INSTRUCTION BOOK

Marine diesel engines

TAMD60C, MD70C, TMD70C, TAMD70E

VOLVO
PENTA

Marine Diesel Engines
TAMD60C · MD70C · TMD70C · TAMD70E

Applies to engines manufactured from and including March 1983

Contents

Presentation

The engines are six-cylinder, in-line, fourstroke marine diesel engines. They are of the direct injection type and equipped with a heat exchanger for thermostat-controlled freshwater cooling of the cylinder block, cylinder heads and exhaust manifold.

The engines are lubricated by a pressure lubricating system in which an oil pump feeds the oil under pressure to all the lubricating points. The pistons in TAMD70E are cooled by oil sprayed up through jets in the cylinder block to cooling channels in the pistons.

The fuel system is protected against the intrusion of contaminants by two replaceable fine filters.

The engines have "wet" replaceable cylinder liners.

TAMD60, TMD70 and TAMD70 are fitted with a turbo-compressor which is driven by the exhaust gases and lubricated and cooled by the engine lubricating oil. The turbine housing is fresh-water cooled to reduce radiated heat in the engine compartment. The turbo-compressor supplies the engine with an excess of air under pressure. This enables the quantity of injected fuel to be increased, which results in an increase of engine output.

TAMD60 and TAMD70 are also fitted with an after-cooler (charge-air cooler) which lowers the temperature of the inlet air, thus enabling a further increase in engine output.

Basic engine no. Conversion no. Engine designation

Number Plate example

Number Plate location	
Engines:	
60-Series	On the right side of the cylinder block in front of the lubricating oil filters.
70-Series	On the left side of the cylinder block above the injection pump coupling.
Reverse Gear:	
Borg Warner	On the left side
SCG	On top
Twin Disc	On top

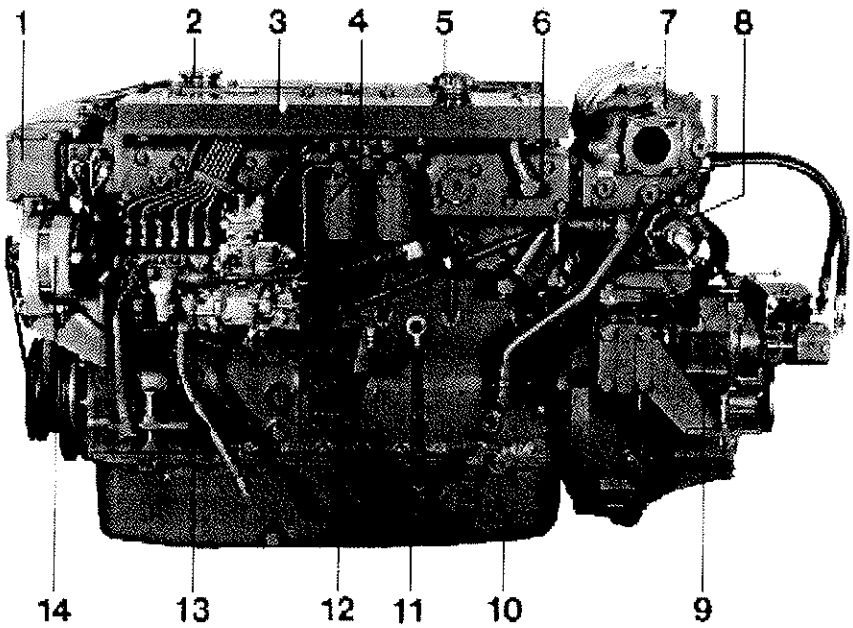


Fig. 1. Engine, TAMD60C

1. Heat exchanger
2. Cap (coolant)
3. Shield plate
4. Fuel filters
5. Cap, engine oil filler
6. Liquid cooled exhaust manifold
7. Turbo-compressor
8. Oil cooler for reverse gear
9. Oil dipstick, reverse gear
10. Oil sump
11. Oil dipstick, engine
12. Stop solenoid
13. Fuel injection pump
14. Alternator

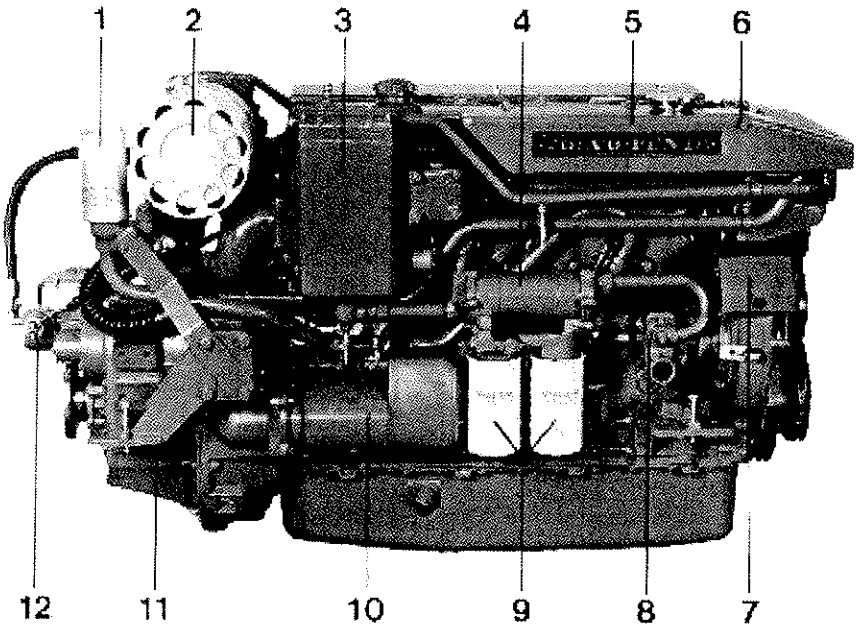


Fig. 2. Engine, TAMD60C

1. Crankcase ventilation filter
2. Air cleaner
3. After-cooler
4. Oil cooler for engine
5. Expansion tank (cooling system)
6. Connection for separate expansion tank
7. Electric connection box with fuses
8. Seawater pump
9. Lubricating oil filters
10. Starter motor
11. Reverse gear, TD MG 506
12. Oil pump

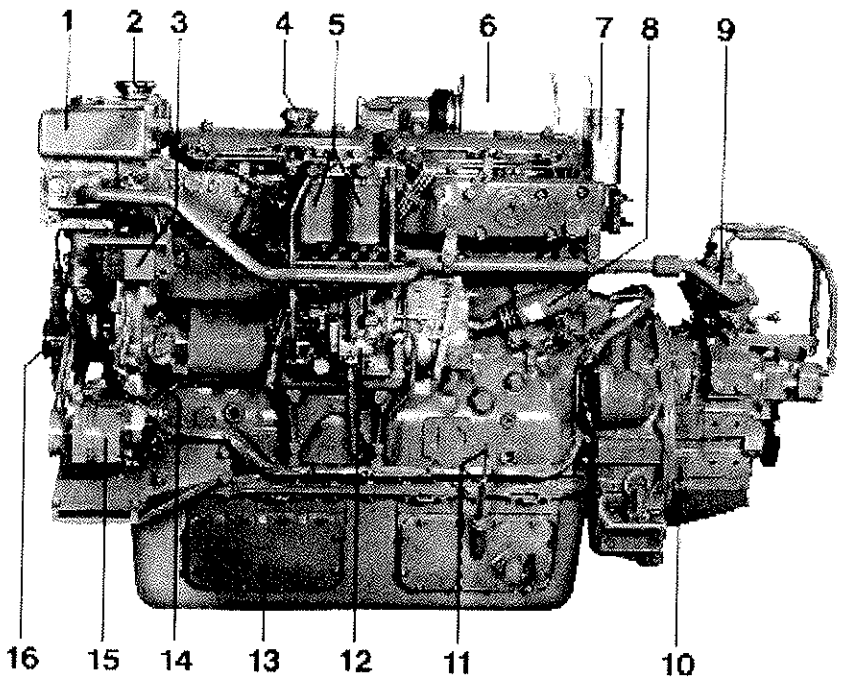
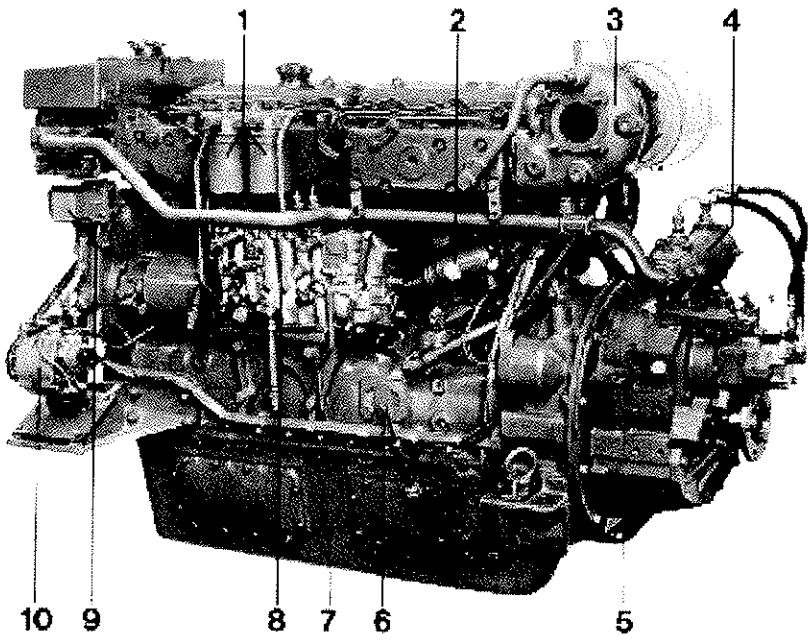


Fig. 3. Engine, MD70C with plate heat exchanger

1. Expansion tank
2. Fresh-water filler cap
3. Voltage regulator
4. Oil filler cap
5. Fuel filters
6. Air cleaner
7. Crankcase ventilation filter
8. Stop solenoid
9. Oil cooler, reverse gear
10. Reverse gear
11. Oil dipstick
12. Fuel injection pump
13. Inspection cover
14. Engine speed sender
15. Alternator
16. Bilge pump (extra equipment)



FFig. 4. Engine, TMD70C with plate heat exchanger

1. Fuel filters
2. Stop solenoid
3. Turbo-compressor
4. Oil cooler, reverse gear
5. Reverse gear TD MG506
6. Oil dipstick
7. Deep oil sump (with inspection covers)
8. Fuel injection pump
9. Voltage regulator
10. Alternator

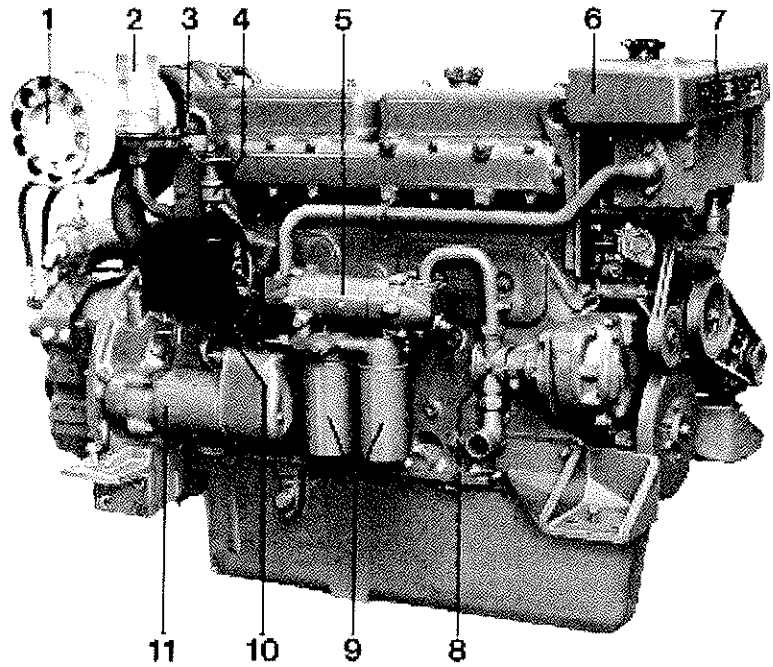


Fig. 5. Engine, TMD70C with plate heat exchanger

1. Air cleaner
2. Crankcase ventilation filter
3. Valve for crankcase ventilation (opens at pre-determined pressure)
4. Sender for charging pressure (extra equipment)
5. Oil cooler
6. Expansion tank
7. Plate heat exchanger
8. Seawater pump
9. Oil filters
10. Connection box
11. Starter motor

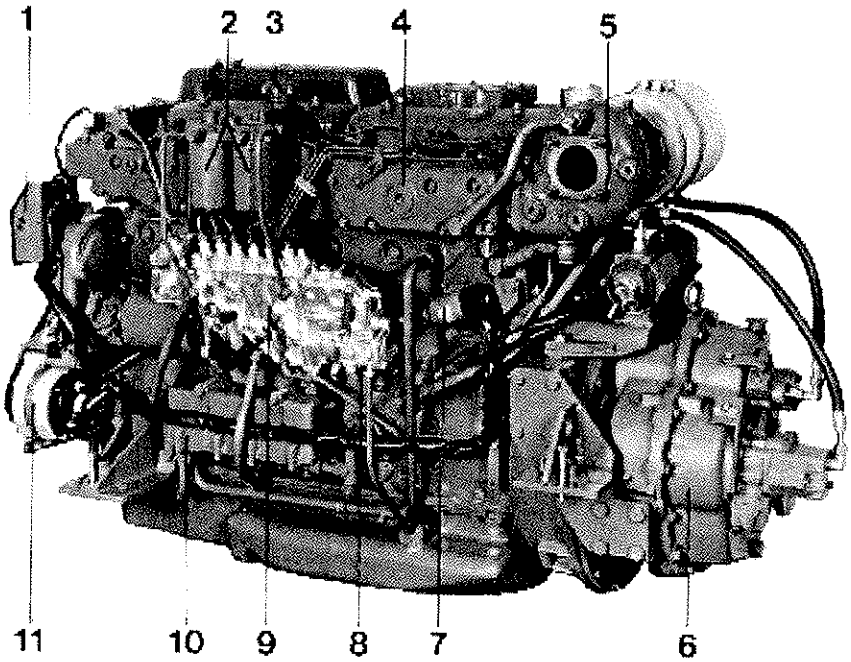


Fig. 6. Engine, TAMD70E with tubular heat exchanger

1. Electric connection box with fuses
2. Fuel filters
3. Oil filler cap
4. Exhaust manifold
5. Turbo-compressor
6. Reverse gear TD MG507
7. Stop solenoid
8. Oil dipstick
9. Fuel injection pump
10. Oil cooler for engine
11. Alternator

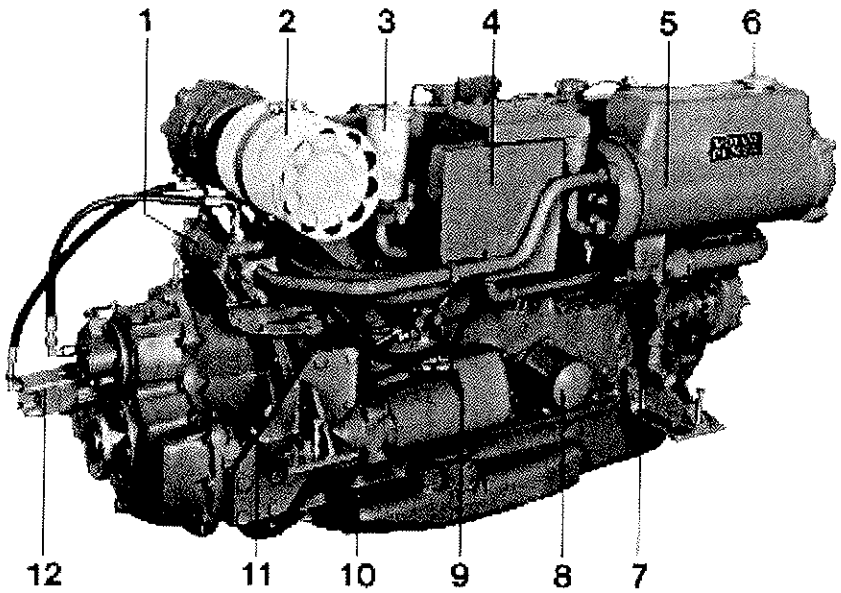


Fig. 7. Engine, TAMD70E with tubular heat exchanger

1. Oil cooler for reverse gear
2. Air cleaner
3. Crankcase ventilation filter
4. After-cooler (charge-air cooler)
5. Tubular heat exchanger
6. Coolant filler cap
7. Seawater pump
8. Oil filter
9. Starter motor
10. Oil sump
11. Oil dipstick, reverse gear
12. Oil pump

Lubricating oil

Engine and reverse gear

Use only oil which satisfies the demands made by the standards referred to in the table below. Volvo Penta diesel engine oil satisfies these quality demands by a wide margin and can therefore be used to advantage.

NOTE! The warranty no longer applies if the engine is operated with the wrong lubricating oil.

Viscosity is also to be adapted to air temperature, see "Technical Data", page 42.

Designation	Standard
CD*	API (American Petroleum Institute)
MIL-L-2104C	US Government's Military Spec.

For MD70 and TMD70 with deep oil sump, the interval between oil changes may be extended under certain conditions, see page 20. In which case a SHPD-oil** according to Volvo Drain Specification and/or CCMC D3*** shall be used.

* **In the reverse gear** it is permissible to use oil of quality **CC**.
** SHPD-oil (Super High Performance Diesel Oil).
*** CCMC D3 (Committee of Common Market Automobile Constructors D3-oil).

Fuel

The diesel fuel oil used in the engine must satisfy high quality demands and must primarily be free from solid impurities and water. The sulphur content should also be as low as possible.

If low quality fuel is used, this can give rise to abnormal wear, running interruptions and smoky exhaust emission.

Diesel fuel must satisfy the demands according to the following standards: DIN 51601, CEC-ERF-D1, ASTM-D975-No 2-D, or Volvo Group Standard (Diesel fuel oil 97863-02).

A few of the points in the Volvo Standard are given below:

Cetane rating	min 45
Viscosity at 20° (68°F)	2.0-5 cSt
Lowest pour temperature	
summer grade	-9°C (+ 16°F)
winter grade	-24°C (-11 °F)
Flash point	40°C min. (104°F)
Solid impurities	None
Sulphur content	0.5 % by weight

To ensure fuel supply and easy starting in severe cold during winter it is advisable to use the special winter fuels as sold by the major oil companies. These fuels are less viscous, which reduces the risk of paraffin precipitation in the fuel system. Alternatively approx. 30 % lamp paraffin can be added to the diesel fuel. **Engine or heater paraffin must not be used because their low cetane rating reduces the willingness to ignite.**

Avoid the formation of condensate by always keeping the tank as full as possible. Alcohol must never be added to diesel fuel since even small quantities can damage the fuel system.

Coolant

Precautions in case of frost

When the engine is stopped and there is risk of frost, the **seawater cooling system** should be drained in order to prevent the cooling jackets and pipelines from being damaged by frost. See "Draining the coolant" on next page.

The fresh-water system should be filled with at least a 40 % mixture of approved ethylene glycol and water the entire year round in order to avoid both frost and corrosion damage, see "Glycol" below. Prior to the cold season the freezing point of the coolant should be checked and more ethylene glycol added if necessary.

Glycol

As a frost protecting additive **ethylene glycol to BS 3151B with copper inhibitor** can be used. We recommend the use of our **original Volvo ethylene glycol***, which has correctly balanced additives to neutralise corrosive substances in the cooling water. If this red glycol is used, then it need only be changed once a year - most suitably in the autumn.

Anti-freeze fulfills a dual purpose, not only does it protect against frost damage but it also helps to prevent corrosion. Always use therefore a coolant mixture containing at least 40 % glycol. Topping-up, if necessary, should also be made using the same glycol mixture. This mixture gives protection down to about -25°C (-13°F). For lower temperatures a greater percentage of glycol must be added according to the table.

The freezing point can be lowered to a maximum of -56°C (-69°F) with the addition of 60 % glycol.

Any increase of the glycol content above 60 % reduces the degree of frost protection.

Mix the glycol with water in a separate vessel before filling the cooling system.

NOTE! Glycol is a dangerous, poisonous liquid.

Never use anti-freeze which is not approved. Certain anti-freeze products of the wrong type can actually cause corrosion in the engine.

No alcohol of any kind is to be used since it evaporates fairly quickly. Furthermore, the use of alcohol increases the risk of corrosion in the cooling system.

* Part no. 1129616, 1 kg = approx. 0.9 litre (2 lb = approx. 1 qt)
Part No. 1129617, 5 kg = approx. 4.5 litre
(10 lb = approx. 1 gall.)

Capacities

Capacity of freshwater system in dm³ = litres (Imp.galls/US.galls) approx:		Amount of glycol in dm³ = litres (Imp.galls/US. galls) for frost protection down to (–13°F)	(–22°F)	(–40°F)	(–69°F)
TAMD60C	20	8.5	9.5	11	12
	(4.4/5.3)	(1.9/2.2)	(2.1/2.5)	(2.4/2.9)	(2.6/3.2)
TAMD60C*	23	9.5	11	13	14
	(5.1/6.1)	(2.1/2.5)	(2.4/2.9)	(2.9/3.4)	(3.1/3.7)
MD70C**	29	12	13.5	16	17.4
	(6.4/7.7)	(2.6/3.2)	(3.0/3.6)	(3.5/4.2)	(3.8/4.6)
TMD70C,**	30	12.3	14	16.5	18
TAMD70E**	(6.6/7.9)	(2.7/3.2)	(3.1/3.7)	(3.6/4.4)	(4.0/4.8)
(T)MD70C***	34	14	15.5	18.4	20.4
	(7.5/9.0)	(3.1/3.7)	(3.4/4.1)	(4.0/4.9)	(4.5/5.4)
TAMD70E***	35	14.3	16	19	21
	(7.7/9.2)	(3.1/3.8)	(3.5/4.2)	(4.2/5.0)	(4.6/5.5)

* Incl. extra expansion tank.
** With plate heat exchanger.
*** With tubular heat exchanger.

