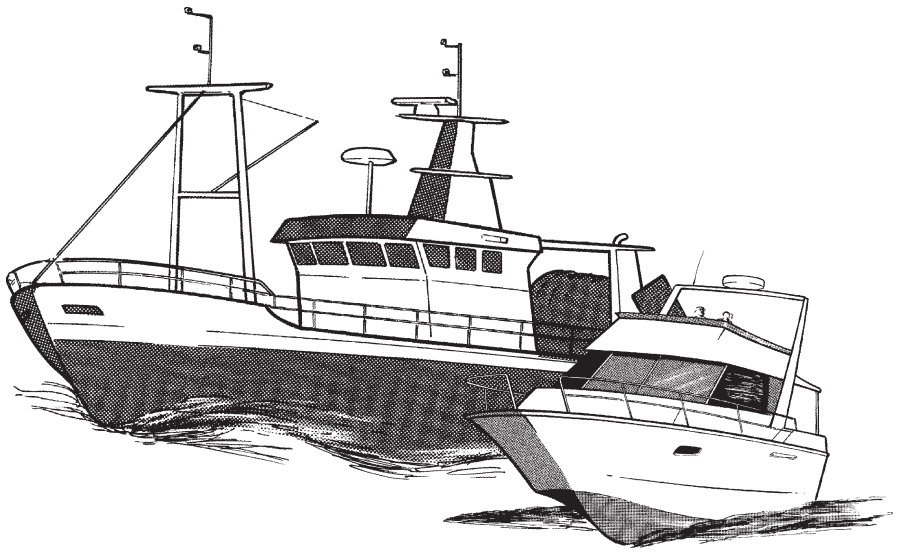
INSTRUCTION BOOK

TMD102A, TAMD102A, TAMD102D
TMD122A, TAMD122A, TAMD122P

Contents



CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its consistituents are known to the state of California to cuse cancer, birth defects, and other reproductive harm.

Safety Precautions

Introduction

This Instruction Book contains the information you will need to operate the engine correctly. Check that you have the correct Instruction Book for your engine.

Read the book carefully before operating or servicing the engine. If operations are performed incorrectly it could result in personal injury, or damage to property or the engine.

If you do not understand or are uncertain about any opertion or information in this manual, please contact your Volvo Penta dealer who will be able to assist with an explanation and demonstration of the operation.

Important

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

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

Read the Instruction Book.

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

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

Always turn the engine off before starting service procedures. Avoid burns. Take precautions to avoid hot surfaces and liquids in supply lines and hoses when the engine has been turned off immediately prior to starting work on it and it is still hot.

Reinstall all protective parts removed during service operations before starting the engine. Make a point of familiarizing yourself with other risk factors, such as rotating parts and hot surfaces (exhaust manifold, turbocharger, charge pipe, starter element, charge air cooler, intake pipe etc.).

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 the service operation requires that the engine is operating let your Penta authorized dealer carry out the work. If working in proximity of an engine which is operating, careless movements or a dropped tool can result in personal injury.

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

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 or similar agent to start the engine, it could cause an explosion in the inlet manifold. Danger of personal injury.

Steam or hot coolant can be ejected and the pressure built up will be lost. Steam or hot coolant can spray out and the system pressure will be lost. Open the filler cap slowly and release coolant system pressure, if the filler cap or a drain cock/venting cock must be opened, or if a plug or engine coolant line must be removed on a hot engine. Steam or hot coolant can spray out.

Stop the engine and close the seacock valve before carrying out operations on the engine cooling system.

Only start the engine in a well-ventilated area. If operating the engine in a closed area ensure that there is exhaust ventilation leading out of the work area to remove exhaust gases and crankcase ventilation emissions.

Anti-corrosion agents are hazardous to health. Read the instructions on the product packaging!

Anti-freeze agents are hazardous to health. Read the instructions on the product packaging!

Certain engine conservation oils are inflammable. Some of them are also dangerous if breathed in. Ensure good ventilation in the work place. Use a protective mask when spraying.

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.

⚠ Never allow an open 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 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. Refer to instructions in the Instruction Book.

⚠ 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 without delay.

⚠ Turn the engine off and turn off the power at the main switches (breakers) before carrying out work on the electrical system.

⚠ Clutch adjustments, where a clutch is fitted, must be carried out with the engine turned off.

⚠ 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 a lifting beam 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 against the side 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.

⚠ **WARNING!** The components in the electrical system and in the fuel system on Volvo Penta products are designed and manufactured to minimize risks of fire and explosion.

The engine must not be run in areas where there are explosive materials.

⚠ Fuel filter replacement should be carried out on a cold engine in order to avoid the risk of fire caused by fuel spillage on the exhaust manifold. Always cover the generator (alternator), if it is located under the fuel filter. The generator (alternator) can be damaged by spilled fuel.

⚠ Always use protective gloves when detecting leaks. Liquids ejected under pressure can penetrate the body tissues and cause serious injury. Danger of blood poisoning.

⚠ Always use 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.

⚠ Observe the following when cleaning with high-pressure water jets. Never point the water jet at seals, rubber hoses or electrical components. Never use high pressure jets when washing the engine.

General Information

Welcome aboard

Thank you for choosing a Volvo Penta marine engine.

Volvo Penta have been building marine engines since 1907. Quality, operating reliability and innovation have made Volvo Penta a world leader in the marine engine industry.

As owner of a Volvo Penta marine engine we would also like to welcome you to a worldwide network of dealers and service workshops to assist you with technical advice, service requirements and replacement parts. Please contact your nearest authorized Volvo Penta dealer for assistance.

We would like to wish you many pleasant voyages.

AB VOLVO PENTA

Technical Information

Your new boat

Every new boat has it own special characteristics. Even experienced boat owners are advised to note carefully how the boat behaves at different speeds, weather conditions and loads. If your boat and engine combination permit high-speed use, we strongly recommend that a safety breaker is fitted, regardless of the type of boat. If your boat is not fitted with a safety breaker contact your Volvo Penta dealer who can assist you in selecting one.

Running-in

When the engine is new, it should be run normally. However, full loading should be avoided for more than brief periods during the first ten hours of use. **Unnecessary idling of an unloaded engine should always be avoided.**

Check the instrumentation extra carefully during this period so that any abnormal conditions may be discovered in good time.

Check also that there are no leaks.

With a new or reconditioned engine, the valve clearance should first be checked after 150 hours of operation.

The oil and oil filter* in the Twin Disc reverse gear should first be changed at this point too. Remove and clean the reverse gear's oil screen at the same time. In the case of MPM reverse gears, the oil screen should be cleaned after 10 and 50 hours of operation, and the first oil and filter change* should be made after 50 hours of operation.

The disengageable clutch should be checked more closely during the first few days. It may be necessary to adjust it to compensate for wear to the laminate.

* Only the TD MG514, MPM IRM 310 and MPM IRM 311 have oil filters.

Fuel and lubricants

Only use lubricants and fuels recommended on page 16 or under "Technical Data". Use of other qualities can cause malfunctions and reduced service life.

Spare parts

⚠ **Warning!** The components in the electrical system and in the fuel system on Volvo Penta products are designed and manufactured to minimize risks of fire and explosion.

Using parts that are not Original Volvo Penta parts which do not correspond to the demands above, can result in fire or explosion on board. 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.

Safety

Everyone wants and expects to have a problem-free and pleasant time when they take their boat out. To help you do this we have provided a pre-journey check-list below, which can of course be added to according personal experience. A major area is naturally the engine, its equipment and that the boat in general is properly maintained.

Planning your trip

– Get out up-to-date charts for the route planned.
– Calculate distance and fuel consumption.
– Note down if there are fuel points on your planned course.
– Tell friends or relatives about your trip plans.

Boat equipment

– Rescue and emergency items such as lifevests and signal rockets. Does everyone know where they are?
– Spare parts on board, for example Kit with water pump impeller etc.
– Proper tools for the equipment.
– Fire extinguisher (checked and charged).

Our joint responsibility

Volvo Penta continually commits a considerable part of its development resources towards minimizing the environmental impact of its products. Examples of areas where we are always looking for improvements are exhaust emissions, noise levels and fuel consumption.

Regardless of whether your Volvo Penta engine is installed in a boat used for pleasure or in commercial operation, incorrect operation or improper maintenance of the engine will result in disturbance or damage to the environment.

In this instruction book there are a number of service procedures, which, if not followed will lead to a deterioration of engine characteristics with regard to how it effects the environment, its service life and cost of operation. Always follow the recommended service intervals and make a habit of checking that the engine is operating normally every time you use it. One example is excessively smoky exhaust. Contact an authorized Volvo Penta workshop if you cannot correct the fault yourself.

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. Always dispose of engine and transmission oil waste, old paint, degreasing agents and cleaning residue etc. at proper disposal areas so they do not harm the environment.

Adapt speed and distance during your boat trips so that swell and noise generated by the boat do not disturb or harm wildlife, moored boats, landing stages etc. Wherever you land or cruise, please show consideration and always leave the areas you visit as you would like to find them yourself.

Warranty and guarantee

A Service and Warranty book with conditions for Volvo Penta's International Limited Warranty is supplied with every engine. Contact your nearest Volvo Penta dealer or importer for your copy if you have not received one.

Some markets can have other warranty conditions depending on national legislation and regulations. These conditions are provided by the Volvo Penta importer or distributor for the market in question. If you wish to have a copy of the conditions please contact your local Volvo Penta representative.

Warranty Registration Card

The Warranty Registration Form (North American market) or Warranty Card (other markets) should always be filled out and sent in by the dealer. Make sure that this has been done, if no proof of the delivery date can be provided the warranty undertakings might not be honored.

Maintenance and care

– PDC (Pre-Delivery Commissioning) delivery undertaking for marine engines: "PDC" enables us to ensure that Volvo Penta products operate correctly after installation in a boat, and further that the end-user gets acquainted with the product, its functions and care (refer to checklist in the Warranty and Service book). Delivery undertaking "PDC" is carried out at the time of the delivery of the boat to the end-user. The cost of this work is covered by the Volvo Penta company's International Limited Warranty.
– **First Service inspection:** A First Service inspection must be carried out after 150–300 running hours or within 180 days of delivery, or at the end of the first season, whichever comes first. Labor and material costs in connection with the First Service Inspection are **not** covered by the Volvo Penta International Limited Guarantee (for checklist see your Warranty and Service book).

Regular maintenance should be carried out after the First Service Inspection in accordance with the maintenance scheme in this book. Any work carried out in addition to maintenance services should be documented (refer to the Warranty and Service book).

It is an absolute condition for the Volvo Penta International Limited Warranty to apply that the Pre-Delivery Commissioning and First Service Inspection have been carried out by an authorized Volvo Penta service dealer.

Volvo Penta Service

Volvo Penta has a comprehensive dealer network that offers both service and spare parts for Volvo Penta engines. These dealers have been carefully selected and trained to provide professional assistance for service and repairs. They also have the special tools and testing equipment required for maintaining a high standard of service. Volvo Penta dealers and vendors must maintain a stock of original spare parts and accessories to cover most requirements of Volvo Penta owners.

When ordering a service or spare parts always quote the engine and reverse gear complete type designation and serial number. You will find this information on the engine product plate and on a label on the front valve cover (see page 7).

Certificated engines

Important information for engines certificated for Lake Constance and Switzerland

All Volvo Penta engines and products are developed to minimize environmental impact.

National and regional legislation is not identical in all the markets where Volvo Penta sells its products. Occasionally legislation requires that we build special engine variants, or that an engine must be approved in advance, that is, certificated by the local authorities.

An engine with certification means that we, as the manufacturer, guarantee that all engines manufactured are of the same type as the certificated and approved example. Certification is not only a requirement covering engines from the factory, but also that engines in use must meet the environmental demands set for that engine. In order for Volvo Penta as the manufacturer to take responsibility for engines in use, certain requirements pertaining to service and spare parts must be met. We do not wish to discourage owners from carrying out service work themselves, rather the opposite since an owner can quickly notice if an engine is not operating normally.

However, a number of service operations demand access to special expertise, workshop manuals, special tools and other equipment designed for the engines. These service operations may only be carried out by an authorized Volvo Penta Service workshop. Always contact your Volvo Penta dealer if you are not sure about anything concerning your engine's function or maintenance.

As an owner or operator of a certificated Volvo Penta engine it is important that you are aware of 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 injection pump and injectors or pump settings 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 spare parts are required use only Volvo Penta Original parts.

Use of spare parts other than AB Volvo Penta Original spare parts will result in AB Volvo Penta cannot assume any liability for the engine meeting requirements under the engine certification. 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.

Identifying Numbers

Immediately after you have taken delivery of your boat, make a note of the serial number and model designation of the engine and reverse gear. Include the serial number and model designation of the boat and any extra equipment. This information is necessary when you contact your Volvo Penta or boat sales representative for service and spare parts. Take a copy of the information. Take a copy of the information and keep it in a safe place so it is available should the boat be stolen.

Engine type .....

Serial No. .....

Reverse gear type .....

Serial No. .....

Propeller designation .....

Boat type .....

Serial No. .....

Other equipment .....

Serial No. .....

The engines

TMD102A, TAMD102A, TAMD102D, TMD122A, TAMD122A, TAMD122P-A

The engines are four-stroke, 6 cylinder in-line marine diesel engines with direct fuel injection. The engines are equipped with turbochargers and either heat exchangers for thermostat controlled freshwater cooling or components for keel cooling.

The engines are lubricated by a pressurized lubrication system with an oil pump that provides lubrication to the engine. On all engines except the TMD102A the pistons are cooled by lubricating oil through special jets located in the cylinder block.

All the engines have wet, replaceable cylinder liners.

The exhaust manifold and turbocharger are freshwater-cooled to reduce the radiant heat to the engine compartment.

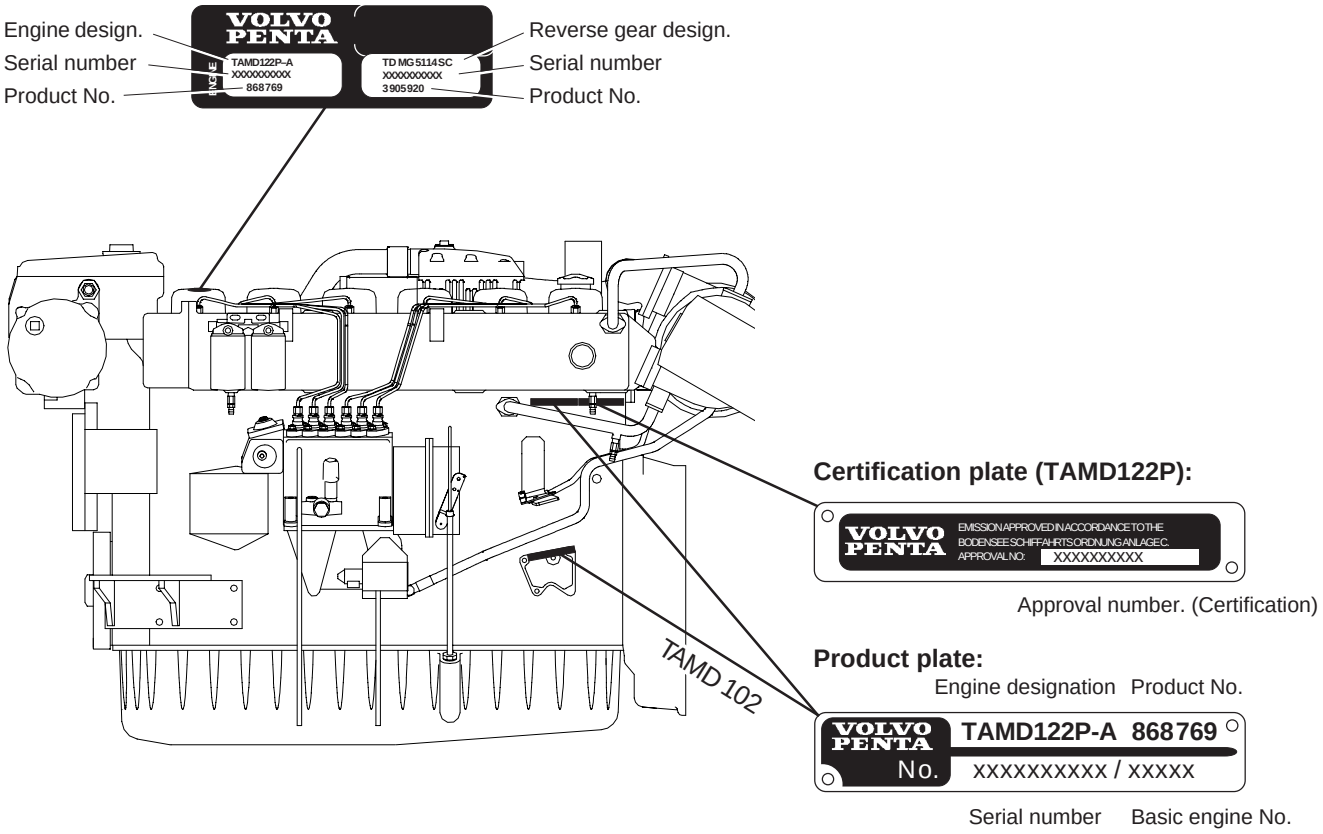
TAMD102A, TAMD102D, TAMD122A and TAMD122P engines are equipped with a watercooled charge air cooler (CAC). The CAC reduces the temperature of the intake air to the engine after it has been compressed in the turbocharger. This permits a high power output while keeping the combustion and exhaust gas temperatures to appropriate levels.

For a more detailed description of the engine, its fuel,

lubrication, and cooling systems, etc., see under “Technical description” on pages 31–63.

Location of engine product plates

Label:



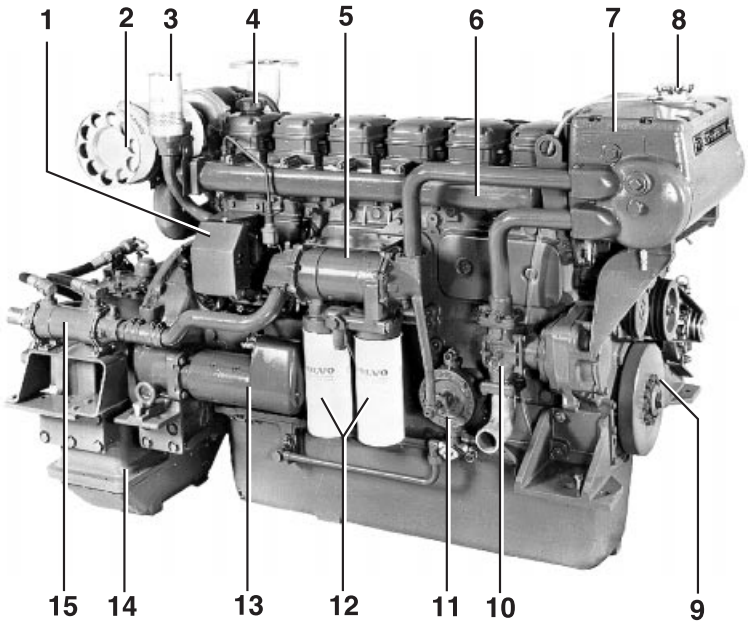


Fig. 1. TMD102A from starboard.

1. Terminal box with semi-automatic fuses
2. Air filter
3. Filter for crankcase ventilation
4. Oil filler cap
5. Oil cooler
6. Intake pipe
7. Expansion tank
8. Cover for engine coolant filling
9. Vibration dampener
10. Seawater pump
11. Oil bilge/scavenging pump
12. Oil filters
13. Starter motor
14. Reverse gear
15. Oil cooler, reverse gear

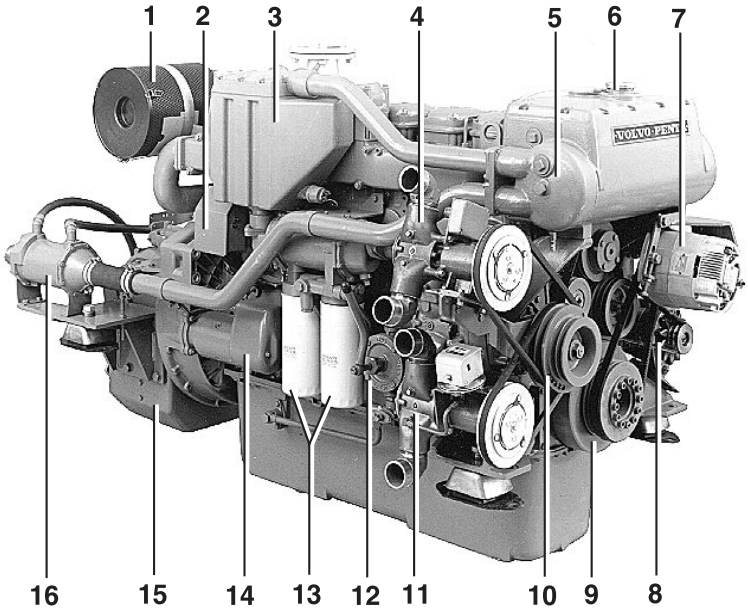


Fig. 2. TAMD102A from starboard.

1. Air filter
2. Terminal box with semi-automatic fuses
3. Charge air cooler (CAC)
4. Flushing pump
5. Heat exchanger
6. Cover for engine coolant filling
7. Extra generator
8. Generator (GEN)
9. Vibration dampener
10. Extra drive take-off
11. Bilge pump
12. Oil bilge/scavenging pump
13. Lubricating oil filter
14. Starter motor
15. Reverse gear
16. Oil cooler, reverse gear

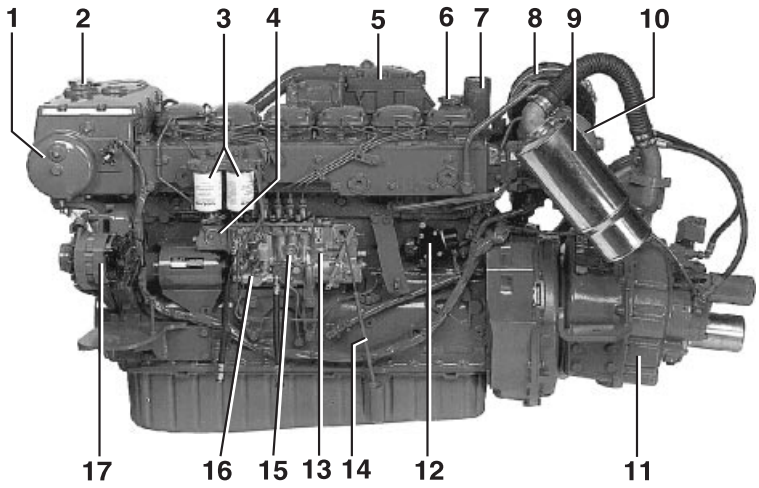


Fig. 3. TAMD102D from port.

1. Heat exchanger
2. Cover for engine coolant filling
3. Fuel filter
4. Smoke limiter
5. Charge air cooler (CAC)
6. Oil filler cap
7. Filter for crankcase ventilation
8. Air filter
9. Water-cooled exhaust elbow
10. Turbocharger
11. Reverse gear
12. Stop solenoid
13. Regulator
14. Oil dipstick
15. Injection pump
16. Feed pump
17. Generator (GEN)

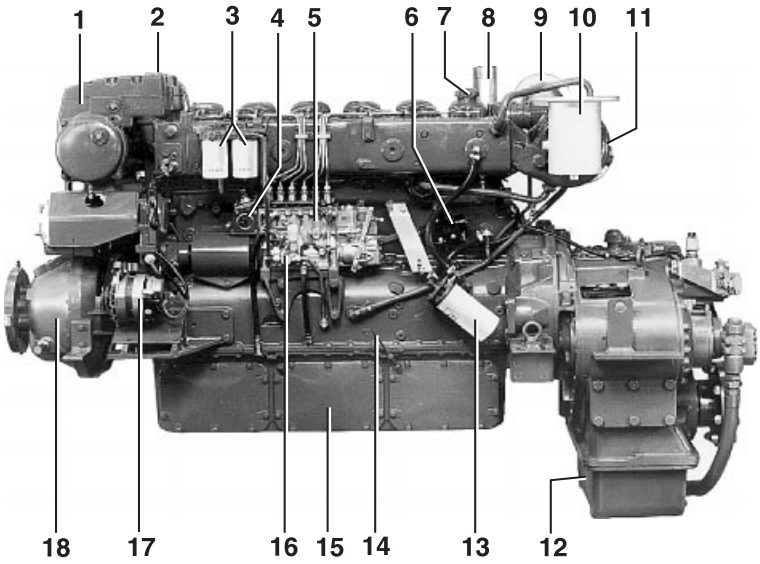


Fig.4. TMD122A from port side

1. Heat exchanger
2. Cover for engine coolant filling
3. Fuel filter
4. Smoke limiter
5. Injection pump
6. Stop solenoid
7. Oil filler cap
8. Filter for crankcase ventilation
9. Air filter
10. Exhaust elbow
11. Turbocharger
12. Reverse gear
13. Freshwater filter
14. Oil dipstick
15. Inspection cover
16. Feed pump
17. Generator (GEN)
18. Power take-off for example for hydraulic pump

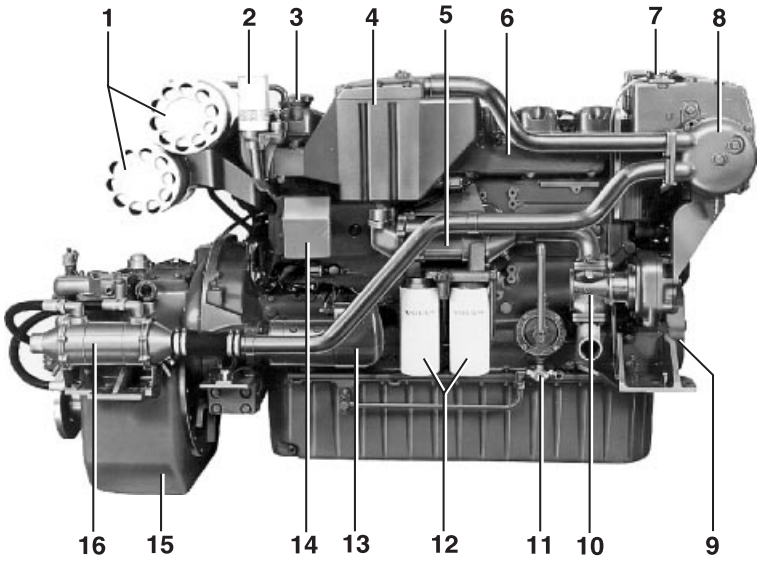


Fig.5. TAMD122A from starboard

1. Air filter
2. Filter for crankcase ventilation
3. Oil filler cap
4. Charge air cooler (CAC)
5. Oil cooler
6. Intake pipe
7. Cover for engine coolant filling
8. Heat exchanger
9. Vibration dampener
10. Seawater pump
11. Oil scavenger pump, know for pumping engine or reverse gear oil.
12. Oil filters
13. Starter motor
14. Terminal box with semi-automatic fuses
15. Reverse gear
16. Oil cooler, reverse gear

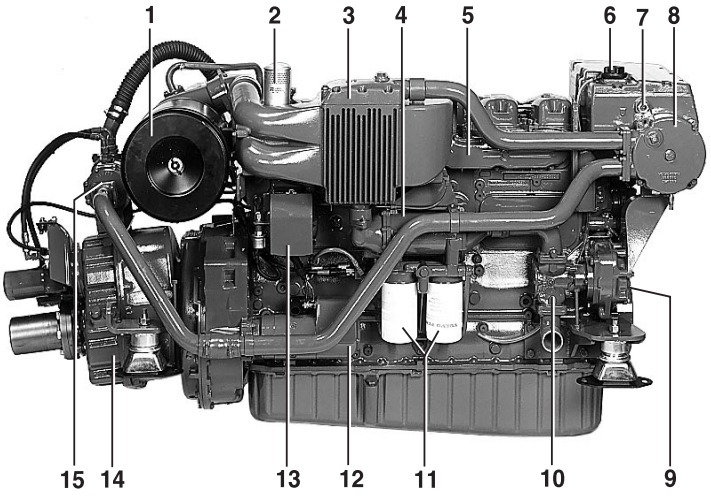


Fig. 6. TAMD122P–A from starboard.

