

YANMAR

OPERATION MANUAL

**MARINE
PROPULSION
ENGINE**

6CXBM-GT

EN English

**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.

**California
Proposition 65 Warning**

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the state of California to cause cancer and reproductive harm.
Wash hands after handling.

Disclaimers:

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Date of issue: Jan. 2011

OPERATION MANUAL	Model	6CXBM-GT
	Code	0A6CX-G00300

INTRODUCTION

Welcome to the world of Yanmar Marine! Yanmar Marine offers engines. 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 6CXBM-GT 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 contact 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

RECORD OF OWNERSHIP

Take a few moments to record the information you need when you contact Yanmar for service, parts or literature.

Engine Model: _____

Engine Serial No.: _____

Date Purchased: _____

Dealer: _____

Dealer Phone: _____

SAFETY

FOR YOUR SAFETY

Warning Symbols

Most operation, maintenance and inspection problems arise due to user's failure to comply with the rules and precautions for safe operation described in this operation manual. Often, users do not understand nor recognize the signs of approaching problems. Mis-handling can cause burns, other injuries and can result in death.

Be sure to read and understand this operation manual carefully before operating the engine and observe all of the instructions and precautions described in this manual.



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

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

WARNING

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

CAUTION

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

NOTICE

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

■ Precautions for operation

⚠ DANGER

COOLANT TANK FILLER CAP



- Never open the cap of the coolant tank while the engine is still hot. Steam and hot water will spurt out and seriously burn you. Wait until the temperature of the coolant tank has dropped, wrap a cloth around the filler cap and loosen the cap slowly. After inspection, refasten the cap firmly.

⚠ DANGER

BATTERY



- Never smoke or permit sparks near the battery, because the battery may emit explosive hydrogen gas. Place the battery in a well ventilated place.

⚠ DANGER

FUEL



- Use only diesel fuel. Never use other fuels, including gasoline, kerosene, etc., because they could cause a fire. The wrong fuel could also cause the failure of the injection pump and injector due to lack of proper lubrication. Be sure to check that you have selected diesel fuel before filling the fuel tank.

⚠ DANGER

BURNS



- The whole engine is hot during operation and immediately after stopping. The turbocharger, exhaust manifold, exhaust pipe, intercooler and high pressure fuel pipe are very hot. Never touch these parts.

⚠ WARNING

FIRE PREVENTION



- Be sure to stop the engine and confirm that there are no open flames in the vicinity before supplying fuel.
- If you spill fuel, wipe such spillage carefully and properly dispose of the wiping materials. Wash your hands thoroughly with soap and water.
- Never place oils or other flammable materials in the engine room.
- Install a fire extinguisher near the engine room and familiarize yourself with its use.

⚠ WARNING

EXHAUST GAS



- Exhaust gas contains poisonous carbon monoxide and should not be inhaled. Be sure to install ventilation ports or ventilators in the engine room and ensure good ventilation during engine operation.

⚠ WARNING

MOVING PARTS



- Do not touch or let your clothing get caught in the moving parts of the engine, such as the front pulley, V-belt or propeller shaft, during engine operation. You will be injured.
- Never operate the engine without the covers on the moving parts.

⚠ WARNING

ALCOHOL



- Never operate the engine while you are under the influence of alcohol. Never operate the engine when you are ill or feeling unwell.

■ Safety precautions for inspection

⚠ DANGER

BATTERY FLUID



- Battery fluid is dilute sulfuric acid. It can blind you if it gets in your eyes, or burn your skin. Keep the fluid away from your body. Wash it off immediately, if you touch it, with a large quantity of freshwater and call your doctor for treatment.

⚠ WARNING

FIRE BY ELECTRIC SHORT-CIRCUITS



- Always turn off the battery switch before inspecting the electrical system. Failure to do so could cause short-circuiting and fires.

⚠ WARNING

STOP ENGINE BEFORE SERVICING



- Stop the engine before you service it. Turn off the battery switch. If you must inspect it while the engine is operating, never touch moving parts. Keep your body and clothing away from all moving parts.

⚠ CAUTION

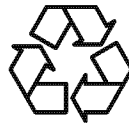
SCALDS



- If extracting oil from the engine while it is still hot, do not let the oil splash on you.
- Wait until the temperature has dropped before extracting cooling water from the engine. Do not let it splash on you.

NOTICE

PRECAUTIONS FOR DISPOSING OF WASTE PRODUCTS



- Be careful not to spill used oil and fluids, and place them in containers for disposal. Never dump waste products on the ground, in sewers, rivers, or in the ocean. Arrange for the waste products to be collected and disposed of safely in compliance with the laws governing disposal.

NOTICE

DO NOT MODIFY THIS ENGINE

Do not modify the engine by removing limiting devices (speed limiter, limiter for amount of fuel injected) or replacing parts. Modifying the engine will make the engine unsafe during operation and lower its efficiency and shorten the engine life.

FOR YOUR SAFETY

Warning Labels

For safe operation, the warning labels should be affixed in the correct place.

Replace the labels with new ones if lost or damaged. Order them from your Yanmar dealer or distributor.

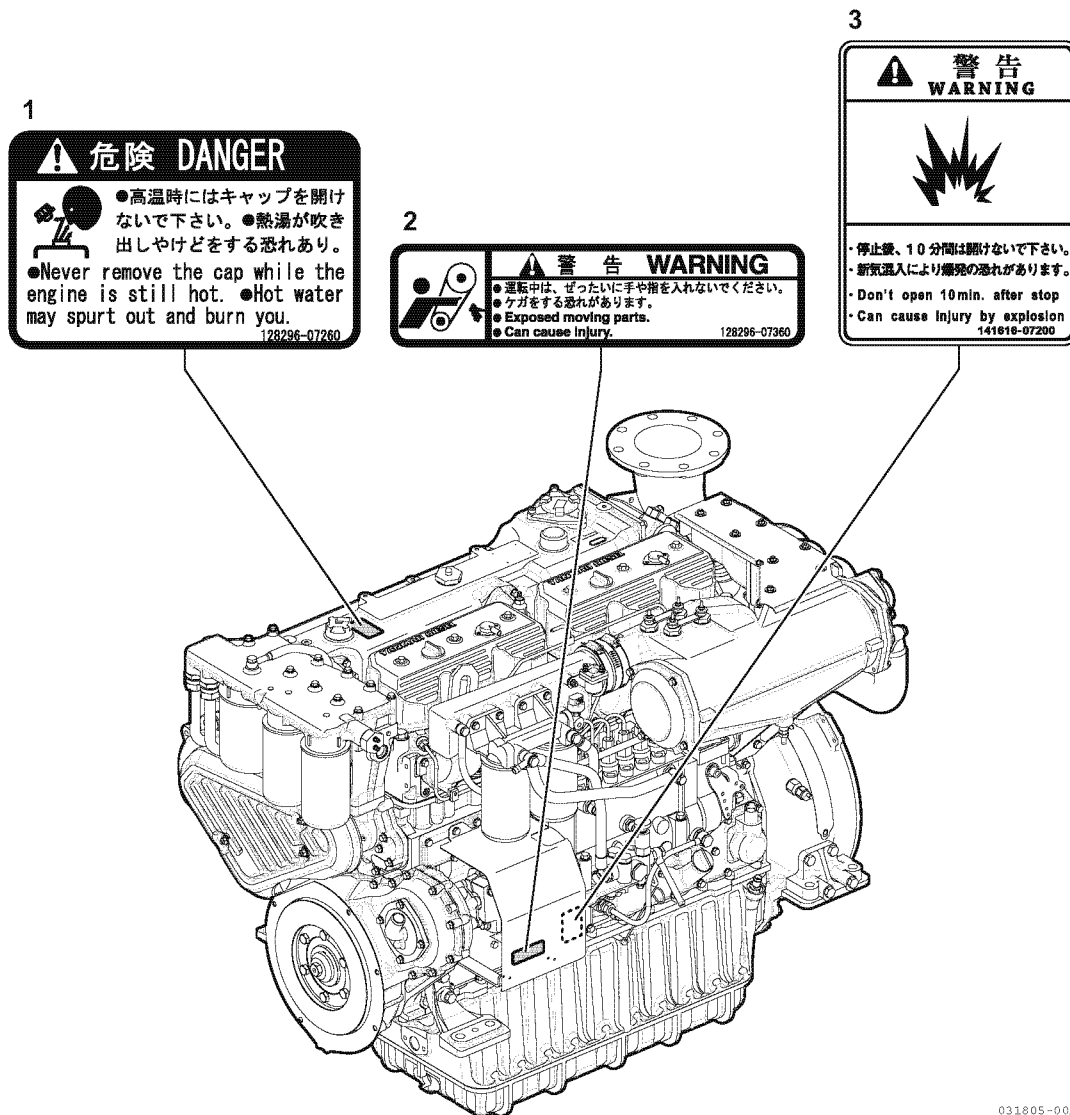
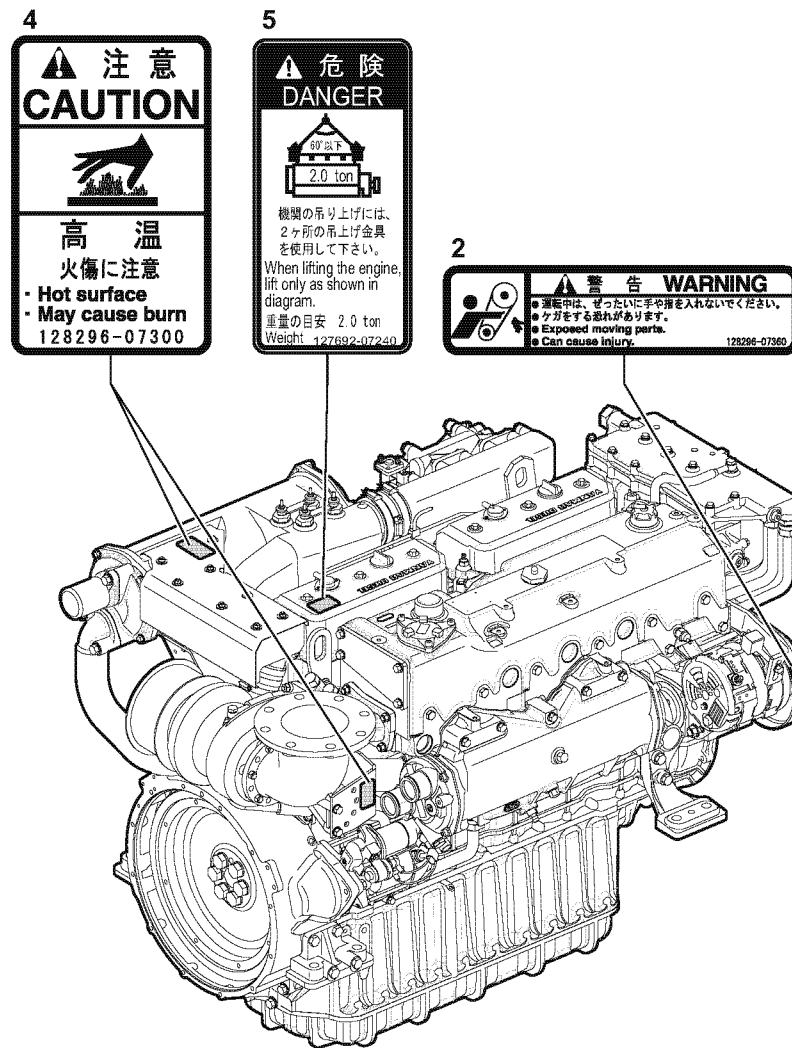


Figure 1

No	Parts No.
1	128296-07260
2	128296-07360
3	141616-07200



031806-00X

Figure 2

No	Parts No.
2	128296-07360
4	128296-07300
5	127692-07240

Engine Name Plate

To use your engine in the best conditions, it is important to perform periodic inspection and maintenance. If you are requesting for engine maintenance or ordering a replacement part, check the engine number (model number) on this name plate in advance.

The engine name plate is attached on the top of the exhaust manifold.

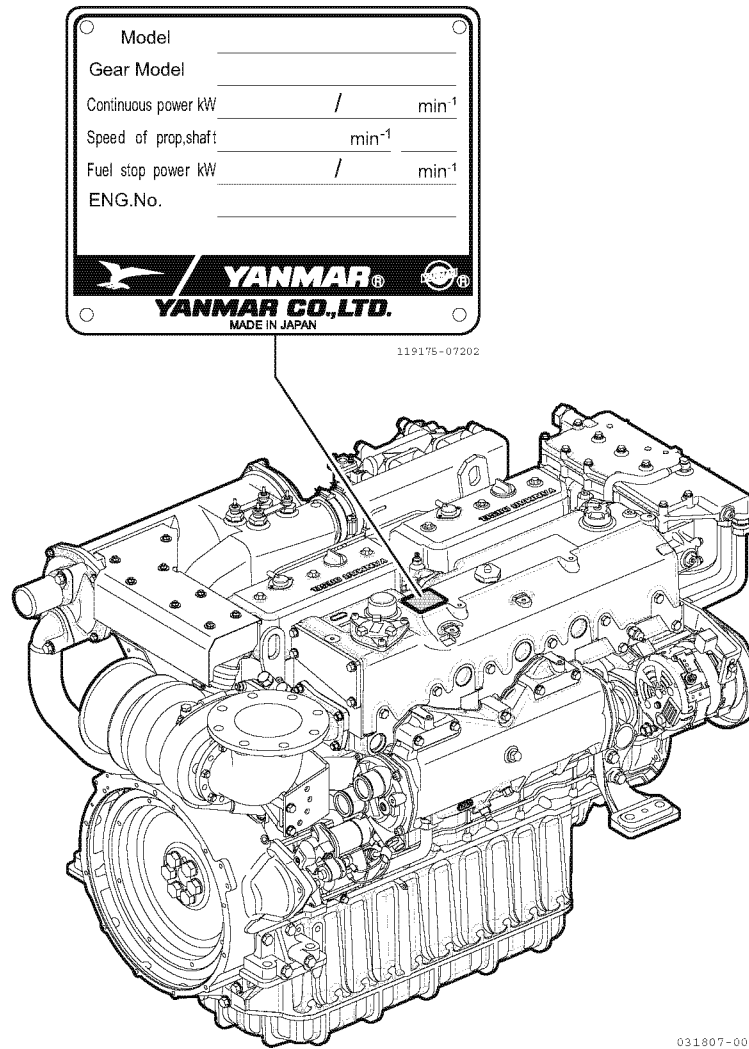


Figure 3

CONTENTS

	Page
Product Explanation	1
Location of Components.....	1
Specifications	3
Fuel, Lubricating Oil and Cooling Water	4
Fuel.....	4
Biodiesel Fuels	5
Additional Technical Fuel Requirements	6
Handling of Diesel Fuel	6
Lubricating Oil.....	7
Cooling Water	7
Running-In	8
Fuel.....	8
Lubricating Oil.....	8
Cooling System	9
Rechecking Lubricating Oil and Coolant Levels	10
Fuel System Bleeding.....	11
Lubricating Engine Components	12
Visual Inspection	12
Remote Control Device (Option)	13
Cranking	13
Instruments.....	14
Alarm Devices	16
Procedure after Starting	17
Operation	18
Starting	18
Notice after Starting.....	20
Notice During Running with Load.....	21
Stopping	22
Long-term Storage.....	24

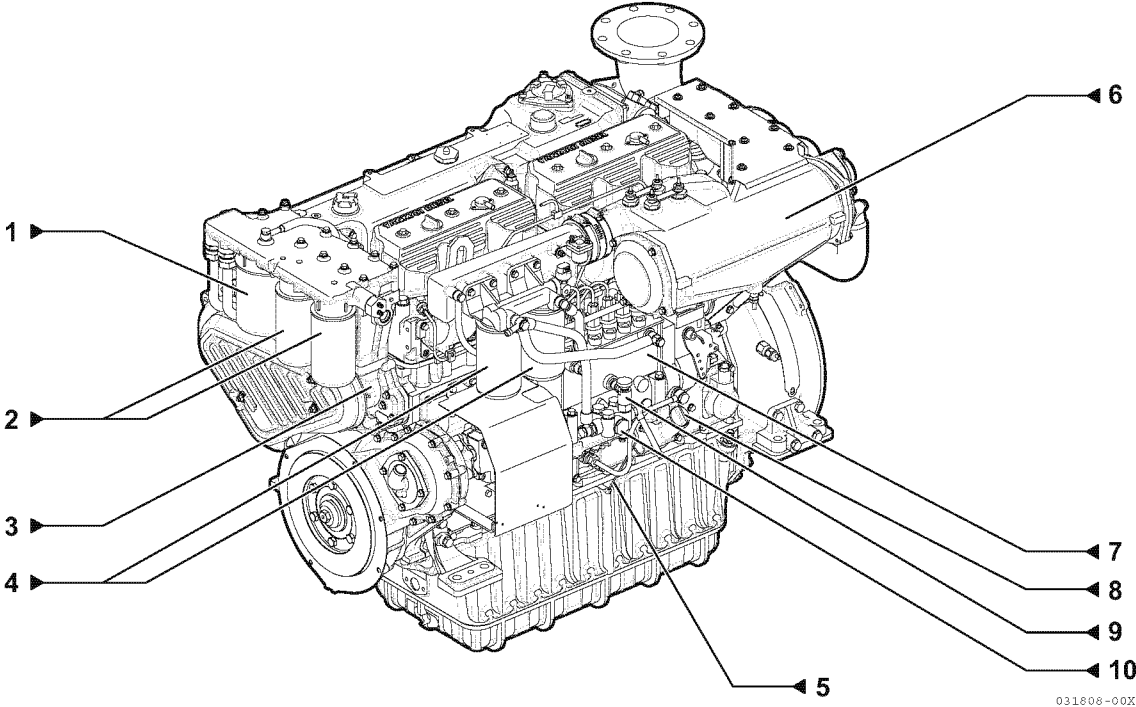
CONTENTS

Checking and Servicing the Turbocharger	25
Periodic Maintenance	26
Periodic Maintenance Schedule.....	26
Technical Data	28
Tightening Torque for Major Parts.....	28
Check Hose Clips.....	29
Valve Clearance Adjustment.....	30
Fuel System	31
Lubricating System.....	33
Cooling System (Seawater and Coolant)	34
Turbocharger.....	36
Air Cooler	36
Remote Control Cables.....	37
Electrical Parts	37
Yanmar Standard Motor-driven Bilge Pump (Option).....	38
Troubleshooting	39
Simple Problems and the Appropriate Countermeasures	39
Engine Does not Start	40
Alarm Lamps and Buzzers Do not Function when Starter Switch is ON	41
Lubricating Oil Pressure Alarm Lamp Comes on (Engine/Marine Gear).....	42
Lubricating Oil Temperature Alarm Lamp Comes on	43
Cooling Water Temperature Alarm Lamp Comes on	44
Black Smoke Emitted (Insufficient Engine Output).....	45
White Smoke Emitted.....	46
External View (Operation Side).....	47
External View (Non-Operation Side)	48
Wire Harness (Engine)	49
Wiring Diagrams	51
24 V Engine Negative Ground Type (Standard).....	51
24 V Insulated Ground Connection Type (Option)	52