Corrosion inhibitors

The easiest way to avoid corrosion is to use a suitable mixture of Volvo original glycol all year round (min. 40 %). It should be changed every autumn.

In cases when glycol is never necessary, corrosion inhibitor should be added to the cooling water. Use Volvo's corrosion inhibitor (part no. 1129709-0) available in 1/2 litre (1 pint) packs. Two packets (1 litre = 1 qt) are required for TAMD60 and MD70 with plate heat exchanger. For other engines three packets (1.5 litres = 1.5 qts) are required. The cooling system must be thoroughly cleaned before corrosion inhibitor is added. Run the engine warm immediately after filling to give the best possible effect. To maintain protection against corrosion a further 1/2 litre (1 pint) of inhibitor should be **added after every 400 hours of operation.**

NOTE! Glycol or any other type of anti-freeze **must absolutely never** be mixed with this corrosion inhibitor. Corrosion inhibitor does not prevent ice forming and may only be used when the temperature is always above 0°C (32°F).

Draining the coolant

Before draining, the engine should first be stopped, the filler cap screwed off, and the boat's sea-cock closed. Then open the drain cocks in the fresh and sea-water systems as well as the air-venting cocks, see figs. 8-14. There may also be extra cocks at the lowest points on the cooling water and exhaust lines. Screw off the fresh-water filter, if fitted.

Remove the seawater pump cover and the cover from any extra bilge pump. Make sure that all the water runs out.

Bilge-pump the boat and make sure that there are no leakages.

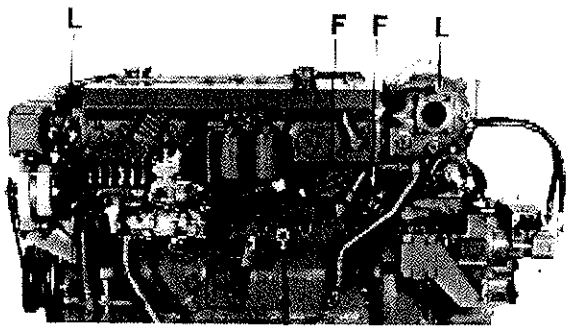


Fig. 8 Drain and air-venting cocks, TAMD60

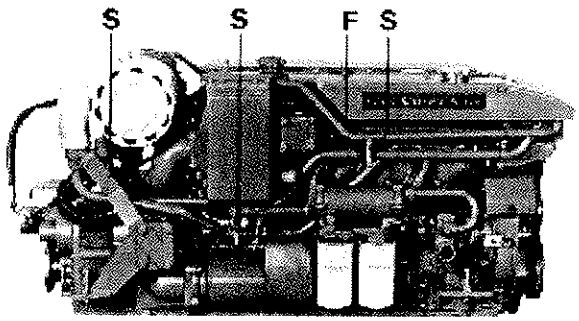


Fig. 9 Drain cocks, TAMD60

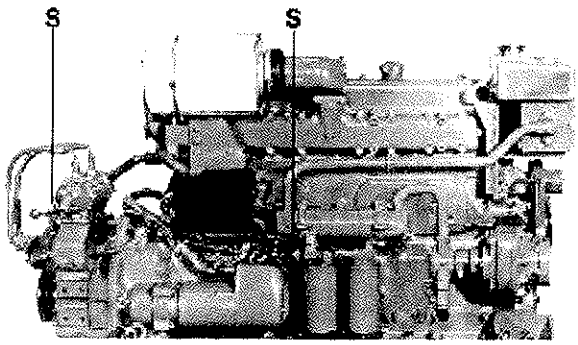


Fig. 10. Drain cocks, (T)MD70

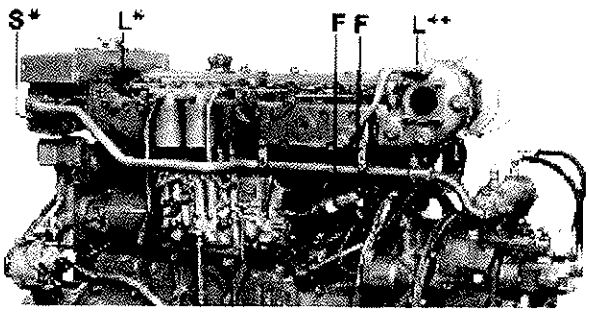


Fig. 11. Drain and venting cocks (T)MD70

* Only for engines with plate heat exchanger.
** Only TMD70.

Figs. 8–11. S = Seawater cocks
L = Venting cocks F = Fresh-water cocks

Adding coolant

Flush the cooling system before filling with coolant. Check hoses and hose clamps and also remedy any possible leakages. Screw in a new fresh-water filter (extra equipment). Shut the drain cocks.

NOTE! When coolant is being added open the air-venting cock on the thermostat housing on MD70, TMD70 with tubular heat exchanger and on TAMD60 and TAMD70. On MD70 and TMD70 with plate heat exchanger the air-venting cock is at the rear of the expansion tank. On TAMD60, TMD70 and TAMD70 there is also an air-venting cock on the turbo-compressor. See figs. 8-14.

Filling should be carried out whilst the engine is stopped. The engine must not be started until the system has been air-vented and is completely full. If a heater system is connected to the engine cooling system then the heat control valve should be opened fully and the heater system air-vented during filling.

On **TAMD60**, small topping-up quantities may be added to the expansion tank (1, fig. 15) but in other cases remove the hexagon plug (2) and add coolant directly into the heat exchanger until the system is completely full and air-vented. Then close the air-venting cocks and fit the hexagon plug. **Afterwards** fill the engine expansion tank up to about 5 cm (2") below the filler cap sealing surface (to allow for coolant expansion) and refit the cap.

If there is a separate plastic expansion tank (fig. 16, extra equipment) then the engine expansion tank should be filled completely. Fit the cap and finally fill the separate tank to between the "MIN" and "MAX" marks.

Check that the cooling system is correctly air-vented by **carefully opening each venting cock** after the engine has been started and reached operating temperature. Any remaining air will thus be expelled.

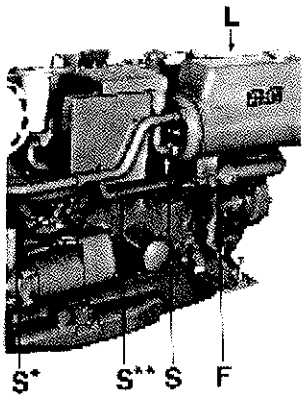


Fig. 12. Drain and air-venting cocks, (T)MD70, TAMD70 with tubular heat exchanger.

* Only MD70, TMD70
** Only TAMD70

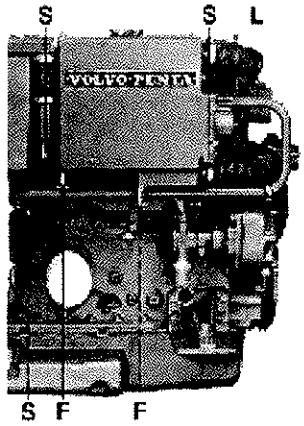


Fig. 13. Drain and air-venting cocks, TAMD70 with plate heat exchanger.

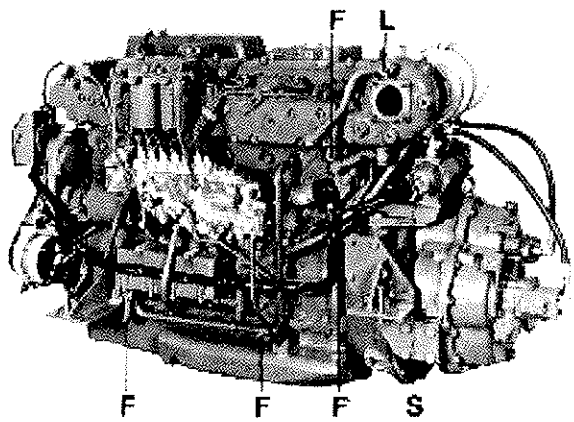


Fig. 14. Drain and air-venting cocks, TAMD70

Fig. 12–14. S = Seawater cocks F = Fresh-water cocks L = Air-venting cocks

Engine speed

NOTE! Special regulations apply to running-in, see under heading "Running in".

In the case of engines set for light-duty operation (this applies mostly to leisure craft) the speed of the engine at cruising speed should be about 200 r/min less than the maximum obtainable engine speed attained under the prevailing conditions of loading. This ensures economical and favourable operation.

TAMD60, TMD70, TAMD70: Do not run the engine for prolonged periods at less than **1400 r/min** and with the engine under full load. Check now and then that the turbo-compressor is operating properly by observing the exhaust gases. This check should be carried out at normal operating speed and with the engine at full loading.

If, after a period of time, engine speed appears to be decreasing, this may be due to dirt or marine growth on the bottom of the boat. For this reason, the hull below the waterline should always be thoroughly cleaned in such cases and treated with anti-fouling paint before other measures are taken.

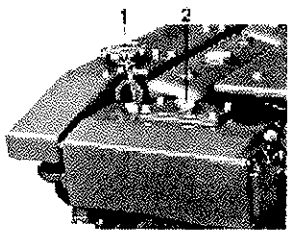


Fig. 15. TAMD60

1. Cap on expansion tank. Topping-up.
2. Hexagon plug on heat exchanger. Filling.

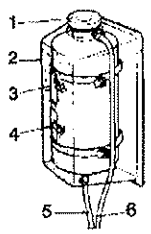


Fig. 16. Separate expansion tank

1. Filler cap
2. Cover
3. Max. level
4. Min. level
5. Hose from engine
6. Hose with open end

Running-in

When the engine is new it must be run with a certain amount of caution during the first **200 hours**. The same applies to a newly reconditioned engine. Read the instruments often and make sure that they give normal readings.

Run at full speed only during short periods for the first **50 hours**. During this time, cruising speed should also be reduced so that it is at least **300 r/min** below the maximum speed attainable.

The cruising speed can subsequently be increased gradually, but in the case of engines with settings for light duty running, the operating speed must always be around **200 r/min** below the maximum engine speed attainable under the prevailing conditions of loading.

For a new or newly reconditioned engine the valve clearance should be checked for the first time after 150 hours of operation.

If a fresh water filter is fitted (extra equipment) then a new filter should be fitted for the first time after 200 hours of operation.

Changing the oil during running-in

The oil and oil filter in both the engine and reverse gear* is to be changed for the first time after **150 hours** of operation. This also applies to changing the oil for the first time in any reduction gear, if fitted.

The oil is then to be changed at the normal intervals shown in the service scheme.

* Only certain models of reverse gear have an oil filter, see service instructions.

Propeller shaft brake

For certain stipulated conditions of operation a propeller shaft brake may be necessary, due to the fact that the propeller shaft may be caused to rotate by forces acting upon the propeller, when the engine is shut down. This propeller "trailing" can damage the reverse gear since the oil pump is driven by the input shaft which is stationary together with the engine.

For the SCG - reverse gear, however, a special oil pump for the circulation of lubricating oil can be fitted. This pump, which is driven by the output shaft, should be ordered at the same time as the reverse gear (not included in Volvo Penta's standard range). If this extra pump is fitted, the shaft can "trail" for unlimited periods of time and no shaft brake is needed. The pump cannot be fitted to previously installed reverse gears.

The propeller shaft may be allowed to rotate, whilst the engine is shut down, for up to 24 hours. It is however, if possible, advantageous to run the engine for a short while after every 8 hours for lubrication and cooling of the reverse gear. In cases where the shaft rotates faster than during normal operation, whilst under sail for example, a temperature gauge should be connected to the reverse gear in order to monitor the oil temperature. The maximum permitted temperature for the SCG-reverse gear is approx. 70°C (158°F) and 110°C (230°F) for the Twin Disc reverse gear.

If these regulations cannot be fulfilled a propeller shaft brake must be fitted (in exceptional cases the reverse gear drive may be disconnected instead).

Borg Warner do not make any stipulations regarding propeller shaft braking for engines whilst sailing or in the case of twin engine installations when one of the engines is shut down. The oil level should, however, be checked carefully under these conditions as well as during normal operating conditions.

Get-you-home device

Reverse gears SCG MRF 350 HD MK3B are fitted with a get-you-home device (mechanical safety clutch) as standard equipment.

In the event of a serious breakdown of the reverse gear hydraulic system or excessive slipping when attempting "ahead" running, the get-you-home device can be engaged in order to reach port.

When engaged, this get-you-home device mechanically locks the input and output shafts together, preventing the disengagement of the reverse gear. The control lever must **unconditionally** be in the "Ahead" position while the engine is running with the get-you-home device engaged. Any other position of the control lever will cause damage to the clutch linings.

In the interests of safety the gear cable should be disconnected from the reverse gear.

Engaging, SCG MRF 350 HD MK3B

NOTE! Stop the engine before engaging the get-you-home device. Serious bodily injury can result otherwise.

Remove the cover with the oil pump which is located on the left hand side of the reverse gear. Screw in the three screws alternately until all the screws are properly tightened. Use a hexagonal wrench (5 mm). **Start the engine and proceed with reduced speed.**

Let a workshop carry out the necessary repairs as soon as possible.

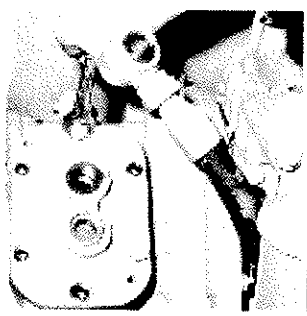


Fig. 17. Removing the oil pump

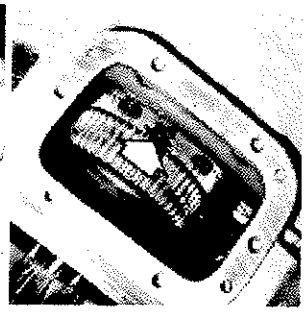


Fig. 18. Locking screws for the get-you-home device

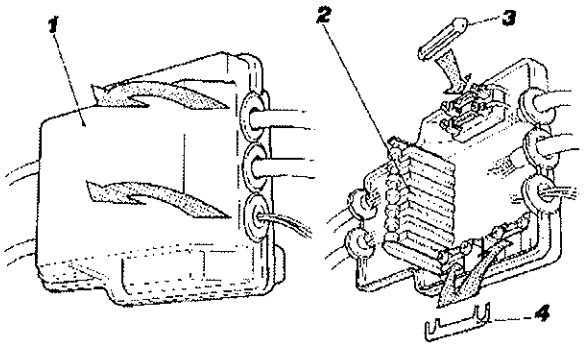


Fig. 19. Connection box with fuses, MD70, TMD70

1. Cover
2. Terminal
3. Fuses (25A, engine)
4. Fuses 50A for small alternator, and 80A for large alternator (CAV, 28V/60A)

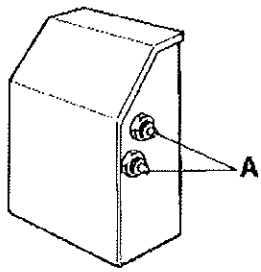


Fig. 20. Connection box with automatic fuses (A), TAMD60, TAMD70

A = Resetting buttons

Electrical System

The engines are equipped with a 2-pole electrical system with alternator. TAMD60 and TAMD70 can be equipped with a single-pole electrical system (extra equipment).

TAMD60 has a 12V system (alternatively 24V) while the 70-series engines have 24V systems as standard (alternatively 12V).

The wiring diagrams are to be found on pages 38-47.

Fuses

MD70 and TMD70 have the engine and alternator fuses located in the connection box on the right hand side of the engine (fig. 19).

When replacing a fuse, prise the cover (1) in the direction of the arrows. Replace the damaged fuse with a new one. Check that the terminal block (2) is in its groove and clip the cover back into place. Ensure that the sealing rings are properly seated.

TAMD60 and TAMD70 are fitted with two automatic fuses; located in the connection box on the right hand side of the engine, in the case of TAMD60; and at the front of the engine for TAMD70. The fuses can be reset by pushing in the buttons (A, Fig. 20). Engines with the large alternator (CAV, 28V/60A) have a further two 80A fuses for the alternator. See wiring diagram.

Important

1. **Never break the circuit between the alternator and the battery while the engine is running. The master switches must never be switched off until the engine has stopped completely.** No other cable may be disconnected while the engine is running since this can damage the voltage regulator.
2. Check the batteries, battery cables and cable terminals at regular intervals. The battery terminals must be kept very clean and the terminal clamps must always be well tightened and thoroughly greased to avoid any interruptions. All cables should be well tightened. There must be no loose connections.

   NOTE! Never confuse the battery positive and negative poles when installing the batteries. Compare with the wiring diagram. Check the drive belt tension regularly
3. **When starting with the help of auxiliary batteries, see the following section.**
4. If repairing the alternator equipment, always first remove both the battery cables. The same applies when rapid charging the batteries.

   NOTE! Follow the appropriate safety instructions when charging the batteries.
5. Never test by placing a screwdriver or similar tool against a connection to see if there is a spark.
6. **Electric welding**

   When carrying out electrical welding on the engine or installed components, the following measures should be taken:

   Disconnect both the battery cables first, and then all the cables to the alternator (and to the voltage regulator, if it is mounted separately). Insulate the cables and reconnect the battery cables. Remember to disconnect the battery cables again before reconnecting the cables to the alternator and voltage regulator.

   Connect welding cable clamps so that current does **not** pass through any bearing.

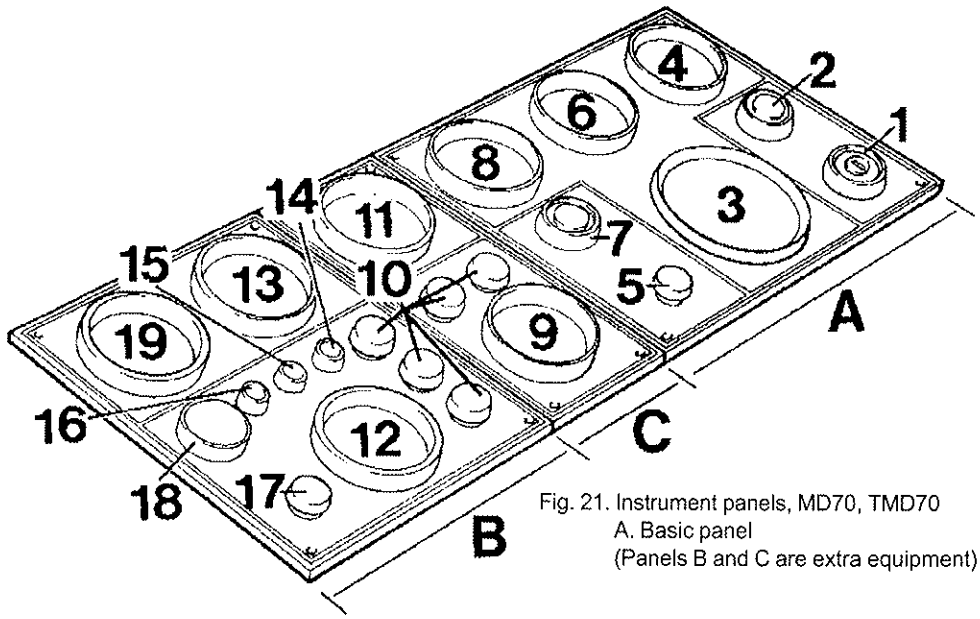


Fig. 21. Instrument panels, MD70, TMD70
A. Basic panel
(Panels B and C are extra equipment)

Starting with auxiliary batteries

Warning!

The batteries (especially auxiliary batteries) contain oxyhydrogen gas which is very explosive. A spark, which can be caused by faulty connection of the auxiliary start cables, is sufficient to cause a battery to explode resulting in both bodily injury and damage to property.

If the batteries have frozen, they must be thawed before attempting to start with auxiliary batteries.

1. Check that the auxiliary batteries are connected (in series or parallel) so that the rated voltage agrees with the engine system voltage.
2. Connect one end of the red auxiliary start cable to the auxiliary battery's positive pole (marked with red, P or +). Always check to ensure that the clamps are properly secured so that no sparks occur when attempting to start.
3. Connect the other end of the red cable to the positive pole of the discharged battery, where the positive cable to the starter motor is connected.
4. Connect one end of the black cable to the auxiliary battery's negative pole (marked with blue, N or-).
5. Connect the other end of the black cable to a point **which is situated some way away from the discharged batteries**, i.e. at the master switch to the negative cable or to the negative cable's point of connection to the engine.
6. Start the engine. **NOTE! Do not disturb the connections when attempting to start because of the risk of sparking and do not lean over any of the batteries.**
7. Remove the cables in exactly the reverse order to that of connecting. **NOTE! The normal cable connections to the standard batteries must on no account be disconnected.**

Instruments

Instrument panels - MD70, TMD70

The most important instruments for the engine are grouped on the basic panel (A). There is also a panel (B) with for example, hour meter, warning lamps, warning siren and pressure gauges for the reverse gear oil pressure and turbo-charging pressure.

