



M2

Operation manual

M2.02
M2.06

Operation manual



M2.02

M2.06

Serial numbers

Engine serial number Vetus:

.....

Engine serial number 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.

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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' (320199.06).

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 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.

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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.



WARNING

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



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.



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, non-flammable, non-poisonous solvents that are available from dealers.
- Always be alert to possible fuel or oil leakage!
If you discover a leak, take counter-measures 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.

- 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 turn the engine over. 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 coolant level after the engine has been stopped and the filler cap on the heat exchanger is cool enough to be removed with bare hands.
- Never attempt to adjust the fan belt on a running engine.

- 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.

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 fan belt is broken:

Immediately stop the engine. If an engine is used with a broken fan belt, this can lead to the engine overheating, which in turn can cause coolant to spray 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 for pleasure 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.

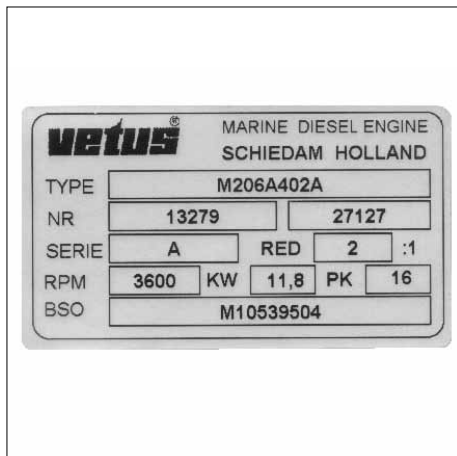
We have endeavoured to highlight any differences so that you will be able to locate the operating and maintenance instructions relevant to your engine quickly and easily.

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.

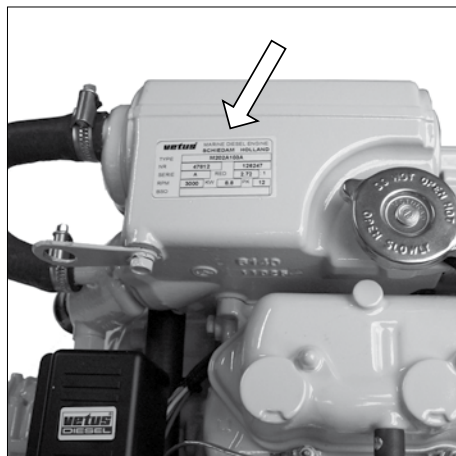
2 Introduction



1 Engine data tag

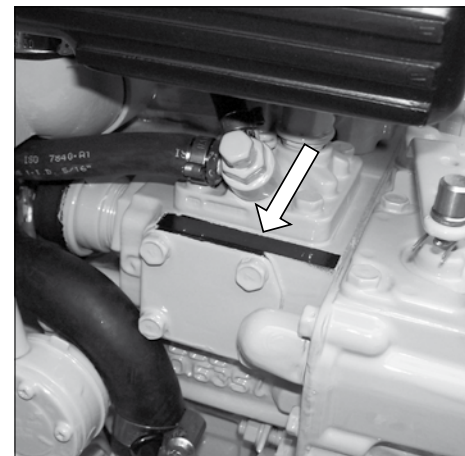
The Vetust engine serial number and performance data are printed on the engine data tag.

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



2 Engine data tag location

The type plate is positioned as shown.

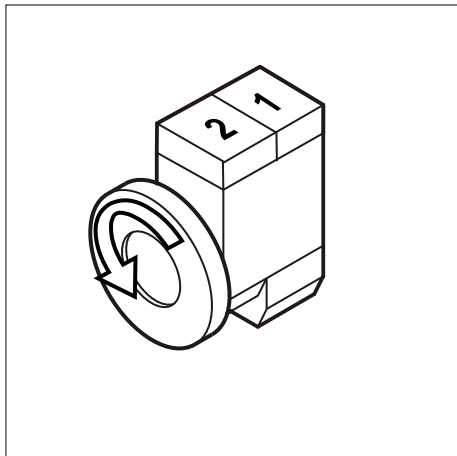


3 Engine serial number

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

2 Introduction

Cylinder numbering and direction of rotation Fuel pump seal



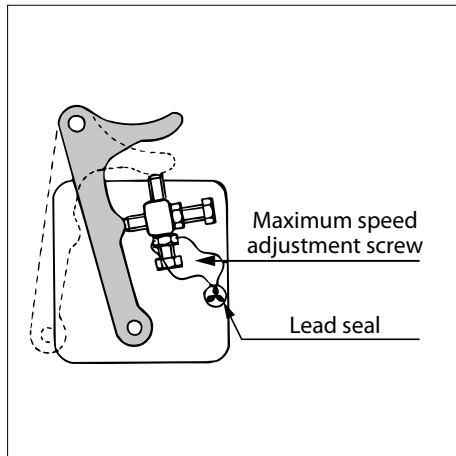
4 Cylinder numbering and direction of rotation

Cylinder numbering

Cylinders are numbered consecutively, beginning at the front end.

Direction of rotation

The direction of rotation is viewed towards the flywheel counter clockwise.



5 Fuel pump seal



CAUTION

Breaking the seals on the regulator to alter the settings of maximum rpm and maximum injector volume may only be carried out by authorised Vetus Service personnel.

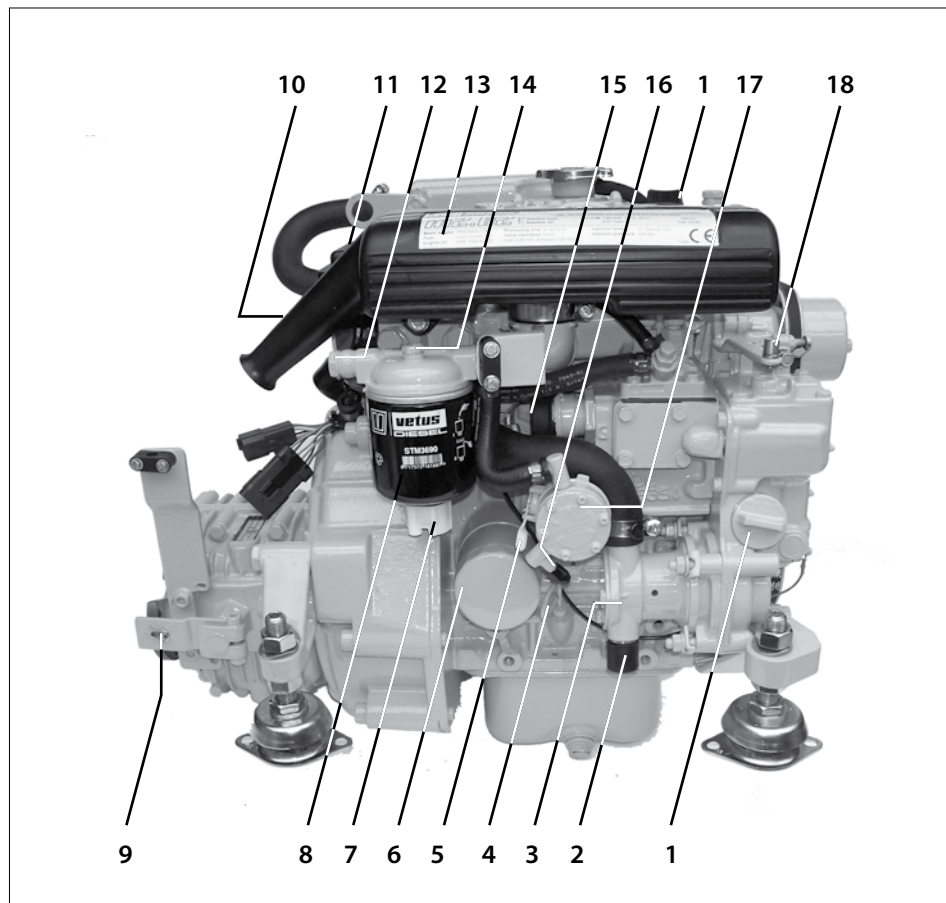
Breaking the seals and altering the settings can lead to:

- Accelerated wear of engine components.
- Increased fuel and oil consumption.
- Incorrectly adjusted injector volume and poor engine performance.
- Breaking emission regulations.

2 Introduction

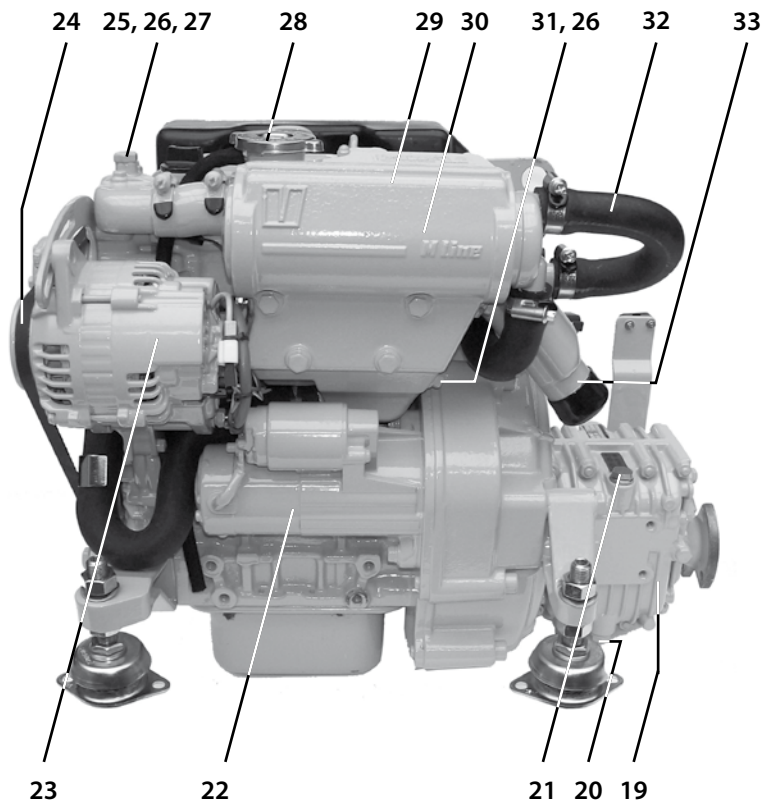
Identification of engine parts Service side

- 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 Connection for gearbox push-pull cable
- 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



2 Introduction

Identification of engine parts Starter side

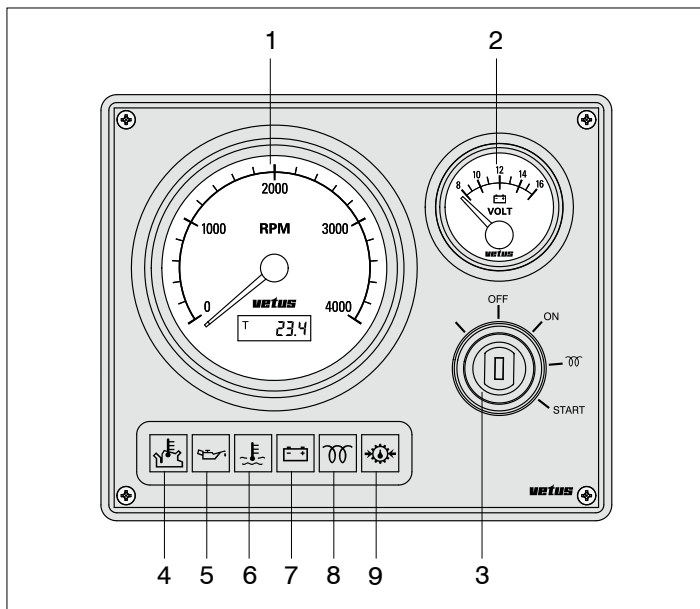


- 19 Gearbox
- 20 Gearbox drain plug
- 21 Gearbox oil dipstick/filler cap
- 22 Starter motor
- 23 Alternator
- 24 V-belt
- 25 Connection for extra expansion tank
(Keel cooling model only)
- 26 Calorifier connection
- 27 Cooling system air bleed nipple
- 28 Filler cap for cooling system
- 29 Expansion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

1007254

2 Introduction

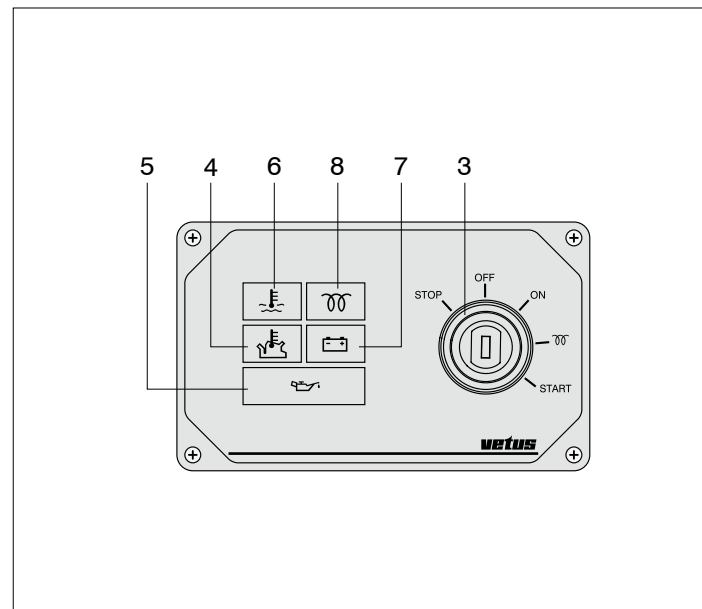
Control panels



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
- 7 Warning light battery charging



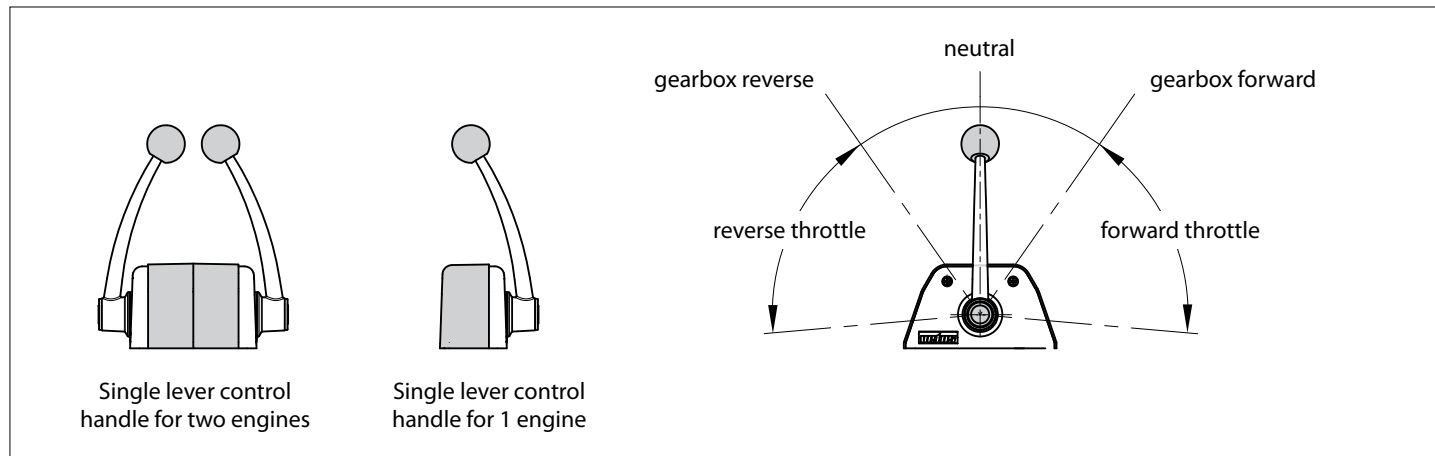
Sailingboat panel, model 10

- 8 Indicator light pre-heating
- 9 Warning light gearbox low oil pressure ^[1]

[1] This is an option, not fitted as standard.

2 Introduction

Control lever



6 Operating lever

Operating lever for 1 or 2 engines.

The control lever works as shown in the diagram.

Starting from neutral put the engine in ahead or astern by moving the lever 35° forwards or backwards.

The throttle lever operates at an angle of 60° forwards and 60° reverse.

3 First commissioning

Engine Oil

2.4 litres 15 W40
(4.2 Imp. pt, 5.1 US pt)

API: CF4, CG4, CH4, CI4

ACEA: A3/B3, A3/B4, E7

For example:

- Vetus Marine Diesel Engine Oil 15W40
- Shell Rimula R4 L 15W40

1 Commissioning the engine

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



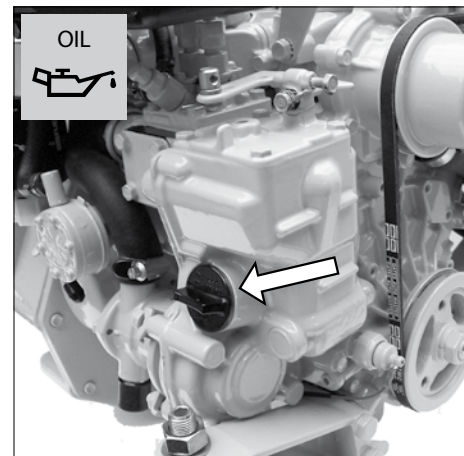
2 Filling with engine oil

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 oil specification see page [102](#) and [106](#).

