

OPERATOR'S MANUAL

VOLVO PENTA IPS 350/400/450/500/600

ENG

This operator's manual is available in English.

Complete the form at the end of the operator's manual to order a copy.

GER

Diese Betriebsanleitung ist auch auf Deutsch erhältlich.

Ein Bestellcoupon ist am Ende der Betriebsanleitung zu finden.

FRE

Ce manuel d'instructions peut être commandé en français.

Vous trouverez un bon de commande à la fin du manuel d'instructions.

SPA

Este libro de instrucciones puede solicitarse en español.

El cupón de pedido se encuentra al final del libro.

SWE

Den här instruktionsboken kan beställas på svenska.

Beställningskupong finns i slutet av instruktionsboken.

ITA

Questo manuale d'istruzioni può essere ordinato in lingua italiana.

Il tagliando per l'ordinazione è riportato alla fine del manuale.

DUT

Dit instructieboek kan worden besteld in het Nederlands.

De bestelcoupon vindt u achter in het instructieboek.

DAN

Denne instruktionsbog kan bestilles på dansk.

Bestillingskupon findes i slutningen af instruktionsbogen.

FIN

Tämän ohjekirjan voi tilata myös suomenkielisenä.

Tilaukuponki on ohjekirjan lopussa.

POR

Este manual de instruções pode ser encomendado em português.

O talão de requerimento encontra-se no fim do manual.

GRE

Αυτό το εγχειρίδιο χρήσης διατίθεται στην αγγλική γλώσσα.

Για να παραγγείλετε ένα αντίτυπο, συμπληρώστε τη φόρμα που βρίσκεται στο τέλος αυτού του εγχειριδίου χρήσης.

TUR

Bu kullanýcý el kitabý Türkçe dillerinde mevcuttur.

Birñüşhasýný sipariş etmek için kullanýcý el kitabýnýñ sonundaki formu doldurun.

RUS

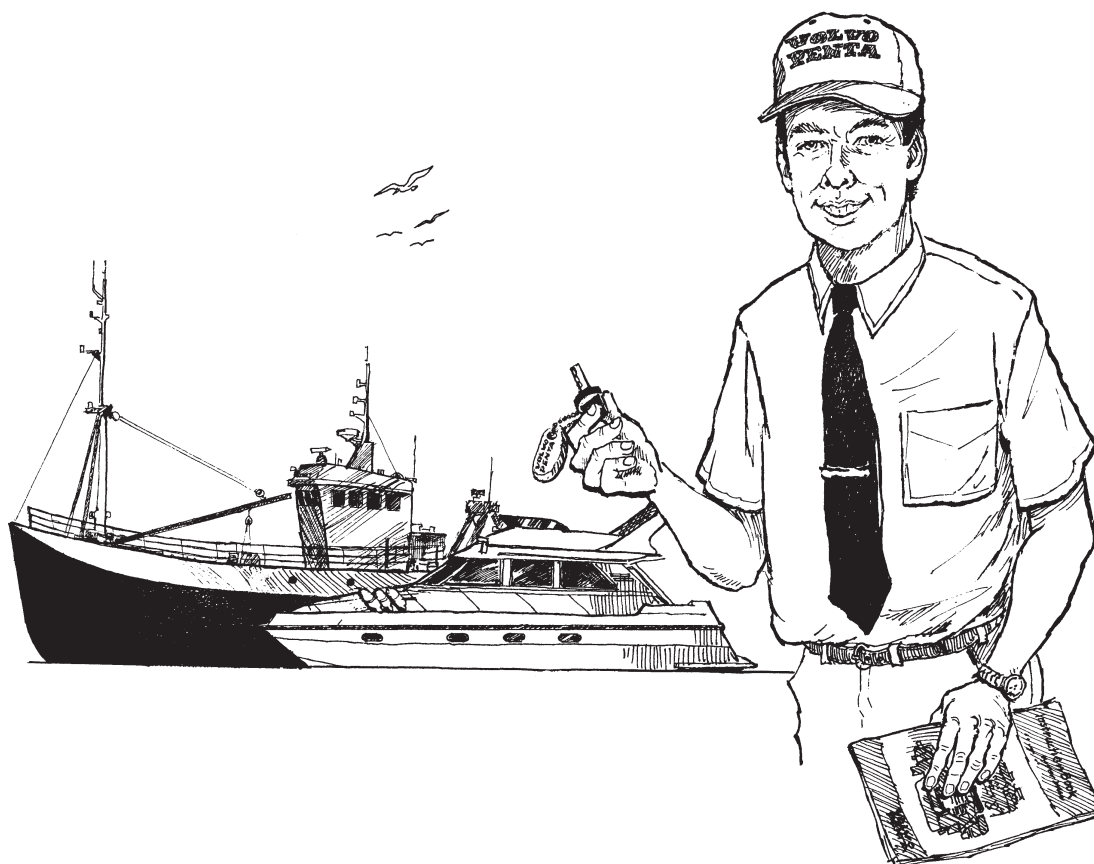
Данное руководство оператора имеется на турецком и русском языках.

Для получения инструкции на нужном языке заполните форму в конце инструкции.

CALIFORNIA

Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.



Welcome aboard

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. That's not surprising.

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 operation 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.

We also invite you to visit our home page on the Internet at www.volvopenta.com

With warm regards

AB VOLVO PENTA

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Safety Information

Read this chapter carefully. It concerns your safety. This section describes how safety information is presented in the operator's manual and on the engine. It also gives a general account of basic safety precautions to be taken when operating the boat and maintaining the engine.

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



If operations are performed incorrectly it could result in personal injury, or damage to property or the engine. Read the operator's manual carefully before operating or servicing the engine. If anything is unclear please contact your Volvo Penta dealer for assistance.

 This symbol is used in the book and on the engine to make you aware of safety information. Always read these safety precautions very carefully.

In the operator's manual warning texts have the following priority:

 **WARNING!** If these instructions are not followed there is a danger of personal injury, extensive damage to the product or serious mechanical malfunction.

 **IMPORTANT!** Used to draw your attention to something that can cause damage, product malfunction or damage to property.

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



This symbol is used in certain cases on our products and refers to important information in the operator's manual. Ensure that warning and information symbols on the engine and transmission are always visible and legible. Replace symbols that have been damaged or painted over.

Safety precautions to be taken when operating the boat

Your new boat

Read operator's manuals and other information supplied with your new boat. Learn to operate the engine, controls and other equipment safely and correctly.

If this is your first boat, or is a boat type with which you are not familiar, we recommend that you practice controlling the boat in peace and quiet. Learn how the boat behaves at different speeds, weather conditions and loads before casting off for your "real" maiden voyage.

Remember that the person driving a boat is legally required to know and follow the current rules regarding traffic and safety at sea. Make sure you know the rules that apply to you and the waters you are sailing in by contacting the relevant authorities or organization.

A good piece of advice is to take a course in seamanship. We recommend that you contact your local boating organization to find a suitable course.

Accidents

Statistics show that poor maintenance of boats and engines and a lack of safety equipment are often the cause of accidents at sea.

Ensure that your boat is maintained in accordance with the relevant Instruction Manual and that the necessary safety equipment is on-board and is serviceable.

Daily checklist

Make a habit of checking the engine and engine compartment visually before operating the boat (**before the engine is started**) and after operating the boat (**after the engine has been stopped**). This will help you to quickly detect fuel, coolant or oil leaks and spot anything else unusual that has or is about to happen.

Maneuvering

Avoid violent and unexpected changes in course and gear engagement. This could cause someone on the boat to lose their balance and fall over or overboard.

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.

Refueling

When refueling there is always a danger of fire and explosion. Smoking is forbidden and the engine must be switched off.

Never overfill the tank. Close the fuel tank filler cap properly.

Only use the fuel recommended in the operator's manual. The wrong grade of fuel can cause operating problems or cause the engine to stop. On a diesel engine poor quality fuel can cause the control rod to seize and the engine to overrev with a resultant risk of damage to the engine and personal injury.

Do not start the engine

Do not start or run the engine with a suspected fuel or LPG leak in the boat, nor when you are close to or in a discharge of explosive media, etc. There is risk for fire and/or explosion in explosive surroundings.

Safety breaker

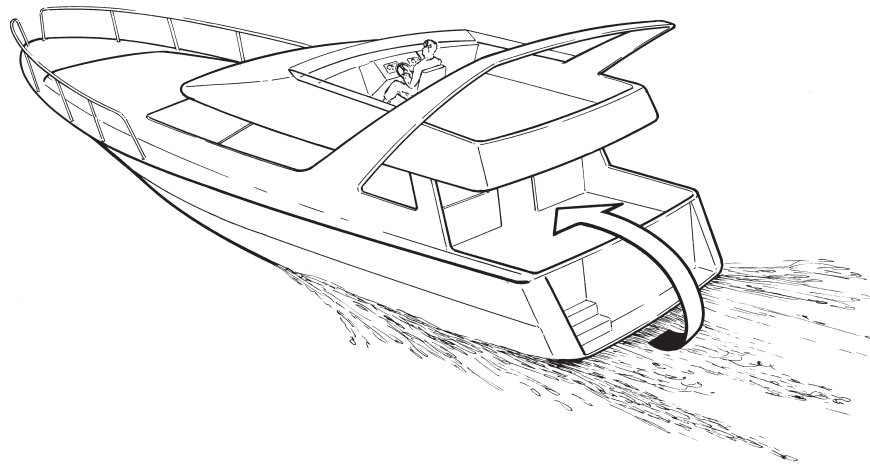
We recommend that you install and use a safety breaker (accessory), especially if you boat can travel at high speeds. The safety breaker stops the engine if the driver falls down and loses control over the boat.

⚠ Carbon monoxide poisoning

When a boat is moving forward, it will cause a certain vacuum to form behind the boat. In unfortunate circumstances, the suction from this vacuum can be so great that the exhaust gases from the boat are drawn into the cockpit or cabin and cause carbon monoxide poisoning.

This problem is most prevalent on high, wide boats with abrupt stern. In certain conditions, however, this suction can be a problem on other boats, e.g. when running with the cover up. Other factors that can increase the effect of the suction are wind conditions, load distribution, swells, trim, open hatches and portholes, etc.

Most modern boats, however, are designed in such a way that this problem is very rare. If suction should arise anyway, do not open hatches or portholes at the fore of the boat. Surprisingly, this will otherwise increase the suction. Try changing speed, trim or load distribution instead. Try taking down/opening or in any other way changing the setup of the cover as well. Get in touch with your boat dealer for help in obtaining the best solution for your boat.



⚠ Checklist

- Safety equipment Life jackets for all passengers, communication equipment, emergency rockets, approved fire extinguisher, first-aid equipment, life belt, anchor, paddle, torch etc.
- Replacement parts and tools: impeller, fuel filters, fuses, tape, hose clamps, engine oil, propeller and tools for any repairs that might have to be carried out.
- Get out your charts and go over the planned route. Calculate distance and fuel consumption. Listen to the weather reports
- Make sure that relations or contact persons are informed when planning a longer voyage. Remember to inform them if your plans have changed or been delayed.
- Tell your passengers and crew where the safety equipment is stored and how to operate it. Make sure you are not the only person on board who knows how to start the boat and operate it safely.

This list can be added to because safety equipment and other requirements vary depending on the type of boat and how it is used. We recommend that you contact your local boating organization for more detailed information on safety afloat.

Safety precautions for maintenance and service operations

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 that 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 be undertaken by an authorized Volvo Penta workshop.

Lifting the engine

When lifting the engine use the lifting eyes installed on the engine. Always check that lifting equipment is in good condition and has sufficient load capacity to lift the engine (engine weight 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 ignition system (gasoline engines) and electrical systems on Volvo Penta products are designed and constructed to minimize the risk of fire and explosion.

Using non-original Volvo Penta parts can result in fire or explosion on board.

Batteries

The batteries contain and give off 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.

Incorrectly connection 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.

Steering system

The boat has a advanced steering system. DO NOT change connectors, wiring or splice of the components.

Service must be done by approved workshops which have certified personnel with qualified professional training.

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 compiled to help you get the most from your Volvo Penta engine. It contains all the information you need in order to operate and maintain your engine safely and correctly. Please read the operator's manual carefully and learn how to operate the engine, controls and other equipment safely.

Always have the operator's manual available. Keep it in a safe place and do not forget to give it to the new owner if you sell your boat.

Care of the environment

We would all like to live in a clean and healthy environment. Somewhere where we can breathe clean air, see healthy trees, have clean water in our lakes and oceans, and are able to enjoy the sunshine without being worried about our health. Unfortunately, this cannot be taken for granted nowadays but is something we must work together to achieve.

As a manufacturer of marine engines, Volvo Penta has a special responsibility, why care of the environment is a core value in our product development. Today, Volvo Penta has a broad range of engines where progress has been made in reducing exhaust emissions, fuel consumption, engine noise, etc.

We hope you will take care in preserving these qualities. Always follow any advice given in the instruction manual concerning fuel grades, operation and maintenance and you will avoid causing unnecessary interference to the environment. Get in touch with your Volvo Penta dealer if you notice any changes such as increased fuel consumption exhaust smoke.

Adapt speed and distance to avoid wash and noise disturbing or injuring animal life, moored boats, jetties, etc. Leave islands and harbours in the same condition as you want to find them. Remember to always leave hazardous waste such as waste oil, coolant, paint and wash residue, flat batteries, etc., for disposal at a destruction plant.

Our joint efforts will make a valuable contribution to our environment.

Environmental performance for Volvo Penta IPS500/IPS400

The Volvo Penta IPS500 /IPS400 has been developed as a complete system with excellent environmental performance as one of the main design targets. The very high efficiency of the Volvo Penta IPS system gives greatly reduced overall emissions per nautical mile. Sound emissions are also extremely low compared with traditional inboard installations.

Running-in

The engine must be run in for its first 10 operating hours as follows: Operate the engine normally. Do not operate it at full load except for short periods. Never run the engine at a constant engine speed for long periods during the running-in period.

The engine can be expected to use more engine oil during the running-in period than would otherwise be normal. Check the oil level more often than is normally recommended.

A First Service Inspection must be carried out after 20–50 running hours. For further information: See the Warranty and Service Book.

Fuel and oils

Only use the fuel and oils recommended in the chapter Technical Data. Other grades of fuel and oil can cause operating problems, increased fuel consumption and, in the long-term, a shorter engine service life.

Always change oil, oil filters and fuel filters at the recommended intervals.

Service and replacement parts

Volvo Penta marine engines are designed for high operational reliability and long service life. They are constructed to withstand the marine environment while also affecting it as little as possible. Through regular service and the use of Volvo Penta original spare parts, these qualities will be retained.

The Volvo Penta worldwide network of authorized dealers are at your service. They are specialists in Volvo Penta products and have accessories and the original replacement parts, test equipment and special tools necessary for high quality service and repair work.

Always follow the maintenance intervals contained in the operator's manual. Remember to state the engine/transmission identification number when ordering service and replacement parts.

Certified engines

It is important to be aware of the following information if you own or run an engine that is exhaust emission certified:

Certification means that an engine type is inspected and approved by the authorities. The engine manufacturer guarantees that all engines manufactured of that type correspond to the certified engine.

This places special requirements for maintenance and service as follows:

- The maintenance and service intervals recommended by Volvo Penta must be observed.
- Only by Volvo Penta approved replacement parts may be used.
- The service of injection pumps and injectors or pump settings must always be carried out by an authorized Volvo Penta workshop.

- The engine must not be modified in any way except with accessories and service kits approved by Volvo Penta.
- No modifications to the exhaust pipes and air supply ducts for the engine may be undertaken.
- Seals may only be broken by authorized personnel.

Otherwise the general instructions contained in the Operator's Manual concerning operation, service and maintenance must be followed.

⚠ IMPORTANT! Late or inadequate maintenance/service or the use of spare parts other than by Volvo Penta approved spare parts 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.



Warranty

Your new Volvo Penta marine engine is covered by a limited warranty according to the conditions and instructions contained in the Warranty and Service book.

Note that AB Volvo Penta's liability is limited to that contained in the Warranty and Service Book. Read this book as soon as you take delivery of the engine. It contains important information about warranty cards, service and maintenance which you, the owner, must be aware of, check and carry out. Liability covered in the warranty may otherwise be refused by AB Volvo Penta.

Contact your Volvo Penta dealer if you have not received a Warranty and Service Book and a customer copy of the warranty card.

VOLVO PENTA

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

VOLVO PENTA IPS

Engine manufacturer

AB Volvo Penta
Gropegårdsgatan
405 08 Göteborg
Sweden

Body for sound and exhaust emission assessment

International Marine Certification Institute
Rue Abbé Cuypres 3
B-1040 Bruxells
Belgium
ID Number: 0609

Module used for sound emission assessmentAa

Internal production control
Test according to Annex VI

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 with stern drive
with integral exhaust

Engine(s) models covered by this declaration

Volvo Penta IPS 350 (D4-260)

Volvo Penta IPS 400 (D4-300).....SDVOLF005 (noise)
EXVOLF001 (exhaust)

EC Type certificate number

Volvo Penta IPS 400 (D6-310)

Volvo Penta IPS 450 (D6-330)

Volvo Penta IPS 500 (D6-370)

Volvo Penta IPS 600 (D6-435).....SDVOLF004 (noise)
EXVOLF001 (exhaust)

Essential requirements	Standards Used	Other normative document used
Annex I.B – Exhaust Emissions		
Engine identification	Volvo Penta std	Annex I.B.1
Exhaust emission requirements	EN ISO 8178-1:1996	Annex I.B.2
Durability	Volvo Penta std	Annex I.B.3
Operator's manual	ISO 10240:2004	Annex I.B.4
Annex I.C – Noise Emissions		
Sound emission levels	EN ISO 14509:2000/prA1:2004	Annex I.C.1
Operator's manual	ISO 10240:2004	Annex I.C.2
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) mentioned above comply(s) with all applicable essential requirements in the way specified and is in conformity with the type for which above mentioned EC type examination certificate(s) has been issued.

Name and function: Sam Behrmann, Laws and Regulations
(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) 2007/04/26 Göteborg

PL-101/07

Identification numbers

Always provide the engine and transmission identification numbers when ordering service or replacement components.

The identification numbers are on an information decal located on the front edge of the engine. Note the information below. Make a copy of the page. Store the information so that it is available in event of the boat being stolen.

Engine

Product designation (1*)

Serial number (2*)

Product number (3*)

Drive-unit

Product designation (4*)

Gear ratio (5*)

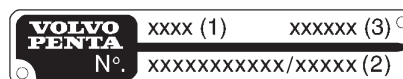
Serial number (6*)

Product number (7*)

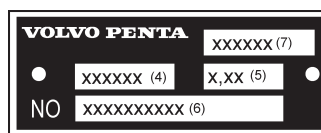
* The numbers refer to the position of the identification numbers on the information decal



Warranty decal (Engine/Drive-unit)

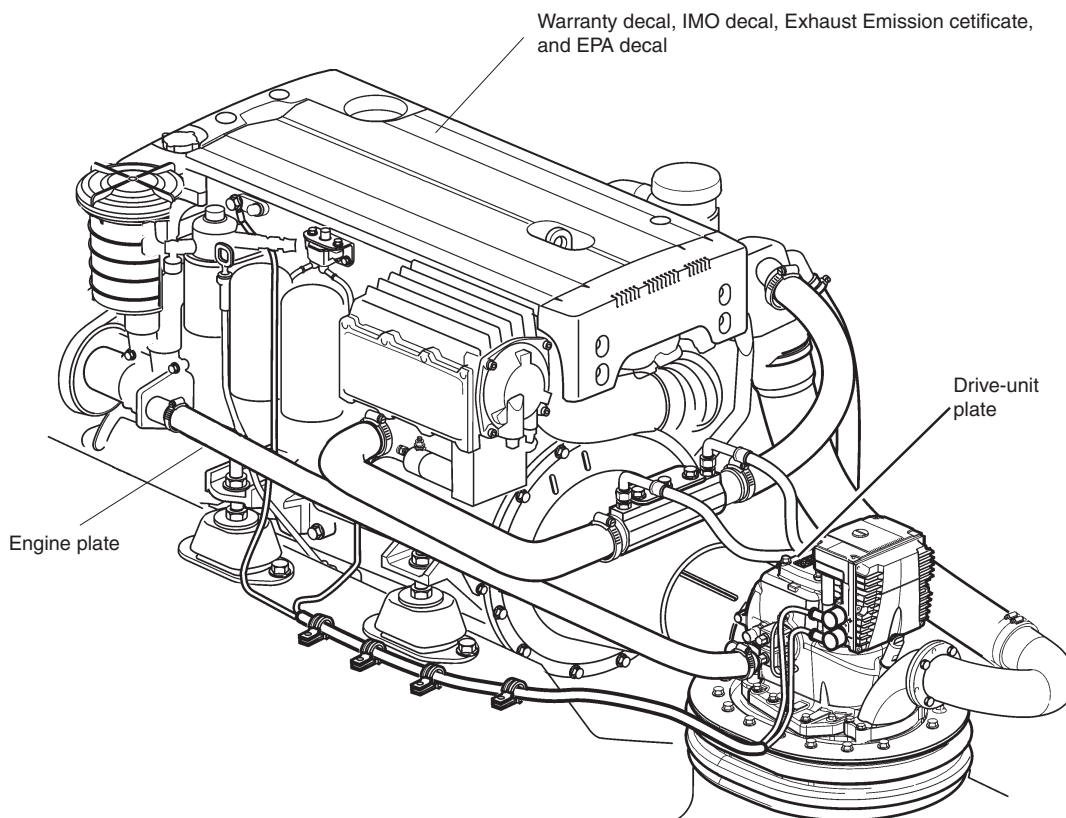


Engine plate

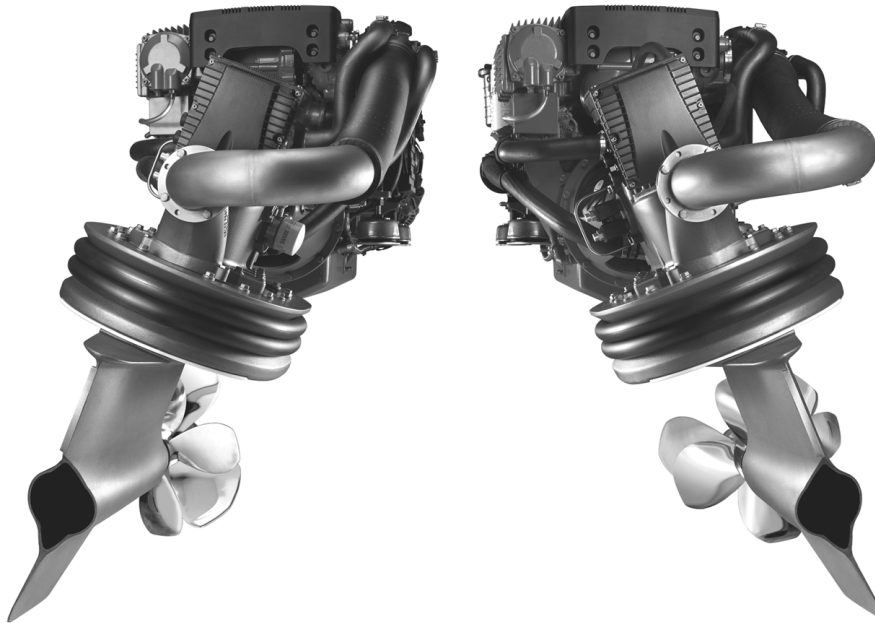


Drive-unit plate

Location of information decal and identification plates:



Volvo Penta IPS – Inboard Performance System



Volvo Penta IPS overview

Volvo Penta IPS is setting a new standard:

- Much improved efficiency, higher top speed, reduced fuel consumption/extended range and great acceleration
- Low-speed maneuvering is easier than ever before, and high speed handling is a dream
- Onboard comfort is greatly enhanced thanks to much lower levels of sound and vibrations
- Installation is greatly simplified
- More space available for accommodation
- Improved safety and quality
- Ease of service and a complete system supported by one supplier
- Improved overall environmental care

All this is combined with the usual benefits of a traditional inboard such as a robust, high strength construction, excellent corrosion resistance and the propellers under the hull.

Maneuvering and handling

The reasons for the amazing maneuverability are:

- The Volvo Penta IPS drive-units are steerable, turning and pointing the entire thrust in the desired direction. This results in much higher efficiency and far greater response to driver commands.
- Two counter-rotating propellers on each propulsion unit means that there are no lateral forces to consider and that tracking is completely straight.
- Electronic controls give a distinct and precise feeling, and shifting is immediate. Thanks to the progressive electronic steering, the wheel spins easier at low speed, further reducing driver effort.

Comfort

Volvo Penta IPS new technology leads to major improvements for all comfort enhancing factors.

- The propulsion forces and vibrations are absorbed by the combined rubber suspension and sealing.
- A U-joint in the drive shaft makes it possible to have the engine soft suspended, which efficiently reduces engine vibrations.
- The propellers are working in undisturbed water with no cavitation, and have good clearance from the hull.
- There is an increased number of propeller blades to distribute the forces. This means that the pulses created by the propellers have very little effect on the hull.
- Exhaust fumes are truly minimized. First of all, the new engine has very low exhaust emissions, and secondly, the exhausts are emitted through the propulsion unit into the prop wash and carried well behind the boat.

Installation

The Volvo Penta IPS system can be installed in various ways, either as a compact system or with an extended jackshaft, giving opportunities for different boat designs.

The system is always used in twin engine installation configuration.

Safety and quality

Heavy duty material throughout means excellent corrosion resistance. Everything in contact with seawater is either made from a specially formulated nickel-aluminum-bronze alloy or stainless steel. Propulsion unit, bearings, couplings, etc. are all robustly dimensioned to cope with the unexpected and ensure a really long and trouble-free service life.

EVC handles all communication and monitoring including shift, throttle and steering. Several safety functions in the system minimize the risk of damage to engine or propulsion unit.

The Volvo Penta IPS system is designed with full redundancy, i.e. even if you have a total breakdown in one driveline, the remaining one will bring you home safely.

Environmental care

The Volvo Penta IPS has been developed as a complete system with excellent environmental performance as one of the main design targets. The very high efficiency of the Volvo Penta IPS system gives greatly reduced overall emissions.

Volvo Penta's new D6 in-line engines have been developed from the latest design in modern diesel technology. The engines have common rail fuel injection system, double overhead camshafts, 4 valves per cylinder, turbocharger, compressor (Volvo Penta IPS 350, IPS 500 and IPS 600), and aftercooler. The interaction of these, the large swept volume, and the EVC system results in exceptional diesel performance combined with low emissions.

The D4/D6 engines have emission levels that meet the forthcoming, stringent US and EU regulations due in 2006.

Engine technical description

Volvo Penta's D6 is developed from the latest design in modern diesel technology. The engine has common rail fuel injection system, double overhead camshafts, 4 valves per cylinder, turbocharger, compressor, and after-cooler. The interaction of these, the large swept volume, and the EVC system results in exceptional diesel performance combined with low emissions.

