

OPERATOR'S MANUAL

D2-40

Running-in

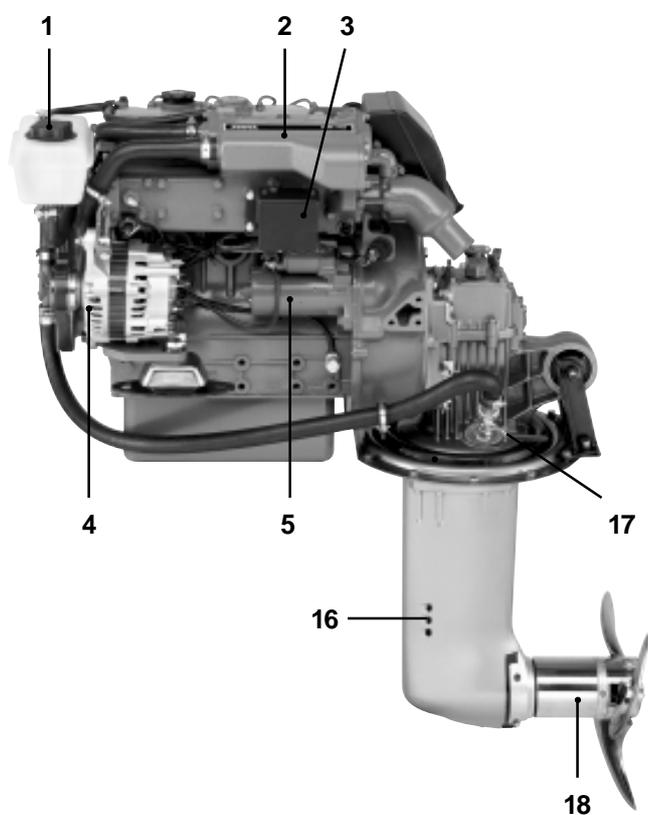
The engine must be run in for its first 10 operating hours as follows:

Operate the engine normally. Do not operate it at full load except for short periods.

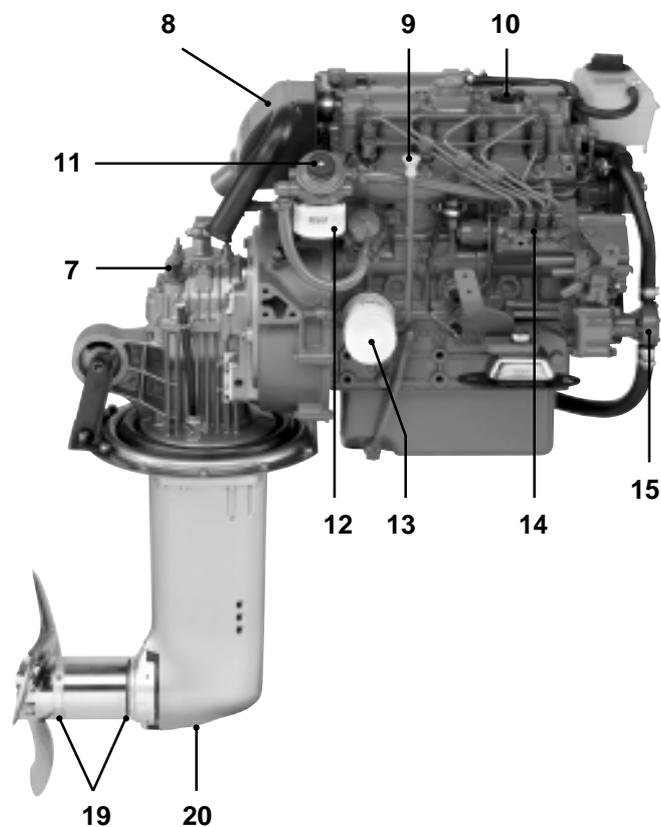
Never run the engine at a constant engine speed for long periods during the running-in period.

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D2-40 with sailing boat drive 130S



D2-40 with sailing boat drive 130S

- 1. Coolant filler cap
- 2. Heat exchanger
- 3. Relay box with fuses
- 4. Generator
- 5. Starter motor
- 6. Oil cooler, reverse gear
- 7. Dipstick, reverse gear/S-drive

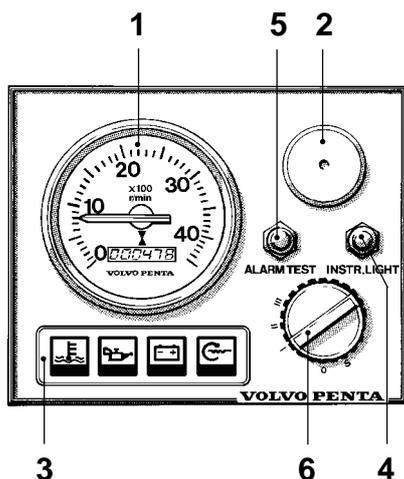
- 8. Air cleaner (ACL)/Air intake
- 9. Dipstick, engine
- 10. Oil filler cap, engine
- 11. Fuel pump
- 12. Oil filter
- 13. Fuel filter
- 14. Injection pump

- 15. Seawater pump
- 16. Cooling water intake, S-drive
- 17. Sea cock, S-drive
- 18. Folding propeller
- 19. Sacrificial anodes
- 20. Oil drain plug, S-drive

Instrumentation

This chapter only describes the instrument panels available as standard alternatives for your engine from Volvo Penta. Note that in certain boats instruments, alarm panels, key switches etc. may be installed separately without the instrument panels shown here.

If you want to install additional instrumentation, or your boat is equipped with instruments not described here, please contact your Volvo Penta dealer.



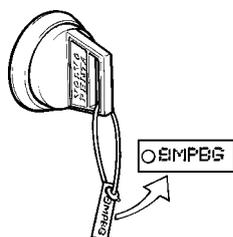
Instrument panel with ignition switch

1. Tachometer and hour counter (accessory). Displays engine speed. Multiply this value by 100 for revolutions per minute. The hour counter displays engine operating time in hours and tenths of an hour.
2. Siren for acoustic alarm.
3. Warning display. See pos. 13-16.
4. Switch for instrument lighting.
5. Alarm test/acknowledgment switch.

To test alarm: Press the switch. All warning lights light and the acoustic alarm sounds.

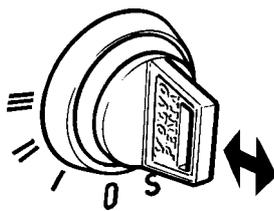
Alarm acknowledgment: Press the switch if there is an alarm. The acoustic alarm stops but the relevant warning lamp continues to flash until the malfunction is corrected.

6. Ignition switch. See description in the next chapter.



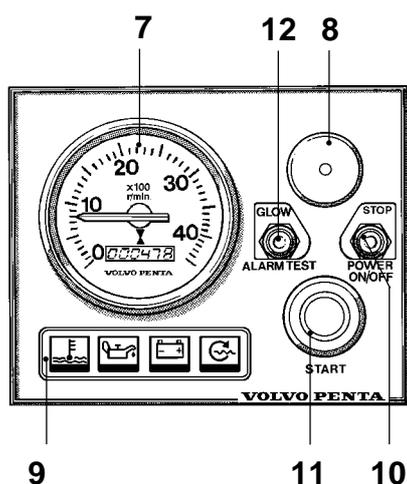
Ignition switch

The starter keys are tagged with a key code. This code must be quoted when ordering extra keys. Keep the code where it is **not** available to unauthorized persons.



- S = The mechanical restart inhibitor is disengaged. The key springs back automatically to the 0 position.
- 0 = The key can be inserted and removed.
- I = Operating position.
- II = Glow plug position. The glow plugs are connected and pre-heating the engine.
- III = Start position. The starter motor is engaged.

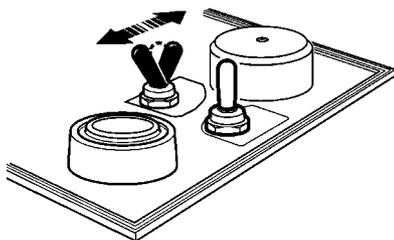
⚠ IMPORTANT! Read the starting instructions in the chapter: Starting the engine.



Instrument panel with electrical start/stop function

The instrument panel does not have an ignition switch. To stop unauthorized persons starting the engine the wheelhouse should have a lock or a lockable main switch should be used.

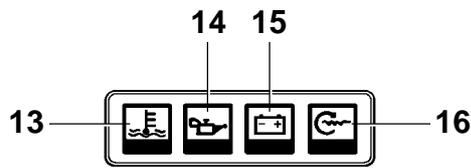
7. Tachometer and hour counter (accessory). Displays engine speed. Multiply this value by 100 for revolutions per minute. The hour counter displays engine operating time in hours and tenths of an hour.
8. Siren for acoustic alarm.
9. Warning display. See pos. 13-16.
10. Rocker switch for connecting/disconnecting the instrument panel and stop function.
11. Starter button. The starter motor is engaged when this button is pressed.
12. Alarm test/acknowledgment and glow plug rocker switch.



Glow plugs active: When the rocker switch is in the up position the glow plugs are activated.

To test alarm: Move the rocker switch down. All warning lights light and the acoustic alarm sounds.

Alarm acknowledgment: If there is an alarm the rocker switch is moved down and the alarm is acknowledged. The acoustic alarm stops but the relevant warning lamp continues to flash until the malfunction is corrected.



Warning display

If the acoustic alarm sounds, one of the three warning lamps (13-15) on the instrument panel starts to flash to indicate the source of the alarm.

13. Engine coolant temperature too high.

⚠ IMPORTANT! If the alarm sounds: Reduce engine speed to idle (neutral). Stop the engine if the temperature does not drop. Investigate and correct the malfunction.

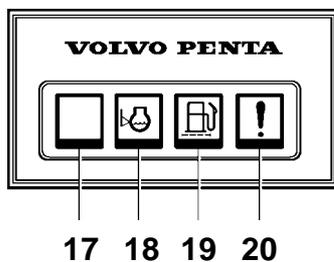
14. Low oil pressure.

⚠ IMPORTANT! If the alarm sounds: Stop the engine immediately and investigate.

15. Generator not charging.

16. Indicator lamp Comes on when the glow plugs are activated.

Check that the warning lamps are operating before starting the engine according to the description of the relevant instrument panel.



Extra warning display

If the acoustic alarm sounds, one of the four warning lamps starts to flash to indicate the source of the alarm. The extra warning display is an accessory.

17. Not used.

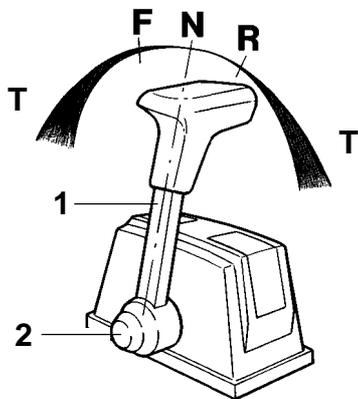
18. Low coolant level. Top up to correct level before starting.

19. Water in extra fuel pre-filter. Drain off water in filter. See instructions in the chapter Maintenance.

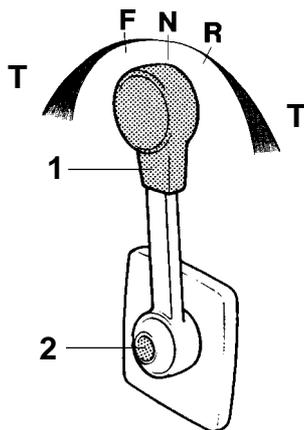
20. Extra alarm for an optional function.

Controls

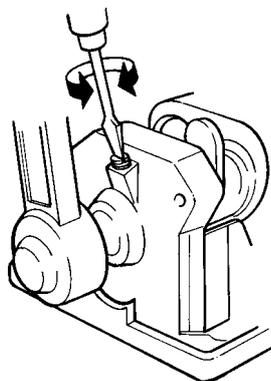
The shift function and engine speed control are combined in one lever. If necessary the shift function can be easily disengaged so that only the engine speed (rpm) is affected by the lever. The control lever has an adjustable friction brake. A neutral position switch is available as an accessory, this will only permit the engine to be started with the drive/reverse gear disengaged.



For top-mounted controls



For side-mounted controls



Maneuvering

Shifting and engine speed are controlled with the same lever (1).

N = Neutral position. Drive/reverse gear disengaged.

F = Drive/reverse gear engaged for movement ahead.

R = Drive/reverse gear engaged for movement astern.

T = Engine speed control

Disengaging the shift function

- Move lever (1) to the neutral position (N).
- Press in button (2), move the lever slightly forward and release the button.

The shift function is now disengaged and the lever affects only engine speed. When the lever is moved back to the neutral position it will automatically re-engage.

⚠ IMPORTANT! Take care not to engage the drive/reverse gear by mistake.

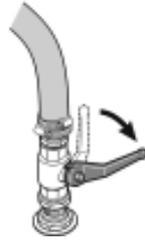
Adjusting the friction brake

The friction brake only affects the engine speed control movements.

- Lift the cover over the control. For side-mounted controls the lever must first be removed.
- Set the lever to the half-open throttle/reverse position.
- Adjust the friction brake. Turning the screw clockwise (+) makes the lever movement stiffer, while turning counterclockwise (-) makes it easier to move the lever.
- Reinstall the cover and lever.

Starting the engine

Make a habit of checking the engine and engine compartment visually before operating the boat. This will help you to quickly detect anything unusual that has or is about to happen. Also check that instruments and the warning display are indicating normal values when you have started the engine.



