Workshop Manual

Intake, exhaust, cooling systems

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

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Group 25 Intake and exhaust systems
Group 26 Cooling systems

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 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. 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 as 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 reinstalling. 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.

Tow 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.

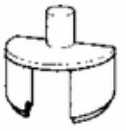
- Always used chloroprene rubber gloves (gloves for handling chemicals) and protective glasses.
- Treat removed seals in the same way as corrosive acid. All remains, even the ash can be extremely corrosive. Never use compressed air jets for blowing clean.
- Put old seal remnants in a plastic container, 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 temeratures can be handled normally.

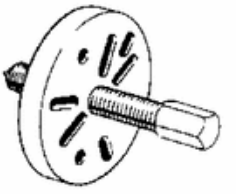
Special tools

884 347



884 635

949 402



357 8670

999 2000

999 2265

999 2268

999 6033

999 6666

999 6858

999 8039

884 347-6 Drift for reconditioning the seawater pump

884 635-4 Removal punch for the oil cooler insert (early version only)

949 402-2 Nipple, checking boost pressure

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

999 2000-1 Standard shaft

999 2265-0 Puller for circulation pump belt pulley

999 2268-4 Drift for installing bearing in circulation pump

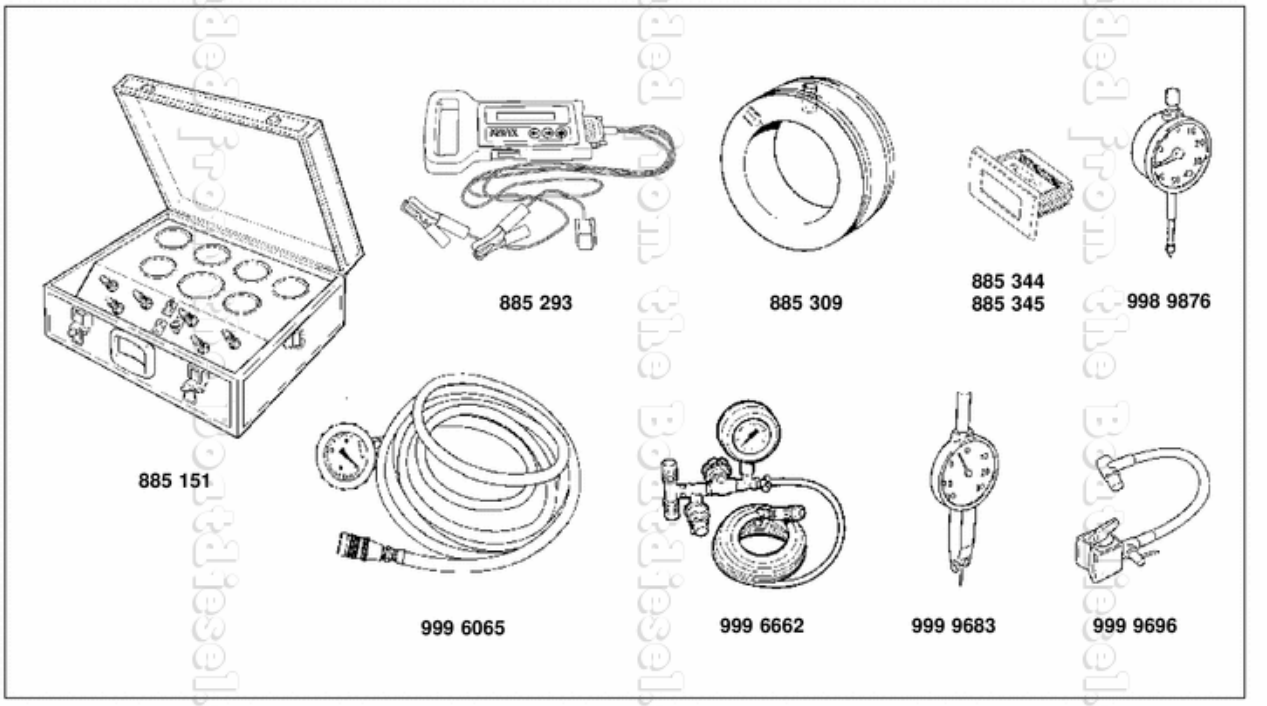
999 6033-8 Bracket to test pressurization of oil cooler (2 x)

9996666-5 Nipple with quick-release coupling for connection to 6065

999 6858-8 Drift for removing circulation pump pulley

999 8039-3 Drift for installing shaft seal in circulation pump

Other special equipment



885 151-1 Kit with test instrument for measuring exhaust gas back pressure and exhaust temperature.

885 293-1 Diagnostic key

885 309-5 Flange for measuring the exhaust gas back pressure and exhaust temperature (KAMD, TAMD)

885 344-2 Program cassette for diagnostic tool (Swedish, English, German and French menu choices)

885 345-9 Program cassette for diagnostic tool (Spanish, Dutch, Portuguese and Italian menu choices)

998 9876-9 Dial indicator

999 6065-0 Manometer with hose for connection to banjo nipple 999 6666 when checking turbocharger (TC) boost pressure.

999 6662-4 Test pressurization equipment

999 9683-7 Rocker indicator

999 9696-9 Magnetic stand for dial indicator

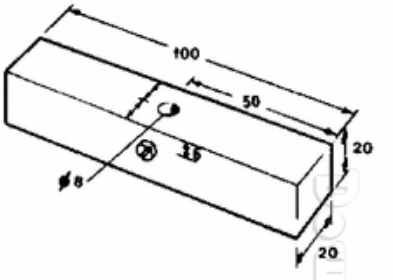


Diagram of the special tool for the Turbo

The tool is not supplied by Volvo Penta but must be manufactured at your own workshop

Group 25 Intake and exhaust system Design and function

General

All engines are equipped with an exhaust driven turbocharger (TC) which supplies the engine with overpressured air.
This increases the oxygen flow to the motor and more fuel can be combusted at the same time as combustion is more efficient. This results in greater engine output, lower specific fuel consumption and cleaner emissions.

TAMD31S-A has a turbocharger with wastegate valve. This means that a smaller turbocharger could be used.

A small turbocharger gets enough exhaust gas to give high turbine speed/charge pressure at low engine speeds, i.e. the engine gets considerably improved low speed torque, at the same time as it reacts faster to load changes.

At higher engine loading, the wastegate valve opens and allows some of the exhaust gas to pass by the turbocharger, straight into the exhaust pipe.

KA(M)D42/43/44/300 and KAD32 also have a mechanically driven supercharger, for higher power in the low and medium speed sections of the power curve.

The charge air from the turbocharger passes through a charge air cooler (CAC) which lowers the temperature of the intake air. This means that a greater quantity of oxygen enters the cylinder combustion chamber which in combination with an increased quantity of fuel increases the engine output.

The charge air cooler (CAC) is located on the left of the engine.

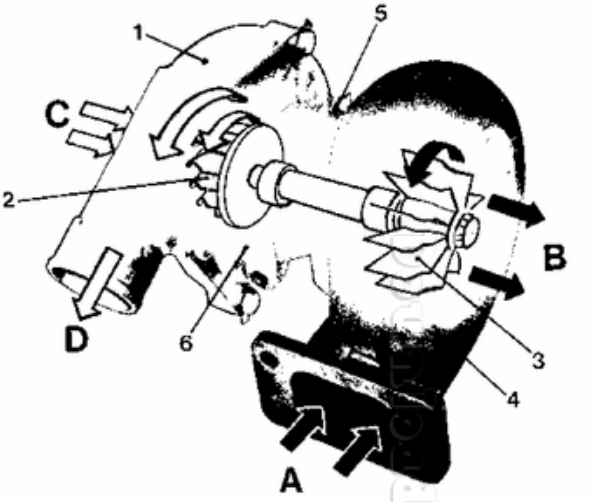
Turbocharger

The turbocharger (TC) which is borne on sliding bearing consists of turbine housing (4) with turbine (5), bearing housing (3) and compressor housing (2) with compressor wheel (1). The turbocharger is driven by the exhaust gases passing the turbine housing and flowing on to the exhaust system. By locating a turbine (5) in the exhaust flow (exhaust side) and letting it drive a compressor wheel (1), mounted on the same shaft on the intake side, the intake air is compressed so that the air input to the engine increases.

The compressor wheel is located in a compressor housing which is connected between the air cleaner (ACL) and the engines intake pipe. When the compressor wheel rotates air is drawn from the air cleaner, it is compressed and pressed into the engine cylinder.

The compressor, which is mounted on the exhaust manifold at the rear of the engine, is lubricated and cooled by the engine's lubricating oil. An external oil line connection supplies and removes the oil required.

The turbocharger turbine housing is freshwater-cooled to reduce radiant heat to the engine compartment.



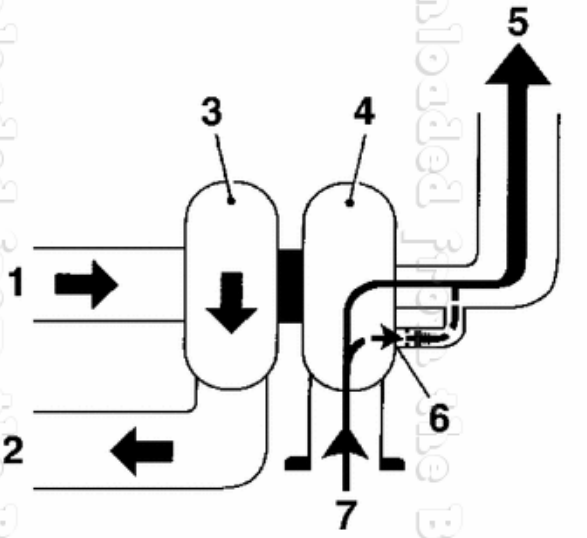
Turbocharger

1. Compressor housing
2. Compressor wheel
3. Turbine
4. Turbine housing (freshwater)
5. Oil intake
6. Oil output

A = exhaust gases from engine
B = to exhaust system
C = air from air filter
D = compressed air to the engine

Wastegate valve

The wastegate valve is intended to prevent the turbocharger from overspeeding at high engine speeds. The valve is controlled by a pressure cylinder with a spring-loaded diaphragm, which is influenced by the charge air pressure coming via a hose from the compressor housing. When a certain charge pressure has been attained, the wastegate valve opens and allows some of the exhaust gas (6) to pass by the turbine wheel, straight into the exhaust pipe (5).



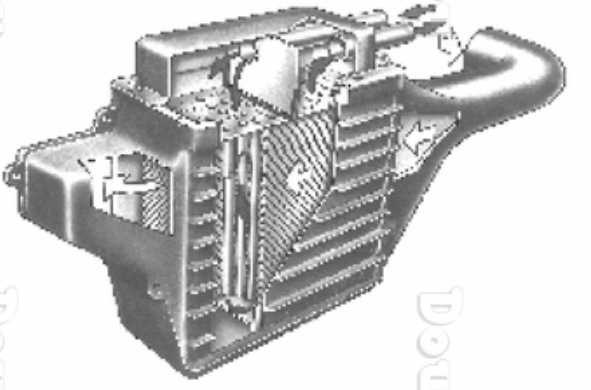
Principle sketch of turbocharger with wastegate valve

1. Air from air filter
2. Compressed air to engine
3. Compressor housing
4. Turbine housing
5. Exhaust pipe
6. Exhaust gas flow past turbine wheel, via wastegate valve, at high engine loading
7. Exhaust gas from engine

Charge air cooler (CAC)

Intake air passes the charge air cooler (CAC), which is seawater cooled, after compression in the turbocharger (TC) or in the Roots compressor. The charge air cooler lowers the temperature of the air and thereby considerably improves the output ratio as the volume of the air is reduced. More air (oxygen) can therefore be forced into the engine's cylinders and burn more fuel per compression stroke; thus increasing output.

A turbocharged diesel engine with charge air cooler (CAC) has the highest efficiency of any internal combustion engine.



Roots compressor

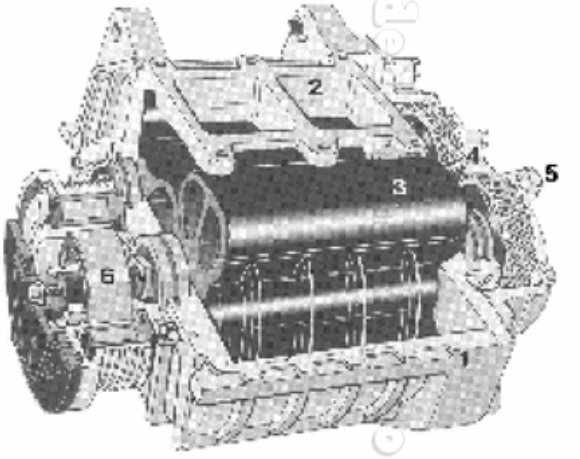
KAD32 and KA(M)D42/43/44/300 have a new concept for engine supercharging, a mechanically driven supercharger and an exhaust turbocharger. The advantage with this system is that the engine can be supercharged over a very broad engine speed range.

In an exclusively turbocharged engine the choice of turbocharger (TC) must always be made on the basis of which engine speed range maximum boost pressure is required for. For good acceleration a smaller turbocharger (TC), easily driven by the smaller exhaust output generated at lower engine speeds, must be selected. The disadvantage is that at high engine speeds the turbocharger is too small, both in terms of the exhaust gases the turbine is able to accept and the boost capacity of the compressor. To protect the turbocharger against overrevving a portion of the exhaust gases must be released past the turbine directly into the exhaust pipe using a boost pressure control (BPC) valve. In these circumstances the turbocharger provides a limited output increase at the top of the engine speed range at the same time as the "free energy" in the exhausts is not exploited to the maximum.

A larger turbocharger (TC) on the other hand has a turbine which is able to accept the entire exhaust mass at maximum RPM and is therefore able to drive a large compressor wheel for the supercharging requirement at maximum RPM. The disadvantage is that exhaust gases at low revs are not sufficient to drive the large turbine. There is therefore only limited boost available at engine speeds in the low and medium registers. Because of the large rotating mass in the turbocharger it is sluggish and the engine does not respond sufficiently fast to throttle opening.

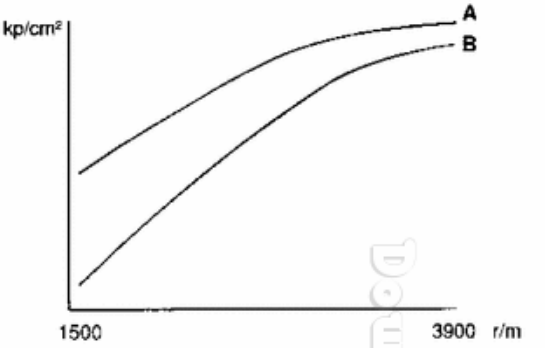
The supercharging system in the KAD32 and KA(M)D42/43/44/300 is based on two units which are each optimized for an engine speed area.

In the low and mid range the mechanical compressor is connected and can therefore provide higher torque in that area. With the "Kickdown" function direct connection is obtained for acceleration from idling speed. In the high rev range the exhaust powered turbocharger (TC) takes over therefore using the energy in the exhaust gases most effectively.



