YANMAR

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SERIVICE MANUAL

MARINE DIESEL ENGINE

GM Series

1GM(10L)
2GM(F)(L)
3GM(D)(F)(L)
3HM(F)(L)

2000. 3. 15

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)

CHAPTER 14 GENERAL

CHAPTER 15 COOLING SYSTEM

CHAPTER 16 DISASSEMBLY AND REASSEMBLY

CHAPTER 17 MODIFYING THE COOLING SYSTEM

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.

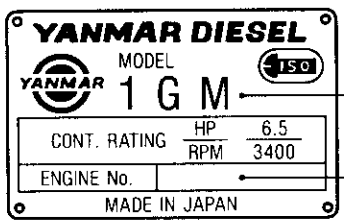
The specifications or components of the engine or clutch may be partially altered to improve performance, and the components involved may not necessarily be interchangeable.
Therefore, when parts are ordered, please furnish the item description in the blank spaces shown in the figures, using the descriptions 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]

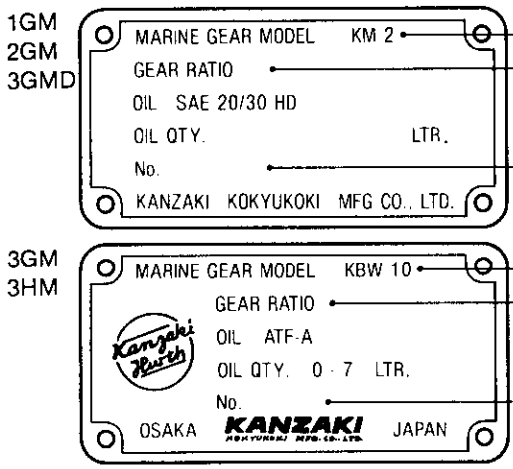
Engine model name plate



Your engine model

Your engine number

Clutch model name plate



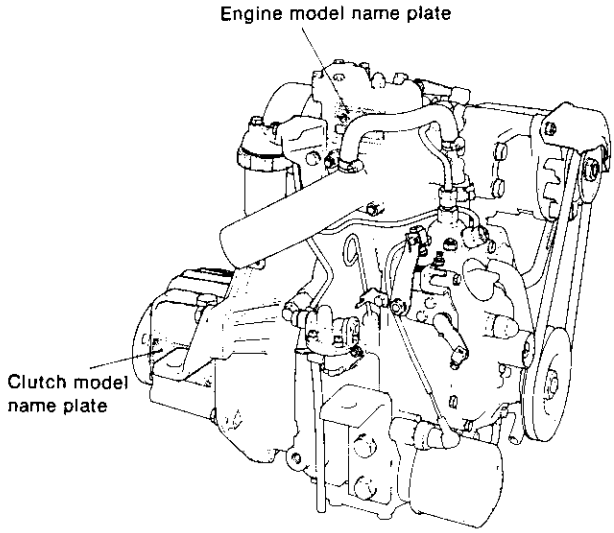
Your clutch model

Your clutch gear ratio

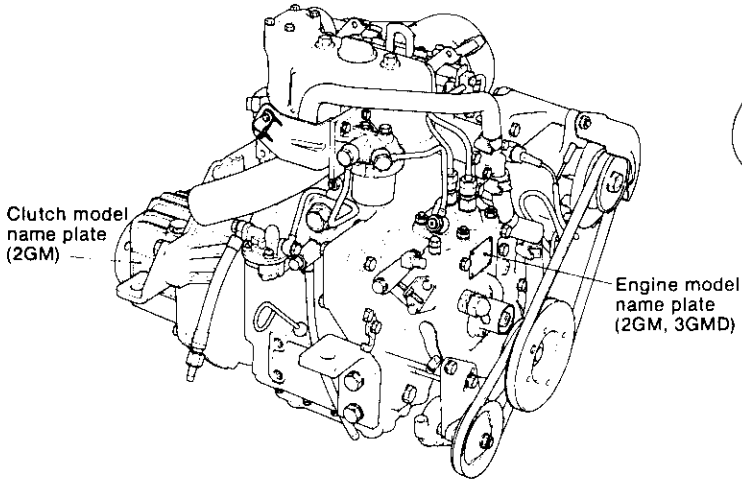
Your clutch number

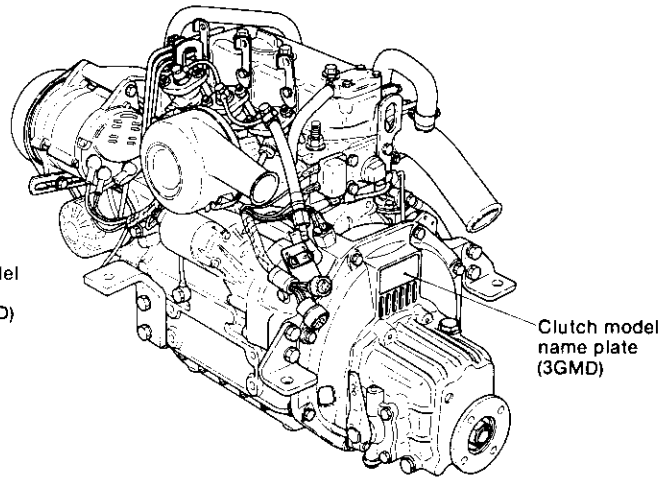
B-2 Location of engine model name plate and clutch model name plate

