

OPERATOR'S MANUAL

Generating set and industrial engines

16 liter (EMS 2)

**VOLVO
PENTA**

ENG

An English version of this Operator's Manual may be ordered free of charge up to 12 months after delivery, via internet, mail or fax. Refer to the order form in the back of the book.

All information is stored internally at AB Volvo Penta and will not be passed on to third parties.

GER

Diese deutsche Version dieses Handbuchs kann innerhalb von 12 Monaten ab Lieferung kostenlos online, per Brief oder per Fax bestellt werden. Bitte Bestellformular hinten im Buch verwenden.

Alle Angaben werden bei AB Volvo Penta gespeichert und nicht Dritten übermittelt.

FRE

Une version française de ce manuel d'instructions peut être commandée gratuitement, jusqu'à 12 mois après la date de livraison, via Internet, la poste ou par fax. Voir à la fin de ce document.

Toutes les informations sont stockées en interne chez AB Volvo Penta et ne sont divulguées à aucun tiers.

SPA

Hay disponible una versión en español gratuita de este manual de instrucciones, la cual puede pedirse, a través de Internet, correo postal o fax, en el plazo de 12 meses después de la entrega del producto. Véase el formulario de pedido en las últimas páginas del manual.

Todos los datos recibidos son almacenados de forma interna por Volvo Penta AB y no se ponen a disposición de terceras partes.

ITA

Una versione in lingua italiana di questo manuale di istruzioni può essere ordinata gratuitamente, fino a 12 mesi dopo la consegna, via internet, per posta o via fax. Vedere il modulo per l'ordinazione alla fine del manuale.

Tutti i dati forniti saranno memorizzati internamente presso AB Volvo Penta e non saranno divulgati a terzi.

SWE

En svensk version av denna instruktionsbok kan beställas kostnadsfritt, upp till 12 månader efter leverans, via internet, post eller fax. Se beställningsformulär i slutet av boken.

Alla uppgifter lagras internt hos AB Volvo Penta och lämnas inte ut till tredje part.

DUT

Een Nederlandse versie van dit instructieboek kan kosteloos worden besteld tot 12 maanden na aflevering, internet, post of fax. Zie het bestelformulier achterin het boek.

Alle gegevens worden intern opgeslagen bij AB Volvo Penta en niet verstrekt aan derden.

DAN

En dansk version af denne instruktionsbog kan bestilles gratis, op til 12 måneder efter levering, via internet, post eller telefax. Se bestillingsformular i slutningen af bogen.

Alle oplysninger gemmes internt hos AB Volvo Penta og overgives ikke til tredje part.

FIN

Tämän ohjekirjan suomenkielisen version voi tilata veloittuksetta 12 kuukauden sisällä toimituksesta internetistä, postin kautta tai faksilla. Katso tilauslomake kirjan lopusta.

AB Volvo Penta tallentaa kaikki tiedot sisäisesti eikä niitä luovuteta kolmannelle osapuolelle.

POR

Pode-se encomendar uma versão gratuita deste manual de instruções em português, até 12 meses após a entrega, através de Internet, correio ou fax. Consultar o formulário de encomenda no fim do manual.

Todas as informações são armazenadas internamente pela Volvo Penta e não são partilhadas com terceiros.

GRE

Εντός 12 μηνών από την παράδοση μπορείτε να παραγγείλετε μέσω Internet, ταχυδρομικής επιστολής ή φαξ μια ελληνική έκδοση του Βιβλίου χρήσης χωρίς χρέωση. Χρησιμοποιήστε το δελτίο παραγγελίας στο τέλος του βιβλίου.

Όλες οι πληροφορίες αποθηκεύονται από την AB Volvo Penta και δεν θα μεταβιβαστούν σε τρίτα πρόσωπα.

RUS

Вариант настоящего руководства по эксплуатации на русском языке можно заказать бесплатно в течение 12 месяцев после доставки по Интернету, электронной почте или по факсу. См. бланк заказа на обложке руководства.

Вся информация используется компанией AB Volvo Penta конфиденциально и не передается третьим сторонам.

TUR

Bu Kullanım Kılavuzunun Türkçe versiyonu teslimden 12 ay sonrasına kadar internet, posta veya faks yoluyla sipariş edilebilir. Kitabın arka kısmında bulunan sipariş formuna bakınız.

Tüm bilgiler AB Volvo Penta'da saklıdır ve üçüncü kişilere verilmez.

CALIFORNIA PROPOSITION 65 WARNING

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

Content

Foreword	2
Safety Information	3
Introduction	7
Presentation	9
Instruments and Controls	11
Starting	18
Operation	22
Engine Shutdown	23
Fault Handling	26
Fault Code Register	31
Maintenance Schedule	43
Maintenance	45
Storage	71
Technical Data	73
Alphabetical index	81

Foreword

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

We would like you to read this operator's manual thoroughly and consider the advice we give on running and maintenance. Please pay attention to the safety instructions contained in the manual.

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

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

Safety information

Read the Operators Manual 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. This chapter describes how safety precaution is presented in the Operators Manual and on the product. It also gives you an introduction to the basic safety rules for using and looking after the engine. If there is still something which is unclear or if you feel unsure about it, please contact your Volvo Penta dealer for assistance.

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



This symbol is used in the Operators Manual and on the product, to call your attention to the fact that this is safety information. Always read such information very carefully. **Safety texts in the Operators Manual have the following order of priority:**

DANGER!

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

WARNING!

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

CAUTION!

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

IMPORTANT!

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

NOTICE! Used to draw your attention to important information that will facilitate the work or operation in progress.



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

Safety rules for operation and maintenance

Daily checks

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

Carbon monoxide poisoning

Only start the engine in a well ventilated area. When operated in a confined space, exhaust fumes and crankcase gases must be ventilated.

Cooling System

Avoid opening the coolant filling cap when the engine is hot. Steam or hot coolant can spray out and cause scalding, 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 and lubrication oils

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).

Only use the fuel recommended in the Operators Manual. The wrong grade of fuel can cause malfunctions or stop the engine. In a diesel engine, it can also cause the injection pump to seize and the engine will over-rev, entailing a strong risk of personal injury and machinery damage.

Always cover the alternator if it is located beneath the fuel filters. Fuel spillage can damage the alternator. Always change the oil, oil filter and fuel filter at the specified intervals.

Starting lock

If the instrument panel does not have a key switch, the engine room must be lockable, to prevent unauthorized persons from starting the engine. Alternatively, a lockable main switch can be used.

Hot surfaces and fluids

A hot engine always increases the risk for burns. Be on your guard against hot surfaces: the exhaust manifold, turbocharger, oil pan, charge air pipe, starting heater, hot coolant and hot lubricating oil in pipes, hoses etc.

Fuel filling

There is always a risk of fire and explosion during fuel filling. Smoking is forbidden, and the engine should be stopped.

Never overfill the tank. Shut the tank cap securely. Only use the fuel recommended in the Operators Manual. The wrong grade of fuel can cause malfunctions or stop the engine. In a diesel engine, it can also cause the injection pump to seize and the engine will over-rev, entailing a strong risk of personal injury and machinery damage.

Operation

The engine must not be operated in environments which contain explosive media since none of the electrical and mechanical components are explosion proof.

Going close to a running engine is a safety risk. Hair, fingers, loose clothes, or dropped tools can catch on rotating components and cause severe injury.

When engines are supplied without touch guards, all rotating components and hot surfaces must be protected after installation in their application, if necessary for personal safety.

Care and maintenance

Knowledge

The Operators Manual contains instructions for doing the most common service and maintenance tasks in a safe and correct manner. Read them carefully before starting work.

Literature for more major tasks is available from your Volvo Penta dealer.

Never do a job if you are not entirely sure about how to do it. Please contact your Volvo Penta dealer and ask for assistance instead.

Stopping the engine

Stop the engine before opening or removing the engine hatch/hood. Service and maintenance work should be done with the engine stopped unless otherwise specified.

Prevent the engine from being started by pulling out the starter key and disconnect the power with the main switch. Lock them in the "Off" position.

If the instrument panel does not have a key switch, remove the system voltage with the main switch.

Fix a notice by the operator position to say that work is in progress.

Working with, or approaching a running engine is a safety risk. Hair, fingers, loose clothes, or dropped tools can catch on rotating components and cause severe injury. Volvo Penta recommends that all service work which requires the engine to be running should be done by an authorized Volvo Penta workshop.

Fire and explosion

Fuel and lubrication oil

All fuel, most lubricants and many chemicals are flammable. Always read and observe the advice on the packages.

Work on the fuel system must be done with the engine cold. Fuel leakage and spills on hot surfaces or electrical components can cause fires.

Store oil and fuel soaked rags and other flammable material in a fireproof manner. Oil soaked rags can self-ignite in certain circumstances.

Never smoke when filling fuel, lubrication oil or when close to fuel filling stations or the engine bay.

Spare parts

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.

The use of spare parts not approved by Volvo Penta can cause an explosion or fire.

Before starting

Re-install all guards which have been removed during service work, before re-starting the engine. Make sure that there are no tools or other objects left behind on the engine.

Never start a turbocharged engine without the air filter in place. The rotating compressor turbine in the turbocharger can cause severe injury. There is also a risk that foreign bodies could be sucked in and cause damage to the machinery.

Lifting the engine

The lifting eyes fitted on the engine should be used for lifting. Always check that the lifting devices are in good condition and that they have the correct capacity for the lift (engine weight together with auxiliaries, if fitted). The engine should be lifted with an adjustable lifting boom for safe handling. All chains or cables should be parallel to each other and should be as square as possible to the top of the engine. Please note that auxiliary equipment installed on the engine could change its center of gravity. Special lifting devices may then be needed to obtain the correct balance and safe handling. Never carry out work on an engine that is **only** suspended in a hoist.

Batteries

Batteries contain and give off an explosive gas, especially when charged. This gas is very flammable and highly explosive.

Smoking, open flames or sparks must never occur in or near to batteries or the battery locker.

Incorrect connection of a battery cable or start cable can cause a spark which can be sufficient, in its turn, to make the battery explode.

Start spray

Never use start spray or similar preparations to help in starting an engine with air pre-heating (glow plugs / starting heater). They may cause an explosion in the inlet manifold. Danger of personal injury.

Electrical System

Disconnect the power

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

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 cables to the alternator **and engine control unit connector before** reconnecting the battery cables.

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.

Introduction

This Operator's Manual 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 Operators Manual carefully and learn to handle the engine, controls and other equipment in a safe manner before you start the engine.

NOTICE! When ordering service and spare parts always note identification numbers for the engine and for the transmission. Please refer to *Technical Data page 79*.

NOTICE! This Operators Manual 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 Operators Manual for the relevant application.

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 contains important information about the warranty card, service intervals and service that the owner must be aware of, check and perform. 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.

Environmental responsibility

We all 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 a matter of course 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 an obvious 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 Operators Manual about fuel grades, operation and maintenance, to avoid unnecessary environmental impact. Please contact your Volvo Penta dealer if you notice any changes such as increased fuel consumption or increased exhaust smoke.

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:

Run the engine in normal operation. Full load should however, 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 operable clutch is installed, this should be checked more carefully during the first days. Adjustment may need to be done to compensate for bedding in of the friction plates.

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. These qualities are retained through regular service and use of spare parts approved by Volvo Penta.

Volvo Penta has a worldwide 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 Operators Manual, 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 followed.
- Only use spare parts approved by Volvo Penta.
- Service to injection pumps, pump settings and injectors must always be performed 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 made.
- Any security seals on the engine may not be broken by unauthorized persons.

The general advice in the Operator's Manual about operation, service and maintenance applies.

NOTICE! Neglected or poorly performed maintenance/service, as well as use of spare parts not approved by Volvo Penta, entails that AB Volvo Penta can no longer guarantee that the engine conforms to the certified model.

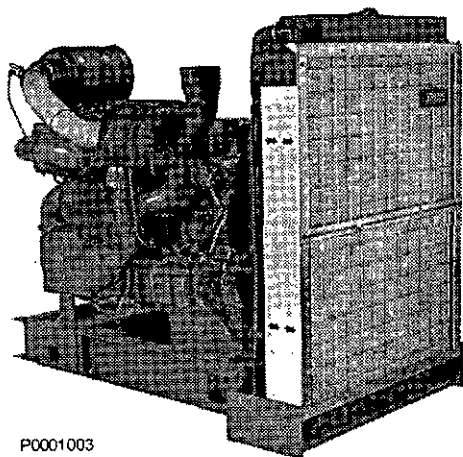
Damage, injury and/or costs which arise from this will not be compensated by Volvo Penta.

Presentation

Engines

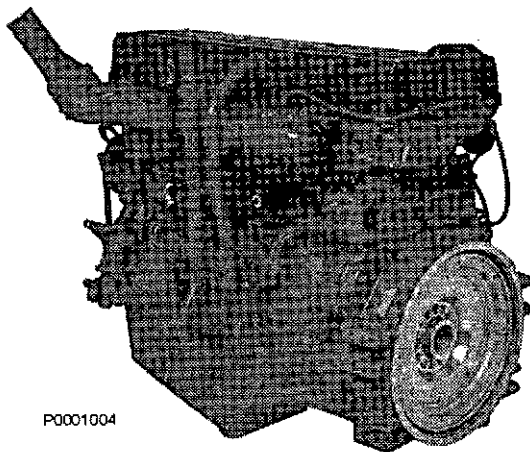
This Operator's Manual contains industrial engines TAD1640GE, TAD1641GE, TAD1642GE, TWD1643GE, TAD1641VE, TAD1642VE, TAD1643VE and TAD1650VE.

These are in-line, directly injected, 6-cylinder industrial diesel engines. All engines are equipped with electronically controlled fuel management (EMS), turbo-charger, charge air cooler, thermostatically controlled cooling systems and electronic speed control.



P0001003

TWD1643GE



P0001004

TAD1650VE

EMS (Engine Management System)

EMS (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.

Input signals

The control module receives input signals about the engines operating conditions and other things from the following components:

- coolant temperature sensor
- charge pressure/charge temperature sensor
- crankcase pressure sensor
- position sensor, camshaft
- speed sensor, flywheel
- coolant level sensor
- oil level and temperature sensor
- oil pressure sensor
- fuel pressure sensor
- water in fuel indicator
- exhaust temperature sensor (TWD1643GE)

Diagnostic function

The task of the diagnostic function is to discover and localize any malfunctions in the EMS 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.

Output signals

Based on the input signals the control module controls the following components:

- unit injectors
- starter motor
- main relay
- pre-heating relay
- wastegate (TWD1643GE, TAD1650VE)
- cold start valve (TWD1643GE)
- valve mechanism, internal EGR (TAD1650VE)

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 in 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.

Instruments and Controls

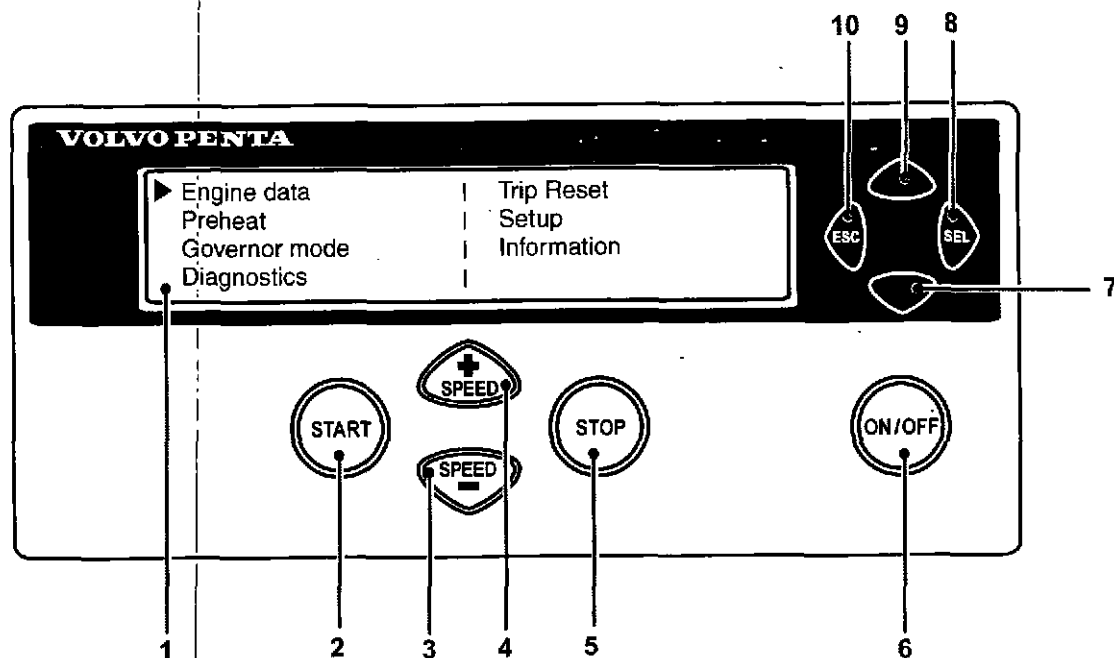
DCU (Display Control Unit)

The DCU (Diesel Control System) control panel is available as an optional accessory for the EMS (Engine Management System) electronic control system.

