Workshop Manual

Lubrication System

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TAMD61A, TAMD62A, TAMD63P-A
TAMD63L-A, TAMD71A, TAMD71B
TAMD72A, TAMD72WJ-A, TAMD72P-A

Group 22 Lubrication Systems

Marine Engines
TAMD61A • TAMD62A • TAMD63P-A • TAMD63L-A
TAMD71A • TAMD71B • TAMD72A • TAMD72WJ-A • TAMD72P-A

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Safety Precautions

Introduction

This Workshop Manual contains technical specifications, descriptions and instructions for the repair of the Volvo Penta products or product types described in the Table of Contents. Check that you have the correct Workshop Manual for your engine.

Before starting work on the engine read the "Safety Precautions", "General Information" and "Repair Instruction" sections of this Workshop Manual carefully.

Important

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

WARNING! Possible danger of personal injury, extensive damage to property or serious mechanical malfunction if the instructions are not followed.

IMPORTANT! Used to draw your attention to something that can cause damage or malfunctions on a product or damage to property.

Note! Used to draw your attention to important information that will facilitate the work or operation in progress.

Below is a summary of the risks involved 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.

As a general rule all service operations must be carried out with the engine stopped. However, some work, for example certain adjustments require that the engine is running when they are carried out. Approaching an engine which is operating is a safety risk. Loose clothing or long hair can fasten in rotating parts and cause serious personal injury. If working in proximity of an engine which is operating, careless movements or a dropped tool can result in personal injury. Take care to avoid contact with hot surfaces (exhaust pipes, Turbocharger (TC), air intake pipe, start element etc.) and hot liquids in lines and hoses on an engine which is running or which has just been stopped. Reinstall all protective parts removed during service operations before starting the engine.

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

Engines with turbocharger (TC): Never start the engine without installing the air cleaner (ACL) filter. 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 products or similar when starting the engine. They may cause an explosion in the inlet manifold. Danger of personal injury.

Avoid opening the filler cap for engine coolant system (freshwater cooled engines) when the engine is still hot. Steam or hot coolant can spray out. Open the filler cap slowly and release the pressure in the system. Take great care if a cock, plug or engine coolant line must be removed from a hot engine. Steam or hot coolant can spray out in any direction.

Hot oil can cause burns. Avoid getting hot oil on the skin. Ensure that the lubrication system is not under pressure before carrying out any work. 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 area ensure that there is exhaust ventilation leading out of the engine compartment or workshop area to remove exhaust gases and crankcase ventilation emissions.

Always use protective glasses or goggles when carrying out work where there is a risk of splinters, grinding sparks, acid splashes or where other chemicals are used. The eyes are extremely sensitive, an injury could result in blindness!

Avoid getting oil on the skin! Repeated exposure to oil or exposure over a long period can result in the skin becoming dry. Irritation, dryness and eczema and other skin problems can then occur. Used oil is more dangerous than fresh oil from a health aspect. Use protective gloves and avoid oil soaked clothes and shop rags. Wash regularly, especially before eating. There are special skin creams which counteract drying out of the skin and make it easier to clean off dirt after work is completed.

Many chemicals used on the product (for example engine and transmission oils, glycol, gasoline and diesel oil), or chemicals used in the workshop (for example degreasing agents, paint and solvents) are dangerous to health. Read the instructions on the product packaging carefully! Always follow the safety precautions for the product (for example use of protective mask, glasses, gloves etc.). Make sure that other personnel are not exposed to hazardous chemicals, for example in the air. Ensure good ventilation in the work place. Follow the instructions provided when disposing of used or leftover chemicals.

Excercise extreme care when leak detecting on the fuel system and testing the fuel injector jets. Use eye protection. The jet from a fuel injector nozzle is under extremely high pressure and has great penetrative energy, so the fuel can penetrate deep into the body tissue and cause serious personal injury. Danger of blood poisoning.

All fuels and many chemical substances are flammable. Do not allow naked flame or sparks in the vicinity. Fuel, certain thinner products and hydrogen from batteries can be extremely flammable and explosive when mixed with air. Smoking is not to be permitted in the vicinity! Ensure that the work area is well ventilated and take the necessary safety precautions before starting welding or grinding work. Always ensure that there are fire extinguishers at hand when work is being carried out.

Ensure that rags soaked in oil or fuel and used fuel or oil filters are stored safely. Rags soaked in oil can spontaneously ignite under certain circumstances. 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 expose a battery to naked flame or electrical sparks. 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 single spark which is sufficient to cause an explosion with resulting damage. Do not shift the connections when attempting to start the engine (spark risk) and do not lean over any of the batteries.

Always ensure that the Plus (positive) and Minus (negative) battery leads are correctly installed on the corresponding terminal posts on the batteries. Incorrect installation can result in serious damage to the electrical equipment. Refer to the wiring diagrams.

Always use protective goggles when charging and handling the batteries. Battery electrolyte contains sulfuric acid which is highly corrosive. Should the battery electrolyte come into contact with unprotected skin wash off immediately using plenty of water and soap. If battery acid comes in contact with the eyes, immediately flush with plenty of water and obtain medical assistance at once.

Turn the engine off and turn off the power at the main switch(es) before carrying out work on the electrical system.

Clutch adjustments must be carried out with the engine stopped.

Use the lifting eyes fitted on the engine/reverse gear when lifting the drive unit. Always check that the lifting equipment used is in good condition and has the load capacity to lift the engine (engine weight including reverse gear and any extra equipment installed).

Use an adjustable lifting beam or lifting beam specifically for the engine to raise the engine to ensure safe handling and to avoid damaging engine parts installed on the top of 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 which alters its center of gravity a special lifting device is required to obtain the correct balance for safe handling.

Never carry out work on an engine suspended on a hoist without other supporting equipment attached.

Never work alone when removing heavy engine components, even when using lifting devices such as locking tackle lifts. When using a lifting device two people are usually required to do the work, one to take care of the lifting device and another to ensure that components are lifted clear and not damaged during the lifting operations. If working onboard a boat check before starting work if there is enough room to carry out removal work without risking personal injury or damage to the engine or parts.

The components in the electrical system, in the ignition system (gasoline engines) and in the fuel system on Volvo Penta products are designed and manufactured to minimize the risk of fire and explosion. The engine must not be run in areas where there are explosive materials.

Always use the fuels recommended by Volvo Penta. Refer to the Instruction manual. Use of fuels that are of a lower quality can damage the engine. On a diesel engine poor quality fuel can cause the actuating rod to seize and the engine to overrev with resulting risk of damage to the engine and personal injury. Poor fuel quality can also lead to higher maintenance costs.

General Information

About this Workshop Manual

This Workshop Manual contains technical specifications, descriptions and instructions for the repair of the following engines in standard format: TAMD61A, TAMD62A, TAMD63P-A, TAMD63L-A, TAMD71A, TAMD71B, TAMD72A, TAMD72WJ-A, TAMD72P-A. This Workshop Manual can show operations carried out on any of the engines listed 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. However the repair and service operations described are in all essential details the same. Where they are not the same this is stated in the manual and where the difference is considerable the operations are described separately. The Engine Designations and Engine Number can be found on the product plate. Please always include both the engine designation and the engine number in all correspondance.

The Workshop Manual is produced primarily for the use of Volvo Penta workshops and service technicians. For this reason the manual presupposes a certain basic knowledge of marine propulsion systems and that the user can carry out the mechanical/electrical work described to a general standard of engineering competence.

Volvo Penta products are under a continual process of development and we therefore reserve all rights regarding changes and modifications. All the information in this manual is based on product specifications available at the time the book was published. 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 the electrical and fuel systems are subject to various national safety requirements, for example the United States Coast Guard Safety Regulations. Volvo Penta Original Spare Parts meet these specifications. Any type of damage which is the result of using replacement parts that are not original Volvo Penta replacement parts for the product in question will not be covered under any warranty or guarantee provided by AB Volvo Penta.

Certificated engines

Engines certificated to meet national and regional environmental legislation (for example Lake Constance) carry with them an undertaking from the manufacturer that both new and existing engines in use meet the enviromental demands of the legislation. The product must correspond to the validated example that was granted certification. In order for Volvo Penta as the manufacturer to take responsibility for engines in use, certain requirements regarding service and spare parts must be met by the user according to the following:

- The Service Intervals and maintenance operations recommended by Volvo Penta must be followed.
- Only Volvo Penta Original Spare Parts intended for the certificated engine may be used.
- Service work on the ignition system, timing and fuel injection system (gasoline) or injection pump and injectors (diesel) must always be carried out by an authorized Volvo Penta workshop.
- The engine may not be altered or modified in any way, with the exception of accessories and service kits developed by Volvo Penta for that engine.
- No modifications to the exhaust pipes and air supply ducts for the engine room (ventilation ducts) may be undertaken as this may effect exhaust emissions.
- Any seals on the engine may not be broken other than by authorized persons.