1. Air filter
2. Filter for crankcase ventilation
3. Charge air cooler (CAC)
4. Oil cooler
5. Intake pipe
6. Cover for engine coolant filling
7. Level glass, engine coolant
8. Heat exchanger
9. Vibration dampener
10. Seawater pump
11. Oil filters
12. Starter motor
13. Terminal box with semi-automatic fuses
14. Reverse gear
15. Oil cooler, reverse gear

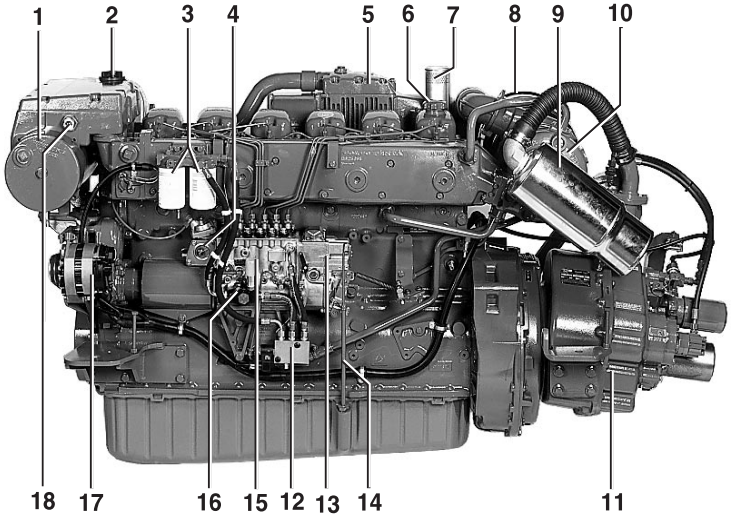


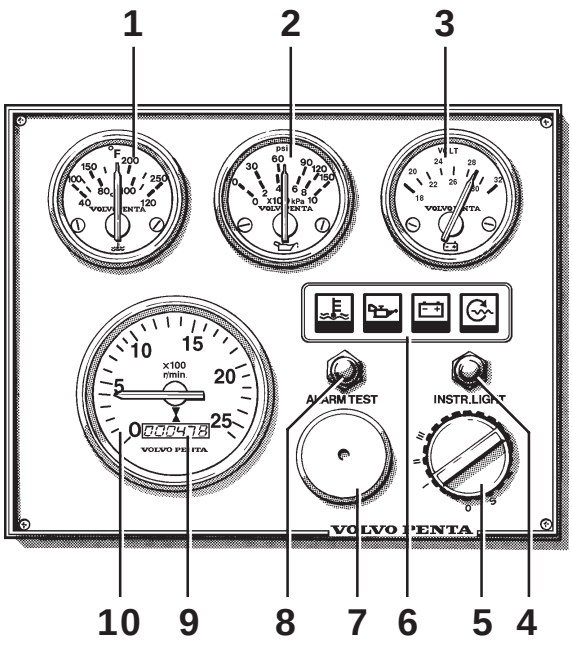
Fig. 7. TAMD122P–A from port.

1. Heat exchanger
2. Cover for engine coolant filling
3. Fuel filter
4. Smoke limiter
5. Charge air cooler (CAC)
6. Oil filler cap
7. Filter for crankcase ventilation
8. Air filter
9. Water-cooled exhaust elbow
10. Turbocharger
11. Reverse gear
12. Fuel shut-off valve
13. Regulator
14. Oil dipstick
15. Injection pump
16. Feed pump
17. Generator (GEN)
18. Level glass, engine coolant

Instrumentation

The instrument panels used are the main panel, the Flying Bridge (instrument panel for alt. control position) and the auxiliary panel. In addition there is an extra alarm panel.

The instrumentation is also supplied separately in sets if Volvo Penta instrument panels are not used. These sets include three smaller panels for starting, stopping and alarm functions.

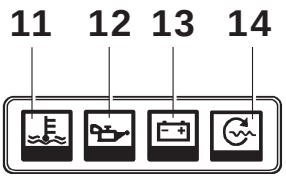


Main panel

1. Engine coolant temperature (ECT) gauge
2. Oil pressure gauge, engine.
3. Voltmeter. Displays the voltage in the starter battery circuit.
4. Pressure switch for instrument lighting.
5. Key switch (start lock) with start and stop functions and a built-in restart inhibitor (starter motor protection).

   The restart inhibitor prevents the key being moved to the start position unless it has first been returned to the stop position (S).
6. Alarm panel with warning symbols (pos. 11–14).
7. Alarm (siren) for fault alerts. Sounds when lubricating oil pressure is too low (engine), when coolant temperature is too high or there is a loss of charge.
8. Pressure switch for testing alarm functions or acknowledging alarms.
   - – **No alarm:** Alarm test (all warning lights shine steadily and the siren sounds).
   - – **If the alarm sounds:** Alarm acknowledgement.*
9. Hours run meter. Displays the engine's operating time in hours and tenths of an hour.
10. Tachometer, engine speed. Multiply this value by 100 for revolutions per minute

*** Note:** The siren stops but the warning lamps continue flashing until the malfunction has been corrected. If a new alarm condition occurs, the siren sounds again and the next warning lamp starts to flash, and so on.



Alarm panel

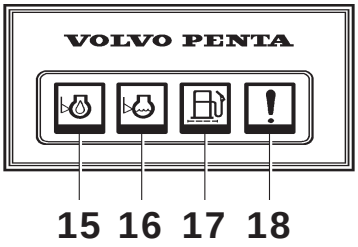
This panel has four "windows". If the acoustic alarm comes on, one of the windows "11–13" starts to flash (red) to show the cause of the alarm.

11. Warning light – high coolant temperature.
12. Warning light – low lubricating oil pressure, engine.
13. Warning light – comes on if the charging current from the alternator stops.
14. Indication lamp – preheating on (starter element).*

    This light also works as a bulb failure warning sensor for the starter element.* This light is on even when the key switch is in the I position (operating position) if there is a fault in the starter element (open-circuit).

*** Note:** The starter element is available as an accessory on the TMD 102A.

Extra alarm panel

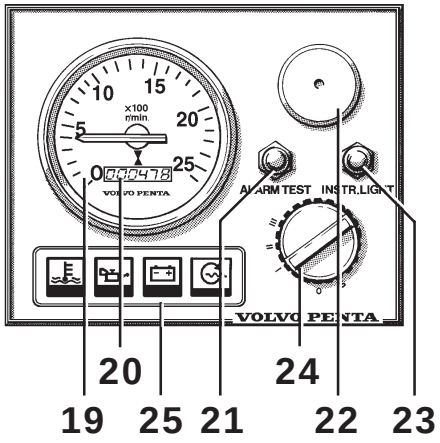


This panel has four “windows”. If the acoustic alarm comes on, one of the windows starts to flash (red) to show the cause of the alarm.

15. Lubricating oil level too low. Top up to correct level before starting.
16. Coolant level too low. Top up to correct level before starting.
17. Water in extra fuel pre-filter. Drain off water in filter. See maintenance schedule on page 27 (item 13).
18. Extra alarm.

Panel for alternative control position

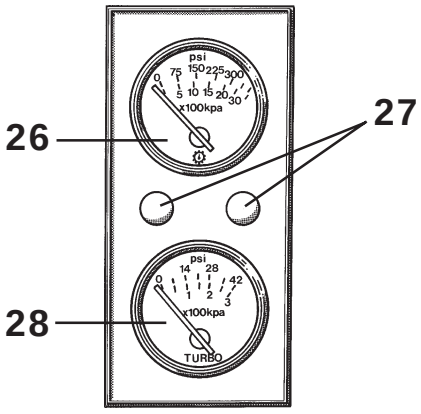
(“Flying Bridge”)



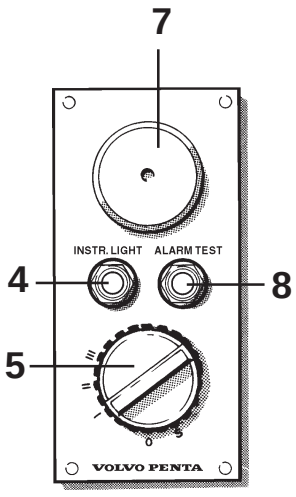
19. Tachometer, engine speed. Multiply this value by 100 for revolutions per minute
20. Hours run meter. Displays the engine’s operating time in hours and tenths of an hour.
21. Pressure switch for testing alarm function.
22. Alarm for fault alerts, corresponding to same in main panel.
23. Pressure switch for instrument lighting.
24. Key switch (start lock) with start and stop functions and a built-in restart inhibitor (starter motor protection).

    The start lock means that new attempts at ignition can be made only once the key has been returned to the stop position (S).
25. Alarm panel with warning symbols corresponding to same in main panel.

Supplementary panel



26. Oil pressure gauge for reverse gear.
27. Blind plugs. Space for (e.g.) extra switch.
28. Manometer for turbocharger’s charging pressure.



Pilot house

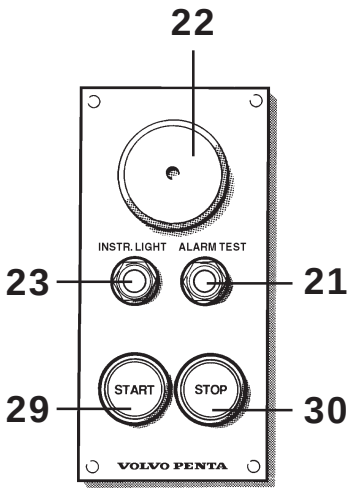
Instrument kits

The instrumentation is also supplied separately in kits. These kits include the following three smaller panels for starting and stopping and for utilising the alarm functions.

Control panel for pilot cabin

(Main panel)

The pilot control panel has the same functions as the main panel (pos. 4–5 and pos. 7–8).



Alt. operating position

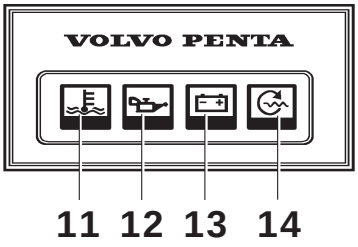
Control panel for alt. operating position

The control panel at the alternative operating position has the same functions as the panel for the alternative operating position (pos. 21–23).

Note: The key switch in the pilot house control panel must be in position I (operating position) for starting to be carried out from the alt. operating position.

Engines with starter element: The starter element may be engaged only via the key switch on the panel in the pilot house.

29. Starter button. The starter motor is engaged when this button is pressed. Release the button as soon as the engine has started.
30. Stop button. The stop solenoid or stop valve is engaged when this button is pressed.



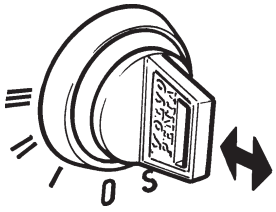
Alarm panel

Alarm panel

The alarm panel has warning symbols corresponding to those in the main panel (pos. 11–14).

Controls

Key switch



The key switch has five positions, including 0 position:

Pos. 0 = The key can be inserted and taken out.

S = Stop position (stop solenoid or stop valve engaged). The key springs back automatically to the 0 position after stopping.

The key springs back automatically to the operating position after preheating or starting.

II = Intermediate position.

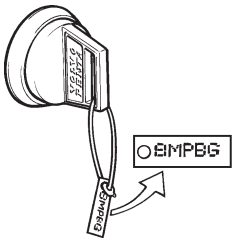
Alternatively: Pre-heating position, (starter element connected)*.

III = Starting position (starter motor engaged).

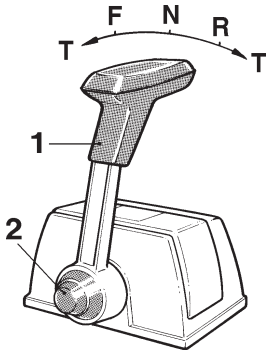
See also instructions for starting.

***Note:** The starter element is available as an accessory on the TMD 102A

Starter keys



The starter keys are tagged with a key code. Use this code when ordering new keys. Do not keep the tag on your boat. The code must not be divulged to unauthorized persons.



VP single control

Lever (1) for reversing maneuvers and controlling engine speed

Pos. N – neutral position
From N to F – reverse gear engaged for forward motion
From N to R – reverse gear engaged for reverse motion
T – affects engine speed

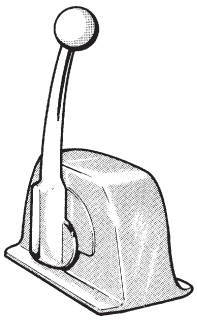
Disengaging reverse gear from the control:

Push the button (2) when the lever is in neutral, then push the lever forwards. The lever can then be used as a throttle control with the reverse gear disengaged. **Take care not to engage reverse gear by mistake.**

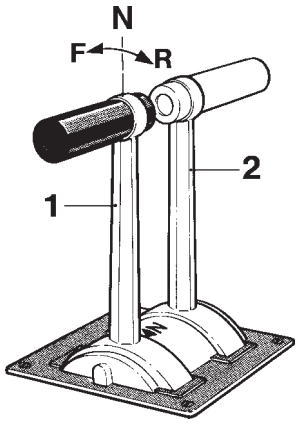
The shift function is engaged automatically when the lever is moved to the Neutral position.

Controls

Volvo Penta uses two types of controls single lever and dual lever. With single lever controls, both acceleration and reverse gear maneuvers are controlled using one lever, while the dual lever controls have a separate lever for each function.

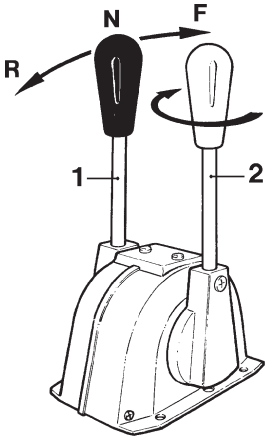


Type S controls for maneuvering trolling valve



VP dual controls

1. Lever for reverse gear maneuvers (black handle)
   Pos. N – neutral position
   From N to F – reverse gear engaged for forward motion
   From N to R – reverse gear engaged for reverse motion
2. Lever for controlling engine speed (red handle)



NB dual controls

1. Lever for reverse gear maneuvers (black handle)
   Pos. N – neutral position
   From N to F – reverse gear engaged for forward motion
   From N to R – reverse gear engaged for reverse motion
2. Lever for controlling engine speed (red handle)

   One brake can be adjusted by turning this handle in order to counteract the regulator power.

Single lever control

Volvo Penta single lever controls have functions for acceleration and reverse gear maneuvers all in one lever. When starting, for example, the gearing function can simply be disengaged so that only the engine speed is affected by the lever. When maneuvering the boat forwards or backwards, at the moment of changing gear the lever mechanism makes the engine speed drop to idling.

The control lever has an adjustable friction brake. A neutral contact which allows the engine to be started only when the reverse gear is disengaged is available as an accessory.

A dual single lever control is available for use with double engines.

Single lever controls with a single function are suitable for controlling a trolling valve*, if fitted. One of these is the type S control.

Dual lever control

These controls have separate levers for acceleration and shifting. A mechanical lock means you can shift only when the acceleration lever is in the idling position. The controls have a neutral contact to prevent starting with the reverse gear engaged. Both control levers have separately adjustable friction brakes.

Fuel, Oils, Coolant

Diesel fuels

The composition of the fuel is vital for operation of the engine, its service life, and emissions. To meet the performance specified and to run your boat cleanly and quietly, it is vital that you use fuel as recommended below.

Fuel specifications

The fuel must be approved according to national and international standards for commercial fuels, for example:

– EN 590 (With environmental and sub-zero temperature specifications according to national requirements)
– ASTM-D 975 No. 1-D and 2-D
– JIS KK 2204

Sulfur content: According to current legislation in the respective country.

Use of fuel with an extremely low sulfur content (Urban Diesel fuel in Sweden and City Diesel in Finland) can result in a reduction in output of approx. 5% and increase in fuel consumption of approx. 2–3%.

Lubricating oil, engine

A **lubricating oil** of a quality as shown in the table below should be used:

Designation	Standard
VDS*	Volvo Drain Specification
CD, CE	API (American Petroleum Institute)
MIL-L-2104D	US Government's Military Spec.

* A VDS oil must be used if there is to be a long period between oil changes. See also the maintenance schedule and "Technical Data".

We do not advise that you run on an oil of a quality which does not meet the above requirements. This is a poor solution with respect to both economy and operating safety.

For viscosity and capacities, see "Technical Data" on page 69.

Lubricating oil, reverse gear

For the reverse gear, a single grade oil of quality CC, CD or CE according to the API system should be used. Oil according to the MIL-L-2104D standard may also be used.

For viscosity and capacities, see "Technical Data" on pages 71–72.

Oil for power steering system, hydraulic pump (accessory)

ATF oil* should be used in the servo unit system.

* ATF = Automatic Transmission Fluid (oil for automatic gearboxes).

Coolant

The engine's internal cooling system (freshwater system) is filled with a mixture of freshwater and additives.

Note! Never use freshwater without additives. The following recommendations should be followed to prevent frost and corrosion damage to your engine:

When there is a chance of freezing

Use a mixture of 50% Volvo Penta antifreeze (glycol) and 50% pure water (as neutral as possible). **This mixture will protect against freezing to a temperature of approx. –40°C (–40°F) and should be used all year round.**

There should be at least 40% antifreeze in the system for complete protection against corrosion.

⚠ **N.B Glycol is harmful to health (do not drink!)**

When there is no chance of freezing

When there is no risk of freezing the engine coolant mixture additive is Volvo Penta anti-corrosion agent (P/N 1141526-2) which must be used unless an anti-freeze mixture is used all year round. Mixture ratio = 1:30.

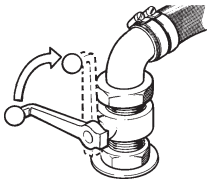
See the instructions on page 48 for topping up the coolant. Warm up the engine after filling to allow the additive to work as efficiently as possible.

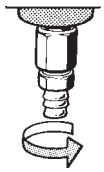
⚠ **N.B Anti-corrosive agents are harmful to health (do not drink!)**

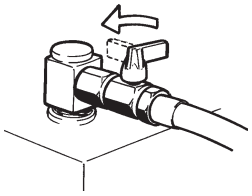
* **Note!** Never mix the anti-corrosive agent with antifreeze (glycol).

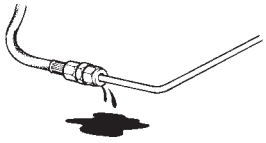
Replacing the coolant

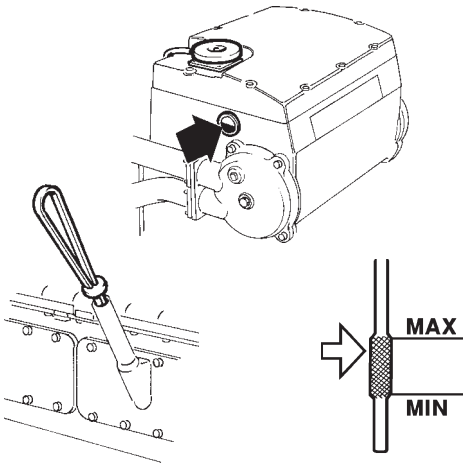
The coolant should be replaced and the system flushed at least once a year. See also the maintenance schedule.

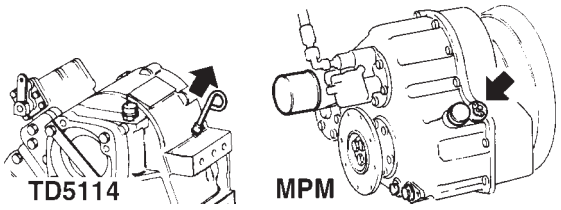


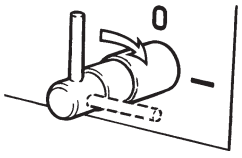


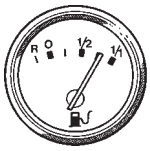












Before starting

1. Open the cooling water intake's sea cock.

2. Check that all the drain cocks are closed and all the drain plugs are fitted.

For location of cocks/plugs see illustrations on page 23.

3. Open the fuel cocks.

4. Check that no fuel, water or oil is leaking out.

5. Check the coolant level. The level must be 5 cm below the filling cap seal surface. For filling, see page 48.

⚠ **Note! Do NOT open the pressure cap or the venting nipples on a hot engine. Steam or hot coolant can spray out and the system pressure will be lost.**

Note: On TAMD122P engines there is a level glass for checking engine coolant level. The glass is located on the side of the heat exchanger.

6. Check the engine oil level. This should be within the area marked on the dipstick.

The oil level must never be below the MIN mark on the stick.

7. Check the oil in the reverse gear.

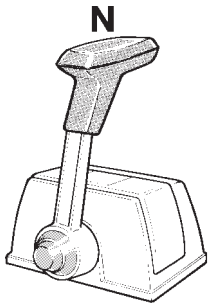
Note: Since the marks on the dipstick apply for operating temperature (with the engine idling and the control in neutral), the correct level before starting must be judged by experience.

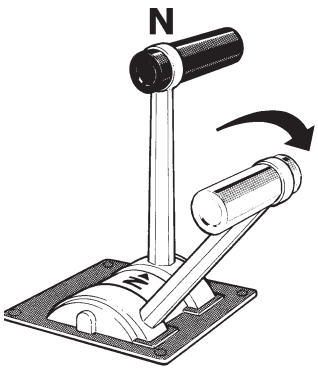
8. Engage the main switches.

9. Check the amount of fuel.

Starting the engine

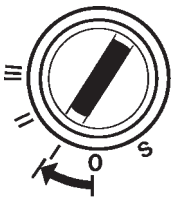
⚠ **WARNING!** Engines with intake air pre-heating: The starter element may cause an explosion in the inlet manifold. **Danger of personal injury.**

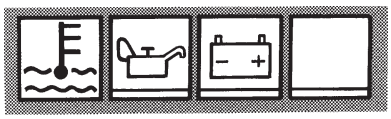




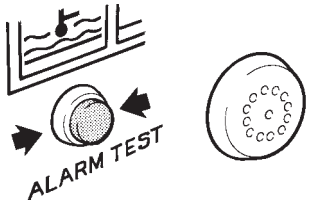
1. **Single lever control:** Check that the lever is in neutral “N”. This means that the throttle control is set to idling and the reverse gear is disengaged.

Dual lever control: Put the forward/reverse lever into neutral to start. Pull the throttle lever right back (idling position).

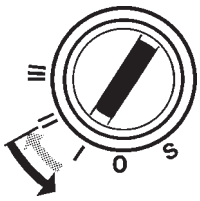


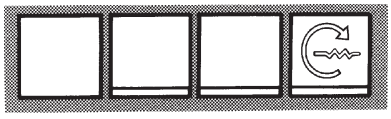


2. Put the key in the key switch. Turn it to the “I” position (operating position). All warning lights will come on and stay on for max. 20 s. The high coolant temperature warning light will then go off.



3. Push the “Alarm test” button and check that the alarm sounds (warning lights come on). The alarm will go off when the button is released.





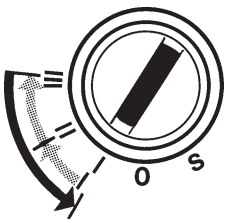
4. **Engines with a starter element***

Cold engine: Turn key to the “II” position. Hold the key in this position for approx. 50 seconds. The indicator light is on so the starter element is in circuit.

If the indicator lamp comes on while running the engine it means there is an open circuit in the starter element circuit.

Hot engine: Turn the key directly to position “III” to start.

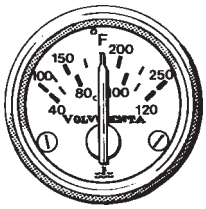
*** Note:** The starter element is available as an accessory on the TMD102A.



5. Turn the key to position “III” to start (after the indicator light has gone out in the case of engines with a starter element). Release the key as soon as the engine starts.

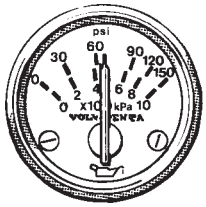
The key switch has a restart guard. The starting procedure must therefore always begin at the “S” position when making repeated attempts to start.

Warm up the engine at low speed and low load. **Do not race the engine while it is cold.**



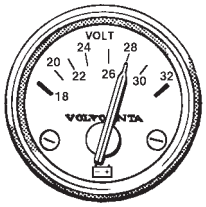
When warming up the engine, check that the instruments display normal values.

The needle on the temperature gauge should rise slowly up to operating temperature, 75–95°C (167–203°F).



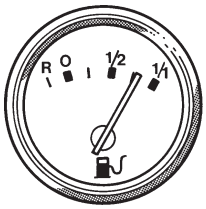
At operating speed, the engine's oil pressure gauge should show at least:

300–500 kPa
At low idle approx. 150 kPa

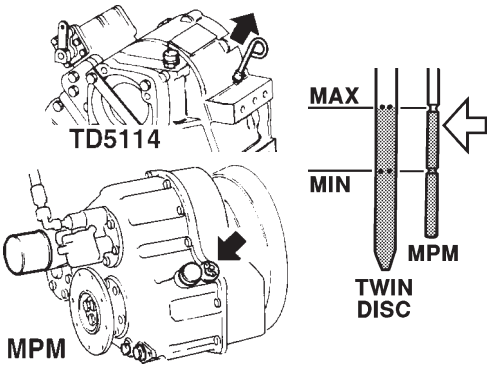


The system voltage should be approx. 28 V.

The warning lights should be off and the alarm silent.



Check the amount of fuel.



Check the oil level in the reverse gear when it has reached **operating temperature** (with the engine idling and the control in neutral). The oil level should reach the upper mark on the dipstick.

⚠ **N.B. Never break the circuit with the main switches while the engine is running.**

The voltage regulator and alternator may be seriously damaged.

The starter motor must **never** be engaged while the engine is running. The starter motor and starter gear on the flywheel may be seriously damaged.

Starting using auxiliary batteries

⚠ **WARNING!**

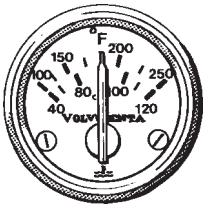
The batteries (auxiliary batteries in particular) contain extremely explosive oxyhydrogen gas. One spark, which may be formed if the auxiliary batteries are connected incorrectly, is sufficient to explode a battery and cause damage and injury.

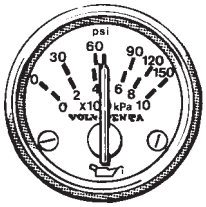
1. Check that the auxiliary batteries are connected (in series or in parallel) so that their rated voltage is the same as the engine's system voltage.
2. First connect the red jump lead (+) to the auxiliary battery, then to the discharged battery. Then connect the black jump lead (–) to the auxiliary battery, then to a spot **a distance from the discharged batteries**, for example at the main switch on the negative cable or at the negative cable's connection to the starter motor.
3. Start the engine. **N.B Do not shift the connections when attempting to start the engine (spark risk) and do not lean over any of the batteries.**
4. Remove the jump leads in exactly the opposite order to which you put them on. **N.B The normal leads to the standard batteries should under no circumstances be moved.**

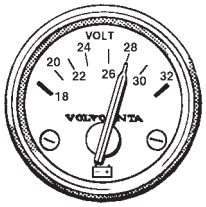
Checks during operation

The normal operating values are:

Engine coolant temperature	Oil pressure, engine	System voltage
75–95°C	300–500 kPa, at low idle approx. 150 kPa	28V







If the oil pressure drops, the temperature rises above the permitted values or there is a loss of charge, the alarm will sound and one of the warning lights will start to flash to show what the alarm is for.

If the alarm sounds:

- High coolant temperature: **Reduce the speed to idling (in neutral) until the temperature drops. Investigate the cause of the alarm** (e.g. blocked engine water intake). **Stop the engine if the temperature does not drop.**
- Low lubricating oil pressure: **Stop the engine immediately and investigate the cause of the alarm.**
- TAMD102, TAMD122 (keel cooled engine version): High charge air temperature: **Reduce the speed to idling (in neutral) until the temperature drops. Investigate the cause of the alarm** (e.g. clogged charge air cooler – CAC).

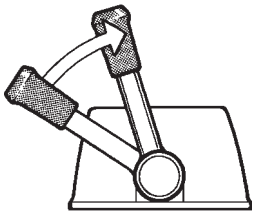
If an extra alarm panel is fitted, the alarm will also sound if the lubricating oil or coolant levels are too low before starting or if there is water in the extra fuel pre-filter. An extra alarm function may also be connected.

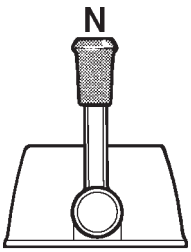
Note: If the engine is run continuously for long periods the engine oil level must be checked **at least once every day.**

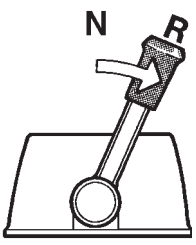
Maneuvering during operation

In all respects, economical operation is achieved by not cruising faster than is necessary. **The recommended cruising speed is the maximum speed which can be achieved at any given time minus 200 r/min.**

All forward/reverse maneuvering should be done at idling speed. Maneuvering at higher speeds may damage the reverse gear and will also be uncomfortable for those on board. Maneuver as follows:







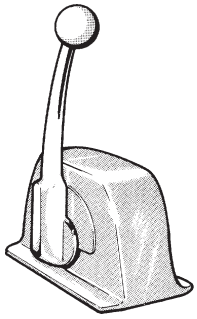
Reverse gear

1. Drop the speed to idling and. if possible, let the boat lose most of its speed.

2. Move the reverse gear control lever quickly and firmly into the neutral position, then wait for a moment.

3. Move the control lever quickly and firmly into reverse, then increase the speed.

Note: If the boat has two engines, it is vital that both engines are running, particularly when maneuvering forwards and backwards. If one engine has not been started and the other is used to reverse, water may enter the switched-off engine via the exhaust port and cause serious damage.



Type S controls for maneuvering trolling valve

The equipment shown on this page can be obtained only for propulsion engines in working boats.

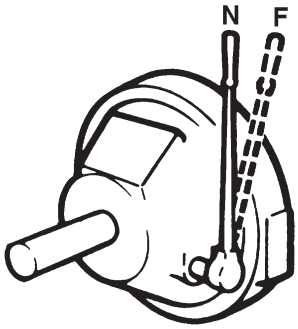
Trolling valve

If the reverse gear has a trolling valve (accessory), this should be used when the boat is to move very slowly.

Engage the trolling valve to max. slip when the reverse gear control is in neutral. After selecting “Forward” or “Reverse”, the trolling valve can then be set in the required trolling position within the permitted speed range.

⚠ **The engine speed must never exceed 1100 rpm. when using the trolling valve.**

Note: For full propeller power during operation, the trolling valve control lever should always be in the “Disengaged” position when the valve is not in use.