Engine block and head

- Cylinder block and cylinder head made of cast-iron
- Ladder frame fitted to engine block
- Double overhead camshafts
- Oil-cooled pistons with two compression rings and one oil scraper ring
- Integrated cylinder liners
- Replaceable valve seats
- Seven-bearing crankshaft
- Rear-end transmission

Engine mounting

- Flexible engine mounting

Lubrication system

- Easily replaceable separate full-flow and by-pass oil filter
- Seawater-cooled tubular oil cooler

Fuel system

- Common rail fuel injection system
- Control unit for processing the injection
- Fine filter with water separator

Air inlet and exhaust system

- Belt-driven compressor with silencer of absorption type on both inlet and output port
- Air filter with replaceable insert
- Crankcase gases vented into the air inlet
- Exhaust elbow or exhaust riser
- Freshwater-cooled turbocharger

Cooling system

- Thermostatically regulated freshwater cooling
- Tubular heat exchanger with separate large volume expansion tank
- Coolant system prepared for hot water outlet
- Seawater strainer and easily accessible impeller pump

Electrical system

- 12V/24V two-pole electrical system
- 115A/80A marine alternator with Zener-diodes to protect the system from peak voltage, and integrated charging regulator with battery sensor cable for maximum use of alternator
- Fuses with automatic reset
- Aux. stop device

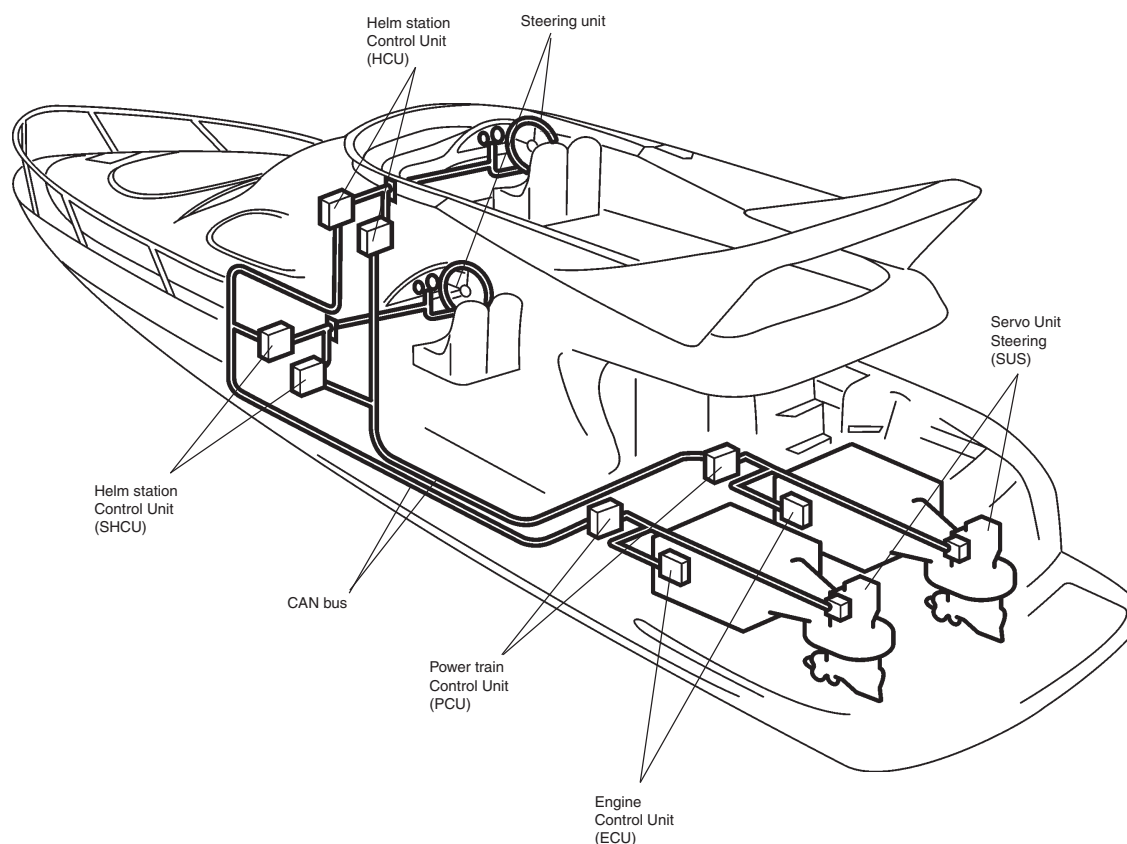
Instruments/control

- Complete instrumentation including key switch and interlocked alarm
- EVC monitoring panels for single or twin installations
- Electronic remote control for throttle and shift
- Plug-in connections

Accessories

- An extensive range of accessories are available. For detailed information, please see Accessory catalogs.

Engine monitoring and the EVC^{EC} system



Engine monitoring system

The engines are equipped with common rail system and electronically controlled injectors.

The injectors contain an electro-magnetic valve which sets the amount of fuel injected and the correct timing. The monitoring system measures the charge air pressure and temperature, and calculates the available air mass. This determines the maximum amount of fuel that can be injected (smoke limiter function).

The system also limits the maximum torque available at the engine speed registered to protect the engine and transmission from overload.

To protect the engine at too high coolant or charge air temperatures and boost pressure as well as oil pressure, the monitoring system reduces the amount of fuel (reduced engine output) until the current values are normalized.

The engine monitoring system also has a diagnostic system, which helps users and service technicians to determine the cause of malfunctions.

Users get information about faults by pop-ups that are shown on the EVC system tachometer display.

The EVC^{EC} system

The Electronic Vessel Control (EVC) system is a so called distributed system. The principle of a distributed system is to have "small" electronic units, called nodes, located at suitable places in the boat.

The EVC nodes are the Powertrain Control Unit (PCU) and the Steering Helm station Control Unit (SHCU). Nodes are located close to the components they control. A helm node is located close to the helm. A powertrain node is mounted in the engine room.

Each node controls a number of adjacent components, such as sensors, controls, instruments and actuators.

Each PCU and HCU is programmed for a specific engine. There is a sticker with serial no. and chassis no. on each PCU and HCU. The chassis no. must correspond with the sticker on the engine.

A data bus, a CAN bus, connects the nodes to each other. Together they form a network and exchange information and take advantage of each others' services. The principle of forming a network of nodes to which all components are connected reduces wiring radically. A CAN bus can be very long, but in the EVC system the bus length shall not exceed 50 meters.

CAN stands for Controller Area Network, an industry standard for communication between nodes in distributed systems.

A distributed system supports a growing multiplicity of system configurations and optional features. New nodes can be connected to the network with minimal wiring redesign. New effective functionality can be created by letting the nodes interact and combine their capabilities, creating a more useful and safe product.

Functionality

Steering system

The steering system is operated through the EVC system and gives a smooth and exact steering. It also provides possibilities, which are not possible with a traditional steering system.

The helm steering unit sends an electrical signal via the EVC system to the servo unit fitted on the drive-unit.

The steering is progressive and the turn rate automatically adjusted to suit the actual boat speed for optimised comfort and boat handling.

For reliability the steering system is built with redundancy on several levels.

Engine speed and gear shift

Speed and gear shift control is handled electronically with dual function electronic controls.

Multiple helm stations

Up to four helm stations can easily be installed (plug in). The EVC system provides different options for station transfers in neutral position or under way. Another safety feature is a helm station "lock function" to avoid unexpected station transfers.

Engine synchronization

Engine synchronization results in better comfort, good fuel economy and minimized wear due to less vibration and reduced noise level. The master (port) and slave (starboard) systems must be able to communicate to allow synchronization. For this reason a synchronization cable must be installed at each helm.

Instrumentation

The instruments use a serial communication bus. The serial communication bus in combination with EVC radically reduces wiring and simplifies installation.

Gauges are available with white or black dial face and chromed or black bezel.

EVC system tachometer

The EVC system tachometer is mandatory for boats with EVC, unless the optional EVC system display is installed. The tachometer display shows operation information, information messages and alarms. The user selects what operation information to display with the control panel. **NOTE!** Only one operation information can be displayed at one and the same time.

The EVC system tachometer and control panel is also used when calibrating EVC functions.

Extra optional equipment

EVC system display

The EVC system display is a complement or replacement for EVC system tachometer and optional instruments. The display shows operation information, information messages and alarms. The user selects what operation information to display with the buttons on the display. The EVC system display can display more than one operation information at one and the same time. The display also has access to the same display mode and calibration functions as for the EVC system tachometer display.

Fuel level

Fuel level can be displayed on the EVC system tachometer if a (0-180 ohm or 240-30 ohm) fuel level sender is installed in the fuel tank. The sender is connected to the PCU-engine cable harness. If a fuel level gauge is used it must be connected to the instrument serial communication bus.

Fresh water level

Fresh water level can be displayed on the EVC system tachometer if a (0-180 ohm) fuel level sender is installed in the water tank. The sender is connected to the PCU-engine cable harness. If a fresh water level gauge is used it must be connected to the instrument serial communication bus.

Rudder indicator

A rudder indicator sender is included in all drive-units. The rudder angle can be displayed on the EVC system tachometer. If a rudder instrument is used it must be connected to the instrument serial communication bus.

Multi sensor (Boat speed, depth and water temp)

Boat speed, depth and water temperature can be displayed on the EVC system tachometer if a multi sensor is installed on the boat. The sensor is connected to the multilink cable. If instruments (speed, depth, water temp.) are used they must be connected to the instrument serial communication bus.

Boat speed

Boat speed can be shown on the EVC system tachometer, if a multisensor or NMEA 0183/NMEA 2000 compatible component (plotter, GPS, paddle wheel etc) is installed. If a speedometer is used it must be connected to the instrument serial communication bus.

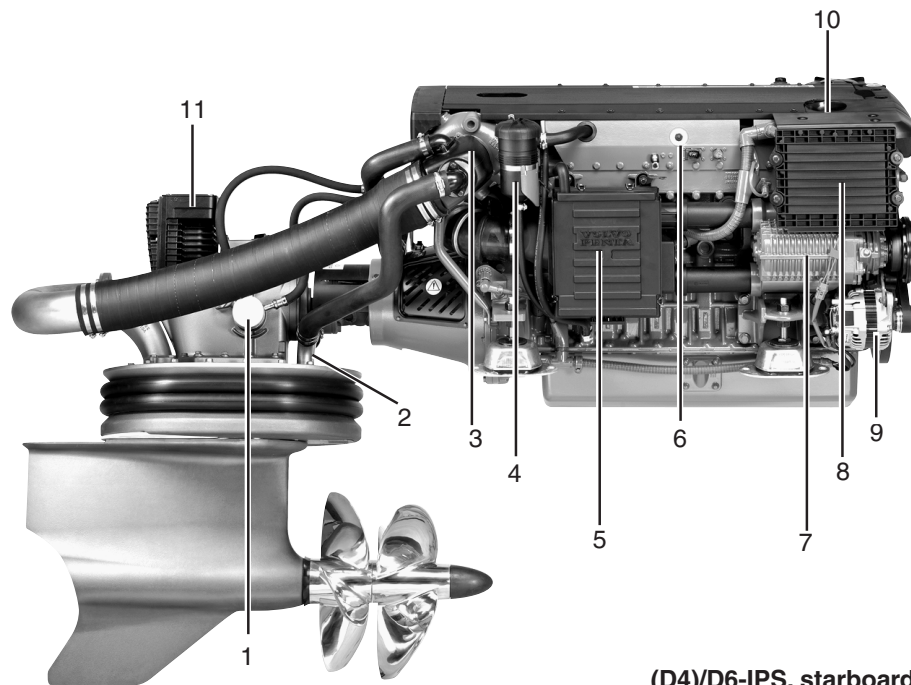
Trip computer

EVC supports trip computer functions if following are installed.

- multisensor or NMEA 0183/NMEA 2000 compatible component (plotter, GPS, paddle wheel etc)
- fuel level sender
- software for trip computer (order and download from VODIA website).

Trip computer information can be displayed on the EVC system tachometer or/and on the optional EVC system display.

Orientation

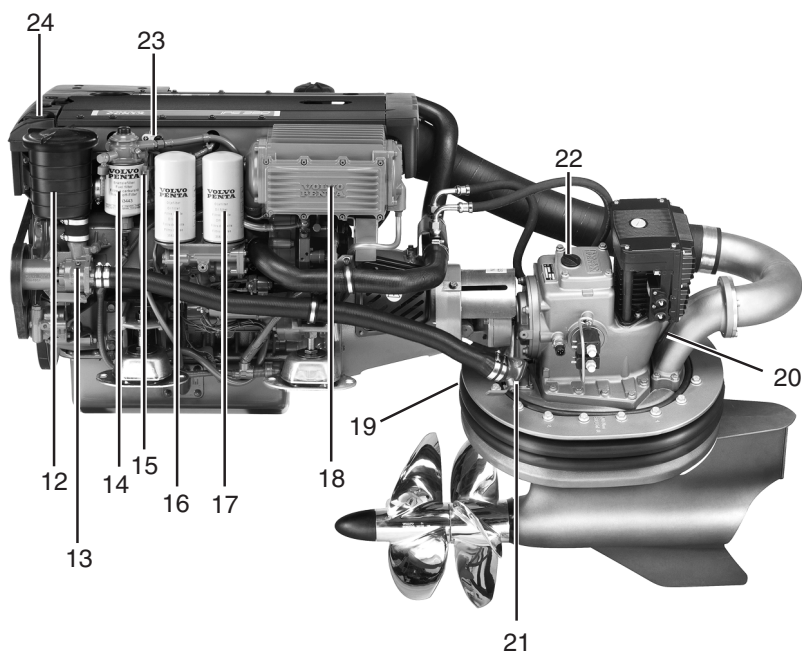


(D4)/D6-IPS, starboard

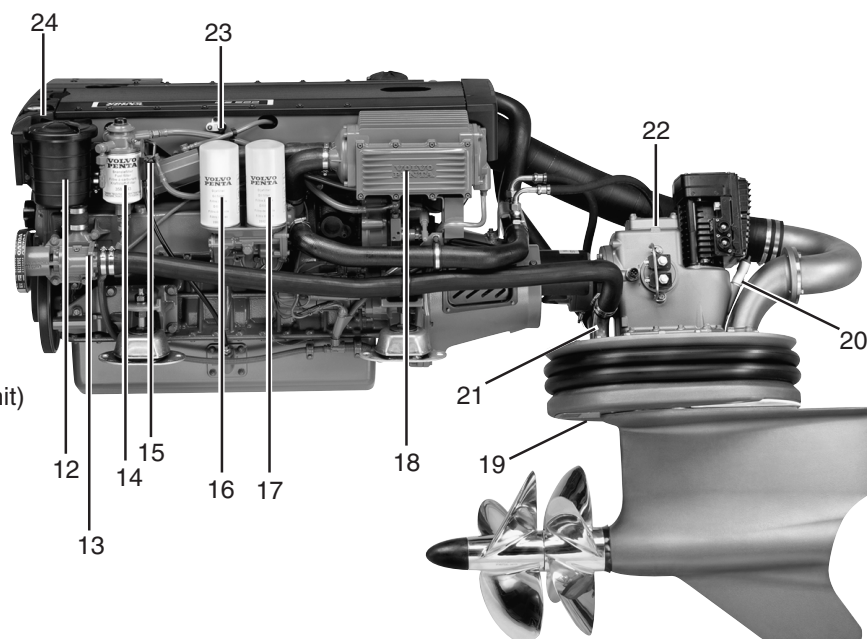
1. Oil filter, drive-unit
2. Water shut off valve, drive-unit (only D6)
3. Turbocharger
4. Crankcase ventilation filter
5. Air filter
6. Aux stop
7. Compressor
8. Engine control unit
9. Generator
10. Oil filler cap
11. Volvo Penta IPS,
Servo Unit Steering (SUS)

D4-IPS, port

- 12. Sea water filter
- 13. Sea water pump
- 14. Fuel filter
- 15. Oil dipstick, engine
- 16. Oil bypass filter
- 17. Oil filter
- 18. Charge air cooler
- 19. Cooling water intake
- 20. Oil dipstick, drive-unit
- 21. Water shut off valve, drive-unit
- 22. Oil filler cap, drive-unit
- 23. Automatic fuse
- 24. Expansion tank

**D6-IPS, port**

- 12. Sea water filter
- 13. Sea water pump
- 14. Fuel filter
- 15. Oil dipstick, engine
- 16. Oil bypass filter
- 17. Oil filter
- 18. Charge air cooler
- 19. Cooling water intake
- 20. Oil dipstick, drive-unit
- 21. Water shut off valve (drive-unit)
- 22. Oil filler cap, drive-unit
- 23. Automatic fuse
- 24. Expansion tank

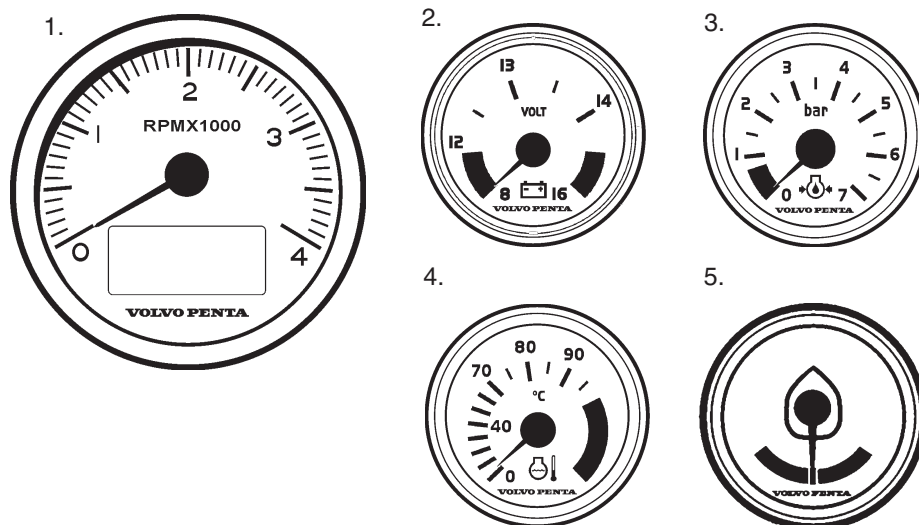


Instruments

This chapter describes the instrument and control panels sold by Volvo Penta for your engine.

If you want to supplement the instrumentation, or if your boat is equipped with instruments not described here, or you are not sure about their function, please contact your Volvo Penta dealer.

Instruments



1. EVC system tachometer (with display)
2. Voltmeter
3. Oil pressure gauge
4. Temperature gauge
5. Rudder indicator

Ignition lock

A tab with the key code accompanies the ignition keys, and is used to order extra ignition keys. Do **not** store the code where it is accessible to unauthorized persons.

S = Stop position.

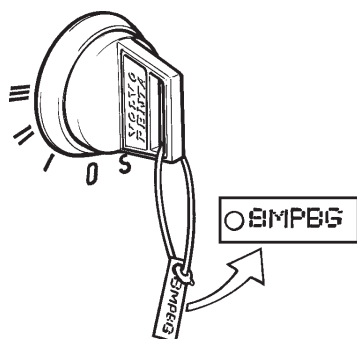
0 = Key can be inserted and removed.

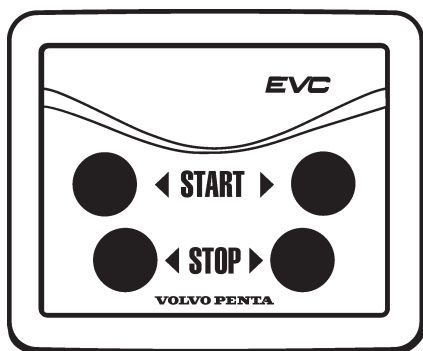
I = System voltage on (drive position).

II = Not used.

III = Start position.

⚠ IMPORTANT! Read the starting instructions in the "Engine starting" chapter.





Start/stop panel

The start/stop panel is used to start or stop the engine. The starter key on the main helm station must be in position "I" (driving position) for the engine to start. The engine can only be stopped if the control panel is activated.

⚠ IMPORTANT! Read the starting instructions in the "Engine starting" chapter.

Alarm display (extra optional)

The following warning lamps should never light up during operation. On the other hand, the warning lamps light up when the starter key is first turned to the drive position. Check that all lamps function. When the engine has started, all lamps should have gone out. The lamps flash if the diagnostic function has registered malfunction. When the fault has been acknowledged, the lamp gives continuous light.



Warning lamps (should never light up during operation).

Oil pressure (red indication)



If the oil pressure lamp lights up during operation, the oil pressure in the engine is too low. Stop the engine at once.

- Check the oil level in the engine. Please refer to "Maintenance: Lubrication" to check and top the oil up.
- Also check that the oil filters are not blocked. Please refer to "Maintenance: Lubrication system"

Please refer to the "In case of emergency" chapter, and you will find detailed information about recommended action in the "Diagnostic function" section.



WARNING! Continued operation when the oil pressure is too low can cause serious engine damage.

Water in fuel filter (orange indication)



If the lamp lights up, there is too much water in the water trap in the fuel filters.

- Empty the water trap underneath the fuel filter on the engine and pre filters. Please refer to "Maintenance: Fuel system".



Battery. (orange indication)



The battery lamp lights up if the alternator is not charging. Stop the engine if this lamp lights up during operation. If the lamp lights up, this can be due to a fault in the electrical system or because the alternator drive belt is slack.

- Check the alternator drive belts. Please refer to "Maintenance: Engine, general".
- Also check that there is no poor contact/broken wires.



WARNING! Do not continue operation if there is any problem with the alternator drive belts. This could cause serious engine damage.

Coolant temperature (red indication)



The coolant temperature lamp lights up when the coolant temperature is too high. Stop the engine if this lamp lights up during operation.

- Check the coolant level. Please refer to "Maintenance: Fresh water system".
- Check that the sea water filter is not blocked. Please refer to "Maintenance: Sea water system".
- Also check the impeller in the sea water pump. Please refer to "Maintenance: Sea water system".

Please refer to the "In case of emergency" chapter, and you will find detailed information about recommended action in the "Diagnostic function" section.



WARNING! Do not open the coolant filler cap when the engine is warm, except in emergencies. Steam or hot fluid could spray out.



Coolant level (orange indication)



The coolant lamp lights up when the coolant level is too low.

- Check coolant level. Please refer to “Maintenance: Fresh water system”.

Red warning indication, serious fault



If the red warning indication is shown during operation, a serious fault has occurred.

Please refer to the “In case of emergency” chapter, and you will find detailed information about recommended action in the “Diagnostic function” section.

Orange alarm indication, fault

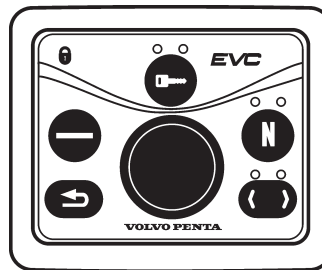


If the orange alarm indication is shown during operation, a fault has occurred.

Please refer to the “In case of emergency” chapter, and you will find detailed information about recommended action in the “Diagnostic function” section.

EVC control panel

The control panel is used in combination with the EVC system tachometer. The tachometer display shows operating information and menus that can be navigated from the control panel.



Activation button

Used to activate and lock the control panel and helm-station.

Indication (red):

Off: Control panel not activated.

Lit: Control panel activated.

Flashes: Control panel not activated due to the control lever not being in neutral or the system has been locked from another control panel.



Padlock

The padlock symbol lights if the control panel is locked manually by depressing the -button, or if exchange has been activated by routine "Change of control panel during journey".

Lit: The system is locked and the engine can only be controlled from the activated control panel.



Neutral button

Used to disengage the drive so that the engine speed can be increased without driving (warming up).

Indication (green):

Off: Drive engaged.

Lit: Control lever in neutral position.

Flashes: Drive disengaged or system in calibration mode.



Navigation wheel

Used to navigate through the menus shown on the tachometer EVC system display. Navigate through the menus by turning the wheel. Depress the wheel to confirm a selection.



Tachometer display selection (twin installation, port or starboard tachometer)

Is used to select which of the engines menu systems should be navigable from the control panel. The menu is shown on the display of the corresponding engines tachometer. Select port or starboard.

Indication (red/green):

Off: Not possible to navigate in menu.

Lit: Possible to navigate in menu for selected engine, port (red), starboard (green).



Multifunction button

Used to increase or decrease the instrument's and panel's backlighting.

Depress the button for at least 1 second to turn the backlighting on or off. The backlighting can be adjusted in five stages by pressing the multifunction button.

If the button is pressed on an inactive control panel, operating information is shown on the display(s) and it is possible to navigate in the menus.

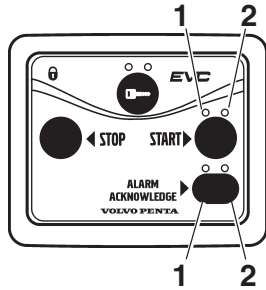


Back button

Used to back a step in the menu.



IMPORTANT! Always press the buttons firmly, and for at least one second each time.



Docking Station Panel

The docking station panel allow stopping and restarting of the engines and handling of faults when operating the boat from a docking station.

The docking function (maneuvering with the joystick) is enabled when the docking station is activated.

Please refer to the chapter "Operation" section "Docking (Joystick)" for more information on docking.

NOTE! Docking station can only be activated when the engines are running.

NOTE! Always push the buttons firmly for at least one second.



ACTIVATION BUTTON

Push this button on the docking station panel to activate and lock/unlock the docking station. For more detailed instructions please refer to the section "EVC control panel", headlines "Activation button" and "Padlock sign", in this chapter.



STOP and START BUTTONS

Push these buttons to stop or restart the engines.

NOTE! Both engines must be running when using the docking function.

LED indication above the button: White

Lit: Port engine (1)/Starboard (2) engine are/is running.
 Off: Port engine (1)/Starboard (2) engine are/is shut off.
 Flashing and accompanied with a buzzer: The engine(s) has stopped without a stop request. Silence the buzzer with the  ALARM ACKNOWLEDGE BUTTON and restart the engine(s).

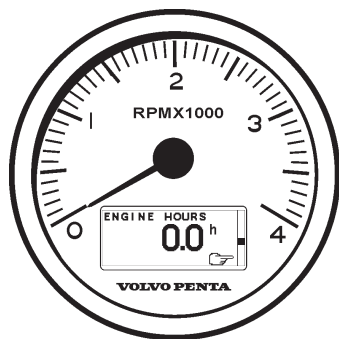


ALARM ACKNOWLEDGE BUTTON

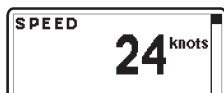
Push this button to acknowledge an alarm of a fault. A fault is always indicated with a flashing LED above the button and a more serious faults is also indicated with a buzzer. When the fault is acknowledged the LED will light continuously and the buzzer will silence. The fault pop-up must be read and acknowledged on a station that is equipped with displays. Please refer to the "Operation" chapter, section "Acknowledging alarms and messages".

LED indication above the button: Red

Flashing: Port (1)/Starboard (2) engine has a fault.
 Lit: The fault is acknowledged.



Main menu structure



Trip menu



Gauges menu



Settings menu



Faults list

EVC System Tachometer

Introduction

Volvo Penta EVC System Tachometer presents relevant boat and engine information to the helmsman. Information is presented on a display in the tachometer.

Information is depending on engine model, number of sensors and type of accessories.

Using the instrument

Start-up screen

This is the start-up screen for the EVC System Tachometer. After a few seconds the first item in MAIN MENU will appear.

Main menu

Navigating the menus

Navigate the menus by turning NAVIGATION WHEEL clockwise or counter-clockwise. Views with a POINTING HAND-symbol indicates a SUB-MENU. To enter a SUB-MENU, push NAVIGATION WHEEL.

Speed (Optional)

Boat speed. Requires multisensor or GPS.

Water temp (Optional)

Water temperature. Requires multisensor.

Depth (Optional)

Water depth. Requires multisensor.

Trip menu (Optional)

Shows trip information. Requires the following:

- Multisensor or NMEA 0183/NMEA 2000 compatible component (plotter, GPS, paddle wheel etc)
- Fuel level sender
- Trip computer software

Gauges menu

Shows data parameters.

Settings menu

The SETTINGS MENU allows the user to set various options for the EVC System and to calibrate various parameters.

Faults list

Number after word FAULTS indicates number of faults stored in FAULTS LIST. List is reset when system is rebooted.

NOTE! Faults list is not shown if no faults are registered.

Trip menu (extra optional)

In the TRIP MENU the user gets trip information from the EVC System and the user is allowed to select which view that should be presented in the EVC System Tachometers MAIN MENU as trip information. To get trip information following are required:

- Multisensor or NMEA 0183/NMEA 2000 compatible component (plotter, GPS, paddle wheel etc)
- Fuel level sender
- Trip computer software

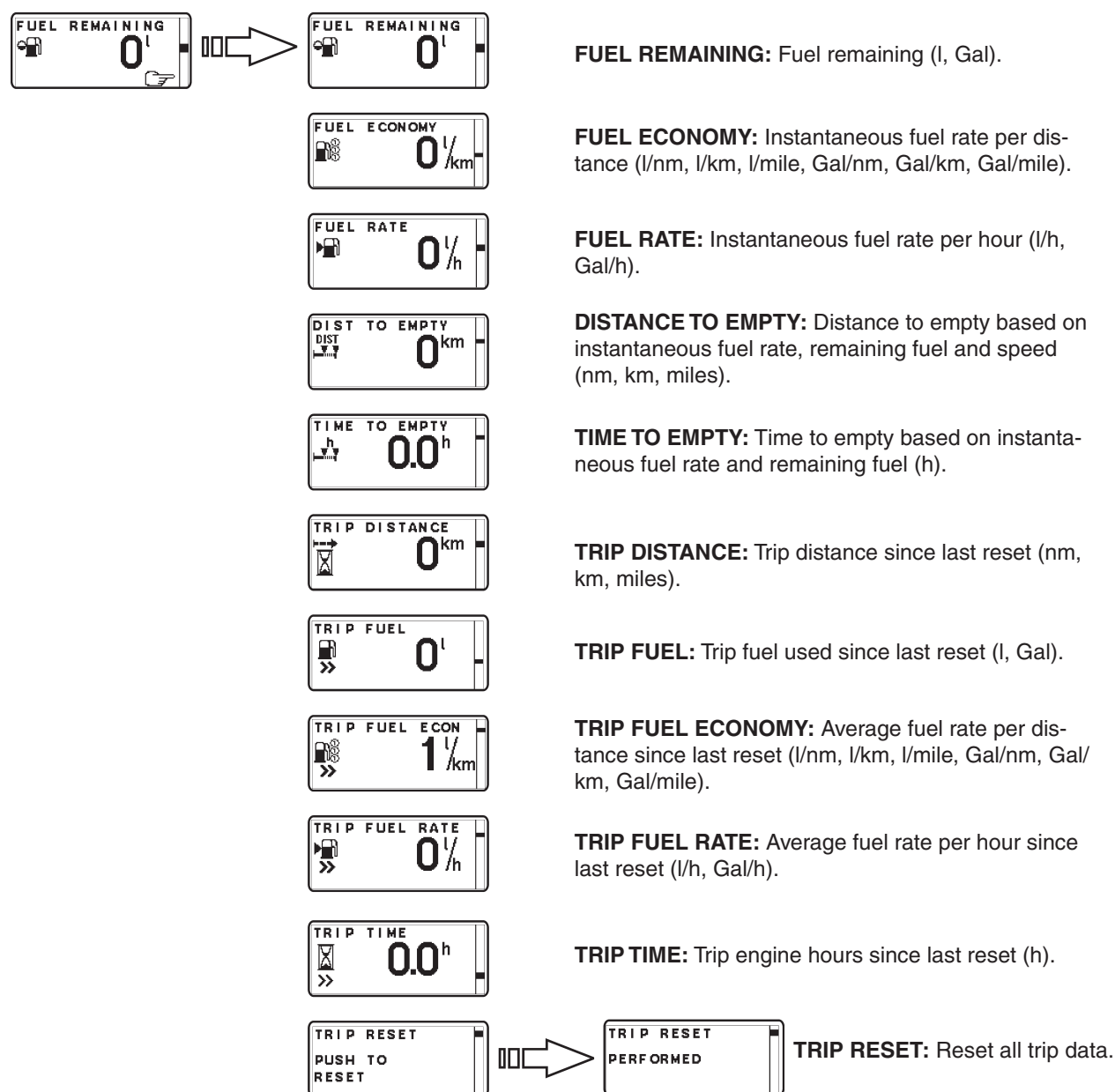
NOTE! The accuracy of trip information concerning, and based on, remaining fuel volume depends on which method the user has chosen for calibrating the fuel tank.

