

YAMAR

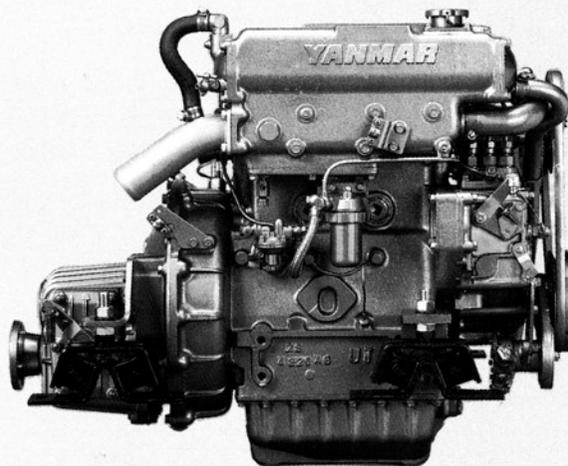
OPERATION MANUAL

GM series

OPERATION MANUAL
MODE D'EMPLOI
BEDIENUNGSANLEITUNG
MANUAL DE OPERACION
MANUALE DI ISTRUZIONI
BRUKSANVISNING

YANMAR

**YANMAR DIESEL
ENGINE
GM series**



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.

California Proposition 65 Warning

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

California Proposition 65 Warning

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

ENGLISH

GM-SERIES DIESEL ENGINE

OPERATION MANUAL

FRANCAIS

MOTEUR DIESEL SERIE GM

MODE D'EMPLOI

DEUTSCH

DIESELMOTOR DER SERIE GM

BEDIENUNGSANLEITUNG

ESPAÑOL

MOTOR DIESEL SERIE GM

MANUAL DE OPERACION

ITALIANO

MOTORE DIESEL SERIE GM

MANUALE DI ISTRUZIONI

SVENSK

DIESELIMOTOR SERIE GM

BRUKSANVISNING

ENGLISH

GM-SERIES DIESEL ENGINE

OPERATION MANUAL

Thank you for purchasing a Yanmar product.

This Operation Manual tells you how to operate and service your new Yanmar marine engine. Please read it before using your engine to insure proper handling and operation. Follow the instructions carefully to keep your engine in the best running condition. If you have any question concerning this manual, or any suggestions, please contact your nearest Yanmar dealer.

This Operation Manual deals with the main points for operation of the GM engine.

In order to insure safe working conditions, be sure to read the precaution sections for safe operation of your engine.

Pay special attention to statements preceded by the following words:



WARNING:

Indicates a strong possibility of severe personal injury or loss of life if instructions are not followed.



CAUTION:

Indicates a possibility of personal injury or equipment damage if instructions are not followed.

NOTE:

Gives helpful information.

If a problem should arise, or if you have any questions about the engine, consult an authorized Yanmar dealer.



WARNING:

The Yanmar GM engine is designed to give safe and dependable service provided that it is operated according to instructions.

Read and understand the Operation Manual before operating your engine. Failure to do so could result in personal injury or equipment damage.

TIPS ON SAFETY



WARNING:

1. PREVENTING FIRES

Never add fuel to the fuel tank while the engine is running. Wipe away all fuel spills with a clean cloth. Keep gasoline, kerosene, matches, other explosives and inflammables away from the engine, since the temperature around the exhaust muffler is very high during operation.

- To prevent fire hazards and to provide adequate ventilation, keep the engine at least 3 ft(1 m) away from the other equipment during operation.

2. PREVENTING EXHAUST GAS INHALATION

- Exhaust gas contains poisonous carbon monoxide.
- Never use the engine in poorly ventilated conditions, provide proper ventilation so that people and animal will not be affected.

3. PREVENTING BURNS

- Never touch the muffler, muffler cover or engine body while the engine is running or hot.

4. OTHER SAFETY TIPS

- Know how to stop the engine quickly and understand operation of all the controls. Never permit anyone to operate the engine without proper instructions.
- Do not operate under the influence of alcohol.
- Keep children and pets away from the engine when it is in operation.
- Keep away from rotating parts while the engine is running.
- When the engine is coupled with a machine, be sure to provide suitable covers for the belt, coupling and other dangerous parts.
- Work according to the rules and regulations of work area. When working with others, be sure to maintain good communication with everyone else.
- Use correct tools and equipment.

5. WHEN CHARGING THE BATTERY

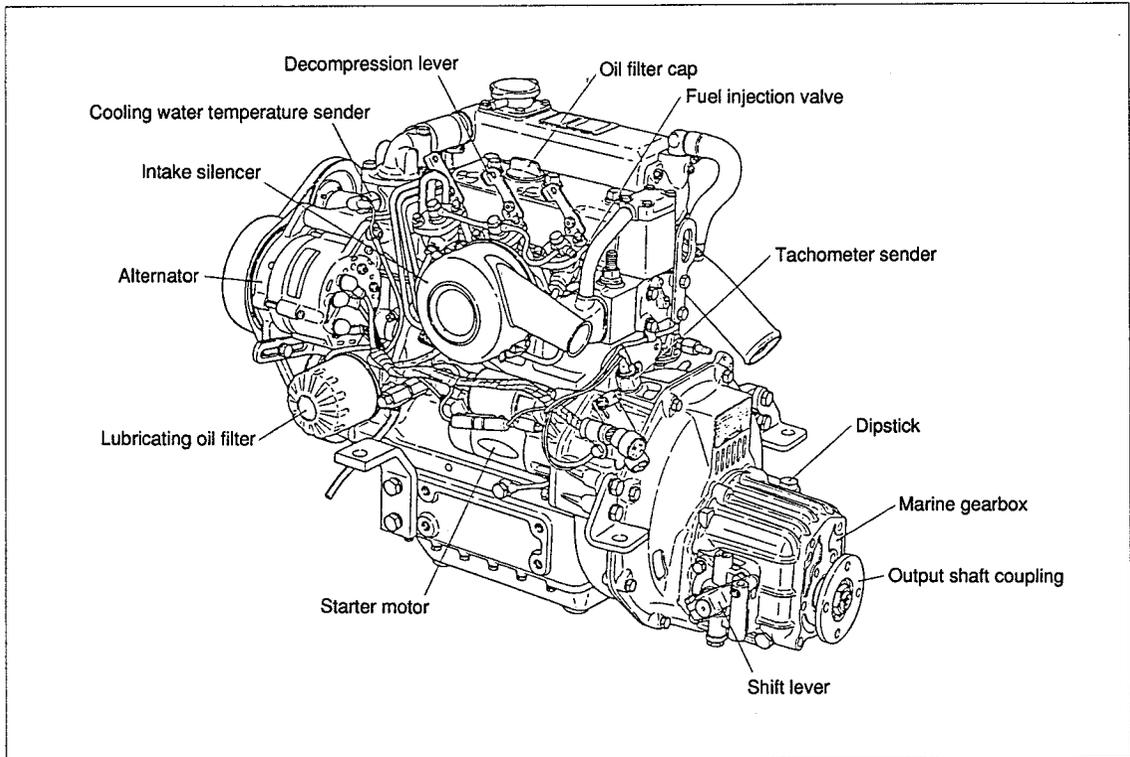
- Battery electrolyte contains sulphuric acid. Protect your eyes, skin and clothing. In case of contact, flush thoroughly with water and get prompt medical attention, especially if your eyes are affected.
- Batteries generate hydrogen gas which can be highly explosive. Do not smoke or allow flames or sparks near a battery, especially during charging.
- Charge the battery in a fully ventilated place.

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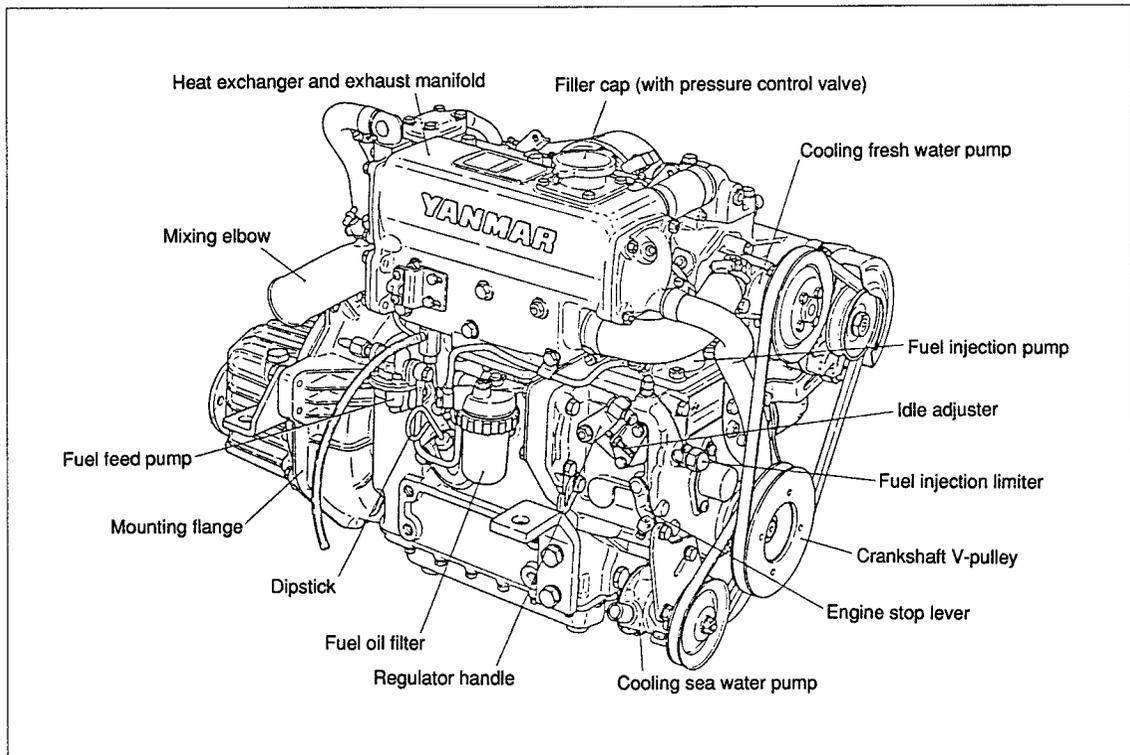
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1. Name of parts

1. Name of parts



Air intake side of 3GM30F

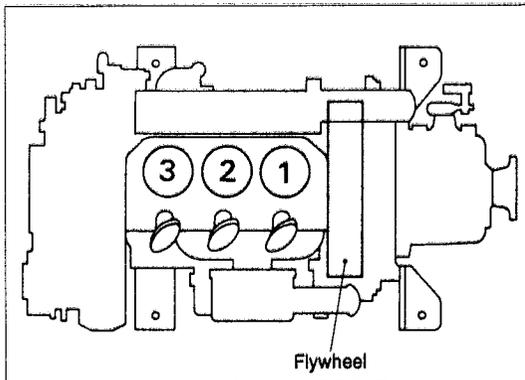


Exhaust side of 3GM30F

1. Name of parts

Cylinder Number

The cylinder numbers of the 1, 2 cylinder engine (1GM, 2GM) and 3 cylinder engine (3GM) described in this manual are designated as follows.



- (1) The sequence of cylinder numbers is given as No. 1, No. 2 and No. 3 starting from the flywheel side.
- (2) These cylinder numbers are consistently used for devices and parts connected with the cylinder head and valve moving mechanism. However, please note that items related to the fuel injection pump do not correspond to the numbering of the cylinders.

2. Specifications

2. Specifications

2-1. Direct Sea Water Cooling Type, GM series.

Engine Model			1GM10			2GM20			3GM30			
Type			Vertical 4-cycle water cooled diesel engine									
Combustion system			Swirl pre-combustion chamber									
Number of cylinders			1			2			3			
Bore × stroke		mm (in.)	75 × 72 (2.95 × 2.83)									
Displacement		ℓ (cu.in.)	0.318 (19.40)			0.636 (38.81)			0.954 (58.21)			
Continuous rating output (DIN 6270A)	Output/crankshaft speed	kW/rpm (HP/rpm)	5.9/3400 (8.02/3400)			11.8/3400 (16.0/3400)			17.7/3400 (24.1/3400)			
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	6.66 (94.71)									
	Piston speed	m/sec. (ft./sec.)	8.16 (26.77)									
One hour rating output (DIN 67270B)	Output/crankshaft speed	kW/rpm (HP/rpm)	6.7/3600 (9.1/3600)			13.4/3600 (18.2/3600)			20.1/3600 (27.3/3600)			
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	7.07 (100.54)									
	Piston speed	m/sec. (ft./sec.)	8.64 (28.35)									
Compression ratio			23.0									
Fuel injection timing (b.T.D.C.)		degree	b.TDC 15°±1°			b.TDC 15°±1°			b.TDC 18°±1°			
Fuel injection pressure		kg/cm ² (lb./in. ²)	170 ± 5 (2347 – 2489)									
Main power take off			at Flywheel side									
Front power take off			at Crankshaft V-pulley side									
Direction of rotation	Crankshaft		Counter-clockwise viewed from stern									
	Propeller shaft (Ahead)		Clockwise viewed from stern									
Cooling system			Direct sea water cooling (rubber impeller water pump)									
Lubrication system			Complete enclosed forced lubrication									
Starting system	Type		Electric and manual									
	Starting motor		DC 12V, 1.0kW									
	AC generator		12V, 35A			12V, 55A						
Marine gear system	Model		KM2P						KM3P			
	Type		Mechanical cone clutch with single stage for both ahead and astern									
	Reduction ratio	Forward		2.21	2.62	3.22	2.21	2.62	3.22	2.36	2.61	3.20
		Reverse		3.06	3.06	3.06	3.06	3.06	3.06	3.16	3.16	3.16
	Propeller speed DIN 6270A rating	Forward		1540	1298	1055	1540	1298	1055	1441	1303	1063
		Reverse		1113	1113	1113	1113	1113	1113	1076	1076	1076
	rpm											
Lubricating oil capacity		ℓ (cu.in.)	0.3 (18.31)						0.35 (21.36)			
Weight		kg (lb.)	10.3 (22.71)						11.5 (25.36)			
Dimensions	Overall length		mm (in.)			554 (21.81)			645 (25.39)			740 (29.13)
	Overall width		mm (in.)			410 (16.14)			455 (17.91)			455 (17.91)
	Overall height		mm (in.)			485 (19.09)			495 (19.50)			495 (19.50)
Lubricating oil capacity (rake angle 8°)	Total		ℓ (cu.in.)			1.3 (79.33)			2.0 (122.05)			2.6 (158.65)
	Effective		ℓ (cu.in.)			0.6 (36.61)			1.3 (79.33)			1.6 (97.63)
Engine weight with marine gear		kg (lb.)	76 (167)			106 (233)			130 (286)			

2. Specifications

2-2. Direct Sea Water Cooling Type, GMF series.

