

# OPERATION MANUAL

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MARINE ENGINE

**6LF**

**6LF550**

**6LF530**

**6LF485**

(en) English

(da) Danish

(de) German

(es) Spanish

(fr) French

(fi) Finnish

(el) Greek

(it) Italian

(no) Norwegian

(nl) Dutch

(pt) Portuguese

(sv) Swedish

**YANMAR**

**California  
Proposition 65 Warning**

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

**Disclaimers:**

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OPERATION MANUAL	MODEL	6LF550, 6LF530, 6LF485
	CODE	0A6LF-EN0010

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# INTRODUCTION

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Welcome to the world of YANMAR Marine! YANMAR Marine offers engines, drive systems and accessories for all types of boats, from runabouts to sailboats, and from cruisers to mega yachts. In marine leisure boating, the worldwide reputation of YANMAR Marine is second to none. We design our engines to respect nature. This means quieter engines, with minimal vibrations, cleaner than ever. All of our engines meet applicable regulations, including emissions, at the time of manufacture.

To help you enjoy your YANMAR 6LF series engine for many years to come, please follow these recommendations:

- Read and understand this *Operation Manual* before you operate the machine to ensure that you follow safe operating practices and maintenance procedures.
- Keep this *Operation Manual* in a convenient place for easy access.
- If this *Operation Manual* is lost or damaged, order a new one from your authorized YANMAR Marine dealer or distributor.
- Make sure this manual is transferred to subsequent owners. This manual should be considered a permanent part of the engine and remain with it.
- Constant efforts are made to improve the quality and performance of YANMAR products, so some details included in this *Operation Manual* may differ slightly from your engine. If you have any questions about these differences, please consult your authorized YANMAR Marine dealer or distributor.
- The specifications and components (instrument panel, fuel tank, etc.) described in this manual may differ from ones installed on your vessel. Please refer to the manual provided by the manufacturer of these components.
- Refer to the YANMAR Limited Warranty Handbook for a complete warranty description.

## INTRODUCTION

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### RECORD OF OWNERSHIP

Take a few moments to record the information you need when you consult YANMAR for service, parts or documentation.

Engine Model: \_\_\_\_\_

Engine Serial No.: \_\_\_\_\_

Date Purchased: \_\_\_\_\_

Dealer: \_\_\_\_\_

Dealer Phone: \_\_\_\_\_

#### ■ To Register Your YANMAR Engine

1. Visit <https://yanmar.microsoftcrmportals.com/>  
or <https://www.yanmar.com/marine>
2. Click on "Register & Support".





# SAFETY

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YANMAR considers safety of great importance and recommends that anyone that comes into close contact with its products, such as those who install, operate, maintain or service YANMAR products, exercise care, common sense and comply with the safety information in this manual and on the machine's safety decals. Keep the labels from becoming dirty or torn and replace them if they are lost or damaged. Also, if you need to replace a part that has a label attached to it, make sure you order the new part and label at the same time.



This safety alert symbol appears with most safety statements. It means attention, become alert, your safety is involved! Please read and abide by the message that follows the safety alert symbol.

## **DANGER**

Indicates a hazardous situation which, if not avoided, *will* result in death or serious injury.

## **WARNING**

Indicates a hazardous situation which, if not avoided, *could* result in death or serious injury.

## **CAUTION**

Indicates a hazardous situation which, if not avoided, *could* result in minor or moderate injury.

## **NOTICE**

Indicates a situation which can cause damage to the machine, personal property and/or the environment, or cause the equipment to operate improperly.

## SAFETY PRECAUTIONS

### General Information

There is no substitute for common sense and careful practices. Improper practices or carelessness can cause burns, cuts, mutilation, asphyxiation, other bodily injury or death. This information contains general safety precautions and guidelines that must be followed to reduce risk to personal safety. Special safety precautions are listed in specific procedures. Read and understand all of the safety precautions before operation or performing repairs or maintenance.

### Before You Operate

#### DANGER

The safety messages that follow have DANGER level hazards.



Never permit anyone to install or operate the engine without proper training.

•Read and understand this *Operation Manual* before you operate or service the engine to ensure that you follow safe operating practices and maintenance procedures.

- Safety signs and labels are additional reminders for safe operating and maintenance techniques.
- Consult authorized YANMAR Marine dealer or distributor for additional training.

### During Operation and Maintenance

#### WARNING

The safety messages that follow have WARNING level hazards.

#### Explosion Hazard



While the engine is running or the battery is charging, hydrogen gas is being produced and can be easily ignited. Keep the area around the battery well-ventilated and keep sparks, open flames and any other form of ignition out of the area.

#### Fire and Explosion Hazard

Diesel fuel is flammable and explosive under certain conditions.

Never use a shop rag to catch the fuel.

Wipe up all spills immediately.

Never refuel with the engine running.

#### Fire Hazard



Undersized wiring systems can cause an electrical fire.  
Never use improper capacity of fuses.

Store any containers containing fuel or other flammable products in a well-ventilated area, away from any combustibles or source of ignition.

Store any equipment in a designated area away from moving parts.

Never use the engine compartment for storage.

**⚠ WARNING****SEVER HAZARD**

Rotating parts can cause severe injury or death. Never wear jewelry, unbuttoned cuffs, ties or loose-fitting clothing and always tie long hair back when working near moving/rotating parts such as the flywheel or PTO shaft. Keep hands, feet and tools away from all moving parts.

**Alcohol and Drug Hazard**

Never operate the engine while under the influence of alcohol or drugs, or when feeling ill.

**Exposure Hazard**

Always wear personal protective equipment including appropriate clothing, gloves, work shoes, and eye and hearing protection as required by the task at hand.

**Sudden Movement Hazard**

Never operate the engine while wearing a headset to listen to music or radio because it will be difficult to hear the warning signals.

**Burn Hazard**

Some of the engine surfaces become very hot during operation and shortly after shutdown. Keep hands and other body parts away from hot engine surfaces.

**Exhaust Hazard**

Never block windows, vents or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation and special precautions are required to avoid carbon monoxide poisoning.

**⚠ CAUTION**

The safety messages that follow have CAUTION level hazards.

**Poor Lighting Hazard**

Ensure that the work area is adequately illuminated. Always install wire cages on portable safety lamps.

**Tool Hazard**

Always use tools appropriate for the task at hand and use the correct size tool for loosening or tightening machine parts.

**Flying Object Hazard**

Always wear eye protection when servicing the engine or when using compressed air or high-pressure water. Dust, flying debris, compressed air, pressurized water or steam may injure your eyes.

**Coolant Hazard**

Wear eye protection and rubber gloves when you handle engine coolant. If contact with the eyes or skin should occur, flush eyes and wash immediately with clean water.

## NOTICE

The safety messages that follow have NOTICE level hazards.

It is important to perform daily checks as listed in the *Operation Manual*. Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor engine performance and helps extend the life of the engine.

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Consult authorized YANMAR Marine dealer or distributor if you need to operate the engine at high altitudes. At high altitudes the engine will lose power, run rough and produce exhaust gases that exceed the design specifications.



Always be environmentally responsible.

Follow the guidelines of the EPA or other governmental agencies for the proper disposal of hazardous materials such as engine oil, diesel fuel and engine coolant. Consult the local authorities or reclamation facility.

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Never dispose of hazardous materials by dumping them into a sewer, on the ground, or into ground water or waterways.

If a YANMAR Marine Engine is installed at an angle that exceeds the specifications stated in the YANMAR Marine *Installation Manuals*, engine oil may enter the combustion chamber causing excessive engine speed, white exhaust smoke and serious engine damage. This applies to engines that run continuously or those that run for short periods of time.

## NOTICE

If you have an installation with two or three engines and only one engine is operating, the water pickup (thru-hull) of the non-running engine(s) should be closed. This will prevent water from being forced past the seawater pump and eventually finding its way into the engine. The result of water entering the engine could cause seizure or other serious problems.

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If you have an installation with two or three engines, and only one engine is operating, please note that if the propeller shaft thru-hull (stuffing box) is lubricated by engine water pressure and the engines are interconnected, care must be taken that water from the running engine does not enter the exhaust of the non-running engine(s). This water could cause seizure of the non-running engine(s). Consult authorized YANMAR Marine dealer or distributor for a complete explanation of this condition.

If you have an installation with two or three engines, and only one engine is operating, it is important to limit the amount of throttle applied to the running engine. If you observe black smoke or movement of the throttle does not increase engine speed, you are overloading the engine that is running. Immediately throttle back to approximately 2/3 throttle or to a setting where the engine performs normally. Failure to do so may cause the running engine to overheat or cause excess carbon buildup which may shorten the engine's life.

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Never turn off the battery switch (if equipped) or short the battery cables during operation. Damage to the electrical system will result.

# GENERAL INFORMATION

## PRINCIPAL ENGINE SPECIFICATIONS

Specification		6LF485	6LF530	6LF550
Use		For light duty commercial use		For recreational use
Type		Vertical water cooled 4-cycle diesel engine		
Combustion System		Direct injection (Common rail system)		
Air Charging		Turbocharged with air cooler		
Number of Cylinders		6		
Bore x Stroke		104 mm x 132 mm		
Displacement		6,700 cm <sup>3</sup>		
Fuel stop power		356 kW / 3000 min <sup>-1</sup> *	389 kW / 3000 min <sup>-1</sup> *	404 kW / 3000 min <sup>-1</sup> *
Installation		Flexible mounting		
Fuel Injection Timing		Variable timing (Electronic control)		
Fuel Injection Pressure		Variable pressure (Maximum injection pressure: 160 MPa)		
Direction of Rotation	Crankshaft	Counterclockwise viewed from flywheel side		
Cooling System		Coolant cooling with heat exchanger		
Lubrication System		Forced lubrication system		
Cooling Water Capacity (coolant)		24.5 L		
Lubricating Oil Capacity (engine)	Total	19.0 L		
	Effective	5.5 L		
Starting System	Type	Electric		
	Starting motor	DC 12 V - 3.2 kW		
	AC generator	14 V - 90 A		
Marine gear		ZF280-1 / ZF280-1A		
Engine Dimension	Overall length	1383 mm		
	Overall width	842 mm		
	Overall height	813 mm		
Engine Dry Mass (including marine gear)		721 kg		

\* Rating Condition: Temperature of fuel; 40°C at fuel pump inlet; ISO 8665 & Back pressure; 15 kPa

# YANMAR 6LF COMMON RAIL SERIES FEATURES AND APPLICATIONS

The 6LF common rail series are four-stroke diesel engines equipped with direct injection common rail system and with liquid coolant systems.

The 6LF is 6-cylinder and turbocharged with an air cooler.

The engines are equipped with a marine gear. (Option)

These engines are designed for recreational craft use.

Applying other purpose except recreational (in this case) can lead to reduced vessel performance, lead to increased smoke levels and cause permanent damage to your engine.

The engine must be installed correctly with coolant lines, exhaust gas lines and electrical wiring. No auxiliary equipment without prior agreement YMI is allowed. To handle the drive equipment, propulsion systems (including the propeller) and other inboard equipment, always observe the instructions and cautions given in the operation manuals supplied by the shipyard and equipment manufacturers.

The 6LF common rail series engines are designed to be operated at maximum throttle\*1 for less than 5% of total engine time (30 minutes out of every 10 hours) and cruising speed\*2.

The laws of some countries may require hull and engine inspections, depending on the use, size and cruising area of the boat. The installation, fitting and surveying of this engine all require specialized knowledge and engineering skills. See Yanmars local subsidiary in your region or your authorized Yanmar Marine dealer or distributor.

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\*1 maximum throttle: fuel stop power engine speed

\*2 cruising speed: fuel stop power engine speed -200 min-1 or less

## New Engine Break-In

As with all reciprocating engines, the way your engine is operated during its first 50 hours of operation plays a very significant role in determining how long it will last and how well the engine will perform over its lifetime.

A new Yanmar diesel engine must be operated at suitable speeds and power settings during the break-in period to make the sliding parts, such as piston rings, break-in properly and to stabilize engine combustion.

During the break-in period, the engine coolant temperature gauge should be monitored; temperature should be between 71° and 80°C (160° and 176°F).

During the first 10 hours of operation, the engine should be run at maximum engine speed minus 400 to 500 min<sup>-1</sup> (approximately 60 to 70% of load) most of the time. This will ensure the sliding parts break in properly. During this period, avoid operating at maximum engine speed and load to avoid damaging or scoring sliding parts.

### NOTICE

Do not operate at WOT (wide open throttle) for more than a minute at a time during the first 10 hours of operation.

Do not operate the engine at low idle or at low speed and light load for more than 30 minutes at a time. Since unburned fuel and engine oil will adhere to the piston rings when operating at low speeds for long periods, this will interfere with proper movement of the rings and the engine oil consumption may increase. Low idle speed does not allow break-in of sliding parts.

If operating engine at low speed and light load, you must race the engine to clean the carbon from the cylinders and fuel injection valve.

Perform this procedure in open waters:

- With the clutch in NEUTRAL, accelerate from the low-speed position to the high-speed position briefly.
- Repeat this process five times.

Once past the initial 10 hours until 50 hours, the engine should be used over its full operating range, with special emphasis on running at relatively high power settings. This is not the time for an extended cruise at idle or low speed. The boat should be run at maximum speed minus 400  $\text{min}^{-1}$  most of the time (approximately 70% load), with a 10 minute run at maximum minus 200  $\text{min}^{-1}$  (approximately 80% load) every 30 minutes and a 4 to 5 minute period of operation at WOT (wide open throttle) once each 30 minutes. During this period, be sure not to operate your engine at low speed and light load for more than 30 minutes. If operating engine at low speed and light load by necessity, just after the low idle operation, be sure to race the engine.

To complete engine break-in, perform *After Initial 50 Hours of Operation* maintenance procedures.

## GENERAL INFORMATION

# MANUFACTURER'S DECLARATION OF POWER ACCORDING TO DIRECTIVE 2013/53/UE - ISO8665

### N67 404 kW (550 hp)

Net power at the flywheel with full load, compliant with Directive 2013/53/EU, fuel EN590, tests carried out in accordance with ISO 8665 and ISO 15550.

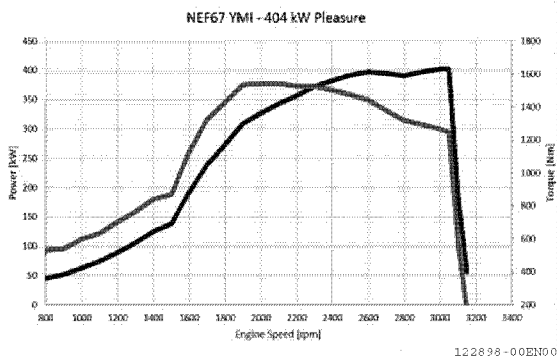


Figure 1

### N67 353 kW (500 hp)

Net power at the flywheel with full load, compliant with Directive 2013/53/EU, fuel EN590, tests carried out in accordance with ISO 8665 and ISO 15550.

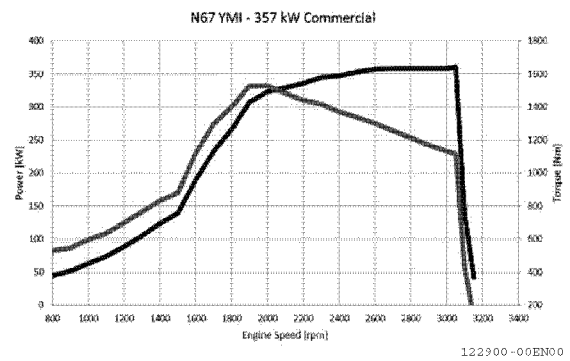


Figure 3

### N67 390 kW (530 hp)

Net power at the flywheel with full load, compliant with Directive 2013/53/EU, fuel EN590, tests carried out in accordance with ISO 8665 and ISO 15550.

