VOLVO PENTA

OPERATOR'S MANUAL 16L

TWD1672GE, TWD1673GE

WARNING! Operating, servicing and maintaining an engine can expose you chemicals including engine exhaust, carbon monoxide, phthalates, and lead which are known to the State of California to cause cancer and birth defects or other reproductive harm.

Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm.

To minimize exposure, avoid breathing exhaust when operating, servicing and maintaining the engine.

- Always start and operate the engine in a well-ventilated area.
- If in an enclosed area, vent the exhaust to the outside.
- Wear gloves or wash your hands frequently when servicing the vessel.
- Do not modify or tamper with the exhaust system.
- Do not idle the engine except as necessary.

For more information go to
www.P65warnings.ca.gov
www.p65warnings.ca.gov/products/diesel

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Foreword

Welcome!

Volvo Penta engines are designed to fulfill Volvo's core values; quality, safety and environmental care. After more than 100 years as en engine manufacture, the Volvo Penta brand has also become a symbol of reliability, technical innovation, top-of-the-range performance and long service life. Volvo Penta engines are used all over the world, in all possible operating conditions.

Make sure to thoroughly read through the Operator's Manual regarding operating and maintenance. It contains the information you need to be able to operate and maintain the engine safely and correctly. Pay careful attention to the safety instructions included in the manual.

As the owner of a Volvo Penta engine, you become part of a worldwide network of dealers and service workshop that assist you with technical advice, service requirements and replacement parts. Contact you nearest authorized Volvo Penta dealer for assistance.

It is possible to buy additional literature about your Volvo Penta engine, e. g. the Service & Maintenance manual. More information on how to do this can be found at www.volvopenta.com.

Information about your closest Volvo Penta dealer and other useful news and information can be found at www.volvopenta.com and by following Volvo Penta on Facebook.

www.volvopenta.com

www.facebook.com/volvopenta

Safety Information

This chapter describes how safety precautions are presented in the manual and on the product. Read the chapter through very carefully before you start the engine or do any maintenance or service. It has to do with your safety; an incorrect operation can lead to personal injury and damage to products or property. It also gives you an introduction to the basic safety rules for using and looking after the engine.

If anything remains unclear or if you are unsure of something, contact your Volvo Penta dealer for assistance.

IMPORTANT:
Always follow local safety instructions and regulations.

Safety texts have the following order of priority:

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

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

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

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

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

⚠
This symbol is may be used on the product to call your attention to the fact that this is safety information. Always read such information very carefully.

Make sure that warning and information symbols on the engine are clearly visible and legible. Replace symbols that have been damaged or have been painted over.

📖
In some cases, this symbol is used on our products and refers to important information in the Operator's Manual.

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Most chemicals such as engine and transmission oils, glycol, petrol and diesel oil and chemicals used in workshops such as degreasing agents, paint and solvents are harmful to health.

Carefully read the instructions on the product packaging! Always follow the safety regulations, such as the use of protective masks, goggles, gloves, etc. Make sure that other personnel are not exposed to substances that are hazardous to health. Ensure good ventilation.

Manage used and leftover chemicals in the prescribed manner.

Daily Checks

⚠ WARNING!
Do not start the engine if there is reason to suspect fuel leaks or if there is explosive material nearby.

Make it a habit to give the engine and engine compartment a visual check before the engine is started and after operations, once the engine has stopped. This helps you to quickly discover fuel, coolant or oil leakages or any other abnormality that has occurred, or is about to occur.

Personal safety equipment

⚠ CAUTION!
Always use appropriate safety equipment. Personal protective equipment does not eliminate the risk of injury but it will reduce the degree of injury if an accident does happen.

Some examples are ear protection, eye and face protection, protective footwear, personal protective equipment, head protection, protective clothing, gloves and respirators.

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⚠ WARNING!
Ensure that all machine guards and safety devices are in place and are functional.

⚠ CAUTION!
Never use tools or products that show signs of damage.

Protect your eyes

⚠ CAUTION!
Wear safety glasses.

Always wear safety glasses if there is a risk of splintering, sparks and spray from the electrolyte (so-called battery acid), or other chemicals. Your eyes are very delicate and damage can result in loss of sight!

Protect your skin

⚠ CAUTION!
Risk of skin damage.

Avoid getting oil on your skin! Prolonged or repeated exposure to oil can dry out the skin. Thereafter, irritation, dryness and eczema and other skin problems may occur.

Use protective gloves and avoid oil-soaked clothes and rags. Wash regularly, especially before eating. Wear suitable protective creams to prevent skin from drying out and to facilitate cleaning.

Fire safety

⚠ WARNING!
Fire and Explosion Risk!
Accidental spark could ignite fuel vapors.

All fuels – as well as many lubricants and chemicals – are flammable. Do not allow open flames or sparks near them. **Smoking forbidden!** Hydrogen from the batteries is also very flammable and explosive in certain mixture with air.

Ensure that the workplace is well ventilated and take the necessary precautions before welding or grinding begins. Always ensure that there is a fire extinguisher close at hand in the work area.

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Spare parts — safety

WARNING!
Always use spare parts with the same quality as genuine Volvo Penta parts to minimize the risk of an explosion or fire.

Components in fuel systems and electrical systems on Volvo Penta engines are designed and manufactured to minimize the risk of explosions and fire, in accordance with applicable legal requirements.

Used oils, filters and chemicals etc.

WARNING!
Risk of fire.
Store fuel soaked rags and other flammable material so that there is no danger of them catching fire.

Oil-soaked rags can spontaneously ignite under certain circumstances.

IMPORTANT:
Used fuel and oil filters are environmentally hazardous waste and must be taken to an approved waste management facility for correct handling, as must any used lubricating oil, contaminated fuel, paint residue, solvents, degreasers and wash residue.

Prevent start of the engine

WARNING!
Immobilize the engine by turning off the power supply with the main switch(es) and lock it (them) in the off position before starting work. Place a warning notice at the main switch.
If the engine is equipped with BMS (Battery Management System), always disconnect both battery cables from the battery terminals.

Ventilation when running the engine

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

The engine must not be operated in areas where there are explosive materials or stored gas.

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Rotating parts and hot surfaces

DANGER!

Working with or approaching a running engine is a safety risk. Watch out for rotating components and hot surfaces.
If the engine is in operation and operates another device, you must not, under any circumstances, staying close to the engine.

Work on running engines is strictly prohibited. There are however adjustments that require the engine to be run. Approaching a running engine is a safety risk. Loose clothing and long hair can get caught in the rotating parts; careless movements or a dropped tool can lead to serious personal injury.

Be careful to avoid hot surfaces (exhaust pipes, turbochargers, charge air manifolds, start elements etc.) and hot fluids in pipes and hoses on engines that are running or have just stopped. Re-install all protective covers that were removed during maintenance work before starting the engine.

Information on the engine

IMPORTANT:

Make sure that all warning and information decals on the product are always visible. Replace decals which have been damaged or painted over.

Prohibition on use of start spray

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WARNING!

Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.

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Before start of engine

WARNING!
Never start the engine if there is reason to suspect fuel and/or gas leaks, or if there is explosive material nearby.

IMPORTANT:
Only start the engine with the air filter and protective caps fitted. Foreign objects in the inlet line could cause machine damage. Also make sure that no tools or other parts have been left next to the engine.

WARNING!
Never start the engine with the valve cover removed. There is a risk of personal injury.
For engines with turbochargers, the rotating compressor turbine can in addition cause serious personal injuries.

Before any work on the electrical system

WARNING!
Always stop the engine first. Then disconnect the current at the main switches and any external power supply before working on the electrical system – to minimize the risk of electrical hazards.

IMPORTANT:
Never disconnect the current using the main switches when the engine is running or by disconnecting the battery cables.
The alternator and electronics could be damaged.

Avoid damage to the engine control module and other electronics

IMPORTANT:
Switch off the main switch before connecting or disconnecting a connector.

Before welding work

IMPORTANT:
Before any work with electric weld can begin, the connection to all control units must be disconnected. After finished welding, re-connect the connection to all control units before connecting any battery cable.

Before any work on the cooling system

⚠ WARNING!
Stop the engine and let it cool before starting work on the cooling system. Hot fluids and hot surfaces can cause burns.

Hot coolant under pressure

⚠ CAUTION!
Hot coolant can cause burns. Avoid opening the filler cap for the coolant when the engine is still hot. Steam or hot coolant can spray out and system pressure is lost.

Open the filler cap slowly and release the pressure in the cooling system if the filler cap or valve must be opened – or if a plug or a coolant hose must be removed from a hot engine.

Hot oil under pressure

⚠ CAUTION!
Hot oil can cause burns. Avoid getting hot oil on the skin. Ensure that the lubrication system is not pressurized before starting any work. Never start or operate the engine without the oil filler cap is on. There is a risk that hot oil can spray out.

Refueling

⚠ WARNING!
There is always a risk of fire and explosion during refueling. Smoking is forbidden and the engine must be stopped.

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Proper fuel quality

IMPORTANT:
Always use the fuel recommended by Volvo Penta. See *Technical Data* in Operator's Manual. Other fuel can damage the engine.
Wrong fuel quality can also lead to higher service costs.

⚠ WARNING!
Risk of personal injury.
Wrong fuel quality in a diesel engine can cause the fuel control mechanism to bind which can cause the engine to overspeed!

Legal requirements to use proper fuel

IMPORTANT:
To meet regulatory requirements for certified emission levels must always recommended fuel according to *Technical Data* in the Operator's Manual be used.

At any leak detection on the fuel system

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⚠ WARNING!
Wear safety goggles!
Be extremely careful when searching for leaks in the fuel system high-pressure circuits. There is very high pressure in the jet from pipes and injectors. The fuel may penetrate the tissue and cause serious risk of blood infection (septicemia).

Handling of fuel pipes

IMPORTANT:
High pressure pipes for fuel must not be bent or straightened under any circumstances. Cracks may occur. Damaged pipes must be replaced.

Safe handling of batteries

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

A spark caused by an incorrectly connected battery can be enough for the battery to explode with serious injuries.

Do not touch the connections during start attempts. Sparking hazard! Do not lean over batteries.

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Correct polarity of the batteries

IMPORTANT:
Make sure that the positive (+) and negative (–) battery cables are correctly connected to the corresponding battery terminals. Wrong connection may cause severe damage to electrical equipment.

Risks of electrolyte in batteries

⚠ WARNING!
Always wear protective goggles when charging or handling batteries.
Battery electrolyte is highly corrosive.

Rinse immediately with copious amounts of water if the electrolyte gets in your eyes. Search directly after the rinsing help by medical staff.

If it comes electrolyte to unprotected skin, wash immediately with soap and water.

Layout of the battery compartment

IMPORTANT:
Make sure the battery compartment is designed according to current safety standards.

Cleaning the engine and components

IMPORTANT:
Never use a high pressure washer for cleaning of engine or engine components.

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Cleanliness for sensitive components

IMPORTANT:
Observe meticulous cleanliness when handling system components.
Even minimal amounts of dirt could cause a breakdown.

Adjustment of the clutch

⚠ CAUTION!
Clutch adjustments must be carried out with the engine stopped.

