

OPERATION MANUAL

MARINE ENGINE

6LY3

6LY3-ETP

6LY3-STP

6LY3-UTP

6LY3-ETA

6LY3-STA

 English

YANMAR

**California
Proposition 65 Warning**

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

Disclaimers:

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OPERATION MANUAL	MODEL	6LY3-ETP, 6LY3-STP, 6LY3-UTP, 6LY3-ETA, 6LY3-STA
	CODE	0ALY3-EN0013

TABLE OF CONTENTS

	Page
Introduction	1
Record of Ownership	2
Safety	3
Safety Precautions	4
General Information	4
Before You Operate	4
During Operation and Maintenance	4
Location of Labels	8
Product Overview	9
Yanmar 6LY3 series features and applications.....	9
New Engine Break-In.....	10
Component Identification	11
Operation Side.....	11
Non-Operation Side	12
Nameplate.....	13
Function of Major Components	14
Electronic Control System (ECS)	15
Display	16
Before You Operate	23
Diesel Fuel	23
Diesel Fuel Specifications	23
Filling the Fuel Tank	26
Bleeding the Fuel System.....	27

TABLE OF CONTENTS

Engine Oil	28
Engine Oil Specifications	28
Engine Oil Viscosity	29
Checking Engine Oil.....	29
Adding Engine Oil	29
Selection of Marine Gear Oil	29
Engine Coolant	30
Filling Heat Exchanger with Engine Coolant	31
Engine Operation	33
Starting the Engine	34
Before Starting the Engine	34
To Start the Engine	34
Shifting	36
Cautions During Operation	37
Shutting Down the Engine	38
Normal Shutdown.....	38
Emergency Shutdown	39
Checking the Engine After Operation	40
Periodic Maintenance	41
Precautions.....	42
The Importance of Periodic Maintenance	42
Performing Periodic Maintenance	42
The Importance of Daily Checks	42
Keep a Log of Engine Hours and Daily Checks	42
Yanmar Replacement Parts	42
Tools Required.....	42
Ask Your Authorized Yanmar Marine Dealer or Distributor for Help	42
Tightening Fasteners	43
Periodic Maintenance Schedule	44
Periodic Maintenance Procedures.....	47
Daily Checks	47
After Initial 50 Hours of Operation.....	48
Every 50 Hours of Operation.....	51
Every 250 Hours of Operation.....	54
Every 500 Hours of Operation.....	57
Every 1000 Hours of Operation.....	58
Every 2000 Hours of Operation.....	59

Long-Term Storage 61

 Before You Place the Engine in Long-Term Storage.... 61

 Returning the Engine to Service 62

Troubleshooting 63

 Troubleshooting After Starting 63

 Troubleshooting Information 64

 Troubleshooting Chart..... 65

Specifications 67

 Principal Engine Specifications 67

 6LY3-ETP / 6LY3-STP / 6LY3-UTP Engines..... 67

 6LY3-ETA / 6LY3-STA Engines 69

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INTRODUCTION

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

To help you enjoy your Yanmar 6LY3 series engine for many years to come, please follow these recommendations:

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

INTRODUCTION

RECORD OF OWNERSHIP

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

Engine Model: _____

Engine Serial No.: _____

Date Purchased: _____

Dealer: _____

Dealer Phone: _____

SAFETY

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



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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

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

SAFETY PRECAUTIONS

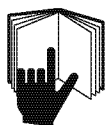
General Information

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

Before You Operate

DANGER

The safety messages that follow have DANGER level hazards.



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

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

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

During Operation and Maintenance

WARNING

The safety messages that follow have WARNING level hazards.

Explosion Hazard



While the engine is running or the battery is charging, hydrogen gas is being produced and can be easily ignited. Keep the area around the battery

well-ventilated and keep sparks, open flames and any other form of ignition out of the area.

Fire and Explosion Hazard

Diesel fuel is flammable and explosive under certain conditions.

Never use a shop rag to catch the fuel.

Wipe up all spills immediately.

Never refuel with the engine running.

Fire Hazard



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

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

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

Never use the engine compartment for storage.

⚠ WARNING**Sever Hazard**

Rotating parts can cause severe injury or death.

Never wear jewelry, unbuttoned cuffs, ties or loose-fitting clothing and

always tie long hair back when working near moving/rotating parts such as the flywheel or PTO shaft. Keep hands, feet and tools away from all moving parts.

Alcohol and Drug Hazard

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

Exposure Hazard

Always wear personal protective equipment including appropriate clothing, gloves, work

shoes, and eye and hearing protection as required by the task at hand.

Sudden Movement Hazard

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

Burn Hazard

Some of the engine surfaces become very hot during operation and shortly after shutdown.

Keep hands and other body parts away from hot engine surfaces.

⚠ DANGER**Exhaust Hazard**

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

CAUTION

The safety messages that follow have CAUTION level hazards.

Poor Lighting Hazard

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

Tool Hazard

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

Flying Object Hazard

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

Coolant Hazard



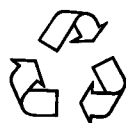
Wear eye protection and rubber gloves when you handle engine coolant. If contact with the eyes or skin should occur, flush eyes and wash immediately with clean water.

NOTICE

The safety messages that follow have NOTICE level hazards.

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

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



Always be environmentally responsible.

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

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

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

NOTICE

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

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

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

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

LOCATION OF LABELS

Figure 1 shows the location of regulatory and safety labels on Yanmar 6LY3 series engines. Please replace if damaged or lost.

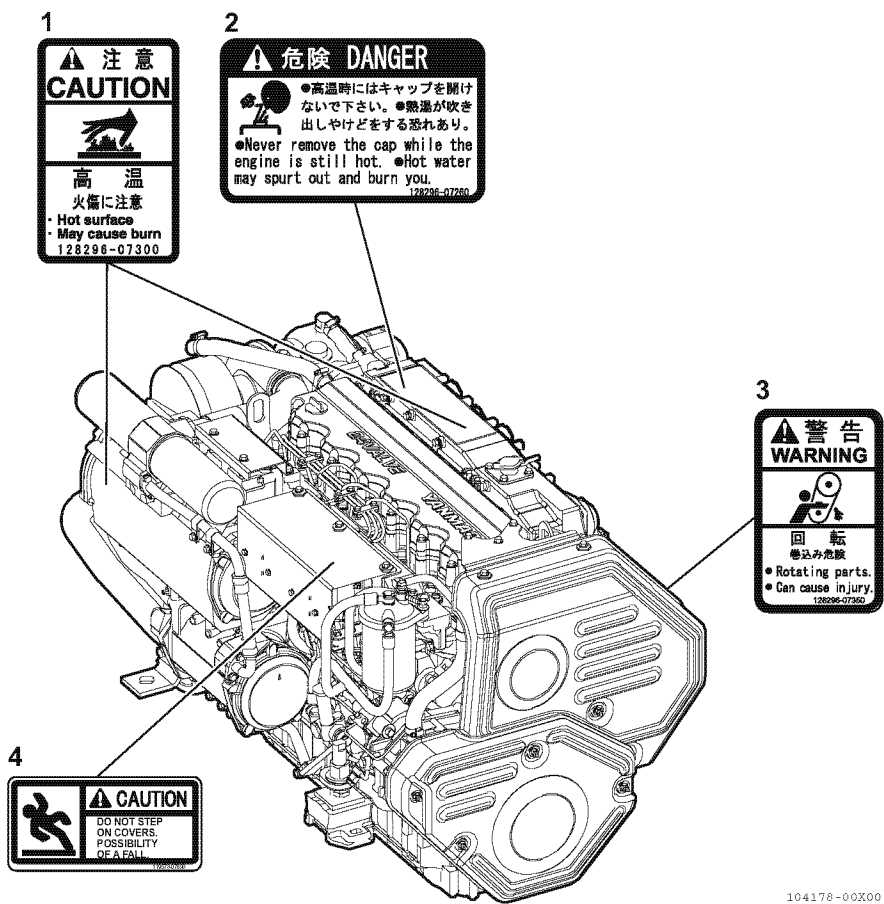


Figure 1

No.	Part No.
1	128296-07300
2	128296-07260
3	128296-07350
4	119578-07890

PRODUCT OVERVIEW

YANMAR 6LY3 SERIES FEATURES AND APPLICATIONS

The 6LY3 series are four-stroke diesel engines equipped with direct injection diesel system and with liquid coolant systems.

The 6LY3 is 6-cylinder and turbocharged with an air cooler.

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

These engines are designed for recreational craft use.

It is recommended that new vessels be propped so the engines can operate at 50 to 100 min⁻¹ above the fuel stop power engine speed to allow for some added weight and hull resistance.

Failure to do so can lead to reduced vessel performance, lead to increased smoke levels and cause permanent damage to your engine.

The engine must be installed correctly with coolant lines, exhaust gas lines and electrical wiring. Any auxiliary equipment attached to the engine should be easy to use and accessible for service. To handle the drive equipment, propulsion systems (including the propeller) and other inboard equipment, always observe the instructions and cautions given in the operation manuals supplied by the shipyard and equipment manufacturers.

The 6LY3 series engines are designed to be operated at maximum throttle for less than 5% of total engine time (30 minutes out of every 10 hours) and cruising speed^{*1}.

The laws of some countries may require hull and engine inspections, depending on the use, size and cruising area of the boat. The installation, fitting and surveying of this engine all require specialized knowledge and engineering skills. See Yanmars local subsidiary in your region or your authorized Yanmar Marine dealer or distributor.^{*2}

^{*1} *cruising speed: fuel stop power engine speed -200 min⁻¹ or less*

^{*2} *maximum throttle: fuel stop power engine speed*

New Engine Break-In

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

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

During the break-in period, the engine coolant temperature gauge should be monitored; temperature should be between 71° and 87°C (160° and 190°F).

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

NOTICE

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

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

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

Perform this procedure in open waters:

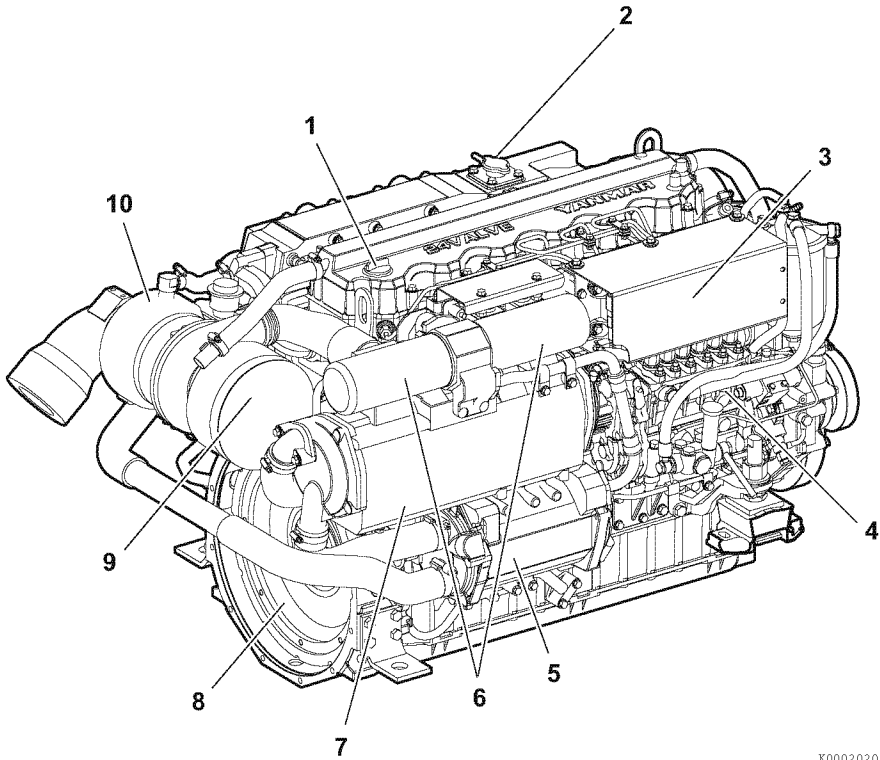
- With the clutch in NEUTRAL, accelerate from the low-speed position to the high-speed position briefly.
- Repeat this process five times.

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

To complete engine break-in, perform *After Initial 50 Hours of Operation* maintenance procedures. *After Initial 50 Hours of Operation* on page 48.

