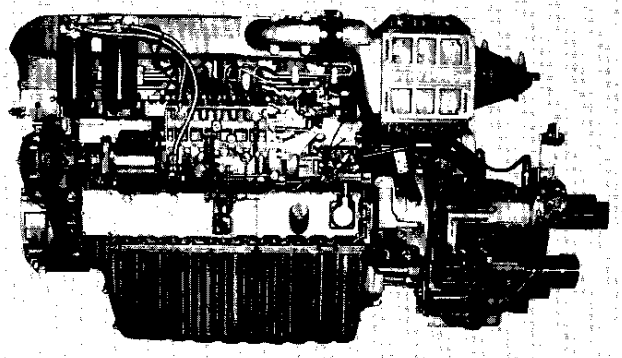
OPERATION MANUAL

YANMAR

YANMAR DIESEL ENGINE

6CX(M)-ETE



Be sure to read this manual for safe and proper operation.
Store this manual carefully after use.

Congratulations on your choice of
YANMAR product from YANMAR DIESEL ENGINE CO., LTD.
This manual describes operation, periodic inspection and maintenance servicing for the ENGINE manufactured by YANMAR DIESEL ENGINE CO., LTD.
Please read this manual carefully before use, and operate your engine properly under the optimum conditions, should you have any questions or concerns, please do not hesitate to contact your nearest dealer or distributor.

California Proposition 65 Warning

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

YANMAR
MARINE DIESEL ENGINE
MODELS : 6CX(M)-ETE
OPERATION MANUAL

Thank you purchasing a YANMAR Marine Diesel Engine.

[INTRODUCTION]

●This Operation Manual describes the operation, maintenance and inspection of the **6CX(M)-ETE,** Yanmar marine diesel engine.

●Read this Operation Manual carefully before operate the engine to ensure that the engine is used correctly and that it stays in the best possible condition.

●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 dealer or distritor.

●Make sure this manual is transfered to subseguent owners. This manual should be considered a permanent part of the engin and remain 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 such difference please contact your Yanmar Dealer or Distributor.

●For handling of the marine gear, this manual describes on the model YX-70S only.

Operation Manual (Marine Engine)	Models	**6CX(M)-ETE**
	Code No.	**499613-00241**

CONTENTS

FOR YOUR IN SAFETY

WARNING SYMBOLS

Most operation, maintenance and inspection problems arise due to users failure to comply with the rules and precautions for safe operation described in this operation manual.
Often, users don' t understand or recognize the signs of approaching problems.
Mis-handling may cause burns and other injuries and can result in death.

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

● **These are** the warning signs and their meanings which are used in this manual. Pay special attention to these parts.

⚠ DANGER — **DANGER-indicates an imminently hazardous situation which, if not dealt with. WILL result in death or serious injury.**

⚠ WARNING — **WARNING-indicates a potentially hazardous situation which, if not dealt with, COULD result in death or serious injury.**

⚠ CAUTION — **CAUTION-indicates a potentially hazardous situation which, if not dearlt with, MAY result in minor or moderate Injury.**
This sign is also be used to alert you against unsafe practice.

● The descriptions captioned by **[NOTICE]** are for the particularly Important items for handling.
If you ignore them, the performance of your machine may be deteriorated leading to a problems.

9. EASY TROUBLESHOOTING GUIDE

9-1 Air Is Mixed in Fuel System

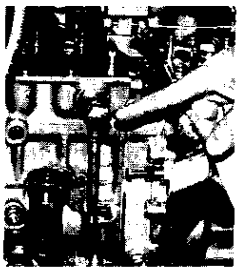
The fuel system includes the fuel tank, oil-water separator, fuel oil filter, feed pump, fuel injection pump, high pressure pipe and fuel injection valve.

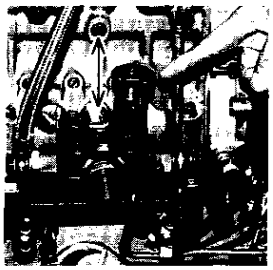
If air enters this system, fuel oil cannot be injected. Completely bleed air from the fuel system by using the following procedure:

(1) Set the regulator lever to the NORMAL position.

(2) Open all the valves of the fuel system.

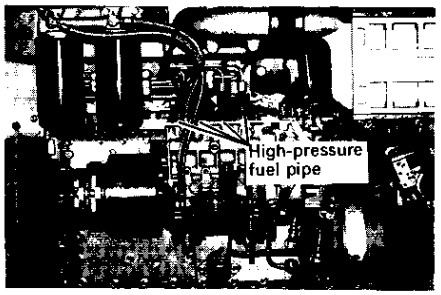
(3) Loosen the air vent bolt of the fuel pump.





(4) Operate the priming pump attached to the side of the fuel pump. (Turn the knob counterclockwise, and the piston of the priming pump will move up and down.) Check that fuel oil flows out of the air vent hole and air is completely purged, and then tighten the air vent bolt. Also turn the knob of the priming pump clockwise to lock it. (Photo above)

(5) Loosen the cap nut of the high-pressure fuel pipe. While turning the flywheel by running the starting motor, check that fuel flows out of the cap nut portion, and then tighten the cap nut. Repeat this procedure for all cylinders.



(6) After bleeding air from all the cylinders, turn the flywheel, and check that fuel is being injected by the sound Brr! Brr! the injectors generate.

9-2 Pressures of Engine Lube Oil Is Abnormal

The engine lube oil pressure has been factory-adjusted before shipping. Normally, therefore you need not readjust them. However, if the lube oil pressure is not normal (4.5 to 5.5 kg/cm^2) or if the LUB-OIL PRESS alarm lamp does not go out, consult the nearest YANMAR dealer.

9-3 Fresh Water Temperature Is Abnormally High

⚠ CAUTION

Beware of oil splashes if extracting the lube oil while it is hot.

If the fresh water temperature exceeds 90°C, the following problems may be affecting the fresh water system or seawater system.

(1) The fresh water passage is blocked due to failure of the fresh water pump or clogging of the fresh water passage.

(2) Fresh water does not circulate through the cooler due to malfunction of the thermostat.

(3) The flow rate of fresh water is reduced due to failure of the seawater pump or clogging of the seawater passage.

(4) Fresh water is not cooled due to contamination of the cooler. In this case, consult the nearest YANMAR dealer.

9-4 Clutch Oil Pressure is Abnormal

The clutch oil pressure has been factory-adjusted before shipment. However, if the slipping of the clutch should be caused by a drop in clutch oil pressure, temporarily tighten the emergency bolt, and the boat can sail ahead.
For details on the emergency bolt, refer to Sec. 7-3.
The LUB-OIL PRESS alarm lamp may light when the engine speed is rapidly reduced. Note that this is not abnormal.

8. PERIODICAL CHECK AND SERVICE

To use the engine at the best condition, periodical check is essential. For the maintenace items and inspection schedules, refer to the maintenace list below.

Maintenance List

● : Consult nearest dealer.
○ : Check ◉ : Replace

Item	Description	Schedule						Page
		Daily	Every 50 service hrs.	Every 250 service hrs.	Every 500 service hrs.	Every 1000 service hrs. (or every 5 or 6 months)	Every 2500 service hrs. (or annually)	
Fuel	Check of oil volume in tank and supply of oil	○						24
	Drainage of tank	○(Before oil supply)						24
	Drainage of filter and oil-water separator		○					24
	Replacement of filter element				◉			24
Lube oil and hydraulic oil	Check of oil level in oil pan, and oil supply	○						27
	Replacement of filter element (including bypass filter)		◉ (1st time)		◉			27
	Cleaning of lube oil cooler						●	28
	Change of lube oil — Engine side		○ (1st time)	○(A-heavy oil)	○ (Light oil)			28
	Change of lube oil —							
Cooling water (seawater side)	Check of cooling water discharge	○						29
	Check and replacement of impeller					○	◉	29
	Check and replacement of anticorrosive zinc				◉			29
	Cleaning of seawater system (including fresh water and lube oil cooler)					●		30
Cooling water (fresh water side)	Check and supply of fresh water level	○						30
	Replacement of fresh water					●		31
	Cleaning of fresh water system (including fresh water cooler)						●	31
Fuel injection pump and fuel injection valve	Adjustment of injection timing						●	25
	Overhaul and check of fuel feed pump						●	38
	Adjustment of injection pressure and atomizing condition			● (1st time)		●		23
	Replacement of fuel injection valve						●	26
Cylinder head	Adjustment of clearance between intake and exhaust valve head		● (1st time)			●		23
	Seating of intake and exhaust valves						○	—
Check and adjustment of remote control cable			○ (1st time)		○			33
Electrical parts	Check of alarm lamps	○						34
	Check of battery electrolyte volume			○				34
	Adjustment of alternator (generator) drive belt tension				○			34
	Replacement of battery of liquid crystal display clock						○	34
Turbo-charger	Flushing of blower			○				36

Item	Description	Schedule							
		Daily	Every 50 service hrs	Every 250 service hrs	Every 500 service hrs (or every 2 or 3 months)	Every 1000 service hrs (or every 5 or 6 months)	Every 2500 service hrs (or annually)	Every 5000 service hrs (or once every 2 years)	Page
Intercooler	Flushing of blower			○					36
Reduction and reversing gear	Check and cleaning of lube oil cooler						●		32
	Check and cleaning of lube oil inlet filter net		●(1st time)	●(2nd time)		●			32
	Check of bearings, friction plate, and seal							●	32
	Check of lube oil level, and oil supply	○							32
	Check of lube oil		○(2nd time)	○(2nd time)		○			32

Adjustment table

Item			Standard value	
			6CXM-ETE	6CX-ETE
Clearance between intake and exhaust valve heads (in cold condition)			Intake : 0.25±0.03 mm ; Exhaust : 0.40±0.03 mm	
Intake valve	Open	Crank angle : Before T.D.C.	50°±5	
	Close	Crank angle : After B.D.C.	44°±5	
Exhaust valve	Open	Crank angle : Before B.D.C.	55°±5	
	Close	Crank angle : After T.D.C.	47°±5	
Fuel injection start		Crank angle : Before T.D.C.	12°±1	
Pressure		Fuel injection start pressure	240±5kg/cm²	
		Engine lube oil pressure	5±0.5kg/cm²	
Temperature		Cooling water temperature at engine outlet	45℃ or less (at inlet: 30℃) ; Seawater temperature: +10℃	
		Lube oil temperature at cooler inlet	95℃ or less	
Engine fresh water capacity			36 ℓ	
Amount of lube oil			F:33 ℓ L:19 ℓ	
Axial clearance of each clutch shaft		Input shaft	0~0.05mm	
		Support shaft	0~0.05mm	
		Output shaft	0~0.1mm	
Clutch oil pressure		Hydraulic oil pressure in engaged status	22±0.5kg/cm² (2700rpm)	
		Lube oil pressure	2.5±0.5kg/cm² (2700rpm)	

Torque Requirements for Major Parts

Torque requirements for major parts	Cylinder head bolt	25±0.5kg-m
	Main bearing retaining bolt	28±1kg-m
	Connecting rod bolt	23±0.5kg-m
	Flywheel mounting bolt	29±1kg-m
	Fuel oil valve tightening nut	3.2±0.2kg-m
	Valve arm support shaft tightening nut	1.7±0.2kg-m
	Fuel oil pump drive gear tightening nut	20±1kg-m
Torque requirement for major parts of clutch	Rubber block ring	5±0.5kg-m
	Input shaft joint	9±1.0kg-m
	Output shaft joint	9±1.0kg-m
	Emergency bolt	1.9±0.1kg-m
	Low speed valve mounting bolt	2.1±0.2kg-m
	Hydraulic pump mounting bolt	2.1±0.2kg-m

Torque Requirements for Standard Bolts

Screw diameter × pitch (mm)	M6×1	M8×1.5	M10×1.5	M10×1.75	M14×1.5	M16×1.5
Torque (kg-m)	1.1±0.1	2.6±0.2	5.0±0.5	9.0±0.5	14±1	23±1.5

Note :

Torque requirements for bolts other than the major bolts should conform to the table above.
The bolts to be tightened by the torque specified above should be those made of S45C material which are identified by having "7" marked on the bolt head.
Bolts marked with "M" are not used in this engine.
(When the material of the tightening part is aluminum, tighten it to 80% of the torque listed above.)

8-1 Fuel Oil System

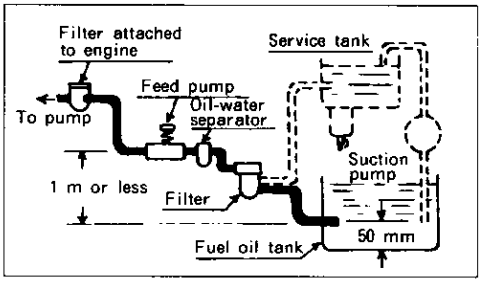
For the diagram of the fuel oil system, refer to Sec 10.

1) Checking the fuel oil level in the fuel tank and replenishing

Level check	Daily

Replenish fuel oil whenever necessary. For details of the procedures, refer to Sec. 4-1.

[Reference] The fuel piping system is generally configured as shown in the figure below.



Some fuel oil systems are equipped with a fuel service tank indicated by the dotted line.

2) Draining the fuel oil tank

Open the drain valve of the tank, and discharge impurities accumulated on the bottom of the tank.

Schedule	Daily (or before oil replenishment)

3) Draining the fuel oil filter and changing the filter element

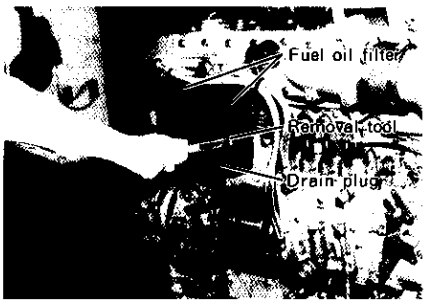
(1) Draining the filter attached to the engine
Remove the drain plug, and discharge water and dirt accumulated in the filter.

Schedule	Every 50 service hrs (or weekly)

(2) Changing the filter element

1) Remove the element using the element removal tool.
2) Replace the element with a new one, and reassemble the filter. Before you install the packing, clean the packing installation surface. Install the packing while checking that there are no foreign materials on the packing installation surface.
3) Operate the engine, and check that fuel oil is not leaking.