A further panel (C) with rudder indicator and fuel gauge is also available. (Panels B and C are extra equipment).

The location of the panels in relation to each other can be varied, since they are built to a modular system.

For an alternative manoeuvre position (or Flying Bridge) a separate panel with less instruments is available. (Extra equipment). See fig. 22.

The numbering on figs. 21 and 22 coincide. The instruments on the alternative manoeuvre position panel which have the same function as those on the main panel therefore have the same number.

The engine can be stopped and started from the alternative panel. The key on the basic panel should however be switched to the running position.

1. **Key switch** with 4 positions.
   Position 0 - the key can be inserted and removed.
   Position I - is not used, turn key past this position
   Position II - running position
   Position S - not used
2. **Stop button** - pushing it in engages the stop solenoid and stops the engine.
3. **Revolution counter, engine speed** - multiply the values on the scale by 100 to obtain revs. per minute.

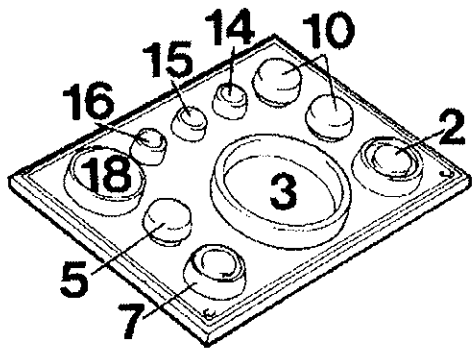


Fig. 22. Instrument panel for alternative manoeuvre position (Flying Bridge) MD70, TMD70. Extra equipment.

4. **Voltmeter, charging** of batteries and system voltage. With a 24V system, the gauge needle (during running) should be pointing to approx. 28 volts, but for a 12 volt system it should read approx. 14 volts. Should the voltage reading during running drop to 24V or 12V respectively, the batteries are not being charged.

   The gauge is connected across the master switch, and indicates 24V and 12V respectively when the engine is stopped.

5. **Instrument lighting** - indirect lighting of all instruments. A rheostat switch enables variation of lighting strength by turning the knob.

6. **Pressure gauge - engine lubricating oil pressure**, should be at 300-500 kPa (3-5 kp/cm² = 43-71 p.s.i.) during normal operation. At idling speed it should be min. 150 kPa (1.5 kp/cm² = 21 p.s.i.). The engine must not be run if the oil pressure is too low.

7. **Start button** - pushing it in engages the starter motor. A relay prevents engagement while the engine is running.

8. **Temperature gauge - engine coolant.** During normal operation the temperature should be between 65 and 95°C. (149-203°F). The engine must not be run for more than a few seconds if the temperature is too high.

9. **Rudder indicator** - indicates the position of the rudder. The middle position of the needle indicates the rudder in neutral.

10. **Push - pull switches** - for extra lighting. (Max. load 5A per switch).

11. **Fuel gauge** - indicates how much fuel there is in the tank. F means a full tank, E an empty tank- although a small amount of reserve fuel (R) still remains.

12. **Hour meter** - registers the number of hours and minutes the engine has been running.

13. **Pressure gauge** - reverse gear oil pressure. The pressure should be according to the values given in "Technical Data", pages 50 and 51.

14. **Battery charging warning lamp** - lights if the batteries discharge.

15. **Warning lamp** - lights if the lubricating oil pressure is too low.

16. **Warning lamp** - lights if the engine coolant temperature is too high.

17. **Push-pull switch** - for extra lighting. (Max. load 5A).

18. **Alarm (buzzer)** - engages automatically if the engine temperature becomes excessive or its oil pressure too low. Either lamp 15 or 16 will light at the same time to indicate which fault has occurred.

19. **Pressure gauge** - for the turbo-compressor charging pressure. For pressures, see "Technical Data", page 49.

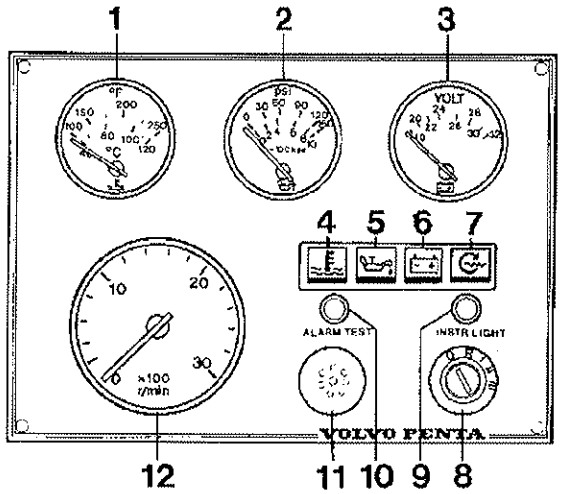


Fig. 23. Instrument panel. Basic panel

Instrument panels - TAMD60, TAMD70

The most important instruments for the engine are grouped on the basic panel above. There are also further panels available as extra equipment. See figs. 24, 25 and 26 on the next page.

1. **Temperature gauge-engine coolant.**
   The temperature during normal operation should be between 65° and 95°C (149-203°F). If the gauge indicates an abnormally high temperature for a prolonged period of time, stop the engine and investigate the cause. The engine should, on the other hand, not be run at too low a temperature for long periods either.
2. **Oil pressure gauge - engine.**
   The lubricating oil pressure should be between 300 and 500 kPa (3-5 kp/cm² = 43-71 p.s.i.) when the engine is hot. If the pressure should drop to below 150 kPa (1.5 kp/cm² = 21 p.s.i.) at higher engine speeds than idling, stop the engine immediately and investigate the cause.
3. **Voltmeter - system voltage.**
   During running 28 volts should be indicated for a 24 volt system, whilst 14 volts should be indicated for a 12 volt system. If the voltage reading falls to 24 or 12 volts respectively when running, then the batteries are not being charged.

   The gauge is connected across the master switches and indicates 24 and 12 volts respectively when the engine is stopped.
4. **Warning lamp - high coolant temperature.**
   The lamp lights if the coolant temperature becomes too high - above about 95°C (203°F). An alarm is also sounded at the same time. The lamp also lights if there is a fault in the charging circuit (although no alarm is heard).
5. **Warning lamp - low oil pressure, engine.**
   The lamp lights if the oil pressure in the engine becomes too low - below about 150 kPa (1.5 kp/cm² = 21 p.s.i.). An alarm is also sounded at the same time.
6. **Warning lamp - charging of batteries.**
   The lamp lights if there is no charging current supplied from the alternator.
7. **Warning lamp.**
   This warning lamp is not used.
8. **Key switch (starter switch).**
   The current is connected when the key is turned clockwise. The key shall be engaged when running. When the engine has stopped the key shall be disengaged (position 0).

   The key switch has a mechanical re-start locking device which prevents the starter motor from being engaged while the engine is running. The key must first be turned back to position R (stop) before it can be returned to the start position.

   Position 0 - the key can be inserted and removed.
   Position R - stop position.
   Position I- running position.
   Position II - not used.
   Position III - starting position (starter motor engaged).
9. **Push-button switch - instrument panel lighting.**
   The instrument lighting is switched on and off by pressing and re-pressing the button.
10. **Push-button switch - alarm test.**
    The alarm should sound when the button is held pressed in.
11. **Alarm (buzzer)**
    The alarm (buzzer) is heard if the coolant temperature is too high, if the engine lubricating oil pressure is too low or if the button 10 ("Alarm test") is pressed in.
12. **Revolution counter - engine speed.**
    Multiply the values by 100 to obtain revs. per minute.

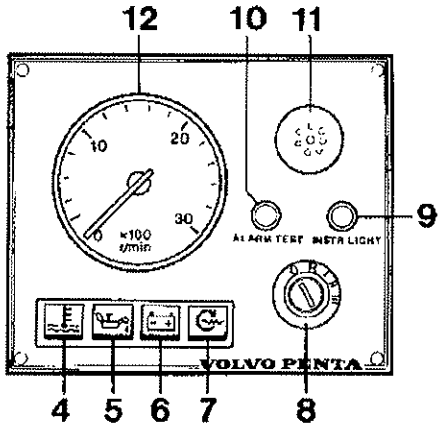


Fig. 24. Panel for alternative manoeuvre position (Flying Bridge). Extra equipment.

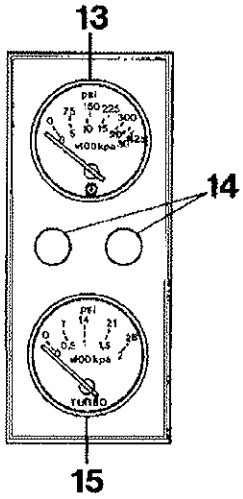


Fig. 25. Supplementary panel (extra equipment)

Extra equipment panels, TAMD60, TAMD70

An instrument panel, for an alternative manoeuvre position (Flying Bridge), with fewer instruments than on the basic panel is available as extra equipment. See fig. 24.

Also available as extra equipment, is a supplementary panel (fig. 25.) with gauges to measure the oil pressure in the reverse gear and the turbo-charging pressure.

In cases when the instruments from the basic panel are mounted separately, a special "alarm panel" is available (fig. 26.). The "alarm panel" consists of a panel fitted with warning lamps from the basic panel.

The numbering on figs. 23, 24, 25 and 26 coincide. The instruments on the extra equipment panels which have the same function as those on the main panel therefore have the same number. See previous page.

13. **Oil pressure gauge - reverse gear.**
The lubricating oil pressure when running should be in accordance with the values given in "Technical Data", pages 50-51.

14. **Blind plugs.**
Place for extra switches etc.

15. **Gauge for turbo-charging pressure.**
For pressures, see "Technical Data", page 49.

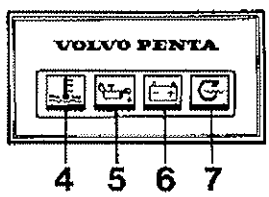


Fig. 26. Alarm panel (lamp panel). Extra equipment

Controls

Volvo Penta single lever control (single or twin) operates both the reverse gear and controls engine speed.

Lever (1) position **N - neutral position**
From N to F - reverse gear engaged for running forwards.
From N to R- reverse gear engaged for running backwards.
T - engine speed control

Disengaging the reverse gear from the control lever.

Push in the button (2) when the lever is in the neutral position and then move the lever forward. The lever can then be used for controlling engine speed, but with the reverse gear disengaged. Take care not to engage the reverse gear unintentionally.

When it is desired to use the lever again for operating the reverse gear, **keep the button (2) pushed** and pull the lever to the neutral position again.

As extra equipment, the control can have a neutral position switch, in which case the engine can only be started when the reverse gear is in the neutral position.

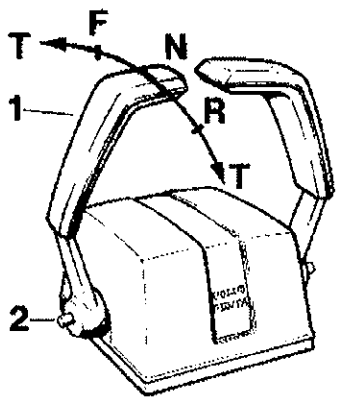


Fig. 27. VP Twin control.

Running

The following instructions apply to engines which have both standard instrumentation and optional extra instrument equipment. In the case of standard instruments only, the instructions apply where appropriate.

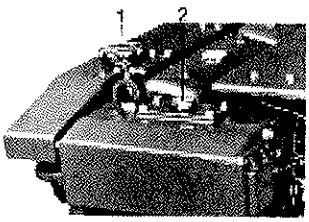


Fig. 28. TAMD60
1. Cap on expansion tank. For topping-up
2. Hexagon plug on the heat exchanger. For filling the system

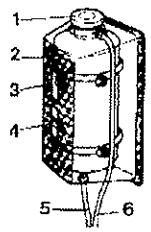


Fig. 29. Separate expansion tank
1. Filler cap
2. Cover
3. Max. level
4. Min. level
5. Hose from engine
6. Hose with open end

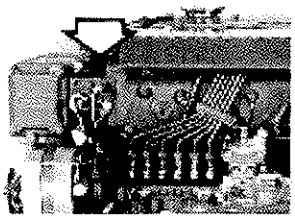


Fig. 30. Venting cock TAMD60 (not fitted on earlier models)

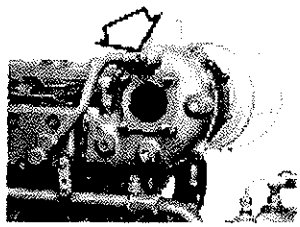


Fig. 31. Venting cock, TAMD60, TMD70, TAMD70

Procedure before starting

1. **Coolant level.** Check that the level is about 5 cm (2") below the expansion tank filler cap sealing surface. There must be an air cushion to allow for the expansion of the coolant.

   On TAMD60 engines with a separate plastic expansion tank (extra equipment) the level should be between the "MIN" and "MAX" marks on the tank.

   NOTE! Remove the cap very carefully if the engine is hot. When adding coolant, remember to open the air-venting cocks to prevent the formation of air pockets. See "Adding coolant", page 8.

   If the engine becomes abnormally hot, carefully ventilate the cooling system and fill up with coolant.

2. **Lubricating oil level, engine.** Check, when the engine is stopped, that the level is between the marks on the dipstick. For oil grade, see "Technical Data". The oil level must never be permitted to fall below the lower mark.

3. **Oil level, reverse gear and clutches with reduction gear.** The level should be up to the mark (or alternatively lie between the two marks) on the dipstick. Repeat the check when the engine is idling with the control in the neutral position for Twin Disc reverse gear.

   The oil level for Borg Warner and SCG reverse gears should be checked when the engine is stopped.

   In the case of reduction gears (extra equipment) the level should reach up to the level plug.

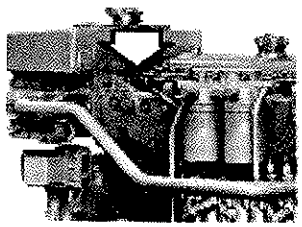


Fig. 32. Venting cock MD70, TMD70 with plate heat exchanger

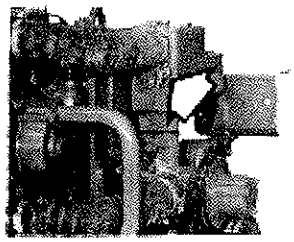


Fig. 33. Venting cock TAMD70 and also MD70 and TMD70 with tubular heat exchanger

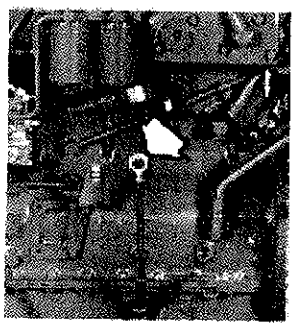


Fig. 34. Oil dipstick, engine (the picture shows a 70-series engine)

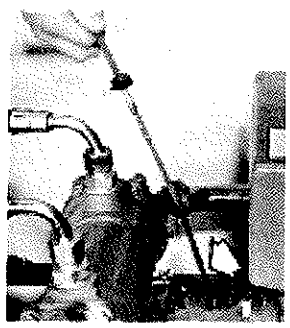


Fig. 35. Oil dipstick, reverse gear (the picture shows the Twin Disc reverse gear)

4. Check that the **seawater cocks** on the engine are closed. See illustrations on pages 7 and 8.
5. Open the boat's **sea-cock** and the **trickle feed cock** to the bilge pump, if fitted (fig. 36).
6. **Fuel**. Check that there is sufficient fuel in the tanks and open the fuel cocks.
7. **Master switches**. Switch on the master switches. NOTE! The switches must never be turned off while the engine is running since this can damage the voltage regulator.

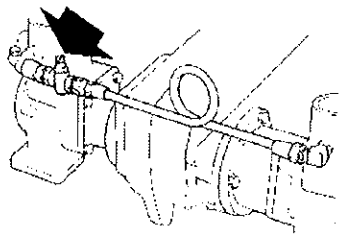


Fig. 36. Trickle-feed cock. The scribed line should be in line with the pipe when the cock is open

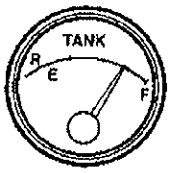


Fig. 37. Fuel gauge (not standard)
F = Full tank
E = Empty tank
R = Reserve fuel

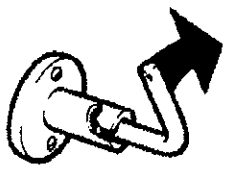


Fig. 38. Master switch

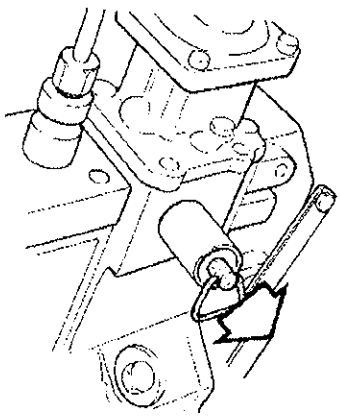


Fig. 39. Cold start device, TAMD60C

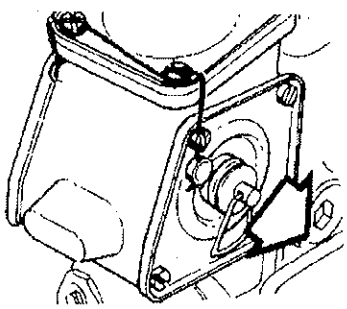


Fig. 40. Cold start device, MD70, TMD70, TAMD70

Starting

To assist cold starting, the injection pump is equipped with a cold start device.

On TAMD60C the cold start device is located in the centrifugal governor (under the smoke limiter) at the rear of the injection pump. It is engaged by **pulling a ring at the end of a shaft** on the side of the governor (fig. 39), after the speed control lever has been set to the max. position.

For the other engines the cold start device is located in the smoke limiter at the front of the injection pump. It is engaged by **pulling a ring at the end of a shaft** on the side of the smoke limiter (fig. 40), after the speed control lever has been set to the max. position.

When the engine has started, the cold start device, in both cases, is automatically disengaged.

1. Set the control lever (both levers in the case of a twin installation) to the neutral position. Press in the button (1) to disengage the reverse gear. Keep the button pressed in and set the control lever to full speed "Ahead" (2). If the engine is fitted with a disengaging clutch, then the control lever on the clutch must be moved to the disengaged position.

2. **MD70C, TDM70C:** Engage the cold start device before starting a cold engine. See figs. 40.

3. **MD70, TMD70**: Turn the key switch to the running position-II, fig. 42. Check that the warning lamps for battery charging and oil pressure (14 and 15, fig. 21) are alight. The alarm buzzer is switched on at the same time. Dampen the noise by holding your thumb over the buzzer (18).

   Always carry out this check before starting, to make sure that the warning lamps and alarm function; in order to be well prepared for an emergency.

4. **MD70, TMD70**: Press in the start button 7, fig. 21. Release the button and reduce the engine speed to about 1000 r/min as soon as the engine has started. Check that the warning lamps have gone out.

5. **TAMD60, TAMD70**: Turn the key switch to running position-I, fig. 43. Check that the warning lamps for coolant temperature (1, fig. 44), oil pressure (2) and charging (3) are alight.

6. **TAMD60, TAMD70**: Press the button marked "Alarm test" and check that the alarm is heard.

7. **TAMD60, TAMD70**: Start the engine by turning the key to position-III.

8. **TAMD60, TAMD70**: Release the key and reduce the engine speed to about 1000 r/min as soon as the engine has started. Check that the warning lamps go out.

Never race a cold engine. The lubricating oil is viscous in its cold condition and it is possible that scoring may occur if the engine is raced.

If another start attempt has to be made with a cold engine, reset the control to full speed at the same time as the cold start device is re-engaged.

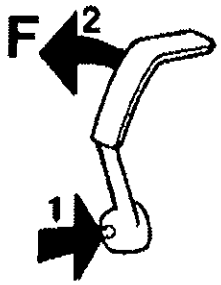


Fig. 41. Disengaging the control from the reverse gear

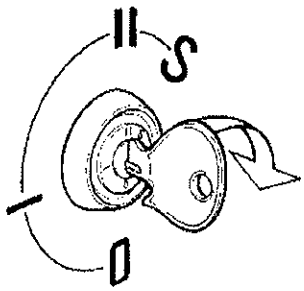


Fig. 42. Key switch on instrument panel, MD70, TMD70
0 = Key can be inserted and removed
I = Not used
II = Running position
S = Not used

Fig. 43. Key switch on instrument panel, TAMD60, TAMD70
0 = Key can be inserted and removed
R = Stop position
I = Running position
II = Not used
III = Starting position

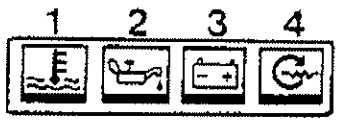


Fig. 44. Warning lamps on instrument panel, TAMD60, TAMD70
1. High coolant temperature
2. Low lubricating oil pressure
3. Alternator not charging
4. Not used.

Fig. 45. Engine speed

During running

Frequently check during running that all the instruments give normal readings. Some of the instruments are extra equipment, see pages 18–21.