Before starting

- Open the cooling water intake sea cock.
- Open fuel valve.
- Carry out the actions in the “Daily before the first start-up” section in the maintenance schedule
- Switch on the main switch.
 - ⚠ **IMPORTANT!** Never break the circuit with the main switch while the engine is running. This could damage the generator.
- Start the engine compartment fan if one is fitted and let it run for at least four minutes.
- Check that there is sufficient fuel.

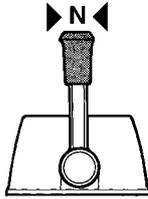
Starting. Instrument panel with ignition lock

⚠ WARNING! Never use start spray or similar to start the engine. Danger of explosion!

1. **If the engine is cold:** Disconnect the gear shift function and move the control lever forwards to half throttle.

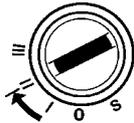
⚠ WARNING! Make sure that the gear shift function is disconnected.

If the engine is warm: Move the control lever to the neutral/idling position.



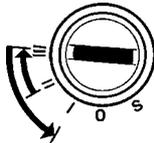
2. Insert the key in the ignition switch. Turn key to the "I" position. The three warning lamps come on and can be tested.

Check that the acoustic alarm is operating by pressing the "Alarm Test" button.



3. Turn key to the "II" position. The indicator light comes on and the glow plugs are connected to pre-heat the engine. Let the glow plugs remain activated for 10 seconds (max. 30 seconds).

⚠ IMPORTANT! Always pre-heat the engine (even when it is warm).

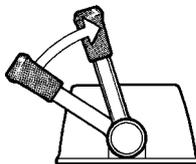


4. Turn key to the "III" to start. Release the key as soon as the engine has started, the key will automatically spring back to the "I" position.

⚠ IMPORTANT! If the starter motor is engaged for its maximum engagement time (20-30 seconds) let it cool down for five minutes before trying to start the engine again.

5. Warm up the engine at low speed and low load.

⚠ IMPORTANT! Do not race the engine while it is cold.



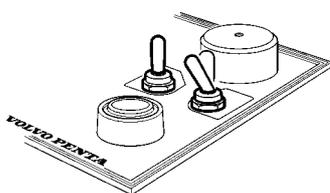
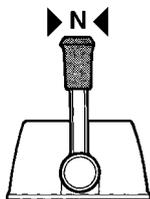
Starting. Instrument panel without ignition switch

⚠ WARNING! Never use start spray or similar to start the engine. Danger of explosion!

1. **If the engine is cold:** Disconnect the gear shift function and move the control lever forwards to half throttle.

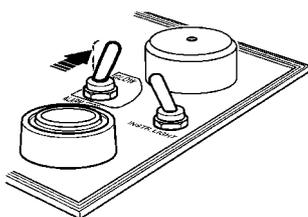
⚠ WARNING! Make sure that the gear shift function is disconnected.

If the engine is warm: Move the control lever to the neutral/idling position.



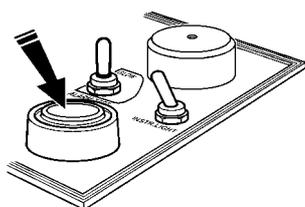
2. Activate the instrument panel by pressing the rocker switch downwards to "Power ON/OFF". The three warning lamps come on and can be tested.

Check that the acoustic alarm is operating by pushing the rocker switch to the "Alarm Test" position.



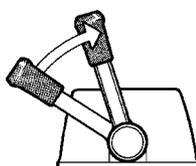
3. Push the rocker switch to the "Glow" position. The indicator light comes on and the glow plugs are connected to pre-heat the engine. Let the glow plugs remain activated for 10 seconds (max. 30 seconds).

⚠ IMPORTANT! Always pre-heat the engine (even when it is warm).



4. Press the starter button. Release the starter button as soon as the engine starts.

⚠ IMPORTANT! If the starter motor is engaged for its maximum engagement time (20-30 seconds) let it cool down for five minutes before trying to start the engine again.



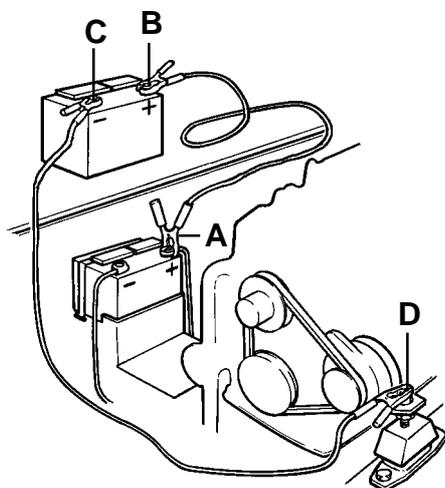
5. Warm up the engine at low speed and low load.

⚠ IMPORTANT! Do not race the engine while it is cold.

Starting using auxiliary batteries

⚠ WARNING! Batteries produce oxyhydrogen. This gas is easily ignited and highly volatile. A short-circuit, naked flame or spark can cause a large explosion. Ensure that the ventilation is good.

Never mix up battery positive and negative terminals. This may cause sparks and an explosion.



1. Check the auxiliary batteries have the same rated voltage as the engine's system voltage.
2. First connect the red jump lead to the discharged battery's **+ terminal** (A) and then to the auxiliary battery's **+ terminal** (B).
3. First connect the black jump lead to the auxiliary battery's **- terminal** (C) and then to a site (D) where there is good contact with the cylinder block as far away from the discharged battery as possible.
4. Start the engine and run it at a fast idle for approximately ten minutes to charge the battery.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

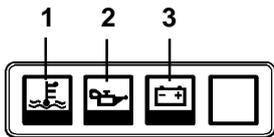
Do not touch the connections while trying to start the engine: This may cause sparks. Do not lean over the batteries.

5. Stop the engine. Remove the jump leads in **exactly** the opposite order to which you put them on.

Operation

Avoid violent and unexpected changes in course and gear engagement. There is a risk that someone aboard will fall over or overboard.

⚠ WARNING! A rotating propeller can cause serious injury. Check that nobody is in the water before engaging ahead or astern. Never drive near bathers or in areas where people could be in the water.



Checking instruments

Check the instruments and warning display directly after starting the engine and then at regular intervals while driving the boat. Stop the engine if there is an abnormal reading or any warning lamp comes on and the alarm sounds. For engines with measuring instruments the following standard values apply:

Engine coolant temperature (ECT) (1)

Normal operating temperature is between 75–95°C. The acoustic alarm will automatically go off if the engine coolant temperature (ECT) is too high.

⚠ IMPORTANT! If the alarm sounds: Reduce engine speed to idle (neutral). Stop the engine if the temperature does not drop. Investigate and correct the malfunction.

Oil pressure (2)

Normal operating oil pressure is between 150–500 kPa (21–71 psi). At engine idle this is normally lower. The acoustic alarm will automatically go off if the oil pressure is too low.

⚠ IMPORTANT! If the alarm sounds: Stop the engine immediately. Investigate and correct the malfunction.

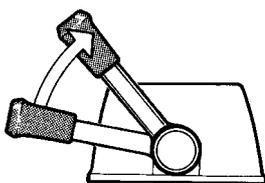
Charging (3)

The operating charge voltage is approx. 14 V. When the engine is stopped battery voltage is approx. 12 V.

Cruising speed

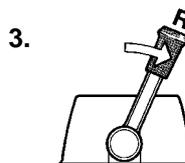
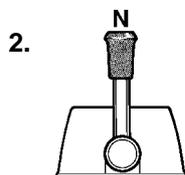
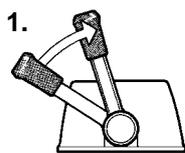
Operating the engine at full speed should be avoided since it is both uneconomical and uncomfortable. Volvo Penta recommends a cruising speed in the range 500–1000 rpm lower than maximum rpm at full speed. Depending on hull type, choice of propeller, load and conditions etc. the maximum engine speed at top speed can vary, but it should be within the full speed range.

Full speed range: 2,800–3,200 rpm

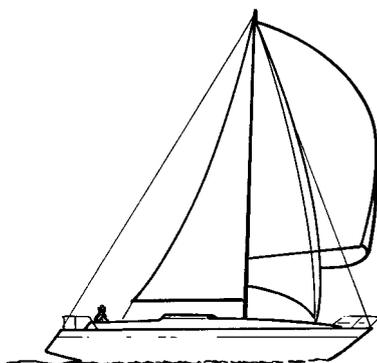


Maneuvering

All shifting between ahead and astern must be done at engine idle speed. Shifting at higher speeds may damage the drive or reverse gear and will also be uncomfortable for those on board.



1. Reduce engine speed to idling and, if possible, let the boat lose most of its speed.
2. Move the reverse gear control lever quickly and firmly into the neutral position. Wait for a moment.
3. Move the gear control lever quickly and firmly into astern, then increase the speed.

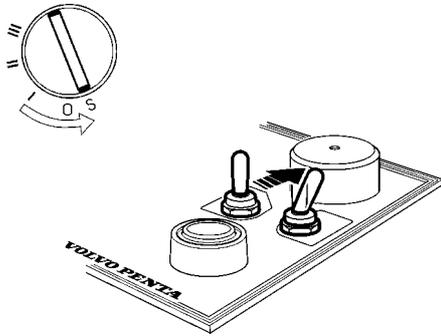


When sailing

When sailing the control lever should be in the reverse position if a folding propeller is used and in neutral position if a fixed propeller is used.

Stopping the engine

The engine should be run for a few minutes at idle (in neutral) before turning it off. This will avoid boiling and even out the temperature. This is especially important if the engine has been operated at high engine speeds and loads.



Stopping

If the instrument panel has an ignition switch the key should be turned to the stop position "S". The key will automatically spring back to the "0" position when it is released and can then be removed.

If the boat is fitted with an electric start/stop function: Push the rocker switch to the "Stop" position until the engine stops. Release the rocker switch and it returns automatically to the "Power OFF" position.

After stopping the engine

- Inspect the engine and engine compartment for any leaks.

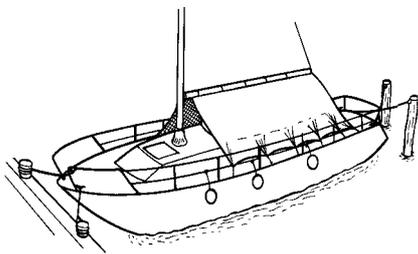
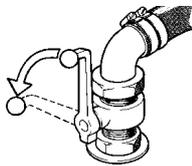
- Close the fuel cock and sea cock for the cooling water intake.

⚠ IMPORTANT! Do not forget to open the cocks before the engine is started again.

- Read off the hours counter and do preventive maintenance as in the maintenance schedule.

- Switch off the main switch if the boat is not to be used for some time.

⚠ IMPORTANT! Never break the circuit with the main switches while the engine is running. This could damage the generator.



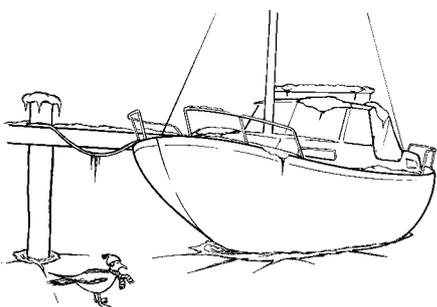
Laying up

If the boat is not going to be used for some time but is being left in the water, the engine must be run to operating temperature at least once every 14 days. This prevents corrosion in the engine. If the boat will not be used for more than two months then inhibiting should be carried out: See chapter "Laying up/ Launching".

Cold weather precautions

To prevent freezing damage, the seawater system must be drained and the freshwater system coolant must have sufficient antifreeze protection. See chapter Maintenance "Cooling systems".

⚠ IMPORTANT! A poorly charged battery may burst as a result of freezing.



Maintenance schedule

Your Volvo Penta engine and associated equipment is designed to provide high operational reliability and long service life. They are constructed to withstand the marine environment while also affecting it as little as possible. Preventive maintenance in accordance with the maintenance schedule will ensure that it retains these qualities and avoid unnecessary operational disturbances.

Warranty inspection

The prescribed warranty inspection "First Service Inspection" must be carried out at an authorised Volvo Penta workshop during this first period of operation. Directions for when and how this is to be carried out can be found in the **Warranty and Service Book**.

Extended Protection

Volvo Penta offers an Extended Protection for your marine diesel engine, including transmission, if used for pleasure use only. To be valid a Extended Protection service has to be performed at the owners cost and expense by an authorized Volvo Penta distributor, dealer or workshop before the expiry of the 12 months Warranty Period. Further directions can be found in the **Warranty and Service Book**.

MAINTENANCE SCHEDULE

 **WARNING!** Read the chapter "Maintenance" thoroughly before starting any maintenance work. It contains directions for performing maintenance in a safe and correct manner.

 **IMPORTANT!** When both operating time and calendar time is given, the one occurring first is to apply. Maintenance points marked with are to be carried out at an authorised Volvo Penta workshop.