Schedule	Every 500 service hrs (or 2 or 3 months)



Important: For the separate-type fuel oil filters, remove impurities and change the element by using the procedure in Sec. 8-1-3).

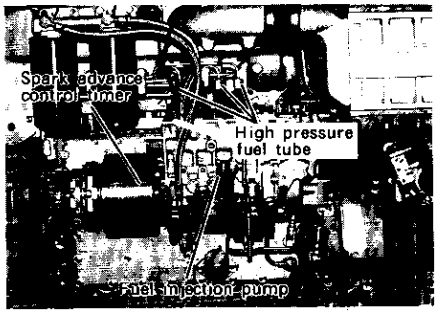
4) Checking and adjusting the fuel injection timing

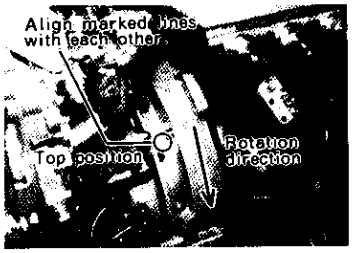
(1) Remove the high-pressure fuel oil pipe from the fuel injection pump.

(2) While manually turning the flywheel slowly, check that the timing of the fuel flowing out of the discharge valve holder of the cylinder injection pump conforms to the specified timing by visually inspecting the flywheel and indicator.

(3) Check the fuel injection timing of all the cylinders by following the step (2) above. (If the observed timing does not conform to the specified timing, consult the nearest YANMAR dealer.)

Inspection schedule	Every 2500 service hrs (or annually)
Fuel injection timing	6CX(M)-ETE 12°±1

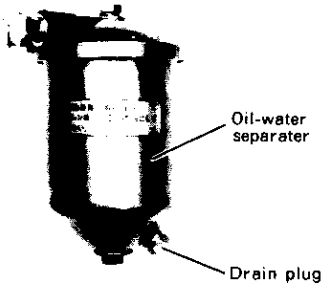


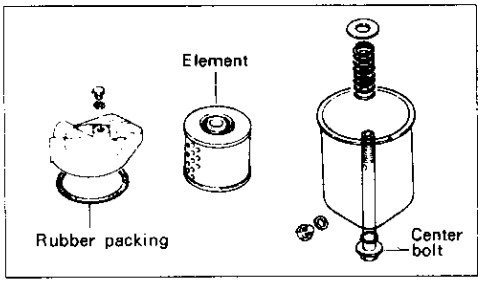


5) Drainage of oil-water separator

Remove the drain plug, and discharge water and dirt accumulated in the oil-water separator.

Schedule	Every 50 service hrs (or weekly)





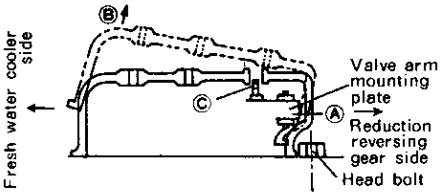
6) Removing the fuel injection valve and nozzle protector

(1) Removing the fuel injection valve
Remove all the tightening bolts from the bonnet.

(2) Slowly lift the bonnet until it comes in contact with the valve arm mount.

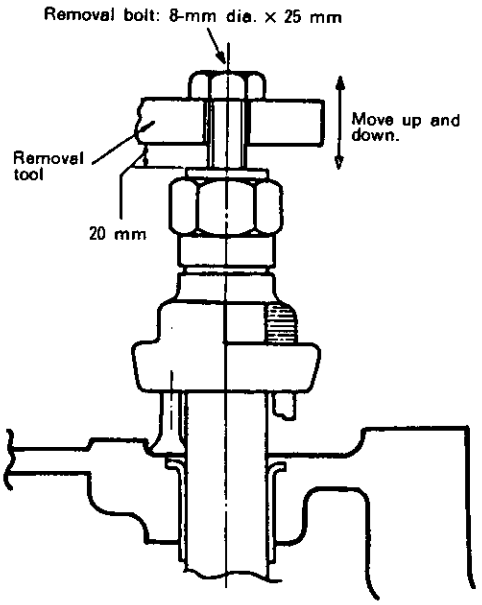
(3) Lift the B side of the handle while fixing its other end on the A side.

(4) If the bonnet comes out from the stud bolt, slightly shift the bonnet to the reduction and reversing gear side. Completely remove the bonnet.

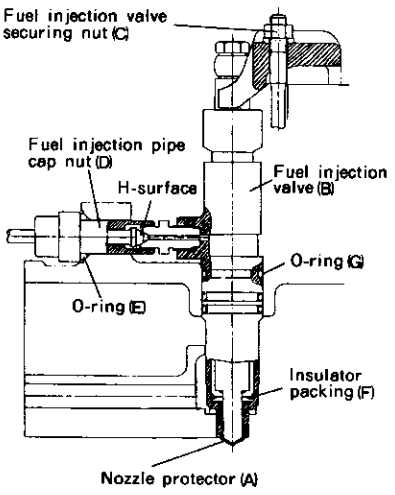


(5) Remove the high-pressure pipe, oil discharge pipe, and mounting nut.
(6) Install the fuel injection valve removal tool.
(7) Check that the removal tool is perpendicular to the fuel injection valve, and that approximately 20-mm clearance is ensured between the tool and the valve.
(8) Apply lube oil to the removal bolt, and then insert the bolt into the pipe joint hole of the oil discharge pipe on the top of the valve. Move the removal bolt up and down to apply shock to the valve, and the valve will be removed.
(9) Removing the nozzle protector
A nozzle protector is attached to the end of the fuel injection valve (see figure below).
1. After completing steps (1) through (8) above, check that nozzle protector is attached to the end of the fuel injection valve removed from the cylinder head.
2. If the nozzle protector remains inside the cylinder block, and it is difficult to remove it, use the protector removal tool.

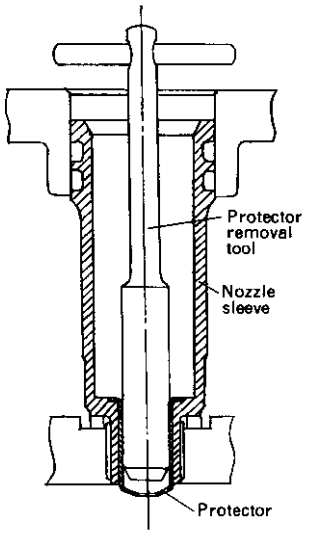
Note :
Each time you remove the fuel injection valve, be sure to replace the nozzle protector with a new one. If the used protector is attached to the nozzle again, the protector may be damaged, or fuel injection amount may be reduced.



7) Reinstalling the fuel injection valve and nozzle protector



(1) Clean the injection valve insertion hole of the cylinder head using a waste cloth. Especially clean the nozzle protector bearing surface, because foreign materials remaining on the bearing surface may cause fuel gas leakage.
(2) Insert a new nozzle protector (A) into the injection valve insertion hole.
(3) Also insert the insulation packing (F) into the injection valve insertion hole.
(4) Attach the O-ring (G) to the fuel injection valve (B), and then fit the valve to the cylinder head. Tighten the fuel injection valve presser nut (C) by applying 3.2 kg-m torque.
(5) Loosen the tightened nut (C). Attach the O-ring (E) to the fuel injection pipe cap nut (D), and then connect the pipe to the fuel injection valve by applying 3.5 kg-m.
(6) Tighten the fuel injection valve presser nut (C) again by applying 3.2 kg-m.



Note :
(1) Tightening the presser nut (C) first may cause fuel oil to leak from the H-surface, and the leakage oil may be mixed with the lube oil.
(2) For removal of the fuel valve, ask the nearest YANMAR dealer.

8-2 Lube Oil System

1) Checking the lube oil level in oil pan

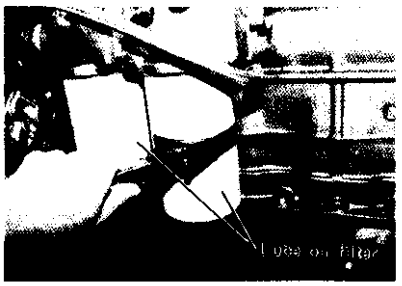
For the diagram of the lube oil system, refer to Sec. 10.

Remove the dipstick before starting the engine, and check that the oil level is between the upper limit and lower limit. Replenish the lube oil whenever necessary. For details of the lube oil check, refer to Sec. 5-2.

Inspection schedule	Daily (before start-up)

2) Changing the lube oil filter element

Remove the filter, and replace the filter element with a new one.



Schedule	1st replacement	At 50 service hrs
	2nd and subsequent replacements	Every 500 service hrs (or annually)

● Replacing the filter element

(1) Remove the filter element using the element removal tool. To remove the element from the bypass filter, loosen the drain cock, and then drain oil. Loosen the center bolt. and then remove the element.

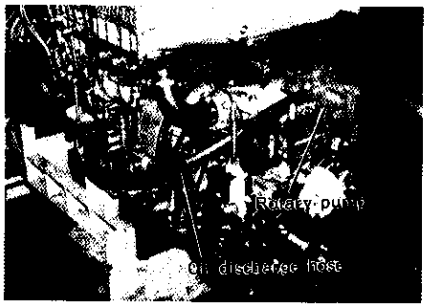
(2) Replace the filter element with a new one. At the same time, clean the seating surface of the packing to prevent improper sealing caused by foreign material.

(3) Check that there is no oil leakage during operation.

3) Changing the lube oil

Change the lube oil while the engine is still warm after shutdown. In this condition, the oil flows smoothly and can be drained completely.

Draw up the oil from the oil pan using the rotary pump (optional). 2 hours after drawing-up of oil, check that there is another drain oil in the oil pan. Draw up the oil again. Also remove the oil from the lube oil filter by removing the plug.



Schedule	1st change	At 50 service hrs
	2nd and subsequent changes	Every 500 service hrs (or annually)

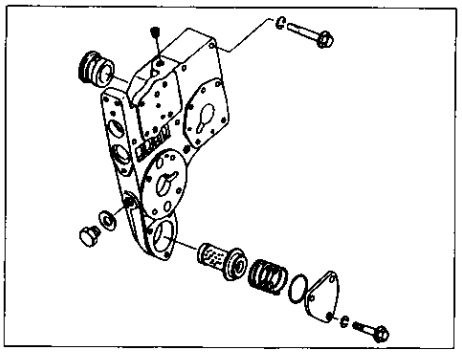
Replace the lube oil of the reduction and reversing gear by following the procedure described above. See Sec. 7-4.

4) Cleaning the lube oil cooler

Consult the nearest dealer.

Schedule	Every 2500 service hrs (or annually)

5) Cleaning the subfilter

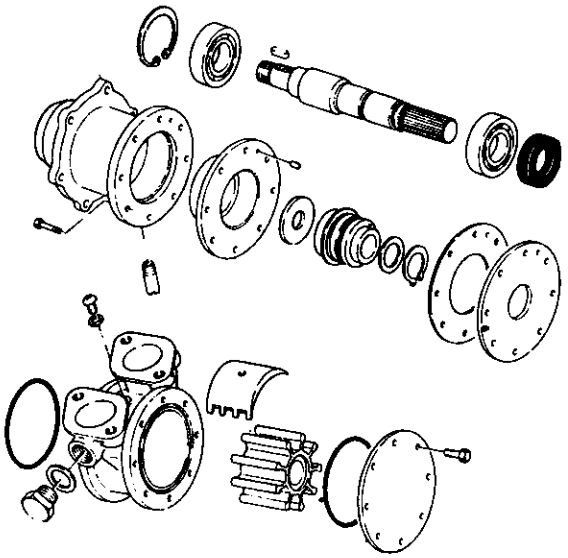


Loosen the 2 tightening nuts of the subfilter. Remove the filter, and then wash the filter. After washing, refit the filter while checking that the spring is properly inserted.

Overhauling and washing schedule	1st washing	At 50 service hrs
	2nd washing	At 250 service hrs
	3rd and subsequent washings	Every 1000 service hrs

8-3 Cooling Water System (Seawater and Fresh Water)

Seawater System



Note :

1) Checking the seawater discharge conditions

During operation, occasionally check that the water is properly flowing out of the seawater outlet pipe. If the seawater comes out intermittently or the rate of the water flow is lower during high-speed operation, immediately stop the engine and identify the cause of the trouble.

For further details, refer to Sec. 6-3-1).

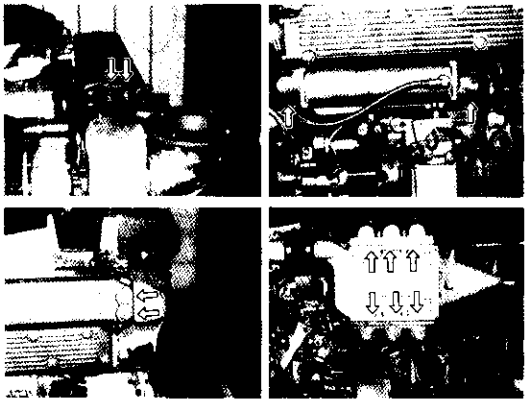
Inspection schedule	Daily (during operation)

2) Checking and replacing the anticorrosive zinc

The replacement schedule of the anticorrosive zinc depends on the conditions of the seawater and sailing conditions of the boat. Before checking the anticorrosive zinc, remove the sludge from the anticorrosive zinc, and then check the zinc for wear. If the thickness of the zinc is reduced to 1/2 of its original thickness, replace the zinc with a new one.

The units equipped with anticorrosive zinc are listed below:

Fresh water cooler: 4 zincs
Lube oil cooler: 2 zincs
Air cooler: 6 zincs



Inspection schedule	Every 500 service hrs (or annually)

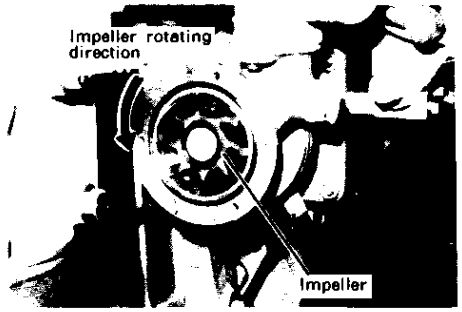
3) Checking and replacing the seawater impeller and casing

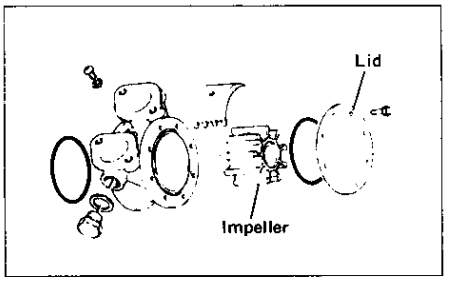
(1) Remove the lid of the seawater pump, and pull out the impeller. Check to see if there is damage on the impeller, wear plate, lid, and mechanical seal.