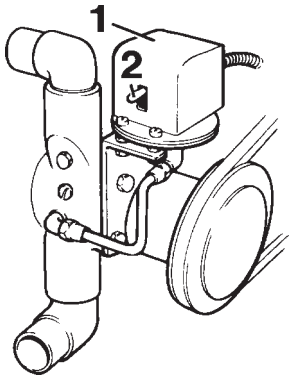


Disengageable clutch

F = Engaged
N = Neutral position.

Disengageable clutch

The clutches have two positions on the control lever. Lever towards engine for declutching, away from it for neutral. **When engaging and disengaging the clutch, the engine speed must not exceed 800 r/min.**



Bilge pump

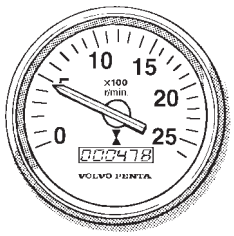
1. Vacuum switch
2. Actuating lever

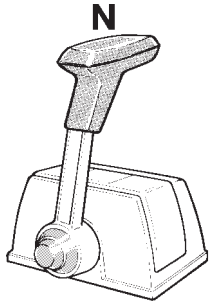
Disengageable scavenging/bilge pump

These pumps are engaged and disengaged via electromagnetic connections and switches on the instrument panel. The bilge pump has a vacuum switch which automatically disengages it when the level is so low that no water is being sucked into the pump. The vacuum switch also has a lever for manually engaging the pump.

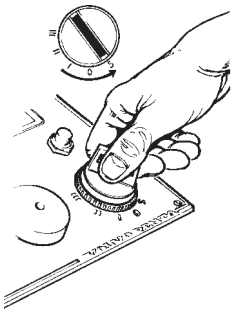
The lever should be depressed 20 s when engaging the pump.

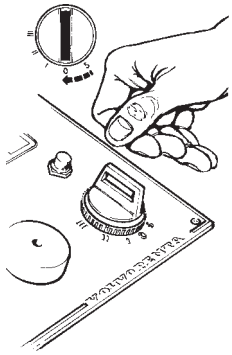
After operation



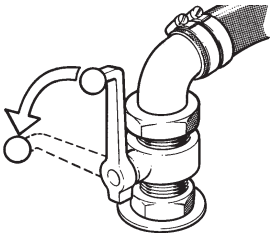


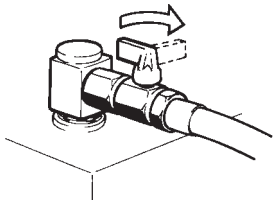
1. Let the engine idle for a few minutes with the reverse gear in neutral after landing. This will even out the engine temperature and prevent local overheating which may cause the coolant to boil.





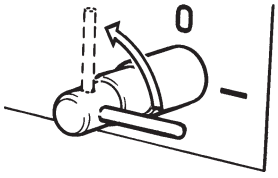
2. Turn the key to stop position “S”. Release the key when the engine has stopped (key will spring back automatically into the 0 position). The key can then be taken out.



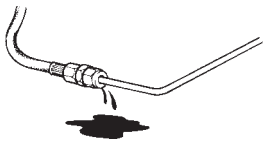


Safety measures:

3. Close the cooling water intake sea cock and the fuel cocks. For antifreeze protection, see “Coolant” on page 14. See also under the heading “Action when there is a risk of freezing” on the next page.



4. Switch off the main switches if the boat is not to be used for some time.



5. Inspect the engine and engine compartment for any leaks.

Propeller shaft brake

Under certain operating conditions, the propeller may make the propeller shaft rotate when the engine is stopped. This rotation may damage the reverse gear since its oil pump, which is driven by the integral shaft, stops when the engine stops.

The propeller shaft can be permitted to rotate with the engine stopped for up to 6–8 hours. After this time the engine must be started for at least 5 minutes to ensure the reverse gear is lubricated and cooled.

If the shaft may rotate more quickly than during normal operation, e.g. during sailing, a temperature gauge should be fitted which monitors the temperature of the oil.

The max. permitted temperatures are 110°C (230°F) for Twin Disc and 95°C (203°F) for MPM reverse gears.

If the above conditions cannot be met a brake must be installed. A temporary solution is to lock the propeller carrier mechanically instead.

Note: On Twin Disc MG514 the mechanical safety coupling can be engaged, see instructions on page 23.

Action when there is a risk of freezing

Check the antifreeze in the freshwater system after the engine has stopped if there is a risk of freezing. See under the heading. “Coolant” on page 16.

Drain the water from the seawater system as described below. Check that all the water has drained out.

Check the batteries as described on page 56. A poorly charged battery may easily burst as a result of freezing.

Draining coolant

Before draining the coolant, the engine should be stopped, the filler cap unscrewed and the boat’s sea cock closed. Then open the drain cocks or remove the drain plugs of the engine’s freshwater and seawater systems. See illustrations below.

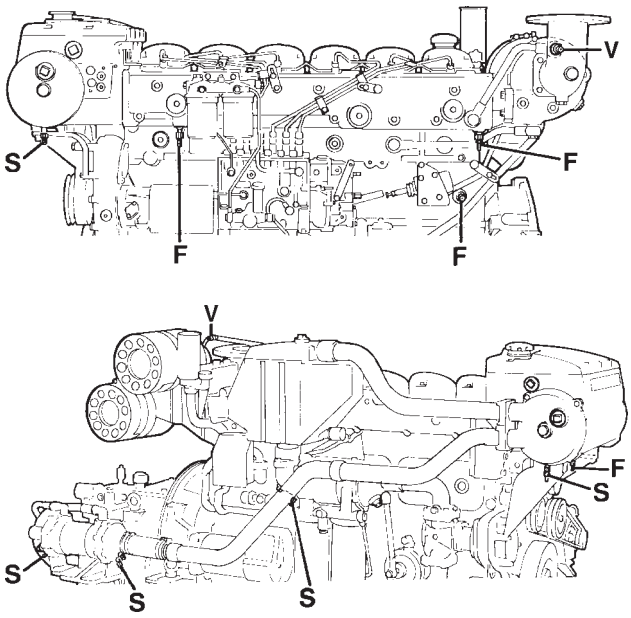
Check that all the water has drained out. There may be deposits inside the cock/plug which must be flushed away, otherwise there is a risk that water may remain in the system and cause serious damage.

Check whether the installation has any more cocks or plugs on the cooling water and exhaust pipes’ lowest points.

Remove the cover from the seawater pump and the cover on any extra pump.

Close the cocks, fit the plugs and put the cover on the seawater pump. Carry out same procedure on any extra pump installed. **Pump out the boat if required. Ensure that there are no leaks before you leave the boat.**

See the instructions on page 48 for topping up the coolant.



F = Freshwater cocks/plugs
S = Seawater cocks/plugs
V = Venting cock

Mechanical safety coupling

The Twin Disc reverse gear MG514 is equipped with a mechanical safety coupling on both “Forward” and “Reverse” engagements. **Only the engagement used for forward movement must be locked.**

Engagement

⚠ **Stop engine before engaging! There is otherwise a risk of serious personal injury.**

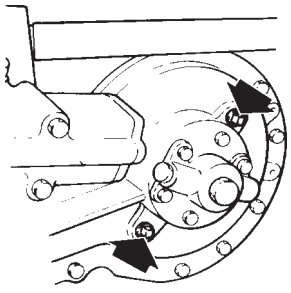
Unscrew the plugs on teh cover for the “Forward” clutch.

Turn the propeller shaft so that two of the locking screws in the clutch are centered in both the plug holes. Tighten the screws alternately using a 3/16" hexagon socket wrench. Turn the propeller shaft a further 1/4 turn and tighten the other two screws.

After engagement the input and output shafts are mechanically locked to each other and the reverse gear cannot be put in neutral. It is vital to ensure that the control lever is in the “Forward” position when the engine is running and the safety coupling is engaged. In any other position the clutch plates will be damaged.

On the grounds of safety it is best to detach the control cable from the reverse gear.

Start and run at reduced speed.



Plugs to remove when tightening locking screws in the safety coupling, Twin Disc MG514.

Maintenance and care

Periodic maintenance

If your engine and its fittings are to work perfectly, periodic maintenance in accordance with the maintenance schedule is required. Several of the items deal with the replacement of wear parts such as oil filters, fuel filters, etc.

To ensure continued trouble-free use of your engine, it is important always to use original spares. Always state the type designation and serial number of your engine and its fittings when ordering parts.

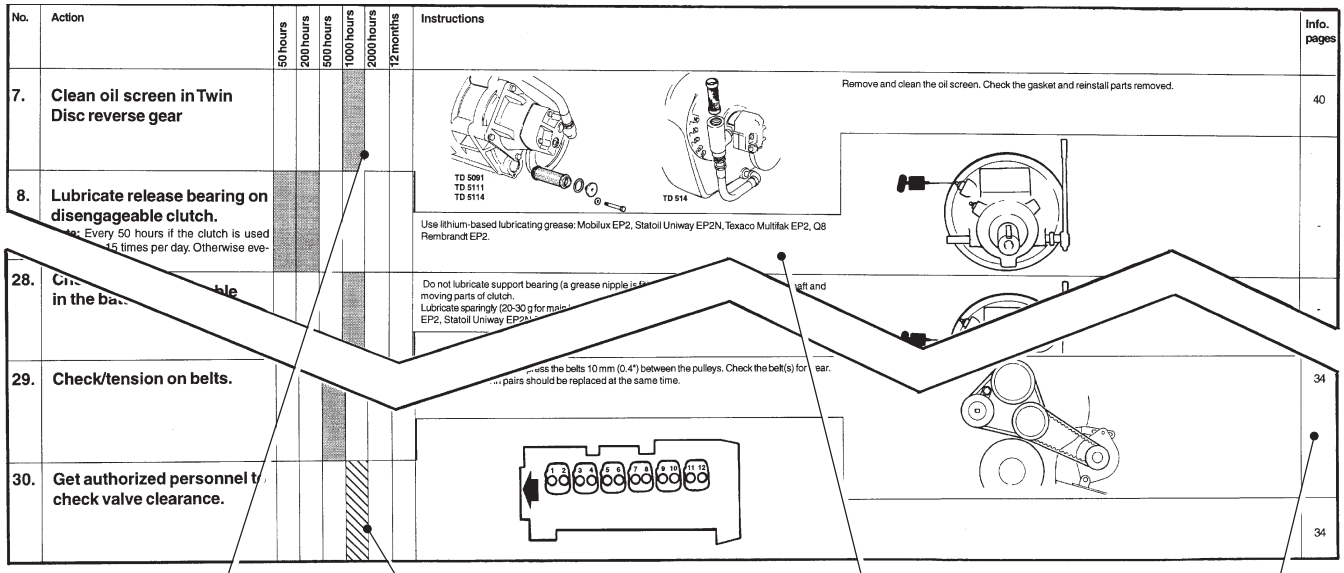
Some operations require professional experience and special tools. Therefore, get authorized service personnel to carry out more extensive work.

For further information, see under the heading “Maintenance” in accordance with the respective section in “Technical Description”.

New engine with reverse gear

See Running-in on page 4.

Layout of the maintenance schedule



Shaded area indicate simpler operations which the boatowner can carry out.

Stripes indicate operations which require experience and/or special tools. This work should therefore be left to authorized service personnel.

Under the heading **“Instructions”** is a brief summary of what should be rectified when carrying out the maintenance job in question.

Under the heading. **“Info. pages”** there are references to information pages further on in the manual. In most cases, these pages provide a more detailed description of the operations required.

Preventive Maintenance

To achieve maximum operating safety and service life, it is vital to maintain the engine and its fittings in accordance with the maintenance schedule. This gives instructions on when and how to carry out maintenance. Always consult an authorized Volvo Penta service dealer, who will have the equipment and trained staff to help you.

For boats used for commercial purposes, there is also a program of preventive maintenance known as ”Condition Test”, which is part of the ”Cost Control Program”. This program is carried out every 6 months, and every other time in accordance with an extended program.

A maintenance program well carried out gives better operating economy and fewer unplanned periods of non-operation.

Engine, oil change intervals

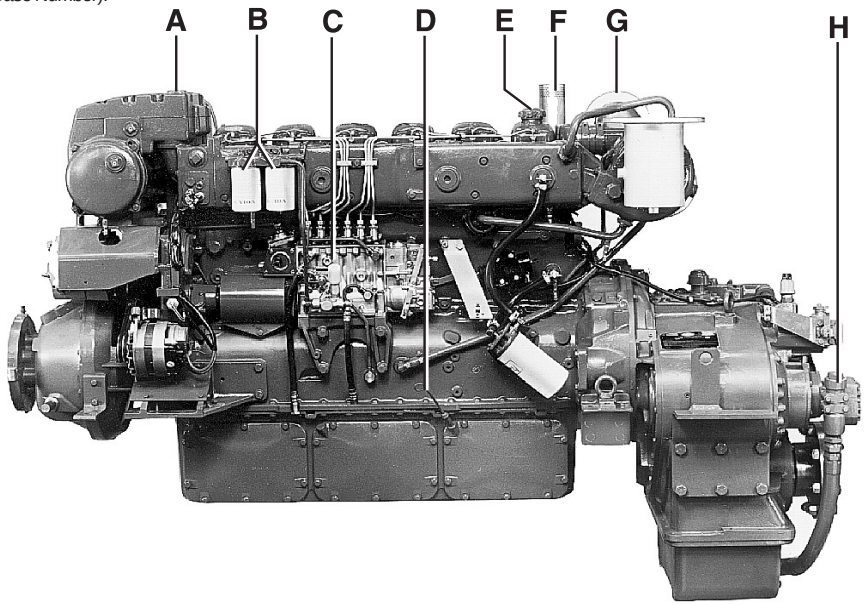
Dependent on the fuel’s sulfur content and the quality of the lubricating oil.

However, the oil should always be changed at least once a year even if the operating times in the table are not achieved.

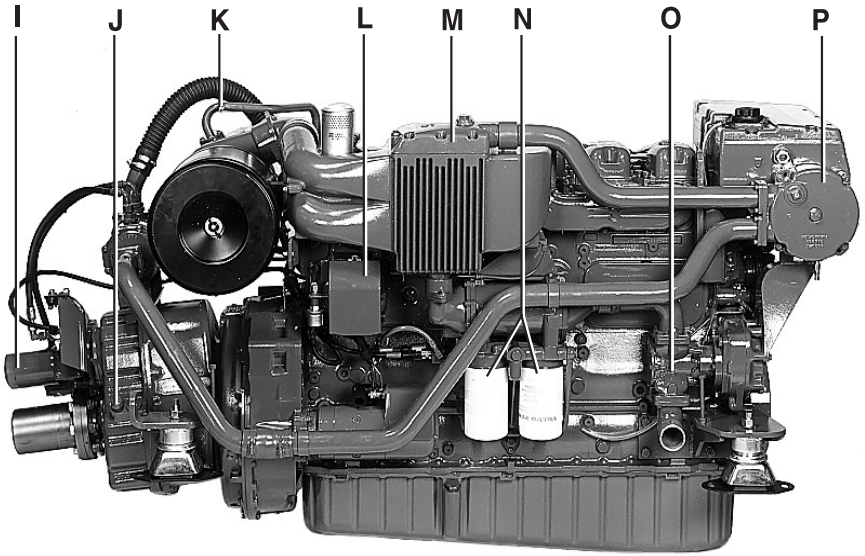
Engine	**Oil quality**	**Fuel sulfur content, % by weight**		
		<0.5	0.5–1.0	>1.0**
		Hours	**Hours**	**Hours**
TMD102A, TAMD102A/D, TMD122A, TAMD122A	VDS*	500	250	125
	API: CD or CE	250	125	60
TAMD122P	VDS*	250	125	60
	API: CD or CE	125	60	30

* VDS = “Volvo Drain Specification”

** In cases where diesel fuel with a sulphur content of more than 1% by weight, oil with a TBN>15 is recommended. (TBN = Total Base Number).



A. Engine coolant, checking and topping up
B. Fuel filter
C. Feeder pump, fuel hand pump
D. Oil dipstick
E. Topping up oil, engine.
F. Crankcase ventilation filter.
G. Air Cleaner (ACL)
H. Oil strainer, reverse gear.
I. Oil filter, reverse gear.
J. Oil dipstick, reverse gear.
K. Venting cock
L. Terminal box with semi-automatic fuses.
L. Oil dipstick, engine.
N. Oil filter, engine
O. Seawater pump.
P. Heat exchanger



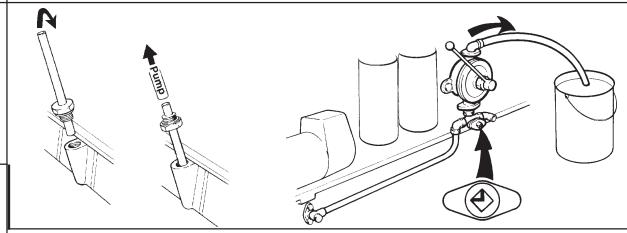
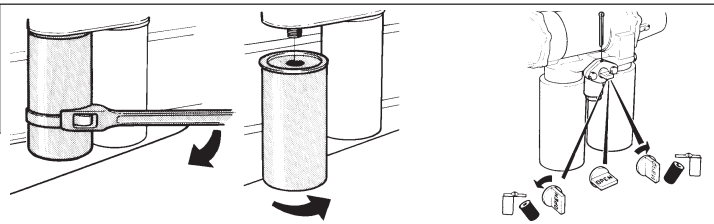
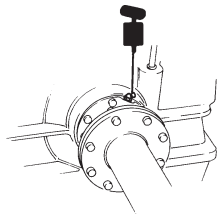
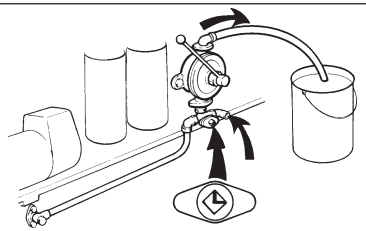
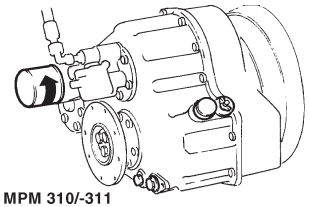
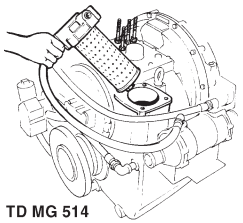
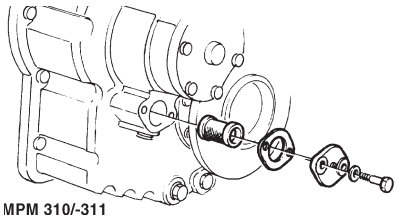
Maintenance Schedule

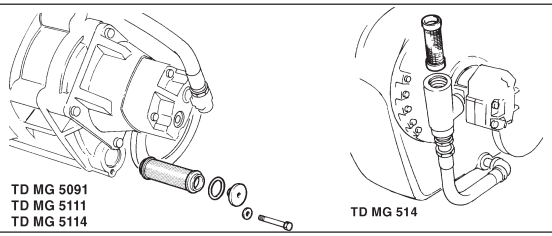
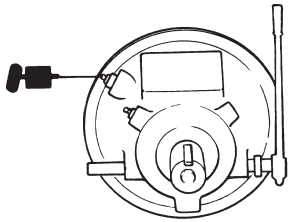
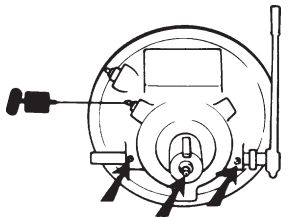
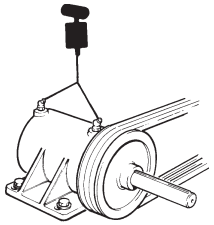
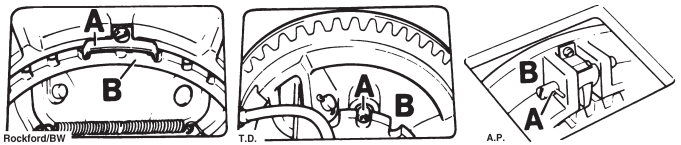
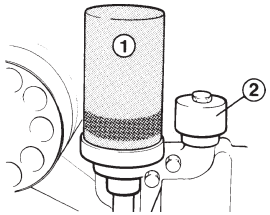
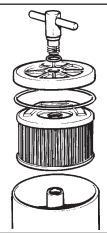
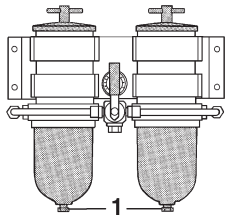
The operations apply generally for all 102 and 122 engines unless otherwise stated.

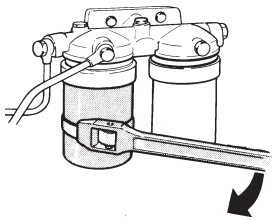
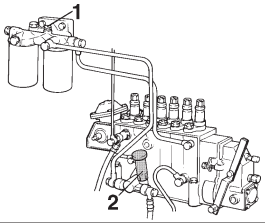
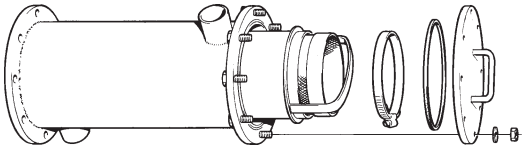
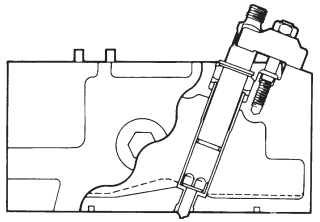
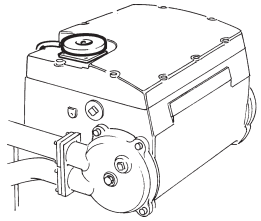
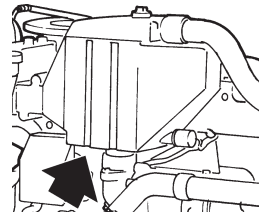
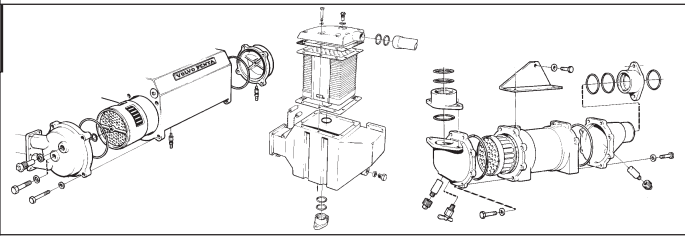
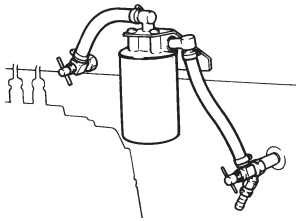
If longer intervals between oil changes ar required the condition of the oil must be checked by the manufacturer taking regular oil samples for testing.

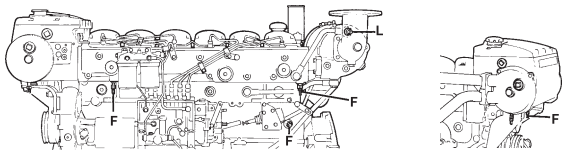
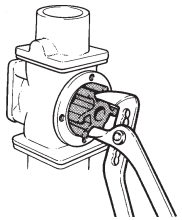
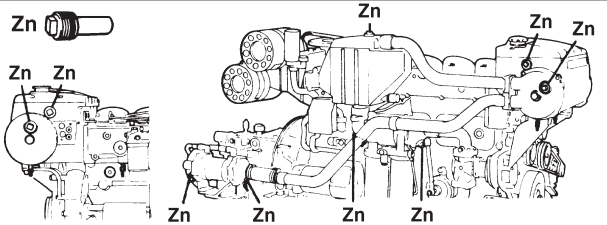
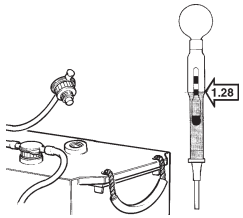
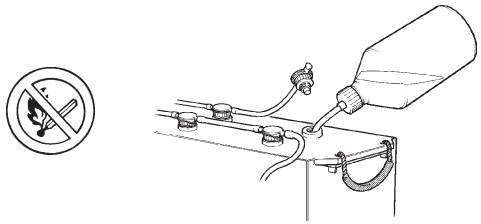
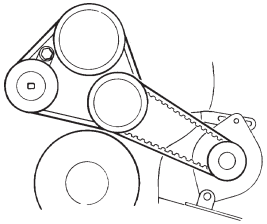
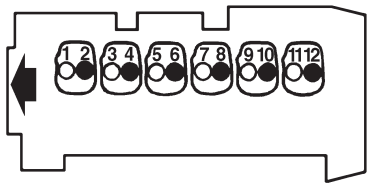
The intervals are given as a guide only apply to normal operating conditions. For new or reconditioned engines see information under the section ”Running in” on page 4.

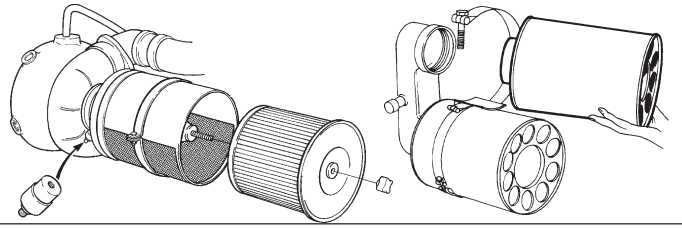
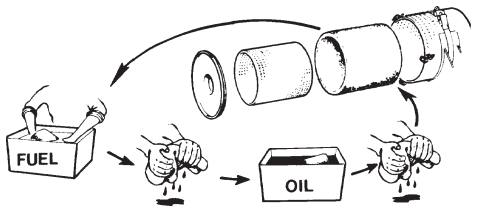
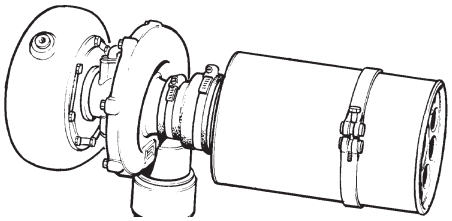
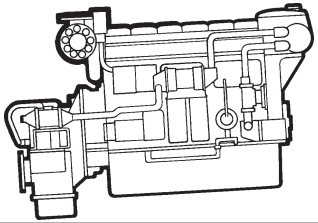
⚠ **Note: Stop the engine before starting any service procedures.**

No.	Action	50 hours	200 hours	500 hours	1000 hours	2000 hours	12 months	Instructions	Info. pages
1.	**Engine oil change** **Note:** See table ”Engine, oil change intervals” on page 25 for information about oil change intervals in relation to oil quality and the sulfur content of the fuel.							VDS engine oil or CD or CE in as per API system. Drain or pump out oil while engine is hot. Use the engine scavenging pump or remove the oil plug. Hot oil can cause burns.	38
2.	**Replace engine oil filters (when changing oil).**							 Remove the oil filter using the special tool. Lubricate gasket and screw on new filters by hand. Tighten a further 3/4 turn once gasket is in contact with the mounting. Top up oil, start, check for leaks. Stop engine and check oil level again. 	38-39
3.	**Lubricate seal at output shaft on Twin Disc reverse gear.**							Use a grease gun and lithium grease: Mobilux EP2, Statoil Uniway EP2N, Texaco Multifak EP2, Q8 Rembrandt EP2. 	–
4.	**Replace oil in reverse gear.**								39
5.	**Replace oil filter on MPM IRM 310, -311 and on Twin Disc MG 514 reverse gears.**							 MPM 310/-311  TD MG 514 Remove and clean the oil screen. Check the gasket. Reinstall the parts removed and check for leaks.	Remove the oil filter using the special tool. Lubricate gasket and screw on new filters by hand. Tighten a further 3/4 turn once gasket is in contact with the mounting.  MPM 310/-311	40
6.	**Clean oil screen MPM reverse gear**								40

No.	Action	50 hours	200 hours	500 hours	1000 hours	2000 hours	12 months	Instructions	Info. pages
7.	**Clean oil screen in Twin Disc reverse gear**							 Remove and clean the oil screen. Check the gasket and reinstall parts removed.	40
8.	**Lubricate release bearing on disengageable clutch.** **Note:** Every 50 hours if the clutch is used more than 15 times per day. Otherwise every 500 hours.							Use lithium-based lubricating grease: Mobilux EP2, Statoil Uniway EP2N, Texaco Multifak EP2, Q8 Rembrandt EP2. 	–
9.	**Lubricate disengageable clutch (if fitted).**							Lubricate inner support bearing (when a grease nipple is fitted), main bearings, disengaging shaft and moving parts of clutch mechanism. Lubricate sparingly (20–30 g for main bearings). Quality: Use lithium-based lubricating grease: Mobilux EP2, Statoil Uniway EP2N, Texaco Multifak EP2, Q8 Rembrandt EP2. 	–
10.	**Lubricate side mounted power take-off.**							 3–4 pumps on each nipple.	–
11.	**Check/adjust disengageable clutch (if fitted).**							 Adjustments must be made with the engine stopped. Remove the inspection cover. Release the catch (A) and turn the adjuster ring (B) counterclockwise (Rockford/BW), or clockwise (A.P. and T.D.). Lock the catch. The clutch plates must not slip after engagement.	40
12.	**Replace crankcase ventilation filter.** **Note:** The crankcase ventilation filter must be replaced when oil mist is forced out through the valve (2). 1) TAMD122P. 2) Other engines.		1)	2)				Remove the filter (1) by turning counterclockwise. Screw on the new filter by hand. 	34
13.	**Check/drain extra fuel filter**							Wait a few hours after the engine has been turned off before checking/draining the filter. Drain off water/contaminants through the cock/plug (1).  	43
14.	**Replace insert in extra fuel pre-filter.**							Alternatively change at a vacuum of 16–20 in Hg measured in the suction line between the filter and the feeder pump.	43

No.	Action	50 hours	200 hours	500 hours	1000 hours	2000 hours	12 months	Instructions	Info. pages
15.	**Replace fine fuel filters.**							 Remove the fuel filter using the special tool. Screw on the new filters by hand. Then turn a further half turn when the rubber gasket on the filter base in contact with the filter housing mounting. Vent fuel system. **Observe strict cleanliness!** The fuel in the system must not become contaminated.	43-44
16.	**Vent fuel system.**							Open vent screw (1). Pump with hand pump (2) until no air bubbles are visible in the fuel. Then pump a further 10–20 times with the hand pump. Tighten the venting screw (1). Check for leaks. **Observe strict cleanliness!** The fuel in the system must not become contaminated. 	44
17.	**Get authorized personnel to check injectors.**							If necessary take the injectors to an authorized workshop. Tightening torques: Injector 50 Nm (5 kpm), pressure line 15–25 Nm, (1.5–2.5 kpm)  	–
18.	**Check and clean seawater filter.** **Note:** The seawater filter can require cleaning more frequently (experience will indicate the best interval after a period of running the engine)							Close the sea cock. Remove cover and lift the insert. Clean insert and housing. Reinstall components. Open the sea cock and check for leaks. The picture shows the seawater filter turned 90° clockwise.	49
19.	**Top up anti-corrosive agent in freshwater system.** **Note:** Only if anti-freeze is not used or the freshwater filter is not installed.							  Add 1/2 liter anti-corrosion agent to the freshwater system (P/N 1141526-2).	–
20.	**Check the drainage hole in the charge air cooler (CAC) is not blocked.**							Clean if required. 	–
21.	**Replace freshwater filter.**							Not to be carried out at the same time the engine coolant is changed as the concentration of anti-corrosion agent in the coolant may be too high.  	–
22.	**Check/clean heat exchanger, charge air cooler (CAC), and the engine and reverse gear oil coolers.**							Close sea cock and drain the water from the seawater and freshwater systems.	49-50

No.	Action	50 hours	200 hours	500 hours	1000 hours	2000 hours	12 months	Instructions	Info. pages
23.	**Clean the engine coolant system and change coolant.** **Note:** If a freshwater filter is used change the coolant every 24 months.							 Close sea cock and drain the water from the seawater and freshwater systems.	23, 48
24.	**Check/replace impeller in the seawater pump.**								51
25.	**Check/replace zinc anodes.** **Note:** Replacement interval dependant on local conditions.							⚠ **WARNING!** Hot engine coolant can cause burns. When only 50% of the anodes remains they must be replaced. A good electrical contact is vital. Also replace the zinc anode on the reverse gear oil cooler. 	51
26.	**Check that no fuel, water or oil is leaking out.**							 Check all connections and check for leaks. Rubber hoses must not be cracked or damaged. All hose clamps and connections must be tight.	–
27.	**Check battery charge condition.**							 Check the batteries' charge condition using a hydrometer. At an ambient temperture of approx. +25°C (77°F) the battery electrolyte density should be 1.28 g/cm³ (1.24 g/cm³ with tropical acid). Charge the batteries if the density has dropped by 0.04 g/cm³.	56
28.	**Check the electrolyte level in the batteries.**							Distilled water approx. 10 mm (0.39") over cell plates. 	–
29.	**Check/tension on belts.**							It should be possible to depress the belts 10 mm (0.4") between the pulleys. Check the belt(s) for wear. Belts which work in pairs should be replaced at the same time. 	34
30.	**Get authorized personnel to check valve clearance.**								34

No.	Action	50 hours	200 hours	500 hours	1000 hours	2000 hours	12 months	Instructions	Info. pages
31.	**Check/replace air cleaner (ACL) filter.** **Note:** The filter must be changed when the ACL indicator shows all red field when engine stopped, every 2,000 hours or at least every 12 months.							 Take care that no contaminants enter the engine. Reset the air cleaner (ACL) filter indicator by pressing the button.	35
32.	**Clean Air Cleaner (TAMD102)**							Wash the insert in clean diesel oil and squeeze out excess. Dip the insert in clean engine oil and squeeze out excess. Reinstall the insert. If the air cleaner (ACL) insert is damaged it must be replaced. 	35
33.	**Check charge pressure and turbocharger condition.**								35
34.	**General inspection of engine and equipment.**								–

Engine

These engines are four-stroke, straight six marine diesel engines with overhead valves. They are fluid-cooled and equipped with turbochargers.

