VF4 VF5

Installation manual

VF4.140E
VF4.170E
VF4.190E
VF5.220E
VF5.250E

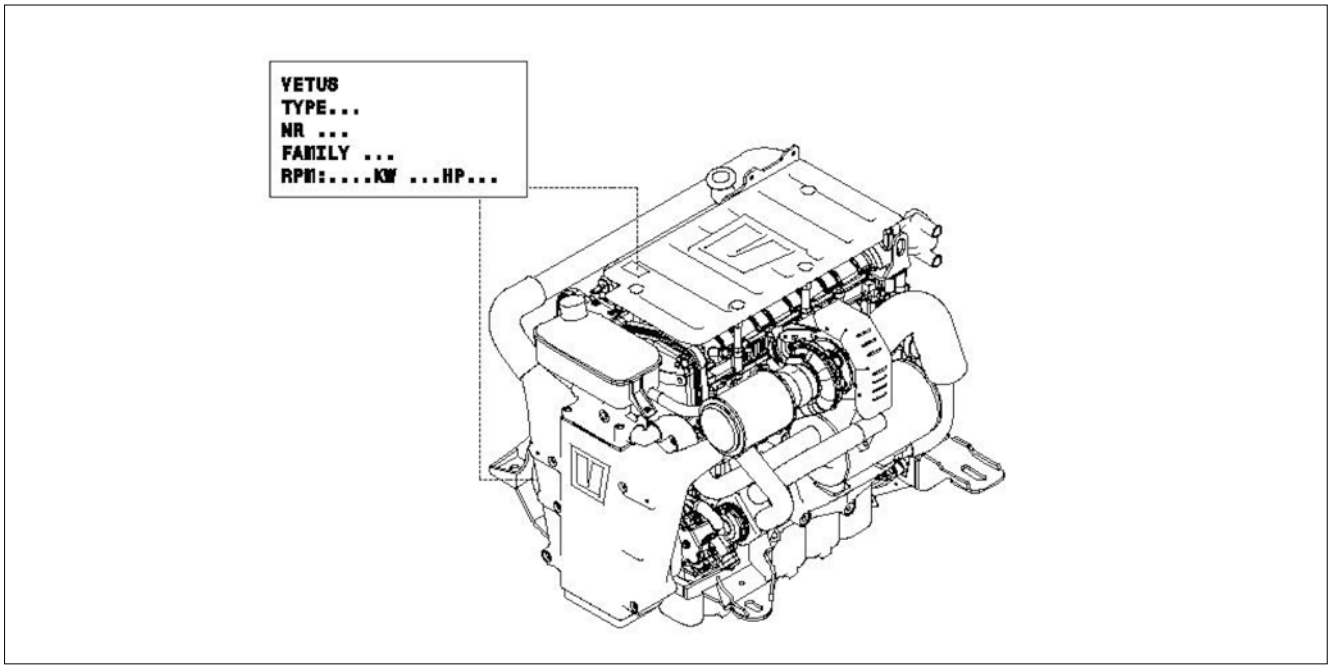
Contents

1 Preface

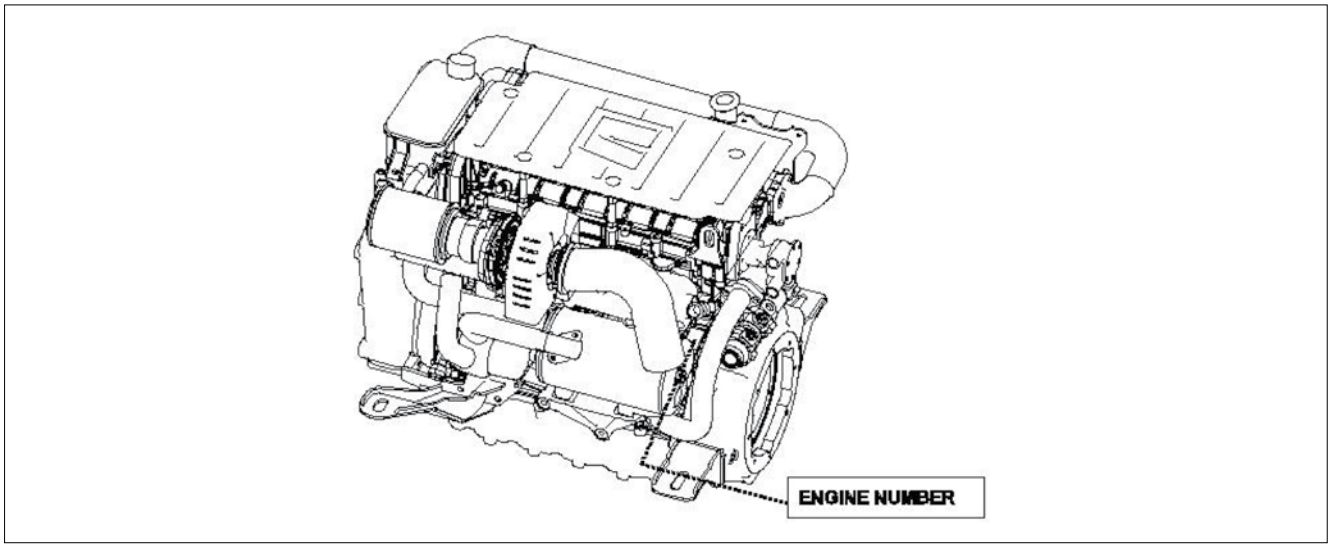
The reliability of the total propulsion unit is dependent on the quality of the installation. Nearly all the problems are caused by faults or inaccuracies which occur during the installation. It is most important therefore to follow during installation the recommendations mentioned in this manual.

1.1 Engine ID Plates

The ID labels are placed on the engine as shown in the pictures below:



The engine number is marked on the engine where indicated in the picture below:



1.2 Engine storage, before use

If the engine is stored for a prolonged period, check the possible conditions of conservation in relation to the storage environment and the type of packaging.
The engine is supplied with a protection treatment which is valid for 6 months from delivery date.

1 Check for the coolant (coolant circuit). The engine supplied with a mixture to withstand storage temperature of -15 °C (5 °F).

2 **Attention: The raw water circuit could contain engine test bed water. Drain completely the raw water circuit if the storage temperature is lower than 0°C (32°F).**

3 Grease the turbocharger operating mechanism after this period.

4 Verify the packages integrity.

5 Humidity and salt corrosion could damages the engines during their storage.

1.3 First engine start

1 Read the owner's manual.

2 **Verify the fuel feed line for possible leaks. Take care to avoid restrictions in the fuel line pipes.**

3 Verify and if required grease all the couplings, the turbocharger operating mechanism.

4 Check and verify the electrical connections. **Important: Wrong connection of positive and negative could provoke short circuit and damage the engine.**

5 Check the battery condition and state of charge.

6 Check the raw water circuit, the connection and open the sea cock.

7 Check the belt and belt tensioner.

8 Check coolant level and oil levels of both engine and gearbox, verify if fuel is available in the tank. Fuel tank must be clean!

9 Turn ON the red button on the ECU box and verify that the fuse LED's light-up.

10 Verify the position of the control lever and make sure it is in Neutral position.

11 Verify the gearbox – stern drive oil level.

12 Make engine diagnosis. **Important: Compile and send the installation form data request.**

13 Verify the engine – propulsion alignment, grease the mechanical connections.

14 Start the engine, lets warm up the engine for few minutes at minimum RPM idle.
15 Verify for any leaks, verify the sea water pump, and verify the flush of water on exhaust system, verify that all warning lights on the instrument panel are OFF and no alarm buzzer sounds and verify if oil pressure – water temperature and charge current are OK *.

Important: **If you hear a strange noise, or vibration of the engine is extreme or black smoke is coming out of the exhaust stop the engine immediately and ask for assistance.**

When the temperature of the engine stabilizes at a temperature higher than normal it might be necessary to bleed the coolant circuit.

Bleeding the coolant circuit:

- Open the expansion tank cap to let the air escape.
- Increase the RPM to 2000 and decrease few times without engaging the gearbox.
- Add water to the coolant circuit if necessary.
- Close the cap.
- Verify the engine coolant temperature again.

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16 Take the command on the levers.

17 Never exceed the first time 3/4 of maximum rpm.

18 Verify all person are on board and engage the gear to test the gearbox – stern drive and carry bout the sea trial.

1.4 Long engine storage – Inactivity

If the engine remains inactive for a period of time exceeding 6 months, you need to protect it from oxidation and breakdowns in accordance with the following instructions:

1 Let the engine run for 15 minutes at 800 rpm; stop the engine and drain the oil.

2 Put oil (according to the specifications MIL-60B-type 2) into the oil sump until the oil sump reaches at least 'Min' on the oil dipstick.

3 After emptying the fuel filters, disconnect the pipes of the feeding of the injection system at the top of the feeding pump, and connect it with the proper tank containing oil CFB (ISO 4113).

4 Let the engine run for 15 min. at 800 rpm; then, by using an oil gun, slowly atomize (nebulize) for about one minute 60 grams of oil MIL-60B-type-2 into the intake manifold.

5 Disconnect the pipes of the feeding of the injection system from the tank containing the oil CFB and re-connect it to the fuel tank.

6 Seal with tape, on both the engine and exhaust pipe, the access lights, aeration lights and breather pipe lights.

7 Put a very visible paper on the engine where it is clearly stated that the engine is 'WITHOUT OIL'.

8 Disconnect the batteries and put them in a dry place, always making sure that they are charged.

9 Drain the cooling water in case it does not have anti-freezing liquid or anti-corrosion liquid

10 If the engine is connected with the propulsion system verify for the oil level.

11 Clean the engine from salt and eventual rust. Paint rusted parts. Spray the engine with CRC 6-66 marine lubricant spray to avoid corrosion.

After a period of inactivity, it is necessary to carry out a some maintenance work before starting the engine again to ensure its efficiency conditions.

1 Check the battery charge level conditions. Assure that the battery voltage is over 12.5 V.

2 Make sure the electric contacts are intact. Assure the correct electrical connections.

3 Carry out the engine diagnosis.

4 Check the oil level-conditions, and if necessary, top- up or replace.

5 Verify and if necessary replace the oil filter.

6 Check the coolant level an mixture, and if necessary top – up.

7 Replace / Clean the fuel filter.

8 Clean the air filter.

9 Verify the belts status and tighteners.

10 Verify the integrity of the sea water pump impeller.

11 Check the integrity of electrolytic zincs.

12 Verify and if is necessary grease: starter pinion, turbocharger leverages mechanical propulsion couplings.

13 Start the engine and run at minimum speed for few minutes.

14 If no anomalies bring the engine to its operating temperature, 70 - 80 °C (158 - 176 °F). Verify that there is no air in the coolant circuit – bleed the air from coolant circuit if necessary.

15 Turn off the engine and check again the engine oil level and coolant level.

16 Verify for tightening.

2 Technical data

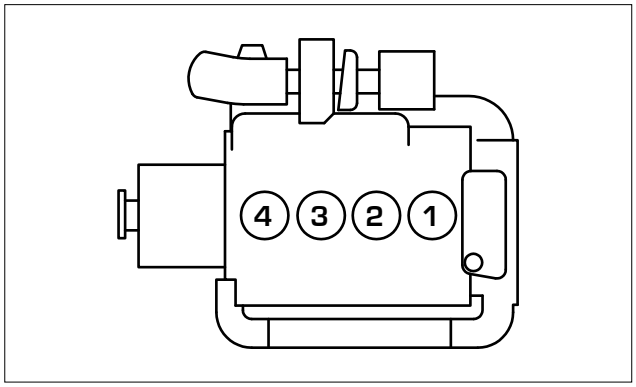
2.1 Engine specifications

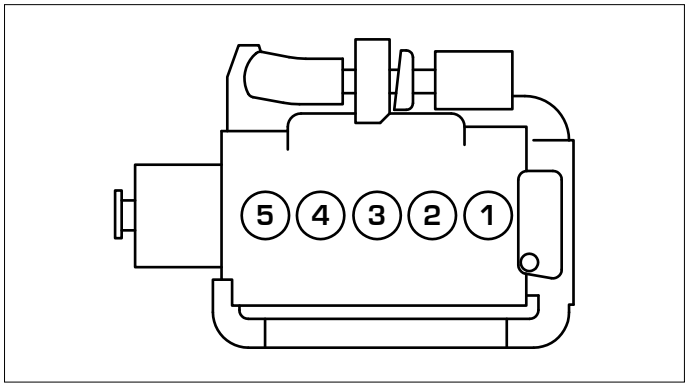
Model	:	**VF4.140E**	**VF4.170E**	**VF4.190E**	**VF5.220E**	**VF5.250E**
General						
Make	:			Vetus C.M.D.		
Number of cylinders	:	4	4	4	5	5
Type	:			4-stroke diesel, in-line, DOHC		
Injection	:			Direct injection, common rail		
Aspiration	:			Turbo-charged with variable geometry		
Bore	:	82 mm	82 mm	82 mm	82 mm	82 mm
Stroke	:	90,4 mm	90,4 mm	90,4 mm	90,4 mm	90,4 mm
Total displacement	:	1910 cm^3 (116 cu.inch)	1910 cm^3 (116 cu.inch)	1910 cm^3 (116 cu.inch)	2387 cm^3 (146 cu.inch)	2387 cm^3 (146 cu.inch)
Idling speed	:	800 rpm	800 rpm	800 rpm	750 rpm	750 rpm
Max. no. of revolutions at no load	:	4700 rpm	4700 rpm	4700 rpm	4700 rpm	4700 rpm
Max. no. of revolutions at max. load	:	4000 rpm	4000 rpm	4000 rpm	4200 rpm	4200 rpm
Direction of rotation				counter clockwise, viewed from the flywheel side		
Weight (with standard gearbox)	:	320 kg (705 lbs)	320 kg (705 lbs)	320 kg (705 lbs)	333 kg (734 lbs)	333 kg (734 lbs)
Engine installation						
Max. installation angle	:			10 degrees backwards		
Max. athwartships angle	:			20 degrees continuously, 30 degrees intermittend		
Maximum Output						
at the flywheel (ISO 3046-1)	:	103 kW (140 hp)	125 kW (170 hp)	140 kW (190 hp)	162 kW (220 hp)	184 kW (250 hp)
at the prop shaft (ISO 3046-1)	:	99.9 kW (135.8 hp)	121.2 kW (164.9 hp)	135.8 kW (184.3 hp)	157.1 kW (213.4 hp)	178.5 kW (242.5hp)
at no. of revolutions of	:	4000 rpm	4000 rpm	4000 rpm	4000 rpm	4200 rpm
Torque,	:	310 Nm (31.6 kgm, 2441 ft.lb)	345 Nm (35.1 kgm, 254 ft.lb)	370 Nm (37.7 kgm, 273 ft.lb)	416 Nm (42.4 kgm, 307 ft.lb)	450 Nm (45.9 kgm, 332 ft.lb)
at no. of revolutions	:	2400 rpm	2200 rpm	2400 rpm	2500 rpm	2600 rpm
Fuel consumption	:	215 g/kW.h (158 g/hp.h) (5.6 oz/hp.h)	237 g/kW.h (174 g/hp.h) (6.1 oz/hp.h)	231 g/kW.h (170 g/hp.h) (6.0 oz/hp.h)	236 g/kW.h (173 g/hp.h) (6.1 oz/hp.h)	260 g/kW.h (191 g/hp.h) (6.7 oz/hp.h)
at no. of revolutions	:	4000 rpm	4000 rpm	4000 rpm	4000 rpm	4000 rpm
Fuel System (Self-bleeding)						
Fuel lift pump	:			Suction height max. 1,5 m (5 ft)		
Fuel supply connection	:			8 mm (5/16") I.D.		
Fuel return connection	:			8 mm (5/16") I.D.		

Model	:	VF4.140E	VF4.170E	VF4.190E	VF5.220E	VF5.250E
Oil lubrication system						
Oil capacity, max.						
without oil filter	:	4 l (7 UK pt, 8.5 US pt)			4.5 l (7.9 UK pt, 9.5 US pt)	
with oil filter	:	4.5 l (7.9 UK pt, 9.5 US pt)			5 l (8.8 UK pt, 10.6 US pt)	
Cooling system						
Capacity,		7.6 litres (1 gal - 5.4 pt UK) (2 US gal)			8.5 litres (1 gal - 7 pt UK) (2 gal - 2 pt US)	
Thermostat	:	opening at 65°C ± 1.5°C (149°F ±3°F), fully opened at 76°C (169°F)				
Coolant pump,						
Flow at max. engine rpm	:	90 l/min (19.8 UK gal/min, 23.8 US gal/min)				
Raw water pump,						
Flow at max. engine rpm	:	100 l/min (22 UK gal/min, 26.4 US gal/min)				
Total head at max. flow	:	1.5 bar (21 psi)				
Inlet connection for hose	:	32 mm (1 1/4") I.D.				
Heater supply connection	:	32 mm (1 1/4") I.D.				
Heater return connection	:	32 mm (1 1/4") I.D.				
Exhaust system						
Exhaust diameter	:	for gear box 90 mm for stern drive 76 mm (3")				
Exhaust back pressure	:	at specified output max. 300 mbar				
Electrical System						
Voltage	:	12 Volt				
Alternator	:	14 Volt, 105 A			14 Volt, 140 A	
Startmotor	:	14 Volt, 2.3 kW				
Capacity, starter battery	:	min. 70 Ah, max. 200 Ah				
Protection	:	Fuse 'ATO' 10 Amp				

Gearbox			Gear ratio				
Technodrive:	type TM345	:	1.54 : 1			—	—
	type TM345A	:	1.54 : 1			—	—
	type TM485A	:	2.09 / 2.40 / 2.51 : 1			2.09 / 2.40 / 2.51 : 1	
ZF Hurth:	type ZF25	:	1.97 : 1	—	—	—	—
	type ZF25A	:	2.03 : 1	—	—	—	—
	type ZF45	:	2.20 / 2.51 : 1			2.20 / 2.51 / 3.03 : 1	
	type ZF45A	:	1.26 / 1.51 / 2.03 / 2.43 : 1			1.26 / 1.51 / 2.03 / 2.43 : 1	
	type ZF63 IV	:	2.00 / 2.48 : 1			2.00 / 2.48 : 1	

2.2 Engine cylinder numbering





2.3 Engine coat paint RAL

SIKKENS LV AUTCOAT 450 RAL 1007

2.4 Tightening torque

Tightening torque for vital connections, which should be tightened with a torque wrench are indicated in the pictures.
The torque readings refer to lightly oiled or dry thread, screw heads and mating surfaces. For connections where special torque denotations are not indicated, the general tightening torque is applicable according to the table below. The torque readings are guide values, and connections do not need to be tightened with a torque wrench.
The screws and nuts divided into different class. It is therefore important when a screw connection is dismantled to return the screw to their original positions. The table refer to 8.8 class screws.

Size	Tightening torque (Nm)
M5	6
M6	10
M8	25
M10	50
M12	80
M14	100

2.5 Operation / duty cycle

With respect to operation and duty cycle VF4 and VF5 diesel engines are rated for PLEASURE CRAFT DUTY ONLY!

Maximum RPM:

Model	Max. RPM (under load)
VF4 series	4000
VF5 series	4200

Wide open throttle operation is limited to short periods of time.

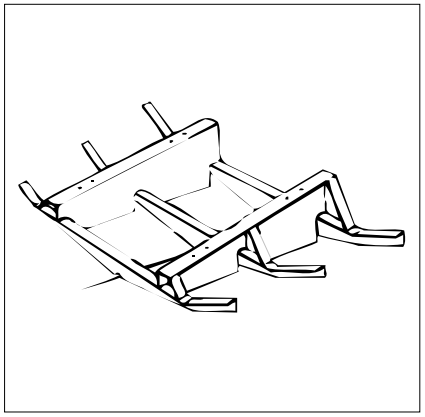
Important: **Damage caused by improper application or failure to operate within the operational capability or duty cycle, will not be covered by the Vetus Warranty.**

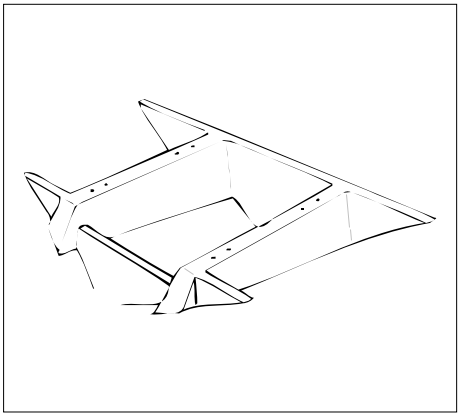
2.6 Engine bed

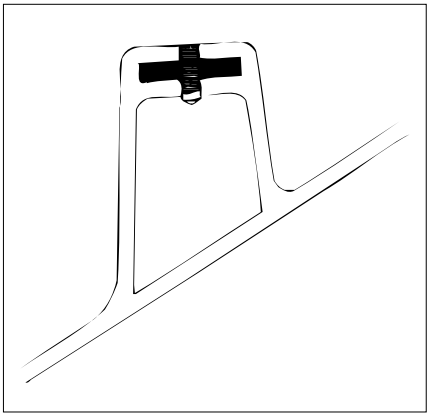
The engine bed should have sufficient stiffness and strength: it must be bonded or connected over its total length to the bottom of the boat and in addition must have sufficient transverse reinforcement either by its own method of construction or alternatively by the use of straightening ribs.

An engine which is easily accessible will be inexpensive to work on is terms of both time and money, for example the water pump situated on the rear side required a sufficient distance from bulkheads.
It is particularly important that both sides of the engine are easily accessible.

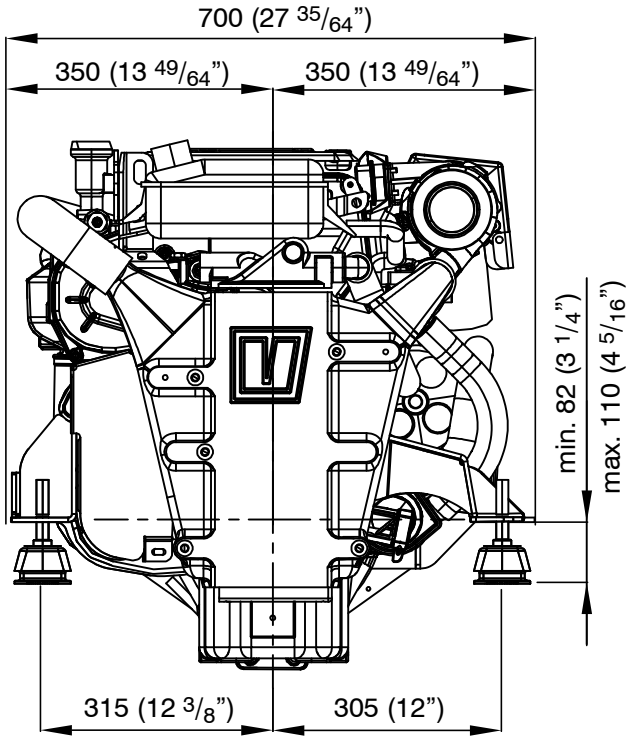
The engine inclination should never exceed 15° backwards.