The DCU is a digital instrument panel which communicates with the engine control unit. The DCU has several functions, such as engine control, monitoring, diagnostics, and parameter setting.

The menus in the DCU system can be used to check, and in some cases to set, a number of different functions in the EMS system.

NOTICE! The menus and illustrations shown here are the English version. The language can be changed, however; refer to the *Setup* menu.



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

Start

When the DCU panel is started, the "Engine Data" menu is displayed; press "ESC" to come to the main menu.

▶ Engine data	Trip Reset
Preheat	Setup
Governor mode	Information
Diagnostics	

P0002063

▶ Eng speed	rpm	Boost prs	kpa
Cool temp	c	Boost trp	C
Oil pres	kpa	Oil temp	C
Eng hours	h	Batt Volt	V

P0002064

Menus

There are several sub-menus under each main menu. There is not space for all the menu choices on the display. To scroll through the menus, use the **7** and **9** buttons on the display. Press the **SEL** button **8** to make a selection. Refer to the illustration on the previous page.

NOTICE! The **Setup** menu can be used to select the language that you want to use on the display.

Main menu

- **Engine data**, current engine data
- **Preheat**; manual activation of pre-heating. Must be activated with temperatures below 0°C (32°F)
- **Governor mode**, activation of droop
- **Diagnostics**, shows fault codes as text
- **Trip reset**, resets trip data
- **Setup**, parameter setting
- **Information**, shows the currently applicable hard/software, data sets and engine identification for the engine and DCU data

Engine data

shows relevant engine data.

- Engine speed, can be controlled with the **SPEED+** and **SPEED-** buttons (rpm)
- Charge pressure (kPa)
- Coolant temperature (°C)
- Charge air temperature (°C)
- Oil pressure (kPa)
- Oil temperature (°C)
- Engine hours (h)
- Battery voltage (V)
- Fuel consumption (l/h)
- Instantaneous fuel consumption (trip fuel) (l)

*** Preheat ***
Press SEL to request preheat

P0002065

*** Governor mode ***
Droop mode

P0002066

*** Diagnostics 7/9 ***
20.0h Engine oil pressure
signal failure Inactive

P0002067

*** Trip Data Reset ***
Press SEL to reset trip data

P0002068

Preheat

manual activation of pre-heating. When it is activated, the EMS system senses at start-up if pre-heating is needed. For automatic pre-heating, refer to the *Setup / Preheat on ignition* menu.

NOTICE! Must be activated with temperatures below 0°C (32°F).

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

- Press **SEL**, the text **Preheat requested** will be shown
- The display automatically returns to the **Engine Data** menu.

Governor mode

activates/shuts off droop. To set the droop level, refer to the *Setup / Governor gradient or Governor droop* menu.

- Select **Isochronous mode** or **Droop mode** with the SEL button.

Diagnostics

shows the error list containing the 10 latest active and inactive faults. The fault codes are shown as text on the display.

- Scroll through the fault list with the arrow keys.

Trip Data reset

resets trip data, such as fuel consumption.

- Press the **SEL** button to reset trip data

Setup	
▶ Set Application :	(Versatile)
Units :	(metric)
Language :	(English)

P0002069

Setup

parameter setting in the engine's control systems. Different menus appear under **Customer parameter**, depending on whether **Versatile** or **Gen set** has been selected from **Set application**. See below.

The parameters that can be set/selected (choice is made with the SEL button) are:

- **Set application**, setting **Versatile** or **Gen set**. Depending on the selection made here, different menus will appear under **Customer parameter**.
- **Unit**, setting of units (metric or US imperial).
- **Language**, setting the language used on the display. Choose between English, French, German and Spanish.
- **Stop energized to**, setting of external stop input. Activated by **Stop** or **Run**.
Stop: The stop input must be connected to voltage to stop the engine.
Run: The stop input must be connected to voltage to run the engine.
- **Customer parameter**, setting alarm limits. Refer to *Customer parameter / Versatile and Customer parameter / Gen set*.
- **Throttle input setting**, setting of engine-speed control and voltage limits. Refer to *Throttle input setting*.
- *Display setting*, setting the display. refer to *Display setting*.

Customer parameter / Versatile

- **Idle engine speed** - setting idle speed.
- **Preheat on ignition** - activation of automatic preheating. The engine control system senses if preheating is needed and activates it directly at switch-on.
- **Governor gradient (Nm/rpm)** - setting of droop level, when activated. For activation, refer to *Governor droop* in the main menu.
- **Oil temp warning limit (°C)** - setting alarm limit for oil temperature.
- **Coolant temp warning limit (°C)** - setting alarm limit for coolant temperature.

Set up (Versatile)	
▶ Idle engine speed :	rpm
Preheat on ignition :	
Governor gradient :	Nm/pm

P0002070

Set up (Gen set)

▶ Primary engine speed :
 Preheat on ignition :
 Governor droop :

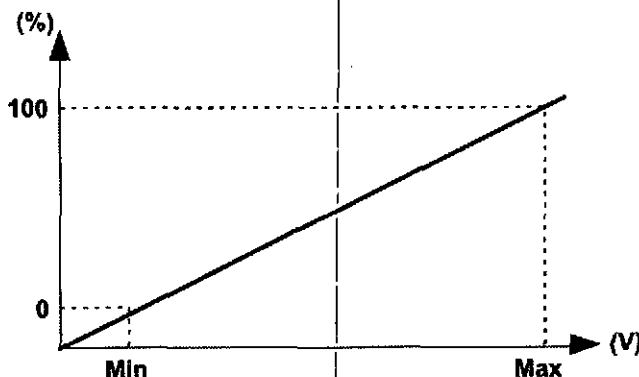
P0002071

Setup(Throttle)
 Setup throttle mode : *** OFF ***

Setup(Throttle)

▶ Set throttle mode :
 Set idle voltage :
 Set mx voltage :

P0002955



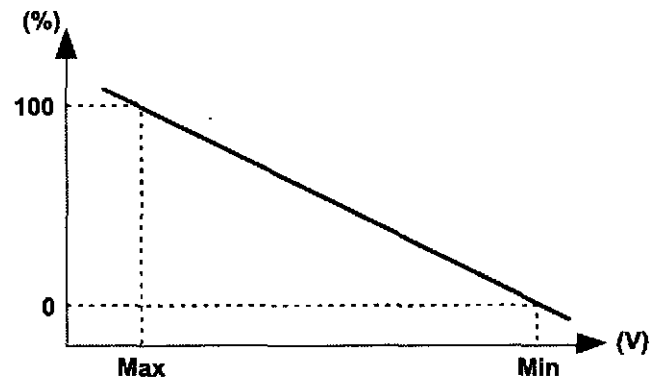
Customer parameter / Gen set

- **Primary engine speed** - selection of engine rpm, 1500 or 1800 rpm.
- **Preheat on ignition** - activation of automatic pre-heating. The engine control system senses if pre-heating is needed and activates it directly at switch-on.
- **Governor droop (%)** - setting of droop level, when activated. For activation, refer to "Governor droop" in the main menu.
- **Overspeed limit (%)** - setting of limit for overspeed alarm, % of set engine rpm.
- **Overspeed shutdown** - activation of engine shutdown with overspeed alarm. Refer to "Overspeed limit" to activate the alarm limit for the excess rpm alarm.
- **Oil temp warning limit (°C)** - setting alarm limit for oil temperature.
- **Coolant temp limit (°C)** - setting alarm limit for coolant temperature.

Throttle input setting

rpm control setting (throttle operation).

- **Set throttle mode** - OFF - engine rpm is controlled via the DCU panel.
 ext throttle input - engine speed is controlled with a potentiometer (accelerator).
 ext voltage input - engine rpm is controlled by an external unit.
- **Set idle voltage (V)** - idle voltage level setting.
- **Set max voltage (V)** - full throttle voltage level setting.



Setup(Display)		
▶ Set contrast	:	60%
Set backlighttime	:	5 sec
Set backlight brightness	:	10

P0002075

*** Information ***		
▶ Engine hardware Id	:	
Engine software Id	:	
Engine Dataset1 Id	:	

P0002076

Display setting

settings for the display. Adjustment is made with the 7 and 9 buttons; see DCU panel illustration.

- **Set contrast (%)** - contrast setting.
- **Set backlight time (sec)** - time setting (in seconds) for display backlighting on, lighting is then shut off if the panel is not used.
- **Set backlight brightness** - display backlighting brightness setting.

Information

shows the data for the engine and DCU.

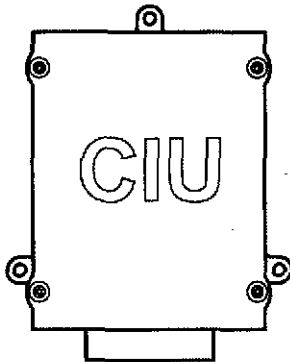
- **Engine hardware Id** - engine control unit part number.
- **Engine software Id** - engine control unit software part number.
- **Engine dataset1 Id** - engine data set 1 part number.
- **Engine dataset2 Id** - engine data set 2 part number.
- **Vehicle Id** - chassis number.
- **DCU hardware Id** - DCU part number.
- **DCU software Id** - DCU software part number.
- **DCU dataset1 Id** - DCU data set 1 part number.
- **DCU dataset2 Id** - DCU data set 2 part number.

CIU (Control Interface Unit)

The CIU is a "translator" between the control unit (EMS) and the customer's own control panel. The CIU has two serial communication links, one fast and one slow.

The fast one is a so-called CAN link. All data related to instruments, indication lamps, connectors and potentiometers is controlled by this link.

The slow link manages diagnostic information for flashing codes etc.



P0002060

Easy Link Instruments

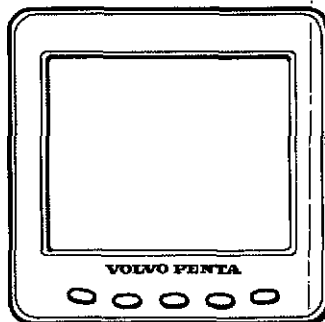
The following Easy Link instruments are available:

- 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

DU (Display Unit)

The DU is an instrument panel which shows engine working values graphically on an LCD screen. It consists of an computerized unit for permanent installation in a control panel.

The DU is connected between the engine control unit and the CIU or DCU.



P0002061

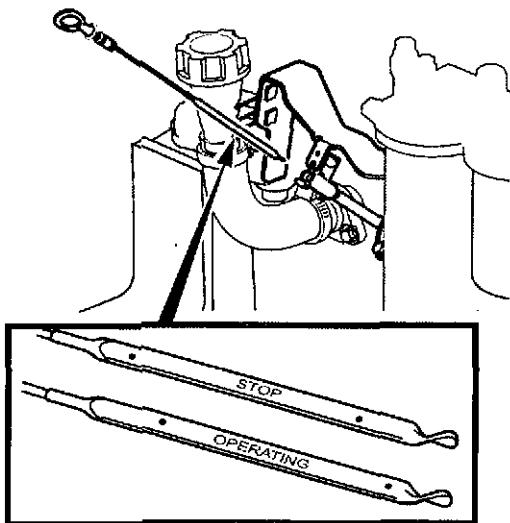
Starting

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.

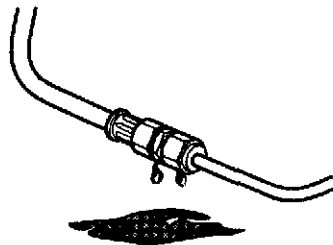
Also check that instruments and warning displays show normal values after you have started the engine.

WARNING!

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



P0004311



P0002078

Before Starting

- Check that the oil level is between the MAX and MIN marks.

NOTICE! 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).

For topping up please refer to the *Oil level, checking and topping up* page 55.

- Open the fuel stopcocks.

- 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 *Coolant Level, Checking and Topping Up* page 61 and *Charge Air Cooler, External Cleaning* page 63

WARNING!

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

- Turn the main switch(es) on.
- Move the engine speed control to idle, and disengage the clutch/gearbox if installed.

IMPORTANT!

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

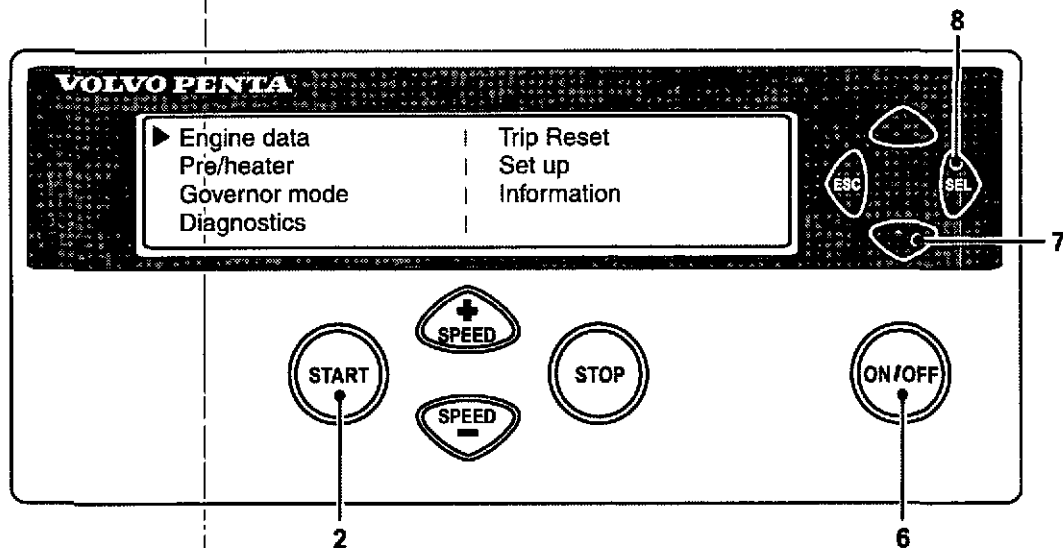
Starting the Engine

EMS (Engine Management System)

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)



P0002079

With pre-heating

- 1 Depress the **ON/OFF**-button (6).
- 2 Press the **SEL** button (8) to come to the main-menu.
- 3 Scroll down to **Pre/heater** with scroll button (7), press **SEL**-button (8)
- 4 In the **pre-heater** menu, press the **SEL**-button (8) to select pre-heating.
- 5 Press the **START**- button (2).

Without pre-heating

- 1 Depress the **ON/OFF**-button (6).
- 2 Press the **START**-button (2).

Leave the engine to idle for the first 10 seconds. Then warm the engine up at low speed and under low load. Never race the engine when it is cold.

Starting in Extreme Cold

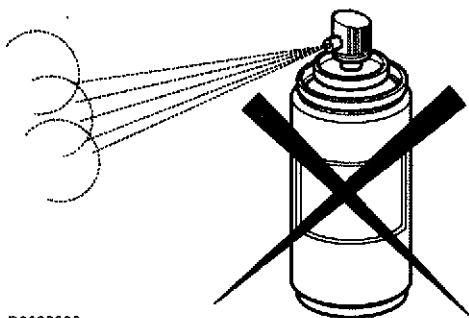
Certain preparations must be made to facilitate engine starting, and in some cases to make starting possible at all:

- 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.
- 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 starting aid. Explosion risk!



P0002080

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 be loosened on any condition.

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 and operation at high engine rpm.

Reading the Instruments

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

NOTICE! On engines in continuous operation, the lubrication oil level must be checked at least every 24 hours. Refer to *Oil level, checking and topping up* page 55.

Alarms

If the EMS 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 can be found in the chapter. *Alarm handling*.

Maneuvering

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 pressure.

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

At low loads, the combustion temperature may become so low that complete combustion cannot be ensured, resulting in possible fuel dilution of lubricating oil and eventually leakage from the exhaust manifold.

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, the duration of this operation should be limited to 5 minutes.
- Run the engine at full load for about 4 hours once a year. In this way carbon deposits in the engine and exhaust system are given the chance to burn up.

