

# **YANMAR**

## ***SERVICE MANUAL***

### ***MARINE DIESEL ENGINE***

#### **MODELS**

**1GM (10L)**

**2GM (F)(L)**

**3GM (D)(F)(L)**

**3HM (F)(L)**

## **FOREWORD**

This service manual has been compiled for engineers engaged in sales, service, inspection and maintenance. Accordingly, descriptions of the construction and functions of the engine are emphasized in this manual while items which should already be common knowledge are omitted.

One characteristic of a marine diesel engine is that its performance in a vessel is governed by its applicability to the vessel's hull construction and its steering system.

Engine installation, fitting out and propeller selection have a substantial effect on the performance of the engine and the vessel. Moreover, when the engine runs unevenly or when trouble occurs, it is essential to check a wide range of operating conditions—such as installation on the hull and suitability of the ship's piping and propeller—and not just the engine itself. To get maximum performance from this engine, you should completely understand its functions, construction and capabilities as well as proper use and servicing.

Use this manual as a handy reference in daily inspection and maintenance, and as a text for engineering guidance.



# Models **1GM·2GM(F)·3GM(D)(F)·3HM(F)**

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## A. Engine model (3GM, 3GMD)

## B. Engine model name plate and Clutch model name plate

SM/1GM•2GM•3GM(D)•3HM

# A. Engine Model (3GM, 3GMD)

The difference between the engine models 3GM and 3GMD is that a different model of marine gear box is fitted to the same engine body, namely, KBW10-D to 3GM and KM3-A to 3GMD.

Therefore, the items described as 3GM(D) in this service manual are identical for both 3GM and 3GMD engines.

When the items are separately described as 3GM as 3GMD, the description applies specifically to either 3GM or 3GMD.

# B. Engine Model Name Plate and Clutch Model Name Plate

To every engine model described in this manual, an engine model name plate and clutch model name plate are fitted as shown in the following figures. In addition, the engine serial number is stamped on the cylinder body.

Specifications of engine and clutch to be shipped are recorded and filed using the numbers marked on the engine model name plate and clutch model name plate.

The specifications or components of the engine or clutch may be partially altered to improve performance, and the components involved may not necessarily be interchangeable.

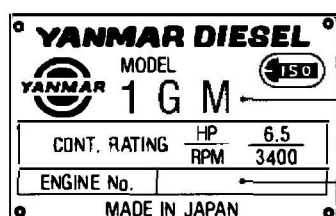
Therefore, when parts are ordered, please furnish the item description in the blank spaces shown in the figures, using the descriptions given on these plates.

## B-1 Item descriptions on the model name plates and information to be forwarded to us

[Item descriptions on Model name plates]

[Information to be forwarded to us]

### Engine model name plate

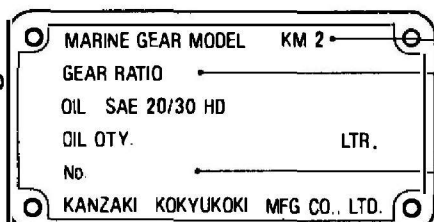


Your engine model

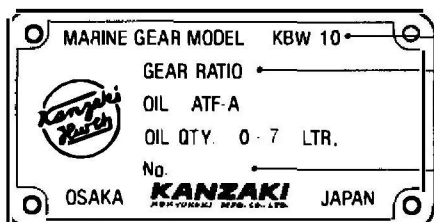
Your engine number

### Clutch model name plate

1GM  
2GM  
3GMD



3GM  
3HM



Your clutch model

Your clutch gear ratio

Your clutch number

**B-2 Location of engine model name plate and clutch  
model name plate**

**B-2.1 1GM**

Engine model name plate



name plate

**B-2.2 2GM, 3GMD**

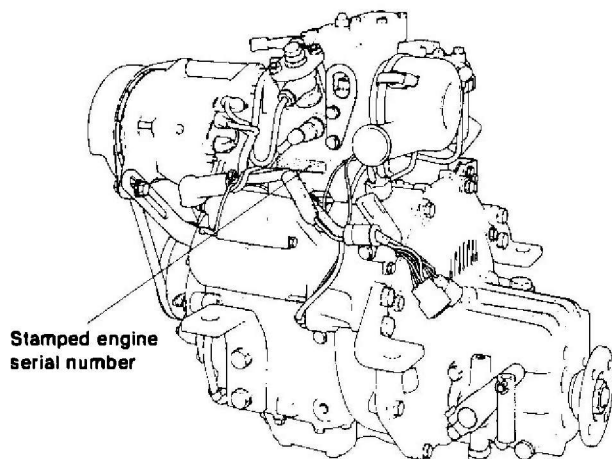
Clutch model  
name plate  
(2GM) --

~Engine model  
name plate  
(2GM, 3GMD)

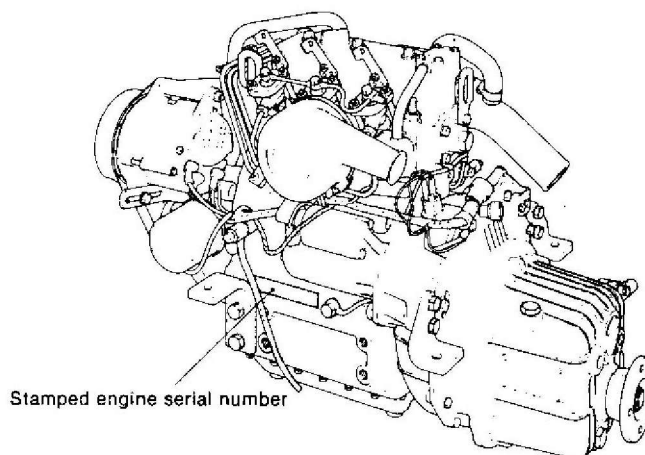
**B-2.3 3GM, 3HM**

### B-3 Location of stamped engine serial number

#### B-3.1 1GM

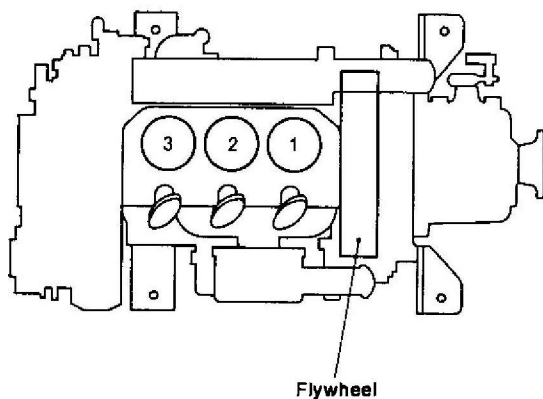


#### B-3.2 2GM, 3GM(D), 3HM



## C. Cylinder Number

The cylinder numbers of the 2 cylinder engine (2GM) and 3 cylinder engine (3GMD, 3GM, 3HM) 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.