When in TRIP MENU, select view by turning NAVIGATION WHEEL. To select view as favorite, push NAVIGATION WHEEL. System returns to MAIN MENU.

Push BACK BUTTON to return to MAIN MENU without setting a new favorite.

Units are user selectable. See section "Units".

Trip menu structure



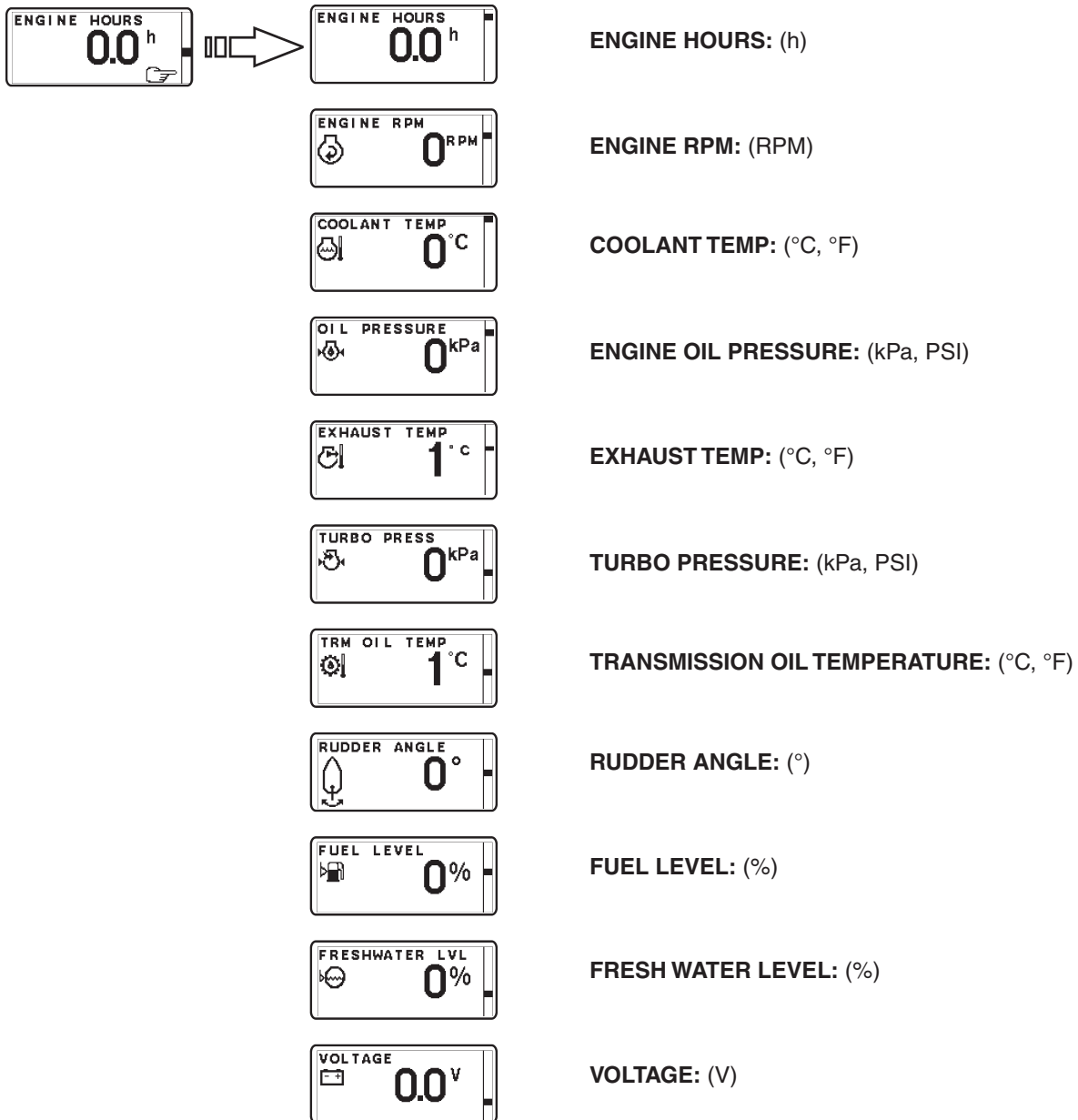
Gauges menu

In GAUGES MENU the user gets information from analogue senders, placed on the engine. If the data is not available the parameter will not be displayed.

When in GAUGES MENU, select view by turning NAVIGATION WHEEL. To select view as favorite, push NAVIGATION WHEEL. System returns to MAIN MENU.

Push BACK BUTTON to return to MAIN MENU without setting a new favorite.

Gauges menu structure



Settings menu

In the SETTINGS MENU the user is allowed to set various options for the EVC system and to calibrate various parameters.

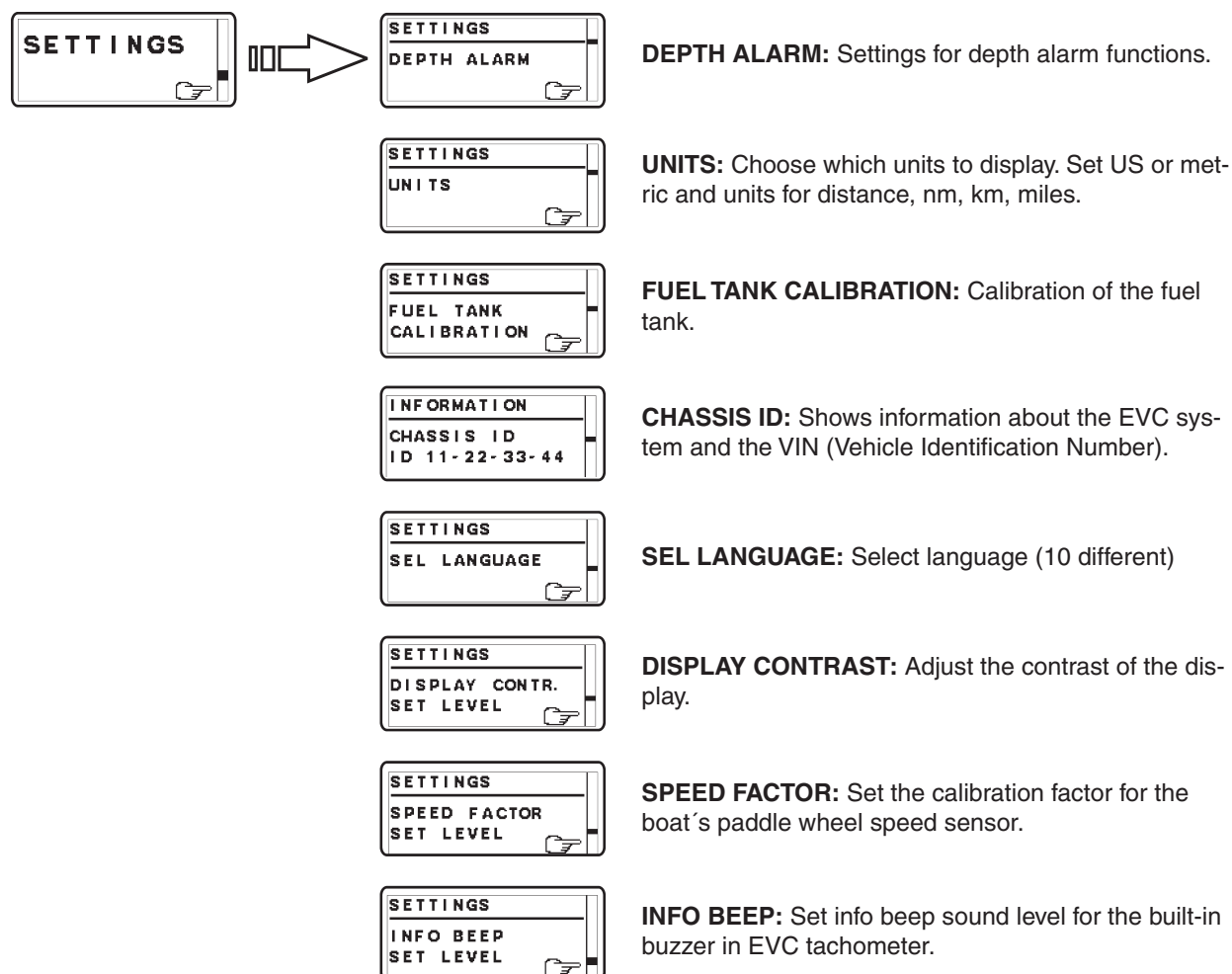
⚠ IMPORTANT! For all settings and calibration procedures: Activate helm station by pushing the ACTIVATION BUTTON.

NOTE! For twin installations always perform the settings on the port side system. Port side is the master side.

When in SETTINGS MENU, select view by turning NAVIGATION WHEEL. Views with a POINTING HAND-symbol indicates a SUB-MENU. To enter a SUB-MENU, push NAVIGATION WHEEL.

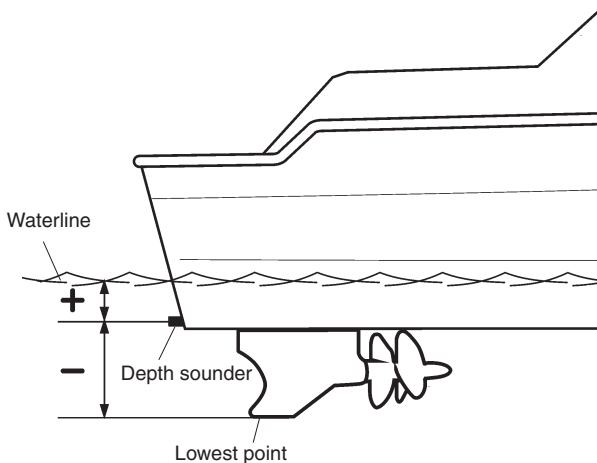
Push BACK BUTTON to return to MAIN MENU.

Settings menu structure



Depth alarm (extra optional)

All depth alarm functions are accessed through this menu. A multisensor needs to be installed.



DEPTH ALARM, ON/OFF

Depth alarm can be switched ON/OFF.

SET DEPTH

Adjust the depth alarm value by turning the NAVIGATION WHEEL. The value can be adjusted at a resolution of 0.1 m or 1 ft.

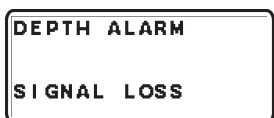
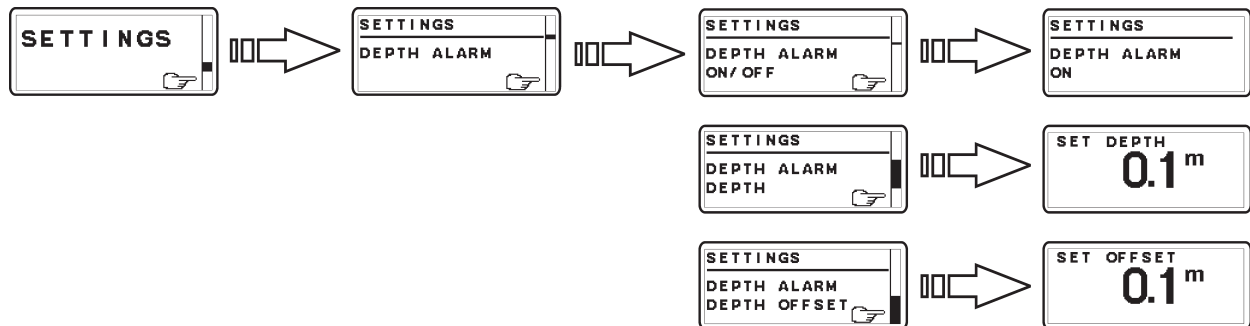
Once adjustment value is reached, the data is stored by pushing NAVIGATION WHEEL.

DEPTH OFFSET

The depth sounder can be placed somewhere on the hull that gives another depth than the desired depth. You can then add or subtract a distance so that the display shows the depth from, for example, the lowest point on the boat, or from the surface.

Adjust the depth offset value by turning the NAVIGATION WHEEL. The value can be adjusted at a resolution of 0.1 m or 1 ft.

Once adjustment value is reached, the data is stored by pushing NAVIGATION WHEEL.



Depth alarm pop-up

The depth alarm pop-up will appear when the depth is less than the depth alarm setpoint. The pop-up shows the actual depth.

Acknowledge depth alarm by pushing NAVIGATION WHEEL.

The depth alarm pop-up will re-appear every 30 seconds until the depth increases and exceeds the depth alarm setpoint.

Depth alarm signal loss

If the depth alarm is enabled and the depth signal is lost, for instance in the case of sensor malfunction, the depth alarm signal loss pop-up will appear.

Select units and language

Choose which units and languages to display.

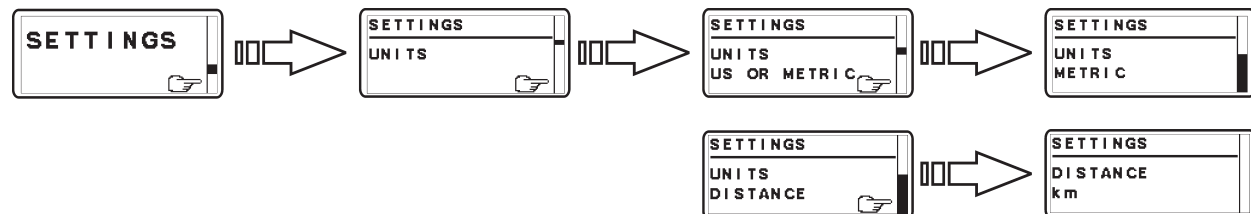
NOTE! Language and unit settings must be performed in all EVC system tachometers.

US or METRIC

1. Activate helm station by pushing the ACTIVATION BUTTON.
2. Select SETTINGS from MAIN MENU by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter SETTINGS MENU.
3. Select UNITS and push NAVIGATION WHEEL.
4. Select US OR METRIC and push NAVIGATION WHEEL.
5. Set US or METRIC units by turning NAVIGATION WHEEL and confirm by pushing NAVIGATION WHEEL.

DISTANCE

1. Activate helm station by pushing the ACTIVATION BUTTON.
2. Select SETTINGS from MAIN MENU by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter SETTINGS MENU.
3. Select UNITS and push NAVIGATION WHEEL.
4. Select DISTANCE and push NAVIGATION WHEEL.
5. Set distance unit: km, nm or miles and confirm by pushing NAVIGATION WHEEL.



LANGUAGE

1. Activate helm station by pushing the ACTIVATION BUTTON.
2. Select SETTINGS from MAIN MENU by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter SETTINGS MENU.
3. Select SEL LANGUAGE and push NAVIGATION WHEEL.
4. Select language and confirm by pushing NAVIGATION WHEEL.



Fuel tank calibration

There are two possible calibration methods for the fuel tank. One approximative, FULL TANK CALIBRATION, and one more precise, FUEL MULTIPOINT CALIBRATION. A fuel level sender need to be installed.

NOTE! If FUEL TANK CALIBRATION is not shown in SETTINGS MENU, please contact your Volvo Penta dealer.

FUEL MULTIPOINT CALIBRATION

When FUEL MULTIPOINT CALIBRATION is selected, the fuel level sender is calibrated in five equally divided steps; 20% full (pos 1), 40% full (pos 2), 60% full (pos 3), 80% full (pos 4) and 100% full (pos 5)

NOTE! To perform multipoint calibration, fuel tank must be LESS than 20% full. If calibration skips POS 1 and goes directly to POS 2, the fuel tank contains too much fuel and the calibration will not be correct.

1. Activate helm station by pushing the ACTIVATION BUTTON.
2. Select SETTINGS from MAIN MENU by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter SETTINGS MENU.
3. Select FUEL TANK CALIBRATION and push NAVIGATION WHEEL.
4. Select FUEL MULTIPOINT CALIBRATION by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter FUEL MULTIPOINT CALIBRATION.

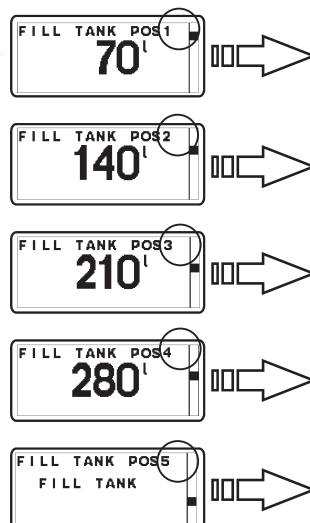


NOTE! The fuel multipoint calibration procedure differs depending on EVC software release.

5A. If the number after “POS” in the display is flashing:

Fill fuel tank with displayed volume (POS 1) and push NAVIGATION WHEEL. Add fuel (do not reset the pump) up to displayed volume for each POS until the tank is filled.

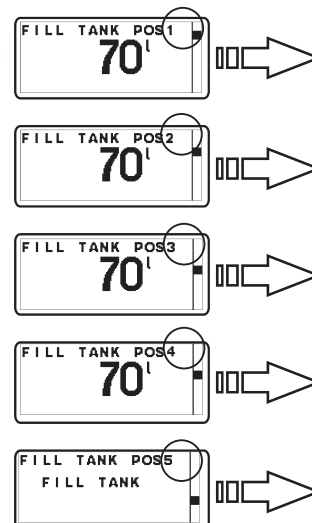
Push BACK BUTTON to return to SETTINGS MENU.



5B. If the number after “POS” is **not** flashing:

Fill fuel tank with displayed volume (POS 1) and push NAVIGATION WHEEL. Repeat procedure for each POS until the tank is filled.

Push BACK BUTTON to return to SETTINGS MENU.



FUEL FULL TANK CALIBRATION

When FUEL FULL TANK CALIBRATION is selected, the fuel level sender is calibrated in one step. This only gives an approximated value of the fuel level. Therefore all trip data concerning and based on, remaining fuel volume should be recognized as approximated values only.

1. Activate helm station by pushing the ACTIVATION BUTTON.
 2. Select SETTINGS from MAIN MENU by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter SETTINGS MENU.
 3. Select FUEL TANK CALIBRATION and push NAVIGATION WHEEL.
 4. Select FUEL FULL TANK CALIBRATION by turning NAVIGATION WHEEL. Push NAVIGATION WHEEL to enter FULL TANK CALIBRATION.
 4. Fill fuel tank and push NAVIGATION WHEEL.
- Push BACK BUTTON to return to SETTINGS MENU.



Approximated trip data

This pop-up will be shown every time after start-up if FUEL FULL TANK CALIBRATION is performed.

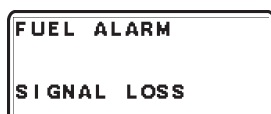


Fuel alarm pop-up

The fuel level alarm pop-up will appear when the fuel level is lower than fuel alarm setpoint. The pop-up shows the percentage of fuel remaining.

Acknowledge fuel alarm by pushing NAVIGATION WHEEL.

Fuel level alarm pop-up will re-appear every 10 minutes until the fuel level in tank is higher than fuel alarm setpoint.



Fuel level signal loss

If the fuel level has been set and the fuel level signal is lost, for instance in the case of sensor malfunction, the fuel level alarm signal loss pop-up will appear.

Speed factor

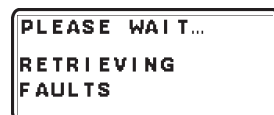
The speed factor for the boat's paddle wheel speed sensor can be adjusted at a resolution of 1% and is used by the EVC to apply a correction to the output from the speed sensor.

Set speed factor

Set speed factor while driving the boat. Compare displayed speed with speed data from GPS (or other boat) and adjust the speed factor until they correspond.

Adjust the speed factor by turning the NAVIGATION WHEEL.

Once adjustment value is reached, the data is stored by pushing NAVIGATION WHEEL.



Information message

Start attempt with gear engaged

The engine control lever must always be in neutral before starting. If not, this pop-up will be shown.

Approximated trip data

This pop-up will be shown every time after start-up if FUEL FULL TANK CALIBRATION is performed.

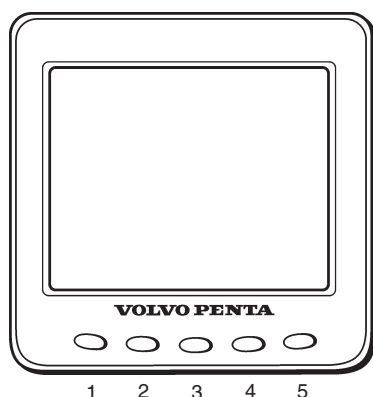
Retrieving faults

The EVC system is retrieving faults from its nodes.

Monitoring mode (inactive station)

An inactive station can show system information. Push MULTIFUNCTION BUTTON on the inactive station.

It is possible to navigate the menus when in monitoring mode.



EVC System Display (extra optional)

Introduction

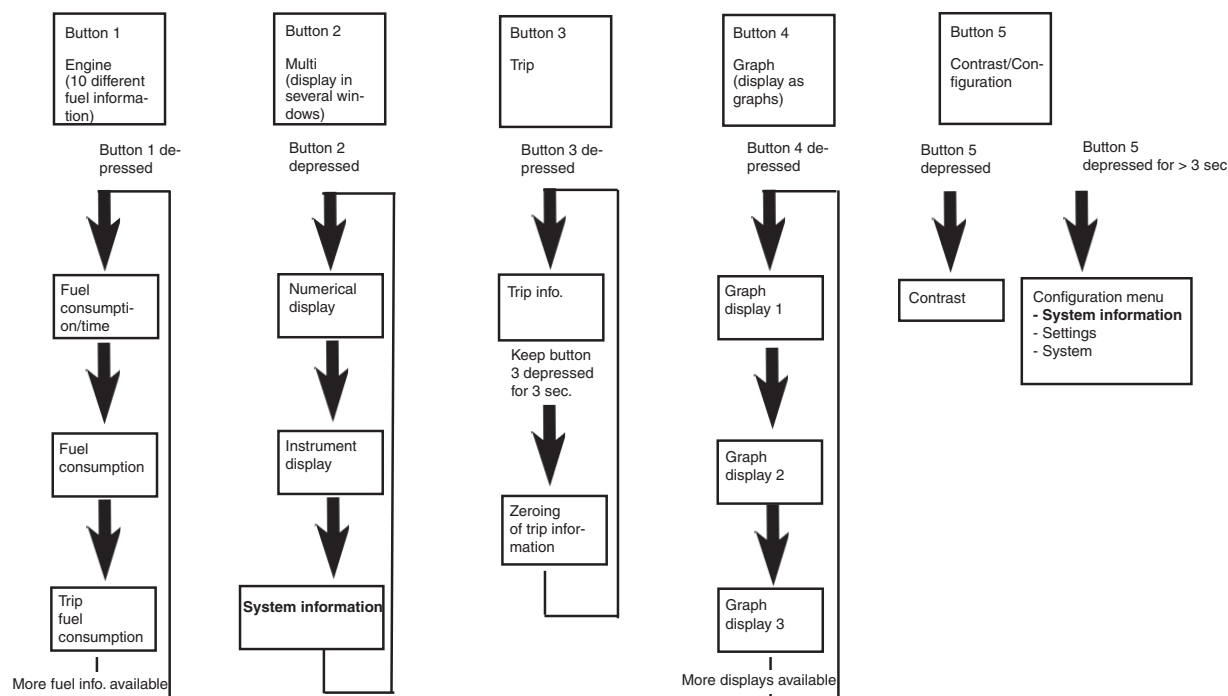
Volvo Penta EVC system display is an instrument which displays operating information about the engine and allows you to communicate with the engine's electrical system.

Operation information is shown on an LCD display. The driver can select the display mode operative on the display with the aid of the five buttons on the front of the instrument.

The four buttons at the furthest left are used to display operating information in different ways. The button at the furthest right is used to adjust the display contrast and to access the so-called configuration menu. Various settings etc. can be done in it. You can also use the configuration menu to reach the display mode SYSTEM INFORMATION (which can also be reached via button 2, please refer to the schedule below). This display mode functions in the same way as the display in the tachometer (EVC System Tachometer).

Before the display is used, it may be necessary to modify the way that the display shows operating information, to comply with user requirements. You can see the settings that can be changed in the section about the configuration menu.

Structure of the display functions





Start image

This is the starting image that is shown on the display for a brief period after starting.

If the unit gives a constant audible warning after starting, the self-test has failed. The unit will still work, but may behave in an unexpected manner.

Symbols for operating information

	Engine speed		Turbocharge pressure (current)
	Coolant temperature		Induction air temperature
	Engine temperature		Exhaust temperature
	Fuel pump pressure		Voltage
	Oil pressure		Oil pressure, reverse gear
	Coolant temperature		Oil temperature, reverse gear
	Speed		Fuel level
	Fuel consumption/time		Differential pressure, oil filter

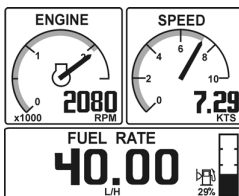


Figure for single engine installation

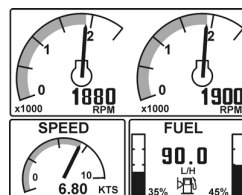
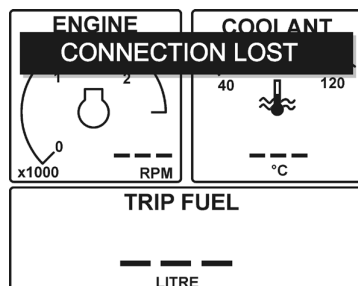


Figure for twin engine installation

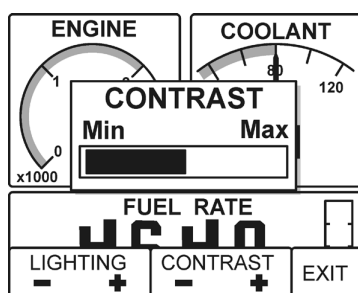
Display after starting screen

Display mode ENGINE (button 1) is always shown after the starting screen when the display is first started up (more information about this display mode can be found below in the instructions). Once the display has been used, it will always show the display mode when it starts up, that was selected when the display was last switched off.



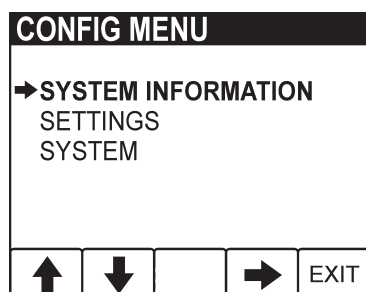
Connection fault

If the display does not register transfer of operating information from the electrical system, the pop-up window will flash CONNECTION LOST. When operating information has been registered/reset, the pop-up window disappears.



Set display contrast

Press button 5 (furthest right) to set display contrast. Then press the appropriate buttons to adapt the levels, then save the settings by pressing EXIT. The display unit has 5 contrast settings.



