

Workshop Manual

Engine Body

| |
|-------------|
| B |
| 2(0) |

**31, 32, 41, 42, 43,
44, 300 series**

Group 21 Engine Body

Marine Engines

MD31A • TMD31B, D, L-A
TAMD31B, D, S.O.L.A.S, L-A, M-A, P-A, S-A
AD31B, D, L-A, P-A • KAD32P
TMD41B, D, L-A
TAMD41B, D, S.O.L.A.S, L-A, M-A, P-A, H-A, H-B
D41B, D, L-A • AD41B, D, L-A, P-A
TAMD42AWJ, BWJ, WJ
KAMD42A, B, P • KAD42A, B, P
KAMD43P • KAD43P
KAMD44P-A, P-B, P-C • KAD44P-A, P-B, P-C
KAMD300-A • KAD300-A

Contents

| | | | |
|---|----|--|----|
| Safety information | 2 | Cleaning seat for copper sleeve | 54 |
| General information | 5 | Copper sleeve, installing | 54 |
| Special tools | 9 | Cylinder head, installing | 56 |
| Other special equipment | 12 | Valves, adjusting | 57 |
| Design and function | 13 | Cylinder head, reconditioning | 59 |
| Engine, general | 13 | Cylinder block, inspection | 59 |
| Location of identification plates | 14 | Cylinder block, surface grinding | 59 |
| Engine presentation | 15 | Cylinder liner, inspection and measurement | 59 |
| Component description | 26 | Cylinder liner, honing | 60 |
| Repair Instructions | 30 | Piston and connecting rod, inspection | 61 |
| General | 30 | Piston, installing | 62 |
| Engine fixture attachment | 31 | Piston rings, inspection and alignment | 63 |
| Engine condition test | 32 | Piston rings, installing | 63 |
| Compression test | 32 | Lifters and camshaft, inspection | 64 |
| Removing components from the Cylinder block .. | 32 | Camshaft measurement | 64 |
| Removing | 32 | Camshaft bearings, replacing | 65 |
| Disassembling Cylinder block | 39 | Crankshaft and bearing, inspection | 65 |
| Removing | 39 | Crankshaft, reconditioning | 67 |
| Cylinder head, reconditioning | 45 | Flywheel, replacing | 68 |
| Cylinder head, assembly/disassembly | 45 | Ring gear, replacing | 69 |
| Guide pin, valve yoke, change (44/300) | 46 | Flywheel, indication | 70 |
| Cylinder head, leakage check | 47 | Flywheel house, indication | 70 |
| Cylinder head, inspection | 48 | Flywheel cover reconditioning | 71 |
| Valve guides, inspection | 49 | Cylinder block, installing | 72 |
| Valve guides, replacing | 49 | Cylinder liner, installing | 72 |
| Valve seat, replacing | 50 | Piston, installing | 73 |
| Valve seat, grinding | 51 | Oil pump, installing | 73 |
| Valve, grinding | 51 | Injection timing, setting | 82 |
| Rocker mechanism, reconditioning | 52 | Drive belts, tensioning | 87 |
| Checking valve springs | 53 | Checks before starting | 91 |
| Copper injector sleeves, replacing | 53 | Checks after starting | 91 |

Safety Precautions


Introduction


This Workshop Manual contains technical data, descriptions and repair instructions for Volvo Penta products or product versions contained in the contents list. Ensure that the correct workshop literature is being used.

Read the safety information and the Workshop Manual "General Information" and "Repair Instructions" carefully before starting work.

Important


In this book and on the engine you will find the following special warning symbols.


 **WARNING!** If these instructions are not followed there is a danger of personal injury, extensive damage to the product or serious mechanical malfunction.


 **IMPORTANT!** Used to draw your attention to something that can cause damage, product malfunction or damage to property.


NOTE! Used to draw your attention to important information that will facilitate work or operations.


Below is a summary of the risks and safety precautions you should always observe or carry out when operating or servicing the engine.


 Immobilize the engine by turning off the power supply to the engine at the main switch (switches) and lock it (them) in the OFF position before starting work. Set up a warning notice at the engine control point or helm.


 Generally, all servicing should be carried out with the engine switched off. Some work (carrying out certain adjustments for example) requires the engine to be running. Approaching a running engine is dangerous. Loose clothing or long hair can fasten in rotating parts and cause serious personal injury.
If working in proximity to a running engine, careless movements or a dropped tool can result in personal injury. Avoid burns. Take precautions to avoid hot surfaces (exhausts, turbochargers, charge air pipes and starter elements etc.) and liquids in supply lines and hoses when the engine is running or has been turned off immediately prior to starting work on it. Reinstall all protective parts removed during service operations before starting the engine.


 Check that the warning or information decals on the product are always clearly visible. Replace decals that have been damaged or painted over.


 Never start the engine without installing the air cleaner (ACL). The rotating compressor in the Turbo can cause serious personal injury. Foreign objects entering the intake ducts can also cause mechanical damage.


 Never use start spray or similar to start the engine. The starter element may cause an explosion in the inlet manifold. Danger of personal injury.












 Avoid opening the coolant filling cap when the engine is hot. Steam or hot coolant can spray out at the same time as the pressure which has built up is lost. Open the filler cap slowly, and release the pressure in the cooling system if the filling cap or tap has to be opened, or if a plug or coolant hose has to be removed when the engine is hot. Steam or hot coolant can stream out in an unexpected direction.






 Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before commencing work on it. Never start or operate the engine with the oil filler cap removed, otherwise oil could be ejected.

 Stop the engine and close the sea cock before carrying out operations on the engine cooling system.

 Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, ensure that exhaust gases and crankcase ventilation emissions are ventilated out of the working area.

 Always use protective goggles where there is a danger of pieces of metal, sparks from grinding, acid or other chemicals being thrown into your eyes. Your eyes are very sensitive, injury can lead to loss of sight!

-  Avoid skin contact with oil. Long-term or repeated contact with oil can remove the natural oils from your skin. The result can be irritation, dry skin, eczema and other skin problems. Used oil is more dangerous to health than new oil. Use protective gloves and avoid using oil-soaked clothes and rags. Wash regularly, especially before meals. Use the correct barrier cream to prevent dry skin and to make cleaning your skin easier.
 -  Most chemicals used in products (engine and transmission oils, glycol, petrol and diesel oil) and workshop chemicals (solvents and paints) are hazardous to health. Read the instructions on the product packaging carefully! Always follow safety instructions (using breathing apparatus, protective goggles and gloves for example). Ensure that other personnel are not unwittingly exposed to hazardous substances (by breathing them in for example). Ensure that ventilation is good. Handle used and excess chemicals according to instructions.
 -  Be extremely careful when tracing leaks in the fuel system and testing fuel injection nozzles. Use protective goggles! The jet ejected from a fuel injection nozzle is under very high pressure, it can penetrate body tissue and cause serious injury. There is a danger of blood poisoning.
 -  All fuels and many chemicals are inflammable. Ensure that a naked flame or sparks cannot ignite fuel or chemicals. Combined with air in certain ratios, petrol, some solvents and hydrogen from batteries are easily inflammable and explosive. Smoking is prohibited! Ensure that ventilation is good and that the necessary safety precautions have been taken before carrying out welding or grinding work. Always have a fire extinguisher to hand in the workplace.
 -  Store oil and fuel-soaked rags and fuel and oil filters safely. In certain conditions oil-soaked rags can spontaneously ignite. Used fuel and oil filters are environmentally dangerous waste and must be deposited at an approved site for destruction together with used lubricating oil, contaminated fuel, paint remnants, solvent, degreasing agents and waste from washing parts.
 -  Never allow a naked flame or electric sparks near the batteries. Never smoke in proximity to the batteries. The batteries give off hydrogen gas during charging which when mixed with air can form an explosive gas - oxyhydrogen. This gas is easily ignited and highly volatile. Incorrect connection of the battery can cause a spark which is sufficient to cause an explosion with resulting damage. Do not disturb battery connections when starting the engine (spark risk) and do not lean over batteries.
 -  Never mix up the positive and negative battery terminals when installing. Incorrect installation can result in serious damage to electrical equipment. Refer to wiring diagrams.
 -  Always use protective goggles when charging and handling batteries. The battery electrolyte contains extremely corrosive sulfuric acid. If this comes into contact with the skin, wash immediately with soap and plenty of water. If battery acid comes into contact with the eyes, immediately flush with copious amounts of water and obtain medical assistance.
 -  Turn off the engine and turn off power at main switch(es) before carrying out work on the electrical system.
 -  The clutch must be adjusted with the engine shut off.
 -  Use the lifting eyes mounted on the engine/reverse gear when lifting the drive unit. Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine (engine weight including reverse gear and any extra equipment installed). To ensure safe handling and to avoid damaging engine components on top of the engine, use a lifting beam to raise the engine. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine. If extra equipment is installed on the engine altering its center of gravity, a special lifting device is required to achieve the correct balance for safe handling.
- Never carry out work on an engine suspended on a hoist.

-  Never remove heavy components alone, even where secure lifting equipment such as secured blocks are being used. Even where lifting equipment is being used it is best to carry out the work with two people; one to operate the lifting equipment and the other to ensure that components are not trapped and damaged when being lifted.
When working on-board ensure that there is sufficient space to remove components without danger of injury or damage.
-  Components in the electrical and fuel systems on Volvo Penta products have been designed to minimize the risks of explosion and fire. The engine must not be operated in environments with adjacent explosive media.
-  Fuel delivery pipes must not be bent or straightened under any circumstances. Damaged pipes must be replaced.
-  Remember the following when washing with a high pressure washer: Never aim the water jet at seals, rubber hoses or electrical components. Never use a high pressure washer for engine cleaning.
-  Always use fuels recommended by Volvo Penta. Refer to the Instruction Book. The use of lower quality fuels can damage the engine. On a diesel engine poor quality fuel can cause the control rod to seize and the engine to overrev with the resulting risk of damage to the engine and personal injury. Poor fuel quality can also lead to higher maintenance costs.

General information

About the workshop manual

This workshop manual contains technical specification, descriptions and instructions for repairing the standard versions of the following engines 31/32/41/42/43/44/300. The workshop manual displays the operations carried out on any of the engines above. As a result the illustrations and pictures in the manual that show certain parts on the engines, do not in some cases apply to all the engines listed above. However the repair and service operations described are the same in all essential details. Where they are not the same this is stated in the manual and where the difference is considerable the operations are described separately. Engine designations and numbers are given on the number plate (See page 14). The engine designation and number should be given in all correspondence about the engine.

This Workshop Manual has been developed primarily for Volvo Penta service workshops and qualified personnel. Persons using this book are assumed to have a grounding in marine drive systems and be able to carry out related mechanical and electrical work.

Volvo Penta is continuously developing their products. We therefore reserve the right to make changes. All the information contained in this book is based on product data available at the time of going to print. Any essential changes or modifications introduced into production or updated or revised service methods introduced after the date of publication will be provided in the form of Service Bulletins.

Replacement parts

Replacement parts for electrical and fuel systems are subject to statutory requirements (US Coast Guard Safety Regulations for example). Volvo Penta Genuine parts meet these requirements. Any type of damage which results from the use of non-original Volvo Penta replacement parts for the product will not be covered under any warranty provided by Volvo Penta.

Certified engines

When doing service and repair on emission certified engines, it is important to be aware of the following:

Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines made of the same type are equivalent to the certified engine.

This makes special demands on service and repair work, as follows:

- Maintenance and service intervals recommended by Volvo Penta must be complied with.
- Only Volvo Penta original spares may be used.
- Service to injection pumps, pump settings and injectors must always be done by an authorized Volvo Penta workshop.
- The engine must not be converted or modified, except for the accessories and service kits which Volvo Penta has approved for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be done.
- No seals may be broken by unauthorized personnel.

The general advice in the instruction book about operation, care and maintenance applies.



IMPORTANT! Delayed or inferior care/maintenance, and the use of non-original spares, mean that AB Volvo Penta can no longer be responsible for guaranteeing that the engine complies with the certified version.

Damage, injury and/or costs which arise from this will not be compensated by Volvo Penta.

Repair instructions

The working methods described in the Service Manual apply to work carried out in a workshop. The engine has been removed from the boat and is installed in an engine fixture. Unless otherwise stated reconditioning work which can be carried out with the engine in place follows the same working method.

Warning symbols occurring in the Workshop Manual (for their meaning see *Safety information*)

 **WARNING!**

 **IMPORTANT!**

NOTE!

are not in any way comprehensive since it is impossible to predict every circumstance under which service work or repairs may be carried out. For this reason we can only highlight the risks that can arise when work is carried out incorrectly in a well-equipped workshop using working methods and tools developed by us.

All procedures for which there are Volvo Penta special tools in this Workshop Manual are carried out using these. Special tools are developed to rationalize working methods and make procedures as safe as possible. It is therefore the responsibility of any person using tools or working methods other than the ones recommended by us to ensure that there is no danger of injury, damage or malfunction resulting from these.

In some cases there may be special safety precautions and instructions for the use of tools and chemicals contained in this Workshop Manual. These special instructions should always be followed if there are no separate instructions in the Workshop Manual.

Certain elementary precautions and common sense can prevent most risks arising. A clean workplace and engine eliminates much of the danger of injury and malfunction.

It is of the greatest importance that no dirt or foreign particles get into the fuel system, lubrication system, intake system, turbocharger, bearings and seals when they are being worked on. The result can be malfunction or a shorter operational life.

Our joint responsibility

Each engine consists of many connected systems and components. If a component deviates from its technical specification the environmental impact of an otherwise good engine may be increased significantly. It is therefore vital that wear tolerances are maintained, that systems that can be adjusted are adjusted properly and that Volvo Penta Genuine Parts are used. The engine Maintenance Schedule must be followed.

Some systems, such as the components in the fuel system, require special expertise and special testing equipment for service and maintenance. Some components are sealed at the factory for environmental reasons. No work should be carried out on sealed components except by authorized personnel.

Bear in mind that most chemicals used on boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of biodegradable degreasing agents for cleaning engine components, unless otherwise stated in a workshop manual. Take special care when working on-board, that oil and waste is taken for destruction and is not accidentally pumped into the environment with bilge water.

Tightening torques

Tightening torques for vital joints that must be tightened with a torque wrench are listed in workshop manual "Technical Data": "Tightening Torques" and are contained in work descriptions in this Manual. All torques apply for cleaned threads, screw heads and mating surfaces. Torques apply for lightly oiled or dry threads. If lubricants, locking fluid or sealing compound are required for a screwed joint this information will be contained in the work description and in "Tightening Torques" Where no tightening torque is stated for a joint use the general tightening torques according to the tables below. The tightening torques stated are a guide and the joint does not have to be tightened using a torque wrench.

| Dimension | Tightening Torques | |
|-----------|--------------------|--------|
| | Nm | lbt.ft |
| M5 | 6 | 4.4 |
| M6 | 10 | 7.4 |
| M8 | 25 | 18.4 |
| M10 | 50 | 36.9 |
| M12 | 80 | 59.0 |
| M14 | 140 | 103.3 |

Tightening torques-protractor (angle) tightening

Tightening using both a torque setting and a protractor angle requires that first the recommended torque is applied using a torque wrench and then the recommended angle is added according to the protractor scale. Example: a 90° protractor tightening means that the joint is tightened a further 1/4 turn in one operation after the stated tightening torque has been applied.

Locknuts

Do not re-use lock nuts that have been removed during dismantling as they have reduced service life when re-used - use new nuts when assembling or re-installing. For lock nuts with a plastic insert such as Nylock® the tightening torque stated in the table is reduced if the Nylock® nut has the same head height as a standard hexagonal nut without plastic insert. Reduce the tightening torque by 25% for bolt size 8 mm or larger. Where Nylock® nuts are higher, or of the same height as a standard hexagonal nut, the tightening torques given in the table apply.

Tolerance classes

Screws and nuts are divided into different strength classes, the class is indicated by the number on the bolt head. A high number indicates stronger material, for example a bolt marked 10-9 indicates a higher tolerance than one marked 8-8. It is therefore important that bolts removed during the disassembly of a bolted joint must be reinstalled in their original position when assembling the joint. If a bolt must be replaced check in the replacement parts catalogue to make sure the correct bolt is used.

Sealants

A number of sealants and locking liquids are used on the engines. The agents have varying properties and are used for different types of jointing strengths, operating temperature ranges, resistance to oil and other chemicals and for the different materials and gap sizes in the engines.

To ensure service work is correctly carried out it is important that the correct sealant and locking fluid type is used on the joint where the agents are required.

In this Volvo Penta Service Manual the user will find that each section where these agents are applied in production states which type was used on the engine.

During service operations use the same agent or an alternative from a different manufacturer.

Make sure that mating surfaces are dry and free from oil, grease, paint and anti-corrosion agent before applying sealant or locking fluid.

Always follow the manufacturer's instructions for use regarding; temperature range, curing time and any other instructions for the product.

Two different basic types of agent are used on the engine and these are:

RTV agent (Room temperature vulcanizing). Use for gaskets, sealing gasket joints or coating gaskets. RTV agent is clearly visible when a component has been dismantled; old RTV must be removed before the joint is resealed.

The following RTV agents are mentioned in the Service Manual: Loctite® 574, Volvo Penta 840879-1, Permatex® No. 3, Volvo Penta P/N 1161099-5, Permatex® No. 77. Old sealant can be removed using methylated spirits in all cases.

Anaerobic agents. These agents cure in an absence of air. They are used when two solid parts, for example cast components, are installed face-to-face without a gasket. They are also commonly used to secure plugs, threads in stud bolts, cocks, oil pressure switches and so on. The cured material is glass-like and it is therefore colored to make it visible. Cured anaerobic agents are extremely resistant to solvents and the old agent cannot be removed. When reinstalling the part is carefully degreased and then new sealant is applied.

The following anaerobic agents are mentioned in the Service Manual: Loctite® 572 (white), Loctite® 241 (blue).

NOTE! Loctite® is the registered trademark of Loctite Corporation, Permatex® is the registered trademark of the Permatex Corporation.

Safety precautions for Fluorine rubber

Fluorine rubber is a common material in sealing rings for shafts and O rings.

When fluorine rubber is exposed to high temperatures (over 300°C) it can release highly corrosive **hydrofluoric acid**. Exposing the skin to this chemical can cause serious burns. If splashed in the eyes it can cause malignant ulcers. Breathing the fumes can damage the respiratory tract.



WARNING! Take the greatest care when working on engines that have been operating at high temperatures, for example an overheated engine that has seized or an engine involved in a fire. The seals must never be burned off when disassembling or be burnt afterwards in anything other than a special disposal site.

- Always used chloroprene rubber gloves (gloves for handling chemicals) and protective glasses.
- Treat removed seals in the same way as corrosive acid. All remains, even the ash can be extremely corrosive. Never use compressed air jets for blowing clean.
- Put old seal remnants in a plastic container, close it and stick a warning label on it. Wash gloves under running water before removal.

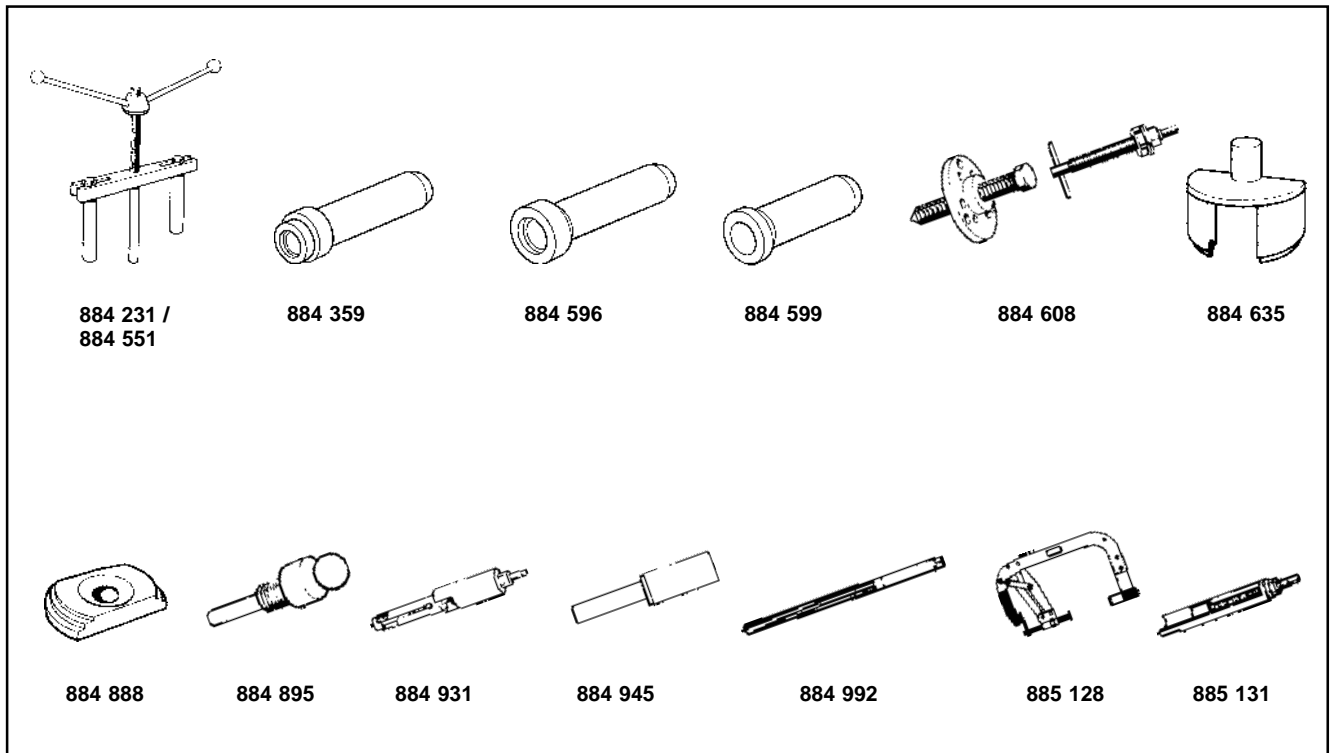
The following seals are very likely to contain fluorine rubber:

Crankshaft, camshaft and intermediate shaft seals
O rings, wherever used. O rings for cylinder liner sealing are almost always fluorine rubber.

Note that seals not exposed to high temperatures can be handled normally.

Special tools

In all cases where it is practical the tool number, except for the final digit, has been stamped on the tool. The final digit (after the hyphen) is a control number.



884 231-2 Puller (center screw and puller nut are used to withdraw liners)

884 359-1 Drift for installing seal in flywheel housing

884 551-3 Puller (caliper from the puller is used to withdraw liners)

884 596-8 Drift for installing primary shaft in flywheel housing

884 599-2 Drift for installing seal in flywheel housing

884 608-1 Puller for the polygon hub in the crankshaft

884 635-4 Removal punch for oil cooler insert

884 888-9 Plate liner puller

884 895-4 Lock pin for flywheel, pump setting

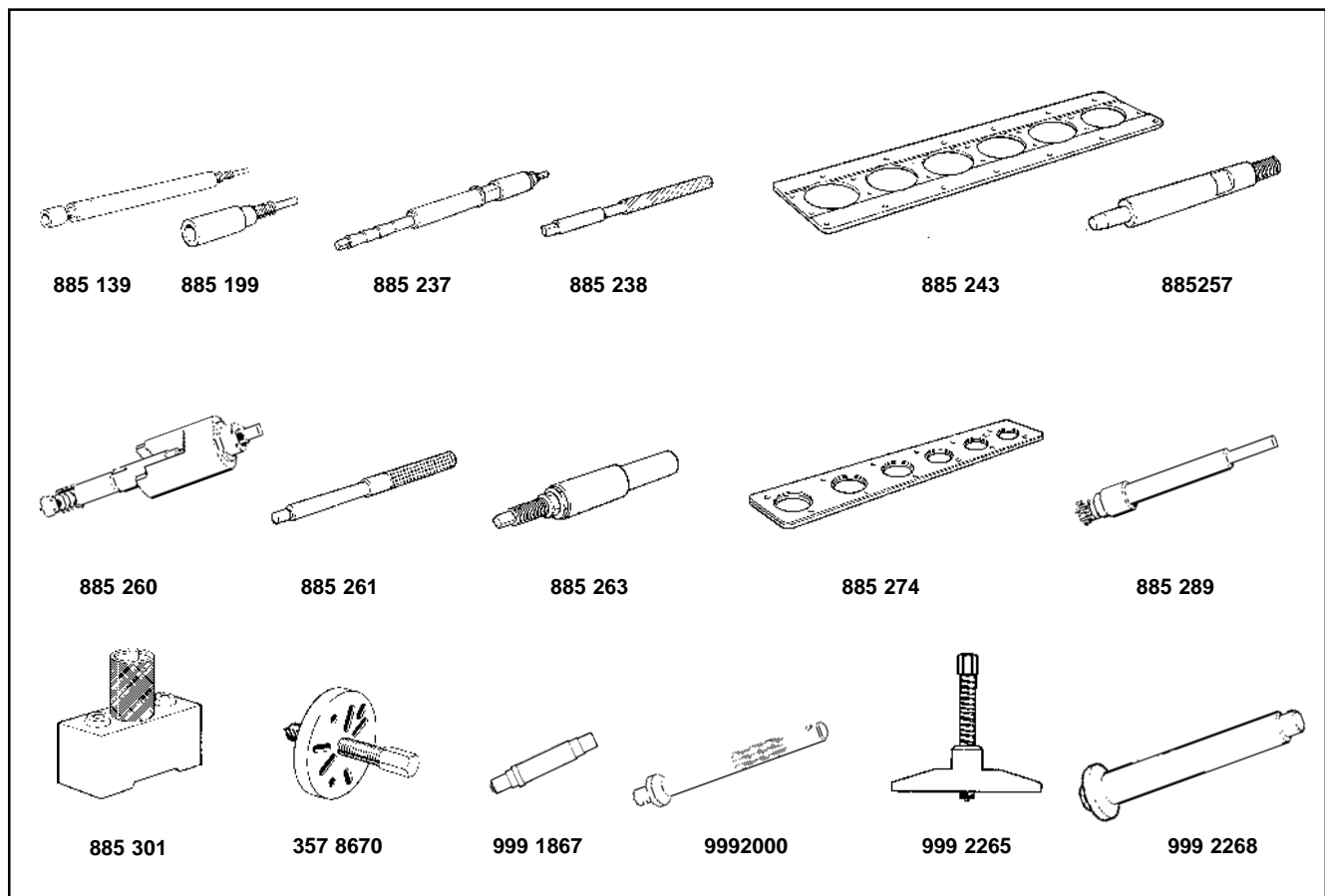
884 931-7 Puller for injector sleeve (31, 32, 41, 42, 43)

884 945-7 Drift for installing injector sleeve (31, 32, 41, 42, 43)

884 992-9 Reamer (valve guide) (31, 32, 41, 42, 43)

885 128-9 Valve spring tensioner

885 131-3 Puller for dismantling injector nozzle (31, 32, 41, 42, 43)



885 139-6 Holder for injector angle dial gauge (41, 42, 43, 44, 300)

885 199-0 Holder for dial gauge (31, 32)

885 237-8 Expander drift tool for copper sleeve. (44, 300)

885 238-6 Reamer (valve guide) (44, 300)

885 243-6 Sealing plate for test pressurization of cylinder head

885 257-6 Adapter, compression test (44, 300)

885 260-0 Injector sleeve extractor (44, 300)

885 261-8 Drift for removing and installing valve guide (44, 300)

885 263-4 Injector sleeve extractor (44, 300)

885 274-1 Sealing plate for test pressurization of cylinder head

885 289-9 Brush for cleaning bottom of copper sleeve and for sealing sleeve between copper sleeve and cylinder head

885 301-2 Tool for pressing in the Alfa reset piston (44P-A)

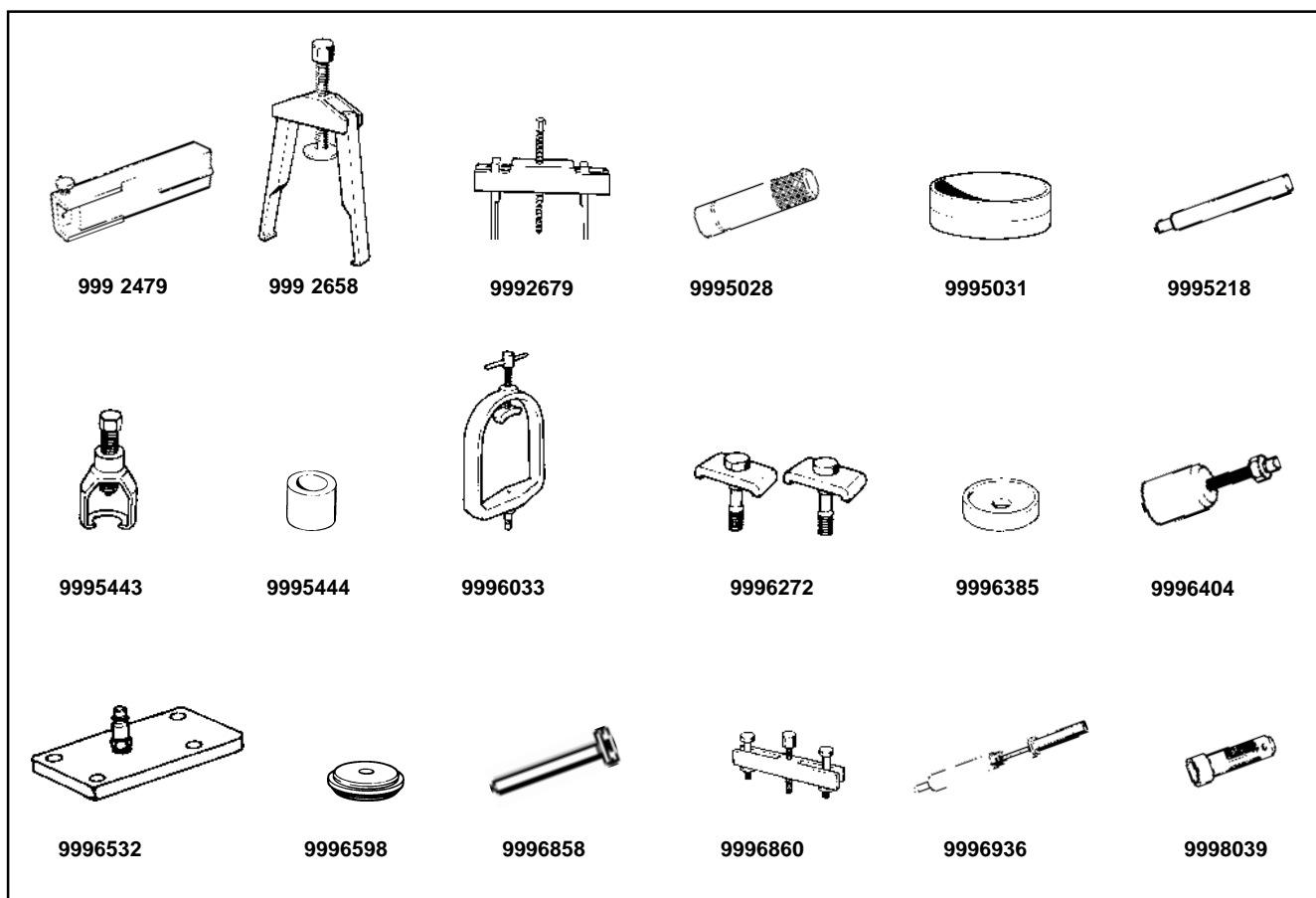
357 8670-6 Puller for compressor magnetic clutch (32, 42, 43, 44, 300)

999 1867-4 Drift for removing and installing rocker arm bushing

999 2000-1 Standard shaft

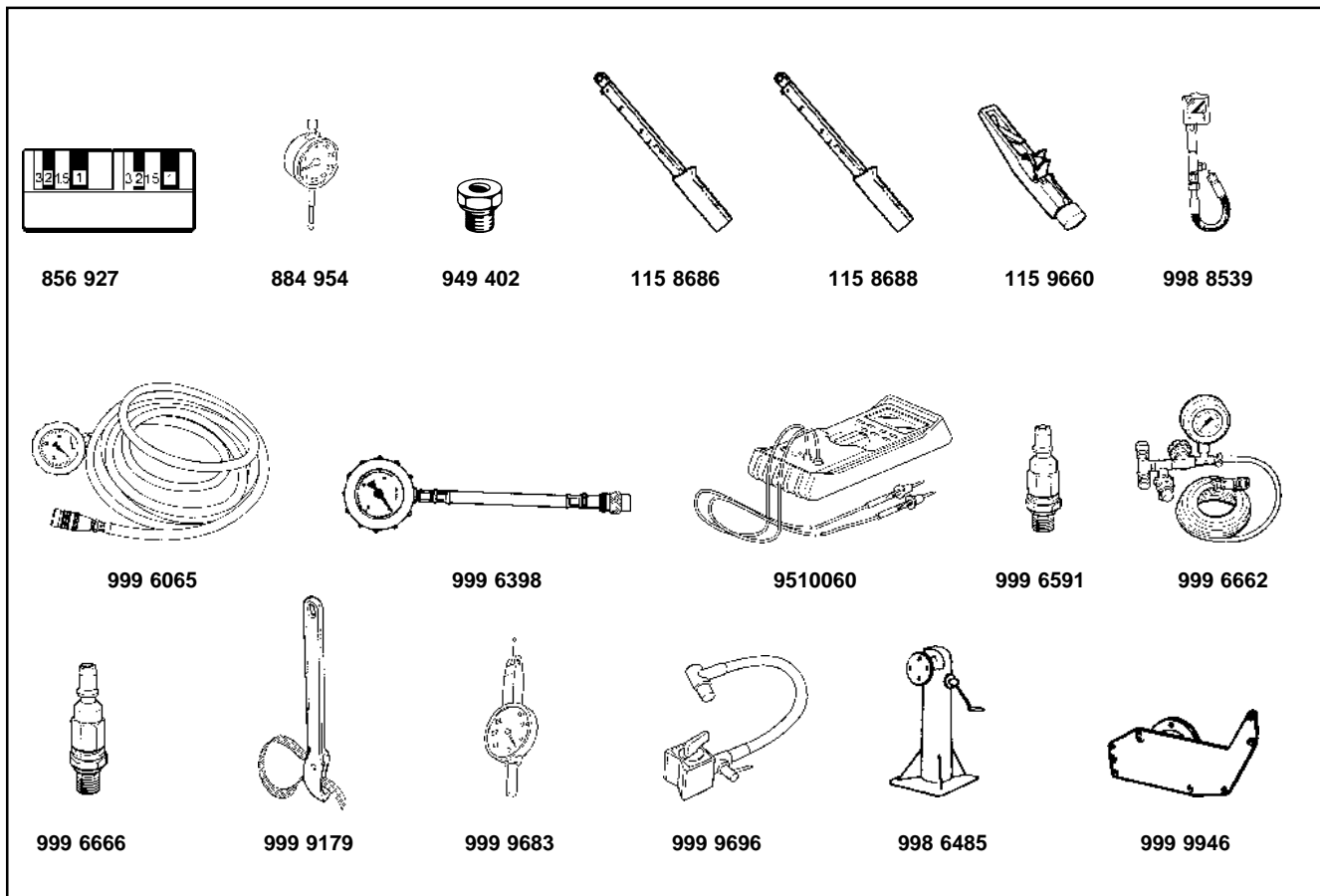
999 2265-0 Puller for circulation pump belt pulley

999 2268-4 Drift for installing bearing in circulation pump



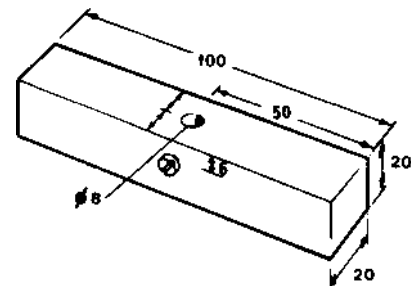
- | | | | |
|------------|---|------------|---|
| 999 2479-7 | Holder for dial test indicator when checking liner height | 999 6385-2 | Drift for replacing rear crankshaft seal |
| 999 2658-6 | Puller for crankshaft drive | 999 6404-1 | Press tool for the crankshaft and polygon hub |
| 999 2679-2 | Separator for camshaft drive | 999 6532-9 | Terminal plate for test pressurization of cylinder head |
| 999 5028-9 | Drift for installing valve guide | 999 6598-0 | Plate for installing cylinder liner |
| 999 5031-3 | Installation ring for piston | 999 6858-8 | Drift for removing circulation pump pulley |
| 999 5218-6 | Drift for removing valve guide | 999 6860-4 | Puller for oil pump drive |
| 999 5443-0 | Puller for Servo pump belt pulley | 999 6936-2 | Adapter, compression test (31, 32, 41, 42, 43) |
| 999 5444-8 | Drift for installing servo pump pulley | 999 8039-3 | Drift for installing shaft seal in circulation pump |
| 999 6033-8 | Bracket to test pressurization of oil cooler (2 x) | | |
| 999 6272-2 | Press tool for cylinder liner when measuring liner height (2 x) | | |

Other special equipment



- 856 927-9 Plastic gauge for measuring main and big end bearing clearance
- 884 954-9 Dial indicator
- 949 402-2 Nipple, checking boost pressure
- 115 8686-4 Torque wrench 3/8" 5–50 Nm
- 115 8688-0 Torque wrench 1/2" 40–200 Nm
- 115 9660-8 Belt tensioner check tool
- 998 8539-4 Compression tester
- 999 6065-0 Pressure gauge, for checking fuel supply pressure and boost pressure
- 999 6398-5 Pressure gauge, for checking oil pressure

- 951 0060-8 Multimeter
- 999 6591-5 Nipple, oil pressure gauge
- 999 6662-4 Test pressurization equipment
- 999 6666-5 Nipple, checking boost pressure
- 999 9179-6 Wrench for removing fuel/oil filters.
- 999 9683-7 Rocker indicator
- 999 9696-9 Magnetic stand for dial indicator
- 998 6485-2 Unit stand
- 999 9946-8 Engine fixture for unit stand



1. Diagram of the special tool for the Turbo
- The tool is not supplied by Volvo Penta but must be manufactured at your own workshop.