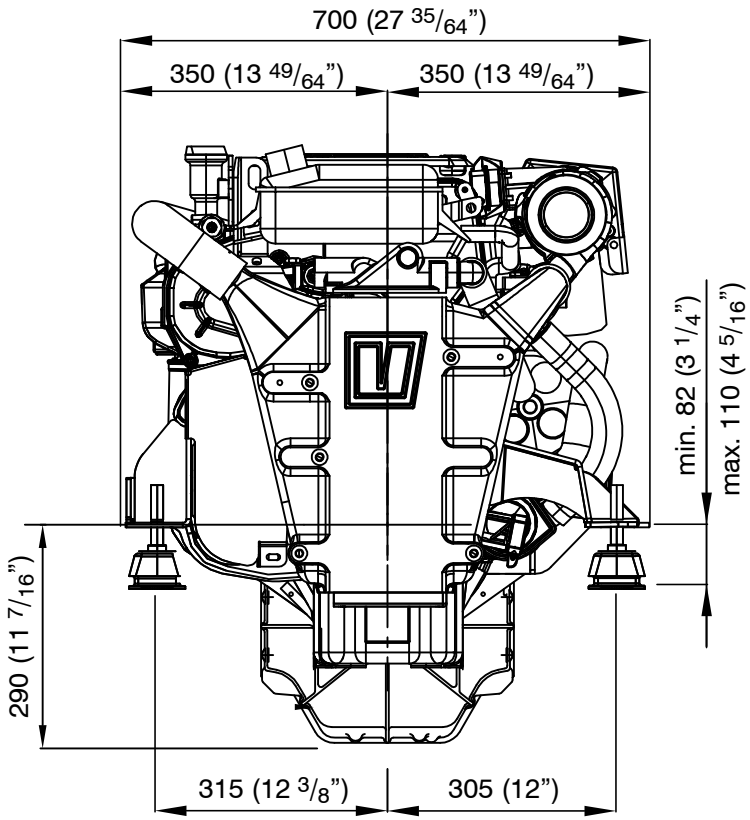




2.7 Overall dimensions

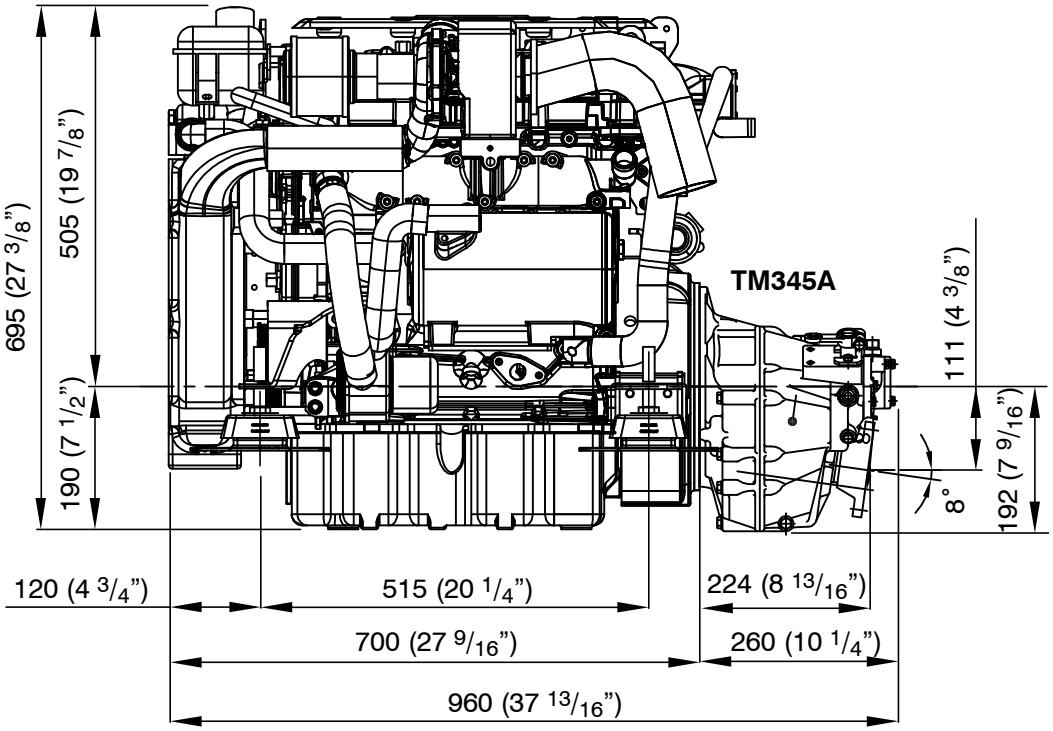


VF4.140E



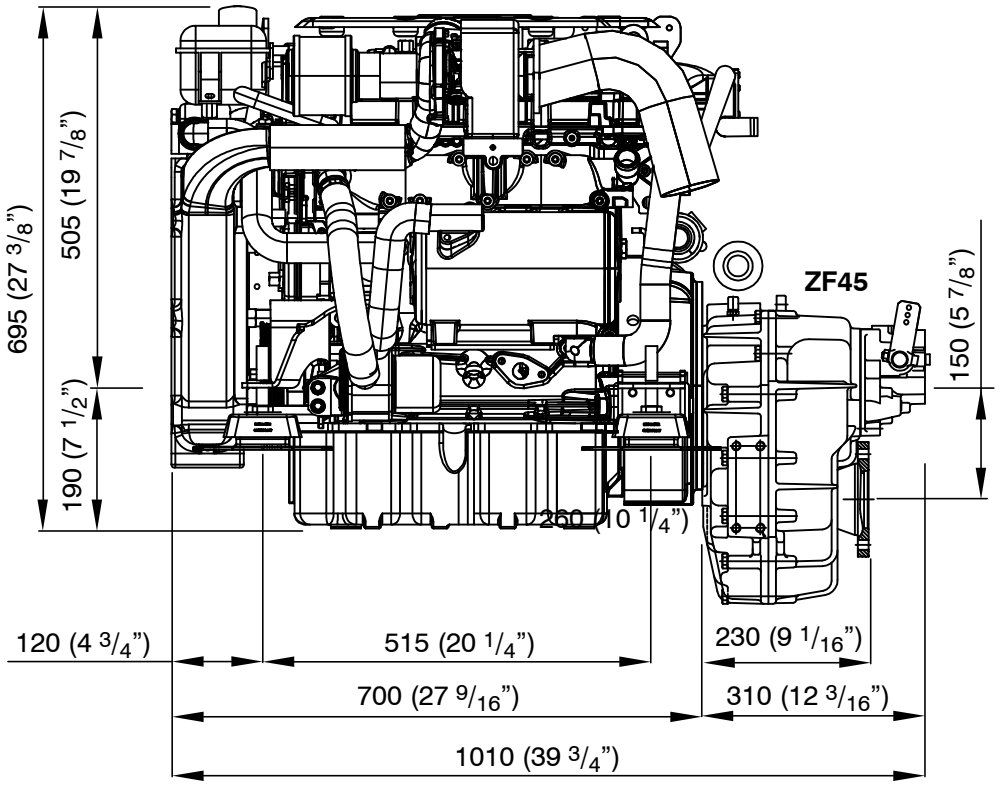
VF4.170E, VF4.190E

VF4.140E

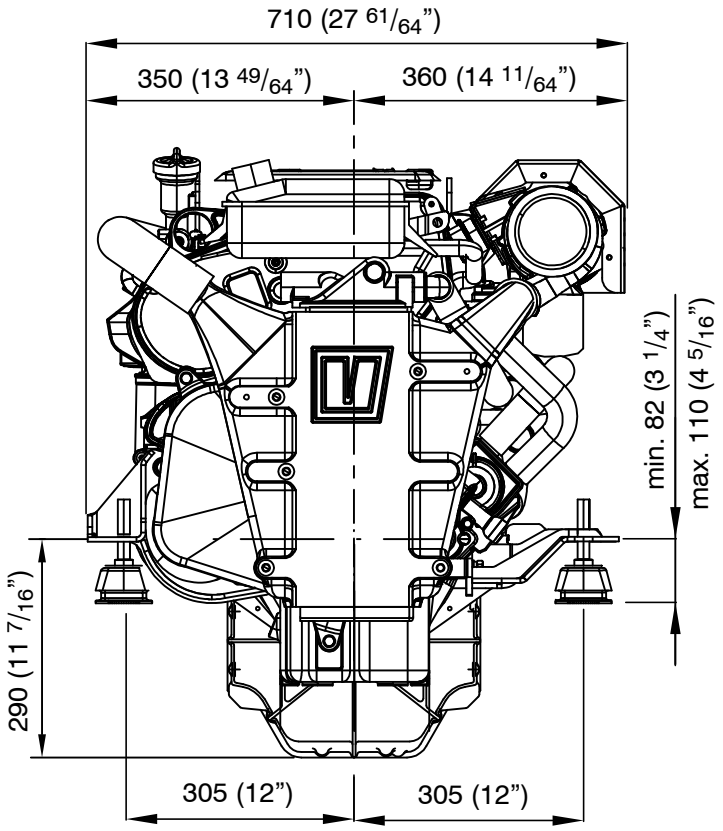


1 : 10

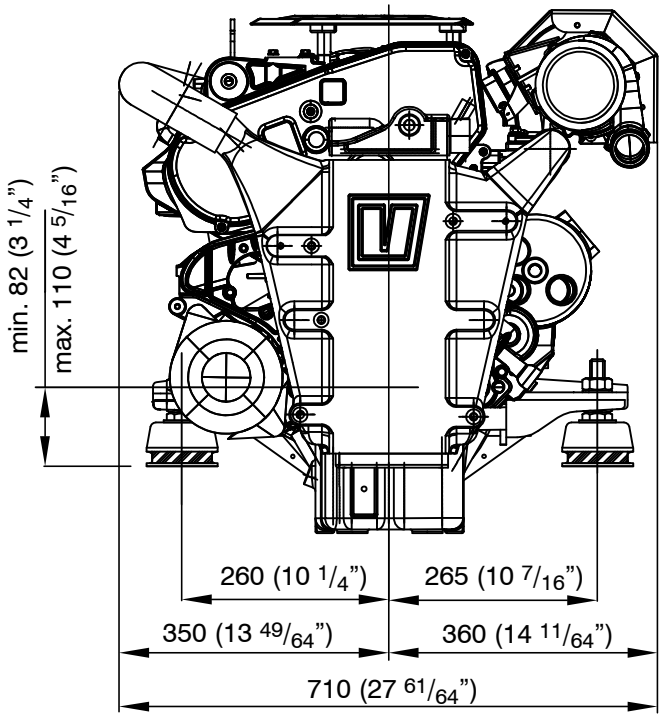
VF4.170E
VF4.190E

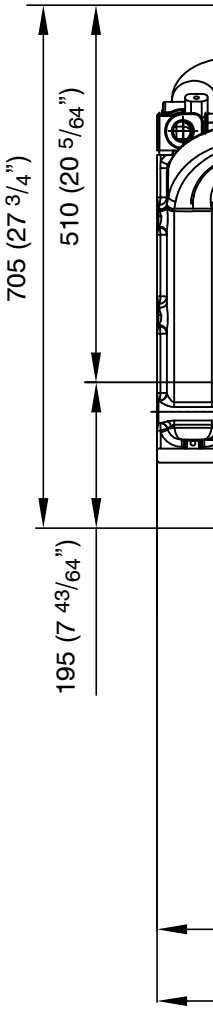


1 : 10

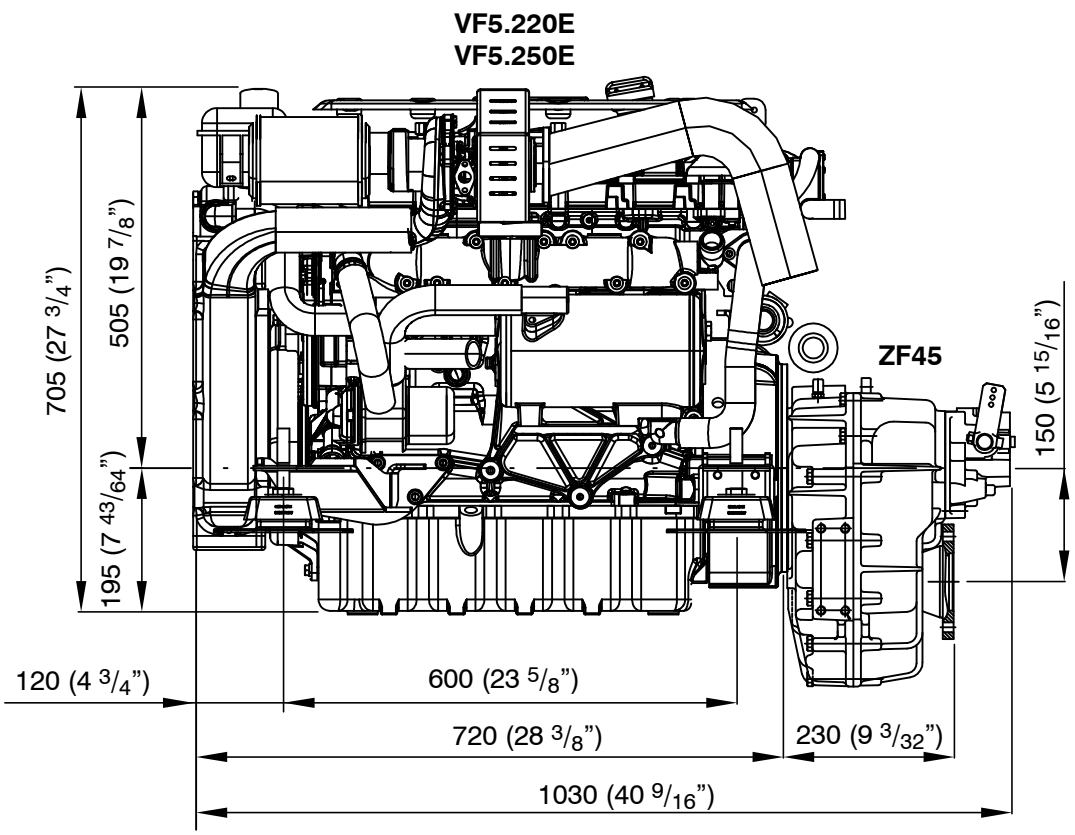


VF5.220E, VF5.250E

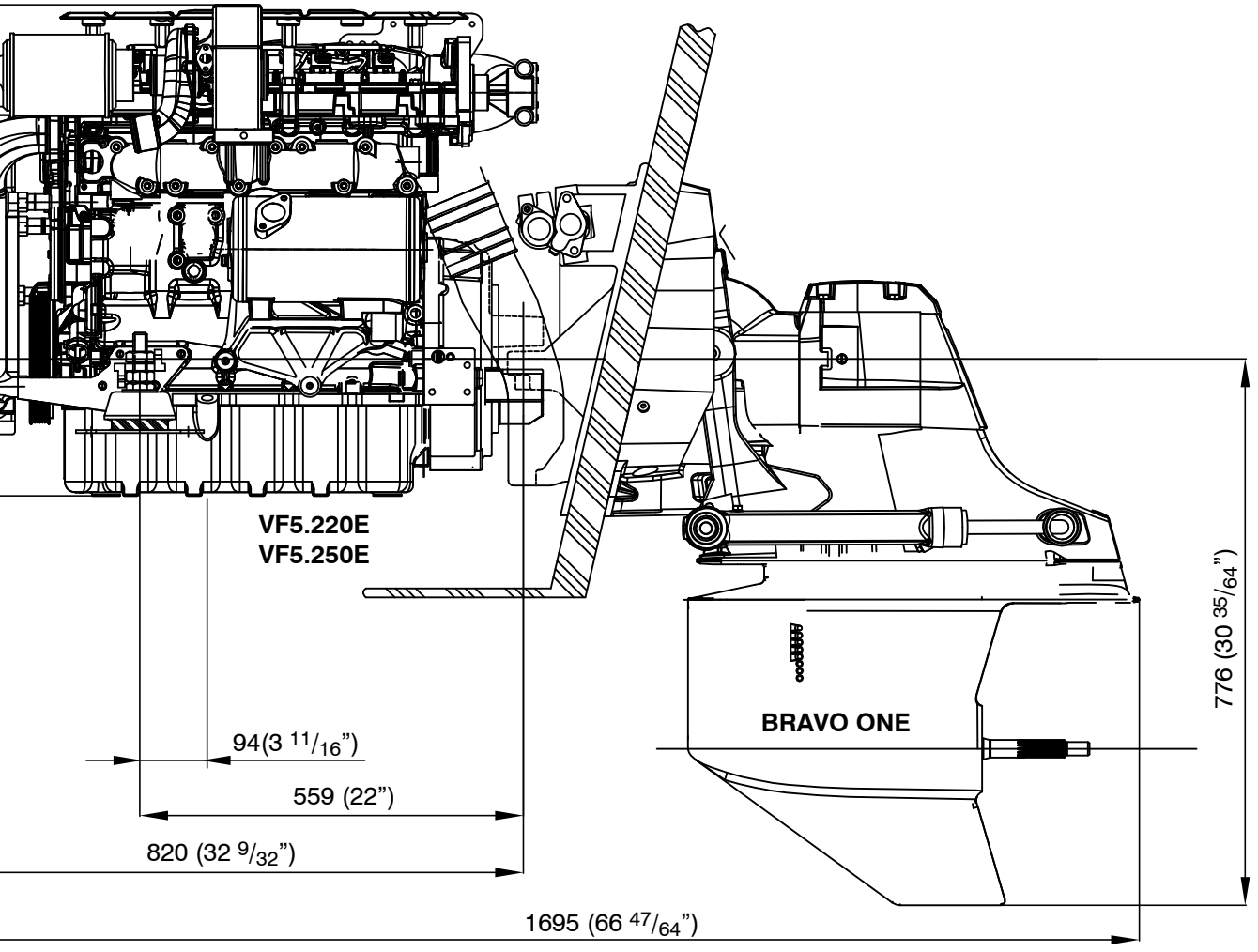




VF5.220EB1, VF5.250EB1


VF5.220E
VF5.250E
705 (27 3/4")
505 (19 7/8")
195 (7 43/64")
ZF45
150 (5 15/16")
120 (4 3/4")
600 (23 5/8")
720 (28 3/8")
230 (9 3/32")
1030 (40 9/16")

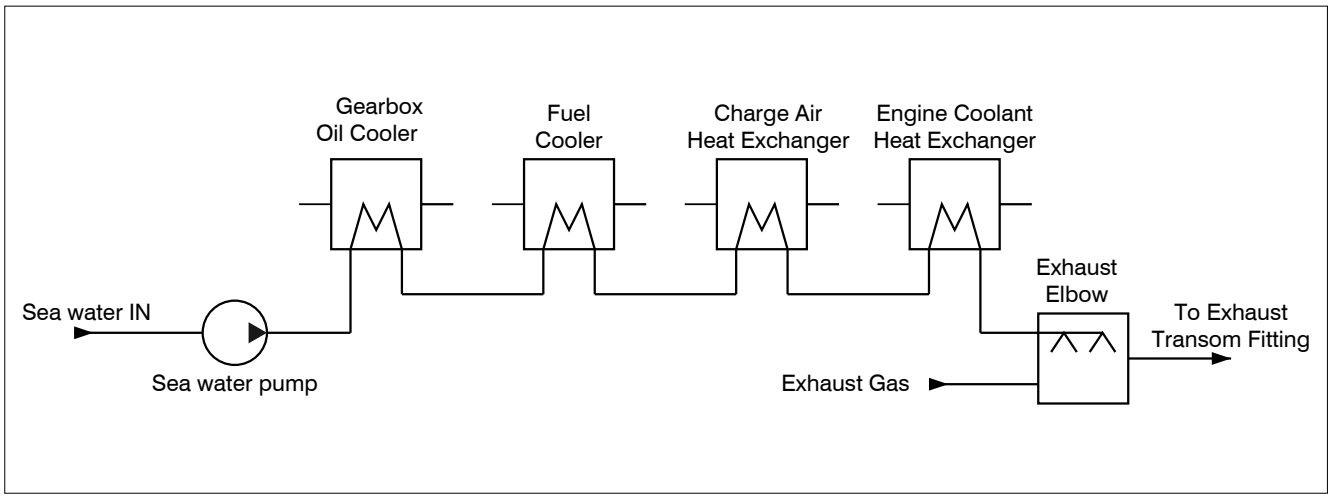
1 : 10


VF5.220E
VF5.250E
BRAVO ONE
776 (30 35/64")
94(3 11/16")
559 (22")
820 (32 9/32")
1695 (66 47/64")

1 : 10

2.8 Raw water circuit

The engine heat exchange circuit is represented in the block diagram below:



The sequence is as follows:

1 the raw water cools the power steering oil or the gearbox oil and the fuel feed circuit;

2 then the air compressed air from the turbo is cooled (After cooler);

3 then the internal coolant circuit is cooled;

4 then the exhaust elbow is cooled

5 the the raw water is injected into the exhaust gasses and mixed with the exhaust gasses it goes overboard.

3 Safety Information

The operation manual contains technical data and maintenance instructions for the designated Vetus engines. Read the instruction and information before starting service works.

⚠ WARNING - Hazards or unsafe practices which could result in severe personal injury or serious product damages.

⚠ CAUTION - Hazards or unsafe practices which could result in minor personal injury or product damages-malfunctions.

3.1 Safety rules

- The manufacturer cannot be held responsible for any damage resulting from misuse of the engine, from the failure to follow the indications contained in this manual and for every tampering with or change made without the manufacturer' s authorization.

- Refer only to a technician staff, with precise technical skills, specific abilities and experiences.

The lack of these requirements could provoke damages to people's safety.

- Use the engine only for the task authorized by the manufacturer, do not manipulate anything to obtain different performances.

- When lift and during the transport of unpacked engine use means of appropriate load capacity.

- When lift packed engine pay attention on load indication printed on box!

- During the installation the installer had to follow the designer's indications. Do not make changes to the engine components for any reason.

- If appropriate, before using the engine for the first time simulate a few trial manoeuvres to identify the controls and their main functions, especially those related to start -stop operations and emergency operations.

- Do not keep using the engine if anomalies are detected.

- In case of anomaly, stop immediately the engine or reduce the speed as much as possible. Start again only when normal condition are restored.

- Replace only original spare parts. Use oils and greases recommended by manufacturer.

- Stop the engine and switch of the power with the main switch (switches) before working on the electrical system.

- Never start the engine without air filter, turbo compressor rotor could provoke damages. Dirty could damage the engine.

- **Don't smoke near the battery pack !** The battery release flammable gases. Wrong battery connection could provoke sparks and explosion.

- Never confuse the plus and minus terminal when fittings the batteries.

- **Use correct protection (clothes etc.) during maintenance operations!**
- Switching the gearbox should be conducted only when the engine is at idle speed.
- **Always close the raw water inlet valve when you dismount the coolant system!**
- Never use starter spray or similar. To prevent the risk of explosion in the air inlet pipe.
- Avoid to opening the coolant filler cap when the engine is hot. Steam or hot coolant can spray out, and built up pressure will be lost. Open the filler cap slowly and release the overpressure if the filler cap must be opened.
- Hot oil can cause burnt injuries. Avoid skin contact with hot oil. Make sure that the oil system is not pressurized before working on it. **Never start the engine with the oil filter cap removed!**
- **During maintenance operation make sure that the engine room is well ventilated.**
- Do not throw away any polluting material. Follow the local rules of legislation.
- If you wash the engine with high pressure wash, observe the following:
  - never point the jet of water at seals, rubber hoses or electrical components.
  - never use high pressure function when washing the engine.
- Use the correct fuel, see the fuel indications.
- Keep the equipment as much efficient as possible and carry out the scheduled maintenance operations established with the manufacturer.

Important

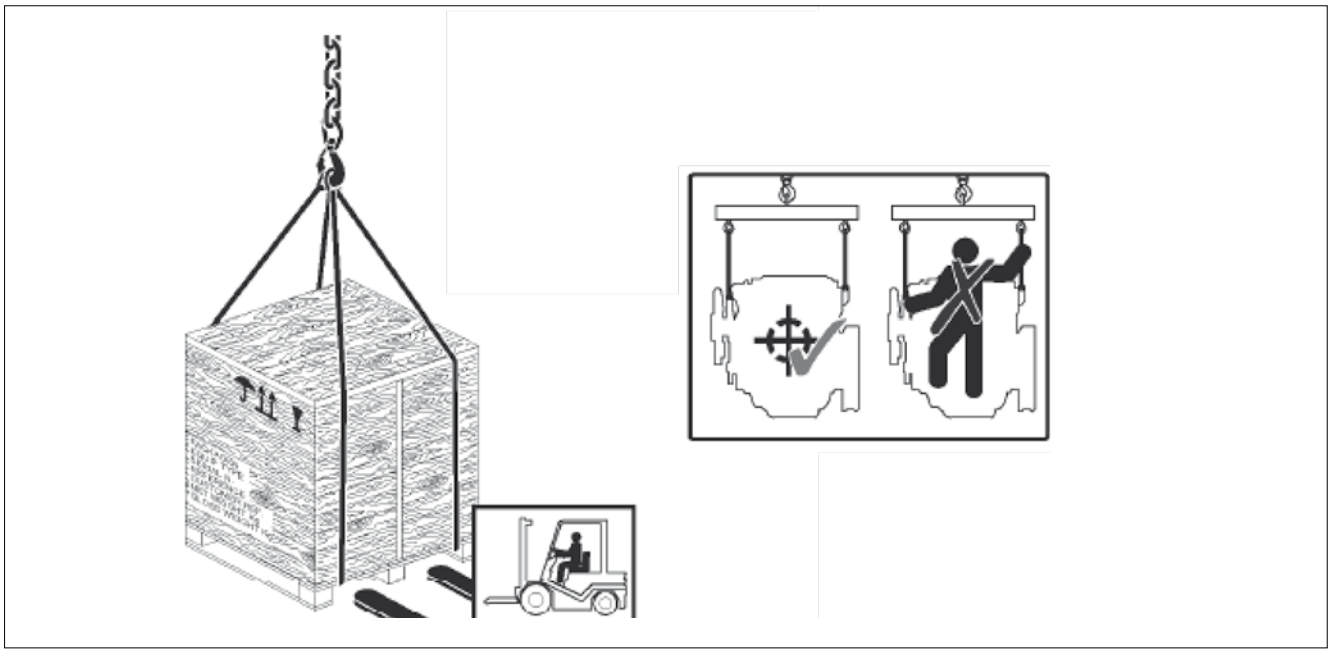
This installation manual has been published by VETUS to aid the boat manufacturer involved in the application and installation of the products described herein.

