

M3.28

Operation manual

Operation manual



Serial numbers

Engine serial number Vetus:

Mitsubishi:

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.

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.

For the Guarantee Conditions, see the Vetus Diesel 'Service and Warranty Manual' (320199.04 / STM0016).

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 therefrom. 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 which are familiar with the former and the hazards involved.

The relevant accident prevention guide-

lines 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 the oil level	23	5 Winter storage procedure	49
		Checking the coolant level	24		
2 Introduction	5	Checking and cleaning the		6 Recommissioning after winter	
Data tag	6	raw water strainer	25	storage	51
Serial number	6	Draining water from the water			
Cylinder numbering	7	separator/fuel filter	26	7 Troubleshooting	56
Fuel pump seal	7	(Bleeding)	26		
Identification of engine parts	8	Changing the oil	28	8 Technical Data	62
Control panels	10	Battery, cables and cable			
		connections	30	9 Operating media	
3 Use		Checking the gearbox oil level	32	Lubrication Oil	65
General guidelines	11	Changing the gearbox oil	33	Fuel	66
First commissioning	12	Checking valve clearance	34	Coolant	67
Running-in	15	Replacing the fuel filter	36		
Starting	16	Checking the V-belt	38	10 Wiring Diagrams	68
Pre-heating	17	Checking flexible engine mounts	39		
Cruising	19	Checking hose connections	39	11 Overall Dimensions	70
Stopping	20	Checking fastenings	39		
		Checking the raw water pump	40	12 Index	71
4 Maintenance		Coolant replacement	42		
Introduction	21	Cleaning the heat exchanger	44		
Maintenance schedule	22	Checking engine rpm	47		

1 Safety measures



All safety instructions in this manual are designated by the accompanying symbol. Please follow them carefully.

Pass the safety instructions to other persons operating the engine as well.

General regulations and laws for safety and accident prevention must also be observed.

- Never attempt to touch moving parts when the engine is running.
- Never touch hot parts of the engine, and keep flammable materials well away from the engine.
- Always stop the engine before checking or adjusting components.
- Always stop the engine before checking or topping up the coolant or oil.
- **NEVER** open cap on top of header tank when the engine is at operating temperature.
- Always carry out maintenance safely by only using tools well matched in size.

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.

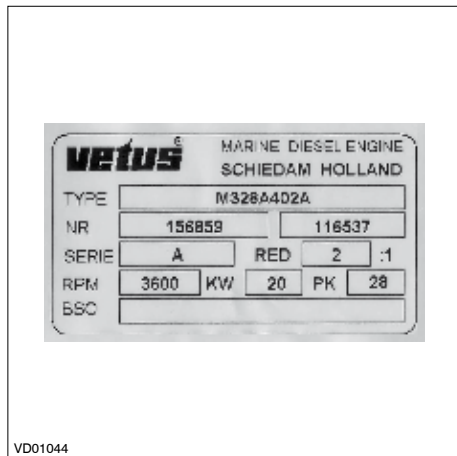
We have endeavoured to highlight any differences so that you will be able to locate the operating and maintenance instructions relevant to your engine quickly and easily.

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 den Ouden n.v.

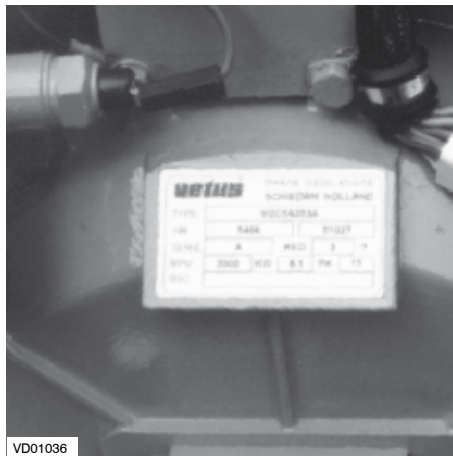
2 Introduction



1 Engine data tag

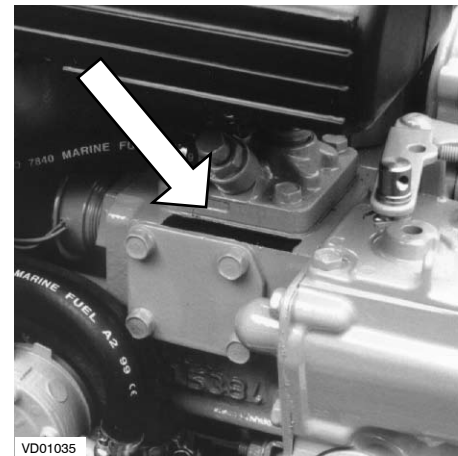
The **VETUS** engine serial number and performance data are printed on the engine data tag.

Model and engine serial number must be given when ordering spare parts.



2 Engine data tag location

The **VETUS** engine data tag is attached to the flywheel housing.

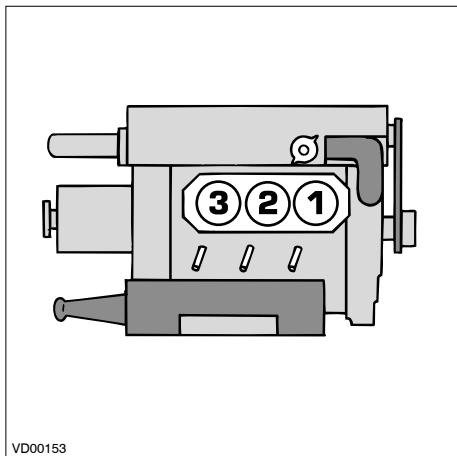


3 Engine serial number

The **MITSUBISHI** engine serial number is stamped on the fuel injection pump. (arrow)

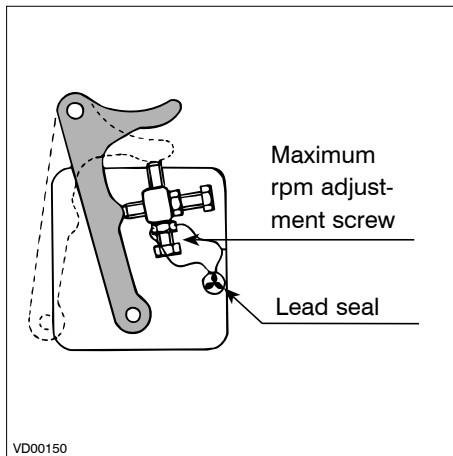
2 Introduction

Cylinder numbering, Fuel pump seal



4 Cylinder numbering

Cylinders are numbered consecutively, beginning at the front end.



5 Fuel pump seal

The manufacturer shall not be held liable for damages resulting from adjustments made to the fuel injection pump. The maximum engine speed adjustment screw has been sealed to prevent this.

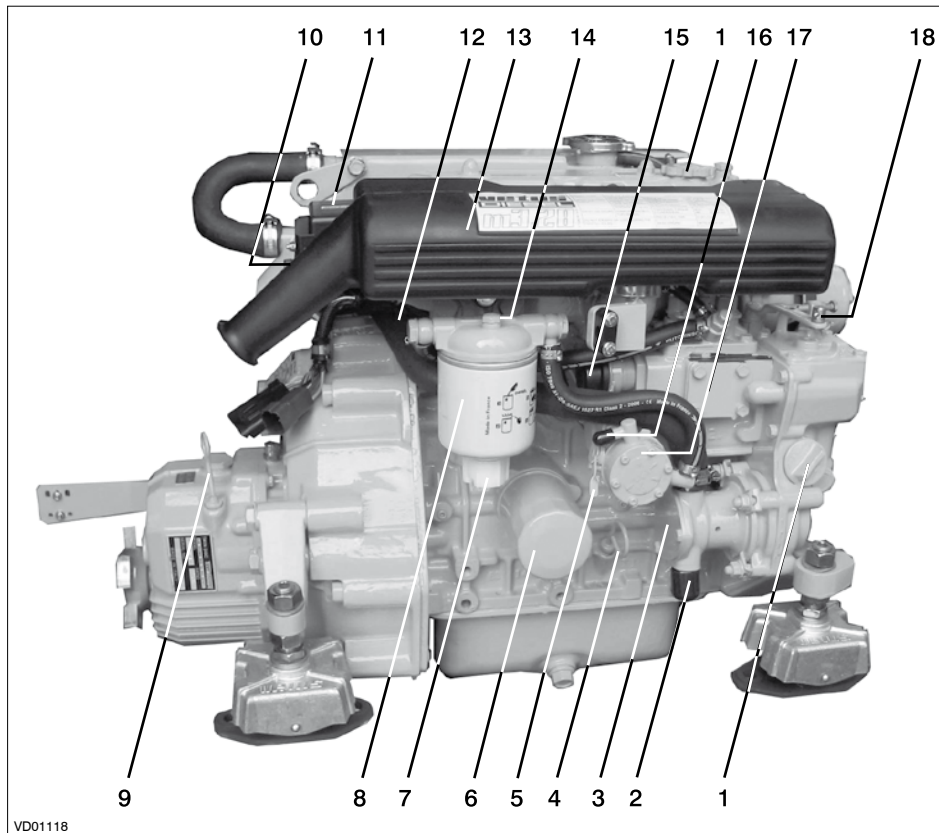


Adjustments to the fuel pump are to be carried out by authorized Vetus-Mitsubishi Service specialists only.

2 Introduction

Identification of engine parts Service side

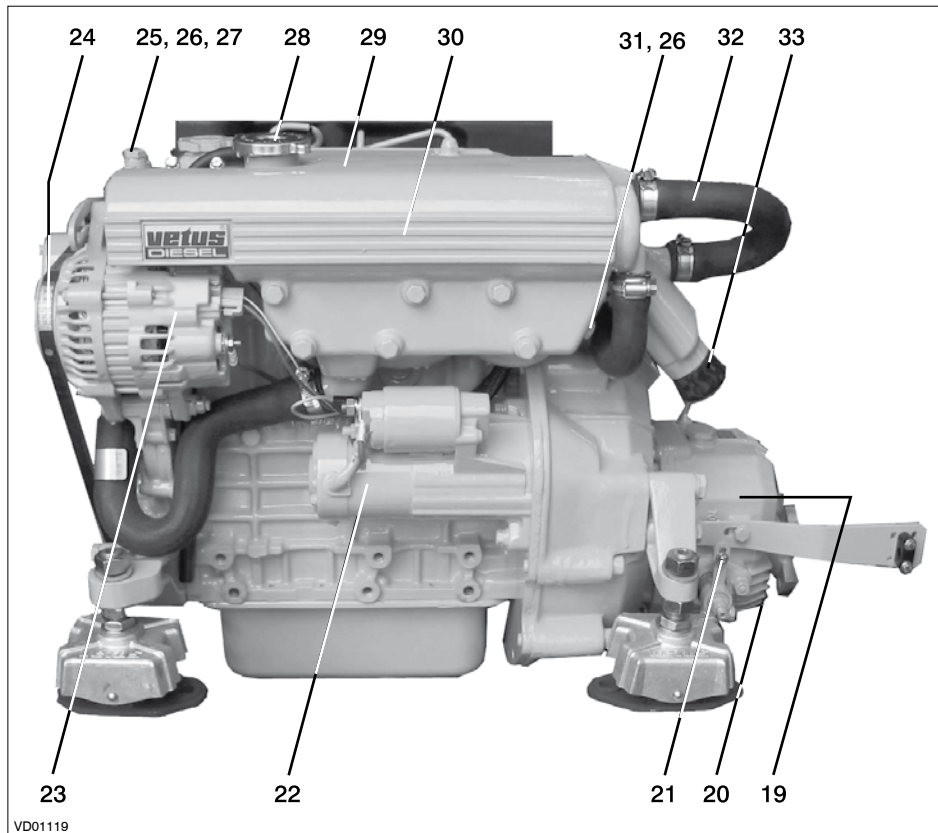
- 1 Oil filler cap
- 2 Raw water inlet \varnothing 20 mm
- 3 Raw water pump
- 4 Oil dipstick
- 5 Manual operation of fuel supply pump
- 6 Oil filter
- 7 Water separator/fuel filter drain plug
- 8 Water separator/Fuel filter
- 9 Gearbox oil dipstick/filler cap
- 10 Fuse
- 11 Electrical system connector box
- 12 Fuel return pipe connection \varnothing 8 mm
- 13 Air inlet silencer
- 14 Water separator/fuel filter air bleed nipple
- 15 Manual operation of electric stop
- 16 Fuel supply pipe connection \varnothing 8 mm
- 17 Fuel lift pump
- 18 Connection for throttle push-pull cable
- 19 Gearbox



VD01118

2 Introduction

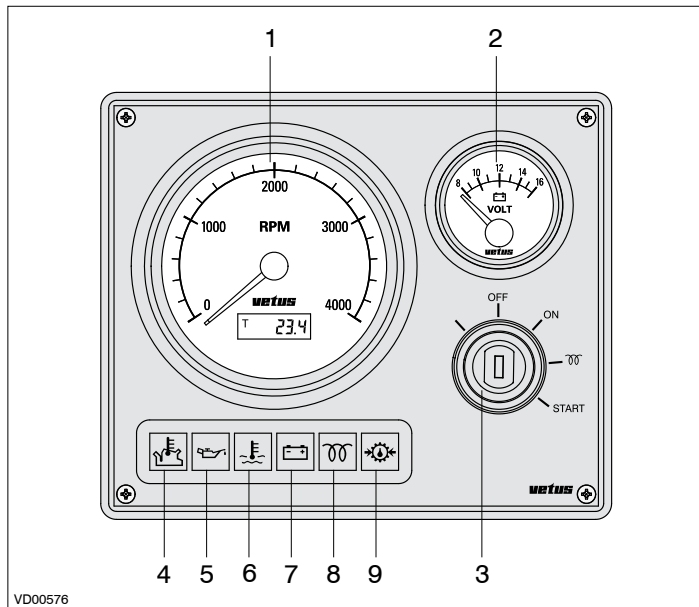
Identification of engine parts Starter side



- 20 Gearbox drain plug
- 21 Connection for gearbox push-pull cable
- 22 Starter motor
- 23 Alternator
- 24 V-belt
- 25 Connection for extra expansion tank (Keel cooling model only)
- 26 Calorifier connection
- 27 Cooling system air bleed nipple
- 28 Filler cap for cooling system
- 29 Expansion tank
- 30 Heat exchanger
- 31 Cooling system drain plug
- 32 Airvent connection
- 33 Exhaust injection bend \varnothing 40 mm

2 Introduction

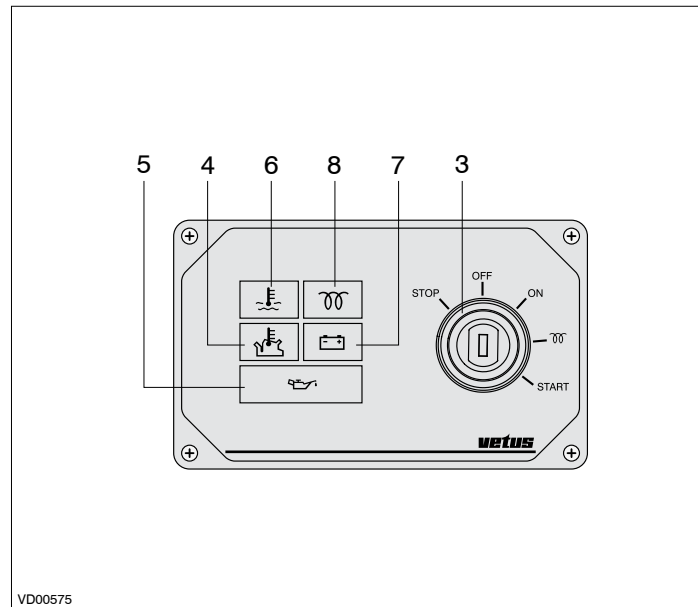
Control panels



Basic panel (model 22)

Fly-bridge panel (excl. voltmeter, model 21)

- 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



Sailingboat panel (model 10)

- 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.