COMPONENT IDENTIFICATION

Operation Side

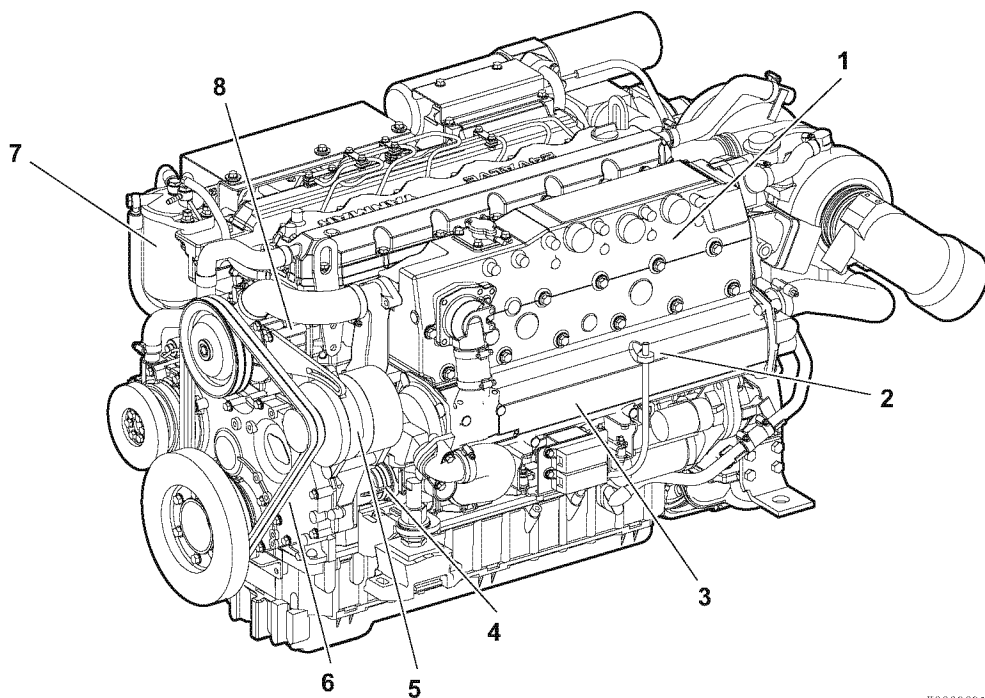


X0002020

- | | |
|---|-------------------------|
| 1 – Oil fill cap | 6 – Lube oil filter |
| 2 – Coolant fill cap | 7 – Air-cooler |
| 3 – Electronic Control Unit cover plate | 8 – Flywheel |
| 4 – Fuel injection pump | 9 – Air intake silencer |
| 5 – Lube oil cooler | 10 – Turbocharger |

Figure 1

Non-Operation Side



K0002021

1 – Coolant tank (exhaust manifold)

2 – Dipstick

3 – Heat exchanger

4 – Seawater pump

5 – Alternator

6 – V-belt

7 – Fuel filter

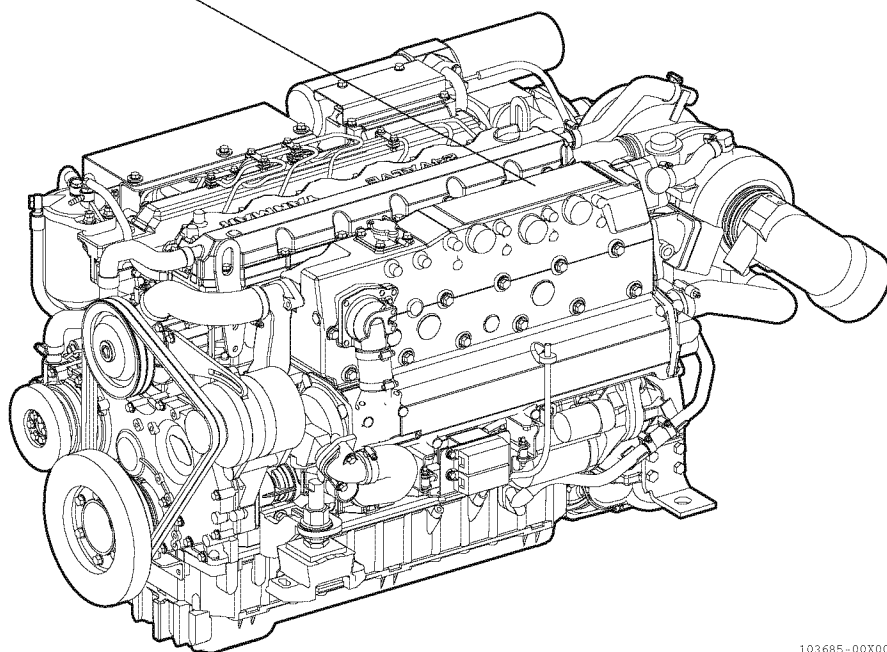
8 – Coolant pump

Figure 2

NAMEPLATE

The engine nameplate and its typical location is shown in **Figure 3**. Replace if damaged or lost. Check the engine model, output, rpm and serial number on the nameplate.

Model		
Gear Model		
Continuous power kW	kW/	min ⁻¹
Speed of prop.shaft	min ⁻¹	
Fuel stop power kW	/	min ⁻¹
ENG.No.		
MFG.DATE	/	
YANMAR		
YANMAR CO.,LTD.		
<small>MADE IN JAPAN</small>		



103685-00X00

Figure 3

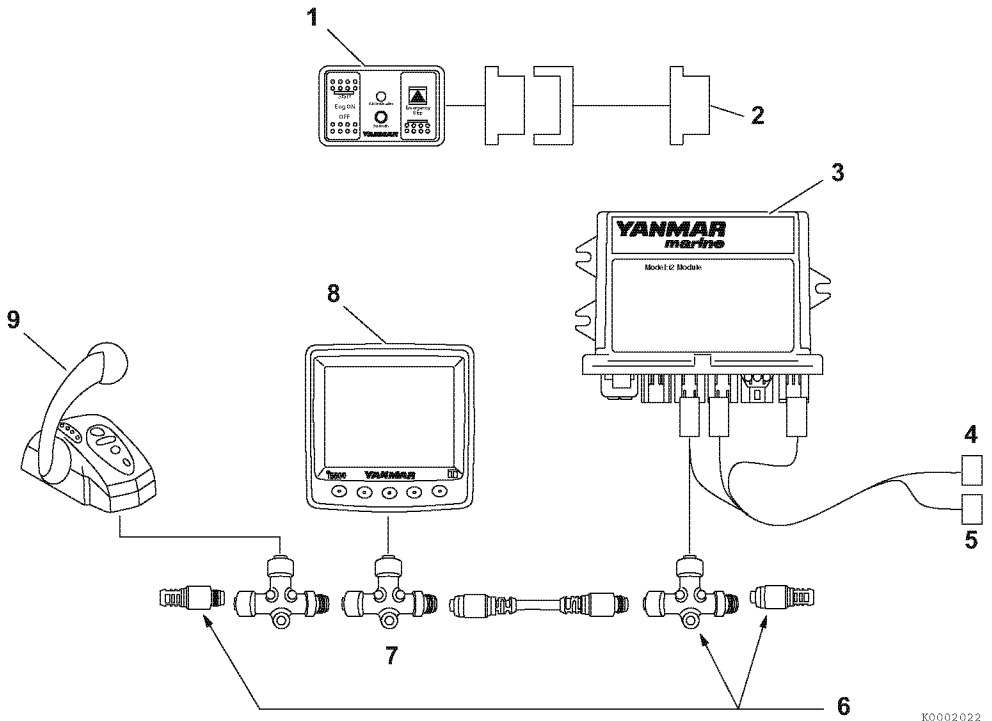
FUNCTION OF MAJOR COMPONENTS

Name of component	Function
Fuel filter	Removes dirt and water from the fuel. Drain the filter periodically. The filter element should be replaced periodically. <i>See Replace the fuel filter element on page 48.</i>
Fuel feed pump	Pumps fuel from tank to the fuel injection pump. Equipped with built-in centrifugal vane.
Engine oil fill port	The fill port used to add engine lubricating oil.
Lubricating oil filter (at full-flow and bypass sides)	Filters fine metal fragments and carbon from the lubricating oil. Filtered lube oil is distributed to the engine's moving parts.
Cooling water system	There are two cooling systems: coolant and seawater. The engine's combustion heat is cooled by the fresh water/coolant in a closed circuit. The fresh water is cooled by seawater using heat exchanger. The seawater also cools the lube oil of engine/marine gear and also intake air through coolers in an open circuit.
Heat exchanger	The heat exchanger is a heat exchanger to cool the fresh water by using seawater.
Coolant pump	The centrifugal water pump circulates fresh cooling water inside the engine. The fresh water pump is driven by V-belt.
Seawater pump	The rubber impeller type pump raises seawater for cooling. Never operate it without seawater, as this will damage the impeller.
Coolant filler cap	The fill cap on the coolant tank covers the water supply port. The cap has a pressure regulating valve. When the cooling water temperature rises, the pressure rises inside the coolant system.
Coolant recovery tank	The pressure regulating valve releases vapor and hot water overflow to the coolant recovery tank. When the engine stops and the cooling water cools, the pressure in the cooling water tank also drops very low. The fill cap valve then opens to send water back from the coolant recovery tank. This minimizes cooling water consumption. Coolant level can easily be checked and refilled in this tank.
Oil cooler	This heat exchanger cools high temperature lube oil with seawater.
Turbocharger	The pressurized intake air feeding device: the exhaust gas turbine is rotated by the exhaust gas, and the power is used to rotate the blower. This pressurizes the intake air for sending to the cylinder.
Air cooler	This heat exchanger cools the pressurized intake air from the turbocharger with seawater.
Anti-corrosion zinc anode	The metal area of the seawater cooling system is prone to electrical corrosion. The anti-corrosion zinc anode is installed in the oil cooler, air cooler, etc. to prevent this. The anti-corrosion zinc anode is itself reduced over time by electrical corrosion, so it must be replaced at fixed intervals before it is completely consumed in order to ensure that the metal area of the seawater cooling system remains fully protected.
Nameplates	Nameplates are provided on the engine and the marine gear and include the model, serial number and other data.
Starter	Starter motor for the engine. Powered by the battery.
Alternator	Driven by V-belt and generates electricity and charges the battery.

ELECTRONIC CONTROL SYSTEM (ECS)

The control equipment consists of the rocker switch panel, the display, engine interface module and the control head, which are connected by the wire harness to the engine (electronic governor and marine gear) for remote control operation.

See *Yanmar Electronic Control System Operation Manual for LY3 Engines* for a more complete description of the electronic control system (ECS).



K0002022

- | | |
|---|---------------------------------------|
| 1 – First station rocker switch panel | 5 – To marine gear |
| 2 – To engine | 6 – NMEA tee and terminators kit |
| 3 – Interface module without trolling
interface module with trolling
(optional) | 7 – NMEA tee connector |
| 4 – To engine | 8 – Digital display |
| | 9 – Control head (shift and throttle) |

Figure 4

PRODUCT OVERVIEW

Display

Refer to the *Electronic Control System Manual for 6LY3*, available as a separate volume, for details.

■ Display function

Runtime engine data tri-screen

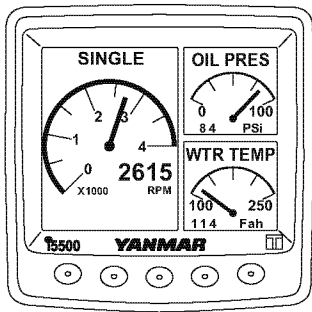


Figure 5

This screen displays real time engine data and alarm indications.

Alarm indicators

YANMAR marine DUAL PORT Alarms	
HOT ENGINE	CHECK ENGINE
OVER REV	EMERGENCY
OIL PRESSURE	LOW VOLTAGE
TURBO BOOST	ALTERNATOR
GEAR OIL	SEA WATER FLOW
ENG COM ERROR	LOW COOLANT
MAINTENANCE	WATER IN FUEL
NETWORK	THROTTLE PROBLEM

Figure 6

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

Note: When starting the engine, make it a rule to check for any highlighted alarms. If the system does not function normally, contact your authorized Yanmar Marine dealer and ask for diagnostics.

Alarm log screen

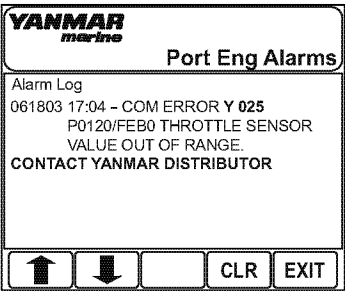


Figure 7

■ Alarm indicator functions

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

- Cooling water temperature alarm indicator comes on when the fresh water gets too hot.
- Lube oil pressure alarm indicator comes on when the engine lube oil pressure drops.
- Electric charge alarm indicator comes on when there is a charging failure.

■ Rocker switch panel

The rocker switch panel has the following functions.

1st station panel

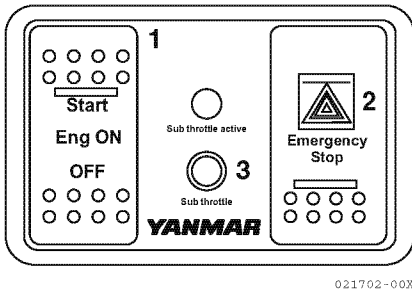


Figure 8

- To start and stop the engine:
 - To start the engine, push upper half of Eng ON switch (Start).
 - To stop the engine, push bottom half of Eng ON switch (OFF).

Note: The engine will take 2 to 7 seconds to stop running after the bottom of the rocker switch is pressed.

- Emergency stop (2, **Figure 8**):
Use this switch only in an emergency.

NOTICE

Under normal circumstances, use the Eng ON switch (1, **Figure 8**) to stop the engine. The engine shuts down suddenly when the upper half of the emergency stop switch is pushed. Push the bottom half of the switch after the engine has shut down to return the switch to the center.

Note: Restarting the engine after using the emergency stop switch may be slower or more difficult than normal starting.