PRODUCT EXPLANATION

Location of Components

■ Operation side



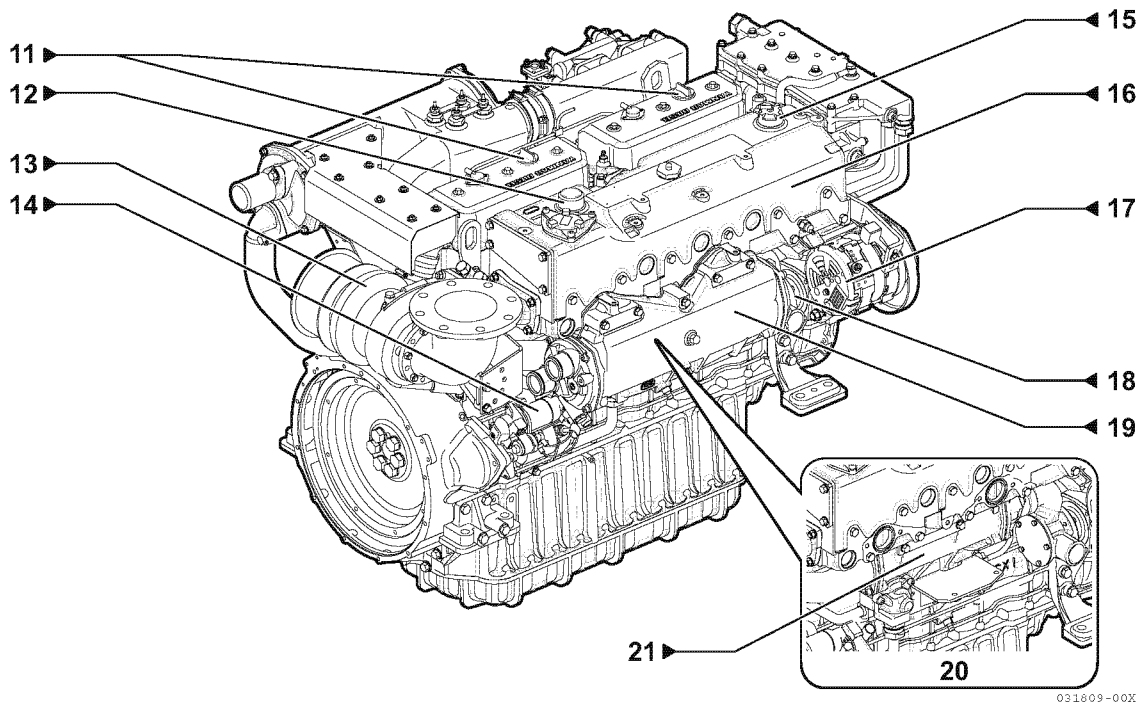
- 1 - Engine lubricating oil bypass filter
- 2 - Engine lubricating oil filter
- 3 - Freshwater pump
- 4 - Fuel filter
- 5 - Engine oil dipstick

- 6 - Air cooler
- 7 - Fuel injection pump
- 8 - Engine oil filler
- 9 - Fuel priming pump
- 10 - Fuel feed pump

Figure 1

PRODUCT EXPLANATION

■ Non-operation side



- 11 - Engine oil filler
- 12 - Spare filler cap
- 13 - Turbocharger
- 14 - Starter
- 15 - Coolant filler cap
- 16 - Exhaust manifold with coolant tank

- 17 - Alternator
- 18 - Seawater pump
- 19 - Heat exchanger
- 20 - Condition on the back of heat exchanger
- 21 - Engine lubricating oil cooler

Figure 2

SPECIFICATIONS

Model	Unit	6CXBM-GT			
Type	–	Vertical, 4-cycle, turbo-charged diesel engine			
No. of cylinders	–	6			
Bore × stroke	mm	110 × 130			
Rated output (flywheel output)	Rating	S	L	M	H
	kW/min ⁻¹ (hp/rpm)	374/2700 (502/2700) (0.5 hour rating)	341/2700 (457/2700) (2 hour rating)	294/2500 (394/2500) (10 hour rating)	265/2400 (355/2400) (24 hour rating)
Direction of rotation	–	Counterclockwise (Viewed from flywheel side)			
Firing order (Flywheel side is No.1)	–	1-4-2-6-3-5-1			
Combustion system	–	Direct injection			
Cooling system	–	Freshwater (Engine) / Seawater (Cooler)			
Lubrication system	–	Forced lubrication with gear pump			
Starting system	–	Electrical, DC 24 V, 5 kW			
Engine mass (without marine gear)	kg	856			

FUEL, LUBRICATING OIL AND COOLING WATER

Fuel

The properties of fuel applicable to this engine are shown in the following table.

The properties of fuel are uncertain and broadly ranged; thus they affect such factors as a smooth run of the engine, maintenance interval and service life of parts. Consequently, it might be necessary to change the specifications of engine or add attachment in accordance with the applied fuel.

■ Quality criteria of fuel oil

Viscosity	at 50 °C	mm ² /s (cst)	3 - 8
Property critical value	Specific gravity at 15 °C	g/cm ³	< 0.86
	Flash point	°C	> 60
	Residual carbon	mass. %	< 0.7
	Sulfur content	mass. %	< 1.0
	Ash content	mass. %	< 0.03
	Moisture content	vol. %	< 0.1
	Vanadium	ppm	–
	Sodium	ppm	–
	Aluminum	ppm	–
	Diesel index		(Cetane no. of ≥ 45)
Quality criteria equivalent fuel oil	ASTEM D975		2D
	BSI-2869		Class B1
	ISO8217		DMX

NOTICE

The fuel injection system consists of precision parts and for that reason, do not use fuel to which water and dust are mixed in. If such fuel is used, it causes a trouble. Consequently, pay attention to the following in supply of fuel. Besides, as for daily maintenance, carry out draining and maintenance servicing of fuel filter mentioned in *Periodic Maintenance on page 26*.

In time of fuel supply

- When supplying fuel stored in a drum, stand the drum still for longer than one whole day to settle the impurity, and supply supernatant liquid of the drum to this engine.
- In the case of supplying fuel from a storage tank to the service tank, supply such fuel after more than one whole day elapsed from when fuel is supplied to the storage tank.

Biodiesel Fuels

Yanmar approves the use of biodiesel fuels that do not exceed a blend of 5 % non-mineral oil based fuel with 95 % standard diesel fuel. Such biodiesel fuels are known in the marketplace as B5 biodiesel fuels. B5 biodiesel fuel can reduce particulate matter and the emission of “greenhouse” gases compared to standard diesel fuel.

NOTICE

If the B5 biodiesel fuel used does not meet the approved specifications, it will cause abnormal wear of injectors, reduce the life of the engine and it may affect the warranty coverage of your engine.

B5 diesel fuels must meet certain specifications

The biodiesel fuels must meet the minimum specifications for the country in which they are used:

- In Europe, biodiesel fuels must comply with the European Standard EN14214.
- In the United States, biodiesel fuels must comply with the American Standard ASTM D-6751.

Biodiesel should be purchased only from recognized and authorized diesel fuel suppliers.

Precautions and concerns regarding the use of bio-fuels:

- Biodiesel fuels have a higher content of methyl-esters, which may deteriorate certain metal, rubber and plastic components of the fuel system. The customer and/or boat builder are responsible to verify the usage of biodiesel compatible components on the vessel fuel supply and return systems.
- Free water in biodiesel may result in plugging of fuel filters and increased bacterial growth.
- High viscosity at low temperatures may result in fuel delivery problems, injection pump seizures, and poor injection nozzle spray atomization.
- Biodiesel may have adverse effects on some elastomers (seal materials) and may result in fuel leakage and dilution of the engine lubricating oil.
- Even biodiesel fuels that comply with a suitable standard as delivered, will require additional care and attention to maintain the quality of the fuel in the equipment or other fuel tanks. It is important to maintain a supply of clean, fresh fuel. Regular flushing of the fuel system and/or fuel storage containers may be necessary.
- The use of biodiesel fuels that do not comply with the standards as agreed to by the diesel engine manufacturers and the diesel fuel injection equipment manufacturers, or biodiesel fuels that have degraded as per the precautions and concerns above, may affect the warranty coverage of your engine.

Additional Technical Fuel Requirements

- NEVER mix kerosene, used engine oil, or residual fuels with the diesel fuel.
- Water and sediment in the fuel should not exceed 0.05 % by volume.
- Keep the fuel tank and fuel-handling equipment clean at all times.
- Carbon residue content not to exceed 0.35 % by volume. Less than 0.1 % is preferred.
- Total aromatics content should not exceed 35 % by volume. Less than 30 % is preferred.
- PAH (polycyclic aromatic hydrocarbons) content should be below 10 % by volume.
- Do not use Biocide.
- Do not use kerosene or residual fuels.

Handling of Diesel Fuel

1. Water and dust in the fuel may cause engine failure. When fuel is stored, be sure that the inside of the storage container is clean and dry, and that the fuel is stored away from dirt or rain.

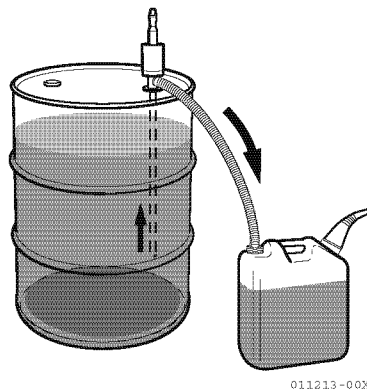


Figure 3

2. Keep the fuel container stationary for several hours to allow any dirt or water to settle to the bottom of the container. Use a pump to extract the clear, filtered fuel from the top of the container.

Lubricating Oil

1. Selection of lubricating oil is very important for a diesel engine. If improper lubricating oil is used or change of lubricating oil is neglected, it causes sticking of piston rings, seizure or early wear of pistons and cylinder liners and faster wear of bearings and various other working parts that reduce the durability of the engine.
2. Service Categories
Use an engine oil that meets or exceeds the following guidelines and classifications:
 - A.P.I. Classification: Grade CD, CF, CF-4, CI-4
 - A.E.C.A. Classification: Grade E3, E4, E5
 - SAE Viscosity grade: 15W-40
 - T.B.N [mgKOH/g]: 9 - 15
3. Do not mix the different kind of oils. If mixed, oil will be deteriorated.

Cooling Water

■ Cooling water selection

Use clean soft water (tap water) for the cooling water.

Use the water having the properties shown in the right table.

Recommended Water Quality	
pH 298K (25 °C)	6.5 - 8.0
Total hardness (CaCO ₃)	< 100 ppm
M alkalinity	30 - 100 ppm
Ammonium ion (NH ₄ ⁺) concentration	< 0.05 ppm
Chlorine ion (Cl ⁻) concentration	< 100 ppm
Sulfate ion (SO ₄ ⁻) concentration	< 100 ppm
Evaporated residue	< 400 ppm

■ Long Life Coolant (LLC) mixture selection

Always add Long Life Coolant (LLC) to the cooling water.

Yanmar recommends the following Long Life Coolant (LLC):

- TEXACO LONG LIFE COOLANT/standard and premixed
Product Code 7997 and 7998
- HAVOLINE EXTENDED LIFE ANTIFREEZE/COOLANT
Product Code 7994

or equivalent to above LLC.

NOTICE

Choose LLC which will not have any adverse effects on the materials (cast iron, aluminum, copper, etc.) used in the engine's water cooling system, if different from the above.

Without this mixture, scale or rust is generated inside the parts of the cooling water system, thus deteriorating cooling performance. In winter, never neglect to use LLC in order to prevent freezing. If LLC use is neglected, the cooling water freezes and expands inside the engine, resulting in breakage of parts in the cooling water system. The mixing ratio of LLC depends on the temperature. Be careful in using the mixing ratio specified by the manufacturer.

NOTICE

- Excess LLC deteriorates cooling performance.
A thin mixture which does not provide protection sufficient for the lowest temperature will freeze and damage the cooling water system.
- Never mix different types (brands) of LLC, chemical reactions may make the LLC useless and engine trouble could result.

RUNNING-IN

When starting a new engine, perform the following procedure.

Fuel

1. Make sure the inside of the fuel tank and fuel lines have been thoroughly cleaned. Fill the fuel tank with fuel.

Fuel system

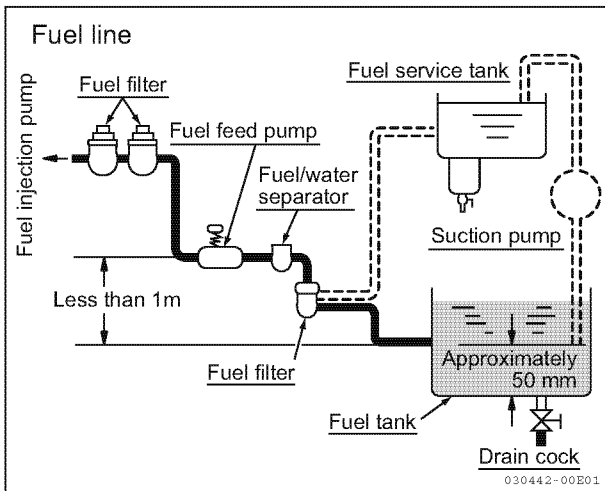


Figure 4

2. Install the fuel piping between the fuel tank and the engine as illustrated above. Be sure to install a drain cock at the bottom of the fuel tank to remove drain. Install a fuel/water separator and a fuel filter in the fuel piping.
3. The fuel oil system has an automatic air bleeding device. In order to bleed the air, press down the fuel priming pump.

Lubricating Oil

As it is necessary to keep the correct oil level, please check the oil level with a dipstick. Please obey the following if you need to pour and add oil.

1. Remove the yellow oil filler cap (1, **Figure 5**), (1, **Figure 6**) attached to the rocker cover or the engine side cover and pour lubricating oil if it is not enough.
2. Fill with lubricating oil up to the full line on the dipstick (2, **Figure 6**).
3. Fully insert and remove the dipstick (2, **Figure 6**) to check the oil level. As a guideline, the upper limit capacity of the oil pan is 33 liter.

4. Retighten the oil filler cap (1, **Figure 5**), (1, **Figure 6**).

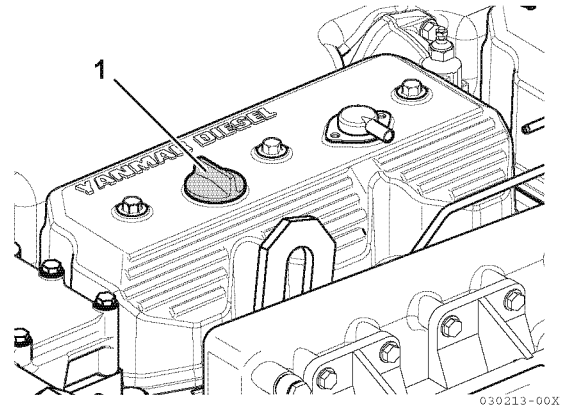


Figure 5

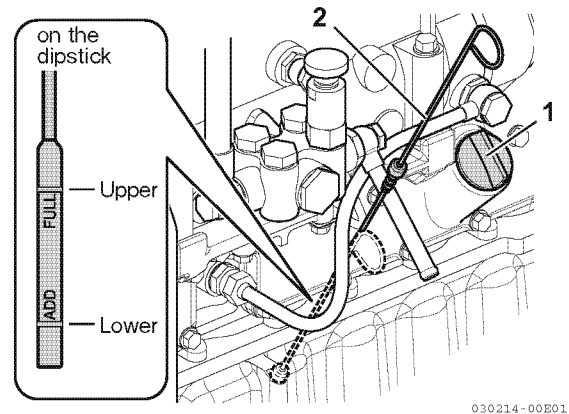


Figure 6

NOTICE

- Be sure to stop the engine before refueling with engine lubricating oil.
- Do not fill lubricating oil exceeding the full line on the dipstick. Overfilling will cause lubricating oil to be sprayed out from the breather during operation and lead to engine problems.

Cooling System

1. Before filling, check to be sure the drain cocks on the cylinder block as well as those on heat exchanger are closed.

Cylinder block

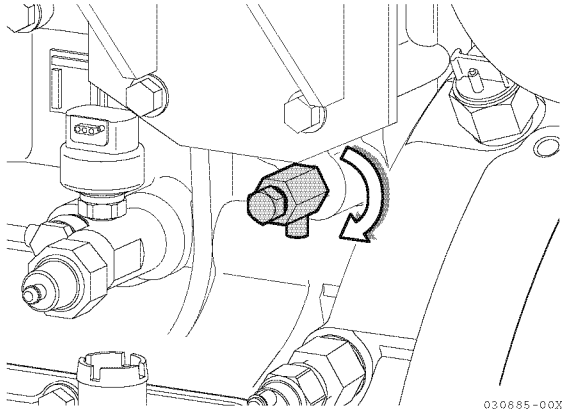


Figure 7

Heat exchanger

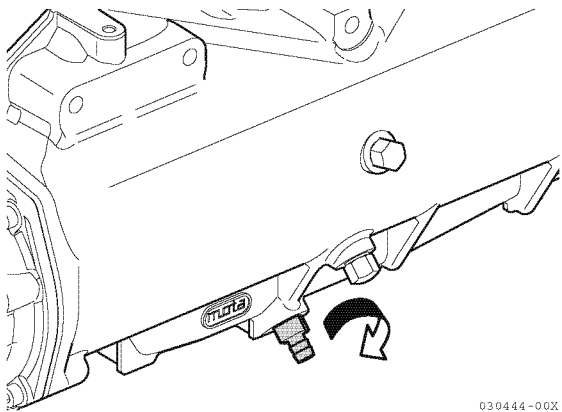


Figure 8

2. It is necessary to keep the correct coolant level. Please obey the following if it is not enough.
3. Remove the filler cap on the coolant tank and pour coolant until it overflows from the filler.

Capacity of all coolant system	40.5 ℓ
--------------------------------	--------

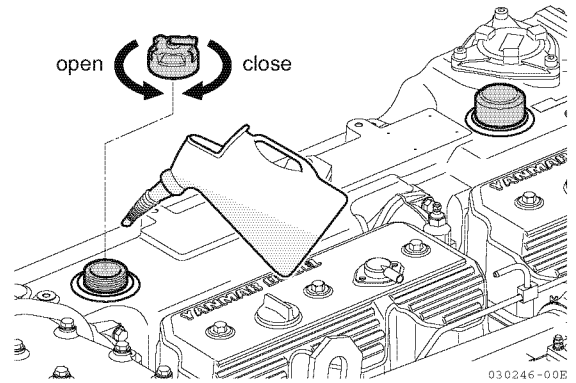


Figure 9

NOTICE

- Always fill with clean soft water (tap water).
- Always use coolant mixed with LLC.

4. After filling the tank, securely tighten the filler cap clockwise.

⚠ DANGER



If the filler cap is not secure, steam and hot water may spurt out during operation and seriously burn you. Never remove the filler cap while the engine is still hot during operation or just after stopping.

Allow some time until the water temperature drops, wrap a cloth or other protective material around the filler cap, and loosen it slowly.

RUNNING-IN

5. Remove the filler cap located on the coolant reservoir tank, pour coolant up to the upper level (FULL) marker, and restore the filler cap.

Reservoir tank amount	3.4 l (FULL)
-----------------------	--------------

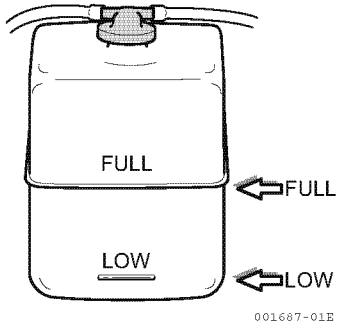


Figure 10

6. Check to be sure that the joints of the overflow pipe between the reservoir tank and the coolant tank are securely tightened.

Rechecking Lubricating Oil and Coolant Levels

NOTICE

When the engine oil, marine gear oil, and cooling water are being replaced or supplied to a new engine, the levels need to be rechecked after test running the engine (approx. 5 mins.). Oil and water will be distributed to the parts of the engine during operation and the levels will fall. Refill to the upper limit.

- Supplying engine lubricating oil
(See *Lubricating Oil* on page 8.)
- Filling coolant tank and closing drain cocks
(See *Cooling System* on page 9.)

Fuel System Bleeding

If air enters this system, fuel is not injected. The procedure to bleed air completely out of the system is the following.

The air bleeding is needed after the replacement of the fuel element as well.

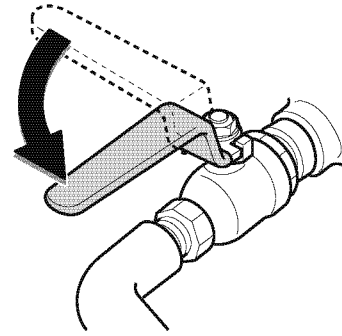
1. Place the shift handle in the neutral "N" position.
2. Open all cocks or valve of the fuel system.
3. Turn the priming pump knob on the fuel feed pump counterclockwise until the priming pump can be moved up and down.
4. Loosen the air bleed bolts at the fuel filter, and operate the priming pump up and down. Make sure that fuel flows out of the air bleed bolt and air is completely bled. Then tighten the bolts and priming pump knob completely, otherwise fuel oil may leak.