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 67.
- Never run the engine without a thermostat.
- Use a good quality lubricating oil. For specifications see page 65.
- 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.

3 Use

Engine Oil

3.6 litres (6 UK pt, 7.6 US pt) 15W-40

API: CF, CF-4 or CI-4

ACEA: A3/B3, A3/B4

For example:

- Vetus Marine Diesel Engine Oil 15W-40
- Shell Nautilus Premium Inboard Oil 15W-40

1 Commissioning the engine

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



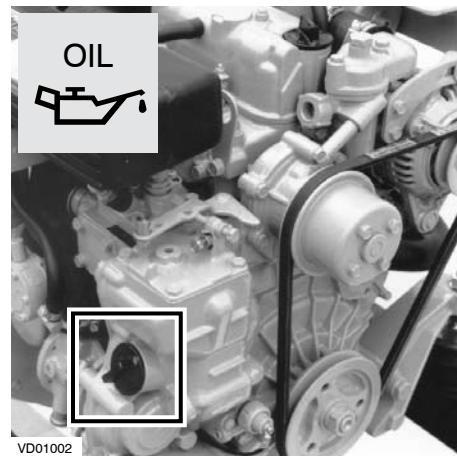
2 Filling with engine oil

As a rule engines are delivered empty of oil.

Fill the engine with oil through the filler neck on top of the valve cover, for quantity and specification see page 65.

Check the oil level with the dipstick, see page 23.

First commissioning



A second oil filling cap is located at the distribution cover.

3 Use

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

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

3 Filling gearbox with oil

Fill the gearbox with oil.

Check the oil level with the dipstick, see page 32.



ZF Hurth:

type ZF10M	: 0.35 litres ATF*) (0.6 UK pt, 0.74 US pt)
type ZF12	: 1.1 litres ATF*) (1.9 UK pt, 2.3 US pt)
type ZF15MA	: 0.56 litres ATF*) (1 UK pt, 1.2 US pt)
type ZF15V	: 1.0 litres ATF*) (1.8 UK pt, 2.1 US pt)

*) ATF: Automatic Transmission Fluid type A, Suffix A.

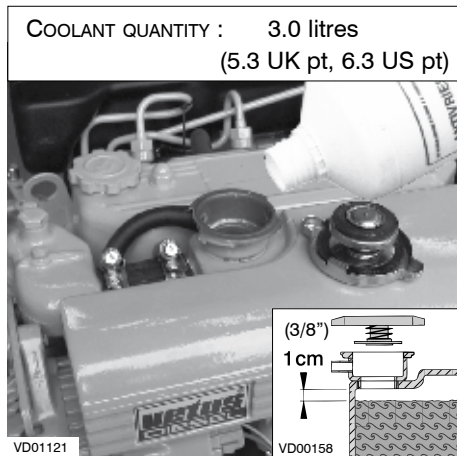


Technodrive:

type TMC40	: 0.20 litres Engine oil SAE 20/30
type TMC40M	: 0.20 litres, ATF*)
type TMC40P	: 0.20 litres, ATF*) (0.35 UK pt, 0.4 US pt)
type TM345 A / H:	1.6 litres, Engine oil SAE 20W40-CD (2.8 UK pt, 3.4 US pt)

*) ATF: Automatic Transmission Fluid type A, Suffix A.

3 Use



4 Filling the cooling system

Remove the cap of the filler neck on the top of the heat exchanger housing.
Remove the bolt from the upper side of the thermostat cover, so that air can escape from the cooling system.

Fill the cooling system.

Use a mixture of 40% antifreeze (ethylene-glycol based) and 60% tap water or use a special coolant.

For specifications see page 67.



The level of the coolant must be approx. 1 cm (3/8") below the lower edge of the filler neck.

Bleeding will take place automatically during filling!

Replace the filler cap.

After the engine has run for the first time and has reached operating temperature and has cooled down again to ambient temperature, check the coolant level in the heat exchanger housing.

First commissioning

WATER HEATER

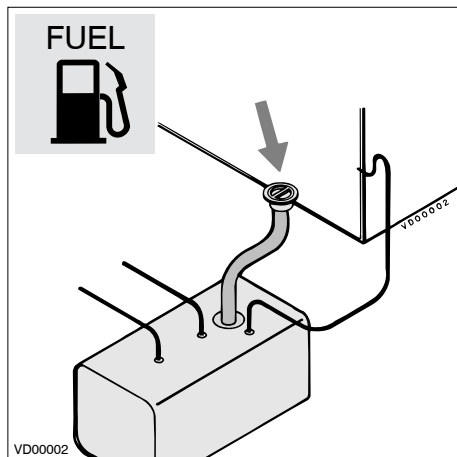
If a water heater is connected to the engine and this heater is positioned above the upper side of the engine then bleeding of the heater will not take place automatically! Fill the heater separately to bleed the cooling system completely.

If necessary, add coolant.



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

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 66.

Bleed the fuel system, see page 26.



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

6 Other preparations

- Check battery and cable connections.
- Start the engine, see page 16, and let it run for about 10 minutes without load. Check the engine and all connections (fuel, cooling water and exhaust) for leaks.

First commissioning Running-in

7 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.

3 Use

Before starting, **ALWAYS** check the following points:

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

After repair work:

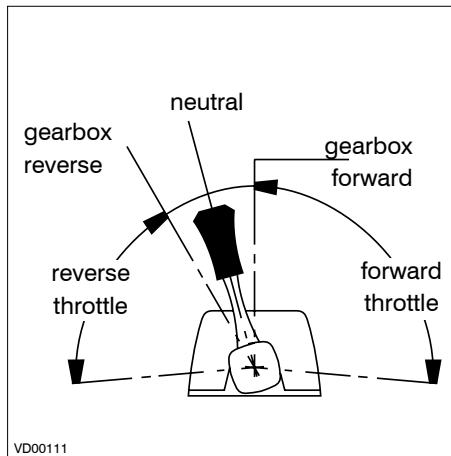
Check that all guards have been replaced and that all tools have been removed from the engine.

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



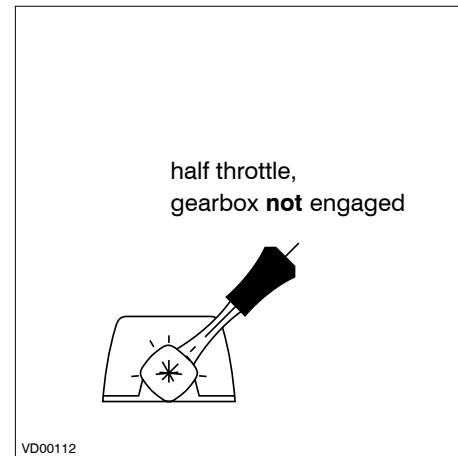
**Never start the engine with the fuel injection pump removed.
Disconnect battery.**

Starting



8 Preparation starting

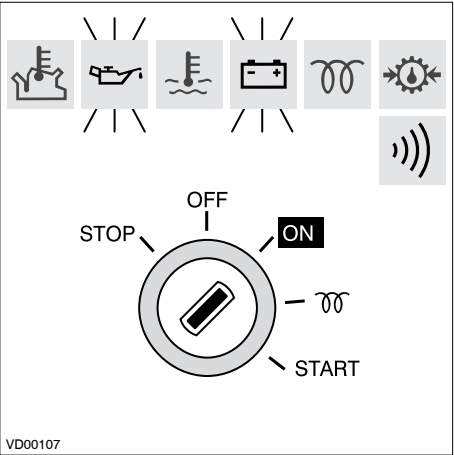
Before starting the engine, always check that the control lever(s) is (are) in the neutral position.



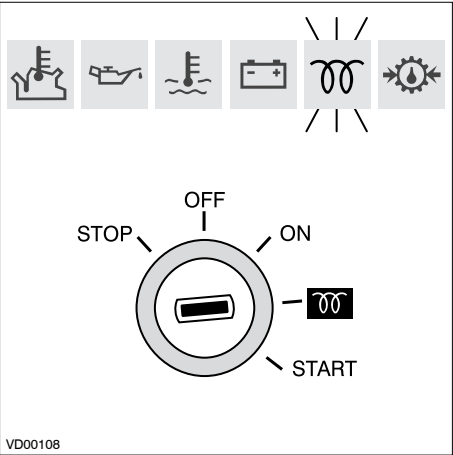
9 Control lever

Set the control lever to 'half throttle' **without** engaging the gearbox.

3 Use



Turn the start key on the instrument panel clock-wise; the warning lights for oil pressure and alternator will now light up and the alarm buzzer will sound.



10 Pre-heating

Turn the key further clockwise to the 'OFF' position; only the pre-heating indicator light will be lit now.

Hold the key in this position for about 6 seconds.

Starting

Ambient Temperature	Pre-heating time
Above + 5°C (41°F)	about 6 seconds
+5°C to -5°C (+41°F to +23°F)	about 12 seconds
Below -5°C (23°F)	about 18 seconds
Maximum pre-heating time	1 minute

11 Pre-heating time

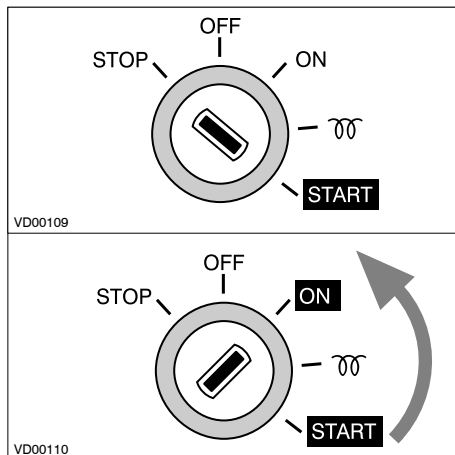
The ideal pre-heating time depends on ambient temperature; the lower the ambient temperature, the longer the pre-heating time required. See table.



WARNING

To prevent the glow plugs from burning out, **never** exceed the stated maximum pre-heating time.

3 Use



12 Starting

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

Release the key as soon as the engine fires (the key will return to the 'ON' position) and throttle back.

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



WARNING

Release the key if the engine does not fire within 10 seconds. Wait until the starter motor has stopped running completely before turning the key to the 'START' position again. Never allow the starter motor to run for more than 30 seconds consecutively.

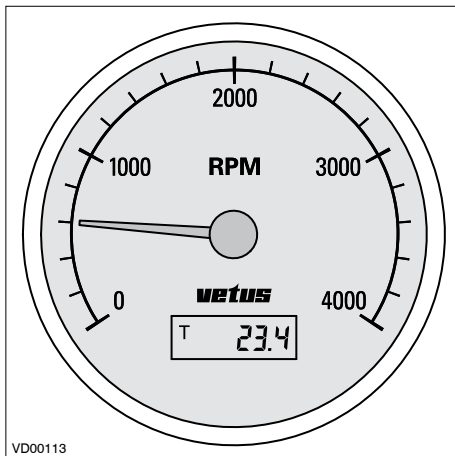


WARNING

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

3 Use

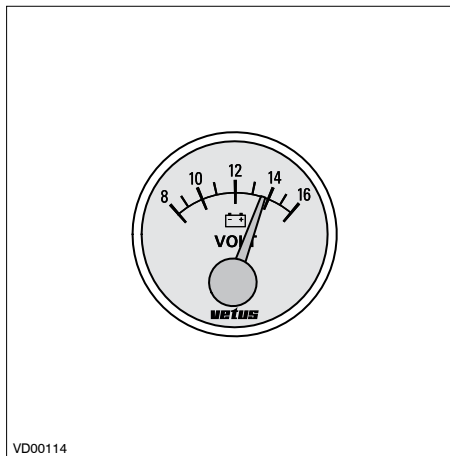
Cruising



13 Tachometer

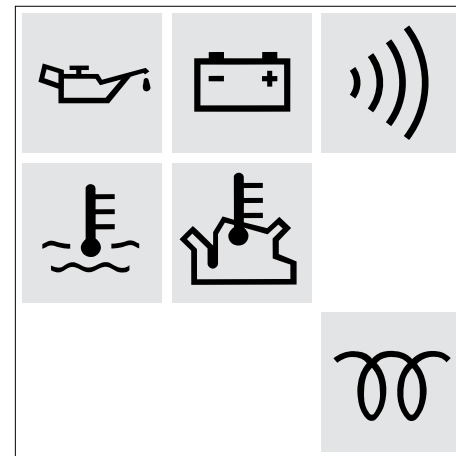
Indicating the number of revolutions per minute of the engine.
Avoid idling for more than 10 minutes.
Also the number of running hours is indicated.

Idling speed : 900 rpm



14 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.

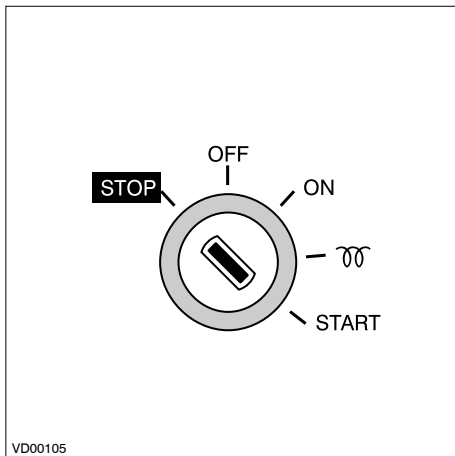


15 Warning lights

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

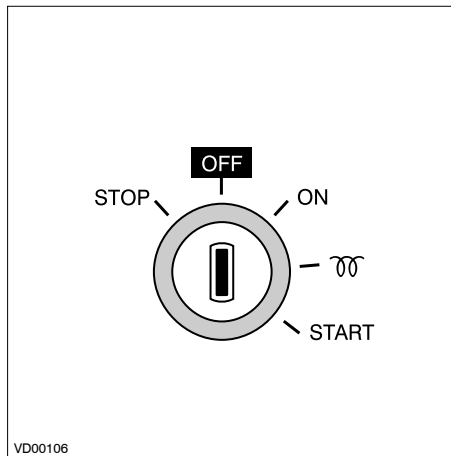
Stopping



16 Electrical shutdown

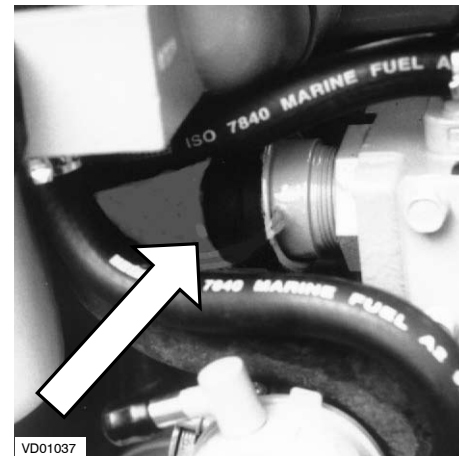
Reduce engine speed to idle and shift the gearbox to '**NEUTRAL**'. Turn the key entirely to the left, **through** the '**OFF**' position.

Never stop the engine immediately after it has been in operation for a long time. Allow the engine to idle for a few minutes before stopping.



When the engine has stopped, turn the key to the '**OFF**' position.

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.



