

OPERATOR'S MANUAL

Generating set and industrial engines

16 litre (EMS 2)

**VOLVO
PENTA**


Safety information

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


Check that you have received the correct instruction book before you read on. If not, please contact your Volvo Penta dealer.




Incorrect operation can lead to personal injury and damage to products or property. So read the instruction book through very carefully before you start the engine or do any maintenance or servicework. If there is still something which is unclear or if you feel unsure about it, please contact your Volvo Penta dealer for assistance.


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

Safety texts in the instruction book have the following order of priority:

 **WARNING!** Warns for the risk of personal injury, major damage to product or property, or serious malfunctions if the instruction is ignored.

 **IMPORTANT!** Is used to call attention to things which could cause damage or malfunctions to product or property.

NOTE! Is used to call attention to important information, to facilitate work processes or operation.

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

⚠ Cooling system

Avoid opening the coolant filling cap when the engine is hot. Steam or hot coolant can spray out at the same time as the pressure built up is lost.

If the filler cap, coolant hose etc., still has to be opened or removed when the engine is hot, undo the filler cap slowly and carefully, to let the pressure out before removing the filler cap completely and starting work. Note that the coolant can still be hot and cause scalding.

⚠ Fuel system

Always protect your hands when searching for leaks. Fluids which leak under pressure can force their way into body tissue and cause severe injury. There is a risk of blood poisoning (septicemia).

Always cover the alternator if it is located beneath the fuel filters. Fuel spillage can damage the alternator.

⚠ Electrical system

Cut the current

Before any work is done on the electrical system, the engine must be stopped and the current cut by switching off the main switch(es). External current supply for engine heaters, battery chargers or other auxiliary equipment connected to the engine must be disconnected.

Batteries

Batteries contain a highly corrosive electrolyte. Protect your eyes, skin and clothes during charging and other handling of batteries. Always use protective goggles and gloves.

If acid comes into contact with your skin, wash at once with soap and a lot of water. If you get battery acid in your eyes, flush at once with a lot of cold water, and get medical assistance at once.

⚠ Electric welding

Remove the positive and negative cables from the batteries. Then disconnect all cables connected to the alternator.

Disconnect both connectors from the engine control module.

Always connect the welder earth clamp to the component to be welded, and as close as possible to the weld site. The clamp must never be connected to the engine or in such a way that current can pass through a bearing.

When welding is completed: Always connect the alternator cables to the alternator **and the connectors to the engine control module** before the battery cables are put back.

Introduction

This instruction book has been prepared to give you the greatest possible benefit from your Volvo Penta industrial engine. It contains the information you need to be able to operate and maintain the engine safely and correctly. Please read the instruction book carefully and learn to handle the engine, controls and other equipment in a safe manner before you start the engine.

⚠ IMPORTANT! This instruction book describes the engine and equipment sold by Volvo Penta. Variations in appearance and function of the controls and instruments may occur in certain variants. In these cases, please refer to the instruction book for the relevant application.

Environmental responsibility

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

As an engine manufacturer, Volvo Penta has particular responsibility and for this reason, environmental care is a self-evident foundation of our product development. Volvo Penta has a wide engine program these days, where considerable progress has been made in reducing exhaust fumes, fuel consumption, engine noise etc.

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

Please remember to always hand in hazardous waste such as drained oil, coolant, old batteries etc. for destruction at an approved recycling facility.

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

Running in

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

Use the engine in normal operation. Full load should only be applied for short periods. Never run the engine for a long period of time at constant speed during this period, this does not apply to GE engines.

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

When an opening clutch is installed, this should be checked more carefully during the first days. Adjustment may need to be done to compensate bedding in of the friction plates.

Fuel and oils

Only use the grades of fuels and oils recommended in the instruction book (please refer to the "Maintenance" chapter under the fuel and lubrication system headings). Other grades of fuel and oils can cause malfunctions, increased fuel consumption and eventually even shorten the life of the engine.

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

Maintenance and spare parts

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

Volvo Penta has a world-wide network of authorized dealers. They are Volvo Penta product specialists, and have the accessories, original spares, test equipment and special tools needed for high quality service and repair work.

Always observe the maintenance intervals in the instruction book, and remember to note the engine/transmission identification number when you order service and spare parts.

Certified engines

If you own an emission certified engine, which is used in an area where exhaust emissions are regulated by law, it is important to be aware of the following:

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

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

- Maintenance and service intervals recommended by Volvo Penta must be complied with.
- Only Volvo Penta original spares may be used.
- Service to injection pumps, pump settings and injectors must always be done by an authorized Volvo Penta workshop.

- The engine must not be converted or modified, except for the accessories and service kits which Volvo Penta has developed for the engine.
- No installation changes to the exhaust pipe and engine air inlet ducts may be done.
- No seals may be broken by unauthorized personnel.

The general advice in the instruction book about operation, care and maintenance applies.

⚠ IMPORTANT! Delayed or inferior care/maintenance, and the use of non-original spares, parts means that AB Volvo Penta can no longer be responsible for guaranteeing that the engine complies with the certified version.

Damage, injury and/or costs which arise from this will not be compensated by Volvo Penta.

Warranty

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

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

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

Introduction

TAD1640GE, TAD1641GE, TAD1642GE, TAD 1641VE and TAD1642VE are in-line, direct injected, 6-cylinder industrial diesel engines.

All engines are equipped with electronically controlled fuel management (EMS 2), turbocharger, intercooler, thermostatically controlled cooling systems and electronic speed control.

Technical description

Engine and engine block

- The engine block and cylinder head are manufactured of alloyed cast iron
- Seven bearing induction hardened crankshaft
- Wet, replaceable cylinder liners
- Cast aluminum pistons with oil cooling
- Three piston rings, with a "keystone" type top ring
- Induction hardened, overhead, seven bearing camshaft with
- Four valves per cylinder
- Replaceable valve seats and valve guides

Fuel system

- Microprocessor based fuel supply control unit (EMS 2)
- Gear driven fuel supply pump
- Centrally located unit injectors with electromagnetically controlled fuel valves
- Spin-on secondary fuel filter and water trap

Lubrication system

- Water cooled oil cooler
- Gear driven oil pump
- Two full flow filters and a spin-on bypass filter

Turbocharging system

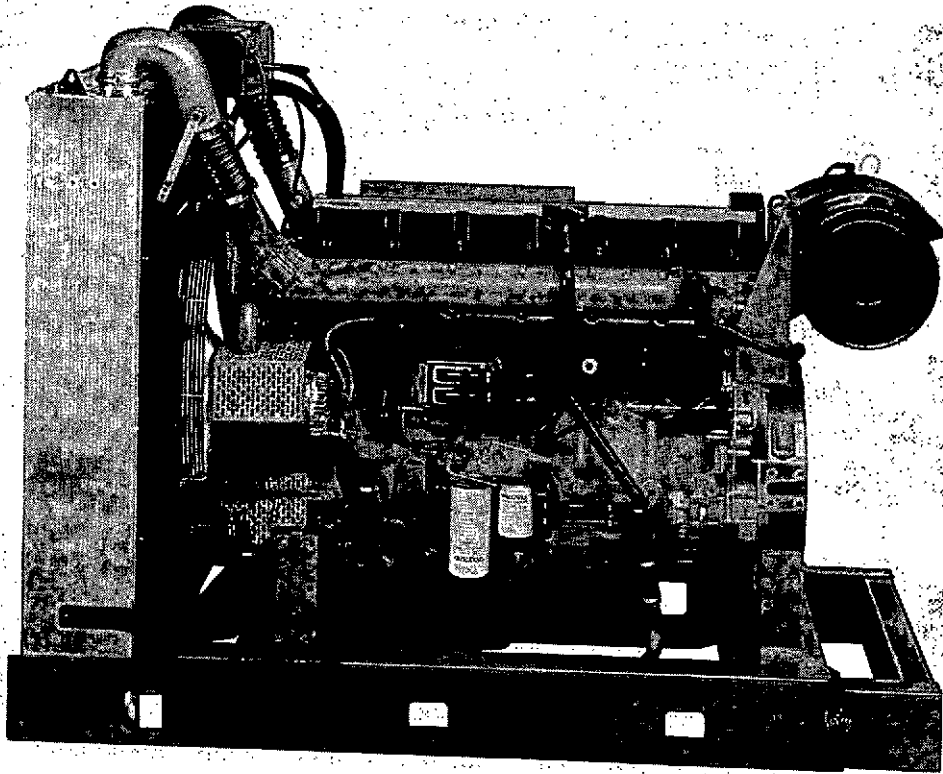
- Turbocharger

Cooling system

- Radiator with expansion tank
- Air cooled intercooler
- Belt-driven water pump
- Piston thermostat

Electrical system

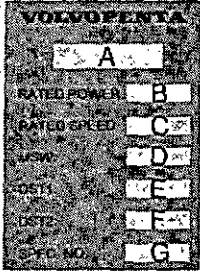
- 24 V electrical system
- Alternator with charge sensor
80 A (110 A option)
- Engine mounted extra stop (AUX STOP)



TAD1640GE, TAD1641GE, TAD1642GE
TAD 1641VE, TAD1642VE

Identification numbers

Location of engine signs



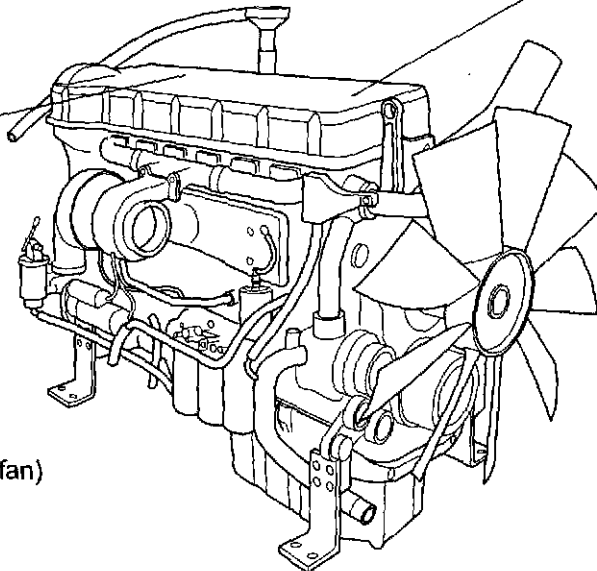
The sign above shows:

- A Engine designation
- B Engine power, net, (without fan)
- C Max. engine speed
- D Main software
- E Data set 1
- F Data set 2
- G Product number



The sign above shows:

- 1 Engine designation
- 2 Serial number
- 3 Specification number



Explanation of engine designation:

E.g. TAD1641GE/TAD941VE

- T - Turbo
- A - Air to air intercooler
- D - Diesel engine
- 16 - Cylinder volume, liter
- 4 - Generation
- 1 - Version
- G - Generator unit engine
- V - Stationary and mobile operation
- E - Emission certified

EMS 2

EMS 2 (Engine Management System) 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 control and diagnostic function.

Summary

The system includes sensors, control unit and unit injectors. The sensors send input signals to the control unit, which controls the unit injectors in its turn.

Input signals

The control unit receives input signals about engine operating conditions etc. from the following components:

- coolant temperature sensor
- charge pressure / charge temperature sensor
- crankcase pressure sensor
- position sensor, camshaft
- speed sensor, flywheel
- piston cooling pressure sensor
- coolant level sensor
- oil pressure sensor
- oil level and oil temperature sensor
- fuel pressure sensor
- water in fuel indicator
- air filter indicator
- inlet temperature sensor

Output signals

The control unit controls the following components on the basis of the input signals received:

- unit injectors
- starter motor
- main relay
- pre-heating relay

Information from the sensors provides exact information about current operation conditions and allows the processor in the control unit to calculate the correct fuel injection volume and timing, check engine status etc.

Fuel control

The engine fuel requirement is analyzed up to 100 times per second. The amount of fuel injected into the engine and the injection advance are fully electronically controlled, via fuel valves and the unit injectors.