Engine Shutdown

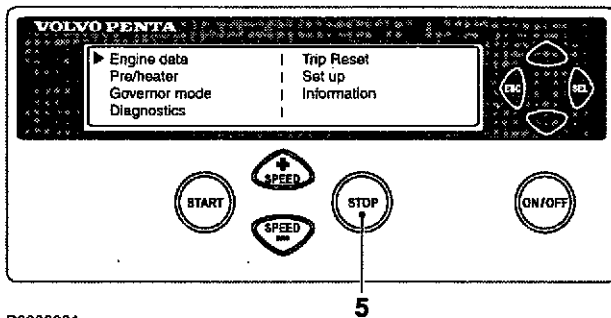
During longer breaks in operation, the engine must be warmed up at least once every two weeks. This prevents corrosion in the engine. If you expect the engine to remain unused for two months or more, it must be laid up: Refer to the chapter *Storage* page 71.

Before Engine Shutdown

Let the engine run for a few minutes without loading before stopping it. This allows engine temperature equalization and prevents boiling once stopped and also allows the turbocharger to cool down. This contributes to long service life without malfunctions.

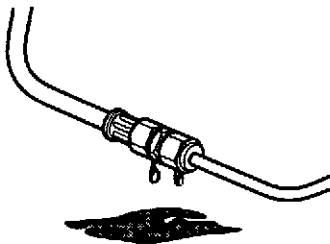
Stop the Engine

- Disengage the clutch (if possible).
- Depress the **STOP**-button (5).



After Engine Shutdown

- 1 Check the engine and engine bay for leakage.
- 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, the engine must be warmed up at least once every two weeks. This prevents corrosion attacks in the engine.

If you expect the engine to be unused for two months or more, it must be laid up. Refer to the chapter *Short Term Storage*.

NOTICE! If there is a risk of frost, the coolant in the cooling system must have sufficient frost protection. Refer to the chapter *Maintenance* page 59.

A poorly-charged battery can freeze and burst; refer to *Battery, Charging* page 69.



P0003479

Extra Stop

For location of the extra stop, please refer to *Location of Sensors page 48*.

WARNING!

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



A series of horizontal dotted lines spanning the width of the page, providing a guide for handwriting practice.

Fault Handling

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 safety advice for care and maintenance work in the chapter *Safety Information page 3* before you start work.

Symptoms and possible causes

The diagnosis button lamp flashes	Please refer to <i>Fault Handling page 28</i>
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 (only TWD1643GE)	13, 17, 18, 19, 21, 25, 27, 28, 29, 30

- 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 unit 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

Diagnostic Function

The diagnostic function monitors and controls that the EMS system functions normally. The diagnostic function has the following tasks:

- Detecting and locating disturbances
- Reporting detection of disturbances
- Providing guidance when fault tracing

NOTICE! With the DCU:n it is possible choose the language that the information is presented in.

If the diagnostic function detects a disturbance in the system, this is reported using fault codes via the instruments.

Both active (unrectified) and passive (rectified) faults are stored in the control unit.

Refer to the "Operation" heading for reading fault codes/fault messages.

All fault codes and fault messages are found in the fault code list, with information about the reason, reaction and measures to be taken. Refer to *Fault Code Register*.

NOTICE! All instruments are optional.

Affect on engine

Engines are affected differently, depending on the severity of the fault discovered by the diagnostic function.

A fault message in the form of a fault code is always generated when a malfunction is discovered by the diagnostic function.

Engines are affected differently, depending on the severity of the fault:

- The engine is not affected
- Engine goes to idle
- Engine torque is restricted to a certain amount
- Engine is stopped

Active and Inactive Faults

Active faults

At the same time, the fault is stored in the control unit memory. When the fault has been attended to and the ignition is switched off and on again, the fault disappears as active.

DCU (Display Control Unit)

- text **!! ENGINE WARNING !!** shown on the display.

CIU (Control Interface Unit)

- the diagnostic lamp starts to flash.
- **"Easy Link" instrument**
 - the relevant lamp on the alarm panel lights up
 - after the diagnostic button has been pressed, the fault code is shown as text on the tachometer display.

DU (Display Unit)

- Either **WARNING!** or **ALARM STOP** (a buzzer sounds) will be shown on the display, depending on the severity of the fault.
- Fault codes can also be read off using the VODIA tool. For instructions, see "VODIA User's Guide".

Operation

When a malfunction has occurred and the diagnostic system has generated one or more fault codes, these are read out differently depending on the equipment used. Please refer to *Fault code messages*.

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

- 1 Cut engine speed to idle, or shut the engine off.
- 2 **For DCU/DU**
Read the fault code from the display, please refer to **Reading fault codes via the DCU** or **Reading fault codes via the DU**.
For CIU
press the diagnostic button and read the fault code, by observing the flashing of the diagnostic lamp. Refer to **Reading fault codes via the diagnostic lamp, CIU**.
- 3 Look up the fault code in the *Fault Code Register* chapter and take the recommended measures.

Inactive faults

- DCU – the fault is indicated as passive
- CIU – the diagnostic lamp goes out
- DU – the fault message disappears (inactive faults cannot be read out)
- Easy Link – the lamp on the alarm panel goes out

Reading fault codes via the DU (Display Unit)

Depending on the severity of the fault the text, either **WARNING!** or **ALARM STOP** (a buzzer sounds) will be shown on the display

- 1 Press any button to come to the fault list. The fault list shows operation hours and fault message.
- 2 Look up the fault code in *Fault Code Register* and take the recommended measures.
- 3 Press on **ACK** to acknowledge the fault code. The display background will change color (the buzzer stops sounding).
- 4 Press on **EXIT** to leave the fault list.

Reading fault causes via the DCU (Display Control Unit)

When a fault code is set, the following text is shown on the display:

!! ENGINE WARNING !!

alternated with **Press SEL for information.**

Read the fault code as follows:

- 1 Press **SEL**-button to come to the fault list.
The fault list shows:
 - Operation hours
 - Fault message
 - Active/inactive
- 2 Look up the fault code in the *Fault Code Register* chapter and take the recommended measures.
- 3 Press **ESC**-button to leave the fault list.

NOTICE! To enter the fault list when no fault code has been set, press the **SEL** button and select **Diagnostics** from the menu.

Reading fault codes via the diagnostic lamp on the instrument panel, CIU

When the system has discovered a malfunction, the diagnostic lamp starts to flash. 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: ✨ ✨ paus ✨ ✨ ✨ ✨ = **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 Register* chapter.

Read the fault code 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.

NOTICE! When the first fault code reoccurs, all the fault codes have been read.

If the diagnostics button is depressed after the fault has been corrected and the fault code deleted, the **code 1.1**, No fault, will be shown.

Reading fault codes via an "Easylink" instrument

When the system has discovered a malfunction, this is reported by the diagnostic lamp which starts to flash.

- 1 Press the diagnostic button. The fault code is shown as text on the tachometer display.
- 2 Look up the fault code in the *Fault Code Register* chapter and take the recommended measures.
- 3 When the fault has been rectified, the fault code disappears from the display and the diagnostic lamp goes out.

Erasing fault codes

Fault codes must be erased by an authorized Volvo Penta workshop by means of the VODIA tool.

Fault Code Register

No fault (Code 1.1)

Cause	Reaction	Remedy
There are no active faults.		

Preheating Relay (Code 5.4, PID 45/SPN 626)

Cause	Reaction	Remedy
<ul style="list-style-type: none">• Short circuit to positive (+) or earth (ground) (-).• Open circuit.	<ul style="list-style-type: none">• Preheating can not be activated.• Preheating is constantly connected.	<ul style="list-style-type: none">• Check that the relay input cable is not damaged.• Check relay function.

Fuel Pressure Sensor (Code 3.6, PID/SPN 94)

Cause	Reaction	Remedy
<ul style="list-style-type: none">• Short circuit to positive (+) or earth (ground) (-).• Open circuit.	<ul style="list-style-type: none">• None	<ul style="list-style-type: none">• 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 is correctly installed.• Check fuel pressure sensor function.

Fuel Pressure (Code 3.8, PID/SPN 94)

Cause	Reaction	Remedy
<ul style="list-style-type: none">• Low supply pressure	<ul style="list-style-type: none">• None	<ul style="list-style-type: none">• Check if it is possible to build up pressure with the hand pump• Check the fuel filter• Check the fuel pre-filter

Water in Fuel (Code 2.1, PID/SPN 97)

Cause	Reaction	Remedy
<ul style="list-style-type: none">• Water in fuel	<ul style="list-style-type: none">• None	<ul style="list-style-type: none">• Empty the primary fuel filter

Indicator for Water in Fuel (Code 2.9, PID/SPN 97)

Cause	Reaction	Remedy
<ul style="list-style-type: none">• Short circuit• Open circuit• Fault in indicator	<ul style="list-style-type: none">• None	<ul style="list-style-type: none">• Check the indicator cables for breaks and short circuits• Check indicator function. Change indicator as necessary

Oil Level (Code 5.7, PID/SPN 98)

Cause	Reaction	Remedy
<ul style="list-style-type: none">• Oil level to low	<ul style="list-style-type: none">• None	<ul style="list-style-type: none">• Check the oil level

Oil Level Sensor (Code 5.9; PID/SPN 98)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Break 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the cable harness to the oil level sensor has not been damaged Check the oil level sensor function

Oil Pressure Sensor (Code 3.1, PID/SPN 100)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Short circuit to positive (+) or earth (ground) (-) Open circuit 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the oil pressure sensor cable is not damaged Check that the oil pressure sensor is correctly connected

Oil Pressure (Code 6.6, PID/SPN 100)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Oil pressure is too low 	<ul style="list-style-type: none"> Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool) 	<ul style="list-style-type: none"> Check oil level Check that the air filter is not blocked Check system pressure valves and safety valves in the oil system Check oil pressure sensor function

Boost Temperature Sensor (Code 3.2, PID/SPN 105)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Short circuit to positive (+) or earth (ground) (-) Open circuit 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the boost temperature sensor connector is correctly installed Check that the boost temperature sensor cable is not damaged Check that the boost temperature sensor is correctly installed Check boost temperature sensor function

Boost Temperature (Code 6.2, PID/SPN 105)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Boost temperature is too high 	<ul style="list-style-type: none"> Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool) 	<ul style="list-style-type: none"> Check the coolant level Check the charge air cooler (cleanliness) Check boost temperature sensor function Check the function of the thermostat

Boost Pressure Sensor (Code 3.4, PID/SPN 102/106)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Short circuit to positive (+) or earth (ground) (-) • Open circuit 	<ul style="list-style-type: none"> • Engine smokes more than normally during acceleration/load increase 	<ul style="list-style-type: none"> • Check that the boost pressure sensor connector is correctly installed • Check that the boost pressure sensor cable is not damaged • Check that the boost pressure sensor is correctly installed • Check boost pressure sensor function

Boost Pressure Sensor (Code 3.5, PID/SPN 106)

Cause	Reaction	Action
<ul style="list-style-type: none"> • High charge pressure 	<ul style="list-style-type: none"> • Engine power is reduced or engine stops. 	<ul style="list-style-type: none"> • Check that the charge air pressure sensor connector is correctly installed • Check that the charge air pressure sensor cable is not damaged • Check that the charge air pressure sensor is correctly installed • Check charge air temperature sensor function

Air Filter Pressure (Code 5.5, PID/SPN 107)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Too large pressure drop across filter 	<ul style="list-style-type: none"> • Less good response from engine 	<ul style="list-style-type: none"> • Check the air filter

Air Filter Sensor (Code 5.6, PID/SPN 107)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Shorted to plus (+) or minus (-) • Break 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Check that the air filter sensor contact is correctly installed • Check that the cable harness to air filter sensor has not been damaged • Check the air filter sensor functionality

Coolant Temperature Sensor (Code 3.3, PID/SPN 110)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Short circuit to positive (+) or earth (ground) (-) • Open circuit 	<ul style="list-style-type: none"> • Preheating is also activated when the engine is hot 	<ul style="list-style-type: none"> • 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

Coolant Temperature (Code 6.1, PID/SPN 110)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Coolant temperature is too high 	<ul style="list-style-type: none"> • Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool) 	<ul style="list-style-type: none"> • Check the coolant level • Check the charge air cooler (cleanliness) • Check if there is air in the cooling system • Check the pressure cap on the expansion tank • Check coolant temperature sensor function • Check thermostat function

Coolant Level (Code 2.2, PID/SPN 111)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Low coolant level 	<ul style="list-style-type: none"> • Engine control module reduces engine power (unless the protection has been shut off with the VODIA diagnostic tool) 	<ul style="list-style-type: none"> • Check the coolant level • Check coolant level monitor function

Coolant Level Sensor (Code 2.3, PID/SPN 111)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Short circuit to positive (+) • Fault in sensor 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Check that the coolant level sensor cable is not damaged • Check coolant level sensor function

Crankcase Ventilation Pressure (Code 7.7, PID/SPN 153)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Crankcase ventilation pressure too high 	<ul style="list-style-type: none"> • The engine is shut down (if the protection has not been shut off by the parameter tool) 	<ul style="list-style-type: none"> • Check whether the crankcase ventilation is blocked • Check whether cylinder liners, pistons or piston rings are worn or damaged

Crankcase Ventilation Pressure Sensor (Code 7.8, PID/SPN 153)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Break 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the crankcase ventilation pressure sensor contact is correctly installed Check that the cable harness to the crankcase ventilation pressure sensor has not been damaged Check that the crankcase ventilation pressure sensor is correctly installed Check crankcase ventilation pressure sensor function

Battery Voltage, EMS (Code 3.9, PID/SPN 158)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Faulty alternator Faulty battery, battery cables 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check the supply voltage from the control unit

Battery Voltage, CIU (Code 6.9, PID/SPN 158)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Short circuit to negative (-) Faulty alternator Faulty battery, battery cables 	<ul style="list-style-type: none"> Problems in engine starting 	<ul style="list-style-type: none"> Check the supply voltage from the control unit Check the batteries Check the alternator Check the 8-pin contact

Air Temperature Sensor, Inlet (Code 7.9, PID/SPN 172)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Break 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the air temperature sensor contact is correctly installed Check that the cable harness to the air temperature sensor has not been damaged Check that the air temperature sensor is correctly installed Check the air temperature sensor functionality

TWD1643GE

Exhaust Temperature (Code 1.9, PID 173/SPN 1184)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Exhaust temperature to high 	<ul style="list-style-type: none"> Warning lamp lights up Engine is shutdown 	<ul style="list-style-type: none"> Insufficient air supply Low coolant level Air in the coolant system Faulty circulation pump Blocked charge air cooler High temperature, charge air-cooler High back pressure in the exhaust system Check wastegate function

TWD1643GE

Exhaust Temperature (Code 4.9, PID 173/SPN 1184)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Short circuit to positive (+) or negative (-) Open circuit Exhaust temperature to high 	<ul style="list-style-type: none"> Warning lamp lights up Engine control unit limits engine power 	<ul style="list-style-type: none"> Check that the exhaust temperature sensor connector is properly mounted Check that the wiring to the exhaust temperature sensor is not damaged Check that the exhaust temperature sensor is correctly mounted Check the exhaust temperature sensor function

Oil Temperature Sensor (Code 3.7, PID/SPN 175)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Break 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the cable harness to the oil temperature sensor has not been damaged Check that the oil temperature sensor has been connected correctly

Oil Temperature (Code 5.8, PID/SPN 175)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Oil temperature is too high 	<ul style="list-style-type: none"> The engine control module limits engine output(unless protection has been turned off with the diagnosis tool VODIA) 	<ul style="list-style-type: none"> Check the oil level Check the oil temperature Check the oil temperature sensor function

TAD1640GE, TAD1641GE, TAD1642GE,
TAD1643VE, TWD1643GE

Engine Speed (Code 2.6, PID/SPN 190)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Engine speed too high 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> After the engine has stopped, look for the reason for the high speed

Starter Input CIU (Code 5.2, PPID 4/SPN 520194)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to minus (-) Activated for too long 	<ul style="list-style-type: none"> The engine cannot be started The engine starts immediately when ignition is turned on 	<ul style="list-style-type: none"> Check that connections to the ignition key/start panel have not been damaged Check that the cable harness to the ignition key/start panel has not been damaged

Stop Input CIU (Code 5.3, PPID 6/SPN 52095)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Short circuit to negative (-) Open circuit Activated for too long time 	<ul style="list-style-type: none"> Engine can only be stopped with the auxiliary stop (AUX STOP) on engine Engine stops. A fault code is displayed for 40 seconds and the engine can not be started during this time. When a fault code is active, the engine can be started but not stopped 	<ul style="list-style-type: none"> Check that the starter switch connections are not damaged Check that the ignition switch cable is not damaged

Stop Input EMS (Code 4.8, PPID 6/SPN 970)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Short circuit to negative (-) Open circuit 	<ul style="list-style-type: none"> Engine can only be stopped with the auxiliary stop 	<ul style="list-style-type: none"> Check that the starter switch connections are not damaged