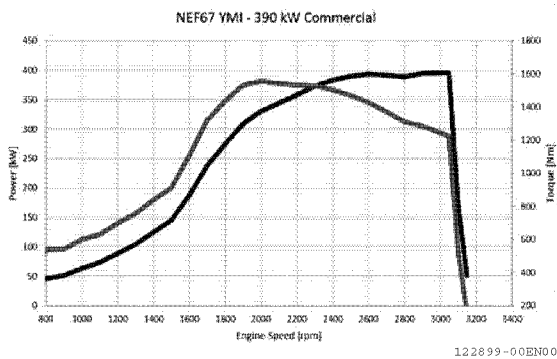
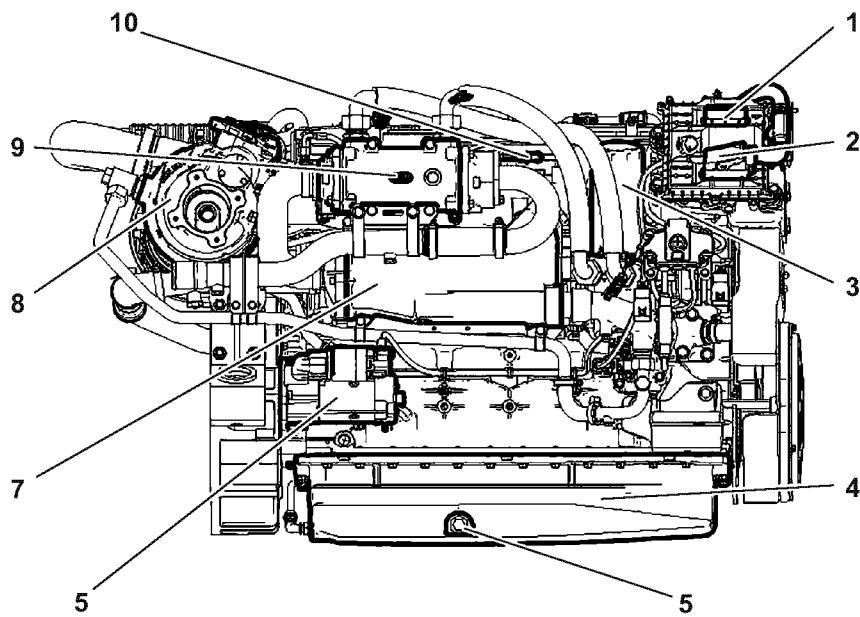


Figure 2



EXTERNAL VIEW

Right side view



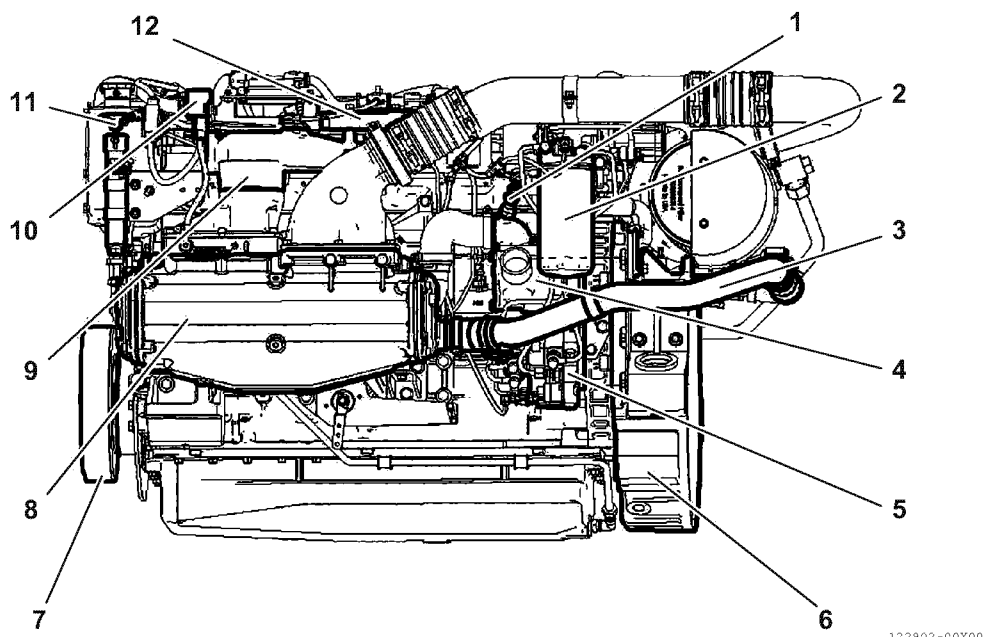
122901-00X00

- |                       |                                     |
|-----------------------|-------------------------------------|
| 1 – Boat side cable   | 6 – Starter motor                   |
| 2 – Engine side cable | 7 – Seawater/water heat exchanger   |
| 3 – Oil filter        | 8 – Turbocharger                    |
| 4 – Oil sump          | 9 – Seawater/oil heat exchanger     |
| 5 – Oil drain plug    | 10 – Exhaust gas temperature sensor |

Figure 4

## GENERAL INFORMATION

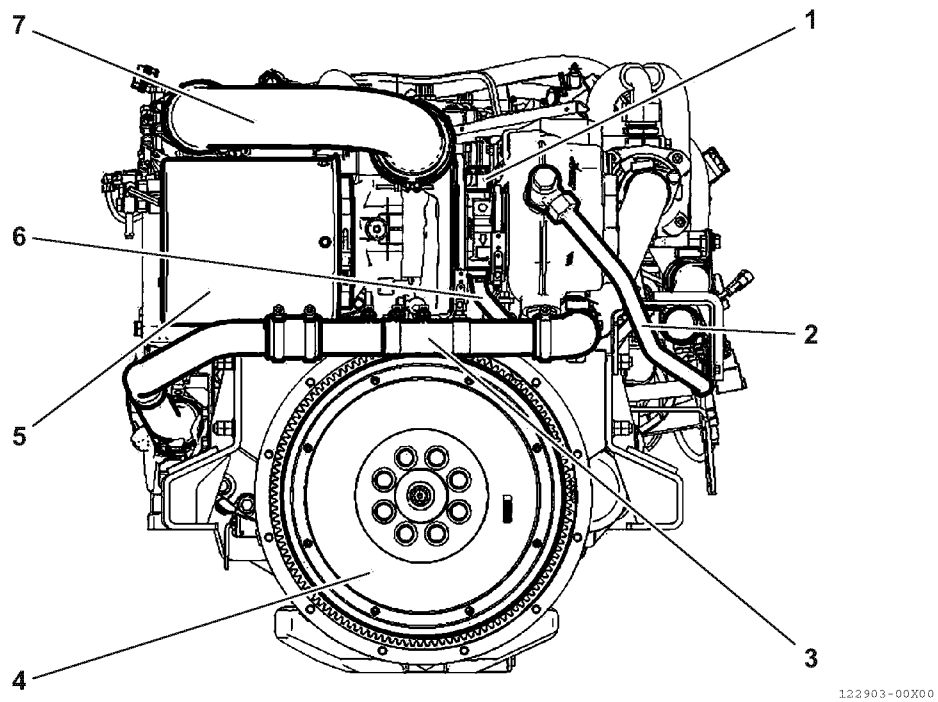
### Left side view



- |   |   |
|---|---|
| 1 – Seawater pressure sensor                              | 7 – Damper  |
| 2 – Fuel filter   | 8 – Seawater/air heat exchanger                       |
| 3 – Seawater outlet pipe from seawater/air heat exchanger | 9 – Intake manifold                                   |
| 4 – Seawater pump   | 10 – Grid heater start-up thermal relay (Grid heater) |
| 5 – High-pressure fuel pump                               | 11 – Oil evacuation pump                              |
| 6 – Flywheel housing                                      | 12 – Common rail                                      |

*Figure 5*

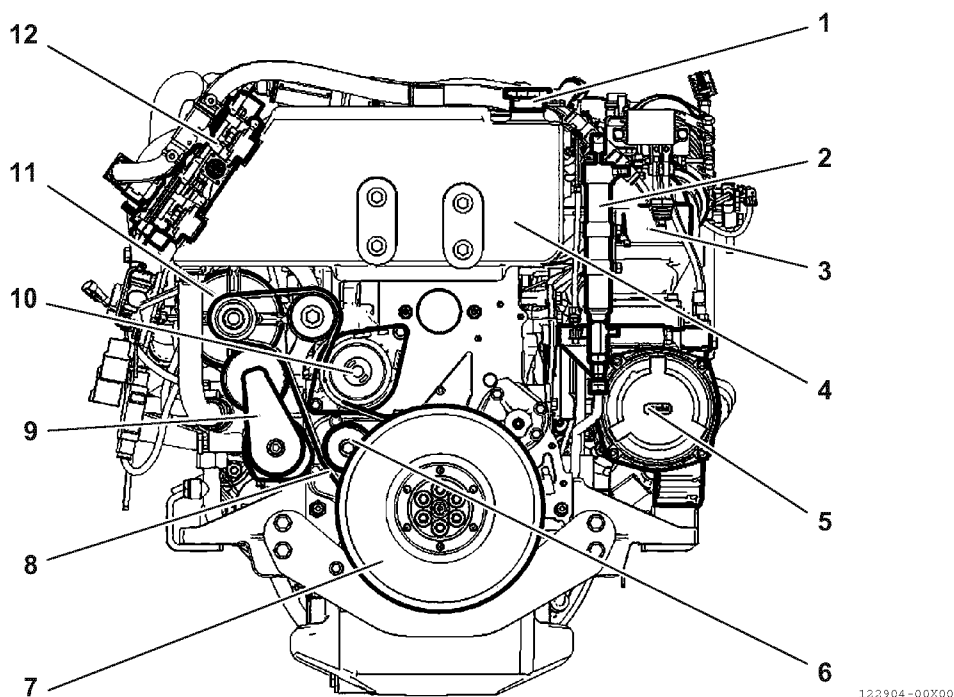
Rear view



- |  |  |
|--|--|
| 1 – Oil delivery pipe to the turbocharger                | 5 – Air filter   |
| 2 – Turbocharger coolant return pipe                     | 6 – Oil return pipe  |
| 3 – Seawater outlet pipe from seawatercooled Intercooler | 7 – Boost air pressure delivery hose to the seawatercooled Intercooler |
| 4 – Engine flywheel                                      |  |

Figure 6

## Front view



- 1 – Cooling system pressure cap
- 2 – Manual pump for extracting oil
- 3 – Intake manifold
- 4 – Expansion tank
- 5 – Air/seawater heat exchange
- 6 – Guide pulleys

- 7 – Damper
- 8 – Auxiliary belt
- 9 – Belt tensioner
- 10 – Water pump
- 11 – Alternator
- 12 – EDC17CV41 electronic control unit

*Figure 7*

# ENGINE OPERATION

---

## FOR PROPER USE OF THE ENGINE

- Do not extend the start-up control when the engine is already running.
- After starting the engine, begin navigation at a low speed and do not remain in dock while waiting for the engine to warm up; allowing the engine to run at medium power will allow the operating temperatures to be reached correctly.
- Do not idle for long periods as this increases the production of harmful emissions from the engine and does not guarantee its optimum performance.
- The engine speed must be increased and decreased gradually so as to permit normal combustion and the optimum functioning of all engine components.

Maximum cruising speed must not exceed 90% of maximum Power (see the page 7).

- During navigation, check that:
  - The temperature of the engine coolant has not reached the alarm thresholds.
  - The oil pressure remains within the expected normal values.

## PRELIMINARY CHECKS

- Each time before starting the engine:

Make sure that the sea-water inlet valve is open. Dry operation of the seawater pump would quickly cause irreparable damage to the internal impeller.

Check the level of the technical fluids (fuel, engine oil and coolant)

### **WARNING**

#### **RISK OF INJURY**

**Before starting the engine, make sure that there are no gas or combusive vapours in the engine room.**

**Failure to comply with these prescriptions can result in the risk of serious injury.**

---

### SPECIAL WARNINGS

#### High coolant temperature

If high temperature is indicated by the instrument or with an alarm, reduce the engine speed and return to port to check the status of the seawater inlet and the cooling circuits; also check and have the following checked:

1. the tension of the water pump and alternator drive belts.
2. the operation of the thermostatic valve.
3. the cleanliness of the heat exchangers.

#### WARNING

##### **RISK OF BURNS**

When the engine is hot, pressure builds up in the cooling circuits which may eject hot liquid violently, resulting in a risk of burns.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

Open the filler cap of the coolant tank only if necessary and only when the engine is cold. Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

#### Low lubricant oil pressure

Should the pressure indicated by the instrument be considered insufficient or if the "low oil pressure" warning light comes on, stop the engine and check the oil level. Top-up as needed (see the page 35). If the fault persists, return to low speed, and contact a Service centre

#### Presence of water in the fuel pre-filter

It is good practice to drain the water from the filters before the relevant warning light comes on.

Do not use the engine if the tank only contains the quantity of fuel kept as reserve; this condition promotes the formation of condensate and the intake of sludge or air, causing the engine to stop.

#### WARNING

##### **CONTAMINATION, FIRE**

When refuelling, always make sure that no solid or liquid pollutants enter the fuel tank; remember that it is prohibited to smoke or use naked flames when refuelling.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

#### Clogged air filter and exhaust circuit inefficiencies

Regularly inspect the cleanliness of the air intake inlets and the exhaust ducts. The maintenance intervals contained in this manual only take into account the performances of the engine parts and not of those parts manufactured at the Yard or any other external intervention.

#### WARNING

##### **RISK OF BURNS**

Visually check that the exhaust circuit is not clogged or damaged, to prevent hazardous or toxic emissions inside the pipes.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

#### Alternator fault

Periodically check the cleanliness, condition and correct tensioning of the drive belt.

**⚠ WARNING****RISK OF INJURY**

The cranking elements are located below the protective bonnet. They must only be removed when the engine is not turning over. Failure to comply with these prescriptions can result in the risk of serious injury.

---

**Electrical system irregularities**

Periodically check, and especially in winter, to ensure that the batteries are clean and in full working order, checking and topping up as indicated on the page 37. Close attention must be paid to the caution notices. If the batteries are replaced, strictly observe the specifications as indicated on the page 7.

**Running in**

Thanks to modern engine construction technologies a particular run-in procedure is not required. However, it is recommended to avoid using the engine at high power for long periods during the first 50 hours.

# ENGINE OPERATION

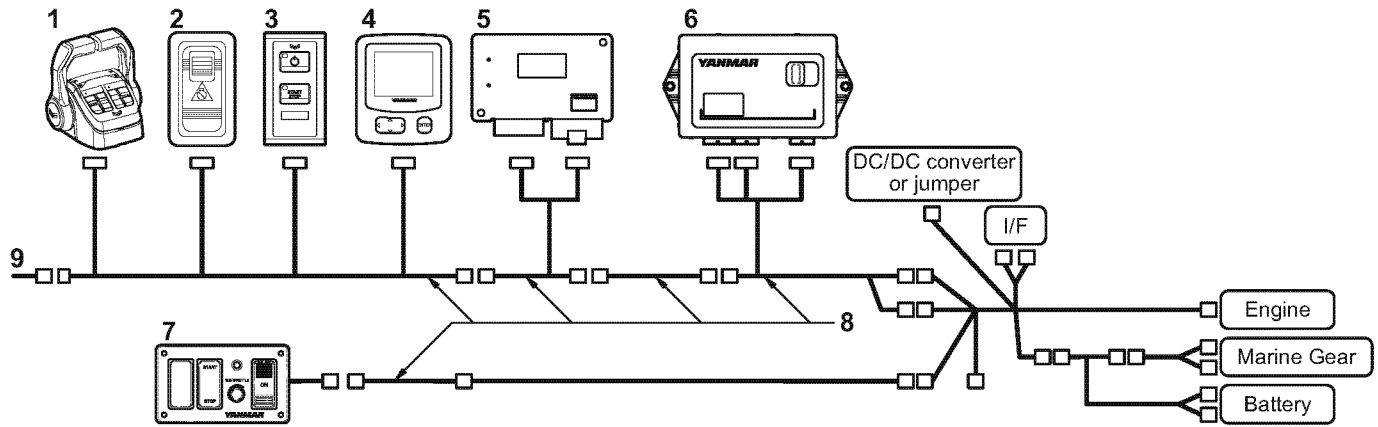
## VESSEL CONTROL SYSTEM (VC20)

6LF series engine is a fully electronic controlled engine, which is controlled by YANMAR's original "Vessel Control System (VC20)".

The control equipment consists of the Switch Panel, the Display, the Drive & Helm ECU, the Control Head and the Backup Panel, which are connected by the cable harness to the engine and marine gear for remote control operation.

*Note: The YANMAR Vessel Control System (VC20) was designed to operate the 6LF engine and drive system. There are many control functions and diagnostic functions that are integrated together to insure safe operation. If this system is not utilized in specific accordance with the instructions in this manual or the system is modified in any way, YANMAR will not be responsible for any warranty failures in the operation of the system or the vessel utilizing the system.*

*YANMAR has designed the Vessel Control System (VC20) in conjunction with the 6LF engine. The system has many functions that must be configured and calibrations must be made before the vessel can be operated. Please arrange to have a YANMAR trained technician inspect the vessel prior to the vessels operation.*



037618-05EN00

**Figure 1**

No.	Description
1	Shift and Throttle Control Head
2	Emergency Stop Switch (Option)
3	Switch Panel (to start and stop the engine)
4	Display
5	Helm ECU
6	Drive ECU
7	Backup Panel
8	Cable Harness Set
9	Adapter, Terminal

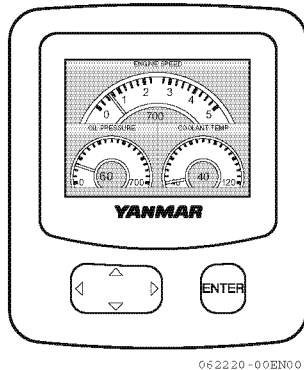


## ■ Display Function

The multi-function information display has the following functions.

When starting the engine with pressing power switch on the switch panel, the welcome screen appears on the display.

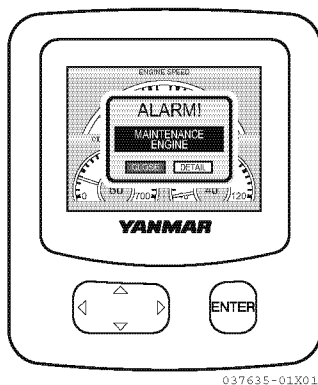
### Engine Data



**Figure 2**

This screen displays real time engine data.

### Alarm Indicators

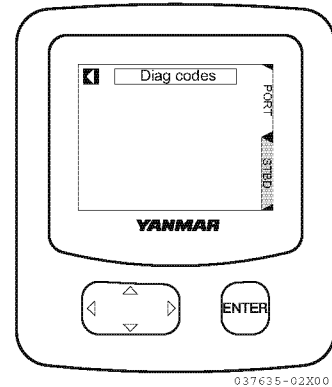


**Figure 3**

The alarm window appears with an audible alarm when abnormal engine activity occurs.

*Note: If the system does not function normally, consult your authorized YANMAR Marine dealer or distributor and ask for diagnostics.*

### Diag Codes Screen



**Figure 4**

This screen displays the specific diagnostic codes in case of active alarms.

### When Alarm Indicator is activated

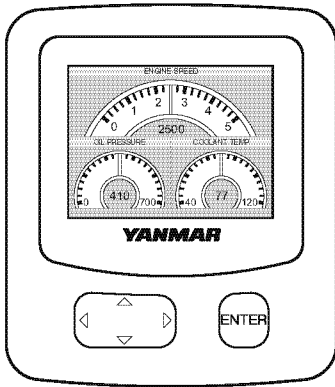
The alarm indicators and buzzer are activated when sensors detect an abnormality during engine operation. The alarm indicators are off during normal operation, but are activated as follows when an abnormality arises:

- The coolant temperature alarm indicator activates when the coolant gets too hot.
- The engine oil pressure alarm indicator activates when the engine oil pressure drops.
- The electric charge alarm indicator activates when there is a charging failure.