(2) If the wear plate or lid is worn out, turn it over for reuse.

(3) When assembling the pump, apply grease to the engagement parts of the pump and impeller, both end surfaces of the impeller, and the tips of the blades.

(4) To mount the impeller, set the impeller blades as shown in the photo below.





Inspection schedule	Every 1000 service hrs (or 2 years)
Impeller replacement	Every 2500 service hrs (or 4 years)

4) Cleaning the seawater system (including fresh water and lube oil cooler)

When the seawater system has been used for a prolonged period of time, the cooler will be contaminated by dirt, and the cooling performance drops. As a result, the temperature of the fresh water rises abnormally (85°C or more). To avoid such a problem, cleaning is required. Ask the dealer to clean and service the seawater system.

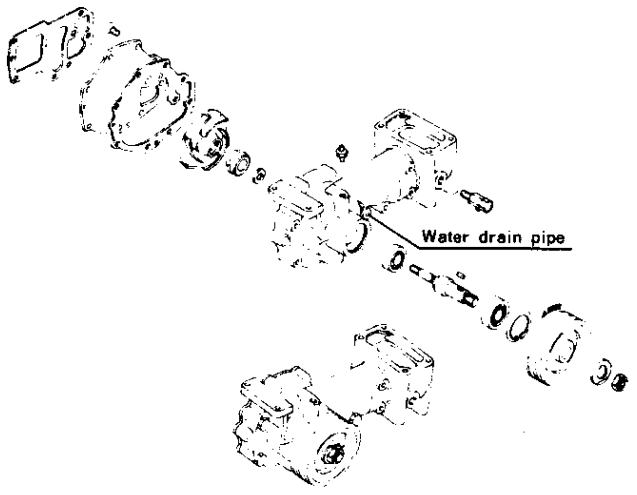
Schedule	Every 1000 service hrs (or 5 or 6 months)

5) Checking the fresh water level

(1) Checking the fresh water level in tank

Remove the pressure cap from the fresh water tank, and check the water level in the tank. Normally, the tank should be filled to its maximum capacity. If the water level is low, add water to fill up the tank.

Fresh water system



(2) Checking the fresh water level in subtank

Normally, the fresh water tank should be filled to its maximum capacity, and the water level in the subtank to at least the lower limit level mark. If the water level in the subtank is below the lower limit level mark, add water so that the water level reaches the upper limit level mark.

Important:

1. If water is left in the subtank even though the water level in the fresh water tank is lowered, the rubber rubber joint between the fresh water tank and subtank may be loosened or the pressure cap may be damaged. In this case, consult the nearest YANMAR dealer.

Note :

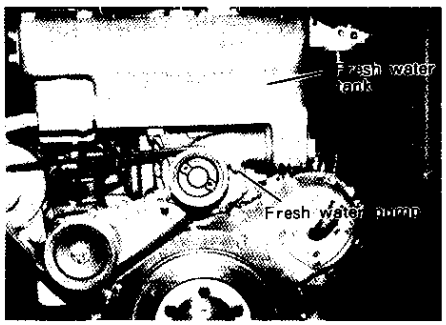
2. Checking the volume of the fresh water only by the water level in the subtank is unreliable. Check the water levels in both the fresh water tank and the subtank.

Inspection schedule	Daily

6) Checking of water leakage from fresh water pump

Water leakage from the fresh water pump may cause serious problems such as engine seizure.

Check that water is not leaking from the water drain pipe of the fresh water pump. If water has leaked from the water drain pipe, consult the nearest YANMAR dealer.



Inspection schedule	Daily

7) Cleaning the fresh water cooler and thermostatic valve

When the fresh water cooler has been used for a prolonged period of time, the cooler will be contaminated by dirt. As a result, the temperature of fresh water rises abnormally (85°C or more), and the cooling performance drops. Be sure to clean the fresh water cooler at the regular time intervals.

At the same time, also clean the thermostatic valve.

Consult your nearest YANMAR dealer for maintenance service.

Schedule	Every 1000 service hrs

8) Replacing the fresh water

Replacement Schedule	Every 1000 service hrs

(1) Application of antirust agent

Fresh water forms deposits of scales and rust on the fresh water passage, which lowers the cooling performance. Add antirust to the fresh water.

When adding antirust, use the following mixing ratio:

Mixing ratio

Antirust: 1

Fresh water: 10

(2) Application of antifreeze

In cold areas where cooling water may freeze, be sure to add antifreeze to the fresh water. Be careful not add an excessive volume of antifreeze.

Use of antifreeze

Lowest ambient temperature (℃)	−5	−10	−15	−20	−25	−30	−35	−40
Ratio to fresh water volume (%)	15	25	30	35	40	45	50	55
Antifreeze volume (ℓ)	3.5	5.8	6.9	8.1	9.2	10.4	11.5	12.7

8-4 Checking and Adjusting the Engine Parts

1) Checking and adjusting valve arm lubrication

After starting the engine, keep the engine at a low speed (approx. 700 rpm) and remove the valve arm chamber lid to check that the valve arm is sufficiently lubricated.

If the valve arm is not lubricated, consult the nearest YANMAR dealer.

Lubrication of external parts

Lubricate the regulator lever of the fuel oil pump, clutch lever, and ball joint of the remote control cable.

8-5 Checking the Reduction and Reversing Gear

1) Checking the lube oil level and replenishing the lube oil

Before start-up, remove the dipstick and check that the oil level is at the midpoint between the upper and lower limit marks. If the oil level is below the midpoint, replenish the lube oil.

For the check and replenishment methods, refer to Sec. 5-2.

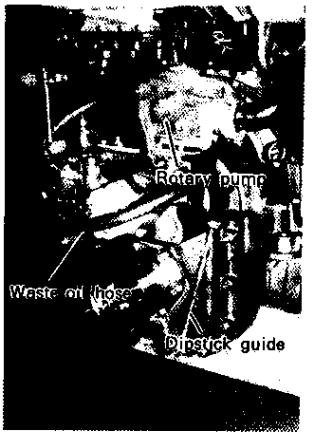
Inspection schedule	Daily (before start-up)

2) Changing the lube oil

Change the lube oil while the engine is still warm after shutdown. In this condition, the oil flows smoothly and can be drained completely.

To remove the waste oil, pump up the oil by connecting the hose of the engine waste oil pump to the dipstick guide, or drain the oil by loosening the drain plug on the clutch case.

For lube oil supply, refer to Sec. 8-5-1).

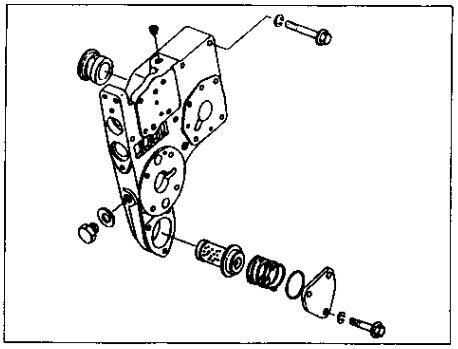


Amount of the lube oil at the upper limit marker on the dipstick	YX-70S	4 ℓ
	T/D MG507-1	6.5 ℓ

Oil change Schedule	1st change : At 50 service hrs 2nd change : At 250 service hrs 3rd and subsequent change : Every 1000 service hrs (or 5 or 6 months)

3) Checking and cleaning the lube oil filter

Remove the filter from the clutch case, and wash it with clean oil.



Inspection schedule	1st inspection : At 50 service hrs after overhauling 2nd inspection : At 250 service hrs after overhauling 3rd and subsequent inspections : Every 1000 service hrs (or 5 or 6 months)

4) Checking and cleaning the oil cooler

Consult the nearest dealer.

Schedule	Every 2500 service hrs (or annually)

5) Checking and replacing the bearings, friction plate, and seal

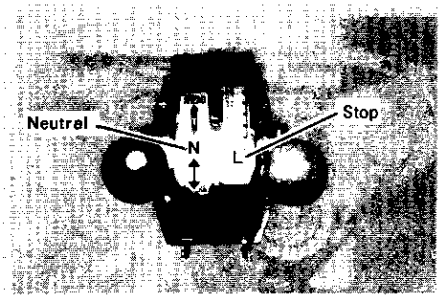
Consult the nearest dealer.

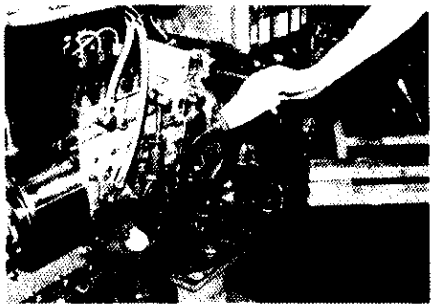
Schedule	Every 5000 service hrs (or 2 years)

8-6 Adjusting the Remote Control Cable

1) Adjusting the regulator lever

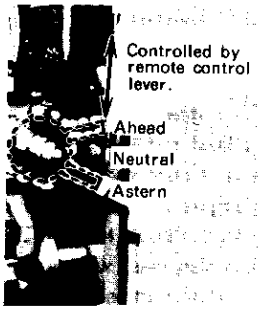
Shift the regulator lever from the DECEL position to the ACCEL position, and check that the corresponding lever position is indicated in the wheel house. If there is any difference in indication, adjust the regulator lever by using the cable adjustment bolt.





2) Adjusting the clutch lever

Operate the clutch lever to the AHEAD, NEUTRAL and ASTERN positions, and check that the lever of the reduction and reversing gear moves firmly to the intended position. Also operate the trawling lever from the high to low speed positions, and check that the lever of the reduction and reversing gear moves firmly to the intended position. If the lever does not operate properly, adjust the lever by using the cable adjustment nut.



Adjustment schedule	1st adjustment	At 250 service hrs (or 1 month)
	2nd and subsequent adjustments	Every 500 service hrs (or 2 or 3 months)

3) Adjusting the trawling lever

Operate the trawling lever, and check that the lever for the clutch comes in contact with the stopper when the trawling lever is set to the H and L positions. If the lever does not operate properly, adjust the lever by using the cable adjustment nut.

Adjustment schedule	1st adjustment	At 50 service hrs (or 1 week)
	2nd and subsequent adjustments	Every 500 service hrs (or 2 or 3 months)

8-7 Checking the Electrical Parts

⚠ WARNING

- **Before inspecting the electrical system, be sure either to turn off the battery switch or to disconnect the negative (—) terminal of the earth cable. Otherwise, a short-circuit could cause a fire.**
- **Ensure good ventilation when charging the battery. The use of open flames is strictly prohibited. Hydrogen gas may also catch fire.**
- **Battery fluid is diluted sulfuric acid. It can blind or burn your eyes or skin. Wear goggles and gloves when handling battery fluid. Should the fluid be deposited on your skin, wash with a large quantity of fresh water and seek treatment from a doctor.**

1) Checking the alarm lamps

2) Checking the alarm devices

For details of the procedures for checking the alarm devices, refer to Sec. 5-9 and 5-10.

Inspection schedule	Daily

If any abnormality is found, consult the nearest YANMAR dealer.

3) Checking the battery electrolyte

The volume of electrolyte gradually decreases through repeated charging and discharging. (In particular, the amount of decrease is larger in hot weather than cold weather.)

Before starting up, check the level of the battery electrolyte. If the level is lower, add commercially-available distilled water.

Inspection schedule	Monthly

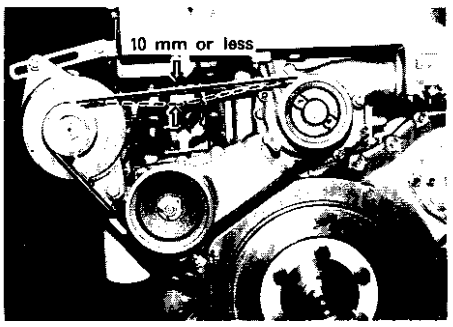
4) Checking and adjusting the alternator (generator) drive belt tension

The tension of the V-belt that drives the alternator (generator) should be correctly adjusted. Excessive tension may accelerate wear of the belt. In contrast, a loose belt may cause pulley slippage, with the result that power is not generated.

(1) To exert tension on the V-belt, loosen the fastening bolt shown in the photo below and pry the alternator away from the engine. To loosen the belt, loosen the fastening bolt and push the alternator toward the engine block.

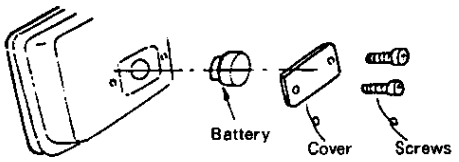
(2) Do not handle the belt with greasy hands or allow any oil to come in contact with the belt. Oil on the belt will cause the belt to slip.

Belt tension	Approx. 10 mm or less deflection
Inspection schedule	Every 500 service hrs (or 2 or 3 months)



Replacing the battery

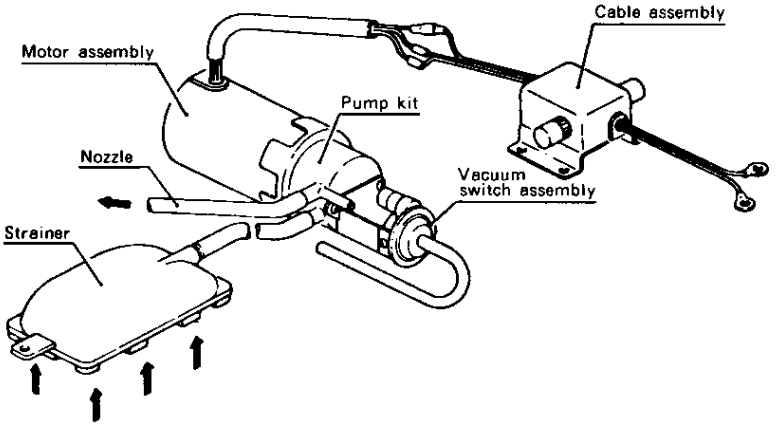
Use silver oxide battery G13.