This means that the engine always receives the correct volume of fuel in all operating conditions, which offers lower fuel consumption, minimal exhaust emissions etc.

Diagnostic function

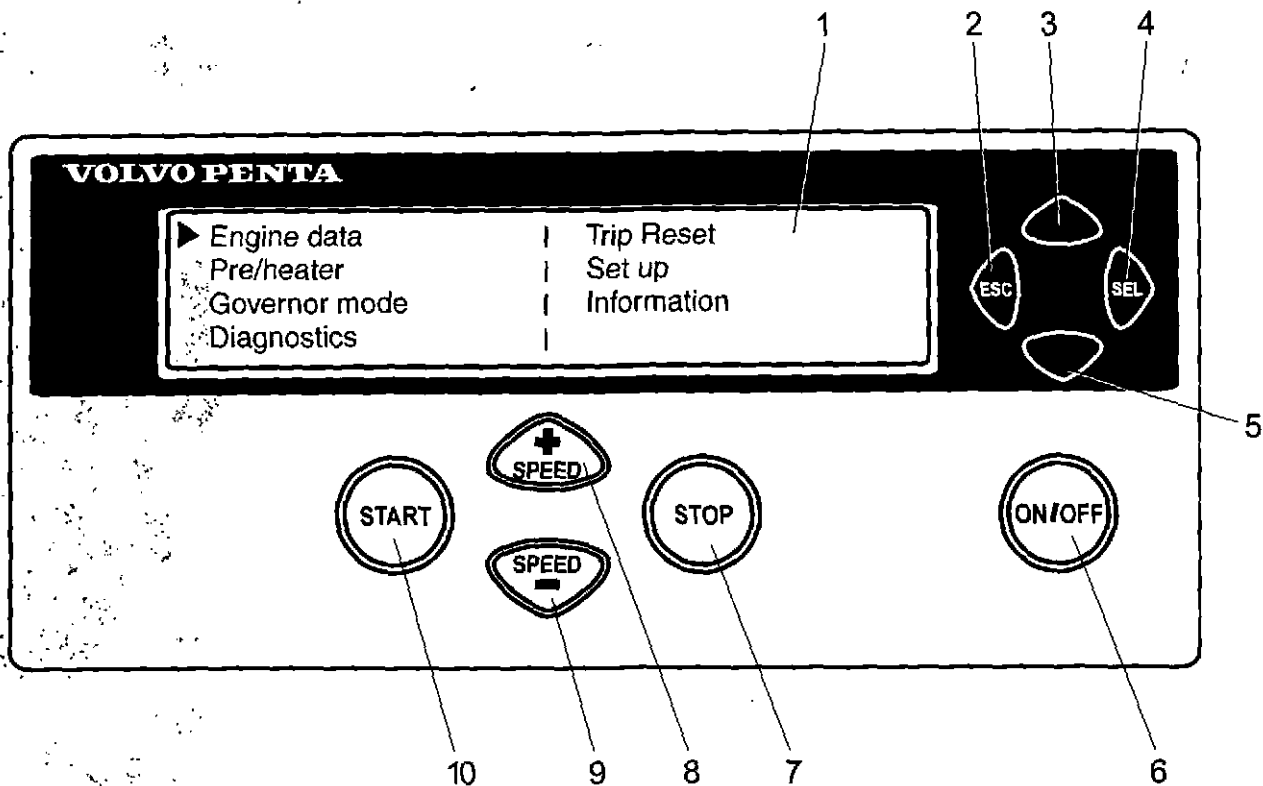
The task of the diagnostic function is to discover and localize any malfunctions in the EMS 2 system, to protect the engine and to ensure operation in the event of serious malfunction.

If a malfunction is discovered, this is announced by warning lamps, a flashing diagnostic lamp or in plain language on the instrument panel, depending on the equipment used. If a fault code is obtained as a flashing code or in plain language, this 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 altogether, or the control unit will reduce the power delivered (depending on application). Once again, a fault code is set for guidance in any fault tracing.

Instruments

DCU (Display Control Unit)



1. LED display.
2. ESC. Returns to the earlier menu selection.
3. Scroll upwards in menus
4. SEL. Selects in menus
5. Scroll downwards in menus
6. ON/OFF. Starts and stops the system.
7. STOP. Stops the engine.
8. SPEED +. Increases engine speed
9. SPEED -. Reduces engine speed
10. START. Starts the engine.

DCU (Display Control Unit) is started by pressing the "ON/OFF" button (6). You come to the main menu by pressing the "SEL" button (4).

The following menus and sub-menus are found in the main menu on the DCU display:

Engine data, shows engine speed, charge pressure, charge temperature, coolant temperature, oil pressure, oil temperature, engine hours, battery voltage, instantaneous fuel consumption and fuel consumption (trip fuel).

The choice is selected by the SPEED+ and SPEED- buttons on the instrument panel.

Pre/heater, activates/shuts off pre-heating.

Governor mode, activates/shuts off droop.

Diagnostics, shows fault codes in text. Lists previous faults.

Trip reset, resets trip data, such as fuel consumption.

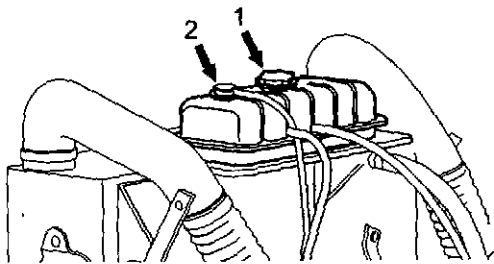
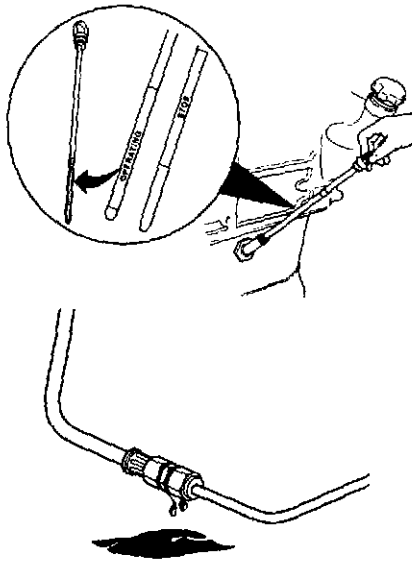
Set up, sets units, language and warning limits.

Information, shows data for hardware, software, data set 1 and data set 2, and engine identification for both engine and DCU.

Starting the engine

Make it a habit to give the engine and engine bay a visual check before starting. This will help you to discover quickly if anything abnormal has happened, or is about to happen. Also check that instruments and warning displays show normal values after you have started the engine.

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



Before starting

- Check that the oil level is between the MAX and MIN marks. Please refer to the "Maintenance, lubrication system" chapter.
- Open the fuel taps.
- Check that no leakage of oil, fuel or coolant occurs.

- Check the coolant level and that the radiator is not blocked externally. Please refer to the "Maintenance, cooling system" chapter.

⚠ WARNING! Do not open the filler cap (1) when the engine is hot. Steam or hot fluid could spray out.

NOTE! Only open filler cap (1). Do not open filler cap (2).

- Turn the main switch(es) on.

⚠ IMPORTANT! Never disconnect the current with the main switch(es) when the engine is running. This can damage the alternator.

- Move the engine speed control to idle, and release the opening clutch/gearbox if installed.

Starting method EMS 2

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 cut for 80 seconds to protect the starter motor against over-heating.

DCU (Display Control Unit)

With pre-heating.

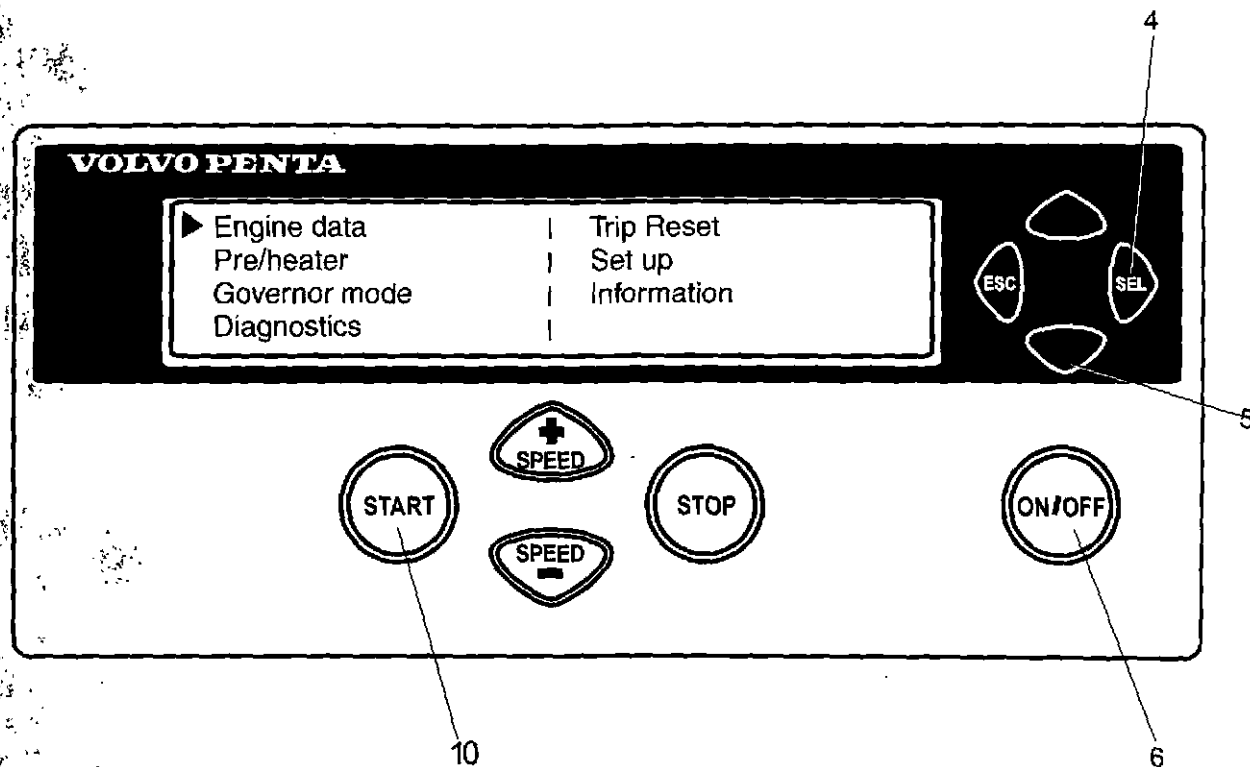
1. Depress the "ON/OFF" button (6).
2. Press the "SEL" button (4) to come to the main menu.
3. Scroll down to **Pre/heater** with the scroll button (5), press the "SEL" button (4).
4. In the pre-heater menu, press the "SEL" button (4) to select pre-heating.
3. Press the "START" button (10).

Without pre-heating

1. Depress the "ON/OFF" button (6).
2. Press the "START" button (10).

Leave the engine to idle for the first 10 seconds. Then warm the engine up at low speed and under low load.

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



Starting in extreme cold

Certain preparations must be made to facilitate engine starting, and in some cases to make starting possible at all.

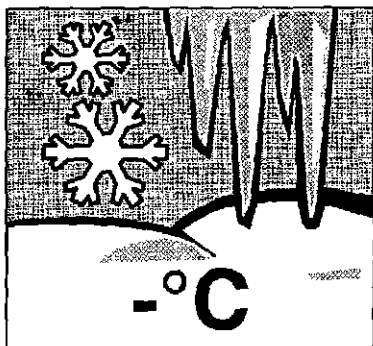
Use a winter grade fuel (of a well-known make) which has been approved for the relevant temperature. This reduces the risk of wax deposits in the fuel system. At extremely low temperatures, the use of a fuel heater is recommended.