On the TAMD102A, TAMD102D, TAMD122A and TAMD122P engines the intake air to the engine is cooled by a sea-water cooled charge air cooler after being compressed in the turbocharger. The TMD102A and TMD122A engines do not have a charge air cooler.

The engines have piston cooling* (oil-cooled pistons). The engine lubrication system has full-flow, double oil filters

The cooling system is divided into a freshwater and a seawater system. The seawater system cools the freshwater system via a heat exchanger.

***Note:** The TMD102A engines do not have piston cooling.

Cylinder heads

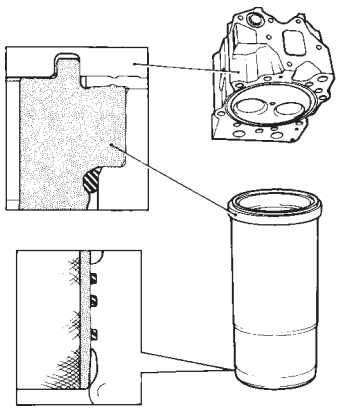
The engines have six separate cylinder heads, one for each cylinder. A special alloy cast iron material is used for the cylinder heads. The cylinder head gaskets are of steel plate. Between the cylinder head and the cylinder block are seperate rubber sealing rings for the coolant system galleries.

Valve system

The camshaft is driven by the timing gear. The camshaft actuates the inlet and outlet valves in the cylinder heads via lifters, push rods and rockers.

Cylinder block

The cylinder block is made of special alloy cast iron and cast in one piece. The cylinder liners are of the wet type and are replaceable. Liners on TMD122A, TAMD122A and TAMD122P engines have a flame barrier which considerably increases the service life of the cylinder head gaskets.

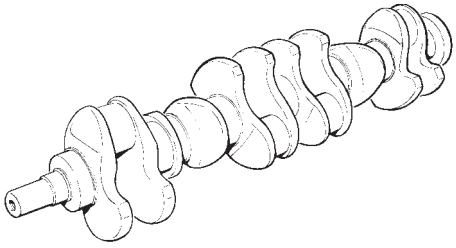


Cylinder head and the replaceable cylinder liner with flame barrier

Crankshaft

The heavy-duty crankshaft is extremely strong and is journalled in seven main bearings. The shaft is tempered using a special treatment (nitrocarburization). This increases the fatigue strength and gives the bearing journals an extremely hard surface.

The journal at the front of the crankshaft has been ground to a polygonal shape. A polygon joint can withstand the stresses from the vibration damper (extra pulley or disengageable clutch) considerably better than a keyed joint.



Crankshaft

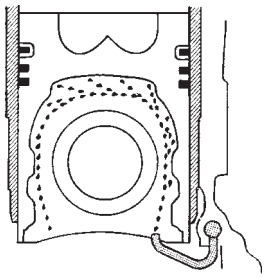
Pistons

The pistons are made of an aluminum alloy. The piston crowns are designed so the fuel/air mixture is distributed to optimize combustion.

The pistons have two compression rings and one oil scraper ring.

To reduce carbonization at high engine loads the pistons are oil cooled. The piston cooling increases the life of the pistons, piston rings and cylinder liners while reducing oil consumption on high performance engines.

The TMD102A engine has no piston cooling. Since the combustion chamber temperature on these engines is lower, no oil cooling is required.



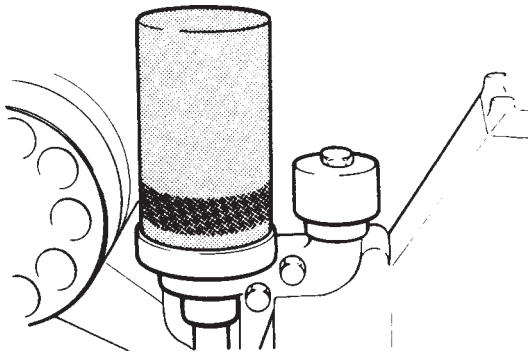
Piston cooling

Crankcase ventilation

The engines have ventilation devices to prevent overpressure and to seperate fuel fumes, water vapor and other gaseous combustion products. These are fitted on the right side of the engine and connected to the air cleaner (ACL).

Crankcase gases pass through a renewable paper filter which seperates oil mist from the gases. On the filter retainer there is also a relief valve which opens if the pressure in the crankcase is too high due to a clogged filter.

As an alternative the crankcase gases can also be led out from the engine room by a hose.



Crankcase ventilation filter

Timing gears

The camshaft, engine oil pump, injection pump, seawater pump and hydraulic pump, if fitted, are all driven off the crankshaft helical spur gears.

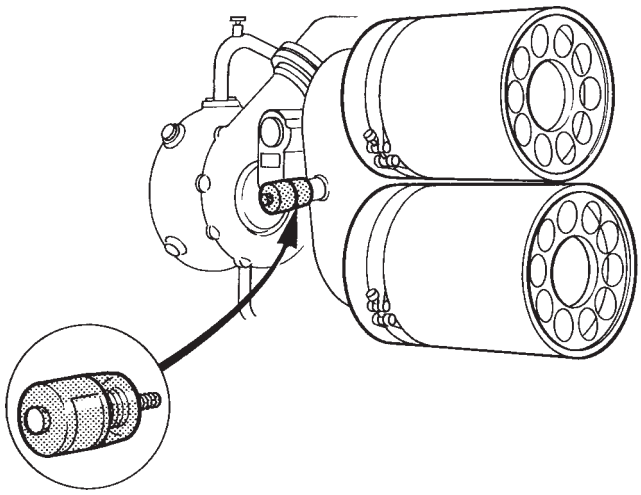
Helical spur gear wheels are used in order to keep engine noise to a minimum.

Air Cleaner (ACL)

The air cleaner prevents harmful particles from being sucked into the engine.

– The TAMD122P engine has a dry filter with a filter element (disposable) of folded paper.
– TAMD102A and TAMD102D engines have an air cleaner with a washable insert.
– Other engines have one or two completely replaceable air cleaners.

A pressure drop indicator is located on the air cleaner unit. When the indicator shows all red on an engine which is not running the air cleaner must be replaced with a new one.

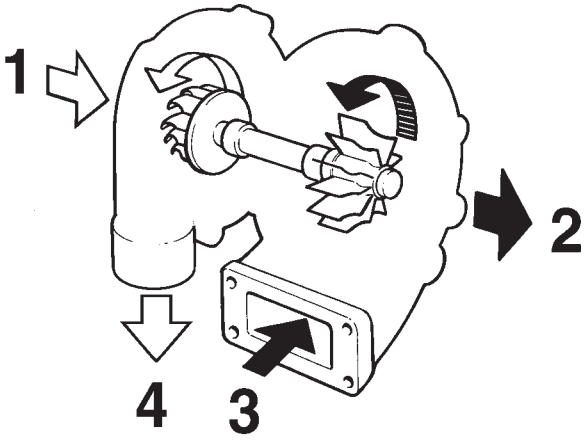


Air cleaner (ACL) with pressure drop indicator

Turbocharger

The engines are fitted with a turbo charger which ensures a flow of air to the engine under pressure and thereby increases the amount of oxygen to the engine. The compressor, which is fitted to the exhaust manifold at the rear of the engine, is lubricated and cooled by the engine's lubricating oil.

The turbocharger is freshwater cooled to reduce radiant heat in the engine room.



Turbocharger

1. Air from air cleaner (ACL)
2. Exhaust gases
3. Exhaust gases from engine
4. Compressed air to the engine

Charge air cooler (CAC)

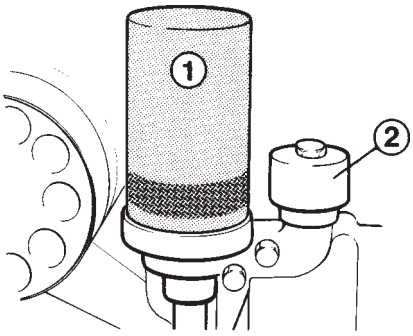
(TAMD102A, TAMD102D, TAMD122A and TAMD122P)

The intake air enters the charge air cooler after compression in the turbo compresser. The intercooler reduces the air temperature and thus improves the take-up capacity of the cylinders considerably because the volume of air is reduced. In this way more air (oxygen) can be forced into the cylinders. The engine burns more fuel per compression stroke and output is increased.

Charge air cooling also helps reduce the thermal load on the engine.

Replacing crankcase ventilation filter

1. Remove the old filter by unscrewing it counterclockwise.
2. Check the rubber gasket in the bracket, replace if necessary. Screw on the new filter by hand.



Crankcase ventilation air cleaner filter

1. Filter 2. Relief valve

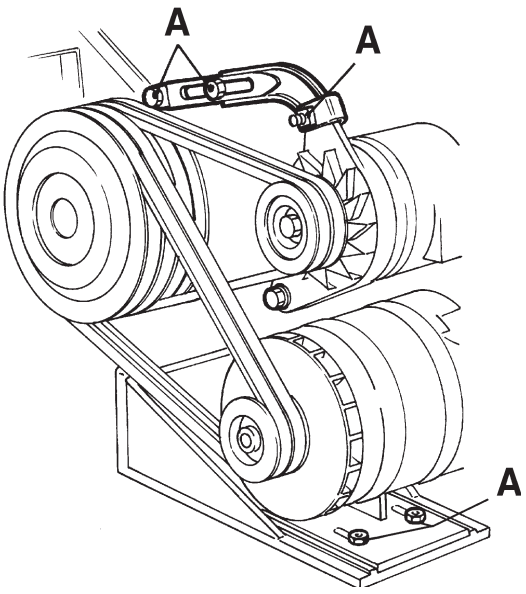
Inspecting/adjusting belt tension

Check the belt(s) for wear. Belts which work in pairs should be replaced at the same time.

Undo the screws (A) before tensioning the generator belts.

It should be possible to depress the belts 10 mm (0.4") between the pulleys at the correct tension.

Tighten screws (A).

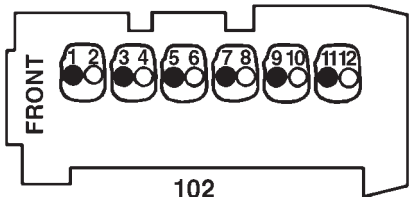


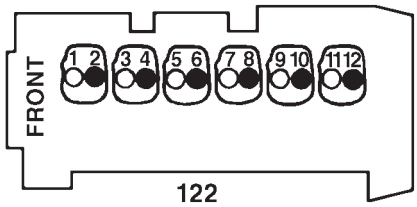
A. Locking screws (the illustration shows an engine with extra generator)

Checking valve clearance

This check should be left to authorized service personnel.

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





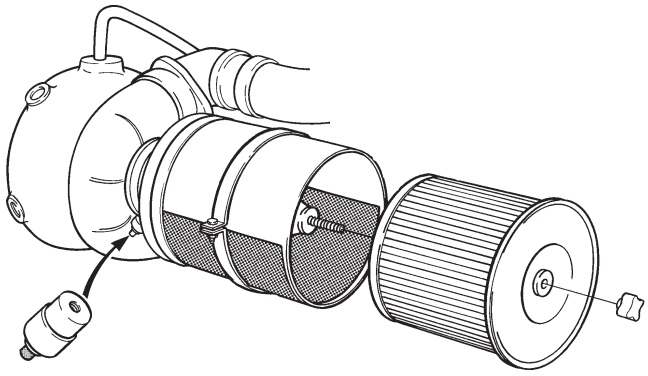
Valve location

❍ Inlet ● Outlet

Replacement/cleaning of air cleaner (ACL) filter

TMD102A engines have a single renewable ACL filter. TMD122A and TAMD122A engines have double ACL filters. These can be replaced after the clamp(s) have been detached.

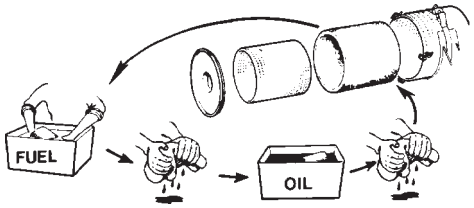
TAMD122P engines have a renewable ACL insert filter. The ACL can be replaced by unscrewing it from the center stud.



Air cleaner (ACL) insert and pressure drop indicator, TAMD122P

The ACL filter insert on TAMD102 engines is reusable and should only be replaced if it has been damaged. Clean the insert as follows:

1. Lift out insert from ACL. If the insert is damaged it must be replaced.
2. Wash insert in clean diesel oil. Squeeze out excess diesel oil.
3. Dip the insert in clean engine oil. Squeeze out excess engine oil.
4. Reinstall filter insert. Reinstall cover.



Washable air cleaner (ACL) filter insert on TAMD102A and TAMD102D engines

Checking turbocharger

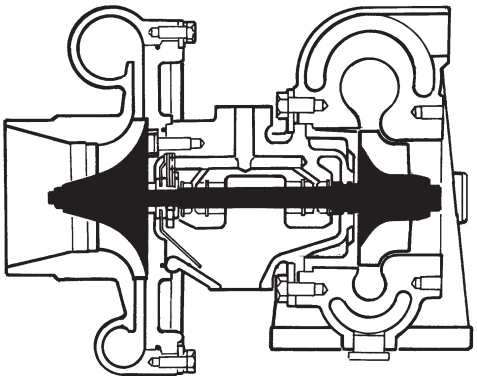
This check should be left to authorized service personnel.

However a general check of the turbocharger can be made when replacing/cleaning the air cleaner (ACL) as follows:

1. Remove ACL.
2. ⚠ **Warning! Check that the turbocharger's impeller is stationary before checking.**
3. Check if the rotor shaft is stiff or if the turbine or impeller is contacting its respective housing. Turn the rotor, 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.

Note: If the turbocharger unit is to function satisfactorily, it is vital that the engine's lubrication system be maintained according to the maintenance schedule and that the correct type of lubricating oil be used in the engine.



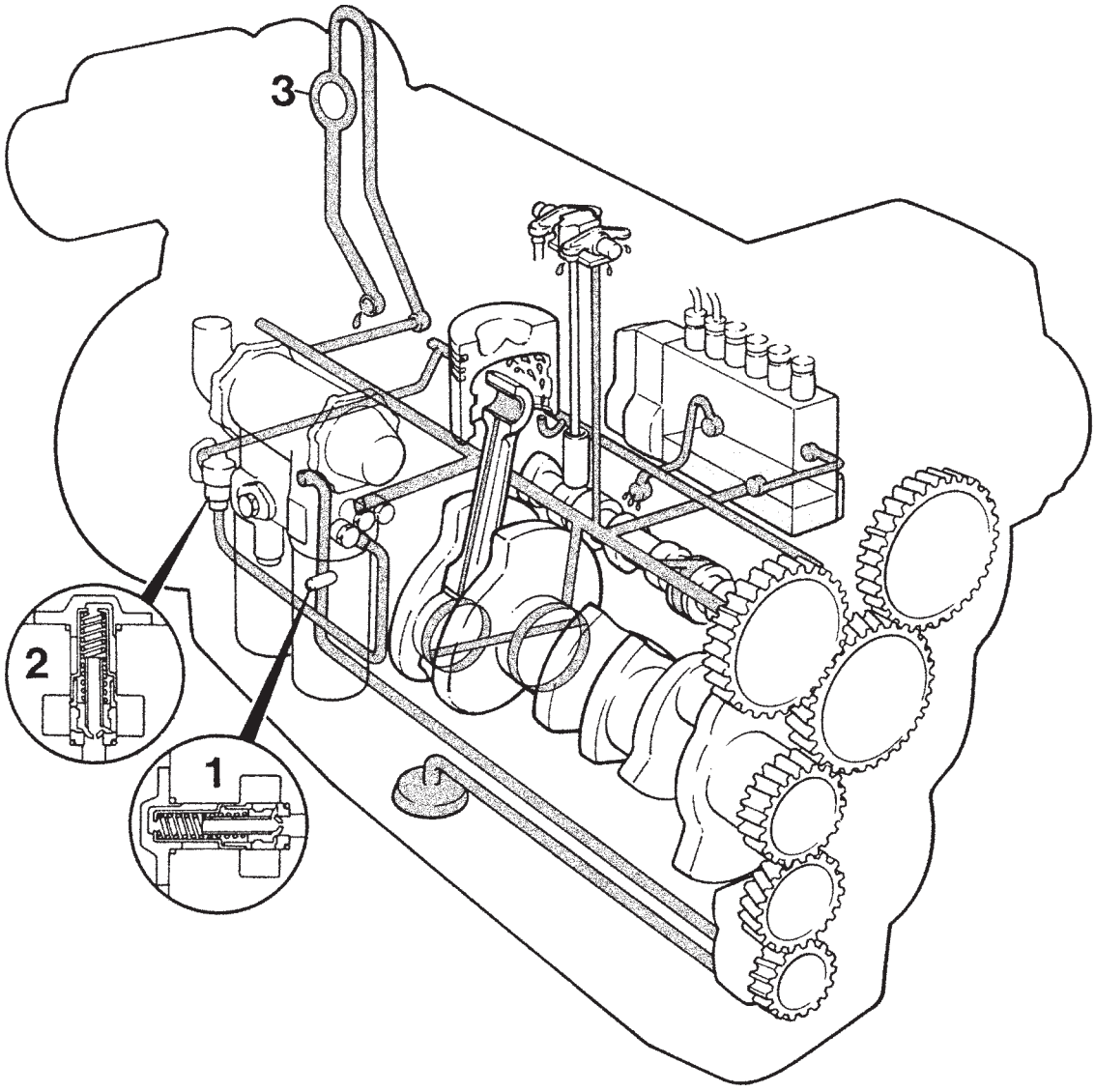
Turbocharger rotor shaft

Lubrication System

The oil pump is driven by the crankshaft via an intermediate gear. Oil under pressure flows through the oil cooler from the oil pump, through the oil filter and out into the lubrication system channels.

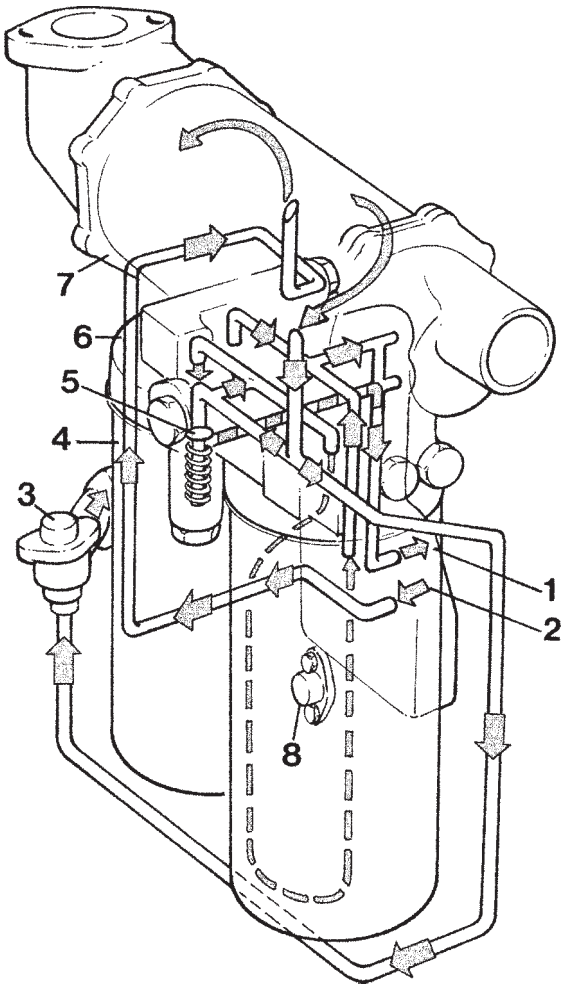
All bearings and journals as well as the valve mechanism and timing gears are pressure lubricated. The injection pump and turbocharger are also lubricated by the engine lubrication system.

Except for the TMD102A all the engines have injected oil piston cooling where each cylinder has a fixed jet that sprays oil upward against the bottom of the piston.



Lubrication system, TMD122 and TAMD122 engines

1. Reduction valve
2. Piston cooling valve
3. Turbocharger



Lubrication system, oil filter mounting TMD122 and TAMD122 engines

1. Oil to lubrication point
2. Oil from oil pump
3. Piston cooling valve
4. Oil filter
5. Overflow valve
6. Filter mounting
7 Oil cooler
8. Bypass valve

Valves in the lubrication system

Three springloaded valves control the oil flow in the engine. These are located at the oil filter bracket on the right of the engine.

– **The piston cooling valve*** (3) opens when the engine speed (rpm) exceeds the idle speed and directs the oil via outlet to the piston cooling oil channel in the cylinder head. There are six jets, one for each cylinder, connected to the piston cooling oil channels. These spray oil on the bottom of the piston.

– **The oil filter relief valve** (5) opens if the filter is clogged and allows unfiltered oil to lubricate the engine.

– **The by-pass valve** (8) opens if the oil pressure is too high and directs the excess oil back to the oil pan.

***Note:** The TMD 102 does not have a piston cooling valve. The piston cooling valve on the TAMD102 is located in the cylinder block on the port side of the engine behind the injection pump. The valve is connected to the engine oil filter mounting by a transverse pressure line.

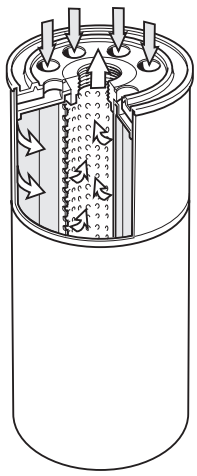
Oil cooler

The engine oil temperature is maintained at a relatively low level by the oil cooler which ensures less wear and retention of the oil's lubricating properties.

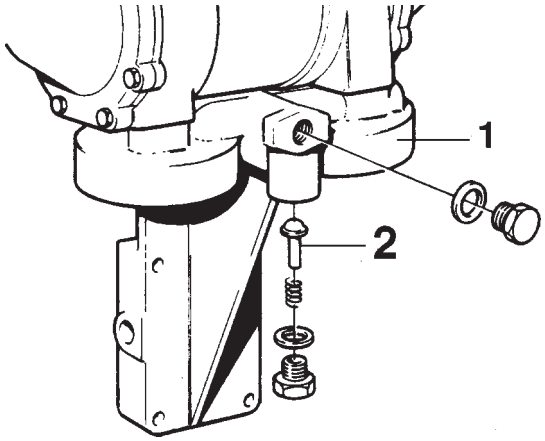
Oil filter

The oil filter is of the full-flow type, that is to say all the oil passes through the filter before entering the engine lubrication system. The filter insert is of folded paper.

The overflow valve which allows oil to directly by-pass the filter if the insert is clogged, is located in the filter bracket.



Oil filter



Filter bracket

1. Filter bracket
2. Overflow valve

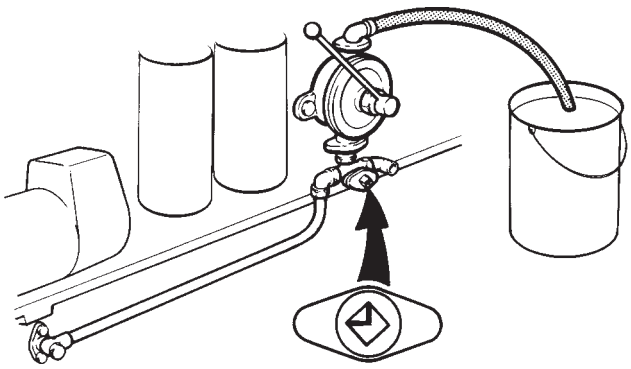
Engine oil change

The oil should be changed when the engine is hot.

Warning! Hot oil can cause burns.

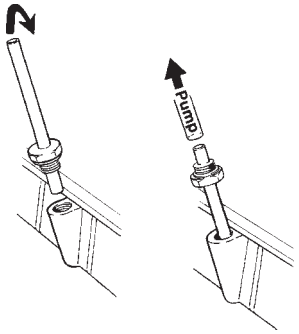
The engine oil can be changed in different ways depending on the engine equipment installed.

Engines with manual oil scavenging pump installed on the engine: Turn the knob under the pump housing to engine pumping position. Pump out the oil and collect in a container.



Pumping out oil with manual pump

Engines with power oil scavenging pump (accessory)*: Remove the oil dipstick and remove the oil dipstick tube. Reverse the tube and insert in to the oil pan, connect the suction pipe to the tube.



Oil dipstick tube when pumping out oil using a power pump

***Note:** The power pump (accessory) can also be used for filling the engine oil (reverse the + and – leads on the power scavenging pump). Refer to the Wiring Diagram on page 61.

The oil can also be drained by removing the oil pan drain plug.

Fill engine with oil through the oil filler cap on the rear valve cover.

Oil quality: refer to “Engine, Oil change intervals” on page 25. Quality and capacity, refer to “Technical Data” on page 70.

The oil level should be within the marked area on the dipstick. **The level must never be allowed to drop beneath the lower mark.**

Note! Collect up the old oil and deposit at a proper site for disposal. Never discharge oil into the environment.

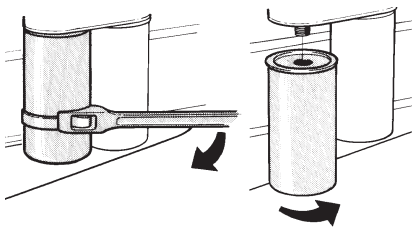
Oil filter replacement

Note: Place a container beneath the filter when removing to avoid spillage.