17 Mechanical shutdown

On the engine itself stopping is possible by pressing the black button on the fuel injection pump.

If the fuel supply is not shut off by the electrically operated fuel solenoid stopping of the engine can be done this way.

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.

4 Maintenance

Maintenance schedule

Every 10 hours or daily, before starting	
Check engine oil level	23
Check coolant level	24
Check water strainer	25

After the first 50 hours	
Drain water from fuel filter	26
Engine oil change	28
Replace oil filter	28
Gearbox oil change	33
Replace fuel filter	36
Check idle rpm	47

Every 100 hours, at least once every year	
Drain water from fuel filter	26
Engine oil change	28
Replace oil filter	28
Battery, cables and cable connections	30
Check gearbox oil level	32

Every 500 hours, at least once every year	
Gearbox oil change	33
Check valve clearance	34
Replace fuel filter	36
Check V-belt	38
Check flexible engine mounts	39
Check engine for leaks	39
Check tightness of all fasteners, bolts and nuts	39

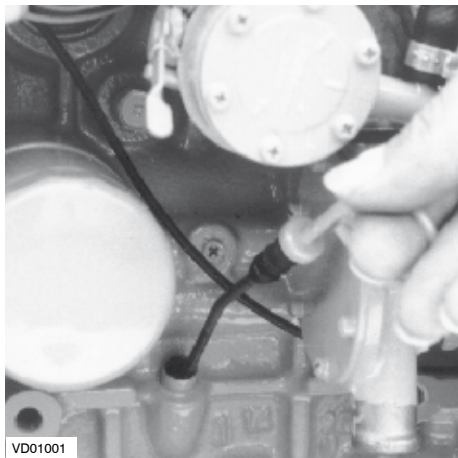
Every 1000 hours, at least once every 2 years	
Raw water pump inspection	40
Replace coolant	42

When required	
Bleeding fuel system	26
Cleaning heat exchanger	44
Check idle rpm	47



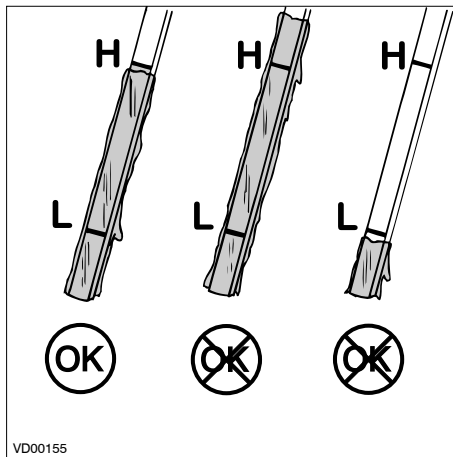
Stop the engine before carrying out any maintenance work.

4 Maintenance



1 Check oil level

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



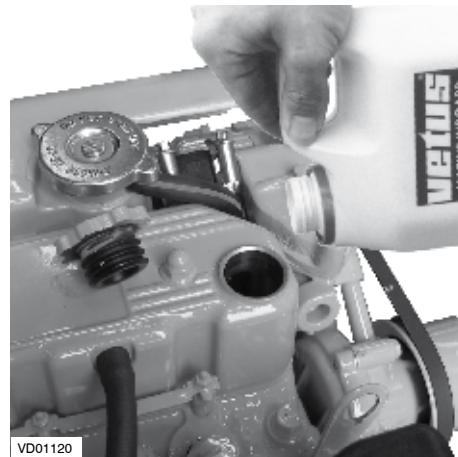
2 Oil level

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:
1.8 litres (3.2 UK pt, 3.8 US pt)

Checking engine oil level

Daily, before starting.

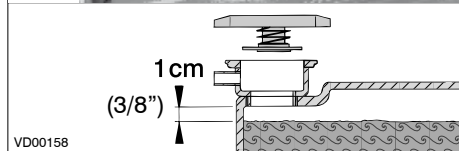
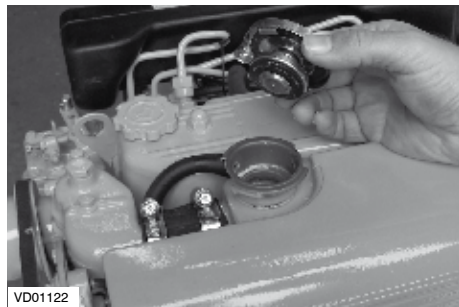


3 Topping up oil

The oil filling cap is on top of the the valve cover,.

A second oil filling cap is located at the distrubution cover, see page 12.

4 Maintenance

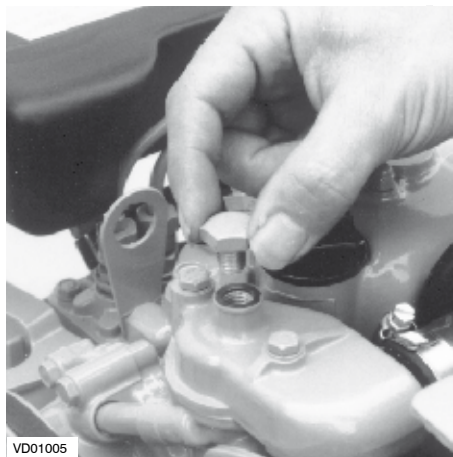


4 Checking coolant level

Check the coolant level in the header tank. This has to be checked when the engine is **cold**.

Remove the cap of the filler neck on the heat exchanger.

The level of the coolant must be approx. 1 cm (3/8") below the lower edge of the filler neck.



If necessary, top up.

When topping up coolant, remove the bolt from the upper side of the thermostat cover, so that air can escape from the cooling system.

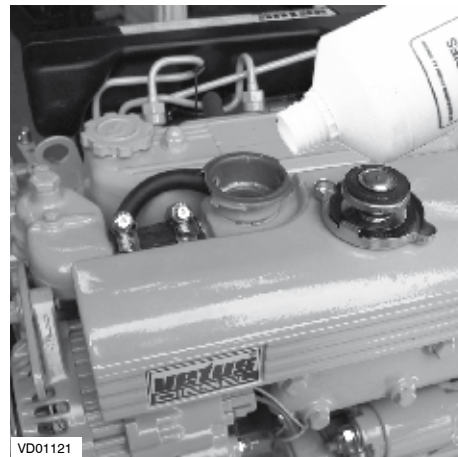


WARNING

Never open the cap on the header 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 67

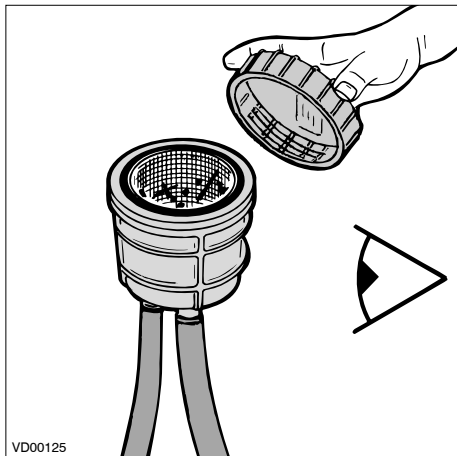


Never fill the cooling system with sea water or brackish water.

4 Maintenance

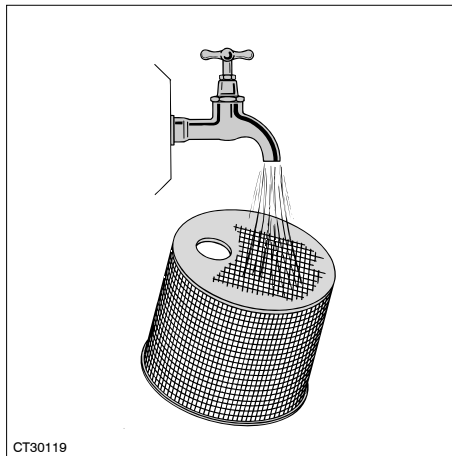
Checking and cleaning the raw water strainer

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 seacock 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

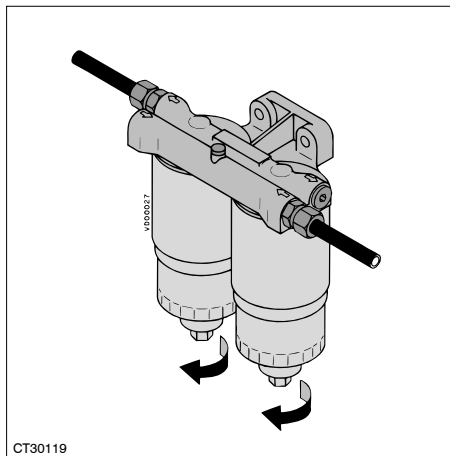
Draining of water from the water separator/fuel filter

Every 100 operating hours.



8 Empty fuel filter

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



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

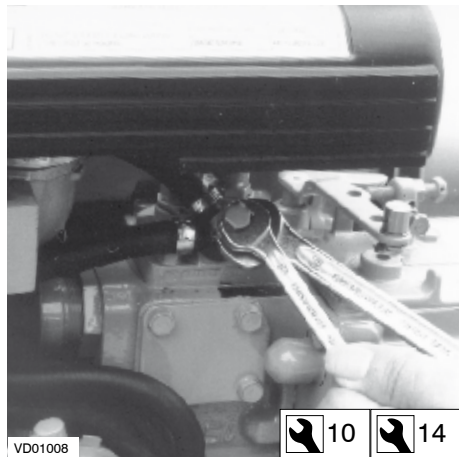
The fuel system is self-bleeding; but manual bleeding the system is recommended. Open the two bleeding nipples.

One (1) bleeding nipple is located at the filter.

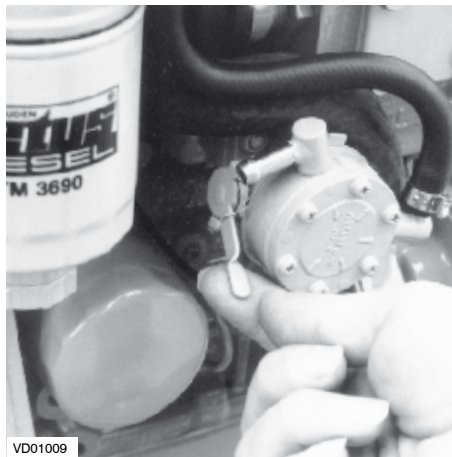
4 Maintenance

Draining of water from the water separator/fuel filter

Every 100 operating hours.



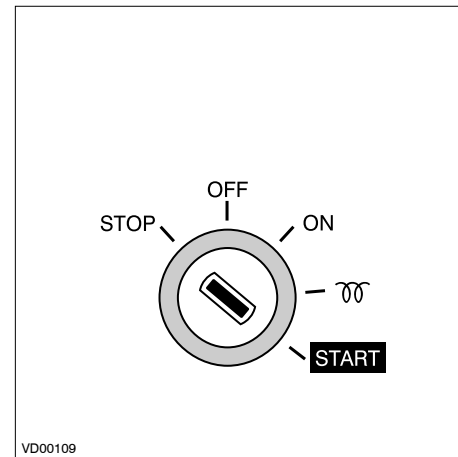
A second bleeding nipple is located at the fuel injection pump.



Prime the fuel system by pumping the fuel pump.

Close the bleeding nipples when all air has escaped.

N.B. It is necessary to operate the lever over the full stroke for proper operation.



11 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.

4 Maintenance

12 Engine oil change

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

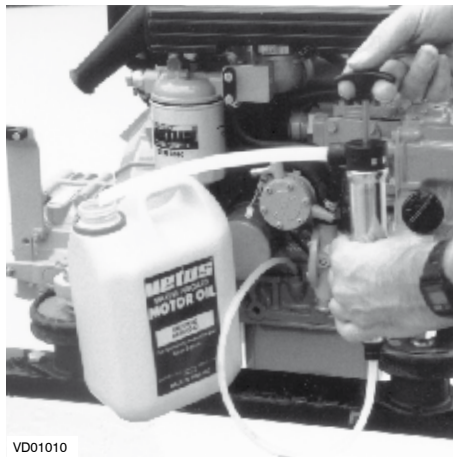
If the engine runs less than 100 hours during the year the oil should be changed at least once a year.

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 approx. 80°C (176°F).)



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.



VD01010

13 Draining the oil

Remove the dipstick; insert the suction hose of the supplied sump pump in the dipstick tube.

Push down the pump handle quickly and pull it up slowly.



VD01026

14 Removing the oil filter

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

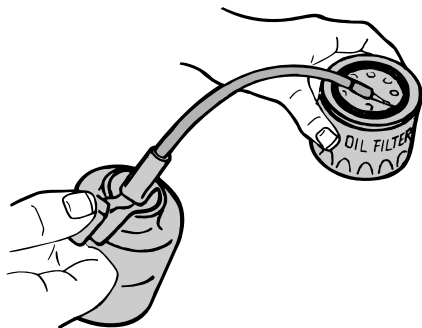
Catch any dripping oil.



Beware of burns from hot oil.

4 Maintenance

OIL FILTER, ART.CODE: STM0051



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.



VD01011

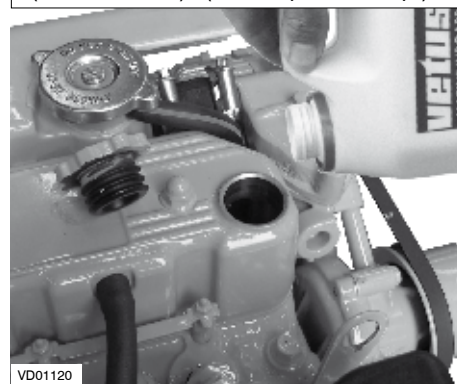
16 Oil filter installation

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

Engine oil change

Every 100 operating hours.

AMOUNT OF OIL: 4.1 litres
(OIL FILTER INCL.) (7.2 UK pt, 8.7 US pt)



VD01120

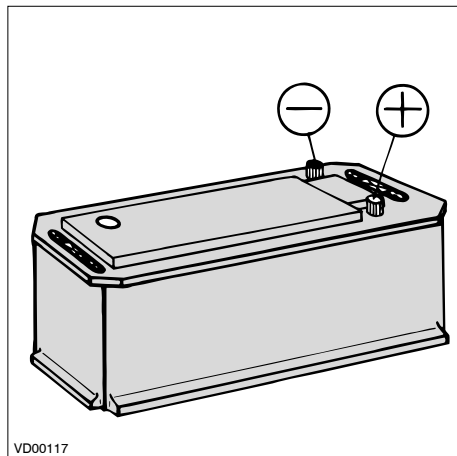
17 Refilling with oil

Refill the engine with new oil (for specifications see page 65) through the filler opening in the valve cover.

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

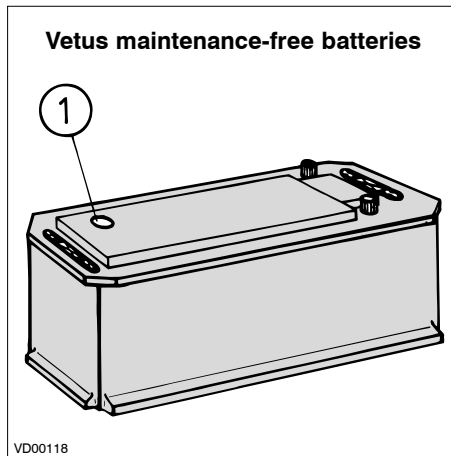
Stop the engine. Allow 5 minutes for the oil to return to the sump. Check the oil level with the dipstick.

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.