It is assumed that these personnel are familiar with marine product application and the installation procedures of these products, or like or similar products manufactured and marketed by VETUS. furthermore, it is assumed that they are familiar with, if not trained in, the recommended installation procedures of these products.
It is the responsibility of the purchaser (whether boat builder or dealer) of a VETUS propulsion engine to select the appropriate package (including sufficient horsepower, appropriate drive unit, correct gear ratio and appropriate propeller) for a given boat. Making such a selection requires knowledge of the boat, including the boat weight, length, hull design, intended use, intended duty cycle, and desired speed, all of which is in the exclusive possession of the purchaser.

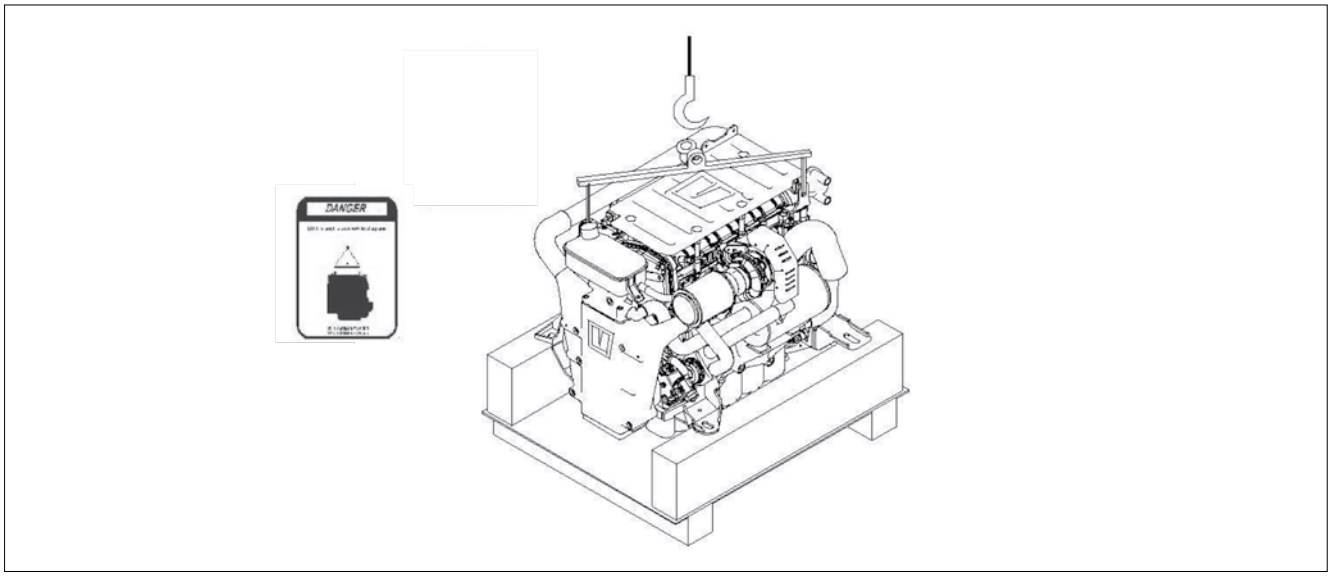
All information, illustrations, and specifications contained in this manual are based on the latest product information available at time of publication. Vetus reserves the right to make changes at any time without obligation.

3.2 Engine lifting

WARNING - The lifting hooks are engineered only to lift the engine without any extra weights!



When you install the engine on your boat after opening the engine packages always use the spacer rod as is show in the figure to lift the engine.
Assure that the spacer rod is in 'good condition' and strong enough to withstand the weight.
For complete indications see the 'danger' label on the engine cover carter.



WARNING - The weight of the gearbox will shift the engine centre of gravity astern; take care when lifting the engine.

4 Engine's requirements

4.1 Engine Compartment

IMPORTANT: **Boating standards and Coast Guard regulations must be adhered to when constructing the engine compartment.**

Care must be exercised in the design and construction of the engine compartment. Seams must be located so that any rain water that may leak through the seams is directed away from the air intake system. Water that runs onto the air intake may enter the engine and cause serious damage to internal engine and/or turbocharger parts.

IMPORTANT: **Vetus will not honour any warranty claim for engine damage as a result of water entry.**

⚠ **WARNING - RISK OF FIRE! Turbocharger became hot during the engine use.**

Take care during installation. The turbocharger should be kept away not less than 30 cm (12 inch) from bulkheads or VTR structure. Use thermal protection.

4.1.1 Engine Compartment Ventilation

This section does not cover the design of the ventilation system as it pertains to ventilation of fumes from the engine compartment. The requirements for ventilation of fumes varies considerably from one boat design to the next, as well as from country to country, and therefore, the boat manufacturer is responsible for ensuring their application is in compliance with the appropriate industry regulations and standards.
According to boating standards and Coast Guard regulations the engine compartment ventilation system has multiple tasks. Included the following:

- To supply the engine with combustion air.
- To maintain a low temperature in the engine compartment.

Fresh air should enter the engine compartment as low as possible and the heated air should be discharged from the highest point.
If a separate air shaft (or similar) is used to provide engine compartment ventilation, or additional ventilation, care must be taken to prevent seawater and spray from entering it.

⚠ **WARNING**

Ventilating air is required to clear the bilges, as well as the compartment in which the engine is located, of potentially toxic and flammable vapours.

4.1.2 Intake air requirement

Engine compartments with natural draft ventilation must have vent openings of sufficient size and location to accomplish the tasks previously outlined.

IMPORTANT: **The size of ventilation openings must be increased if any auxiliary equipment is located in the engine compartment.**

The combustion air requirement (per engine) for the specified engines at wide open throttle are shown in the table below:

Combustion Air Requirements (single engine)

Model	Engine Air requirements at maximum speed
VF4	7 m^3/min (250 cu.ft /min)
VF5	8.5 m^3/min (300 cu.ft /min)

In order to guarantee the optimum engine temperature, 30 - 40°C (86 - 104°F), it is necessary to make sure that the engine compartment ventilation meets the following requirements:

- Inlet (combustion air): the surface must not be lower than 230 cm^2 (35 sq.in.) (per engine). We recommend that the air inlets are positioned in such a way as to favour a continuous air flow towards the engine's air filter.

- Hot air outlet: the surface must not be less than 100 cm^2 (16 sq.in.) per engine and the air outlets must be positioned in the upper part of the engine compartment. Favourite the correct ventilation of turbocharger.

For all those applications that do not allow for these requirements to be fully met, it is required that the air inlets must be connected directly from the outside of the engine compartment with an appropriate water system and also we require that a ventilation system must be installed so that the hot air flow is forced from the engine compartment to the outside. All the components must meet the European Community standards and regulations.

⚠ WARNING

If the temperature at the engine air inlet exceeds 40°C (104°F), the engine may be seriously damaged.

4.1.3 Compartment temperature indications.

Too high an inlet air temperature lowers the engine performance. Engine compartment temperature shall not exceed outside air temperature by more than 15 °C (59°F).
Since many factors influence engine compartment temperature, temperature measurements should always be carried out.
Observe the following:

- The boat being tested shall be a standard production boat fitted as it would be for delivery to a dealer.

- Temperature test meter used shall be of the type that can be read without opening the engine cover.

- During the test, in Step 1., engine compartments are to remain closed. No outside air is to be forced into the engine compartment during the test and the bilge blower should not be running.

Engine Running and Heat Soak Test:
Use 1 meter and 1 thermocouple. Position the thermo couple at the engine air inlet(air filter).
Start engine to warm it up. After engine is at its normal operating temperature, run engine at WOT for 20 minutes. Record temperature readings at 5 minute intervals.

IMPORTANT: **If the temperature at the engine air inlet (air filter) exceeds specifications, the engine compartment will need additional engine combustion air openings, or an increase in engine compartment ventilation area, until the temperature remains within specification.**

4.2 Fuel connection

4.2.1 Fuel Delivery System

IMPORTANT! **Boating standards (CE-ABYC) and Coast Guard regulations must be adhered to when installing fuel delivery system.**

The main concern of a boat's fuel system is safety; this must be achieved through a technically sound installation and constant inspection.
The fuel system, from the filler pipe to the fuel pump is the same, in principle, for all boats.
The fuel tank is an integrated component of the boat. Refer to the special information on service and maintenance from the tank manufacturer.
Only a few points related to function and safety are listed here:

- All connections should be on the upper side of the tank.
- The drain plug at the lowest point on the tank serves to permit the removal of water and sediment.
- The filler tank pipe outer diameter should be at least 50 mm (2 in.).
- The tank breather pipe must have an inner diameter (I.D.) of at least 13 mm (1/2 in.) and must be fitted with a goose neck to prevent water from entering the tank.

It is recommended that the exact route and length of the fuel lines be established at the first installation of the engine to prevent problems later in connecting them to the engine.

ATTENTION! **All fuel lines must be well secured. The holes where the lines run through the bulkheads should be carefully rounded off, or protected with rubber grommets. This prevents damage to the lines from abrasion.**

ATTENTION! **The max. fuel pump suction pressure head is around 1.5 m (60 inches) take care when install the fuel line.**

ATTENTION! **Air leaks or narrow needs on fuel line could provoke engine stop.**

4.2.2 Fuel connections

The following, but not limited to the following, additional fuel connection related points, applying to all engines unless otherwise stated, must be considered.

- Fuel pickup should be at least 25 mm (1 in.) from the bottom of fuel tank, to prevent picking up impurities.
- Fuel inlet fitting is an 8 mm (5/16 in.) barbed fitting attached to the fuel supply pump.
- A flexible fuel line must be used to connect fuel supply line to fuel inlet fitting on the engine to absorb deflection when engine is running. Injection pump fuel return line must also have a flexible rubber hose segment.
- Fuel supply lines must not be smaller than 8 mm (5/16 in.) I.D. tube. A fuel return line between engine and fuel tank is required, having the same size I.D. as the supply line.
- On Multi-Engine Diesel Installations: Use a separate tube for the fuel supply line and fuel return line, for each engine.
- Larger diameter (than previously specified) lines and fittings must be used on installations requiring long lines or numerous fittings.
- Fuel line(s) should be installed free of stress and firmly secured to prevent vibration and/or chafing.
- Sharp bends in fuel lines should be avoided.

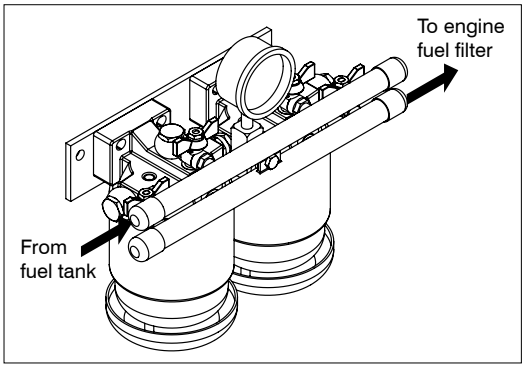
4.2.3 Shut off valve.

Make sure your fuel system has positive shut-off valves; know their locations and how they operate.

4.2.4 Diesel fuel Pre-filter and fuel additives.

There is the possibility that contamination of diesel fuel and algae growth in the diesel fuel could block the lift pump resulting in poor performance.

IMPORTANT: The engine is provided with an element type fuel filter, but to help eliminate water and dirty it is recommended to use an additional 10 micron, 230 l/h (50 Imp. gph, 60 US gph) flow rated filter that has a water separator.



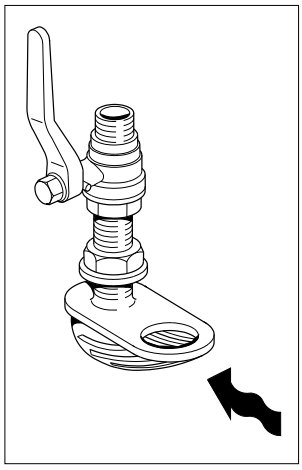
It is recommended to install an additional fuel filter equipped with a water separator before the fuel lift pump. We recommend a 10 micron, **230 l/h (50 Imp. gph, 60 US gph)** per hour rated filter (single or double installation). This will help to filter out contaminants in diesel fuel.
Select a suitable position in the fuel system between the fuel supply pump and the fuel tank for the additional filter The position selected must be free from vibrations, and allow for easy inspection and replacement. It is also recommended that a diesel fuel additive be used to combat algae growth, particularly in warmer climates. Additives reduce the chances of algae growth in the diesel fuel in warmer clime.

IMPORTANT: See the certification data on the filter i.e CE,ABYC or Solas

4.3 Sea water circuit

4.3.1 Sea cock

Sea cock must provide minimum restriction to water flow. A ball or gate valve is recommended. The ball valve is most common and is typically equipped with a lever type handle that operates in a 90 degree arc. This design gives a clear indication of whether the valve is open or shut. Industry standards/requirements typically require that the sea cock be rigidly attached to the hull at the water pickup. Sea cock location should be readily accessible for quick, easy operation.



4.3.2 Seawater pickup hose

Seawater inlet hose connections must be made with wire reinforced hose of adequate wall thickness to prevent it from collapsing from pump suction. Be sure to secure hose connections with hose clamps. Secure hose to prevent contact with any moving parts of the engine. Select the proper hose from the following table.

Seawater Pickup Hose Inner Diameter	
All Models	32 mm (1 $^1/_4$")

IMPORTANT: **For sea water fittings use only MARINE WATER HOSE steel reinforced and 2.5 bar (35 psi) max pressure for suction or pressure use.**

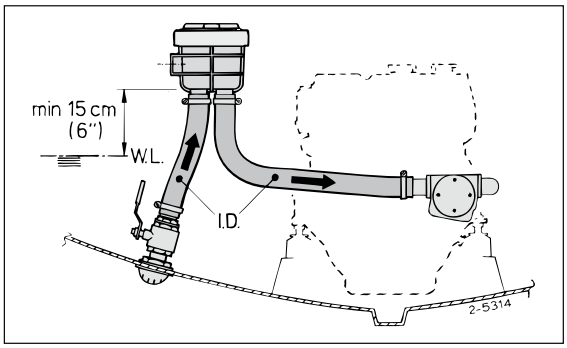
IMPORTANT: **Take care for the hose temperatures working range.**

4.3.3 Seawater strainer

Seawater strainer used must be of sufficient size to ensure that an adequate supply of water will be maintained for cooling the engine. Select a proper seawater strainer based on the following chart:

Seawater Strainer Minimum Flow Rate	
All Models	100 l /min (22 Imp. gal/min, 26.5 US gal/min)

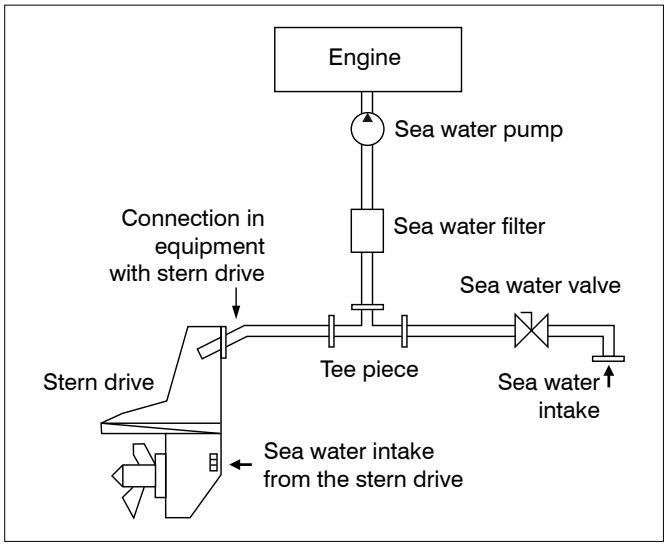
Install seawater strainer in an area where it will be easily accessible for inspection and cleaning. Strainer should be installed in water inlet hose after the sea cock (water inlet valve) to allow operator to shut off water when cleaning strainer.



A through-hull fitting that is completely flush with the surface of the boat's hull and without an external strainer may be necessary for the engine raw water intake on very high-speed boats. The protrusion of a standard type through hull fitting and a strainer can cause a Venturi effect on the intake of a high speed boat, creating a suction which works against the raw water pump causing an inadequate supply of cooling water to the engine.

4.3.4 Stern drives sea water pick up circuit.

For Mercruiser stern drives we suggest to use the sea water circuit diagram pictured alongside.



4.3.5 Fittings

All pipe and fittings should be of bronze. Use sealing compound or tape at all connections to prevent air leaks. The neoprene impeller in the raw water pump should never be run dry. All hose joints should be double clamped with 304/316 stainless-steel hose clamps. T-bolt clamps are even better but must be 304/316 stainless.

IMPORTANT: **For sea water fittings use only MARINE WATER HOSE steel reinforced and 2.5 bar (35 psi) max. pressure for suction or pressure use.**

IMPORTANT: **Follow the instructions for the hose temperatures range.**

IMPORTANT: **For fuel hose use A1 quality tube for petrol and diesel with NBR inside.**

IMPORTANT: **Exhaust tube Lloyd's register or shipping approval or R.I.N.A approved.**

4.4 Exhaust system

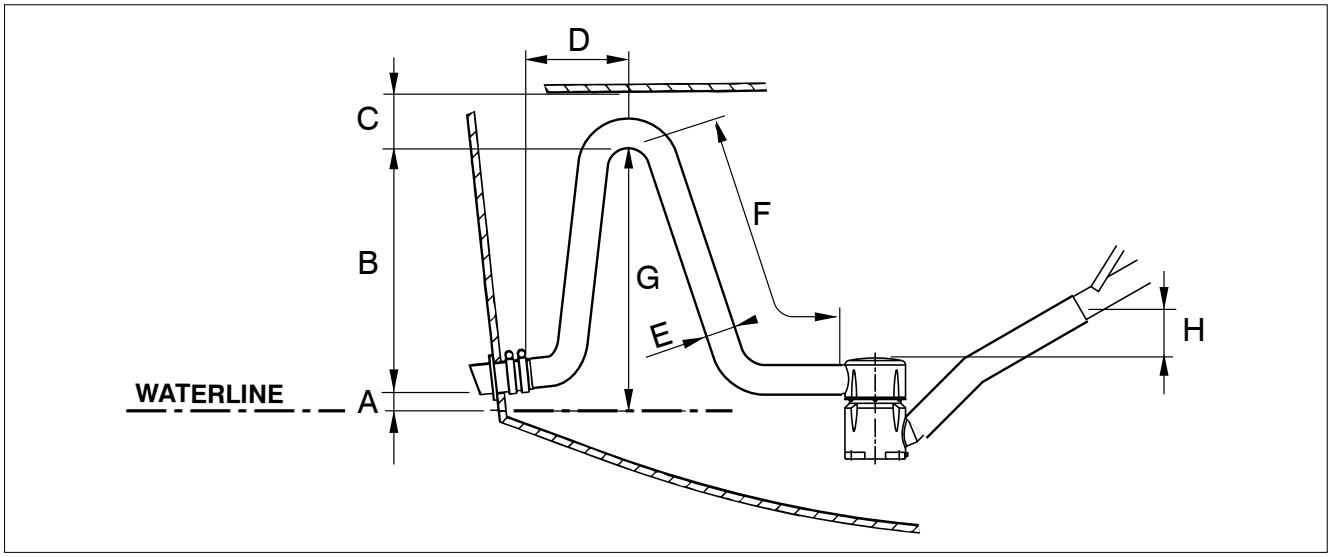
4.4.1 Wet exhaust systems installation.

Beyond conveying exhaust gases and cooling system sea water out of the boat, the other purpose of the exhaust system is to prevent sea water intrusion into the engine (at the exhaust outlet) under all conceivable conditions of boat trim, boat operation, sea conditions, and heel angle while not exceeding the manufacturer's back pressure recommendations. Seawater intrusion is usually catastrophic to turbocharger and engine.

IMPORTANT!: **The engine supplier is not in a position to judge what installation characteristics will prevent water intrusion in all conceivable circumstances. That judgment is the responsibility of the engine installer.**

What we as the manufacturer can do is advise the best practice.

We need to define the water line for exhaust installation purposes. By water line we mean the highest point the water level can reach, at the location of the exhaust through hull fitting, from all conceivable causes - other than passing waves of a duration of not more than a second or two. This worst case water level could be caused by any of the following: backing down aggressively, turning aggressively, coming up onto a plane, decelerating off a plane, extreme boat trim, high seas, wallowing in following seas, heeling, etc. Here after these instructions will refer exclusively to this worst case water level as the relevant water level to plan a good installation.



Dimension **A** is the height between worst case water level and transom fitting. **A** should be minimal 5 cm (2”).

Dimension **B** is the height of the exhaust loop or goose neck. This is to prevent the ingress of water in case the transom fitting dips below the water level. B should be minimal 45 cm (19”), but not more than 150 cm (60”).

Dimension **C** depends on the space available.

Dimension **D** should be kept as minimal as possible. The steeper this part of the exhaust hose the lesser the risk of ingress of water in case waves are coming from behind into the transom fitting.

Dimension **F**, the length of the exhaust hose from water lift muffler to the highest point of the goose neck, should be kept as short as possible.
The shorter this length, the lower the back pressure and the greater will be the reserve capacity inside a given water lift muffler. The shorter the better, but it is much more important to minimize **A** than to minimize **F**.

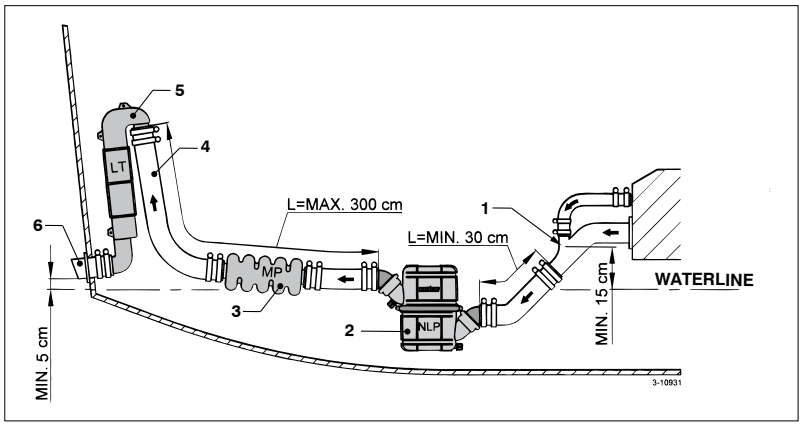
The water lift muffler should be sized to hold multiples of the volume of water that spills back from the exhaust highest point when the engine shuts off. The actual amount of normal spill back at shut down is a function of length F, the exhaust hose inside diameter, **E**, and the sea water pump flow rate (about 100 litres/min - 22 Imp. gal/min - 26.5 gal/min at maximum speed). The larger the water lift the better. Remember - when all else fails and water comes pouring over the high point, only reserve capacity in the water lift can contain it and will prevent it from entering the engine.

