

OPERATOR'S MANUAL

D1, D2

**VOLVO
PENTA**

CALIFORNIA PROPOSITION 65 WARNING

Engine exhaust, some of its constituents, and a broad range of engine parts are known to the State of California to cause cancer, birth defects, and other reproductive harm. Additionally, lubricants, fuels, and other fluids used in engines—including any waste created through the wearing of engine parts—contain or produce chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

Battery posts, terminals, and related accessories contain lead and lead compounds. Wash your hands after handling. Used engine oil contains chemicals that have caused cancer in laboratory animals. Always protect your skin by washing thoroughly with soap and water.

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Foreword

Volvo Penta marine engines are used all over the world. They are used in all possible operating conditions for professional as well as leisure purposes. This is not a coincidence. After 100 years as an engine manufacturer the Volvo Penta name has become a symbol of reliability, technical innovation, top of the range performance and long service life. We also believe that this is what you demand and expect of your Volvo Penta engine.

We would like you to read this operator's manual thoroughly and consider the advice we give on running and maintenance before your maiden voyage so that you will be ensured of fulfilling your expectations. Please pay attention to the safety instructions contained in the manual.

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

You will find your closest dealer at our home page on the Internet www.volvopenta.com - amongst other useful information about your Volvo Penta engine - we invite you to visit!

Safety Information

Read this chapter very carefully. It has to do with your safety. This describes how safety information is presented in the operator's manual and on the product. It also gives you an introduction to the basic safety rules for using and looking after the engine.

Check that you have received the correct operator's manual before you read on. If not, please contact your Volvo Penta dealer.



This symbol is used in the operator's manual and on the product, to call your attention to the fact that this is safety information. Always read such information very carefully.

Safety texts in the operator's manual have the following order of priority:



DANGER!

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



WARNING!

Indicates a hazardous situation which, if not avoided, could result in death or serious personal injury.



CAUTION!

Indicates a hazardous situation which, if not avoided, could result in minor or moderate personal injury.

IMPORTANT!

Indicates a situation which, if not avoided, could result in property damage.

NOTICE! Used to draw attention to important information that will facilitate work or operations.



This symbol is used on our products in some cases and refers to important information in the operator's manual. Make sure that warning and information symbols on the engine are clearly visible and legible. Replace symbols which have been damaged or painted over.

Your new boat

Read the instruction books and other information carefully, which came with your new boat. Learn to handle the engine, controls and other equipment in a safe and correct manner.

If this is your first boat, or a type of boat you are not experienced in using, we recommend that you practice operating the boat in peace and quiet. Get to know the way the boat reacts to sea and to the controls under different speed, sea and loading conditions before you cast off for your first "real" maiden voyage. Remember that the captain of every boat is required by law to know and to observe applicable rules for traffic and safety at sea. Get to know the rules which apply to you and your waters, by contacting the relevant authority or sea safety organization.

It is a good idea to go on some kind of boat operation course. We recommend that you contact a regional boat or sea safety organization to find a suitable course.

Daily checks

Make it a habit to give the engine and engine bay a visual check before driving (before starting the engine) and after operation (when you have stopped the engine). This helps you to quickly discover whether any leakage of fuel, coolant, oil or any other abnormal event has happened, or is about to happen.

Manoeuvring

Avoid sudden or surprising rudder movements and gear shifting. There is a risk that passengers could fall over, or overboard.

A rotating propeller can cause severe injury. Check that there is nobody in the water before you engage forward / astern (reverse) drive. Never drive close to bathers or in areas where you could reasonably expect that people could be in the water.

Fuel filling

There is always a risk of fire and explosion during fuel filling. Smoking is not permissible, and the engine should be stopped.

Never over-fill the tank. Shut the tank cap securely. Only use the fuel recommended in the instruction book. The wrong grade of fuel can cause serious malfunctions, power loss or stop the engine.

Do not start the engine

Do not start the engine if you suspect a fuel or LPG leak in the boat, close to explosive media, or if there is a spillage of explosive media. An explosive environment entails a risk of fire and/or explosion.

Accidents and near misses

Life saving statistics show that inadequate care of boats and engines, and deficiencies in safety equipment are frequent causes of accidents and near misses at sea.

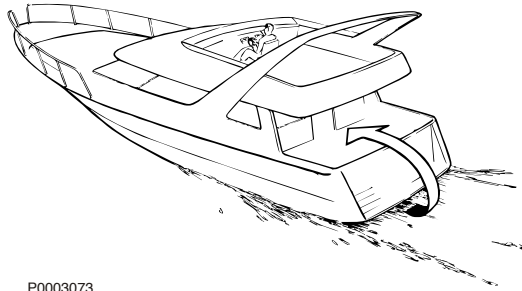
Make sure that your boat and engine are maintained in accordance with the advice in each instruction book, and that the necessary safety equipment is on board, and is in working condition.

Carbon monoxide poisoning

When a boat moves forwards, an area of low pressure air forms behind the boat. In adverse conditions, this low pressure can be so strong that the boat's own exhaust fumes are sucked into the cockpit or cabin, which entails a risk of carbon monoxide poisoning for all aboard.

The problem of low-pressure suction is worst in high, wide boats with a square transom. But even in other types of boats, low-pressure suction can be a problem in some conditions, such as if you drive with the hood up. Other factors which increase the low-pressure effect are wind conditions, load distribution, pitching, trimming, open windows and ventilators etc.

Most modern boats are designed so that the problem of low-pressure suction is very rare, however. If low-pressure suction does occur anyway, do not open hatches or ventilators in the forward part of the boat. Strangely enough, this makes the problem worse. Try changing speed, trimming or load distribution instead. Also try taking down/opening the hood or modifying it in some other manner. Ask your boat dealer for advice about the best solution for your particular boat.



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Remember

- Safety equipment: Life jackets for everybody aboard, communication equipment, emergency rockets, approved fire extinguisher, first aid kit, life buoy, anchor, paddle, torches etc.
- Spare parts and tools: Impeller, fuel filters, fuses, tape, hose clamps, engine oil, propeller and tools for the jobs you could be expected to have to do.
- Take your chart out and study your planned route. Calculate distance and fuel consumption. Listen to weather reports.
- Tell your friends/relatives about route plans if you undertake a long journey. Remember to notify changed plans or delays.
- Inform everybody aboard about where the safety equipment is located, and how it works. Make sure that there is more than one person aboard who can start and operate the boat safely.

This list can be extended, since the need for safety equipment varies with the type of boat, and where or how it is used etc. We recommend that you ask a regional boat or sea safety organization for more detailed maritime safety information.

Preparations

Knowledge

The operator's manual contains instructions on how to carry out general maintenance and service operations safely and correctly. Read the instructions carefully before starting work.

Service literature covering more complicated operations is available from your Volvo Penta dealer.

Never carry out any work on the engine if you are unsure of how it should be done, contact your Volvo Penta dealer who will be glad to offer assistance.

Stop the engine

Stop the engine before opening or removing engine hatches. Unless otherwise specified all maintenance and service must be carried out with the engine stopped.

To prevent accidental start of the boat engine, remove the ignition key, turn off the power supply to the engine at the main switches and lock them in the OFF position before starting work. Put up a warning sign in the control position that work on the engine is being carried out.

Approaching or working on an engine which is running is a safety risk. Loose clothing, hair, fingers or a dropped tool can be caught in the rotating parts of the engine and cause serious personal injury. Volvo Penta recommend that all servicing with the engine running should be undertaken by an authorized Volvo Penta workshop.

Lifting the engine

When lifting the engine, use the lifting eyes installed on the engine (reverse gear where installed). Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine (engine weight including reverse gear and any extra equipment installed). For safety's sake lift the engine using an adjustable lifting beam. All chains and cables should run parallel to each other and as perpendicular as possible in relation to the top of the engine. Bear in mind that extra equipment installed on the engine may alter its center of gravity. Special lifting equipment may then be required in order to maintain the correct balance and make the engine safe to handle. Never carry out work on an engine suspended on a hoist.

Before starting the engine

Reinstall all protective parts removed during service operations before starting the engine. Check that no tools or other items have been left on the engine.

Never start a turbocharged engine without installing the air cleaner (ACL). The rotating compressor in the Turbocharger unit can cause serious personal injury. Foreign objects can also be sucked in and cause mechanical damage to the unit.

Fire and explosion

Fuel and lubrication oil

All fuel, most lubricants and many chemicals are inflammable. Read and follow the instructions on the packaging.

When carrying out work on the fuel system, make sure the engine is cold. A fuel spill onto a hot surface or electrical components can cause a fire.

Store fuel soaked rags and other flammable material so that there is no danger of them catching fire. Fuel-soaked rags can self-ignite under certain conditions.

Do not smoke when filling fuel, oil or in proximity of a filling station or in the engine room.

Non-original components

Components used in the fuel and electrical systems on Volvo Penta products are designed and constructed to minimize the risk of fire and explosion.

Using spare parts other than by Volvo Penta approved spare parts can result in fire or explosion on board.

Batteries

The batteries contain and emit oxyhydrogen gas, especially during charging. This gas is easily ignited and highly volatile.

Do not under any circumstances smoke or use naked flame or allow sparks in the vicinity of the batteries or battery compartment.

An incorrect connection of a battery terminal cable or jump-start cable can cause a spark which in its turn can be sufficient to cause an explosion.

Start spray

Never use start spray or similar agents to start an engine equipped with air pre-heating (glow plugs/ starter element). This may cause an explosion in the inlet manifold. Danger of personal injury.

Hot surfaces and fluids

There is always a risk of burns when working with a hot engine. Beware of hot surfaces. For example: the exhaust pipe, turbo unit, oil pan, charge air pipe, starter element, hot coolant and hot oil in oil lines and hoses.

Carbon monoxide poisoning

Only start the engine in a well-ventilated area. If operating the engine in an enclosed space, ensure that there is proper ventilation in order to remove exhaust gases and crankcase ventilation emissions from the working area.

Chemicals

Most chemicals such as anti-freeze, rustproofing agent, inhibiting oil, degreasing agent etc. are hazardous to health. Read and follow the instructions on the packaging.

Some chemicals such as inhibiting oil are inflammable and dangerous if breathed in as well. Ensure good ventilation and use a protective mask when spraying. Read and follow the instructions on the packaging.

Store chemicals and other hazardous materials out of the reach of children. To protect the environment, please dispose of used or leftover chemicals at a properly designated disposal site for destruction.

Cooling system

There is a risk of flooding when working on the seawater system. Turn off the engine and close the sea cock (where installed) before starting work on the system.

Avoid opening the coolant filler cap when the engine is hot. Steam or hot coolant can spray out and cause burns.

If work must be carried out with the engine at operating temperature and the coolant filler cap or a cock open or a coolant hose disconnected, open the coolant filler cap carefully and slowly to release pressure before removing the cap completely. Note that the coolant may still be hot and can cause burns.

Lubrication system

Hot oil can cause burns. Avoid skin contact with hot oil. Ensure that the lubrication system is not under pressure before commencing work on it. Never start or operate the engine with the oil filler cap removed, oil can spray out.

Fuel system

Always use protective gloves when tracing leaks. Liquids ejected under pressure can penetrate body tissue and cause serious injury. There is a danger of blood poisoning.

Always cover the generator if it is located under the fuel filter. The generator can be damaged by spilled fuel.

Electronic Vessel Control (EVC)

The boat has a advanced control system. Never cut or modify connectors, wiring or splice of the components.

Installing non Volvo Penta components may cause the system to malfunction.

Service must be done by approved workshops.

Electrical system

Cutting off power

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.

Batteries

The batteries contain an extremely corrosive electrolyte. 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.

Introduction

This Operator's Manual has been prepared to give you the greatest possible benefit from your Volvo Penta marine engine. It contains the information you need to be able to operate and maintain the engine safely and correctly. Please read the Operator's Manual carefully and learn to handle the engine, controls and other equipment in a safe manner before you cast off on your maiden voyage.

Always have the Operator's Manual available. Store it safely and do not forget to hand it over to the next owner if you sell your boat.

The Operator's Manual describes the engine and equipment sold by Volvo Penta. The illustrations in this book covers several varieties and might differ, the essential information is always correct though. Installations with e.g. different controls and instrumentation might occur, in these cases we refer to this products manual.

Warranty

Your new Volvo Penta marine engine is covered by a limited warranty, under the conditions compiled in the Warranty book.

Please note that AB Volvo Penta's liability is limited to the specification in the Warranty book. Read it carefully, as soon as possible after delivery. It includes important information about warranty cards, service, maintenance, which it is the responsibility of the owner to know, check and carry out. If this is not done, AB Volvo Penta may fully or partly refuse to honour its warranty undertakings.

Please contact your Volvo Penta dealer if you have not received a Warrant book, a Service book or a customer copy of the warranty card.

Environmental care

All of us want to live in a clean, healthy environment. Where we can breathe clean air, see healthy trees, have clean water in lakes and seas, and be able to enjoy the sunlight without fearing for our health. Unfortunately, this is not self-evident these days, it is something all of us must work hard for.

As a manufacturer of marine engines, Volvo Penta has particular responsibility and for this reason, environmental care is a core value in our product development. Volvo Penta has a wide engine programme these days, where considerable progress has been made in reducing exhaust fumes, fuel consumption, engine noise etc.

We hope that you will be want to preserve these values. Always observe the advice in the Operator's Manual about fuel grades, operation and maintenance, to avoid unnecessary environmental impact. Please contact your Volvo Penta dealer if you notice any changes such as increased fuel consumption or increased exhaust smoke.

Moderate your speed and distance so that wake and noise do not disturb or damage animal life, moored boats, jetties etc. Leave the archipelago and harbours in the same state you would like to find them. Remember to always hand in drained oil, coolant, paint and wash residue, used batteries etc. for destruction at a recycling station.

If we all pull together, we can make a valuable contribution to the environment together.

Running in

The engine must be "run in" during its first 10 hours, as follows:

Use the engine in normal operation. Full load should only be applied for short periods. Never run the engine for a long period of time at constant speed during this period.

Higher oil consumption is normal during the running in period. For this reason, check the oil level more frequently than normally recommended.

After the first period of operation, the specified warranty inspection "First service inspection" can be done. For more information: Please refer to the Maintenance Schedule.

Fuel, oils and coolant

Only use the fuels and oils recommended in the Operator's Manual. Other grades can cause malfunctions, increased fuel consumption and eventually even shorten the life of the engine.

Always change the oil, oil filters and fuel filter at the specified intervals.

Future warranty claims related to engine and accessories may be refused if an unsuitable coolant has been used, or if the instructions for coolant mixture have not been followed.

Service and spare parts

Volvo Penta marine engines are designed for high reliability and long life. They are built to withstand a marine environment, but also to have the smallest possible environmental impact. Through regular service and use of by Volvo Penta approved spare parts, these qualities are retained.

Volvo Penta's world-wide network of authorised dealers is at your service. They are Volvo Penta product specialists, and have the accessories, original spares, test equipment and special tools needed for high quality service and repair work.

Always observe the maintenance intervals in the Operator's manual, and remember to note the engine/transmission identification number when you order service and spare parts.

Certified engines

If you own or operate an emission certified engine it is important to be aware of the following:

Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines made of the same type are equivalent to the certified engine.

This makes special demands on the care and maintenance you give your engine, as follows:

- Maintenance and service intervals recommended by Volvo Penta must be complied with.
- Only Volvo Penta original spares may be used.
- Service on injection pumps, pump settings and injectors must always be done by an authorised Volvo Penta workshop.
- The engine must not be converted or modified, except for the accessories and service kits which Volvo Penta has approved for the engine.
- Installation changes to the exhaust pipe and engine air inlet ducts must not be done.
- No seals may be broken by unauthorised personnel.

The general advice in the Operator's manual about operation, care and maintenance apply.

Late or inadequate maintenance/service or the use of spare parts not approved by Volvo Penta will invalidate AB Volvo Penta's responsibility for the engine specification being in accordance with the certificated variant.

Volvo Penta accepts no responsibility or liability for any damage or costs arising due to the above.

Instruments and Controls

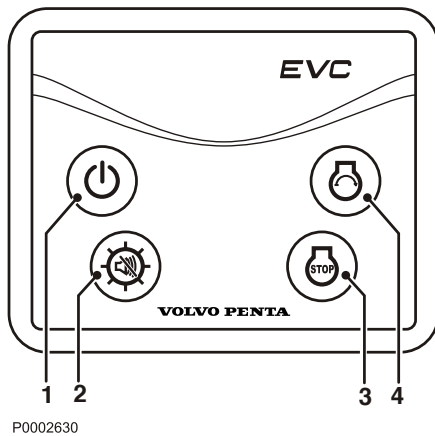
This chapter describes the instruments, panels and controls Volvo Penta sells for your engine. If you would like to complement your instrumentation, or if your boat is equipped with instruments not described here, we ask that you contact your Volvo Penta dealer.

Ignition Lock

The system lacks a start lock. Therefore, the helm station should be lockable, or alternatively a lockable main switch should be fitted, to prevent unauthorized engine start.

Start/Stop Panel

Control Panel



On/Off button (1)

Depress the button to start or stop the system. The panel cannot be switched off when the engine is running.

Start button (4)

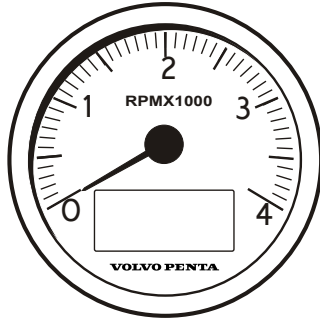
When the button is depressed the pre-heat function is activated and the start motor engaged.