Start output/Start motor relay (Code 4.6, PPID 3/ SPN 677)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Activated for too long 	<ul style="list-style-type: none"> The engine cannot be started The engine starts immediately when ignition is turned on 	<ul style="list-style-type: none"> Check that connections to the ignition key/start panel have not been damaged Check that the cable harness to the ignition key/sart panel has not been damaged

Piston Cooling Pressure (Code 6.7, PPID 8/SPN 520192)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Piston cooling pressure is too low 	<ul style="list-style-type: none"> Engine stopped 	<ul style="list-style-type: none"> Check that the oil pressure in the engine exceeds 175 kPa (25.4 psi)

Piston Cooling Pressure Sensor (Code 6.8, PPID 8/SPN 520192)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Break 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check that the piston cooling pressure sensor contact is correctly installed Check that the cable harness to the piston cooling pressure sensor has not been damaged Check the piston cooling pressure sensor functionality

TAD1650VE

Internal EGR (Code 8.5, PPID 19/SPN 2791)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Fault in cable harness (boost pressure sensor) Mechanical fault on the IEGR 	<ul style="list-style-type: none"> Engine control module reduces engine power 	<ul style="list-style-type: none"> Check cable harness (boost pressure sensor) Check the IEGR Contact a Volvo Penta authorized workshop

TWD1643GE

ECU Temperature (Code 8.4, PPID 55/SPN 1136)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Control unit too hot, incorrect assembly Electrical fault, damaged sensor 	<ul style="list-style-type: none"> None 	<ul style="list-style-type: none"> Check the control unit installation. Recommended ambient temperature is 50°C (122°F)

Speed Potentiometer Connected to CIU (Code 2.8, PPID 132/SPN 91, 608,)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Shorted to plus (+) or minus (-) Fault in sensor 	<ul style="list-style-type: none"> Engine goes to idle Speed freezes 	<ul style="list-style-type: none"> Check that the potentiometer has been connected correctly Check that the cable harness to the potentiometer has not been damaged Check the potentiometer function

Snjector, Cylinder #1 (Code 7.1, SID 1/SPN 651)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> Electrical fault Faulty compression or injector 	<ul style="list-style-type: none"> Engine runs on 5 cylinders Abnormal sound Reduced performance 	<ul style="list-style-type: none"> Check that the injector cables are not damaged Check that the injector connections are not damaged Check fuel supply pressure Check the valve clearance Do a compression test and check cylinder #1

Injector, Cylinder #2 (Code 7.2, SID 2/SPN 652)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Electrical fault • Faulty compression or injector 	<ul style="list-style-type: none"> • Engine runs on 5 cylinders • Abnormal sound • Reduced performance 	<ul style="list-style-type: none"> • Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #2

Injector, Cylinder #3 (Code 7.3, SID 3/SPN 653)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Electrical fault • Faulty compression or injector 	<ul style="list-style-type: none"> • Engine runs on 5 cylinders • Abnormal sound • Reduced performance 	<ul style="list-style-type: none"> • Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #3

Injector, Cylinder #4 (Code 7.4, SID 4/SPN 654)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Electrical fault • Faulty compression or injector 	<ul style="list-style-type: none"> • Engine runs on 5 cylinders • Abnormal sound • Reduced performance 	<ul style="list-style-type: none"> • Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #4

Injector, Cylinder #5 (Code 7.5, SID 5/SPN 655)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Electrical fault • Faulty compression or injector 	<ul style="list-style-type: none"> • Engine runs on 5 cylinders • Abnormal sound • Reduced performance 	<ul style="list-style-type: none"> • Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #5

Injector, Cylinder #6 (Code 7.6, SID 6/SPN 656)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Electrical fault • Faulty compression or injector 	<ul style="list-style-type: none"> • Engine runs on 5 cylinders • Abnormal sound • Reduced performance 	<ul style="list-style-type: none"> • Check that the injector cables are not damaged • Check that the injector connections are not damaged • Check fuel supply pressure • Check the valve clearance • Do a compression test and check cylinder #6

Camshaft Drive Speed Sensor (Code 2.5, SID21/SPN 636)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • No signal • Abnormal frequency • Fault in sensor 	<ul style="list-style-type: none"> • Engine takes longer to start than normal. Engine runs normally when running 	<ul style="list-style-type: none"> • 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.

Flywheel Speed Sensor (Code 2.4, SID 22/SPN 637)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • No signal • Abnormal frequency • "Intermittent" signal from the sensor • Fault in sensor 	<ul style="list-style-type: none"> • Engine is very difficult to start and runs roughly when it starts 	<ul style="list-style-type: none"> • 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

TAD1650VE, TWD1643GE

Wastegate (SID 32/SPN 1188)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Short circuit to positive (+) or negative (-) • Open circuit • Wastegate damaged mechanically 	<ul style="list-style-type: none"> • Warning lamp lights up • Engine control unit limits engine power 	<ul style="list-style-type: none"> • Check that the wastegate connector is properly mounted • Check that the wiring to the wastegate is not damaged • Check that the wastegate is correctly mounted • Check the wastegate

TAD1650VE, TWD1643GE

Preheating Sensor (Code 8.6, SID 70/SPN 729)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Fault in cable harness • Fault in preheating relay 	<ul style="list-style-type: none"> • Preheating can not be activated 	<ul style="list-style-type: none"> • Check the cable harness • Check the preheating relay

Data Link (CAN), CIU (Code 6.4, SID 231/SPN 639)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Faulty data link (CAN), CIU 	<ul style="list-style-type: none"> • Instruments and warning lamps stop working 	<ul style="list-style-type: none"> • Check that the 8-pin connector is not damaged • Check that the cables between the CIU and the engine management unit are not damaged

Data Link (CAN), EMS 2 (Code 6.5, SID 231/SPN 639/2017/PSID 201)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Internal fault in control module 	<ul style="list-style-type: none"> • Engine not operating: engine can not be started. Engine operating: engine idles and can only be stopped with the auxiliary stop (AUX-stop) 	<ul style="list-style-type: none"> • 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

TWD1643GE

Power Supply to Sensor (Code 9.3, SID 211/232, SPN 1079/1080)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Shortcut • Fault in sensor 	<ul style="list-style-type: none"> • Faulty values in oil pressure and boost pressure sensors • Fault code for oil pressure- and boost pressure sensor • Low engine output • The instrument shows zero oil pressure and boost pressure 	<ul style="list-style-type: none"> • Check that the cable harness to oil pressure and boost pressure sensor has not been damaged • Check oil pressure and boost pressure sensors

TWD1643GE

Power Supply to Sensor (Code 9.3, SID 211, 232/SPN 1080, 1079)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Shortcut • Fault in sensor 	<ul style="list-style-type: none"> • Faulty values in oil pressure and boost pressure sensors • Fault code for oil pressure- and boost pressure sensor • Low engine output • The instrument shows zero oil pressure and boost pressure 	<ul style="list-style-type: none"> • Check that the cable harness to oil pressure and boost pressure sensor has not been damaged • Check oil pressure and boost pressure sensors

TAD1640GE, TAD1641GE, TAD1641VE,
TAD1642GE, TAD1642VE, TAD1643VE,
TAD1650VE

Power Supply Sensor (Code 9.3, SID 232/SPN 620)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Shortcut • Fault in sensor 	<ul style="list-style-type: none"> • Faulty values in oil pressure and boost pressure sensors • Fault code for oil pressure- and boost pressure sensor • Low engine output • The instrument shows zero oil pressure and boost pressure 	<ul style="list-style-type: none"> • Check that the cable harness to oil pressure and boost pressure sensor has not been damaged • Check oil pressure and boost pressure sensors

Memory Fault EMS (Code 9.9, SID 240/SPN 628)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Memory fault in engine management system 	<ul style="list-style-type: none"> • Engine might not start 	<ul style="list-style-type: none"> • Re-program the unit

Faulty data link (J1587) (Code 9.2, SID 250/SPN 608)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Faulty data link 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • 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

Data Set Memory EEPROM, CIU (Code 9.8, SID 253/SPN 630)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Internal fault in control module • Programming faulty 	<ul style="list-style-type: none"> • Engine does not start 	<ul style="list-style-type: none"> • Re-program the control module.

Data Set Memory EEPROM, EMS (Code 9.9, SID 253/SPN 630)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Internal fault in control module • Internal fault in control module 	<ul style="list-style-type: none"> • Engine does not start 	<ul style="list-style-type: none"> • Re-program the control module. If the fault remains, change the control module

Fault in Control Unit, CIU (Code 9.8, SID 254/SPN 629)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Faulty EEPROM, CIU • Faulty flash memory, CIU • Fault in control module, CIU 	<ul style="list-style-type: none"> • CIU returns to factory setting • Engine goes to idle • Engine can not be started 	<ul style="list-style-type: none"> • Re-program the unit

Control Module EMS (Code 9.9, SID 254/SPN 629)

Cause	Reaction	Remedy
<ul style="list-style-type: none"> • Internal fault in control module 	<ul style="list-style-type: none"> • Engine misfires • Engine does not start 	<ul style="list-style-type: none"> • Change engine control unit

Maintenance Schedule

General Information

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.

CAUTION!

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

When both operation and calendar time are specified, perform the maintenance job at the interval which is reached first.

FSI = First Service Inspection	C = Clean
S2 = First Time Service	R = Replace
S = Lubrication service	A = Adjustment
A - F = Type of service (regular service)	L = Lubrication
	I = Inspect (Clean, Adjust, Lubricate or Replace if necessary)

FSI	After the first 100-200 Hours	
Fuel pre-filter, draining condensed water		I
Coolant Level		I
Drive Belts		I
Start and warm up engine		
Coolant/oil/fuel, leakage		I
Inspection with VODIA (Diagnostic Tool)		I
Engine and transmission, abnormal noises		I
Stop Engine		
Engine Oil and Oil Filters / By-pass filter ⁽¹⁾⁽²⁾		R
Restart engine		
Oil pressure / oil leakage		I

S2	After the First 1000 Hours	
Valve clearance		A

S	Every 50-600 Hours / at Least Every 12 Months	
Engine Oil and Oil Filters / By-pass filter ⁽¹⁾⁽²⁾		R

1. Oil change intervals vary, depending on engine type, oil grade and sulfur content of the fuel.

2. Change the filters during each oil change.

Maintenance Schedule

A	Every 500 Hours / at Least Every 12th Month	
	Fuel Tank (sludge trap), Drain	I
	Inspection with VODIA (Diagnostic Tool)	I
	Fuel pre-filter, draining condensed water	I
	Air Filter Inserts (Indicator), Engine	I
	Radiator	I
	Drive Belts	I
	Batteries, electrolyte level	I

B	Every 1000 Hours / at Least Every 12 Months	
	Fuel pre-filter	R
	Air filter insert , motor	R
	Fuel Filter	R
	Coolant Filter	R

C	Every 2000 Hours	
	Valve clearance	I

D	Every 2000 Hours / at Least Every 24th Month	
	Turbocharger	I
	Turbocharger, Wastegate (TWD1643GE)	I
	Engine, with Respect to Leakage	I
	Engine, with Respect to Hose and Cable Clamping	I
	Engine, with Respect to Hose and Cable Clamping	I
	Air Filter, Tank Breather	R
	Air Filter, Compressor	R

E	Every 4000 hour / at Least Every 24 month	
	Belt Tensioner	I
	Drive Belts	R

F	Every 8000 Hours / at Least Every 48th Month	
	Coolant	R

Maintenance

This chapter describes how the specified maintenance points in *Maintenance Schedule page 43* should be performed, where also service intervals are stated.

CAUTION!

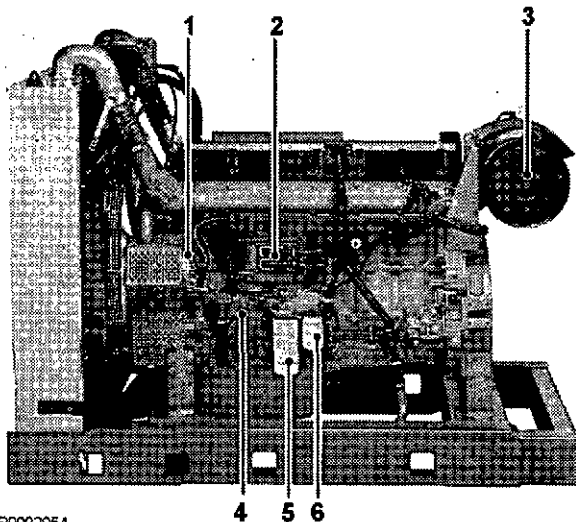
Read the chapter on Maintenance before starting work. It contains instructions on how to carry out maintenance and service operations in a safe and correct manner.

Service and maintenance work should be done with the engine stopped unless otherwise specified. Make it impossible to start the engine by removing the system voltage with the main switch.

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

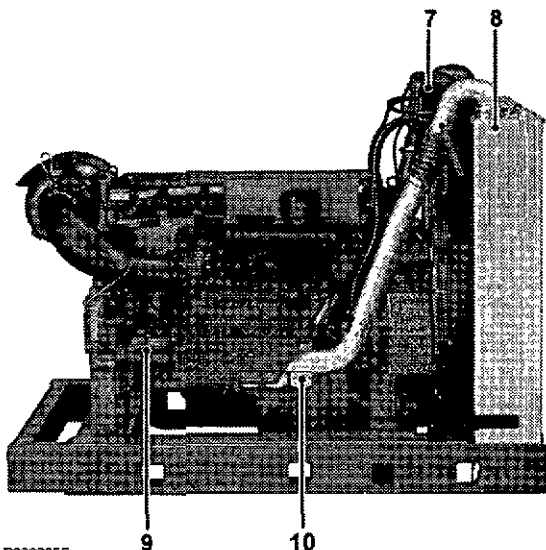
Orientation

TAD1640GE, TAD1641GE, TAD1641VE,
TAD1642GE, TAD1642VE, TAD1643VE



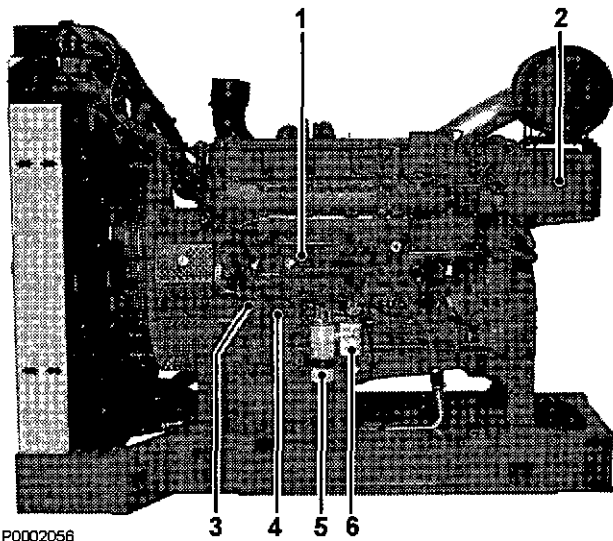
P0002054

- 1 Alternator
- 2 Control unit EMS 2
- 3 Air filter
- 4 Oil dipstick
- 5 Fuel filter, with fuel pressure monitor
- 6 Fuel prefilter with water monitor
- 7 Expansion tank
- 8 Charge air cooler (only TAD)
- 9 Starter motor
- 10 Oil filter



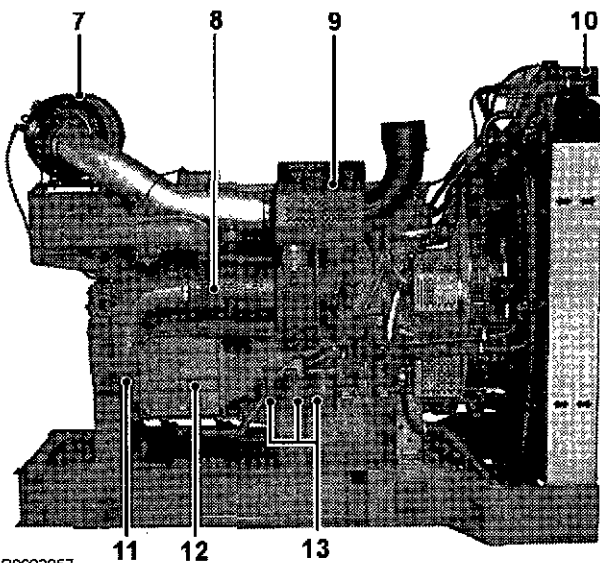
P0002055

TWD1643GE



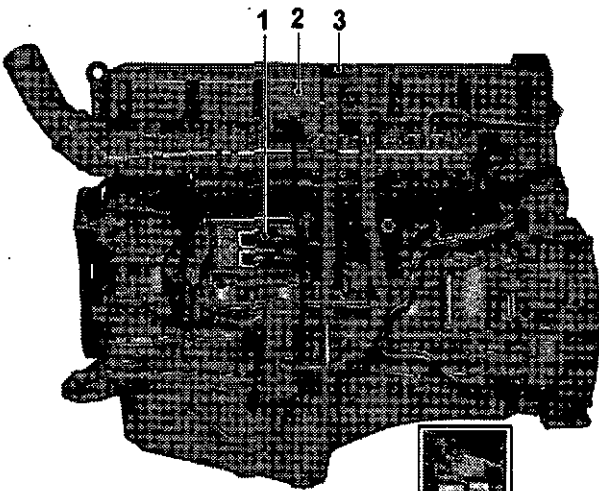
P0002056

- 1 Control unit, EMS
- 2 Charge air cooler, HP-turbo
- 3 Oil filler
- 4 Oil dipstick
- 5 Fuel filter with fuel pressure monitor
- 6 Fuel pre-filter with water monitor
- 7 Air filter
- 8 HP-turbo
- 9 LP-turbo
- 10 Expansion tank
- 11 Starter motor, located behind charge air cooler
- 12 Charge air cooler, LP-turbo
- 13 Oil filter