B-2.1 1GM

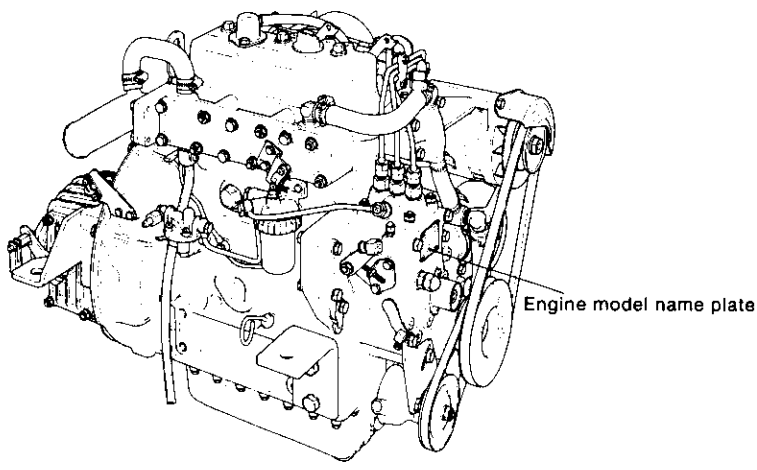


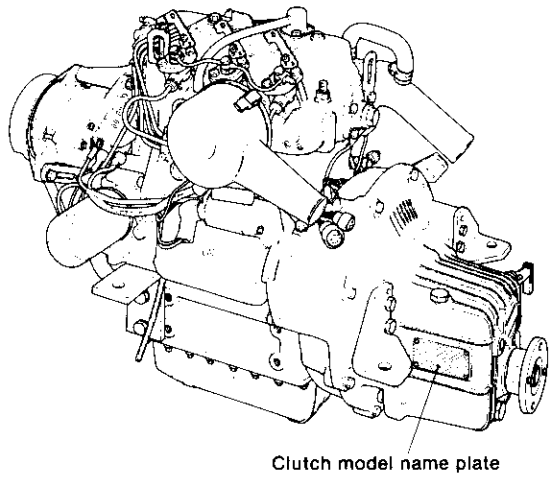
B-2.2 2GM, 3GMD





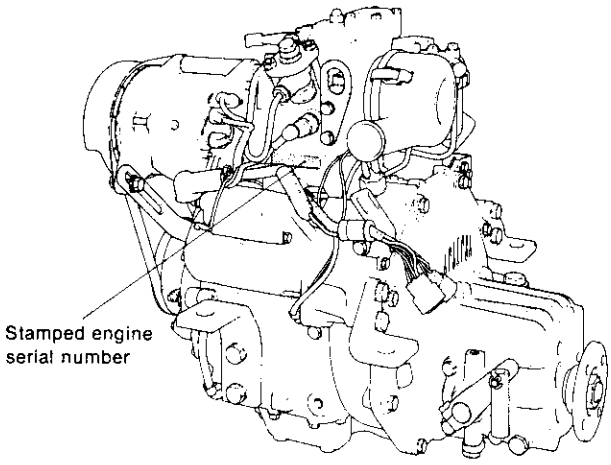
B-2.3 3GM, 3HM



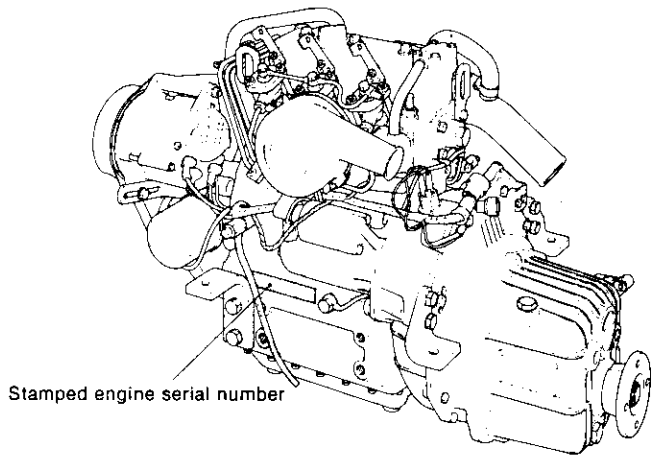


B-3 Location of stamped engine serial number

B-3.1 1GM

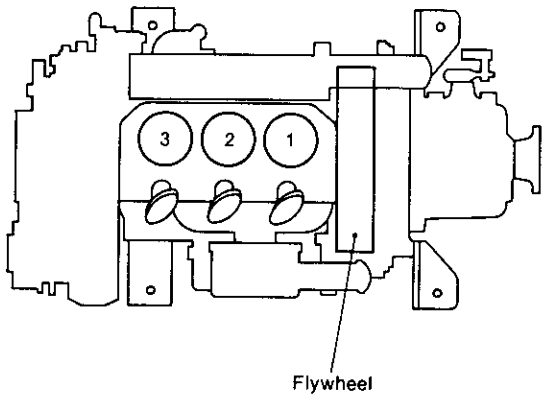


B-3.2 2GM, 3GM(D), 3HM



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.