Roots compressor, function

1. Compressor housing
2. Air output
3. Compressor blades
4. Toothed gears
5. Oil filler
6. Magnetic clutch

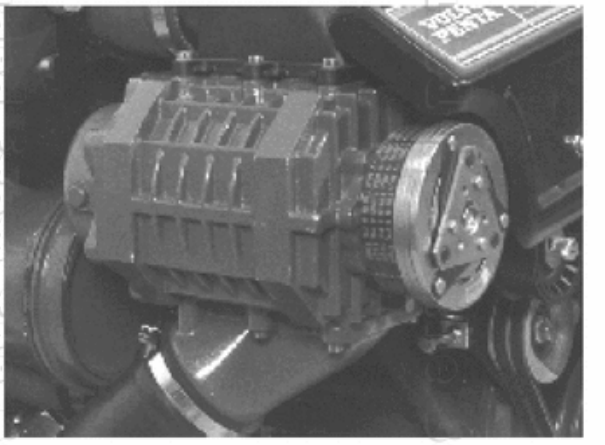


Boost pressure, principle diagram

A = Compressor +Turbo
B = Engine with turbocharger (TC) only

Supercharger

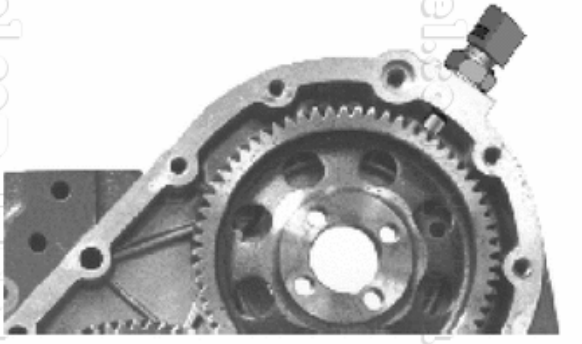
The mechanical compressor is of the Roots type, which consists of two counter rotating compressor blades, which are connected with a toothed gear. The compressor is driven by the engine circulation pump (indirectly from the crankshaft) with a multi V drive belt. The total output ratio compared to the engine crankshaft is 1:2.5 for the KAD32, 1:3 for the KA(M)D42/43 and 1:3.26 for the KA(M)D44/300. The compressor is equipped with an electromagnetic clutch of the same type used on air-conditioning compressors etc. Compressor connection and disconnection is carried out electronically.



Compressor

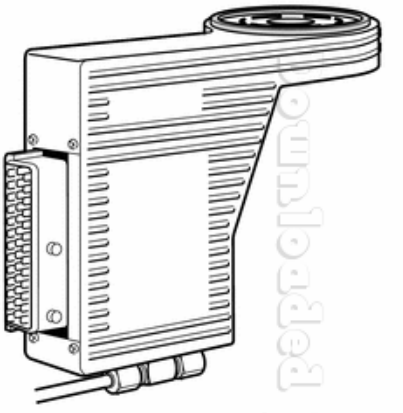
Compressor control

On the KAD32 and KA(M)D42/43 connection of the mechanical compressor is controlled from an electronic box, which receives values from an engine speed (RPM) sensor, and a micro-switch on the engine control rod. The engine speed (RPM) sensor, which is the inductive sensor type (tooth counter) is installed on the timing cover and reads the fuel injection pump pulley. Half the number of the 66 pump pulley teeth, that is to say 33 teeth correspond to one engine revolution. Description of the electronics box see Workshop manual “Electrical system”.



Engine speed (RPM) sensor, compressor control KAD32 and KA(M)D42/43

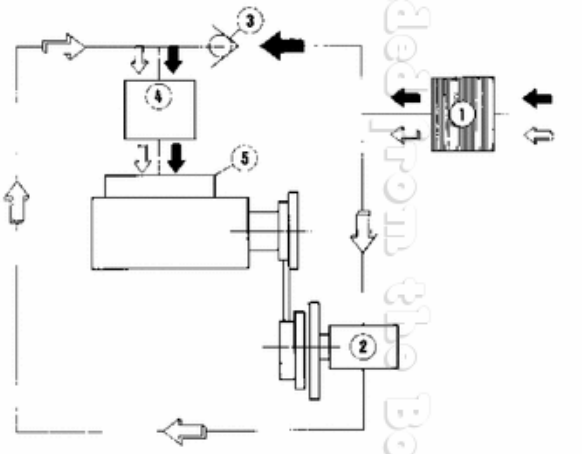
On the KA(M)D44/300 connection is controlled by the EDC unit which receives values from the engine speed sensor, boost pressure sensor and charge air temperature sensor.



EDC–unit

Charge air control KAMD/KAD

The mechanical compressor (2) boosts the engine through the turbocharger (TC) (4) and the charge air cooler (CAC). When the turbocharger (TC) begins to boost and the turbocharger (TC) boost pressure exceeds the compressor pressure by more than atmospheric pressure the check valve (3) opens and air is supplied to the turbocharger (TC) directly from the air cleaner (ACL). The engine becomes exclusively turbocharged engine. The check valve consequently opens even when the compressor is disconnected at a drop in engine speed; the engine takes air directly from the air cleaner (ACL).



Charge air control

1. Air Cleaner (ACL)
2. Roots compressor
3. Check valve
4. Turbo
5. Charge air cooler (CAC)

Repair instructions

Removing turbocharger

If the turbocharger unit is to function satisfactorily, it is vital that the engine's lubrication system be maintained and that the correct type of lubricating oil be used, see Workshop manual "Technical data".

Replace the engine oil and oil filter before removing the turbocharger (TC), so that the engine can be run for a few minutes with the new oil.

1

Clean around the turbocharger.

2

Does not apply to TAMD31S-A

Drain some of the coolant from the fresh water system and remove the vent hose from the turbocharger.

3

Remove the exhaust elbow pipe at the turbocharger exhaust.

4

Remove the pipe or the hose (TAMD31S-A) between the turbocharger and the intercooler.

5

Only applies to the 31/41 series

Remove the air filter.

6

Only applies to the 32/42/43/44/300 series

Remove the induction elbow between the turbocharger and the non-return valve.

7

Remove the oil pressure line and the oil return line.

8

Remove the turbocharger from the exhaust pipe.

Do **not** remove the adapter flange (only TAMD31S-A).

Installing turbocharger

NOTE! Determine the causes of replacement when replacing the turbocharger. Then remedy any faults before installing the new turbocharger (TC).

If the turbocharger unit is to function satisfactorily, it is vital that the engine's lubrication system and intake system be maintained, that replacements of engine oil, the oil filter and air filter are carried out at the correct intervals and that the correct type of lubricating oil be used.

1

Replace the engine oil and engine oil filter at the same time as a turbocharger (TC) is replaced.
Use the correct quality, see the Workshop manual "Technical Data"

Be sure to follow the oil and oil filter replacement intervals.
Replacement should be carried out according to the instruction book in order to guarantee a clean engine.

Clean the turbocharger pressure and return oil lines. Bearing failure in the turbocharger ids nearly always caused by sludge deposits in the engine lubricating system.
Sludge build up can be determined by lifting off the valve cover.

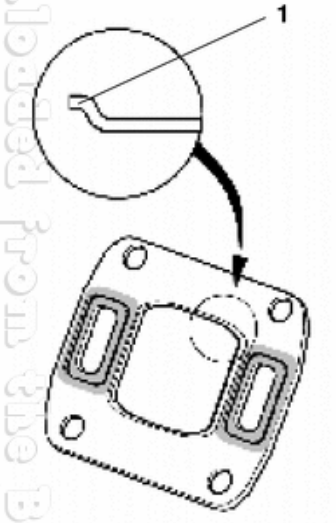
In case of sludging the whole lubricating system must be thoroughly cleaned before a new or reconditioned turbocharger is installed.

2

Clean any loose soot, overheating residue or metal particles from the exhaust manifold and install the turbocharger on the engine.
Make sure that the turbo and exhaust pipe mating surfaces are clean. Sand gently with emery cloth if necessary.

Also check the flatness of the exhaust pipe flange.

3



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 TAMD31S-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 at all. This can cause leakage.

4

Install the turbocharger on the exhaust pipe. Torque the nuts evenly, tightening torque **45 Nm (33.1 lbf-ft)**.

On TAMD31S-A, the turbocharger is installed on the adapter flange, tightening torque **22 Nm (16.2 lbf-ft)**.

5

Only applies to the 32/42/43/44/300 series

Install the induction elbow between the turbocharger and the non-return valve.

6

Only applies to the 31/41 series

Install the air filter housing and install a new air filter insert.

7

Clean and install the connection pipe or hose (TAMD31S-A) between the turbocharger and the intercooler.

8

It is important that the intercooler is also checked and cleaned.

If a turbocharger failure has occurred, where the compressor wheel has broken, the intercooler must be removed and pressure tested in accordance with the instructions in the “Intercooler, renovation” chapter.

9

Install the turbocharger return oil pipe.

10

Does not apply to TAMD31S-A

Connect the vent hose to the turbine housing.

Fill up with coolant in accordance with the instructions in the “Coolant, filling” chapter.

11

Connect the exhaust pipe bend to the turbocharger.

12

Squirt lubrication oil into the turbocharger bearing housing, using an oil can.

Install the oil supply pipe.

13

Put a suitable vessel under the compressor return oil connection, to catch the oil.

NOTE! To avoid damage to the turbocharger, the engine should be cranked by the starter motor, with the stop solenoid activated, until oil pressure is obtained (can not be done on KA(M)D44/300).

Start the engine.

Immediately loosen the return oil pipe union beneath the turbocharger and check that oil circulates correctly.

Start the return oil pipe and check that no oil leakage occurs.

Remove the oil collection vessel.

14

Only applies to TAMD31S-A

Install the heat shield and its spring clamps.

15

After changing or renovating the turbocharger unit, the charge pressure must be checked.

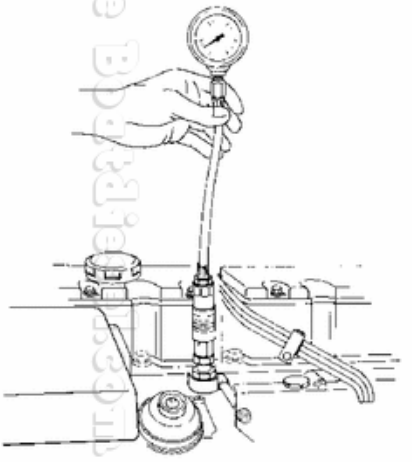
Checking boost pressure

Special tools: 949 402, 999 6065, 999 6666

If the engine is particularly weak or if the exhaust is very smoky the turbocharger function can be suspect. Because of this boost pressure should always be checked before replacing the turbocharger.
Note that low boost pressure can depend on other reasons than the turbocharger (TC), see “Corrective action in case of low boost pressure” on the next page.

Only applies to the 31/32/41/42/43 series

1



Output for checking boost pressure

Remove the plug/sensor installed in the intake pipe.
Install the standard nipple 949 402 in the hole.
Install nipple 999 6666 on the standard nipple.
Connect manometer 999 6065.

Only applies to the KA(M)D44/300 series

2

Diagnostic tool 885 293 is used to measure boost pressure on the KA(M)D44/300. See instructions in Workshop manual “Fuel system EDC”.

3

Start the engine/s and begin measurement as follows:

Measurement should occur continuously under full load with wide open throttle (WOT) while the engine speed (RPM) relatively slowly passes a given engine speed for the engine type.

NOTE! In the KAD32 and KA(M)D42/43/44/300 the boost pressure is checked only with engine speed (RPM) exceeding 3100 rpm so that the compressor does not contribute to the boost pressure.

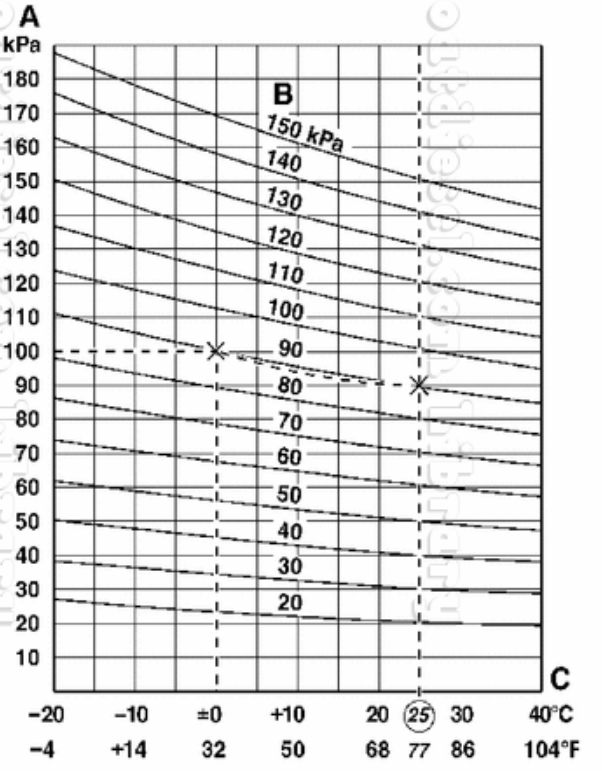
See Workshop manual “Technical Data”.

The boost pressure should not be less than the minimum value given for the engine type.

Check the engine speed (RPM) with a workshop rev-counter.

NOTE! It is important that full load is retained for as long as it takes for the boost pressure to stabilize so that the result is accurate.

Boost pressure at various temperatures



A. Boost pressure measured
B. Correction graphs
C. Intake air temperature (IAT)

The boost pressure is given at +20°C/68°F, which means that the measured value must be corrected according to the diagram, if the intake air does not have that temperature at the time of measuring.

Example: A pressure of 100 kPa (1kp/cm²/14 psi) registered at 0°C/32°F is equivalent to 92 kPa (0.92 kp/cm²/12 psi) at +25°C/77°F.

Corrective action in case of low boost pressure

- **Air intake**

  Check that the air intakes to the engine compartment are not blocked.
  In frequent cases check that the air intakes are the correct size, see the installation hand book.

- **Air Cleaner (ACL)**

  Check the air cleaner (ACL) is not clogged.
  Replace if required.

- **Sealing**

  Check the sealing.
  The inlet and exhaust pipes or hose connections may not have any leaks.
  Check that charge air cooler (CAC) is sealed to the intake manifold.

- **Throttle mechanism (does not apply to KA(M)D44/300)**

  Check that the mechanism can move the fuel injection pump throttle arm to maximum position.

- **Turbocharger**

  Check whether the rotor shaft is running stiffly or whether the turbine or compressor wheel is catching on its housing.
  Turn the wheel, first with a light pressure and then with the application of a light axial load. If the rotor is difficult to turn, the turbocharger must be replaced or reconditioned as soon as possible.
  Check the wheel for wear.

⚠ **IMPORTANT!** Never run the engine if you suspect that the turbocharger (TC) compressor wheel is damaged because fragments from the wheel can be drawn into the engine.

- **Wastegate valve (only applies to TAMD31S-A)**

  A sticking wastegate valve can cause either too high or too low charge air pressure.
  If the valve sticks open, this gives low charge air pressure at medium engine speeds, with consequent weak acceleration. But the charge air pressure could well be correct at full load, when the valve is normally partly open.
  If the opposite occurs, and the valve sticks closed, the result is **too high** charge air pressure at full speed, which means that there is a risk of damage to the turbocharger and the engine.

- **Cleaning**

  In event of daily use in dusty or oil vapor rich air and if the air filter replacement intervals have not been followed the compressor housing and compressor wheel may need to be cleaned. Dirty compressor components can cause low boost pressure.

  The compressor components can be cleaned with the turbocharger (TC) still mounted on the engine as follows:
  Remove the compressor housing.
  Clean the compressor housing, compressor wheel and shield with kerosene or similar.
  Install the compressor housing and measure the boost pressure again.

If the boost pressure is too low, check the following:

- **Injection pump**

  Check the pre injection angle and fast idling speed.