Engine Model			2GM20F			3GM30F			
Type			Vertical 4-cycle water cooled diesel engine						
Combustion system			Swirl pre-combustion chamber						
Number of cylinders			2			3			
Bore × stroke		mm (in.)	75 × 72 (2.95 × 2.83)						
Displacement		ℓ (cu.in.)	0.636 (38.81)			0.954 (58.21)			
Continuous rating output (DIN 6270A)	Output/crankshaft speed	kW/rpm (HP/rpm)	11.8/3400 (16.0/3400)			17.7/3400 (24.1/3400)			
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	6.66 (94.71)						
	Piston speed	m/sec. (ft./sec.)	8.16 (26.77)						
One hour rating output (DIN 7270B)	Output/crankshaft speed	kW/rpm (HP/rpm)	13.4/3600 (18.2/3600)			20.1/3600 (27.3/3600)			
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	7.07 (100.54)						
	Piston speed	m/sec. (ft./sec.)	8.64 (28.35)						
Compression ratio			23.0						
Fuel injection timing (b.T.D.C.)		degree	b.TDC 15°±1°			b.TDC 18°±1°			
Fuel injection pressure		kg/cm ² (lb./in. ²)	170 ± 5 (2347 – 2489)						
Main power take off			at Flywheel side						
Front power take off			at Crankshaft V-pulley side						
Direction of rotation	Crankshaft		Counter-clockwise viewed from stern						
	Propeller shaft (Ahead)		Clockwise viewed from stern						
Cooling system			Fresh water cooling with heat exchanger						
Lubrication system			Complete enclosed forced lubrication						
Starting system	Type		Electric						
	Starting motor		DC 12V, 1.0kW						
	AC generator		12V, 55A						
Marine gear system	Model		KM2P			KM3P			
	Type		Mechanical cone clutch with single stage for both ahead and astern						
	Reduction ratio	Forward		2.21	2.62	3.22	2.36	2.61	3.20
		Reverse		3.06	3.06	3.06	3.16	3.16	3.16
	Propeller speed DIN 6270A rating	Forward	rpm	1540	1298	1055	1441	1303	1062
		Reverse		1113	1113	1113	1076	1076	1076
	Lubricating oil capacity		ℓ (cu.in.)	0.3 (18.31)			0.35 (21.36)		
Weight		kg (lb.)	10.3 (22.71)			11.5 (25.36)			
Dimensions	Overall length		mm (in.)	650 (25.59)			745 (29.33)		
	Overall width		mm (in.)	482 (19.00)			455 (17.91)		
	Overall height		mm (in.)	545 (21.46)			545 (21.46)		
Lubricating oil capacity (rake angle 8°)	Total		ℓ (cu.in.)	2.0 (122.05)			2.6 (158.65)		
	Effective		ℓ (cu.in.)	1.3 (79.33)			1.6 (97.63)		
Engine weight with marine gear		kg (lb.)	114 (251)			138 (304)			
Cooling water capacity (Fresh water)	Fresh water tank		ℓ (cu.in.)	2.9 (176.97)			3.4 (207.48)		
	Sub-tank		ℓ (cu.in.)	0.8 (48.82)					

2. Specifications

2-3. Direct Sea Water Cooling Type, GMV-series

Engine Model			1GM10V	2GM20V	3GM30V	
Type			Vertical 4-cycle water cooled diesel engine			
Combustion system			Swirl pre-combustion chamber			
Number of cylinders			1	2	3	
Bore x stroke		mm (in.)	75 x 72 (2.95 x 2.83)			
Displacement		ℓ (cu.in.)	0.318(19.40)	0.636(38.81)	0.954(58.21)	
Continuous rating output (DIN 6270A)	Output/crankshaft speed	kW/rpm (HP/rpm)	5.9/3400 (8.02/3400)	11.8/3400 (16.0/3400)	17.7/3400 (24.1/3400)	
	Brake mean effective	kg/cm ² (lb./in. ²)	6.66 (94.71)			
	Piston speed	m/sec. (ft./sec.)	8.16 (26.77)			
One hour rating output (DIN 6270B)	Output/crankshaft speed	kW/rpm (HP/rpm)	6.7/3600 (9.1/3600)	13.4/3600 (18.2/3600)	20.1/3600 (27.3/3600)	
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	7.07 (100.54)			
	Piston speed	m/sec. (ft./sec.)	8.64 (28.35)			
Compression ratio			23.0			
Fuel injection timing (b.T.D.C.)		degree	b.TDC 15° ± 1°	b.TDC 15° ± 1°	b.TDC 18° ± 1°	
Fuel injection pressure		kg/cm ² (lb/in. ²)	170 ± 5 (2347 - 2489)			
Main power take off			at Flywheel side			
Front power take off			at Crankshaft V-pulley side			
Direction of rotation	Crankshaft		Clockwise viewed from stern			
	Propeller shaft (Ahead)		Clockwise viewed from stern			
Cooling system			Direct sea water cooling (rubber impeller water pump)			
Lubrication system			Complete enclosed forced lubrication			
Starting system	Type		Electric and manual			
	Starting motor		DC 12V, 1.0kW			
	AC generator		12V, 35A	12V, 55A		
Marine gear system	Model		KM3V			
	Type		V-drive, mechanical cone clutch with single stage for both ahead and astern (Angle 15 degree)			
	Reduction ratio	Forward		2.36	2.61	3.20
		Reverse		3.16	3.16	3.16
	Propeller speed DIN 6270A rating	Forward	rpm	1441	1303	1063
		Reverse		1076	1076	1076
	Lubricating oil capacity		ℓ (cu.in.)	0.8(48.92)		
Weight		kg (lb.)	19.5 (43.0)			
Dimensions	Overall length		mm (in.)	680 (26.77)	771 (30.35)	856 (33.70)
	Overall width		mm (in.)	450 (17.71)	475 (18.70)	475 (18.70)
	Overall height		mm (in.)	554 (21.81)	564(22.20)	564 (22.20)
Lubricating oil capacity (rake angle 8°)	Total		ℓ (cu.in.)	1.3 (79.33)	2.0 (122.05)	2.6 (158.65)
	Effective		ℓ (cu.in.)	0.6 (36.61)	1.3 (79.33)	1.6 (97.63)
Engine weight with marine gear		kg (lb.)	90 (198)	119 (261)	138 (303)	

2. Specifications

2-4. Fresh Water Cooling Type, GMFV-series

Engine Model			2GM20FV	3GM30FV		
Type			Vertical 4-cycle water cooled diesel engine			
Combustion chamber			Swirl pre-combustion chamber			
Number of cylinders			2	3		
Bore x stroke		mm (in.)	75 x 72 (2.95 x 2.83)			
Displacement		ℓ (cu.in.)	0.636(38.81)	0.954(58.21)		
Continuous rating output (DIN 6270A)	Output/crankshaft speed	kW/rpm (HP/rpm)	11.8/3400 (16.0/3400)	17.7/3400 (24.1/3400)		
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	6.66 (94.71)			
	Piston speed	m/sec. (ft./sec.)	8.16 (26.77)			
One hour rating output (DIN 6270B)	Output/crankshaft speed	kW/rpm (HP/rpm)	13.4/3600 (18.2/3600)	20.1/3600 (27.3/3600)		
	Brake mean effective pressure	kg/cm ² (lb./in. ²)	7.07 (100.54)			
	Piston speed	m/sec. (ft./sec.)	8.64 (28.35)			
Compression ratio			23.0			
Fuel injection timing (b.T.D.C.)		degree	b.TDC 15°±1°	b.TDC 18°±1°		
Fuel injection pressure		kg/cm ² (lb./in. ²)	170 ± 5 (2347 – 2489)			
Main power take off			at Flywheel side			
Front power take off			at Crankshaft V-pulley side			
Direction of rotation	Crankshaft		Clockwise viewed from stern			
	Propeller shaft (Ahead)		Clockwise viewed from stern			
Cooling system			Fresh water cooling with heat exchanger			
Lubrication system			Complete enclosed forced lubrication			
Starting system			Electric			
	Starting motor		DC 12V, 1.0kW			
	AC generator		12V, 55A			
Marine gear system	Model		KM3V			
	Type		V-drive, mechanical cone clutch with single stage for both ahead and astern (Angle 15 degree)			
	Reduction ratio	Forward		2.36	2.61	3.20
		Reverse		3.16	3.16	3.16
	Propeller speed DIN 6270A rating	Forward	rpm	1441	1303	1062
		Reverse		1076	1076	1076
	Lubricating oil capacity		ℓ (cu.in.)	0.8 (48.82)		
Weight		kg (lb.)	19.5 (43.0)			
Dimensions	Overall length		mm (in.)	776 (30.55)	861 (33.90)	
	Overall width		mm (in.)	482 (19.00)	475 (18.70)	
	Overall height		mm (in.)	614 (24.17)	614 (24.17)	
Lubricating oil capacity (rake angle 8°)	Total		ℓ (cu.in.)	2.0 (122.05)	2.6(158.65)	
	Effective		ℓ (cu.in.)	1.3 (79.33)	1.6 (97.63)	
Engine weight with marine gear		kg (lb.)	125 (278)	147 (323)		

3. Basic rules that must be kept for engine handling

3. Basic rules that must be kept for engine handling

Observe the following rules strictly to prolong the life of your engine.

No.	Items to be observed	Details and troubles which may arise if the instructions are neglected
1	Be sure to conduct run-in operation while your engine is still new.	Applications of heavy loads may shorten the life of the engine while it is still new.
2	Be sure to warm-up the engine.	Warm-up the engine at idling speed for about 5 minutes after starting to permeate the lube oil to all parts of the engine. If the engine is not warmed up, there will be excessive wear of the moving parts.
3	Use fuel with a cetane value of over 45.	Inferior quality fuel can cause starting failure, and the engine will emit bluish white exhaust.
4	Drain the fuel tank on a regular basis.	Before operating the engine, open the drain cock of the fuel tank and remove the precipitates from the fuel. 1st time After 50 hrs. 2nd time and thereafter . . . Every 300 hrs.
5	Use high quality lube oil.	Inferior quality lube oil will cause seizure of the piston and liner, excessive wear of moving parts and other troubles. The engine's durability will also be lowered.
6	Be sure to replace the lube oil and lube oil filter element on a regular basis.	Lube oil replacement: 1st time After 50 hrs. 2nd time and thereafter . . . Every 150 hrs. Element replacement: 1st time After 50 hrs. 2nd time and thereafter . . . Every 300 hrs.  CAUTION: <ul style="list-style-type: none"> • Use of old lube oil will make engine parts wear fast and cause engine troubles. • The oil pressure drops if the element is old or clogged with dust. This causes main bearing seizures and any dust in the bearing makes it wear faster.

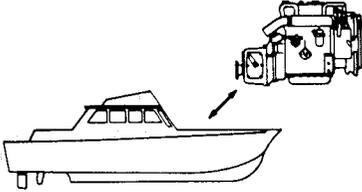
3. Basic rules that must be kept for engine handling

No.	Items to be observed	Details and troubles which may arise if the instructions are neglected
7	Use clean tap water for cooling.	Hard water from wells causes scale deposits on the cooling water system. This lowers the cooling efficiency and raises the cooling water temperature too high, causing seizures of the piston and liner.
8	Be sure to add anti-rust agent to the cooling water.	Rust in the cooling water system not only accelerates the corrosion of the system but shortens the engine's life on account of the loss of cooling efficiency.
9	Use the anti-freeze in cold areas.	The anti-freeze prevents the cooling water from freezing and cracking the engine. If the cooling water freezes, it may crack the cylinder block, or cooling water pump. So, if anti-freeze is not used, be sure to drain the cooling water completely after operation.
10	Replace cooling water every year.	Contaminated cooling water has a lower cooling efficiency, so the cooling water temperature is liable to rise too high. This causes engine seizure.
11	Prior to operation, always check the cooling water level in the sub tank (Eng. w/sub tank only). In addition, check the cooling water level in the fresh water cooler (heat exchanger) at least once a week.	If the cooling water runs short, the cooling water temperature will rise too high. This causes engine seizure.
12	Check and adjust the drive belt tension of the alternator/cooling water pump.	An improper belt tension will either fail to transmit power satisfactorily or cause overheating. The belt will be damaged.
13	Do not make the starting motor run for more than 15 sec. continuously.	Continuous use of the starting motor for more than 15 sec. will damage the motor.

