



VF4 VF5

Operation manual

VF4.140E
VF4.170E
VF4.190E

VF5.220E
VF5.250E

Operation manual



VF4.140E

VF4.170E

VF4.190E

VF5.220E

VF5.250E

Serial numbers

Engine serial number:

.....

Gearbox serial number:

.....

.....

Please enter the serial numbers here.

These numbers should be quoted when inquiring about Customer Service, Repairs or Spare Parts (see page 6).

We reserve the right to make any changes without previous notice.

Copyright © 2012 Vetus N.V. Schiedam Holland

Please read and observe the information given in this operation manual. This will enable you to avoid accidents, preserve the manufacturer's warranty and maintain the engine in peak operating condition.

Make sure that the manual will remain intact and damage is prevented. Keep the manual away from humidity and heat.

Do not alter the content of the manual.

The manual is an integral part of the engine. Hand over the manual to the new owner if boat or engine is being sold.

For the Guarantee Conditions, see the Vetus Diesel 'Service and Warranty Manual' (320199.05).

This engine has been built exclusively for the application specified in the scope of supply and is to be used only for the intended purpose. Any use exceeding that scope is considered to be contrary to the intended purpose. The manufacturer will not assume responsibility for any damage resulting there from. The risks involved are to be borne by the user.

Use in accordance with the intended purpose also implies compliance with the conditions laid down by the manufacturer for operation, maintenance and servicing. The engine should only be operated, maintained and serviced by persons who are familiar with the former and the hazards involved.

The relevant accident prevention guidelines and other generally accepted safety and industrial hygiene regulations must be observed.

Unauthorized engine modifications will invalidate any liability claims against the manufacturer for resultant damage.

Manipulations of the injection and regulating system may also influence the performance of the engine, and its emissions. Adherence to legislation on pollution cannot be guaranteed under such conditions.

Contents

| | | | | | |
|--------------------------------|----|----------------------------------|----|-----------------------------------|-----|
| 1 Safety measures | 4 | Checking engine oil level | 44 | 5 Winter storage procedure | 80 |
| | | Checking coolant level | 45 | | |
| 2 Introduction | 9 | Checking and cleaning the raw | | 6 Recommissioning after | |
| Data tag | 10 | water strainer | 46 | winter storage | 92 |
| Serial number, | 11 | Draining of water from the water | | | |
| Cylinder numbering | 11 | separator/fuel filter | 47 | 7 Troubleshooting | 98 |
| Identification of engine parts | 12 | Engine oil change | 49 | | |
| Control panels | 14 | Battery, cables and connections | 52 | 9 Operating media | 115 |
| Single lever control | 16 | Gearbox oil level check | 55 | Fuel | 115 |
| ECU box | 17 | Cleaning the air filter | 56 | Lubricating oil | 116 |
| | | Changing the gearbox oil | | Coolant | 119 |
| 3 Use | 18 | (Technodrive) | 57 | | |
| General guidelines | 18 | Changing the gearbox oil | | 10 Wiring diagrams | 120 |
| Control lever | 20 | (ZF-Hurth) | 58 | | |
| Starting | 26 | Fuel filter replacement | 60 | 11 Overall dimensions | 128 |
| Cruising | 30 | Flexible engine mounts, hose | | | |
| Stopping | 33 | connections and fasteners | 63 | 12 Index | 133 |
| First commissioning | 35 | Raw water pump inspection | 64 | | |
| Running-in | 40 | Coolant replacement | 66 | | |
| | | Replace drive belt | 70 | | |
| 4 Maintenance | 41 | Checking the alternator | 73 | | |
| Introduction | 41 | Cleaning the heat exchanger | 74 | | |
| Maintenance schedule | 42 | Cleaning the after cooler | 78 | | |

1 Safety measures

Warning indications

Warning indications

The following warning indications are used in this manual in the context of safety:



DANGER

Indicates that great potential danger exists that can lead to serious injury or death.



CAUTION

Indicates that the usage procedures, actions etc. concerned can result in serious damage to or destruction of the engine. Some CAUTION indications also advise that a potential danger exists that can lead to serious injury or death.



WARNING

Indicates that a potential danger that can lead to injury exists.



NOTE

Emphasises important procedures, circumstances etc.

Symbols



Indicates that the relevant procedure must be carried out.



Indicates that a particular action is forbidden.

Pass the safety precautions on to other people who will use the engine.

General rules and laws concerning safety and accident prevention must always be observed.

1 Safety measures



FIRE RISK!

- Do not smoke if refuelling.
- Avoid spilling fuel on hot surfaces. Spilled fuel must be cleaned up immediately.
- Do not use petrol or diesel to clean components but make use of good quality, nonflammable, nonpoisonous solvents that are available from dealers.
- Always be alert to possible fuel or oil leakage!
If you discover a leak, take countermeasures immediately. If fuel or oil is spilled on a hot engine, fire can break out. This can cause physical injury or damage to the equipment.
- Do not fill the fuel tank while the engine is running!
Only refuel with the engine stopped.
- Never put flammable materials in the vicinity of the engine!
- Keep the engine and engine compartment clean!
Remove all inflammable materials such as fuel, oil and other litter before it builds up in the vicinity of the engine.

Preventing fire and explosion

- Connecting (emergency) extra starting battery
Proceed as follows when an extra starting battery is used to jump start the engine:
 - First connect the positive lead
 - Lastly connect the earth cable (negative pole) to the engine block

If this cable is connected in error to the negative pole of the engine battery, a spark can occur. The result of this could be that explosive gas produced by the battery explodes.

 - Once the engine is started, first remove the earth cable.

1 Safety measures

Prevention of injury

- The moving parts of the engine are dangerous. Never touch moving parts of the engine while it is running, to prevent cuts and other injuries.
- Stop the engine before carrying out maintenance!
- Always stop the engine before topping up or replacing fuel, oil or coolant.
- Before carrying out inspection or maintenance, the ignition key must be removed and the main battery switch turned off.
- Satisfy yourself that everything is in order before the engine is started again!
Make sure that no-one is working on or close to the engine before you start it. Remove all foreign objects from around the engine, such as litter, oil, tools and other components that are not part of the engine.
- Install all protective covers!
To prevent injury, make sure that all protective covers and cover plates are replaced over moving parts.
- Remove any tool used to bar the engine. If you leave this in position, serious injury or damage to the equipment can result.
- NEVER open the cap of the expansion tank when the engine is at working temperature.
- Only check the level of the coolant after the engine has been stopped and the cap of the expansion tank is cool enough to remove with bare hands.

1 Safety measures

Prevention of injury

- Be careful with battery acid!
If battery acid comes in contact with the eyes or skin, rinse the affected part immediately with copious amounts of water. If battery acid comes in contact with the eyes, rinse them out immediately with plenty of water and consult a doctor.
- Be careful with antifreeze!
If you accidentally swallow antifreeze, make yourself vomit and consult a doctor immediately. If antifreeze comes in contact with your eyes, wash them out immediately with plenty of water and consult a doctor.
- Make sure that you are wearing suitable clothing before starting work!
For your own safety you will most likely need special equipment – safety helmet, eye protection, safety boots, safety goggles, heavy gloves, ear protectors etc. Use them when necessary.
- Carry out maintenance procedures safely by only using suitable tools.
- Exhaust gases
Do not start the engine if the exhaust system is not connected.

1 Safety measures

When problems occur

- **When the engine stops suddenly:**

If the engine stops suddenly, do not start it again immediately. Track down the cause and carry out the necessary repairs before you start the engine again. If you do not do this, serious engine problems can develop.

- **If the oil pressure is too low:**

Stop the engine immediately and check the lubrication system. Running an engine with low oil pressure can cause bearing and other parts to seize.

- **If the engine overheats:**

If the engine should overheat, do not switch it off immediately. If an overheated engine is stopped suddenly, this can cause the coolant temperature to rise rapidly and moving parts to seize. First let the engine run in neutral to allow the hot parts of the engine to cool down, stop the engine and allow it to cool, and then gradually top up the coolant. Remember: adding coolant to an overheated engine can cause damage to the cylinder head.

- **If the drive belt has broken:**

Stop the engine immediately. If an engine is running with a broken drive belt this can result in the engine overheating and in turn to coolant squirting out of the expansion tank.

- **If the engine behaves strangely:**

Stop the engine or reduce the speed as far as possible.
Do not use the engine again until the cause of the defect has been solved.

2 Introduction

Dear customer,

Vetus diesel engines are designed both for pleasure and commercial craft. Consequently, a wide range of variants are offered to meet the requirements of specific cases.

Your engine is appropriately equipped for your vessel, which means that not necessarily all components described in this manual are mounted to your engine.

We have endeavoured to highlight any differences so that you will be able to locate the operating and maintenance instructions relevant to your engine quickly and easily.

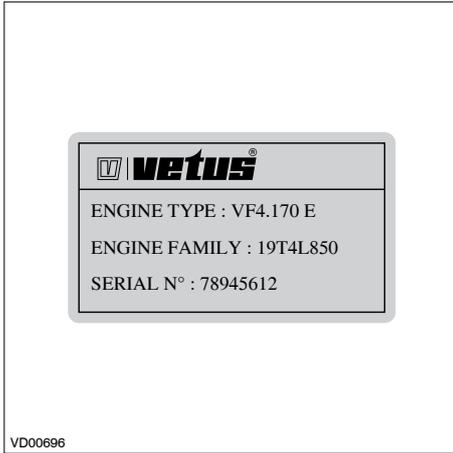
Please read this manual before starting your engine and always observe the operating and maintenance instructions.

We are available to help with any additional inquiries.

Sincerely,
Vetus n.v.

2 Introduction

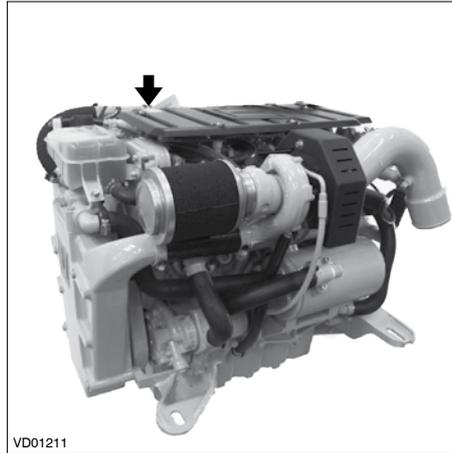
Data tag



1 Type plate

The engine type and the serial number are on the type plate.

The engine type and serial number must be quoted when ordering spare parts.



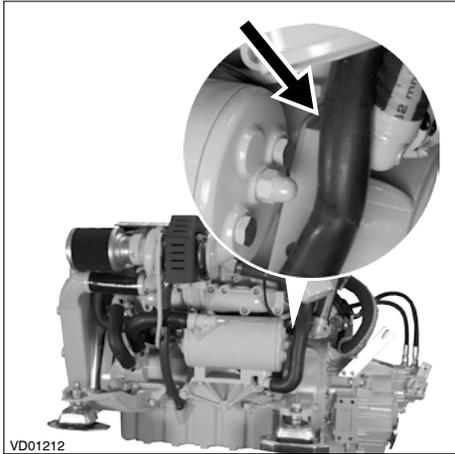
2 Position of the type plate

The type plate is positioned as shown.



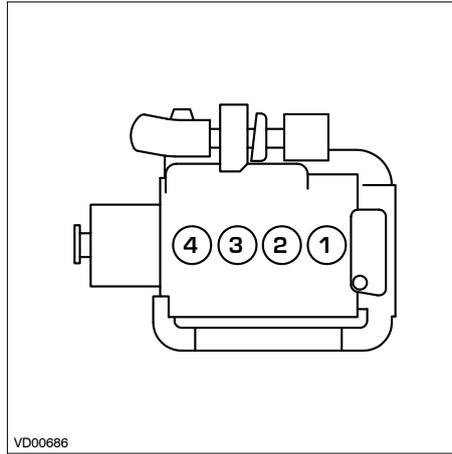
There is a second type plate on the ECU box.

2 Introduction



3 Position of serial number

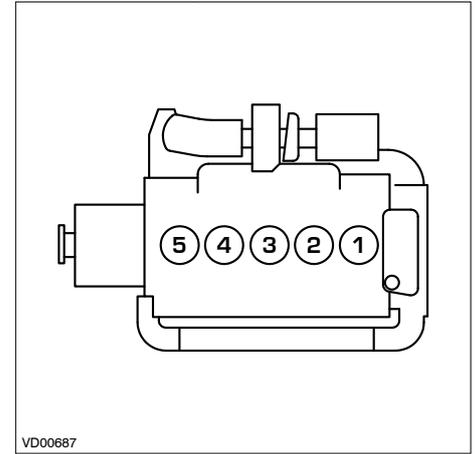
The serial number is stamped in the engine block in the position shown.



4 Cylinder numbering

Cylinders are numbered consecutively, beginning at the front end.

Serial number, Cylinder numbering

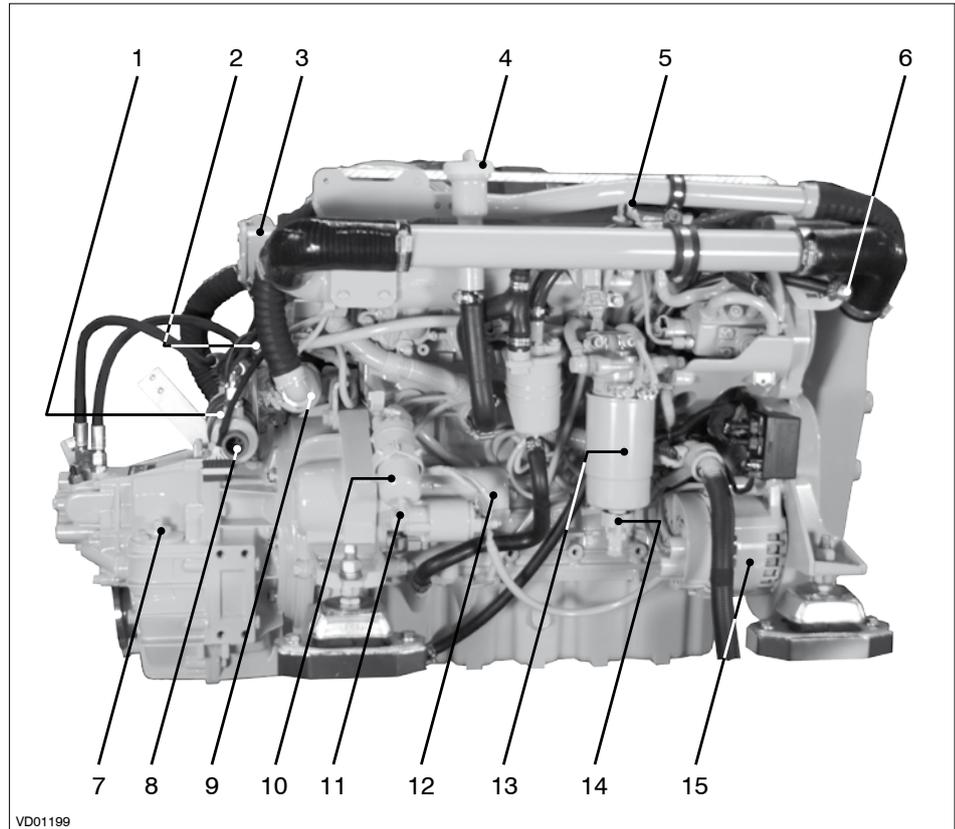


VD00687

2 Introduction

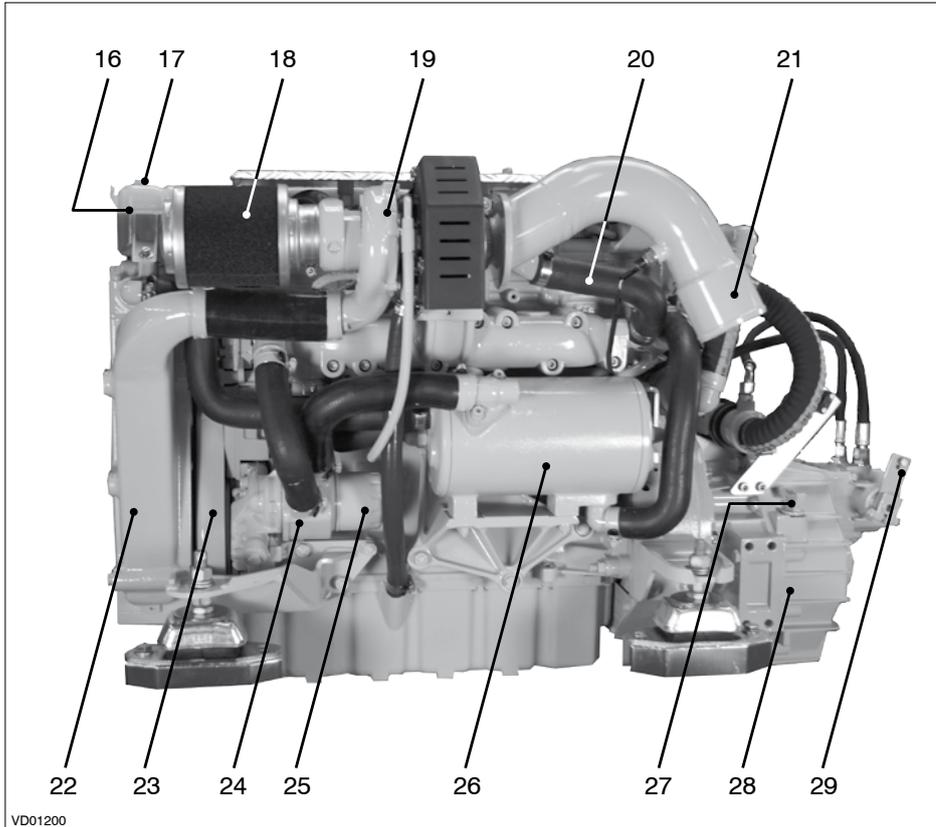
Identification of engine parts

- 1 Oil cooler, gearbox
- 2 Return fuel pipe connection \varnothing 8 mm
- 3 Raw water pump
- 4 Oil filler cap
- 5 Oil dipstick
- 6 Oil drainage connection
- 7 Gearbox filter
- 8 Raw water intake, \varnothing 32 mm
- 9 Fuel cooler
- 10 Fuel pump
- 11 Fuel supply pipe connection \varnothing 8 mm
- 12 Starter motor
- 13 Water separator/fuel filter
- 14 Drain plug for water separator/fuel filter
- 15 Alternator



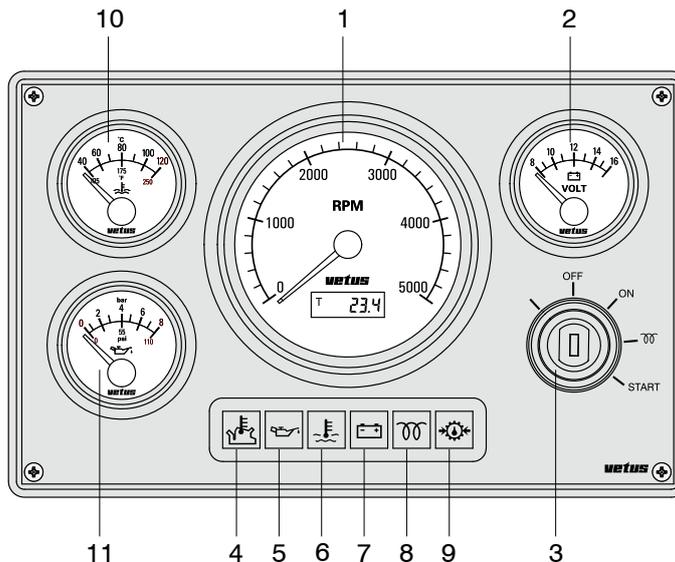
2 Introduction

Identification of engine parts



2 Introduction

Control panels



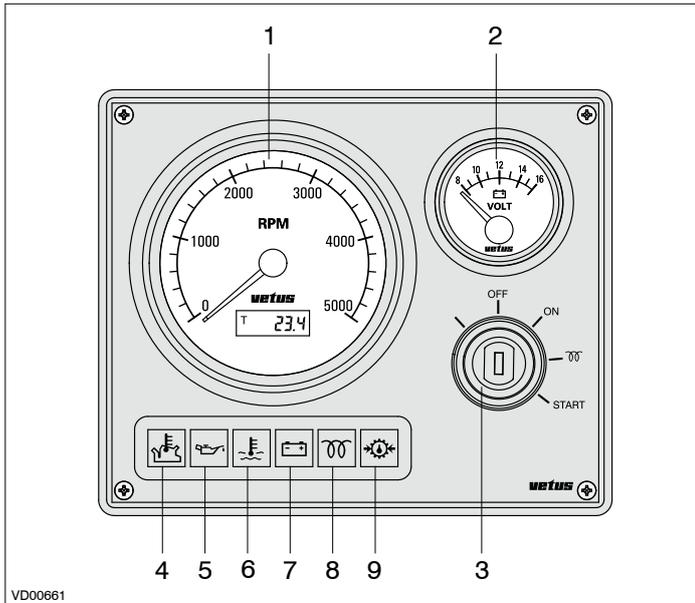
VD00662

Standard panel (model 34)

- | | | | |
|---|--|----|--|
| 1 | Tachometer/Operating hours counter | 7 | Warning light battery charging |
| 2 | Voltmeter | 8 | Indicator light pre-heating |
| 3 | Starter pre-heat switch/lock | 9 | Warning light gearbox low oil pressure * |
| 4 | Warning light high raw water temperature | 10 | Temperature gauge, coolant |
| 5 | Warning light low oil pressure | 11 | Oil pressure gauge |
| 6 | Warning light high coolant temperature | | |
- *) This is an option, not fitted as standard.

2 Introduction

Control panels, Optional

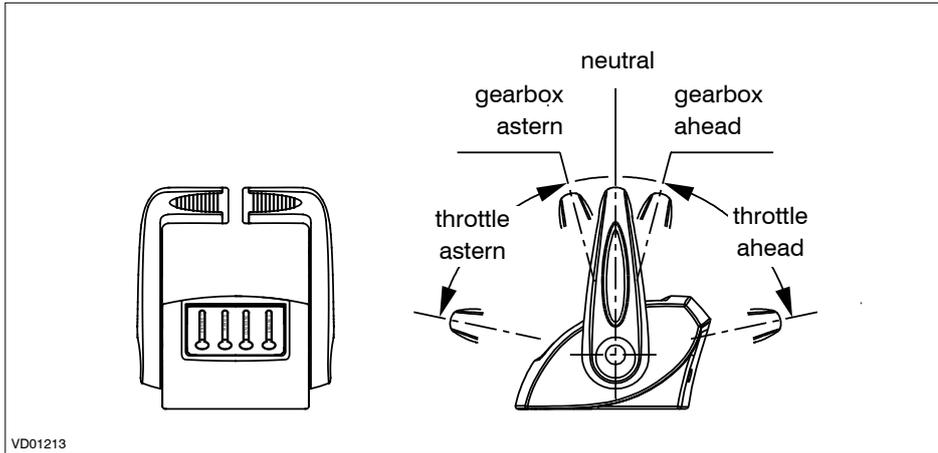


Fly-bridge panel (model 22)

- 1 Tachometer/Operating hours counter
- 2 Voltmeter
- 3 Starter pre-heat switch/lock
- 4 Warning light high raw water temperature
- 5 Warning light low oil pressure
- 6 Warning light high coolant temperature
- 7 Warning light battery charging
- 8 Indicator light pre-heating
- 9 Warning light gearbox low oil pressure *

*) This is an option, not fitted as standard.

2 Introduction



VD01213

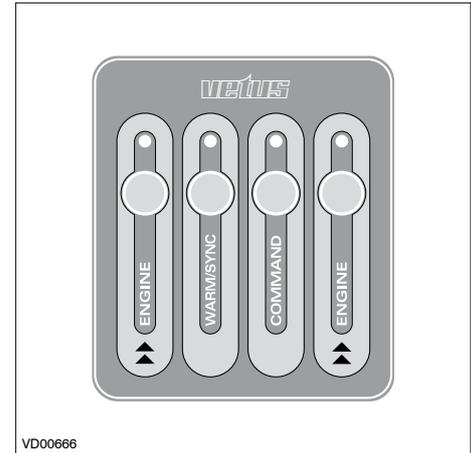
Operating lever

Operating lever for 1 or 2 engines.

There is a keyboard with 4 operating switches and 4 LEDs on the lever.

| Name | LED colour |
|------------|------------|
| Engine (*) | Green |
| Warm/Sync | Orange |
| Command | Red |
| Engine (*) | Green |

Single lever control



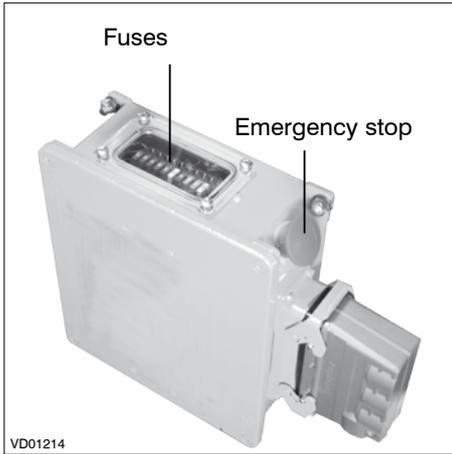
VD00666

(*) Both Engine switches and LEDs refer to the same engine where the installation only has one engine.

The port Engine switch and LED refer to the port engine and the starboard Engine switch and LED refer to the starboard engine where the installation has two engines.

2 Introduction

ECU box



The ECU box

The ECU box contains the electronic control unit for the engine, the stop knob, the fuses, the engine wiring connections and the control panel wiring connections.

The stop knob switches the ECU off if faults may possibly have been caused by incorrect connections made during the installation.

Press the red key in an emergency to stop the engine.

3 Use

General guidelines

General guidelines for use

Implementing the following recommendations will result in longer life and better performance and more economical operation of your engine.

- Carry out the maintenance described regularly, including the 'Daily procedures before starting'.
- Use anti-freeze in the engine coolant all year long, this helps prevent corrosion as well as protecting against frost damage. For specifications see page 119.
- Never run the engine without a thermostat.
- Use a good quality lubricating oil. For specifications see page 116.
- Use a good quality diesel fuel that is free of water and other pollutants.
- Always stop the engine immediately if one of the warning lamps for oil pressure, high coolant temperature, high raw water temperature or battery charging lights up.
- Always follow the safety advice, see page 4.



NOTE

First commissioning

Follow the instructions given for 'First commissioning' on page 35 and further if the engine is being commissioned for the first time.

After repair work:

Check that all guards have been replaced and that all tools have been removed from the engine.

When starting with pre-heating, do not use any other substance (e.g. injection with 'Easy Start'). Doing so could result in an accident.

3 Use

General guidelines

Before starting, ALWAYS check the following points:

- Engine oil level.
- Coolant level.
- Sea cock open.
- Main switch 'ON'.
- Control lever in 'NEUTRAL' position.



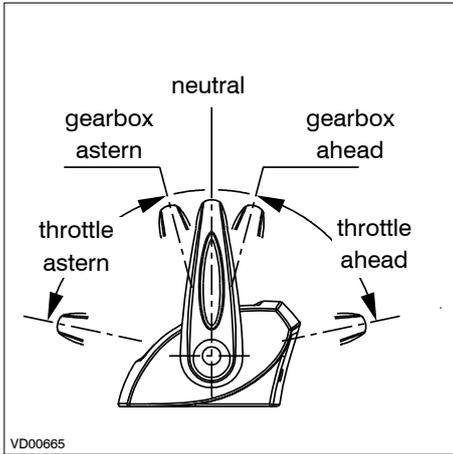
WARNING

Never start the engine with the fuel injection pump removed.

Disconnect battery.

3 Use

Control lever



1 Control lever

The control lever works as shown in the diagram.

Every control lever is designed to operate 1 or 2 engines.

Starting from neutral put the engine in placed in forwards or reverse by moving the lever 16° forwards or backwards.

The throttle lever operates at an angle of 62° forwards and 62° reverse.



2 Control lever keyboard

There is a keyboard with 4 operating switches and 4 LEDs on the lever.

| Name | LED colour |
|------------|------------|
| Engine (*) | Green |
| Warm/Sync | Orange |
| Command | Red |
| Engine (*) | Green |

(*) Both *Engine* switches and LEDs refer to the same engine where the installation only has one engine.

The port *Engine* switch and LED refer to the port engine and the starboard *Engine* switch and LED refer to the starboard engine where the installation has two engines.

3 Use

Control lever

Activate the operating lever as follows:

- Put the lever(s) in the neutral position.
- Press key Command and hold this pressed in for at least three seconds.
- The Command LED will come on and the Warm/Sync LED will begin to flash. The engine control is now in position 'Warm-up'.
- Press key Warm/Sync and hold this pressed in for at least three seconds with the lever(s) in neutral in order to be able to control the engines fully.

| Key | LED | Meaning |
|------------------|-------------------|--|
| (Operating) | (Indication) | |
| | Engine | - If the LED is on the corresponding engine is in neutral. |
| | Command | - If this is off the engine cannot be operated with the control lever. - If this is on the engine can be operated with the control lever. |
| | Warm/Sync | - While the LED flashes WARM-UP is in progress, i.e. the engine(s) can run at increased revolutions while the gearbox remains in neutral. - When the LED is on the revolutions of both engines will be synchronized. The right-hand lever controls both engines and the right-hand trim control controls both trims (if present). |
| <i>Warm/Sync</i> | | - Make sure that both levers of the active control lever are set to neutral. Press the key Warm/sync and hold this in for at least three seconds to switch on the WARM-UP. |
| <i>Command</i> | | - Make sure that the control lever is set to neutral. Press the key Command and hold this in for at least three seconds, after which the engine can be operated. |
| | All LEDs flashing | - There are faults in the engine controls. |

3 Use

Control lever

3 Warming up the engine

- Make sure that the lever(s) is (are) in neutral.
- Press key Warm/Sync and hold this in for at least three seconds.
- The Warm/Sync LED will begin to flash and the warm-up function is active. It is now possible to increase revolutions without the gearbox being engaged.
- The warm-up function can be switched off by pressing the key Warm/Sync again and holding it in for at least three seconds while the lever(s) is (are) in neutral. The Warm/Sync LED will now stop flashing. The engine(s) and the gearbox (es) can now be operated.