- Check the oil level with the dipstick, see page [40](#).



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

3 First commissioning

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 owners manual.

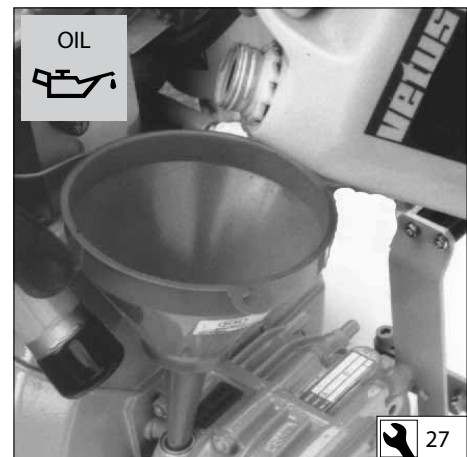
3 Filling gearbox with oil

- Fill the gearbox with oil.
- Check the oil level with the dipstick, see page 42.



Technodrive:

type TMC40P : 0.2 litres, ATF ^[1]
(0.35 Imp. pt, 0.42 US pt)
type TMC60A : 0.6 litres, ATF ^[1]
(1.05 Imp. pt, 1.25 US pt)



ZF Hurth:

type ZF10M : 0,42 litres ATF ^[1]
(0.73 Imp. pt, 0.89 US pt)

^[1] ATF :Automatic Transmission Fluid;
Transmissie olie type A, Suffix A.

^[1] ATF :Automatic Transmission Fluid;
Transmissie olie type A, Suffix A.

3 First commissioning



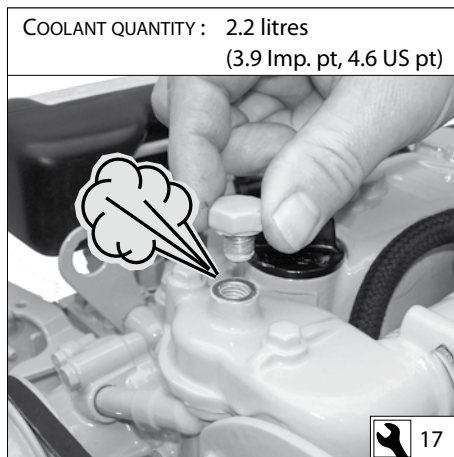
4 Filling the cooling system, INTERCOOLING,

- 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.



NOTE

If a water heater is connected to the engine, see page [20](#) and [21](#).



- Fill the cooling system.

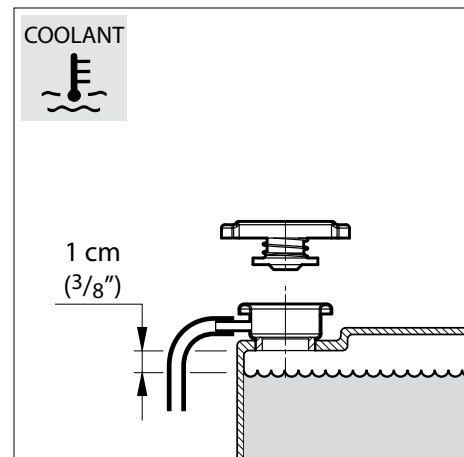
Use a mixture of 40% antifreeze (ethylene-glycol based) and 60% tap water or use a special coolant.

For specifications see page [109](#).



CAUTION

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

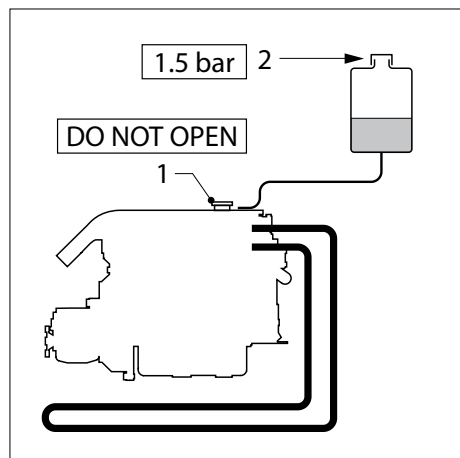


The level of the coolant must be approx. 1 cm (3/8") below the lower edge of the filler neck.

Bleeding will take place automatically during filling!

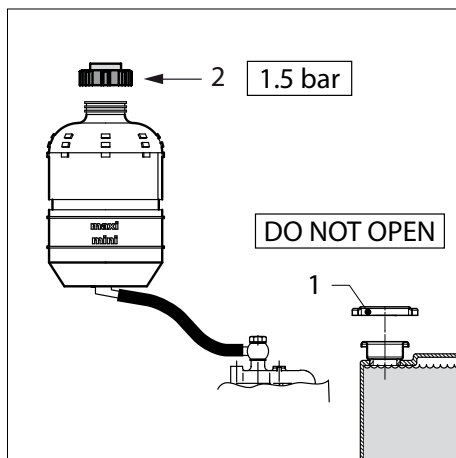
- Replace the filler cap.
- Reinstall the bolt in the thermostat cover..

3 First commissioning



5 Filling the cooling system, KEEL COOLING

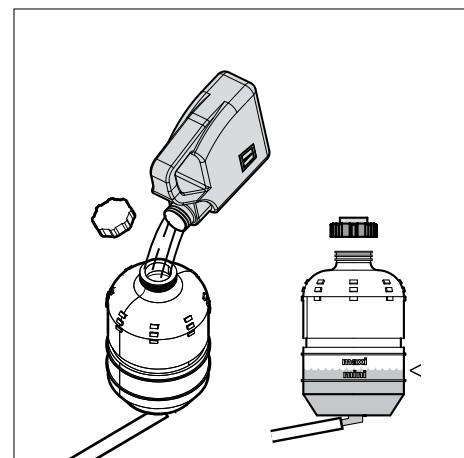
- Remove the cap 'DO NOT OPEN' (1) of the filler neck on the top of the heat exchanger housing.
- Fill the cooling system.
- Reinstall the filler cap 'DO NOT OPEN'.
- Remove the pressure cap (2) of the extra expansion tank.



- Top up the extra expansion tank to the minimum level.
- Reinstall the pressure cap (2).

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

For specifications see page 109.



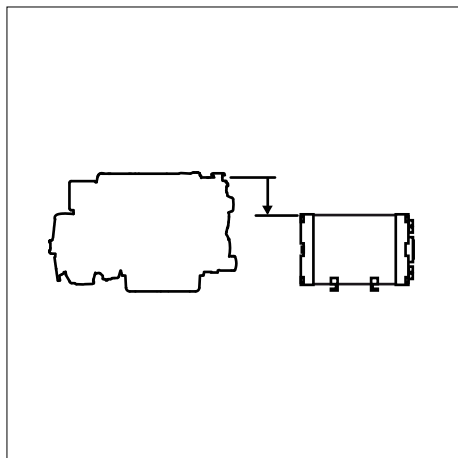
NOTE

If a water heater is connected to the engine, see page 20 and 21.

CAUTION

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

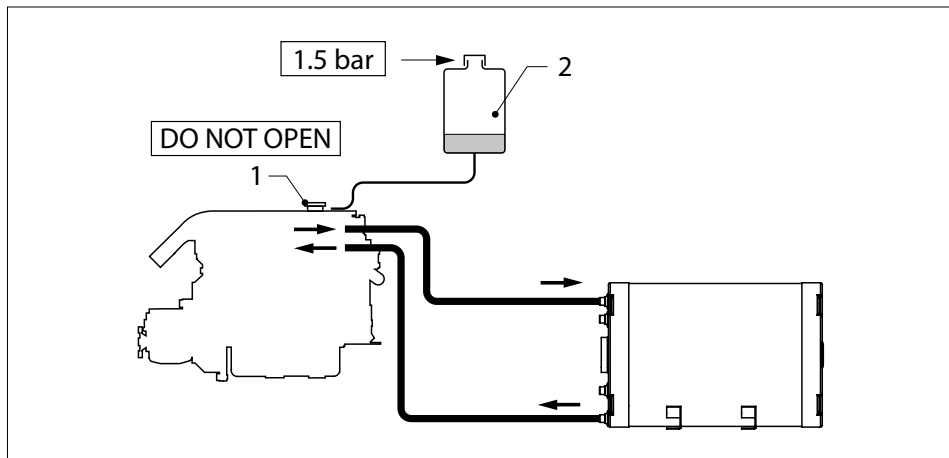
3 First commissioning



6 Filling coolant system, if a water heater is connected (1)

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.



- Remove the 'DO NOT OPEN' cap (1) and fill the cooling system via the filler neck.
- Add coolant into the expansion tank (2) until minimal level has been reached.

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

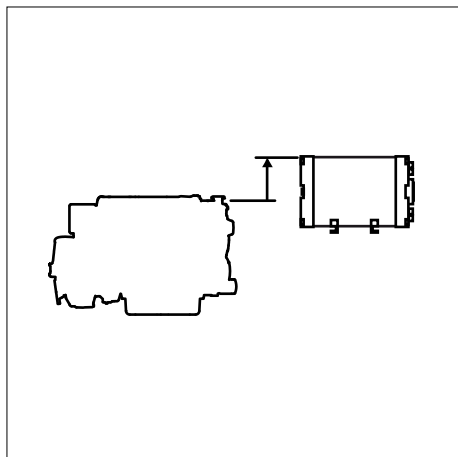
For specifications see page 109.



CAUTION

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

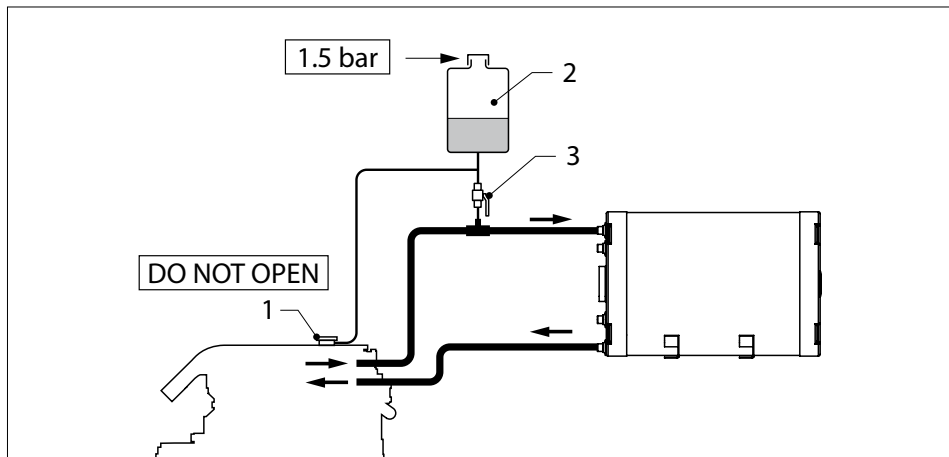
3 First commissioning



7 Filling coolant system, if a water heater is connected (2)

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 expansion tank (2).
- Open valve (3) during filling and bleeding the system.

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

For specifications see page 109.



NOTE

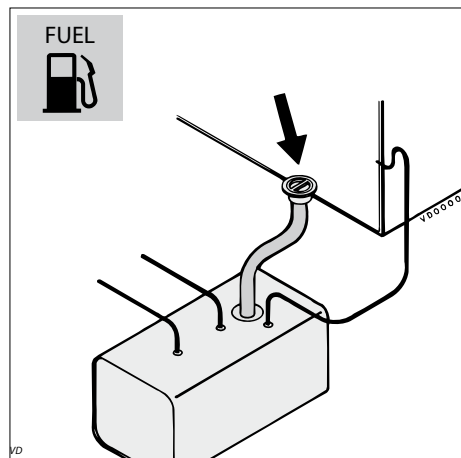
- Remember to close valve (3) after filling the system.



CAUTION

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

3 First commissioning



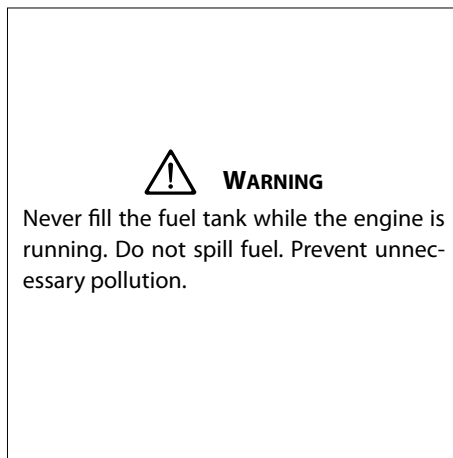
8 Fuel

- Ensure that the fuel tank is filled with diesel fuel.

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

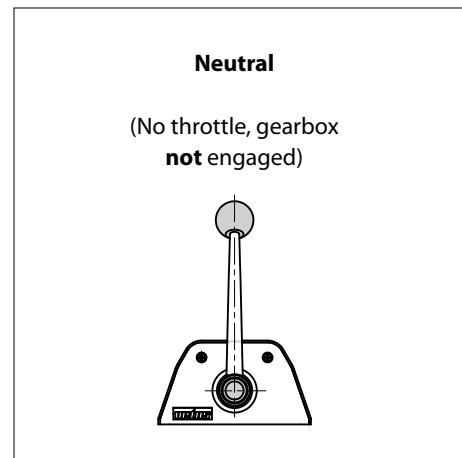
For fuel grade see page 105.

- Bleed the fuel system, see page 45.



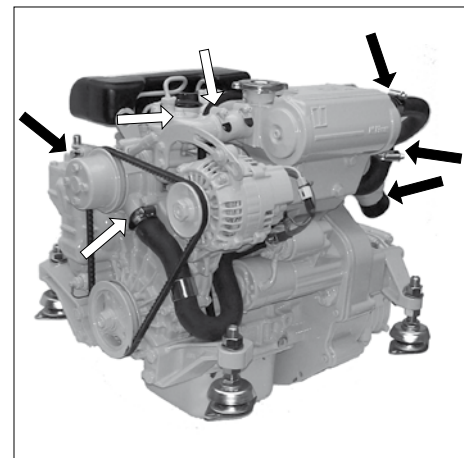
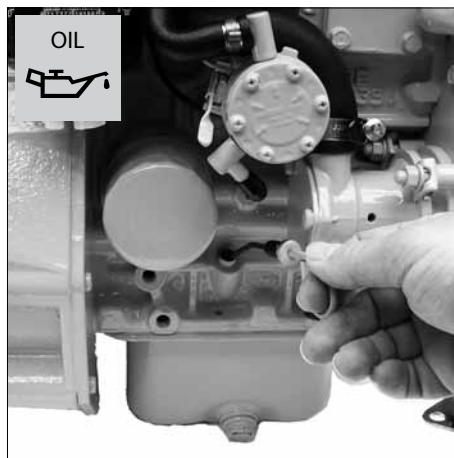
9 Other preparations

- 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'.

3 First commissioning



10 Test run

- Start the engine.

How to start the engine and what to check before, during and immediately after starting is described on page 28 and further.

- Allow the engine to test run for about 2 minutes at idling speed .
- Stop the engine.
- Check the oil level. If necessary top up to the indicated level.
- Start the engine.
- Allow the engine to test run for about 10 minutes at idling speed.
- Stop the engine.

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



CAUTION

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

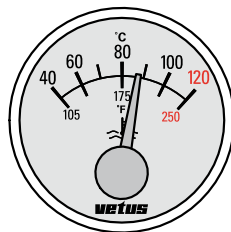
3 First commissioning



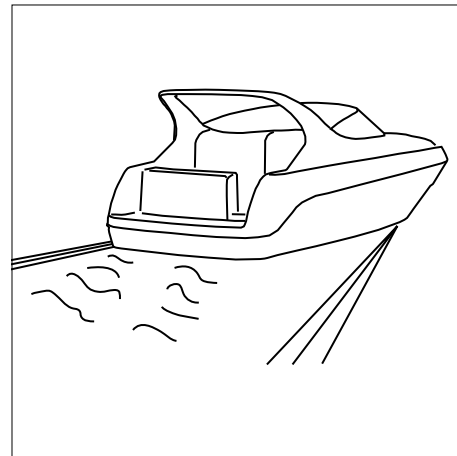
11 Bleeding

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

- Open the cap on the filler neck.
- Vary the revolutions between idling and 2000 rev/min.
- Add coolant if necessary.



- Replace the cap on the filler neck.
- Check the coolant temperature.



12 Sea trial

- Check the operation of the remote control.
- Carry out a sea trial

4 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.

After the first 50 operation hours carry out the following maintenance:

- Drain water from fuel filter, see page 44.
- Engine oil change, see page 47.
- Replace oil filter, see page 48.
- Replace fuel filter, see page 55.
- Change gearbox oil (Technodrive), see page 58.
- Change gearbox oil (ZF Hurth), see page 59.
- Check V-belt, see page 62.
- Check flexible engine mounts, see page 63.
- Check engine for leaks, see page 63.
- Check tightness of all fasteners, bolts and nuts, see page 63.