Introduction

Check that you heave received the correct operator's manual before continuing reading. If not, please contact your Volvo Penta dealer. Read the Operator's Manual carefully and learn to handle the engine, controls and other equipment in a safe manner before you start the engine.

For engine designations, refer to *Engine*. The designation is stated on the engine plate, refer to *Identification Numbers.*

The illustrations in this book may cover several product types, which means that there may be slight differences between the illustrations and the purchased product. This does, however, not affect the validity of the information and/or instructions in the manual. Volvo Penta reserves the right to make alterations to specifications, design features, and illustrations without prior notice.

At service, software can be updated that affects the functionality described in this manual.

About this manual

This Operator's Manual contains the information required for the correct, safe operation and maintenance of your Volvo Penta engine. Read the Operator's manual carefully and learn to handle the engine and other equipment in a safe manner before you start the engine.

Warranty

Your new Volvo Penta engine is covered by a limited warranty, subject to the conditions compiled in the Warranty Information. Note that AB Volvo Penta's liability is limited to the specification in the Warranty Information (included CD) and Emission Control System Warranty Statement.

Read the information carefully, as soon as possible after delivery. It includes important information about service and maintenance; the owner is responsible for being familiar with, checking and implementing these. Otherwise AB Volvo Penta may deny its warranty obligations in part or in full.

Contact your Volvo Penta dealer if you have not received the Warranty Information or Service Book.

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Running in the engine

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

Run the engine in normal operations. However, full load may not be applied other than for short periods. Never run the engine for long stretches at constant speeds during this period.

Higher oil consumption is normal during the first 100–200 hours of operation. For this reason, check the oil level more frequently than the normal recommendation.

When a disengageable clutch is installed, it should be checked more carefully during the first days. Adjustments may be necessary to compensate bedding-in of the friction plates.

Fuel, oils and coolant

Only use the fuels and oils recommended in the Operator's Manual, since other grades may cause malfunctions, increased fuel consumption, and possibly shorten the life of the engine.

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

Make sure to always use suitable and correctly mixed coolant.

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

Maintenance and replacement parts

Volvo Penta engines are designed for maximum reliability and long life and built to withstand a demanding environment. The engines also are designed to have a minimal environmental impact. These qualities will be maintained through regular servicing and the use of spare parts with the same quality as genuine Volvo Penta parts. If reliable and purpose-built parts are not used, your safety, health, and the machine's function may be compromised. Volvo Penta has a world-wide network of authorized dealers.

The authorized dealers are Volvo Penta product specialists, and have the accessories, genuine parts, test equipment and special tools needed for high quality service and repair work. Always observe the maintenance intervals in the manual, the complete Service Protocol can be found at *volvopenta.com*. Remember to note the engine / transmission identification number when you **order service and spare parts.**

Excessive strain on a product and components

Volvo Penta products and components are not dimensioned for external loads. Never stand or step onto an engine, transmission or its components. Loads can bring about damage and the malfunction of a product or property.

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Environmental care

Environmental care is a core value at Volvo Penta. Energy efficiency and low emissions are among the most important product related aspects and priority focus areas for Volvo Penta business. Several of the global challenges the world faces are directly or indirectly related to power industries and transports. We recognize that Volvo Penta is part of the environmental problems, but we are also convinced that we are a part of the solution.

Volvo Penta currently has a broad engine program in which great advances have been made in reducing exhaust emissions in the same time as the fuel consumption has been improved. Through regular maintenance, the Volvo Penta engines retain its low fuel consumption and low emissions. We hope that you will be keen to preserve these qualities.

Always follow the directions in the Operator's Manual regarding fuel grades, operation and maintenance to avoid unnecessary environmental impact. Contact your Volvo Penta dealer if you notice any changes such as increased fuel consumption or exhaust smoke.

Remember always to hand in environmental hazardous waste such as drained oil, coolant, old batteries, etc. for treatment at a recycling facility. Our united efforts can make a valuable contribution to the environment.

Certified engines

If you own an emission-certified engine used in an area where exhaust emissions are regulated by law, this places special demands on the care and maintenance you provide your engine.

NOTICE! Neglects or failure to follow the points listed here may invalidate the engine emission certificate. This means AB Volvo Penta can no longer guarantee engine conformity with the certified model. Volvo Penta is not responsible for damages or costs arising as a result of this.

- Certification means that an engine type has been checked and approved by the relevant authority. The engine manufacturer guarantees that all engines of the same type are equivalent to the certified engine.
- It is the responsibility of the operator/user to ensure that no intentional misuse of the engine takes place.
- Volvo Penta maintenance and service intervals must be complied with.
- Any case of malfunction must be rectified without delay.
- Only use genuine Volvo Penta parts or spare parts with the same quality as genuine Volvo Penta parts.
- Volvo Penta recommends that service to injection pumps, pump settings and injectors always are carried out by a qualified workshop.
- The engine must not be converted or modified in any way, except with accessories and service kits that Volvo Penta has approved for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be made.
- No warranty seals (where present on the product) may be broken by unauthorized persons.
- The general instructions in the Operator's Manual concerning operation, service and maintenance apply.

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Emission Aftertreatment System

AdBlue®/DEF

AdBlue®/DEF [1][2] is mandatory for the equipment/ vehicle to comply with emission directive certification.

When adding AdBlue®/DEF, the solution must fulfill ISO22241 standards. If the solution used don't fulfill the ISO standard, any warranty claims will be rejected.

Using an engine that does not use AdBlue®/DEF, or the use of low quality solution, where such is required to reduce air pollution is a punishable offense. A consequence of such a failure may entail invalidation of conditions and warranties provided in the country where the engine is used.

Filling should take place between scheduled service intervals. The consumption of AdBlue/DEF is a percentage of the fuel consumption and is varying depending on the operating conditions. For filling instructions, refer to *Filling AdBlue®/DEF , page 71*.

If the exhaust gas control system does not work correctly the operator will be informed by a fault indication.

Volvo Penta Dealer Network

The Volvo Penta global network of authorized dealers is at your service. We strongly recommend that you take your product to an authorized Volvo Penta dealer for service and repair. They are specialists in Volvo Penta products and have the accessories, genuine Volvo Penta parts, the special tools and the latest service information for high quality service and repair work.

Dealer Locator Services

Locate the nearest Volvo Penta dealer through our dealer locator on ***www.volvopenta.com*** or download the dealer locator app to your smartphone.

1. AdBlue® = Registered trademark of the Verband der Automobilindustrie e.V. (VDA).

2. DEF = Diesel Exhaust Fluid

Volvo Penta Action Service

Our global dealer network, your first line of contact, is backed up by Volvo Penta Action Service, a phone based breakdown and support service providing assistance 24 hours a day, every day of the year.

How it works

A dedicated operator will support you all the way through your case and keep you updated on status and progress.
Whenever on-site assistance or technical support is needed, the operator will put you in contact with the closest Volvo Penta dealer that can support your product.

Phone numbers

Find your Volvo Penta Action Service phone number and more information on ***www.volvopenta.com***.

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Presentation

Engines

This Operator's Manual covers the industrial engines TWD1672GE and TWD1673GE.

All of the models are in-line, six-cylinder, direct injection industrial engines. They are equipped with electronic management systems (EMS), turbochargers, charge air coolers, thermostatically controlled cooling systems and electronic speed control.

To reduce emissions, the engines are equipped with EATS systems. Refer to *Presentation, page 23*.

EMS (Engine Management System)

EMS is an electronic system with CAN communication (Controller Area Network) for diesel engine control. The system has been developed by Volvo Penta and includes fuel regulation and diagnostic functions. The system consists of a control unit, injectors, a number of sensors that supply the control unit with information, and connectors for diagnostics and functional checks. The engine can be connected to a communication interface comprising a CAN link and a serial link.

Input/Output signals

The information from the sensors provides precise data about prevailing operating conditions and allows the processor in the control module to, among other things, calculate correct injection amount, injection timing and check the engine's condition.

Fuel regulation

The engine fuel requirement is analyzed up to 100 times per second. The engine injection volume and injection timing are controlled electronically via the fuel valves in the injectors. The control unit receives signals from sensors and monitors in order to determine when the fuel valve must open and close. This means the engine always receives the correct fuel volume under all operating conditions, which means lower fuel consumption and the lowest possible exhaust emission.

Diagnostic function

The purpose of the diagnostic function is to detect and locate any malfunctions in the EMS system, as well as to protect components from damage.
If a malfunction is detected, this is announced by warning lamps, a flashing diagnostic lamp or a text message on the instrument panel, depending on the equipment fitted. If a fault code is displayed it is used for guidance in any fault tracing. Fault codes can also be read by Volvo’s VODIA tool at authorized Volvo Penta workshops.
If there is a serious malfunction, the engine will be shut down completely or the control unit may reduce power output (depending on the application). Fault codes are registered as an aid to fault tracing.

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EATS (Exhaust Aftertreatment System)

EATS (Exhaust Aftertreatment System) is used to reduce emissions. In the SCR-system (Selective Catalytic Reduction) the exhaust gases are treated through the addition of AdBlue®/DEF before they pass through the catalytic converter. Sensors measure nitrogen oxide (NOx) levels in the exhaust gases.

The engine control unit calculates the optimum amount of solution to be added in relation to engine load and engine speed, to achieve efficient reduction of nitrogen oxides.

AdBlue®/DEF

The solution that is added to the exhaust gases is a clear, transparent liquid with a faint odor of ammonia; it consists of de-ionized water mixed with 32.5% urea (the solution must meet ISO 22241 standards / API AUS 32). The urea in the exhaust is broken down into ammonia which reacts with NOx to form harmless nitrogen and water vapor, which occur naturally in our surroundings.

The solution is not flammable or harmful to health with normal use; it is however very corrosive to metals, especially copper and aluminum.

IMPORTANT:
The use of solution that do not fulfill the ISO 22241 standard will compromise the aftertreatment system performance, increase emissions.
Any warranty claims will be rejected.

NOTICE! The urea solution has different names in different markets, e.g. DEF or AdBlue®. The solution is designated either AdBlue or AdBlue/DEF in display messages.

Monitoring

The system is monitored to ensure that all system components are working as they should, that the quality of the AdBlue®/DEF fulfills set standards and that the tank level is not too low. Should the system detect deviations, the maximum engine torque and engine speed will be reduced and a fault code stored in the control unit. For further information refer to *EATS Inducements, page 48*.

Shut-down

Should any solution remain in the hoses in freezing weather, the entire system can be damaged. To avoid this and any solution spillage, the system is equipped with automatic drainage when the engine is switched off so that hoses, the pump and injector are emptied and the solution runs back to the tank.

NOTICE! The automatic drainage only works when the engine is stopped using the ignition switch or the stop button on the instrument panel (depending on application), not if only the engine power supply is disconnected. If the system is not drained properly, solution may squirt out if the hoses are disconnected.

⚠ CAUTION!
The EATS system needs time to for automatically drainage and depressurizing.
Wait at least two minutes after the engine been turned off before removing the AdBlue/DEF hoses.

Overview

The system comprises:

1 AdBlue®/DEF Tank

2 AdBlue®/DEF Pump

3 AdBlue®/DEF Injector

4 EATS Catalyst and Muffler

5 Catalytic Converter

The atomized urea solution is sprayed into the exhaust gases upstream of the catalytic converter.