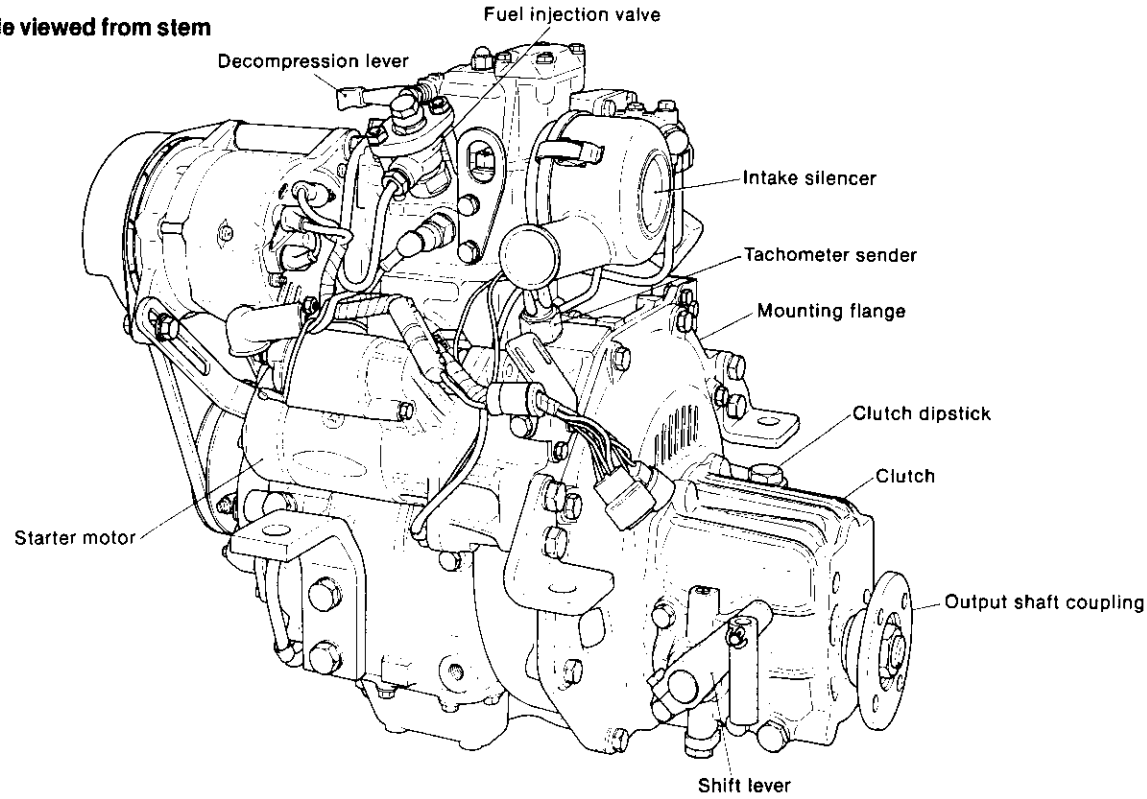
CHAPTER 1

GENERAL

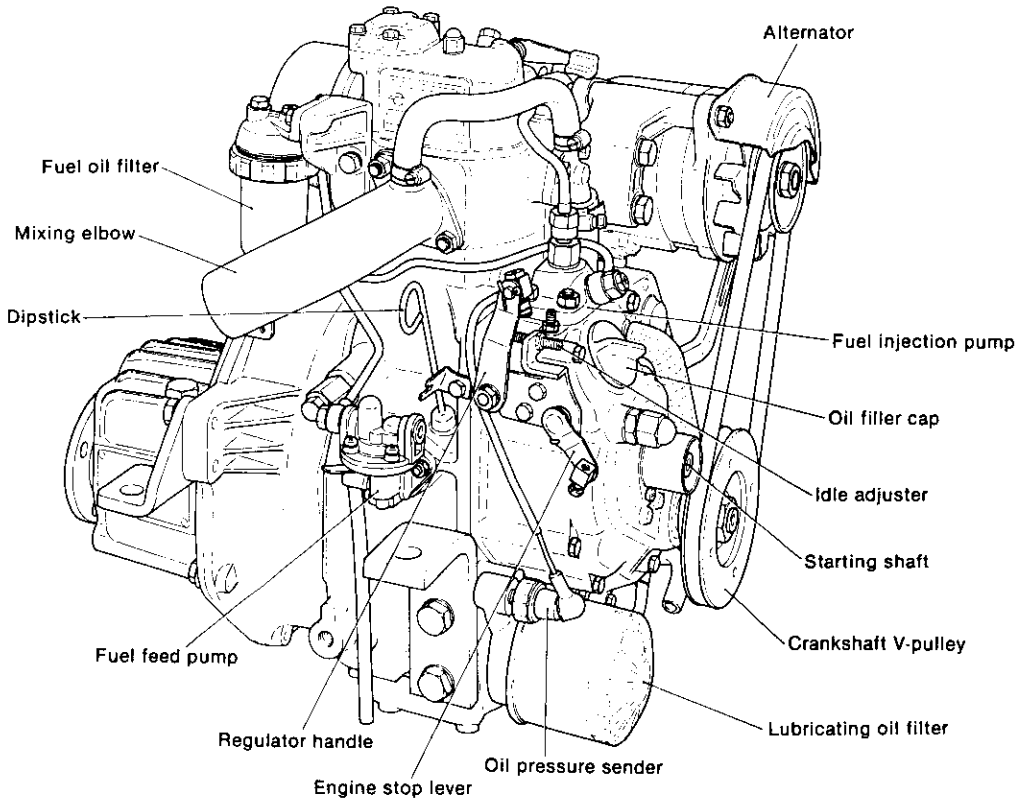
1. Exterior Views