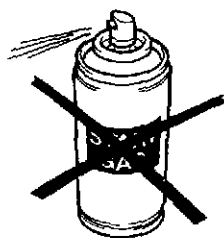
For fully acceptable lubrication, a synthetic engine oil of recommended viscosity for the relevant temperature should be used. Please refer to the "Maintenance, lubrication system" chapter: Synthetic lubricants are able to manage a wider temperature range than mineral-based lubricants.

Pre-heat the coolant with a separately installed electric engine heater. In extreme cases, a diesel-burning engine heater may be needed. Ask your Volvo Penta dealer for advice.

⚠ IMPORTANT! Make sure that the cooling system is filled with a glycol mixture. Please refer to the "Maintenance, cooling system" chapter:

The batteries should be in good condition. Cold weather reduces battery capacity. Increased battery capacity may be necessary.





Never use start spray

⚠ WARNING! Never use start spray or similar products as a starting aid. They may cause an explosion in the inlet manifold. Personal injury could also be caused.

Starting with auxiliary batteries

⚠ WARNING! Batteries (especially auxiliary batteries) contain hydrogen which is highly explosive in contact with air. A spark, which can be formed if the auxiliary batteries are wrongly connected, is enough to make a battery explode and cause damage.

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 lastly to a place which is **some distance away from the flat batteries**, e.g. at the mainswitch on the negative cable or the negative cable terminal on the starter motor.
3. Start the engine.

⚠ WARNING! Do not move the connections when you attempt to start the engine (risk of arcing), and do not stand and lean over one of the batteries.

4. Remove the jumper cables in the reverse order from installation.

⚠ WARNING! The ordinary cables to the standard batteries must not be loosened on any condition.

Operation

Correct operation 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 and operation at high engine speeds.

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

⚠ IMPORTANT! On engines which operate continuously, the lubrication oil level must be checked, at least every **24 hours**. Please refer to the "Maintenance, lubrication system" chapter.

Fault indication

If the EMS 2 system 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 is found in the "Diagnostic function" chapter.

Operation at low load

Avoid long-term operation at idle or at low load, since this can lead to increased oil consumption and eventually to oil leakage from the exhaust manifold, since oil will seep past the turbocharger seals and accompany the induction air into the inlet manifold at low turbo boost pressure.

One consequence of this is that carbon builds up on valves, piston crowns, exhaust ports and the exhaust turbine.

At low load, the combustion temperature is so low that full combustion of the fuel can not be ensured, which means that the lubrication oil can be diluted by diesel fuel, and the exhaust manifold will eventually leak oil.

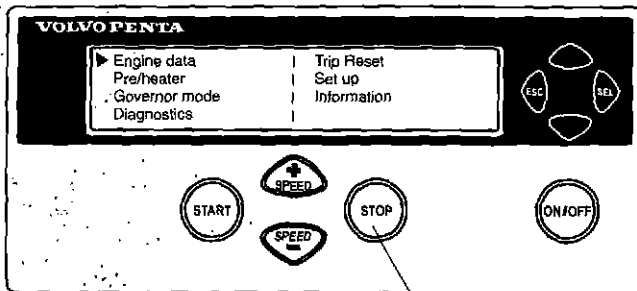
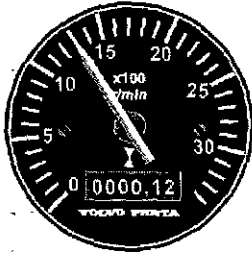
If the following points are done as a complement to normal maintenance, there will be no risk of malfunctions caused by operation at low load:

- Reduce operation at low load to a minimum. If the engine is regularly test run without load once a week, operation duration should be limited to 5 minutes.
- Run the engine at full load for about 4 hours once a year. Carbon deposits in the engine and exhaust pipe can then be burned off.

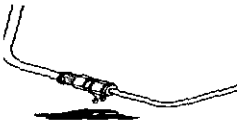
Stopping the engine

During longer breaks in operation, the engine must be warmed up at least once every fortnight. This prevents corrosion attack in the engine. If you expect the engine to be unused for two months or more, it must be laid up: Please refer to the chapter entitled "Laying up".

⚠ IMPORTANT! If there is a risk of frost, the coolant in the cooling system must have sufficient frost protection. Please refer to the "Maintenance, cooling system" chapter: A poorly charged battery can freeze and burst.



7



Before stopping

Let the engine run for a few minutes without loading before stopping it. This permits the temperature inside the engine to even up, "after-boiling" is avoided, at the same time as the turbocharger cools somewhat. This contributes to long service life without malfunctions.

Stop

- Disengage the clutch (if possible).
- Depress the "STOP" button (7).

After stopping

- Check the engine and engine bay for leakage.
- Turn off the main switches before any long stoppage.
- Carry out maintenance in accordance with the schedule.

Extra stop

The extra stop device (AUX STOP) is located on the right side of the engine above the control unit, please refer to "Component location".

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

Troubleshooting

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.

⚠ WARNING! Read through the safety advice for care and maintenance work in the chapter entitled "Safety-information" before you start work.

Symptoms and possible causes

* The diagnosis button lamp flashes.	Please refer to the "Diagnostic information" chapter
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
Too low coolant temperature	20
No, or poor charge	2, 23

- | | | |
|---|--|--|
| 1. Flat batteries | 10. Air in the fuel system | 16. Too low oil level |
| 2. Poor contact/open circuit in cables | 11. Water/contamination in fuel | 17. Coolant level too low |
| 3. Main switch turned off | 12. Faulty unit injector | 18. Air in the coolant system |
| 4. Main circuit breaker faulty | 13. Insufficient air supply to engine: | 19. Faulty circulation pump |
| 5. Faulty ignition lock | – blocked air filter | 20. Defective thermostat |
| 6. Faulty main relay | – air leakage between turbo-charger and engine inlet pipe. | 21. Blocked intercooler |
| 7. Faulty starter motor/solenoid | – fouled compressor section in turbocharger | 22. Too high oil level |
| 8. Lack of fuel: | – faulty turbocharger | 23. Alternator drive belt slips |
| – fuel taps closed | – poor engine bay ventilation | 24. Water entry into engine |
| – fuel tank empty/wrong tank connected | 14. Excessive coolant temperature | 25. High back pressure in exhaust system |
| 9. Blocked fuel filter/pre-filter (because of contamination, or paraffin fraction separation in fuel at low temperature). | 15. Too low coolant temperature | 26. Break in "Pot+" cable to pedal |

Diagnostic function

Diagnostic function

The diagnostic function monitors and checks that the EMS 2 system functions normally.

The diagnostic function has the following tasks:

- Discover and localize malfunctions.
- Notify that malfunctions have been discovered.
- Give advice in fault finding.

Malfunction message

If the diagnostic function discovers a malfunction in the EMS 2 system, this is announced by:

- the diagnostic lamp starts to flash
or
- information is shown in plain language on the instrument panel

(depending on the equipment used).

All fault codes are found in the fault code list, with information about the reason, reaction and measures to be taken. Please refer to the "Fault codes" chapter.

NOTE! The flashing codes noted only apply when a Volvo Penta CIU is used.

At the same time, the fault is stored in the control unit memory. As soon as the fault has been attended to and the ignition is turned off and on, the fault code lamp goes out. Both rectified (passive) and unrectified (active) faults are stored in the control unit and can be read by an authorized workshop.

Effect on engine

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

1. The diagnostic function has registered a minor malfunction which does not damage the engine:

Reaction: The engine is not affected.

2. The diagnostic function has registered a serious malfunction which will not immediately damage the engine (e.g. high coolant temperature).

Reaction:

GE engines: Engine is shut off.

VE engines: The engine torque is lowered until the relevant value is normalised.

3. The diagnostic function has registered a serious malfunction which prevents engine control:

Reaction:

GE engines: Engine speed is retained.

VE engines: Engine goes down to idle.

Operation (CIU)

If the system indicates that a fault code has been set:

1. Reduce engine speed to idling.
2. Press the button to acknowledge the message. Release the diagnostic button and make a note of the diagnostic trouble code (DTC) that is flashed out. Please refer to "Reading fault codes"

or

Read the fault code which is set directly on the instrument panel.

3. Look up the fault code in the fault code list and take the necessary measures.

NOTE! If the warning lamps and other instrumentation show normal function, at the same time as the controls function normally, the operator can choose to continue operation and remedy the malfunction at a later time. If the engine is shut off, some fault codes may disappear

Reading fault codes

Fault codes can either be read via:

- Plain language on the instrument panel via the CAN link.
- Diagnostic lamp on the instrument panel.
- VODIA tool. Please refer to the "VODIA User's Guide" for advice on use.

If the diagnostic button is depressed and then released, a fault code is flashed out.

The fault code consists of two groups of flashes, separated by a pause of two seconds. A fault code is obtained by counting the number of flashes in each group.

Example: * * pause * * * * = Fault code 2.4

The fault code is stored and can be read as long as the malfunction remains. You can find information about cause, reaction and actions in the fault code list.

Read as follows:

1. Press the diagnostic button.
2. Release the diagnostic button and make a note of the fault that is flashed out.
3. Repeat items 1-2. A new fault code is flashed out if more are stored. Repeat until the first fault code is repeated.

NOTE! When the first fault code is repeated, all fault codes have been read out.

Erasing fault codes

The fault code memory in the diagnostic function is re-set when system voltage to the engine is shut off.

NOTE! The system voltage must be completely cut off.

When system voltage is switched on again, the diagnostic function checks to see whether there are any faults in the EMS 2 system. If this is the case, new fault codes are set.

This means that:

1. Fault codes for malfunctions that have been rectified or disappeared are set as inactive (the inactive fault code can then be erased with the VODIA tool).
2. Fault codes for malfunctions which have not been attended to must be acknowledged every time the system voltage is switched on.

If the diagnostic button is pressed after all faults have been attended to and stored fault codes have been erased, code 1.1 ("No fault") will be flashed out. Please refer to the "Fault Code" chapter.

Maintenance schedule

General

Your Volvo Penta engine and its equipment are designed for high reliability and long life. It is built so as to have minimal environmental impact. If given preventive maintenance, according to the maintenance schedule, and if Volvo Penta original spares are used, these properties are retained and unnecessary malfunctions can be avoided.

MAINTENANCE SCHEDULE

⚠ WARNING! Before you start to do any maintenance work, read the "Maintenance" chapter carefully. This contains instructions for doing work in a safe and correct manner.

⚠ IMPORTANT! When both operation and calendar time are specified, do the maintenance job at the interval which is reached first. Maintenance points marked must be done by an authorized Volvo Penta workshop

Daily, before first start

- Engine and engine bay, general inspection page 24
- Oil level, checking and filling page 28
- Coolant, checking level page 30

Every 50 hours / at least every 12 months.

- Primary fuel filter. Drain water/contamination page 37

After the first 150 hours

- Engine oil, changing ¹⁾ page 27

¹⁾ **NOTE!** An oil change is recommended, change the oil to a grade recommended by Volvo Penta.

Every 50-600 hours / at least every 12 months.

- Engine oil, changing ¹⁾ page 27
- Oil filter/By-pass filter, change ²⁾ page 29
- Primary fuel filter, change page 37
- Fuel filter, changing page 37

¹⁾ Oil change intervals vary, depending on oil grade and sulfur content of the fuel. page 26.

²⁾ Change the filters during each oil change.

Every 400 hours / at least every 12 months.

- Fuel tank (sludge trap), drain not shown
- Drive belts, inspection page 25
- Coolant (corrosion protection mixture), top up ¹⁾ page 30
- Batteries, checking the electrolyte level page 40

¹⁾ Top up with ½ liter (1 US Pint) corrosion protection fluid. **IMPORTANT!** This applies **only** if the cooling-system is filled with corrosion protection mixture (not glycol mixture).

Every 800 hours / at least every 12 months.

- Charge air pipe, leakage check page 24
- Primary fuel filter, check not shown

Every 1000 hours / at least every 6 months.