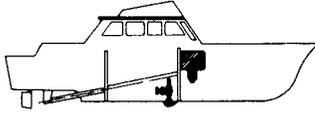
4. Installation

4-1. Procedures of Installation

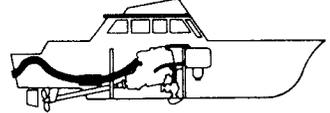
1 Matching engine and boat



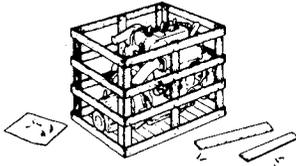
7 Installation of kingston valve and fuel tank



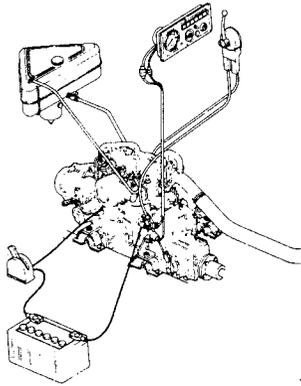
12 Installation of pipes, wires and exhaust pipe etc.



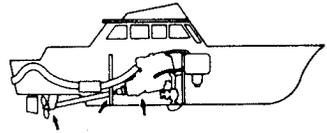
2 Make sure all engine parts and standard accessories are included.



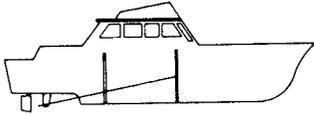
8 Engine running test



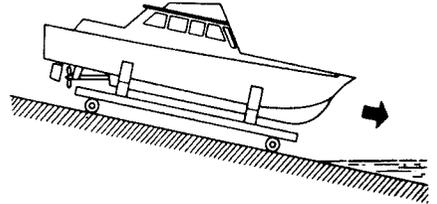
13 Completion check



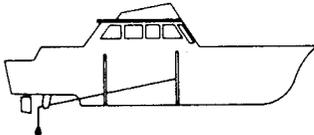
3 Finding the propeller shaft



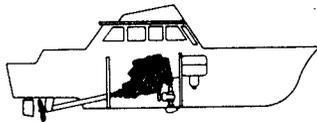
14 Launching



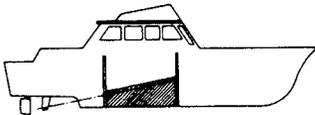
4 Centering



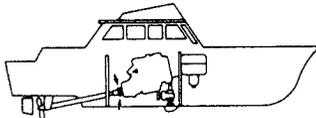
9 Installation of engine and propeller shaft



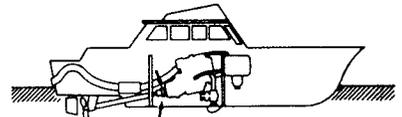
5 Installation of engine bed using propeller shaft as a center



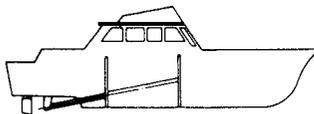
10 Adjustment of propeller shaft alignment



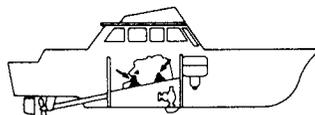
15 Adjustment of the propeller shaft alignment when boat is in the water



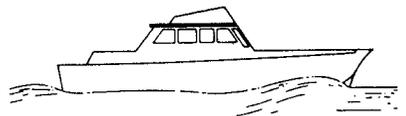
6 Installation of stern tube



11 Tightening the engine mounting bolts



16 Trial run



4. Installation

4-2. Notes for the installation

If you (boat owners) want to install the engine on your boat by yourself, please ask advice of your neighboring YANMAR distributors or dealers.

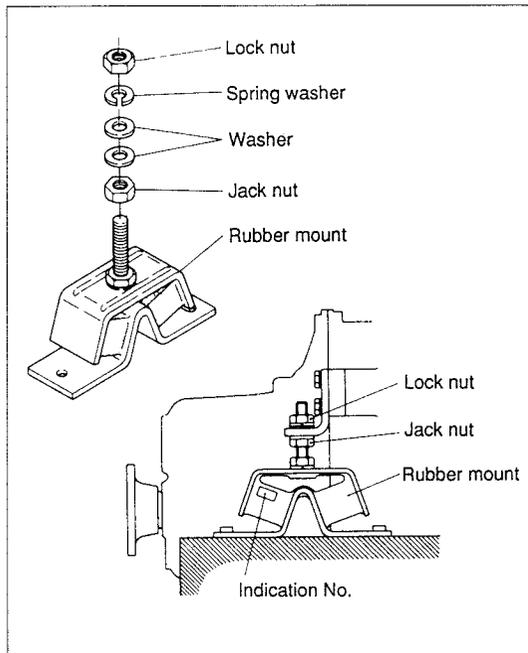
YANMAR has prepared "INSTALLATION MANUAL (PLEASURE BOAT USE)", so you are kindly requested to obtain this manual and work carefully to install the engine following the details in it.

For your reference, brief notes for your work during and after installation are mentioned as follows:

(1) Flexible engine mount

Be sure to use a flexible mount for the installation of every Yanmar engine model. Do not install the engine directly to the engine bed. The use of a flexible mount reduces vibration and noise by absorbing the vibrations at the couplings between the engine and the engine bed.

The dimensions for both front and rear-side use flexible mounts are identical. However, the rubber elastic modulus is different for front and rear, so be sure to remember their indication numbers.

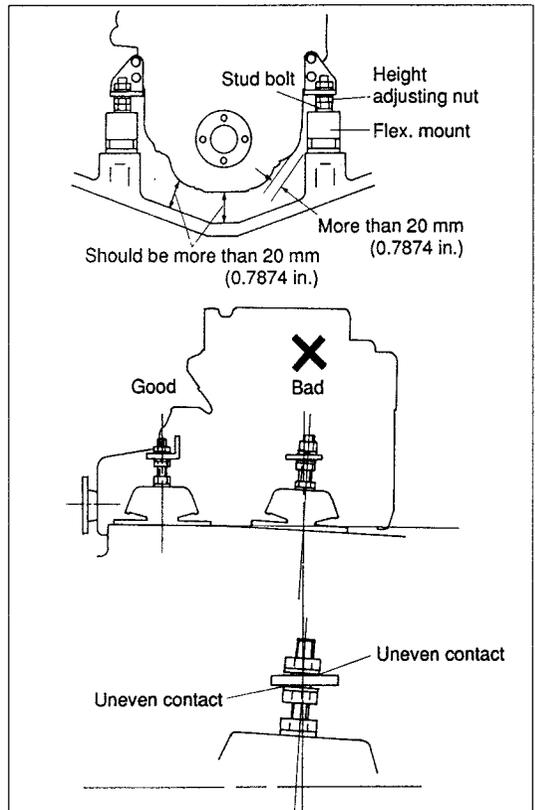


	Indication No. of flexible mount	
	Front side	Rear side
1GM10(V)	70	50
2GM20(F) 3GM30(F)	100	75
2GM20(F)V 3GM30(F)V	100	100

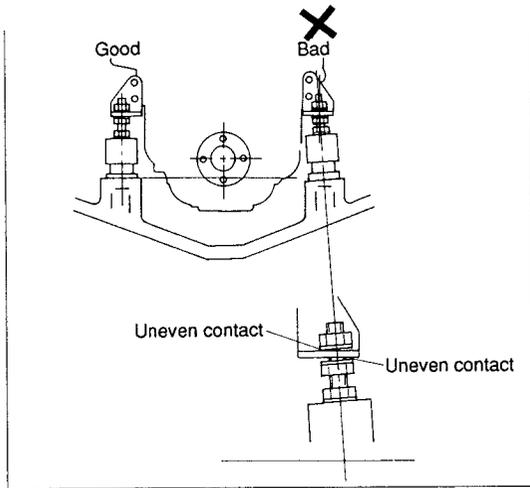
When fabricating the engine bed, be sure to leave a 20 mm or larger clearance between the engine bed, and the engine body and marine gear. In addition, be sure to leave 20 mm or larger clearance between the hull bottom, and the engine's oil pan and marine gear. (Measure these values with the height adjusting nuts of the engine's flexible mount brought down to the lower-most point, where they come into contact with the fixing nut of the stud bolts).

NOTE:

The use of flexible mounts for too many hours makes the rubber lose its tension. This reduces the clearance and there will be interference between the engine and the hull bottom.

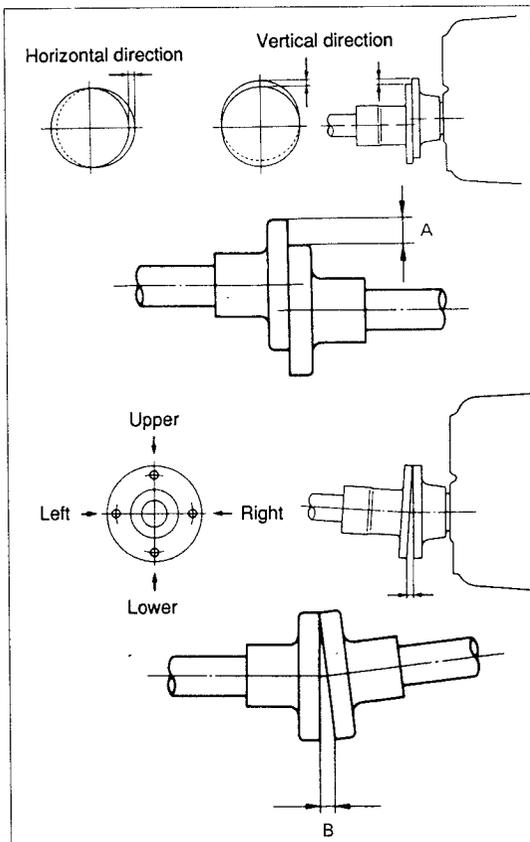


4. Installation



(2) Centering the engine

Before connecting the marine gear drive shaft with the propeller shaft, make sure that the flange surfaces of both parts are parallel to each other, and that their centers are aligned. Then adjust the centering of the engine.



mm (in.)

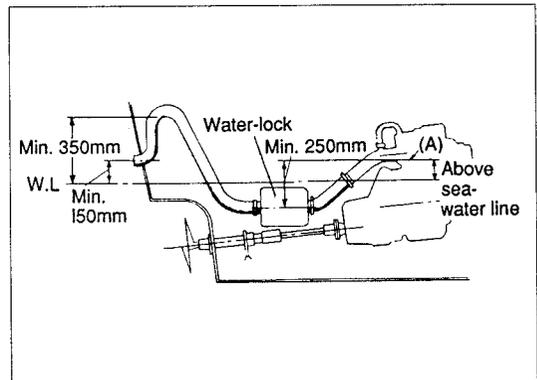
Coupling disalignment A	0.1 - 0.3 (0.0039 - 0.0118)
Coupling face run-out B	0 - 0.2 (0 - 0.0079)

(3) Exhaust system

It is necessary to arrange the piping to allow for inspection of the whole system. Also, a suitable arrangement is necessary to prevent sea-water from flowing back into the engine. A water-lock must be equipped to prevent water remaining in the hose from flowing back to the engine side when stopping the engine or immediately after starting.

The water-lock must be fixed at the lowest possible position, and the hose must be tilted downward as much as possible. It is also necessary to elevate the exhaust hose at the exhaust outlet to more than 350 mm (13.78 in.) above the loading draft line.

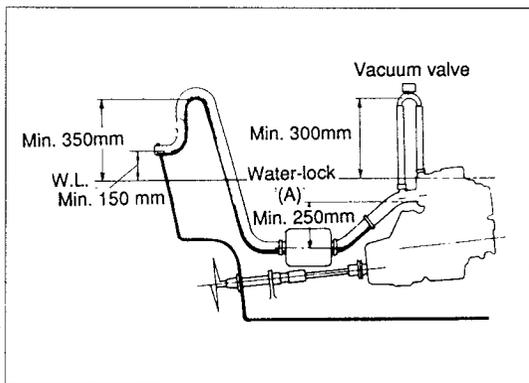
- 1) When the water outlet of the engine (A) is above the water line:



- 2) When the water outlet of the engine (A) is below the water line:

In this case attach a vacuum valve to the elbow of the cooling water pipe.

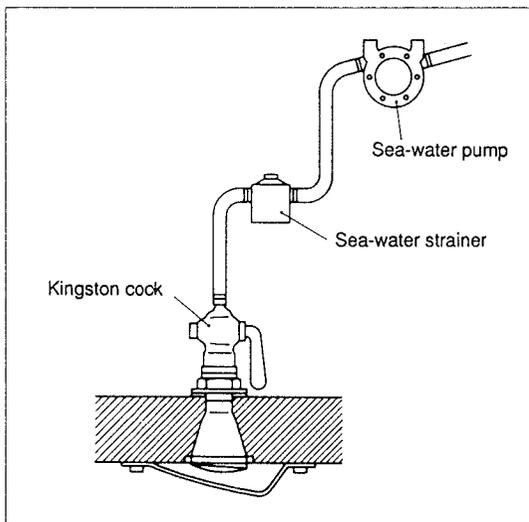
4. Installation



(4) Sea water cooling system

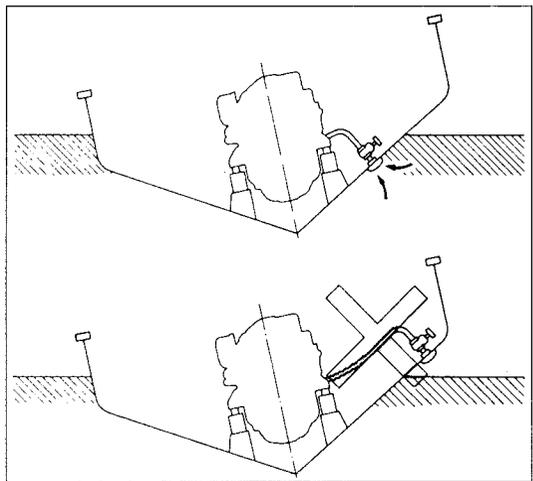
The cooling water inlet consists of the kingston cock and the cooling water hose which connects the cock to the cooling water pump. When the boat is operated in dirty water, provide a sea-water strainer between the kingston cock and the cooling water pump.