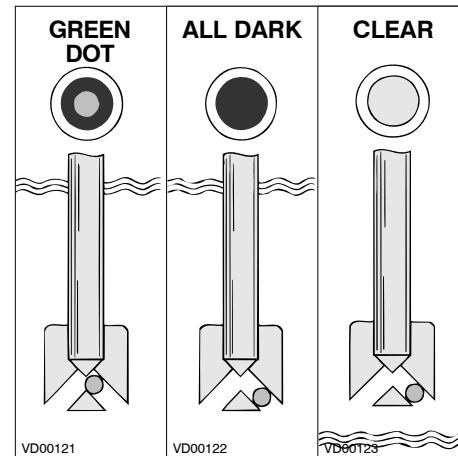


19 Checking specific gravity

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.



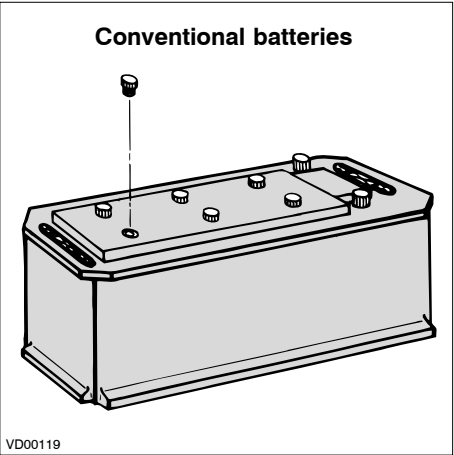
20 Hydrometer operation

- **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

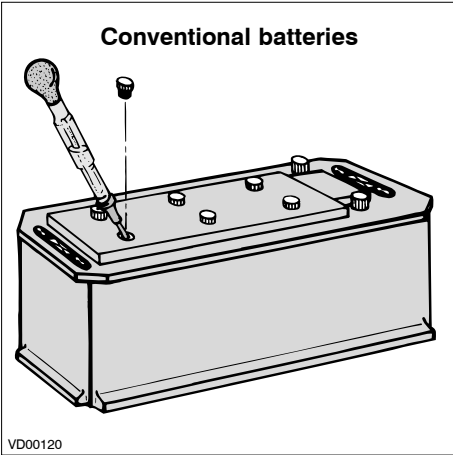
Battery, cables and connections

Every 100 operating hours.



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).

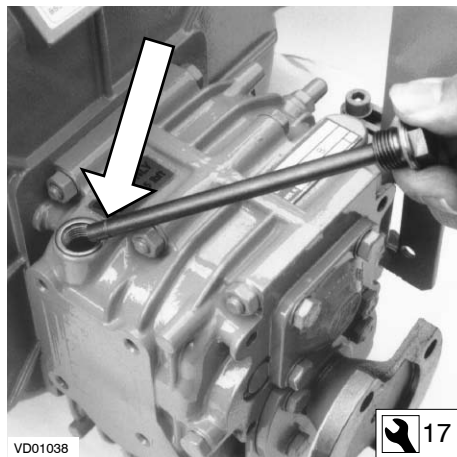
Specific gravity	State of charge	
1.280	100%	
1.200	50%	recharge
1.120	10%	recharge immediately



The gases emitted by the battery are explosive! Keep sparks and naked flames away from the battery!

Do not allow battery acid to come into contact with skin or clothing!
Wear protective goggles!
Do not rest tools on the battery!

4 Maintenance

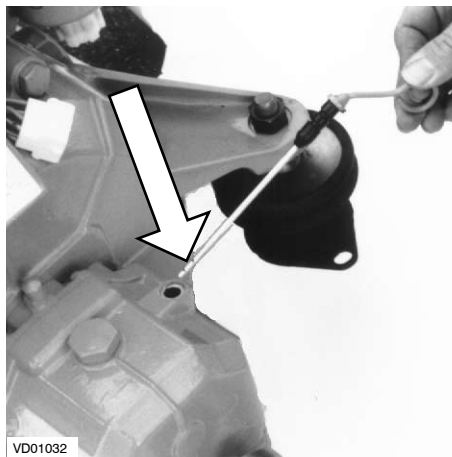


23 Oil level check (ZF-Hurth)

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 should be between the end and the notch in the dipstick.

If necessary top up by pouring oil in the dipstick hole. For oil type and specification see page 65.



24 Oil level check (Technodrive)

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 65.

Gearbox oil level check

Every 100 operating hours.



Vetus engines are normally equipped with ZF-Hurth or Technodrive 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 owners manual for changing oil and other care and maintenance.

4 Maintenance

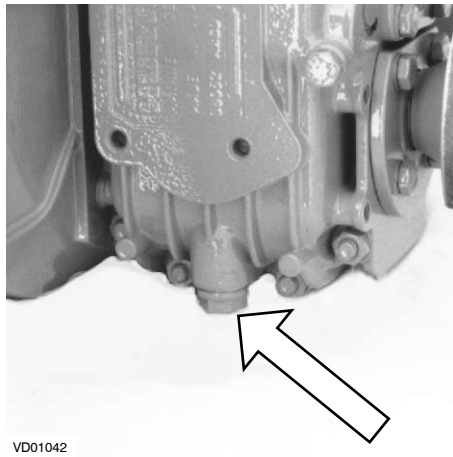


25 Draining the oil


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

Remove the dipstick (ZF-Hurth,  17) or remove the dipstick (Technodrive,  27).

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.



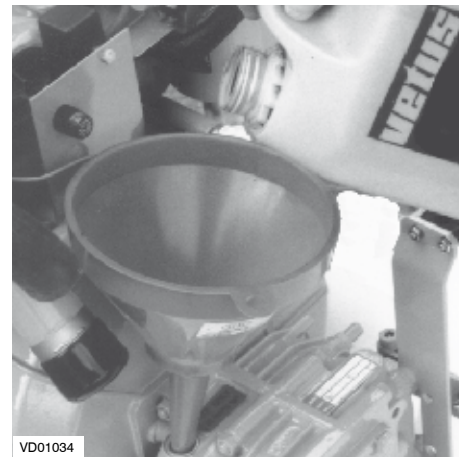
Or, if sufficient space below the gearbox is available, oil can be drained by removing the drain plug.

Drain plug: ZF-Hurth  17
Technodrive  14



Collect the oil in a dripping pan.

Changing the gearbox oil

Every 500 operating hours.



26 Filling with new oil

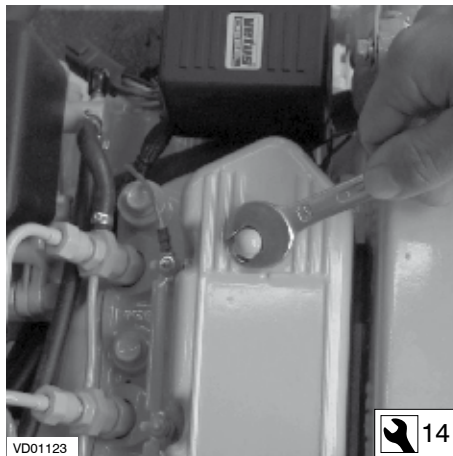
Refill the gearbox to the correct level via the dipstick opening (ZF-Hurth,  17) or via the filling hole (Technodrive,  27). For oil specification see page 65.

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

4 Maintenance

27 Checking / adjusting valve clearance

Checking the valve clearance must be done with a cold engine, that is an engine which did not run for at least 6 hours.

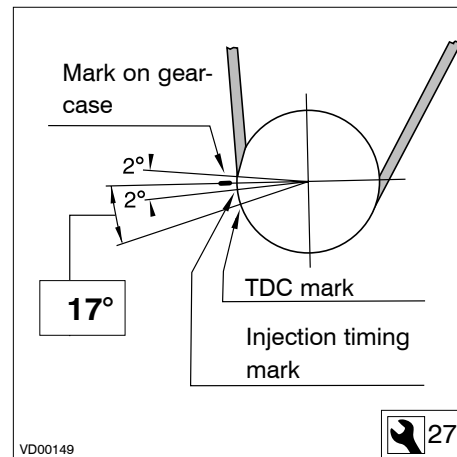


28 Remove rocker cover

Remove the 2 nuts of the rocker cover. Complete the following steps:

Checking valve clearance

Every 500 operating hours.



29 Locating TDC

Locate the Top Dead Center (TDC), at the end of the compression stroke, for cylinder 1 by barring the engine slowly until the TDC marks of the engine block and the crank pulley match.

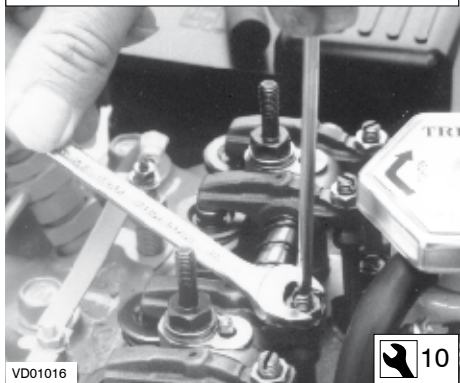
Note: There are two TDC's e.g. compression and suction. At the TDC at the end of the compression stroke the rocker arm

does not move when the crank pulley is rotated a little.

4 Maintenance

VALVE CLEARANCE: INLET 0.25 mm (0.010")

EXHAUST 0.25 mm (0.010")

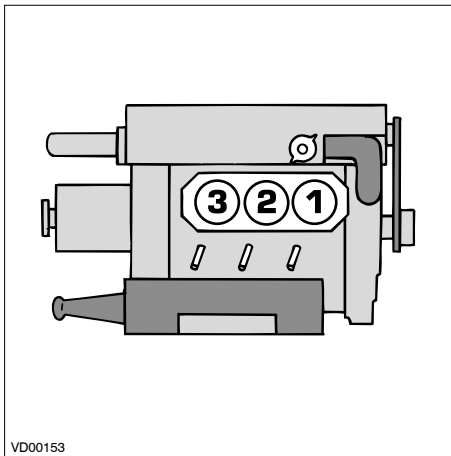


VD01016

30 Adjusting valve clearance

Cylinders are numbered consecutively, beginning at the front end.

- Check valve clearance at cylinder 1 and adjust if necessary.
- Rotate the crankshaft 240° clockwise and check valve clearance at cylinder 3.
- Again rotate the crankshaft 240° and check valve clearance at cylinder 2.

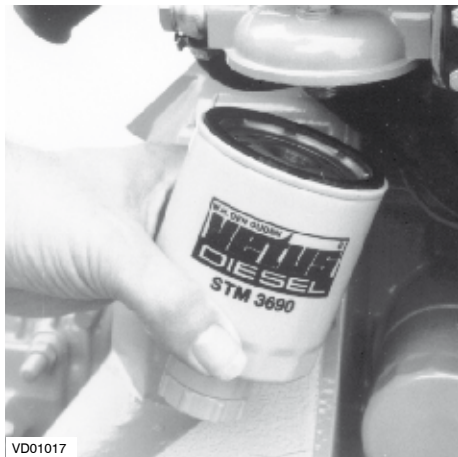


VD00153

Checking valve clearance

Every 500 operating hours.

4 Maintenance



31 Fuel filter removal

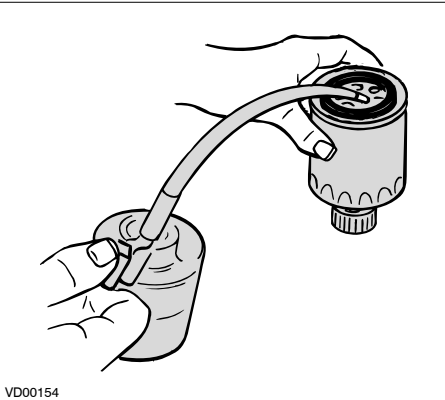
The fuel filter is to be replaced as a unit.

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



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

FUEL FILTER, ART.CODE: STM3690

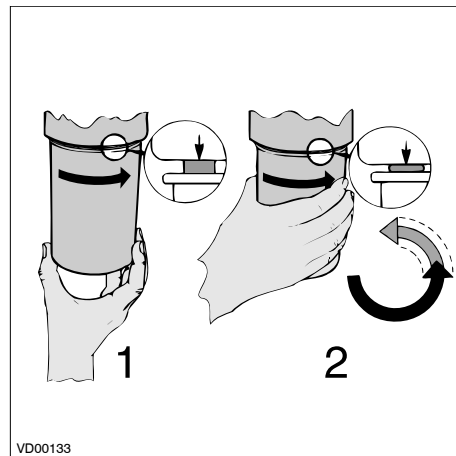


32 Fuel filter installation

- 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.

Fuel filter replacement

Every 500 operating hours.

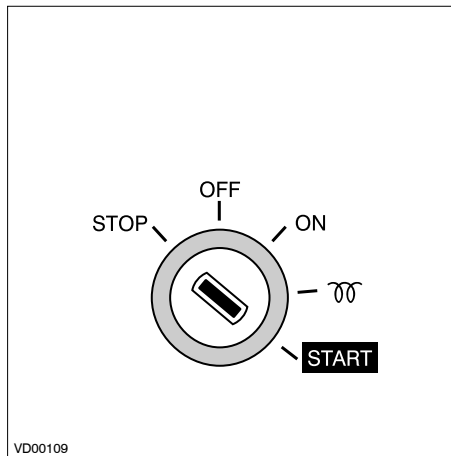


- Install the filter. When the rubber gasket touches the housing, apply another tightening of a half to three quarters of a turn by hand.
- Open fuel stopcock.
- Check for leaks.

4 Maintenance

Fuel filter replacement

Every 500 operating hours.



33 Bleeding

After replacing the fuel filter the air has to be bled from the fuel system.

For bleeding see page 26.

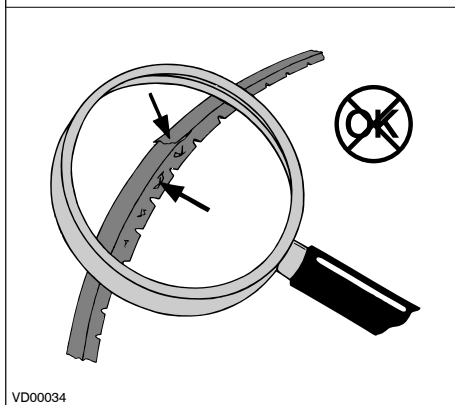
34 Start the engine

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.

4 Maintenance

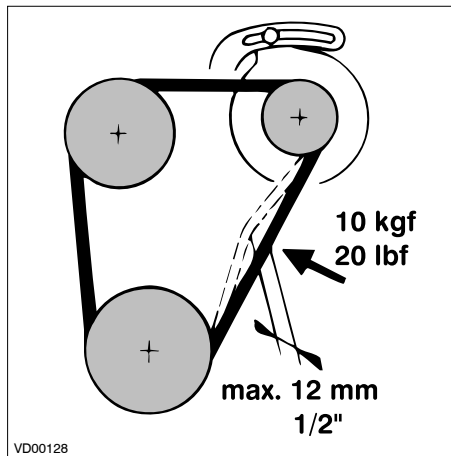
V-BELT, ART.CODE: STM7439



35 Inspection V-belt

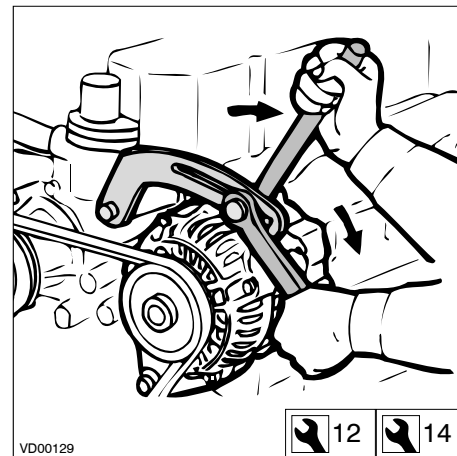
Inspect the belt for wear and tear (fraying and cracking). Belts which are in poor condition should be replaced.