Replace the battery every 2 years.

Insert the battery with the "+" side forward, and close the cover. Then adjust the hour and minute of the clock.

8-8 Handling of Electrical Bilge Pump (optional)



1) Features

(1) The bilge pump is durable, because it consists of vinyl chloride, acidproof, and alkaliproof materials where in contact with bilge.

(2) To prevent the bilge pump from seizure caused by non-load operation, the pump is designed to stop when no bilge water is pumped.

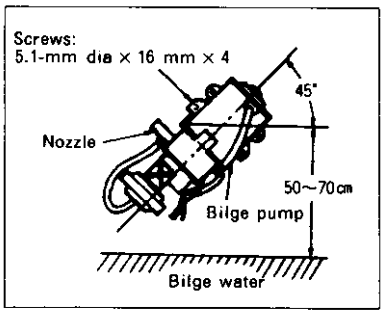
2) Installing and operating the bilge pump

(1) Connect the red wire to the "+" terminal and the black wire to the "-" terminal.

(2) The bilge pump has a 3-m cable. Install the pump on an appropriate position according to the positions of the battery, pump, and switches.

(3) Install the strainer of the bilge pump on the bottom of the boat where there is much bilge water. Firmly secure the strainer using the fixing metals.

(4) Press the start switch of the bilge pump, and the pump will start discharging the bilge overboard. Since the pump automatically stop operating, you do not have to hold the start switch for a long time.



Important:

Install the bilge pump 50 to 70 cm above the bilge well, at an angle of 45° with a horizontal level, while the nozzle directed upward.

8-9 Checking the Turbocharger

1) Cleaning the turbocharger blower

(1) Hints on cleaning schedule

Cleaning schedule	When the intake pressure lowers approx. 10% compared with that of the test run, or every 6 months (approx. 250 service hrs.)
Remarks	Example : Intake pressure in test run : 2.0 kg/cm² (at 2700 rpm) If intake pressure lowers to 1.7 kg/cm² (at 2700 rpm), clean the blower.

2) Procedures for cleaning

Step 1

While operating the engine under a normal load (3/4 to 4/4 load), inject detergent using a 50-cc oiler (commercially-available gasoline supply container, etc.) for approximately 10 seconds.

Step 2

After adding the detergent, wait 3 to 5 minutes to allow dirt to dissolve, and then add 50 cc of water over approximately 10 seconds, using a vinyl container or the like.

Step 3

Do not supply all the volume of detergent or fresh water at once. Otherwise, too much detergent and fresh water may momentarily flow to the turbocharger, and may cause blower blade fracture or other troubles. Be sure to use the appropriate volume of detergent and fresh water, and conform to the specified injection time.

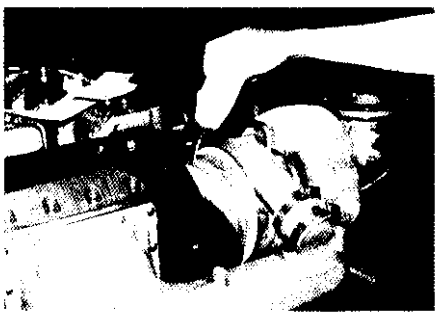
Step 4

If the air intake pressure or exhaust temperature does not change before and after cleaning, repeat the above cleaning procedures 10 minutes later.

If no change occurs after repeating the cleaning 3 or 4 times, the blower may have been excessively contaminated, or other problems may have been occurred. In this case, overhaul and clean the blower.

Step 5

After cleaning, operate the engine under a normal load for at least 15 minutes to dry the blower.



3) Checking the connection parts

For details on checking the connection part, refer to Sec. 3 "Precautions".

Inspection schedule	Daily

4) Checking operation of the major parts

Consult the nearest YANMAR dealer.

Inspection schedule	Every 2500 service hrs (or annually)

8-10 Air Cooler

1) Replacement of anticorrosive zinc

For details on replacement of anticorrosive zinc, refer to Sec. 8-3-2).

Inspection schedule	Every 500 service hrs (or annually)

7. HANDLING THE CLUTCH

7-1 Handling Precautions

1) The durability of the clutch largely depends on how it is handled. When shifting the clutch lever to ASTERN from AHEAD or vice versa, be sure to shift down the regulator lever to reduce the speed (lower than 1000 rpm), set the clutch lever once to the neutral position, and then set it to the ASTERN or AHEAD position.
2) Do not attempt to operate the regulator lever before completing the operation of the clutch lever. Shifting the clutch lever suddenly to AHEAD or ASTERN with the engine running at high speed may cause the clutch to malfunction. Never perform such an operation.

7-2 Trawling

The trawling device enables a vessel to sail under very low speed. By using a special remote control handle, clutch hydraulic pressure is reduced to 1 to 3 kg/cm^2 causing clutch slippage, and allowing propeller rpm to be less than minimum engine speed.
Trawling devices of special specifications are available according to engine type.
Normally, the following three types are available: B, EB, and A2. The propeller rpm controlled by the trawling device can change depending on the vessel type, engine type, amount of cargo, and weather including wind and waves, etc.

Trawling Device Types

B type: Ensures stable propeller rpm, by converting change in propeller rpm (change in propeller load by the effect of current, wind, and waves, etc.) in trawling to hydraulic pressure of the governor valve that is engaged with the output shaft viagears, then feeding the governor valve pressure back to the clutch hydraulic pressure.

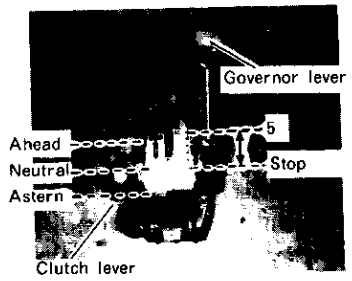
EB type: Silencer valve (dampening rattling noise) added to B type.

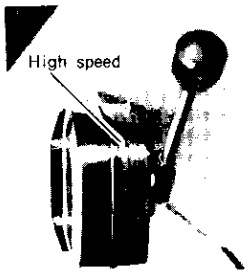
A2 type: Simple structure with no governor valve, which does not feed back change in propeller rpm to clutch.

Features

(a) Vessel can set sail smoothly, slowly, and quietly.
(b) Vessel can be brought alongside the pier smoothly and slowly in fair weather. (Beware the response of the trawling device is affected by weather. Be extremelycareful when operating the device in rough weather.)
(c) A very low speed can be maintained for a specific period of time.(Due to feed-back to propeller rpm, B and EB types provide stabler slow speed.)

(1) Trawling Operation
(a) Reduce the engine rpm to 1/2 or lower of the rated rpm.
(b) To set propeller rpm, shift the clutch lever from N position (neutral) to AHEAD position, then, shift the trawling lever through each position from H (high) toL (low).
(c) If extremely low speed is not attained, run the propeller at high speed, then at low speed. The condition will be improved.
(d) Do not operate the clutch lever during high speed run, or the clutch disc may bedamaged.





(2) Returning to Normal Operation

(a) Reduce engine rpm to idling speed, then set the trawling lever to the H position.

(3) Handling Precautions

In handling the trawling device, be sure to observe the following instructions:

(a) Wash the strainers every time when oil is replaced. (Two strainers are installed in the pump inlet and the low speed valve orifice.)

(b) Operate the trawling device once a day. If not, the low speed valve orifice may be blocked, causing malfunction of the device.

(c) When the trawling device is not used, secure the lever so that it does not move by vibration, etc.

(d) When using the trawling device for one engine on 2-engine, 2-shaft vessel, run that engine at 1/3 or lower of the rated rpm.

Precautions when running one engine or 2-engine, 2-shaft vessel; or towing a vessel

When towing a vessel for a long time, the propeller continually turns the output shaft. As the result, the marine gear turns without lubrication, possibly damaging the trawling device. Therefore, when towing a vessel or running only one engine on a 2-engine, 2-shaft vessel for one hour or longer, secure the propeller shaft. If the propeller shaft cannot be secured, be sure to dismantle the trawling device after the towing operation to inspect working parts (clutch, bearings, etc.).

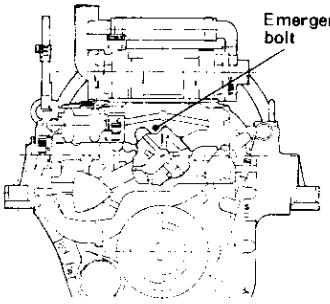
7-3 Handling the Emergency Bolts

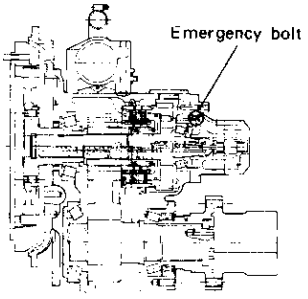
1) Shold trouble occur in the clutch lube oil engine and remove the emergency bolt plug from the clutch case. Then slightly and uniformly tighten four emergency bolts on the clutch rotation section by turning them clockwise. After that, firmly tighten the bolts again.

2) Now the clutch is connected to the ahead side. You can temporarily run the engine at a low speed (1000 rpm or less).

Note :

High speed operation may cause seizure of the clutch disc or metal.





Note :

(1) To tighten the emergency bolts, turn the engine until the head of the bolt lines up with the hole, and tighten the four bolts evenly.

(2) When using the emergency bolts, the clutch is directly connected to the ahead side and cannot be used in the neutral or astern position. Thus, special care must be taken when starting the engine and entering port.

(3) After returning to port using the emergency bolts, ask the nearest YANMAR dealer to service the engine as soon as possible.

7-4 Checking and Adjusting the Reduction and Reversing Gear

1) Checking the clutch lube oil

Remove the dipstick before starting the engine, and check that the oil level is between the upper limit and lower limit. Supply lube oil if required.

2) Cleaning the clutch lube oil cooler fouled or clogged by seawater

3) Changing the clutch lube oil

4) Checking the bearings, friction disc thickness, and seal

To check the bearings, friction disc, and seal, the reduction and reversing gear needs to be disassembled. Ask the nearest dealer to undertake the servicing.

5) Cleaning the lube oil filter

6) Checking connection of the remote control cable

The items 1) through 6) above are prerequisite to correct operation. For further details, see Sec. 8.

6. OPERATION

Before starting the engine, check around the engine especially the rotating parts to see that there is nothing that may prevent safe operation.

⚠ WARNING

- To prevent exhaust gas poisoning, ensure good ventilation during operation. Install ventilation windows, ports or ventilators in the engine room.
- Never touch or allow your clothes to touch the moving parts of the engine during operation.

If the front pulleys, V-belt, propeller shaft, etc. catch your body or clothes, serious injury may result.

Check that no tools, cloth, etc. are left on or around the engine.

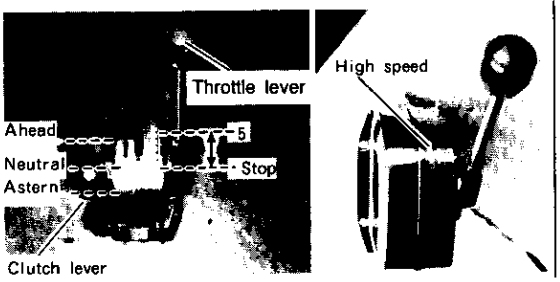
⚠ CAUTION

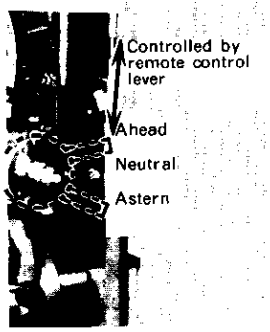
- The engine is very hot during operation and immediately after stopping, especially the turbocharger, fresh water tank, exhaust pipe and high pressure fuel pipe. Avoid burns!

Never touch or allow your clothes to touch these parts.

6-1 Starting

Turn the key of the starter switch to the START position to start the engine. As soon as the engine is started, release the key; the key automatically returns to the ON position.





Important:

Do not turn off the battery switch even after starting the engine.

With the start switch at the ON position, the gauges and alarms on the instrument panel are activated.

Important:

(1) To protect the battery, do not continue running the starting motor for more than 15 seconds. If you fail to start the engine, wait about 15 seconds and then try again.

(2) When restarting the engine, make sure that the engine has stopped and turn the starter switch key to the START position. If the starter switch is turned while the engine is still running, the starter motor and/or flywheel gears may be damaged.

(3) To facilitate the start-up of the engine in cold weather:

- Use a light oil of a high cetane number.
- Use air heater (optional).

1. In cold weather, set the key of the starter switch to the GLOW position (instantaneous setting to the GLOW position is acceptable), and preheating of the engine will start.

   15 to 30 seconds after starting of preheating, set the key of the starter switch to the START position, and the engine will start. When the microprocessor detects starting of the engine, afterheating of the engine starts. Afterheating is completed in 3 minutes. The maximum preheating time is 1

minute. Note that afterheating will not start if the engine is not started while it is being preheated. Therefore, be sure to change the key position to the START in 1 minute after setting it to the GLOW position.
For normal starting, preheating and afterheating are not performed.

2. Set the remote control lever of the clutch to the neutral position.
3. Set the remote control lever of the governor to the normal position.
4. Set and hold the key of the starter switch at the GLOW position for approximately 15 seconds, and the air heater will start to heat the air inside the intake manifold.
5. 15 seconds after setting the key to the GLOW position, change the key position to the START, and the engine will start. Release the key immediately after starting of the engine, and the key will automatically be set to the ON position.

6-2 Cautions Required Immediately After Starting

While keeping the clutch lever at the neutral position, follow the procedures described below.

1) Immediately after starting the engine, run the engine for 2 to 3 minutes at approximately 700 rpm.
2) Check that water is flowing out of the cooling water outlet pipe.
3) Check that the CHARGE lamp goes out.
4) Operate the engine at 700 to 800 rpm. Check that the "WAIT" alarm lamp lights. Do not run the engine under load if this lamp is on. This is to thoroughly distribute lube oil to all the moving parts (including white metal bearings) and to warm up the engine. This step is called "warming up."
5) If the WARMING UP alarm lamp goes out, run the engine under load.