# ENGINE OPERATION

## ■ Operation of the Display's Buttons

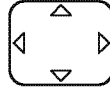
### Buttons



061584-00EN00



- Act on pop-up menu (MAIN MENU)
- Perform the function



- ▲ Up Arrow moves menu selection up
- ▼ Down Arrow moves menu selection down
- ◀ Left Arrow acts on current menu item
- ▶ Right Arrow acts on current menu item

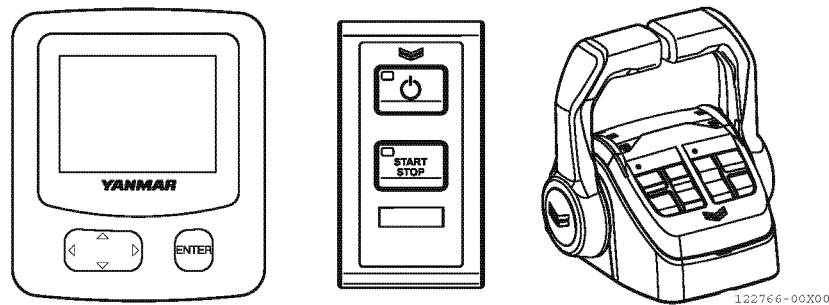
### Hot Key List

Item	Operation	Indication
MAIN MENU	Press the [ENTER] button.	Display MAIN MENU.
MENU LAYER SKIP	Hold the ◀ button down for 1 second.	Close MENU and return to the normal screen.
ICON INFO	Press the ▼ button while the icon with a detail information indication function is displayed.	Display the related setting screen of the relevant icon. If there are multiple items, execute with the [ENTER] button after selecting with the ◀ ▶ buttons.
Adjusting Brightness	Press the ▲ button.	Display the brightness adjustment screen and adjust brightness with the ▲ ▼ buttons. (Manual dimmer mode only)
Switching Night Mode	Press the ◀ button.	Switch to the night mode indication.
Setting Complete	Hold the [ENTER] button down for 1 second while the ■ icon is highlighted.	Close the setting screen and MENU and return to the normal indication.
Switching Monitor Display Indication	Press the ▶ button.	Switch to the monitor screen in the normal indication. Send the screen in order with the ◀ ▶ buttons. The monitor screen is fixed when there is no operation with the ◀ ▶ buttons for 5 seconds.

## ■ Dimmer Linkage

The light on the VC20 components can be varied in intensity to a more comfortable level if desired.

The dimmer levels of components are linked per station, so the same brightness as the setting of Display is applied to Switch panel and Control head of the same station.



**Figure 5**

The lamps can be dimmed (light adjustment) using the following two methods.

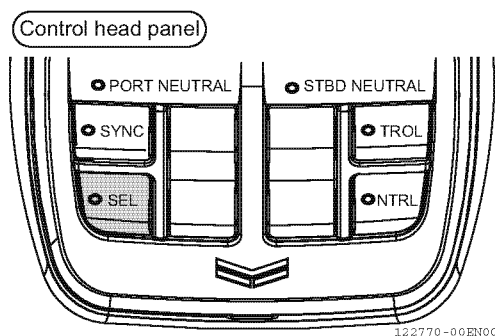
1. Dimmer with the display dimmer settings.
2. Dimmer with the control head “SEL” switch.

### ***Dimmer with the control head “SEL” switch***

1. The lamp brightness will decrease one level each time the “SEL” switch of the selected station control head is pressed.
2. Pressing “SEL” switch with the brightness on its lowest level will return the brightness to its highest level.

### ***Dimmer with the display dimmer settings***

1. Go to the brightness setting in the display.
2. Select the desired brightness level.



**Figure 6**

# ENGINE OPERATION

## ■ Auto Dimmer

If auto dimmer is enabled, the brightness of each device is automatically adjusted according to the ambient brightness.

1. Select "Auto dimmer".  
(Display: Auto dimmer)
  - "YES": Auto dimmer mode
  - "NO": Manual dimmer mode

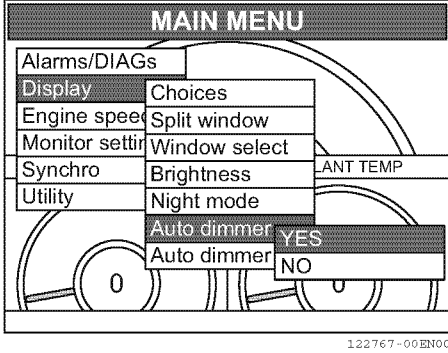


Figure 7

- This setting can be chosen for each station individually.

2. Select "Auto dimmer limit".  
(Display: Auto dimmer limit)

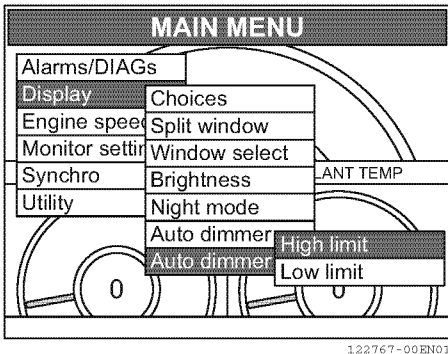


Figure 8

3. Set the minimum and maximum brightness as required.
  - The brightness is adjusted in 8 steps.

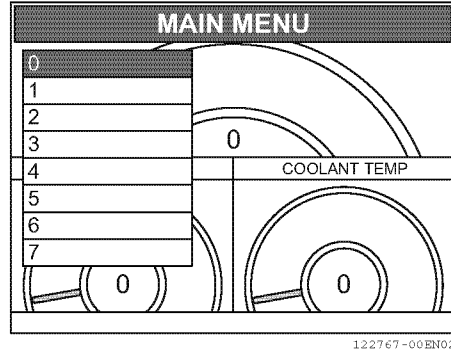
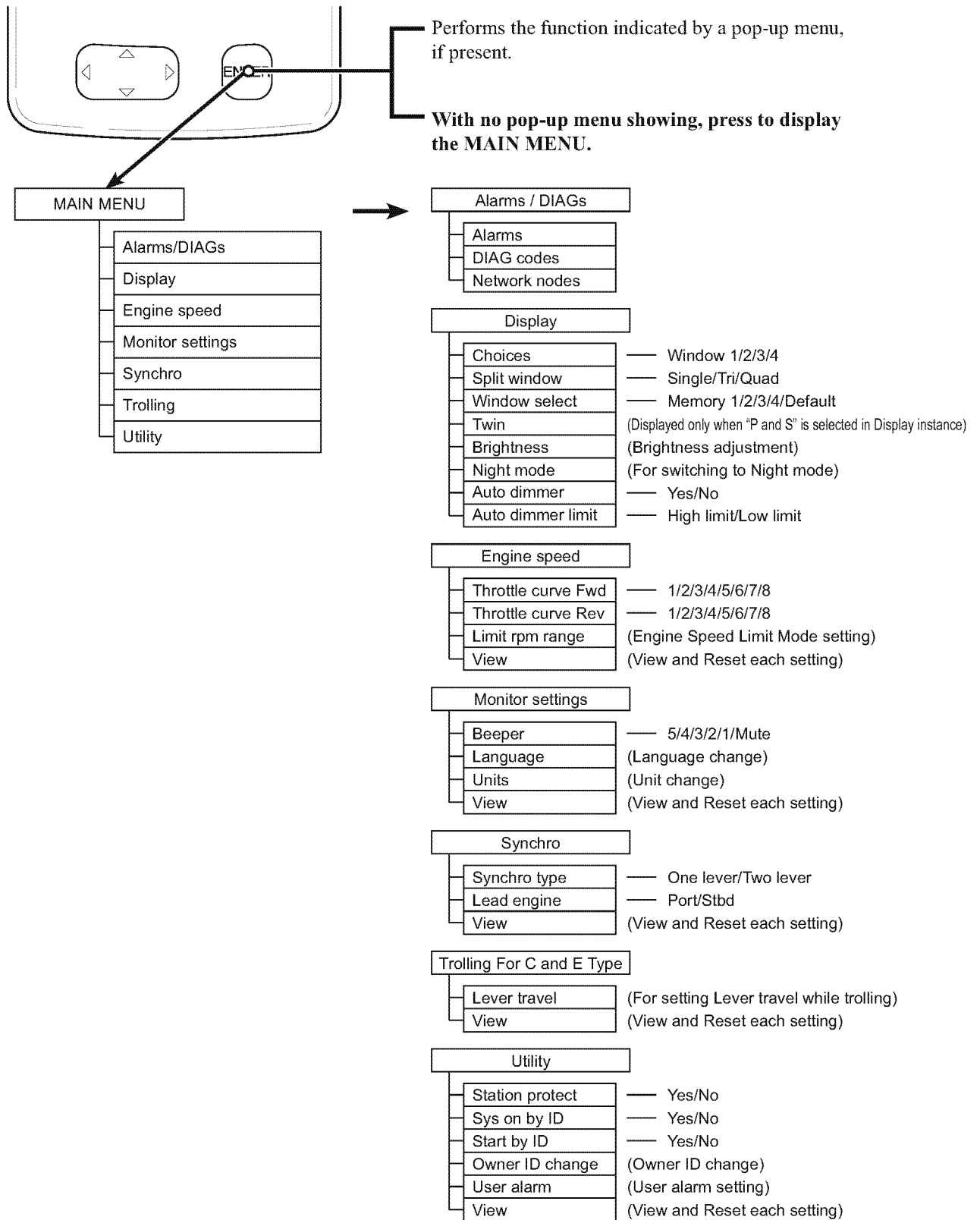


Figure 9

■ Display Menu Navigation

Owner ID Using (Normal Menu)



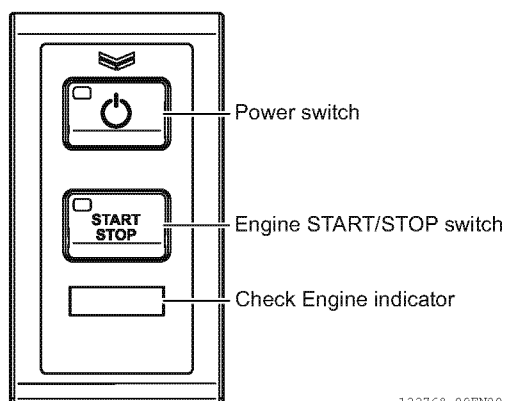
037533-01EN03

Figure 10

## ENGINE OPERATION

### ■ Switch Panel (to start and stop the engine)

The switch panel has the following functions.



**Figure 11**

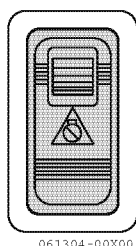
If this light illuminates, check the fault indication on the VC20 display.

#### **To start and stop the engine:**

Press the START/STOP switch.

### ■ Emergency Stop Switch (Option)

Use this switch only in an emergency to immediately stop the engine.



**Figure 12**

## NOTICE

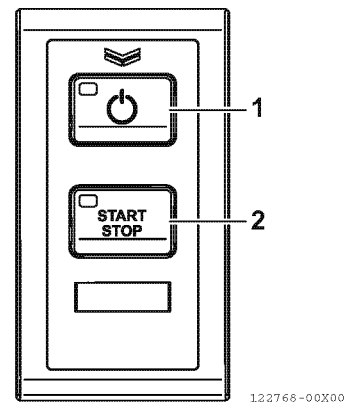
Under normal circumstances, do not use the Emergency stop switch to stop the engine. The engine shuts down suddenly when the Emergency stop switch is pressed. After the engine has stopped, press the Emergency stop switch to release the emergency stop.

## STARTING THE ENGINE (START UP)

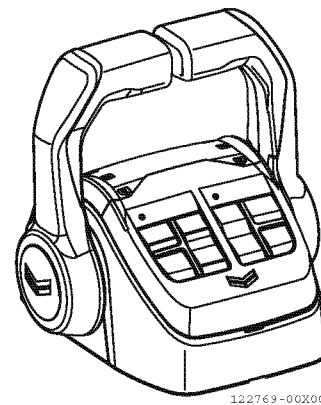
1. Open the seacock.
2. Open the fuel tank cock.
3. Turn the battery switch on for engine and VC20.
4. Press the Power switch on the switch panel of the selected station to turn the power ON (1, **Figure 13**).
  - The switch panel lamp will come on, and the control head (**Figure 14**) “SEL” lamp (**Figure 15**) will come on or flash.
5. If the “Sys on by ID” has been set, enter the password into the display.
6. (Only for multi-station)  
Press the control head “SEL” switch.
  - Wait until the display shows the engine data.
7. If the “Start by ID” has been set, enter the password into the display.
  - The “Start by ID” has been set, the engine can be started in 10 seconds after entering the password into the display.
8. Move the control head handle to the N (Neutral) position.
9. Press the Engine START/STOP switch (2, **Figure 13**) to power on the starter.
  - When the engine starts, the VC20 display will show the screen with engine conditions (**Figure 16**).

**Note:**

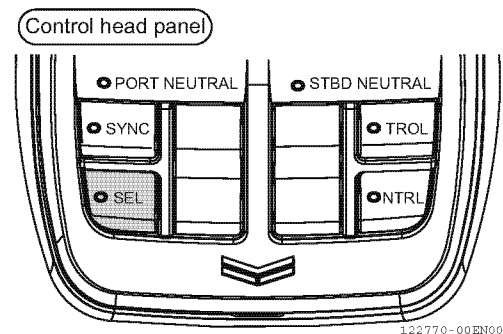
1. Concerning the control head “SEL” lamp.  
For Multi-Station: the “SEL” lamp will flash.  
For Single Station: the “SEL” lamp will come on.
2. Pressing the Engine START/STOP switch when the “SEL” lamp is flashing allows the station to be selected as the engine is started.
3. The engine will not start or stop if the Power switch is OFF. The Power switch must be ON at all times when the engine is running.
4. Do not press the engine START/STOP switch except for stopping the engine.



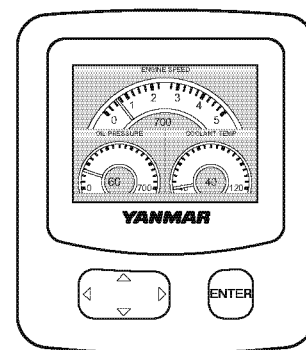
**Figure 13**



**Figure 14**



**Figure 15**



**Figure 16**

# ENGINE OPERATION

## Station Selection (only for multiple stations)

### ■ Engine not running (Control head in Neutral)

When first turning the panel switch to the "POWER ON" position, the "SEL" lamp will flash and the NEUTRAL lamp will light up. This is an indication that no specific helm station has been selected for boat operation.

By simply pressing the "SEL" switch at the station desired for operation, the flashing lamp will turn on continuously. This indicates control of the boat is now at this station location. If you choose to change helm locations while cruising, switch the station as described below.

### ■ Engine not running (Control head in Neutral)

To change stations when the engine is running but in Neutral position, do the following:

1. Press the control head "SEL" switch of the desired station (make sure control head is in Neutral position).
2. The "SEL" lamp will come on at the same time as the stations switch, enabling control of the selected station.

### ■ Engine running (Control head not in Neutral)

To change stations when the engine is running and not in Neutral position (so the boat is moving), do the following:

1. Press the control head "SEL" switch of the desired station.
2. The "SEL" lamp will flash and switch to standby mode for 5 seconds.
3. Stations will switch when the handle position (throttle and shift) of the desired station is the same as the handle position of the station current active station.
4. The "SEL" lamp will come on at the same time as the stations switch, enabling control of the selected station.

Note:

1. All lamps for stations that have not been selected will turn off.
2. If the handle is not aligned with the station to be selected during the idling period for 5 seconds, the lamps will turn off and the station to be selected will remain unusable.
3. For dual control heads, both handles must be aligned.
4. SD mode and trolling mode for the newly selected station will be applied to the selected station. Synchro-mode will not be applied.

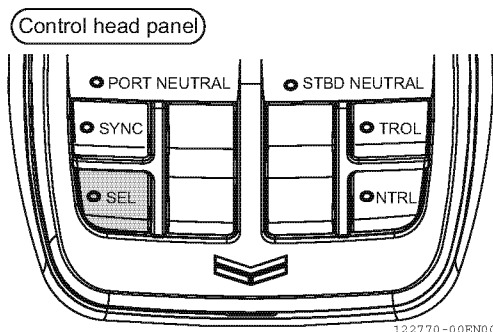


Figure 17



## Synchronization

*Note: Power train sync. and cruise sync. may be selected using the display.  
Be sure to set the lead engine on the display before using SYNC.*

### ■ Two lever sync. (Cruise sync.)

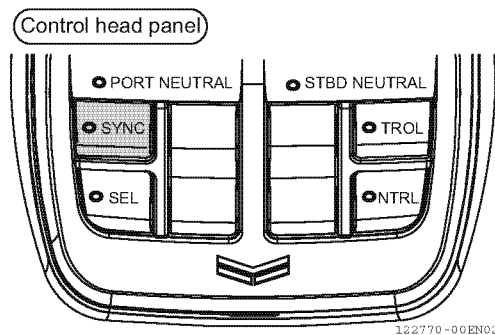
The engine speed synchronization is activated when the engine speed exceeds 1000 rpm and the control head handle is in proximity.

1. Press "SYNC" switch.
2. Match the control head handle positions within 10 % of each other. ("SYNC" lamp goes steady when handles match.)
3. When handles are moved within 10 % of each other and over 1000 rpm forward throttle, cruise sync. is engaged.
4. When handles are moved more than 10 % apart or under 1000 rpm forward throttle, cruise sync. is disengaged. ("SYNC" lamp flashes.)
5. To leave the sync. mode, return the handles to the Neutral position and press the "SYNC" switch.

### ■ One lever sync. (Power train sync.)

Automatically synchronizes engines and transmission. The engine handle controls throttle and shift of both engines across the entire control range.