Daily before starting for first time

- Engine and engine room. General inspection page 27
- Engine oil. Checking level page 30
- Coolant. Checking level page 33

Every 14 days

- Fuel pre-filter. Drain water page 40
- Drive belt. Check page 28
- Seawater filter. Cleaning page 36
- Battery. Check electrolyte level page 42
- Reverse gear. Check oil level page 47
- S-drive. Check oil level page 47

Every 200 operating hours or at least once a year, included in Extended Protection

- D1-13, D1-20, D1-30. Engine oil. Replace page 30
- D1-13, D1-20, D1-30. Oil filter. Replace page 30
- Reverse gear. Oil change page 48
- Reverse gear. Lubricate propeller shaft seal page 51
- S-drive. Oil change page 47
- S-drive/Reverse gear. Checking corrosion protection page 49

Every 500 operating hours or at least once a year, included in Extended Protection

- D2-40. Engine oil. Replace page 30
- D2-40. Oil filter. Replace page 30
- Fuel filter. Replace page 40
- Fuel pre-filter. Replace page 40
- Idling speed. Check page 29
- Seawater pump. Check impeller page 35
- Vacuum valve. Cleaning page 36

Least once a year, included in Extended Protection

- Folding propeller. Cleaning page 49
- S-drive. Check rubber seal (hull/drive) page 51

Every 500 operating hours or at least once every two years

- Air Cleaner (ACL). Replace page 29
- Coolant. Replace page 34
- Heat exchanger. Cleaning page 34
- Injectors. Test pressure not shown
- Valve clearance. Adjustment not shown

Every 500 operating hours or at least every fifth year

- Reverse gear. Replacing propeller shaft seal not shown

Every seventh year

- S-drive. Replacing rubber seal between drive and hull not shown

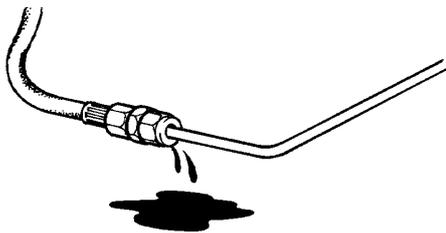
Maintenance

This chapter contains instructions regarding how the above maintenance points should be carried out together with general technical information. Read the instructions carefully before starting work. Maintenance intervals are contained in the chapter above. Maintenance schedule

⚠ WARNING! Read the safety precautions for maintenance and service in the chapter: Safety Precautions, before starting work.

⚠ WARNING! Unless otherwise specified all maintenance and service must be carried out with the engine stopped. Stop the engine before opening or removing engine hatches. Immobilize the engine by removing the ignition key, turning off the power supply with the main switch.

Engine, general



General inspection

Make a habit of “visually” inspecting the engine and engine room **before starting the engine and after stopping** when the engine has been turned off. This will help you to quickly detect abnormalities that have occurred or are about to occur.

Look especially carefully for oil, fuel and coolant leaks, loose bolts, worn or slack drive belts, loose connections, damaged hoses and electric cables. This inspection takes only a few minutes but can prevent serious operating disturbances and costly repairs.

⚠ WARNING! Accumulations of fuel, oil and grease on the engine or in the engine room is a fire hazard and must be removed immediately they are detected.

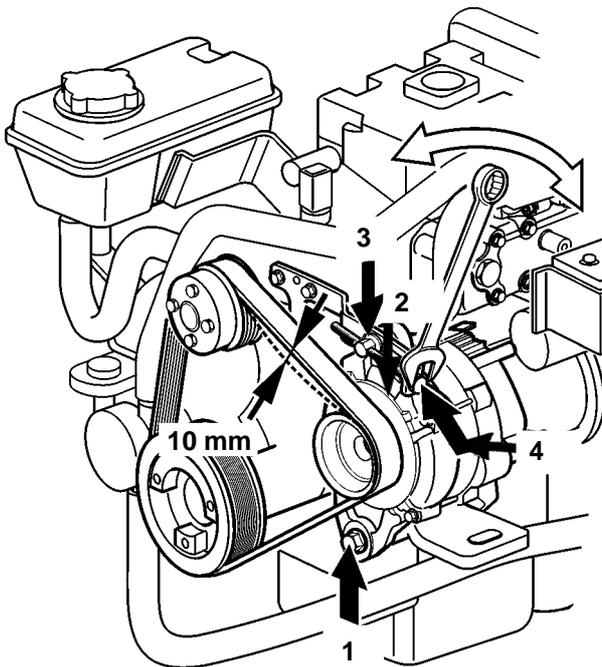
⚠ IMPORTANT! If an oil, fuel or coolant leak is detected, the cause must be investigated and the fault rectified before the engine is started.

⚠ IMPORTANT! Never point high-pressure water jets directly at seals, rubber hoses or electrical components. Never use the high-pressure function when washing the engine.

Drive belt. Check

The belt drives both the circulation pump and the generator. A belt that is too loose can result in slippage, poor cooling and poor charging. A belt that is too tight can damage the bearings in the circulation pump and damage the generator.

Check the tension of the belt regularly. Adjust as required. Check that the belt is not cracked or damaged. Replace a worn belt. Keep a spare belt on-board.



Drive belt. Adjusting and replacing

⚠ WARNING! Always turn the engine off before starting maintenance work.

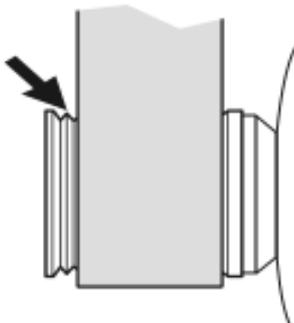
⚠ IMPORTANT! Tighten screw (1) to 50 Nm.

Check and adjust as necessary after operating the engine when the belts are warm. It should be possible to depress a belt at the correct tension approx. 10 mm between the pulleys using normal thumb pressure.

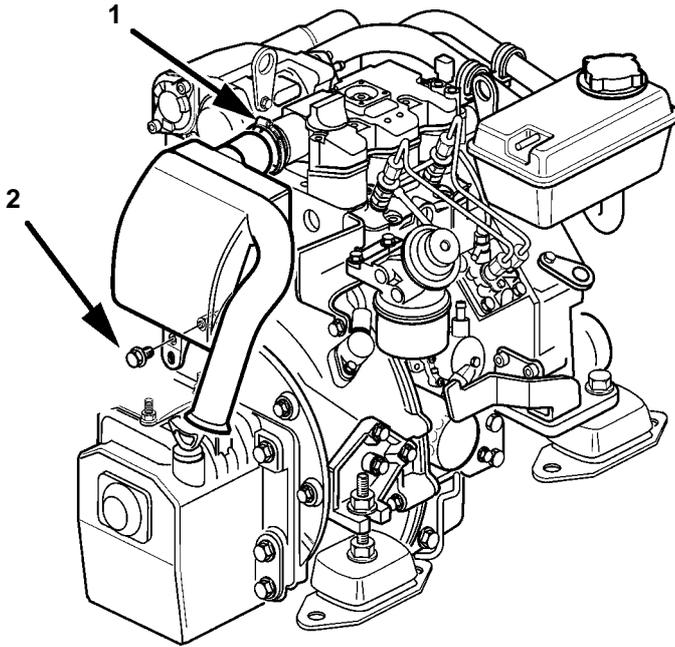
Loosen the alternator fixing screws (1-3). Tension the belt with the adjustment screw (4), to the correct tension. Tighten the screws (1-3). Check the tension.

To replace the belt slacken off screws (1 and 2). Press the generator in towards the cylinder block so that the belt can be removed. Clean off the pulley grooves. Install the new belt. Adjust as above. Check belt tension again after a few hours' operation.

⚠ IMPORTANT! D1-30 and D2-40: make sure the drive belt is positioned in the track closest to the alternator.



D1-30, D2-40

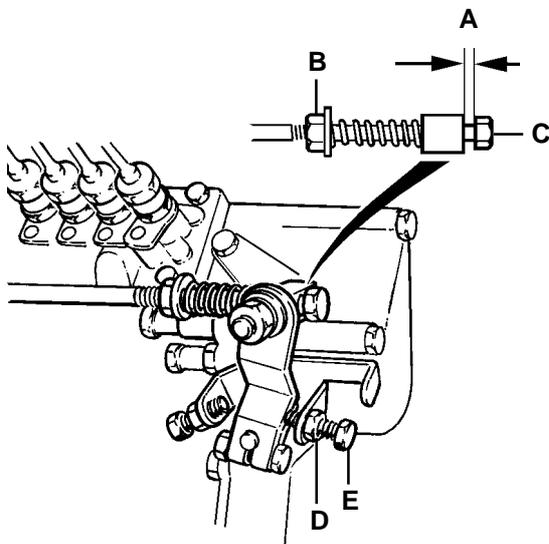


Air Cleaner (ACL). Changing

Loosen the hose clamp (1) and screw (2) to remove the old filter.

Fit the new filter and tighten the hose clamp.

⚠ IMPORTANT! Take care that no contaminants enter the engine.



Idling. Adjustment

For engine idling speed: Please refer to the Technical Data chapter. A lower engine speed can cause the engine to stall and a higher engine speeds can cause extra stresses to the drive/reverse when shifting.

Adjust with the engine at operating temperature as follows:

- 1* Set the control lever in the neutral position. Check that gap (A) is approx. 3 mm. Adjustment: Slacken off the locknut (B) and adjust until the correct gap is obtained with screw (C). Tighten the locknut.

*This point does not apply to boats with double control positions.

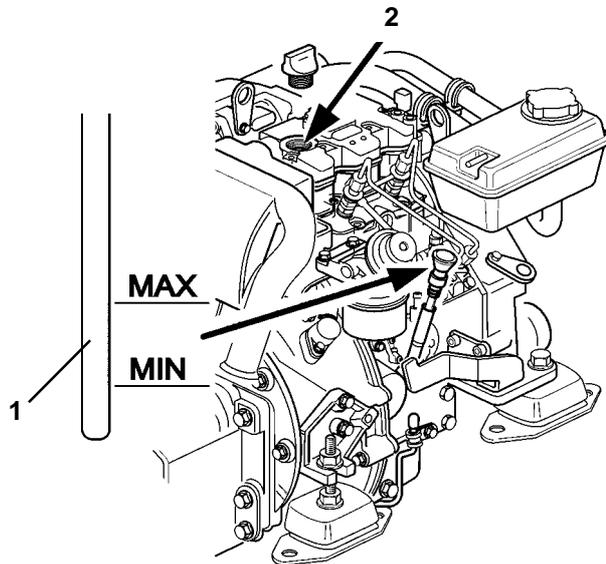
- 2 Start engine and allow to idle with gear selector in neutral.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

- 3 Slacken off locknut (D). Adjust engine speed with adjustment screw (E). Tighten the locknut. Repeat step 1.

Lubrication system

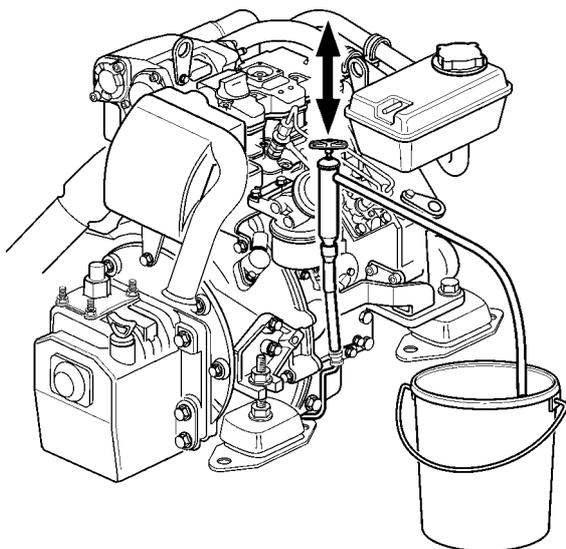
⚠ IMPORTANT! With a new or reconditioned engine, the oil and oil filters must be changed after 20-50 hours of operation. After that they should be changed every 500 operating hours or at least once a year. Use only the recommended grades of oil: See the chapter "Technical Data".



Oil level. Checking and topping up

The oil level should be within the marked area on the dipstick (1). It should be checked every day before the engine is started. Topping up is done through the valve cover (2). Top up oil slowly. Wait a few minutes before checking the oil level again to give the oil time to run down to the oil pan. Then check the level again. Use only the recommended grades of oil: See the chapter "Technical Data".

⚠ IMPORTANT! Do not fill the oil above the MAX level.



Oil and oil filters. Changing

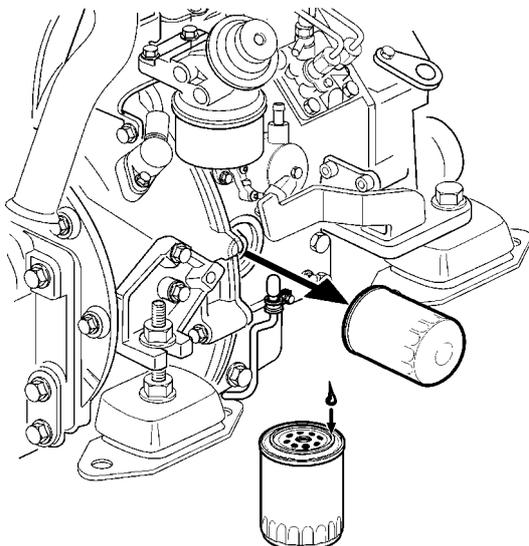
1. Run the engine to operating temperature so that the oil is easier to suck out. Stop the engine.
2. Suck out the oil using an oil drain pump through oil drain pipe.

⚠ WARNING! Hot oil and hot surfaces can cause burns.

3. Unscrew the old filter. (To avoid oil spills put a plastic bag over the filter before it is unscrewed).
4. Check that the engine mating surface is clean.
5. Moisten the filter rubber gasket with a little oil. Screw on the new filter by hand until it is in contact with the mating surface. And then a further half turn **but no more!**
6. Top up oil to correct level. Start the engine and let it idle. Check that the warning lamp for low oil pressure goes out.

7. Stop the engine. Wait for approx. 10 minutes before checking the oil level. Top up if required. Check that there are no leaks round the oil filter.

NOTE! Collect up the old oil and filter for deposit at a proper disposal site.



Freshwater system

The fresh water system is the engines' internal cooling system, which ensures that the engine operates at the correct temperature. It is a closed circuit system and must always be filled with a mixture of at least 40 % concentrated coolant and 60 % water to protect against internal corrosion, cavitation and damage caused by freezing.

