

# **OPERATOR'S MANUAL**

**D5A T/TA Genset Engine**

**Classifiable control system**

**CALIFORNIA**

**Proposition 65 Warning**

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

# Foreword

Thank you for purchasing this Volvo Penta Marine Auxiliary Engine.

The Operator's Manual contains operation instructions and maintenance and inspection information. In order to ensure safety and bring out the maximum performance of the engine, do not operate it until you have read and fully understood the contents of this manual. Also do not operate the engine unless in compliance with local regulations.

For information on genset and/or generator specific items refer to generator information supplied by genset builder and/or generator manufacturer. In case of contradictions, the information in this Volvo Penta Operator's Manual overrules any information given in the documentation provided by the generator manufacturer. Do not hesitate to consult your Volvo Penta dealer.

Failure to follow the instructions and cautions in this manual may result in serious accidents.

\* Keep this manual at hand for easy reference.

\* If this manual is damaged or misplaced, immediately order a new one from your dealer.

All information and illustrations in this manual are based on the specifications that were available at the time of printing. This manual does not cover all available variants of accessories and options.

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# Safety Information

Read this chapter thoroughly. It concerns your safety. This section describes how safety information is presented in this manual and on the product. It also includes a summary of basic safety regulations for operation and maintenance of the engine.

**This Operator's Manual is only valid for the auxiliary engine built in the Volvo Penta factory. Make sure you are in possession of the right operator's manual before reading on. If this is not the case, please get in touch with your Volvo Penta dealer.**

**If operations are performed incorrectly it could result in personal injury or damage to property or the engine. Read the Operator's Manual carefully before operating or servicing the engine. For safety information on genset operation and maintenance of the generator, refer to the documentation provided by the genset builder. If anything is unclear please contact your Volvo Penta dealer for assistance.**



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

In the Operator's Manual warning texts have the following priority:

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

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

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

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

## Safety regulations during engine operation

### The new engine

Read instruction manuals and other information accompanying the new vessel thoroughly. Accustom yourself with handling the engine, controls and other equipment in a safe and correct manner.

Remember that when operating a vessel, you have a legal responsibility to be aware of and follow regulations concerning traffic and safety at sea. Inform yourself of the regulations applicable to your vessel and the waters you are in by getting in touch with the relevant authorities or marine safety organization.

### Accidents and other incidents

Sea rescue statistics show that deficient maintenance of vessels and engines together with defective safety equipment often causes accidents and other incidents at sea.

Make sure your vessel and engine are maintained in accordance with directions in the instruction manuals and that the safety equipment on board is in good working order.

### Daily inspection

Make a habit of visually inspecting the engine and engine room before starting and after stopping the engine. This will help you to quickly detect any fuel, coolant or oil leaks and any other abnormalities that have occurred or are about to occur.

### Maneuvering

Avoid violent and rapid rudder movement and gear shifting. There is a risk of the passengers falling down or falling overboard. A rotating propeller can cause serious injury. Make sure there is nobody in the water before engaging forward/reverse. Never run close to bathers or in places where you have reason to believe there are people in the water.

### Filling fuel

There is a risk of fire and explosion when filling fuel. Smoking is prohibited and the engine must be turned off. Never overfill the tank. Close the filler cap securely. Use only fuel recommended in the operators manual. The incorrect grade of fuel can disturb operation or cause breakdown. This can also lead to the control rod jamming on diesel engines, which will cause the engine to overspeed and risk damaging machinery and causing personal injury.

### Combustible environment

Due to the risk of fire and/or explosion, do not start or continue to run the engine if there is a suspected leak or discharge of combustible media, e.g. fuel oil or LPG, in the engine surroundings.

### Carbon monoxide poisoning

When a vessel is moving forward, it will cause a certain vacuum to form behind the vessel. In unfortunate circumstances, the suction from this vacuum can be so great that the exhaust gases from the vessel are drawn into the bridge or cabin and cause carbon monoxide poisoning. This problem is most prevalent on high, wide vessels with abrupt stern. Other factors that can increase the effect of the suction are wind conditions, load distribution, swells, trim, open hatches and portholes, etc. Most modern vessels, however, are designed in such a way that this problem is very rare. If suction should arise anyway, do not open hatches or portholes at the fore of the vessel. Surprisingly, this will otherwise increase the suction. Try changing speed, trim, or load distribution instead. Get in touch with your Volvo Penta dealer for help in obtaining the best solution for your vessel.

## Safety directions for maintenance and service

### ⚠ Preparations

#### Knowledge

The operator's manual contains directions for performing normal maintenance and service in a safe and correct manner. Read the directions carefully before starting work. More detailed service literature is available from your Volvo Penta dealer. Never perform a task unless you are absolutely sure how it is to be carried out; call your Volvo Penta dealer for assistance instead.

#### Stop the engine

Stop the engine before opening or dismantling the engine hatch/hood. Maintenance and service must be carried out with the engine stationary unless stated otherwise in the instructions. Prevent inadvertent start of the engine by removing the starter key and turning off the power with the main switch, locking it in the off position. Place warning signs stating that service is in progress in every position from which the engine can be started. Working on or approaching a running engine is a safety hazard. Loose clothing, hair, fingers or a dropped tool can be caught in rotating parts and cause serious bodily injury. Volvo Penta recommend leaving all work requiring the engine to be running to an authorized Volvo Penta dealer.

#### Lifting the engine

Always use the lifting eyes mounted on the engine when lifting the engine. Always make sure lifting equipment is in good condition and constructed for the lift (engine weight together with possible reverse gear and extra equipment). Use an adjustable lifting boom to ensure safe handling when lifting the engine. All chains and wires must run parallel with each other and as much at right angle as possible to the top of the engine. Note that any extra equipment mounted on the engine can change the center of gravity. Special lifting devices may be required to obtain the right balance and safe handling. Never perform service on an engine suspended only from a lifting device.

⚠ **IMPORTANT!** Engine must only be lifted horizontally.

#### Before starting

Refit all guards and covers that have been removed before starting the engine. Make sure there are no tools or other objects left on the engine. A turbocharged engine must never be started without the air filter fitted. The rotating compressor wheel in the turbocharger can cause severe personal injury.

There is also a risk of foreign objects being drawn in and causing mechanical damage.

### ⚠ Fire and explosion

#### Fuel and lubricants

All fuels, most lubricants, and many chemicals are flammable substances. Always read and follow the directions on the packaging. Work performed on the fuel system must be done on a cold engine. Fuel leaks and spills on hot surfaces or electrical components can cause fires.

Keep oil- and fuel drenched rags and other hazardous materials where they are safe in case of fire. Oil drenched rags can selfignite in certain conditions. Never smoke when refueling, topping up with oil or when in the vicinity of the fuel station or the engine room.

#### Non-original parts

Components in fuel, lubrication, ignition and electrical systems on Volvo Penta engines are designed and manufactured to minimize the risk of explosion and fire in compliance with existing legislation.

The use of non-original parts can result in explosion or fire.

#### Batteries

Batteries contain and generate oxyhydrogen gas, especially when charging. Oxyhydrogen is easily ignited and extremely explosive. Smoking, open flames and sparks must never occur in, or close to, the batteries or battery compartment. A faulty battery connection or jumper cable can generate sparks that can cause the battery to explode.

## **Start spray**

Never use start spray or similar start help. Explosions can occur in the intake manifold. Risk for personal injury.

## **⚠ Hot surfaces and fluids**

At operating temperature, the engine and its components are hot. A hot engine always involves risk for burn injuries. Take care with hot surfaces. E.g.: exhaust manifold, turbocharger, oil pan, charge air pipe, starting heater, hot coolant and warm lubricant in pipes and hoses.

**⚠ WARNING!** Do not open the crankcase covers while the engine is still hot.

## **⚠ Carbon monoxide poisoning**

Start the engine in well-ventilated spaces only. When running in confined spaces, the exhaust gases and crankcase gases must be evacuated.

## **⚠ Chemicals**

Most chemicals such as glycol, anti-corrosion agent, preservatives, degreasing agent, etc., are hazardous to health. Always read and follow the directions on the packaging.

Certain chemicals such as preservatives are flammable and harmful to inhale. Provide good ventilation and use breathing protection when spraying. Always read and follow the directions on the packaging. Store chemicals and other hazardous materials out of reach of children. Leave left over or used chemicals to a destruction plant.

## **⚠ Cooling system**

There is a risk of water entering when working on the seawater system. Therefore, stop the engine and close the seawater cock before starting work.

Avoid opening the coolant filler cap when the engine is warm. Steam or hot coolant may spurt out and cause burn injuries.

If the filler cap, coolant pipe, cock, etc., must nevertheless be opened or dismantled while the engine is warm, the filler cap must be opened carefully to release the pressure before removing it completely and starting work. Note that the coolant can still be hot and cause burn injuries.

## **⚠ Lubricating system**

Hot oil can cause burn injuries. Avoid skin contact with warm oil. Make sure the lubricating system is depressurized before starting work. Never start or run the engine with the oil filler cap removed or there will be a risk of the oil being thrown out.

## **⚠ Fuel system**

Always protect your hands when carrying out leak detection.

Escaping fluids under pressure can pierce bodily tissue and cause serious injury. Risk of blood poisoning. Always cover any electric component if it is located under the fuel filter. Otherwise it might be damaged by fuel spills.

## **⚠ Electrical system**

Turn off the power before commencing work on the electrical system, the engine must be stopped and the powered turned off with the main switch/switches. Shore power to the engine heater, battery charger or other extra equipment fitted to the engine must be disconnected.

## **Batteries**

Batteries contain a highly corrosive electrolyte. Protect your eyes, skin and clothing when charging and handling batteries. Always use protective goggles and gloves.

In case of splashes on the skin, wash with soap and plenty of water. In case of splashes in the eyes, rinse immediately with plenty of water and call a doctor.

## **Avoid burns and crushing or cutting!**

At operating temperature, the engine coolant is hot and under pressure. Steam can cause personal injury. Check the coolant level only after the engine has been stopped and the coolant filler cap has cooled enough to touch with your hand. Never adjust the V-belts while the engine is running.

## **Service batteries carefully!**

If you spill electrolyte on yourself, flush skin immediately with lots of water. Apply baking soda to help neutralize the acid. If electrolyte gets in your eyes, rinse immediately with large amounts of water then contact a doctor at once.

### **Handle antifreeze carefully!**

Antifreeze contains alkali. Avoid contact with skin and eyes to prevent personal injury. Dispose of drained antifreeze coolant according to local regulations. For disposal, consult your dealer.

### **Dress properly for the job!**

Wear protective devices - hard hat, face shield, safety shoes, goggles, heavy gloves, ear protectors, etc. - for your own safety.

### **Recommended fuel, lubrication oil and coolant!**

Use of any other fuel oil, lubrication oil or coolant than the recommended can cause engine damage and reduce engine service life.

### **Perform all recommended inspections!**

Perform pre-start inspection and periodic inspection on items listed in this manual. Failure to follow this recommendation can cause serious engine damage.

# Introduction

This operator's manual has been produced to give you the greatest benefit of your Volvo Penta auxiliary engine. It contains the information necessary to handle and maintain your engine in a safe and correct manner. We would like you to read this operator's manual thoroughly and learn how to handle the engine, controls and other equipment in a safe manner before starting the engine.

**Keep the operator's manual within reach at all times.**

## Care of the environment

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

As a manufacturer of marine engines Volvo Penta has a special responsibility. That is why care of the environment is a core value in our product development. Volvo Penta has a broad range of engines where progress has been made in reducing exhaust emissions, fuel consumption, engine noise, etc. We hope you will take part in preserving these qualities.

Always follow any advice given in the operator's manual concerning fuel grades, operation and maintenance and you will avoid causing unnecessary interference to the environment. Get in touch with your Volvo Penta dealer if you notice any changes such as increased fuel consumption and/or exhaust smoke.

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

## Fuel and oil

Use only fuel and lubrication oil grades recommended in the technical data section of this Operator's Manual. Other grades can cause operational problems, increase fuel consumption and have long-range effects on engine service life.

## Service and spare parts

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

The worldwide Volvo Penta network of authorized dealers is at your service. They are specialists in Volvo Penta products and stock accessories, original spare parts, test equipment and the special tools required to perform high-quality service and repairs.

Always follow the maintenance intervals specified in the operator's manual and remember to specify the engine number when ordering service and spare parts.

## Certified engines

It is essential that owners and operators of emission certified engines, used in areas where exhaust emissions are regulated by law, are aware of the following points:

A certification involves the engine type being checked and approved by applicable authorities. Engine manufacturers guarantee that all engines of the same type correspond with the certified engine.

### **This puts special demands on the maintenance and service of your engine:**

- \* Maintenance and service intervals recommended by Volvo Penta must be followed.
- \* Only Volvo Penta original spare parts may be used.
- \* Service of injector pumps, pump settings and injectors must always be performed by an authorized Volvo Penta service person.
- \* The engine must not be modified in any way with the exception of accessories and service kits approved by Volvo Penta for use on the engine.
- \* Installation modifications must not be made to the engine exhaust pipe or inlet channels.
- \* Sealed sections must not be broken by anyone other than authorized personnel.

Otherwise, general directions concerning running, care and maintenance given in the operator's manual apply.



**IMPORTANT!** Neglected or deficient maintenance/service and the use of non-original spare parts will entail Volvo Penta renouncing any responsibility for the engine corresponding to the certified version. Volvo Penta will not compensate for damage and/or costs arising from the above.

## Warranty

Your new Volvo Penta auxiliary engine is covered by a limited warranty complying with the conditions and instructions given in the Warranty and Service Book.

Note that AB Volvo Penta's responsibility is limited to what is specified in the Warranty and Service Book. Read it carefully as soon as possible after delivery. It contains important information concerning the warranty card, service, maintenance and what the owner is responsible to be aware of, check and perform. AB Volvo Penta will otherwise decline warranty liability completely or fully.

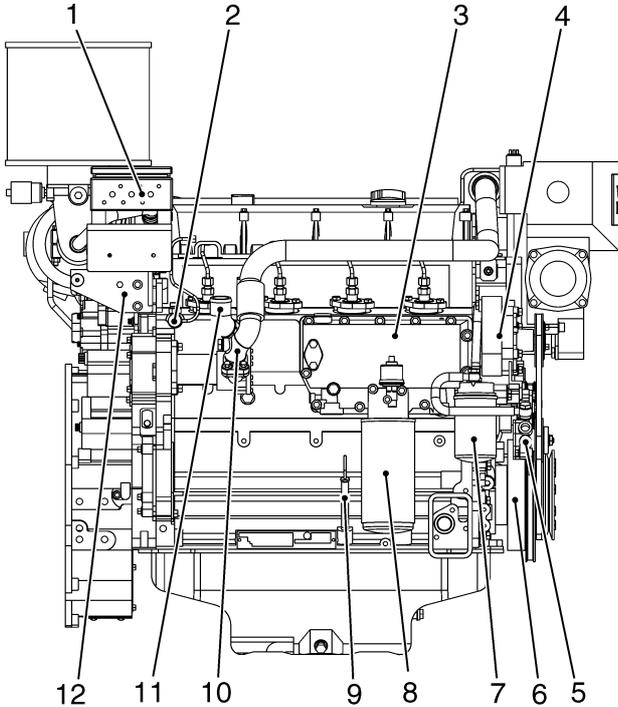
**Get in touch with your Volvo Penta dealer if you have not received a Warranty and Service Book or a copy of the warranty card.**

# Presentation

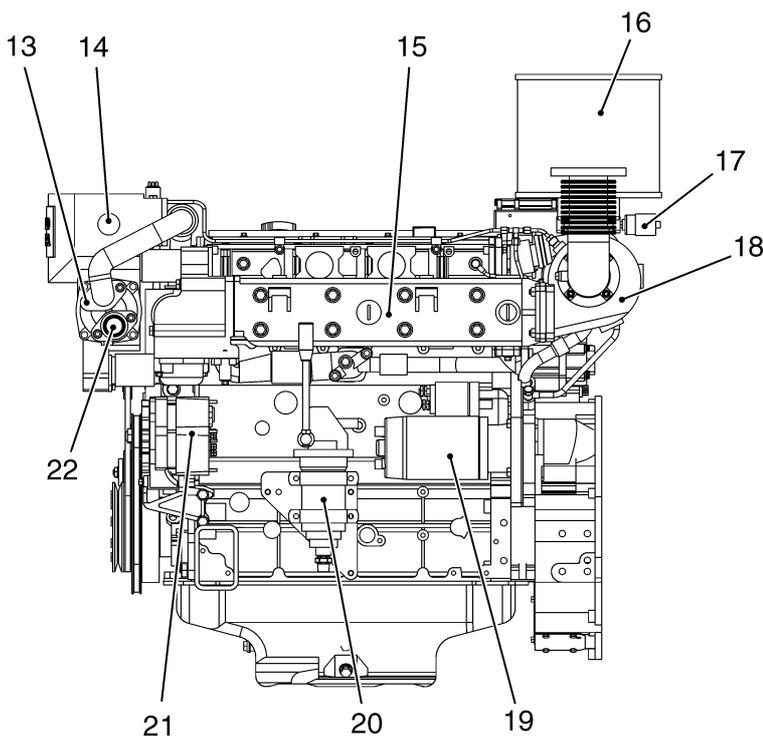
## D5A T HE Genset Engine

The D5A T HE is a turbocharged, in-line, direct injection, 4-cylinder, 4-stroke marine genset engine. It is equipped with an engine mounted heat exchanger suitable for seawater cooling or connection to a central cooling system.

An optimal combination of combustion chambers, fuel injection system, and effective turbocharger, provide excellent fuel consumption over the whole range of power output.



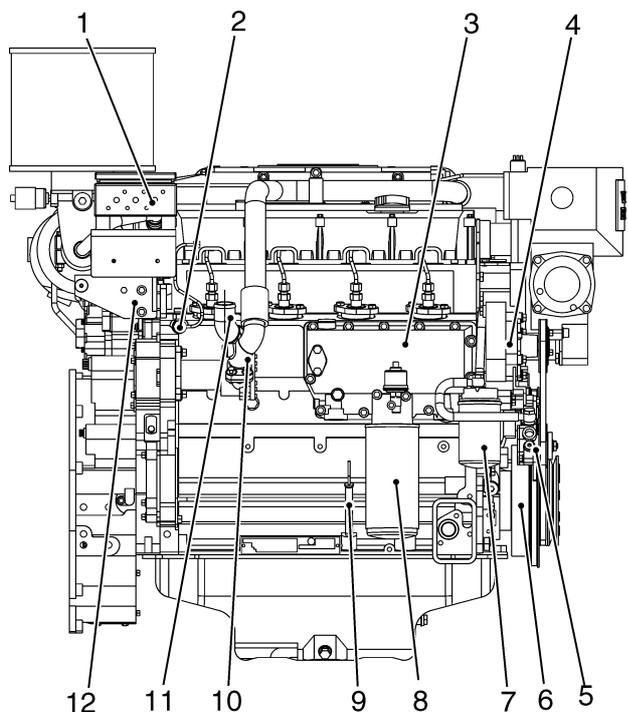
1. Electrical connection box
2. Fuel return
3. Oil cooler
4. Fresh water pump
5. Fuel pump & Fuel inlet
6. Vibration damper
7. Fuel filter
8. Oil filter
9. Oil dip stick
10. Raw water pump
11. Raw water inlet
12. Governor & Stop solenoid
13. Heat exchanger
14. Expansion tank
15. Exhaust manifold
16. Air filter
17. Air filter indicator
18. Turbocharger
19. Electrical starter
20. Engine oil drain pump
21. Alternator
22. Raw water outlet



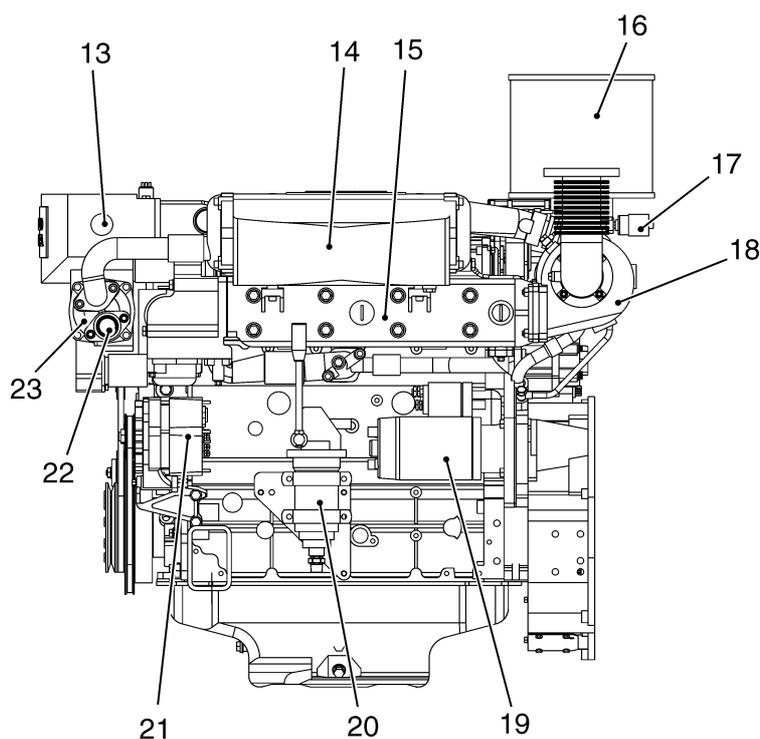
## D5A TA HE Genset Engine

The D5A TA HE is a turbocharged, aftercooled in-line, direct injection, 4-cylinder, 4-stroke marine genset engine. It is equipped with an engine mounted heat exchanger suitable for seawater cooling or connection to a central cooling system.