1. Press "SYNC" switch.
2. Match the control head handle positions within 10 % of each other. ("SYNC" lamp goes steady when handles match.)
3. To leave the sync. mode, return the handles to the Neutral position and press "SYNC" switch.



**Figure 18**

## ENGINE OPERATION

VC20 has the following functions, which can be set in the Utility screen of MAIN MENU in the Digital Display. For more details, refer to the Vessel System Installation Manual.

### Station Protect

This function prevents operation from the other stations while steering.

- Select "YES" to enable "Station protect". The display and control head of other stations can no longer be operated.
- Select "NO" or turn off the system power to disable "Station protect".

### Sys on by ID, Start by ID

This is a function to check ID to prevent theft.

- If you select "YES" in "Sys on by ID", it is necessary to enter the Owner ID on the display when turning on the system power.  
If you select "YES" in "Start by ID", it is necessary to enter the owner ID on the display at engine start.
- The initial ID is "00000" and it can be changed with the "Owner ID change" below function.
- After entering the ID and verification, if you don't operate for 10 seconds, the entry becomes invalid and it is required to enter the Owner ID again.

### Owner ID Change

The ID used in "Sys on by ID" and "Start by ID" can be set and changed as follows.

- If you select "Owner ID change", the ID verification screen is displayed and you are asked to enter the current ID (Default: "00000").
- If you enter the wrong ID 5 times, the ID is locked and you are no longer able to make an input. The lock can be released by turning off the system power.
- ID can be changed to any 5 digit number from 00000 to 99999.
- Select the number from 0 to 9 with the ▲ ▼ buttons. The fixed number is displayed by an asterisk when you press the ► button and the next digit is highlighted.
- Press the [ENTER] button after highlighting it with the ► button when all 5 digits are entered and the new ID becomes valid.

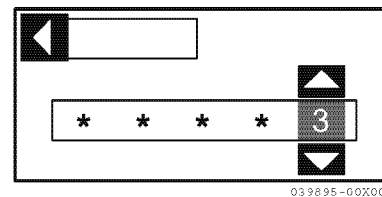


Figure 19

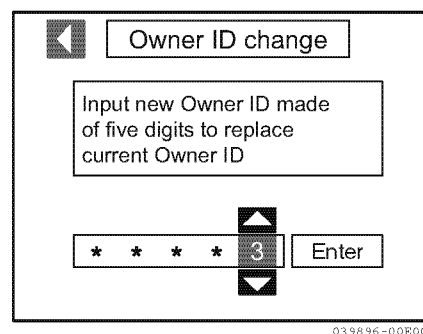


Figure 20

## If the Engine Fails to Start

Before pressing the Start switch again, confirm that the engine has stopped completely. If the starter motor is operated before the engine has completely stopped, the starter motor pinion gear will be damaged.

### NOTICE

Operate starter motor for Maximum 15 seconds continuously, then stop.

If the engine does not start the first time, wait at least 15 seconds before trying again.

### NOTICE

If the vessel is equipped with a water lift (water lock) muffler, excessive cranking could cause seawater to enter the cylinders and damage the engine. If the engine does not start after cranking 15 seconds, close the thru-hull water intake valve to avoid filling the muffler with water. Crank for 15 seconds or until the engine starts. When the engine does start, stop the engine immediately and press the stop switch. Be sure to re-open the seacock and restart the engine. Operate the engine normally.

## After the Engine has Started

After the engine has started, check the following items at a low engine speed:

1. Check that the indicators on the display and the control head are normal.
2. Check for water or oil leakage from the engine.
3. Check that exhaust gas color, engine vibrations, and sound are normal.
4. When there are no problems, keep the engine at low speed to send engine oil to all parts of the engine.
5. In case of dry exhaust line, check that sufficient seawater is discharged from the seawater outlet pipe. Operation with inadequate seawater discharge will damage the impeller of the seawater pump. If seawater discharge is too small, stop the engine immediately. Identify the cause and repair.
  - Is the seacock open?
  - Is the inlet of the seacock on the hull bottom clogged?
  - Is the seawater suction hose broken, or does the hose suck in air due to a loose joint?

- Check the engine seawater filter for sufficient flow, no leaking, no clogging

### NOTICE

Engine can be damaged if it is operated when seawater discharge is too small or if load is applied without any warming up operation.

## WARM UP MODE (SHIFT DISCONNECT)

1. Move the control head handle to the N (Neutral) position. (The NEUTRAL lamp will come on)
2. Press the "NTRL" switch of the selected station control head.
3. The NEUTRAL lamp will come on, and the NEUTRAL lamp will flash.
4. Move the Throttle Handle. The engine speed can be controlled while the gear shift is in neutral.
5. Move the control head handle to the N (Neutral) position, press the "NTRL" switch and cancel warm up mode.

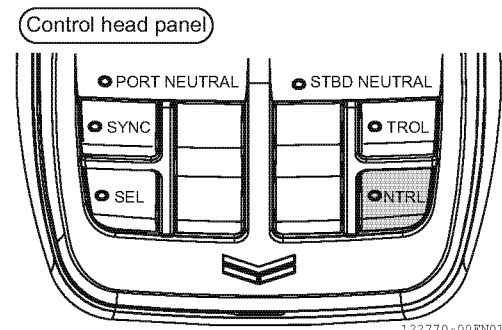


Figure 21

## THROTTLE AND SHIFT CONTROL

### **WARNING**

#### **SUDDEN MOVEMENT HAZARD**

The boat will start to move when the marine gear is engaged:

- Ensure the boat is clear of all obstacles forward and aft.
- Quickly shift to the FORWARD position then back to the NEUTRAL position.
- Observe whether the boat moves in the direction you expect.

### Neutral

1. Move the control head handle to the N (Neutral) position. (The NEUTRAL lamp will come on)
2. When switching between forward and reverse, move the handle slowly between the forward and reverse positions. Move the handle until you reach the Forward or Reverse idle detent position.

### Forward

Move the handle toward F (forward) to the forward-side notch position. The engine will remain idling. Moving the handle forward further will increase the engine speed.

### Reverse

Move the handle toward R (reverse) to the reverse-side notch position. The engine will remain idling. Pulling the handle back further will increase the engine speed.

### Forward to Reverse or Reverse to Forward

Moving the handle quickly and switching from forward to reverse or vice versa will activate the gear shift delay (astern delay). The engine speed will decrease to idle speed for several seconds.

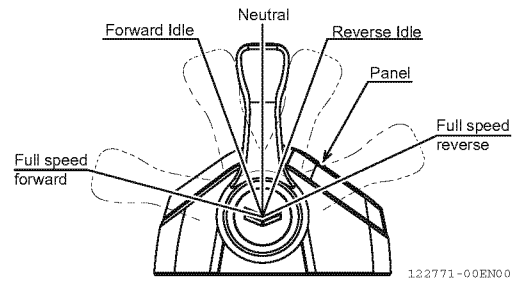


Figure 22

## ENGINE SPEED LIMIT MODE

1. Move the control head handle to the Forward Idle position. (Both sides in the case of twin engine.)
2. Press the "NTRL" switch of the selected station. (The lamp above "NTRL" switch will flash.)
3. Even if you tilt the handle to accelerate, the engine speed increases only up to the setting value.
4. Move the control head handle to the N (Neutral), Forward Idle, or Reverse Idle position (both sides in the case of twin engine) and press the "NTRL" switch to release the [Engine Speed Limit Mode].

*Note: Note: The setting value can be set by the VC20 display. The default value is 50 %.*

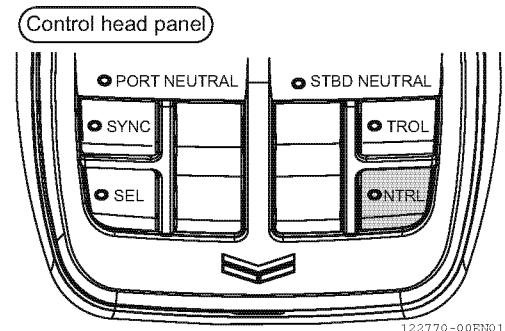


Figure 23

**CAUTIONS DURING OPERATION**

**NOTICE**

- Engine trouble can arise if the engine is operated for a long time under overloaded conditions with the control lever in the full throttle position (maximum engine speed position), exceeding the continuous rated output engine speed. Operate the engine at about 100 min<sup>-1</sup> (rpm) lower than the full throttle engine speed.
- If the engine is in the first 50 hours of operation, see *New Engine Break-In* on page 8.

Always be on the lookout for problems during engine operation.

Pay particular attention to the following:

1. Is sufficient seawater being discharged from the exhaust and seawater outlet pipe?  
If the discharge is small, stop the engine immediately; identify the cause and repair.
2. Is the exhaust color normal?  
The continuous emission of black exhaust smoke indicates engine overloading. This shortens the engine's life and should be avoided.
3. Are there abnormal vibrations or noise?

**NOTICE**

Excessive vibration may cause damage to the engine, marine gear, hull and onboard equipment. In addition, it causes noticeable passenger and crew discomfort.

Depending on the hull structure, engine and hull resonance may suddenly become great at a certain engine speed range, causing heavy vibrations. Avoid operation in this speed range. If you hear any abnormal sounds, stop the engine and inspect.

4. Alarm buzzer sounds during operation.

**NOTICE**

If any alarm indicator with audible alarm sound appears on the display during engine operation, stop the engine immediately. Determine the cause and repair the problem before you continue to operate the engine.

5. Is there water, oil, or fuel leakage, or are there any loose bolts? Check the engine room periodically for any problems.
6. Is there sufficient diesel fuel in the diesel fuel tank? Replenish diesel fuel before leaving the dock to avoid running out of fuel during operation.
7. When operating the engine at low speed for long periods of time, rev up the engine once every 2 hours as described below.

**NOTICE**

Revvng up the engine: With the gear in NEUTRAL, accelerate from the low speed position to the high speed position and repeat this process about 5 times. This is done to clean out carbon from the cylinders and the fuel injection valve. Neglecting to rev up the engine will result in poor exhaust color and reduce engine performance.

8. If possible, periodically operate the engine at near maximum rpm, while underway.

This will generate higher exhaust temperatures, which will help clean out hard carbon deposits, maintaining engine performance and prolonging the life of the engine.

**NOTICE**

Never turn off the battery switch (if equipped) or short the battery cables during operation. Damage to the electric system will result.

## SHUT-DOWN THE ENGINE (STOPPING)

Stop the engine in accordance with the following procedures:

### Normal Stopping

1. Move the control head handle to the N (Neutral) position. (The NEUTRAL lamp will come on.)
2. Cool the engine down at low speed (below 1000 min<sup>-1</sup> (rpm)) for about 5 minutes.

### NOTICE

For maximum engine life, YANMAR recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as the turbo-charger and exhaust system, to cool slightly before the engine itself is shut down.

3. Press the Engine START/STOP switch on the switch panel of the selected station.
4. Press the Power switch and turn the power OFF.

### CAUTION

**Do not press the Engine START/STOP switch when the engine is stopped. The engine will restart.**

**Do not turn the Battery switch OFF before turning the Power switch OFF.**

### NOTICE

After stopping the engine, do not forget to switch off power. Leaving on the power will drain the battery and heat up the alternator(s).

Wait 4 seconds or more before turning battery switch off for secure system settle down.

5. Turn the battery switch off for engine and VC20.
6. Close the fuel tank cock.
7. Close the seacock.

### CAUTION

- Be sure to close the seacock. Neglecting to close the seacock could allow water to leak into the boat and may cause it to sink.
- If seawater is left inside the engine, it may freeze and damage parts of the cooling system when the ambient temperature is below 0 °C (32 °F).



Figure 24

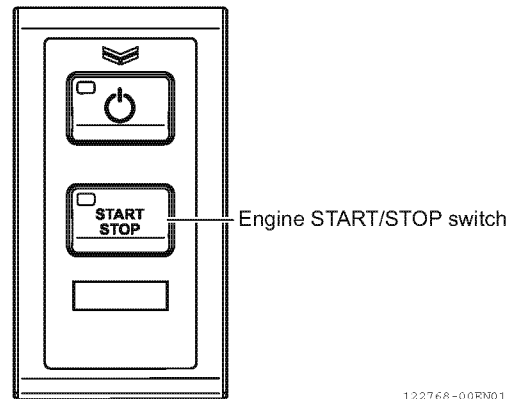


Figure 25

## Emergency Stop

### ■ Electric Emergency Stop

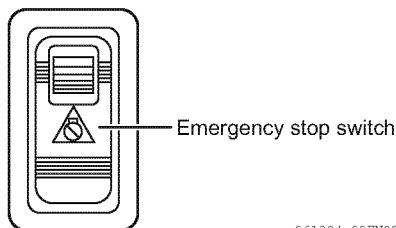
#### NOTICE

Never use the Emergency Stop switch for a normal engine shutdown. Use this switch only when stopping the engine suddenly in an emergency.

1. Pressing the Emergency Stop switch will stop the engine immediately.
2. The Emergency Stop screen will be shown on the display, and the buzzer will sound.
3. After the engine has stopped, press the Emergency Stop switch to release the emergency stop. After releasing, it may take sometime to restart.

Note:

1. *The Emergency Stop switch should only be used in emergencies. Use the Engine START/STOP switch to stop the engine normally.*
2. *The engine cannot be started while the Emergency Stop switch is pressed (emergency stop mode not canceled).*



061304-00EN00

Figure 26

## EMERGENCY OPERATION

There are two ways to operate the engine in an emergency.

- Backup Panel (VC20)
- Starter Coordinator (Installed near the engine)

#### NOTICE

- For failures regarding the control system, try “Backup Panel” first, and then “Starter Coordinator”.
- If the interface is failed, the Backup Panel (VC20) cannot be used.

The difference of the two operations are as below.

	Starter Coordinator	Backup Panel (VC20)
Engine start	○	○
Engine speed control	○	○
Shift	-*	○

- During the starter coordinator operation, use the backup panel (VC20) to shift.

# ENGINE OPERATION

## Control The Backup Panel

### ⚠ WARNING

Only use this in an emergency.

1. Pull out the protect cover.
2. Check that the power switch on the switch panel is OFF and that the control head handle and backup panel's shift switch are in the N (Neutral) position.
3. Press the power switch to the "ON" position on the backup panel. The lamp will come and control by the backup panel is enabled.
4. Adjust the engine speed using the sub throttle control knob. (counterclockwise: lower engine speed, clockwise: raise engine speed)  
When controlling the throttle, first move it fully counterclockwise.
5. The engine can be started or stopped with the START/STOP switch.
6. Shift gears using the shift switch. (FWD: forward, NTRL: neutral, REV: reverse)

### NOTICE

- The throttle and gear shift of the engine that has been turned on can be controlled.
- When controlling the throttle, always move it fully counterclockwise first.
- The error lamp will be on to indicate that sub throttle is active.
- Be sure to lower the engine speed by turning the sub throttle volume fully to counterclockwise before stopping the engine.

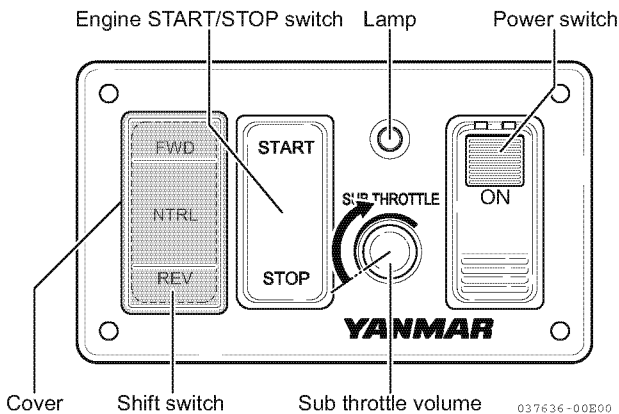


Figure 27

## Control The Starter Coordinator

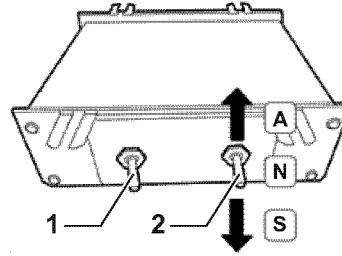


Figure 28

	Switch 1	Switch 2
A	Bridge	Start (Acceleration/ deceleration)
N	-	Neutral
S	Engine room	Stop

The starter coordinator is backup operation device directly connected to the YANMAR engine. It is installed near the engine, and two toggle switches on the body. It makes available to start/stop the engine, and also control the engine speed by operating the switches even in case of interface malfunction.

The operation by the starter coordinator is available when VC20 power is OFF.

During operation by the starter coordinator, use the YANMAR backup panel to shift. This is available even when VC20 power is OFF.

When VC20 power is ON, once the user turns switch [1] to "Engine room", VC20 display indicates "OPERATION FROM ENGINE ROOM", and the operation from VC20 become unavailable and only operation from the starter coordinator is active.

This situation will continue until rebooting the system.



## CHECKING THE ENGINE AFTER OPERATION

- Check that battery switch is turned to OFF.
- Fill the fuel tank.
- Close seacock(s).
- If there is a risk of freezing, check that the cooling system contains enough coolant. See the page 35.
- If there is a risk of freezing, drain the seawater system.
- Consult your dealer for measures matching the expected winter conditions in your area.

## REFILLING

Fluids and Lubricants	6LF series Recreational	6LF series Light Duty Commercial
Fuels (full compliance)	EN590, Bio B7, ASTM D975, ASTM D975-2 / F54, JIS KK 2204	
Fuels (compliance with limitation)	B10 (Bio), JP-5 / ASTM D975-1 /F-44, JP8, DMA, DMX, F75/F76, XTL acc. to EN 15940 (GTL, BTL, HVO, ...)	
Lubricating oil	SAE 15W-40, ACEA E5/E7, API CI-4	
Coolant	Organic ASTM D3306 type1 ASTM D6210 type1 Havoline Extended Life Antifreeze / Coolant, product code 7994	

- Engine coolant, standard solution: organic based, compliant with specification ASTM D6210 Type 1-FF. If a concentrated product is used, mix it 50% with water.