- Coolant filter, changing ¹⁾ page 34
- ¹⁾ Not at same time as coolant change.

Every 2000 hours

- Turbocharger, check not shown
- Valve clearance, inspection/adjustment not shown
- Coolant (corrosion protection mixture), change page 32-33

Every 12 months

- EMS 2-system. Inspection with diagnostic tool (VODIA) please refer to the "VODIA User's Guide"
- Engine, general inspection page 23
- Engine, cleaning/painting not shown
- Air filter, tank breather, change. not shown
- Inspection, air compressor, change. not shown

Every 24 months

- Air filter inserts, check/change page 26

Every 36 months or every 8000 hours.

- Drive belts, change page 25

Every 48 months or every 10000 hours.

- Cooling system, inspection/cleaning page 31, 33, 34
- Coolant (glycol mixture), change page 32, 33

Newly renovated engine:**After the first 250 hours**

- Valve clearance, adjustment not shown

Maintenance

This chapter describes how the specified maintenance points should be done. Read them carefully before starting work. The times when maintenance points need to be attended to are given in the previous chapter: Maintenance schedule

⚠ WARNING! Read through the safety advice for care and maintenance work in the "Safety information" chapter before starting work.

⚠ WARNING! Care and maintenance work should be done with the engine stopped unless otherwise specified. Make it impossible to start the engine by removing the ignition key and cutting the system voltage with the main switch. Working with, or going close to a running engine is a safety risk. Watch out for rotating components and hot surfaces.

Engine, general

General inspection

Make it a habit to give the engine and engine bay a visual check **before the engine is started and after operation, when the engine has been 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 screws, 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! Deposits of fuel, oils and grease on the engine or in the engine bay are a fire hazard and must be removed as soon as they are discovered.

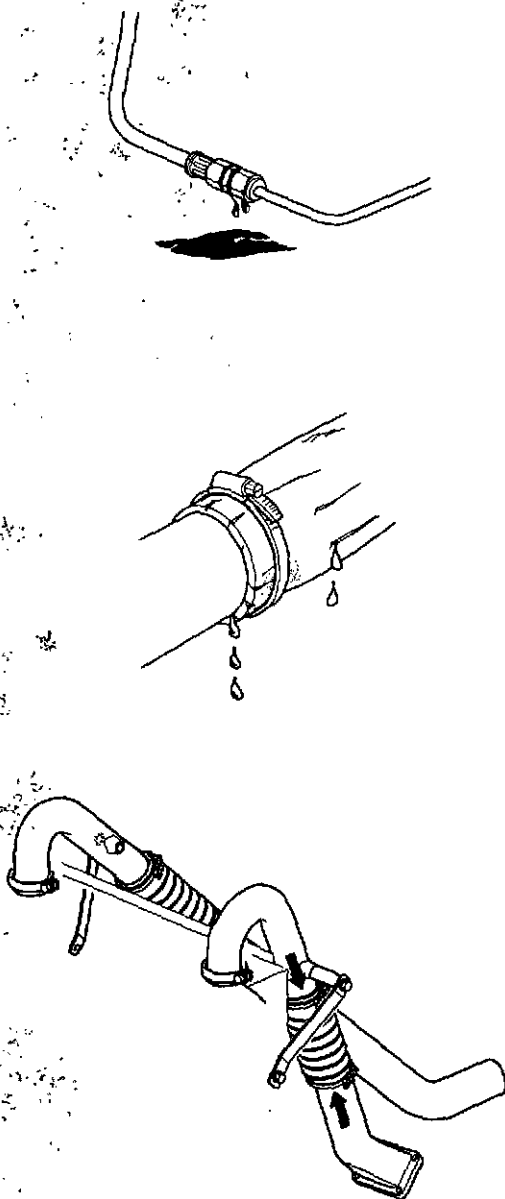
⚠ IMPORTANT! If you discover a leakage of oil, fuel or coolant, investigate the cause and fix the fault before you start the engine.

⚠ IMPORTANT! Remember the following when washing with a high pressure washer: Never aim the water jet at radiators, intercoolers, seals, rubber hoses or electrical components.

Charge air pipe, leakage check

Check the charge air pipes, hose connections and the condition of the clamps for cracks or other damage. Change as necessary.

⚠ IMPORTANT! Torque the clamps to $9 \pm 2 \text{ Nm}$ ($6.6 \pm 1.5 \text{ lbf-ft}$).



Drive belt/Alternator belt, inspection

Inspection should be done after operation, when the belts are hot.

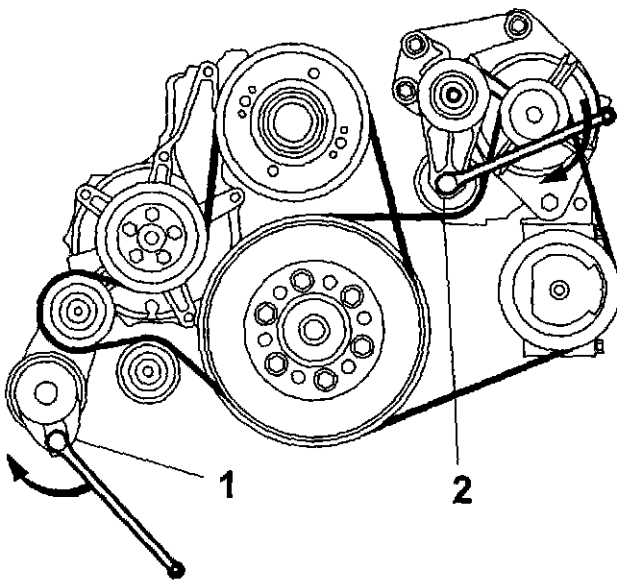
It should be possible to press the alternator belts and drive belts down about 3-4 mm (0,118-0,157 ") between the pulleys.

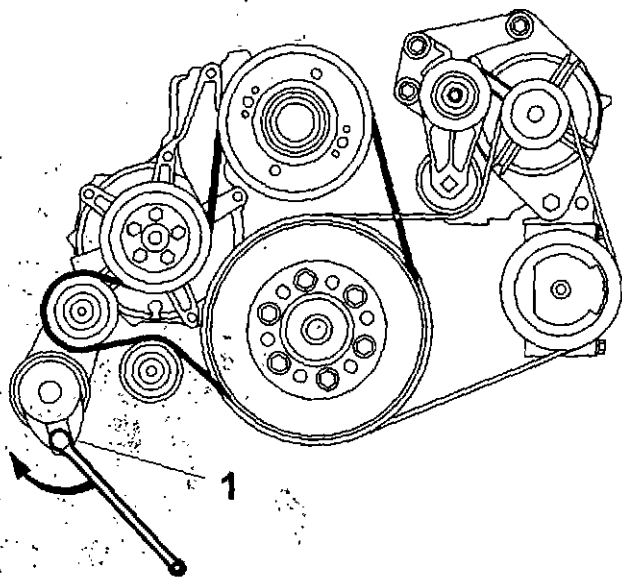
The alternator belts and drive belts have automatic belt tensioners and do not need to be adjusted. Check the condition of the drive belts. Change as necessary, please refer to "Alternator belt, change" and "Drive belt, change".

Alternator belts, changing

⚠ IMPORTANT! Always change a drive belt which appears worn or cracked.

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 right-hand belt tensioner (1). Lift the wrench up and lift the water pump drive belt off.
5. Insert a 1/2" square wrench in the left-hand belt tensioner (2). Press the wrench down and remove the alternator belts.
6. Check that the pulleys are clean and undamaged.
7. Press the 1/2" wrench in the left-hand belt tensioner (2) down and install the new alternator drive belt.
8. Lift the 1/2" wrench in the right-hand 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.





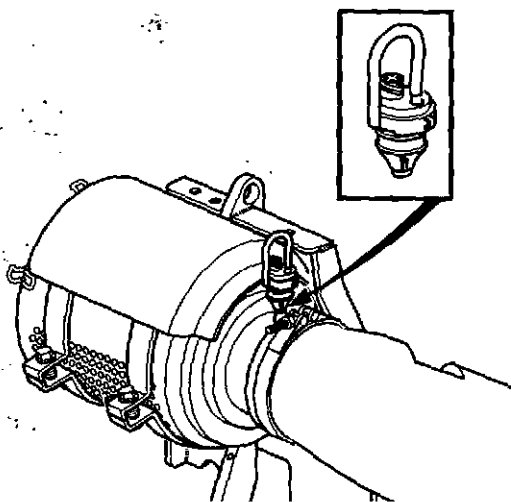
Drive belt, changing

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 right-hand 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.

Air filter Check/change.

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.



NOTE! Scrap the old filter. No cleaning or re-use is permissible.

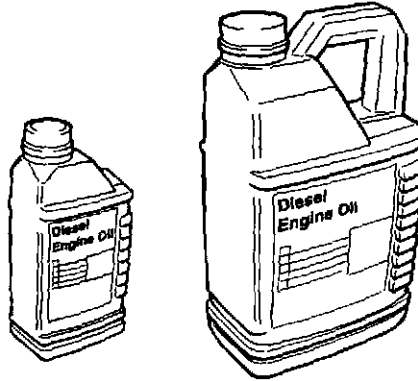
⚠ IMPORTANT! In continuous operation, the filter should be checked every 8 hours.

Driving in extremely contaminated environments—such as coal mines or rock crushers requires special air filters.

Lubrication system

Oil change intervals can vary from **50 to 600 hours**, depending on the grade of lubrication oil and the sulfur content of the fuel. **Note that oil change intervals must never exceed a period of 12 months.**

If you want longer oil change intervals than given in the table below, the condition of the oil must be checked by the oil manufacturers through regular oil testing.



Oil grade	Sulfur content in fuel, by weight		
	up to 0.5 %	0,5 - 1,0 %	more than 1.0 % 1)
	Oil change interval: Reached first in operation:		
VDS-3, VDS-2 and ACEA E3 2)	600 hours or 12 months.	300 hours or 12 months.	150 hours or 12 months.
VDS and ACEA E3 2)	400 hours or 12 months.	200 hours or 12 months.	100 hours or 12 months. 3)
ACEA: E4, E3, E2 API: CE, CF, CF-4, CG-4, CH-4	200 hours or 12 months.	100 hours or 12 months.	50 hours or 12 months. 3)

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

2) Lubrication oil must comply with both requirements. API: CG-4 or CH-4 can be approved in markets outside Europe (instead of ACEA E3).

3) Use oil with TBN 14-20.

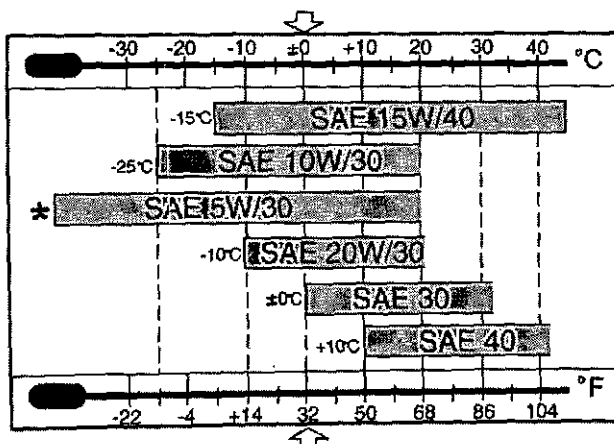
NOTE! Mineral based oil, either fully or semi-synthetic, can be used on condition that it complies with the quality requirements above.

VDS = Volvo Drain Specification

ACEA = Association des Constructeurs Européenne d'Automobiles

API = American Petroleum Institute

TBN = Total Base Number



Viscosity

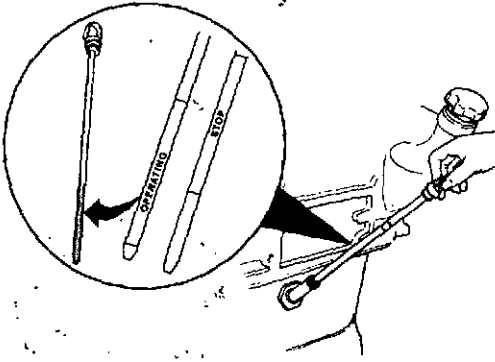
Select the viscosity from the adjacent table, for the appropriate continuous ambient air temperature.