Design and Function

Engines general

The engines are straight 6 cylinder (31/32 series have 4 cylinders), 4 stroke diesel engines with overhead valves. KA(M)D44/300 have 4 valve technology, other models conventional 2 valve technology. All are directly injected and turbocharged. KA(M)D42/43/44/300 and KAD32 also have a mechanically driven compressor for higher power at low and mid range of the rev curve.

The engines have wet on wet replaceable cylinder liners and a completely new cylinder head.

Engine lubrication is covered by a press lubrication system which uses a an effective oil pump to move the oil through the oil cooler to the oil distribution housing.

The oil is forced partially through the oil filter to the engine lubricating points and partially via the piston cooling valve to the piston cooling nozzles.

The piston cooling valve opens when the oil pressure reaches a certain pressure and oil is injected into the underside of the piston. The oil is routed further through a cooling pipe into the upper part of the piston.

The oil cooler transfers heat from the oil to the engine cooling system.

Oil cleaning is carried out by a full-flow oil filter.

The cooling system is divided into a freshwater and a seawater system.

The fresh water system is thermostat regulated and cools the cylinder block and cylinder head.

The seawater system cools the freshwater system via a heat exchanger.

The turbocharger supplies the engine with pressurized fresh air which gives greater air capacity. This means that the amount of fuel injected can be increased, which gives better engine power.

The engines are equipped with seawater cooled charge air cooler (CAC), which lower the intake air temperature after turbo compression. This lowers the volume of the air and more air can be supplied to the engine. The increased air capacity further increases the amount of fuel injected and therefore the engine power.

By cooling the intake air, the combustion and exhaust temperatures are also reduced despite the increased power output.

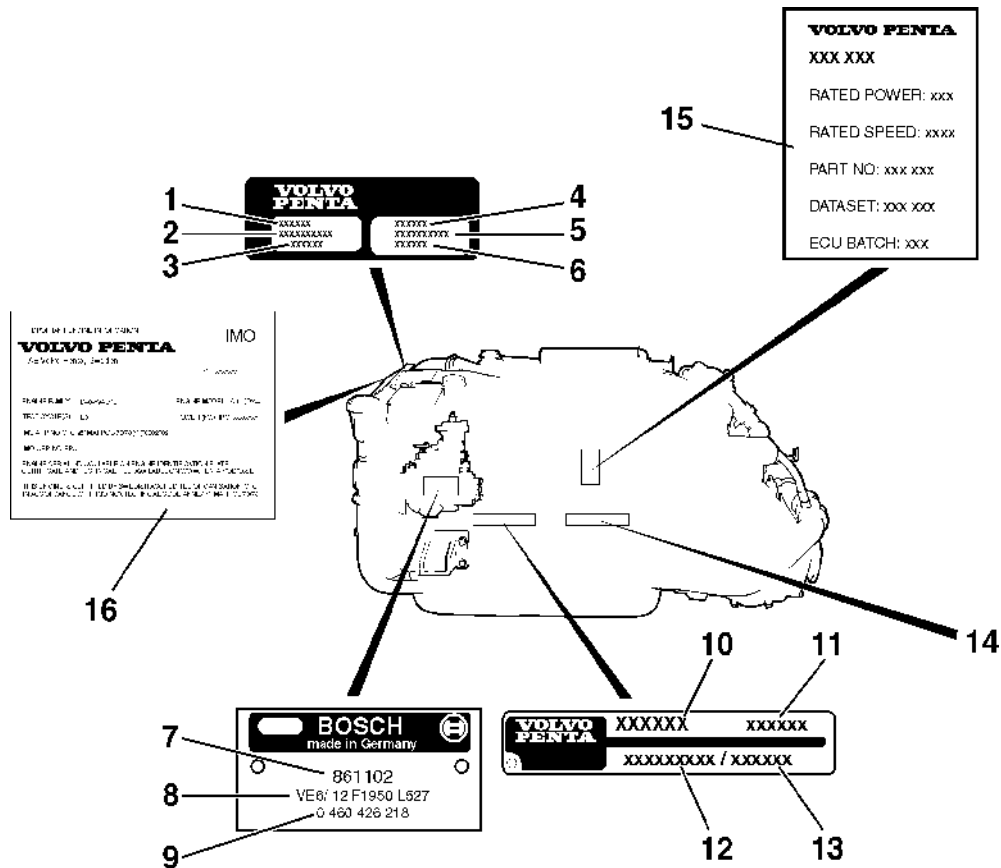
The charge air cooler (CAC) also gives lower exhaust emissions because combustion is more efficient because of the higher oxygen content of the intake air.

The turbocharger turbine housing is freshwater cooled, otherwise the turbocharger (TC) is cooled and lubricated by the engine oil.

KA(M)D44/300 is equipped with EDC (Electronic Diesel Control). The system is built up around a compressor which is continuously supplied with information from all engine functions such as boost pressure, throttle opening, fuel temperature etc. The information is analyzed up to 100 times per second and gives the processor an exact picture of the prevailing operating conditions. The fuel supply and alfa angle are regulated through the electronic actuator on the injection pump.

The result is that the engine always receives the optimal amount of fuel in all drive conditions, which gives faster throttle response, lower fuel consumption and reduced exhaust emissions.

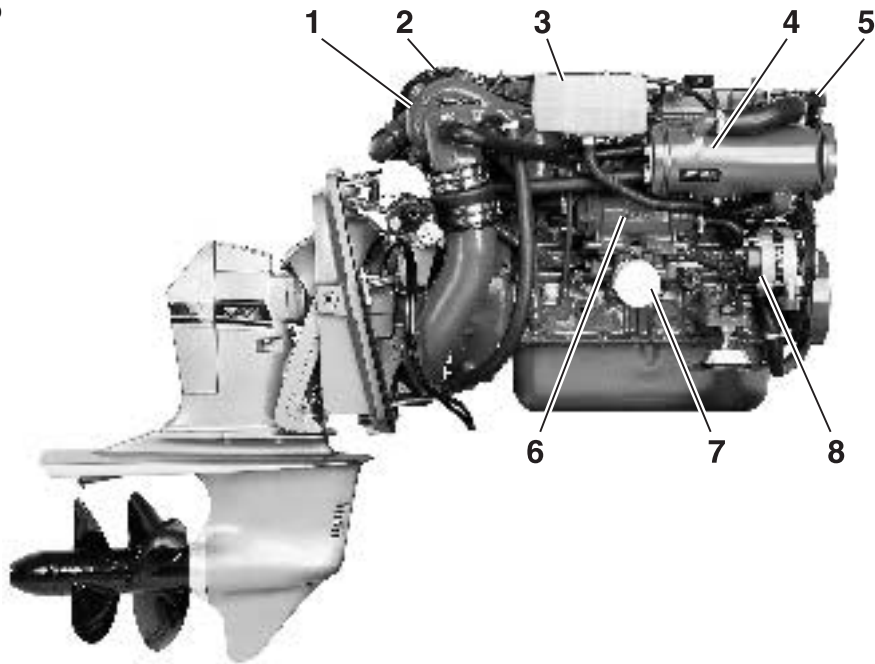
Location of information decals and type plates



1. Engine designation
2. Engine serial number
3. Engine Product number
4. Reverse gear-/drive designation
5. Reverse gear-/drive serial number
6. Reverse gear-/drive product number
7. Volvo Penta Part Number (P/N)
8. Pump type and version
9. BOSCH P/N
10. Engine designation and product number
11. Engine Product number
12. Serial number/ Base engine number
13. Certification number
14. Certification sign
15. Control unit (only EDC engines)
16. IMO decal (only engines above 130 kW/174 bhp)

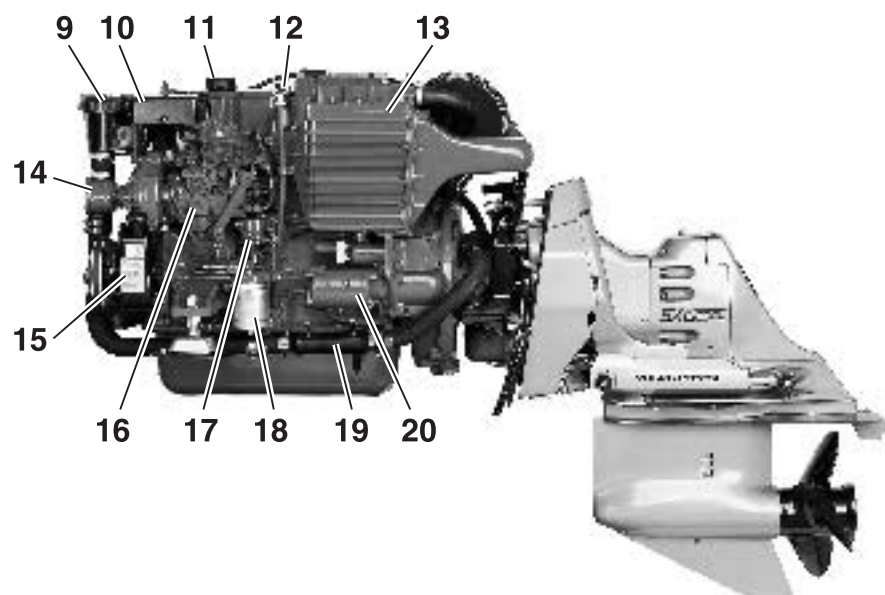
Introduction to the engine

AD31L,P/DP

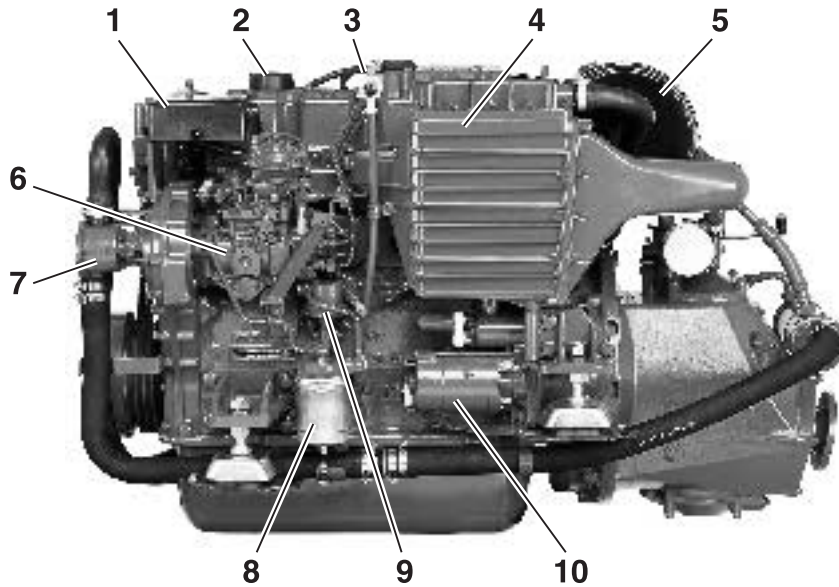


- | | |
|---|-------------------------------|
| 1 Turbocharger | 11 Oil filler cap |
| 2 Air Cleaner (ACL) | 12 Dip stick |
| 3 Expansion tank | 13 Charge air cooler (CAC) |
| 4 Heat exchanger | 14 Seawater pump |
| 5 Thermostat housing | 15 Steering servo pump |
| 6 Oil cooler | 16 Injection pump |
| 7 Lubricating oil filter | 17 Fuel pump |
| 8 Generator | 18 Fuel filter |
| 9 Seawater filter | 19 Oil cooler, power steering |
| 10 Terminal box with semi-automatic fuses | 20 Starter motor |

AD31L,P/SX

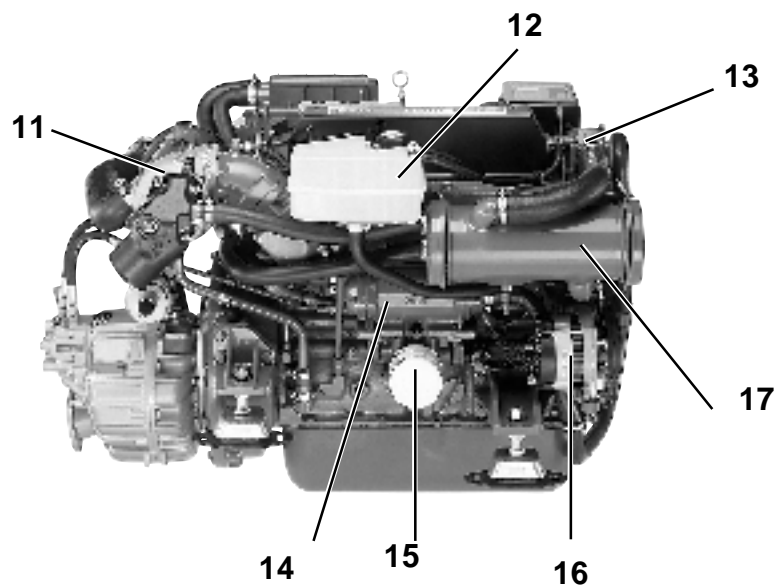


TAMD31M,L,P/HS1

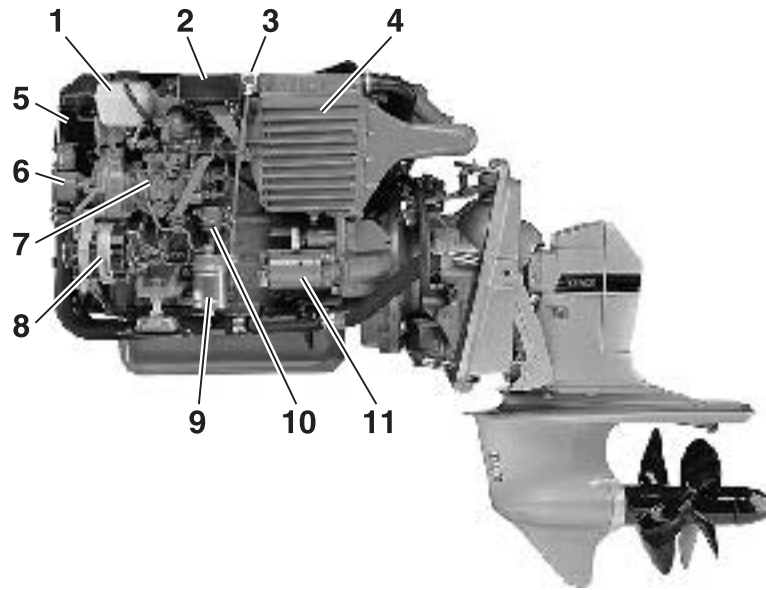


- | | |
|--|---------------------------|
| 1 Terminal box with semi-automatic fuses | 10 Starter motor |
| 2 Oil filler cap | 11 Turbocharger |
| 3 Dip stick | 12 Expansion tank |
| 4 Charge air cooler (CAC) | 13 Thermostat housing |
| 5 Air Cleaner (ACL) | 14 Oil cooler |
| 6 Injection pump | 15 Lubrication oil filter |
| 7 Seawater filter | 16 Alternator |
| 8 Fuel filter | 17 Heat exchanger |
| 9 Fuel pump | |

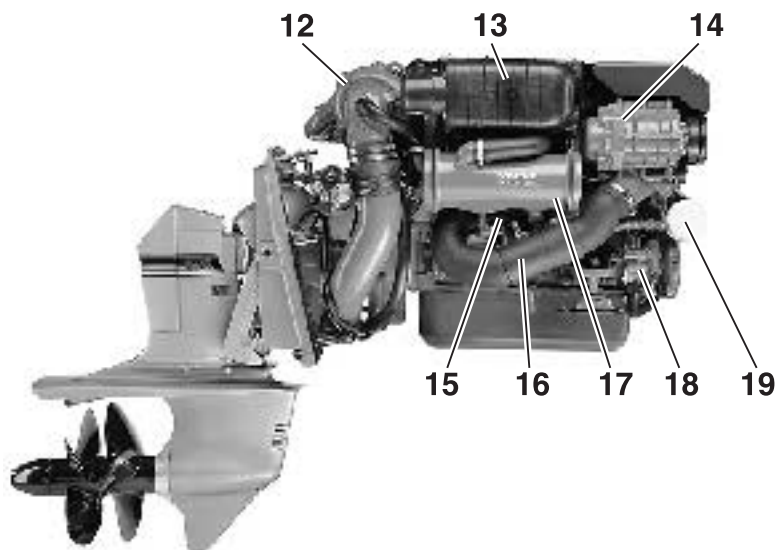
TAMD31S/HS25A



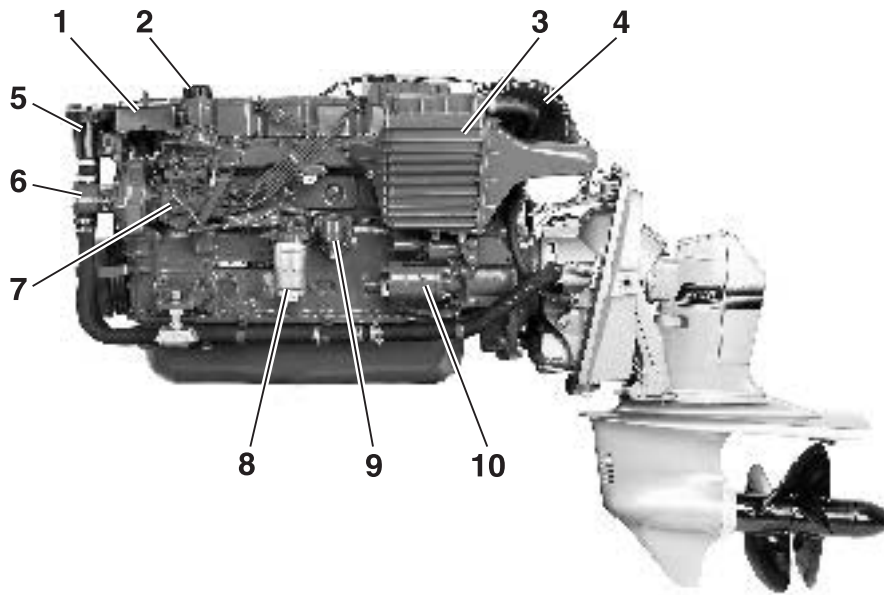
KAD32P/DP



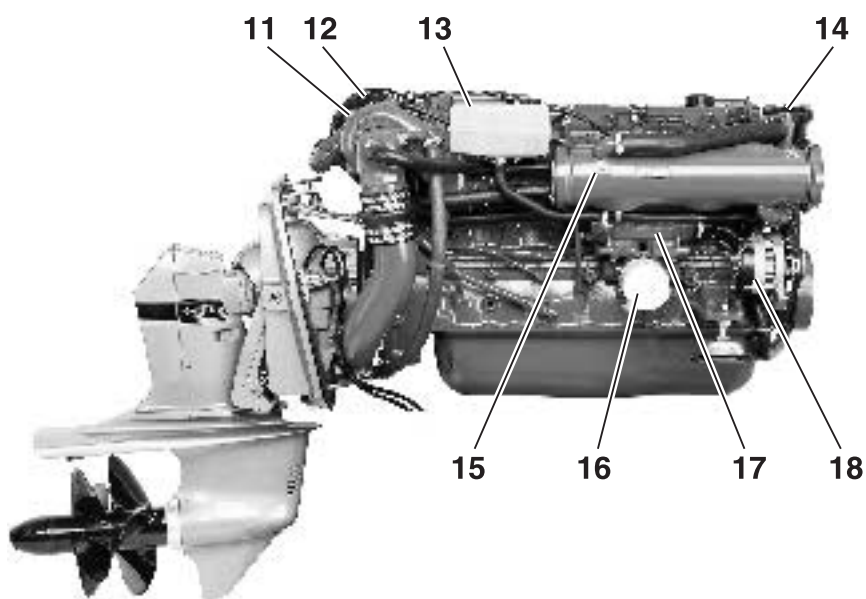
- | | |
|--|------------------------|
| 1 Expansion tank | 11 Starter motor |
| 2 Terminal box with semi-automatic fuses | 12 Turbocharger |
| 3 Dip stick | 13 Air Cleaner (ACL) |
| 4 Charge air cooler (CAC) | 14 Compressor |
| 5 Seawater filter | 15 Oil cooler |
| 6 Seawater pump | 16 Silencer compressor |
| 7 Injection pump | 17 Heat exchanger |
| 8 Generator (GEN) | 18 Steering servo pump |
| 9 Fuel filter | 19 Oil filter |
| 10 Fuel pump | |



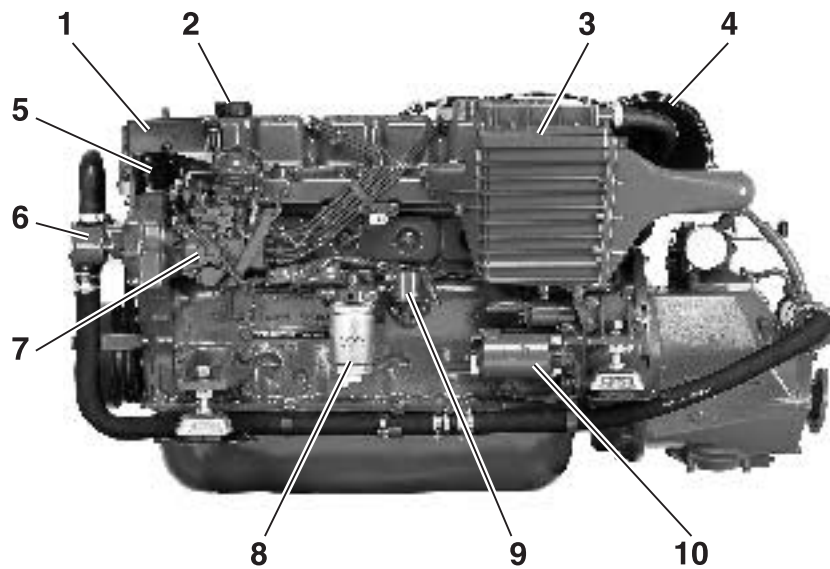
AD41P/DP



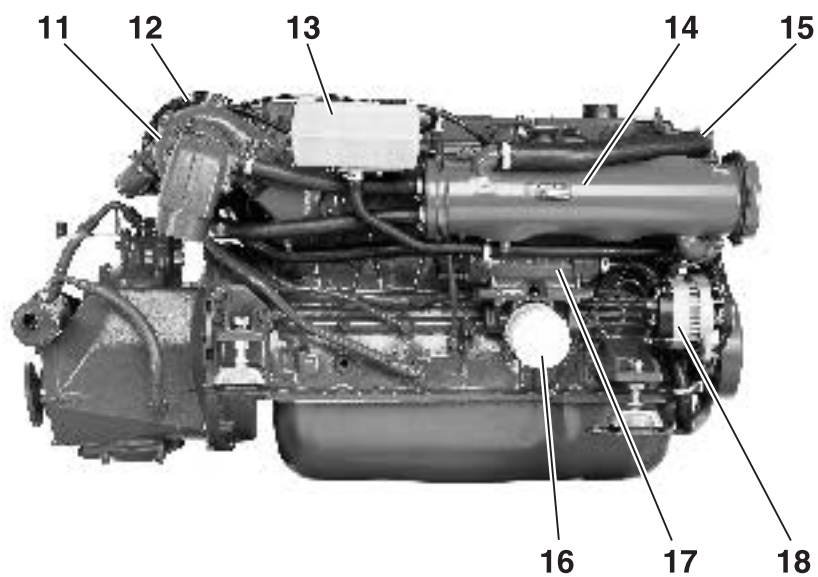
- | | |
|--|-----------------------|
| 1 Terminal box with semi-automatic fuses | 10 Starter motor |
| 2 Oil filler cap | 11 Turbocharger |
| 3 Charge air cooler (CAC) | 12 Air Cleaner (ACL) |
| 4 Air Cleaner (ACL) | 13 Expansion tank |
| 5 Seawater filter | 14 Thermostat housing |
| 6 Seawater pump | 15 Heat exchanger |
| 7 Injection pump | 16 Oil filter |
| 8 Fuel filter | 17 Oil cooler |
| 9 Fuel pump | 18 Generator |



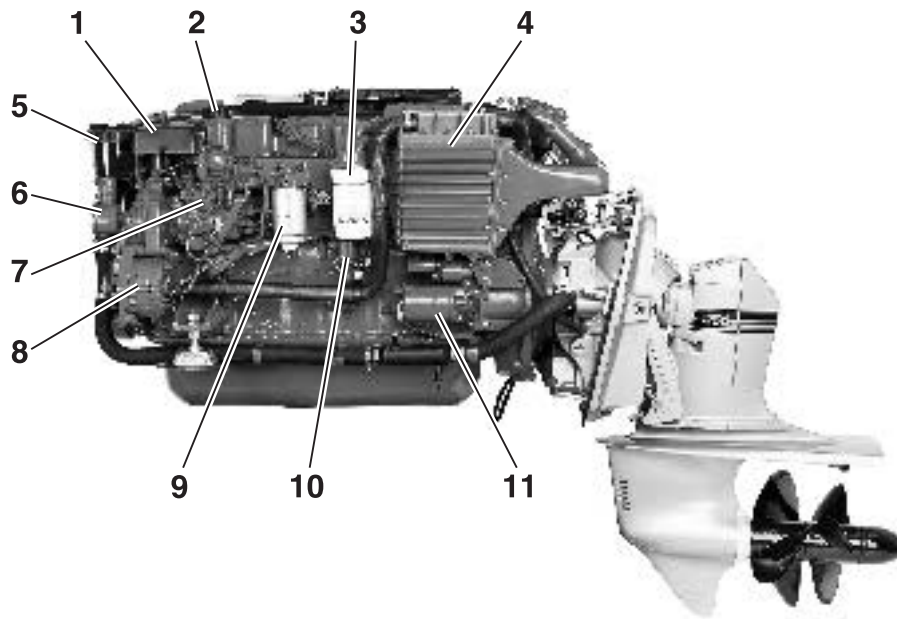
TAMD41H,M,P/HS1



- | | |
|--|-----------------------|
| 1 Terminal box with semi-automatic fuses | 10 Starter motor |
| 2 Oil filler cap | 11 Turbocharger |
| 3 Charge air cooler (CAC) | 12 Air Cleaner (ACL) |
| 4 Air Cleaner (ACL) | 13 Expansion tank |
| 5 Engine coolant temperature (ECT) | 14 Heat exchanger |
| 6 Seawater pump | 15 Thermostat housing |
| 7 Injection pump | 16 Oil filter |
| 8 Fuel filter | 17 Oil cooler |
| 9 Fuel pump | 18 Generator |

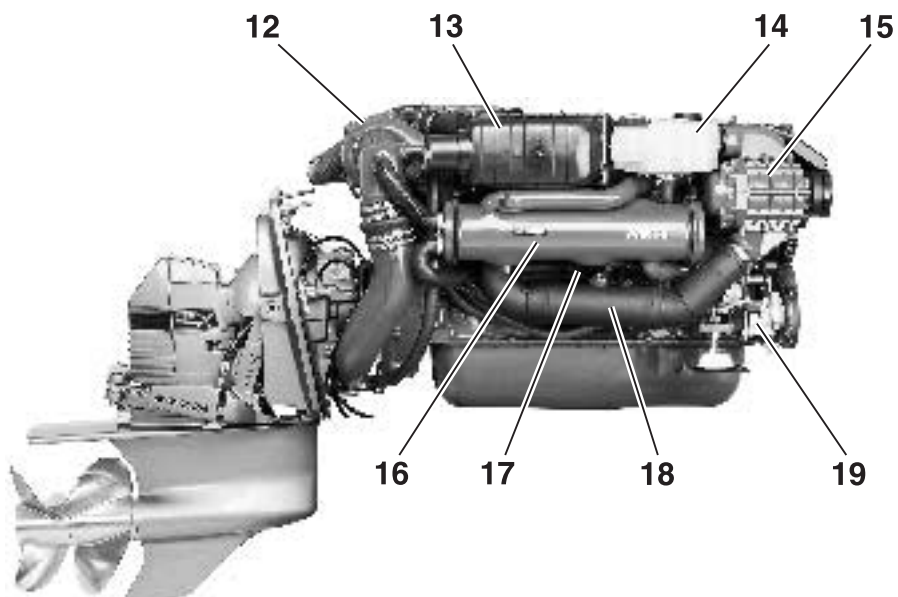


KAD43P/DP

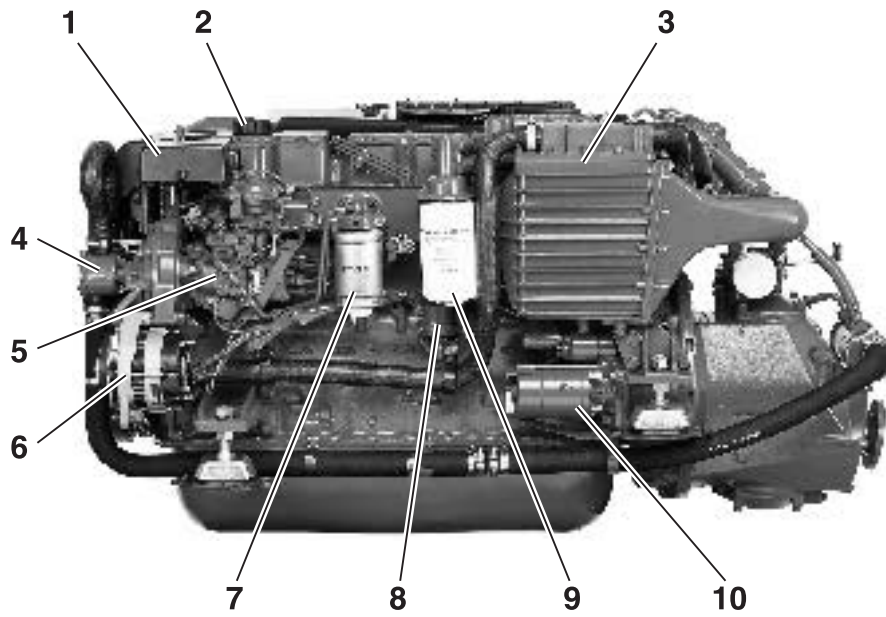


- | | |
|--|------------------------|
| 1 Terminal box with semi-automatic fuses | 11 Starter motor |
| 2 Oil filler cap | 12 Turbocharger |
| 3 Oil filter | 13 Air Cleaner (ACL) |
| 4 Charge air cooler (CAC) | 14 Expansion tank |
| 5 Seawater filter | 15 Compressor |
| 6 Seawater pump | 16 Heat exchanger |
| 7 Injection pump | 17 Oil cooler |
| 8 Generator | 18 Silencer compressor |
| 9 Fuel pump | 19 Steering servo pump |
| 10 Fuel pump | |