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DCU

Tank

IMPORTANT:
Dirt/dust, oil, greases, detergents and any chemicals and natural products must be prevented from entering the Adblue/DEF tank.
The system will be damaged if dust or dirt enters the tank clogging the filters in the dosing system.
Keep the tank clean at all times.

The AdBlue®/DEF is stored in a separate tank.
There is a fitting in the tank that comprises a heating coil (2), a filter (3) and a quality sensor (5). The filter on the suction line prevents any particles from circulating through the system and causing disruptions. The filter must be checked and cleaned if necessary.

There is a drain plug (4) on the side of the tank so that the solution can be emptied when necessary, e.g. for cleaning. The tank is fitted with a breather to equalize pressure changes.

The filler pipe (1) is equipped with a blue cap to prevent confusion when filling. The tank is vented through the filler cap or through the venting nipple on the tank fitting.

Tank level

The solution consumption varies during operations. The level in the tank is shown on the gauge as a percentage of the total tank volume.

When the level in the tank falls below the set limit, the level sensor in the tank transmits a signal that stops AdBlue®/DEF dosing. A fault code is set in the engine control unit, a warning lamp lights up and a fault message is shown on the control panel. If solution is not added, injection into the exhaust pipe will cease and engine torque and the engine will be shut down after three hours. When solution is added the fault message is canceled and the engine is able to revert to full power. Refer to *EATS Inducements, page 48* for further information.

Should the tank become empty during operations this will not lead to damage to the engine or the EATS system, as the remaining solution will circulate and cool the system. However, emissions from the engine will increase as the injection valve is closed and no exhaust aftertreatment will take place.

1 Supply 24V when engine is running

2 120/240V

3 Relay, normally closed

4 Engine heater with pump

5 Valve, normally open

6 AdBlue®/DEF tank

7 Engine

Heating

NOTICE! This is only an outline diagram. The engine heater and circulating pump are not supplied by Volvo Penta.

AdBlue®/DEF freezes at around -11 °C (12.2 °F); if the engine is started without AdBlue®/DEF there is a risk of the injector overheating. To avoid this, an engine heater and circulation pump for heating both the engine and the tank should be installed between the engine and the tank.

When the engine is shut down a relay is closed and starts the heater which then draws coolant from the engine. The coolant is led to the heating coil in the tank and then back to the engine. Both the engine and the solution in the tank are heated to around 30 °C (86 °F). When the engine is started again, the relay opens so that the heater and pump are stopped.

A suction line and return line are fitted between the AdBlue®/DEF pump unit and the tank. The tank has a combined sensor that measures quality, temperature and tank level. The sensor is connected to the control unit; the level sensor value can be read if a display is installed.
There is a temperature sensor in the tank that transmits a signal to the control unit so that the pump cannot start until the AdBlue®/DEF is fluid.

The hoses between the tank and the pump are electrically heated and the hose connections are equipped with extra insulation.

NOTICE! Hoses must be handled carefully and not twisted or bent excessively in order to avoid damaging the heating system.

Storage

To prevent breakdown and evaporation during long-term storage, AdBlue®/DEF may not be stored at temperatures higher than 25 °C (77 °F) or in direct sunlight. Remember that the solution expands upon freezing and to leave room for expansion in the tank when storing in spaces where there is a risk of freezing.

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Operation

⚠ WARNING!
In the case of any contact with eyes or skin the affected area must be thoroughly rinsed with lukewarm water.
If you inhale any fumes, make sure you breathe fresh air.

⚠ CAUTION!
Risk of corrosive damage.
Contact with the fluid can cause irritation and corrosion.
Wear protective gloves!
Change gloves and clothing that have been in contact with the liquid.

⚠ CAUTION!
Risk of material damage.
AdBlue®/DEF oxidises metal and the capillary action creeps through lines at a speed of approx. 0.6 metres per hour.
If spillage occurs, electrical connectors must be replaced immediately. Do not try to clean with water or compressed air.

AdBlue®/DEF is not a combustible product. When exposed to high temperatures it will convert to ammonia and carbon dioxide. However, do not allow the solution to come into contact with other chemicals or be mixed with other chemicals.

When handling AdBlue®/DEF it is important that electrical connectors are connected or well-encapsulated. The solution is corrosive toward certain metals such as copper and aluminum. Should oxidation occur, it cannot be removed.
If connectors come into contact with the solution they must be replaced immediately to prevent the solution from seeping further along the copper wiring.

If the solution is spilled onto the engine, wipe it away and flush with water. White crystals of concentrated AdBlue®/DEF may form in the event of a spill; wash the crystals away using water.

IMPORTANT:
AdBlue®/DEF spillages may not be washed into drains.
If a spill should occur, the solution must be absorbed using dry sand or other non-flammable material and handled according to local and national regulations.

p0013225

Cleaning tools and clothes

⚠ CAUTION!
Gloves must be changed. Take off contaminated clothes.

⚠ CAUTION!
Tools that come into contact with the fluid must be cleaned.

It is important that tools and clothes are thoroughly cleaned from AdBlue®/DEF so that the liquid or crystals are not transferred to other parts and cause them damaged.

Contact with AdBlue®/DEF

- **skin contact** — flush with copious amounts of water and remove contaminated clothing.
- **eye contact** — flush thoroughly for several minutes; contact physician as necessary.
- **inhalation** — breathe fresh air and contact physician as necessary.

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Instruments and Controls

DCU II (Display Control Unit)

The Volvo Penta DCU II instrument panel communicates with the engines control unit and has a number of functions as control, monitoring and diagnostics.

NOTICE! Settings and the type of engine data presented on the display may vary depending on the installation and engine model.
Depending on the installation the DCU II can also be used as presentation display only.

NOTICE! The menus and illustrations shown here are the English version. Refer to the section *Settings* to change the display language.

P0018811

Turn On/Off the ignition

START Start the engine

Reduce engine rpm

Increase engine rpm

STOP Stop the engine

Scroll upwards in menus

OK Select and confirm in menus

Scroll downwards in menus

Return to previous menu selection

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Display

The DCU II basic view shows three main menus.

- **ENGINE DATA** (ENGINE DATA), shows current engine data.
- **DIAGNOSTICS** (DIAGNOSTICS), shows active fault codes.
- **SETTINGS** (SETTINGS), shows display and engine settings.

Press OK to proceed in the submenus and scroll using the panel arrow buttons.
Press ⮌ to return to previous menu.

Status bar

The status bar with symbols for active malfunctions is shown in the top right of the display.

	Emission related malfunction
	EMS system malfunction

Alarms and messages

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Messages to the operator are of three types, color coded according to degree of severity.
When a message is shown on the display, press OK to reach the diagnostic menu to get more information regarding registered faults and instructions for remedial actions.

- **ALARM** (ALARM), red text, the system has detected a serious fault — Volvo Penta recommends to immediately contact a qualified workshop .
- **VARNING** (WARNING), yellow text, the system has detected a fault — Volvo Penta recommends to contact a qualified workshop as soon as possible.
- **MEDDELANDE** (MESSAGE), blue text, non-critical engine message for the operator.

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Menus

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ENGINE DATA (ENGINE DATA)

Engine data shown may vary depending on the engine installation.

- **Engine Hours** (Engine Hour) (tim)
- **Engine Speed** (Engine Speed) (rpm)
- **Coolant Temperature** (Coolant Temperature) (°C)
- **Oil Pressure** (Oil Pressure) (kPa)
- **Fuel Rate** (Fuel Rate) (l/h)
  Current fuel consumption.
- **Boost Temperature** (Boost Temperature) (°C)
- **Boost Pressure** (Boost Pressure) (kPa)
- **Oil Temperature** (Oil Temperature) (°C)

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DIAGNOSTICS (DIAGNOSTICS)

If the system detects a malfunction, the operator is informed via a pop-up message on the display. The fault codes are listed in the diagnostics menu; active fault codes are at the top of the list and are denoted be a green dot. For more information regarding cause and remedies, use the arrow button to scroll to the fault concerned and press OK. This will also provied information about number of engine hours when the fault became active and the SPN and FMI codes.

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SETTINGS (SETTINGS)

Display (Display)

- **Set backlight time** (Set backlight time). On/OFF, sets backlight to run in standby mode. *On* is the default setting.
- **Set backlight brightness** (Set backlight brightness). Adjust display backlight brightness using the panel arrow buttons.
- **Set Instrument Brightness** (Set Instrument Brightness). Sets backlighting in the display instrument.
- **Change background color** (Change background color). Select background color, gray or white.

Language (Language)

Sets the display language; chooses between English, French, German, Spanish and Chinese.

Save/Restore (Save/Restore)

- **Save current configuration** (Save current configuration). Save the current display settings.
- **Restore last configuration** (Restore last configuration). Restore the last displayed settings saved.
- **Restore default configuration** (Restore default configuration). Restores *all* display setting menus to factory settings.

NOTICE! The settings in the following menus do not normally need to be changed; should a change be necessary it must be carried out by an authorized Volvo Penta technician. Refer to the installation manual for further engine information.

Authorized Volvo Penta dealer or OEM only

- I/O Status (I/O Status)
- CAN Termination (CAN Termination)
- Stop Logic DCU (Stop Logic DCU)
- Potentiometer supply (Potentiometer supply)
- Speed Control (Speed Control)
- Control display unit (Control display unit)
- Genset/VE (Genset/VE)
- Buzzer (Buzzer)
- Information (Information)

Easy Link Instruments

The following Easy Link instruments are available:

- Tachometer / hours counter (fault codes are also displayed on the tachometer display when the diagnostic button is pressed)
- Coolant temperature
- Oil pressure
- Oil temperature
- Battery voltage
- Alarm panel
- Turbo pressure

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Starting

Make it a habit of giving the engine and engine room 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.

⚠ WARNING!
Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.

Before Starting

- Check that the oil level is between the MIN and MAX marks.
  For filling refer to *Oil level, checking and topping up*.

NOTICE! Dipstick marked STOP/OPERATING can be read both when the engine is stopped and when it is running. Use the STOP side of the dipstick when engine is stopped and the OPERATING side when in operation.

- Open the fuel valves.
- Check the fuel pre-filter; refer to *Draining condensate, fuel system, page 60*.
- Check the coolant level and that the radiator is not blocked externally. Refer to *Coolant Level, Checking and Topping Up, page 65* and *Charge Air Cooler, External Cleaning, page 67*

  ⚠ WARNING!
  Do not open the coolant filler cap when the engine is hot, except in emergencies as this could cause serious personal injury. Steam or hot fluid could spray out.
- Check that no leakage of oil, fuel or coolant is present.
- Turn the main switch(es) on.
- Move the engine speed control to idle, and open the disengageable clutch/gearbox if installed.

IMPORTANT:
Never break the circuit with the main switch while the engine is running.
Alternator and electronics could be damaged.

Starting the Engine

The pre-heating time is adjusted to suit the engine temperature, and can last for up to 50 seconds both before and after starting.

The starter motor connection time is maximized to 20 seconds. After that, the starter motor circuit is temporarily cut to protect the starter motor against overheating.