Check, tension and change belts only with the engine off. Refit belt guard, if provided.



36 Checking tension

Check tension of the V-belt by applying moderate finger and thumb pressure. If the deflection of the belt is more than 12 mm (1/2"), using about 10 kg (20 lbs) thumb pressure, it should be tensioned.



37 Tensioning V-belt

Loosen the bolt of the adjustment bracket and both the alternator mounting bolts. Now push the alternator outwards until the belt tension is correct.

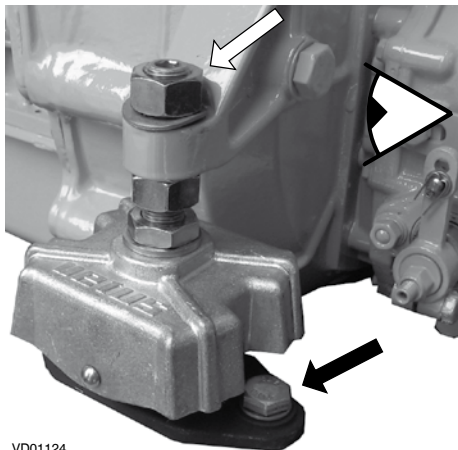
Now first re-tighten the upper mounting bolt of the alternator.

Then re-tighten the bolt of the adjustment bracket and the lower mounting bolt.

4 Maintenance

Flexible engine mounts, hose connections and fasteners

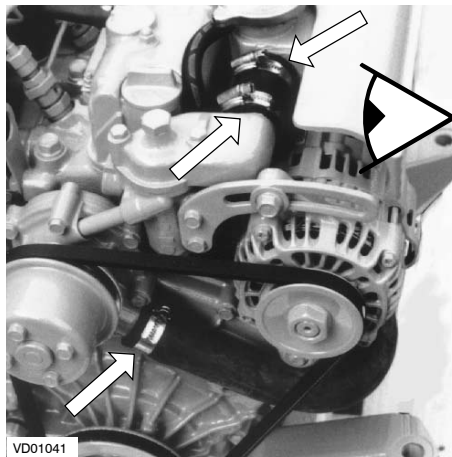
Every 500 operating hours.



38 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 propshaft! Re-align engine in case of doubt.



39 Inspection hose connections

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

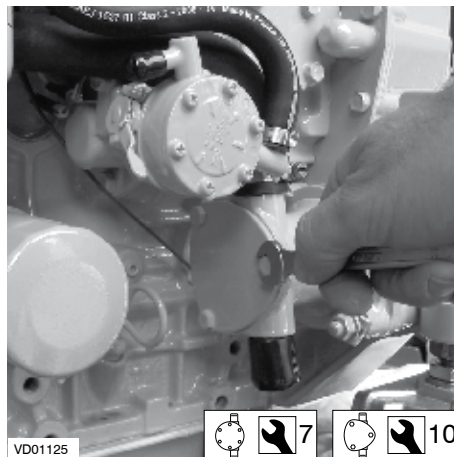
40 Check fasteners

Check tightness of all fasteners, bolts and nuts.

4 Maintenance

41 Raw water pump inspection

The rubber impeller of the outboard 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.



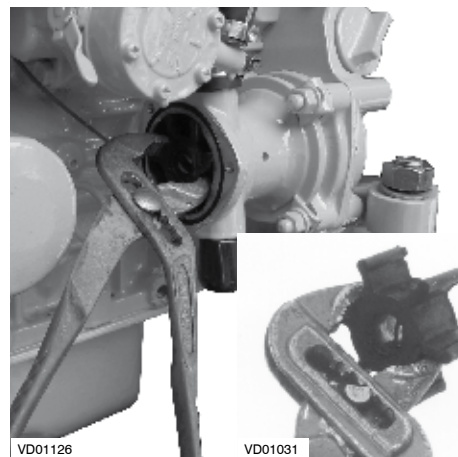
42 Pump cover removal

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.

Raw water pump inspection

Every 1000 operating hours.

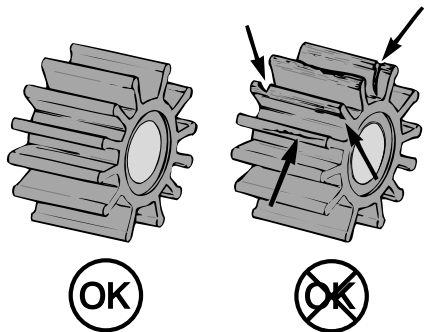


43 Impeller removal

- Slide the impeller off of the shaft using a waterpump plier.
- 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

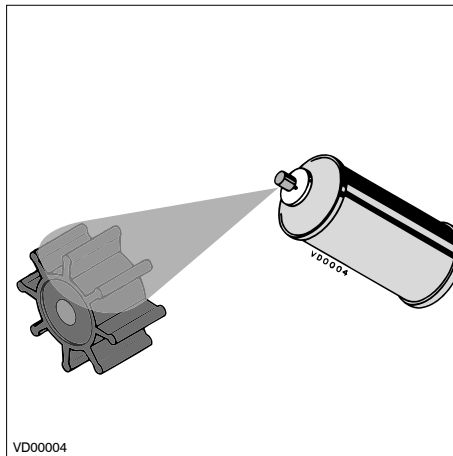
IMPELLER, ART.CODE: STM8061



VD00127

44 Impeller inspection

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



VD00004

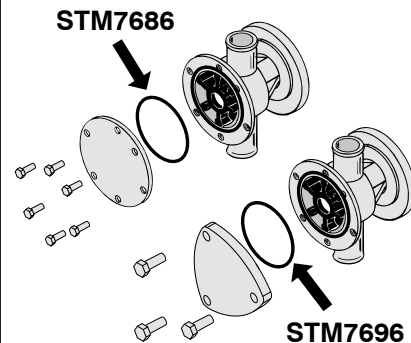
45 Re-install the impeller

- 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).

Raw water pump inspection

Every 1000 operating hours.

O-RING, ART.CODE:



VD00582

46 Replacing the pump cover

- Replace the cover with a **new** O-ring.
- Check the water filter and open the sea cock.

4 Maintenance

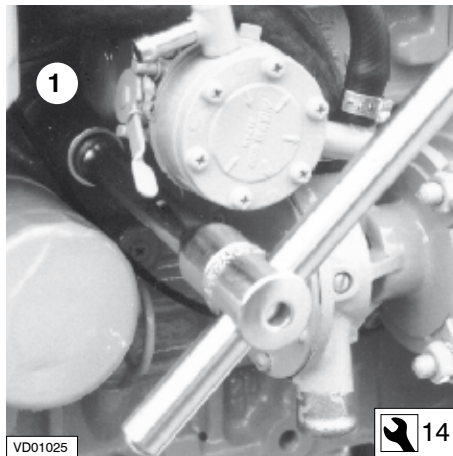
47 Coolant replacement

The coolant has to be replaced every 1000 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.

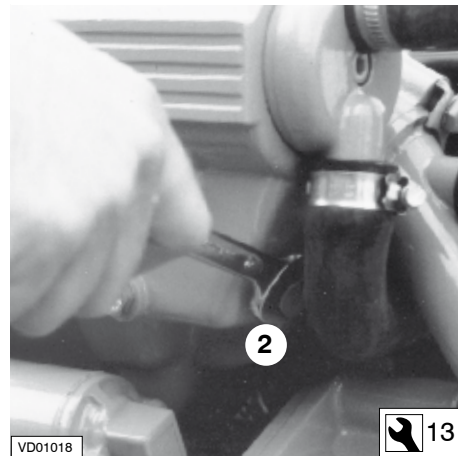


Be aware of the risk of skin burning during draining the hot coolant! Used coolant must be collected in a container for proper disposal according to laws and regulations.



48 Draining of coolant

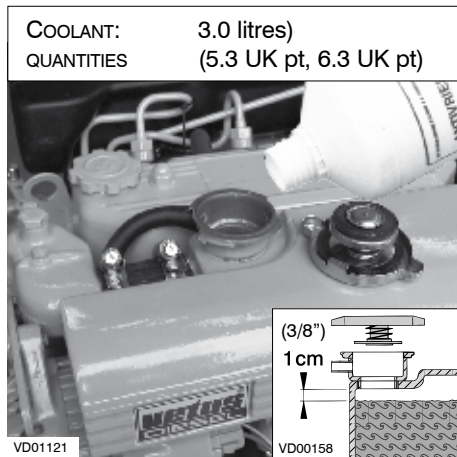
Remove the drain plugs from the engine block (1) and heat exchanger (2). Remove the filler cap to vent the cooling system and check that all the coolant has been drained. After draining replace the drain plugs.



Coolant replacement

Every 1000 operating hours.

4 Maintenance



49 Filling the cooling system

Remove the cap of the filler neck on the top of the heat exchanger housing.
Remove the bolt from the upper side of the thermostat cover, so that air can escape from the cooling system.

Fill the cooling system.

Use a mixture of 40% antifreeze (ethylene-glycol based) and 60% tap water or use a special coolant.

For specifications see page 67.



The level of the coolant must be approx. 1 cm (3/8") below the lower edge of the filler neck.

Bleeding will take place automatically during filling!

Replace the filler cap.

After the engine has run for the first time and has reached operating temperature and has cooled down again to ambient temperature, check the coolant level in the

Coolant replacement

Every 1000 operating hours.

WATER HEATER

If a water heater is connected to the engine and this heater is positioned above the upper side of the engine than bleeding of the heater will not take place automatically! Fill the heater separately to bleed the cooling system completely.

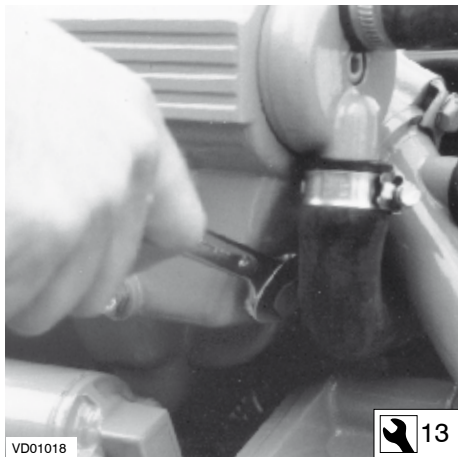
heat exchanger housing.

If necessary, add coolant.



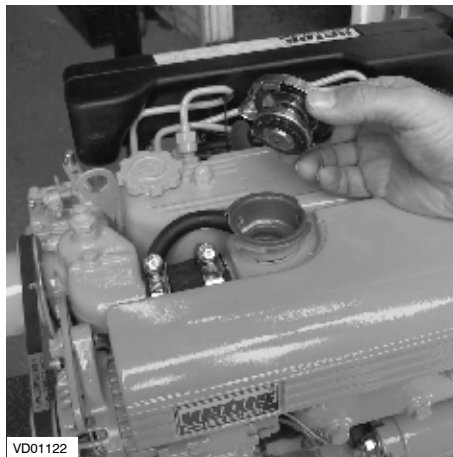
Never fill the cooling system with sea water or brackish water.

4 Maintenance



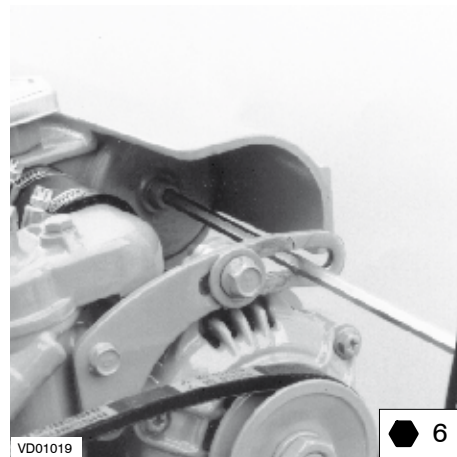
50 Remove the drain plug

- Close the seacock and detach the water inlet hose from the sea water pump.
- Drain the coolant: To do this, remove the drain plug from the heat exchanger housing.



- Remove the filler cap from the top of the heat exchanger housing to allow air into the system and check that all coolant has drained off.
- Remove the alternator.

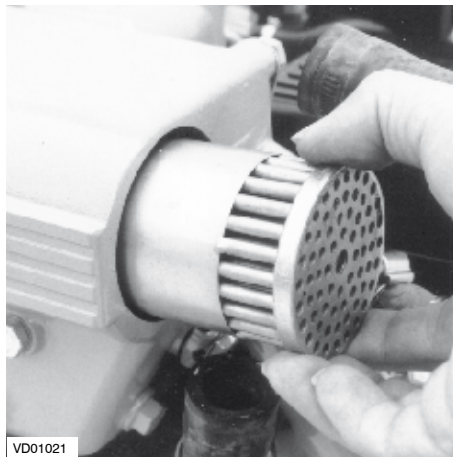
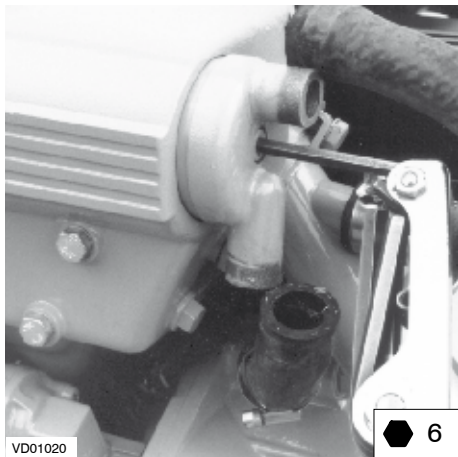
Cleaning the heat exchanger



51 Removal of bolts out of the end covers

Take out both central bolts from the end covers and take the end covers with the O-rings out of the housing.

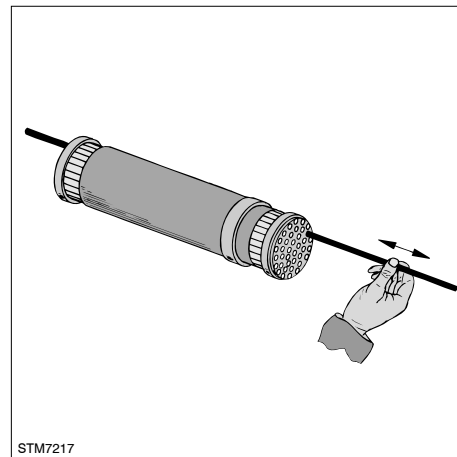
4 Maintenance



52 Remove heat exchanger

Slide the heat exchanger out of the housing.

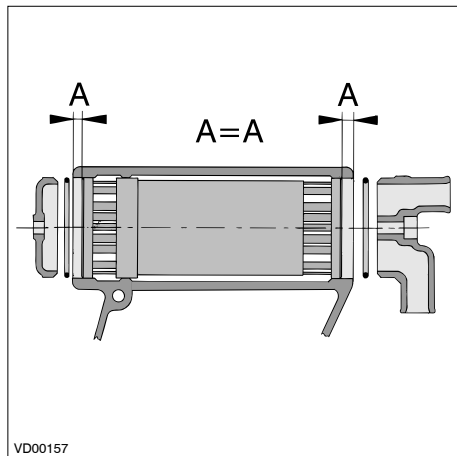
Cleaning the heat exchanger



53 Cleaning the heat exchanger

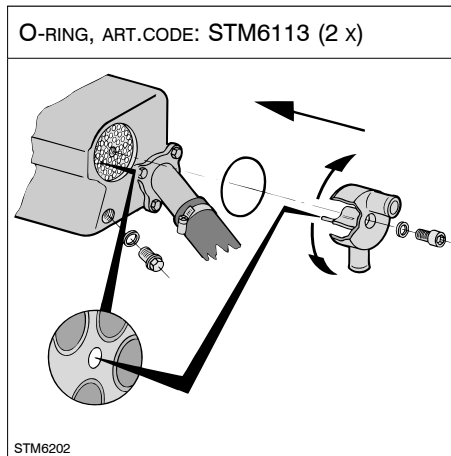
Clean the heat exchanger: Use a pipe cleaner to remove fouling in the pipes. Then rinse the heat exchanger pipes with clean water. Ensure that both heat exchanger end chambers are free from dirt.