Check	Instrument	Observation	Remarks/Actions
Engine speed		The speed should be within the permitted range. See pages 15–16.	
Engine lubricating oil pressure		300-500 kPa (3-5 kp/cm² = 43-71 p.s.i.) normally during operation.	Stop the engine if the oil pressure is too low and remedy the fault.
Warning lamp (low oil pressure)		The lamp should not light unless the pressure falls below 150 kPa (1.5 kp/cm² = 21 p.s.i.)	If the lamps lights and/or the alarm is heard the oil pressure is too low. Stop the engine. Remedy the fault.
Alarm (buzzer)		The alarm is heard if the oil pressure falls below 150 kp/cm² = 21 p.s.i.)	
Engine coolant temperature		65-95°C (150-203°F) normally during operation.	
Warning lamp (coolant temperature)		The lamp should not light unless the engine temperature exceeds approx. 95°C (203°F).	If the lamp lights and/or the alarm is heard the engine temperature is too high. Stop the engine. Remedy the fault.
Alarm (buzzer)		The alarm is heard if the engine temperature exceeds approx. 95°C (203°F).	
Reverse gear oil pressure		The pressure should correspond with the values given in "Technical Data".	Slipping can occur if the pressure is too low. This can cause damage to the reverse gear.
Fuel quantity in tanks		F = Full tank E = Empty tank R = Reserve fuel	Avoid stoppages for want of fuel. If this should happen, the fuel system must be vented, after filling with fuel.
Charging voltage		During normal running approx. 28 volts for 24 V system and approx. 14 volts for 12 V system.	If the voltage drops to 24 (or 12) volts during running, the batteries are not being charged. Remedy the fault as soon as possible.
Warning lamp (battery charging)		The lamp should not light.	The batteries are not being charged if the lamp lights. Remedy the fault as soon as possible.
Turbo-charging pressure		Normal pressure, see "Technical Data". The pressure depends greatly on power output. The engine should run at full load for 2-3 minutes before reading the pressure gauge.	The charging pressure is considerably lower than those values given in "Technical Data", unless full engine output can be developed. Check that the charging pressure does not drop unduly from the normal test pressure reached for the boat in question.

Manoeuvring

Manoeuvring of the reverse gear and clutches should be carried out at idling speed. The engine speed must not exceed **800 r/min**. Manoeuvring at higher engine speeds can damage the reverse year, clutches and reduction gears.

When running backwards with Borg Warner reverse gears, full engine power output may not be utilised continuously. In the case of SCG reverse gear, the engine speed should not exceed **1500 r/min**. However, maximum output can be utilised if necessary for not more than 15 minutes. For Twin Disc reverse gear full power output can be used continuously, even when reversing.

All manoeuvring is to be carried out quickly and positively. Manoeuvring from full speed "Ahead" to full speed "Astern" is carried out as follows:

1. Move the speed control to the idling position and, if possible, allow the boat to lose most of its speed.
2. With a fast, firm action, move the reverse gear control to the neutral position and pause for a moment.
3. Then, with a firm and rapid action, move the reverse gear control over to the reverse position and increase the engine speed.

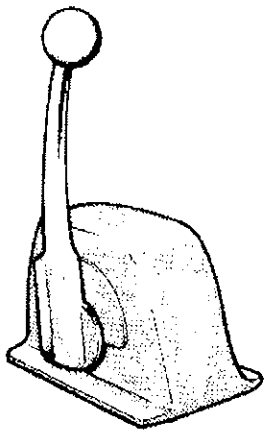


Fig. 46. Control for operating the trolling valve

Trolling valve (Twin Disc-reverse gear MG 506)

If the reverse gear is fitted with a trolling valve (extra equipment) this should be used when the boat is to proceed very slowly. This ensures that the engine runs at a favourable and sufficiently high speed in spite of the low propeller speed. **Engine speed must not, however, exceed 1100 r/min when the trolling valve is being used.** The trolling valve can be engaged gradually and used to advantage when trawling or in other similar situations.

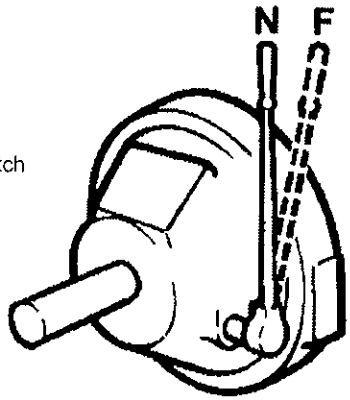


Fig. 47. Disengaging clutch

F= Engaged
N = Neutral position

Disengaging clutch

The clutches have two control lever positions. The lever is moved towards the engine to engage - and away from the engine to disengage. **Engine speed must not exceed 800 r/min when a clutch is being engaged or disengaged.**

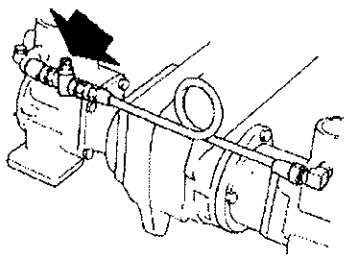


Fig. 48. Trickle-feed cock for bilge pump closed.

Stopping

1. Allow the engine to run off-load for a few minutes so that the engine temperature decreases. This is to avoid after-boiling or overheating of the turbo-compressor.
2. **MD70, TMD70**: Press in the stop button and keep it there until the engine has stopped. If the button is released too soon the alarm (extra equipment) may be engaged; the engine may also continue to run.

   TAMD60, TAMD70: Stop the engine by turning the key switch to position-"R".
3. When the engine has stopped, **break the electrical circuit by** turning the key switch to position - "0". Otherwise the batteries will discharge (the stop solenoid is engaged on TAMD60 and TAMD70).

   If the engine is not to be operated for a long time, the master switches should also be switched off and all the cocks for fuel and cooling water closed.

   NOTE! The master switches must never be switched off while the engine is running. This can cause damage to the voltage regulator.
4. Close the cock on the trickle-feed pipe to the bilge pump, if fitted. The marking is to be at right angles to the pipe when the cock is closed.
5. If there is risk of frost, the cooling system must be drained or anti-freeze added, see "Precautions in case of frost" on page 6.

Servicing Scheme

During the running-in period the service intervals on page 9 apply.

The numbering in the schemes below list the service operations described on the following pages. Servicing work requiring the attention of experienced mechanics and the use of special tools is marked with an "A" and should, therefore, be carried out by authorized service personnel.

Daily

1. Check the oil level in the engine.
2. Check the coolant level and the seawater filter (extra equipment).

Every 50 hours

3. Check the oil level in the reverse gear.
4. Disengaging clutches and reduction gears (extra equipment):

   Check the oil level. Lubricate the throw-out bearing.
5. Check the batteries.
6. Check/drain extra fuel pre-filters.
7. Disengaging clutches: Lubricate the inner support bearing.

Every 200 hours

8. Disengaging clutches: Lubricate the output shaft support bearing, disengaging shaft and the moving parts of the clutch mechanism.
9. Change the oil in the engine.[1)]
10. Replace engine lubricating oil filter on TAMD70.
11. Check/tension the V-belts.
12. Check air lines, oil and cooling pipes at the turbo for leakage.
13. Clean the seawater filter (extra equipment).

Every 400 hours

14. Check the zinc electrodes.
15. Replace the crankcase ventilation filter.
16. Add corrosion inhibitor to the cooling system.[2)]
17. Replace engine lubricating oil filters on TAMD60.

Every 800 hours

18. Change the engine oil filters, MD70, TMD70.
19. Change the lubricating oil filter on Twin Disc MG 506 reverse gear with trolling valve (extra equipment).
20. Disengaging clutch with reduction gear: Change the oil.
21. Change the fresh-water filter (extra equipment).
22. Check the fuel injectors (A).
23. Disengaging clutch (extra equipment): Check.

Every 1200 hours

24. Check valve clearances (A).
25. Change the oil in the reverse gear, clean the suction strainer, replace filter, if fitted.
26. Check the reverse gear.
27. Replace the fine filters in the fuel system.[3)]
28. Replace the filter element(s) in extra fuel pre-filter(s).
29. Check and, if necessary, clean the cooling system.
30. Replace the air cleaner.
31. Check the starter motor and the alternator. Lubricate the CAV alternator (1600W) (extra equipment).

Every 2400 hours or when necessary

32. Check/clean heat exchanger and after-cooler.
33. Check/clean the engine and reverse gear oil coolers.
34. Replace the impeller in the seawater pump (preferably at the beginning of the season).
35. Check the fuel injection pump (A).
36. Check the turbo-compressor (A).
37. General check of the engine and its equipment (A).
38. Inhibiting (when laying-up).
39. De-inhibiting (when launching).

All the measures listed above (except for nos. 24, 31, 32, 33 and 35 to 39 incl.) should be carried out at least once a year, even if the running time in the scheme has not been reached.

[1)] **For MD70 and TMD70 with deep oil sump** the interval between oil changes can be extended to **400 hours** under the following conditions:
- The oil shall be an SHPD-oil according to Volvo Drain Specification and/or CCMC D3, see page 6.
- The diesel fuel's sulphur content must not exceed 0.5 % by weight.

The frequency of changing depends greatly upon the quality of the fuel and operating conditions. If a longer interval between changes is required the condition of the oil must be checked by the oil manufacturer by means of regular lubricating oil tests.

[2)] This point does not apply when a water/glycol-mixture is used in the cooling system.

[3)] This applies under normal conditions using high-quality fuel. During unfavourable conditions of operation the filters should be replaced more often.

Checks and Servicing

1. Engine oil level

Check the oil level every day before starting the engine. Wipe the oil dipstick with a clean rag (do not use cotton waste). The oil level should be between the two marks on the dipstick, never below the lower mark.

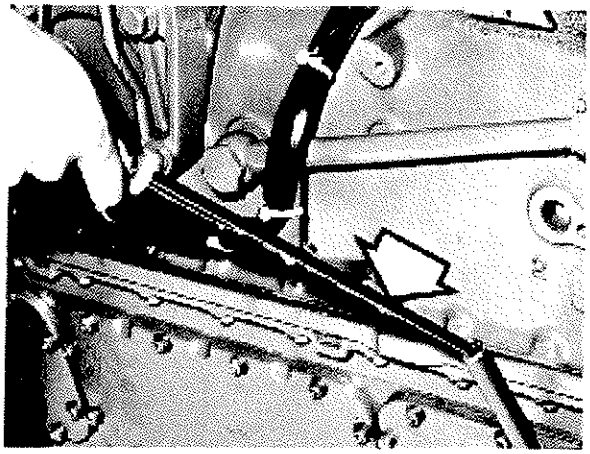
The fuel injection pump and the turbo-compressor is lubricated automatically from the engine lubricating system.

The fresh-water pump and seawater pump are lubricated in connection with manufacture and no further lubrication is necessary.

Engine oil

Quality grade according to the API-system: CD

For viscosity at various ambient air temperatures, see "Technical Data" on page 49.



Checking the oil level. Engine

Engine	Oil capacity, approx dm³ (= litres) (Imp. galls/US galls) With engine inclination		
	0°	15°	18°
TAMD60C	20 (4.4/5.3)	–	13 (2.8/3.4)
MD70C, TMD70C	32, 30* (7.1/8.5), (6.6/7.9)*	19 (4.2/5.0)	19* (4.2/5.0)
TAMD70E	30 (6.6/7.9)	–	19 (4.2/5.0)

* With shallow oil sump (bulb).

2. Engine coolant level

Check the level daily before starting.

NOTE! Open the coolant filler cap carefully when the engine is hot.

When the engine is cold the level should be approx. 5 cm (2") below the sealing surface of the filler cap so that the coolant can expand when the engine becomes warm.

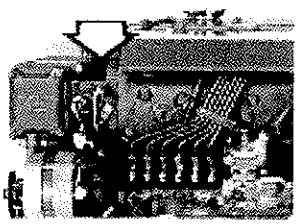
On TAMD60 with separate plastic expansion tank (extra equipment) the level should be between the "MIN" and "MAX" marks on the tank.

See pages 6-7 for information concerning coolant composition etc.

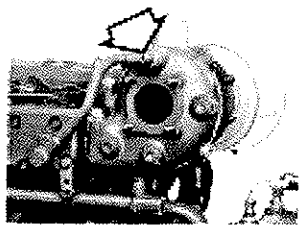
When topping-up, remember to open the air-venting cocks to prevent the formation of air pockets. See "Adding coolant" on page 8. Close the cock (or cocks) after topping-up.

If there is risk of frost the system should be drained or anti-freeze added, see "Precautions in case of frost".

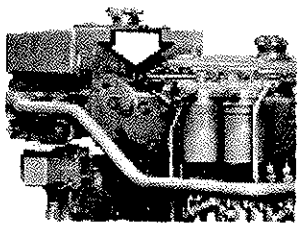
The seawater filter (extra equipment) should be checked and cleaned when needed. For cleaning, see page 25. The frequency of this service will be found by experience and depends upon the amount of contaminants etc. in the seawater.



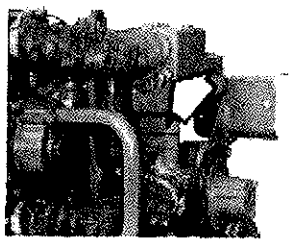
Venting cock TAMD60 (not on earlier models)



Venting cock TAMD60, TMD70, TAMD70



Venting cock MD70, TMD70 with plate heat exchanger



Venting cock TAMD70 and MD70, TMD70 with tubular heat exchanger

3. Reverse gear oil level

Check the oil level with the dipstick **after every 50 hours**. Fill, if necessary, to the (upper) mark on the dipstick.

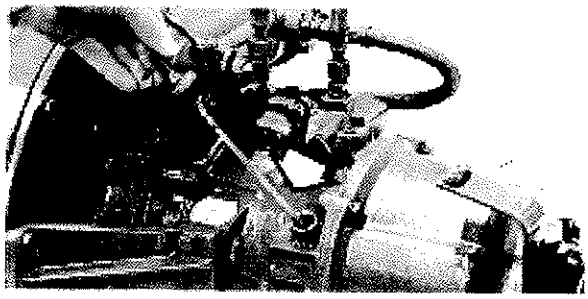
For the Twin Disc reverse gear the oil level should be checked with the engine idling and the operating control set to "Neutral". In the case of Borg Warner and SCG reverse gears the oil level should be checked when the engine is not running.

The oil dipstick on Borg Warner reverse gear can be lifted out after turning the handle two turns to the left. Re-secure the dipstick by pushing it down and then turning the handle to the right.

Oil quality: Same as in the engine. (Although lubricating oil of quality grade CC according to the API-system is permitted in the **reverse gear**).

Viscosity: Same as in the engine. For the Twin Disc reverse gear however only **single-grade** (**one** viscosity number).

For capacities, see "Technical Data".



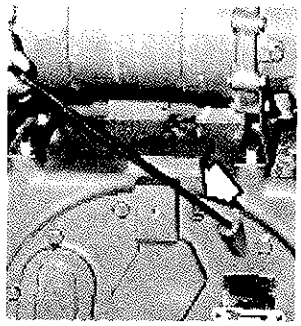
Checking the oil level in Borg Warner reverse gear and V-drive

4. Oil level

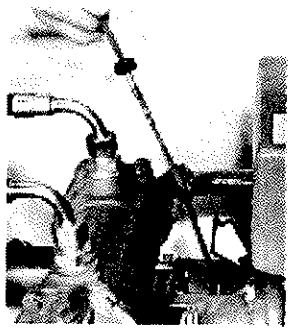
(reduction gear, disengaging clutch - extra equipment)

Check the level after every 50 hours.

The reduction gear at the front of the engine is fitted with a level plug (1). Unscrew the plug and check that the oil is level with the hole. For oil quality and viscosity, see "Technical Data".



Checking oil level in SCG reverse gear



Checking the oil level in Twin Disc reverse gear

Lubricating, disengaging clutch

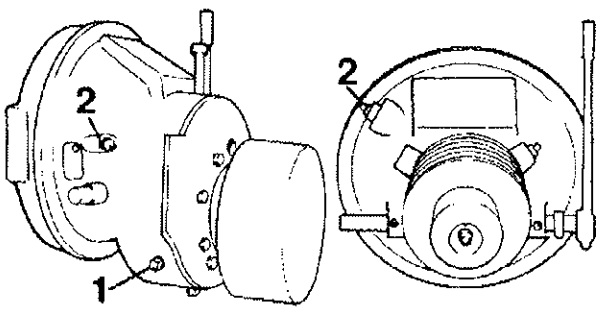
After every 50 hours: Lubricate the throw-out bearing (nipple 2). Use universal grease. NOTE! Lubricate sparingly. Excess grease can find its way onto the clutch linings and cause slip.

5. Checking the batteries

Check the level in the batteries **at least after every 50 hours** of operation. The level should be at least 10 mm (3/8") above the cell plates. Top-up, if necessary with distilled water. Also, make sure that the cable terminals are clean, firmly attached and greased.

Check the condition of battery charge with a hydrometer if the voltage is too low.

The density of the electrolyte should be 1.28 g/cm³. If it has decreased to 1.23 the batteries should be re-charged. If rapid charging is to be carried out - first disconnect the battery cables (both + and -).



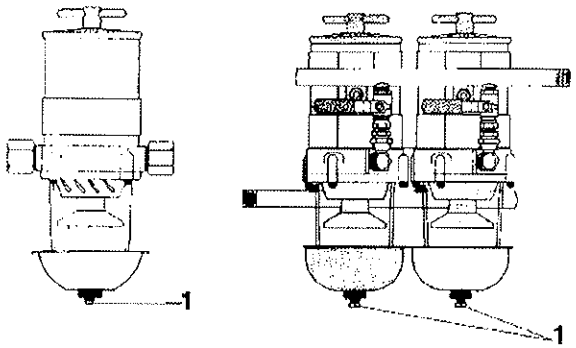
1. Level plug 2. Lubricating nipple

Disengaging clutch

6. Fuel pre-filter

(extra equipment)

Check the fuel filter and drain off any water after every **50 hours** by means of the draining plugs (1). The check should not be carried out until the engines has been shut down for several hours. Re-fit the plugs.



Single fuel pre-filter Double fuel pre-filter

1. Draining plugs

7. Disengaging clutch

(extra equipment)

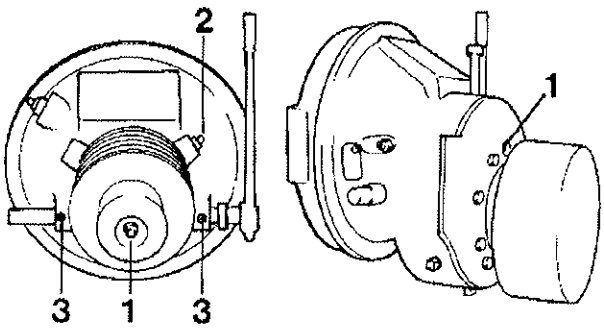
After every 50 hours: Lubricate the inner support bearing (nipple, 1). This nipple has been deleted on some clutches with reduction gear. Use multi-purpose heat resistant grease.

8. Disengaging clutch

(extra equipment)

After every 200 hours: Lubricate the shaft bearings (nipple, 2) and the throw-out shaft bearings, if the two grease nipples (3) are fitted.

Remove the inspection cover and lubricate the moving parts with a few drops of oil.



9. Engine, oil change

NOTE! Collect the old oil and take it to a recognised disposal centre. Never pollute the water with oil by discarding it overboard.

Change the oil after every 200 hours of operation.* For **MD70 and TMD70 with deep oil sump** the interval between changes may, however, be extended to **400 hours*** under certain conditions, see page 20. During the running-in period, however, the oil should be changed for the first time after **150 hours**.

Oil changing shall be carried out while the engine is warm.

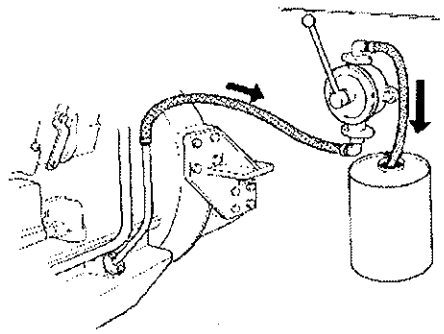
Replacing the oil filter(s), see pages 24 and 26.

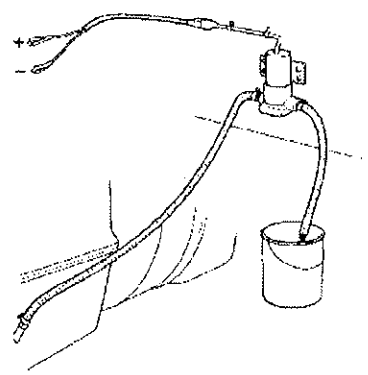
Engines with an oil scavenging pump (extra equipment): Remove the oil dipstick and connect the suction pipe to the dipstick tube, see illustrations. (The tube is 13 mm (approx. 1/2") O.D. Start the pump and collect the oil in a suitable container.

It is also possible to use the scavenging pump for filling the engine with oil. (The + and - cables being reversed on the electric scavenger pump).

Fill with oil through the rocker arm casing cap. For oil capacities and viscosity, see page 49.

* If longer intervals are required, see page 20.



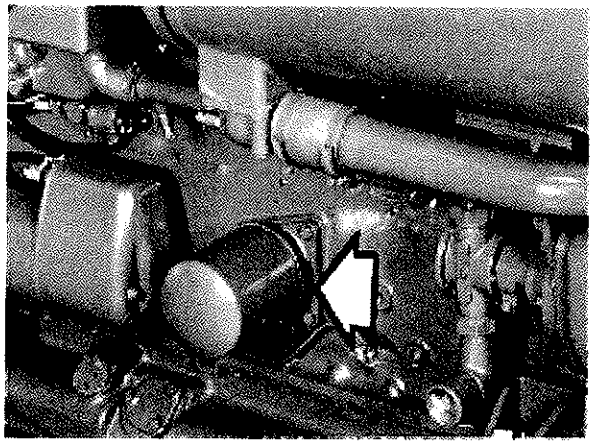


10. Lubricating oil filter, replacing

Applies to TAMD70

Replace the engine oil filter after every **200 hours of operation** - although, during the running-in period, replace for the first time after **150 hours**.