Note : After launching and running the engine for the first time, continue to warm-up the engine for 10 to 15 minutes.

6-3 Cautions Required During Navigation

Be sure to check the following items once or twice daily during navigation.

⚠ Caution:

1) Cooling water (seawater)

Check that water is flowing out of the cooling water outlet pipe.
If water is flowing out intermittently or the volume of the flowing water is small, there may be the following problems:

(1) Air has been taken in to the cooling water system.
(2) The impeller or other parts of the cooling water pump are malfunctioning.
(3) The cooling water pipe or kingston cock is clogged with foreign solids.

If you cannot identify the cause of the problem, return to nearest port at low speed and consult the nearest YANMAR dealer.

2) Cooling water (fresh water)

⚠ DANGER

Do not open the filler cap during operation or immediately after stopping the engine. Hot steam and water will spout out. To remove the cap, wait until the engine has cooled down, wrap the cap with a cloth and loosen the cap slowly. After checking, fasten the filler cap firmly.

The temperature of fresh water must not rise above 90°C (75°C to 85°C for a new engine) during operation. Temperatures higher than 90°C indicate that a problem has occurred in the cooling water system. The cause of the problem may be as follows:

(1) The volume of fresh water rapidly reduces due to leakage from the cooling system. If the temperature of fresh water rises abnormally or the volume of fresh water reduces abnormally, the alarm devices trigger.

(2) The flow rate of fresh water is insufficient due to failure in the fresh water pump or clogging of the fresh water passage.

(3) The seawater pump is malfunctioning, or the seawater passage is clogged.

Note :

(4) Fresh water is not cooled sufficiently due to the contaminated cooler.

If you cannot identify the cause of the problem, return to port at low speed and consult the nearest YANMAR dealer.

Note :

Temperature of fresh water

When the temperature of fresh water rises after start-up, heated water flows into the subtank from the fresh water tank and the volume of fresh water in the subtank increase consequently. Note that this is normal.

After the water temperature drops after stopping the engine, the water automatically returns to the fresh water tank.

3) **Exhaust color**

Black exhaust smoke are a sign of improper engine operation. As a result, the service life of suction valves, exhaust valves, piston rings, cylinder liners, and, especially, the fuel injection valves are shortened. Do not operate the engine if black fume is emitted.

4) **Water and oil leakage, and other operating conditions**

From time to time, check that there is no water leakage, oil leakage, gas leakage, loosened bolts, abnormal noise, abnormal heat, and abnormal vibration. If any of such abnormalities are found, consult the nearest YANMAR dealer.

5) **Resonating rotation**

Depending on the structure of the hull, the vessel begins to resonate at a certain engine speed, thereby increasing the vibrations suddenly. Avoid operation in such a speed range.

Note :

6) **Operation of clutch lever**

When operating the clutch lever, lower engine speed down below 1,000 rpm.) Engaging or disengaging the clutch suddenly during high speed operation or operating the clutch at a half-engaged position may result in clutch seizure and shorten the service life of the clutch. For trawling instructions, see Sec. 7-2.

7) **Abnormal noise during operation**

If unusual noise is generated during operation, or if the alarm buzzer sounds during operation, check first to see which alarm lamp is lit, and turn off the buzzer switch. Then immediately stop the engine. Note that sudden deceleration may activate the clutch oil pressure alarm. However, this is not abnormal.

Investigate the possible causes of the trouble. If the cooling system and lube oil system are free of problems, return to the nearest port at low speed and consult the nearest YANMAR dealer.

8) **Prolonged operation at low speed**

When operating the engine at low speed for a prolonged period of time, "race" the engine every 3 to 4 hours or so.

Note :

"Racing" is required to discharge the deposits that have accumulated on the cylinders during low speed operation and to prevent the contamination of the cylinders.

For "racing," disengage the clutch and run the engine at 1,800 rpm for approximately 1 minute.

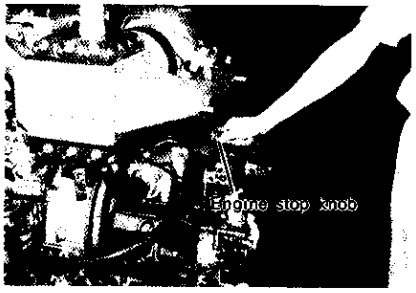
6-4 Stopping

1) Before stopping the engine, race the engine.

(1) Set the clutch lever to the neutral position, and race the engine for approximately 5 minutes at as low a speed as approximately 700 to 800 rpm.

(2) Set the regulator lever to the normal speed position, and race the engine for about 5 seconds at approximately 1800 rpm.

(3) Reduce speed to the lowest speed (700 to 800 rpm), stop the supply of fuel, and stop the engine.



Note :

If the engine is stopped in a heated condition, the temperatures of the fresh water and the engine parts may rise rapidly, possibly causing troubles.

2) After stopping the engine, set the starter switch to the OFF position, and set the buzzer switch to the OFF position.

3) Be sure to close the kingston cock after stopping the engine.

4) Discharge of cooling water:

In cold weather, cooling water (seawater) may freeze. After shutting down the engine, be sure to discharge the water from the system. (Use antifreeze for fresh water.)

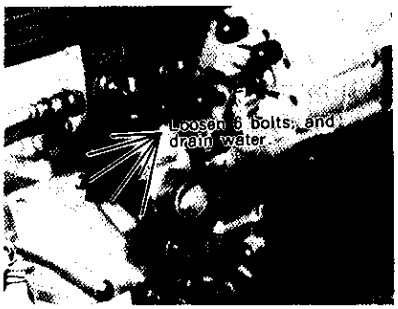
When the engine is not used for a prolonged period of time, discharge all the water from the system.

If seawater is left in the system, it may freeze and break the cooler or the seawater pump.

Discharge cooling water (seawater) by following the steps:

(1) Loosen the water drain valve of the clutch lube oil cooler.

(2) Loosen the bolts on the seawater pump lid (Yabusco pump).



5) Thoroughly remove dust and dirt while the engine is still warm.

6) Turn off the battery switch (locally procured).

5. INITIAL OPERATION OF NEW ENGINE

When operating a new engine for the first time, follow the procedures described below.

5-1 Fuel Supply

⚠ DANGER

- **Gasoline will catch fire ! Check again before supplying that you are using the proper fuel.**
- **If any fuel is spilled, clean it off completely.**

Check again that the inside of the fuel tank and the pipes in the fuel system have been thoroughly cleaned.
After doing this, supply fuel to the tank.

Follow these steps after the 1st operation:

1) Draining impurities

Even if supernatant fuel is primed out and fed to the tank, some dirt and water may have been mixed in the fuel.
To prevent these impurities from entering various components, therefore, it is necessary to eliminate them. This step is called drainage.

2) Drainage of fuel tank

Be sure to provide an oil-water separator or precipitation tank having a drain valve to the fuel tank, to drain out dirt and water. Periodically open the drain valve to eliminate impurities.

3) Drainage fuel oil filter

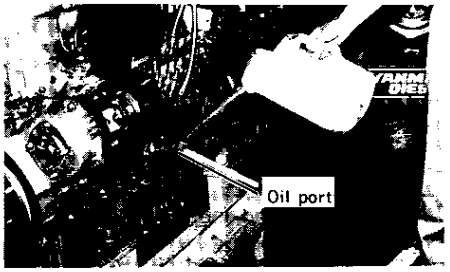
Loosen the drain plug shown in the photo to drain the filter. If reddish and rusty colored water comes out, there may be a considerable accumulation of water and dirt. In this case, disassemble and clean the fuel oil filter.
For further details, see Sec. 8-1.

4) Be sure to also drain the separate-type oil-water separator and the filter.

5-2 Lube Oil Supply

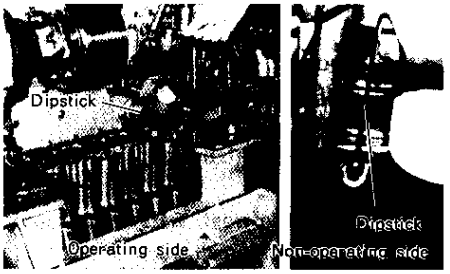
1) Lube oil supply to oil pan

Remove the oil port cap from the side plate, and supply lube oil as shown in the photo below.



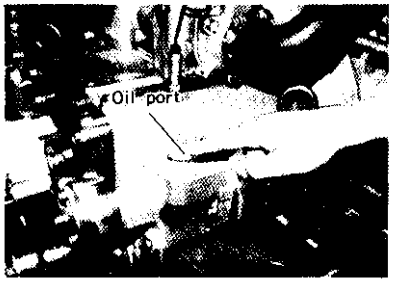
2) Checking the oil level

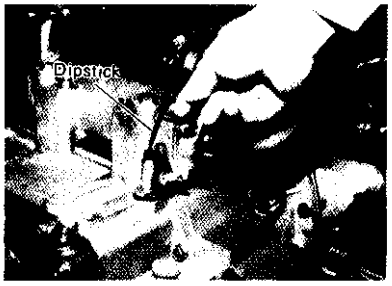
Completely insert the dipstick and check the oil level. If the oil level is lowered, supply lube oil up to the upper limit marker on the dipstick.



Amount of oil at the upper limit makers on the dipstick	23 ℓ

3) **Lube oil supply to marine gear**
Supply lube oil from the oil port shown in the photo below. The procedures for supplying lube oil and checking the oil level in the marine gear box are similar to that for the engine.





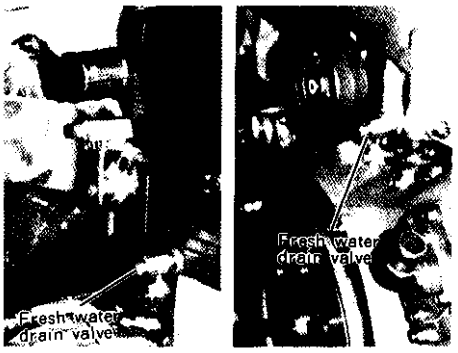
Amount of oil at the upper limit marker on the dipstick	5 ℓ

[NOTICE]
Never supply too much lube oil. If overfilled, oil will spurt from the breather and cause engine trouble.

5-3 Cooling Water Supply to Fresh Water Tank

Use clean soft water (tap water) for the fresh water tank.

1) **Tightening the fresh water drain cock**
Before supplying fresh water to the tank, be sure to tighten the 3 water drain cocks shown in the photo below.



2) **Water supply**

⚠ DANGER

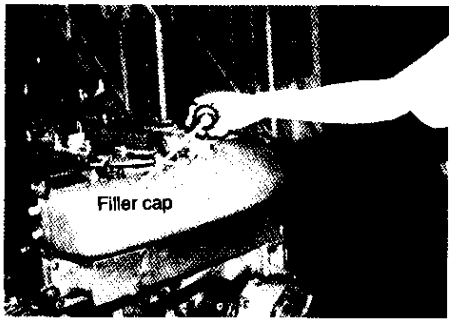
If the fillter cap is loose, hot steam and water will spout out and you may be burned.

Check that the rubber pipe joint between the subtank and fresh water tank is securely tightened. The subtank must be in position where the top of the subtank is equal to that of the fresh water tank, or lower by approximately 5cm than the fresh water tank.

Remove the filler cap of the fresh water tank, and supply fresh water to the fresh water tank until water flows out of the port To facilitate water supply, remove the plug of the air bleed pipe (connecting the fresh water cooler to the fresh water tank) on the fresh water cooler side.

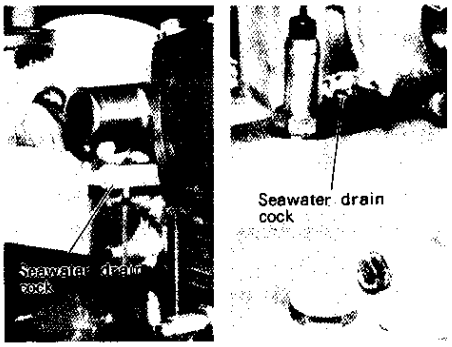
Supply fresh water to the subtank to the upper limit level. After completion of water supply, be sure to refit the plug.

For the amount of fresh water, see Sec 2.



5-4 Tightening Drain Cock of Seawater System

Before you start the engine, be sure to tighten 2 drain cocks shown in the photos below:

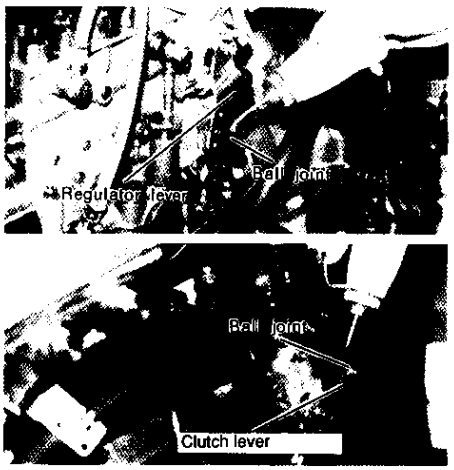


5-5 Bleeding Air from Fuel System

For the air removal procedures, refer to Sec. 9-1.

5-6 Lubricating Each Section

Lubricate the ball joints of the regulator lever of the fuel pump, clutch change lever, and remote control cable.



5-7 External Inspection

Note :
Check that tools or other things are not placed on the moving parts or on the engine, and ensure that the engine room is neat.

5-8 Checking Operation of Remote Control Unit

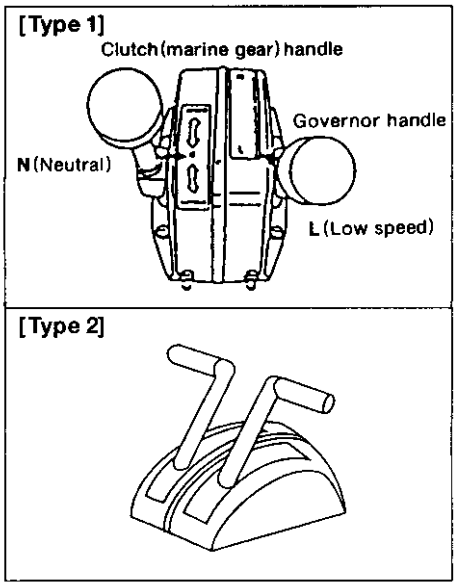
(1) While operating the regulator lever from the DECEL position to the ACCEL position, check that there is no difference in operation between the wheel house and engine side. If difference is detected, adjust the regulator lever.
(2) While operating the clutch lever from the AHEAD position, NEUTRAL position, to ASTERN position, check that there is no difference in operation between the wheel house and clutch side. If difference is detected, adjust the clutch lever.