⚠ **IMPORTANT!** If replacement parts are required use only Volvo Penta Original Parts. **Use of replacement parts other than AB Volvo Penta Original Parts will result in AB Volvo Penta being unable to assume any liability that the engine corresponds to the certificated engine variant.** Volvo Penta AB excludes any liability for all and any type of damage or costs caused by the use of replacement parts that are not Volvo Penta Original Parts for the product in question.

Repair instructions and methods

The working methods described in the Workshop 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 used in this Workshop Manual (for full explanation of the symbols refer to the section; “Safety Precautions”)

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. Volvo Penta AB can only indicate the risks considered likely to occur as a result of incorrect working methods in a well-equipped workshop using working methods and tools tested by Volvo Penta AB.

All operations described in the Workshop Manual for which there are Volvo Penta Special Tools available assume that these tools are used by the service technician or person carrying out the repair. Volvo Penta Special Tools have been specifically developed to ensure as safe and rational working methods as possible. It is therefore the responsibility of the person or persons using other than Volvo Penta Special Tools or approved Volvo Penta working methods (as described in a Workshop Manual or Service Bulletin), to acquaint themselves of the risk of personal injury or actual mechanical damage or malfunction that can result from failing to use the prescribed tools or working method.

In some cases special safety precautions and user instructions may be required in order to use the tools and chemicals mentioned in the Workshop Manual. Always follow these precautions as there are no specific instructions given in the Workshop Manual.

By following these basic recommendations and using common sense it is possible to avoid most of the risks involved in the work. A clean work place and a clean engine will eliminate many risks of personal injury and engine malfunction.

Above all when working on the fuel system, engine lubrication system, air intake system, Turbocharger unit, bearing seals and seals it is extremely important to observe the highest standards of cleanliness and avoid dirt or foreign objects entering the parts or systems, since this can result in reduced service life or malfunctions.

Our joint responsibility

Every engine consists of many systems and components that work together. If one component deviates from the technical specifications this can have dramatic consequences on the environmental impact of the engine even if it is otherwise in good running order. It is therefore critical that the stated wear tolerances are observed, that systems which can be adjusted are correctly set up and that only Volvo Penta Original Parts are used on the engine. The stated service intervals in the 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 factory sealed for environmental and product specific reasons. Under no circumstances attempt to service or repair a sealed component unless the service technician carrying out the work is authorized to do so.
Bear in mind that most of the chemicals used around boats are harmful to the environment if used incorrectly. Volvo Penta recommends the use of bio-degradable degreasing agents for all cleaning of engine components unless otherwise stated in the Workshop Manual. When working onboard a boat make a special point of preventing oil, waste water from washing components entering the bilges; instead remove all such waste for safe disposal at an approved site for destruction.

Tightening torques

The correct tightening torques for critical joints which must be tightened using a torque wrench are listed under “Technical Specifications -Tightening Torques” and stated in the method descriptions in the Workshop Manual. All tightening torques apply to cleaned threads, bolt heads and mating surfaces. Tigthening torques stated are for lightly oiled or dry threads. Where grease, locking or sealing agents are required for screwed joints this is stated in both the operation 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 torque	
	Nm	ft.lbs
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 torque with Protractor tightening (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.

Lock nuts

Do not re-use lock nuts that have been removed during dissassembly operations as these 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.

Strength classes

Bolts and nuts are divided up into different classes of strength; 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 strength 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.

Sealant

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 Workshop Manual the user will find that each section where these agents are applied in production states which type was used on the engine.

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

Make sure that mating surfaces are dry and free from oil, grease, paint and anti-corrosion agent before applying sealant or locking fluid. Always follow the manufacturer’s instructions for use regarding temperature range, curing time and any other instructions for the product.

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

RTV agent (Room temperature vulcanizing). Used for gaskets, sealing gasket joints or coating gaskets. RTV is visible when a part has been disassembled; old RTV must be removed before resealing the joint.

The following RTV agents are mentioned in the Service Manual: Loctite® 574, Volvo Penta P/N 840879-1, Permatex® No. 3, Volvo Penta P/N 1161099-5, Permatex® Nr 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 Workshop Manual: Loctite® 572 (white), Loctite® 241 (blue).

Note: Loctite® is the registered trademark of Loctite Corparation, Permatex® the registered trademark of the Permatex Corporation.

Safety rules for fluorocarbon rubber

Fluorocarbon rubber is a common material in seal rings for shafts, and in O-rings, for example.

When fluorocarbon rubber is subjected to high temperatures (above 300°C), **hydrofluoric acid** can be formed, which is highly corrosive. Skin contact can give severe chemical burns. Splashes in your eyes can give severe chemical burns. If you breathe in the fumes, your lungs can be permanently damaged.

⚠ **Warning!** Be very careful when working on engines which have been exposed to high temperatures, e.g. overheating during a seizure or fire. Seals must never be cut with an oxy-acetylene torch, or be burned up afterwards in an uncontrolled manner.

- Always use gloves made of chloroprene rubber (gloves for handling chemicals) and protective goggles.
- Handle the removed seal in the same way as corrosive acid. All residue, including ash, can be highly corrosive. Never use compressed air to blow anything clean.
- Put the remains in a plastic box which is sealed and provided with a warning label. Wash the gloves under running water before removing them.

The following seals are probably made from fluorocarbon rubber:

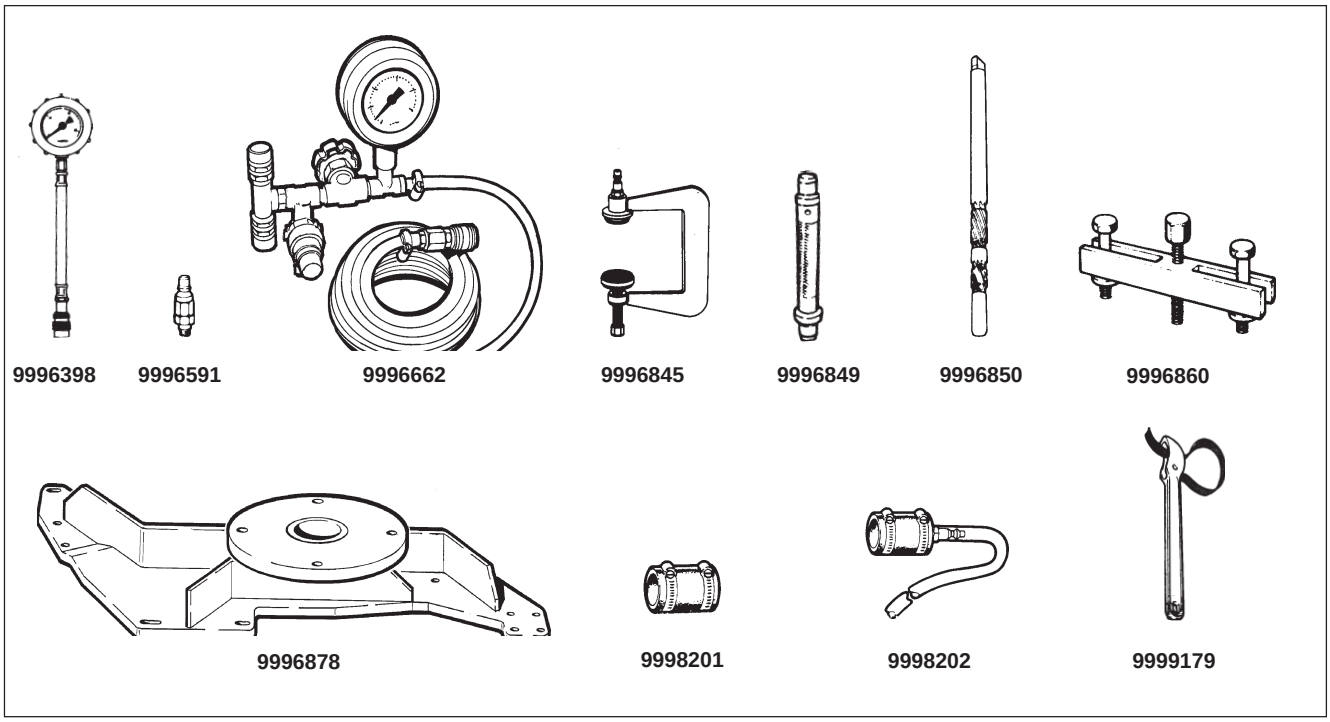
Seal rings for the crankshaft, camshaft, intermediate shafts.

O-rings irrespective of where they are installed. O-rings for cylinder liner sealing are almost always made from fluorocarbon rubber.

Note that seals which have not been subjected to high temperature can be handled normally.

Special tools

In all cases where it is practical, tools have had their part number punched on, but not the last figure. The last figure (after the dash) is a check sum figure.