## CHAPTER 1

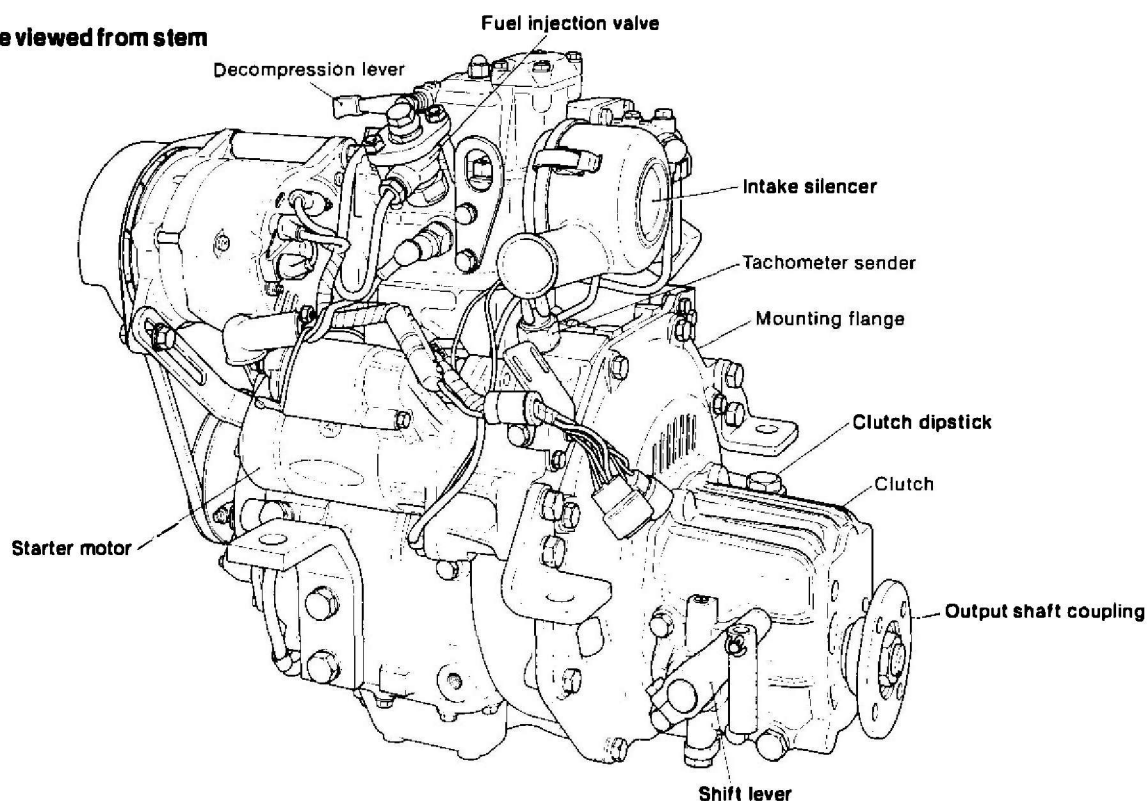
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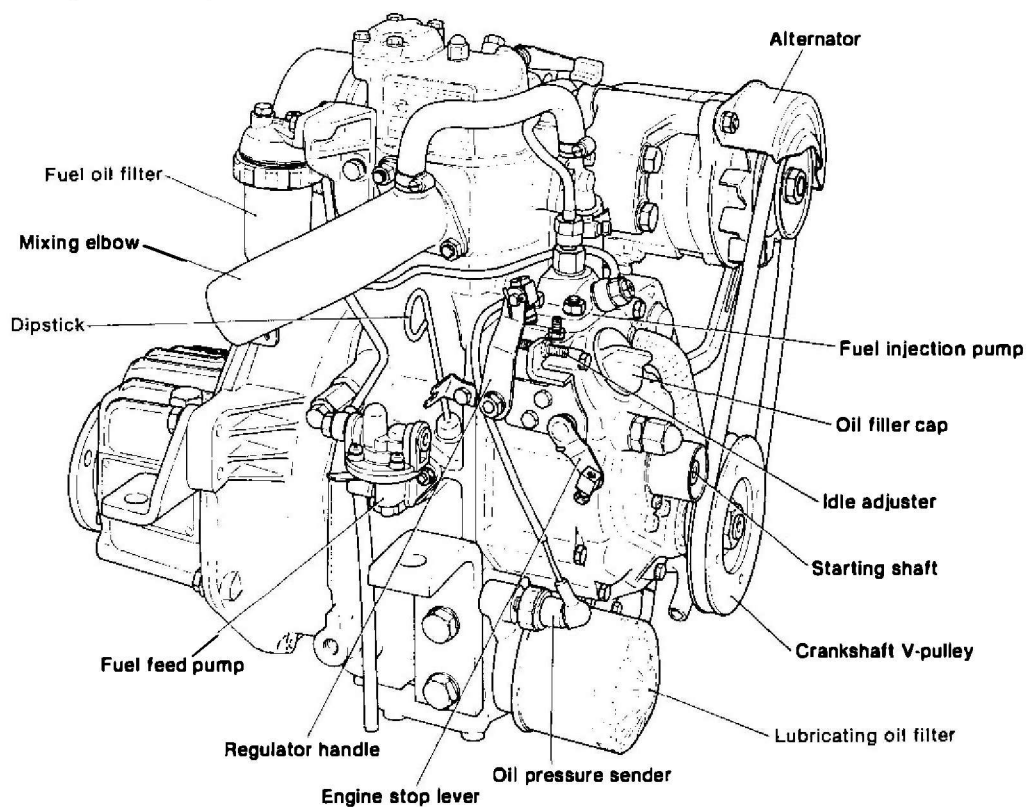
# 1. Exterior Views