Multi-function button (2)

- Confirm the alarm. If an alarm occurs, a flashing warning symbol will be displayed in the tachometer window and an audible alarm will sound. The alarm is confirmed by depressing the multi-function button. The audible alarm is silenced and the warning symbol is lit continuously until the fault is remedied.
- Backlighting. To switch tachometer window backlighting on or off, depress the button for 1 - 5 seconds. The backlighting can be adjusted in five steps by depressing the button for less than 1 second.
- Adjust the tachometer window contrast by holding down the button for more than 5 seconds.

Stop button (3)

The engine stops running when the button is depressed.



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Gauges

Tachometer

The tachometer shows engine speed; multiply the value shown on the dial by 1,000 to get the number of engine revolutions per minute.

Operating information is displayed in the tachometer window.

Operating information symbols

1 Pre-heating

The pre-heat symbol is displayed when the glow function is active.

2 Starting

The start symbol is displayed when the start motor is engaged.

3 Stopping

The stop symbol is shown when the stop button is depressed.

4 Fuel level

If a fuel level sensor is installed (accessory) the fuel level symbol is displayed when there is around 20% of fuel remaining in the tank.

The engine must run for at least one minute before the function is activated.

5 System fault

The system fault symbol lights up in the case of short circuits or cable breaks.

6 Auxiliary alarm

Auxiliary alarm for accessory sensors.

7 Coolant temperature

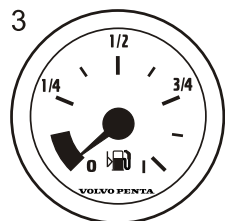
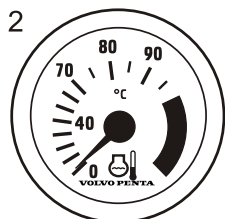
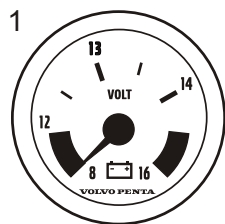
The coolant temperature symbol lights up if the engine coolant temperature is too high.

8 Oil pressure

If the oil pressure lamp lights up during operations, the engine oil pressure is too low.

9 Charging

The charging lamp lights up if the alternator stops charging.



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Optional instruments

These instruments are sold as engine accessories by Volvo Penta.

1 Voltmeter, battery charging

The meter shows the alternator charge current. During operations the charge voltage must be around 14 V. When the engine is stopped and electrical power switched on, battery voltage is around 12 V.

2 Coolant temperature gauge

The instrument shows engine coolant temperature. During operations coolant temperature must normally be between 75-95°C (167-203°F).

3 Fuel level gauge

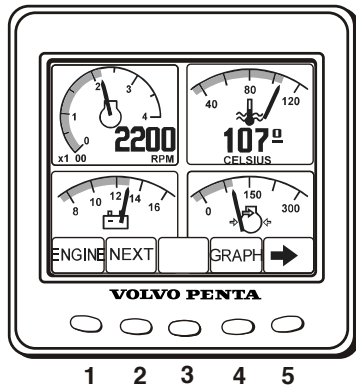
The fuel level gauge shows the quantity of remaining fuel.

4 Alarm monitor

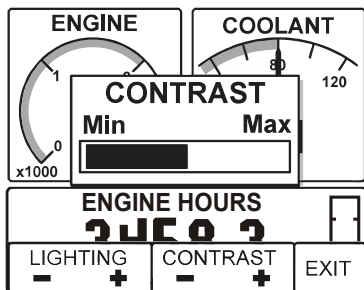
The alarm monitor gives a visual warning to call attention to any alarms that occur.



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EVC System Display

It is possible to present several windows with different operational information in the EVC system display. The various screens are selected using the instrument buttons.

Before the display is put to use certain settings must be entered in the configuration menu; refer to *Configuration menu*.

It is also possible to bring up a menu identical to that shown in the tachometer display by navigating to System information in the *Configuration menu*, or by depressing button 2; refer to *Multi, button 2*.

A self-test is performed at start; the display will emit a constant audible signal if a fault is detected. The display will continue to function, but may behave in unexpected ways.

Only installed functions are shown in the display.

Screens

Depress any of the buttons 1 to 4 to bring up the function menu for the buttons on the lower part of the display.

Buttons 1, 2 and 4 provide different screens.

Button 1 – Engine

Button 2 – Multi

Button 4 – Graph

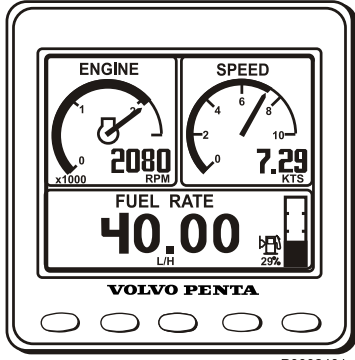
Use button 5 to adjust contrast and to access the configuration menu for display settings; refer to *Configuration menu*.

Exit the menu by waiting a few seconds or by depressing button 5 (EXIT).

Contrast

The display has five contrast settings. Depress button 5 (far right) and change the contrast by depressing + (button 4) or – (button 3).

Store the setting by depressing EXIT (button 5).

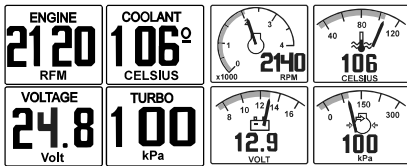


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Engine, button 1

Engine revolutions and speed are shown in the upper part of the window. Operating hours are displayed in the lower part, along with a fuel level indicator if this function is installed.

If speed information is lacking, coolant temperature will be shown instead.

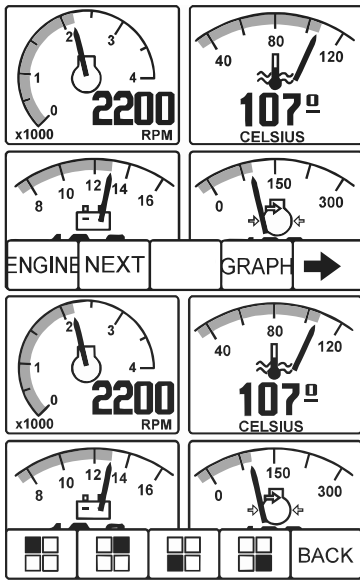


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Multi, button 2

Operational information is displayed in four analog or digital windows in the multi screen. The display can either show several windows, or be divided so that the lower part shows System information. To switch between the different screens depress button 2 repeatedly.

If the selected information is lacking, the symbol “—” will be displayed: for analog instruments the dial will be absent.

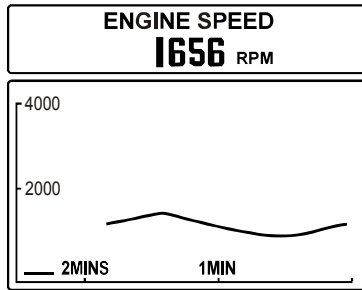


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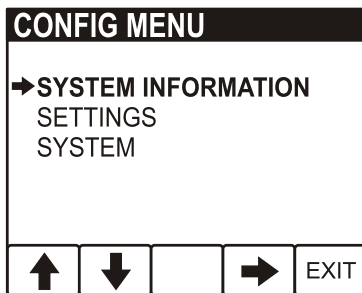
Selecting screens

Depress the right arrow (button 5) to select the information to be displayed in each respective window. Then repeatedly depress the button that corresponds to the window to be set until the desired information is shown.

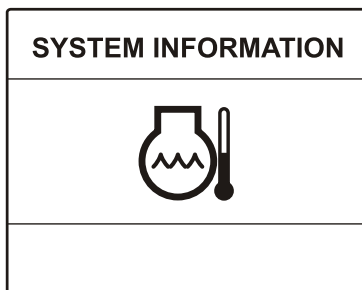
The type of information accessible depends on the type of electrical system and sensors the boat is equipped with.



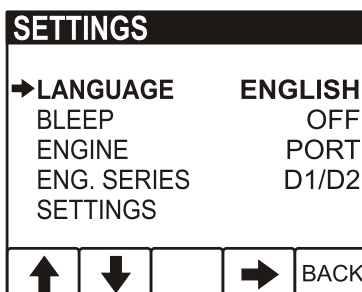
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Graph, button 4

This screen displays operational information in the form of graphs. Depress button 4 repeatedly to select the information to be displayed. To set the time interval, refer to *Configuration menu*.

If contact with the system is lost, a straight line will proceed across the screen.

Configuration menu

Open the Configuration menu by holding down button 5 for at least 3 seconds. In this screen it is possible to retrieve System information, enter various display settings, calibrate depth compensation and speed and retrieve other system information.

Engine ignition must be switched on when changing display settings or calibrating functions.

Navigate through the menu using the up and down arrows, and select using the right arrow.

System Information

This screen shows the same information as that shown in the tachometer display; refer to *Instruments and Controls page 11* for further information.

Alarm

When the system detects a fault, the display automatically switches to the System Information screen. For further information, refer to *Fault Handling page 25*.

Settings

Language: setting the display language.

Bleep: setting button bleep On or Off.

Engine: setting the installation the display forms part of, and the engine to be shown in the display (single, port, starboard or twin).

Eng. series: setting the engine series for the display (D1/D2, <D2). The display is factory set for engines larger than D1/D2, therefore the display must be re-set before it can be used on D1/D2 engines.

Display: setting speed indicator and tachometer intervals.

- Rpm intervals, 2500–9000 rpm in 500 rpm stages. Set 4000 rpm.
- Speed, on/off.
- Speed intervals, 10–100 knots in 10 knot stages.
- Graph intervals: 2 min, 10 min, 30 min, 60 min, 2 h, 4 h or 8 h.
- Speed (Speed): KNOTS, MPH, KM/H

UNITS	
SPEED	KM/H
→DISTANCE	KM
OIL PRESSURE	kPa
TURBO PRESSURE	kPa
FUEL RATE	L/H
↑	↓
→	BACK

P0002409

Units: Selection of operational information units to be shown (this menu is only displayed if “Local” is selected in the settings menu: “Local” must always be selected for D1/D2 engines).

- Distance: NM, MILE, KM
- Oil pressure/Turbo pressure: kPa, psi
- Fuel rate: L/H, GAL/H, IGAL/H
- Temperature: °C, °F

DEPTH OFFSET	
DEPTH DATA	6.6M
OFFSET	-0.6M
DISPLAY	6.0M
↑	↓
→	BACK

P0003002

Calibration: the engine must be switched on during calibration.

Depth compensation

Setting the Volvo Penta echo sounder. The echo-sounder can be installed anywhere between the waterline and the boat's deepest point. Set the deviation – off set – so that the display value shows one of these points. To adjust the value up (+), set the distance between the echo-sounder and the waterline; to adjust the value down (–), set the distance between the echo-sounder and the boat's deepest point. The value can be set in 0.1 unit stages.

Store the set value by depressing BACK (button 5).

SPEED CALIBRATION	
SPEED DATA	6.6 kts
CALIBRATION	x0.90
DISPLAY	6.0 kts
–	+
→	BACK

P0003005

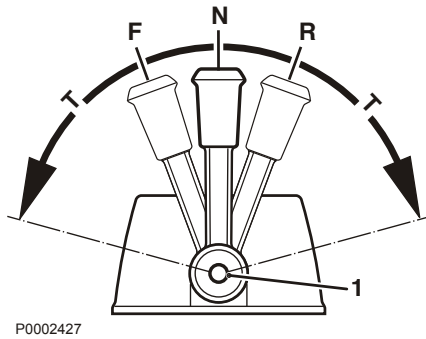
Speed factor

The speed factor must be set while the boat is under way. Compare the displayed boat speed value with GPS data (or another boat) and adjust the speed factor until the values agree.

The speed sensor calibration value can be adjusted upwards (+) or downwards (–) in stages of 0.01 units (+ or – 1%). Store the adjusted value by depressing BACK (button 5).

Controls

This section describes the controls Volvo Penta sells for your engine. Contact your dealer if your boat is equipped with controls other than those described here, and you feel uncertain about their function.



Maneuvering

A single-lever control operates both gearshift and throttle functions from the same lever.

The engine can only be started with the control lever in the neutral position.

- N** = Neutral position. Reverse gear/drive disengaged and engine at idle.
- F** = Reverse gear/drive engaged for movement ahead.
- R** = Reverse gear/drive engaged for movement astern.
- T** = Engine rpm control (throttle).

Disconnecting the gearshift function

The gearshift function can be disconnected so that the control lever only operates the throttle.

- 1 Put the control lever in neutral (N).
- 2 Depress the neutral button (1), and keep it depressed at the same time as the lever is moved forward.
- 3 Release the neutral button, the shift function is disengaged and the lever only influences engine revolutions.

The gear shift function is reconnected automatically when the lever is returned to the neutral position.

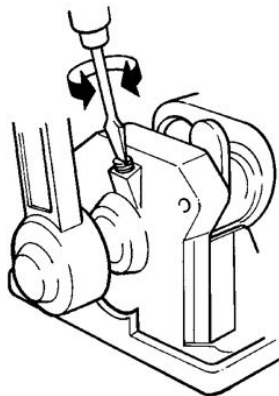
CAUTION!

Take care not to engage the gear by mistake.

Adjusting the friction brake

The lever is fitted with a friction brake to allow adjustment for easier or stiffer movement as required. The friction brake only affects movement of the throttle control lever.

- 1 Lift away the cover from the control. On side-mounted controls the lever must be removed first.
- 2 Move the lever to the half throttle/astern position.
- 3 Adjust the friction brake by turning the screw clockwise (+) for stiffer lever movement, and counter-clockwise (-) for easier movement.
- 4 Replace the cover and the lever.



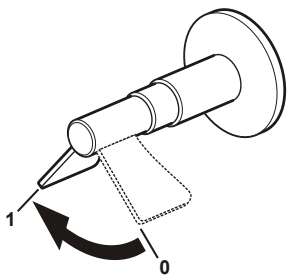
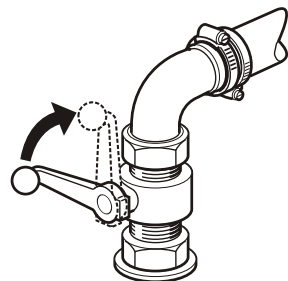
Starting

Make a habit of visually checking the engine, engine bay and transmission before start. This will help you to discover quickly if anything abnormal has happened, or is about to happen. Also check that instruments and warning displays show normal values when you have started the engine.

To minimize cold start smoke we recommend the installation of an engine heater or engine bay heater if temperatures below +5°C (41°F) are encountered.

WARNING!

Never use start spray or similar products as starting aid. Explosion risk!



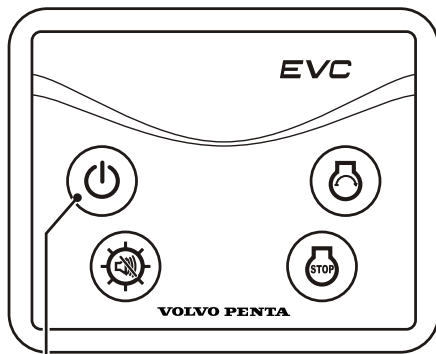
P0005851

Before Starting

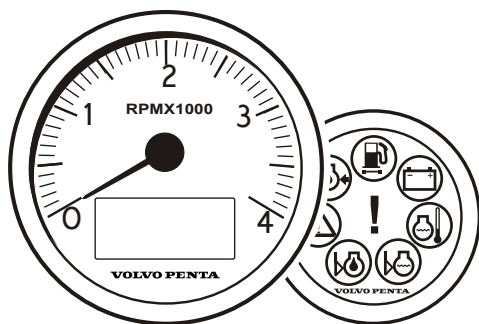
- Check the engine and transmission oil levels.
- Check coolant level.
- Open the sea cock.
- Open the fuel cock.
- Turn the main switch(es) on.
IMPORTANT!
Never disconnect the current with the main switches when the engine is running. The alternator and electronics could be damaged.
- Start the engine bay fan, where fitted, and allow it to run for at least four minutes.
- Check that there is sufficient fuel for the planned trip.

Starting the Engine

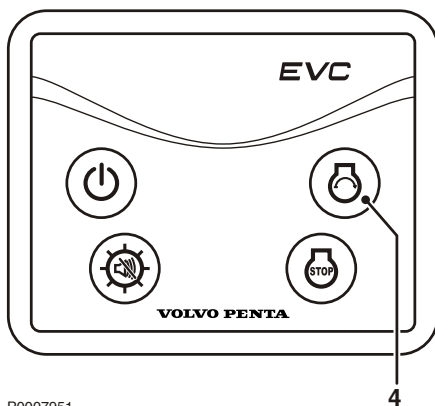
Activate the control panel by depressing the on/off button (1). The Volvo Penta logo is displayed in the window. Two audible signals are sounded to indicate the system is ready and that the engine may be started.



P0007529



P0008437



P0007951

Check the tachometer

If an operational fault occurs an audible alarm will sound and a symbol will flash in the tachometer window. Refer to the *Fault Handling page 25* chapter for more detailed information and recommended actions.

Check the alarm instrument (accessory).

The lamps in the alarm instrument light up each time the ignition is turned on. Check that all lamps light up and then extinguish. If any lamp flashes, a fault has been registered; refer to the *Fault Handling page 25* chapter for more detailed information and recommended actions.

Start the engine

Press the start button (4). Release the start button as soon as the engine starts.

The pre-heating symbol is displayed in the tachometer window. Pre-heating is automatic and lasts for 20 seconds.

Pre-heating only takes place if engine temperature is below 50° (122° F).

Pre-heating may be activated before the engine is started by depressing the start button (4) for a short moment. Pre-heating will continue for 20 seconds. The pre-heating symbol is displayed in the tachometer window.