9996398-5 Pressure gauge for checking oil pressure

9996591-5 Nipple for checking oil pressure

9996662-4 Pressure test device

9996845-5 Leakage test equipment for flat oil cooler

9996849-7 Mandrel for changing oil pump bushings

9996850-5 Reamer for oil pump

9996860-4 Oil pump drive puller

9996878-6 Adaptor for engine block

9996201-9 Seal plug for oil cooler leakage test

9996202-7 Hose coupling for oil cooler leakage test

9996179-6 Oil filter removal tool

General

The engines have a pressurised lubrication system containing a full flow oil filter, an oil cooler and piston cooling.

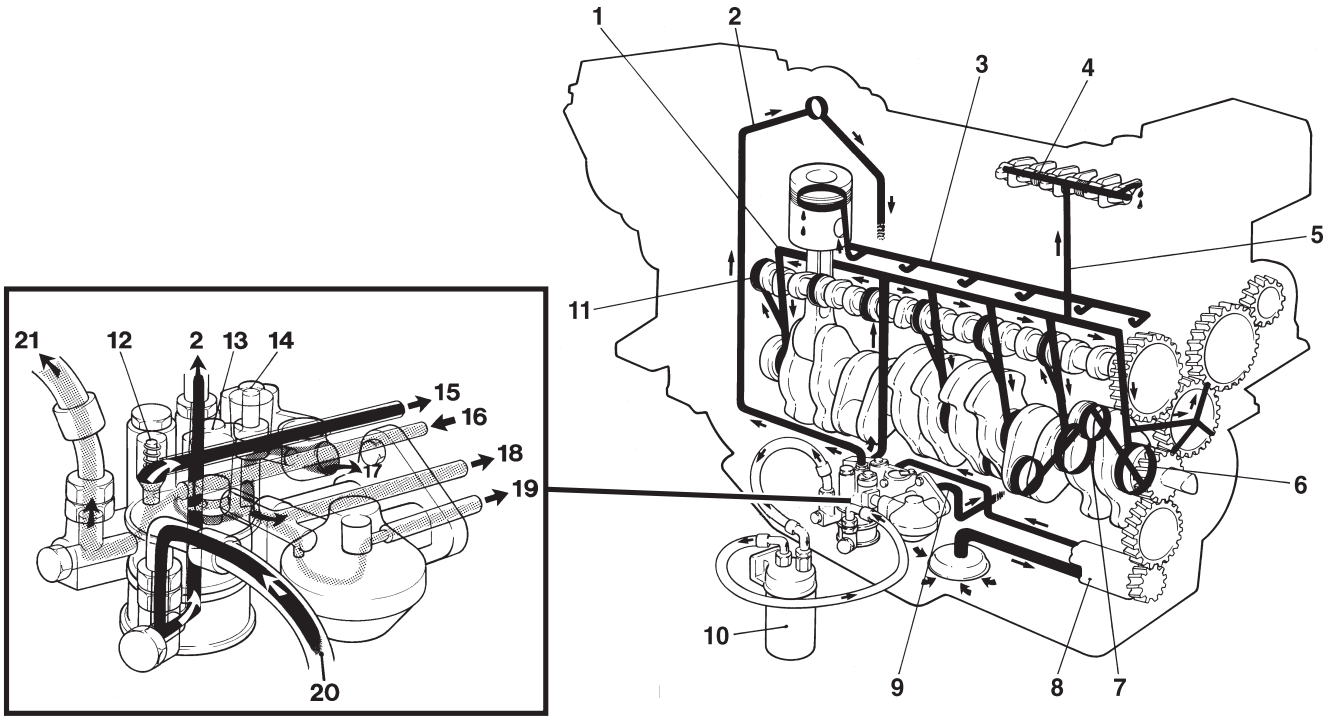
The TAMD 63 also has a by-pass oil filter for the lubrication oil. (The by-pass oil filter is an optional extra for the other engines.)

The oil pump is located at the front of the sump, and is driven by the crankshaft, via an idler wheel. The pump sucks up oil from the sump and forces it out into two oil galleries in the cylinder block, via the oil filter, to the lubrication points in the engine, via the piston cooling valve and the oil cooler to the piston cooling nozzles.

All bearings, the gudgeon pins and the bearings of the valve mechanism and gear wheel drives are connected to the pressure lubrication system. The injection pump and turbocharger are also connected to the pressure lubrication system.

The gear wheel drives are lubricated by splash from the idler wheel bearing, which is connected to the main oil gallery by drillings.

The illustration below shows the lubrication system of the TAMD 61, -62 and TAMD 71, -72.

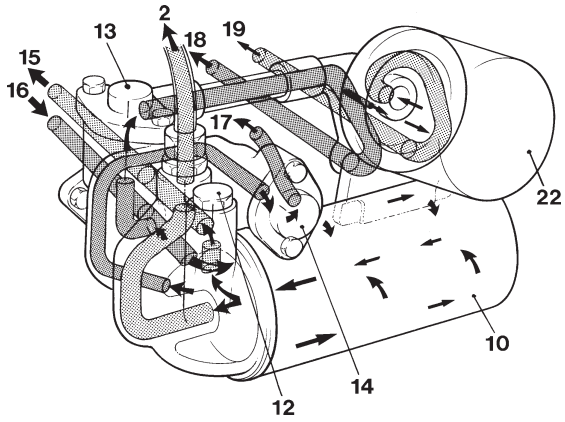


Lubrication system, TAMD 61, -62 and TAMD 71, -72.

1 Main oil gallery (lubricating oil)
2 Oil supply pipe to turbocharger
3 Main oil system (piston cooling oil)
4 Rocker mechanism
5 Oil duct to rocker mechanism
6 Main bearing
7 Big end bearing
8 Oil pump
9 Oil to oil cooler and piston cooling
10 Lubrication oil filter (full flow type)
11 Camshaft bearing
12 Pressure relief valve
13 Piston cooling valve
14 Reduction valve
15 Filtered oil supply to lubrication system
16 Oil supply from oil pump
17 Return oil to sump via reduction valve
18 Oil supply via piston cooling valve to oil cooler and piston cooling
19 Return oil to sump (via by-pass filter if fitted)
20 Filtered oil returning from lubrication oil filter
21 Unfiltered oil to oil filter

The lubrication system in the TAMD 63 is identical in design, apart from the filter housing, see the detailed illustration (right).

The filter housing has an different design for installation reasons. In addition, a by-pass filter has been connected. Part of the oil which leaves the piston cooling valve (oil for piston cooling) is diverted to the by-pass filter. After filtering, the oil is returned to the sump. Apart from this, the oil has the same flow paths as the filter housing in the other engines (previous page).

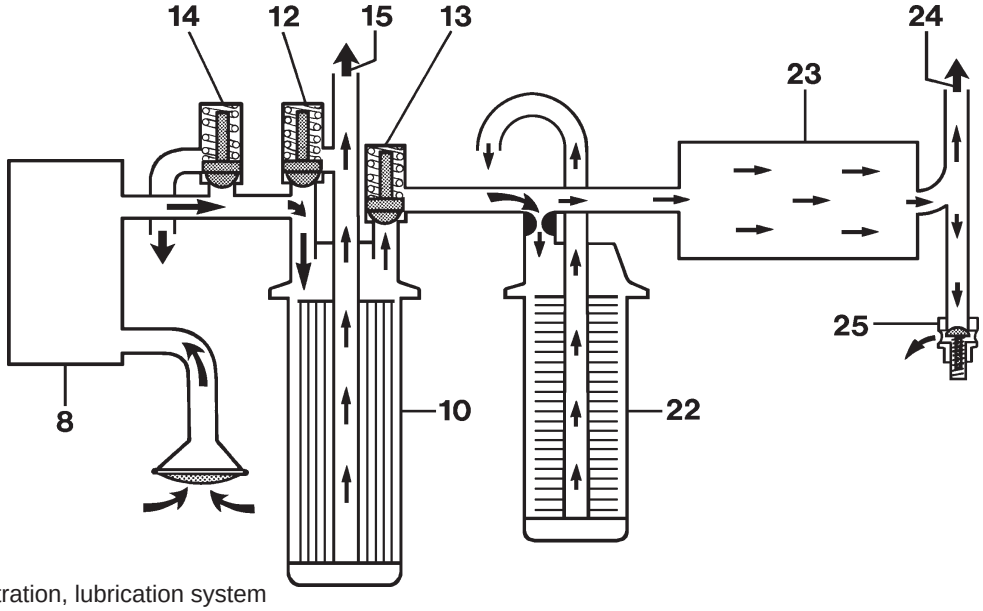


Lubrication system (detail illustration of filter housing) TAMD 63

2 Supply pipe to turbo compressor
10 Lubrication oil filter
12 Pressure relief valve
13 Piston cooling valve
14 Reduction valve
15 Filtered oil supply to lubrication system
16 Oil supply from oil pump
17 Return oil to sump, via reduction valve
18 Oil supply via piston cooling valve to oil cooler and piston cooling
19 Return oil to sump (via by-pass filter)
22 By-pass filter

Control valves

The oil flow in the engine is regulated by four spring-loaded valves. Three of these (pos nos. 12, 13 and 14) are located in the filter housing, the fourth (pos. no. 25) is located in the oil duct between the oil cooler and the piston cooling nozzles, at the lower edge of the cylinder block, on the left-hand (port) side of the engine).