DANGER



- Use only diesel fuel. Never use other fuels, including gasoline, kerosene, etc., because they could cause a fire. Be sure to check that you have selected diesel fuel before filling the fuel tank.
- Be sure to stop the engine and confirm that there are no open flames in the vicinity before supplying fuel.
- If you spill fuel, wipe such spillage carefully.

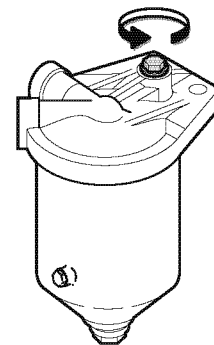
Fuel cock



000016-01X00

Figure 11

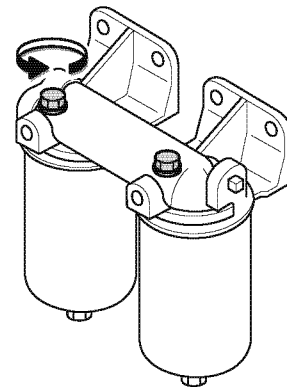
Water separator (option)



030882-00X00

Figure 12

Fuel filter



030883-00X

Figure 13

Priming pump

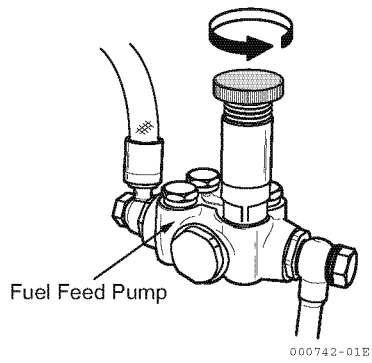


Figure 14

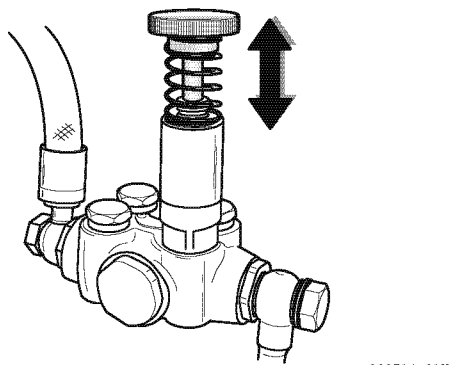


Figure 15

Lubricating Engine Components

Apply oil to the lubricating points on the ball joints (for the governor) (1, **Figure 16**) and the rocker arm (1, **Figure 17**).

Governor lever

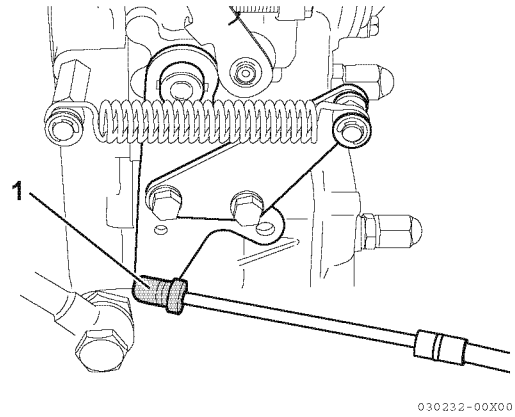


Figure 16

Rocker arm

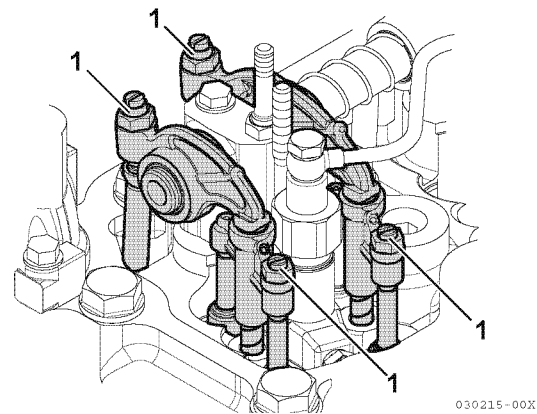


Figure 17

Visual Inspection

Check to see that no tool or anything is touching any rotating part or the engine top, and keep the engine room tidy.

Remote Control Device (Option)

1. Operate the throttle handle from the position “L” to the (full) position “H” and check that the governor lever at the governor moves into correct position.
Adjust the control cable if necessary.

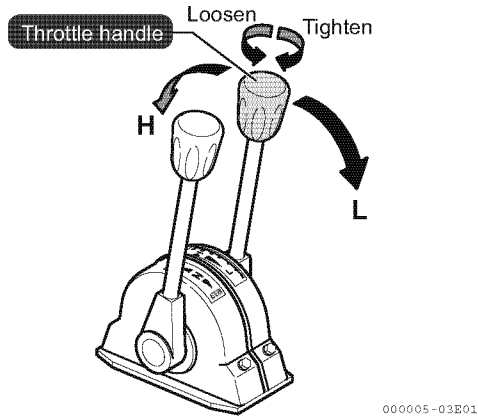


Figure 18

2. Operate shift handle into “AHEAD”, “NEUTRAL” and “ASTERN” and check that the lever position on marine gear is correct and that the marine gear moves into correct positions.
Adjust the shift handle if necessary.

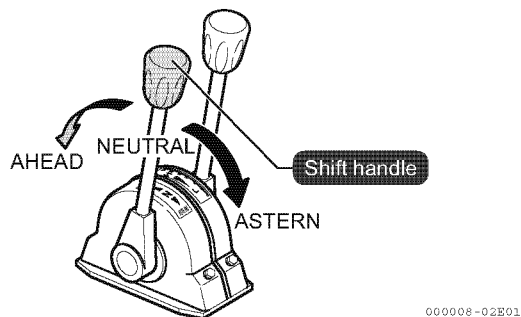


Figure 19

Cranking

Oil reaches all parts of the engine sufficiently, crank the engine according to the following procedure.

1. Set the shift handle into the “NEUTRAL” position.
2. Set the throttle handle into the “L” position.
3. Open the seacock.
4. Turn the battery switch “ON”.
5. Start cranking.
 - 1 - Put the key in the starter switch and turn it to the ON position.
 - 2 - Pull the engine stop lever or press the “STOP” button of the instruments while turning the key to the START position to start the cranking.
 - 3 - Cranking time is 5 seconds; check for abnormal sounds during that time.

Starter switch

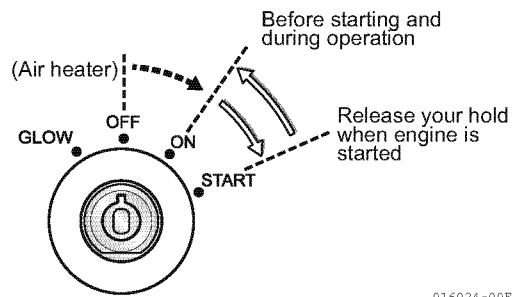


Figure 20

Stop button

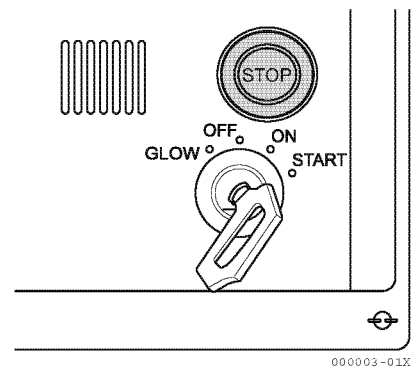
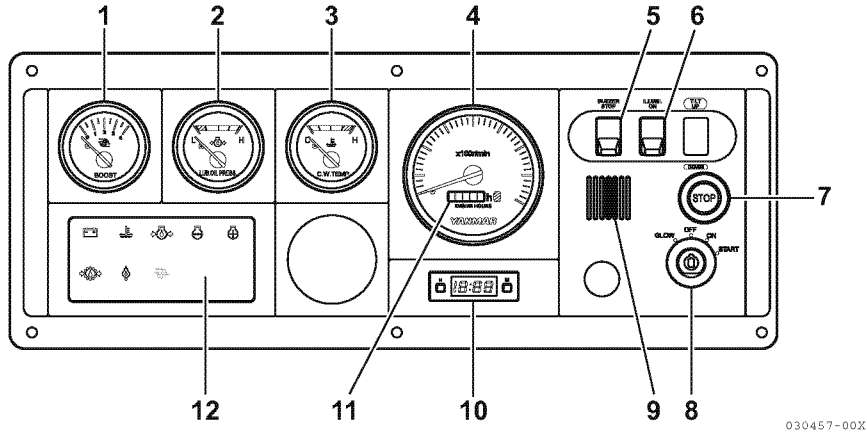


Figure 21

Instruments

Turn the starter key to the "ON" position.

1. The needle of the oil pressure meter should indicate "0".
2. Make sure that the cooling water (coolant) temperature meter operates properly.
3. The hour meter should be working.
4. With the illumination switch ON, the illumination lamps of the lubricating oil pressure meter, the boost pressure meter, the tachometer, and the coolant temperature meter should all come on.



- | | |
|---|------------------------|
| 1 - Boost pressure meter | 7 - Engine stop button |
| 2 - Engine lubricating oil pressure meter | 8 - Starter switch |
| 3 - Coolant temperature meter | 9 - Buzzer |
| 4 - Tachometer | 10 - Clock |
| 5 - Buzzer stop switch | 11 - Hour meter |
| 6 - Illumination switch | 12 - Alarm display |

Figure 22

Starter switch

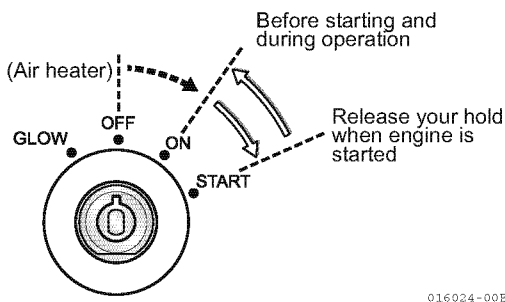


Figure 23

Stop button

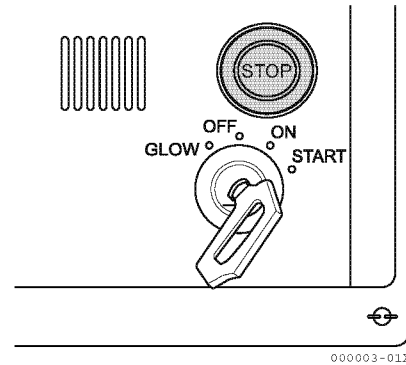


Figure 24

Buzzer

If one of the alarm lamps mentioned on page 16 comes on, the buzzer will sound intermittently. However, no buzzer will sound when the charge lamp comes on.

Alarm lamps

Should any failure occur, the corresponding alarm lamp will come on in the alarm display.

Buzzer stop switch

The switch used to pause the buzzer sound. Do not turn off the buzzer stop switch unless you check for a failure.

Illumination switch

The switch used to illuminate the instrument panel.

Tachometer

It shows the engine speed by min^{-1} (rpm). The read value can be used as a guide for judging the load condition and the boat speed.

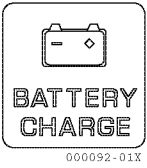
Hour meter

It shows the accumulated operation time. The read value can be used as a guide for periodic maintenance checks. The information is displayed in a window inside the tachometer.

Engine lubricating oil pressure meter

It shows the engine oil pressure by kg/cm^2 . The red zone is a critical zone. The read value can be used as a guide for judging whether the engine is lubricated properly to prevent engine troubles.

Alarm Devices



BATTERY CHARGE

When the charge is abnormal, the lamp will come on. In this case, however, the buzzer will not sound. Check for failures such as a broken V-belt in the alternator.

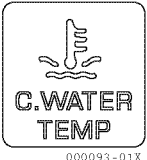
000092-01X



COOLANT LEVEL LOW ALARM LAMP

Comes on if the coolant level drops below the minimum. Continuing operation at temperatures exceeding the maximum will result in coolant temperature rise, damage and seizure. Check the coolant level. In addition, check that there is no leakage from the coolant cooling system.

000096-01X



COOLING WATER TEMPERATURE HIGH ALARM LAMP

Comes on if the cooling water temperature becomes abnormally high. Continuing operation at temperatures exceeding the maximum will result in damage and seizure. Check the load and the water cooling system for any abnormalities.

000093-01X



LUBRICATING OIL FILTER CLOGGED ALARM LAMP

Comes on if the lubricating oil filter is clogging. Replace the filter element (cartridge) as soon as possible.

000097-01X



LUBRICATING OIL PRESSURE LOW ALARM LAMP

Comes on if the engine lubricating oil pressure drops below the minimum. Continuing operation with insufficient oil will result in damage and seizure. Check the oil level.

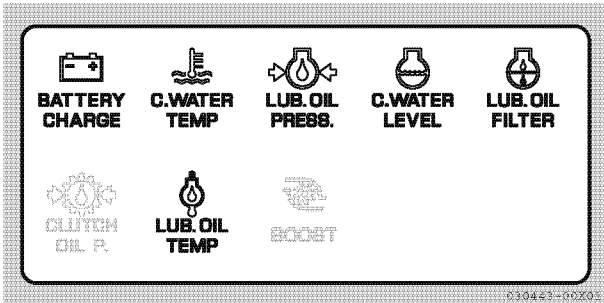
000094-01X



ENGINE LUBRICATING OIL TEMPERATURE HIGH ALARM LAMP

Comes on if the engine lubricating oil temperature becomes abnormally high. Continuing operation at temperatures exceeding the maximum will result in damage and seizure. Check the failures in the seawater cooling system.

000098-01X



030423-00X01

Procedure after Starting

⚠ WARNING



- Maintain good ventilation in the engine compartment while the engine is running. Exhaust gas can be very toxic. Avoid the operation of engines in a closed space or in the ship's hold. The exhaust gas will not be able to get out.

⚠ WARNING



- Pay attention when the engine is rotating. Be careful to keep your clothes and hands away from the engine. Make sure there are no tools or rags left in the area.

⚠ WARNING



- Be careful not to get an electric shock from the electric circuits. Do not touch the terminals, or wiring while the engine is running. Contact with the electric circuits can be particularly dangerous when your hands are wet.

⚠ CAUTION



- Be careful when working around a hot engine, exhaust manifold or exhaust pipes during and immediately after running the engine. Do not touch these parts with your body or clothes.

When a new engine is operated for the first time, the lubricating oil level of the oil pan will drop due to the engine oil to the oil cooler, oil filter, etc.

Therefore, stop the engine after operating for two to three minutes.

Wait for about five minutes and then check the following items:

1. Check the engine oil level with the dipstick, and add oil up to the upper level if necessary.
2. Check the marine gear oil level with the dipstick, and add oil up to the upper level if necessary.
3. Remove the filler cap from the coolant tank, and check the coolant level.
The coolant level may drop due to escaping air trapped in the cooling system up to the coolant tank.
If the level is below the filler neck, add soft water up to the filler neck.

⚠ DANGER

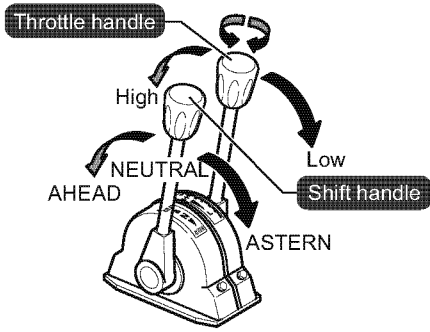
- Never remove the filler cap when the engine is hot (above 60 °C). The coolant is under pressure and severe scalding could result.

OPERATION

Prior to starting the engine, check to see if there is nothing nearby the engine, particularly the rotating parts that may cause damage.

Starting

1. Move the shift handle to the neutral "N" position.
2. Move the throttle handle to the "L" position.



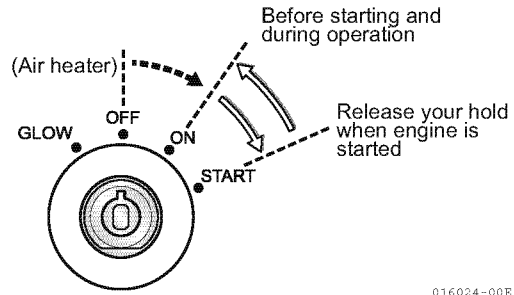
000044-03E01

Figure 25

Before starting engine

- 1- Turn ON the battery switch.
- 2- Put the key in the starter switch. Turn the key from the OFF to ON position and check that alarm devices shown in the table on page right "Before Starting" are working properly.
 - The buzzer sounds briefly (for approx. 1 second).
 - The battery charge lamp should sequentially-lighted; other alarm lamps should go on and off after approx. 3 seconds.
- 3- Insert the key into the starter switch and turn it to the "START" position. Once the engine starts, release your hand from the key. Then it will return to the "ON" position automatically. With the key in the "ON" position, the power source of the instruments and warning devices is engaged.

Starter switch



016024-00E

Figure 26

Checking just after starting engine

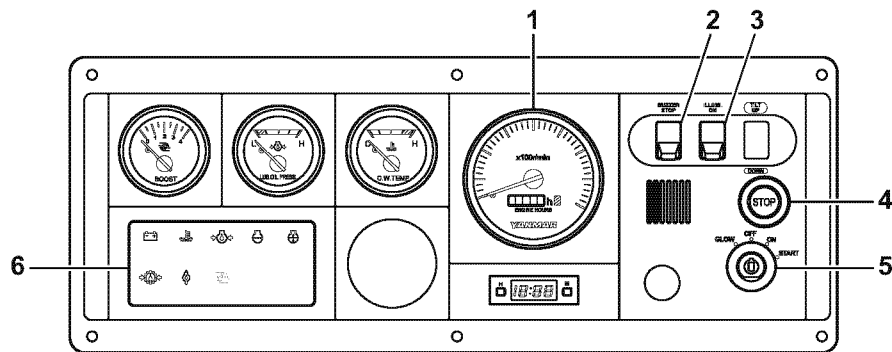
Release the key from the START to ON position and check that the alarm devices shown in the table on page right "After Starting" are working properly.

- The buzzer stops.
 - All alarm lamps go off.
- By performing these procedures, it can be determined whether or not the electric circuit of the buzzer and alarm lamps are in good working order. If there is any problem, consult your authorized Yanmar dealer or distributor for investigation and repair.

Normal Function of Alarm Devices		
	Before starting OFF → ON	After starting START → ON
Starter switch operation		
Buzzer	On	Off
Alarm lamps		
Battery charge lamp	On	Off
Cooling freshwater temperature	On briefly	Off
Engine lubricating oil pressure	On briefly	Off
Marine gear lubricating oil pressure	On briefly	Off
Cooling freshwater level	On briefly	Off
Lubricating oil filter clogged	On briefly	Off
Engine lubricating oil temperature	On briefly	Off

[Option]

3. The air heater warms intake air to enable easy starting in cold conditions.



034467-00X

- | | |
|-------------------------|--------------------|
| 1 - Tachometer | 4 - Stop button |
| 2 - Buzzer switch | 5 - Starter switch |
| 3 - Illumination switch | 6 - Alarm display |

Figure 27

NOTICE

- Do not turn off the battery switch when operating the engine.
- Do not turn the key in the "OFF" position when operating the engine.
- If the engine did not start, do not continue cranking for longer than 15 seconds at any one attempt. Allow at least 30 seconds of rest between attempts. This will permit the battery to recover.
- When restarting, turn the starter switch to the START position after stopping the engine completely. If the starter switch is turned on before the engine comes to a complete stop, serious damage to the starting motor pinion and ring gear of flywheel may result.

OPERATION

■ Cold start procedure

● Glow plug operation (option)

1. When starting during cold condition, first turn the starter switch to GLOW (for a few moments) to activate the heater.
2. Next, after 20 - 30 seconds turn the starter switch to START. When the engine starts, the microcomputer catches the engine revolution and activates the after-heater which remains on for 3 minutes.
3. The heater will operate for a maximum of 1 minute before the after-heat mechanism is activated. During this period if the engine does not start, the after-heater will not be activated. Start the engine within 1 minute after turning the key to "GLOW".
4. When starting under normal conditions, the "GLOW" position is not used, and the heating mechanism is not activated.