### NOTICE

- An inorganic based engine coolant can be used, compliant with specifications ASTM D6210 Type 1-FF, provided that the internal engine cooling circuit has been suitably washed beforehand. Wash the circuit with "fresh" water and a specific additive to facilitate removal of any residue before changing the fluid. If a concentrated product is used, mix it 50% with water.
- It is not permitted to mix different fluids, organic and inorganic based, as they are not miscible.

- If using an inorganic based engine coolant, the replacement interval must be brought forward to 1200 h or 2 years.

- Minimum engine oil specifications: compliant with specifications ACEA E7 e/o API CI-4. Viscosity grade: see the table on the page 63.
- The quantity indicated refers to the first refilling and concerns the engine, oil sump and filter
- Fuel compliant with standard EN 590 (Sulphur content less than 10 ppm) and/or ASTM D975 (Sulphur content less than 15 ppm).

## Low temperature diesel

EN 590 specifications distinguish different classes of diesel fuel, identifying the characteristics of those best suited to low temperatures.

It is entirely up to the Oil companies to comply with these regulations, which requires that fuels suited to the climatic and geographic conditions of the various Countries be distributed.

## Inverter

For the oil specifications and the quantities, refer to the Manufacturer's user manual.

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# INSPECTION AND MAINTENANCE

---

## INTRODUCTION

This section of the *Operation Manual* describes the procedures for proper care and maintenance of the engine.

## SAFETY PRECAUTIONS

Before performing any maintenance procedures within this section, read the following safety information and review the *Safety* section on page 3.

### WARNING

#### Crush Hazard



If the engine needs to be transported for repair, have a helper assist you attach it to a hoist and load it on a truck.

The engine lifting eyes are engineered to lift the weight of the marine engine only. Always use the engine lifting eyes when lifting the engine.

Additional equipment is necessary to lift the marine engine and marine gear together. Always use lifting equipment with sufficient capacity to lift the marine engine.

### WARNING

#### Welding Hazard

- Always turn off the battery switch (if equipped) or disconnect the negative battery cable and the leads to the alternator when welding on the equipment.
- Remove the engine control unit multi-pin connector. Connect the weld clamp to the component to be welded and as close as possible to the welding point.
- Never connect the weld clamp to the engine or in a manner which would allow current to pass through a mounting bracket.
- When welding is completed, reconnect the alternator and engine control unit prior to reconnecting the batteries.

#### Entanglement Hazard



Never leave the power switch on when you are servicing the engine. Someone may accidentally start the engine and not realize you are servicing it.

#### Shock Hazard



Always turn off the battery switch (if equipped) or disconnect the negative battery cable before servicing the equipment.

Always keep the electrical connectors and terminals clean. Check the electrical harnesses for cracks, abrasions, and damaged or corroded connectors.

## **⚠ WARNING**

Never use undersized wiring for the electrical system.

---

### **Tool Hazard**

Always remove any tools or shop rags used during maintenance from the area before operation.

## **NOTICE**

Any part which is found defective as a result of inspection, or any part whose measured value does not satisfy the standard or limit, must be replaced.

---

Modifications may impair the engine's safety and performance characteristics and shorten the engine's life. Any alterations to this engine may void its warranty. Be sure to use Yanmar genuine replacement parts.

---

## **PRECAUTIONS**

### **The Importance of Periodic Maintenance**

Engine deterioration and wear occur in proportion to the length of time the engine has been in service and the conditions the engine is subjected to during operation. Periodic maintenance prevents unexpected downtime, reduces the number of accidents due to poor machine performance and helps extend the life of the engine.

### **Performing Periodic Maintenance**

## **⚠ WARNING**

### **Exhaust Hazard.**

Never block windows, vents, or other means of ventilation if the engine is operating in an enclosed area. All internal combustion engines create carbon monoxide gas during operation. Accumulation of this gas within an enclosure could cause illness or even death. Make sure that all connections are tightened to specifications after repair is made to the exhaust system. Failure to comply could result in death or serious injury.

---

### **The Importance of Daily Checks**

The Periodic Maintenance Schedule assumes that the daily checks are performed on a regular basis. Make it a habit to perform daily checks before the start of each operating day.

### **Keep a Log of Engine Hours and Daily Checks**

Keep a log of the number of hours the engine is run each day and a log of the daily checks performed. Also note the date, type of repair (e.g., replaced alternator) and parts used for any service needed between the periodic maintenance intervals. Periodic maintenance intervals are every 150, 300, 600, 1000, 1200, 2400 and 3000 engine hours. Failure to perform periodic maintenance will shorten the life of the engine.

## **NOTICE**

Failure to perform periodic maintenance will shorten the life of the engine and may void the warranty.

### **Yanmar Replacement Parts**

Yanmar recommends that you use genuine Yanmar parts when replacement parts are needed. Genuine replacement parts help ensure long engine life.

### **Tools Required**

Before you start any periodic maintenance procedure, make sure you have the tools you need to perform all of the required tasks.

### **Consult Your Authorized Yanmar Marine Dealer or Distributor for Help**

Our professional service technicians have the expertise and skills to help you with any maintenance or service related procedures you need help with.

## Tightening Fasteners

Use the correct amount of torque when you tighten fasteners on the engine. Applying excessive torque may damage the fastener or component and not enough torque may cause a leak or component failure.

### NOTICE



The tightening torque in the Standard Torque Chart should be applied only to the bolts with a “8.8” head (JIS strength classification: 8.8). Apply 60% torque to bolts that are not listed. Apply 80% torque when tightened to aluminum alloy.

Bolt Diameter x Pitch (mm)		M6x1.0	M8x1.25	M10x1.5	M12x1.75	M14x1.5	M16x1.5
Tightening Torque	N·m	10.8 ± 1.0	25.5 ± 3.0	49 ± 5.0	88.2 ± 10.0	140.0 ± 10.0	230.0 ± 10.0
	ft-lb	8.0 ± 0.7	18.8 ± 2.2	36.2 ± 3.7	65.1 ± 7.4	103 ± 7.2	170 ± 7.2

Taper Plugs		1/8	1/4	3/8	1/2
Tightening Torque	N·m	9.8	19.6	29.4	58.8
	ft-lb	7.4	14.5	21.7	43.2

When lock adhesive is applied, decide separately.

Pipe Joint Bolts		M8	M10	M12	M14	M16
Tightening Torque	N·m	14.7 ± 2	22.5 ± 3	29.4 ± 5	44.1 ± 5	53.9 ± 5
	ft-lb	10.9 ± 1.5	16.6 ± 2.2	21.7 ± 3.7	32.6 ± 3.7	69.8 ± 3.7

When seal washer applied, torque is 34 ± 5 N·m (25.1 ± 3.7 ft-lb).

## EPA MAINTENANCE REQUIREMENTS

To maintain optimum engine performance and compliance with the Environmental Protection Agency (EPA) Regulations for Engines, it is essential that you follow the *Periodic Maintenance Schedule on page 41* and the *Maintenance Procedures on page 43*.

### EPA Requirements for USA and Other Applicable Countries

The EPA emission regulation is applicable only in the USA and other countries that have adopted the EPA requirements in part or in whole. Determine and follow the emission regulations in the country where your engine will be operating to assist you in specified compliance.

### Environmental Condition for operation and maintenance

The following environmental operating conditions and maintenance should be observed, in order to keep engine performance.

- Ambient temperature: -15°C to +40°C (5°F to +104°F)
- Relative humidity: 80% or lower

The diesel fuel should be:

- ASTM D975 No. 1-D S15, No. 2-D S15, or equivalent (minimum of cetane No. 45)

The lubricating oil should be:

- API Service Categories CD, CF, CF-4, CI and CI-4.

Be sure to perform inspections as outlined in *Maintenance Procedures on page 43* and keep a record of the results.

Pay particular attention to these important points:

- Replacing the engine oil
- Replacing the engine oil filter
- Replacing the fuel filter
- Cleaning the intake silencer (air cleaner)

*Inspections are divided into two sections in accordance with who is responsible for performing the inspection: the user or the maker.*

### Inspection and Maintenance

Inspection and maintenance procedures are covered in *Periodic Maintenance Schedule on page 41*.

This maintenance must be performed to keep the emission values of your engine in the standard values during the warranty period. The warranty period is determined by the age of the engine or the number of hours of operation.

## PERIODIC MAINTENANCE SCHEDULE

Daily and periodic maintenance is important to keep the engine in good operating condition. The following is a summary of maintenance items by periodic maintenance intervals. Periodic maintenance intervals vary depending on engine application, loads, diesel fuel and engine oil used and are hard to establish definitively. The following should be treated only as a general guideline.

### NOTICE

Establish a periodic maintenance plan according to the engine application and make sure to perform the required periodic maintenance at the intervals indicated. Failure to follow these guidelines will impair the engine's safety and performance characteristics, shorten the engine's life and may affect the warranty coverage on your engine. Consult authorized Yanmar Marine dealer or distributor for assistance.

Item	Periodic Maintenance Interval							
	Daily	Every 150 hours or monthly whichever comes first	Every 300 hours or 1 year which ever comes first	Every 600 hours or 1 year which ever comes first	Every 1000 hours or 2 years which ever comes first	Every 1200 hours or 2 years which ever comes first	Every 2400 hours or 4 years which ever comes first	Every 3000 hours or 5 years which ever comes first
Engine lubricant oil level check	○							
Engine coolant level check	○							
Drain the water from the pre-filters / filters								
Check integrity of the wiring, connectors, positive and negative poles of the power supply system and check their fastening		○						
Check the level of the electrolyte solution and clean the battery poles (positive-negative)		○						
Check the engine mount fastening torques		○						
Check the alignment of the engine with the propeller shaft		○						
Check the condition of the air filter Clean and replace if necessary			○					
Check anode wear; replace*4 if necessary			○					
Check the condition of the oil vapour recirculation filter; replace the filter if necessary			○					
Engine lubricant oil replacement*2			○					
Replace the engine oil filter*2			○					
Check the condition of the sea strainer at the seawater pump inlet Clean if necessary			○					
Check the state of wear of the seawater pump impeller Replace if necessary			○					
Fault memory reading via diagnostics tool			○					
Check the state of wear of the seawater pump impeller Replace if necessary			○					
Check the sections of the seawater cooling circuit pipes and clean if necessary			○					

# INSPECTION AND MAINTENANCE

Item	Periodic Maintenance Interval							
	Daily	Every 150 hours or monthly whichever comes first	Every 300 hours or 1 year whichever comes first	Every 600 hours or 1 year whichever comes first	Every 1000 hours or 2 years whichever comes first	Every 1200 hours or 2 years whichever comes first	Every 2400 hours or 4 years whichever comes first	Every 3000 hours or 5 years whichever comes first
Check seawater /engine oil heat exchanger, seawater / engine coolant heat exchanger and intercooler heat exchanger (air-seawater) Clean if necessary*5			○					
Turbocharger visual inspection			○					
Fuel pre-filter replacement*1				○				
Fuel filter replacement*1				○				
Check auxiliary belt (V belt) (alternator and engine cooling water pump)				○				
Check for signs of condensation inside the fuel tank Clean if necessary				○				
Change air filter					○			
Replace engine oil vapour filter					○			
Replace the seawater pump impeller				○ (or 5 years)				
Coolant replacement*3							○	
Replace auxiliary belt (V belt) (alternator and engine cooling water pump)						○		
Check integrity of damper pulley mounted on the crankshaft (front side)	2400 hours or 5 years whichever comes first							
Check valve clearance								○

- \*1 Fuel compliant with standard EN 590 (sulphur content less than 10 ppm) and/or ASTM D975 (sulphur content less than 15 ppm)
- \*2 Minimum specifications of engine oil: compliant with standard ACEA E7 and/or API CI-4. Degree of viscosity: see the table on the page 63.
- \*3 Engine coolant standard solution: organic base compliant with specifications ASTM D6210 Type 1-FF. If concentrated products are used, they must be mixed 50% with water. Original Petronas products are recommended
- \*4 The anode must be replaced if the corrosion has affected more than 50% of the volume of zinc.
- \*5 Seawater/comburent air heat exchanger: clean both the air and water section; seawater/engine coolant exchanger: clean the seawater section; if a seawater/ oil exchanger is present: clean the seawater section.



## REQUIREMENTS

### Guidelines

- Do not disconnect the batteries when the engine is running.
- Never carry out arc welding close to the engine without first removing the electrical cables.
- After performing any maintenance work that involves removing the battery/batteries, make sure that the terminals are securely connected to the poles.
- Do not use a battery charger to start the engine.
- Do not paint the equipment, components and electrical connectors fitted to the engine.
- Always disconnect the battery/batteries before carrying out any work on electrical devices.

### NOTICE

#### General prescriptions

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

## MAINTENANCE PROCEDURES

### Check oil level in engine

Proceed only with engine not running and at low temperature to avoid any risk of burns.

- Use the dipstick (**Figure 1, (1)**) to check that the oil level is between the "MIN" and "MAX" limits.
- If the level is too low, remove the relevant plug (**Figure 1, (2)**) and top-up through the filler inlet on the cylinder head observing the quantities indicated on the page 35.

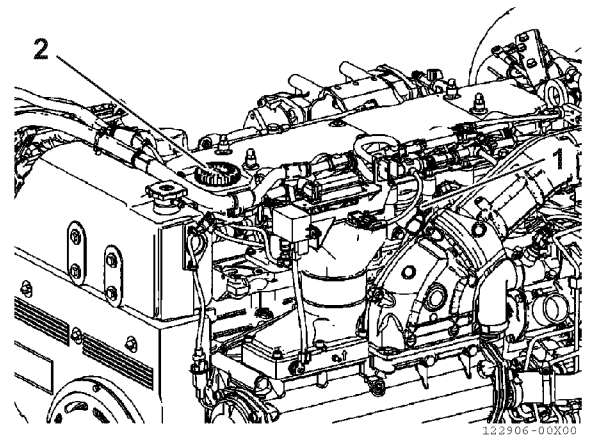


Figure 1

### NOTICE

#### General prescriptions

After refilling, make sure that the oil level does not exceed the "Max" limit indicated on the dipstick. Make sure that the oil dipstick is inserted correctly and that the oil refill filler neck plug has been tightened fully in a clockwise direction.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

### Check coolant level

Proceed only with engine not running and at low temperature to avoid any risk of burns.

- Remove the coolant filter cap of the tank.
- Visually check the coolant level.
- Top-up the tank if necessary according to the indications provided on the page 35.
- Make sure that when the engine is cold, the coolant level is a few centimetres below the coolant filter port.

#### **WARNING**

#### **RISK OF BURNS**

Open the filler cap of the coolant tank only if necessary and only when the engine is cold. Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

---

### Drain the Fuel Prefilter/ waterseparator

Drain the Fuel Prefilter/ waterseparator every 50 hours.

Replace the filter element at the same interval als the fine filter on the engine.

Component not supplied by YANMAR. Refer to the documentation provided by the Boatbuilder.

### Check integrity of wiring, connectors, positive and negative poles of the supply system and check their fixing

Check the integrity of the following parts of the wiring: corrugated cables, connectors and fastening points to the engine.

Check the connections relating to connectors-electrical components and the state of preservation of the positive and negative poles of the power cables.

If any oxidation is present, clean the surfaces of the poles (+/-) and the relative cable terminals. Protect them with grease - protective lubricant for electrical contacts.

### Check the level of the electrolytic solution in the batteries / Check and clean the terminals

Proceed after positioning the batteries on a horizontal surface.

- Visually check that the level lies between the "Min" and "Max" limits; in the absence of any reference marks, make sure the liquid covers the lead plates contained in the elements by approx. 5 mm.
- When required, only use distilled water to top up the elements whose level is below the minimum.
- If the battery needs to be recharged, contact a specialised workshop.
- Diagnose the state of efficiency of the battery charging system if a voltage level of less than 11 V (for nominal 12 V systems) or 22 V (for nominal 24 V systems) is detected while the engine is rotating.
- Check that the terminals and clamps are clean, well tightened and protected by petroleum jelly. Some batteries have a single cover for the inspection plugs.

#### **WARNING**

#### **RISK OF DAMAGE**

The batteries contain sulphuric acid which is highly caustic and corrosive. Always wear gloves and protective glasses while topping up. If possible, ensure that the check is carried out by specialised personnel. Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

---

#### **WARNING**

#### **RISK OF INJURY**

During the checks do not smoke or allow naked flames near the batteries. Ensure that the work area is suitably ventilated. Failure to comply with these prescriptions can result in the risk of serious injury.

---

## Check integrity of charge air and coolant system

Visually check that the exhaust system is not blocked or damaged. Make sure that there is no risk of any dangerous fumes inside the boat. Contact the Ship Yard if necessary.

Check there is no sign of any leaks on the external surface of the individual components.

Check that the hose clamps (**Figure 2, (1)**) are tightened. Visually check that the charge air system is not blocked or damaged.

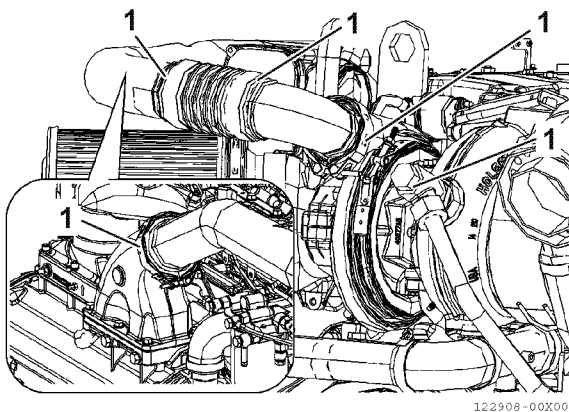


Figure 2

## Check tightening torque of engine mount

Check that all the fastening screws of the engine mounts are tightened to the specified torque.