4 Taking over control where there are two control positions

Control can be transferred to another control position as follows.

When the vessel is not moving:

- Make sure that the lever(s) is (are) in neutral.
- Press key Command and hold this in for at least three seconds.
- The Command LED will come on and the Warm/Sync LED will begin to flash.
- Press key Warm/Sync and hold this in for 3 seconds.
The engine(s) and the gearbox (es) can now be controlled from this position.

During sailing:

- Set the lever(s) at the position where control is to be taken over to the same positions as the control lever that is to relinquish control.
- The Engine LED will begin to flash as soon as the requesting control lever is correctly set relative to the control lever that is to relinquish control (with a margin of 10°).
- When both levers are in the correct position (and thus the corresponding Engine LEDs are flashing) it is possible to take over the control by pressing key Command and holding this in for 3 seconds.

3 Use

Control lever

5 Running in sync

Important: the function running in sync is only available for systems with two engines.

Engine again and holding these in for three seconds. The Warm/Sync LED will now be off.

This function makes it possible to control both engines using only one lever. When in this position both reverse couplings will be set in the same position and the engines will run at the same speed.

Control of both engines is transferred to the right-hand lever by pressing both keys Engine and holding these in for three seconds with the levers in neutral.

The function running in sync is shown by the Warm/Sync LED and the Command LED being on permanently, except when in neutral when all LEDs are on permanently.

Control of the engines is transferred back to the corresponding levers by setting the two levers to neutral and pressing keys

3 Use

Control lever



6 Trim control

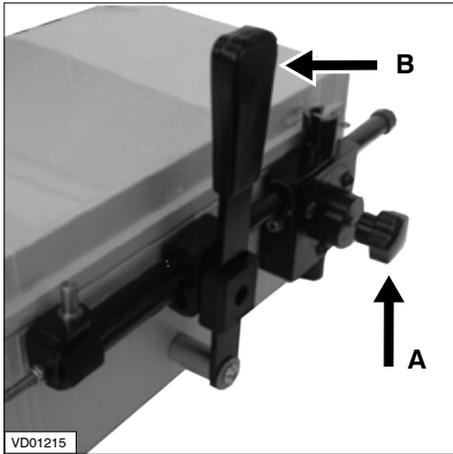
A stern drive can be moved up and down using the '+' and '-' keys on the control lever in order to trim the vessel.

For installations with two engines the keys on the right-hand side control the trim settings of both engines simultaneously when in Sync mode.

The stern drives are lifted out of the water by holding both keys '+' and '-' pressed in simultaneously for 3 seconds.

3 Use

Control lever



7 Emergency levers

In an emergency you can switch off the electronic system quickly and operate the propulsion system engines directly using the mechanical emergency levers.

These emergency levers are on the control box.

Turn knob A in fully.

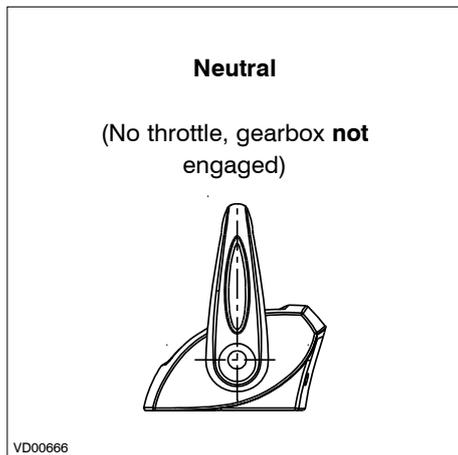
The gearbox can then be operated manually using levers B with the throttle set to minimum (idling revolutions).

Reset the controls by turning knob A out fully.

When the control lever moves for the first time, the emergency lever automatically goes back to the position that it was in before the emergency cycle was used.

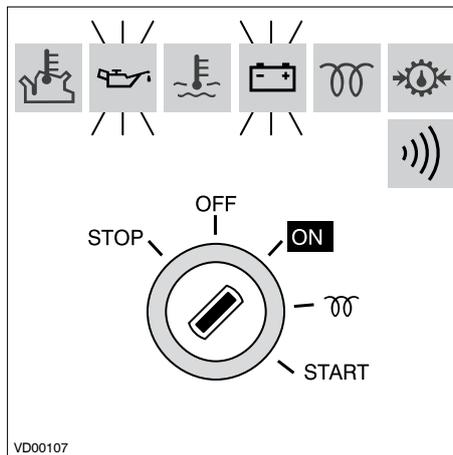
3 Use

Starting



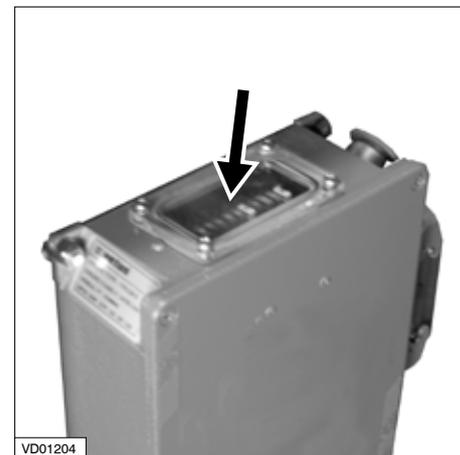
8 Preparation starting

Before starting the engine, always check that the control lever(s) is (are) in the **neutral position**.



9 Switching on

Turn the starter key on the instrument panel to the right; the oil pressure and dynamo control lights will come on and the alarm buzzer will sound.



All LEDs for the fuses should come on when the starter key is in position 'ON'.

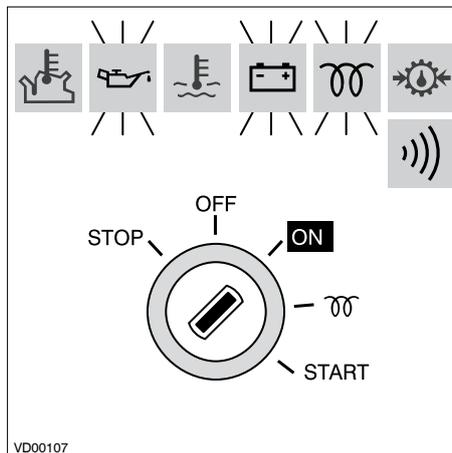
3 Use

Starting

| Ambient temperature | Pre-heat time |
|---------------------|---------------|
| Lower than 0°C | 20 sec |
| 0°C to 10°C | 15 sec |
| 10°C to 30°C | 10 sec |
| Higher than 30°C | - |

10 Pre-heating

Automatic pre-heating will take place depending on the engine temperature.

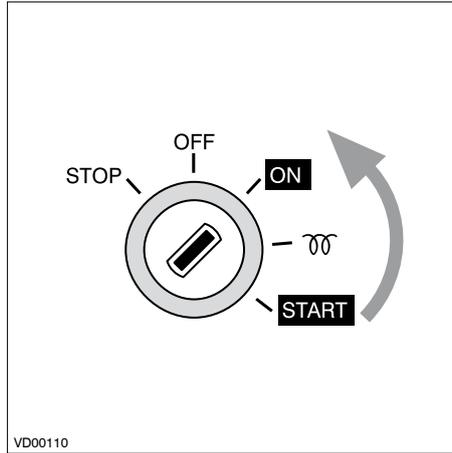
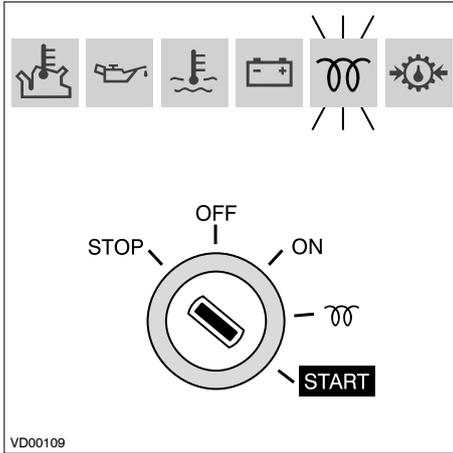


While pre-heating takes place the pre-heating indicator light will be on and the alarm buzzer off.

The engine can be started when the pre-heating indicator light goes out and the buzzer sounds.

3 Use

Starting



11 Starting

Now turn the key further to the 'START' position.

Automatic pre-heating will also take place during starting when the ambient temperature is low.

Release the key as soon as the engine fires (the key turns back to the 'ON' position).

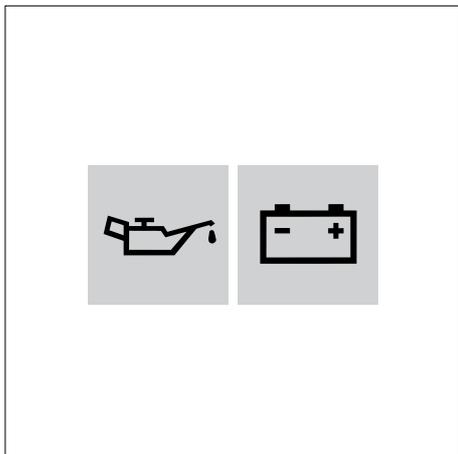
Leave the key in this position while the engine is running.



Release the key if the engine does not fire within 10 seconds.

Let the starter motor cool down for 30 seconds before turning the key to the 'START' position again.

3 Use



Check that the indicator lights for oil pressure and alternator are off.

Cooling water should now flow out of the exhaust; if this is not the case, stop the engine immediately.

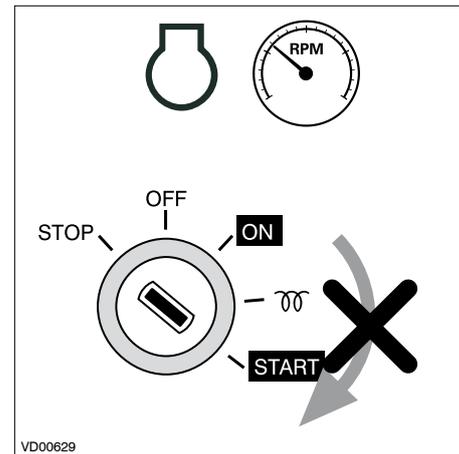
NOTE

Idling speed will be about 100 rev/min higher than normal when the engine is cold, the coolant temperature is lower than 40°C (104°F), or the battery voltage is less than 11 Volt.

Let the engine run for 5 to 10 minutes in neutral. A good warm up is essential to ensure maximum lifetime and good performance.

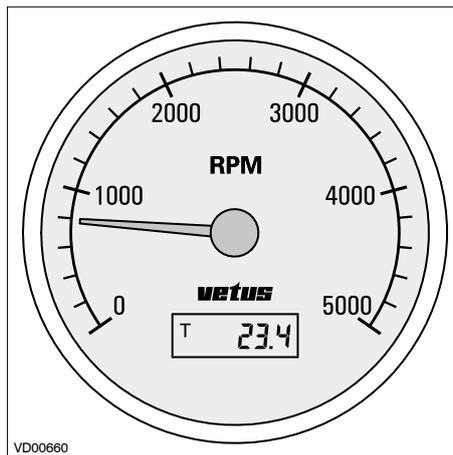
NEVER turn the main switch off while the engine is running.

Starting



CAUTION

Never turn the key to the 'START' position while the engine is running. Doing so will damage the starter motor.



The instrument panel is provided with the following instruments (Depending of the type of panel, see page 14).

12 Tachometer

Indicating the number of revolutions per minute of the engine.

Also the number of running hours is indicated.

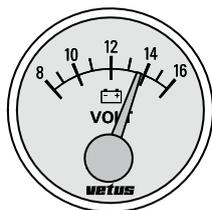
Idling speed : VF4: 800 rpm
VF5: 750 rpm



WARNING

Avoid idling for more than 10 minutes.

This can lead to carbon deposits in the combustion chambers and incomplete combustion of fuel.



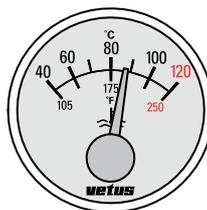
VD00578

13 Voltmeter

Indicating the battery voltage.

When the engine is running, the battery voltage should be between 12 and 14 Volts.

With the engine stopped and the start key in the first position, the voltmeter should indicate 12 Volts.



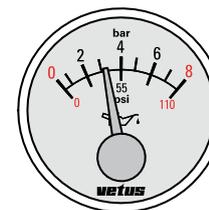
VD00663

14 Temperature gauge

Indicating the temperature of the internal cooling system.

The operating temperature is 75°C - 90°C. (167°F - 194°F).

In case the engine is overheated: turn off the engine and establish the cause, see fault finding table, page 98 .. 109.



VD00664

15 Oil pressure gauge

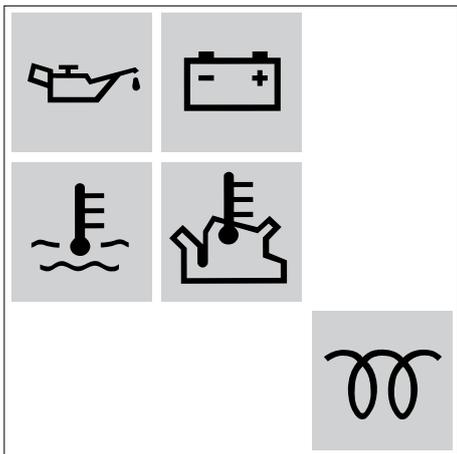
With the engine at operating temperature, the oil pressure is:

When idling: at least 1 bar (7 psi).

In case the oil pressure is too low: turn off the engine and establish the cause, see fault finding table, page 98 .. 109.

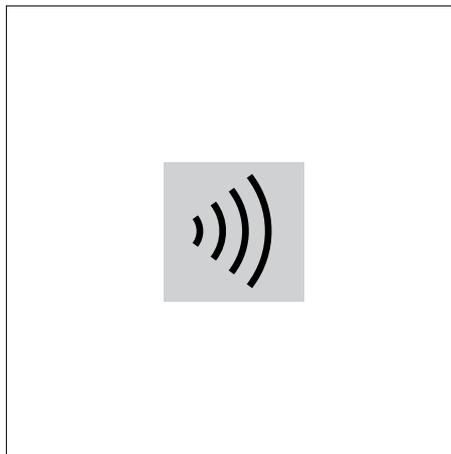
3 Use

Cruising



16 Warning lights

None of the five warning lights should light up while the engine is running.

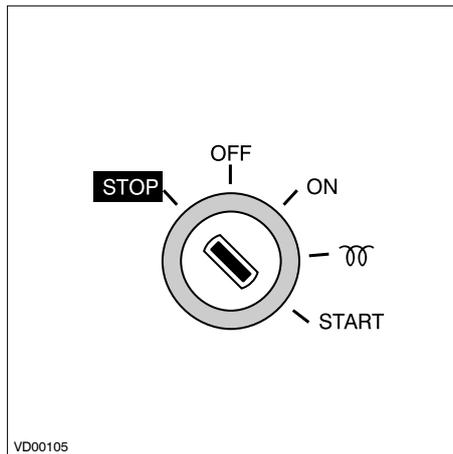
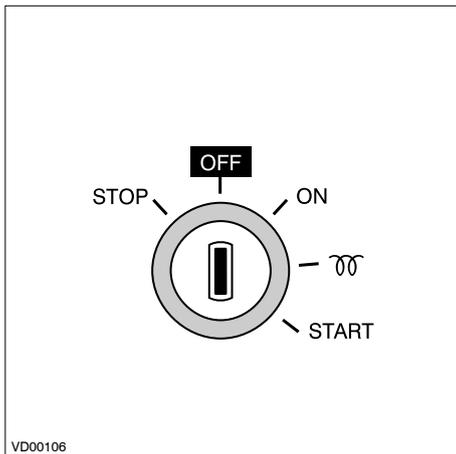


17 Alarm buzzer

Oil pressure, battery charging and temperature indicator lights are all connected to an alarm buzzer. If this alarm buzzer sounds while running, **STOP THE ENGINE IMMEDIATELY!**

3 Use

Stopping



18 Electrical shutdown

Reduce engine speed to idle and place the control lever in '**NEUTRAL**' position. Turn the key to the left to the '**OFF**' position.

Never stop the engine immediately after it has been in operation for a long time.

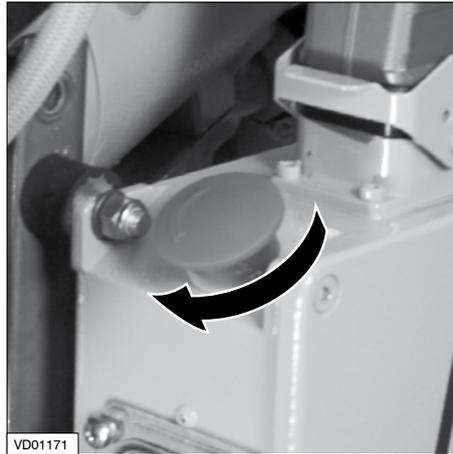
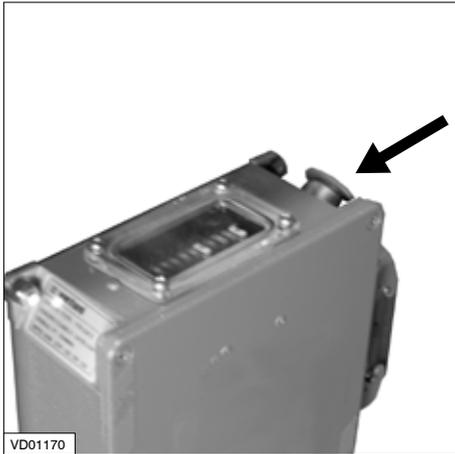
Note The '**STOP**' position, left of the '**OFF**' position on the control panel, has normally no function for this engine.

When 2 control panels are connected to one engine, the engine can always be stopped by turning the key to the '**STOP**' position, no matter what the position is of the key on the other panel.

If the engine is not to be used for some time, it is recommended that the sea cock is closed and the battery main switch turned off.

3 Use

Stopping



19 Mechanical stopping

If there is a fault, the engine can be stopped by pressing the red button on the ECU box.

Turn the knob in the direction of the arrow when the engine has stopped. Trace the source of the fault and repair this. The engine can then be started again.

3 Use

First commissioning

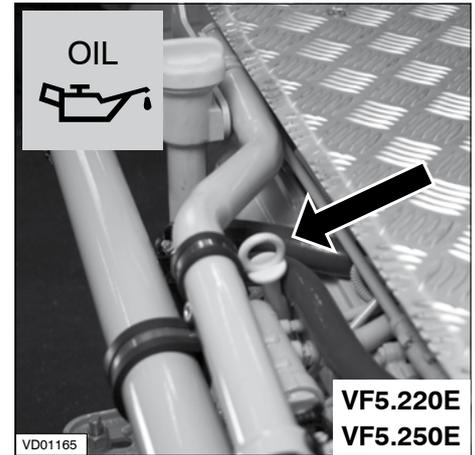
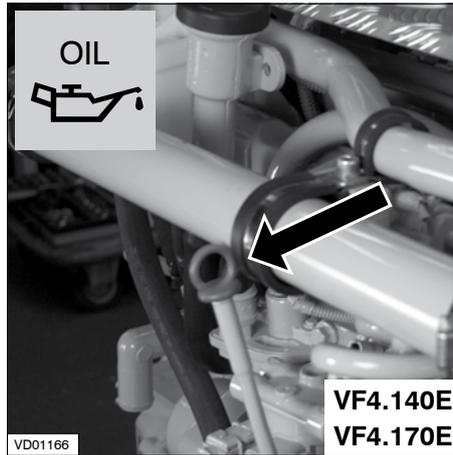
1 Commissioning the engine

Before starting the engine for the first time, the following procedures must be carried out:

2 Check the oil level

The engine is already filled with oil.

Check the oil level, see page 44.



3 Use

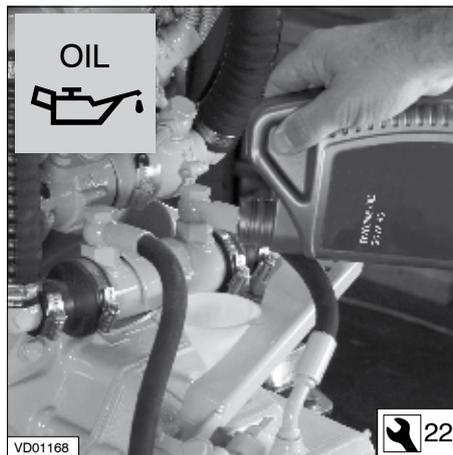
Vetus engines are normally equipped with Technodrive or ZF-Hurth gearboxes.

In case your engine is equipped with another brand of gearbox follow the instructions given in the supplied owner's manual.

3 Filling gearbox with oil

Fill the gearbox with oil.

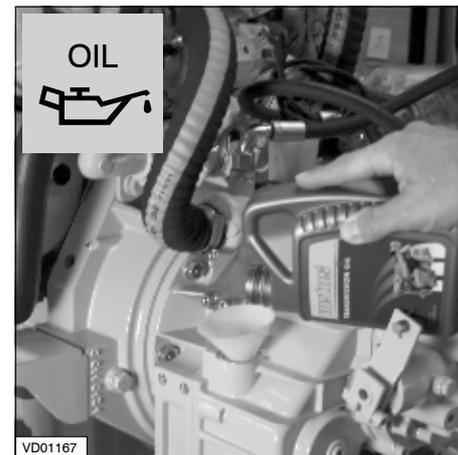
Check the oil level with the dipstick, see page 55.



Technodrive:

- type TM345 : 1.6 litres, Engine oil
SAE 20W40-CD
(2.8 UK pt, 3.4 US pt)
- type TM345A : 1.6 litres, Engine oil
SAE 20W40-CD
(2.8 UK pt, 3.4 US pt)
- type TM485A : 2.6 litres, Engine oil
SAE 20W40-CD
(4.6 UK pt, 5.5 US pt)

First commissioning



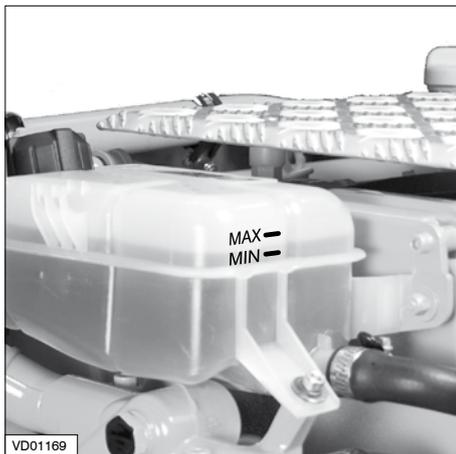
ZF Hurth:

- type ZF25 : 2.5 litres, without oil cooler
(4.4 UK pt, 5.3 US pt)
- type ZF25A : 1.8 litres, without oil cooler
(3.2 UK pt, 3.8 US pt)
- type ZF45 : 3.0 litres, without oil cooler
(5.3 UK pt, 6.3 US pt)
- type ZF45A : 2.0 litres, without oil cooler
(3.5 UK pt, 4.2 US pt)
- type ZF63IV : 3.8 litres, without oil cooler
(6.7 UK pt, 8 US pt)

ATF: Automatic Transmission Fluid type A, Suffix A.

3 Use

First commissioning



4 Check the coolant level

The engine cooling system is already filled with coolant.

Check the coolant level in the expansion tank, see page 45.

Top up if necessary.



CAUTION

Never fill the cooling system with sea water or brackish water.



NOTE

WATER HEATER

If the engine is connected to a water heater the cooling system must be topped up, see page 69.

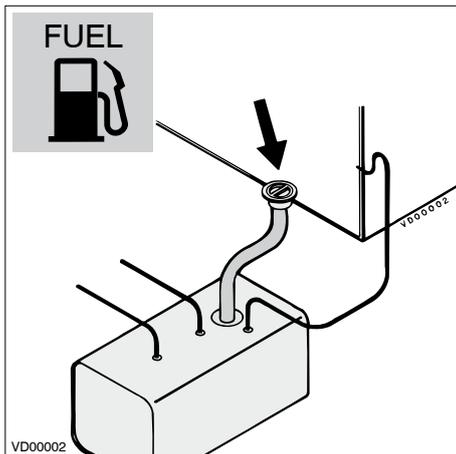


NOTE

If the water heater is positioned higher than the top of the engine then it will not be bled automatically!

Follow the instructions for filling on page 69.

3 Use



5 Fuel

Ensure that the fuel tank is filled with diesel fuel.

Use only clean, water-free, commercial approved diesel fuel.

For fuel grade see page 115.

Bleed the fuel system, see page 48.



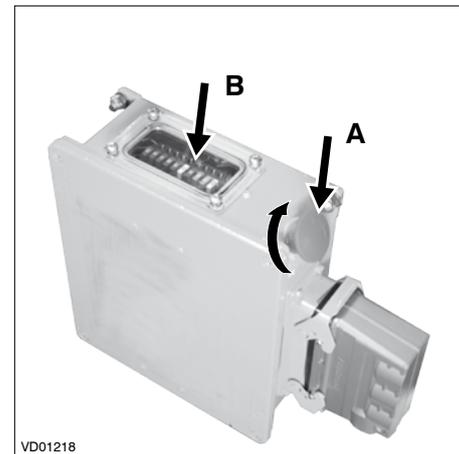
WARNING

Never fill the fuel tank while the engine is running. Do not spill fuel. Prevent unnecessary pollution.

6 Other preparations

- Check that the battery is charged and check the battery cable connections.
- Set the main switch to position 'ON'.
- Open the sea cock.
- Check that the gearbox control lever is set to 'NEUTRAL'.

First commissioning



- Check that switch (A) on the ECU box is 'ON'. Turn the knob in the direction of the arrow.
- Check that the fuse control LEDs (B) all light up.

3 Use

First commissioning

7 Starting

- How to start the engine and what to check before, during and immediately after starting is described on page 26 and further.

Allow the engine to test run for about 10 minutes at idling speed.

Check that the engine and all connections (fuel, coolant and exhaust) for leaks.

Stop the engine immediately if it makes any strange noises, vibrates excessively or if black smoke comes out of the exhaust!

8 Bleeding

The cooling system must be bled as soon as the engine has reached normal working temperature.

- Open the cap on the expansion tank.
- Vary the revolutions between idling and 2000 rev/min.
- Add coolant if necessary.
- Close the cap on the expansion tank.
- Check the coolant temperature.

9 Sea trial

Make sure that the control lever(s) is (are) activated, see page 21.

Engage the gearbox or stern drive and carry out a sea trial.

3 Use

Running-in

10 Running-in

In order to ensure a long life for your engine, please observe the following for the first 50 operating hours:

- Allow the engine to reach operating temperature before applying a load.
- Avoid fast acceleration.
- Do not allow the engine to run faster than 3/4 of maximum RPM.

Introduction

The following guidelines should be observed for daily and periodic maintenance. Perform each function at the indicated time interval.

The intervals stated are for normal operational conditions. Service the unit more frequently under severe conditions.

Failure to carry out maintenance can result in faults and permanent damage to the engine.

No claim can be made on the Guarantee if maintenance has been neglected.

Keep record of the following information in the logbook and/or the 'Service and Guarantee Book':

- Total engine hours (reading engine hour counter).
- Amounts of oil, fuel and coolant needed for topping up.
- The dates and intervals at which the oil and coolant are changed.
- Oil pressure and coolant temperature.
- Parts on which maintenance is conducted and type of maintenance (adjustment, repair or replacement), and the

results of each procedure.

- Changes in operating conditions, such as 'Exhaust gas became black', etc.

4 Maintenance

| Every 10 hours or daily, before starting | page |
|---|-------------|
| Check engine oil level | 44 |
| Check coolant level | 45 |
| Check water strainer | 46 |
| Check oil level Stern drive | *) |

| After the first 50 hours | page |
|--|-------------|
| Drain water from fuel filter | 47 |
| Engine oil change | 49 |
| Replace oil filter | 50 |
| Change gearbox oil (Technodrive) | 57 |
| Change gearbox oil and replace filter (ZF Hurth) | 58 |
| Replace fuel filter | 60 |



DANGER

Stop the engine before carrying out any maintenance work.

Maintenance schedule

| Every 100 hours, at least once every year | page |
|--|-------------|
| Drain water from fuel filter | 47 |
| Engine oil change | 49 |
| Replace oil filter | 50 |
| Battery, cables and cable connections | 52 |
| Check gearbox oil level | 55 |
| Check oil level power steering Stern drive | *) |

| Every 200 hours, at least once every year | page |
|--|-------------|
| Clean air filter | 56 |

*) Consult the owner's manual supplied with the stern drive.

4 Maintenance

| Every 400 hours, at least once every year | page |
|--|-------------|
| Change gearbox oil (Technodrive) | 57 |
| Change gearbox oil and replace filter (ZF Hurth) | 58 |
| Replace fuel filter | 60 |
| Check flexible engine mounts | 63 |
| Check engine for leaks | 63 |
| Check tightness of all fasteners, bolts and nuts | 63 |

| Every 400 hours | page |
|------------------------------------|-------------|
| Check and adjust injector pressure | **) |
| Check glow plugs | **) |



DANGER

Stop the engine before carrying out any maintenance work.