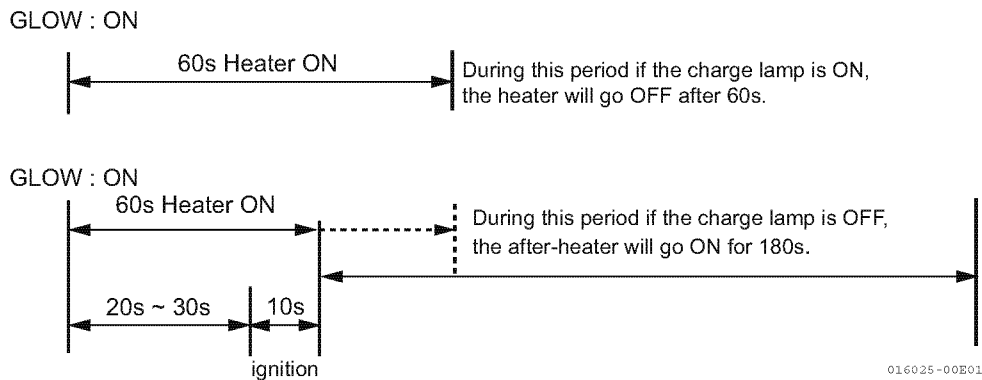


Figure 28

■ Procedure

1. Put the shift handle in "N".
2. Put the throttle handle to the low idle position.
3. Turn the starter switch key to "GLOW" (for a moment).
4. After 30 seconds, turn the key to "START", and the engine starts.
5. Release your hand from the key after starting; the key will return automatically to "ON".

Notice after Starting

With the shift handle in the neutral position, observe the following instructions.

1. After starting, set the engine speed to low idling.
2. Make sure that seawater is coming out from the cooling water (seawater) outlet.
3. Check that the battery charge warning lamp (CHARGE) is turned off consequently.
4. Make sure that the cooling water temperature meter on the instrument panel reads 40 °C or more.

Notice During Running with Load

During engine operation, pay attention to the following.

1. Cooling water (seawater)

Make sure that water is coming out from the cooling water (seawater) outlet.

When water is coming out intermittently or in small volume, check the following.

- 1- Air in the cooling system.
- 2- Faulty cooling water pump impeller.
- 3- Clogged cooling water pipe and seacock.
If the cause can not be found, return to port at a low speed, and consult your Yanmar dealer or distributor.

NOTICE

Never operate the engine if the seawater pump is not sucking up water. The water pump impeller will seize in about 30 seconds and become impossible to use again.

2. Coolant

Normally, the water temperature during running with load is 70 - 80 °C.

If the temperature exceeds 85 °C, check the following.

- 1- Water leakage (temperature and water level warning devices activate)
- 2- Faulty coolant pump or clogged coolant passage
- 3- Faulty seawater pump or clogged seawater passage
- 4- Insufficient cooling of coolant due to heat exchanger restriction

If the cause can not be found, return to port at a low speed, and consult your Yanmar dealer or distributor.

NOTICE

As the coolant temperature rises after starting, hot water overflows from the coolant tank into the reserve tank and the reserve tank level rises. However this is not abnormal. After the engine is stopped, coolant returns naturally to the coolant tank.

3. Color of exhaust gas

Black smoke is a sign that the engine is overloaded. Such operation will shorten the life of intake and exhaust valves, piston rings, cylinder liners and particularly fuel injection nozzles. Avoid continuing operation if black smoke is being emitted, and consult your Yanmar dealer or distributor.

4. Water leakage, oil leakage and other operational conditions

Always check for water leakage, oil leakage, gas leaks, loose fasteners, abnormal noise or temperature, and vibration.

5. Avoid operating at an engine speed that produces resonance (critical speed).

Depending upon the construction of hull, the engine and ship resonate at a certain rate of revolutions, and vibration may suddenly become great. Avoid operating the engine at critical speed.

6. Operation of shift handle

Be sure to operate the throttle handle at a low speed (less than 1000 min⁻¹ (rpm)).

If the marine gear is engaged or disengaged during high-speed or if it is used under half-clutch, the marine gear will damage or its life will be shortened.

7. Alarm devices

When the buzzer sounds during engine running, check which alarm lamp is on, and then turn off the buzzer stop switch. Stop the engine immediately, and check for cause. If there is no abnormality, return to port at a low speed, and consult your Yanmar dealer or distributor.

8. Long time operation at low speed

When the engine is operated for more than four hours at low speed, set the shift handle to the "NEUTRAL" position, and increase the engine speed without load for one minute at about 1800 min⁻¹ (rpm) to discharge residue from cylinders.

OPERATION

Stopping

To stop the engine, set the shift handle to the “NEUTRAL” position, and perform no-load running at idling speed for about five minutes.

NOTICE

If the engine stops in a hot condition due to overheating, the temperature of the coolant and various engine parts will rise abruptly, and the engine may be damaged.

1. To stop the engine remotely, press and hold the “STOP” button until the engine stops.
2. Set the key switch to the “OFF” position after stopping the engine.
3. Remove the key from the starter switch, and turn off the battery switch.
4. Close the fuel cock.
5. Close the seacock.
6. While the engine is still warm, wipe off dust and dirt from the engine.
7. Discharge the cooling water

Because there is the possibility that cooling water (seawater) will freeze in sub zero temperature, be sure to close the seacock and drain seawater after using the engine. If the engine will not be used for a long time, also drain seawater completely. If this is not done, the heat exchanger or seawater pump may be damaged by the freezing of cooling water in the seawater system.

Note: Always use LLC in the coolant system under these conditions.
(Refer to *Cooling Water* on page 7.)

Loosen the drain plug (1, **Figure 29**) at the lubricating oil cooler, and loosen also the seawater pump cover bolts (**Figure 30**) to drain seawater.

Lubricating oil cooler

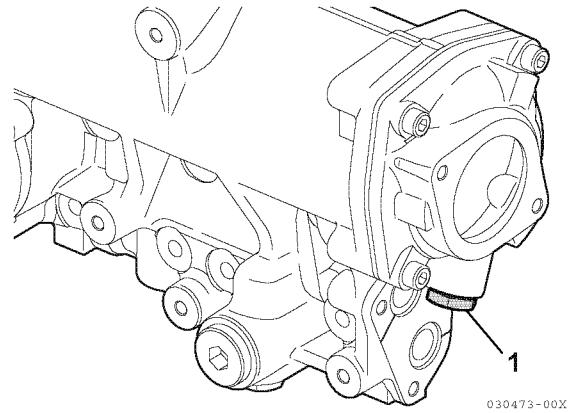


Figure 29

Seawater pump

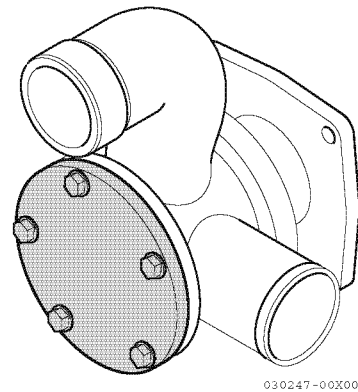


Figure 30

Draining procedure

1. Open the drain cock(s) on the cylinder block, heat exchanger, engine lubricating oil cooler, and marine gear lubricating oil cooler and remove the five bolts on the side cover of the seawater pump to drain the water from inside. While draining, open the coolant filler cap on the top of the exhaust manifold.

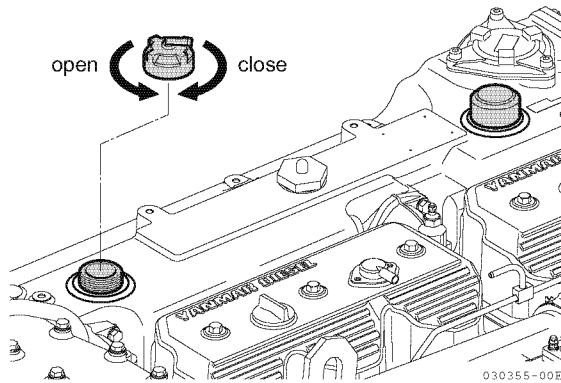


Figure 31

**Location of drain cocks (gray)
(Seawater drain plug is indicated as 1:
Coolant drain plug is indicated as 2)**

Cylinder block: 1 position.

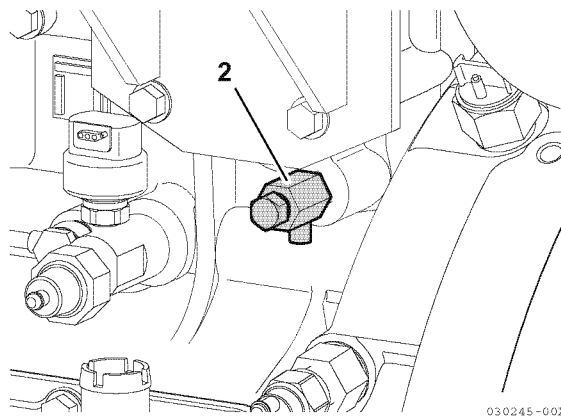


Figure 32

Heat exchanger: 2 positions.

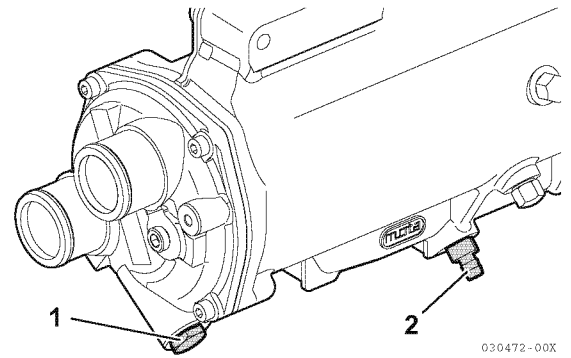


Figure 33

Engine lubricating oil cooler: 1 position.

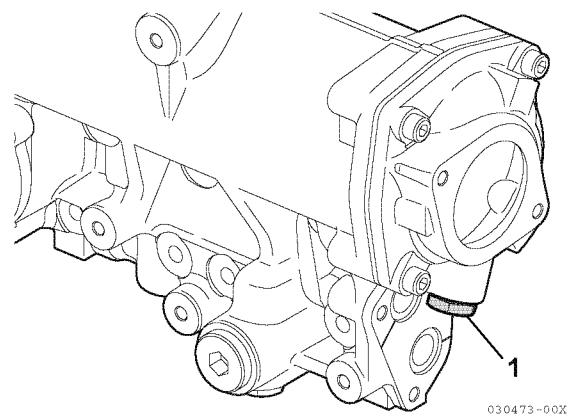


Figure 34

2. Remove the 5 bolts that secure the side cover of the seawater pump to drain the seawater from inside.

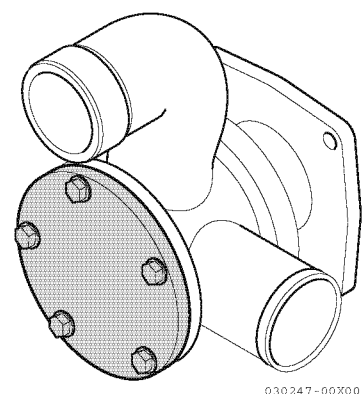


Figure 35

OPERATION

3. You do not need to drain the coolant if it is mixed with LLC.

NOTICE

Storing the engine without draining may cause the seawater left inside the engine to freeze and damage to parts (heat exchanger, lubricating oil cooler, seawater pump) in the cooling water passage.

Long-term Storage

When the engine will not be used for a long term, perform the following.

1. Choose a dry, dust-free location for storage.
2. In cold areas, there is the danger of freezing and the cooling water should be completely drained off.
(Refer to *Stopping* on page 22.)
3. Loosen the belt.
4. Disconnect the battery terminals from the engine, and store the battery fully charged. Charge the battery once a month to compensate for the battery's self discharge.
5. Remove any dirt, grime, or oil on the exterior and wipe it clean, and apply a coat of antirust oil or clean oil.
6. Cover the exhaust pipe, suction inlet, and electric devices with vinyl sheets to guard against moisture and dust.

■ Operating after long-term storage

Follow the steps below when reusing an engine which has been stored for 6 months or longer.

1. Refer to *Running-In* on page 8 before starting.
2. Remove the rocker cover, and apply lubricating oil to the rocker arms.
3. Perform cranking before operation to distribute lubricating oil to all of the parts.
(Refer to *Cranking* on page 13.)

CHECKING AND SERVICING THE TURBOCHARGER

If you notice that the engine seems sluggish or the exhaust color is abnormal, the turbocharger pre-filter and blower may be contaminated.

■ Wash the pre-filter

A pre-filter removes contaminations in the air and keeps the engine output in good condition.

1. Wash the pre-filter with a neutral detergent.
2. Wash the pre-filter with tap water, dry it sufficiently, and install.

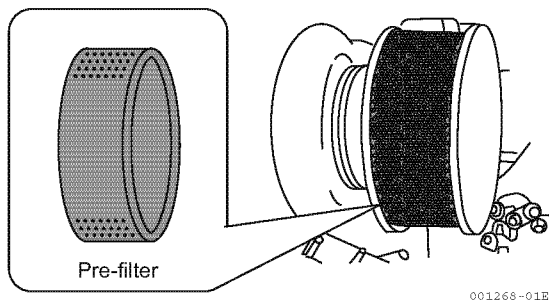


Figure 36

■ Wash the blower

If the turbocharger blower is contaminated, the blower speed decreases and the boost pressure drops, causing the engine output to fall. Wash the blower, if the pressure drops (approx. 10 % pressure drop compared with normal condition).

1. Prepare the blower wash fluid, freshwater, and oiler.
2. Remove the pre-filter from the intake silencer, and remove the water filler plug (**Figure 37**).
3. During the load operation, fill 50 cc of the blower wash fluid slowly from the turbocharger water filler in approx. 10 seconds.
4. Approx. 3 minutes after filling the blower wash fluid, fill 50 cc of the freshwater from the turbocharger water filler in approx. 10 seconds.
5. Continue the load operation for approx. 10 minutes to dry and check the output recovery.

6. Repeat the above washing operation 3 to 4 times, if the performance is not recovered. Contact your Yanmar dealer or distributor for repair, if the performance does not recover after repeating the washing operation 3 to 4 times.

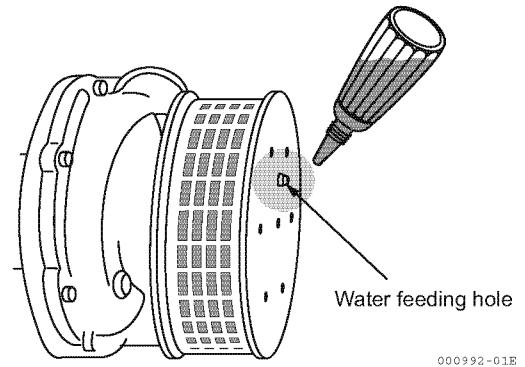


Figure 37

Interval	Pre-filter	When the boost pressure drops by 10 % in comparison with the trial run. Or every 250 hours (1 month).
	Blower	

NOTICE

Do not fill a large amount of the wash fluid and freshwater at once. It may result in a water hammer accident.

PERIODIC MAINTENANCE

PERIODIC MAINTENANCE

- Periodic maintenance is an important factor in keeping the engine in the best condition. In accordance with operating hours given in the following maintenance schedule, perform periodic maintenance.
- When the parts are disassembled for checking and/or servicing, reassemble them properly.

Periodic Maintenance Schedule

○: Check ◇: Replace ●: Consult local dealer or distributor

Item	Content	Inspection Interval						Remarks
		Every Day	Every 50 Hours (or Every Week)	Every 250 Hours (or Every Month)	Every 500 Hours (or Every 2 - 3 Months)	Every 1000 Hours (or Every 5 - 6 Months)	Every 2500 Hours (or Every Year)	
Fuel system	Check fuel oil level and refill fuel tank.	○						
	Drain the fuel tank.	○ (When refilling)						
	Drain the fuel filter/water separator.		○					
	Replace the fuel filter/water separator element.				◇			
Lubricating oil system	Check the lubricating oil pressure.	○						
	Check the lubricating oil level and refill. (Oil pan)	○						
	Replace the lubricating oil filter element.		◇ (1st time)		◇ (2nd time and after)			
	Clean the lubricating oil cooler.					●		
	Replace the lubricating oil. (Engine)		◇ (1st time)		◇ (Diesel oil)			
Cooling water (Seawater) system	Check the cooling water discharge.	○						
	Check and replace zinc anode.				◇			
	Check and replace the seawater pump impeller.					○	◇	
	Replace the seawater pump mechanical seal.						●	
	Clean the seawater passage (heat exchanger, marine gear lubrication oil cooler)						●	
Cooling water (Coolant) System	Check the cooling water temperature.	○						
	Check and refill coolant.	○						
	Replace the coolant pump mechanical seal.						●	
	Replace coolant.						*●	
	Check and replace the thermostat.						○	● (Replace)
	Clean the coolant passage (including the heat exchanger).						●	
Re-tighten the hose clips of rubber hoses (fuel, lubricating oil, cooling water, intake air)			○ (1st time)		○ (2nd time and after)			
Check and replace the rubber hoses (fuel, lubricating oil, cooling water, intake air, breather pipe)							○	● (Replace)

PERIODIC MAINTENANCE

○: Check ◇: Replace ●: Consult local dealer or distributor

Item	Content	Inspection Interval							Remarks
		Every Day	Every 50 Hours (or Every Week)	Every 250 Hours (or Every Month)	Every 500 Hours (or Every 2 - 3 Months)	Every 1000 Hours (or Every 5 - 6 Months)	Every 2500 Hours (or Every Year)	Every 5000 Hours (or Every 2 Years)	
Fuel injection pump and injection valve	Check and adjust the fuel injection timing.			● (1st time)				● (2nd time and after)	
	Disassemble and check the fuel feed pump.						●		
	Check and adjust the injection pressure and atomizing condition.					●			
	Replace the injection nozzle.						●		
	Replace the fuel pump timer lubricating oil.						●		
Cylinder head	Adjust the valve clearance.		● (1st time)				● (2nd time and after)		
	Lap the intake and exhaust valves							●	
	Re-tighten the head bolts.					●			
Piston	Replace the piston rings								● (7500 hrs)
	Check the piston.								● (7500 hrs)
Liner	Check the liner internal surface.								● (7500 hrs)
Turbocharger	Wash the pre-filter and blower			○					
	Check air/gas leakage from connections	○							
	Check the clamped parts	○							
	Check the turbine shaft play/rotating condition						●		
	Disassemble and check the main parts.							●	
Check and replace the viscous damper								●	Check: 5000 hrs Replace: 10000 hrs
Check and replace the remote control cables.				○ (1st time)	○ (2nd time and after)			● (Replace)	
Lubricate the governor link					○				
Electric parts	Check the alarm lamps and buzzer.	○							
	Check the battery fluid level			○					
	Check and adjust the alternator drive belt tension		○ (1st time)		○ (2nd time and after)				
	Sensors and relays for instrument panel							●	Check: 5000 hrs Replace: 10000 hrs
	Check the wire harness. • Damage to the wire harness sheath • Check the electrical instrument connector terminals • Connector terminal corrosion and conduction failure						○		
Engine exterior	Check on looseness of bolts and nuts	○							
	Check on water/oil/gas leakage at various parts	○							

* Refer LLC product maker instruction manual

PERIODIC MAINTENANCE

Technical Data

Item			6CXBM-GT
Valve clearance (at engine cold)	Intake	mm	0.25 ± 0.05
	Exhaust	mm	0.40 ± 0.05
Fuel injection timing (FID) before T.D.C.		°	11 ± 1
Pressure	Fuel injection pressure	MPa (kgf/cm ²)	29.4 ± 0.49 (300 ± 5)
	Engine oil pressure	MPa (kgf/cm ²)	0.55 ± 0.05 (5.6 ± 0.5)
Coolant capacity	Engine	ℓ	40.5
	Reserve tank	ℓ	3.4
Lubricating oil capacity	Engine	ℓ	oil pan: 33
	Marine gear	ℓ	Refer to marine gear manual
Lubricating oil temperature	Lubricating oil cooler (inlet)	°C	Max 95

Tightening Torque for Major Parts

N-m (kgf-m)

Cylinder head	245 ± 5 (25 ± 0.5)
Main bearing cap	275 ± 10 (28 ± 1.0)
Connecting rod	Tighten to 62 ± 2 (6.3 ± 0.2) and then turn another 90 - 120 degrees.
Flywheel	410 ± 20 (42 ± 2.0)
Fuel injection pipe	34 ± 2 (3.5 ± 0.2)
Fuel injection nozzle	31 ± 2 (3.1 ± 0.2)

Put lubricating oil on bolts or nuts when tightening them.