DCU II (Display Control Unit)

P0018811

1 Press the button to switch on the ignition. The display switches on at the same time.

2 Press the START button to start the engine.

Starting in Extreme Cold

Certain preparations must be made to enable engine starting in extreme cold, and in some cases to make starting possible at all:

- Use a winter grade fuel (of a well-known make) that is approved for the prevailing temperature. This reduces the risk of paraffin wax precipitation in the fuel system. At extremely low temperatures, we recommend the use of a fuel heater.
- Use a synthetic engine oil of a viscosity recommended for the prevailing temperature to achieve satisfactory lubrication. Refer to *Viscosity, page 83*. Synthetic lubricants are able to handle a wider temperature range than mineral-based lubricants.
- Pre-heat the coolant with a separately-installed electric engine heater. In extreme cases, a diesel-fired engine heater may be necessary. Ask your Volvo Penta dealer for advice.
- Make sure the cooling system is filled with a coolant mixture. Refer to *Maintenance, page 64*.
- The batteries must be in good condition. Cold weather reduces battery capacity. Increased battery capacity may be necessary.

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Never Use Start Spray

⚠ WARNING!
Never use start spray or similar agents to start an engine. This may cause an explosion in the inlet manifold. Risk of personal injury.

Starting Using Auxiliary Batteries

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

1 Check that the auxiliary batteries are connected (series or parallel) so that the rated voltage corresponds to the engine system voltage.

2 First connect the red (+) jumper cable to the auxiliary battery, then to the flat battery. Then connect the black (-) jumper cable to the auxiliary battery and to a location that is **somewhere away from the discharged battery**, e.g. the main switch negative terminal or the negative terminal on the starter motor.

3 Start the engine.

   ⚠ WARNING!
   Do not touch the connections during the start attempt: Risk of arcing.
   Do not bend over any of the batteries either.

4 Remove the cables in the reverse order.

IMPORTANT:
The ordinary cables to the standard batteries must not under any circumstances be loosened.

Operation

Correct operating technique is very important for both fuel economy and engine life. Always let the engine warm up to normal operating temperature before operating at full power. Avoid sudden throttle openings.

Reading the Instruments

Check all instruments directly after starting, and then regularly during operation.

NOTICE! On engines in continuous operation, it is recommended that the lubrication oil level is checked at least every 24 hours. Refer to *Oil level, checking and topping up*.

Alarms

If the EMS receives abnormal signals from the engine, the control unit generates fault codes and alarms, in the form of lamps and audible warnings. This is done by means of CAN signals to the instrument.

More information about fault codes and fault tracing can be found in the chapter *Fault handling, page 41*.

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Maneuvering

Operation at low load

Avoid long-term operation at idle or at low load. It takes a long time for the engine to reach working temperature, resulting in high viscosity of the oil and large clearances in the engine mechanics. In cold climate, it takes even longer.

The combustion temperature and cylinder pressure can become so low that an effective combustion cannot be ensured. At these conditions unburned fuel could dilute the lubricant oil. Because of the low cylinder pressure, the piston ring performance could be affected causing oil from the crankcase to pass the rings and go further out with the exhaust gases. This mixture of unburned fuel and oil in exhaust gases is referred to as “slobber”. A new engine produces more “slobber” at low load compared to an engine with more hours of operation.

At low load, the pressure in the turbocharger is low and oil could seep past the turbocharger seals and mix with the air into the engine. The consequences can be carbon build-up on valves, piston crowns and the exhaust turbine, which could affect engine performance.

Both conditions can lead to increased oil consumption and eventually external oil leakage from joints in the exhaust system. For example, leakage could be seen at the exhaust manifold, before and after the turbo, around the muffler and in worse case even in the exhaust end pipe. Consequences could lead to clogged exhaust gas recirculation systems and exhaust aftertreatment systems.

Signs of oil leaking caused by "slobber" do not indicate an engine problem but indicates low load operation. To minimize the risk of malfunctions caused by operation at low load, follow these points as a complement to normal maintenance:

- Run in the engine as soon as possible.
- Load the engine so it reaches working temperature as soon as possible.
- Turn off the engine instead of running on idle for longer periods.
- Avoid load levels below 20% as constant operation.
- If the engine is regularly tested without load, limit the duration of the operation to 5 minutes. Run the engine at full load for about 4 hours once a year, for

the carbon deposits in the engine and exhaust system to burn off.

- If visible slobber has occurred, it can be burned off by running the engine on at least 30% load for about 40-60 minutes.

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Engine Shutdown

During longer breaks in operation, the engine must be warmed up at least once every two weeks. This prevents corrosion in the engine. If you expect the engine to remain unused for two months or more, it must be preserved: Refer to the chapter *Storage, page 80*.

Before Engine Shutdown

Let the engine run at high idle (1500 or 1800rpm) for a minimum of 5 minutes before the shutdown after normal use. Normal use is defined as minimum 50% load. After use with less than 50% load, high idle for approximately 3 minutes is sufficient. This allows engine temperature equalization and prevents boiling once stopped and also allows the turbochargers to cool down. This contributes to long, fault-free service life.

NOTICE! Do not turn off the main switch within 30 seconds after turning off the ignition. This is in order to save engine data to the engine control unit.

Stop the Engine

P0018811

1 Disengage the clutch, if possible.

2 Press the STOP button to turn off the engine.

3 Press the button to turn off the ignition.

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Auxiliary Stop

For location of the extra stop, refer to *Maintenance, page 53*.

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

After Engine Shutdown

1 Check the engine and engine compartment for leaks.

2 Turn off the main switches before any long stoppage.

3 Carry out maintenance in accordance with the schedule.

For longer breaks in operation

During longer breaks in operation, it is recommended that the engine is warmed up at least once every two weeks. This prevents corrosion in the engine.
If you expect the engine to be unused for two months or more, it should be conserved. Refer to *Storage, page 80* .

IMPORTANT:
If there is a risk of freezing, the coolant in the cooling system must have adequate antifreeze protection.

Refer to *Maintenance, page 64*.

IMPORTANT:
A poorly charged battery can freeze and burst.

Refer to *Battery, Charging*.

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Fault handling

Despite regular service in accordance with the planned maintenance schedule and perfect operating conditions, faults may occur that must be remedied before operations continue. This chapter describes the diagnostics function, simple fault tracing and the fault code register.

Diagnostic Function

The purpose of the diagnostic function is to monitor, control and protect the engine and its surrounding system and components from damage, as well as to ensure a minimal environmental impact.

If a malfunction is detected the diagnostic function informs of the occurred fault in the form of a fault code. The fault code provides guidance when fault tracing. All fault codes and fault messages can be found in the *Fault Code Register*.

The operator is warned that there is a malfunction via the instruments. Depending on the instrumentation in use, the fault message is shown in various ways. Fault codes can also be read out by the Volvo Penta diagnostic tool.

Depending on the severity of the fault, the diagnostic function will take various actions to protect the engine and limit emissions (e.g. torque derate, idle speed only, engine shut down etc.)

DCU II (Display Control Unit)

P0018293

DIAGNOSTICS

If the system detects a malfunction the driver/operator is informed via a pop-up message on the display. The fault codes are listed in the diagnostics menu; active fault codes are at the top of the list and are denoted by a green dot. For more detailed information regarding the cause and remedies, use the arrow buttons to scroll to the fault concerned and press OK. This will also provide information about the number of engine hours when the fault became active and the SPN and FMI codes.

Easy Link Instruments

1 When a malfunction is detected this is reported by the diagnostic lamp which starts to flash.

2 Press the diagnostics button. The fault code is shown as text in the tachometer display.

3 Look up the fault code in the *Fault Code Register* and take the necessary actions.

4 When the fault has been rectified, the fault code disappears from the display and the diagnostics lamp goes out.

Erasing fault codes

The memory of the diagnostic function is reset when the power to the engine is disconnected. When the power is switched on again, the diagnostic function will check if there are any malfunctions in the system. If so a new fault codes is registered.

If a malfunction has not been corrected it will be registered once again and has to be acknowledged again. The Volvo Penta diagnostic tool VODIA must be used to erase a fault code.

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Fault Tracing

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

IMPORTANT:
Read through the instructions for care and maintenance in before starting work.

Refere to *Safety precautions for maintenance and service operations*.

Symptoms and possible causes	
The diagnosis button lamp flashes	Please refere to *Diagnostic Function*
Engine can not be stopped	2, 5
Starter motor does not rotate	1, 2, 3, 4, 5, 6, 7, 24
Starter motor rotates slowly	1, 2
Starter motor rotates normally but engine does not start	8, 9, 10, 11,
Engine starts but stops again	8, 9, 10, 11, 13
Engine does not reach correct operating speed at full throttle	9, 10, 11, 12, 13, 21, 25, 26
Engine runs roughly	10, 11
High fuel consumption	12, 13, 15, 25
Black exhaust smoke	12, 13
Blue or white exhaust smoke	15, 22
Too low lubrication oil pressure	16
Excessive coolant temperature	17, 18, 19, 20, 28
Too low coolant temperature	20
No, or poor charge	2, 23
Too high exhaust temperature	13, 17, 18, 19, 21, 25, 27, 28, 29, 30

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1 Discharged batteries

2 Poor contact/open circuit in electrical wiring

3 Main switch turned off

4 Main fuse faulty

5 Faulty ignition lock

6 Faulty main relay

7 Faulty starter motor/-solenoid

8 No fuel:
– fuel cocks closed
– fuel tank empty/wrong tank connected

9 Blocked fuel fine-filter/pre-filter (due to contaminations, or stratification in the fuel at low temperature)

10 Air in the fuel system

11 Water/contamination in fuel

12 Faulty fuel injectors

13 In sufficient air supply to the engine:
– blocked air filter
– air leakage between the turbo and the engine's intake manifold
– dirty compressor part in the turbocharger
– faulty turbo compressor
– poor engine room ventilation

14 Coolant temperature too high

15 Coolant temperature too low

16 Oil level too low

17 Coolant level too low

18 Air in the coolant system

19 Faulty circulation pump

20 Defective thermostat

21 Blocked charge air cooler

22 Oil level too high

23 Alternator drive belt slips

24 Water entry into engine

25 High back pressure in the exhaust system

26 Break in ”Pot+” cable to throttle

27 High temperature, charge air cooler

28 Blocked radiator

29 No pressure in cooling system

30 Check wastegate function

EATS Warnings and Inducements

EATS system monitoring checks the quality of the urea solution, the level in the tank and the correct function of the system components. If a fault is detected the operator is warned via the instrument panel and finally the engine will be shut down. To enable fault tracing and the remedy of any faults, the engine can be re-started according to a start schedule; refer to *EATS Inducements, page 48*.

NOTICE! Warning messages and symbols may vary depending on the installation; shown here are those seen on panels sold by Volvo Penta.

Warning Symbols

Stimulus for power reduction warning. A fault has been detected in the EATS system. or The AdBlue®/DEF tank level has dropped to the first warning level.	
 	• The warning symbol shines with a constant yellow light. • The EATS symbol shines with a constant light.

Major stimulus for power reduction warning. or The AdBlue®/DEF tank level has dropped to the second warning level.	
 	• The warning symbol shines with a constant red light. • The EATS symbol flashes.