## 1-1 1GM

### 1-1.1 Intake side viewed from stern

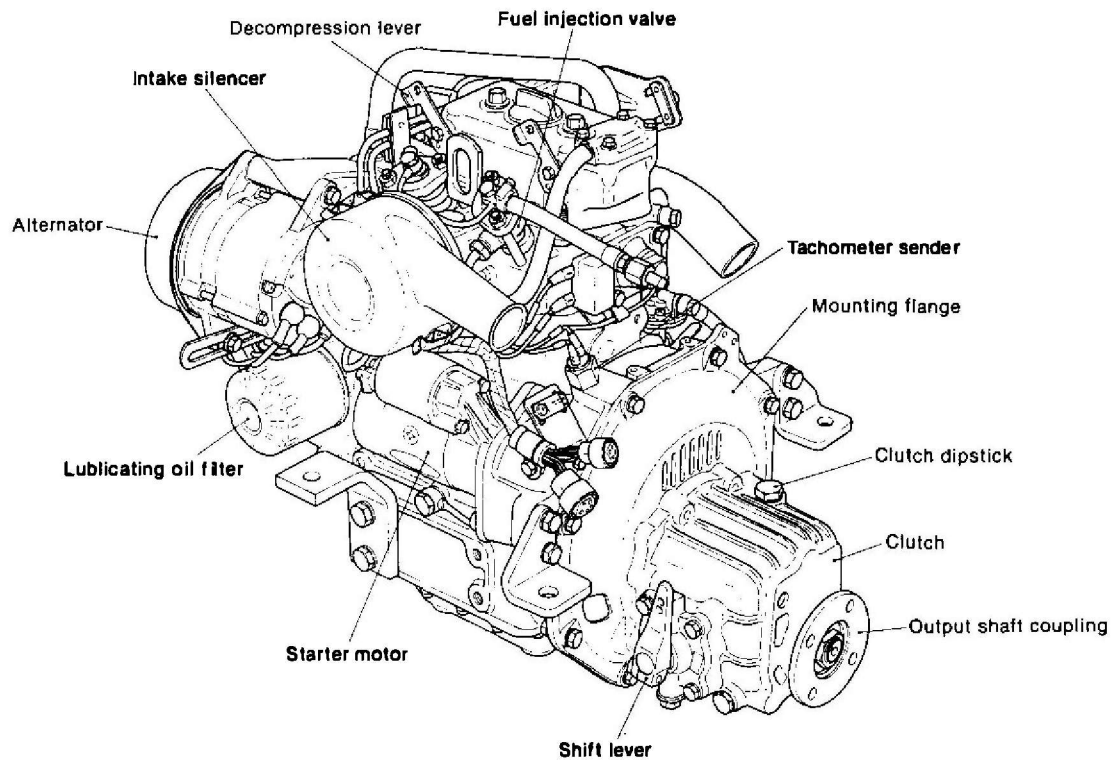


### 1-1.2 Exhaust side viewed from bow

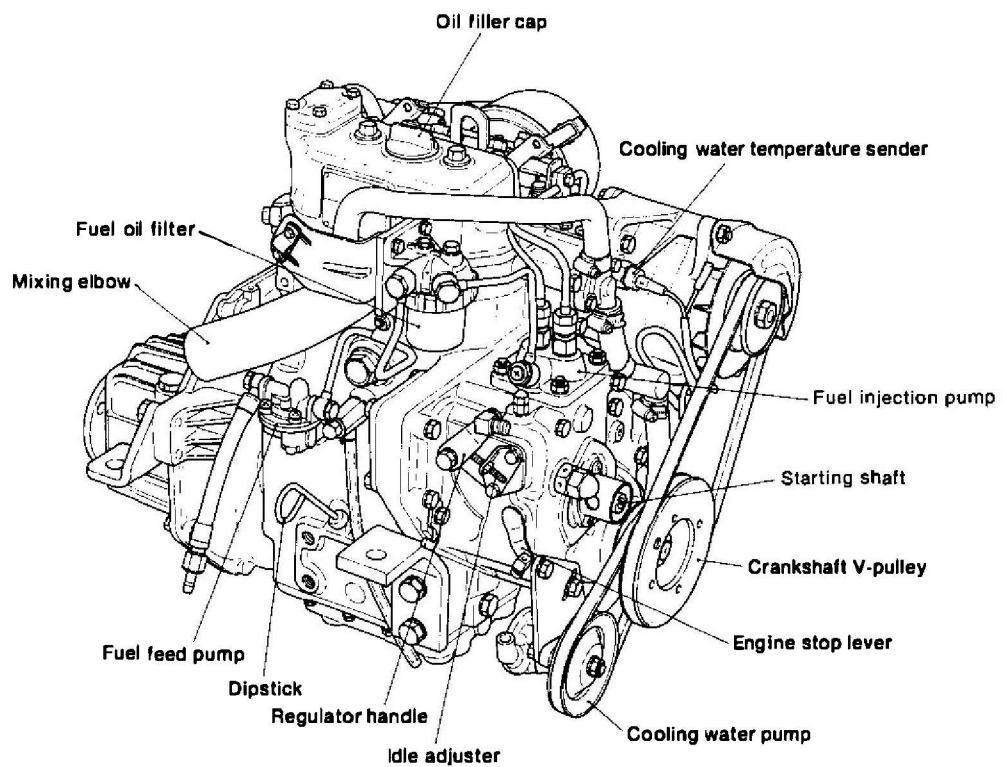


**1-2 2GM**

**1-2.1 Intake side viewed from stern**

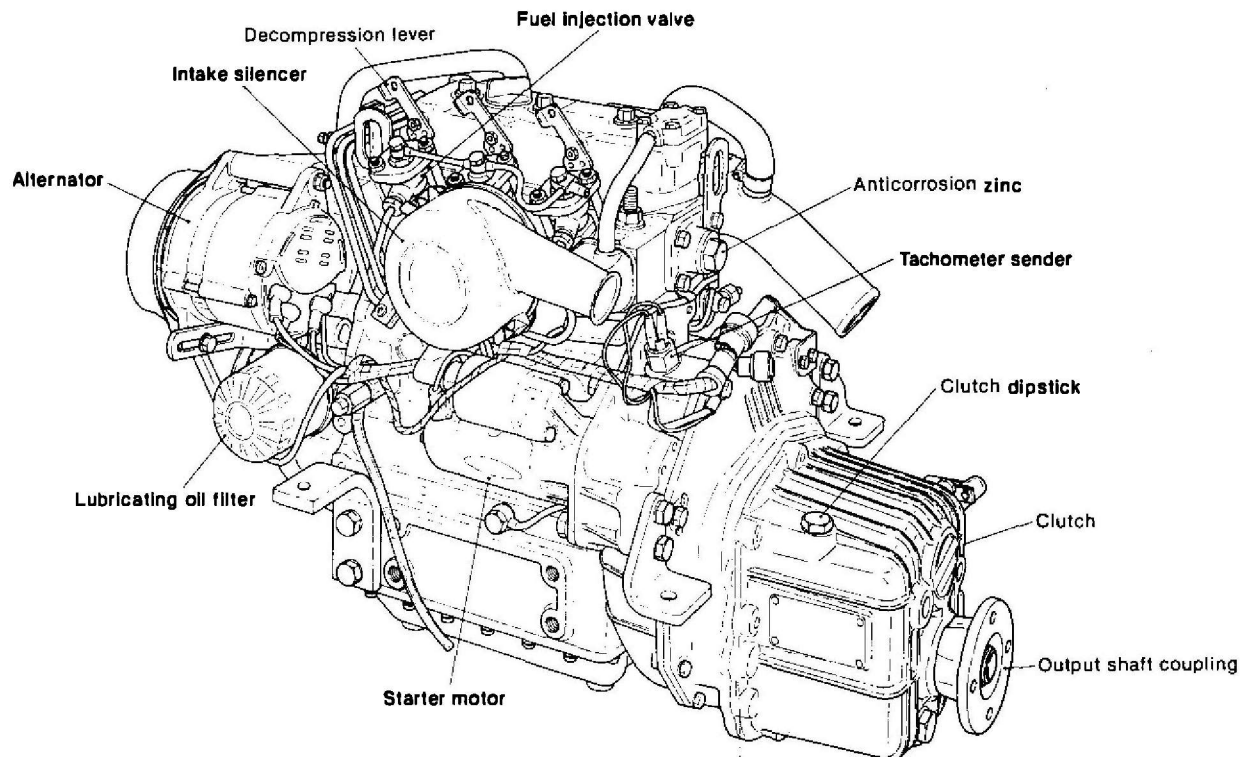


**1-2.2 Exhaust side viewed from bow**

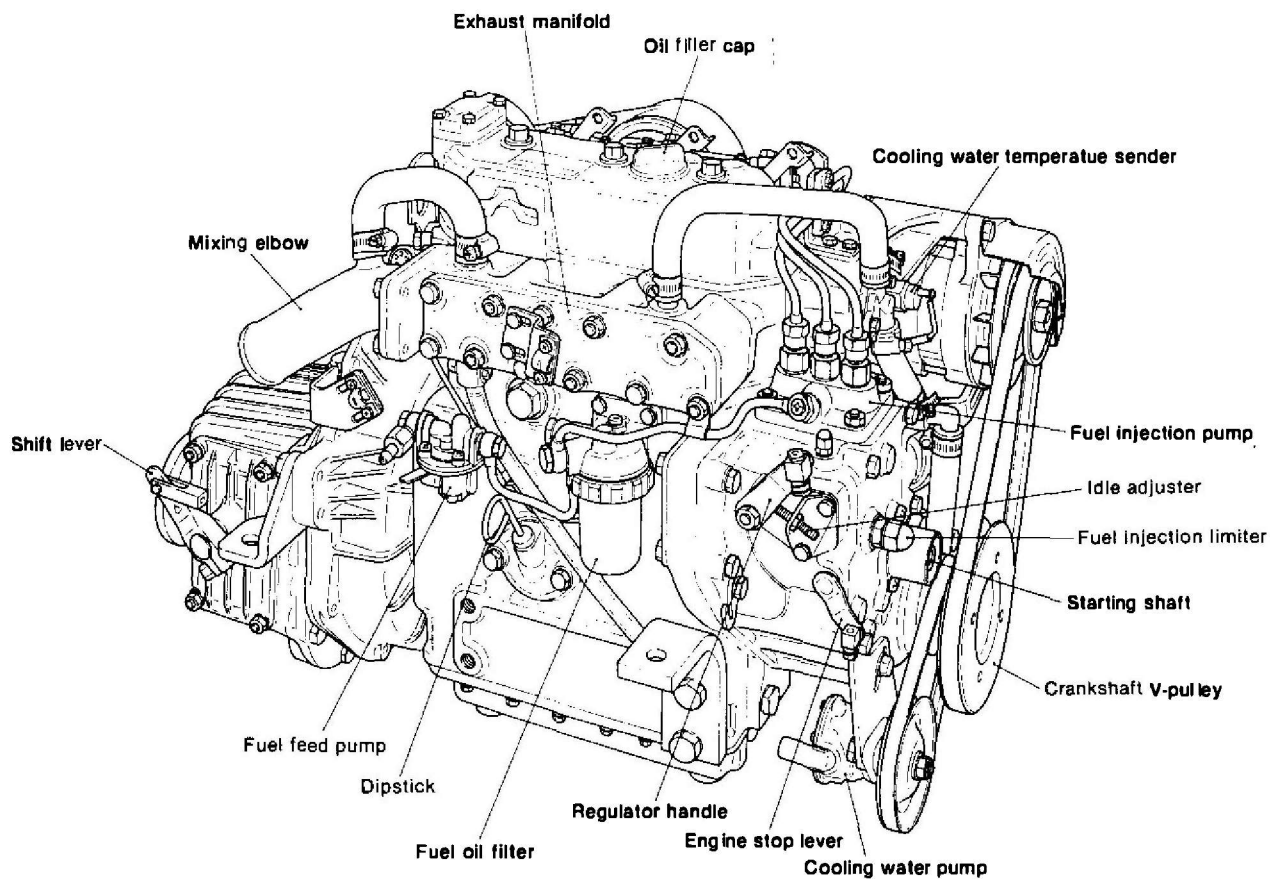


**1-33GM**

**1-3.1 Intake side viewed from stern**



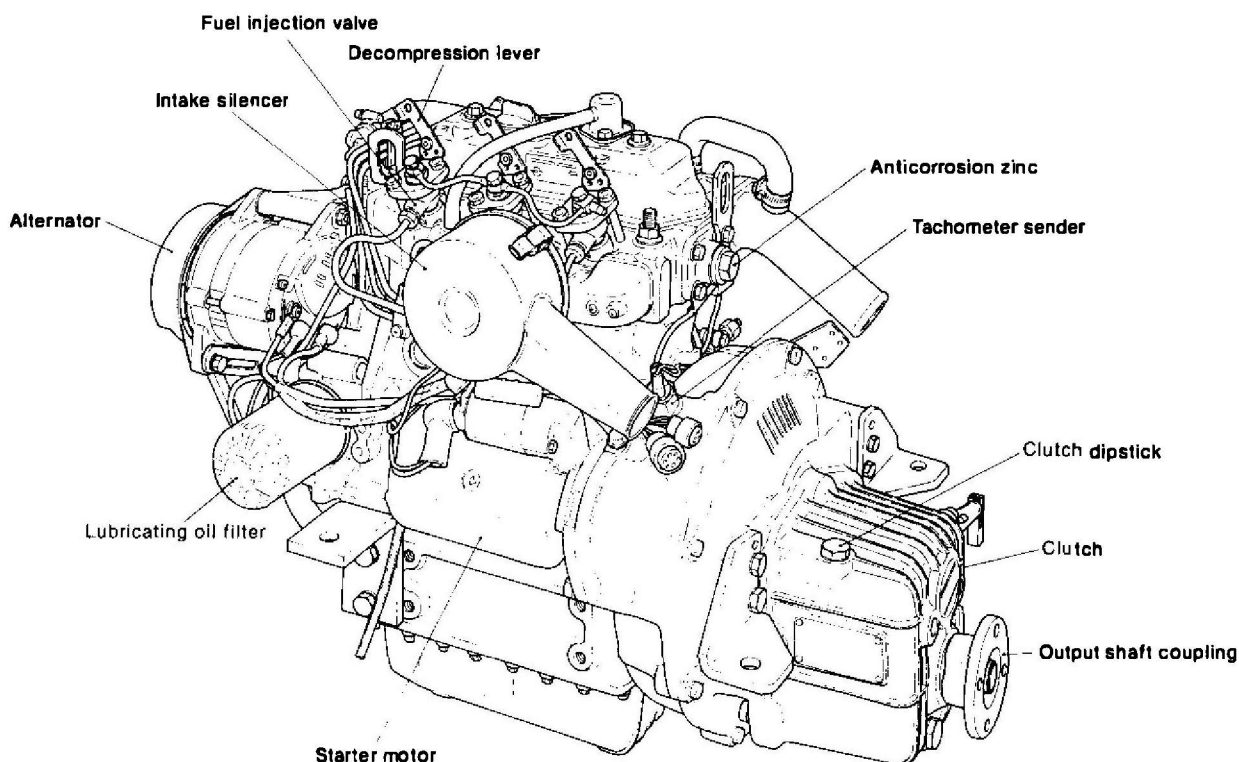
**1-3.2 Exhaust side viewed from bow**



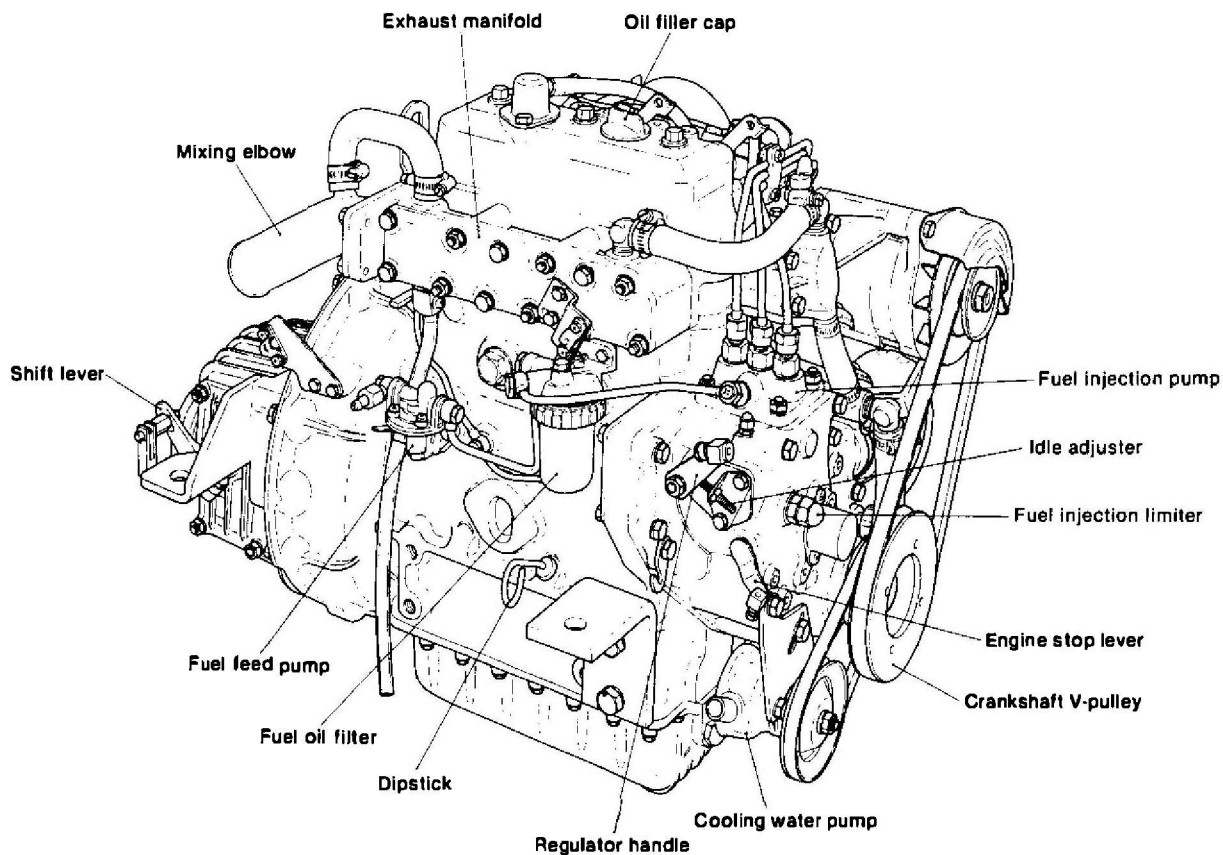


**1-4 3HM**

**1-4.1 Intake side viewed from stern**



**1-4.2 Exhaust side viewed from bow**



## 2. Specifications

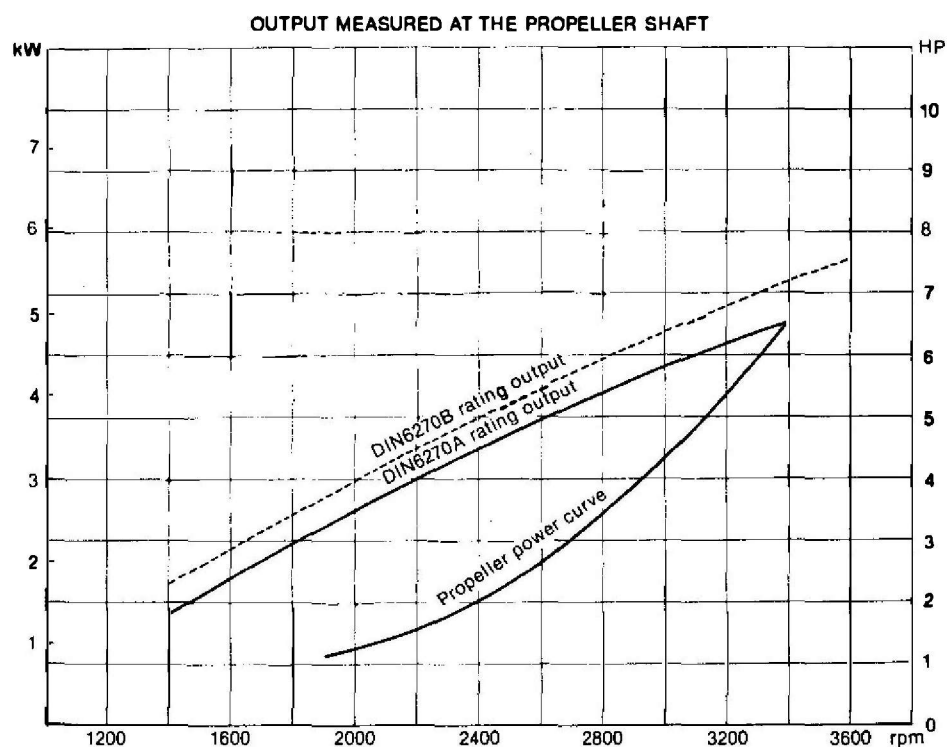
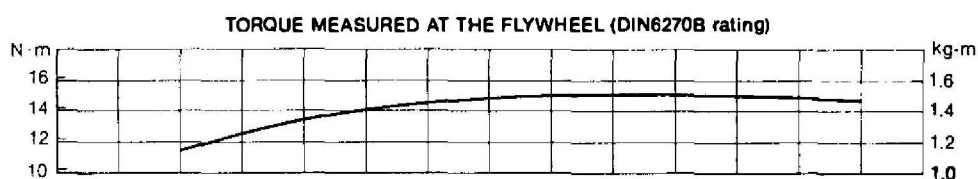
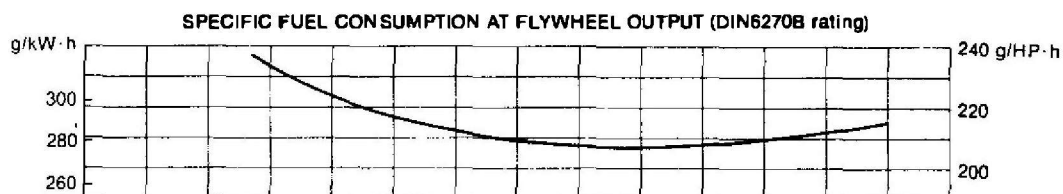
Model	1GM	2GM	3GMD	3GM	3HM
Type	Vertical 4-cycle water cooled diesel engine				
Combustion chamber	Swirl pre-combustion chamber				
Number of cylinders	1	2	3	3	3
Bore x stroke	72 x 72				
Displacement	0.93 l	0.586	0.879	1.128	1.128
Output/Crankshaft speed	HP/rpm	13/3400	20/3400	27/3200	27/3200
Continuous rating output (DIN62/04)	kg/cm <sup>2</sup>	5.87	5.87	6.74	6.74
Piston speed	m/sec.	8.16	8.16	9.07	9.07
Output/Crankshaft speed	HP/rpm	15/3600	22.5/3600	30/3400	30/3400