■ Standard tightening torque

Thread diameter	mm	M6	M8	M10	M12	M14	M16
Pitch	mm	1.0	1.25	1.5	1.75	1.5	1.5
Width across flat	mm	10	12	14	17	19	24
Tightening torque	N-m (kgf-m)	11 ± 2 (1.1 ± 0.2)	25 ± 2 (2.5 ± 0.2)	49 ± 2 (5.0 ± 0.2)	88 ± 5 (8.9 ± 0.5)	118 ± 5 (12.0 ± 0.5)	196 ± 10 (20.0 ± 1.0)

Note: Use 80 % of the torque for bolts made of aluminum or aluminum alloys.

Do not apply oil on bolts, nuts or washers.

■ Torque for pipe joint bolts

Thread diameter	mm	M8	M12	M14	M16	M18	M20	M22
Pitch	mm	1.25	1.25	1.5	1.5	1.5	1.5	1.5
Width across flat	mm	14	17	19	22	24	27	30
Tightening torque	N-m (kgf-m)	13 - 17 (1.3 - 1.7)	27 - 31 (2.8 - 3.2)	40 - 50 (4.1 - 5.1)	50 - 60 (5.1 - 6.1)	70 - 80 (7.1 - 8.2)	90 - 100 (9.2 - 10.2)	150 - 200 (15.2 - 20.4)

Note: Do not apply oil on bolts.

Check Hose Clips

■ **Re-tighten the hose clips for various rubber hoses (fuel, lubricating oil, cooling water, breather and intake air)**

A loose hose clip may result in water, lubricating oil and air leakage. Check for looseness and retighten.

Service period	1st time	50 hours (or 1 week) later
	2nd time and after	Every 500 hours (or every 3 months)

■ **Check and replace rubber hoses (fuel, lubricating oil, cooling water, breather and intake air)**

Rubber hoses harden and deteriorate with age. Check for deformation, hardening, cracks or the like periodically. If any abnormality is found, replace it with a new one.

Service period	Check	Every 2500 hours (or annually)
	Replace	Every 5000 hours (or every 2 years)

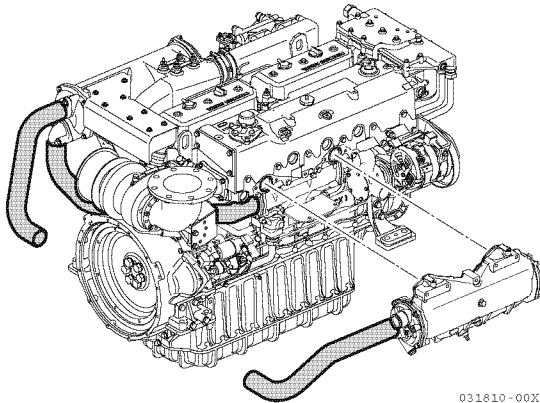


Figure 38

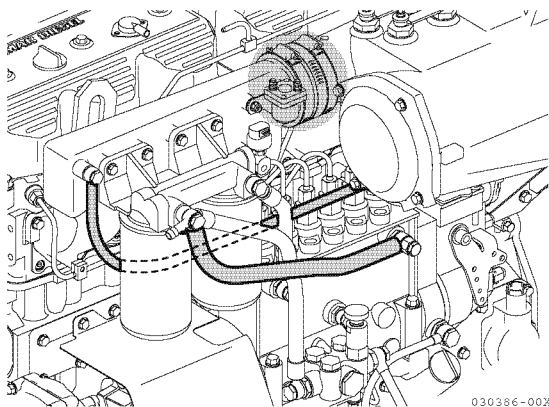


Figure 39

■ **Check and replace sensors for instrument panel**

Check sensors for instrument panel. If there is any abnormality, replace sensor.

Service period	Check	Every 2500 hours
	Replace	Every 5000 hours

■ **Check wire harness**

1. Check the coner of the wire harness

Peeling, scraping and heat hardening of the wire harness cover may result in failures including electrical burning, malfunction or the like. Check the wire harness. If any abnormality is found, repair or replace it with a new one.

Service period	Every 1000 hours (or every 5 - 6 months)
----------------	--

2. Check the electric device connection terminal

A loose connection terminal may result in malfunction. Check each connection terminal and retighten it if there is looseness.

Service period	Every 1000 hours (or every 5 - 6 months)
----------------	--

3. Check the connector contact terminal

Corrosion and continuity failure in connector contact terminal may result in failures including malfunction of the electric device or the like. Check the connector contact terminal for corrosion and inspect continuity as required. If any abnormality is found, replace it with a new one.

Service period	Check	Every 1000 hours (or every 5 - 6 months)
	Replace	If failed

PERIODIC MAINTENANCE

Valve Clearance Adjustment

Adjusting the valve clearance should be done while the engine is cold.

■ Valve bridge parallel adjustment

Adjustment procedures for the intake and exhaust valves are the same.

1. Turn the flywheel until the No.1 cylinder is at T.D.C. (Top Dead Center) on the compression stroke.
2. Loosen the valve bridge lock nut and loosen the bridge adjusting screw 1 - 2 turns.
3. Loosen the rocker arm lock nut and screw in the adjusting screw until the rocker arm tip just touches the bridge center.

NOTICE

Do not tighten the adjusting screw or it will compress the valve spring.

4. Screw in the valve bridge adjusting screw until it just touches the valve stem.

NOTICE

Be careful not to screw in the adjusting screw since it will compress the valve spring.

5. Keep the adjusting screw in this position and tighten the bridge lock nut with a wrench.

NOTICE

Secure the valve bridge with the adjusting wrench or the like, when you tighten the nut. Tightening the nut without securing the valve bridge may cause the valve to bent.

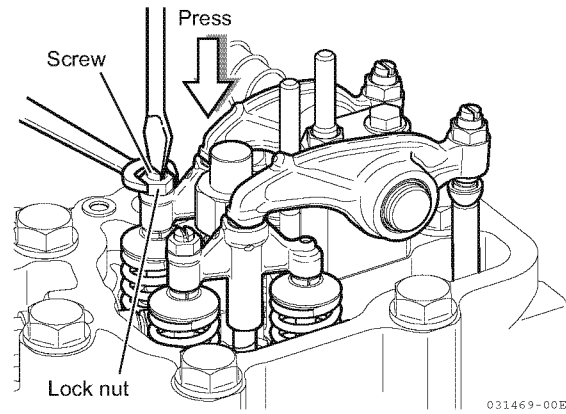


Figure 40

■ Valve clearance adjustment

Valve clearance	Intake	$0.25 \pm 0.05\text{mm}$
	Exhaust	$0.40 \pm 0.05\text{mm}$

Insert a thickness gauge between the rocker arm and the center of the bridge and adjust valve clearance by turning the adjusting screw. Tighten the lock nut and recheck the valve clearance.

Service period	1st time	50 hours (or every week)
	2nd time and after	Every 1000 hours (or every 5 - 6 months)

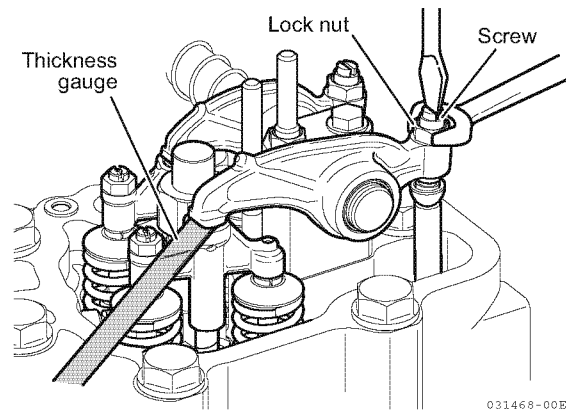


Figure 41

Fuel System

(For fuel system diagram, refer to Fuel on page 8.)

■ Fuel level check

Service period	Daily
----------------	-------

Refill as required.

■ Fuel tank deposit draining

Open the drain cock on the tank to drain out sediment and water at the tank bottom.

Service period	Daily (when refilling)
----------------	------------------------

■ Fuel filter element replacement and water separator

Service period	Every 500 hours (or 2 - 3 months)
----------------	-----------------------------------

Replace the fuel filter and the water separator periodically. Dust and other foreign substances contained in fuel may cause clogging, preventing fuel flow.

Fuel filter

1. Close the fuel cock of the fuel tank.
2. Turn each fuel filter cartridge counterclockwise to remove it.
3. Replace it with a new filter cartridge.
4. Open the fuel cock.
5. After replacing each filter cartridge, be sure to bleed the air trapped in the fuel system. (Refer to page 11 and 12.)

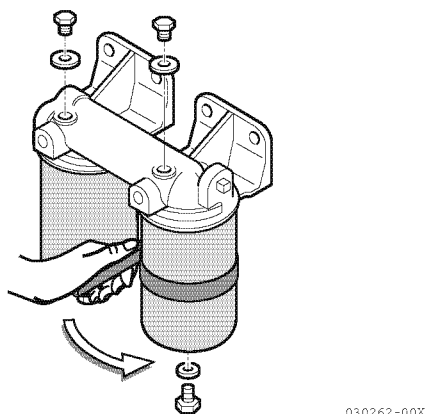


Figure 42

Water separator

1. Close the fuel cock of the fuel tank.
2. Loosen the center bolt (2, Figure 43) of the water separator, remove the lower casing, and extract the internal element.
3. Replace it with a new element (1, Figure 43) and tighten the center bolt (2, Figure 43) securely. Replace the packing (3, Figure 43), if damaged.
4. Open the fuel cock.
5. After replacing the element (1, Figure 43), be sure to bleed the air trapped in the fuel system using the air bleed plug (4, Figure 43).

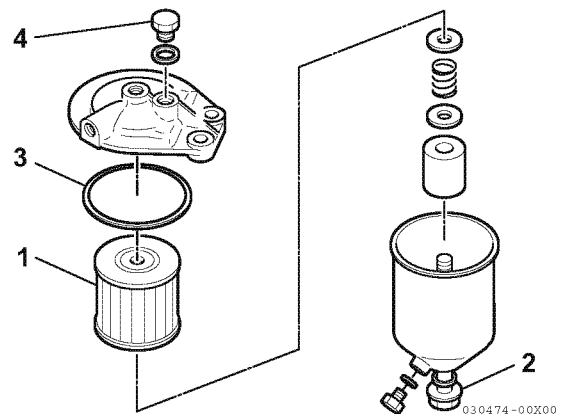


Figure 43

NOTICE

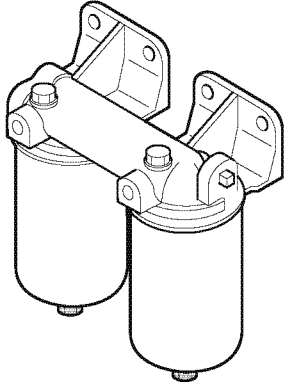
- Before installing the element, clean the inside of the filter case.
- Do not forget to install the spring, retainer and O-rings.
- After replacing the element, be sure to bleed air from the fuel system.

PERIODIC MAINTENANCE

■ Fuel filter and water separator draining

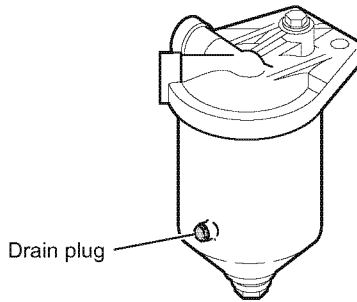
Remove the drain plug to drain water from the fuel filter and water separator.

Service period	Every 50 hours (or weekly)
----------------	----------------------------



030261-00X00

Figure 44



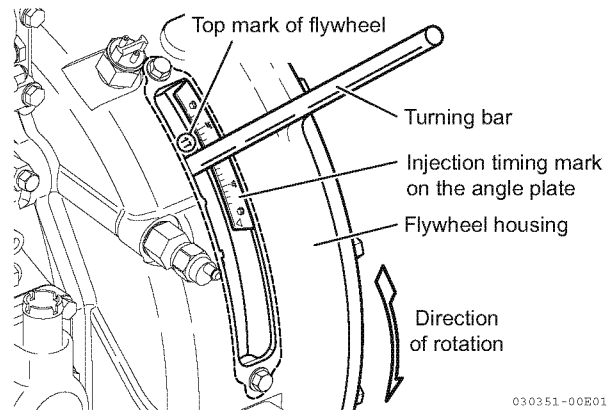
030908-00E

Figure 45

■ Fuel injection timing

Inspection

1. Set the piston of the No.1 cylinder to T.D.C. (compression stroke.)
Make sure that the marking 1.6 T on the flywheel is aligned with the top position of the angle plate.
2. Set the piston of the No.1 cylinder to approximately 50° before T.D.C.
Then adjust the injection timing by turning the flywheel in the normal rotating direction, and align the 1.6 T marking on the flywheel to the position 11° on the angle plate.
3. Check to see that the guide markings for the body of the fuel injection pump and the automatic timer are aligned. When they are aligned, the injection timing is standard.



030351-00R01

Figure 46

Adjustment

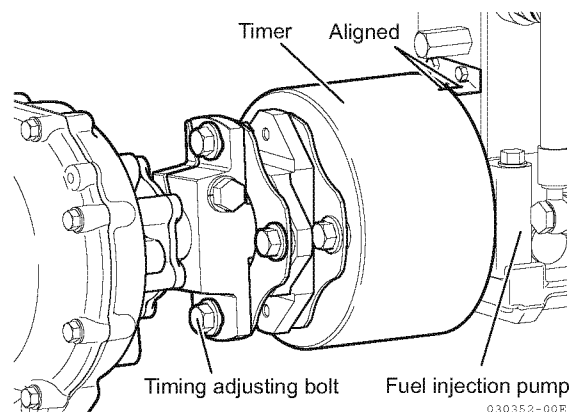
1. Set the piston of the No.1 cylinder to T.D.C. and align the 1.6 T marking on the flywheel with the standard injection timing (11°).

Injection timing (FID)	11° ± 1° B.T.D.C.
------------------------	----------------------

2. Loosen the timing adjusting bolts (2 bolts) for the fuel injection pump timer, and turn the timer by hand to align the guide markings on the body of the fuel injection pump and the automatic timer. When they are aligned, the injection timing is standard.

Service period	1st time	250 hours
	2nd time and after	Every 2500 hours (or annually)

3. After completing adjustment, tighten the timing adjusting bolts firmly and evenly.



030352-00E

Figure 47

Injection nozzle (consult your Yanmar dealer or distributor)

Replacement

Remove the injection nozzle, and replace it with a new one (consult your Yanmar dealer or distributor).

Service period	Every 2500 hours (or annually)
----------------	--------------------------------

Lubricating System

Oil level checking

Check the oil level with the dipstick. The oil level must be maintained between the upper and lower level marks on the dipstick. Add the recommended oil up to the upper level mark, if necessary.

Service period	Daily (prior to operation)
----------------	----------------------------

Replacing the full/bypass lubricating oil filter element (cartridge type)

1. Remove each filter element (cartridge) by turning it counterclockwise with a filter wrench.
2. Before replacing it with a new element (cartridge), clean the fitting surface carefully and lubricate the rubber packing surface.
3. Replace it with a new element (cartridge) and tighten it securely to the fitting surface by turning clockwise by hand. Then, retighten it with a filter wrench.
4. Operate the engine to check that there is no oil leakage.

Service period	1st time	50 hours (or after 1 week)
	2nd time and after	Every 500 hours (or every 2 - 3 months)

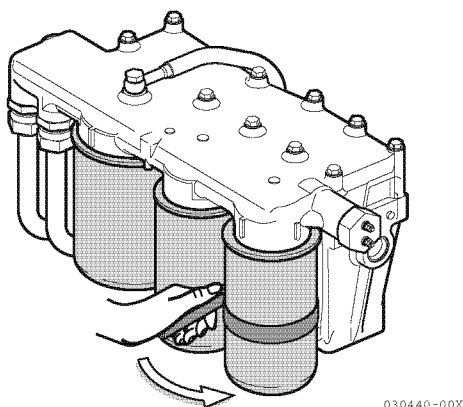


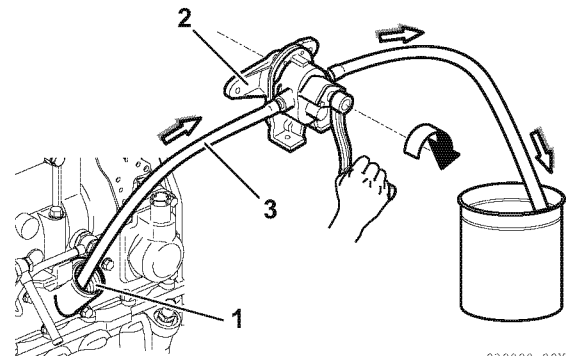
Figure 48

Engine oil change

Wait for about one to two hours after stopping the engine, connect the end of the rotary pump vinyl tube to the oil drain port, and drain oil. Fill the oil pan with recommended oil.

(Refer to Lubricating Oil on page 7.)

Service period	1st time	50 hours (or after 1 week)
	2nd time and after	Every 500 hours (or every 2 - 3 months)



- 1 - Oil port
- 2 - Rotary pump
- 3 - Vinyl tube

Figure 49

PERIODIC MAINTENANCE

Cooling System (Seawater and Coolant)

■ Seawater system

1. Discharging seawater

From time to time during operation, check if water is coming out of the seawater outlet pipe. If water comes out intermittently or its volume is low during a high-speed run, stop the engine immediately, and check for the cause.
(Refer to Fuel System Bleeding on page 11.)

Service period	Daily (durings operation)
----------------	---------------------------

2. Checking and replacement of zincs anode

Remove the zinc anode and scrape or remove with a wire brush the coating on the zincs. If more than 50 % of the zinc is corroded away, it should be replaced with new zinc.

Zincs anode are built into the following places:

	Q'ty
Heat exchanger.....	1
Engine lubricating oil cooler	1

Service period	Every 500 hours (or every 2 - 3 months)
----------------	--

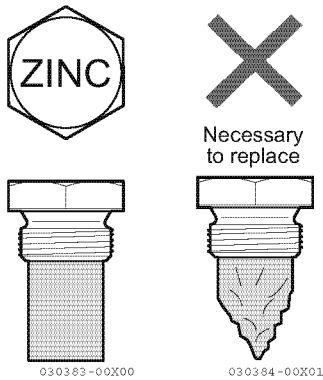
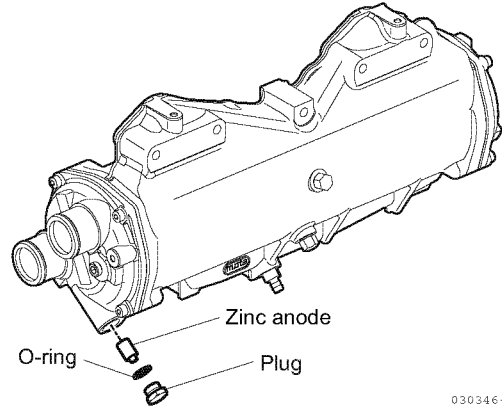


Figure 50

Heat exchanger



Lubricating oil cooler

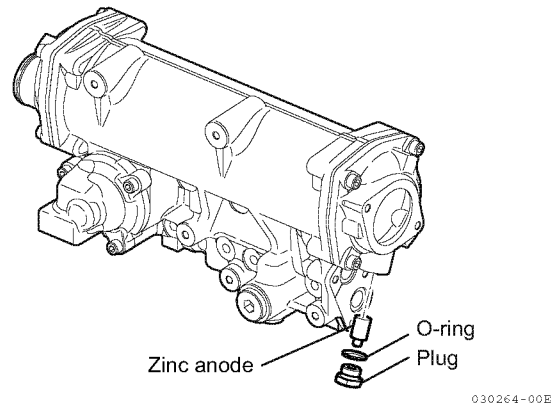


Figure 51

3. Checking and replacement of seawater pump impeller and casing (consult your Yanmar dealer or distributor)

- 1- Remove the seawater pump cover and pull out the impeller. Check the impeller, wear plate, cover, and mechanical seal for wear or damage.
- 2- If the wear plate and cover are excessively worn, replace them with new ones.
- 3- When reassembling the pump, apply grease to the fitting area of the pump shaft and impeller, both end faces of the impeller and the tip of impeller blades.
- 4- When installing the impeller, position blades of the impeller as shown in the figure.