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Quality shortcomings and component defects

If the system signals a quality shortcoming or component defect, check the following:

- that the level sensor in the AdBlue®/DEF tank is connected.
- that system hoses and the injection valve are not clogged or disconnected.
- that the injection valve is connected.
- that the AdBlue®/DEF pump is connected.
- that the SCR system electrical cables are connected.
- that the NO_x sensors are connected.
- that the exhaust temperature sensor is connected.
- that the temperature sensor for the AdBlue®/DEF is connected.
- that there are no leaks in the exhaust system where substantial amount of solution can escape.

If the fault can not be reminded with any of the above, refer to *EATS Inducements, page 48*.

EATS Inducements

Low tank level

1 When the level in the AdBlue®/DEF tank has dropped to around 15%, a warning lamp lights up.

2 If the tank level drops to around 6%, the warning lamp flashes. If AdBlue®/DEF is not added to the tank, the engine will stop after 30 minutes.

3 If the engine is started when the tank is below 6%, the engine will only run at idle and a warning message will be shown in the display.

4 For the engine to revert to full power, the tank level must be above 12%. The tank level must be above 21% for the system to extinguish the warning lamp and cancel the fault message.

AdBlue/DEF quality

P0020516

A Engine speed and torque

B Time axis

1 A fault is detected and a warning lamp lights up.

2 If the fault is not remedied within 2.5 hours, the warning lamp will start to flash.

3 After a further half hour, the engine will be shut down.

4 Following re-start, the engine will only run at idle.

5 When the fault is remedied, the engine will revert to full power.

6 Depending on the installation, it is possible after the first 3 hours to manually override system functions and run the engine at full power for 2 x 30 minutes. After 30 minutes the engine is shut down. Each 30-minute period requires a new manual activation.

7 If a fault returns within 40 hours, available running time will be reduced to 30 minutes.

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AdBlue/DEF high temperature and component fault

P0020536

A Engine speed and torque

B Time axis

1 A fault is detected and a warning lamp lights up.

2 If the fault is not remedied within 3.5 hours, the warning lamp will start to flash.

3 After a further half hour, the engine will be shut down.

4 Following re-start, the engine will only run at idle.

5 When the fault is remedied, the engine will revert to full power.

6 If a fault returns within 40 hours, available running time will be reduced to 30 minutes.

Fault Code Register

SPN	Component	FMI
20	Coolant Water Pressure	1, 3, 5, 18
51	Engine Throttle position (cold)	3, 5, 7, 12, 13
91	Percent Accelerator Pedal Position	0, 9, 19
94	Fuel Delivery Pressure *Maintenance, page 60*	3, 5, 12, 18
97	Water in fuel indicator *Draining condensate, fuel system, page 60*	0, 4, 12
98	Engine Oil Level *Oil level, checking and topping up, page 57*	1, 4, 5, 18
99	Engine Oil Filter Differential Pressure	0
100	Engine Oil Pressure *Oil level, checking and topping up, page 57*	1, 3, 4, 5, 18
101	Crankcase pressure	0, 3, 5
102	Boost pressure	0, 3, 4, 5, 16
105	Boost temperature	0, 4, 5, 16
107	Air filter pressure	0, 3, 4, 5, 12
108	Ambient air pressure	5
110	Coolant Temperature *Coolant Level, Checking and Topping Up, page 65*	0, 4, 5, 16
111	Coolant Level *Coolant Level, Checking and Topping Up, page 65*	1, 3, 4, 5, 18
131	Exhaust back pressure	3, 5, 12
158	Battery voltage *Battery, Charging*	0,1, 2
172	Ambient Air Temperature Sensor	4, 5
173	Exhaust gas temperature	0, 16
175	Engine Oil Temperature *Oil level, checking and topping up, page 57*	0, 3, 4, 5, 16
190	Engine Speed	0, 16
626	Preheat relay	3, 4, 5
628	Program Memory	2
636	CAM Speed sensor	7, 8, 9
637	Crank Speed sensor	2, 8, 9
639	J1939 Network #1 Primary Vehicle Network	2
647	Engine Fan Driver	3, 4, 5
651	Fuel Injector, Cylinder #1	3, 5
652	Fuel Injector, Cylinder #2	3, 5
653	Fuel Injector, Cylinder #3	3, 5
654	Fuel Injector, Cylinder #4	3, 5
655	Fuel Injector, Cylinder #5	3, 5
656	Fuel Injector, Cylinder #6	3, 5
677	Starter motor relay	3, 4, 5, 6
729	Starter element	5, 6, 7, 12
970	Engine stop switch	3, 4, 5, 11, 14
1188	Wastegate Valve	3, 4, 5

SPN	Component	FMI
1485	Main relay output	7
1639	Fan speed	3
1668	J1939 Network #4 (engine subnet)	2
1761	Aftertreatment Reagent Tank Level	12, 17, 18
2017	Lost Communication (Source Address 17)	9
2036	Lost Communication (Source Address 36)	9
3031	Aftertreatment Reagent Tank Temperature	12
3216	NOx Sensor Inlet	2, 3, 5, 9, 11, 12, 13, 14
3226	NOx Sensor Outlet	2, 3, 5, 7, 9, 12, 13, 14
3241	Exhaust gas temperature	19
3361	Aftertreatment Reagent Dosing Unit	12
3364	Aftertreatment Tank Reagent Quality	2, 17
3464	Engine throttle actuator (cold) Engine Throttle Actuator	3, 4, 5, 7, 10, 12
3509	Sensor Supply Voltage #1 (+5 V DC)	3, 4
3510	Sensor Supply Voltage #2 (+5V DC)	3, 4
3511	Sensor Supply Voltage #3 (+5V DC)	3, 4
5394	Aftertreatment reagent dosing valve	12
520193	Sea Water Pressure	1, 3, 4, 5, 18
520335	ECU battery potential	5
520416	Lost communication with reductant control module on engine subnet	9
520567	Aftertreatment Exhaust Temperature - Wet	0, 3, 4, 5, 16
520570	Engine Oil Pressure Before Filter	3, 4, 5, 11
520688	Aftertreatment Exhaust Temperature - Dry	0, 3, 4, 5, 16
520691	Torque Speed Control 1 Received With Errors (Counter or Checksum) Torque speed control	14

Maintenance Schedule

Your Volvo Penta engine and its equipment are designed for high reliability and long life. The engines are built to have the smallest possible environmental impact. If given preventive maintenance, according to the maintenance schedule, these qualities will be retained and unnecessary malfunctions will be avoided. In order for the warranty to be valid, the owner must make sure that the services in the service intervals are performed.

NOTICE! For emission related warranty rights see Emission Control System Warranty Statement.

Service Intervals

Service intervals are shown below. The service content can be found in the Service Protocol available for download at **www.volvopenta.com**.

NOTICE! More information on how to perform service and maintenance can be found in the Service and Maintenance handbook. Information on how to purchase the Service and Maintenance handbook can be found at www.volvopenta.com.

Extended service intervals

The interval between engine oil changes may be extended in certain circumstances. To determine whether the service interval may be extended, Volvo Penta's conditions for extended service intervals must be met and an oil analysis performed. Contact your Volvo Penta dealer for further information.

Where both operational and calendar times are specified, perform the maintenance item at whichever time is the sooner.

Special Interval Service **S1**	Every 1000 hours of operation, or every 12 months.(1)(2)
Special Interval Service **S2**	Oil analysis.
Special Interval Service **S3**	After the first 1000 hours of operation.
Type **A** Service	Every 1000 hours of operation.
Type **B** Service	Every 2000 hours of operation.
Type **C** Service	Every 8000 hours of operation.

1) Oil change intervals vary, depending on oil grade and sulfur content of the fuel. Refer to *Oil recommendations*.

2) Change oil filters every time the oil is changed.

Maintenance

This chapter describes the most common maintenance items. Refer to *Maintenance Schedule, page 52* for service intervals.

NOTICE! More information on how to perform service and maintenance can be found in the Service and Maintenance handbook. Information on how to purchase the Service and Maintenance handbook can be found at www.volvopenta.com.

⚠ CAUTION!
Read through the safety advice before starting any work.

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

When ordering service or spare parts, always specify the engine and transmission identification number. Refer to *Technical Data, page 89*.

Orientation

1 Expansion tanks
2 Oil filler cap, engine
3 Control Unit, EMS
4 Auxiliary Stop
5 Air Filter
6 Charge air cooler (High-Pressure Turbo)
7 Crankcase ventilation
8 Fuel filter, with fuel pressure monitor
9 Fuel prefilter with water monitor
10 Oil dipstick
11 Air filter indicator
12 Low-Pressure Turbo
13 High-Pressure Turbo
14 Charge air cooler (Low-Pressure Turbo)
15 Oil filter

Engine, General

General inspection

Make it a habit to give the engine and engine compartment a visual inspection before starting the engine and after operation once the engine has stopped. This will help you to discover quickly if anything abnormal has happened, or is about to happen.
Look especially carefully at oil, fuel and coolant leakage, loose bolts, worn or poorly tensioned drive belts, loose connections, damaged hoses and electrical cables. This inspection only takes a few minutes and can prevent serious malfunctions and expensive repairs.

⚠ WARNING!
Risk of fire.
Remove all accumulations of fuel, oil and grease when detected on the engine or in the engine room.

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

IMPORTANT:
Washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.

Air Filter, Check and Replace

P0018636

The engine is equipped with electronic air filter indication.
The control unit provides an output signal which is announced as a warning on the instrument panel. The warning indicates a pressure drop in the air filter, which must then be checked and possibly changed.

- Scrap the old filter. No cleaning or re-use is permissible
- In continuous operation, the filter should be checked every 8 hours. For operations in extremely dirty environments such as coal mines and rock crushing mills, special air filters must be used.

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Charge Air Pipe, Leakage Check

P0020410

Inspect the condition of the charge air hoses, hose unions and clamps for cracks and other damage. Change as necessary.

Clamps must be tightened using a torque wrench to 9 ±2 Nm (6.6 ±1.5 lbf.ft.).

Drive Belt and Alternator Belt, Inspection

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

IMPORTANT:
Always change a belt which looks worn or cracked.

Inspections must be carried out after operations, while the belts are hot.
You should be able to depress the alternator belt and the drive belt about 3-4 mm between the pulleys.
The alternator belts and drive belts have automatic belt tensioners and do not need to be adjusted.
Check the condition of the drive belts. Replace as necessary; refer to *Alternator Belt, Replace, page 56* and *Drive belt, change, page 55*.

Drive belt, change

P0020554

1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.
2 Remove the fan guard and fan ring round the cooling fan.
3 Remove the belt guard.
4 Insert a 1/2” square wrench in the belt tensioner (1). Lift the wrench and remove the drive belt.
5 Thread the drive belt round the fan and remove it.
6 Check that the pulleys are clean and undamaged.
7 Thread the new drive belt over the fan.
8 Lift the 1/2" wrench and install the new drive belt.
9 Install the belt guards.
10 Install the fan guard and fan ring round the cooling fan.
11 Start the engine and do a function check.

Alternator Belt, Replace

IMPORTANT!

Always change a drive belt which appears worn or cracked.