Read off the instruments and warm up the engine

Allow the engine to idle for the first 10 seconds. Read off the instruments and check that they show normal values. Check that no warning lamps are flashing. If any lamp flashes, a fault has been registered; refer to the *Fault Handling page 25* chapter for more detailed information and recommended actions.

Warm up the engine at low speed and low load, so that normal working temperature is reached before full power is applied.

Operation

Learn to handle the engine, controls and other equipment in a safe and proper manner before casting off on your maiden voyage. Remember to avoid sudden and extreme rudder maneuvers and gear shifts. There is a risk for passengers and crew falling over or falling 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.

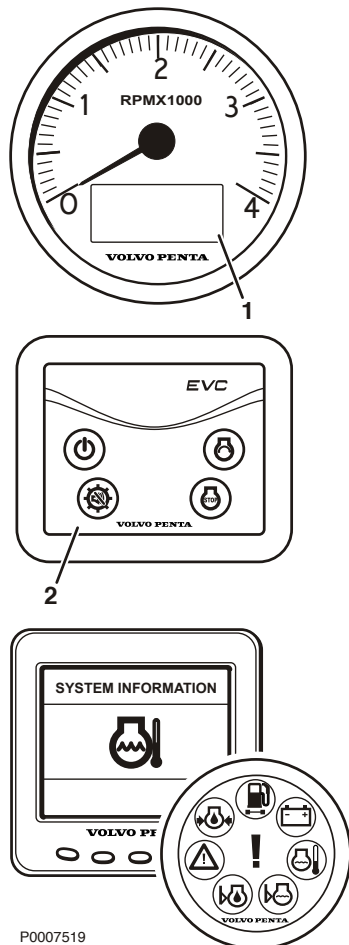
Reading the Instruments

Read off the instruments and alarm display immediately after start, and then regularly during operation.

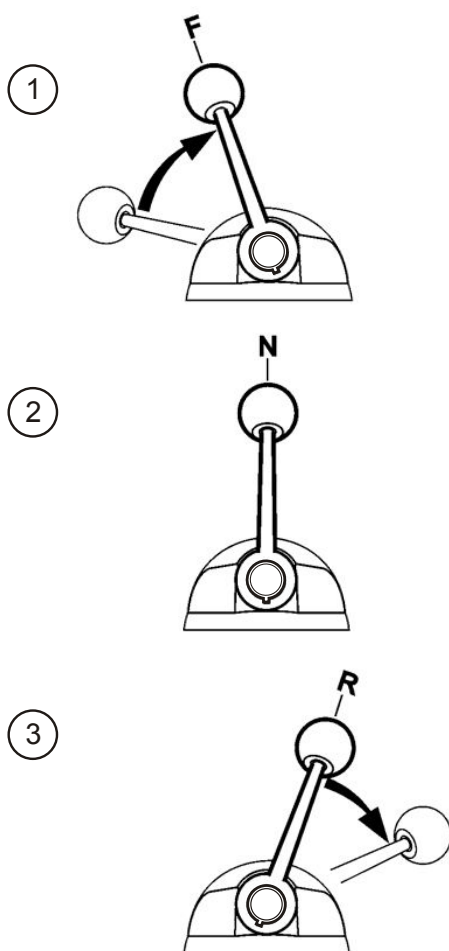
Alarms

If an alarm is tripped, an audible alarm will sound and a symbol will flash in the tachometer window (1). If optional equipment such as alarm instruments or an EVC display are installed, the relevant warning lamp will flash there also.

- 1 Reduce engine speed to idle.
- 2 Cancel the alarm by depressing the multi-function button (2).
The audible alarm will be silenced. The symbol will be lit continuously until the fault is remedied
- 3 Take the necessary action: refer to the *Fault Handling* page 25 section.



P0007519



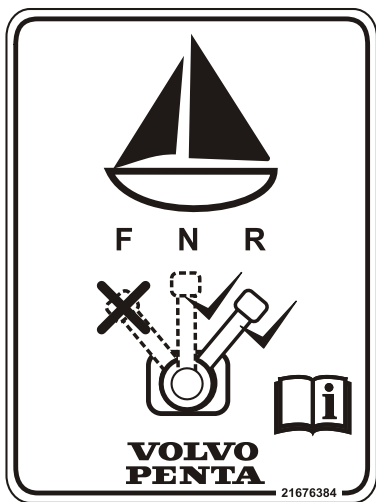
P0005856

Maneuvering

Shifting between ahead and astern must be done at idle revolutions. Shifting at higher revolutions can be uncomfortable for those on board and cause unnecessary stress to the transmission or make the engine stall.

Always shift between ahead and astern in the following manner:

- 1 Reduce engine revolutions to idle and allow the boat to lose most of its speed.
- 2 Move the control lever to the neutral position with a quick, firm movement. Pause a moment.
- 3 Move the control lever back with a quick, firm movement and increase revolutions.



P0014764

Sailing

When sailing, set the control lever to astern if a folding propeller is fitted.

If a fixed propeller is fitted the control lever should be set in neutral or reverse. When using a fixed propeller and sailing with the control lever set to reverse the speed is slowed down though less noise is being made.

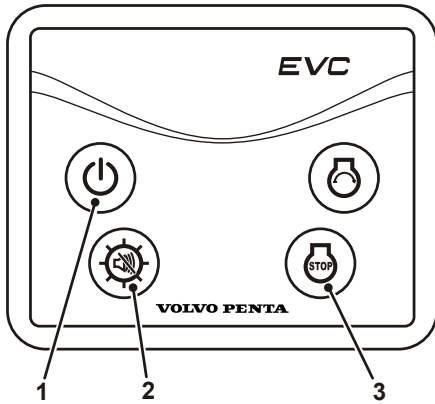
Cruising Speed

Avoid operations at full throttle for best fuel economy. We recommend a cruising speed that is around 500-1000 rpm below the maximum rpm at top speed (full throttle).

Depending on the type of hull, choice of propeller, load and sea state etc., maximum revolutions at top speed may vary, but should be within the full throttle range; refer to the *Engines* section.

Engine Shutdown

Allow the engine to run at low idle, in neutral, for a few minutes after operations are completed. In this way after-boiling is avoided at the same time as temperature equalization takes place. This is especially important when the engine has been run under heavy load at high rpm .



P0014272

Stop the Engine

Press the Stop button (3) until the engine stops running.
Press the On/Off button (1) to cut the power to the system.

If the engine is stopped and the ignition still turned on, an alarm sounds after 10 seconds to prevent the ignition is left on unintentionally and the battery will become discharged.

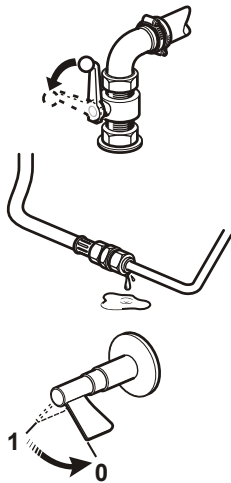
Silence the alarm by turning the ignition off, or reset the alarm with the multifunction button (2) if the ignition is to be turned on.

Auxiliary stop

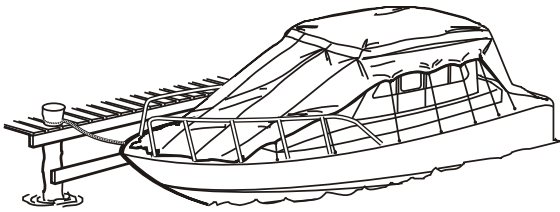
If the engine cannot be stopped in a normal procedure, it is possible to stop the engine via the auxiliary stop mounted on the side of the engine.

After Engine Shutdown

- Check the engine and engine bay for leakages.
- Close the fuel tap.
- Close the sea cock where fitted.
- Take an hour meter reading and carry out preventive maintenance according to the maintenance schedule.
- Turn off the main switch before any long stoppage.



P0005914



P0002451

Operation break with the boat in water

If the boat is not used, but left in the water, the engine must be warmed up at least once every fortnight. This prevents corrosion damage in the engine. If you expect the boat to be unused for two months or more, it must be laid up, please refer to *Storage page 64*

Operation break with the boat out of water

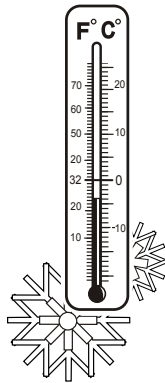
Where boats are kept laid up on land when not in use, there is a lower level of galvanic corrosion protection due to oxidation on the sacrificial anodes. Before launching the boat the sacrificial anodes on the drive and shield must be cleaned with emery paper to remove any oxidation. If you expect the boat to be unused for two months or more, it must be laid up, please refer to *Storage page 64*.

IMPORTANT!

Use emery paper. Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.

Cold Weather Precautions

If the engine bay cannot be kept frost free, the raw water system must be drained and the freshwater system coolant must have sufficient frost protection to prevent frost bursting; refer to *Seawater System, Draining page 48* and *Maintenance page 43* respectively for more detailed information. Check the charge status of the battery. A poorly-charged battery can freeze and burst.

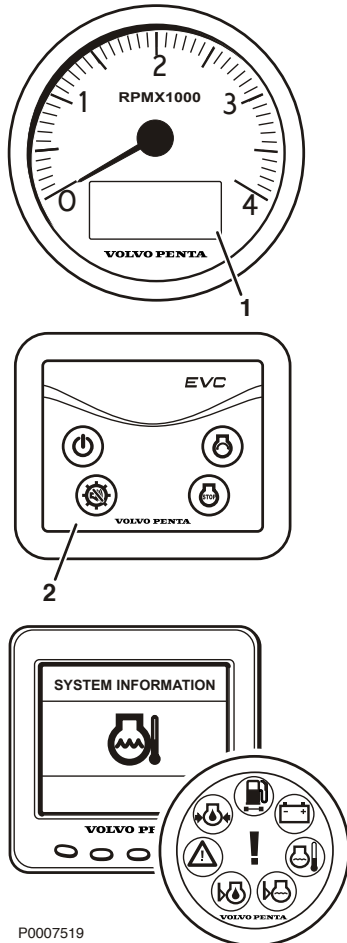


P0005905

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Fault Handling

Despite regular maintenance according to the maintenance schedule and perfect operation conditions faults may occur which must be attended to before the boat can travel further. This chapter describes alarms and fault handling.



If an operational fault arises an audible alarm will sound and a symbol will flash in the tachometer window(1) If optional equipment such as an alarm monitor or an EVC display are installed, the relevant warning lamp will flash there also.

Cancel the alarm by depressing the multi-function button (2). The audible alarm will be silenced. The symbol will be lit continuously until the fault is remedied.

This chapter describes faults and actions to be taken.

⚠ CAUTION!

Read the safety precautions for maintenance and service in the Safety Information chapter before starting work.



Coolant Temperature

The coolant temperature lamp is lit if the coolant temperature is too high.

IMPORTANT!

Continued operations with too-high engine temperature may cause serious engine damage.

- Check coolant level. Refer to *Coolant Level, Checking and Topping Up* page 45.
- Check that the raw water filter, where such is fitted, is not clogged. Refer to *Seawater Filter, Check and Cleaning* page 51.
- Check the impeller in the seawater pump. Refer to *Impeller, Check and Change* page 49.

If the alarm continues despite the above actions being carried out, run the engine at low revolutions and drive the boat to the nearest service workshop for repair.



Oil pressure

If the oil pressure lamp lights up during operations, the engine oil pressure is too low.

IMPORTANT!

Continued operations with too-low oil pressure will cause serious engine damage.

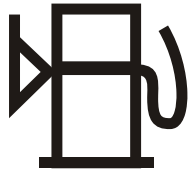
- Checking Engine Oil Level, refer to *Oil level, checking and topping up* page 39.
- Check that the oil filter is not blocked. Change the oil filter as necessary; refer to *Engine oil and engine oil filter, changing* page 40.
- Please contact a Volvo Penta workshop if the fault remains.



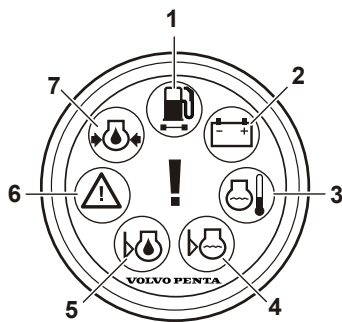
Battery

The charging lamp lights up when the alternator stops charging the batteries, which may result from a fault in the electrical system or the need to tension the alternator drive belt.

- Check belt tension. Refer to *Drive Belt, Check and Change* page 37.
- Check to see if there are no short circuit, chafed wires or wires with loose connections.
- Check the fluid level in the battery; refer to *Battery, Maintenance* page 53.
- Please contact a Volvo Penta workshop if the fault remains.



AUX



P0004761

System failure

The "system fault" symbol is displayed when there is a short circuit or cable break.

The symbol shows if the ignition is left on, refer to *Engine Shutdown page 23*.

- Check to see if there are any chafed wires or wires with loose connections.
- Please contact a Volvo Penta workshop if the fault remains.

Fuel level

The fuel level symbol is displayed when less than 20% fuel remains in the tank if a fuel level sensor is installed (optional equipment).

Auxiliary alarm

Alarm for auxiliary sensors (optional equipment).

Alarm Display (optional instrument)

- 1 The fuel level symbol lights up during operation when less than 20% fuel remains in the tank if a fuel level sensor is installed (optional equipment).
- 2 The battery lamp lights up if the alternator is not charging.
- 3 The coolant temperature lamp lights up when the coolant temperature is too high.
- 4 This indicator is not activated for the engine.
- 5 This indicator is not activated for the engine.
- 6 The "System Failure lamp" will light up at short circuit, broken wire and AUX failure.
- 7 If the oil pressure lamp lights up during operation, the oil pressure in the engine is too low.

Fault Tracing

A number of symptoms and possible causes of engine malfunctions are described in the table below. Always contact your Volvo Penta dealer if any problems occur which you cannot solve by yourself.

NOTICE! Read the safety regulations for care and maintenance in the *Safety Information page 6* chapter before work you start work.

Symptoms and possible causes

Start motor will not turn, or turns slowly	1, 2
Engine does not start	3, 4, 5, 6, 7, 8
Engine starts but stops again	5, 6, 7, 8
Engine is difficult to start	5, 6, 7, 8
Engine does not reach correct operating speed at full throttle	6, 7, 8, 9, 10, 11, 12, 17
Engine knocks	13
Engine runs roughly	5, 6, 7, 8, 12, 13
Engine vibrates	17, 18
High fuel consumption	9, 10, 12, 14, 17
Black exhaust smoke	4, 12, 14, 17
Blue or white exhaust smoke	14, 24
Lubrication oil pressure too low	15, 16
Coolant temperature too high	19, 20, 21, 22, 23
No charge, or poor charge	1, 25

1. Flat battery
2. Poor contact/open circuit in cables
3. The stop lever is pulled out
4. Insufficient preheat
5. Lack of fuel
6. Blocked air filter
7. Air in the fuel system
8. Water/contamination in fuel
9. Boat abnormally loaded
10. Fouling on hull, drive or propeller
11. Limited movement in engine control lever
12. Insufficient air supply to engine
13. Coolant temperature too high
14. Coolant temperature too low
15. Oil level too low
16. Blocked oil filter
17. Faulty / wrong propeller
18. Faulty engine mounting
19. Coolant level too low
20. Blocked raw water inlet, lines or filters
21. Circulation pump drive belt slipping
22. Faulty impeller
23. Faulty / wrong thermostat
24. Oil level too high
25. Alternator drive belt slipping

In Case of Emergency

Despite regular service in accordance with the planned maintenance schedule and perfect operating conditions, faults may occur that must be remedied before the boat can continue its trip. This chapter provides advice on how to remedy a number of conceivable faults.

If a fault occurs, confirm any fault alarm and take the necessary actions. See this chapter and refer to the *Fault Handling page 25* chapter.

Starting Using Auxiliary Batteries

WARNING!

Explosion hazard. Batteries contain and give off an explosive gas which is highly flammable and explosive. A short circuit, open flame or spark could cause a violent explosion. Ventilate well.

WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and explosion.

- 1 Check that the auxiliary battery has the same voltage as the engine system voltage.
- 2 Connect the red positive cable to the plus (+) terminal on the discharged battery and then to the plus terminal on the auxiliary battery.
- 3 Connect the black start cable to the minus (-) terminal on the auxiliary battery and to a place a little distance away from the discharged battery, e.g. the start motor's negative terminal.

WARNING!

Under no circumstances may the black jumper cable (-) come in contact with the positive connection on the starter motor.

- 4 Start the engine and let it run at fast idle for approximately 10 minutes to charge the batteries. Make sure there is no extra equipment connected to the electrical system.



P0002107

 **WARNING!**

Working with or going close to a running engine is a safety risk. Watch out for rotating components and hot surfaces.

 **WARNING!**

Do not touch the connections during the start attempt:
Risk of arcing.

Do not bend over any of the batteries either.

- 5 Turn off the engine. Remove the start cables in the exact opposite order to their connection.

Maintenance Schedule

Your Volvo Penta engine and its equipment are designed for high reliability and long life. The engines are built to withstand the marine environment, but also to have the smallest possible environmental impact. If the engine and transmission are serviced regularly according to the schedule, these qualities will be retained and unnecessary malfunctions will be avoided.

Warranty inspection

During the initial period of use a special warranty inspection - a First service inspection - must be carried out by an authorized Volvo Penta workshop. Instructions regarding when this must be done can be found in the **Warranty and service book**.

Extended protection for leisure use

Volvo Penta offers extended protection for marine diesel engines, including power trains, applicable only to leisure boats. For the warranty to be valid, all prescribed services must have been carried out at the owner's expense by an authorized Volvo Penta dealer or service workshop before the 12 month warranty period has expired. Further instructions are contained in the Warranty and service book.