H is the height of the engine’s water injected exhaust elbow outlet above the top of the water lift muffler. This should be maximized. This length of hose is additional reserve capacity to contain both intruding water and splashing inside the water lift muffler.

G is the total height engine exhaust gas pressure must move water up hill – from the bottom of the muffler to the spillover point at the exhaust run high point. **G** is driven by other installation dimensions. It results from a conservative installation, rather than being a driving factor.

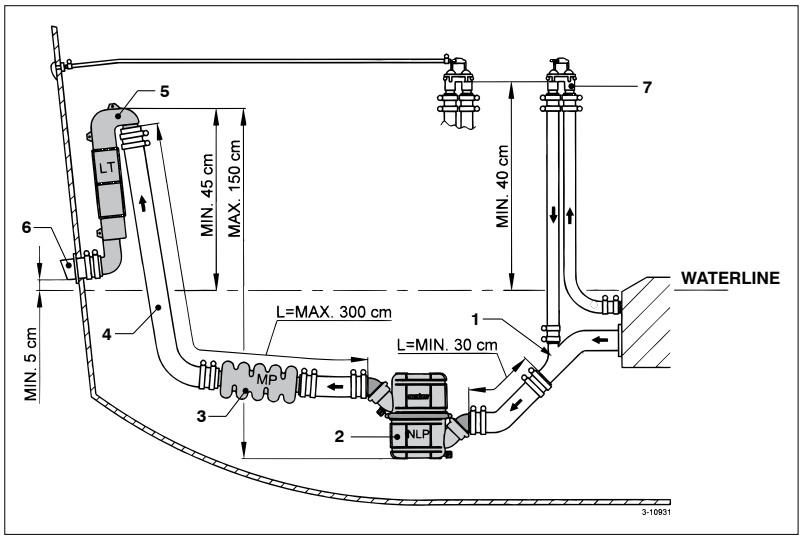
4.4.2 Sea water intrusion through the intake sea-cock

Another means of water intrusion is through the sea water intake sea-cock. This can occur when any part of the sea water system or exhaust system are below the worst case water level (other than the sea-cock itself which is already below the water level, of course). What happens is that, upon engine shutdown, sea water siphons from the intake sea-cock, up through the sea water cooling circuit containing the sea water pump, heat exchanger, and water injected exhaust elbow, into the water lift muffler. This seawater will siphon past the impeller of the sea water pump and fill the muffler and all hoses attached to the muffler until the outside water level is reached. If the engine exhaust manifold is below the worst-case water level, seawater will simply pour into the cylinders, destroying the engine. This form of water intrusion is avoided by the proper installation of an anti siphon valve in the sea water circuit between the sea water pump outlet and the water injected exhaust elbow inlet. The anti siphon valve must be well above the worst case water level under all conceivable conditions of boat trim, boat operation, sea conditions, and heel angle. The anti-siphon break and the exhaust hose point should be located as near to the boats centre-line as possible; especially on sailboats due to large and steady healing. The siphon must be accessible for maintenance.



System with water injection point 15 cm (6 in.) or more above the waterline

1 Water injection point
2 Waterlift
3 Muffler
4 Exhaust hose
5 Goose neck
6 Transom fitting



System with water injection point below or less than 15 cm (6 in.) above the waterline

1 Water injection point
2 Waterlift
3 Muffler
4 Exhaust hose
5 Goose neck
6 Transom fitting
7 Air vent

4.4.3 Cranking the starter: draining the muffler

⚠ WARNING!

Prolonged cranking of the starter may cause excessive sea water to build up between the engine and the high point.

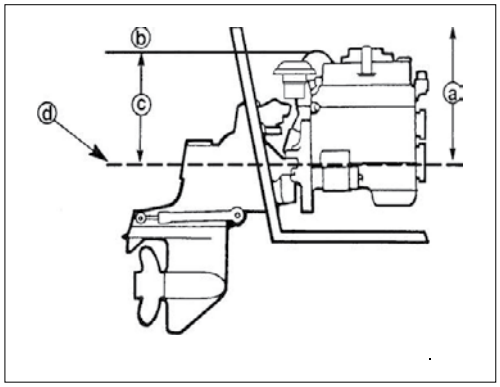
Each time cranking is interrupted additional water may spill back into the muffler. In time this cumulative spill back can flood the engine. Unusual cranking and/or cranking interruptions must be monitored and the muffler drained before excessive water buildup occurs. This may be made more convenient by installing a suitable, non-corrosive valve at the muffler drain fitting.

4.5 Exhaust system for stern drive version

IMPORTANT: **It is the responsibility of the boat manufacturer or installing dealer to properly locate the engine and install the exhaust system.**

Improper installation may allow water to enter the exhaust manifolds and combustion chambers and severely damage the engine. Damage caused by water in the engine will not be covered by Warranty, unless this damage is the result of defective part(s).
Verify that the riser provides the required dimension “c,” or a distance greater than “c,” as indicated.

Model	
VF5-VF4	“c” Must be at least 580 mm (23 inches)



Engine With Standard Riser
a - From Waterline To Top Of Transom
b - From Highest Point On Exhaust Riser To Top Of Transom
c - From “a” Minus “b” (from water line to the highest point of the riser)
d - Waterline At Rest

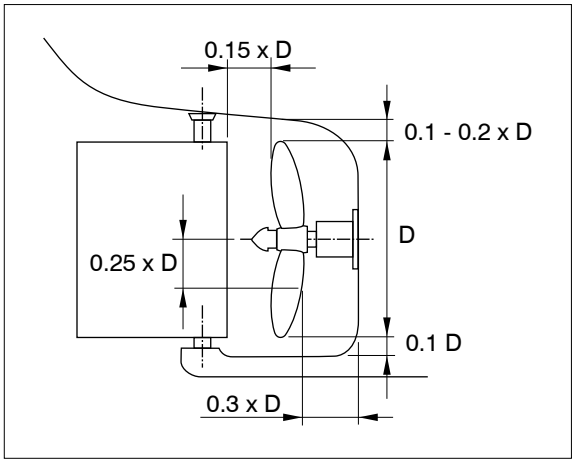
4.6 Propeller selection

IMPORTANT: **Installed propeller must allow engine to run at the upper end of the specified wide open throttle operating revolutions per minute (rpm) range, with a normal load aboard the boat. Use an accurate service tachometer to verify engine operating rpm.**

It is the responsibility of the boat manufacturer and/or the selling dealer to equip the power package with the correct propellers.

The type and size of propeller varies with the gear ratio and must be selected to fit the application, based upon boat tests. To utilize the full power of the engine and to achieve ideal loading conditions, use a propeller which will permit the engine to reach its full rated rpm at full throttle while under a normal load and while the boat is moving forward through the water.
The following information is needed to calculate and match a marine propeller to a boat:

- The engine output in HP.
- The maximum RPM of the engine.
- The reduction of the transmission.
- The maximum hull speed of the boat.
- The type of boat and its displacement.
- The waterline length (LWL).



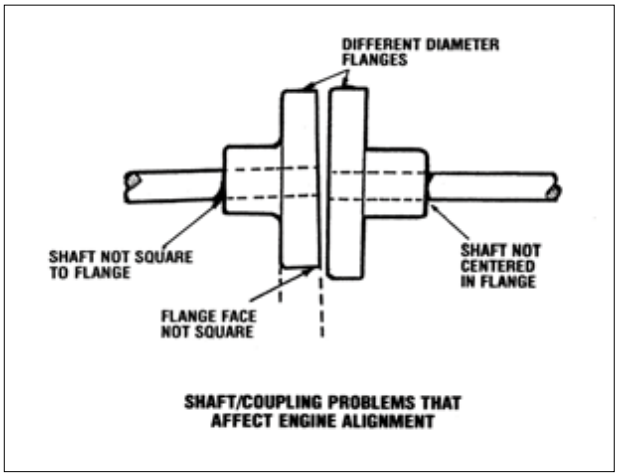
High rpm, caused by an excessive trim angle, should not be used in determining correct propeller selection.If full throttle operation is below the specified range, the propeller must be changed to prevent loss of performance and possible engine damage. On the other hand, operating an engine above the specified operating rpm range will cause higher than normal wear and/or damage.
After initial propeller selection, the following common problems may require that the propeller be changed to a lower pitch:

- Warmer weather and greater humidity cause an RPM loss (not as significant on EDI models).
- Operating with increased load (additional passengers, pulling skiers).

For better acceleration, such as is needed for water skiing, use the next lower pitch propeller. Do not operate at full throttle when using the lower pitch propeller but not pulling skiers.
Because of the many variables of boat design, only testing will determine the best propeller for a particular application.

4.7 Gearbox version: propeller shaft alignment

The engine must be exactly aligned with the propeller shaft. No matter what material is used to build a boat, the material will be flexible to some extent. The boat's hull will change its shape to a greater extent than is usually realized when the boat is launched and operated in the water. Therefore, it becomes extremely important to check the engine's alignment at frequent intervals and to correct any errors when they appear.



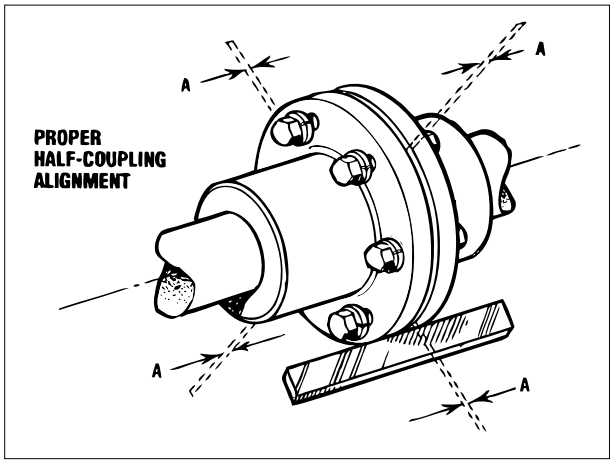
SHAFT/COUPLING PROBLEMS THAT AFFECT ENGINE ALIGNMENT

Misalignment between the engine and the propeller shaft often creates serious problems which are often blamed on other areas suspected of causing the trouble. Misalignment will cause excessive bearing wear, rapid shaft wear, and will, in many cases, reduce the life of the boat's hull by loosening the hull's fastenings. A bent propeller shaft will produce these same effects, therefore a perfectly straight propeller shaft is absolutely necessary. One result of misalignment may be leakage of transmission oil through the transmission's rear oil seal. If oil should leak from this seal, check and make sure that the alignment is within the limits prescribed.

Never attempt a final alignment when the boat is on land. The boat should be in the water and have had an opportunity to assume its final water form. The propeller shaft/transmission coupling alignment is best performed with the fuel and water tanks about half full, with all the usual equipment on board, and, on sailboats, after the mainmast has been stepped and the final rigging has been installed.

Take sufficient time to make this alignment — don't be satisfied with less than perfect results.

The alignment is correct when the propeller shaft can be easily slipped backward and forward into the counter bore, and when a feeler gauge indicates that the flanges come together at all points. In making the final check for alignment, the transmission half-coupling should be held in one position and the alignment with the propeller shaft half-coupling tested with the propeller shaft half-coupling in each of four positions (A), while rotated 90 degrees between each position. This test will also check whether the propeller shaft half-coupling is in exact alignment on its shaft.



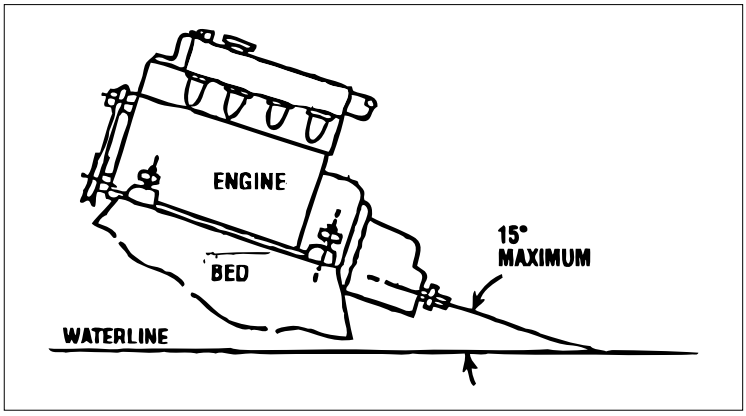
Then, keeping the propeller shaft half-coupling in one position, the alignment should be checked by rotating the transmission half-coupling in 90 degree increments, checking dimension A while in each 90 degree position until it has been rotated full-circle.

The engine's alignment should be rechecked after the boat has been in service for one to three weeks and, if necessary, the alignment performed again. Usually it will be found that the engine is no longer in alignment. This does not mean that the first alignment has been done improperly, rather, it means that the boat has taken some time to take its final shape and that the engine's bed and stringers have probably absorbed some moisture. It may even be necessary to realign the coupling halves again at a later time.

4.8 Engine bed mounting

For the distance between starboard and port engine mount read the installation drawings. Engine bed must position engine so that a minimum of 6 mm (1/4 in.) up and down adjustment still exists on mounts after performing final engine alignment. This is necessary to allow for realigning engine in the future.

IMPORTANT! **For the engine installation don't exceed the 15 degrees astern alignment angle.**



5 Electric/electronic system

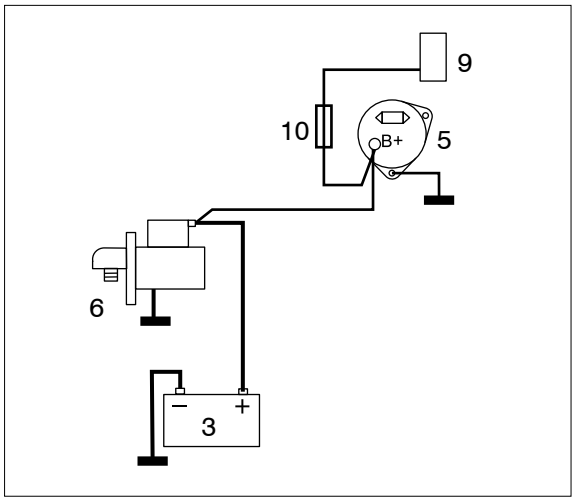
5.1 Electrical system

5.1.1 Battery connection

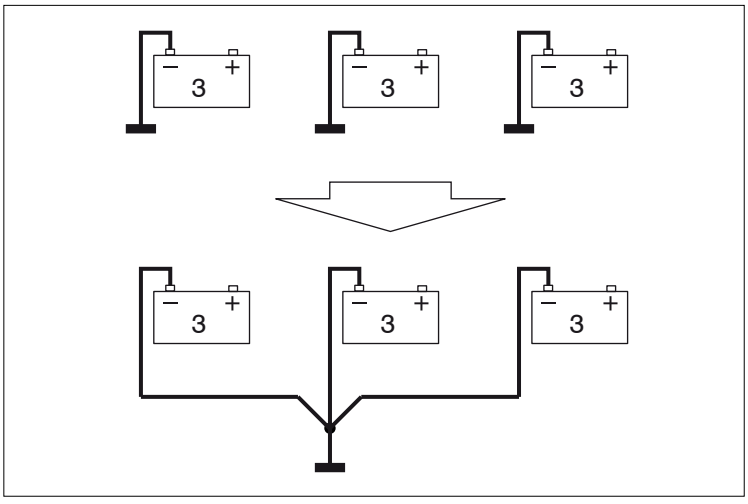
Here below you will find a series of diagrams how to connect the batteries in case that it is necessary to use an auxiliary battery or in case of a twin engine installation.
The alternator should charge also the auxiliary battery without having the auxiliary battery getting discharged by transferring power to the engine battery. Use either a battery selector switch or a diode splitter to achieve this.

5.1.2 Diagrams

Diagram	Engines	Batteries	Battery selector switches	Diode splitters	Remarks
1	1	1			Reference diagram, Engine wiring as supplied
2					Ground connections; all ground connections together must be tied together to one ground point.
3	1	2	1		
4	1	2	1		
5	1	2		1	Connection of battery charger
6	1	2	1	1	One starter battery, one domestic battery
7	2	2	1		
8	2	2		2	
9	2	3	2		Two starter batteries, one domestic battery
10	2	2	1	2	
11	2	2	1	2	Connection of battery charger
12	2	3		2	Two starter batteries, one domestic battery

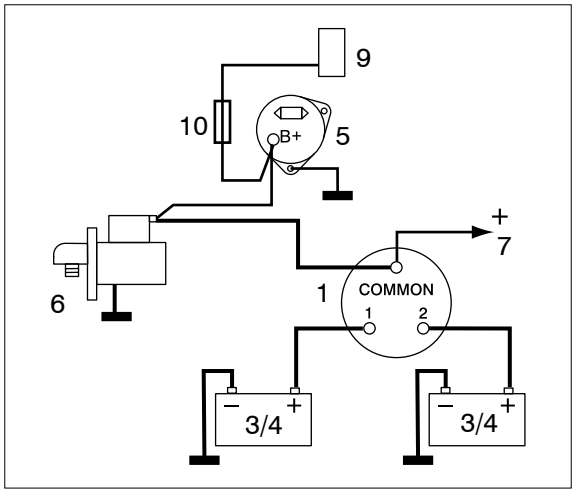


1 As a reference a diagram of the engine wiring as supplied

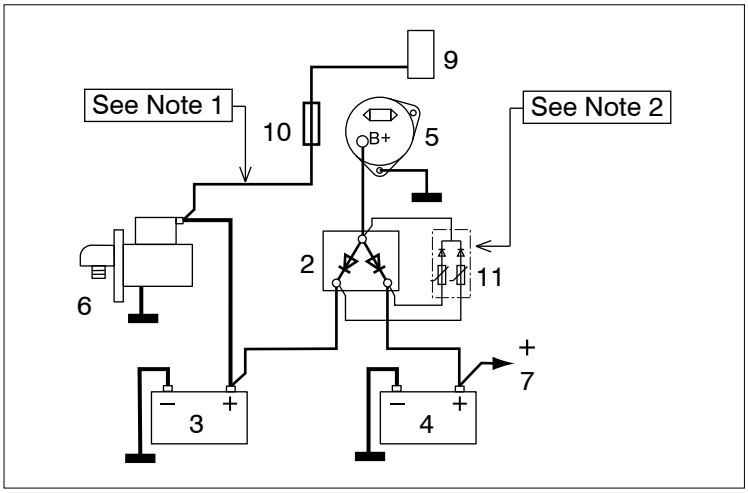


2 Use one ground point to tie all ground connections together.

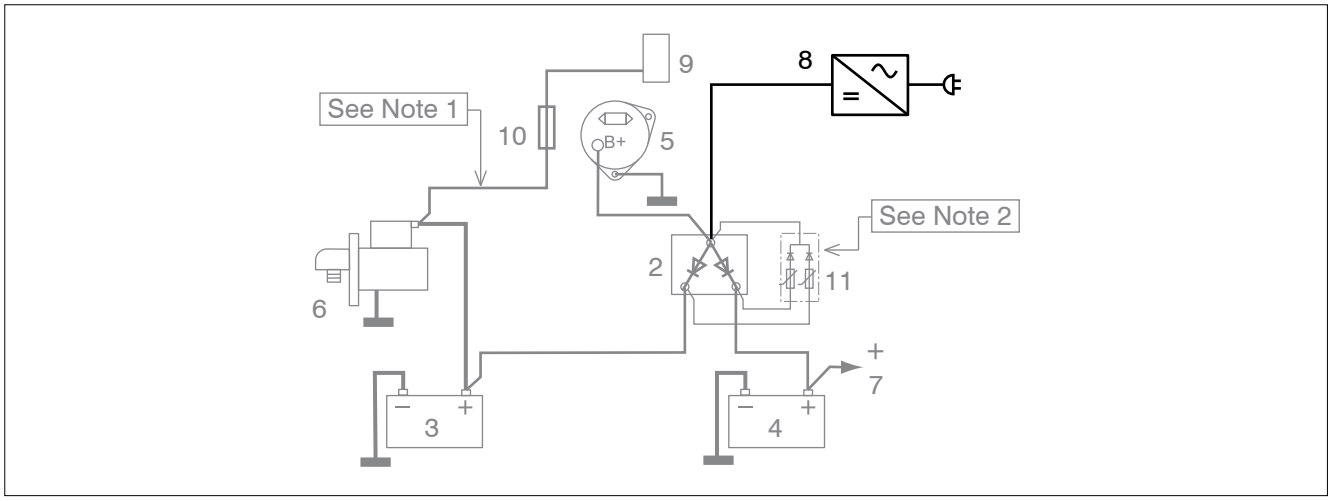
1 Battery selector switch
2 Diode splitter
3 Starter battery
4 Domestic battery
5 Alternator
6 Starter motor
7 Domestic consumers
8 Battery charger
9 Preheating timer relay
10 Fuse glow plugs
11 Alternator start-up assistance



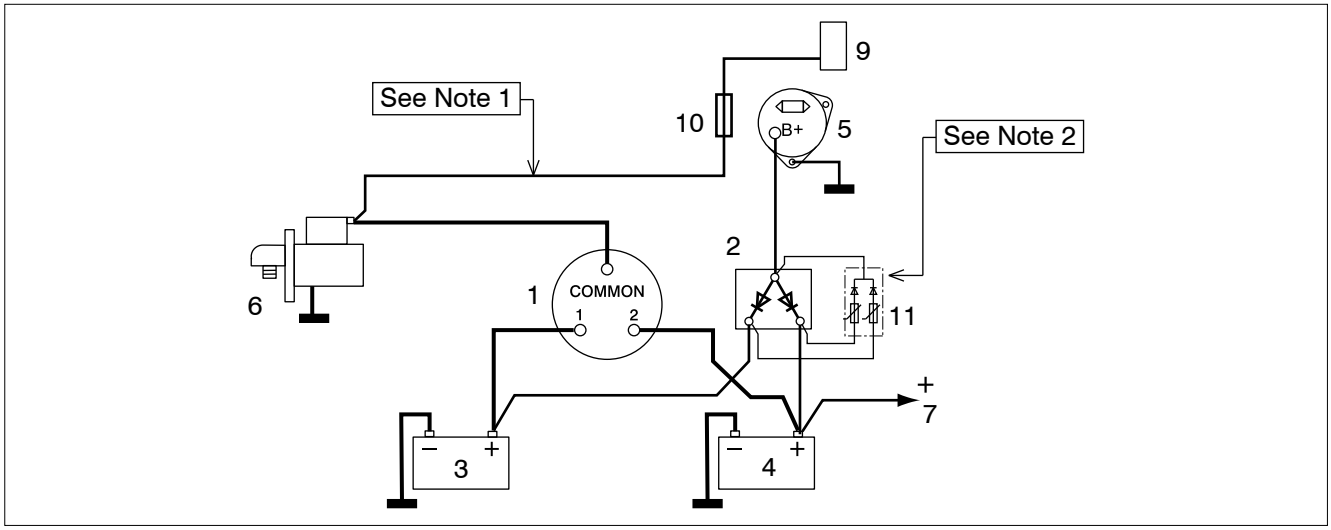
3 One engine - two batteries - one battery selector switch



4 One engine - two batteries - one diode splitter



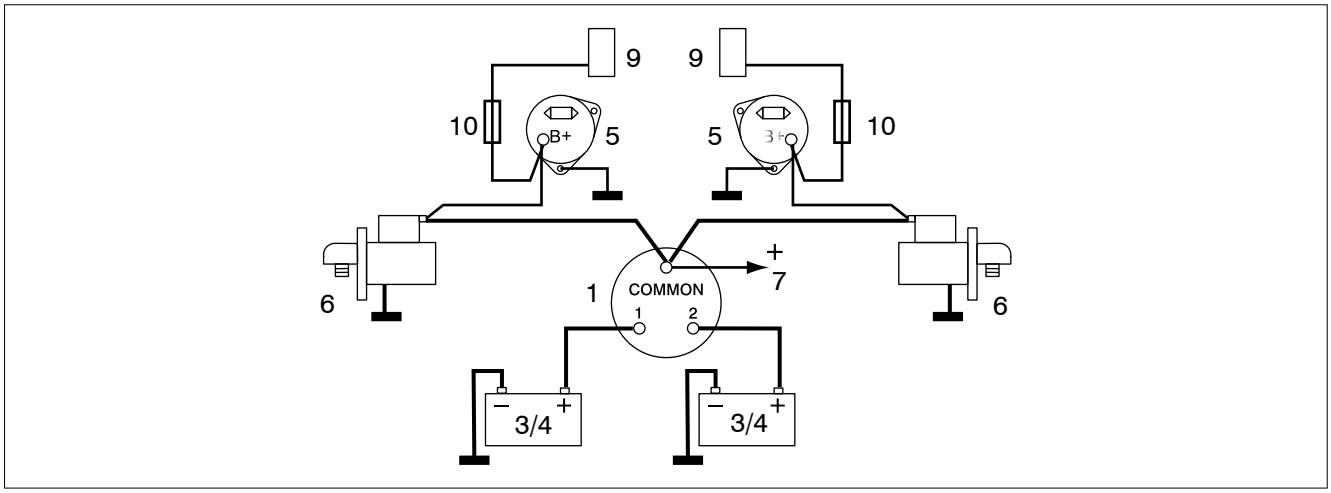
5 Connection of battery charger to one engine - two batteries - one diode splitter



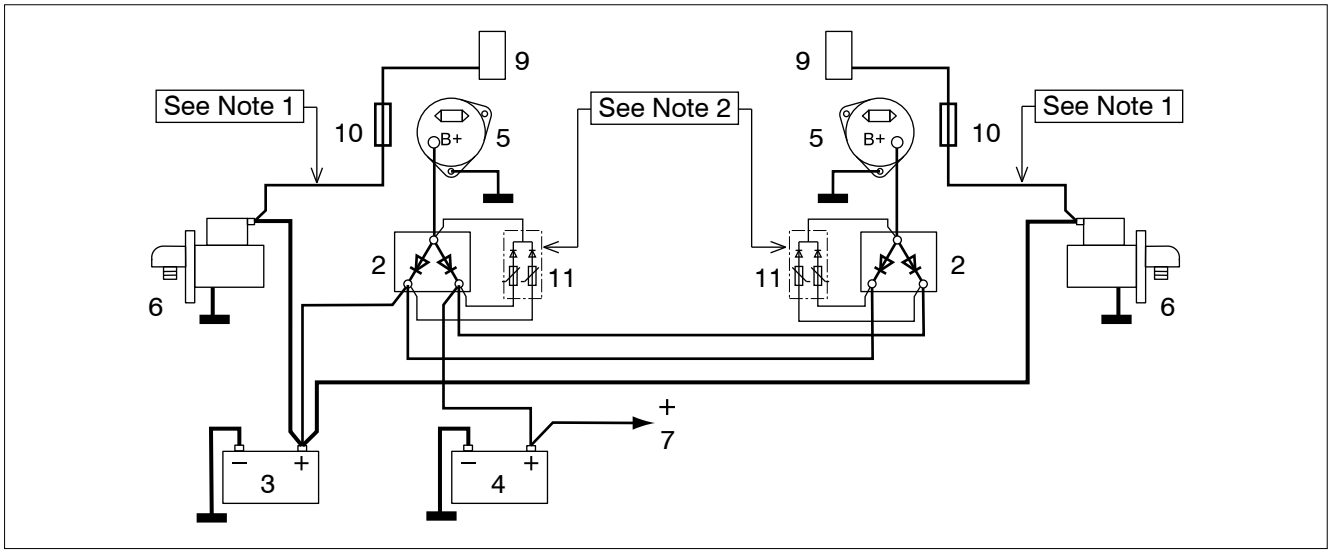
6 One engine - two batteries - one battery selector switch - one diode splitter

Note 1: Disconnect the supply for the preheating relay / glow plugs from the alternator B+ and reconnect to starter motor battery + terminal.