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 109.
- Never run the engine without a thermostat.
- Use a good quality lubricating oil. For specifications see page 106.
- 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 ^[1] or battery charging lights up.
- Always follow the safety advice, see page 4.

^[1] Only engines with intercooling.



NOTE

First commissioning

Follow the instructions given for 'First commissioning' on page 16 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.

5 Use

Before starting, always check the following points:

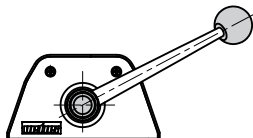
- Engine oil level.
- Coolant level.
- Sea cock open.
- Main switch 'ON'.
- Gearbox in '**NEUTRAL**' position.



WARNING

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

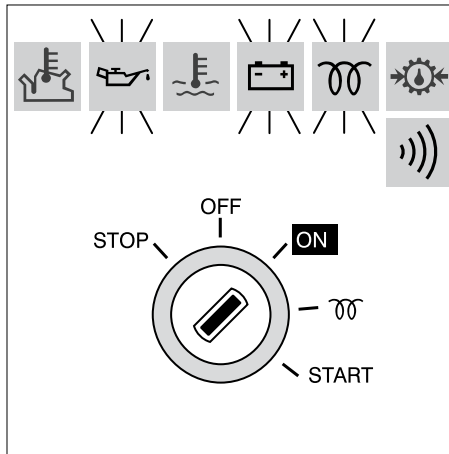
half throttle,
gearbox **not** engaged



1 Control lever

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

Starting



2 Switching on

- 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.

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

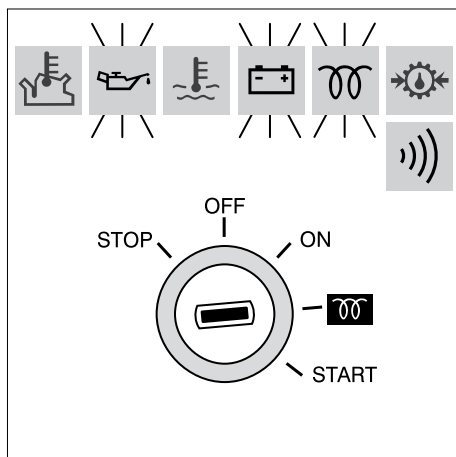
3 Pre-heating

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



CAUTION

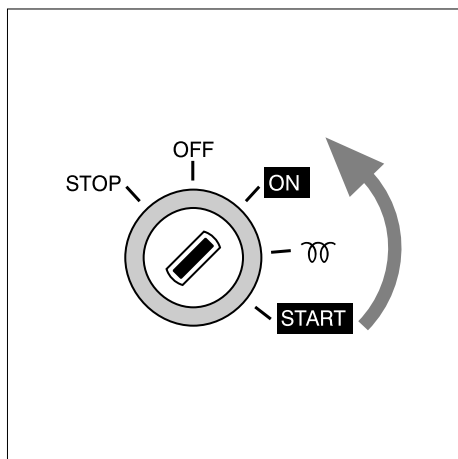
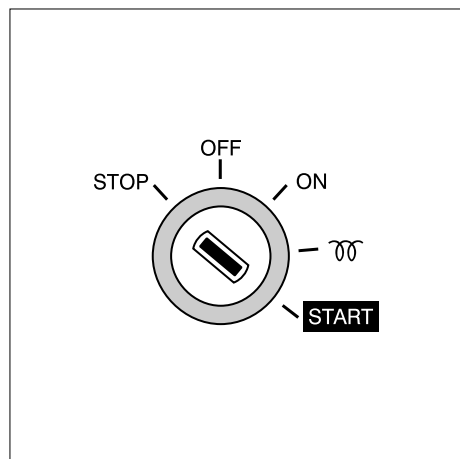
To prevent the glow plugs from burning out, **never** exceed the stated maximum pre-heating time.



- Turn the key further clockwise to the '00' position.

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

- Hold the key in this position for about 6 seconds.



4 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.

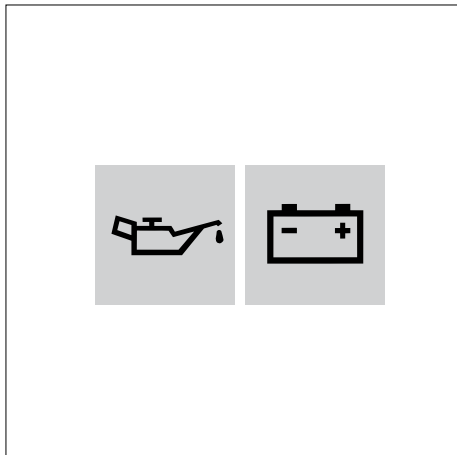


CAUTION

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

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

5 Use



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

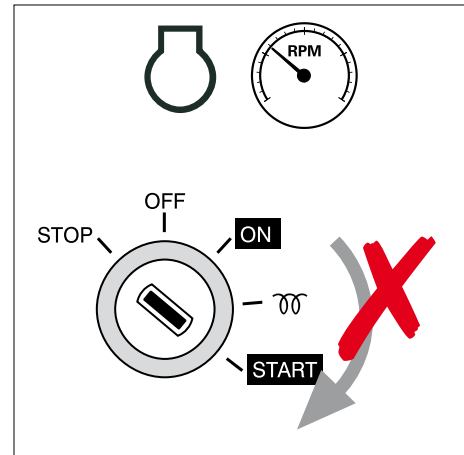
Cooling water should now flow out of the exhaust; if this is not the case, stop the engine immediately ^[1].

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.

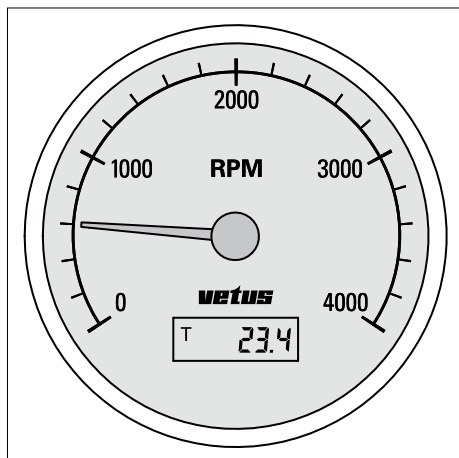
^[1] Only engines with intercooling.

Starting



CAUTION

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

**5 Tachometer**

The instrument panel is provided with the following instruments (Depending of the type of panel, see page 17).

Indicating the number of revolutions per minute of the engine.

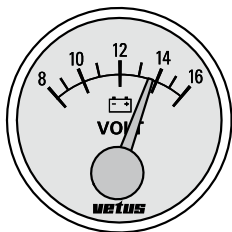
Also the number of running hours is indicated.

Idling speed : 850 rpm

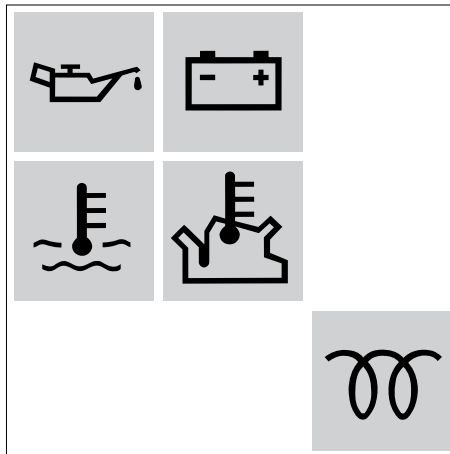
**WARNING**

Avoid idling for more than 10 minutes.

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

**6 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.

**7 Warning lights**

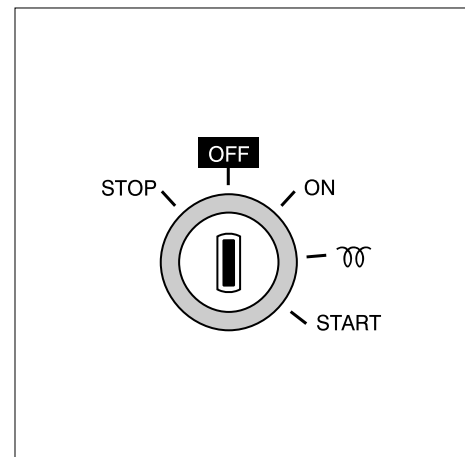
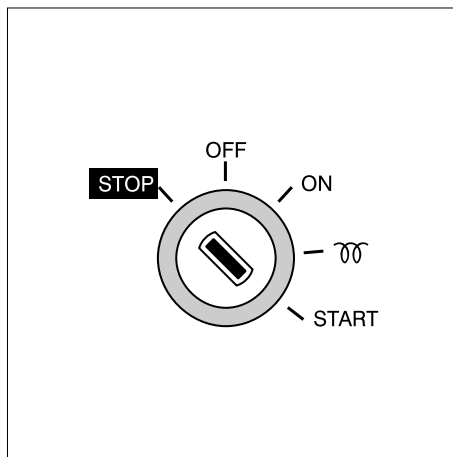
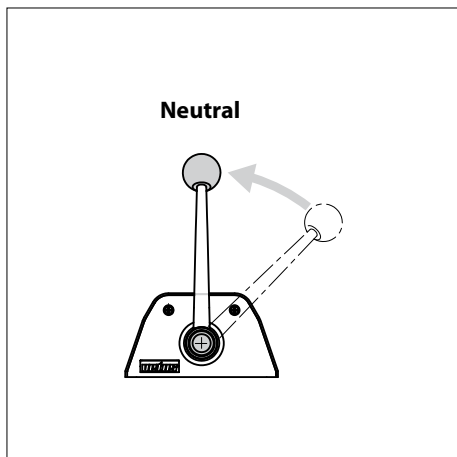
None of the five warning lights should light up while the engine is running.

**8 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!

5 Use

Stopping



9 Stopping

- Reduce engine speed to idle and shift the gearbox to '**Neutral**'.
- Turn the key **entirely** to the left, through the '**OFF**' position.
- When the engine has stopped, turn the key to the '**OFF**' position.



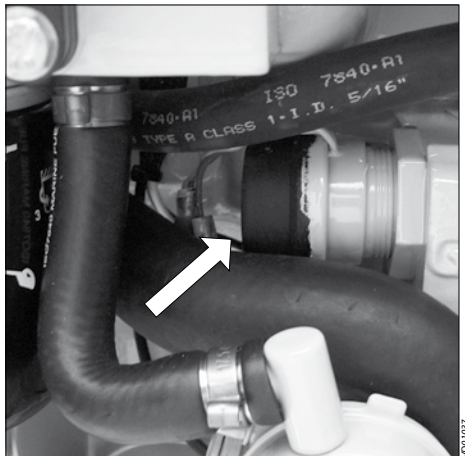
NOTE

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.



NOTE

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.



10 Stopping on the engine itself

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.

Keep record of the following information in the logbook and/or the 'Service and Warranty Manual':

- 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.

6 Maintenance

Maintenance schedule

Every 10 hours or daily, before starting	page
Check engine oil level	40
Check water strainer	41
Check coolant level	42

After the first 50 hours	page.
Drain water from fuel filter	44
Engine oil change	47
Replace oil filter	48
Check gearbox oil level	54
Replace fuel filter	55
Check V-belt	62
Check flexible engine mounts	63
Check engine for leaks	63
Check tightness of all fasteners, bolts and nuts	63

Every 100 hours, at least once every year	page
Drain water from fuel filter	44
Engine oil change	47
Replace oil filter	48
Battery, cables and cable connections	50
Check gearbox oil level	54

Every 500 hours, at least once every year	page
Replace fuel filter	55
Change gearbox oil (Technodrive)	58
Change gearbox oil and replace filter (ZF Hurth)	59
Check valve clearance	60
Check V-belt	62
Check flexible engine mounts	63
Check engine for leaks	63
Check tightness of all fasteners, bolts and nuts	63



DANGER

Stop the engine before carrying out any maintenance work

6 Maintenance

Maintenance schedule

Every 500 hours	page
Check glow plugs	[1]

Every 1000 hours, at least once every 2 years	page.
Raw water pump inspection	64
Replace coolant	66

Every 1000 hours	page
Check starter motor	70
Check alternator	70

When required	page
Bleeding fuel system	45
Check idle rpm	71
Cleaning heat exchanger	72

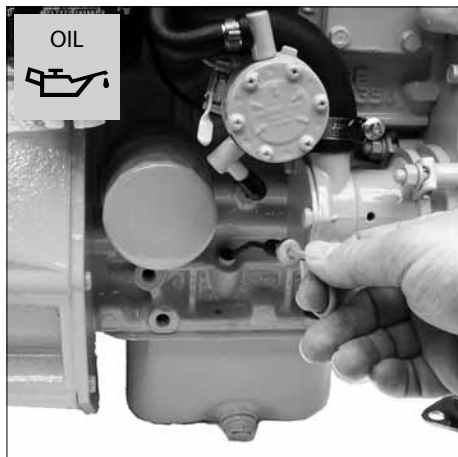


DANGER

Stop the engine before carrying out any maintenance work

[1] Consult the service manual, work to be carried out by a Vetus Mitsubishi dealer.

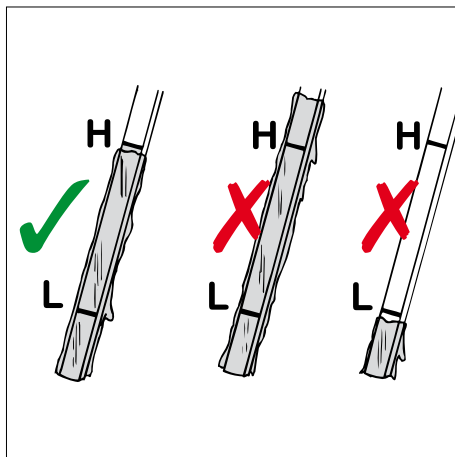
6 Maintenance



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 ^[1].

- If necessary top up with the same brand and type of oil.

Checking engine oil level

Daily, before starting.



3 Topping up oil

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

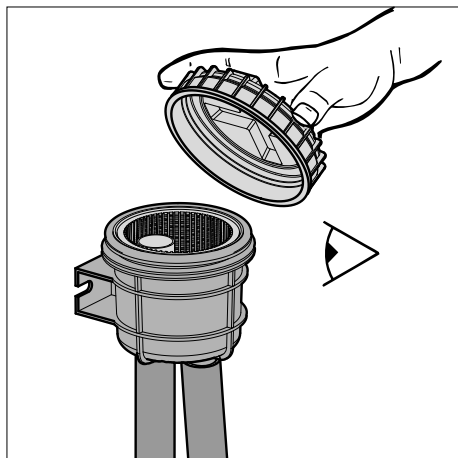
A second oil filling cap is located at the distribution cover, see page 16.

^[1] The difference between the two oil level marks is: 1.0 litres (1.8 Imp. pt, 2.1 US pt)

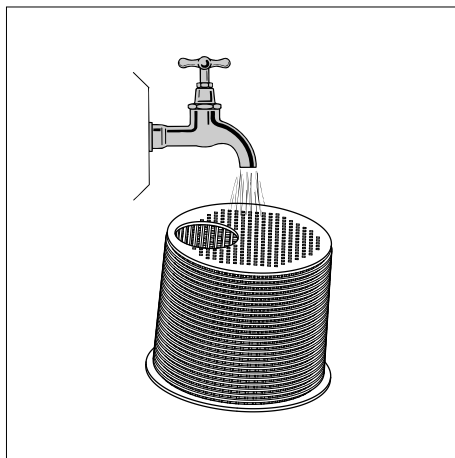
6 Maintenance

Checking and cleaning the raw water strainer

Daily, before starting.



4 Checking the raw water strainer



5 Cleaning the strainer

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



NOTE

Only engines with intercooling!

6 Maintenance



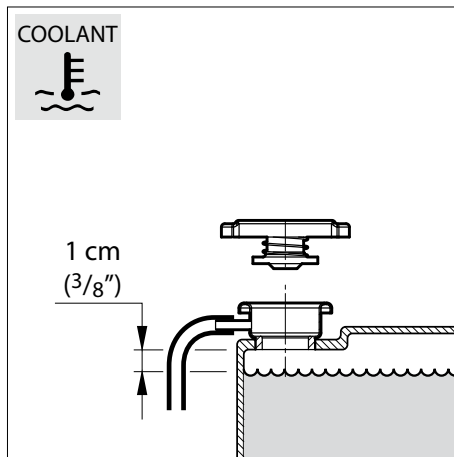
6 Checking coolant level

- 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.



WARNING

Never open the cap on the header tank when the engine is at operating temperature.



7 Coolant level

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



NOTE

For a keel-cooled version, see page 19.
If a water heater is connected, see page 20 and 21

Checking coolant level

Daily, before starting.