An optimal combination of combustion chambers, fuel injection system, effective turbocharger and charge air cooling, provide excellent fuel consumption over the whole range of power output.



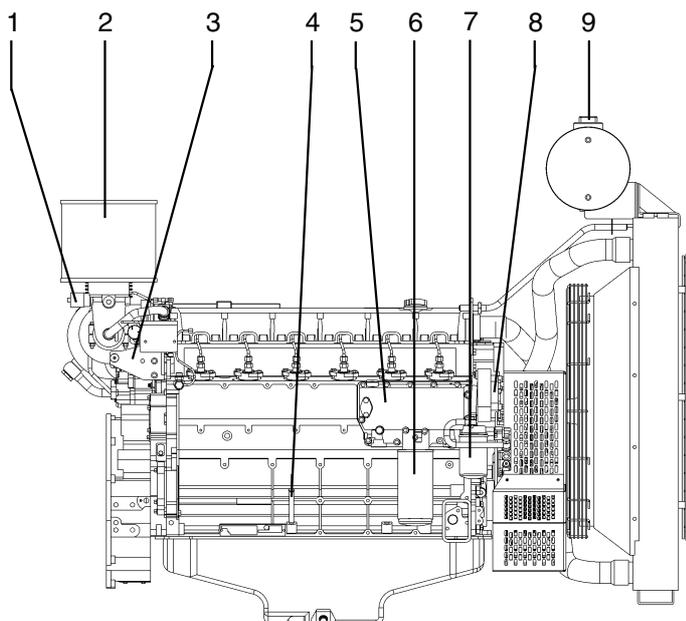
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15. Exhaust manifold
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17. Air filter indicator
18. Turbocharger
19. Electrical starter
20. Engine oil drain pump
21. Alternator
22. Raw water outlet
23. Heat exchanger



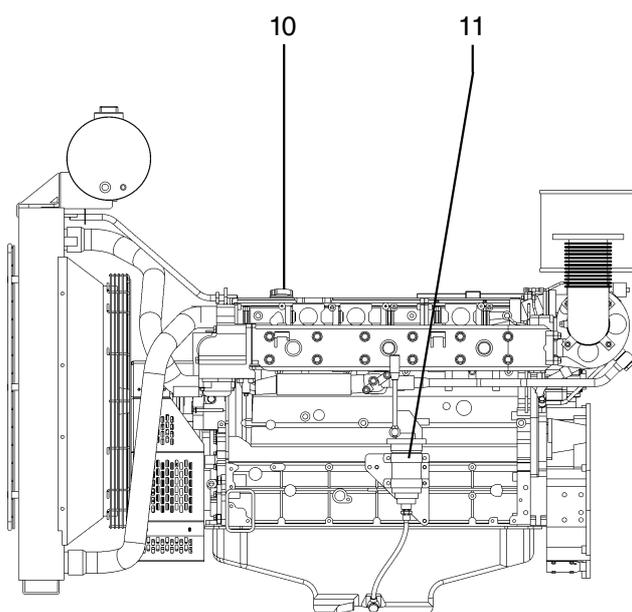
## D5A T RC Genset Engine

The D5A T RC is an in-line, direct injection, 4-cylinder, 4-stroke marine diesel engine. It has a turbocharger and is equipped with radiator cooling.

An optimal combination of combustion chambers, fuel injection system, effective turbocharger and charge air cooling, provide excellent fuel consumption over the whole range of power output.



1. Maintenance indicator air filter
2. Air filter
3. Governor & stop solenoid
4. Oil dip stick
5. Oil cooler
6. Oil filter
7. Fuel filter
8. Freshwater pump
9. Pressure cap exp. tank

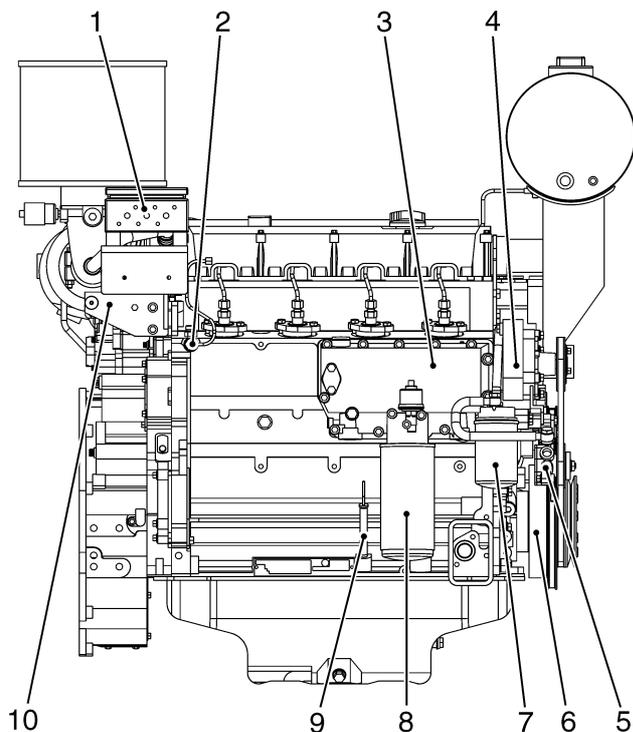


10. Oil filler
11. Oil drain pump

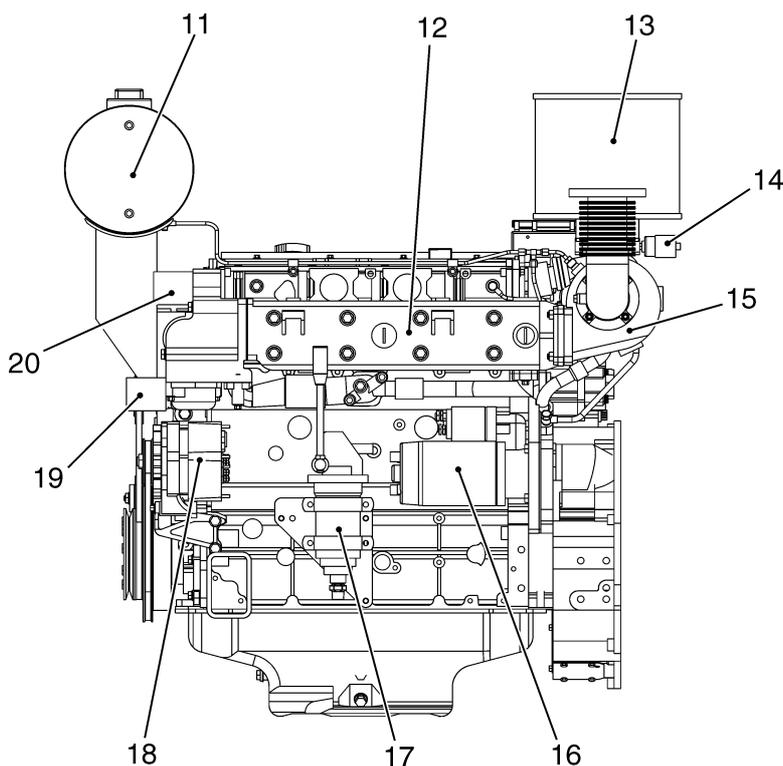
## D5A T KC Genset Engine

The D5A T is a turbocharged, in-line, direct injection, 6-cylinder, 4-stroke marine genset engine. It is fitted with connections for keel cooling (1-circuit).

An optimal combination of combustion chambers, fuel injection system, and effective turbocharger, provide excellent fuel consumption over the whole range of power output.



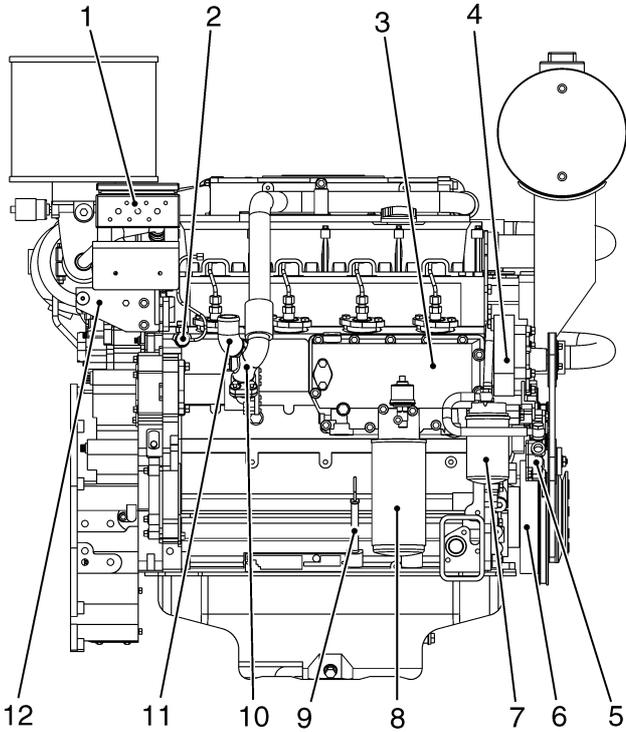
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11. Expansion tank
12. Exhaust manifold
13. Air filter
14. Air filter indicator
15. Turbocharger
16. Electrical starter
17. Engine oil drain pump
18. Alternator
19. Freshwater outlet
20. Fresh water inlet



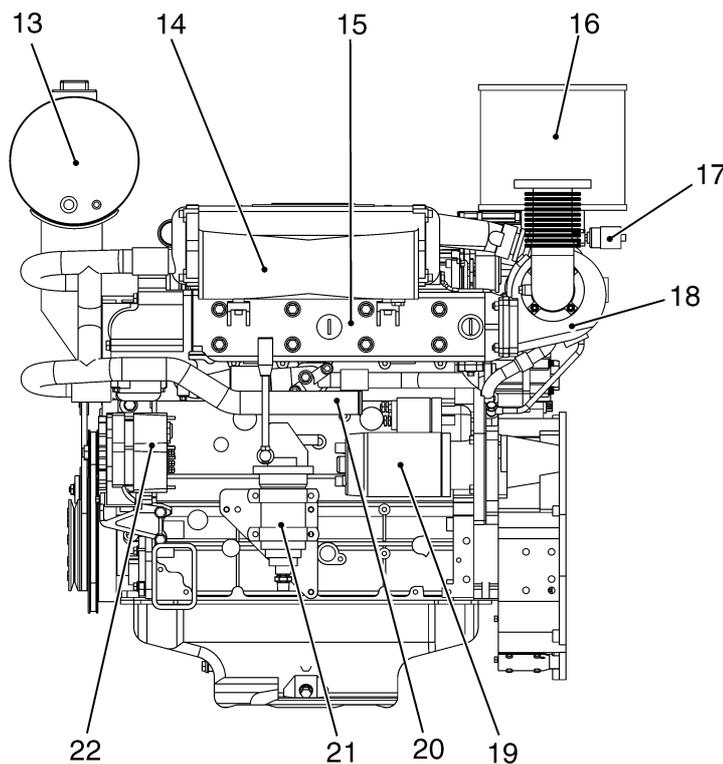
## D5A TA KC Genset Engine

The D5A TA KC is a turbocharged, aftercooled in-line, direct injection, 4-cylinder, 4-stroke marine diesel engine. It is fitted with connections for keel cooling (1½-circuit).

An optimal combination of combustion chambers, fuel injection system, effective turbocharger and charge air cooling, provide excellent fuel consumption over the whole range of power output.



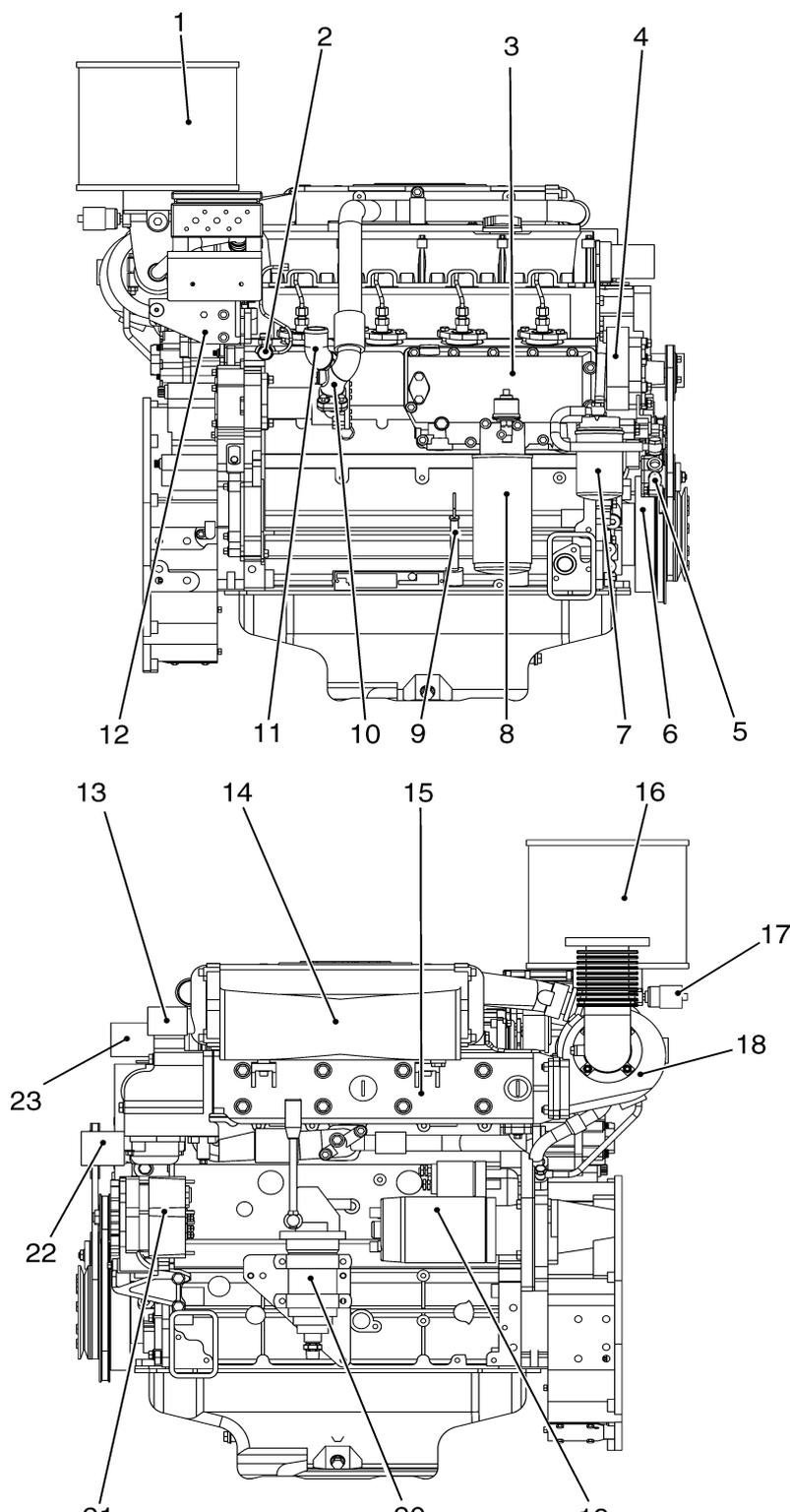
1. Electrical connection box
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4. HT-pump
5. Fuel pump & Fuel inlet
6. Vibration damper
7. Fuel filter
8. Oil filter
9. Oil dip stick
10. LT- pump
11. Coolingwater inlet (LT-circuit)
12. Governor & Stop solenoid
13. Expansion tank
14. Charge air cooler
15. Exhaust manifold
16. Air filter
17. Air filter indicator
18. Turbocharger
19. Electrical starter
20. Cooling water outlet (LT-circuit)
21. Engine oil drain pump
22. Alternator



## D5A TA KC Genset Engine

The D5A TA KC is a turbocharged, aftercooled, in-line, direct injection, 4-cylinder, 4-stroke marine diesel engine. It is fitted with connections for keel cooling (2-circuit).

An optimal combination of combustion chambers, fuel injection system, effective turbocharger and charge air cooling, provide excellent fuel consumption over the whole range of power output.



1. Electrical connection box
2. Fuel return
3. Oil cooler
4. HT-pump
5. Fuel pump & Fuel inlet
6. Vibration damper
7. Fuel filter
8. Oil filter
9. Oil dip stick
10. LT- pump
11. Coolingwater inlet (LT-circuit)
12. Governor & Stop solenoid
13. Cooling water outlet (LT-circuit)
14. Charge air cooler
15. Exhaust manifold
16. Air filter
17. Air filter indicator
18. Turbocharger
19. Electrical starter
20. Engine oil drain pump
21. Alternator
22. Cooling water outlet (HT-circuit)
23. Cooling water inlet (LT-circuit)

# New engine initial service

## General

Before starting a new or reconditioned engine for the first time, give it an initial inspection. This to guarantee your own safety as well as the maximum service life of the engine.

## External inspection

1. Check the control system for loose terminals.
2. Look for defects on engine parts.
3. Check the following components for loose bolts or nuts:
  - \* Plugs and covers of fuel, lubrication and cooling system
  - \* Coupling of fuel injection pump and shaft
  - \* Mounting brackets
  - \* Fuel control link
  - \* Turbocharger
  - \* Timing gear case
  - \* Exhaust manifolds
  - \* Cylinder heads
  - \* Air-duct connection-hose clamp
4. Check for fuel, oil, coolant and air leaks and repair if needed.
5. Make commissioning report for new or overhauled engine.

 **IMPORTANT!** All covers on the engine must be mounted before attempting to start your engine.

## Valves and plugs

Make sure the following valves and plugs are open or closed properly:

Fuel supply valve	Open
Coolant drain cocks	Closed

 **IMPORTANT!** If the coolant drain cocks are not closed the coolant will drain from the engine and this may cause severe damage to the engine.

## Electrical wiring

Check for loose or damaged electrical wiring on the engine. If necessary firmly reconnect to terminals or cable-joint portions. Damaged cables must be replaced.

If your engine is reconditioned, make sure the wiring is according to the drawings.

## Filling fuel system

Refer to chapter "Maintenance: Fuel system".

## Filling lubrication system

Refer to chapter "Maintenance: Lubrication system".

## Filling cooling system

Refer to chapter "Maintenance: Cooling system".

# Starting

## Before starting

- ⚠ WARNING!** Before starting the engine make sure that neither people, nor tools, are in contact with moving parts of the engine. Notify the people in the vicinity of the engine when starting.
- ⚠ WARNING!** Make sure that you know how to stop the engine before you start it (in case of emergency). If you are starting the engine for the first time, stop the engine in case abnormal noise occurs during start up.
- ⚠ IMPORTANT!** If the starter motor has been engaged for the maximum time (30 seconds), it must be allowed to cool down for at least one minute before a new attempt is made at starting.

## Warming-up

- ⚠ WARNING!** Do not conduct warm-up operation for an extended period of time. Prolonged warm-up operation causes carbon buildup in the cylinders that leads to imperfect combustion.

**NOTE!** To warm up the engine, operate at no load for a short time and then apply a low load.

**NOTE!** If the Lubrication oil pressure does not increase when you have started the engine, immediately stop the engine and do not restart until the problem has been fixed.

**NOTE!** Make sure that the cooling water flow is sufficient.

# Marine Commercial Control

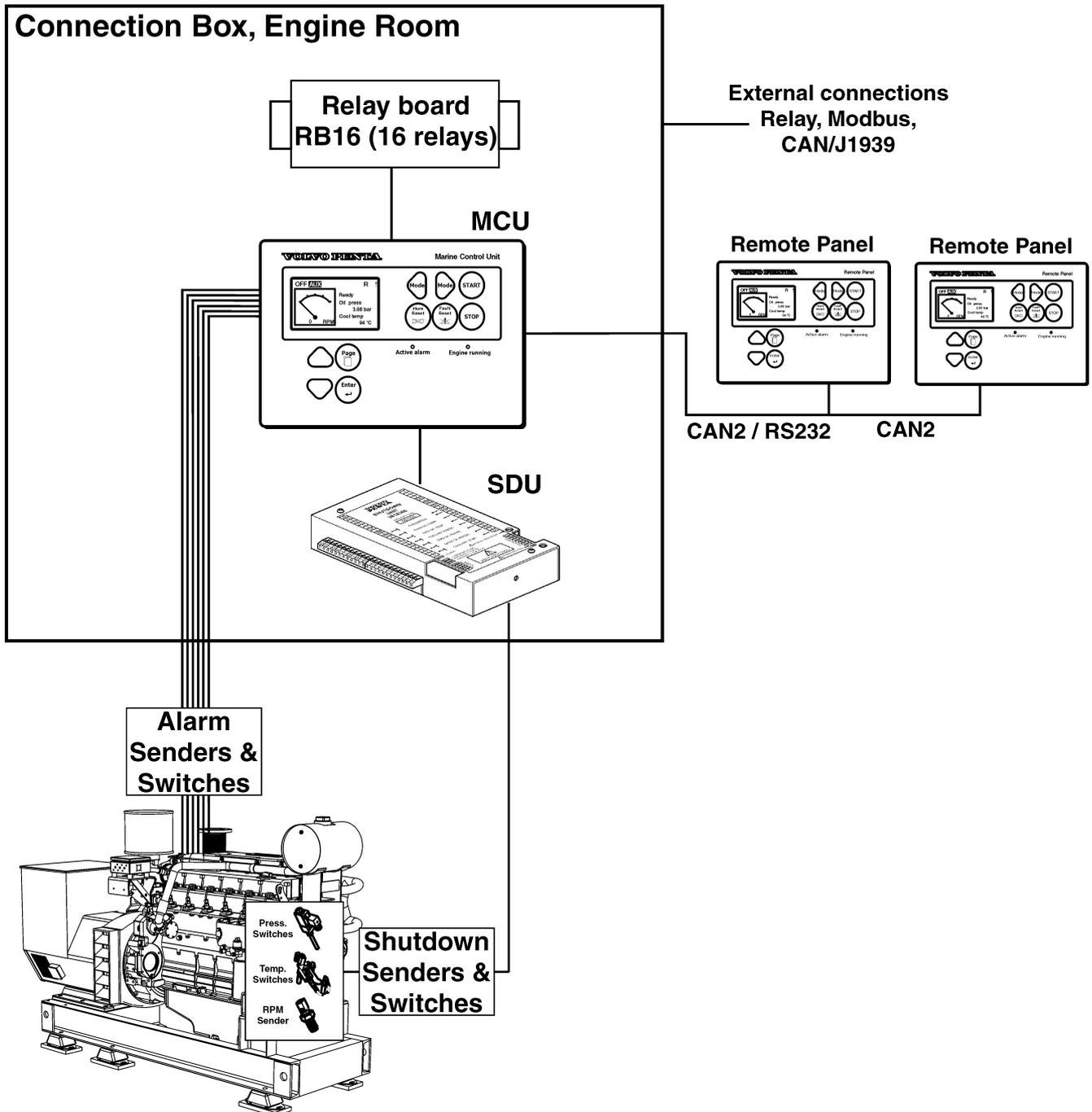
This chapter describes functions and operation of the Marine Commercial Control system (MCC) and the MCU (Marine Control Unit).