Service period	Checking	Every 1000 hours (or every 5 - 6 months)
	Impeller replacement	Every 2500 hours (or annually)

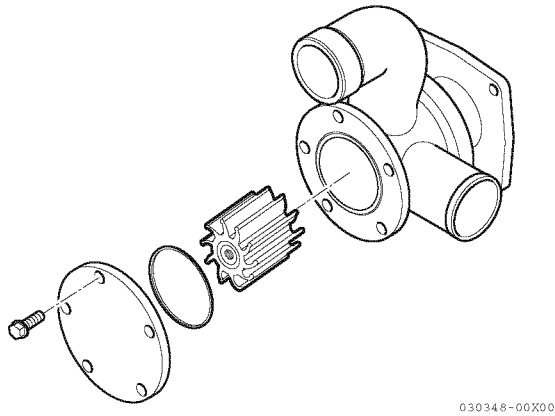


Figure 52

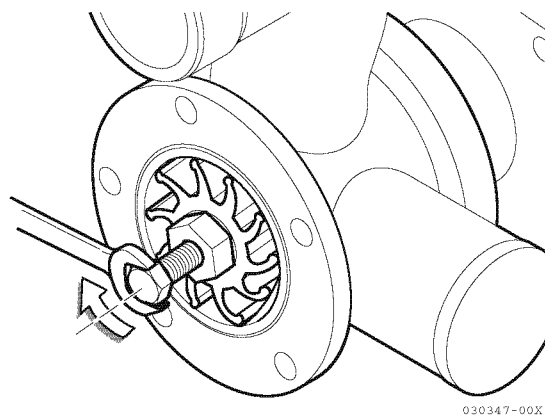


Figure 53

4. Seawater system cleaning

As the engine is used, coolers become fouled, their cooling effect worsens, and coolant temperature becomes abnormally high (above 85 °C). Consequently, eliminate fouling of the seawater system, coolers in particular. To clean the seawater system, consult your Yanmar dealer or distributor.

■ Coolant system

1. Coolant level checking

- 1- Remove the filler cap from the coolant tank, and check coolant level.
The level should be at the filler neck. If the level is low, add soft water up to the filler neck.

⚠ DANGER

**Do not remove the filler cap when the engine is hot (above 60 °C).
The coolant is under pressure and severe scalding could result.**

- 2- On the cooling system with reservoir tank, check the coolant level in the reservoir tank. The level should be between the “FULL” and “LOW” level marks. Add soft water up to the “FULL” mark.

Service period	Daily
----------------	-------

2. Replace coolant pump mechanical seal

Leakage of coolant may cause serious problems, such as seizure of the engine, as the volume of coolant decreases. Check that there is no water leakage from the mechanical seal of the coolant pump. If there is water leakage, consult your Yanmar dealer or distributor.

Service period	Every 2500 hours (or annually)
----------------	-----------------------------------

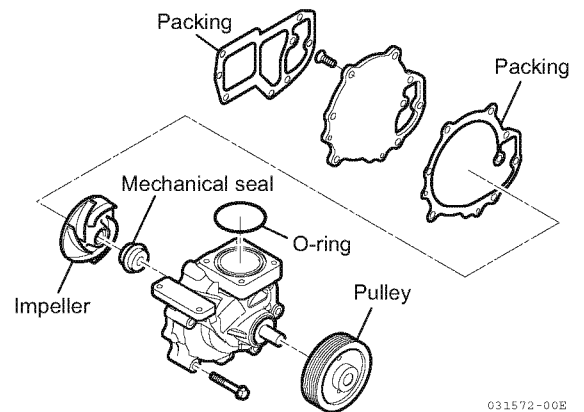


Figure 54

3. Replace coolant

As the coolant system becomes dirty naturally, cooling efficiency worsens, and coolant temperature becomes abnormally high (above 85 °C) when the engine is operated for long time, replace coolant periodically. At the same time, clean the thermostats. As for periodic servicing, consult your nearest Yanmar dealer or distributor.

Service period	Check	Every 2500 hours (or annually)
	Replace	Every 5000 hours (or every 2 years)

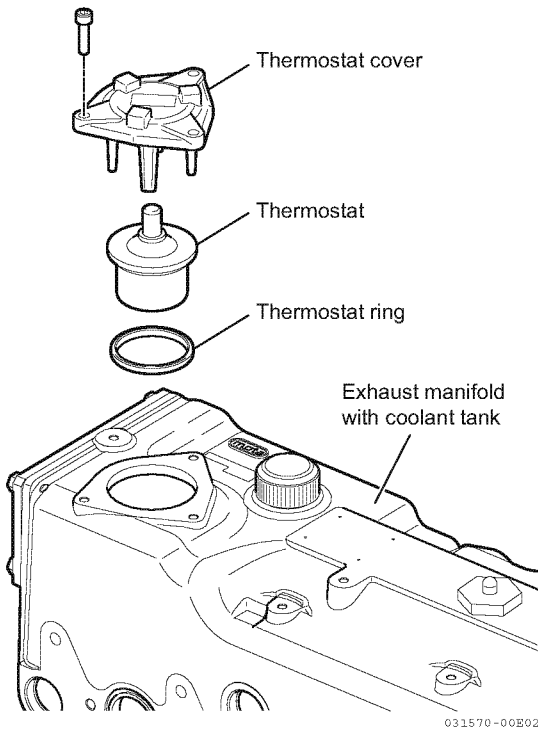


Figure 55

4. Coolant change

Service period	Every 2500 hours (or annually)
----------------	-----------------------------------

NOTICE

- Be sure to replace the cooling water at the specified time.
- Be sure to follow the correct mixture ratio for long life coolant (LLC).
(Refer to *Cooling Water* on page 7.)

Turbocharger

1. Clearing of pre-filter and turbocharger

Refer to Checking and Servicing the Turbocharger on page 25.

2. Checking each joint area

Check the turbocharger-to-aircooler and turbocharger-to-exhaust manifold connections for damage or leaks.

Service period	Daily
----------------	-------

3. Overhaul

Consult your Yanmar dealer or distributor.

Service period	Every 5000 hours (or 2 years)
----------------	----------------------------------

Air Cooler

Checking and replacement of zinc anode.
(Refer to *Cooling System (Seawater and Coolant)* on page 34.)

Service period	Every 500 hours (or every 2 - 3 months)
----------------	--

Remote Control Cables

■ Throttle handle

Operate the throttle handle from the position “L” to the position “H”, and check if the governor lever at the governor moves into the correct position. If there is disalignment between the throttle handle and the governor lever in their position, adjust the control cable by changing the clamping position of the bracket (1, Figure 57).

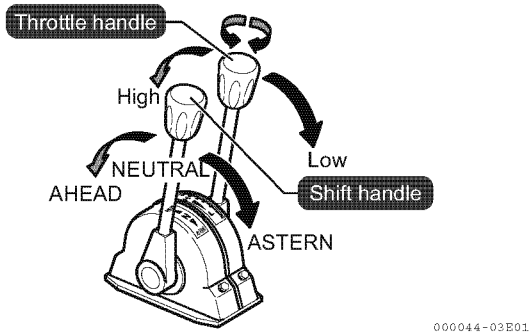


Figure 56

Service period	1st time	250 hours (or every month)
	2nd time	Every 500 hours (or 2 - 3 months)
	Replace	Every 5000 hours (or every 2 years)

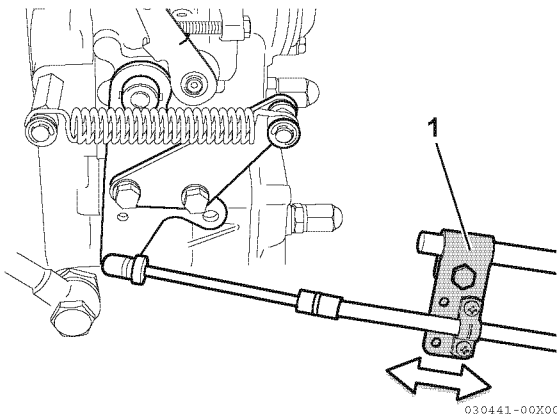


Figure 57

Electrical Parts

■ Checking warning lamps and devices

⚠ DANGER



- Recharging produces hydrogen gas. Provide a good ventilation and keep open flames and sparks away from the area.

Refer to Alarm Devices on page 16.

Service period	Daily
----------------	-------

■ Battery electrolyte level

Battery electrolyte decreases as charging and discharging are repeated. Check if the electrolyte level is 10 - 20 mm above the pole plates. If level is low, add distilled water. Refer to the figure below.

Service period	Every 250 hours (or every months)
----------------	-----------------------------------

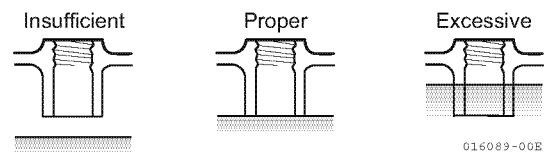


Figure 58

■ Alternator drive belt tension

If tension of the belt is too strong, wear and tear of the belt are more rapid. If too weak, the belt slips and the alternator does not charge. Check if the belt deflection is 5 - 6 mm by pushing the center of the belt between the pulleys with 100 N (10 kgf) force.

To adjust, turn the adjusting bolts and move the alternator until the proper belt tension is obtained.

Deflection		5 - 6 mm (Pressed by 100 N)
Service period	1st time	1st 50 hours (or one week later)
	2nd or after	Every 500 hours (or every 2 - 3 months)

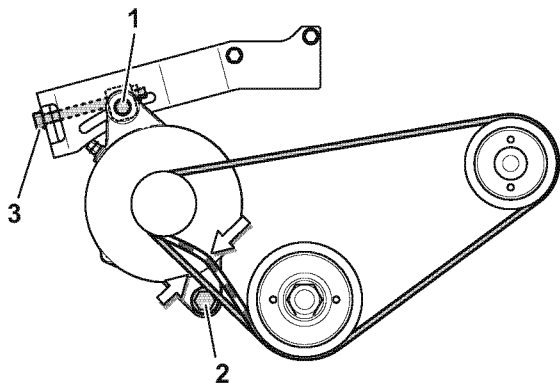
Yanmar Standard Motor-driven Bilge Pump (Option)

■ Features

1. Since parts of this bilge pump that come in contact with bilge are made of polyvinyl chloride (PVC) and acid and alkali resistant materials, you may use this pump without worrying about its wearing out.
2. There is no need to worry about idling or seizure of this bilge pump because it is equipped with a protective device which brings about an automatic stop when bilge is gone and the pump does not lift anything.

■ Method of fitting and use

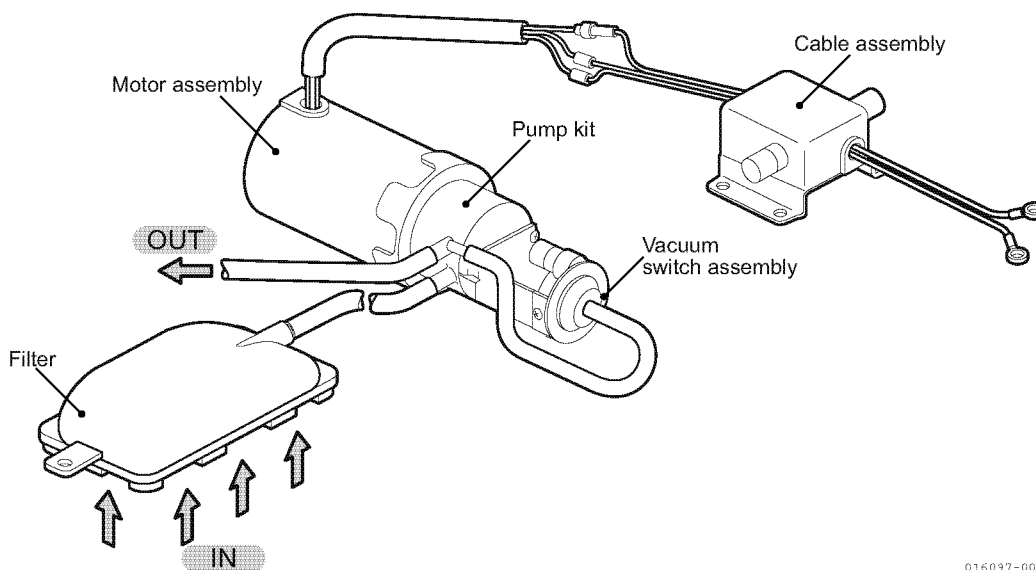
1. Connect the red wire to positive (+) and black wire to negative (-) respectively, avoid mis-wiring.
2. Install the pump body where it can be used easily with the battery and operating switch as the pump body is connected with 3 m long cord.
3. Fit the strainer part of the bilge pump to the ship bottom by use of metal fittings.



030349-00X

- 1 - Set bolt
- 2 - Set bolt
- 3 - Adjust bolt

Figure 59



016097-00E

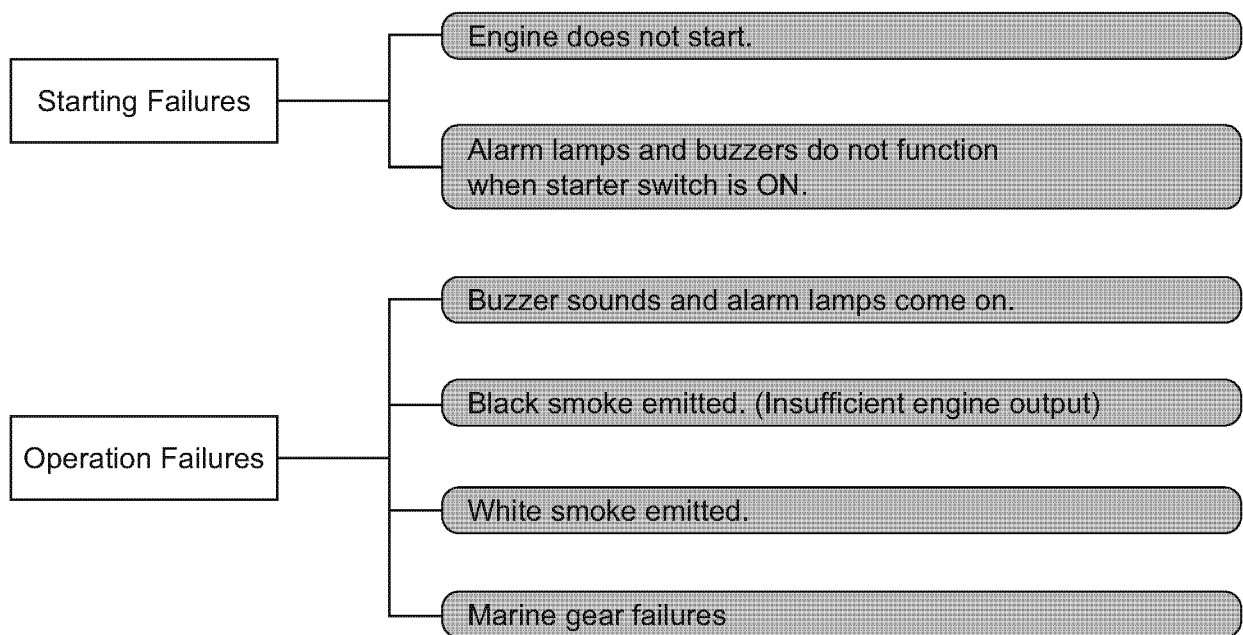
Figure 60

TROUBLESHOOTING

Simple Problems and the Appropriate Countermeasures

If you encounter some difficulty during operation, try to identify what kind of failure has occurred and stop the engine immediately. Then, you can check and troubleshoot the engine for that failure.

The tables of failures and countermeasures provided in each section include the corresponding part numbers used in the “External View” section. Refer to these numbers to locate the target parts in the schematic drawings and take appropriate countermeasures.

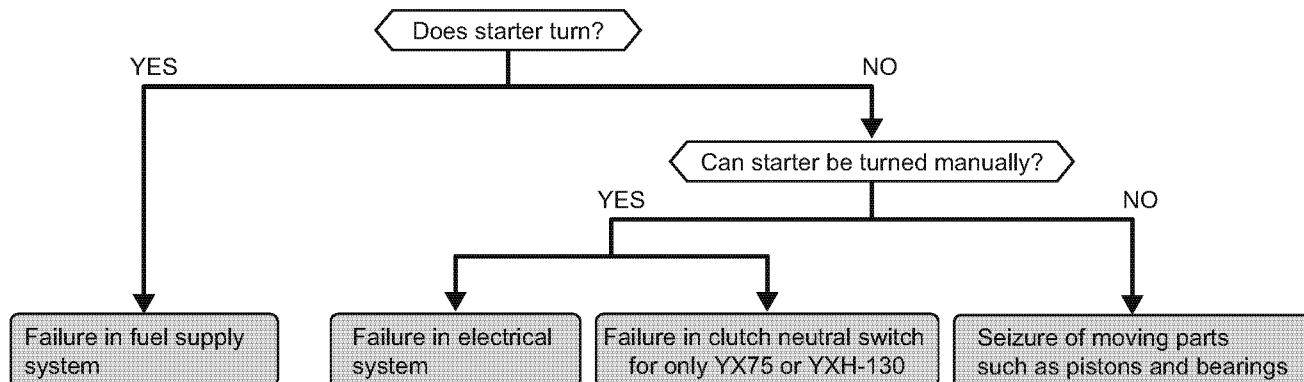


006684-00E02

NOTICE

- Although some failures can be solved by the user, others are not. For failures that require disassembly for repair and servicing or those that are not covered in this chapter, consult your Yanmar dealer or distributor.
- If you judge that you can continue using the engine after inspection, cruise at a slow speed to return to port and, when landed, ask for repairs. If you cannot judge on your own, ask your Yanmar dealer or distributor.
- Do not operate the engine if alarm devices are not working properly. Doing so may lead to a severe accident in case of a failure because you will not receive any alarm notifications.