  Check the function of the fuel injection pump smoke limiter (not KA(M)D44/300).

- **Feed pressure**

  Check the feed pressure.

  Replace the fuel filter and any prefilters as necessary.

- **Injectors**

  Check the opening pressure and spray pattern.

- **Engine**

  Check the valve clearance and compression.

- **Exhaust back pressure**

  This point initially applies to inboard engines which may have been equipped with an exhaust system that does not have the dimensions indicated in the installation instructions.

  Drive engines: check that the exhaust outlet has not been blocked by any growth.

If the boost pressure still cannot be approved the turbocharger (TC) must be reconditioned or replaced.

Checking exhaust back pressure

Special tools: 885 151, 885 309 (does not apply to TAMD31S-A)

KAMD and TAMD only

An exhaust system with too great a back pressure lowers the boost pressure, gives diminished engine output, increased exhaust smoke and higher exhaust temperature. This in turn can lead to burnt valves and turbocharger failure.

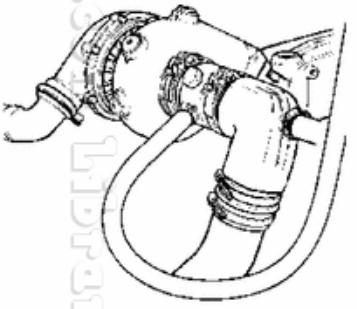
1

Remove exhaust elbow pipe from the turbocharger exhaust output.

2

Clean mating surface.

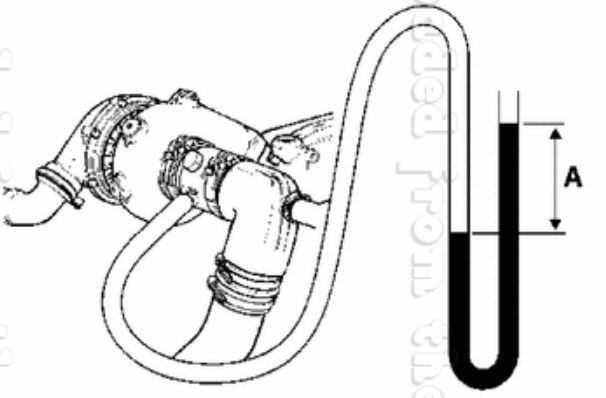
3



Connecting measuring flange

Install the measuring flange with V clamp to the turbine housing flange.
Install the exhaust elbow pipe on the measuring flange with a V clamp.

4



Connect a pressure gauge graduated to 40 kPa (4000 mm (158") wp) with a pressure hose and suitable union, to connect to the measurement flange.

Alternatively a transparent plastic hose can be connected to the measuring flange as illustrated.

The difference between the water columns (A) provides the exhaust system back pressure in mm wg.

Run the engine at **full load** and full throttle for about one minute and check that the back pressure is within the following interval:

TAMD31M/L/P, AD31L/P:
10–20 kPa (1.4-2.9 psi) (1000–2000 mm (79") wp)

TAMD31S-A:
15–20 kPa (2.1-2.9 psi) (1500–2000 mm (79") wp)

TMD41L:
5–15 kPa (0.7-2.1 psi) (500–1500 mm (20-59") wp)

TAMD41H/M/P:
20–30 kPa (2.9-4.3 psi) (2000–3000 mm (79-118") wp)

KAMD42P/KAD42P:
10–30 kPa (1.4-4.3 psi) (1000–3000 mm (39-118") wp)

KAMD43P-A/KAD43P-A:
10–30 kPa (1.4-4.3 psi) (1000–3000 mm (39-118") wp)

KAMD44P-A/P-B/P-C:
15–25 kPa (2.1-3.6 psi) (1500–2500 mm (59-98") wp)

KAD44P-A/P-B/P-C:
25–35 kPa (3.6-5.0 psi) (2500–3500 mm (98-138") wp)

KAMD300-A:
15–23 kPa (2.1-3.3 psi) (1500–2300 mm (59-91") wp)

Checking exhaust temperature

Special tools: 885 151, 885 309 (does not apply to TAMD31S-A)

KAMD and TAMD only

The exhaust temperature reflects the engine's thermal load. The exhaust temperature in relation to the highest permitted exhaust temperature indicates combustion function in the engine at the current load.

If the permitted exhaust temperature is exceeded the engine's thermal load increases with the risk of failures (or much reduced lifetimes) in the pistons and valve systems.

With exhaust temperature measurement one can easily check that the engines in double installations are working with the same thermal loads.

Note that engines can have the same engine speed (RPM), but different thermal loads.

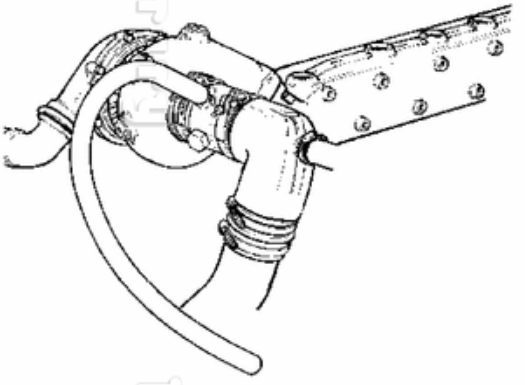
1

Remove exhaust elbow pipe from the turbocharger exhaust output.

2

Clean mating surface.

3



Install the measuring flange with V clamp to the turbine housing flange.
Install the exhaust elbow pipe on the measuring flange with a V clamp.

4

Connect pyrometer sensor to output provided on the measuring flange.

5

Run the engine/s under full load for several minutes.

6

Measure the exhaust temperature. Max. permissible temperature for

TAMD31M at 3250 rpm	395°C (743.0°F)
TAMD31L at 3800 rpm	420°C (788.0°F)
TAMD31P at 3900 rpm	622°C (1151.5°F)
TAMD31S-A at 3000 rpm	425°C (797.0°F)
TAMD41H at 2500 rpm	370°C (698.0°F)
TAMD41M at 3250 rpm	394°C (741.2°F)
TAMD41P at 3800 rpm	413°C (775.3°F)
KAMD42P at 3800 rpm	420°C (788.0°F)
KAMD43P at 3800 rpm	420°C (788.0°F)
KAMD44P-A,P-B at 3800 rpm	460°C (860.0°F)
KAMD44P-C at 3800 rpm	466°C (870.7°F)
KAMD300-A at 3800 rpm	490°C (914.0°F)

Turbocharger failure, causes

Very high temperature and high temperatures mean that turbocharger faults which cannot be put down to normal wear because of long usage hours, are generally have their cause, directly or indirectly, in the lubrication function.

Oil supply is critical to the function, and therefore the turbocharger (TC) requires that care instructions and oil change intervals, oil grades and oil and air filter replacement intervals are followed.

Certain damage may also occur if the driving instructions for the engine are not followed.

The following points should be checked:

- **Oil impurities**

  The turbocharger (TC) turbine shaft is borne on a sliding bearing. Sliding bearing function is based on the borne component moving on the surface tension of a thin layer of oil. Absence of the oil film results in mechanical contact between the bearing surface and the shaft. Fixed impurities result in the oil film being broken locally. The combination of a little bearing play and high rpm mean that incoming impurities can cause serious bearing wear.

  When this type of bearing wear has occurred for a sufficiently long time the bearing play is so large that mechanical contact can occur between the turbine or compressor wheel and housing.

  Mechanical contact between turbine-turbine housing results in serious turbocharger damage and cause subsequent damage to the engine.

- **Oil pressure**

  Oil pressure is important for building up and retaining the sliding bearing oil film. The oil film degrades faster in event of impurities if the oil pressure is low. The oil exchange in the turbocharger is lower which means less effective cooling which means that the oil can coke up.

  Coking up can also occur if the engine is stopped directly after running at full throttle. The turbocharger (TC) turbine rotates at high speed and is extremely hot, because the engine has been operating under high load. When the engine stops the oil pressure disappears and the oil exchange stops, the remaining oil can then get so hot that the more evaporative constituents totally or partially boil off. Coked by products remain. At the next start the turbocharger will suffer from a lack of lubrication. Over time the coked by products also sludge up the oil channels and diminish the oil flow.

- **Lack of oil**

  Lack of oil can depend on sludged up oil channels or that the engine has rapidly increased speed (RPM) directly after a coldstart. The risk of lack of oil increases markedly when starting in cold weather or when the engine has stood unused for a period. **The engine should be allowed to run without load for a few minutes after start and before stopping.**

- **Oil grade**

  Running on substandard oil grades most often reveals itself in the form of turbocharger damage than other engine damage. This is because the turbocharger (TC) is more sensitive to sludge and other oil impurities. The high temperatures in the turbo should not cause the oil to degrade and sludge to occur. Therefore always use a recognized make of oil.

- **Oil leakage**

  The shaft seal in the turbocharger (TC) is of the piston ring type in order to withstand the extremely speeds (RPM). The disadvantage is that it is not completely tight when the oil pressure in the turbocharger (TC) is higher than the air pressure in the compressor housing, which is the case at low engine speeds. There is then a certain amount of oil leakage which is completely normal and **should not need any corrective action.** On engines using normal drive it is seldom noticed but in engines often used at low engine speed the turbocharger (TC) can give off oil, which may collect in small amounts in the charge air cooler (CAC) (charge air cooled engines).

The following points may also cause a larger internal oil leak, but may not necessarily mean that there is a turbocharger fault:

Lower overpressure in compressor housing than normal (boost pressure too low)

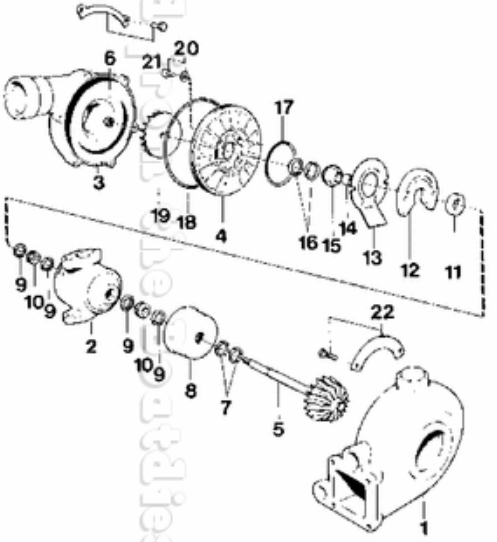
- Air cleaner filter clogged. Replace filter.
- Compressor section of turbocharger (TC) requires cleaning. Soot and oil impurities cause too low boost pressure.

Higher than normal oil pressure in the turbocharger (TC)

- Crankcase ventilation filter (engines with crankcase ventilation filter) and gives higher crankcase pressure. Oil mist is drawn in from the crankcase. Indication: turbo is oily at air intake.
- Oil drainage from turbocharger (TC) is choked or blocked because of deposits in the drain hole. Requires cleaning and checking of the turbocharger (TC).
- Engine oil level too high.

Turbocharger (water cooled), renovation

Special tools: 998 9876, 999 9683, 999 9696, holder as illustrated on page 10

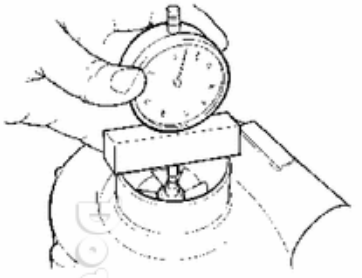


Turbocharger

1. Turbine housing
2. Bearing housing
3. Compressor housing
4. Shield, compressor housing
5. Turbine and shaft
6. Shaft nut
7. Piston rings
8. Heat shield
9. Locking ring
10. Bearing bushing
11. Thrust washer
12. Axial bearing
13. Oil baffle
14. Socket
15. Piston ring holder
16. Piston ring
17. O-ring
18. O-ring
19. Compressor wheel
20. Screw, washer
21. Screw, segment
22. Screw, segment

Checking before disassembly

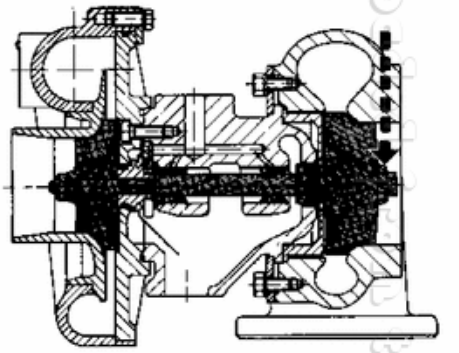
Checking axial clearance



Position dial indicator 998 9876 with the holder on the compressor housing. Ensure that the gauge tip is resting against the center of the shaft. Press the holder down against the turbocharger intake at the same time as the turbine is pressed upwards respectively downwards by hand. Read off the dial indicator.

Maximum permitted axial clearance: 0.16 mm (.0063 in)

Checking radial clearance



Position rocker dial indicator measuring tip 999 9683 on the turbine hub.

Press the turbine down at the same time as the other end of the shaft (the compressor side) is moved upwards. Zero the indicator.

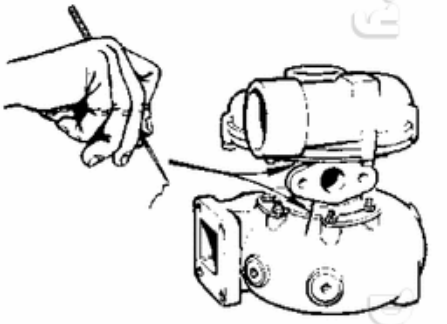
Move the turbine upwards, at the same time as the wheel on the other end of shaft is pressed down. Read off the radial clearance. Then turn the shaft 90° and repeat the measurement.

Maximum radial clearance: 0.42 mm (.0165 in).

If the wear limits of axial and radial play have been reached the turbocharger should be replaced or reconditioned.

Dismantling

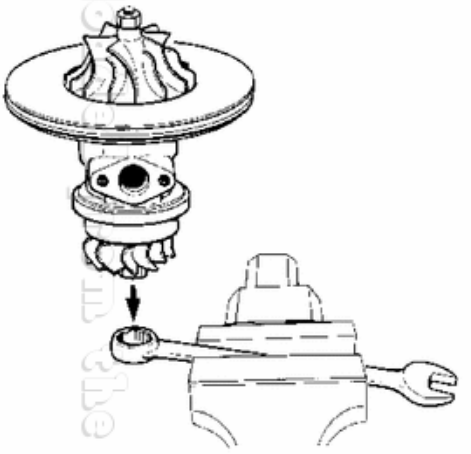
1



Score a mark between the turbine housing (1), bearing housing (2) and compressor housing (3). Remove the turbine housing and compressor housing. Tap carefully with a plastic or rubber mallet so that the sections separate.

NOTE! Be careful when removing the housing so as not to damage the compressor wheel or turbine. These components cannot be repaired but must be replaced if damaged.

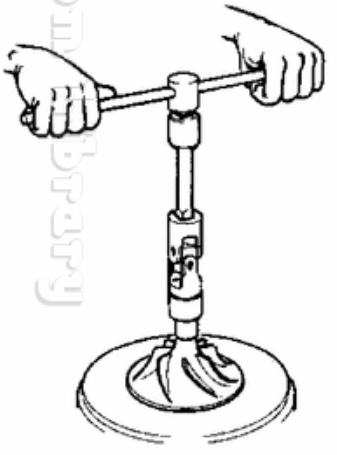
2



Position the turbine housing hub in a suitable ring wrench. Alternatively a socket welded to a suitable piece of steel, so that safe mounting in a vise is possible, can be used.

NOTE! Allow someone to hold the turbine housing hub in place so that it does not fall out during repair work.