C = Clean
 R = Replace
 A = Adjust
 L = Lubricate
 I = Inspect (Clean, Adjust, Lubricate or Replace if necessary)

First service inspection, after 20–50 running hours ¹⁾	
Transmission, oil level	I
Coolant level and antifreeze mixture	I
Drive belt (tension)	I
Seawater filter	I C
Instrument panel function	I
Start and warm up engine	
Engine and transmission, oil / fuel / water leakage	I
Engine and transmission, abnormal noises	I
Stop Engine	
Engine oil and oil filters	L
Restart engine	
Oil pressure / oil leakage	I

¹⁾ Or within 180 days of the date of delivery, or the end of the first season, whichever comes first.

Daily, Before First Start

Engine and engine room. General inspection	I
Checking Engine Oil Level	I
Check coolant level.	I

Every 14 days

Drive belts, wear	I
Seawater Filter, Check and Cleaning	I C
Fuel pre-filter, draining water / contamination	I
Batteries, electrolyte level	I
Reverse gear, oil level	I
S-drive, oil level	I

Every 200 hours / at least once a year, included in extended protection

D1 Engine oil and oil filters ¹⁾	R
Reverse gear, oil	R
Reverse gear, propeller shaft seal	I
S-drive, oil	R
S-drive/reverse gear, corrosion protection	I

¹⁾ Oil change intervals vary, depending on engine type, oil grade and sulfur content of the fuel. Se avsnitt *Oil Grade and Oil Change Interval*.

Every 500 operating hours / at least once per year; included in extended warranty

D2 Engine oil and oil filters ¹⁾	R
Fuel pre-filter and fuel fine filter	R
Idle	I
Seawater pump impeller	I
Vaccum Valve, Cleaning	C

¹⁾ Oil change intervals vary, depending on engine type, oil grade and sulfur content of the fuel. Se avsnitt *Oil Grade and Oil Change Interval*.

Once per year; included in extended warranty

Folding Propeller	C
S-drive, Rubber Sealing between Drive and Hull	I

Every 500 operating hours / at least once every 2 years

Heat exchanger	C
Injectors	I
Valve clearance	A

Every 4 years

Coolant	R
---------	---

Every 500 operating hours / at least once every 5 years

Reverse gear, propeller shaft seal	R
------------------------------------	---

Every 7 years

S-drive, Rubber Sealing between Drive and Hull	R
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Maintenance

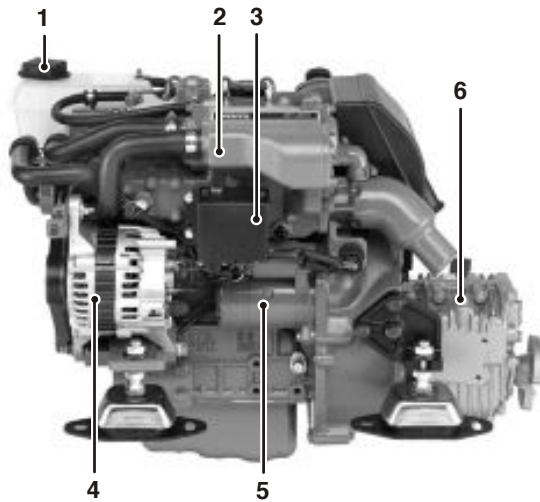
This chapter contains general technical information and instructions on how the prescribed maintenance items must be carried out. Read through the instructions carefully before starting work. The times when maintenance items must be carried are indicated in the *Maintenance Schedule page 31*.

Read through the safety precautions for maintenance and service in the *Safety Information page 4* chapter before work on the engine is begun.

WARNING!

Care and maintenance work should be done with the engine stopped unless otherwise specified. Stop the engine before opening or removing the engine hatch/hood. Make it impossible to start the engine by removing the start key and cutting the system voltage with the main switches.

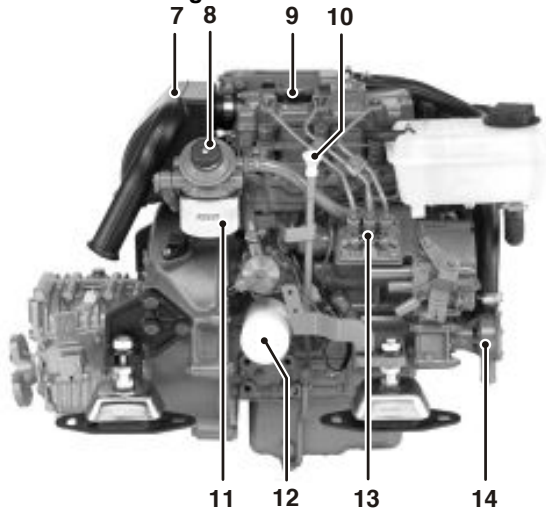
D1-20 with MS10A reverse gear



P0008052

- 1 Coolant filling
- 2 Heat exchanger
- 3 Relay box
- 4 Alternator
- 5 Starter motor
- 6 Oil dipstick, reverse gear

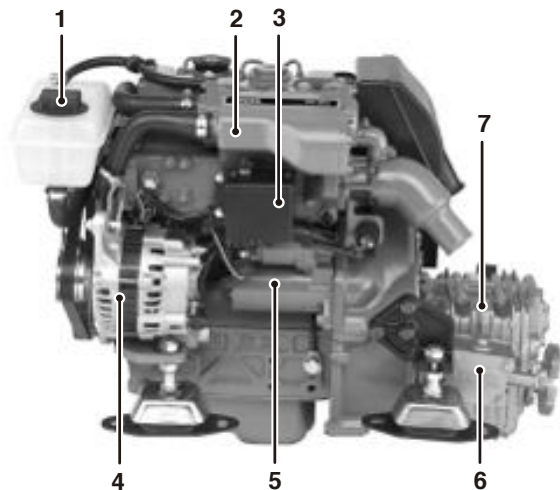
D1-20 with MS10A reverse gear



P0008053

- 7 Air filter/air intake
- 8 Fuel hand pump
- 9 Oil filler, engine
- 10 Oil dipstick, engine
- 11 Fuel filter
- 12 Oil filter
- 13 Injection pump
- 14 Raw water pump

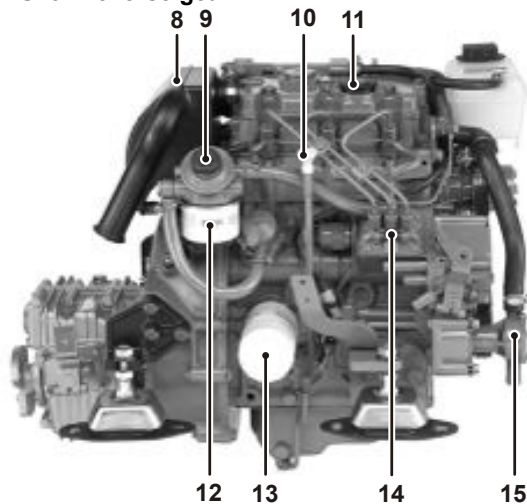
D1-30 with MS15A reverse gear



P0008054

- 1 Coolant filling
- 2 Heat exchanger
- 3 Relay box
- 4 Alternator
- 5 Starter motor
- 6 Oil cooler, reverse gear
- 7 Oil dipstick, reverse gear

D1-30 with MS15A reverse gear

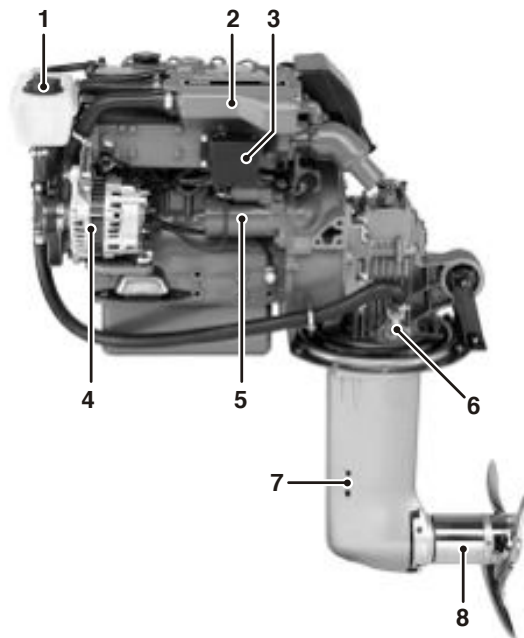


P0008055

- 8 Air filter/air intake
- 9 Fuel hand pump
- 10 Oil dipstick, engine
- 11 Oil filler, engine
- 12 Fuel filter
- 13 Oil filter
- 14 Injection pump
- 15 Raw water pump

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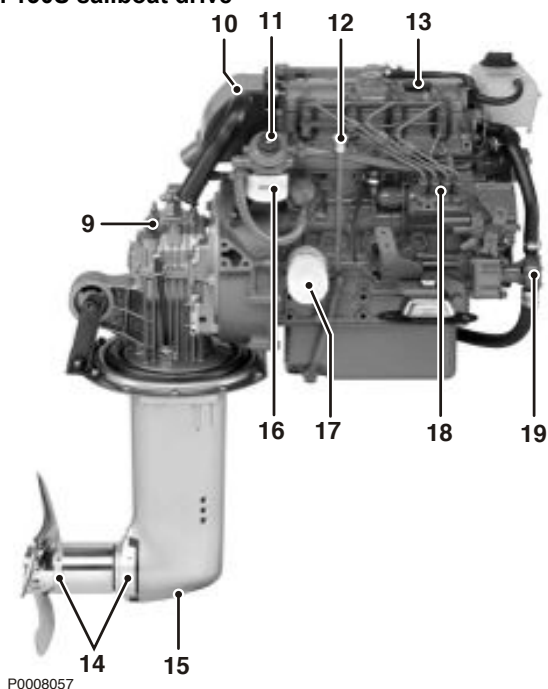
D2-40 with 130S sailboat drive



- 1 Coolant filling
- 2 Heat exchanger
- 3 Relay box
- 4 Alternator
- 5 Starter motor
- 6 Sea cock, S-drive
- 7 Cooling water inlet, S-drive
- 8 Folding propeller

P0008056

D2-40 with 130S sailboat drive



- 9 Oil dipstick, S-drive
- 10 Air filter/air intake
- 11 Fuel hand pump
- 12 Oil dipstick, engine
- 13 Oil filler, engine
- 14 Sacrificial anodes
- 15 Oil drain, S-drive
- 16 Fuel filter
- 17 Oil filter
- 18 Injection pump
- 19 Raw water pump

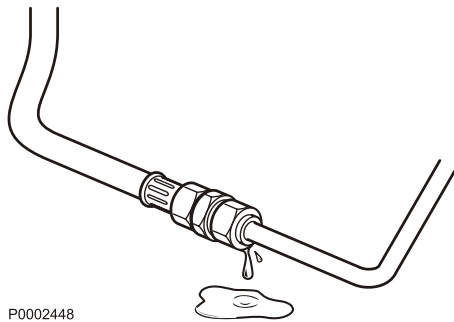
P0008057

Engine, General

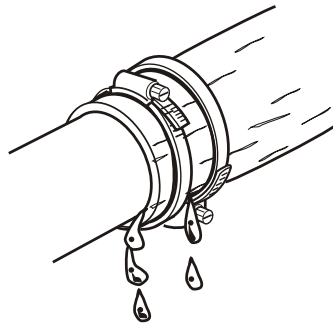
General inspection

Make a habit of visually checking the engine and engine bay before starting, and after operations when you have stopped the engine. This will help you to discover abnormalities quickly, or if something is about to happen.

Look especially carefully for oil, fuel and coolant leakages, loose bolts, worn or poorly-tensioned drive belts, loose cable connections, damaged electrical cables and hoses. This inspection only takes a few minutes and can prevent serious malfunctions and expensive repairs.



P0002448



P0002455

⚠ WARNING!

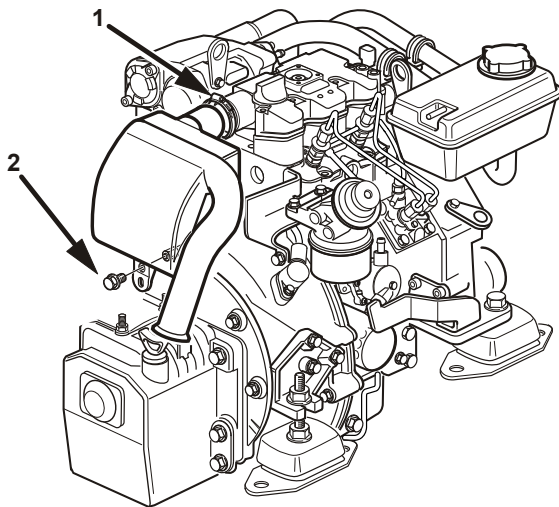
Accumulations of fuel, oil and grease on the engine or in the engine room is a fire hazard and must be removed immediately they are detected.

⚠ WARNING!

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

Never direct the jet from a high-pressure washer at seals, rubber hoses or electrical components. Never use the high pressure setting for engine cleaning.

Air Filter, Change



P0007521

- 1 Loosen the hose clamp (1) and undo the bolt (2) and remove the filter.
Make sure that contaminants do not enter the engine.
- 2 Install the new filter; fasten with the hose clamp and the bolt.

Drive Belt, Check and Change

⚠ WARNING!

Stop the engine before doing any maintenance work.

Check belt tensions and condition regularly. A belt that is tensioned too tightly may damage bearings, while a belt too-loosely tensioned may slip.

Check and adjust the belt after operation, while the belt is still warm.

A correctly-tensioned belt should be possible to depress approx. 10 mm (0.4") between the pulleys.

IMPORTANT!

Always replace a belt that appears worn or has cracks (belts that work in pairs must always be changed together).

Adjusting the drive belt

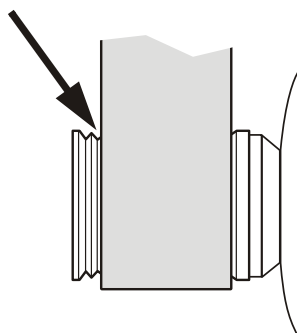
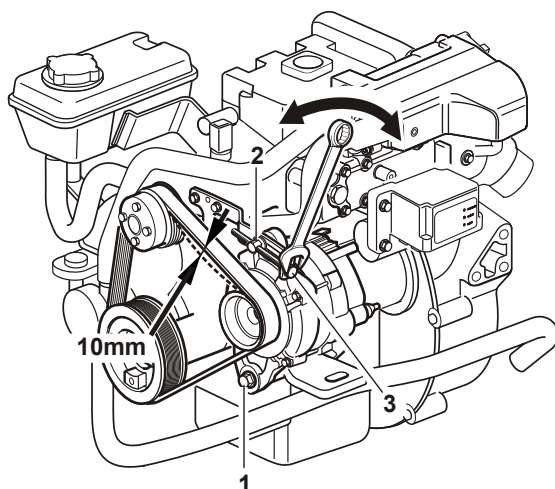
- 1 Undo the alternator retaining bolts (1-2).
- 2 Using the adjuster screw (3), adjust the belt to the correct tension.
- 3 Tighten the bolts (1-2) and check the tension.

Replacing the drive belt

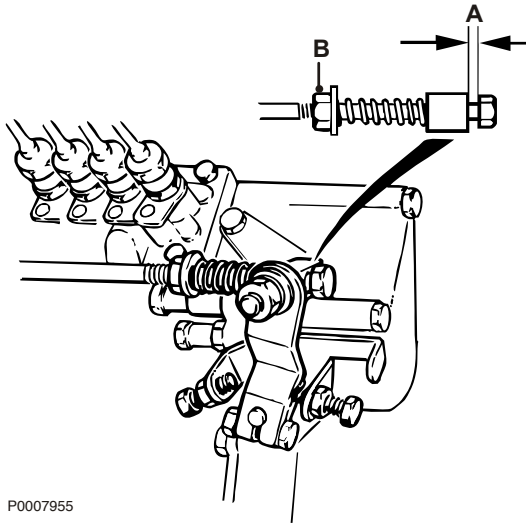
- 1 Undo the alternator retaining bolts (1 and 2).
- 2 Press the alternator toward the engine block so that the belt can be removed. Wipe clean the belt grooves
- 3 Install the new belt. Adjust.
- 4 Check the belt tension again after a few hours' operations.

IMPORTANT!

D1-30, D2-40: Ensure that the alternator belt is placed in the groove closest to the alternator.



D1-30 and D2-40



P0007955

Idling, adjustment

For engine idle revolutions, refer to the *Engines* section. Low idle revolutions may cause the engine to stall, while higher idle revolutions cause extra stress on the drive/reverse gear during shifting maneuvers.

Adjustment must be made while the engine is warm.

- 1 Put the control lever in neutral.
Check that the gap (A) is around 3 mm.
Undo locknut (B) and adjust screw (C) to give the correct gap. Tighten the locknut.⁽¹⁾
- 2 Start the engine and let it idle with the control lever in the neutral position.

WARNING!

Working with or going close to a running engine is a safety risk. Watch out for rotating components and hot surfaces.

- 3 Undo the locknut (D). Adjust to the correct revolutions using the adjuster screw (E). Tighten the locknut.
- 4 Repeat item 1.

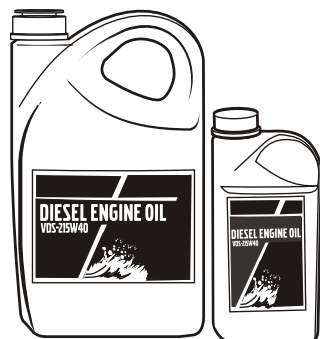
1. This item does not apply to boats with twin helm stations.

Lubrication System

Oil change intervals can vary depending on oil grade and sulphur content of the fuel, please refer to *Technical Data, Lubrication System*.