One hour rating output (DIN62/06)	kg/cm <sup>2</sup>	6.40	6.40	7.05	7.05
Piston speed	m/sec.	8.64	8.64	9.63	9.63
Compression ratio	23.0	23.0	23.0	22.7	22.7
Fuel injection timing (FID)	bTDC15±1	bTDC15±1	bTDC18±1	bTDC18±1	bTDC21
Fuel in action pressure	170	170	170	180	180
Main power take off	at Flywheel side				
Front power take off	at Crankshaft V-pulley side				
Direction of rotation	Counter-clockwise viewed from stern				
Cooling system	Clockwise viewed from stern				
Lubrication system	Direct sea water cooling (rubber impeller water pump)				
Starting system	complete and bleed forced lubrication				
Model	Electric and/or manual				
Type	Electric				
Reduction ratio (Ahead/Astern)	KM2A KM3A				
Propeller speed (DINA rating (Ahead/Astern))	Mechanical cone clutch with single stage for both ahead and astern				
Lubricating oil capacity	0.26 0.26 0.3 0.3 0.7				
Clutch weight	9.3 9.3 10.8 10.8 17				
Overall length	527 527 740 740 755				
Overall width	410 410 410 410 451				
Overall height	485 485 485 485 502				
Total	1.3 1.3 2.0 2.0 2.7				
Lubricating oil capacity (take angle 8°)	0.6 0.6 1.3 1.3 1.8				
Engine weight with clutch (dry)	70 70 100 100 130				
	kg				
	19 19 791 791 812				
	5.5 5.5 3.0 3.0 5.8				
	158				