Principle illustration, lubrication system

8 Oil pump
10 Oil filter
12 Pressure relief valve
13 Piston cooling valve
14 Reduction valve
15 Filtered oil supply to lubrication system
22 By-pass filter*
23 Oil cooler
24 Oil supply to piston cooling
25 By-pass valve

* Note. On TAMD 61, -62 and TAMD 71, the by-pass filter is an optional extra.

Reduction valve

The reduction valve (pos no. 12) opens and allows oil to pass by the oil filter if the resistance presented by the filter is too great. This ensures a continuous flow through the lubrication system, even if the oil filter is blocked. Unfiltered oil does reach the lubrication point in the engine, however, which increases engine wear and shortens its service life. It is therefore important that the lubrication oil filter is replaced at the intervals indicated in the service schedule for the engine.

Piston cooling valve

The piston cooling valve (pos no. 13), regulates the oil flow through the oil cooler and onwards to piston cooling. The valve closes the oil supply to piston cooling at low engine speeds (just above idling speed).

This means that the risk of exhaust smoke (white smoke) is reduced after a cold engine is started.

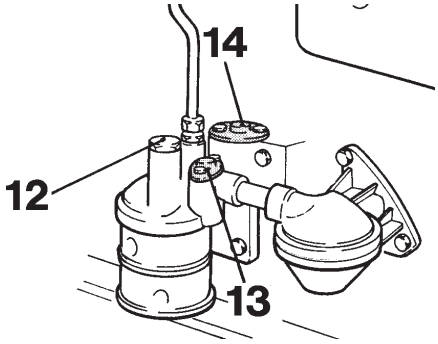
Reduction valve

The reduction valve (pos no. 14) limits the oil pressure in the engine. The valve opens if the oil pressure is too high and allows oil to return to the sump. The opening pressure can be met by a cold engine (viscous oil) or at high engine speeds.

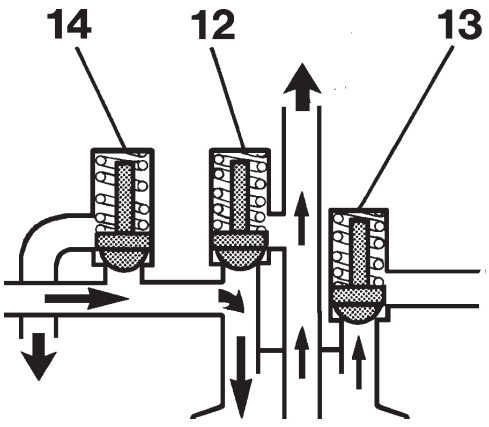
There are two versions of reduction valves (depending on oil pump capacity). The valves are colour coded to avoid confusion.

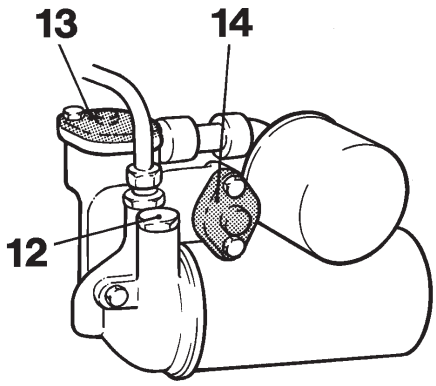
Earlier models of TAMD 61A, TAMD 71A, -B have a valve which is marked blue. Opening pressure is 480 kPa.

Later models of TAMD 61A, TAMD 71A, -B and all TAMD 62, -63, TAMD 72 have a valve which is marked yellow. Opening pressure is 690 kPa.



TAMD 61, -62, -71, -72.





TAMD 63

Valve location, filter housing

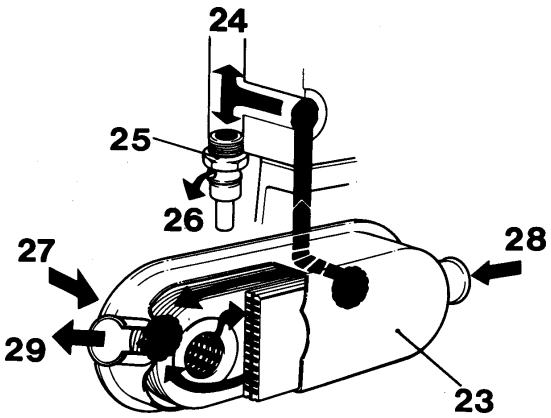
12 Pressure relief valve
13 Piston cooling valve
14 Reduction valve

Bypass valve*

The by-pass valve (pos. No. 25) opens and allows surplus oil which is not needed for piston cooling back to the sump. This increases the oil flow in the oil cooler, which then leads to reduced oil temperatures.

Opening pressure: 90–120 kPa.

* Early models of TAMD61 and TAMD71 do not have the by-pass valve. The by-pass valve was introduced as from engine No. xxxx/61082 on TAMD61 and from engine No. xxxx/41797 on TAMD71.



By-pass valve piston cooling

23. Oil cooler
24. Oil to piston cooling
25. By-pass valve
26. Surplus oil, return to sump
27. Inlet, oil from oil pump
28. Inlet, coolant
29. Outlet, coolant.

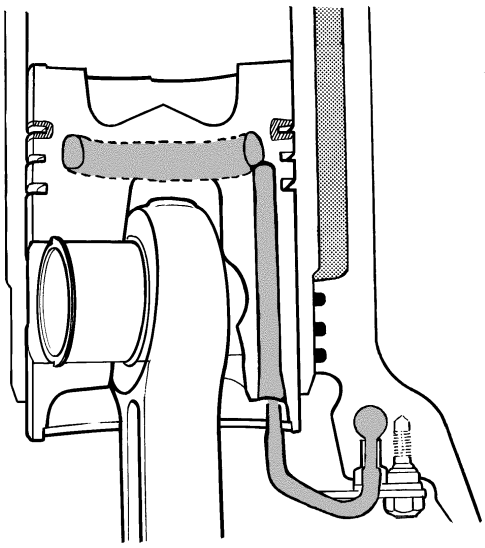
Piston cooling

The piston is exposed to very high temperatures at the instant of combustion. The majority of the heat from the piston is transferred via the piston rings and the oil film to the engine block, a small portion is transferred to the crankcase via the connecting rod.

Oil is sprayed onto the piston from underneath, to further increase piston cooling, which gives a considerable reduction in piston temperature.

This gives longer life to the pistons, piston rings and cylinder linings, a reduced risk of carbon formation on the pistons (piston ring grooves) and lower oil consumption.

The oil for piston cooling is sprayed in through fixed nozzles, one for each cylinder, into a gallery at the lower edge of the piston. The oil is led to the upper part of the piston via the duct. After circulating in the piston, the oil leaves the piston via drain channels and runs down into the sump.

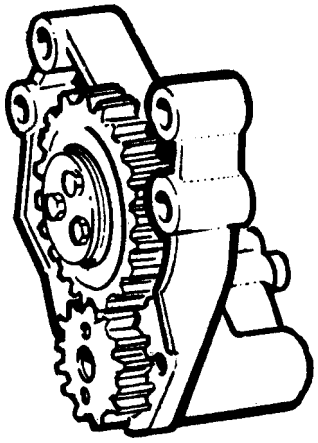


Piston cooling

Oil pump

The oil pump is of the gear wheel type. The pump sucks in oil through the strainer and the suction pipe to the suction side of the pump.

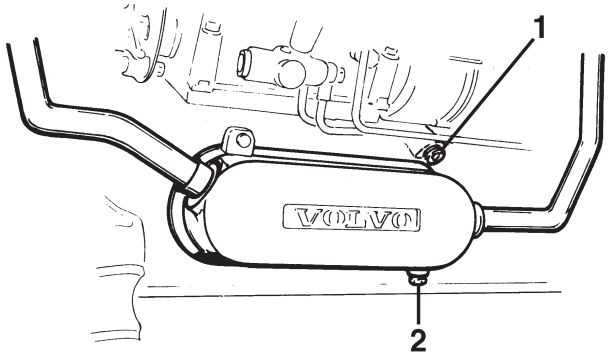
The oil strainer, which is a wire mesh grating, separates any large particles from the oil, before it is sucked up and into the pump.



Oil cooler

The oil transports heat away from the hottest parts of the engine and evens out temperature differences during its circulation. The heat is removed from the oil in the oil cooler.