Oil change intervals must never exceed a period of 12 months.

If you want longer oil change intervals than given in the table *Oil Grade and Oil Change Interval*, the condition of the oil must be checked by the oil manufacturers through regular oil testing.



P0002089

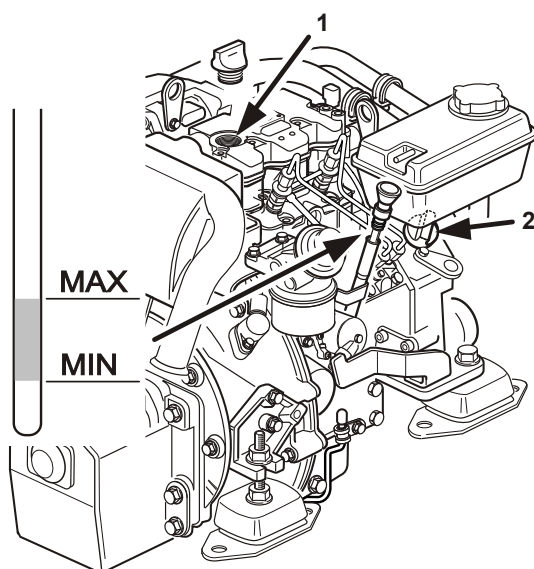
Oil level, checking and topping up

The oil level must be within the marked area on the oil dipstick and must be checked daily before the first start.

IMPORTANT!

Do not fill above the limit for max. oil level. Use only oil of the recommended grade; refer to *Technical Data, Lubrication System*.

- 1 Fill oil slowly through the oil filler on top of the engine (1) or at the side (2).
- 2 Wait 5 minutes so that the oil has time to run down into the engine.
- 3 Check the oil level again when the engine has cooled.



P0007522

Engine oil and engine oil filter, changing

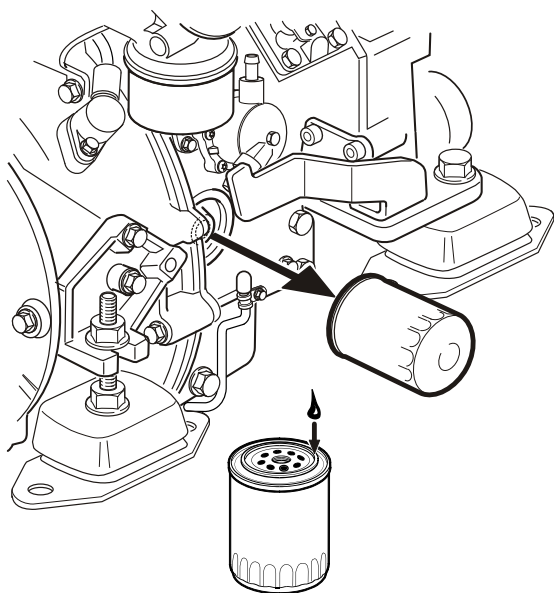
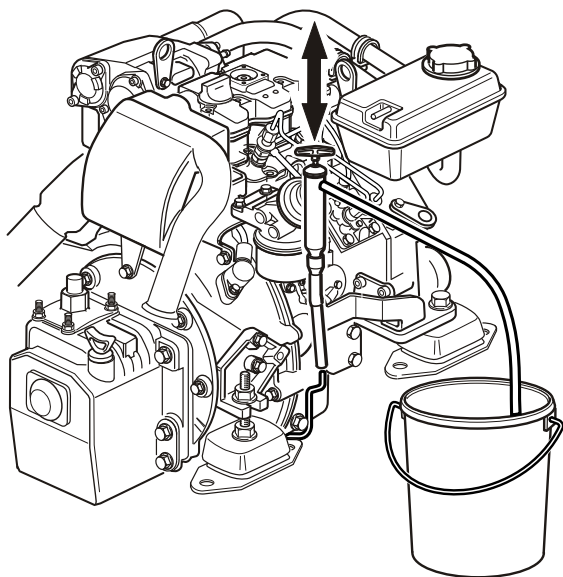
Always follow the recommended oil change interval. Use only oils of the recommended grades; refer to *Oil Grade and Oil Change Interval*.

WARNING!

Hot oil and hot surfaces can cause burns.

- 1 Run the engine until warm so that the oil is easier to pump. Stop the engine.
- 2 Connect an oil drain pump to the oil drain pipe. Pump out the oil.
- 3 Unscrew the lubricating oil filter. Place a plastic bag over the filter before it is unscrewed to avoid oil spillage.
- 4 Check that the filter contact area on the engine is clean.
- 5 Apply a film of oil on the new filter gasket. Screw the filter on by hand until it touches the contact surface. Then tighten an extra half turn, no more!
- 6 Fill with oil to the correct level through the oil filler on top or to the side of the engine. For oil quantity, refer to the *Technical Data, Lubrication System* section.
Start the engine. Run the engine until it reaches normal operating temperature. Check that the low oil pressure lamp goes out and that there are no leaks around the oil filter.
- 7 Turn off the engine. Wait ten minutes before checking the oil level. Top up as needed.

Hand in the old oil and oil filter to a re-cycling station.



P0007523

Fuel System

Only use the grades of fuel recommended in the fuel specification, see *Technical Data, Fuel System*.

Always observe the greatest cleanliness during refuelling and work on the fuel system.

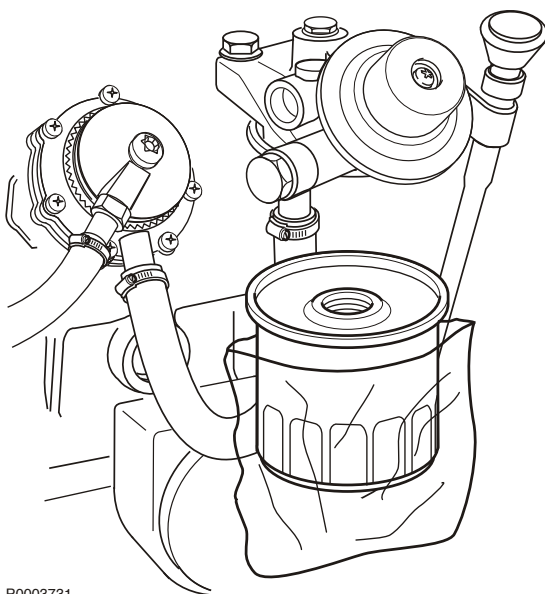
All work on the unit injectors of the engine must be carried out by an authorized workshop.

WARNING!

Fire hazard. 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 so that they can not cause fire.

Engine Fuel Filter Replacement

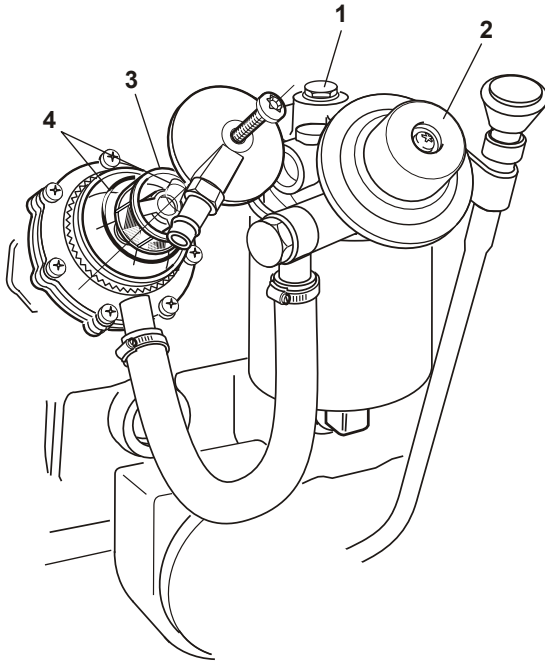
- 1 Clean the filter bracket.
Avoid fuel spills by placing a plastic bag around the filter
- 2 Unscrew the filter
- 3 Apply a film of oil on the new filter gasket.
- 4 Screw the filter on by hand until it touches the contact surface. Then tighten an extra half turn, no more!
- 5 Purge the fuel system, refer to the *Fuel system, bleeding page 42* section.
- 6 Start the engine and check for leaks.
- 7 Hand in the old filter to a re-cycling station.



P0003731

Fuel system, bleeding

The fuel system must be purged after a filter change, if the fuel tank has been run dry and after a long-term stoppage.



P0007532

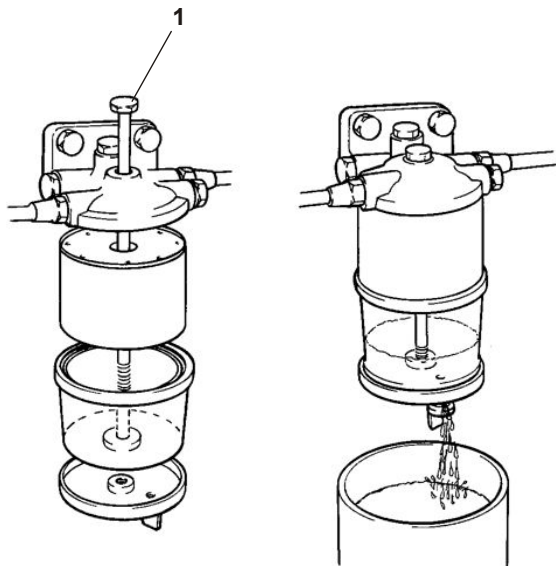
- 1 Open the purge screw (1) on the fuel filter approx. three turns. Avoid fuel spills; use rags to soak up fuel at the purging point.
- 2 Pump fuel up with the hand pump (2) until fuel without air bubbles can be seen. Continue pumping and tighten the purging screw at the same time. The pump inlet pipe contains a strainer (3) which normally does not need to be cleaned since the engine has a fuel pre-filter. If a fuel pre-filter is not fitted, poor feed flow can be due to a blocked strainer.
If either of the two O-rings (4) are damaged, they must be replaced.
- 3 Start the engine and check for leaks.

Fuel pre-filter

The fuel pre-filter is an optional extra.

Draining

Wait a few hours after the engine has been turned off before draining the filter..
Position a container under the fuel filter. Drain off water and contaminants using the cock/plug at the bottom of the filter bowl.



P0007533

Replacing filter insert

- 1 Close fuel cock at the fuel tank. Position a container under the fuel filter.
- 2 Remove the filter bowl by undoing screw (1).
- 3 Empty and clean the filter bowl. Replace insert and reinstall the bowl.
- 4 Open fuel cock.
- 5 Vent the fuel system, please refer to section *Fuel system, bleeding* page 42.
- 6 Start the engine and check for leaks.
- 7 Deposit the old filter insert at a properly designated disposal site.

Freshwater System

The freshwater system is the engine's internal cooling system that ensures that the engine operates at the correct temperature. It is a closed system that must always be filled with a coolant mixture in order to protect the engine against internal corrosion, cavitation and frost bursting.

IMPORTANT!

Coolant of a suitable chemical composition must be used all year round. This applies even when there is no risk for frost damage, so that the engine always has complete corrosion protection.

The use of anti-corrosion agents alone is not permitted in Volvo Penta engines. Never use water alone as the coolant.

The corrosion protection additives become less effective over time, which means that the coolant must be changed at regular intervals; refer to *Maintenance Schedule page 31*. The cooling system must be flushed whenever the coolant is changed, refer to *Freshwater system, Flushing*.

Volvo Penta recommend "Volvo Penta Coolant VCS, Ready Mixed" or the concentrate "Volvo Penta Coolant VCS" mixed with pure water according to specifications, see *Water Quality*.

Volvo Penta Coolant VCS and VCS Ready Mixed are based on organic acid technology (OAT). Using other types of coolant, such as conventional or hybrid types, can drastically reduce the heat transfer and result in overheating of the engine.



P0013077

Coolant, Mixing

WARNING!

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

IMPORTANT!

Different types of coolant must not be mixed with each other!

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

This mixture protects against internal corrosion, cavitation and frost bursting down to -24°C (-11°F). At 60% glycol concentration, the freezing point is lowered to -46°C (-51°F).

Never mix more than 60% concentrate (Volvo Penta Coolant) in the coolant. A greater concentration provides reduced cooling effect with the risk for overheating and reduced frost protection.

The coolant must be mixed with distilled, deionized water. The water must fulfil the requirements specified by Volvo Penta; refer to *Water Quality*.

It is extremely important that the system is filled with the correct coolant concentration. Mix in a separate clean vessel before filling the cooling system. Make sure that the liquids mix.



P0002463

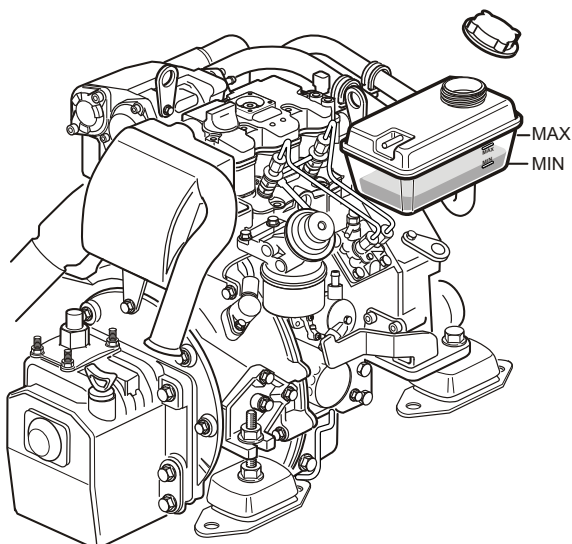
Coolant Level, Checking and Topping Up

⚠ WARNING!

Do not open the coolant filler cap when the engine is warm, except in emergencies, this could cause serious personal injury. Steam or hot fluid could spray out.

- 1 Turn the filler cap slowly counter-clockwise and release any pressure from the system before removing the cap completely.
- 2 Top up with coolant as necessary. The coolant level must be between the MAX and MIN marks on the expansion tank.
- 3 Screw on the filler cap.

When filling a completely empty system the coolant level must be checked after the engine has been run for an hour or so, as the system is self purging. Top up with coolant as necessary.



P0007524

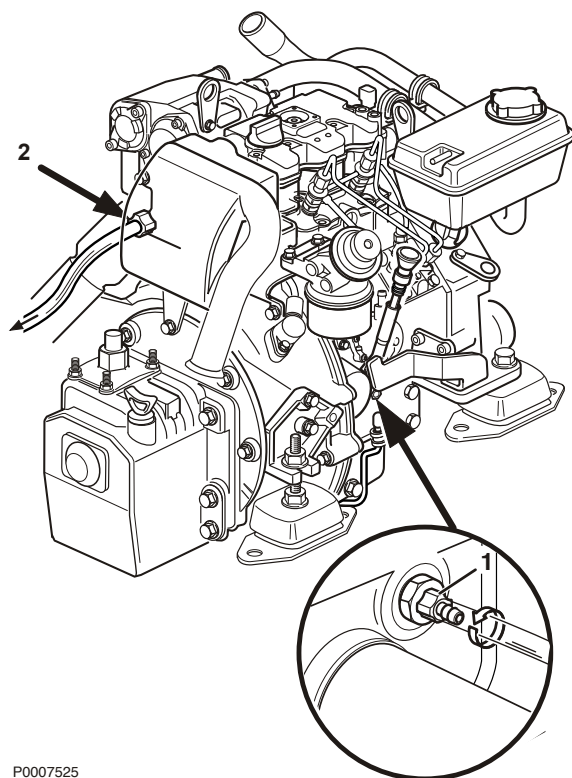
Coolant, Draining

⚠ WARNING!

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

- 1 Connect a hose to the engine block drain tap (1) and one to the heat exchanger drain tap (2).
- 2 Remove the filler cap on the expansion tank to speed up coolant drainage.
- 3 Open the drain taps (1) and (2). Allow all the coolant run out into a container.
- 4 Collect the old coolant and hand it to a recycling station

The heat exchanger must be cleaned before new coolant is added.



P0007525

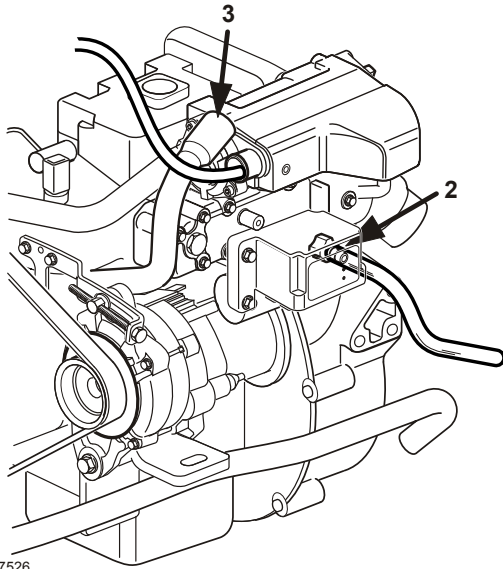
Heat Exchanger, Cleaning

WARNING!

All coolant is hazardous and harmful to the environment. Do not consume. Coolant is flammable.

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

- 1 Drain the coolant, please refer to section *Coolant, Draining* page 45.
- 2 Loosen the hose (3) and insert a hose into the filling pipe on the heat exchanger. Rinse with fresh water until the water which runs out of the drain tap (1) and the engineblock (2) is clean. Let all the water run out.
- 3 Close the draining points (1 and 2) . Fill up with coolant to the correct level. Put the filler cap back.
- 4 Fit the hose (3).



P0007526

Seawater System

The raw water system is the engine's external cooling system. On engines with drives, the raw water pump sucks in water via the drive, through the control system's oil cooler to the raw water pump. The water then passes through the raw water filter before being pumped through the fuel cooler, intercooler, engine oil cooler and heat exchanger. Finally the water is fed out through the exhaust elbow, where it is mixed with the exhaust gases.