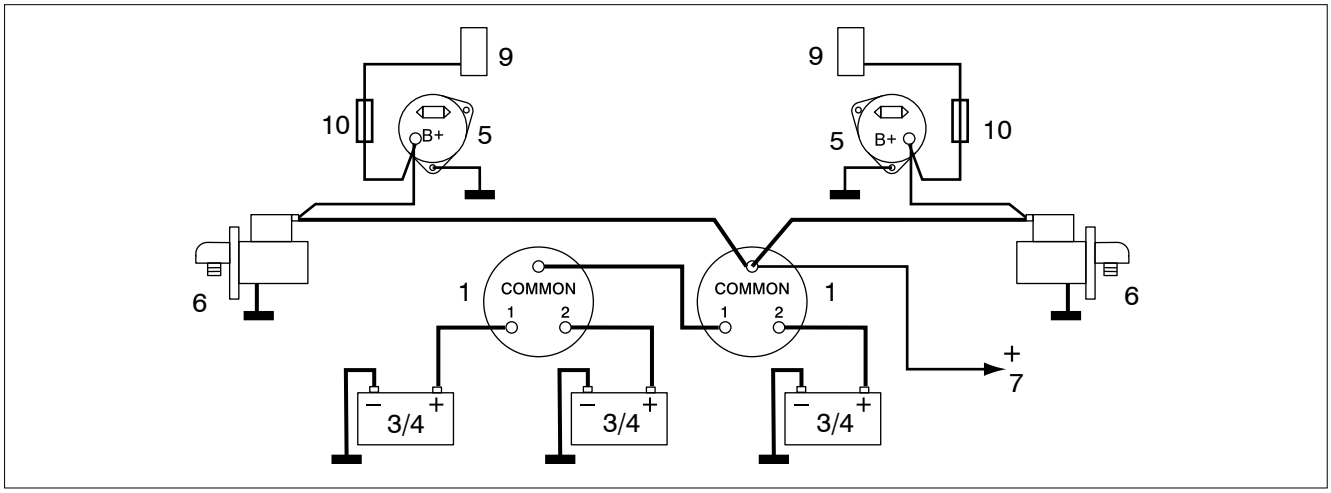
Note 2: To speed up the start of the charging process of the alternator a start-up circuitry should be installed on to the diode splitter.



7 Two engines - two batteries - one battery selector switch

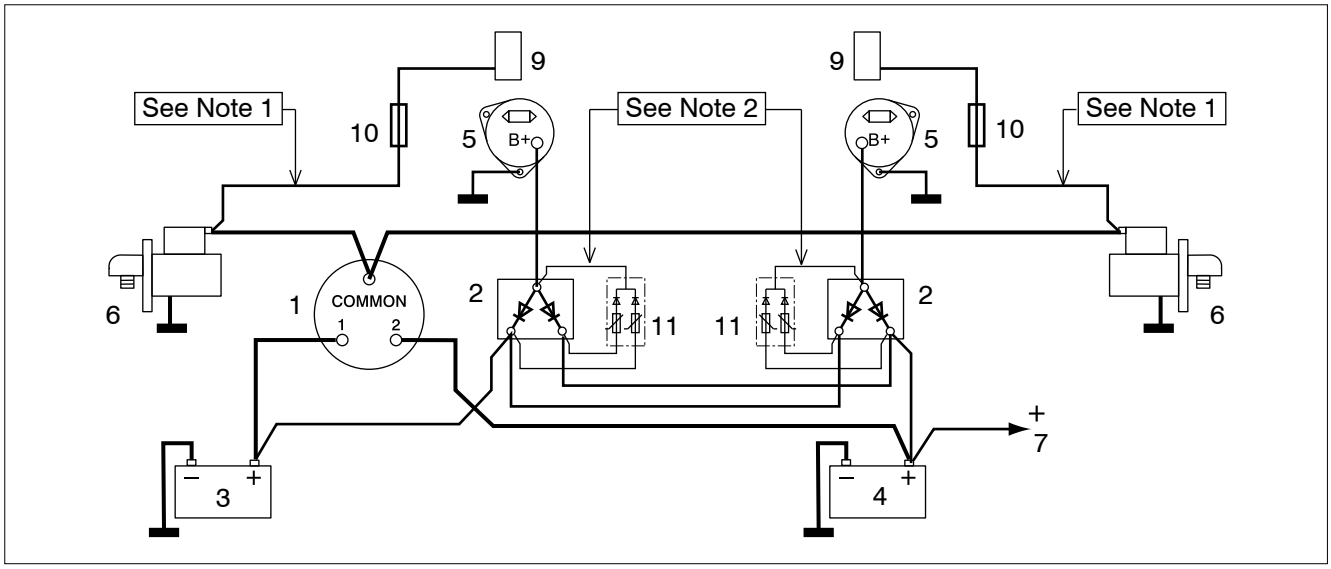


8 Two engines - two batteries - two diode splitters

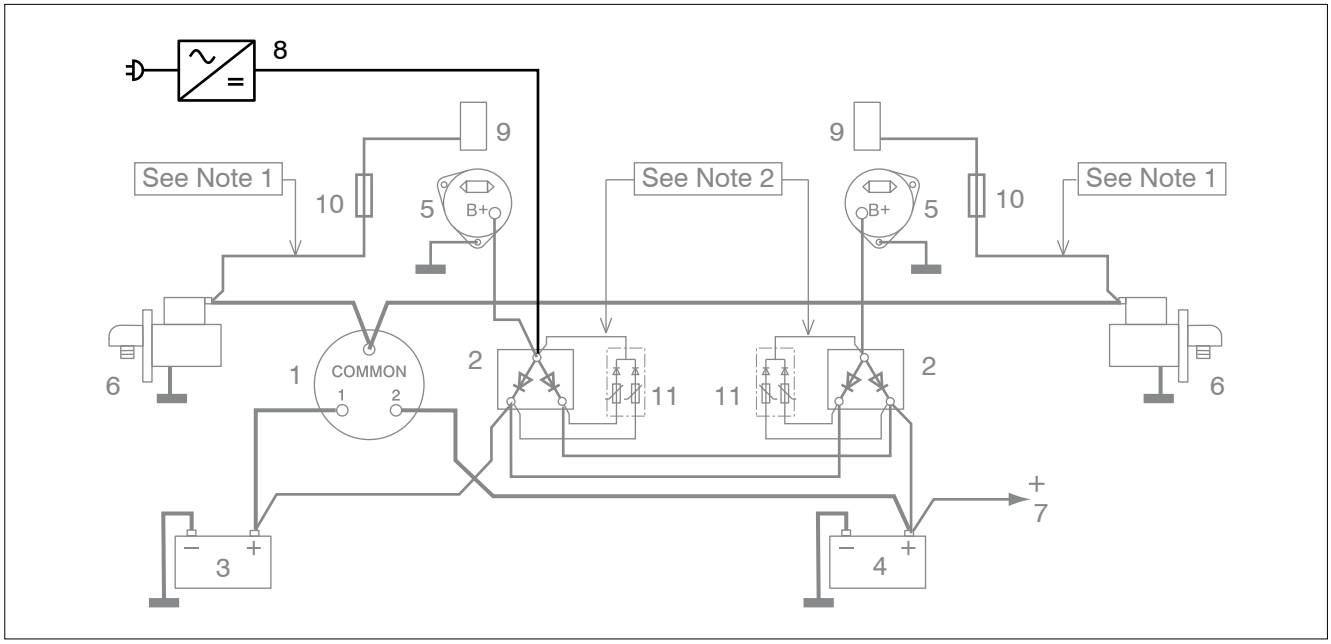


9 Two engines - two starter batteries - one domestic battery - two battery selector switches

1 Battery selector switch
2 Diode splitter
3 Starter battery
4 Domestic battery
5 Alternator
6 Starter motor
7 Domestic consumers
8 Battery charger
9 Preheating timer relay
10 Fuse glow plugs
11 Alternator start-up assistance



10 Two engines - one starter battery - one domestic battery - one battery selector switch - two splitters

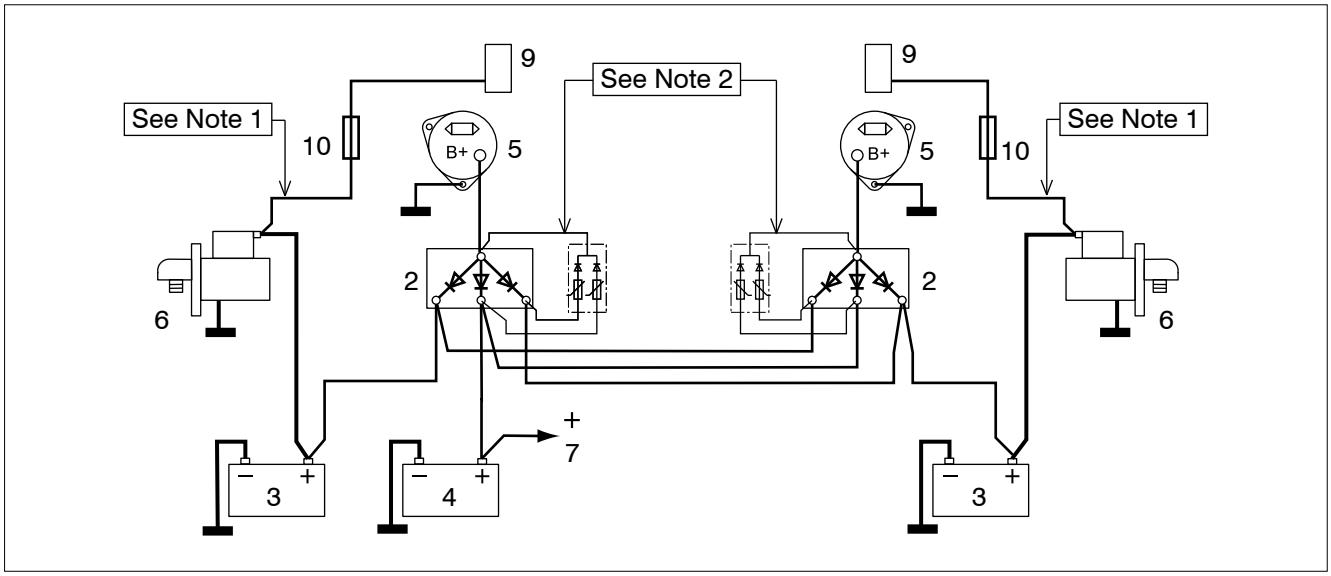


11 Connection of battery charger to two engines - one starter battery - one domestic battery - one battery selector switch - two splitters

Note 1: Disconnect the supply for the preheating relay / glow plugs from the alternator B+ and reconnect to starter motor battery + terminal.

Note 2: To speed up the start of the charging process of the alternator a start-up circuitry should be installed on to the diode splitter.

1 Battery selector switch
2 Diode splitter
3 Starter battery
4 Domestic battery
5 Alternator
6 Starter motor
7 Domestic consumers
8 Battery charger
9 Preheating timer relay
10 Fuse glow plugs
11 Alternator start-up assistance



12 Two engines - two starter batteries - one domestic battery - two splitters

For the connections of the cables carrying the charging current use at least 25 mm^2 (AWG 4), for cables longer than 1 m (3 ft) use at least 35 mm^2 (AWG 2).

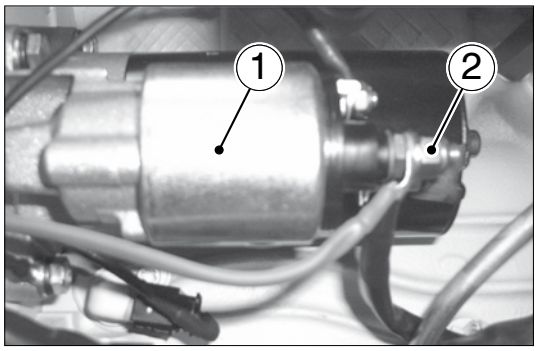
WARNING! **Heavy current through wiring that is too thin, or resistance provoked by bad connection, can generate excessive heat and could cause fire.**

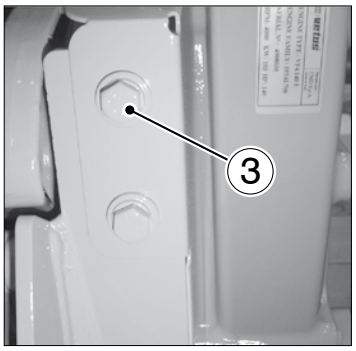
WARNING! **For Vetus splitter model 1252-1253.Maximum current: the battery splitter can be used for a continuous current up to a maximum of 125 Amps. Make sure that the maximum total current of alternator and battery charger not exceed the maximum specify current.**

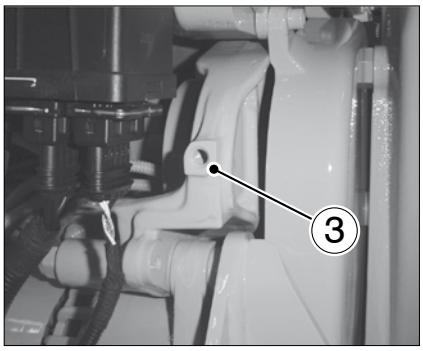
5.1.3 Connecting the battery cable

Connect battery cables to engine. Be sure to observe the following:

- Make sure that grounding stud and starter solenoid terminal are free of paint or any other material that could cause a poor electrical connection.
- Ensure the positive battery cable is inserted through the protective rubber boot before attachment.
- After battery cables are connected, apply a thin coat of liquid neoprene to the terminals.
- Be sure to slide rubber boot over positive (+) terminal after making connection.







VF4 series **VF5 series**

1 Engine Starter
2 Positive battery cable connections
3 Negative battery cable connections

IMPORTANT: **Remove the paint from connections when installing the engine !**

5.1.4 Battery cable size

Select proper size positive (+) and negative (-) battery cables, using chart. Battery should be located as close to engine as possible.

IMPORTANT: Terminals must be soldered to cable ends to ensure good electrical contact. Use electrical grade (resin flux) solder only. Do not use acid flux solder, as it may cause corrosion and a subsequent failure.

Battery Cable Length		Minimum Cable Cross-section	
Up to 0.9 m	(3 ft)	35 mm^2	2
0.9- 1.2 m	(3 - 4 ft)	50 mm^2	1
1.2 - 1.5 m	(4 - 5 ft)	50 mm^2	0
1.5 - 1.8 m	(5 - 6 ft)	70 mm^2	00
1.8 - 2.4 m	(6 - 8 ft)	95 mm^2	000
2.4 - 3 m	(8 - 10 ft)	120 mm^2	0000

5.1.5 Battery specification

IMPORTANT: **Standards and regulations must be adhered to when installing battery. Be sure battery cable installation meets the pull test requirements and that positive battery terminal is properly insulated in accordance with regulations.**

IMPORTANT: **It is recommended (required in some states) that the battery be installed in an enclosed case. Refer to regulations for your area.**

IMPORTANT: **Engine electrical system is negative (-) ground.**

1) Select an starter battery that meets all of the following specifications:
- 12 Volt marine type.
- Cold Cranking Amps (CCA): not lower than 850 A.
- Tapered post connectors or side terminal connectors. Do not use a battery with wing nut connectors.
- Battery capacity rating of at least: 110 Ah.
- Good resistance to charge/discharge cycles.Deep cycle.

2) Select a service battery that meets all of the following specifications:
- Battery capacity: not lower than 200 Ah.
- Cold Cranking Amps (CCA): not lower than 850 A.
- Optimum resistance to charge/discharge cycles. Deep cycle.

IMPORTANT: **Even use a service battery if you need other board services ! Avoid to use only one battery to feed services and engine !**

5.1.6 Fuses and relays indications

The ECU box is equipped with a panel LED indicators to see the state of the fuses.

The fuses on the printed circuit board have been inserted on eyelet connectors on the circuit in order to make the replacement procedure easier. In order to replace the fuses, please refer to the following table:

Fuse	Color	Current protection (A)	Protected Device
F1	Red	10	Not used
F2	Red	10	Not used
F3	Red	10	DIRECT-EOBD diagnosis
F4	Red	10	KEYON-(KEYON ECU)
F5	Brown	25	DIRECT-Main relay
F6	Blue	15	DIRECT-Fuel pump
F7	Transparent	25	DIRECT-Fuel Pre-heating resistor
F9	Blue	15	OUT MAIN RELAYS -Glow-plug pre-heating RELAY
F10	Yellow	25	OUT MAIN RELAYS -Pin 5 ECU/PRE – Heating RELAY
F11	Brown	10	OUT MAIN RELAYS -Pin 4 ECU/FUEL – Fuel pump RELAY

Relay	Code TYCO	Characteristics	Description
J4	46520432	12V/30A	Main Relay
J5		12V/30A	Fuel pump
J6		12V/30A	Fuel pre-heating
J8		12V/30A	Battery alarm light
J7		12V/70A	Engine starter

⚠ WARNING

Take care at the rubber O-Ring gasket when dismount the transparent panel over the fuses to warrant a good IP protection.

The ECU box is sealed IP65:

- The length of the engine cable allows attachment of the ECU box on the wall of the boat and not on the engine.
- The box is equipped with a panel LED indicators to see the state of the fuses.
- At KEYON all LEDs must be ON.

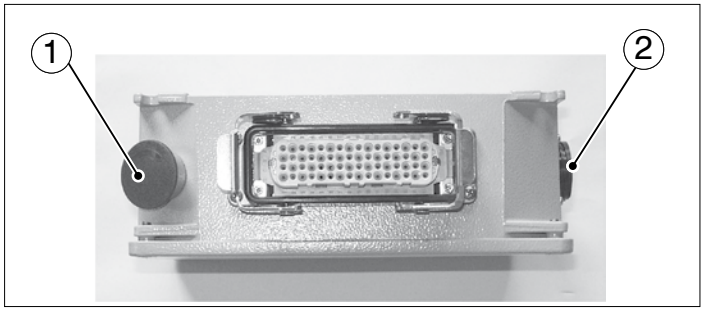
5.2 Elements that constitute the electronic control of the Vetus VF series engines

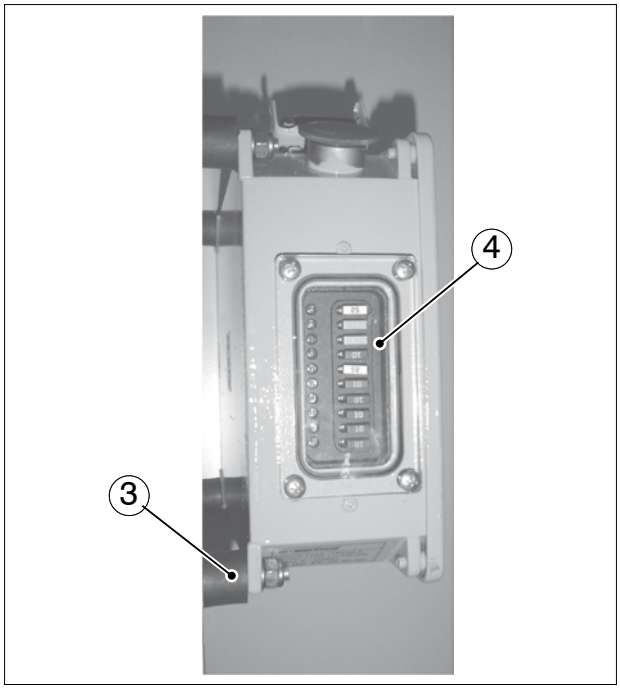
The parts that constitute the electric system of the engine are as following:

- Waterproof box in steel featuring the ECU;
- Engine harness;
- Instrument panel.