3



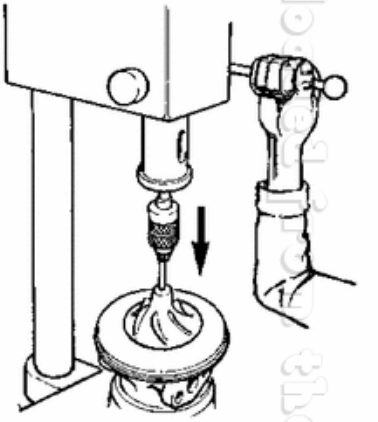
Remove the compressor wheel locknut (6). Socket 14 mm. The nut is fixed with locking fluid. Heat the nut to 200–250 °C/392–482 °F, if it is difficult to remove.

NOTE! Newer turbochargers have a left hand threaded nut, socket 15 mm (.0061 in). The nut is not secured with locking fluid, and so heating is not required.

Mark the turbine position in relation to the shaft.

NOTE! When the shaft nut is removed the shaft must not be subjected to torsion. Therefore use a T-handle and socket.

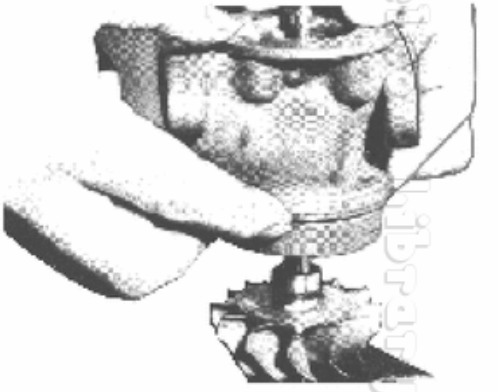
4



Remove the compressor wheel. If the wheel is stuck: press out the shaft.

NOTE. The turbine backplate (heat shield) (8) must be held centered to the bearing housing when the shaft is pressed out.

5



Remove the shield (4) and press out the piston ring holder (15). Remove the piston rings (16), oil baffle (13), axial bearing (12) and the thrust washer (11) Lift off the bearing housing and the turbine backplate (heat shield) from the shaft. Remove the piston rings (7) and bushings (10).

Cleaning

Check all components before cleaning for signs of friction, heat damage or similar that are not so easily seen after cleaning.

Clean the components thoroughly, take care not damage not to damage them. Submerge the components in a coking solvent which does not etch. Remove impurities with a stiff horsehair brush after soaking. Dry the components carefully,

NOTE! A steel brush must **never** be used for cleaning, risk of scratches.

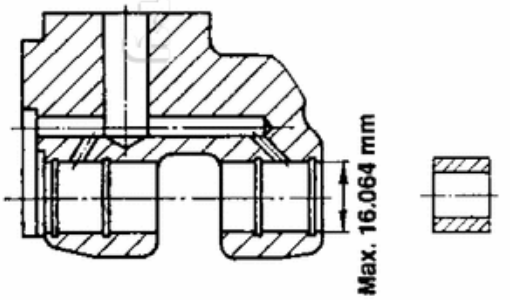
Inspection

Carry out a thorough inspection of the compressor components. Lesser damage can be polished or rubbed out. Use a polishing cloth with silicon carbide as a polishing medium for aluminum and high shine polish for steel components. Clean the components thoroughly after polishing.

Always replace bushings, snap rings, piston rings, compressor wheel shaft nut and O-rings when reconditioning.

Bearing housing

Check the bearing housing for cracks or other damage. The mating surface for the turbine side piston rings must not be grooved or worn and the oil channels must be clean and free of impurities.



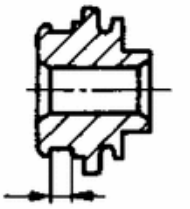
Bearing housing and bushing

Measure the diameter of the bearing bushings (sliding bearing) position in the bearing housing. The diameter may be a maximum of 16.064 mm (.63244 in).

Bearing bushing

Replace bearing bushings at every reconditioning. Note that the bushings should have a floating alignment in the bearing housing.

Piston rings, piston ring holder



Piston ring holder

Replace piston rings at every reconditioning. Measure the width of the piston ring groove in the piston ring holder. The width may not exceed 3.0 mm (.1181 in).

Axial bearing, thrust washer

Wear damage to these components can be determined by measuring the turbocharger axial clearance before disassembling, see “Checking axial clearance”.

Replace the components at every reconditioning.

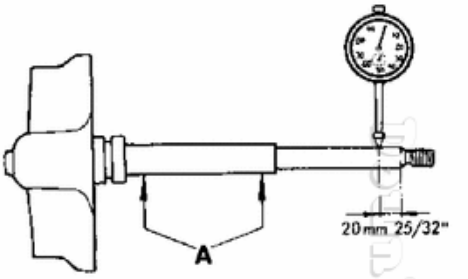
Turbine wheel and shaft, compressor wheel

that the turbine and shaft are not mechanically affected. The blades may not be worn, deformed or have any cracks. The shaft may only have minor marks, scratches or friction damage at the bearing locations. The piston ring groove may not be conically worn.

A damaged turbine wheel and shaft may never be straightened or ground but must always be replaced completely.

The reason for damaged blades may be abnormal bearing wear, so that mechanical contact between the turbine and the housing has occurred. Damage may also occur if loose particles have entered the turbine from the exhaust manifold; on the compressor side dirt or other particles may have entered the intake manifold, for example when changing the air filter.

Place the shaft on two supports which should be placed under bearing positions **A**. Measure shaft run out approximately 20 mm (.78 in) from the threaded lug.



Maximum permitted runout: 0.007 mm (.00028 in).

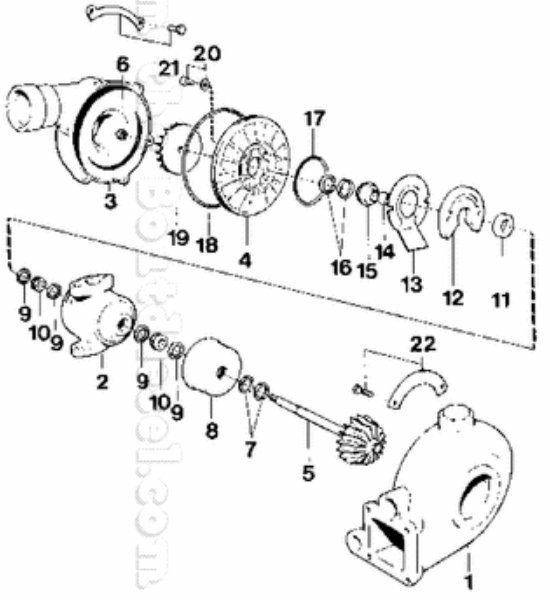
Check the diameter of the shaft at the shaft bearing positions:
Minimum diameter 9.95 mm (.3917 in).

Check the width of the shaft piston ring groove:
Maximum width 3.0 mm (.1181 in).

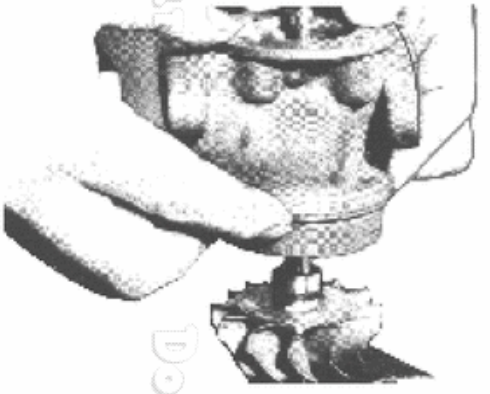
Assembly

IMPORTANT! Check before assembling that all components are thoroughly cleaned. It is extremely important that no foreign particles enter the turbo during assembly.

Lubricate all moving parts with clean engine oil during assembly.



1

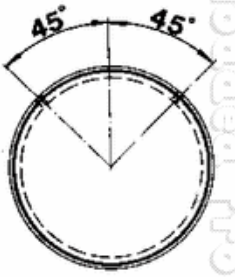


install bushing (10) and snap rings (9) on the turbine side of the bearing housing. Also install the inner snap ring on the compressor side.

Install the turbine backplate (heat shield) (8) on the bearing housing. Tighten the hub on the turbine (5) in a vise equipped with jaw guards.

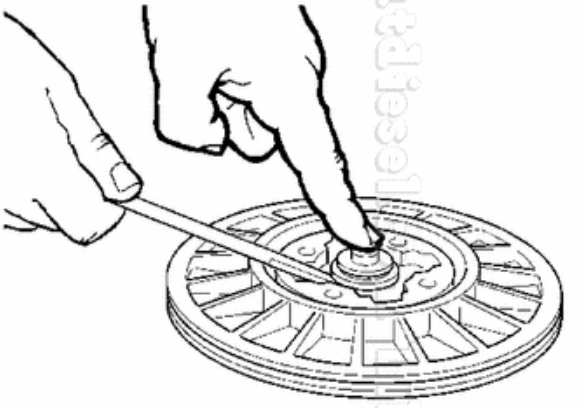
Install the piston rings (7) and carefully thread the bearing housing over the shaft.

2



Locate the piston ring gap with 90° inward displacement, 45° in relation to the oil intake. Press the rings together so that they can be inserted in the bearing housing. Check afterwards that the turbine backplate (heat shield) (8) can be turned easily.

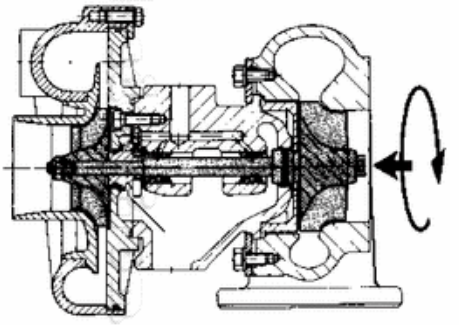
3



Install bushing (10) and outer snap ring (9) on the compressor side of the bearing housing. Install the thrust washer (11), axial bearing (12) and oil baffle (13).

Install the piston rings (16) on the piston ring holder (15). Locate the piston ring gap in the same position (illustration 23) as the turbine side and install the holder in the shield (4).

4



Smear Loctite® 573 or similar sealing compound on the shield sealing surfaces and screw into place against the bearing housing.

NOTE! The 4 self locking screws should be replaced with new ones (alternatively the old ones can be used if they are sealed with Loctite® 640). Tightening torque: **8 Nm/5.9 ft.lbs**.

Heat the compressor wheel to a maximum of 130°C and install it against the shaft journal. Check that the marking on the wheel and the shaft correspond.

Allow the components to cool to room temperature. Apply Loctite® 640 on the shaft journal threads. Install the new nut as illustrated and tighten to **10 Nm/7.4 ft.lbs.** Then angle tighten the nut 60°.

NOTE! Newer turbochargers have a left hand threaded nut, socket 15 mm. The nut should **not** be sealed with Locktite®. Torque to **5 Nm/3.7 ft.lbs**. Then angle tighten the nut 60°.

⚠ **IMPORTANT!** Use a T-handle and socket so that the shaft is not subject to torsion.

Check the shaft axial and radial clearance.

5

Install a new O-ring (18) on the shield and install the compressor housing (3).

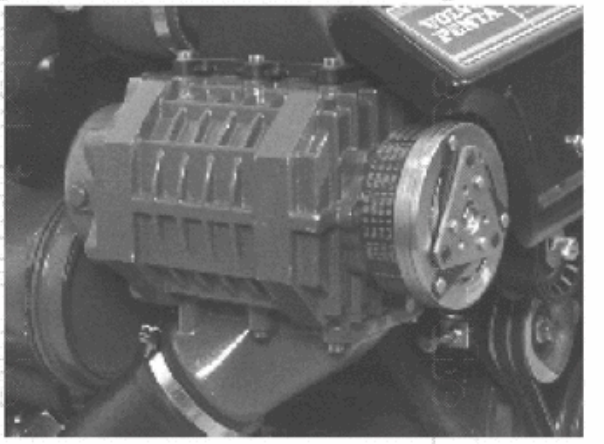
Tightening torque: **7 Nm/5.2 ft.lbs**. Install the turbine housing (1). Apply high temperature grease to the screws Tightening torque **8 Nm/5.9 ft.lbs**.

NOTE! Take care that the compressor and turbine housing are installed according to mark made at disassembly.

Check that the rotor freewheels by spinning the shaft while pressing in the turbine wheel. Carry out the corresponding check on the compressor wheel.

Install protective covers over all openings unless the unit is to be installed immediately.

Roots compressor



Roots compressor KAD32 and KA(M)D42/43/44/300

If the engine is weak during acceleration in the mid range, but gives full effect in the other engine speed ranges, a fault in the supercharger function should be suspected initially.

Note however that it may not mean a fault in the supercharger but may depend on external causes.

Any supercharger reconditioning can only be carried out by a specialist workshop. If fault-tracing has established that the fault lies in the compressor it must be replaced by a new one or by a reconditioned exchange part.

Roots compressor, fault-tracing

Checking the supercharger drive belt

Belt damaged? Check belt tension. See Workshop manual “Engine block”.

Checking coupling function

The supercharger has two different coupling speeds: a “kick down” function connects the compressor immediately at rapid throttle opening from idling or within the range 600–3100 rpm. The other connection occurs when running in the mid range with throttle opening corresponding to 1700 rpm. Run the engine and listen (with the engine compartment hatch open) if coupling occurs.

If the supercharger does not connect at all there is an electrical fault, see Workshop manual “Electrical system”.

If the supercharger connects at the wrong engine speed (RPM), see Workshop manual “Electrical system”.

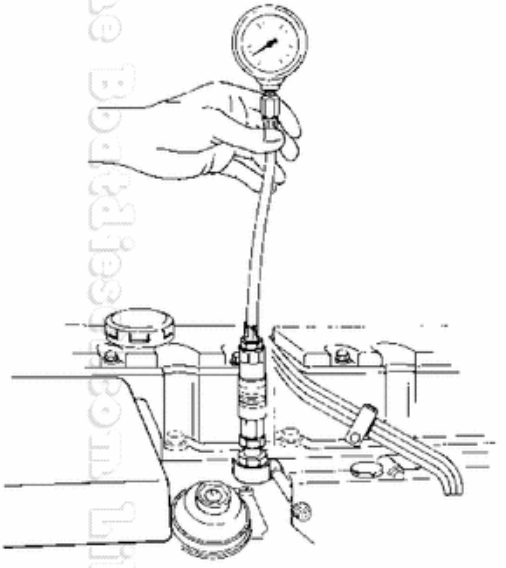
Charge pressure, supercharger, checking

Special tools: 885 293, 999 6666, 999 6065

Applies to the KAD32 and KA(M)D42/43 series

Install nipple 999 6666 on intake manifold output. The nipple is threaded M10x1 and the outlet is M18x1.5 which means that the standard nipple 949 402-2 must be used as an adapter. Connect manometer 999 6065.

The measurement can only take place at an engine speed where the supercharger is connected and the turbocharger (TC) is not boosting.



Run the engine with no load at 2000 rpm and read off the boost pressure. Check the engine speed (RPM) with a workshop rev-counter.

Correct the obtained value after the prevailing temperature and the atmospheric temperature at the time of measurement.

The supercharger should boost at a minimum of 70 kPa (0,7 kp/cm²/10 psi) at 20°C/68°F and 760 mm Hg (1 bar/14.7 psi) atmospheric pressure.

Applies to the KA(M)D44/300 series

1

Connect diagnostic tool 885 293 to the engine.

2

Remove the cable from the temperature sensor.