## Applications and Modes

The MCC system can be configured for different applications. Auxiliary (AUX), Emergency (EME), Combined (CMB) and Propulsion (PRP). The difference lies in the configuration file for the software and in the connections between the MCU and SDU. In each application the system operate in a number of modes.

Application	Modes	Interface to Start/Stop the engine	Note
Auxiliary	OFF-AUX	Blackout start on terminal Start on terminal Stop on terminal Start button on MCU and RP Stop button on MCU and RP	Blackout start will give the number of start attempts specified in the setpoint "Crank attempts". Default is 3 start attempts, for unlimited, set to zero (0).
Emergency	OFF-EME	Blackout start on terminal Start on terminal Stop on terminal Start button on MCU and RP Stop button on MCU and RP	Blackout start will give the number of start attempts specified in the setpoint "Crank attempts". Default is 3 start attempts, for unlimited, set to zero (0).
Combined	OFF-EME-HRB	In EME Mode Blackout start on terminal Start on terminal Stop on terminal Start button on MCU and RP Stop button on MCU and RP In HRB Mode Start on terminal Stop on terminal Start button on MCU and RP Stop button on MCU and RP	Blackout start will give the number of start attempts specified in the setpoint "Crank attempts". Default is 3 start attempts, for unlimited, set to zero (0).  Blackout start inactive. Controller operates like in AUX mode.
Propulsion	OFF-PRP	Start on terminal Stop on terminal Start button on MCU and RP Stop button on MCU and RP	Only on variable speed engines. Blackout start inactive

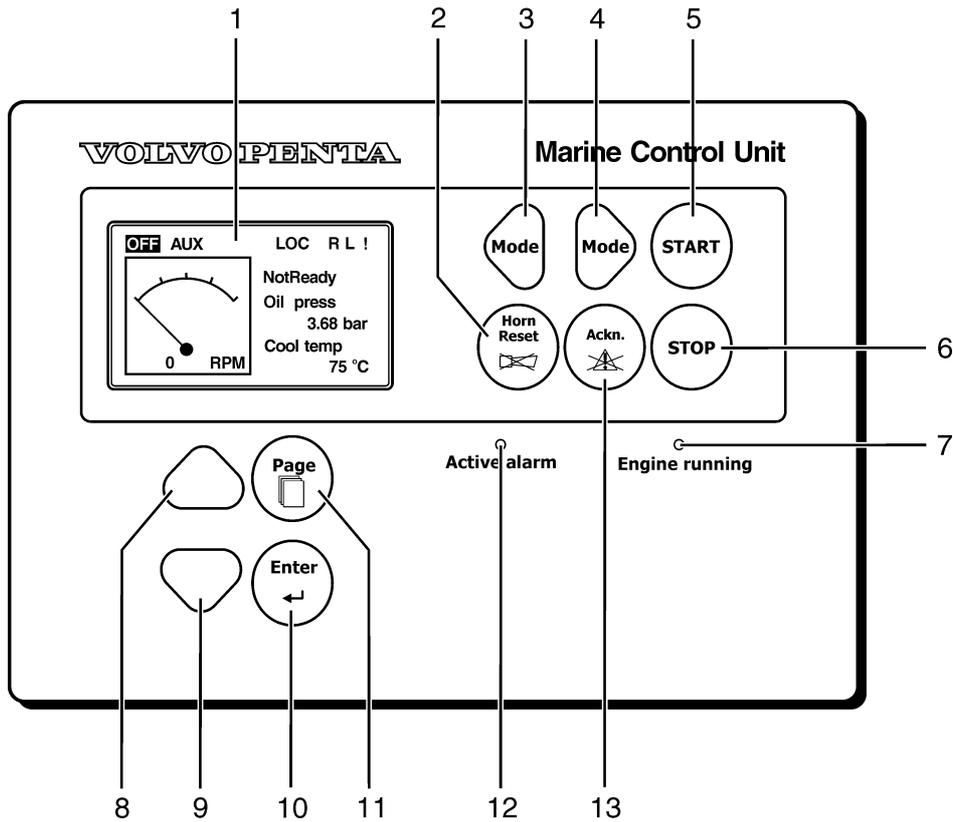
## MCC system overview



### Terminology

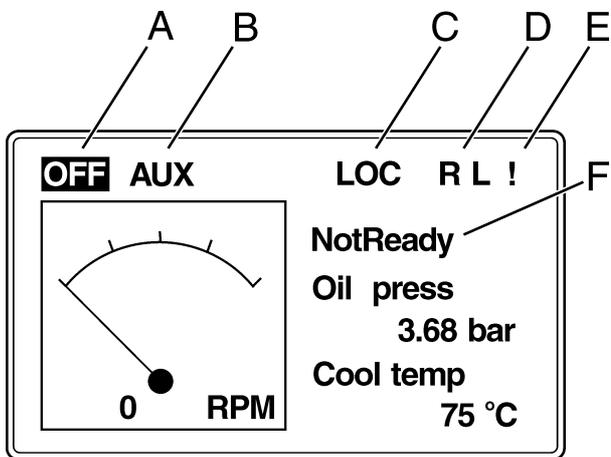
MCC .....	Marine Commercial Control, name of the over all system.
MCU .....	Marine Control Unit, the central control unit of the system.
SDU .....	Shutdown Unit, for engine protection. Activates a fuel shut-off valve to shut down the engine. Separated from the engine control system. All functions hard wired.
COM .....	Communication Module, for J1708/J1587 and CAN2 bus (for RP and other extension modules).
RP .....	Remote Panel, additional display panel for remote monitoring.

# MCU Panel layout

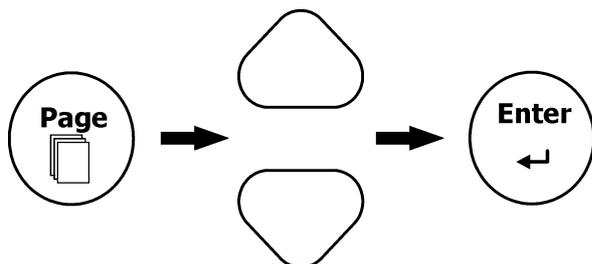
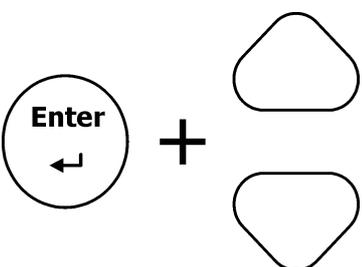
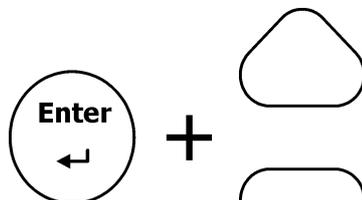
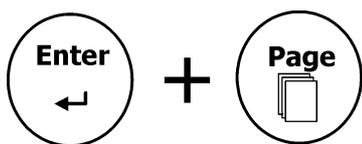


- 1. LCD display
- 2. Horn reset (stops sound alarm)
- 3. Mode Left, toggles modes backwards [Off - AUX(EME,HRB)]
- 4. Mode Right, toggles modes forwards [Off - AUX(EME,HRB)]
- 5. Start button
- 6. Stop button
- 7. LED - Engine running
- 8. Up button (Select and Increase)
- 9. Down button (Select and Decrease)
- 10. Enter (confirmation of selection)
- 11. Page, toggles screens (Measurement - Adjustment - History)
- 12. LED - Active alarm (Blinking light when new alarm is activated. Steady light when alarm is active but confirmed.)
- 13. Acknowledge button

## Display



- A. Highlighted indicates OFF-mode
- B. Highlighted indicates operational mode AUX (EME, HRB)
- C. Indicates Local mode
- D. R - Remote connection (Slave Panel or PC Software)
- L - Access lock
- ! - Active alarm
- F. Engine state (NotReady - Ready - Running)



## Info view

### Serial number and software revision

In MAIN page (A1), press and hold ENTER while pressing PAGE. INFO view with serial number and software revision will appear.

**NOTE!** INFO view is only displayed for 10 seconds.

## MCU adjustments

### Backlight - INFO view

In INFO view, press and hold ENTER and adjust brightness with UP/DOWN buttons.

### Contrast - MAIN page

In MAIN page (A1), press and hold ENTER and adjust contrast using UP/DOWN buttons.

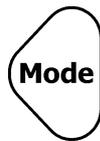
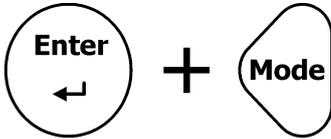
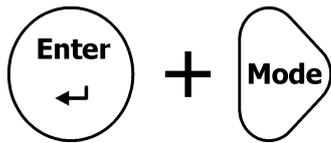
### Change language - INFO view

In INFO view, press PAGE. Use UP/DOWN buttons to scroll. Press ENTER to select language and exit window.

### Enter password

Password is a 4 digit code.

1. Select Adjustment view (C1).
2. Select PASSWORD (C1) with UP/DOWN buttons. Confirm with ENTER button.
3. Select ENTER PASSWORD (C2) with UP/DOWN buttons. Confirm with ENTER button.
4. Select digits with UP or DOWN buttons. Confirm with ENTER button.



## Operational modes

### Local mode

In Local Mode the MCU is operational only from the main panel. All external interfaces are disabled.

Local mode is activated by pressing ENTER + MODE- Right buttons.

Local mode is deactivated by pressing ENTER + MODE- Left buttons.

### OFF-mode

OFF mode is available in all applications – AUX, EME HRB. All inputs are disabled and all outputs are switched off.

**NOTE!** Engine can not be started when OFF-mode is activated.

Activate OFF-mode by pressing left MODE-button repeatedly until OFF is highlighted in upper left corner of display.

## Menus

There are 4 display menus available:

### Main

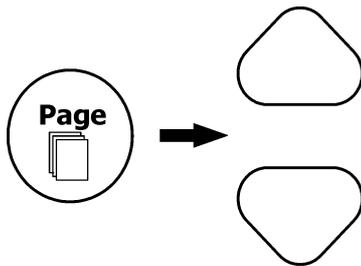
### Measurement

### Adjustment

### History

### Main

Press PAGE button to toggle the menu screens. Select MAIN page (A1). Use UP/DOWN buttons to toggle the different screens.



### Alarm list

ECU (Engine Control Unit) alarm list and Alarm list are the last two screens in the MAIN page (A1).

Select MAIN page (A1). Press UP button (twice for ECU list).

**NOTE!** ECU Alarmlist will always be empty since this is only valid for electronic engines.

This will list all active alarms (number of alarms indicated in the upper right corner). Highlighted alarms are still active. The other alarms are not active but not yet acknowledged.

**NOTE!** In case of multiple alarms, scroll alarmlist using ENTER button.

ACKNOWLEDGE button acknowledges all alarms. Non-active alarms disappears from the list.

Alarm list appears on the screen when a new alarm is set and MAIN page (A1) is active.

**NOTE!** Alarm list is not activated when you are viewing values, parameters or history.

### Three state Alarm list indication

1. Active not acknowledged alarm
2. Active acknowledged alarm
3. Inactive not acknowledged alarm
- A. Number of alarms

### Statistics

Select MAIN page (A1). Press UP button three (3) times.

1. Running hours
2. Successful starts
3. Unsuccessful starts
4. Service time (hours to service)

Alarmlist		3
*Wrn SD Syst Fail		1
ECU AlarmList		2
*Wrn SD Syst Fail		3

Run Hours	336	h
NumSuccStarts	97	
NumUnscStarts	24	
Service time	3640	h

Statistic values can be adjusted from PC software (password protected), contact your Volvo Penta dealer.

### Measurement

Press PAGE button repeatedly to toggle the menu screens. Select MEASUREMENT view (B1). Use UP/DOWN buttons to toggle the different screens.

### Adjustment

In the Adjustment view it is possible to view and edit setpoints. For a complete list of setpoints, see

1. Press PAGE button repeatedly to scroll the menu screens. Select ADJUSTMENT screen.
2. Use Up and Down buttons to toggle the different set points group.
3. Press ENTER to confirm.
4. Use Up and Down buttons to select requested set point. Set points marked “\*” are password protected.
5. Press ENTER to edit.
6. Use Up and Down buttons to modify the set point. When Up or Down button is pressed for 2 sec, auto repeat function is activated.
7. Press ENTER to confirm or PAGE to leave without change. Press PAGE to leave selected set points group.

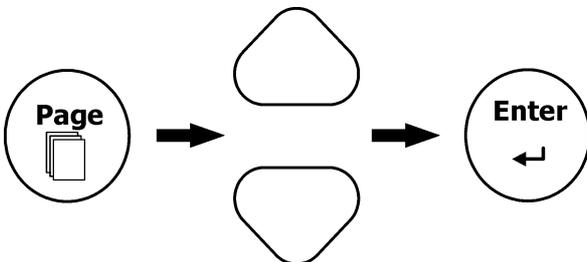
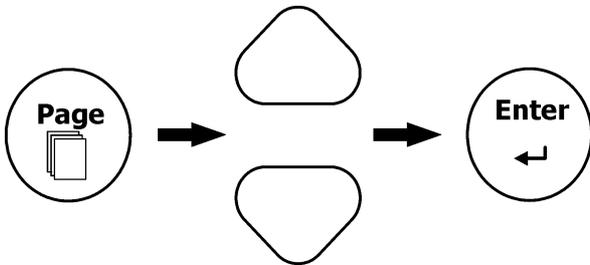
### History

1. Press PAGE button repeatedly to scroll the menu screens. Select the HISTORY screen.
2. Use Up and Down buttons to select the requested record.
3. Press ENTER to select requested screen (record items) within displayed records.

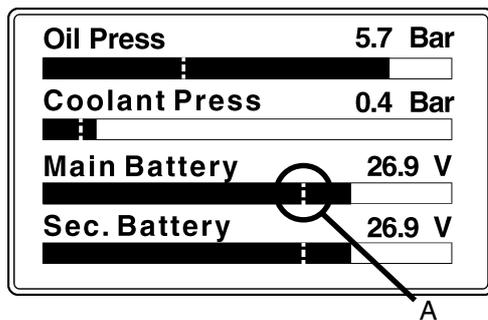
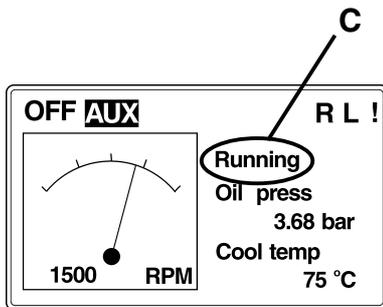
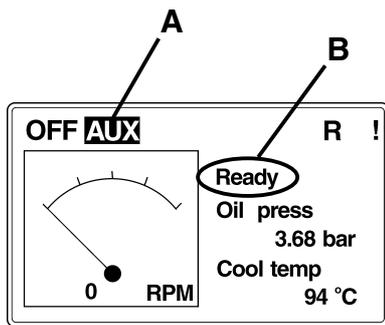
### Alarm list and History

#### Alarm list and History record prefixes

Prefix	Meaning
Wrn .....	Warning
Sd .....	Shutdown
Fis .....	Sensor fail



No.	Reason
> 0	Fault Reset
- 1	CAN control
- 2	Wrn SDU Syst Fa:
- 3	Wrn SDU Syst Fa:
- 4	Wrn SDU Syst Fa:
- 5	Fault Reset
25/02/05 12:34:49.6	



## Operation

### Starting the engine

1. In MAIN menu, select mode of operation (AUX, HRB, EME), refer to section "Applications & Modes", using MODE button (left or right)(A).
2. Make sure engine status is "Ready"(B).
3. Press START button and the engine state should change to "Running"(C).

### Running

#### Operational data

Monitor engine data in the MAIN menu:

1. Use UP and DOWN arrows to select wanted engine data.

Data are presented with bar-graphs and in text/figures. Dotted line across bar-graph(A) indicates alarm-level.

#### Alarms

Alarms generated in the SDU or MCU are shown in the alarm list.

1. Press HORN RESET button to silence the alarm.

To view active alarms:

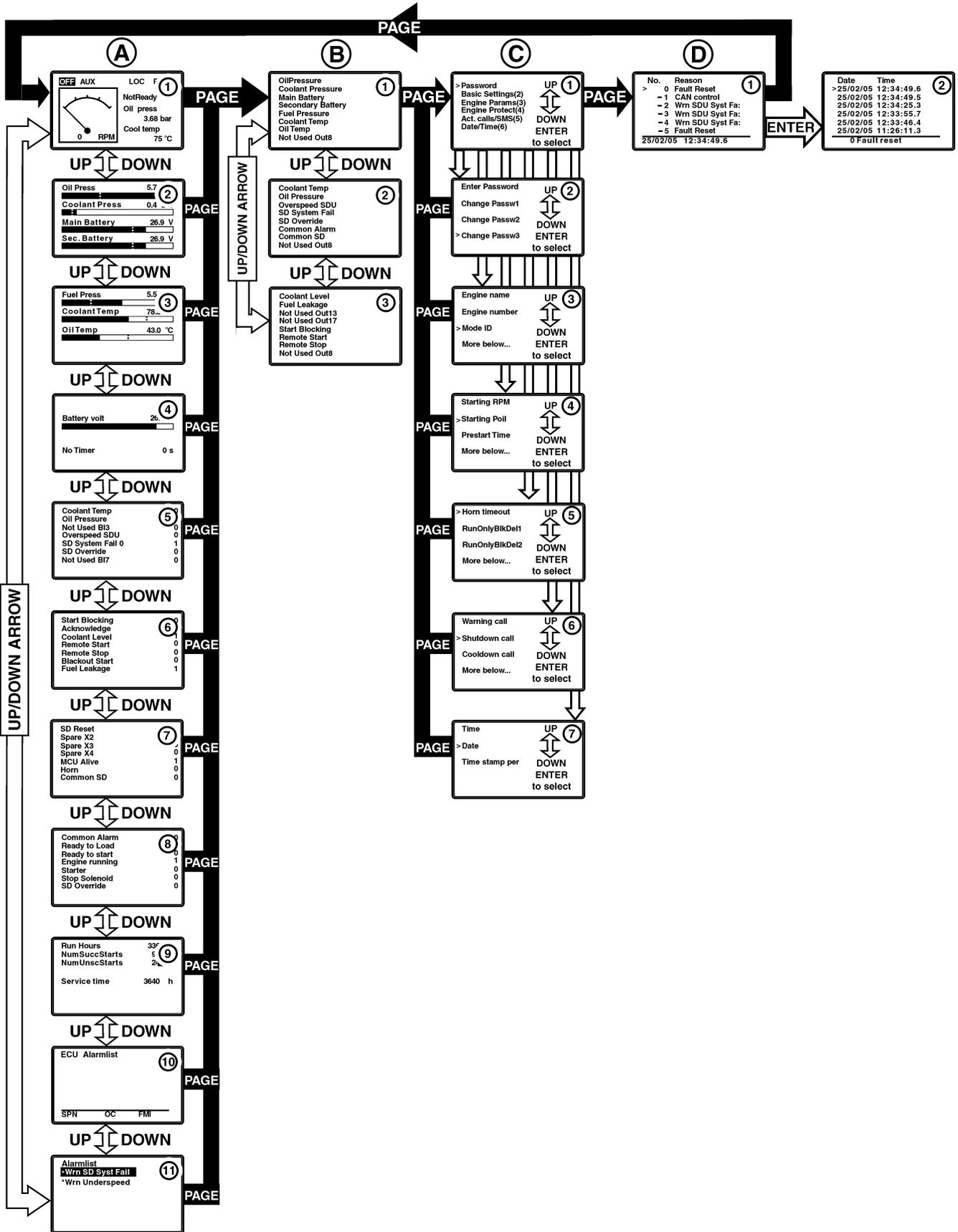
2. In MAIN view, press UP arrow once for SDU/MCU alarm list.
3. In case of multiple alarms, scroll alarmlist using ENTER button.
4. Press ACKN. button to acknowledge all alarms.