- Sub throttle control (3, **Figure 8**):

In the unlikely event that the throttle control fails, the sub throttle indicator light will flash and the engine speed is controlled by the sub throttle. Engine speed rises when the sub throttle knob is turned clockwise.

- When the sub throttle indicator flashes, turn the sub throttle knob counterclockwise to the end and turn the knob clockwise gradually until the sub throttle indicator turns on (steadily light).
- Each engine is controlled by a dedicated Sub throttle controller.

2nd station panel - optional

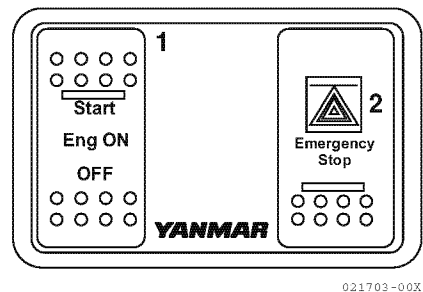


Figure 9

- Eng ON switch (1, **Figure 9**) is wired to 1st station panel.
- Able to start and stop the engine from 2nd station panel.
- Emergency stop switch (2, **Figure 9**) is wired in series with 1st station panel.

PRODUCT OVERVIEW

■ Control head shift and throttle functions

Use the two-lever control head (4, **Figure 10**) in the helm station for AHEAD (1, **Figure 10**), ASTERN (3, **Figure 10**), NEUTRAL (2, **Figure 10**) and speed control in a twin installation.

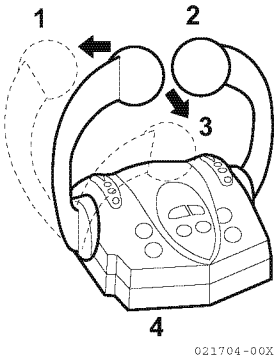


Figure 10

Use the single-lever control head (4, **Figure 11**) in the helm station for AHEAD (1, **Figure 11**), ASTERN (3, **Figure 11**), NEUTRAL (2, **Figure 11**) and speed control in a single installation.

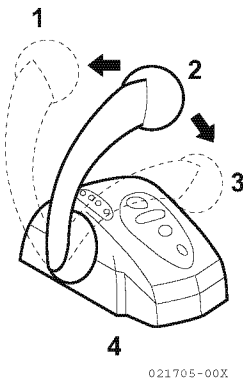


Figure 11

Control head button functions

- **N** (or **NEUTRAL**) button – If the associated control head lever is in the “Neutral Idle” position, pushing this button engages/disengages neutral throttle control, allowing throttle but no forward or reverse thrust. If the associated control head lever is in a “Gear Idle” position, pushing this button engages/disengages Split Range Throttle (SRT) (if installed).
- **SELECT** (or **SEL**) button – If the station is inactive, pushing this button activates the station (used in conjunction with two or more control stations).
- **SYNC** button – Pushing this button engages/disengages the cruise synchronization option (if installed) when the port and starboard control head levers are set to nearly the same positions.

■ Control head operation

Selecting active station:

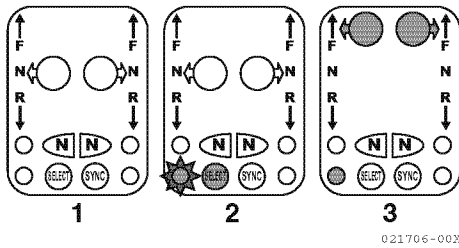


Figure 12

1. (1, **Figure 12**) shows a typical inactive station.
2. Press the SELECT button (2, **Figure 12**). The button lights (grayed in **Figure 12**) and the station select light flashes (star around light in (**Figure 12**)).
3. Move the handle(s) to F (forward) or R (reverse) throttle to match the handle location of the active station (3, **Figure 12**). The corresponding handle button lights glow steadily (grayed in (3, **Figure 12**)) and the station select light glows steadily (grayed in (3, **Figure 12**)).

Engaging/disengaging shift disconnect mode:

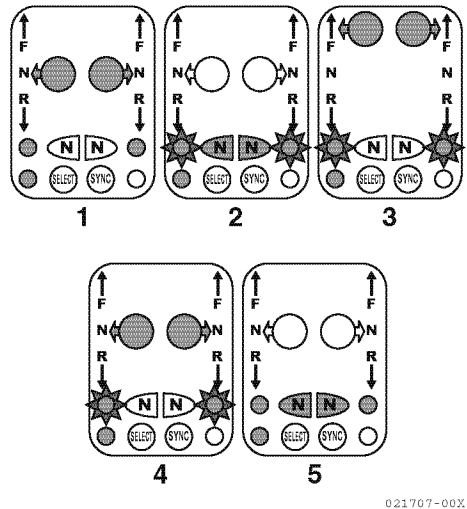


Figure 13

Engage:

1. Return the handle(s) to N (neutral). The neutral light(s) glow steadily (1, **Figure 13**).
2. Press the N (neutral) button(s) (2, **Figure 13**). The neutral light(s) flash (star around light(s) in (2, **Figure 13**)).
3. Move the handle(s) to forward or reverse throttle (3, **Figure 13**) resulting in engine rpm control without engaging marine gear.

Disengage:

1. Return the handle(s) to N (neutral) (4, **Figure 13**).
2. Press the N (neutral) button(s) (5, **Figure 13**). The neutral light(s) glow steadily (5, **Figure 13**).

PRODUCT OVERVIEW

Engaging/disengaging Split Range Throttle (SRT):

Note: Split Range Throttle is not available if the boat is equipped with the Trolling option.

The Split Range Throttle control head mode gives you greater throttle sensitivity. In Split Range Throttle (SRT), moving an engine's control lever all the way to the "Full Forward" position will only produce the maximum percentage of wide open throttle selected in the "Features Selection" of the ECU program options. Typical throttle limit percentages for SRT are 5 % to 50 %, with 25 % being the default value.

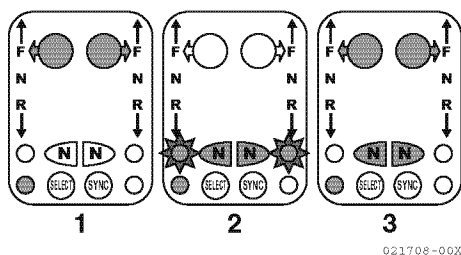


Figure 14

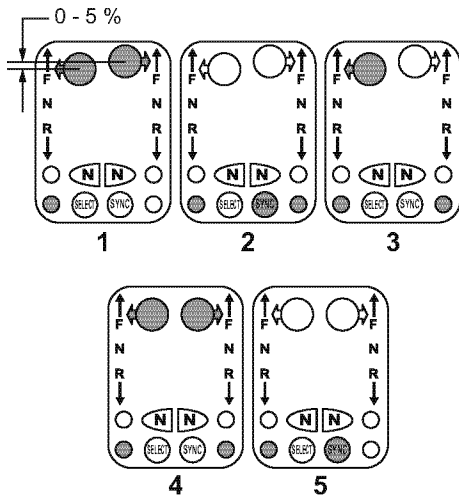
Engage:

1. Move the engine's lever to an in-gear idle position (Forward Idle or Reverse Idle) (1, **Figure 14**) and press the N (neutral) button (2, **Figure 14**) next to this lever on the control head. The N (neutral) lamp (2, **Figure 14**) will flash to indicate that the Split Range Throttle is engaged.
2. While in the Split Range Throttle, the system will shift normally but the throttle will be limited in both gears.
3. If the system is shifted into neutral while in the Split Range Throttle engine mode, the N (neutral) lamp will come on (steadily) to indicate that the system is in neutral. When the lever is moved back into gear, the N (neutral) lamp will resume flashing to indicate that the system is still in Split Range Throttle.

Disengage:

Return the engine lever to a gear idle position (Forward Idle or Reverse Idle) (3, **Figure 14**). Press the N (neutral) button next to the lever on the control head. The N (Neutral) lamp will stop flashing, indicating that the Split Range Throttle has been disengaged.

Engaging/disengaging cruise synchronization:



021709-00X01

Figure 15

Engage:

1. Disengage any other engine mode being used.
2. Match all engine shift and throttle settings by moving the active port and starboard control head levers to within 5 % of each other (1, **Figure 15**) and press the SYNC button (4, **Figure 15**) on the control head. The sync lamp flashes if the handles are not within 5 % of each other (3, **Figure 15**). The sync lamp will stop flashing and remain continuously lit (4, **Figure 15**) when the levers are moved to within this 5 % range.

A steadily sync lamp confirms that the cruise sync is engaged. While the engines are synchronized, all engine speeds are matched any time the control levers are set to within 5 % of each other and are above 20 % throttle.

Disengage:

Press the SYNC button on the control head.

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BEFORE YOU OPERATE

This section of the *Operation Manual* describes the diesel fuel, engine oil, and engine coolant specifications and how to replenish them. It also describes the daily engine checkout.

Before performing any operations within this section, review the *Safety section on page 3*.

DIESEL FUEL



Diesel fuel is flammable and explosive under certain conditions. Refer to Fire and Explosion Hazard on page 4.

Diesel Fuel Specifications

NOTICE

Only use diesel fuels recommended by Yanmar Marine for the best engine performance, to prevent engine damage. Only use clean diesel fuel.

Diesel fuel should comply with the following specifications. The table lists several worldwide specifications for diesel fuels.

Diesel fuel specification	Location
ASTM D975 No. 2-D, No. 1-D	USA
EN590-2009	European Union
ISO 8217 DMX	International
BS 2869-A1 or A2	United Kingdom
JIS K2204 Grade No. 2	Japan

BEFORE YOU OPERATE

■ Bio-diesel fuels

Yanmar approves the use of biodiesel fuels that do not exceed a blend of 7 % non-mineral oil based fuel with 93 % standard diesel fuel. Such biodiesel fuels are known in the marketplace as B7 biodiesel fuels. B7 biodiesel fuel can reduce particulate matter and the emission of “greenhouse” gases compared to standard diesel fuel.

CAUTION

If the B7 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.

B7 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, D7467 B7.

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

- The fuel cetane number should be equal to 45 or higher.
- The sulfur content must not exceed 0.5 % by volume. Less than 0.05 % is preferred.
- 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.
- Ash content not to exceed 0.01 % by volume.
- 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.
- Lubricity: Wear mark of WS1.4 should be Max. 0.016 in. (400 μm) at HFRR test.

■ 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.

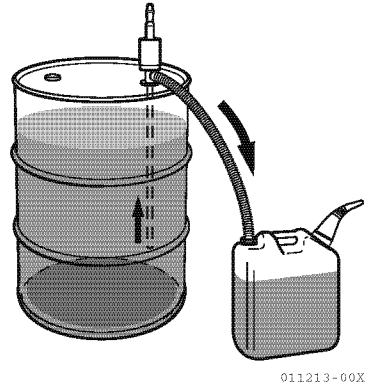
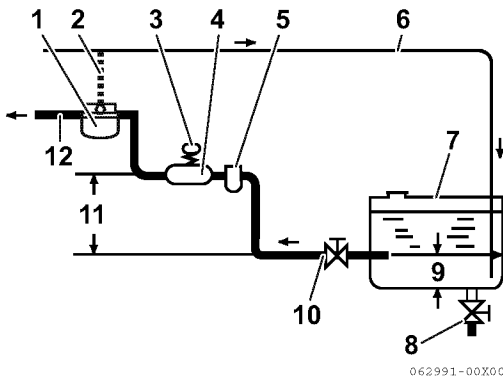


Figure 1

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.

BEFORE YOU OPERATE

■ Diesel fuel lines



- 1 – Fuel Filter
- 2 – Orifice for air bleeding
- 3 – Fuel priming pump
- 4 – Fuel feed pump
- 5 – Fuel filter/Water separator
- 6 – Fuel return line
- 7 – Fuel Tank
- 8 – Drain cock
- 9 – Approximately 20 to 30 mm (0.8 to 1.2 in.)
- 10 – Fuel Cock
- 11 – Less than 500 mm (20 in.)
- 12 – To Fuel Injection Pump

Figure 2

Install the fuel line from the fuel tank to the fuel injection pump as shown in **Figure 2**. The recommended fuel / water separator (optional) is installed at the intermediate section of that line.

Filling the Fuel Tank

⚠ DANGER

Never refuel with the engine running. Refer to Fire and Explosion Hazard on page 4.

1. Clean the area around the fuel cap.
2. Remove the fuel cap from the fuel tank.
3. Fill the tank with clean fuel free of oil and dirt.

NOTICE

Hold the hose nozzle firmly against the filler port while filling. This prevents static electricity buildup which could cause sparks and ignite fuel vapors.

4. Stop fueling when gauge shows fuel tank is full.

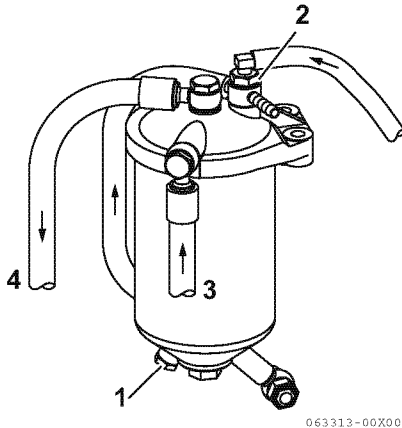
NOTICE

Never overfill the fuel tank.