Maintenance schedule

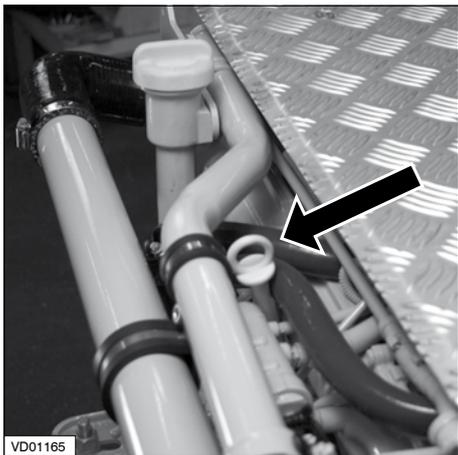
| Every 800 hours, at least once every 2 years | page |
|---|-------------|
| Raw water pump inspection | 64 |
| Replace coolant | 65 |

| Every 800 hours | page |
|--------------------------|-------------|
| Replace drive belt | 70 |
| Check alternator | 73 |
| Check turbocharger | **) |
| Replace distributor belt | **) |

| When required | page |
|-------------------------|-------------|
| Bleeding fuel system | 48 |
| Cleaning heat exchanger | 74 |
| Clean after cooler | 78 |

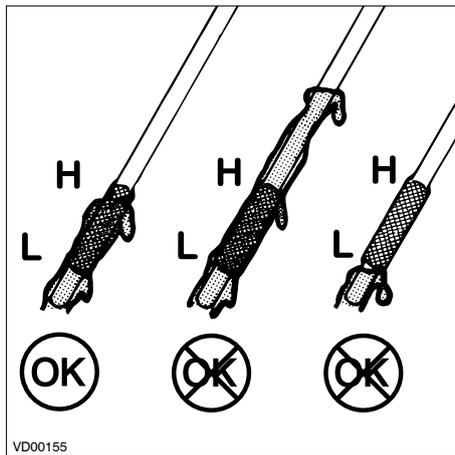
**) Consult the service manual, work to be carried out by a Vetus dealer.

4 Maintenance



1 Check oil level

Turn the engine off.
The dipstick is located on the starboard side of the engine.



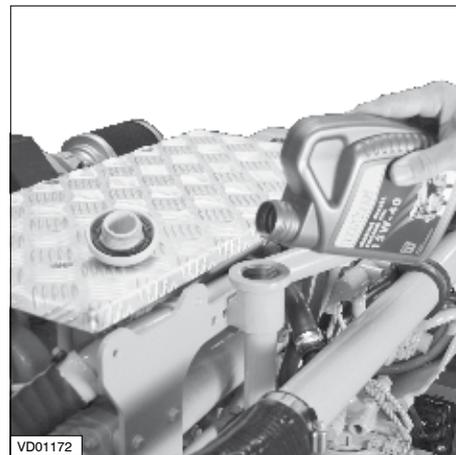
2 Oil level

The oil level must be at or near the upper mark on the dipstick*. If necessary top up with the same brand and type of oil.

*) The difference between the two oil level marks is:
0.8 litres (1.4 UK pt, 1.7 US pt)

Checking engine oil level

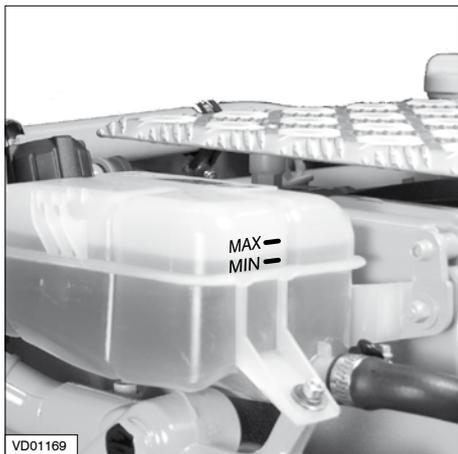
Daily, before starting.



3 Topping up oil

The oil filler cap is positioned next to the cover over the valves.

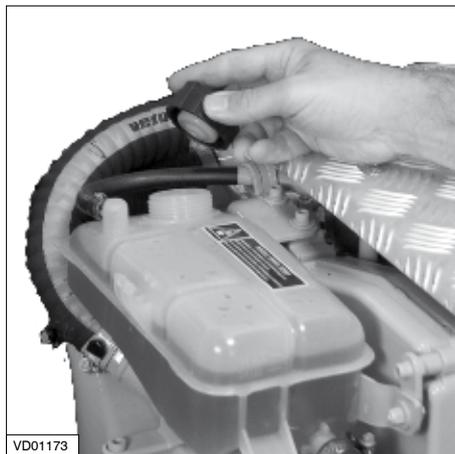
4 Maintenance



4 Checking coolant level

Check the coolant level in the expansion tank. The level must be checked when the engine is **cold**.

The coolant level must be between the markings MIN and MAX.



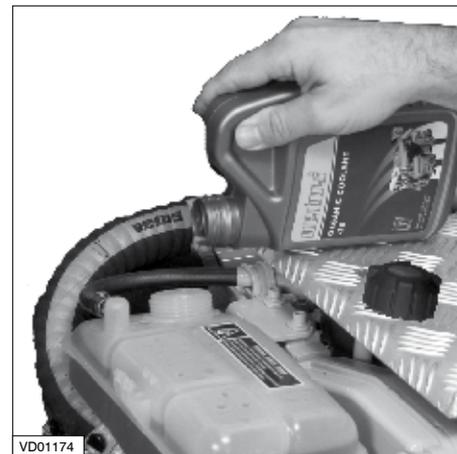
Top up if necessary.
Remove the cap from the expansion tank.



Never open the cap of the expansion tank when the engine is at operating temperature.

Checking coolant level

Daily, before starting.



5 Topping up coolant

The internal cooling system can be filled with a mixture of anti-freeze (40 %) and tap water (60 %) or with a special coolant. For specification, see page 119.

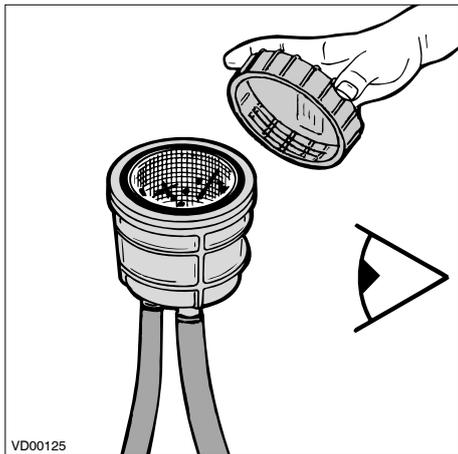


Never fill the cooling system with sea water or brackish water.

4 Maintenance

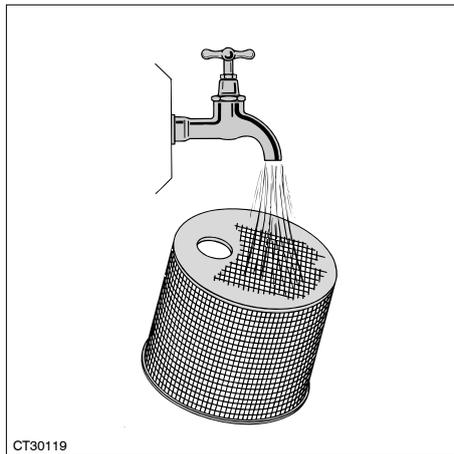
Checking and cleaning the raw water strainer

Daily, before starting.



6 Checking the raw water strainer

Check daily whether there is any dirt in the raw water strainer.



7 Cleaning the strainer

Close the sea cock before removing the lid of the water strainer.

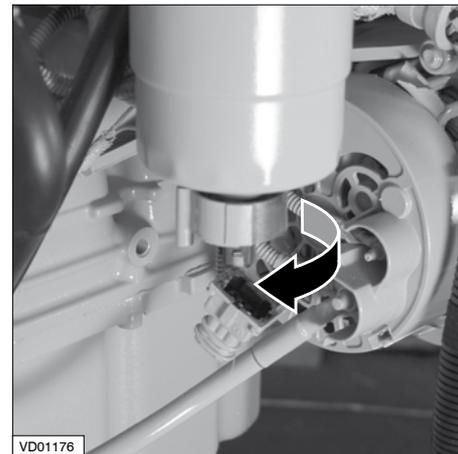
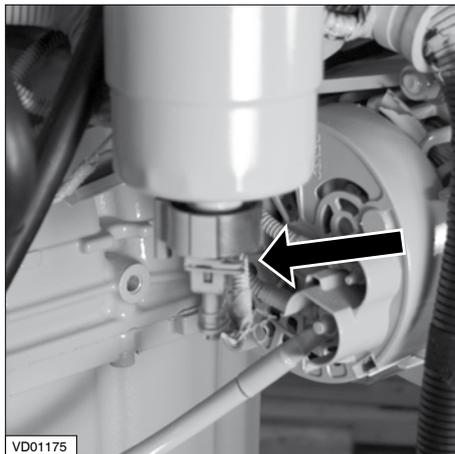
Clean the raw water strainer as often as is necessary, depending on the pollution of the waterways, but at least once every 6 months. A clogged raw water strainer will result in excessive temperatures or overheating of the engine coolant.

Check the sealing between the lid and housing after cleaning and re-assembling the strainer. An improperly sealed lid will result in air sucked in by the sea water pump which again will result in overheating of the engine.

4 Maintenance

Draining of water from the water separator/fuel filter

Every 100 operating hours.



CAUTION

Do not smoke when draining off water and sediment. Keep flame and sources of ignition out of the area. Remove spilled fuel and litter before you start the engine.

8 Drain fuel filter

The drain plug is on the bottom of the filter.

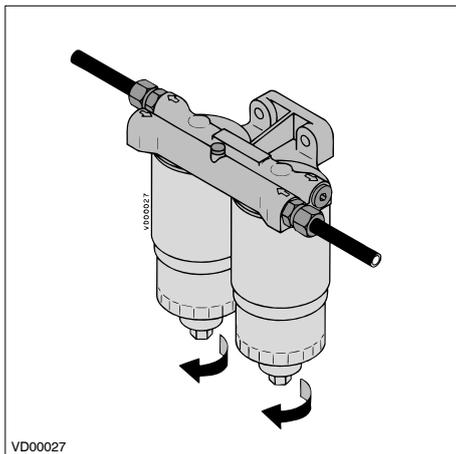
- First disconnect the connection on the drain plug.
The locking spring must be pushed in to release the connection.

- Unscrew the drain plug.
- Allow the water to drain out and then close the drain plug.
- Put the connection back on the drain plug. The locking spring must be pushed in to allow the connection to be put back on the drain plug.

4 Maintenance

Draining of water from the water separator/fuel filter

Every 100 operating hours.

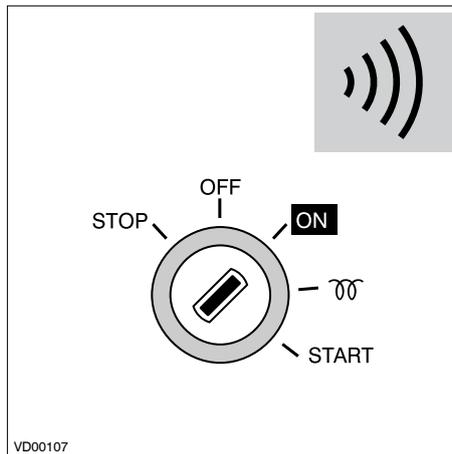


9 Empty water separator

Empty the separately installed water separator/fuel filter:

- Open the drain plug at the lower side of the filter.
- Drain the water and close the drain plug.

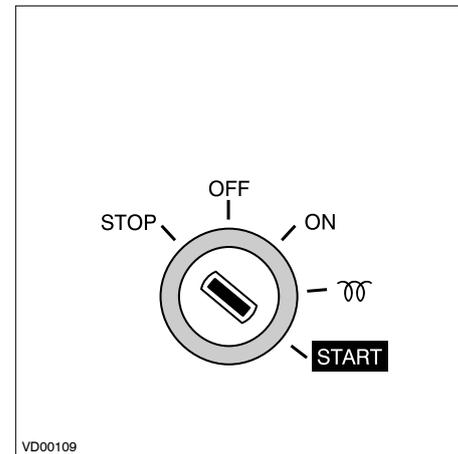
Note : The water separator is not within the scope of supply but installation is required!



10 Bleeding

After the water separator/fuel filter has been drained, the air has to be bled from the fuel system. The fuel system is self-bleeding.

Turn the key in the ignition lock to 'ON' and leave the key in this position for 30 seconds. The fuel pump will now bleed the system.



11 Start the engine

Operate the starter switch until the engine fires; release the starter switch if the engine does not fire within 6 seconds. Wait until the starter motor has stopped before making a new attempt to start the engine.

Repeat the above if the engine cuts out after a short time.

4 Maintenance

Engine oil change
Every 100 operating hours.

12 Engine oil change

Change the engine oil every 100 hours of operation (together with engine oil filter replacement).

If the engine runs less than 100 hours during the year the oil should be changed at least once a year.

Run the engine for a few minutes before changing the oil; warm oil can be pumped out more easily.

Change the oil with a switched off engine at operation temperature. (Lube oil temperature max. 80°C (176°F).)



DANGER

Be aware of the risk of skin burning during draining the hot oil! Used oil must be collected in a container for proper disposal according to laws and regulations.

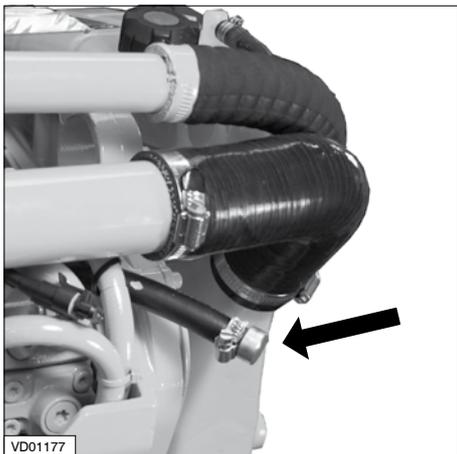


WARNING

Never use additives.

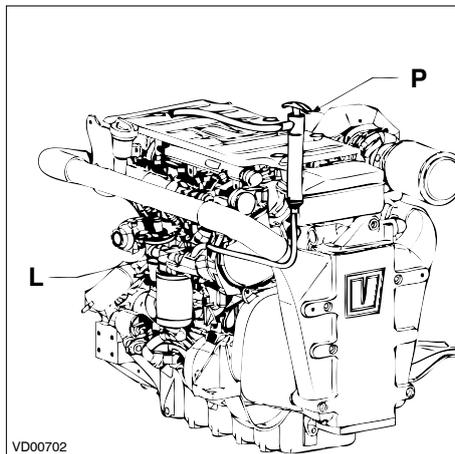
This could cause damage to the engine which is not covered by the guarantee.

4 Maintenance



13 Drain oil

- Remove the oil filler cap.
- Remove the plug from the oil drain pipe (L) and connect the oil drain pump (P) to this.
- Place the drain hose from the pump in a suitable receiver and pump the sump empty.



VD00702

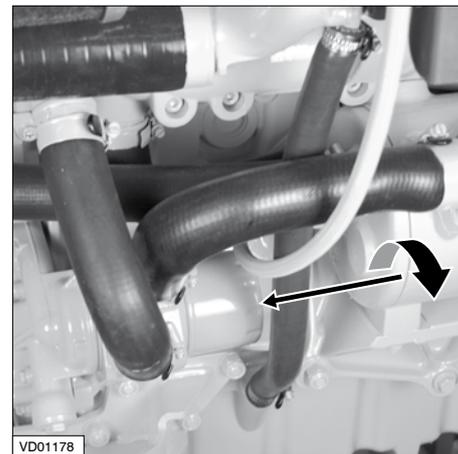


WARNING

The engine oil must be disposed in accordance with the applicable environmental regulations.

Engine oil change

Every 100 operating hours.



14 Removing the oil filter

Unscrew the oil filter, with a commercially available tool, when all the oil has been pumped out. Catch any dripping oil.

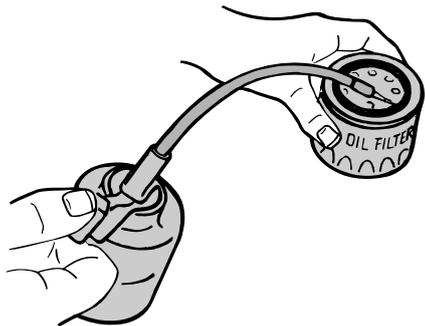


DANGER

Beware of burns from hot oil.

4 Maintenance

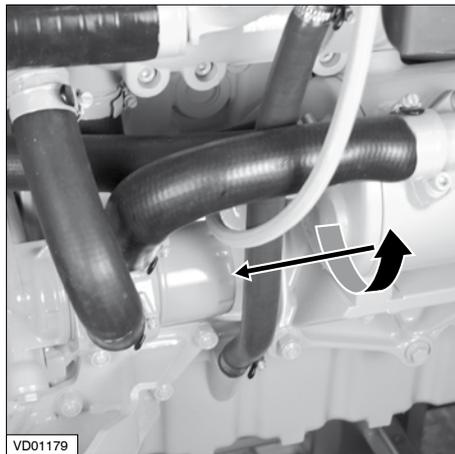
OIL FILTER, ART.CODE: STM9452



VD00124

15 Oiling the oil seal

Clean the contact surface of the gasket. Lubricate the oil seal of the new filter element with clean engine oil.



VD01179

16 Oil filter installation

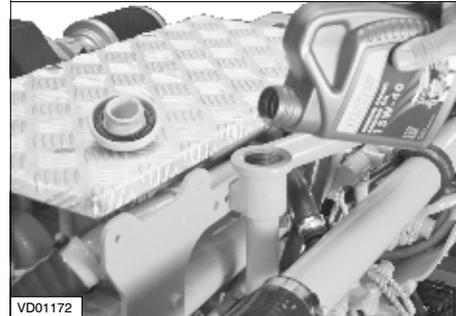
Install the filter in accordance with the instructions printed on the filter element housing.

Tightening torque 25 Nm (18 ft.lbf)

Engine oil change

Every 100 operating hours.

| | |
|--------------------|---|
| OIL CAPACITY: | 4 CYL.: 4.5 litres (7.9 UK pt, 9.5 US pt) |
| (INCL. OIL FILTER) | 5 CYL.: 5.0 litres (8.8 UK pt, 10.6 US pt) |



VD01172

17 Refilling with oil

Fill the engine with fresh oil (see page 116 for the specification) through the filler opening.

Check the oil level with the dipstick.

Operate the engine at idling speed for a short period of time. Check for oil leaks whilst the engine is running.

Stop the engine. Allow 5 minutes for the oil to return to the sump and check the oil level with the dipstick once more.

4 Maintenance

Warning notes and safety regulations for working with batteries



Wear eye protection.



Keep children away from acid and batteries.



Explosion hazard:

- A highly-explosive oxyhydrogen gas mixture occurs when charging batteries, therefore:



Fires, sparks, naked flames and smoking are prohibited:

- Avoid causing sparks when dealing with cables and electrical equipment, and beware of electrostatic discharges.
- Avoid short-circuits.



Corrosive hazard:

- Battery acid is highly corrosive, therefore:
- Wear protective gloves and eye protection.
- Do not tilt battery, acid can escape from the degassing openings or vents.



First aid:

- Rinse off acid splashed in the eyes immediately for several minutes with fresh water. Then consult a doctor immediately.
- Neutralize acid splash on skin or clothes immediately with acid neutralizer (soda) or soap suds and rinse with plenty of water.
- If acid is consumed, consult a doctor immediately.

Battery, cables and connections

Every 100 operating hours.



Warning note:

- Do not place batteries in direct daylight without protection.
- Discharged batteries can freeze up, therefore store in an area free from frost



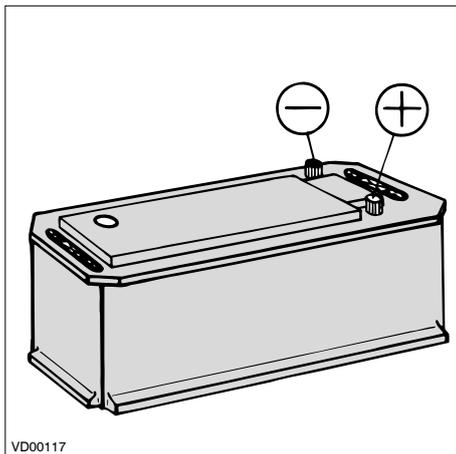
Disposal:

Hand in old batteries at a collection point. The notes listed under 1 (Storage and transport) are to be followed for transport. Never dispose of old batteries as domestic waste.



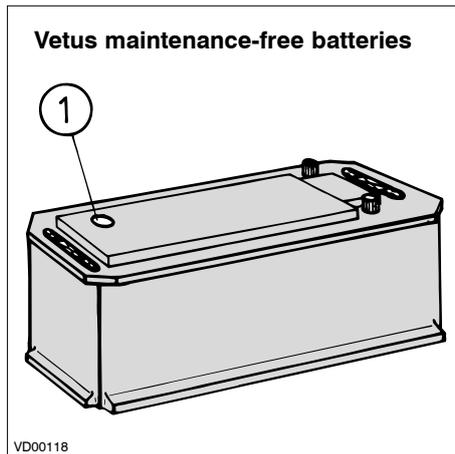
Careful! Metal parts of the battery are always live so never lay objects or tools on the battery.

4 Maintenance



18 Battery, battery connections

Keep battery clean and dry.
Remove battery cables (negative first).
Clean battery posts (+ and -) and clamps and grease with acid-free and acid-resistant grease.
Ensure that clamps make good contact after reassembling. Hand tighten the bolts only.

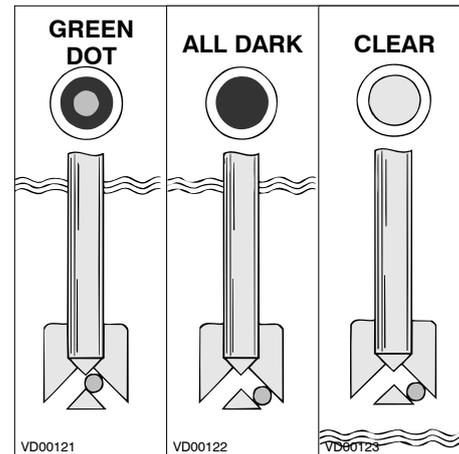


19 Checking specific gravity

Every Vetus Maintenance-free battery has a hydrometer (1) built into the cover.
Visual inspection of the hydrometer will show one of three conditions:

Battery, cables and connections

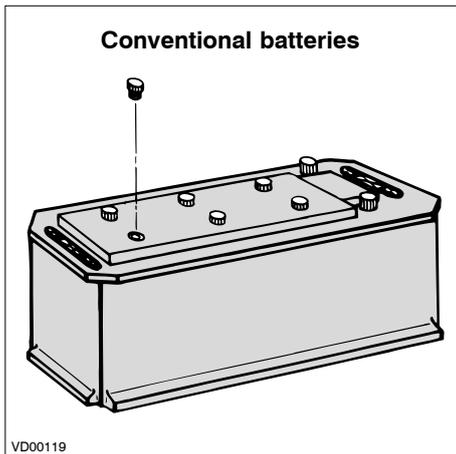
Every 100 operating hours.



20 Hydrometer operation

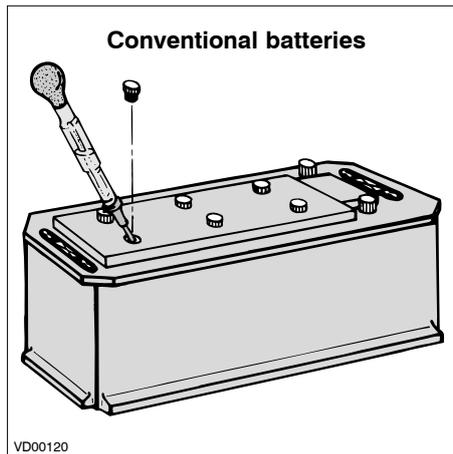
- **Green dot visible** - State of charge 65 % or more.
- **Dark** - State of charge less than 65 %. Recharge immediately.
- **Clear or light yellow** - Electrolyte level low.
In case of low level, caused by over-charging the battery for a long period of time with a voltage too high, replace battery. Check alternator and/or voltage regulator.

4 Maintenance



21 Checking electrolyte level

For conventional batteries it is required to check the electrolyte level regularly. Remove vent caps (taking care no spark or open flame is nearby) and inspect the level. Fluid should be 10 to 15 mm (3/8" to 5/8") above top of all plates. If necessary top up with distilled water. Replace vent caps and charge the battery for 15 minutes at 15 - 25 Amps to mix electrolyte.



22 Checking specific gravity

Measure the electrolyte specific gravity of the individual cells with a commercial hydrometer. The hydrometer reading (see table) indicates the state of charge. Hydrometer reading of all cells should be at least 1.200 and show less than 0.050 between high and low. If not, recharge or replace battery. During checking the temperature of the electrolyte should preferably be 20°C (68°F).

Battery, cables and connections

Every 100 operating hours.

| Specific gravity | State of charge | |
|------------------|-----------------|----------------------|
| 1.280 | 100% | |
| 1.200 | 50% | recharge |
| 1.120 | 10% | recharge immediately |

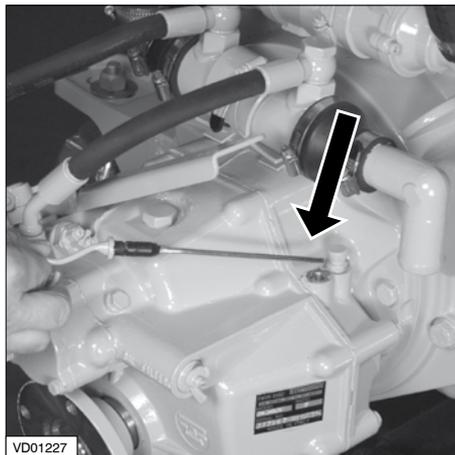
The temperature of the electrolyte during checking should be preferably 20°C (68°F).

Measuring the specific gravity shortly after water has been added results in an incorrect measurement. First charge the battery to mix the added water thoroughly.

4 Maintenance

Gearbox oil level check

Every 100 operating hours.



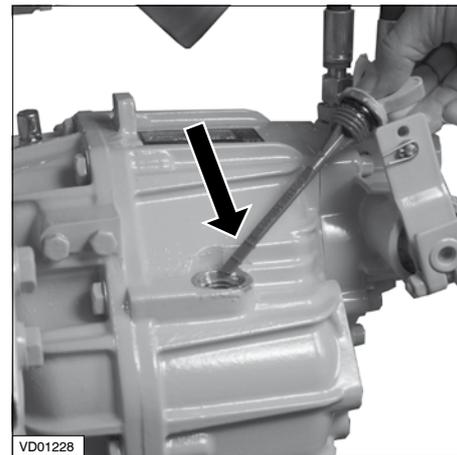
23 Oil level check (Technodrive)

Vetus engines are normally equipped with Technodrive or ZF-Hurth gearboxes. Consult the supplied Owners Manual for more details about care and maintenance. In case your engine is equipped with another brand of gearbox follow the instructions given in the supplied owner's manual for changing oil and other care and maintenance.

The oil level must be between the two marks on the dipstick

If necessary top up.

The filler cap is on top of the gearbox housing. For oil type and specification see page 118.



24 Oil level check (ZF-Hurth)

Unscrew the dipstick out of the gearbox housing.

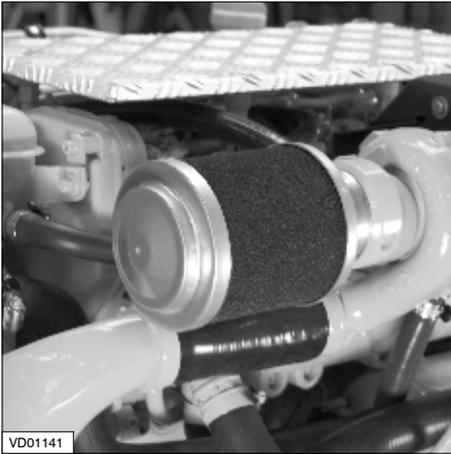
Check the oil level by cleaning the dipstick and lowering it into the hole, without screwing it in. The oil level must be between the two marks on the dipstick

If necessary top up by pouring oil into the dipstick hole. For oil type and specification see page 118.

4 Maintenance

Cleaning the air filter

Every 200 operating hours.



25 Cleaning the air filter

- Stop the engine.
- Loosen the hose clamp.
- Remove the filter.
- Clean the filter material using a mixture of water and washing powder.
- Let the filter dry or blow dry using compressed air, maximum pressure 5 bar (70 psi) to prevent damage to the filter.
- Replace the filter and tighten the hose clamp.



WARNING

Never clean the filter element with petrol or hot liquids.

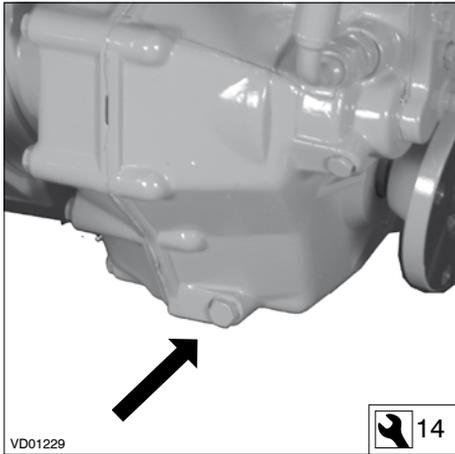
Never apply any oil to the air filter.

Never start the engine without the air filter in place.

4 Maintenance

Changing the gearbox oil (Technodrive)

Every 400 operating hours.

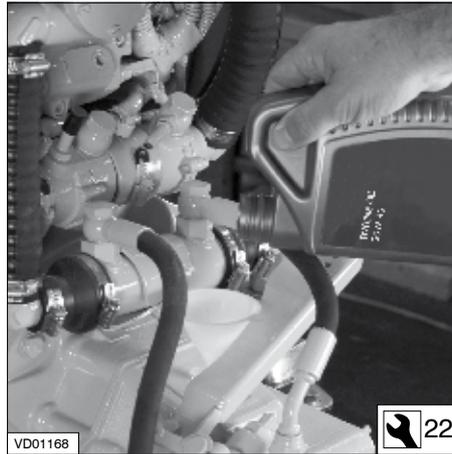


26 Draining the oil

Remove the drain plug to drain the oil.