1. Unscrew the oil filter and discard it.
2. Smear the new oil filter's rubber gasket with oil and check its mating surface on the filter head.
3. Screw on the new filter by hand until the gasket makes contact with the sealing surface. Then tighten a further half turn but not more.
4. Fill the engine with oil if necessary. Start the engine and check for leakages.



Lubricating oil filter, TAMD70

11. V-belts. Checking

Check the V-belts for tension and wear after every **200 hours**.

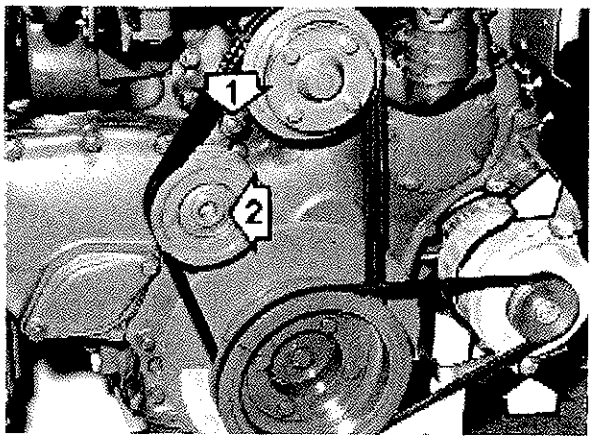
Remove the safety shield.

Tension the belts by loosening the bolts on the alternator and tensioning pulley (1) respectively. It should be possible to depress the belts about 10 mm (3/8") midway between the pulleys. The belt tensioner pulley has a square inset wrench recess (2).

In the case of double-belts, always replace both belts simultaneously if one belt is damaged.

CAV-alternator (1600W) (extra equipment): Tension the belts after loosening the 4 attachment bolts.

Re-fit the safety shield.

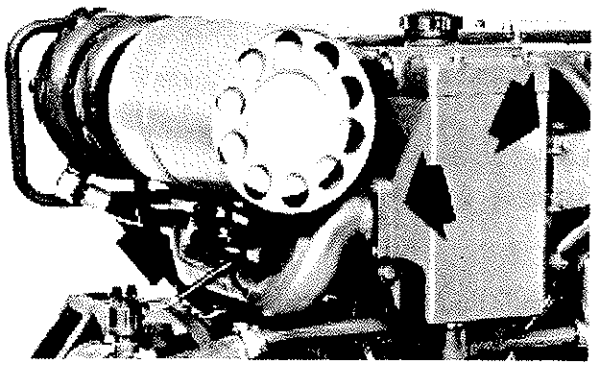


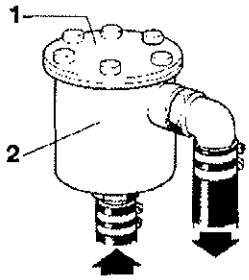
12. Turbo-compressor, checking for leakage

Check the air lines and hose connections for leakages after every **200 hours.**

Check that there is no leakage in the air lines by listening carefully along them while the engine is running. A whistling or hissing sound indicates leakage. Leakage can also be detected by applying soapy water to suspected areas on the delivery side between the turbo and the engine. Tighten the hose clamps or replace the air line, if necessary.

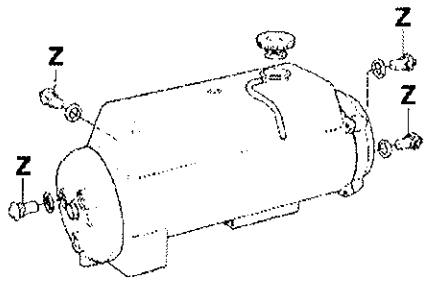
Any leakage in the lubricating oil or cooling water lines must be remedied immediately in order not to impair the function of the turbo-compressor.





Seawater filter

1. Cover, transparent 2. Housing with element



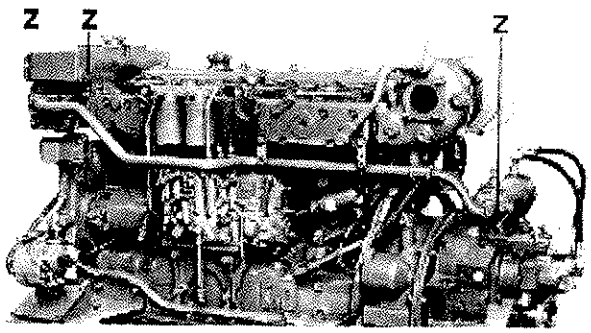
Tubular heat exchanger, optional equipment MD70, TMD70, TAMD70

13. Seawater filter. Cleaning

(extra equipment)

The filter should be taken apart and cleaned after every **200 hours** or more often if necessary. The correct interval will be found by experience after some time of running.

First close the sea-cock. Then remove the screws (1) attaching the cover. Lift up the cover and the element and clean the element in the housing (2). Re-fit the parts, open the sea-cock and check that there is no leakage.



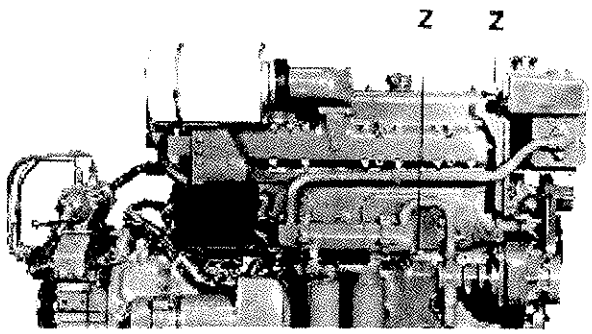
MD70, TMD70 with plate heat exchanger

14. Zinc electrodes, checking

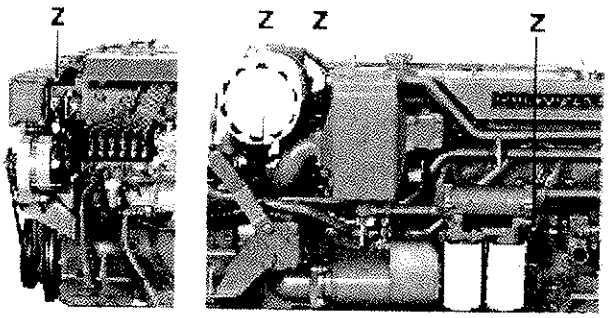
Check the zinc electrodes after every **400 hours**. First close the sea-cock and drain off some of the coolant. Screw out the electrodes and scrape or brush off any deposits. Any electrode which is only about 50 % of its original size should be replaced. **Make sure when fitting that there is good electrical contact between the electrode and the part of the engine to which it is fitted.**

If any electrode has not been attacked by corrosion, then the reason can be poor contact between the electrode and the engine. Scrape the mating surfaces clean and make sure that the electrode is not loose in the retainer. Replace if necessary.

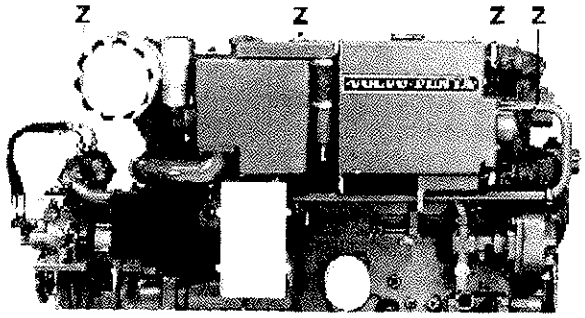
Close the drain cocks, open the sea-cock. Add the drained coolant which belongs to the fresh-water system.



MD70, TMD70 with plate heat exchanger



TAMD60

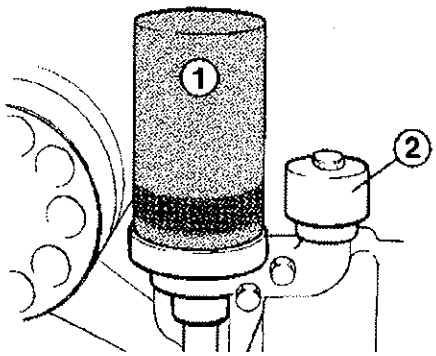


TAMD70 with plate heat exchanger

15. Crankcase ventilation. Replacing filter.

The filter (1) should be replaced after every **400 hours** or when oil-mixed air begins to emit from the valve (2).

1. Unscrew the old filter by turning it anti-clockwise.
2. Screw on the new filter by hand.



Filter for crankcase ventilation

1. Filter 2. Pressure relief valve

16. Cooling system, corrosion inhibitor

In cases where glycol is not used then corrosion inhibitor should be added to the coolant, see page 7.

To maintain protection against corrosion add a further 1/2 litre (1 pint) of corrosion inhibitor (part no. 1129709-0) to the cooling system after every **400 hours of operation**.

NOTE! Glycol or any other type of anti-freeze must **absolutely never be mixed** with this corrosion inhibitor.

17. Lubricating oil filters, replacing

Applies to TAMD60

Replace the engine lubricating oil filters after every **400 hours of operation** - although, during the running-in period, replace for the first time after **150 hours**.

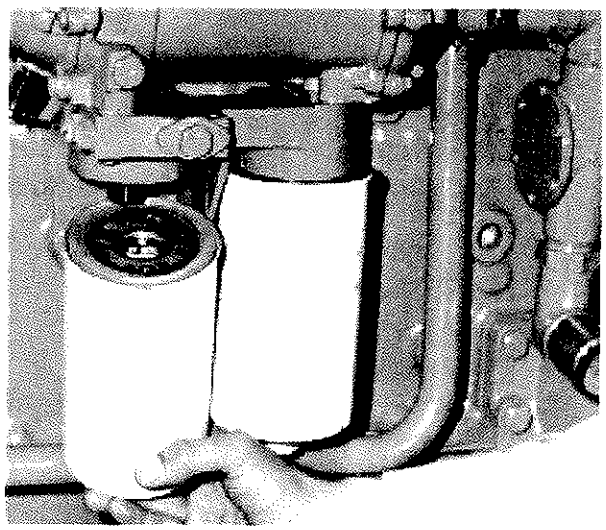
How to change the filters, see point 18, below.

18. Lubricating oil filters, replacing

Applies to MD70 and TMD70.

Replace the engine lubricating oil filters after every **800 hours of operation** - although, during the running-in period, replace for the first time after **150 hours.**

1. Unscrew the oil filters and discard them.
2. Smear the new oil filter rubber gaskets with oil and check their mating surfaces on the filter head.
3. Screw on the new filters until the gaskets make contact with the sealing surface. Then tighten a further half turn but not more.
4. Fill the engine with oil if necessary. Start the engine and check for leakages.
5. Stop the engine and check the oil level.



Replacing the lubricating oil filters, TAMD60, MD70, TMD70

19. Lubricating oil filter - reverse gear. Replacing

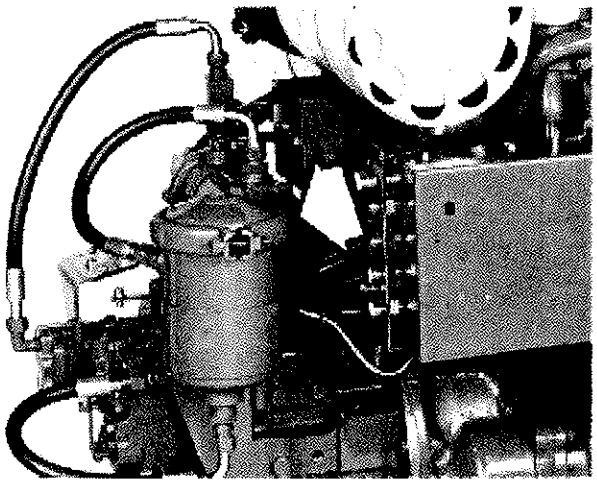
Applies only to Twin Disc MG506 with trolling valve

Replace the filter after every **800 hours of operation** - although, during the running-in period, replace for the first time after **150 hours**.

1. Remove the clamp which holds the filter cover. Take away the cover and lift the filter out.
2. Clean the filter housing and fit a new filter. Use new gaskets when fitting.
3. Fit the cover and tighten the clamp.
4. Start the engine and check the oil level in the reverse gear. Also check for leakages.

   Add oil if necessary. When checking the oil level the engine should be idling with the operating control in the neutral position.

   For oil quality and viscosity, see "Technical Data".



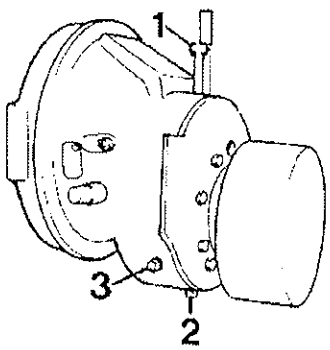
20. Reduction gear, oil change

(disengaging clutch - extra equipment)

NOTE! Collect the old oil and take it to a recognised disposal centre. Never pollute the water with oil by discarding it overboard.

Change the oil after every **800 hours of operation**. During the running-in period the oil should be changed for the first time after **150 hours**. Suck out the oil with the help of the oil scavenging pump or drain it off by removing the bottom plug. At the same time, clean the breather filter in the filler cap, if fitted.

For oil capacity and quality, see "Technical Data", page 58.



Reduction gear

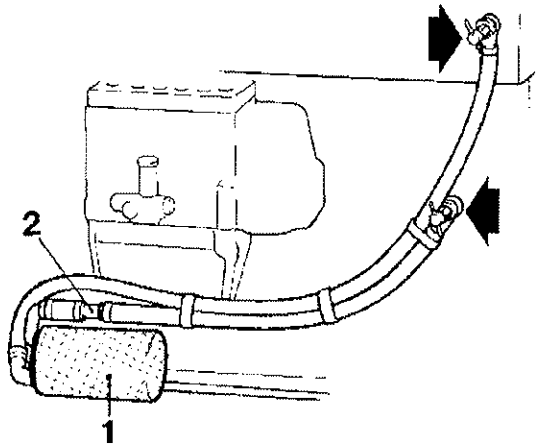
1. Oil filler
2. Drain plug
3. Level plug

21. Fresh-water filter. Replacing

(extra equipment)

Replace the filter after every 800 hours.

1. Close the cocks on the supply and outlet pipes (see arrows). Unscrew the old filter.
2. Smear the new filter gasket with oil. Screw on the filter by hand until the gasket is touching the cover. Then tighten the filter a further one half turn.
3. Open the cocks, start the engine and check for leakages. Top-up with coolant if necessary.



Fresh-water filter. (The picture shows a 70-series engine)

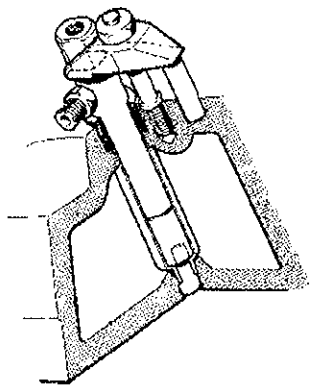
1. Filter
2. Flow indicator

22. Injectors, checking

The fuel injectors should be checked after every **800 hours**.

Remove the injectors and take them to an authorized diesel workshop for cleaning and checking of the opening pressure, spray pattern and leakage. For injector values see "Technical Data".

NOTE! Turn the injectors carefully when removing and ensure that no coolant enters the engine. Leakage can occur if a copper sleeve should come loose during removal. As a safety precaution, the coolant can be drained before removal.



Attachment of injectors

23. Disengaging clutch, checking

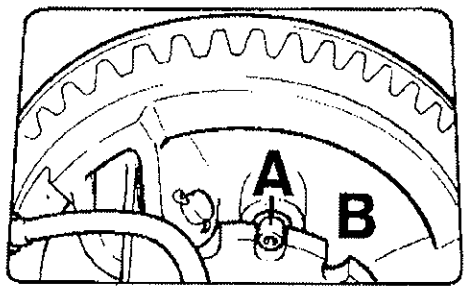
(extra equipment)

Check the function of the clutch after every **800 hours**. Check to see if the clutch slips, becomes warm or has a tendency to disengage. The clutch should also be checked for excessive noise, leakage or abnormally high temperature.

Stop the engine and set the clutch lever in the neutral (disengaged) position. Switch off the master switches to prevent any attempt to start the engine whilst work is in progress.

Adjusting, Twin Disc

1. Remove the inspection cover. Set the lever to the disengaged position and turn the clutch so that the locking pin (A) becomes accessible.
2. Press in the locking pin and turn the adjustment ring (B) so many notches to the right that a powerful force is required to engage the lever.
3. Screw on the inspection cover.



Twin Disc

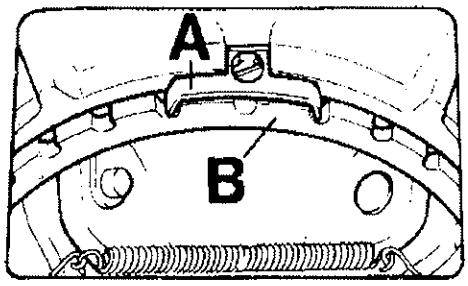
Adjusting, Rockford/BW

1. Remove the inspection cover. Set the lever to the disengaged position and turn the clutch so that the locking plate (A) becomes accessible.
2. Loosen the locking plate and turn the adjustment ring (B) so many notches to the left that a powerful force is required to engage the lever.
3. Screw on the locking plate and the inspection cover.

24. Valve clearance. Checking

Check the valve clearances after every **1200 hours**. This is to be carried out by authorized service personnel. In the case of a new or newly re-conditioned engine the clearances should be checked for the first time after the first **150 hours**. For clearances, see "Technical Data".

NOTE! Valve clearances must never be checked while the engine is running, but should always be carried out with the engine stopped, either when the engine is cold or at its operating temperature.



Rockford/BW

25. Reverse gear. Oil change.

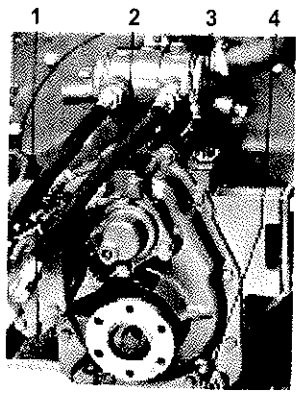
NOTE! Collect the old oil and take it to a recognised disposal centre. Never pollute the water with oil by discarding it overboard.

Oil changing should be carried out after every **1200 hours**. In the case of a new or re-conditioned reverse gear, the oil must be changed for the first time after **150 hours**. In connection with the oil change the filter element should also be replaced on certain reverse gears as well as cleaning the oil strainer, if fitted, see illustrations. See also, "Measures in connection with oil change" below.

1. Drain the oil by removing the bottom plug or suck up the oil with the oil scavenging pump (extra equipment).

   Twin Disc: Remove the oil dipstick and connect a hose to the dipstick tube.

   Borg Warner and SCG: Remove the oil dipstick and insert a pipe into the dipstick hole. Connect a hose to the pipe.
2. Fill with oil. **For oil quality and capacities, see "Technical Data".**
3. Start the engine and let it run at idling speed for a few minutes. Check the oil level on Twin Disc reverse gear while the engine is idling, and with the operating control in the "Neutral" position.
4. Stop the engine and check the oil level in the case of other reverse gears.



Reverse gear TD MG 502 (60-series engines)

1. Plug, remove for cleaning strainer
2. Oil filler and breather
3. Dipstick tube. O. D. = 13 mm (approx. 1/2")
4. Drain plug

Reverse gear Twin Disc MG 506 (70-series engines)

1. Oil dipstick
2. Strainer
3. Filler cap

Measures in connection with oil change

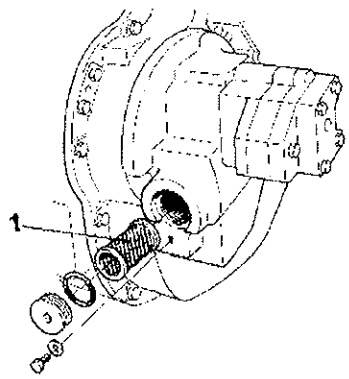
Additional for Borg Warner and Twin Disc reverse gears: Cleaning the oil strainer

Remove and clean the oil strainer which is located behind the drain plug (Borg Warner) or behind the plug (Twin Disc). See illustrations.

Additional for SCG reverse gears: Replacing the filter.

Remove the filter housing and take out the filter, see illustration. Clean the housing in white spirit. Replace the rubber seal if necessary and fit a new filter.

After filling up with oil, start the engine and run it for a few minutes at idling speed in order to fill the filter with oil. Stop the engine and check the oil level.



Reverse gear Twin Disc MG 507 (70-series engines)

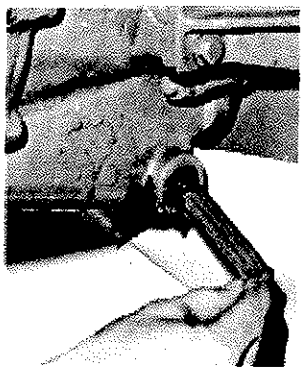
1. Strainer

26. Reverse gear, checking.

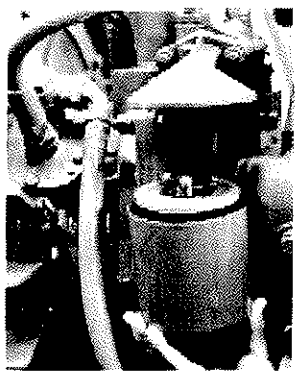
Check the reverse gear after every **1200 hours** with regard to leakage, excessive noise or abnormally high temperature.