5. Replace the fuel cap and hand-tighten. Over-tightening the fuel cap will damage it.

Bleeding the Fuel System

The fuel system has an automatic air bleeding device that purges air from the fuel system. No manual air bleeding is required for normal operation. Bleeding must be done if any fuel system maintenance has been performed (replacement of fuel filter, etc.) or if the engine does not start after several attempts.



- 1 – Drain plug
- 2 – Air Bleed Screw
(Check valve assembly)
- 3 – From Fuel Tank
- 4 – To Fuel Injection Pump

Figure 3

1. Check the fuel level in the fuel tank.
Refill if necessary.
2. Open the fuel cock of the fuel tank.

⚠ WARNING

Exposure Hazard.

Always wear safety glasses when bleeding the fuel system.

3. Loosen the air bleed screw
(**Figure 3, (2)**) half turns.

4. Push up and down on the priming pump to release air out of the air bleed screw.
5. Continue pumping until a stream of fuel with no air bubbles begins to flow.
6. Tighten the air bleed screw.

NOTICE

Never use an engine starting aid such as ether. Engine damage will result.

ENGINE OIL

NOTICE

Only use the engine oil specified. Other engine oils may affect warranty coverage, cause internal engine components to seize and/or shorten engine life. Never mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil.

Engine Oil Specifications

Use an engine oil that meets or exceeds the following guidelines and classifications:

■ Service categories

- API service categories CD or higher
- ACEA service categories E-3, E-4 and E-5
- JASO service category DH-1

■ Definitions

- API classification (American Petroleum Institute)
- ACEA classification (Association des Constructeurs Européens d'Automobilies)
- JASO (Japanese Automobile Standards Organization)

NOTICE

- Be sure the engine oil, engine oil storage containers and engine oil filling equipment are free of sediment or water.
- Change the engine oil after the first 50 hours of operation and then at every 250 hours thereafter.
- Select the oil viscosity based on the ambient temperature where the engine is being operated. See the SAE service grade viscosity chart (**Figure 4**).
- Yanmar does not recommend the use of engine oil "additives".

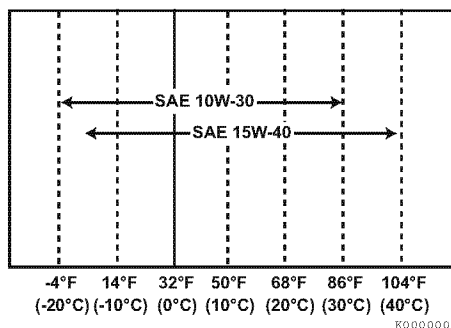


Figure 4

■ Additional technical engine oil requirements

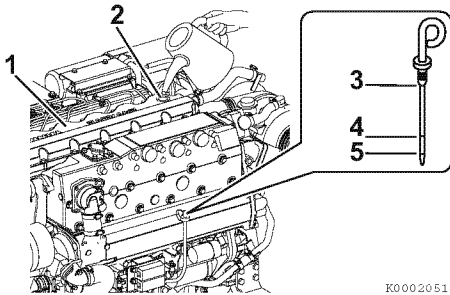
The engine oil must be changed when the Total Base Number (TBN) has been reduced to 2.0. TBN (mgKOH/g) test method; JIS K-2501-5.2-2 (HCl), ASTM D4739 (HCl).

Engine Oil Viscosity

SAE 15W40 is the recommended oil viscosity.

Checking Engine Oil

1. Make sure engine is level.
2. Remove dipstick (3, **Figure 5**) and wipe with clean cloth.
3. Fully reinsert dipstick.
4. Remove dipstick. The oil level should be between upper (4, **Figure 5**) and lower (5, **Figure 5**) lines on the dipstick.
5. Fully reinsert dipstick.



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Figure 5

Adding Engine Oil

1. Remove the yellow oil filler port cap (2, **Figure 5**) at the top of the rocker arm cover (1, **Figure 5**) and fill with engine oil.

NOTICE

Prevent dirt and debris from contaminating engine oil. Carefully clean the dipstick, filler port cap and the surrounding area before you remove the cap.

2. Fill with engine oil to the upper limit (4, **Figure 5**) on the dipstick (3, **Figure 5**). Insert the dipstick fully to check the level.

NOTICE

Never overfill the engine with engine oil.

Engine lube oil capacity (at rake 0 deg.)

Full: 18.8 ℓ (19.9 quarts)

Effective: 8 ℓ (8.5 quarts)

- “Full” means the oil amount at the upper limit (4, **Figure 5**) on a dipstick.
- “Effective” means the difference between oil amount at upper limit and that at lower limit (5, **Figure 5**).

NOTICE

Always keep the oil level between upper and lower lines on the oil cap/dipstick.

3. Hand-tighten the filler port (2, **Figure 5**) cap securely.

Selection of Marine Gear Oil

Refer to the instruction book for each marine gear.

BEFORE YOU OPERATE

ENGINE COOLANT

Use a Long Life Coolant (LLC) that meets or exceeds the following guidelines and specifications:

Note: In the U.S., LLC is required for the warranty to be valid.

- ASTM D3306, D4985 (US)
- JIS K-2234 (Japan)
- SAE J814C, J1941, J1034 or J2036 (International)

NOTICE

Following the manufacturer's recommendations, use a proper LLC which will not have any adverse effects on the materials (cast iron, aluminum, copper, etc.) of the engine's cooling system.

Always use the mixing ratios specified by the antifreeze manufacturer for the temperature range.

NOTICE

- Always add LLC to soft water - especially when operating in cold weather. Never use hard water. Water should be clean and free from sludge or particles. Without LLC, cooling performance will decrease due to scale and rust in the coolant system. Water alone may freeze and form ice; it expands approximately 9 % in volume.
- Use the proper amount of coolant concentrate for the ambient temperature as specified by the LLC manufacturer. LLC concentration should be a minimum of 30 % to a maximum of 60 %. Too much LLC will decrease the cooling efficiency. Excessive use of antifreeze also lowers the cooling efficiency of the engine.
- Never mix different types or brands of LLC, as a harmful sludge may form. Mixing different brands of antifreeze may cause chemical reactions, and may make the antifreeze useless or cause engine problems.

Replace the engine coolant periodically, according to the maintenance section in this *Operation Manual*.

Remove scale from the cooling system periodically by flushing the system.

Filling Heat Exchanger with Engine Coolant

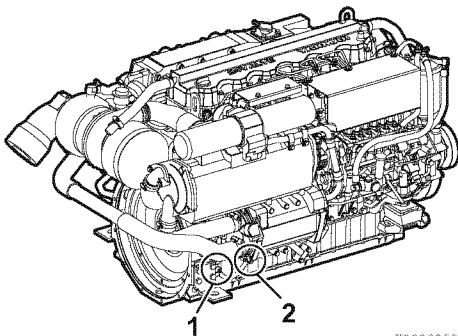
This procedure is for filling the heat exchanger for the first time or refilling it after it is flushed. Note that a typical heat exchanger is shown (Figure 6).

WARNING

- **Never remove the coolant filler cap if the engine is hot. Steam and hot engine coolant will spray out and seriously burn you. Allow the engine to cool down before you attempt to remove the cap.**
- **Always tighten the coolant tank cap securely after checking the coolant tank. Steam can spray out during engine operation if the cap is loose.**

1. Close the four water drain cocks/plugs (two for engine coolant and two for seawater).

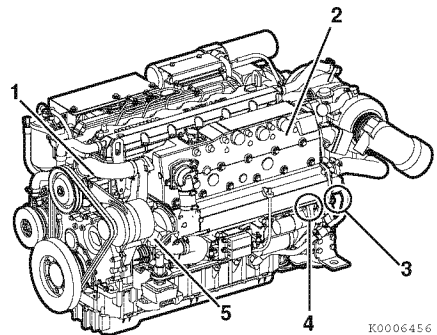
Note: The drain cocks are opened before shipping from the production plant.



K0002052

- 1 – Coolant drain cock
- 2 – Seawater drain cock

Figure 6

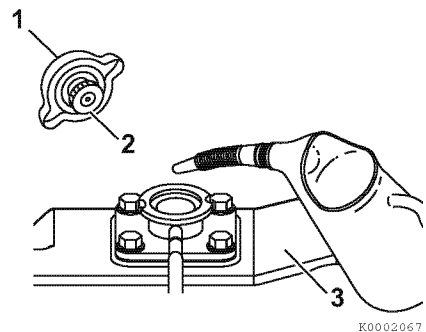


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- 1 – Coolant pump
- 2 – Coolant tank (heat exchanger)
- 3 – Seawater drain cock
- 4 – Coolant drain cock
- 5 – Seawater pump

Figure 7

2. Remove the fill cap (1, Figure 8) on the heat exchanger (3, Figure 8) by turning the cap counterclockwise 1/3 of a turn.



K0002067

Figure 8

3. Pour coolant mix slowly into the heat exchanger (3, Figure 8) so that air bubbles do not develop. Pour until the coolant overflows from the filler port.

NOTICE

Never pour cold coolant into a hot engine.

BEFORE YOU OPERATE

4. After filling the heat exchanger, replace fill cap and tighten it firmly (1, **Figure 8**). Failure to do so will cause coolant leakage. To replace the cap, align the tabs (2, **Figure 8**) on the bottom of the cap with the notches on the filler port and turn clockwise 1/3 of a turn.
5. Remove the coolant recovery tank cap (2, **Figure 9**) and fill with coolant mix to the lower limit (4, **Figure 9**). Replace cap. Never fill to the upper limit (3, **Figure 9**).
Coolant recovery tank capacity: 0.8 ℓ (1.7 pints)
6. Check the rubber hose (1, **Figure 9**) connecting the coolant recovery tank to the heat exchanger. Be sure the hose is securely connected and there is no looseness or damage.
If leaks develop in the hose or at the connection, an excessive amount of coolant will be lost.

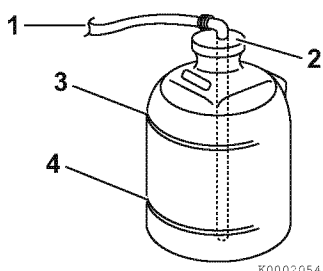


Figure 9

When engine coolant is supplied for the first time or when it has been replaced, conduct a trial operation of the engine for about 5 minutes and check the quantity of engine oil and coolant.

ENGINE OPERATION

This section of the *Operation Manual* describes the diesel fuel, engine oil and engine coolant specifications and how to replenish them. It also describes the daily engine checkout.

Before performing any operations within this section, review the *Safety section on page 3*.

STARTING THE ENGINE

Before Starting the Engine

- 1. Open the seacock.
- 2. Open the fuel tank cock.
- 3. Set the control lever on the control head (2, **Figure 1**) in N (neutral) (1, **Figure 1**) position.

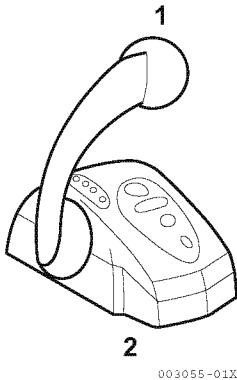


Figure 1

- 4. Turn on the battery switch and the start-up/version screen (**Figure 2**) pops up on the display. Then, the screen will change to the engine data display mode.



Figure 2

- 5. Press the Eng ON (1, **Figure 3**) switch and the following changes occur:

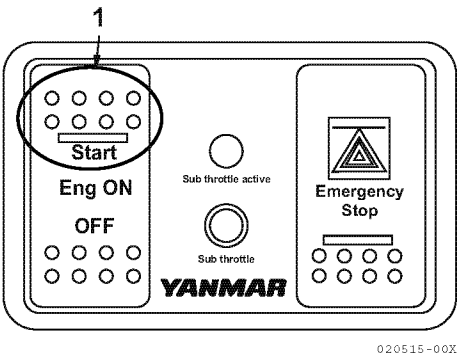


Figure 3

The needle appears in the engine tachometer on the display.

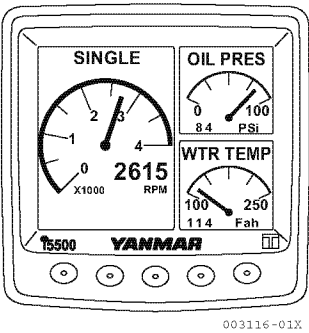


Figure 4

To Start the Engine

To start the engine, press Start (upper half) of Eng ON switch (1, **Figure 3**).

NOTICE

Never hold the key in the start position for longer than 15 seconds or the starter motor will overheat.

■ If the engine fails to start

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

Note: Hold the key switch for a maximum of 15 seconds in the Start position. If the engine does not start the first time, turn the key switch OFF and wait for about 15 seconds before trying again. After the engine has started, do not turn the key switch OFF. (It should remain on.)

NOTICE

If the vessel is equipped with a water lift (water lock) muffler, excessive cranking could cause seawater to enter the cylinders and damage the engine. If the engine does not start after cranking for 15 seconds, close the thru-hull water intake valve to avoid filling the muffler with water. Crank for 10 seconds at a time until the engine starts. When the engine does start, stop the engine immediately and turn the key switch to the OFF position. Be sure to re-open the seacock and restart the engine. Operate the engine normally.