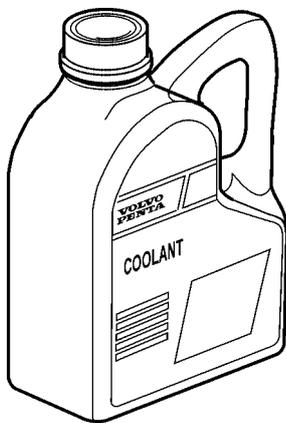
We recommend that you use “**Volvo Penta Coolant, Ready Mixed**”, alternatively “**Volvo Penta Coolant**” (concentrated) mixed with **pure** water according to spec, see “Coolant. Mixture”. Only coolant of this quality is suited too and approved by Volvo Penta.

The coolant should contain ethylene glycol of a good quality with a suitable chemical consistency for an adequate protection of the engine. Using anti-corrosion additive exclusively is not permitted in Volvo Penta's engines. Never use water by itself as coolant.

⚠ IMPORTANT! Coolant must be used all year round. This applies even if there is never any risk for frost , to ensure that the engine has an adequate protection against corrosion.

Future warranty claims on the engine and additional equipment may be rejected if an unsuitable coolant has been used or if the instructions concerning coolant mixing have not been followed.

NOTE: The anti-corrosive agents become less effective after a time, which means that the coolant must be replaced, see “Service schematic”. The cooling system should be flushed out at the same time as the coolant is replaced, see “Cooling system. Flushing”.



“**Volvo Penta Coolant**” is a concentrated coolant that is to be mixed with water. It has been developed to function optimally with Volvo Penta's engines and provides excellent protection against corrosion, cavitation and frost damage.

“**Volvo Penta Coolant, Ready Mixed**” is a ready-mixed coolant, 40% “Volvo Penta Coolant” and 60% water. This concentration protects the engine against corrosion, cavitation damage and freezing conditions down to -28 °C (18°F).



Coolant. Mixture

⚠ WARNING! All glycol is hazardous and harmful to the environment. Do not consume!
Glycol is flammable.

⚠ IMPORTANT! Ethylene glycol must not be mixed with other types of glycol.

**Mix: 40 % “Volvo Penta Coolant” (conc. coolant)
60 % water**

This mixture protects the engine against internal corrosion, cavitation and frost damage down to -28 °C (18°F). (Using 60 % glycol lowers the freezing point to -54 °C (65°F)). Never mix more than 60 % concentrate (Volvo Penta Coolant) in the cooling liquid, this will give reduced cooling effect and increase the risk of overheating, and will give reduced freezing protection.

⚠ IMPORTANT! Coolant must be mixed with **pure** water, use **distilled - de-ionized water**. The water must fulfill the requirements specified by Volvo Penta, see “Water quality”.

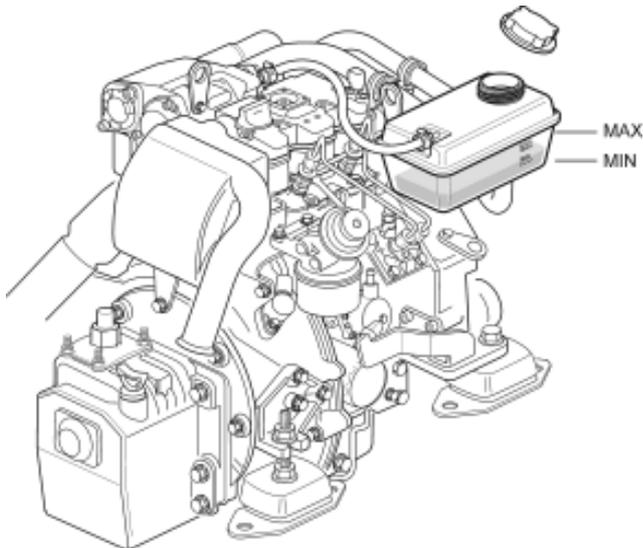
⚠ IMPORTANT! It is extremely important that the correct concentration of coolant is added to the system. Mix in a separate, clean vessel before adding into the cooling system. Ensure that the liquids mix properly.



Water quality

ASTM D4985:

Total solid particles	< 340 ppm
Total hardness:	< 9.5° dH
Chloride	< 40 ppm
Sulfate	< 100 ppm
pH value.....	5,5–9
Silica (acc. ASTM D859)	< 20 mg SiO ₂ /l
Iron (acc. ASTM D1068)	< 0.10 ppm
Manganese (acc. ASTM D858)	< 0.05 ppm
Conductivity (acc. ASTM D1125)	< 500 µS/cm
Organic content, COD _{Mn} (acc. ISO8467)	< 15 mg KMnO ₄ /l

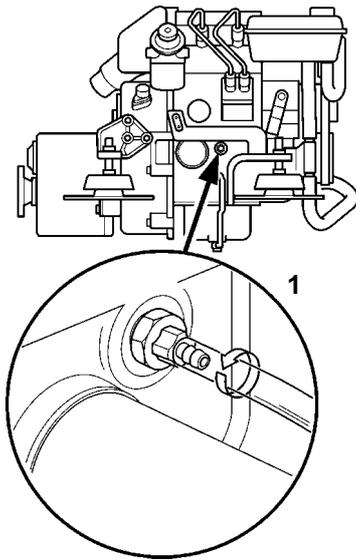


Coolant level. Checking and topping up

⚠ WARNING! Stop the engine and allow it to cool before opening the filler cap. Steam or hot coolant may spurt out. Hot coolant and hot surfaces can cause burns.

Turn the filler cap slowly counter clockwise and let any pressure escape from the system before removing the cap. The coolant level should be between the MAX and MIN marking on the expansion tank, when the engine is cold. Top up coolant if necessary. Reinstall the filler cap.

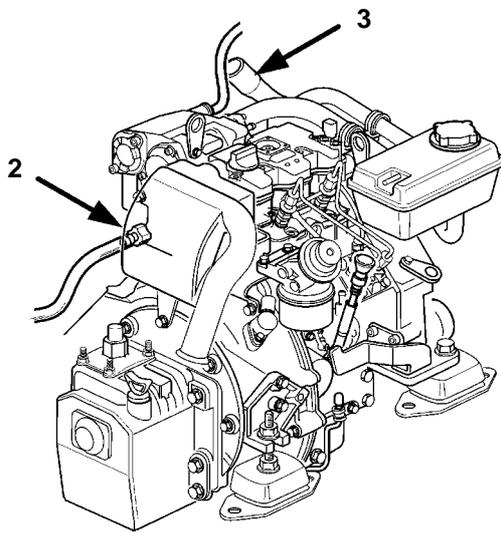
⚠ IMPORTANT! When filling a completely drained system the coolant level must be checked after an hours use because the system is self bleeding. Top up if required.



Coolant. Draining

Connect a hose to the engine drain cock(1) and another to the heat exchanger drain tap (2) and lower these into a vessel. Remove the filler cap on the heat exchanger to let the coolant run out faster. Open the drain cock (1) and the drain tap (2) and drain off all coolant. Before new coolant is put in, clean the heat exchanger as in the following paragraphs.

NOTE! Deposit old coolant at a properly designated disposal site.

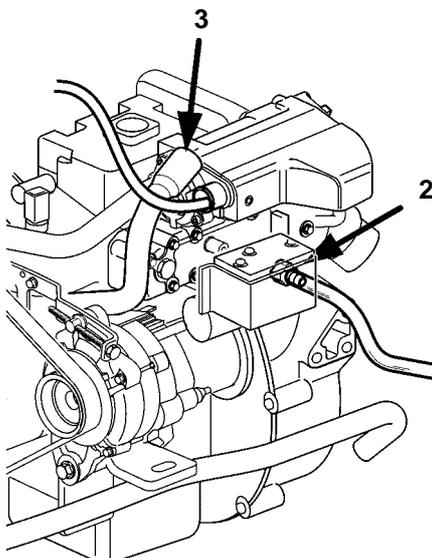


D1-13

Heat exchanger. Cleaning

Cooling performance is reduced by scaling in the heat exchanger. It should therefore be flushed when the coolant is changed.

1. Drain the coolant as above.
2. Insert a hose into the filling pipe (3) on the heat exchanger. Rinse with fresh water until the water which runs out of the drain tap and the engine block is clean. Let all the water run out.
3. Close the drain tap and the drain plug. Fill up with coolant to the correct level. Put the filler cap back.



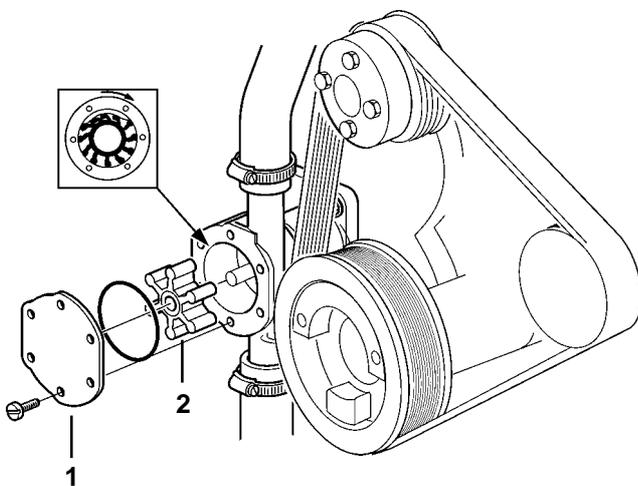
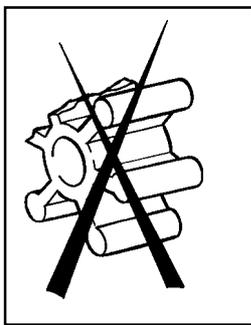
D1-20, D1-30 & D2-40

Seawater system

The sea water system is the external cooling system of the engine. On engines with a stern drive, the sea water pump sucks in water via the drive, after which the water passes the sea water filter (optional extra) before it is pumped through the heat exchanger. Finally, the water is pumped out into the exhaust elbow pipe, where it is mixed with the exhaust gases.

On engines with a reverse gear, the sea water pump suck in water via the sea water inlet, after which the water passes the sea water filter (optional extra) and the reverse gear oil cooler before it is pumped through the heat exchanger. Finally, the water is pumped out into the exhaust bend, where it is mixed with the exhaust gases.

⚠ WARNING! There is a risk that water will enter while working on the seawater system (if the boat is in the water). Water may flow into the boat if a hose, plug or similar object located below the waterline is removed. So always close the seawater cock. If the boat does not have a seawater cock, the flow of water must be stopped in a safe manner. The boat must be brought up on land if this is not possible.

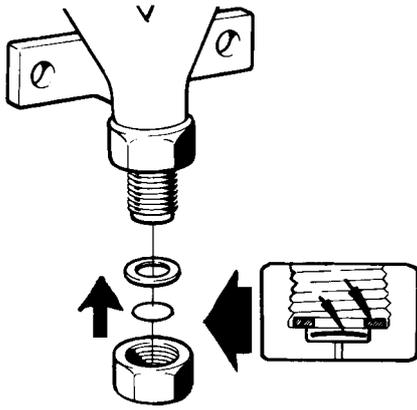


Impeller. Checking/Replacing

⚠ WARNING! Risk for water penetration. Close the sea cock.

Close the sea cock. Remove cover (1) on the seawater pump. Remove impeller (2). If there are cracks or other defects the impeller must be replaced. Lubricate the pump housing and the inside of the cover with a little waterproof grease **for rubber**. Reinstall the impeller using a clockwise rotating movement. Install the cover together with a new gasket. Open the sea cock.

⚠ IMPORTANT! Always carry a spare impeller on board.

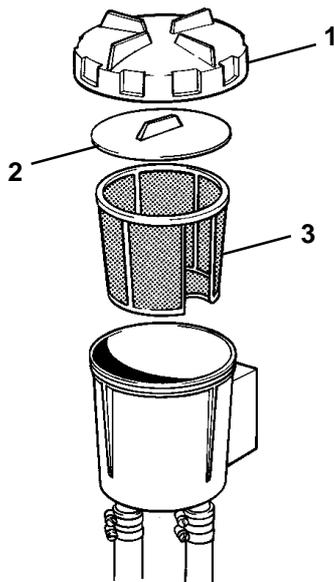


Vacuum valve. Cleaning

Some engines have a vacuum valve installed in the seawater piping.

⚠ WARNING! Risk for water penetration. Close the sea cock.

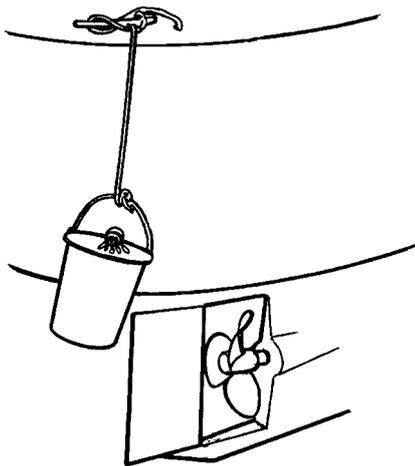
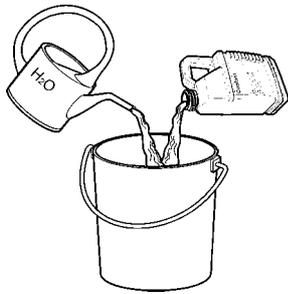
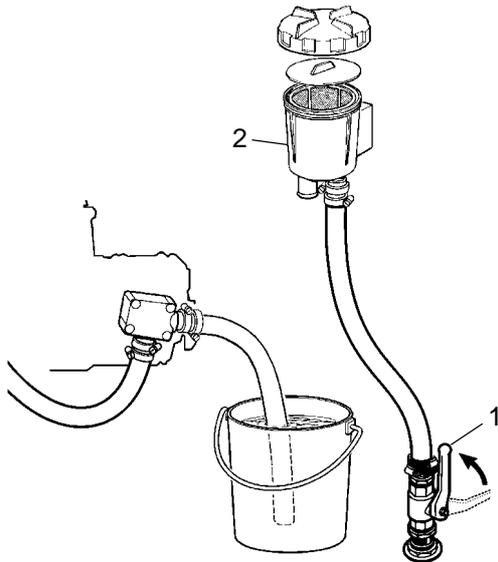
Close the sea cock. Disassemble the valve. Unscrew the hexagonal cover. In the cover there is a membrane and a gasket. Clean all the parts. Turn the cover upside down. Install the membrane first and then the gasket. Turn the valve housing upside down as well. Screw the cover into position, but not too hard (0.2 kpm), or the valve may stop working.