8 Topping up coolant

- If necessary, top up.
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 109.



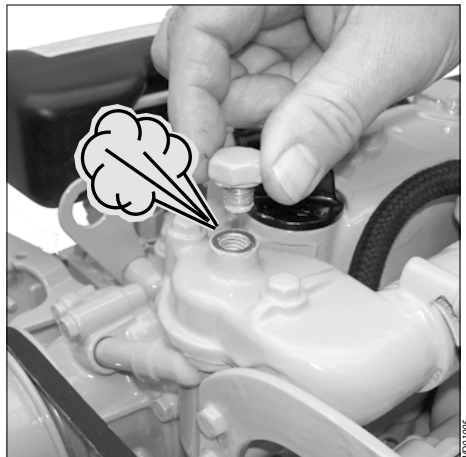
CAUTION

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

6 Maintenance

Checking coolant level

Daily, before starting.

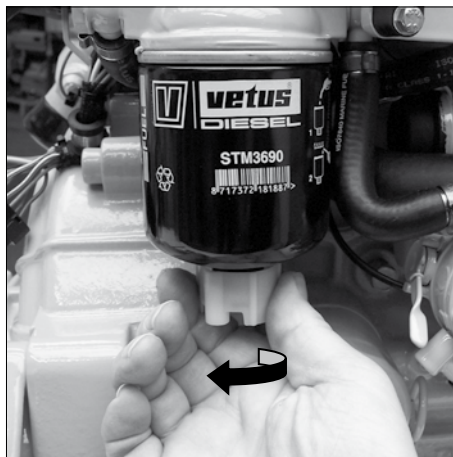


- When topping up coolant, remove the bolt from the upper side of the thermostat cover, so that air can escape from the cooling system.

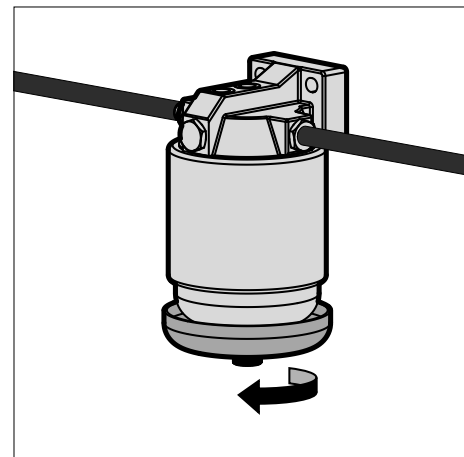
6 Maintenance

Draining of water from the water separator/fuel filter

Every 100 operating hours.



9 Empty fuel filter



10 Empty water separator



DANGER

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.

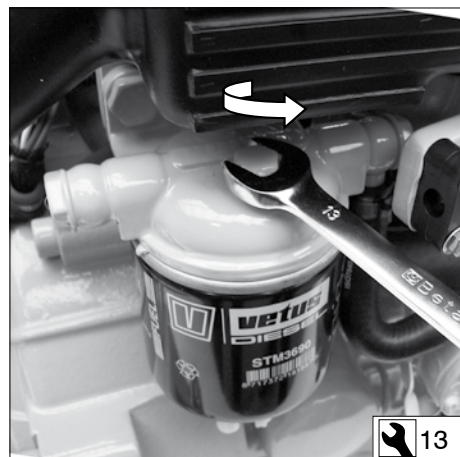
- Open the drain plug at the lower side of the filter.
- Drain the water and close the drain plug.

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!

6 Maintenance

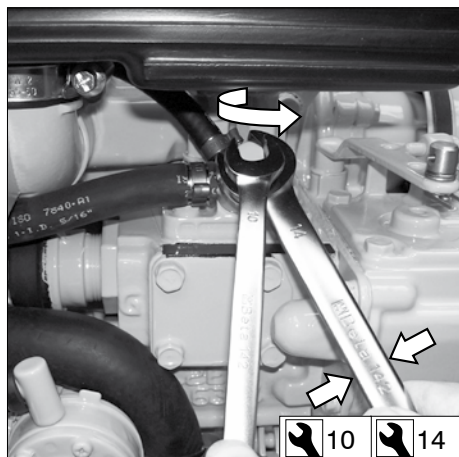


11 Bleeding

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.



Draining of water from the water separator/fuel filter

Every 100 operating hours.

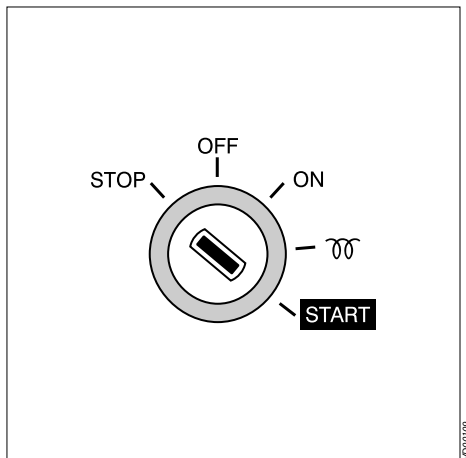


- A second bleeding nipple is located at the fuel injection pump.

- 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.

6 Maintenance



12 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.

Draining of water from the water separator/fuel filter

Every 100 operating hours.

6 Maintenance

Engine oil change

Every 100 operating hours.

13 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).)



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.

6 Maintenance



14 Draining the oil

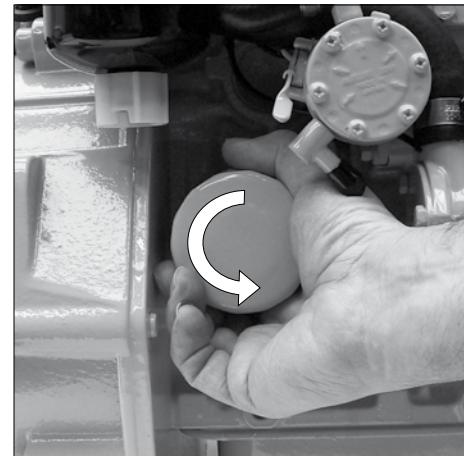
- Remove the dipstick; insert the suction hose of the supplied sump pump in the dipstick tube.
- Push down the pump handle quickly and pull it up slowly.
- Pump the sump empty.



WARNING

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

Engine oil change Every 100 operating hours.



15 Removing the oil filter

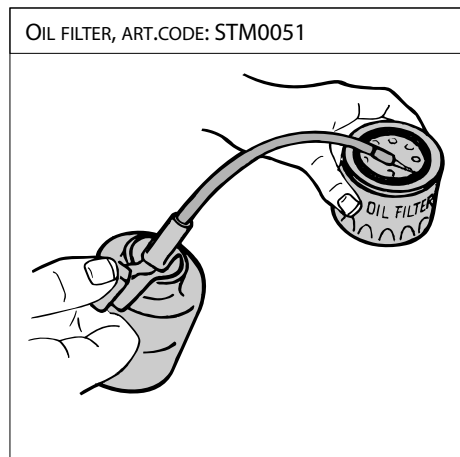
- Unscrew the oil filter, with a commercially available tool.
Catch any dripping oil.



DANGER

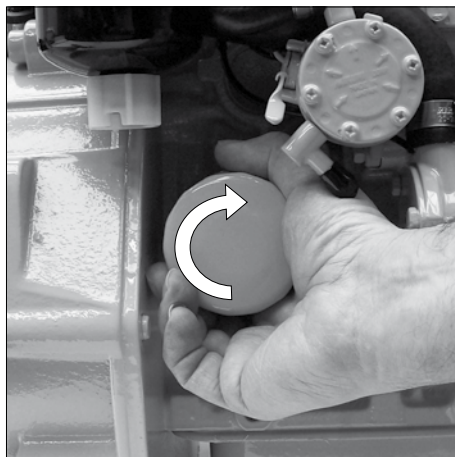
Beware of burns from hot oil.

6 Maintenance



16 Oiling the oil seal

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



17 Oil filter installation

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



18 Refilling with oil

- Refill the engine with new oil (for specification see page 106) 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.

6 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.

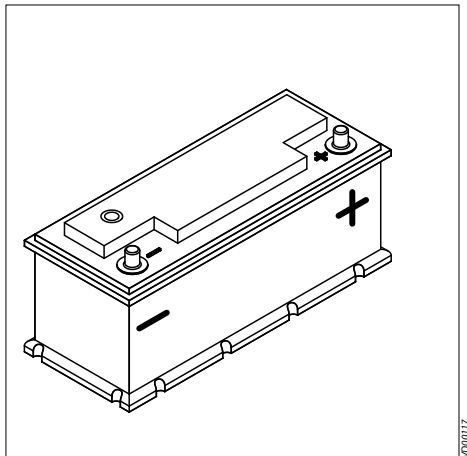
Keep the batteries upright and do not tip during transport and storage to prevent acid leaking out.

Never dispose of old batteries as domestic waste.



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

6 Maintenance



19 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.

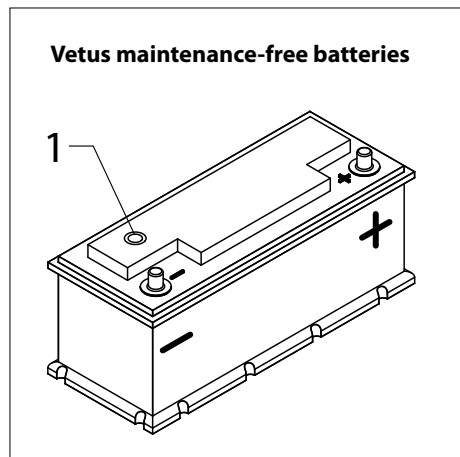
Battery, cables and connections

Every 100 operating hours.

6 Maintenance

Battery, cables and connections

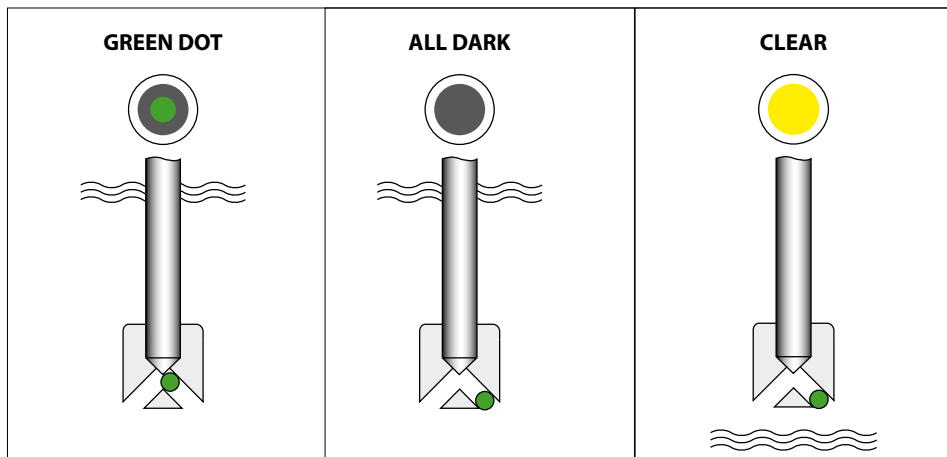
Every 100 operating hours.



20 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:



21 Hydrometer operation

Green dot visible:

State of charge 65 % or more.

Dark:

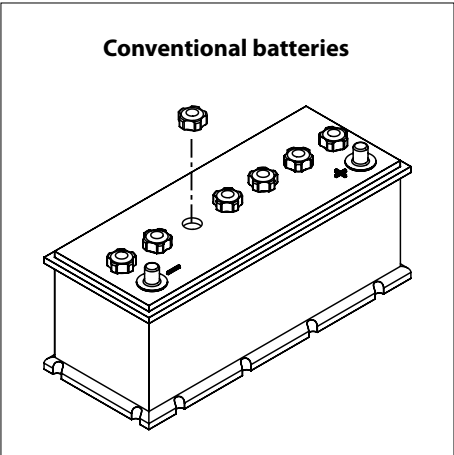
State of charge less than 65 %. Recharge immediately.

Clear or light yellow:

Electrolyte level low.

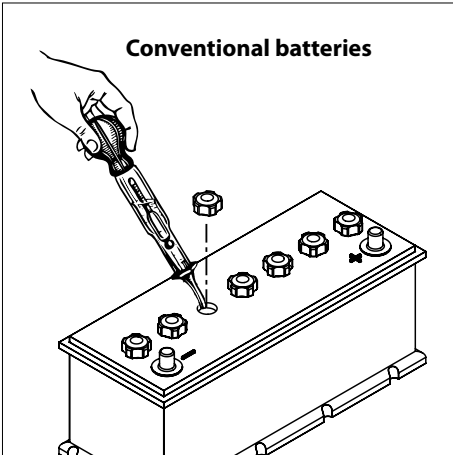
In case of low level, caused by overcharging the battery for a long period of time with a voltage too high, replace battery. Check alternator and/or voltage regulator.

6 Maintenance



22 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 ($\frac{3}{8}$ " to $\frac{5}{8}$ ") 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.



23 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.

Battery, cables and connections

Every 100 operating hours.

Specific gravity	State of charge	
1,8 kg/l	100%	
1.20 kg/l	50%	recharge
1.12 kg/l	10%	recharge immediately

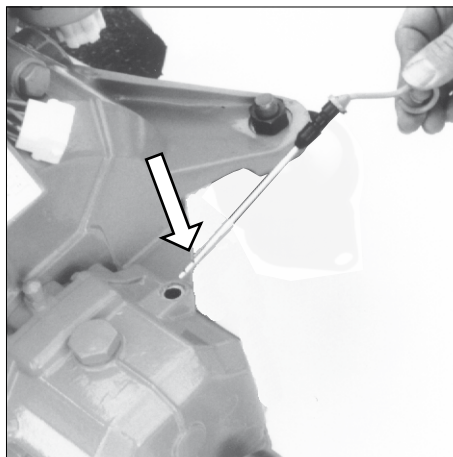
During checking the temperature of the electrolyte should preferably be 20°C (68°F).

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.

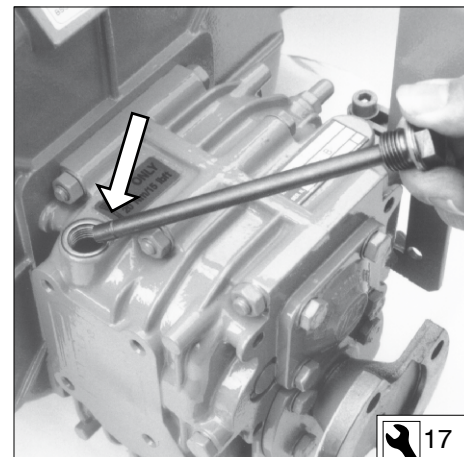
6 Maintenance

Gearbox oil level check

Every 100 operating hours.



24 Oil level check (Technodrive)



25 Oil level check (ZF-Hurth)

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 owners manual for changing oil and other care and maintenance.

- Take the dipstick out of the gearbox housing by pulling or unscrewing.
- Check the oil level by lowering the dipstick (cleaned) into the hole.

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

- If necessary top up by pouring oil into the filler hole or the dipstick hole.

For oil type and specification see page 108.

6 Maintenance

Fuel filter replacement

Every 500 operating hours.



26 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.



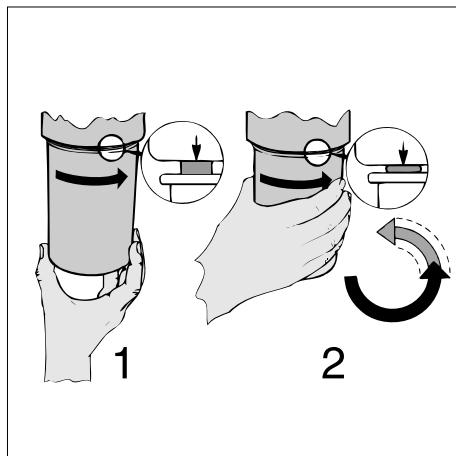
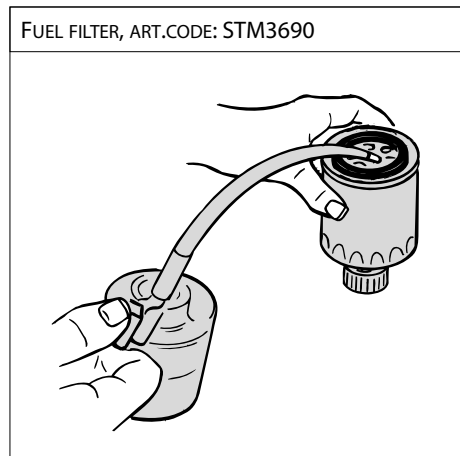
DANGER

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

6 Maintenance

Fuel filter replacement

Every 500 operating hours.