■ After the engine has started

CAUTION

The engine will seize if it is operated when seawater discharge is too small or if load is applied without any warming up operation.

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

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

Shifting

⚠ WARNING

Sudden Movement Hazard

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

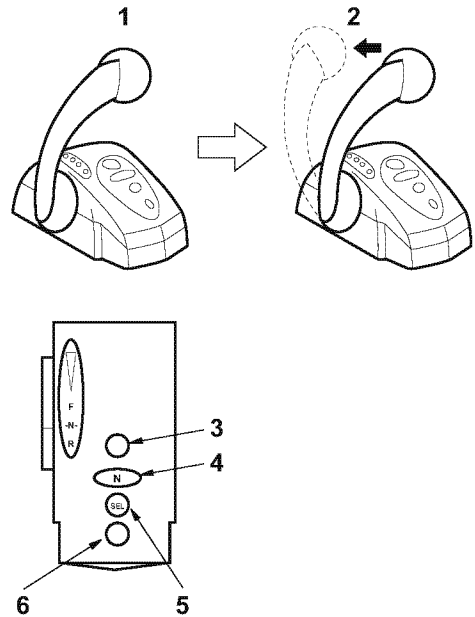
- Ensure the boat is clear of all obstacles forward and aft.
- Quickly shift to the **FORWARD** position then back to the **NEUTRAL** position.
- Observe whether the boat moves in the direction you expect.

■ Neutral

Be sure to set the control lever at N (neutral) position (1, **Figure 5**).

Note: Clutch operation or the use of trolling during high speed will cause internal parts of the clutch to break or to wear excessively.

1. Before using the marine gear, be sure to move the control lever (throttle) to a low idle position (the detent position). Then, move the control lever slowly to a higher speed position after completing clutch engagement.
2. When changing between FORWARD and REVERSE, bring the clutch to NEUTRAL and pause before slowly shifting to the desired position. Do not shift abruptly from FORWARD to REVERSE or vice versa.
3. Move the control lever accurately into the FORWARD, NEUTRAL and REVERSE positions.



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Figure 5

■ Ahead

Gradually move the control lever in the F (forward) direction (2, **Figure 5**) to the position of the Forward Detent. The marine gear will shift into FORWARD. The engine will remain at idle. Pushing further on the control lever will increase the rpm up to a maximum of wide open throttle (WOT).

■ Astern

Gradually move the control lever in the R (reverse) direction to the position of the Reverse Detent. The marine gear will shift into REVERSE. The engine will remain at idle. Pulling further on the control lever will increase the rpm up to a maximum of wide open throttle (WOT).

CAUTIONS DURING OPERATION

CAUTION

Excessive vibration may cause damage to the engine, marine gear, hull and onboard equipment. In addition, it causes noticeable passenger and crew discomfort. Carefully select engine mounts and propellers when you design Yanmar Marine engine applications.

Note:

- *Engine trouble can arise if the engine is operated for a long time under overloaded conditions with the control lever in the full throttle position (maximum engine speed position), exceeding the continuous rated output engine speed. Operate the engine at about 100 min⁻¹ (rpm) lower than the full throttle engine speed.*
- *If the engine is in the first 50 hours of operation, see New Engine Break-In on page 10.*

Always be on the lookout for problems during engine operation.

Pay particular attention to the following:

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

3. Are there abnormal vibrations or noise?

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

4. Alarm buzzer sounds during operation.

NOTICE

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

5. Is there water, oil or fuel leakage, or are there any loose bolts?

Check the engine room periodically for any problems.

6. Is there sufficient diesel fuel in the diesel fuel tank?

Replenish diesel fuel before leaving the dock to avoid running out of fuel during operation.

7. When operating the engine at low speed for long periods of time, race the engine once every 2 hours.

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

8. If possible, periodically operate the engine at near maximum rpm while underway. This will generate higher exhaust temperatures, which will help clean out hard carbon deposits, maintaining engine performance and prolonging the life of the engine.

NOTICE

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

SHUTTING DOWN THE ENGINE

Stop the engine in accordance with the following procedures:

Normal Shutdown

CAUTION

- **For maximum engine life, Yanmar recommends that when shutting the engine down, you allow the engine to idle, without load, for 5 minutes. This will allow the engine components that operate at high temperatures, such as the turbocharger (if equipped) and exhaust system, to cool slightly before the engine itself is shut down.**
 - **Be sure to close the seacock. Neglecting to close the seacock could allow water to leak into the boat and may cause it to sink.**
 - **If seawater is left inside of the engine, it may freeze and damage parts of the cooling system when the ambient temperature is below 0 °C (32 °F).**
-
1. Return the control lever to NEUTRAL position. (The N light turns on.)
 2. Cool the engine down at low speed (below 1000 min⁻¹ (rpm)) for about 5 minutes.
 3. Push OFF (bottom half) of Eng ON switch (3, **Figure 6**). The engine shuts down within 2 to 7 seconds normally. The regular engine shutdown takes time because the controller is adjusted in the fuel injection timing to the most suitable position for the next start.
 4. Turn the battery switch off.
 5. Close the fuel tank cock.
 6. Close the seacock.

Emergency Shutdown

■ Electric emergency stop:

⚠ CAUTION

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

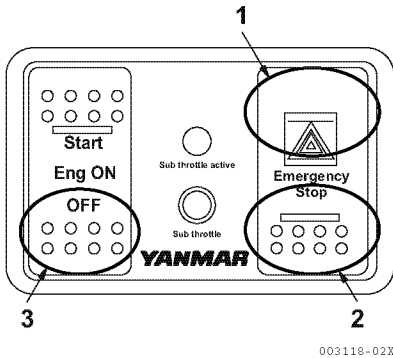


Figure 6

Push the upper part of the Emergency Stop switch (1, **Figure 6**) on the right of the panel and the engine shuts down immediately, without the time lag of regular engine shutdown. After shutdown, push the bottom part of the emergency stop switch (2, **Figure 6**) to be returned to the former position.

NOTICE

Use this switch only in an emergency. Under normal circumstances, use the OFF, Eng ON, Start switch (3, **Figure 6**) to stop the engine.

Note: Restarting the engine after using the emergency stop may be slower or more difficult than normal starting.

■ Mechanical emergency stop

⚠ WARNING

Sever Hazard

Always keep hands, body parts and loose fitting clothes away from moving/rotating parts such as the flywheel or PTO shaft.

If for some reason you can't stop the engine by the stop switch on the panel, push the stop lever (1, **Figure 7**) towards the front of the engine (2, **Figure 7**) to shut down the engine in the engine room.

When pushing the stop lever to the front side, the trouble indication of the governor pops up in the display. After the engine is shut down, return the stop lever to the former position.

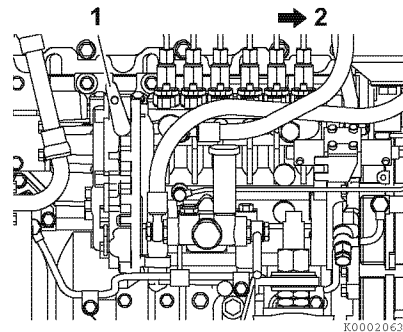


Figure 7

CHECKING THE ENGINE AFTER OPERATION

- Check that the starter switch is in the OFF position and battery master switch (if equipped) is turned to OFF.
- Fill the fuel tank. *See Filling the Fuel Tank on page 26.*
- Close seawater cock(s).
- If there is a risk of freezing, check that the cooling system contains enough coolant. *See Filling Heat Exchanger with Engine Coolant on page 31.*
- If there is a risk of freezing, drain the seawater system. *See Before You Place the Engine in Long-Term Storage on page 61.*
- At temperatures below 0 °C (32 °F), drain seawater system and connect the engine heater (if equipped).

PERIODIC MAINTENANCE

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

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

PRECAUTIONS

The Importance of Periodic Maintenance

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

Performing Periodic Maintenance

WARNING

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

The Importance of Daily Checks

Periodic Maintenance Schedules assume that the daily checks are performed on a regular basis. Make it a habit of performing daily checks before the start of each operating day. *See Daily Checks on page 47.*

Keep a Log of Engine Hours and Daily Checks

Keep a log of the number of hours the engine is run each day and a log of the daily checks performed. Also note the date, type of repair (e.g., replaced alternator) and parts needed for any service needed between the periodic maintenance intervals. Periodic maintenance intervals are every 50, 250, 500, 1000 and 2000 engine hours. Failure to perform periodic maintenance will shorten the life of the engine.

NOTICE

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

Yanmar Replacement Parts

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

Tools Required

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

Ask Your Authorized Yanmar Marine Dealer or Distributor for Help

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

Tightening Fasteners

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

NOTICE



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

■ Standard torque chart

Bolt diameter × pitch (mm)		M6 × 1.0	M8 × 1.25	M10 × 1.5	M12 × 1.75	M14 × 1.5	M16 × 1.5
Tightening torque	N·m	11.0 ± 1.0	26.0 ± 3.0	50.0 ± 5.0	90.0 ± 10.0	140.0 ± 10.0	230.0 ± 10.0
	kgf·m	1.1 ± 0.1	2.7 ± 0.3	5.1 ± 0.5	9.2 ± 1.0	14.3 ± 1.0	23.5 ± 1.0
	lb-ft	8.0 ± 0.7	19.0 ± 2.1	37 ± 3.6	66.0 ± 7.2	103 ± 7.2	170 ± 7.2

PERIODIC MAINTENANCE SCHEDULE

Daily and periodic maintenance are important to keep the engine in its best operating condition. The following is a summary of inspection and servicing items by inspection interval. Periodic maintenance intervals should vary depending on the uses, loads, fuels and lubricating oils used, and handling conditions, and are hard to establish definitively. The following should be treated as a general guide only. *Periodic Maintenance Procedures on page 47* gives a detailed explanation of which parts must be inspected and the procedure for doing so for each interval.

⚠ CAUTION

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

○: Check or Clean ◇: Replace ●: Contact your authorized Yanmar Marine dealer or distributor

System	Item	Periodic maintenance interval					
		Daily	Every 50 hours or monthly, whichever comes first	Every 250 hours or one year, whichever comes first	Every 500 hours or two years, whichever comes first	Every 1000 hours or four years, whichever comes first	Every 2000 hours or eight years, whichever comes first
Whole	Visual inspection of engine exterior	○					
Fuel system	Check the fuel level and refill if necessary	○					
	Drain the fuel tank			○			
	Drain the fuel filter and fuel/water separator		○				
	Replace the fuel filter element		◇ (1st time)	◇			
	Check the fuel injector spray pattern			● (1st time)		●	
	Overhaul and check fuel feed pump						●
	Replace rubber fuel hoses	Replace every 2 years or every 2000 hours, whichever comes first.					

PERIODIC MAINTENANCE

○: Check or Clean ◇: Replace ●: Contact your authorized Yanmar Marine dealer or distributor

System	Item		Periodic maintenance interval					
			Daily	Every 50 hours or monthly, whichever comes first	Every 250 hours or one year, whichever comes first	Every 500 hours or two years, whichever comes first	Every 1000 hours or four years, whichever comes first	Every 2000 hours or eight years, whichever comes first
Lubricating system	Check the engine oil level	Crankcase	○					
	Replace the engine oil	Crankcase		◇ (1st time)	◇			
	Replace the oil filter element			◇ (1st time)	◇			
	Clean engine oil cooler							●
Cooling system	Seawater outlet		○ During Operation					
	Check coolant level		○					
	Check the seawater pump impeller				○	◇		
	Replace the engine coolant		Every year. When Long Life Coolant (LLC) is used, replace every two years. <i>See Engine Coolant on page 30.</i>					
	Clean and check the seawater passages						●	
	Clean seawater and engine cooling system							●
	Replace zinc anode				◇			
Air intake and exhaust system	Clean the air intake silencer				○			
	Clean the exhaust/water mixing elbow				○	◇		
	Clean the turbocharger blower				●			
	Flush air cooler				●			
Electrical system	Check the alarm indicators		○					
	Check the electrolyte level in the battery			○				
	Adjust the tension of the alternator V-belt or replace V-belt			○		○	◇	
	Check the wiring connectors				○			

PERIODIC MAINTENANCE

○: Check or Clean ◇: Replace ●: Contact your authorized Yanmar Marine dealer or distributor

System	Item	Periodic maintenance interval					
		Daily	Every 50 hours or monthly, whichever comes first	Every 250 hours or one year, whichever comes first	Every 500 hours or two years, whichever comes first	Every 1000 hours or four years, whichever comes first	Every 2000 hours or eight years, whichever comes first
Engine cylinder head and block	Check for leakage of fuel, engine oil and engine coolant	○ After starting					
	Tighten all major nuts and bolts			●			
	Adjust intake/exhaust valve clearance			● (1st time)		●	
Miscellaneous items	Check the electronic control system operation	○	○ (1st time)				
	Adjust the propeller shaft alignment		● (1st time)		●		
	Check/replace flexible engine mounts			○		◇	

Note: These procedures are considered normal maintenance and are performed at the owner's expense.