1. Unscrew the oil filter using the special tool, discard the filter.

   Warning! Hot oil can cause burns.

2. Lightly moisten the new filter’s rubber gasket and check its mating surface with the mounting.
3. Screw on the new filter by hand until the gasket is in contact with the sealing surface. The tighten the filter a further 3/4 turn (approx.).
4. Replace both oil filters.
5. Fill with oil, start the engine and check for leaks. Stop engine and check the oil level.

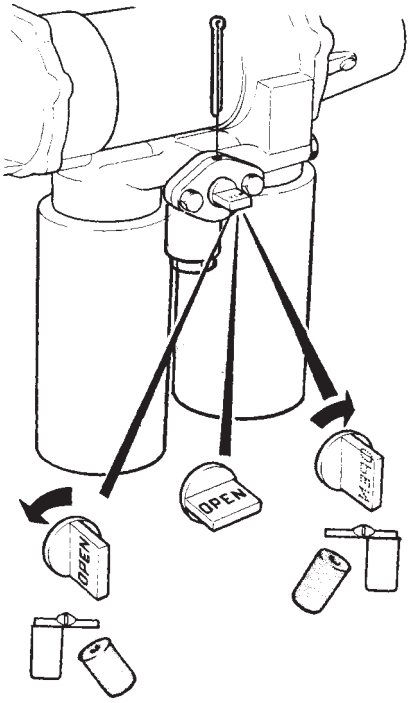


Oil filter replacement

Replacement of oil filters with switchable filters

These filters can be replaced while the engine is running

1. Remove the locking pin.
2. Turn the tap counterclockwise and replace the right filter according to “Oil filter replacement” operations 1–3.
3. Turn the tap clockwise and replace the left filter according to “Oil filter replacement” operations 1–3.
4. Turn the tap to the horizontal position. Install the locking pin.



Replacement of switchable oil filters with engine running

Oil Change – Reverse Gear

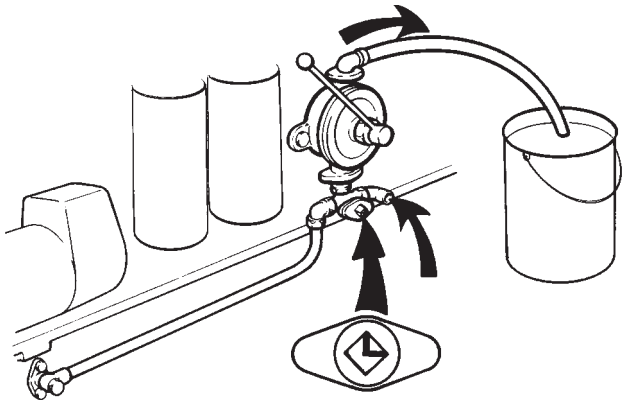
Connect a hose from the oil scavenging pump to the oil dipstick tube on the reverse gear. Turn the know under the pump housing to the position for pumping the reverse gear.

Alternatively, drain the oil by removing the drain plug.

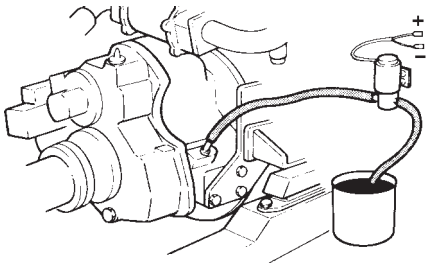
See also. “Oil change – Engine”.

1. Fill with oil through the filler opening on the top of the reverse gear. For oil quality and capacity, see “Technical Data” on pages 72–73.
2. Start the engine and run it until the reverse gear reaches **operating temperature**.
3. Check the oil level with the engine idling and with the neutral position selected.

   The oil level should reach the upper mark on the dipstick. Top up if required.



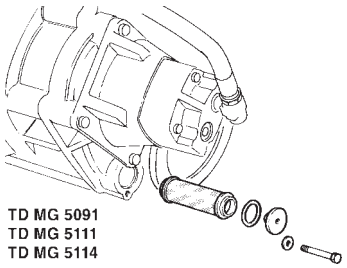
Pumping out oil from the reverse gear using a hand pump

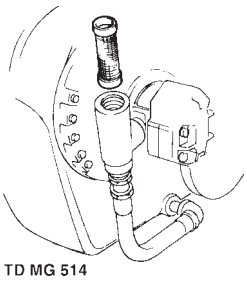


Pumping out oil from the reverse gear using a power pump.

Cleaning the reverse gear oil screen.

Remove and clean the oil screen. Check gaskets. Reinstall the parts removed and check for leaks.

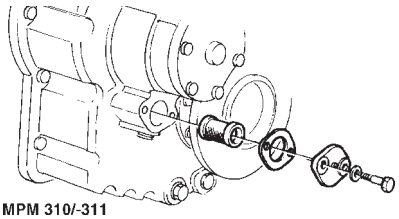

TD MG 5091
TD MG 5111
TD MG 5114


TD MG 514

Reverse gear oil filter replacement.

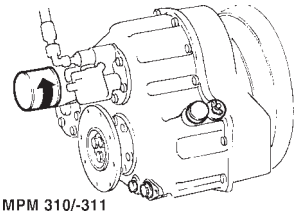
MPM IRM 310/311

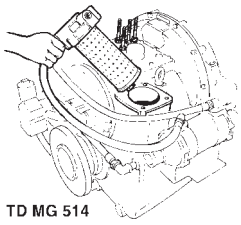
Remove the oil filter using the special tool. Moisten the filter gasket with oil and screw into position by hand. Tighten filter in place with a further 3/4 turn when the gasket is contacting the mating surface.


MPM 310/-311

Twin Disc MG 514

Remove four screws. Install new oil filter.


MPM 310/-311


TD MG 514

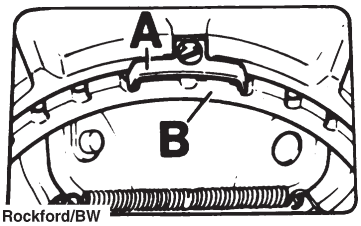
Check/adjust disengageable clutch

Adjustment

Turn off the engine and move the clutch lever to the neutral position. Remove the inspection cover and turn the clutch unitl the locking unit on the adjuster ring is accessible. The locking unit can be of different designs depending on the manufacturer (see illustrations).

Rockford/BW

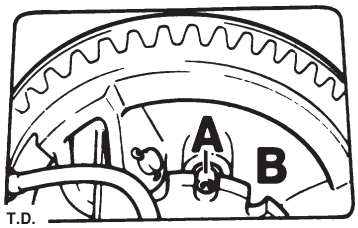
1. Undo the locking plate (A) and turn the adjuster ring (B) so many marks to the left that considerable force is required to move the lever in order to engage the clutch.
2. Tighten the locking plate and reinstall the inspection cover.



Rockford/BW

Twin Disc (T.D.)

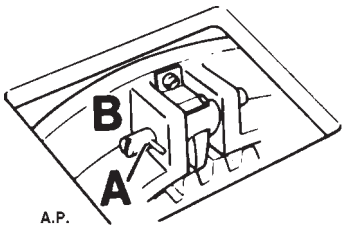
1. Press in the locking pin (A) and turn the adjuster ring (B) so many marks to the right that considerable force is required to engage the clutch.
2. Tighten the inspection cover.



T.D.

Automotive Products (A.P.)

1. Undo the locking screw (A) and turn the adjuster ring (B) until a considerable force is required to move the lever in order to engage the clutch.
2. Tighten the locking screw so that it engages in between two gear teeth. Tighten the inspection cover.



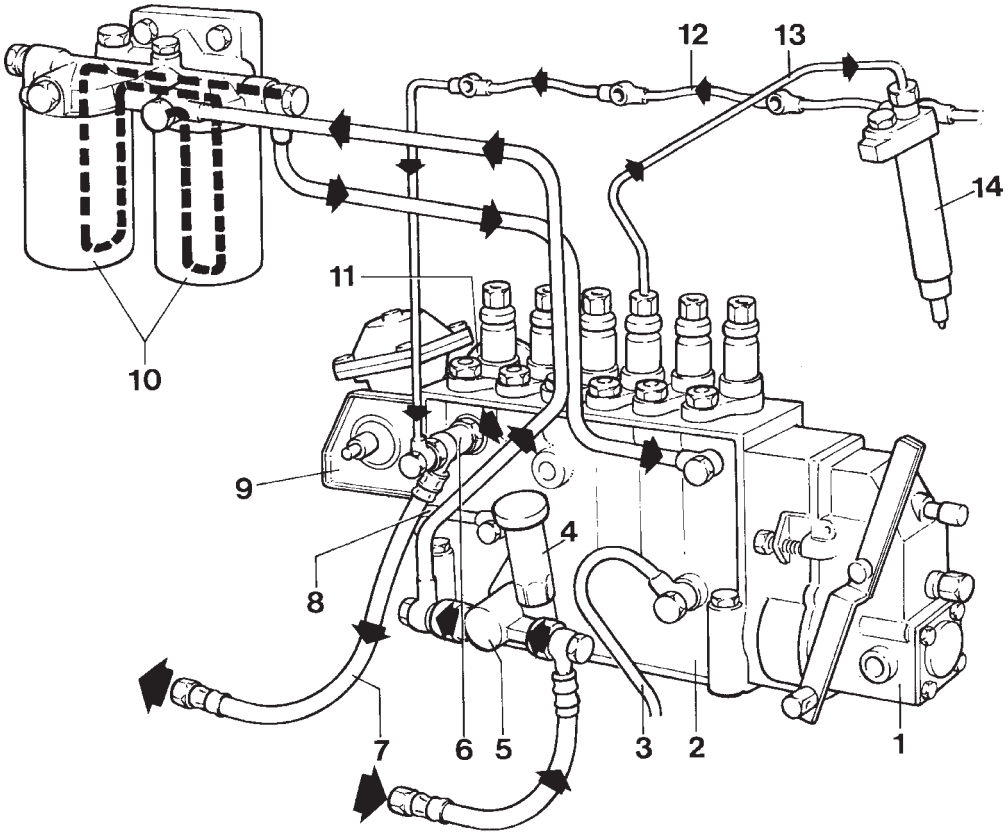
A.P.

Fuel system

The fuel is drawn up by the feed pump from the fuel tank through the pre-filters and is forced through the fine filters to the injection pump.

The injection pump then forces the fuel at high pressure into the injectors. The fuel is atomized when it is sprayed into the combustion chamber where a powerful air rotation assists uniform combustion of the mixture.

Excess fuel and leak-off from the injectors is returned to the fuel tank via the overflow valve. This valve is located on the injection pump.

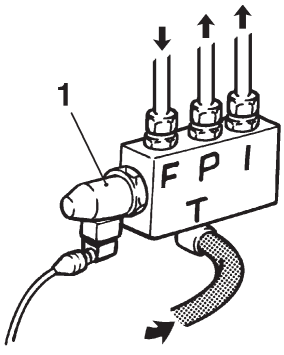


Fuel system

1. Regulator
2. Injection pump
3. Return pipe, lubricating oil
4. Hand pump
5. Feed pump
6. Overflow valve
7. Return pipe to fuel tank
8. Lubricating oil pipe, inlet
9. Smoke limiter
10. Fuel filter
11. Pressure equalizer
12. Leak-off line
13. Pressure pipe
14. Injector

Solenoid valve (fuel cut-off valve) for stopping engine

1. Solenoid valve



Connections in valve housing, marking:

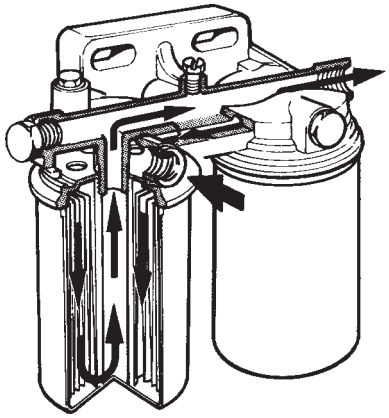
- T. Inlet from fuel tank (**T**ank)
- P. Outlet to feed pump (**P**ump)
- F. Inlet from fuel filters (**F**ilter)
- I. Outlet to injection pump (**I**njection pump)

Fuel filters

The fuel system has two fine fuel filters connected in parallel but with a common cover. These filters are disposable, and the filter insert is made of a spirally wound paper filter.

A double water-separating pre-filter is also available as an accessory. The inserts of the double pre-filter can be replaced while the engine is running if necessary.

It is important to replace the fuel filters according to the maintenance schedule. Clogged filters make the engine difficult to start and reduce engine performance.



Fine fuel filters, flow

Injection pump

The injection pump is located on the left side of the engine and is driven by the timing gears. The pump, which is of piston type, has a centrifugal governor. This governor regulates the fuel feed to the engine so that the speed set by the driver using the control is achieved. It also limits the engine's max. speed if the load should suddenly drop.

Pressure-dependent full load stop (smoke limiter)

The injection pump has a pressure-dependent full load stop (smoke limiter) which is located at the front of the pump. The smoke limiter reduces sooty exhaust gases during hard acceleration from low speeds when the flow of exhaust gases through the turbocharger results in a low turbo pressure and too little air in proportion to the amount of fuel injected by the injection pump. The smoke limiter is connected to the inlet manifold via a plastic tube.

Feed pump

If the injection pump is to work, it requires a supply of fuel at pressure. This is provided by the feed pump, which is of piston type. The feed pump is located on the injection pump and is driven by the injection pump's camshaft.

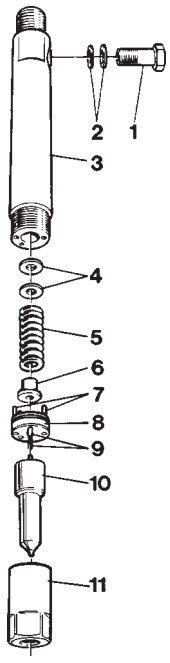
The feed pressure is determined by an overflow valve located on the injection pump. This valve both limits the feed pump pressure and ensures continuous venting of the fuel system.

When the engine is off, it is possible using the feed pump's hand pump to pump fuel to the filters and injection pump when venting the fuel system, e.g. after replacing the fuel filters.

Injectors

The job of the injectors is to atomize and spray the fuel, metered precisely by the injection pump, into the engine's combustion chambers. This injection takes place under extremely high pressure so that atomization and combustion of the fuel takes place as effectively as possible. The tension of the pressure spring determines the opening pressure of the injector.

The injectors should be checked regularly by authorized personnel, refer to maintenenance chart. An incorrect opening pressure or faulty nozzle will result in smoky exhaust gases and lower engine output.



Injectors

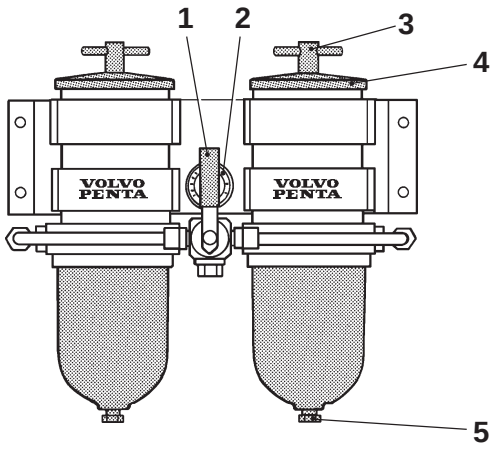
1. Union screw
2. Gaskets.
3. Injector mounting
4. Adjustment washers
5. Spring
6. Thrust pin
7. Guide pins
8. Guide
9. Guide pins
10. Jet
11. Jet nut

Maintenance – Fuel System

Checking/draining fuel pre-filters

Check the fuel filter and drain off any water and contaminants through the drain plugs (5).

The engine should be off and allowed to stand for a few hours before carrying out this check. Reinstall the plugs.



Double pre-filters

1. Line valve knob (both filters connectred in this position)
2. Pressure gauge
3. Retaining screw
4. Cover
5. Drain plug

Fuel pre-filter – insert replacement

The inserts can be cleaned and replaced while the engine is running.

As a rule, the filter inserts should be replaced when the pressure gauge indicates a vacuum of 6–10 in. Hg* (idle) 16–20 in respectively. Hg (max. rpm, loaded engine). However, filters must be replaced every **1000 hours.**

Close the fuel taps at the tank if the double filter insert is to be replaced when the engine is not running.

If inserts are to be replaced when the engine is running, shut off the container with the insert to be replaced by turning the valve handle (1) to the horizontal position.

***Note!** In. Hg = Inches of mercury.

Positions of the valve knob

Up: Normal operating position. Both filters on line.

Right: Left side filter insert can be replaced.

Left: Right side filter insert can be replaced.

Down: Both filters are off line.

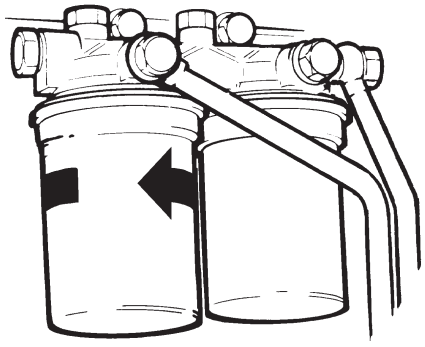
1. Place a container beneath the fuel filters. Remove the cover (4) and lift out the insert by rotating it.
2. Drain off any water or contaminants through the drain plug (5).
3. Install new filter insert and fill container with clean diesel oil. Fit the cover with a new gasket and tighten it by hand.

   Note: Moisten the gasket with diesel oil before installation.

   Cleanliness! The fuel in the system must not become contaminated.
4. Replace the other filter insert in the same way.
5. Dry off any diesel fuel spilt on the heat shield.
6. Turn the line valve knob to the vertical position to put both fuel filters on line again.
7. Open the fuel line taps and check that there are no leaks.

Fuel fine filter, replacement

1. Clean the filter mounting carefully.
2. Unsrew the old fuel filters and discard. If necessary, use a special tool to remove.
3 Check that the new filters are absolutely clean and that the gaskets are undamaged. Lightly moisten the gaskets with oil.
4. Screw on the new filters by hand until the gaskets come into contact with the filter mounting. Then tighten **a further half turn** by hand.
5. Vent the fuel system according to the instructions on the next page. Start the engine and check for leakage around the filters.

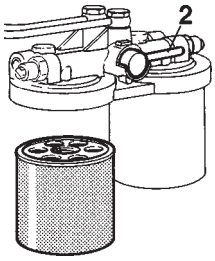


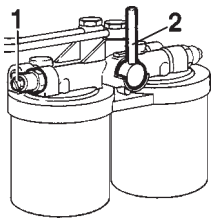
Replacing the fine fuel filters

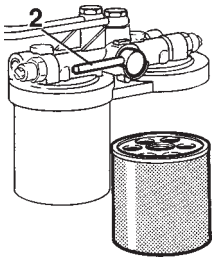
Switchable fine fuel filters

(Replacing while engine is running)

1. Place a container beneath the fuel filters. Carefully clean the filter mounting.
2. Valve lever (2) in the filter cover to its **right** end position.
3. Unscrew the **left** fuel filter and discard it. If necessary, use a special tool to remove.
4. Screw on the new filter by hand until the gasket comes into contact with the filter mounting. Then tighten the filter by hand a further **half turn**.
5. Open left vent screw (1) on the filter mounting. Move lever (2) to vertical (on-line) position. Close the vent screw when no more air bubbles are visible in the fuel.
6. Lever in its **left** end position and replace the **right** fuel filter in the same way.





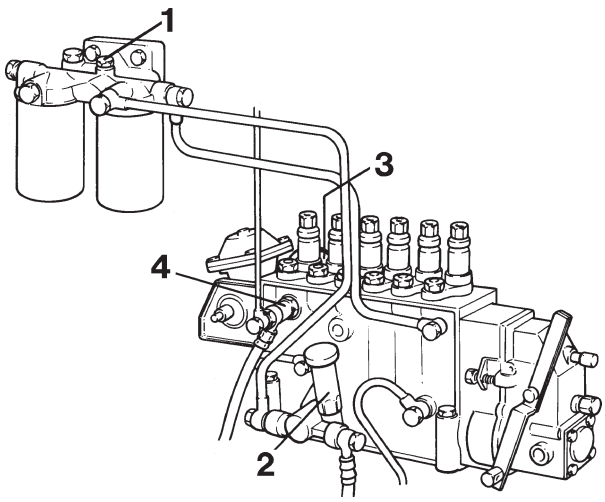


Venting the fuel system

The fuel system must be vented after the fuel filters have been replaced or after refilling the fuel tank after it has been run dry.

1. Place a container beneath the fuel filters. Open vent screw (1) on the filter mounting.
2. Pump out fuel using the feed pump's hand pump (2) until no air bubbles are visible in the fuel. Tighten the screw while fuel is flowing.
3. Pump a further 10 – 20 strokes with the vent screw closed so that sufficient feed pressure is obtained. **Further venting is not normally required.**

   If the injection pump needs to be vented anyway, undo the overflow valve (3) connection at the pump and continue to pump by hand until no air bubbles are visible in the fuel. Tighten the connection while fuel is flowing. Pump a further 10 – 20 strokes so that sufficient feed pressure is obtained.
4. Check for leaks.



Venting the fuel system

1. Venting screw
2. Hand pump
3. Pressure equalizer
4. Overflow valve

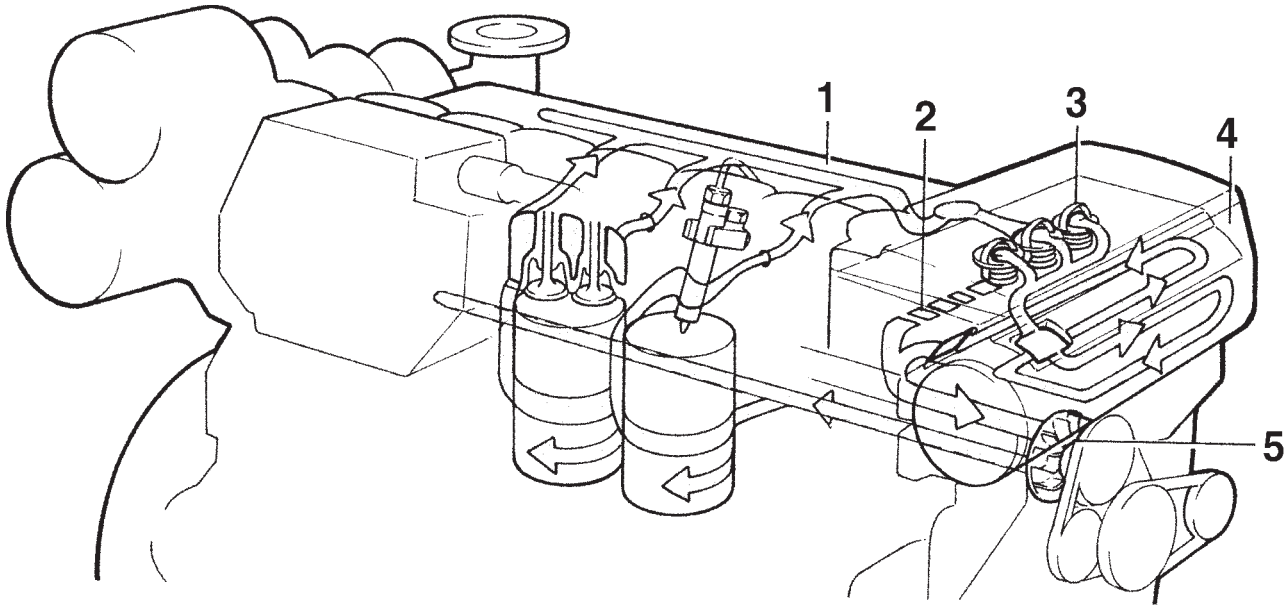
Cooling system

The engine uses a liquid coolant system and most engines incorporate a seawater cooled heat exchanger in the system. The coolant in the freshwater system is pumped round by the belt-driven engine coolant pump. When the engine is cold the coolant is directed through an inner circuit in the engine by the thermostats. When the engine reaches operating temperature the coolant is directed into the heat exchanger where the excess heat is removed.

The turbocharger's turbine housing is also cooled by the engine coolant.

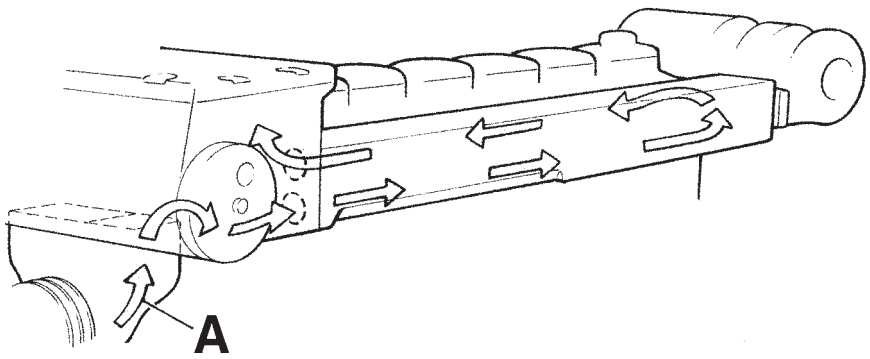
The gear driven seawater pump sucks in cooling water through a sea cock and then pumps it through the seawater circuit in the engine and on to the reverse gear oil cooler. The seawater pump is an impeller with rubber pump wheel.

The seawater cooled charge air coolers (TAMD102 and TAMD122) reduce the temperature on the engine intake air. Cooled air has a reduced volume which permits greater volumes of air to be compressed into the cylinders. In turn more fuel can be injected and this increases the engines' performance.



Freshwater system, 122 series

1. Exhaust pipe
2. By-pass
3. Thermostats
4. Heat exchanger
5. Engine coolant pump



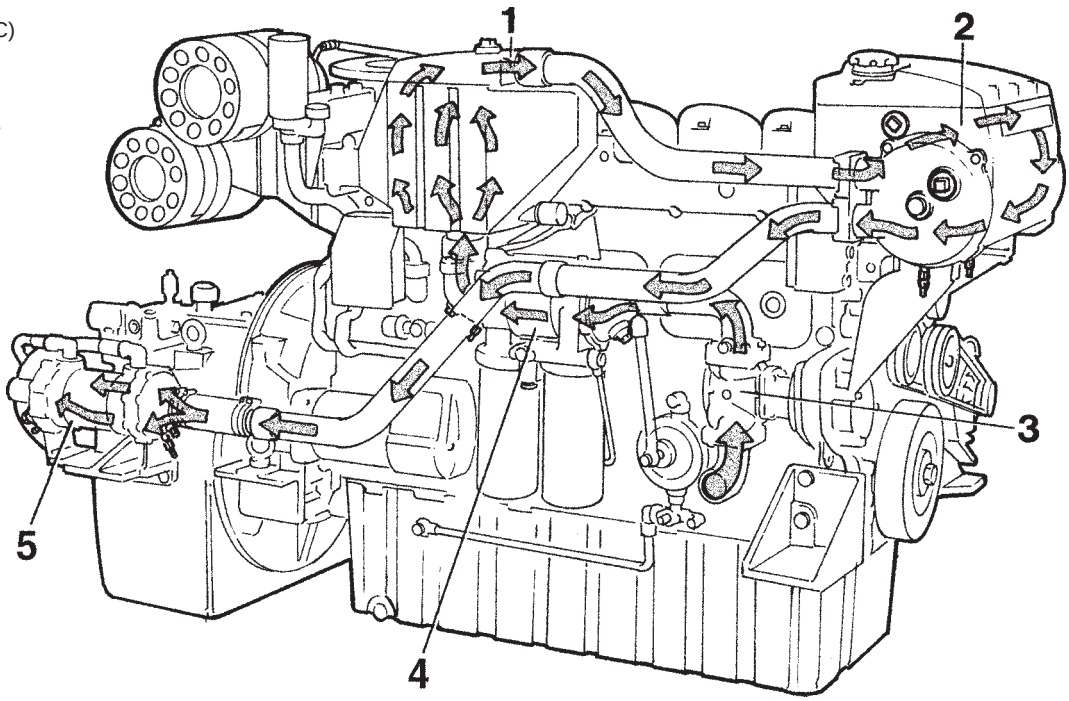
Freshwater system components, 102 series

A. Coolant from cylinder block

Seawater system

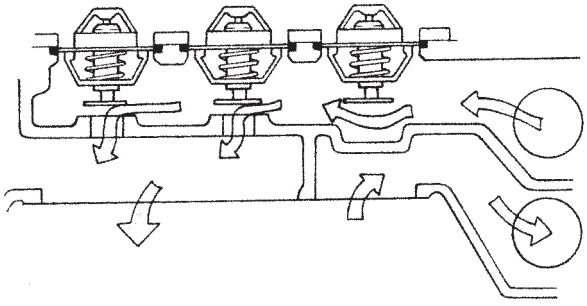
TAMD102, 122

1. Charge Air Cooler (CAC)
2. Heat exchanger
3. Seawater pump
4. Oil cooler, engine
5. Oil cooler, reverse gear

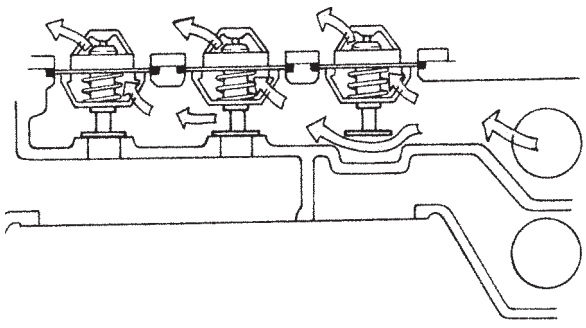


Thermostats

The engines have three piston thermostats with wax-filled activators. When the engine is cold, the thermostat keeps the heat exchanger circuit completely closed. The coolant is then fed directly back to the engine through a bypass line. After the engine has warmed up, the volume of the wax increases and the thermostat gradually increases flow to the heat exchanger circuit, while closing the bypass line.