Configuration menu (button 5)

(depressed for longer than 3 s)

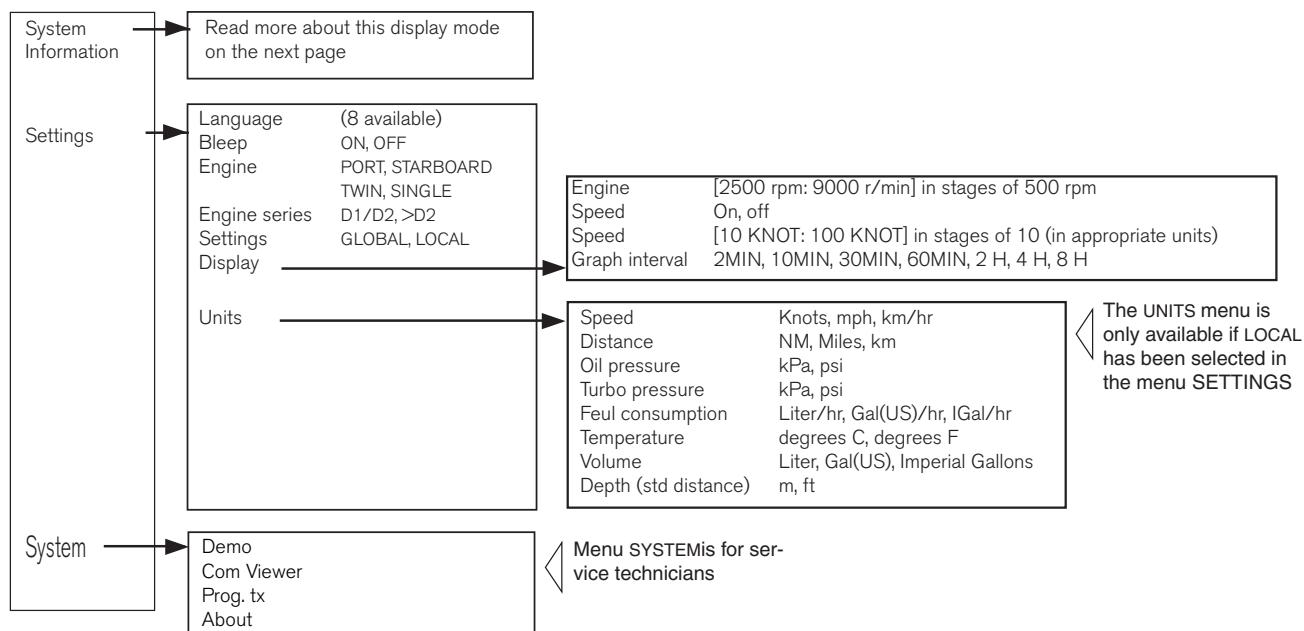
The configuration menu is used to:

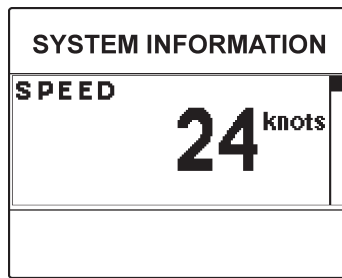
- access the display mode SYSTEM INFORMATION.
- do various settings for the display.
- reach information and functions for servicing the display.

Please refer to the configuration menu structure below and read the following section, which explains each section in the menu.

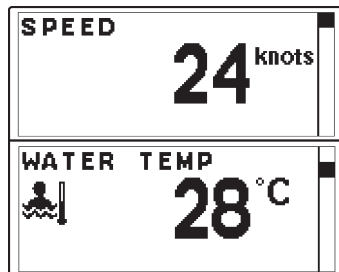
Note! The port engine or both engines must have the ignition switched on when display settings are changed.

Configuration menu structure





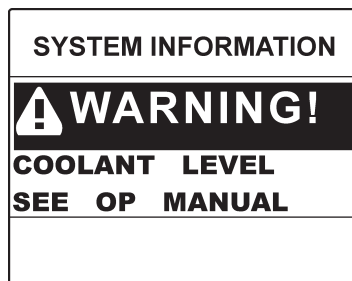
SYSTEM INFORMATION display mode for single engine installations



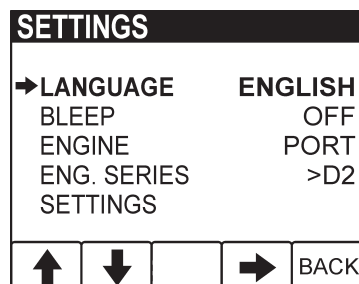
SYSTEM INFORMATION display mode for twin engine installations



Control panel



Alarm example



Display mode System Information

SYSTEM INFORMATION is a display mode that functions in the same way as the display in the tachometer (EVC System Tachometer). You navigate round these functions, using the buttons on the free-standing control panel.

In display mode SYSTEM INFORMATION there are several functions:

- Display of operating information, information messages and alarm (note! The display is adapted to suit the size of the panel in the tachometer).
- Settings for displaying operating information in this display mode.
- All calibrations.

Detailed instructions for the functions in display mode SYSTEM INFORMATION are found in the section about the tachometer in this owner's manual .

Information message and alarm

The display automatically switches to display mode SYSTEM INFORMATION when the electrical system needs to show information messages or alarms. Instructions about how information messages and alarms should be handled are found in the section about the tachometer and in the section "In case of emergency" in this owner's manual.

Settings

Menu SETTINGS is used to do various settings for the display.

- **Language:** This is where you select the language that the display should use (8 different languages are available).
- **Bleep:** This is where you select whether a beep should be heard when any button is depressed. ON/OFF.
- **Engine:** This is where you select the engine for which operating data will be displayed. SINGLE, PORT, STARBOARD or TWIN.
- **Engine series:** This is where you select the engine for which the display has been installed D1/D2, >D2. The display is pre-set for use with engines larger than D2.
- **Display:** This is where you set the measure-

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

SYSTEM	
DEMO	ON
COM VIEWER	
PROG. TX	
→ABOUT	
↑	↓
→	BACK

ment intervals of the speedometers and tachometers. Rpm engine: [2500 rpm: 9000 r/min] in stages of 500 rpm

- Speed: Change speed display (on/off)
- Speed: [10 KNOT: 100 KNOT] in states of 10 (in the appropriate speed intervals)
- Graph interval: 2 MIN, 10 MIN, 30 MIN, 60 MIN, 2 H, 4 H, 8 H
- **Units:** (This menu is only displayed if LOCAL has been selected in menu SETTINGS). This is where you select the measurement units to be used to display operating information. (GLOBAL is pre-set, which means that the units of measurement are pre-set, but they can be changed if LOCAL is selected in menu UNITS).
 - Speed: KNOT, MPH, KM/H
 - The distance is adjusted to suit the speed unit: NM, MILE, KM
 - Oil or Turbo pressure: kPa, PSI
 - Volume: LITER, GAL, Imperial GAL
 - Fuel consumption / time: is adjusted to suit the volume unit: L/H, GAL/H, IGAL/H
 - Temperature: °C (CELSIUS), °F (Fahrenheit)

System

Menu SYSTEM is intended to provide the necessary functions and information for service technicians.

- **Demo:** Switches between demo mode ON/OFF
The unit is in normal operation mode when Demo is OFF.
- **Com Viewer:** Shows the latest messages received on the communication inputs
- **Prog tx:** Transfers the contents of the application program in the flash memory to other CANtrak units on the same CANbus link
- **About :** Shows the following information:
 - ID no:** Display serial number
 - Eeprom:** No. of writes to the EEPROM
 - Vers:** Software version number
 - Chk:** Flash memory checksum
 - Part no:** Volvo's part number for the software
 - Source:** Shows the source of the received data
 - Label:** Label allocated on the bus. Each unit on the same bus must have its own unique label

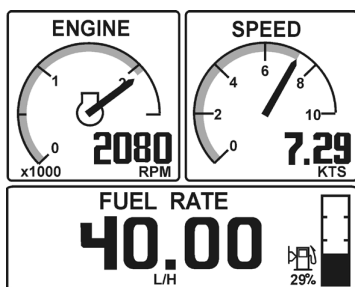


Figure for single engine installation

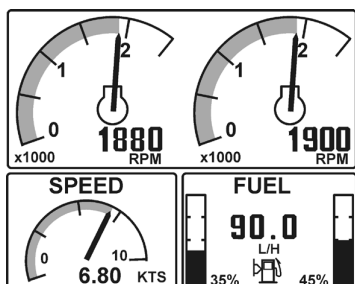


Figure for twin engine installation

Display mode Engine (Button 1)

This display mode shows the engine speed and boat speed in the form of standard instruments, together with a trip computer and fuel level gauge. The fuel level gauge are displayed if there is a tank sender installed.

Note! Trip information is only displayed if following are installed:

- Multisensor or NMEA 0183/NMEA 2000 compatible component (plotter, GPS, paddle wheel etc)
- Fuel level sender
- Software for trip computer (order and download from VODIA website)

The trip computer shows various types of information if you repeatedly press the button ENGINE (ENGINE) (button 1). Please refer to the trip computer menu below.

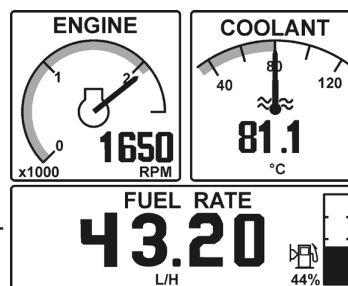
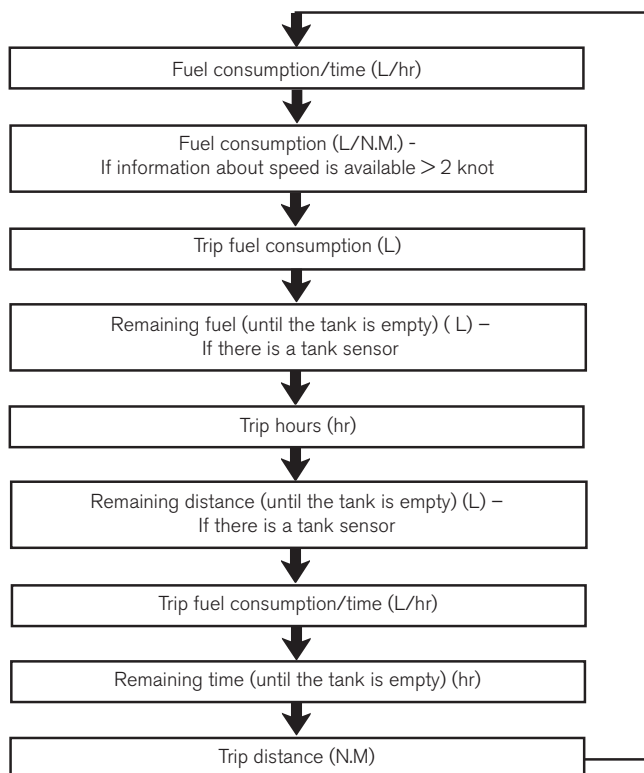
Note! Only metric values are displayed, but other units can be displayed if they have been chosen in the configuration menu.

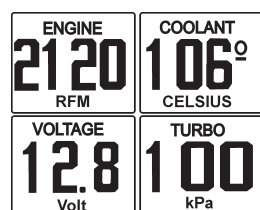
The scale values for maximum engine speed and maximum speed can be set in the configuration menu.

If information about boat speed is not available, the display shows coolant temperature instead.

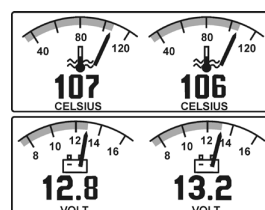
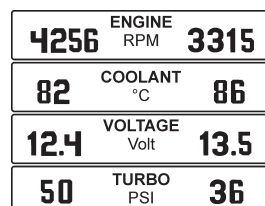
Menu, trip computer

Button 1
Changes display each time the button is pressed





Example of display in several windows for single engine installation



Example of display in several windows for twin engine installation

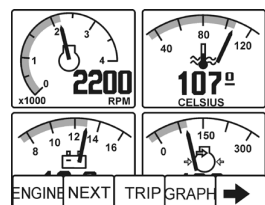


Figure for single engine installation

Press button 5 to choose setting mode

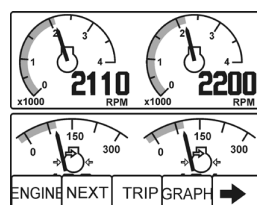


Figure for twin engine installation

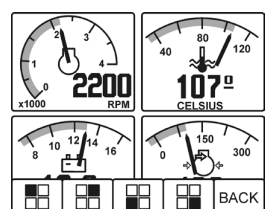


Figure for single engine installation

Buttons 1 to 4 are used to adjust the corresponding window (please refer to the black markings)

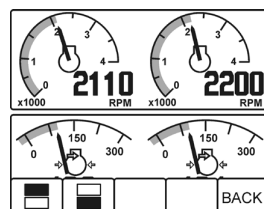


Figure for twin engine installation

Display mode Multi (button 2)

This display mode shows operating information in four different windows (see below). The user can choose the operating information to be displayed in each window.

The information can be displayed as figures or as standard instruments. Display indication shifts between the two modes when you press button 2 repeatedly.

If an item of operating information is not available, the unit displays "—" and the analogue gauge needle is not shown.

From this display mode MULTI, you can also reach display mode that functions in the same way as the smaller display in the tachometer. Read more about this display mode SYSTEM INFORMATION in the configuration menu section.

Set the appearance of the display mode Multi

Display mode MULTI has a mode to set the operating information to be displayed in each window.

The setting mode is reached by pressing button 5 (furthest right), when you are in the display mode MULTI. Please refer to the illustrations below.

Note! The type of operating information available depends on the electrical system in the boat and the sensors that the boat is equipped with. Optional sensors include depth gauge, water temperature, speed, trim angle and rudder angle.

Note! This applies to the graphic display:

The maximum engine speed range can be set on the configuration menu.

The voltage interval can be [8V: 16V] or [16V: 32V] and is changed automatically, depending on the latest data value.

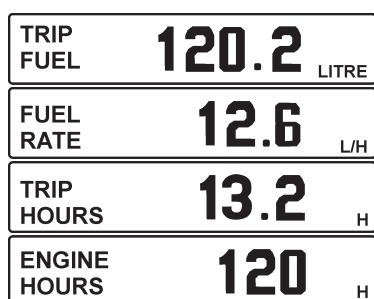


Figure for single engine installation

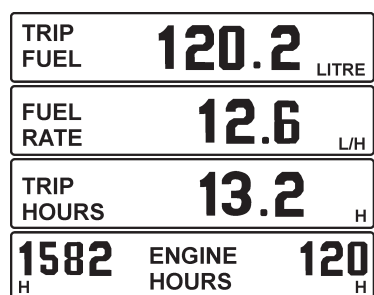


Figure for twin engine installation

Display mode Trip (button 3)

This display mode shows:

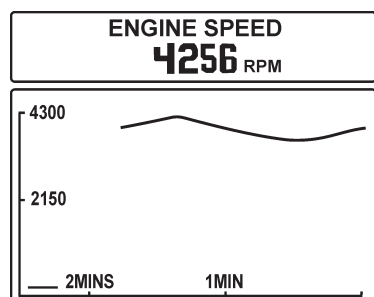
- Fuel used after last zeroing
- Instantaneous fuel consumption (amount of fuel used per hour) (If speed information is available, instantaneous fuel consumption can also be calculated in relation to distance.)
- Operation time after last zeroing
- Total operating time (can not be zeroed)

If you want to zero the trip values (trip fuel consumption and trip operating time), keep button 3 depressed for 1 second. The unit beeps and the values are zeroed.

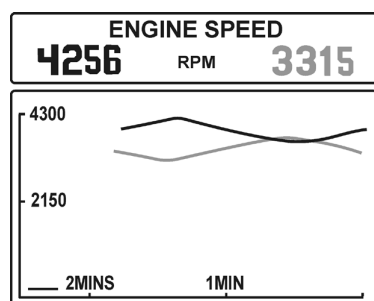
Note!

When the display is set for a twin engine installation, the information displayed for each engine will be the sum of the values from both engines, apart from operating time. Operation times for twin engines are shown separately.

The size of the operating hours figures shown on the display is reduced if the number does not fit in the window.



Window with curve for single engine installation (shows engine speed)



Window with curve for twin engine installation (shows engine speed)

Display mode Graph (button 4)

In this display mode, operating information is displayed in the form of a histogram. Press button 4 repeatedly to show different operating information.

If an item of operating information is not available, that window can not be chosen.

If contact with the relevant information is lost during display, the curve will no longer be drawn, but the line will continue to scroll across the window.

Data for the port engine or single engine information is drawn with a black line.

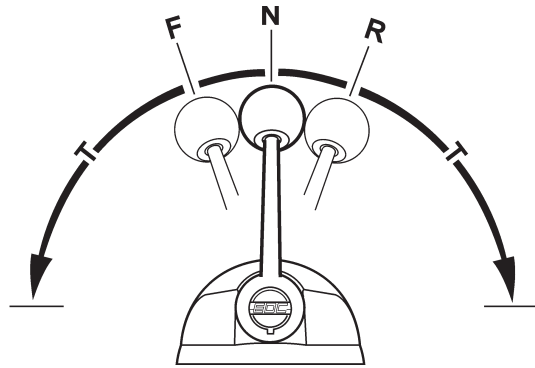
Data for the starboard engine information is drawn with a gray line.

The maximum time interval can be set to one of the following values in the configuration menu: 2 min, 10 min, 30 min, 1 h, 2 h, 4 h, 8 h.

The interval on the Y axis is automatically adjusted for best indication.

Controls

This chapter describes the controls sold by Volvo Penta for your engine.



Electronic lever control

Operation

Both the shift function and engine speed control are controlled using the lever control.

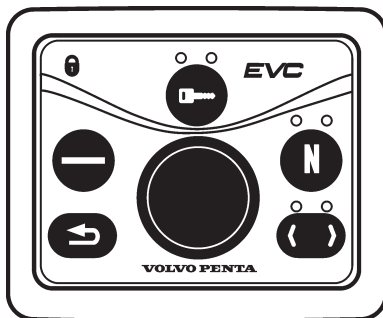
N = Neutral position (Drive-unit is disengaged and the engine runs at idle speed).

F = Drive-unit engaged for movement ahead.

R = Drive-unit engaged for movement astern.

T = Adjustment of engine speed.

NOTE! The engine can only be started if the Control lever is in the neutral position.



Disengaging the shift function

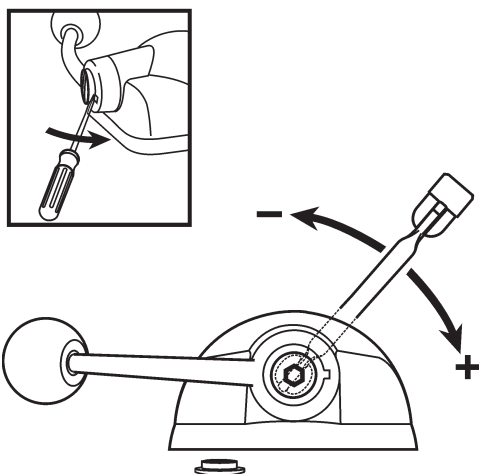
The shift function can be disengaged so that the control lever only affects the engine speed.

1. Move the lever to the neutral position (N)
2. Press the neutral button (N) in and hold it down while moving the control lever forward to the shift position (F).
3. Release the neutral button. The green indicator begins to flash to acknowledge that the shift function is disengaged.

The lever now only controls engine speed.

When the lever is moved back to the neutral position it will automatically re-engage. This is confirmed by the green indication which gives constant light.

⚠ WARNING! Take care not to engage the drive-unit unintentionally.



Friction brake

The control has a friction brake which can be adjusted as necessary to provide lighter or heavier lever action.

Adjusting the friction brake:

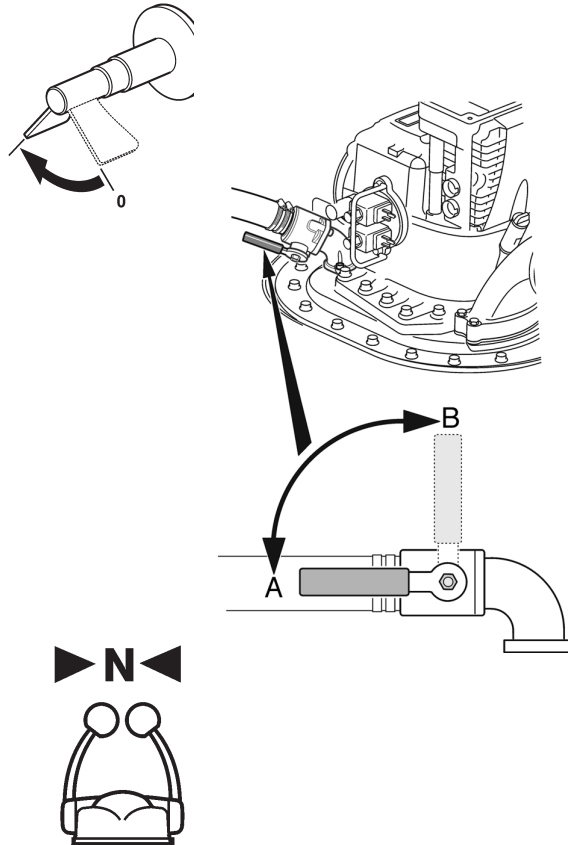
1. Stop the engine.
2. Move the control lever forwards so that the groove in the hub of the control lever is accessible.
3. Position a screwdriver in the groove and remove the plug.
4. Adjust the friction brake (8 mm wrench):
Clockwise = heavier lever action
Counter clockwise = lighter lever action.
5. Reinstall the plug.

Starting the engine

Make it a habit to give the engine and engine bay a visual check before starting. 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 after you have started the engine.

To minimize starting smoke in cold starting, we recommend that a heater should be installed to warm the engine bay at temperatures below +5°C.

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



Before starting

- Open the fuel tap
 - Do the tasks under the “Daily before first start” heading in the maintenance schedule.
 - Turn the main switches on.
- ⚠ IMPORTANT!** Never disconnect the current with the main switches when the engine is running. This can damage the alternator.
- Start the engine bay fan, if one is installed, and let it run for at least four minutes.
 - Check that the amount of fuel aboard is enough for your planned voyage.
 - Check the oil level.
 - Open the sea water cock(s) (two for D6, one for D4) on the drive-unit, position **A** open and position **B** closed .
 - Put the drive-unit in neutral by moving the control levers to neutral at all control positions.

General information about starting

The engine control lever must always be in neutral before starting. The engine management system ensures that the engine receives the correct amount of fuel - even when the engine is cold.

The engine is pre-heated by the engine control unit, which allows the engine to crank several revolutions with the starter motor before fuel is injected. The colder the engine is, the more revolutions the engine makes. This raises the temperature in the combustion chambers, which ensures reliable starting and reduces starting smoke.

The idling speed is also governed by engine temperature, and is somewhat raised after a cold start.

Starting method

Turn the ignition on

Turn the starter key to position I to switch the ignition on.



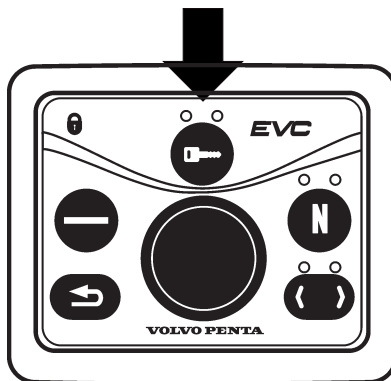
Check LEDs

Each time the ignition is turned on, all LEDs are illuminated on the main control panel. Check that all LEDs function.

If the boat has more than one control panel, the LEDs on the other panel(s) are not checked until the control panel(s) is(are) activated.

Check the tachometer display

If a fault is registered it will be shown in the tachometer display.



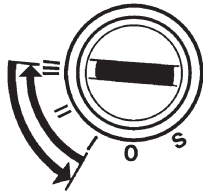
Activate the control position and lock the system.

Press the activation button for at least one second. When the button is released, the indication lights up to confirm that the control position is activated.

NOTE! If the indicator flashes, the control position has not been activated because the control levers are not in the neutral position or the system has been locked from another control panel.

If the boat has more than one control panel, the system can be locked, so that the engine can only be controlled from the activated control board. Press the activation button for a further second to lock the system. The padlock sign lights up in confirmation.

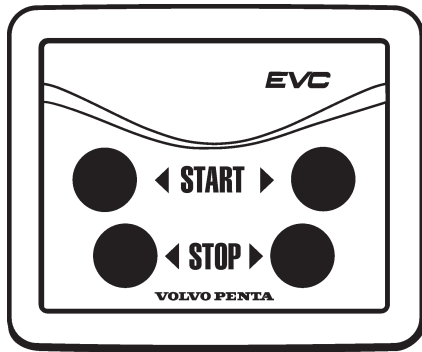
Unlock the system by pressing the activation button for one second. This can only be done from an activated control panel.



Start the engine

Start using the ignition switch

Turn the key to position **III**. Release the key and let it spring back to position **I** as soon as the engine has started. Stop cranking if the engine does not start within 20 sek.



Starting with the starter button

Press the starter button. Release the button as soon as the engine has started. Please note that if you start from an alternative control station, the starter key at the main control station must be in position **I**. Stop cranking if the engine does not start within 20 sek.

Overheating protection

If the starter motor is engaged for its maximum activation time (30 seconds), the starter motor circuit is cut automatically to protect the starter motor from overheating. Leave the starter motor to cool for at least five minutes (if possible) before making a new start attempt.

Read the instruments and warm the engine up

Allow the engine to idle for the first ten seconds, and check that instruments and displays show normal values. Check that no alarms are displayed and that no warning lamps are flashing.

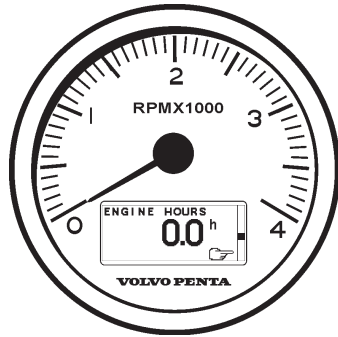
Then warm the engine up at low speed and low load, so that it reaches normal operating temperature before full power is used.

 **IMPORTANT!** Never race the engine when it is cold.

Operation

Learn to handle the engine, controls and other equipment in a safe and correct manner before you cast off on your maiden voyage. Remember to avoid sudden or surprising rudder movements and gear shifting. There is a risk that passengers could fall over, or overboard.

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



Reading the instruments

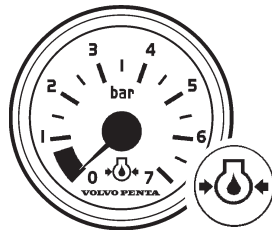
Read all instruments and displays directly after starting, and then regularly during your voyage.

EVC system tachometer

Shows user selected boat and engine information.

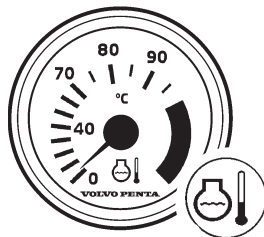
Oil pressure

The oil pressure gauge should normally indicate between 3-5 bar. It will indicate a somewhat lower value when idling.



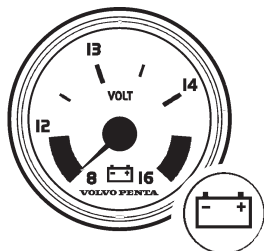
Coolant temperature

The temperature gauge should normally indicate between 75–95°C (167-203°F) in normal operation.



Charging

During operation, system voltage should be within normal values, not in any of the red fields.





Acknowledging alarms and messages

There are several types of alarms and messages that can appear as a pop-up in the tachometer/display.

NOTE! Some alarms for fault are also accompanied by a buzzer. First silence the buzzer by pushing the  NAVIGATION WHEEL on the control panel.

1. Read the alarm/message pop-up.
2. Acknowledge the pop-up by pushing the  NAVIGATION WHEEL on the control panel (sometimes repeatedly). The pop-up will disappear.
3. Take the indicated actions.

If there is an alarm pop-up of a fault please refer to the "In case of emergency" and "Fault register" chapters.

NOTE! If there is a fuel alarm pop-up it will reappear every 10 minutes until tank is filled. If there is a depth alarm pop-up it will reappear every 30 seconds until the depth exceeds the depth alarm setpoint.



Cruising speed

Avoid operation at full throttle, for best fuel economy. We recommend a cruising speed which is at least 10% below the maximum engine speed at full speed (full throttle). The maximum engine speed will vary due to propeller choice, load and sea conditions, but it should be in the full throttle range.

Full throttle range:

D4	3400–3600 rpm
D6	3400–3600 rpm

If the engine does not reach the full throttle range, this could be caused by a number of factors which are noted in the "Fault tracing" chapter. If the engine speed exceeds the full throttle range, select a coarser pitch propeller. Ask your Volvo Penta dealer for advice.