4 Maintenance



54 Replacing heat exchanger

Replace the heat exchanger in the original position in the heat exchanger housing. Use new O-rings (61 x 2.5 mm) which have been greased.



55 Replacing the end covers

Fit the end covers in the housing; the connector cover is fitted with a locating pin so that it can be fitted in one way only in relation to the heat exchanger.

This ensures the correct position of the separator baffle in the connector cover in relation to the heat exchanger.

Cleaning the heat exchanger

Tighten up the bolts when both covers are in the correct position.

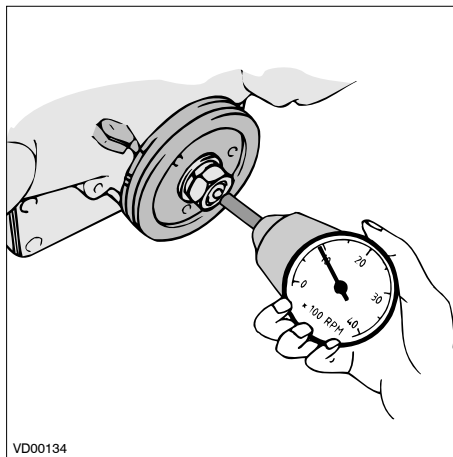
- Refit the drain plug.
- Reconnect all hoses previously removed.
- Refill the cooling system, see page 43.

4 Maintenance



WARNING

The maximum engine speed adjustment screw has been correctly set at the factory and sealed. DO NOT attempt to remove this seal.



VD00134

56 Checking engine speed

At full load (with the boat cruising) the maximum engine speed should be about 3600 RPM (see technical data page 62). If the engine does not reach this speed, it is being overloaded!

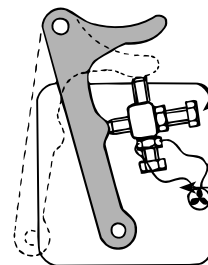
If this is the case, check the ship's propeller for defects or irregularities, and also to see that it is the correct pitch and diameter.

The engine idling speed should be 900 rpm.

Allow the engine to warm up normally (until the coolant temperature reaches at least 60°C (140°F).) before checking and/or adjusting the idling speed.

Check the engine RPM using a rev. counter, or use the rev. counter fitted to the control panel.

Checking engine speed



Minimum speed adjustment screw

Maximum speed adjustment screw

Lead seal

VD00150



10

57 Adjusting engine idling speed

If the engine speed differs from that stated above, it must be adjusted.

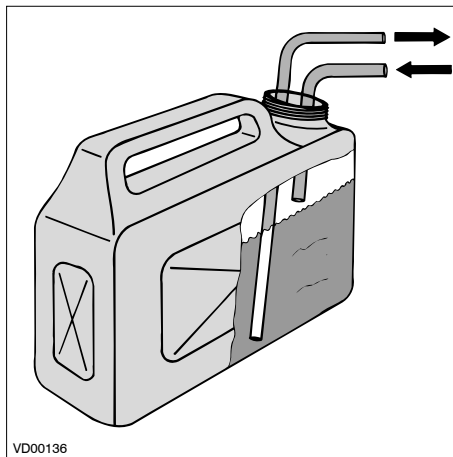
The engine idling speed can be reset using the adjustment screw on the fuel pump.

5 Winter storage procedure



1 Fuel system

Drain the water from the water separator/fuel filter and the fuel tank. Ensure that the tank is completely filled with fuel.



Running with protective fuel mixture

Connect the fuel supply pipe to a can filled with a mixture of one (1) part of engine oil* to nine (9) parts of clean fuel**. Use this mixture to run the engine at **no load** for approx. 10 minutes.
Stop the engine.

* Engine oil with protective properties.
E.g. Shell Super Diesel T 10W40

** Preferably water-free fuel.
Collect some fuel from the return pipe, while engine is running.



Never run the engine under load with this mixture of fuel and oil.

5 Winter storage procedure

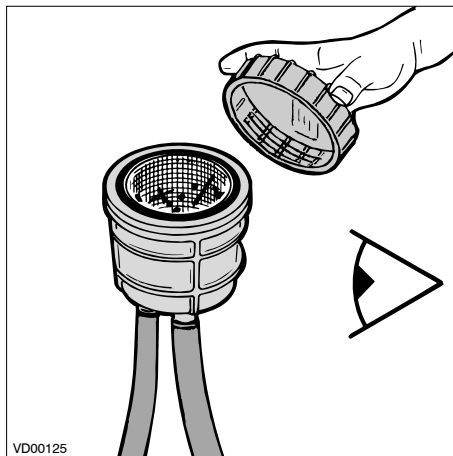


VD01010

2 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; use oil with protective properties. See page 65.



VD00125

3 Raw water cooling system

Close the seacock before removing the lid of the water strainer. If necessary, clean the raw water strainer.

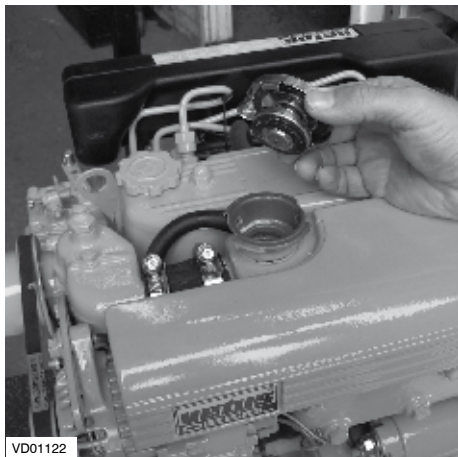
Pour 1 litre (1/4 Imp.gal.) of anti-freeze into the water strainer and run the engine until the anti-freeze has disappeared into the cooling system.

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.

5 Winter storage procedure

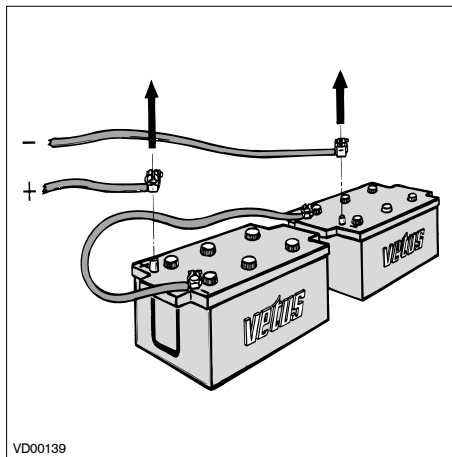


4 Fresh water cooling system

To avoid corrosion during winter storage the cooling system must be filled with an antifreeze/water mixture (or a coolant). For specifications see page 67.

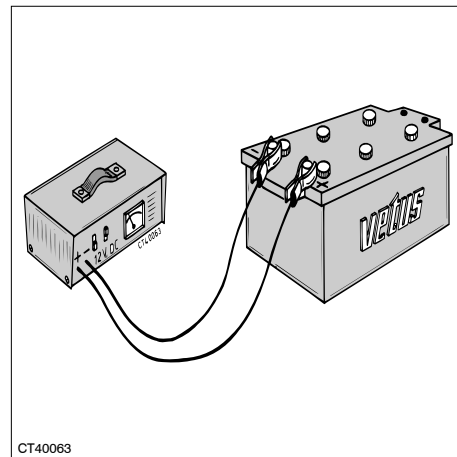
N.B. Replacing the coolant is only necessary if the coolant present in the cooling system offers insufficient protection for the winter.

For coolant replacement see page 42.



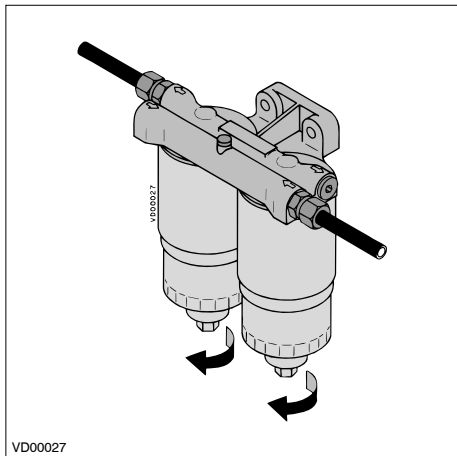
5 Electrical system

Disconnect the battery cables.



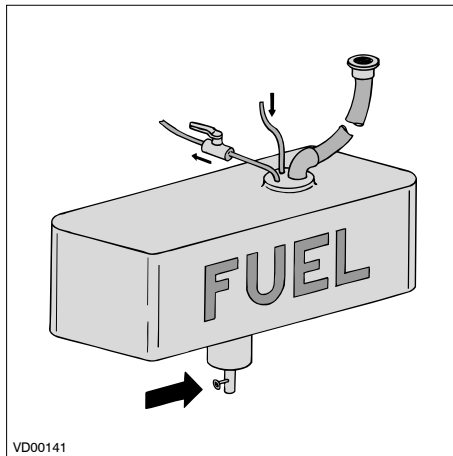
Charge batteries during winter lay-up regularly if required!

6 Recommissioning after winter storage



1 Fuel system

Drain the water from the water separator/
fuel filter. (page 26)



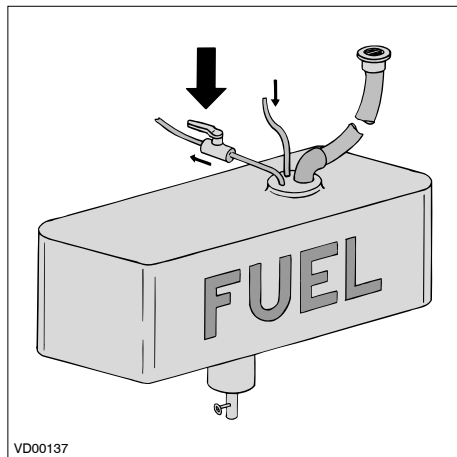
Drain the water from the fuel tank.



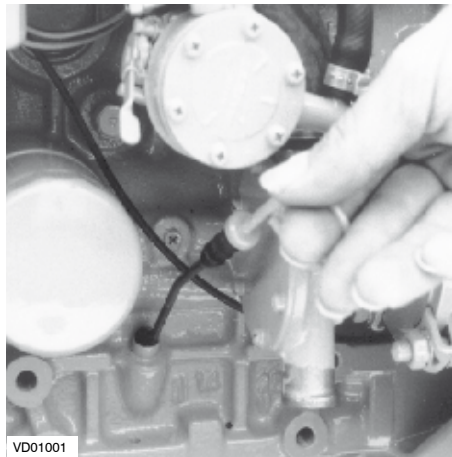
Install a new fuel filter. (page 36).



6 Recommissioning after winter storage

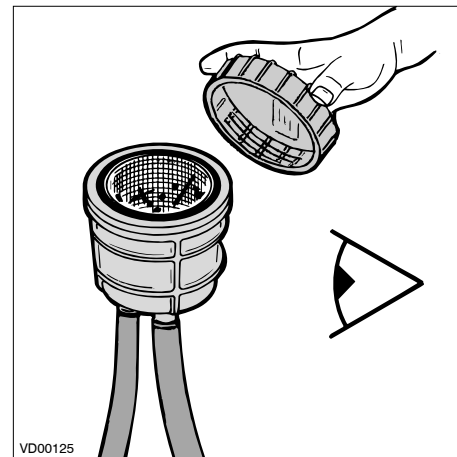


➞ Open the fuel valve.



2 Lubrication system

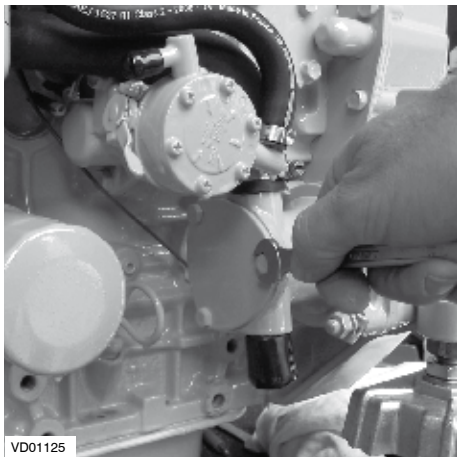
Check the engine oil level. (page



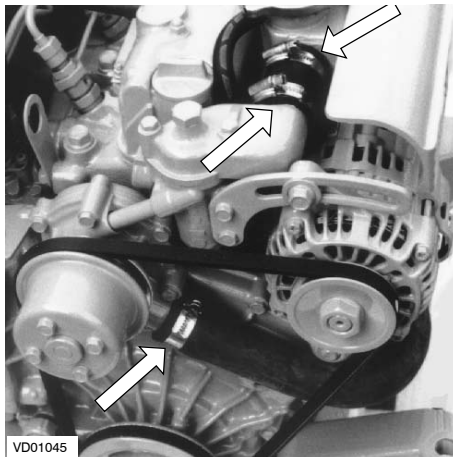
3 Raw water cooling system

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

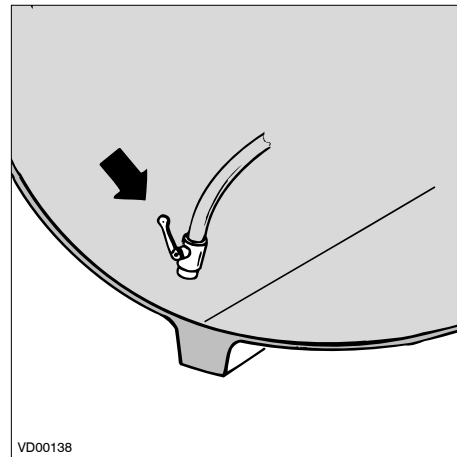
6 Recommissioning after winter storage



The lid of the raw water pump and drain plugs are reinstalled. (pages 40, 42)

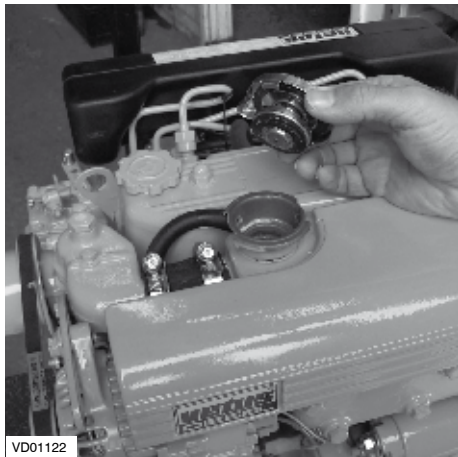


Re-tighten possible loose hose clamps.