1-1 1GM

1-1.1 Intake side viewed from stem

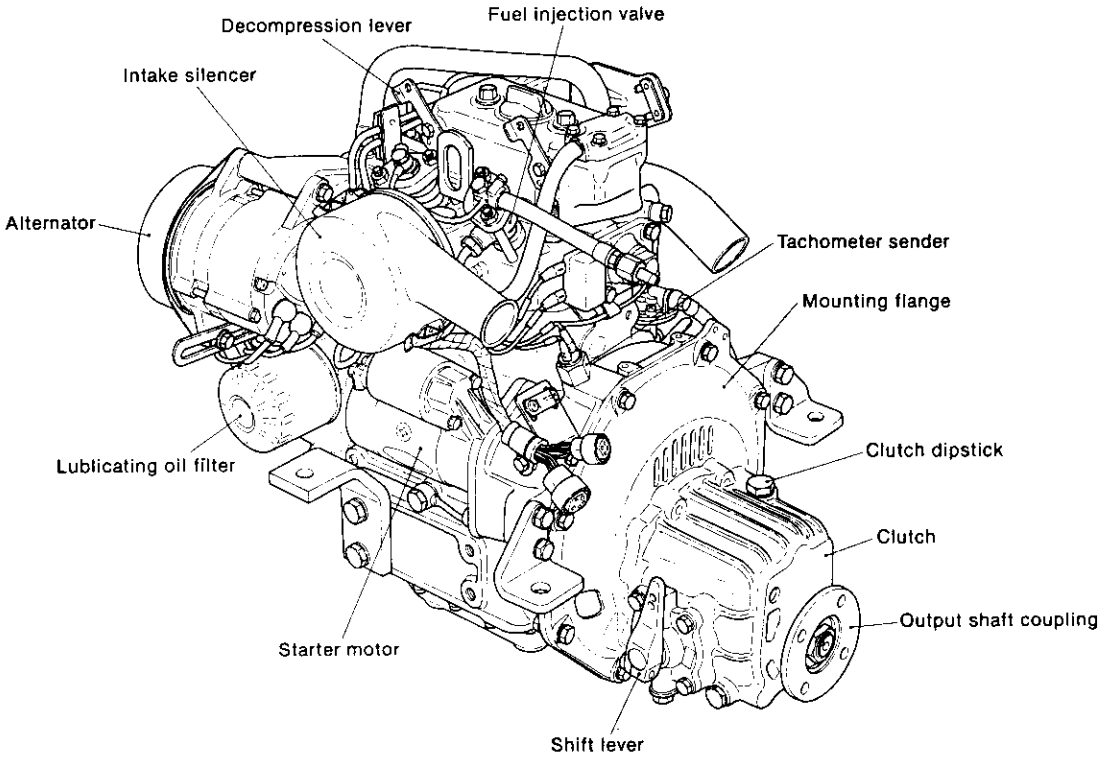


1-1.2 Exhaust side viewed from bow