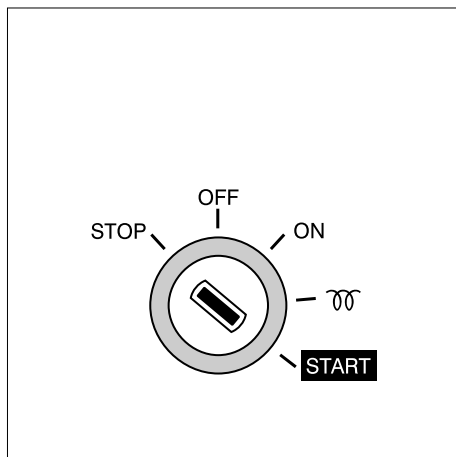
27 Fuel filter installation

- 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.
- 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.

6 Maintenance

Bleeding, after fuel filter replacement

Every 500 operating hours.



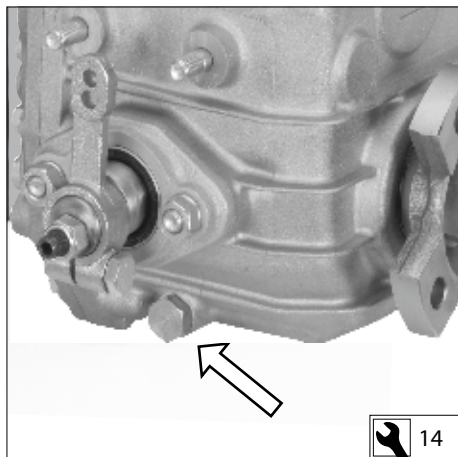
28 Bleeding

- After replacing the fuel filter the air has to be bled from the fuel system.
- For bleeding see page 45.

29 Start the engine

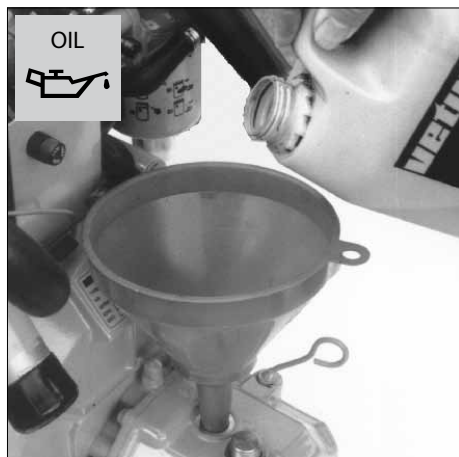
- Operate the starter switch until the engine fires; release the starter switch if the engine does not fire within 20 seconds. Wait until the starter motor has stopped before making a new attempt to start the engine.
- Repeat the above if the engine cuts out after a short time.
- Check for leaks once more.

6 Maintenance



30 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.



31 Filling with new oil

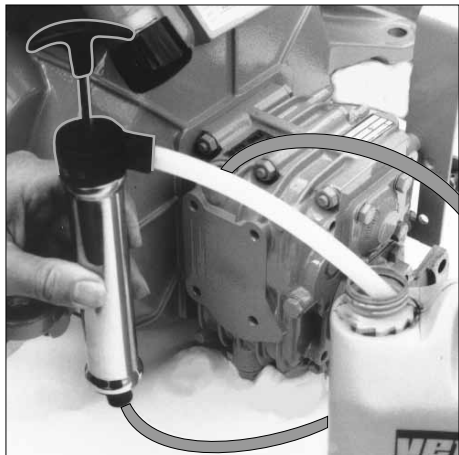
- Refill the gearbox to the correct level via the filling hole.
- For quantity and oil specification see page 108.

Changing the gearbox oil (Technodrive)

Every 500 operating hours.

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.

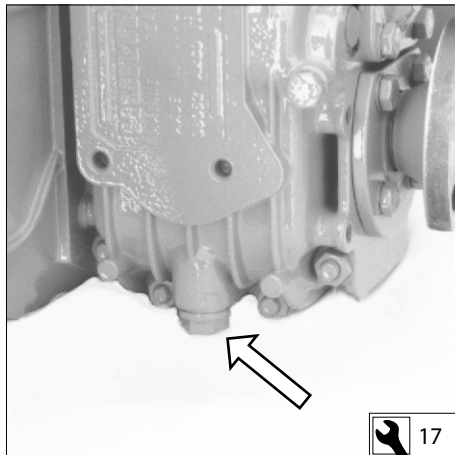
6 Maintenance



32 Draining the oil

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

- Remove the dipstick.
- 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.

Changing the gearbox oil (ZF-Hurth)

Every 500 operating hours.



33 Filling with new oil

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

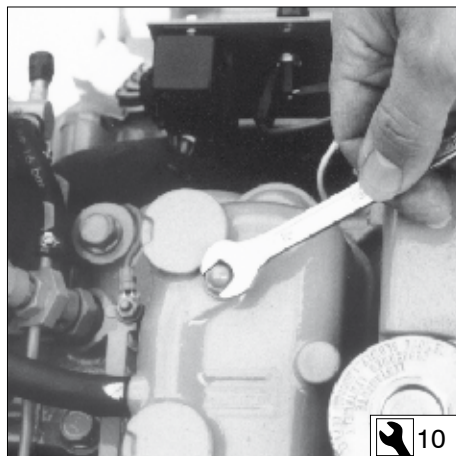
For oil specification see page 108.

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.

6 Maintenance

34 Checking / adjusting valve clearance

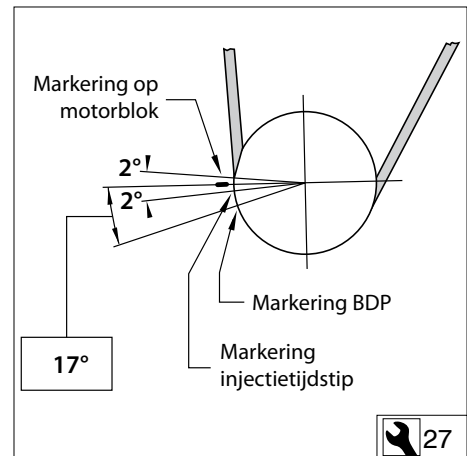
Checking the valve clearance must be done with a cold engine, that is an engine which did not run for at least 6 hours.



35 Remove rocker cover

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

Checking valve clearance Every 500 operating hours.

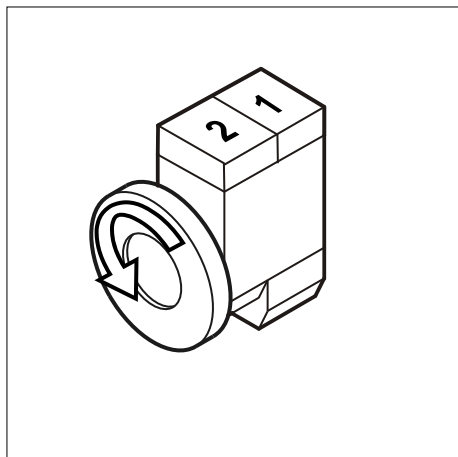


36 Locating TDC

- 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.

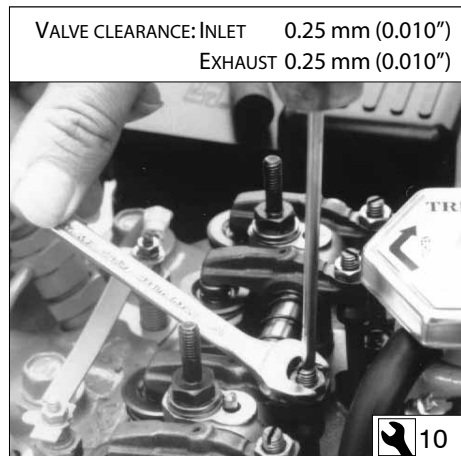
Note: There are two TDC's e.g. compression and suction. At the TDC at the end of the compression stroke the rocker arm does not move when the crank pulley is rotated a little.

6 Maintenance



37 Adjusting valve clearance

Cylinders are numbered consecutively, beginning at the front end.

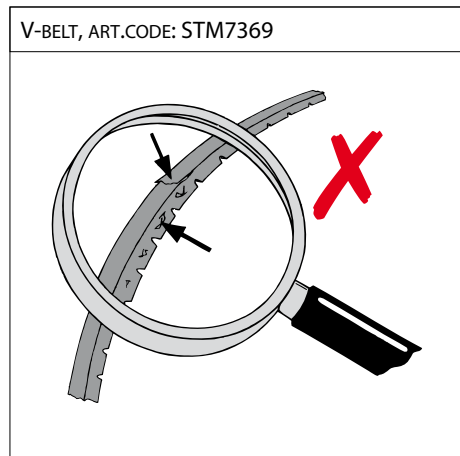


- Check valve clearance at cylinder 1 and adjust if necessary.
- Rotate the crankshaft 180° clockwise and check valve clearance at cylinder 2.

Checking valve clearance

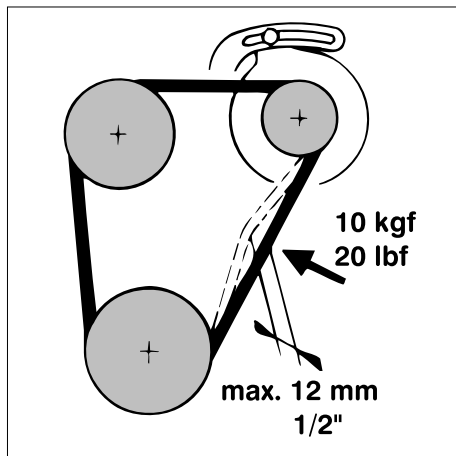
Every 500 operating hours.

6 Maintenance



38 Inspection V-belt

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

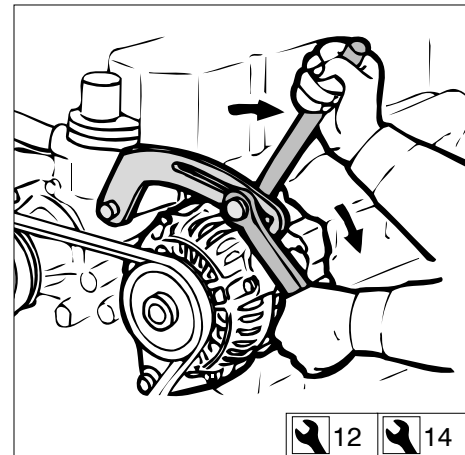


39 Checking tension

- 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.

Checking the V-belt

Every 500 operating hours.



40 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.



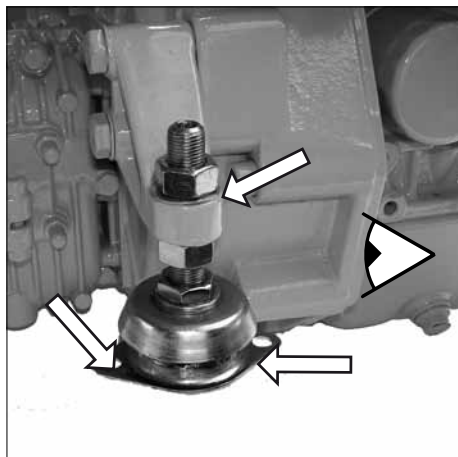
DANGER

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

6 Maintenance

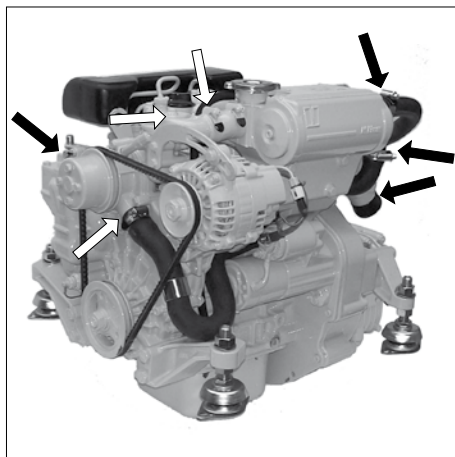
Flexible engine mounts, hose connections and fasteners

Every 500 operating hours.



41 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.



42 Inspection hose connections

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

43 Check fasteners

- Check tightness of all fasteners, bolts and nuts.

6 Maintenance

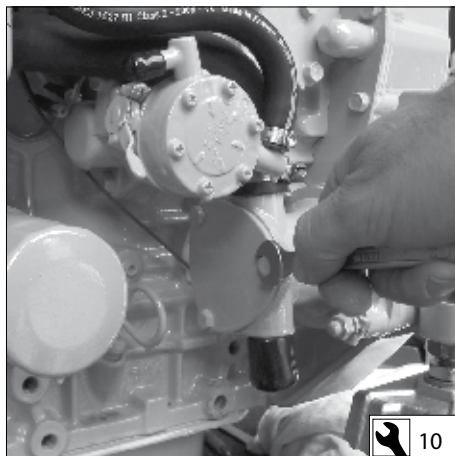


NOTE

Only engines with intercooling!

44 Raw water pump inspection

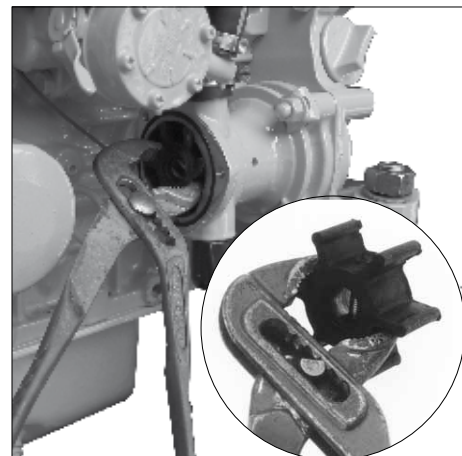
The rubber impeller of the outboard water pump is not proof against running dry. If the water supply has been blocked, it may be necessary to replace the impeller. Always carry a spare impeller on board.



45 Pump cover removal

Inspection where appropriate changing is as follows:

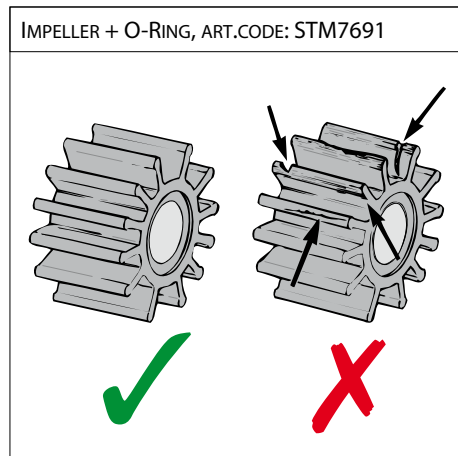
- Close the sea cock.
- Remove the cover of the pump by unscrewing the screws out of the housing.



46 Impeller removal

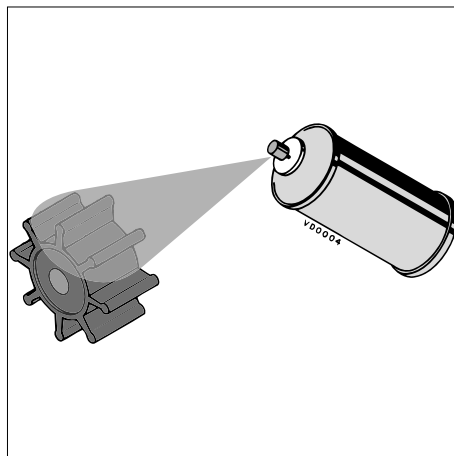
- Slide the impeller off of the shaft using a waterpump plier.
- Mark the impeller to ensure correct re-installation if it is to be re-used. The impeller must be installed in the same position as removed.

6 Maintenance



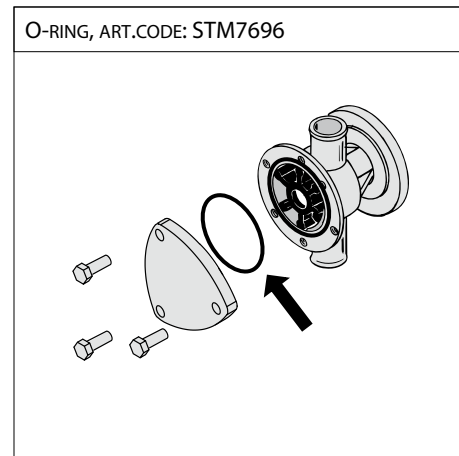
47 Impeller inspection

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



48 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).



49 Reinstall the pump cover

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

6 Maintenance

Coolant replacement

Every 1000 operating hours.

50 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.



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.

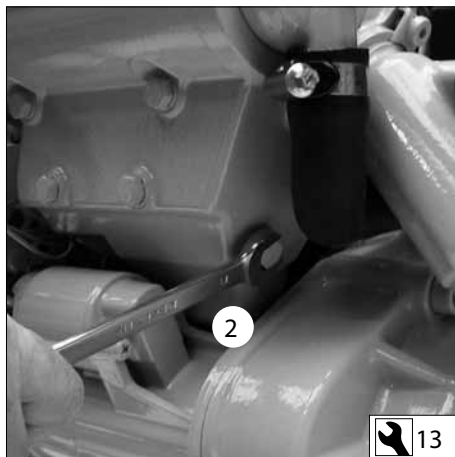
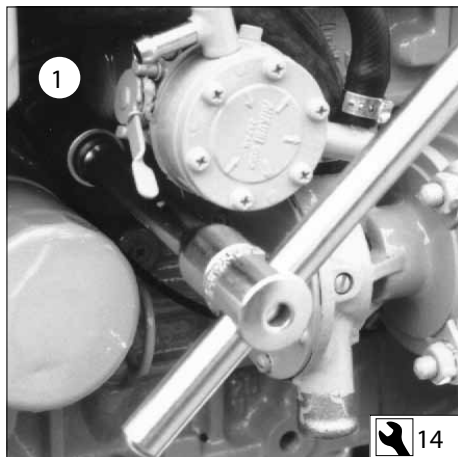


WARNING



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

6 Maintenance



51 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.