PERIODIC MAINTENANCE PROCEDURES

WARNING

Always wear personal protective equipment. Refer to *Exposure Hazard* on page 4.

Daily Checks

Before you head out for the day, make sure the Yanmar engine is in good operating condition.

CAUTION

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

Make sure you check the following items.

■ Visual checks

WARNING

Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak, such as a broken fuel injection line. High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment. Never check for a fuel leak with your hands. Always use a piece of wood or cardboard. Have your authorized Yanmar Marine dealer or distributor repair any damage.

CAUTION

If any problem is noted during the visual check, the necessary corrective action should be taken before operating the engine.

1. Check for engine oil leaks.
2. Check for fuel leaks.
3. Check for engine coolant leaks.
4. Check for damaged or missing parts.
5. Check for loose, missing or damaged fasteners.
6. Check the electrical harnesses for cracks, abrasions and damaged or corroded connectors.
7. Check hoses for cracks, abrasions and damaged, loose or corroded clamps.
8. Check the fuel filter/water separator for presence of water and contaminants. If you find any water or contaminants, drain the fuel filter/water separator. See *Drain fuel filter and fuel filter/water separator* on page 51. If you have to drain the fuel filter/water separator frequently, drain the fuel tank and check for the presence of water in your fuel supply. See *Drain the fuel tank* on page 54.

■ Check diesel fuel, engine oil and engine coolant levels

Follow the procedures in *Diesel Fuel* on page 23, *Engine Oil* on page 28 and *Engine Coolant* on page 30 to check these levels.

■ Checking and refilling marine gear oil

Refer to the *Operation Manual* for the marine gear.

PERIODIC MAINTENANCE

■ Checking the control head

Be sure to check that the control lever moves smoothly before use. If it is hard to operate, consult your authorized Yanmar Marine dealer or distributor.

■ Checking the alarm indicators

When operating the start switch on the rocker switch panel, check that there is no alarm message on the display and the alarm indicators work normally. *See Display function on page 16.*

■ Preparing fuel, oil and coolant in reserve

Prepare sufficient fuel for the day's operation. Always store engine oil and coolant in reserve (for at least one refill) onboard, to be ready for emergencies.

After Initial 50 Hours of Operation

Perform the following maintenance after the initial 50 hours of operation.

- Replace fuel filter element
 - Replace engine oil and engine oil filter
 - Check electronic control system operation
 - Adjust propeller shaft alignment
- Replace the fuel filter element

WARNING

When removing any fuel system component to perform maintenance (such as changing the fuel filter), put an approved container under the opening to catch the fuel. Never use a shop rag to catch the fuel. Vapors from the rag are flammable and explosive. Wipe up any spills immediately. Wear eye protection. The fuel system is under pressure and fuel could spray out when removing any fuel system component.

WARNING

Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak, such as a broken fuel injection line. High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment. Never check for a fuel leak with your hands. Always use a piece of wood or cardboard. Have your authorized Yanmar Marine dealer or distributor repair any damage.

When the engine is operated on light diesel oil, replace the fuel filter element every 250 hours or one year of operation.

1. Close the fuel tank drain cock.
2. Remove the center bolt (1, **Figure 1**) at the bottom of the filter and take out the filter element (2, **Figure 1**).
3. Replace the element with a new one and tighten the center bolt (1, **Figure 1**).

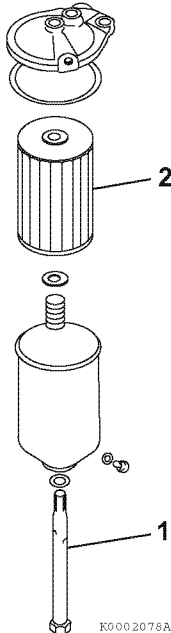


Figure 1

4. Check for fuel leaks.

■ Replace engine oil and engine oil filter

⚠ WARNING

If the engine oil must be drained while it is still hot, stay clear of the hot engine oil to avoid being burned.

⚠ CAUTION

Be careful not to get any oil on the V-belt. Oil on the belt causes slipping and stretching. Replace the belt if it is damaged.

The engine oil on a new engine becomes contaminated from the initial break-in of internal parts. It is very important that the initial oil change is performed as scheduled.

It is easiest and most effective to drain the engine oil after operation while the engine is still warm.

1. Turn the engine off.
2. Remove the engine oil dipstick. Attach the oil drain pump and pump out the oil.

NOTICE

Prevent dirt and debris from contaminating engine oil. Carefully clean the dipstick and the surrounding area before removing the dipstick.

For easier draining, remove the engine oil fill cap (2, **Figure 2**) (yellow) at the top of the rocker arm cover. Dispose of used oil properly.

NOTICE

Always be environmentally responsible.

3. Remove the engine oil filter (1, **Figure 2**) with a filter wrench (turn counterclockwise).
4. Clean the filter installation face, attach the new full-flow oil filter and tighten by hand until the seal touches.
5. Turn the full-flow oil filter an additional 3/4 of a turn clockwise with the filter wrench.

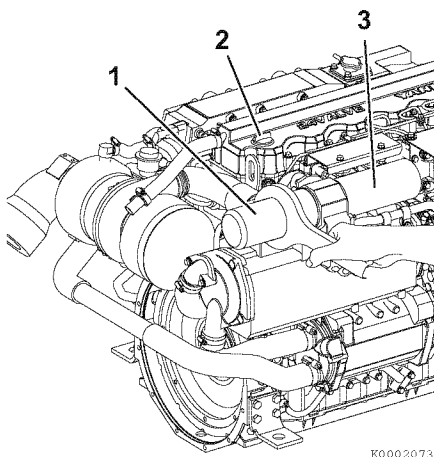


Figure 2

6. Fill with new engine oil. See *Adding Engine Oil* on page 29.

NOTICE

Never mix different types of engine oil. This may adversely affect the lubricating properties of the engine oil. Never overfill. Overfilling may result in white exhaust smoke, engine overspeed or internal damage.

7. Perform a trial run and check for oil leaks.
8. Approximately 10 minutes after stopping the engine, remove the oil dipstick and check the oil level. Add oil if the level is too low.

■ Check the electronic control system operation

The electric governor on the engine and the marine gear are connected to the control head, rocker switch panel and display through electric devices such as the engine interface module.

■ Adjust the propeller shaft alignment

The flexible engine mounts are compressed a little in the initial engine operation, which may cause centering misalignment between the engine and the propeller shaft.

Check for any unusual noise and vibration in the engine/boat hull, while increasing and decreasing the engine speed gradually.

If there is unusual noise and/or vibration, this maintenance requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to adjust the propeller shaft alignment.

Every 50 Hours of Operation

Perform the following maintenance every 50 hours or one month of operation, whichever comes first.

- Drain fuel filter and fuel filter/water separator
- Check battery electrolyte level
- Adjust alternator V-belt tension or replace alternator belt

■ Drain fuel filter and fuel filter/water separator

⚠ WARNING

When removing any fuel system component to perform maintenance (such as changing the fuel filter), put an approved container under the opening to catch the fuel. Never use a shop rag to catch the fuel. Vapors from the rag are flammable and explosive. Wipe up any spills immediately. Wear eye protection. The fuel system is under pressure and fuel could spray out when removing any fuel system component.

⚠ CAUTION

- If the fuel filter/water separator is positioned higher than the fuel level in the fuel tank, water may not drip out when the fuel filter/water separator drain cock is opened. If this happens, turn the air vent screw on the top of the fuel filter/water separator 2 - 3 turns counterclockwise.
- Be sure to tighten the air vent screw after the water has drained out.

Drain the fuel filter

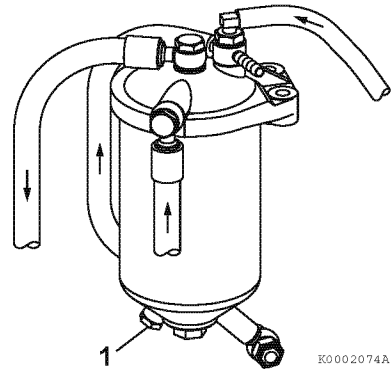


Figure 3

1. Close the fuel tank cock.
2. Loosen the drain plug (1, **Figure 3**). Drain off any water and dirt collected inside. Dispose of the collected water and dirt properly.

NOTICE

Always be environmentally responsible.

Drain the fuel filter/water separator

⚠ WARNING

Avoid skin contact with the high-pressure diesel fuel spray caused by a fuel system leak, such as a broken fuel injection line. High-pressure fuel can penetrate your skin and result in serious injury. If you are exposed to high-pressure fuel spray, obtain prompt medical treatment. Never check for a fuel leak with your hands. Always use a piece of wood or cardboard. Have your authorized Yanmar Marine dealer or distributor repair any damage.

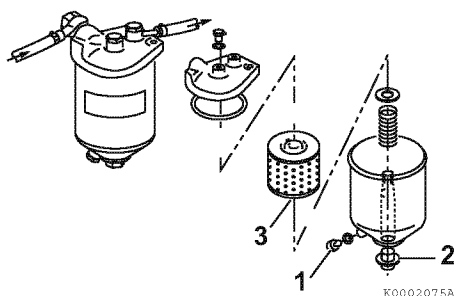


Figure 4

1. Close the fuel tank drain cock.
2. Loosen the drain plug (1, **Figure 4**) at the bottom of the fuel filter/water separator and drain off any water and dirt.
3. Remove the center bolt (2, **Figure 4**) to disassemble the fuel filter/water separator. Clean the element (3, **Figure 4**) inside with clean fuel.
4. When a fuel filter or fuel filter/water separator is provided in the hull in addition to those installed on the engine, also drain and clean it or replace the element.
5. After reassembly of the fuel filter/water separator, be sure to bleed air from the fuel system. *See Bleeding the Fuel System on page 27.*
6. Check for fuel leaks.

■ Check the battery

⚠ WARNING

Batteries contain sulfuric acid. Never allow battery fluid to come in contact with clothing, skin or eyes. Severe burns could result. Always wear safety goggles and protective clothing when servicing the battery. If battery fluid contacts the eyes and/or skin, immediately flush the affected area with a large amount of clean water and obtain prompt medical treatment.

NOTICE

- Never turn off the battery switch (if equipped) or short the battery cables during operation. Damage to the electrical system will result.
- Never operate with insufficient battery electrolyte. Operating with insufficient electrolyte will destroy the battery.
- Battery fluid tends to evaporate in high temperatures, especially in summer. In such conditions, inspect the battery earlier than specified.

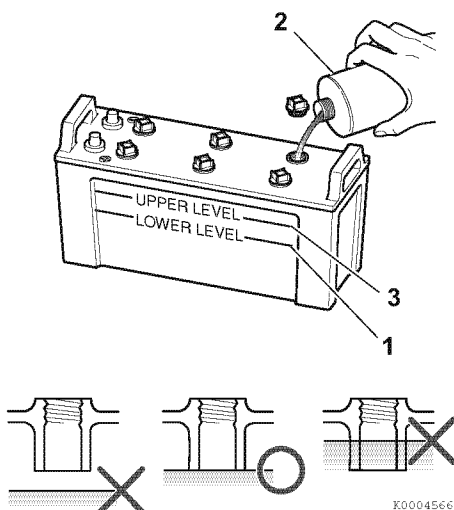


Figure 5

1. Do not operate engine if battery has insufficient battery fluid, as the battery will be destroyed. Check the fluid level periodically. If the level is lower than the minimum fill level (1, **Figure 5**), fill with distilled water (2, **Figure 5**) (available in the grocery store) up to the upper limit (3, **Figure 5**) of the battery. (Battery fluid tends to evaporate in high temperatures, especially in summer. In such cases, inspect the battery earlier than specified.)

2. If the starter rpm is too low and the engine cannot be started, measure the specific gravity of the battery with a hydrometer.

When the specific gravity of the fluid is over 1.27 at 20 °C (68 °F), it is fully charged. Fluid with a specific gravity of below 1.24 needs charging. If the specific gravity cannot be raised by charging, the battery must be replaced.

Note: The capacities of the standard alternator and the recommended battery assume only the power necessary for regular operation. If the power is also used for inboard lighting or other purposes, the generating and charging capacities may be insufficient. In such cases, consult your authorized Yanmar Marine dealer or distributor.

■ Adjust alternator V-belt tension

When there is not enough tension in the V-belt, it will slip and the coolant pump will fail to supply coolant. Engine overheating and seizure will result.

When there is too much tension in the V-belt, the belt will become damaged more quickly and the coolant pump bearing may be damaged.

WARNING

Perform this check with engine off and key removed to avoid contact with moving parts.

NOTICE

Never get any oil on the belt(s). Oil on the belt causes slipping and stretching. Replace the belt if it is damaged.