**NOTE!** Alarm item will stay in alarm list until acknowledged and made "not active" (fault rectified).

### Stopping the engine

1. Press and hold STOP button until the rpm starts decreasing (approx. 1 s).
2. Make sure rpm indication decreases to 0 and engine state returns to "Ready".

# MCU menu flow chart



**Main page (A)****A1.**

The main page of the system. Most important parameters are shown. Mode change is possible.

**A2 & A3.**

Displays analogue parameters measured by the MCU.

**A4.**

System voltage information measured by the MCU.

**A5 & A6.**

Status of MCU 14 digital inputs.

0 - input inactive

1 - input active.

Inverted 0 or 1 indicates alarm due to current status.

**NOTE!** Pages can be used to verify interface to superior system. Activate signal from superior system and monitor input state change.

**A7. & A8.**

Pages display status of MCU 14 digital outputs.

0 - input inactive

1 - input active.

**A9.**

Statistic information. Run hours of the engine, No. of successful start, etc.

**A10.**

Will always be empty.

**A11.**

Displays alarms from the Shutdown system (SDU) and MCU. Navigate alarmlist with Enter button.

**NOTE!** Engine cannot be started with active or unacknowledged SD.

**Measurement (B)****B1. - B3.**

MCU to external interface. Modbus.

**Adjustments (C)****C1.**

Menu for change of setpoints. Navigate with up and down arrows - select with Enter.

**C2.**

Enter and change passwords. Most setpoints are password protected to avoid accidental changing. Password 0 in standard configuration.

**C3.**

Page for changing basic settings of the systems, e.g governor mode and speed select.

**C4.**

Page for changing Engine parameters settings. Refer to section "MCU adjustments" for details.

**C5.**

Page for changing parameters concerning MCU engine protection functionality.

**NOTE!** In the MCC system engine protection functionality is handled by the SDU. Changing these setpoints will not affect the SDU.

**C6.**

Changing setpoints concerning MCU telematics functionality.

**NOTE!** Telematics functionality is not supported by Volvo Penta. Refer to <http://www.huegli-tech.com>

**C7.**

Page or changing date and time.

**History (D)****D1.**

Displays previous actions/alarms. Enter button for further information, D2 (D3, D4, etc).

## Setpoints

Below is a list of setpoints used in the system. The setpoints are grouped as:

- Basic settings
- Engine parameters
- Engine protection settings
- Active calls/SMS settings
- Date/Time settings

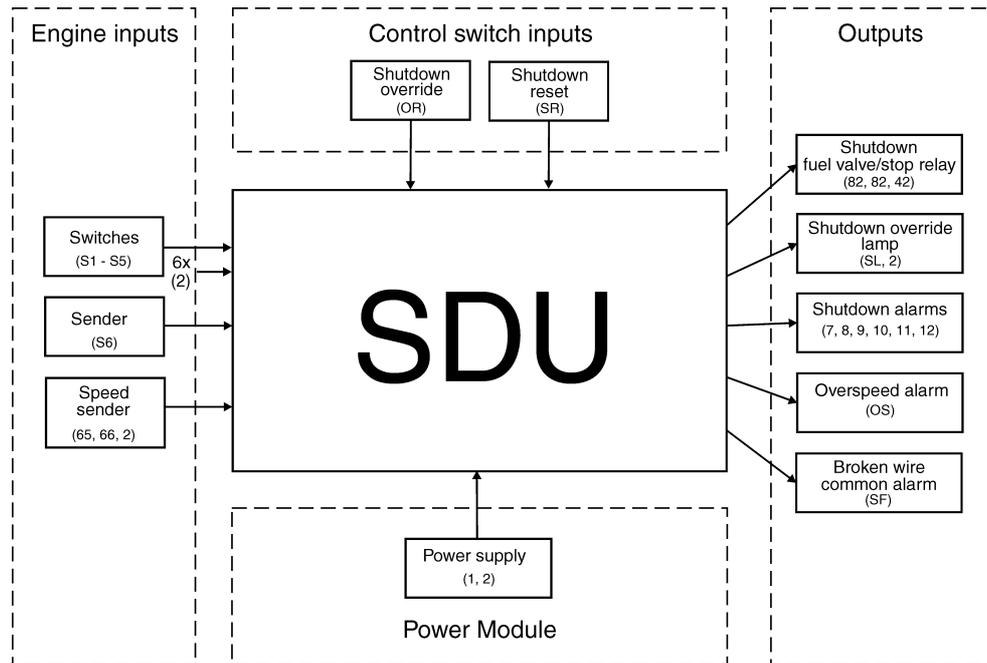
This is how they appear in the MCU menu.

Note! An "N" in column "Customer edit allowed" implies that the setpoint MUST NOT be edited by customer.

### Basic settings

Setpoint	Unit (if applicable)	Note	Edit allowed (Y/N)
Engine name		User defined name for identification at remote (phone/mobile) connection. Max. 14 characters long.	N
Engine No.		Visible in INFO view	N
Mode ID		Defines operational MODE	N
Gear teeth		Number of teeth on flywheel	N
Nominal rpm	RPM	Nominal engine speed. Used to calculate overspeed protection limit and requested RPM %	N
Contr. Addr.		Controller identification number. Can be edited by user when two or more MCU:s are connected, i.e. Propulsion EMS.	Y
RS232 mode		RS232 mode is default and must be used when downloading software. Must be set to MODBUS if that is used.	Y
CAN mode		CAN bus speed selection. Default is Low Speed CAN (50kbps), max. bus length is 900 meters.	Y
LightTimeOff	min	Time Out for automatic backlight switch off. Setpoint to 0 will give backlight continuously. Backlight is automatically switched on at the touch of a button or any system event.	Y
MODBUS	bps	MODBUS interface speed selection	Y

# Shutdown system overview



## Shutdown unit (SDU)

The SDU has 6 shutdown channels and one over-speed shutdown.

- S1 Cooling water temp
- S2 Lube oil pressure, Marine Gear
- S3 Lube oil pressure, Engine
- S4 Cooling water pressure
- S5 Oil temp (optional D12)
- S6 Exhaust temp (optional D12)

S1 - S5 has a ~1 second delay: S6 has no delay.  
S1 - S6 are enabled or disabled accord. to eng. spec.

## Shutdown reset

Activated shutdown must be reset before engine can be restarted. Shutdown reset button on engine connection box or MCU ACKN. button.

**NOTE!** Shutdown reset button will still show SD alarm in MCU alarm list as not acknowledged alarm.

Acknowledge button on MCU panel will reset shutdown and clear alarm list.

## Broken wire

All channels are equipped with broken wire detection that activate an alarm if connection is lost or power supply to SDU is lost. Yellow LED indicates broken wire. Reset alarm on Broken wire reset button (A).

**NOTE!** Use only plastic tool for reset.

## Overspeed shutdown

The overspeed function shuts down the engine in case of overspeed.

## Overspeed test

To test the overspeed function push the overspeed test button (inside the SDU). When pushed the overspeed limit drops 25%.

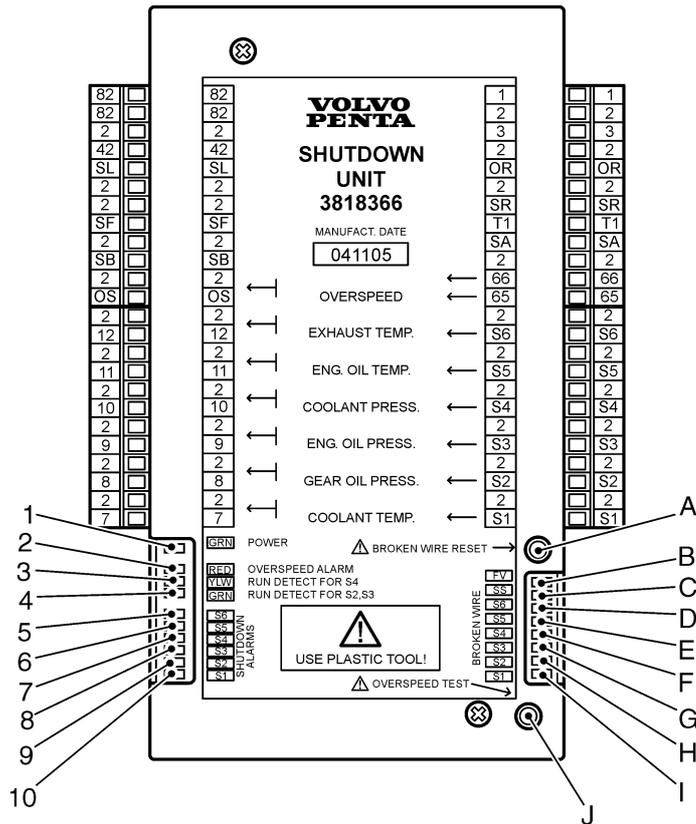
## Emergency mode (shutdown override)

The system can be overridden by activating the OR input (the Emergency mode lamp, when installed on output SL, will be activated). Override does not include overspeed.

## Run detection

To avoid alarms when starting and stopping the engine an interlock for the shutdown pressure switches (run detection) is implemented.

# SDU indications



- |                                 |   |
|---------------------------------|---|
| 1. Green – Power                | A. Broken wire reset button                   |
| 2. Red – Overspeed Alarm        | B. Yellow – Fuel valve Broken wire detected   |
| 3. Yellow – Run detection S4    | C. Yellow – Speed sender Broken wire detected |
| 4. Green – Run detection S2, S3 | D. Yellow – S6 Broken wire detected           |
| 5. Red – S6 Shutdown active     | E. Yellow – S5 Broken wire detected           |
| 6. Red – S5 Shutdown active     | F. Yellow – S4 Broken wire detected           |
| 7. Red – S4 Shutdown active     | G. Yellow – S3 Broken wire detected           |
| 8. Red – S3 Shutdown active     | H. Yellow – S2 Broken wire detected           |
| 9. Red – S2 Shutdown active     | I. Yellow – S1 Broken wire detected           |
| 10. Red – S1 Shutdown active    | J. Overspeed shutdown test button             |

# Operation

## General

Learn how to handle the engine, controls and other equipment in a safe and correct manner before starting the engine

 **WARNING!** Stay clear of all rotating and moving parts during operation.

 **IMPORTANT!** Always keep the engine room well ventilated. Insufficient air supply to the engine means imperfect combustion and generator cooling and a loss of power.

 **IMPORTANT!** Do not turn OFF the battery switch when the engine is running since this may damage the alternator.

 **WARNING!** A hot engine may cause burns. Beware of hot surfaces. E.g.: exhaust manifold, turbocharger, oil pan, charge air pipe, starting heater, hot coolant and warm lubricant in pipes and hoses.

 **IMPORTANT!** Avoid overloading. This can cause incomplete fuel combustion often indicated by black exhaust, high fuel consumption and carbon deposits in combustion chambers, affecting engine life.

 **IMPORTANT!** Do not push the START button when the engine is running, this may damage the starter.

## Applying load

If possible, do not apply heavy loads until the engine has reached operating temperature.

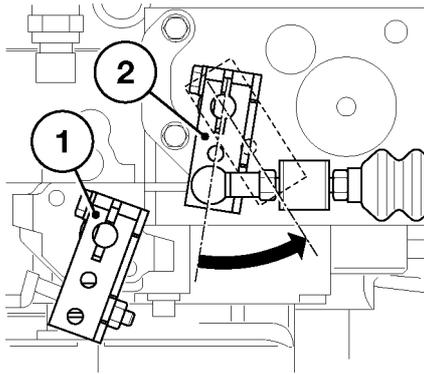
### During load operation make sure that:

1. No engine related alarms occur.
2. There are no visible leaks of fuel, lube oil, coolant or exhaust gas.
3. No abnormal noise or vibrations occur.
4. The color of the exhaust gas is normal.
5. Instrument readings are the normal, refer to chapter Technical Data.

# Stopping

Allow the engine to run at no load for a couple of minutes before turning it off. This will keep the engine temperature in balance and prevent it from boiling.

**⚠ IMPORTANT!** The procedure described above is especially important if the engine has been run at heavy loads.



**⚠ IMPORTANT!** If the engine stops abnormally, try to locate the problem and make the repairs needed before starting again. After restarting the engine, make sure it runs properly.

## Emergency stop

If a fault occurs that prevents the engine from being stopped normally it can be stopped manually using the speed adjustment lever on the engine.

1. Move the speed adjustment lever (1) to idle.
2. Move the shut-off lever (2) in the direction of the arrow until the engine comes to a stop. The warning display lamps for “No charge voltage” and “Low oil pressure” will turn on when the engine stops.
3. Turn the key to position “0” and remove. The warning display lamps will turn off.

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

**⚠ WARNING!** Never try to increase the rpm with the speed adjustment lever since this will make the engine overspeed and cause damage.

## After stopping

### General

- \* Check the genset and engine room for leaks.
- \* Close the fuel cock and seawater cock.
- \* Read off the hour counter and carry out preventive maintenance according to the maintenance schedule.
- \* Turn off the main switch if the genset is not to be used for a long period.

**⚠ IMPORTANT!** Never turn the power off using the main switch while the genset is running. This can damage the alternator.

**⚠ IMPORTANT!** Make sure the generator heater is working properly to avoid condensation in the generator

## Anti-freezing measures

If the engine room cannot be protected from frost, the raw water system must be drained (if it contains sea water) and the coolant in the freshwater system must contain the right mix of anti-freeze and water. Refer to chapter Maintenance "Raw water system" and "Freshwater system" respectively.

 **WARNING!** If the raw water system bursts due to freezing, the vessel could sink.

 **IMPORTANT!** If the coolant does not give sufficient anti-freeze protection, it may cause costly damage to the engine. Check the charge of the battery. A poorly charged battery can freeze and break.

## Breaks in operation [not using the genset]

During periods out of service, the engine must be run warm once a fortnight. This will prevent it from corroding.

 **IMPORTANT!** The genset must be conserved if it is not to be used for longer than two months. Refer to chapter Inhibiting.

# Maintenance

Your Volvo Penta engine and associated equipment is designed to provide high operational reliability and long service life. They are constructed to withstand the marine environment while also affecting it as little as possible.

Preventive maintenance in accordance with the maintenance schedule will ensure that it retains these qualities and avoid unnecessary operational disturbances.

The maintenance schedule shows the standard service intervals. When you think the engine should be serviced more frequently due to particular operating conditions, adjust the intervals accordingly. Appropriate service intervals vary with usage and operating conditions and with fuel, lubricant and coolant used. Due to particular operating conditions the service intervals may be adjusted accordingly. Consult your Volvo Penta dealer.

**NOTE!** Dust and foreign particles are the most common cause of excessive wear of parts. When disassembling a component, take measures to prevent dust and foreign particles from entering it.

## Daily operation records

It is recommended to keep daily operation records. Daily recording is a preventive maintenance program and when comparing values with engine history it will help you recognize conditions, signs or indications of approaching trouble. Daily operation records also make trouble shooting easier and will lessen the down time (to save time and money for servicing).

## Maintenance records

Volvo Penta recommends that accurate maintenance records are kept. With accurate maintenance records your Volvo Penta Dealer can help in fine tuning the recommended service intervals to meet the specific operating situation. This should result in a lower engine operation cost.

## Fluids

It is also important to keep record of the fluids used in the engine. If brand or type of fuel, lubrication oil or coolant is changed this should be recorded.

## Warranty inspection

The prescribed warranty inspection "First Service Inspection" must be carried out at an authorized Volvo Penta workshop during this first period of operation. Directions for when and where this is to be carried out can be found in the **Warranty and Service Book**.

 **WARNING!** Read the chapter "Maintenance" thoroughly before starting any maintenance work. It contains directions for performing maintenance in a safe and correct manner.

 **WARNING!** Working on or approaching a running engine is a safety hazard. Maintenance and service must be carried out with the engine stationary unless stated otherwise in the instructions. Prevent inadvertent start of the engine by disabling the start-button and turning off the power with the main switch, locking it in the off position.

 **WARNING!** Place warning signs stating that service is in progress in every position from which the engine can be started.

 **IMPORTANT!** Handle parts carefully. Use only original Volvo Penta spare parts.

**NOTE!** When both operating time and calendar time is given, the one occurring first is to apply.

## Recommendation of Daily Operation Records

Daily recording is a preventive maintenance program and when comparing values with engine history it will help you recognize conditions, signs or indications of approaching trouble. Daily operation records also make trouble shooting easier and will lessen the down time (to save time and money for servicing).

### Items to be recorded

The following items are recommended to be recorded once a day:

1. Operating hours.
2. The amount of lubrication oil and coolant (fresh water) required for refilling. Fuel consumption.
3. Lubrication oil and coolant (fresh water) changes.
4. Lubrication oil pressure and temperature, engine rpm, exhaust temperature, coolant temperature, and charge air temperature and pressure.
5. Rawwater pressure and rawwater temperature before and after heat exchanger. Ambient temperature and engine room temperature at turbo charger inlet.
6. Parts serviced and kinds of service (adjustment, repairs or replacement).
7. Change in operating conditions (for example, "Exhaust smoke turned black," etc.)



## Maintenance schedule

### Daily

- General inspection engine and engine room
- Check air filter indicator (change filter if necessary)
- Drain charge air cooler (make sure drain hole is not clogged)
- Check lubrication oil level
- Check coolant level
- Check fuel oil level
- Check/drain fuel pre-filter/water separator ..... (refer to note 1)
- Drain water from fuel tank
- Daily operation records

### Weekly

- Check starting batteries; electrolyte level/load
- Check electrical system for loose terminals/contacts, remove dirt/oxides
- Check foundation bolts
- Check lubrication oil for abnormal smell or waterdilution
- Check settings of valves and operate valves to keep them movable

### After first 10 operating hours

- Check lubrication oil level
- Check coolant level

### After first 150 operating hours

- Check/adjust drive belts
- Check/adjust valve clearances

### Every 125-500 operating hours or every 12 months

- Change lubrication oil ..... (refer to note 3)
- Change lubrication oil filters ..... (refer to note 4)

<sup>1)</sup> Check the manometer(valid only for twin filters) and change filter if necessary.  
<sup>2)</sup> To be carried out at an authorized Volvo Penta workshop.  
<sup>3)</sup> Oil change intervals vary, depending on oil grade and sulphur content of the fuel. Refer to chapter "Technical Data Lubrication oil specification"  
<sup>4)</sup> Change oil filters every second oil change.

**Every 250 operating hours or every 12 months**

Check/clean seawater filter

Check/change zinc anodes

**Every 500 operating hours or every 12 months**

Check/adjust drive belts

**Every 1000 operating hours or every 12 months**

Change fuel filter

Change air filter

Change seawater pump impeller

Change fuel pre-filter/water separator filter element

Clean turbo compressor

**Every 1500 operating hours or every 12 months**

Check/adjust valve clearances

**Every 2000 operating hours**

Pressure test fuel injectors ..... (refer to note 2)

**Every 12 months**

Check turbocharger ..... (refer to note 2)

Check/clean charge air cooler

Check/clean heat exchanger

Clean and paint the engine

**Every 24 months**

Change coolant

<sup>1)</sup> Check the manometer and change filter if necessary.

<sup>2)</sup> To be carried out at an authorized Volvo Penta workshop.

<sup>3)</sup> Oil change intervals vary, depending on oil grade and sulphur content of the fuel. Refer to chapter "Technical Data Lubrication oil specification"

<sup>4)</sup> Change oil filters every time the oil is changed.

## Engine

### Drive belts

Check belt tension and condition regularly. Check and adjust belt tension after operation when the belt is warm.

**⚠ IMPORTANT!** Always change worn or cracked belts (belts working in pairs must be replaced together).

**⚠ IMPORTANT!** If the belt is too taut it can damage bearings and/or pump and a too loose belt may slip.

### Adjusting/Changing

It can generally be said that the belts are correctly tensioned if they can be pressed down 10 mm (3/8") by thumb pressure. Clean the belt grooves before fitting a new belt.

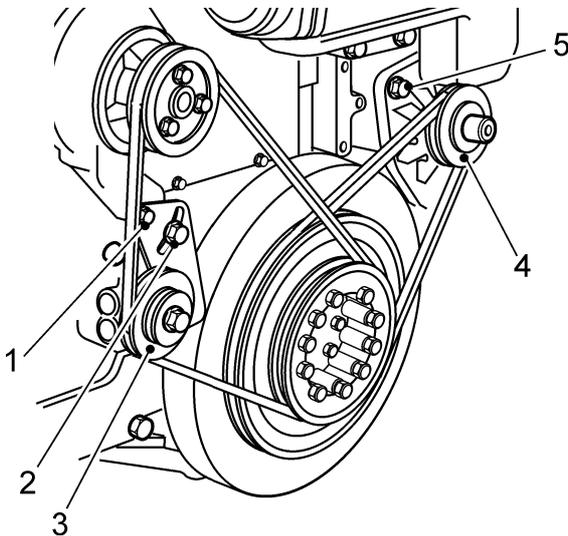
### Coolant pump/Fuel pump

#### Adjusting

1. Loosen screws 1 and 2.
2. Push the fuel pump (3) to the left until the belt is correctly tensioned.
3. Tighten the screws.