NOTE

Keel cooler

How the cooling system in engines with **keel cooling** should be drained depends on the installation of the keel cooler. Refer to the keel cooler manufacturer's instructions for this.

Check using a coolant hydrometer whether the coolant is providing sufficient protection against freezing if total draining off is not possible.

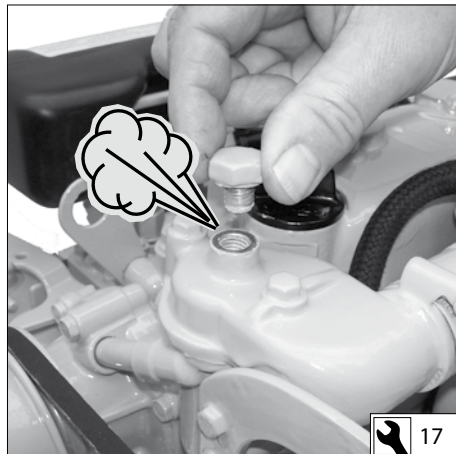
6 Maintenance

COOLANT QUANTITY: 2.2 litres
(3.8 Imp. pt, 4.6 US pt)



52 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 109.

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.



CAUTION

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

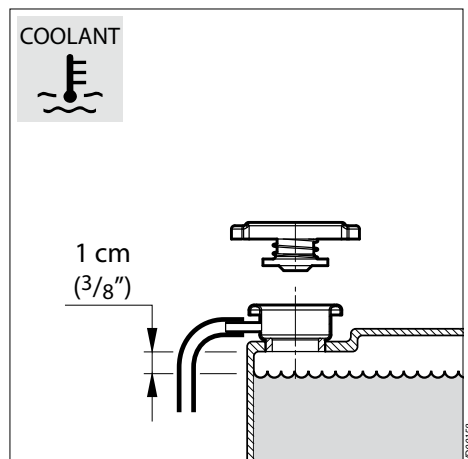


NOTE

For a keel-cooled version, see page 19.
If a water heater is connected, see page 20 and 21

6 Maintenance

Coolant replacement
Every 1000 operating hours.



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!

- 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.
- If necessary, add coolant.
- After filling replace the filler cap and re-install the plug.



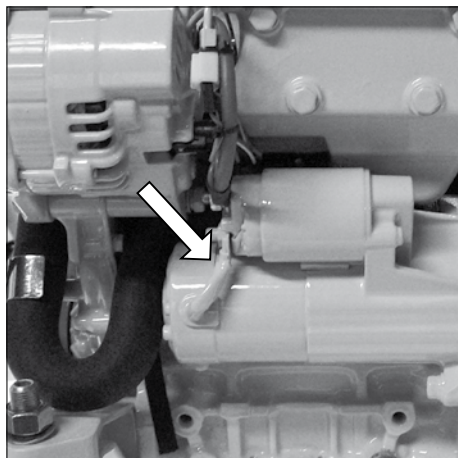
CAUTION

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

6 Maintenance

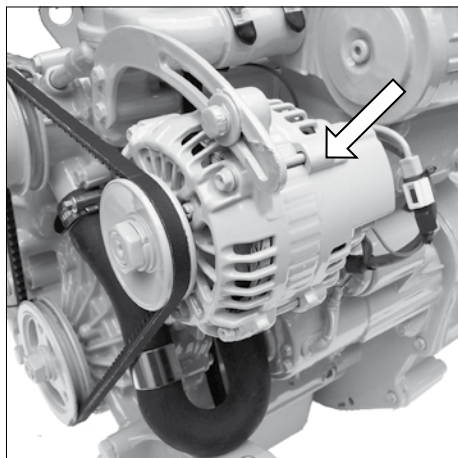
Checking the starter motor and alternator

Every 1000 operating hours.



53 Checking the starter motor

- Check for visible defects.
- Check whether the Bendix engages with the starter ring when the starter motor is activated. If the Bendix does not engage properly, contact your Vetus dealer.



54 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.

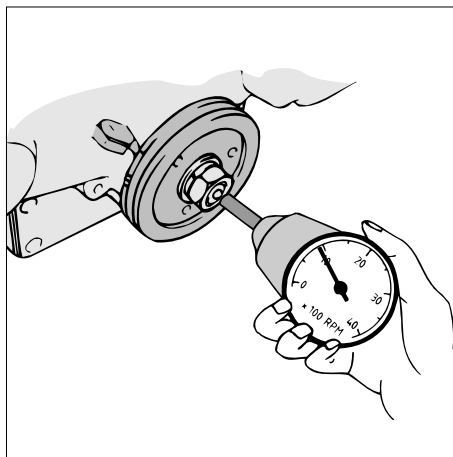
6 Maintenance



WARNING

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

At full load (with the boat cruising) the maximum engine speed should be about 3,000 resp. 3600 RPM (see technical data page 101). 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.

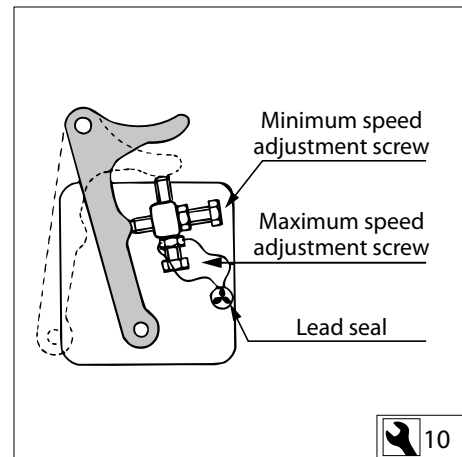


55 Checking engine speed

The engine idling speed should be 850 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



56 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.



NOTE

Cleaning of the heat exchanger is not a routine maintenance job.

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:

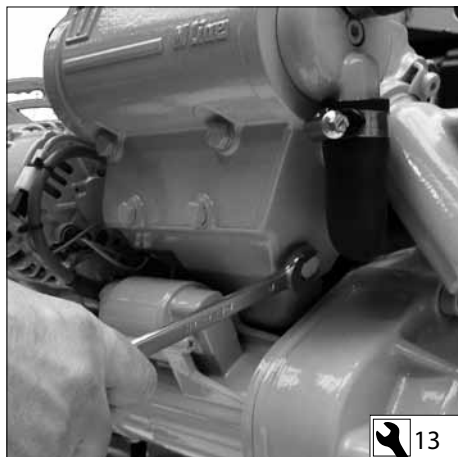
- Small rubber particles from a damaged sea water pump impeller.
- Growth of algae or seaweed.



NOTE

Only engines with intercooling!

6 Maintenance

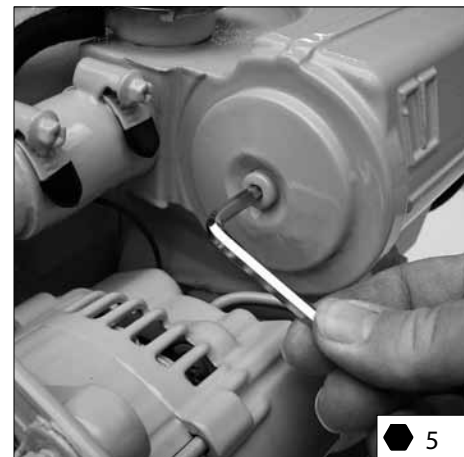


57 Remove the drain plug

- 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.



58 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.



Only engines with intercooling!

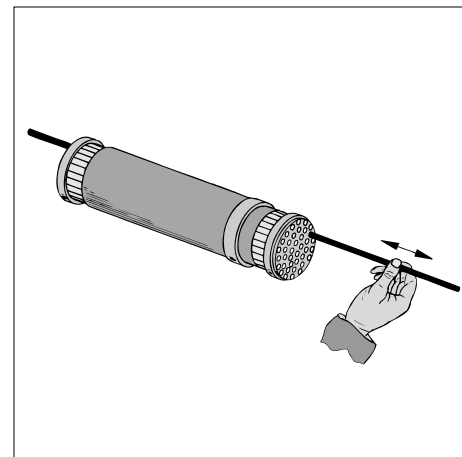
6 Maintenance



59 Remove heat exchanger

- Slide the heat exchanger out of the housing.

Cleaning the heat exchanger



60 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.

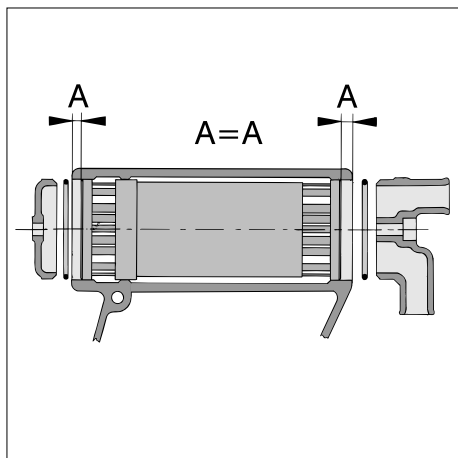


NOTE

Only engines with intercooling!

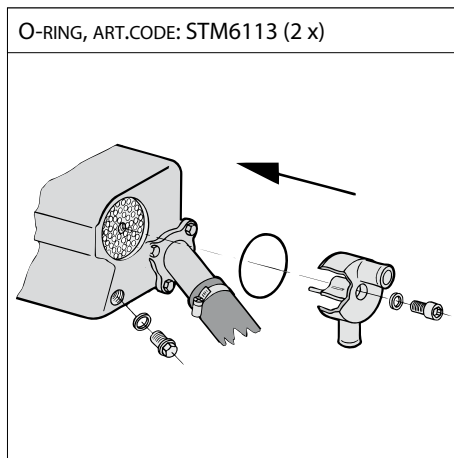
6 Maintenance

Cleaning the heat exchanger



61 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.



62 Replacing the end covers

- Fit the end covers in the housing.
- 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 68.



NOTE

Only engines with intercooling!

7 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:

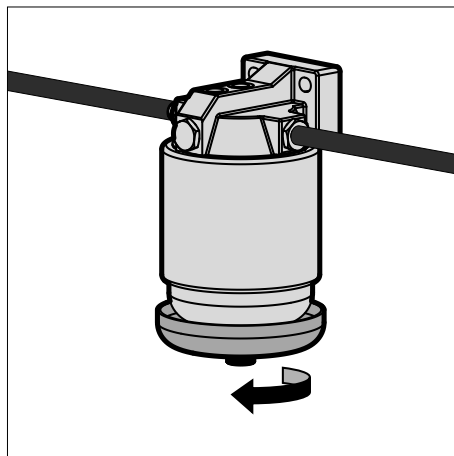
7 Winter storage procedure

Inspections and maintenance work to be carried out:		page
1	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.	78
2	Drain off the water from the fuel system and fill the fuel tank.	78
3	Make sure that the engine fuel system is filled with a fuel mixture with protective properties.	79
4	Flush out the raw water circuit with fresh water and if necessary fill with antifreeze. Clean the heat exchanger if necessary.	80
5	Make sure that the cooling system is filled with a suitable anti-freeze.	81
6	Change the oil filter and the engine oil.	82
7	Change the oil in the gearbox.	82
8	Disconnect the battery cables, charge the batteries if necessary and grease the battery terminals.	83

7 Winter storage procedure

1 Corrosion protection

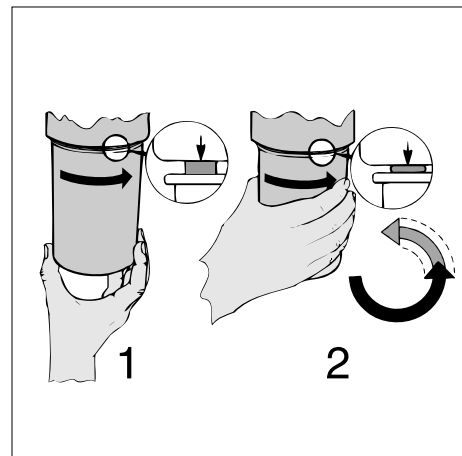
The various parts of the engine (except the engine block) have been treated with an anti-corrosion protective medium. In order to prevent corrosion, the engine should be rinsed off to remove any salt residues. If there is any corrosion, the paint should be touched up. Engine parts that become hot must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



2 Fuel system

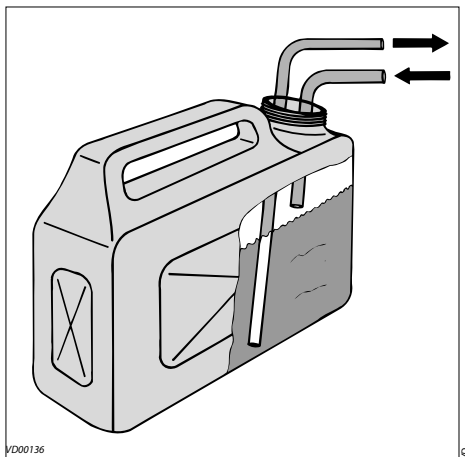
- Drain the water from the water separator/ fuel filter and the fuel tank.

Ensure that the tank is completely filled with fuel.



- Install a new fuel filter. (page 55).

7 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 ^[1] to 9 parts of clean fuel ^[2].
- Use this mixture to run the engine at **no load** for approx. 5 minutes.
- Stop the engine.



CAUTION

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



TIP!

Combine running the engine with the protective fuel mixture with flushing the raw water circuit with fresh water, see 'Winter storage procedure - Raw water cooling system'.

^[1] Engine oil with protective properties.

E.g.:

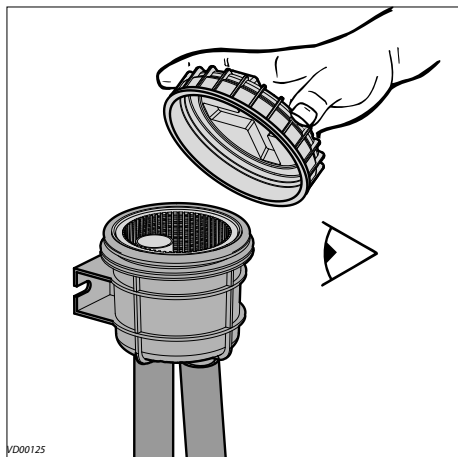
- Vetus Marine Diesel Engine Oil 15W40
- Shell Rimula R4 L 15W40

^[2] Only use CEN EN 590 Diesel fuel.

Preferably water-free fuel.

Collect some fuel from the return pipe, while engine is running.

7 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.



NOTE

Only engines with intercooling!



TIP!

Combine flushing the raw water circuit with fresh water with running the engine with the protective fuel mixture, see 'Winter storage procedure - Protective fuel mixture'

Heat exchanger

Only clean the heat exchanger if this is absolutely necessary, see page 72.

Raw water pump

Check the impeller of the raw water pump at least once every two years, see page 64.

- 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 sea cock.
- The raw 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 (preferably a non-toxic biodegradable anti-freeze) into the water strainer and run the engine until the anti-freeze has disappeared into the cooling system.

7 Winter storage procedure

Tip!

Protect the sea cock as follows:
With the motor stopped.

- Place the sea cock in a position that it is just opening.
- Pour a small amount of non-toxic biodegradable anti-freeze into the raw water strainer.
- Close the sea cock as soon as it is filled with anti-freeze.



5 Fresh water cooling system

Anti-freeze can be toxic. Take care that no anti-freeze is spilled into the waterway

- 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

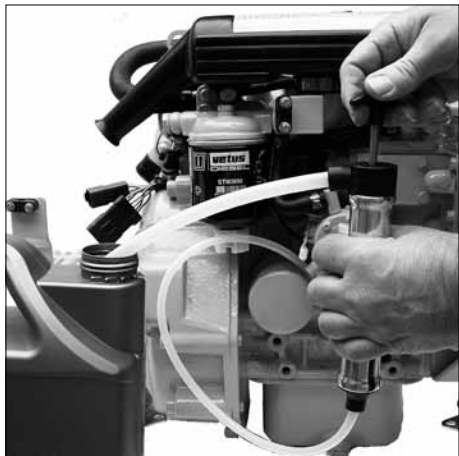
To avoid corrosion during winter storage the cooling system must be filled with an anti-freeze/water mixture (or a coolant).

For specifications see page 109.