The sea-water pump will be damaged if foreign matter is allowed to get into it. Therefore, if the sea-water cock is not already equipped with a strainer, one should be attached between sea-water cock and the pump inlet.



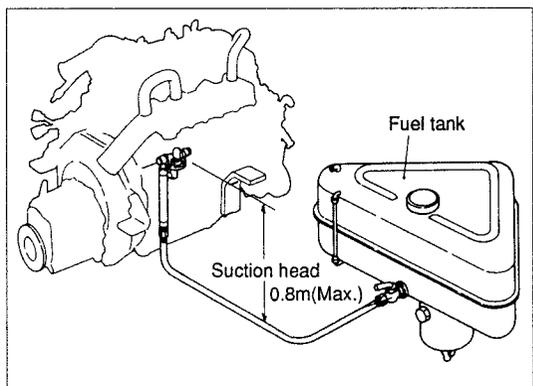
NOTE:

Locate the sea-water inlet well under the draft line. Even when the hull rolls, the inlet must remain under water.



(5) Fuel system

- 1) The fuel tank should be installed as far as possible from the engine itself.
- 2) The height of the fuel tank must not be more than 0.8 meter below the fuel feed pump attached to the engine. If lower, an extra feed pump should be attached.



- 3) Since the fuel that overflows from the injection nozzle returns to the injection pump, connect the fuel return rubber hose between the fuel injection pump and fuel tank.

4. Installation

(6) Electric system

- 1) Select battery of sufficient capacity.

Recommended battery capacity	
1GM10 2GM20 3GM30	12V – 70AH

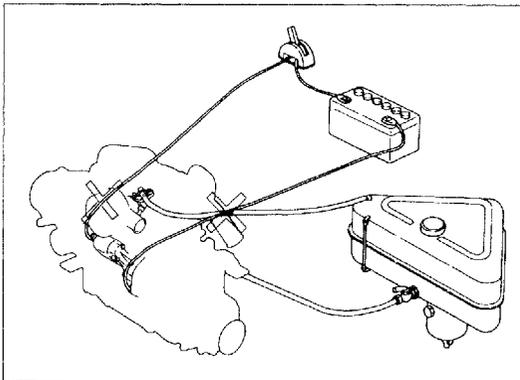
- 2) To wire the battery, connect (+) wire to the (+) terminal and the (-) wire to the (-) terminal.
Do not confuse them.

CAUTION:

If connect the (+) wire to the (-) terminals, the I.C. regulator built in the AC alternator will be damaged.

WARNING:

Route the cable so that it doesn't come in contact with the sharp edges of the engine or heated areas.



WARNING:

Do not clamp the cables together with the fuel pipes. Keep them away from the fuel pipes as much as possible.

- 3) Use wire of the correct size. Carry out correct wiring according to the wiring diagram for each model.

(7) Remote control system

Only use the single lever remote control head.

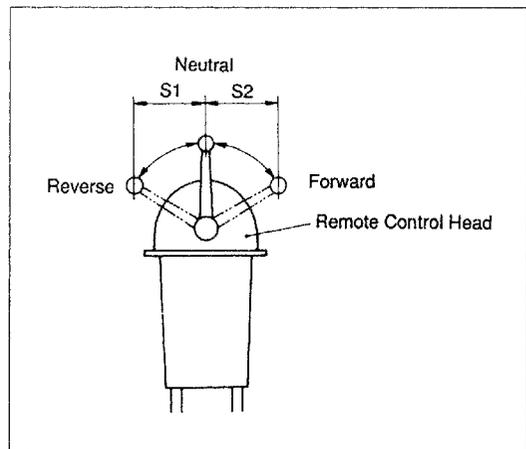
NOTE:

The dual lever remote control head cannot be used because of the large torque needed to operate the marine gear shift lever at engine high speeds (over 1800 rpm). This exceeds its capacity, and make the clutch inoperable.

- 1) Adjustment of the remote control head
- Marine gearbox control side -
 - (a) Equal distribution of the control lever stroke.

The stroke between neutral → forward (S2), and neutral → reverse (S1) must be equalized.

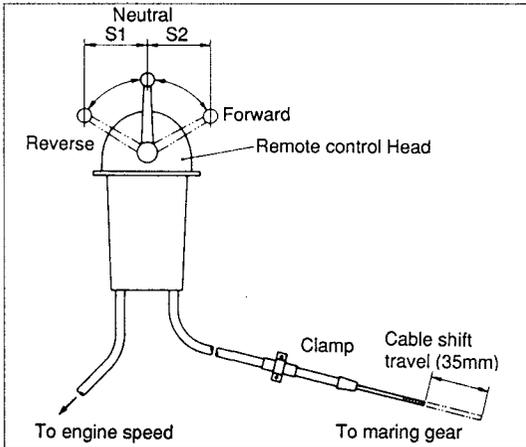
When either stroke is too short, clutch engagement becomes faulty.



- (b) Equalizing the travel distance of the control cable.

After ensuring the equal distribution of the stroke described in (a), connect the cable to the control head, and check that the cable shift travel is 35 mm (1.38 in.) when the control lever is moved from "Neutral" to "Forward" or to "Reverse".

4. Installation

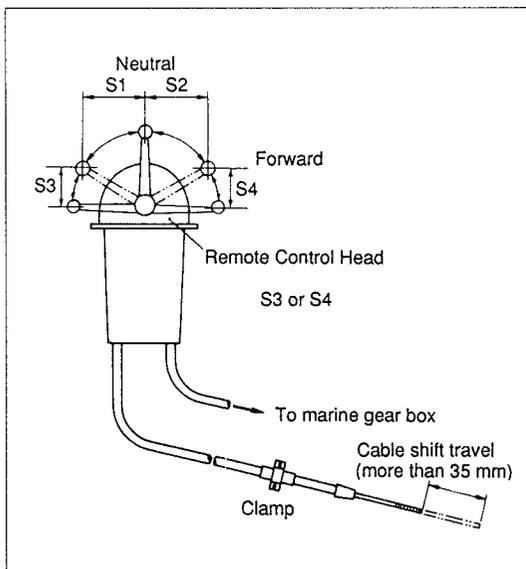


- Engine speed control side -

- (a) Confirmation of the control cable shift travel.

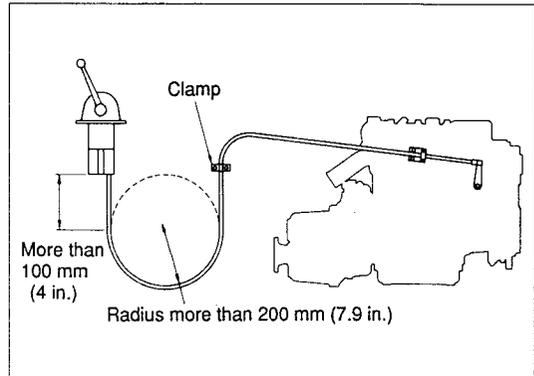
Connect the cable to the control head. Move the control lever to full stroke, and confirm that the cable shift travel is more than 35 mm (1.38 in.). Then connect the cable to the connection part of the governor lever.

If the cable shift travel is below 35 mm (1.38 in.), max. engine speed may not be obtained. If the cable shift travel distance falls below 35 mm after connection, due to cable shift stress, use the cable adjusting screw to adjust it back to 35 mm.

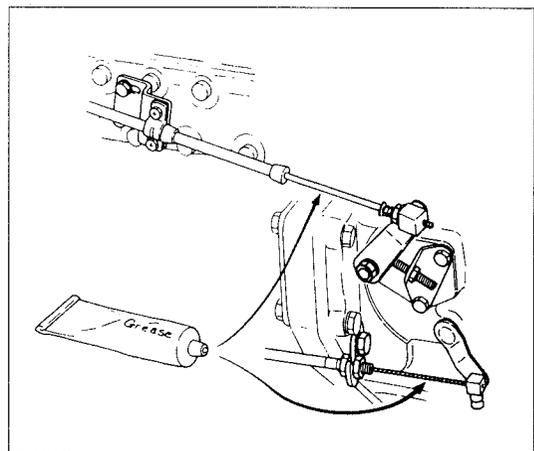


2) Wiring precautions

- (a) The minimum radius of cable bend should be 200 mm (7.9 in.).
- (b) The outer cable should be bent, if required, at a point more than 100 mm (3.9 in.) from an outer cable clamp so that the clamp can be protected from strain.



- (c) The exposed portion of the inner cable should be coated with a water resistant grease for rust prevention and also for smooth movement of the cable.



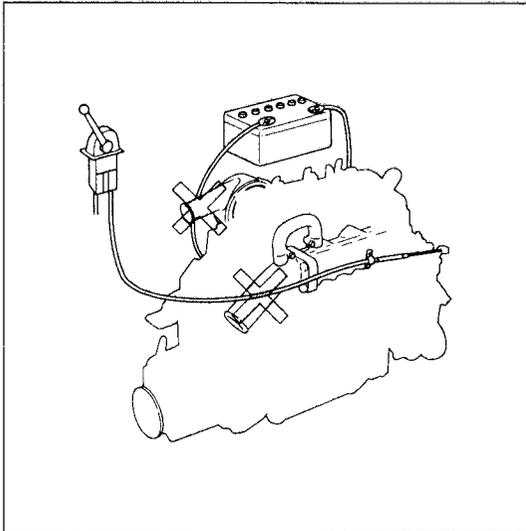
- (d) The cable should be routed so that it does not come into contact with the heated area of the engine, sharp edges of metallic parts or moving parts.

- 4. Installation
 - 5. Fuel oil, lube oil and cooling water
-



WARNING:

Avoid clamping a wire harness or any other electrical wire to the cable.



5. Fuel oil, lube oil and cooling water

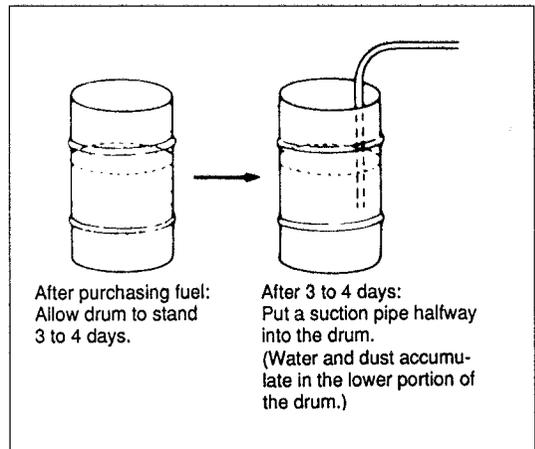
5-1. Selection and handling of fuel oil

(1) Selection of fuel oil

Use the diesel fuel oil which is most suitable for the engine. (Use diesel fuel oil with cetane value of over 45, less than 0.5% sulphur content and 0.1% water content)

(2) Handling of fuel oil

- 1) Water and dust in the fuel oil cause engine failure.
- 2) Stand the drum for several days to precipitate the water and dust to the bottom. Use the fuel at the top.



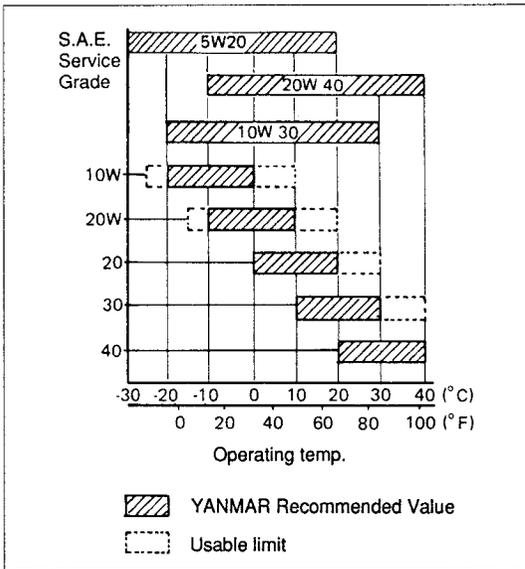
5-2. Selection of lube oil, and refilling

(1) Selection

Nothing affects the performance and durability of your engine more than the lube oil you use. If inferior oil is used, or if your engine oil is not changed regularly, the risk of piston seizure, piston ring sticking, and accelerated wear of the cylinder liner, bearing and other moving components increases significantly. Your engine life may be seriously shortened.

Use Class CD (API Service Classification) oil.

5. Fuel oil, lube oil and colling water



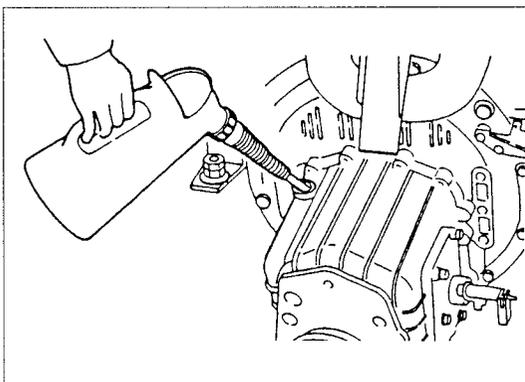
For Marine gear, use the following lube oil.