#### Changing

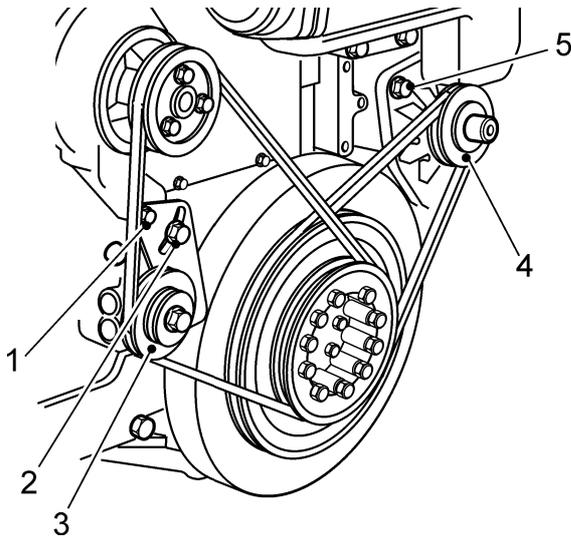
1. Loosen screws 1 and 2 and push the fuel pump (3) to the right.
2. Remove the belt and replace it with a new one.
3. Push the fuel pump (3) to the left until the belt is correctly tensioned. Tighten the screws.



### Alternator

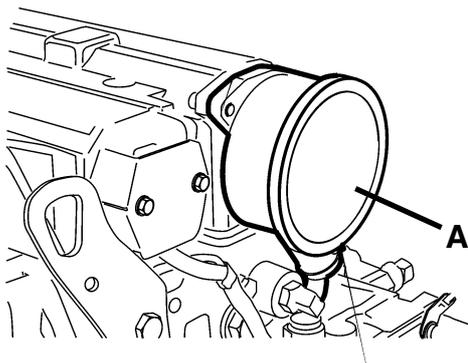
#### Adjusting

1. Loosen screw (5).
2. Push the alternator belt pulley (4) to the right until the belt is correctly tensioned.
3. Tighten the screw.



### Changing

1. Remove the belt for the fuel pump.
2. Loosen screw (5) and push the alternator belt pulley (4) to the left and remove the belt.
3. Replace it with a new one.
4. Push the alternator belt pulley (4) to the right until the correct belt tension is achieved, tighten the screw (5).
5. Replace the belt for the fuel pump and adjust it.

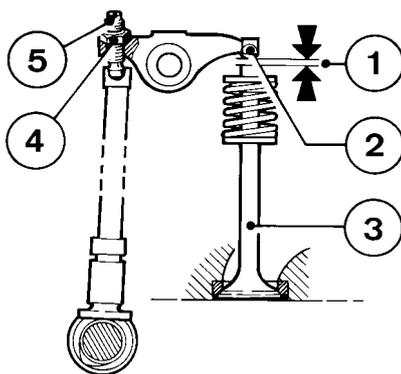


### Valve clearance

**NOTE!** Before adjusting valve clearance, allow the engine to cool for at least 30 min. The oil temperature should not exceed 80°C (176°F).

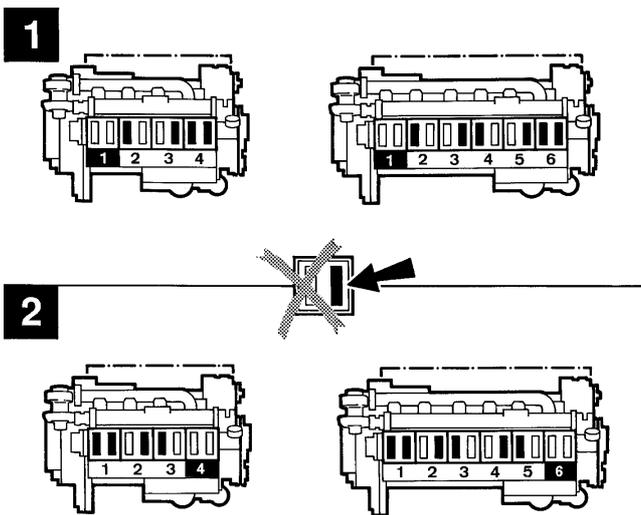
### Checking

1. Remove crankcase ventilation oil-trap housing(A).
2. Remove the cylinder head cover.
3. Position crankshaft as in the figure at the bottom of this page.
4. Check valve clearance (1) between rocker arm / tappet contact face (2) and valve stem (3) with a feeler gauge (6) (there should only be slight resistance when blade is inserted). For data on valve clearance, see "Technical data".



### Adjusting

1. Release locknut (4).
2. Turn the adjustment screw (5) to obtain correct valve clearance.
3. Tighten lock nut (4).
4. Reinstall cylinder head with a new gasket if necessary.
5. Refit crankcase ventilation oil-trap housing.



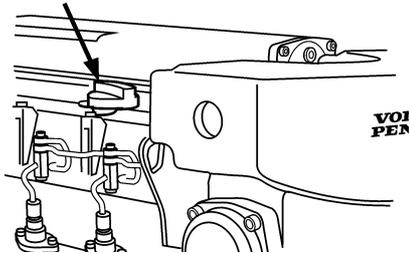
**Crankshaft position 1:**

- Turn crankshaft until both valves in cylinder 1 overlap (exhaust valve about to close, inlet valve about to open).
- Adjust clearance of valves marked in black on schematic.
- Mark respective rocker arm with chalk to show that adjustment has been carried out.

**Crankshaft position 2:**

- Turn crankshaft one full revolution (360°).
- Adjust clearance of valve marked in black on schematic.

## Lubrication system



### Checking oil level

The oil level must be within the marked range on the dipstick and should be checked daily.

### Filling oil

Top up the oil through the filler opening in the ventilation cover. Make sure the correct level is attained but wait a few minutes to allow the oil to run into the oil sump.

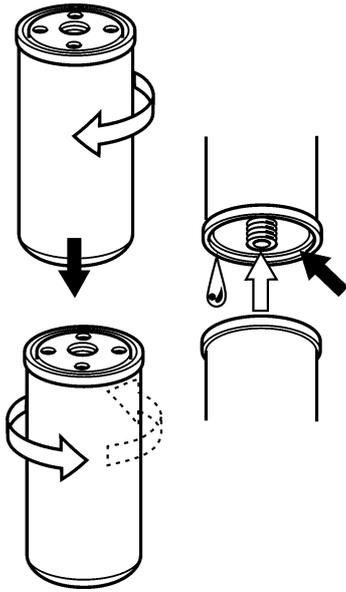
- ⚠ WARNING!** Lubrication oil on hot surfaces or electrical components may cause fire. Do not smoke while filling oil or when handling oil containers.
- ⚠ WARNING!** Hot oil and hot surfaces can cause burns.
- ⚠ IMPORTANT!** Do not fill above the maximum oil level. Use only oil of the recommended grade (refer to chapter Technical Data).

### Changing oil

Always observe the recommended oil change interval. Use the oil drain pump to drain the oil from the sump.

- ⚠ IMPORTANT!** Only use recommended grades of oil (refer to chapter Technical Data).
1. Warm the engine up (this makes it easier to pump the oil from the sump). Then stop the engine.
  2. Connect a hose to the outlet pipe of the oil drain pump. Pump the oil out.
  3. Change the oil filters at every second oil change (refer to section oil filter change).
  4. Fill up with oil to the correct level.
  5. Start the engine and allow it to idle. Check the oil pressure and that there is no leakage by the filters.
  6. Stop the engine. Wait a few minutes before you check the oil level. Top up if necessary.

**NOTE!** Process the old oil and discarded filters in accordance with local regulations.



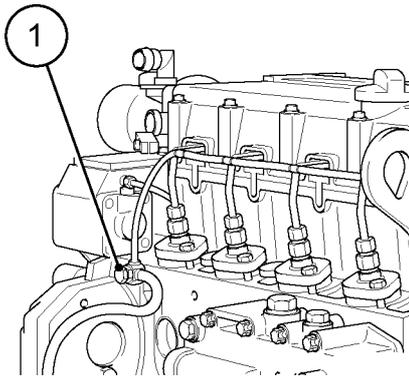
## Changing oil filter

Change the oil filter every second oil change.

1. Drain the oil, see section "Changing oil".
2. Put a vessel underneath the filter to avoid oil spill.
3. Unscrew the oil filters with a suitable filter wrench.
4. Lightly oil the rubber seal of the new filters and make sure its mating surfaces on the filter brackets are clean.
5. Mount the new filter by hand until the gasket is in contact with the sealing surface. Then tighten the filter another 1/2 turn.
6. Fill up with oil, refer to section "Lubrication oil filling".
7. Start the engine (idle) and make sure that no leakages occur. Check the oil level once the engine has stopped.

**NOTE!** Process the discarded oil filters in accordance with local regulations.

## Fuel system

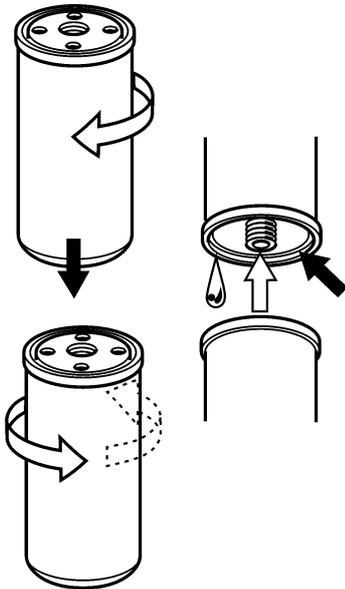


### Bleeding the fuel system

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

1. Put a suitable vessel under the fuel return (1).
2. Loosen the bolt.
3. Turn the engine over with the starter (max. 20 sec.) until fuel free of bubbles comes out.
4. Tighten the bolt.
5. Start the engine and make sure there are no leaks.

**⚠ IMPORTANT!** Do not loosen the injector delivery pipes. If the delivery pipes are loose they must be changed.



### Changing fuel filter

Clean the filter bracket and place a receptacle under the filters.

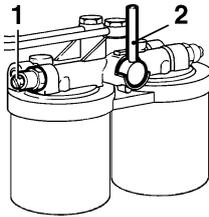
**NOTE!** Leave the old filters to a destruction plant.

#### Standard fuel filter

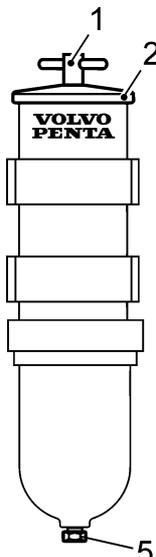
1. Close the fuel supply to the engine.
2. Unscrew the filter.
3. Make sure the new filter are absolutely clean and that the gasket undamaged. Lightly moisten the gasket with oil.
4. Screw on the filters by hand until they make contact with the sealing surface. Then screw a further half turn, not any more!
5. Open the fuel supply.
6. Bleed the fuel system as described above.
7. Start the engine and make sure there are no leaks.

### Switchable fuel filters

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



1. Place a receptacle beneath the filters and carefully clean the filter bracket.
2. Put the lever (2) in its right-hand end position.
3. Unscrew the left-hand fuel filter and discard it. Use a filter wrench if necessary.
4. Screw on the new filter by hand until the gasket make contact with the sealing surface. Then tighten a further half turn, not any more!
5. Open the left-hand bleed screw (1) on the filter bracket. Put the lever in operating position (straight up). Close the bleed screw when the fuel running out is free from air.
6. Put the lever in its left-hand end position and change the right-hand fuel filter in the same way.



### Fuel pre-filter/water separator

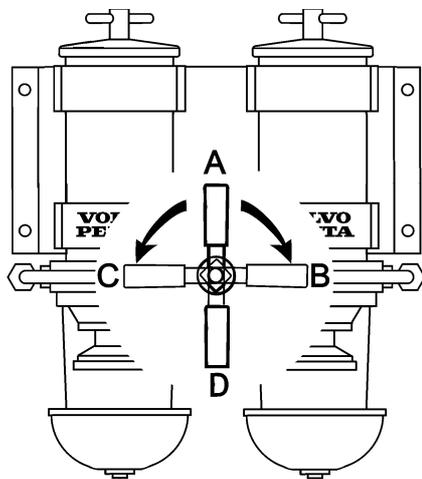
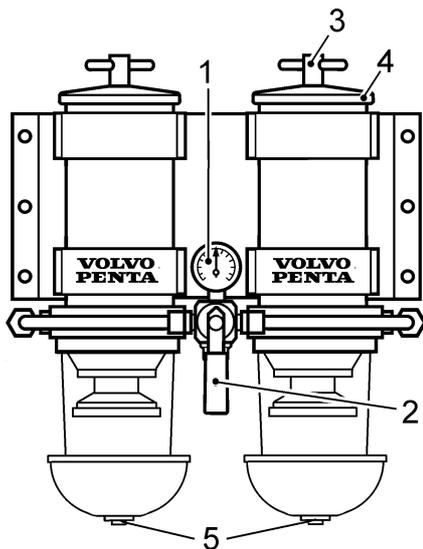
The pre-filter/water separator is installed between the fuel tank and the engine and works in three stages – Centrifugal separation, coagulation and filtration.

Water and impurities are collected in the bowl beneath and can be drained through the drain valve. Place a receptacle under the filter. Drain off water and contaminants through the plug (D).

### Changing the filter elements

Close the fuel cock on the tank and place a receptacle under the filter before changing filter.

1. Undo the T-bolt (1), remove the cover (2) and take out the filter insert carefully while turning it.
2. Drain off water and contaminants through the drain plug (D).
3. Fit a new filter insert and fill the container with clean fuel.
4. Change the gasket on the cover and the O-ring on the T-bolt. Moisten the gasket and O-ring with fuel before assembling.
5. Fit the cover and tighten it by hand. Wipe off any fuel from the filter housing.
6. Open the fuel cock and make sure there are no leaks.



### Twin fuel pre-filter/water separator

The twin filter is equipped with a pressure gauge (1). The filter inserts must be changed according to the maintenance schedule or earlier if the pressure gauge indicates a vacuum of 6–10 inHg at no load or 16–20 inHg at full load.

### Draining the filter

Place a receptacle under the filter. Drain off water and contaminants through the plug (5).

### Valve positions

The flow of the fuel is governed by putting the handle in the following positions:

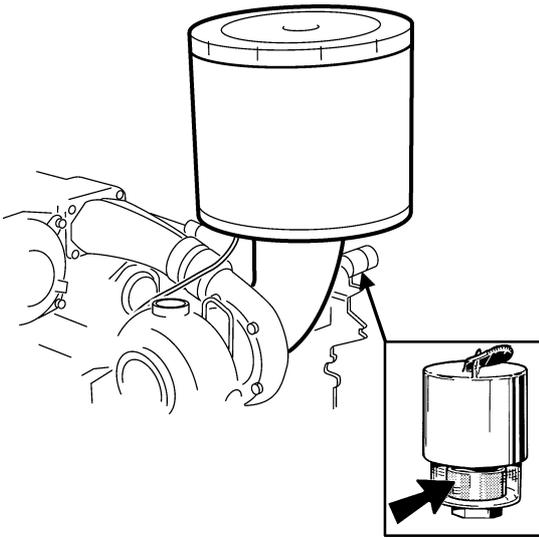
- A: Normal running (both filters connected).
- B: Left filter insert can be changed.
- C: Right filter insert can be changed.
- D: Both filters turned off.

### Changing the filter elements

If the engine is not running close the fuel cocks on the tank before changing filters. If the engine is running cut off the flow of fuel through the filter to be changed with the handle (2) on the filter itself. Place a receptacle under the filters.

1. Undo the T-bolt (3) remove the cover (4) and take out the filter insert carefully while turning it.
2. Drain off water and contaminants through the drain plugs (5).
3. Fit a new filter insert and fill the container with clean fuel.
4. Change the gasket on the cover and the O-ring on the T-bolt. Moisten the gasket and O-ring with fuel before assembling.
5. Fit the cover and tighten it by hand. Wipe off any fuel from the heat shield.
6. Change the other filter in the same way.
7. Open the fuel cocks and put the handle in position for normal running. Make sure there are no leaks.

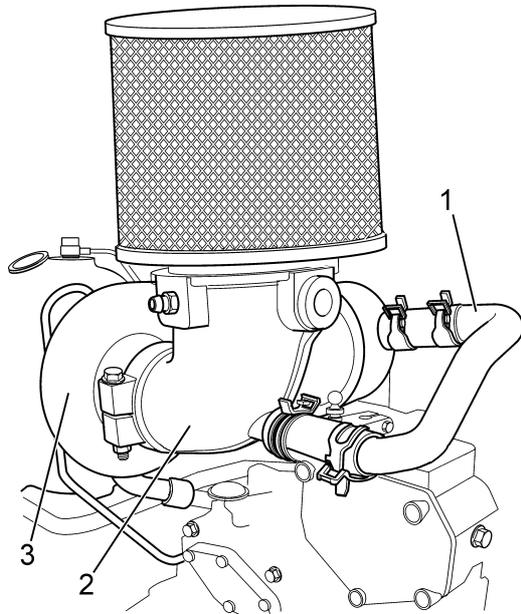
## Air inlet and exhaust systems



### Changing air filter

Replace the air filter when the red field in the service indicator is fully visible when the engine is stopped.

1. Undo the hose clamp below the air filter cartridge and pull off the cartridge.
2. Replace the air filter cartridge and tighten the hose clamp.
3. Press the button on the service indicator to reset the signal after service. The indicator is now ready to operate again.



### Cleaning the compressor

When using mineral oil as lubricant, soot must be removed from the compressor and the compressor housing.

1. Loosen the ventilation pipe (1) from the air intake (2) and remove the air filter together with the air intake.
2. Loosen the compressor housing (3) and remove it carefully.
3. Clean the housing and compressor wheel from soot using a sharp knife.

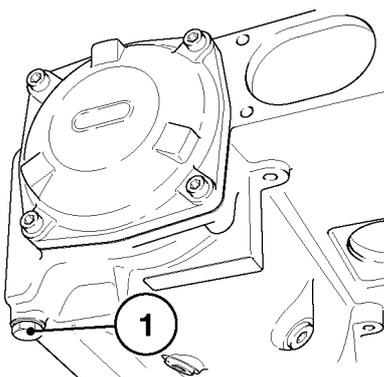
**NOTE!** Be very careful not to damage anything.

4. Install the compressor house and tighten the screws equally.
5. Check that the compressor wheel can turn easily; if not, the housing is not in its right position.
6. Reinstall the air filter together and the air intake.
7. Fit the ventilation pipe to the air intake.

### Checking drain hole of charge air cooler

Condensation can form in the charge air cooler during operation. The condensation should be drained through the plug (1) on the bottom of the charge air cooler (If necessary refit the plug with a new seal). Make sure the drain is not blocked.

**⚠ IMPORTANT !** If considerable amounts of water run out of the drain hole, the insert must be removed and test pressurized. This must be done by an authorized workshop.



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## Cooling system, general

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The freshwater system is the internal cooling system of the engine. It is a closed system and shall always be filled with coolant that protects the engine from internal corrosion and frost damage if the climate requires it. Anti-corrosive additives become less efficient with age and the coolant must therefore be changed in accordance with the recommendations in the maintenance schedule.

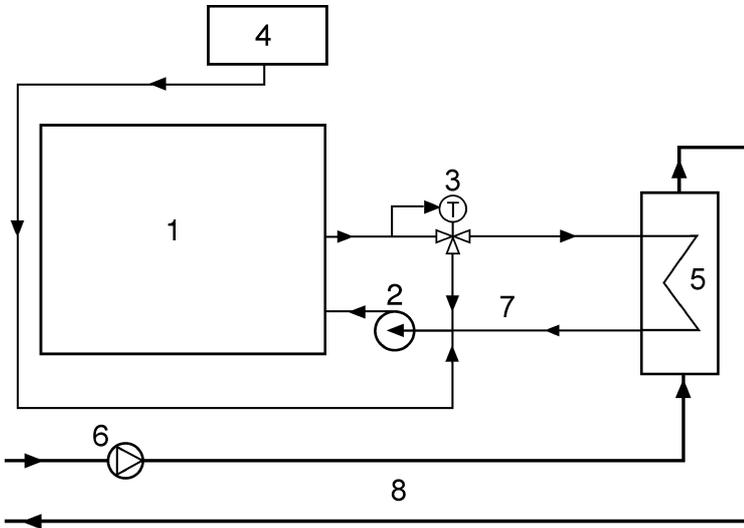
The rawwater system is the engine's external cooling system and it is either a seawater system or a central cooling system. It cools the internal cooling system in an engine mounted or externally mounted heat exchanger.

The Volvo Penta Genset comes with an internal freshwater system connected to an engine mounted heat exchanger, a radiator cooler, or prepared for external cooling, e.g. keel cooling or central cooling.

-  **WARNING!** Never open the pressure cap or drain the cooling system when the engine is warm. Steam or hot fluid may spurt out.
-  **WARNING!** The coolant is dangerous to your health and an environmental hazard. Handle coolant with care and dispose of old coolant in accordance with local regulations.
-  **IMPORTANT!** For coolant specification, refer to section "technical data".
-  **IMPORTANT!** Check the coolant level on a cold stationary engine.
-  **IMPORTANT!** Coolant to be added should have the same concentration as the coolant in the engine. Do not add plain water.
-  **IMPORTANT!** Certain parts of the system are made of light alloy. Chemical additives must therefore not be used when cleaning the system.