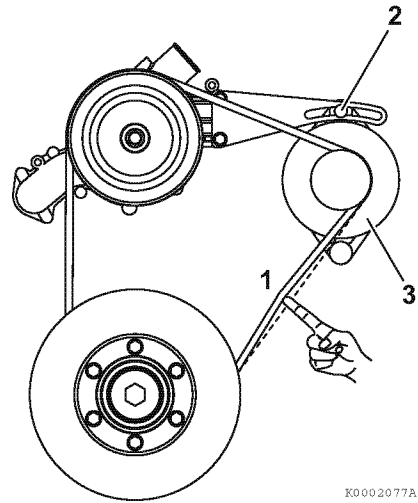


Figure 6

1. Check the tension of the V-belt by pressing on the middle of the belt (1, **Figure 6**) with your finger approximately 98 N, 10 kgf (22 lbf). With proper tension, the V-belt should deflect 8 - 10 mm (approximately 3/8 in.).
2. If the V-belt deflection is out of the limit, adjust the V-belt tension. Loosen the adjuster bolt (2, **Figure 6**) and move the alternator (3, **Figure 6**) to adjust the V-belt tension.
3. If the V-belt is damaged or worn, replace it. Loosen the adjuster bolt (2, **Figure 6**) and move the alternator (3, **Figure 6**). Remove belt from pulleys.
4. Install new belt per routing (**Figure 6**) and adjust the tension as shown in Step 2.

Every 250 Hours of Operation

Perform the following maintenance every 250 hours or one year of operation, whichever comes first.

- **Check fuel injector spray pattern**
- **Adjust intake/exhaust valve clearance (1st time)**
- **Drain the fuel tank**
- **Replace the fuel filter element**
- **Replace the engine oil (crankcase)**
- **Replace the engine oil filter element**
- **Check the seawater pump impeller**
- **Replace the zinc anode**
- **Clean the air intake silencer**
- **Clean the exhaust/water mixing elbow**
- **Clean the turbocharger blower**
- **Flush the air cooler**
- **Check the wiring connectors**
- **Tighten all major nuts and bolts**
- **Check or replace the flexible engine mounts**
- **Replace engine coolant**

■ Check the fuel injector spray pattern

Inspection and adjustment are necessary to obtain optimal fuel injection to ensure the best possible engine performance. This inspection requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to check the injection spray condition.

■ Adjust intake/exhaust valve clearance (1st time)

Inspection and adjustment must be made to correct opening/closing timing lags of the intake/exhaust valves which might arise due to initial parts wear. This inspection requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to adjust the intake/exhaust valve clearance.

■ Drain the fuel tank

Position an approved container under the fuel tank drain. Open the drain cock and let the water, dirt, etc. drain from the tank's bottom into the container. Drain until fuel with no water and dirt flows out. Close the drain cock. *See Filling the Fuel Tank on page 26.*

■ Replace the fuel filter element

See Replace the fuel filter element on page 48.

■ Replace the engine oil (crankcase)

See Replace engine oil and engine oil filter on page 49.

■ Replace the engine oil filter element

See Replace engine oil and engine oil filter on page 49.

■ Check the seawater pump impeller

Depending on use, the inside parts of the seawater pump deteriorate and discharge performance drops.

At the specified interval or when the volume of seawater discharged is reduced, inspect the seawater pump in accordance with the following procedures:

1. Loosen the side cover bolts and remove the side cover.
2. Illuminate the inside of the seawater pump with a flashlight and inspect.
3. If any of the following problems are found, disassembly and maintenance are necessary:
 - Impeller blades are cracked or nicked.
 - Edges or surfaces of the blades are marred or scratched.
 - Wear plate is damaged.
4. If no damage is found when inspecting the inside of the pump, reassemble the side cover.

Note: Fit the O-ring to the groove on the joint face before replacing the side cover.

If a large amount of water leaks continuously from the water drain pipe beneath the seawater pump during operation, disassembly and maintenance (replacement of the lip seal) are necessary.

When disassembly and maintenance of the seawater pump are necessary, consult your Yanmar dealer or distributor.

Note: The seawater pump turns in the direction as shown (Figure 7) and the impeller must be installed to run in this direction. If the impeller has been removed for any reason and must be reassembled, be very careful not to install it in the wrong direction. Additionally, if the engine is being turned manually, be careful to turn it in the correct direction. Incorrect turning will twist the impeller and damage it.

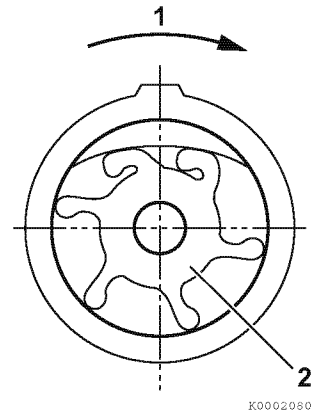


Figure 7

■ Replace the zinc anode

The timing for replacing the zinc anode varies depending on the characteristics of the seawater and operational conditions.

Inspect the zinc anode periodically and remove the corroded area on the surface.

Replace the zinc anode when it has decreased to less than 1/2 of the original volume. If replacement of zinc anode is neglected and operation is continued with a corroded zinc anode, corrosion of the seawater cooling system will occur and water leakage or parts breakage will result.

The label (**Figure 8**) is stamped on the plugs which have the zinc anode.

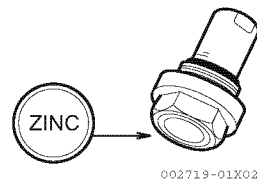


Figure 8

Be sure to close the seacock before removing the plug to replace the zinc anode.

PERIODIC MAINTENANCE

■ Clean the air intake silencer

Disassemble the intake silencer and clean the inside thoroughly.

1. Take off the clamp and remove the muffler.
2. Clean the element with a neutral detergent.
3. Reassemble after the muffler is completely dry.

■ Clean the exhaust/water mixing elbow

The mixing elbow is attached to the turbocharger. The exhaust gas is mixed with seawater in the mixing elbow.

1. Clean dirt and scale out of the exhaust gas passage and seawater way in the mixing elbow.
2. Repair the crack or damage of the mixing elbow by welding, or replace if necessary.
3. Inspect the gasket and replace if necessary.

■ Clean the turbocharger blower

Contamination of the turbocharger blower causes blower revolutions to drop and engine output to fall.

If a drop of engine output is noted (by about 10 %), clean the blower. This should only be done by a trained and qualified technician. Consult your authorized Yanmar Marine dealer or distributor to clean the turbocharger blower.

■ Flush the air cooler

Contamination of the air cooler causes the engine output to fall.

If a drop of engine output is noted (by about 10 %), flush and clean the air cooler.

This should be done only by a trained and qualified technician. Consult your authorized Yanmar Marine dealer or distributor to flush the air cooler.

■ Check the wiring connectors

Check for any loose connections.

■ Tighten all major nuts and bolts

After a long period of usage, the major nuts and bolts of the engine may loosen. Tighten the major nuts and bolts to the standard tightening torques. This inspection requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to tighten major nuts and bolts.

■ Check/replace the flexible engine mounts

CAUTION

Never get any engine oil or diesel fuel oil on the flexible rubber mount. Oil makes rubber deteriorate.

The rubber tension of the flexible engine mounts is lost after many hours of use.

This leads to a drop in vibration absorption performance, and also causes centering misalignment of the propeller shaft.

1. Check if the rubber is cracked. If necessary, replace the flexible mount.
2. Check for abnormal noise or vibration while engine is running. If necessary, replace the flexible mount.

■ Replace engine coolant

CAUTION

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

Cooling performance drops when coolant is contaminated with rust and scale. The coolant must be replaced periodically because its properties deteriorate over time.

To drain the engine coolant, open the coolant drain cocks (two places).

See Engine Coolant on page 30 for coolant specifications.

NOTICE

Never mix different types and/or colors of coolants.

Discard old coolant in an approved manner according to environmental laws.

Every 500 Hours of Operation

Perform the following maintenance every 500 hours or two years of operation, whichever comes first.

- **Replace seawater pump impeller**
- **Adjust the propeller shaft alignment**
- **Check alternator belt tension**
- **Replace the exhaust/water mixing elbow**
- **Adjust the no-load minimum speed**

■ Replace the seawater pump impeller

Replace the used seawater pump impeller periodically. Consult your authorized Yanmar Marine dealer or distributor.

■ Adjust the propeller shaft alignment

The rubber tension of the flexible engine mounts is lost after many hours of use. This leads to a drop in vibration absorption performance, and also causes centering misalignment of the propeller shaft.

This maintenance requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to adjust the propeller shaft alignment.

■ Check alternator belt tension

Check the alternator belt tension. *See Adjust alternator V-belt tension on page 53.*

■ Replace the exhaust/water mixing elbow

The exhaust/water mixing elbow must be replaced at 500 hours or 2 years, even if no damage is found. Consult your authorized Yanmar Marine dealer or distributor.

PERIODIC MAINTENANCE

■ Adjust the no-load minimum speed

This maintenance requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to adjust the no-load minimum speed.

Every 1000 Hours of Operation

Perform the following maintenance every 1000 hours or four years of operation, whichever comes first.

- **Check the fuel injector spray pattern**
- **Clean and check the water passages**
- **Replace alternator belt**
- **Adjust intake/exhaust valve clearance**
- **Replace flexible engine mounts**

■ Check the fuel injector spray pattern

Adjustment is necessary to obtain the optimal fuel injection to ensure the best possible engine performance.

This inspection requires specialized knowledge and techniques. Consult your authorized Yanmar Marine dealer or distributor to check the injection spray condition.

■ Clean and check the seawater passages

When it is used for a long time, cleaning the seawater passages is periodically necessary because trash, scales, rust and other deposits or debris collect in the seawater passages and the cooling performance declines.

This maintenance requires specialized knowledge. Consult your authorized Yanmar Marine dealer or distributor to clean and check the water passages.

■ Replace alternator belt

Replace the alternator belt with a new one every 1000 hours or four years, whichever comes first, even if there is no crack or damage in the surface.

See Adjust alternator V-belt tension on page 53.

■ Adjust intake/exhaust valve clearance

Proper adjustment is necessary to maintain the correct timing for opening and closing the valves. Improper adjustment will cause the engine to run noisily, resulting in poor engine performance and engine damage. Consult your authorized Yanmar Marine dealer or distributor to adjust the intake/exhaust valve clearance.

■ Replace flexible engine mounts

Be sure to replace the Yanmar flexible engine mounts every 1000 hours or 4 years, whichever comes first.

The rubber tension of the flexible engine mounts is lost after many hours of use. This leads to a drop in vibration absorption performance, and also causes centering misalignment of the propeller shaft.

Every 2000 Hours of Operation

Perform the following maintenance every 2000 hours or eight years of operation, whichever comes first.

- **Overhaul and check fuel feed pump**
- **Clean engine oil cooler**
- **Clean seawater and engine coolant system**
- **Replace rubber fuel hoses**

■ Overhaul and check fuel feed pump

Fuel feed pump must be overhauled and checked to ensure optimal engine performance.

This maintenance requires specialized knowledge. Consult your authorized Yanmar Marine dealer or distributor to overhaul and check the fuel feed pump.

■ Clean engine oil cooler

Rust and scale are deposited inside the seawater system during long use. These deposits lower cooling performance, so it is necessary to clean and maintain the engine oil cooler.

Consult your authorized Yanmar Marine dealer or distributor to clean the engine oil cooler.

PERIODIC MAINTENANCE

■ Clean seawater and engine coolant system

Rust and scale are deposited inside the seawater and engine coolant system during long use. This lowers cooling performance, so it is necessary to clean and maintain the following parts in addition to replacing the coolant.

Relevant coolant system parts:

Seawater pump, engine oil cooler, air cooler, coolant pump, heat exchanger, thermostat, etc.

Consult your authorized Yanmar Marine dealer or distributor to clean the seawater and engine coolant systems.

■ Replace rubber fuel hoses

Rubberized fuel hoses tend to dry out and become brittle after 2000 hours or 2 years of engine operation, whichever comes first.

Consult your authorized Yanmar Marine dealer or distributor to replace the rubber fuel hoses.

LONG-TERM STORAGE

BEFORE YOU PLACE THE ENGINE IN LONG-TERM STORAGE

Before performing any storage procedures within this section, review the *Safety section on page 3*.

In cold temperatures or before long-term storage, be sure to drain the seawater from the cooling system.

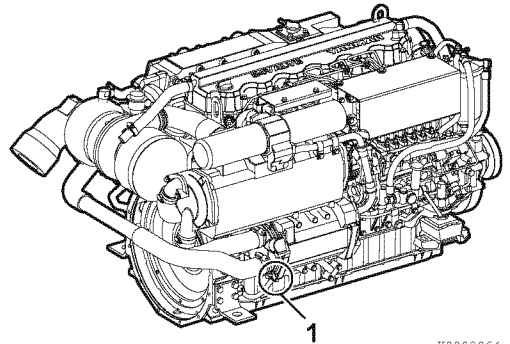
WARNING

Never remove the coolant filler cap if the engine is hot. Steam and hot engine coolant will spray out and seriously burn you. Allow the engine to cool down before you attempt to remove the cap.

CAUTION

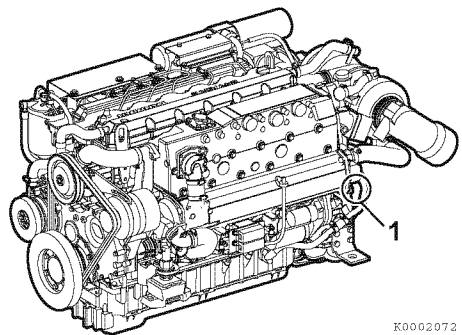
- Do not drain the coolant system. A full coolant system will prevent corrosion and frost damage.
- If seawater is left inside of the engine, it may freeze and damage parts of the cooling system when the ambient temperature is below 0 °C (32 °F).