KM series	Mechanical cone clutch	Same lube oil as the engine
KBW series	Wet multi-disc clutch	ATF-A oil



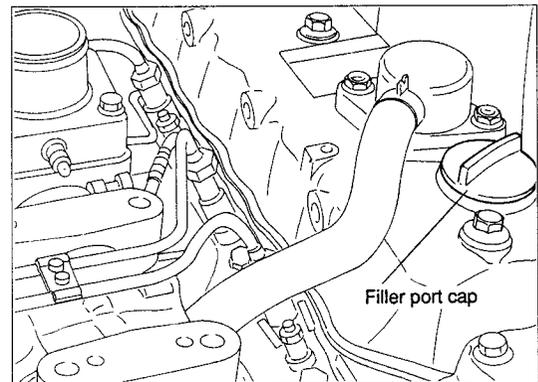
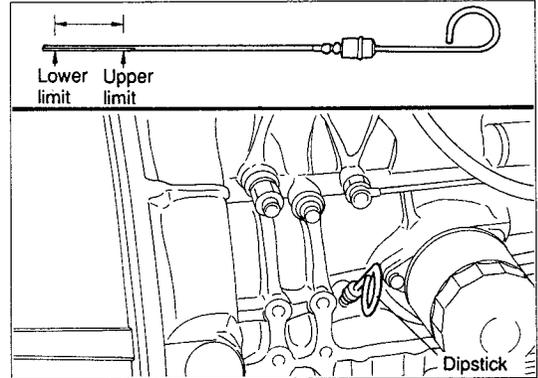
WARNING:

Don't use the ATF-A oil for the mechanical cone clutch (KM series) due to protecting a slip or seizure.



(2) Lube oil supply

- 1) Open the oil filler port and supply the oil to upper limit of dipstick.



CAUTION:

- It takes a little while for the lube oil supplied from the filler port to fill the crankcase. Wait for about 3 minutes and then check the oil level.
- Make sure that your boat is sitting level when you check the oil. You cannot get the correct reading if it is tilted.
- The lube oil quantity in the crankcase falls during the breaking-in operation of a new engine because the oil spreads to the lube oil cooler and lube oil piping. Stop the engine once and wait for about 3 minutes before checking the oil level again.

5. Fuel oil, lube oil and cooling water

5-3. Cooling water (Fresh water cooled engine)

(1) Handling the cooling water

- 1) Be sure to use clean tap water (with anti-rust agent).

CAUTION:

Hard water from wells or sea water causes rusting of the cooling water system. This lowers the cooling efficiency and may cause overheating.

2) Use of anti-freeze

Use anti-freeze, if the temperature is expected to fall below freezing point. The use of anti-freeze removes the need for daily draining of the cooling water. For safety, choose a temperature which is about 5°C lower than the lowest temperature of your area, and then decide the mixing ratio according to the instructions given by the anti-freeze maker.

CAUTION:

- *To use the anti-freeze, first drain the cooling water completely from the engine, pour in the anti-freeze to the specified amount, and fill the cooling water up to the mouth of cooling water filler port. Operate the engine for about 30 minutes to fully mix the anti-freeze with water, and then store the engine.*
- *Anti-freeze is usually effective for one year. Refer to the instructions given by the anti-freeze maker.*

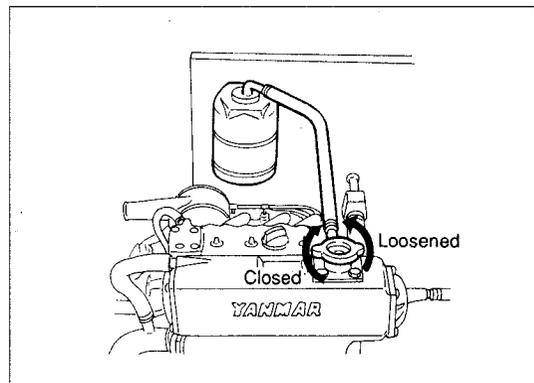
- 3) If no anti-freeze is used in winter, be sure to drain the cooling water from the engine after operation.

CAUTION:

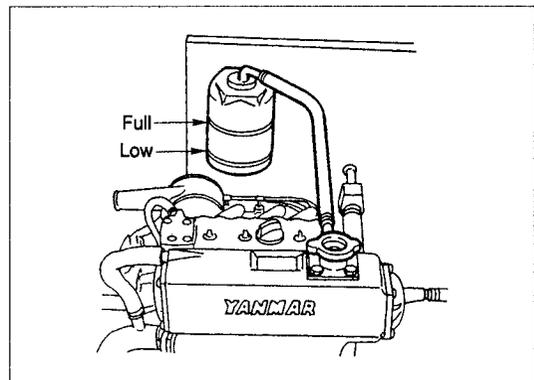
If the cooling water is left in the engine, it may freeze and cause cracking in cooling water pump and cylinder block.

(2) Supply and check of cooling water

- 1) Supplying water to the engine
Remove the cap on the heat exchanger top to supply cooling water. The cap can be removed by turning it about 120 degrees counterclockwise. Before breaking-in the engine, fill with clean tap water up to the mouth of the filler port. To tighten, slot the cap rear lobe into the filler port notch and press-turn the cap about 120 degrees clockwise.



- 2) Checking and refilling with cooling water (Engine w/sub-tank)
Check the cooling water level against the "Full" and "Low" marks on the sub-tank. Remove the cap on top to refill. Fill to the "Full" mark.



6. Breaking-in operation

6. Breaking-in operation

Operate your new engine in accordance with the following procedures.

6-1. Fuel oil

Supply fuel to the fuel tank.

CAUTION:

To prevent fuel from overflowing, supply to 80 - 90% of the tank's capacity.

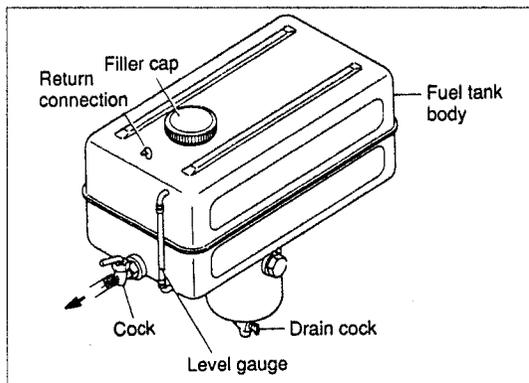
In subsequent engine operations, observe the following rules:

(1) Draining

Even when only using fuel from the top of drum, there will still be some dust or water impurities. These must be drained off before they get into the inner parts of the engine.

(2) Draining the fuel tank

Be sure to install the precipitation trap and draining cock on the bottom of the fuel tank. Before operating the engine, open the cock and remove the sediments from the fuel.



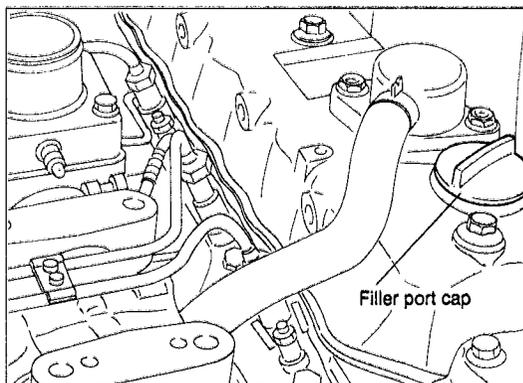
WARNING:

To avoid fire hazards, be sure to stop the engine before refilling with fuel.

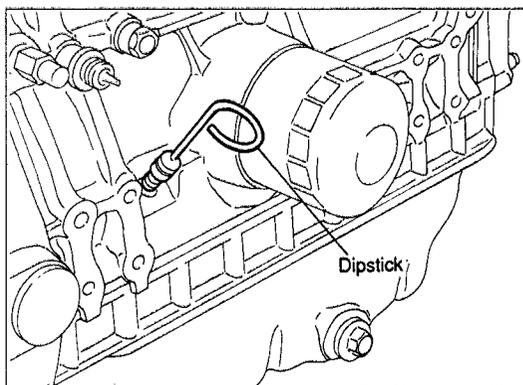
6-2. Supply of lube oil

(1) Lube oil supply to the crankcase

Remove the filler port cap (yellow) to supply lube oil to the crankcase.



Insert the oil dipstick to the port and check that the oil comes up to the upper limit of the oil dipstick.



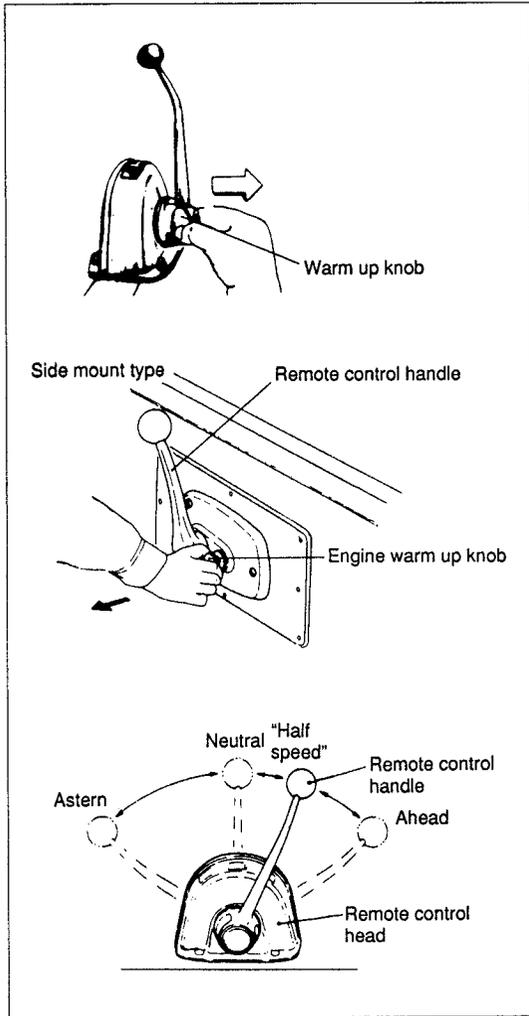
6-3. Air bleeding

The fuel system runs from the fuel tank, through the fuel filter, fuel injection pump and high pressure piping, to the fuel injection nozzles. Fuel is not injected if air is admitted into the fuel system.

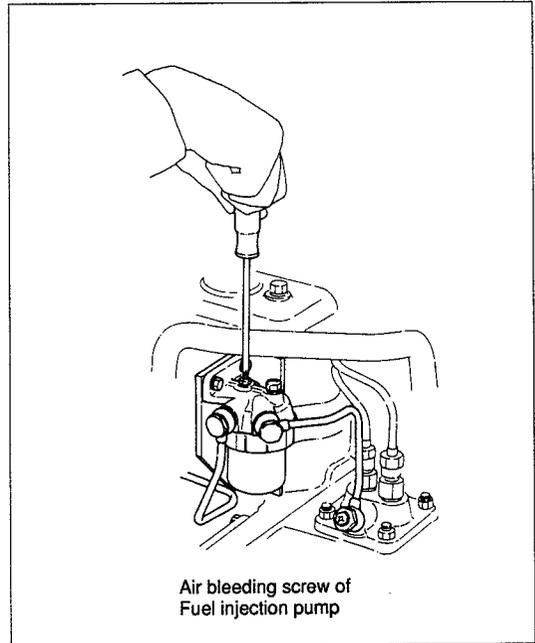
Bleed the air according to the following steps.

- (1) Pull out the engine warm up knob on the remote control head and place the control lever in the "HALF SPEED" position.

6. Breaking-in operation

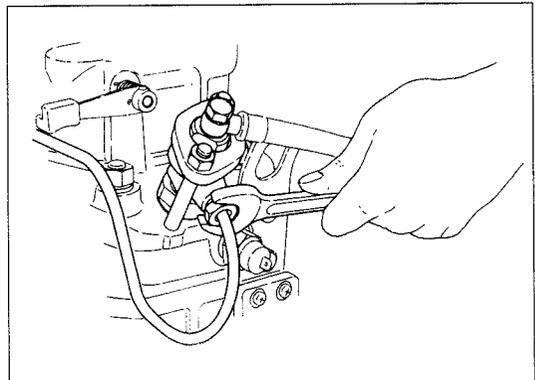
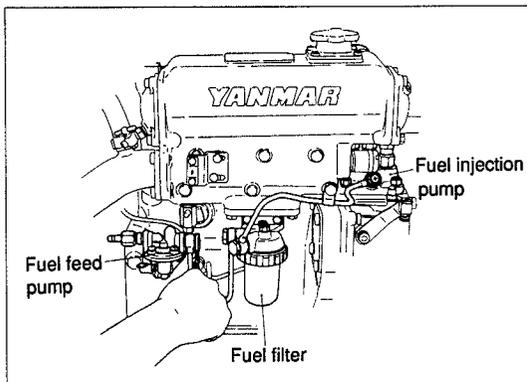


- 1) Bleed air by loosening the air bleeding screws of the fuel filter and fuel injection pump.



- 2) Vent air in the fuel injection piping. Loosen the fuel injection pipe nipple on the fuel injection valve side. Repeat this procedure several times. After venting, tighten the fuel injection pipe nipple firmly.

- (2) While operating the priming knob on the fuel feed pump or the fuel filter.



6. Breaking-in operation

6-4. Lubricating engine parts

- (1) Lubricate the governor linkage.
- (2) Lubricate the shaft of the regulator handle mount.