## 3. Principal Construction

Engine model		1GM	2GM	3GMD	3GM	3HM
Group	Part	Construction				
Engine block	Cylinder block	Integrally-cast water jacket and crankcase				
	Cylinder liner	Sleeveless	Dry sleeve type			
	Main bearing	Metal housing type				
	Oil sump	Oil pan				
Intake and exhaust systems and valve mechanism	Cylinder head	Integrated type cylinders				
	Intake and exhaust valves	Poppet type, seat angle 90°				
	Exhaust manifold	—		Separated water-cooled type	Integral water-cooled type	
	Exhaust silencer	Water-cooled mixing elbow type				
	Valve mechanism	Overhead valve push rod, rocker arm system				
	Intake silencer	Round polyurethane sound absorbing type				
Main moving elements	Crankshaft	Stamped forging				
	Flywheel	Attached to crankshaft by flange, with ring gear				
	Piston	Oval type				
	Piston pin	Floating type				
	Piston rings	2 compression rings, 1 oil ring				
Lubrication system	Oil pump	Trochoid pump				
	Oil filter	Full-flow cartridge type, paper element				
	Oil level gauge	Dipstick				
Cooling system	Water pump	Rubber impeller type S	Rubber impeller type A			Rubber impeller type B
	Thermostat	Wax pellet type				
Fuel system	Fuel injection pump	YPFR-0707-1	YPFR-0707-2	YPFR-0707		
	Fuel injection valve	530 semi-throttle valve				
	Fuel strainer	Filter paper				
Governor	Governor	Centrifugal all-speed mechanical type				
Starting system	Electric	Pinion ring gear type starter motor				
	Manual	Camshaft starting				—
Electrical system	Charger	Alternator (with built-in IC regulator)				
Reduction reversing	Reduction gear	Helical gear constant-mesh system				
Clutch system	Clutch	Servo-cone type			Wet multi-disc mechanical type	

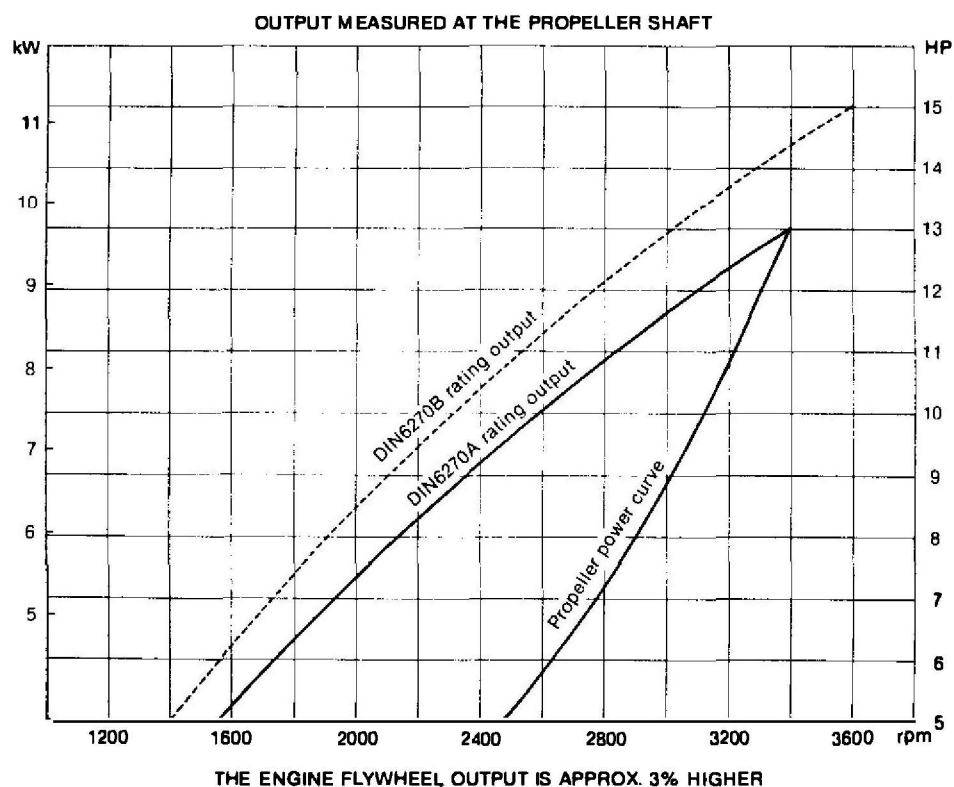
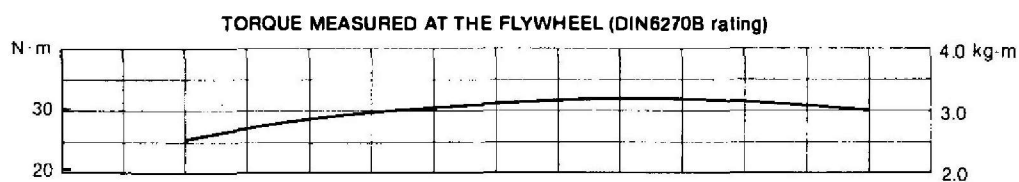
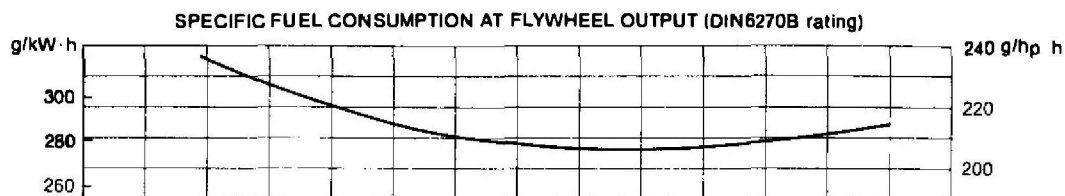
## 4. Performance Curves