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

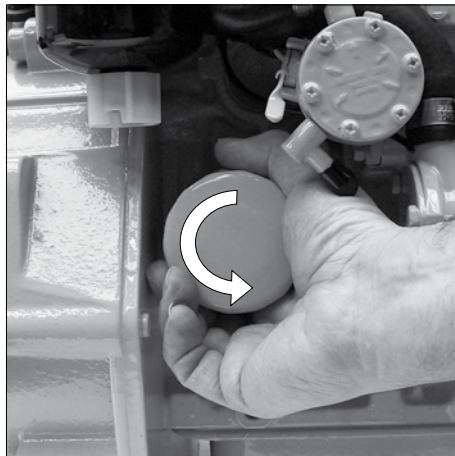
For coolant replacement see page 66.

7 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; use oil with protective properties. See page [47](#).

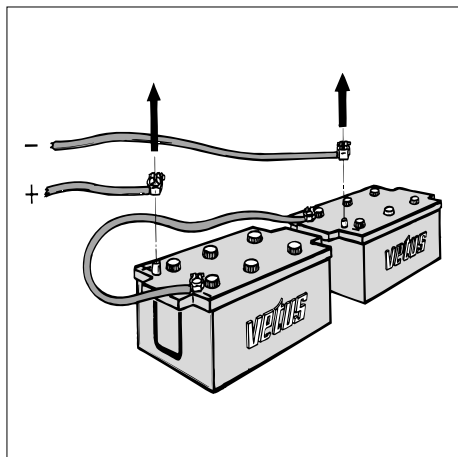
For quantity and oil specification see page [102](#) and [106](#).



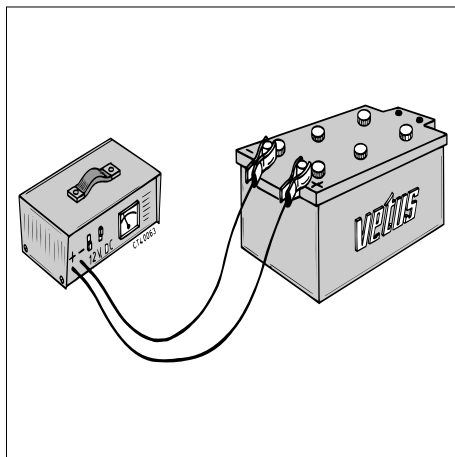
7 Changing the gearbox oil

- Stop the engine and change the oil of the gearbox. (page [58](#) and [59](#))

7 Winter storage procedure



8 Electrical system



- Disconnect the battery cables.
- Charge batteries during winter lay-up regularly if required!
- Follow the recommendations given on pages 50 to 53 or consult the recommendations given by the battery supplier for inspection and maintenance of the batteries.

8 Recommissioning after winter storage

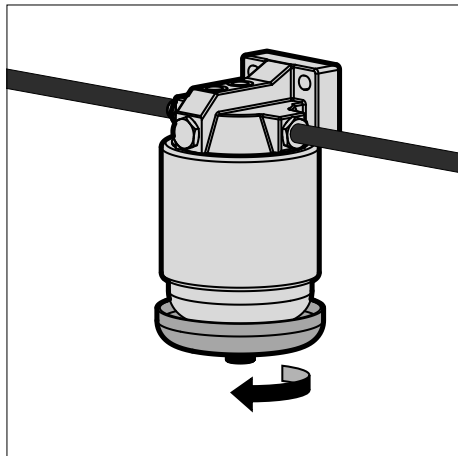
The engine must be inspected and any maintenance work carried out at the beginning of the sailing season.

Consult a Vetus Dealer if help is required with this.

Inspections and maintenance work to be carried out are:

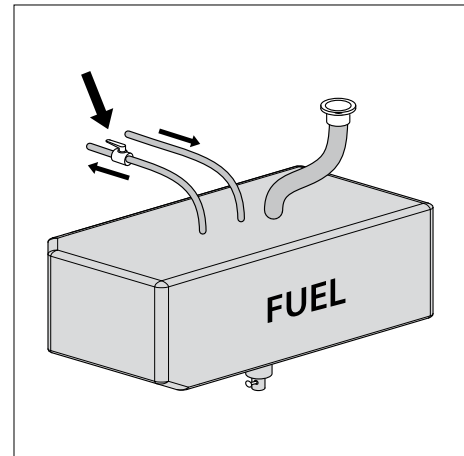
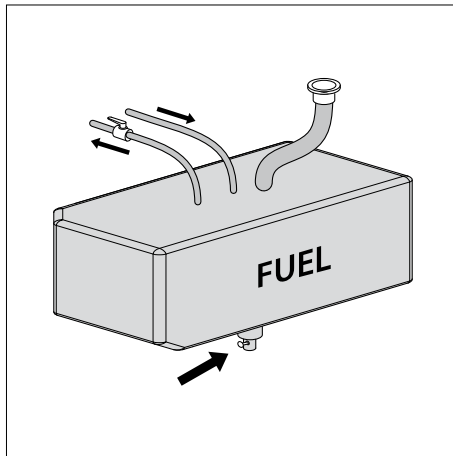
Inspections and maintenance work to be carried out are:		page
1	Drain the water from the fuel system.	85
2	Check the raw water system.	86
3	Check the coolant level in the internal cooling system.	87
4	Check the oil level.	87
5	Check the batteries and reconnect these.	88
6	Check the operation of the engine.	88
7	Check all hose connections for leaks.	89
8	Check the operation of the instruments and the engine controls.	89

8 Recommissioning after winter storage

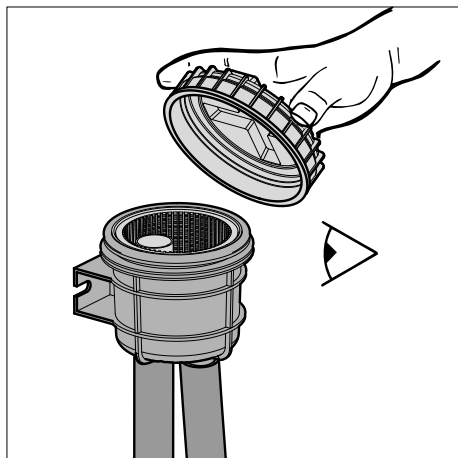


1 Fuel system

- Drain the water from the water separator/fuel filter. (page 44)
- Drain the water from the fuel tank.
- Open the fuel valve.

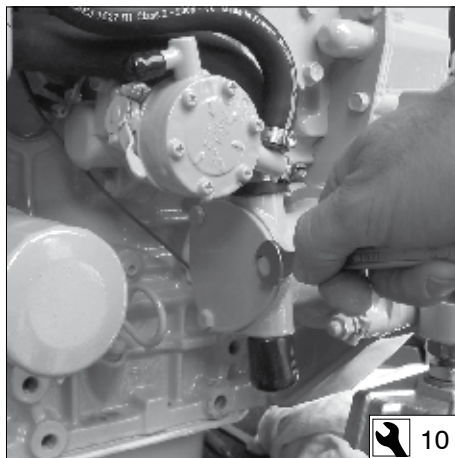


8 Recommissioning after winter storage

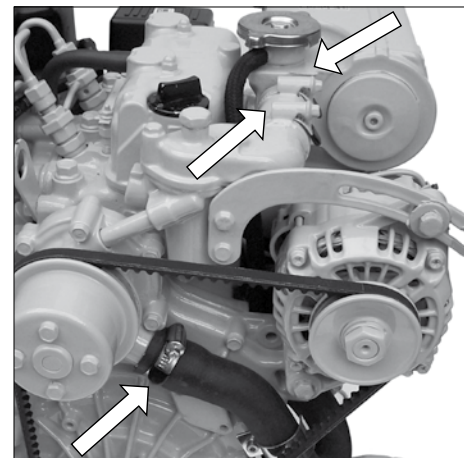


2 Raw water cooling system

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



- Check whether the lid of the raw water pump and drain plugs are reinstalled. (pages 64, 67)



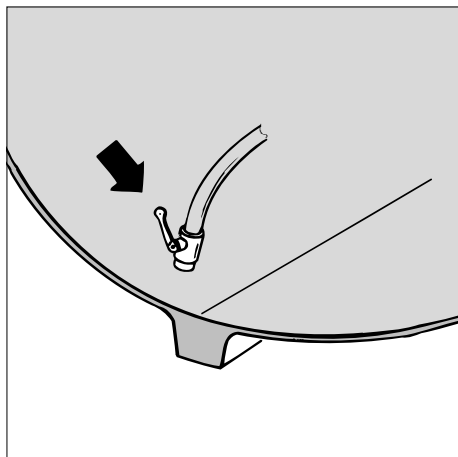
- Re-tighten possible loose hose clamps.



NOTE

Only engines with intercooling!

8 Recommissioning after winter storage

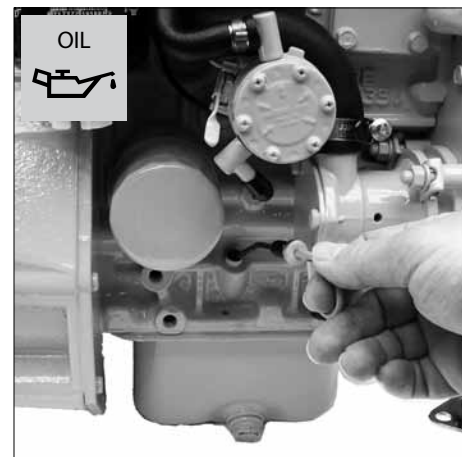


- Open the sea cock.



3 Fresh water cooling system

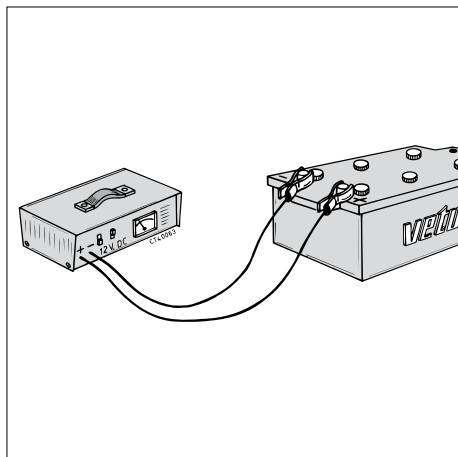
- Check the coolant level. (page 42)



4 Lubrication system

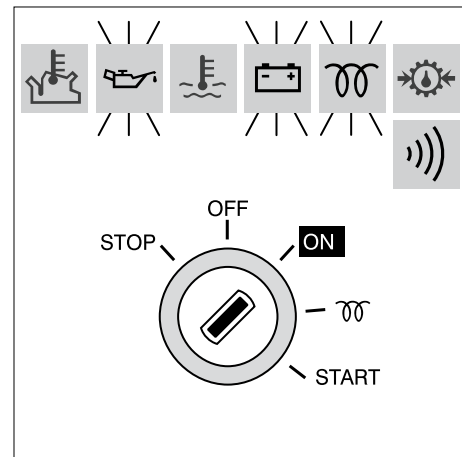
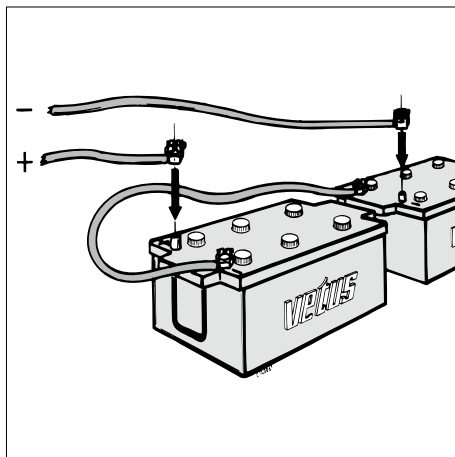
- Check the engine oil level. (page 40)

8 Recommissioning after winter storage



5 Electrical system

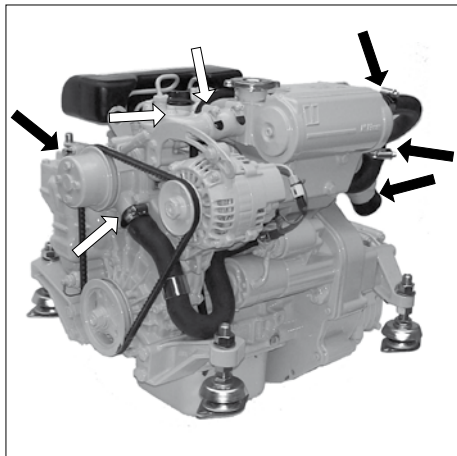
- Make sure that the batteries are fully charged. (page 50, 83)
- Connect the batteries.



6 Switching on

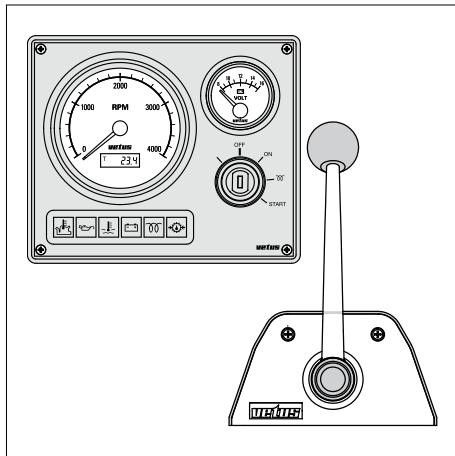
- Turn the start key on the instrument panel clock-wise; the warning lights for oil pressure and alternator will now light up and the alarm buzzer will sound.

8 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!

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9 Troubleshooting

Fault finding table

1 Engine will not crank

Possible fault	Remedy
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.
Wrong engine electric mass connection.	Repair.
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
Faulty starter-switch or faulty starter-relay.	Check / replace.
Faulty starter-motor or pinion does not engage.	Check / replace starter-motor.
Seized components.	Repair.
Control lever not in neutral.	Put operating lever in neutral.
Water in the cylinder .	Check / Repair.

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

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

9 Troubleshooting

Fault finding table

3 Engine cranks but will not start, smoke from exhaust

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

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

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

9 Troubleshooting

Fault finding table

5 Engine does not reach maximum rpm under load

Possible fault	Remedy
Fuel pre filter clogged .	Clean/replace.
Fuel filter clogged with water and/or contamination.	Check or replace.
Faulty injector/injection pump.	Check, replace if required.
Leaking fuel supply line or fuel injection line.	Check / replace.
Air in fuel system.	Check and bleed.
Wrong fuel quality or contaminated fuel.	Check fuel. Drain and flush fuel tank. Replace with new fuel.
Incorrect injection timing.	Check / adjust.
Setting of stop valve incorrect.	Check / adjust.
Oil level too high.	Lower level.
Lubricating oil incorrect SAE spec or quality for ambient temperature.	Replace.
Insufficient intake air.	Check.
Exhaust restricted.	Check / clean.
Incorrect valve clearance.	Adjust.
Transmission defect.	Check
Engine overloaded.	Check size of propeller. Clean the propeller.
Boat load inadequate .	-

5 Engine does not reach maximum rpm under load

Possible fault	Remedy
Hull/propeller dirty .	Clean

9 Troubleshooting

Fault finding table

6 Engine overheats

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

7 Engine not firing on all cylinders

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

9 Troubleshooting

Fault finding table

8 Engine has little or no oil pressure

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

9 Engine oil consumption excessive

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

9 Troubleshooting

Fault finding table

10 Fuel consumption excessive

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

11 Black exhaust smoke (idling)

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

12 Blue exhaust smoke (idling)

Possible fault	Remedy
Oil level too high.	Lower level.

9 Troubleshooting

Fault finding table

13 Black exhaust smoke (at load)

Possible fault	Remedy
Faulty injector / injection pump.	Check / replace if required.
Incorrect injection timing.	Check / adjust.
Oil level incorrect.	Check .
Insufficient intake air, air filter dirty.	Check/clean the filter .
Incorrect valve clearance.	Adjust.
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
Faulty injector/injection pump.	Check, replace if required.
Air in fuel system.	Check and bleed.
Wrong fuel quality or contaminated fuel.	Check fuel. Drain and flush fuel tank. Replace with new fuel.
Water in fuel system.	Check water separator.
Incorrect injection timing.	Check / adjust.
Faulty glow plugs.	Check / replace.
Incorrect valve clearance.	Adjust.
Vapour in exhaust gases condenses as a result of very low ambient temperature.	-

15 Burnt oil trace in exhaust line .

Possible fault	Remedy
Oil level too high .	Lower level.
Excessive wear of cylinder / piston, piston rings.	Check compression; refurbish engine.