## Check the alignment of the engine with the propeller shaft of the vessel

Refer to the technical specifications relating to refitting as indicated in the boatbuilder documentation.

## Check of air filter and cleanliness of housing

Open the collar (**Figure 3, (2)**) as indicated in the figure. Remove the air filter body (**Figure 3, (1)**).

Use Dehumidified compressed air to blow debris from filter by working from the inside of the filter out. Never blow air into the filter from the outside.

Do not use detergents; do not use diesel. Replace the filter in the event of rupture or lacerations.

Correctly position the filter (**Figure 3, (1)**) in its seat and secure it with the collar (**Figure 3, (2)**).

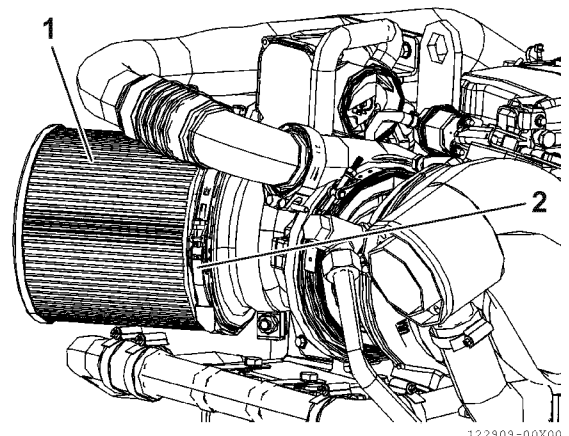


Figure 3

## Check the state of corrosion of the zinc anodes

### NOTICE

Only proceed when the engine is off and at a low temperature.

1. Remove the zinc anode (**Figure 4, (2)**) by unscrewing it from the seawater / air heat exchanger (**Figure 4, (1)**).

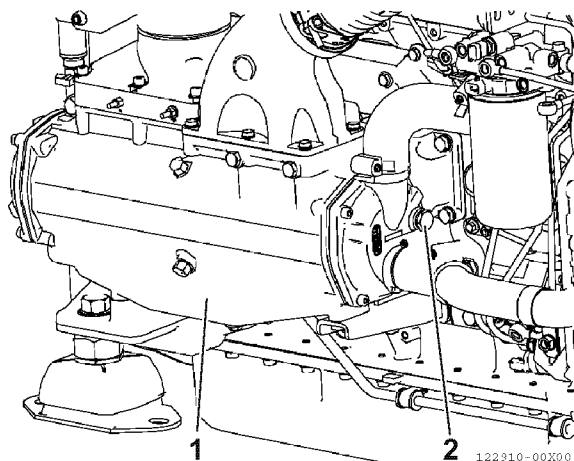


Figure 4

### NOTICE

Use a container to collect the liquid.

2. Check the level of corrosion of the zinc anode (**Figure 4, (2)**); if the corrosion exceeds 50% of the volume, replace it.  
Insert the zinc anode (**Figure 4, (2)**) into the seawater / air heat exchanger (**Figure 4, (1)**) and tighten it to a torque of 30 +/- 3 N·m.

3. Repeat the procedure for the anodes (**Figure 5, (4)**) and (**Figure 5, (5)**) located close to the seawater / oil heat exchanger (**Figure 5, (3)**).

- Tighten the anode (**Figure 5, (4)**) to the specified torque: 25 N·m.
- Tighten the anode (**Figure 5, (5)**) to the specified torque: 30 +/- 3 N·m.

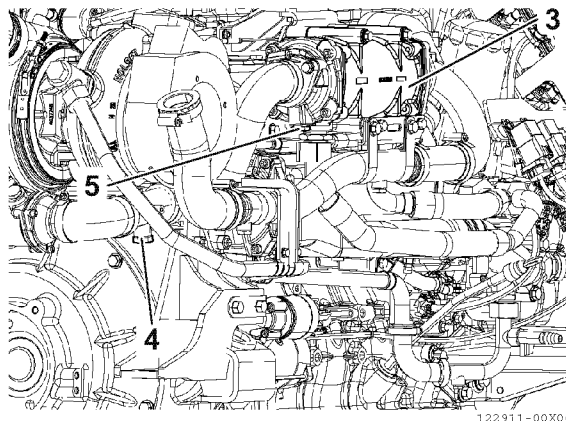


Figure 5

## Check condition of oil vapour recirculation filter

### NOTICE

Only proceed when the engine is off and at a low temperature.

1. Loosen the screws (**Figure 6, (1)**) and remove the filter housing cover (**Figure 6, (2)**).
2. Remove the two filters and check there are no deposits. If any deposits are present, replace the filter.
3. Refit the cover in its seat.

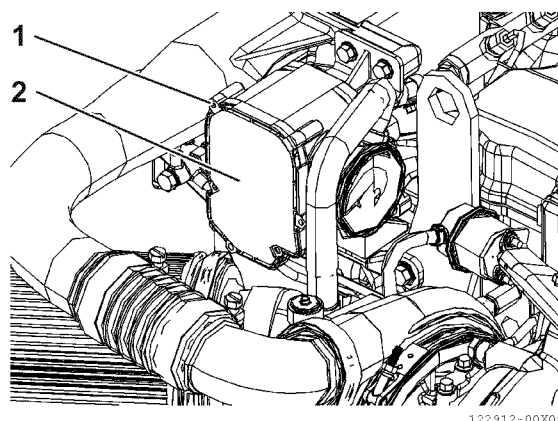


Figure 6

## Change engine lubricant oil

### NOTICE

Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

- Place a container under the hand pump (**Figure 7, (3)**) at the outlet pipe (**Figure 7, (2)**) to collect the spent oil.
- Open the extraction cock by setting the lever (**Figure 7, (1)**) to the vertical position.
- Loosen the oil filler plug (**Figure 7, (4)**) and act on the hand pump (**Figure 7, (3)**) required to extract the oil until the oil sump is completely empty.
- Refill with oil through the filler on the cover. Refer to the table entitled REFILLING (P 35) for the correct type of oil. Tighten the cap.
- Using the dipstick (**Figure 7, (4)**), check that the oil level is between the "Min" and "Max" levels.
- Close the cock by lifting the lever (**Figure 7, (1)**) to the horizontal position.

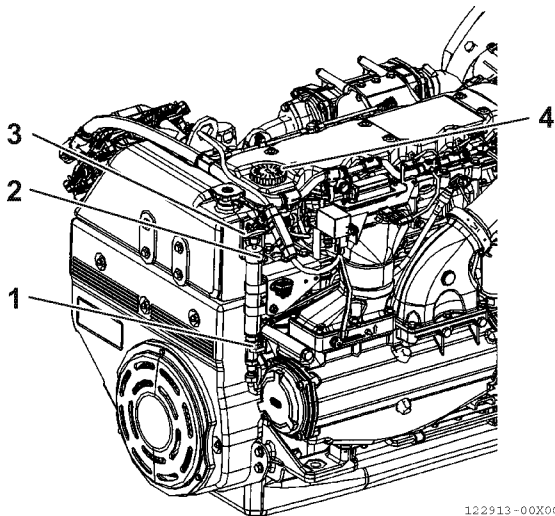


Figure 7

### ⚠ WARNING

#### RISK OF INJURY

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law. The workshops of the Service Network are equipped for this purpose. Correct behavior will ensure that vessel is used as environmentally friendly as possible.

### NOTICE

#### General prescriptions

After refilling, make sure that the oil level does not exceed the "Max" limit indicated on the dipstick. Make sure that the oil dipstick is inserted correctly and that the oil refill filler neck plug has been tightened fully in a clockwise direction.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

#### Replace engine oil filter

Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

Only use original Yanmar filters specified for this engine type.

- Place a container under the filter support (**Figure 8, (1)**), to collect the spent oil.
- Loosen the filter and remove it.
- Carefully clean the surfaces of the support that are in contact with the filter sealing gasket.
- Moisten the new filter gasket with a thin layer of oil.
- Manually tighten the new filter in position until the seal ring is in contact with the support, then tighten by a further 3/4 of a turn.
- Dispose of the old filter according to legislation in force.

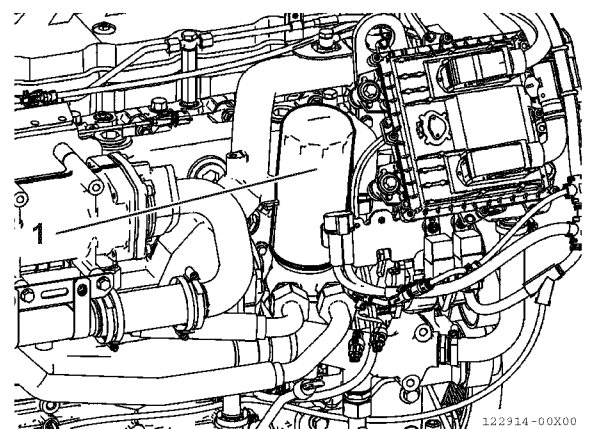


Figure 8

## **⚠ WARNING**

### **RISK OF INJURY**

Given the high operating temperature of the engine, it is recommended that suitable protection is worn. The engine oil reaches extremely high temperatures: always wear protective gloves.

Failure to comply with these prescriptions can result in the risk of serious injury.

### **GENERAL RISK**

Eliminate the consumables and any materials in contact with them (for example, filters) in accordance with current regulations. The workshops of the Service Network are equipped for this purpose.

Correct behavior will ensure that vessel is used as environmentally friendly as possible.

## **NOTICE**

### **General prescriptions**

The engine oil is highly pollutant and harmful. In case of contact with the skin, wash thoroughly with soap and water. Protect skin and eyes appropriately; work in accordance with accident prevention regulations. Dispose of the residue in full compliance with legal regulations.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

For correct engine operation, only use recommended oils or oils with the required characteristics. In the case of refilling, do not mix oils with different characteristics. Failure to observe these indications will void the guarantee.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

## **MARINISATION - CHECK**

### **Check the filter at the seawater pump inlet (replace if necessary)**

Refer to the technical documentation for installing the engine on the boat.

### **Fault memory reading via diagnostics tool**

Take a fault memory reading using the diagnostics tool.

### **Check the state of wear of the seawater pump impeller (replace if necessary)**

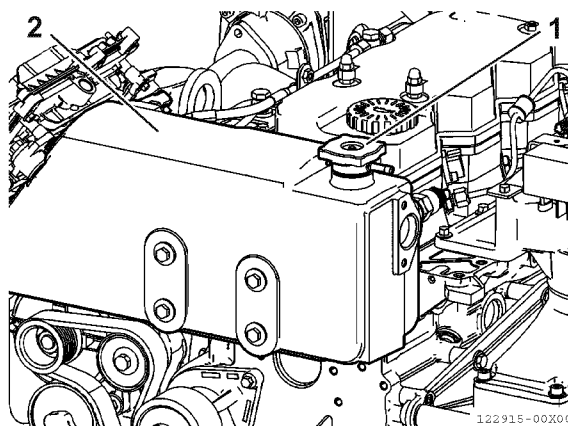
Remove the pump as described in the seawater pump replacement procedure and check the state of wear of the impeller.

### **Check seawater cooling circuit pipes (clean if necessary)**

Inspect the pipes ensuring that there are no deposits.

### **Check the exchangers (clean if necessary)**

1. Empty the main circuit of the water system.
2. Open the expansion tank (Figure 9, (2)) coolant filter cap (Figure 9, (1)).



**Figure 9**

- Unscrew the plug (Figure 10, (1)) or disconnect the cab heater pipe (Figure 10, (2)). During assembly, tighten the plug to the specified torque.

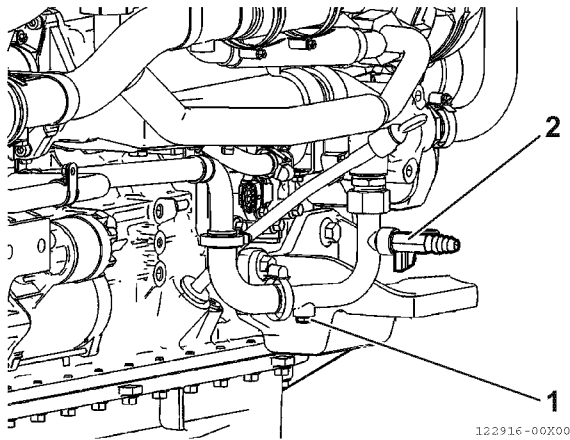


Figure 10

Tightening torque	
Water drainage plug M10 X 1.25	10 ± 1 N·m

- Open the drain cock (Figure 11, (1)).

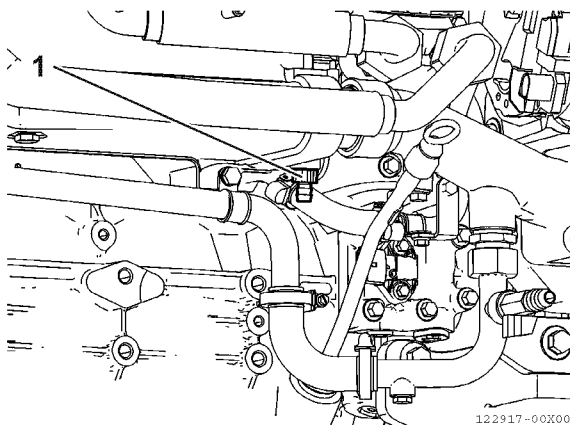


Figure 11

- Remove the plug (Figure 12, (1)) and, during assembly, tighten it to the specified torque.

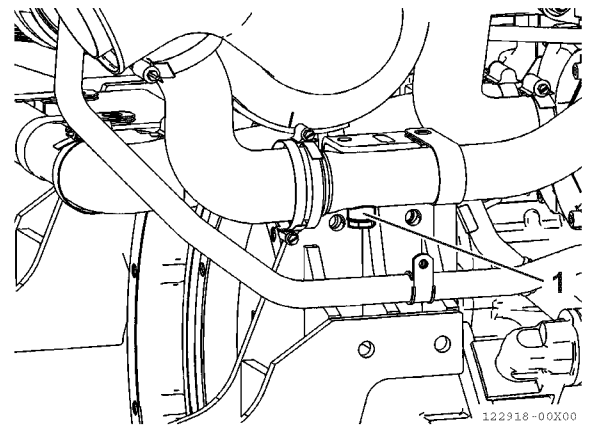


Figure 12

Tightening torque	
Water drainage plug M14 X 1.5	25 N·m

- Loosen the clamp screws (Figure 13, (1)) and remove the sleeve (Figure 13, (2)).

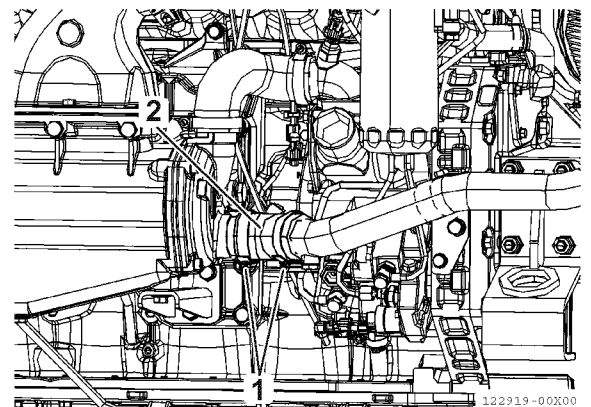
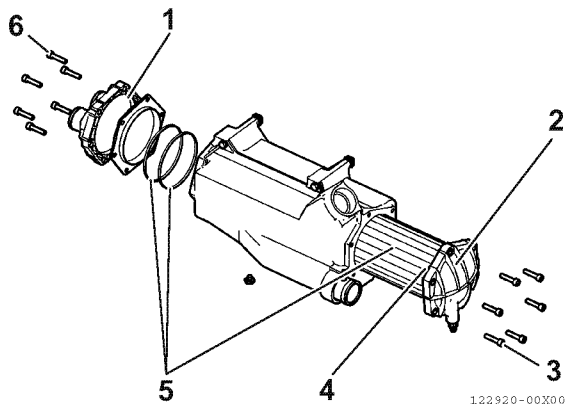


Figure 13

## Coolant/seawater heat exchanger



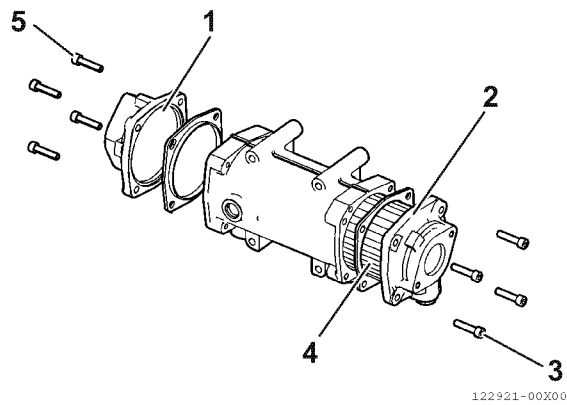
**Figure 14**

1. Drain the coolant circuit and the seawater circuit.
2. Remove the components which prevent access to the coolant - seawater heat exchanger.
3. Remove the coolant - seawater heat exchanger.
4. Remove the covers (**Figure 14, (1)**) and (**Figure 14, (2)**) at the bench or in a suitable place.
5. Extract the tube bundle (**Figure 14, (4)**).
6. Clean the parts with soapy water. Do not use aggressive solutions.
7. Clean the shell and tube with low pressure steam and water.
8. Blow compressed air to dry the parts before refitting the heat exchanger parts.
9. Do not use aggressive detergents for copper, brass, aluminium and tin.
10. Replace all the gaskets (**Figure 14, (5)**) during assembly.
11. Tighten the screws (**Figure 14, (3)**) and (**Figure 14, (6)**) to the specified torque.

Tightening torque	
Coolant/seawater heat exchanger screws	16.5 ± 1.5 N·m

- Refit the heat exchanger to the engine. Complete assembly of the remaining components following the operations indicated above but in the reverse order, ensuring that the screws are tightened to the specified torque.