See also respective reverse gear manufacturer's own literature.

Check the oil pressure from the built-in oil pump. It is important that the oil pressure is correct to prevent the clutch plates from slipping. For oil pressure, see "Technical Data".



Removing the strainer, Borg Warner reverse gear.



Replacing the filter, SCG - reverse gear (70-series engines)

27. Fuel fine filters. Replacing

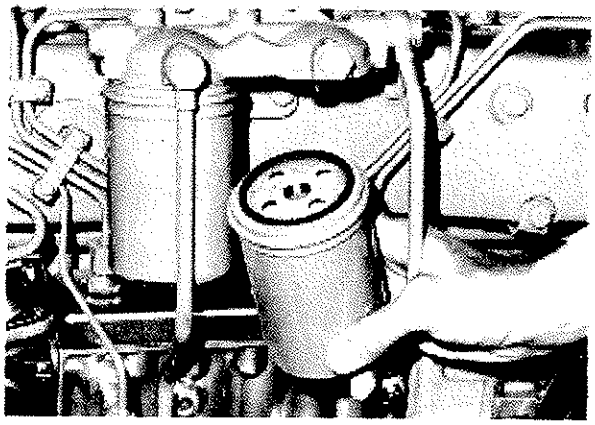
When working with the fuel system the highest possible degree of cleanliness should be exercised in order to prevent impurities entering the fuel system.

Replace the fuel fine filters after every **1200 hours**. This applies for normal operating conditions. The filters should be replaced more frequently if operating conditions are unfavourable.

However, the filters should be replaced at least once a year, preferably at the beginning of the season.

At the same time replace the elements in the extra fuel filters, see point 28.

1. Wash the filter head carefully, especially at the lower edge, then screw off both the old filters and discard them.
2. Check that the new filters are absolutely clean and that the gaskets are not damaged.
3. Screw on the new filters by hand until the gaskets touch the filter head. Then tighten them one further half turn, but not more.
4. Vent the fuel system according to the instructions below. Pump up the feed pressure and check for leakages around the filters.

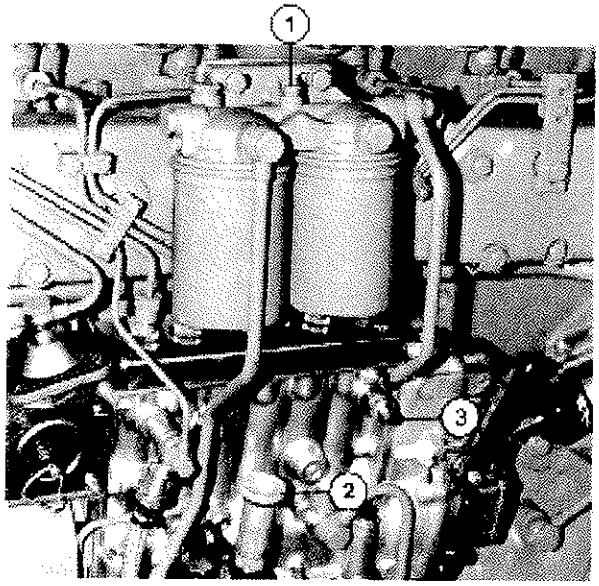


Replacing the fine filters

Venting the fuel system

1. Open the venting screw (1) on the fine filter head and pump up fuel with the hand primer (2) until the fuel is free of air bubbles. Tighten the screw. (The handle on the pump is released by screwing anti-clockwise).
2. **MD70, TMD70, TAMD70**: Open the venting screw (3) on the fuel injection pump and pump up fuel until all the air bubbles in the fuel disappear. Then tighten the venting screw.

   (The injection pump on TAMD60 is vented directly through the fine filters and is therefore not fitted with this screw).
3. Pump with the hand pump until a proper feed pressure is obtained.
4. Start the engine. If the engine does not start almost at once, slacken the delivery pipes at the injectors a couple of turns. Then run the starter motor until fuel runs out. Tighten the delivery pipes and then start the engine.

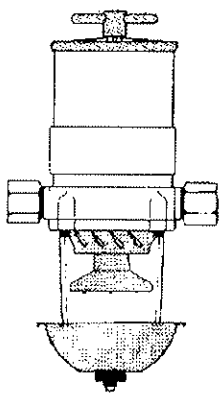


28. Fuel pre-filters. Replacing element

(extra equipment)

The filter element - or, in the case of a double filter, both the filter elements - should be replaced when a vacuum of 200-380 mm Hg is measured in the suction line between the filter and the feed pump. Alternatively replacement should be made after every **1200 hours of operation**, although at least once a year, preferably at the beginning of the season.

Suitable gauges for mounting into the suction line (between the filter and the feed pump) can readily be purchased (not sold by Volvo Penta).



Single pre-filter

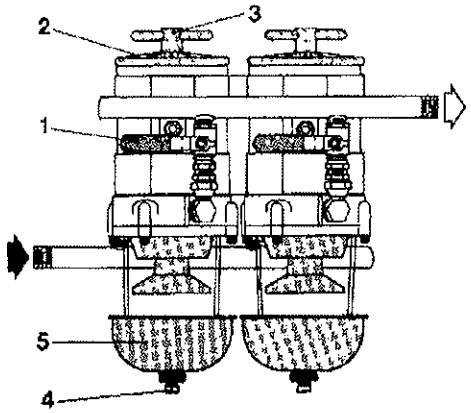
NOTE! Clean the filter covers and housings carefully on the outside before dismantling and make sure that no impurities enter the fuel system.

Close the fuel cocks at the tank before dismantling the single filter, or double filter if replacement of filter elements is carried out while the engine is shut down.

If replacement is carried out with the engine running (this applies in the case of a double filter), close the valve on the filter body where the element is to be replaced (turn the lever (1) upwards to the horizontal position, see illustration) and check the vacuum in suction line between the filter and the feed pump. If the vacuum is less than 50 mm Hg or if there is positive pressure, close the fuel cock slowly (between the tank and the filter) until the vacuum reaches 50-100 mm Hg.

If the vacuum is already 100 mm Hg or more, proceed directly according to the following:

1. Remove the cover (2) and lift out the element with the help of the plastic ring. Check the gasket, replace if necessary.
2. Drain off any water or impurities by means of the drain plug (4).
3. Fit a new filter element and fill the body with clean diesel oil. Fit the cover and tighten by hand.
4. Dry off any diesel fuel from the heat shield (5). Open the valve (1) on the filter where the element is being replaced (applies to the double filter).
5. Replace the other filter element in the same way (applies to the double filter).
6. Open the fuel cocks and check that there are no leakages.



Double pre-filter

1. Valve lever (closed position)
2. Cover
3. Attachment screw
4. Drain plug
5. Heat shield

Replacement of elements and cleaning can be carried out whilst running.

29. Cooling system, checking

Check the cooling system for leakage and blockage after every **1200 hours**. Clean if necessary!

Close the sea-cock and drain off the cooling water before starting any work on the cooling system.

Excessively high coolant temperature can be caused by deposits in the coolant channels or heat exchanger. High coolant temperature can also be caused by low coolant level, poor tensioning of the fresh-water pump V-belts, damaged seawater pump impeller, a faulty temperature gauge or faulty thermostats.

Flushing of the cooling system should be carried out when changing the anti-freeze (every autumn) or more often if necessary. Flush with water; chemical aids can be used in more difficult cases.

NOTE! TAMD60 and TAMD70 engines with plate heat exchanger have certain parts of the cooling system in light-alloy, and for this reason only clean water may be used for cleaning.

If it is found that flushing alone is insufficient, the inserts in the heat exchanger and oil cooler - as well as (in the case of TAMD60 and TAMD70) the after-cooler insert - must be removed and cleaned. See points 32 and 33.

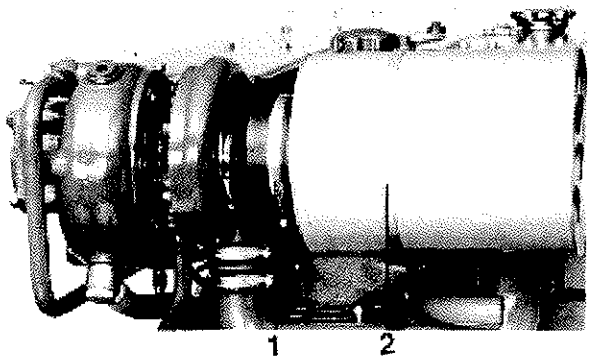
30. Air cleaner. Replacing

Replace the air cleaner after every **1200 hours**. When operating under favourable conditions the replacement interval can be extended. The cleaner must never be used so long that the air supply to the engine becomes restricted, resulting in smoky exhaust emissions and reduced power output.

1. Clean the rubber hose to the cleaner. Slacken the clamp (1) and the attaching strap (2) which holds the cleaner.
2. Remove the old cleaner and discard it.
3. Check that the rubber hose is not damaged. Fit the new cleaner after making sure that it is absolutely clean.

NOTE! No impurities may be allowed to enter the engine.

4. Start the engine and check that there are no leakages.



Replacing the complete air cleaner

1. Hose clamp 2. Attachment strap

31. Starter motor and alternator.

Checking

This check should be carried out after every **1200 hours** by authorized service personnel.

NOTE! Disconnect both battery cables before starting work on the electrical system.

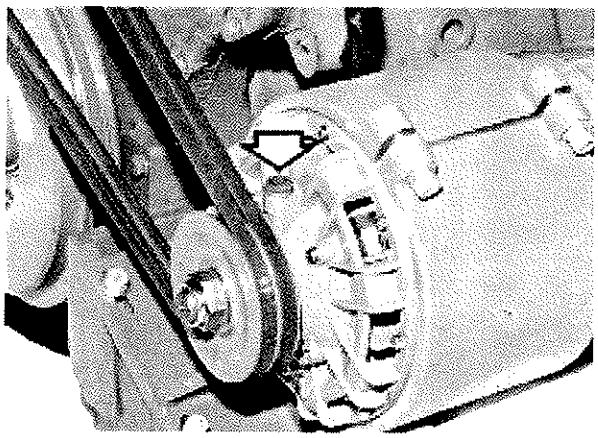
Starter motor: Check the brushes and commutator.

Alternator: Check the brushes and slip rings.

Lubrication

The large alternator (CAV) should be lubricated after every **1200 hours**. The other makes of alternator are lubricated only in connection with re-conditioning.

Unscrew the plug which covers the lubricating hole at the bearing by the belt pulley. Lubricate with a **small** amount of Shell Retinax A or another manufacturer's equivalent lubricant. Re-fit the plug.



32. Heat exchanger and aftercooler.

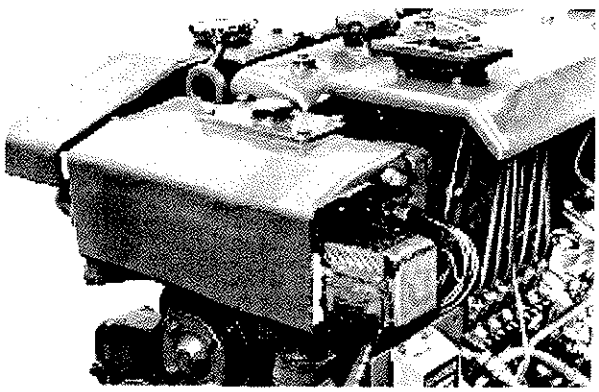
Cleaning

Clean the inserts in the heat exchanger and the after-cooler after every **2400 hours**. (MD70 and TMD70 have no after-cooler).

TAMD60

1. Close the sea-cock and drain off the water in the sea and fresh-water systems respectively.
2. Remove the cover over the after-cooler. Lift out the insert.
3. Remove the coolant pipe between the heat exchanger and the after-cooler cover.
4. Remove the heat exchanger end cover. Take off the rubber gaiter.
5. Carefully push out the insert using a hammer shaft, for example. Take care of the inner rubber gaiter.
6. Wash and clean the inserts both externally and internally. Also clean the housings.

   NOTE! The housings are made of light alloy and care should therefore be taken not to use any chemical solution which can be damaging to this metal.

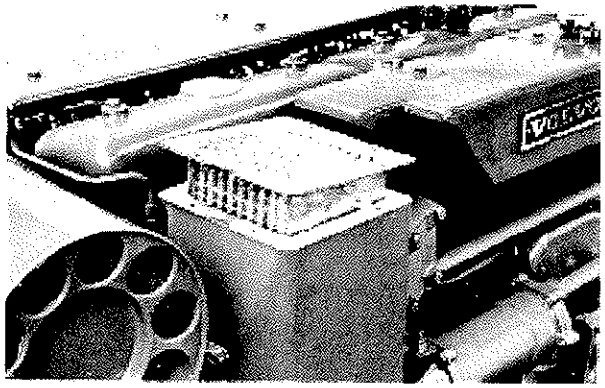


Heat exchanger TAMD60

Check that the drain hole (Ø1.5 mm = approx. 1/16") in the bottom of the after-cooler housing is clear.

Be especially careful to ensure that no impurities enter the engine intake manifold.

7. Re-fit the parts in reverse order. Use new gaskets and seal rings. Grease the heat exchanger pipe connections and the after-cooler connections with water-resistant grease before fitting.
8. Fill the engine with coolant. Open the sea-cock, start the engine and check that there are no leakages.



After-cooler TAMD60

MD70, TMD70 with plate heat exchanger

1. Close the sea-cock and drain off the water in the sea and fresh-water systems respectively.
2. Remove the cooling water pipe between the heat exchanger and the engine oil cooler and reverse gear oil cooler respectively.
3. Unscrew the bolts which secure both end covers and remove the covers. Pull out the insert.
4. Wash and clean the insert both externally and internally. Also clean the heat exchanger housing.
5. Re-fit the parts in reverse order. Use new gaskets and seal rings. Grease the heat exchanger pipe connections with water-resistant grease before fitting.
6. Fill the engine with coolant. Open the sea-cock, start the engine and check that there are no leakages.

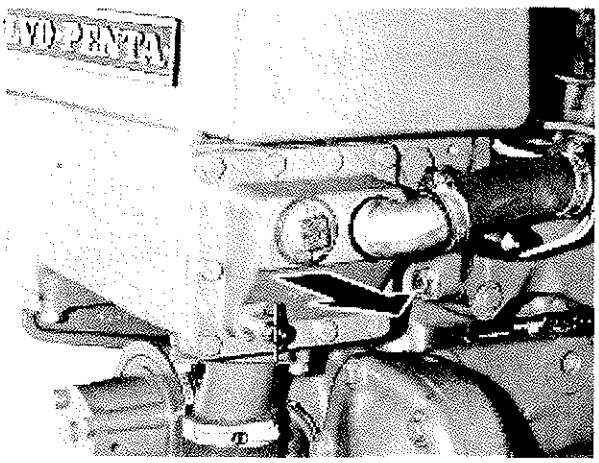
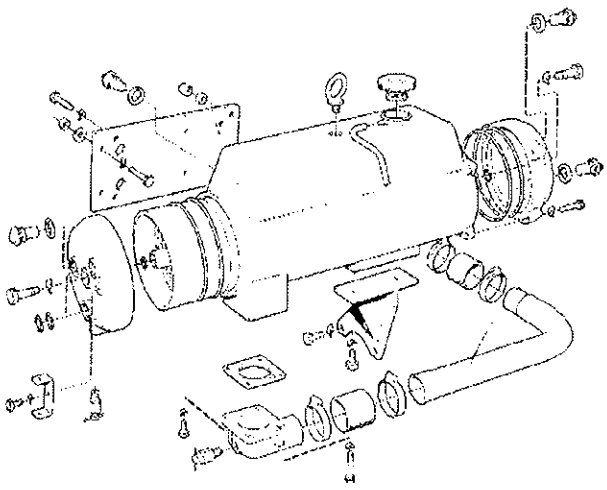


Plate heat exchanger, MD70, TMD70

MD70, TMD70 and TAMD70 with tubular heat exchanger

1. Close the sea-cock and drain off the water in the sea and fresh-water systems respectively.
2. Remove the coolant hoses to the rear end cover of the heat exchanger.
3. Unscrew the four bolts securing the front end cover. Remove the both end cover centre bolts and take off the covers.
4. Pull the insert out forwards and clean it both externally and internally using suitable brushes. Also clean the accessible surfaces in the heat exchanger housing. Rinse off the parts.
5. Make sure when assembling that the holes in the insert jacket are located opposite the holes in the housing. Replace all the seal rings and smear a little soap on them before fitting.
6. **TAMD70:** Clean the after-cooler, see next page.
7. Fill the engine with coolant. Open the sea-cock, start the engine and check that there are no leakages.



Tubular heat exchanger, MD70, TMD70, TAMD70

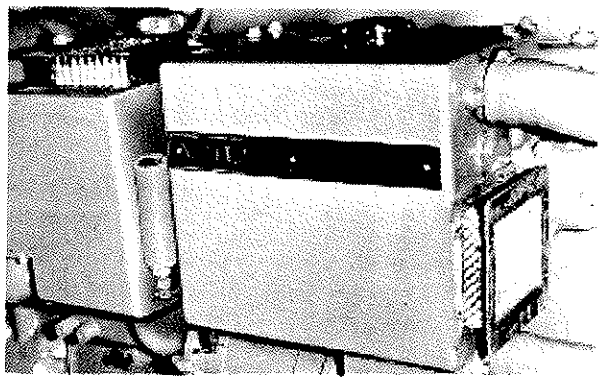
TAMD70 with plate heat exchanger

1. Close the sea-cock and drain the water in the sea and fresh-water systems respectively.
2. Remove the screws which secure the cooling water pipe between the heat exchanger end cover and the reverse gear oil-cooler.
3. Disconnect the cooling water pipe from the end cover.
4. Loosen the hose clamp on the cooling water line beneath the after-cooler, and also the hose clamp under the after-cooler cover.
5. Unscrew the bolts which secure the end cover in front of the heat exchanger and the cover over the aftercooler. Lift off the covers and pull out the inserts.
6. Wash and clean the inserts both externally and internally. Also clean the housings. NOTE! The housings are made of light alloy and care should therefore be taken not to use any chemical solution which can be damaging to this metal.

Check that the drain hole (Ø1.5 mm = approx. 1/16") in the bottom of the after-cooler is clear.

Be especially careful to ensure that no impurities enter the engine intake manifold.

7. Re-fit the parts in reverse order. Use new gaskets and seal rings.
8. Fill the engine with coolant. Open the sea-cock, start the engine and check that there are no leakages.



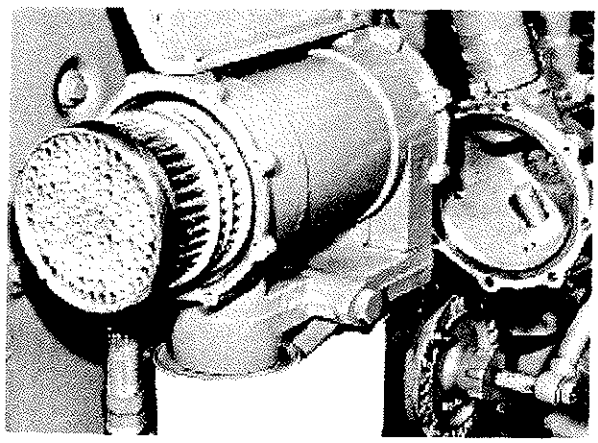
Inserts in after-cooler and heat exchanger, TAMD70.

33. Oil cooler. Cleaning

Clean the oil-cooler on the engine and reverse gear after every **2400 hours**.

TAMD60, MD70, TMD70 and all reverse gears

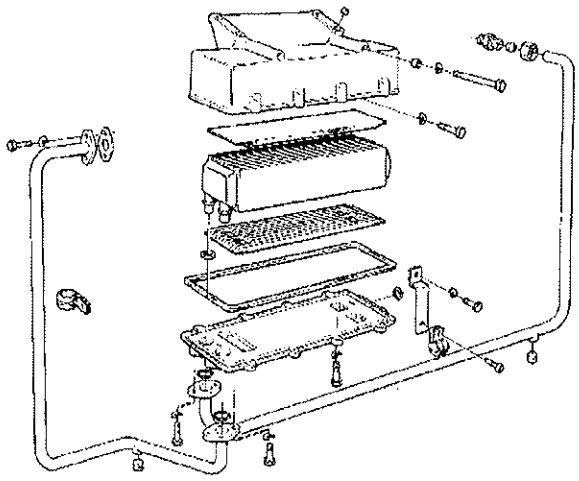
1. Close the sea-cock and drain the water in the seawater system.
2. **TAMD60:** Remove the pipe between the seawater pump and the engine oil-cooler. Remove the cooler's front end cover.
3. **TAMD60:** Loosen the pipe between the oil-cooler and the after-cooler. Loosen the cooler's rear end cover and remove the cover and the pipe.
4. **TAMD60:** Pull out the cooler insert. The insert can only be pulled out forwards since it has a flange on its front end.
5. **Other engines and all reverse gears:** Remove both end covers and take out the insert.
6. Wash the insert in white spirit, for ex. and blow dry with compressed air. Clean inside the tubes and the end sides of the insert with a suitable brush. Clean the housing.
7. Fit the parts together with new gaskets and seal rings.