### 4-1 1GM



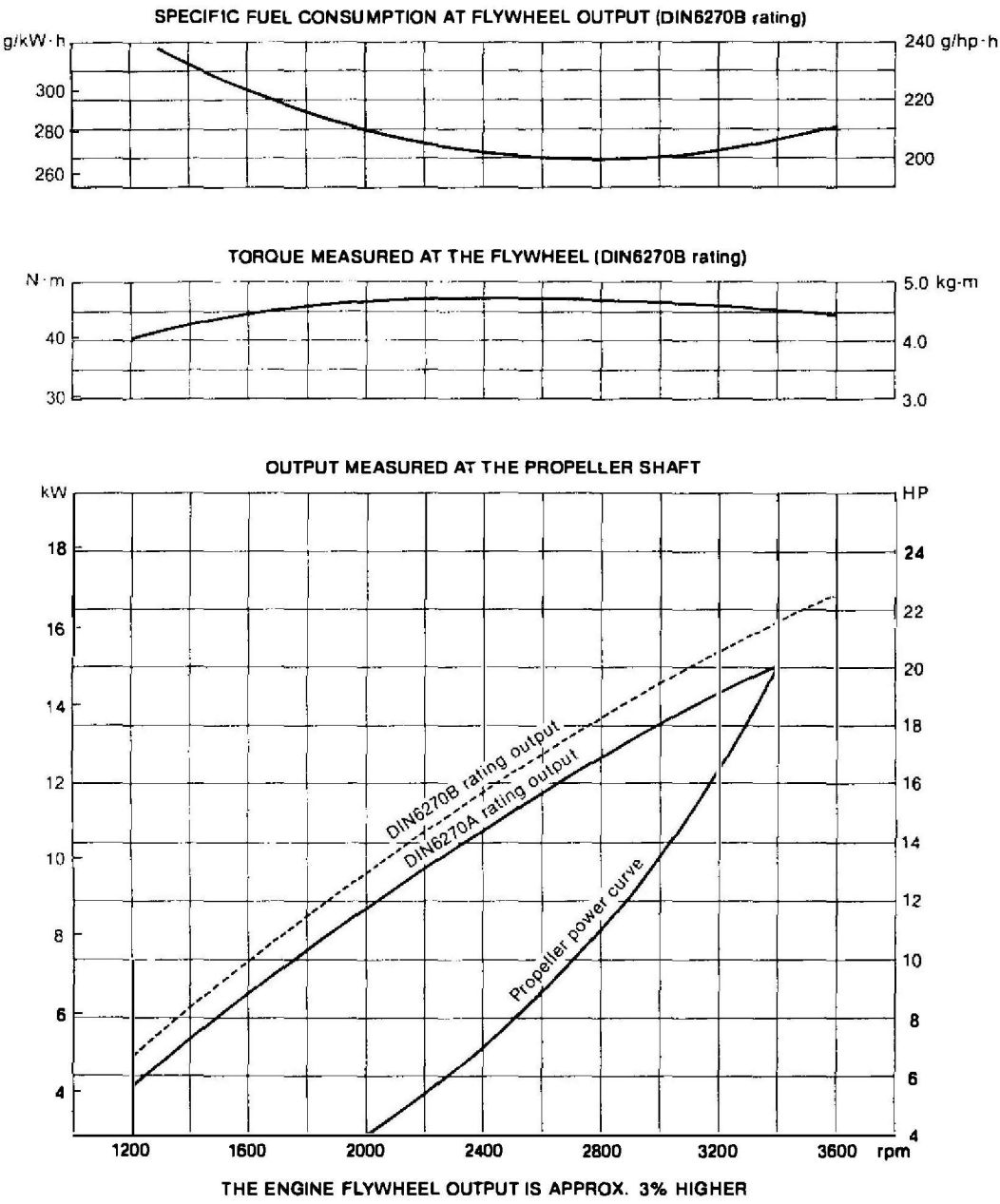
THE ENGINE FLYWHEEL OUTPUT IS APPROX. 5% HIGHER

4-2 2GM (F)

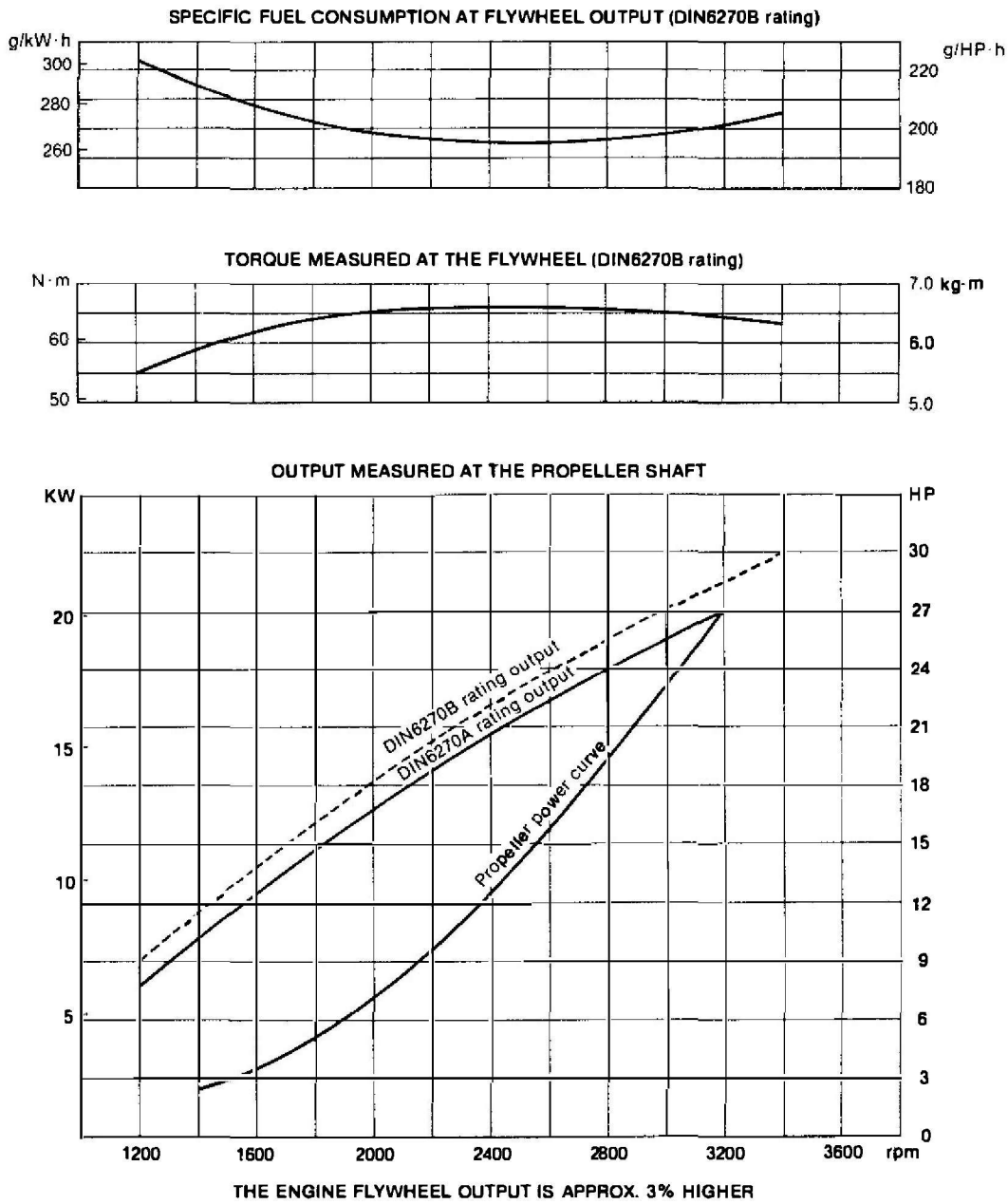


Chapter 1 General  
4. Curves

4-3 3GM (D)  
3GM (F)



4-4 3HM (F)



## 5. Features

### 5-1 Superior combustion performance

The unique Yanmar swirl precombustion chamber and new cooling system display superior combustion performance in all types of operation. Low-speed, low-load combustion performance, especially demanded for marine applications, is also superb, and stable performance is maintained over a wide range of speeds. Since starting characteristics are also excellent and warm-up is fast, full engine performance can be obtained within a short time.

### 5-2 Low operating costs

Excellent combustion and low friction reduce fuel costs, while the optimized piston shape and ring configuration and improved cooling system reduce oil consumption. Continuous operating time has been extended and operating costs reduced through improved durability.

### 5-3 Compact, lightweight

The cylinder head is the integrally-cast type, and the crankshaft is the housing type. Minimum weight has been pursued for each engine part, and a reduction reversing gear employing a special new mechanism has been incorporated to obtain revolutionary engine lightness.

### 5-4 Long term continuous operation

Improved durability has been achieved by adopting special construction and materials for main moving parts and the valve mechanism, which are the areas most subject to trouble in high-speed engines. Moreover, a bypass system with a thermostat maintains the cooling water at a stable high temperature, resulting in reduced cylinder liner and piston ring wear, reduced thermal load around the combustion chamber, and substantially improved durability. Long-term continuous operation is possible by correct operation and proper attention to fuel and lubricating oil.

### 5-5 Low vibration

Vibration has been reduced by minimizing the weights of the pistons, connecting rods, and other sources of vibration, stringent weight management at assembly, and balancing of the flywheel, V-pulley, etc. Vibration has also been suppressed through the adoption of a special cylinder block rib construction and improved rigidity. Rubber shock mounts are available when the engine is to be used under conditions which may lead to severe vibration.

### 5-6 Quiet operation

Intake and exhaust noises have been lowered by adopting an intake silencer, water-cooled exhaust manifold and water mixing elbow type exhaust system.

The precombustion chamber system and semi-throttle type injection valve suppress combustion noise substantially.

Moreover, gear noise has been reduced by the use of helical gears around the gear train and clutch gear, and by the buffering effect of a damper disc.

In addition, noise prevention measures have also been taken at the control valve mechanism and other parts.