## Seawater/oil heat exchanger



**Figure 15**

1. Refill the engine coolant circuit through the expansion tank plug.
2. Drain the lubrication system and the cooling water system for the seawater circuit.
3. Remove the components which prevent access to the engine oil - seawater heat exchanger.
4. Remove the engine oil - seawater heat exchanger.
5. Remove the covers (**Figure 15, (1)**) and (**Figure 15, (2)**) at the bench or in a suitable place.
6. Extract the tube bundle (**Figure 15, (4)**).
7. Clean the parts with soapy water. Do not use aggressive solutions.
8. Clean the shell and tube with low pressure steam and water.
9. Blow compressed air to dry the parts before refitting the heat exchanger.
10. Do not use aggressive detergents for copper, brass, aluminium and tin.
11. Replace all the gaskets during assembly.
12. Tighten the fastening screws (**Figure 15, (3)**) and (**Figure 15, (5)**) to the prescribed torque.

Tightening torque	
Seawater/oil heat exchanger screws	16.5 ± 1.5 N·m

- Refit the heat exchanger to the engine. Complete assembly of the remaining components following the operations indicated above but in the reverse order, ensuring that the screws are tightened to the specified torque.



## Intercooler exchanger (air/seawater)

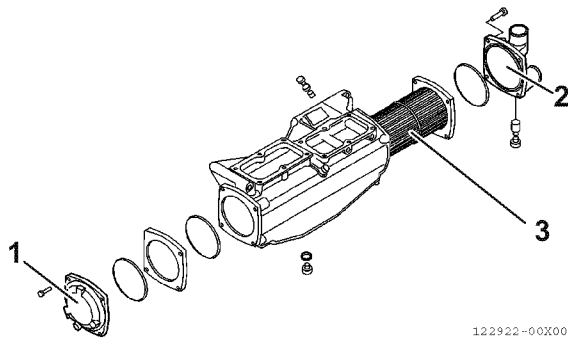


Figure 16

1. Drain the seawater circuit system.
2. Remove the components which prevent access to the coolant - seawater heat exchanger.
3. Remove the heat exchanger from the engine.
4. Remove the covers (**Figure 16, (1)**) and (**Figure 16, (2)**) at the bench or in a suitable place.
5. Extract the tube bundle (**Figure 16, (3)**).
6. Clean the parts with soapy water. Do not use aggressive solutions.
7. Clean the shell and tube with low pressure steam and water.
8. Blow compressed air to dry the parts before refitting the heat exchanger.
9. Do not use aggressive detergents for copper, brass, aluminium and tin.
10. Replace all the gaskets during assembly.
11. Complete assembly of the remaining components following the operations indicated above but in the reverse order, ensuring that the screws are tightened to the specified torque.

Tightening torque	
Air/seawater heat exchanger screws	18 N·m

12. Refill the engine coolant circuit through the coolant filler cap and check and top up level in subtank.

- Start the engine and let it run for a few minutes;

Switch off the engine and wait for a few minutes before checking the engine coolant level through the coolant filler cap and in subtank.

Top up the system if necessary.

## Visually inspect turbocharger

- Apply manual torque on shaft to verify free rotation and catch any sticking effect.
- Verify possible wear patterns of compressor housing.
- Verify visual integrity of the wheels.
- Check integrity of wastegate actuator lever to detect sticking due to rust or mechanical damage.
- At cold condition
  1. Removing mixing elbow.
  2. Check waste gate valve should be close.

## Fuel filter change

To avoid the risk of burns, only do this with the engine switched off and at a low temperature:

- Remove the filter by unscrewing it.
- Check that the new filter has performance levels that satisfy the needs of the engine (e.g. by comparing them with the old one. See the page 37).
- Moisten the new filter seal with diesel or engine oil.
- Manually tighten the new filter in position until the seal ring is in contact with the support, then tighten by a further 3/4 of a turn.

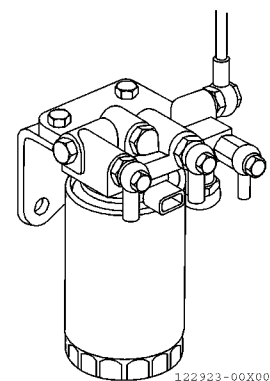


Figure 17

## ⚠ WARNING

### RISK OF INJURY

During this operation, do not smoke or use naked flames.

Do not breathe in vapours from the filter. Pay close attention to the electric fuel reheater (if fitted) and the relative electrical connections. Failure to comply with these prescriptions can result in the risk of serious injury.

## ⚠ WARNING

### GENERAL PRECAUTIONS

Make sure that the fuel coming from the bleed plug or drain screw does not dirty the transmission belt of the auxiliary organs and do not dispose of it in the environment. Never loosen the common rail and high pressure fuel pipe connectors.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

Do not fill the new fuel filter until it has been positioned on the support, to prevent any damaging impurities from entering the fuel circuit and injection system.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

## NOTICE

### General prescriptions

Dispose of consumable materials and the parts in contact with them (for example filters) in accordance with the law. The workshops of the Service Network are equipped for this purpose.

Correct behavior will ensure that vessel is used as environmentally friendly as possible.

### Replacement of fuel pre-filter

Component not supplied by YANMAR. Refer to the documentation provided by the boatbuilder.

### Check drive belt

Only proceed with the engine stopped and at a low temperature, so as to avoid the risk of burning.

- Remove the belt protection cover.
- Check that the pulleys are not cracked or worn and that there is no trace of lubricant or fuel. Otherwise, replace it.
- At the same time, make sure that the tensioning device (**Figure 18, (1)**) is working properly, proceeding as indicated in the figure.
- Reposition the protection cover in its seat and lock all the tightening elements.

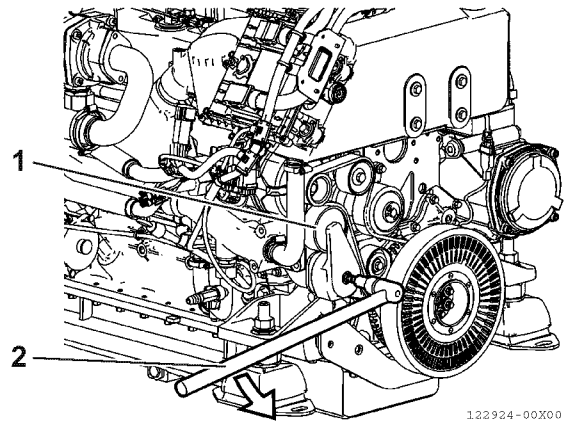


Figure 18

### Draining condensate from the fuel tank

If possible, visually inspect the inside of the tank through the top filler; if this is not possible, take a sample of the fuel from the bottom of the tank to check if any water and debris in fuel is present.

Refer to the indications in the documentation provided by the shipyard-bodybuilder.

## Replace the seawater pump impeller

- After having accessed the impeller, remove the rear cover (Figure 19, (1)).
- Insert a screw (Figure 19, (2)) M16 X 1.5 into the impeller shaft.
- Remove the rotor by slowly loosening the screw (Figure 19, (2)).

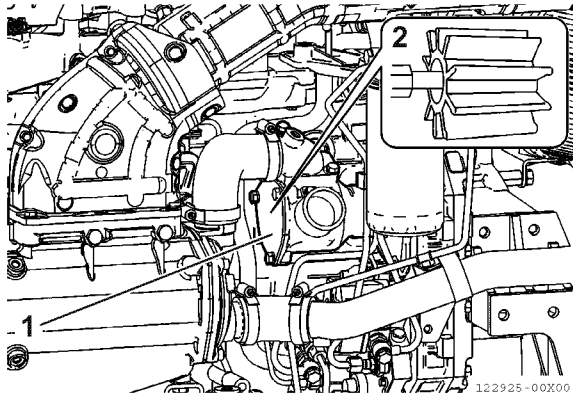


Figure 19

- Check the state of wear of the rubber impeller; replace the impeller if they are broken or show excessive signs of wear.
- Only insert the impeller with silicon lubricant or soapy water.
- In order to insert correctly, do not exert too much force on the impeller.
- If the impeller damage is large, please check and clean the missing bits inside of cover of heat exchanger.

## Coolant change

Only proceed when the engine is not running and is at low temperature in order to avoid the risk of burns.

- Use suitable containers to ensure that the coolant is not dispersed into the environment.
- Remove the plugs of the circuit components and wait until the circuit has emptied completely (the position of the plugs is indicated on the page 11). After emptying, refit the plugs in their housings, ensuring that the sealing rings are intact.
- Refill the circuit completely as indicated in the table on the page 35.
- Bleed the circuit and top-up if necessary.

### **WARNING**

#### **RISK OF INJURY**

When the engine is hot, the pressure inside the cooling circuit can be such that it may expel the hot liquid in an extremely violent manner with the risk of burns. Only open the refill plug of the coolant tank when the engine is cold. Failure to comply with these prescriptions can result in the risk of serious injury.

### **NOTICE**

#### **General prescriptions**

The failure to observe the aforesaid procedure does not guarantee the presence of the correct quantity of coolant in the engine.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

## Change auxiliary belt

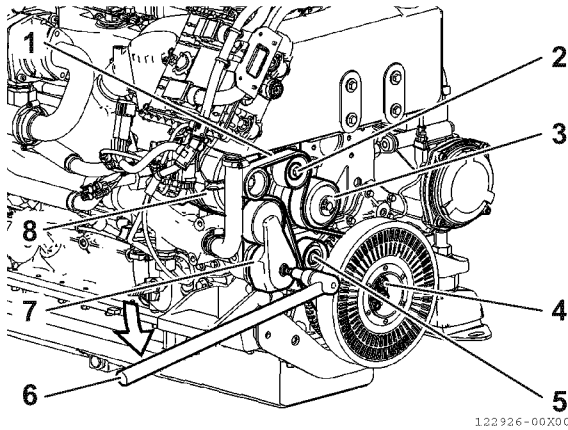


Figure 20

1. Remove the belt protection cover.
2. Remove the belt (Figure 20, (1)) acting on the automatic belt tensioner (Figure 20, (7)) using the designated tool (Figure 20, (6)) from the alternator (Figure 20, (8)), water pump (Figure 20, (3)), pulleys (Figure 20, (2)) and (Figure 20, (5)), crankshaft pulley (Figure 20, (4)).
3. Replace the worn belt with new one.
4. Place the auxiliary unit belt on the pulley and guide roller.
5. Use the designated tool (Figure 20, (6)) on the automatic belt tensioner (Figure 20, (7)) to fit the new belt in operating position.
6. Further adjustments are not required. The belt tension is adjusted automatically by the calibrated spring in the automatic belt tensioner (Figure 20, (7)).
7. Operate the engine for several hours and check that the belt is correctly positioned.

### **WARNING**

#### **RISK OF INJURY**

When the engine is off, but still hot, the belt may start to move without warning. Wait for the engine temperature to decrease to prevent serious danger of an accident.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

### **NOTICE**

#### **General prescriptions**

Replace the belt if there are any signs of abrasions, cracks, lacerations, oil or fuel stains.

Failure to comply completely or partially with these requirements may result in the risk of serious damage to the engine and may even, on occasion, invalidate the warranty.

#### **Check integrity of damper flywheel**

1. Unscrew the nuts (Figure 21, (1)), (Figure 21, (2)) and remove the front guard (Figure 21, (3)).  
Check that the surfaces of the damper flywheel do not show any sign of damage or rupture. If the damper is damaged, replace it.

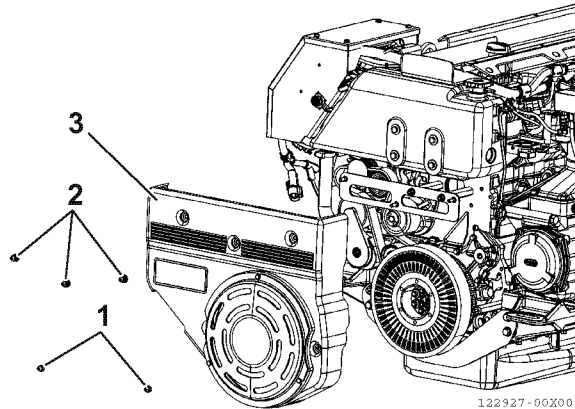
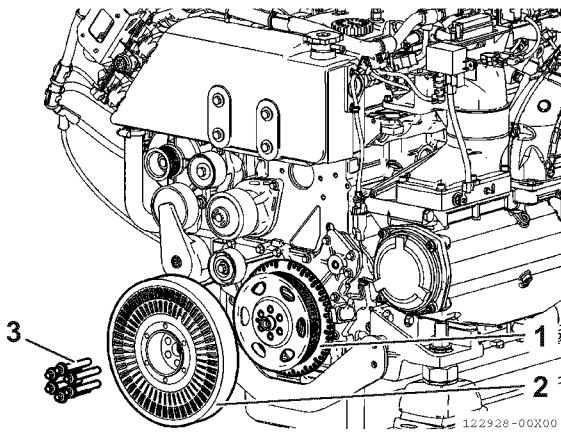


Figure 21

2. Unscrew the screws (Figure 22, (3)) and remove the damper flywheel (Figure 22, (2)) from the pulley (Figure 22, (1)).  
The engine flywheel locking tool can make it easier to remove the damper flywheel (Figure 22, (2)) fitted on the pulley (Figure 22, (1)).  
Replace the damper flywheel (Figure 22, (2)) with a new one.  
Screw in the fastening screws (Figure 22, (3)) and tighten them to the specified torque.

#### **Tightening torque**

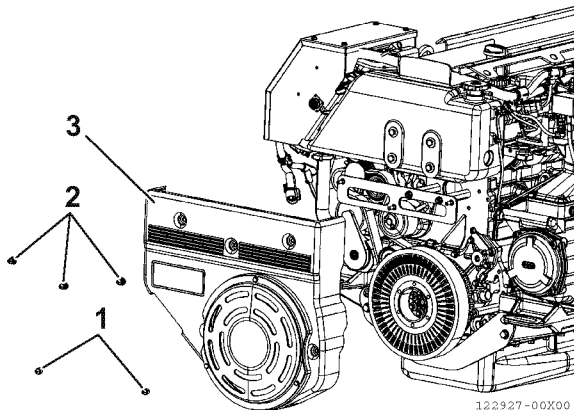
Damper flywheel (6 screws M12 X 1.25 X 78.5) (Figure 22, (3))	1. Pretightening with the torque wrench $50 \pm 5 \text{ N}\cdot\text{m}$ 2. Tightening to angle $90^\circ$
---	--



**Figure 22**

3. Correctly position the cover (Figure 23, (3)) and tighten the nuts (Figure 23, (1)), (Figure 23, (2)) to the specified torque.

Tightening torque	
Belt protection cover (2 nuts M8 X 1.25) (Figure 23, (1))	21 ± 2 N·m
Belt protection cover (3 nuts M8 X 1.25) (Figure 23, (2))	30 ± 3 N·m

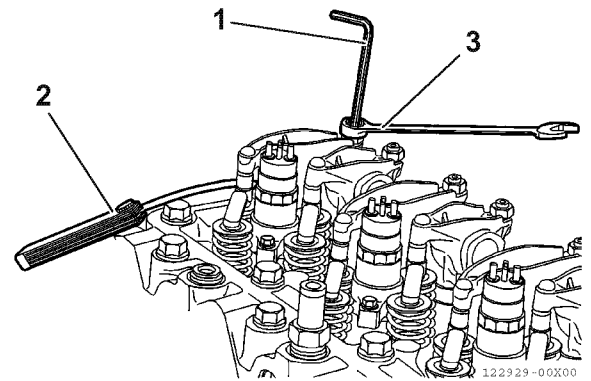


**Figure 23**

## Check lifter clearances and adjust if necessary

1. Bring the piston of the cylinder whose clearance needs to be adjusted to the TDC. The valves of this cylinder will be closed.
2. Adjusting the clearance between the rocker arms and the exhaust and intake valve control push-rods must be carried out strictly using an allen key wrench (Figure 24, (1)), feeler gauge (Figure 24, (2)) and ring spanner (Figure 24, (3)).

Valve clearance adjustment	
Intake	0.25 ± 0.05 mm
Exhaust	0.51 ± 0.05 mm



**Figure 24**

3. After adjustment, lock the nut securing the adjustment screw.

Tightening torque	
Rocker arm adjustment nut (12 nuts M8 X 1.25)	24 ± 4 N·m

## Moving the engine

- Operations for loading and unloading the engine onto/off the boat are the full responsibility of personnel from the Technical Service Network.
- When lifting the engine, only use the eyelets indicated on the engine by the designated labels.
- The engine is to be lifted using a beam that keeps the metal ropes supporting the engine parallel, using all the eyelets at the same time. It is not permitted to lift the engine using just one eyelet.
- The system used to lift the engine must be suitable for the weight and dimensions of the engine itself. make sure there is no interference between the hoisting system and the engine components.

## Disposal of waste

The engine is composed of parts and elements that, if discarded, could cause environmental damage.

The materials listed below must be handed over to specialised Collection Centres; the laws in force in the various countries provide for severe penalties for lawbreakers:.

- Starter batteries.
- Used lubricants.
- Mixtures of water and antifreeze.
- Filters.
- Additional cleaning materials (e.g. greasy or fuel-soaked cloths).