Oil cooler

TAMD70E

1. Drain off the cooling water in the fresh-water system. Remove the coolant pipes to the oil-cooler.
2. Place an oil collecting vessel under the oil-cooler and loosen the oil distribution housing from the cylinder block. Pull out the connections from the oil-cooler cover.
3. Take off the cover and remove the insert. Take care of the flat upper and lower seals (rubber).
4. Wash the insert in white spirit, flush out internally and blow dry with compressed air. Clean the housing.
5. Re-fit the parts in reverse order. Note that the **lower** flat seal is provided with cut-outs for the flow of oil. Use new seal rings. Grease the cooler insert pipe connections with water-resistant grease before connecting the coolant pipes.
6. Fill the engine with coolant. Start the engine and check that there are no leakages.



Oil cooler TAMD70E

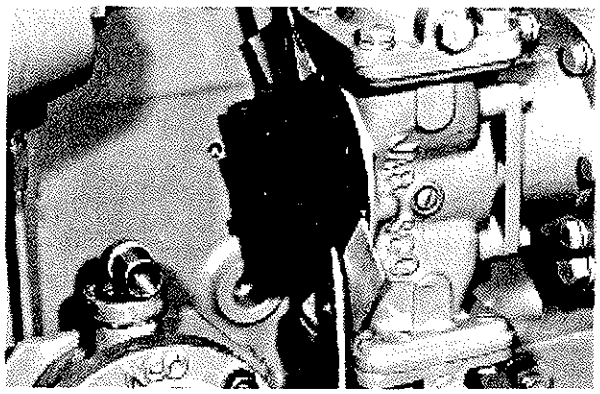
34. Seawater pump, impeller. Replacing

Replace the impeller after every 2400 hours.

Close the sea-cock and drain the seawater from the engine before commencing work.

1. Loosen the screws on the cover and remove the cover. Prise off the impeller with the aid of two screwdrivers. Place some form off protection under the screwdrivers so as not to damage the housing.
2. Clean the housing internally. Grease the inside of the pump housing and inside the cover lightly with lubricating grease.
3. Press in the new impeller using a rotating action (clockwise). Fit the sealing washers in the outer end of the impeller centre, if this has not already been done. Fit the cover together with a new gasket.

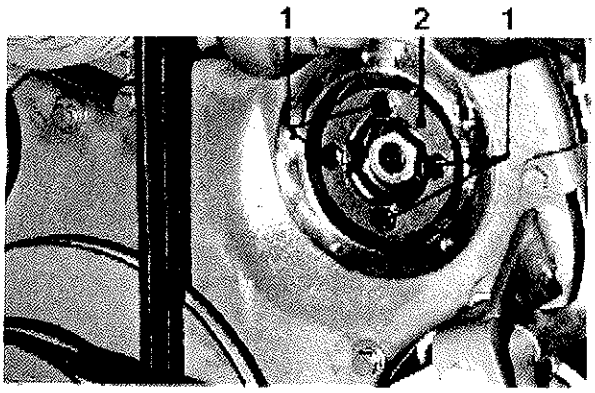
Make sure that there is always a spare impeller and gasket onboard.



Replacing the impeller

35. Fuel injection pump. Checking.

NOTE! Any repair work required to be done on the injection pump which can alter its settings, may only be carried out by specially trained mechanics who have at their disposal the necessary tools and testing equipment. All warranty on the engine becomes null and void if the seals are broken by unauthorized persons.

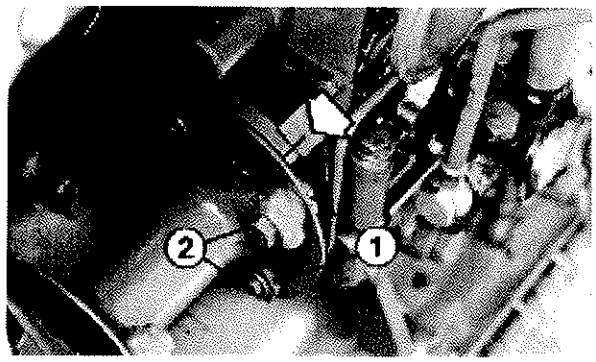


Pump drive TAMD60

1. Screws in drive flange
2. Lock washer

Since operating conditions vary considerably, it is difficult to indicate any definite interval, but the pump settings, max. and idle speeds, exhaust smoke, etc. should generally be checked after every **2400 hours**. Clean and check the injectors and make sure that the air lines to the turbo (if fitted) do not leak before checking the engine exhaust smoke. The air cleaner must not be blocked and the air lines must be free from constrictions.

In order to ensure even loading of the cylinders, the fuel injection pump must be checked (and adjusted if necessary) on a test bench. This check is very important with regard to engine life.



Pump coupling (protective cover removed), 70-series engines

1. Nuts 2. Coupling screws

36. Turbo-compressor. Checking

Checking should be carried out after every 2400 hours

The turbo-compressor should be checked carefully with regard to leakages at the pipe connections and in air hoses. Bearing clearances and charging pressure as well as the general condition of the unit should also be checked. This check is to be carried out by authorized personnel.

If necessary, replace the turbo-compressor with a new or re-conditioned unit.

Always fit new oil filters and change the engine oil when replacing the turbo-compressor. Fill the turbo-compressor bearing housing with 0.1 liter (0.2 pints) of oil before connecting the oil delivery pipe.

Start the engine, see "Running". Check that there are no leakages.

37. General checking, engine

It is difficult to indicate a definite time for reconditioning the engine, since operating conditions and general maintenance vary considerably. By observing the oil consumption it is, however, possible to estimate roughly when the engine should be dismantled and checked for wear. A reliable way of checking the condition of the engine is to carry out a compression test. This should be done after every **2400 hours**. When carrying out this test the engine should be at normal operating temperature and have well charged batteries.

In connection with a major overhaul of the engine, the reverse gear and reduction gear, if fitted, should also be dismantled and checked for wear.

Angle graduation marking on the flywheel.

38. Inhibiting when laying-up

Corrosion of the engine components must be prevented otherwise the engine will gradually be destroyed. For this reason, the engine should be protected against such damage by the following measures:

A. If the engine is to remain idle for a period of time not exceeding two months it should be started and run warm once every 14 days.

If there is a risk of frost, the seawater cooling system circuit should be drained after stopping the engine. The freshwater system should be filled with a Volvo Penta ethylene glycol mixture. The concentration of glycol used should be able to cope with the lowest temperature likely to occur. Do not use less than 40 % by volume of ethylene glycol. With a low ethylene glycol content there is risk of damage from corrosion. See page 6.

If an exhaust line condensation water collector is fitted, then its drain plug should be removed to allow the condensate to run out. Drain any water that may have collected at low points in the exhaust line.

B. If the engine is to remain idle for more than two months inhibiting is recommended according to the points given in the following text:

If inhibiting is intended for a period not exceeding 6-8 months, then Volvo Penta engine oil can be used. This means that the engine can be run directly when required. In this case, the oil and oil filter should be changed immediately before laying-up and the oil should not, of course, be drained. The engine should be run warm after the oil change. **If the engine is to be laid up for a longer period then special conserving oil as sold by the oil companies, should be used.**

Remember to utilise the break in operation to perform the periodical routine servicing which must, in any case, be carried out.

1. Run the engine warm to its normal operating temperature.
2. Stop the engine and drain or pump out the lubricating oil from the oil sump.
3. When laying-up for a period not exceeding 6-8 months, the engine should be filled to normal level with Volvo Penta lubricating oil. If laying-up for a longer period the engine should be filled with conserving oil to just above the lower mark on the dipstick.

   The reverse gear and clutch with reduction gear, if applicable, should be filled to the (upper) mark on the dipstick with the recommended lubricating oil. Top-up as necessary.
4. **When laying-up for max. 6-8 months:** Run the engine warm.
5. **If inhibiting for a longer period than 6-8 months:** Disconnect the fuel line to the feed pump and the return line to the tank. Connect the lines, using hoses, to a vessel filled with 1/3 conserving oil and 2/3 diesel fuel. Some oil companies sell a special oil especially for this purpose which does not require mixing with diesel fuel.

   Vent the fuel system and start the engine. See chapter "Running". Let the engine run at rapid idle until just over 2 litres (2 quarts) have been consumed from the vessel.

   Stop the engine and drain or pump out the conserving oil from the oil sump. Connect the normal fuel lines.
6. Close the sea-cock and drain the seawater system completely, see "Precautions in case of frost". The engine fresh-water system must either be completely drained or have anti-freeze added, suitably in the form of Volvo Penta ethylene glycol. See page 6.
7. Remove the batteries from the boat and take them to a charging station for periodical charging in accordance with the manufacturer's instructions.
8. Protect all external unpainted surfaces with suitable preservative fluid. The surfaces should be clean and dry before the fluid is applied.

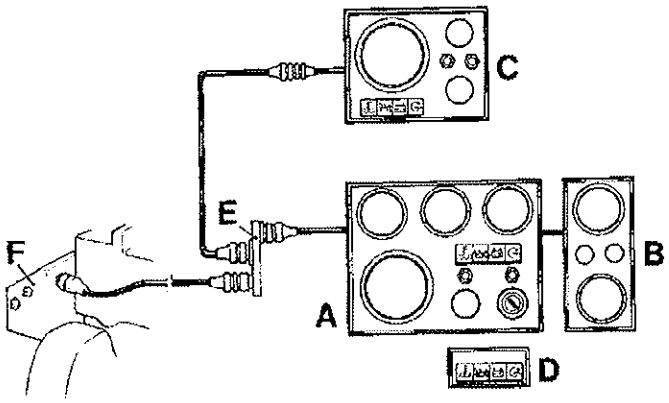
   NOTE! Certain preservative fluids intended for outside use are inflammable and should, therefore, be used with care. Furthermore, some fluids are dangerous to inhale, a breathing mask should therefore be worn when such fluid is being sprayed on.
9. From this point on, the engine must not be turned over again until it is to be taken into use. **Mark the engine clearly with some kind of notice saying that the engine has been inhibited and give the date.** Also state that the seawater has been drained and whether the fresh-water system has been drained or glycol been added and state the freezing point of this protection. Also make a note of whether the oil has been drained or a change of Volvo Penta lubricating oil has been carried out.

39. De-inhibiting

1. Remove any cover from the engine.
2. Wash off the preservative fluid on the outside with white spirit.
3. Close the drain cocks and fill the fresh-water system with water mixed with Volvo Penta glycol if the coolant was drained. See page 6. Open the sea-cock.
4. Fill the engine with the correct grade of lubricating oil, if necessary and check the level in the reverse gear and clutch with reduction gear (if fitted). Fit new oil filters, if they were not changed in connection with changing the oil to Volvo Penta lubricating oil when laying-up.
5. Connect the batteries.
6. Fit new fuel filters and vent the fuel system.
7. Start the engine. See, "Running". Warm up the engine at rapid idle before running under load.

   Check that there are no oil, fuel or coolant leakages.

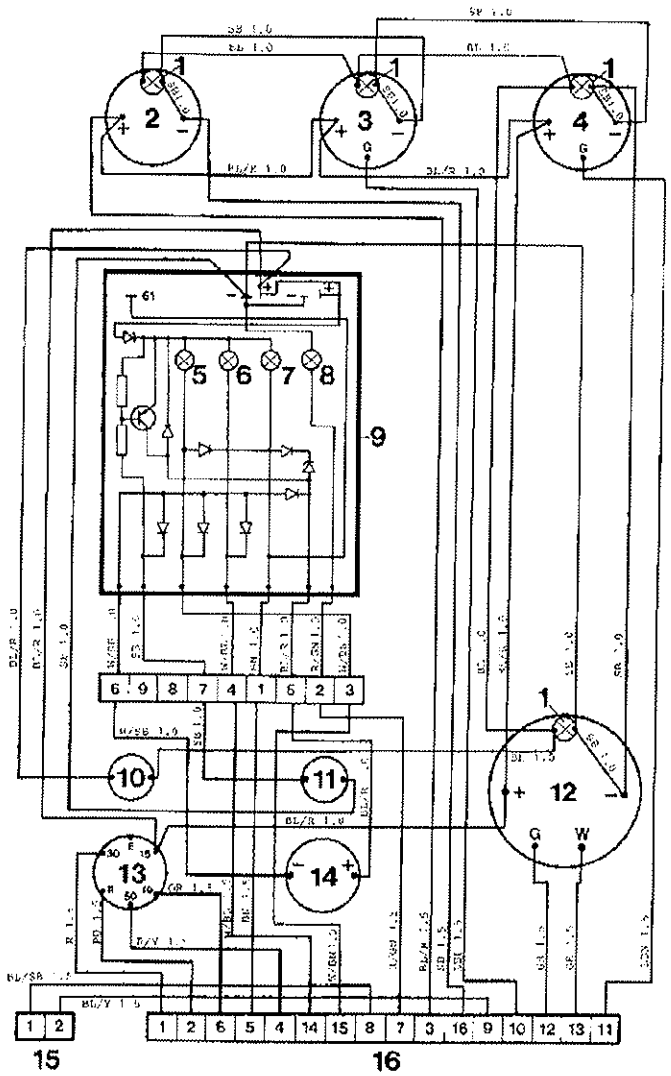
TAMD60C, TAMD70E



Position diagram

A. Basic panel
B. Supplementary panel
C. Panel for alternative manoeuvre position (Flying Bridge)*
D. Alarm panel. (Used only if basic panel "A" is not fitted)
E. T-connection
F. Connection box with fuses

* The basic panel "A" can also be used for the alternative manoeuvre position (although the temperature and oil pressure senders must be changed).



Instruments, basic panel

1. Instrument lighting
2. Voltmeter
3. Oil pressure gauge
4. Cooling water temperature gauge
5. Warning lamp, cooling water temperature
6. Warning lamp, oil pressure
7. Warning lamp, battery charging
8. Warning lamp, (not used)
9. Printed circuit
10. Switch, instrument lighting
11. Switch, alarm test
12. Revolution counter
13. Key switch
14. Alarm
15. 2-pole connector (for any supplementary panel)
16. 16-pole connector

Cable colours

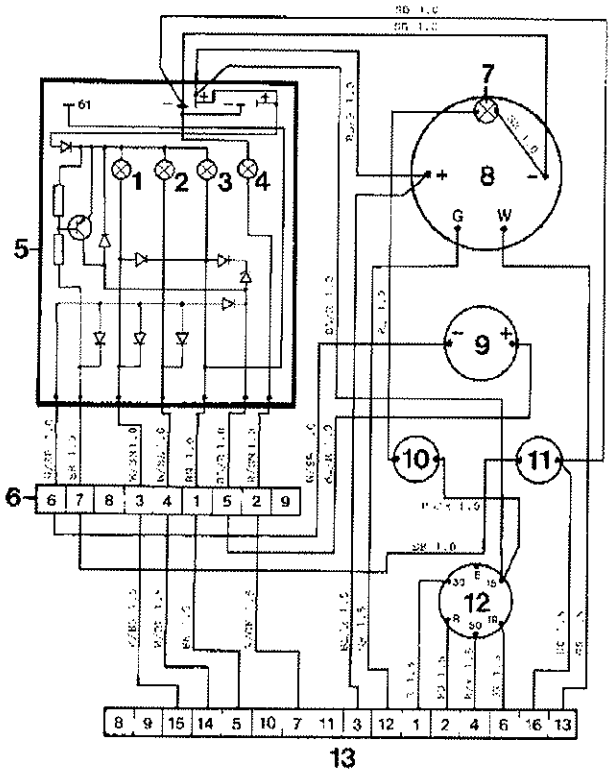
GR	= Grey	GN	= Green
SB	= Black	OR	= Orange
BN	= Brown	Y	= Yellow
LBN	= Light brown	W	= White
R	= Red	BL	= Blue
PU	= Purple	LBL	= Light blue

Cable areas in mm²

Relationship mm²/AWG

mm²	1.0	1.5
AWG	16(17)	15(16)

TAMD60C, TAMD70E



Panel for alternative manoeuvre position (Flying Bridge)

1. Warning lamp, cooling water temperature
2. Warning lamp, oil pressure
3. Warning lamp, battery charging
4. Warning lamp (not used)
5. Printed circuit
6. 9-pole connector
7. Instrument lighting
8. Revolution counter
9. Alarm
10. Switch, instrument panel
11. Switch, alarm test
12. Key switch
13. 16-pole connector

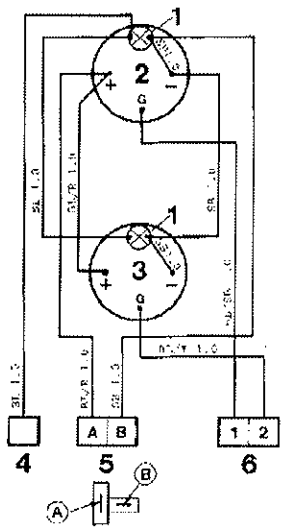
Cable colours

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

Cable areas in mm²

Relationship mm²/AWG

mm²	1.0	1.5
AWG	16(17)	15(16)



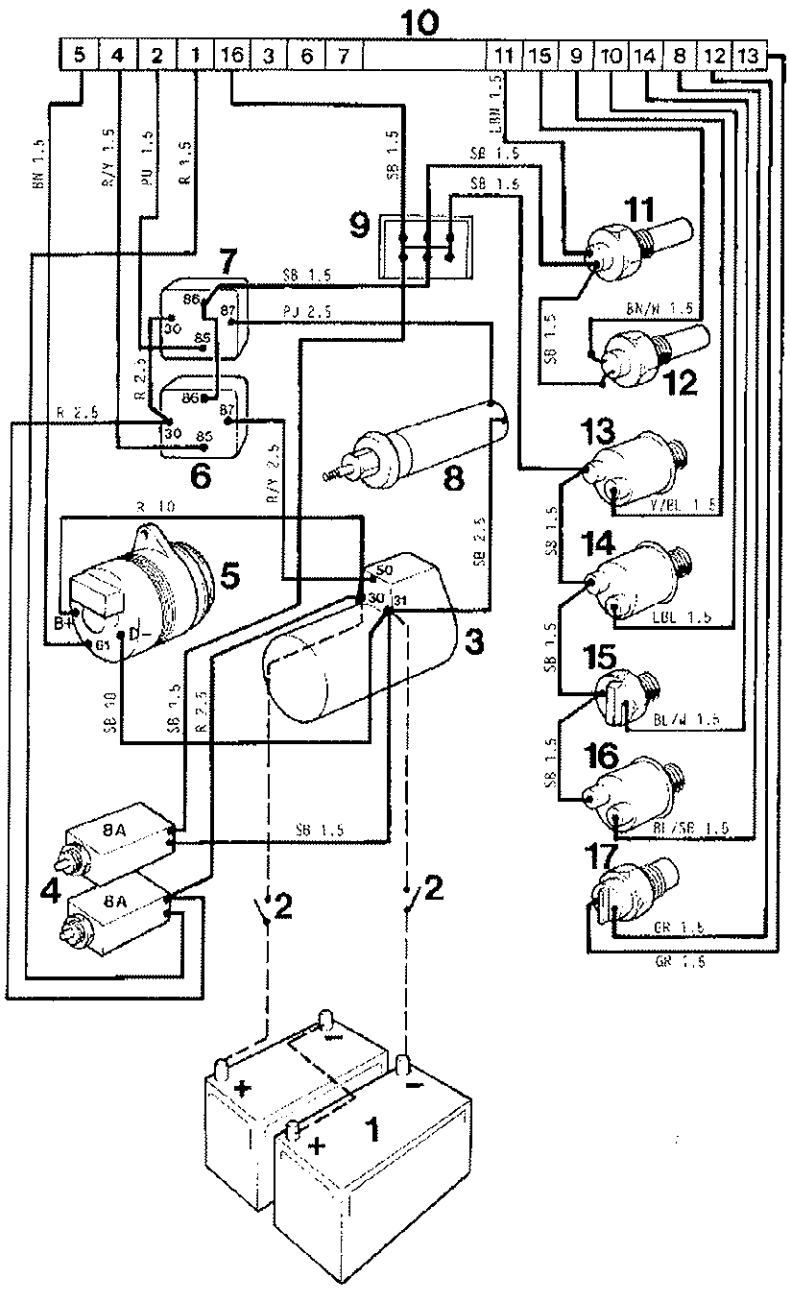
Supplementary panel

1. Instrument lighting
2. Oil pressure gauge - reverse gear
3. Gauge for turbo charging pressure
4. Connector to instrument lighting on basic panel
5. Connector to printed circuit on basic panel
6. Connector to terminal plug (15) on basic panel

TAMD60C, TAMD70E

Engines with Paris-Rhone alternator (28V/55A), alternatively (14V/50A)

2-pole system



Engine

1. Battery
2. Master switches
3. Starter motor
4. Automatic fuses*
5. Alternator
6. Starter relay (16MS)*
7. Stop relay (16S)*
8. Stop solenoid
9. Earth terminal*
10. 16-pole connector*
11. Coolant temperature sender
12. Coolant temperature switch
13. Pressure sender, turbo
14. Oil pressure sender, engine
15. Oil pressure switch
16. Oil pressure sender, reverse gear
17. Speed sender

* Located in connection box.