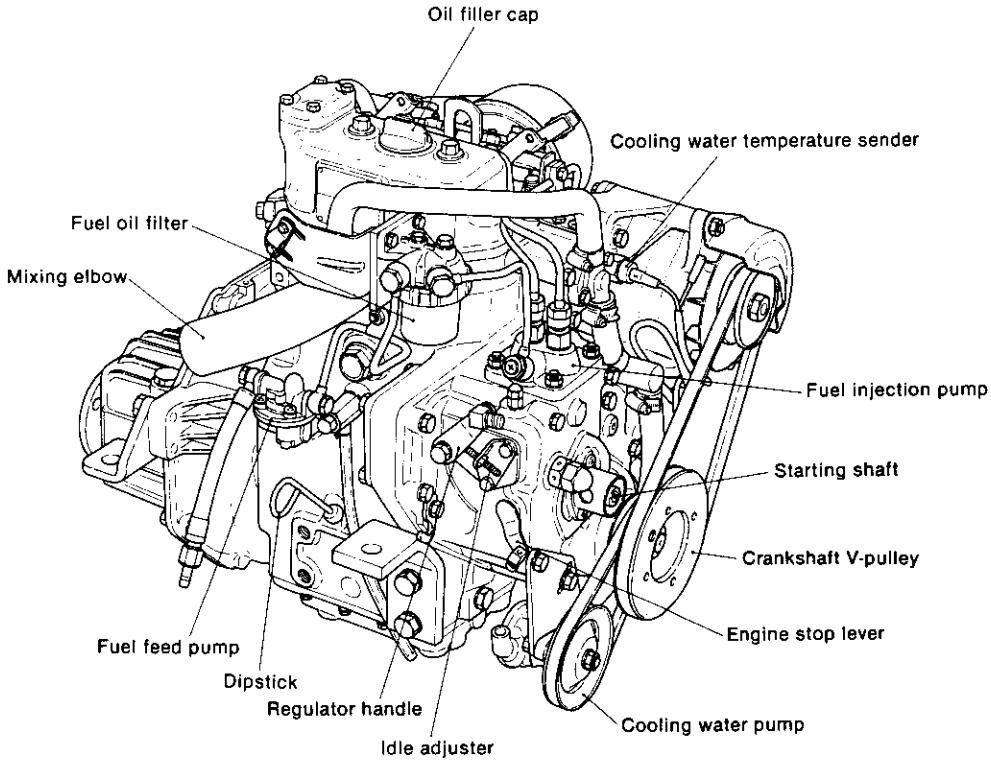


1-2 2GM

1-2.1 Intake side viewed from stem

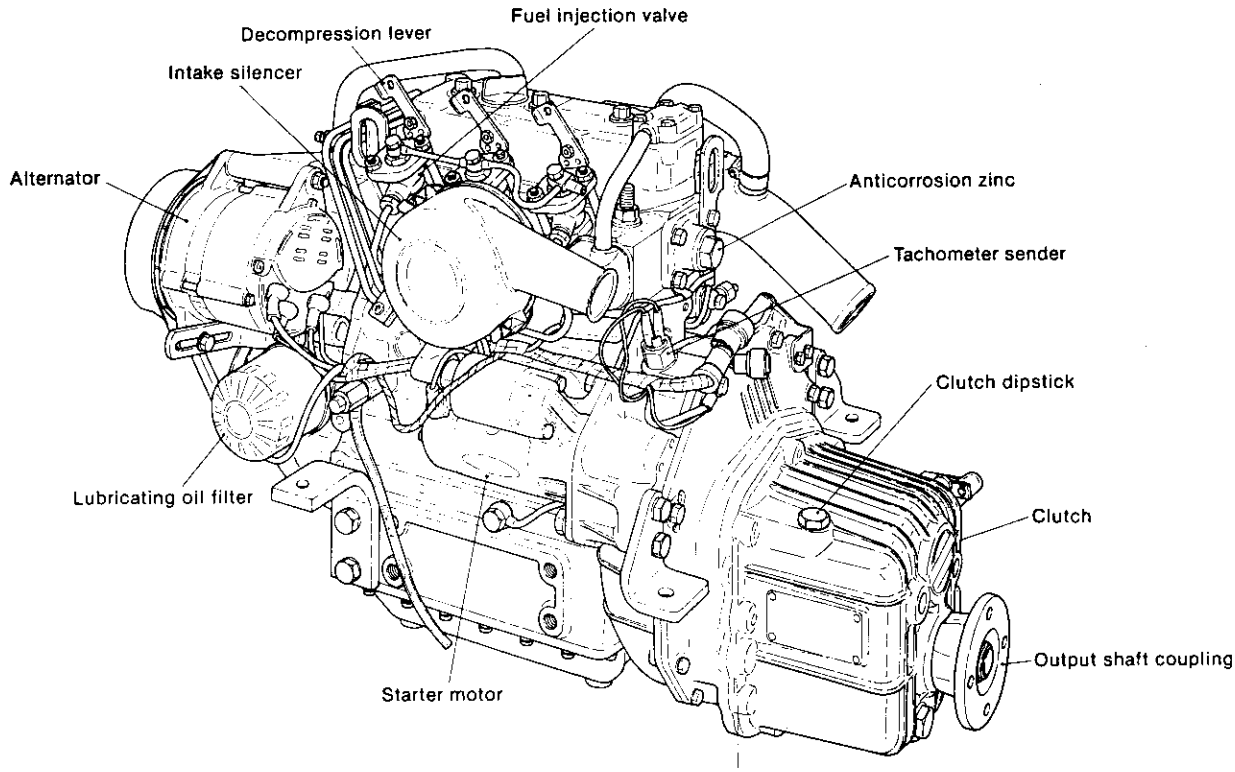