### 5-7 Superior matching to the hull

- (1) Four-point support engine installation feet make installation easy.
- (2) Mist intake system prevents contamination of the engine room.
- (3) Since the fuel pump is mounted on the engine, the fuel tank can be installed anywhere.
- (4) Water-cooled manifold prevents a rise in the engine room temperature.
- (5) Independent type instrument panel can be installed wherever it is easiest to see.
- (6) Speed, clutch forward and reverse, and engine stop can all be remotely controlled.
- (7) The use of rubber and vinyl hoses for ship interior piping not only facilitates piping work, but also eliminates brazing faults caused by vibration.
- (8) Electric type bilge pump is available as an option.

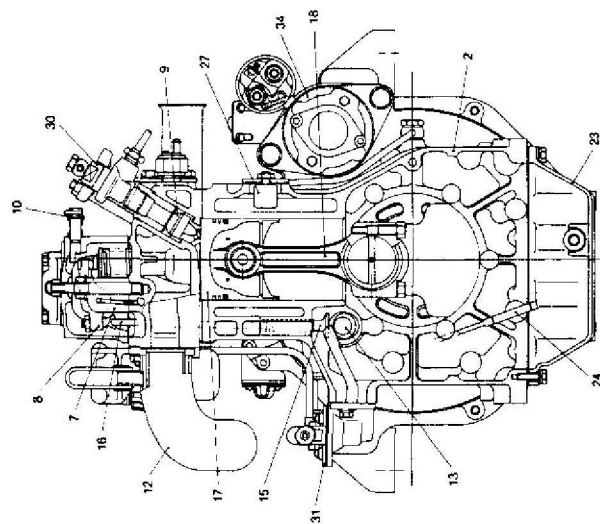
### 5-8 Easy to operate

- (1) Cooling water temperature switch and lubricating oil pressure switch are provided, and alarm lamps and buzzer are mounted on the instrument panel.
- (2) Manual starting handle permits manual starting. (Except model 3HM.)
- (3) Positive clutch engagement and disengagement; propeller shaft does not rotate when clutch is placed in neutral position.



## 6. Engine Cross-Sections

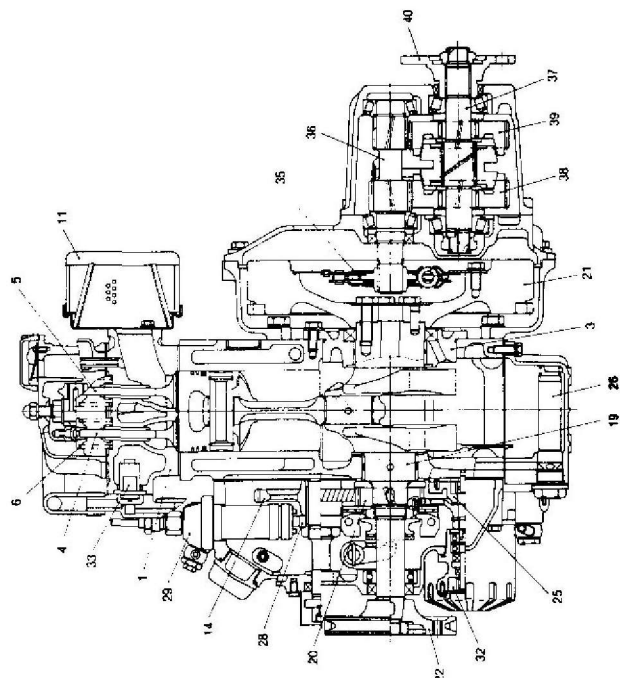
B-11GM



1. Cylinder head
2. Crankshaft
3. Main bearing housing
4. Exhaust valve
5. Intake valve
6. Valve spring
7. Valve rocker arm support
8. Valve rocker arm
9. Crankshaft
10. Decompression lever

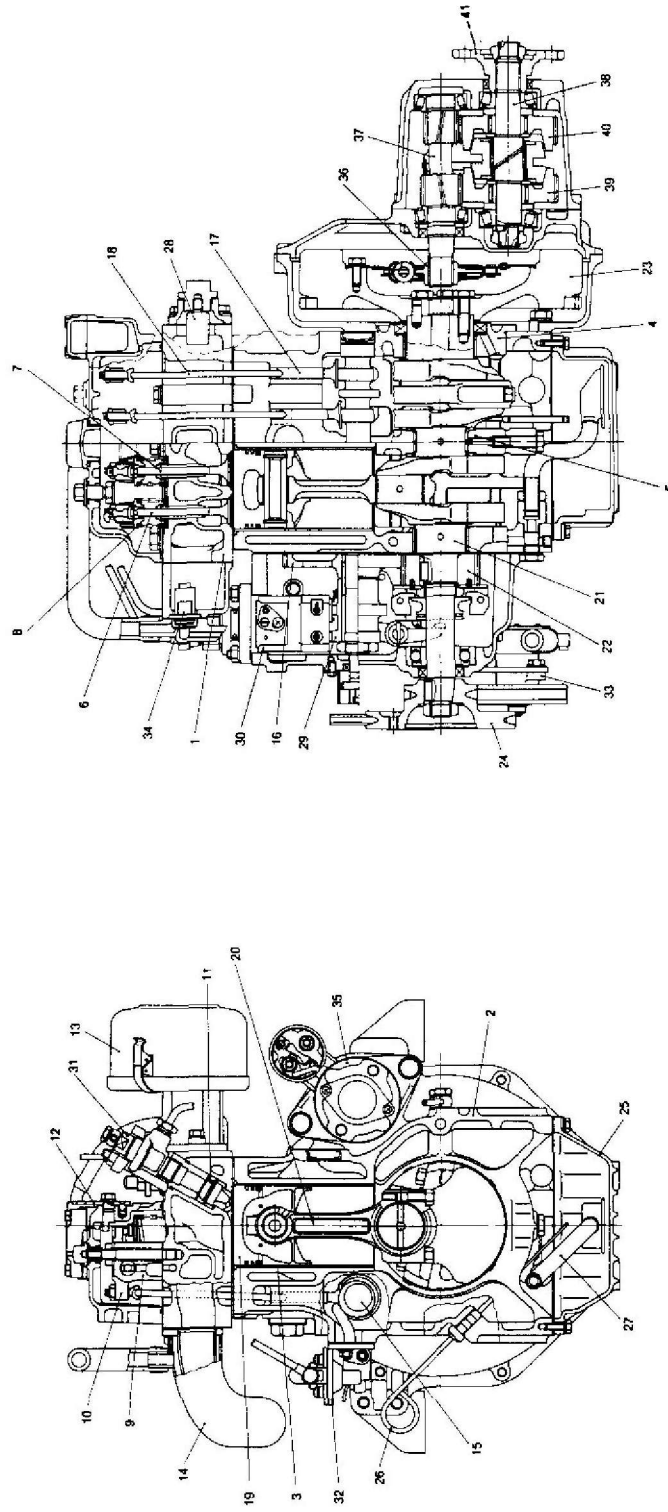
11. Intake air valve
12. Main bearing
13. Crankshaft
14. Crankshaft gear
15. Tappet
16. Push rod
17. Piston
18. Connecting rod
19. Crankshaft
20. Crankshaft gear

21. Flywheel
22. Crankshaft V-pulley
23. Oil pan
24. Dipstick
25. Lubricating oil pump
26. Lubricating oil filter
27. Anticorrosion zinc
28. Fuel injection pump
29. Fuel injection pump cam
30. Fuel injection nozzle



31. Fuel oil pump
32. Cooling water pump
33. Thermostat
34. Starter motor
35. Damp disc
36. Input shaft
37. Output shaft
38. Rearward large gear
39. Forward large gear
40. Output shaft coupling

B-22GM



1. Cylinder head
2. Cylinder body
3. Main bearing housing
4. Main bearing housing
5. Intermediate main bearing housing
6. Exhaust valve
7. Intake valve
8. Valve spring
9. Valve rocker arm support
10. Valve rocker arm