Engine Does not Start



006685-00E01

■ Failure in fuel supply system

No.	Failure Content	Countermeasure	Part
1	Fuel valve (cock) is closed	Open the fuel valve (cock)	–
2	Fuel tank is empty	Refill with fuel	–
3	Air is trapped in fuel system	Bleed air	6
4	Fuel filter is clogged	Replace the cartridge	6
5	Water separator is clogged	Replace the filter element	–
6	Fuel injection nozzle atomization is abnormal	Service the fuel injection nozzle	–
7	Engine stop lever is pulled toward Low fuel side	Adjust the stop cable position	14
8	Fuel piping is clogged with foreign substances	Clean the interior of piping	6

■ Failure in electrical system

No.	Failure Content	Countermeasure	Part
1	Battery switch is not turned on.	Turn the battery switch to "ON"	13
2	Battery charge level is low	Recharge the battery	13
3	Battery fluid level is low	Refill with battery fluid	13
4	Starter or starter relay is defective	Replace the starter or starter relay	24
5	Connecting coupler has a bad connection	Remove and reinstall the coupler	13, 24
6	Cable terminal is not tightened sufficiently	Retighten the terminal	4, 13, 24
7	Harness cable is broken	Replace the harness, or join the broken pieces of cable and wrap vinyl tape around it as an emergency procedure	4

■ Failure in clutch neutral switch for only YX75 or YXH-130

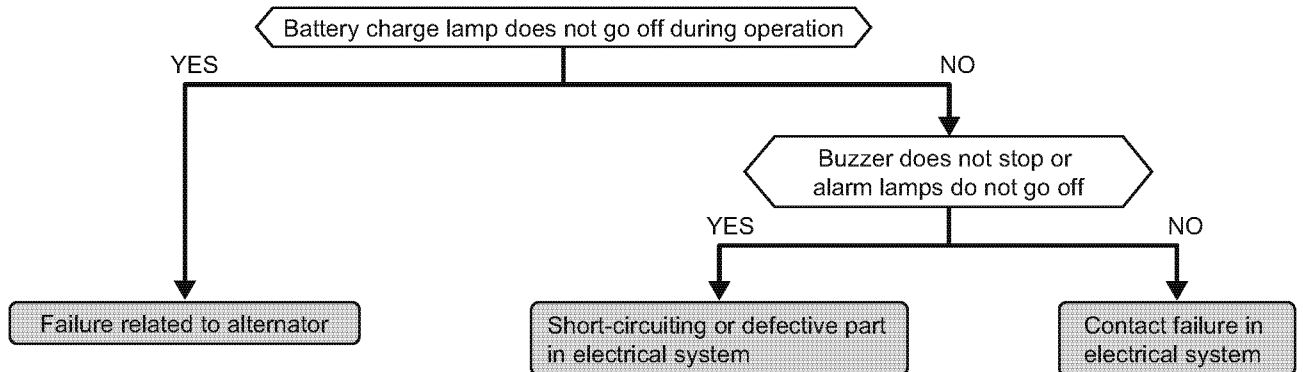
No.	Failure Content	Countermeasure	Part
1	Shift handle is not put in Neutral	Put the shift handle in Neutral position	15
2	Clutch neutral switch is defective	Replace the clutch neutral switch	–

■ Seizure of moving parts such as pistons and bearings

No.	Failure Content	Countermeasure	Part
1	Moving part is seized up	Consult your Yanmar dealer/distributor	–

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

Alarm Lamps and Buzzers Do not Function when Starter Switch is ON



006686-00E

■ **Failure related to alternator**

No.	Failure Content	Countermeasure	Part
1	Engine speed is low	Increase engine speed	15
2	Alternator drive belt is loosened	Adjust the belt tension	9
3	Alternator is defective	Replace the alternator	9
4	Lamp is defective	Replace the lamp	12

■ **Short-circuiting or defective part in electrical system**

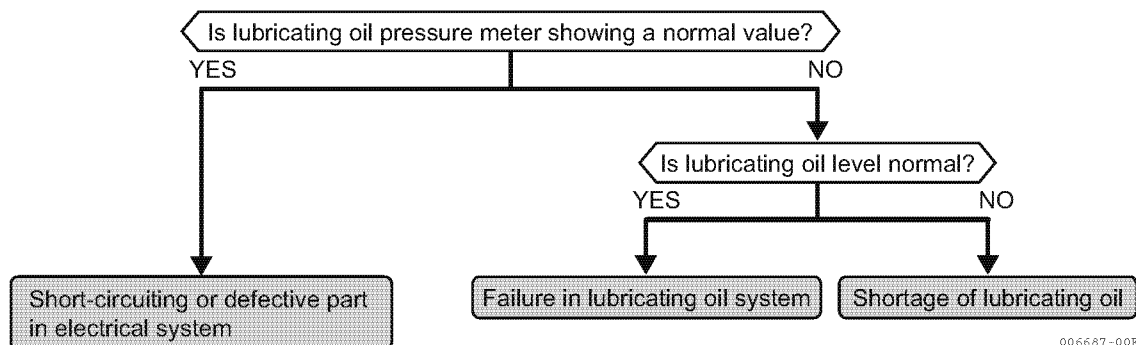
No.	Failure Content	Countermeasure	Part
1	Harness sheath is broken, causing short-circuiting	Replace the harness, or wrap vinyl tape around the sheath as an emergency procedure	4
2	Terminal is disconnected, causing short-circuiting	Retighten the terminal	4
3	Instrument panel is defective	Replace the instrument panel	12
4	Sensor/switch is defective	Replace the part	2, 5, 7, 18,19

■ **Contact failure in electrical system**

No.	Failure Content	Countermeasure	Part
1	Connection coupler has a bad connection	Remove and reinstall the coupler	4
2	Harness terminal is not tightened sufficiently	Retighten the terminal	4
3	Harness terminal is not caulked properly	Replace the harness	4
4	Harness terminals are corroded	Replace the harness	4
5	Harness wire is broken	Replace the harness	4

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

Lubricating Oil Pressure Alarm Lamp Comes on (Engine/Marine Gear)



005687-00E

■ Short-circuiting or defective part in electrical system

No.	Failure Content	Countermeasure	Part
1	Harness sheath is broken, causing short-circuiting	Replace the harness, or wrap vinyl tape around the sheath as an emergency procedure	4
2	Terminal is disconnected, causing short-circuiting	Retighten the terminal	4
3	Instrument panel is defective	Replace the instrument panel	12
4	Pressure switch is defective	Replace the pressure switch	5, 7

■ Failure in lubricating oil system

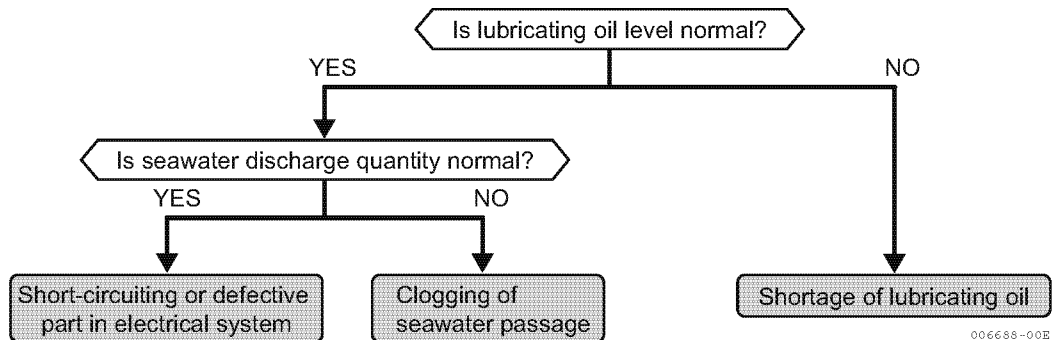
No.	Failure Content	Countermeasure	Part
1	Lubricating oil pressure regulating valve failed	Service the pressure regulating valve	21
2	Lubricating oil is contaminated severely (Engine/Marine Gear)	Replace the lubricating oil (Engine/Marine Gear)	-

■ Shortage of lubricating oil

No.	Failure Content	Countermeasure	Part
1	Lubricating oil level is low (Engine)	Refill with lubricating oil (Engine)	-
2	Lubricating oil level is low (Marine Gear)	Refill with lubricating oil (Marine Gear)	-
3	Lubricating oil is leaking	Locate where leakage is present and take corrective measure	-

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

Lubricating Oil Temperature Alarm Lamp Comes on



■ Short-circuiting or defective part in electrical system

No.	Failure Content	Countermeasure	Part
1	Harness sheath is broken, causing short-circuiting	Replace the harness, or wrap vinyl tape around the sheath as an emergency procedure	4
2	Terminal is disconnected, causing short-circuiting	Retighten the terminal	4
3	Instrument panel is defective	Replace the instrument panel	12
4	Temperature switch is defective	Replace the temperature switch	3

■ Clogging of seawater passage

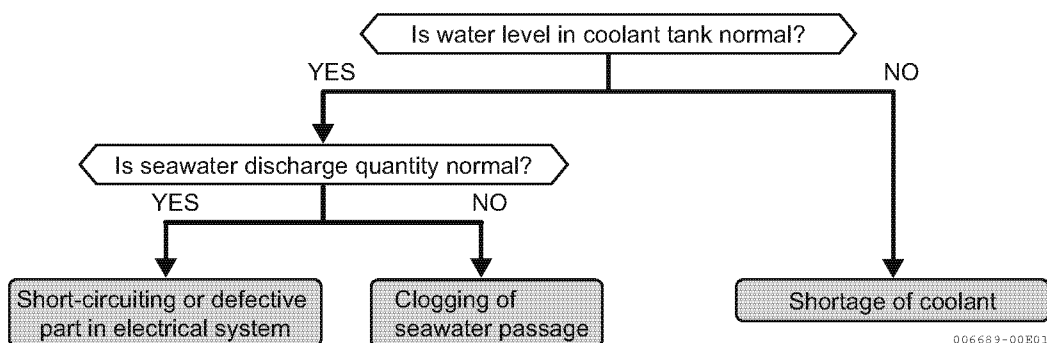
No.	Failure Content	Countermeasure	Part
1	Seacock is not fully opened	Open the seacock fully	10
2	Seacock is clogged	Remove anything that is clogged (inside boat or on bottom)	10
3	Seawater filter is clogged	Clean the seawater filter	11
4	Seawater passage side of heat exchanger/ lubricating oil/air cooler is clogged or contaminated	Clean the seawater passage side of cooler	22, 23
5	Seawater pump rubber impeller is broken	Replace the impeller	20

■ Shortage of lubricating oil

No.	Failure Content	Countermeasure	Part
1	Lubricating oil level is low	Refill with lubricating oil	—
2	Lubricating oil is leaking	Locate where leakage is present and take corrective measure	—

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

Cooling Water Temperature Alarm Lamp Comes on



! DANGER



- Never remove the filler cap from the coolant tank while the engine is still hot. Steam and hot water will spurt out and seriously burn you.

■ Short-circuiting or defective part in electrical system

No.	Failure Content	Countermeasure	Part
1	Harness sheath is broken, causing short-circuiting	Replace the harness, or wrap vinyl tape around the sheath as an emergency procedure	4
2	Terminal is disconnected, causing short-circuiting	Retighten the terminal	4
3	Instrument panel is defective	Replace the instrument panel	12
4	Temperature switch is defective	Replace the temperature switch	19

■ Clogging of seawater passage

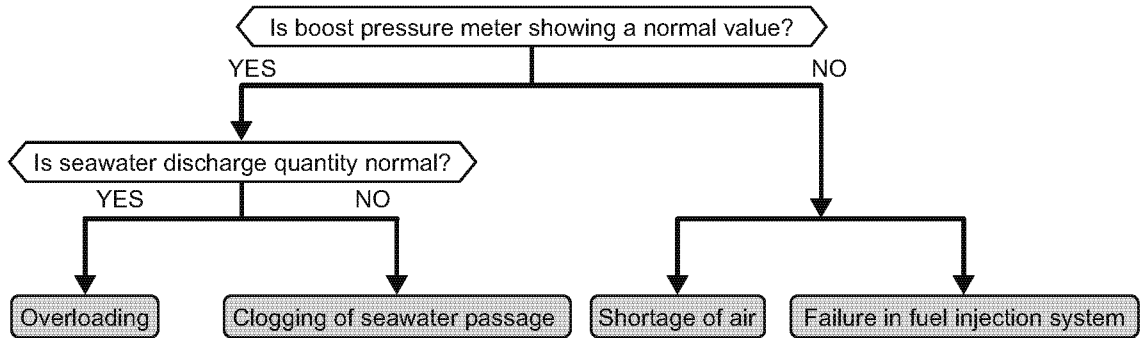
No.	Failure Content	Countermeasure	Part
1	Seacock is not fully opened	Open the seacock fully	10
2	Seacock is clogged	Remove anything that is clogged (inside boat or on bottom)	10
3	Seawater filter is clogged	Clean the seawater filter	11
4	Seawater passage side of heat exchanger/ lubricating oil/air cooler is clogged or contaminated	Clean the seawater passage side of cooler	22, 23
5	Seawater pump rubber impeller is broken	Replace the impeller	20

■ Shortage of coolant

No.	Failure Content	Countermeasure	Part
1	Coolant level is low	Refill with coolant	1
2	Coolant is leaking <ul style="list-style-type: none"> • Coolant pump mechanical seal is defective • Rubber hose band is loosened • Drain cock is not fully closed • Piping is not sealed properly • Filler cap is defective • Gas is leaking from head gasket 	Locate where leakage is present and take corrective measure such as tightening and replacing part	—

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

Black Smoke Emitted (Insufficient Engine Output)



008246-00E01

■ Overloading

No.	Failure Content	Countermeasure	Part
1	Propeller is damaged or contaminated	Repair, replace, or clean the propeller	–
2	Hull is noticeably contaminated	Clean the hull	–
3	Attitude of hull is not good	Change the load position	–
4	Boat is overloaded	Respect the load capacity	–
5	Propeller shaft is not centered to engine	Center the propeller shaft	–

■ Clogging of seawater passage

No.	Failure Content	Countermeasure	Part
1	Seacock is not fully opened	Open the seacock fully	10
2	Seacock is clogged	Remove anything that is clogged (inside boat or on bottom)	10
3	Seawater strainer is clogged	Clean the seawater strainer	11
4	Seawater passage side of heat exchanger/ lubricating oil cooler is clogged or contaminated	Clean the seawater passage side of cooler	22, 23
5	Seawater pump rubber impeller is broken	Replace the impeller	20

■ Shortage of air

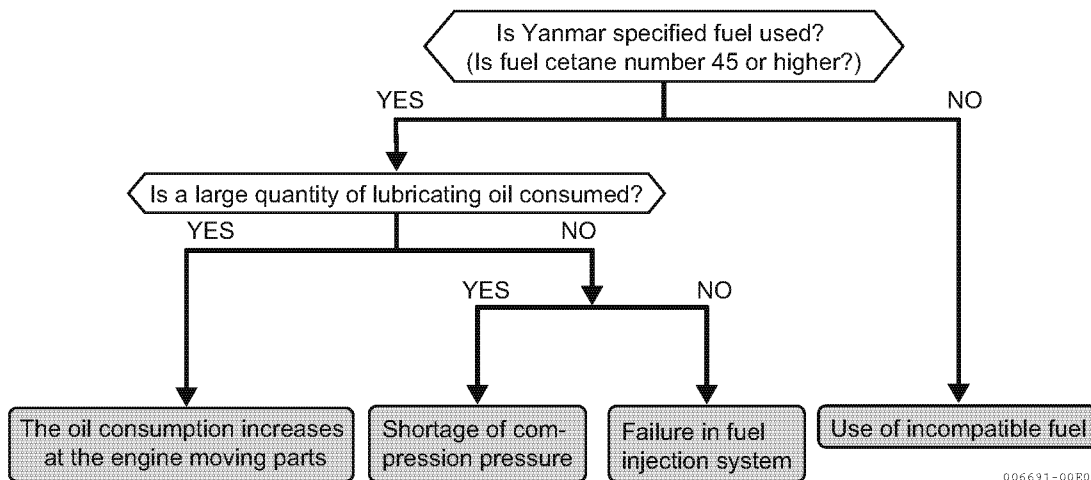
No.	Failure Content	Countermeasure	Part
1	Ventilator switch is not turned on	Turn the switch to ON	–
2	Ventilator is defective	Replace the ventilator	–
3	Ventilating hole is blocked	Remove anything that blocks the ventilating hole	–

■ Failure in fuel injection system

No.	Failure Content	Countermeasure	Part
1	Fuel nozzle atomization is abnormal	Service the fuel valve	–
2	Fuel injection timing is not correct	Adjust the fuel injection timing correctly	–

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

White Smoke Emitted



■ The oil consumption increases at the engine moving parts

No.	Failure Content	Countermeasure	Part
1	Oil ring or piston ring is worn out	Replace the ring	–
2	Valve stem seal is defective	Replace the valve stem seal	–
3	Valve guide is worn out	Replace the valve guide	–
4	Cylinder liner is worn out	Service or replace the cylinder liner	–

■ Shortage of compression pressure

No.	Failure Content	Countermeasure	Part
1	Intake/exhaust valve makes improper contact	Service or replace the intake/exhaust valve	–
2	Piston ring is worn out	Replace the piston ring	–
3	Cylinder liner is worn out	Service or replace the cylinder liner	–

■ Failure in fuel injection system

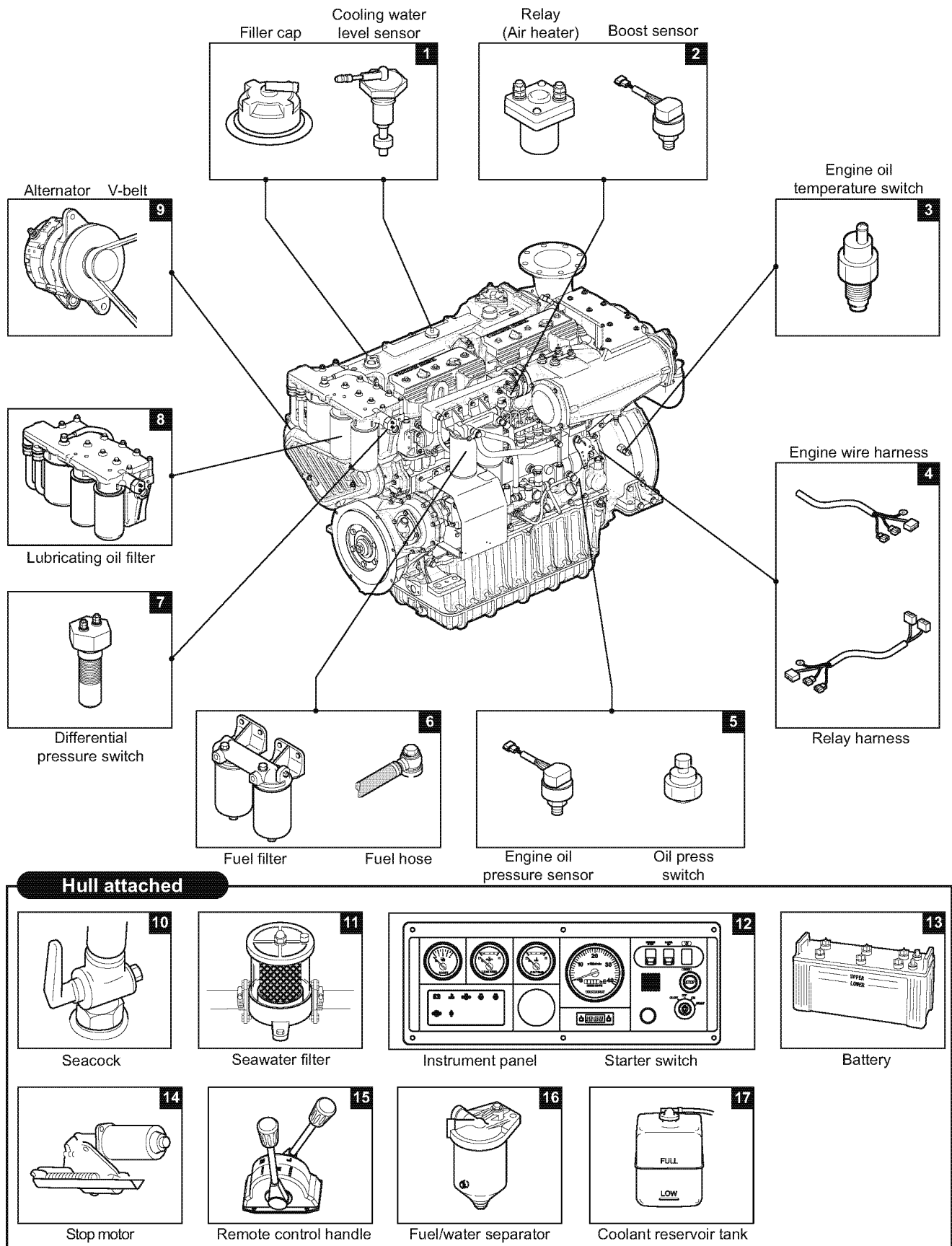
No.	Failure Content	Countermeasure	Part
1	Fuel nozzle atomization is abnormal	Service or adjust the fuel valve	–
2	Fuel injection timing is not correct	Adjust the fuel injection timing correctly	–

■ Use of incompatible fuel

No.	Failure Content	Countermeasure	Part
1	Fuel does not provide properties specified by Yanmar	Use the fuel oil specified by Yanmar	–

If the above countermeasures do not solve your problem or are difficult to handle on your own, consult your Yanmar dealer or distributor.