Remove the filler cap to vent the gearbox and check if all oil has been drained

Collect the oil in a dripping pan.



27 Filling with new oil

Refill the gearbox to the correct level via the filling hole.

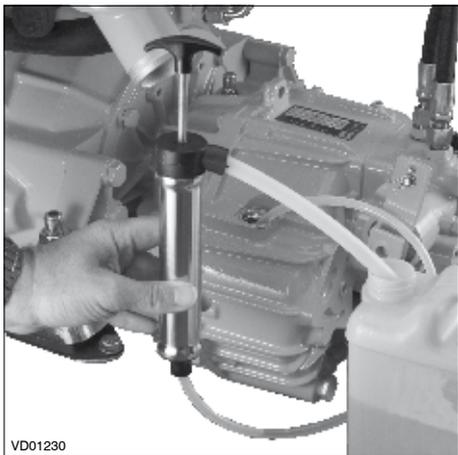
For oil specification see page 118.

In case your engine is equipped with another brand of gearbox follow the instructions given in the supplied owner's manual for changing oil and other care and maintenance.

4 Maintenance

Changing the gearbox oil (ZF-Hurth)

Every 400 operating hours.

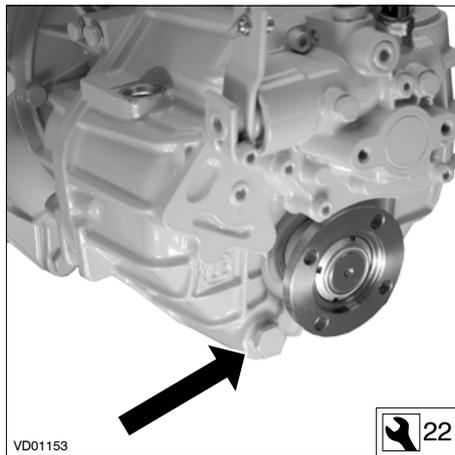


28 Draining the oil

Drain the oil with the aid of a separate sump pump.

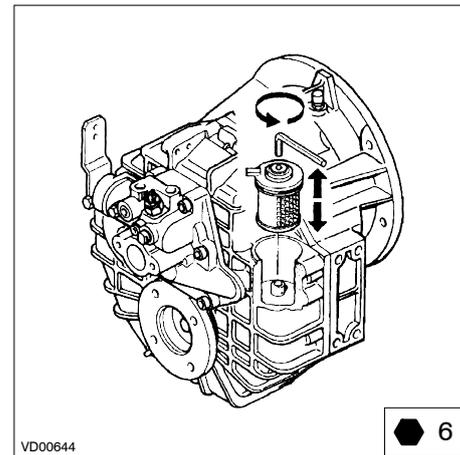
Insert the suction hose of the sump pump in the dipstick hole. Push down the pump handle quickly and pull it up slowly.

Remove the sump pump when all the old oil has been pumped out.



Or, if sufficient space below the gearbox is available, oil can be drained by removing the drain plug.

Collect the oil in a dripping pan.



29 Changing the oil filter

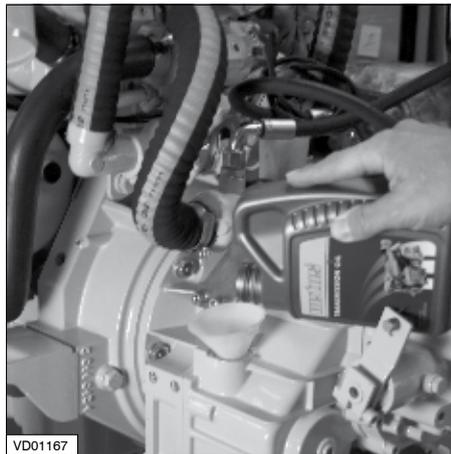
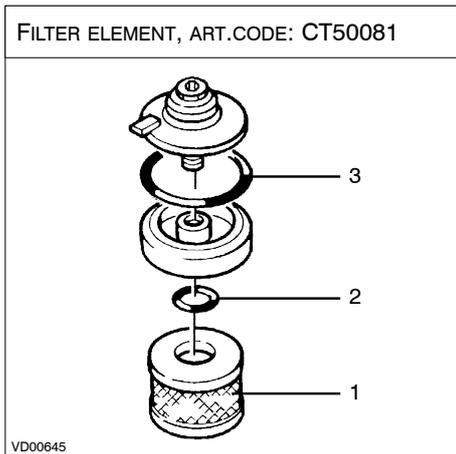
The filter element must be replaced at the same time as the oil.

Turn the screw that holds on the filter cover to the left and remove the filter from its housing. Use an Allen key for this.

4 Maintenance

Changing the gearbox oil (ZF-Hurth)

Every 400 operating hours.



Withdraw the filter element (1).

Check the O-rings (2 and 3) for damage and replace if necessary.

Install the new filter and mount the unit on the gearbox.

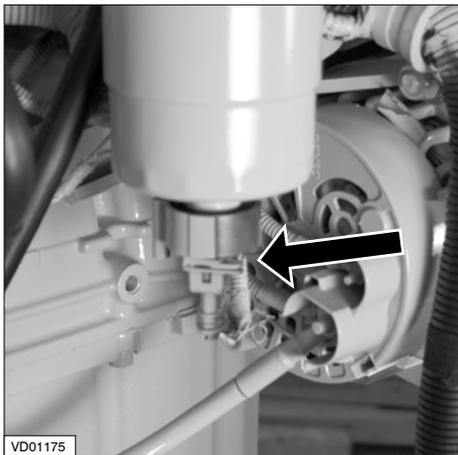
30 Filling with new oil

Refill the gearbox to the correct level via the dipstick opening.

For oil specification see page 118.

In case your engine is equipped with another brand of gearbox follow the instructions given in the supplied owner's manual for changing oil and other care and maintenance.

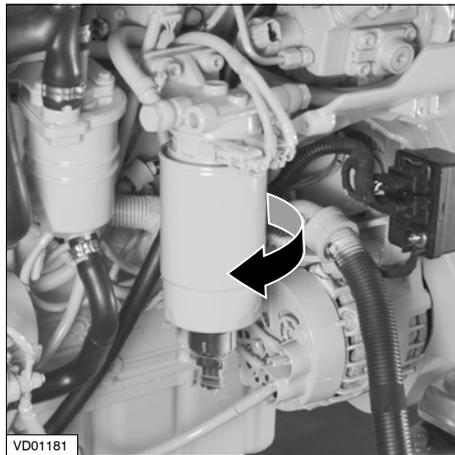
4 Maintenance



31 Fuel filter removal

The fuel filter is to be replaced as a unit.

- Close the fuel stopcock.
- Loosen the connector on the drain plug at the lower side of the filter housing. Press the retainer spring to loosen the connector.



FUEL FILTER, ART.CODE: STM9451



32 Fuel filter installation

- Remove the fuel filter, use a filter wrench. Catch any fuel.

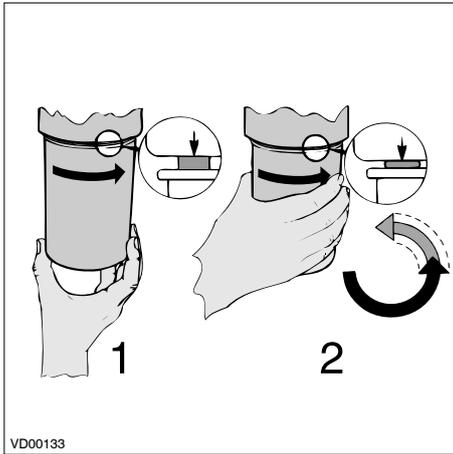
- Clean any debris from the filter carrier rim.
- Lubricate the rubber gasket sparingly with clean engine oil.
- Fill the new filter with clean diesel fuel.



ANGER

Keep naked flames away when working on the fuel system. Do not smoke!

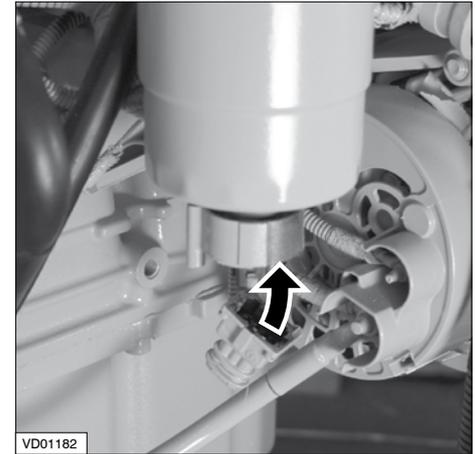
4 Maintenance



- Install the filter. When the rubber gasket touches the housing, apply another tightening of a half to three quarters of a turn by hand.
- Open fuel stopcock.
- Check for leaks.

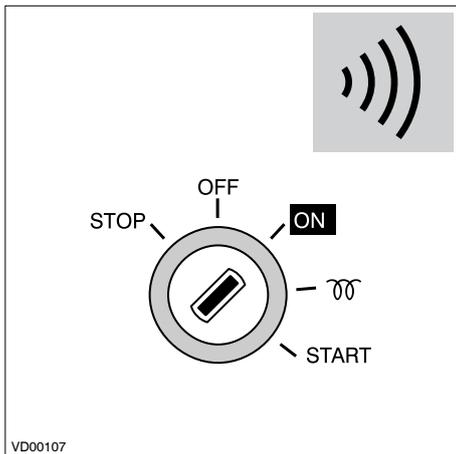
Fuel filter replacement

Every 400 operating hours.



- Put the connection back on the bottom of the filter.

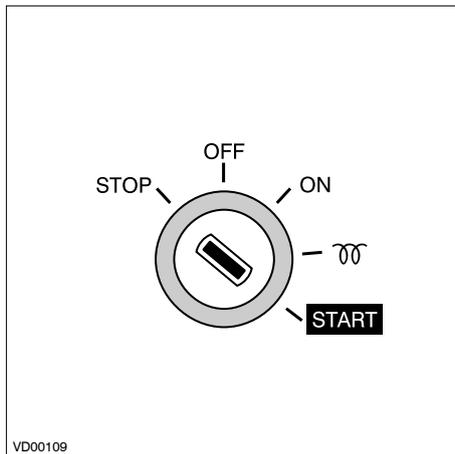
4 Maintenance



33 Bleeding

After replacing the fuel filter and cleaning the pilot filter inside the fuel lift pump the air has to be bled from the fuel system. The fuel system is self-bleeding.

Turn the key in the ignition lock to 'ON' and leave the key in this position for 30 seconds. The fuel pump will now bleed the system.



34 Start the engine

Start the engine

Operate the starter switch until the engine fires; release the starter switch if the engine does not fire within 20 seconds. Wait until the starter motor has stopped before making a new attempt to start the engine.

Repeat the above if the engine cuts out after a short time.

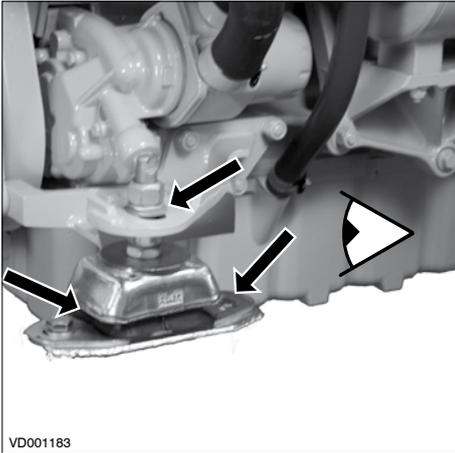
Fuel filter replacement

Every 400 operating hours.

4 Maintenance

Flexible engine mounts, hose connections and fasteners

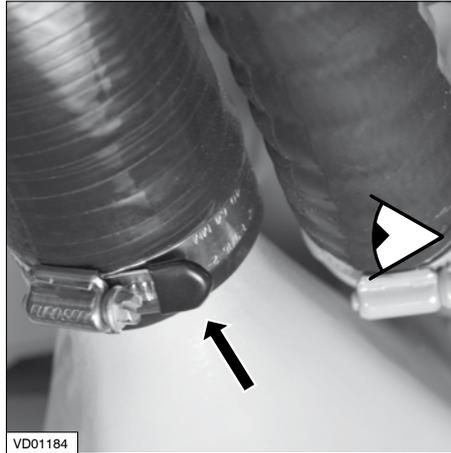
Every 400 operating hours.



35 Check flexible engine mounts

Check the bolts which secure the damper element, the mounting bolts to engine bed and the nuts at the adjustment spindle for tightness.

Inspect the rubber element of the engine support for cracks. Also check the deflection of the damper element, the deflection influences the alignment of engine and prop shaft! Re-align engine in case of doubt.



36 Inspection hose connections

Inspect all hose connections of the cooling system. (Cracked hoses, loose hose clamps)

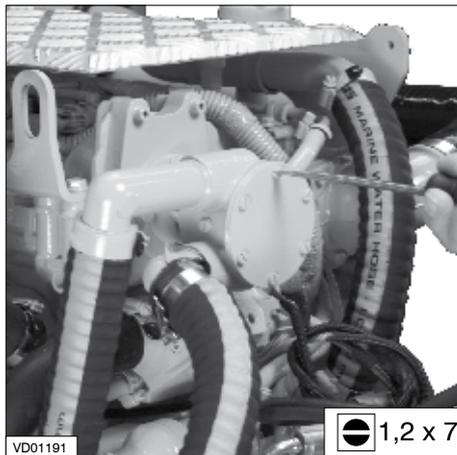
37 Check fasteners

Check tightness of all fasteners, bolts and nuts.

4 Maintenance

Raw water pump inspection

Every 800 operating hours.



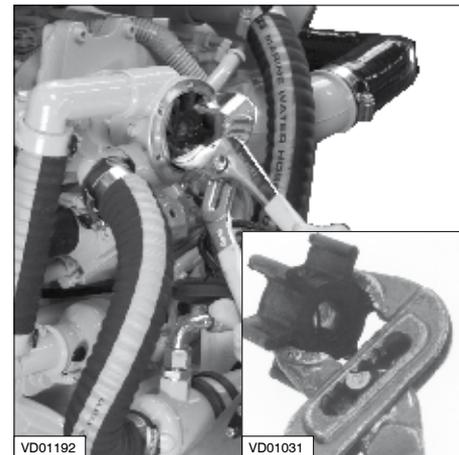
38 Raw water pump inspection

The rubber impeller of the raw water pump is not proof against running dry. If the water supply has been blocked, it may be necessary to replace the impeller. Always carry a spare impeller on board.

39 Pump cover removal

Inspection where appropriate changing is as follows:

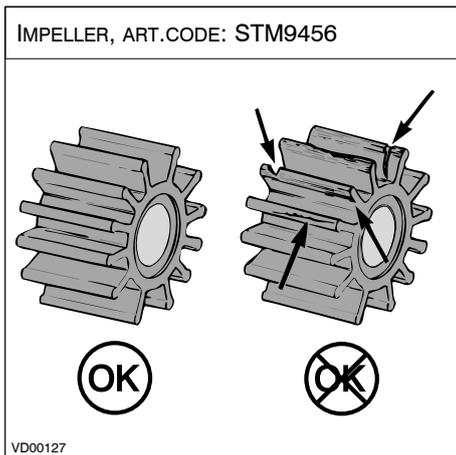
- Close the sea cock.
- Remove the cover of the pump by unscrewing the screws out of the housing.



40 Impeller removal

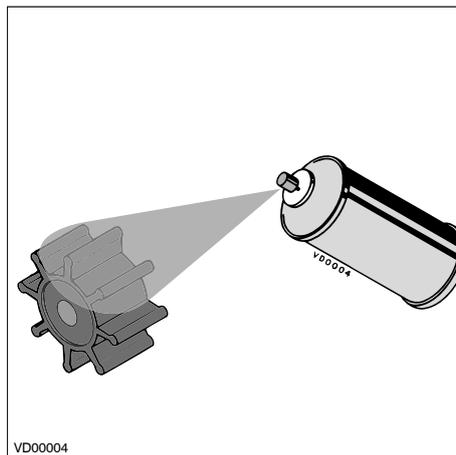
- Use a special impeller puller or pipe wrench to slide the impeller off the shaft.
- Mark the impeller to ensure correct re-installation if it is to be re-used. The impeller must be installed in the same position as removed.

4 Maintenance



41 Impeller inspection

- Inspect the impeller for damage.
- Replace the impeller if necessary.



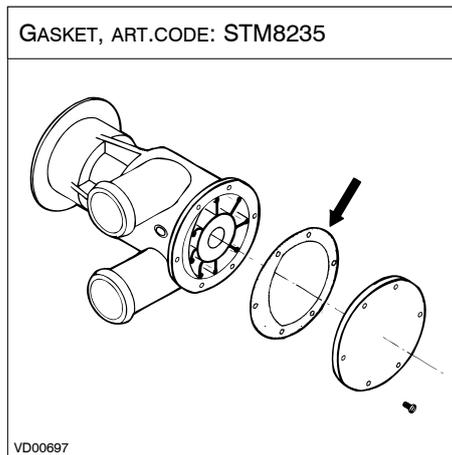
42 Re-install the impeller

- The impeller should be lubricated with glycerin or a non-petroleum based lubricant such as a silicone spray before fitting it into the impeller housing.
- Fit the impeller to the pump shaft. (if an existing impeller is re-used, install it in the same position as removed).

The direction of rotation of the impeller is anti-clockwise.

Raw water pump inspection

Every 800 operating hours.



43 Replacing the pump cover

- Always use a new gasket when replacing the cover.
- Check the water filter and open the sea cock.

4 Maintenance

Coolant replacement

Every 800 operating hours.

44 Coolant replacement

The coolant has to be replaced every 800 operating hours or at least once every two years.

N.B. Replacing the coolant may also be necessary as part of the winter storage procedure; in case that the coolant present in the cooling system offers insufficient protection for the winter.



DANGER

Be aware of the risk of skin burning during draining the hot coolant! Used coolant must be collected in a container for proper disposal according to laws and regulations.

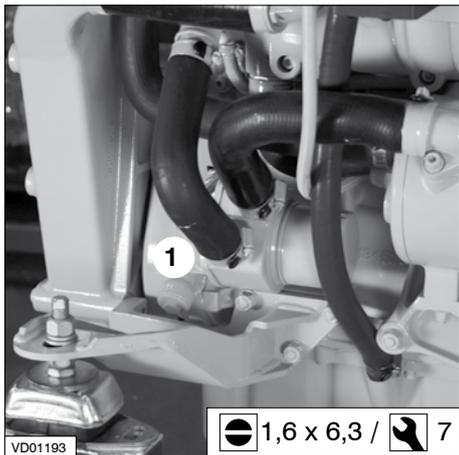


WARNING



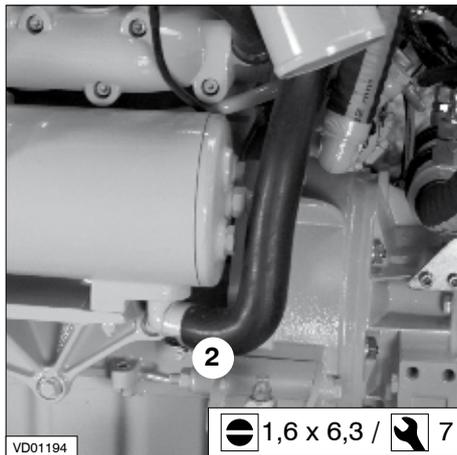
Cooling system protective liquids must be disposed of in accordance with environmental regulations.

4 Maintenance



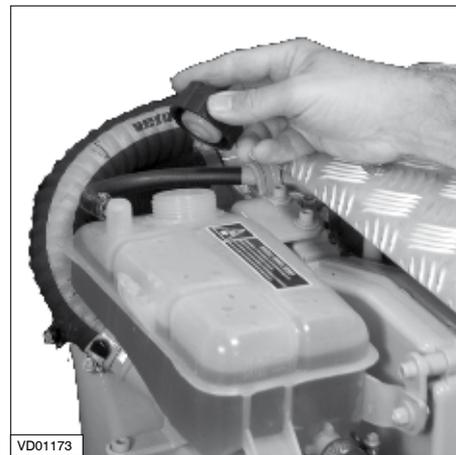
45 Drain coolant

Remove the hose to the oil cooler (1) and the hose of the heat exchanger (2).



Coolant replacement

Every 800 operating hours.



Remove the filler cap on the top of the expansion tank to allow air into the cooling system and check that all the liquid drains out.

4 Maintenance

COOLANT 4 CYL. 7.6 litres
QUANTITY : 5 CYL. 8.5 litres



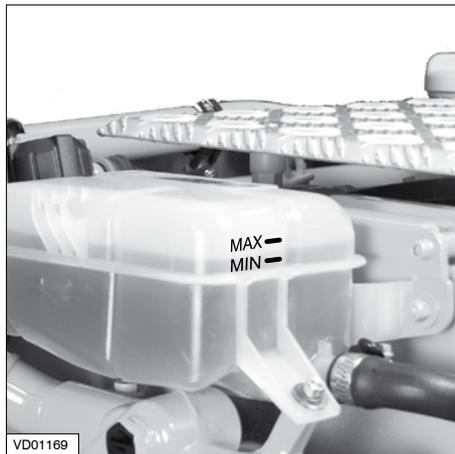
46 Fill cooling system

Remove the cap on the expansion tank.

Fill the cooling system.

Use a mixture of 40% antifreeze (on ethylene glycol basis) and 60% clean tap water or use a coolant.

See page 119 for specifications.



Put the filler cap back.

Check the coolant level after the engine has been run again for the first time has reached operating temperature and then has cooled back to ambient temperature.

Top up if necessary.

Coolant replacement

Every 800 operating hours.

COOLANT QUANTITY:

4 CYL.. 7.6 litres = (1 gal - 5.4 pt UK)
(2 US gal)

5 CYL. 8.5 litres = (1 gal - 7 pt UK)
(2 gal - 2 pt US)



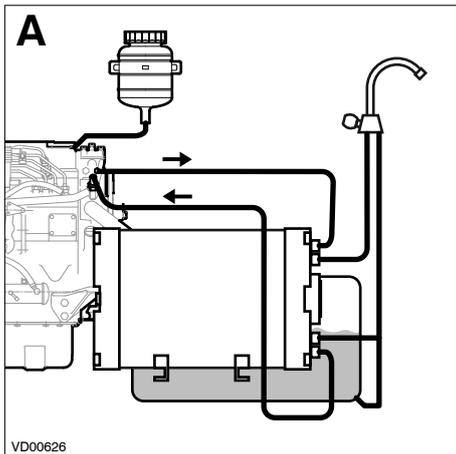
CAUTION

Never fill the cooling system with sea water or brackish water.

4 Maintenance

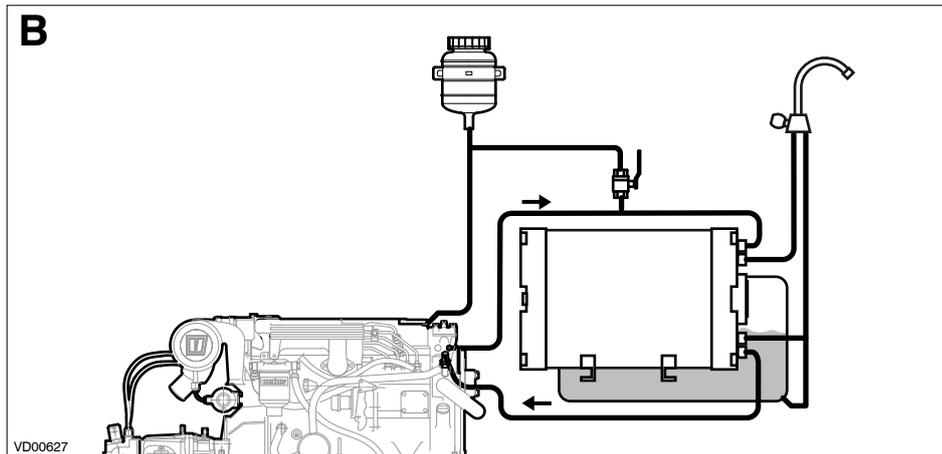
Coolant replacement

Every 800 operating hours.



47 Filling coolant system if a water heater is connected

A) The **HIGHEST** point of the water heater is situated at a **LOWER** level than the expansion tank for the ship's engine. The water heater **will be filled and bled automatically** during filling of the cooling system.



NOTE

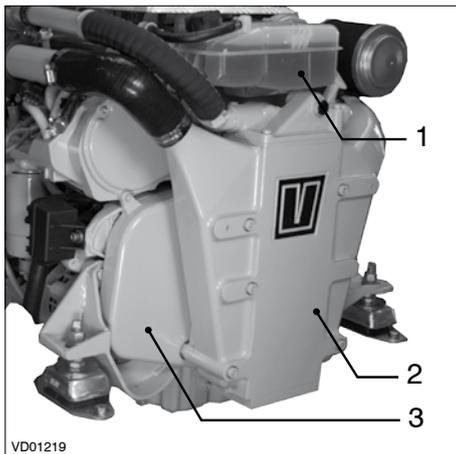
B) The **HIGHEST** point of the water heater is situated at a **HIGHER** level than the expansion tank for the ship's engine. The water heater **will NOT be filled and bled automatically** during filling of the cooling system.

Fill the cooling system via the extra expansion tank.

Open the valve during the filling and bleeding of the system.

Close the valve again once the system is filled.

4 Maintenance



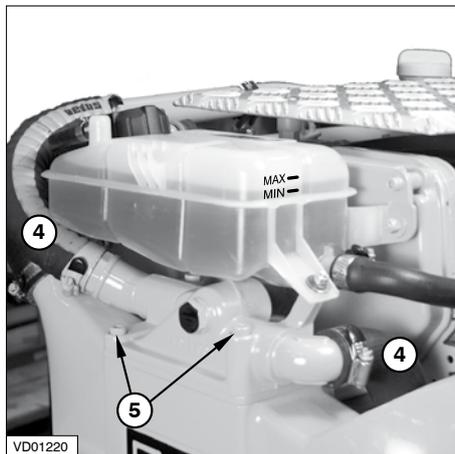
48 Replace drive belt

The expansion tank (1), the after cooler (2) and the drive belt cover (3) have to be removed before the drive belt can be replaced.



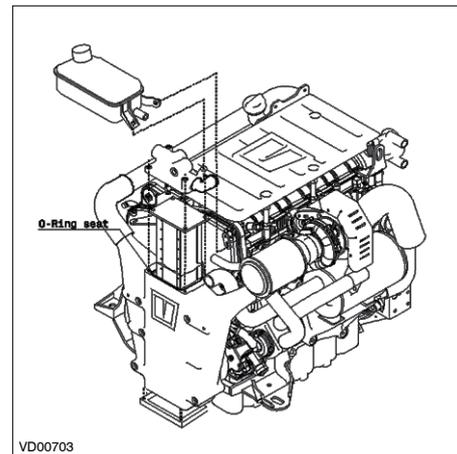
DANGER

Only check, tension or replace the drive belt when the engine is stopped.



- Stop the engine, **close the sea cock** and drain the system.
- Loosen the hose clamps for the external water (IN and OUT) and take the hoses (4) off the hose connection points.
- Drain the internal water system and remove the hoses from the expansion tank.

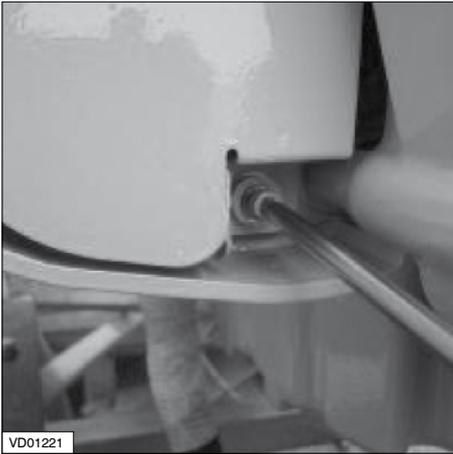
Replace drive belt Every 800 operating hours.



- Remove the expansion tank (1).
- Loosen the bolts (5) and remove the covers at the top and bottom of the after cooler. Be careful with the red silicone gaskets.

4 Maintenance

Replace drive belt
Every 800 operating hours.

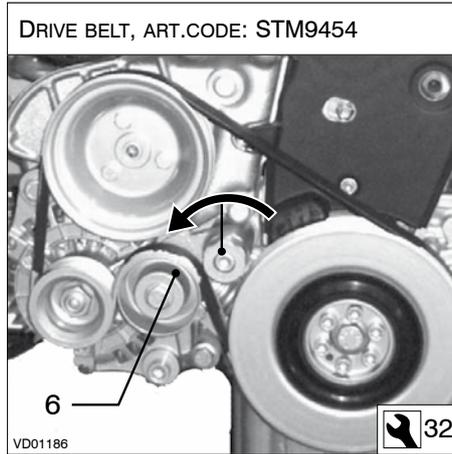


Loosen the fixing screws and remove the drive belt cover (3).

4 Maintenance



Remove the spacer.



Slacken the belt tensioner (6) in order to be able to remove the worn out belt.

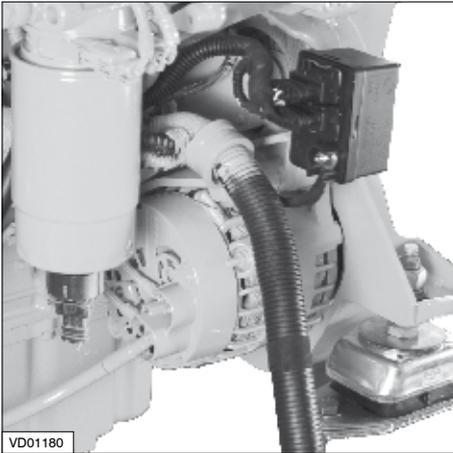
Fit a new belt. Make sure that the teeth on the belt fit well in the grooves of the belt pulleys.