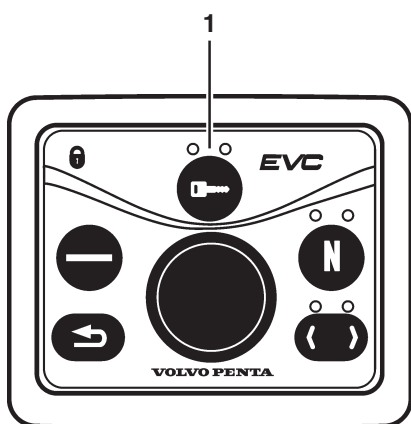
Synchronizing engine speed

When driving with twin engines, both the operating economy and comfort will be increased when the engines are operating at the same engine speed (rpm).

When the synchronization function is activated, the engine speed (rpm) of the starboard engine is automatically adjusted to that of the port engine. The synchronization function is activated automatically if the following conditions are met.

1. The engine speed levers for both engines are in (approximately) the same position.
2. The engine speed on both engines must exceed 800 rpm.

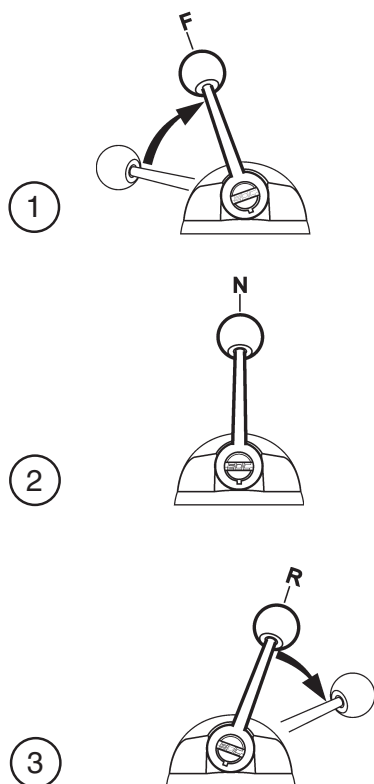
NOTE! The synchronizer is disengaged as soon as the conditions are no longer met.



Changing the helm station

The first time you change control panel after starting the EVC system, a bulb check is done automatically. All LEDs and bulbs light up for 2 seconds.

1. Check that the control levers are in neutral on **both** the control panel you leave and on the new control panel.
2. Check that the EVC system is not locked.
3. Press the activation button (1) for at least one second. When the button is released, the indication lights up to confirm that the control position is activated.
4. Press the activation button (1) for a further second to lock the EVC system. The padlock sign lights up in confirmation. Unlock the system by pressing the activation button for one second. This can only be done from an activated control panel.



Operation

Shifting between forward and reverse should be done at idling. Shifting at higher engine speeds can be uncomfortable for passengers and cause unnecessary stress on the drive-unit, or cause the engine to stop.

If you attempt to shift gear at an excessive engine speed, a safety function cuts in automatically, and delays shifting until engine speed has fallen to 1500 rpm.

Always do a forward/reverse operation as follows:

1. Reduce engine speed to idle and let the boat more or less lose way.

⚠ WARNING! Never shift to reverse when the boat is planing.

2. Move the control lever to neutral with a rapid, distinct movement. Make a brief pause.

NOTE! A beep will sound to indicate that the control lever is in neutral.

3. Then move the control lever to reverse with a rapid, distinct movement and increase engine speed.

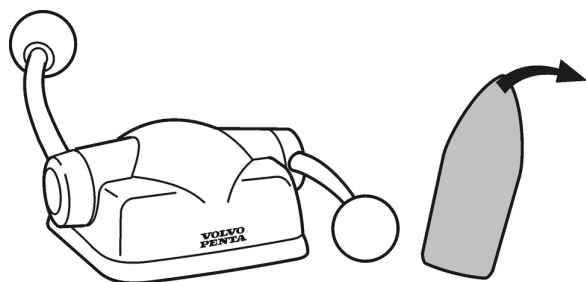
⚠ IMPORTANT! If the boat has twin engines, it is important that both should be running during reversing maneuvers, to avoid the risk of water entry (via the exhaust pipe) into the stationary engine.

Steering

A boat with a Volvo Penta IPS drive-unit has more progressive steering than a boat with a conventional drive or reverse gear. At half lock, the steering effect is more or less the same, and at full lock, the steering effect is stronger than for a boat with a conventional propeller.

Note! That the boat always turns in the direction that the steering wheel is turned.

⚠ WARNING! Full lock when driving at high speed will make the boat turn strongly, which entails a great risk of personal injury, or that people aboard will fall over or be thrown overboard. Warn everybody aboard before doing any emergency manoeuvres.



Steering with control levers

NOTE! Engine speed is limited to 1500 rpm .

Rotate the boat

Put one control lever in the position for forward and put the other control lever in the position for reverse. Use a suitable engine speed for manoeuvring.

The direction of rotation is determined by the lever which is put in the position for reverse. If the boat is to move to starboard, the starboard control lever should be put in the position for reverse.

Steering the boat

Put the control levers in forward. Use a suitable engine speed for manoeuvring.

The direction of the steering is determined by the use of the control levers. If the boat is to move to port, reduce speed on port engine. For immediate reaction, move the port control lever in reverse and then back again to forward.



Auto pilot (extra optional)

Activation

The activation of the autopilot, along with other user information, is described in the autopilot suppliers documentation.

NOTE! The system can refuse activation if the steering wheel is turned at the same time as an attempt is made to activate the autopilot.

The autopilot does not work when traveling backwards.

The steering wheel is braked while the autopilot is in control (AUTO position)

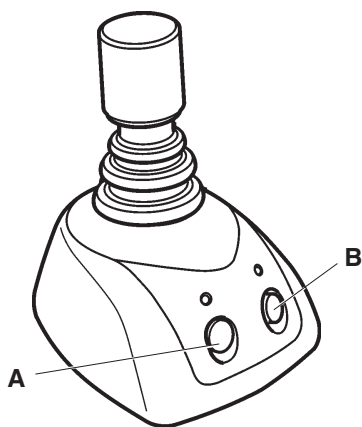
Disconnection

The autopilot is disconnected with steering wheel movements greater than 2°, with change of helm, or if a serious fault occurs.

NOTE! If the autopilot is activated from a passive helm, then disconnection via steering wheel movement is not possible from that helm.

Running aground

After a minor impact or running aground always check that the drive-unit or propeller are not damaged or if there are vibrations from the drive-unit. If this is the case then the boat (if possible) should be run to harbor at reduced speed and taken out of the water and the drive-unit must be inspected at an authorized Volvo Penta workshop.



Docking (Joystick)

The Volvo Penta IPS docking function (joystick) makes it possible to rotate the boat and maneuver it in any direction – sideways, diagonally, forward and backward – with one hand.

⚠ IMPORTANT! The the docking function (joystick) should only be used for docking (slow speed maneuvering).

NOTE! Learn to use the docking function (joystick) and its functions in a safe and correct manner, before starting to use the function in a crowded marina.

NOTE! Engine speed is restricted when in docking mode.

A. Docking button (ON/OFF)

B. Boost button (ON/OFF)

NOTE! Always push the buttons firmly and hold for at least one second.

The docking function

Follow the instructions below when you wish to enable the docking function (for a joystick) on the main or flybridge station. The docking function is automatically enabled on the docking station when the docking station is activated.

Before the docking function can be enabled:

- The engines must be running.
- The control levers must be in neutral.
- The joystick must be in the center position.
- The station from where you are going to dock must be activated.

1. Push the docking button (A) on the joystick.
2. A beep indicates that the docking function is enabled. The LED above the docking button lights up. The system is now in docking mode and the boat can only be maneuvered with the joystick.

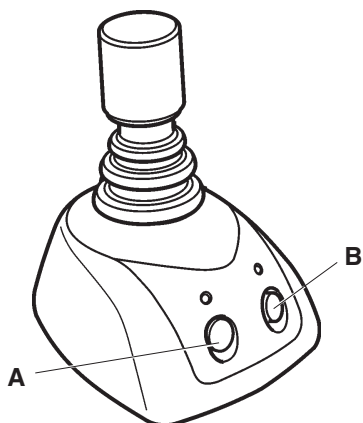
⚠ WARNING! The docking function is disabled automatically if the control lever(s) are moved from neutral.

Disabling the docking function

The docking function can be quickly disabled.

⚠ WARNING! If the docking function is disabled, the boat cannot be maneuvered with the joystick.

1. Push the docking button (A) on the joystick or move the control lever(s) out of neutral.
2. Two beeps indicate that the docking function is disabled. The LED above the docking button stops flashing. The boat can now be maneuvered with the wheel and control lever(s) only.



Enabling boost mode

In situations where normal thrust is insufficient, for example when it is windy or there is a strong current, the boost mode can be enabled. When the boost mode is enabled, the operator has more thrust available than in the normal docking mode.

NOTE! The boost mode should not be used more than necessary.

1. Enable the docking function.
2. Enable the boost mode by pushing the boost button (B) on the joystick.
3. A beep indicates that the boost mode is enabled. The LED above the button lights up.

Disabling the boost mode

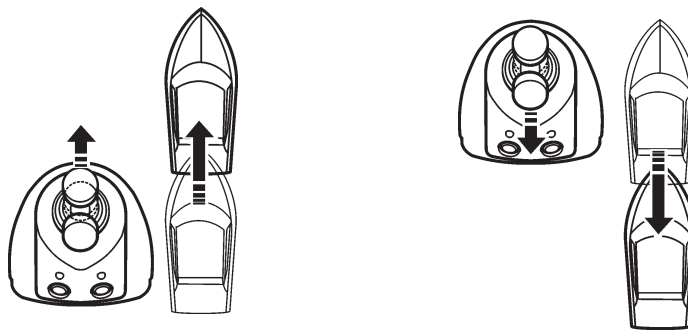
1. Disable the boost mode by pushing the boost-button (B) on the joystick.
2. Two beeps indicate that the boost mode is disabled. The LED above the button goes out.
3. The system is now in normal docking function.

NOTE! If the docking button is pushed, the docking function is disabled and the boat cannot be maneuvered with the joystick.

Maneuvering with the joystick

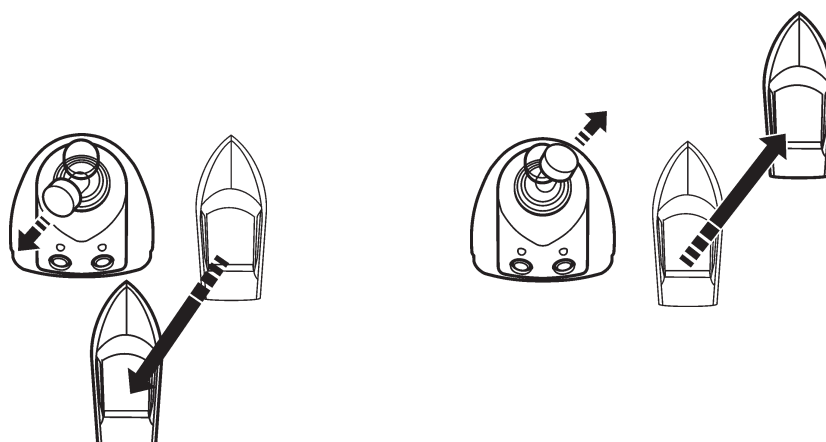
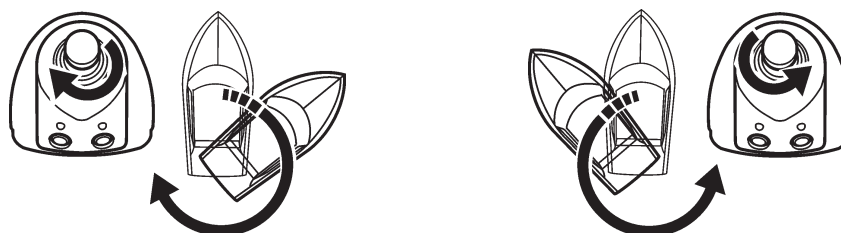
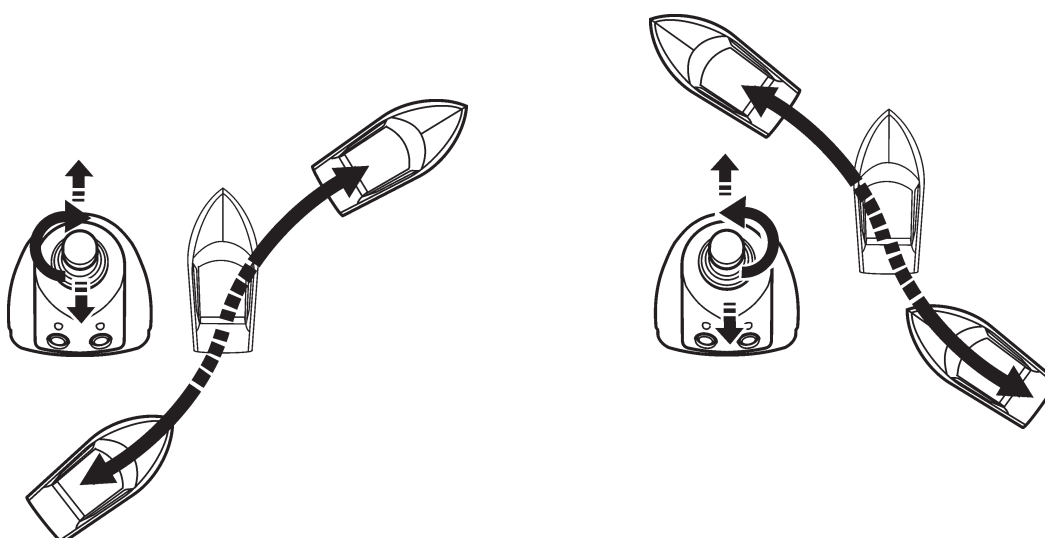
- ⚠ WARNING!** A rotating propeller can cause serious injury. Ensure that there is no one in the water before you enable docking mode. Never go near people who are bathing or where there is a risk that there are people in the water.
- ⚠ WARNING!** Remember that the side thrust is considerably greater than with a conventional bow propeller. The boat will continue to move in the selected direction even after the joystick has been released. Compensate for this movement by moving the joystick in the opposite direction.
- ⚠ IMPORTANT!** The joystick and it's functions are only to be used when docking. In all other cases, the wheel and control lever(s) should be used.

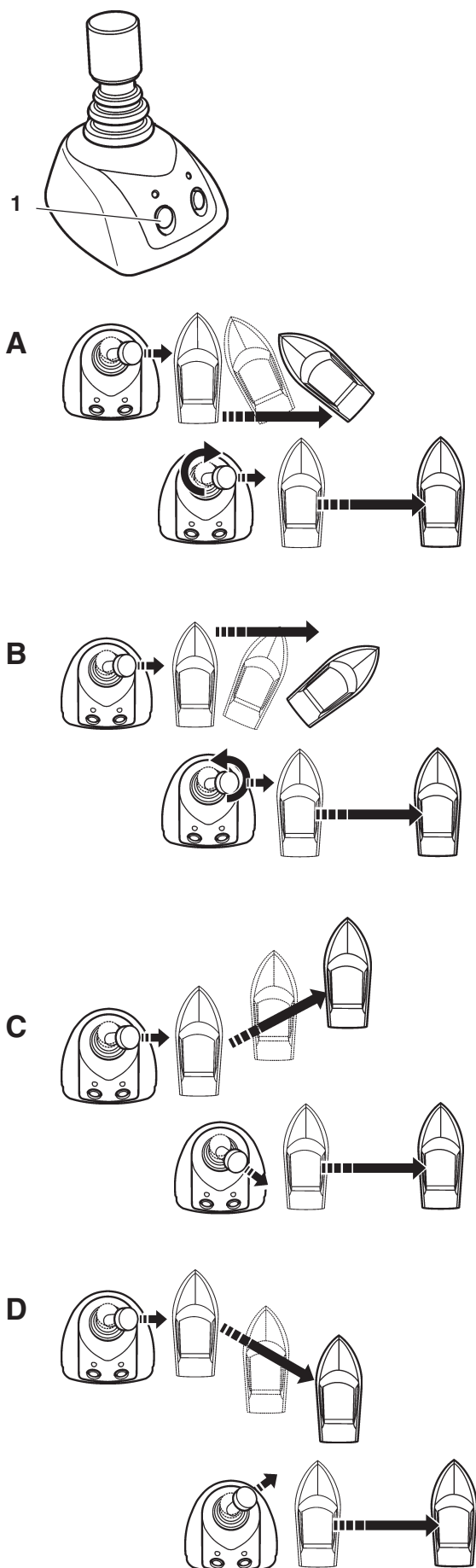
Forwards / reverse



Straight to the side



Diagonally**Rotate****Turn**



Calibrating joystick function

This calibration only needs to be performed if the boat movement does not corresponds to the movement of the joystick.

Calibrate the joystick function as follows:

⚠ IMPORTANT! When calibrating the joystick function the boat must be operated in open water and under safe conditions. Avoid performing the calibration in strong winds or sea-current as such conditions may affect the outcome of the calibration.

NOTE! Calibration only needs to be done in one direction, port or starboard.

1. Enable docking function. For docking station please refer to the "Instruments" chapter, section "Docking station panel", for other stations please refer to "Operation" chapter, section "Docking (Joystick)".
2. Push both the buttons on the joystick and hold them down for 5 seconds or more. A sound signal indicates that the system is in calibration mode. The LEDs above the buttons starts to flash.
3. Move the joystick sideways to one of its end positions. Correct the boat's incorrect movement by turning and/or moving the joystick as illustrated in examples A-D.

NOTE! Combinations of the examples shown can occur.

NOTE! Let the boat move for quite a long distance during the calibration routine. Hold the joystick in position.

4. When the boat is moving directly sideways, push the docking button (1). The new calibration is stored and this is confirmed with a beep.
5. Release the joystick. The system is now in normal docking function.

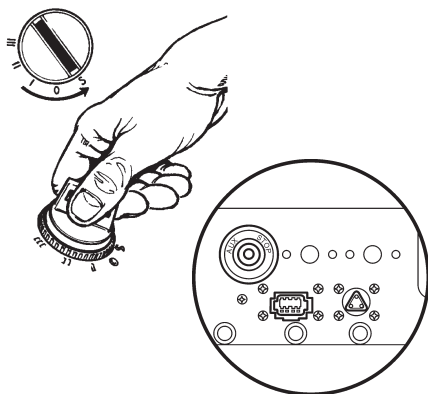
Joystick calibration is now complete.

NOTE: It is always possible to reset the calibration as follows:

1. Enable docking function.
2. Push both the buttons on the joystick and hold them down for 5 seconds or more. A sound signal indicates that the system is in calibration mode. The LEDs above the neutral button starts to flash, and the LED above the docking button lights up.
3. Push the docking button (1). Calibration is reset and this is confirmed with a beep.
4. The system is now in normal docking function.

Stopping the engine

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



Stopping

Turn the key to stop position “S”. Keep the key turned until the engine stops. The key will automatically return to the “0” position when it is released and can then be removed.

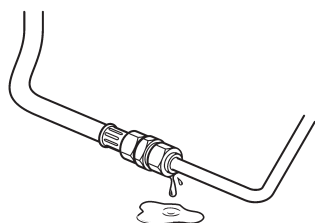
⚠ IMPORTANT! Never switch off the main switches while the engine is running. This could damage the alternator.

⚠ IMPORTANT! Never switch off the main switches before the starter key is turned off (is in “0” position or removed). This could damage the electrical system.

When the engine is stopped the drive-units will automatically be positioned in straight forward position.

Auxiliary stop

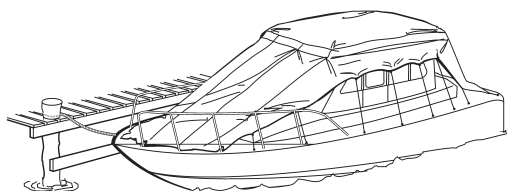
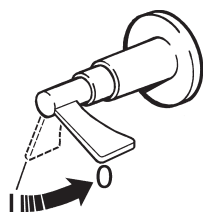
If the engine cannot be stopped in a normal procedure, it is possible to stop the engine via auxiliary stop mounted on the side of the engine.



After stopping the engine

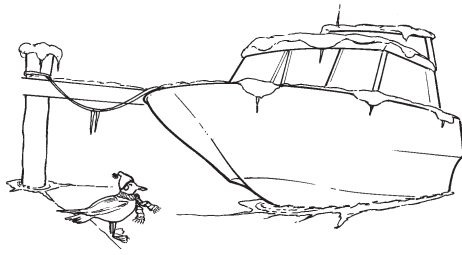
⚠ IMPORTANT! Make sure that the starter key is turned off (is in “0” position or removed) before main switches are switched off. Otherwise the electrical system could be damaged.

- Inspect the engine and engine compartment for any leaks.
- Switch off the main switches if the boat is not to be used for some time.



Laying up

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



Cold weather precautions

To prevent freezing damage, the seawater system must be drained and the freshwater system coolant must have sufficient antifreeze protection. Refer to the cooling system section in chapter "Maintenance".

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



Laying up on land

Where boats are kept laid up on land when not in use, for example, trailer boats, 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-unit must be cleaned with emery paper to remove any oxidation.

⚠ IMPORTANT! Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.

Maintenance schedule

General information

Your Volvo Penta engine and its equipment 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. If given preventive maintenance, according to the maintenance schedule, and if Volvo Penta original spares are used, these qualities are retained and unnecessary malfunctions can be avoided.

Warranty inspection

During the first period of operation, the specified warranty inspection "First service inspection" must be done by an authorised Volvo Penta workshop. Instructions about when and where this should be done are found in the **Warranty and service book**.

Extended Protection

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

MAINTENANCE SCHEDULE

 **WARNING!** Before you do any maintenance work, read the "Maintenance" chapter carefully. This contains advice on doing the work in a safe and correct manner.

 **IMPORTANT!** Maintenance points marked ☐ must be done by an authorised Volvo Penta workshop.

Daily, before first start:

- Engine and engine room. General inspection..... page 63
- Engine oil. Check level..... page 67
- Coolant. Check level page 72
- General inspection. Leakage and function check. not shown
- Drive-unit. Check oil level page 85

Every 14 days:

- Drive belts. Check for wear. Change as required..... page 65
- Sea water filter. Cleaning..... page 74
- Battery. Check electrolyte level..... page 81

Every 100-200 hours / at least once a year, included in extended protection:

- Engine oil. Change¹⁾ page 68
- Engine oil filter. Change²⁾ page 69

¹⁾ Oil change intervals vary, depending on oil grade and sulfur content of the fuel. Please refer to Technical Data.

²⁾ Change the filters during each oil change.

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

- Crankcase ventilation filter. Change page 64
- Air filter Change..... page 64
- Drive belts. Check belt tension page 65
- Compressor Check oil level..... page 66
- Sea water pump. Check impeller page 73
- Sacrificial anodes. Charge air cooler, heat exchanger. Check..... page 75
- Fuel filter/ fuel pre-filter. Change page 77
- Drive-unit. Check corrosion protection between housing and clamping ring page 86
- Paintwork. Clean and touch up as required not shown
- ☐ All hoses and pipes – Check the condition and re-tighten unions/clamps not shown
- ☐ EVC system. Inspection with diagnostic tool not shown

Every 400 hours / at least once a year, included in extended protection:

- Drive-unit. Oil and oil filter. Change page 85
- Drive-unit. Check corrosion protection (anode) page 86
- Drive-unit antifouling coating. Repair as required..... page 91

Every second year:

- Coolant. Change page 70

Every 600 hours / at least every 5 years:

- ☐ Turbo. Inspection/cleaning as required not shown
- ☐ Drive-unit, check for function and wear not shown
 - Propeller shaft (check straightness)
 - Steering

Every 1200 hours / at least every 5 years:

- Drive belt. Change page 65
- ☐ Drive belt, compressor. Change not shown
- Compressor. Change oil page 66
- ☐ Heat exchanger. Inspection/Cleaning not shown
- ☐ Intercooler. Inspection/Cleaning not shown
- ☐ Inspection of exhaust hose and cooling water hoses. not shown
 - Checking hoses/pipes, unions and hose clamps

¹⁾ Oil change intervals vary, depending on oil grade and sulfur content of the fuel. Please refer to Technical Data.

²⁾ Change the filters during each oil change.

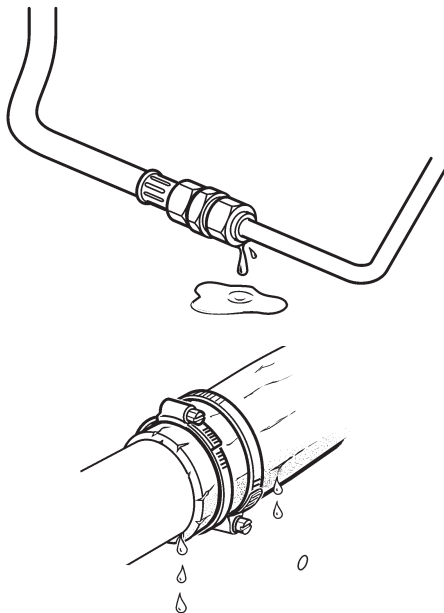
Maintenance

This chapter describes how to carry out the above maintenance. Read the instructions carefully before starting work. Maintenance intervals are contained in the chapter above: Maintenance schedule

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

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

Engine, general



General inspection

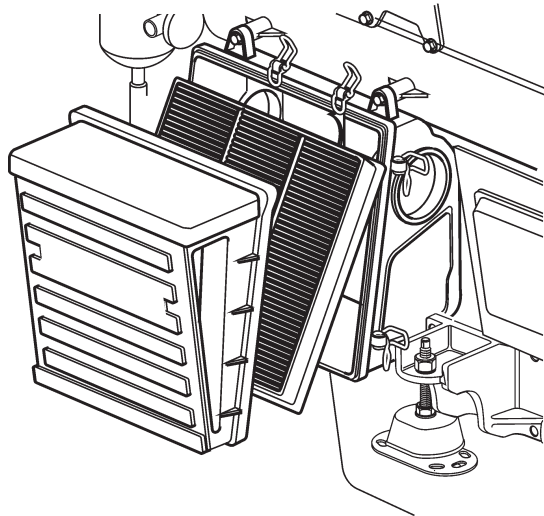
Make a habit of “visually” inspecting the engine and engine room before starting the engine and after stopping when the engine has been turned off. This will help you to quickly detect abnormalities that have occurred or are about to occur.

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

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

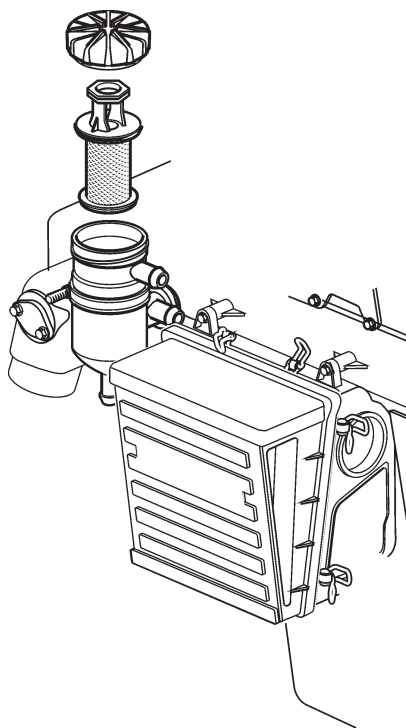
⚠ IMPORTANT! If an oil, fuel, coolant or exhaust leak is detected, the cause must be investigated and the fault rectified before the engine is started.

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



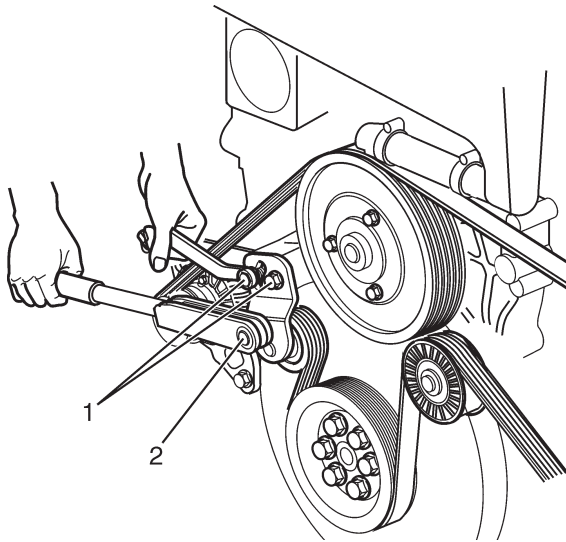
Changing air filter

Remove the air filter cover. Remove the old air filter. Clean the air filter cover/housing if necessary. Take care not to allow impurities to enter the engine. Fit the new air filter and the air filter cover.



Changing crankcase ventilation filter

Unscrew the lid and remove the old filter. Clean the filter cover/housing if necessary. Take care not to allow impurities to enter the engine. Fit the new filter.



Checking drive belts

⚠ WARNING! Stop the engine before commencing maintenance work.