P0002057

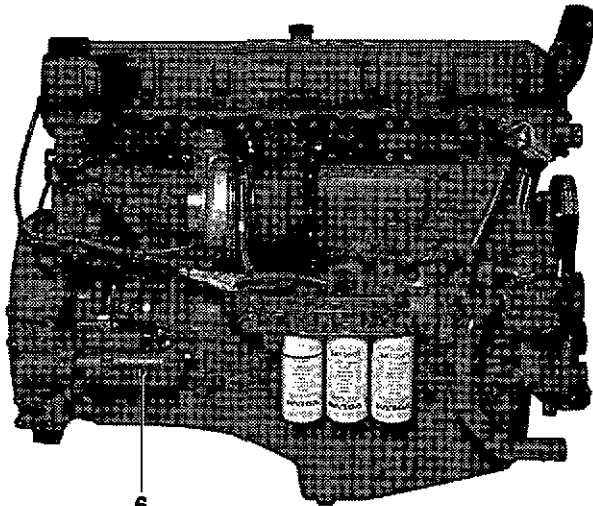
TAD1650VE



- 1 Control unit, EMS
- 2 Oil filler
- 3 Oil dipstick
- 4 Fuel filter, to be installed separately
- 5 Fuel pre-filter with water monitor, to be installed separately
- 6 Starter motor



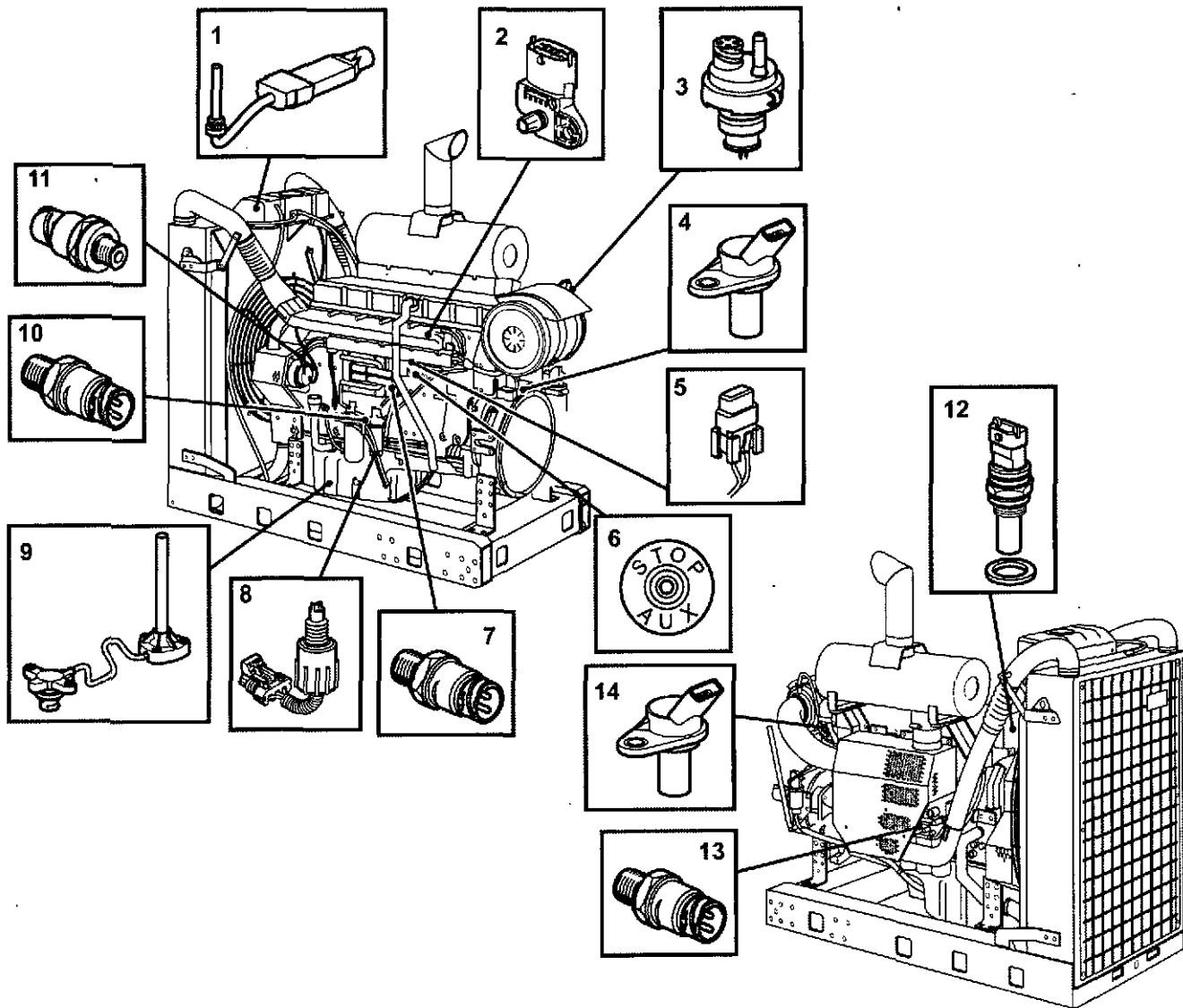
P0005082



P0005083

Location of Sensors

TAD1640GE, TAD1641GE, TAD1641VE,
TAD1642GE, TAD1642VE, TAD1643VE



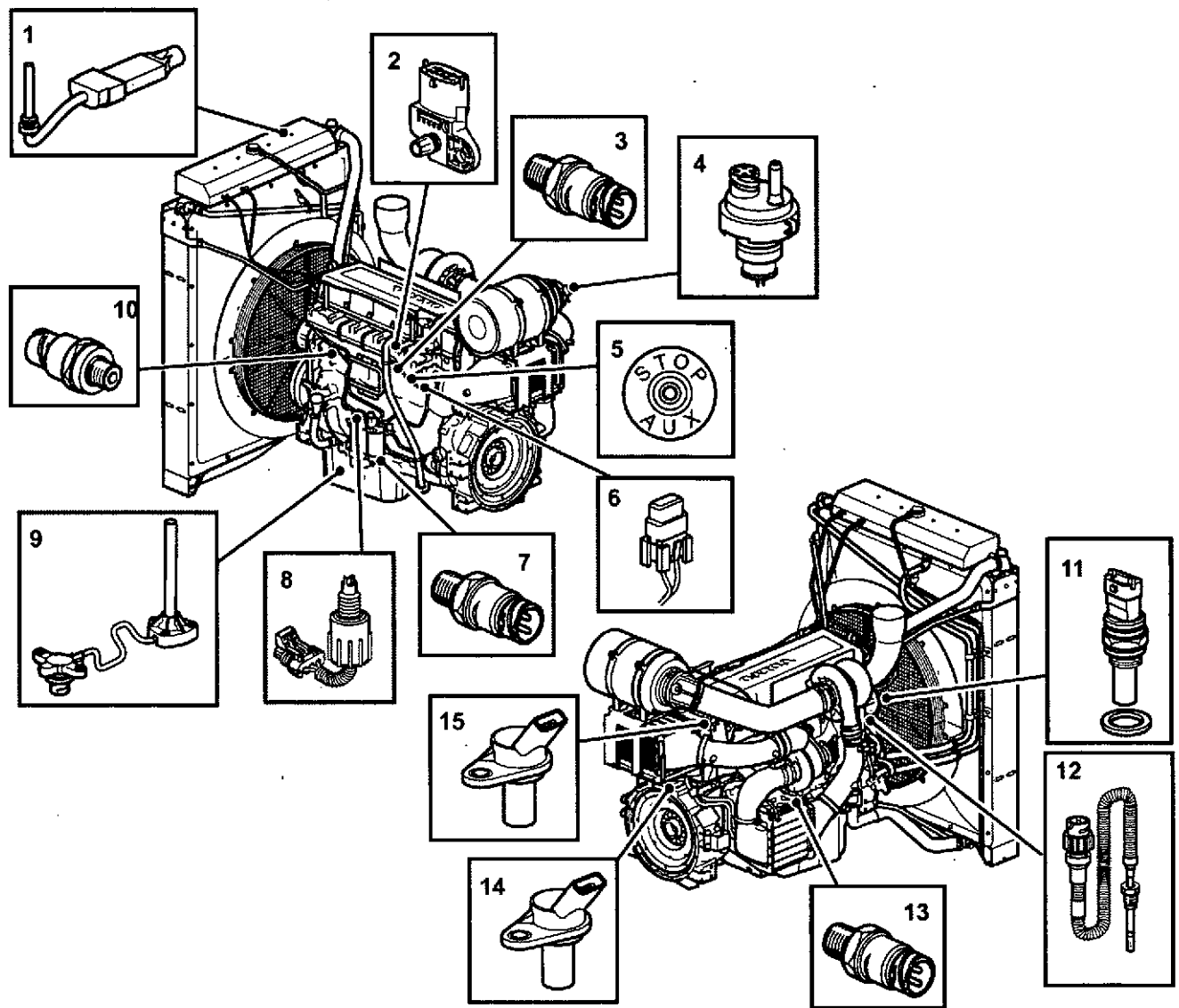
P0002058

- 1 Coolant level sensor, in the expansion tank
- 2 Combined charge air pressure and charge air temperature sensor
- 3 Under-pressure sensor, air filter
- 4 Flywheel position and engine speed sensor
- 5 Fuse
- 6 Extra stop (Aux stop)
- 7 Oil pressure sensor

- 8 Water in fuel sensor
- 9 Combined oil level and temperature sensor
- 10 Fuel pressure sensor
- 11 Crankcase pressure sensor
- 12 Coolant temperature sensor
- 13 Piston cooling pressure sensor
- 14 Camshaft position sensor

Location of Sensors

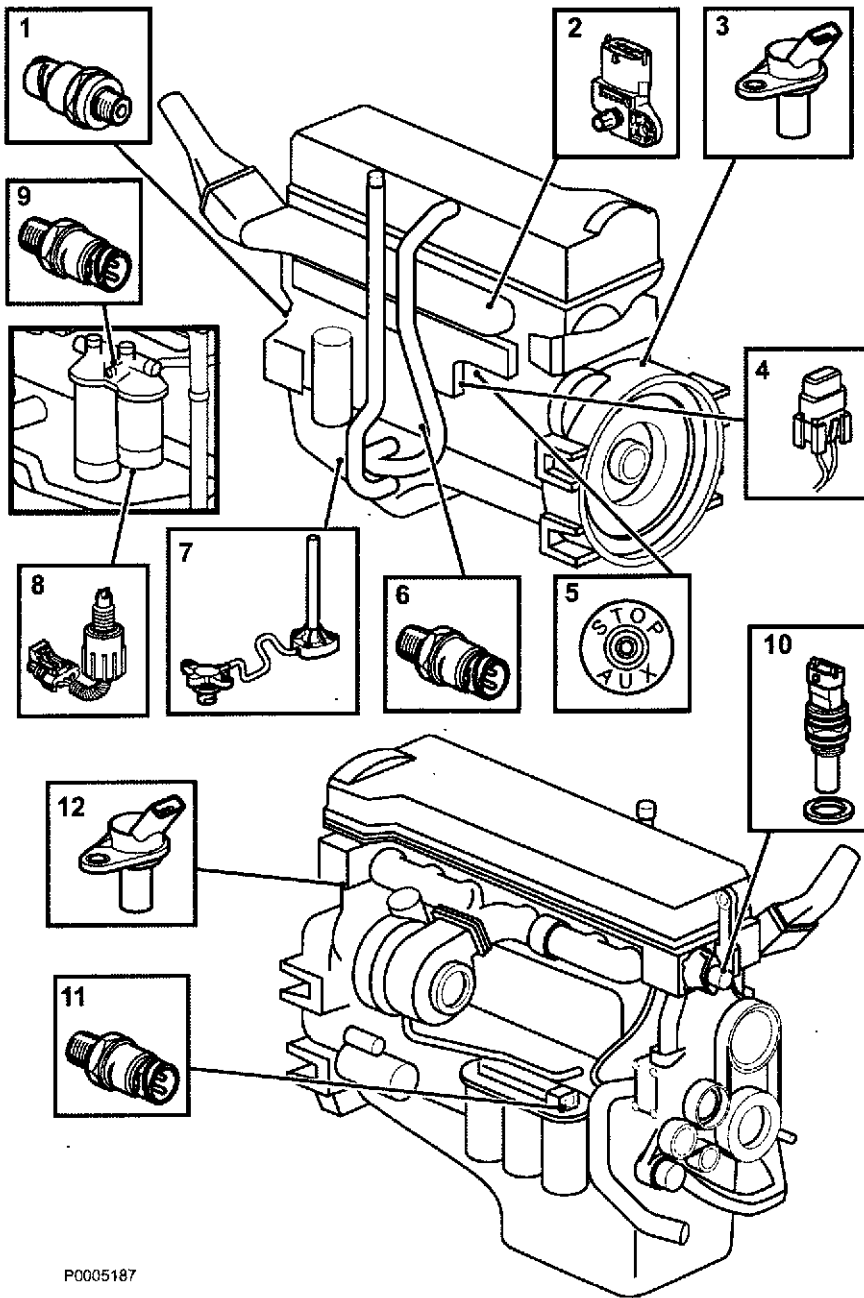
TWD1643GE



- | | |
|--|---|
| 1 Coolant level sensor, in the expansion tank | 9 Combined oil level and oil temperature sensor |
| 2 Combined charge air pressure and charge air temperature sensor | 10 Crankcase pressure sensor |
| 3 Oil pressure sensor | 11 Coolant temperature sensor |
| 4 Under-pressure sensor, air filter | 12 Exhaust temperature sensor |
| 5 Extra stop (Aux stop) | 13 Piston cooling pressure sensor |
| 6 Fuse | 14 Flywheel position and engine speed sensor |
| 7 "Water in fuel" sensor | 15 Camshaft position sensor |
| 8 Fuel pressure sensor | 16 Solenoid valve, drainage, water trap (optional), not shown in illustration |

Location of Sensors

TAD1650VE



P0005187

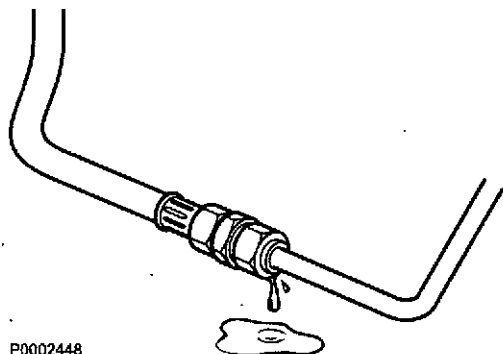
- | | |
|--|---|
| 1 Crankcase pressure sensor | 7 Combined oil level and oil temperature sensor |
| 2 Combined charge air pressure and charge air temperature sensor | 8 "Water in fuel" sensor |
| 3 Flywheel position and engine speed sensor | 9 Fuel pressure sensor |
| 4 Fuse | 10 Coolant temperature sensor |
| 5 Extra stop (Aux stop) | 11 Piston cooling pressure sensor |
| 6 Oil pressure sensor | 12 Camshaft position sensor |

Engine, General

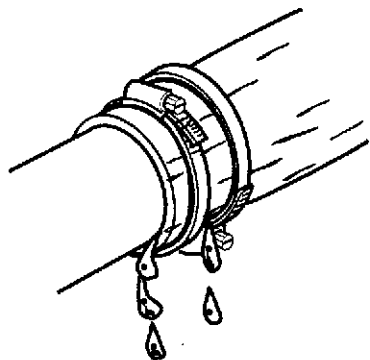
General inspection

Make it a habit to give the engine and engine bay 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.