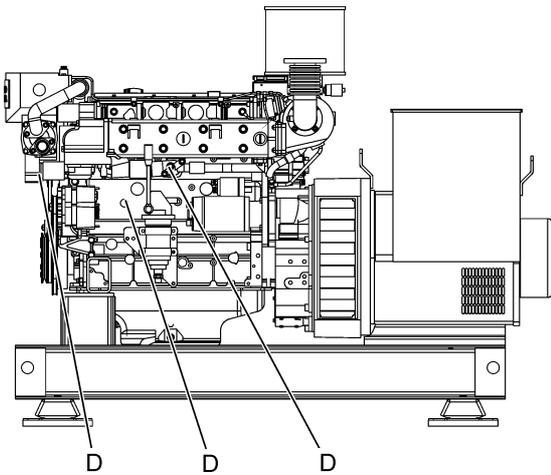
## Cooling system D5A T HE

The system includes two circuits. The freshwater system is cooling the cylinder liners and the cylinder heads. An engine driven cooling water pump circulates the coolant through the heat exchanger and through the engine. The rawwater system is cooling the coolant in the freshwater cooling system. The rawwater system is connected to a seawater inlet or a central cooling system.

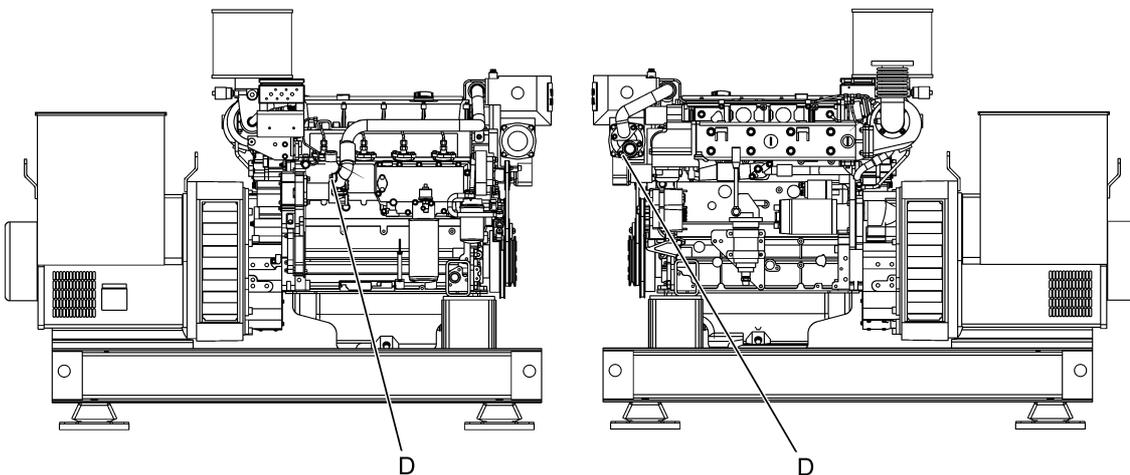


- 1. Engine
- 2. Freshwater pump
- 3. Thermostat valve
- 4. Expansion tank
- 5. Heat exchanger
- 6. Rawwater pump
- 7. Freshwater circuit
- 8. Rawwater circuit

### Drain points freshwater system

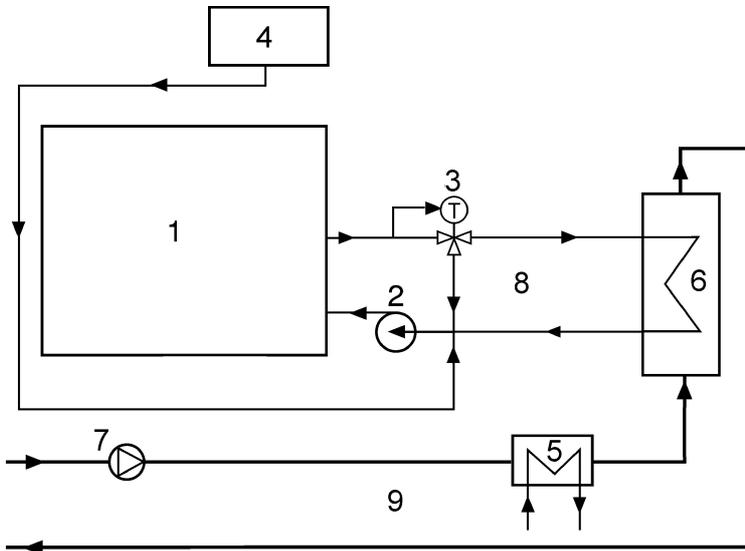


### Drain points rawwater system



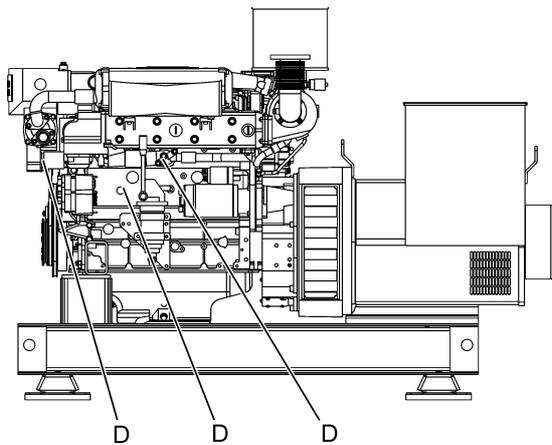
## Cooling system D5A TA HE

The system includes two circuits. The freshwater system is cooling the charge air, the cylinder liners and the cylinder heads. An engine driven cooling water pump circulates the coolant through the heat exchanger and through the engine. The rawwater system is cooling the coolant in the freshwater cooling system. The rawwater system is connected to a seawater inlet or a central cooling system.

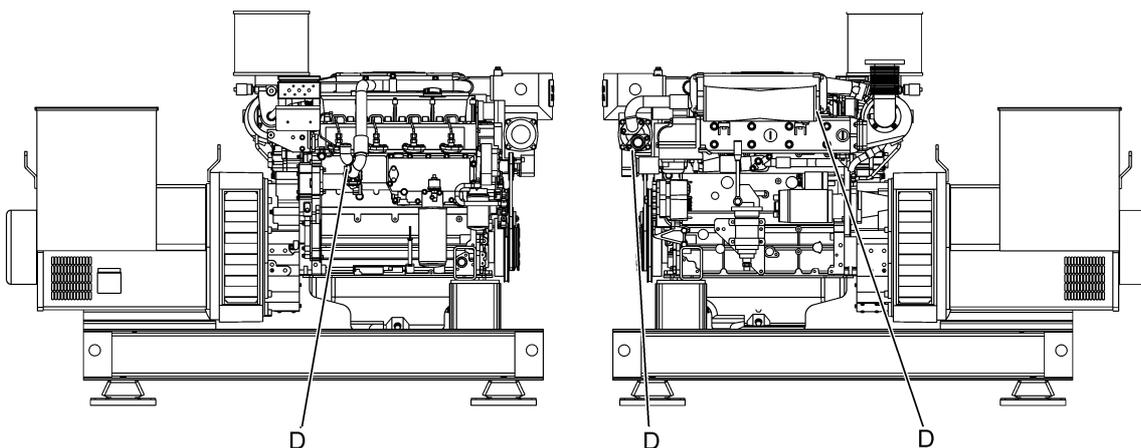


1. Engine
2. Freshwater pump
3. Thermostat valve
4. Expansion tank
5. Charge air cooler
6. Heat exchanger
7. Rawwater pump
8. Freshwater circuit
9. Rawwater circuit

### Drain points freshwater system

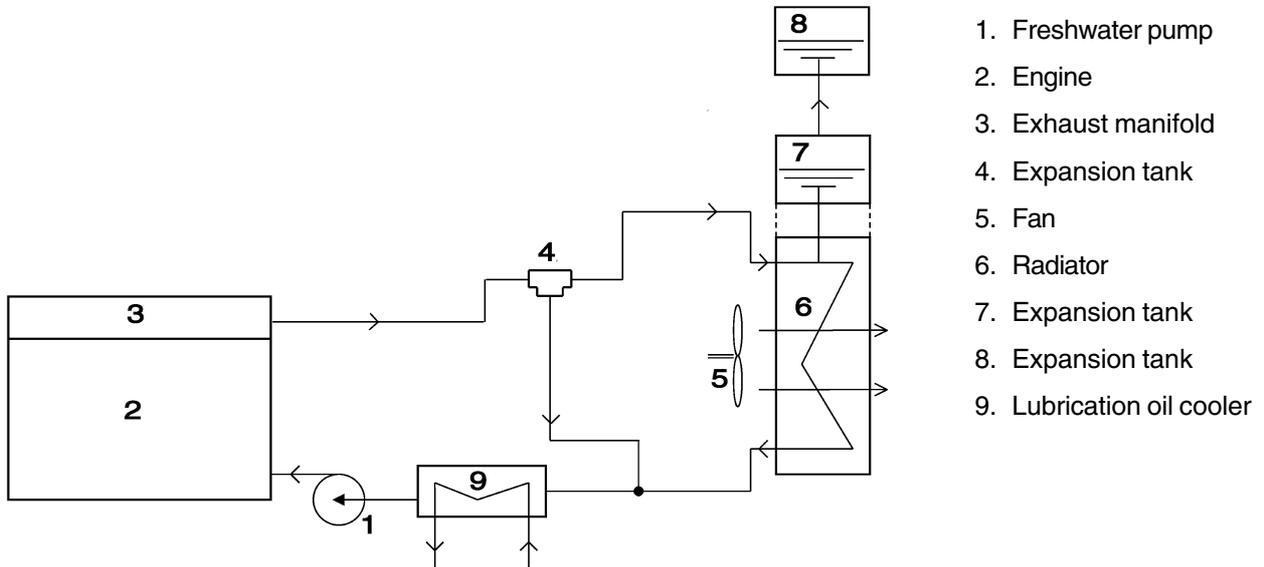


### Drain points rawwater system

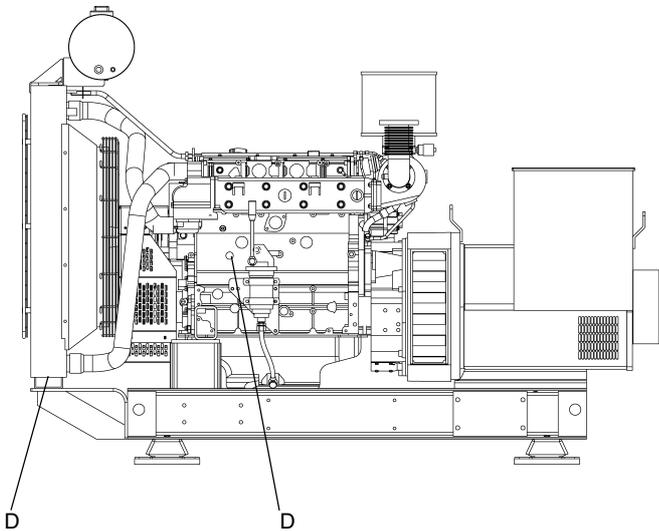


## Cooling system D5A T RC

The engine cooling water is cooled by a radiator in a one-circuit cooling system. Air is forced through the radiator by an engine driven cooling air fan. The charge air is cooled in an air-to-air charge air cooler mounted in front of the radiator and it make use of the air flow from the engines cooling fan before it enters the radiator.

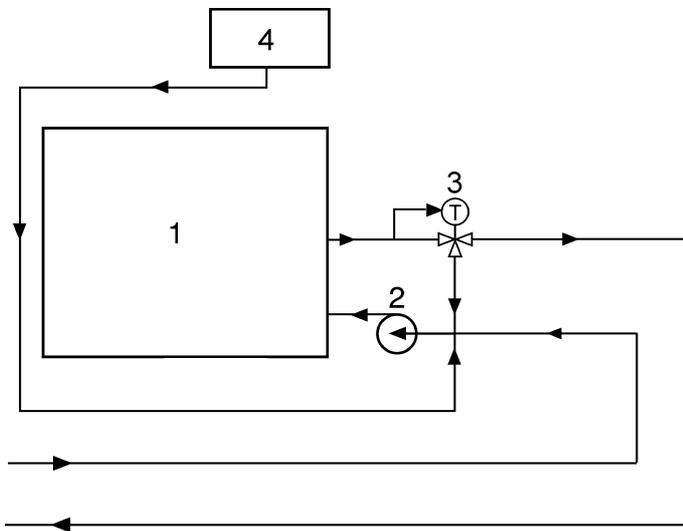


## Drain points freshwater system



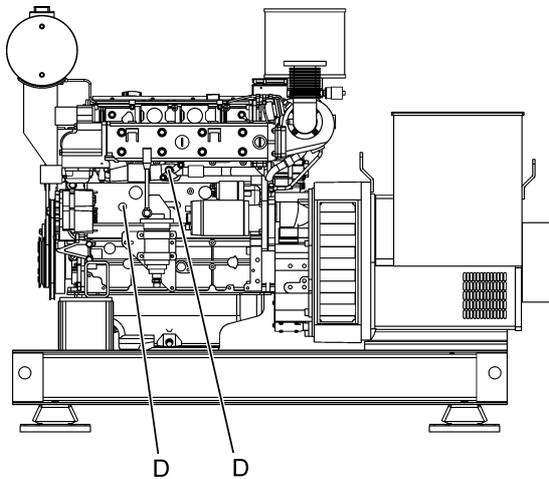
## Cooling system D5A T KC (1-circuit)

The engine cooling water (freshwater) is cooled by, e.g, a box cooler, a grid cooler, or any other external heat exchanger. The system is cooling the cylinder liners and the cylinder heads. An engine driven freshwater pump circulate the coolant through the engine.



1. Engine
2. Freshwater pump
3. Thermostat valve
4. Expansion tank

## Drain points freshwater system

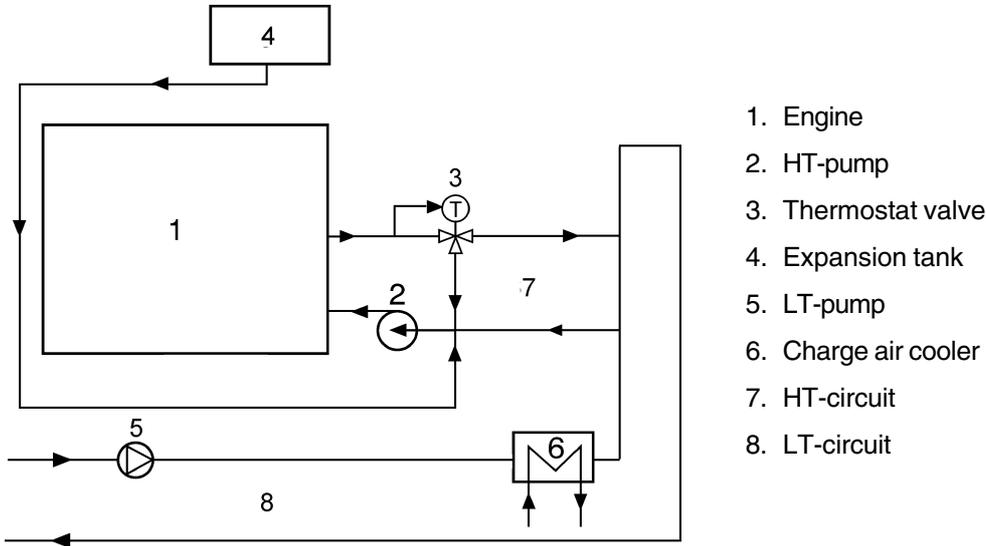


### Cooling system D5A TA KC (1½-circuit)

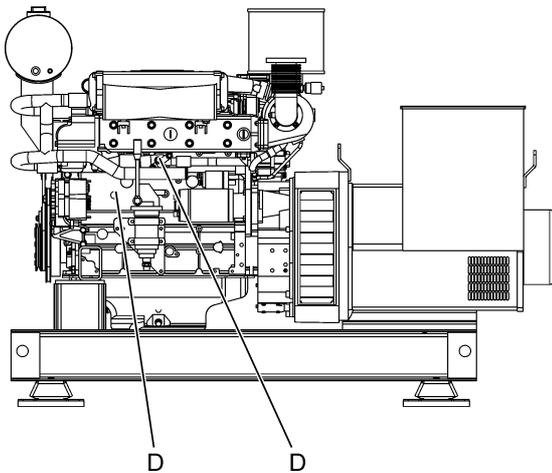
The engine cooling water is cooled by, e.g. a box cooler, a grid cooler, or any other external heat exchanger. When the coolant temperature in the HT-circuit is too high the thermostat valve opens and allows water of a lower temperature from the LT-circuit to enter the HT-circuit.

The HT-circuit is cooling the cylinder liners, the cylinder heads, and the lubrication oil.. An engine driven HT-pump circulates the coolant through the engine.

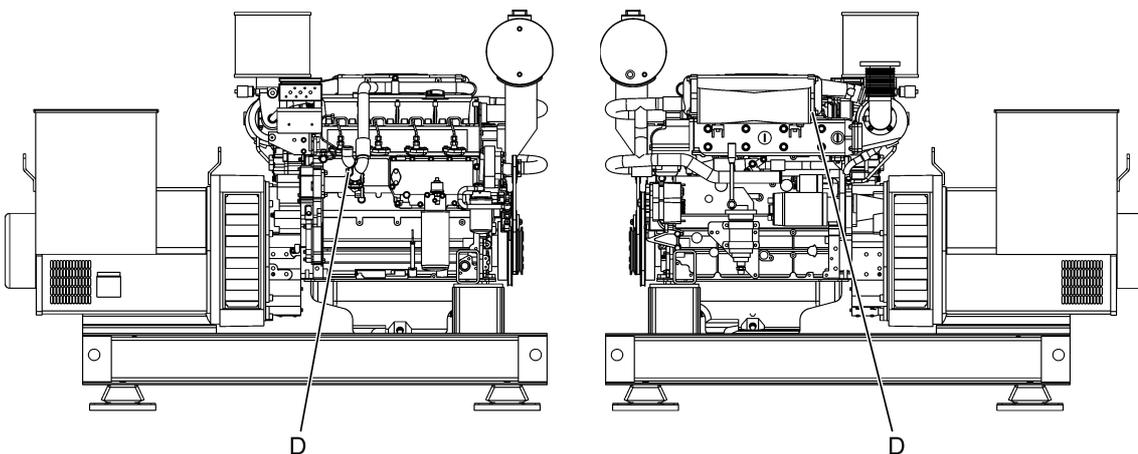
The LT-circuit is cooling the charge air. An engine driven LT-pump circulates the coolant through the CAC.



#### Drain points HT-circuit



#### Drain points LT-circuit

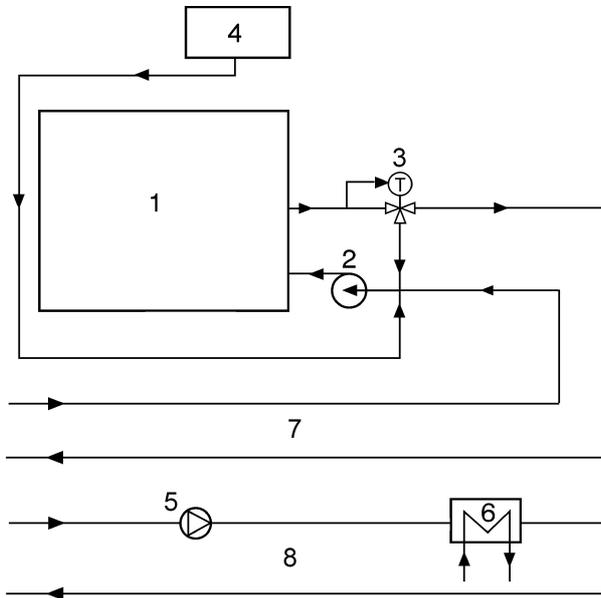


## Cooling system D5A TA KC (2-circuit)

The engine cooling water is cooled by, e.g, a box cooler, a grid cooler, or any other external heat exchanger.

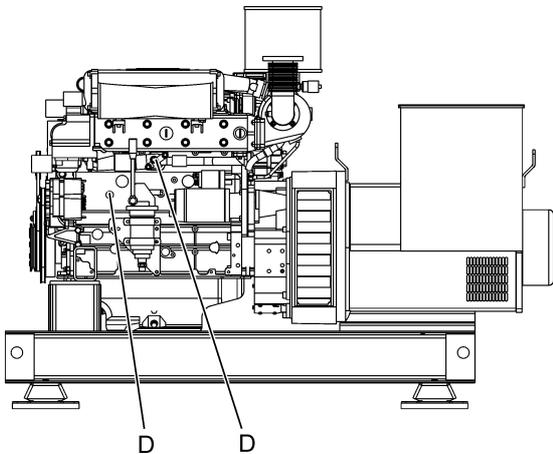
The HT-circuit is cooling the cylinder liners, the cylinder heads, and the lubrication oil.. An engine driven HT-pump circulates the coolant through the engine.

The LT-circuit is cooling the charge air. An engine driven LT-pump circulates the coolant through the CAC.