10 Technical data

Engine specifications

Model	:	M2.02	M2.06
General			
Make	:	Vetus Mitsubishi	Vetus Mitsubishi
Number of cylinders	:	2	2
Based on	:	L2E-61DM	L2E-61DM
Type	:	4-stroke diesel, in-line	4-stroke diesel, in-line
Injection	:	Indirect	Indirect
Aspiration	:	Natural	Natural
Bore	:	76 mm	76 mm
Stroke	:	70 mm	70 mm
Total displacement	:	635 cm ³ (39 cu.in.)	635 cm ³ (39 cu.in.)
Compression ratio	:	23:1	23:1
Idling speed	:	850 rpm	850 rpm
Max. no. of revolutions at no load	:	3000 rpm	3600 rpm
Direction of rotation	:	Counter clockwise, viewed towards the flywheel	
Valve Clearances (cold)	:	Inlet 0.25 mm (0.010")	
		Exhaust 0.25 mm (0.010")	
Weight (with standard gearbox)	:	98 kg (216 lbs)	98 kg (216 lbs)
Engine installation			
Max. installation angle	:	15 degrees backwards	
Max. athwartships angle	:	25 degrees continuously, 30 degrees intermittent	

10 Technical data

Engine specifications

Model	:	M2.02	M2.06
Maximum Output			
at the flywheel (ISO 8665)	:	8.8 kW (12 hp)	11.8 kW (16 hp)
at the prop shaft (ISO 8665)	:	8.7 kW (11.8 hp)	11.6 kW (15.8 hp)
at no. of revolutions of	:	3000 rpm	3600 rpm
Torque,	:	32.7 Nm (3.3 kgm, 24.1 ft.lb)	35.1 Nm (3.6 kgm, 25.9 ft.lb)
at no. of revolutions	:	1600 rpm	2000 rpm
Fuel consumption			
	:	268 g/kW.h (196 g/hp.h, 6.9 oz/hp.h)	268 g/kW.h (196 g/hp.h, 6.9 oz/hp.h)
at no. of revolutions	:	2500 rpm	2500 rpm
Fuel System (Self-bleeding)			
Injection pump	:	Bosch model NC (Nippon Denso)	
Injectors	:	Plug injector	
Opening pressure	:	140 bar (kgf/cm ²) (2030 psi)	
Firing order	:	1 - 2	
Injection timing	:	17° BTDC	
Fuel filter element	:	Vetus 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.	

10 Technical data

Engine specifications

Model	:	M2.02	M2.06
Oil lubrication system			
Oil capacity, max.	without oil filter	:	2.4 litres (4.2 Imp. pt, 5.1 US pt)
	with oil filter	:	2.9 litres (5.1 Imp. pt, 6.1 US pt)
Oil Filter		:	Vetus STM0051
Oil temperature in sump		:	max. 130°C (266°F)
Cooling system			
Capacity,	Intercooler version	:	2.2 litres (3.9 Imp. pt, 4.6 US pt)
	Keel cooler version, engine only	:	3 litres (5.3 Imp. pt, 6.3 US pt)
Thermostat		:	opening at 71°C (160°F), fully opened at 84°C (183°F)
Coolant pump,			
Flow	at max. engine rpm	:	50 l/min (11 Imp. 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 Imp. Gal/min, 5.3 US Gal/min)
Total head	at max. flow	:	2 m Water (6' 7")
Impeller		:	Vetus STM6161
Inlet connection	for hose	:	20 mm (3/4") I.D.
Heater supply connection		:	10 mm (3/8")
Heater return connection		:	8 mm (5/16")

10 Technical data

Engine specifications Gearbox specifications

Model		:	M2.02	M2.06
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, 75 Amp	
Starter motor		:	14 Volt, 1,2 kW	
Battery capacity		:	min. 55 Ah, max. 108 Ah	
Protection		:	Tubular glass fuse, 32 x 6.3 mm 10 A slow blow	
V-belt				
		:	Vetus STM7369	
Gearbox				
			Gear ratio	Gear ratio
Technodrive:	model TMC40P	:	2.05 / 2.60 : 1	2.05 / 2.60 : 1
	model TMC60A	:	2.00 / 2.45 : 1	2.00 / 2.45 : 1
ZF Hurth:	model ZF10M	:	2.05 / 2.72 : 1	2.05 / 2.72 : 1

10 Technical data

Torque wrench settings

Screw connection	Torque				
	Diameter	Wrench size	Nm	(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)

11 Operating media

Fuel

Fuel Quality Grade

Use only diesel fuel or diesel blends with up to 7% FAME (B7), with less than 0.5% sulphur content of which the quality is fully controlled and conform the standards below.

The following fuel specifications / standards are approved:

- CEN EN 590:2009
- ASTM D975-09

Don't use fuel with more than 1% sulfur!

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. These fuels match the diesel fuels which are in accordance with CEN EN 590 and ASTM D 975. Emission levels cannot be guaranteed with other fuels.

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).

Biodiesel



Use only the prescribed diesel fuel or diesel blends. **Do not use 100% biodiesel (B100)!**

Although the use of biodiesel is allowed in diesel blends with up to 7% FAME (Fatty Acid Methyl Esters) (B7) fast degradation of the biodiesel should be taken in account.

Problems caused by using FAME of poor quality or degraded fuel are not covered by warranty.

Engine oil

Lubricating oils are specified by performance and quality classes. It is usual for the specifications to be indicated according to the API (American Petroleum Institute) and ACEA (European Automobile Manufacturers Association).

Acceptable API oils: CF4, CG4, CH4, CI4

Acceptable ACEA oils: A3/B3, A3/B4, E7

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 lifespan.

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 15W-40 all-season motor oil.

For example:

Vetus Marine Diesel Engine Oil 15 W40

Shell Rimula R4 15W40

For oil capacity see p. 102.

11 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 numberI (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.

11 Operating media

Lubricating oil

Gearbox Lubricating Oil

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

Technodrive:

type TMC40P : 0.2 litres, ATF ^[1]
(0.35 Imp. pt, 0.42 US pt)

type TMC60A : 0.6 litres, ATF ^[1]
(1.05 Imp. pt, 1.25 US pt)

ZF Hurth:

type ZF10M : 0.42 litres ATF ^[1]
(0.73 Imp. pt, 0.89 US pt)

^[1] ATF : AutomaticTransmission Fluid;
Transmission oil type A, Suffix A.

For example: Vetust Transmission Oil
Shell Donax T6
Gulf Synth

Other brands of gearboxes:

See supplied owners manual for oil type and quantities.

11 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. Therefor 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/dm³]	–	100
Sulfate ion content	[mg/dm³]	–	100
Total hardness	[degrees]	3	12



CAUTION

Never use sea-water or brackish water.



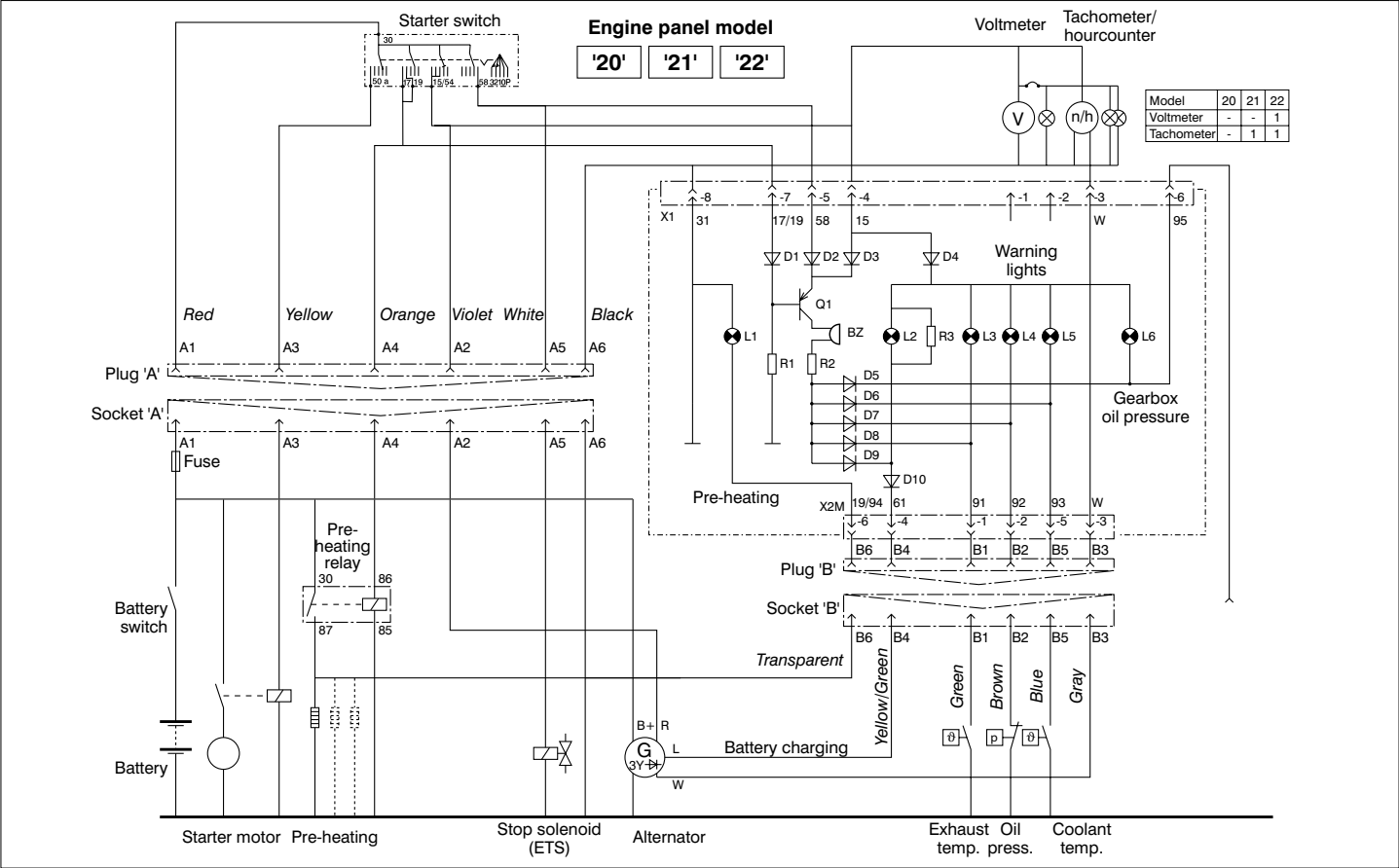
WARNING

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



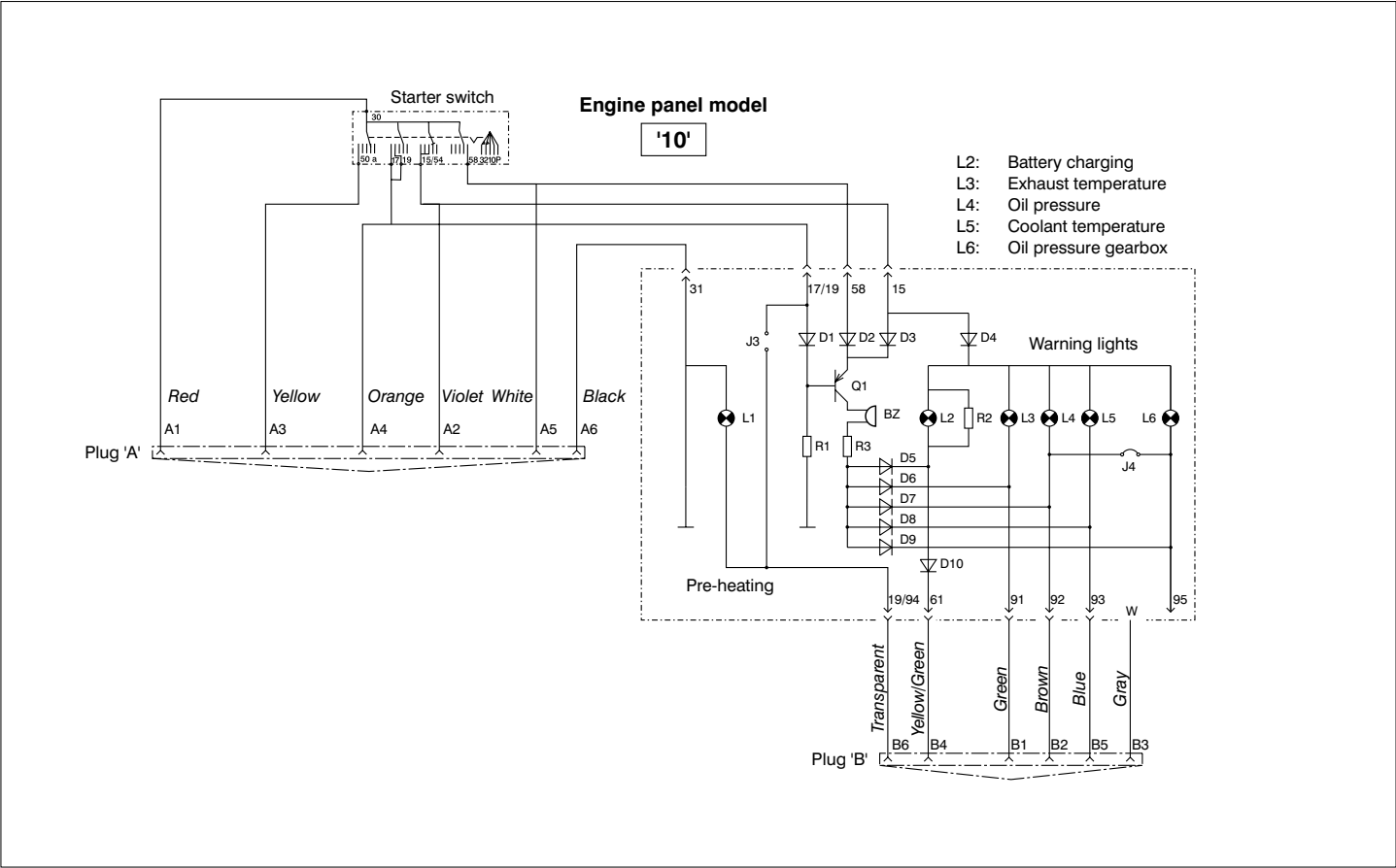
12 Wiring diagram

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

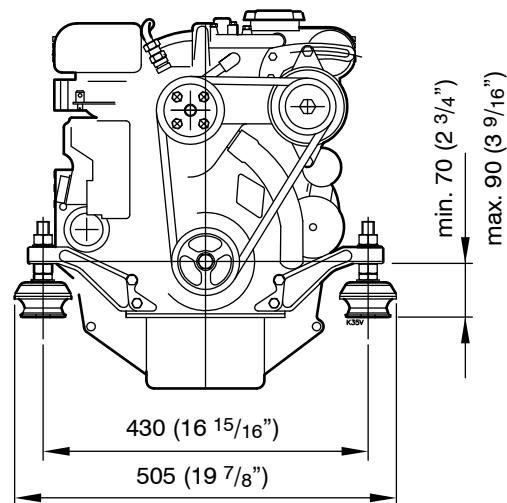
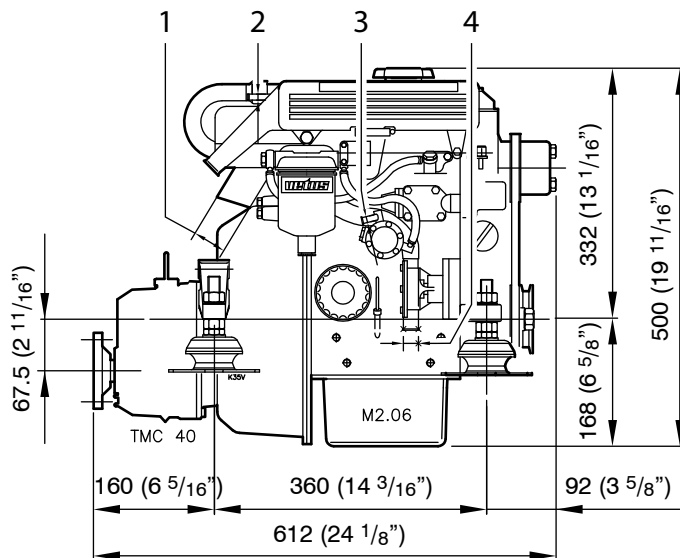


12 Wiring diagram

Options, panel model '10'



13 Overall dimensions



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

vetus[®] M2.02 / M2.06

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340801.01	Bedieningshandleiding M2.02, M2.06	(Nederlands)
340802.01	Operation manual M2.02, M2.06	(English)
340803.01	Bedienungsanleitung M2.02, M2.06	(Deutsch)
340804.01	Manuel d'utilisation M2.02, M2.06	(Français)
340805.01	Manual de operacion M2.02, M2.06	(Español)
340806.01	Istruzioni per l'uso M2.02, M2.06	(Italiano)
340807.01	Brugsanvisning M2.02, M2.06	(Dansk)
340808.01	Användarmanual M2.02, M2.06	(Svenska)
340809.01	Bruksanvisning M2.02, M2.06	(Norsk)
340810.01	Käyttöopas M2.02, M2.06	(Suomeksi)
320331.01	(STM0032) Installatiehandleiding / Installation manual	(Nederlands / English)
320199.06	(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)
341131.06	Onderdelenboek / Parts manual M2	(Nederlands / English)
342102.01	Service manual M2, M3	(English / Deutsch / Français / Español)



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