P0002448



P0002455

⚠ WARNING!

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

⚠ WARNING!

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

IMPORTANT!

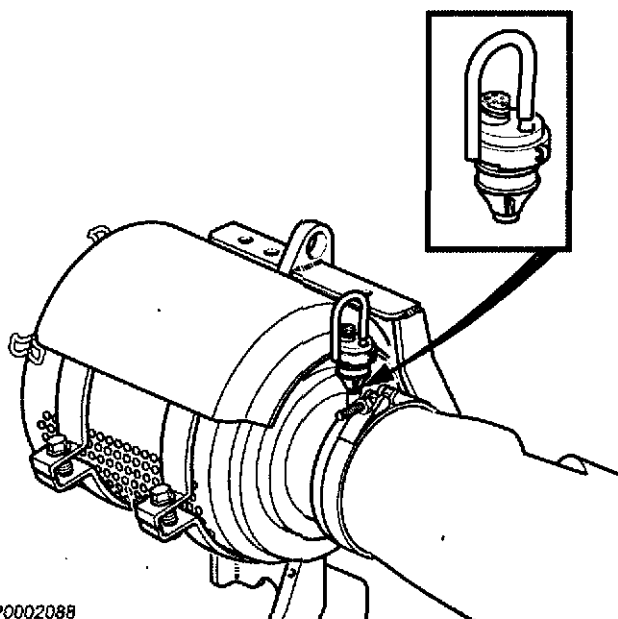
Remember the following when washing with a power washer: Never aim the water jet at radiators, charge air cooler, seals, rubber hoses or electrical components.

Air Filter, Check and 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.

- 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.



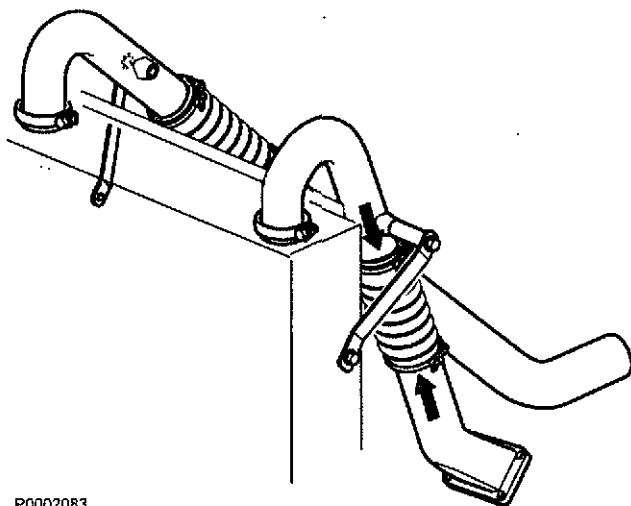
P0002088

Charge Air Pipe, Leakage Check

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

IMPORTANT!

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



P0002083

Drive Belt and Alternator Belt, Inspection

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.

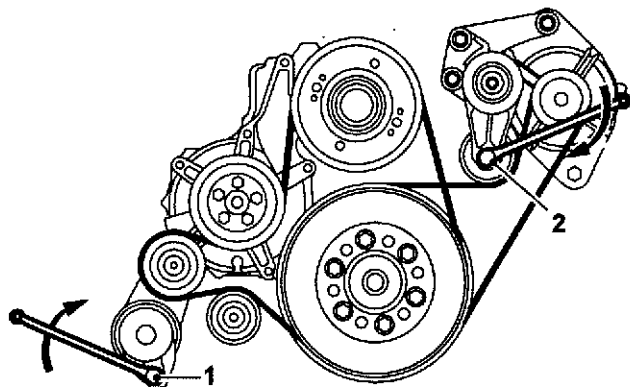
The alternator belts and drive belts have automatic belt tensioners and do not need to be adjusted.

Check the condition of the drive belts. Replace as necessary; refer to *Alternator Belts, Change* page 53 and *Drive Belt, Change* page 54.

Alternator Belts, Change

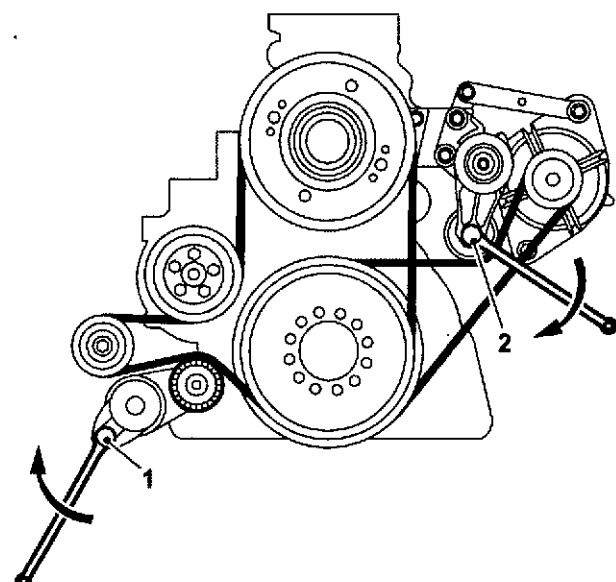
IMPORTANT!

Always change a drive belt which appears worn or cracked.



P0002084

TAD1640GE, TAD1641GE, TAD1642GE, TAD1641VE,
TAD1642VE, TAD1643VE, TAD1650VE

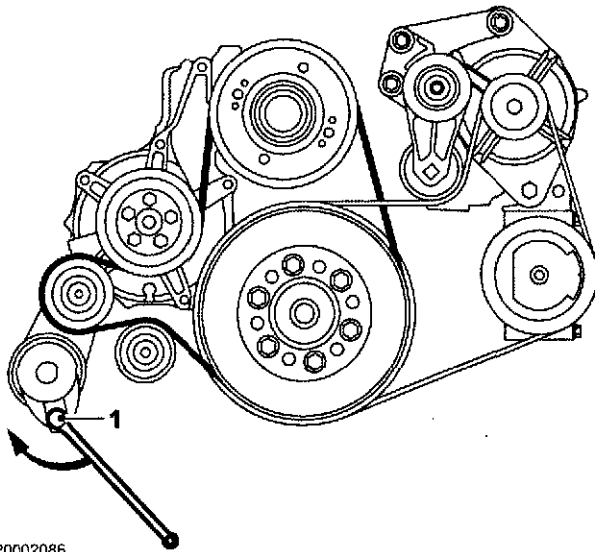


P0002085

TWD1643GE

- 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 belts.
- 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 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.

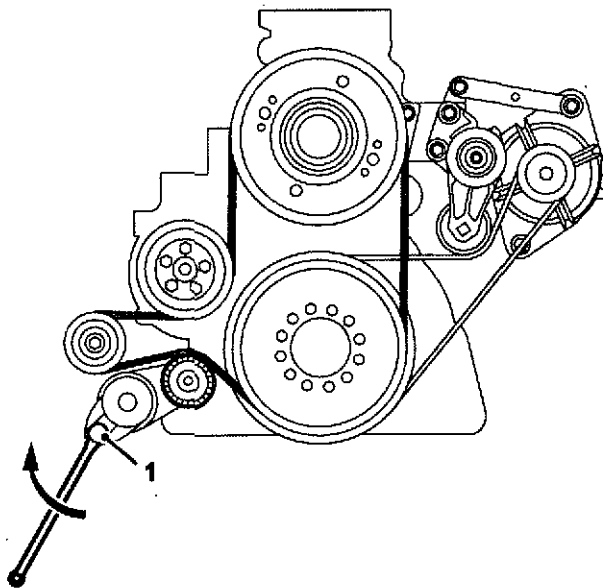
Drive Belt, Change



P0002086

TAD1640GE, TAD1641GE, TAD1642GE TAD1641VE,
TAD1642VE, TAD1643VE, TAD1650VE

- 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.



P0002087

TWD1643GE

Lubrication System

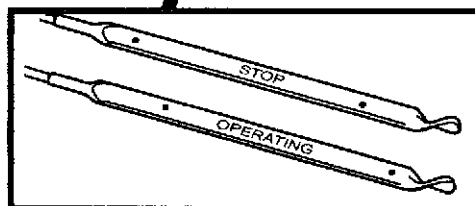
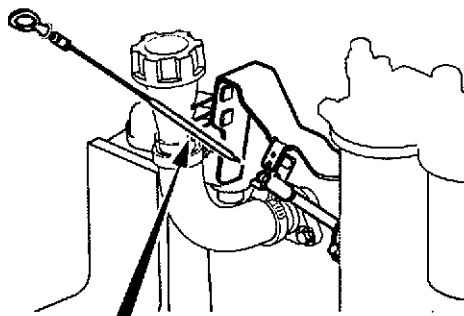
Oil change intervals may vary according to the lubrication oil grade and fuel sulfur content. **Refer to Technical data, Lubrication system.**

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

If longer oil change intervals than those given in Technical data are required, the condition of the oil must be checked by the oil manufacturer via regular oil tests.



P0002089



P0004311

Oil level, checking and topping up

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

- Top up with oil via the filler opening, please refer to *Maintenance page 45*.
- 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). Do not fill up above the maximum oil level. Only use a recommended grade of oil, please refer to *Technical Data page 74*.
- 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.

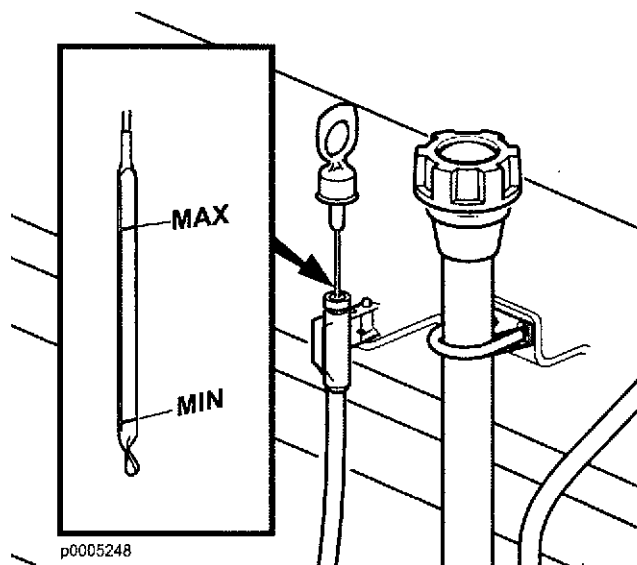
TAD1650VE

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

Top up with oil via the filler opening, located on the 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 *Technical Data page 74*.



p0005248

TAD1650VE

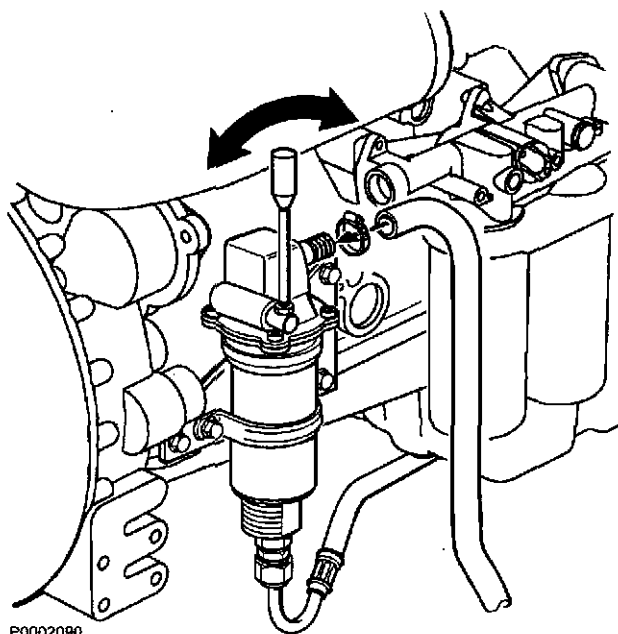
Engine Oil, Change

⚠ WARNING!

Hot oil and hot surfaces can cause burns.

Oil changes 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 oil).
Collect all the old oil and old filters, and leave them at 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 74.



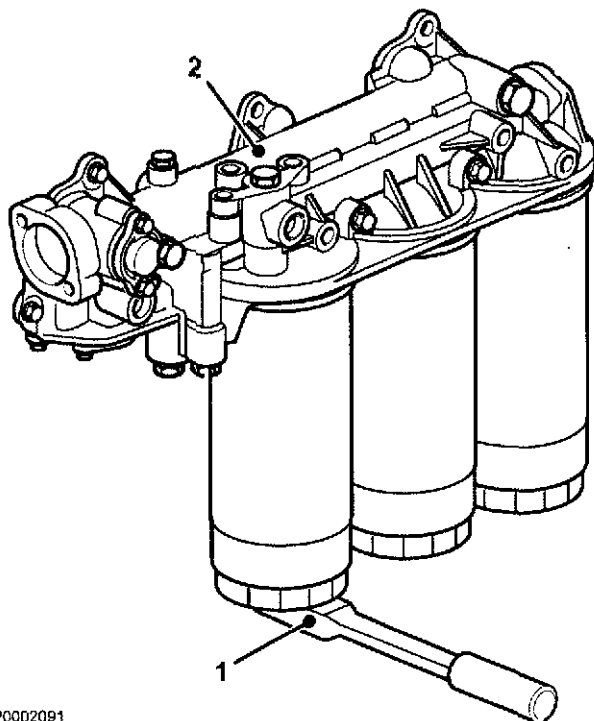
P0002090

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 $\frac{3}{4}$ -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.



P0002091

Fuel System

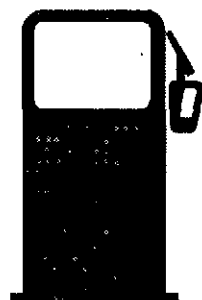
Only use the grades of fuel recommended in the fuel specification below, please refer to *Technical Data page 75*. Always observe the greatest cleanliness during re-fueling and work on the fuel system.

IMPORTANT!

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

⚠ WARNING!

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



P0002101

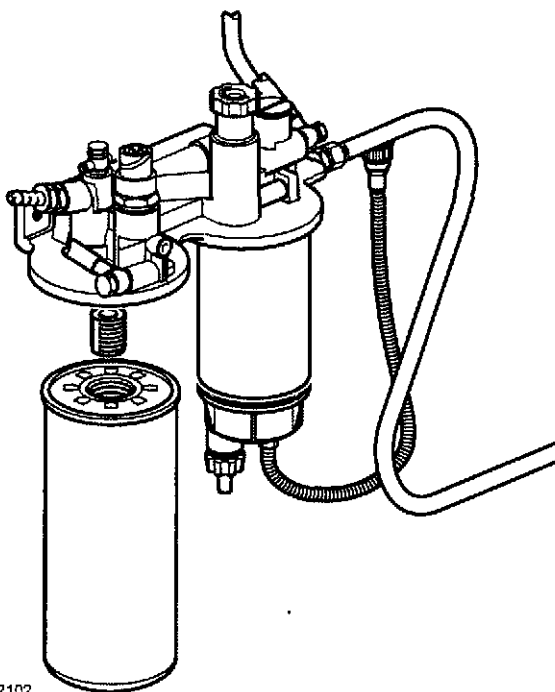
Engine Fuel Filter Replacement

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.

⚠ WARNING!

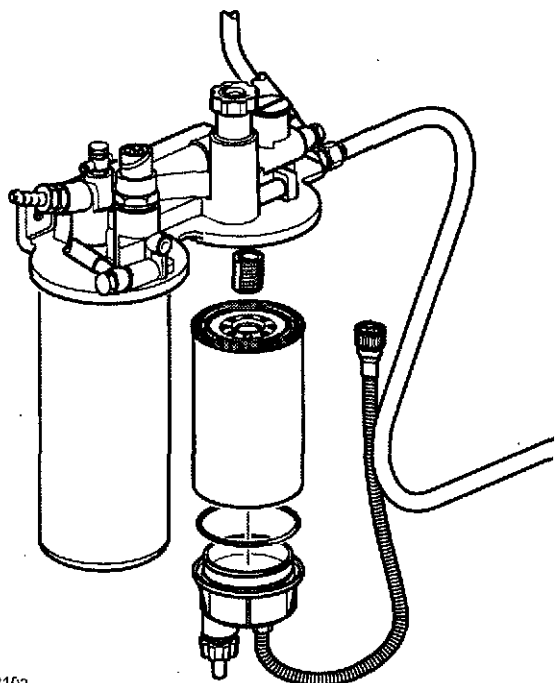
Fire hazard. When carrying out work on the fuel system make sure the engine is cold. A fuel spill onto a hot surface or an electrical component can cause a fire. Store fuel soaked rags so that they can not cause fire.



P0002102

- 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 *Bleeding the Fuel System page 58*.