Replace drive belt
Every 800 operating hours.

4 Maintenance

Checking the alternator

Every 800 operating hours.



49 Checking the alternator

Check for visible defects.

Remove the alternator belt. Turn the pulley by hand to check whether the alternator can be turned easily. If this is not the case, contact your Vetus dealer.

4 Maintenance

Cleaning the heat exchanger

Only clean the heat exchanger if this is (badly) fouled.

Under normal conditions of use cleaning the heat exchanger is not necessary!

The engine temperature will be higher than normal if the heat exchanger is fouled.

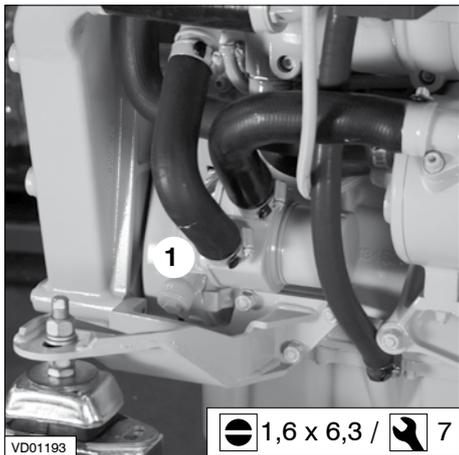
Possible causes of fouling are:

- Small rubber particles from a damaged raw water pump impeller.
- Growth of algae or seaweed.

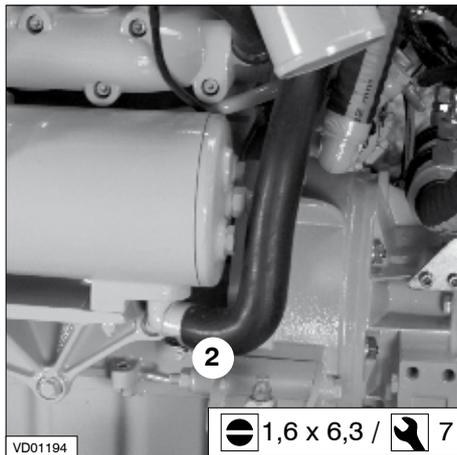
50 Removing heat exchanger

- Close the valve to the raw water supply and remove the water input hose to the oil cooler.

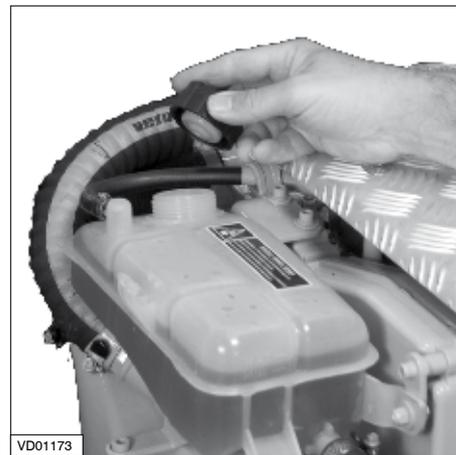
4 Maintenance



Remove the hose to the oil cooler (1) and the hose of the heat exchanger (2).

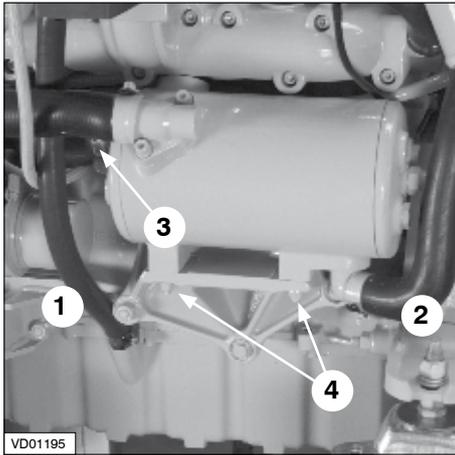


Cleaning the heat exchanger

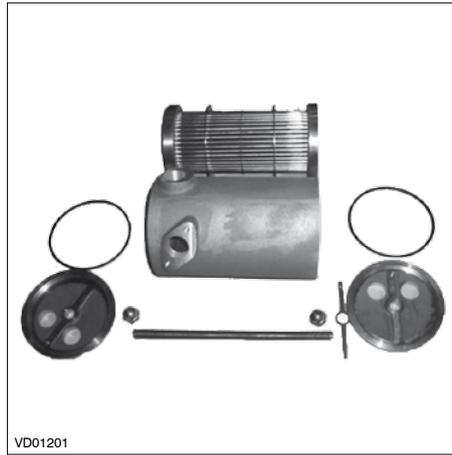


Remove the filler cap on the top of the expansion tank to allow air into the cooling system and check that all the liquid drains out.

4 Maintenance



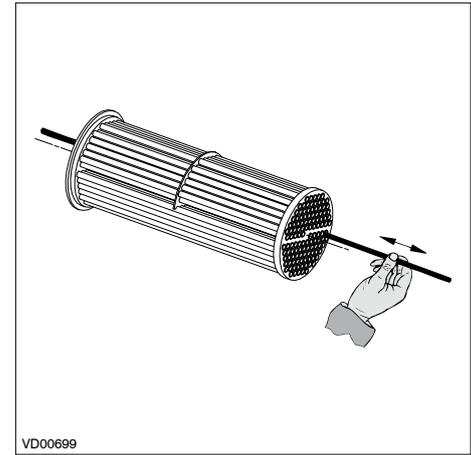
- Remove the oil leak pipe (1).
- Remove the second hose for the internal water (2).
- Remove both hoses for the raw water (3).
- Remove the nuts (4).
The heat exchanger is now free from the engine.



51 Take out the heat exchanger

- Unscrew the 2 cap nuts and pull the rod out of the end covers.
- Remove the heat exchanger from the housing.

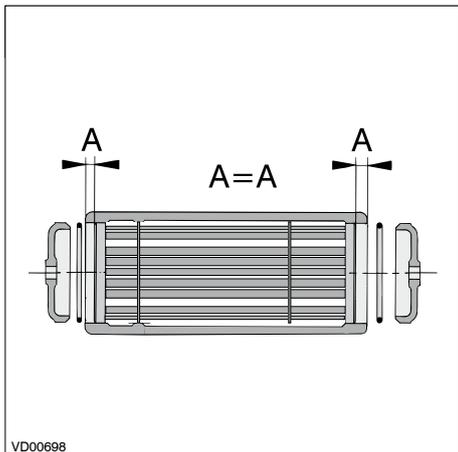
Cleaning the heat exchanger



52 Cleaning the heat exchanger

Clean the heat exchanger: Use a pipe cleaner to remove fouling in the pipes. Then rinse the heat exchanger pipes with clean water. Ensure that both heat exchanger end chambers are free from dirt.

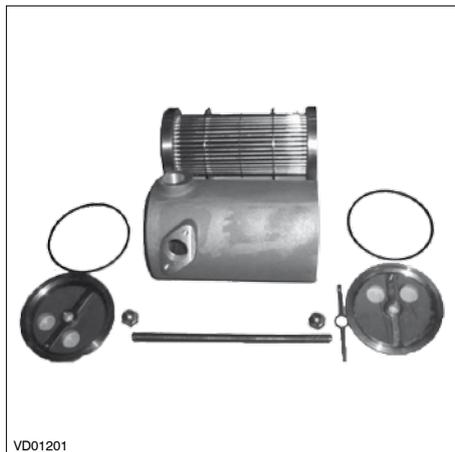
4 Maintenance



53 Replacing heat exchanger

- Replace the heat exchanger in the original position in the heat exchanger housing.

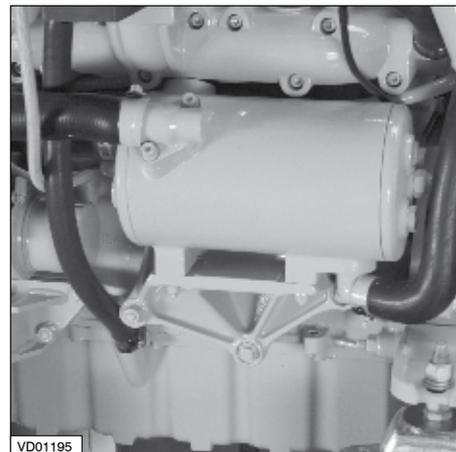
Use new O-rings (STM9457) which have been greased.



54 Fit end covers

- Fit the end covers in the housing.
- Put the threaded rod back and refit the nuts.

Cleaning the heat exchanger



- Refit all hoses disconnected.
- Top up the cooling system, see page 68.

4 Maintenance

If the performance of the engine decreases this can be caused by a dirty heat exchanger in the after cooler.

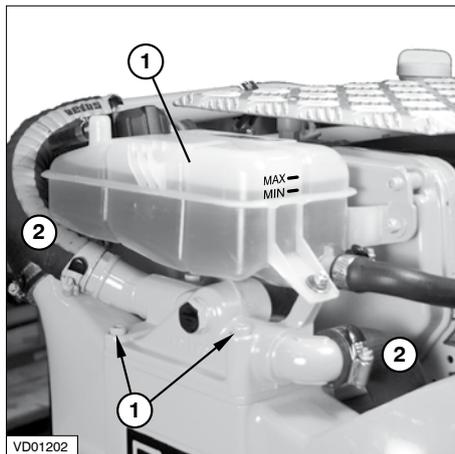
The heat exchanger must then be cleaned.

CAUTION

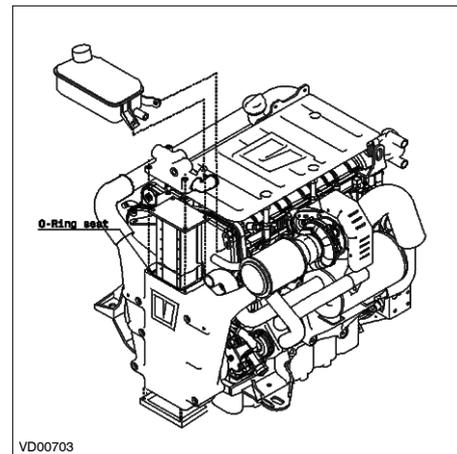
The heat exchanger element in the after cooler is very vulnerable!

55 Take out heat exchanger

- Stop the engine, **close the sea cock** and drain the system.
- Loosen the hose clamps for the raw water (IN and OUT) and take the hoses (2) off the hose connection points.
- Drain the coolant system and remove the hoses from the expansion tank.
- Remove the expansion tank (1).

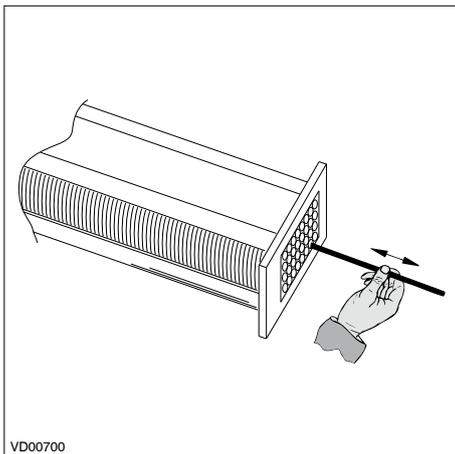


Cleaning the after cooler



- Loosen the bolts (3) and remove the covers at the top and bottom of the after cooler. Be careful with the red silicone gaskets
- Take the heat exchanger out of the after cooler housing. Prevent damage from occurring to the fins and the O-ring.

4 Maintenance



56 Cleaning the heat exchanger

- Clean the pipes of the heat exchanger; use a pipe brush and fresh water to remove any growth in the pipes.
- Then rinse the heat exchanger pipes with clean water.
- Clean the fins using petrol and compressed air, maximum pressure 2 bar (28 psi) to prevent damage to the fins.
- Make sure there is no dirt on either of the covers to the after cooler housing.



CAUTION

Handle with care, avoid shoves during assembly – disassembly that could damage the tube bundle and the cooling fins.

Cleaning the after cooler

57 Replacing the heat exchanger

- Put the heat exchanger back in exactly the same position in the after cooler housing.
- Clean the seatings for the silicone gaskets and the O-rings.
- Put the covers back in place.
- Use compressed air (2 bar, 28 psi) to check the seals for tightness to prevent leaks.
- Reconnect the cooling water hoses and fit the expansion tank back in place.

5 Winter storage procedure

Make sure that the engine compartment is well ventilated during the winter period.

Good ventilation prevents damp in the engine compartment, thus preventing corrosion of the engine from occurring.

The engine should be inspected at the end of the sailing season and any necessary repairs carried out.

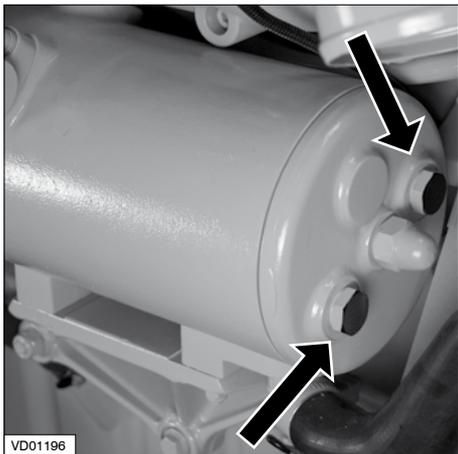
Consult a Vetus Dealer if help is required with this.

Inspections and maintenance work to be carried out are:

5 Winter storage procedure

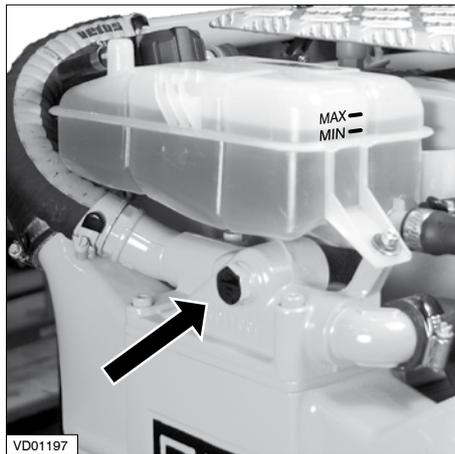
| Inspections and maintenance work to be carried out: | | page |
|--|---|-------------|
| 1 | Check the zinc anodes. | 82 |
| 2 | Drain off the water from the fuel system and fill the fuel tank. | 84 |
| 3 | Make sure that the engine fuel system is filled with a fuel mixture with protective properties. | 85 |
| 4 | Flush out the raw water circuit with fresh water and if necessary fill with anti-freeze. | |
| | Clean the heat exchanger if necessary. | 86 |
| 5 | Make sure that the cooling system is filled with a suitable anti-freeze. | 87 |
| 6 | Change the oil filter and the engine oil. | 88 |
| 7 | Change the oil in the gearbox. | 88 |
| 8 | Grease moving parts of the engine, including the turbo. | 89 |
| 9 | Clean the engine, remove any salt. Paint any rust spots and spray the whole engine with a protective medium, for example CRC protective 6-66. | 90 |
| 10 | Disconnect the battery cables, charge the batteries if necessary and grease the battery terminals. | 91 |

5 Winter storage procedure



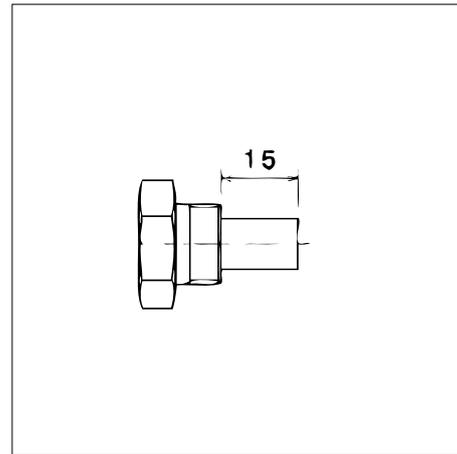
1 Zinc anode

There are 2 zinc anodes in the heat exchanger to protect engine parts that come into contact with the external water from galvanic corrosion.



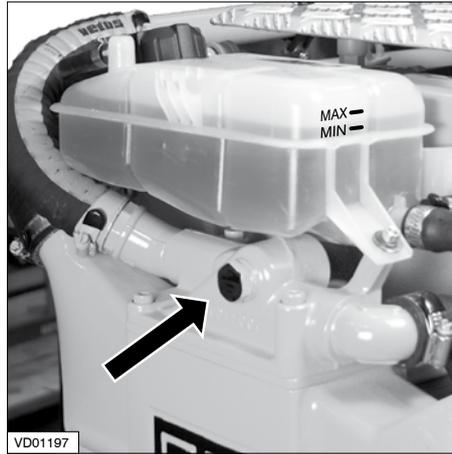
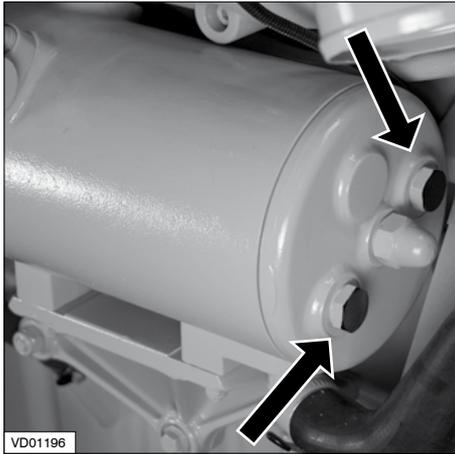
There is a third zinc anode in the after cooler.

The speed at which the zinc anodes are sacrificed depends on many external factors.



Check the zinc anodes; a new zinc anode is 15 mm in length; if a zinc anode is shorter than 7 mm it should be replaced.

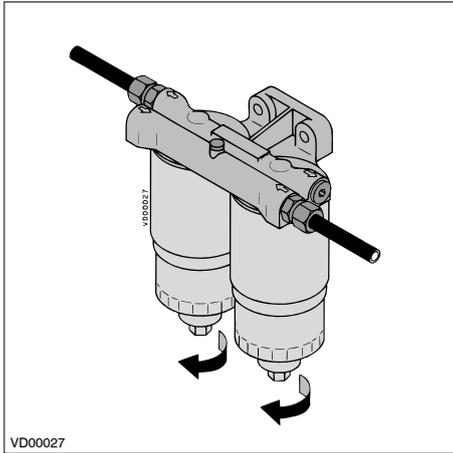
5 Winter storage procedure



Check and replace the zinc anodes as follows:

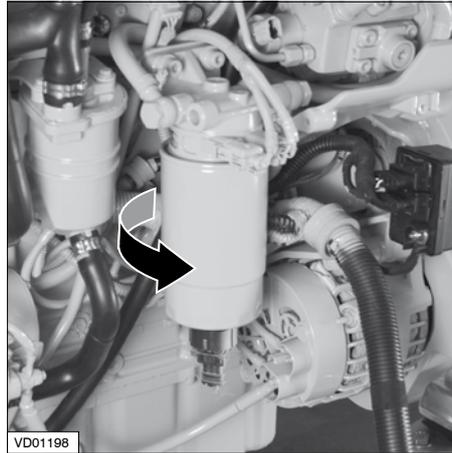
- Stop the engine.
- Close the sea cock.
- Remove the zinc anodes from the heat exchanger housing and the after cooler respectively.
- Replace the (new) zinc anodes and the copper rings.
Use a sealant, for example Loctite® Thread Sealant with PTFE or LOXEAL® 18-10 Pipe Sealant.
- Open the sea cock, start the engine and check for leaks.

5 Winter storage procedure



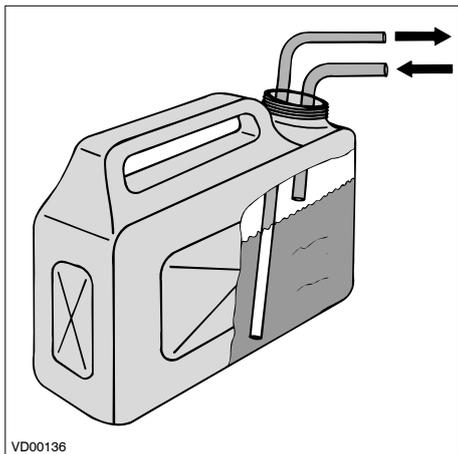
2 Fuel system

Drain the water from the water separator/fuel filter and the fuel tank. Make sure that the tank is completely filled with fuel. This prevents condensation from forming.



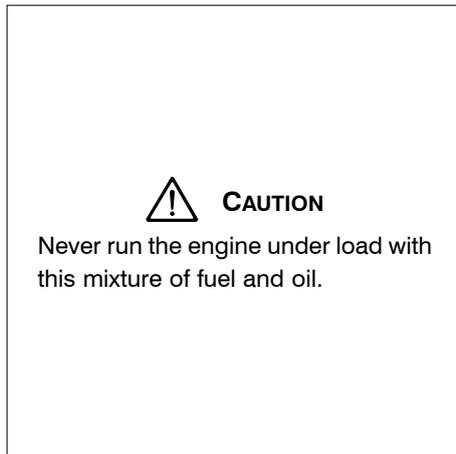
Fit a new fuel filter element. (page 60)

5 Winter storage procedure



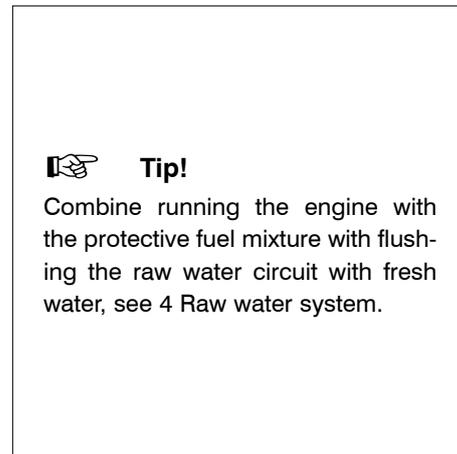
3 Protective fuel mixture

- Connect the fuel supply pipe to a can filled with protective diesel fuel, for example 'Calibration Fluid' (ISO 4113) or with a mixture of 1 part of engine oil* to 9 parts of clean fuel**.
- Use this fuel to run the engine for 5 minutes at idling speed.



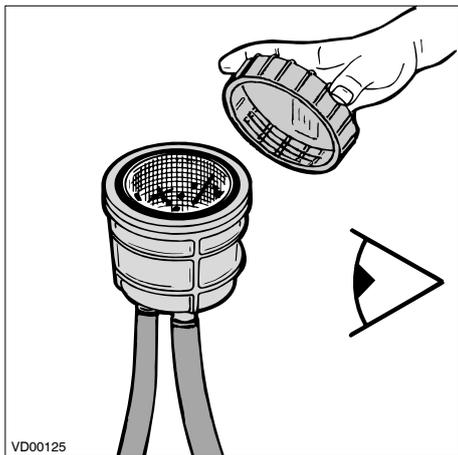
- Stop the engine.

* Engine oil with protective properties.
E.g.:
Vetus Marine Diesel Engine Oil 15 W-40
Shell Nautilus Premium Inboard 15 W-40



** Only use DIN EN 590 Diesel fuel.
Preferably water-free fuel.
Collect some fuel from the return pipe, while engine is running.

5 Winter storage procedure



4 Raw water cooling system

- Close the sea cock.
- Remove the lid of the water strainer.
- If necessary, clean the raw water strainer.

Tip!

Combine flushing the raw water circuit with fresh water with running with the protec

Heat exchanger

Only clean the heat exchanger if this is absolutely necessary, see page 74

Raw water pump

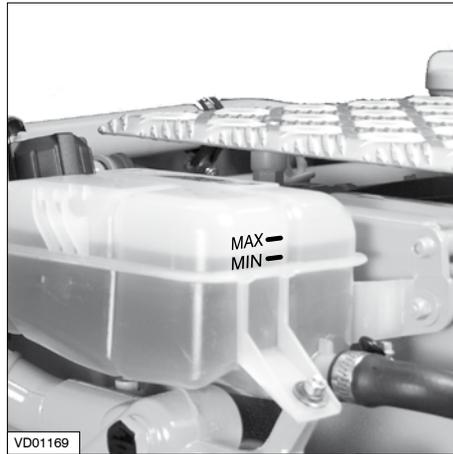
Check the impeller of the raw water pump at least once every two years, see page 65.

- Connect the raw water intake to a fresh water (tap water) supply or a tank containing fresh water. Open the tap and allow the engine to idle for at least 5 minutes to remove any salt and contamination from the raw water cooling system.
Make sure that there is a sufficient supply of water to prevent the engine from overheating.

- Stop the engine and close the cock.
- The external water system must be protected in areas where the temperature drops to below zero during the winter.

Pour 1 litre (1/4 gallon) of anti-freeze into the water strainer and run the engine until the anti-freeze has disappeared into the cooling system.

5 Winter storage procedure



5 Fresh water cooling system

Take care that no anti-freeze is spilled into the waterway (anti-freeze is poisonous).

- Check the seal between the lid and housing after cleaning and re-assembling the strainer.

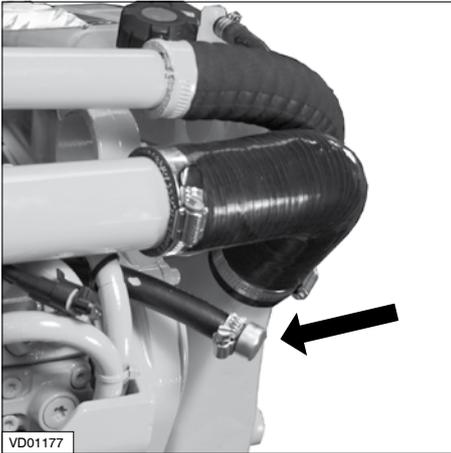
An improperly sealed lid will result in air sucked in by the raw water pump which again will result in overheating of the engine.

To avoid corrosion during winter storage the cooling system must be filled with an antifreeze/water mixture (or a coolant). For specifications see page 119.

N.B. Replacing the coolant is only necessary if the coolant present in the cooling system offers insufficient protection for the winter.

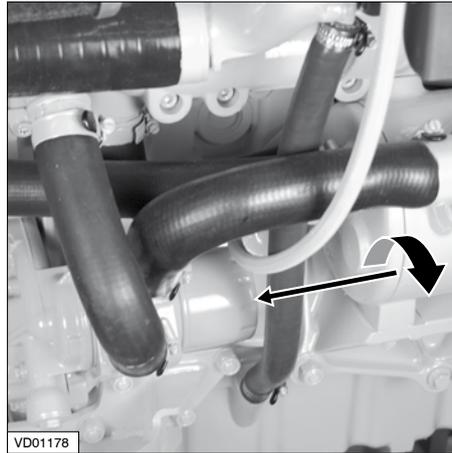
For coolant replacement see page 66.

5 Winter storage procedure



6 Lubrication system

With the engine still at operating temperature: (If not, run the engine until warm, then turn off.)



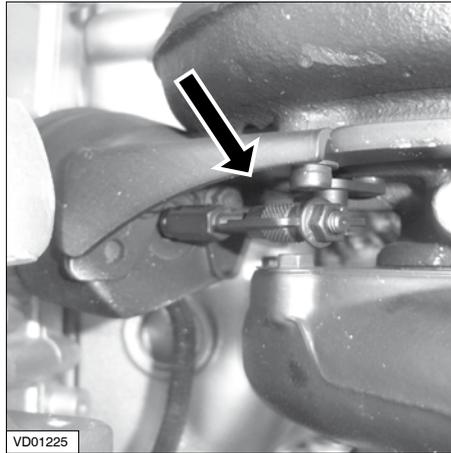
Replace the oil filter and change the engine oil, see page 49; use oil with protective properties. For oil specification see page 116.



7 Changing the gearbox oil

Stop the engine and change the oil of the gearbox. (page 57 and 58)

5 Winter storage procedure



8 Greasing moving parts

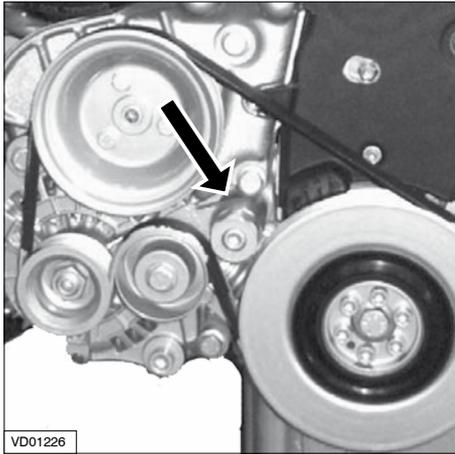
For a good working of the engine it is essential to grease a number of moving parts on the outside of the engine or to spray them with oil.

Turbocharger

The turbocharger is a variable geometry type (VGT). The operating mechanism for this is on the outside of the turbo. This operating mechanism must be free of corrosion and well greased if it is to work on the best possible way.

- Apply long-life water-resistant lithium-based grease, for example 'ZEP RED LITHIUM GREASE', to the operating mechanism.
- Then spray the cast-iron housing and the aluminium parts of the turbo with liquid lubricant containing Teflon®, for example 'ZEP 2000.'
- Disconnect the hose connecting the turbo to the after cooler from the turbo. Remove any oil residue from the surface of the turbo exhaust and then replace the hose.
- Remove the air filter. Remove any oil residue from the surface of the turbo intake and then replace the hose.
- Clean the air filter if necessary, see page 56.

5 Winter storage procedure



Belt tensioner

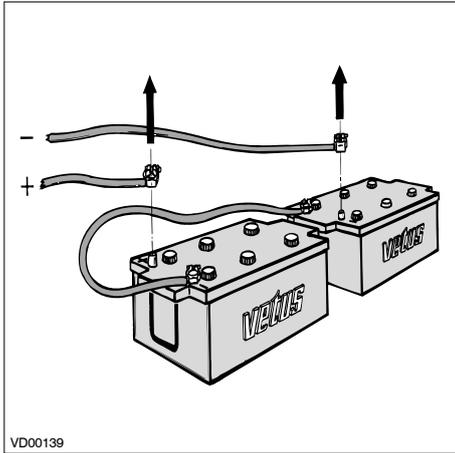
- Spray the spring and the rotation point of the belt tensioner with a liquid lithium-based lubricant.