6-5. Safety checks

Tidy the area around the engine. Remove any tools or other obstacles from the vicinity of flywheel, rotating parts and the top of the engine.

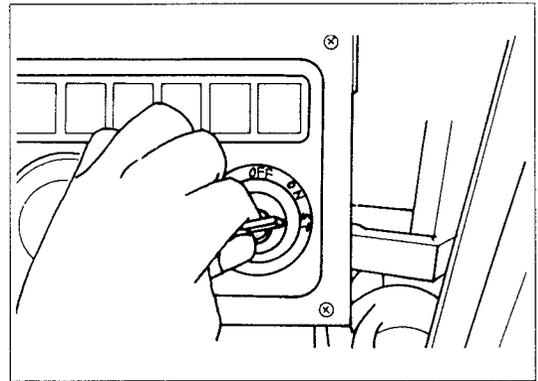
6-6. Spreading the lube oil

When using the engine after a period of non-use (for more than a month), it is necessary to circulate the lube oil as follows before starting regular engine operation.

- (1) Turn the battery switch "ON"
- (2) Shift the speed control lever to the "Neutral" position.
- (3) Open the kingston cock.
- (4) Yanmar offers two lube oil spreading methods. Conduct the following procedure depending on your engine stop method.

1) Manual engine stop type

While pulling on the engine stop cable, insert the key into the starter switch, and turn it to "START". Run the engine for 3 - 5 seconds with the starting motor, and check for abnormal sounds.



2) Electrical engine stop type

While pushing the engine stop button on the instrument panel, turn the key switch to "START". Follow the same procedure as with the manual stop type.

CAUTION:

- Do not release the engine stop cable or stop button when handling the key.

6-7. Checking the pilot lamps

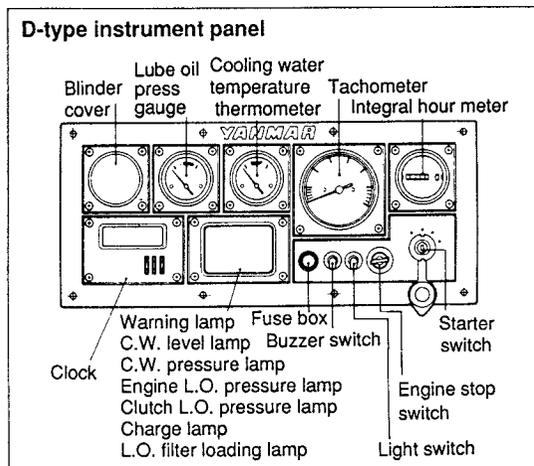
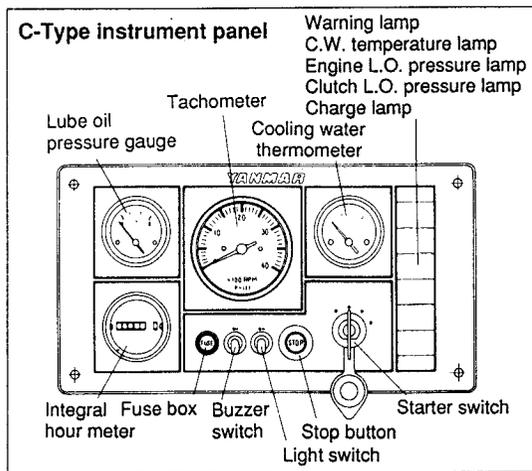
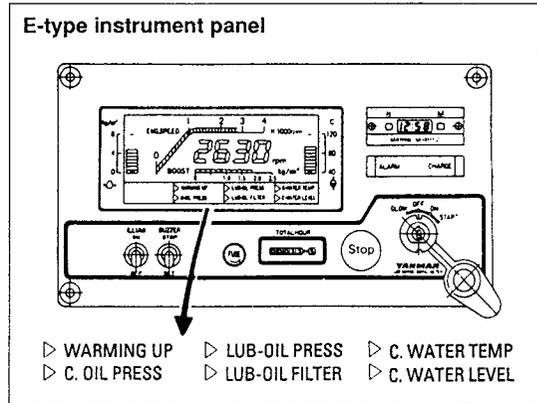
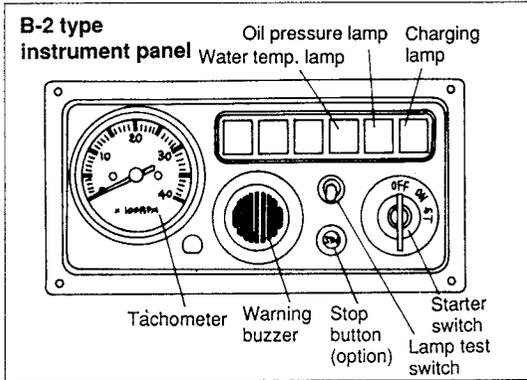
Check that the pilot lamps on the instrument panel are as shown below when the starter key is turned on:

Pilot lamps	Low L.O. pressure alarm lamp	Lit
	Charge lamp	Lit
	Cooling water temp. alarm lamp	Off

NOTE:

All these signals will continue until the engine starts up or the key is turned off.

6. Breaking-in operation
 7. Operating your engine



7. Operating your engine

Before operating the engine, check that there are no obstacles around the engine, especially around the rotational parts.

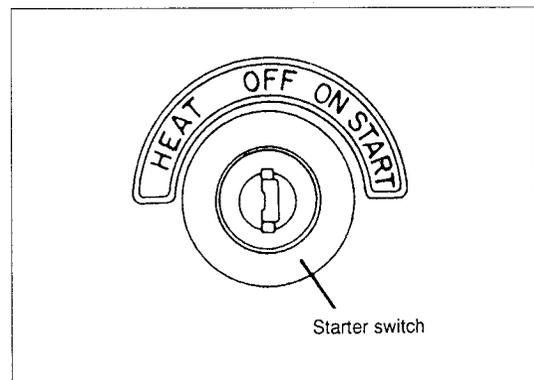
7-1. Starting

- (1) Turn the battery switch "ON".
- (2) Pull out the engine warm up knob and place the control lever in the "HALF SPEED" position.

NOTE:

The knob for engine warm up can only be operated when the control lever is placed in the "Neutral" position.

- (3) Open the kingston cock
- (4) Turn the starter switch key to "START". The engine should start.



7. Operating your engine

Once the engine is started, release the key. The key automatically returns to "ON". (Do not turn off the battery switch and the key switch even after the engine is started). At "ON", the gauges on the instrument panel start operating.

CAUTION:

Protecting the battery

Do not run the starter motor for more than 15 seconds at a time. If the engine can't be started, wait for about 15 seconds before using the starter motor again.

Engine re-starting

Be sure to check that the flywheel has come to a standstill before turning the starter switch to "START".

- *The starter motor or flywheel gear may be damaged if the starter switch is operated with the flywheel still moving.*
- *Engines with a safety relay in the circuit can't be re-started unless the starter switch has been turned off once the starter motor was run.*

Battery and key switch

Do not turn off the battery switch and the key switch even after the engine start due to protecting alternator.

When the engine is operated at a low idling speed (below 1000 rpm) for a long time (over 2 hours), excessive carbon and fuel residue tends to accumulate due to incomplete combustion.

Carbon deposits on the injection holes of the fuel injection valve, exhaust valve, the turbine blades of the turbocharger, etc. cause a drop in engine output, knocking, and other troubles. To prevent these problems, be sure to blow off the carbon accumulations by full speed operation.

Operate the engine at over 2500 rpm for one minute in every two (2) hours of continuous low idling operation.

Cold weather starting aid

- *Turn the starter key counterclockwise to the "Heat" (or Glow) position and hold it in that position for about 15 seconds.*
 - *Then, return the starter key to "START" to start the engine.*
- (5) When the engine is started, return the remote control handle to the "NEUTRAL" position.

7-2. Cautions after engine starting

Once the engine is started, observe the following instructions.

- (1) Warm-up the engine for more than 5 minutes.

CAUTION:

- *The lube oil will not spread all the way to the main bearing and other moving parts for some time after starting. To protect these parts from wear, the engine must be idled for about 5 minutes at low speed.*
- *For breaking-in, idle the engine at low speed for 15 - 20 minutes.*

- (2) Raise the engine speed above 1000 rpm, and check that the low oil pressure alarm lamp and the charge lamp go out.



WARNING:

If the warning lamps still do not go out when the engine speed is raised above 1000 rpm, the engine is faulty. Stop the engine immediately and consult your nearest Yanmar dealer.

7. Operating your engine

7-3. During engine operation

During engine operation, check the following items once or twice a day.

(1) Exhaust color

Black exhaust indicates that the engine is under strain. Continued operation will shorten the lives of the intake and exhaust valves, piston rings, cylinder liner and fuel injection valves. Stop engine operation when black exhaust is emitted.

(2) Water and oil leakage

Check that there are no water, oil or gas leaks, loose bolts and abnormal noise, overheating and excessive vibrations. If any abnormality is found, contact your nearest Yanmar dealer.

(3) Avoid resonance range operation



WARNING:

Depending on the driven machine, engine vibrations will be excessive in a certain speed range due to resonance of the engine with the engine bed. Avoid engine operation in this range.

(4) Alarm lamps

● Low oil pressure alarm lamp ("OIL")

If the low oil pressure alarm lamp is lit while the engine is running at higher than low idle, check whether the lube oil is too low. If not, there is an abnormality in the lube oil circuit. Continued operation will cause engine seizure. Stop the engine soon, and consult your nearest Yanmar dealer.

NOTE:

To check the lube oil level, stop the engine and wait for more than 3 minutes.

● Charge alarm lamp ("CHG")

If the charge alarm lamp is lit while the engine is running at over 750 rpm, there

is a fault in either the charging circuit or the V-belt (slippage or damage). Stop the engine and check. If the V-belt is OK, consult your nearest Yanmar dealer.

● Cooling water temp. alarm lamp ("WATER")

If the cooling water temp. alarm lamp is lit during load operation of the engine, the engine is overheated. Stop the engine immediately and check the cooling water level. If it is OK, consult your nearest Yanmar dealer.

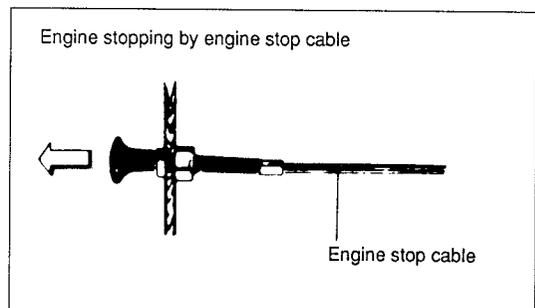
(5) Abnormal noise

If abnormal sounds are heard during engine operation, stop the engine soon and locate the cause. If it can't be located, consult your nearest Yanmar dealer.

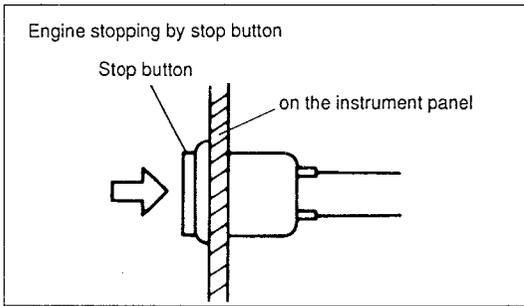
7-4. Engine stopping

(1) Idle the engine before stopping

- 1) To stop the engine, place the control lever to the "Neutral" position and operate the engine at low idling speed for about 5 minutes.
- 2) Cut the fuel by the following steps and stop the engine.



7. Operating your engine



CAUTION:

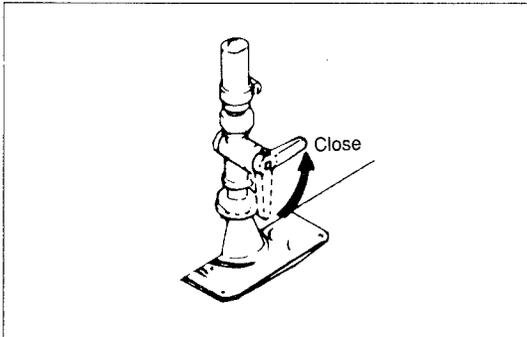
If the engine is stopped suddenly at a high temperature, the temperature of various parts will increase, and engine troubles may occur.

- 3) Turn off the key switch.

NOTE:

When stopping the engine with the starter switch "ON", the lube oil pressure warning buzzer will sound. This is normal and does not indicate engine trouble.

- (2) Be sure to close the kingston cock after stopping.



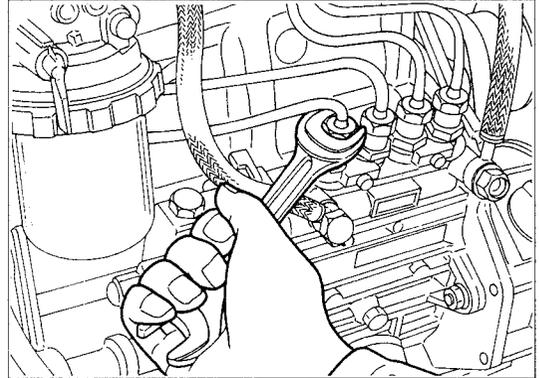
WARNING:

Emergency stop

If the engine can't be stopped with the engine stop cable (or stop button on the instrument panel) or the engine speed can't be lowered by the speed control lever, stop the engine as follows:

Loosen all the nuts on either the fuel injection pump side or the fuel injection nozzle side. This cuts off the fuel supply, and the engine

stops. In such cases, consult your nearest Yanmar dealer to locate the cause and have them repair the engine.