Thermostat function, cold engine



Thermostat function at operating temperature

Seawater pump

The seawater pump is fitted to the timing gear cover at the front of the engine. This pump is driven via the timing gears. The pump impeller is made of rubber and can be replaced.

Note: The impeller may be damaged if the pump is run dry.

Heat exchanger and charge air cooler (CAC)

Most of the engines have a heat exchanger at the front end of the engine. Engine coolant is cooled in the heat exchanger to the correct temperture. The heat exchanger inlet/outlet are located on the starboard side. Seawater enters the upper connection on the starboard side end, passes through the heat exchanger core and out through the lower connection on the starboard side end.

TAMD 102 and TAMD122 engines have a charge air cooler (CAC) which uses seawater to cool the intake air to the engine.

The heat exchanger and CAC must be regularly cleaned as the pipes can become clogged by contaminants.

Oil cooler, engine

The lubricating oil transports heat from the high temperature parts in the engine and equalizes the temperature differences within the engine. Heat is removed from the lubricating oil in the oil cooler. The temperature of the oil can therefore be kept lower at high load and speeds. This reduces engine wear as the oil's lubricating properties are impaired if the oil temperature gets too high. Lubricating oils of lower quality are most sensitive to high temperatures.

The engine oil cooler is located on the starboard side. Seawater passes through the pipes in the cooler core and the oil passes between the pipes.

Oil cooler, reverse gear

The reverse gear oil cooler is installed on a bracket near the reverse gear. The cooler is connected to the seawater system. The seawater passes through the pipes in the cooling core and draws heat off from the oil which passes between the pipes.

The oil coolers for engine and reverse gear have a similar construction.

Maintenance – Cooling System

Antifreeze and anti-corrosion, cleaning

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

The coolant should be changed at least once a year to prevent cooling from becoming impaired due to deposits in the cooling system, and to avoid the risk of corrosion damage to the freshwater system since the anti-corrosive additives in the coolant deteriorate over time.

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

For information on draining the coolant, refer to: “Draining coolant” on page 23. For antifreeze protection, see “Coolant” on page 16.

Filling with coolant

⚠ **Do NOT open the pressure cap or the venting nipples on a hot engine. Steam or hot water can spray out and the pressure will be 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.

When filling an empty system, or if the coolant level for some reason has dropped so low that it cannot be seen through the filling opening, open the vent cock at the turbocharger during filling. **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 heat control valve should be opened and the unit vented during filling.

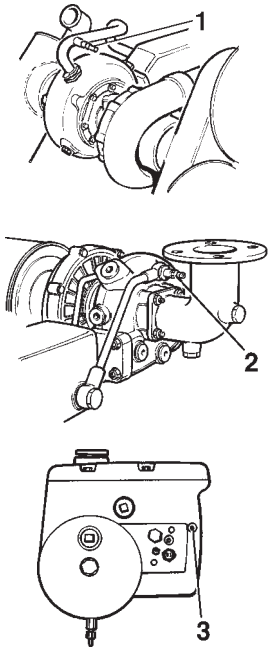
Fill coolant to approx. 5 cm (2 in.) below the filling cap’s seal.

On TAMD122P engines the coolant level can be checked on the level glass on the expansion tank’s starboard and port ends.

The coolant level must be visible through the level glass.

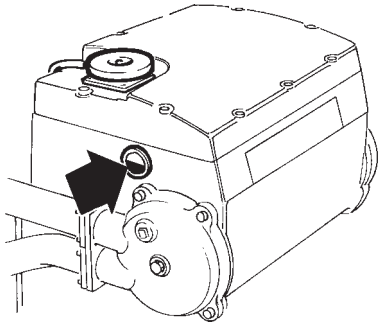
For information on coolants refer to: “Coolant” on page 16. When topping up, use the same coolant mixture as is already in the cooling system.

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



Venting cocks

1. Venting cocks TMD122, TAMD122
2. Venting cocks TMD102, TAMD102
3. Venting plug TMD102, TAMD102



Level glass TAMD122P

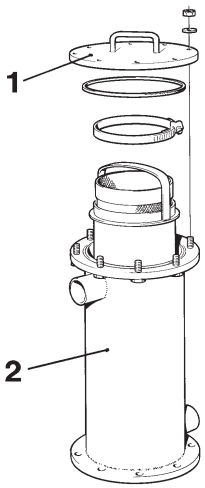
Seawater filter, checking/cleaning

The filter cleaning intervals depend largely on operating conditions and can be determined according to experience after operating your boat for a time. If necessary, clean the filter more often than specified in the maintenance schedule.

It is vital that the flow of seawater is never restricted in any way.

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

1. Remove cover (1) and lift up the insert.
2. Clean te insert and housing (2).
3. Fit the parts as shown in the figures below. Check the gaskets or O-ring. Replace if required.
4. Open the sea cock and check for leaks.



Seawater filter

Cleaning the charge air cooler (CAC)

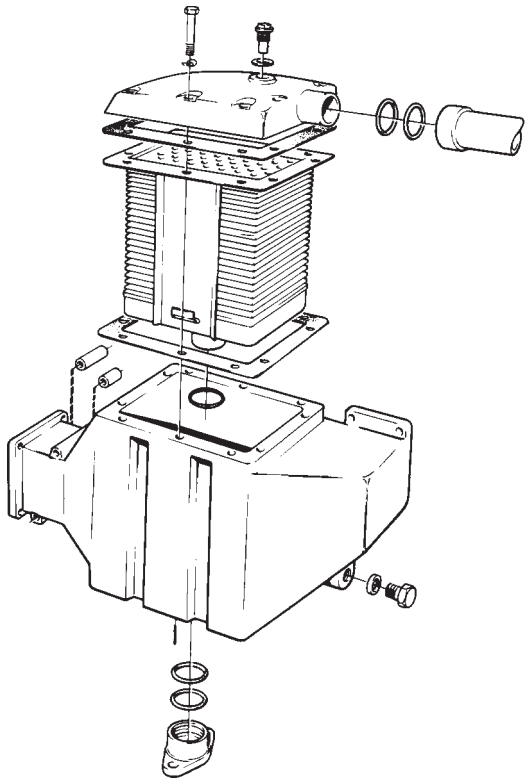
⚠ **Close the sea cock and drain the water from the seawater and freshwater systems before working on the cooling system.**

If a lot of water runs out of the drain hole in the housing bottom the insert must be disassembled and pressure tested. This should be done at an authorized workshop.

1. Detach the upper coolant pipe and the charge air cooler (CAC) cover.
2. Remove the insert and clean inside and out. Also clean the CAC housing and cover.

   Note! Make sure no contaminants enter the engine through the intake manifold.
3. Check the drainage hole in the bottom of the housing is not blocked.

   Note! The sealing plate on the insert must not be damaged.
4. Install the insert and other parts using new oiled-in O rings and new gaskets.
5. Open the sea cock and start the engine. Check for leaks.



Charge air cooler (CAC)

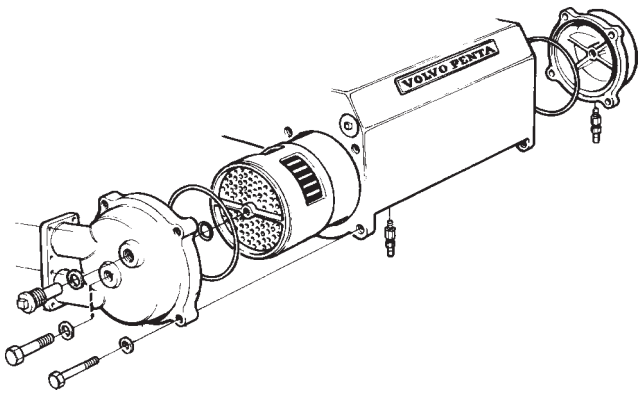
Cleaning the heat exchanger

Close the sea cock and drain the water from the seawater and freshwater systems before working on the cooling system.

Clean if there are signs of clogging, gradually increasing engine temperature and increased seawater pressure. Check/clean the seawater filter first. Check the seawater pump impeller.

It is often enough to clean the heat exchanger's insert core when the end has been removed. The freshwater system does not have to be drained. When disassembling the insert and cleaning, do the following:

1. Remove pipe connections from the heat exchanger end on the starboard side.
2. Remove both ends of the heat exchanger.
3. Clean the heat exchanger insert core using a brush and then flush the core through with water.
4. Reinstall the heat exchanger's end covers.
5. Reinstall the pipe connections to the starboard end cover. Check the gaskets and replace if required.
6. Open the sea cock. Fill the freshwater system.
7. Start the engine and check for leakage in the seawater system.



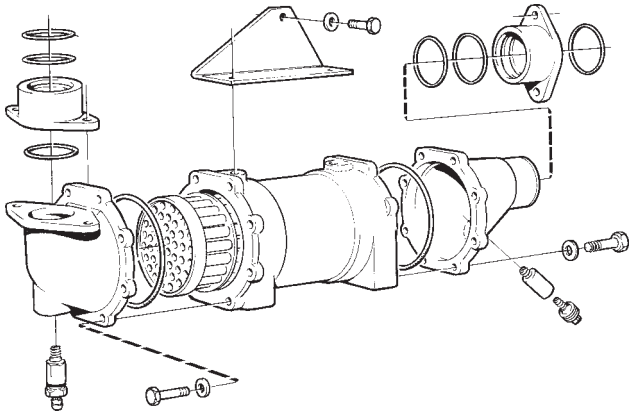
Heat exchanger

Cleaning oil cooler, engine and reverse gear

Close sea cock before working on cooling system.

If there is suspected leakage the oil cooler must be removed from the engine or the reverse gear and pressure tested separately. This should be done at an authorized workshop.

1. Open the drain cock on the oil cooler. Remove the cooling water pipes to and from the oil cooler.
2. Remove both end covers and press the core out (it can only be removed from one direction).



Oil cooler, engine

3. Wash the insert in (e.g.) white spirit and blow it dry using compressed air (or let it stand and dry). Clean the tubes internally and the ends of the core using suitable brushes. Clean the housing too.
4. Reinstall all parts in the opposite order. Use new oil-in sealing rings.
5. Close the drain cock and open the sea cock. Start the engine and check for leaks.

Checking/replacing zinc anodes

Close sea cock before working on cooling system.

1. Open the drain cock (S) on the reverse gear's oil cooler.
2. Unscrew the zinc anodes (Z) on:
   - Heat exchanger end cover, 2 anodes
   - Expansion tank sides, 2 anodes*
   - Charge air cooler (CAC) cover, 1 anode
   - Engine oil cooler, 2 anodes (TAMD122P, 1 anode)
   - Reverse gear oil cooler, 2 anodes
3. Replace the anode if more than 50% of it has been consumed. Otherwise clean the anode with an emery cloth to remove the oxide layer.

   Note! Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.
4. Reinstall the zinc anodes. Ensure that there is good metallic contact between the anodes and the engine parts.
5. Close the drain cock. Open the sea cock before starting the engine. Check for leaks.

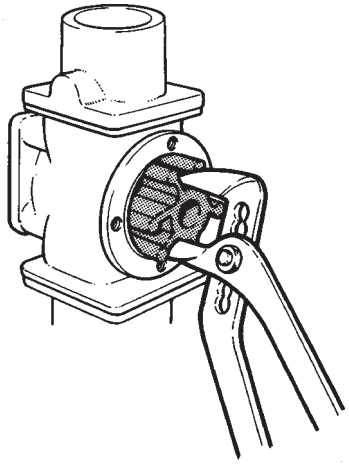
***Note!** TAMD122P: The level glass for checking the coolant level in the freshwater system has replacement zinc anodes on the expansion tank starboard and port sides respectively.

Replacing the seawater pump impeller

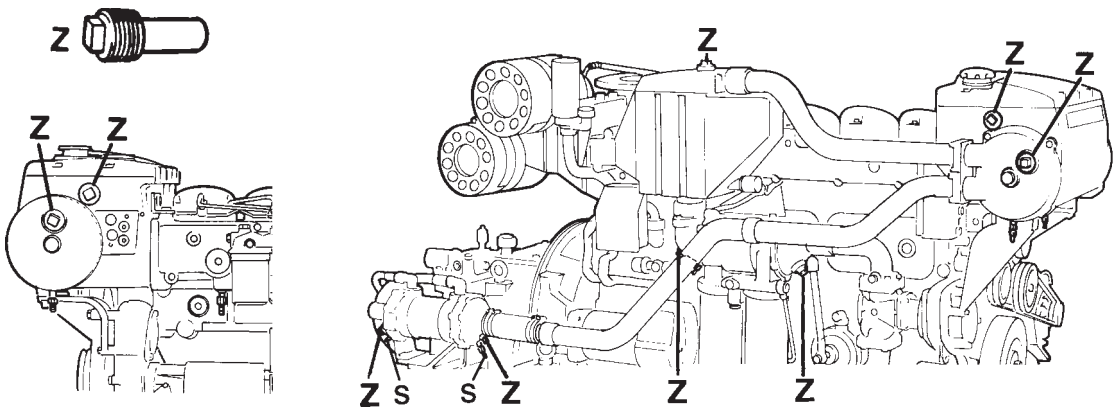
Close sea cock before working on cooling system.

1. Remove the pump's end cover. Pull and twist out the pump impeller using pump pliers.
2. Clean inside the housing. Lubricate the pump housing and the inside of the cover with a little lubricating grease.
3. Push in the new impeller with a **clockwise** rotating movement.
4. Fit the cover together with a new gasket.

   Always keep a spare pump impeller and gasket on board.
5. Open the sea cock. Start the engine and check for leaks.



Replacing the seawater pump impeller



Location of zinc anodes (Z) and drain cock for seawater (S).

Technical Description

Electrical System

T(A)MD102 and T(A)MD122 engines have an electrical system with a generous generator capacity for a normal sized boat. When an extra power supply is required, we recommend that you fit an extra generator or install a separate generator unit.

These engines have a two-pole electrical system with an alternating current generator. Supply voltage is 24V.

The electrical system also includes switches for monitoring the engine's coolant temperature and oil pressure. TAMD102 and TAMD122 (keel cooled engine versions) are also fitted with a switch for monitoring the charge air temperature.

Certifiable engines for propulsion have an extremely comprehensive system for monitoring the engine. These engine are not fully described in this section.

Location of electrical components on engine:

1. Engine coolant temperature (ECT) switch
2. Engine coolant temperature (ECT) sender*
3. Stop solenoid**
4. Generator (GEN)
5. Engine speed (RPM) sender
6. Solenoid valve (fuel shut-off valve)**
7. Terminal box with 2 semi-automatic fuses
8. Oil pressure switch, engine

9a. TAMD102, TAMD122 (keel cooled engine version): Switch, high charge air temperature

9b. TAMD122P (keel cooled engine version): Switch, high charge air temperature

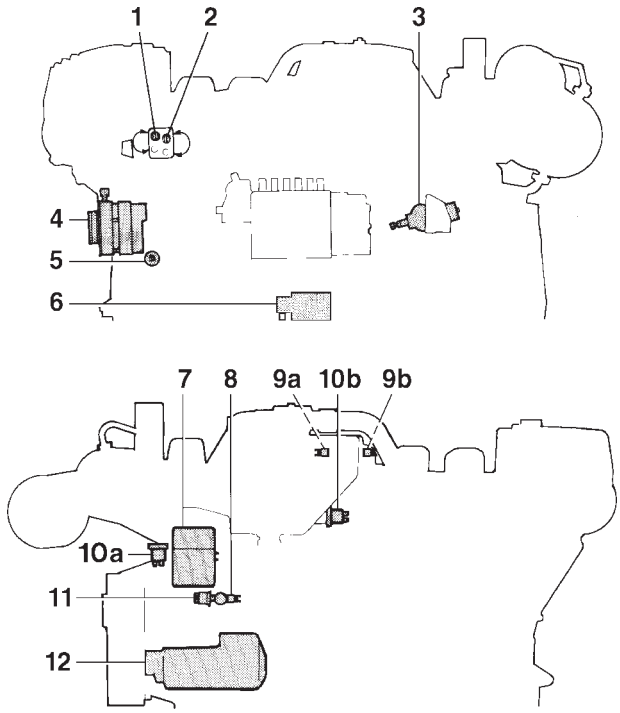
10a. TAMD122P: Turbo pressure sender (accessory)

10b. Other engines: Turbo pressure sender (accessory)

11. Oil pressure sender, engine
12. Starter motor

* The sender has coarser threads than the switch.

** On TAMD122P a fuel shut-off valve is used instead of a stop solenoid. On other engines, the stop solenoid is replaced by a fuel shut-off valve as of engine No. 1101052438/xxxx.



Fuses

Two semi-automatic 8A fuses are located in the terminal box. The fuses break the circuit on overload and can be reset by pushing in the buttons on the side of the terminal box.

Starter motor

The starter motor is mounted on the flywheel casing on the starboard side of the engine.

When the starter motor is engaged, a drive on the starter motor's rotor shaft is moved in an axial direction so that it engages with a spur ring on the engine's flywheel. The drive's axial movement and the engagement of the starter motor are controled by a control solenoid on the starter motor.

The starter motor's control solenoid is engaged in turn via the starter relay when the ignition key is held in position **III**.

Generator for alternating current

The generator is belt driven and located at the front of the engine.

The engine's standard generator can be fitted with a charge distributor as an accessory. Two independent battery circuits can then be charged simultaneously. The charge distributor separates the two groups from one another so that the engine's storage batteries are kept fully charged even if the "accessory batteries" are weak or almost discharged.

Note: The charging voltage from the 28V/60A alternator is thermally compensated. The voltage increases at low temperatures and is reduced at higher temperatures.

Stop devices

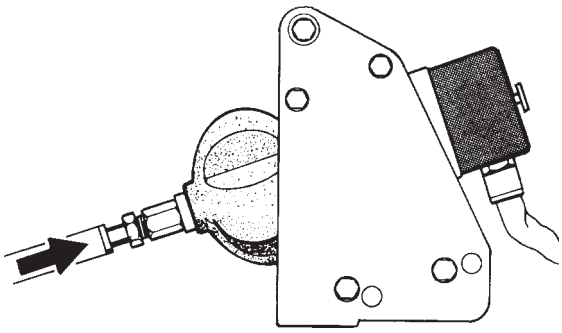
Stop solenoid*

The solenoid is connected via the stop relay when the ignition key is turned and held in the stop position **(S)**.

When the solenoid is activated, the injection pump's control rod is moved into the zero delivery position and the engine stops as the flow of fuel is cut off.

***Note:** TAMD122P engines have no stop solenoid.

On the other engines the stop solenoid has been replaced by a fuel shut-off valve as of engine No. 1101052438/xxxx.



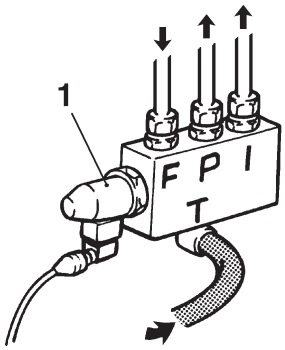
Stop solenoid

Solenoid valve (fuel shut-off valve)*

The solenoid valve (1) is activated when the engine is turned off (key switch in the "**S**" position). The valve changes the direction of the fuel flow to and from the feed pump so that a vacuum is created in the fuel chamber of the injection pump. This makes it impossible for the pump element to fill up and the engine stops.

This valve is located on a bracket beneath the injection pump.

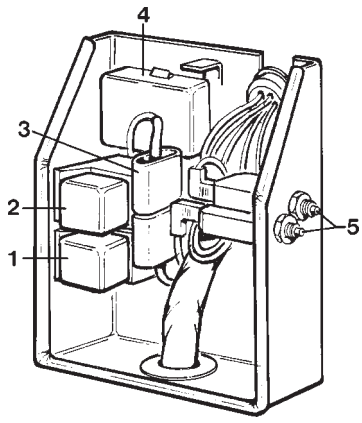
***Note:** A fuel shut-off valve is fitted to all TAMD122P engines. On the other engines a fuel shut-off valve is fitted as of engine No. 1101052438/xxxx.



Fuel shut-off valve

1. Solenoid valve

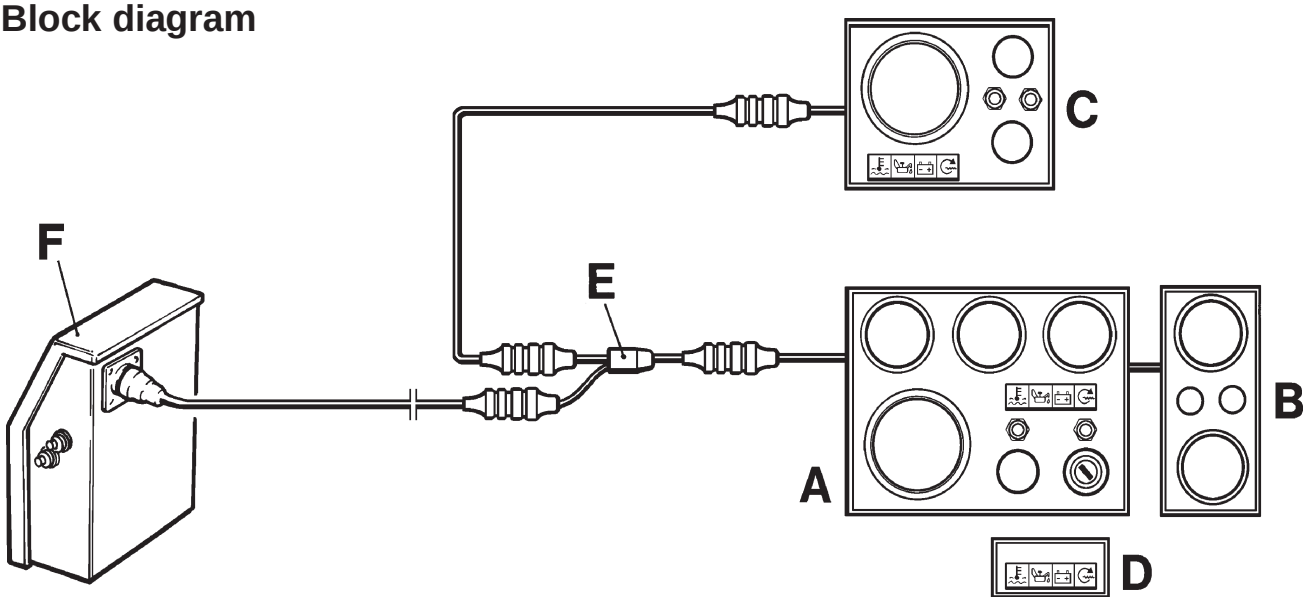
Electronics Terminal box



1. Start relay
2. Stop relay
3. Ceramic stop solenoid fuse* (8A)
4. Ground plate
5. Semi-automatic fuses (8A)

***Note:** TAMD122P and later versions of the other engines have no stop solenoid.

Block diagram



A. Main panel
B. Supplementary panel
C. Flying bridge panel
D. Alarm panel (Used only when there is no main panel A)
E. Y connection
F. Electronics terminal box

General information

Electrolytic corrosion

Your boat and its engine/reverse gear have sacrificial anodes made of zinc as protection against galvanic corrosion. This protection may be rendered ineffective if there are any leakage currents from the electrical system due to faulty equipment or incorrectly connecting electrical components on the negative side (grounding, protector ground).

The following should always be borne in mind:

The main engine switches should be mounted on both the positive (+) and the negative (–) battery leads. The main switches should break the current to all parts consuming electricity. Electrical leads should be fitted in such a manner that they are not exposed to moisture and there is no risk of them being exposed to bilgewater in the keelson.

If there are several battery circuits, there must be separate switches for the extra equipment. There must also be a main switch between the extra battery's positive (+) pole and the fuse panel for the boat's electrical equipment. The main switch for the extra battery circuit should break the current to all power consuming equipment connected to this circuit and be switched off when there is no requirement for extra current. The main switches to the engine must be switched off when the boat is not in use.

The propulsion package must not be electrically connected to other equipment such as the trim tab, steps, etc. Nor should it be used as ground for radio or navigational equipment or other electrical equipment where there are separate ground cables. All separate ground connections should be collected together to form a joint ground connection which is separate from the propulsion package.

If shore power is connected, protector ground should not be connected to the engine or to any other ground on the boat.

A transformer connected to shore power must be installed so that protector grounds on the inlet side (120/220V) and the minus connection on the outlet side (12/24V) are not cross-connected.

⚠ **Warning!** Electrolytic corrosion as a consequence of leakage currents may cause serious and expensive damage to your boat's equipment within a short time. Work on the boat's low tension circuits should only be carried out by qualifed personnel or someone who knows what they are doing. Installation or work on the shore power equipment must only be carried out by electricians authorised to work with high-voltage installations.

Electrical system – Important!

Stop engine turn off the power using the main switches before working on the electrical system.

1. **Main switch**

   Never break the circuit between the generator and batteries while the engine is running. In other words, the main switches must never be disconnected before the engine has stopped. If the circuit is broken while the engine is running, the voltage regulator may be destroyed and the generator seriously damaged.

   Charging circuits must not be switched over while the engine is running, for the same reason. To simultaneously charge two independent battery circuits, fit a Volvo Penta charge distributor to the regular generator (accessory).

2. **Batteries**

   Never mix up the batteries' positive and negative poles when installing them. Incorrect connection of the plus and minus terminals may cause serious damage to the electrical equipment. See wiring diagram. The battery terminal posts should always be well cleaned and the cable terminals well tightened and greased to prevent open circuits.

   Avoid booster charging the batteries. If the battery must be booster charged, first remove both battery leads.

   Note! Follow relevant safety regulations when charging batteries. When charging, the cell plugs should be unscrewed, but they should remain in their holes. There should be good ventilation, particularly if the batteries are being charged in a closed area. Always turn off the charging circuit before removing the charging connectors.

Warning! The battery area must never be exposed to naked flames or electrical sparks. Never smoke in the vicinity of the batteries. When charging, the batteries give off hydrogen gas which, together with air, forms oxyhydrogen gas. This gas is highly inflammable and extremely explosive.

Always use eye protection when charging or handling batteries.

Battery electrolyte contains sulhuric 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 you get battery acid in your eyes, flush at once using plenty of water and obtain medical assistance immediately.

3. **See instructions on page 19 for how to start using auxiliary batteries.**

4. **Connecting accessories and extra equipment**

   All extra equipment should be connected to a separate junction box and fused. Extra outlets directly from the instrument panels should be avoided. A extra outlets can be installed up to **a total max. 5A** (applies to all the instrument panels as a whole).

Arc welding

Remove the positive and negative leads from the batteries. Then remove all leads to the generator.

Always connect the weld clamp to the component to be welded and as close to the welding point as possible. The clamp should never be connected to the engine or in such a manner that the current is able to pass over any bearings.

When welding is complete: Always connect the leads to the generator before replacing the battery leads.

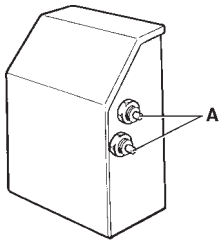
Maintenance – Electrical System

Note! Always stop the engine and turn off the power using the main switches before working on the electrical system.

Also read the section entitled "Electrical system – Important" on the previous page.

Resetting semi-automatic fuses

The semi-automatic fuses are reset by pressing the respective fuse's button (A).



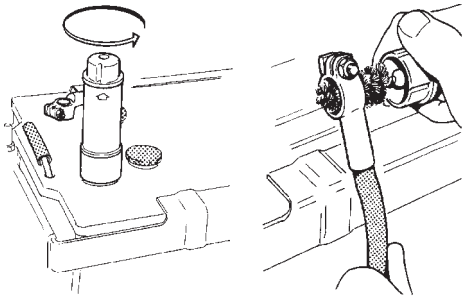
Electronics Terminal box with semi-automatic fuses (A).

Checking batteries and electrical connections

Read the section entitled "Electrical system – Important" on the previous page.

The service life of your batteries depends largely on how they are maintained. Keep the batteries dry and clean. Dirt on the batteries may cause tracking and discharge them, particularly in damp weather.

Clean the battery terminals and connections using suitable wire brushes. Poor contact may cause unnecessary voltage drops. Tighten the cable terminals well and spray the battery terminals and connections with anti-corrosive agent or coat them with Vaseline.



Cleaning the battery terminals

Check that the batteries are connected properly.

Also check that all other electrical connections are dry and free of oxidation and that there are no loose connections. If necessary, spray these connections with a water-repellent spray (Volvo Penta Universal oil).

Charge condition

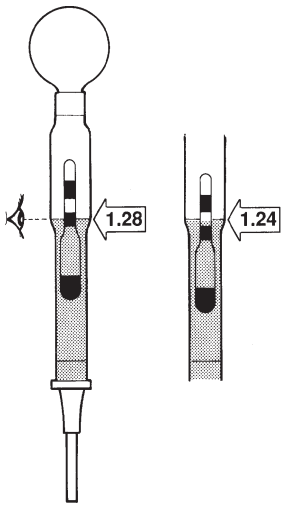
Check the batteries' charge condition using a hydrometer. The battery electrolytic specific gravity should be 1.28 g/cm³* Charge battery if reading has dropped to 1.24 g/cm³* (approx. 75% charge).