General

Check belt tension and condition regularly. If the belt is too taut it can damage bearings and if it is too loose it may slip.

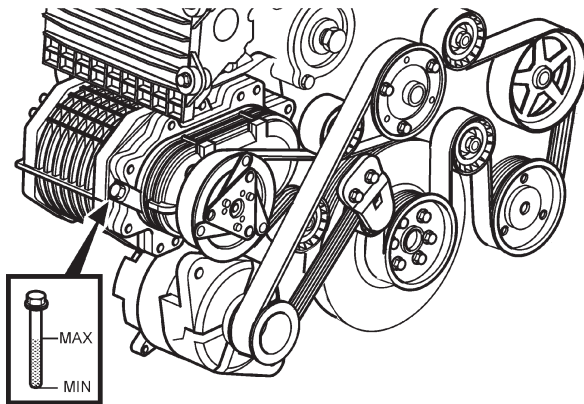
Therefore, check the belt tension regularly. **Check and adjust after operation when the belt is warm.**

⚠ IMPORTANT ! Always change a belt that appears worn or is cracked (belts working in pairs must be replaced together).

Adjusting/changing drive belts.

The standard generator and water pump are driven by a poly-V belt for optimum function and service life. Change/tension the belt as follows:

1. Undo the bolts (1) on the tensioning roller bracket. Remove and change the belt if necessary.
2. Tension the belt to apply a torque of 70 Nm on the tensioning roller square fitting (2). Secure the tensioning roller with the bolts (1). The bolts must be torque tightened to 50 Nm.
3. Undo the bolts (1) when warm and repeat the belt tensioning procedure.



Compressor. Checking oil

Checking and topping up

Unscrew and remove the dipstick. Wipe off oil. Screw the dipstick down fully and then remove it again. Check that the level oil is between the markings. If the dipstick is not screwed down fully the oil level will be slightly above the MIN marking if the oil level is correct. Ensure therefore that the dipstick is fully screwed in to read off the oil level correctly. Top up the oil as required (use the dip stick tube to fill). For oil quality and capacity: See the "Technical Data" chapter.



IMPORTANT! The oil level should always be within the MAX and MIN range marked on the dipstick.

Oil change

Run engine to normal operating temperature. Remove the oil dipstick. Remove the plug (1) and let the oil run out. Reinstall the plug and fill with oil to correct level as above.

Lubrication system, Engine

⚠ IMPORTANT! With a new or reconditioned engine, the oil and oil filters must be changed after 20–50 hours of operation. Use only the recommended grades of oil. Please refer to the “Technical Data” chapter.

⚠ Oil change intervals can vary from 100 to 200 hours, depending on oil grade and sulphur content of the fuel. Please refer to the “Technical Data” chapter. **Note that oil change intervals must never exceed a period of 12 months.** If you want longer oil change intervals, the condition of the oil must be checked by the oil manufacturers through regular oil testing.

Oil change volume

Please refer to the “Technical Data” chapter.

Checking and topping up the oil level

NOTE! Check the oil level every day **before** the engine is started for the first time.

⚠ IMPORTANT! Do not check the oil level directly after the engine is shut down. The oil in the engine needs time run down to the oil pan before a correct oil level check can be performed.

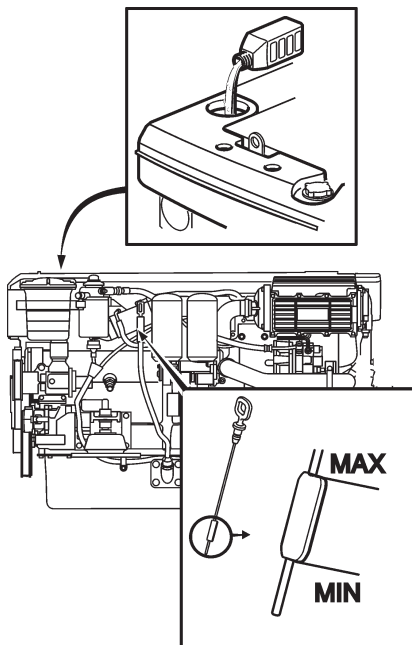
Wait 15 minutes if the engine has been run up to normal operating temperatures.

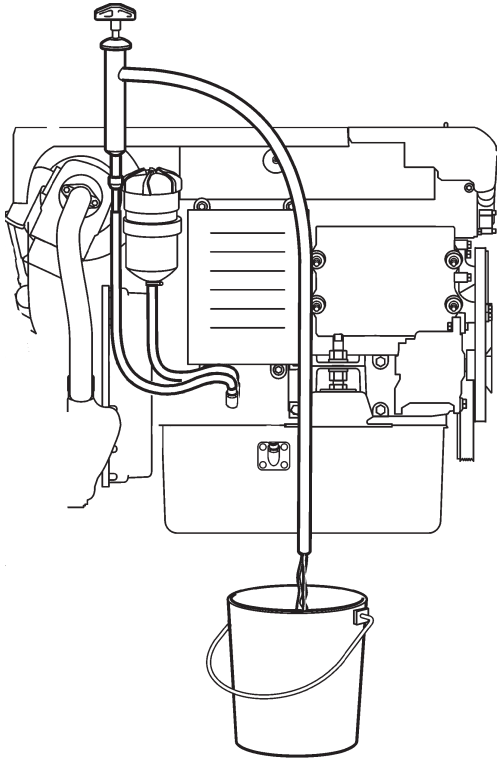
Wait one hour if the engine only has been run at idle.

⚠ IMPORTANT! The oil level should always be between the MAX and MIN marks on the dipstick. Higher or lower oil level than permitted could lead to engine damage.

Topping up is done via the filler hole on the top of the engine. Top up oil slowly. Wait 5 minutes before checking the oil level again since the oil needs time to run down to the oil pan. Then check the level again. Use only recommended grades of oil: Please refer to the “Technical Data” chapter.

NOTE! The volume between MAX and MIN is approx. 1,5 liter (0,4 US gals) for D4 and 3,5 liter (0,9 US gals) for D6.





Changing engine oil

Always observe the recommended oil change interval.

⚠ IMPORTANT! Only use a recommended grade of oil. Please refer to the “Technical Data” chapter.

⚠ IMPORTANT! The oil level should always be between the MAX and MIN marks on the dipstick. Higher or lower oil level than permitted could lead to engine damage.

1. Start the engine (this makes it easier to suck the oil up from the sump). Let the engine run till operation temperature is reached (temperature gauge indicate a value between 75– 95°C (167-203°F)). Then stop the engine.

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

2. Connect the oil bilge pump to the drain pipe. Pump up the oil.
3. Change the oil filter and bypass filter at each oil change (please refer to chapter “Changing oil filter and bypass filter”).
4. Fill up with new oil through the filling hole on the top of the engine.

NOTE! Fill 1.5 liters (0.4 US gals) less than the total oil volume since there always is a small amount of oil left in the oil pan. Please refer to the “Technical Data” chapter for oil volume.

5. Start the engine. Check that the oil pressure warning lamp goes out and that no leakage occurs by the filters.

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

6. Stop the engine. Wait one hour before checking the oil level again since the oil needs time to run down to the oil pan. Top up if necessary.

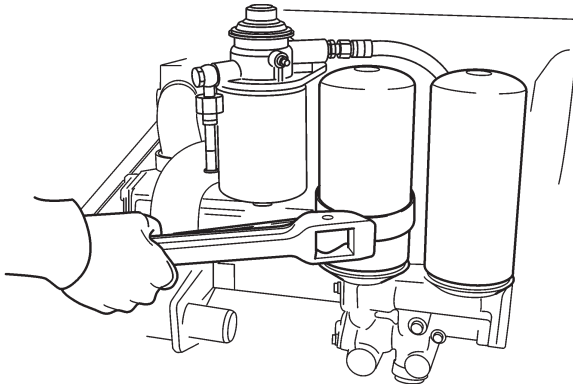
NOTE! Hand the old oil in to a re-cycling station.

Changing oil filter and bypass filter.

Change the oil filter and bypass filter during each oil change.

Remember to hand the old filters in to a re-cycling station.

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



1. Put a suitable vessel underneath the filters to avoid oil spillage.
2. Clean the filter bracket.
3. Unscrew the bypass filter (1) and the oil filters (2) with a suitable extractor.
4. Check that the mating surfaces on the filter brackets are clean, and that no residue from the old seals remains.
5. Moisten the seals on the new filters with engine oil.
6. **NOTE!** Screw the filters on by hand until the rubber seals just touch the mating surface on the filter brackets. Then tighten a further 1/2 to 3/4 turn.
7. Start the engine (low idle) and check that no leakage occurs. Check the oil level once the engine has stopped.

Freshwater system

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

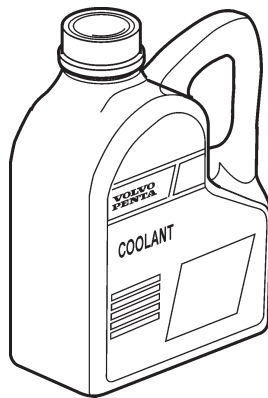
We recommend that you use **“Volvo Penta Coolant, Ready Mixed”**, alternatively **“Volvo Penta Coolant”** (concentrated) mixed with **pure** water according to spec, see “Coolant. Mixture”. Only coolant of this quality is suited too and approved by Volvo Penta.

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

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

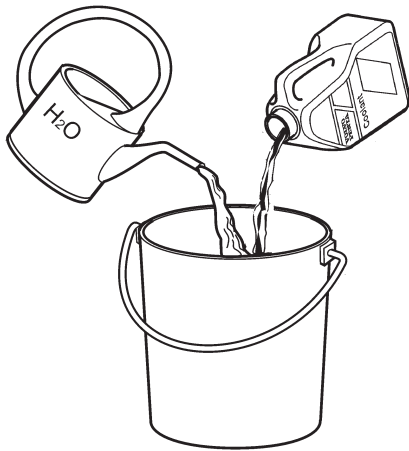
Future warranty claims on the engine and additional equipment may be rejected if an unsuitable coolant has been used or if the instructions concerning coolant mixing have not been followed.

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



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

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



Coolant. Mixture

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

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

Mix:

40 % “Volvo Penta Coolant” (conc. coolant)

60 % water

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

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

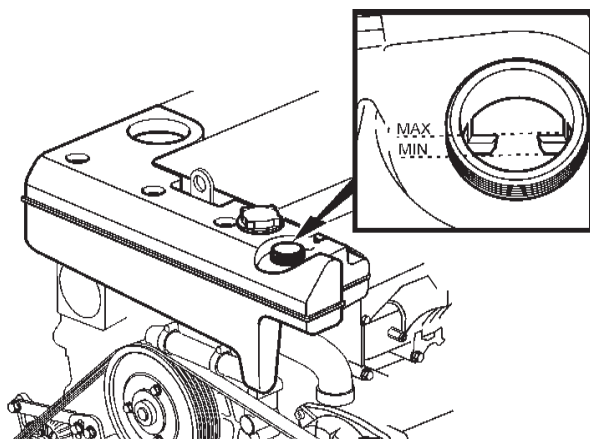
⚠ IMPORTANT! It is extremely important that the correct concentration of coolant is added to the system. Mix in a separate, clean vessel before adding into the cooling system. Ensure that the liquids mix properly.



Water quality

ASTM D4985:

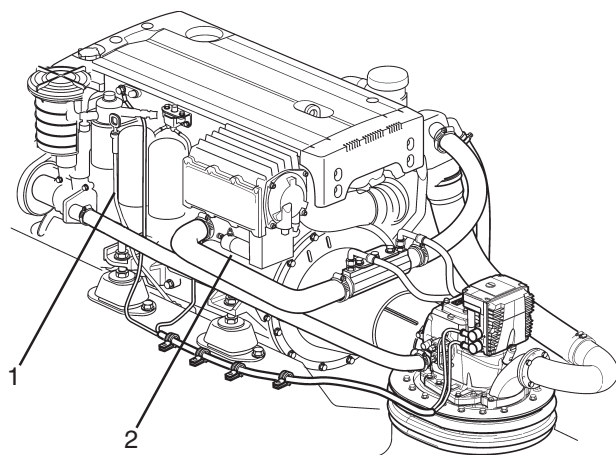
Total solid particles	< 340 ppm
Total hardness:.....	< 9.5° dH
Chloride	< 40 ppm
Sulfate.....	< 100 ppm
pH value.....	5,5–9
Silica (acc. ASTM D859)	< 20 mg SiO ₂ /l
Iron (acc. ASTM D1068)	< 0.10 ppm
Manganese (acc. ASTM D858).....	< 0.05 ppm
Conductivity (acc. ASTM D1125).....	< 500 µS/cm
Organic content,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



Checking coolant level

⚠ WARNING! Do not open the engine coolant system filler cap when the engine is still hot except in an emergency. Steam or hot coolant may spray out.

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



Draining fresh water system

Remove the filler cap on the expansion tank (to allow the coolant to run out faster). Use a suitable receptacle while draining.

There is a hose mounted on the intercooler. Move the hose and connect it to the drain nipple (1). Open the drain nipple by carefully screwing the nipple. Drain all coolant and screw in the nipple by hand.

Move the hose and then continue to drain the coolant from the drain nipple (2) on the engine block.

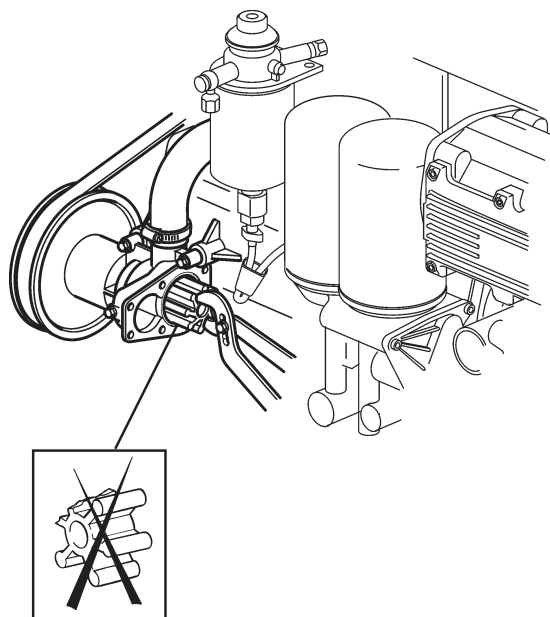
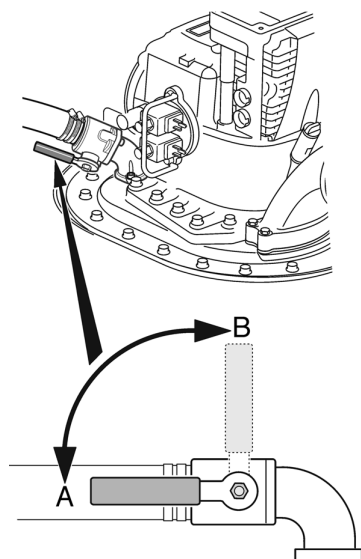
NB! Leave the old coolant to a facility for destruction

Seawater system

The seawater system is the boat's external cooling system. On engines with drives, the seawater pump draws in water via the drive-unit, through the control system oil cooler to the seawater pump, after which the water passes the seawater filter before being pumped through the fuel cooler, intercooler, engine oil cooler and heat exchanger. Finally, the water is pumped into the exhaust pipe elbow, where it is mixed with the exhaust gases.

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

- A. Open
- B. Closed



Checking/Changing impeller

⚠ WARNING! Risk for water penetration.

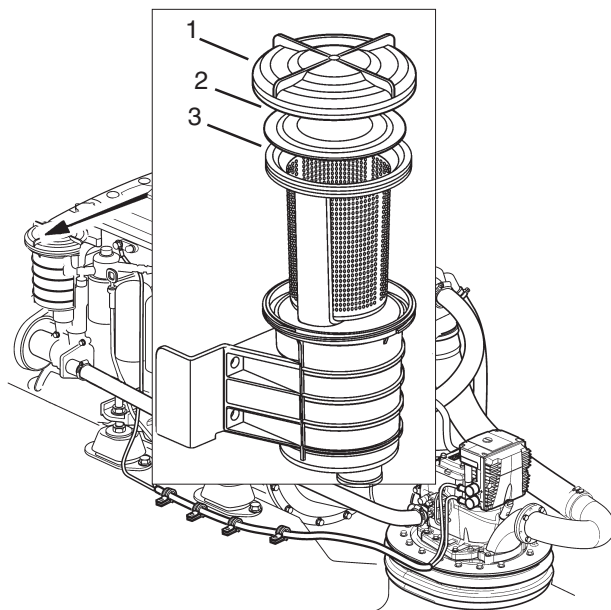
Remove the cover from the seawater pump and remove the impeller (1).

If there are cracks or other defects the impeller must be replaced. (If the pump shaft can be turned by hand the flange must be replaced). Lubricate the pump housing and the inside of the cover with a little **glycerin**.

⚠ IMPORTANT! The impeller will be damaged if other types of lubricant than glycerin are used.

⚠ WARNING! If the impeller is damaged, the pump will not work, which can lead to engine damage or fire.

Reinstall the impeller using a rotating movement. Install the seal washers on the shaft center. Install the cover together with a new o-ring.

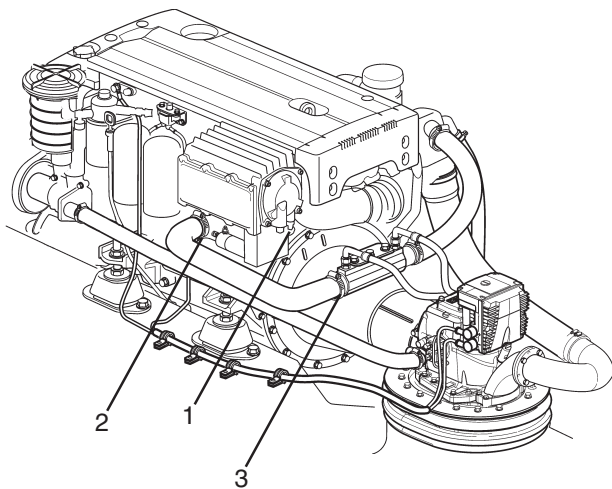


Cleaning seawater filter

⚠ WARNING! Risk for water penetration.

Screw off cover (1) and remove seal plate (2). Lift out and clean the insert (3).

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



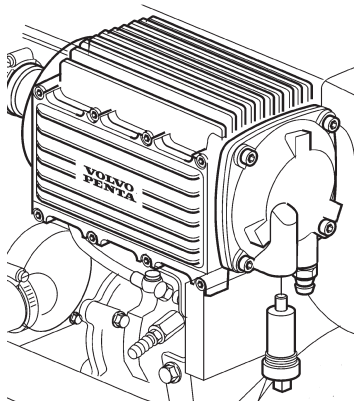
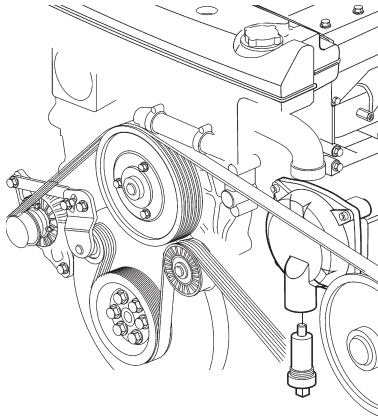
Draining seawater system

Use a suitable receptacle while draining.

Open the drain nipple (1) by carefully screwing the nipple. Use a no. 17 block spanner if the nipple sticks. Drain all coolant and screw in the nipple by hand.

Move the hose and then continue to drain the coolant from the drain nipple (2).

Remove hose (3) and hose clamb and drain of the coolant from the oil cooler.



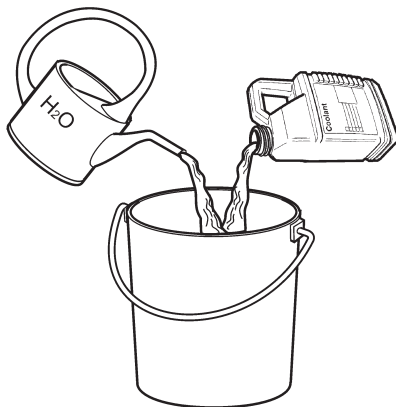
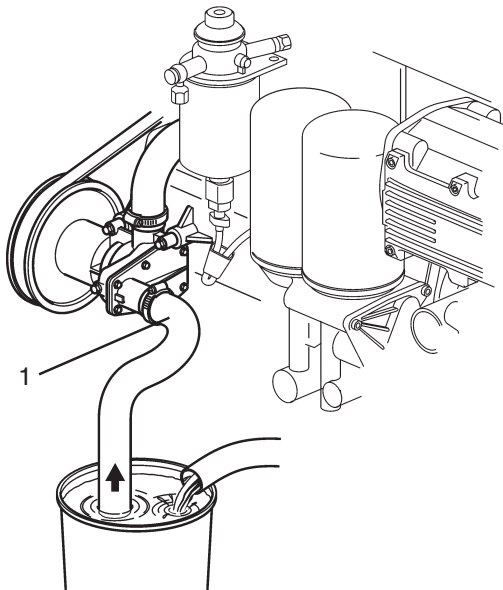
Checking/Changing sacrificial anodes

⚠ WARNING! Risk of water entering. Close the seawater cock before starting work on the seawater system.

1. Close the seawater cock.
2. Drain the seawater as described in "Draining the seawater system".
3. Remove the sacrificial anodes in the heat exchanger and the intercooler.
4. Check the sacrificial anodes and replace them if they are less than 50% of their original size. Otherwise, clean the sacrificial anodes with sandpaper to remove the layer of oxide before refitting them.

⚠ IMPORTANT ! Clean with sandpaper. Use no steel tools as this will impair electrical protection.

5. Fit the sacrificial anodes. Make sure there is good contact between the anode and the metal goods.
6. Close the drain nipples.
7. Open the seawater cock before starting the engine.
8. Make sure there are no leaks.



Seawater system. Cleaning and inhibiting

To prevent the build up of deposits and salt crystals in the seawater system it must be flushed with freshwater. When the boat is laid up it must also be inhibited.

⚠ WARNING! Risk of water penetration. Cleaning and inhibiting the seawater system should be carried out with the boat on land.

1. Open the seawater cock on drive-unit.
2. Detach hose from the seawater pump and connect a hose (1) which reaches to a bucket filled with fresh water. Take care of filling.
3. Check that there is nothing that will get splashed behind the exhaust outlet.

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

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

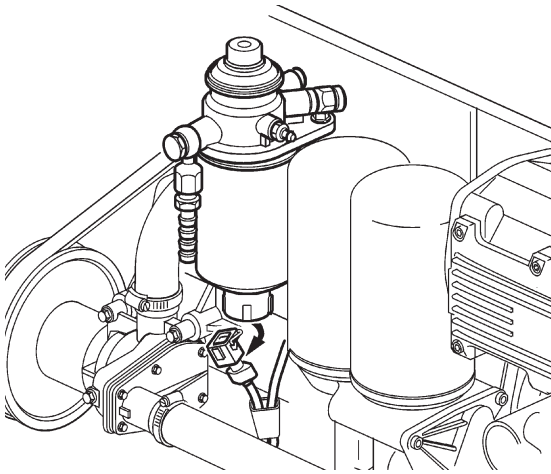
4. Set the gear control lever in the neutral position. Check that nobody is near the propellers. Start the engine. Let it run at fast idle a few minutes. Stop the engine.
5. For inhibiting fill a bucket with antifreeze mixture (50/50 freshwater and antifreeze). Secure a container by the exhaust outlet. Repeat step 4.
6. Connect seawater hose.
7. The system is now inhibited. The antifreeze mixture should be left in the system while the boat is laid up. Drain the mixture just before the boat is launched. Reuse the antifreeze mixture next season or deposit it at a properly designated disposal site.

Fuel system

The engine fuel system is a so-called common rail-system. The advantage of the common rail-system is that the engine control unit controls the timing and fuel amount, this mean better emission control and a smooth running engine.

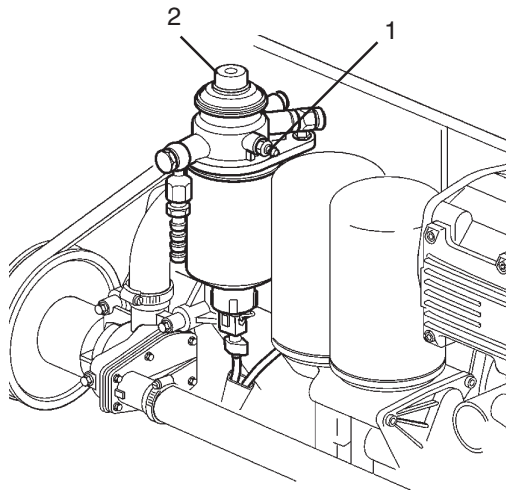
All work on the engine common rail-system must be carried out at an authorized workshop. Use only the recommended grade of fuel: See the chapter "Technical Data".

⚠ WARNING! Fire risk. When carrying out work on the fuel system makes 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 cannot cause a fire.



Changing fuel filter

1. Close the fuel valve/valves.
2. Clean the filter bracket and put a suitable vessel under the filter.
3. Remove the cables from the water trap (1).
4. Unscrew the filter, use a filter wrench if needed.
5. Clean the sealing surfaces of the filter bracket. Make sure the filter is absolutely clean and the sealing surfaces are undamaged. Moisten the sealing rings with engine oil, including the inner rubber seal located inside the threaded hole in the center of the filter.
NOTE! Do not fill the new filter with fuel before assembly. Contaminations may get into the system and cause damage and malfunction.
6. Screw the new filter on by hand until the seal just touches the mating surface. Then tighten a further 1/2 turn. Reinstall the water trap cables.
7. Open the fuel valve.
8. Bleed the fuel system. See Chapter "Bleeding the fuel system".
9. Start the engine and check for leakages.



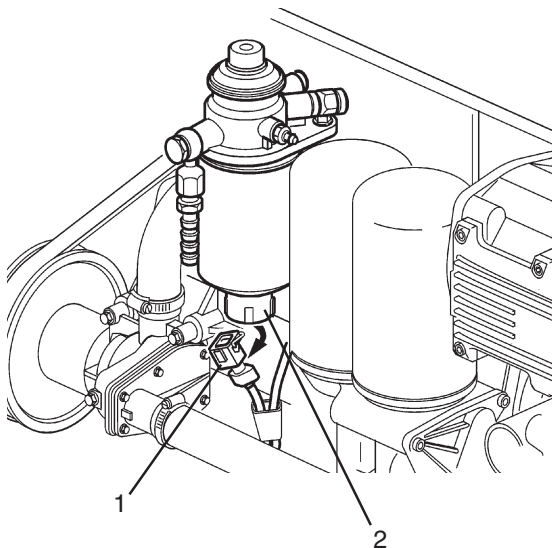
Bleeding the fuel system

The fuel system must be bled e.g. after changing fuel filter, if the fuel tank has been run dry and after long stops.

⚠ WARNING! Never detach the pressure pipes.

1. Attach a transparent hose to the air vent valve (1). Lead the hose to a suitable receptacle to avoid spillage.
2. Open the air vent valve and pump fuel using the hand pump (2) until the fuel running out is free from air bubbles. Close and tighten the air vent valve.
3. Pump another 10 strokes with the hand pump. The resistance in the hand pump may seem quite high and is normal and necessary for bleeding the system.
4. Remove the hose and refit the protective cap on the air vent valve.

⚠ WARNING! Working on or approaching a running engine is a safety hazard. Beware of rotating parts and hot surfaces.



Water in fuel

Draining the fuel filter

If the pop-up "water in fuel" on the tachometer display or the lamp  on the optional alarm display comes on, there is too much water in the water separator on the fuel filter. Proceed as follows to rectify this:

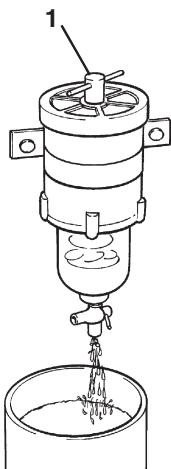
1. Stop the engine and take the starter key out of the starter switch.
2. Remove the cable from the water separator (1).
3. Place a suitable receptacle under the fuel filter and carefully unscrew the water separator (2) enough to allow the water to run out. Screw in the water separator until it bottoms against the filter. Then, screw a further 1/4 to 1/2 of a turn.
4. Fasten the cable from the water separator (1).

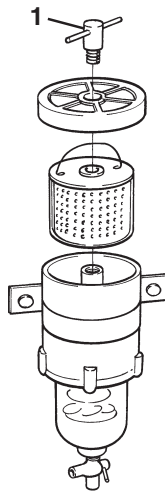
Draining of fuel pre-filter.

The fuel pre-filter is an accessory.

Position a container under the fuel filter. On the fuel filter first open the venting screw (1) approximately 4 turns. Drain off water and contaminants using the cock/plug at the bottom of the filter. Vent fuel system.