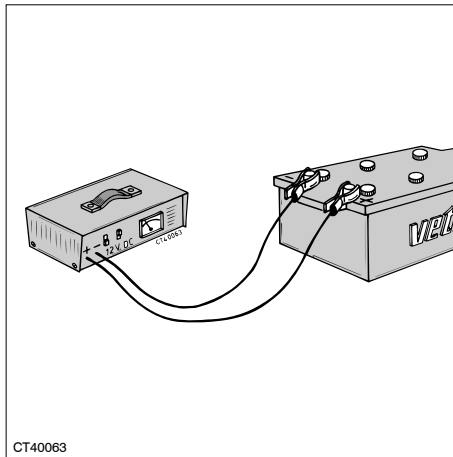
Open the sea cock.

6 Recommissioning after winter storage



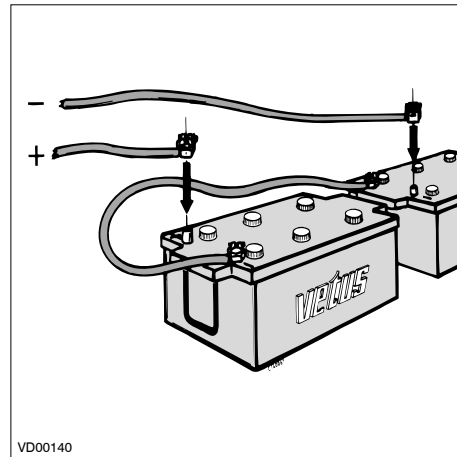
4 Fresh water cooling system

Check the coolant level. (page 24)



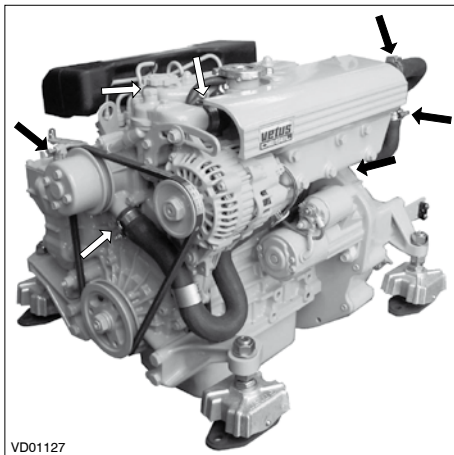
5 Electrical system

Make sure that the batteries are fully charged. (page 30, 50)



Connect the batteries.

6 Recommissioning after winter storage



6 Check engine for leaks

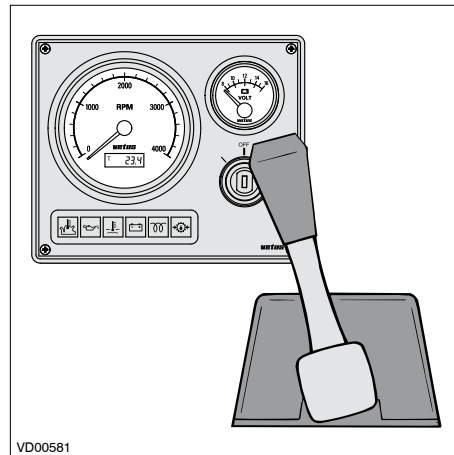
Start the engine.

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



7 Changing the gearbox oil

Stop the engine and change the oil of the gearbox. (page 33)



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.



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 removed.

Disconnect battery!

7 Troubleshooting

Fault finding table

1 Engine will not crank

Possible fault	Remedy
A Faulty or discharged battery.	A Check / recharge battery and check engine alternator and/or battery charger.
B Loose or corroded connections in starting circuit.	B Clean and tighten connections.
C Faulty starter-switch or faulty starter-relay.	C Check / replace.
D Faulty starter-motor or pinion does not engage.	D Check / replace starter-motor.
E Starter relay is not engaged due to a voltage too low; caused by a very long intermediate cable from engine to control panel.	E Install an auxiliary starter relay.

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

Possible fault	Remedy
A Fuel stop valve closed.	A Open.
B (Nearly) Empty fuel tank.	B Refill.
C Air in fuel system.	C Check and bleed.
D Fuel filter clogged with water and/or contamination.	D Check or replace.
E Leaking fuel supply line or fuel injection line.	E Check / replace.
F Faulty injector/injection pump.	F Check, replace if required.
G Vent line of fuel supply tank clogged.	G Check / clean.
H Exhaust restricted.	H Check.

7 Troubleshooting

Fault finding table

3 Engine cranks but will not start, smoke from exhaust

Possible fault	Remedy
A Air in fuel system.	A Check and bleed.
B Faulty injector/injection pump.	B Check, replace if required.
C Setting of stop valve incorrect.	C Check / adjust.
D Faulty glow plugs.	D Check / replace.
E Incorrect valve clearance.	E Adjust.
F Incorrect injection timing after overhauling of engine.	F Check / adjust.
G Insufficient intake air.	G Check.
H Wrong fuel quality or contaminated fuel.	H Check fuel. Drain and flush fuel tank. Replace with new fuel.
I Incorrect lube oil SAE class or quality for ambient temperature.	I Replace.

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

Possible fault	Remedy
A (Nearly) Empty fuel tank.	A Refill.
B Air in fuel system.	B Check and bleed.
C Fuel filter clogged with water and/or contamination.	C Check or replace.
D Leaking fuel supply line or fuel injection line.	D Check / replace.
E Faulty injector/injection pump.	E Check, replace if required.
F Vent line of fuel supply tank clogged.	F Check / clean.
G Fuel supply line restricted.	G Check / clean.
H Incorrect valve clearance.	H Adjust.
I Idle setting too low.	I Check/ adjust.
J Exhaust restricted.	J Check.
K Wrong fuel quality or contaminated fuel.	K Check fuel. Drain and flush fuel tank. Replace with new fuel.

7 Troubleshooting

Fault finding table

5 Engine does not reach maximum rpm under load

Possible fault	Remedy
A Air in fuel system.	A Check and bleed.
B Fuel filter clogged with water and/or contamination.	B Check or replace.
C Leaking fuel supply line or fuel injection line.	C Check / replace.
D Faulty injector/injection pump.	D Check, replace if required.
E Setting of stop valve incorrect.	E Check / adjust.
F Oil level too high.	F Lower level.
G Incorrect valve clearance.	G Adjust.
H Exhaust restricted.	H Check / clean.
I Insufficient intake air.	I Check.
J Wrong fuel quality or contaminated fuel.	J Check fuel. Drain and flush fuel tank. Replace with new fuel.
K Engine overloaded.	K Check size of propeller.

6 Engine overheats

Possible fault	Remedy
A Faulty injector/injection pump.	A Check, replace if required.
B Oil level too high.	B Lower level.
C Oil level too low.	C Increase level.
D Faulty oil filter.	D Replace.
E Coolant pump defective.	E Check / clean.
F Heat exchanger dirty or clogged as a result of rubber particles from a worn impeller.	F Check / clean.
G Coolant level too low.	G Check / top up.
H Sea cock closed.	H Open.
I Raw water strainer clogged.	I Check / clean.
J Leaking raw water intake system.	J Check / replace.
K Faulty thermostat.	K Check / replace.
L Faulty impeller raw water pump.	L Check / replace.
M Insufficient intake air.	M Check / replace air intake filter.
N Motor becomes apparently overheated as a result of faulty temperature switch, sensor or meter.	N Check / replace.

7 Troubleshooting

Fault finding table

7 Engine not firing on all cylinders

Possible fault	Remedy
A Air in fuel system.	A Check and bleed.
B Fuel filter clogged with water and/or contamination.	B Check or replace.
C Leaking fuel supply line or fuel injection line.	C Check / replace.
D Faulty injector/injection pump.	D Check, replace if required.
E Fuel supply line restricted.	E Check / clean.
F Faulty glow plugs.	F Check / replace.
G Incorrect valve clearance.	G Adjust.

8 Engine has little or no oil pressure

Possible fault	Remedy
A Oil level too low.	A Increase level.
B Excessive inclination of engine.	B Check / Adjust.
C Incorrect lube oil SAE class or quality for ambient temperature.	C Replace.

9 Engine oil consumption excessive

Possible fault	Remedy
A Oil level too high.	A Lower level.
B Excessive inclination of engine.	B Check / Adjust.
C Incorrect lube oil SAE class or quality for ambient temperature.	C Replace.
D Excessive wear of cylinder/piston.	D Check compression; overhaul engine.
E Insufficient intake air.	E Check.
F Engine overloaded.	F Check size of propeller.

7 Troubleshooting

Fault finding table

10A Blue exhaust smoke (idling)

Possible fault	Remedy
A Oil level too high.	A Lower level.
B Excessive inclination of engine.	B Check / Adjust.

10B Black exhaust smoke (at load)

Possible fault	Remedy
A Insufficient intake air.	A Check.
B Faulty injector / injection pump.	B Check / replace if required.
C Engine overloaded, max. rpm is not reached.	C Check sizes of propeller.

10C White exhaust smoke (at full load)

Possible fault	Remedy
A Air in fuel system.	A Check and bleed.
B Faulty injector/injection pump.	B Check, replace if required.
C Water in fuel system.	C Check water separator.
D Faulty glow plugs.	D Check / replace.
E Incorrect valve clearance.	E Adjust.
F Incorrect injection timing.	F Check / adjust.
G Wrong fuel quality or contaminated fuel.	G Check fuel. Drain and flush fuel tank. Replace with new fuel.
H Vapour in exhaust gases condenses as a result of very low ambient temperature.	H -

8 Technical data

Engine specifications

Model

M3.28

General

Make	: Vetus Mitsubishi
Number of cylinders	: 3
Based on	: L3E-6ADM
Type	: 4-stroke diesel, in-line
Injection	: Indirect
Aspiration	: Natural
Bore	: 76 mm
Stroke	: 70 mm
Total displacement	: 952 cm ³
Compression ratio	: 22 : 1
Idling speed	: 900 rpm
Max. no. of revolutions at no load	: 3600 rpm
Valve Clearances (cold)	: Inlet 0.25 mm (0.010") Exhaust 0.25 mm (0.010")
Weight (with standard gearbox)	: 123 kg (271 lbs)

Engine installation

Max. installation angle	: 15 degrees backwards
Max. athwartships angle	: 25 degrees continuously, 30 degrees intermittent

Maximum Output

at the flywheel (ISO 3046-1)	: 20 kW (27.2 hp)
at the prop shaft (ISO 3046-1)	: 19.3 kW (26.2 hp)
at no. of revolutions of	: 3600 rpm
Torque,	: 51.3 Nm (5.2 kgm, 37.8 ft.lb)
at no. of revolutions	: 3600 rpm

Fuel consumption

	: 270 g/kW.h
	: (199 g/hp.h,
	: 7.0 oz/hp.h)
at no. of revolutions	: 2600 rpm

Fuel System (Self-bleeding)

Injection pump	: Bosch model NC (Nippon Denso)
Injectors	: Plug injector
Opening pressure	: 140 bar (kgf/cm ³) (2030 psi)
Firing order	: 1- 3 - 2
Injection timing	: 17° BTDC
Fuel filter element	: STM3690
Fuel lift pump	
Suction height max.	: max. 1,5 m (5 ft)
Fuel supply connection	: for hose 8 mm (5/16") I.D.
Fuel return connection	: for hose 8 mm (5/16") I.D.

8 Technical data

Oil lubrication system

Oil capacity, max.	
without oil filter	: 3,6 litres (6 UK pt, 7.6 US pt)
with oil filter	: 4,1 litres (7.2 UK pt, 8.7 US pt)
Oil Filter	: STM0051
Oil temperature in sump	: max. 130°C (266°F)

Cooling system

Capacity,	
Intercooler version	: 3 litres (5.3 UK pt, 6.3 US pt)
Keel cooler version	: 4 litres (7 UK pt, 8.5 US pt)
Thermostat	: opening at 71°C±1.5°C : (160°F±3°F), : fully opened at 84°C (183°F)

Coolant pump,

Flow at max. engine rpm	: 50 l/min (11 UK Gal/min, 13.2 US Gal/min)
Total head keelcooler at max. flow	: 2 m Water (6' 7")
Inlet connection for hose keelcooler	: 28 mm (1 1/8") I.D.

Raw water pump,

Flow at max. engine rpm	: 20 l/min (4.4 UKGal/min, 5.3 US Gal/min)
Total head at max. flow	: 2 m Water (6' 7")
Impeller	: STM8061
Inlet connection for hose	: 20 mm (3/4") I.D.
Heater supply connection	: 10 mm (3/8")
Heater return connection	: 8 mm (5/16")

Engine specifications

Exhaust system

Exhaust diameter	: 40 mm
Exhaust back pressure	: at specified output : max. 150 mbar (2.2 psi)

Electrical System

Voltage	: 12 Volt
Alternator	: 14 Volt, 50 Amp / 75 Amp see alternator data tag Fuse 'ATO'10 Amp
Battery capacity	: min. 55 Ah, max. 108 Ah
Protection	: Fuse 'ATO'10 Amp

V-belt	: STM7439
---------------	-----------

Gearbox

		Gear ratio
ZF Hurth:	type ZF10M	: 1.97 / 2 / 2.72 : 1
	type ZF12	: 1.14 / 2.63 / : 1
	type ZF15MA	: 1.88 / 2.63 : 1
	type ZF15V	: 2.13 / 2.99 : 1
Technodrive:	type TMC40	: 2.00 / 2.60 : 1
	type TMC40M	: 2.00 / 2.60 : 1
	type TMC40P	: 2.00 / 2.60 : 1
	type TM345A	: 2.00 / 2.47 : 1
	type TM345H	: 2.00 / 2.47 : 1

8 Technical data

Torque wrench settings

Screw connection	Diameter	Wrench size	Nm	Torque (kgm)	(ft.lbf)
Cylinder head bolt	M10	14	78 ±5	(8 ±0.5)	(58 ±3.5)
Cilinder head bolt	M8	12	25 ±5	(2.5 ±0.5)	(18 ±3.5)
Connecting rod nut	M8	14	33 ±1.5	(3.35 ±0.15)	(24 ±1)
Fly wheel bolt	M10	17	88 ±5	(9 ±0.5)	(65 ±3.5)
Crank shaft pulley nut	M16	24	108 ±10	(11 ±1.0)	(80 ±7)
Main bearing cap bolt	M10	17	52 ±2.5	(5.25 ±0.25)	(38 ±2)
Rocker stay bolt	M8	12	18 ±3.5	(1.85 ±0.35)	(13 ±2.5)
Valve cover nut	M6	10	6 ±1	(0.6 ±0.1)	(4.5 ±0.8)
Nozzle holder	M20	21	54 ±5	(5.5 ±0.5)	(40 ±3.5)
Fuel leak oil pipe nut	M12	17	25 ±5	(2.5 ±0.5)	(18 ±3.5)
Nozzle retaining nut	M16	21	37 ±2.5	(3.75 ±0.25)	(27 ±2)
Fuel injection pipe nut	M12	17	29 ±5	(3.0 ±0.5)	(21 ±3.5)
Delivery valve holder	M16	17	36 ±2	(3.7 ±0.2)	(26 ±1.5)
Injection pump hollow screw	M10	14	12 ±2.5	(1.25 ±0.25)	(9 ±2)
Injection pump air vent screw	M6	10	6 ±1	(0.6 ±0.1)	(4.5 ±0.8)
Solenoid lock nut	M30	36	44 ±5	(4.5 ±0.5)	(32 ±3.5)
Temperature switch	M16	19	22.5 ±4	(2.3 ±0.4)	(16.5 ±3)
Oil filter	M20	—	12 ±1	(1.2 ±0.1)	(9 ±0.8)
Oil pressure switch	PT1/8	26	10 ±2	(1 ±0.2)	(7 ±1.5)
Pressure relief valve	M18	22	44 ±5	(4.5 ±0.5)	(32 ±3.5)
Oil drain plug	M18	19	54 ±5	(5.5 ±0.5)	(40 ±3.5)
Glow plug	M10	12	17.5 ±2.5	(1.75 ±0.25)	(13 ±2)

9 Operating media

Lubricating oil

Engine Lubricating Oil

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

Lube oils are differentiated according to their performance and quality class. In common use are specifications named after API (American Petroleum Institute) and ACEA (European Automobile Manufacturers Association).