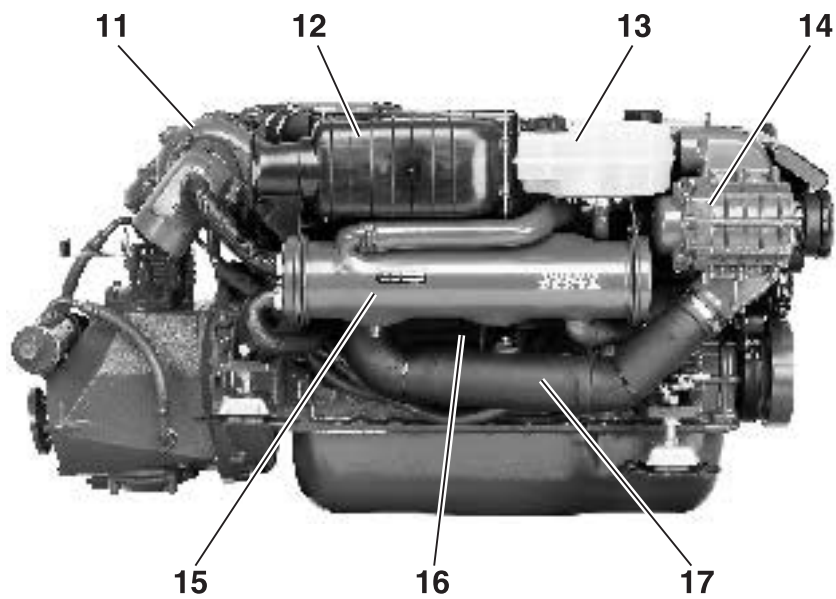
KAD43P/DPX



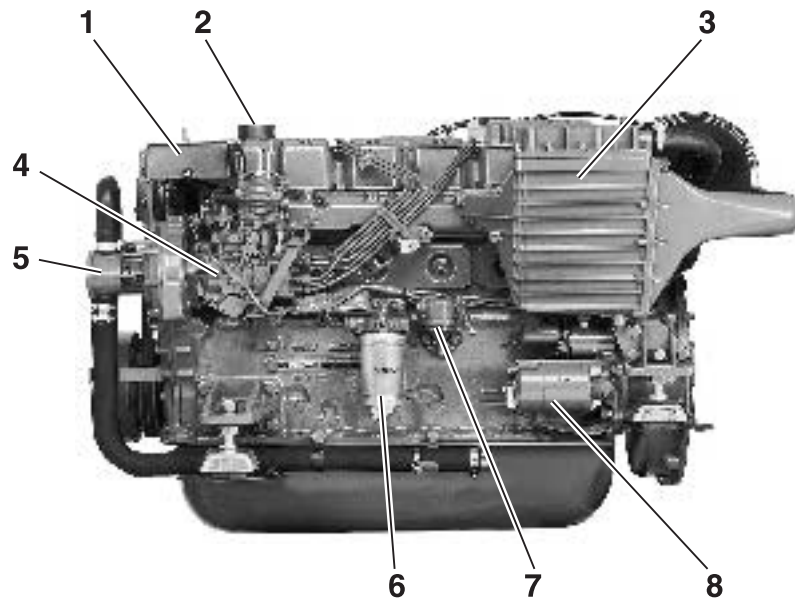
KAMD43P/HS1



- | | |
|--|------------------------|
| 1 Terminal box with semi-automatic fuses | 9 Oil filter |
| 2 Oil filler cap | 10 Starter motor |
| 3 Charge air cooler (CAC) | 11 Turbocharger |
| 4 Seawater pump | 12 Air Cleaner (ACL) |
| 5 Injection pump | 13 Expansion tank |
| 6 Generator | 14 Compressor |
| 7 Fuel filter | 15 Heat exchanger |
| 8 Fuel pump | 16 Oil cooler |
| | 17 Silencer compressor |

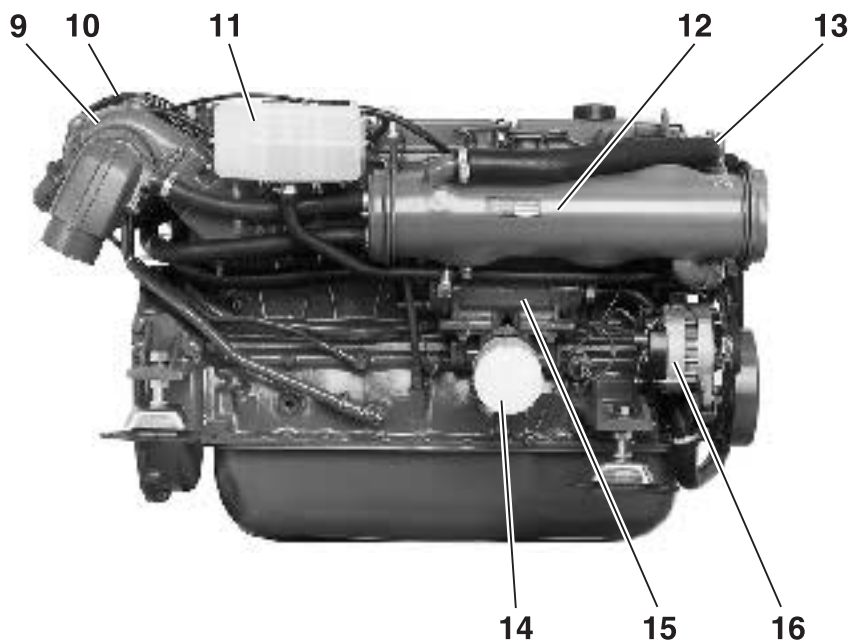


TAMD42WJ

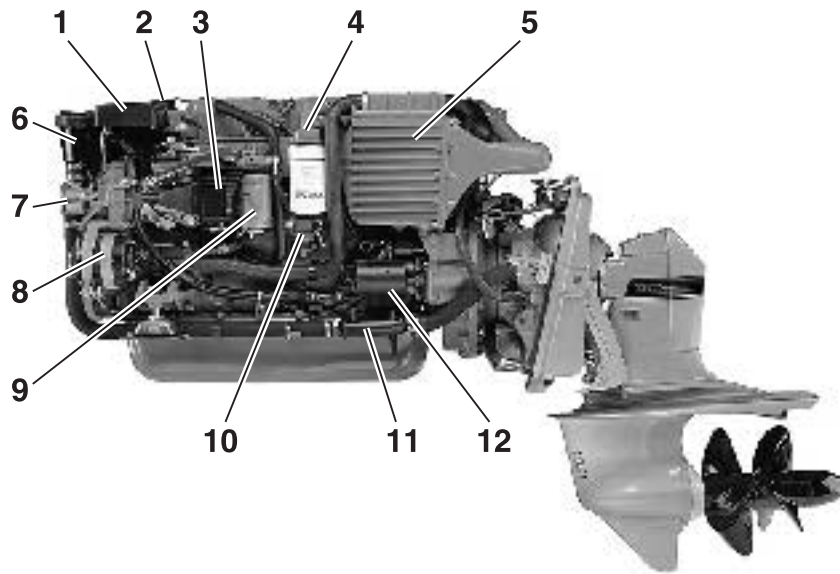


- 1 Terminal box with semi-automatic fuses
- 2 Oil filler cap
- 3 Charge air cooler (CAC)
- 4 Injection pump
- 5 Seawater pump
- 6 Fuel filter
- 7 Fuel pump
- 8 Starter motor

- 9 Turbocharger
- 10 Air Cleaner (ACL)
- 11 Expansion tank
- 12 Heat exchanger
- 13 Thermostat housing
- 14 Oil filter
- 15 Oil cooler
- 16 Generator

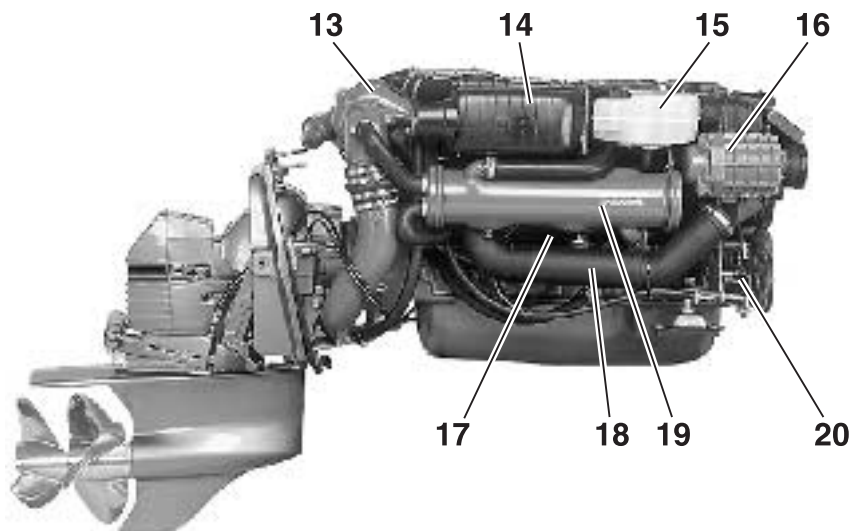


KAD44P/DP

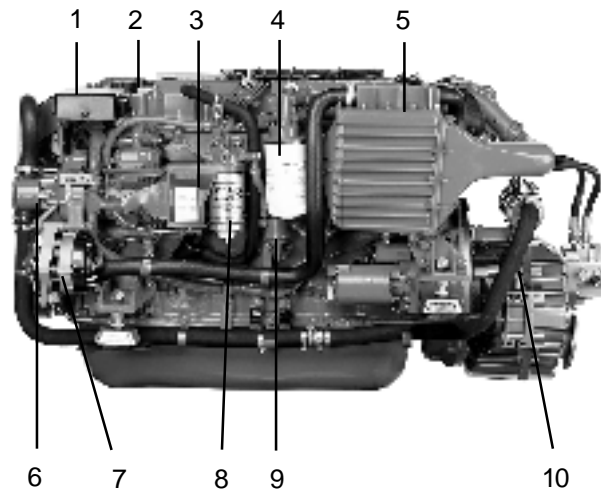


- | | |
|--|-------------------------------|
| 1 Terminal box with semi-automatic fuses | 11 Oil cooler, power steering |
| 2 Oil filler cap | 12 Starter motor |
| 3 EDC-unit | 13 Turbocharger |
| 4 Oil filter | 14 Air Cleaner (ACL) |
| 5 Charge air cooler (CAC) | 15 Expansion tank |
| 6 Seawater filter | 16 Compressor |
| 7 Seawater pump | 17 Oil cooler |
| 8 Generator | 18 Silencer compressor |
| 9 Fine fuel filter | 19 Heat exchanger |
| 10 Fuel pump | 20 Steering servo pump |

KAD44P/DPX

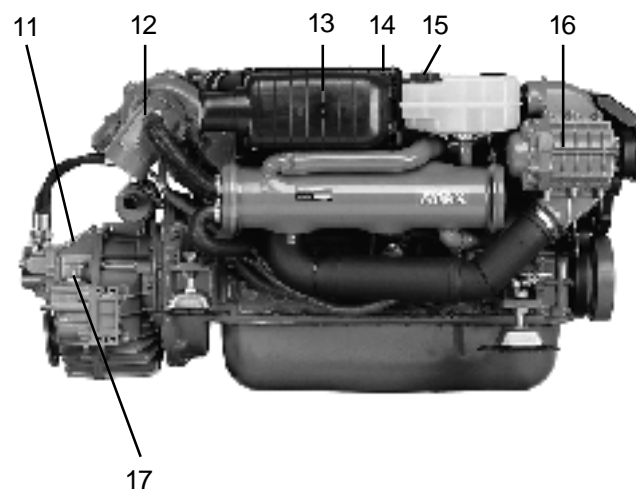


KAMD44P/KAMD300, HS63AE

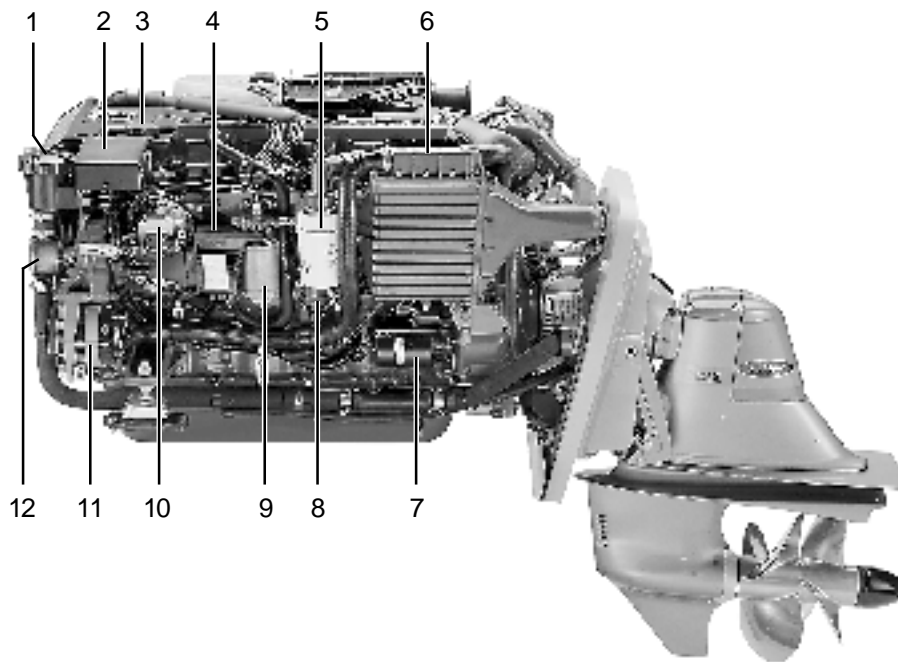


- 1 Terminal box with semi-automatic fuses
- 2 Oil filler cap
- 3 EDC-unit
- 4 Oil filter
- 5 Charge air cooler (CAC)
- 6 Seawater pump
- 7 Generator
- 8 Fuel filter
- 9 Feed pump, fuel

- 10 Dipstick, reverse gear.
- 11 Type plate
- 12 Water-cooled exhaust elbow
- 13 Air Cleaner (ACL)
- 14 Oil dipstick
- 15 Topping up the engine coolant
- 16 Compressor
- 17 Oil filter, reverse gear

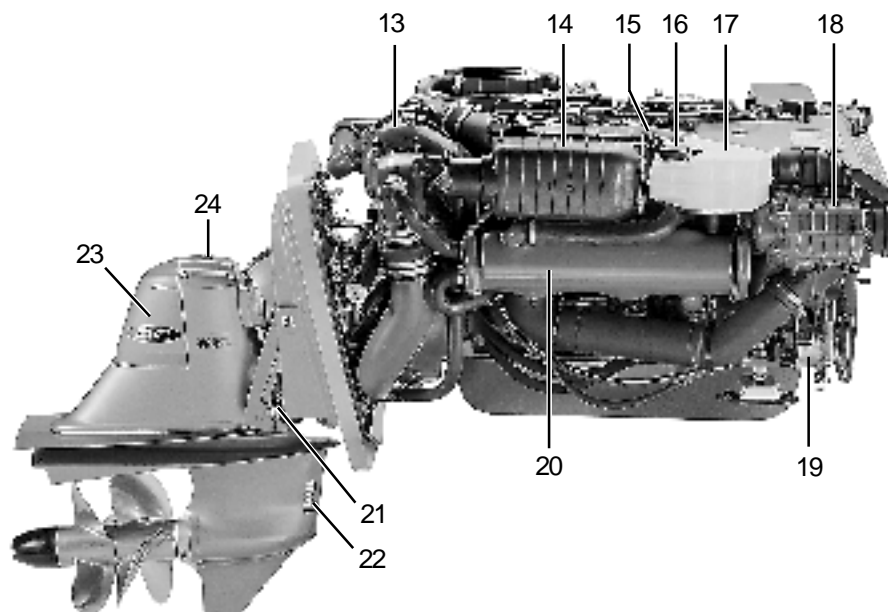


KAD300/DP-G



- 1. Sea water filter
- 2. Distribution box
- 3. Oil filler, engine
- 4. Control unit (EDC)
- 5. Oil filter, engine
- 6. Intercooler
- 7. Starter motor
- 8. Fuel supply pump
- 9. Fuel filter
- 10. Injection pump
- 11. Alternator
- 12. Sea water pump

- 13. Turbocharger
- 14. Air filter
- 15. Dipstick, engine
- 16. Coolant filler
- 17. Expansion tank
- 18. Supercharger
- 19. Servo pump, steering
- 20. Heat exchanger
- 21. Trim cylinder
- 22. Cooling water inlet
- 23. Oil filler, drive
- 24. Dipstick, drive



Component specification

Cylinder block

The cylinder block is made of special alloy cast iron and cast in one piece. Combustion induced tensile stresses in the cylinder head screws are directed through stiffened sections between the cylinder block walls into the main bearings.

The camshaft bearings are bored to the correct dimension and aligned after installation.

Cylinder heads

The engine has a whole cylinder head. The cylinder head surface is absolutely flat and therefore the combustion chamber is completely extended to the piston head. The seal between the engine block and cylinder head is of the composite type. The cylinder head is secured with 27 screws (31/32-series 19 screws). The screws are tightened by torque tightening in three stages with complementary protractor tightening in two stages.

Pistons

The pistons are made of an aluminum alloy. The upper compression ring, which leads off the greater part of the heat transferred by the piston rings, is located in a forged piston ring carrier of high alloy cast iron. This gives the piston ring groove long service life despite the heat stresses. The piston ring grooves for other piston rings are machined directly into the piston.

All engines have piston cooling. The pistons have a channel inside the upper section of the pistons through which the oil for piston cooling passes. The intake is in the inner mantle by the piston bolt hole, the drainage hole is in the upper section of the piston under the combustion chamber. The piston cooling oil is sprayed from fixed nozzles, one for each cylinder. Oil is sprayed from the nozzles up to the piston cooling channel. The oil to the piston cooling is allowed forward from a pressure valve which opens when the oil pressure has reached 2.2–3 kp/cm². By piston cooling the temperature is reduced by approximately 20°C measured at the upper piston ring groove.

Piston rings

Each piston has two compression rings and an oil ring.

The upper ring "A" is of the "Keystone" type (trapezium shaped) The keystone is molybdenum coated and should be used with the marking TOPCD upwards.

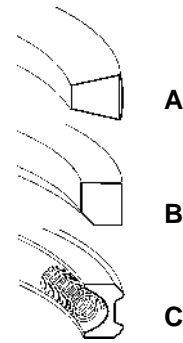
The other compression ring "B" (chromed) is a burred "twist"-ring The ring is slightly tapered and has a turned inner face which should be installed with the TOPCF marking upwards.

NOTE! TAM41H-B are different to other engines. These engines have a unique second compression ring of which the internal chamfer should point downwards.

The oil ring "C" (chromed) can be installed in either way. The ring has two scraper edges which are pressed against the cylinder walls, partly through its own tension and partly through an expander spring on the inside of the ring. The opening of the expander ring should be placed on the opposite side of the gap in the oil ring.



Piston ring location all engines except TAM41H-B

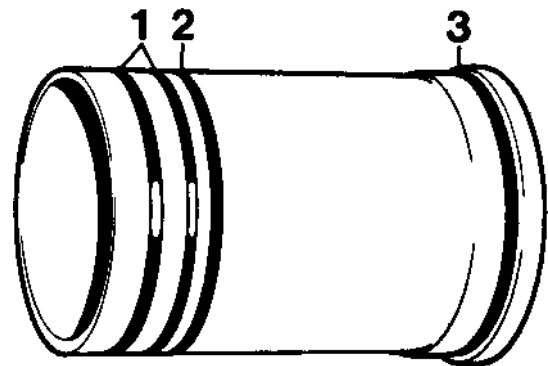


Piston ring location TAM41H-B

Cylinder liners

The cylinder liners are of the wet type and are replaceable. They are made of a special alloy cast iron and are spun cast.

Four rubber O-rings are used as the cylinder liners outer seals. The three lower rings (1, 2) are located in machined grooves in the liner. The upper sealing ring (3) seals under the liner flange by pressing the flange down onto the liner against the collar in the cylinder block. These rings are made of different materials. The two lower sealing rings (purple) are made of fluoroine rubber (FPM), the other ring is ethylene-propene rubber (EPDM) and is black.



⚠ WARNING! Special safety precautions apply for fluoroine rubber exposed to high temperatures, see page 8.

Valve system

The valves are made of chrome-nickel steel. The valve stems are chromed.

The valve seats of special steel are replaceable. The seats are available as replacement parts as standard size and as over-sized. The over-sized seat has a 2 mm larger outer diameter and is used if new valve seats need to be cut in the cylinder head.

Camshaft

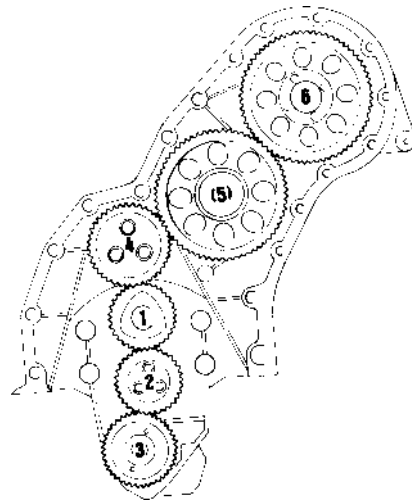
The camshaft is carried in seven bearings (31/32-series 5 bearings). The bearings are replaceable, the new bearings should be bored to the right size and aligned after pressing in.

Transmission

The transmission consists of gear wheels with helical teeth.

Transmission

- 1 Crankshaft gear
- 2 Intermediate gear for oil pump
- 3 Intermediate gear for oil pump
- 4 Intermediate gear for camshaft
- 5 Camshaft gear
- 6 Injector pump and water pump gear



Crankshaft

The crankshaft is supported on seven main bearings. The thrust bearing consists of thrust washers located each side of the central main bearing. On late model engines, the thrust washers are integrated into the central main bearing.

The crankshaft is statically and dynamically balanced. The crankshaft nose is provided with a so-called polygon profile, and the rear end has a flange to which the flywheel is screwed.

Main and crankshaft bearings

The main and crankshaft bearings consist of indium plated leaded bronze lined steel shells. The bearings are precision manufactured and ready for installation.

Three under-sizes can be obtained as replacement parts. The thrust washers for the crankshaft axial bearings are available in three over-sizes.

Connecting rods

The con rods are of I section and are drilled for pressure lubrication to the gudgeon pin. Late-model con rods have a trapezoidal gudgeon pin end. Early and late model con rods can be mixed, however.

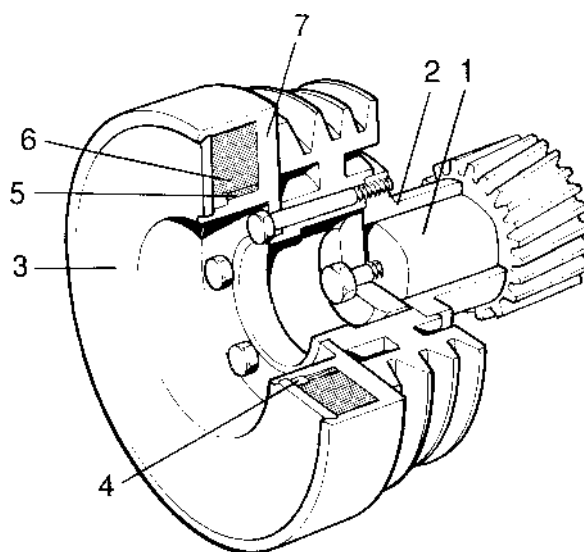
The gudgeon pin bushings are steel with bronze alloy coatings.

Flywheel

The flywheel is screwed to a flange at the rear end of the crankshaft. It is statically balanced and fully machined. The starter ring gear is pressed onto the flywheel.

Vibration damper

The vibration damper consists of a hermetically sealed housing in which a rectangular cross section flywheel mass is located. The flywheel mass (damper ring) has a central bearing on a bushing and is surrounded on all other sides by a viscous fluid (silicon).



Vibration damper

- | | |
|----------------|-----------------|
| 1 Crankshaft | 5 Bushing |
| 2 Hub | 6 Flywheel mass |
| 3 Cover | 7 Housing |
| 4 Fluid cavity | |

Repair Instructions


General

If possible a condition test should be carried out before every major service correction, so that the engine condition can be established and any contributory fault causes discovered. A condition test requires the engine to be run so this should be carried out before removal of the engine or any components is begun.

See Condition test, engine on page 32.

Action before repairing in the boat


- 1 Cut off battery supply.
- 2 Clean the outside of the engine.
NOTE! Ensure that the cleaning residues are collected for destruction and do not accidentally affect the environment. See also warning text under point 12.
- 3 Work requiring action to cooling system: Close sea cock and drain coolant from the sea water and freshwater systems respectively.

 **WARNING!** Ensure that the sea water intake is properly closed and that water cannot enter when removing cooling system components.

Actions before lifting the engine out of the boat

- 4 Take the boat out of the water.
- 5 Cut off battery supply, remove battery terminals from the starter motor.
- 6 Remove the engine wiring-instrument's connector.
- 7 Remove the sea water terminal/keel cooling terminal.
- 8 Remove the exhaust system.
- 9 Close the fuel cocks. Remove the fuel terminals.
- 10 Remove the fuel and transmission cables.
- 11 Disconnect the propeller shaft from the reverse gear. Disconnect the engine pads from the bed and lift out the engine.

Actions after lifting out the engine

- 12 Clean the engine
 **IMPORTANT!** Observe the following rules when cleaning with high-pressure water jets. Be extremely careful that water does not penetrate engine components. With the high pressure function connected the water jet must never be directed at sealed joints, shaft seals for example, joints with gaskets and rubber hoses and electrical components.
- 13 Drain out engine oil.
- 14 Dismantle reverse gear (if necessary)

Engine fixture attachment

Fixture 999 9946 is used to attach the engine to unit stand 998 6485.

The fixture is screwed onto the engine's right side according to the picture below.

NOTE! It is important that the instructions for the number and size of screws is followed so that a secure attachment of the engine is obtained.

Necessary screws:

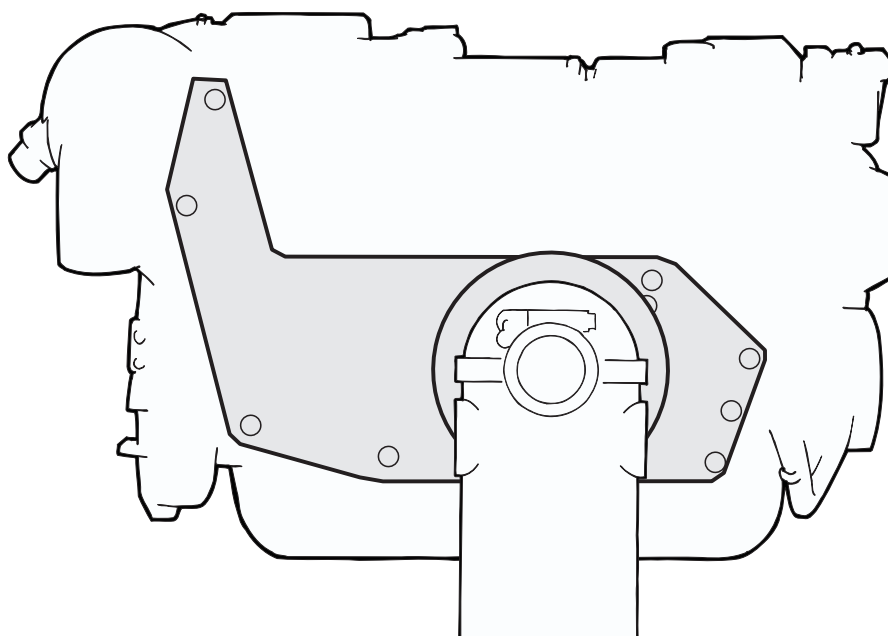
41/42/43/44/300 series

2 screws M12x30 mm

2 screws M16x30 mm

The following components must be removed from the engine before the fixture can be attached and the engine installed on the stand:

Compressor (42/43/44/300 series), heat exchanger with expansion tank, oil cooler with oil distribution housing, front engine mounting, oil pipe to turbo, dipstick pipe.



Engine condition test

Compression test

*Special tools 31/32/41/42/43 series: 999 6936
44/300 series: 885 257*

A compression test indicating the cylinders and valve sealing is carried out as a easy and reliable way of judging engine condition.

- Run engine to operating temperature and shut it off.
- Dismantle all injectors and test cylinders in turn and order.

! **IMPORTANT!** Cleanliness is extremely important, no dirt must get into the fuel system. Plug terminals on disconnected injectors and fuel lines.

Compression should be read off at normal starter motor speed. A deviation of up to 10% below the figure given in the Workshop manual "Technical data" is acceptable.

Low compression on all cylinders indicates worn cylinder liners and piston rings. If by comparison one cylinder deviates below it can depend on either unsealed valves, broken piston rings or a leaking cylinder head gasket .

Install adapter 999 6936 (31/32/41/42/43) or 885 257 (44/300) in the injector outlets and secure with the injector mounting nut.

Install a compression meter in the adapter and carry out the compression test.

Removing components from the Cylinder block

Removing

1



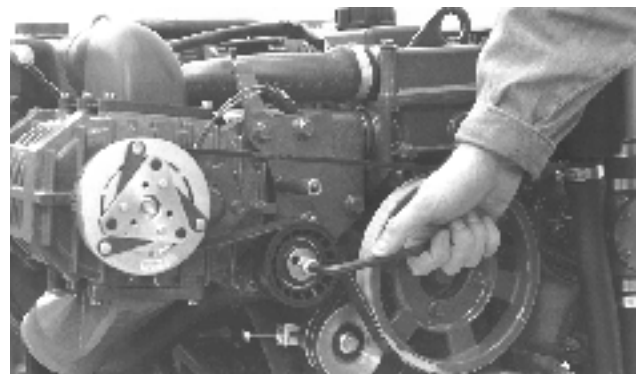
Remove the front cover (KA(M)D32/42/43/44/300)

2



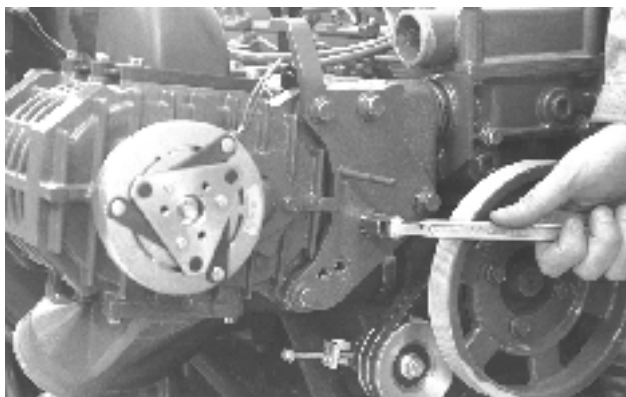
Remove the compressor-turbocharger-air cleaner airpipes. Remove the air cleaner. Remove the compressor silencer (KA(M)D32/42/43/44/300)

3



Remove the tension pulley and remove the compressor belt, 8 mm Allen key (KA(M)D32/42/43/44/300)

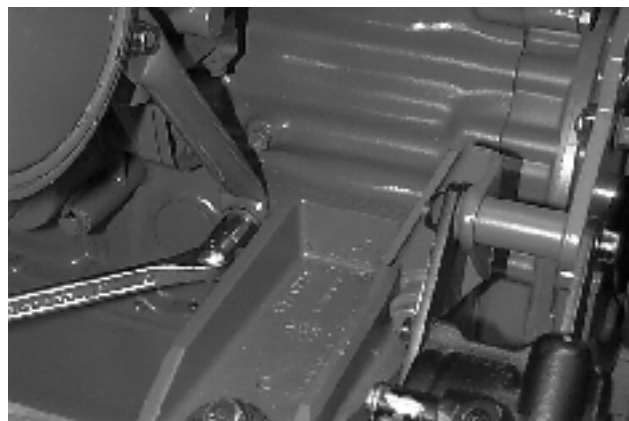
4



Remove the compressor bracket and remove the compressor. Wrench sizes 14 mm and 15 mm (KA(M)D32/42/43/44/300)

⚠ IMPORTANT! Cover the compressor intake and outlet pipes with clean paper or similar so that nothing can fall into the compressor housing.

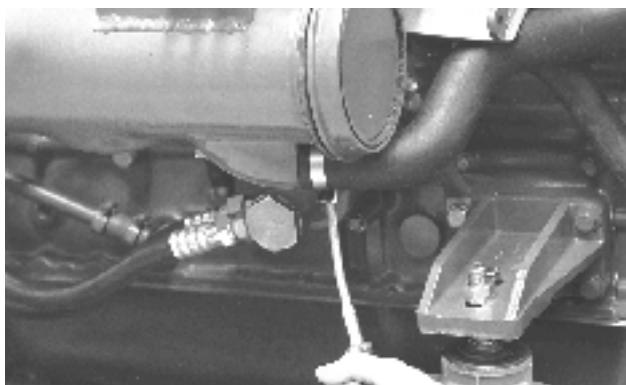
6



Remove the lower screw from the heat exchanger-cylinder block strut. Wrench 17 mm.

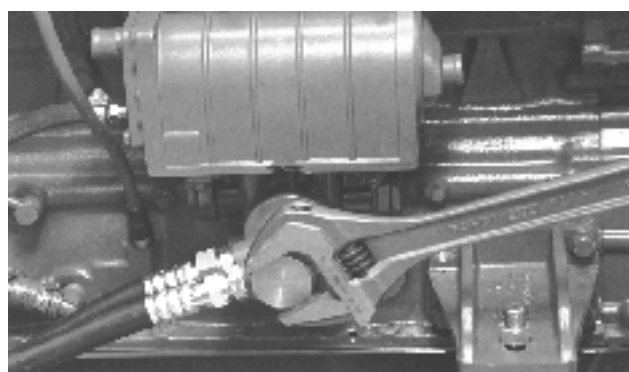
Remove the heat exchanger and expansion tank complete with respective brackets. Wrench 15 mm.

5



Disconnect the coolant hoses from the heat exchanger housing, charge air cooler (CAC), oil cooler, expansion tank, water filter and sea water pump.

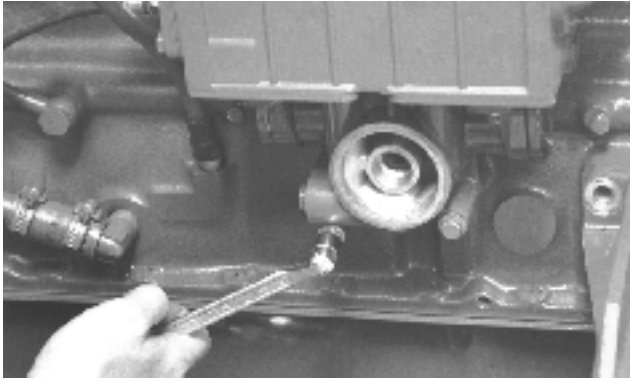
7



Remove the terminal adapter with the oil hoses from the oil distribution housing. (KA(M)D32/42/43/44/300)

Other engines: Remove the oil filter with 999 9179.

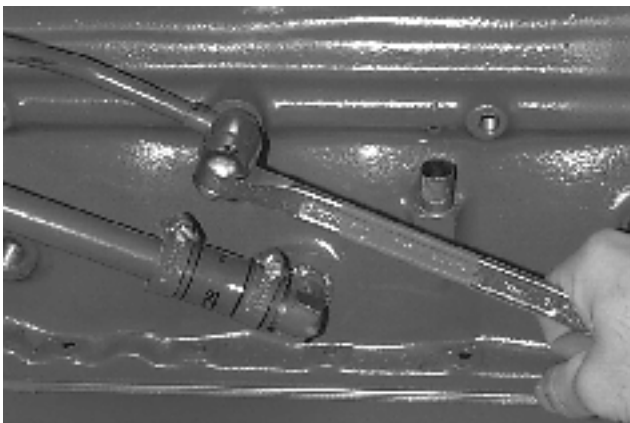
8



Remove the oil cooler with the oil distribution housing Wrench 12 mm.