On engines with reverse gears, the raw water pump sucks in water via a raw water intake, after which the water passes a raw water filter (extra equipment) before being pumped through the intercooler, heat exchanger, engine oil cooler and gearbox oil cooler. Finally the water is fed out through the exhaust elbow, where it is mixed with the exhaust gases.

WARNING!

Risk of water entry. Water will flow into the boat if any hose, plug etc. located below the waterline is removed when the boat is in the water. Always close the sea cocks. If the boat does not have sea cocks the water flow must be blocked in a safe manner. If this is not possible, the boat must be drawn up on land before work starts.

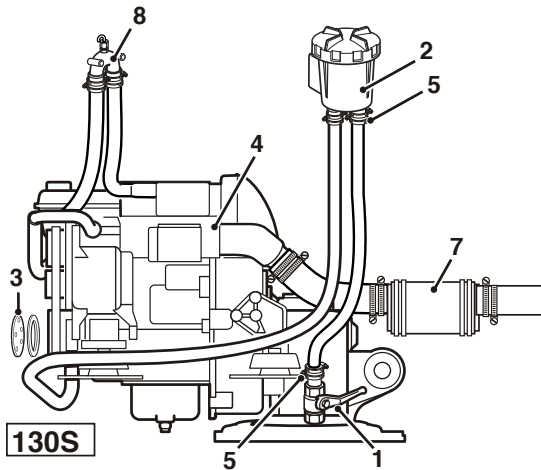
Seawater System, Draining

WARNING!

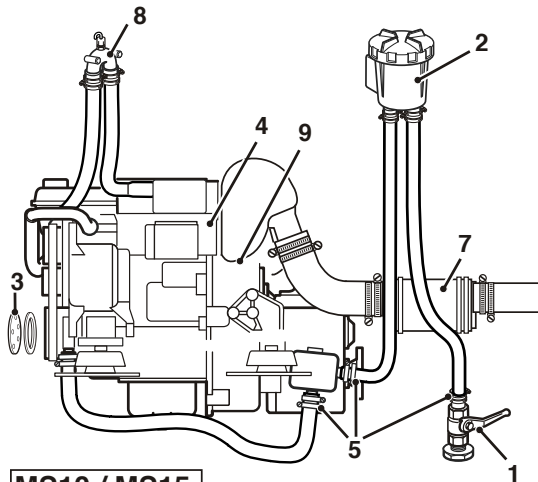
Risk of water entry. Close the seawater cocks before doing any work on the seawater system.

To prevent freeze bursting, the raw water system must be drained during cold weather when there is a risk of freezing. An alternative to draining is to keep the engine bay warm using an approved heater fan.

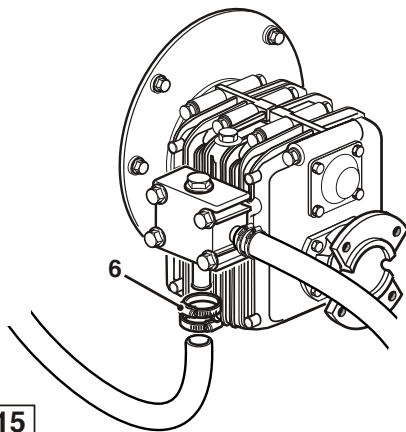
Note that all raw water must be drained and that the draining process must be adapted to suit the engine installation and any auxiliary equipment connected to it, such as a raw water filter (2), vacuum valve (8), exhaust riser and drain tap (9) and silencer (7) etc.



130S



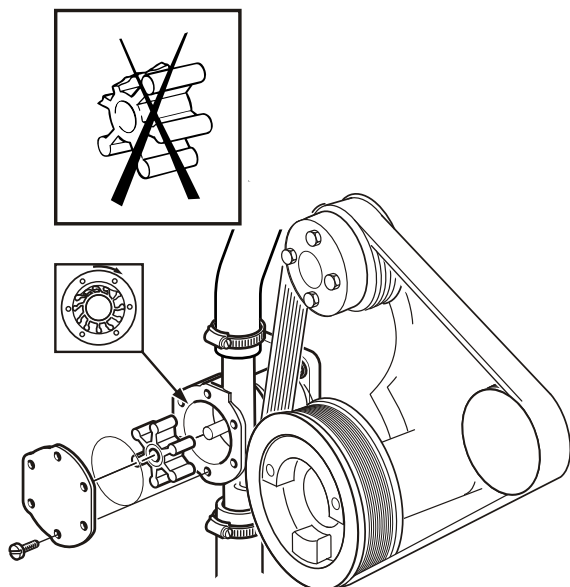
MS10 / MS15



MS15

P0007978

- 1 Close the sea cock (1).
- 2 Remove the cover and the sealing plate on the raw water filter (2).
- 3 Remove the cover (3) from the raw water pump and let the water run out.
- 4 Open the drain tap (4) on the heat exchanger side panel and drain off the water.
- 5 Loosen the hoses at the arrows (5) and empty them of water.
- 6 Connect a hose to the drain tap on the riser (9) and lead it into a container. Open the tap and drain off the water. Close the tap.
- 7 Remove the hose (6) on the reverse gear oil cooler and drain off the water.
- 8 Drain the silencer (7), the exhaust system and other auxiliary equipment connected to the raw water and exhaust systems.
- 9 Reinstall all hoses, the raw water pump cover and the raw water filter cover and sealing plate. Close the heat exchanger drain tap.
- 10 Open the raw water tap when the boat is returned to operations.
Check that no leakage exists in the raw water system.



P0007527

Impeller, Check and Change

⚠ WARNING!

Risk of water entry. Close the seawater cocks before doing any work on the seawater system.

- 1 Close the sea cock.
- 2 Remove cover on the seawater pump. Remove impeller .
If there are cracks or other defects the impeller must be replaced.
- 3 Lubri-cate the pump housing and the inside of the cover with a little glycerin.
IMPORTANT!
Impellern skadas om andra typer av smörjmedel än glycerin används.
- 4 Reinstall the impeller using a clockwise rotating movement.
- 5 Install the cover together with a new gasket. Open the sea cock.

Always carry a spare impeller on board.

Seawater System, Cleaning and Inhibiting

The raw water system must be flushed with fresh water, to prevent deposits and salt crystals from building up inside it. The system must also be conserved when the boat is laid up for winter or out-of-season storage so that it is protected from internal corrosion.

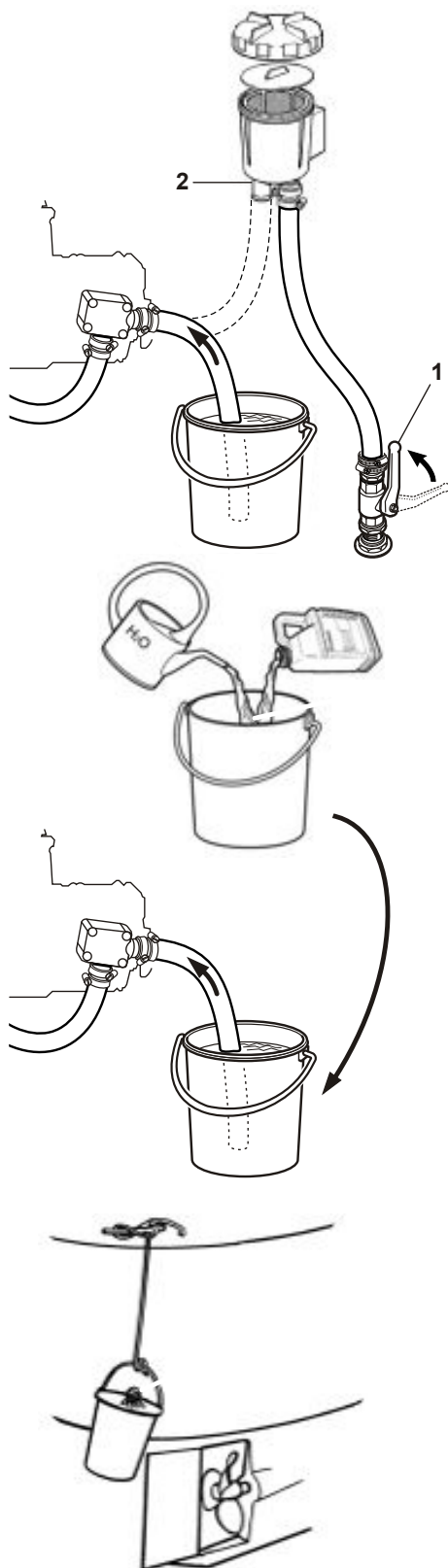
⚠ WARNING!

Risk of water penetration.

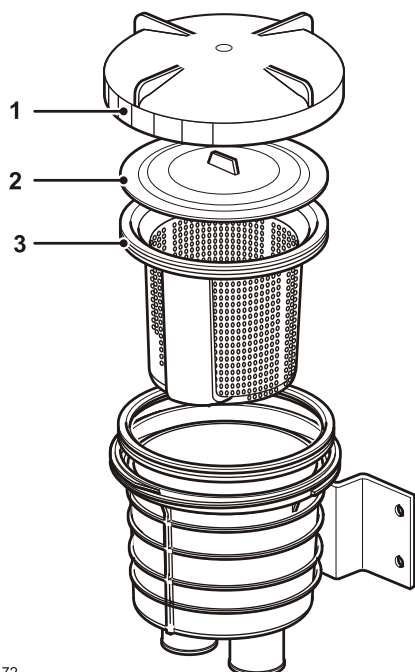
Cleaning and inhibiting the seawater system should be carried out with the boat on land.

⚠ WARNING!

Working with or going close to a running engine is a safety risk. Watch out for rotating components and hot surfaces.



- 1 Open the sea cock (1).
 - 2 Remove the hose from the sea cock (1) or from the outlet side of the raw water filter (2) if such is fitted to the engine.
 - 3 Put the free end of the hose into a bucket of fresh-water. Proceed with refilling.
- IMPORTANT!**
The impeller will be damaged if it is run dry.
- 4 Check that there is no one in the vicinity of the propeller and that nothing risks being splattered by the exhaust outlet.
 - 5 Set the control lever to neutral and start the engine. Let it run at fast idle for a few minutes. Stop the engine.
 - 6 Fill the bucket with an antifreeze solution (40% Volvo Penta Coolant and 60% freshwater) and arrange for the collection of the solution throughout.
 - 7 Start the engine and let it idle. Stop the engine just before the mixture is depleted. Repeat until the entire system has been flushed with the mixture.
 - 8 Reconnect the removed hose.
 - 9 The system is now conserved. The glycol mixture should remain in the system during storage. Before launching the boat, drain the mixture and hand it to a re-cycling station.



P0002472

Seawater Filter, Check and Cleaning

⚠ WARNING!

Risk of water entry. Close the seawater cocks before doing any work on the seawater system.

If the water where the boat is used contains contaminants, seaweed, etc. the filter should be checked more frequently than stated in the maintenance schedule. Otherwise there is a risk that the filter may be blocked resulting engine overheating.

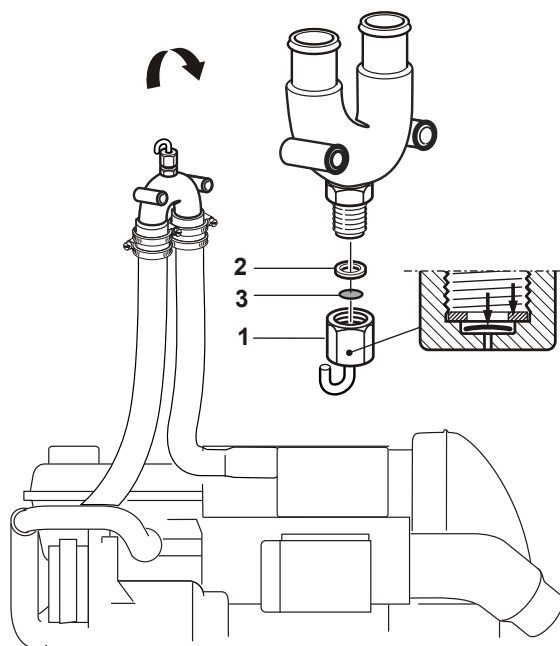
- 1 Close the sea cock.
- 2 Unscrew the cover (1) and remove the sealing plate (2).
- 3 Lift out the insert (3) and clean it.
- 4 Replace parts as illustrated.
- 5 Open the sea cock and check for leaks.

Vaccum Valve, Cleaning

Certain configurations have a vacuum valve installed in the raw water system.

⚠ WARNING!

Risk of water entry. Close the seawater cocks before doing any work on the seawater system.



P0007528

- 1 Close the sea cock.
- 2 Remove the valve. Unscrew the hexagonal cover (1).
- 3 The cover contains a membrane (2) and a gasket (3). Clean all components.
- 4 Turn the cover upside down. First insert the membrane and then the gasket.
- 5 Turn the valve housing upside down as well. Screw on the hexagonal cover to around 2 Nm. If the cover is screwed on too tightly the valve may stop working.

Electrical System

The engine is equipped with a 2-pole electrical system and an alternator. System voltage is 12V.

WARNING!

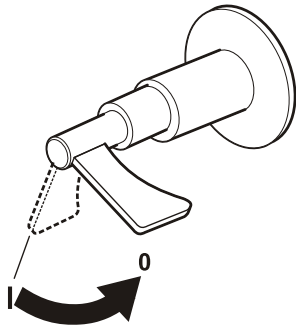
Always stop the engine and break the current using the main switches before working on the electrical system. Isolate shore current to the engine block heater, battery charger or accessories mounted on the engine.

Main switch

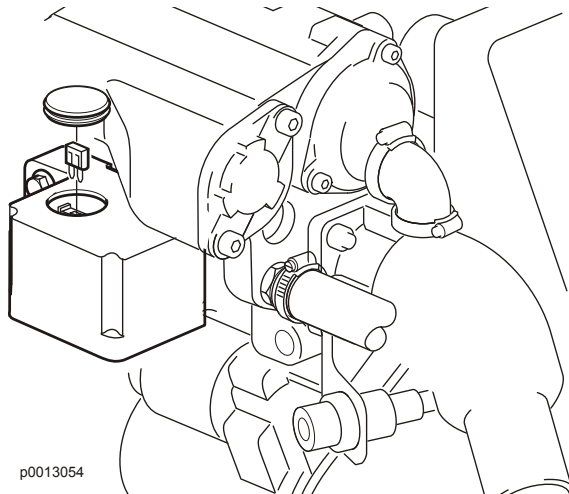
IMPORTANT!

Never disconnect the current with the main switches when the engine is running, the alternator and electronics could be damaged.

The main switches must never be switched off before the engine has stopped. If the circuit between the alternator and the battery is disconnected when the engine is running, the alternator and electronics can be damaged. For the same reason the charging circuits must never be re-connected with the engine running.



P0002576



p0013054

Fuses

The engine is equipped with a strip fuse.

The fuse cut the power if the electrical system becomes overloaded.

If it is not possible to start the engine or if the gauges stop working during operations the fuse may have deployed.

IMPORTANT!

Always investigate the cause of the overload. If the fuse trips frequently, contact an authorized Volvo Penta workshop.



P0002479



P0002107

Electrical Connections

Check that electrical connections are dry, free from oxide, and that they are securely tightened. Spray the connections as necessary with water-repellent spray (Volvo Penta universal oil).

Battery, Maintenance

⚠ WARNING!

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

⚠ WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and 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 in contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

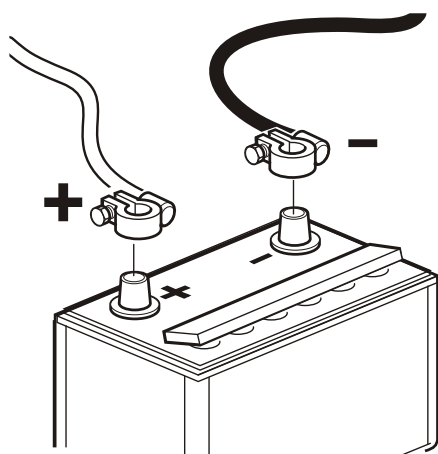
Connecting and disconnecting the battery

Connecting

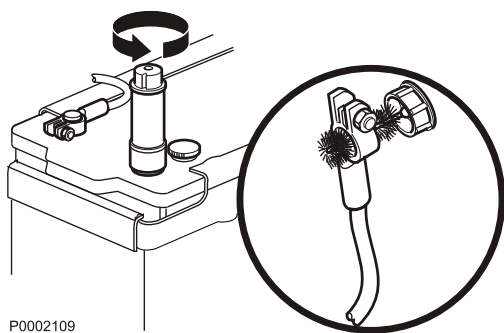
- 1 Connect the + cable (red) to the + pole on the battery.
- 2 Connect the – cable (black) to the – pole on the battery.

Disconnecting

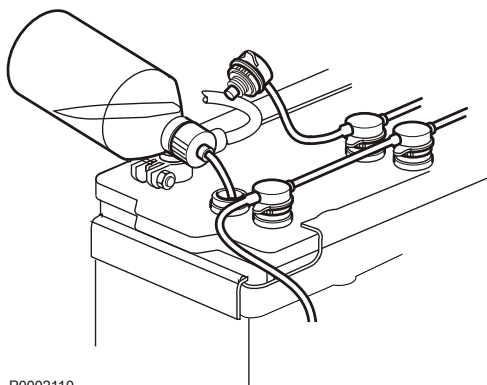
- 1 Remove the – cable (black).
- 2 Remove the + cable (red).



P0002108



P0002109



P0002110



P0002107

Cleaning

Keep the batteries clean and dry. Contamination and oxide on the batteries and battery poles can cause stray currents, voltage drop and discharge, especially in wet weather. Remove oxidation from the battery poles and terminals, using a brass brush. Tighten the terminals securely and grease them with terminal grease or petroleum jelly.