* Refers to synthetic or semi-synthetic oils.

Oil change volume

Please refer to the "Technical Data" chapter.

Oil level, checking and filling



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

NOTE! The oil level can be read both when the engine is stationary (the STOP side of the dipstick) and with the engine running (the OPERATING side of the dipstick).

Top up with oil via the filler opening on the left side of the engine.

Check that the correct level has been achieved. If the engine is stationary, wait for a few minutes to allow the oil to run down into the oil pan.

⚠ IMPORTANT! Do not fill up above the maximum oil level. Only use a recommended grade of oil. (please refer to previous page).

NOTE! The oil level sensor only measures the oil level at the time when the ignition is turned on. In other words, not continually during operation.

Engine oil, changing

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

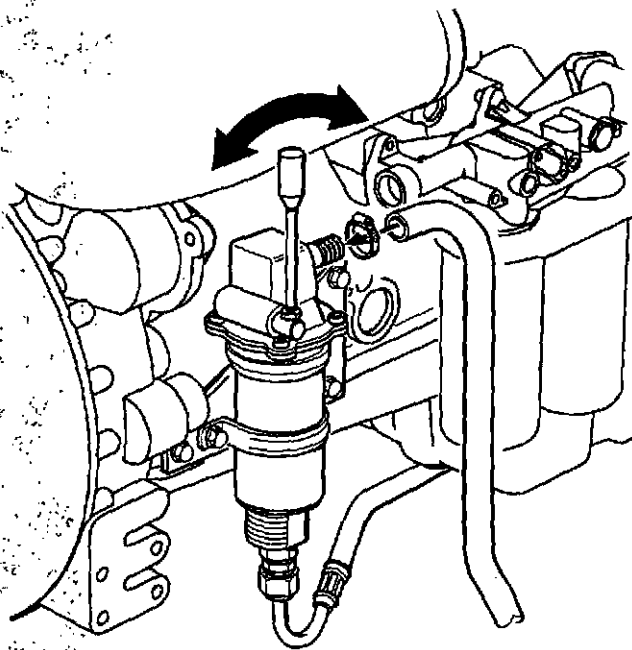
NOTE! Topping up must be done when the engine is warm.

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 engine oil).

Collect all the old oil and old filters, and hand them to a re-cycling station for destruction.

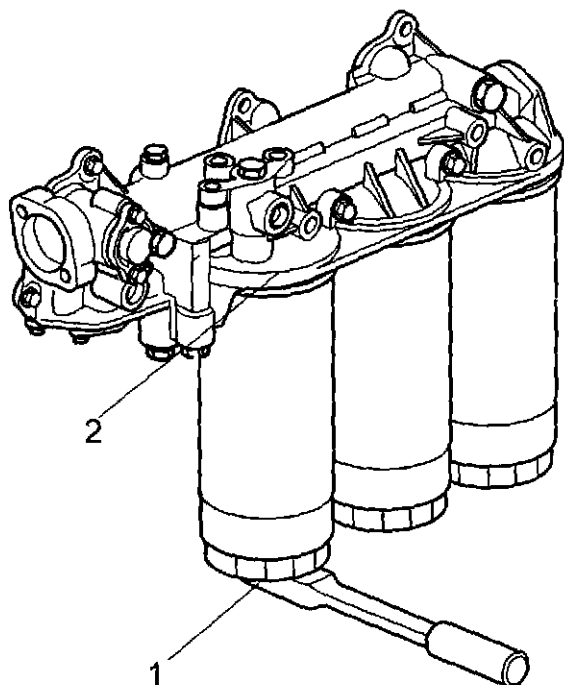
3. Remove the drain hose (or install the bottom drain plug).
4. Fill up with engine oil.

Change volume, please refer to the "Technical Data" chapter.



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 remover (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 two full-flow filters (on the right of the illustration) $\frac{1}{2}$ - $\frac{3}{4}$ turns after they just touch. Tighten the bypass filter $\frac{3}{4}$ - 1 turn after it just touches.
6. Top up with engine oil, start the engine and let it run for 20-30 seconds.
7. Shut the engine off, check the oil level and top up engine oil as necessary.
8. Check sealing round the oil filters.

Cooling system

The cooling system shall always be filled with coolant which protects the engine from internal corrosion and from bursting. **Never use water by itself.**

The corrosion protection additives become less effective as time passes, which means that the coolant must be changed. The following change intervals apply, on condition that Volvo Penta's recommendations are followed:

Coolant	Change interval
Volvo Penta coolant (glycol mixture) with coolant filter	Every 4 years or at least every 10.000 hours.
Volvo Penta coolant (glycol mixture) without coolant filter	Every 2 years or at least every 5000 hours.
Volvo Penta anti-corrosion agent	Every year

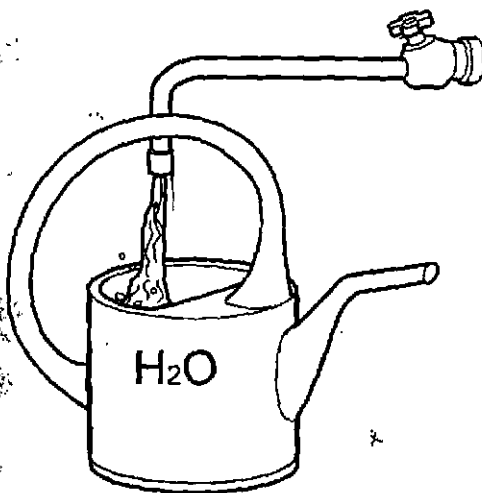
⚠ IMPORTANT! The cooling system should be flushed when the coolant is changed. Please refer to the "Cooling system" heading. Flushing". The coolant filter should not be changed at the same time as the coolant, it should be changed six months after the first coolant change and then every 6 months. Please refer to "Coolant filter". Replacement".

Coolant. General

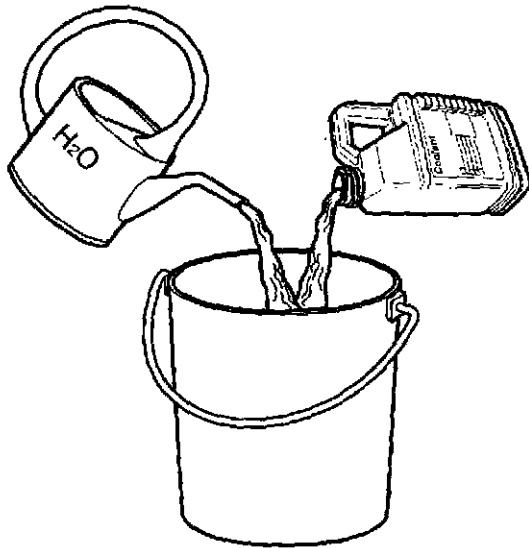
⚠ IMPORTANT! The following recommendations must be followed to avoid blockage and/or frost and corrosion damage in the engine and cooling system:

Water quality

Always use fresh water which complies with the requirements in ASTM D4985. If this requirement is not complied with, the coolant system will be obstructed, with consequent lower cooling capacity. If the water can not be purified to comply with this demand, distilled water or ready-mixed coolant **must** be used.



Total solid particles	< 340 ppm
Total hardness:	< 9.5° dH
Chloride	< 40 ppm
Sulfate	< 100 ppm
pH value	5.5-9
Silica	< 20 mg SiO ₂ /l
Iron	< 0.10 ppm
Manganese	< 0.05 ppm
Conductivity	< 500 uS/cm
Organic content, COD _{Mn}	< 15mg kMnO ₄ /l



If there is a risk of frost

Use a mixture of 40% Volvo Penta anti-freeze fluid (glycol) and 60% water (to ASTM D4985). This mixture provides protection against freezing down to about -25°C and should be used all year round.

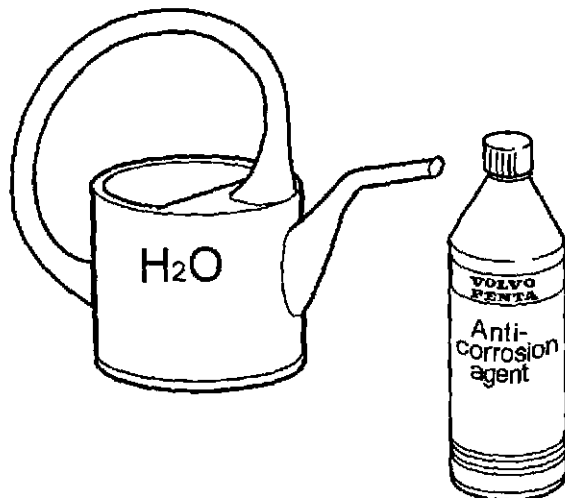
⚠ IMPORTANT! Even if the temperature never falls so far down as -25°C the above mixture should be used to provide full corrosion protection.

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

⚠ WARNING! Glycol is poisonous (dangerous to drink).

⚠ IMPORTANT! Do not use alcohol in the cooling system.

* Max. freezing point reduction is -56°C at 60% glycol in the coolant.



No risk of frost

When there never is a risk of frost, water (to ASTM D4985) with the addition of Volvo Penta anti-corrosion agent can be used as coolant.

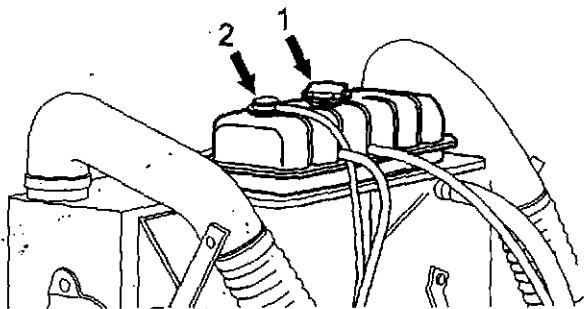
We recommend that a mixture of Volvo Penta glycol and water should be used all year round, irrespective of the climate.

Mixing ratio 1:30. Warm the engine up after filling, to give the additive the best effect.

If operation time exceeds 500 hours per annum, the corrosion protection of the coolant must be topped up with 1/2 liter (1 US Pint) of anti-corrosion additive every 500 hours of operation.

⚠ WARNING! Anti-corrosion additive is poisonous (dangerous to drink).

⚠ IMPORTANT! Never mix anti-corrosion additive with anti-freeze (glycol). Foaming can occur, which severely affects cooling ability.



Coolant, inspection

⚠ WARNING! Do not open the filler cap (1) when the engine is warm, except in emergencies. Steam or hot fluid could spray out.

NOTE! Only open filler cap (1). Do not open filler cap (2).

The coolant level must be higher than the MIN marking. Check the coolant level daily before starting. Top up with coolant as necessary, please refer to Coolant, filling.

Cooling system, filling

⚠ WARNING! Do not open the filler cap (1) when the engine is warm, except in emergencies. Steam or hot fluid could spray out.

NOTE! Do not open filler cap (2).

Filling a completely empty system

1. Open filler cap (1).
2. Check that all drain points are closed.

NOTE! Only use the coolant recommended by Volvo Penta.

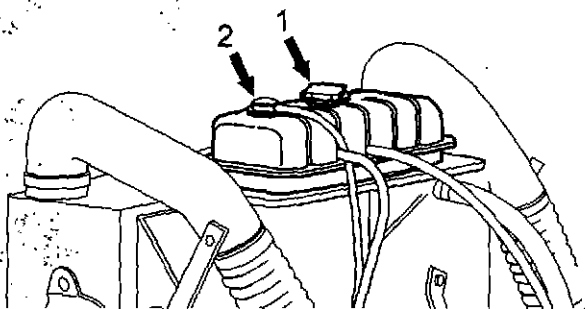
3. Mix the correct amount of coolant in advance, to ensure that the cooling system is completely filled.
4. Fill up with coolant, so that the level ends up between the MIN and MAX markings. **Do not start the engine until the system is vented and completely filled.**

Filling should be done with the engine stationary. Fill up slowly, to allow the air to flow out.