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





Fuel pre-filter. Changing filter insert

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

Remove the cover by slackening off screw (1). Replace insert and reinstall cover. Open fuel cock. Vent fuel system. **Deposit the old filter insert at a properly designated disposal site.**

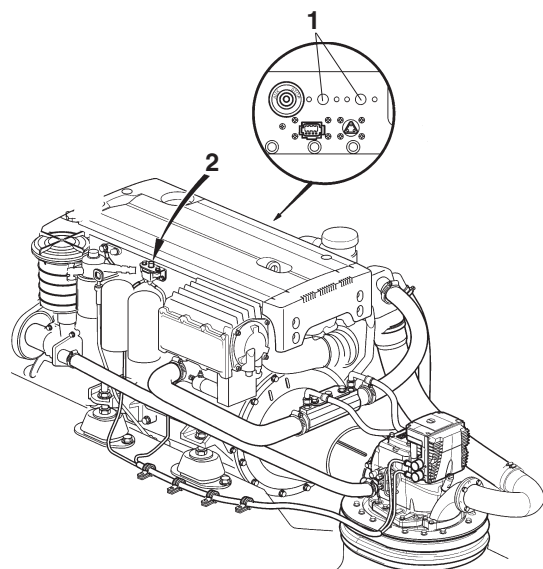
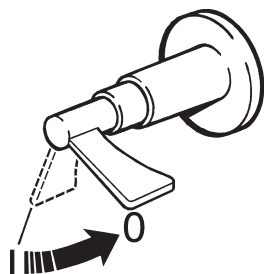
Start the engine and check for leaks.

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

Electrical system

The engine is equipped with a two-pole system electrical system which means that the voltage (minus) is returned directly from the starter motor minus terminal with the battery negative lead. Individual components on the system return voltage to the starter motor minus terminal via separate cables.

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



Main switch

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

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

Fuses

12/24-volt system and drive-unit

The engine and the drive-unit are fitted with automatic circuit breakers, (1) engine and (2) drive-unit. The circuit breakers cut the power if the system is overloaded.

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

If the fault persists, read out the flash codes and take the necessary measures.

⚠ IMPORTANT ! Always investigate the cause of the overload!

EVC system

The EVC system is protected through the engine circuit breakers.

⚠ IMPORTANT ! Always investigate the cause of the overload!



Electrical connections

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

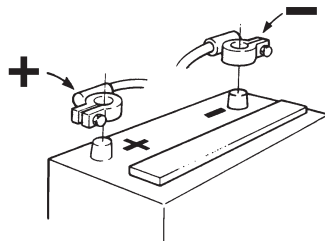


Battery. Maintenance

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

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

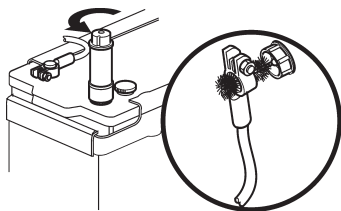
⚠ WARNING! The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries. Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin wash off immediately using plenty of water and soap.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



Connecting and disconnecting

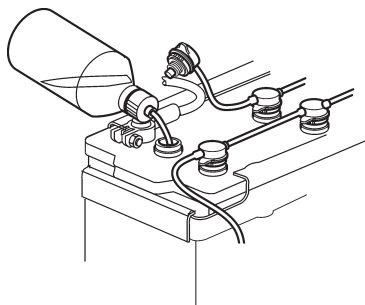
First connect the red battery lead (+) to the battery (+) terminal. Then connect the black battery lead (-) to the battery (-) terminal.

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



Cleaning

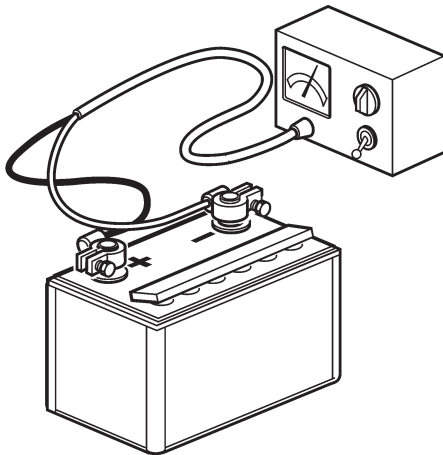
Keep batteries dry and clean. Oxidation or dirt on the battery and battery terminals can cause short-circuits, voltage drop and discharge especially in damp weather. Clean the battery terminals and leads to remove oxidation using a brass brush. Tighten the cable terminals well and grease them with terminal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



Topping up

The electrolyte should be 5–10 mm over the plates in the battery. Top up using **distilled water** if necessary. Charge the battery after topping up for at least 30 minutes by running the engine at fast idle.

NOTE! Certain maintenance-free batteries have special instructions which must be followed.



Battery. Charging

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

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

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

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

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

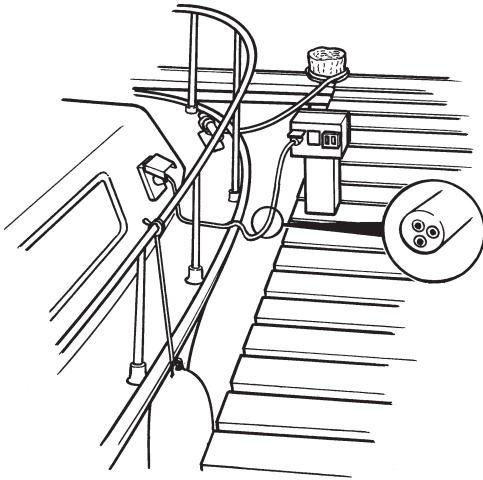
⚠ WARNING! Always switch off the charging circuit **before** removing the battery charger connectors. Never mix up battery positive and negative terminals. This may cause sparks and an explosion.

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

Electrical installations

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

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



The following should always be observed:

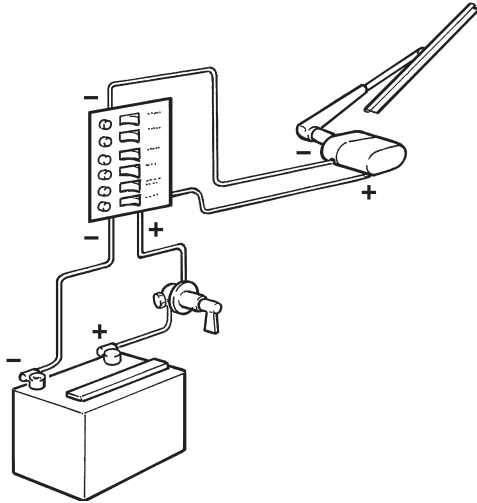
1. When shore power is connected (120V–230V), the shore safety ground (earth) must not be connected to the engine or any other ground point on the boat. The safety ground must always be connected to the connection cabinet's ground (earth) terminal ashore. The safety ground should not be connected to the negative connection on the output side (12/24V), i.e. it must be galvanically separated.

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

2. Route and clamp electric cables so that they will not be exposed to rubbing, damp or bilge water in the keelson.
3. Engine or drive must never be used as a ground point.

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

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



4. There must be a main switch connected to the starter battery positive (+) terminal. The main switch should cut off power to all power consuming equipment and should be switched off when the boat is not in use.
5. If an auxiliary battery is in use, a main switch should be connected between its (+) terminal and the fuse block, and the (-) terminal and the terminal block for the boat's electrical equipment. The main switch for the auxiliary battery must cut off all power consuming equipment connected to that battery and be turned off when power is no longer needed.

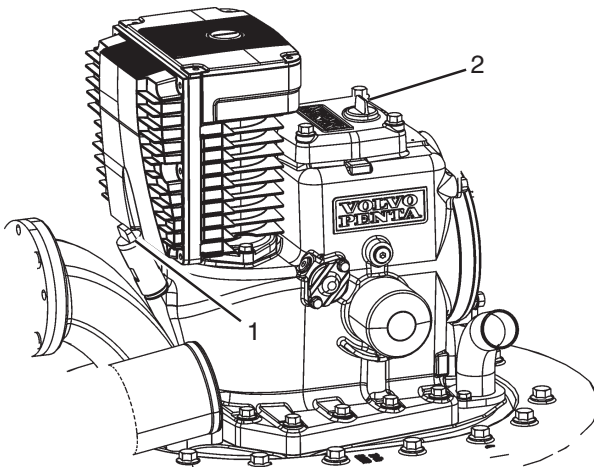
All equipment connected to the auxiliary battery should have separate switches.

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

Volvo Penta IPS drive-unit

The drive-unit is hydraulic, which means that forward/reverse engagement and disengagement is hydraulically activated. The drive-unit lubrication system has an oil filter and oil cooler. The drive-unit is equipped with solenoid valves for electronically controlled shifting.

The drive-unit is protected against galvanic corrosion. This protection consists of sacrificial anodes and ground braids. The ground braids maintain a connection between the different components of the drive-unit. A broken connection can result in the rapid corrosion of an individual component even though the protection is otherwise effective. Check ground braids every year. Faulty electrical installation can also cause the break down of the galvanic protection. Damage due to electrolytic corrosion occurs rapidly and is often extensive. For further information see the chapter: "Electrical system".



Oil level

⚠ IMPORTANT! The drive-unit must be shut down for at least 12 hours before a correct oil level check can be done. Check the oil level every day before starting the engine.

Open the oil filler cap (2) slowly so that the overpressure disappears. Remove the dipstick (1) by turning it anti clockwise. Dry off the dipstick and reinstall it in the drive-unit, **screw it into place**. Remove the oil dipstick again and check the oil level. The correct oil level is inside the marked area.

If necessary, top the oil up through the filling hole. Please refer to the "Technical Data" chapter for oil grades and volume.

⚠ IMPORTANT! Never over-fill the drive-unit. The oil level must always be inside or at the recommended levels.

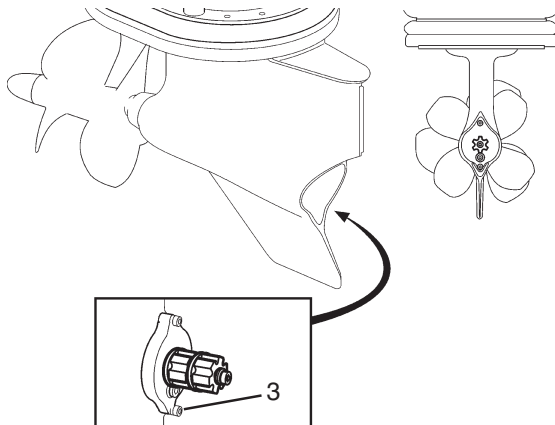
Changing oil and filter

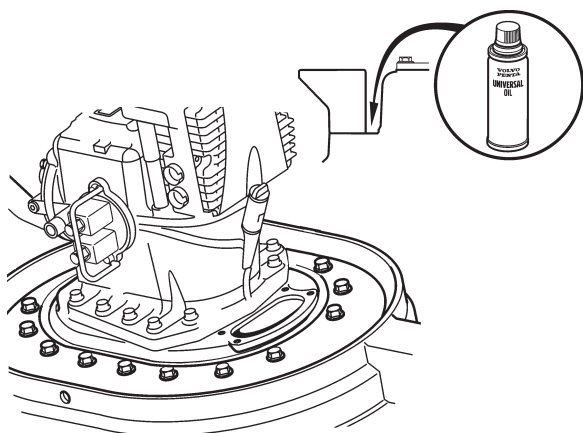
1. Open the oil filling (2) cap slowly so that the overpressure disappears. Unscrew the draining plug (3) and allow the oil to run out.
2. Change the filter.
3. Refit the drain plug and a new gasket.

NOTE! Always replace the gasket when the drain plug has been removed.

4. Measure up the correct quantity of oil and fill the drive-unit with the oil via the oil filling hole. Please refer to the "Technical Data" chapter for oil grades and volume.

⚠ IMPORTANT! Never over-fill the drive-unit. The oil level must always be inside or at the recommended levels.

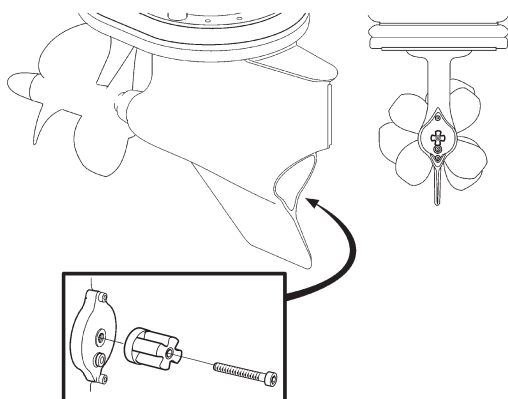




Checking corrosion protection between the housing and the clamping ring

Check that the space between the drive-unit housing and the clamping ring are entirely coated with corrosion protection, Volvo Penta P/N 9510227. If the coating needs to be renewed, follow the instructions below:

1. Clean and dry off the space between the housing and the clamping ring.
2. Spray a liberal coating of corrosion protection in the space between the housing and the clamping ring.



Checking/changing the corrosion protection – Sacrificial anodes

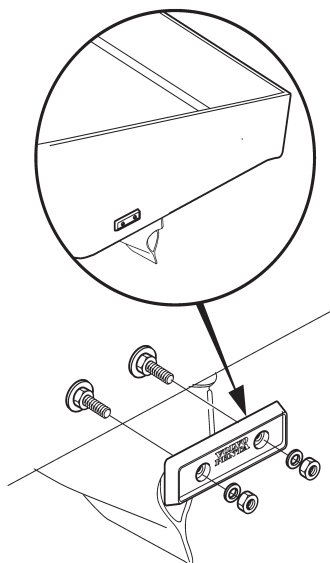
Check the sacrificial anodes regularly. There are two anodes per drive-unit, one is attached to the drive-unit and one is attached to the transom. Please refer to the figures. Replace an anode when approximately 1/3 of the anode has been eroded.

When the boat is kept laid up on land there is a lower level of galvanic corrosion protection due to the oxidation on the sacrificial anodes. Even a new anode can be oxidized on the surface. Before launching the boat the sacrificial anodes must be cleaned.

⚠ IMPORTANT! Clean with sandpaper or emery cloth. Use no steel tools (e.g. wire brush) as this will impair electrical protection.

Changing the corrosion protection

All anodes are secured with screws or with nuts. Undo the screw or the nuts holding the anode. Clean the contact surface and fit the new anode. Tighten the new anode so that there is a good electrical contact.

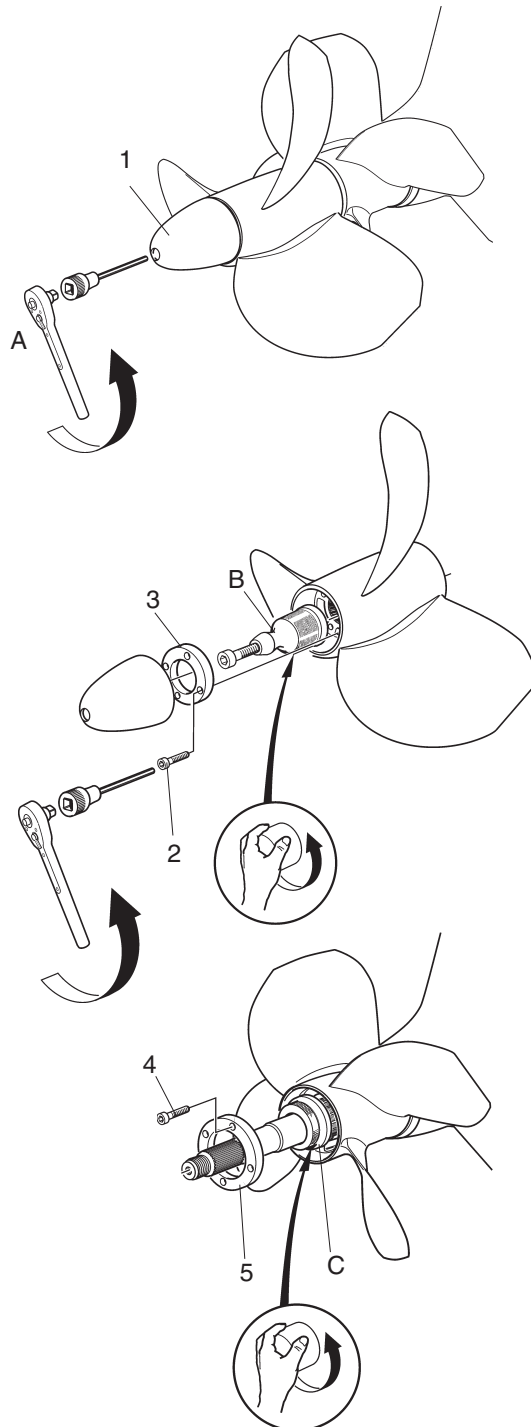


Propellers

For best performance and fuel economy the engine speed should be within the maximum RPM range: See chapter "Operation". If the engine speed at maximum RPM falls outside the max. RPM range then the propeller should be changed.

⚠ WARNING! Make it impossible to start the engine when working on the propellers. Take the starter key out of the starter switch.

⚠ IMPORTANT! Damaged propellers should be replaced immediately. Operating the boat with a damaged propeller should be undertaken with extreme care and only at reduced engine speeds.



Propellers. Drive-unit

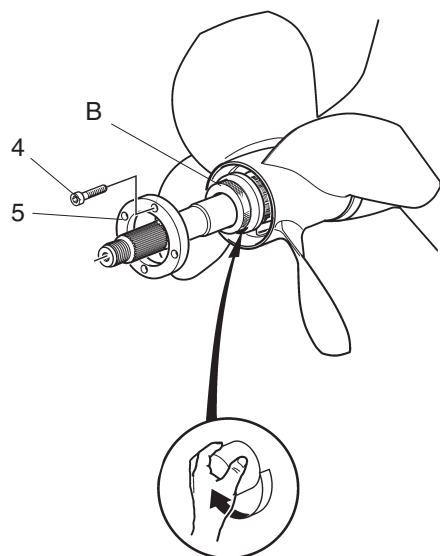
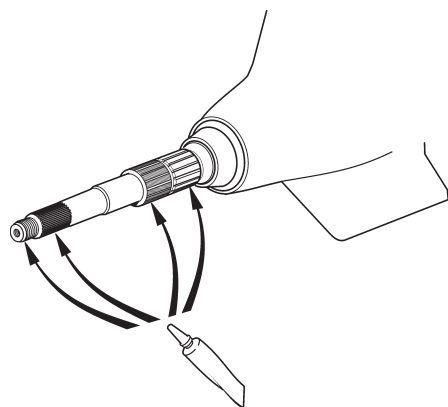
Note! A special tool (A) for removing and fitting the propellers is supplied together with the drive-unit (see figure).

Dismantling

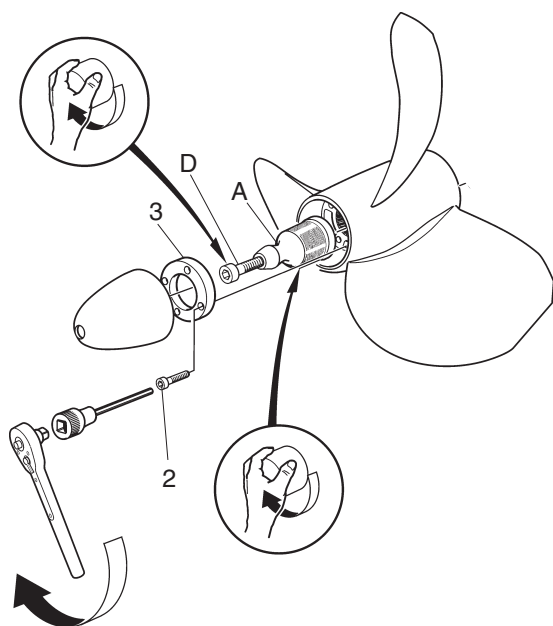
1. Take the starter key out of the starter switch.
2. Remove the spinner (1) using the special tool.
3. Undo the locking ring with the accompanying special tool by unscrew the four socket cap screws (2). Remove nut (B) and locking ring (3). Remove the forward propeller from the propeller shaft.
4. Undo the locking ring for the aft propeller with the accompanying special tool by unscrew the four socket cap screws (4). Remove nut (C) and locking ring (5). Remove the aft propeller from the propeller shaft.
5. Wipe the propeller shafts clean.

Assembly

1. Apply water-resistant grease, part no. 828250 to the splines and thread on both propeller shaft.



2. Install the aft propeller. Then install the aft nut (C) and tighten it by hand until it bottoms. Install locking ring (5). Tighten the locking ring with the accompanying special tool and four socket cap screws (4). **Torque 24-28 Nm (17.7-20.65 lbf ft).**



3. Install the forward propeller on the propeller shaft. Tighten nut (A) by hand and install locking ring (3). Tighten the locking ring with the accompanying special tool and four socket cap screws (2). **Torque 24-28 Nm (17.7-20.65 lbf ft).**

4. **⚠ IMPORTANT!** Tighten the screw D until it bottoms. Otherwise it will not be possible to change propeller without damaging the spinner.
5. Push the spinner into place by hand.

Laying up/Launching

Before taking the boat out of the water for winter/out-of-season storage have an authorized Volvo Penta workshop inspect the engine and other equipment. Have any necessary repairs or service work carried out so that your boat is in top condition for the new season.

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

 **WARNING!** Read the chapter on Maintenance carefully before starting work. It contains instructions on how to carry out the most common maintenance and service operations safely and correctly.

Inhibiting

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

- Change engine oil and replace oil filter.
- Replace fuel filter. Replace fuel pre-filter if installed.
- Run engine to normal operating temperature.

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

- Clean the hull and drive-unit directly after taking up the boat (before it dries).
- Change oil in drive-unit and replace oil filter.

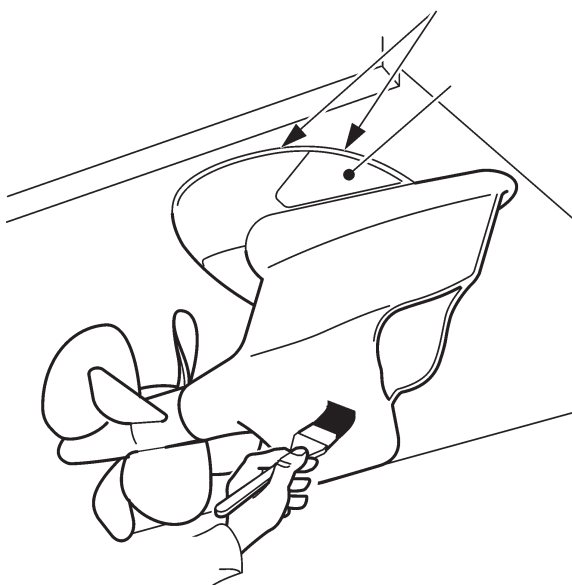
 **IMPORTANT!** Be careful when cleaning with a high pressure water spray. The spray must not be pointed toward the propeller shaft seal, hoses etc.

- Clean the seawater filter.
- Clean and inhibit the seawater system.
- Remove the impeller from the seawater pump. Store the impeller in a sealed plastic bag in a cool place.
- Check the condition of the engine coolant anti-freeze. Top up if required.
- Drain any water and contaminants from the fuel tank. Fill the tank completely with fuel to avoid condensation.

- Clean the outside of the engine. Do not use a high pressure spray to clean the engine. Touch up any damaged areas of paintwork with Volvo Penta original paint.
- Clean the outside of the drive-unit. Do not use a high pressure spray to clean the drive-unit. Repair any damaged areas of the drive-unit antifouling coating, please refer to "Repairing the drive-unit antifouling coating".
- Disconnect battery leads. Clean and charge the batteries. **NOTE!** A poorly charged battery may burst as a result of freezing.
- Spray electrical system components with moisture repellent spray.
- Remove propeller for winter storage. Grease the propeller shaft using water repellent grease VPnr. 828250.
- Check anodes on both engine and drive-unit. Replace with new anodes when approximately 1/3 of the anode has been eroded. Tighten the new anode so that there is a good electrical contact.

Bringing out of storage

- Check oil level in the engine and the drive-unit. Top up if necessary. If there is inhibiting oil in the system drain and fill with new oil, change oil filter. For correct oil grade: See the chapter “Technical Data”.
 - Drain the antifreeze from the seawater system.
 - Install the impeller in the seawater pump. Replace if the old one looks worn. Please refer to the Sea Water System chapter.
 - Close/tighten drain cocks/plugs.
 - Check the tension and condition of the drive belts.
 - Check the condition of rubber hoses and tighten hose clamps.
 - Check engine coolant level and antifreeze protection. Top up if necessary.
 - Connect the fully charged batteries.
 - Paint the hull, please refer to “Painting the underwater hull”.
 - Check the sacrificial anode on the drive-unit. If there is less than 2/3 of the anode left it must be replaced. Clean with emery cloth just before the boat is launched.
-  **IMPORTANT!** Do not use a wire brush or other steel tools when cleaning, as these may damage the galvanic protection.
- Install propellers.
 - Launch the boat. Check for leaks.
 - Start the engine. Check that there are no fuel, engine coolant or exhaust gas leaks and that all control functions are operating.



Repairing the drive-unit antifouling coating

The propulsion unit and propellers have an antifouling coating applied from delivery. Inspect the coating annually and scrape off any loose coating and apply a fresh coating. Volvo Penta recommends the coating "Prop speed®". For instructions on how to apply the coating, please refer to the instructions that come with the "Prop speed®".

NOTE! Do not apply coating in the groove (A) between the propulsion unit and the hull or on the exhaust pad (B).

Wait for the coating to dry before launching the boat.

Painting the underwater hull

All types of paints with anti-fouling properties are poisonous and cause damage to the marine environment. Avoid the use of such agents. Most countries have introduced legislation controlling the use of anti-fouling agents. Check the legislation that applies where the boat is to be used.

NOTE! Always abide by these regulations. In many cases it is completely forbidden to use them on pleasure boats, for example in freshwater.

Tin-based agents (TBT) must not be used.

For boats that are relatively easy to get out of the water we recommend only Teflon treatment combined with mechanical cleaning several times per season. For larger craft, this is not practicable. If the boat is in an area where the water quickly produces fouling, then anti-fouling paint must probably be used.

NOTE! Do not paint in the groove (A) between the Propulsion unit and the hull or on the exhaust pad (B).

Wait for the paint to dry before launching the boat.

In case of emergency

Despite regular maintenance according to the maintenance schedule and perfect operation, faults may occur which must be attended to before the boat can travel further. This chapter contains tips for rectifying some of the possible faults.

There are safety functions which are activated when certain faults occur, to protect the engine. The following can occur:

- Engine can not be started
- Gear in neutral and engine speed is limited to 1500 rpm, no steering.
- The engine stops

If fault occurs, acknowledge any alarm and take the recommended measures. Please refer to this chapter and the "Fault register" chapter.



Starting with auxiliary batteries

⚠ WARNING! Ventilate well. 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.

⚠ WARNING! Never mix the positive and negative poles on the batteries. Risk of arcing and explosion.

1. Check that the rated voltage of the help start battery is the same as the system voltage of the engine.
2. Connect the red jumper cable to the positive pole (+) of the flat battery, and then to the positive pole of the help start battery.
3. Connect the black jumper cable to the **negative pole (-)** of the help start battery, and then to a place some distance from the flat batteries, such as the negative connection on the starter motor.

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

4. Start the engine and run at a fast idle for about ten minutes to charge the batteries. Make sure that there are no extra accessories connected to the electrical system.

⚠ 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 stand bending over any of the batteries either.

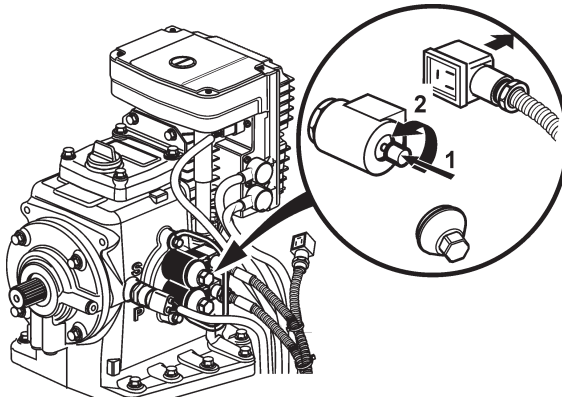
5. Stop the engine. Remove the jumper cables in the exact reverse order from installation.

Emergency shifting

If a fault occurs which prevents the drive-unit from being operated (shifted) with the control lever it is possible to shift manually using the description below.

⚠ WARNING! In emergency shifting, the unit is locked in forwards operation. Please note that the gear can not then be disengaged with the control lever. Forward motion can only be cut off by stopping the engine with the ignition key or stop button.

This description is for manual engagement of the drive-unit, for forward travel.