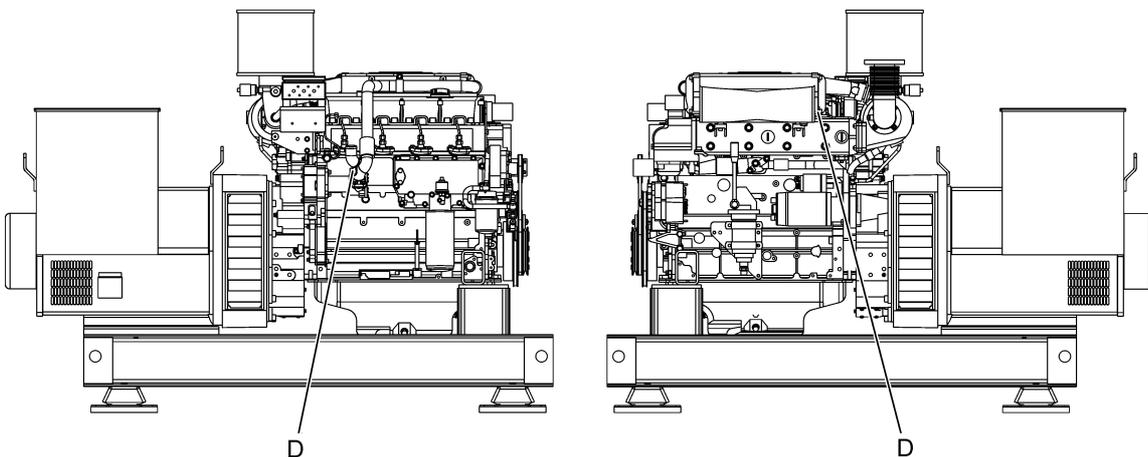


1. Engine
2. HT-pump
3. Thermostat valve
4. Expansion tank
5. LT-pump
6. Charge air cooler
7. HT-circuit
8. LT-circuit

### Drain points HT-circuit



### Drain points LT-circuit



## Freshwater system

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### Checking coolant level

 **WARNING!** Never open the pressure cap when the engine is warm. Steam or hot fluid may spurt out. Stop the engine and allow it to cool.

When engine is cold the coolant level must be visible at the lower edge of the filler neck on the expansion tank.

### Filling coolant

The freshwater system (HT) is automatically bled via the pressure relief spring on the pressure cap on the expansion tank. Check the closure plug and seal ring for leaks when the engine is in operation. Tighten the plug if necessary.

### Topping up

 **IMPORTANT!** When topping up, use the same coolant mixture as already in the system.

Fill the freshwater system (HT) with coolant to the correct level through the filler opening in the expansion tank, for correct level, refer to section “coolant level check”. Fill slowly so that evacuated air is able to pass the filler opening.

**NOTE!** For coolant specification refer to section “technical data coolant”.

### Filling the system when empty

Fill the freshwater system (HT-circuit) with coolant to the correct level through the filler opening in the expansion tank, for correct level, refer to section “coolant level check”. Fill slowly so that evacuated air is able to pass the filler opening.

**NOTE!** For coolant specification refer to section “technical data coolant”.

1. Start the engine and run it under no load until the thermostat valve opening temperature is reached.

 **IMPORTANT!** The engine must not be operated under full load before the system has been bled and topped up.

2. Check air vent for leakage.
3. Stop the engine and allow it to cool. Check the coolant level and top up if needed.

## Draining the coolant

 **WARNING!** Stop the engine and allow it to cool down before draining. Hot coolant and hot surfaces can cause burns.

 **WARNING!** Glycol is a health hazard (poison). Collect the old coolant and leave it to a destruction plant.

1. Remove the filler cap from the expansion tank.
2. Connect a suitable hose to each drain point, refer to section "Drain points". Open the drains and allow the coolant to drain off into a suitable vessel.

 **IMPORTANT!** Check that all coolant really does drain out. Deposits may need to be cleared away, inside the drain plug(s)/tap(s).

3. Drain all other systems connected to the freshwater system (HT-circuit), e.g. heater, water heater, etc.
4. Close all drains.

## Flushing the freshwater system

(HT-circuit)

The system should be flushed before changing coolant to avoid inferior cooling performance due to deposits in the cooling system.

1. Drain the coolant as described earlier.
2. Insert a hose into the filler opening on the expansion tank and flush with fresh water.
3. Flush until the water running out of the drainage points is clean.
4. Close all drain points when the flushing water has run out.
5. Fill with coolant. See section "coolant filling when empty".

## Rawwater system

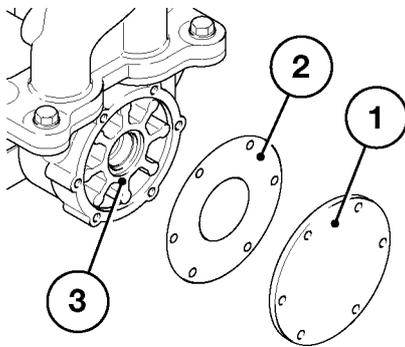
**⚠ WARNING!** The rawwater system (LT-Circuit) must be closed and drained before commencing work on the system. This due to the risk of seawater or water from the central cooling system entering the vessel.

### Draining the rawwater system

(LT-circuit)

1. Close the in- and outlet cocks.
2. Open the drains, refer to section "Drain points", and allow the water to drain.

**⚠ IMPORTANT!** Check that the water really drains. Deposits may need to be removed from inside the drain plugs.

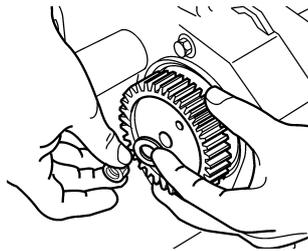
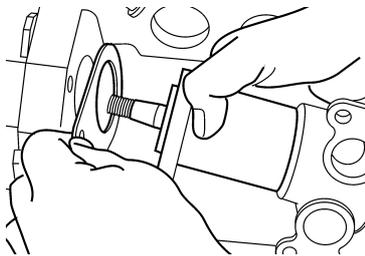
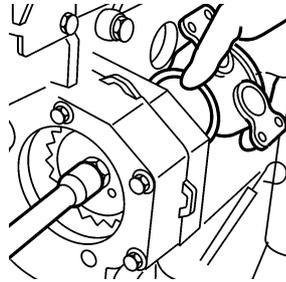
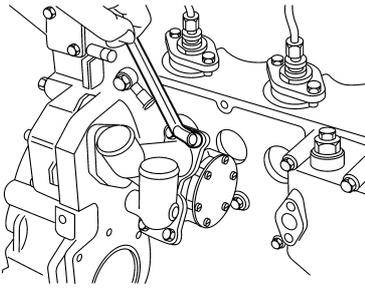


### Rawwater pump (LT-pump) impeller

#### Checking and changing

**⚠ IMPORTANT!** Always keep a spare impeller and gasket in store aboard the ship.

1. Close the raw water cocks and drain the external cooling water as described in the chapter draining the raw water system.
2. Remove the pump end cover (1), the seal (2), and the impeller(3).
3. Inspect the impeller. Change the impeller if there are any visible cracks or other defects.
4. Clean the inside of the housing. Lubricate the pump housing and the inside of the cover with water-resistant grease (non-aggressive on rubber).
5. Push the impeller into position while rotating it in the normal operating direction.
6. Fit the cover with a new seal.
7. Open the raw water cocks.



## Rawwater pump (LT-pump)

### Disassembly

1. Drain the water from the raw water system.
2. Remove the coolant pipes to and from the raw water pump.
3. Remove the connecting socket.
4. Remove the screw cap.
5. Remove the hex nut from the gear.
6. Remove bolts.
7. Remove gear from shaft by using an arbor.

**NOTE!** In order not to damage the shaft when removing the gear, the hex nut must be flush with the shaft of the raw water pump.

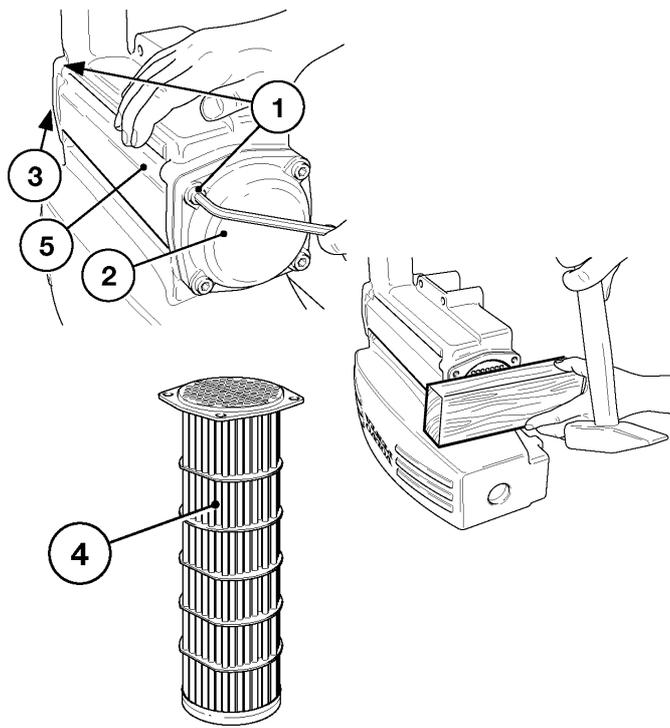
### Assembly

**⚠ IMPORTANT!** Always use new gaskets and O-rings.

8. Install the pump with a new gasket.
9. Fit the gear with a new hex nut, tighten to 80 Nm, Pay attention that the key is fitted.

**Note!** The cones of the gear and shaft must be free from lubricant, clean and undamaged.

10. Fit the screw cap with a new O-ring.
11. Fit the connecting socket with a new gasket.
12. Install the coolant pipes to and from the raw water pump.



## Engine mounted heat exchanger

### (HE-engines only)

1. Loosen screws (1).
2. Remove the reverse cover (2) and on the rear side the connecting cover (3).
3. Gently drive out the raw water bundle (4).
4. Clean the raw water bundle and the heat exchanger housing (5). Make sure that there are no cracks or other damages, replace if necessary.
5. Reinsert the raw water bundle (4) and reconnect to the heat exchanger housing (5).
6. Fit the reverse cover (2) and the connecting cover (3) with new seals and screws.

## Electrical system

### General

The engines have a comprehensive electrical engine management system. This automatic system monitors engine speed as well as the electrical and fuel systems and the engine cooling and lubrication functions. The system consists of a number of switches and sensors which activate an alarm or shutdown (optional) if a fault is detected in the engine.

Supply voltage is 24V.

**⚠ WARNING!** Before starting work on the electrical system, the engine must be stopped and the power turned off with the main switches. Shore power to the engine heater, battery charger or other extra equipment fitted on the engine must be disconnected.



### Checking the electrical wiring

Make sure electrical connections are tightened, dry and free from oxide. If necessary, spray these connections with water-repellant (Volvo Penta all-round oil).

### Main switches

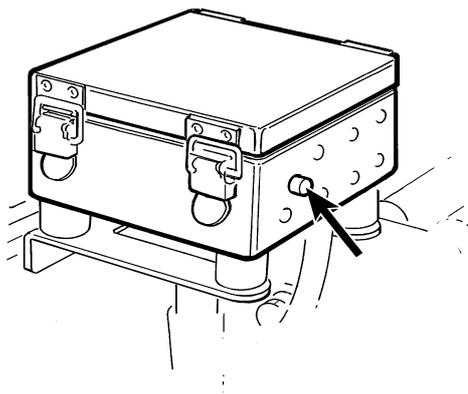
The main switches must never be turned off until the engine has been stopped. Breaking the circuit between the generator and the batteries while the engine is running can damage the generator. For the same reason, the charge circuits must never be switched while the engine is running.

**⚠ IMPORTANT!** Never turn the power off using the main switches while the engine is running.

### Fuses

The engine is equipped with a semi-automatic fuse (8A) which cut the current if overloaded. The fuse is located in the junction box on the engines service side. The semi-automatic fuse are re-set by pressing the red button, once any faults have been attended to.

**⚠ IMPORTANT!** If the fuse trips frequently, an authorized Volvo Penta workshop should be contacted to investigate the cause of the overload.



### Electric welding

Disconnect the positive and negative battery cables. Then disconnect all the leads to the generator.

Always connect the weld clamp to the component being welded and as close to the welding point as possible. Never connect the clamp to the engine or generator in such a way that current can pass across a bearing.

**⚠ IMPORTANT!** When welding has ceased, connect the leads to the generator before reconnecting the battery cables.



## Battery maintenance

- ⚠ WARNING!** Risk for fire and explosion. Never expose the battery to naked flames or sparks.
- ⚠ WARNING!** Never reverse the polarity of the battery. Risk of sparks and explosion.
- ⚠ WARNING!** Battery electrolyte is extremely corrosive. Protect eyes, skin and clothes when handling batteries. Always use protective goggles and gloves. In case of splashes on the skin, wash with soap and plenty of water. In case of splashes in the eyes, rinse immediately with plenty of water and call a doctor.

## Connecting and disconnecting

Connect the (+) cable (red) to the (+) terminal of the battery first. Then connect the (-) cable (black) to the (-) pole of the battery.

Disconnect the (-) cable (black) first and then the (+) cable (red).

## Cleaning

Keep batteries dry and clean. Contaminants and oxide on batteries and battery terminals can cause short-circuits, voltage drops and discharging, especially in damp weather. Clean oxide from battery terminals and cable shoes with a brass brush. Tighten cable shoes well and grease them with terminal grease or petroleum jelly.

## Electrolyte level

The electrolyte should be 5–10 mm (0.2–0.4") above the cell plates in the battery. If necessary, top up with distilled **water**. The battery should be charged for at least 30 minutes after filling by running the engine at no load.

**NOTE!** Special instructions must be followed for certain maintenance-free batteries.



## Battery charging

**⚠ WARNING!** Risk for explosion. Charging generates hydrogen gas (oxyhydrogen gas). A short circuit, naked flame or spark can cause a powerful explosion. Ventilate well.

**⚠ WARNING!** Battery electrolyte is extremely corrosive. Protect eyes, skin and clothes. Always use protective goggles and gloves. In case of splashes on the skin, wash with soap and plenty of water. In case of splashes in the eyes, rinse immediately with plenty of water and call a doctor.

Charge the batteries if they have been discharged. The batteries will be harmed if left discharged and can also freeze and crack in cold weather.

**⚠ IMPORTANT!** Follow the battery charger user instructions carefully. Disconnect the battery cables before connecting the battery charger to avoid electrochemical corrosion when using an external battery charger.

The battery plugs must be unscrewed but left in the holes while charging is in progress. Ventilate well, especially if batteries are being charged in confined spaces.

**⚠ WARNING!** Always cut the charging current **before** disconnecting the charger cables. Never reverse the polarity of the battery. Risk of sparks and explosion.

Special directions apply for rapid charging. Rapid charging can impair the service life of the batteries and should be avoided.

# Inhibiting

## General

To prevent the genset and other equipment from being harmed during long (2 months or more) periods out of service, it must be conserved. It is of utmost importance that the conservation is performed correctly. Therefore we have compiled a checklist of the most important points. Before taking the genset out of service for long periods, it should be checked by a Volvo Penta dealer for possible need of overhaul or repair.

-  **WARNING!** Certain preservatives are flammable. Some are also dangerous to inhale. Provide good ventilation. Use a protective mask when spraying.
-  **WARNING!** Read the chapter "Maintenance" thoroughly before starting any maintenance work. It contains directions for performing maintenance in a safe and correct manner. Certain preservatives are flammable. Some are also dangerous to inhale. Provide good ventilation. Use a protective mask.
-  **IMPORTANT!** The following must be considered when cleaning with a high-pressure water jet: Never point high-pressure water jets directly at seals, rubber hoses or electrical components. Never use the high-pressure function when washing the engine.
-  **IMPORTANT!** For generator specific inhibiting information, refer to generator documentation.

## Preparation

1. Stop up to eight months: Change oil and oil filter on the engine and then run it warm  
  
Stop over eight months: Treat the lubricating and fuel systems with conservation oil. See directions on next page.
2. Make sure there is enough anti-freeze in the coolant. Add more if necessary. An alternative is to drain the coolant.
3. Drain the rawwater system.
4. Remove the impeller from the rawwater pump. Keep the impeller in a cool place in a closed plastic bag.
5. Drain off any water and contaminant from the fuel tank. Fill the tank with fuel to avoid condensation.
6. Disconnect the battery cables and clean and charge the batteries. Trickle charge during the storage period. A poorly charged battery can freeze and break.

7. Clean the engine externally. Touch up any paint damage with Volvo Penta original paint.
8. Spray electric system components with water repellent.
9. Inspect all control cables and apply anti-corrosion agent.
10. Cover the air intake to the engine, the exhaust aperture and the engine.

 **IMPORTANT!** Never use vinyl sheets for covering. This can result in condensation and harm the installation.

 **IMPORTANT!** Store the engine in a well-ventilated room.

 **IMPORTANT!** Affix a label on the engine giving the date, type of conservation and the preservative that was used.

## Care during storage

Recharge the battery at least once a month.

 **IMPORTANT!** During longer periods out of operation, the preparations must be repeated every 12 months.

## Return the engine to service

1. Remove any protective covers on the engine, air intake and exhaust pipe.
2. Top up with lubricant of the correct grade in the engine if necessary.
3. Fit new fuel filters and bleed the fuel system.
4. Check drive belts.
5. Check the condition of rubber hoses and check the tightness of all hose clips.
6. Close the drain cocks and fit the drain plugs of the rawwater system. Fit the impeller in the rawwater pump. Fill and bleed the rawwater system.
7. Check the coolant level and anti-freeze. Top up if necessary.
8. Check under and around the engine for such items as loose or missing bolts, oil, fuel or coolant leaks and repair if needed.
9. Connect fully charged batteries.
10. Start the genset and run it at idling speed until it reaches operating temperature before loading it.
11. Check for oil, fuel or coolant leaks.
12. When the engine has run long enough to warm up apply the load and bring it to operating speed.

### Conserving the lubricating and fuel systems for stops longer than eight months:

1. Drain the oil from the engine and fill with **conservation oil\*** to just over the MIN mark on the dipstick.
2. Connect supply and return fuel lines to a fuel can filled with 1/3 conservation oil\* and 2/3 diesel fuel.
3. Bleed the fuel system.
4. Start the engine and run it at idling speed until approximately two liters of the fuel/conservation oil mixture have been consumed. Stop the engine and re-connect the fuel lines.
5. Drain the conservation oil from the engine.
6. Follow the directions on the previous page in other respects.

\* Conservation oils are available from oil companies.

# Troubleshooting

A number of symptoms and possible causes for engine disturbances are described in the table below. For generator specific troubleshooting, refer to generator documentation. If faults or hitches arise that you cannot solve alone, you must always get in touch with your Volvo Penta dealer.

## Symptoms and possible causes

Starter motor does not rotate when cranking	1,2,3,4,5,
Starter motor rotates slowly when cranking	1,2,3,21,45,46
Engine does not start	7,8,9,10,11,12,13,14,19,20,22,23,25,47,54
Engine is difficult to start	7,8,9,10,11,12,13,14,19,20,22,23,25,47,48
Engine starts but stops again	7,8,9,10,11,12,13,14,19,20,22,23,25,47,48,49
Engine does not reach correct operating speed	7,8,9,10,11,12,13,14,17,18,19,20,21,22,23,24,25,30,33,54
Engine runs unevenly	7,8,9,10,11,12,13,14,15,16,22,23,25,26,48,54
Engine knocks	20,26,49
Engine vibrates	8,16,22,30,31,34
Engine does not stop	2,3,4,5,50
High fuel consumption	12,14,16,18,19,20,25,27,30
Black or dark gray exhaust smoke	12,14,16,17,18,19,20,25,27
Blue or white exhaust smoke	16,18,19,20,21,27,30,40,41,48,54
High lubrication oil consumption	21,29,30,31,41
Lubrication oil pressure too low	21,28,32,42,43
Coolant temperature too high	33,35,36,37,38,39,40,51
Coolant temperature too low	40
No charge or poor charge	2,3,44,52,53

- |   |  |   |
|---|--|---|
| 1. Defective starter                        | 22. Air in fuel system                       | 43. Defective relief valve  |
| 2. Flat batteries                           | 23. Water/contamination in fuel              | 44. Alternator drive belt slips                                     |
| 3. Poor contact/broken cables               | 24. Engine speed control wrongly adjusted    | 45. Clutch is engaged   |
| 4. Main switch turned off                   | 25. Insufficient air supply                  | 46. Defective bearings or abnormal cylinder friction                |
| 5. A fuse/circuit breaker has blown/tripped | 26. Too high coolant temperature             | 47. Fuel supply pump strainer blocked                               |
| 6. Lack of fuel                             | 27. Too low coolant temperature              | 48. Very cold engine and lubrication oil                            |
| 7. Blocked fuel filter                      | 28. Too low lubrication oil level            | 49. Heavy initial load  |
| 8. Defective fuel filter                    | 29. Lubrication oil leakage                  | 50. Engine consume lubrication oil or combustible gas               |
| 9. Blocked fuel pipes                       | 30. Worn cylinder liners and/or piston rings | 51. Cylinder liner have scalings or such that reduce cooling effect |
| 10. Defective fuel pipes                    | 31. Worn valve stem seals                    | 52. Alternator/Rectifier broken                                     |
| 11. Blocked fuel supply pump                | 32. Blocked lubrication oil filter           | 53. Faulty governor   |
| 12. Defective fuel supply pump              | 33. Radiator blocked                         | 54. Broken piston   |
| 13. Blocked fuel injection pump             | 34. Faulty engine mounting                   |   |
| 14. Defective fuel injection pump           | 35. Too low coolant level                    |   |
| 15. Blocked fuel injectors                  | 36. Air in fresh water system                |   |
| 16. Defective fuel injectors                | 37. Blocked sea water inlet/pipe/filter      |   |
| 17. Incorrect valve clearance               | 38. Circulation pump drive belt slips        |   |
| 18. Incorrect fuel injection timing         | 39. Defective cooling water pump             |   |
| 19. Low compression pressure                | 40. Defective/wrong thermostat               |   |
| 20. Improper fuel oil                       | 41. Too high lubrication oil level           |   |
| 21. Improper lubrication oil                | 42. Defective lubrication oil pump           |   |

# Technical Data

## D5A T HE

### General

Number of cylinders .....	4
Displacement .....	4,76 liters (290 in <sup>3</sup> )
Valve clearance (cold engine):	
inlet .....	0,30 mm (0,0118")
exhaust .....	0,50 mm (0,0197")
Compression pressure	
at starter motor speed (120 rpm) .....	not available
Dry Weight*, engine with, without generator and frame, approx. ....	510 kg (1124 lbs)
*excl. engine oil & coolant	

### Exhaust temperatures\*: **77 kW @ 1500 rpm**

at 25% of ISO Standard Power .....	210°C (410°F)
at 50% of ISO Standard Power .....	300°C (572°F)
at 75% of ISO Standard Power .....	385°C (725°F)
at 100% of ISO Standard Power .....	455°C (851°F)
at 110% of ISO Standard Power .....	480°C (896°F)

### Exhaust temperatures\*: **81kW @ 1800 rpm**

at 25% of ISO Standard Power .....	205°C (401°F)
at 50% of ISO Standard Power .....	280°C (536°F)
at 75% of ISO Standard Power .....	340°C (644°F)
at 100% of ISO Standard Power .....	385°C (725°F)
at 110% of ISO Standard Power .....	400°C (752°F)

\*Approximated values, temperatures varies with ambient temperature and back pressure in the exhaust line.