(3) While operating the trawling lever, check that there is no difference in operation between the wheel house and the clutch side. If difference is detected, adjust the trawling lever. (Trawling unit is optional.)
Note:
For adjustment of remote control unit, refer to Sec. 8-6.

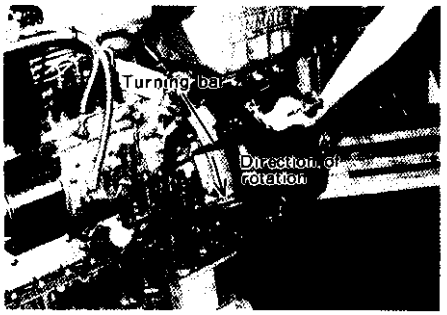
5-9 Turning

To distribute lube oil sufficiently to various parts, follow the steps below:

(1) Set the clutch lever to the neutral position.
(2) Set the regulator lever to the stop position.

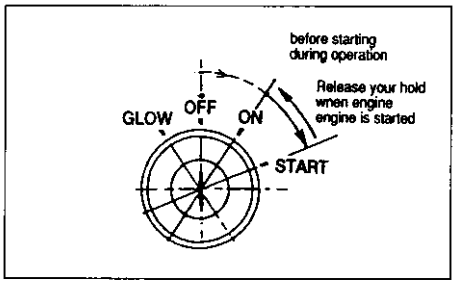


(3) Set the trawling lever to the high speed position.
(4) Open the kingston cock.
(5) Turn on the battery switch.
(6) Insert the key into the starter switch, and then set the key to the START position. While rotating the engine using the starting motor for 3 to 5 seconds, check the engine for abnormal noise.
When you set the starter switch to the ON position, the condition of gauges on the instrument panel are as follows:



5-10 Checking Operation of Gauges

(1) The lamps of all the gauges light for 3 seconds.
(2) One of the lube oil pressure gauge lamps lights (0).
(3) One of the cooling water temp. gauge lamps lights (40°C).
(4) One of the tachometer lamps lights, and one of the intake pressure gauge lamp lights.
(5) The digital tachometer indicates "0."
(6) The total timer is operating.
(7) Turn on the illumination switch, and check that the illumination lamps of lube oil pressure gauge, intake pressure gauge, cooling water temp. gauge, tachometer, and clock light.

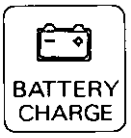


5-11 Checking Alarm Devices

(1) Functions of Alarm Devices (Alarm Buzzer & Lamps)

1) The alarm buzzer sounds when any warning lamp (except the charge lamp) comes on.
2) Warning lamps come on when sensors detect an abnormality during engine operation.
   The warning lamps in the display column on the left bottom of the control panel are off during normal operation, but come on as follows when an abnormality arises:

① Charge Lamp



The lamp comes on when there is a charging failure. The alarm buzzer does not sound. Check for breakage in the alternator V-belt.

② Cooling Water Temp. Warning Lamp

The lamp comes on when the fresh cooling water gets too hot.
Check the water level in the sub-tank and fresh water cooler, and the discharge volume of the cooling seawater.

③ Lube Oil Pressure Warning Lamp

The lamp comes on when the engine lube oil pressure drops.
Check the engine oil level.

(3) Functions of Warning Devices

When the starter is turned on, the alarm devices function as follows:

①Turning the key to ON:

1) Warning buzzer still sounds.
2) Lube oil pressure, cooling water temperature, seawater discharge, oil/water separater, and charge lamps come on.

(Note) When the warning buzzer and lamps function as above, everything is normal.

②When the key is turned to START for engine starting and then returned to ON:

1) The warning buzzer stops sounding.
2) All warning lamps go out one by one.
   When starting the engine, make it a rule to check alarm devices.
   If they do not function normally, contact your dealer and ask for repairs.

Functions of Warning Devices		Switch Key Operation OFF→ON⇒START→ON	
		Before starting	Immediately after starting
Warning buzzer		Sound off	Sound off
Warning Lamps	L.O. press.	On	Off
	C.W. temp.	On	Off
	Seawater discharge	On	Off
	Clogged fuel fater	On	Off
	Charge lamp	On	Off

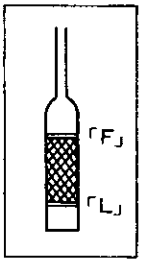
5-12 Re-checking Immediately After Starting Engine

After a new engine has been run for the first time, the level of the oil in the oil pan may slightly go down because the lube oil has been thoroughly distributed to the lube oil cooler and lube oil alter. In this case, stop the engine and leave it for a while (approx. 5 minutes), and then check again for the following items:

1) Check the oil level in the oil pan using the dipstick.

dipstick.

2) Check the oil level in the reduction and reversing gear box using the dipstick. The level may be lower than full marker F; however, this is not abnormal.



The oil level is normal when it is between the upper limit position F and lower limit position L.

3) Remove the pressure cap from the fresh water tank, and check the water level. The level may be lower due to air entry from the fresh water passage. In this case, supply fresh water until water flows out of the water port.

4. FUEL AND LUBE OIL

4-1 Selection and Handling of Fuel

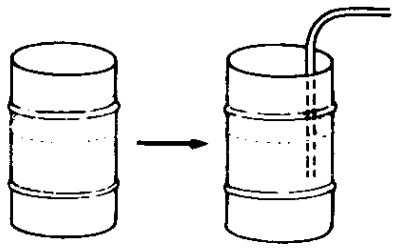
1) Selection of fuel

It is recommended that a diesel light oil best-suited for the required engine performance be used. Be sure to use an oil of cetane number 45 or more.

2) Handling of fuel

(1) Fuel containing water, dirt, sludge or other impurities may cause engine trouble.

(2) Place the drum of fuel oil upright, and allow it to stand until all impurities have settled. After this, place a suction tube halfway down the drum, and draw up fuel oil at that level.



Immediately after purchase

Allow the drum to stand for 3 to 4 days without subjecting it to vibration or movement.

After 3 to 4 days

Place s suction tube halfway down the drum to draw up fuel.

Caution: Impurities such as water and dirt will settle at the bottom of the drum.

4-2 Selection of Lube Oil

1) Selection of lube oil

Selection of the proper lube oil is essential to the optimum operation of the diesel engine. Using an improper lube oil or failure to maintain regular oil changes will result in the following problems:

1. Piston ring sticking
2. Seizure or premature wear of pistons and cylinder liners
3. Premature wear of bearings and other moving parts
4. Shorter engine life

2) Types of lube oil

Grade	SAE No.
CD class	J183 15W40

Note :

- If you have any questions regarding the selection of the proper lube oil, consult your nearest YANMAR dealer.
- If a lube oil other than those recommended above is used, the service life of the engine may be substantially reduced.
- If lube oils different brands are blended, the quality of the lube oil may deteriorate.
- To prevent this, do not use a mixed lube oil.

3. PRECAUTIONS

To plolong the service life of your YANMAR engine, be sure to observe the following precautions.

No.	Precautions	Troubles Due Failure to Observe
1	Note Be sure to break-in the new YANMAR engine.	Some components of a new engine may not form a smooth fit with each other, imposing undue load on the engine and shortening its service life. For this reason, observe the following precautions for new engines. **Note : Do not impose any undue load on the engine for at least 50 hours after installation and running of the engine. Be sure to operate the engine at 2000 rpm or lower.**
2	(1) Selecting the Fuel Use the following diesel fuels for best engine performance: Fuels equivalent to Japanese Industrial Standard, JIS. No. K2204-2 (2) Be sure to properly drain the fuel filter, oil-water separator. and fuel tank For draining procedures. see Sec. 8-1. (3) Replace the fuel filter element every year or every 500 service hours. See Sec. 8-1 for details of replacement.	Be sure to use a fuel oil of cetane number 45 or more. Use of a cetane number less than 45 may deteriorate the combustion performance (ignition) Fuel oil mixed with water or moisture may cause failures to occur in the fuel injection pump and injection valve, and may significantly shorten the service life of the engine. If the filter element has been used for a long period of time without servicing, it will become clogged so that the flow rate of fuel oil will drop. causing engine trouble.
3	Use lubricant complying to SAE J183 15W40 (Class CD). If oil of this grade is not available. contact nearest our dealer.	Using an oil other than the one recommended may shorten the service life of the engine, due to, for example, piston ring sticking. seizure of pistons and liners, premature wear of moving parts. or other trouble

No.	Precautions	Trouble Due to Failure to Observe
3	Be sure to change both the lube oil and filter element at the time intervals indicated on the right	(1) Lube oil change Engine side 1st change: At 50 service hrs 2nd and subsequent changes : Every year or every 500 service hrs Clutch side 1st change : After 50 service hrs 2nd change: After 250 service hrs 3rd and subsequent changes : Every 1000 service hrs or every 5 or 6 months Replacement of filter element 1st replacement : After 50 service hrs 2nd and subsequent replacements : Every year or every 500 service hrs Cleaning of clutch oil filter 1st washing : At 50 service hrs after overhauling or initial operation 2nd washing : At 250 service hrs after overhauling 3rd and subsequent washings : Every 1000 service hrs or every 5 or 6 month **Note 1** : Using old lube oil may cause premature wear of each part, leading to serious trouble. **Note 2** : Using the filter element for an excessively long period of operation will cause it to clog with dirt. This in turn will cause various problems such as low oil pressure, metal seizure, and entry of dirt between the metal parts, resulting in premature wear. **Note 3** : The clogged clutch oil filter may cause reduction in hydraulic oil pressure, Clutch slipping, or dirt attached to the metal parts or pump. This will result in the quick wear of clutch.
4	Important : Extra care should be taken when using fresh water.	
	Use tap water or clean rain water as fresh water.	**Note** : If hard water such as that taken from a well is used, foreign deposits in the water will build up on the cooling passage. As a result, the cooling performance drops as the temperature of the cooling water rises abnormally, causing seizure of pistons and liners.
	Be sure to add antirust agent to the fresh water. For further details, see Sec (8-3-8).	Once the cooling water passage begins to corrode, the corrosion in the passage will spread quickly, and the cooling performance will be consequently lowered. This can shorten the service life of the engine
	In cold weather, use an antifreeze. For further details, see Sec. (8-3-7).	**Note** : Antifreeze prevents the fresh water passage from being cracked by freezing. Determine the mixing ratio of fresh water and antifreeze according to the lowest ambient temperature. The mixing ratio of more than the specified value may cause engine overheating.
	Change the fresh water every year.	Contamination of fresh water lowers the cooling performance, abnormally raises the engine temperature, and causes engine trouble such as seizure.
	Before starting the engine, check the fresh water level in the subtank. In addition, check the water level in the fresh water tank at least once a week. For further details, see Sec. 5-3-2)	If the level of fresh water goes down, the temperature of the fresh water abnormally rises and causes seizure of the parts.

No.	Precautions	Troubles Due to Failure or Careless
	Do not loosen the pressure cap during operation, or immediately after the engine has been stopped Wait until the temperature falls below 60 ℃.	⚠ DANGER  **If the filler cap is loose, hot steam and water will spout out and you may be burned.**
	When the temperature of the cooling water rises to 90℃ or higher, remove scales accumulated on the fresh water and seawater passages.	Higher temperature of the cooling water, in most cases, causes decrease in the cooling performance. If the engine continues to run with decreased cooling performance, the service life of the engine will be shortened or seizure of parts may occur. In such a case, consult the nearest YANMAR dealer.
5	Do not operate the engine while the seawater pump is not drawing up seawater.	**Note:** If the engine runs while the pump is not drawing up seawater, the seawater pump impeller will seize after approximately 30 seconds and be permanently damaged. If the operation will be continued under such conditions, the temperature of the fresh water will rise excessively, and serious faulty will occur, such as seizure of pistons or crank shaft. An alarm is employed to detect the abnormally high temperature of fresh water.
	When turning the engine manually, be sure to turn it in the normal engine rotating direction For further details, see Sec 5-9.	The seawater pump impeller will fracture and be damaged permanently.
	In cold weather. be sure to completely drain the water from the seawater passage after engine shutdown. For further details, see Sec. 6-4-4).	If seawater remains in the passage and freezes, it will cause the cooler and seawater pump to break down.
	Seawater flows inside the fresh water cooler, engine oil cooler, and air cooler. Therefore, check the anticorrosive zinc inside these coolers every 500 service hours, and replace the zinc if it is worn by 1/2 or less of its original thickness. For further details, sea Sec. 8-3-2.	**Note :** Use of anticorrosion zinc more than 500 service hours may cause corrosion of each part.

No.	Precautions	Troubles Due to Failure to Observe
6	When removing the fuel injection valve, thoroughly remove carbon deposits on the perforated nozzle seat surface, and replace the seat packing and nozzle protector with new ones. For further details, see Sec 8-1-6) and,8-1-7).	Carbon deposits on the nozzle seat surface may cause gas leakage or corrosion. Consequently, gas leakage or corrosion may make it difficult to pull out the fuel injection valve or requires replacement of the nozzle sleeve. Be sure to ask the authorized YANMAR dealer to perform overhaul and assembly of the fuel injection valve. **Important :** Torque the fuel injection valve securing nut to 3.2 kg-m.
7	When trawling (optional), run the engine at a speed of 1400 rpm or lower, and do not continue trawling more than 2 hours. When not trawling, set the trawling lever to the H position (high speed), and be sure to lock it.	Failure to do this will cause the clutch friction plate to seize up.
8	Be sure to warm up the engine. For further details, see Sec. 6-2.	To allow lube oil to be distributed to all necessary parts. warm up the engine for approximately 5 minutes at 700 to 800 rpm after starting the engine. Insufficient warming up may cause abnormal wear or seizure of the moving parts.
9	Check the alternator drive belt for tension, and adjust it whenever necessary. For details of the adjustment, see Sec. 8-7-4).	**Note :** If the tension is not properly adjusted, power is not transmitted appropriately and the drive belt may be damaged or broken. Moreover, improper belt tension may cause insufficient electric charging, with the result that the engine cannot be started.
10	Do not continuously use the starter motor for more than 15 seconds.	**Note :** Prolonged operation of the starter motor (continuously for more than 15 seconds) may cause seizure of the starter motor.