Fuel Pre-filter, Change

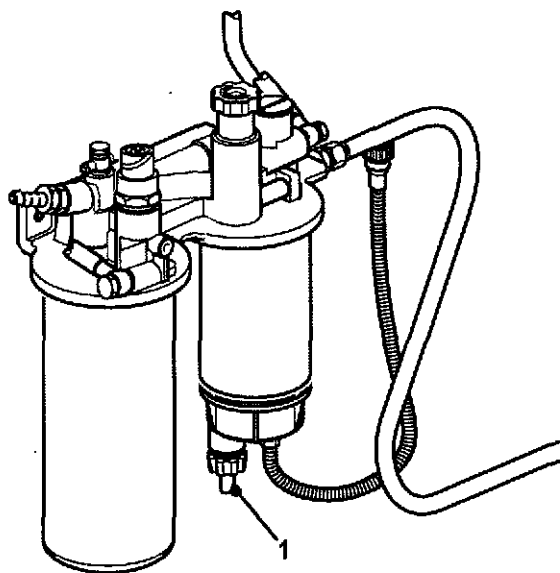


P0002103

- 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 page 58*.

Draining condensate, fuel system

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



P0002104

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

Bleeding the Fuel System

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

Cooling System

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

We recommend "Volvo Penta Coolant, Ready Mixed", or "Volvo Penta Coolant" (concentrated) mixed with pure water according to specifications. Refer to the table *Water Quality page 77*. Only coolant of this grade is suitable for, and approved by, Volvo Penta. The use of anti-corrosion agents alone is not permitted in Volvo Penta engines. Never use water alone as the coolant.

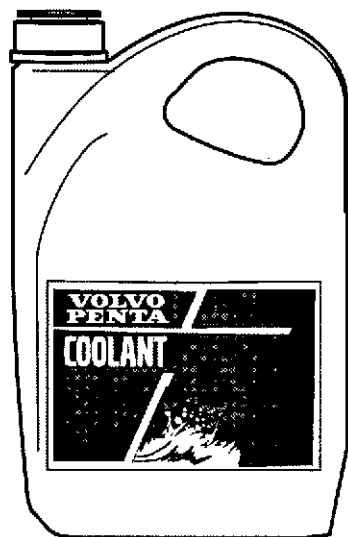
IMPORTANT!

Coolant of a suitable chemical composition must be used all year round. This applies even when there is no risk for frost damage, so that the engine always has complete corrosion protection. Future warranty claims related to engine and accessories may be refused if an unsuitable coolant has been used, or if the instructions for coolant mixture have not been followed.

The corrosion protection additives become less effective over time, which means that the coolant must be changed at regular intervals; refer to the *Maintenance Schedule page 43*. The cooling system must be flushed whenever the coolant is changed, refer to the *Cooling System, Cleaning page 64* section.

"Volvo Penta Coolant" is a concentrated coolant that must be mixed with water. It has been prepared to work best with Volvo Penta engines and offers excellent protection against corrosion, cavitation damage and frost bursting.

"Volvo Penta Coolant, Ready Mixed" is a ready-mixed coolant, 40 % "Volvo Penta Coolant" and 60 % water. This mixture protects the engine from corrosion damage, cavitation damage and frost bursting down to -28°C (-18°F).



P0002092

Coolant, Mixing

WARNING!

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

IMPORTANT!

Volvo VCS coolant (yellow in color) must **not** be used in Volvo Penta engines.

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

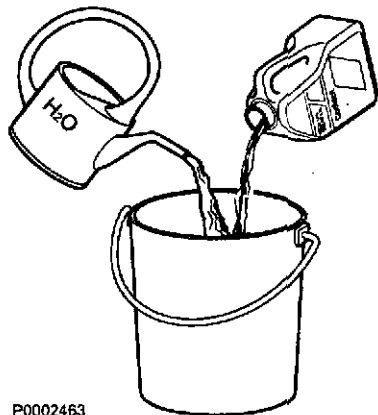
Mix: 40 % "Volvo Penta Coolant" (conc. coolant) and 60 % water

This mixture protects against internal corrosion, cavitation and frost bursting down to -28°C (-18°F). At 60 % glycol concentration, the freezing point is lowered to -54°C (-65°F).

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

The coolant must be mixed with distilled, deionized water. The water must fulfill the requirements specified by Volvo Penta; refer to *Water Quality page 77*.

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



P0002463

Coolant Level, Checking and Topping Up

WARNING!

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

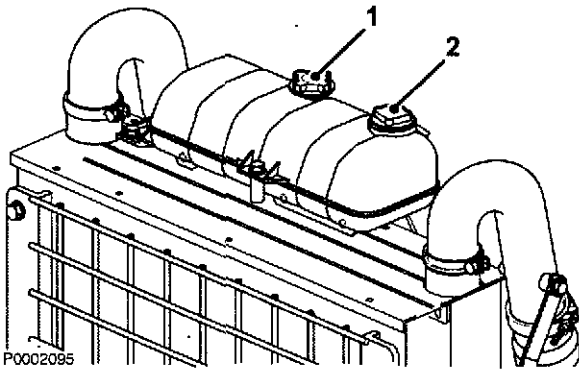
IMPORTANT!

Filling of coolant must be performed with the engine stopped. Fill up slowly, to allow the air to flow out.

Coolant Level, Checking and Topping Up

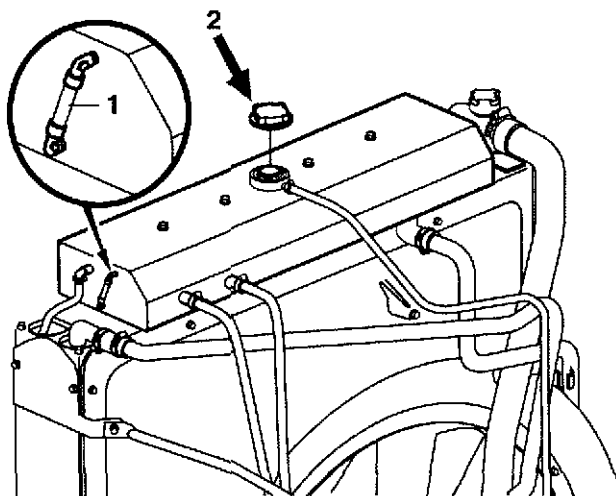
NOTICE! Only use coolant recommended by Volvo Penta.

NOTICE! Open only the filler cap (1). Do not open the pressure cap (2).



P0002095

TAD1640GE, TAD1641GE, TAD1642GE TAD1641VE,
TAD1642VE, TAD1643VE



P0002096

TWD1643GE

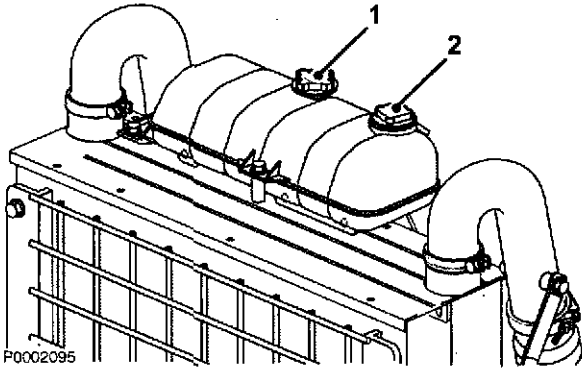
NOTICE! TWD1643GE: The cap (2) is both filler cap and pressure cap.

Check the coolant level daily before starting.

- 1 Check that the coolant level is above the MIN mark on the expansion tank.
- 2 Top up with coolant as required, so that the level is between the MIN and MAX marks.

TWD1643GE: Fill the expansion tank to the MAX mark on the sight glass.

Filling a completely empty system



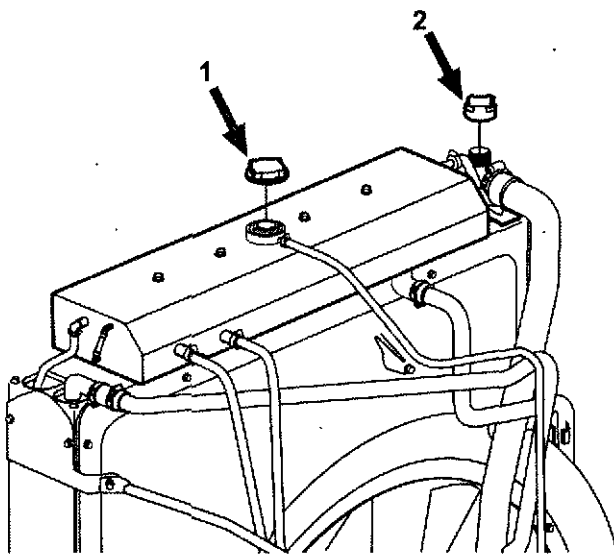
P0002095

TAD1640GE, TAD1641GE, TAD1642GE TAD1641VE,
TAD1642VE, TAD1643VE

NOTICE! Mix the correct amount of coolant in advance, to ensure that the cooling system is completely filled. Refer to *Technical Data page 77* for the correct coolant volume.

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

- 1 Check that all drain points are closed.
- 2 Open filler cap (1). Do not open the pressure cap (2).
- 3 Fill with coolant, so that the level is between the MIN and MAX marks.
- 4 Start the engine when the cooling system has been completely filled and vented. Open any venting taps a short while after starting, to allow trapped 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.
- 5 Stop the engine after about an hour and check the coolant level. Top up as necessary.



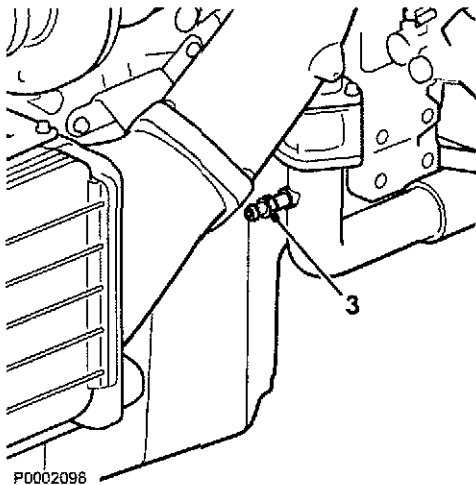
P0002097

TWD1643GE

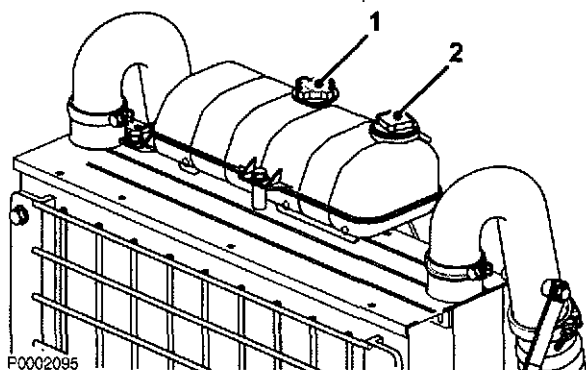
TWD1643GE

- 1 Open the caps to both the expansion tank (1) and radiator (2).
- 2 Fill coolant into the expansion tank until it is completely full.
- 3 Fill the radiator. Vent via the venting nipple (3).
- 4 Top up until the system is completely full. Refer to *Technical Data page 77* for the correct coolant volume.

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

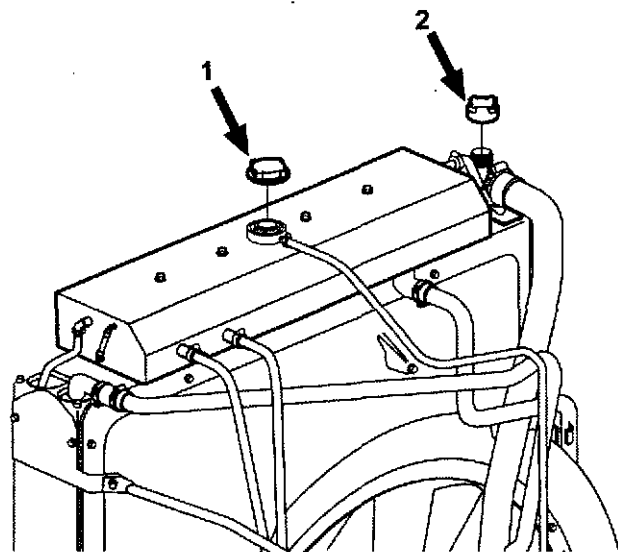


P0002098



P0002095

TAD1640GE, TAD1641GE, TAD1642GE TAD1641VE,
TAD1642VE, TAD1643VE



P0002097

TWD1643GE

Coolant, Draining

WARNING!

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

IMPORTANT!

On engines which are to be put in storage, the engine cooling system should **not** be drained. The coolant contains corrosion inhibiting additives.

1 Stop the engine before draining the cooling system and remove the expansion tank cap.

2 Remove the filler cap (1).

NOTICE! Do not open pressure cap (2).

NOTICE! On TWD1643GE both the pressure cap on the expansion tank (1) and the filler cap on the radiator (2) are opened.

3 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.

4 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.

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

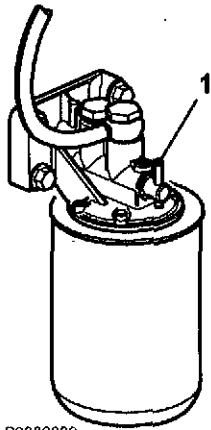
Charge Air Cooler, External Cleaning

Remove guards as necessary, to access the cooler. Clean with water and a mild detergent. Use a soft brush. Be careful not to damage the radiator matrix. Re-install the components.

IMPORTANT!

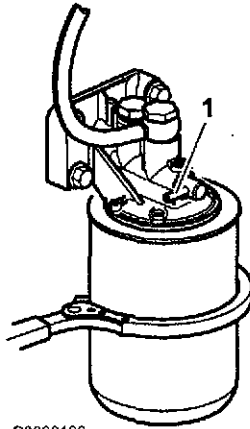
Do not use a high pressure power washer.

Open



P0002089

Closed



P0002100

Coolant Filter, Change

- 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 perform a leakage check.
- 6 Switch the engine off and check the coolant level. Refer to *Coolant Level, Checking and Topping Up* page 61.

Cooling System, Cleaning

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

IMPORTANT!

Cleaning must not be done if there is any risk of the cooling system freezing, since the cleaning solution does not have any frost prevention ability.

IMPORTANT!

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

- 1 Empty the cooling system. Refer to *Coolant, Draining* page 63.
- 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 77 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, you can do a cleanout with 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.
- 9 Fill up with Volvo Penta recommended coolant, following the instructions in the chapters entitled *Maintenance page 59* and *Coolant Level, Checking and Topping Up page 61*.

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.

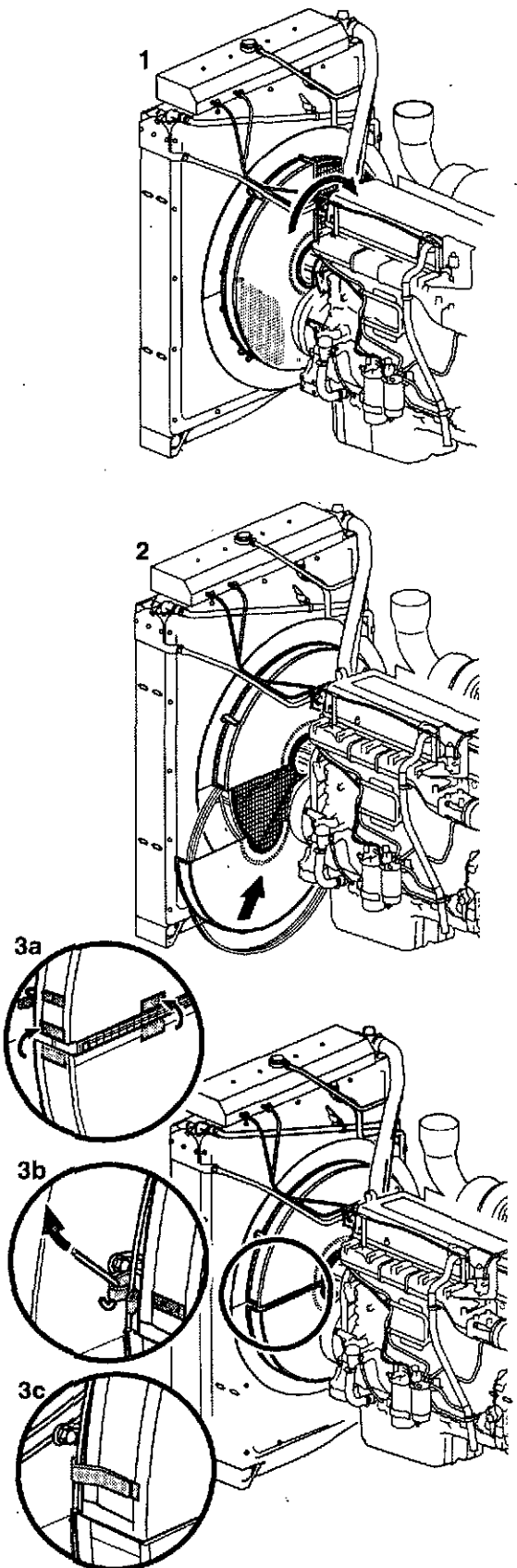
NOTICE! If a cleaning agent is necessary, an eco-friendly degreaser (e.g. coconut oil based) must be used as a first choice. Alternatively, use a paraffin fraction as a second choice.