3

Select menu “Boost pressure” from the main menu on the diagnostic tool.

Run the engine with no load at 1500 rpm and read off the boost pressure.

Correct the obtained value after the prevailing temperature and the atmospheric temperature at the time of measurement.

The supercharger should boost at a minimum of 80 kPa (0,8 kp/cm²) at 20°C/68°F and 760 mm Hg (1 bar/14.7 psi) atmospheric pressure.

4

Connect the cable to the temperature sensor.

5

If the engine is run without the temperature sensor cable connected, a fault code will be displayed on the EDC unit control panel. This can be erased as follows:

6

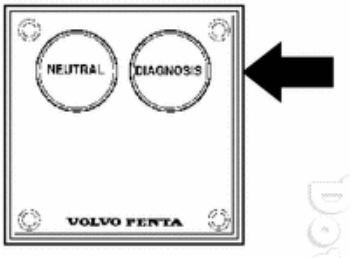
Put the control lever in the neutral position.

Turn the starter key to the stop position “S” and release it.

Check that the starter keys are at position “0” on all control panels.

7

only 44P-A/44P-B



Press the diagnosis button and keep it depressed at the same time as you turn the starter key to position “I” (operating position). Then keep the switch depressed for a further 3 seconds.

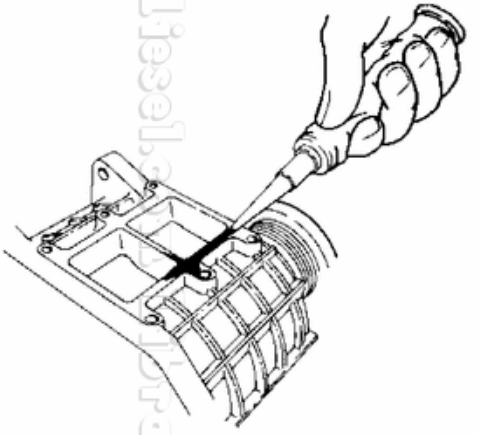
8

The fault code is now erased.

Abnormal supercharger noise

- Check that the supercharger is correctly installed.
- Check that the Multi-V-belt is correctly tensioned.
- Check that the pipe couplings are correctly installed and tightened.
- Check the oil level.
- Check that the clutch is correctly installed with the correct air gap. Check the clutch roller bearing and voltage supply

Sealing compound supercharger terminals



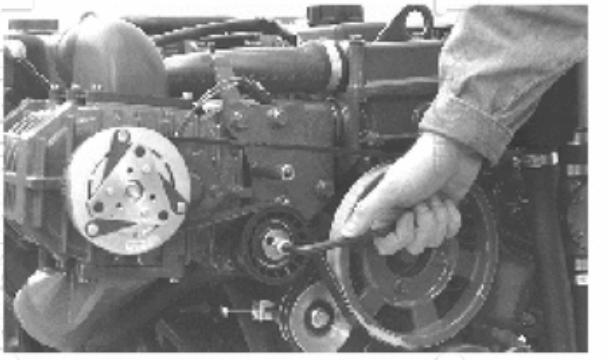
The supercharger connector pipes, both intake and exhaust sides, should be locked with a silicon sealing compound, for example Permatex® No.6 or Loctite® Silicon sealant.

Replacing clutch

Special tools 357 8670-6

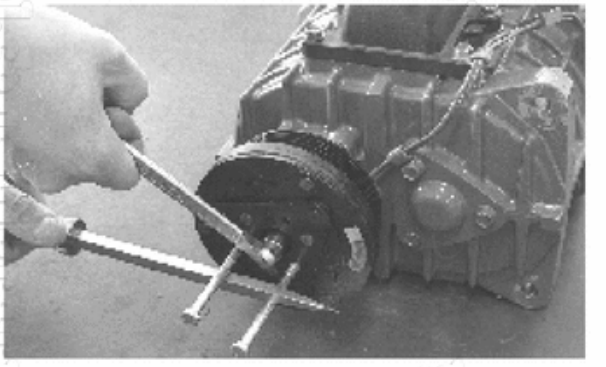
Removal

1



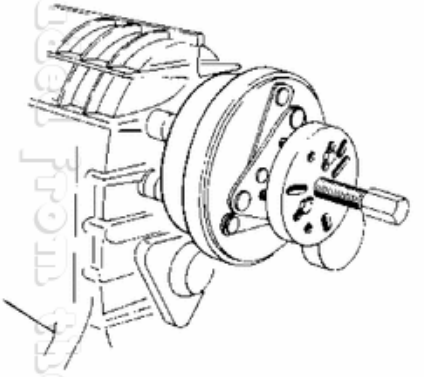
Remove the engine top cover, remove the drive belt. Replacement can be carried out with the supercharger installed.

2



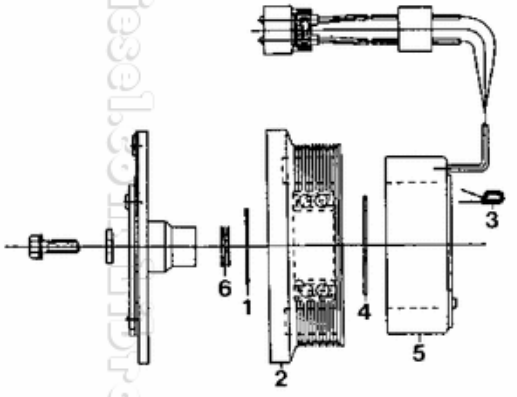
Screw 2 M6 screws into the pressure plate as a counterhold. Remove the center screw. Socket 10 mm.

3



The pressure plate is mounted on splines and is pulled off with puller 3578670.

4

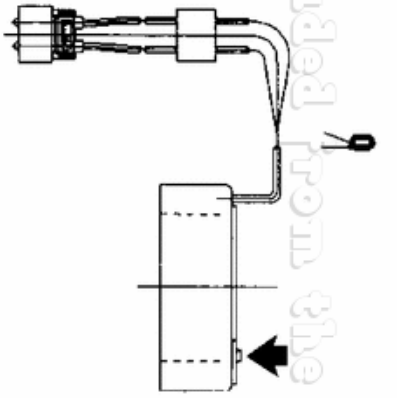


Remove the clutch plate snap ring (1) with snap ring pliers. Remove the clutch plate (2).

Remove the cable clamp (3). Remove the snap ring (4) for the magnetic coil and remove the coil (5).

Installing

5



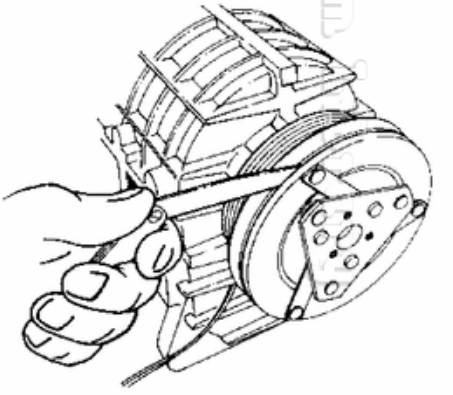
Install the magnetic coil, ensure that the guide pin is in the correct place.

NOTE! Do not forget the cable clamp.

Install the clutch plate with the snap ring bevelled section outwards.

Install the pressure plate and tighten the center screw. Tightening torque **18.6 Nm/13.7 ft.lbs**. Socket 10 mm.

6

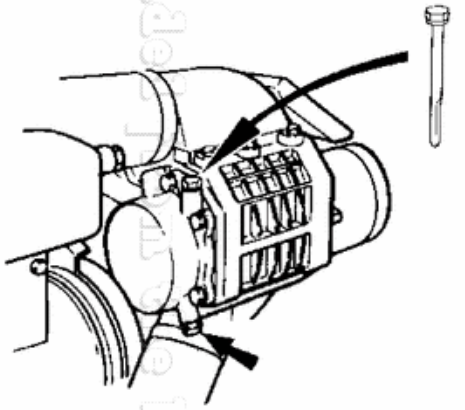


Check the gap between pressure plate and clutch plate. Use a feeler gauge. The gap should be 0.35–0.7 mm (.0137–.02775 in) Adjust the distance with shims (position 6, illustration 34) if required.

Test clutch function **before starting** the engine by applying a 12 V current to the cable.

Install the belt and engine cover.

Oil change



Oil changes should be made every two hundred hours of operation. Run the engine to operating temperature and remove the dipstick. Remove the drain plug and fill up with oil.

Oil grade: Volvo Penta 1141641-9

Oil capacity: 0.1 l/0.1 US quart

NOTE! The supercharger uses an unusual oil grade. Use only Volvo Penta 1141641-9 to guarantee the correct oil grade. **All warranties are invalid if the incorrect oil has been used.**

⚠ **IMPORTANT!** It is important that the correct oil level is always maintained. Too high a level can lead to supercharger damage because of oil generated friction heat, too low level can result in insufficient transmission lubrication. Wait for a moment before checking the level after filling, so that the level has stabilized.

Turbocharger (air cooled), renovation

(only TAMD31S-A)

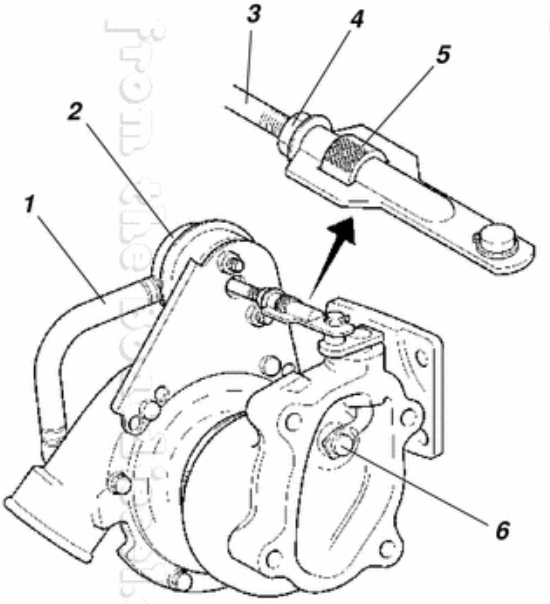
If the turbocharger needs to be renovated/changed, there are service replacement turbochargers available. Please contact the Volvo Penta spare parts department.

Renovation is not permissible. The pressure cylinder on the wastegate valve can be changed separately, however, please refer to the next page.

Pressure cylinder for wastegate valve, changing

(only TAMD31S-A)

Special tools: 998 9876, 999 6662, 999 9696



1

Undo the hose (1) between the pressure cylinder (2) and the compressor wheel.

Undo lock nut (4) and separate the push rod (3) from the adjustment screw (5).

Unscrew the pressure cylinder from the bracket.

2

Check that the wastegate valve (6) moves easily.

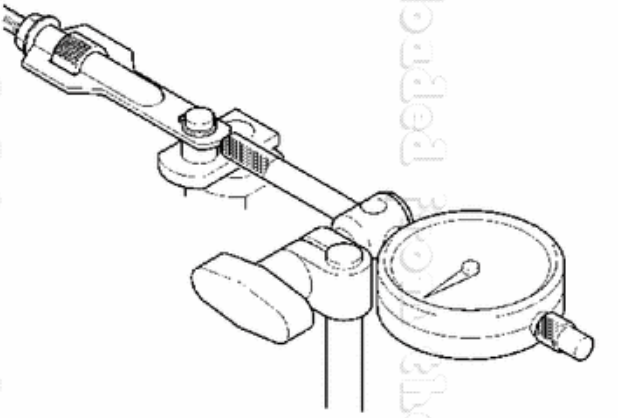
3

Install the new pressure cylinder.

NOTE! To protect the diaphragm in the pressure cylinder, the push rod (3) should not be loaded before installation.

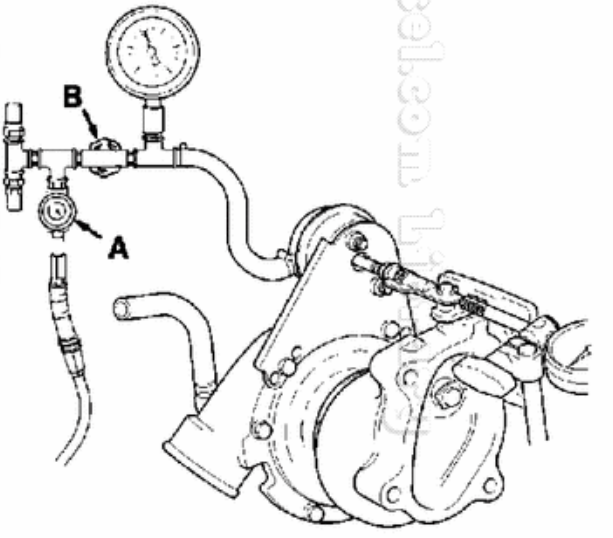
Move the lock nut (4) over to the new pressure cylinder push rod (3) and screw it together with the adjustment screw (5). Do not tighten the lock nut (4) at this point.

4



Set up magnetic stand 999 9696 and dial gauge 998 9876. Put the point against the adjustment screw, as in the illustration. Zero the dial gauge.

5



Connect pressure test unit 999 6662 to the pressure cylinder hose connection and to the compressed air mains.
Open tap (B) and increase the pressure with tap (A) until the pressure gauge reads **148 ± 5 kPa (21.4–0.7 psi).**

The wastegate valve should have opened at this pressure: **1 mm.** Read the dial gauge, and adjust with the adjuster screw if necessary (5). Lock the adjustment screw with nut (4).

⚠ **IMPORTANT!** Be careful when adjusting. An incorrectly adjusted wastegate valve can cause engine failure.

Group 26 Cooling system
Design and function

General

The engines are liquid cooled and equipped with a closed cooling system. The system is divided into two circuits.

Coolant is pumped around the inner circuit (the freshwater system) by a centrifugal type coolant pump.

The coolant pump is driven from the crankshaft using a drive belt.

The coolant is pumped from the coolant pump out to a distribution channel in the cylinder block and is pumped around the cylinder liners and onward through the cylinder block.

From the cylinder head the coolant passes out through the exhaust pipe, passes the turbocharger turbine housing and then returns to the thermostat housing where two thermostats regulate the engine coolant temperature.

As long as the coolant is cold the thermostats shuts off the flow to the heat exchanger. The coolant travels through a by-pass line under the thermostats directly back to the intake side of the pump.

When engine coolant temperature has risen to a certain temperature the thermostats open and allow coolant through to the heat exchanger, at the same time the by-pass line is closed.

In the heat exchanger heat from the coolant is transferred to the seawater before the coolant is returned to the coolant pump.

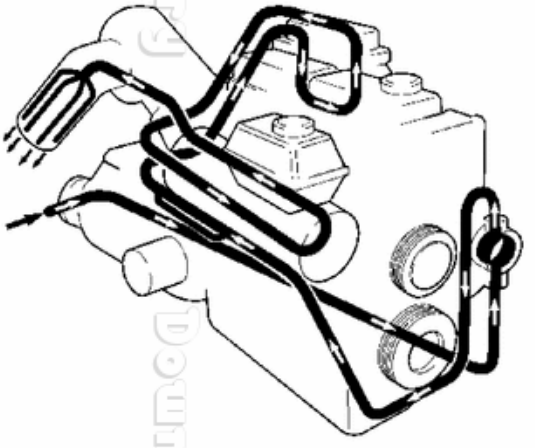
Large amounts of heat are also dissipated by lubricating oil which transfers the heat to the seawater system via the oil cooler.