- (3) Draining the cooling water

WARNING:

Cooling water freezes in cold temperatures. If anti-freeze is not used, be sure to drain the cooling water after stopping the engine. Also drain the cooling water completely before long storage. Otherwise, water in the cylinder may freeze and crack the cylinder.

- Before draining the cooling water, remove the pressure cap and the drain plugs of the engine, air cooler and heat exchanger. If the cap is not removed, draining will be hard and may be incomplete.
- Do not remove the pressure cap when the engine is in hot condition.

- (4) Wipe off dust and soil and clean the engine.

- (5) Turn off the battery switch (if your engine has one).

- (6) Pull out the starter key.

8. Periodic checks and maintenance

8. Periodic checks and maintenance

Periodic checks and maintenance are very important for keeping the engine in good condition and durable.

The chart below indicates which checks to make and when to make them.

System	Item	Before starting	Alter 50 hrs or one month	Every 150 hrs	Every 300 hrs	Every 600 hrs
Fuel system	Check the fuel level, and refill	○				
	Drain the fuel tank		○ (First)		○	
	Replace the fuel filter				○	
	Check the injection timing					○
	Check the injection spray condition					○
Lubricating system	Check the lube oil level	Crankcase	○			
		Marine gear	○			
	Replace the lube oil	Crankcase		○ (First)	○	
		Marine gears		○ (First)	○	
	Check the oil pressure warning lamp function	○				
	Replace the lube oil filter		○ (First)		○	
Cooling system	Seawater outlet	○ During operation				
	Check cooling water level	○				
	Adjust the tension of cooling water pump driving belt		○ (First)		○	
	Replace the impeller of the cooling water pump (sea water pump)					○ (Replace)
	Replace the cooling fresh water		Every year			
Air intake and exhaust system	Clean the element of the air intake silencer				○	
	Clean the exhaust/water mixing elbow				○	
	Clean the breather pipe				○	
	Check the exhaust gas condition	○ During operation				
Electrical system	Check the charge lamp function	○				
	Check the electrolyte level in the battery	○				
	Adjust the tension of the alternator driving belt		○ (First)		○	
	Check the wiring connectors				○	
Cylinder head, etc.	Check for leakage of water and oil	○ (After starting)				
	Retighen all major nuts and bolts					○
	Retighten the cylinder head bolts					○
	Adjust intake/exhaust valve clearance		○ (First)			○
Remote control system, etc.	Checking the remote control operation		○ (First)			○
	Adjust the propeller shaft alignment		○ (First)			○

8. Periodic checks and maintenance

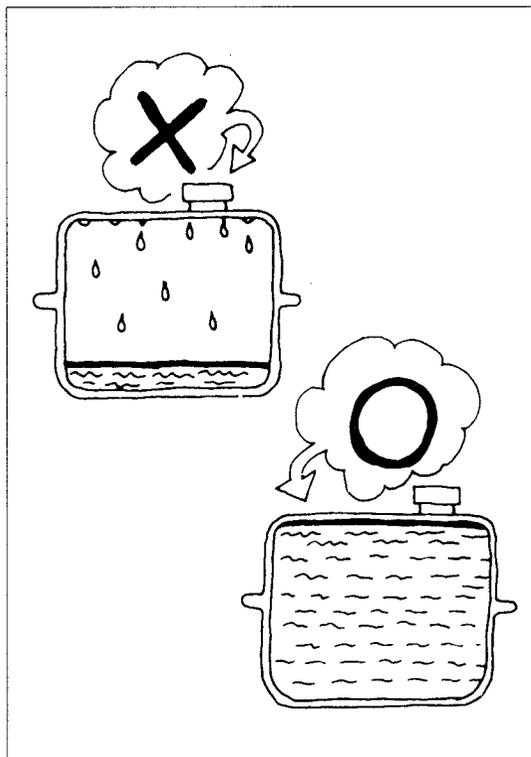
8-1. Check and adjustment of fuel oil system

(1) Fuel level check and resupply

Resupply clean fuel to the fuel tank.

Interval	Daily (after each day's operation)
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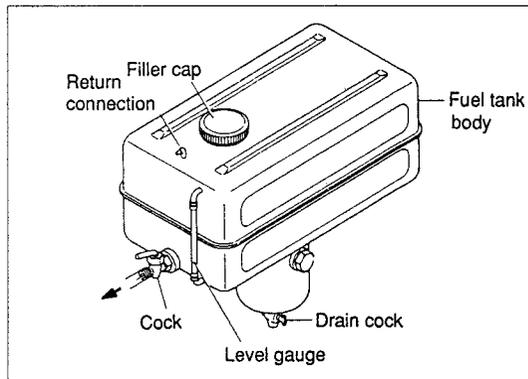
Fill the fuel tank at the end of each day's operation. This prevents water condensation in the fuel tank.



(2) Draining of the fuel tank

Open the drain cock at the bottom of the tank and drain off the sediment.

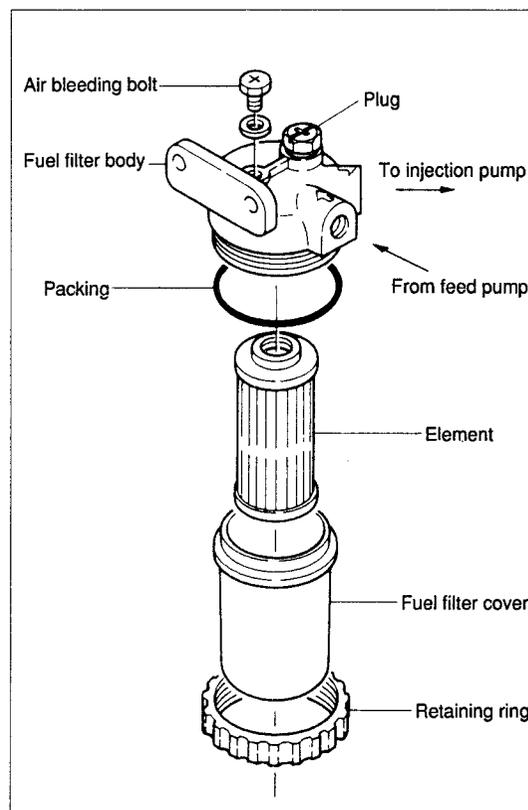
Interval	1st time ... after 50 hrs.
	2nd time and thereafterevery 300 hrs.



(3) Replacing the fuel filter

Remove the fuel filter and replace.

Interval	Every 300 hrs.
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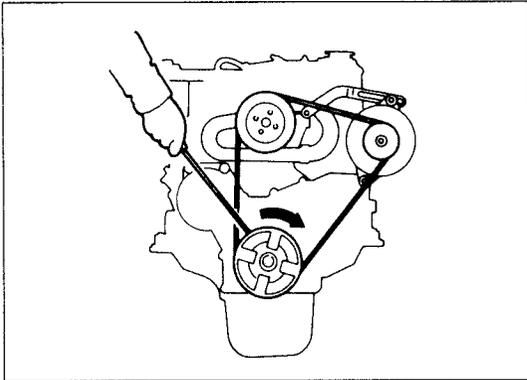


Also remove the dust and water deposited on the bottom of the trap in the fuel filter.

8. Periodic checks and maintenance

(4) Check of fuel injection timing

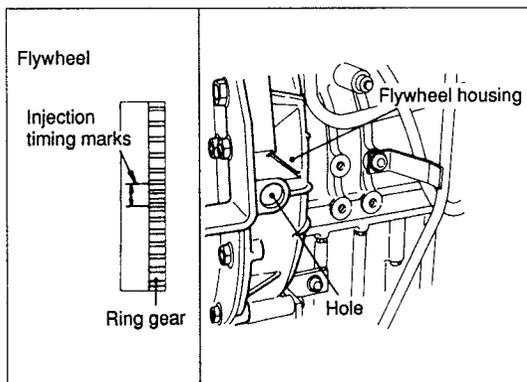
- 1) Remove the high pressure pipe from the fuel injection pump.
- 2) Pull the engine warm up knob out and place the control lever in the "half speed" position.
- 3) Crank the engine lightly to check the fuel injection timing.



- 4) Timing marks on the flywheel can be seen through the hole on the flywheel housing.

NOTE:

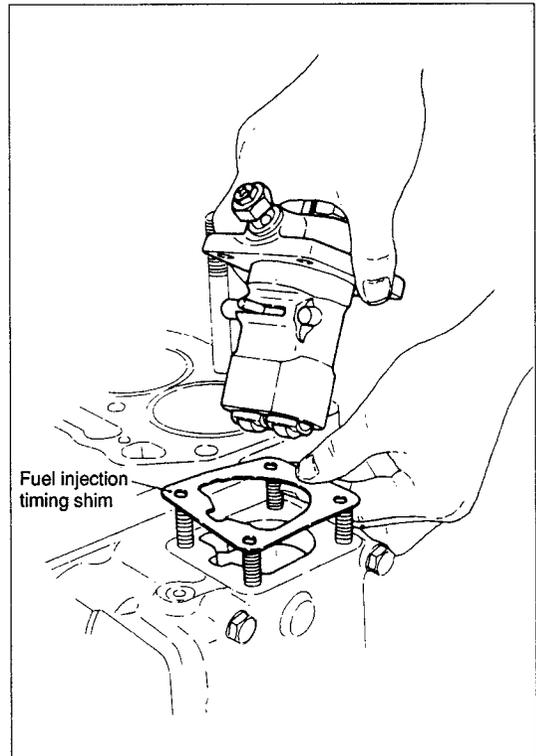
All timing marks on the flywheel are indicated by number; for example, 1, 2 or 3. These indicate top dead center of the pistons. Fuel injection timing marks are specified degree before this TDC mark.



- 5) Fuel should bubble out at the same time the timing mark on the flywheel and the indication mark on the flywheel housing line up.
- 6) If the injection timing is off, add plunger shims when the timing is slow, and remove shims when the timing is fast.

Fuel injection timing

1GM10 2GM20	FID (b.T.D.C.): $15^{\circ} \pm 1^{\circ}$
3GM30	FID (b.T.D.C.): $18^{\circ} \pm 1^{\circ}$



- 7) Check the fuel injection timing for all of the cylinders.

Interval	Every 600 hrs.
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8. Periodic checks and maintenance

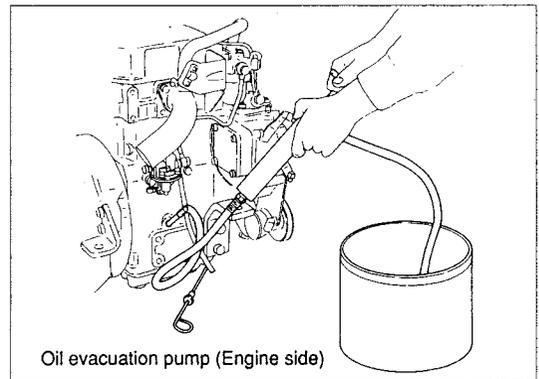
(5) Check the injection spray condition

Remove the fuel injection nozzle and check the injection spray condition. The spray should be cone-shaped.

NOTE:

For disassembly, adjustment and inspection of the fuel injection pump and fuel injection valve, consult your nearest Yanmar dealer.

Interval	Every 600 hrs.
----------	----------------



8-2. Lube oil system

(1) Checking the oil level in the crankcase and the marine gear

Prior to the engine operation, pull out the oil dipstick and check that the oil level is between the upper and lower limits. If the oil is low, resupply.

Check interval	Daily (prior to operation)
----------------	----------------------------

(2) Replacement of lube oil

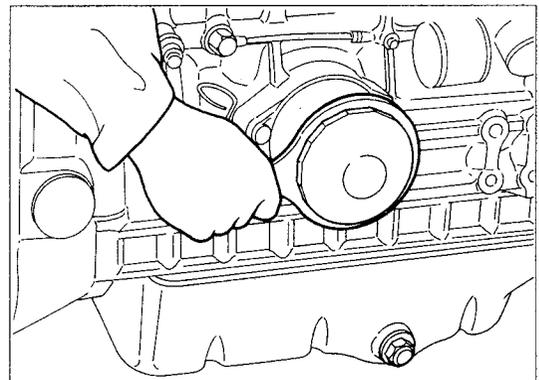
It is most effective to drain the lube oil while the engine is still warm. Replace the lube oil as follows:

Replacement interval	1st time . . . After 50 hrs.
	2nd time and thereafter . . . Every 150 hrs.

Drain out the lube oil by using oil evacuation pump.

(3) Replacement of lube oil filter

Remove the filter and replace.

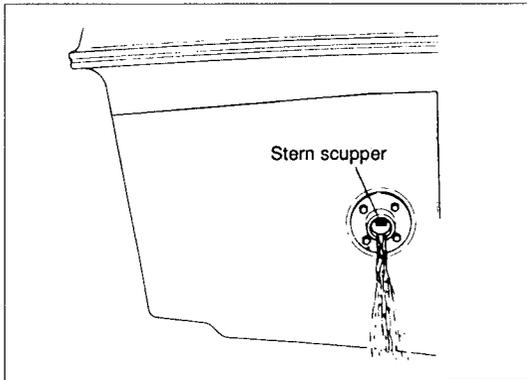


Replacement interval	1st time . . . After 50 hrs.
	2nd time and thereafter . . . Every 300 hrs.

8. Periodic checks and maintenance

8-3. Cooling water system

- (1) Make sure that water is coming out of the cooling water outlet pipe during operation.



- (2) Checking the cooling water level
(Fresh water cooled engine)

[Engines w/sub-tank]

Daily checks of the cooling water level can be done by observing the sub-tank water level. If it is low, refill up to the "FULL" limit. Then press-fit the cover completely back on.