Here below you will find a description of the parts:

Waterproof ECU box





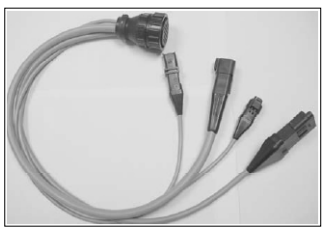
1 Emergency RED Button

2 Connector for instrument panel

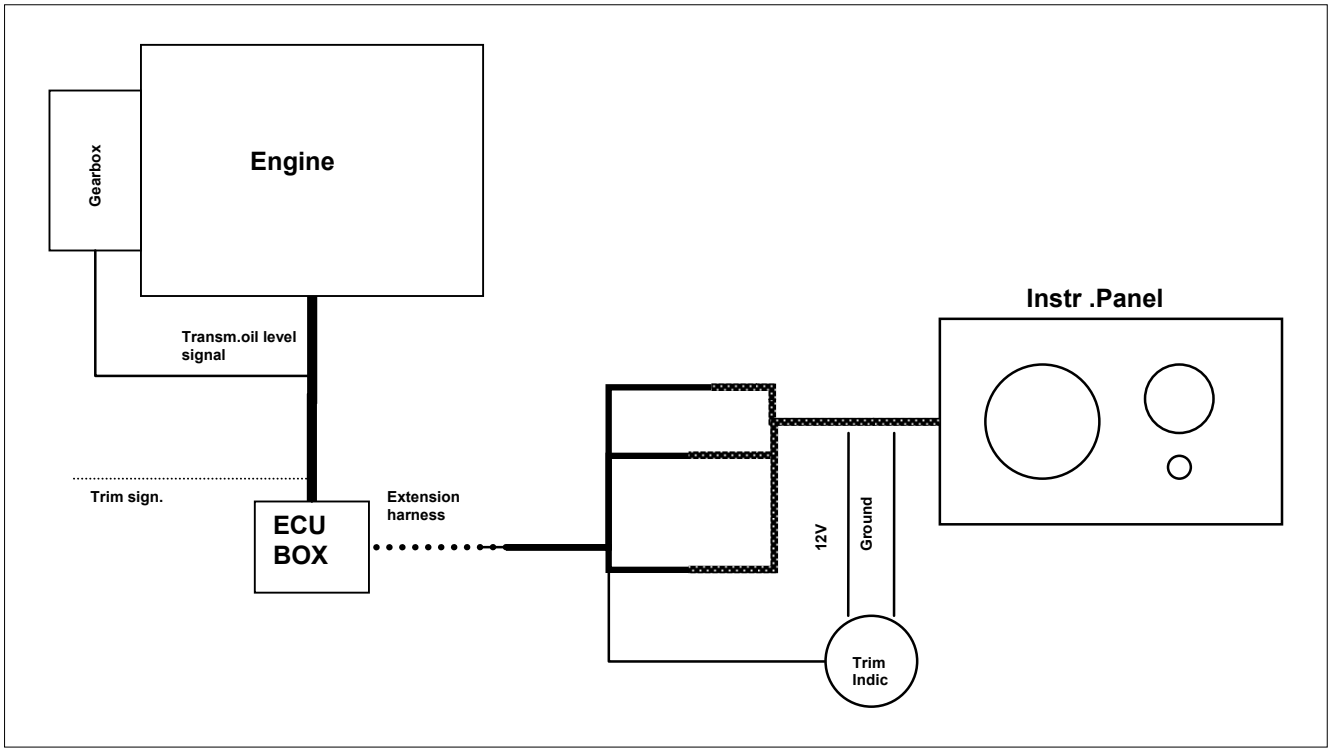
3 Anti-vibration mounting set

4 Fuses

Instrument panel cable

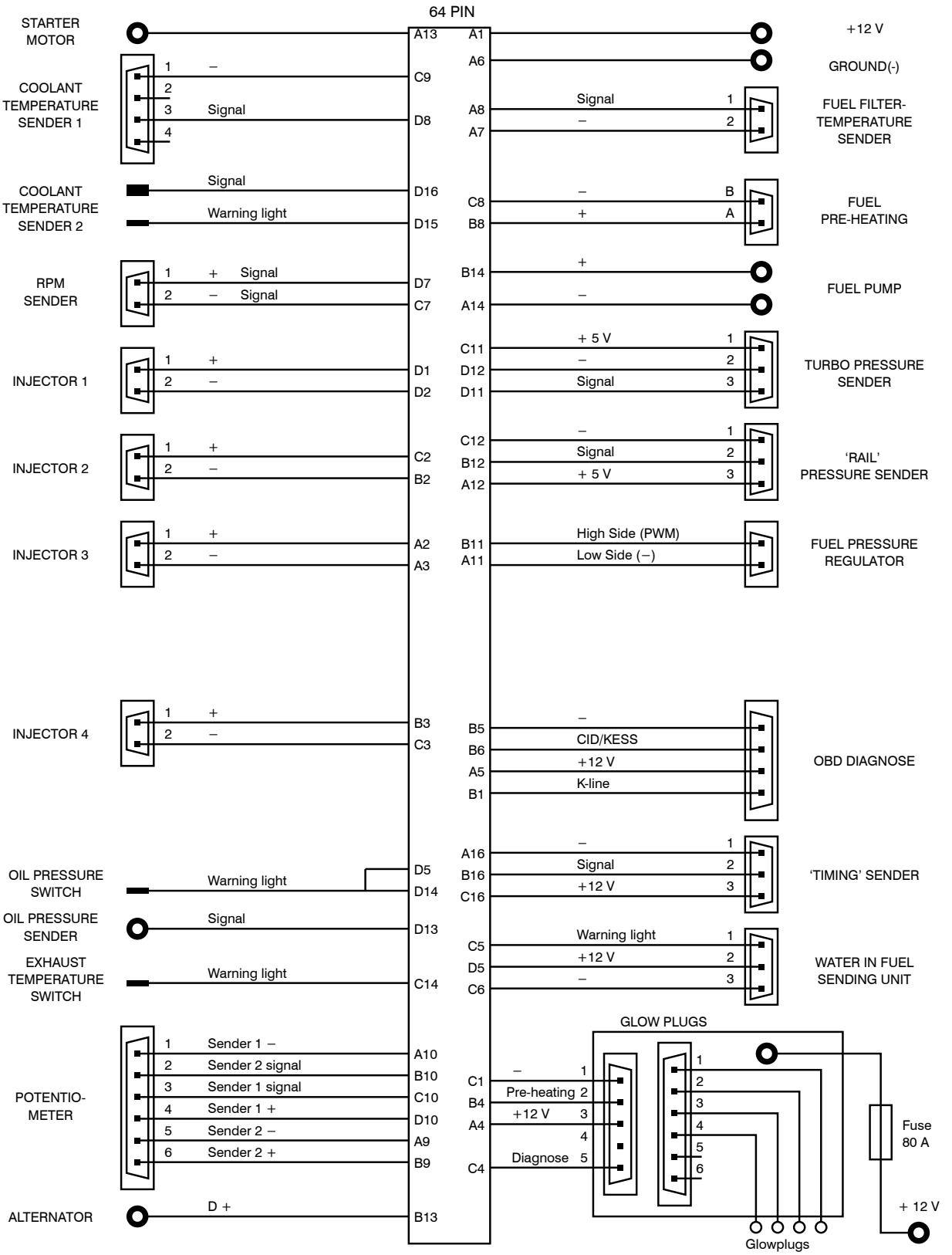


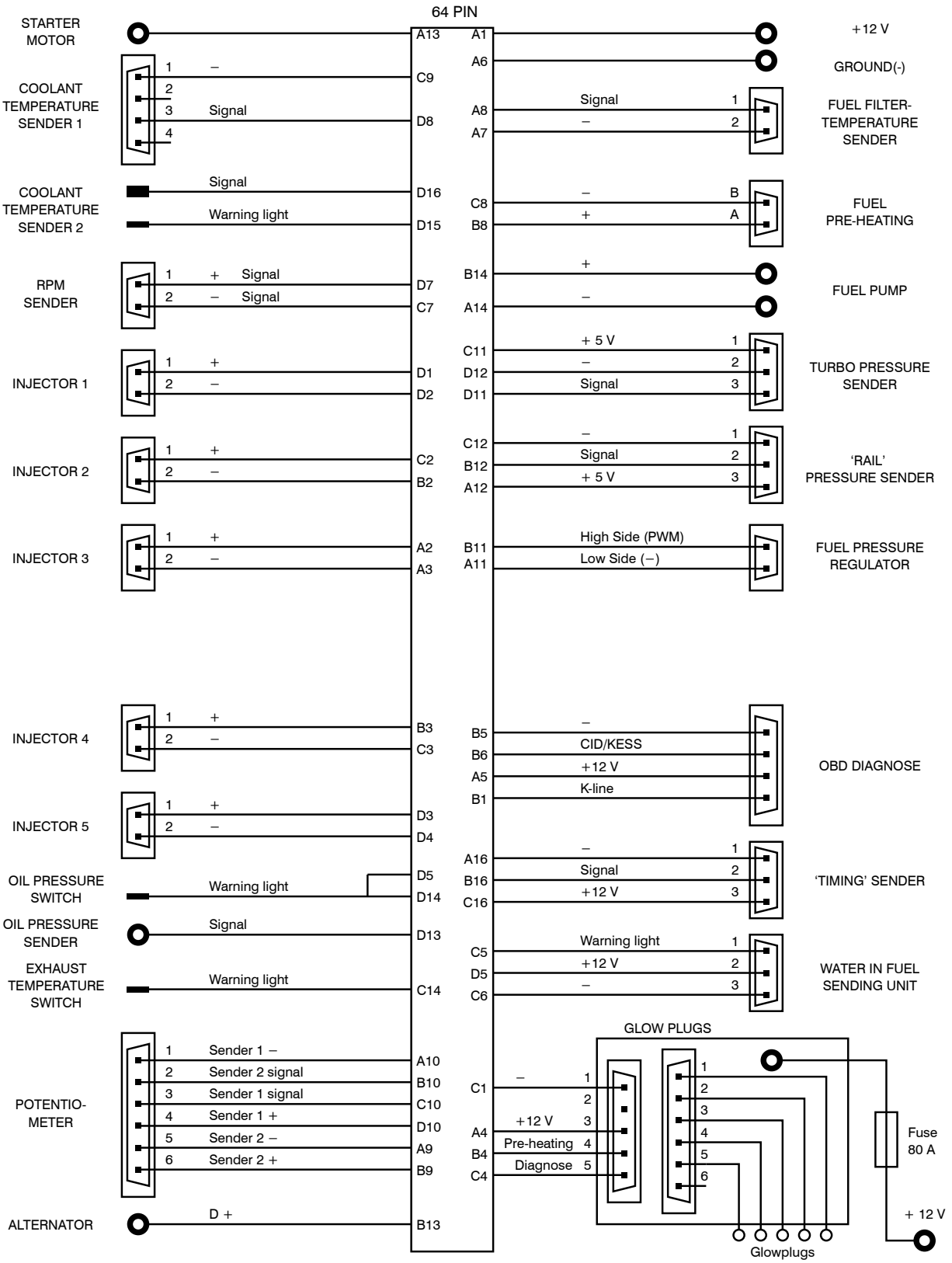
5.2.1 Engine installation wirings



5.2.2 Engine harness

VF 4 SERIES




64 PIN
STARTER MOTOR
A13
A1
+12 V
A6
GROUND(-)
COOLANT TEMPERATURE SENDER 1
1 –
2
3 Signal
4
C9
D8
A8
A7
Signal 1
– 2
FUEL FILTER-TEMPERATURE SENDER
COOLANT TEMPERATURE SENDER 2
Signal
Warning light
D16
D15
C8
B8
– B
+ A
FUEL PRE-HEATING
RPM SENDER
1 + Signal
2 – Signal
D7
C7
B14
A14
+
–
FUEL PUMP
INJECTOR 1
1 +
2 –
D1
D2
C11
D12
D11
+ 5 V 1
– 2
Signal 3
TURBO PRESSURE SENDER
INJECTOR 2
1 +
2 –
C2
B2
C12
B12
A12
– 1
Signal 2
+ 5 V 3
'RAIL' PRESSURE SENDER
INJECTOR 3
1 +
2 –
A2
A3
B11
A11
High Side (PWM)
Low Side (–)
FUEL PRESSURE REGULATOR
INJECTOR 4
1 +
2 –
B3
C3
B5
B6
A5
B1
–
CID/KESS
+12 V
K-line
OBD DIAGNOSE
INJECTOR 5
1 +
2 –
D3
D4
OIL PRESSURE SWITCH
Warning light
D5
D14
A16
B16
C16
– 1
Signal 2
+12 V 3
'TIMING' SENDER
OIL PRESSURE SENDER
Signal
D13
EXHAUST TEMPERATURE SWITCH
Warning light
C14
C5
D5
C6
Warning light 1
+12 V 2
– 3
WATER IN FUEL SENDING UNIT
GLOW PLUGS
POTENTIO-METER
1 Sender 1 –
2 Sender 2 signal
3 Sender 1 signal
4 Sender 1 +
5 Sender 2 –
6 Sender 2 +
A10
B10
C10
D10
A9
B9
C1
A4
B4
C4
– 1
+12 V 3
Pre-heating 4
Diagnose 5
Fuse 80 A
+ 12 V
Glowplugs
ALTERNATOR
D +
B13

5.3 Electronic command system:

The electronic engine remote control couples mechanical-electronic solutions to digital communication technology so that flexible, reliable and easy to install modular systems can be achieved. Only a few pieces of equipment are required to compose a complete electronic engine remote control.

- operating levers
- control boxes
- data transfer cables that connect the operating controls to the control boxes

5.3.1 Maximum specifications of the system

Maximum configuration of the system:

Actuators	;	The maximum number of engines that the system can control is 2
Command stations	:	The maximum number of operating levers in the installation is 3
Operating temperature	:	From -10 to 85°C
Storage temperature	:	From -40 to 90°C

Mechanical features:

Nominal load when control box is providing a pushing force	:	150 N (15 kgf) with power consumption 1.5 A
Max load when control box is providing pushing force	:	450 N (45 kgf) with power consumption 5 A (with time <1 s)
Stroke of gearbox - forward	:	The stroke can be set to between 5 and 40 mm
Stroke of gearbox – reverse	:	The stroke can be set to between 5 and 40 mm

Electrical features:

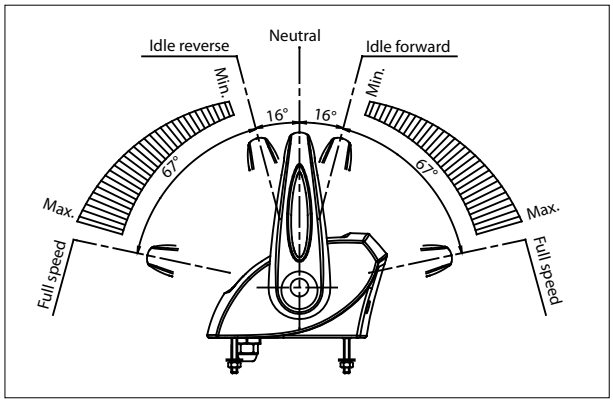
Power supply	:	9,0 to 16 V dc
Max. current taken	:	5 A
Current taken when not loaded	:	0,5 A

5.3.2 Command station – Pilot instruction

The electronic control lever permit to command the boat from different positions.

Each station can be programmed for the control either of one or of two engines. Each lever repeats the functionality of a traditional mechanical lever.

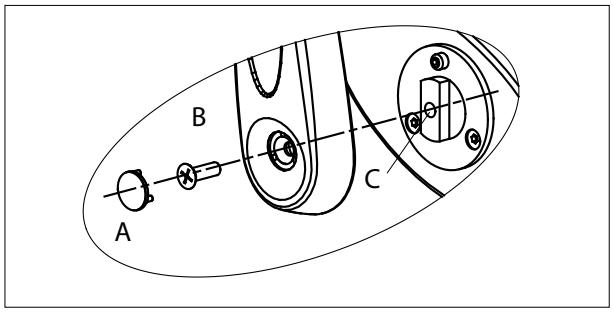
Moving the lever from the neutral position, after 15° forward or reverse automatically the electronic system clutch in respectively the forward or reverse gear.
The accelerator has a stroke of 67° both in forwards or reverse mode



5.3.3 Friction adjustment

To adjust the inner fiction of the control lever is sufficient to remove the PVC cap (A) and unscrew the control lever fixing screw. It is possible to adjust the friction screwing and unscrewing the inner screw placed into the hole B. When the regulation will be done, mount the screw and the plastic cap.

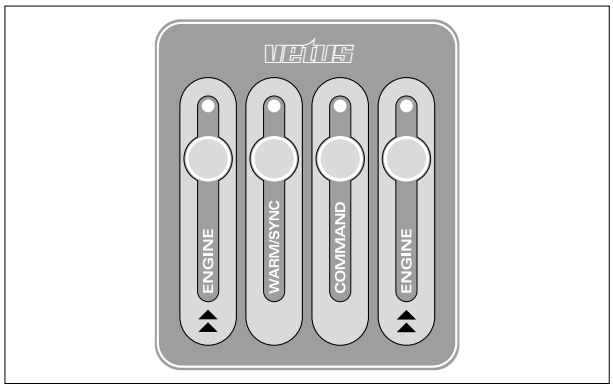
IMPORTANT: **In case of command station for one engine, the friction is placed under the right command lever**



5.3.4 Control keypad

On the command station is mounted an electronic keypad with 4 push-buttons and 4 LEDs.

Name	Colour of LED
Engine *)	Green
Warm/Sync	Orange
Command	Red
Engine *)	Green



*): In installations with single engine, both the green LED are referring to the same engine. In systems with 2 engines the push button and the green LED on the right are referring to the starboard engine while the push button and the green LED on the left side are referring to the port engine.

The meaning of the LEDs and the buttons is shown in the table.

Button	LED	Meaning
(Operating)	(Reporting)	
	Engine	- The left LED is for the port (left) engine, while the right LED is for the starboard (right) engine. If the LED is fixed light on (green), the engine which it corresponds is in neutral condition.
		- If the LED is blinking (green), the lever on the Led side is synchronised with the lever of the station that at the moment has the Command.
	Command	- If the LED is off the station does not have control over the installation\.
		- If the LED is on the station has control over the installation.
	Warm/Sync	- If the LED flashes it is busy with the WARM-UP, i.e. the engine/engines can run at increased speed because the gearbox is still in neutral.
		- If the LED is on the installation is functioning in synchronous mode. Both engines are controlled by the right-hand lever and the right-hand trim appliance controls both trims (if present).
Warm/Sync		- After setting both levers of the operating station in neutral hold the warm/sync key pressed in for at least three seconds; the WARM-UP function will now operate.
Command		- Control of the installation is gained by holding the Command key pressed in for at least three seconds, provided that the operating lever is in neutral.
All LEDs flash		- The installation is malfunctioning.

5.3.5 Taking over control

Control of the installation can be taken over at any operating station by carrying out one of the following actions.

- **When vessel is not moving**

  1 Position all operating levers in neutral.

  2 Hold the Command key pressed in for at least three seconds.

  3 The LED Command will come on and the LED Warm/Sync begin to flash.

  4 **The installation is now busy with the warm-up**, that is the gearboxes are deactivated. It is only possible to use the throttle to carry out engine warming up actions.

  5 **In order to definitely take over control at the station** it is sufficient to position the levers in neutral and hold the Warm/Sync key pressed in for at least three seconds.

  6 The operating lever will now be released and ready for use.

- **While sailing**

  1 Position both levers of the station that is to take over control synchronous relative to the levers of the station that is to relinquish control.

  2 The LED Engine begins to flash as soon as the lever of the asking station is set correctly relative to the station that is to relinquish control (with a margin of 10°).

  3 When both levers are synchronous (and therefore the corresponding LEDs Engine flash) it is possible to take over control by holding the Command key pressed in for three seconds.

IMPORTANT: **Once the takeover procedure has been carried out the station is ready for operating the engine.**

IMPORTANT: **Before taking the command, check that all the passengers are safely on board.**

5.3.6 Warming up the engine (Warm-up)

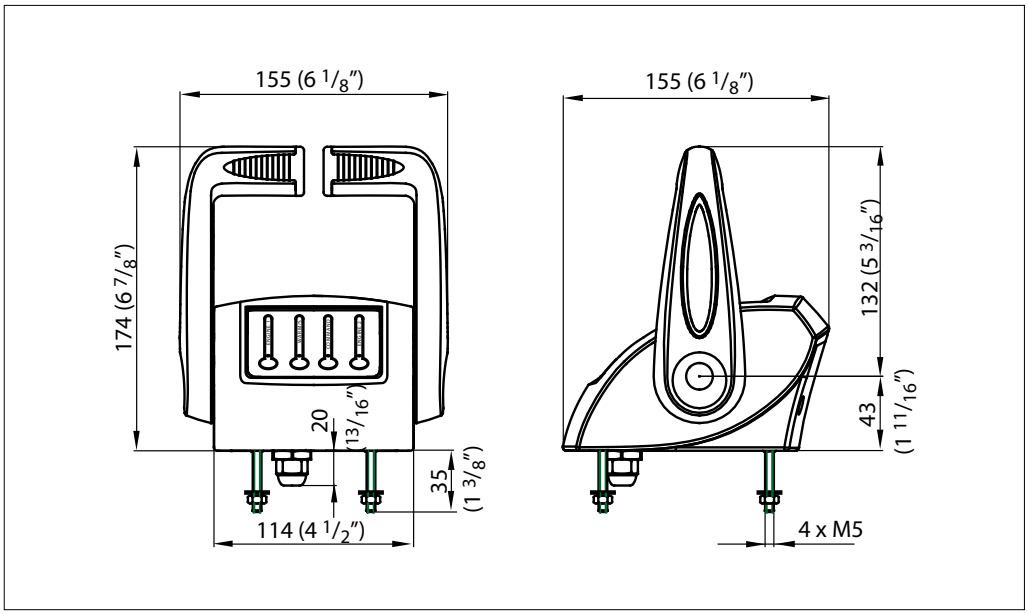
If both levers are in neutral, by pressing for 3 seconds the button Warm/Sync of station which has the command you enter in Warm-up mode. If you move the each lever it is only affected the accelerator but not the gear.
In Warm-up mode the LED Warm/Sync is blinking.
After positioning again both lever in neutral and pressing for 3 seconds the Warm/Sync the system comes back to the normal operation mode.

5.3.7 Synchro mode operation

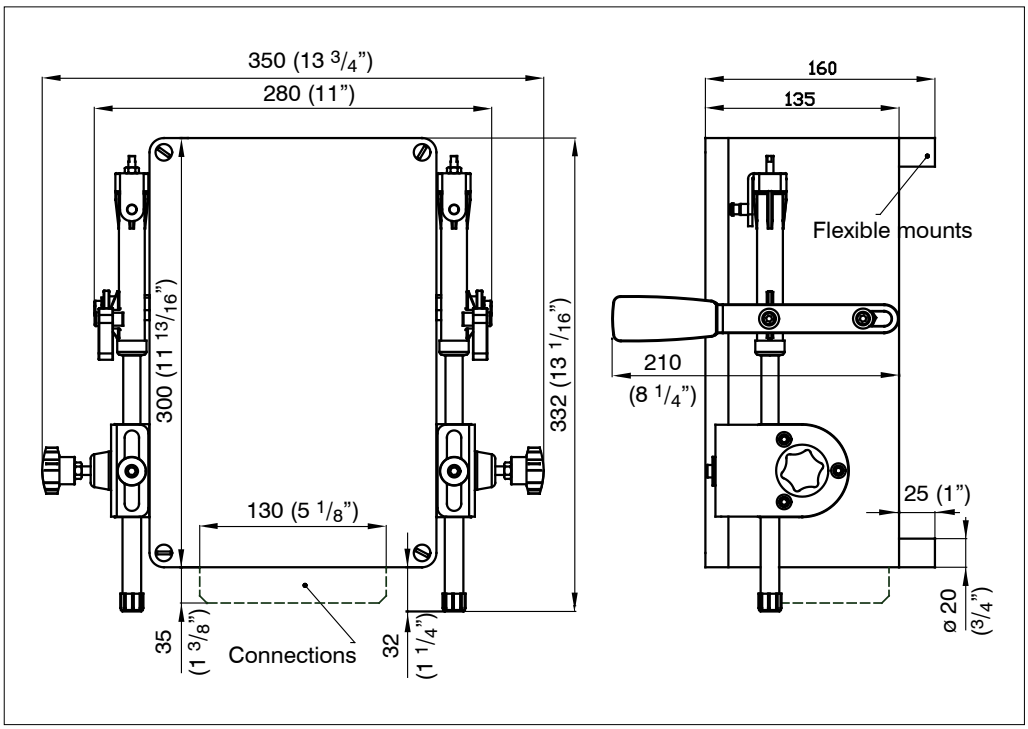
It is possible to command both engine at the same speed and direction with only one lever. This function can be activated only by the Station which has the command.
With both levers in neutral position, press at the same time for 3 seconds engine push-buttons. The command of both engines is now on the right lever. In synchro mode operation LEDs ‘Warm/Sync’ and ‘Command’ are lighted on. Position both lever in neutral, press for 3 seconds Engine push buttons at the same time and the command of each engine is again assigned to the respective lever and LED ‘Warm/Sync’ is switched off.