1-2.2 Exhaust side viewed from bow

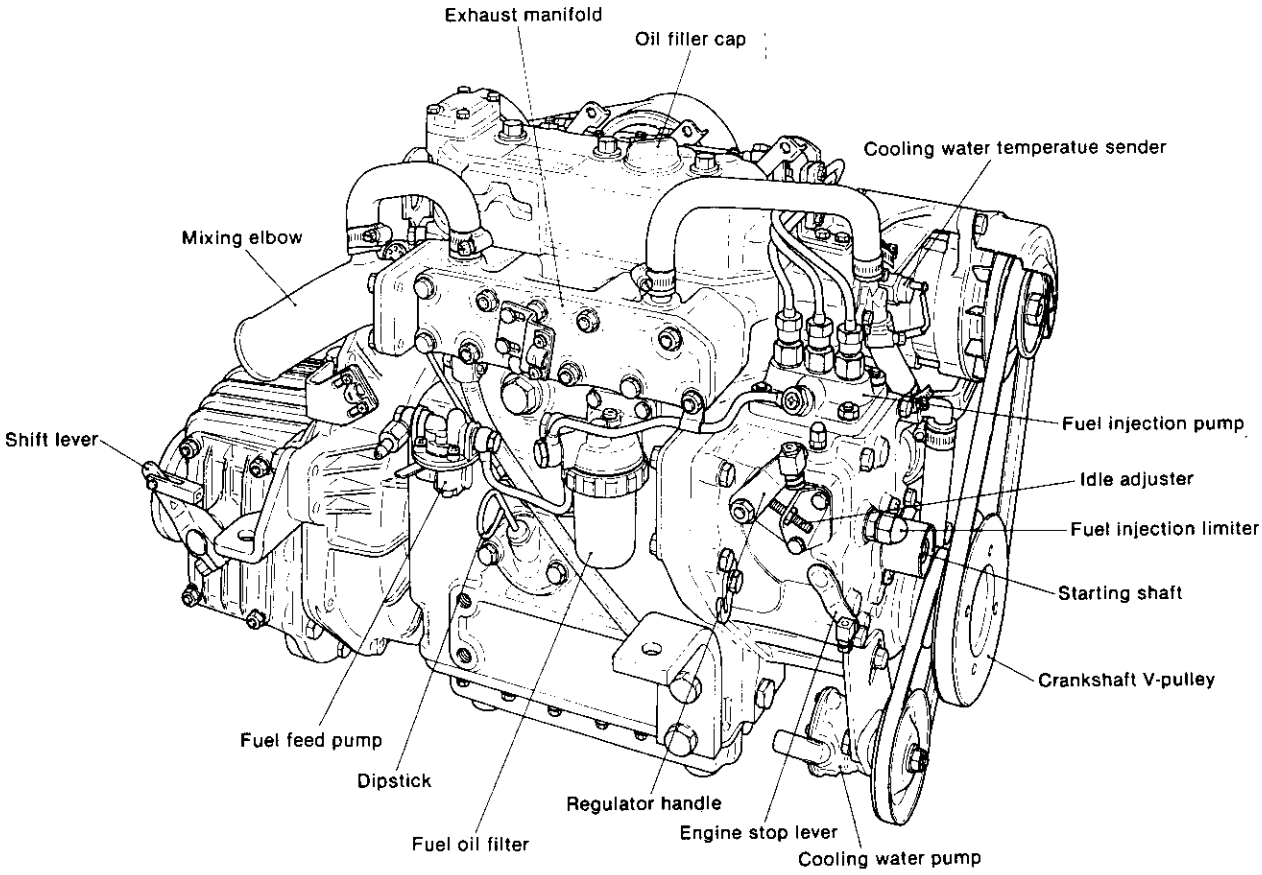


1-3 3GM

1-3.1 Intake side viewed from stem