Seawater filter. Cleaning

The seawater filter is an accessory. Screw off cover (1) and remove seal plate (2). Lift out and clean the insert (3).

⚠ IMPORTANT! If the boat is used in water that has a lot of contaminants, seaweed etc. the filter must be checked more frequently than indicated in the maintenance schedule. Otherwise there is a risk the filter will clog and the engine will overheat.



Seawater system. Flush cleaning and corrosion inhibition

When laying up during winter (or out of season), the seawater system must be flushed clean of all deposits and salt crystals. It must also be treated to protect against internal corrosion.

⚠ WARNING! Risk of water penetration. This work must be carried out with the boat on dry land.

Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

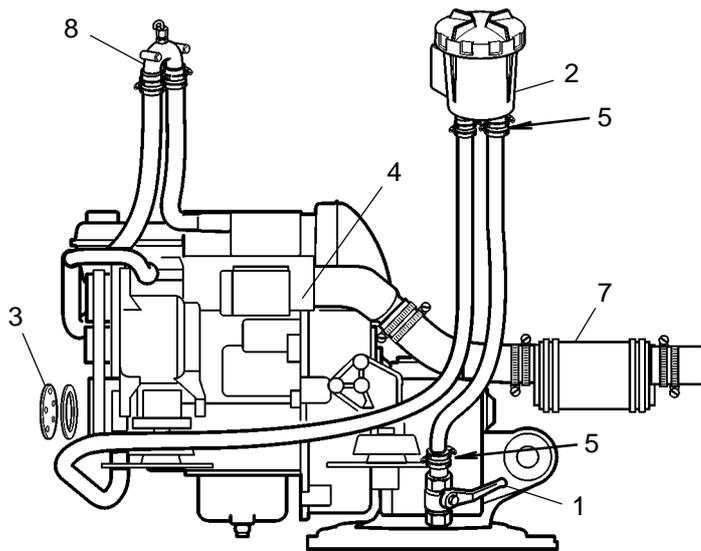
Glycol is harmful to health (dangerous if ingested). Collect used and drained glycol and take it to a proper disposal site.

1. Open the seawater cock (1).
2. Disconnect the hose at the seawater cock (1) or on the outlet side of the sea water filter (2) (if the engine is equipped with such a filter).
3. Place the free end of the hose in a bucket of fresh water. Fill the system.

⚠ IMPORTANT! The impeller will be damaged if it runs dry.

4. Check that there is nobody close to the propeller and there is nothing that will get splashed behind the exhaust outlet.
5. Set the control lever to neutral. Start the engine. Let the engine run at fast idle for a few minutes. Stop the engine.
6. Fill the bucket with an anti-freeze mixture (50% Volvo Penta glycol and 50% fresh water). Collect the mixture from the system in a suitable container.
7. Start the engine and let it idle. Stop the engine just before the mixture is finished.
Repeat as necessary until the entire system has been flushed with the mixture.
8. Reconnect the hose.

This mixture prevents corrosion and protects against freezing. It must be left in the seawater system throughout the laying-up period. Drain the mixture just before the boat is launched.



130S

Seawater system. Draining

If it is not possible to keep the engine compartment free of frost, the seawater system must be drained to prevent freezing damage.

Note that all the seawater must be drained. The type of drainage must be adapted to the way in which the engine is installed and any additional equipment that is connected, for example sea water filter (2), vacuum valve (8), exhaust riser with drain cock (9), silencer (7) etc.

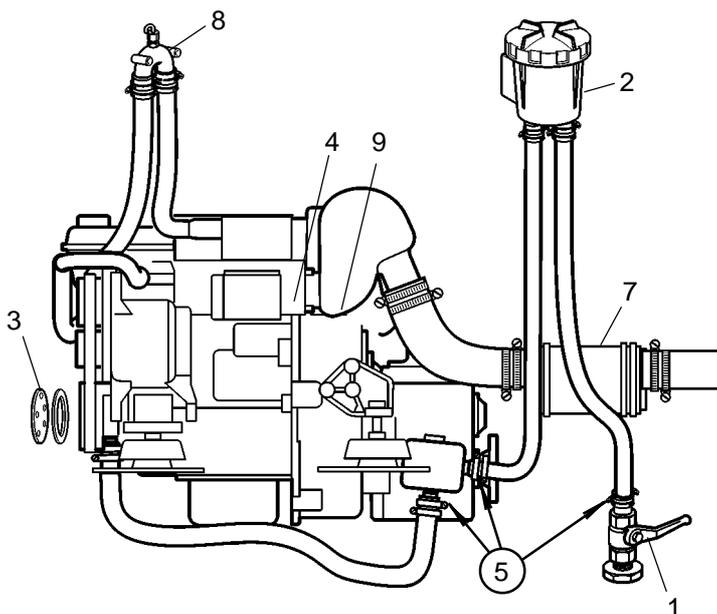
⚠ WARNING! Risk of water penetration. Close the sea cock before starting work.

⚠ IMPORTANT! If the boat is laid-up for winter or the off season, the seawater system must be instead flushed clean and protect against corrosion according to the instructions in the previous section.

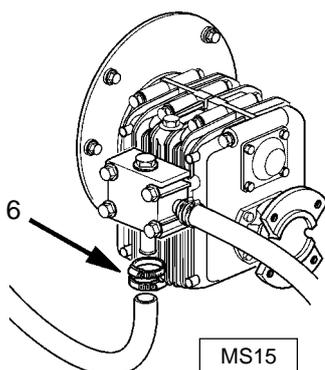
Draining:

1. Close the seawater cock (1).
2. Remove the cover and sealing plate on the sea water filter (2).
3. Remove the cover (3) from the seawater pump. Let the water run out.
4. Open the drain cock (4) on the rear end of the heat exchanger and drain the water off.
5. Disconnect the hoses where indicated by the arrows (5). Drain the hoses.
6. Connect a hose to the drain cock on the heat exhaust riser (9) and lower into a vessel. Open the drain cock and drain the water. Close the drain cock.
7. Disconnect the hose (6) on the reverse gear oil cooler and drain the water off.
8. Drain the silencer (7), the exhaust system and any other additional equipment connected to the seawater and exhaust systems.
9. Reinstall all hoses, the cover on the seawater pump and the cover and sealing plate on the seawater filter. Close the drain cock on the heat exchanger.
10. Opened the seawater cock the next time the boat is used.

⚠ WARNING! Check that there is no leakage in the seawater system.



MS10 / MS15

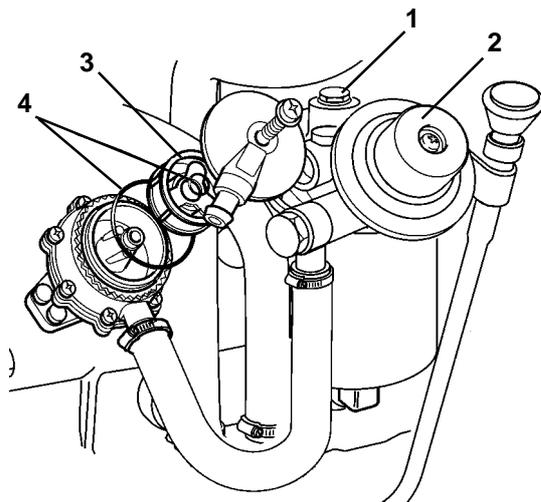


MS15

Fuel system

All work on the engine injection pump or injectors must be carried out at an authorized workshop. Use only the recommended grade of fuel: See the chapter "Technical Data".

⚠ WARNING! Fire risk. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags and other flammable material in fireproof conditions.



Venting the fuel system

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

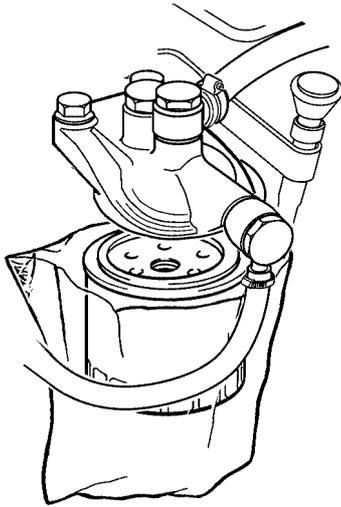
1. Open vent screw (1) on the filter mounting approx. three turns. Avoid fuel spillage. Use rags around the venting point.
2. Pump the fuel using hand pump (2) until there are no more air bubbles visible in the fuel. Continue pumping and at the same time tighten the venting screw.

There is a strainer (3) in the intake manifold for the pump. The strainer does not normally need to be cleaned since the engine should be installed with a fuel pre-filter. Low output may be due to a blocked strainer.

If any of the two o-rings (4) are damaged they need to be replaced.

3. Start the engine and check for leaks.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

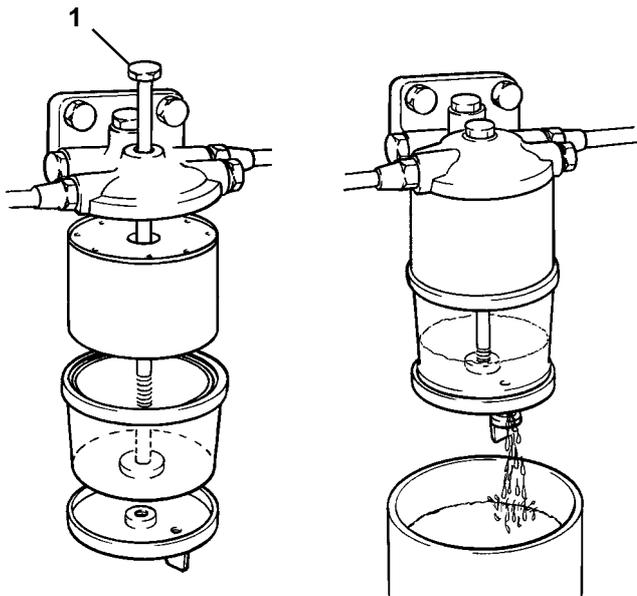


Fuel filter. Changing

Clean the filter mounting. To avoid fuel spills put a plastic bag over the filter before it is unscrewed. Unscrew the filter. Moisten the filter rubber gasket with a little oil. Screw on the new filter by hand until it is in contact with the mating surface. And then a further half turn **but no more!** Vent fuel system. **Deposit the old filter at a properly designated disposal site.**

Start the engine and check for leaks.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.



Fuel pre-filter. Draining and replacing filter insert

Draining

The fuel pre-filter is an optional extra.

Position a container under the fuel filter. Drain off water and contaminants using the cock/plug at the bottom of the filter bowl.

⚠ IMPORTANT! Wait a few hours after the engine has been turned off before draining the filter.

Replacing filter insert

Close fuel cock at the fuel tank. Position a container under the fuel filter.

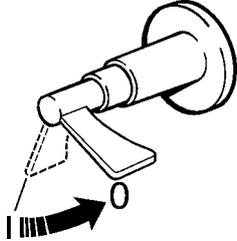
Remove the filter bowl by undoing screw (1). Empty and clean the filter bowl. Replace insert and reinstall the bowl. Open fuel cock. Vent fuel system. **Deposit the old filter insert at a properly designated disposal site.**

Start the engine and check for leaks.

⚠ WARNING! Approaching or working on a running engine is dangerous. Watch out for rotating components and hot surfaces.

Electrical system

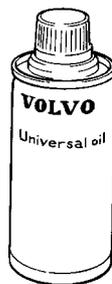
⚠ WARNING! Always stop the engine and break the current using the main switches before working on the electrical system. Isolate shore current to the engine block heater, battery charger, or accessories mounted on the engine.



Main switch

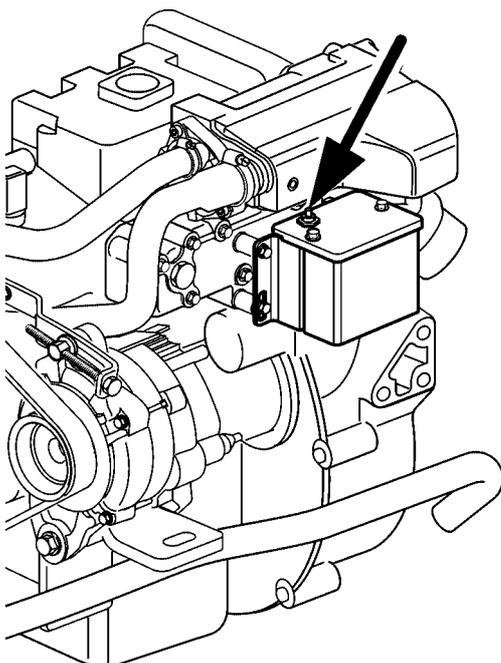
The main switch must never be turned off before the engine has stopped. If the circuit between the generator and the battery is cut off when the engine is running the generator can be seriously damaged. For the same reason charging circuits must never be switched over while the engine is running.