P0020553

1 Disconnect the main switch(es) and check that the engine is not connected to system voltage.

2 Remove the fan guard and fan ring round the cooling fan.

3 Remove the belt guard.

4 Insert a 1/2” square wrench in the belt tensioner (1). Lift the wrench up and lift the water pump drive belt off.

5 Insert a 1/2” square wrench in the belt tensioner (2). Press the wrench down and remove the alternator/ water pump belt.

6 Check that the pulleys are clean and undamaged.

7 Press the 1/2” wrench in the belt tensioner (2) down and install the new alternator/water pump drive belt.

8 Lift the 1/2” wrench in the belt tensioner (2) and install the new water pump drive belt.

9 Install the belt guards.

10 Install the fan guard and fan ring round the cooling fan.

11 Start the engine and do a function check.

Lubrication System

P0002089

Oil change intervals may vary according to the lubrication oil grade, fuel sulfur content and running conditions. Refer to *Oil recommendations*.

The oil change interval may under certain conditions be increased. To see if the engine complies Volvo Penta oil analysis needs to be performed. Contact your Volvo Penta dealer for further information.

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

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Oil level, checking and topping up

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

- Normally the oil level is to be checked when the engine is stopped. Wait a few minutes before reading off the level, so that the oil has time to run down into the oil sump.
- Dipstick marked **STOP/OPERATING** can be read both when the engine is stopped and when it is running. Use the STOP side of the dipstick when the engine is stopped and the OPERATING side when in operation.
- The oil level must be inside the marked area on the dipstick. Never fill above the maximum limit on the oil dipstick.
- Only fill oil when the engine is stopped.
- Only use Volvo Penta recommended oils; refer to *Technical Data, page 83*.
- The oil level sensor only measures the oil level when the ignition is switched to on, not continuously during operation.

Checking the oil with a flexible dipstick

IMPORTANT:
Insert the dipstick in increments of around 200 mm, without bending the wire, for the entire length of the plastic tube.

Engine Oil, Change

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

Oil changes must be done when the engine is hot.

1 Connect the drain hose to the oil drain pump and check that no leakage can occur.

2 Pump the oil out (or remove the bottom drain plug and drain the oil).
Collect all the old oil and old filters, and hand them to a re-cycling station for destruction.

3 Remove the drain hose (or install the bottom drain plug).

4 Fill with engine oil.
For change volume, please refer to *Technical Data, page 83*.

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Oil Filter/By-pass Filter, Change

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

1 Clean the oil filter bracket (2).

2 Remove all oil filters with a suitable oil filter extractor (1).

3 Clean the mating surface of the oil filter bracket. Make sure that no pieces of old oil seal are left behind. Carefully clean round the inside of the protective rim (2) on the oil filter bracket.

4 Put a thin layer of engine oil on the seal rings of the new fuel filters.

5 Install the new oil filters. Tighten the filters ¾–1 turn after they touch.

6 Top up with engine oil, start the engine and let it run for 20-30 seconds.

7 Turn off the engine, check the oil level and top up as required.

8 Check sealing round the oil filters.

P0002101

Fuel System

WARNING!
Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they cannot cause fire.

Store fuel-soaked rags so that they cannot cause fire.

IMPORTANT:
Always observe the greatest cleanliness during refueling and work on the fuel system.
Only use the grades of fuel recommended in the fuel specification.

P0024714

Draining condensate, fuel system

NOTICE! Put a collection vessel under the fuel filter tocollect the condensate and fuel.

1 Open the drain nipple in the base of the fuel pre-filter.

2 Tighten the drain tap when fuel without water starts to run out.

Engine Fuel Filter Replacement

⚠ WARNING!
Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they cannot cause fire.

IMPORTANT:
Do not fill the new fuel filter with fuel before assembly. There is a risk that contamination could get into the system and cause malfunctions or damage.

1 Clean round the fuel filter.

2 Remove the filter with a suitable filter remover. Collect any spilled fuel in a collection vessel.

3 Clean the filter mating surface on the filter bracket.

4 Lubricate the seal with diesel fuel and install the new fuel filter. Tighten the fuel filter in accordance with the instructions on the fuel filter.

5 If necessary, vent the fuel system, please refer to *Fuel system, bleeding, page 63*.

Fuel Pre-filter, Change

P0025686

1 Undo the cable from the water trap sensor.

2 Remove the water trap filter from the filter housing. Collect any spilled fuel in a container.

3 Remove the lower part of the water trap from the filter.

4 Clean the lower part of the water trap with a soft rag. Check that the drain hole in the lower part is not blocked.

5 Install a new seal on the lower part and lubricate the seal with diesel fuel. Re-install the lower part of the filter.

6 Lubricate the seal with diesel fuel. Screw the filter onto the filter bracket by hand until the rubber seal just touches the mating surface. Then tighten a further half turn, no more.

7 Connect the cable to the water trap sensor.

8 If necessary, vent the fuel system, please refer to *Bleeding the Fuel System*.

P0025497

Fuel system, bleeding

1 Check that there is sufficient fuel in the tank, and that any fuel taps are open.

2 Release the hand pump on the fuel bracket by pushing down and twisting the plastic handle.

3 Vent the fuel system by pumping with the hand pump.
Air is vented to the tank via the fuel return pipe. No breathing nipples need be opened.

4 Lock the hand pump, push down and twist the handle.

5 Start the engine and allow it to idle fast for about 10 minutes.

6 Perform a leakage and function check.

P0013077

Cooling System

The cooling system ensures that the engine operates at the correct temperature. It is a closed system that should always be filled with a coolant mixture.

IMPORTANT:
Coolant of a suitable chemical composition must be used all year round to protect the engine against internal corrosion, cavitation and freeze bursting. This even applies when there is no risk for freeze damage, to make sure the engine always has a complete corrosion protection.

Therefore, the use of anti-corrosion agents alone, or water alone as a coolant, is not permitted in Volvo Penta engines.

The coolant must be based on Organic Acid Technology (OAT). Using an improper coolant or mixing with another coolant will rapidly reduce the performance and lifetime of the engine. Material incompatibility can lead to leakages, which - in the worst case - can cause engine breakdown.

Volvo Penta strongly recommend the use of our own coolants, ”Volvo Penta Coolant VCS Ready Mixed” or the concentrate ”Volvo Penta Coolant VCS”, which ensure the protection of the cooling system components from corrosion, ageing, swelling and cracking, thereby ensuring optimal engine lifetime.

Over time the corrosion protection additives become less effective, and consequently the coolant must be changed at regular intervals to maintain sufficient protection of the engine. The latest Service Protocol that specifies service intervals can be found at *volvopenta.com*.

Coolant, Mixing

It is extremely important that the system is filled with the correct coolant concentration; refer to *Coolant, Mixing, page 86*.
The coolant should be mixed with distilled, deionized water. For Volvo Penta specified water requirements; refer to *Coolant, Mixing, page 86*.

NOTICE! If water quality can not be guaranteed, use ready mixed coolant.

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Coolant Level, Checking and Topping Up

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

IMPORTANT:
Only use coolant recommended by Volvo Penta.
Top up with the same type of coolant as already used in the system.
Different types of coolant must not be mixed.

NOTICE! Only fill coolant with the engine stopped. Fill slowly, to allow air to flow out.
Check coolant level daily before starting.

P0020397

Coolant Level, Checking and Topping Up

1 Check that the coolant level is above the MIN mark on the sight glass (2).

2 If necessary, fill the expansion tank (1) to the MAX mark on the sight glass.

Filling a completely empty system

NOTICE! Mix the correct amount of coolant in advance, to ensure the cooling system is completely filled. Refer to *Technical Data, page 86* for the correct coolant volume.

NOTICE! Do not start the engine until the system is vented and completely filled.

1 Open the caps to both the expansion tank (1 and 2) and radiator (3).

2 Fill coolant into the expansion tank until it is completely full, to the MAX mark on the sight glass.

3 Fill the radiator. If nipples are fitted to the connections at the bottom of the radiator (4) these can also be used to fill the radiator.

4 Top up until the system is completely full.

5 Vent the system through openings on the expansion tank and radiator.

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Coolant, Draining

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

IMPORTANT:
The coolant contains corrosion-inhibiting additives. Never drain the engine cooling system on engines, which are to be put in storage.

1 Stop the engine before draining the coolant.

2 Remove the caps to both the expansion tanks (1 and 2) and radiator (3).

3 Place a suitable vessel for the coolant to drain off into.

4 Open all drain points (4). Drain the coolant from the radiator and engine block using a drain hose.

5 Check that all coolant drains out. Clear away any deposits found inside the drain tap/plug. There is otherwise a risk that coolant will remain and cause freeze bursting. Check whether the installation has any further taps or plugs at the lowest points of the coolant lines.

6 Shut any taps and check that the spring-loaded covers on the nipples close completely. Install the rubber plugs.

Charge Air Cooler, External Cleaning

IMPORTANT:
Do not use a high pressure power washer.

Remove guards as necessary, to access the radiator. Clean with water and a mild detergent. Use a soft brush. Be careful not to damage the radiator vanes. Reinstall removed parts.

Cooling System, Cleaning

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

IMPORTANT:
Never clean the cooling system if there is any risk of freezing, since the cleaning solution does not have any antifreeze properties.

IMPORTANT:
It is extremely important that the correct concentration and volume of coolant is added to the system.
Mix in a separate clean vessel before filling the cooling system. Make sure that the liquids mix.

IMPORTANT:
Always follow local safety instructions and regulations.

Cooling performance is reduced by deposits in the radiator and cooling galleries. The cooling system should be cleaned out when the coolant is changed.

1 Empty the cooling system. Refer to *Coolant, Draining, page 67*.

2 Put a hose into the expansion tank filling hole and flush with clean water, as specified by Volvo Penta– refer to section Water quality in *Technical Data, page 86* until the water draining out is completely clear.

3 If there should still be some contamination left after flushing for a long time, cleaning can be done with coolant. Otherwise, continue as in item 8 below.

4 Fill the cooling system with 15-20 % mixture of concentrated coolant. Use only Volvo Penta recommended concentrated coolant mixed with clean water.

5 Drain the coolant after 1-2 days of operation. Remove the filler cap and possibly the lower radiator hose to increase the speed of emptying. To prevent suspended material from settling back in the system emptying should be done rapidly, within the space of 10 minutes, when the engine has not been standing still for a long time.

6 Flush the system immediately and thoroughly with clean hot water to prevent dirt from settling in the inner areas. Flush until the water that runs out is completely clean. Make sure that any heater controls are set to full heating during emptying.

7 If contamination should still be left after a long period of flushing, cleanout using Volvo Penta radiator cleaner, followed by finishing-off with Volvo Penta neutralizer. Carefully follow the instructions on the package. Otherwise, continue as in item 8 below.

8 When the cooling system is completely free from contamination, close the drain taps and plugs.

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9 Fill up with Volvo Penta recommended coolant, following the instructions in the chapters entitled *Maintenance, page 64* and *Coolant Level, Checking and Topping Up, page 65*.

P0025788

Cooling air filter

⚠ WARNING!
Stop the engine before doing any maintenance work.

A newly-installed cooling air filter reduces cooling performance by 4 %.