Remove the dipstick pipe. Wrench 10 mm.

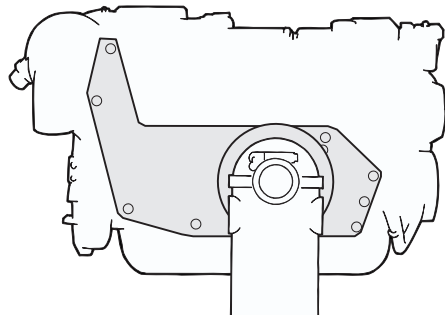
9



Remove the oil pipes turbocharger (TC) – cylinder block. Wrench 12 mm and 19 mm and flexible screwdriver.

Remove the oil plugs from the oilways in the engine block, partly to attach the engine fixture, partly to allow the oilways to be flushed.

10



Lift the engine with the appropriate lifting gear. Remove the engine pads. Wrench 17 mm.

Install engine fixture 999 9946.

NOTE! If the dipstick pipe cannot be removed the fixture must be modified so that the dipstick pipe is not crimped.

Install engine in the unit stand 998 6485.

11



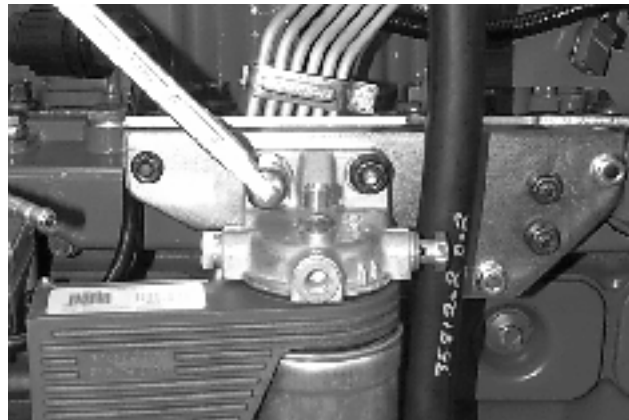
Remove connectors for oil pressure sensor and oil pressure switch. Remove oil filter with 999 9179 and oil filter adapter. Wrench 12 mm (KA(M)D42/43/44/300).

12



Remove EDC unit connector. Carefully bend down the red lock pin at the same time as the connector is pulled out (KA(M)D44/300).

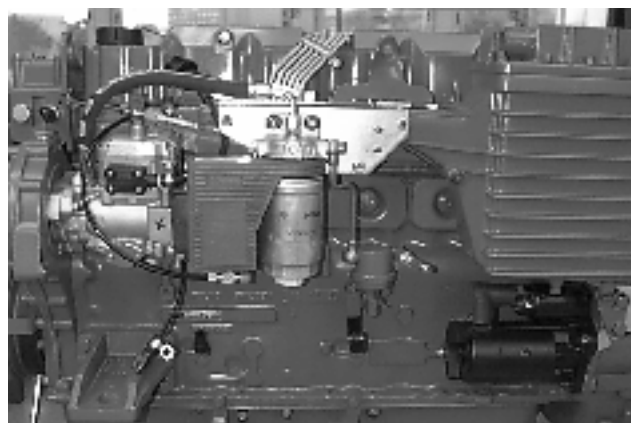
14



Remove fuel filter complete with electronic diesel control (EDC) unit (KA(M)D44/300) and bracket. Wrench 14 mm.

Remove fuel pipe bracket. Wrench 13 mm.

13

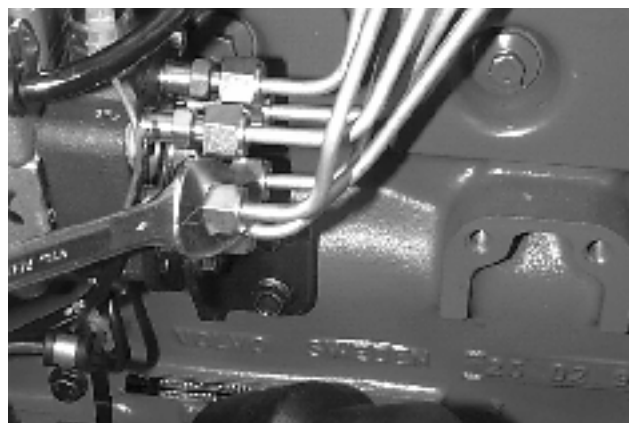


Remove the fuel pipe/ hose between injector pump, fuel filter and supply pump. Wrench 17 mm.

Remove the air hose between the electronic diesel control (EDC) unit and the intake pipe.

⚠ WARNING! Take great care to ensure cleanliness when working with the fuel system. Be alert for fuel spillage, diesel oil is hazardous if in frequent contact with the skin.

15

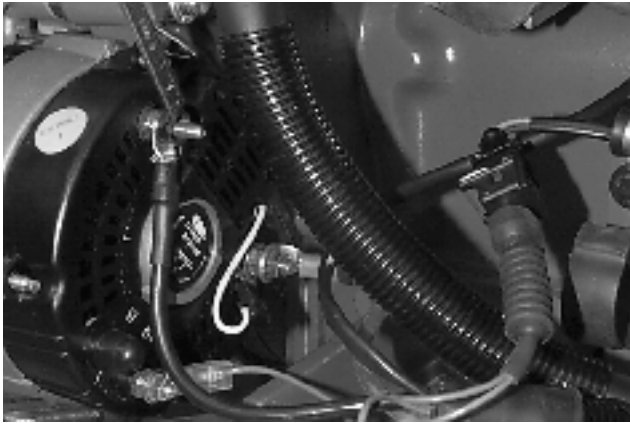


Remove the delivery line terminals at the fuel pump and injector. Wrench 17 mm. Lift off the delivery line.

Remove fuel return line. Wrench 10 mm.

⚠ IMPORTANT! Cleanliness is extremely important, no dirt must get into the fuel system. Plug the fuel pump (FP) and injector terminals with appropriate plugs.

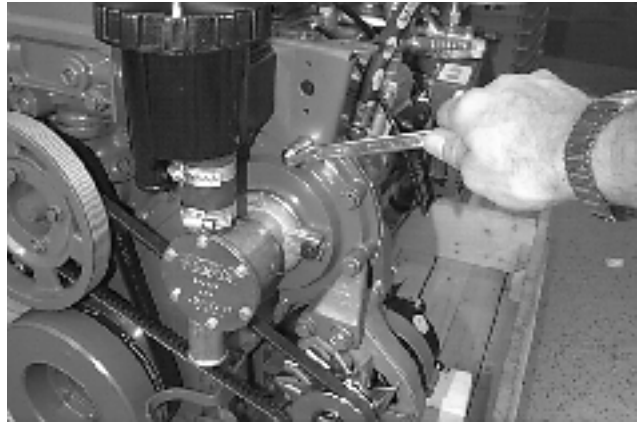
16



Remove the generator (GEN) electrical terminals. Wrench 7 mm, 8 mm and 10 mm.

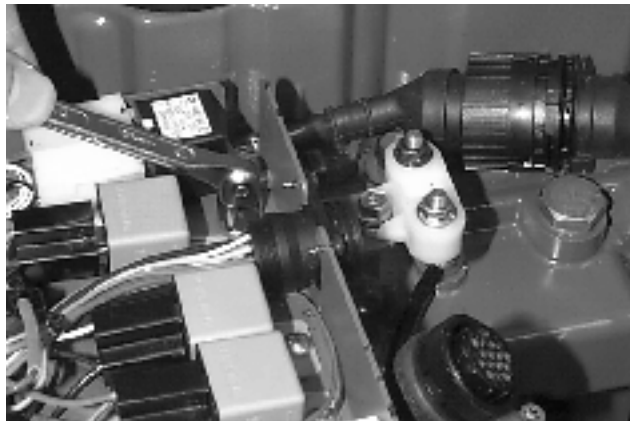
Remove the starter motor solenoid electrical terminals. Wrench 8 mm and 13 mm.

18



Remove water filter bracket. Remove the sea water pump and lift off the filter and pump as one unit. Wrench 12 mm.

17



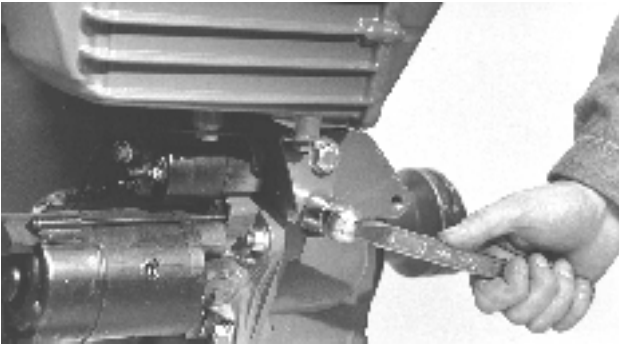
Remove electronics box. Disconnect all connectors and remove engine wiring in one piece.

19



Remove the generator. Wrench 11/16", 5/8", 12 mm and 13 mm.

20



Remove the charge air cooler (CAC). Disconnect the turbocharger (TC) connector pipe, wrench 10 mm. Slacken off the support bracket at the bottom edge and on the inside of the CAC and the terminal to the intake manifold. Wrench 13 mm and 17 mm.

22



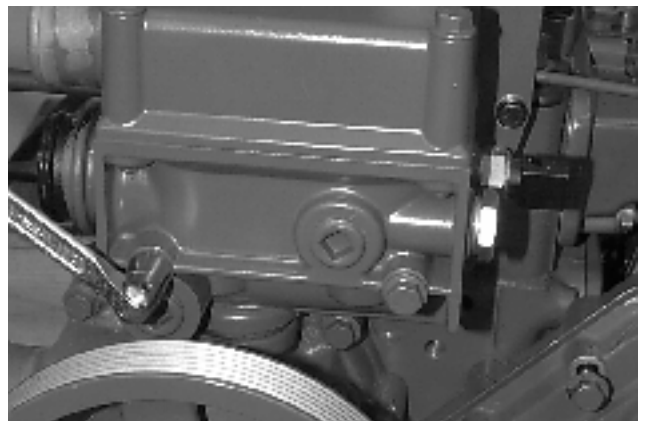
Remove the exhaust pipe. Socket 15 mm. Lift off the exhaust pipe and turbocharger (TC) as one unit.

21



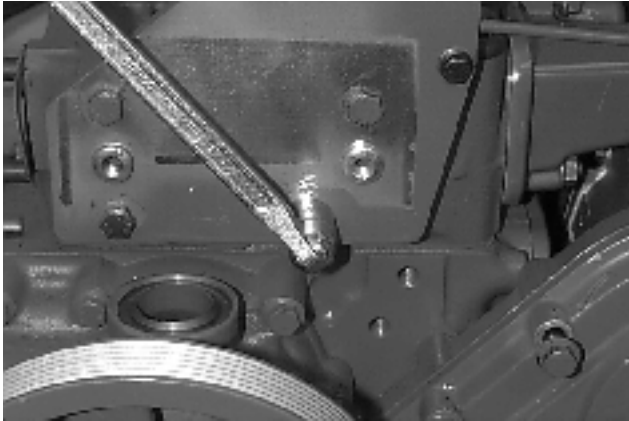
Remove the starter motor. Wrench 15 mm.
Remove the injector pump. Socket 13 mm.
Remove supply pump. Socket 12 mm.

23



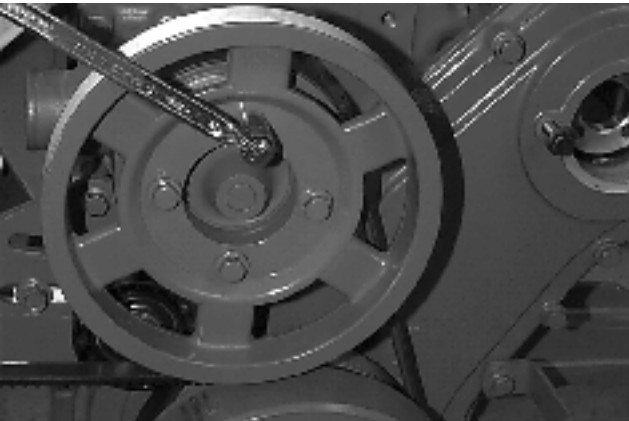
Remove the thermostat housing. Socket 12 mm.

24



Remove the lifting bracket. Socket 13 mm.

25



Remove the outer pulley on the circulation pump.
Socket 12 mm.

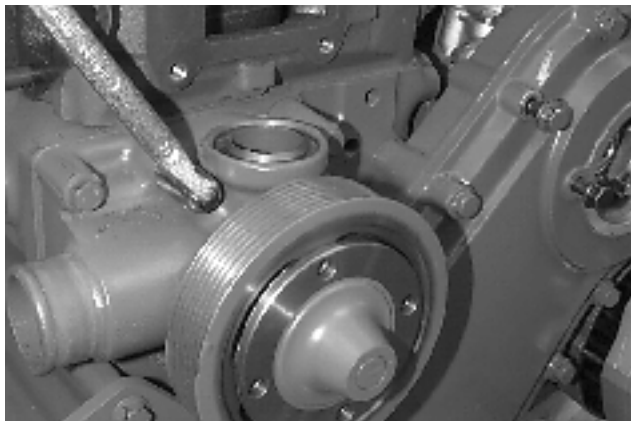
26



Slacken and remove the circulation pump drivebelt.
Remove tension reel. Wrench 8 mm allen.

Dismantling cylinder block Removal

1



Remove circulation pump. Socket 12 mm.

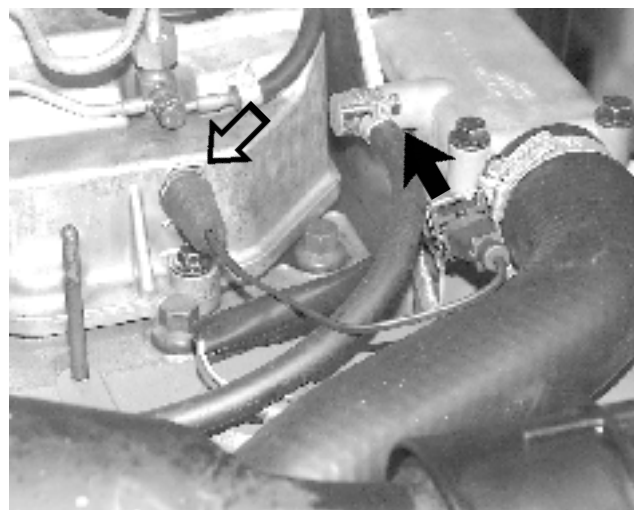
2



KA(M)D44P-A

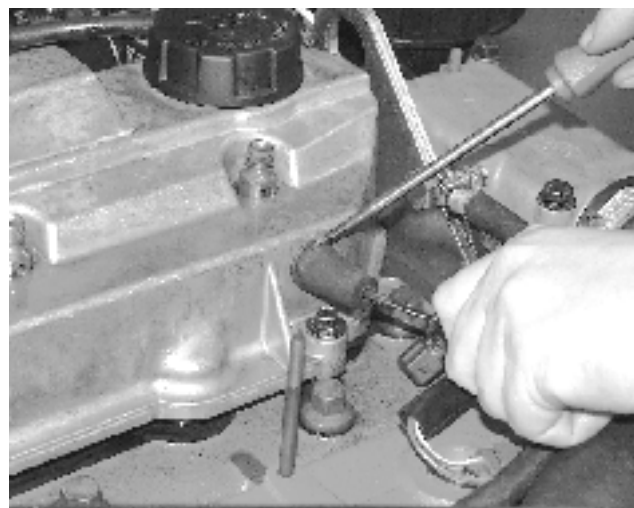
Remove the valve cover. Remove the seal against the valve cover (the O-rings, washer and spring) on each injector.

Inspect the valve cover gasket. If it is undamaged the gasket does not need to be changed.



KA(M)D44P-B/44P-C/300

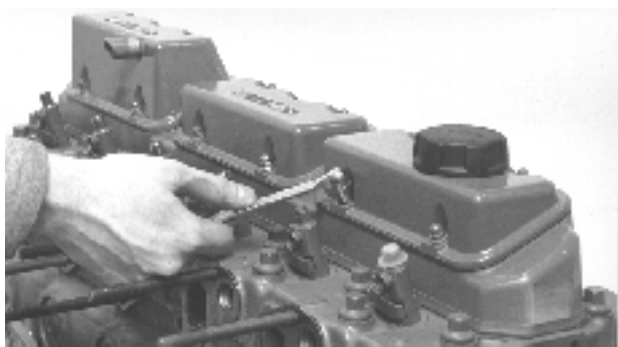
Remove the clip on the rubber grommet for the cable to the injector on cylinder 1. Separate the connector.



Remove the screws for the valve cover. Carefully press the rubber grommet in using a screwdriver at the same time lifting the valve cover slightly. Insert the cable through the hole. Remove the valve cover. Remove the seal against the valve cover (the O-rings, washer and spring) on each injector.

NOTE! The springs on cylinder 1 cannot be removed before the injector is removed from the cylinder head.

Inspect the valve cover gasket. If it is undamaged the gasket does not need to be changed.



31/32/41/42/43

Remove the upper valve covers. Socket 10 mm.

Remove the lower part of the valve covers. Socket 13 mm.

3



Remove the rocker arm bracket.

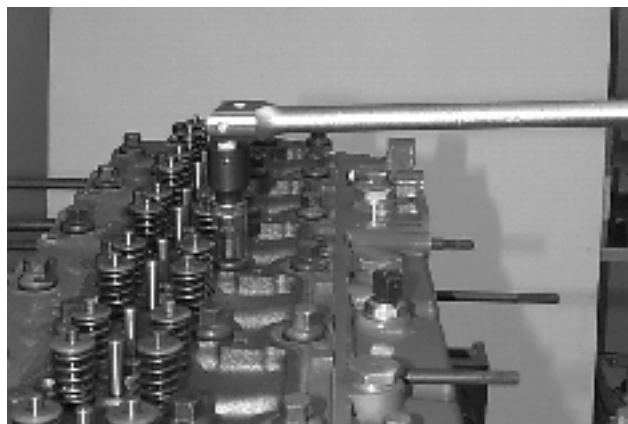
Prepare a stand marked with cylinder numbers. Rocker arms, valve yokes (KA(M)D44/300), push rods, valves, valve springs, and valve lifters **must** be reinstalled in the original positions if they are to be re-used.

Lift out the push rods and valve yokes (KA(M)D44/300) and place them in the marked up stand.

4

Remove the injectors. Use extractor 885 131 (31/32/41/42/43 series) and 885 263 (44/300 series). This is to ensure that the copper sleeves are not extracted as well.

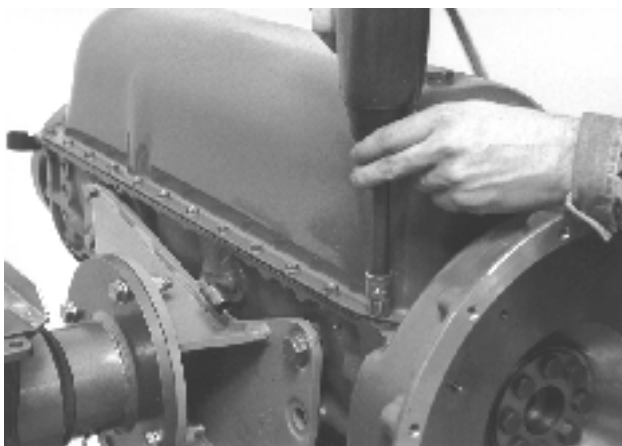
5



Remove the cylinder head. Socket 14 mm. Slacken off the screws in reverse tightening order.

Remove the inspection hatches and remove the lifters. Place the lifters in number order as in point 3.

6



Turn the engine and remove the oil sump. Socket 12 mm.

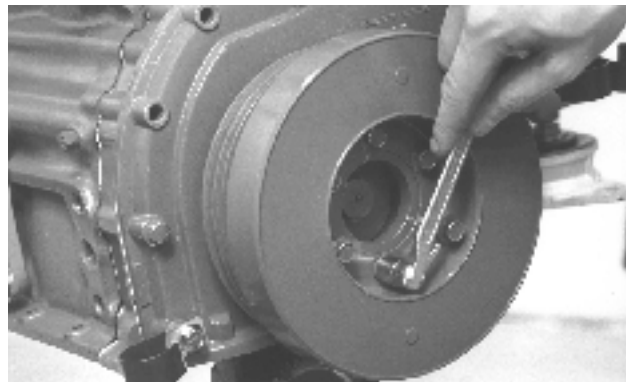
7



Remove oil feed pipe and oil delivery pipe and their bracket. Socket 12 mm.

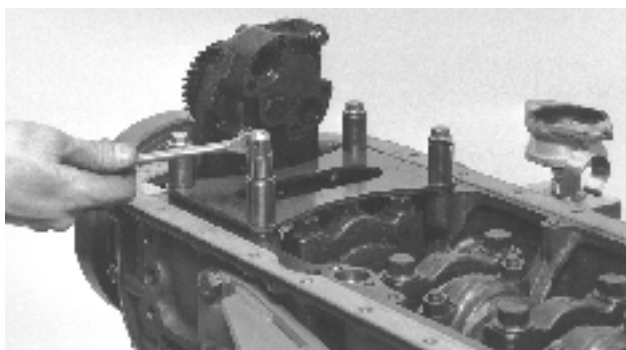
NOTE! The bracket screws have sprung washers which may not be mixed with the other washers.

9



Remove the vibration damper and belt pulley. Socket 12 mm.

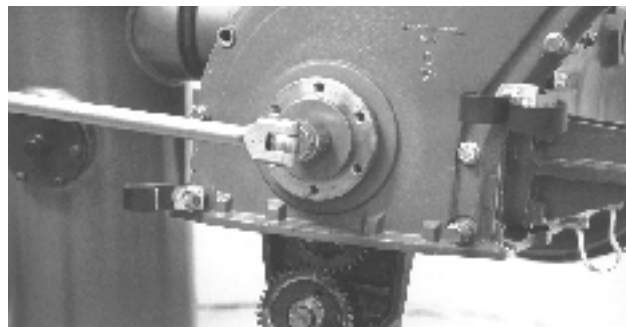
8



Remove the cylinder block reinforcement panel. Socket 14 mm.

NOTE! Do not drop the spacer washers between the panel and the engine block.

10



Remove the polygon hub center bolt. Use tool 884 895 as a counterhold.

⚠ IMPORTANT! Do not turn the crankshaft belt pulley without holding the fuel injection pump gear wheel in position. The gear wheel can otherwise engage incorrectly and be damaged or cause damage.

11



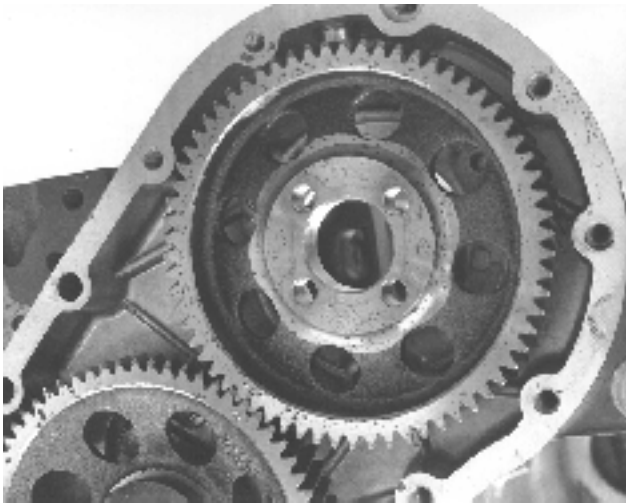
Screw the center bolt back in loosely and without the washer. Pull off the polygon hub, use puller 884 608 with 3 belt pulley screws. Remove the center screw.

14



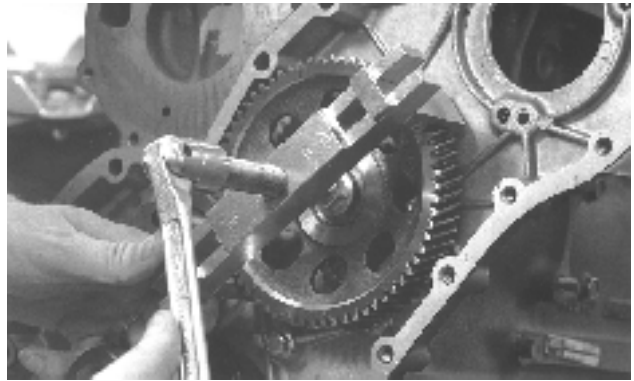
Remove the intermediate gear. Socket 12 mm.

12



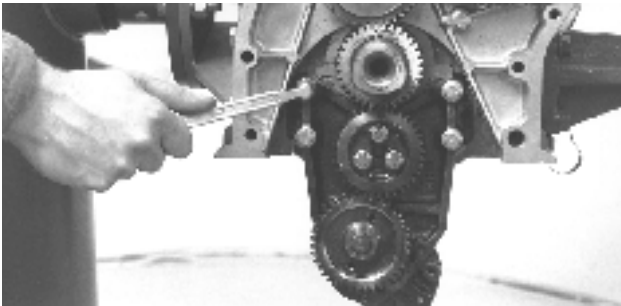
Remove the timing cover, socket 12 mm. Lift off the fuel injection gear wheel.

15



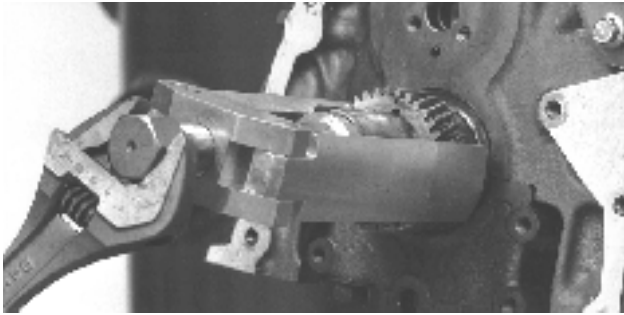
Remove the camshaft pulley center screw and washer. Screw the center screw back in loosely and pull off the camshaft pulley with puller 999 2679.

13



Remove the oil pump. Socket 12 mm.

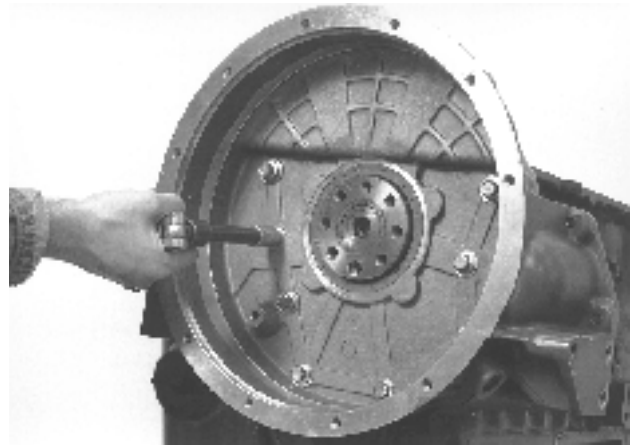
16



Remove the inner timing cover and intermediate gear hub. Socket 12 mm.

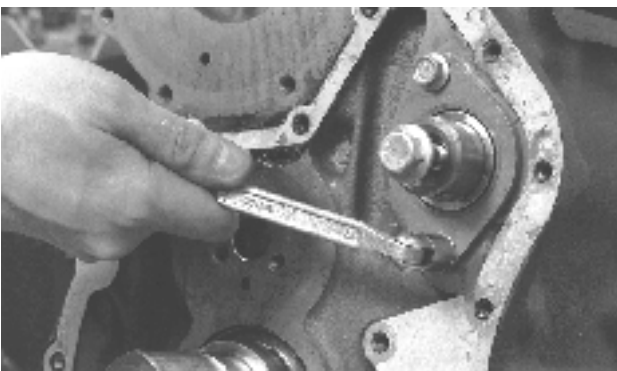
Remove the crankshaft gear with puller 999 2658. Use tool 884 895 as a counterhold.

19



Remove the inner flywheel cover. Socket 14 mm.

17



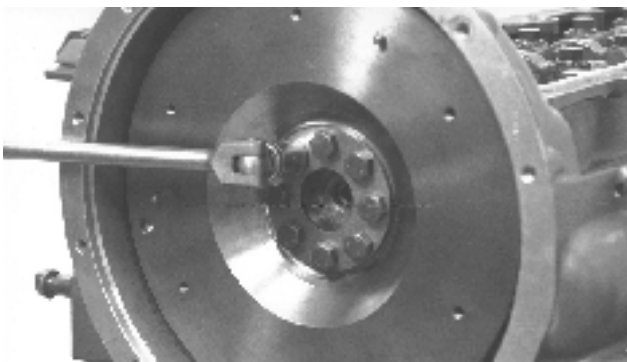
Remove camshaft pressure washer and carefully withdraw the camshaft. Socket 12 mm.

20



Remove the connecting rod cap and press out the pistons. Take care not to damage the piston cooling nozzles. Socket 17 mm.

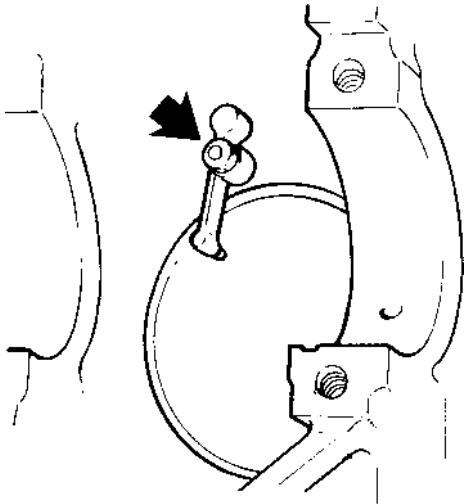
18



Remove the flywheel. Use tool 884 895 as a counterhold. Socket 19 mm.

NOTE! To minimize the risk of damage to the RPM sensor (44/300 series) it should be removed before the flywheel is removed.

21



Remove the main bearing caps and remove the crankshaft. The main bearing caps are numbered and must be reinstalled in their original positions. Socket 19 mm.

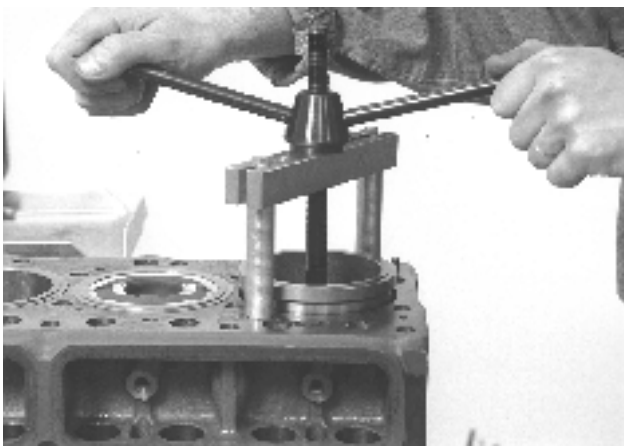
Remove piston cooling nozzles.

NOTE! Lock nuts should not be reused but should always be replaced with new ones. Socket 10 mm.

Removing cylinder liner

The cylinder liners should not be removed until it is decided, after measurement or some other method, that it is absolutely necessary that they are changed. See "Cylinder liners, inspection and measurement".

22

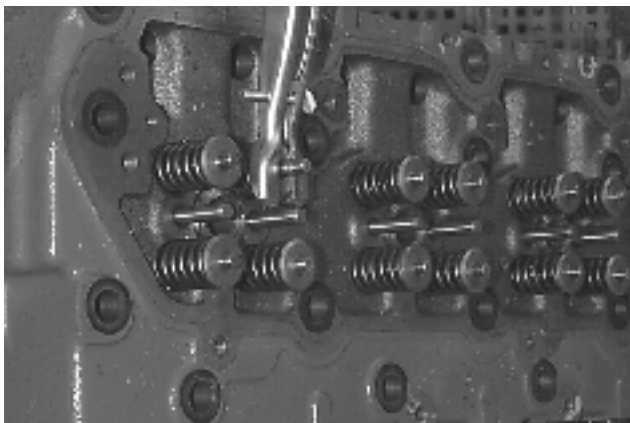


Remove the cylinder liners using tools 884 231, 884 551 and 884 888. The extractor consists of yoke from 884 551 and center screw and puller nut from 884 231. The extractor is then used together with the puller plate 884 888.

Cylinder head, reconditioning

Cylinder head, dismantling/ reassembly

Special tools: 885 128



Dismantling

The cylinder head plugs should not be removed unless they are damaged. Valves and valve springs **must** be reinstalled in the original positions if they are to be reused. Use a marked stand or compartmented box so that the correct positioning can be ensured.

1

Remove the valve springs and valves using a valve spring tensioner. Remove valve cotters, washers, valve stem seals and valves.

Valve stem seal should always be discarded and replaced with new ones.

2

Clean all components, be especially careful with the oil and coolant ducts.
Remove the remaining carbon and pollutants from the cylinder head mating surface.

Reassembling

3

Install the plugs if they have been removed. Clean the plug seats.

Apply Permatex® No. 3 or Volvo Penta 1161099-5 sealing compound.

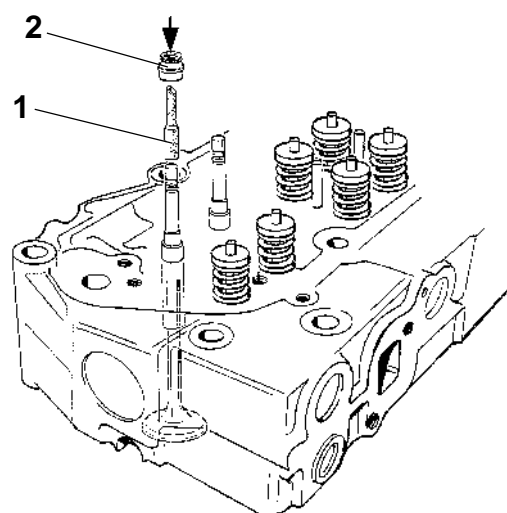
Insert plugs using a drift or socket.

4

Lubricate the valve stems and install the valve in its guide.

NOTE! Follow the markings so that the valves are returned to the original positions.

5



Applies to 44/300 series:

Install protective sleeve (1) on the valve stem (included in the repair kit). This **must** be done to avoid damage to the valve stem seals.

Carefully thread the valve stem seals (2) over the protective sleeve and tap them into place with a suitable tubular drift.

Other engines:

Carefully thread the valve stem seal over the sleeve protector and tap into place using an appropriate tube socket.

6

Install the valve spring/s, valve washer and press the spring/s together with the valve spring tensioner. Install valve cotter/s.