⚠ IMPORTANT! Never break the circuit with the main switches while the engine is running.



Electrical connections

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



Fuses

The engine is fitted with an automatic fuse. The fuse protects the system and cuts power in the event of an overload.

If it is not possible to start the engine or if the instrument stops working while running, the fuse may have been activated. Reset by pressing in the automatic fuse.

⚠ IMPORTANT! Always investigate the cause of the overload!

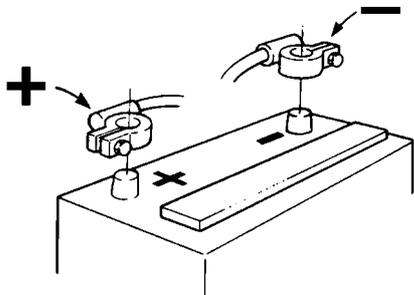


Battery. Maintenance

⚠ WARNING! Risk of fire and explosion. Never allow an open flame or electric sparks near the battery or batteries.

⚠ WARNING! Never mix up battery positive and negative terminals. This may cause sparks and an explosion.

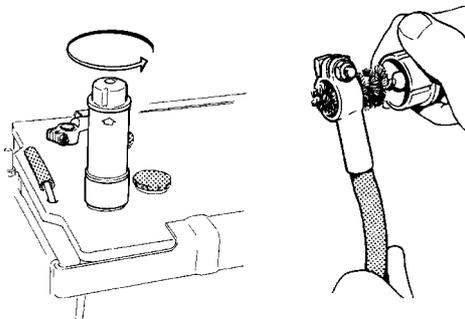
⚠ WARNING! The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries. Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin wash off immediately using plenty of water and soap. If battery acid comes into contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.



Connecting and disconnecting

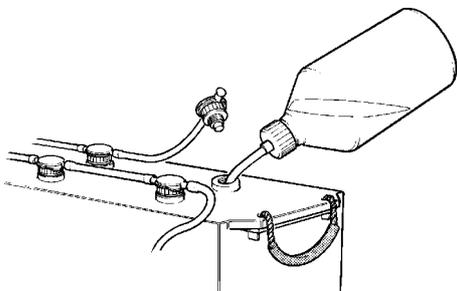
First connect the red battery lead + to the battery + terminal. Then connect the black battery lead - to the battery - terminal.

When disconnecting the battery, disconnect the -lead (black) first and then the + lead (red).



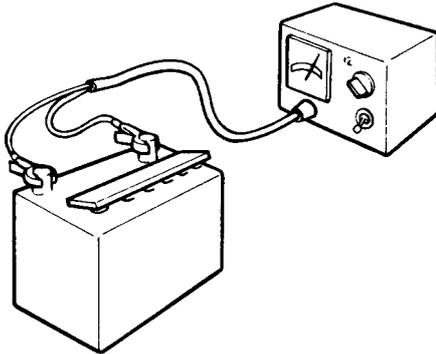
Cleaning

Keep batteries dry and clean. Oxidation or dirt on the battery and battery terminals can cause short-circuits, voltage drop and discharge especially in damp weather. Clean the battery terminals and leads to remove oxidation using a brass brush. Tighten the cable terminals well and grease them with terminal grease or petroleum jelly.



Topping up

The electrolyte should be 5 - 10 mm over the plates in the battery. Top up using **distilled water** if necessary. Charge the battery after topping up for at least 30 minutes by running the engine at fast idle. **NOTE!** Certain maintenance-free batteries have special instructions which must be followed.



Battery. Charging

⚠ WARNING! Danger of explosion! The batteries give off hydrogen gas during charging which when mixed with air can form an explosive gas - oxyhydrogen. A short-circuit, naked flame or spark can cause a large explosion. Ensure that the ventilation is good.

⚠ WARNING! The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries. Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin wash off immediately using plenty of water and soap. If battery acid comes into contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

If the battery has discharged it must be charged. If the boat has not been used for some time charge the battery and then trickle charge it (see manufacturer's recommendations). A poorly charged battery will be damaged and may burst in cold weather.

⚠ IMPORTANT! Follow the instructions supplied with the battery charger carefully. To avoid electrolytic corrosion when an external charger is connected, always disconnect the battery leads before connecting the charger.

When charging, unscrew filler plugs but leave them in their holes. Ventilation should be good, particularly if the batteries are being charged in an enclosed area.

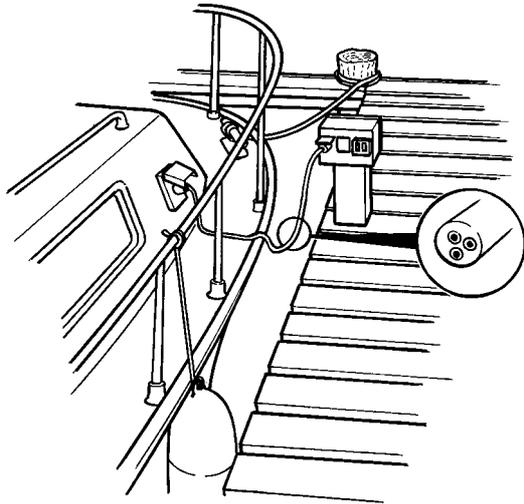
⚠ WARNING! Always switch off the charging circuit **before** removing the battery charger connectors. Never mix up battery positive and negative terminals. This may cause sparks and an explosion.

Special instructions apply when **boost charging** the batteries. Avoid boost charging the batteries as it will shorten their service life.

Electrical installations

Leakage current from the electrical system can be caused by incorrect installation of electrical equipment. Leakage current can knock out the galvanic protection of components such as the drive, propeller, propeller shaft, rudder stock and keel and cause damage by electrolytic corrosion.

⚠ IMPORTANT! Work on the boat's low tension circuit should only be carried out by qualified or experienced persons. Installation or work on the shore power equipment **must only** be carried out by electricians authorized to work with high-voltage installations.



The following should always be observed:

1. If shore power is connected, the protector ground should be ashore, never in the boat. Shore power should always have a ground fault circuit breaker.

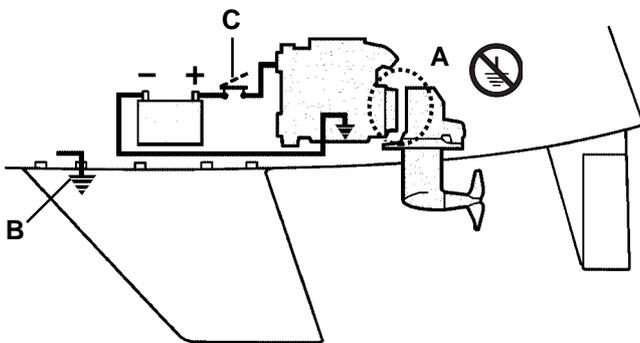
Shore power units (transformer, rectifier, battery chargers etc.) must be intended for marine usage **and the high tension circuit must be galvanically separated from the low tension circuit.**

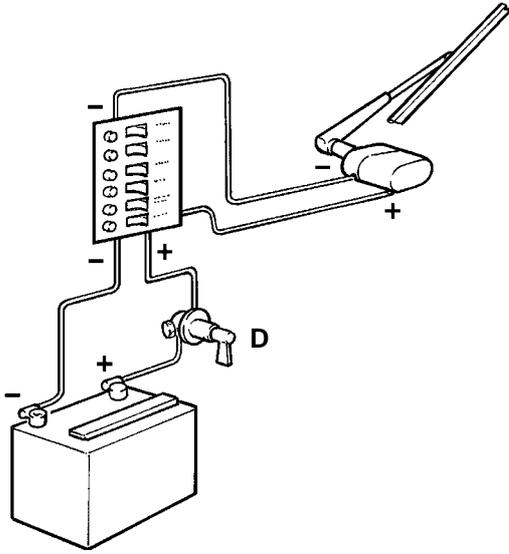
2. Route and clamp electric cables so that they will not be exposed to rubbing, damp or bilge water in the keelson.
3. The S-drive is electrically isolated (A) from the engine and must never be used as a ground.

⚠ IMPORTANT! The S-drive must never be used as a ground or be electrically connected to other equipment such as the radio, navigational equipment, the rudder, bathing steps etc.

Protective grounds for the radio, navigational equipment, rudder, bathing steps or other equipment with separate ground leads must be connected to a common ground terminal (B).

4. There must be a main switch (C) connected to the starter battery positive (+) terminal. The main switch should cut off power to all power consuming equipment and should be switched off when the boat is not in use.



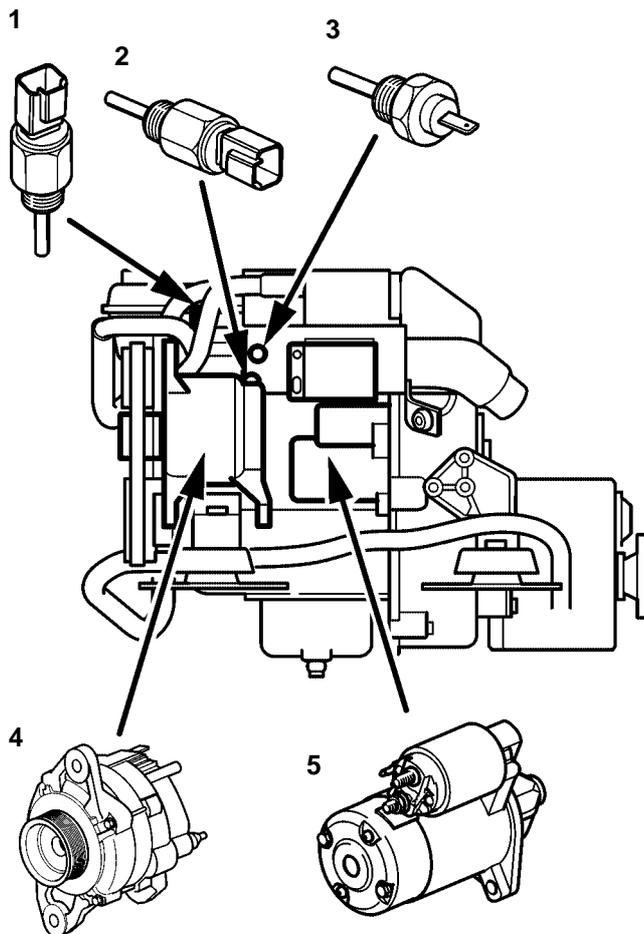


5. If an auxiliary battery is in use, a main switch (D) should be connected between its + terminal and the fuse block. The main switch for the auxiliary battery must cut off all power consuming equipment connected to that battery and be turned off when power is no longer needed.

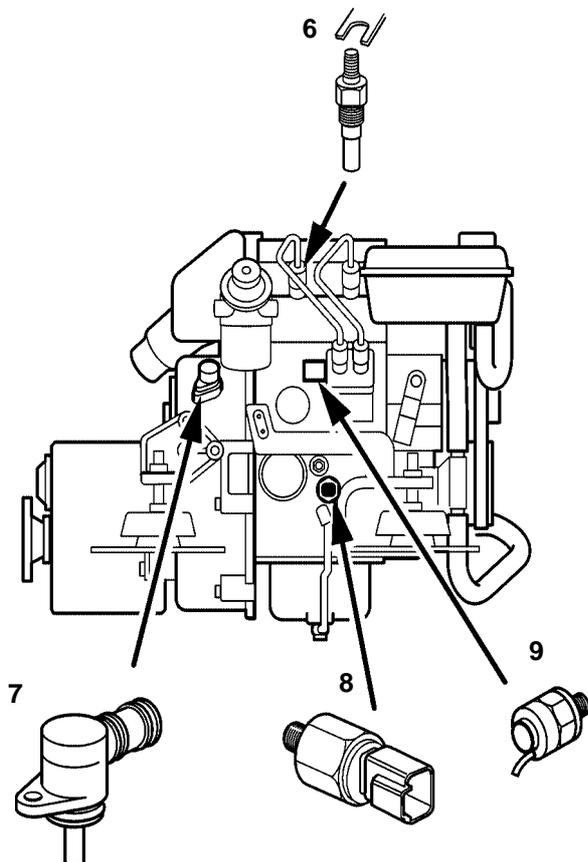
All equipment connected to the auxiliary battery should have separate switches.

To simultaneously charge two independent battery circuits, fit a Volvo Penta charge distributor (accessory) to the regular generator.