Installation

1 Slide one half of the filter over the fan cover (as in fig.1).

2 Turn the half filter until it is able to hang loosely on the fan cover (see fig. 2).

3 Slide on the other filter half and secure the two halves together with self-affixing velcro tape (as in fig. 3a).

4 Fasten the outer velcro tape around the fan cover guard (as in fig. 3b and 3c).

Removal and cleaning

1 Remove the cooling filter.

2 Brush away any heavy dirt with a soft brush.

3 Rinse the filter with water.

NOTICE! If a cleaning agent is necessary, an eco-friendly degreaser (e.g. coconut oil based) must be used as a first choice. Alternatively, use a paraffin fraction as a second choice.
Spray on the degreaser or apply it using a sponge. Allow it to act for a few minutes and then rinse with tap water.

IMPORTANT:
Do not use gasoline, steam, a high-pressure washer or other cleaning agents.

4 Re-install the filter according to instructions.

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Inlet and Exhaust System

Filling AdBlue®/DEF

⚠ CAUTION!
AdBlue®/DEF spilt onto hot components will quickly vaporize. Turn your face away!

P0011697

⚠ CAUTION!
Risk of corrosive damage.
Contact with the fluid can cause irritation and corrosion.
Wear protective gloves!
Change gloves and clothing that have been in contact with the liquid.

⚠ CAUTION!
Risk of material damage.
AdBlue®/DEF oxidises metal and the capillary action creeps through lines at a speed of approx. 0.6 metres per hour.
If spillage occurs, electrical connectors must be replaced immediately. Do not try to clean with water or compressed air.

P0024301

IMPORTANT:
Dirt/dust, oil, greases, detergents and any chemicals and natural products must be prevented from entering the Adblue/DEF tank.
The system will be damaged if dust or dirt enters the tank clogging the filters in the dosing system.
Keep the tank clean at all times.

IMPORTANT:
Never start the engine if anything other than clean AdBlue®/DEF has been added to the tank.

IMPORTANT:
The use of solution that do not fulfill the ISO 22241 standard will compromise the aftertreatment system performance, increase emissions.
Any warranty claims will be rejected.

When topping off AdBlue®/DEF a nozzle with a built-in shut-off function should be used in accordance with ISO standard 22241. These nozzles are designed not to fit any other filling equipment.

The tank cover is blue and marked with the text 'AdBlue/DEF only' to avoid confusion when filling. The ratio between the consumption of Adblue®/DEF and diesel is dimensioned as at least 1:1 to avoid the solution's running out before the diesel.

Never fill with AdBlue®/DEF other than ISO 22241 as specified by Volvo.
If this instruction is not followed the aftertreatment system may be permanently damaged. Engine power may also be affected negatively and engine components risk damage. Damage and costs arising from a failure to meet these requirements are not covered by Volvo Penta warranty obligations.

If AdBlue®/DEF is filled from a can or pump that lacks a stop function, it is important to make sure the tank is not overfilled as the solution may leak out of the breather tube. If the tank is overfilled and the solution in it freezes at temperatures below -1 °C (12.2 °F), the tank and the hoses may be permanently damaged.

Take great care not to spill the solution as it is extremely corrosive toward many materials. If a spill should occur the solution must be absorbed using dry sand or other non-flammable material and handled according to local and national regulations. Avoid spills onto soil and into waterways.

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Erroneus filling of diesel or AdBlue®/DEF

IMPORTANT:

The filling of diesel or AdBlue®/DEF in the wrong tank can result in damage to the engine.

In order to avoid confusion, the AdBlue®/DEF tank has a blue filler cap and a decal affixed to the tank.

Mistaken filling of AdBlue®/DEF in the diesel tank

- The engine will not run at full power or will not run at all
- Injectors may be damaged
- Corrosion in the exhaust system between the turbocharger and aftertreatment system
- Expensive repairs

Mistaken filling of diesel in the AdBlue®/DEF tank

- The aftertreatment system may be seriously damaged
- The engine will no longer fulfill emission level requirements
- Expensive repairs

AdBlue/DEF-Pump Filter, Change

NOTICE! Emission-related component.

1 Stop the engine.

NOTICE! Wait until the pump unit has stopped running as it usually performs automatic emptying of the AdBlue®/DEF hoses.

2 Disconnect the battery negative terminal.

P0019364

3 Place a collection vessel under the filter cover.

NOTICE! Use approved safety equipment and collection vessel.

4 Undo the filter cover

P0019389

P0019390

5 Use the puller (supplied with the filter kit) to pull out the filter by first pressing it into the filter hole until it clicks.

6 Pull out the filter.

P0019391

7 Install the new filter (1).
Install the rubber gasket (2).
Screw on the filter cover (3).

P0019392

8 Tighten the cover.
Tightening torque: 20 (+5) Nm (14.8 +3.68 lbf. ft.)

P0019365

9 Reconnect the battery negative terminal.

10 Start the engine. Check for leaks; check function.

11 Delete any fault codes.

p0013225

NOTICE! Care for equipment and the remaining AdBlue®/DEF.

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Electrical System

The engine is equipped with a 2-pole electrical system and an alternator.

WARNING!
Always stop the engine and break the current using the main switches before working on the engine.

IMPORTANT:
Contact a Volvo Penta dealer for information if any arc welding will be performed on the application.
Arc welding can cause damage to the engine and the electronics.

Main switch

P0002576

IMPORTANT:
Never disconnect the current using the main switches when the engine is running or by disconnecting the battery cables.
The alternator and electronics could be damaged.

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

Fuses

The engine is equipped with a 10 A circuit breaker which cuts the current if overloaded.
The circuit breaker is located on the left-hand side of the engine.

The engine stops if the fuse trips. If the circuit breaker trips frequently, an authorized Volvo Penta workshop should be contacted to investigate the cause of the overload.

Electrical Connections

Check that electrical connections are dry, free from oxide, and that they are securely tightened.

P0002107

Battery

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

⚠ WARNING!
Battery electrolyte is a corrosive acid and should be handled with care. If you spill or splash electrolyte on any part of the body, immediately flush the exposed area with liberal amounts of water and seek medical attention as soon as possible.

⚠ WARNING!
Ventilate the engine compartment before working on batteries or battery connections.

IMPORTANT:
Batteries can be damaged if they are left discharged, and can also freeze and burst easier in cold weather. If the engine is not going to be used for a longer period of time, the batteries should be fully charged, trickle charged if possible.

P0022892

Maintenance

It is important to always follow the battery manufacture's recommendation and instruction when replacing and charging batteries. Depending on battery type, the instructions for maintenance and charging may vary.
Modern batteries are normally maintenance free, but there are some actions that are recommended to increase the battery service life and avoid accidents:

- Keep the batteries clean and dry. Contamination and oxide on the batteries and battery poles can result in stray currents, voltage drop and discharge, especially in wet weather.
- Remove oxidation from the battery poles and terminals, using a brass brush.
- Tighten the terminals securely and grease them with terminal grease or petroleum jelly. Loose battery connections may cause damage to the engine's electrical system.
- Charge the battery regularly. A battery that is kept fully loaded has a maximum service life. The easiest way to check if a battery needs charging is to use a voltmeter.

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P0022893

Replacing Battery

IMPORTANT:
Make sure that the new battery fulfills the specifications in *Technical Data*. Read the information supplied with the battery before you begin the installation.

IMPORTANT:
Do not disconnect the batteries with the engine running.
Sensitive electrical components can be immediately damaged.

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

Disconnecting (A)

1 Untighten the nut and remove the – cable (black).

2 Untighten the nut and remove the + cable (red).

Remove the battery.

Connecting (B)

Place the new battery.

1 Connect the + cable (red) to the + pole on the battery and tighten the nut.

2 Connect the – cable (black) to the – pole on the battery and tighten the nut.

NOTICE! Hand in the old battery to a re-cycling station.

Storage

To prevent the engine and other equipment from being harmed during long (2 months or more) periods out of service, it must be conserved. Conservation protects the engine from freezing and corrosion damages.

It is of utmost importance that the conservation is performed correctly, therefore we have compiled a checklist covering the most important points. Before taking the engine out of service for long periods, Volvo Penta recommends that the engine is checked by a qualified workshop for possible need for overhaul or repair.

⚠ CAUTION!
Read the chapter on Maintenance in the Operator`s Manual before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and technical correct manner.

⚠ WARNING!
Conservations oils can be flammable and dangerous to inhale. Ensure good ventilation. Use a protective face mask when spraying.

IMPORTANT:
Washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.

P0002089

- **For up to 8 month's stoppage:**
  Change the oil and oil filter on the engine, then run the engine until warm.
  More than 8 month's stoppage:
  Conserve the lubrication and fuel systems with conservation oil. Refer to the section *Conservation of the lubrication and fuel systems for more than 8 months' stoppage.*
- Make sure the coolant has adequate antifreeze properties. Top up as necessary.
  Alternatively, you can drain the coolant (also drain the coolant filter).
- Drain any water and contamination from the fuel filters and fuel tank. Fill the fuel tank completely, to avoid condensation.
- Disconnect the battery cables, clean and charge the batteries. Trickle charge the batteries while the equipment is in storage. **A poorly charged battery can freeze and burst**.
- Clean the outside of the engine. Do not use a high pressure washer for engine cleaning. Touch up paint damage with Volvo Penta original paint.
- Put a note on the engine with the date, type of conservation and the conservation oil used.
- Cover the air filter, exhaust pipe and engine if necessary.
- Empty the AdBlue/DEF tank and rinse it with distilled water.

Bringing Out of Storage

- Remove any covers from the engine, air filter and exhaust pipe.
- Fill the engine with the correct grade of oil into the engine, as necessary, refer to *Technical Data, Lubrication System*. Install a new oil filter if the filter was not changed during conservation.
- Install new fuel filters and bleed the fuel system.
- Check the drive belt(s).
- Check the condition of all rubber hoses, and retighten the hose clamps.
- Close the drain taps and install any drain plugs.
- Check the coolant level. Top up as necessary.
- Connect the fully charged batteries.
- Start the engine and warm it up at fast idle with no load.
- Check that no oil, fuel or coolant leakage occurs.
- Fill the AdBlue/DEF tank. The solution must fulfill ISO 22241 standards.

Conservation of the lubrication and fuel systems for more than 8 months' stoppage:

- Drain the engine oil and fill up with **conservation oil*** to just over the MIN marking on the dipstick.
- Connect the fuel suction and return hoses to a 1/3 full jerrican containing **conservation oil*** and 2/3 diesel fuel.
- Bleed the fuel system.
- Start the engine and run at a fast idle until about 2 liters (0.6 US gal) of the fluid in the jerrican have been used. Stop the engine and re-connect the fuel suction and return lines.
- Drain the conservation oil from the engine.
- Follow the other instructions on the previous page.

* Conservation oils are sold by oil companies.