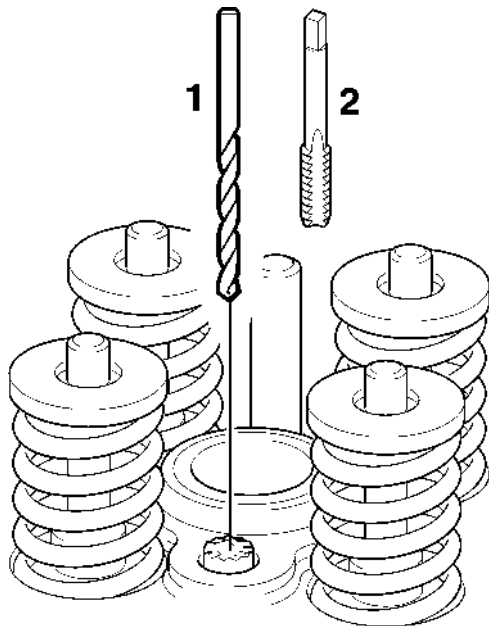
Guide pin, valve yoke, change (only KA(M)D44/300)

The guide pin should only be changed in cases where the guide pin has been broken. Since this task requires great accuracy, we recommend that the cylinder head should be removed from the engine before work starts.

1

Make a center punch mark in the center of the guide pin. Be very careful to center the center punch mark.

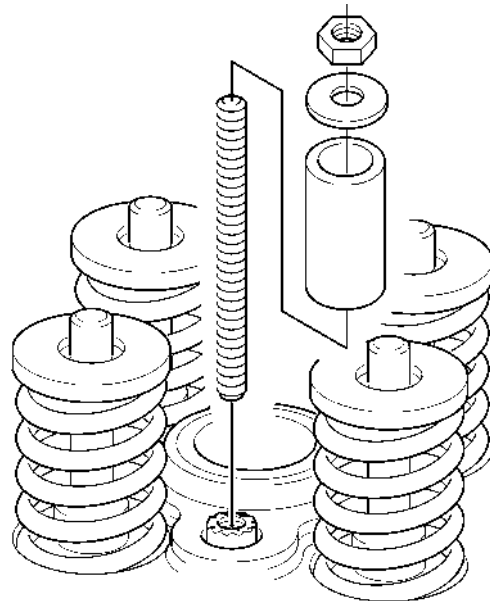
2



Drill with a 3.2 mm (0.125984") hole (1). Drilling depth about 10 mm (0.3937") , or when the case hardened layer of the guide pin is reached. Use a pillar drill.

Thread the hole with an M4 tap (2).

3

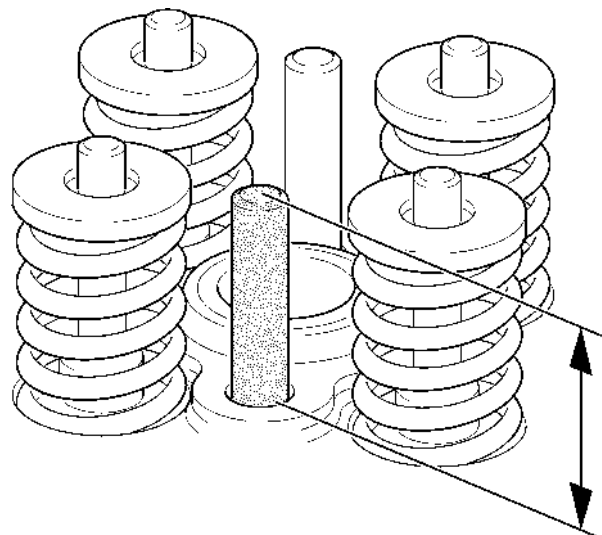


Screw in a stud (M4), slide a spacer sleeve over, plus a suitably sized washer. Pull the guide pin up by screwing the nut down.

4

Inspect and clean the hole for the guide pin.

5



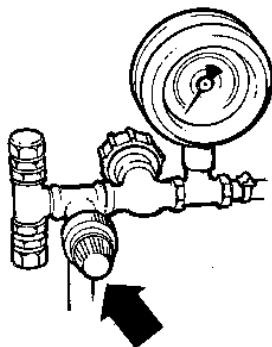
Press the new guide pin in with a suitable mandrel. Press until the guide pin projects 28 mm (1.10236") above the cylinder head plane.

Cylinder head, leakage check

Special tools: 885 243, 885 274, 999 6662, 999 6532

⚠ WARNING! Pressure test equipment 999 6662 should be checked before use. Always follow the safety precautions.

1



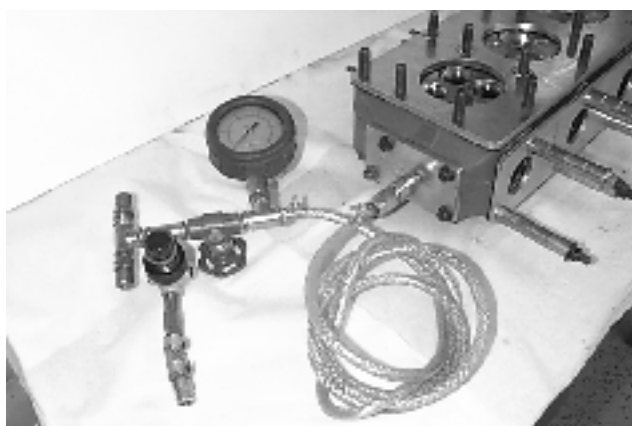
Connect the pressure test equipment to the pressurized air network and set the pressure gauge to **100 kPa (1 kp/cm²)** with the relief valve.

NOTE! The relief valve knob can be locked with an axially moved lock ring.

2

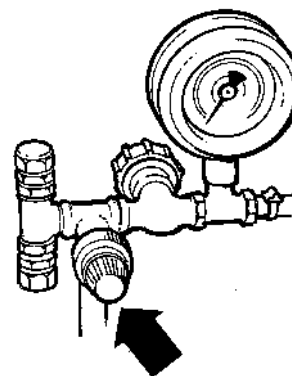
Then close the shut-off valve. To ensure that the pressure test equipment is reliable the pressure reading on the pressure gauge must not sink for **2 minutes**.

3



Install the air terminal plate 999 6532 with four M8 screws and sealing plates 885 274 and 885 243 with M10 nuts and appropriate spacer sleeves or cylinder head screws.

4

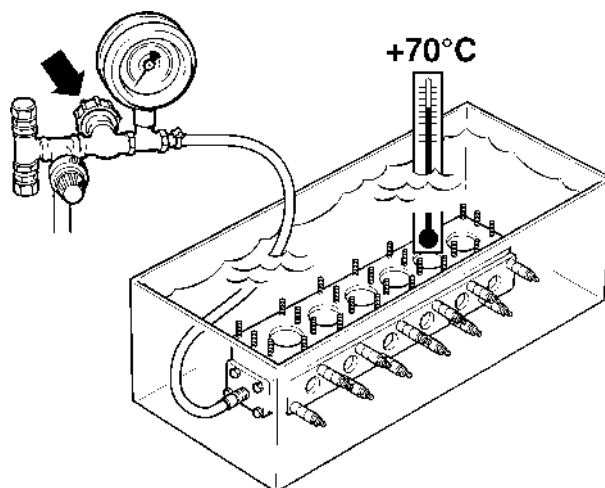


Check that the knob on the pressure test equipment relief valve is unscrewed.

5

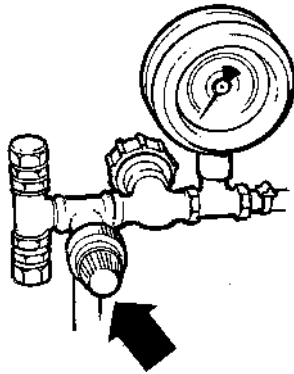
Connect the hose from the pressure test equipment to the air terminal plate.

6



Lower the cylinder head into **70 degree** water bath and open the cock.

7



Screw in the relief valve knob so that a pressure of **50 kPa (0.5 kp/cm²)** is obtained on the pressure gauge. Hold the pressure for **1 minute**.

8

Then raise the pressure to **150 kPa (1.5 kp/cm²)**. Lock the relief valve knob with the lock ring and close the cock.

Check after one or two minutes if the pressure is sinking or if there are air bubbles in the water bath.

Any leakage at the copper injector sleeves is remedied according to "Replacing copper injector sleeves" on pages 52 and 53.

Cylinder head, inspection

Cracks

When checking before reconditioning heat cracks can sometimes be seen between the valve seat and injector nozzle in engines that have a large number of operating hours.

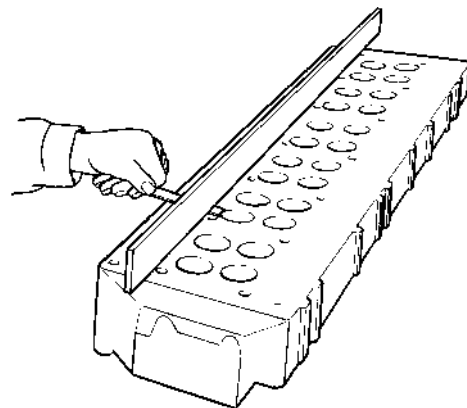
The cylinder head does **not** require changing because of heat cracking

The crack begins at the copper injector sleeve and goes towards the valve seat position. The cause of the crack may be that the injector mounting nuts are too tight, incorrectly torqued. Cracks of this type have never been the cause of gas or fluid leakage, because the crack has not continued through to the bottom of the cylinder head.

When leakage is observed it has been because of pollutants or damage to the copper sleeve seats.

See instruction "Cleaning the copper sleeve seat."

Distortion



The check is carried out with a feeler gauge and straight edge ruler, the edge of which is ground to a tolerance according to DIN 874/Normal.

The measurement is carried out first lengthways and then diagonally. If distortion exceeds 0.10 mm in 100 mm length or 0.20 in the entire length, the cylinder head should be replaced.

NOTE! The cylinder block cannot be ground flat.

If leakage is observed or if the blown marks the measurement is not necessary because a cylinder head in this condition must be replaced.

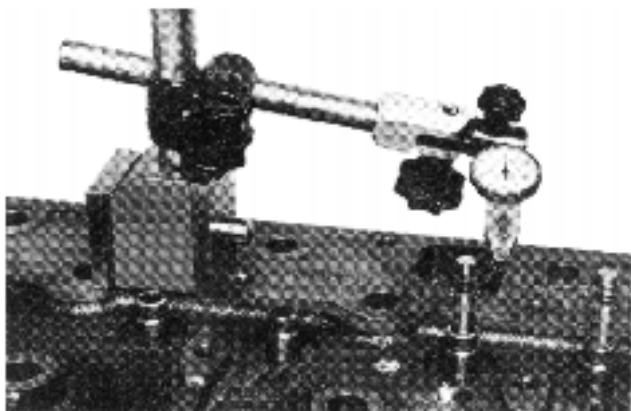
Valve guides, inspection

Special tools: 999 9683, 999 9696

1

Position the cylinder head on a pair of wooden blocks and install new valves in the guides. Lower the valve approximately 2 mm and check wear.

2



Position the rocker dial indicator 999 9683 with magnetic holder 999 9696 so that the dial indicator gauge point is against the valve stem. Move the valve sideways in the direction of the exhaust and intake ports.

Read off the value of the indicator gauge.

Permissible values see "Workshop manual, technical data".

Valve guides, replacing

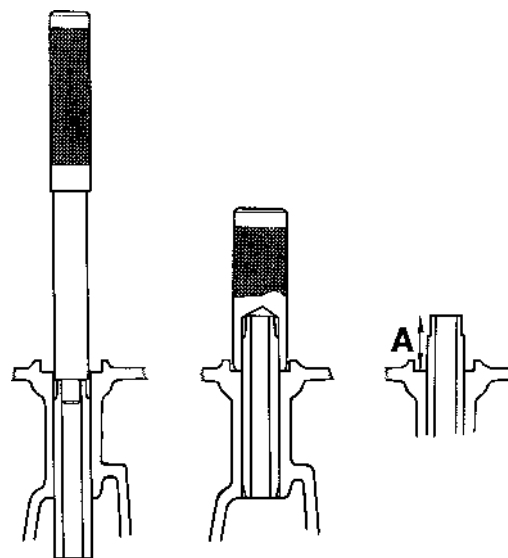
Special tools: 31/32/41/42/43 series: 884 992, 999 5218, 999 5028

44/300 series: 885 238, 885 261

1

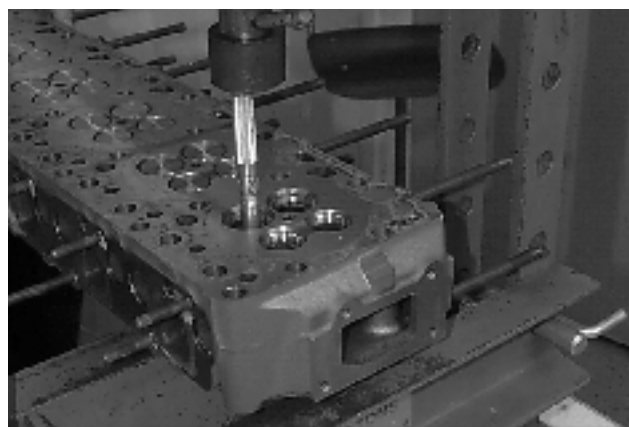
Press out the valve guide with drifts 999 5218 (31/32/41/42/43 series) and 885 261 (44/300 series).

2



31/32/41/42/43 series:

Lubricate the new guides and press them in with drift 999 5028. The drift gives the guides the correct height (A= 18 mm) above the cylinder head spring level.



44/300 series

Position the cylinder head upside down on a flat surface. Lubricate the new guides and press them in with drift 885 261. Press until guides bottom out against the surface underneath.

3

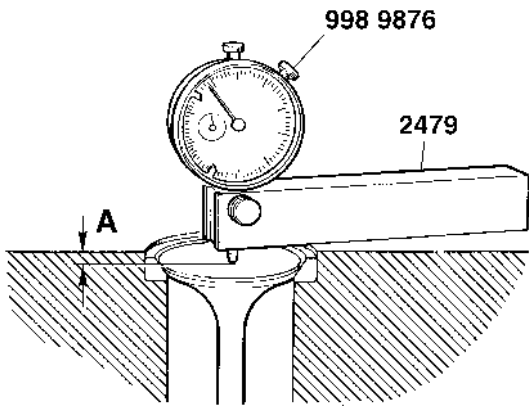
Ream valve guides if necessary.

NOTE! Valve seats must be ground after replacing guides.

Valve seat, replacing

Special tools: 999 2479, 998 9876

1

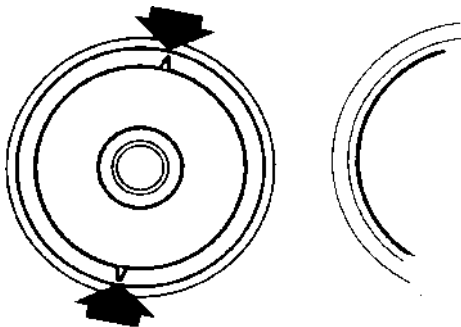


valve seats should be replaced when the when the distance (A), measured to the **new** valve exceeds (for the 42A/B when the distance is less than):

| | 31/32/41/42/43 | 42A/B* | 44/300 |
|---------|----------------|---------|---------|
| Intake | 0.65 mm | 0.05 mm | 1.60 mm |
| Exhaust | 0.65 mm | 0.05 mm | 1.50 mm |

* For the 42A/B that the valve crown is above the cylinder head surface.

2



The old valve seat is removed by grinding two breakage points in the seat and then breaking it with a chisel. Alternatively an scrapped valve can be spot-welded to the seat and then the seat is beaten out.

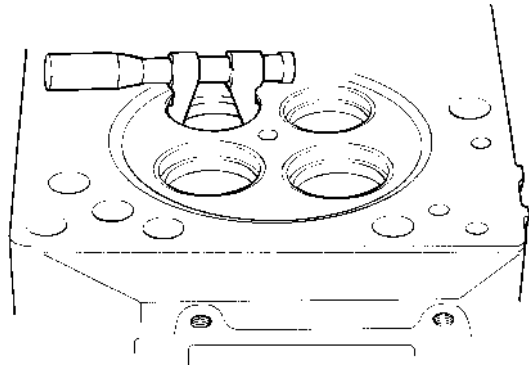
Grind down the scrapped valve crown so that it can be stuck down just under the edge of the valve seat.

MIG or MAG weld, cover the surrounding area so that any welding drops do not fasten anywhere.

IMPORTANT! Be careful so that the cylinder head is not damaged.

3

Clean the seat position and check that there are no cracks.



Measure the diameter of the valve seat position. Decide using the measurement whether a standard or oversized seat is needed.

Carry out any work required on the valve seat position.

Cool the seat with dry ice to **-60 to -70°C** and if necessary heat the cylinder head with warm water by rinsing or similar. Press in the seat with a drift.

NOTE! Turn the seat the correct way, valve face outwards!

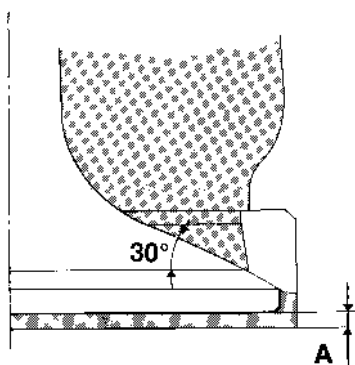
The work must be carried out as quickly as possible so that the largest possible temperature difference is retained.

Work the seat to the correct angle and width.

Valve seat, grinding

Before grinding the valve guides should be checked and replaced if the wear parameters are exceeded.

When grinding the valve seat only remove the minimum amount necessary to ensure that the valve seat has the right shape and surface form.



Valve and valve seat

Mill or grind the valve seats. A **new** seat must be ground so that the distance between the cylinder head level and the valve crown surface (**A**) measured with a **new** valve is:

| | 31/32/41/42/43 | 42A/B* | 44/300 |
|---------|----------------|--------------|------------|
| Intake | 0.05–0.45 mm | 0.25–0.65 mm | 1.0–1.4 mm |
| Exhaust | 0.05–0.45 mm | 0.25–0.65 mm | 0.9–1.3 mm |

* For the 42A/B that the valve crown is above the cylinder head surface.

A **used** seat (within wear parameters) must be ground so that the distance between the cylinder head level and the valve crown surface (**A**) measured with a **new** valve is:

| | 31/32/41/42/43 | 42A/B* | 44/300 |
|---------|----------------|---------|--------|
| Intake | 0,65 mm | 0,05 mm | 1,6 mm |
| Exhaust | 0,65 mm | 0,05 mm | 1,5 mm |

* For 42A/B the above applies as a minimum measurement.

In case of a larger distance the seats should be replaced.

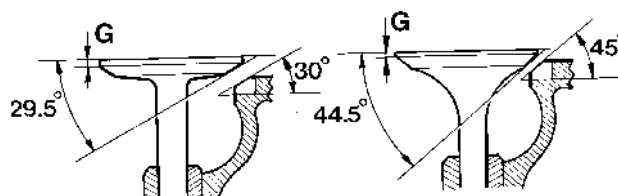
Check the seat angle with a seat pattern after coating the mating surface with marker ink.

Valve, grinding

Valves tightening angles:

Inlet: 29.5°

Exhaust: 44.5°



Check valves before grinding. If there is cracking, damage to the crown or bent valve shafts the valves must be replaced. Grind the sealing area as little as possible, although sufficiently that it is cleaned all round. If the valve crown edge (**G**) is less than **1.2 mm** for the 44/300 series, or **1.7 mm** for the 31/32/41/42/43 series, after grinding the valve must be replaced.

Always grind in the mating surface (even on new valves and seats) with lapping paste and check the mating surface with marker ink. If the seal is bad grind the seat, but not the valve, again using the lapping paste and check with marker ink.

Check the distance (**A**) between the cylinder head surface and the valve crown according to point 1 under the operation "Valve seat replacement".

Rocker mechanism, reconditioning

Special tools: 999 1867

1

Remove the snap rings from the rocker arm shaft and remove rocker arms, bearing supports and springs.

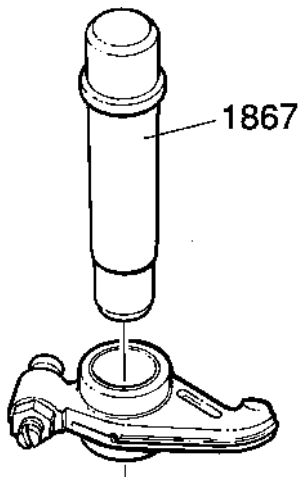
2

Clean the components; be particularly careful with the oilway in the bearing supports (44/300 series) and the rocker arm shaft and rocker arms oil holes.

3

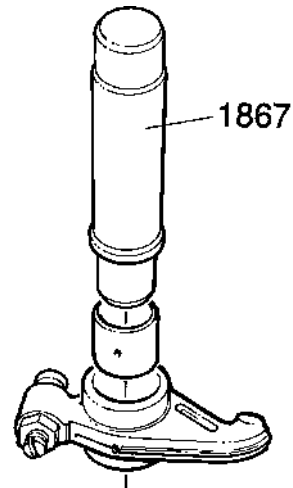
Check the rocker arm shaft wear and the plug tightness in the shaft ends, and that the ball pin spherical part is not deformed or worn. Threads should be undamaged on the pin and locknut. The nut hexagon should also be in condition. The rocker arms mating sphere against the valve should not be unevenly worn or concave. Slight wear can be adjusted with a grinder. Ovally worn rocker mechanism are replaced.

4



Press out the rocker arm bushing with drift 999 1867.

5



Turn the drift and press the new bushing into place. **NOTE!** Ensure that the bushing oil hole is opposite the oilway in the rocker.

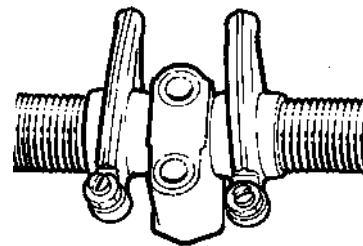
6

Ream the bushing to an exact alignment on the shaft.

22.020–22.041 mm

Remove any swarf resulting from the work.

7

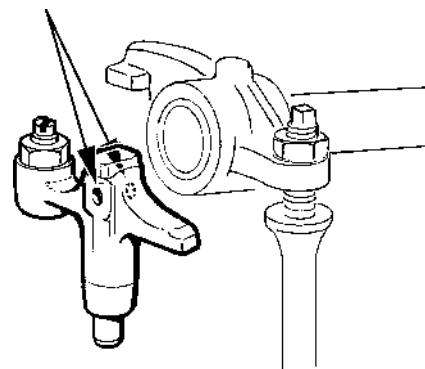


Lubricate the rocker arm shaft and install the separate parts. Ensure that the snap rings on the rocker arm shafts are properly locked in their grooves.

Applies to 44/300 series

8

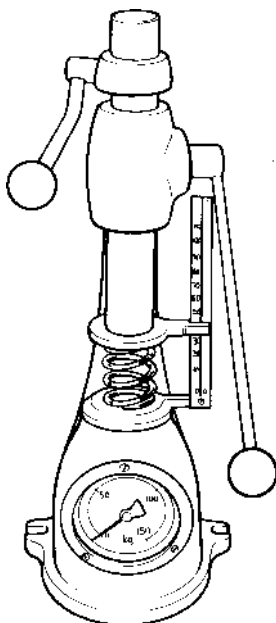
There are two variants of valve yoke (tappet). The hole shown below can occur on the right-hand or left-hand side of the yoke, and can be mixed with no problems during assembly.



Valve springs, checking

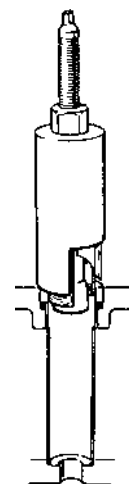
Applies to 31/32/41/42/43 series

1



Check valve springs loaded and unloaded length with a spring test.

The springs should have the values given in the Workshop manual "Technical data".



Pull out the steel ring above the copper sleeve by expanding tool 884 931 just under the ring.

NOTE! To prevent the extractor stem from damage when extracting, the crank must be held and the tightening carried out with a nut. The **nut** should do the work.

Applies to all engines

2

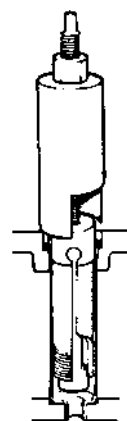
Copper injector sleeves, replacing

Special tools 31/32/41/42/43 series: 884 931, 884945, 885 289

44/300 series: 885 237, 885 260, 885 289

Replacing the copper sleeves can be carried with or without the cylinder head installed.

Cleaning the copper sleeve seat using a nylon brush can be carried out with the cylinder head installed.



Press out the copper sleeve with drifts 884 931 (31/32/41/42/43 series) and 885 260 (44/300 series). Press the extractor stem to the bottom of the copper sleeve. Hold the extractor and screw the stem counter-clockwise until the tool grips the copper sleeve securely.

When the tool has a secure grip in the copper sleeve, the sleeve is pulled out by screwing the nut in at the same time as stem is held.

3

Check that the lower O-ring (31/32/41/42/43 only) has come up with the copper sleeve and that the lower sealing point is clean.

If the sealing surface is damaged or soot coated it can be cleaned with a nylon brush.

See "Cleaning copper sleeve seat" on this page.

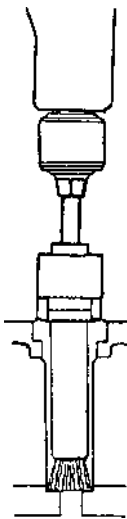
Remove upper seal ring. Clean upper and lower guides in the cylinder head.

Cleaning seat for copper sleeve

Special tools: 885 289

It is very important that all forms of deposits on the copper sleeve mating surface in the cylinder head are removed before installing the new copper sleeve.

1



Mount brush 885 289 on a variable speed drill. Maximum engine speed for the brush is **1000 rpm**. Insert the brush in the nozzle and clean the seat. Blow clean with compressed air.

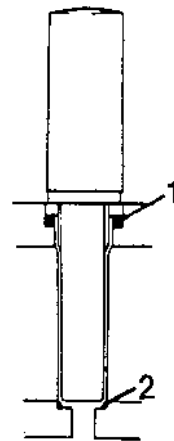
Copper sleeve, installing

*Special tools 31/32/41/42/43 series: 884 945
44/300 series: 885 237*

It is important that the steel ring and the copper sleeve are replaced at the same time in order to retain the correct clearance between ring and sleeve. The O-ring and the upper sealing ring should always be replaced with new ones.

⚠ IMPORTANT! The 31/32/41/42/43 series has an early and a late version of the copper sleeves and cylinder head. Ensure diameter on the copper sleeve points correspond with the cylinder head hole to the combustion chamber. The diameter of the hole on the late version is 10.3 mm, the early version has a smaller diameter.

1



Grease the upper sealing ring (1) with petroleum jelly or soapy water and place it in the cylinder head.

Applies to 31/32/41/42/43 series

2

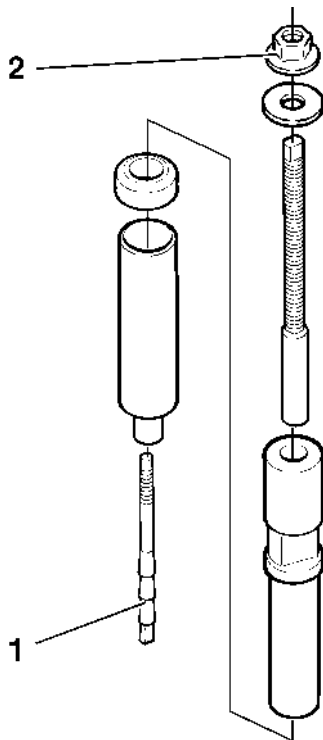
Install a new O-ring (2) around the new copper sleeve lower guide. Place a **new** ring and copper sleeve on drift 884 945.

Guide the drift into the cylinder head. Hit the sleeve in with a plastic mallet until it bottoms.

⚠ IMPORTANT! Note that with the cylinder block installed: **the piston must not be at Top Dead Center (TDC)** when the replacement takes place. The piston may be damaged by the tool during installation.

Applies to 44/300 series

3

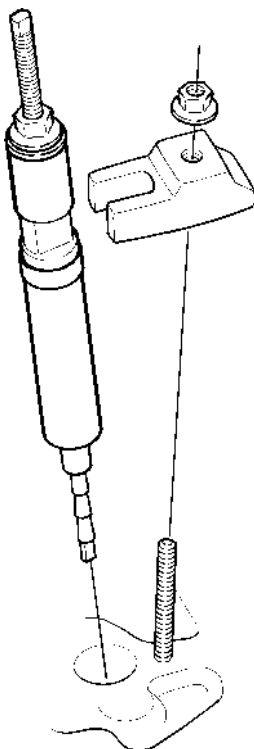


Remove the drift clamp (1) from tool 885 237.
Slacken off the tool stem nut (2).

Install the new steel ring and the new copper sleeve on the tool and screw in the drift clamp.

NOTE! Grease the drift clamp.

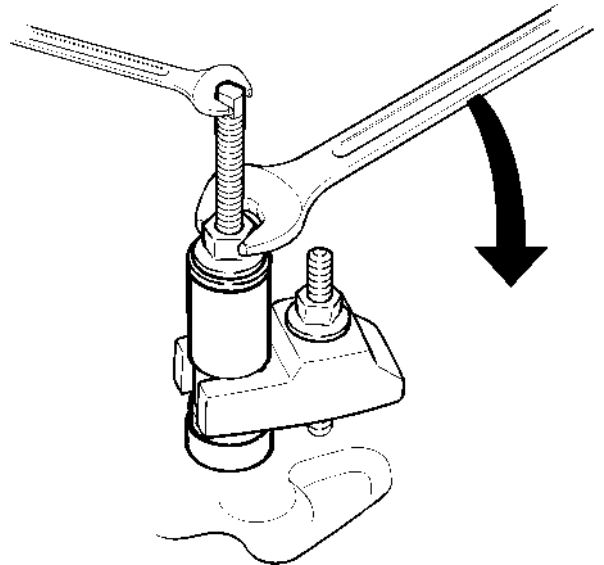
4



Insert the sleeve and the tool into the cylinder head. Mount the injector mounting nut and press the package with the mounting screw until the copper sleeve bottoms in the cylinder head.

! IMPORTANT! Note that when installing with the cylinder head mounted, **the piston must not be at Top Dead Center (TDC)** when the installation takes place. The piston may be damaged by the tool during installation.

5



Hold the tool stem and screw the large nut down. The drift clamp is then pressed up through the lower part of the copper sleeve.

Screw down the nut until the tool stem releases from the sleeve. Then pull up the stem and the remove the rest of the tool from the cylinder head.

Cylinder head, installing

Special tools: 999 2479, 999 6272

1

Clean the cylinder head and the cylinder block surface. Remove any rust and carbon from screw holes and threads of the cylinder head mounting screws. Clean threads with a tap (M12). Remove loose dirt with a vacuum cleaner or compressed air.

2

Check liner height. For liner height see Workshop Manual "Technical data". The height difference between close linings should be **maximum 0.02 mm**. For measuring see "Cylinder liner, installation".

3

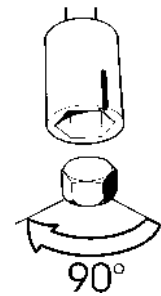
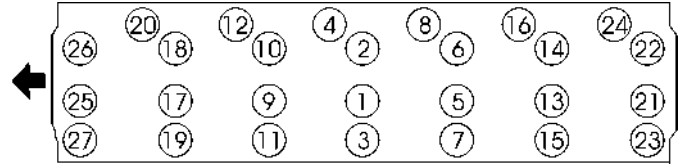
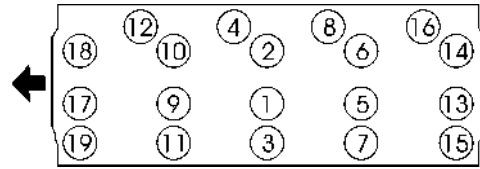
Check the cylinder head screw "waists" for distortion. Dip the screws completely including the screw heads in rustproofing agent P/N 116 1346-0 and allow them to run off in a net. The screw should not drip during installation (oil can otherwise be forced out and interpreted as leakage).

IMPORTANT! The screws are phosphated and must not be cleaned with steel brushes. If the cylinder head is painted the contact areas of the cylinder head screws must be free of paint. Otherwise the pressure in the screwed joint will otherwise be very bad.

4

Apply the cylinder head gasket and install the cylinder head.

5



Tighten the cylinder head screws in numerical order according to the tightening diagram below in five stages.

1st tightening: 30 Nm

2nd tightening: 60 Nm

3rd tightening: 100 Nm

4th tightening:

Angle-tighten the screws 90° in numerical order as follows:

Mark up the position of the screw heads with a chalk mark on the screw and cylinder head. Do not use a punch or a scribe as they can confuse future operations.

Mark a 14mm socket, locate the socket as illustrated above, with the socket marking 90° **counter-clockwise** from the chalk mark on the cylinder head.

Carry out angle tightening by tightening until the socket mark and the cylinder head chalk mark are opposite each other.

Finally:

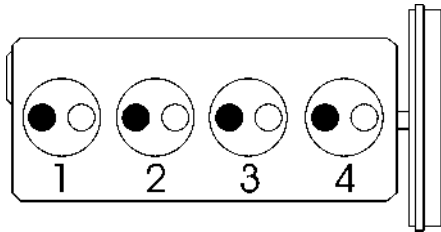
Angle-tighten the screws 90° in numerical order as above.

Tightening is finished when all screws have been angle tightened to 90°. Retightening after use is not necessary.

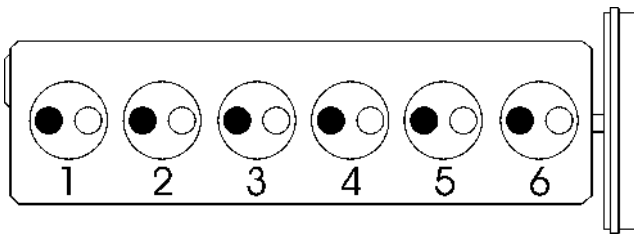
Valves, adjusting

NOTE! The clearance must never be checked with the engine running – the engine must be stopped – cold or at operating temperature.

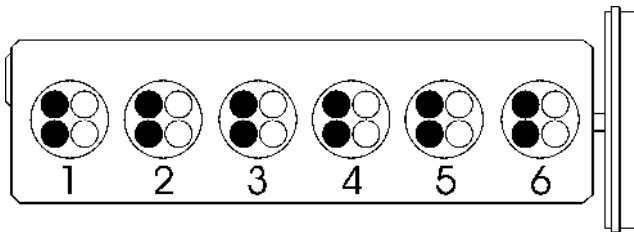
On the KA(M)D44/300 each pair of valves is adjusted in two stages. First the valve yokes are set then the rocker clearance is adjusted



Valve location and cylinder numbering 31/32 series



Valve location and cylinder numbering 41/42/43 series



Valve location and cylinder numbering 44/300 series

Valve clearance

Intake ○ 0.40 mm

Exhaust ● 0.40 mm

4-cylinder engines:

Firing order 1 3 4 2

Corresponding cylinder whose valves "rock"
4 2 1 3

6-cylinder engines:

Firing order 1 5 3 6 2 4

Corresponding cylinder whose valves "rock"
6 2 4 1 5 3

1

Remove valve covers. When checking valve clearance the engine should be turned in the direction of rotation. Turning is carried out using the engines polygon hub with a 24 mm socket and ratchet.