Electrical components diagram



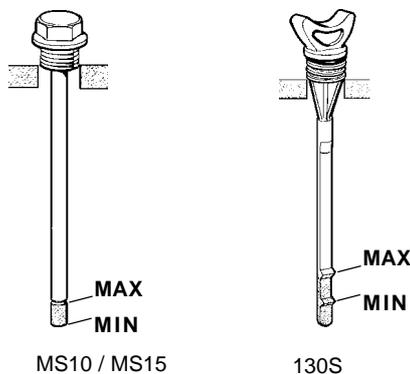
1. Engine coolant temperature switch D1-13, D1-20
2. Engine coolant temperature switch D1-30, D2-40
3. Engine coolant temperature sensor
4. Alternator
5. Starter motor
6. Glow plugs
7. Engine speed sensor
8. Oil pressure switch
9. Electrical stop



S drive and reverse gear

The S drive and in certain cases the propeller (reverse gear) is equipped with a sacrificial anode which prevents galvanic corrosion. Faulty electrical installation can also cause the break down of the galvanic protection. Damage due to electrolytic corrosion occurs rapidly and is often extensive. For further information see the chapter: "Electrical system"

⚠ IMPORTANT! Improperly applied paint or the wrong type of paint on the keel can put the corrosion protection system out of action. For further information on painting see the chapter: Laying up/Launching

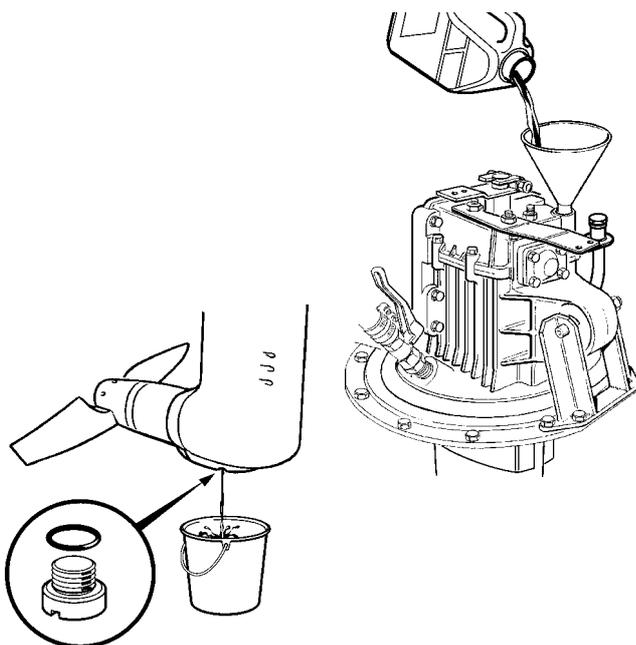


Oil level. Check

Remove the dipstick by turning counter-clockwise. Wipe the dipstick and reinsert it in the drive / reverse gear **without screwing it in**. Remove the dipstick and check the oil level. The correct oil level is between the MAX and MIN markings.

Top up the oil as required using the dip stick tube. For oil quality and capacity: See the chapter "Technical Data".

⚠ IMPORTANT! Do not overfill under any circumstances. The oil level must always be within the recommended level.

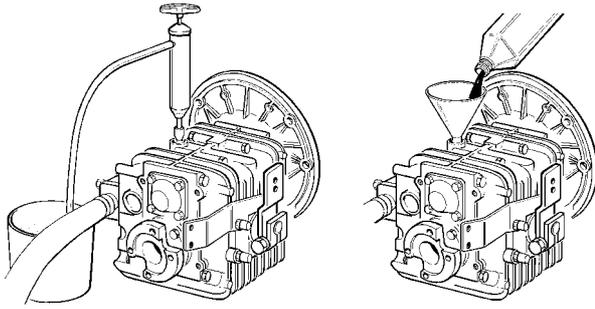


Oil change. S-drive

Remove the oil dipstick. Remove the plug on the propeller gear housing and let the oil run out. Check that the plug o-ring is intact. Replace if necessary. Install the plug and o-ring. Top up oil to correct level through the hole for the oil dipstick. For oil quality and capacity: See the chapter "Technical Data".

Alternatively, it is possible to change oil without taking the boat out of water, e.g. the oil change interval is reached during season. Suck up oil using an oil pump through the oil suction pipe – using this method leaves approximately 0.5 liters (0.13 US gals) in the S-drive. Top up oil to correct level through the hole for the oil dipstick. For oil quality and capacity: See the chapter "Technical Data".

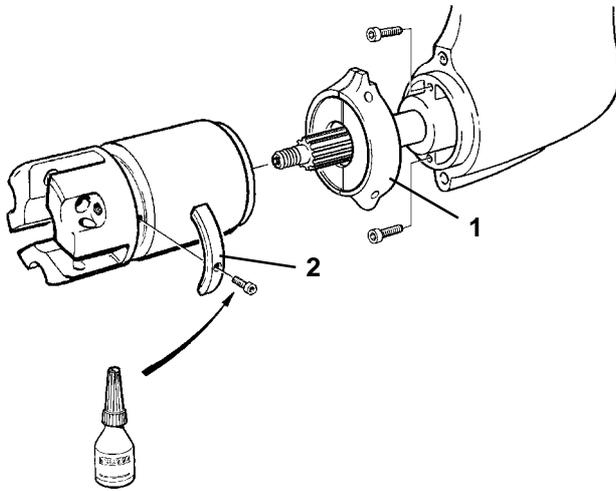
⚠ IMPORTANT! If oil is colored gray then water has entered the drive. Please contact an authorised Volvo Penta workshop.



Oil change. Reverse gear

Remove the dipstick. Suck up oil using an oil pump through the hole for the dipstick. Measure out the correct amount of oil and fill up through the hole for the oil dipstick. For oil quality and capacity: See the chapter "Technical Data".

⚠ IMPORTANT! Never overfill reverse gear. The oil level should always lie at the recommended level.



Corrosion protection. Check

Check the sacrificial anode (1) on the drive and the three sacrificial anodes (2) on the propeller. Replace with a new anode if 50% of the material has perished or at least once per season.

⚠ IMPORTANT! Use zinc sacrificial anodes for salt water and magnesium anodes for freshwater.

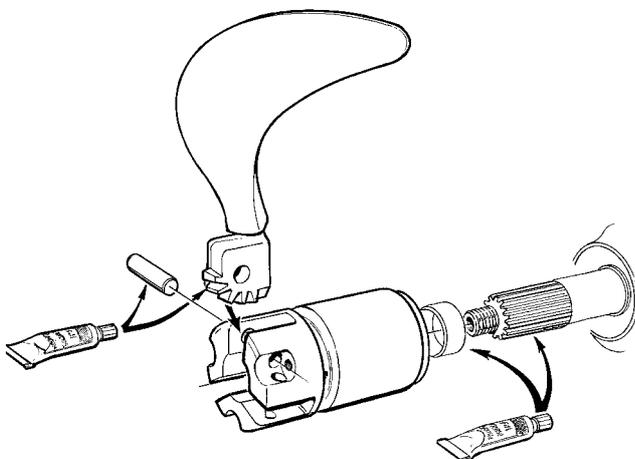
Remedy any paintwork damage on the drive according to the instruction in the chapter: Laying up / Launching.

Replacing sacrificial anodes

1. Remove the propeller (see the next section).
2. Remove the sacrificial anodes. Thoroughly scrape clean the mating surfaces on the drive and propeller.
3. Apply thread sealant to the screws for the sacrificial anodes on the propeller.
4. Install the new sacrificial anodes. Tighten the anodes so that there is a good metal contact.
5. Reinstall the propeller.

The sacrificial anodes oxidise when they come into contact with air. This reduces the galvanic protection. There may even be oxidation on the surface of a completely new anode. **Always clean the sacrificial anodes before launching the boat.**

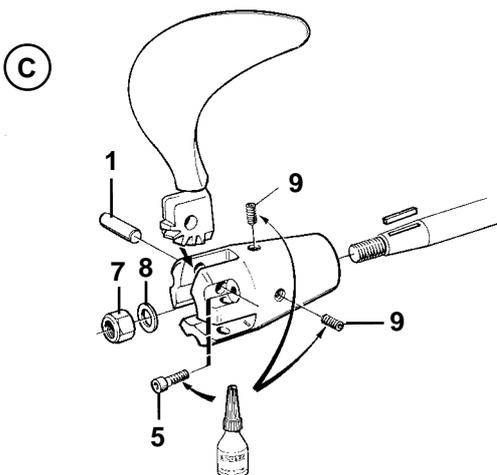
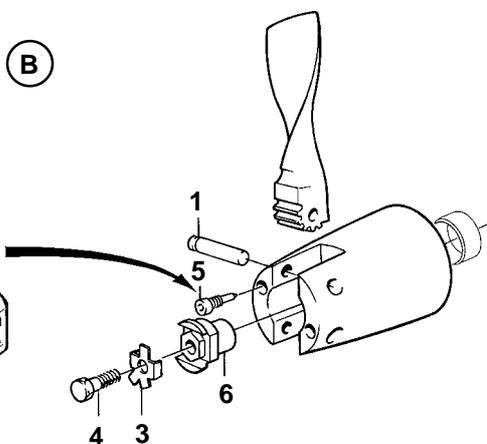
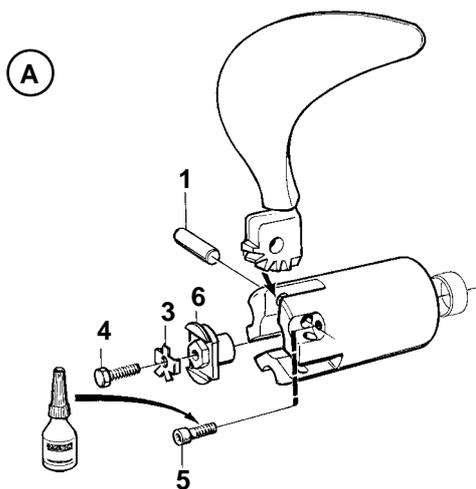
⚠ IMPORTANT! Use emery paper. Do not use steel tools when cleaning, as these may damage the galvanic protection.



Folding propeller. Cleaning

The propeller must be cleaned and lubricated once a year. Remove the propeller and clean all components thoroughly. Apply waterproof grease to the propeller blade teeth and bearing surfaces so that the propeller folds easily. Also apply waterproof grease to the studs, spacing sleeve (drive), propeller shaft and hub.

⚠ WARNING! Prevent accidental starting. Remove the ignition key and turn off the power at the main switch before working on the propeller.



Removing

1. Set the control lever in the "Ahead" position.
2. Remove the propeller blade by first undoing the locking screws (5) completely and then pressing out the shaft studs (1).
3. **Drive:** Bend down the tabs of the tab washer (3) and remove the locking screw (4), tab washer and nut (6).

Reverse gear: Remove the nut (7), washer (8) and then the locking screws (9).

4. Pull off the propeller hub and the spacing sleeve (drive). Clean and lubricate as described.

Installing

1. Reinstall the spacing sleeve (drive) and the propeller hub on the shaft.
2. **Drive:** Install the nut (6). Place a propeller blade on the hub and place a wooden block between the propeller blade and the underwater hull. Tighten locknut to 70 Nm.

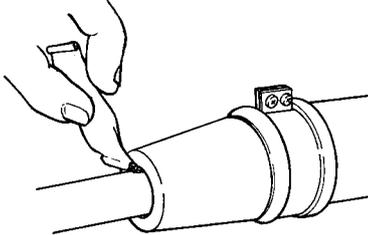
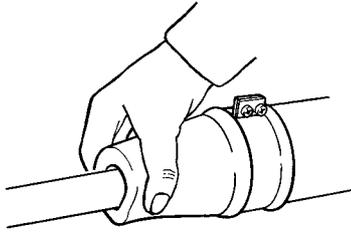
Reverse gear: Install the washer (8) and tighten the nut (7) to 220 Nm. Apply thread sealant to the locking screws (9). After the locking screws have been tightened apply thread sealant to the screw heads as well.

3. **Drive:** Locate the tab washer (3) on the nut. Install and tighten the locking screw (4) to 20 Nm and bend one of the tab washer tabs to the screw head.

⚠ IMPORTANT! The tab washer (3) must be replaced if necessary. Use only Volvo Penta original locking screws (4).

4. Install one propeller blade in the propeller hub and push in the stud (1) in such a position so the groove in the stud is exactly centered in the hole for the locking screw (5). Apply thread sealant to the locking screw and tighten to 10 Nm.
5. Install the other blades in the same way. Check the blades are at the same angle to the propeller shaft and that they move easily.

A = 3-blade folding propeller (drive)
 B = 2-blade folding propeller (drive)
 C = 3-blade folding propeller (reverse)

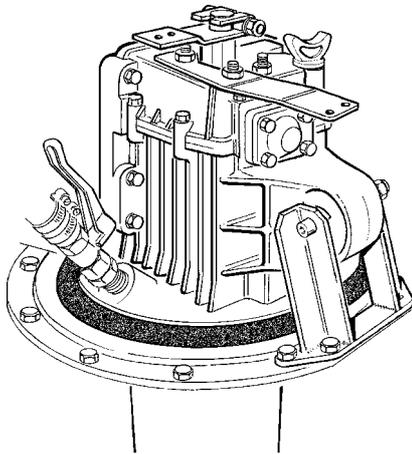


Propeller shaft seal. Reverse gear

If the boat has a Volvo Penta shaft the shaft seal must be vented and lubricated directly after launching.

Vent the bushing by pressing it together while pressing down on the shaft until water appears. Then press in approx. 1 cc **water repellent grease** into the seal.

⚠ IMPORTANT! The seal must be replaced every 500 running hours or every 5th year.



Rubber seal. S-drive

Check the rubber seal between the drive and the hull regularly for cracks and wear.

⚠ WARNING! The seal must be changed every seven years or earlier if it is defective. This work should be carried out by an authorized workshop.

Laying up and launching

Before taking the boat out of the water for winter/out-of-season storage have an authorized Volvo Penta workshop inspect the engine and other equipment.

Inhibition should be carried out to ensure that the engine and transmission are not damaged while out of commission during the winter/off-season. It is important this is done properly and that nothing is forgotten. We have therefore provided a checklist covering the most important points.

⚠ WARNING! Read the chapter on Maintenance carefully before starting work. It contains instructions on how to carry out the work safely and correctly.

Inhibiting

The following are best carried out with the boat in the water:

- Change engine oil and replace oil filter.
- Change oil in the reverse gear.
- Replace fuel filter. Replace fuel pre-filter if installed.
- Run engine to normal operating temperature.
- Take the boat out of the water:

The following should be carried out with the boat out of the water:

- Clean the hull and drive directly after taking up the boat (before it dries).