Be careful not to get any lubricant on the belt!

9 Corrosion protection

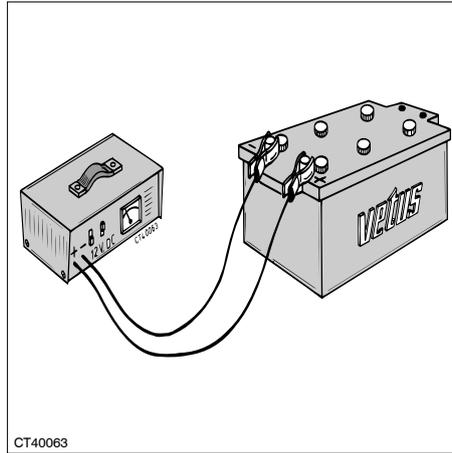
The various parts of the engine (except the engine block) have been treated with an anti-corrosion protective medium. In order to prevent corrosion, the engine should be rinsed off to remove any salt residues. If there is any corrosion, the paint should be touched up. Engine parts that become hot must be touched up with heat-resistant paint.

5 Winter storage procedure



10 Electrical system

Disconnect the battery cables.



Charge batteries during winter lay-up regularly if required!

Follow the recommendations given on pages 52 to 54 or consult the recommendations given by the battery supplier for inspection and maintenance of the batteries.

6 Recommissioning after winter storage

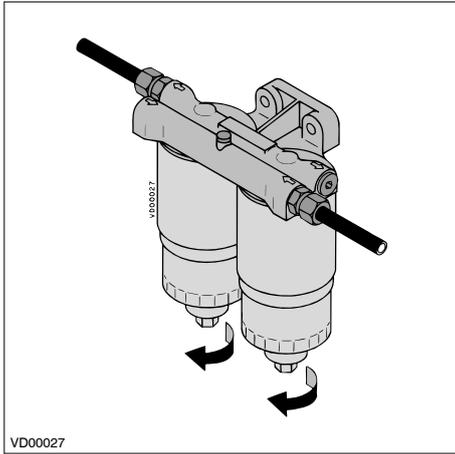
The engine must be inspected and any maintenance work carried out at the beginning of the sailing season.

Consult a Vetus Dealer if help is required with this.

Inspections and maintenance work to be carried out are:

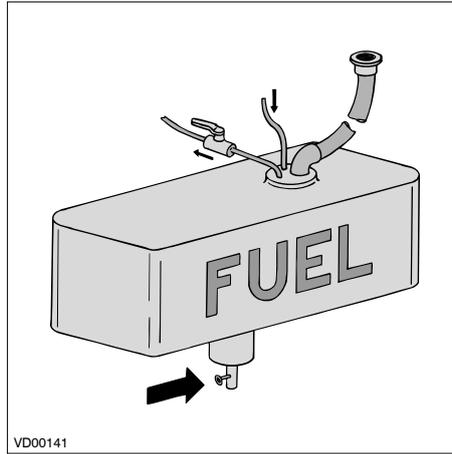
| Inspections and maintenance work to be carried out are: | | page |
|--|---|-------------|
| 1 | Drain the water from the fuel system. | 93 |
| 2 | Check the raw water system. | 94 |
| 3 | Check the coolant level in the internal cooling system. | 95 |
| 4 | Check the oil level. | 95 |
| 5 | Check the batteries and reconnect these. | 96 |
| 6 | Check the working of the ECU box. | 96 |
| 7 | Check all hose connections for leaks. | 97 |
| 8 | Check the working of the instruments and the engine controls. | 97 |

6 Recommissioning after winter storage

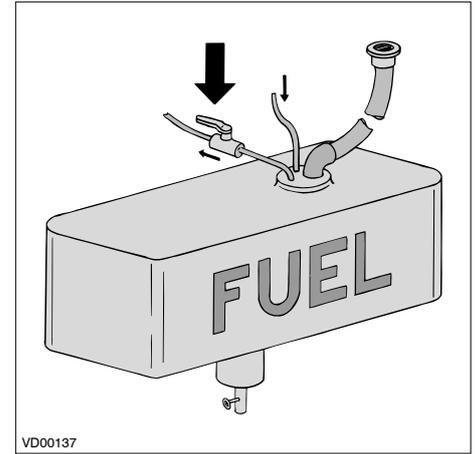


1 Fuel system

Drain the water from the water separator/
fuel filter. (page 47)

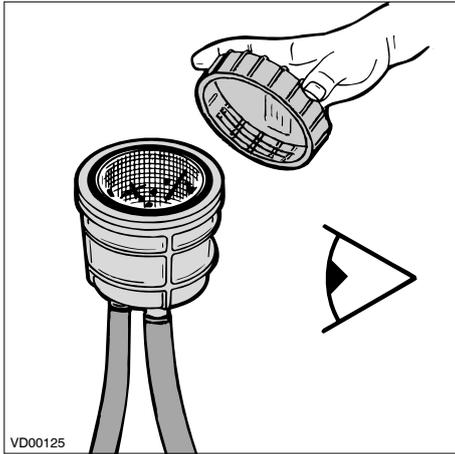


Drain the water from the fuel tank.



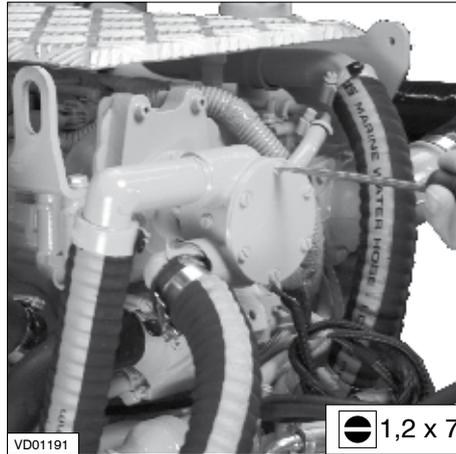
Open the fuel valve.

6 Recommissioning after winter storage

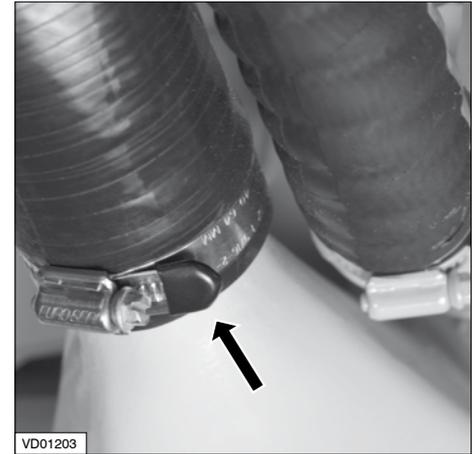


2 Raw water cooling system

Check that the lid of the raw water strainer is reinstalled.

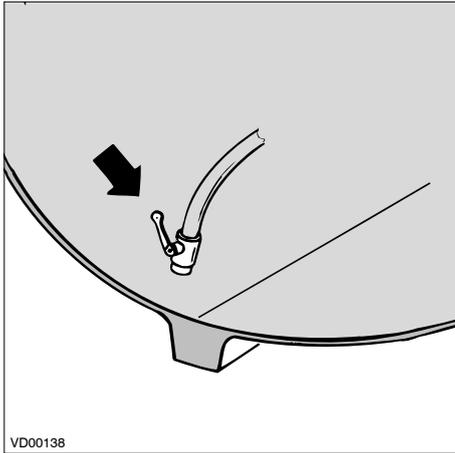


Check that the lid of the raw water pump is in place (page 64, 65).

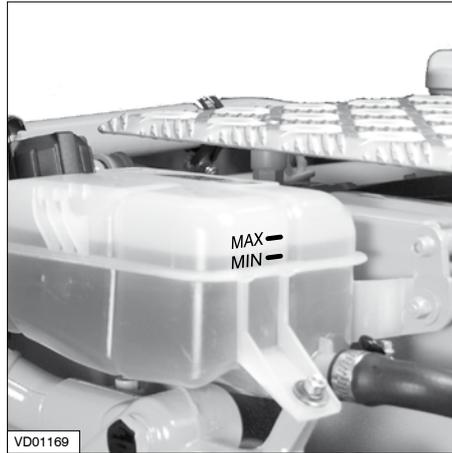


Re-tighten possible loose hose clamps.

6 Recommissioning after winter storage

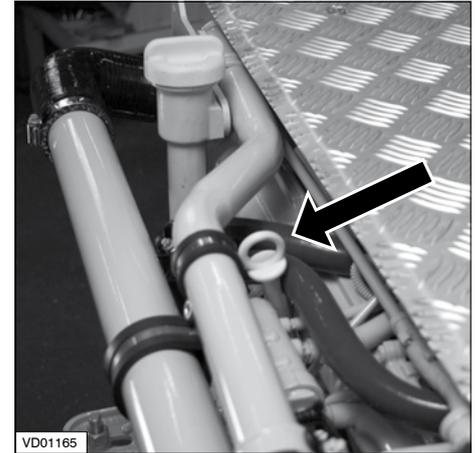


Open the sea cock.



3 Fresh water cooling system

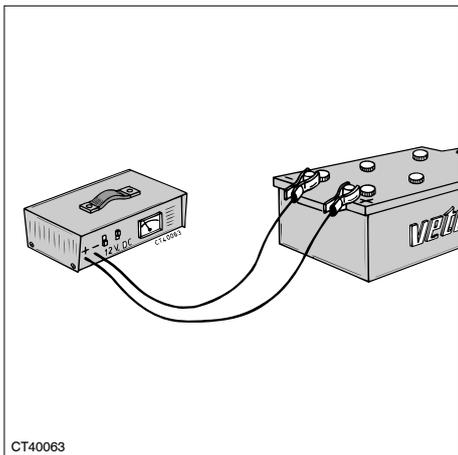
Check the coolant level. (page 45)



4 Lubrication system

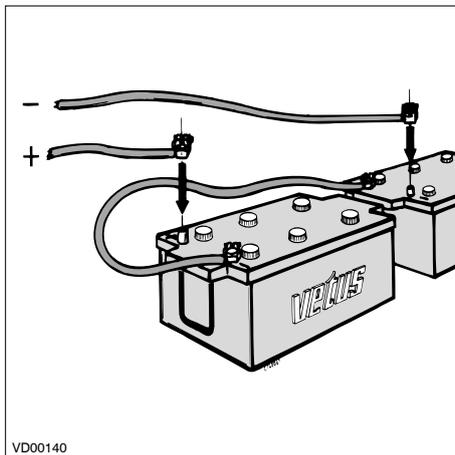
Check the engine oil level. (page 44)

6 Recommissioning after winter storage



5 Electrical system

Make sure that the batteries are fully charged. (page 52, 91)



Connect the batteries.

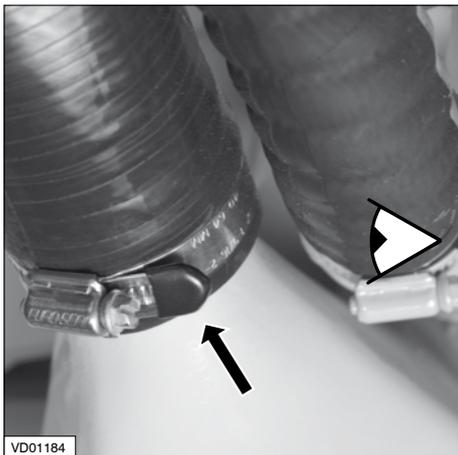


6 Switching on

Turn the starter key on the instrument panel to 'ON'; the indicator lights for oil pressure and the dynamo will now come on and the alarm buzzer will sound.

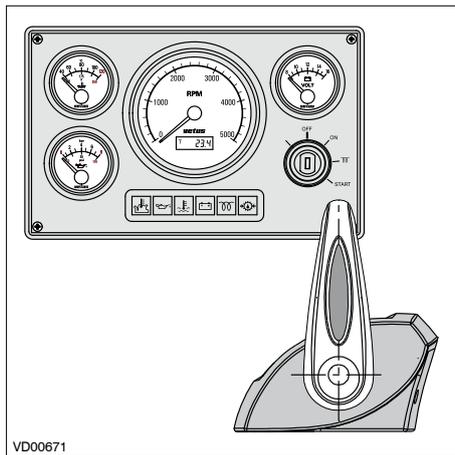
All indicator LEDs for the fuses must light up when the starter key is in position 'ON'.

6 Recommissioning after winter storage



7 Check engine for leaks

Start the engine.
Check the fuel system, the cooling system
and the exhaust for leakage.



8 Checking instruments and remote controls

Check the operation of the instruments,
the remote control and the gearbox.

Engine faults are in most cases caused by improper operation or insufficient maintenance.

In case of a fault, always check first that the operation and maintenance instructions have been followed.

In the following tables information is given about the possible causes of faults and suggested remedies.

Please note that these tables can never be complete.

If you are unable to identify the cause of the fault or to rectify it yourself, then contact the nearest service representative.



DANGER

Before starting, make sure that nobody is in the immediate vicinity of the engine. When carrying out repair, **never** start the engine with the fuel injection pump removed.

Disconnect battery!

7 Troubleshooting

Fault finding table

| | Fault | page |
|----|--|-------------|
| 1 | Engine will not crank | 100 |
| 2 | Engine cranks but will not start, no smoke from exhaust | 101 |
| 3 | Engine cranks but will not start, smoke from exhaust | 102 |
| 4 | Engine starts but runs unevenly (rough idling) or stalls | 102 |
| 5 | Engine does not reach maximum RPM under load | 103 |
| 6 | Engine overheats | 104 |
| 7 | Engine not firing on all cylinders | 105 |
| 8 | Engine has little or no oil pressure | 105 |
| 9 | Engine oil consumption excessive | 106 |
| 10 | Fuel consumption excessive | 106 |
| 11 | Black exhaust smoke (idling) | 107 |
| 12 | Blue exhaust smoke (idling) | 107 |
| 13 | Black exhaust smoke (at load) | 108 |
| 14 | White exhaust smoke (at full load) | 108 |
| 15 | Burnt oil trace in exhaust line . | 109 |
| 16 | Idle speed more than 750-800 RPM | 109 |

7 Troubleshooting

Fault finding table

1 Engine will not crank

| Possible fault | Remedy |
|---|--|
| Control lever not in neutral. | Put operating lever in neutral |
| The emergency stop knob is pushed in (ECU Box) . | Pull the emergency stop knob out. |
| Faulty or discharged battery (too low voltage) . | Check / recharge battery and check engine alternator and/or battery charger. |
| Fuse blown. | Replace. |
| Loose or corroded connections in starting circuit. | Clean and tighten connections. |
| Faulty starter-switch or faulty starter-relay. | Check / replace. |
| Faulty starter-motor or pinion does not engage. | Check / replace starter-motor. |
| Starter relay is not engaged due to a voltage too low; caused by a very long intermediate cable from engine to control panel. | Install an auxiliary starter relay |
| Seized components. | Repair. |

1 Engine will not crank

| Possible fault | Remedy |
|--|------------------|
| Wrong engine electric mass connection. | Repair. |
| Water in the cylinder . | Check / Repair . |

7 Troubleshooting

Fault finding table

2 Engine cranks but will not start, no smoke from exhaust

| Possible fault | Remedy |
|--|---|
| Fuel stop valve closed. | Open. |
| (Nearly) Empty fuel tank. | Refill. |
| Air in fuel system. | Check and bleed. |
| Fuel filter clogged with water and/or contamination. | Check or replace. |
| Fuel pre-filter clogged . | Clean /replace |
| Leaking fuel supply line or fuel injection line. | Check / replace. |
| Faulty injector/injection pump.. | Check, replace if required. |
| Vent line of fuel supply tank clogged. | Check / clean. |
| Exhaust restricted. | Check. |
| Electrical fuel low pressure pump is not working. | Check the electrical connection ,check the pump ,replace. |
| Fuel electric pressure regulator clogged | Check /clean or replace |
| ECU faulty. | Diagnosis -replace . |
| Fuse burnt out in ECU box. | Check/replace. |

7 Troubleshooting

Fault finding table

3 Engine cranks but will not start, smoke from exhaust

| Possible fault | Remedy |
|--|---|
| Air in fuel system. | Check and bleed. |
| Faulty glow plugs. | Check / replace. |
| Insufficient intake air. | Check. |
| Intake air filter clogged . | Clean/replace |
| Wrong fuel quality or contaminated fuel. | Check fuel. Drain and flush fuel tank. Replace with new fuel. |
| Incorrect lube oil SAE class or quality for ambient temperature. | Replace. |

4 Engine starts but runs unevenly (rough idling) or stalls

| Possible fault | Remedy |
|--|---|
| (Nearly) Empty fuel tank. | Refill. |
| Air in fuel system. | Check and bleed. |
| Fuel filter clogged with water and/or contamination. | Check or replace. |
| Leaking fuel supply line or fuel injection line. | Check / replace. |
| Faulty injector/injection pump. | Check, replace if required. |
| Vent line of fuel supply tank clogged. | Check / clean. |
| Fuel supply line restricted. | Check / clean. |
| Exhaust restricted. | Check. |
| Wrong fuel quality or contaminated fuel. | Check fuel. Drain and flush fuel tank. Replace with new fuel. |
| Clogged filter of electric fuel lift pump. | Check / clean |
| Low battery voltage | Recharge /replace |
| Fuel electric pressure regulator fault | Replace |

7 Troubleshooting

Fault finding table

5 Engine does not reach maximum rpm under load

| Possible fault | Remedy |
|--|---|
| Air in fuel system. | Check and bleed. |
| Fuel filter clogged with water and/or contamination. | Check or replace. |
| Leaking fuel supply line or fuel injection line. | Check / replace. |
| Fuel pre-filter clogged . | Clean/replace. |
| Clogged injectors | Check, replace if required. |
| VGT turbocharger actuator blocked . | Check unblock or replace |
| Turbocharger damaged . | Replace |
| Oil level too high. | Lower level. |
| Lubricating oil incorrect SAE spec or quality for ambient temperature. | Replace. |
| Exhaust restricted. | Check / clean. |
| Insufficient intake air. | Check. |
| Wrong fuel quality or contaminated fuel. | Check fuel. Drain and flush fuel tank. Replace with new fuel. |
| Leak in inlet manifold. . | Check / replace and clean |
| Engine overloaded. | Check size of propeller. |

5 Engine does not reach maximum rpm under load

| Possible fault | Remedy |
|------------------------|--------|
| Hull/propeller dirty . | Clean |
| Transmission defect. | Check |
| Boat load inadequate . | - |

7 Troubleshooting

Fault finding table

6 Engine overheats

| Possible fault | Remedy |
|---|------------------------------------|
| Coolant level too low. | Check / top up. |
| Sea cock closed. | Open. |
| Raw water strainer clogged. | Check / clean. |
| Leak in raw water feed system. | Check / replace. |
| Leak in coolant circuit . | Check. |
| Faulty thermostat. | Check / replace. |
| Faulty coolant pump. | Check / replace. |
| Faulty raw water pump impeller. | Check / replace. |
| Faulty injector/injection pump. | Check, replace if required. |
| Oil level too high. | Lower level. |
| Oil level too low. | Increase level. |
| Faulty oil filter. | Replace. |
| Faulty oil heat exchanger. | Replace. |
| Faulty turbo compressor. | Check / replace. |
| Heat exchanger dirty or clogged as a result of rubber particles from a worn impeller. | Check / clean. |
| Insufficient intake air. | Check / replace air intake filter. |

6 Engine overheats

| Possible fault | Remedy |
|--|------------------|
| Motor becomes apparently overheated as a result of faulty temperature switch, sensor or meter. | Check / replace. |

7 Troubleshooting

Fault finding table

7 Engine not firing on all cylinders

| Possible fault | Remedy |
|--|-----------------------------|
| Air in fuel system. | Check and bleed. |
| Fuel filter clogged with water and/or contamination. | Check or replace. |
| Leaking fuel supply line or fuel injection line. | Check / replace. |
| Faulty injector/injection pump. | Check, replace if required. |
| Fuel supply line restricted. | Check / clean. |
| Electric fuel pump filter blocked. | Check / clean. |
| Faulty electric fuel pump. | Check / replace. |
| Intake valve blocked . | Check /replace |

8 Engine has little or no oil pressure

| Possible fault | Remedy |
|---|-------------------|
| Oil level too low. | Increase level. |
| Oil leaks . | Check. |
| Blocked oil filter. | Replace. |
| Faulty oil pump. | Repair / replace. |
| Excessive inclination of engine. | Check / Adjust. |
| Incorrect lube oil SAE class or quality for ambient temperature. | Replace. |
| Oil pressure apparently too low due to faulty oil pressure switch, sensor or meter. | Check / replace. |

7 Troubleshooting

Fault finding table

9 Engine oil consumption excessive

| Possible fault | Remedy |
|--|---|
| Oil level too high. | Lower level. |
| Excessive inclination of engine. | Check / Adjust. |
| Incorrect lube oil SAE class or quality for ambient temperature. | Replace. |
| Leak in lubricating oil system. | Repair / replace. |
| Excessive wear of cylinder/piston. | Check compression; overhaul engine. |
| Insufficient intake air. | Check. |
| Engine overloaded. | Check size of propeller. Clean the propeller. |
| Crank case vapor condenser clogged . | Replace |
| Turbocharger oil leaks . | Replace or repair. |

10 Fuel consumption excessive

| Possible fault | Remedy |
|---------------------------------------|---|
| Incorrect fuel quality or dirty fuel. | Check fuel. Drain and rinse fuel tank. Replace with new fuel. |
| Faulty injector/injector pump. | Check, replace if necessary. |
| Excessive wear of cylinder / piston. | Check compression; refurbish engine. |
| Insufficient air intake. | Check. |
| Fuel leaks . | Check and repair. |

7 Troubleshooting

Fault finding table

11 Black exhaust smoke (idling)

| Possible fault | Remedy |
|----------------------------------|-----------------|
| Oil level too high. | Lower level. |
| Excessive inclination of engine. | Check / Adjust. |
| Injector fault | Check /replace. |

12 Blue exhaust smoke (idling)

| Possible fault | Remedy |
|---|---------------------------|
| Oil level too high. | Lower level. |
| Leaking from turbo compressor oil seal. | Check / replace oil seal. |

7 Troubleshooting

Fault finding table

13 Black exhaust smoke (at load)

| Possible fault | Remedy |
|---|--------------------------------------|
| Faulty turbo compressor. | Check / replace. |
| VGT Turbocharger actuator blocked | Unblock /replace |
| Insufficient intake air, air filter dirty. | Check/clean the filter . |
| Leak in inlet manifold. | Check / replace. |
| Intercooler dirty. | Check/clean. |
| Oil level incorrect. | Check . |
| Faulty injector / injection pump. | Check / replace if required. |
| Excessive wear of cylinder / piston. | Check compression; refurbish engine. |
| Engine overloaded, max. rpm is not reached. | Check sizes of propeller. |
| Engine overloaded, dirty propeller -boat hull, excessive load on-board. | Check /clean. |

14 White exhaust smoke (at full load)

| Possible fault | Remedy |
|--|---|
| Air in fuel system. | Check and bleed. |
| Faulty injector/injection pump. | Check, replace if required. |
| Water in fuel system. | Check water separator. |
| Faulty glow plugs. | Check / replace. |
| Wrong fuel quality or contaminated fuel. | Check fuel. Drain and flush fuel tank. Replace with new fuel. |
| Vapour in exhaust gases condenses as a result of very low ambient temperature. | - |

7 Troubleshooting

Fault finding table

15 Burnt oil trace in exhaust line .

| Possible fault | Remedy |
|--|--------------------------------------|
| Oil level too high . | Verify . |
| Faulty turbocharger . | Check, Repair / Replace . |
| Excessive wear of cylinder / piston, piston rings. | Check compression; refurbish engine. |

16 Idle speed >750-800 RPM

| Possible fault | Remedy |
|--|---|
| Low battery voltage . | On normal functioning: If the battery voltage is lower than 13.5 V increase engine speed to 1050 RPM until the voltage is 13.5 Volt . |
| Coolant temperature lower than 40 °C (104 °F). | On normal functioning: Run the engine at a speed of 900 RPM until the coolant temp is over 40 °C (104 °F) . |
| Wrong indication of tachometer. | Adjust /replace . |
| Fault on electric -electronic equipment. | Check/repair. |

8 Technical data

Engine specifications

| Model | VF4.140E | VF4.170E | VF4.190E | VF5.220E | VF5.250E |
|------------------------------------|---|---------------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|
| General | | | | | |
| Make | Vetus C.M.D. | | | | |
| Number of cylinders | 4 | 4 | 4 | 5 | 5 |
| Based on | FTP technology | | | | |
| Type | 4-stroke diesel, in-line, DOHC | | | | |
| Injection | Direct injection, common rail | | | | |
| Aspiration | Turbo-charged with variable geometry | | | | |
| Bore | 82 mm | 82 mm | 82 mm | 82 mm | 82 mm |
| Stroke | 90,4 mm | 90,4 mm | 90,4 mm | 90,4 mm | 90,4 mm |
| Total displacement | 1910 cm ³ (116 cu.inch) | 1910 cm ³ (116 cu.inch) | 1910 cm ³ (116 cu.inch) | 2387 cm ³ (146 cu.inch) | 2387 cm ³ (146 cu.inch) |
| Compression ratio | 18 : 1 | 18 : 1 | 18 : 1 | 18 : 1 | 18 : 1 |
| Idling speed | 800 rpm | 800 rpm | 800 rpm | 750 rpm | 750 rpm |
| Max. no. of revolutions at no load | 4700 rpm | 4700 rpm | 4700 rpm | 4700 rpm | 4700 rpm |
| Direction of rotation | counter clockwise, viewed from the flywheel side | | | | |
| Number of valves | 16 | 16 | 16 | 20 | 20 |
| Valve Clearances | "mini-lash" hydraulic adjusters with roller fingers | | | | |
| Weight (with standard gearbox) | 320 kg (705 lbs) | 320 kg (705 lbs) | 320 kg (705 lbs) | 333 kg (734 lbs) | 333 kg (734 lbs) |
| Engine installation | | | | | |
| Max. installation angle | 10 degrees backwards | | | | |
| Max. athwart ships angle | 20 degrees continuously, 30 degrees intermittent | | | | |

8 Technical data

Engine specifications

| Model | VF4.140E | VF4.170E | VF4.190E | VF5.220E | VF5.250E |
|------------------------------------|---|---|---|--|---|
| Maximum Output | | | | | |
| at the flywheel (ISO 3046-1) | 103 kW (140 hp) | 125 kW (170 hp) | 140 kW (190 hp) | 162 kW (220 hp) | 184 kW (250 hp) |
| at the prop shaft (ISO 3046-1) | 99.9 kW (135.8 hp) | 121.2 kW (164.9 hp) | 135.8 kW (184.3 hp) | 157.1 kW (213.4 hp) | 178.5 kW 242.5hp) |
| at no. of revolutions of | 4000 rpm | 4000 rpm | 4000 rpm | 4000 rpm | 4200 rpm |
| Torque, | 310 Nm (31.6 kgm, 2441 ft.lb) | 345 Nm (35.1 kgm, 254 ft.lb) | 370 Nm (37.7 kgm, 273 ft.lb) | 416 Nm (42.4 kgm, 307 ft.lb) | 450 Nm (45.9 kgm, 332 ft.lb) |
| at no. of revolutions | 2400 rpm | 2200 rpm | 2400 rpm | 2500 rpm | 2600 rpm |
| Fuel consumption | 215 g/kW.h (158 g/hp.h) (5.6 oz/hp.h) | 237 g/kW.h (174 g/hp.h) (6.1 oz/hp.h) | 231 g/kW.h (170 g/hp.h) (6.0 oz/hp.h) | 236 g/kW.h (173 g/hp.h) (6.1 z/hp.h) | 260 g/kW.h (191 g/hp.h) (6.7 oz/hp.h) |
| at no. of revolutions | 4000 rpm | 4000 rpm | 4000 rpm | 4000 rpm | 4000 rpm |
| Fuel System (Self-bleeding) | | | | | |
| Injection pump | Electronic | | | | |
| Injectors | Bosch | | | | |
| Opening pressure | 200 bar (kgf/cm ²) (2900 psi) | | | | |
| Firing order | 1 - 3 - 4 - 2 | | | 1 - 2 - 4 - 5 - 3 | |
| Injection timing | Electronic | | | | |
| Fuel filter element | STM9451 | | | | |
| Fuel lift pump | Suction height max. 1,5 m (5 ft) | | | | |
| Fuel supply connection | 8 mm (5/16") I.D. | | | | |
| Fuel return connection | 8 mm (5/16") I.D. | | | | |

8 Technical data

Engine specifications

| Model | VF4.140E | VF4.170E | VF4.190E | VF5.220E | VF5.250E |
|-------------------------------|---|----------|----------|------------------------------|----------|
| Oil lubrication system | | | | | |
| Oil capacity, max. | | | | | |
| without oil filter | 4 l (7 UK pt, 8.5 US pt) | | | 4.5 l (7.9 UK pt, 9.5 US pt) | |
| with oil filter | 4.5 l (7.9 UK pt, 9.5 US pt) | | | 5 l (8.8 UK pt, 10.6 US pt) | |
| Oil Filter | STM9452 | | | | |
| Oil temperature in sump | max. 130°C (266°F) | | | | |
| Cooling system | | | | | |
| Capacity, | | | | | |
| Thermostat | opening at 65°C ± 1.5°C (149°F ± 3°F), fully opened at 76°C (169°F) | | | | |
| Coolant pump, | | | | | |
| Flow at max. engine rpm | 90 l/min (19.8 UK gal/min, 23.8 US gal/min) | | | | |
| Raw water pump, | | | | | |
| Flow at max. engine rpm | 100 l/min (22 UK gal/min, 26.4 US gal/min) | | | | |
| Total head at max. flow | 1.5 bar (21 psi) | | | | |
| Impeller | STM9453 | | | | |
| Inlet connection for hose | 32 mm (1 1/4") I.D. | | | | |
| Heater supply connection | 32 mm (1 1/4") I.D. | | | | |
| Heater return connection | 32 mm (1 1/4") I.D. | | | | |

8 Technical data

Engine specifications

| Model | VF4.140E | VF4.170E | VF4.190E | VF5.220E | VF5.250E |
|-----------------------------|--|----------------------------|----------------------------|----------------------------|----------------------------|
| Combustion air | | | | | |
| Air filter | STM9455 | | | STM9456 | |
| Turbo pressure at max. load | max. 2280 mbar (33 psi) | max. 2350 mbar (34 psi) | max. 2400 mbar (35 psi) | max. 2300 mbar (33 psi) | max. 2400 mbar (35 psi) |
| Exhaust system | | | | | |
| Exhaust diameter | for gear box 90 mm (3 9/16") for stern drive 76 mm (3") | | | | |
| Exhaust back pressure | at specified output max. 300 mbar (4.2 psi) | | | | |
| Electrical System | | | | | |
| Voltage | 12 Volt | | | | |
| Alternator | 14 Volt, 105 A | | | 14 Volt, 140 A | |
| Startmotor | 14 Volt, 2.3 kW | | | | |
| Capacity, starter battery | min. 70 Ah, max. 200 Ah | | | | |
| Protection | Fuse 'ATO' 10 Amp | | | | |
| Dive belt | STM9454 | | | | |

8 Technical data

Gearbox specifications

| Model | | VF4.140E | VF4.170E | VF4.190E | VF5.220E | VF5.250E |
|--------------|--------------|-------------------------------|----------|----------|-------------------------------|----------|
| Gearbox | | Gear ratio | | | | |
| Technodrive: | type TM345 | 1.54 : 1 | | | — | — |
| | type TM345A | 1.54 : 1 | | | — | — |
| | type TM485A | 2.09 / 2.40 / 2.51 : 1 | | | 2.09 / 2.40 / 2.51 : 1 | |
| ZF Hurth: | type ZF25 | 1.97 : 1 | — | — | — | — |
| | type ZF25A | 2.03 : 1 | — | — | — | — |
| | type ZF45 | 2.20 / 2.51 : 1 | | | 2.20 / 2.51 / 3.03 : 1 | |
| | type ZF45A | 1.26 / 1.51 / 2.03 / 2.43 : 1 | | | 1.26 / 1.51 / 2.03 / 2.43 : 1 | |
| | type ZF63 IV | 2.00 / 2.48 : 1 | | | 2.00 / 2.48 : 1 | |
| Stern drive | | Gear ratio | | | | |
| MerCruiser: | type Bravo 1 | 1.36 / 1.50 / 1.65 : 1 | | | 1.36 / 1.50 / 1.65 : 1 | |
| | type Bravo 2 | 2.00 / 2.20 : 1 | | | 2.00 / 2.20 : 1 | |
| | type Bravo 3 | 1.65 / 2.00 / 2.20 : 1 | | | 1.65 / 2.00 / 2.20 : 1 | |
| Volvo: | type 290 | A - B - C | | | A - B - C | |
| | type SX | A - M | | | A - M | |

9 Operating media

Fuel

Fuel Quality Grade

Use commercially available diesel fuel with less than 0.5% sulphur content. If the sulphur content is higher than 0.5%, the intervals between oil changes should be halved e.g. change oil every 250 hours. Don't use fuel with more than 1% sulphur!