The lubricating oil is also used to draw heat off the pistons in the engine see Workshop manual “Group 22 Lubricating system”

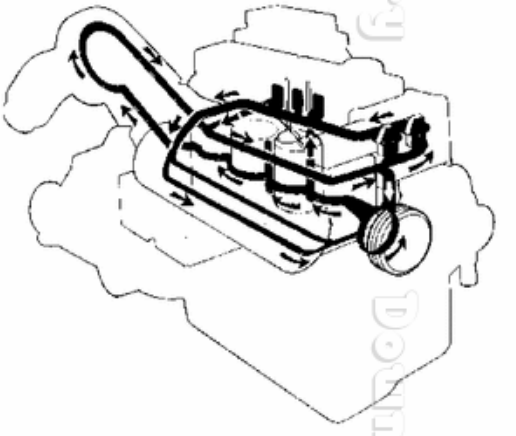
The cooling system can operate with a certain amount of overpressure. The risk of overheating is decreased therefore if temperatures become high. If pressure is higher than usual, a pressure valve in the filler cap opens.

Through flow in the seawater system is provided by an impeller pump directly driven by the injection pump shaft.

The seawater passes through the engine charge air cooler (CAC), oil cooler, heat exchanger, exhaust smoke and in TAMD-, KAMD engines through the reverse gear oil cooler.



Seawater system principle diagram



Freshwater principle diagram

Coolant pump

The coolant pump is mounted on the front edge of the cylinder block and is driven via the crankshaft using a drive belt.

The pump is carried on double roller bearing and equipped with a seal which effectively prevents coolant from leaking.

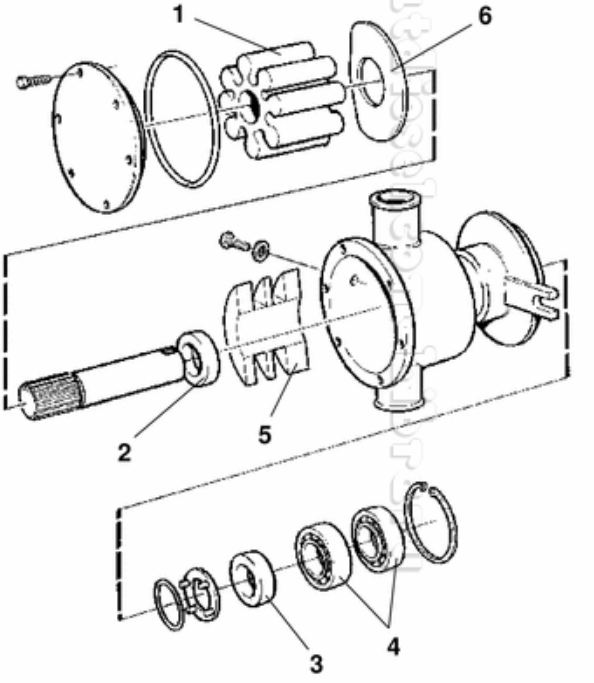
Seawater pump

The sea water pump is mounted on the timing cover, at the front of the engine. The pump is driven from the timing gear in the engine.

The impeller (1) is made of rubber, and is replaceable. The pump is equipped with two seals, a sea water seal (2) and an oil seal (3). The pump spindle rotates on two ball bearings (4).

Early model pumps have a replaceable cam disk (5). The wear washer (6) is only found on late model pumps.

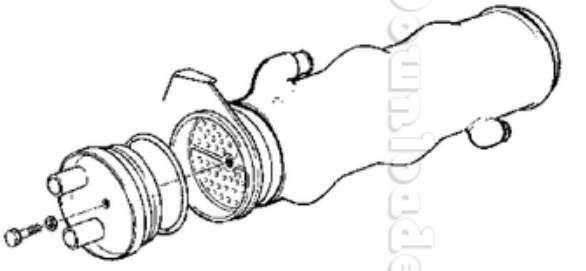
NOTE! The impeller can be damaged if the pump is run dry.



Heat exchanger

The engines are equipped with tubular cooling type heat exchanger. The seawater passes through the tubes while freshwater passes around the tubes. The heat exchanger is mounted on the right hand side of the motor.

Heat from the engine's inner cooling circuit (the freshwater system) is transferred in the heat exchanger to the outer cooling circuit (the seawater).

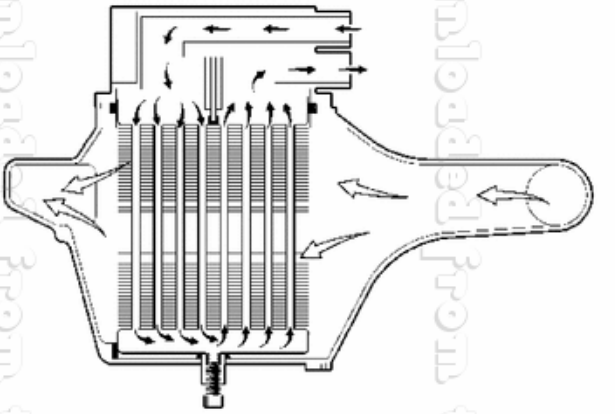


Charge air cooler (CAC)

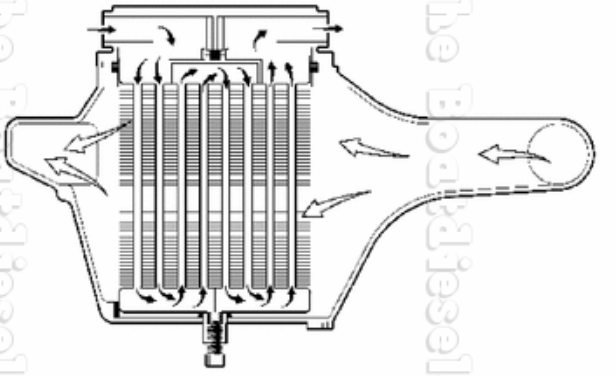
All engines are equipped with a charge air cooler (CAC). The cooler consists of an aluminum housing with a tubular type cooling insert.

The seawater passes through the tubes while the charge air passes around the tubes. The charge air cooler is mounted on the left hand side of the motor.

The charge air cooler (CAC) transfers heat from the charge air from the turbocharger to the seawater.



KAD300-A has a “four-way” intercooler, i.e. the sea water passes through the core four times before it is led away.

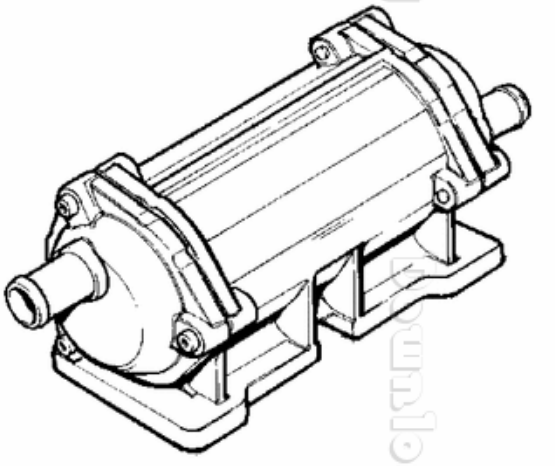


Oil cooler, engine

Lubricating oil dissipates the heat from the hottest parts of the engine and evens out the temperature differences within the engine during circulation.

Heat is drawn the oil in the oil cooler. The oil temperature can, therefore, be held at a lower level under high loads and high engine speed (RPM).
This helps prevent wear because the oil’s lubricant qualities diminish if the oil temperature is too high. Lower quality oils are most susceptible in this situation.

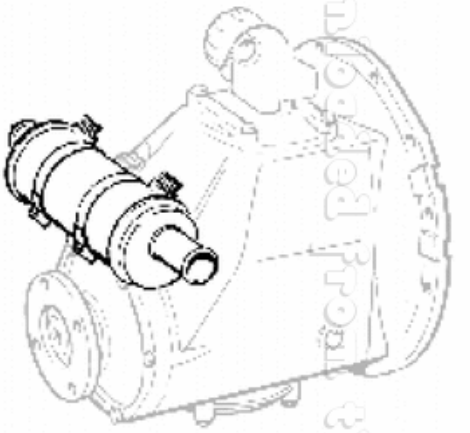
The engine oil cooler is of the tubular type and is located on the right hand side under the heat exchanger. The oil circulates between the tubes while seawater passes through the tubes.



Oil cooler, reverse gearbox TAMD, KAMD

The reverse gearbox oil cooler is mounted on a bracket above the reverse gear.

The cooler is connected to the seawater system. The oil circulates between the tubes in the cooler insert while seawater passes through the tubes.



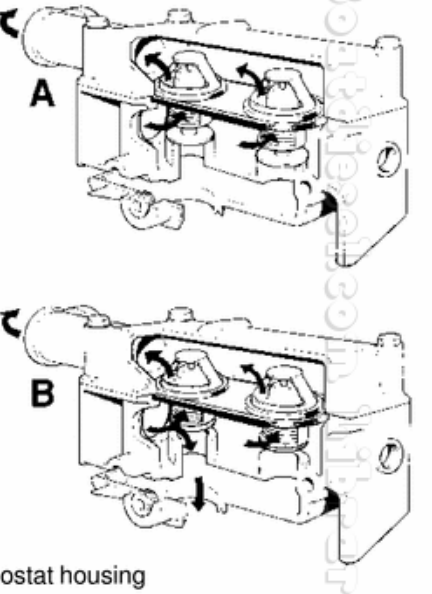
Thermostat

The engines are equipped with piston thermostats which have a wax-filled sensor bodies. When the engine is cold the thermostat keep the route to the heat exchanger completely closed. The coolant is routed into a by-pass line directly back to the engine.

As the engine warms up the wax increases in volume and the thermostat gradually opens the passage to the heat exchanger at the same time closing off the by-pass line.

The engines have two different thermostats. Both have the same temperature settings but one of the thermostats has a valve which allows any air to escape.

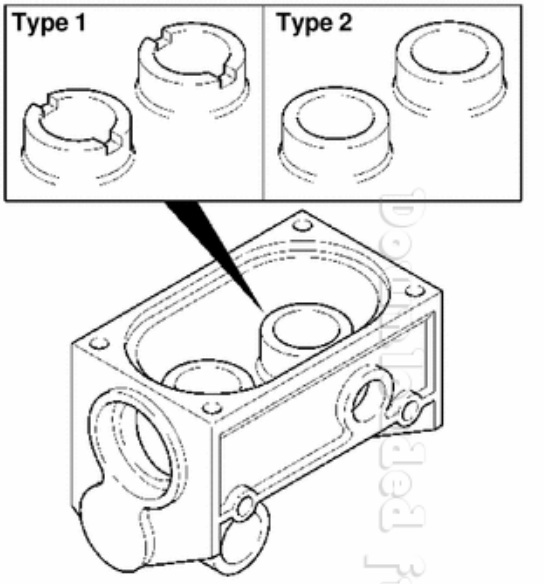
For opening temperatures see Workshop Manual "Technical data".



Thermostat housing

A. Coolant flow, cold engine
B. Coolant flow, warm engine

There are two types of thermostat housings. The difference is different treatments of the surface against which the thermostat seals. Be careful to install the right type in the right engine, please refer to the "Spare Part Catalogue".



Coolant

⚠ **WARNING! Anti-corrosive agents and anti-freeze products are harmful to health (do not drink!)**

The engine's internal cooling system (freshwater system) contains a mixture of freshwater and anti-freeze or anti-corrosive agent

NOTE! It is very important that the engine is not filled only with freshwater without any additives.

The following mixture recommendations should be followed to prevent frost and corrosion damage to your engine:

If there is a risk of freezing

Use a mixture of 50% Volvo Penta antifreeze (glycol) and 50% pure water.

This mixture will protect against freezing to a temperature of approximately –40 °C and should be used all year round.

To obtain a satisfactory corrosion protection the coolant must contain at least 40% antifreeze.

If there is no risk of freezing

When the engine is used in an area with a warm climate, where there is never a risk of freezing, the engine coolant cam be mixed with Volvo Penta anti corrosion agent (P/N 1141526-2).

NOTE! Never mix antifreeze (glycol) and anti-corrosive agents. Combining the two can produce foam and drastically reduce the coolant's effectiveness.

Repair Instructions

Fault-tracing cooling system

Faults in the cooling system can be divided into three groups:

- Engine coolant temperature too high
- Coolant temperature too low
- Coolant loss

Engine coolant temperature too high

Coolant temperature too high can depend on:

- Decreased through flow because of blocked seawater intake, seawater filter, heat exchanger, charge air cooler (CAC), oil cooler or exhaust elbow pipe
- Damaged or worn impeller
- Faulty thermostat(s)
- Slipping drive belt(s) on the circulation pump
- Low coolant level, air in the system
- Incorrect temperature gauge reading
- Incorrectly set injection pump
- Engine coolant channels blocked

Engine coolant temperature is too low

Coolant temperature too low can depend on:

- Faulty thermostat(s)
- Incorrect temperature gauge reading

Coolant loss

The reason for coolant loss can often be seen easily, loss can be caused by;

- Leaking hose or pipe connections
- Combustion gases press into the cooling system and cause coolant loss through the filler cap. The probable reason is a leaking cylinder head gasket
- Leaking charge air cooler (CAC)
- Cracks in the cylinder block, cylinder head, pores in the cylinder sleeves

Draining coolant

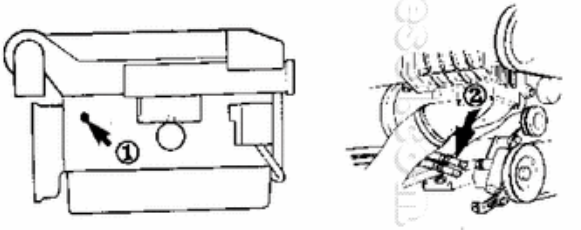
Freshwater system

⚠ **WARNING!** Before draining the coolant, the engine should be stopped and the filler cap unscrewed.

⚠ **WARNING!** Open the cap carefully if the engine is hot. Steam or hot coolant may spray out.

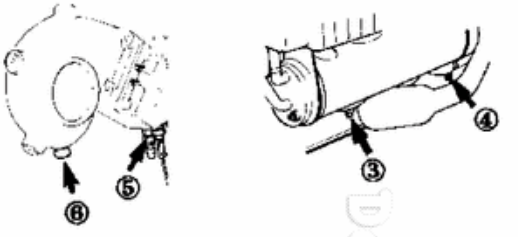
⚠ **IMPORTANT!** Coolant is harmful to the environment, ensure that coolant is handed in for destruction.

1



Open the drain cock (1) or the cock on the hose **without** the blue marking (2).

2



Undo plugs (3 and 4) on the heat exchanger. Drain the exhaust pipe by opening plug (6) on the turbocharger (not TAMD31S-A) and tap (5).

3

Check that all the water has drained out.
There may be deposits inside the cock/plug which must be removed. Otherwise there is a risk that water may remain in the system and cause serious damage.

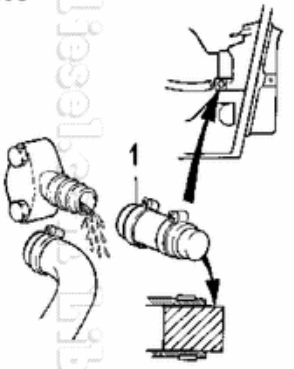
Check whether the installation has any more cocks or plugs on any heating element or hot water heater.

Seawater system

⚠ **WARNING!** Risk of water entry, ensure that the sea cocks (reverse gear (transmission) engines) or the hose terminals on the shield (drive engines) are properly closed.