Note: If an aerometer-type hydrometer (see figure) is used, the value read off applies at a temperature of approx. +25°C. At other temperatures the reading must be compensated as follows:

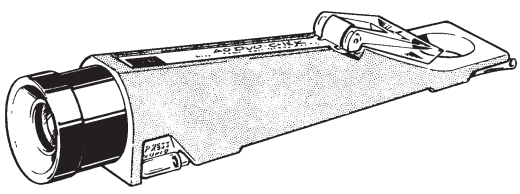
at –20°C	compensate by –0.03
at –5°C	compensate by –0.02
at +10°C	compensate by –0.01
at +40°C	compensate by +0.01

Example: A value of 1.24 measured at –5°C (23°F) should be corrected to 1.22, means extra charging is needed.

***Note:** For batteries with tropical acid substitute 1.24 g/cm³, and 1.20g/cm³.



Aerometer-type hydrometer



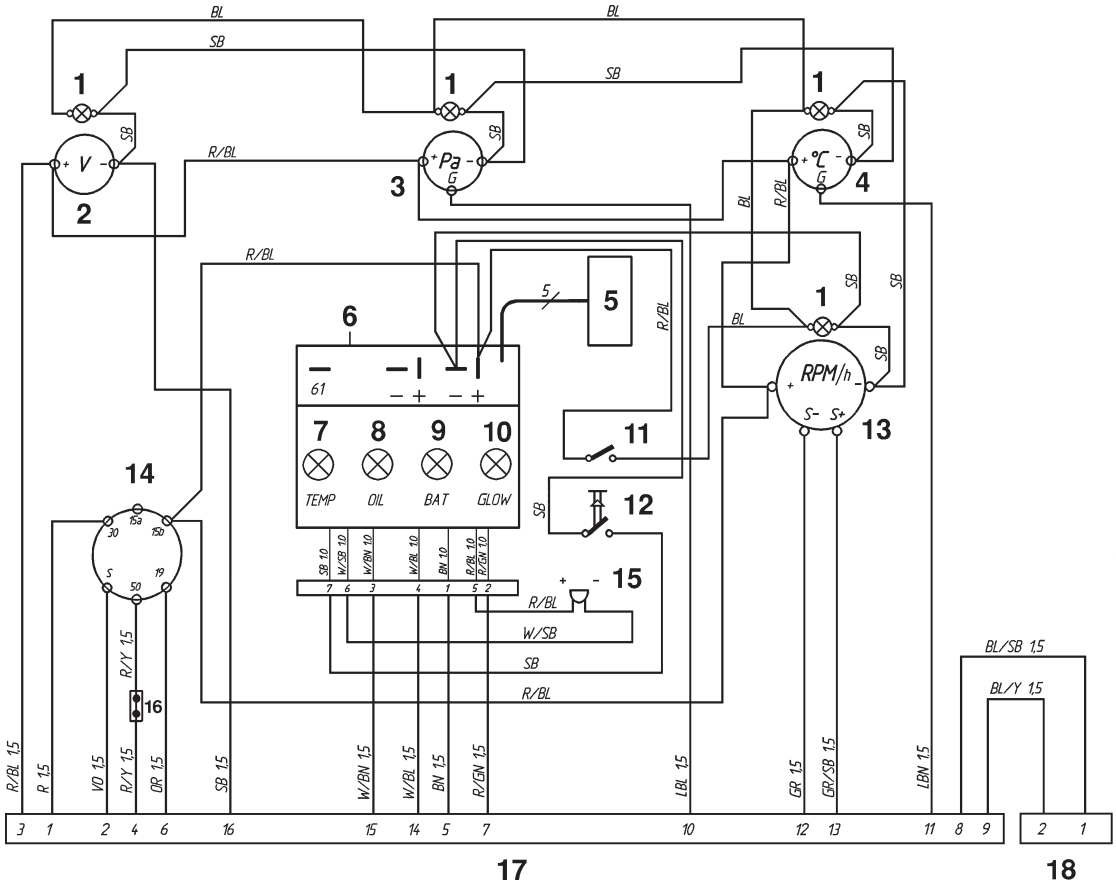
Optical-type hydrometer

Note: Optical-type hydrometers are temperature equalized.

The various battery cells should display relatively even values. Uneven results may mean that the battery is more or less ready for replacement.

Wiring Diagrams

Instrument panel, (main panel)



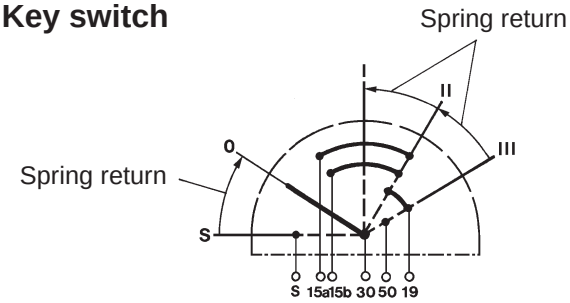
1. Instrument lighting
2. Voltmeter
3. Oil pressure gauge
4. Engine coolant temperature (ECT) gauge
5. Connector for connecting extra warning display (accessory)
6. Electronics module (alarm)
7. Warning light engine coolant temperature (ECT)
8. Warning light, oil pressure
9. Warning lamp, charging
10. Control light, pre-heating (starter element)*
11. Instrument lighting switch
12. Alarm test/acknowledgement switch
13. Tachometer with built-in hours run meter
14. Key switch
15. Alarm
16. Connector for connecting neutral position microswitch (accessory)
17. 17-pin connector
18. 2-pin connector (for supplementary panel)

***Note:** The starter element is an accessory on the TMD102A

Cable colors

BL	=	Blue
R	=	Red
LBL	=	Light blue
SB	=	Black
BN	=	Brown
LBN	=	Light brown
GN	=	Green
VO	=	Violet
GN	=	Gray
W	=	White
OR	=	Orange
Y	=	Yellow
PU	=	Purple

Key switch

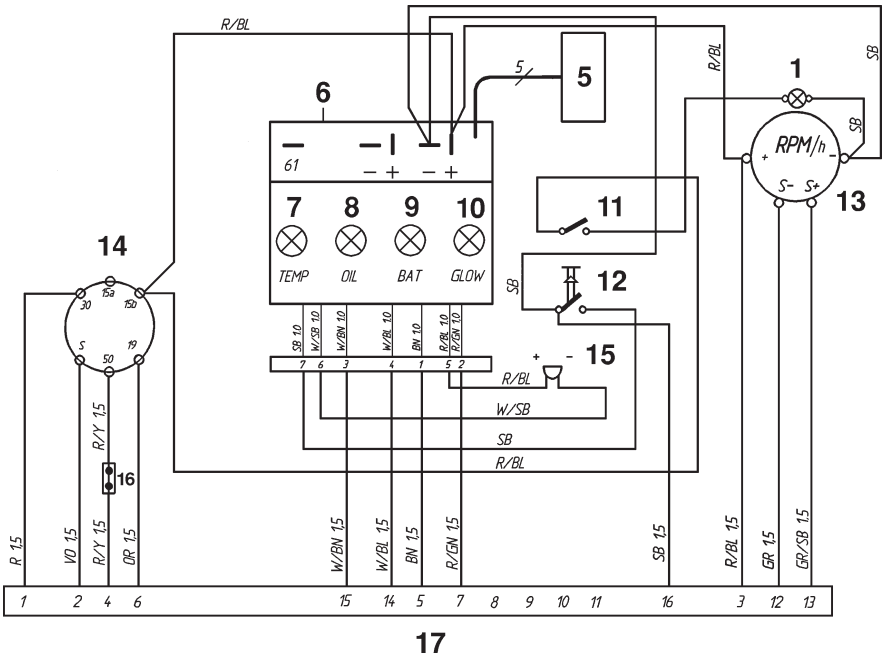


Ratio mm²/AWG*

*American Wiring Gauge

mm²	1.0	1.5	2.5	10	16
AWG	16(17)	15(16)	13	7	5

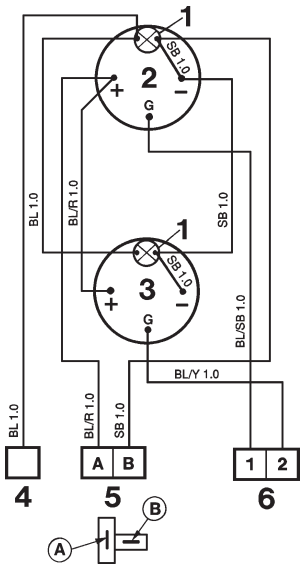
Flying Bridge control panel



1. Instrument lighting
2. Voltmeter
3. Oil pressure gauge
4. Engine coolant temperature (ECT) gauge
5. Connector for connecting extra warning display (accessory)
6. Electronics module (alarm)
7. Warning lamp, engine coolant temperature
8. Warning light, oil pressure
9. Warning lamp, charging
10. Control light, pre-heating (starter element)*
11. Instrument lighting switch
12. Alarm test/acknowledgement switch
13. Tachometer with built-in hours run meter
14. Key switch
15. Alarm
16. Connector for connecting neutral position microswitch (accessory)
17. 16-pin connector

***Note:** The starter element is an accessory on the TMD102A.

Supplementary panel



1. Instrument lighting
2. Oil pressure gauge, reverse gear
3. Turbo charging pressure gauge
4. Connection to instrument lighting on main panel
5. Connection to printed circuit card on main panel
6. Connection to connector (18) on main panel

Cable colors

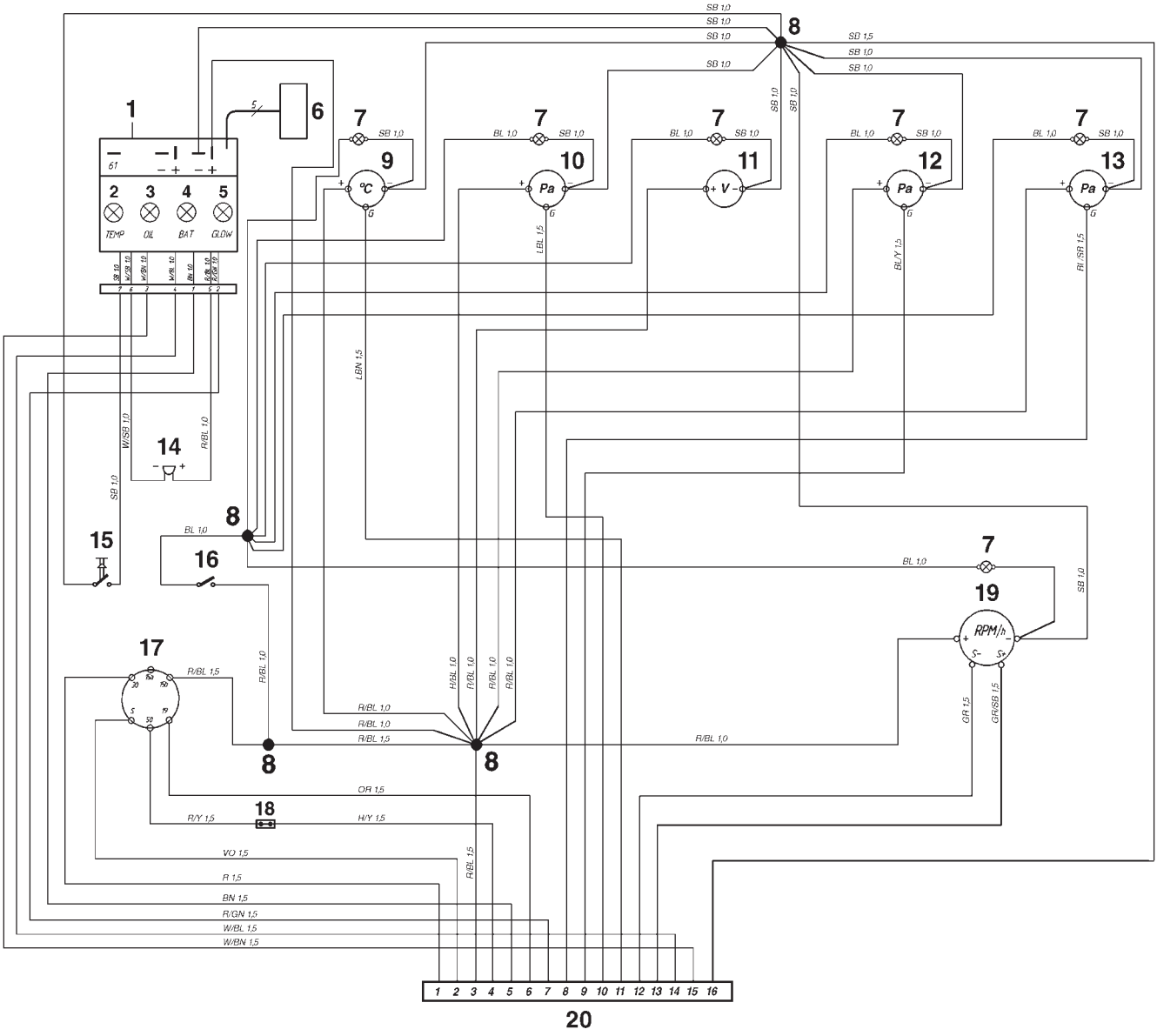
BL	=	Blue
R	=	Red
LBL	=	Light blue
SB	=	Black
BN	=	Brown
LBN	=	Light brown
GN	=	Green
VO	=	Violet
GN	=	Gray
W	=	White
OR	=	Orange
Y	=	Yellow
PU	=	Purple

Ratio mm²/AWG*

*American Wiring Gauge

mm²	1.0	1.5	2.5	10	16
AWG	16(17)	15(16)	13	7	5

Instrument kit for Pilot cabin



1. Electronics module (alarm)
2. Warning light engine coolant temperature (ECT)
3. Warning light, oil pressure
4. Warning lamp, charging
5. Indicator lamp, starter element*
6. Connector for connecting extra warning display (accessory)
7. Instrument lighting
8. Connector (cannot be opened)
9. Engine coolant temperature (ECT) gauge
10. Oil pressure gauge
11. Voltmeter
12. Turbo charging pressure gauge
13. Oil pressure gauge, reverse gear
14. Alarm
15. Alarm test/acknowledgement switch
16. Instrument lighting switch
17. Key switch
18. Connector for connecting neutral position microswitch (accessory)
19. Tachometer with built-in hours run meter
20. 16-pin connector

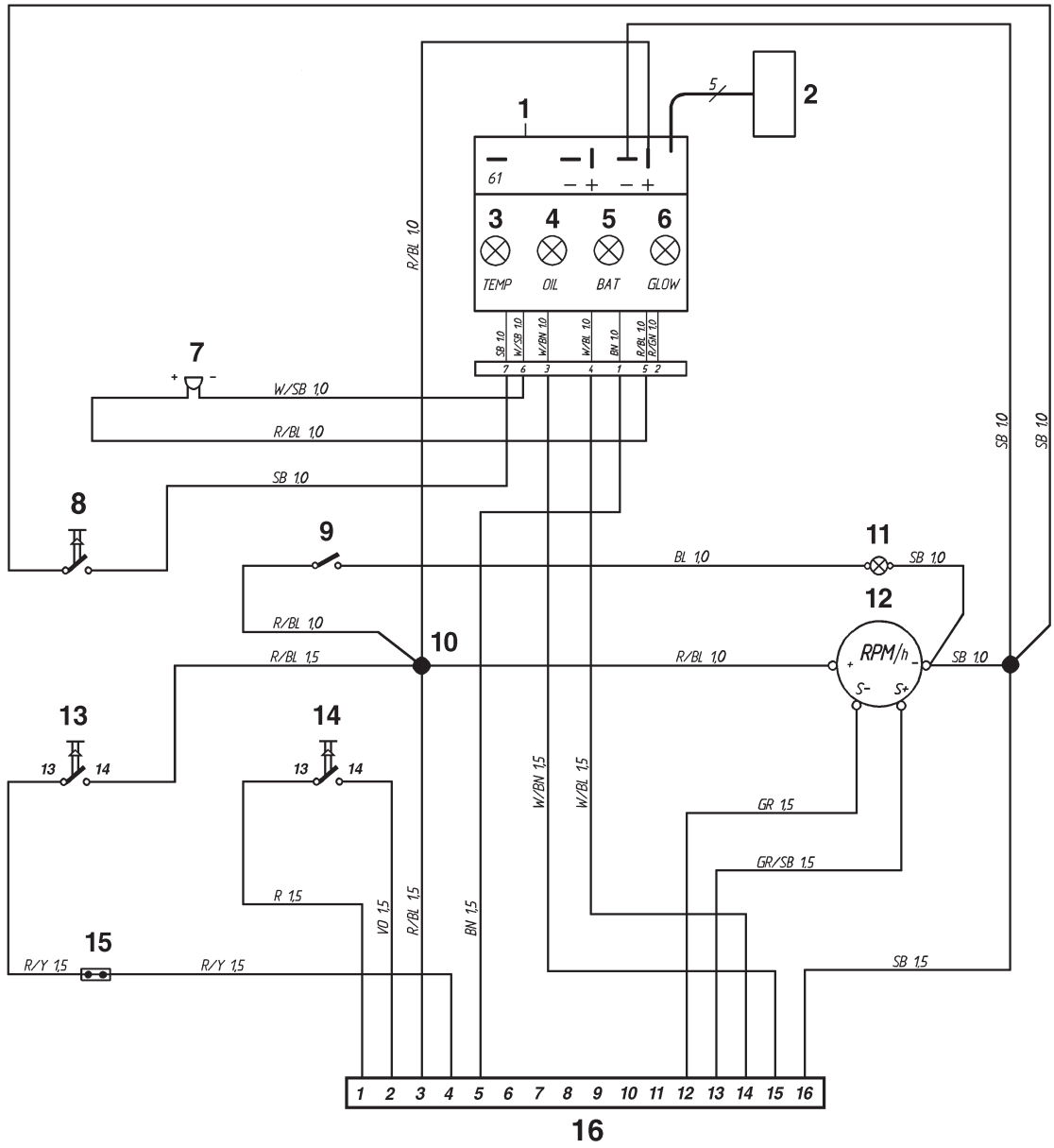
***Note:** The starter element is an accessory on the TMD102A

Cable colors

BL	=	Blue
R	=	Red
LBL	=	Light-blue
SB	=	Black
BN	=	Brown
LBN	=	Light brown
GN	=	Green
VO	=	Violet
GN	=	Gray
W	=	White
OR	=	Orange
Y	=	Yellow

Cable areas in mm² are given after the color code in the wiring diagram.

Flying Bridge instrument kit



1. Electronics module (alarm)
2. Connector for connecting extra warning display (accessory)
3. Warning light engine coolant temperature (ECT)
4. Warning light, oil pressure
5. Warning lamp, charging
6. Indicator lamp, starter element*
7. Alarm
8. Alarm test/acknowledgement switch
9. Instrument lighting switch
10. Connector (cannot be opened)
11. Instrument lighting
12. Tachometer with built-in hours run meter
13. Start button
14. Stop button
15. Connector for connecting neutral position microswitch (accessory)
16. 16-pin connector

***Note:** The starter element is an accessory on the TMD102A

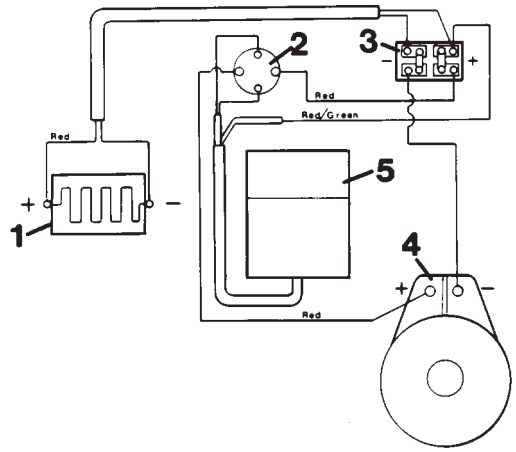
Cable colors

BL	=	Blue
LBL	=	Light-blue
BN	=	Brown
LBN	=	Light brown
GN	=	Green
GN	=	Gray
OR	=	Orange
R	=	Red
SB	=	Black
VO	=	Violet
W	=	White
Y	=	Yellow

Cable areas in mm² are given after the color code in the wiring diagram.

Starter element

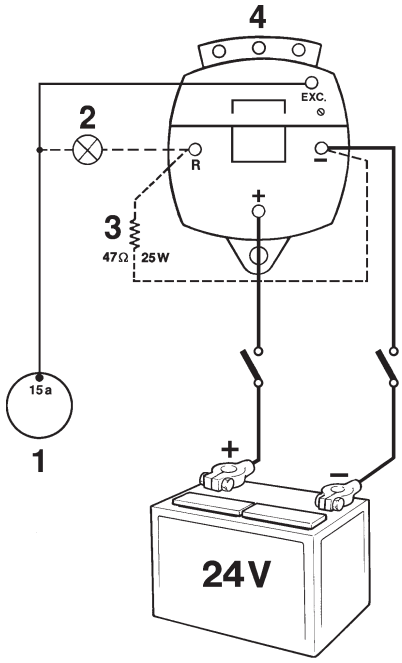
The starter element is an accessory on the TMD102A



1. Starter element
2. Timer relay*
3. Terminal block
4. Starter motor
5. Electronics Terminal box

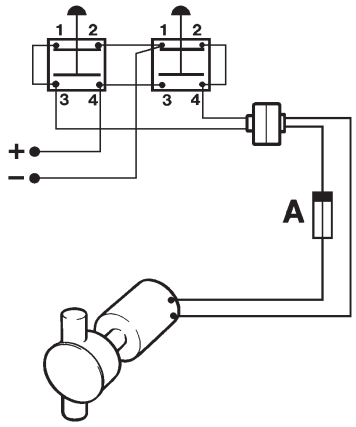
***Note:** The timer relay is an accessory on engines equipped with starter element.

Extra generator 28V/100A



1. Key switch
2. Charge indicator lamp
3. Resistor (47Ω/25W)
4. Generator

Oil scavenging/bilge pump



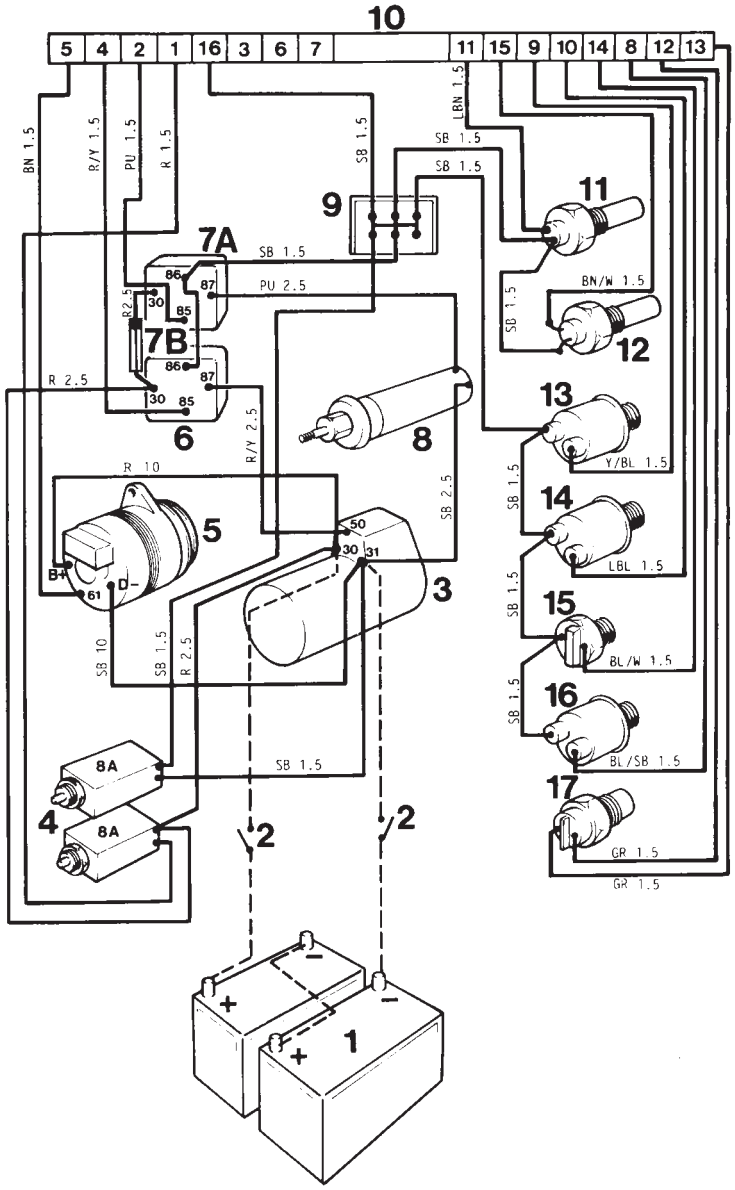
Suggested connection for bilge pump

Cable area 1.5mm^2

A. Fuse (8A)

Engines: TMD102A, TAMD102A, TAMD102D, TMD122A, TAMD122A

Up to and including engine No. 1101052437/xxxx.



1. Battery
2. Main switch
3. Starter motor
4. Semi-automatic fuses (8A)*
5. Generator (GEN)
6. Start relay (16MS)*

7A. Stop relay (16S)*

7B. Stop solenoid fuse, 8A

8. Stop solenoid
9. Ground terminal block*
10. Connector, 16-pin *
11. Engine coolant temperature (ECT) sender
12. Engine coolant temperature (ECT) switch (normally open – closes if fault occurs)
13. Turbo pressure sender. Accessory
14. Oil pressure sender, engine
15. Oil pressure switch, engine
16. Oil pressure sender, reverse gear. Accessory
17. Engine speed (RPM) sender

***Note:** Located in terminal box.

Cable colors

BL	=	Blue	R	=	Red
LBL	=	Light blue	SB	=	Black
BN	=	Brown	VO	=	Violet
LBN	=	Light brown	W	=	White
GN	=	Gray	Y	=	Yellow
OR	=	Orange	PU	=	Purple

Cable areas in mm² are given after the color code in the wiring diagram.

Unless otherwise stated the cable area is 1.0 mm²

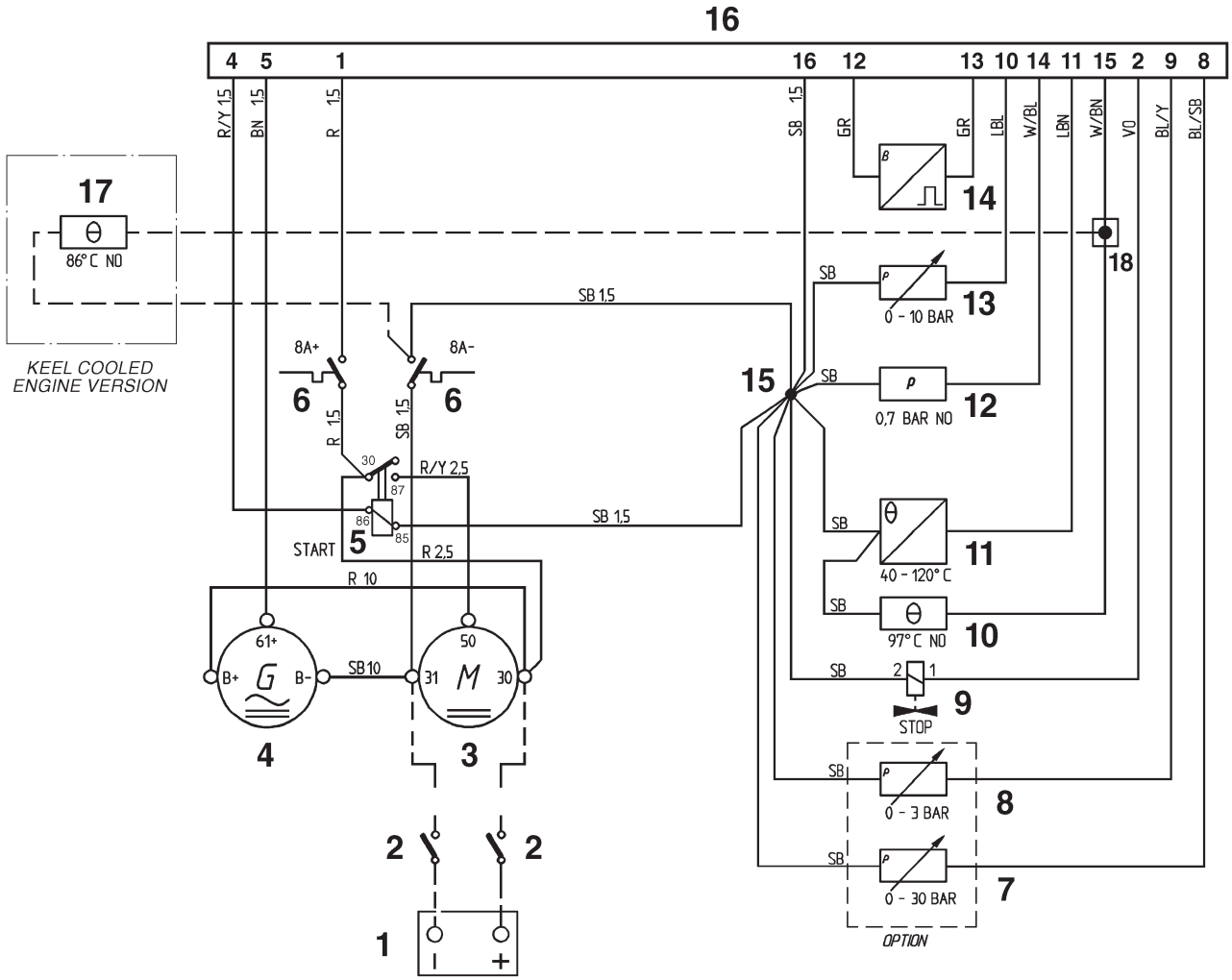
Ratio mm²/AWG*

*American Wiring Gauge

mm²	1.0	1.5	2.5	10	16
AWG	16(17)	15(16)	13	7	5

Engines: TAMD122P
TMD102A*, TAMD102A*, TAMD102D*, TMD122A*, TAMD122A*

*** As of engine No. 1101052438/xxxx.**



1. Battery
2. Main switch
3. Starter motor
4. Generator (GEN)
5. Start relay (16MS)*
6. Semi-automatic fuses (8A)*
7. Oil pressure sender, reverse gear (0 – 30 bar). Accessory
8. Turbo pressure sender (0 – 3 bar). Accessory
9. Fuel shut-off valve
10. Engine coolant temperature (ECT) switch (97°C/ 207°F), (normally open – closes if fault occurs)
11. Engine coolant temperature (ECT) sender (40 – 120°C/104–248°F)
12. Oil pressure switch, engine (0.7 bar), (normally open – closes if fault occurs)
13. Oil pressure sender, engine (0–10 bar)
14. Engine speed (RPM) sender
15. Ground terminal block*
16. Connector, 16-pin*
17. TAMD102, TAMD122 (keel cooled engine version): Temperature switch, charge air temperature (86°C/187°F), (normally open – closes if fault occurs)
18. Connector

***Note:** Located in terminal box.

Cable colors

BL	=	Blue	R	=	Red
LBL	=	Light-blue	SB	=	Black
BN	=	Brown	VO	=	Violet
LBN	=	Light brown	W	=	White
GR	=	Gray	Y	=	Yellow

Cable areas in mm² are given after the color code in the wiring diagram.