NOTE:

- Heat exchanger checks are not necessary for daily checks and refilling.
- Check the cooling water level when the engine is cold. Engine cooling water flows to the sub-tank when the engine is still hot and makes accurate checks impossible.

[Engines w/o sub-tank]

Remove the water filler cap on the heat exchanger and check the water level.



WARNING:

- Do not check the cooling water level while the engine is still hot. Steam or hot water may burst out if the water filler cap is removed soon after the engine is stopped.

- (3) Checking and adjustment of cooling water pump driving belt tension

Check the belt condition, and adjust the tension of the belt.

Adjustment standard.

(For fresh water pump driving belt)
10 mm (with 10kg thumb force)

(For sea water pump driving belt)
5~7mm (with 10kg thumb force)

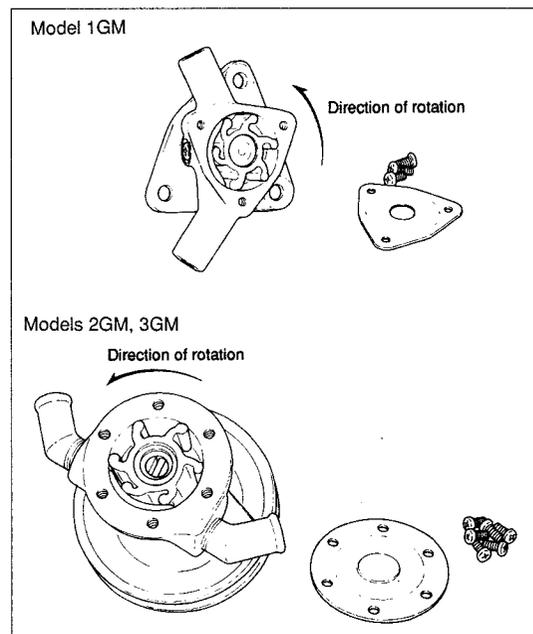
Adjustment interval	1st time . . . After 50 hrs.
	2nd time and thereafter . . . Every 300 hrs.

- (4) Replace the impeller of the sea water cooling pump

Replace the impeller.

NOTE:

1. When inserting the impeller in the pump, make sure that the impeller lies in the proper direction.
2. Coat the inside of pump body impeller housing with grease.



8. Periodic checks and maintenance

(5) Replacing fresh cooling water

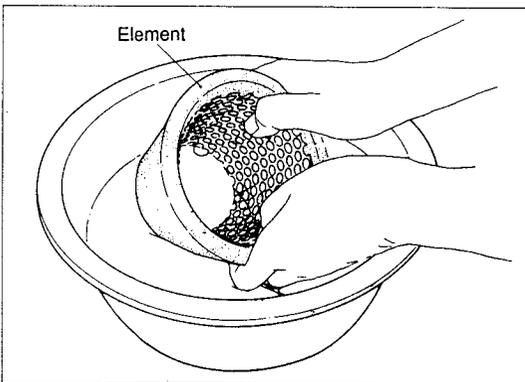
The effectiveness of the anti-corrosive agent will be lowered if the cooling water becomes contaminated.

Replacement interval	Every year
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8-4. Air intake system

(1) Cleaning the intake silencer element

Wash the element inside the air intake silencer with neutral detergent.



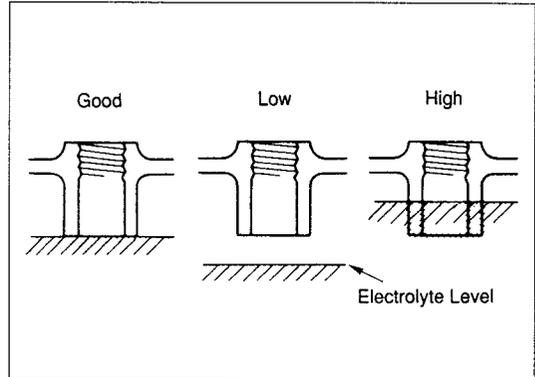
Interval	Every 300 hrs.
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8-5. Checking and maintenance of the battery.

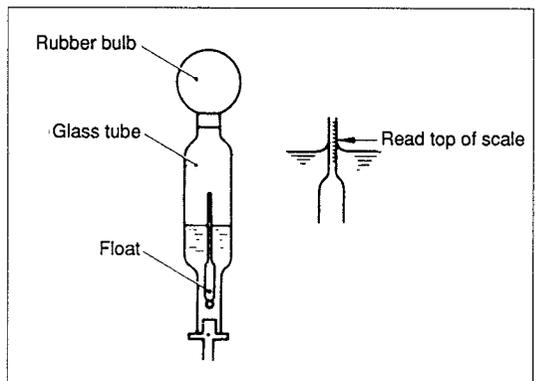
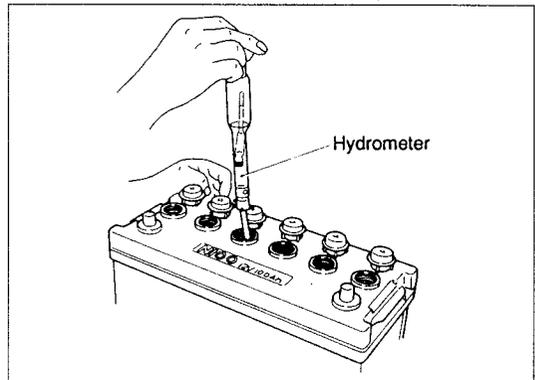
Proper battery maintenance is vital for dependable service.

- (1) Keep the battery clean by wiping it with a damp cloth. Keep all connections clean and tight. Remove any corrosion, and wash the terminals with a solution of baking soda and water.
- (2) Keep the battery fully charged, especially during cold weather. If the battery needs to be charged, charge it after disconnecting the battery cables from the battery.

- (3) Check the level of the electrolyte in each cell before starting. If low, fill to the bottom of the filler neck with distilled water.



- (4) To check the battery, use a battery hydrometer. Check the specific gravity of the electrolyte in each cell. Charge the battery if the reading is below 1.215.



8. Periodic checks and maintenance

⚠ CAUTION:

Keep all sparks and flames away from batteries. To avoid sparks, connect the earth cable last and disconnect it first.

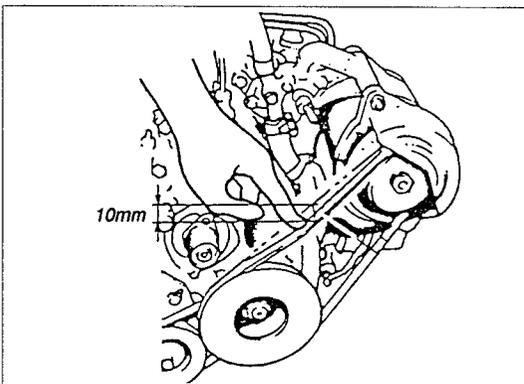
NOTE:

When adding distilled water in freezing weather, run the engine at least 30 minutes to ensure thorough mixing.

8-6. Checking and adjusting the V-belt tension

Too much V-belt tension accelerates V-belt wear, and too little V-belt tension leaves the pulley idle, overheats the engine, and no power is generated. Adjust the belt tension as follows:

- (1) Loosen the adjust bolt, and move the charging generator outwards to increase the tension, or move the charging generator inwards to decrease the tension.
- (2) Do not stain the belt with oil. The belt will idle if stained. Wipe off the oil soon.



Adjustment standard
10 mm (with 10 kg thumb force)

Check interval	1st time . . . 50 hrs.
	2nd time and thereafter . . . Every 300 hrs.

8-7. Checking the engine body

(1) Engine body

For checking and adjusting the following items, consult your nearest Yanmar dealer.

Check and adjustment item	Service interval
Retightening of bolts	Every 600 hrs.
Adjustment of intake/exhaust valve clearance	1st time . . . 50 hrs. 2nd time and thereafter . . . Every 600 hrs.

(2) Lubrication of the governor linkage

Lubricate the governor linkage to ensure smooth operation.

Lubrication interval	Daily (prior to operation)
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8-8. Checking the remote control operation

Make sure that the remote control system is working properly.

Check interval	1st time . . . 50 hrs.
	2nd time and thereafter . . . 600 hrs.

8. Periodic checks and maintenance

9. Long-term storage

8-9. Adjust the propeller shaft alignment

For checking and adjustment the propeller shaft alignment, contact your nearest Yanmar dealer or boatbuilder.

9. Long-term storage

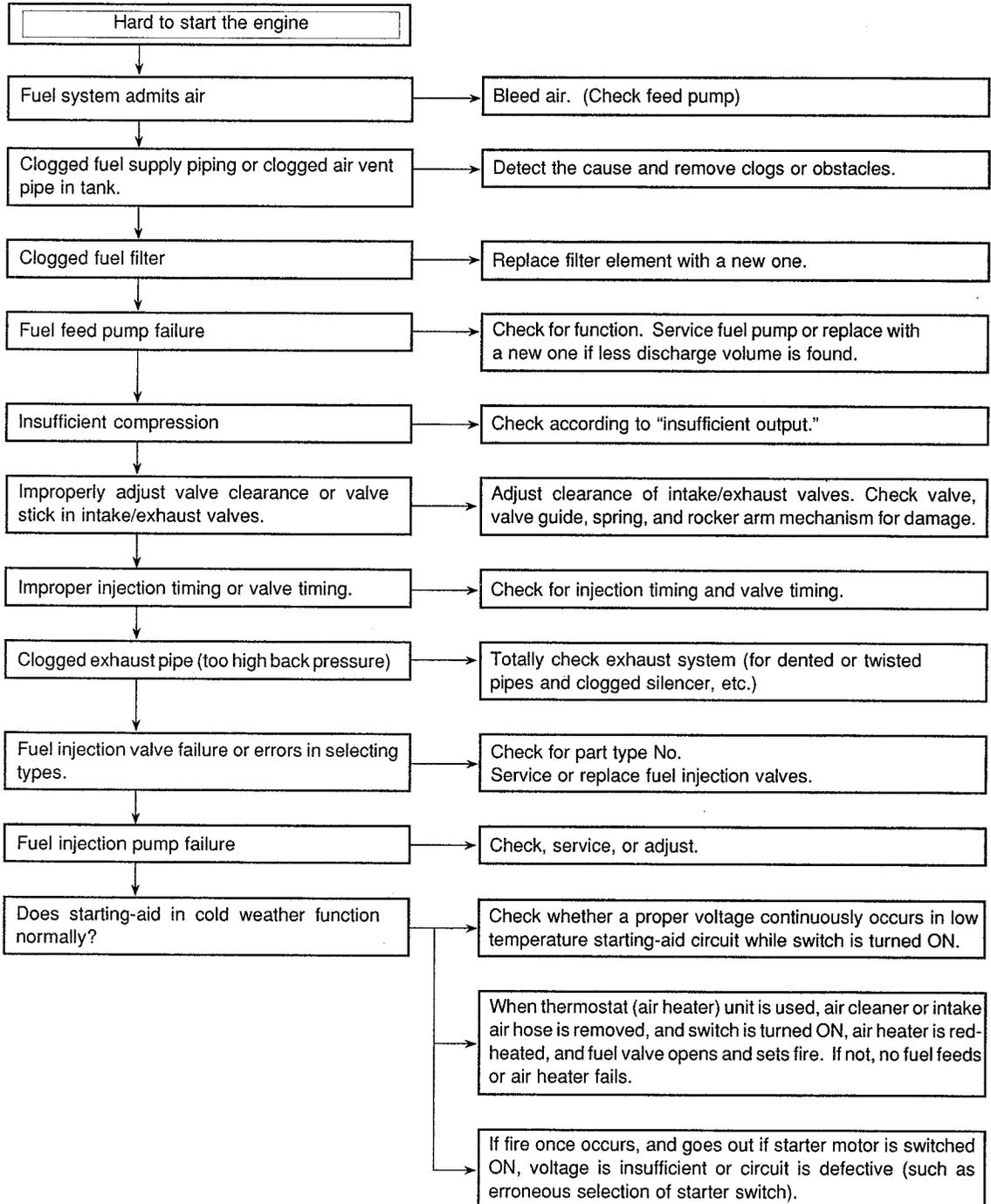
- (1) Store your engine in a well ventilated place free from excessive humidity and dust.
- (2) Carefully follow these directions when storing your engine for a long period (3 months or more):
 - 1) Clean dust, oil, etc. off the surface of your engine.
 - 2) Change the lube oil.
Change the lube oil filter.
 - 3) Run your engine once a month whenever possible. If not, follow these directions when beginning storage and every subsequent 6 months.
 - Remove fuel injection valves on the cylinder head. Supply each combustion chamber with about 2 cc of clean lube oil using an oilcan. Attach and tighten the injection valves.
 - Turn the stop lever to "STOP".
 - Turn the starter key. Crank up for about 10 seconds so that cylinder walls are uniformly oiled.
 - 4) Leave the cooling water with its anti-freeze, provided that the anti-freeze is not too old.
 - 5) Apply a thin coat of clean oil to the uncoated surface of the engine.
 - 6) Cover the exhaust silencer, air intake silencer, etc. with a PVC film to prevent humid air from entering your engine. Carefully protect the electric system from humidity in the same way.
 - 7) Remove the batteries from the engine and charge them fully before storage. Charge the batteries every month during storage, because they run down naturally (self-discharge).

10. Troubleshooting

10. Troubleshooting

The following description summarizes the probable cause of and the remedy for general failure by item.

Immediate countermeasures should be taken before a failure is inflamed if any symptom is detected.



10. Troubleshooting