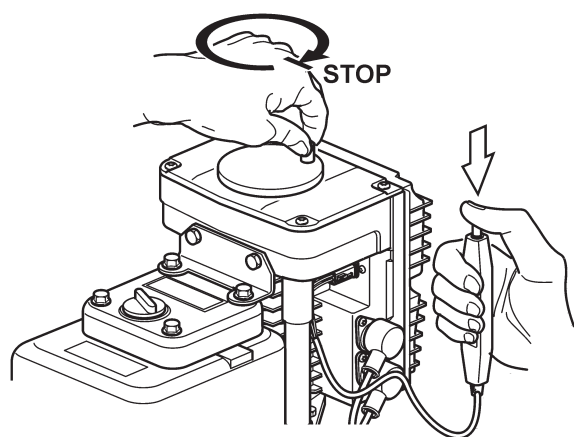
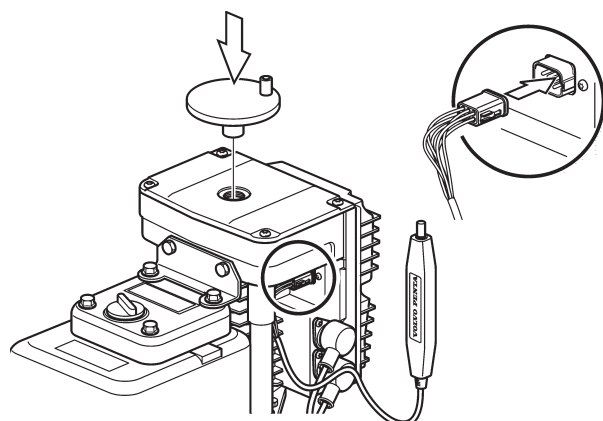
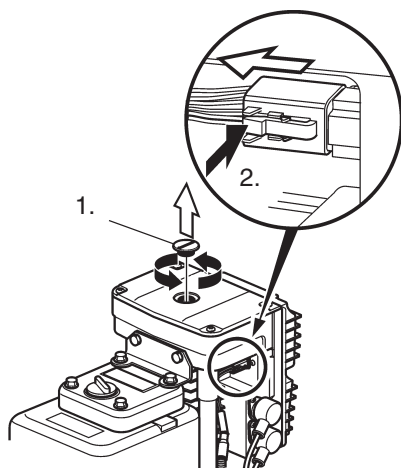
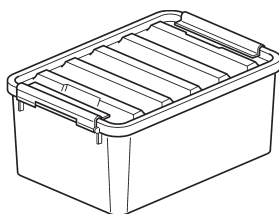


Manual engagement forward gear:

1. Stop the engine and remove the start key from the key switch.
2. Note the valve to which the cable marked "Primary" (lower solenoid) is connected. Then undo both connectors from the solenoid valves.

NOTE! P is forward and S is backward.

3. Remove the cap nut from the valve which was connected to the "Primary" cable.
4. Press the valve (A) while turning the button a 1/2 turn **counter-clockwise** (the button is forced out by spring action). The drive-unit is now connected for forward motion and cannot be disengaged by the control lever.



Alignment of drive-unit

If a fault occurs which prevents the drive-unit from being operated with the steering wheel it is possible to align the drive-unit to straight forward manually using the description below.

The tools needed during this operation are delivered in a special tool box together with the boat.

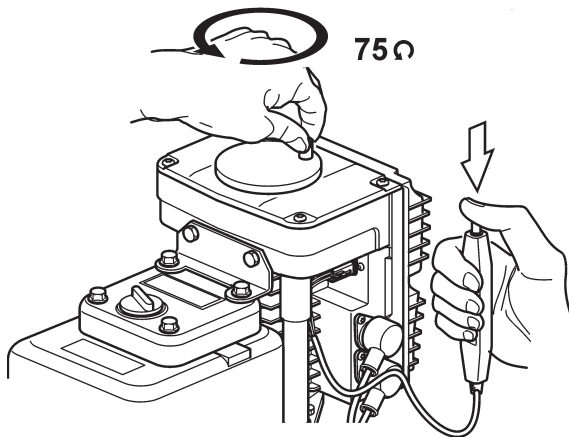
⚠ WARNING! The following procedure must be carried out with the engines stopped.

1. Remove the plug (1). Disconnect the cable by pressing down the lock (2) and at the same time wiggle the connector.

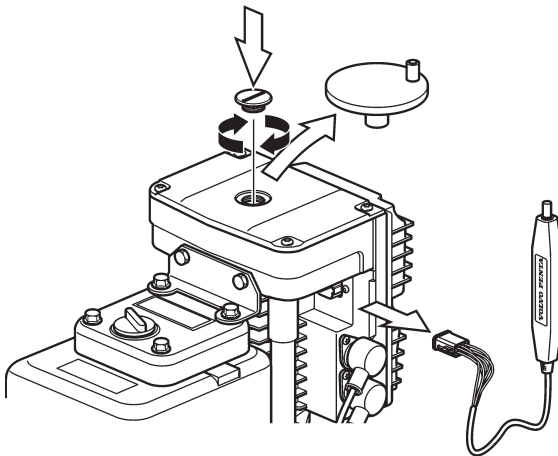
2. Connect the switch and fit the crank tool.

3. Press down the switch button and keep it pressed and turn the crank tool carefully to an end position. When end position is reached, stop turning. The end position feels like a torsion spring.

⚠ WARNING! Do not force the crank tool beyond the end position. Danger of damage to the drive-unit.

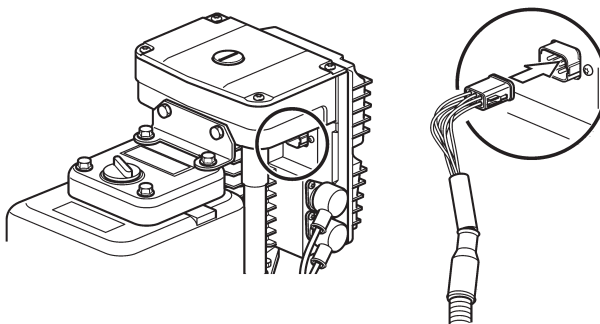


4. Turn the crank tool back 75 turns. The drive-unit is now aligned straight forward.



5. Remove crank tool. Disconnect the switch by pressing down the lock (2) and at the same time unplug the switch by slowly wiggle it (please refer to procedure in step 1)

Fit the plug.



6. Reconnect the cable you disconnected in step 1.

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 problems occur which you can not solve by yourself.

 **WARNING!** Read through the safety advice for care and maintenance work in the “Safety information” chapter before starting work.

Symptom and possible cause	
Pop-ups are shown in the tachometer display	See the “Fault register” chapter
Starter motor not turning (or slow)	1, 2, 3, 24
Engine does not start	4, 5, 6, 7, 24
Engine starts but stops again	6, 7, 24
Engine difficult to start	4, 5, 6, 7
Engine does not reach correct speed at wide open throttle (WOT)	5, 6, 7, 8, 9, 10, 11, 15, 18, 19, 20, 21, 24
Engine knocks	4, 5, 6, 7
Engine runs unevenly	4, 5, 6, 7, 10, 11
Engine vibrates	15, 16
High fuel consumption	8, 9, 10, 12, 15
Black exhaust smoke	10
Blue or white exhaust smoke	12, 22
Low oil pressure	13, 14
Engine coolant temperature too high	17, 18, 19, 20, 21
None or poor charging	2, 23

- | | | |
|---|---|--|
| 1. Discharged battery | 10. Insufficient air supply | 18. Blocked seawater intake/pipe/filter |
| 2. Loose connection/open-circuit | 11. Engine coolant temperature too high | 19. Circulation pump drive belt slipping |
| 3. Fuse tripped | 12. Engine coolant temperature is too low | 20. Defective impeller |
| 4. Lack of fuel | 13. Lubricating oil level too low. | 21. Defective/incorrect thermostat |
| 5. Fouled fuel filter. | 14. Blocked oil filter | 22. Lubricating oil level too high |
| 6. Air in the fuel injection system | 15. Defective/incorrect propeller | 23. Generator drive belt slipping |
| 7. Water/contaminants in the fuel | 16. Defective engine mounting | 24. Stored diagnostic fault codes (NOTE! The codes can only be read and erased by a service technician.) |
| 8. Boat abnormally loaded | 17. Too little coolant | |
| 9. Fouling on underwater hull/drive/propeller | | |

Diagnostic function

The diagnostic function monitors and checks that the engine, drive-unit and EVC system function normally.

The diagnostic function has the following tasks:

- Discover and localize malfunctions
- Notify that malfunctions have been discovered
- Give advice in fault finding
- Protect the engine and ensure continued operation when serious malfunctions are discovered.

The diagnostic function affects the engine in the following ways when:

1. The diagnostic function has discovered a minor malfunction which does not damage the engine or drive-unit.

Reaction: The engine is not affected.

2. The diagnostic function has discovered a serious malfunction which will not immediately damage the engine (e.g. high coolant temperature) or drive-unit.

Reaction: Engine power is reduced till the relevant value is normalized.

3. The diagnostic function has discovered a serious malfunction which will cause serious damage on the engine or the drive-unit.

Reaction: Engine power is reduced.

4. The diagnostic function has discovered a serious malfunction which makes it impossible to control the engine or the drive-unit.

Reaction: The drive-unit is disengaged and engine power is reduced.

It is possible to do an emergency shift: Please refer to the "Emergency shifting" section.

5. The diagnostic function has discovered a serious malfunction on the drive-unit or in the engine fuel injection system.

Reaction: Engine is stopped

It is possible to do an emergency shift: Please refer to the "Emergency shifting" section. In serious emergency it is also possible to start the engine with gear engaged after acknowledging the alarm.

Malfunction messages Steering system

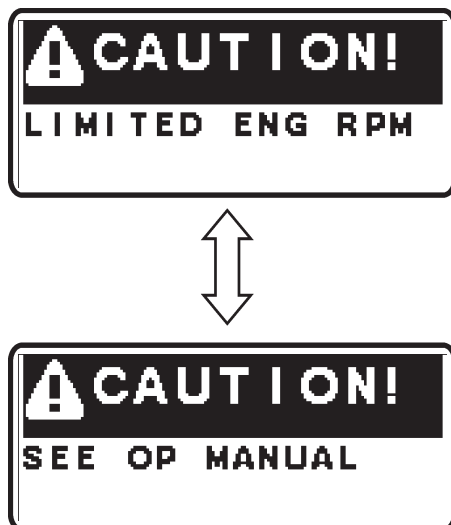
Tachometer display Pop-ups Steering System

If the diagnostic function discovers a malfunction in steering system a steering specific pop-up will appear in the tachometer display. The pop-up is shown in the tachometer display and the ordinary boat information is not visible at all. The audible warning will sound and the relevant warning lamp on the alarm panel will start to flash.

The pop-ups that are shown are related to the steering function only. Errors that does not affect the steering function or safety issues are not considered in this section.

Acknowledge the alarm

1. Press NAVIGATION WHEEL. The buzzers will become silent.
2. Press NAVIGATION WHEEL. The pop-up will disappear and normal display window will be shown.



Limited engine RPM

If there is a fault in the system which will not immediately damage the engine or drive-unit, this pop-up is shown.

NOTE! The pop-up will also be shown when only one engine has been started and gear has been engaged. To avoid this pop-up during normal operation, start both engines before engaging gear.

Steering is working on both sides. The engine speed is limited. The shifting status is unchanged.

Acknowledge the alarm and take the recommended measures. Please refer to the "Fault register" chapter.



Limited steering

If there is steering function on only one driveline side, this pop-up is shown. At least one of the sides is able to shift gear and run the engine to be able to move the boat.

The engine speed is limited. The shifting status is unchanged.

Acknowledge the alarm and take the recommended measures. Please refer to the "Fault register" chapter.



No steering wheel response

If there is no ability to steer the boat with the steering wheel, this pop-up is shown.

There is a fault or several faults in both drivelines. It can be faults in the steering wheel as well as in the drive-unit.

At least one of the driveline sides is able to shift gear and run the engine to be able to move the boat.

The engine speed is limited. The shifting status is unchanged.

It is possible to align the drive-unit straight forward without using the steering wheel, please refer to chapter "In case of emergency", section, "Alignment of the drive-unit".

It is possible to steer the boat using the control levers, please refer to chapter "Operation" section "Steering".

Acknowledge the alarm and take the recommended measures. Please also refer to the "Fault register" chapter.



No gear/throttle and steering

If there are multiple errors unabling the system to control both steering and propulsion this pop-up is shown .

Steering malfunction on both sides. There are also a combination of errors unabling propulsion or control of propulsion through control levers on both sides. It is adviced to shut down the engines on both sides and try to restart them again. If the errors remain after restart, tow the boat to service provider.

Acknowlege the alarm and take the recommended measures. Please also refer to the "Fault register" chapter.

Malfunction message engine and EVC-system

If the diagnostic function discovers a malfunction, it warns the driver by showing pop-ups in the tachometer display and the buzzer will sound.

Pop-ups will alternate between "cause of fault" and "measures to take".

To acknowledge the alarm, press NAVIGATION WHEEL. When the fault has been acknowledged, the buzzer will become silent. Press NAVIGATION WHEEL. The pop-up will disappear and normal display window will be shown.

NOTE! To enable engine start the alarm must be acknowledged.



Danger pop-up

If the Danger pop-up is shown during operation, a serious fault has occurred.

NOTE! Acknowledge the alarm and stop the engine at once.

Information regarding "cause of fault" and "measures to take" is found in chapter "Fault register".

Warning pop-up

If the Warning pop-up is shown during operation, a fault has occurred.

NOTE! Acknowledge the alarm and stop the engine at once.

Information regarding "cause of fault" and "measures to take" is found in chapter "Fault register".

Caution pop-up

If the Caution pop-up is shown during operation, a fault has occurred.

Acknowledge the alarm.

Information regarding "cause of fault" and "measures to take" is found in chapter "Fault register".



Faults are stored and malfunctions have been registered

Faults list

A faults list can be viewed from the MAIN MENU in the tachometer, if a fault is registered.

When in MAIN MENU, select FAULTS by pushing NAVIGATION WHEEL. Number after FAULTS indicates number of faults stored in faults list. Show faults in faults list by turning NAVIGATION WHEEL.

Shown fault pop-ups will alternate between "cause of fault" and "measures to take".

More information regarding "cause of fault" and "measures to take" is found in chapter "Fault register".

Erasing faults in faults list

Any fault pop-up in the diagnostic function are automatically erased every time the starter key is turned to the stop position (S).

NOTE! Stop the engine and check that the ignition key(s) is(are) in position 0 in all control positions.

When system voltage is switched on again, the diagnostic function checks to see whether there are any faults in the EVC system. If this is the case, new fault pop-ups are shown.

This implies that:

1. Faults which have been attended to or have disappeared are automatically erased.
2. Faults which have not been attended to must be acknowledged every time the system voltage is switched on.

Fault register

⚠ WARNING! Read the safety precautions for maintenance and service in the "Safety information" chapter before starting work.

Explanation

Faults are presented with information about reason and proposed measures to be taken.

1.	2.	3.	4.
Description	 R		
Explanation:			
Reaction:			
Action:			

1. Description of current fault and measures to take.
2. Current warning lamp which flashes during an alarm. O/R means that an orange or red lamp flashes.
3. Audible warning
4. Current fault pop-up which is shown on the EVC tachometer display.

Engine speed	 R	
Explanation: Fault in engine speed sensor.		
Reaction: Engine power is reduced.		
Action:		
• Please contact a Volvo Penta workshop.		



Water in fuel	 O
Explanation: Water in water trap in fuel filters.	
Reaction: None	
Action:	
• Empty the water trap underneath the fuel filters, please refer to "Maintenance: Fuel system". • Please contact a Volvo Penta workshop if the fault remains.	



Seawater pressure	 R	
Explanation: Seawater pressure too low.		
Reaction: Engine power is reduced.		
Action:		
• Check that the seawater filter is not blocked. Please refer to "Maintenance: Seawater system". • Check the impeller in the sea water pump. Please refer to "Maintenance: Seawater system". • Check that no leakage occurs. • Please contact a Volvo Penta workshop if the fault remains.		



Air temperature



Explanation: Charge air temperature too high.

Reaction: Engine power is reduced.

Action:

- Please contact a Volvo Penta workshop.



Coolant level



Explanation: Coolant level too low.

Reaction: Engine power is reduced.

Action:

- Check coolant level. Please refer to "Maintenance: Freshwater system".
- Check that no leakage occurs in auxiliary equipment connected to the engine cooling system.
- Please contact a Volvo Penta workshop if the fault remains.



Coolant pressure



Explanation: Coolant pressure too low.

Reaction: Engine power is reduced.

Action:

- Check the coolant level. Please refer to "Maintenance: Freshwater system".
- Check that the seawater filter is not blocked. Please refer to "Maintenance: Seawater system".
- Check the impeller in the seawater pump. Please refer to "Maintenance: Seawater system".
- Check that no leakage occurs.
- Check that no leakage occurs in auxiliary equipment connected to the engine cooling system.
- Please contact a Volvo Penta workshop if the fault remains.



Coolant temperature



Explanation: Coolant temperature too high.

Reaction: Engine power is reduced.

Action:

- Check coolant level. Please refer to "Maintenance: Fresh water system".
- Check that the seawater filter is not blocked. Please refer to "Maintenance: Seawater system".
- Check the impeller in the seawater pump. Please refer to "Maintenance: Seawater system".
- Check that no leakage occurs.
- If the cooling water flow ceases, the exhaust hose should be inspected internally and replaced if the hose shows signs of damage.
- Please contact a Volvo Penta workshop if the fault remains.



Fuel pressure

Explanation: Fuel pressure too low.

Reaction: Engine power is reduced.

Action:

- Check the fuel level.
- Open the fuel taps and check that no leakage occurs.
- Check that the fuel filters are not blocked. Please refer to "Maintenance: Fuel system"
- Please contact a Volvo Penta workshop if the fault remains.

**Fuel temperature**

Explanation: Fuel temperature too high.

Reaction: Engine power is reduced.

Action:

- Check the fuel level.
- Check fuel cooler.
- Check that no leakage occurs.
- Please contact a Volvo Penta workshop if the fault remains.

**Engine oil level**

Explanation: Oil level too low.

NOTE! In rough following seas or head seas, the system can incorrectly sense that the engine oil level is too low. If this happens, acknowledge the fault, and check the points below for safety reasons.

Reaction: Engine power is reduced.

Action:

- Check the oil level in the engine. Please refer to "Maintenance: Lubrication system" to check and top the oil up.
- Check the oil filters. Please refer to "Maintenance: Lubrication system".
- Check that no leakage occurs.
- Please contact a Volvo Penta workshop if the fault remains.

**Engine oil pressure**

Explanation: Oil pressure too low.

Reaction: Engine power is reduced.

Action:

- Check the oil level in the engine. Please refer to "Maintenance: Lubrication" to check and top the oil up.
- Check that the oil filters are not blocked.
- Check that no leakage occurs.
- Please contact a Volvo Penta workshop if the fault remains.



Engine oil temperature



Explanation: Engine oil temperature too high.

Reaction: Engine power is reduced.

Action:

- Check the oil level. Please refer to "Maintenance: Lubrication system".
- Check that the oil filters are not blocked. Please refer to "Maintenance: Lubrication system".
- Check that no leakage occurs.
- Please contact a Volvo Penta workshop if the fault remains.



Engine oil filter



Explanation: Oil pressure differential too big.

Reaction: Engine power is reduced.

Action:

- Check that the oil filters are not blocked. Please refer to "Maintenance: Lubrication system".
- Please contact a Volvo Penta workshop if the fault remains.



Crankcase pressure



Explanation: Crankcase pressure too high.

Reaction: Engine power reduced.

Action:

- Check that the crankcase ventilation is not blocked. Please refer to "Maintenance: Engine, general".
- Please contact a Volvo Penta workshop if the fault remains.



Exhaust temperature



Explanation: Exhaust temperature too high.

Reaction: Engine power is reduced.

Action:

- Please contact a Volvo Penta workshop.



Transmission oil pressure



Explanation: Transmission oil pressure too low.

Reaction: Engine power is reduced.

Action:

- Check oil level. Please refer to "Maintenance: Lubrication system".
- Check that the oil strainer is not blocked. Please refer to "Maintenance: Lubrication system".
- Check that no leakage occurs.
- Please contact a Volvo Penta workshop if the fault remains.



Battery voltage**Explanation:** Battery voltage too low.**Reaction:****Action:**

- Check battery fluid level.
- Check belt tension.
- Please contact a Volvo Penta workshop if the fault remains.

**Auxiliary stop****Explanation:** External stop signal.**Reaction:** Engine stops or can not be started**Action:**

- Check emergency stop button. Reset if necessary. Please refer to "Stopping the engine: Emergency stop"
- Please contact a Volvo Penta workshop if the fault remains.

**Primary battery****Explanation:** Poor battery or charging.**Reaction:****Action:**

- Check battery fluid level.
- Check belt tension.
- Please contact a Volvo Penta workshop if the fault remains.

**Secondary battery****Explanation:** Poor battery or charging.**Reaction:****Action:**

- Check battery fluid level.
- Check belt tension.
- Please contact a Volvo Penta workshop if the fault remains.

**30 V supply fuse****Explanation:** Fuse is broken.**Reaction:****Action:**

- Please contact a Volvo Penta workshop.



EMS supply fuse



Explanation: Fuse is broken.

Reaction:

Action:

- Please contact a Volvo Penta workshop.



Extra supply fuse



Explanation: Fuse is broken.

Reaction:

Action:

- Please contact a Volvo Penta workshop.



Check control lever



Explanation: Fault in control lever.

Reaction: Engine in emergency mode. Gear to neutral.

Action:

- Restart engine(s).
- If the engine can not be operated from the chosen control panel, use an alternative control panel.
- Please contact a Volvo Penta workshop if the fault remains.



Lever calibration



Explanation: Incorrect lever calibration.

Reaction: It is not possible to choose active helm station.

Action:

- Restart engine(s).
- Please contact a Volvo Penta workshop if the fault remains.



Check EVC system



Explanation: Internal fault in the EVC system.

Reaction: Engine power is reduced.

Action:

- Restart engine(s).
- If the engine can not be operated from the chosen control panel, use an alternative control panel.
- Please contact a Volvo Penta workshop if the fault remains.



System failure

Explanation: Miscellaneous fault.

Reaction:

Action:

- Restart engine(s).
- Please contact a Volvo Penta workshop if the fault remains.

**Check joystick**

Explanation: Fault in joystick.

Reaction: Engine power is reduced.

Action:

- Restart engine(s).
- If the engine can not be operated from the chosen control panel, use an alternative control panel.
- Please contact a Volvo Penta workshop if the fault remains.

**Check steering wheel**

Explanation: Fault in steering wheel unit.

Reaction: Engine power is reduced.

Action:

- Restart both engines.
- Please contact a Volvo Penta workshop if the fault remains.

**Limited engine rpm**

Explanation: Fault in steering system.

Reaction: Engine power is reduced on both sides.

Action:

- Restart both engines.
- Please contact a Volvo Penta workshop if the fault remains.

**Limited steering**

Explanation: Fault in steering system.

Reaction: Engine power is reduced on both sides. Limited steering.

Action:

- Restart both engines.
- Please contact a Volvo Penta workshop if the fault remains.



No steering wheel response



R



Explanation: Fault in steering wheel unit.

Reaction: Engine power is reduced on both sides. No steering.

Action:

- Restart both engines.
- Please contact a Volvo Penta workshop if the fault remains.



No gear/throttle and steering



R



Explanation: Fault in steering system.

Reaction: No steering. No propulsion.

Action:

- Restart both engines.
- Please contact a Volvo Penta workshop if the fault remains.



Technical Data

Engine

General information

Volvo Penta IPS system designation	D4 - See table below	D6- See table below
Engine model/after market designation	See table below	See table below
Crankshaft power kW (hp)*	See table below	See table below
Propellershaft power kW (hp)*	See table below	See table below
Idling speed	700 rpm	600 rpm
Swept volume	3.7 liter (1.0 US gals)	5.5 liter (1.5 US gals)
Injection sequence.....	1-3-4-2	1-5-3-6-2-4
Direction of rotation (seen from front).....	Clockwise	Clockwise
Max. forwards inclination	10°	10°
Max. rearwards inclination in operation	20°	20°
Max. sideways inclination in operation.....	30°	30°
Oil pressure, hot engine		
Idling	1.25 bar (18.1 psi)	1.25 bar (18.1 psi)
Full speed	4.5 bars (65 psi)	4.5 bars (65 psi)

Compressor

Oil volume.....	0.1 liter (0.2 US pint)	0.1 liter (0.2 US pint)
Oil grade.	VP, part no. 1141641-9	VP, part no. 1141641-9

Cooling system

Thermostats open/fully open	82°C/92°C	82°C/92°C
Fresh water system volume, app.	13 liter (3.4 US gals)	16.5 liter (4.4 US gals)

Electrical system

System voltage	12V	12V/24 V
Starter motor battery, capacity	2 x 88Ah 800cca	2 x 88Ah 800cca
Alternator, rated power, max.....	14V/115A	14V/115A, 28V/80A
Starter motor, rated power.....	12V/3.6kW	12V/3.6kW, 24V/5kW

Lubrication system

Oil volume, (incl. oil filter).....	12.5 (3.3 US gals)	20 liter (4.4 US gals)
Oil volume, oil filter	1.6 (0.4 US gals)	1.6 liter (0.4 US gals)
Oil volume between min. and max. markings	1.5 (0.4 US gals)	3.5 liter (0.9 US gals)
Oil grade	See table on next page	
Viscosity	SAE 15W/40 (See table on next page)	

* According to ISO 8665

Volvo Penta IPS system designation	Engine model / aftermarket designation	Crankshaft power kW (hp)	Propellershaft power kW (hp)
IPS 350	D4-260 D-B	191 (260)	182 (248)
IPS 400	D4-300 D-A	221 (300)	212 (289)
IPS 400	D6-310 D-B	228 (310)	217 (295)
IPS 450	D6-330 D-B	243 (330)	231 (314)
IPS 500	D6-370 D-B	272 (370)	259 (352)
IPS 600	D6-435 D-A	320 (435)	307 (418)

Recommended types of engine oil

⚠ Important! Use of improper or inferior oil can cause excessive wear of bearings and moving parts, thus shortening the engine life. It can also result in sticking of piston rings and seizing of pistons in the cylinders, thus causing major damage.

Oilgrade ¹⁾	Sulfur content in fuel, by weight	
	< 0,5 – 1,0 %	> 1,0 % ³⁾
	Oil change interval, reached first in operation	
All engines: VDS-2 and ACEA E7 ²⁾ or VDS-2 and Global DHD-1 or VDS-2 and API CH-4 or VDS-2 and API CI-4	200 h / 12 months	100 h / 12 months

¹⁾ When oil quality specifications are joined by “or” (Type 1, 2 and 3), **either** engine oil specification can be used.

When oil quality specifications are joined by “and” (Type 2 and 3), the engine oil must fulfill both requirements.

²⁾ ACEA E7 has replaced ACEA E5, but if available ACEA E5 can be used.

³⁾ If sulphur content is > 1.0 % by weight, use oil with TBN >15.

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

VDS = Volvo Drain Specification

ACEA = Association des Constructeurs Européenne d’Automobiles

API = American Petroleum Institute

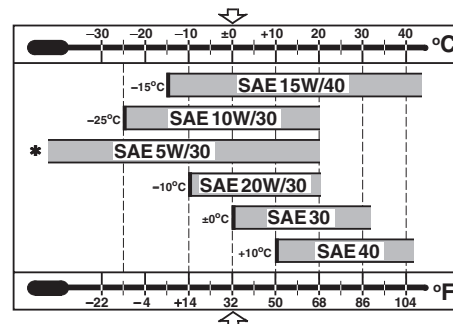
Global DHD = Global Diesel Heavy Duty

TBN = Total Base Number

Selection of oil viscosity

Use the following chart to select appropriate oil viscosity according to the ambient temperature.

⚠ Important! Excessively high oil viscosity causes power loss and higher oil temperature, while excessively low oil viscosity results in inadequate lubrication and leakage of combustion gas with increased wear and reduced output as a result.



Fuel specification

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

EN 590 (with nationally adapted environmental and cold requirements)

ASTM D 975 No. 1-D and 2-D

JIS KK 2204

Sulfur content: Complying with legal requirements in each country.

Drive-unit

Oil volume.....	14 liters (3.7 US gals)
Oil volume between min. and max. markings	0,5 liters (0.8 US pint)
Oil volume, oil filter	0.2 liter (0.4 US pint)
Oil grade and viscosity	VP 1141634 (API GL5 SAE 75W/90) Synthetic
Gear ratio.....	Volvo Penta IPS 350/400(D4) - 2.08:1
	Volvo Penta IPS 400(D6)/450/500 - 1.94:1
	Volvo Penta IPS 600 - 1.82:1

Notes

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Notes

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