2

Turn the engine in the direction of rotation until Cylinder 1 piston is at Top Dead Center after the compression stroke. At this the valves on cylinders nos 6 (6 cylinder) and 4 (4 cylinder) rock.

Applies to 31/32 series

Adjust the valve clearance for Cylinder 1. Turn the engine a half revolution in the direction of rotation and check the play on cylinder 3. The valves on cylinder 2 then "rock". Check the play for the other cylinders in firing order.

Applies to 41/42/43 series

Adjust the valve clearance for Cylinder 1. Turn the engine a third of a revolution in the direction of rotation and check the play on cylinder 5. The valves on cylinder 2 then "rock". Check the play for the other cylinders in firing order.

Applies to 44/300 series



Slacken off the locknut and the adjuster screw on valve pair no 1 in Cylinder 1 so that there is play between the yoke and the valve stem.

3



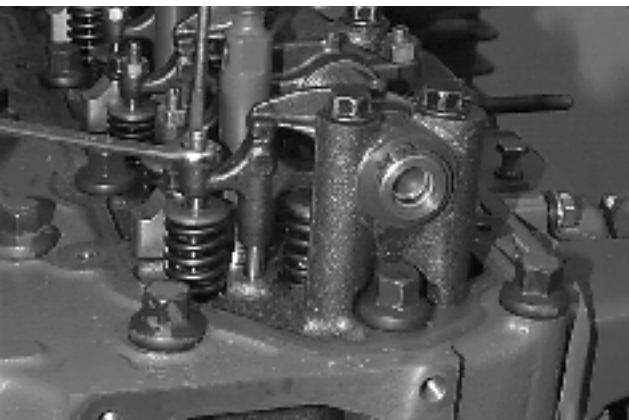
Press the valve yoke down.

4



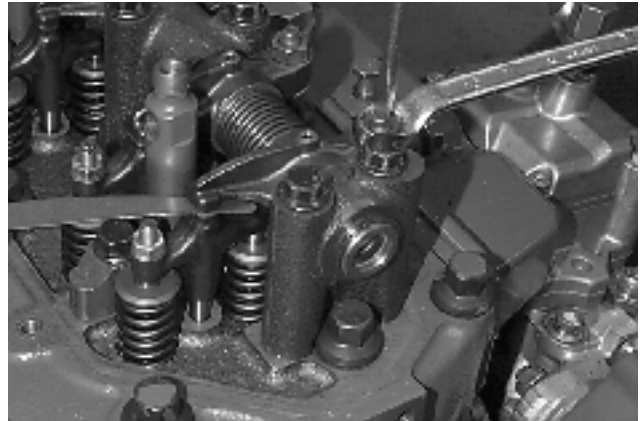
Turn the adjustment screw carefully using fingers until just comes into contact with the valve stem.

5



Lock the adjustment screw with the locknut. Adjust the yoke for valve pair no. 2 in the same way.

6



Adjust the clearance between the rocker and the valve yoke on cylinder 1.

7

Turn the engine a third of a revolution in the direction of rotation and adjust the clearance for the yoke and rocker on cylinder 5. The valves on cylinder 2 then "rock". Check the play for the other cylinders in firing order.

Applies to all engines

8

Clean the valve cover, replace the damaged gasket. Tightening torques see "Workshop manual, Technical data".

Test run the engine and check that there is no oil leakage.

Cylinder block, reconditioning

Cylinder block, inspection

Clean the cylinder block thoroughly and check bearing position, connecting rods and cap for damage.

Check that all the channels are free of deposits and that the block does not have any cracks. Smaller crack build up can be repaired by sweat welding. If the welding is carried on the upper surface the cylinder block must be ground flat. In case of larger defects the cylinder block must be replaced.

The cylinder block is available as a replacement part without the plugs installed in order to facilitate cleaning the lengthwise oilways.

NOTE! It is important that the plugs (P/N 955083-1) are installed again after the cleaning is carried out.

Cylinder liner, inspection and measurement

Inspection

The cylinder liner should be thoroughly cleaned before inspection and measuring. The cylinder liner must be removed from the cylinder block in order to carry out a proper crack check.

⚠ IMPORTANT! The cylinder liner position and cylinder number must be marked up with a felt tip pen before the lining is removed.

NOTE! The cylinder liner should not be removed unless it is proved necessary, by measuring or another method, to replace it, hone it or check it for cracks.

The magnaflux method can be used for the crack check.

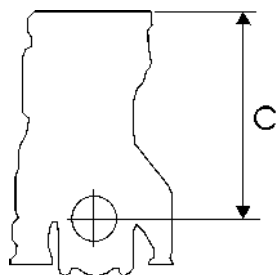
Measuring

1

Measure cylinder liner wear with a cylinder indicator. The cylinder indicator should first be set with a pattern ring or a micrometer so that the wear is measured as precisely as possible.

Use the cylinder liner original diameter as a starting point.

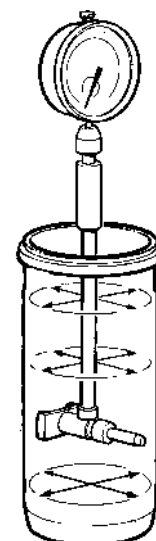
Cylinder block, surface grinding



If the cylinder block requires surface grinding it must not go below the minimum measurement "C". See Workshop Manual "Technical Data".

NOTE! After grinding the upper block surface, piston height above the cylinder block must be checked. See Workshop Manual "Technical Data".

2



Measure the cylinder liner at the end of travel of the top piston ring, and at several places along its travel. At each measurement point, measurements should be done along and across the length of the engine.

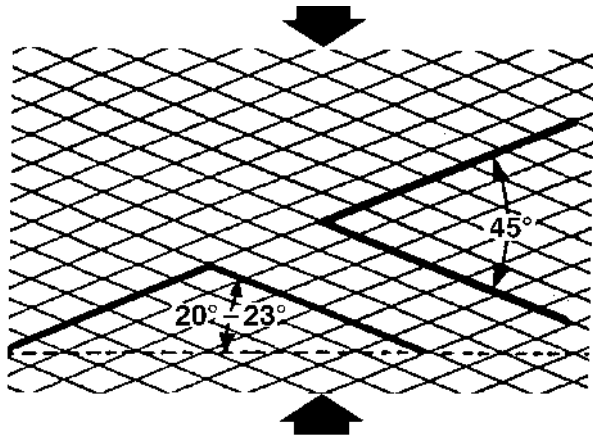
3

If the wear is greater than **0.25–0.30 mm** the cylinder liner with piston and piston rings should be replaced.

NOTE! The piston and cylinder liner are supplied as replacements parts only as a complete cylinder liner kit. The pistons and liners are classed and marked with a letter. C, D or E. This means that a piston marked E may only be mounted in an E marked liner.

| Class | Cylinder bore |
|-------|----------------|
| C | 92.00–92.01 mm |
| D | 92.01–92.02 mm |
| E | 92.02–92.03 mm |

Cylinder liner, honing



Honing pattern in cylinder liner

It is important that the cylinder liner retains the old honing pattern for good lubrication and sealing characteristics. The liner should therefore be honed if there are ring scratches, deposits or polished areas.

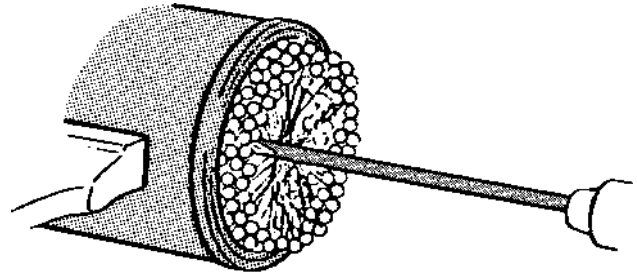
It is **not** recommended that honing is carried out with the cylinder liner in position because pollutants may fall into the oilways and the difficulties in measuring accurately.

The cylinder liners have a honing pattern (see illustration) the angles of which are calculated to give optimal lifetime. When honing in conjunction with piston ring replacement the original pattern must be followed to retain the lubricating function.

The honing lines must be regularly formed and evenly cut in both directions, over the whole surface.

NOTE! The correct speed must be held on the honing tool in order to obtain the correct pattern.

1



Clean any carbon deposits off the removed cylinder liner. Fix the cylinder liner in a vice, use jaw pads to avoid damage.

Use a powerful drill which can operate at low speed, **200–400 rpm**.

Use a Flex-Hone® tool, type GB95.

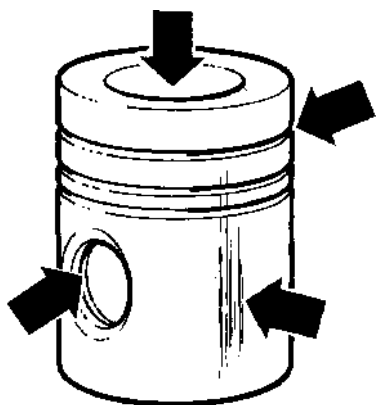
NOTE! Do not use a honing tool with grindstones as these damage the whole liner surface.

Lubricate the liner with thin engine oil before and during honing.

⚠ IMPORTANT! After honing, it is very important that the liner should be carefully cleaned. Use hot water, a brush and detergent (never paraffin (kerosene) or diesel oil). Finish off by wiping with oiled cotton rags, which are changed until they are no longer discolored. Oil the liner with thin engine oil after drying.

Flex-Hone® is a registered trademark of Brush Research Manufacturing Co., Inc.

Piston and connecting rod, inspection



Checking piston wear

Check pistons for cracks, broken piston ring carriers or worn piston ring grooves. If the piston has deep scores in the outer mantle the piston (liner kit) must be discarded. Also if the piston has one or more cracks in the gudgeon pin hole or combustion chamber bottom. Cracks in the edge of the piston head around the combustion chamber are generally not dangerous. The crack test is carried out using the calcium powder test. If this damage is found the injector equipment should also be checked.

Check gudgeon pin bushing wear. There should not be any noticeable wear.

When cold the gudgeon pin should have play of between **0.008–0.018 mm**.

If correctly aligned a lubricated gudgeon pin should be able to slide through the bushing under its own weight (at room temperature).

NOTE! The cylinder liner wear should be checked before replacing piston rings and connecting rod bushings. See "Cylinder liner, inspection and measurement".

There are two types of con rods. Late-model con rods have a trapezoidal gudgeon pin end. Both types can be mixed during engine renovation, however.

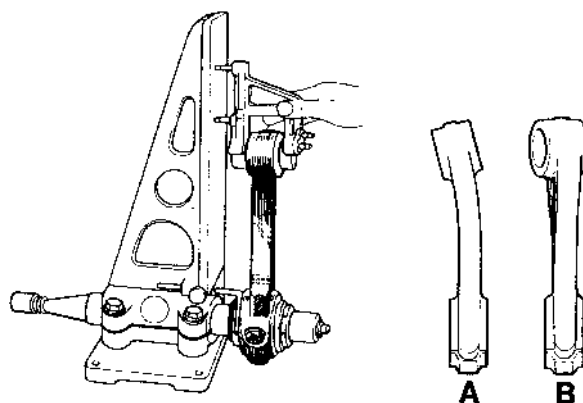
Before the gudgeon pin bush is changed, check the con rod for cracking, straightness and twist. A cracked, bent or twisted con rod must be scrapped.

NOTE! Gudgeon pin bushes may only be changed on early model con rods. On late model con rods (with trapezoidal gudgeon pin ends), no changes may be done.

1

Remove the gudgeon pin snap ring and press out the gudgeon pin with a suitable drift.

2



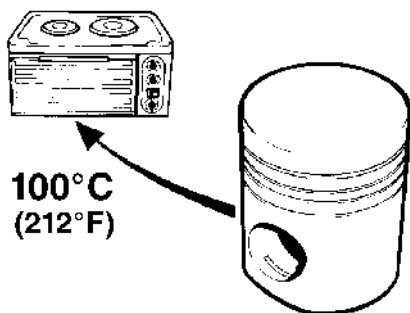
Use a new piston bolt and measure the connecting rod in a fixture. The connecting rod is permitted the following deviation:

- A. Out-of-true: Maximum 0.05 mm per 100 mm measured.**
- B. Distortion: Maximum 0.1 mm per 100 mm measured.**

Piston, installing

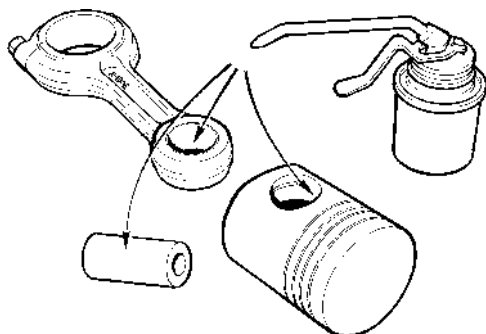
3

1

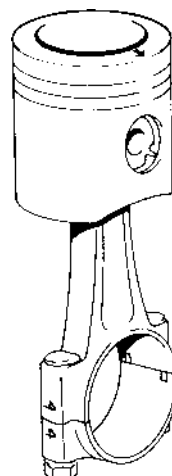


Install one snap ring in the piston. Heat the piston to approximately **100°C**.

2



Lubricate the piston, piston bolt and connecting rod bushing with engine oil.



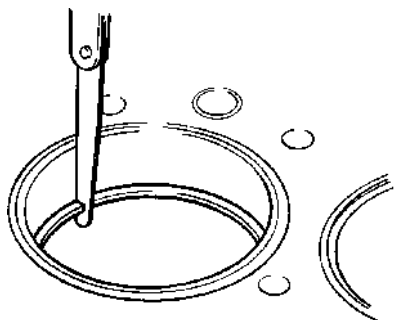
Position the piston and connecting rod so that the front marking on the pistons (arrowed) and the numbering on the connecting rods is in the position illustrated.

4

Carefully push in the piston bolt with a suitable drift and install the other snap ring.

NOTE! The piston bolt should be pushed in easily not hammered in.

Piston rings, inspection and alignment



Checking piston ring gap

Check contact areas and sides. Black fleck on the surfaces are due to bad contact and mean that the rings should be replaced.

Oil consumption can also affect the moment that a piston ring replacement should happen.

Check the piston ring gap (see illustration above).

When measuring the ring is slid down **below the lower limit** using a piston.

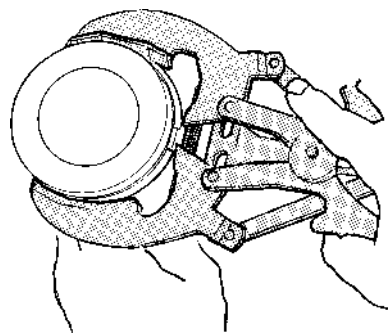
The piston rings are replaced if the gap exceeds the stipulated values in the Workshop Manual "Technical data"

Otherwise the piston rings are replaced if there a noticeable wear (within wear tolerances) in the cylinders, because the rings often return to the same positions that they were in before removal.

Check the piston ring gap on new rings as well. For measurement details see, Workshop manual "Technical data" for engine variant.

Note. New cylinder liners are supplied complete with pistons and piston rings.

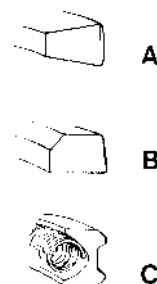
Piston rings, installing



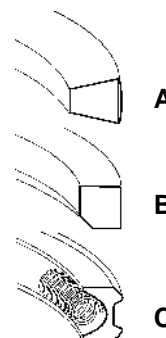
Install the piston rings on the piston using piston ring pliers.

The oil ring (C) is installed first and can be freely turned. The opening in the expander ring is placed opposite the oil ring gap.

The compression rings are marked. The lower (chromed) ring (B) must have the marking TOPCD upwards.



Piston ring location all engines except TAMD41H-B

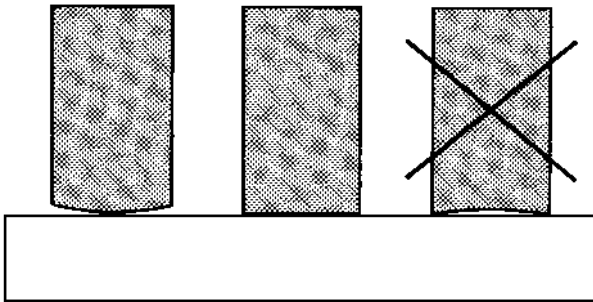


Piston ring location TAMD41H-B

NOTE! TAMD41H-B are different to other engines. These engines have a unique second compression ring the internal chamfer of which should point downwards (other engines have the chamfering upwards).

The upper keystone type ring (A) must be used with the marking TOPCD upwards.

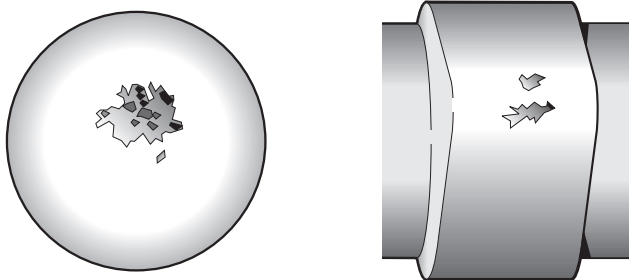
Lifters and camshaft, inspecting



Inspecting valve lifter

Check with a steel ruler that the valve lifter contact surface to the camshaft is spherical (convex). It may also be flat but **never** concave. If light is visible in the center of the lifter surface between ruler and lifter the lifter should be replaced.

NOTE! If the lifter is worn across the lift surface the lifter should be discarded. The “trench” indicates that the lifter is not rotated. A dark line along the edge of the lifter area indicates that the surface is not worn. Investigate why the lifter has not rotated before installing the new lifter.



Small pitting damage on the valve lifter and camshaft.

Check lifter surfaces for pitting damage. Pitting damage can occur for different reasons. The damage occurs by small metal particles being loosened from the hardened surface. Valve lifters and camshafts with minor pitting can be reinstalled.

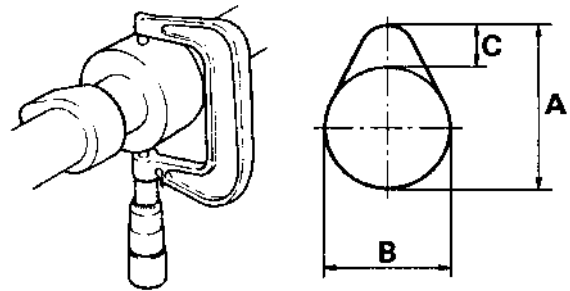
It has been found that the damage seldom gets worse.

Check the camshaft bearing caps and cam lobes for wear. Cams can be unevenly worn axially.

This can be adjusted in minor cases by grinding the cams. Replace the camshaft in cases of further damage or wear.

All valve lifter must be replaced when replacing the camshaft.

Camshaft, measuring



Measuring the camshaft

Measure the camshaft bearing caps with a micrometer. Maximum wear **0.05 mm** and oval **0.010 mm**.

The shaft out-of-true (straightness) is checked by indication. Maximum radial runout relative to end bearing **0.08 mm**.

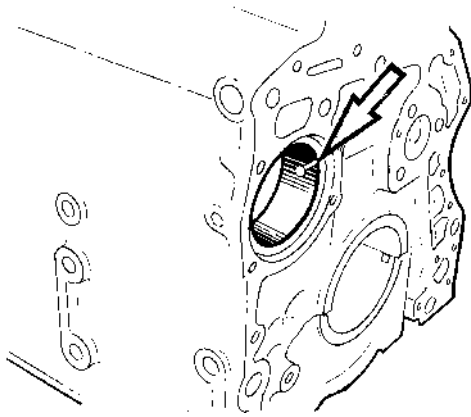
The lift height is measured with calipers as illustrated above.

Lift height $C = A - B$.

For measurement details for camshaft and camshaft bearings, see “Technical data”.

Camshaft bearings, replacing

The bearings are pressed into position and must be bored after pressing in. Replacing the camshaft bearings can only be carried out when overhauling the whole engine.



Oil holes in the bearing

Check when pressing in that the oil hole is opposite the corresponding oilway in the block.

The front camshaft bearings should be installed with the groove turned forwards.

Crankshaft and bearing, inspection

The crankshaft is induction hardened. Crankshaft inspection should be carried out very carefully to avoid unnecessary reconditioning.

Check main and big end bearing shells. Replace worn bearing shells or those with flecked leaded bronze coating.

Clean the crankshaft and all channels thoroughly after removal and inspect it carefully to determine whether it needs reconditioning as follows.

1

Measure wear and ovalness with a micrometer. Greatest permitted ovalness in Main and big end bearings **0.08 mm**, maximum conicity **0.05 mm**.

Grind the crankshaft to a suitable undersize if these values are exceeded.

2

Judge any surface damage

3

Measure crankshaft lengthwise runout

Place the crankshaft on a pair of v-shaped blocks under main bearing journals one and seven. Alternatively the shaft can be held in vises. The measurement should be carried out at the fourth main bearing journal.

The following apply for measured values (total indicated throw)

- <0.2 mm: No corrective action if the wear or surface damage require regrinding
- 0.2–0.7 mm: Align the crankshaft **carefully**. Be careful that overalignment does not happen.

NOTE! Do not align more than absolutely necessary.

- >0.7 mm: Scrap the crankshaft, there are risks that cracks will occur during alignment.

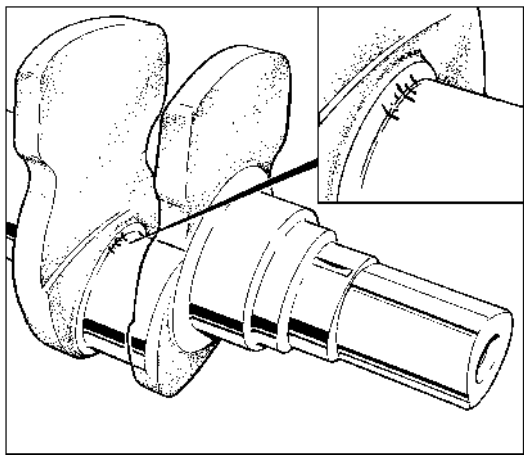
4

Carry out a crack check with the instructions as follows.

Checking for cracks

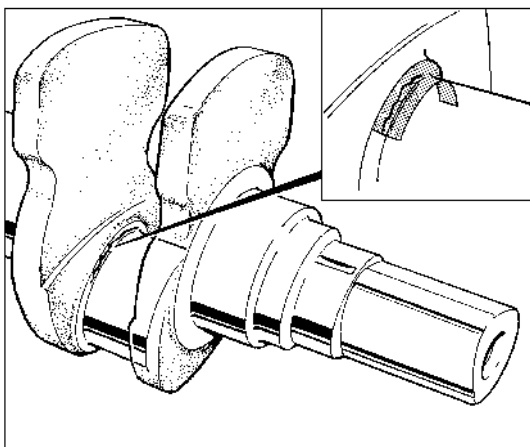
Cutting damage can cause overheating cracks which can only be detected with special equipment. Any cracks and notches can be found most reliably using a magnetic powder such as Magnaglo, fluorescent powder reacting to ultraviolet light. Refer to the relevant equipment manufacturer's instructions for operational procedure. The shaft must be demagnetized after this sort of test.

Cracks of the following type and locations mean that the crankshaft must be discarded.



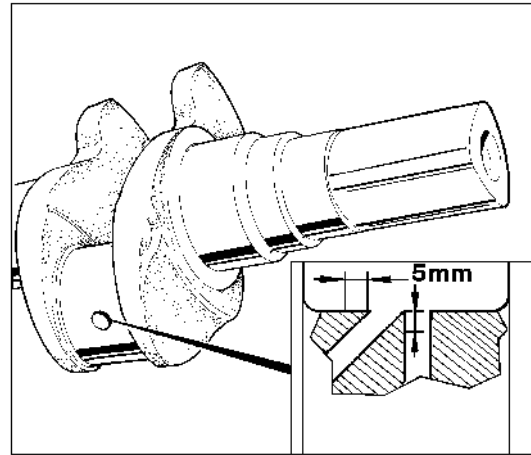
A

A. Lengthwise cracks in the bearing journals and hole edges.



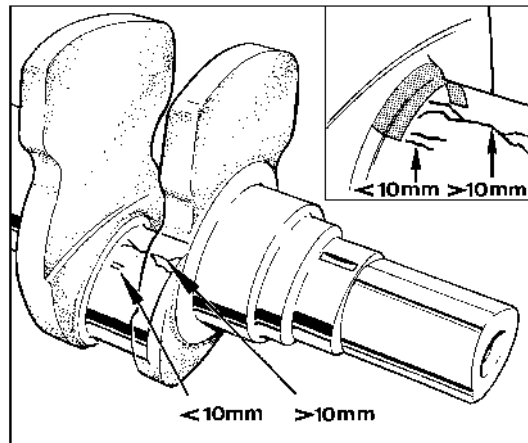
B

B. Lateral cracking in the marked area.



C

C. Cracks longer than 5 mm connected to oilway holes. Cracks shorter than 5 mm are removed with grinding.



D

D. Cracks longer than 10 mm outside the marked area. Single cracks shorter than 10 mm can be accepted.

Crankshaft, reconditioning

In general regrinding and realigning mean a shorter lifetime. Therefore do not regrind unless there is good reason for regrinding, measurement fault (wear, ovalness, conicity) or such serious surface damage that grinding is not sufficient.

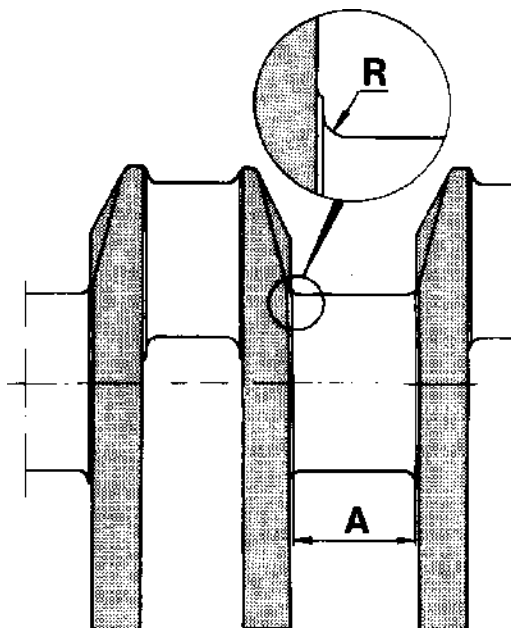
The crankshaft main and big end bearing journals can be ground to 0.25 mm, 0.50 mm and 0.75 mm under-size. See Workshop manual "Technical data" for information about undersize dimensions.

Procedure when reconditioning

- Align the crankshaft.

NOTE! Only align if really necessary, see "Inspection, crankshaft and bearings".

- Carry out crack check, see "Checking for cracks".
- Grind crankshaft if necessary, see next paragraph and carry out new crack check.
- Lap the crankshaft thoroughly after any grinding.
- Clean off any grinding residue and other pollutants. Flush and clean the oilways.



Crankshaft radii

Grinding the crankshaft

A condition of achieving a satisfactory result when grinding is to use the correct method. The following grinding data is recommended:

Grinding wheel: Naxos 33A60 M6VK, alternatively 33A46 M6VK or Norton 23A60 M5VK alternatively 23A46 M5VK

Diameter, New disc \varnothing 36"–42" (914–1067 mm) (the disc can be used down to approximately \varnothing 720 mm).

Peripheral speed:

Grinding wheel 28–33 m/s

Crankshaft max. 0.25 m/s

Cooling: 3% oil emulsion (Soluble). It is important that the cooling is powerful, ideally with flushing from above and below.

The disc should be sharpened with a grinding diamond.

Peripheral dimension 0.1 mm/revolution

Side measurement 0.2 mm/revolution

Cutting depth max. 0.03 mm

- Grinding is carried out in the crankshaft grinding machine to undersize according to the Workshop manual "Technical data".
- It is very important that the hole fillet radii have the correct dimensions.

R = 3.9 mm, and the correct form and surface quality.

Measure radius with a radius template. The shape must follow the illustration "Crankshaft radii" on the previous page. Grinding notches and sharp edges must not occur – these can cause the crankshaft to break.

- The center bearing journal grinding deserves special attention when it comes to width measurement for guide bearing "A", in the illustration "Crankshaft radii" on the previous page. Dimension, see "Workshop manual, Technical data".
- **NOTE!** Break sharp edges which may have formed at the oilways during the bearing grinding. Use a grinding stone or an emery cloth.
- **Clean the shaft** of any grinding residue and other pollutants. Flush and clean the oilways.

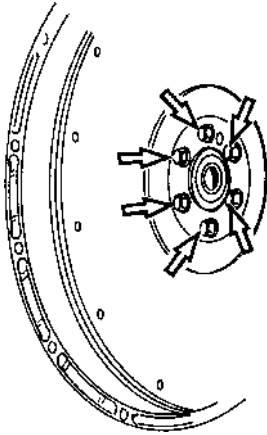
Lapping the crankshaft

The surface finish (profile depth R_a) of the crankshaft flange, bearing surfaces and fillets is $2\mu\text{m}$ ($7.874" \times 10^{-8}$), with surface finish variation $0,5\mu\text{m}$ ($1.969" \times 10^{-8}$). This surface finish is achieved by lapping.

- Lapping is done in the opposite direction to grinding.
- Apply cutting oil (such as VELOCITE 6) to the crankshaft flange and bearing surfaces.
- Lapping cloth, grit size 400.
- Wash the shaft carefully after lapping is finished. Use 95% industrial alcohol.
- **NOTE!** Apply grease, VP part no. 1161447 to the crankshaft flange.

Flywheel, replacing

1



Remove the screws and lift off the flywheel.

NOTE! To minimize the risk of damage to the RPM sensor (44/300 series) it should be removed before the flywheel is removed.

Flywheel, inspection

Check the flywheel for cracks or other damage.
Check that the gear collar is not damaged or worn.
Replace gear collar or flywheel as necessary.

2

Clean the crankshaft flange contact area against flywheel.

3

Clean flywheel contact area against crankshaft flange.

4

Check that the flywheel locating pin in the crankshaft is in place and undamaged.

5

Lift the flywheel into place and install screws.

6

Tighten the flywheel screws to **65 Nm + angle tighten 60°**.

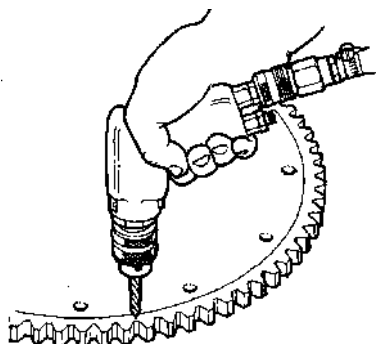
7

Install the RPM sensor (44/300 series).

Gear collar, replacing

(flywheel dismantled)

1

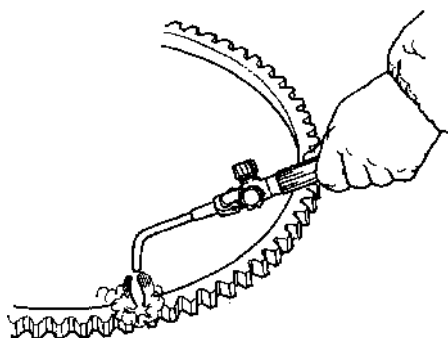


Drill 1–2 holes in a notch on the gear collar. Split the gear collar at the drilling point with a chisel and remove the gear ring.

2

Brush the flywheel contact area with a steel brush.

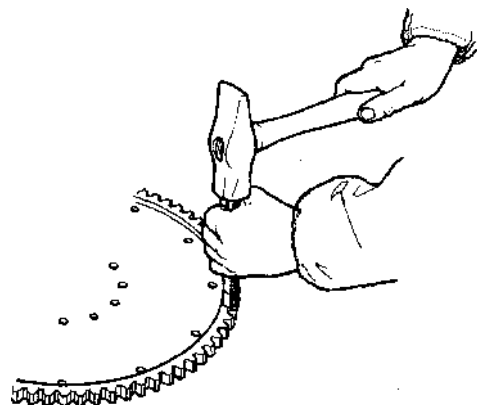
3



Heat the new gear collar in an oven or with a welding torch to **maximum 180–200°C**.

⚠ WARNING! If use a welding torch great care must be taken to ensure that the gear collar is evenly warmed and not partially too hot which will result in running off the flywheel. To check the heating, polish the gear collar to bare metal shine in a few places. Stop heating when these surfaces turn blue.

4



Locate the heated gear collar on the flywheel and knock it into position with a soft drift and hammer.

Let the gear collar cool in open air.

5

Clean the mating surfaces on the flywheel and crankshaft. Check the locating pin in the crankshaft flange and rear crankshaft seal. Replace if required.

Install flywheel. Tightening torque **65 Nm + angle tighten 60°**.

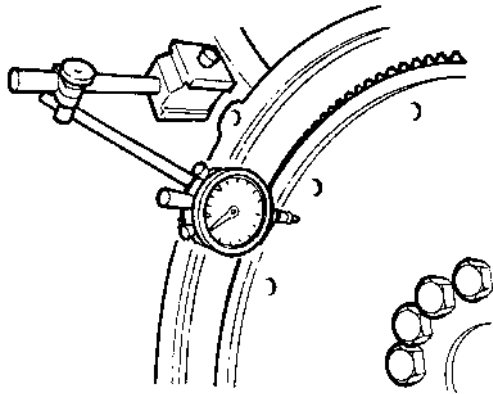
6

Install the RPM sensor (44/300 series).

Flywheel, indication

Special tools: 999 9696, 998 9876

1



Position a dial gauge with the point against the flywheel.

2

Zero dial indicator. Turn the flywheel and read off the greatest value.

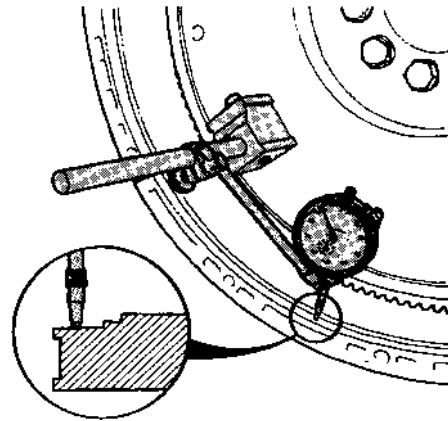
The measured value should not exceed **0.15 mm** in a measurement radius of **150 mm**.

If the out-of-true is greater, remove flywheel and check to see if there is dirt or unevenness between the flywheel and the crankshaft flange.

Read off the value and then move the dial indicator and mounting to the opposite side of the flywheel.

The difference in value between these two indications must not exceed **0.15 mm**.

2



Position the dial gauge magnetic mounting on the flywheel and set the dial indicator point on the inner edge of the flywheel housing (see illustration).

Turn the flywheel and read off the dial indicator.