All engines have a flat heat exchanger for the lubricating oil, located on the left-hand (port) side of the engine beneath the injection pump. The oil passes inside the heat exchanger package whilst the coolant passes between the cell plates. The oil cooler is connected to the fresh water system.



Flat oil cooler

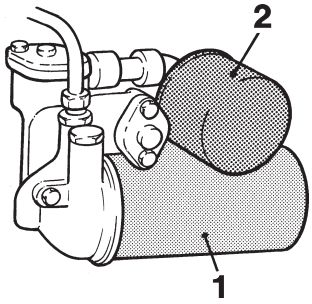
1 Plug for checking the piston cooling oil pressure
2 Drain plug, coolant.

Oil filter

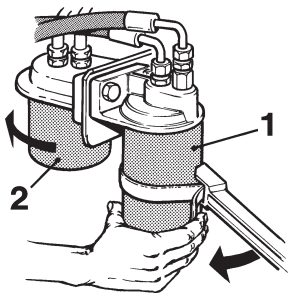
The oil filter is of the full flow type, which means that the oil is filtered before it flows out into the lubrication system, the oil for piston cooling does not pass the filter, however. The filter insert consists of folded paper.

The TAMD 63 also has a by-pass filter (partial flow filter), the by-pass filter is an optional extra on the other engines.

Since only a small proportion of the oil flow passes the by-pass filter, the flow rate is relatively low. The filter can thus remove very fine particles from the oil. For this reason, the filter insert consists of a number of disks of porous paper stacked upon each other.



TAMD 71 and -72



TAMD63

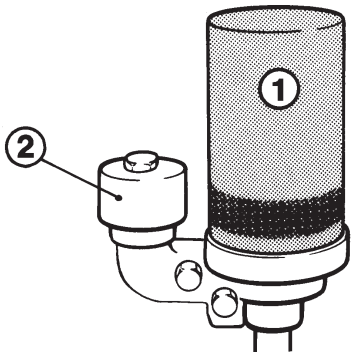
Oil filter

A Oil filter (full flow)
B By-pass filter (partial flow)

Crankcase ventilation

The cylinder block has a ventilation device connected to the rear valve lifter inspection cover, to prevent excess pressure and to separate fuel vapour, water vapour and other gaseous combustion products.

The crankcase gases pass a replaceable paper filter, which separates any oil mist before the gases are evacuated. Any oil is returned to the sump via a drain hose. There is also a pressure limit valve on the filter holder, which opens if the pressure in the crankcase rises too high because the filter is blocked.



Crankcase breather filter

1 Filter
2 Pressure limit valve

Repair Instructions

General

A condition test should be done before each major service job, if possible, to ascertain the general condition of the engine, and any combined fault sources can be discovered. It is necessary that the engine can be run to do the condition test, so this should be done before the engine or engine components are disassembled.

Please refer to the workshop manual, *Engine block*, for information about the condition test.

Measures before renovation in the boat

1 Turn the battery isolator off.

2 Clean the outside of the engine.

NOTE! Make sure that the residue formed by washing is collected and sent for destruction, and does not inadvertently end up in the countryside. Please refer to the warning text in item 11 as well.

3 Tasks involving work on the cooling system. Shut the sea cock and drain the coolant from the sea water and fresh water systems.

Work involving cooling systems with keel cooling: Shut the cocks leading to the keel cooler and drain the coolant from the engine.

⚠ **Warning!** Make sure that all sea water inlets are securely closed and that water entry can not take place when the cooling system components are disassembled.

Measures before lifting the engine out of the boat

5 Turn the battery isolator off. Undo the battery connections to the start motor.

6 Undo the connectors between the engine cables – instruments.

7 Undo the sea water connections/keel cooling connections.

8 Undo the exhaust pipe.

9 Shut the fuel cocks. Undo the fuel connections.

10 Undo the throttle and gear selector cables.

11 Undo the propeller shaft from the reversing gear. Undo the engine mounting pads from the engine bed and lift the engine out.

Measures after lifting the engine out

12 Clean the engine

⚠ **Warning!** Observe the following instruction if you are going to clean the engine with a high pressure washer. Be very careful when cleaning, to avoid water entry into the engine. When the high pressure function is engaged, the water jet must never be aimed at seals, e.g. shaft seals, joints with gaskets, rubber hoses or electrical components.

13 Drain the engine oil off.

14 Remove the reversing gear (when necessary)

Engine adaptor attachment

Adaptor no. 999687 is used to fit the engine to the engine stand.

The adaptor is screwed to the right-hand (starboard) side of the engine as shown in the illustration below.

NOTE! It is important that you observe the instruction about the number and dimension of screws, for safe mounting of the engine.

Screws required:

6(x) series

3 no. M8x30 mm

2 no. M10x30 mm

2 no. M12x40 mm

7(x) series

3 no. M8x30 mm

2 no. M12x40 mm

Before the engine adaptor can be fitted and the engine mounted on the engine stand, the following components must be removed from the engine:

TAMD 61/62

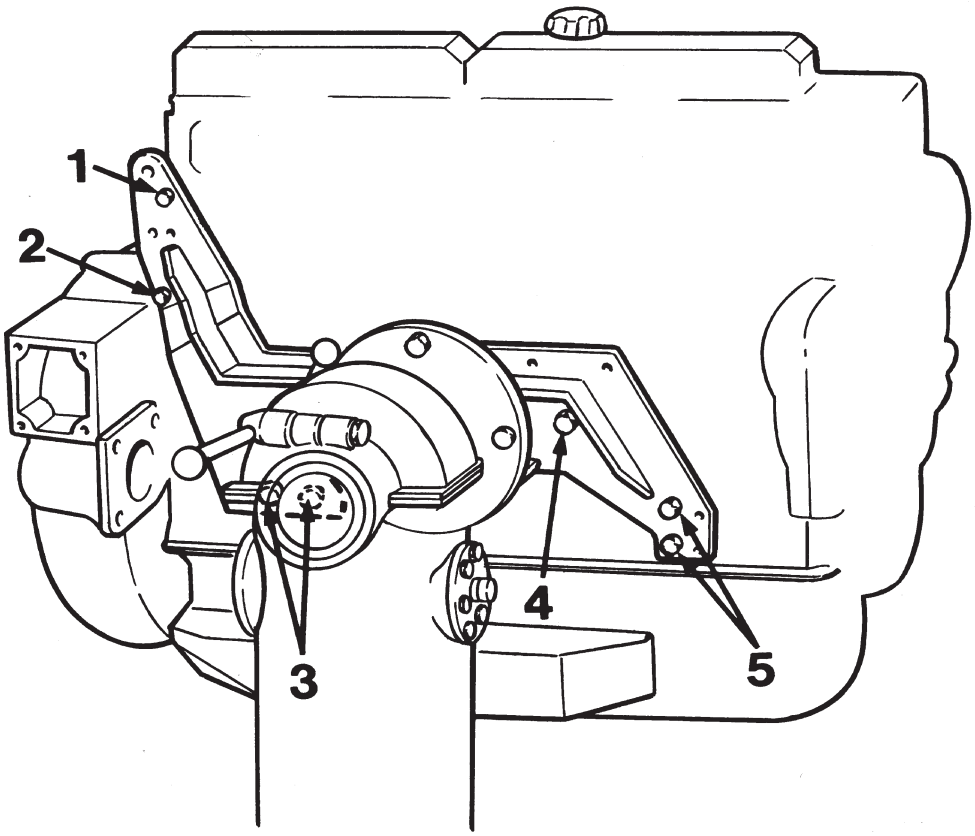
Heat exchanger, intercooler, start motor, oil filter bracket, front engine mounting, rear cover for valve lifters.

TAMD 63

Heat exchanger, intercooler, start motor, oil filter bracket, front engine mounting, rear cover for valve lifters, air filter and expansion tank.

TAMD 71

Heat exchanger, intercooler, start motor, oil filter bracket, rear cover for valve lifters, oil filter housing.



1 M8x30
2 M10x30 [6(x)-series]
3 M8x30
4 M10x30 [6(x)-series]
5 M12x40

Oil pressure, check

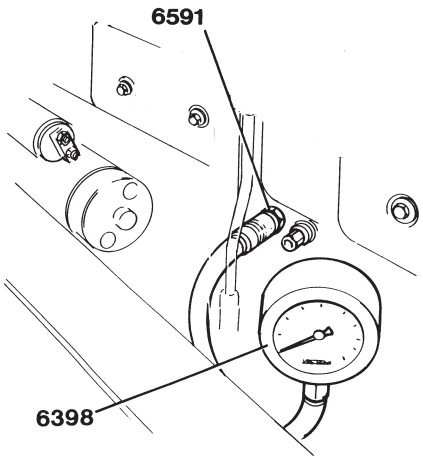
Special tools: 9996398, 9996591

1

Remove the oil pressure sensor on the rear of the right hand (starboard) side of the cylinder block.