No.	Precautions	Troubles Due to Improper Operation
11	Be sure to properly ventilate the engine room.	Note : Install a ventilator or provide vent holes. Insufficient air intake will increase the temperature in the engine room, resulting in reduction of engine output or deterioration of engine performance. (The capacity of the ventilator should be 60 m³/min. or greater.)
12	**Important : Extra care should be taken when handling the turbocharger and inter cooler.**	
	(1) Check that the joint section between the turbocharger and the manifold is not damaged, or air does not leak from the joint section.	Damage or leakage may cause reduction in output.
	(2) Do not suddenly reduce the load or stop the engine after full-speed navigation	The turbocharger blower may be damaged.
	(3) If the air intake pressure drops, clean the pre-filter and blower.	If the engine is operated with reduced sir intake pressure, the combustion performance will be lowered. For further details, refer to section "Handling the Turbocharger."
13	When you restart the engine after long suspension of operation, sufficiently lubricate the engine. To do this, pull the engine Stop knob, and rotate the engine using the starting motor for 5 to 10 seconds.	Do not start the engine without lubricating the engine. Otherwise, the cylinder liner, metal, or movable parts in the valve system may seize up, and the service life of the engine may be shortened.

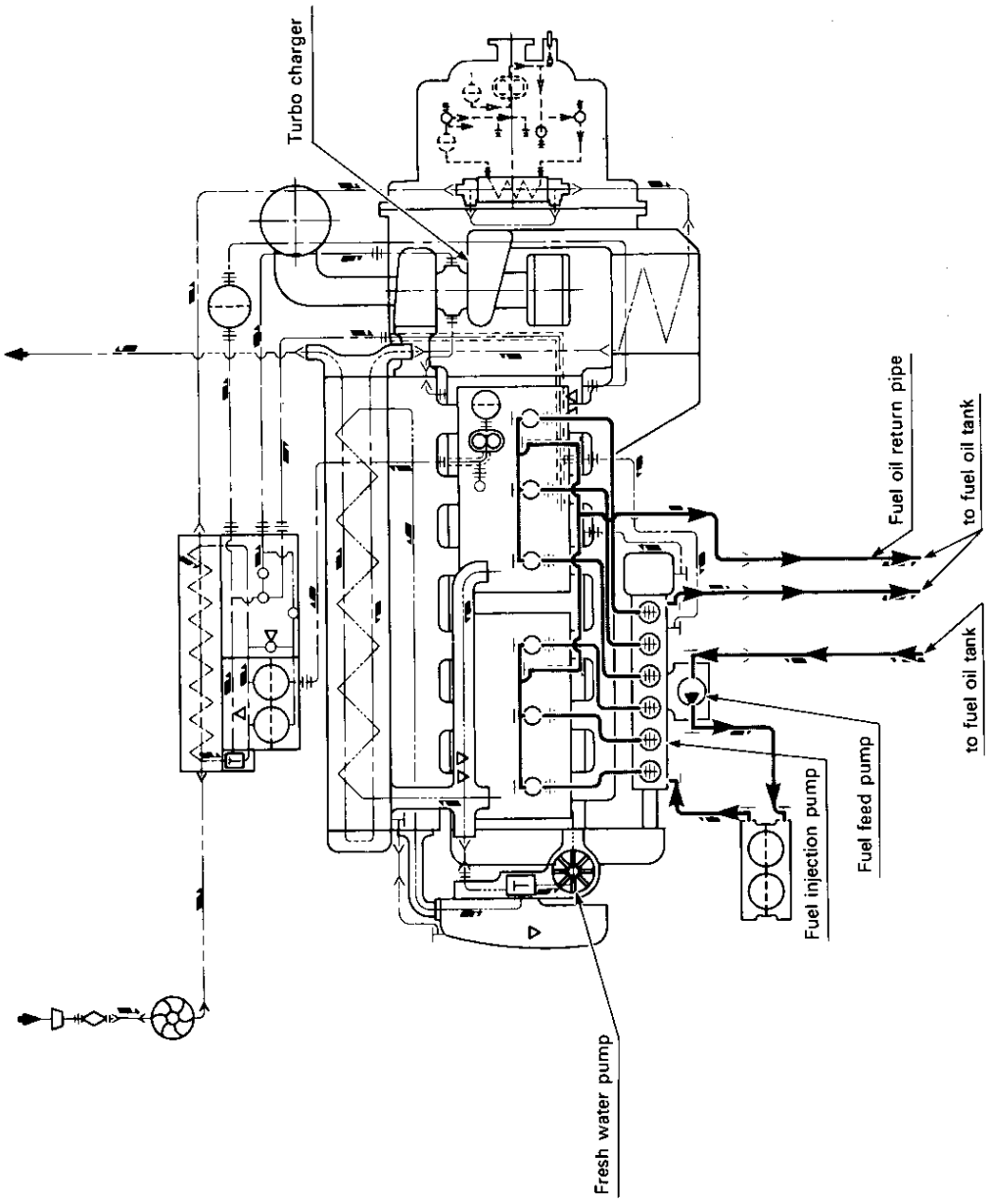
2. ENGINE SPECIFICATIONS

Item

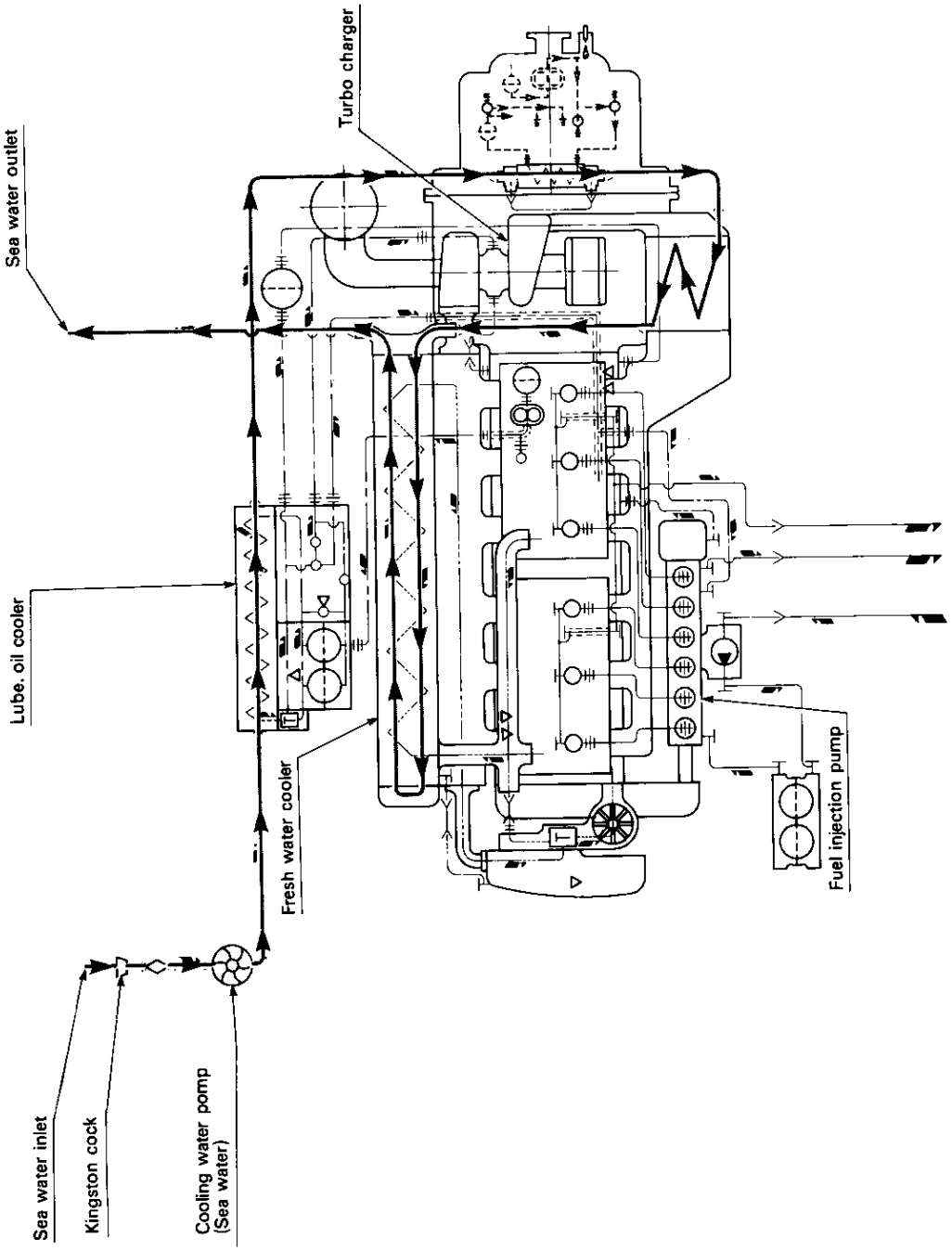
Type				Vertical water-cooled 4-cycle diesel engine				
Model Designation				6CX-ETE				6CXM-ETE
No. of cylinders				6				
Combustion system				Direct injection				
Comtinuous rating output	Output/rotational speed			375HP/2600rpm (276kW/2600rpm)				
	Net average effective pressure			18.21kg/cm²				
	Average piston speed			10.83m/s				
Intake/exhaust valve system				2-valve system for both intake and exhaust valves				
Fuel injection timing				12° ± 1				
Reduction and reversing gear (clutch)	Hydraulic type	Model		YX-70S			T/D MG 507-1	–
		Reduction ratio	Ahead	1.52	1.96	2.50	1.10	–
			Astern	1.52	1.96	2.50	1.10	–
Direction of rotation	Crankshaft			Counterclockwise when viewed from flywheel side				
	Propeller shaft			Clockwise when viewed from stern side			–	
Lubrication system				Totally enclosed and forced lubrication system with gear pump				
Lube oil capacity	Oil pan			23 ℓ				
	Clutch			4 ℓ			6.5 ℓ	4 ℓ
Cooling system				Fresh water cooling				
Fresh water volume	Engine			36 ℓ				
	Subtank			1.1 ℓ				
Cooling water delivery (at engine speed of 2,600 rpm)			Fresh water	≥13000 ℓ /hr				
			Seawater	≥9820 ℓ /hr				
Starter system				Electric starting				
Electrical equipment	Starting motor			DC12V 4kW				
	Alternator (generator)			DC12V 55A				
Turbocharger	Type			GALLET turbo TW51				
	Cooling system			Water cooling				