### Lubricating system

Oil capacity, incl. filters, approx. ....	13 liters (3,4 US gals)
Oil capacity, incl. filters, approx (classified) .....	16 liters (4.2 US gals)
Oil pressure at operating speed:	
1500 rpm .....	320 - 540 kPa
1800 rpm .....	380 - 570 kPa
Shutdown point low oil pressure .....	150 kPa

### Cooling system

Freshwater system capacity including heat exchanger, approx. ....	22 liters (5,8 US gals)
Coolant temp normal operation .....	85 - 95 °C (185 - 203 °F)
Shutdown point High coolant temp. ....	103 °C (217 °F)

### Electrical system

System voltage .....	24V
AC alternator voltage/max. amperage .....	28V/60A
AC alternator output, approx. ....	1700W
Battery electrolyte density at +25°C (77°F):	
fully charged battery .....	1,28 g/cm <sup>3</sup> = 0,0462 lb/in <sup>3</sup>
battery recharged at .....	1,13 g/cm <sup>3</sup> = 0,0408 lb/in <sup>3</sup>

## D5A TA HE

### General

Number of cylinders .....	4
Displacement .....	4,76 liters (290 in <sup>3</sup> )
Valve clearance (cold engine):	
inlet .....	0,30 mm (0,0118")
exhaust .....	0,50 mm (0,0197")
Compression pressure	
at starter motor speed (120 rpm) .....	not available
Dry Weight*, engine, without generator and frame, approx. ....	525 kg (1157 lbs)
*excl. engine oil & coolant	

### Exhaust temperatures\*: 92 kW @ 1500 rpm

at 25% of ISO Standard Power .....	200°C (392°F)
at 50% of ISO Standard Power .....	290°C (554°F)
at 75% of ISO Standard Power .....	365°C (689°F)
at 100% of ISO Standard Power .....	410°C (770°F)
at 110% of ISO Standard Power .....	435°C (815°F)

### Exhaust temperatures\*: 100 kW @ 1800 rpm

at 25% of ISO Standard Power .....	200°C (392°F)
at 50% of ISO Standard Power .....	280°C (536°F)
at 75% of ISO Standard Power .....	325°C (617°F)
at 100% of ISO Standard Power .....	365°C (689°F)
at 110% of ISO Standard Power .....	380°C (716°F)

\*Approximated values, temperatures varies with ambient temperature and back pressure in the exhaust line.

### Lubricating system

Oil capacity, incl. filters, approx. ....	13 liters (3,4 US gals)
Oil capacity, incl. filters, approx (classified) .....	16 liters (4.2 US gals)
Oil pressure at operating speed:	
1500 rpm .....	320 - 540 kPa
1800 rpm .....	380 - 570 kPa
Shutdown point low oil pressure .....	150 kPa

### Cooling system

Freshwater system capacity including heat exchanger, approx. ....	22 liters (5,8 US gals)
Coolant temp normal operation .....	85 - 95 °C (185 - 203 °F)
Shutdown point High coolant temp. ....	103 °C (217 °F)

### Electrical system

System voltage .....	24V
AC alternator voltage/max. amperage .....	28V/60A
AC alternator output, approx. ....	1700W
Battery electrolyte density at +25°C (77°F):	
fully charged battery .....	1,28 g/cm <sup>3</sup> = 0,0462 lb/in <sup>3</sup>
battery recharged at .....	1,13 g/cm <sup>3</sup> = 0,0408 lb/in <sup>3</sup>

# D5A T RC

## General

Number of cylinders .....	4
Displacement .....	4,76 liters (290 in <sup>3</sup> )
Valve clearance (cold engine):	
inlet .....	0,30 mm (0,0118")
exhaust .....	0,50 mm (0,0197")
Compression pressure	
at starter motor speed (120 rpm) .....	not available
Dry Weight*, engine with heat exchanger, without generator and frame, approx. ....	510 kg (1124 lbs)
*excl. engine oil & coolant	

### Exhaust temperatures\*: **73 kW @ 1500 rpm**

at 25% of ISO Standard Power .....	210°C (410°F)
at 50% of ISO Standard Power .....	300°C (572°F)
at 75% of ISO Standard Power .....	385°C (725°F)
at 100% of ISO Standard Power .....	455°C (851°F)
at 110% of ISO Standard Power .....	480°C (896°F)

### Exhaust temperatures\*: **74 kW @ 1800 rpm**

at 25% of ISO Standard Power .....	205°C (401°F)
at 50% of ISO Standard Power .....	280°C (536°F)
at 75% of ISO Standard Power .....	340°C (644°F)
at 100% of ISO Standard Power .....	385°C (725°F)
at 110% of ISO Standard Power .....	400°C (752°F)

\*Approximated values, temperatures varies with ambient temperature and back pressure in the exhaust line.

## Lubricating system

Oil capacity, incl. filters, approx. ....	13 litres (3,4 US gals)
Oil capacity, incl. filters, approx (classified) .....	16 liters (4.2 US gals)
Oil pressure at operating speed:	
1500 rpm .....	320 - 540 kPa
1800 rpm .....	380 - 570 kPa
Shutdown point low oil pressure .....	150 kPa

## Cooling system

Freshwater system capacity, approx. ....	32 litres (8,5 US gals)
Coolant temp normal operation .....	85 - 95 °C (185 - 203 °F)
Shutdown point High coolant temp. ....	103 °C (217 °F)

## Electrical system

System voltage .....	24V
AC alternator voltage/max. amperage .....	28V/60A
AC alternator output, approx. ....	1700W
Battery electrolyte density at +25°C (77°F):	
fully charged battery .....	1,28 g/cm <sup>3</sup> = 0,0462 lb/in <sup>3</sup>
battery recharged at .....	1,13 g/cm <sup>3</sup> = 0,0408 lb/in <sup>3</sup>

## D5A T KC (1-circuit)

### General

Number of cylinders .....	4
Displacement .....	4,76 liters (290 in <sup>3</sup> )
Valve clearance (cold engine):	
inlet .....	0,30 mm (0,0118")
exhaust .....	0,50 mm (0,0197")
Compression pressure	
at starter motor speed (120 rpm) .....	not available
Dry Weight*, engine with heat exchanger, without generator and frame, approx. ....	510 kg (1124 lbs)
*excl. engine oil & coolant	

### Exhaust temperatures\*: 77 kW @ 1500 rpm

at 25% of ISO Standard Power .....	210°C (410°F)
at 50% of ISO Standard Power .....	300°C (572°F)
at 75% of ISO Standard Power .....	385°C (725°F)
at 100% of ISO Standard Power .....	455°C (851°F)
at 110% of ISO Standard Power .....	480°C (896°F)

### Exhaust temperatures\*: 81kW @ 1800 rpm

at 25% of ISO Standard Power .....	205°C (401°F)
at 50% of ISO Standard Power .....	280°C (536°F)
at 75% of ISO Standard Power .....	340°C (644°F)
at 100% of ISO Standard Power .....	385°C (725°F)
at 110% of ISO Standard Power .....	400°C (752°F)

\*Approximated values, temperatures varies with ambient temperature and back pressure in the exhaust line.

### Lubricating system

Oil capacity, incl. filters, approx. ....	13 liters (3,4 US gals)
Oil capacity, incl. filters, approx (classified) .....	16 liters (4.2 US gals)
Oil pressure at operating speed:	
1500 rpm .....	320 - 540 kPa
1800 rpm .....	380 - 570 kPa
Shutdown point low oil pressure .....	150 kPa

### Cooling system

Freshwater system capacity including heat exchanger, approx. ....	11 liters (2,9 US gals)
Coolant temp normal operation .....	83 - 95 °C (181 - 203 °F)
Shutdown point High coolant temp. ....	103 °C (217 °F)

### Electrical system

System voltage .....	24V
AC alternator voltage/max. amperage .....	28V/60A
AC alternator output, approx. ....	1700W
Battery electrolyte density at +25°C (77°F):	
fully charged battery .....	1,28 g/cm <sup>3</sup> = 0,0462 lb/in <sup>3</sup>
battery recharged at .....	1,13 g/cm <sup>3</sup> = 0,0408 lb/in <sup>3</sup>

## D5A TA KC (1½-circuit)

### General

Number of cylinders .....	4
Displacement .....	4,76 liters (290 in <sup>3</sup> )
Valve clearance (cold engine):	
inlet .....	0,30 mm (0,0118")
exhaust .....	0,50 mm (0,0197")
Compression pressure	
at starter motor speed (120 rpm) .....	not available
Dry Weight*, engine, without generator and frame, approx. ....	525 kg (1157 lbs)
*excl. engine oil & coolant	

### Exhaust temperatures\*: 92 kW @ 1500 rpm

at 25% of ISO Standard Power .....	200°C (392°F)
at 50% of ISO Standard Power .....	290°C (554°F)
at 75% of ISO Standard Power .....	365°C (689°F)
at 100% of ISO Standard Power .....	410°C (770°F)
at 110% of ISO Standard Power .....	435°C (815°F)

### Exhaust temperatures\*: 100 kW @ 1800 rpm

at 25% of ISO Standard Power .....	200°C (392°F)
at 50% of ISO Standard Power .....	280°C (536°F)
at 75% of ISO Standard Power .....	325°C (617°F)
at 100% of ISO Standard Power .....	365°C (689°F)
at 110% of ISO Standard Power .....	380°C (716°F)

\*Approximated values, temperatures varies with ambient temperature and back pressure in the exhaust line.

### Lubricating system

Oil capacity, incl. filters, approx. ....	13 liters (3,4 US gals)
Oil capacity, incl. filters, approx (classified) .....	16 liters (4.2 US gals)
Oil pressure at operating speed:	
1500 rpm .....	320 - 540 kPa
1800 rpm .....	380 - 570 kPa
Shutdown point low oil pressure .....	150 kPa

### Cooling system

Freshwater system capacity including heat exchanger, approx. ....	11 liters (2,9 US gals)
Coolant temp normal operation .....	83 - 95 °C (181 - 203 °F)
Shutdown point High coolant temp. ....	103 °C (217 °F)

### Electrical system

System voltage .....	24V
AC alternator voltage/max. amperage .....	28V/60A
AC alternator output, approx. ....	1700W
Battery electrolyte density at +25°C (77°F):	
fully charged battery .....	1,28 g/cm <sup>3</sup> = 0,0462 lb/in <sup>3</sup>
battery recharged at .....	1,13 g/cm <sup>3</sup> = 0,0408 lb/in <sup>3</sup>

## D5A TA KC (2-circuit)

### General

Number of cylinders .....	4
Displacement .....	4,76 liters (290 in <sup>3</sup> )
Valve clearance (cold engine):	
inlet .....	0,30 mm (0,0118")
exhaust .....	0,50 mm (0,0197")
Compression pressure	
at starter motor speed (120 rpm) .....	not available
Dry Weight*, engine, without generator and frame, approx. ....	525 kg (1157 lbs)
*excl. engine oil & coolant	

### Exhaust temperatures\*:

**92 kW @ 1500 rpm**

at 25% of ISO Standard Power .....	200°C (392°F)
at 50% of ISO Standard Power .....	290°C (554°F)
at 75% of ISO Standard Power .....	365°C (689°F)
at 100% of ISO Standard Power .....	410°C (770°F)
at 110% of ISO Standard Power .....	435°C (815°F)

### Exhaust temperatures\*:

**100 kW @ 1800 rpm**

at 25% of ISO Standard Power .....	200°C (392°F)
at 50% of ISO Standard Power .....	280°C (536°F)
at 75% of ISO Standard Power .....	325°C (617°F)
at 100% of ISO Standard Power .....	365°C (689°F)
at 110% of ISO Standard Power .....	380°C (716°F)

\*Approximated values, temperatures varies with ambient temperature and back pressure in the exhaust line.

### Lubricating system

Oil capacity, incl. filters, approx. ....	13 liters (3,4 US gals)
Oil capacity, incl. filters, approx (classified) .....	16 liters (4.2 US gals)
Oil pressure at operating speed:	
1500 rpm .....	320 - 540 kPa
1800 rpm .....	380 - 570 kPa
Shutdown point low oil pressure .....	150 kPa

### Cooling system

Freshwater system capacity including heat exchanger, approx. ....	11 liters (2,9 US gals)
Coolant temp normal operation .....	83 - 95 °C (181 - 203 °F)
Shutdown point High coolant temp. ....	103 °C (217 °F)

### Electrical system

System voltage .....	24V
AC alternator voltage/max. amperage .....	28V/60A
AC alternator output, approx. ....	1700W
Battery electrolyte density at +25°C (77°F):	
fully charged battery .....	1,28 g/cm <sup>3</sup> = 0,0462 lb/in <sup>3</sup>
battery recharged at .....	1,13 g/cm <sup>3</sup> = 0,0408 lb/in <sup>3</sup>

## Fuel specification

Fuel must comply with national and international standards at the least, e.g.:

JIS KK 2204 ..... Type1, Type2, Type3  
 ASTM, D975 ..... No.1-D, No.2-D  
 EN590 ..... with national environment  
 and cold requirements

**Note!** It is necessary to use a fuel that has a pour point suitable for ambient temperature during the operation of the engine. Consult the supplier to select the right type.

## Sulfur content

Complying with legal requirements in each country. If the sulfur content exceeds 0.5 % by weight, service intervals must be changed, see “Maintenance: Lubricating system”.

Fuels with low density (city diesel) can result in a loss of power by approx. 5% and an increase in fuel consumption of approx. 2–3 %.

# Lubrication oil specification

## Recommended types of engine oil

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

Oil grade	Sulfur content in fuel, by weight		
	up to 0.5%	0.5–1.0%	more than 1.0% <sup>1)</sup>
	<b>Oil change interval: Reached first in operation:</b>		
<b>VDS-2</b> <b>ACEA: E3–96, E2–96</b> <b>API: CD, CE, CF, CF-4, CG-4</b>	<b>500 hr. or 12 months.</b>	<b>250 hr. or 12 months.</b>	<b>125 hr. or 12 months.</b>

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

<sup>1)</sup> If the sulfur content in the fuel exceeds 1.0% by weight, an oil with TBN > 15 must be used.

**VDS = Volvo Drain Specification**

**ACEA= Association des Constructeurs Européenne d'Automobiles**

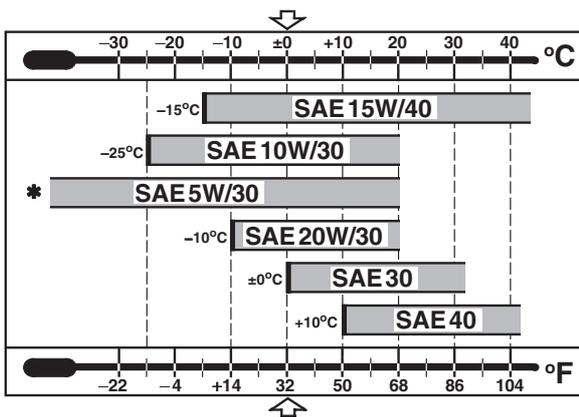
**API = American Petroleum Institute**

**TBN = Total Base Number**

## Selection of oil viscosity

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

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



\* Refers to synthetic or semi-synthetic oils.

## Coolant specification

Always use Volvo Penta Coolant in the freshwater cooling circuit. Volvo Penta Coolant acts both as anti-freeze agent and provides corrosion protection for the metal parts of the cooling system. Future claims might be rejected should Volvo Penta Coolant not have been used.

**⚠ Important!** Mixing other types of concentrated coolant with Volvo Penta Coolant, may decrease corrosion protection and may damage the engine or block the cooling system.

## Water

Always use clean water that complies with the requirements in ASTM D4985. If these requirements are not complied with, corrosion may occur, which would result in impaired cooling performance.

Total solid particle content .....	< 340 ppm
Total hardness .....	< 9,5 °dH
Chloride .....	< 40 ppm
Sulphate .....	< 100 ppm
pH value .....	< 5,5 – 9
Silica .....	< 20 mg SiO <sub>2</sub> /l
Iron .....	< 0.10 ppm
Manganese .....	< 0.05 ppm
Conductivity .....	< 500 µS/cm
Organic content, COD <sub>Mn</sub> .....	<15 mg KMnO <sub>4</sub> /L

## Mixing ratio

The mixture of Volvo Penta Coolant and water should contain 40-55% Volvo Penta Coolant. If the coolant contains less than 40% Volvo Penta Coolant, the cooling galleries in the engine or radiator may be blocked by contamination. If the coolant contains more than 60% Volvo Penta Coolant the cooling ability of the coolant mixture is impaired, this may cause the engine to overheat. Too high concentration of Volvo Penta Coolant also impairs the frost protection.

**⚠ Important!** The mixture of Volvo Penta Coolant and water may never contain less than 40% Volvo Penta Coolant.

**NOTE!** Mix the glycol with water in a separate container before filling the cooling system.

# Identification numbers

Type plates with identification numbers can be found on the engine. This information must always be used as a reference when ordering service and spare parts.

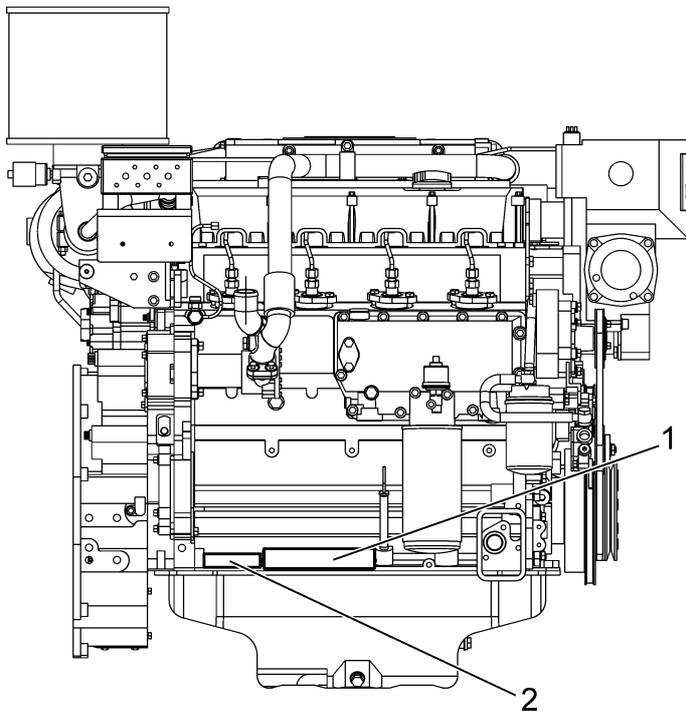
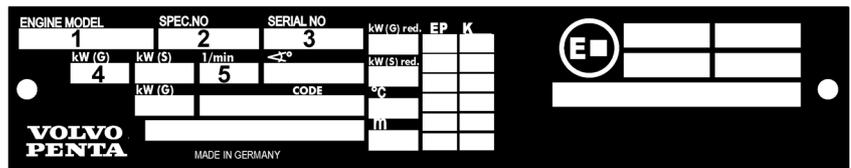
### Engine Type Plate(1)

- 1. Engine designation .....
- 2. Product number .....
- 3. Serial number .....
- 4. Rated power .....
- 5. Rated engine speed .....

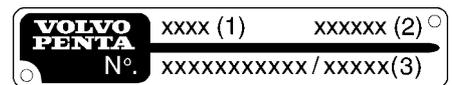
### Engine plate (2)

- 1. Product designation .....
- 2. Product number .....
- 3. Serial & base eng. No. ....

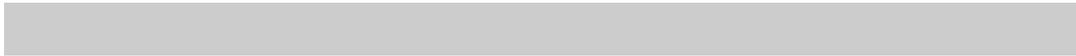
1.



2.



# Notes



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