Approved API Oils : CF, CF-4 or CI-4

Approved ACEA Oils : A3/B3, A3/B4

As the viscosity of lube oil is dependent on temperature, the oil viscosity (SAE grade) should be selected according to the ambient temperature when the engine is started.

To avoid oil changes dictated by the seasons we advise one of the following multi-grade oils.

- SAE 10W40 for temperatures of -25°C up to +30°C
(-13°F up to +86°F)
- SAE 15W40 for temperatures of -20°C up to +35°C
(-4°F up to +95°F)

For example: Vetus Marine Diesel Engine Oil 15W-40
Shell Nautilus Premium Inboard Oil 15W-40

Gearbox Lubricating Oil

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

ZF Hurth:

type ZF10M : 0,35 liter (0.6 UK pt, 0.74 US pt) ATF*)
type ZF12 : 1,1 liter (1.9 UK pt, 2.3 US pt)ATF*)
type ZF15MA : 0,56 liter (1 UK pt, 1.2 US pt)ATF*)
type ZF15V : 1,0 liter (1.8 UK pt, 2.1 US pt)ATF*)

Technodrive:

type TMC40 : 0.20 litres (0.35 UK pt, 0.42 US pt),
Engine oil SAE 20/30
type TMC40M : 0.20 litres (0.35 UK pt, 0.42 US pt), ATF*)
type TMC40P : 0.20 litres (0.35 UK pt, 0.42 US pt), ATF*)
type TM345A : 1.6 litres, Engine oil SAE 20W40-CD
type TM345H : 1.6 litres, Engine oil SAE 20W40-CD
(2.8 UK pt, 3.4 US pt)

*) ATF : Automatic Transmission Fluid;
Transmissie olie type A, Suffix A.

For example : Vetus Transmission Oil
Shell Donax T6
Gulf Dextron

Other brands of gearboxes:

See supplied owners manual for oil type and quantities.

9 Operating media

Fuel

Fuel Quality Grade

Use commercially available diesel fuel with less than 0.5% sulfur content. If the sulfur 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% sulfur!

The following fuel specifications / standards are approved:

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

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

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

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 an other 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
Sulfate ion content [mg/dm ³]	–	100
Total hardness [degrees]	3	12



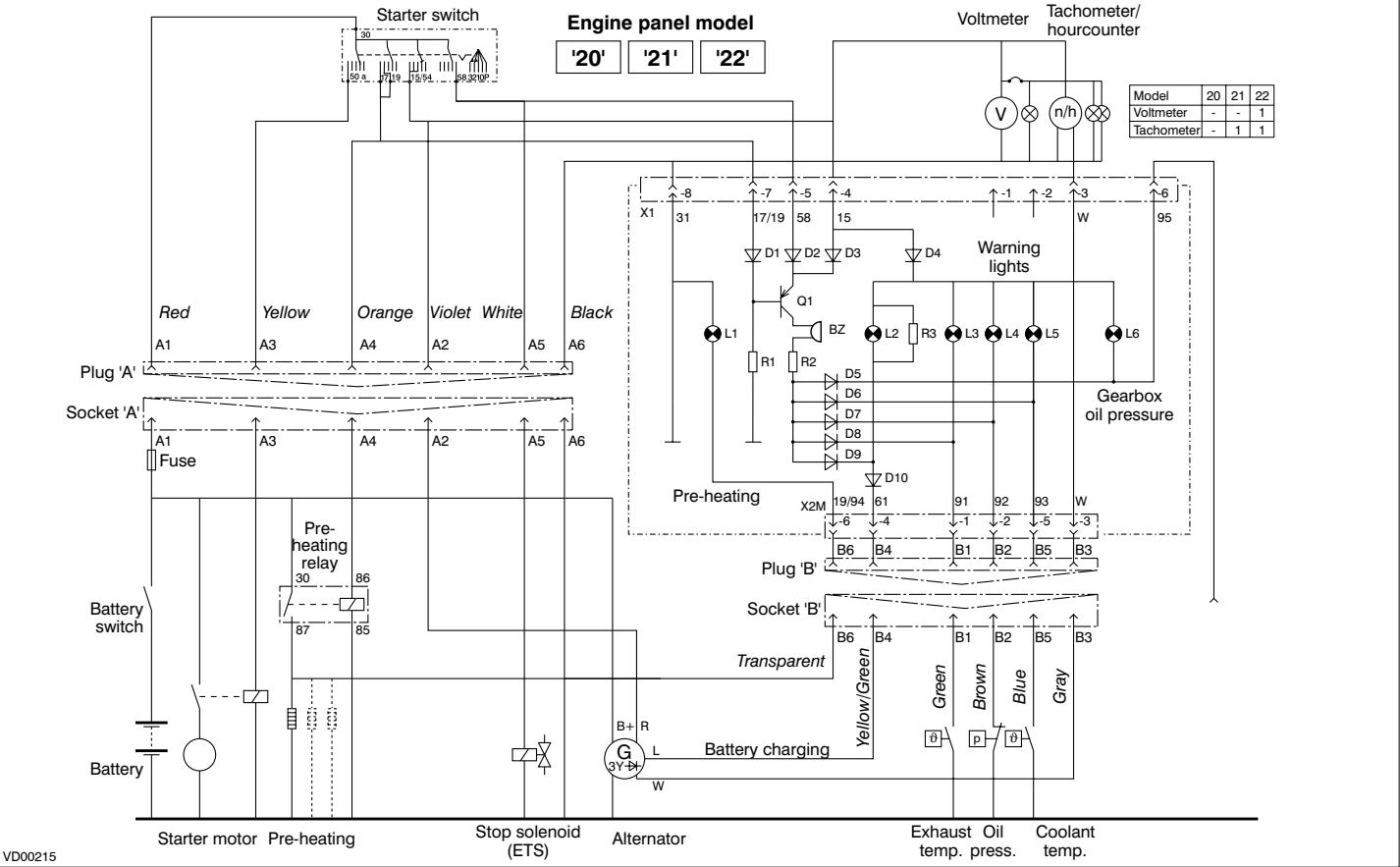
Never use sea-water or brackish water.



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

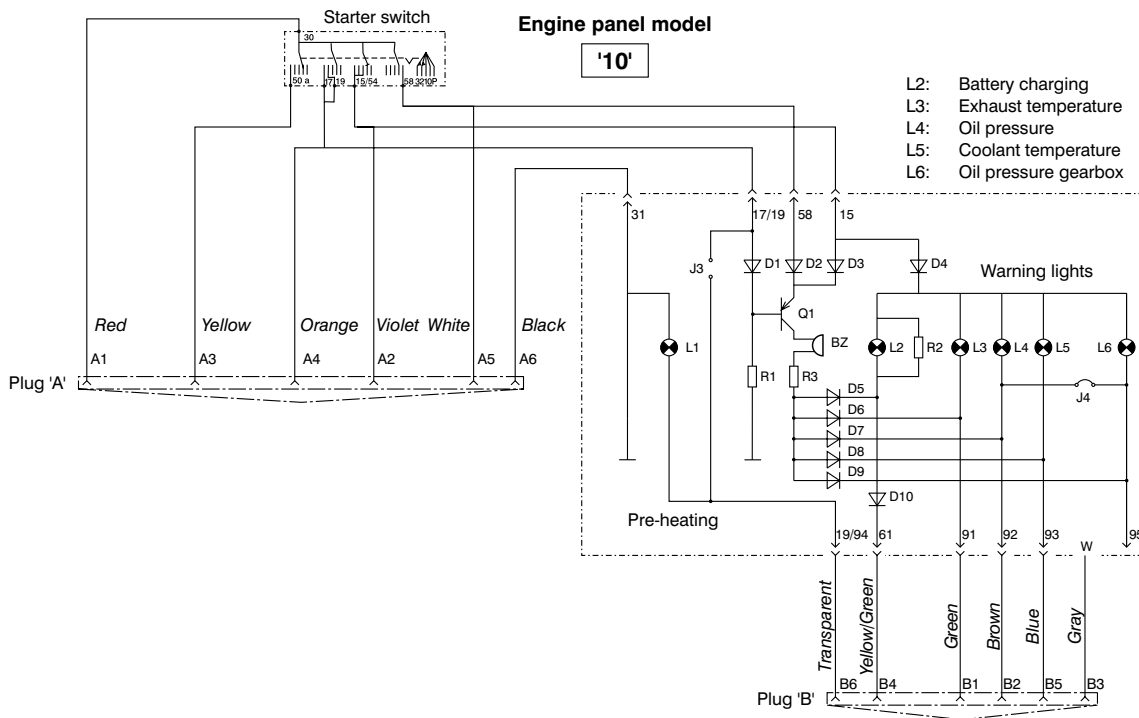
10 Wiring diagram

Engine with panel model '20', '21', '22'

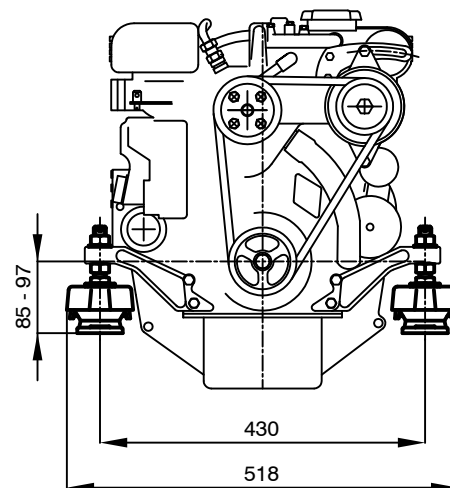
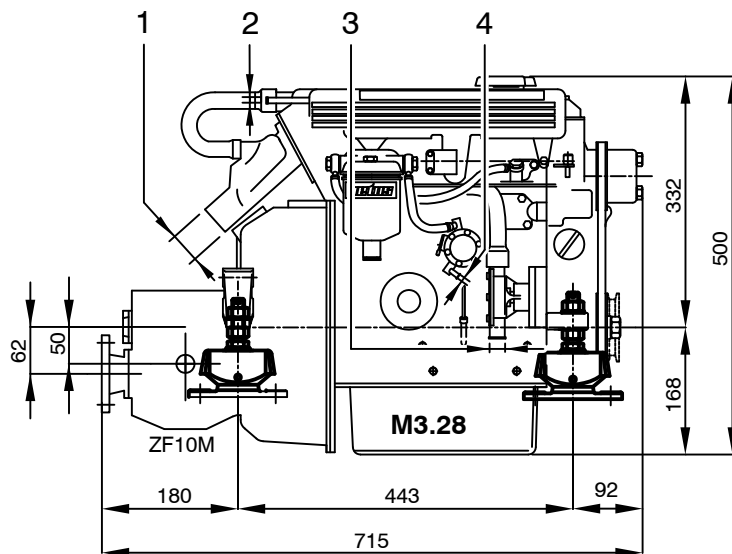


VD00215

Options, panel model '10'



11 Overall dimensions



- 1 Exhaust \varnothing 40 mm
- 2 Fuel return \varnothing 8 mm
- 3 Sea water intake \varnothing 20 mm
- 4 Fuel supply \varnothing 8 mm



M3.28

VD00574

1:10

12 Index

A

Adjusting valve clearance 35
Air inlet silencer 8
Airvent connection 9
Alternator 9

B

Battery 30, 31
Bleeding 26

C

Calorifier connection 9
Changing the gearbox oil 33
Checking engine oil level 23
Checking engine speed 47
Checking the V-belt 38
Checking valve clearance 34, 35
Cleaning the heat exchanger 44–46
Connection for extra expansion tank 9
Connection for gearbox push-pull cable 9
Connection for throttle push-pull cable 8
Control panels 10
Coolant 67
Coolant fluid 67
coolant level 24
Coolant replacement 42, 43
Cooling system air bleed nipple 9
Cooling system drain plug 9
Cruising 19

Cylinder numbering 7

D

Draining the oil 28

E

Electrical system connector box 8
Engine data tag 6
Engine Lubricating Oil 65
Engine Oil 12
Engine oil change 28, 29
Engine serial number 1, 6
Engine specifications 62, 63
Exhaust injection bend 9
Expansion tank 9

F

fasteners 39
Filler cap for cooling system 9
Filling gearbox 13
Filling the cooling system 14
First commissioning 12, 13, 15
flexible engine mounts 39
Fuel 15, 66
fuel filter 26
Fuel filter replacement 36, 37
Fuel lift pump 8
Fuel Quality Grade 66
Fuel return pipe connection 8

Fuel supply pipe connection 8
Fuse 8

G

Gearbox 8
Gearbox drain plug 9
Gearbox Lubricating Oil 65
Gearbox oil dipstick/filler cap 8
Gearbox oil level check 32

H

Heat exchanger 9
hose connections 39

I

Impeller 41
Introduction 5–10

M

Maintenance 21–47
Maintenance schedule 22
Manual operation of electric stop 8
Manual operation of fuel supply pump 8

O

Oil dipstick 8
Oil filler cap 8
Oil filter 8

12 Index

Oil level 23
Operating media 65–67
Overall dimensions 70

P

Pre-heating 17

R

Raw water inlet 8
Raw water pump 8, 40, 41
raw water strainer 25
Recommissioning after winter storage
51–55
 Changing the gearbox oil 55
 Check engine for leaks 55
 Checking instruments and remote
 controls 55
 Electrical system 54
 Fresh water cooling system 54
 Fuel system 51
 Lubrication system 52
 Raw water cooling system 52
Removing the oil filter 28
Running-in 15

S

Safety measures 4
Serial numbers 1
Starter motor 9

Starting 16–18
Stopping 20

T

Tachometer 19
Technical data 62–64
Tensioning V-belt 38
Topping up coolant 24
Topping up oil 23
Torque wrench settings 64
Troubleshooting 56–61

U

Use 11–20

V

V-belt 9
Voltmeter 19

W

Warning lights 19
Water separator/Fuel filter 8
water separator/fuel filter 26, 27
Water separator/fuel filter air bleed nipple
8
Water separator/fuel filter drain plug 8
Winter-grade fuel 66
Winter storage procedure 48–50
 Electrical system 50

Fresh water cooling system 50
Fuel system 48
Lubrication system 49
Raw water cooling system 49
Wiring diagram 68, 69

Manuals

Art. code	Description	
340301.01	Bedieningshandleiding	M3.28 (Nederlands)
340302.01	Operation manual	(English)
340303.01	Bedienungsanleitung	(Deutsch)
340304.01	Manuel d'utilisation	(Français)
340305.01	Manual de operacion	(Español)
340306.01	Istruzioni per l'uso	(Italiano)
340307.01	Brugsanvisning	(Dansk)
340308.01	Användarmanual	(Svenska)
340309.01	Bruksanvisning	(Norsk)
340310.01	Käyttöopas	(Suomeksi)
320331.01	(STM0032) Installatiehandleiding / Installation manual	(Nederlands / English)
320199.04	(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)
341231.01	Onderdelenboek / Parts manual M3.09 / M3.28	(Nederlands / English)
342102.01	Service manual M2.C5 / M2.D5 / M2.06 / M3.09 / M3.28	(English)



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