The following fuel specifications / standards are approved:

- CEN EN 590 or DIN EN 590
- DIN 51 601 (Feb. 1986)
- BS 2869 (1988): A1 and A2
- ASTM D975-88: D1 and D2
- NATO Code F-54 and F75

The cetane number must be at least 49.

The exhaust emission levels determined during certification by the supervising authority are always based on the reference fuel described by law.

Biodiesel



CAUTION

Only use the prescribed diesel fuel.

Do not use biodiesel!

Winter-grade fuel

Waxing may occur at low temperatures, clogging the fuel system and reducing engine efficiency.

If the ambient temperature is less than 0°C (+32°F), winter-grade fuel -suitable down to -15°C (+5°F) - should be used. This fuel is usually available from filling stations well in advance of the cold months. Diesel fuel containing additives (Super Diesel) is often on sale as well, for use down to -20°C (-4°F).

9 Operating media

Lubricating oil

Engine oil

Lubricating oils are specified according to performance and quality class. It is usual for specifications to be given in accordance with the API (American Petroleum Institute) and the ACEA (European Automobile Manufacturers Association).

Permitted API oils: CF, CF-4, CI-4

Permitted ACEA oils: A3/B3, B3/B4

Only use oil of a recognised brand to lubricate the engine. The choice of a correct oil guarantees that the engine starts easily, because an oil film remains on the cylinder walls and bearing surfaces. The friction is low and so the starting rpm necessary for a dependable start can be achieved with a lower starting torque. An incorrect choice of oil can lead to a thickened oil layer on the cylinder walls and bearing surfaces. This can in turn lead to higher frictional resistance and more effort, which forms a hindrance to reaching the starting rpm required for a dependable start, and this results in a reduced life-span.

Recommended lubricating oil viscosity

There are two important considerations when it comes to ambient temperature in order to achieve satisfactory engine performance.

- the possibility to turn the engine over quickly enough to make an easy start possible and
- adequate lubrication of internal wear surfaces during starting and warming up.

By making the right choice of lubricating oil these requirements can be met.

Because the viscosity (runniness) of lubricating oil varies with temperature, the ambient temperature in which the engine is started determines the choice of viscosity class (SAE class).

To avoid having to change the oil for different seasons we recommend SAE 10W-40 all-season synthetic motor oil.

For example:

Vetus Marine Diesel Synthetic Engine Oil 10W-40

Shell Helix Plus 10W-40

For oil capacity see p. 112.

9 Operating media

Lubricating oil



CAUTION

Do not mix oil of different brands together. Oils of different brands are mostly not compatible with each other. If they are mixed, the mixtures can cause components such as piston rings, cylinders etc. to seize up and cause wear to moving parts. The best thing is to keep to one brand and one type of lubricating oil for each subsequent service.

Limits concerning motor oil

If an analysis of the used lubricating oil is conducted to determine its condition, consult the overview below. Change the oil if one or more of the conditions is not met.



NOTE

- How often the oil has to be changed depends on the characteristics of the fuel. Only use the recommended fuels.
- The limit for the total base number is half of that of new oil in the case of an analysis method based on perchloric acid.

Limits concerning motor oil

| Characteristic | Unit | Test method | Limit |
|-------------------------------|-------------|-------------|---------------------------------|
| Viscosity | cSt @ 100°C | JIS: K 2283 | +30% / -15% max. for new oil |
| Total base number (HCl) | mgKOH/g | JIS: K 2501 | 2.0 min. |
| Total acid number | mgKOH/g | | +3.0 max. for new oil |
| Water content | % volume | JIS: K 2275 | 0,2 max. |
| Flash point | °C | JIS: K 2265 | 180 min. |
| Pentane insolubles | % weight | ASTM: D 893 | 0,5 max. |
| Coagulated pentane insolubles | % weight | | 3,0 max. |

9 Operating media

Lubricating oil

Gearbox Lubricating Oil

Only use a recognised brand of oil for lubricating the gearbox.

Technodrive:

- type TM345 : 1.6 litres, Engine oil SAE 20W40-CD
(2.8 UK pt, 3.4 US pt)
- type TM345A : 1.6 litres, Engine oil SAE 20W40-CD
(2.8 UK pt, 3.4 US pt)
- type TM485A : 2.6 litres, Engine oil SAE 20W40-CD
(4.6 UK pt, 5.5 US pt)

ZF Hurth:

- type ZF25 : 2.5 litres, without oil cooler
(4.4 UK pt, 5.3 US pt)
- type ZF25A : 1.8 litres, without oil cooler
(3.2 UK pt, 3.8 US pt)
- type ZF45 : 3.0 litres, without oil cooler
(5.3 UK pt, 6.3 US pt)
- type ZF45A : 2.0 litres, without oil cooler
(3.5 UK pt, 4.2 US pt)
- type ZF63IV : 3.8 litres, without oil cooler
(6.7 UK pt, 8 US pt)

- *) ATF : Automatic Transmission Fluid;
Transmission oil type A, Suffix A.
- For example : Vetus Marine Gearbox Oil
Shell Donax T6
Gulf Dextron

Other brands of gearboxes:

See supplied owner's manual for oil type and quantities.

Stern drive

Power steering

- and trim : Hydraulic oil (ATF) 1.0 litres
(1.8 UK pt, 2.1 US pt)

Tail piece

- Bravo One : High Performance Gear Lube 2.7 litres
(4.8 UK pt, 5.7 US pt)
- Bravo Two : High Performance Gear Lube 3.2 litres
(5.6 UK pt, 6.7 US pt)
- Bravo Three : High Performance Gear Lube 3.0 litres
(5.3 UK pt, 6.3 US pt)

9 Operating media

Coolant

Coolant fluid

The preparation and monitoring of coolant in inter-cooled engines is especially important because corrosion, cavitation and freezing can lead to engine damage. Use as coolant a mixture of a cooling system protective liquid (anti-freeze, ethylene glycol based) and tap water.

In tropical climates, where anti-freeze availability may be limited, use a corrosion inhibitor to protect the engine cooling system.

The concentration of the cooling system protective liquid in the coolant should not fall below/exceed the following limits:

| Cooling system protective liquid (Anti-freeze) | Water | Protection against freezing to |
|--|-------|--------------------------------|
| max. 45 vol% | 55% | -35°C (-31°F) |
| 40 vol% | 60% | -28°C (-18°F) |
| min. 35 vol% | 65% | -22°C (-8°F) |

The protective liquid concentration must be maintained under all circumstances. Therefore if coolant must be added always use the same mixture of anti-freeze and tap water.

Water quality for coolant preparation

Use preferably tap water.

If available fresh water is used; the values given below must not be exceeded.

| Water quality | | min. | max. |
|-------------------------|-----------------------|------|------|
| pH-value at 20°C (68°F) | | 6.5 | 8.5 |
| Chloride ion content | [mg/dm ³] | – | 100 |
| Sulphate ion content | [mg/dm ³] | – | 100 |
| Total hardness | [degrees] | 3 | 12 |



CAUTION

Never use sea-water or brackish water.



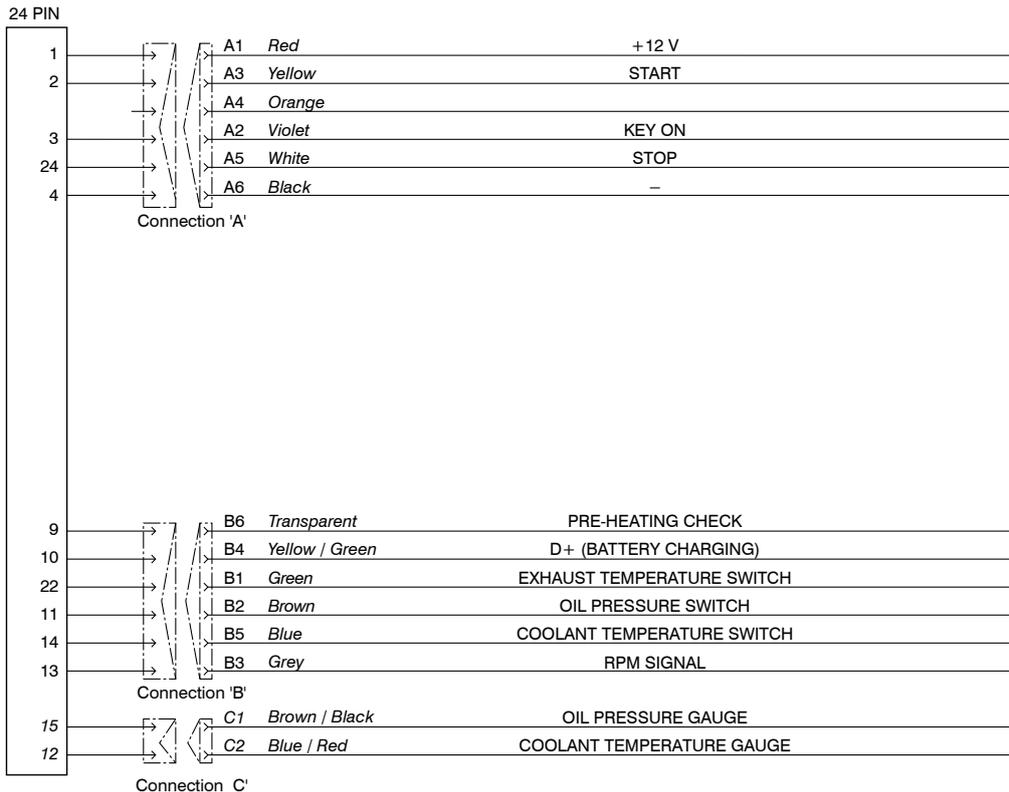
WARNING



Cooling system protective liquids must be disposed of in accordance with environmental regulations.

10 Wiring diagrams

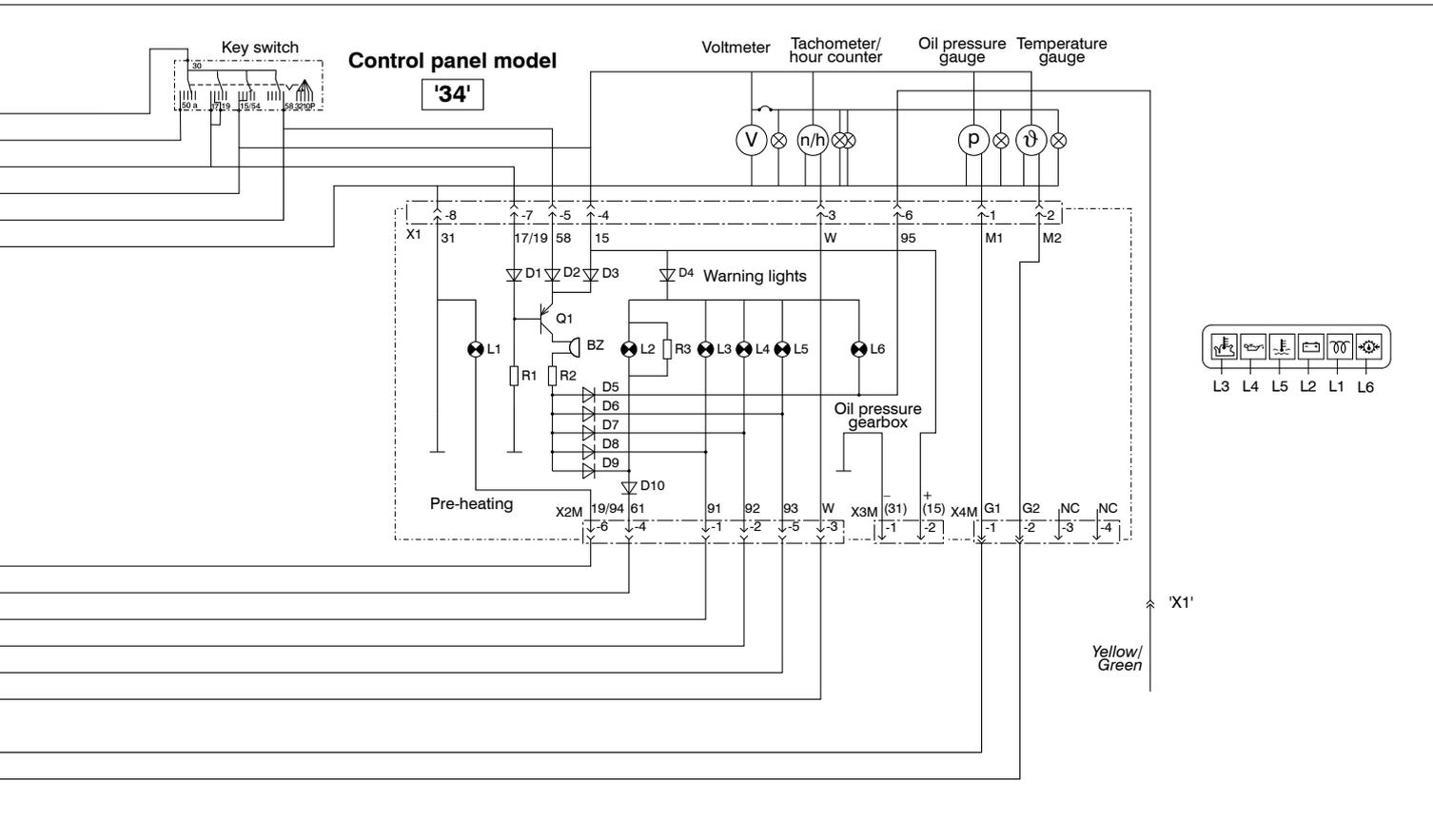
Control panel type '34'



VD00692

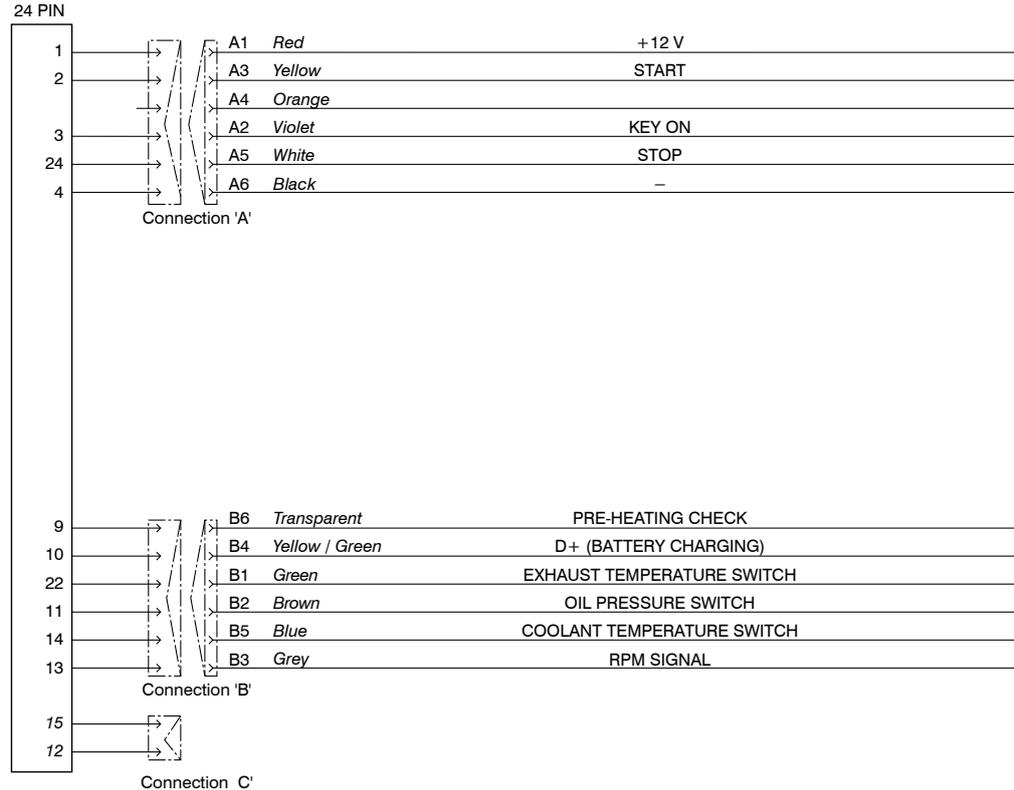
10 Wiring diagrams

Control panel type '34'



10 Wiring diagrams

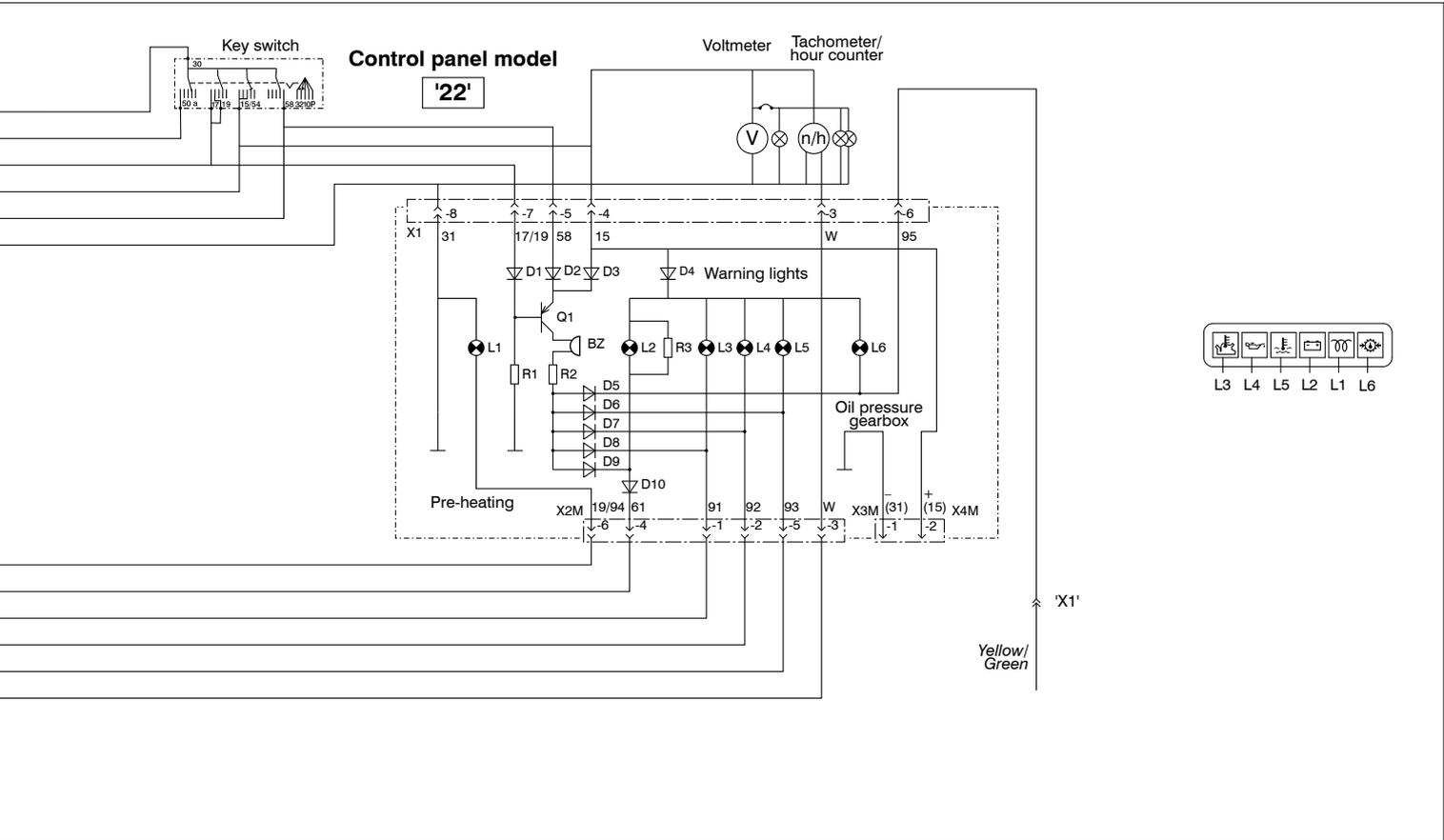
Control panel type '22'



VD00692

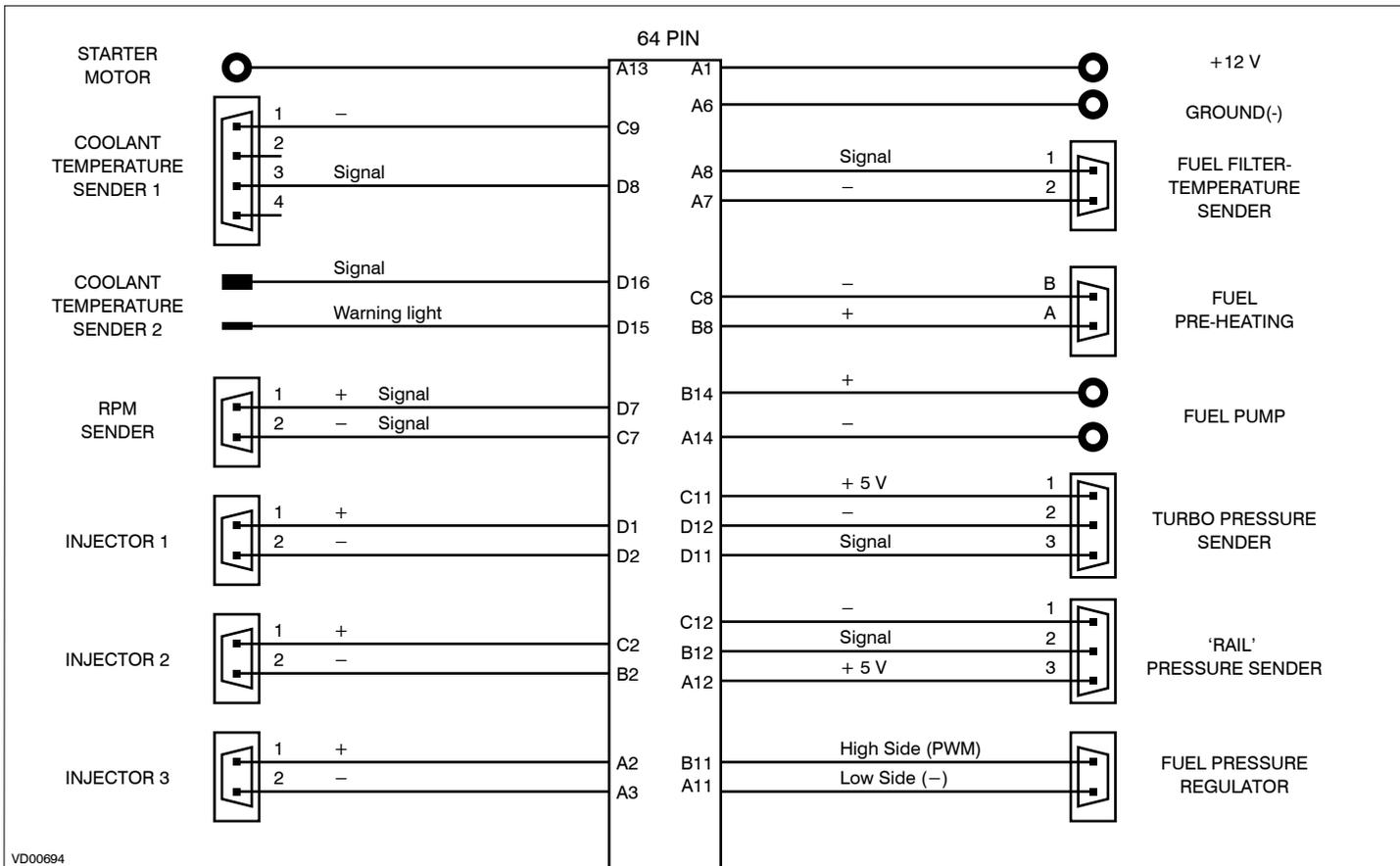
10 Wiring diagrams

Control panel type '22'