Unless otherwise stated the cable area is 1.0 mm²

Ratio mm²/AWG*

*American Wiring Gauge

mm²	1.0	1.5	2.5	10	16
AWG	16(17)	15(16)	13	7	5

Inhibiting

Warning! Using High-pressure jet: Never direct high-pressure jet at seals, rubber hoses or electrical components.

Never direct high pressure jet at the engine when cleaning.

Boat unused for up to two months

If the boat is not expected to be used for up to two months, it is sufficient to start the engine and warm it up once a fortnight.

If there is a danger of freezing, the cooling system's seawater circuit should be drained after stopping. Check/top up the freshwater system's antifreeze to prevent damage. Drain the freshwater tank if installed.

Remove the drain plug (if fitted) on the exhaust pipe condensed water collector. Drain the water from any low-lying parts on the exhaust pipe.

Check the batteries' charge condition. A discharged battery may easily burst.

Boat unused for more than two months

1. Warm the engine up to normal operating temperature.
2. Check that the lubricating oil level in the reverse gear reaches the upper mark ("FULL") on the dipstick. Check the level with the engine idling and the control in neutral.
3. Stop the engine and drain or pump the lubricating oil from the oil sump.
4. **Boat unused for up to max. 8 months:** Replace the lubricating oil filter and fill with Volvo Penta lubricating oil to the normal level. Warm the engine up after changing the oil.
5. **Boat unused for more than 8 months:** Fill the engine with inhibiting oil to just above the lower part of the mark on the dipstick. The oil companies sell inhibiting oil.

   Connect the fuel lines (suction and return) to a can filled with 1/3 inhibiting oil and 2/3 diesel. Some oil companies sell a ready-mixed oil for this purpose.

   Vent the fuel system according to the instructions on page 44. Start the engine and run on fast idle until approx. 2 liters have been used from the can.

   Stop the engine and drain or pump the inhibiting oil from the oil sump. Connect the regular fuel lines.
6. Check that the coolant in the freshwater system has sufficient anti-freeze and top up if required. Or drain the coolant. Close the sea cock and drain the water from the seawater system. See page 23.

   Remove the seawater pump impeller.
7. Check that the batteries are well charged. A discharged battery can burst if it freezes.

   Batteries always have a certain amount of self-discharge which increases the higher the temperature. Batteries in storage should therefore be kept as cool as possible. The should be stored dry and clean and normally charged when the electrolyte s.g. drops below 1.24 g/cm3 (1.20 g/cm3 for batteries with tropical acid).

   You should preferably remove the batteries and hand them in for maintenance charging as instructed by the manufacturer.

   See also point 2 under "Electrical System – Important" on page 55.
8. When necessary, improve the external rust protection by brushing on anti-corrosion oil. The surfaces should be clean and dry before being treated.

   Note! Some inhibiting oils are flammable. Some are also dangerous to breathe. Ensure good ventilation. Wear a protective mask when spraying.
9. Stick a label on the engine stating the date of inhibition, type of inhibition and the inhibiting oil used.
10. Cover the engine's air intake, exhaust port and the engine itself if so required.

Launching procedures

Check the condition of the propeller(s). Damaged propellers should be reconditioned or replaced.

Bringing out of storage

1. Remove any protective cover over the engine, air intake and exhaust pipe.
2. Remove any external inhibitors using white spirit.
3. Close the drain cocks and fit the drain plugs. Install the seawater pump impeller using a clockwise rotating movement.

   Fill the freshwater system if the coolant has been drained. See “Filling coolant” on page 48. For coolants, refer to page 16.
4. If necessary, fill the engine with lubricating oil of the correct grade. Fit a new oil filter if this has not been done when changing the oil during inhibiting. Check the oil level in the reverse gear.
5. Check the batteries as described on page 5. Connect the batteries.
6. Fit new fuel filters and vent the fuel system as described on pages 43 and 44.
7. Open the sea cock. Start the engine (see “Operation”) and warm the engine up at a fast idle before loading the engine.
8. Check for any leaks of oil, fuel or cooling water.

Fault-tracing

1. Engine does not start

Starter motor does not turn engine over

CAUSE	REMEDY
• The reverse gear is not disengaged (applies to control with neutral position switch)	Put the reverse gear control lever into neutral
• Discharged batteries	Charge/replace the batteries (or connect up auxiliary batteries as shown on page 19)
• Main switches off	Switch on the main switches
• One of the semi-automatic fuses in the terminal box has tripped	Reset the fuse by pressing in the button
• Poor contact/open circuit, electrical cables	Rectify any open-circuits/loose connections. Check for oxidation on the contacts. If required, clean them and spray with damp-inhibitor spray. See wiring diagrams, pp. 57-63.
• Key switch malfunction	Replace key switch
• Start relay malfunction	Replace starter relay
• Starter motor/solenoid (control solenoid) malfunction	Contact authorized service personnel
• Water in the engine	Contact authorized service personnel. Do not try to start the engine if you think there is water in it

Starter motor turns over slowly

CAUSE	REMEDY
• Discharged batteries	Charge/replace the batteries (or connect up auxiliary batteries as shown on page 19)
• Poor contact, electrical cables	Rectify any loose connections. Check for oxidation on the contacts. If required, clean them and spray with damp-inhibitor spray. See wiring diagrams, pp. 57–63.

Starter motor turns over as normal but engine does not start

CAUSE	REMEDY
• Air in fuel system	Vent the fuel system as shown on page 44
• No fuel	
– fuel taps closed	Open fuel taps
– fuel tank empty/wrong tank on line	Fill with fuel/connect the correct fuel tank
– fuel filters clogged (due to contaminants/paraffin precipitation in the fuel as a result of low outside temp.)	Install new fuel filters (pre-filter and/or fine filters). Vent the system as shown on page 44
• Solenoid valve (fuel shut-off valve) incorrectly connected	Check solenoid valve has not been switched on unintentionally
	Try to start the engine again following the instructions on page 18.
	Check that none of the semi-automatic fuses has tripped. Reset the fuse by pressing in the button.
	Check the electrical leads and key switch, starter relay and HT relay (swap the starter relay temporarily with stop relay if required). Contact authorized service personnel if the starter element needs to be replaced

2. Engine starts but stops again/runs unevenly

CAUSE	REMEDY
● Air in fuel system	Vent the fuel system as shown on page 44
● No fuel	
– fuel taps closed	Open fuel taps
– fuel tank empty/wrong tank on line	Fill with fuel/connect the correct fuel tank
– fuel filters clogged (due to contaminants/paraffin precipitation in the fuel as a result of low outside temperature)	Install new fuel filters (pre-filter and/or fine filters). Vent the system as shown on page 44 Try to start the engine again following the instructions on page 18. Check that none of the semi-automatic fuses has tripped. Reset the fuse by pressing in the button. Check electric cables and key switch and starter relay
● Insufficient air supply to engine	
– air cleaner filter clogged	Fit a new air cleaner filter/clean air filter, check ventilation to engine compartment
● Break in pressure pipe	Fit new pressure pipe(s)

3. Engine coolant temperature (ECT) too high

CAUSE	REMEDY
● Coolant level in engine too low (air in system)	Fill engine with coolant and vent system as shown on page 48
● Thermostat malfunction	Install a new thermostat
● Seawater pump (pump impeller) malfunction	Replace the seawater pump impeller as shown on page 51.
● Sea cock closed	Open the boat's sea cock
● Seawater intake blocked	Clean the seawater intake
● Seawater filter blocked	Clean the seawater filter as shown on page 49
● Heat exchanger core clogged	Clean the insert as shown on page 50
● Circulation pump malfunction	Contact authorized service personnel

4. Engine coolant temperature too low

CAUSE	REMEDY
● Thermostat malfunction	Install a new thermostat

5. Engine does not reach correct speed at wide open throttle (WOT)

CAUSE	REMEDY
• Boat abnormally loaded	If possible, reduce/redistribute the load
• Fouling on bottom of boat	Clean the bottom of the boat and treat it with anti-fouling paint
• Faulty/damaged propeller	Replace the propeller
• Insufficient fuel flow – fuel filters clogged (due to contaminants/paraffin precipitation in the fuel as a result of low outside temp.)	Install new fuel filters (pre-filter and/or fine filters). Vent the system as shown on page 44
• Water in fuel	Clean fuel tank. Drain water from pre-filter.
• Insufficient air supply to engine – air cleaner filter clogged	Fit new air cleaner filters/clean air cleaner
– air leak between turbo and engine's inlet manifold	Check the pipe between the turbo and the inlet manifold and other connections. Tighten the hose clips
– turbocharger malfunction	Contact authorized service personnel
– poor engine compartment ventilation	Check that the ventilating ducts to the engine compartment are not blocked
• Throttle controls incorrectly adjusted	Adjust the throttle controls
• Charge air cooler (CAC) clogged	Clean the insert as shown on page 49
• Excessive pressure in the exhaust system	Check that the exhaust pipe is not restricted
• Injector malfunction	Get authorized service personnel to check the injectors
• Faulty setting of injection pump	Contact authorized service personnel
• Smoke limiter malfunction – smoke limiter seizing	Contact authorized service personnel
– pressure pipe between inlet manifold and smoke limiter leaking	Fit a new pressure pipe
– faulty diaphragm in smoke limiter	Contact authorized service personnel
– faulty setting	Contact authorized service personnel

6. Engine runs on

CAUSE	REMEDY
• One of the semi-automatic fuses in the terminal box has tripped.	Reset the fuse by pressing in the button.
• Poor contact/open-circuit, electrical leads (loose connections, oxidation)	Rectify any open-circuits/loose connections. Check for oxidation on the contacts. If required, clean them and spray with damp-inhibitor spray. See wiring diagrams, pp. 57–63
• Key switch malfunction	Replace key switch
• Solenoid valve (fuel shut-off valve) malfunction	Contact authorized service personnel

General

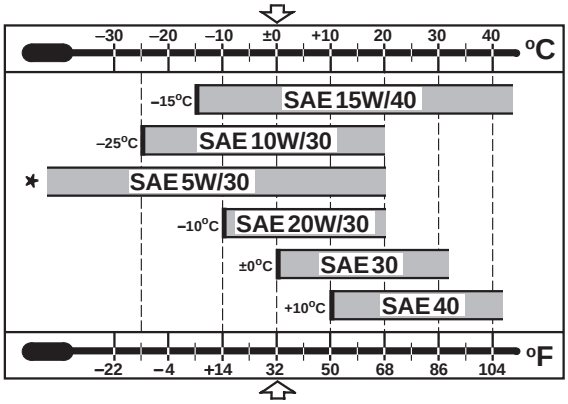
	TMD102A, TAMD102A, TAMD102D	TMD122A , TAMD122A, TAMD122P-A
No. of cylinders	6	6
Swept volume	9.60 dm^3 (litres),(585 in^3)	11.97 dm^3 (litres),(730 in^3)
Low idle:		
TMD	525 rpm	525 rpm
TAMD	530 rpm	550 rpm
Valve clearance, stopped engine, cold or hot,		
TAMD102, TAMD122P-A:		
inlet	0.50 mm (0.0197")	0.50 mm (0.0197")
outlet	0.80 mm (0.0315")	0.80 mm (0.0315")
Other engines:		
intake	0.40 mm (0.0157")	0.40 mm (0.0157")
outlet	0.70 mm (0.0276")	0.70 mm (0.0276")
Compression pressure at starter motor speed (230 rpm):		
TMD102A	2.4 MPa (24.5 kp/cm^2 = 341 psi)	
TAMD102A	2.6 MPa (26.5 kp/cm^2 = 370 psi)	
TAMD102D	2.6 MPa (26.5 kp/cm^2 = 370 psi)	
TMD122A, TAMD122A		2,5 MPa (25.5 kp/cm^2 = 355 psi)
TAMD122P-A		2,5 MPa (25.5 kp/cm^2 = 355 psi)
Weight, engine with heat exchanger, without reverse gear or clutch, approx.:		
TMD102A	1140 kg (2513 lbs)	
TAMD102A	1190 kg (2623 lbs)	
TAMD102D	1190 kg (2623 lbs)	
TMD122A		1320 kg (2910 lbs)
TAMD122A		1360 kg (2998 lbs)
TAMD122P-A		1310 kg (2886 lbs)

Lubrication System

	TMD102A, TAMD102A, TAMD102D	TMD122A, TAMD122A, TAMD122P-A
Oil capacity incl. oil filter, approx.:		
no engine inclination	50 liters (11 Imp. gals/13.2 US gals)	50 liters (11 Imp. gals/13.2 US gals)
engine inclination 15°	30 liters (6.6 Imp. gals/7.9 US gals)	30 liters (6.6 Imp. gals/7.9 US gals)
shallow oil pan, no engine inclination	38 liters (8.4 Imp. gals/10 US gals)	35 liters (7.7 Imp. gals/9.2 US gals)
shallow oil pan, 6°	–	29 liters (6.4 Imp. gals/7.7 US gals)

Oil pressure, hot engine	
TMD102A:	
at normal running rpm	350–550 kPa (3.5–5.5 kp/cm² = 50–78 psi)
at idling rpm (min.)	150 kPa (1.5 kp/cm² = 21 psi)
TAMD102A:	
at normal running rpm	380–480 kPa (3.8–4.8 kp/cm² = 54–68 psi)
at idling rpm (min.)	200–300 kPa (2.0–3.0 kp/cm² = 28.5–44 psi)
TAMD102D:	
at normal running rpm	450–550 kPa (4.5–5.5 kp/cm² = 64–78 psi)
at idling rpm (min.)	250–350 kPa (2.5–3.5 kp/cm² = 35.5–50 psi)
TMD122A:	
at normal running rpm	350–550 kPa (3.5–5.5 kp/cm² = 50–78 psi)
at idling rpm (min.)	150 kPa (1.5 kp/cm² = 21 psi)
TAMD122A:	
at normal running rpm	400 kPa (4.0 kp/cm² = 57 psi)
at idling 600 rpm (min.)	350 kPa (3.5 kp/cm² = 50 psi)
TAMD122P-A:	
at normal running rpm	375–525 kPa (3.75–5.25 kp/cm² = 54–75 psi)
at idling rpm (min.)	200 kPa (2.0 kp/cm² = 28.5 psi)
Oil quality	VDS (Volvo Drain Specification), or CD or CE as per API system.

Viscosity at different ambient temperatures .... (The temperatures refer to constant ambient air temperatures).



* Refers to synthetic or semi-synthetic oil.
Note! SAE 5W/30 **only** may be used.

Fuel system

	TMD102A, TAMD102A, TAMD102D	TMD122A, TAMD122A, TAMD122P-A
Injection pump, settings:		
TMD102A	22° BTDC.	
TAMD102A	20° BTDC.	
TAMD102D	18° BTDC.	
TMD122A		24° BTDC.
TAMD122A		21° BTDC.
TAMD122P-A		17° BTDC.
Injectors, opening pressure:		
TMD102A,TAMD102A, TAMD102D	25.5 MPa (260 kp/cm² = 3698 psi)	
TMD122A	25.0 MPa (255 kp/cm² = 3626 psi)	
TAMD122A	25.5 MPa (260 kp/cm² = 3698 psi)	
TAMD122P-A	27.5 MPa (280 kp/cm² = 3983 psi)	
Injector, Adjustment pressure (new spring):		
TMD102A,TAMD102A, TAMD102D	26.0–26.8 MPa (265–273 kp/cm² = 3771–3887 psi)	
TMD122A	25.5–26.3 MPa (260–268 kp/cm² = 3698–3812 psi)	
TAMD122A	26.0–26.8 MPa (265–273 kp/cm² = 3771–3887 psi)	
TAMD122P-A	28.0–28.8 MPa (286–294 kp/cm² = 4061–4177 psi)	

Turbocharger

Charging pressure, min. values (measured in the engine's inlet manifold at 100% load and wide open throttle (WOT), air temperature approx. +25°C (77°F). When measuring at a different temperature, the charging pressure measured must be corrected (see Workshop Manual).

If full power cannot be achieved, the pressure is considerably lower.

	TMD102A	**TAMD102A**	**TAMD102D**
Rating Pleasure, (Power curve PD)			
1800 rpm.	–	–	187 kPa (1.90 kp/cm² = 27.12 psi)
2000 rpm.	–	–	204 kPa (2.08 kp/cm² = 29.58 psi)
2250 rpm.	–	–	212 kPa (2.16 kp/cm² = 30.75 psi)
Rating 4, (Power curve SLD)			
1800 rpm.	–	–	187 kPa (1.90 kp/cm² = 27.12 psi)
2000 rpm.	–	–	204 kPa (2.08 kp/cm² = 29.58 psi)
2250 rpm.	–	–	212 kPa (2.16 kp/cm² = 30.75 psi)
Rating 3, (Power curve LD)			
1800 rpm.	–	–	170 kPa (1.73 kp/cm² = 24.65 psi)
2000 rpm.	–	–	187 kPa (1.90 kp/cm² = 27.12 psi)
2200 rpm.	–	–	195 kPa (1.99 kp/cm² = 28.28 psi)
Rating 2, (Power curve MD)			
1600 rpm.	102 kPa (1.04 kp/cm² = 14.79 psi)	105 kPa (1.07 kp/cm² = 15.23 psi)	–
1800 rpm.	121 kPa (1.23 kp/cm² = 17.54 psi)	123 kPa (1.25 kp/cm² = 17.84 psi)	–
2000 rpm.	133 kPa (1.35 kp/cm² = 19.29 psi)	139 kPa (1.42 kp/cm² = 20.16 psi)	–
Rating 1, (Power curve HD)			
1500 rpm.	73 kPa (0.74 kp/cm² = 10.58 psi)	72 kPa (0.73 kp/cm² = 10.44 psi)	–
1700 rpm.	91 kPa (0.93 kp/cm² = 13.20 psi)	93 kPa (0.95 kp/cm² = 13.49 psi)	–
1800 rpm.	108 kPa (1.10 kp/cm² = 15.66 psi)	107 kPa (1.09 kp/cm² = 15.52 psi)	–

	TMD122A	**TAMD122A**	**TAMD122P-A**
Rating Pleasure, (Power curve PD)			
1700 rpm.	–	–	189 kPa (1.93 kp/cm² = 27.41 psi)
1900 rpm.	–	–	215 kPa (2.19 kp/cm² = 31.18 psi)
2250 rpm.	–	–	227kPa (2.32 kp/cm² = 32.92 psi)
Rating 4, (Power curve SLD)			
1700 rpm.	–	–	189 kPa (1.93 kp/cm² = 27.41 psi)
1900 rpm.	–	–	215 kPa (2.19 kp/cm² = 31.18 psi)
2250 rpm.	–	–	227kPa (2.32 kp/cm² = 32.92 psi)
Rating 3, (Power curve LD)			
1600 rpm.	–	–	164 kPa (1.67 kp/cm² = 23.79 psi)
1800 rpm.	–	–	189 kPa (1.93 kp/cm² = 27.41 psi)
2000 rpm.	–	–	210 kPa (2.14 kp/cm² = 30.46 psi)
Rating 2, (Power curve MD)			
1500 rpm.	83 kPa (0.85 kp/cm² = 12.04 psi)	108 kPa (1.10 kp/cm² = 15.66 psi)	–
1600 rpm.	93 kPa (0.95 kp/cm² = 13.49 psi)	117 kPa (1.19 kp/cm² = 16.97 psi)	–
1800 rpm.	109 kPa (1.11 kp/cm² = 15.81 psi)	133 kPa (1.36 kp/cm² = 19.29 psi)	–
Rating 1, (Power curve HD)			
1500 rpm.	79 kPa (0.81 kp/cm² = 11.46 psi)	104 kPa (1.06 kp/cm² = 15.09 psi)	–
1600 rpm.	89 kPa (0.91 kp/cm² = 12.91 psi)	113 kPa (1.15 kp/cm² = 16.39 psi)	–
1800 rpm.	101 kPa (1.03 kp/cm² = 14.65 psi)	128 kPa (1.31 kp/cm² = 18.57 psi)	–

Cooling system

	TMD102A, TAMD102A, TAMD102D	TMD122A, TAMD122A, TAMD122P-A
The freshwater system's capacity includes the heat exchanger, approx.	40 liters (8.8 Imp. gals/10.6 US gals)	50 liters (11 Imp. gals/13.2 US gals)
Heat exchanger, tube type:		
The thermostats (3) start to open at	81°C (177°F)	81°C (177°F)
fully open at	94°C (201°F)	94°C (201°F)
Keel cooler and radiator cooler:		
The thermostats (2) start to open at	76°C (168°F)	76°C (168°F)
fully open at	90°C (194°F)	90°C (194°F)
(1) starts to open at	70°C (158°F)	70°C (158°F)
fully open at	84°C (183°F)	84°C (183°F)

Electrical System

System voltage	24 V	24 V
AC generator,		
voltage/max. amperage	28V/60A	28V/60A
output approx.	1700 W	1700 W
Extra generator equipment (accessory):		
voltage/max. amperage	28V/100A	28V/100A
effect approx.	2800 W	2800 W
Battery capacity	2 series connected 12 V, max. 152 Ah	
Battery electrolyte density at +25°C (77°F):		
fully charged battery	1.28 g/cm^3 = 0.046 lb/in^3 (1.24 g/cm^3 = 0.044 lb/in^3)*	
charge battery at	1.24 g/cm^3 = 0.044 lb/in^3 (1.20 g/cm^3 = 0.043 lb/in^3)*	

***Note:** Applies to batteries with tropical acid.

Reverse Gear

MPM

	IRM 310 AL	IRM 311 AL
Type designation		
Ratios	1.52:1; 1.78:1; 1.97:1	1.52:1; 1.78:1; 2:1
Angle (output shaft)	7°	7°
Oil capacity approx.	9 liters (2.0 Imp. gals/2.4 US gals)	9 liters (2.0 Imp. gals/2.4 US gals)
Oil quality (as per API system)	CC, CD, CE	CC, CD, CE
Viscosity	SAE30*	SAE30*
Operating oil pressure	2.2–2.3 MPa (22–23 kp/cm^2 = 320–313 psi)	2.3–2.4 MPa (23–24 kp/cm^2 = 327–341 psi)
Approx. weight	190 kg (419 lbs)	190 kg (419 lbs)

* **Note!** Only **single grade** lubricating oil (only **one** viscosiy number) may be used in the reverse gear.

	IRM 320 A
Type designation	
Ratios	1.55:1
Angle (output shaft)	7°
Oil capacity approx.	17 liters (3.7 Imp. gals/4.5 US gals)
Oil quality (as per API system)	CC, CD, CE
Viscosity	SAE30*
Operating oil pressure	2.1 MPa (21 kp/cm^2 = 300 psi)
Approx. weight	175 kg (386 lbs)

* **Note!** Only **single grade** lubricating oil (only **one** viscosiy number) may be used in the reverse gear.

Twin Disc

Type designation	**MG5091DC (deep oil pan)**	**MG5091SC (shallow oil pan)**
Ratios	3.82:1; 4.50:1	2.04:1; 2.45:1; 2.95:1
Angle (output shaft)	0°	0°
Oil capacity, approx.	18 liters (3.9 Imp. gals/4.7 US gals)	9 liters (2 Imp. gals/2.4 US gals)
Oil quality (as per API system)	CC, CD, CE	CC, CD, CE
Viscosity at oil temperature 66–85°C (151–185°F)	SAE30*	SAE30*
Viscosity at oil temperature 85–100°C (185–212°F)	SAE40*	SAE40*
Operating oil pressure at oil temperature 82°C (180°F), 1800 rpm:		
"Neutral"	0.207–0.634 Mpa (2.1–6.5 kp/cm^2 = 29.4–90.2 psi)	
"Forward"	1.57–1.63 MPa (16–16.6 kp/cm^2 = 223.3–231.9 psi)	
Weight, approx.	250 kg (551 lbs)	220 kg (485 lbs)

***Note!** Only **single grade** lubricating oil (only **one** viscosiy number) may be used in the reverse gear.

Type designation	**MG5111DC (deep oil pan)**	**MG5111SC (shallow oil pan)**
Ratios	3.28:1; 3.92:1; 4.44:1; 4.95:1	2.04:1; 2.54:1
Angle (output shaft)	7°	7°
Oil capacity, approx.	25 liters (5.5 Imp. gals/6.6 US gals)	10.5 liters (2.3 Imp. gals/2.3 US gals)
Oil quality (as per API system)	CC, CD, CE	CC, CD, CE
Viscosity at oil temperature 66–85°C (151–185°F)	SAE30*	SAE30*
Viscosity at oil temperature 85–100°C (185–212°F)	SAE40*	SAE40*
Operating oil pressure at oil temperature 82°C (180°F), 1800 rpm:		
"Neutral"	0.207–0.634 MPa (2.1–6.5 kp/cm^2 = 29.44–90.18 psi)	
"Forward"	1.57–1.63 MPa (16–16.6 kp/cm^2 = 223.31–231.85 psi)	
Weight, approx.	350 kg (772 lbs)	252 kg (556 lbs)

***Note!** Only **single grade** lubricating oil (only **one** viscosiy number) may be used in the reverse gear.

Type designation	**MG5114SC (shallow oil pan)**	**MG514C**
Ratios	1.48:1; 1.92:1; 2.50:1	6.0:1; 5.16:1; 4.5:1; 4.13:1
	–	3.5:1; 3.0:1; 2.0:1; 1.51:1
Angle (output shaft)	7°	0°
Oil capacity, approx.	10.5 liters (2.3 Imp. gals/2.8 US gals)	–
ratios 6.0:1; 5.16:1; 4.5:1; 4.13:1.	–	34 liters (7.4 Imp. gals/8.9 US gals)
ratios 3.5:1; 3.0:1; 2.0:1; 1.51:1	–	23 liters (5.1 Imp. gals/6.0 US gals)
Oil quality (as per API system)	CC, CD, CE	CC, CD, CE
Viscosity at oil temperature 66–85°C (151–185°F)	SAE30*	SAE30*
Viscosity at oil temperature 85–100°C (185–212°F)	SAE40*	SAE40*
Operating oil pressure at oil temperature 82°C (180°F), 1800 rpm:		
"Neutral"	0.207–0.634 MPa (2.1–6.5 kp/cm^2= 29.44–90.18 psi)	0.41–0.67 MPa(4.2–6.8 kp/cm^2= 58.31–95.30 psi)
"Forward"	1.57–1.63 MPa (16–16.6 kp/cm^2= 223.31–231.85 psi)	1.37–1.56 MPa (13.9–15.9 kp/cm^2= 194.861–221.89 psi)
Weight, approx.	213 kg (496 lbs)	–
ratios 6.0:1; 5.16:1; 4.5:1; 4.13:1	–	657 kg (1448.42 lbs)
ratios 3.5:1; 3.0:1; 2.0:1; 1.51:1	–	523 kg (1153 lbs)

***Note!** Only **single grade** lubricating oil (only **one** viscosiy number) may be used in the reverse gear.

Clutch

Disengageable clutches at front of engine (accessory)

Rockford/Borg Warner

Type	Single plate clutch (“over-center” type)
Gear ratio	1:1
Size	203 mm (8"), alt. 254 mm (10")
Permitted rpm, power take-off engaged	900–1800 rpm
Permitted torque, max.	226 Nm (8"), 314 Nm (10")
Weight, approx.	65 kg (143 lbs)

Twin Disc

Type	Double plate clutch (“over-center” type)
Gear ratio	1:1
Size	292 mm (11 1/2")
Permitted rpm, power take-off engaged	900–1800 rpm
Permitted torque, max.	514 Nm
Weight, approx.	78 kg (172 lbs)

Disengageable clutch at rear of engine (accessory)

Automotive Products

Type	Triple plate clutch (“over-center” type)
Gear ratio	1:1
Size	292 mm (11 1/2")
Weight, approx.	83 kg (183 lbs)

Notes

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