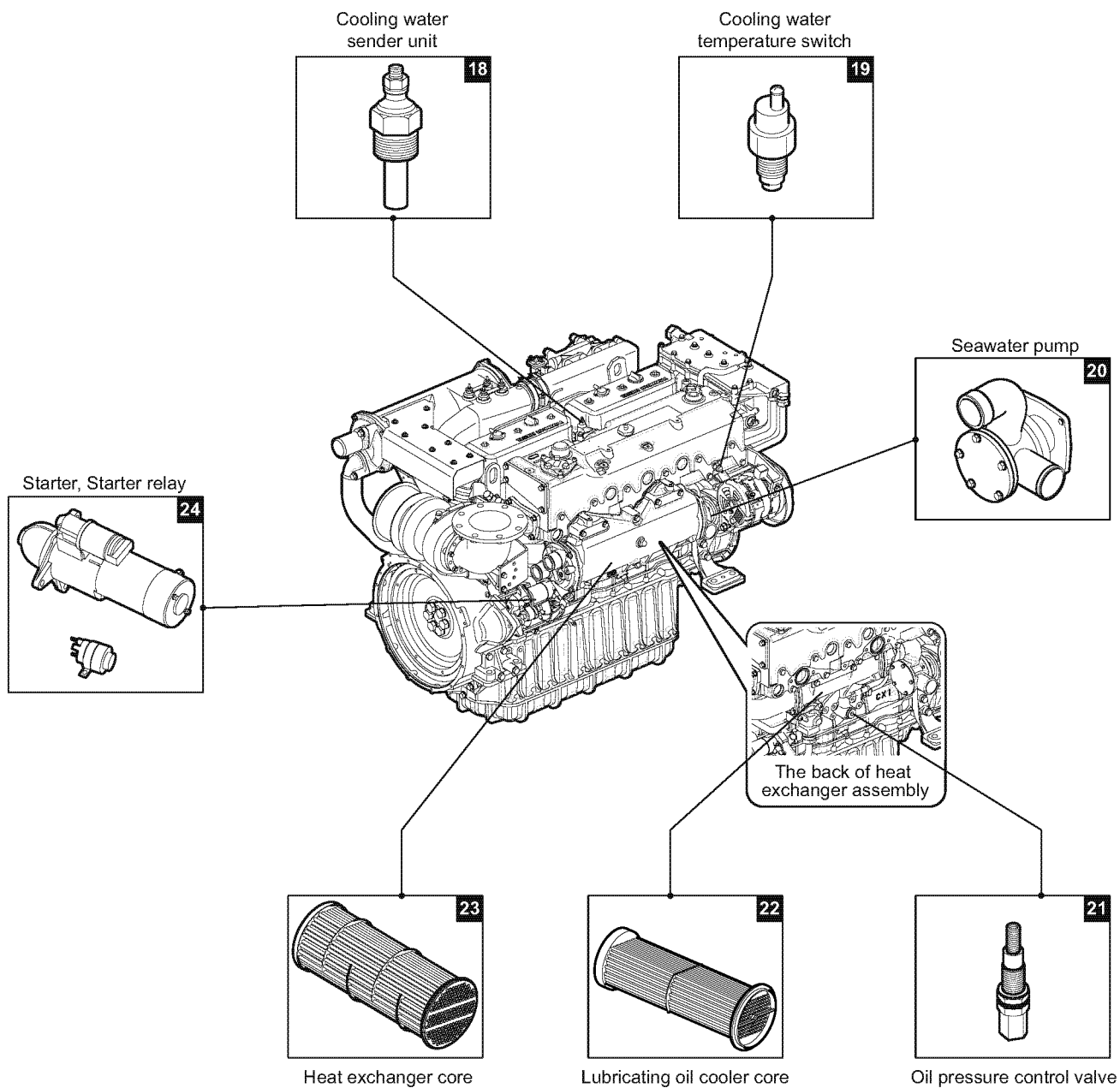
External View (Operation Side)



031811-002

Figure 61

External View (Non-Operation Side)

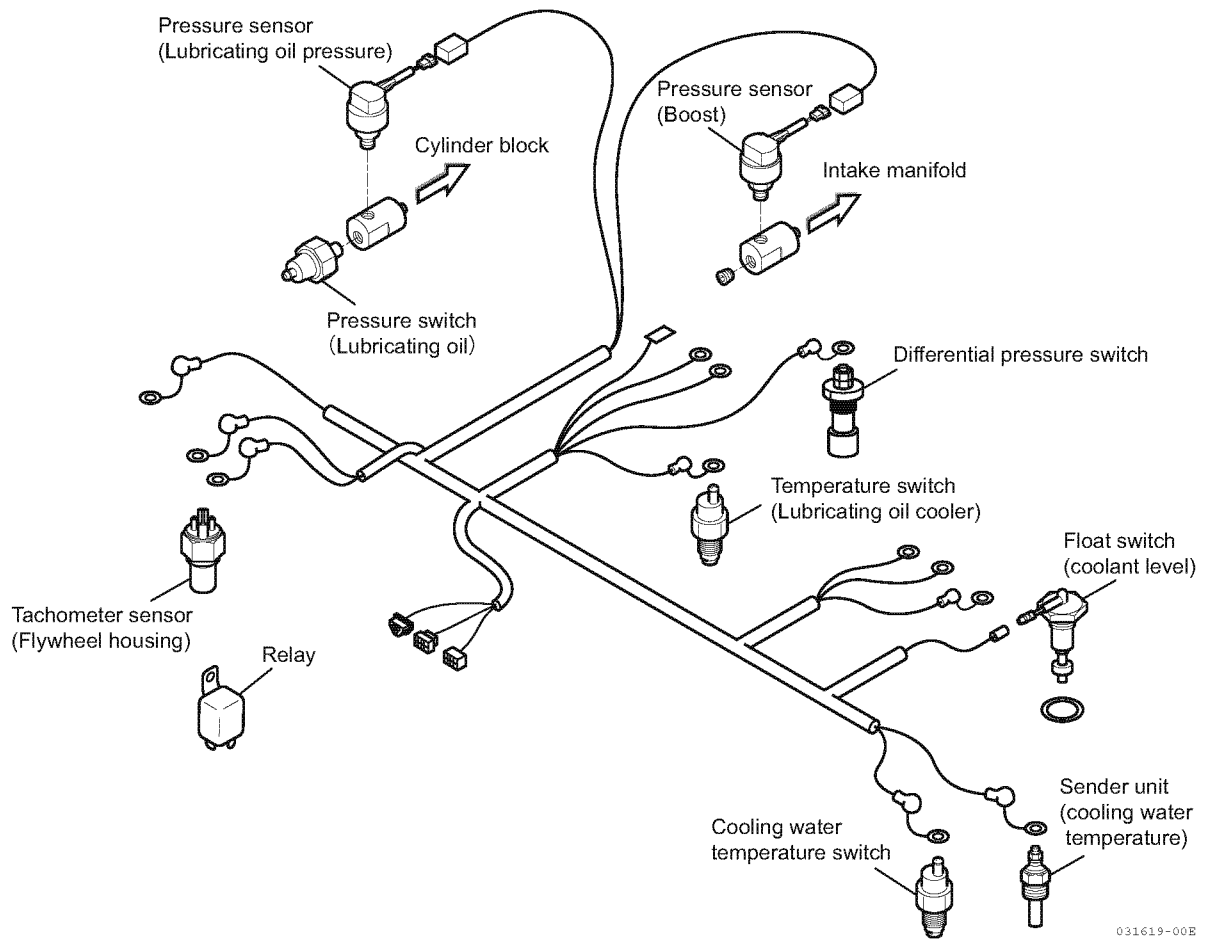


031812-00E01

Figure 62

Wire Harness (Engine)

■ Negative ground type (standard)



031619-00B

Figure 63

TROUBLESHOOTING

■ Earth floating type (option)

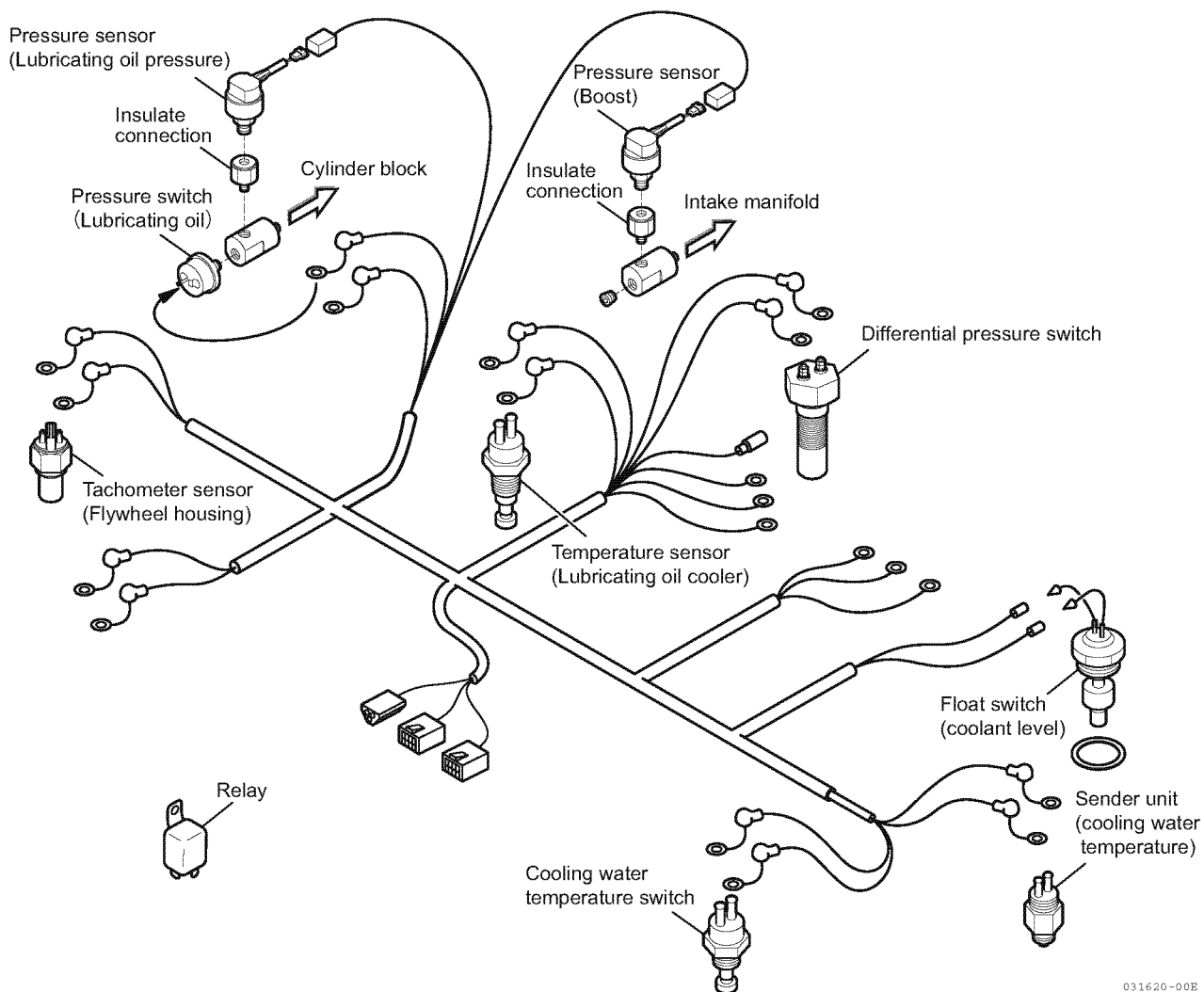


Figure 64

WIRING DIAGRAMS
24 V Engine Negative Ground Type (Standard)

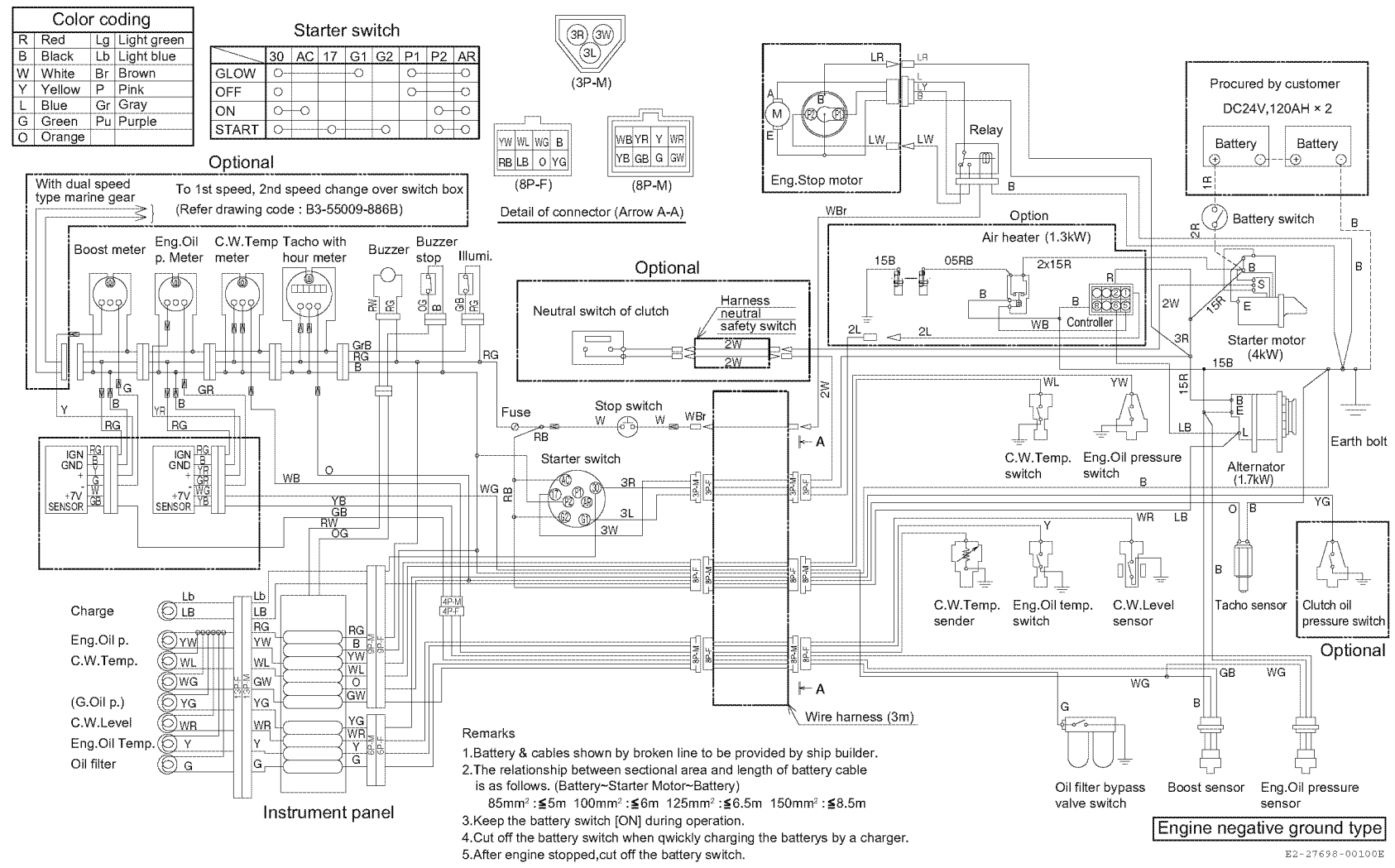
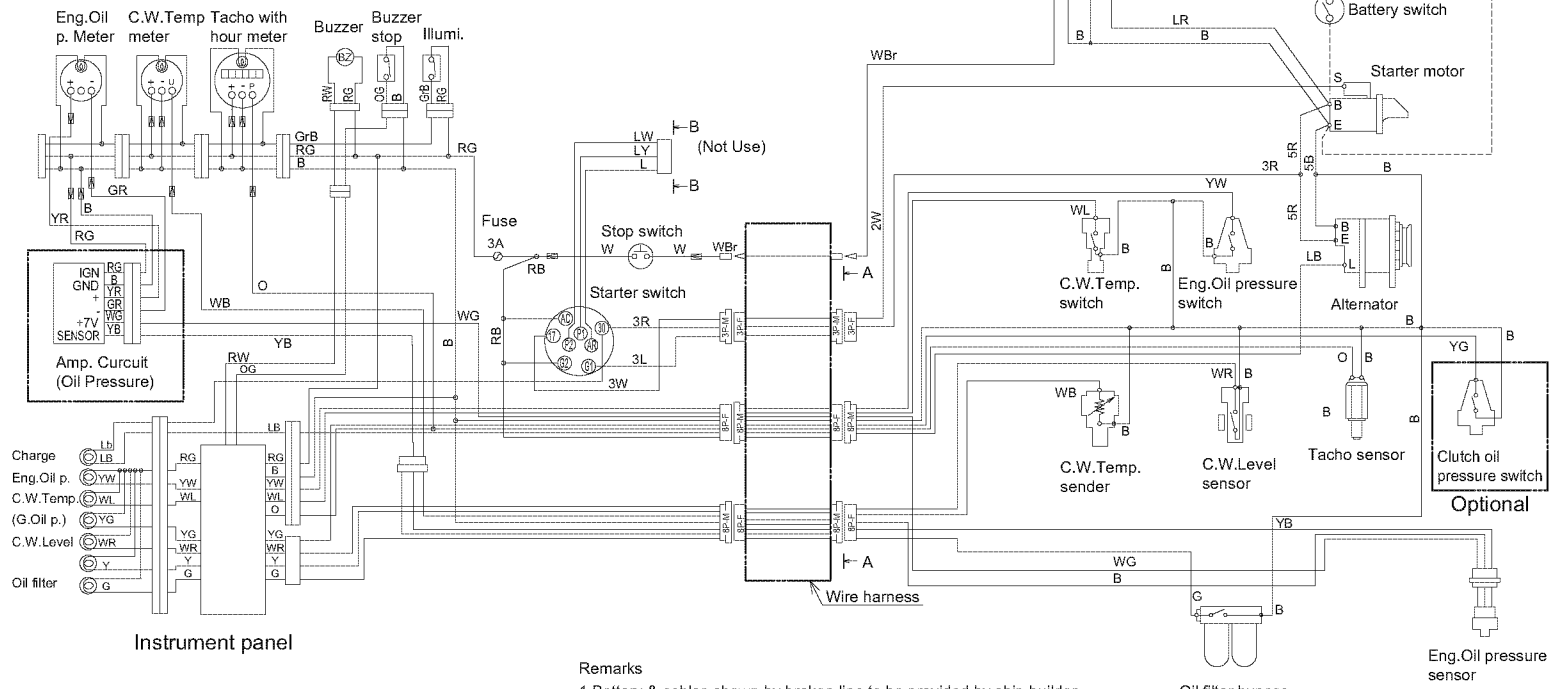


Figure 65

Color coding			
R	Red	Lg	Light green
B	Black	Lb	Light blue
W	White	Br	Brown
Y	Yellow	P	Pink
L	Blue	Gr	Gray
G	Green	Pu	Purple
O	Orange		

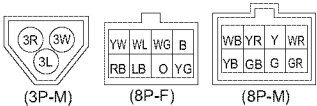
	30	AC	17	G1	G2	P1	P2	AR
GLOW	○			○				○
OFF	○							○
ON	○	○						○
START	○		○					○

Figure 66



Remarks

1. Battery & cables shown by broken line to be provided by ship builder.
2. Sectional area of battery cables should be 60mm² when their total length is less than 5 meters and 80mm² when their length is more than 5 meters. Total cable length are less than 10 meters. (Battery~Starter Motor~Battery).
3. Keep the battery switch [ON] during operation.
4. Cut off the battery switch when quickly charging the batteries by a charger.
5. After engine stopped, cut off the battery switch.



Earth floating type

031404-00E

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