Filling

The electrolyte level should be 5–10 mm (0.2– 0.4”) above the cell plates in the battery. Top up with distilled water as required.

After filling, the battery should be charged for at least 30 minutes by running the engine at idle.

Some maintenance-free batteries have special instructions, which must be followed.

Battery, Charging

⚠ WARNING!

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

⚠ 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 in contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

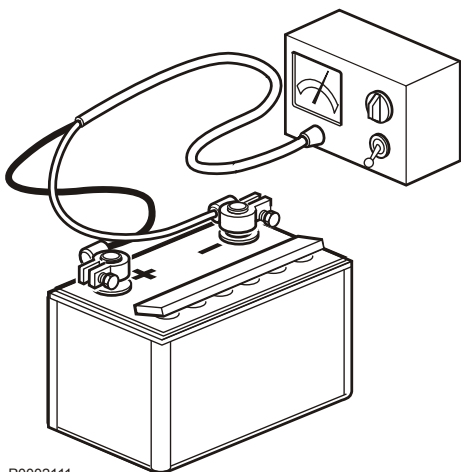
⚠ WARNING!

Never confuse the positive and negative poles on the batteries. Risk of arcing and explosion.

IMPORTANT!

Observe the instruction manual for the battery charger carefully. To avoid the risk of electrochemical corrosion when an external charger is connected, the battery cables should be removed from the batteries before the charger is connected.

Always switch off the charging current before the charging clips are removed.



P0002111

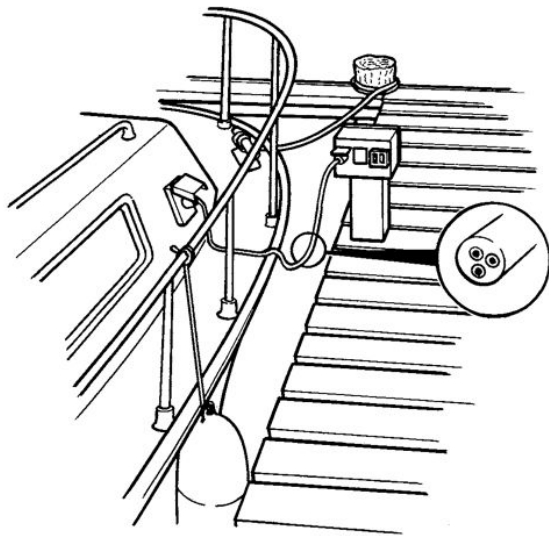
- Charge batteries if they have become discharged. During charging, unscrew the cell plugs but leave them in the plug holes. Ventilate well, especially if the batteries are charged in an enclosed space.
- If the engine is not used for a longer period of time, the batteries should be fully charged, then possibly trickle charged (please refer to the battery manufacturer's recommendations). Batteries are damaged by being left discharged, and can also freeze and burst easier in cold weather.
- Special instructions apply to **boost charging**. Boost charging can shorten battery life, and should therefore be avoided.

Electrical Installations

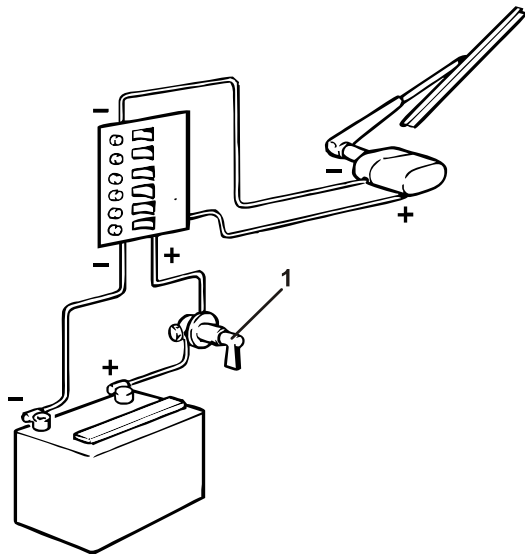
An incorrectly-carried-out electrical installation may generate leakage current from the electrical system. Leakage current can in turn render galvanic protection inadequate in respect of propellers, propeller shafts, rudder posts, the keel etc., and may cause damage through electrochemical corrosion.

WARNING!

Work on the low voltage circuits in the boats should be done by a person with electrical training or knowledge. Installation or work on land current equipment must only be done by a competent electrician, in accordance with local regulations for mains electricity.



P0003051



P0002486

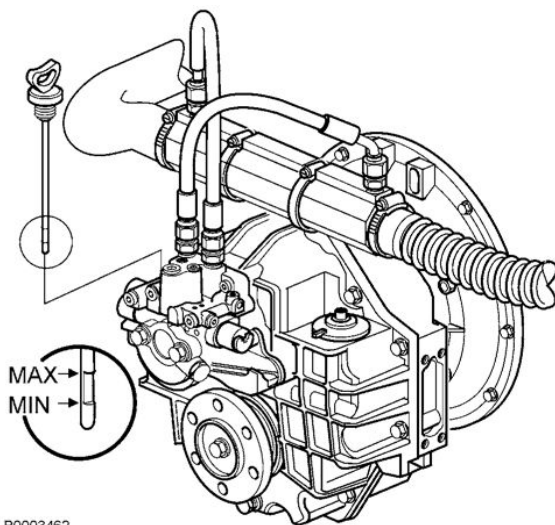
The following must always be heeded:

- 1 If shore power is connected it must always be ground protected ashore, never in the boat. Furthermore, the shore power installation should be equipped with a ground fault interrupter. The shore power installation (transformer, inverter, battery charger etc.) must be designed for marine use where the high-tension side is galvanically separated from the low-tension side.
- 2 Electrical cables must be run and clamped such that there is no risk of exposure to chafing, damp or bilge water.
- 3 Ground protection for radios, navigation instruments, rudder, boarding ladders or other equipment where separate cables for ground protection are present, must be clustered to a common ground connection (**B**) that is not connected to the engine or transmission.
IMPORTANT!
Neither the engine nor transmission may ever be used as a ground.
The S-drive is insulated electrically (**A**) from the engine and may never be used as the ground or be connected electrically to other equipment such as radios, navigation equipment, rudder, and boarding ladders.
- 4 The start battery must have a main switch (**C**) connected to the battery's plus (+) side. The main switch must break the circuit to all equipment and be switched off when the boat is not in use.
- 5 If an auxiliary battery is used, a main switch must be placed between the auxiliary battery's plus (+) terminal and the circuit breaker panel for the boat's electrical equipment. The main switch must break the circuit to all equipment connected to the auxiliary battery and must be switched off when power is no longer required. All equipment connected to the auxiliary battery must have separate main switches.

For simultaneous charging of two independent battery circuits a separate charging distributor (accessory) should be installed on the standard alternator.

Reverse Gear

Oil level, checking and topping up

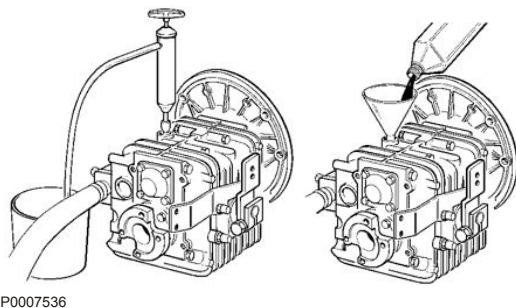


- 1 Start the engine and let it run on idle a few minutes.
- 2 Remove the dipstick by turning counter-clockwise.
- 3 Wipe the dipstick and reinsert it in the reverse gear without screwing it in. Remove the dipstick and check the oil level. The correct oil level is between the MAX and MIN markings.
- 4 Top up the oil as required using the dip stick tube. Please refer to section *Technical Data page 71* for oil quality and capacity.

IMPORTANT!

Never over-fill the reverse gear. The oil level must always be within the recommended range.

Reverse Gear, Oil Change



- 1 Pull out the oil dipstick.
- 2 Pump out the oil with the oil drain pump through the oil dipstick hole.
- 3 Measure out the correct quantity of oil and fill through the oil dipstick hole. For oil grade and quantity, refer to the *Technical Data page 71* section.
- 4 Put the oil dipstick back in place.

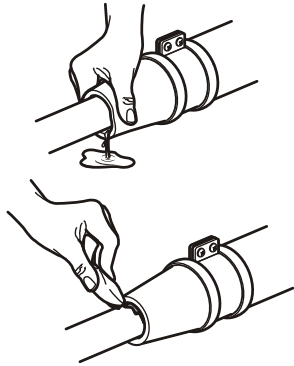
IMPORTANT!

Never over-fill the reverse gear. The oil level must always be within the recommended range.

Propeller Shaft Sealing, Check

If the boat is fitted with a Volvo Penta propeller shaft, the propeller shaft seals must be lubricated before launch and purged directly after launching.

Purge the glands by pressing them together, at the same time as they are pressed down onto the shaft. The press approximately 1 cm³ of water resistant grease into the seal.



P0002609

Drive

The S-Drive is equipped with a sacrificial anode that prevents galvanic corrosion. The galvanic protection can be disabled by incorrect electrical installations and suchlike. Damage caused by so-called electrolytic corrosion can appear quickly and can often be extensive. Read more about this in the *Electrical Installations page 55* section.

Incorrectly performed stern drive painting or the wrong type of hull paint may render the galvanic protection ineffective. Read more about painting in the *Storage page 67* section.

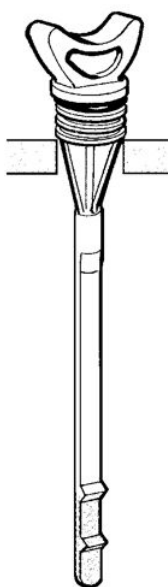
Oil level, checking and topping up

Remove the oil dipstick by unscrewing it counter-clockwise. Wipe the oil dipstick dry and replace it into the stern drive/reverse gear, without screwing it down. Pull out the oil dipstick again and check the oil level. The correct oil level is between the MAX and MIN marks.

If required, top up oil through the oil dipstick hole. For oil grade and quantity, refer to the *Technical Data page 71* section

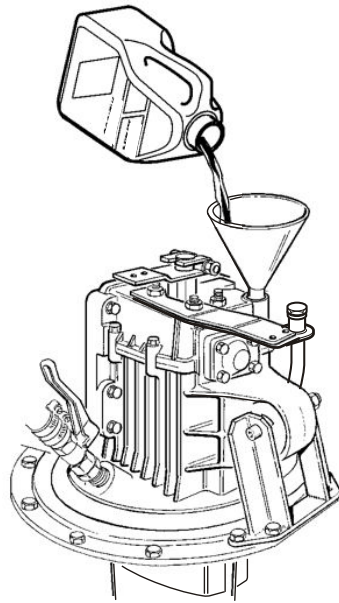
IMPORTANT!

Never overfill the stern drive with oil. The oil level must always be within the marked area.



P0003758

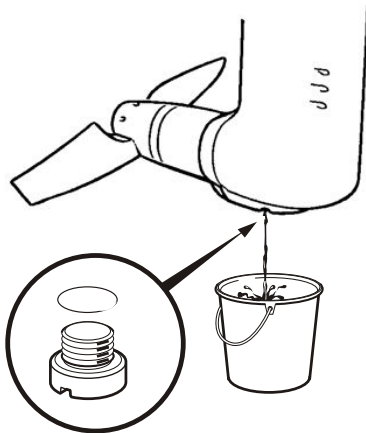
Transmission Oil, Change



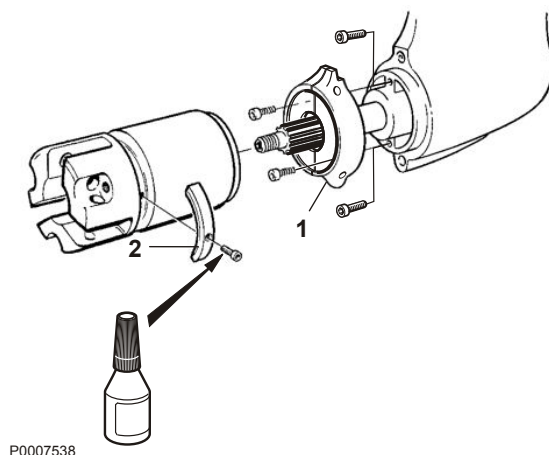
- 1 Pull out the oil dipstick.
- 2 Remove the plug from the propeller gear transmission housing and allow the oil to run out. Check that the plug O-ring is fault free; replace as necessary.
- 3 Install the plug and O-ring.
- 4 Fill with oil to the correct level through the oil dipstick hole. For oil grade and quantity, refer to the *Technical Data page 71* section.

It is also possible to replace oil without laying up the boat, e.g. if the oil change interval is reached during the season. Pump out the oil through a suction pipe using an oil drain pump – this method leaves approx. 0.5 liter (0.15 US gal) remaining in the stern drive. Fill with oil to the correct level through the oil dipstick hole. For oil grade, refer to the *Technical Data page 71* section.

The oil should have a golden brown nuance. If the oil is gray, water has entered the stern drive. In this case let a Volvo Penta workshop carry out checks on the stern drive.



P0007537



Corrosion protection, checking and changing

Check the sacrificial anode (1) on the stern drive and the three sacrificial anodes (2) on the propeller regularly. Replace with new anodes when approximately 1/3 of an anode has corroded away.

When the boat is stored ashore, corrosion protection deteriorates due to oxidization of sacrificial anodes in contact with air. Even new anodes may have surface oxidation. Before launching the sacrificial anodes must be cleaned with emery cloth.

IMPORTANT!

Use emery paper. Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.

- Zinc in salt water.
- Magnesium in freshwater.
- Aluminum when the boat is used primarily in salt water and sometimes in brackish water

Remedy any damaged stern drive paintwork according to the instructions in the *Storage page 67* section.

Replacing sacrificial anodes

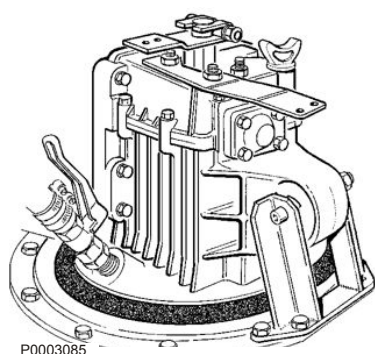
- 1 Remove the sacrificial anodes and thoroughly scrape clean the contact surfaces on the stern drive and propellers.
- 2 Apply thread locking fluid to the bolts to the propeller sacrificial anodes.
- 3 Install the new sacrificial anodes and fasten them to ensure good metallic contact.

Rubber Sealing

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

IMPORTANT!

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



Propeller

The propeller must be cleaned and greased once yearly. Remove the propeller and clean all parts thoroughly. Brush water resistant grease on the propeller blade cogs and bearing surfaces so that the propeller folds easily. Also brush water resistant grease on pins, spacer sleeves (stern drive), propeller shaft and in the propeller hub.

⚠ WARNING!

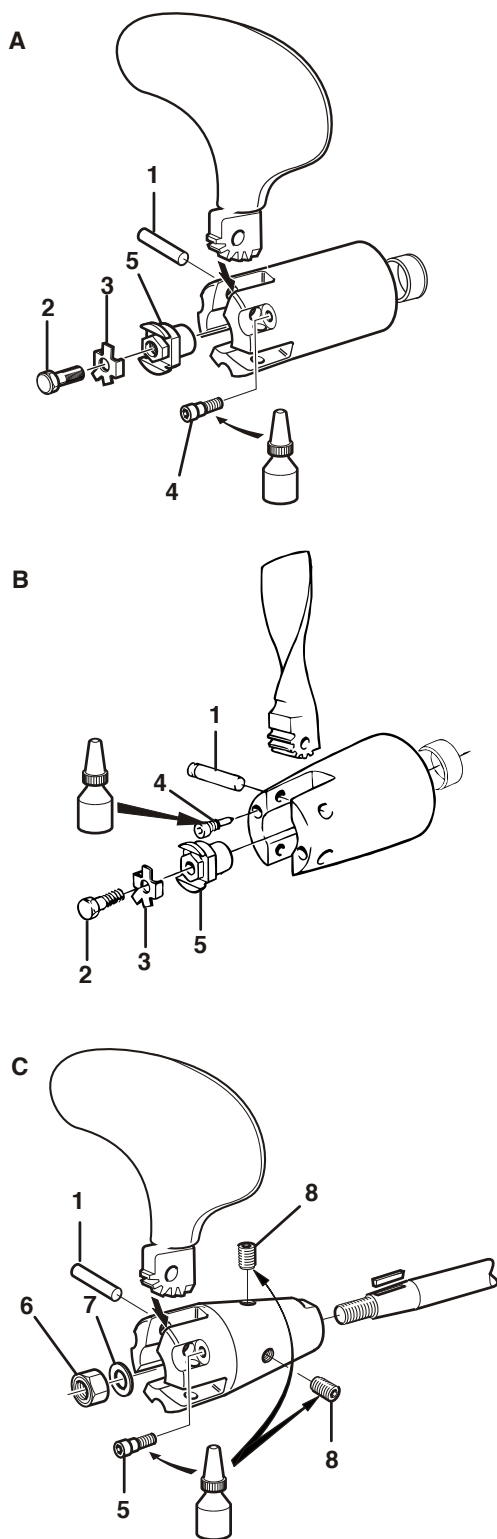
Make sure the engine can not start during work on propeller(s); remove ignition key(s) and shift drive into forward or reverse.