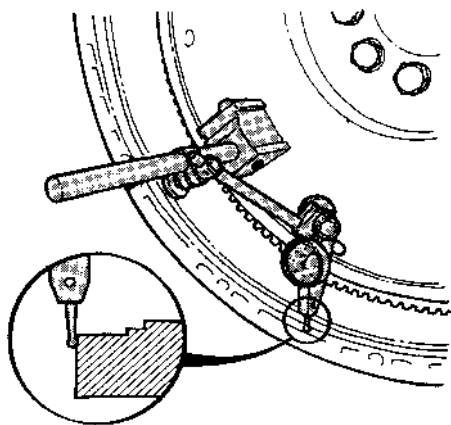
The centering for the flywheel housing inner edge should be within **0.25 mm**.

If some of the measured values exceed **0.25 mm** the flywheel housing position against the engine block should be checked.

Flywheel house, indication

Special tools: 999 9696, 998 9876

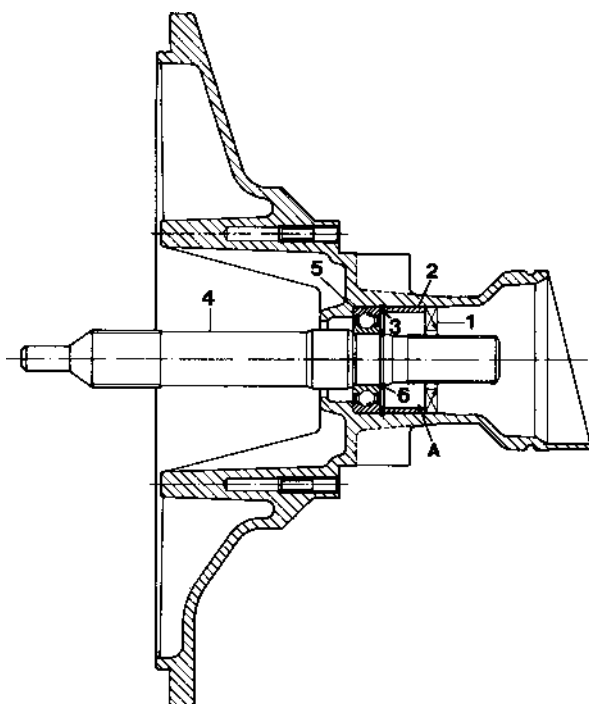
1



Position the dial gauge magnetic mounting on the flywheel and set the dial indicator point on the outer edge of the flywheel housing (see illustration).

Flywheel housing, reconditioning

Special tool: 884 596



Reassembling

4

Press on the new bearing using drift 884 596. Install snap ring.

5

Press the shaft into the housing with drift 884 596. Ensure that the snap ring (6) locates correctly in the tool notch. Fix the shaft with snap ring (3).

6

Press in the bushing (2) with drift 884 596. Fill cavity "A" with grease P/N 1141 644 and press in the seal (2) with drift 884 596.

Dismantling

1

Remove sealing ring (1) and bushing (2) and snap ring (3).

2

Tap out the shaft (4) with bearing (5) using a plastic mallet.

3

Remove the small snap ring (6) from the shaft. Press off roller bearing with drift 884 596.

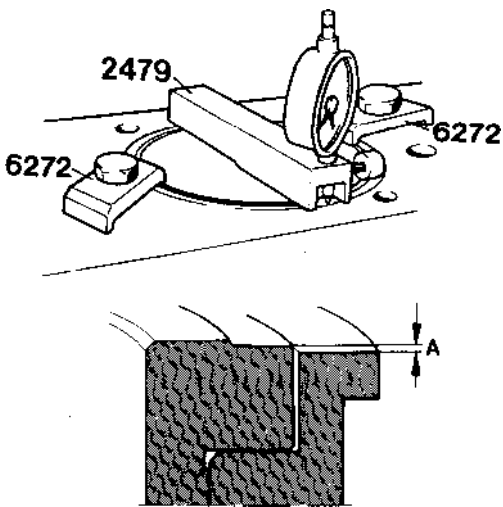
Cylinder block installation

Cylinder liner, installing

Special tools: 998 9876, 999 2479, 999 6272, 999 6598, 999 2000

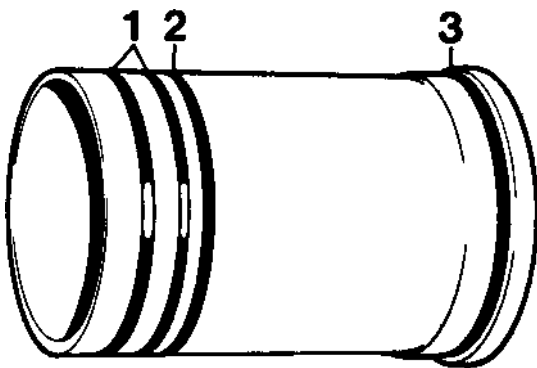
NOTE! All mating surfaces in the block for liners and sealing rings should be thoroughly cleaned. Clean with brush and cleaning agent. **A scraping tool must not be used.**

1



Locate cylinder liners in the block without sealing rings. Measure liner height, dimension A as illustrated. The measurement is done at four diametrically opposed points on each cylinder. Check that the support surface is not damaged when resetting the dial indicator. The check is made with dial indicator 998 9876 and holder 999 2479. The height should be 0.06–0.11, but the difference between two close liners must not exceed 0.02 mm. Mark the liners so that they have the same position when installed.

2



1. Purple 2. Black 3. Black

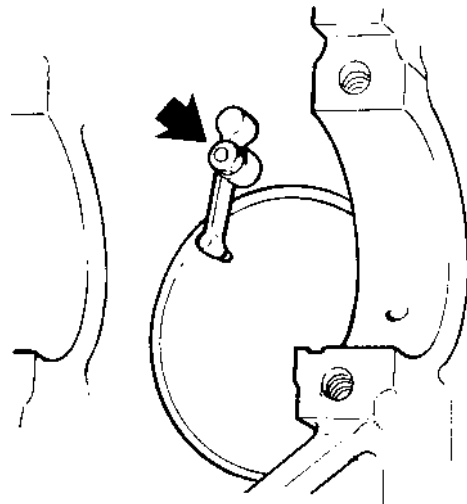
Lift up the cylinder liner and install the new sealing rings as illustrated. Brush the sealing rings and lower sealing surface with soap solution.

3



Install the cylinder liners using drift 999 6598 and shaft 999 2000.

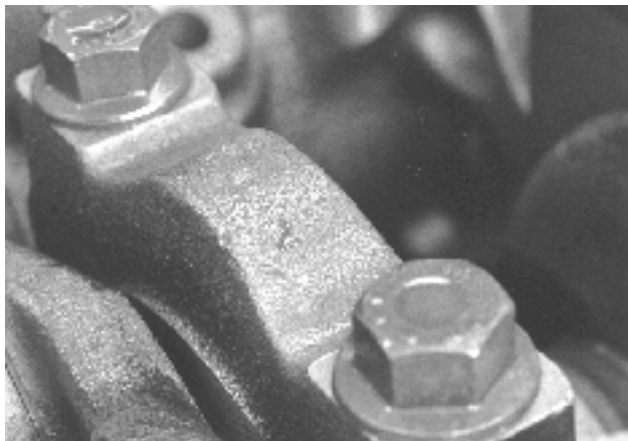
4



Install piston cooling nozzles.

NOTE! New O-ring and locknuts must be used. Socket 10 mm.

5



Install new main- and thrust bearings. **The main bearing shells with oil ways should be install in the cylinder block.** Lubricate the bearing surfaces with engine oil and install the crankshaft.

NOTE! The crankshaft should be thoroughly cleaned.

Install the main bearing caps. Make sure the bearing cap lock heels face each other.

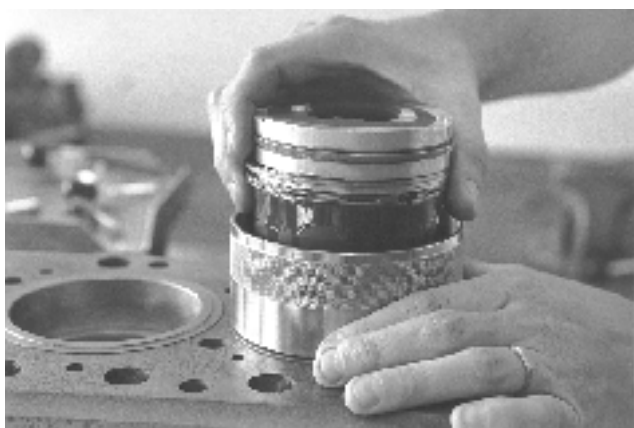
NOTE! Number marking, install bearing cap no. 1 at the front.

There are two types of main bearing screws. These types have different tightening torques, and must not be mixed. Oil the threads with engine oil before tightening. Tightening torque, please refer to the "Technical Data" chapter. Wrench size 19 mm.

Piston, installing

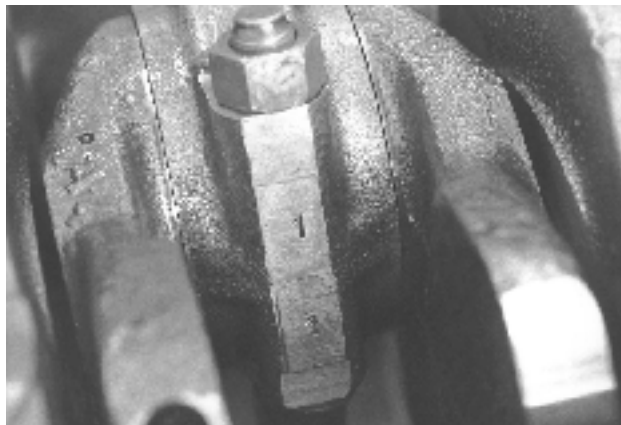
Special tool: 999 5031

6



Install the big end shells. Lubricate the pistons, piston rings and big ends. Turn the piston rings so that the gaps are at approximately 120° to each other. Install the pistons so that the front markings face forward. Use installation ring 999 5031.

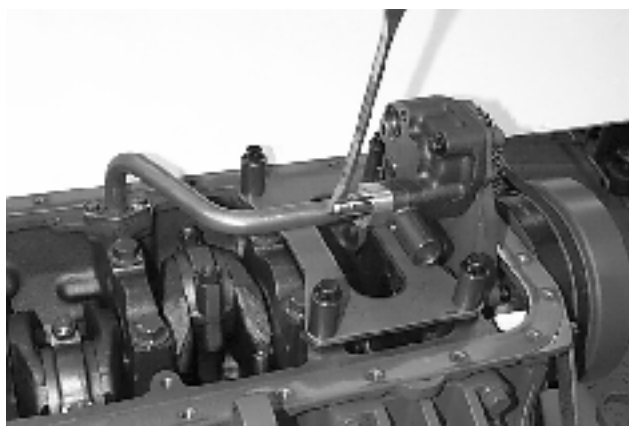
7



Install the big end bearing caps so that the marking matches the marking on the crankshaft. Oil the threads. Tightening torques see "Workshop manual, Technical data". Socket 17 mm.

Oil pump, installing

8



Install the reinforcement panel, do not forget the spacer washers between the panel and the cylinder block. Clean the mating surfaces carefully and install with lightly oiled screws. Tightening torque **46 Nm**.

Screw the oil pump into place at the front main bearing. Install new sealing rings.

NOTE! Do not forget the sealing rings for the delivery line connections to the block.

Screw the oil pipes into place, the relief valve is located between the delivery line and the pump.

NOTE! Turn the relief valve as illustrated when installing.

9

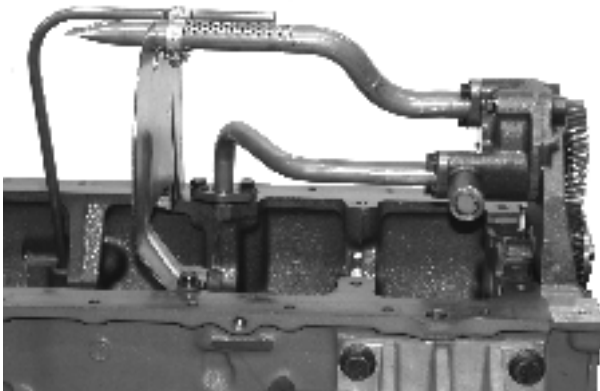


Install the bracket (splash plate) for the inlet pipe.

NOTE! The screws have special washers (spring washer).

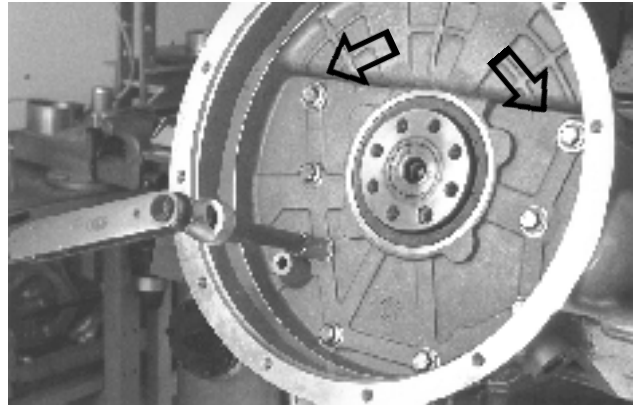
Install the intake pipe and fix it and the dipstick pipe with hose clamps.

Only engines intended for V reversing gear.



NOTE! Engines intended for V reversing gear have a unique oil suction pipe and splash plate.

10



Install a new seal ring in the inner bell housing, using mandrel 999 6385.

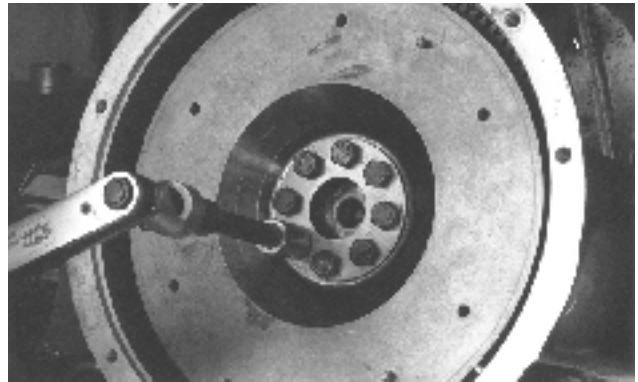
NOTE! Wipe grease, VP part no. 1161447 on the inner edge of the seal ring lip, and on the crankshaft flange before installing the flywheel.

Install the flywheel.

NOTE! Fit the two slightly longer screws underneath (with the engine the right way up).

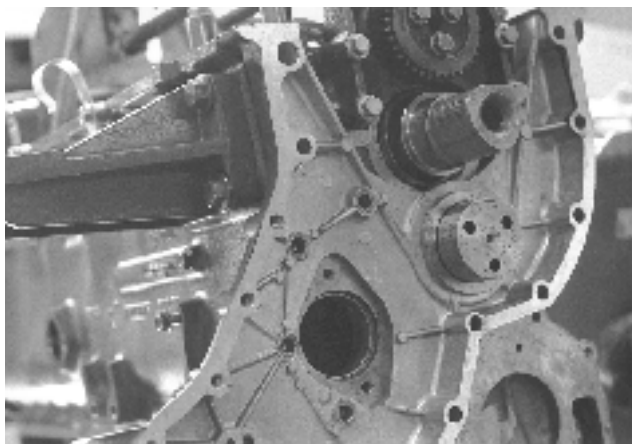
Torque the screws to **48 Nm**.

11



Install flywheel. The flywheel has a guide sleeve which is aligned into the crankshaft. 884 895 can be used as a counterhold when tightening. Tightening torques see "Workshop Manual, Technical data".

12



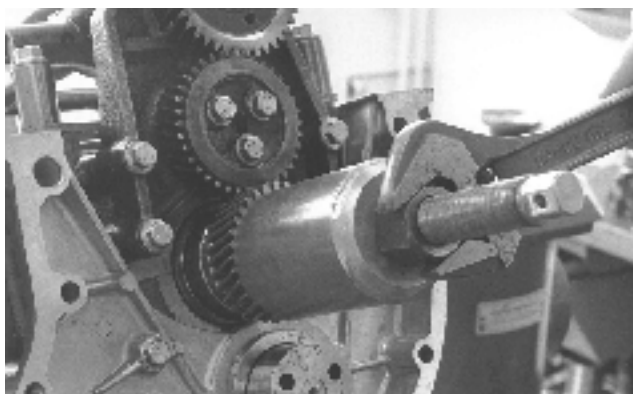
Install the inner timing cover with the intermediate gear shaft journal as a guide. If necessary use a rubber mallet.

13



Clean and then oil the camshaft bearings. Carefully insert the camshaft and install the thrust bearing. Tightening torque **24 Nm**. Check axial clearance which should be **0.04–0.12 mm**.

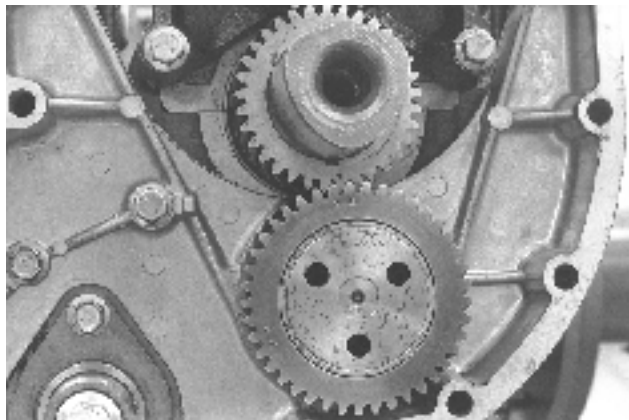
14



Check that the crankshaft key is installed. Install the crankshaft drive gear with tool 999 6404.

NOTE! Ensure that the gears mesh with the oil pump intermediate drive gear.

15



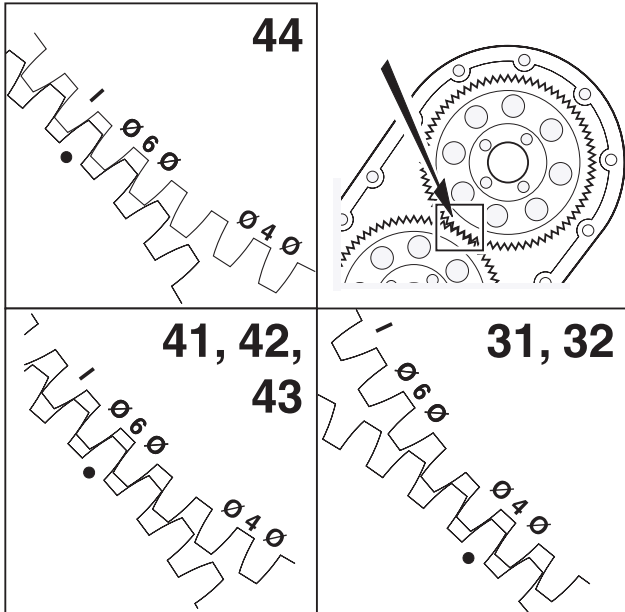
Install the camshaft intermediate drive gear as marked on the gear. Tightening torque **24 Nm**.

16

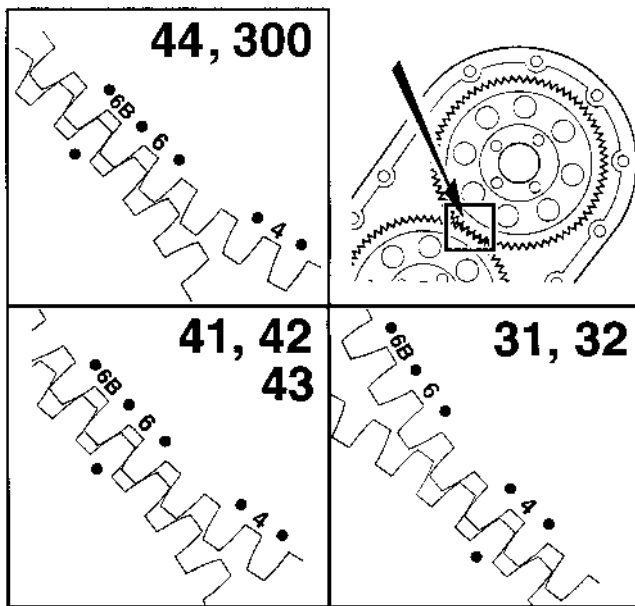


Install the camshaft key. Check the camshaft position so that the markings match with the pulley installed. Heat the camshaft pulley to approximately 100°C and install it on the shaft. Tightening torque **85 Nm**.

17



Early version of marking



Late version of marking

Insert the fuel injection pump pulley as marked on the gear. The pump pulley has markings for the 31/32-, 41/42/43- and 44/300-series.

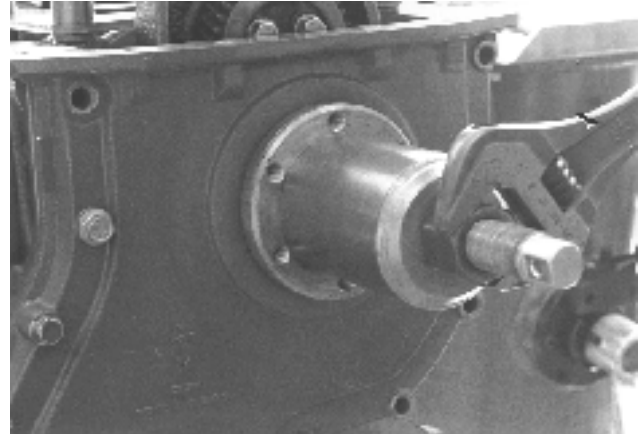
NOTE! There are two types of marking, see above.

⚠ IMPORTANT! The engine (crankshaft) may not be turned with the gear loose.

18

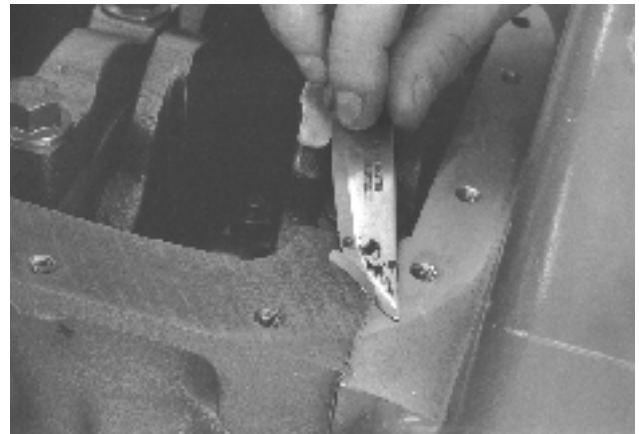
Install the timing gear cover with a new seal. Grease the inner edge of the seal ring lip with grease, VP part no. 1161447. Wrench size 12 mm.

19



Apply molybdenisulphide to the crankshaft shaft. Heat the polygon hub to approximately 100°C and install it on the shaft. Press on the hub with tool 999 6404. Wait to tighten the center screw until the hub has cooled. Tightening torque **180 Nm**. Socket 24 mm.

20



Install the oil pan together with a new gasket. Cut off any excess edges from the timing cover and flywheel housing gaskets. The oil pan gasket joint should be sealed with Permatex No 77 or corresponding silicon agent. Tightening torque **15 Nm**. Socket 12 mm.

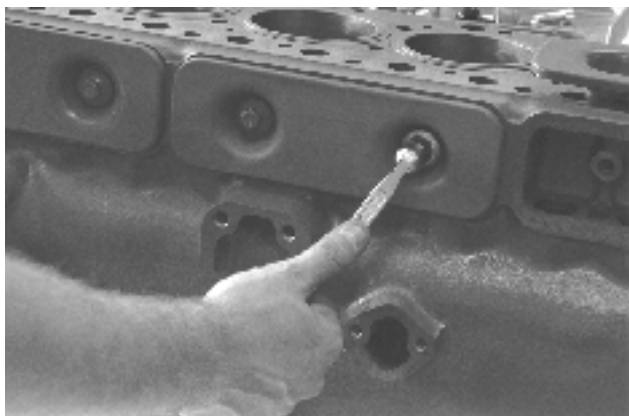
21



Install the valve lifters in their original positions in the block. Clean the lifters and then oil the lifters and the guides in the block.

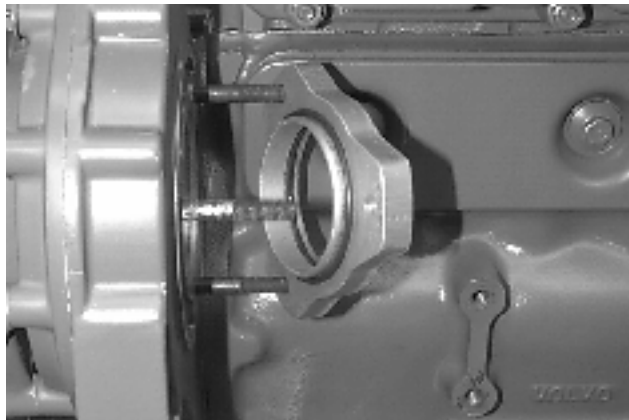
NOTE! Always use new lifters when installing a new camshaft. Apply molybdendisulphide on the lifter sliding area against the cam lobes.

22



Install inspection hatches. Tightening torque **24 Nm**. Socket 13 mm.

23



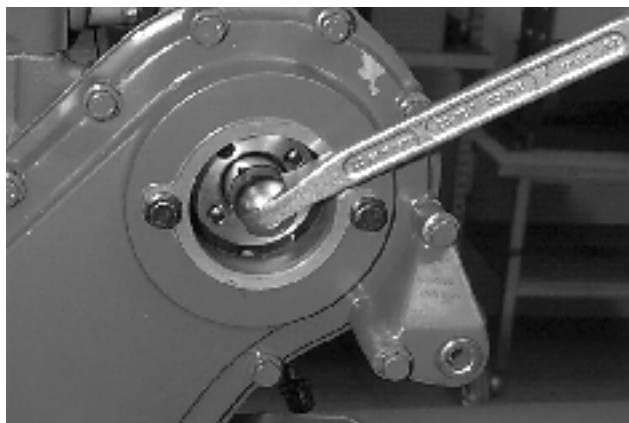
Install the intermediate flange with new O-rings (44/300 series). Install the fuel injection pump. Do not tighten the nuts in this position.

NOTE! If the stud bolts have been removed apply Loctite® 572 to their threads before reinstalling. This reduces the risk of oil leaks.



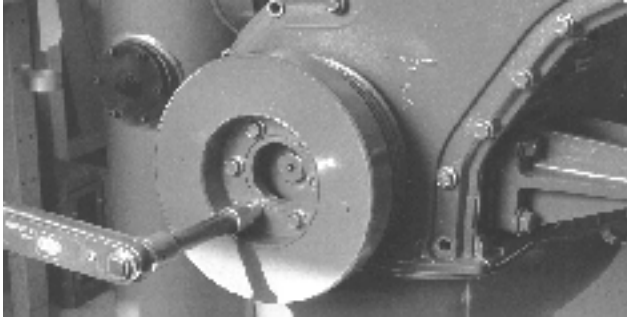
IMPORTANT! Do not turn the engine with the fuel injection pump drive gear loose. This may damage the cogs or engine speed (RPM) sensor (32/42/43 series).

24



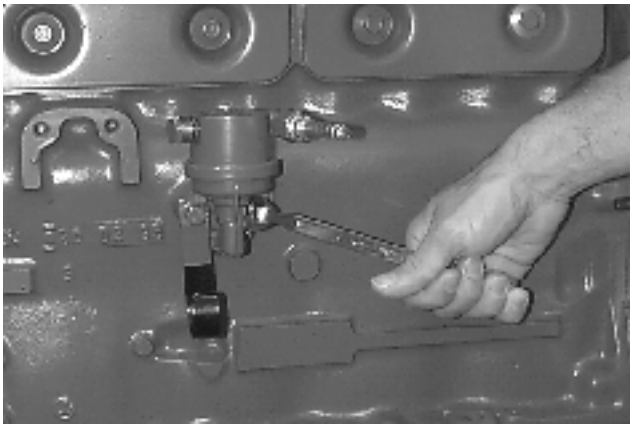
Turn the pump shaft so that the holes for the flange screws correspond to the holes in the camshaft gear (the gear can only be installed in one position). Tightening torques for flange screws **24 Nm**. Socket 13 mm. Install the bracket under the pump without tightening.

25



Install the front vibration damper and belt pulleys. Tightening torque **28 Nm**. Socket 12 mm.

26



Install feed pump. Socket 12 mm. Install starter motor. Socket 15 mm.

27



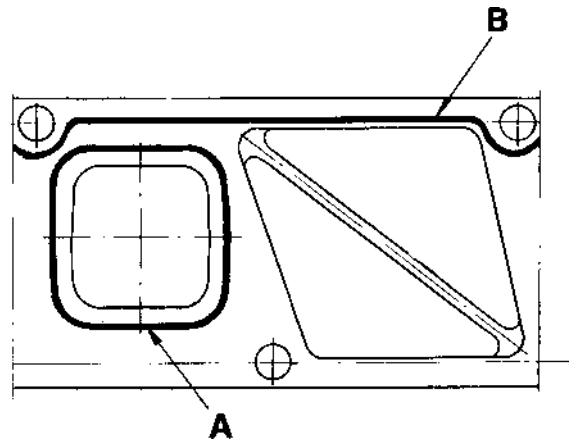
Install circulation pump and belt tensioner bracket. Wrench 12 mm, 13 mm.

Install and tension the drive belts.

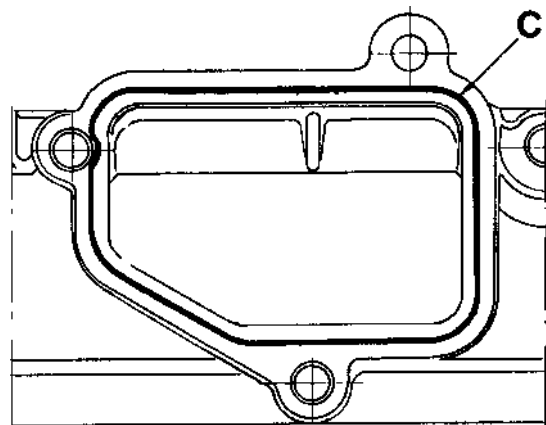
NOTE! There are several versions of belt tensioners. Please refer to "Drive belts, tensioning" for the procedure.

28

Install intake manifold on cylinder head. Apply sealing compound Loctite® 574 to cylinder head and intake manifold. Apply a thin even unbroken bead, bead width 3 mm.



A, B (B only upper edge) = Sealing compound intake manifold



C = Sealing compound cylinder head

Tighten the intake manifold. Tightening torque **20 Nm**.

29

Install a new cylinder head gasket and lift the cylinder head in place. Handling, see "Cylinder head, installing".

30

Install the push rods in their original positions.



Install the valve yokes (44/300 series) and rocker bracket.

NOTE! Install new O-rings on the rocker arm oil delivery line (there is no pipe on the 44/300 series) and be careful that the O-rings are not damaged when installed.

Tightening torques see "Workshop manual, Technical data". Socket 14 mm, wrench 17 mm.

Then adjust valve clearance. See "Valves adjusting".

31

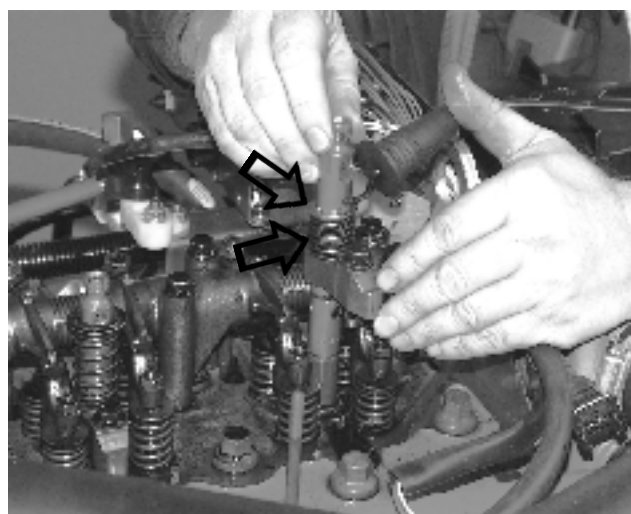


Install the nozzles. Do not forget the lower O-ring on the nozzles (44/300 series only)

NOTE! Ensure that the plane of the return line is as straight as possible.

NOTE! If the copper injector sleeves were not replaced they should be cleaned with brush 885 289 before the nozzles are installed.

Tightening torque **24 Nm**, socket 13 mm.



Applies only to KA(M)D44P-B/44P-C/300

Thread the washer and spring onto the injector for cylinder 1 before installing it. Press the springs together and install the injector yoke in position. Thread the lower O-ring onto the injector.

32



31/32/41/42/43-series

Install the valve cover with new gaskets. Tightening torque upper valve cover **8 Nm**. Socket 10 mm, 13 mm.



Applies only to KA(M)D44P-B/44P-C/300

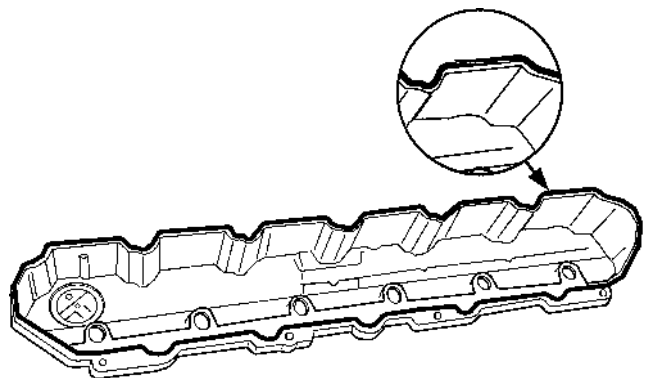
Ensure that the cut out in the sealing washer corresponds to the split pin and the injectors cable terminal (only cylinder 1)

33



44/300 series

Install the seal against the valve cover (the O-rings, washer and spring) on each injector.

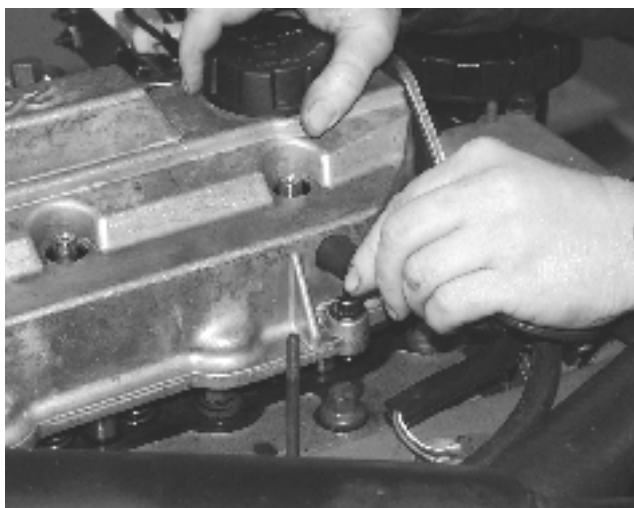


44/300 series

Inspect the valve cover gasket. If it is undamaged and securely fixed to the cover, the gasket does not need to be changed. If it needs to be replaced carry out the following:

Carefully clean the gasket seat. Apply a thin layer of silicone sealant, part no. 116 1231-4 to the valve housing. Put the new gasket on and leave the silicone sealer to harden underneath it before installing the valve housing.