Technical Data

Engines

Type designation	TWD1672GE, TWD1673GE
Power, prime/stand-by	Refer to the sales literature
Torque, Prime/Standby	Refer to the sales literature
No. of cylinders	6
Bore, mm (inch)	144 (5.67)
Stroke, mm (inch)	165 (6.50)
Displacement, liter (inch^3)	16,12 (983.9)
Weight, dry, kg (lbs)	1810 (3990)
Weight, wet, kg (lbs)	1890 (4167)
Firing order	1-5-3-6-2-4
Compression ratio	16,8:1
Low idle, r/min.	900
High idle, rpm	1800

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Lubrication System

Oil change volume, including filter change	
Composite sump (Standard)	48 liters (12.68 US gal)
Aluminum sump (Optional)	55 liters (14.53 US gal)
Additional volume: Remote oil filters (Optional)	5 liters (0.80 US gal)
Oil pressure, hot engine	
at operating speed	300-650 kPa (44–94 psi)
Oil filter	
Full flow filter	2
By-pass filter	1
Lube oil pump	
Type	Gear driven

Oil recommendations

Oil quality	Oil change interval, reached first in operation:
VDS-3	**500** hours or 12 months

VDS = Volvo Drain Specification

Viscosity

Select the viscosity according to the table.

The temperature values refer to stable ambient temperatures.

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

Fuel System

Feed pump	
Feed pressure at 900 rpm	min 100 kPa (14.5 psi)
Feed pressure at 1800 rpm	min 300 kPa (43,5 psi)
Feed pressure at full load	min 300 kPa (43,5 psi)
Bypass valve	
Opening pressure	400-550 kPa (58–80 psi)

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 weather requirements)
ASTM D 975 No 1-D and 2-D
JIS KK 2204
Sulfur content: Complying with legal requirements in each country, however the sulfur content must not exceed 15 ppm.

NOTICE! For TWD1672GE and TWD1673GE only fuel standard ASTM D 975 is allowed.

IMPORTANT!
Use of fuel that does not fulfil the requirements above will damage the SCR system. Damages and costs arising from a failure to meet the requirements above are not covered by Volvo Penta's warranty obligations.
Never start the engine if incorrect fuel has been filled by mistake.

Fuel quality requirements for diesel engines with aftertreatment system

General requirements

Volvo Penta diesel engines are certified for compliance with emission legislations with the diesel test fuels specified by law. These fuels correspond with diesel fuel standards EN 590, ASTM D975, JIS K2204 and paraffinic diesel fuel standard EN 15940. Volvo Penta guarantees compliance with emission legislation and fulfillment of expected lifetime as long as the specified restrictions are followed.

It is the responsibility of the fuel suppliers to always ensure that their fuels meet relevant requirements and are fit for their intended purpose. Their responsibility includes any use of additives for proper engine performance and function.
Special requirements are placed on cold-flow properties, that is, temperature limit values of fuel filterability during operation in winter conditions.

Restrictions for specified diesel fuels

- **Max density for ASTM D975 No 2-D: 860 kg/m^3**
  Insufficient density reduces the power and increases the fuel consumption. Excessive density endangers the durability and function of the fuel injection equipment.
- **Max lubricity (wsd 1.4) for JIS K 2204: 460 µm**
  Sufficient fuel lubricity is essential to protect the fuel injection system against excessive wear.

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Restrictions for other diesel fuels

Volvo Penta also approves the use of other diesel fuels as long as the here specified restrictions are followed. However Volvo Penta does not guarantee compliance with emission legislation or fulfillment of expected lifetime with these other diesel fuels.

NOTICE! Operators must check permission for usage of these fuels according to regional, national or local regulations.

- **Min cetane number: 40**
  An insufficient cetane number (“ignitability”) leads to poor startability and increased exhaust emissions.
- **Max density at 15 °C: 860 kg/m^3**
  Insufficient density reduces the power and increases the fuel consumption. Excessive density endangers the durability and function of the fuel injection equipment.
- **Viscosity between 1.9 to 4.6 mm/s^2 at 40 °C**
  Insufficient viscosity reduces the power and increases the fuel consumption. Excessive viscosity endangers the durability and function of the fuel injection equipment.
- **Max lubricity (wsd 1.4): 520 µm**
  Sufficient fuel lubricity is essential to protect the fuel injection system against excessive wear.
- **Max FAME (biodiesel) content: 10% (V/V)**
  FAME is blended into diesel fuel, excessive FAME content damage the catalytic system.
- **Max sulfur content: 15 mg/kg**
  Excessive sulfur content damage the catalytic system.

Paraffinic fuels - HVO and GTL

Paraffinic diesel fuels (“Synthetic Diesel”) have higher cetane numbers and lower densities than diesel fuels. HVO (Hydrotreated Vegetable Oils) is renewable paraffinic fuels. GTL (Gas-To-Liquid) is fossil paraffinic fuels.

Volvo Penta approves the use of paraffinic diesel fuels that complies with standard EN 15940. The fuel guarantees compliance with emission legislation and fulfills the expected lifetime as long as the service requirements are followed.
Volvo Penta also approves the use of fuel blends between these paraffinic fuels and diesel fuels that comply with the quality requirements.

Service requirements

- When shifting from diesel fuel to paraffinic fuel, the fuel hoses and sealings must be replaced.

Cooling System

Type	Pressurized, sealed
Pressure cap, max opening pressure	75 kPa (10.88 PSI)
Volume (Volvo Penta cooling system)	
Engine circuit (Engine with radiator, hoses and expansion tank) (Pusher system)	86 liters (22.7 US gal)
Charge air cooler circuit (Charge air coolers, hoses and expansion tank) (Pusher system)	64 liters (16.9 US gal)
Thermostat	
Qty	1 pc.
Opening temperature	82 °C (179.6 °F)

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Coolant, Mixing

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

IMPORTANT:
Always use the same type of coolant that is already in the engine.
Different types of coolant must not be mixed with each other.
Risk of reduced cooling function and performance by clogging and isolation.

Coolant shall be based on Organic Acid Technology (OAT).

Follow the mixing recommendation on the product.
The coolant should be mixed with distilled, deionized water. For Volvo Penta specified water requirements; refer to *Water Quality, page 87*.

NOTICE! Always use “Ready Mixed” coolant if water quality cannot be determined or if it does not fulfill ASTM D4985.

NOTICE! Never mix more than 60% concentrated coolant with water. A greater concentration provides reduced cooling effect with the risk for overheating and reduced freeze protection.

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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

Inlet and Exhaust System

Tank	Small	Medium	Large	X Large
Usable volume	17.4 liters (4.54 US gal)	38.6 liters (10.2 US gal)	68 liters (17.96 US gal)	164.2 liters (43.38 US gal)

Electrical System

System voltage	24V
Alternator	
voltage/max. current	28V/80A
power app.	2200W
Alternative generating equipment (optional)	
voltage/max. current	28V/110A
power app.	2800W
Battery capacity	2 pcs. series connected 12 V, max. 220 Ah
Battery electrolyte density at +25°C °	
fully charged battery	1,28 g/cm^3 (1,24 g/cm^3)*
recharge battery at	1,20 g/cm^3 (1,20 g/cm^3)*

* Note. Applies to batteries with tropical acid.

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Identification Numbers

NOTICE! The engine labels are placed on the valve cover.

P0024526

A Label part number

B Product designation

C Specification number

D Chassis ID

E Serial number

F Power (kW)

G Engine speed (rpm)

H Country of manufacturing

P0018882

A Label part number

B Engine Family

C Power Category

D Date of Manufacture (mm-yy)

E Model Year

F Generator (for GenSets and other applications)

G Constant Speed (used in constant speed applications only)

H Exhaust Emission Control System

VOLVO PENTA

Declaration for the installation of partially-completed machinery in accordance with Machinery Directive 2006/42/EC

Engine Manufacturer:
AB Volvo Penta
Gropegårdsgatan, SE 405 08 Gothenburg, Sweden

Description of engine 4-cycle diesel engine. Engine types covered by this declaration:

TAD540VE	TAD840VE	TAD940VE	TAD1140VE	TAD1340VE	TAD1341GE	TAD1640VE-B	TAD1640GE
TAD541VE	TAD841VE	TAD942VE	TAD1141VE	TAD1341VE	TAD1342GE	TAD1641VE	TAD1641GE
TAD542VE	TAD842VE	TAD943VE	TAD1142VE	TAD1342VE	TAD1343GE	TAD1641VE-B	TAD1642GE
TAD550VE	TAD843VE	TAD950VE	TAD1150VE	TAD1343VE	TAD1344GE	TAD1642VE	TAD1650GE
TAD551VE	TAD850VE	TAD951VE	TAD1151VE	TAD1344VE	TAD1345GE	TAD1642VE-B	TAD1651GE
TAD552VE	TAD851VE	TAD952VE	TAD1152VE	TAD1345VE	TAD1350GE	TAD1643VE	TWD1643GE
TAD570VE	TAD852VE	TAD940GE	TAD1170VE	TAD1350VE	TAD1351GE	TAD1643VE-B	TWD1644GE
TAD571VE	TAD853VE	TAD941GE	TAD1171VE	TAD1351VE	TAD1352GE	TAD1650VE	TWD1645GE
TAD572VE	TAD870VE		TAD1172VE	TAD1352VE	TAD1353GE	TAD1650VE-B	TWD1652GE
	TAD871VE			TAD1353VE	TAD1354GE	TAD1651VE	TWD1653GE
	TAD872VE			TAD1360VE	TAD1355GE	TAD1660VE	TWD1663GE
	TAD873VE			TAD1361VE	TAD1371VE	TAD1661VE	TWD1672GE
				TAD1362VE	TAD1372VE	TAD1662VE	TWD1673GE
				TAD1363VE	TAD1373VE	TAD1670VE	
				TAD1364VE	TAD1374VE	TAD1671VE	
				TAD1365VE	TAD1375VE	TAD1672VE	

Fundamental health and safety requirements applied to, and fulfilled by, the above-mentioned engines are described in the following items in Annex I:
1.1.3, 1.1.5, 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.6, 1.5.13, 1.6.1, 1.6.2, 1.6.4, 1.7.1, 1.7.1.1, 1.7.1.2, 1.7.4, 1.7.4 and 1.7.4.3.

The relevant technical documentation is compiled as described in part B of Annex VII.
Relevant information concerning the partially completed machinery will be provided in suitable form upon justified requests from competent national authorities. The individual authorized to compile the relevant technical documentation is the signer of this declaration.

The harmonizing standards applied are:
EN ISO 12100–1: Safety of machinery – Basic concepts, general principles for design – Part 1: Basic terminology. methodology.
EN ISO 12100–2: Safety of machinery – Basic concepts, general principles for design – Part 2: technical principles.
EN 1679–1: Reciprocating internal combustion engines – Safety – Part 1: Compression ignition engines.

The partially completed machinery also complies with the following relevant Directive:
2014/30/EU – Electromagnetic Compatibility (EMC) Directive.
Applied standards: EN 61000–6–1, EN 6100–6–2, EN 61000–6–3, EN 61000–6–4, EN 12895, EN-ISO 14982 and EN 13309.

For engines equipped with the Volvo Penta Start/Stop System the responsibility for the functional safety of the system lies with the machine manufacturer performing the integration.

The engines covered by this declaration may not be put into operation before the completed machinery into which they are to be installed has been declared to conform with the provision of Machinery Directive 2006/42/EC.

Name and function:
Jonas Holmberg, Laws and Regulation
(The identity of the individual authorized to sign on behalf of the engine manufacturer or the latter's authorized representative.)

Signature and title:

Date and place of issue: (yyyy-mm-dd) 2016–12–20 Gothenburg

LR-31/16–01

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