5. Start the engine when the cooling system has been completely filled and vented. Open any venting taps some while after starting, to allow shut-in air to escape.

If a heating unit is connected to the engine cooling system, the heat control valve should be opened and the installation vented during filling.

6. Stop the engine after about an hour and check the coolant level. Top up as necessary.

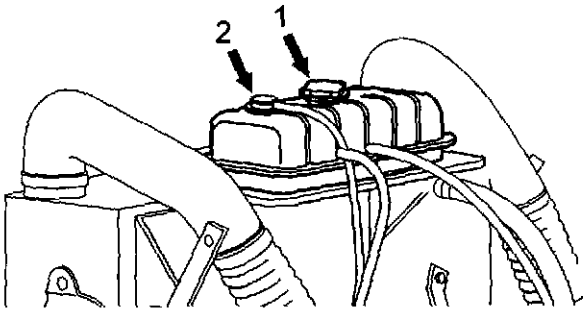


Coolant. Draining.

The engine must be stopped before draining, and the filler cap unscrewed.

⚠ WARNING! Do not open the filler cap (1) when the engine is warm, except in emergencies. Steam or hot fluid could spray out.

NOTE! Do not open filler cap (2). On engines which are to be laid up or put in storage, the engine cooling system should not be drained. The coolant contains corrosion-inhibiting additives.

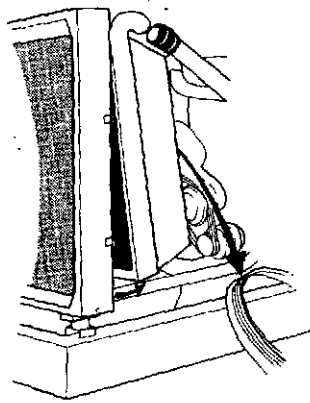


1. Remove the filler cap (1).
2. Open all drain points. Drain the coolant from the radiator and engine block, using the drain hose. The drain nipples are situated under the radiator on the right side of the engine block.
3. Check that all coolant drains out. Deposits may be found inside the drain plug/tap, and need to be cleared away. There is otherwise a risk that coolant could remain and cause frost damage. Check whether the installation has any further taps or plugs at the lowest points of the cooling water pipes.
4. Shut any taps and check that the spring-loaded covers on the nipples close completely. Install the rubber plugs.

Cooling system Flushing

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

1. Drain the coolant, as in the description on the previous paragraph.
2. Insert a hose into the filler hole in the expansion tank, and flush with fresh water until the water which runs out is completely clear.
3. Close the drain taps and plugs. Fill up with fresh coolant, as in the instructions in the chapter entitled "Coolant. Checking and filling".



Intercooler. External cleaning

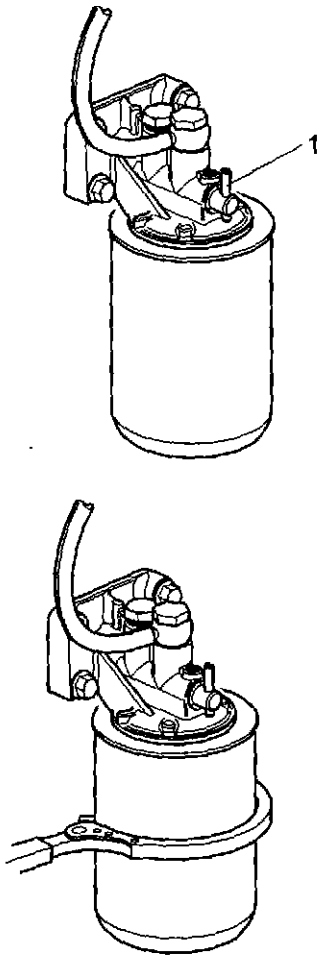
Remove guards as necessary, to access the radiator.

Clean with water and a mild detergent. Use a soft brush. Be careful to ensure that the radiator matrix is not damaged. Re-install the components.

⚠ IMPORTANT! Do not use a high pressure power washer.

Coolant filter, changing

1. Turn the tap (1) 90° to stop the flow through the coolant filter.
2. Remove the coolant filter with a suitable extractor. Make sure that no residue from the old seal remains in the housing.
3. Put a thin layer of engine oil on the new coolant filter seal. Screw the coolant filter on by hand until the seal comes into contact with the mating surface of the filter bracket. Then tighten the coolant filter a further 1/2 turn.
4. Turn the tap (1) 90° to release the flow through the coolant filter again.
5. Start the engine and do a leakage check.
6. Switch the engine off and check the coolant level. Please refer to "Coolant level, check".



Fuel system

Only use the grades of fuel recommended in the fuel specification below. Always observe the greatest cleanliness during re-fueling and work on the fuel system.

All work on the injection system of the engine must be done by an authorized workshop.

⚠ WARNING! Fire hazard. Work on the fuel system must be done with the engine cold. Fuel spills on hot surfaces or electrical components can cause fires. Store fuel-soaked rags in a fire-proof manner.



Fuel specification

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

EN590 (with nationally adapted environmental and cold-requirements)

ASTM D 975 No 1 - D and 2 - D

JIS KK 2204

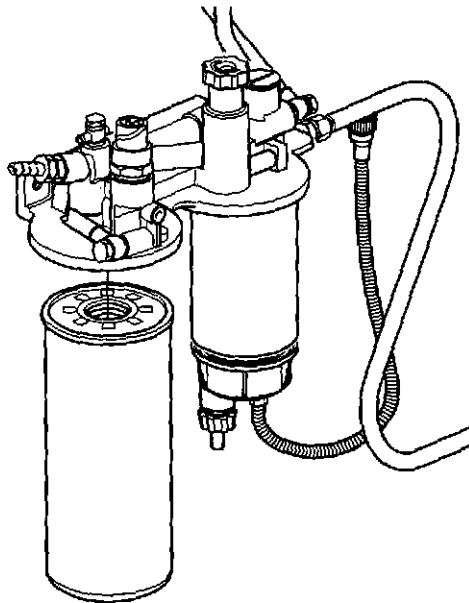
Sulfur content: Complying with legal requirements in each country. If the sulfur content exceeds 0.5 percent by weight, the **oil change intervals** must be changed. Please refer to the "Lubrication system" heading.

Extremely low sulfur content fuel (urban diesel in Sweden and city diesel in Finland) can cause a loss of up to 5% of power and an increase in fuel consumption of about 2-3 %.

Fuel filters, replacing

NOTE! 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.

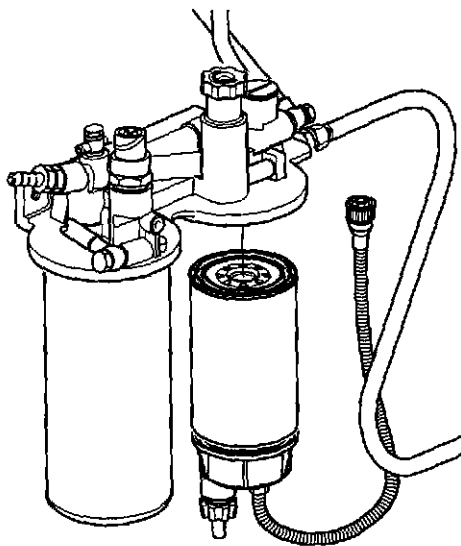
⚠ WARNING! The fuel filter must be changed when the engine is cold, to avoid the risk of fire due to spilled fuel on hot surfaces.



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, Venting".

NOTE! If a water trap is installed: change the filter in it at the same time as the fuel filter, and clean the water trap in the plastic bowl under the filter with a soft rag.

Primary fuel filter, change

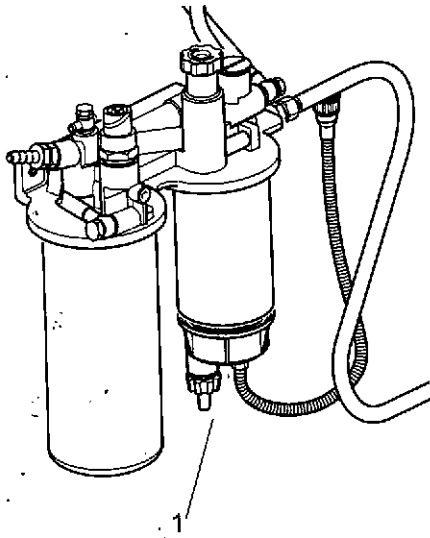


1. Undo the cable from the water trap sensor.
2. Remove the water trap filter from the filter bracket. Collect any spilled fuel in a collection vessel.
3. Remove the lower part of the water trap from the filter.
4. Clean the lower part of the water trap with a soft rag. Check that the drain hole in the 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 "Fuel System, Venting".

Draining condensate, fuel system

NOTE! Put a collection vessel under the fuel filter to collect the condensate and fuel.

1. Open the drain nipple (1) in the base of the primary fuel filter.
2. Tighten the drain tap (1) when fuel without water starts to run out.



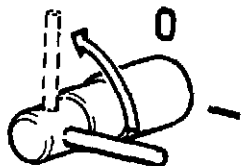
Venting the fuel system

The system does not need to be vented unless it has been run completely dry. Venting is then done with the hand pump on the fuel filter bracket.

Electrical system

The engine is equipped with a 2-pole electrical system and an alternator. System voltage is 24V.

⚠ WARNING! Before any work is done on the electrical system, the engine must be stopped and the current cut by switching off the main switch(es). All connections to equipment such as battery chargers or other auxiliary equipment must be broken.



Main switch

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

⚠ IMPORTANT! Never disconnect the current with the main switch(es) when the engine is running.

Circuit breaker

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, please refer to Component Location.

Note. 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

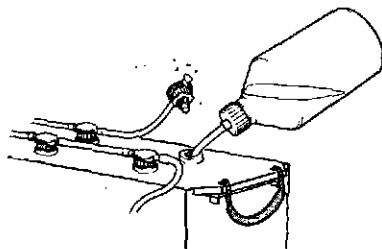
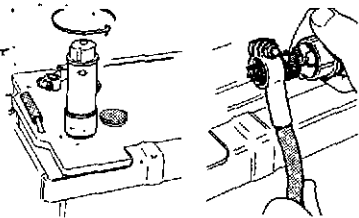
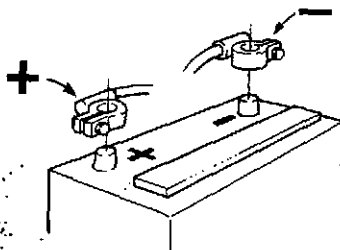
Check that electrical connections are dry, free from oxide and that they are securely tightened. Spray these connections as necessary with water-repellent spray (Volvo Penta universal oil).

Battery. Maintenance

⚠ WARNING! Fire and explosion hazard. Batteries must never be exposed to open flames or sparks.

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

⚠ WARNING! Battery electrolyte is highly corrosive. Always protect your eyes, skin and clothes when handling batteries. Always use protective goggles and gloves. If acid comes into contact with your skin, wash at once with soap and a lot of water. If you get battery acid in your eyes, flush your eyes with a lot of water, and get medical assistance at once.



Connection and disconnection

When you connect batteries, first connect the + cable (red) to the + pole on the battery. Then connect the - cable (black) to the - pole on the battery

When you disconnect batteries, connect the - cable (black) first, then the + cable (red).