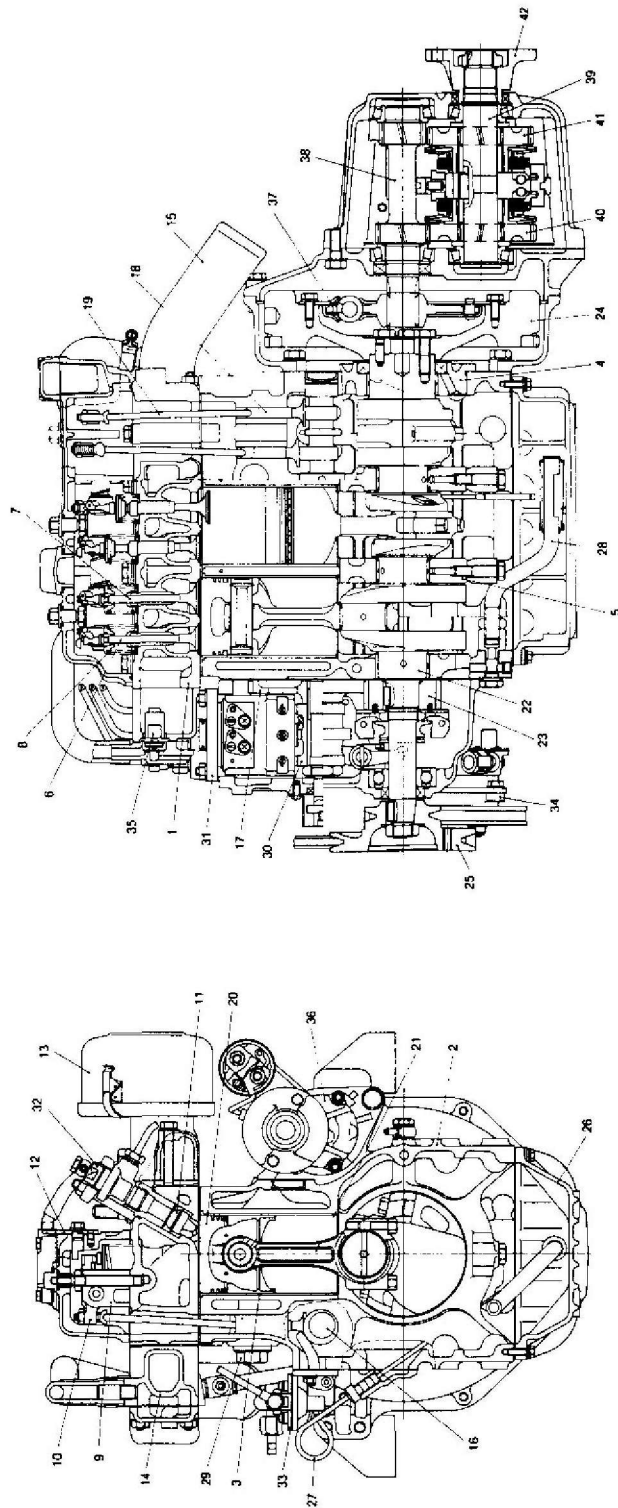
11. Precombustion chamber
12. Compression lever
13. Compression lever
14. Exhaust manifold
15. Camshaft
16. Camshaft gear
17. Tappet
18. Push rod
19. Piston
20. Connecting rod

21. Crankshaft
22. Crankshaft gear
23. Flywheel
24. Crankshaft V pulley
25. Oil pan
26. Dipstick
27. Lubricating oil inlet pipe
28. Anticorrosion zinc
29. Crankshaft timing cam
30. Fuel injection pump

31. Fuel injection nozzle
32. Fuel injection pump
33. Cooling water pump
34. Thermostat
35. Starter motor
36. Dampier disc
37. Input shaft
38. Output shaft
39. Reverse large gear
40. Reverse large gear

41. Output shaft coupling

6-3 3GM



1. Cylinder head
2. Cylinder body
3. Cylinder liner
4. Main bearing housing
5. Intermediate main bearing housing
6. Intake valve
7. Intake valve
8. Valve spring
9. Valve rocker arm support
10. Valve rocker arm

11. Precombustion chamber
12. Decompression lever
13. Intake silencer
14. Exhaust manifold
15. Mixing elbow
16. Crankshaft
17. Crankshaft gear
18. Tappet
19. Push rod
20. Piston

21. Connecting rod
22. Crankshaft
23. Crankshaft gear
24. Crankshaft V pulley
25. Crankshaft V pulley
26. Oil pump
27. Oil pump
28. Lubricating oil inlet pipe
29. Anti-detonation line
30. Fuel injection pump cam

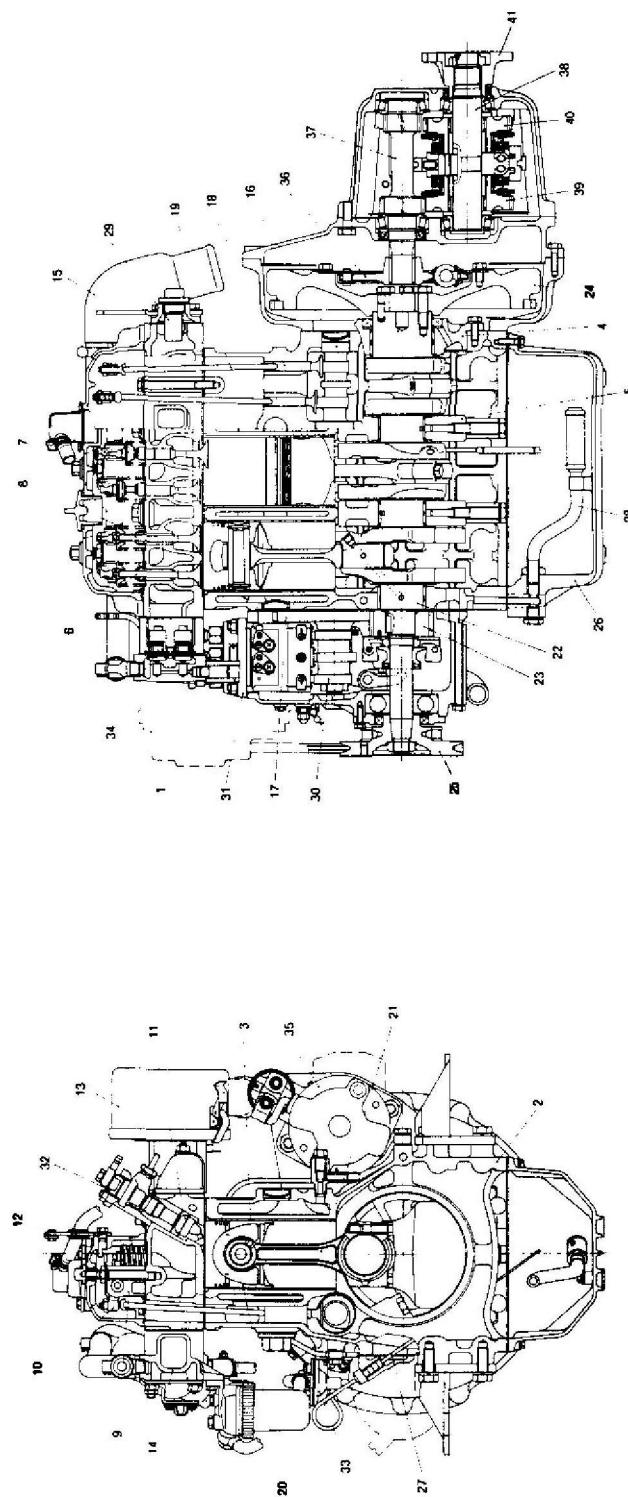
31. Fuel injection pump
32. Fuel injection nozzle
33. Fuel feed pump
34. Cooling water pump
35. Thermostat
36. Water motor
37. Oil pump
38. Input shaft
39. Output shaft
40. Forward large gear

41. Reverse large gear
42. Output shaft coupling

6-4 3GMD

- |                                      |                               |                           |                           |
|--------------------------------------|-------------------------------|---------------------------|---------------------------|
| 1. Cylinder head                     | 21. Connecting rod            | 31. Fuel injection pump   | 41. Reverse large gear    |
| 2. Cylinder body                     | 22. Crankshaft                | 32. Fuel injection nozzle | 42. Output shaft coupling |
| 3. Cylinder liner                    | 23. Crankshaft gear           | 33. Fuel feed pump        |                           |
| 4. Main bearing housing              | 24. Flywheel                  | 34. Cooling water pump    |                           |
| 5. Intermediate main bearing housing | 25. Crankshaft V-pulley       | 35. Thermostat            |                           |
| 6. Exhaust valve                     | 26. Oil pan                   | 36. Starter motor         |                           |
| 7. Intake valve                      | 27. Dorslück                  | 37. Damper disc           |                           |
| 8. Valve rocker                      | 28. Connecting oil inlet pipe | 38. Fuel pump             |                           |
| 9. Valve rocker arm support          | 29. Anticorrosion zinc        | 39. Output shaft          |                           |
| 10. Valve rocker arm                 | 30. Fuel injection pump cam   | 40. Forward large gear    |                           |

8-5 3HM



1. Cylinder head
2. Cylinder body
3. Crankshaft
4. Main bearing housing
5. Intermediate main bearing housing
6. Exhaust valve
7. Intake valve
8. Valve spring
9. Valve rocker arm support
10. Valve rocker arm

11. Precombustion chamber
12. Decompression lever
13. Fuel injection pump
14. Exhaust manifold
15. Mixing elbow
16. Camshaft
17. Camshaft gear
18. Tappet
19. Push rod
20. Piston

21. Connecting rod
22. Crankshaft
23. Crankshaft gear
24. Flywheel
25. Camshaft V pulley
26. Oil pan
27. Opalick
28. Lubricating oil inlet pipe
29. Anticorrosion zinc
30. Fuel injection pump cam

31. Fuel injection pump
32. Fuel injection nozzle
33. Fuel pump
34. Thermostat
35. Starter motor
36. Damper disc
37. Input shaft
38. Output shaft
39. Forward large gear
40. Reverse large gear

41. Output shaft coupling