1

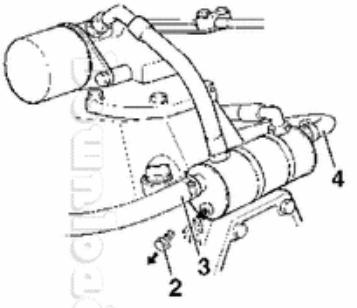
Drive engines



Disconnect the seawater hose at the shield and plug the water intake with a plug (1). Water will flow in as soon as the seawater hose is disconnected. Ensure that the plug, hose clamp and tools are prepared. Bend the seawater hose downwards and drain of water.

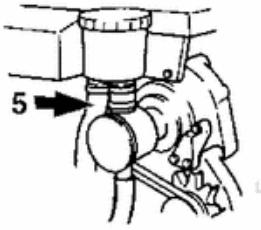
2

Reverse gear (reverse gear) engines



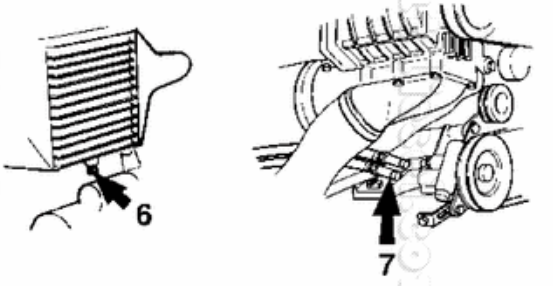
Close the seacocks. Open plug (2) and drain the reverse gear reverse gear oil cooler. Remove the hose (3) and bend it down so that water drains out. Disconnect hose (4) by the sea cock and drain it of water.

3



Disconnect hose (5) at the seawater filter and drain the water from heat exchanger.

4



Drain the charge air cooler (CAC) by opening plug (6) respectively the engine oil cooler with the plug at the rear of the cooler or the plug in the blue marked hose (7)

5

Remove the cover from the seawater pump and let the water run out.

6

Connect and tighten all the clamps on the disconnected hoses. Install the seawater pump cover.

7

Pump out the boat if required. Check that there is no leakage before leaving the boat.

Cleaning the cooling system

⚠ **WARNING!** Close sea cock before working on cooling system.

To avoid loss of cooling performance caused by scaling in the coolant system the coolant must be changed regularly.

Another reason for changing the coolant is the risk of damage from corrosion in freshwater systems due to corrosion inhibitor additives losing their effect over time.

The system should be flushed carefully with tap water when changing the coolant. Flush until the water which runs out of the draining holes is clean.

If the cooling system is filled with a glycol-water mix it should be changed every year. If water with an anti corrosion additive is used it should be hanged every year.

Filling with coolant

⚠ **WARNING!** Do not open the pressure cap or the venting nipples on a hot engine. Steam or hot coolant can spray out as system pressure is lost.

Filling should be carried out with the engine stopped.

Do not fill so quickly that air locks form in the system. Allow the air to flow out via the filling opening or vent cock.

The engine must not be started until the system has been vented and completely filled.

If a heater system is connected to the engine's cooling system, the heater control valve should be opened and the unit vented during filling.

1

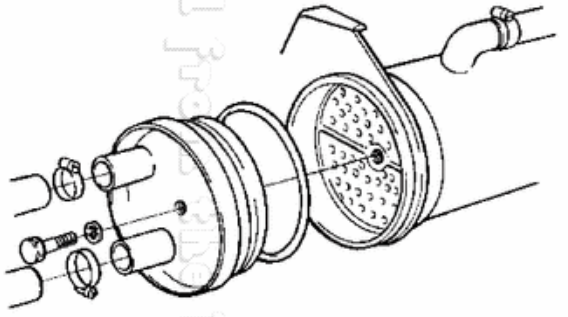
Fill with coolant to 5 cm (2 in) beneath the sealing surface of the filler cap or to between the MIN and MAX marks on the separate plastic expansion tank (accessory).

For antifreeze protection, see "Coolant" on page 38. When topping up, use the same coolant mixture as is already in the cooling system.

2

Allow engine to stand for approximately 1 hour after filling. Then top up the coolant if required, start the engine and warm it up. Check coolant level.

Reconditioning heat exchanger



1

Remove the heat exchanger end cover and inspect the insert tubes thoroughly for any scaling deposits or damage. Brush out the insert tubes through their entire length with an appropriate bottle brush and rinse the tubes with a high pressure hose until no impurities are washed out.

⚠ **IMPORTANT!** High pressure washing must not be used as this can damage the insert.

If the heat exchanger appears to have large amounts of scaling and sludge deposits and blocked tubes the causes should be investigated.

Large amounts of impurities can depend on:

- Broken seawater filter
- The boat is usually run in water containing a lot of impurity or minerals. An extra seawater filter needs to be installed.
- Cooling system is not cleaned when the boat is taken out of the water mid-season. Just draining the seawater system leads to the impurities drying in place and minerals crystallizing. This can lead to the tubes blocking and overheating.

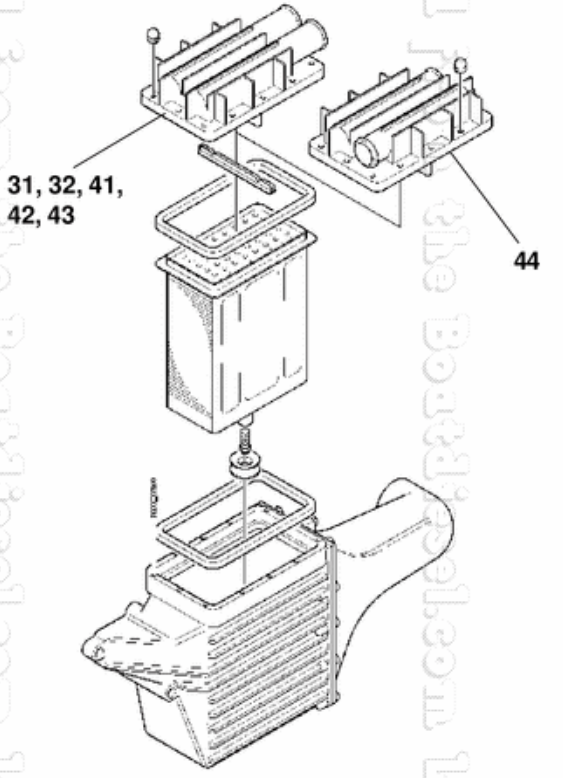
2

Install the heat exchanger end cover with a new O-ring after cleaning.

Reconditioning charge air cooler (CAC)

(31/32/41/42/43/44)

Special tool: 999 6662



1

Remove the cover. Socket 10 mm/.4 in). Withdraw the insert.

Rinse and clean the components thoroughly. Inspect the insert thoroughly for corrosion or other damage.

NOTE! The throat adjacent to the turbocharger should not be disassembled.

2

If there is any suspicion of leakage, the core must be pressure tested. Air is used for pressure testing. Use pressure tester no. 999 6662. Apply a pressure of 0.2 MPa (29.0 psi) for one minute. No pressure drop is permissible.

⚠ **WARNING!** Follow relevant safety regulations when using test pressurization equipment.

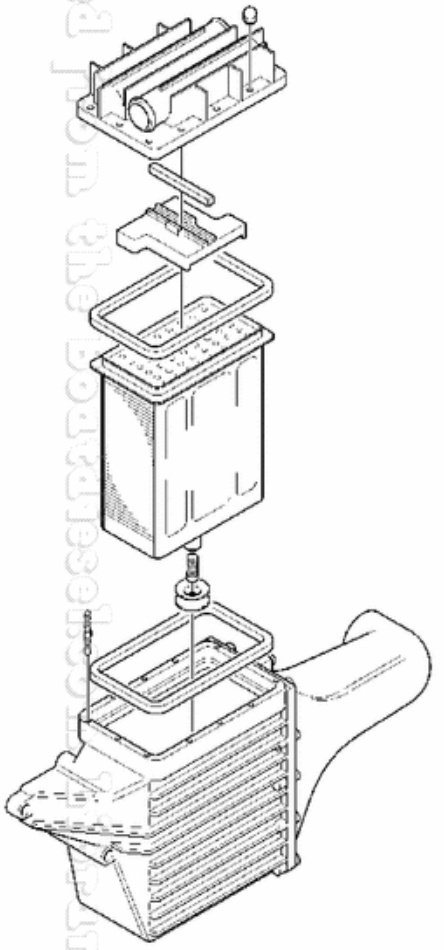
3

Reinstall all parts in the reverse order. Use new sealing trims. The following sealing compound should be used for the charge air cooler (CAC): Loctite® 572 for studs and lower plug, Loctite® 574 between the charge air cooler (CAC) and engine intake manifold.

Intercooler, renovation

(300)

Special tool: 999 6662



1

Remove the cover. Wrench size 10 mm. Remove the plastic cup and its seal. Pull the core out.

Flush and clean the components carefully. Carefully inspect the core for corrosion and other damage.

NOTE! The throat adjacent to the turbocharger should not be disassembled.

2

If there is any suspicion of leakage, the core must be pressure tested. Air is used for pressure testing. Use pressure tester no. 999 6662. Apply a pressure of 0.2 MPa (29.0 psi) for one minute. No pressure drop is permissible.

⚠ **WARNING!** Observe applicable safety rules when using pressure test devices.

3

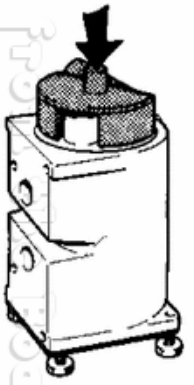
Install the components in reverse order. Check that the plastic cup is correctly installed, so that its seal is tight against the partition in the cover. Use new seal moldings. The following sealants should be used on the intercooler: Loctite® 572 for studs and the bottom plug, Loctite® 574 between the intercooler and the engine inlet manifold.

Reconditioning oil cooler

Special tool: 884 635

(early version)

1



Remove endplate. Take 4 longer M8 screws and screw these in approximately 5 mm (.2 in). Set the oil cooler on the screws, ensure that it is supported by all screws. Tap the insert loose with tool 884 635 and a plastic mallet.

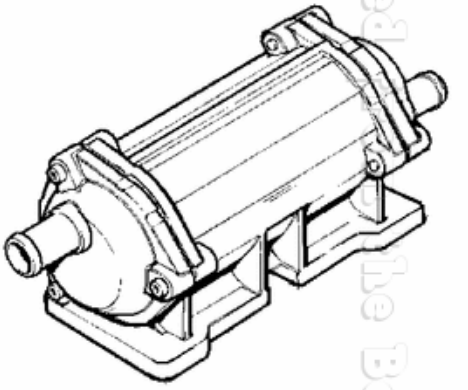
Remove the insert and O-rings.

2

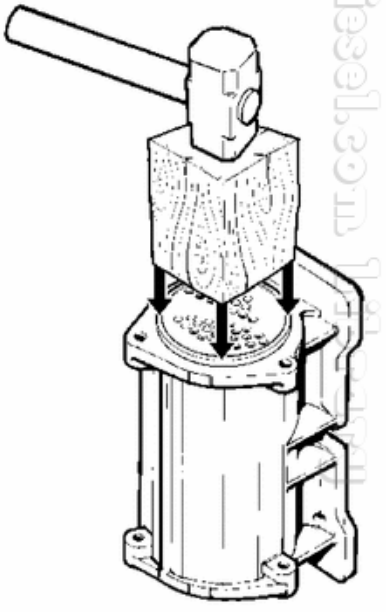
Clean and inspect components. Use new O-rings and gaskets when reinstalling. For the drain cock/nipple threads sealing compound Loctite® 572 is used.

Reconditioning oil cooler

(later version)



1



Remove endplate. Carefully tap the insert loose using a rubber mallet. Use a block of wood between.

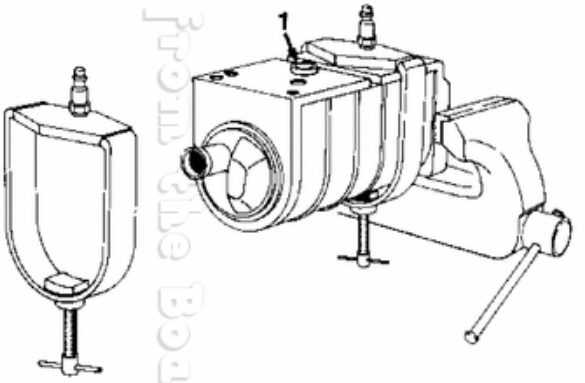
2

Clean and inspect components. Use new O-rings when installing. Apply a thin layer of grease to the end plate mating surfaces to the oil cooler housing before assembly.

Oil cooler, test pressurization

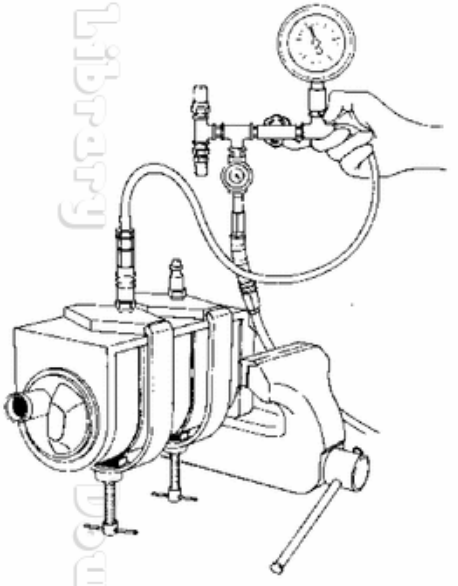
Special tool: 999 6033

1



Remove oil cooler from the oil distribution housing. Install brackets 999 6033 on the cooler with sealing ring 471 637. One of the brackets is located with the nipple opposite the oil intake with sealing ring (1) between, the other bracket is located so that the oil outlet is blocked.

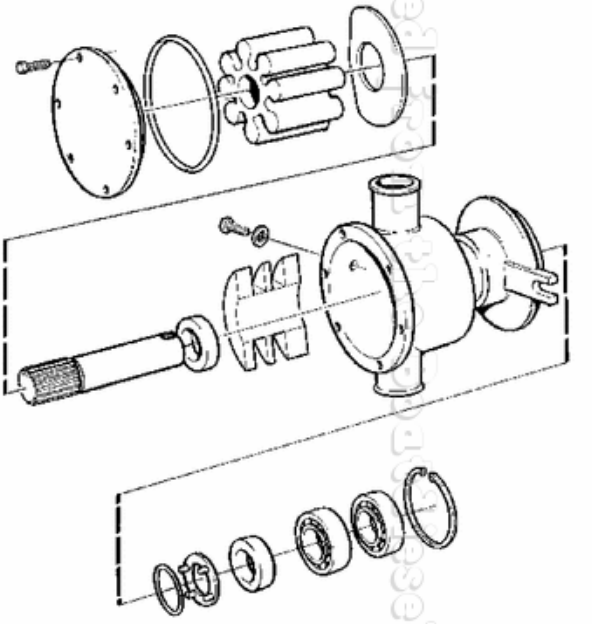
2



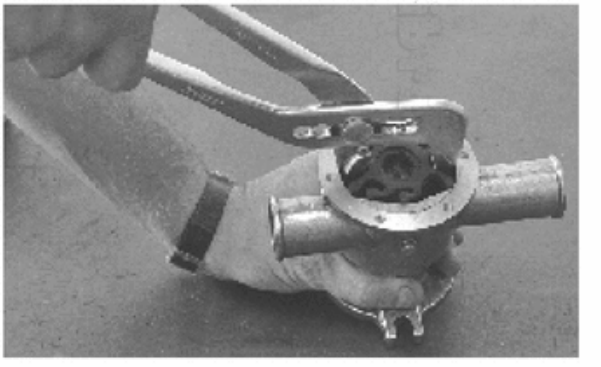
Connect a suitable pressure testing device to the compressed air mains and the union centrally against the oil inlet. Increase the pressure slowly until the pressure gauge reads 0.6 MPa (87.0 psi) . The pressure must not then fall for two minutes. If the pressure falls, there is a leak and the oil cooler core must be changed.