# LONG PERIOD OF INACTIVITY

---

## PREPARING THE ENGINE FOR A LONG PERIOD OF INACTIVITY

In the case of a planned period of inactivity that lasts longer than two months, to prevent the interior parts of the engine and some components of the injection system from oxidising, prepare the engine as follows:

1. Drain the lubricant oil from the sump after heating the engine.
2. Add 30/M type protective oil to the engine (or oil that complies with the specifications MIL 2160B type 2), up to the "minimum" level indicated on the dipstick. Start the engine and let it run at idle for approx. 5 min.
3. Drain the fuel from the injection circuit, from the filter and from the injection pump channels.
4. Connect the fuel circuit to a tank containing CFB protective liquid (ISO 4113), and introduce the liquid by pressurising the circuit and driving the engine for approx. 2 min (One time: 15 sec., Max total: 2 min), after having deactivated the injection system. The required operation may be completed by directly polarising terminal 50 of the electric starter motor with positive voltage equal to that of the nominal system voltage, using the specifically provided conductor.
5. Spray approx. 67 g of protective oil, type 30/M (10 g per litre of displacement) into the turbocharger suction inlet during the pressurised refilling operation described above.
6. Close all of the engine's intake, discharge, ventilation and bleeder holes with plugs or seal them with adhesive tape.
7. Drain the residual 30/M protective oil from the sump, which can be used for an additional 2 preparations.
8. Place signs indicating "ENGINE WITHOUT OIL" on the engine and on the dashboard.
9. Drain the coolant, if it has not been mixed with suitable antifreeze and corrosion inhibitors, and affix a sign to indicate the fact.  
In the case of prolonged inactivity, repeat these operations every 6 months, according to the following procedure:  
A: drain the 30/M protective oil from the sump.  
B: repeat the operations from point 2 to point 7.

Should you intend to protect external parts of the engine, proceed by spraying OVER 19 AR protective liquid on unpainted metal parts, such as the flywheel, pulleys and the like, avoiding belts, connector cables and electrical equipment.

### START THE ENGINE AFTER A LONG PERIOD OF INACTIVITY

1. Drain the residual protective oil from the sump.
2. Add the type and quantity of lubricant oil to the engine as specified in the "Refilling" table on page 35.
3. Drain the CFB protective fluid from the fuel circuit, acting as indicated in point 3 of the section entitled "Preparing the engine for a long period of inactivity".
4. Remove the plugs and/or seals from the engine's intake, discharge, ventilation and bleeder holes, restoring normal conditions of use. Connect the turbocharger intake inlet to the air filter.
5. Join the fuel circuits to the fuel tank of the machine, completing the operations as indicated in point 4 of the chapter entitled "Preparing the engine for a long period of inactivity".  
During the refilling operations, connect the tank fuel return pipe to a collection container to prevent the residual CFB protective liquid from flowing into the tank.
6. Check and fill the engine with coolant as required, degassing if necessary.
7. Start the engine and let it idle until completely stabilised.
8. Check that the indications on the dashboard are plausible and that there are no alarm signals.
9. Stop the engine.
10. Remove the labels of ENGINE WITHOUT OIL from the engine and dashboard.



# TROUBLESHOOTING

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## ENGINE FAULT

The electronic control unit which oversees the control and management of all engine operations is able to recognise a fault and adopt strategies which allow the vehicle still to be driven safely.

The event, signalled by activation of the EDC MALFUNCTION indicator light on the on-board control panels, causes the scheduled limitation of the supply, within certain limits, set according to the seriousness of the specific case.

In the case of temporary malfunctions the reduction in performance will remain in force until the engine is stopped.

## MALFUNCTION OF THE ACCELERATOR ELECTRONIC CIRCUIT FAULT IN THE ACCELERATOR'S ELECTRONIC CIRCUIT

If any problems are detected with the electric circuit of the accelerator, the Electronic Control Unit of the engine adopts a strategy known as "operation at accelerated minimum engine speed" which allows navigation to continue in emergency mode.

The possible operating modes are as follows:

A: The accelerator lever does not "respond": the running speed stabilises at 750 RPM to allow you to proceed slowly and carry out manoeuvres simply by using gear box and off.

B: The accelerator lever "responds partially": the idle rotation speed is 750 RPM. When the accelerator lever is taken to about half its travel, the speed increases progressively up to 2000 RPM; by bringing the lever to idle, the engine speed returns quickly to 750 RPM.

### WARNING

#### **GENERAL RISK, GENERAL PRESCRIPTIONS**

The electronic control unit of the engine adopts safety strategies using the generator set, once all conditions which could compromise the integrity of the engine have been verified. If any of these conditions arise, only proceed if necessary.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

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#### **HAZARD WARNING**

Do not abandon Vessel while engine is running. Secure the vessel.

Failure to comply with these prescriptions can result in the risk of serious injury and serious damages to the vessel.

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# BEHAVIOUR IN EMERGENCY

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## ON-BOARD EMERGENCIES

The user of the boat, built according to safety regulations, following the indications provided in this manual and helped by the indications provided on the engine labels, is able to operate safely.

If incorrect behaviours cause accidents, request the immediate help of specialised emergency personnel. In the case of an emergency and while waiting for emergency personnel to arrive, the following instructions are provided.

### Engine fault

If proceeding to navigate with the engine in a faulty state, pay maximum attention to the manoeuvres and check that any people on-board are secured to secure grips.

### Fire

Extinguish the fire using the on-board equipment as indicated by the competent Authorities (on-board fire-fighting equipment is mandatory in accordance with safety legislation in force).

### Burns

- Put out the flames on the clothing of the burn victim by means of:
  - flooding with water;
  - use of powder extinguishers, without directing the jet towards the face;
  - covers or rolling the victim on the ground.
- Do not remove the shreds of clothing adhering to the skin.
- If burns are caused by liquids, quickly but carefully remove the clothing saturated with the hot liquid.
- Cover the burn with an anti-burn package or with sterile bandaging.

## Carbon monoxide (CO) poisoning

The carbon monoxide contained in the engine's exhaust gas is dangerous both because it causes poisoning as well as because it forms an explosive mixture with the air.

In closed areas, carbon monoxide is very dangerous because it can reach a critical concentration in a short period of time.

If aiding a poison victim in a closed room:

1. Immediately ventilate the room to reduce the concentration of gas.
2. When accessing the room, the rescuer must hold his breath, not light flames, turn on lights or activate electric bells or telephones to prevent explosions.
3. Bring the poison victim to safety in a ventilated room or in the open air, turning him onto his side if unconscious.

## Electrocution

The 12 V or 24 V electrical system of the engines does not involve the risk of electrocution. However, in the event of a short circuit caused, for example, by a metal tool, there is a risk of burning due to overheating of the object through which the electrical current runs. In that case:

- Remove the object that caused the short circuit using device that provide sufficient thermal insulation.
- If present, switch the main switch to cut off the electrical power supply.

### Injuries and fractures

The magnitude of the cases and the specific nature of the interventions makes it necessary to contact medical structures.

- If there are injuries with bleeding, compress the injury externally until the rescuers arrive.
- If there is a possibility of fractures, do not move the concerned part of the body and transfer the injured person very carefully and only if extremely necessary.

### Irritation

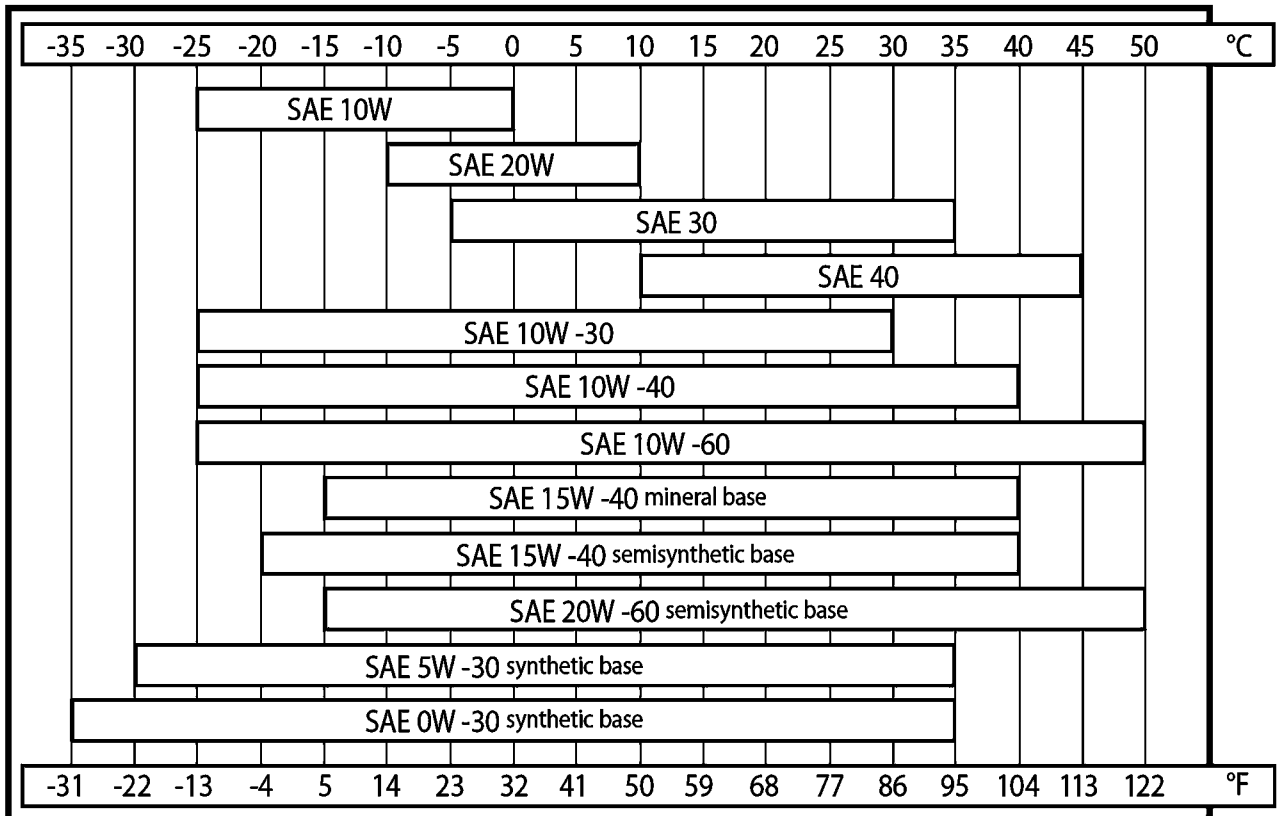
Skin corrosion is caused by contact with substances with a high degree of acidity or basicity.

For personnel performing maintenance on electrical devices, this is typically caused by acid escaping from the batteries; in this circumstance proceed as follows:

- Remove the clothing saturated with the caustic substance.
- Wash thoroughly with running water, without spraying uninvolved parts.

If battery acid, lubrication Oil or diesel Oil has entered the eyes: wash the affected eye with water for at least 20 min, keeping the eyelids open so the water flows onto the eyeball (facilitate washing of the eye by moving it in all directions).

TABLE OF OIL VISCOSITY AS A FUNCTION OF THE AMBIENT WORKING TEMPERATURE OF THE ENGINE



122930-00EN00

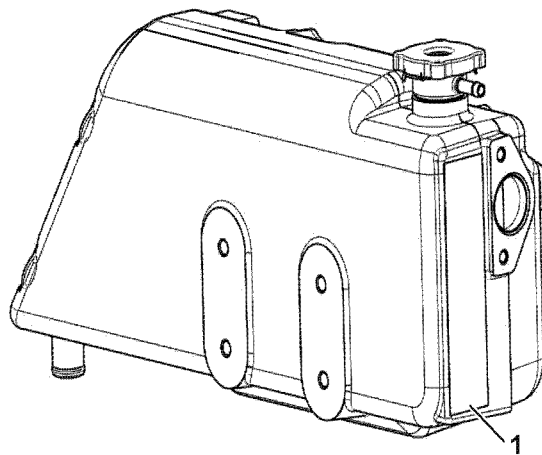
Figure 1

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# EPA WARRANTY USA ONLY

## IDENTIFICATION DATA

The plate is fixed to the engine coolant tank (position (1)).



122905-00X00

6LF485  
6LF530

<b>YANMAR</b> Yanmar Marine International B.V.	EMISSION CONTROL INFORMATION		ENGINE MADE IN: ITALY
EPA Engine Family: <input type="text" value="A"/>	Sales Model: <input type="text" value="B"/>	Engine Serial Number: <input type="text" value="P"/>	*
Manufacture Date: <input type="text" value="I"/>	Engine Category: <input type="text" value="M1"/>	Displacement/Cyl: <input type="text" value="L"/>	Power Density: <input type="text" value="M4"/> kW/L
Maximum Power: <input type="text" value="kW"/>	Engine Rated Power @ Speed: <input type="text" value="E"/>	kW@rpm	Useful Life: <input type="text" value="M2"/> hrs./years
Emission Standards: THC+NOx: <input type="text" value="M5"/> g/kW-hr	CO: <input type="text" value="M6"/> g/kW-hr	PM: <input type="text" value="M7"/> g/kW-hr	
Commercial Variable-Speed Propulsion Engine Used with Fixed-Pitch Propeller			
<p>This Category 1 Marine Engine complies with U.S. EPA regulations for <input type="text" value="H"/> Model Year.          This Engine is certified for operation only with diesel fuel. Modifying the engine to operate on residual or intermediate fuel may be a violation of federal law subject to civil penalties (40 CFR 104.2.601).          This engine does not comply with international marine regulations for commercial vessels unless it is also covered by an EIAPP certificate.          This Engine is certified to operate on: LOW SULFUR DIESEL FUEL</p>			

128413-00X00

6LF550

<b>YANMAR</b> Yanmar Marine International B.V.	EMISSION CONTROL INFORMATION		ENGINE MADE IN: ITALY
EPA Engine Family: <input type="text" value="A"/>	Sales Model: <input type="text" value="B"/>	Engine Serial Number: <input type="text" value="P"/>	*
Manufacture Date: <input type="text" value="I"/>	Engine Category: <input type="text" value="M1"/>	Displacement/Cyl: <input type="text" value="L"/>	Power Density: <input type="text" value="M4"/> kW/L
Maximum Power: <input type="text" value="kW"/>	Engine Rated Power @ Speed: <input type="text" value="E"/>	kW@rpm	Useful Life: <input type="text" value="M2"/> hrs./years
Emission Standards: THC+NOx: <input type="text" value="M5"/> g/kW-hr	CO: <input type="text" value="M6"/> g/kW-hr	PM: <input type="text" value="M7"/> g/kW-hr	
Recreational Variable-Speed Propulsion Engine Used with Fixed-Pitch Propeller			
<p>Installing this recreational engine in commercial vessel or using the vessel for commercial purposes may violate federal law subject to civil penalty.          This Category 1 Marine Engine complies with U.S. EPA regulations for <input type="text" value="H"/> Model Year.          This Engine is certified for operation only with diesel fuel. Modifying the engine to operate on residual or intermediate fuel may be a violation of federal law subject to civil penalties (40 CFR 104.2.601).          This engine does not comply with international marine regulations for commercial vessels unless it is also covered by an EIAPP certificate.          This Engine is certified to operate on: LOW SULFUR DIESEL FUEL</p>			

128412-00X00

## EPA WARRANTY USA ONLY

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THIS EMISSION WARRANTY APPLIES TO THE ENGINES CERTIFIED TO UNITED STATES EPA 40 CFR Part 1042 AND SOLD BY YANMAR THAT ARE INSTALLED IN VESSELS FLAGGED OR REGISTERED IN THE UNITED STATES.

### Your Warranty Rights and Obligations:

Yanmar warrants to the first user and each subsequent purchaser the emission control system on your engine for periods of time listed below provided the engine has been installed according to Yanmar installation requirements and there has been no abuse, neglect, or improper maintenance of your Yanmar Marine engine.

Yanmar warrants that the engine is designed, built and tested using genuine parts and equipped so as to conform to all applicable emission requirements of the U.S. Environmental Protection Agency and is free from defects in material and workmanship which would cause this engine to fail to conform to the applicable emission regulations over its limited emission control system warranty period.

Where a warrantable emissions condition exists, Yanmar will repair your engine at no charge to you for diagnosis, parts, and labor. Warranty service or repair will be provided at authorized Yanmar Marine dealers or distributors.

It is recommended that any replacement parts used for maintenance, repair or replacement of emission control systems are Yanmar parts. The owner may elect to have maintenance, replacement or repair of the emission control components and systems performed by any repair establishment or individual and may elect to use parts other than Yanmar parts for such maintenance, replacement or repair. However, the cost of such service or parts and subsequent failures from such service or parts will not be covered under this emission control system warranty:

### Warranty Period:

The warranty starts on either the date of delivery to the first end-user, or the date the unit is first leased, rented, or loaned.

The warranty period is **five (5) years** or **1000 hours** of use, whichever occurs first. In the absence of a device to measure hours of use, the engine has a warranty period of **five (5) years**.

### Warranty Coverage:

Yanmar recommends that repair or replacement of any warranted parts be performed at an authorized Yanmar dealer or distributor. This limited emission control system warranty covers engine components that are a part of the emission control system of the engine as delivered by Yanmar to the original retail purchaser. Such components may include the following:

- Fuel Injection System
- Intake Manifold
- Exhaust Manifold
- Turbocharger System
- After cooler
- Electronic Engine Control Units and its associated Sensor and Actuators

### Exclusions:

Failures other than those arising from defects in material and / or workmanship are not covered by this limited emissions warranty. This warranty does not extend to the following: malfunction caused by abuse, misuse, improper adjustment, modification, alteration, tampering, disconnection, improper or inadequate maintenance, improper storage or use of non-recommended fuels and lubricating oils, accident-caused damage, and replacement of expendable and / or consumable items made in connection with scheduled maintenance.

Yanmar disclaims any responsibility for incidental or consequential damages such as loss of time, inconvenience, loss of use of marine vessel / engine or commercial loss.



### **Owner's Responsibility:**

As the Yanmar Marine engine owner, you are responsible for the performance of the required maintenance listed in your *Operation Manual*. Yanmar recommends that you retain all documentation, including receipts, covering maintenance on your marine engine, but Yanmar cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.

Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with applicable emission requirements. You are responsible for initiating the warranty process. You are responsible for presenting your marine engine to an authorized Yanmar dealer or distributor as soon as a problem exists.

### **Customer Assistance:**

If you have any questions regarding your warranty rights and responsibilities or would like information on the nearest authorized Yanmar dealer or distributor, you should consult YANMAR Marine International Americas Division for assistance.

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