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.



Electrical System

The engine is equipped with a 2-pole electrical system and an alternator. System voltage is 12V or 24V.

WARNING!

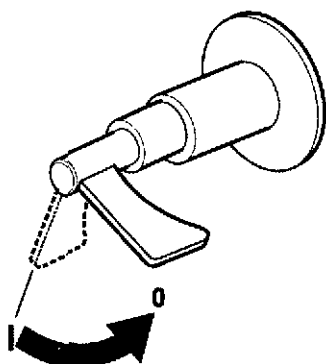
Always stop the engine and break the current using the main switches before working on the engine.

Main Switch

IMPORTANT!

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

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



P0002576

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 *Location of Sensors page 48*.

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 the connections as necessary with water-repellent spray (Volvo Penta universal oil).



P0002479



P0002107

Battery, Maintenance

⚠ WARNING!

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

⚠ WARNING!

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

⚠ WARNING!

The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries.

Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin wash off immediately using plenty of water and soap. If battery acid comes in contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

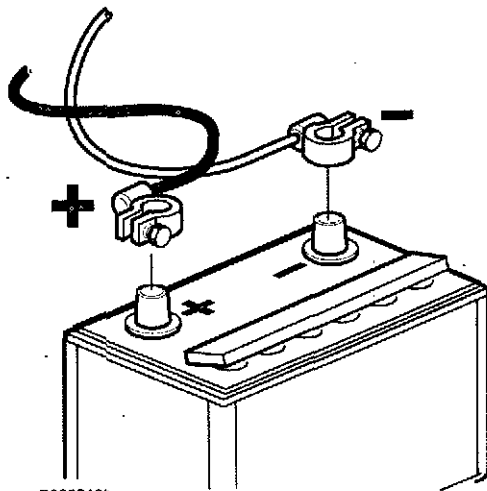
Connecting and disconnecting the battery

Connecting

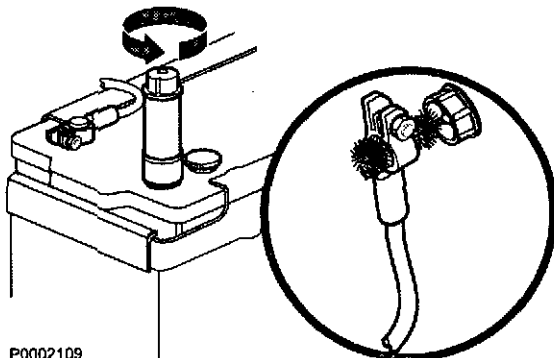
- 1 Connect the + cable (red) to the + pole on the battery.
- 2 Connect the - cable (black) to the - pole on the battery.

Disconnecting

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



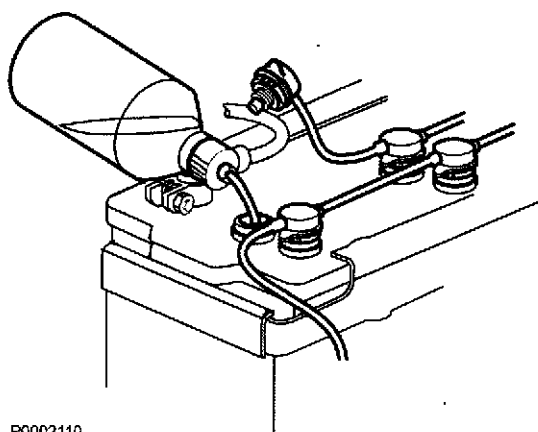
P0002108



P0002109

Cleaning

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



P0002110



P0002107

Filling

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

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

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

Battery, Charging

⚠ WARNING!

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

⚠ WARNING!

The battery electrolyte contains extremely corrosive sulfuric acid. Protect your skin and clothes when charging or handling batteries.

Always use protective goggles and gloves. If battery electrolyte comes into contact with unprotected skin wash off immediately using plenty of water and soap. If battery acid comes in contact with the eyes, flush immediately with plenty of water and obtain medical assistance without delay.

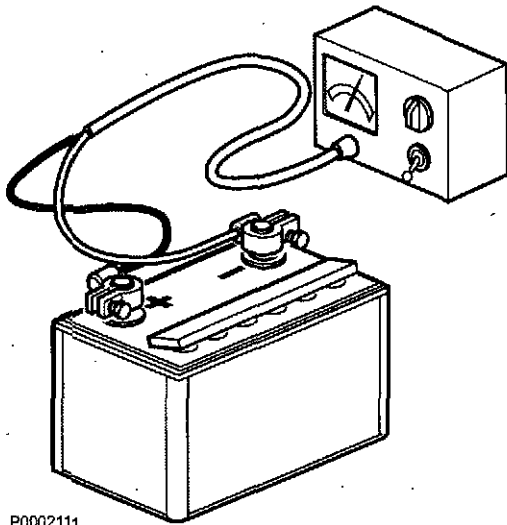
⚠ WARNING!

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

IMPORTANT!

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

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



P0002111.

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

Storage

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.

CAUTION!

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

WARNING!

Conservation oils can be flammable and dangerous to breathe. Ensure good ventilation. Use a protective face mask when spraying.

IMPORTANT!

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



P0002089

- **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 section *Conservation of the lubrication and fuel systems for more than 8 months' stoppage*.
- 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 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.
- 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.

Bringing out of storage

- Remove any covers from the engine, air filter and exhaust pipe.
- Put the correct grade of oil into the engine, if necessary, refer to *Tekniska data, smörjsystem*. 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 retighten the hose clamps.
- Close the drain taps and install any drainplugs.
- 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 (0.6 US gals) 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.

Technical Data

Engines

Engine designation	TAD1640GE	TAD1641GE	TAD1642GE	TWD1643GE
Power, Prime/Stand-by	Refer to the sales literature			
Torque, Prime/Stand-by	Refer to the sales literature			
No. of cylinders	6	6	6	6
Bore, mm (inch)	144 (5.67)	144 (5.67)	144 (5.67)	144 (5.67)
Stroke, mm (inch)	165 (6.50)	165 (6.50)	165 (6.50)	165 (6.50)
Cylinder volume, liter (inch ³)	16,12 (983.9)	16,12 (983.9)	16,12 (983.9)	16,12 (983.9)
Weight dry, kg (lbs)	1440 (3175)	1440 (3175)	1480 (3263)	1700 (3748)
Weight wet, kg (lbs)	1510 (3329)	1510 (3329)	1550 (3417)	1770 (3902)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	17,5:1	16,5:1	16,5:1	16,5:1
Low idle, rpm	900	900	900	900
High idle, rpm	1500/1800	1500/1800	1500/1800	1500/1800

Engine designation	TAD1641VE	TAD1642VE TAD1643VE	TAD1650VE
Power, Prime/Stand-by	Refer to the sales literature		
Torque, Prime/Stand-by	Refer to the sales literature		
No. of cylinders	6	6	6
Bore, mm (inch)	144 (5.67)	144 (5.67)	144 (5.67)
Stroke, mm (inch)	165 (6.50)	165 (6.50)	165 (6.50)
Cylinder volume, liter (inch ³)	16,12 (983.9)	16,12 (983.9)	16,12 (983.9)
Weight dry, kg (lbs)	1480 (3263)	1480 (3263)	1425 (3142)
Weight wet, kg (lbs)	1550 (3417)	1550 (3417)	1495 (3296)
Firing order	1-5-3-6-2-4	1-5-3-6-2-4	1-5-3-6-2-4
Compression ratio	17,5:1	17,5:1	18,0:1
Low idle, rpm	600	600	700
High idle, rpm	1800	1800	1800-2000

Lubrication System

Oil	
Change volume, including filter change	48 liter (12.68 US gal)
TAD1650VE	53 liter (14 US gal)
Oil pressure, hot engine	
at operating speed	300-650 kPa (44-94 psi)
TAD1650VE	400-650 kPa (58-94 psi)
Oil filter	
Full flow filter	2
By-pass filter	1
Lube oil pump	
Type	Gear driven

Oil recommendations

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: E7 ²⁾ VDS-2 and ACEA: E5 ²⁾ VDS-2 and Global DHD-1 ²⁾ VDS-2 and API: CI-4 ²⁾ VDS-2 and API: CH-4 ²⁾	600 hrs / 12 month	300 hrs / 12 month	150 hrs / 12 month
VDS and ACEA: E3 ²⁾	400 hrs / 12 month	200 hrs / 12 month	100 hrs / 12 month
ACEA: E7, E5, E4 API: CI-4, CH-4, CG-4	200hrs / 12 month	100 hrs / 12 month	50 hrs / 12 month

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

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

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

VDS = Volvo Drain Specification

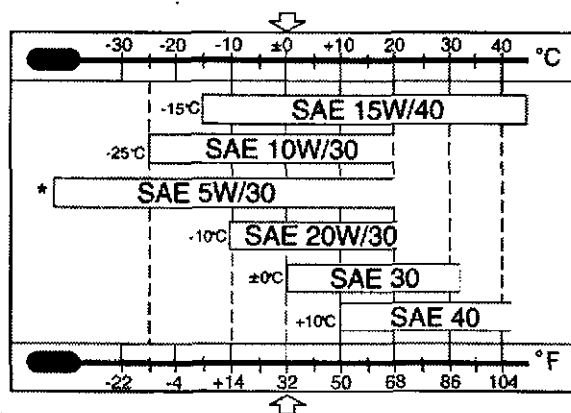
ACEA = Association des Constructeurs Européenne d'Automobiles

API = American Petroleum Institute Global

DHD = Global Diesel Heavy Duty

TBN = Total Base Number

Viscosity



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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 600 rpm	min 100 kPa (14.5 psi)
Feed pressure at 1200 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 och 2-D

JIS KK 2204

Sulfur content: Complying with legal requirements in each country. If the sulfur content exceeds 0.5 weight-percent, the oil change intervals shall be changed, refer to *Technical Data page 74*.

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 %.

Biodiesel

Biodiesel is also known as Fatty Acid Methyl Esters (FAME).

Volvo Penta accepts max 5% FAME in diesel fuel, in accordance with EN590, to be used without any restraint in service recommendations.

Volvo Penta accepts extended FAME use up to 30% blend in diesel fuel for engines produced after Jan 1-2009, under specific conditions and with certain limitations. Specific service requirements are applied for fuel blends with more than 5% FAME.

Engines that are manufactured by Volvo Penta are certified for the use of market diesel fuel according to EN 590. Emission requirements according to EU Stage 3A will only be met with the prescribed EN 590 diesel fuel. At the date of this document En 590 diesel fuel may contain up to 5% FAME.

Conditions

Volvo Penta engines of above are able to run with fuel blends containing up to 30% FAME under specific conditions:

- Oil quality VDS-3 or VDS-4 must be used.
- FAME must comply with EN 14214⁽¹⁾.
- Diesel fuel in which FAME is mixed must comply with EN 590⁽²⁾.
- Specific service requirements must be fulfilled. See Service Bulletin 18-8-8, contact your Volvo Penta service dealer.

The fuel must comply with nationally laws and regional/local provisions regarding the use of FAME. The engine operator has the responsibility of using the fuel that is recommended by the manufacturer and allowed by the national legislation.

Normal rapeseed oil and other pure vegetable and animal oils do not meet EN 14214 and may not be used as fuel or as fuel additives. These products are not approved by Volvo Penta and warranties do not apply in the event of engine damage.

Performance

The energy value of FAME is lower than for standard diesel fuel. The use of 30% FAME can result in an increase in fuel consumption with up to 5% and decrease maximum power performance by up to 4%. The engine fuel consumption data is only valid for diesel and will give incorrect readings if FAME blends are used.

Predictive maintenance on oil drain is not applicable. The exhaust fumes might smell different and visible smoke might be seen during starting when using FAME.

1) European standard that describes the quality requirements and test methods for FAME.

2) European standard that describes the quality requirements and test methods for Diesel.

Cooling System

Type	Pressurized, sealed
Pressure cap, max. opening pressure	75 kPa (10.88 PSI)
Coolant quantity (engine):	
TAD1640-42GE, TAD1641-43VE, TWD1643GE	33 liter (8.72 US gallon)
Coolant quantity (engine, radiator and hoses):	
TAD1640-42GE, TAD1641-43VE	60 liter (15.85 US gallon)
TWD1643GE	95 liter (25.1 US gallon)
Thermostat, quantity	
	1 pc.
Thermostat, opening temperature:	
TAD1640-42GE, TAD1641-43VE	86 °C (186.8 °F)
TAD1650VE, TWD1643GE	82 °C (179.6 °F)

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



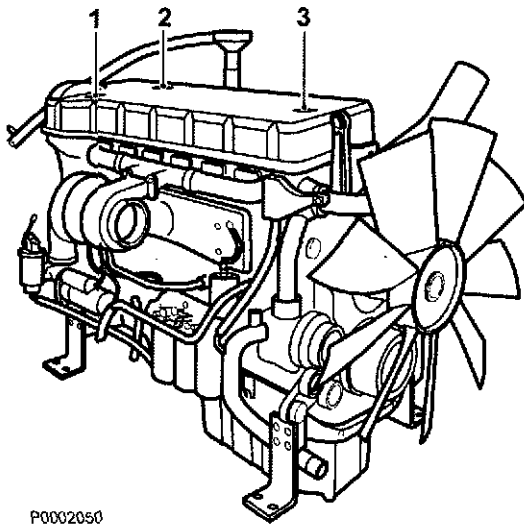
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Electrical System

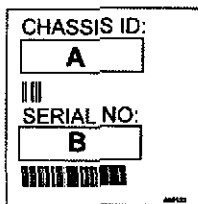
System voltage	24V
Alternator	
voltage/max. current	28V/80A
power app.	2200W
Alternative generating equipment (optional)	
voltage/max. current	28V/110A
power app.	2800W
Battery capacity	2 pcs. series connected 12 V, max. 225 Ah
Battery electrolyte density at +25°C °	
fully charged battery	1,28 g/cm ³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

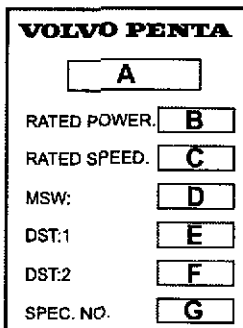
Identification Numbers



P0002050



P0002051



P0002052



P0002053

1
Chassis and serial number

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

3
1 Engine designation
2 Serial number
3 Specification number



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Alphabetical index

After Engine Shutdown.....	23
Air Filter, Check and Change.....	52
Alarms.....	22
Alternator Belts, Change.....	53
Battery, Charging	69
Battery, Maintenance.....	68
Before Engine Shutdown.....	23
Before Starting.....	18
Bleeding the Fuel System.....	58
Charge Air Cooler, External Cleaning	63
Charge Air Pipe, Leakage Check.....	52
CIU (Control Interface Unit).....	17
Coolant Filter, Change.....	64
Coolant Level, Checking and Topping Up.....	61
Coolant, Draining.....	63
Cooling air filter.....	66
Cooling System, Cleaning.....	64
DCU (Display Control Unit)	11, 19
Diagnostic Function.....	28
Draining condensate, fuel system.....	58
Drive Belt and Alternator Belt, Inspection.....	52
Drive Belt, Change.....	54
DU (Display Unit).....	17
Easy Link Instruments	17
Electrical Connections.....	67
EMS (Engine Management System).....	10, 19
Engine Fuel Filter Replacement.....	57
Engine Oil, Change.....	56
Engine, General.....	51
Engines.....	9, 73
Extra Stop.....	24
Fault Tracing	26
Fuel Pre-filter, Change.....	58
Fuel System.....	57, 75
General Information	43
Identification Numbers	79
Location of Sensors	48, 49, 50
Lubrication System.....	55, 74
Main Switch	67
Maneuvering.....	22
Never Use Start Spray	20
Oil Filter/By-pass Filter, Change	56
Oil level, checking and topping up.....	55
Orientation.....	45
Reading the Instruments	22
Starting in Extreme Cold	20
Starting the Engine.....	19
Starting Using Auxiliary Batteries.....	21
Stop the Engine.....	23
Water Quality	77
Viscosity.....	75



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