Note. If necessary, clear the threads in the cylinder block with the requisite **tap (1/8"27 NPSF)**. Wipe a smear of grease on the tap to prevent swarf from sticking to the tap.

2



Install nipple 6571 and connect pressure gauge 6398 to the nipple.

3

Read the pressure gauge and check that the oil pressure corresponds to the values given in the Workshop Manual “Technical Data”, page 14.

4

Remove the nipple and pressure gauge. Re-install the oil pressure sensor.

Measures for low oil pressure

- **Oil temperature too high**

  If the oil temperature is too high, the oil thins out and the pressure falls. Check the cooling system for blockage and thermostat function.

- **Faulty oil grade (viscosity)**

  If the oil is too thick (incorrect viscosity or the oil is contaminated with too many soot particles), the oil pressure takes too long to rise after a start, especially in cold weather.

If the oil shows abnormal amounts of soot, although the oil is changed at the recommended intervals, and the correct grade has been used, the reason for the fault could also be:

– incorrect combustion because of incorrect fuel grade.

– incorrectly set injectors

– incorrect injection advance

– engine worn outside permitted wear limits (oil leakage past piston rings, valve guides etc.)

The oil has become too thin (has the wrong viscosity) because of dilution with fuel.

This can be caused by incorrect combustion because of

– incorrectly set injectors

– incorrect injection advance

The fault is most easily noticed because of low oil consumption. The low oil consumption is an illusion, since the burned oil is compensated by dilution with unburned fuel, so that the oil level can remain constant.

- **Oil filters blocked**

  When the oil filter is blocked, the filter by-pass valve is opened, which allows the normal oil flow resistance through the filters to fall. This is noticeable by a fall in pressure on idling with a hot engine.

- **Defective reduction valve**

- **Defective piston cooling valve**

- **Defective oil pump**

  Worn or leaky oil pump.

Oil filter, replacement

Special tool: 9999179

1

Put a collection vessel beneath the filters or pull a plastic bag over the filters.

2

Clean the filter bracket and undo the filters with tool no. 9179.

3

Moisten the gaskets of the new filters with oil, and screw them on by hand until the gasket comes into contact with the filter bracket. Then turn a further **3/4 turn.**

4

Top up with engine oil and run the engine on the start motor until the oil pressure gauge gives a reading.

Note. The engine should be turned with the start motor when the filter, oil cooler or other components in the lubrication system are changed.

5

Start the engine and check for leakage past the oil filters.

Sump gasket, replacement

1

Drain or suck out the engine oil. Remove the dipstick.

2

Remove the sump. Remove the old gasket and clean the mating surfaces on the sump and cylinder block.

3

Install the sump with a new gasket. Torque the screws in accordance with the schedule on page 24 in the Service Manual “Technical Data”, to **24 Nm (2.4 kpm)**.

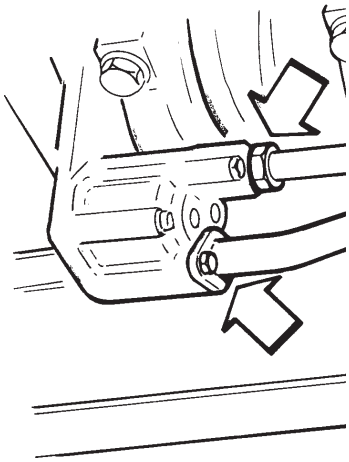
⚠ **NOTE!** The gasket has a string of silicone material baked on (not TAMD 63). If excessive torque is used, the string can crumble and leakage will occur. Do not re-torque the gasket later on.

Oil pump, replacement

(Sump removed)

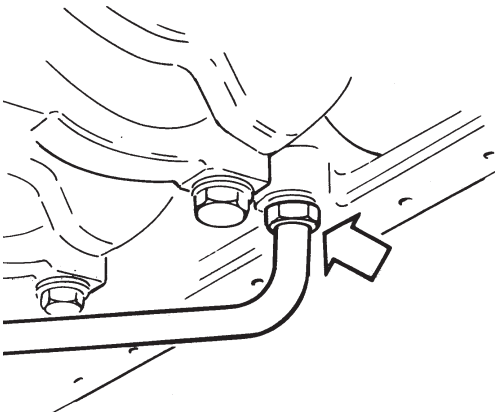
Removal

1



Undo the suction and oil supply pipes from the oil pump.

2



Undo the oil supply pipe and the brackets from the cylinder block. Remove the pipes and brackets.

3

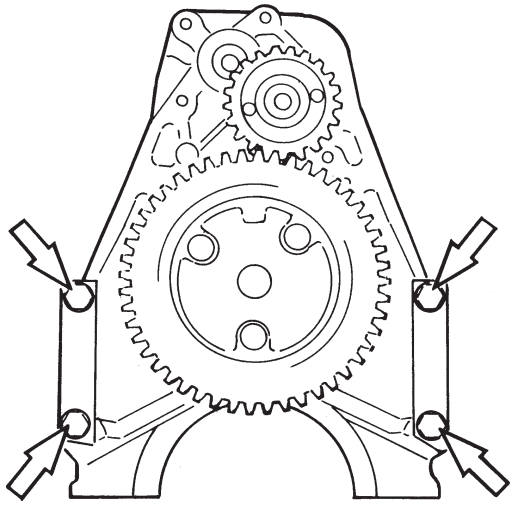
Remove the screws for the first main bearing.

4

Remove the oil pump, together with the main bearing.

Remove the bearing shell from the cap.

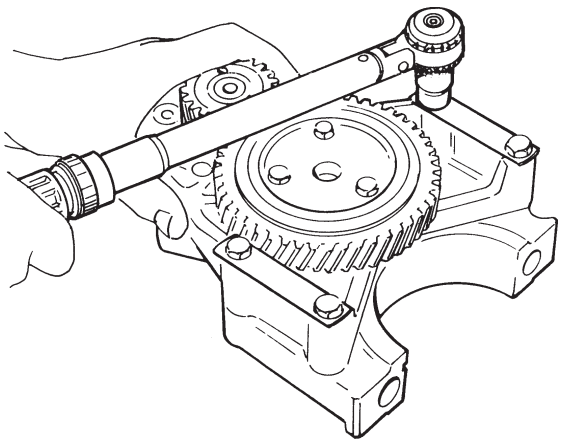
5



Remove the bearing cap from the oil pump bracket.

Installation

6



Screw the bearing cap to the oil pump bracket.

Torque the screws **(65 Nm (6.5 kpm)** and lock with the lock tabs.

7

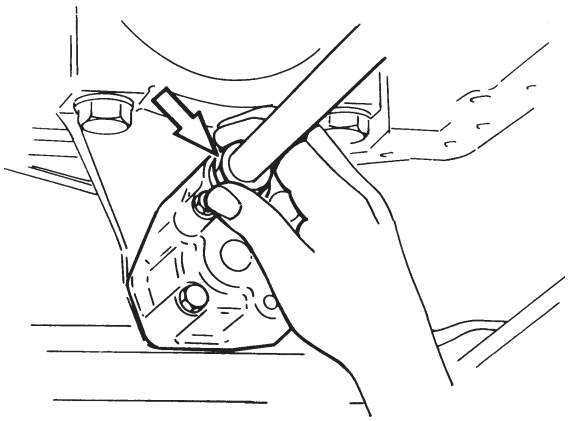
Oil and install the main bearing shell in the cap.

8

Lift the oil pump into place, install and tighten the bearing cap screws.

Torque the screws to **150 Nm (15 kpm**.

9



Install the oil supply pipe on the pump and the cylinder block.

Tighten the unions by hand.

Note! If you re-install the old supply pipe, check the ends of the pipe for cracks.

10

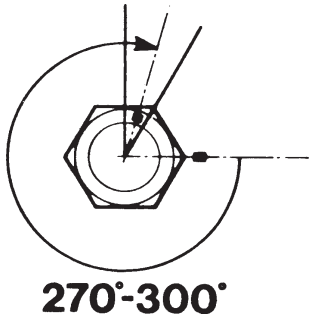
Tighten the unions on the pump and the cylinder block until they bottom.

11

Mark the unions with a felt-tip pen.

Note! Permanent marking must not be used.

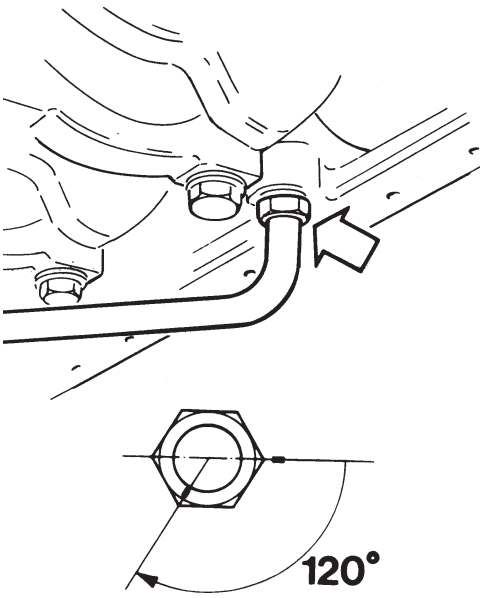
12



Tighten the unions **270–300°** for new pipes. Pipes which have previously been installed shall only be tightened **60°**.