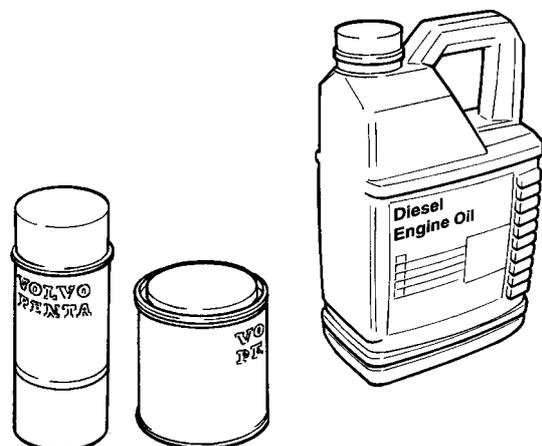
⚠ IMPORTANT! Be careful when cleaning with a high pressure water spray. Never direct the water jet at the propeller shaft seal, grommets etc.

- Change oil in the drive.
- Clean the vacuum valve and seawater filter (accessory).
- Clean and inhibit the seawater system.
- Remove the impeller from the seawater pump. Store the impeller in a sealed plastic bag in a cool place.
- Check the condition of the engine coolant anti-freeze. Top up if required.

⚠ IMPORTANT! An anti-corrosion mixture in the engine coolant system provides no protection against freezing. If there is any possibility the engine will be subjected to freezing temperatures then the system must be drained.

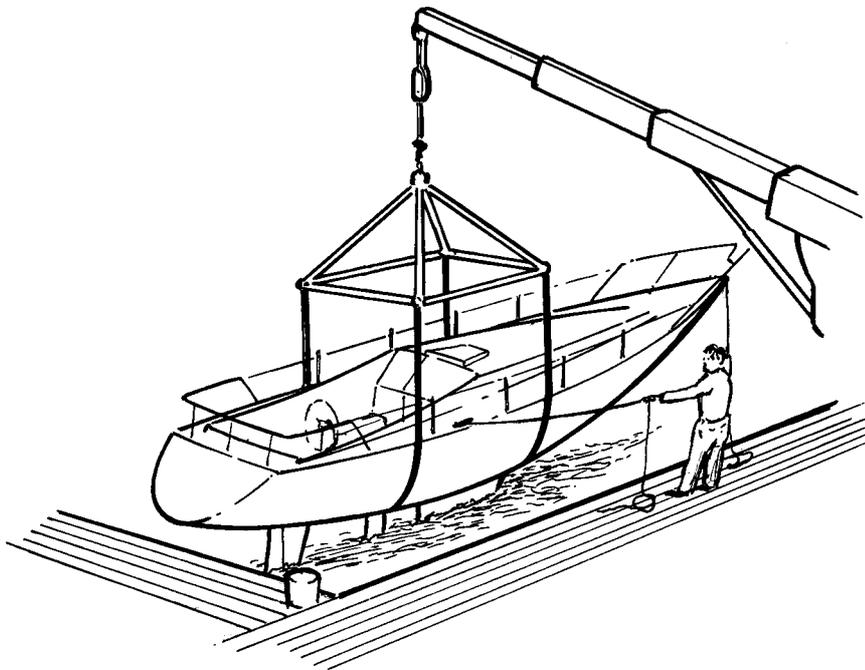
- Drain any water and contaminants from the fuel tank. Fill the tank completely with fuel to avoid condensation.

- Clean the outside of the engine. Do not use a high pressure spray to clean the engine. Touch up any damaged areas of paintwork with Volvo Penta original paint.
- Check all control cables and treat with rust inhibitor.
- Repair any damaged areas of paintwork with Volvo Penta original paint. NOTE! Read the special instructions on painting the drive under the heading: Painting the drive and underwater hull
- Disconnect battery leads. Clean and charge the batteries. NOTE! A poorly charged battery may burst as a result of freezing.
- Spray electrical system components with moisture repellent spray.
- Remove the propeller for storage. Grease the propeller shaft using water repellent grease. Disassemble folding propellers, clean and grease.
- Check the rubber seal between the drive and hull carefully.



Bringing out of storage

- Check oil level in the engine and drive/reverse gear. Top up if necessary. If there is inhibiting oil in the system drain and fill with new oil, change oil filter. For correct oil grade: See the chapter "Technical Data".
 - Drain the antifreeze from the seawater system.
 - Install the impeller in the seawater pump (replace if the old one looks worn).
 - Close/tighten drain cocks/plugs.
 - Check drive belts.
 - Check the condition of rubber hoses and tighten hose clamps.
 - Check engine coolant level and antifreeze protection. Top up if necessary.
 - Connect the fully charged batteries.
 - Paint the drive and hull: See next page.
 - Check the sacrificial anode on the drive. If there is less than 50% of the anode left it must be replaced. Clean with emery cloth just before the boat is launched.
- ⚠ IMPORTANT!** Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.
- Reinstall the propeller.
 - Launch the boat. Check for leaks.
 - Vent and lubricate the propeller shaft seal (reverse gear).
 - Start the engine. Check that there are no fuel, engine coolant or exhaust gas leaks and that all control functions are operating.



Painting the drive and underwater hull

General

Most countries have introduced legislation controlling the use of anti-fouling agents. In some cases these agents are completely forbidden for use on leisure craft. **In these cases ask your Volvo Penta dealer for advice about alternative methods.**

⚠ IMPORTANT! Find out what regulations apply to the use of anti-fouling agents.

Drive

The paintwork is part of the drive's anti-corrosion protection and it is therefore important that any paintwork damage is remedied.

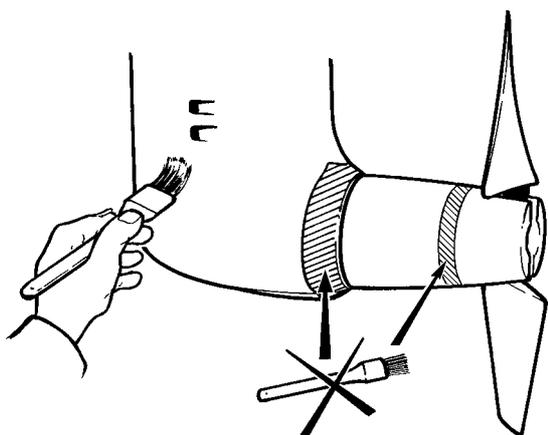
Sand down metal surfaces lightly using a 120 grade paper and a finer grade for painted surfaces. Wash off using thinners or similar. Any pores in the surface should be filled and sanded down. Paint using Volvo Penta original primer and topcoat. Let the paint dry.

The drive should be painted with Volvo Penta anti-fouling to prevent fouling. Apply according to the instructions on the packaging.

⚠ IMPORTANT! The sacrificial anodes on the drive and propeller must not be painted.

Underwater hull

Anti fouling agent containing copper oxide can increase the risk of galvanic corrosion and therefore should never be used.



Fault-tracing

A number of symptoms and possible reasons for engine problems are described in the table below. In case of faults or mishaps which you cannot solve, always contact the Volvo Penta dealership.

⚠ WARNING! Read the safety precautions for maintenance and service in the chapter: Safety Information, before starting work.

Symptoms and possible causes

Starter motor not turning or slow	1, 2, 3
Engine will not start	4, 5, 6, 7, 8, 9
Engine starts but stops again	6, 7, 8, 9
Engine difficult to start	6, 7, 8, 9
Engine does not reach correct speed at full speed	7, 8, 9, 10, 11, 12, 13, 18
Engine knocks	14
Engine runs unevenly	6, 7, 8, 9, 13, 14
Engine vibrates	18, 19
High fuel consumption	10, 11, 13, 15, 18
Black exhaust smoke	5, 13, 15, 18
Blue or white exhaust smoke	15, 25
Low oil pressure	16, 17
Engine coolant temperature too high	20, 21, 22, 23, 24
No or poor charging	2, 26

- | | | |
|-------------------------------------|--|--|
| 1. Discharged battery | 11. Fouling on underwater hull/drive/propeller | 19. Defective engine mounting |
| 2. Loose connection/open-circuit | 12. Limited speed control lever movement | 20. Too little coolant |
| 3. Fuse tripped | 13. Insufficient air supply | 21. Blocked seawater intake/pipe/filter |
| 4. Stop control pulled out | 14. Engine coolant temperature too high | 22. Circulation pump drive belt slipping |
| 5. Inadequate pre-heating | 15. Engine coolant temperature is too low | 23. Defective impeller |
| 6. Lack of fuel | 16. Lubricating oil level too low | 24. Defective/incorrect thermostat |
| 7. Fouled fuel filter | 17. Blocked fuel filter | 25. Lubricating oil level too high |
| 8. Air in the fuel injection system | 18. Defective/incorrect propeller | 26. Generator drive belt slipping |
| 9. Water/contaminants in the fuel | | |
| 10. Boat abnormally loaded | | |

Technical Data

Engine model

Engine model	D1-13	D1-20	D1-30	D2-40
Crankshaft power, kW (hp).....	9.0 (12.2)	13.8 (18.8)	20.9 (28.4)	29.1 (39.6)
Propeller shaft power, kW (hp).....	8.6 (11.8)	13.3 (18.0)	20.1 (27.3)	27.9 (38.0)

Technical data according to ISO 8655

General

After market designation	D1-13 A	D1-20 A	D1-30 A	D2-40 A
Displacement, l (in3)	0.51(31)	0.76 (46.5)	1.13 (69)	1.51 (92.1)
Number of cylinders	2	3	3	4
Bore/stroke, mm	67/72	67/72	77/81	77/81
Bore/stroke, (in.).....	(2.64/2.83)	(2.64/2.83)	(3.03/3.19)	(3.03/3.19)
Compression ratio	23.5:1	23.5:1	23.5:1	23.5:1
Engine speed, rpm	2800-3200	2800-3200	2800-3200	2800-3200
Idling speed, rpm	850 ±25	850 ±25	850 ±25	850 ±25
Rotation, viewed from in front	Clockwise	Clockwise	Clockwise	Clockwise
Max. permitted rake backwards while running	20°	20°	20°	20°
Max. list while running.....	30°	30°	30°	30°
Weight, dry engine	96 kg	118 kg	127 kg	148 kg

Cooling system

Thermostats, no.	1 screws	1 screws	1 screws	1 screws
The thermostat starts opening at.....	90° ±2°C	90° ±2°C	90° ±2°C	90° ±2°C
fully open at.....	102°C (203°F)	102°C (203°F)	102°C (203°F)	102°C (203°F)
Freshwater system capacity, approx.	2.7 litres	3.0 litres	4.0 litres	6.4 litres

Lubrication system

Oil capacity incl. oil filter, approx.:				
no engine inclination.....	1.9 litres	2.8 litres	3.5 litres	6.5 litres
Viscosity at -5° - +50°C*	SAE 15W/40, SAE 20W/50	SAE 15W/40, SAE 20W/50	SAE 15W/40, SAE 20W/50	SAE 15W/40, SAE 20W/50
Oil drain plug tightening torque	30-40 Nm	30-40 Nm	30-40 Nm	30-40 Nm

* Constant ambient air temperature

Oil grade ¹⁾	Oil change interval, reached first in operation ²⁾ :	
VDS-3 or VDS-2 and ACEA E7 ³⁾ or VDS-2 and Global DHD-1 or VDS-2 and API CH-4 or VDS-2 and API CI-4	D1-13, D1-20, D1-30	D2-40
	200 hr. or 12 months.	500 hr. or 12 months.

NOTE! Mineral based oil, either fully or semi-synthetic, can be used on condition that it complies with the quality requirements.

¹⁾ When oil quality specifications are joined by "or", either engine oil specification can be used.

When oil quality specifications are joined by "and", the engine oil must fulfill both requirements.

²⁾ If sulphur content is > 1.0% by weight, use oil with TBN > 15.

³⁾ ACEA E7 has replaced ACEA E5, but if available ACEA E5 can be used.

VDS = Volvo Drain Specification

ACEA = Association des Constructeurs Européenne d'Automobiles

API = American Petroleum Institute

TBN = Total Base Number

Globla DHD = Global Diesel Heavy Duty

Electrical system

System voltage	12 V
Fuses	15A
Battery capacity (starter battery)	70 Ah
AC generator voltage/max. current	14V/115A
output approx.	1610 W
Starter motor, output approx.	2.0 kW

Reverse gear

Type designation	MS10A-B ; MS10L-B	MS15A-B ; MS15L-B
Gear ratio	2.35:1, 2.72:1	2.14:1, 2.63:1
Angle (output shaft):		
MS10A, MS15A	8°	8°
MS10L, MS15L	0°	0°
Oil volume, approx.	0.35 liters (0.09 US gals)	0.56 liters (0.15 US gals)
Oil grade	ATF (Dexron II, III)	ATF (Dexron II, III)
Weight	11 kg (24 lbs)	16 kg (35 lbs)

Sailing boat drive

Type designation	130S-B, 130SR-B
Gear ratio	2.19:1
Oil volume, approx.	2.9 liters (0.77 US gals)
Oil grade	ATF (Dexron II, III)
Weight	26.5 kg (58 lbs)
Tightening torque:	
oil drain plug	10 ±5 Nm (7.4 ±3.7 lbf.ft)

Fuel specification

Fuel must meet national and international standards at least. For example:

EN 590 (with national environmental and cold standards)

ASTM D 975 No 1-D and 2-D

JIS KK 2204

Sulphur content: According to statutory requirements.

Fuels with low density (“urban diesel” in Sweden and “city diesel” in Finland) can cause a drop in output of 5% and an increase in fuel consumption of 2–3%.