5.3.8 Mechanical installation

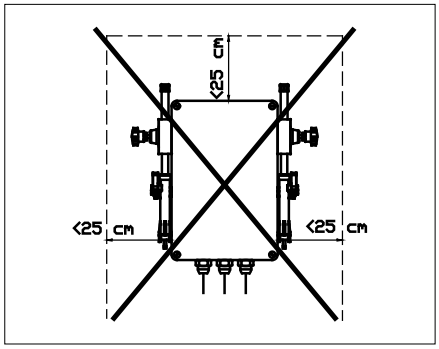
Dimensions of the command station



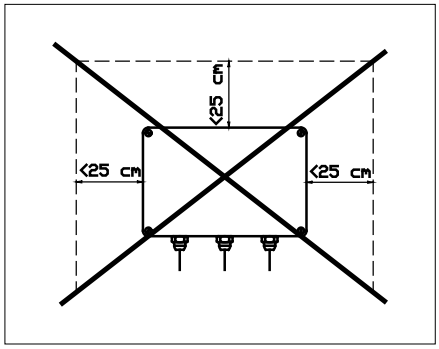
Dimensions of the control box

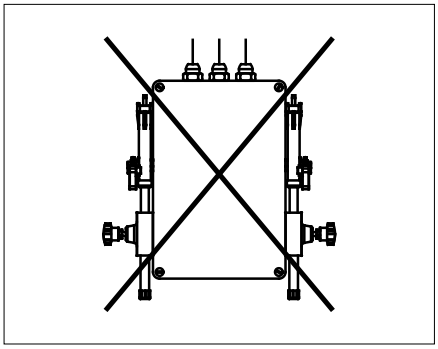


Installation of the control box



Install the control box at least 25 cm (10 in) from the wall.



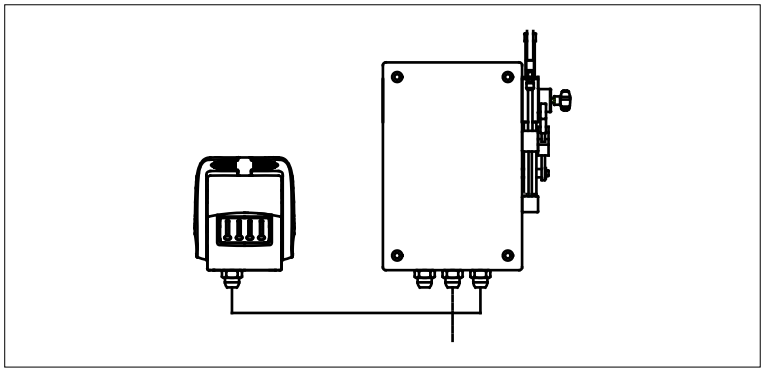


Do not install the control box with the plugs upwards.

System for one engine

Description

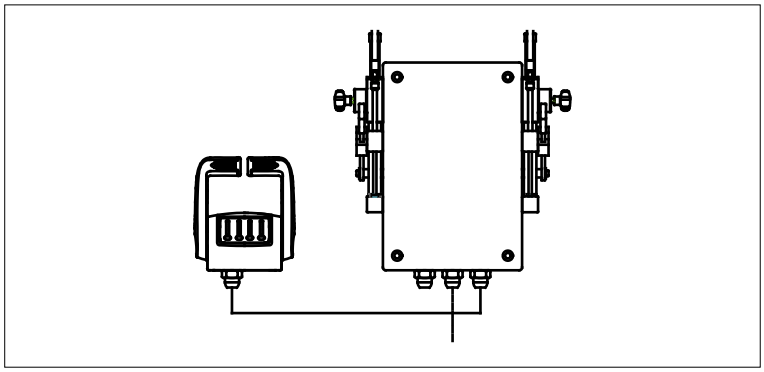
- With trim, cable connection for the push-pull cable outgoing from the Mercruiser® stern drive.
- Without trim, connection for the standard cable (for inboard engine).



System for two engines

Description

- With trim, cable connection for the push-pull cable outgoing from the Mercruiser® stern drive.
- Without trim, connection for the standard cable (for inboard engine).

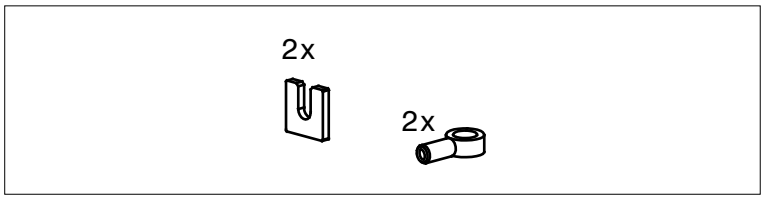


5.3.9 Connection of push-pull cable

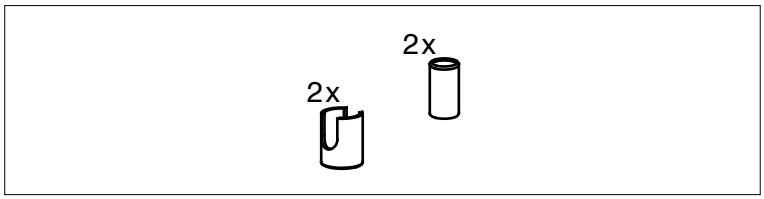
The cable kit selected must be used for connecting the push-pull cable.
A choice of 2 suitable kits is available depending on the type of push-pull cable that is to be used for the gearbox. These kits are: standard cable and the outgoing cable from Mercruiser-outdrive®.

Connection kit

Standard cable kit

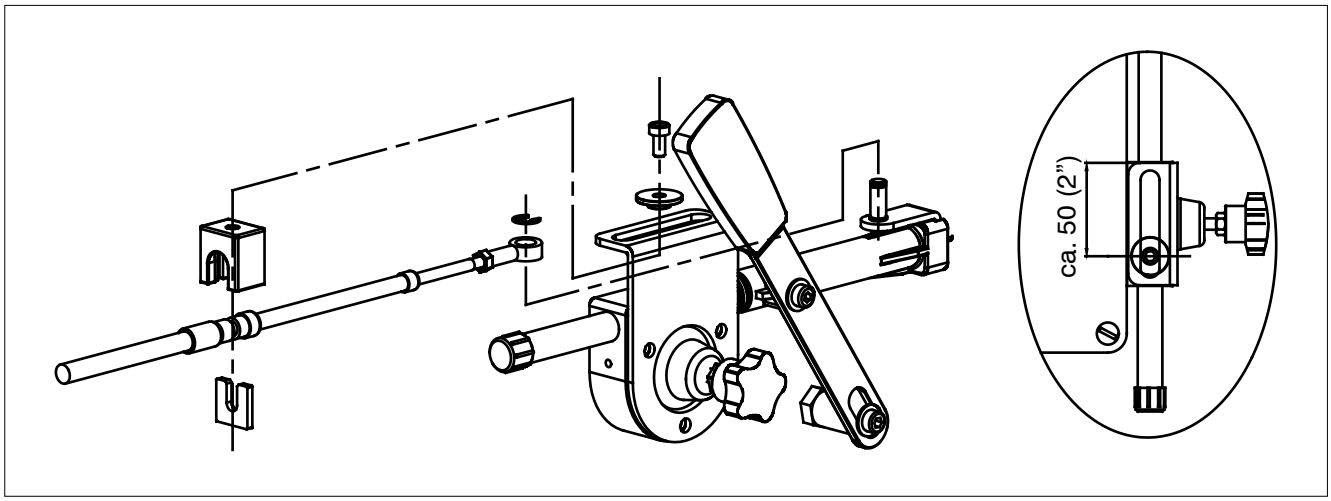


Mercruiser cable kit®



Each kit is sufficient to connect two push-pull cables.

- **Standard push-pull cables**



IMPORTANT: **Before the mounting, the throttle must be in minimum position and the clutch must be in neutral position.**

How to mount it:

1 Tighten the eyelet on the thread of the cable;

2 Screw the emergency knob placed on the actuator until the emergency lever will be free to move;

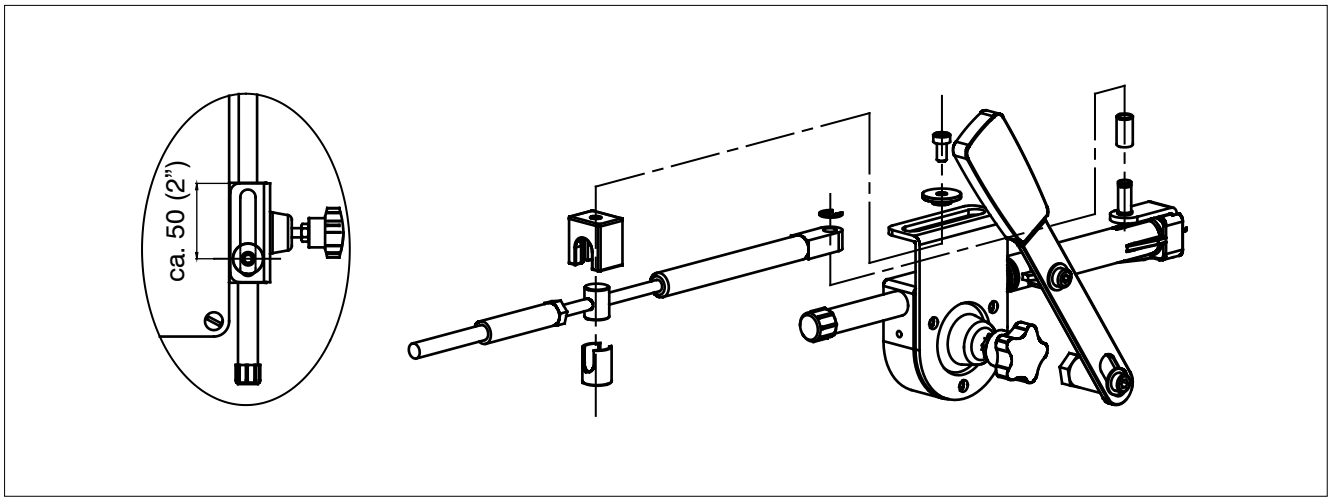
3 Insert the stainless steel plate into the aluminium device locking the cable between them as shown in the picture;

4 Insert the push-pull cable into the bracket on the actuator and connect the eyelet to the pin and lock it using the segeer. Use the emergency lever to help the operations;

5 Lock the aluminium device with the corresponding screw, the brass spacer and the washer at the distance indicated into the picture;

6 Loosen the emergency knob and move the emergency lever until the device will reach the correct position (it will be automatically locked)

- **Push-pull cable outgoing from the Mercruiser® stern drive**



This is the cable that comes out directly from the Mercruiser-outdrive®. If this type of coupling is chosen it is not necessary to fit the Mercruiser turning plate®.

IMPORTANT: **Before the mounting, the throttle must be in minimum position and the clutch must be in neutral position.**

How to mount it:

1 Screw the eyelet on the thread of the cable;

2 Insert the plastic glass into the aluminium device placing the push-pull cable between them as shown into the picture;

3 Insert the push-pull cable into the bracket on the actuator;

4 Put the brass spacer on the pin and fix the plastic eyelet on the cable on it. Lock the eyelet with the Seeger. Use the emergency lever to help the operations;

5 Lock the aluminium device with the screw, the brass spacer and the washer at the distance indicated into the picture;

6 Loosen the emergency knob and move the emergency lever until the device will reach the correct position (it will be automatically locked)

5.3.10 Installation of power supply

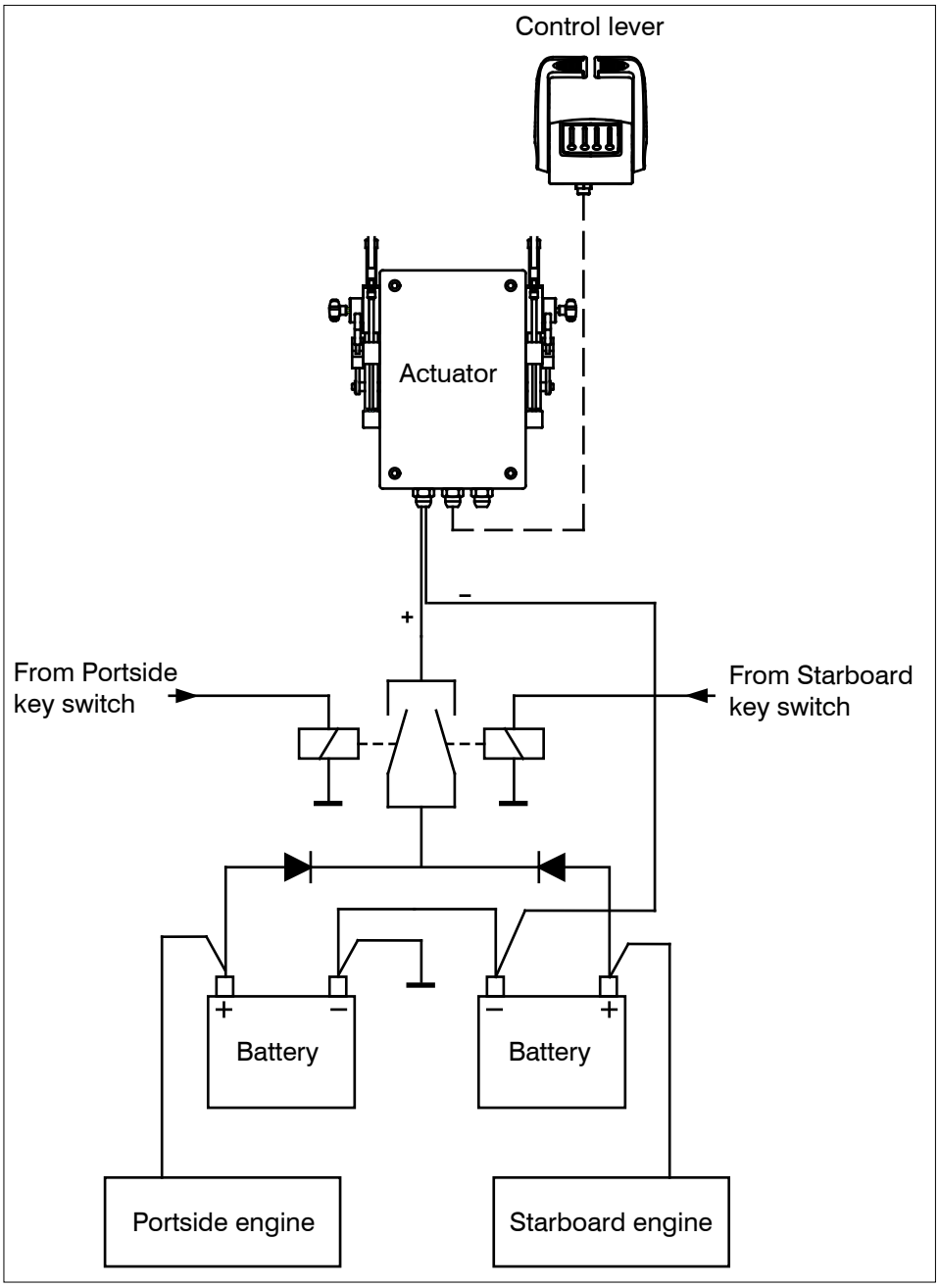
Starter motors: the cables that run from the battery to the starter motors must have a cross-section of at least 50 mm2 (AWG 0)(both the plus and the minus cable).

Electrical installation: the earth poles of the batteries must be connected with a cable with a cross-section of at least 50 mm2. (AWG 0) The earth line from the control box must come directly from the batteries.

Control box: each control box must be powered by the batteries. The power cables (plus) must be fitted with a 10 A decoupling diode.

In this way the control box is always powered by the battery which is highest charged. The minimum cross-section for the cable is 2.5 mm2 (AWG 12).

'R1' is a relay that is activated by the key of the port engine, while 'R2' is a relay that is activated by the key of the starboard engine.



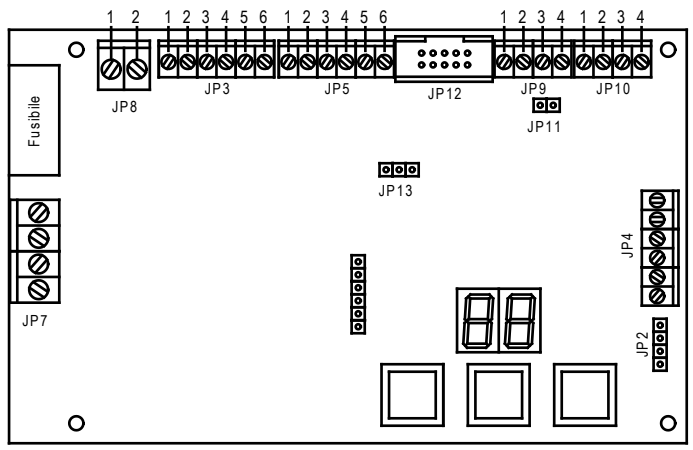
5.3.11 Power supply

The system works on 12 V battery power supply. The table gives the breaking current for the fuses used to protect the electronic cards in the control box.

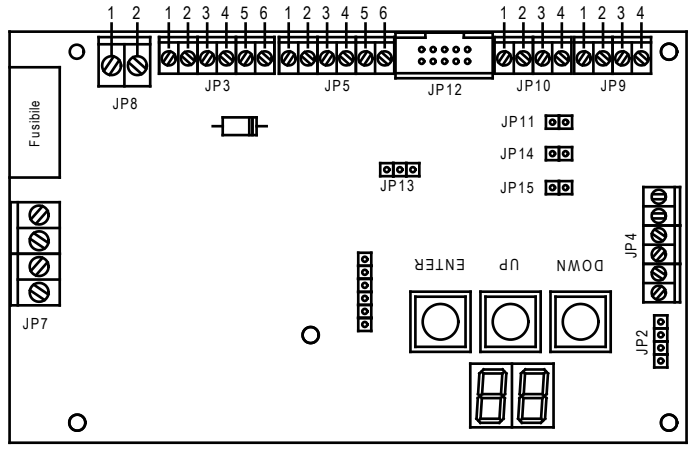
Voltage	12 V
Internal fuse (on card)	3.15 A
Fuse in panel	6.15 A
No load current t	0.5 A

5.3.12 Outgoing cables from the control box

Card in control box, Version rev. 2



Card in control box, Version rev. 3

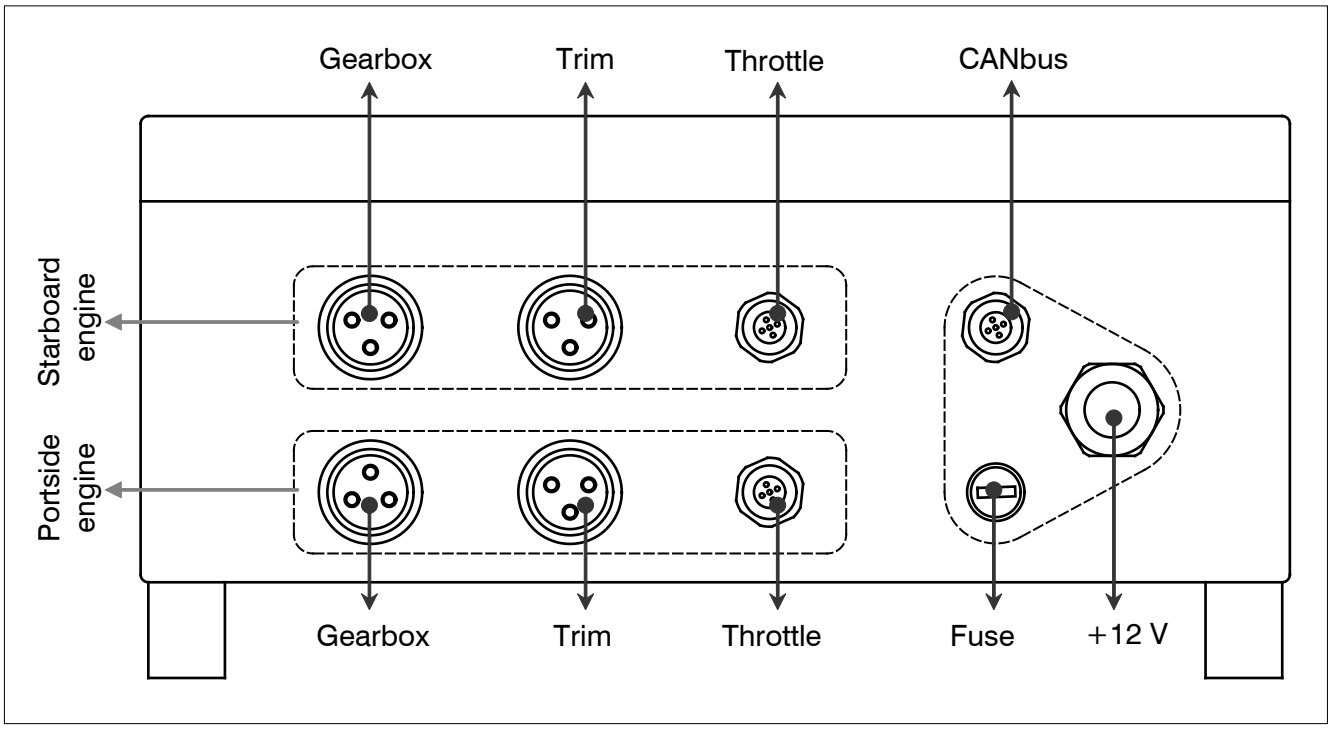


Terminal board	Terminal	Description	Colour of wire		Outgoing cable
			Rev. 2	Rev. 3	
JP8 Power.	1	Vdc	Brown		2 poles, white outer jacket
	2	GND	Blue		
JP9 Engine SX	1	V_out CH1	Yellow/Green		4 poles, black outer jacket
	2	V_out CH2	Grey		
	3		-	Brown	
	4	GND	Black + Brown	Black	
JP10 Engine DX	1	V_out CH1	Yellow/Green		4 poles, black outer jacket
	2	V_out CH2	Grey		
	3		-	Black	
	4	GND	Black + Brown	Brown	

The outgoing cables are 2.5 m (8 ft) in length.

The throttle lever has an AMP SuperSeal plug with 6 poles for coupling to Vetus VF series engines. Should the model of the engine be different take off the plug and follow the pin-out as shown in the table above.

When the command station and the control box have been fixed, it is possible to plug the outgoing cables from the actuator
In case of a system with trim command, please refer to' Trim installation' part of this manual.