Reconditioning seawater pump

Special tool: 884 347



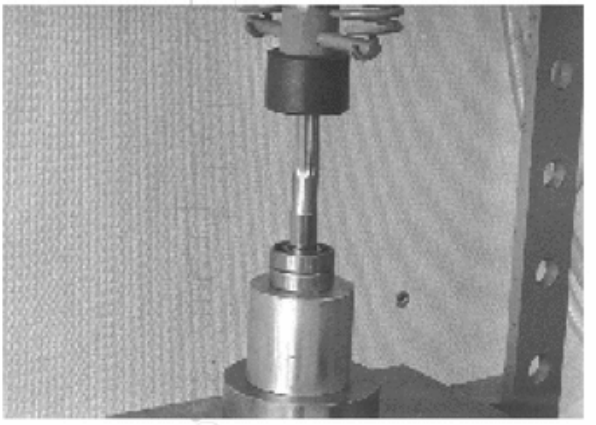
1



Unscrew the cover Prise the impeller out with water pump pliers. Remove the wear washer inside the impeller (only on late model pumps). Undo the cam plate screw and remove it (only on early model pumps).

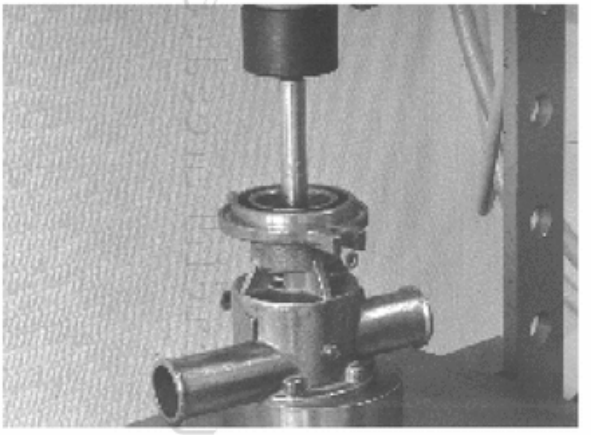
Turn the pump over and remove the circlip. Turn the pump back over and press the spindle, bearings and seal rings out with a suitable mandrel.

2



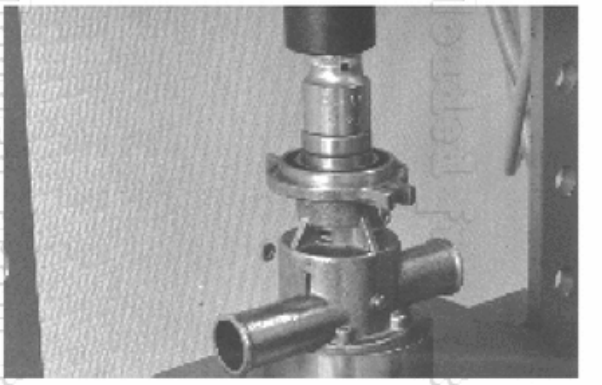
Grease the new bearings and press onto the shaft so that they end up furthest in on the thickest section of the shaft.

3



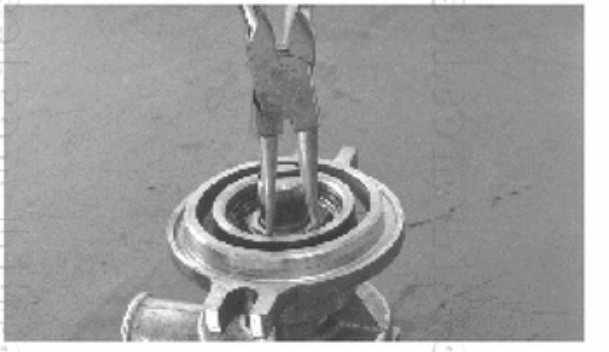
Apply grease to the sealing rings and press them into the housing with springs turned away from each other. Use drift 884 347. The O-ring and the support washer are located between the sealing rings.

4



Insert the shaft into the housing, ensure that the O-ring comes onto the shaft. Press the shaft and bearing into the housing using a large socket or similar.

5



Install the circlip.

Turn the pump over and install a new cam disk (only on early model pumps). Cam disks of height 3.3 mm (0.129921") are used on the MD31A, cam disks of height 6.2 mm (0.244094") are used on other engines. Use sealant, Permatex ® No. 3 between the cam disk and the pump housing. Use a new screw and copper gasket.

Put in a new wear washer (only on late model pumps). A wear washer marked “F” is used on the KA(M)D300, unmarked wear washers are used on other engines.

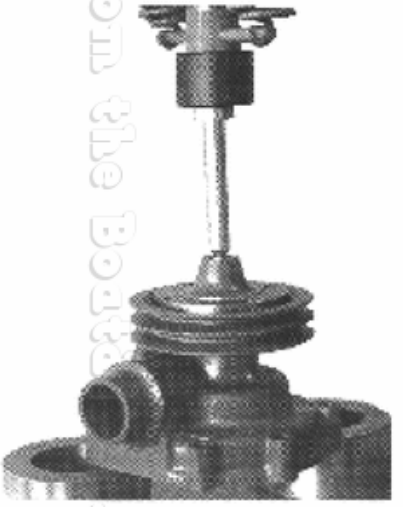
Install a new impeller with its seal washers. Install the lid with a new O-ring or gasket.

Reconditioning coolant pump

Special tools: 999 2265, 999 2268, 999 6858, 999 8039

Removal

1

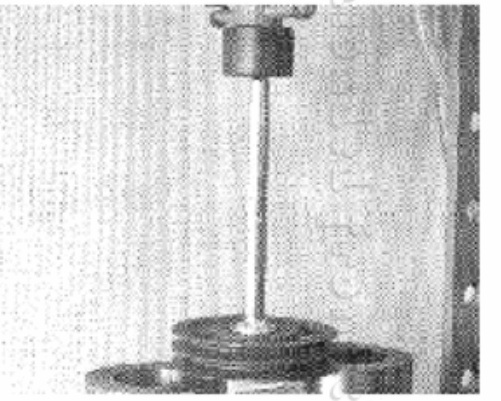


Remove the four screws and remove the outer pulley (32/42/43/44/300). Press the shaft out together with the impeller, seal and rear bearing, using mandrel 999 6858. If the seal and inner bearing do not go out with the other components, use mandrel 999 2268 to press them out.

2

Remove snap ring and pull off the inner pulley. Use puller 999 2265 and 999 6858 as a counterhold.

3



Press out the pulley bearing with drift 999 2268.

Installing

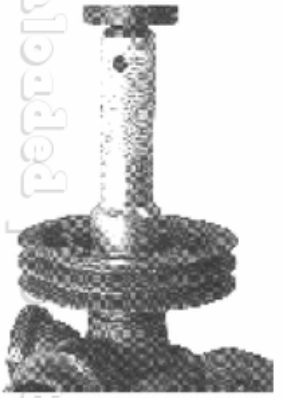
4

Fill the large bearing with high temperature grease, VP part no. 828 250. Turn the sealed side down and press the bearing into the pulley using the drift 999 8039.

5

Press in a new bearing into the pump housing using 999 2268.

6

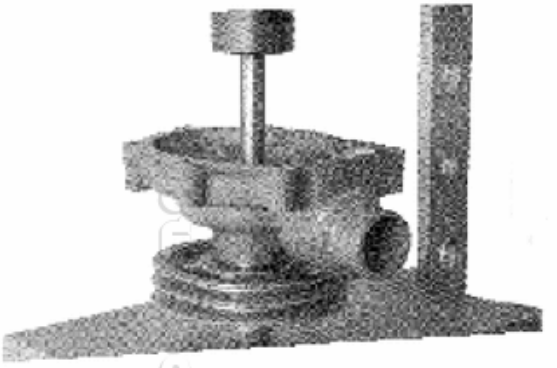


Press the pulley on with drift 999 8039. Install snap ring.

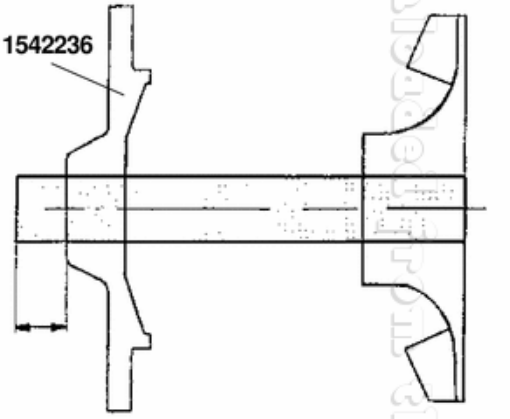
7

Install carrier loosely with two screws.

8



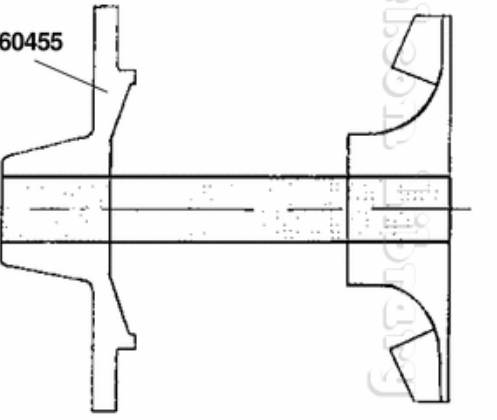
Grease the spindle lightly and press the shaft in with 999 8039. Check that the shaft stub moves easily. Adjust with a plastic hammer if necessary, by tapping the spindle lightly.



On circulation pumps where a hub with VP part no. 1542236 is installed, the shaft should be pressed in so that it projects 12 mm (0.47244"). Applies to the following engines:

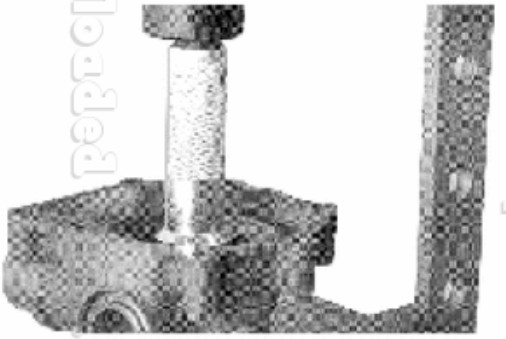
31 series engines with serial numbers up to 2203116853

41 series engines with serial numbers up to 2204141572

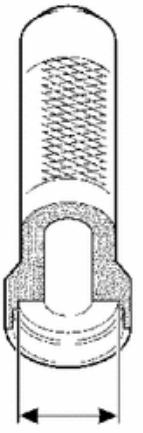


On circulation pumps where a hub with VP part no. 860455 is installed, the spindle should be pressed in until the spindle end is flush with the hub. Applies to the following engines:
31 series engines with serial numbers as from 2203116854
41 series engines with serial numbers as from 2204141573
32, 42, 43, 44, 300 series engines: from production start.

9

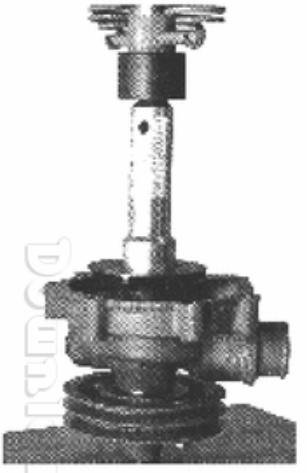


Press the seal on with mandrel no. 999 8039.

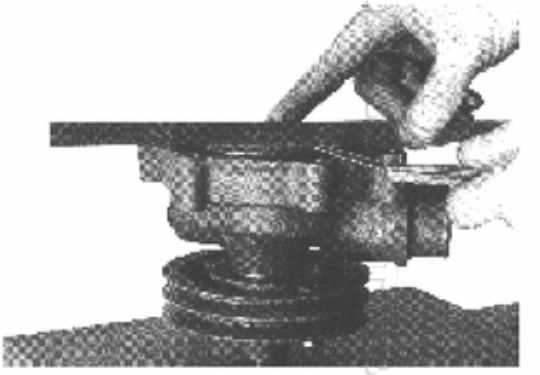


NOTE! Mandrel no. 999 8039 must be a late model item if it is to be used to press the seal in. Early model mandrels can be modified by turning the diameter out to 31.4±0.05 mm (1.236218–0.001968") .

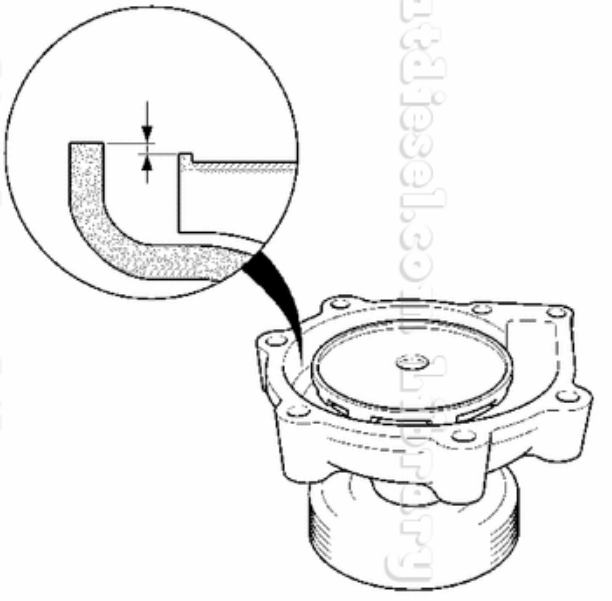
10



Press the impeller on. Use a suitable mandrel as an extension to the press piston.



Only 31/32/41/42/43/44
The impeller should be pressed on until it is **0.8±0.15 mm (0.031496–0.005905")** below the seal plane. Measure with a feeler gauge and tubular rule.



Only KA(M)D300-A
The impeller should be pressed on until the top of the groove is **0.25±0.15 mm** (0.009842–0.005905") below the seal plane.

Thermostat, function test

A function test should be carried out before the thermostat is replaced.

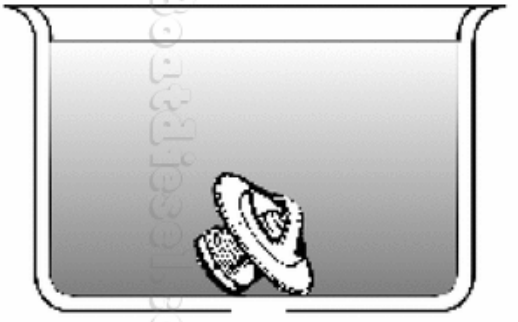
1

Check that the thermostat is completely closed.

Hold the thermostat to the light and check that no air column is visible at the separation point.

If the thermostat does not close completely it should be replaced.

2



Warm up water in a container to **75 °C/167 °F** and insert thermostat as illustrated.

3

Check after at least ½ **minute** that the thermostat is still closed.

4

Heat the water to boiling point **100 °C/212 °F**

Check after a t least ½ minute boiling that the thermostat has opened **7 mm (0.27 in).**

If the thermostat does not open, replace it.

Notes

References to Service Bulletins

Group	No.	Date	Regarding

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