10. SYSTEM DIAGRAMS

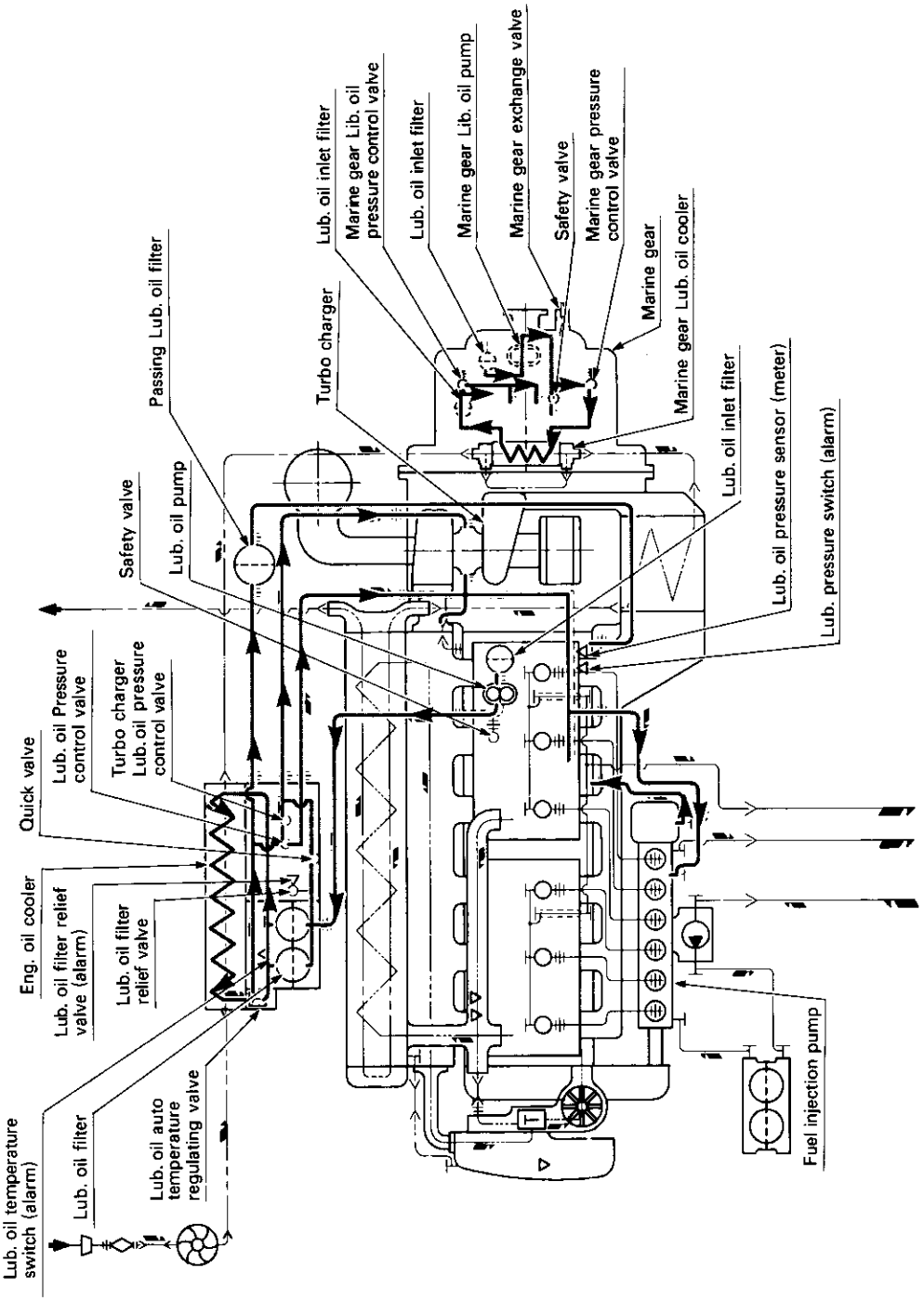
1) Fuel Oil System Diagram



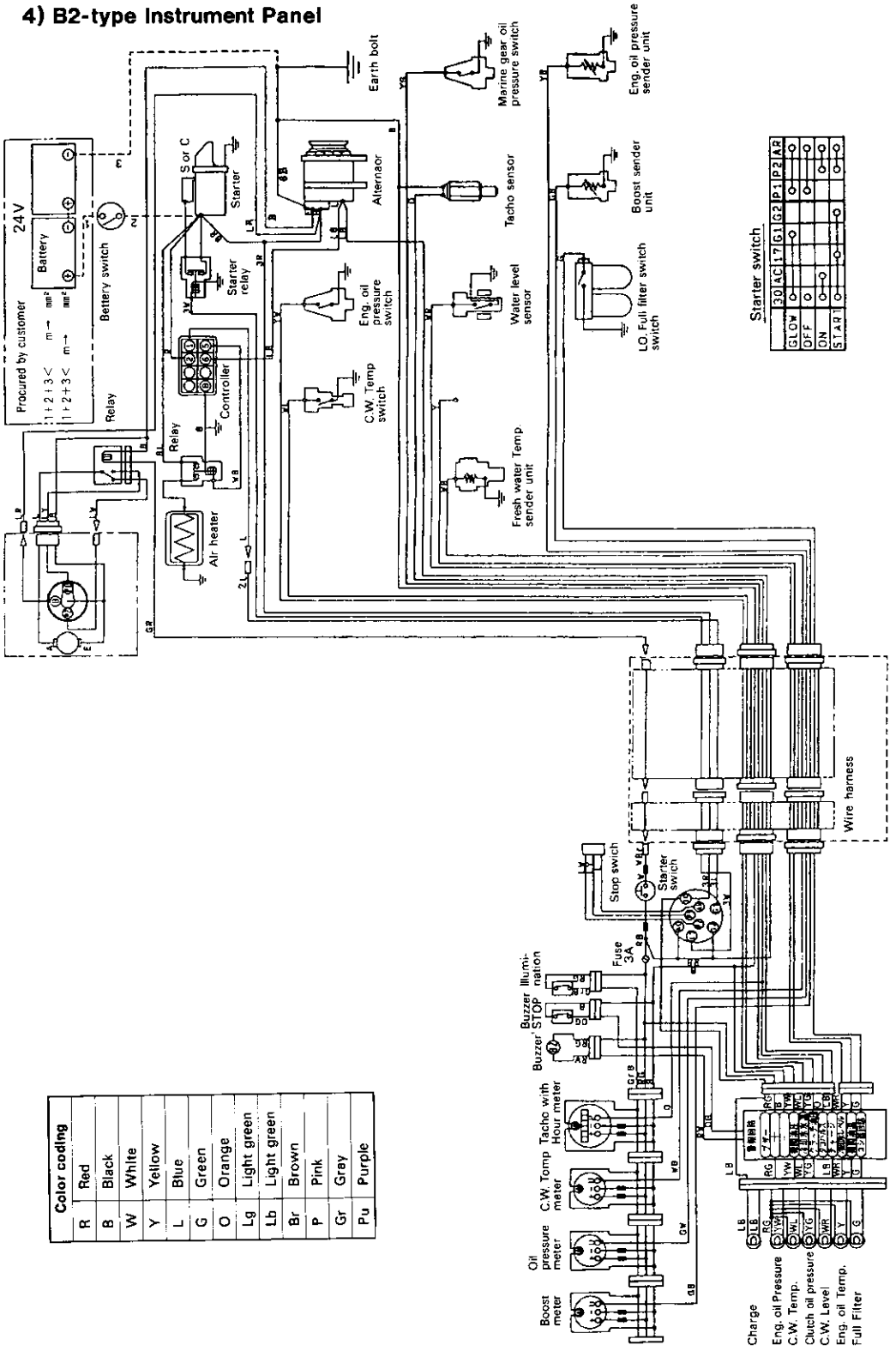
2) Cooling Water System Diagram



3) Lube Oil System Diagram



4) B2-type Instrument Panel



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

Safety Precautions (Observe these instructions for your own safety!)

■ Precautions for Operation

⚠ DANGER

Fresh Water Tank Filler Cap

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

⚠ DANGER

Battery

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

⚠ DANGER

Fuel

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

⚠ WARNING

Fire Prevention

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

⚠ WARNING

Exhaust Gas

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

⚠ WARNING

Moving Parts

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

⚠ CAUTION

Burns

● The whole engine is hot during operation and immediately after stopping. The turbocharger, exhaust manifold, exhaust pipe, intercooler and high pressure fuel pipe are very hot. Never touch these parts with your body or clothing.

⚠ WARNING

Alcohol

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

■ Safety Precautions for Inspection

⚠ DANGER

Battery Fluid

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

⚠ WARNING

Fire by Electric Short-Circuits

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

⚠ WARNING

Stop Engine before Servicing,

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

⚠ CAUTION

Scalds

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

⚠ WARNING

Forbidden Modifications

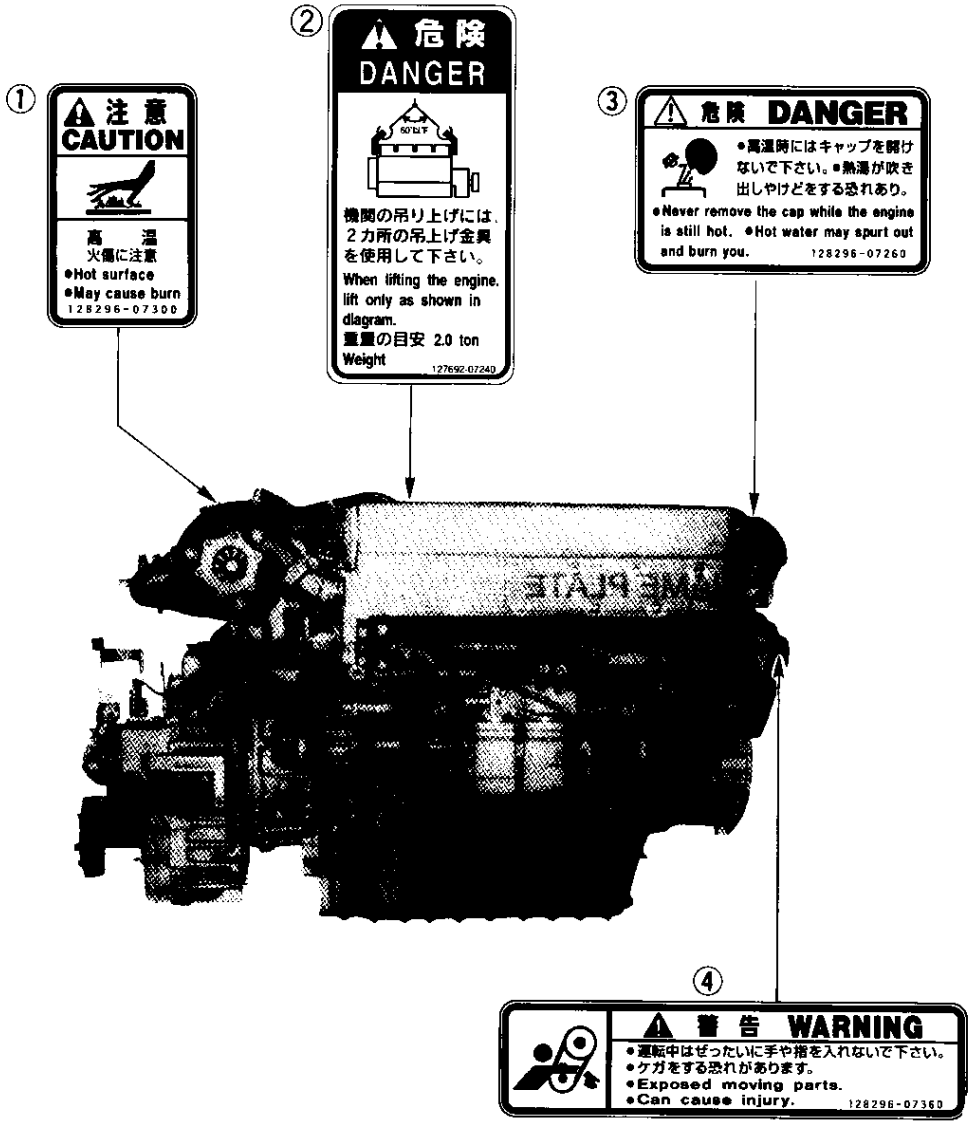
● Never release the limiting devices such as the engine speed limiter, fuel injection limiter etc.
Modification will impair the safety and performance of the product and shorten its product life.
Also note that any troubles arising from such modification are not be covered by our warranty.

Location for Warning Device Labels

To insure safe operation, warning device labels have been attached. Their location is shown in the diagram below. Keep the labels from becoming dirty or torn and replace them if they are lost or damaged. Also, replace labels when parts are replaced, ordering them in the same way parts are ordered.

Warning Device Labels, Parts Numbers

No.	Part Code No.
①	128296-07300
②	127692-07240
③	128296-07260
④	128296-07360



Explanation of Product

Use, Driving System, etc.

In the case of Model 6CX(M)-ETE, engines with marine gear, connect the marine gear output shaft to the propeller shaft.

In order to obtain full performance from your engine, it is imperative that you check the size and structure of the hull and use a propeller of the appropriate size.

The engine must be installed correctly with safe cooling water and exhaust piping and electrical wiring. The PTO work should be easy to use for onboard equipment.

To handle the drive equipment, driven systems (including the propeller) and other onboard equipment, be sure to observe the instructions and cautions given in the operation manuals supplied by the shipyard and equipment manufacturers.

The laws of some countries may require hull and engine inspections, depending on the use, size and cruising area of the boat.

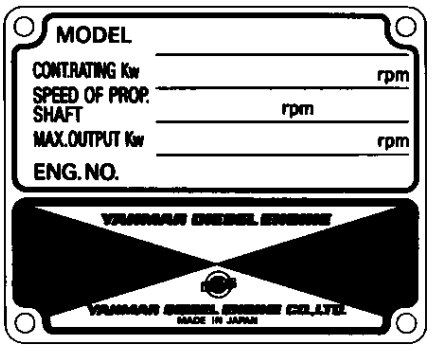
The installation, fitting and surveying of this engine all require specialized knowledge and engineering skills. Consult Yanmar's local subsidiary in your region or your distributor or dealer.

⚠ WARNING

Never modify this product or release the limit devices (which limit engine speed, fuel injection quantity, etc.). Modification will impair the safety and performance of the product and functions and shorten the product life.
Please note that any troubles arising from modification of the product will not be covered by our warranty.

DETAIL OF NAME PLATE

The nameplate shown below is attached on the engine's cylinder block. Check the engine's model number, output, rpm and serial number on the nameplate.



Major Servicing Parts

Name of Part	Function
●Fuel filter	Removes dust and water from fuel. Drain the filter periodically, (there is a drain plug at the bottom). The internal element (filter) should be changed periodically.
●Fuel feed pump	Feeds fuel to the fuel injection pump. Equipped with built-in centrifugal vane.
●Filler port (engine)	Filler port for engine lube oil.
●Filler port (marine gear)	Filler port for marine gear lube oil.
●Lube oil filters (at full-flow & by-pass sides)	Filters fine metal fragments and carbon from the lube oil. These filters have both full-flow and by-pass functions. Lube Oil filtered by the full-flow side filter is sent to the engine's moving parts. Lube Oil filtered by the by-pass side filter returns to the oil pan.
[Cooling Water System]	This engine has two cooling water systems (for fresh water & for seawater). The fresh water line is composed of the fresh water tank, fresh water cooler,fresh water pump, etc. and cools the engine. In the seawater line, cooling water passes from the seawater pump to the lube oil cooler, fresh water cooler, intercooler, etc. and passes to outside through the mixing elbow.
●Fresh water cooler	The fresh water cooler is a heat exchanger using fresh cooling water. The high temp. cooling water returns to the heat exchanger for cooling by seawater.
●Filler cap	The filler cap on cooling water tank covers the water supply port. The cap has a pressure regulating valve.
●Sub tank	When the cooling water temp. rises, the pressure rises inside the fresh water cooler. The pressure regulating valve releases vapor and hot water overflow to the sub tank.
●Rubber hose	The hose connects the filler cap and sub tank. Vapor and hot water discharged to the sub tank return there to the cooling water. When the engine stops and cooling water cools, the pressure in the cooling water tank also drops very low. The filler cap valve then opens to suck water back from the sub tank. This minimizes cooling water consumption.
●Fresh water pump	The centrifugal water pump circulates fresh cooling water inside the engine. The pump and alternator are driven by the V-belt.
●Seawater pump	The impeller-type pump raises seawater for cooling. Never operate it without seawater, as this will damage the impeller.
●Oil cooler (engine)	This heat exchanger cools high temp. engine oil with seawater.
●Oil cooler (marine gear)	This heat exchanger cools high temp. clutch 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 pressurises the intake air for sending to the cylinder.
●Inter-cooler	This heat exchanger cools the pressurized intake air from the turbocharger with seawater.
●Anticorrosion zinc	The metal area of the seawater cooling system is prone to electrical corrosion. The anti-corrosion zinc is installed in the oil cooler, inter-cooler, etc. to prevent this. The anti-corrosion zinc 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.
●Name plate	Name plates are provided on the engine and the marine gear and have the model, serial number and other data.
●Starter	Starter motor for the engine. Powered by the battery.
●Alternator	Rotates by belt drive, generates electricity and charges the battery.

MEMO

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User's record

Date of purchase
Place of purchase (Name of dealer)

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