1. Loosen the seawater drain cocks (1, **Figure 1**), (1, **Figure 2**) and drain the seawater.



K0002064

Figure 1



K0002072

Figure 2

If no liquid comes from the drain cocks, it may be necessary to use a stiff wire to remove any debris to allow drainage.

LONG-TERM STORAGE

2. Loosen the six bolts attaching the side cover of the seawater pump, remove the cover and drain the water from inside.
Retighten the bolts when finished.
3. Close the drain cocks.

Note: Do not drain the coolant (coolant cooling system). If the coolant is drained, the cooling system components could corrode.

Before placing the engine in storage, perform the following:

1. Clean the outside of the engine, wiping off any dust or oil.
2. Drain the fuel or fill the tank completely to help prevent condensation inside the tank.
3. Refill the heat exchanger with engine coolant.
4. Cover the turbocharger, exhaust pipe, etc. with vinyl sheets and seal them to prevent moisture from entering.
5. Completely drain the bilge. Put the boat in dry dock, if possible.
6. Waterproof the engine room to prevent rain and seawater from entering.
7. During long-term storage, charge the battery once a month to compensate for the battery's self-discharge.

RETURNING THE ENGINE TO SERVICE

1. Replace the oil and the oil filter before running the engine.
2. Supply fuel if the fuel in the fuel tank was removed, and prime the fuel system.
3. Confirm that there is engine coolant in the engine.
4. Operate the engine at idle speed for 1 minute.
5. Check fluid levels and check engine for leaks.

TROUBLESHOOTING

Before performing any troubleshooting procedures within this section, review the *Safety section on page 3*.

If a problem occurs, stop the engine immediately. Refer to the symptom column in the troubleshooting chart to identify the problem.

CAUTION

- If any indicator fails to illuminate when the key switch is in the ON position, consult your authorized Yanmar Marine dealer or distributor for service before operating the engine.
- If any indicator illuminates during engine operation, stop the engine immediately. Determine the cause and repair the problem before you continue to operate the engine.

TROUBLESHOOTING AFTER STARTING

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

Is sufficient water being discharged from the seawater outlet pipe?

If the discharge is low, stop the engine immediately. Identify the cause and repair.

Is the exhaust color normal?

The continuous emission of black exhaust smoke indicates engine overloading. This shortens the engine's life and should be avoided.

Are there abnormal vibrations or noise?

Depending on the hull structure, engine and hull resonance may suddenly increase at certain engine speed ranges, causing heavy vibrations. Avoid operation in this speed range. If any abnormal sounds are heard, stop the engine and inspect for cause.

Alarm sounds during operation.

If the alarm sounds during operation, lower the engine speed immediately, check the warning lamps and stop the engine for repairs.

Is there water, oil or fuel leakage? Are there any loose bolts or connections?

Check the engine room daily for any leaks or loose connections.

Is there sufficient fuel in the fuel tank?

Refill fuel in advance to avoid running out of fuel. If the tank runs out of fuel, bleed the fuel system. *See Bleeding the Fuel System on page 27.*

When operating the engine at low speed for long periods of time, race the engine once every 2 hours. Racing the engine with the clutch in NEUTRAL, accelerate from the low speed position to the high speed position and repeat this process about five times. This is done to clean out carbon from the cylinders and the fuel injection valves.

NOTICE

Neglecting to race the engine will result in poor exhaust color and reduce engine performance.

Periodically operate the engine near maximum speed while underway. This will generate higher exhaust temperatures, which will help clean out hard carbon deposits, maintain engine performance and prolong the life of the engine.

TROUBLESHOOTING INFORMATION

If your engine does not operate properly, refer to the Troubleshooting Chart or consult your authorized Yanmar Marine dealer or distributor.

Supply the authorized Yanmar Marine dealer or distributor with the following information:

- Model name and serial number of your engine
- Boat name, hull material, size (tons)
- Use, type of boating, number of hours run
- Total number of operation hours (refer to hourmeter), age of boat
- Operating conditions when the problem occurs:
 - Engine speed
 - Color of exhaust smoke
 - Type of diesel fuel
 - Type of engine oil
 - Any abnormal noises or vibration
 - Operating environment such as high altitude or extreme ambient temperatures, etc.
- Engine maintenance history and previous problems
- Other factors that contribute to the problem

TROUBLESHOOTING CHART

Symptom	Probable cause	Measure	Reference
Alarm indicators and alarm sound come on in the display during operation	Shift to low speed operation immediately, and check which indicator has come on in the display. Stop the engine for inspection. If no abnormality is identified and there is no problem with operation, return to the port at lowest speed and request repairs.		
• Lube oil low pressure alarm indicator comes on.	• Engine lube oil level is low.	• Check lube oil level. Add or replace.	<i>Checking Engine Oil on page 29.</i>
	• Lube oil filter clogged.	• Replace lube oil filter. Replace lube oil.	<i>Replace engine oil and engine oil filter on page 49.</i>
• Marine gear lube oil pressure alarm indicator comes on.	• Marine gear lube oil is low.	• Check the oil level and supply.	—
• Coolant high temperature alarm indicator comes on.	• Coolant/fresh water in coolant tank is low.	• Check coolant level and replenish.	<i>Check diesel fuel, engine oil and engine coolant levels on page 47.</i>
	• Insufficient seawater causing temperature to rise.	• Check seawater system.	—
	• Contamination inside cooling system.	• Consult your authorized Yanmar Marine dealer or distributor.	—
Faulty warning devices	Do not operate the engine if alarm devices are not repaired. Serious accidents may result if difficulties are not spotted due to faulty alarm lamps.		
1. When switch is turned ON:			
• Alarm buzzer sounds.	• Circuit broken. Note: Alarm buzzer only sounds when there is an abnormality.	• Consult your authorized Yanmar Marine dealer or distributors.	—
• Alarm indicator comes on.	• Circuit broken. Note: Alarm indicator only comes on when there is an abnormality.	• Consult your authorized Yanmar Marine dealer or distributor.	—
2. When the rocker switch returned to ON from START after engine starts:			
• Buzzer keeps on sounding.	• Sensor switches faulty (if indicator comes on).	• Consult your authorized Yanmar Marine dealer or distributor.	—
	• Short-circuit (if indicator does not come on).		
• One of the alarm indicators comes on.	• Sensor switches engine faulty.	• Consult your authorized Yanmar Marine dealer or distributor.	—

TROUBLESHOOTING

Symptom	Probable cause	Measure	Reference
• Battery low charge indicator comes on during operation.	• V-belt is loose or broken.	• Replace V-belt; adjust tension.	<i>Adjust alternator V-belt tension on page 53.</i>
	• Battery defective.	• Check battery fluid level, specific gravity. Replace.	<i>Check the battery on page 52.</i>
	• Alternator power generation failure.	• Consult your authorized Yanmar Marine dealer or distributor.	—
White exhaust smoke at start	• Poor fuel quality.	• Replace with fresh fuel.	—
Black smoke on acceleration	• Propeller too large.	• Replace with correct size.	—
	• Hull bottom dirty.	• Clean hull bottom.	

SPECIFICATIONS

PRINCIPAL ENGINE SPECIFICATIONS

6LY3-ETP / 6LY3-STP / 6LY3-UTP Engines

Engine model		6LY3-ETP	6LY3-STP	6LY3-UTP
Use		For recreational use		
Type		Vertical water cooled 4 cycle diesel engine		
Aspiration		Turbocharger with Intercooler		
Combustion system		Direct injection		
Number of cylinders		6		
Bore × stroke		105.9 × 110 mm (4.17 × 4.33 in.)		
Displacement		5.813 ℓ (6.14 qt)		
Continuous power	Output at crankshaft engine/speed	3198 min ⁻¹ (rpm)		
		436 hp Metric	401 hp Metric	345 hp Metric
		321 kW	295 kW	254 kW
Maximum rated output	Output at crankshaft engine/speed	3300 min ⁻¹ (rpm)		
		480 hp Metric	440 hp Metric	380 hp Metric
		353 kW	324 kW	279 kW
		At fuel inlet temp. 40 °C (104 °F)		
High idling		3500 ± 25 min ⁻¹ (rpm)		
Low idling		700 ± 25 min ⁻¹ (rpm)		
Installation		Flexible mounting		
Direction of rotation	Crankshaft	Counterclockwise viewed from stern		
Cooling system		Liquid cooling with heat exchanger		
Normal operating temperature range		71 to 81 °C (160 to 190 °F)		
Lubrication system		Complete enclosed forced lubrication		
Normal oil pressure range		4.0 to 5.0 bar (58 to 73 psi)		

SPECIFICATIONS

Engine model		6LY3-ETP	6LY3-STP	6LY3-UTP
Coolant capacity (fresh)		Engine: 28 ℓ (30 qt) Coolant recovery tank: 1.5 ℓ (1.6 qt)		
Engine lubricating oil capacity	Rake angle	Rake angle 0 deg		
	Total (note 4)	18.8 ℓ (19.9 qt)		
	Effective (note 5)	8.0 ℓ (8.5 qt)		
Starting system	Type	Electric		
	Starting motor	DC 12 V - 3 kW		
	AC generator	12 V - 80 A		
Turbocharger	Model	RHC7W (IHI made)		
	Type	Water cooled		
Engine dimension	Overall length	1300.4 mm (51.2 in.)		
	Overall width	801.3 mm (31.5 in.)		
	Overall height	776.6 mm (30.6 in.)		
Engine dry mass (without marine gear)		640 kg (1410.96 lb)		
Recommended battery capacity		12 V - 150 AH or more		

Note:

- Rating condition: ISO 8665. Temperature of fuel: 40 °C (104 °F) at fuel pump inlet.
- 1 hp (metric horsepower) = 0.7355 kW
- Fuel condition: Density at 15 °C (59 °F) = 0.860 g/cm³ (53.7 lb ft³).
Fuel temperature at the inlet of the fuel injection pump.
- The “Total Engine Lubricating Oil Capacity” includes oil in oil pan, channels, coolers and filter.
- The “Effective Engine Lubricating Oil Capacity” indicates the difference in maximum scale of the dipstick and minimum scale.

6LY3-ETA / 6LY3-STA Engines

Engine model		6LY3-ETA	6LY3-STA
Use		For recreational use	
Type		Vertical water cooled 4 cycle diesel engine	
Aspiration		Turbocharger with Intercooler	
Combustion system		Direct injection	
Number of cylinders		6	
Bore × stroke		105.9 × 110 mm (4.17 × 4.33 in.)	
Displacement		5.813 ℓ (6.14 qt)	
Continuous power	Output at crankshaft engine/speed	3198 min ⁻¹ (rpm)	
		436 hp Metric	401 hp Metric
		321 kW	295 kW
Maximum rated output	Output at crankshaft engine/speed	3300 min ⁻¹ (rpm)	
		469 hp Metric	430 hp Metric
		343 kW	316 kW
		At fuel inlet temp. 40 °C (104 °F)	
High idling		3500 ± 25 min ⁻¹ (rpm)	
Low idling		700 ± 25 min ⁻¹ (rpm)	
Installation		Flexible mounting	
Direction of rotation	Crankshaft	Counterclockwise viewed from stern	
Cooling system		Liquid cooling with heat exchanger	
Normal operating temperature range		71 to 81 °C (160 to 190 °F)	
Lubrication system		Complete enclosed forced lubrication	
Normal oil pressure range		4.0 to 5.0 bar (58 to 73 psi)	
Coolant capacity (fresh)		Engine: 28 ℓ (30 qt) Coolant recovery tank: 1.5 ℓ (1.6 qt)	
Engine lubricating oil capacity	Rake angle	Rake angle 0 deg	
	Total (note 4)	18.8 ℓ (19.9 qt)	
	Effective (note 5)	8.0 ℓ (8.5 qt)	
Starting system	Type	Electric	
	Starting motor	DC 12 V - 3 kW	
	AC generator	12 V - 80 A	
Turbocharger	Model	RHC7W (IHI made)	
	Type	Water cooled	
Engine dimension	Overall length	1300.4 mm (51.2 in.)	
	Overall width	801.3 mm (31.5 in.)	
	Overall height	776.6 mm (30.6 in.)	
Engine dry mass (without marine gear)		640 kg (1410.96 lb)	
Recommended battery capacity		12 V - 150 AH or more	

SPECIFICATIONS

Note:

- *Rating condition: ISO 8665. Temperature of fuel: 40 °C (104 °F) at fuel pump inlet.*
- *1 hp (metric horsepower) = 0.7355 kW*
- *Fuel condition: Density at 15 °C (59 °F) = 0.840 g/cm³ (52.4 lb ft³).
Fuel temperature at the inlet of the fuel injection pump.*
- *The “Total Engine Lubricating Oil Capacity” includes oil in oil pan, channels, coolers and filter.*
- *The “Effective Engine Lubricating Oil Capacity” indicates the difference in maximum scale of the dipstick and minimum scale.*

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