Removal

- 1 Set the control lever to the "Ahead" position.
- 2 Disassemble the propeller blades by screwing out the lock screws (4) completely and then pressing out the pins (1).
- 3 **Stern drive:** Fold down the edge of the tab washer (3) and remove the lock screw (2), tab washer and nut (5).
Reverse gear: Remove the nut (6), washer (7) and then the lock screws (8).
- 4 Pull off the propeller hub and spacer sleeve (stern drive). Clean and grease the propeller.

Installation

- 1 Install the spacer sleeve (stern drive) and the propeller hub onto the shaft.
- 2 **Stern drive:** Install the nut (5). Place a propeller blade in the hub and secure it with a wooden wedge between the propeller blade and hull. Tighten the nut to 70 Nm.
Reverse gear: Fit the washer (7) and tighten the nut (6) to 220 Nm. Apply thread locking fluid to the lock screws (8). Once the lock screws have been tightened, locking fluid should also be applied to their heads.
- 3 **Stern drive:** Place the tab washer (3) on the nut. Install and tighten the lock screw (2) to 20 Nm and bend one of the tab washer tabs against the bolt head.
IMPORTANT!
The tab washer (3) must be replaced if necessary. Only Volvo Penta original lock screws (2) may be used.



P0007539

- A 3-bladed folding propeller (stern drive)
 B 2-bladed folding propeller (stern drive)
 C 3-bladed folding propeller (reverse gear)

- 4 Install one propeller blade to the hub and press in the cotter pin (1) so that the groove in the pin is aligned with the lock screw hole (2). Apply thread locking fluid to the lock screw and tighten it to 10 Nm.
- 5 Install the blades the same way in consecutive order. Check that the blades have the same angle to the propeller shaft and that they move easily.

Storage

Have an authorized Volvo Penta workshop carry out checks on the engine and other equipment before the boat is put into winter storage. Make sure all necessary repairs and service are completed so that the boat is in top condition before the next season.

Conservation is performed to ensure that the engine and drive train are not damaged by non-use during winter storage. It is important that conservation is carried out in the correct manner, and that nothing is forgotten. For this reason, we have compiled a check list of the most important points.

CAUTION!

Read the chapter on Maintenance before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and correct manner.

The engine and other equipment must be laid up to prevent damage if they are not to be used for two months or more. It is important that this is done in the correct manner, and that nothing is forgotten. For this reason, we have compiled a check list of the most important points.

Storage

It is best to carry out the following while the boat is still in the water:

- Change engine oil and oil filters.
- Replace oil in the reverse gear.
- Change the fuel filter. Replace the fuel pre-filter if such is fitted.
- Run engine to normal operating temperature.

It is best to carry out the following when the boat is out of the water:

- Clean the hull and stern drive immediately after the boat is taken out of the water (before they dry). Take care when cleaning with a high pressure jet. 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).
- Cleaning and conserving the raw water system.
- Removing the impeller from the raw water pump. Store the impeller in a sealed plastic bag and keep cool.
- Check the glycol content of the engine coolant. Top up as necessary.

IMPORTANT!

The use of anti-corrosion agent alone in the engine-cooling system does not protect against frost damage. If there is a risk of the engine being exposed to sub-freezing temperatures, the system must be drained.

- Empty the fuel tank of fuel, dirt and sludge. Fill the fuel tank completely, to avoid condensation.
- Clean the outside of the engine. Do not use a high-pressure washer to clean the engine. Touch up any paint damage with Volvo Penta original paint.
- Check all control cables and treat with conservationagent.
- Make good an areas with paintwork damage with Volvo Penta original paint. Read the instructions about painting the stern drive in the section *Storage page 67*.
- Disconnecting the batteries. Clean and charge the batteries. An insufficiently-charged battery can freeze and burst.
- Spraying the components of the electrical system-with water-repellent spray.
- Removing the propeller for winter storage. Grease the propeller shaft with water resistant grease, VP part # 828250.
- Check the rubber seal between the drive and hull.

Bringing Out of Storage

- Check the oil level in the engine and stern drive/ reverse gear. Top up as necessary. If the system contains conservation oil this must be drained, and the system must then be filled with oil. For the correct oil grade, refer to *Technical Data, Lubrication System*. Replace oil filter.
- Drain any antifreeze from the raw water system.
- Install the impeller in the raw water pump. Replace the old one if it displays signs of wear; refer to the chapter *Impeller, Check and Change page 49*.
- Close and tighten drain taps and plugs.
- Check drive belt tensions and conditions.
- Check rubber hoses for condition and tighten hose clamps.
- Check the engine coolant and antifreeze. Top up as necessary.
- Connect the fully-charged batteries.
- Painting the sterndrive and hull bottom.
- Check the sacrificial anode on the stern drive. If less than 2/3 of the anode remain, it must be replaced. Clean with emery cloth shortly before launch.
IMPORTANT!
Use emery paper. Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.
- Install the propellers
- Launch the boat. Check for leaks.
- Vent and grease the propeller shaft packing box (reverse gear).
- Start the engine. Check that there are no fuel, coolant or exhaust leaks and that all controls function.

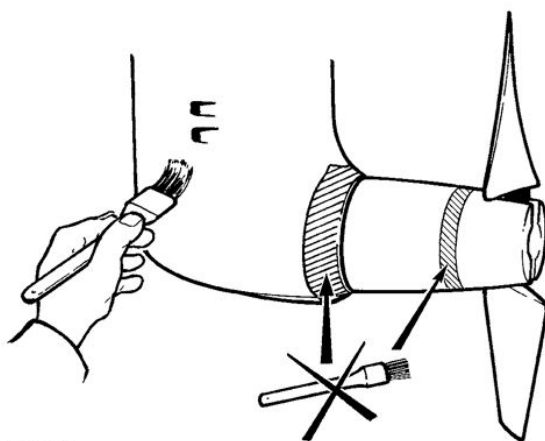
Painting the Drive and Underwater Hull

Stern drive

Paint damage must be remedied before the stern drive is treated with anti-fouling agents.

Most countries have introduced legislation that regulates the use of anti-fouling agents. Anti-fouling agents must be approved for use in those waters where the boat will be deployed. Check what applies where you intend to use the boat. Where anti-fouling agents are not permitted, we recommend brushing pure Teflon®* on the original stern drive paint without prior sanding.

- 1 Lightly sand metal surfaces using emery paper grade 120. Use a finer grade of paper on painted surfaces.
- 2 Wash with cellulose thinners or an equivalent.
- 3 Spackle and sand smooth any pores in the surface.
- 4 Paint with Volvo Penta original primer and paint. Allow to dry.
- 5 Paint the stern drive with anti-fouling agent for aluminum drives according to the manufacturer's recommendations.



P0003083

IMPORTANT!

The sacrificial anodes on the drive must not be painted or treated with Teflon. This also applies to stainless or bronze propellers.

*Teflon is a registered trademark of the DuPont Corporation.

Boat hull

All paints containing anti-fouling agents are poisonous and damage the marine environment. Avoid these preparations. Most countries have introduced legislation that regulates the use of anti-fouling agents. Always follow these regulations. In many cases it is strictly forbidden to use anti-fouling agents on leisure craft.

On boats that are relatively easy to take out of water we recommend treatment using Teflon alone, in conjunction with mechanical cleaning several times per season. However, for larger boats this is not practical. If the boat is in an area where the water causes fast fouling, paints with anti-fouling agents will most likely be necessary. In such cases, use copper-based paint that contains cuprous cyanide and not copper oxide.

Tin-based agents (TBT paints) may not be used. Find out about legislation applicable in the area where the boat is used. Allow the paint to dry before launching the boat.

Technical Data

Engine designation	D1-13	D1-20	D1-30	D2-40
Crankshaft power, kW*	9.0	13.8	20.9	29.1
Propeller shaft, power, kW*	8.6	13.3	20.1	27.9
After sales designation	D1-13 F	D1-20 F	D1-30 F	D2-40 F
Swept volume, l	0.51	0.76	1.13	1.51
No. of cylinders	2	3	3	4
Cylinder diameter/stroke, mm	67/72	67/72	77/81	77/81
Compression ratio	23.5:1	23.5:1	23.5:1	23.5:1
Engine revolutions, rpm	2800-3200	2800-3200	2800-3200	2800-3200
Idle revolutions, rpm	850 ±25	850 ±25	850 ±25	850 ±25
Direction of rotation (seen from front)	Clockwise	Clockwise	Clockwise	Clockwise
Max. permissible rearward inclination in operation	20°	20°	20°	20°
Max. side inclination in operation	30°	30°	30°	30°
Weight, engine less oil and water	96 kg	118 kg	127 kg	148 kg

* According to ISO 8665

Lubrication System

Engine Designation	D1-13	D1-20	D1-30	D2-40
Oil capacity including oil filters, approx.:	1,9 litre	2,8 litre	3,5 litre	6,5 litre
Viscosity	SAE 15W/40, SAE 20W/50	SAE 15W/40, SAE 20W/50	SAE 15W/40, SAE 20W/50	SAE 15W/40, SAE 20W/50
Tightening torque, oil drain plug	30–40 Nm	30–40 Nm	30–40 Nm	30–40 Nm

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

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

- 1) Lowest recommended oil grade. Higher grades oil may always be used.
- 2) If sulfur content is >1.0 % by weight, oil with TBN >15 must be used.
- 3) The lubricating oil must fulfill **both** requirements.
- 4) ACEA E7 has replaced ACEA E5, if the former is not available ACEA E5 may be used.
- 5) ACEA E3 may be replaced by ACEA E4, E5 or E7.
- 6) API CG-4 may be replaced with API CI-4.

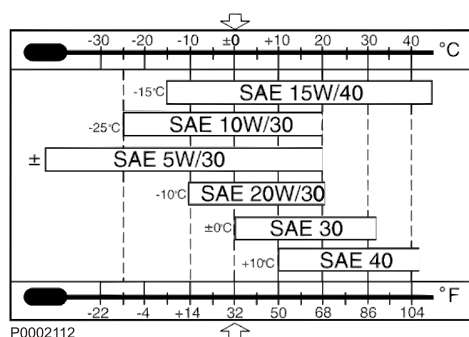
VDS = Volvo Drain Specification
ACEA = Association des Constructeurs Européens d'Automobiles
API = American Petroleum Institute
TBN = Total Base Number
Global DHD = Global Diesel Heavy Duty

Viscosity

Select the viscosity according to the table.

The temperature values refer to stable ambient temperatures.

* SAE 5W/30 refers to synthetic or semi-synthetic oils.



Fuel System

Fuel specification

The fuel must comply with national and international standards for commercially supplied fuels, such as:

EN 590 (with national environment and cold requirements)

ASTM D 975 No 1-D and 2-D

JIS KK 2204

Sulfur content: Complying with legal requirements in each country.

Low density fuel (urban diesel in Sweden and city diesel in Finland) can cause a loss of up to 5% of power and an increase in fuel consumption of about 2–3%.

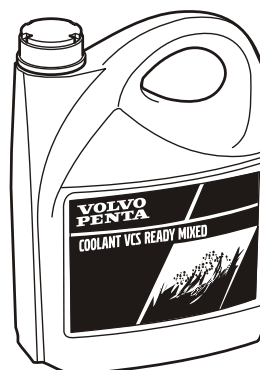
Cooling System

Engine Designation	D1-13	D1-20	D1-30	D2-40
Freshwater system volume, approx	2.7 litre	3.0 litre	4.0 litre	6.4 litre
	0.7 US gals	0.8 US gals	1.0 US gal	1.7 US gals
Thermostat				
starts to open at	90±2°C	90±2°C	90±2°C	90±2°C
	190-198°F	190-198°F	190-198°F	190-198°F
fully open at	102°C	102°C	102°C	102°C
	215°F	215°F	215°F	215°F

Coolant

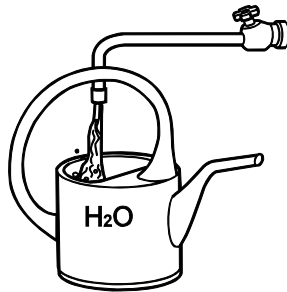
Volvo Penta Coolant VCS and VCS Ready Mixed (yellow colour) are based on Organic Acid Technology, OAT.

Volvo Penta Coolant and Coolant Ready Mixed (green colour) are silicate based.



P0013077

Water Quality



P0002094

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

Electrical System

System voltage	12 V
Battery capacity (starter battery)	70 Ah
Alternator	
voltage/max. current	14 V/115 A
power, approx.	1610 W
Starter motor, power, 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 capacity	0,35 litre	0,56 litre
Oil quality	SAE 15W-40	SAE 15W-40
Weight	11 kg	16 kg

S-drive

Type designation	130S-B, 130SR-B
Gear ratio	2.19:1
Gear ratio	2.9 litre
Oil quality	SAE 15W-40
Weight	26.5 kg
Tightening torque, oil drain plug	10 ±5 Nm

Identification Numbers

There are type plates on the engine and transmission, marked with identification numbers. This information must always be used as reference when service and spare parts are ordered. You will probably find similar plates on your boat and its equipment. Note this information below, make a copy of the page and store it in a safe place, so that you can have the information available if the boat is stolen.

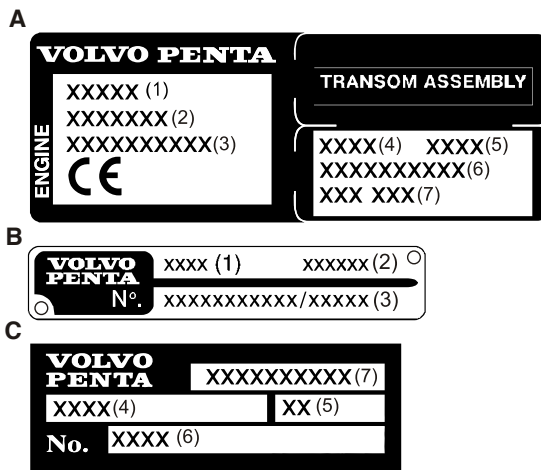
The appearance and location of the type plates is shown below. The figures in brackets refer to the location of the identification number on the type plate.

Engine

Product designation (1):
 Product number (2):
 Serial number (3):

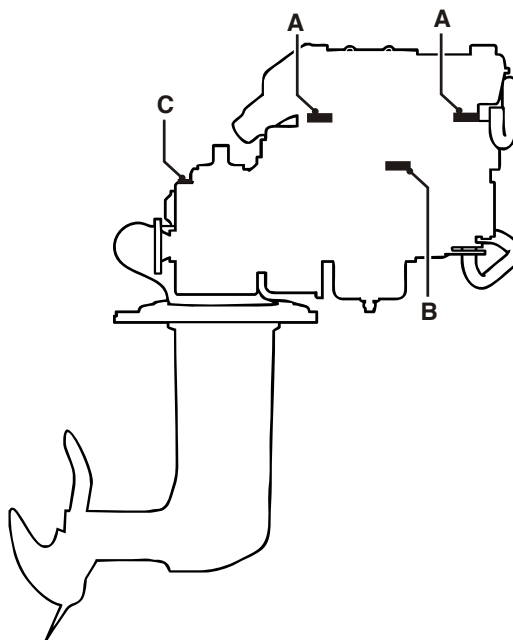
Transmission

Product designation (4):
 Gear ratio (5):
 Serial number (6):
 Product number (7):



P0007541

- A Engine and transmission decal
- B Engine plate
- C Transmission plate



p0007825

VOLVO PENTA

Declaration of Conformity for Recreational Craft Propulsion Engines with the exhaust emission requirements of Directive 94/25/EC as amended by 2003/44/EC

D1, D2

Engine manufacturer:

AB Volvo Penta
Gropegårdsgatan
405 08 Göteborg
Sweden

Body for exhaust emission assessment:

TÜV SÜD Product Service GmbH
Ridlerstrasse 65
80339 München
Germany
ID Number: 0123

Modules used for exhaust emission assessment B + C
Other Community Directives applied EMC 89/336/EEC

Description of engine(s) and essential requirements

Engine Type 4 stroke diesel engine

Engine model(s) covered by this declaration	EC Type certificate number
D1-13.....	SB5 08 07 66019 005
D1-20.....	SB5 08 07 66019 005
D1-30.....	SB5 08 07 66019 006
D2-40.....	SB5 08 07 66019 006

Essential requirements	Standards Used	Other normative document used
Annex I.B – Exhaust Emissions		
Engine identification	Volvo Penta std	Annex 1.B.1
Exhaust emission requirements	EN ISO 8178	Annex 1.B.2
Durability	Volvo Penta std	Annex 1.B.3
Operator's manual	ISO 10240:2004	Annex 1.B.4
EMC Directive	EN 61000-3-2, EN 61000-3-3, CISPR 25	

This declaration of conformity is issued under the sole responsibility of the manufacturer. I declare on behalf of the engine manufacturer that the engine(s) will meet the requirements of above mentioned directives when installed in a recreational craft, in accordance with the engine manufacturer's supplied instructions and that this (these) engine(s) must not be put into service until the recreational craft into which it is (they are) to be installed has been declared in conformity with the relevant provisions of the above mentioned Directives

Name and function: Tom Tveitan Product Liability
(identification of the person empowered to sign on behalf of the engine manufacturer or his authorised representative)

Signature and title:
(or an equivalent marking)



Date and place of issue: (yr/month/day) 2008/08/29 Göteborg

PL-103/08, issue 01

Operator's Manual Order

This Operator's Manual may be ordered in a different language free of charge up to 12 months after delivery, via internet.

Please refer to the link below. On the web page, type in the publication number found in the bottom of this page (7–8 digits).

<http://vppneuapps.volvo.com/manual/coupon/>

If internet access isn't possible, please contact your Volvo Penta dealer.

All order information is stored internally at AB Volvo Penta and will not be shared with third parties.



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**VOLVO
PENTA**

AB Volvo Penta

SE-405 08 Göteborg, Sweden

www.volvopenta.com