Cable areas in mm²

Relationship mm²/AWG

mm²	1.5	2.5	10
AWG	15(16)	13	7

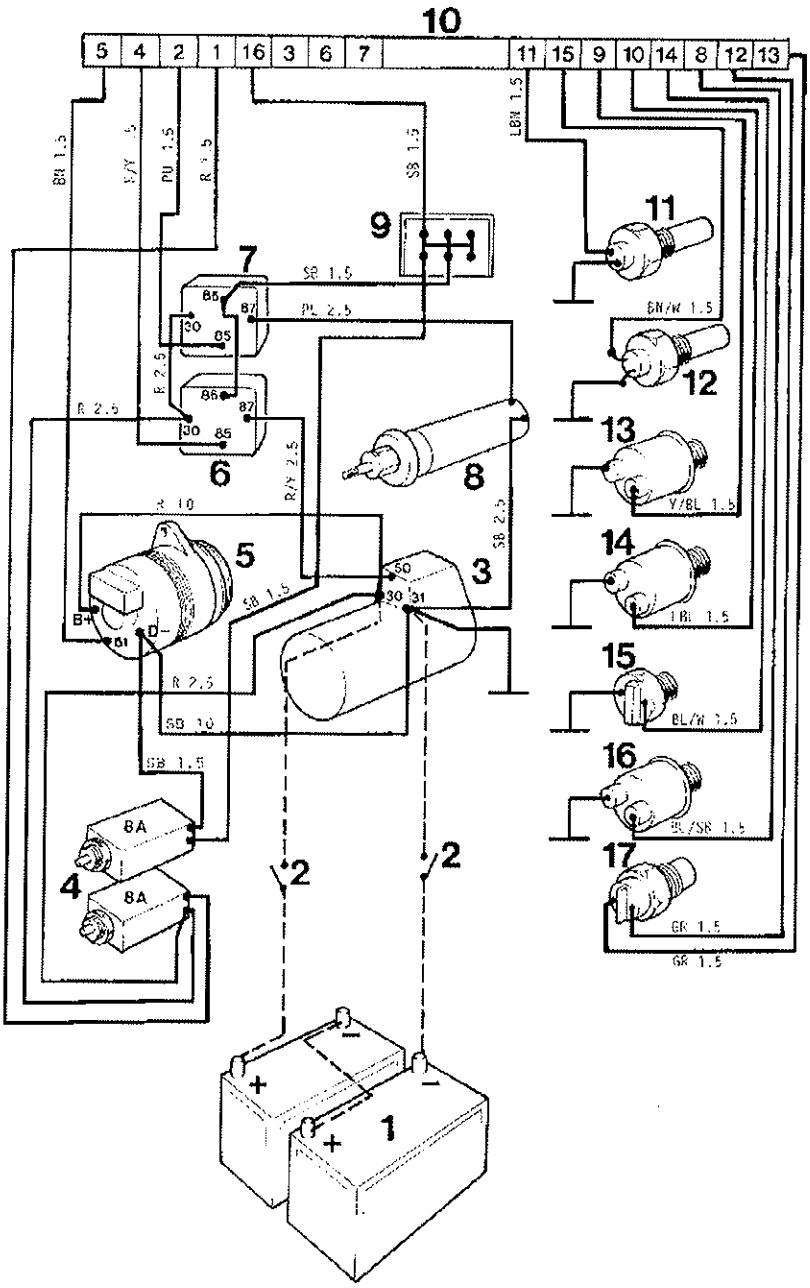
Cable colours

GR	= Grey
SB	= Black
BN	= Brown
LBN	= Light brown
R	= Red
PU	= Purple
GN	= Green
Y	= Yellow
W	= White
BL	= Blue
LBL	= Light blue

TAMD60C, TAMD70E

Engines with Paris-Rhone-alternator (28V/55A), alternatively (14V/50A).

Single-pole system



Engine

1. Battery
2. Master switches
3. Starter motor
4. Automatic fuses*
5. Alternator
6. Starter relay (16 MS)*
7. Stop relay (16 S)*
8. Stop solenoid
9. Earth terminal*
10. 16-pole connector*
11. Cooling water temperature sender
12. Cooling water temperature switch
13. Pressure sender, turbo
14. Oil pressure sender, engine
15. Oil pressure switch
16. Oil pressure sender, reverse gear
17. Speed sender

* Located in connection box.

Cable areas in mm²

Relationship mm²/AWG

mm²	1.5	2.5	10
AWG	15(16)	13	7

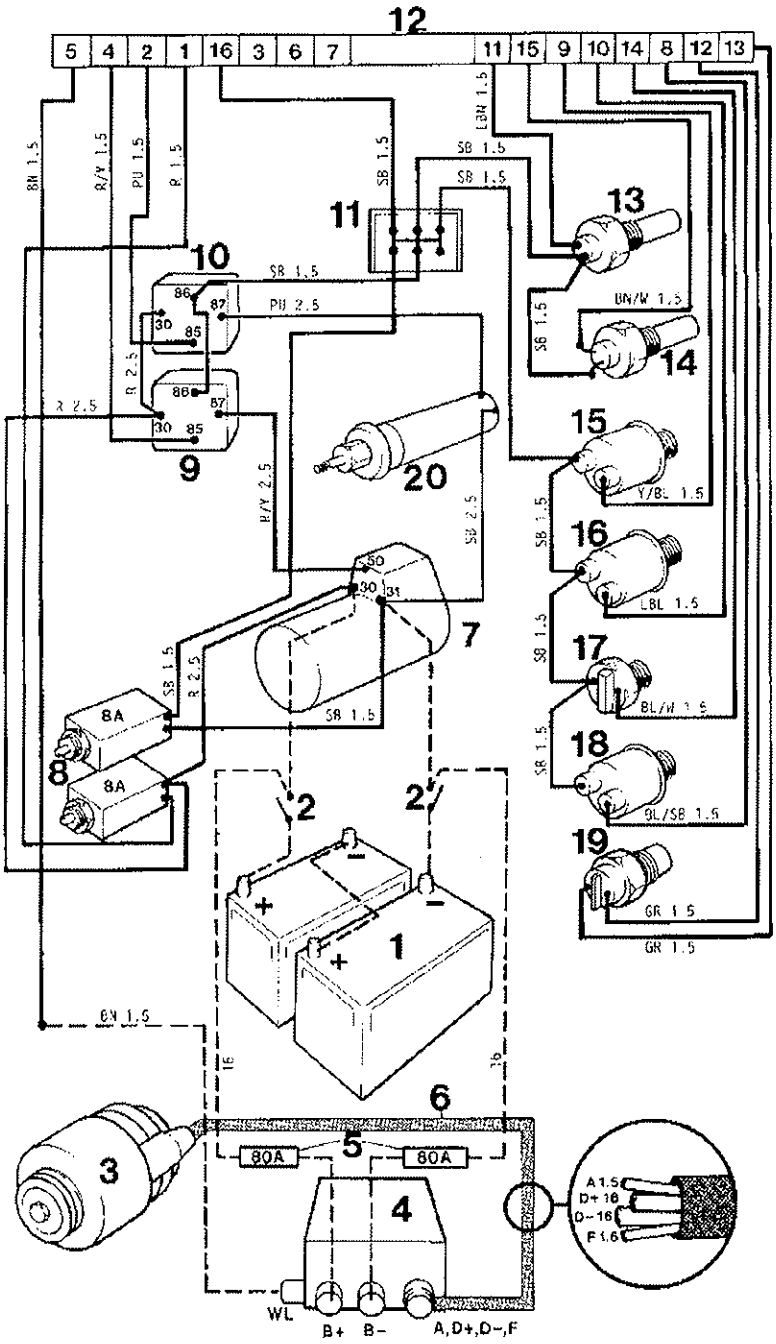
Cable colours

GR = Grey
SB = Black
BN = Brown
LBN = Light brown
R = Red
PU = Purple
GN = Green
Y = Yellow
W = White
BL = Blue
LBL = Light blue

TAMD60C, TAMD70E

Engines with CAV alternator (28V/60A), extra equipment

2-pole system



Engine

1. Battery
2. Master switches
3. Alternator (CAV)
4. Regulator box
5. Automatic fuses*
6. Shielded ships cable
7. Starter motor
8. Fuses*
9. Starter relay (16 MS)*
10. Stop relay (16 S)*
11. Earth terminal*
12. 16-pole connector*
13. Cooling water temperature sender
14. Cooling water temperature switch
15. Pressure sender, turbo
16. Oil pressure sender, engine
17. Oil pressure switch
18. Oil pressure sender, reverse gear
19. Speed sender
20. Stop solenoid

* Located in connection box.

Cable areas in mm²

Relationship mm²/AWG

mm²	1.5	2.5	16
AWG	15(16)	13	5

Cable colours

GR = Grey
SB = Black
BN = Brown
LBN = Light brown
R = Red
PU = Purple
GN = Green
Y = Yellow
W = White
BL = Blue
LBL = Light blue

General

	TAMD60C	MD70C	TMD70C	TAMD70E
Type designation	TAMD60C	MD70C	TMD70C	TAMD70E
Number of cylinders	6		6	
Cylinder bore ..... mm (in)	98.4 (3.87)		104.77 (4.12)	
Stroke ..... mm (in)	20 (4.72)		130 (5.12)	
Displacement ..... dm^3 = litres (cu.in)	5.48 (334.4)		6.73 (410.7)	
Output, see sales literature				
Idling speed ..... r/s (r/min)	10.4-11.2 (625-675)	7.9-9.2 (475-550)		9.6-10.4 (575-625)
Compression ratio	16:1	17:1	16:1	15:1
Compression pressure at starter motor speed* ..... MPa (kp/cm^2/p.s.i.)	2.5 (25/356)	2.7 (27/384)	2.6 (26/370)	2.5 (25/356)
Firing order (No. 6 cylinder furthest back, nearest flywheel)	1-5-3-6-2-4		1-5-3-6-2-4	
Direction of rotation seen from front of engine	Clockwise		Clockwise	
Cylinder liners, type	Wet, replaceable		Wet, replaceable	
Valve system	Overhead		Overhead	
Valve clearances - engine stopped, cold or at operating temp:				
Inlet ..... mm (in)	0.40 (0.016)	0.40 (0.016)	0.40 (0.016)	0.40 (0.016)
Exhaust ..... mm (in)	0.45 (0.018)	0.45 (0.018)	0.55 (0.022)	0.55 (0.022)
Weight, engine without reverse gear or clutch:				
with plate heat exchanger approx .kg (lb.)	670 (1477)	800 (1764)	805 (1775)	820 (1808)
with tubular heat exchanger approx ..... kg (lb.)	–	830 (1830)	835 (1841)	840 (1852)

* 3.0 r/s (180 r/min).

Fuel system

Fuel injection pump, Bosch	PES6MW100/320 RS1111	PE6P110A320 RS367Z	PE6P110A320 RS367Y	PE6P110A320 RS260W
Pump setting, B.T.D.C	22°	20°		22°
Centrifugal governor, Bosch	RSV325-1400MW 2A314	RQV250-1000	PA394/2R	RSV250-1250 P0/347/2R
Feed pump,				
operating pressure, ...kPa	100–150	100–150		140–160
.....(kp/cm^2/p.s.i.)	(1.0–1.5/14–21)	(1.0–1.5/14–21)		(1.4–1.6/20–23)
Injector, complete, part no	844459-8	844285-7	844459-8	844286-5
marking	865	868	865	862
nozzle, part no	844460-6	844462-2	844460-6	844461-4
opening pressure, .MPa (kp/cm^2/p.s.i.)	24 (245/3485)	27 (275/3911)	24 (245/3485)	27 (275/3911)
setting pressure .....MPa	24.5-25.3	27.5-28.3	24.5-25.3	27.5-28.3
.....(kp/cm^2/p.s.i.)	(250-258/ 3556-3670)	(280-289/ 3983-4111)	(250-258/ 3556-3670)	(280-289/ 3983-4111)
hole diameter .....mm (in)	4 x 0.34 (0.013)	4 x 0.30 (0.012)	4 x 0.34 (0.013)	3 x 0.46 (0.018)

Cooling system

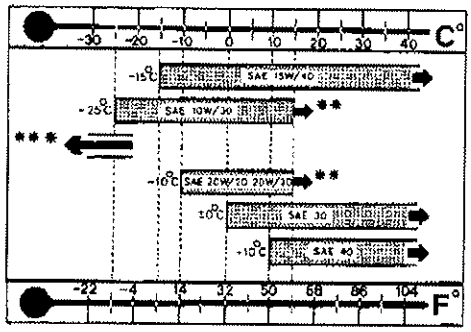
Fresh-water system capacity incl:				
plate heat exchanger, approx:				
.....dm^3 = litres (Imp. gall./US gall.)	20 (4.4/5.3), 23 (5/6)*	29 (6.4/7.7)	30 (6.6/7.9)	30 (6.6/7.9)
tubular heat exchanger, approx:				
.....dm^3 = litres (imp. gall./US gall.)	–	34 (7.5/9.0)		35 (7.7/9.2)
Normal coolant temperature, approx .....C (°F)	65-90 (149-194)		65-90 (149-194)	
Thermostats, number	2		2	
begin to open at .....°C (°F)	68–72 (154–162)/ 74–78 (165–172)**		74–78 (165–172)	
fully open at .....°C (°F)	84-88 (183-190)/ 88-92 (190-198)		88-92 (190-198)	

* With separate expansion tank.
** Thermostats on TAMD60 open at different temperatures.

Lubricating system

	TAMD70E	TAMD60C	MD70C	TMD70C
Oil pressure, warm engine at operating temp .....MPa (kp/cm²/p.s.i.)	0.3-0.5 (3-5/43-71)		0.3-0.5 (3-5/43-71)	
Oil capacity,no engine inclination, approx: ..... dm = litres (Imp. gall./US gall.)	20 (4.4/5.3)	32,30* (7.0/8.5), (6.6/7.9)*		30 (6.6/7.9)
engine inclination 15°, approx: .....dm³ = litres (Imp. gall./US gall.)	–	19 (4.2/5.0)		
engine inclination 18°, approx: .....dm³ = litres (Imp.gall./US gall.)	13 (2.8/3.4)	19* (4.2/5.0)*		19 (4.2/5.0)
Oil quality according to API-system	CD		CD	

Viscosity at various ambient temperatures



* With shallow oil sump (bulb).
** Using these oils at ambient temperatures above +15°C (59°F) can cause increased engine wear.
*** For temperatures below -25°C (-13°F), consult your oil supplier regarding suitable oil.
NOTE! Synthetic oil is only recommended for temperatures below -25°C (-13°F).

Turbo-compressor

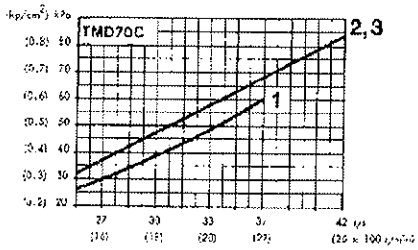
	TAMD70E	TAMD60C	MD70C	TMD70C
Manufacturer, type	KKK-K27-3064 G/14.72	–	KKK-K27-2970 N/14.7	KKK-K27-3068 N/14.7
Lubrication	Pressure lubricated from engine		Pressure lubricated from engine	
Cooling	Fresh-water cooled turbine housing		Fresh-water cooled turbine housing	

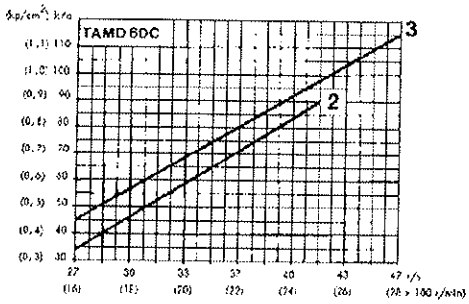
Charging pressure

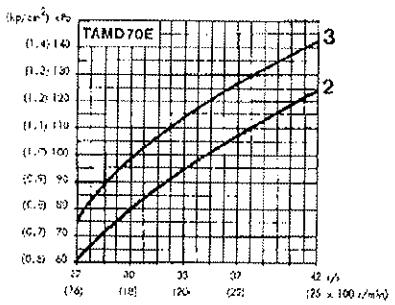
Charging pressure, min. values (measured in engine intake manifold) at 100 % engine loading at full speed setting and at 20°C (68°F) ambient air temperature. If measurement is carried out at any other temperature, the measured charging pressure must be corrected accordingly, see workshop manual.

A considerably lower charging pressure is obtained if the engine is not running at full output.

Curve 1 applies to heavy commercial operation (power curve C).
Curve 2 applies to light commercial operation (power curve C1).
Curve 3 applies to leisure craft (power curve B).







Electrical system

	TAMD60C	MD70C, TMD70C	TAMD70E
System voltage V	12 (alt. 24)	24 (alt. 12)	
Alternator, output:			
S.E.V. Marchal .....W	–	650 (500)	–
Paris-Rhone .....W	650 (1500)	–	1500 (650)
CAV*, extra equipment .....W	1600	1600	
Battery capacity:			
for 12V-system .....Ah	2 batteries connected in parallel 12V, max. 110 Ah** (total max. 220 Ah**)	2 batteries connected in parallel 12V, max. 110 Ah** (total max. 220 Ah**)	
for 24V-system .....Ah	2 batteries connected in series 12V, max. 110 Ah**	2 batteries connected in series 12V, max. 110 Ah**	
Density of battery electrolyte at +20°C (68°F),			
fully charged battery .....g/cm³	1.275-1.285	1.275-1.285	
recharge at .....g/cm³	1.230	1.230	

* Only for 24V-system.
** According to DIN 72311.

Reverse gear

Twin Disc

Type designation	**MG502**	**MG506**	**MG506**
Ratios	1.5:1; 2:1; 2.5:1	1:1; 1.5:1; 2:1; 3:1; 3.8:1; 4.5:1	1:1; 1.5:1; 2:1; 3:1
Oil capacity, approx.			
.....dm³ = litres (Imp. gall./US gall.)	2.5 (0.6/0.7)	5.0 (1.1/1.3) - for ratios 1:1-3:1 5.5 (1.2/1.5)-for ratios 3.8:1; 4.5:1	
Oil quality/viscosity	Same as in engine*	Same as in engine*	
Working oil pressure at oil temperature 82°C (180°F) engaged –30 r/s (1800 r/min)			
.....MPa (kp/cm²/p.s.i.)	2.1-2.4 (21-24.5/299-348)	2.1-2.2	2.5 (25.3/360) - for ratios 1:1-3:1
at cruising speed, min.			
.....MPa (kp/cm²/p.s.i.)	1.9 (19.3/275)	2.1-2.2 (21-22.5/299-320) – for ratios 3.8: 1; 4.5:1	
Weight, approx .....kg (lb.)	80 (176)	1.9 (19/270) 100 (220) - for ratios 1 :1-3: 1 127 (280) - for ratios 3.8:1; 4.5:1	

Type designation	**MG506**	**MG507**
Ratios	1.5:1; 2:1; 3:1	1:1; 1.5:1; 2:1; 3:1
Oil capacity, approx.		
.....dm³ = litres (Imp. gall./US gall.)	5.0 (1.1/1.3)	5.5 (1.2/1.5)
Oil quality/viscosity	Same as in engine*	Same as in engine*
Working oil pressure at oil temperature 82°C (180°F), engaged - 30 r/s (1800 r/min)		
.....MPa (kp/cm²/p.s.i.)	(21-22.5/299-320)	1.7 (17.5/249)
at cruising speed, min.		
.....MPa (kp/cm²/p.s.i.)	1.9 (19/270)	1.6 (16.5/235)
Weight, approx .....kg (lb.)	100 (220)	160 (353)

* NOTE! Only **single-grade** lubricating oil (only **one** viscosity number) may be used in the reverse gear. Oil of quality **CC** according to the API-system is also permitted in the **reverse gear.**

SCG

	TAMD60C	MD70C, TMD70C	TAMD70E
Type designation	–	**MRF 350 HD MK3B**	
Ratio		3:1	
Oil capacity, approx.			
.....dm^3 = litres (Imp. gall./US gall.)		12.5 (2.7/3.3)	
Oil quality/viscosity		Same as in engine*	
Working oil pressure, normal during running .....MPa (kp/cm^2/p.s.i.)		0.85 (8.5/121)	
Weight,			
(rotation same as engine) .....kg (lb.)		175(386)	
(rotation opposite to engine). .....kg (lb.)		170 (375)	

Borg Warner

Type designation	**V-drive 10-05**	**73 CR**
Ratios	1.5:1; 2:1	2:1; 3:1
Oil capacity,		
earlier model,** approx.		
.....dm^3 = litres (Imp. gall./US gall.)	4.5 (1.0/1.2)	2.5 (0.6/0.7)
later model,*** approx.		
.....dm^3 = litres (Imp. gall./US gall.)	3.5 (0.8/0.9)	–
Oil quality/viscosity	Same as in engine* (Viscosity, however SAE 30)	
Working oil pressure, normal during running .....MPa (kp/cm^2/p.s.i.)	0.77–1.05 (7.7-10.5/110-150)	0.85–1 (8.5-10/121-142)
Weight, approx .....kg (lb.)	120 (265)	85 (188)

* In the **reverse gear** oil of quality **CC** according to the API-system is also permitted.
** Oil dipstick located in the reverse gear housing.
*** Oil dipstick located in the V-drive housing.

Clutches

Disengaging clutches on front of engine

Rockford/Borg Warner

Ratios	–	1:1; 2.8:1
Size .....mm (inches)		203 (8), aft. 254 (10)
Permitted speed with power take-off engaged .....r/s (r/min)		15.0-30.0 (900-1800)
Oil quality/viscosity, (reduction gear)		Engine oil SAE 30
Oil capacity, approx.		
8" .....dm^3 (Imp. qts/US qts)		1 (0.9/1.1)
10" .....dm^3 (Imp. qts/US qts)		1.5 (1.3/1.6)
Weight, approx. (1:1) .....kg (lb.)		65 (143)
(2.8:1) .....kg (lb.)		75 (165)

VOLVO PENTA

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