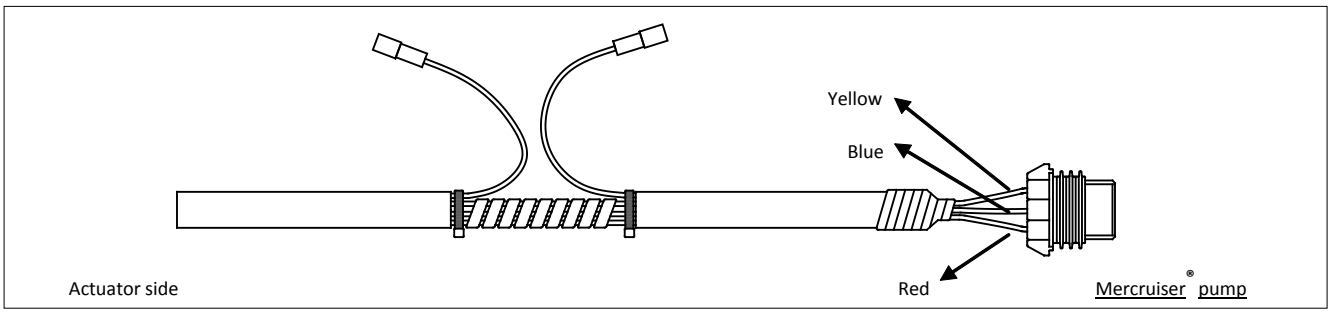


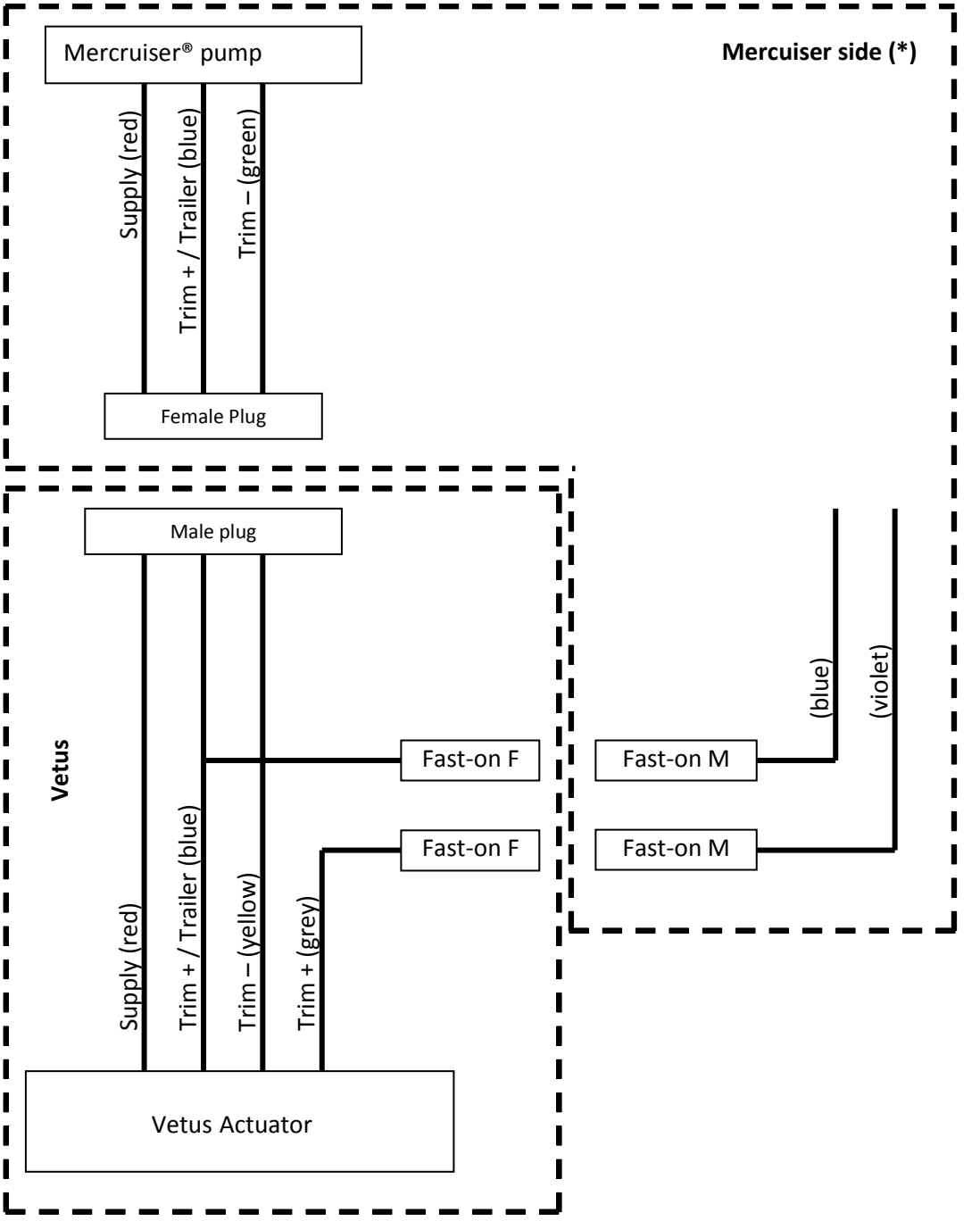
Note 1: **In case of system for 1 engine, the cables outgoing from 'Left engine' section, will be not present**

Note 2: **In case of system without trim, the cables outgoing from Trim sections, will be not present**

5.3.13 Trim cable

In case of actuator for two engines, will be present no. 2 trim cables.





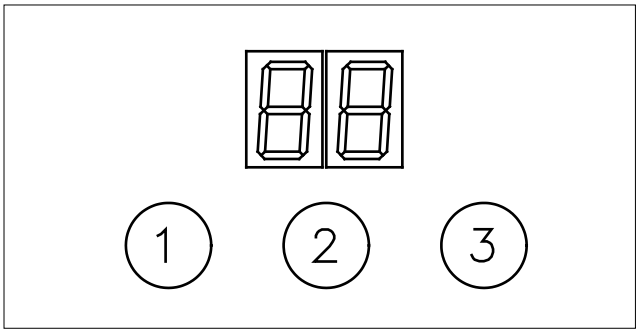
(*) = not supplied by Vetus

5.3.14 Programming keypad

IMPORTANT: **The control boxes and the operating levers must be set to neutral in order to be able to access the programming of the installation and thus also in order to set the parameters.**

Note: **The control boxes are already programmed in the factory and it should not be necessary to make changes to the parameters of the installation, even in particular conditions.**

The keyboard has a display with two figures and three programming keys.



Colour of key	Reference
Red	1 (-)
Yellow	2 (+)
Grey	3 (↵)

The display can show three different texts depending on the programme mode:
- MENU (display is on constantly)
- PROGRAMMING (display flashes)
- DISPLAY (display is on constantly)

Menu – Specific parameters
In mode MENU the display is on constantly and it is possible to move from one parameter to the other using the keys '1' and '2'.
Pressing keys '1' and '2' switches to mode MENU from mode DISPLAY. Pressing key '3' when in mode PARAMETERS also switches to mode MENU.

For the setting of the specific parameters follow this procedure:
1 With the actuator turned on (the display shows _ _) pressed both keys '1' and '2' and the first parameter will appear on the display;
2 Pressing the key '3' the display will start to flash. Now it is possible to tune the parameter using the keys '1' and '2';
3 When the parameter has been set use the key '3' to store this parameter;
4 To set the other parameters, scroll the menu using the keys '1' and '2' and when the parameter that you would like to change will be reached, follow this procedure starting from the point 3.

Program mode
The display flashes when in mode PROGRAMMING and the value of the selected parameter can be changed by using the keys '1' en '2'.

Pressing '3' when in mode PROGRAMMING reverts the system to mode MENU and saves the value given to the parameter.

If key '3' is not pressed within one minute to confirm a change to a parameter then mode PROGRAMMING will be exited and the parameter retains the value from before the change. Mode PROGRAMMING is accessed by holding keys '1' and '2' pressed in while switching the system on.

The procedure is the following:
1 Turn on the actuator keeping pressed both keys '1' and '2';
2 On the display will appear the first parameter to be set;

3 Pressing the key ‘3’ the parameter will start to flash and with the keys ‘1’ and ‘2’ you can set the parameter. In case of parameters in relation to push-pull cable position, the pressing of the keys ‘1’ and ‘2’ will generate a physical moving of the push-pull cable to the position to set;
4 When the parameter has been set use the key ‘3’ to store this parameter;
5 To set the other parameters, scroll the menu using the keys ‘1’ and ‘2’ and when the parameter that you would like to change will be reached, follow this procedure starting from the point 3.
6 When the setting of all parameters is finished, turn off the actuator.

Display mode

The viewer automatically goes to mode DISPLAY (_ _) if no key is pressed for two minutes. The functioning of the installation is shown in mode DISPLAY. Mode Display consists of a series that repeats one or two series of data continuously. It is possible to access mode DISPLAY at any time by pressing keys ‘1’ and ‘2’ simultaneously.

After power up, the display shows a sequence of 2 codes: ‘FI’ and ‘XX’:
- ‘FI’ means FIRMWARE;
- ‘XX’ is the firmware version.

5.3.15 Setting the parameters

It is necessary to set the outgoing minimum and maximum voltage values for installations with an electronically operated engine. The stroke of the gearbox requires mechanical setting.

Parameters to be set for installations with one engine.

Parameters to be set	Display	Values	Factory values	Value on display
Reverse	**0L**	Positions to be set for the push-pull cable in accordance with the procedure in Chapter 10.2.1		
Neutral (*)	**0F**			
Forward	**0H**			
Throttle lever – minimum channel 1	**L1**	0 - 5 Vdc	0.9	9
Throttle lever – maximum channel 1	**H1**		4.3	43
Begin point of acceleration channel 1	**C1**		00	00
Throttle lever – minimum channel 2	**L2**		0.5	5
Throttle lever – maximum channel 2	**H2**		2.1	21
Begin point of acceleration channel 2	**C2**		00	00

Parameters to be set for installations with two engines.

Parameters to be set	Display	Values	Factory values	Value on display
Right-hand engine - Reverse	**0L**	Positions to be set for the push-pull cable in accordance with the procedure in Chapter 10.2.1		
Right-hand engine – Neutral (*)	**0F**			
Right-hand engine – Forward	**0H**			
Left-hand engine- Reverse	**IL**			
Left-hand engine – Neutral (*)	**IF**			
Left-hand engine - Forward	**IH**			
Left-hand engine - Throttle lever – minimum channel 1	**L1**	0 - 5 Vdc	0.9	9
Left-hand engine - Throttle lever – maximum channel 1	**H1**		4.3	43
Begin point of acceleration channel 1	**C1**		00	00
Left-hand engine - Throttle lever – minimum channel 2	**L2**		0.5	5
Left-hand engine - Throttle lever – maximum channel 2	**H2**		2.1	21
Begin point of acceleration channel 2	**C2**		00	00
Right-hand engine - Throttle lever – minimum channel 3	**L3**		0.9	9
Right-hand engine - Throttle lever – maximum channel 3	**H3**		4.3	43
Begin point of acceleration channel 3	**C3**		00	00
Right-hand engine - Throttle lever – minimum channel 4	**L4**		0.5	5
Right-hand engine - Throttle lever – maximum channel 4	**H4**		2.1	21
Begin point of acceleration channel 4	**C4**		00	00

(*) factory values that cannot be changed

NB: it is advisable to check that the gearbox can be engaged for forward before setting the stroke of the control box, so that you can check whether forward is engaged when the push-pull cable is pushed or pulled.

5.3.16 Mechanical setting of the stroke of the gearbox

IMPORTANT: Check before switching on for the first time that the power supply to the control box is connected after the engine key switch.

Notes on the strokes setting:

1: The procedure described has an operational nature and must therefore be carried out while the engine is running and the vessel is sailing. It is important to pay the greatest attention to the settings for forward and reverse in order to prevent sudden or uncontrolled movements of the vessel. If necessary ask for help from a second person who can switch the engine on and off as required.

2: Stern drive and outboard engines: if it is not possible to set the strokes when the engine is running so that this has to be done when the vessel is not in the water, then simulate the rotation of the screws manually to make coupling the gearbox easier.

3: If the strokes of the gearbox are known it is sufficient to physically measure the movement of the cursor on the control box in the various positions to be set.

Specific parameters

IMPORTANT: changing factory values could cause the system to malfunction. Therefore, it is advisable not to change them unless our technician advises this.

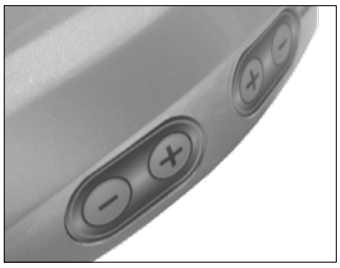
IMPORTANT: on the system with two engines, the strokes of the stern driver (in case of stern driver engines) has to be set checking if it is request a contro-rotation functioning of the propellers. The parameter A0 has the function to invert the movement of both push-pull cables.

5.3.17 Trim command

The trim command can be done directly from the command station toward the push-buttons '+' and '-' placed on the rear side. The signals are transferred from the command station to the actuator. The relais card mounted into the actuator provides the activation on the trim up and trim down.

In case of system with two engines, in Syncro mode the right device on the command station commands both trim pumps.

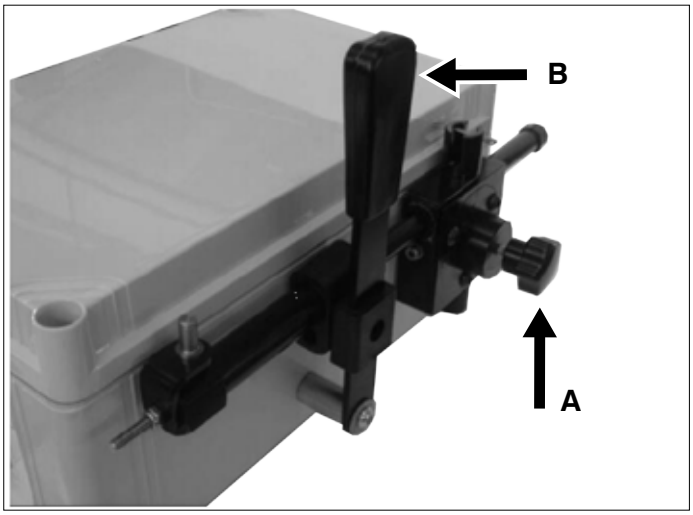
Version for one engine



Version for two engines

5.3.18 Emergency lever

In case of emergency, you can rapidly deactivate the electronic system and command the engines directly through the mechanical levers which are mounted on the actuators. In order to activate the mechanical levers you have to rotate clock wise the taps A on the actuator's levers and then you can command the engine directly from the lever B. In order to come back to normal mode, you have to unscrew the tap A and then move the command station. After the first using, the lever B will engage automatically the position before the emergency operation.



IMPORTANT: **In a emergency situation with a faulty electrical system the vessel can be controlled by using the levers fitted on the control box.**

5.3.19 Unexpected switching off of the engines

In all situations when the engines switch off without the operating levers being in neutral position the system will behave as follows the next time that it is switched on.

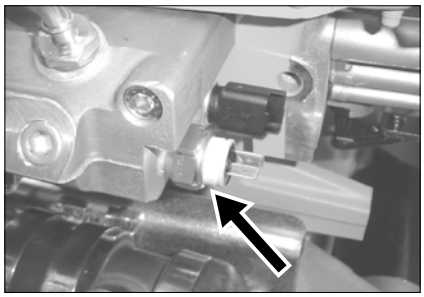
- The control box will set the gearbox to the safe position, that is the gearbox will be set to neutral and the throttle will be minimum.
- The operating station that controlled the vessel will be switched off.

6 Optional

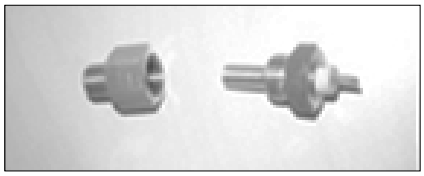
6.1 Fly bridge station installation

For the installation of second command station follow the instruction below:

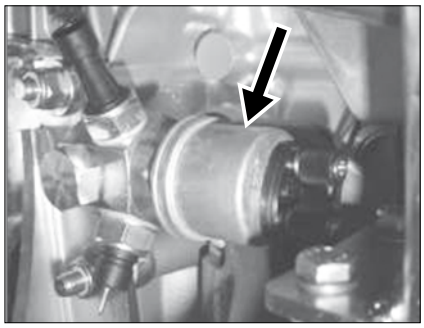
1) Dismount the water temperature sensor from the thermostat house.



Mount the water temperature sensor adapter and new sensor.



2) Dismount the oil pressure sensor.



Mount the adapter and new sensor.

3) Connect the new harness (double station) from ECU BOX to panels.

4) Connect the engine cable to new sensors.

6.2 Water Heater Installation

IMPORTANT: **When connecting a cabin heater or hot water heater, certain requirements must be met, including but not limited to the following:**

- Supply hose (from engine to heater) and return hose (from heater to engine) **MUST NOT EXCEED 16 mm (5/8 in.) I.D. (inside diameter)**.
- Make heater connections only at locations indicated in the following information.
- Refer to manufacturer's instructions for complete installation information and procedures.
- Do not reposition engine temperature switch; it must remain as installed by factory.
- The water heater must be placed with its highest point below the expansion tank to avoid air blocking of the circulation of the coolant.

⚠ **WARNING**

Avoid a performance loss and/or possible engine damage. Engine coolant must flow continuously from the engine intake manifold to the engine water circulating pump. NEVER close-off or block the coolant flow to or from a heater. All heater installations must be plumbed in series with the supply and return connectors.

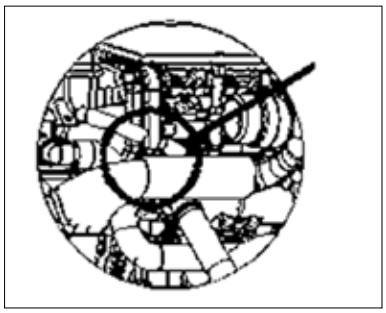
⚠ **CAUTION**

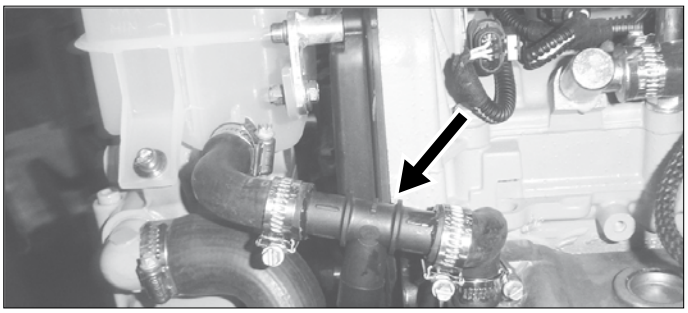
Avoid engine overheating which could result in engine damage. On models equipped with Closed Cooling, an air pocket may form in the closed cooling system if some coolant is lost from the system and the cabin heater or hot water is mounted higher than the filler cap on the expansion tank.

IMPORTANT: **Make sure to add coolant to compensate for the added volume in the cooling system.**

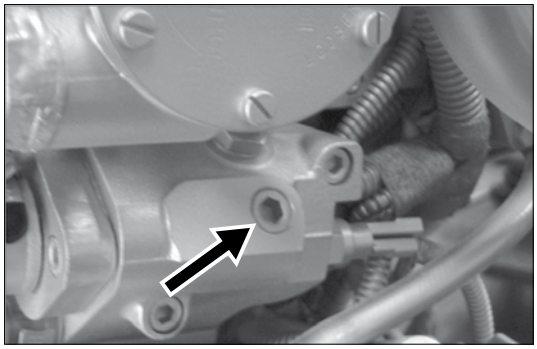
For the installation follow the instruction below:

1) Cut the hose below the expansion tank (first remove the air filter and drain the coolant circuit), as showed in the picture and insert the T pipe fitting (clamp).

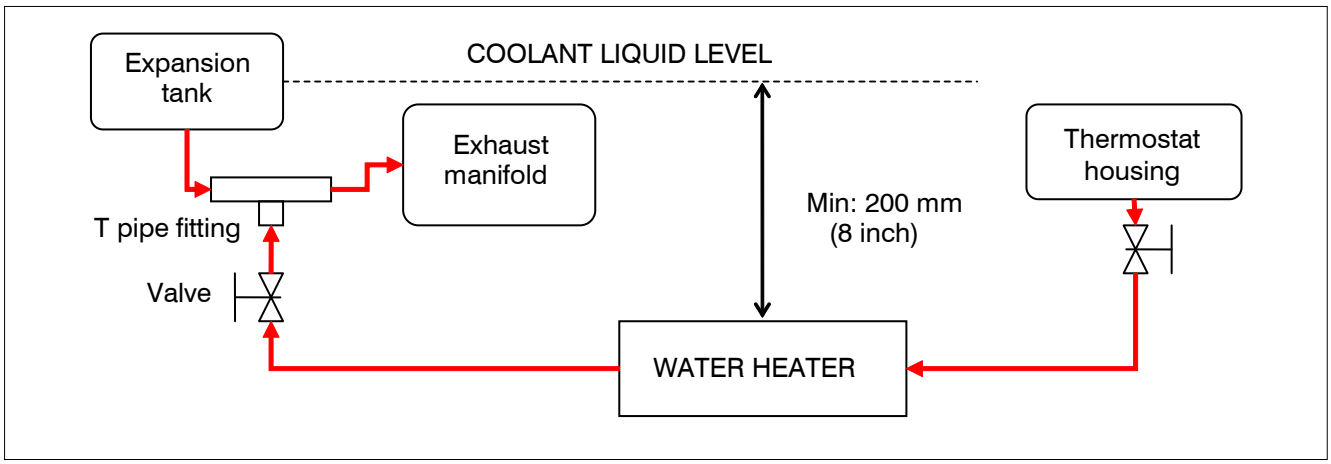




2) Unscrew the plug from thermostat housing and replace it with the brass pipe (use the copper ring).



3) Follow the instruction below how to connect the fittings.



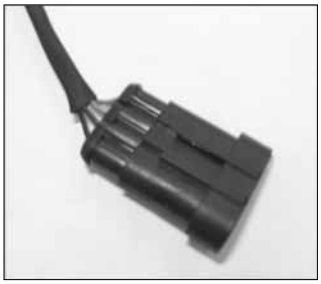
Fill the circuit and take care to drain air.

IMPORTANT: **Take care to avoid engine overheating.**

7 Checks

7.1 Diagnosis

In case of a fault the engine is equipped with a plug for electronic diagnosis. See the picture below.
Refer only to Vetus assistance to make engine diagnosis.



7.2 Check the engine oil level

The engines are delivered complete with oil, therefore it is not necessary to refill the lubrication system before starting the engine for the first time in the most case. Sometimes in particular engine installation could be possible to refill in function of the installation itself !
VETUS advises Multigrade Synthetic Oil viscosity SAE 10W40, ACEA: A3/B3, B3/B4, API: SL, CF.
E.g.: Vetus Marine Diesel Synthetic Engine Oil 10W40 or Shell Helix Plus 10W-40.

Sometimes on particular conditions it could be necessary to use a different viscosity grade oil. Please refer to VETUS assistance for other informations.

- Please, avoid mixing this oil with other oils because in that case the conditions related to the assistance intervals are no longer guaranteed to be the right ones.

- In case you are not able to find the VETUS oil, make sure you use oil with the same characteristics and specifications as the above-mentioned oil (ACEA: A3/B3, B3/B4, API: SL, CF), totally synthetic 10W40.

Recommended lubricating oil viscosity

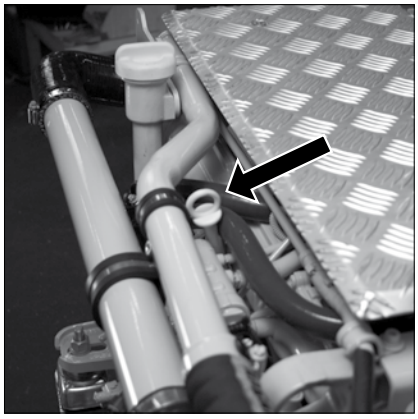
Starting temperature °C (deg F)	-30 (-22)	-20 (-4)	-10 (14)	0 (32)	10 (50)	20 (68)	30 (86)	40 (104)
Lubricating oil viscosity		**SAE 10W-40**						
				SAE 20W-40				
			SAE 15W-40					
		SAE 10W-30						
	SAE 5W-20							

To check the engine oil level:

- Make sure that the engine is stopped for at least 5 minutes to get a complete drain of oil into the pan.

- Remove the oil dipstick, clean it by blotting paper or similar.

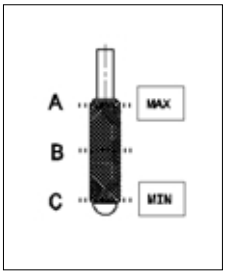
- Reinsert the oil dipstick, take out again and check the oil level:



A If the oil level is at level A on the dipstick, you don't need to refill.

B If the oil is at level B, the you may refill. In this case, you may see the oil reach level A.

C If the oil is at level C or lower than that, then you must refill as soon as possible. Then, it will be enough to take the oil back to at least level B.
The oil level must never exceed level A.



If the engine is to be used under severe conditions, for instance being used for many operating hours (10 – 12 hours), the oil level should be at least in the middle of the two signs (min/max).

- Refill the oil through the oil refill gate as shown below if is required.

IMPORTANT: **Make sure that when you check the oil level that the engine is as level as possible, inclination backwards maximum 15 degrees! A correct weight distribution of the boat helps to read the correct value.**

Nederlands

Vetus Diesel VF4 VF5

vetus n.v.

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

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