Check that the pipe is securely fastened.

13



Tighten the union on the cylinder block **120°** for new pipes. Pipes which have previously been installed shall only be tightened **60°**.

Check that the pipe is securely fastened.

14

Install new seal rings on the oil suction pipe and screw it to the pump.

15

Install the brackets and tighten the oil pipe.

Oil pump, renovation

Special tools: 9996849, 9996850, 9996860

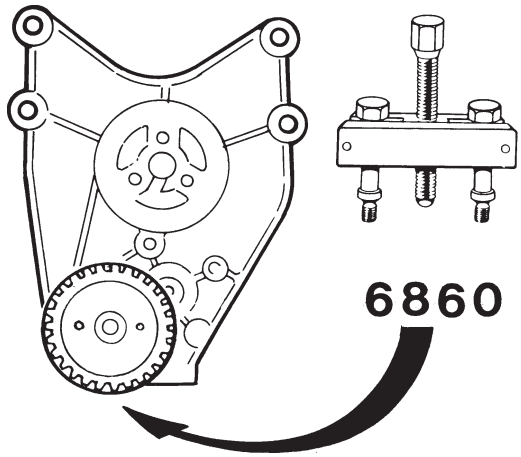
1

Remove the main bearing cap from the oil pump bracket.

2

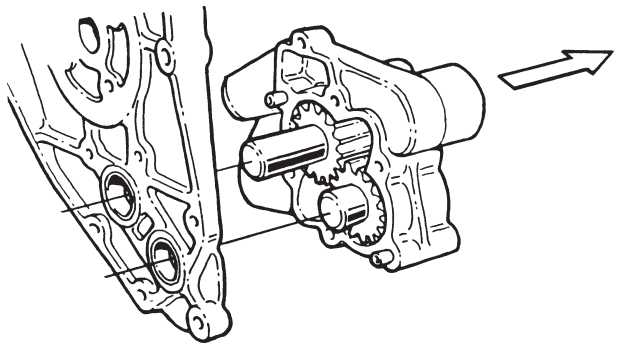
Remove the idler gear

3



Pull the oil pump gear off the shaft, using extractor 6860.

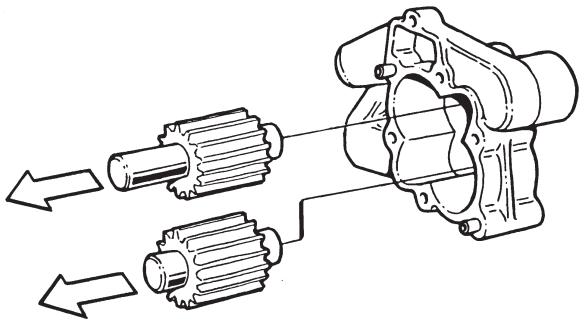
4



Undo and remove the screws which hold the pump housing.

Remove the pump housing from the bracket.

5



Remove the pump gears from the housing

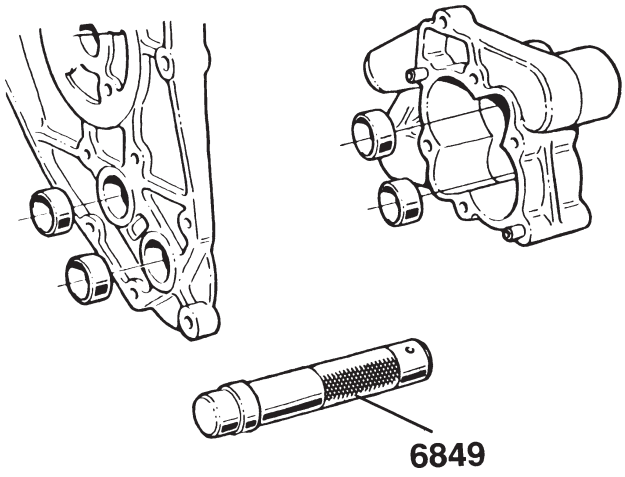
6

Check the pump housing for scratches and wear, and for sealing between the bracket and pump housing. If there is any leakage, the mating surfaces will be black. Wear scratches must not occur.

Check the pump gears for wear on the gear flanks, external diameter and end plane.

Change the bushes in the pump housing and bracket if the radial play between the shaft and the bush amounts to **0.15 mm or greater.**

7

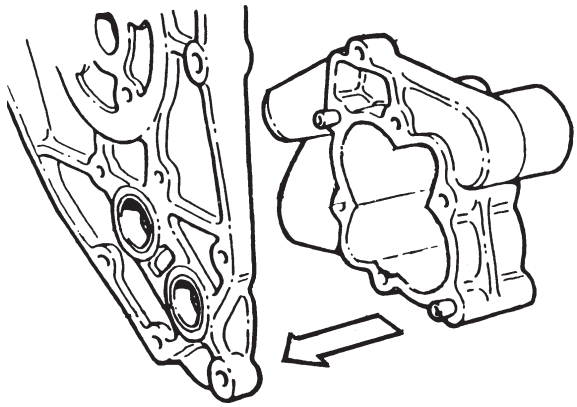


Press the bushes out of the bracket and the pump housing, using mandrel no. 6849.

8

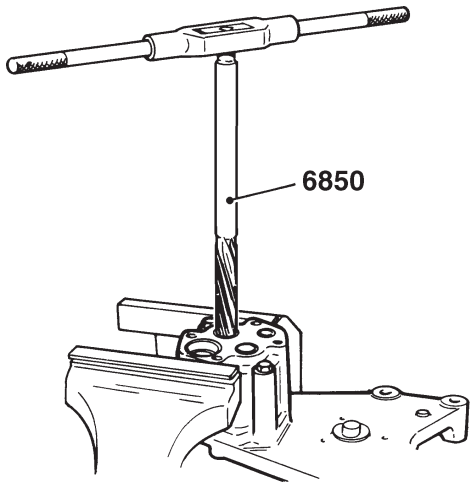
Press new bushes into the bracket and the pump housing, using mandrel no. 6849.

9



Screw the pump housing to the bracket, to provide support for reaming the bushings.

10



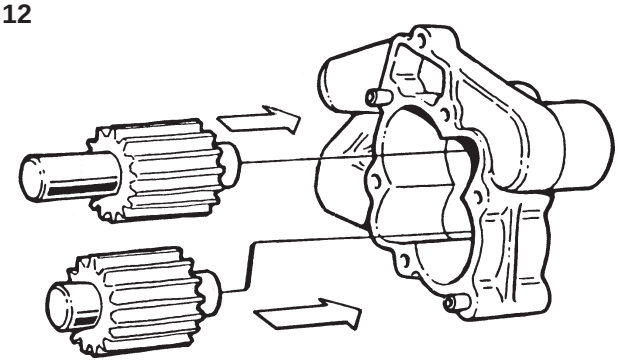
Ream the bushes in the pump housing, using tool no. 6850.

11

Undo the screws and remove the pump housing from the bracket.

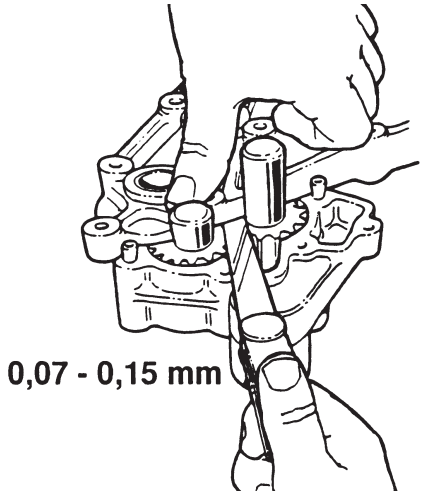
Carefully clean all swarf from the pump housing and bracket.

12



Oil the pump gears and bushes with engine oil, and put the pump gears into the housing.

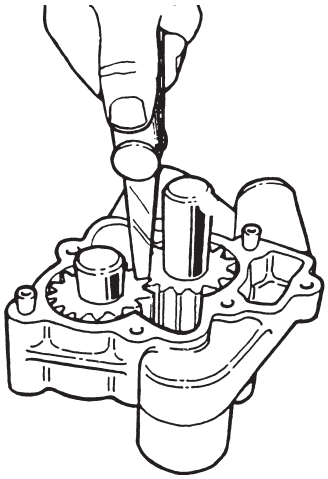
13



Check the end float on the pump gears, using a feeler gauge.

The end float should be **0.07–0.15 mm**.