10 Wiring diagrams

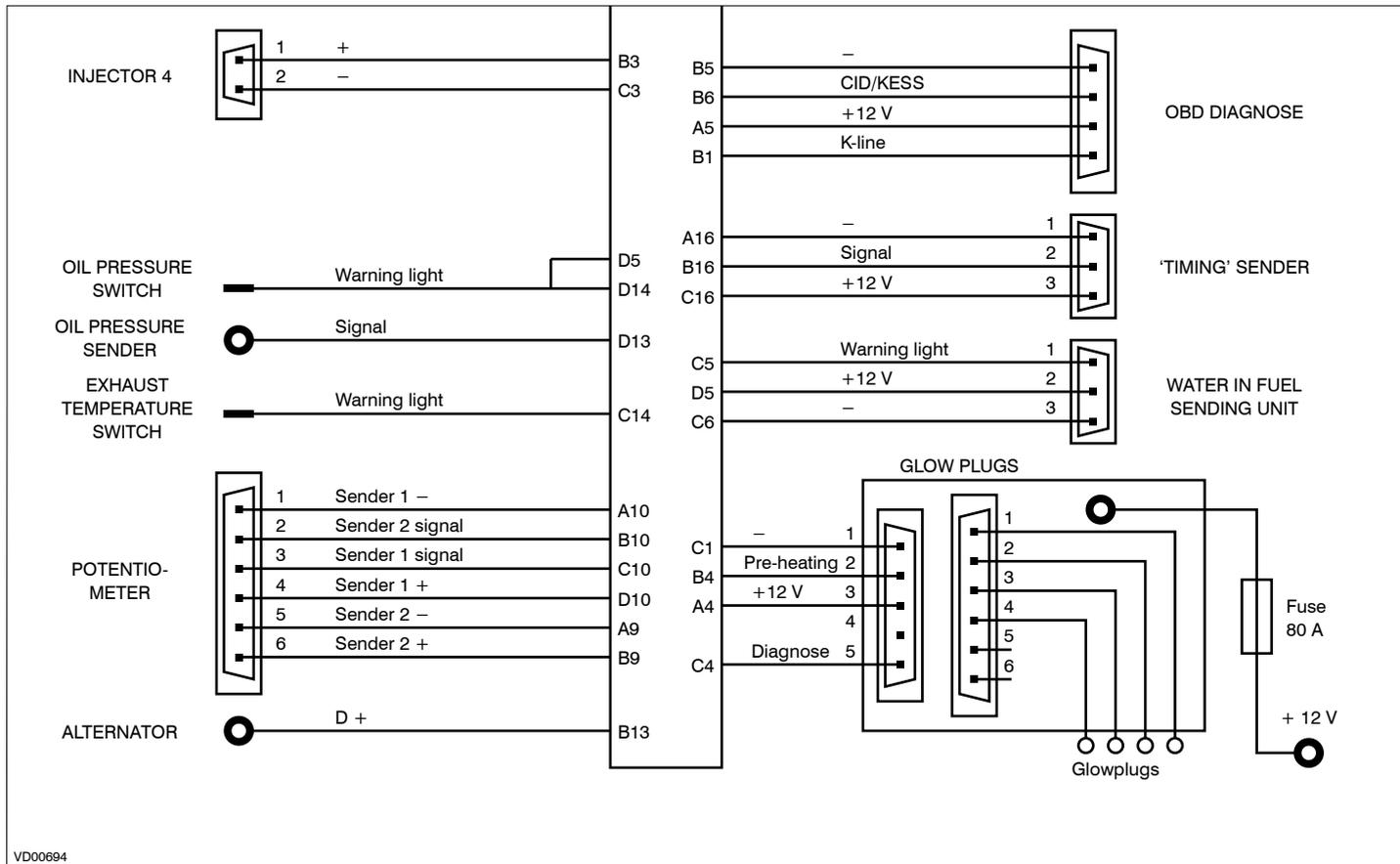
Engine
VF4.140E / VF4.170E



VD00694

10 Wiring diagrams

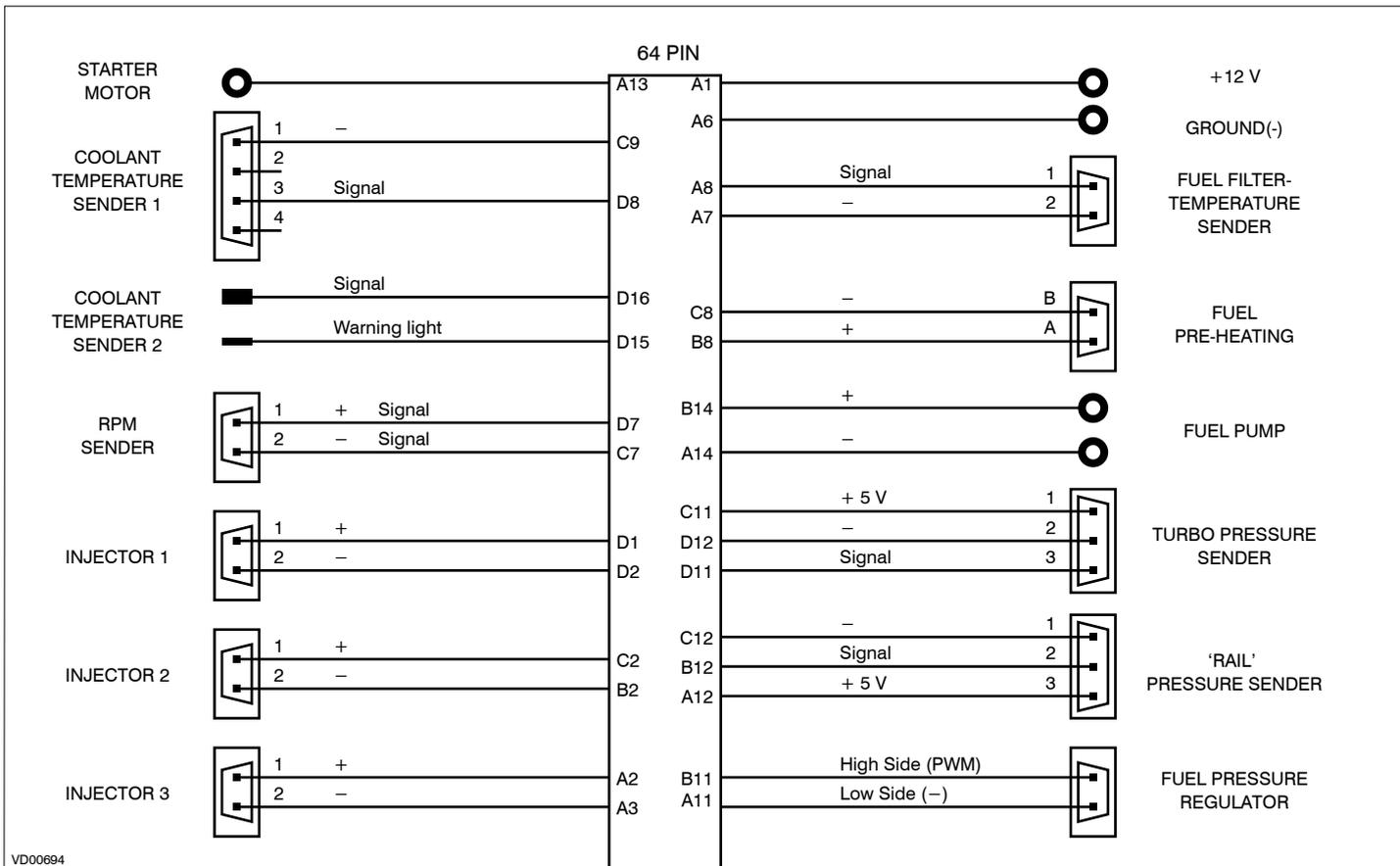
Engine
VF4.140E / VF4.170E



VD00694

10 Wiring diagrams

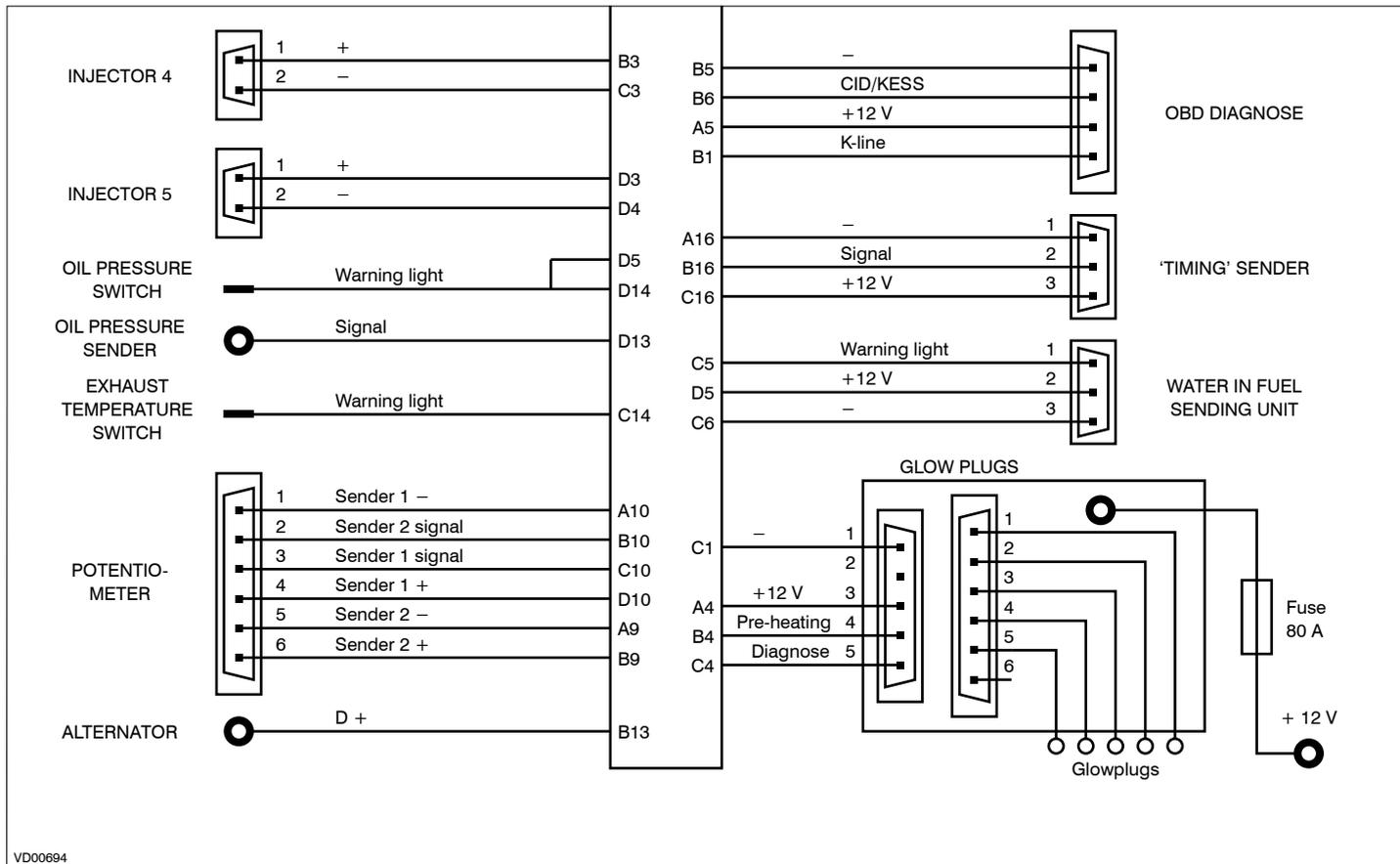
Engine
VF5.220E / VF5.250E



VD00694

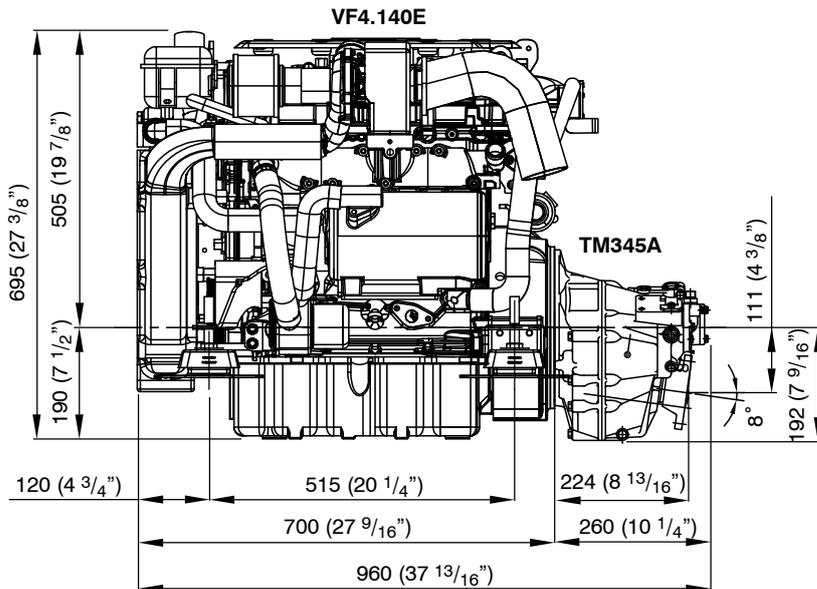
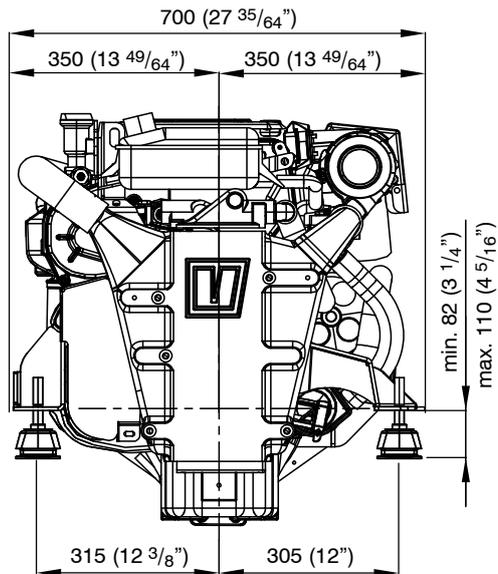
10 Wiring diagrams

Engine
VF5.220E / VF5.250E



VD00694

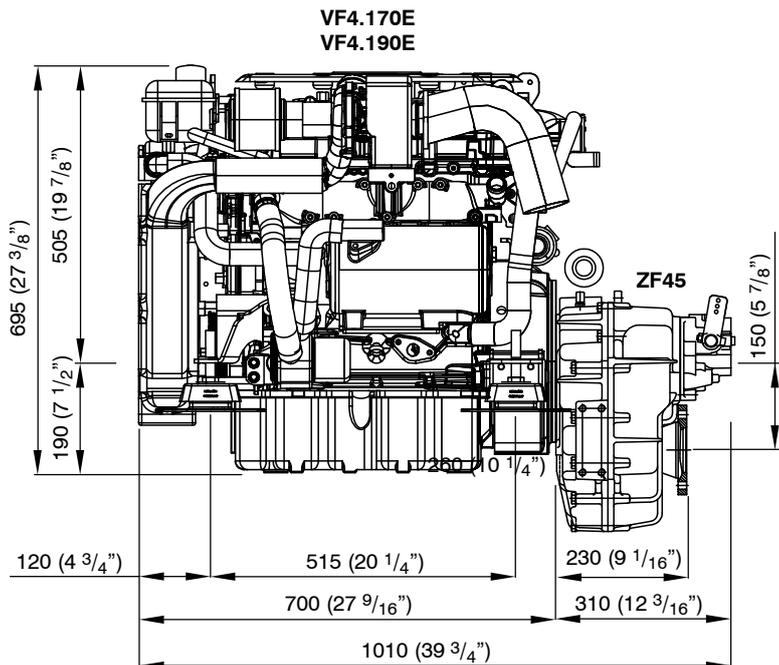
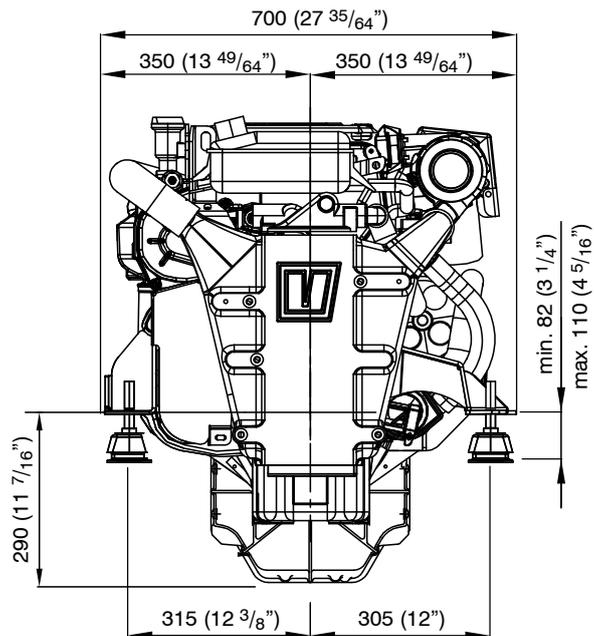
11 Overall dimensions



VF4.140E

VD00688

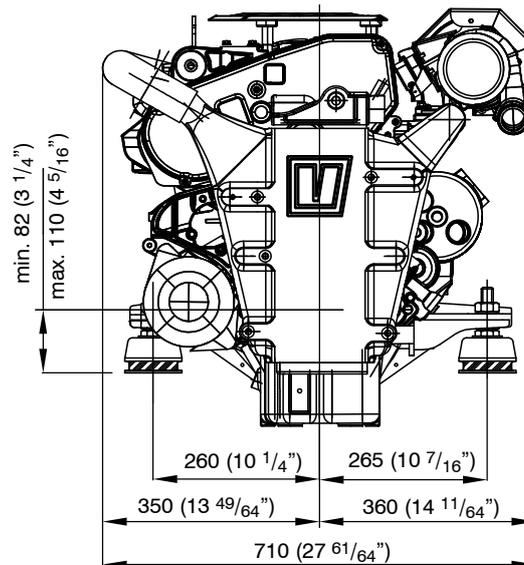
11 Overall dimensions



VF4.170E, VF4.190E

VD00689

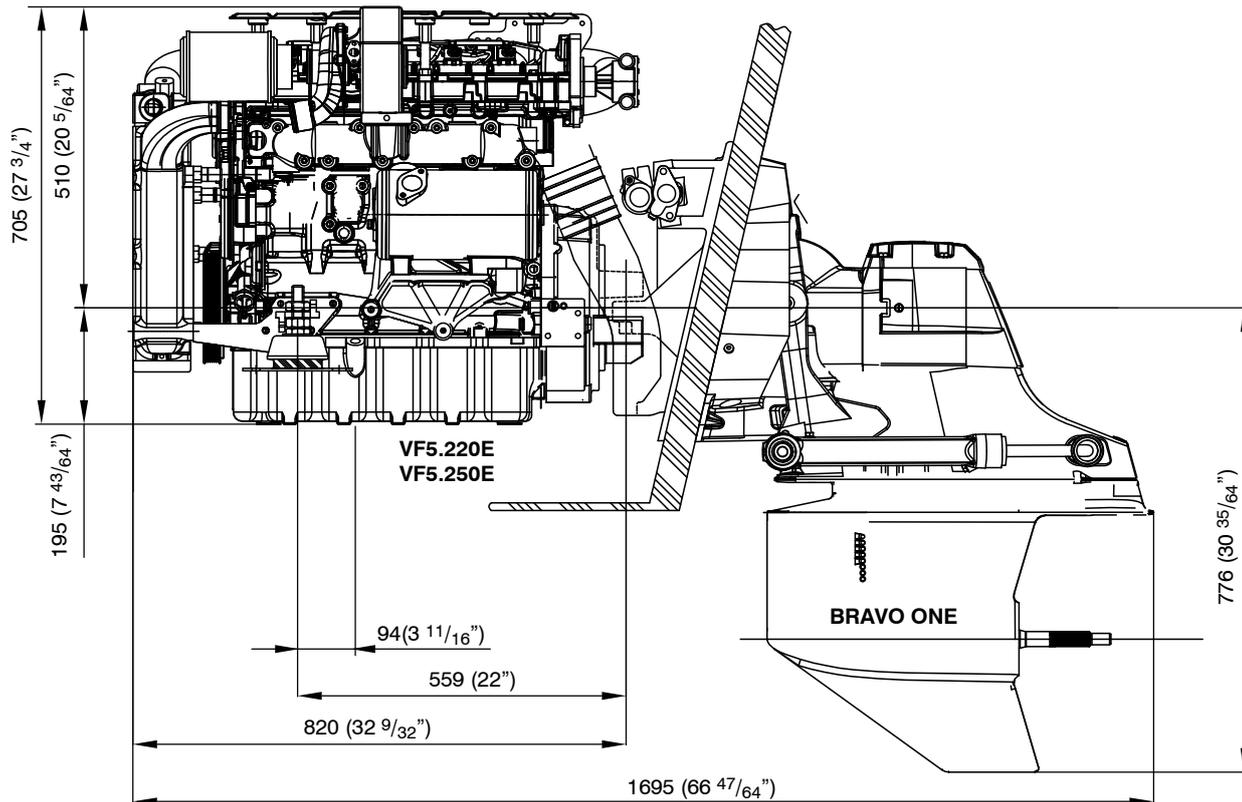
11 Overall dimensions



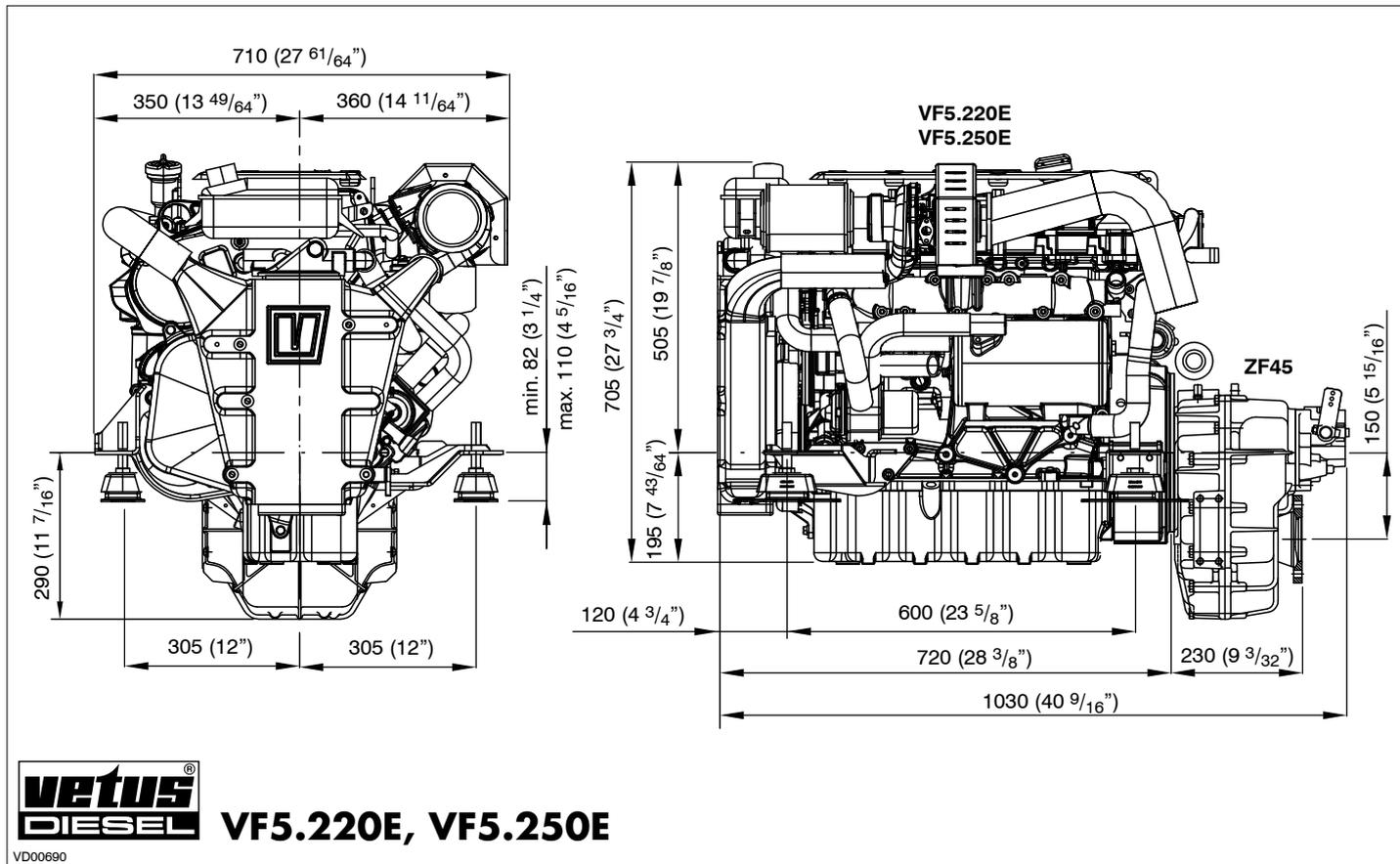
VF5.220EB1, VF5.250EB1

VD00691

11 Overall dimensions



11 Overall dimensions



12 Index

- A**
- Activating the operating lever 21
 - After cooler 13
 - After cooler, Cleaning the 78, 79
 - Air filter 13
 - Air filter, Cleaning the 56
 - Airvent, connection 13
 - Alarm buzzer 32
 - Alternator 12
 - Alternator, Checking the 73
- B**
- Battery 52–54
 - Battery charging, warning light 14, 15
 - Biodiesel 115
 - Bleeding 48
- C**
- Caution 4
 - Changing the gearbox oil 88
 - Changing the gearbox oil (Technodrive) 57
 - Changing the gearbox oil (ZF-Hurth) 58, 59
 - Checking and cleaning the raw water strainer 46
 - Checking coolant level 45
 - Checking engine oil level 44
 - Cleaning the after cooler 78, 79
 - Cleaning the heat exchanger 74–77
 - Control lever 20–25
 - Control lever keyboard 20
 - Control panels 14, 15
 - Coolant 119
 - Coolant level 45
 - Coolant replacement 66–69
 - Coolant temperature, warning light 14, 15
 - Cooling system
 - Filler cap 13
 - Corrosion protection 90
 - Cruising 30–32
 - Cylinder numbering 11
- D**
- Danger 4
 - Data tag 10
 - Dipstick 12
 - Draining of water from the water separator/fuel filter 47, 48
 - Drive belt 13
 - Drive belt, Replacement 70–72

- E**
- ECU box 17
 - Electrical system 91, 96
 - Emergency levers 25
 - Engine oil 116
 - Engine oil change 49–51
 - Engine oil cooler 13
 - Engine serial number 1
 - Engine specifications 110–113
 - Exhaust injection bend 13
 - Expansion tank 13
- F**
- Fasteners 63
 - Filler cap cooling system 13
 - Fire risk! 5
 - First commissioning 35–39
 - Flexible engine mounts 63
 - Fresh water cooling system 87, 95
 - Fuel 115
 - Fuel cooler 12
 - Fuel filter replacement 60–62
 - Fuel pump 12
 - Fuel Quality Grade 115
 - Fuel supply pipe connection 12
 - Fuel system 93

12 Index

G

- Gearbox 13
 - Changing oil (Technodrive) 57
 - Changing oil (ZF-Hurth) 58, 59
 - Connection of push-pull cable 13
 - Filter 12
 - Oil cooler 12
 - Oil dipstick/filler cap 13
- Gearbox low oil pressure, warning light 14, 15
- Gearbox Lubricating Oil 118
- Gearbox serial number 1
- Gearbox specifications 114
- Greasing moving parts 89

H

- Heat exchanger 13
- Heat exchanger, Cleaning the 74–77
- Hose connections 63

I

- Identification of engine parts 12, 13
- Impeller 64
- Indicator light pre-heating 14, 15
- Introduction 9–17

K

- Keyboard, control lever 20

L

- Low oil pressure, warning light 14, 15
- Lubricating oil 116–118
 - Gearbox 118
 - Stern drive 118
- Lubrication system 88, 95

M

- Maintenance 41–79
- Maintenance schedule 42, 43

N

- Note 4

O

- Oil cooler, engine 13
- Oil cooler, gearbox 12
- Oil dipstick 12
- Oil dipstick/filler cap gearbox 13
- Oil drainage connection 12
- Oil filler cap 12
- Oil filter 13, 50

- Oil level 44
- Oil level, Checking engine 44
- Oil level check (Technodrive) 55
- Oil level check (ZF-Hurth) 55
- Oil pressure gauge 14, 31
- Operating lever 16
- Operating lever, activating 21
- Operating media 115–119
- Overall dimensions 128–132

P

- Pre-heating 27
- Pre-heating, Indicator light 14, 15
- Protective fuel mixture 85
- Push-pull cable connection gearbox 13

R

- Raw water cooling system 86, 94
- Raw water intake 12
- Raw water pump 12
- Raw water pump inspection 64, 65
- Raw water strainer, Checking and cleaning the 46
- Raw water temperature, warning light 14, 15
- Recommissioning after winter storage 92–97

12 Index

Electrical system 96
Fresh water cooling system 95
Fuel system 93
Lubrication system 95
Raw water cooling system 94
Switching on 96
Return fuel pipe connection 12
Running-in 40
Running in sync 23

S

Safety measures 4–8
Serial number, 11
Serial numbers 1
Single lever control 16
Starter motor 12
Starter pre-heat switch/lock 14, 15
Starting 26–29
Stopping 33, 34
Symbols 4
Synchronized running 23

T

Tachometer 30
Tachometer/Operating hours counter 14,
15
Technical data 110–114

Temperature gauge 31
Temperature gauge, coolant 14
Topping up coolant 45
Topping up oil 44
Trim control 24
Troubleshooting 98–109
Turbocharger 13
Type plate 10

U

Use 18–40

V

Voltmeter 14, 15, 31

W

Warning 4
Warning light 14, 15
 Battery charging 14, 15
 Coolant temperature 14, 15
 Gearbox low oil pressure 14, 15
 Low oil pressure 14, 15
 Raw water temperature 14, 15
Warning lights 32
Water heater 69
Water separator/fuel filter 12

Drain plug 12
Water separator/fuel filter, Draining of
 water from the 47, 48
Winter-grade fuel 115
Winter storage procedure 80–91
 Changing the gearbox oil 88
 Corrosion protection 90
 Electrical system 91
 Fresh water cooling system 87
 Fuel system 84
 Greasing moving parts 89
 Lubrication system 88
 Protective fuel mixture 85
 Raw water cooling system 86
 Zinc anode 82
Wiring diagrams 120–127

Z

Zinc anode 82

Manuals

| Art. code | Description | |
|-----------|---|---|
| 400101.01 | Bedieningshandleiding VF4, VF5 | (Nederlands) |
| 400102.01 | Operation manual VF4, VF5 | (English) |
| 400103.01 | Bedienungsanleitung VF4, VF5 | (Deutsch) |
| 400104.01 | Manuel d'utilisation VF4, VF5 | (Français) |
| 400105.01 | Manual de operacion VF4, VF5 | (Español) |
| 400106.01 | Istruzioni per l'uso VF4, VF5 | (Italiano) |
| 400107.01 | Brugsanvisning VF4, VF5 | (Dansk) |
| 400108.01 | Användarmanual VF4, VF5 | (Svenska) |
| 400109.01 | Bruksanvisning VF4, VF5 | (Norsk) |
| 400110.01 | Käyttöopas VF4, VF5 | (Suomeksi) |
| 400202.01 | Installation manual VF4, VF5 | (English) |
| 320199.05 | (STM0016) Service- en Garantieboek / Service and Warranty Manual / Service- und Garantieheft / Livret Garantie et Service / Manual de servicio y garantía / Libretto di assistenza e garanzia Service- og garantibog / Service- och garantihäfte Service- og garantibok / Huolto- ja takuukirja | (Nederlands / English / Deutsch / Français / Español / Italiano / Dansk / Svenska / Norsk / Suomeksi) |
| 401131.01 | Onderdelenboek / Parts manual VF4, VF5 | (Nederlands / English) |
| 402102.01 | Service manual VF4, VF5 | (English) |



FOKKERSTRAAT 571 - 3125 BD SCHIEDAM - HOLLAND - TEL.: +31 (10) 4377700
FAX: +31 (10) 4372673 - 4621286 - E-MAIL: sales@vetus.nl - INTERNET: <http://www.vetus.com>