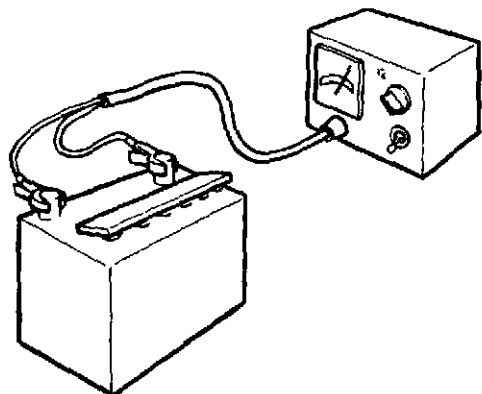
Cleaning

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

Filling

The electrolyte level should be 5-10 mm above the cell plates in the battery. Fill up with **distilled water** if necessary: After filling, the battery should be charged for at least 30 minutes by running the engine at idle. **NOTE!** Some maintenance-free batteries have special instructions, which must be observed.

Batteries, charging



⚠ WARNING! Explosion risk! Hydrogen is given off when batteries are charged. This forms an explosive mixture with air. A short circuit, open flame or spark could cause a violent explosion. Ventilate well.

⚠ WARNING! Battery electrolyte is highly corrosive. Protect your eyes, skin and clothes. Always use protective goggles and gloves. If acid comes into contact with your skin, wash at once with soap and a lot of water. If you get battery acid in your eyes, flush at once with a lot of cold water, and get medical assistance at once.

Charge batteries if they have become discharged. If the engine is not used for a longer period of time, the batteries should be fully charged, then possibly trickle charged (please refer to the battery manufacturer's recommendations). Batteries are damaged by being left discharged, and can also freeze and burst easier in cold weather.

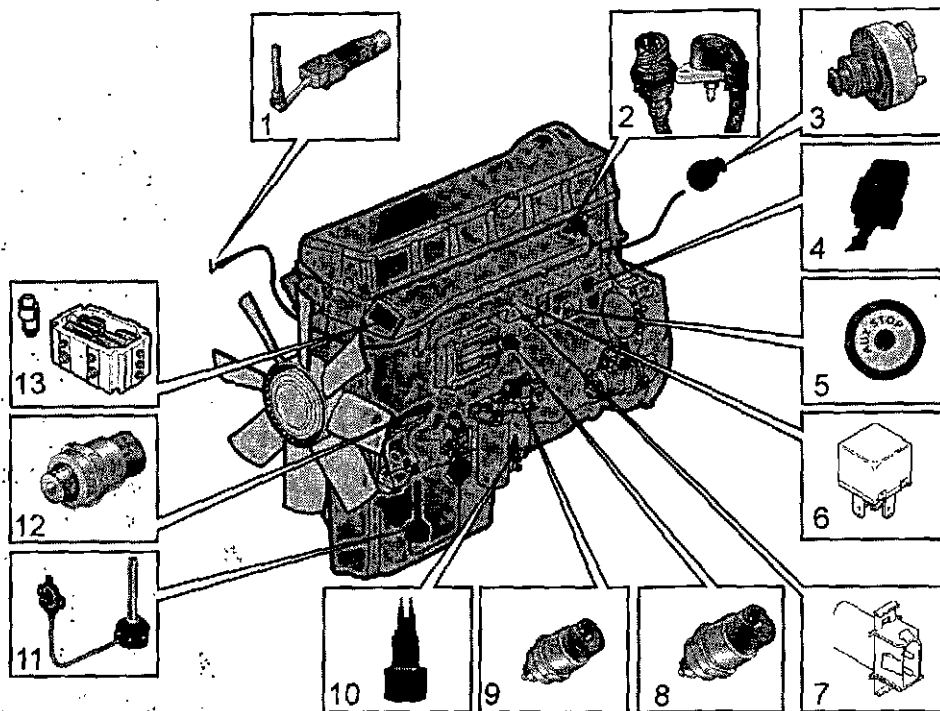
⚠ IMPORTANT! Observe the instruction manual for the battery charger carefully. To avoid the risk of electrochemical corrosion when an external charger is connected, the battery cables should be removed from the batteries before the charger is connected.

During charging, unscrew the cell plugs but leave them in the plug holes. Ventilate well, especially if the batteries are charged in an enclosed space.

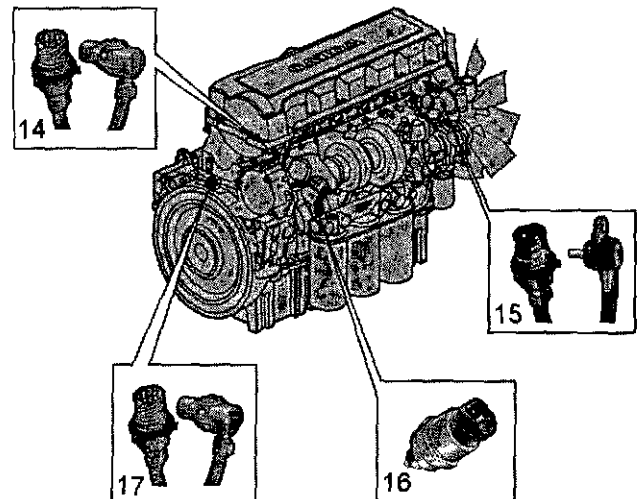
⚠ WARNING! Always cut the charge current **before** the battery charger clamps are undone. Never confuse the positive (+) and negative (-) poles on the batteries. This can cause serious arcing and can cause an explosion.

For so-called **quick charging**, there are special rules. Quick charging can shorten battery life, and should therefore be avoided.

Component location



1. Coolant level sensor
2. Charge pressure / charge temperature sensor
3. Air filter pressure and temperature sensor
4. Main circuit breaker 10 A
5. Extra stop
6. Main relay
7. Diagnostic connector (2-pin connector)
8. Oil pressure sensor
9. Fuel pressure sensor
10. Sensor, water in fuel
11. Oil level and oil temperature sensor (installed inside the oil pan)
12. Crankcase pressure sensor
13. Air pre-heater with pre-heating relay
14. Camshaft position sensor
15. Coolant temperature sensor
16. Piston cooling pressure sensor
17. Flywheel position and speed sensor

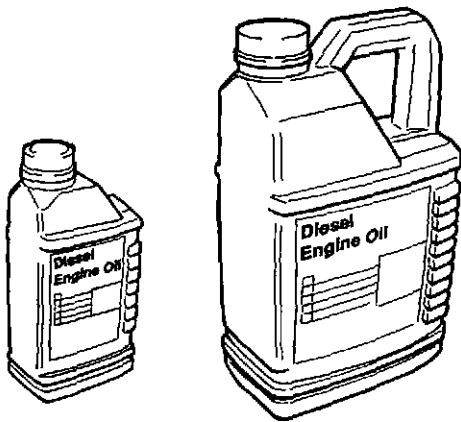


Laying up

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

Before the engine is taken out of service for a long period of time, an authorized Volvo Penta workshop should check it over. Have any faults and deficiencies attended to, so that the equipment is in order, ready for the next start.

- ⚠ **WARNING!** Before you start to do any maintenance work, read the "Maintenance" chapter carefully. This contains instructions for doing work in a safe and correct manner.
- ⚠ **WARNING!** Some conservation oils are flammable. Some are also dangerous to breathe. Ensure good ventilation. Use a protective mask for spraying.
- ⚠ **IMPORTANT!** Remember the following when washing with a high pressure washer: Never aim the water jet at seals, rubber hoses or electrical components.



Conservation

- **For up to 8 month's stoppage:**
Change the oil and oil filter on the engine, then warm it up afterwards.
- **More than 8 month's stoppage:**
Conserve the lubrication and fuel systems with conservation oil. **Please refer to the instruction on the next page.**
- Check that the coolant offers sufficient frost protection. 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 laid up. **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.
- Spray the components of the electrical system with water-repellent spray.
- Check and rust-proof any control cables.
- Put a note on the engine with the date, type of conservation and the conservation oil used.
- Cover over the air filter, exhaust pipe and engine if necessary.

Removing conservation preparations

- Remove any covers from the engine, air filter and exhaust pipe.
- Put the correct grade of oil into the engine, if necessary. Install a new oil filter if the filter was not changed during conservation.
- Install new fuel filters and vent the fuel system.
- Check the drive belt(s).
- Check the condition of all rubber hoses, and re-tighten 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 loading.
- Check that no oil, fuel or coolant leakage occurs.

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.
- Vent the fuel system.
- Start the engine and run at a fast idle until about 2 liters (1 US quart) of the fluid in the jerrican have been used. Stop the engine and connect the ordinary fuel pipes.
- Drain the engine's conservation oil.
- Follow the other instructions on the previous page.

* Conservation oils are sold by oil companies.

Fault codes

⚠ WARNING! Read through the safety advice for care and maintenance work in the "Safety information" chapter before you start work.

Code 1.1 No faults

There are no active faults.

Code 2.1 Water in fuel

Reason:

- Water in fuel.

Reaction:

- Warning lamp lights up.

Action:

- Empty the primary fuel filter.

Code 2.2 Coolant level

Reason:

- Low coolant level

Reaction:

- Warning lamp lights up.
- VE engines: Engine control module reduces engine power (unless the protection has been shut off with the diagnostic tool VODIA).
- GE engines: Engine is shut off (unless the protection has been shut off with the diagnostic tool VODIA).

Action:

- Check the coolant level.
- Check coolant level monitor function.

Code 2.3 Coolant level sensor

Reason:

- Short circuit to positive (+).
- Fault in sensor.

Reaction:

- None.

Action:

- Check that the coolant level sensor cable is not damaged.
- Check coolant level sensor function.
- Check contact pressure in sockets 23 and 10 in the upper cable connector (A) on the engine management module.

Code 2.4 Engine speed sensor, flywheel

Reason:

- No signal
- Abnormal frequency.
- "Intermittent" signal from the sensor.
- Fault in sensor.

Reaction:

- Engine is very difficult to start and runs roughly when it starts.

Action:

- Check that the sensor connector is correctly installed.
- Check that the engine speed sensor cable is not damaged.
- Check that the engine speed sensor is correctly installed in the flywheel housing.
- Check engine speed sensor function.
- Check contact pressure in sockets 37 and 38 in the upper cable connector (A) on the engine management module.

Code 2.5 Speed sensor, camshaft gear

Reason:

- No signal
- Abnormal frequency.
- Fault in sensor.

Reaction:

- Engine takes longer to start than normal. Engine runs normally when is running.

Action:

- Check that the engine speed sensor connector is correctly installed.
- Check that the engine speed sensor cable is not damaged.
- Check that the engine speed sensor is correctly installed in the upper timing gear cover.
- Check engine speed sensor function.
- Check contact pressure in sockets 45 and 46 in the upper cable connector (A) on the engine management module.

Code 2.6 Engine speed

Reason:

- Engine speed too high

Reaction:

- None.

Action:

- Once the engine has stopped, search for the reason for high engine speed.

Code 2.8 Engine speed potentiometer connected to the CIU

Reason:

- Short circuit to positive (+) or earth (ground) (-).
- Faulty potentiometer

Reaction:

- VE engines: Engine goes to idle.
GE engines: Engine speed is maintained.
- If the accelerator is first released and then depressed, the engine can be emergency operated by means of the idling switch.

Action:

- Check that the potentiometer is correctly connected.
- Check that the potentiometer cable is not damaged.
- Check potentiometer function.

Code 2.9 Indicator for water in fuel

Reason:

- Short circuit.
- Open circuit.
- Fault in indicator.

Reaction:

- None.

Action:

- Check the indicator cables for breaks and short circuits.
- Check indicator function. Change indicator as necessary.

Code 3.1 Oil pressure sensor

Reason:

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- None.

Action:

- Check that the oil pressure sensor cable is not damaged.
- Check that the oil pressure sensor is correctly connected.
- Check contact pressure in socket 11 in the lower cable connector (B) on the engine management module.

Code 3.2 Charge air temperature sensor**Reason:**

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- None.

Action:

- Check that the charge air temperature sensor connector is correctly installed.
- Check that the charge air temperature sensor cable is not damaged.
- Check that the charge air temperature sensor is correctly installed.
- Check charge air temperature sensor function.
- Check contact pressure in socket 47 in the upper cable connector (A) on the engine management module.