NOTE! Align the gasket joint as in the illustration.

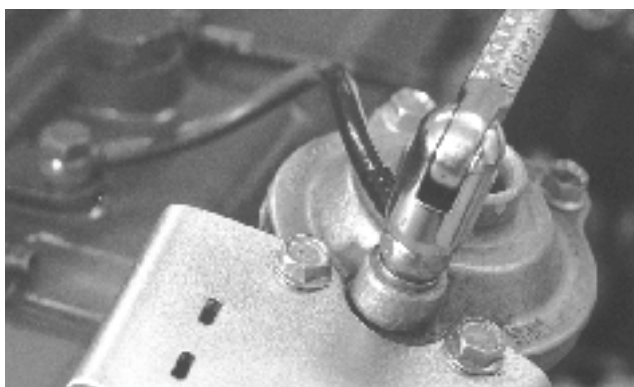


Applies only to KA(M)D44P-B/44P-C/300

Insert the cable for the injector through the valve cover. Press the rubber grommet into place at the same time as the valve cover is lowered against the cylinder head. Install the retaining clip. Connect the cable to the engine cable harness.

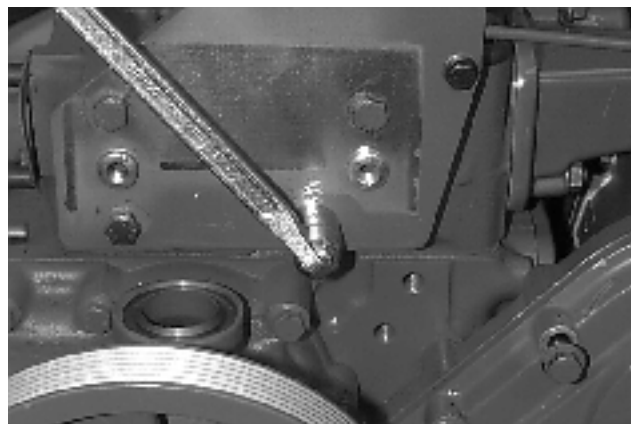
Check that the cable is clear of the rocker arms through the oil filler hole.

34



Install the pipe for the smoke limiter (31/32/41/42/43 series only). Socket 13 mm.

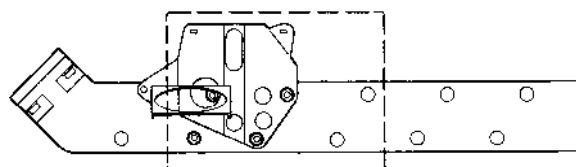
35



Install the lifting brackets. Install the thermostat housing using new sealing ring. Socket 12 mm, 13 mm.

Install the circulation pump outer pulley.

36



Install the exhaust manifold with air filter bracket.

NOTE! Install only the nuts illustrated. Socket 15 mm.

Injection timing, setting

Special tools: 884 895, 884 954

31/32 series: 885 199

41/42/43/44P-B/44P-C/300 series: 885 139

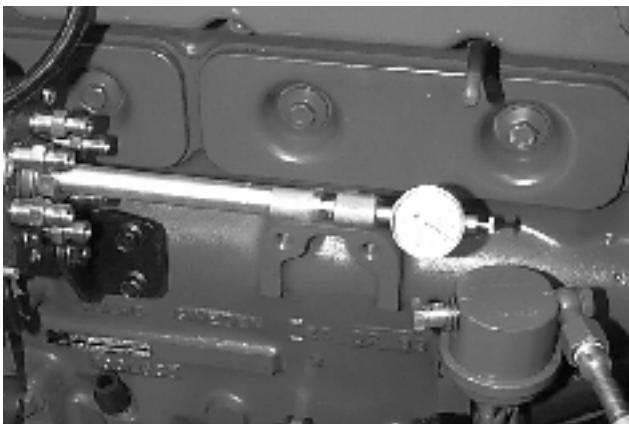
44P-A: 885 139, 885 301

37



Install tool 884 895 in the flywheel housing. Turn the engine in the direction of rotation until the tool lug locks the flywheel.

38



Remove the center screw on the rear face of the fuel injection pump and install the dial indicator 884 954 with holders 885 139 (41/42/43/44/300 series) and 885 199 (31/32 series). Ensure that the indicator is pushed in 3–4 mm.

Applies only to KA(M)D44P-A

39



Remove the pump's reset cover. Use Torx 30 tool.

40



Screw out the center screw on tool 885 301, oil the reset piston and install the tool on the pump.

Tighten the center screw until it reaches the bottom.

Applies to all engines**41**

Release the locking lug on tool 884 895 and turn the engine back (against direction of rotation) approximately 30° (41/42/43/44/300 series) and approximately 45° (31/32 series) or until the clock "stops".

42

Reset the clock

43

Turn the engine in the direction of rotation. Ensure that the clock does not move when the rotation begins, this is to ensure that the turning begins at "zero".

44

When the locking pin "locks" the flywheel the dial indicator should be read off. Compare the read off value with Workshop manual "Technical data".

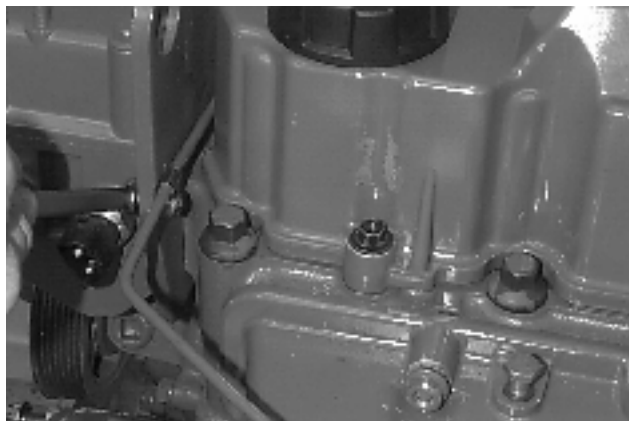
45

If the injectors need to be adjusted, slacken off the pump securing nuts and turn the pump until the correct value is obtained. Turn clockwise (seen from the front) if value is too low (injection too late) and counter-clockwise if the value is too high (injection too early).

Tighten the pump and dismantle specialtools. Reinstall the reset cover (144P-A series only).

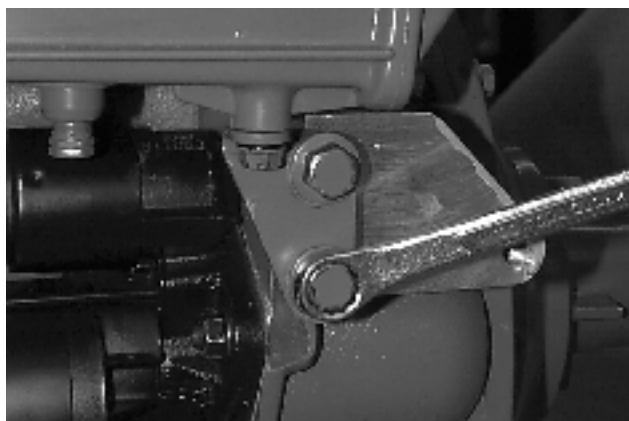
NOTE! The support bracket at the rear of the pump must block the cylinder block and pump before final tightening, so that no tensions are introduced.

NOTE! Do not forget to remove tool 884 895 from the flywheel housing.

46

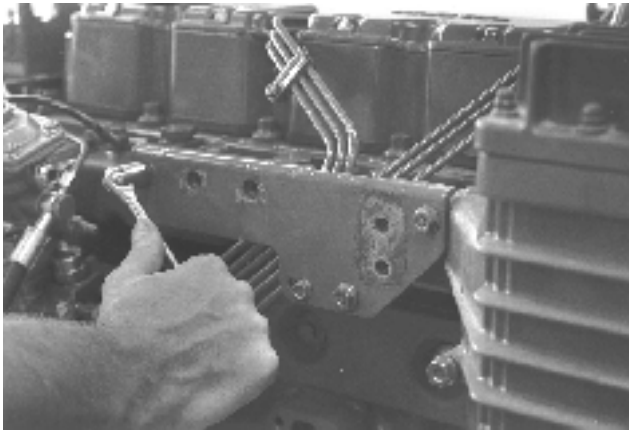
Install the return pipe between the injector nozzles and the fuel injection pump. Use new gaskets. Do not forget the clamp against the lifting bracket. Wrench 10 mm, 12 mm.

Install the delivery pipe to the nozzles. Wrench 17 mm.

47

Install the charge air cooler (CAC). Apply Silicone GE RTV1473W sealing compound on the intake manifold mating surface. Apply a thin even unbroken bead, bead width 3 mm. Ensure that no tension is built into the charge air cooler (CAC) when the support brackets underneath and at the rear are installed. Wrench 13 mm, 17 mm.

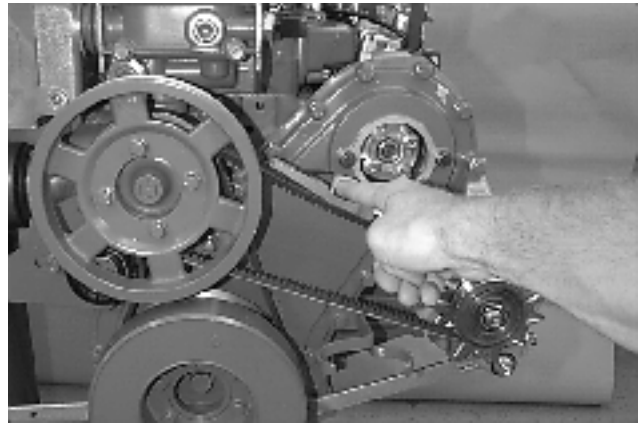
48



Install fuel and oil filters bracket.

NOTE! Mounting for injector pipes in the bracket.
Wrench 10 mm, 13 mm and 17 mm.

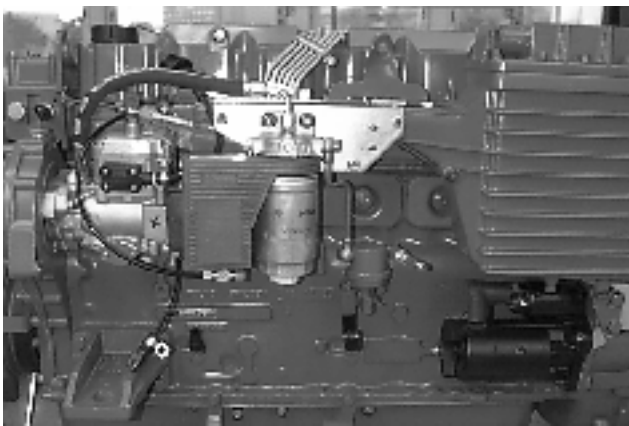
50



Install the generator (GEN) and generator belt.
Wrench 11/16", 5/8", 12 mm, 13 mm.

Tension the generator belt. See "Checking belt tensions".

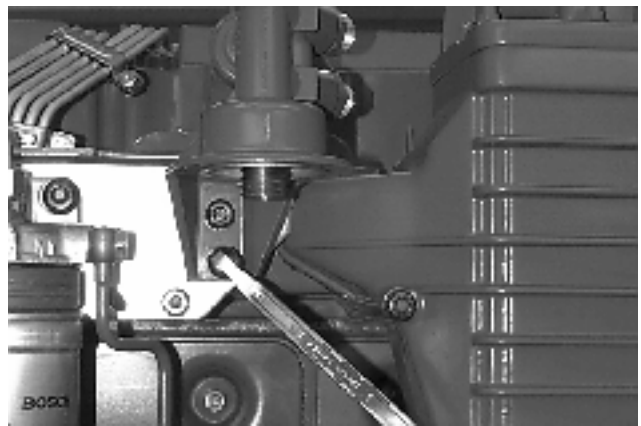
49



Install the fuel filter together with the EDC unit and pipes/ hoses (fuel injection pump filter and feed pump filter). Wrench 10 mm, 13 mm and 17 mm.

Install the air hose between the electronic diesel control (EDC) unit and the intake pipe.

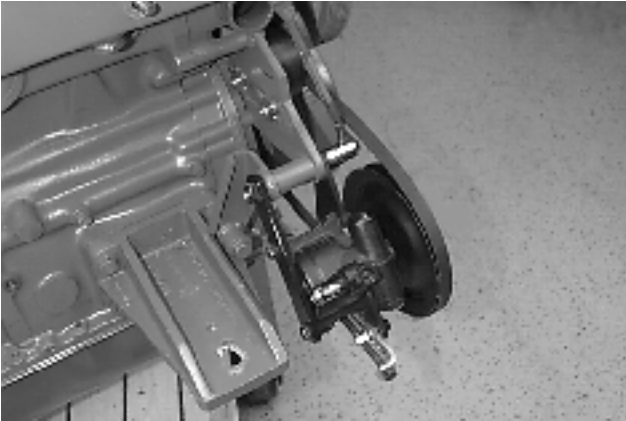
51



Install the oil cooler complete with terminal housing for the oil filter. Use new O-rings. Wrench 12 mm.

Install the terminal adapter for the oil filter (42/43/44/300). Install the hoses from the oil filter adapter – terminal housing (42/43/44/300). Wrench 12 mm + large adjustable wrench.

52



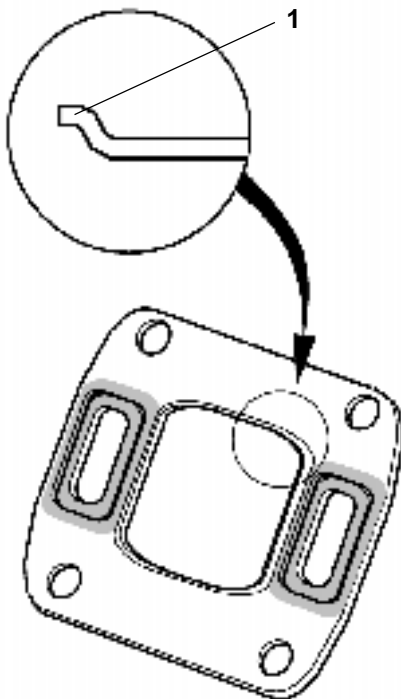
Install the starboard engine bracket and where applicable the servo pump. Install and tension belts. See "Checking belt tensions".

54



Install the sea water pump, water filter with bracket and hose to the charge air cooler (CAC) front terminal and to water intake (shield).

53



Install the turbocharger with all connections except the air inlet elbow.

Install the new gasket. Turn the upwards facing edge (1) around the exhaust duct to face the turbo.

In cases where an adapter flange has been removed (only TAM31S-A), turn the upwards facing edge to face the adapter flange.

Do **not** remove the tape on the gasket.

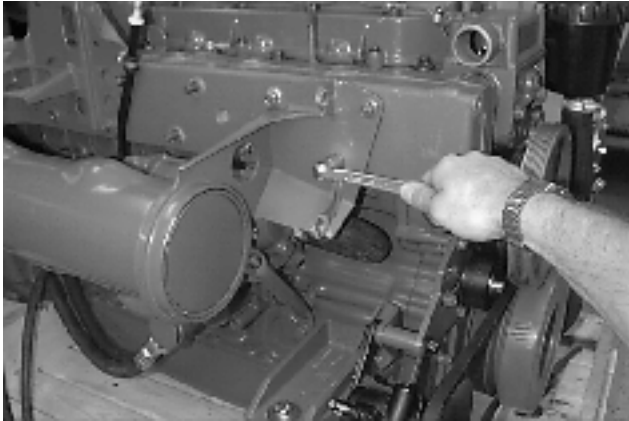
NOTE! Do not use any kind of sealant. This can cause a leakage.

55



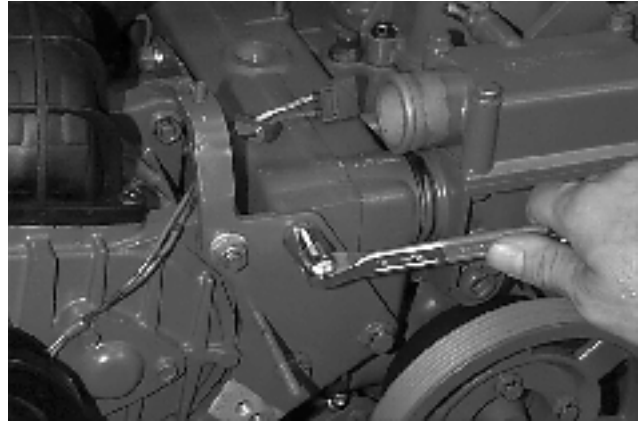
Install the hose between the oil cooler front connection and the charge air cooler (CAC) rear connection. Install the dipstick pipe.

56



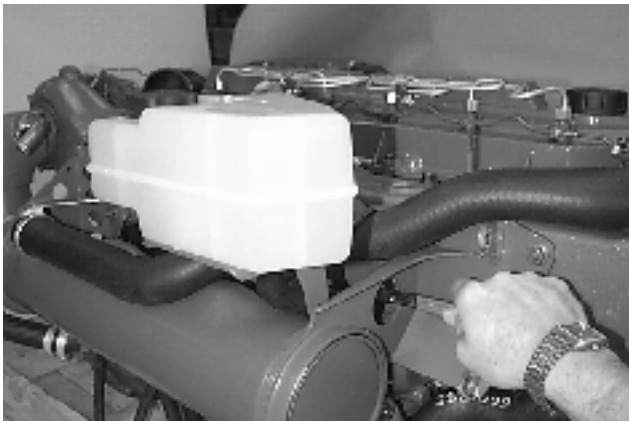
Install the heat exchanger with hose connectors. Do not tighten the clamp at the thermostat in this position. Wrench 15, 17 mm

58



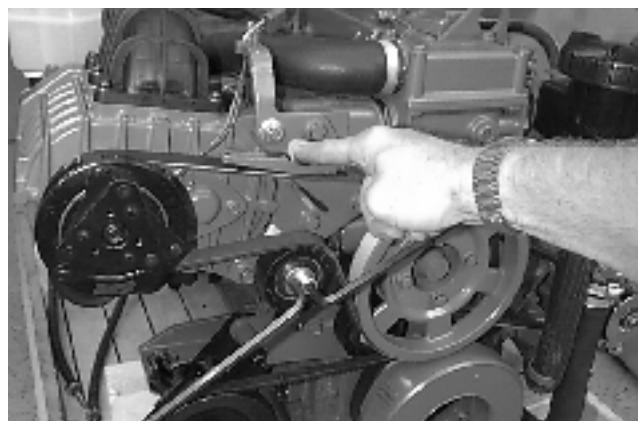
Install the compressor (32/42/43/44/300), and tighten the coolant hose clamp at the thermostat housing. Wrench 14, 15 mm.

57



Install the expansion tank and bracket and the venting hoses to the turbocharger and the thermostat housing.

59



Install and tension the compressor drive belt.

NOTE! There are several versions of belt tensioners. Please refer to "Drive belts, tensioning" for the procedure.

60



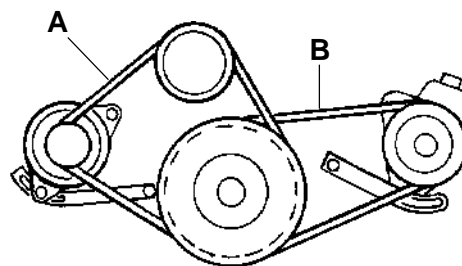
Install the air pipe compressor – air cleaner. Use new O-rings and dip them in soap solution to facilitate installing the air pipe . Install air cleaner. Wrench 10, 11 mm. Install the pipe between the turbo – the air cleaner – the compressor. The compressor terminals, both intake and output sides are sealed with a silicon sealing agent, such as Permatex® No. 6 or Loctite® Silicon sealing.

61

Install the electrical box and connect all components. Wrench 8, 10, 12, 13 mm.

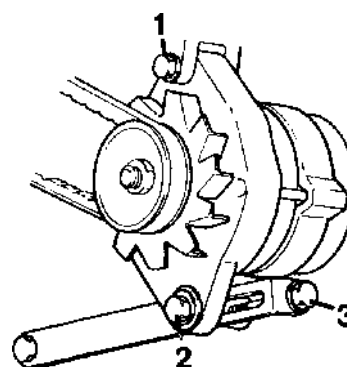
Drive belts, tensioning, 31/41 series

Drive belts, inspection points



62

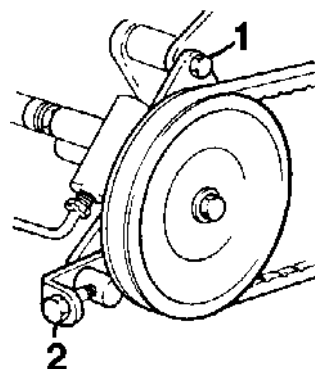
Alternator belt



Undo alternator fixing screws (1) and (2). Tension the belt with adjustment screw (4), so that the belt can be pressed down about 10 mm between the pulleys at (A). Tighten screws (1) and (2).

63

Servo pump belt



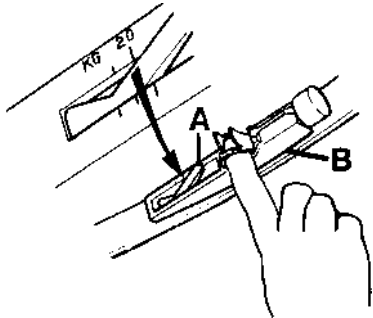
Undo retaining screw (1). Tension the belt with adjustment screw (2), so that the belt can be pressed down about 10 mm under normal thumb pressure between the pulleys at (B). Tighten screw (1).

⚠ IMPORTANT! Re-check belt tension on all belts after the engine has warmed up. Do this check while the belts are still warm.

Drive belts, tensioning
32/42/43/44 series (early model)

Applies to the following engines:
 32 series up to engine number 2203202197
 KA(M)D42 series,
 TAM42WJ up to engine no. 2204216366
 43 series up to engine number 2204303258
 44 series up to engine number 2204404631
 Special tools: 1159 660

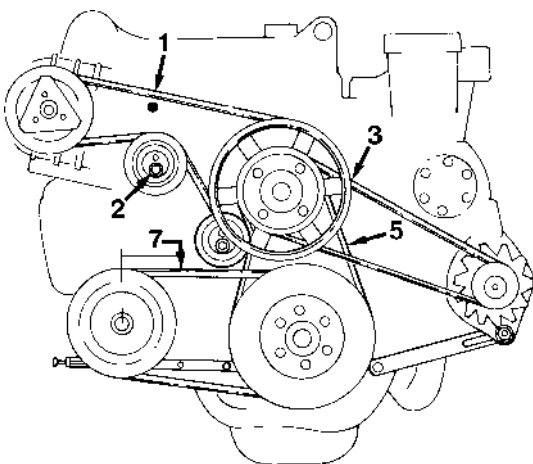
64



Check belt tension with tool no. 1159 660. Make the check at the points on the belt specified for each belt. Tension the belt, zero the tool (press arm "A" down) and put the tool on the belt. Put a finger (pressure point) on the check point as in the illustration. Then press the tool against the belt until a click is heard. **NOTE!** It is important that the tool touches the belt at surface "B" when you press the belt. Read the value on the tool. Tension or slacken the belts as necessary.

IMPORTANT! Tighten the belt tensioner before doing the check. Tension the belts in the following order (items 64–67) to avoid unbalanced loading.

65

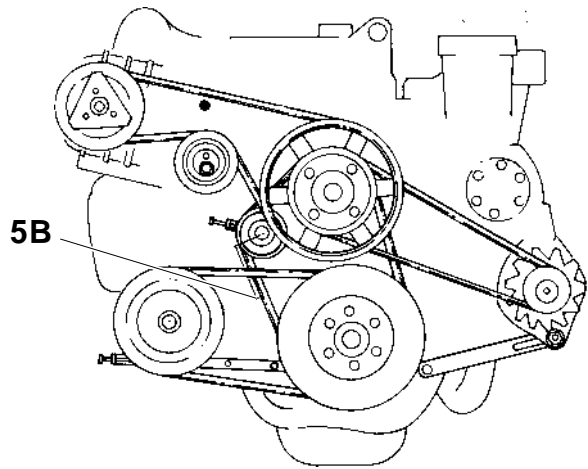


Inspection points, drive belts,

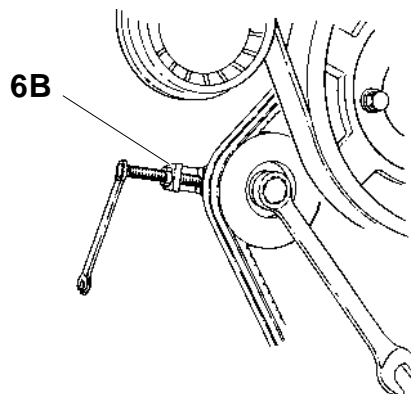
- 1. Supercharger belt
- 2. Alternator belt
- 3. Water pump belt
- 4. Servo pump belt
- 5. Water pump belt
- 6. Supercharger belt
- 7. Servo pump belt

66

Circulation pump belts (double V-belts)
(only KA(M)D42 up to engine no. 2204208023)

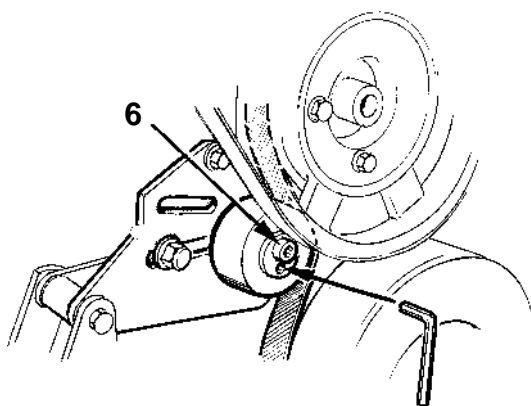


The check point for the belts is at (5B), 80 mm (3.1496") down from the center of the belt tensioner roller.



Adjust with belt tensioner (6B). Belt tension **20–25 kg** (44-55.1 lb)

67

Circulation pump belt (Poly-Vee belt)

The check point for the belt is at (5), mid way between the pulleys. Adjust with belt tensioner (6). Wrench size: 8 mm socket cap (2x).

NOTE! Turn the belt tensioner **anti-clockwise**.

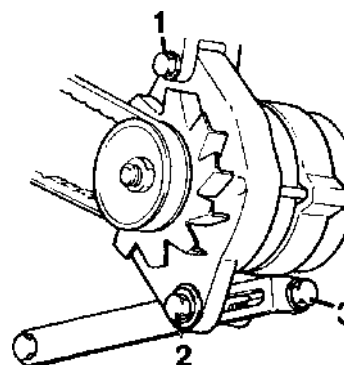
The following applies to installing a **new belt**.

- Tension the belt to **65–70 kg (132–154.3 lb)**.
- Turn the engine round about one turn in its direction of rotation.
- Check that the belt tension is still about **65–70 kg (132–154.3 lb)** (adjust as necessary).
- Warm the engine up at a speed of 1500 rpm for 5 minutes
- Re-check that the belt tension is still about **65–70 kg (132–154.3 lb)** and adjust as necessary.

The following applies to installing a **used belt**.

- Tension the belt to **40–45 kg (88–99.2 lb)**.
- Turn the engine round about one turn in its direction of rotation.
- Check that the belt tension is still about **40–45 kg (88–99.2 lb)** (adjust as necessary).

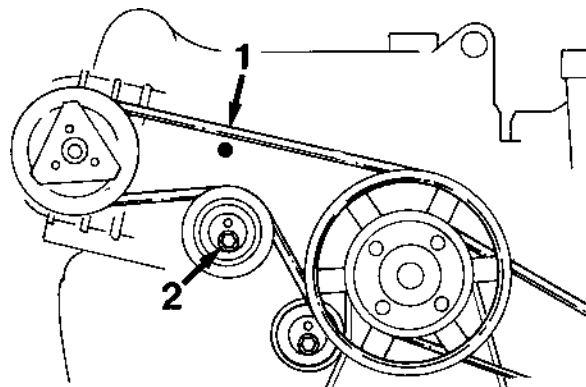
68

Alternator belt

Tension the belts with adjuster screw (3). The check point on the belt is at (3), right behind the edge of the poly-Vee pulley track. Tighten screws (1) and (2).

Belt tension **20–25 kg (44–55.1 lb)**.

69

Compressor belt (not 42WJ)

The check point on the belt is right above the engine housing stud (1). Adjust the belt tension with belt tensioner (2). Turn the jockey pulley **clockwise** so that it tensions the belt, then tighten the socket cap screws. Wrench size 8 mm socket cap (2x).

The following applies to installing a **new belt**.

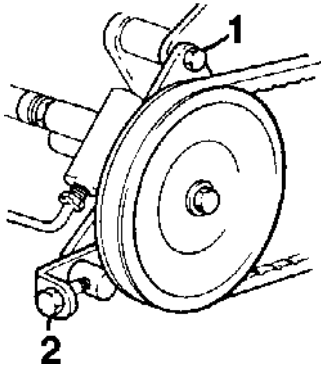
- Tension the belt to **40–45 kg (88–99.2 lb)**.
- Turn the engine round about one turn in its direction of rotation.
- Check that the belt tension is still about **40–45 kg (88–99.2 lb)** (adjust as necessary).
- Warm the engine up at a speed of 1500 rpm for 5 minutes
- Re-check that the belt tension is still about **40–45 kg (88–99.2 lb)** and adjust as necessary.

The following applies to installing a **used belt**.

- Tension the belt to **30–35 kg (66–77.1 lb)**.
- Turn the engine round about one turn in its direction of rotation.
- Check that the belt tension is still about **30–35 kg (66–77.1 lb)** (adjust as necessary).

70

Servo pump belt



Tension the belts with adjuster screw (2). The inspection point for the belt is at (7), 80 mm (3.1496") away from the pump pulley center.

Belt tension **15–20 kg (33–44.0 lb)**.

69

Install the engine cover at the front.

Drive belts, tensioning

32/42WJ/43/44/300 (late model)

Applies to the following engines:

32 series as from engine number 2203202198

42WJ as from engine number. 2204216367

43 series as from engine number 2204303259

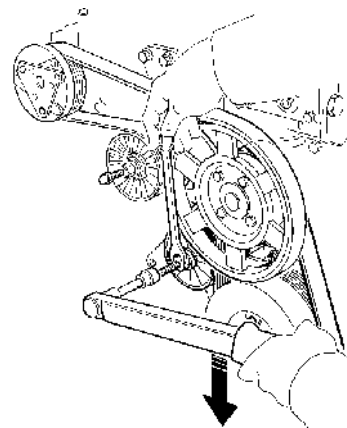
44 series as from engine number 2204404632

300 series as from production start

⚠ IMPORTANT! Tension the belts in the following order to avoid unbalanced loading.

70

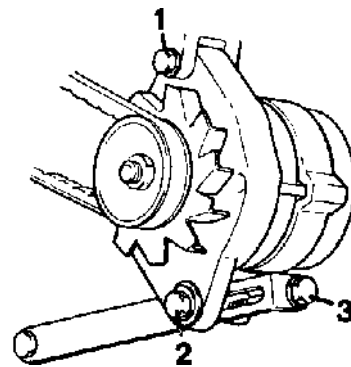
Circulation pump belt



Loosen the nut far enough to allow the belt to slacken off. Tension the belts by applying a torque of **35–40 Nm (26–30 lbf-ft)** to the domed nut on the tensioner screw. Use a torque wrench and a suitable socket. Lock the tensioner screw with the nut.

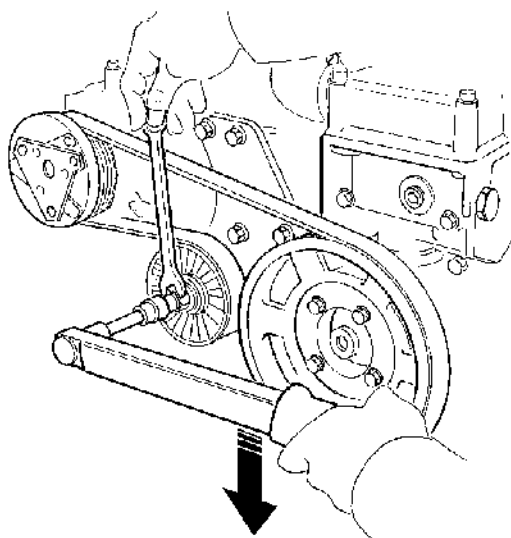
71

Alternator belt



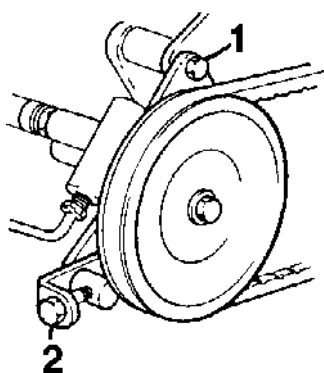
Undo alternator fixing screws (1) and (2). Tension the belt with adjustment screw (4), so that the belt can be pressed down about 10 mm (0.3937") between the pulleys. Tighten screws (1) and (2).72

72

Supercharger belt

Loosen the nut far enough to allow the belt to slacken off. Tension the belts by applying a torque of **35–40 Nm (26–30 lbf-ft)** to the domed nut on the tensioner screw. Use a torque wrench and a suitable socket. Lock the tensioner screw with nut (1).

73

Servo pump belt

Undo retaining screw (1). Tension the belt with adjustment screw (2), so that the belt can be pressed down about 10 mm (0.3937") between the pulleys. Tighten screw (1).

⚠ IMPORTANT! Re-check belt tension on all belts after the engine has warmed up. Do this check while the belt is still warm.

74

Install the engine cover at the front.

Before starting

- Fill engine oil. Check level.
- Fill coolant. Check level.
- Check oil level, compressor (KAD/KAMD 32/42/43/44/300).
- Check that all wiring is connected and that all terminals are properly fastened. Check that the wiring is correctly clamped so that it is not exposed to mechanical wear.
- Check that all the hose clamps on the engine coolant and air hoses are tightened.
- Open any sea water cocks.
- Bleed the fuel system if it has been dismantled.

After starting

Run the engine to operating temperature so that the thermostats open. Then check:

- That no water-, oil-, or fuel leakage occurs.

Stop the engine and carry out the following checks:

- Check the engine oil level. Top up if required.
- Check the fresh water level. Top up if required.
- Check belt tension. Adjust as necessary.

Report form

Do you have any comments or other viewpoints concerning this manual? Make a copy of this page, and write down your comments and send them to us. The address is at the bottom of the page. We would prefer you to write in Swedish or English.

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AB Volvo Penta
Customer Support
Dept. 42200
SE-405 08 Gothenburg
Sweden