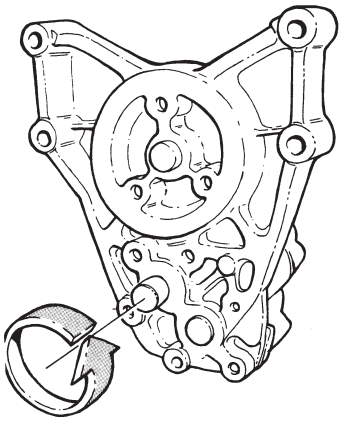
14



Check the pump gear flank clearance, using a feeler gauge.

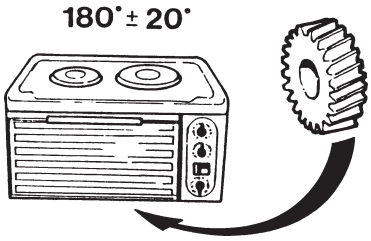
The clearance should be **0.15–0.30 mm**.

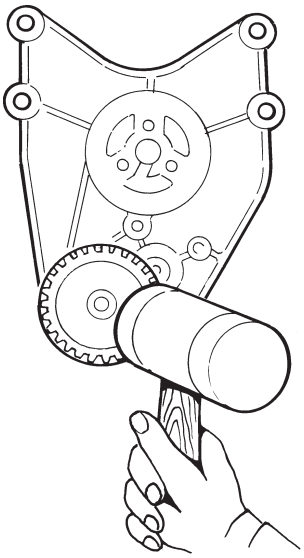
15



Move the gear wheels over to the bracket. Install the pump housing and tighten the screws. Check that the pump gears move easily and do not catch on each other, by turning the pump shaft **a complete turn.**

16

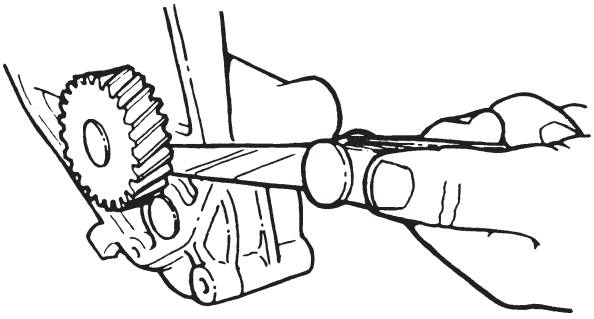




Heat the oil pump gear to **180±20°C** and tap the gear onto the shaft with a plastic-faced hammer.

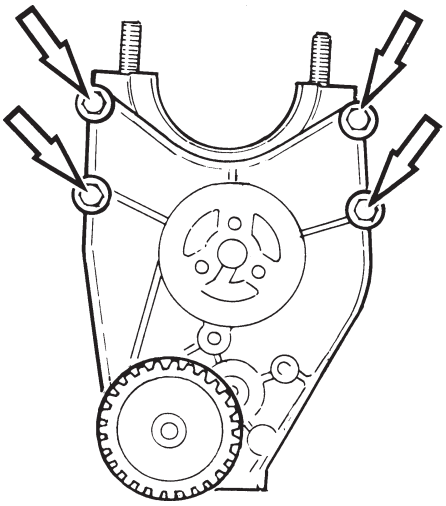
Note. There should be a clearance of **1.0–1.5 mm** between the bracket and gear wheel, so a 1.0 mm feeler gauge should be put into the gap during assembly.

17



Check that the clearance between the bracket and gear wheel is **1.0–1.5 mm**.

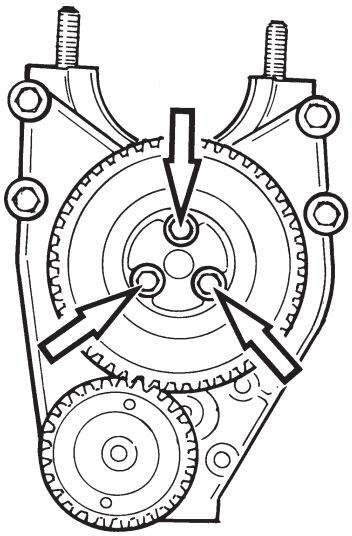
18



Screw the main bearing cap to the oil pump bracket.

Torque the screws to **65 Nm (6.5 kpm)**.

19



Install the idler gear and torque the screws to **33 Nm (3.3 kpm)**.

Oil cooler, replacement

Special tool: 9996049

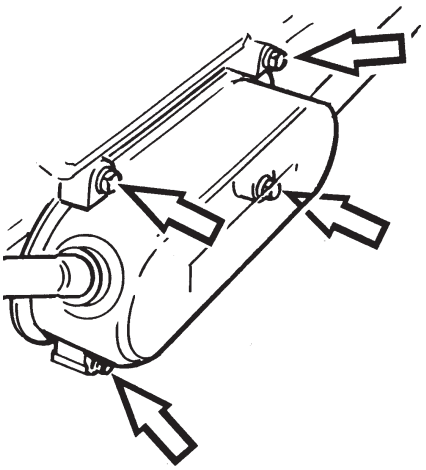
1

Drain off the water in the fresh water system.

2

Undo the rear coolant pipe and pull it out from the cylinder block and oil cooler.

3



Remove the oil cooler fastening screws. If the engine has a fuel shut-off cock, undo the brackets which are fastened to the two upper screws and hang them up.

4

Pull the oil cooler away from the front coolant pipe and remove the oil cooler from the cylinder block.

5

Clean the mating surfaces and install new seal rings in the cylinder block.

6

Install new seal rings on the coolant pipe

Note. Wipe Vaseline or soapy water on the new seal rings.

7

Press the oil cooler onto the front coolant pipe and screw the oil cooler to the cylinder block.

8

Install the rear coolant pipe

Note: Fist press the coolant pipe into the oil cooler, then into the cylinder block.

9

Screw the rear coolant pipe to the cylinder block.

10

Top up with coolant and engine oil.

11

Run the engine with the start motor until the oil gauge gives a reading.

12

Start the engine and check for leakage around the oil cooler and connections.

Oil cooler, cleaning

1

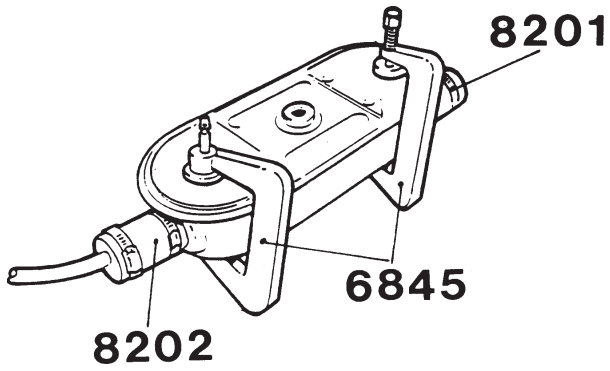
Flush the coolant side of the oil cooler with degreaser.

Clean the oil side with detergent.

Oil cooler, leakage test

Special tools: 9996662, 9996845, 9998201, 9998202

1



The oil cooler must have the same temperature as the test room for small leaks to be detected.

Flush the oil cooler with water at room temperature until it has assumed room temperature.

Drain all water.

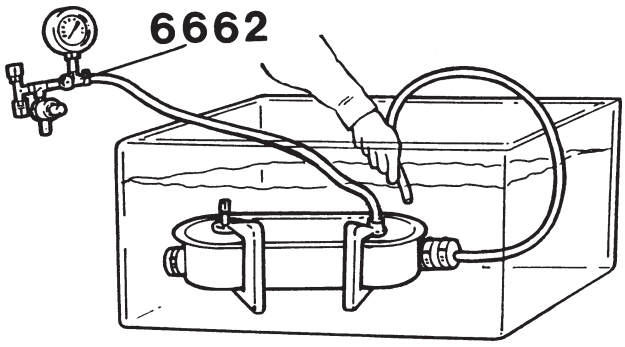
2

Screw leakage test equipment 6845 in place and check that it seals properly.

Install seal 8201 on one of the coolant connections and hose connection 8202 to the other one.

Make sure that the seal and hose connection do not leak.

3



Connect the hose connection from pressure testing equipment no. 6662 to 6845.

Lower the oil cooler into a bath of water at room temperature. Fix the supply hose about **20 mm** beneath the water surface.

Note: The supply hose must not be filled with water.

The leakage test must be carried out at three pressures: **15 kpa, 100 kpa and 250 kpa**. Wait for **at least one minute** at each test pressure.

If air bubbles come from the supply hose, there is internal leakage in the oil cooler. Air bubbles around the oil cooler indicated external leakage.

Note: Avoid starting or stopping the ventilation system in the room during the test, or suddenly changing the air pressure by allowing air to flow in to or out of the room.

This can change the pressure in the room, which can be misinterpreted as leakage during pressure testing.

4

Lift the oil cooler up out of the water bath and remove the leakage test equipment.

References to service bulletins

Group No. Date Refers to

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