Code 3.3 Coolant temperature sensor**Reason:**

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- Pre-heating is also activated when the engine is hot.

Action:

- Check that the coolant temperature sensor connector is correctly installed.
- Check that the coolant temperature sensor cable is not damaged.
- Check that the coolant temperature sensor is correctly installed.
- Check coolant temperature sensor function.

Code 3.4 Charge pressure sensor**Reason:**

- Short circuit to positive (+) or earth (ground) (-).
- Avbrott.

Reaction:

- Engine smokes more than normally during acceleration/load increase.

Action:

- Check that the charge pressure sensor connector is correctly installed.
- Check that the charge pressure sensor cable is not damaged.
- Check that the charge pressure sensor is correctly installed.
- Check charge pressure sensor function.
- Check contact pressure in socket 22 in the upper cable connector (A) on the engine management module.

Code 3.5 Charge air pressure**Reason:**

- Charge pressure too high

Reaction:

- VE engines: Engine control module reduces engine power (unless the protection has been shut off with the diagnostic tool VODIA).

GE engines: Engine is shut off (unless the protection has been shut off with the diagnostic tool VODIA).

Action:

- Check turbocharger compressor function.
- Check charge pressure sensor function.
- Check fuel volume/unit injector.

Code 3.6 Fuel pressure sensor**Reason:**

- Short circuit to positive (+) or earth (ground) (-).
- Open circuit.

Reaction:

- None.

Action:

- Check that the fuel pressure sensor connector is correctly installed.
- Check that the fuel pressure sensor cable is not damaged.
- Check that the fuel pressure sensor cable is correctly installed.
- Check fuel pressure sensor function.
- Check contact pressure in socket 16 in the lower cable connector (B) on the engine management module.

Code 6.2 Charge air temperature

Reason:

- Charge air temperature is too high.

Reaction:

- VE engines: Engine control module reduces engine power (unless the protection has been shut off with the diagnostic tool VODIA).
- GE engines: Engine is shut off (unless the protection has been shut off with the diagnostic tool VODIA).

Action:

- Check the coolant level.
- Check the intercooler (cleanliness).
- Check charge air temperature sensor function.
- Check thermostat function.

Code 6.3 Starter output, EMS 2

Reason:

- Short circuited to (+) or negative (-).
- Activated for too long time.

Reaction:

- Engine can not be started.
- The engine starts as soon as the ignition is switched on.

Action:

- Check that the starter switch connections are not damaged.
- Check that the ignition switch cable is not damaged.

Code 6.4 Data link (CAN), CIU

Reason:

- Faulty data link (CAN), CIU.

Reaction:

- Instruments and warning lamps stop working.

Action:

- Check that the 8-pin connector is not damaged.
- Check that the cables between the CIU and the engine management unit are not damaged.
- Check that sleeves 11 and 12 in the connector on the CIU are not damaged.
- Check contact pressure in sockets 51 and 55 in the lower cable connector (B) on the engine management module.

Code 6.5 Data link (CAN), EMS 2

Reason:

- Internal fault in control module.

Reaction:

- Engine not operating: engine can not be started.
Engine operating: engine idles and can only be stopped with the emergency stop.

Action:

- Check that the 8-pin connector is not damaged.
- Check that the cables between the CIU and the engine management unit are not damaged.
- Check that sleeves 11 and 12 in the connector on the CIU are not damaged.
- Check contact pressure in sockets 51 and 55 in the lower cable connector (B) on the engine management module.

Code 6.6 Oil pressure

Reason:

- Oil pressure is too low.

Reaction:

- Warning lamp lights up.

VE engines: Engine control module reduces engine power (unless the protection has been shut off with the diagnostic tool VODIA).

GE engines: Engine is shut off (unless the protection has been shut off with the diagnostic tool VODIA).

Action:

- Check oil level.
- Check that the air filters are not blocked.
- Check system pressure valves and safety valves in the oil system.
- Check oil pressure sensor function.

Code 6.7 Piston cooling pressure**Reason:**

- Piston cooling pressure is too low.

Reaction:

- Engine stopped, applies to both GE and VE engines. The fault code is de-activated at engine speeds below 1000 rpm.

Action:

- Check that the oil pressure in the engine exceeds 2 kPa (0.3 psi).

Code 6.8 Piston cooling pressure sensor**Reason:**

- Short circuited to (+) or negative (-).
- Open circuit.

Reaction:

- None.

Action:

- Check that the piston cooling pressure sensor connector is correctly installed.
- Check that the piston cooling pressure sensor cable is not damaged.
- Check that the piston cooling pressure sensor is correctly installed.
- Check piston cooling pressure sensor function.
- Check contact pressure in sockets 10 and 14 in the lower cable connector (B) on the engine management module.

Code 6.9 Battery voltage, CIU**Reason:**

- Short circuit to negative (-).
- Faulty alternator
- Faulty battery, battery cables.

Reaction:

- Warning lamp lights up.
- Problems in engine starting.

Action:

- Check the supply voltage from the control unit.
- Check that battery.
- Check the alternator.

Code 7.1 Unit injector, cylinder #1**Reason:**

- Electrical fault.
- Faulty compression or unit injector.

Reaction:

- Engine runs on 5 cylinders.
- Abnormal sound.
- Reduced performance.
- Cylinder balancing is stopped -> Less even running at lower speeds and low loading.

Action:

- Check contact pressure in socket 24 in the upper cable connector (A) on the engine management module.
- Check that the unit injector cables are not damaged.
- Check that the unit injector connections are not damaged.
- Check fuel supply pressure.
- Check the valve clearance.
- Do a compression test and check cylinder #1.

Code 9.2 Faulty data link (J1708/J1587)

Reason:

- Faulty data link.

Reaction:

- Warning lamp lights up.

Action:

- Check that the 8-pin connector is not damaged.
- Check that the cables between the CIU/DCU and the engine management unit are not damaged.
- Check that sleeves 22 and 37 in the connector on the CIU are not damaged.
- Check contact pressure in sockets 33 and 34 in the upper cable connector (A) on the engine management module.

Code 9.3 Power supply to sensor

Reason:

- Short circuit.
- Fault in oil pressure sensor and/or charge air pressure sensor.

Reaction:

- Faulty values in oil pressure and charge air pressure sensors.
- Fault code for oil pressure and charge air pressure sensors.
- Low engine power.
- Oil pressure and oil temperature instruments show 0.

Action:

- Check that the oil pressure and charge air pressure sensors are not damaged.
- Check contact pressure in socket 7 in the upper cable connector (A) on the engine management module.
- Check the oil pressure sensor and charge air pressure sensor.

Code 9.8 Fault in control module, CIU

Reason:

- Faulty EEPROM, CIU.
- Faulty flash memory, CIU.
- Fault in control module, CIU

Reaction:

- CIU returns to factory setting.
- Engine goes to idle.
- Engine can not be started.

Action:

- Change CIU unit.

Code 9.9 Memory fault in EMS

Reason:

- Memory fault in engine management system.

Reaction:

- Engine might not start.

Action:

- Change engine control unit.

Code 9.9 Data set memory, EEPROM

Reason:

- Internal fault in control module
- Faulty programming

Reaction:

- Engine does not start.

Action:

- Re-program the control module. If the fault remains, change the control module.

Code 9.9 Control module, EMS

Reason:

- Internal fault in control module.

Reaction:

- Engine misfires.
- Engine does not start.

Action:

- Change engine control unit.

Technical data

General

Type designation	TAD1641VE	TAD1642VE	TAD1640GE	TAD 1641GE	TAD1642GE
Max effect (kW) / (rpm)	420 / 1800	494 / 1800			
Max torque (Nm) / (rpm)	2700 / 1200	3150 / 1200			
1800 rpm Prime/Stand-by			401 / 440 kW	441 / 484 kW	496 / 545 kW
1800 rpm Prime/Stand-by			445 / 494 kW	504 / 565 kW	551 / 604 kW
Compression ratio	17,5:1	17,5:1	17,5:1	16,5:1	16,5:1
Low idle (rpm)	600	600	900	900	900
High idle (rpm)	1800-2000	1800-2000	1500 / 1800	1500 / 1800	1500 / 1800
Highest full load speed (rpm)	1800	1800	1500 / 1800	1500 / 1800	1500 / 1800
No. of valves	24	24	24	24	24
No. of cylinders	6	6	6	6	6
Cylinder bore (mm/inch)	144	144	144	144	144
Stroke (mm/inch)	165 (6.5)	165 (6.5)	165 (6.5)	165 (6.5)	165 (6.5)
Swept volume (dm, cu.in ³)	16.1 (892)	16.1 (892)	16.1 (892)	16.1 (892)	16.1 (892)
Injection sequence	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4

Lubrication system

Oil

Change volume, including filter change 48 liter (12.6 US gallon)

Oil pressure, hot engine

at operating speed 300-650 kPa (44-94 psi)

at idle, min 270 kPa (39 psi)

Oil grade Please refer to the specification under "Maintenance".

Viscosity Please refer to the specification under "Maintenance".

Oil filter

Full flow filter 2

By-passfilter 1

Oil pump

Type Gear driven

Fuel system

Feed pump

Matartryck vid 600 r/min	min 100 kPa (14.5 psi)
Supply pressure at 1200 rpm	min 300 kPa (43.5 psi)
Supply pressure at full load	min 300 kPa (43.5 psi)

By-pass 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 requirements)

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

JIS KK 2204

Sulfur content: Complying with legal requirements in each country.

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

Cooling system

Type	Pressurized, sealed
Pressure cap, max. opening pressure	75 kPa (11 psi)
Volume (engine)	20 liter (21.1 US quart)
Volume (engine + radiator and hoses)	60 liter (15.8 US gallon)

Thermostat

Quantity	1 pcs.
Opening temperature	86° C (187° F)

Electrical system

System voltage:.....	24V
Alternator	
voltage/max. current density	28V / 80A
power app.	2200W
Alternative generating equipment (optional):	
voltage/max. current density	28V/110A
power app.	2800W
Battery capacity	2 pcs. series connected 12V, max. 225 Ah
Battery electrolyte specific gravity at +25°C:	
fully charged battery	1,28 g/cm ³ (1,24 g/cm ³)*
re-charge battery at	1,20 g/cm ³ (1,20 g/cm ³)*

**NOTE! Applies to batteries with tropical acid.

ENG

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Publication number: 7746102

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Número de publicación: 7746105

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Direc-

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Ja tack,

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Ja graag,

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Publicatienummer: 7746108

Naam

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Ota huomioon, että tarjous on voimassa 1 vuoden ajan moottorin luovutuspäivämäärästä, sen jälkeen vain tuotteen saatavuuden perusteella.

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Sím, obrigado(a)!

Gostaria de receber gratuitamente um manual de instruções em português.

Número de publicação: 7746109

Nome

Endereço

Pais

Notar, que a oferta é válida por um período de 12 meses a partir da data de entrega do motor. Depois desse período, a oferta é válida consoante a disponibilidade.

**VOLVO
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GRE

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RUS

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Заказы также можно размещать через Интернет:
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Ναι,

Θα ήθελα ένα αντίτυπο του εγχειριδίου χρήσης στην αγγλική γλώσσα χωρίς καμιά χρέωση.

Αριθμός έκδοσης: 7746110

Όνομα

Διεύθυνση

Χώρα

Παρακαλούμε σημειώστε ότι αυτή η προσφορά ισχύει για 12 μήνες από την ημερομηνία παράδοσης της μηχανής. Μετά θα είναι θέμα διαθεσιμότητας.

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Да, пожалуйста,

Я бы хотел иметь бесплатное руководство оператора на русском языке.

Номер издания: 7746112

Имя

Адрес

Страна

К Вашему сведению, это предложение действительно в течение 12 месяцев от даты поставки двигателя; в дальнейшем оно зависит от наличия.

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