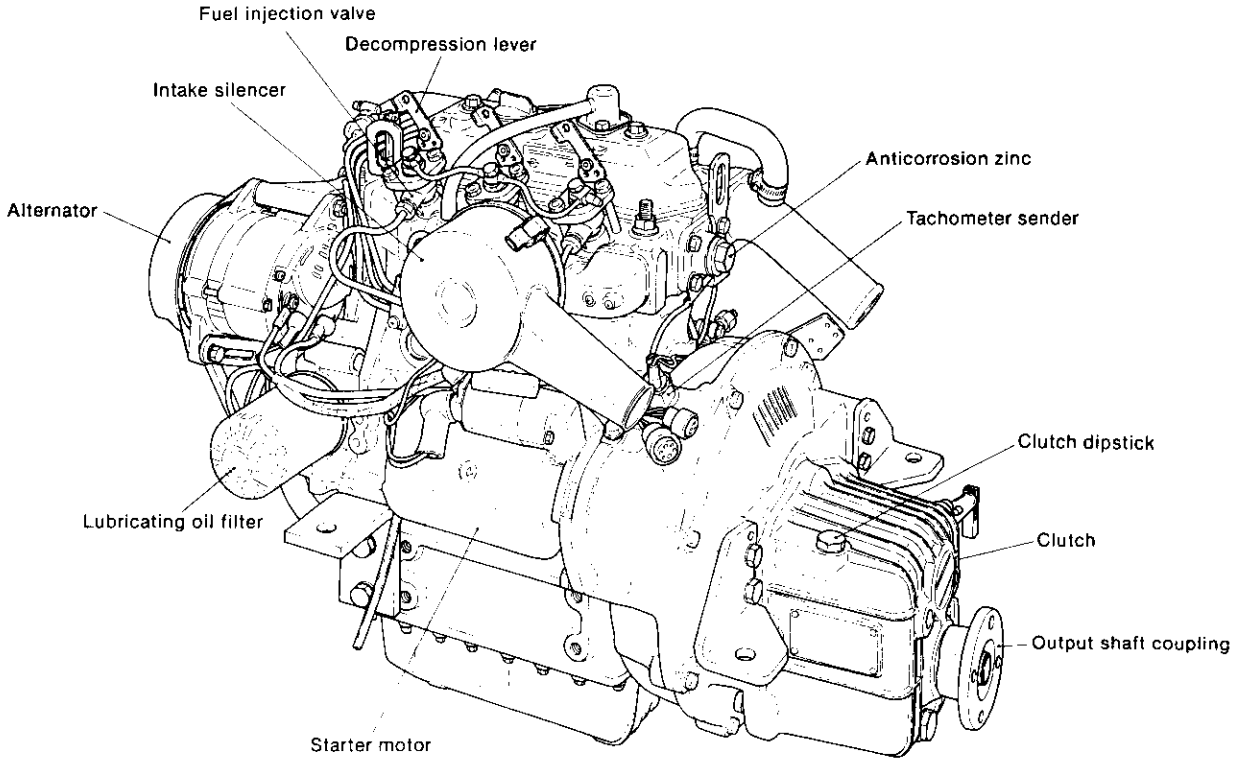


1-3.2 Exhaust side viewed from bow

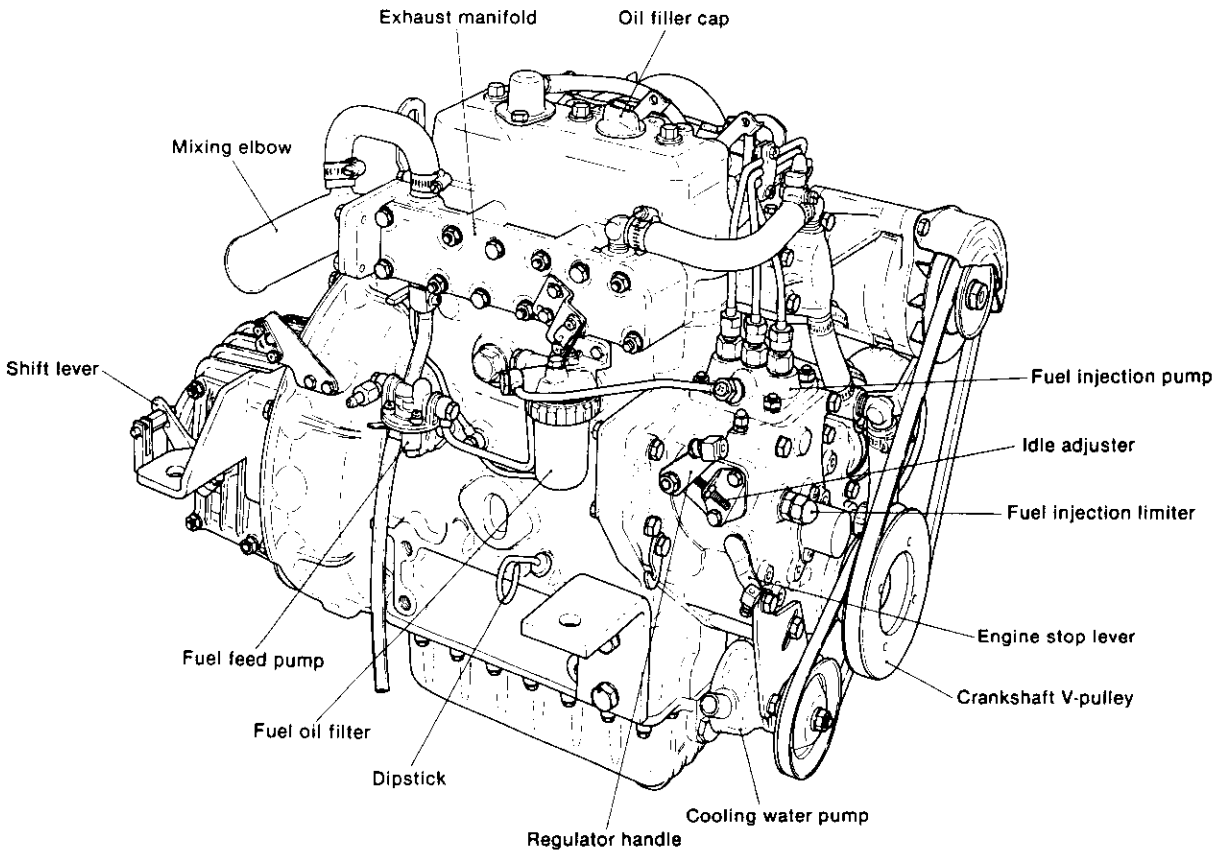


1-4 3HM

1-4.1 Intake side viewed from stem



1-4.2 Exhaust side viewed from bow



2. Specifications

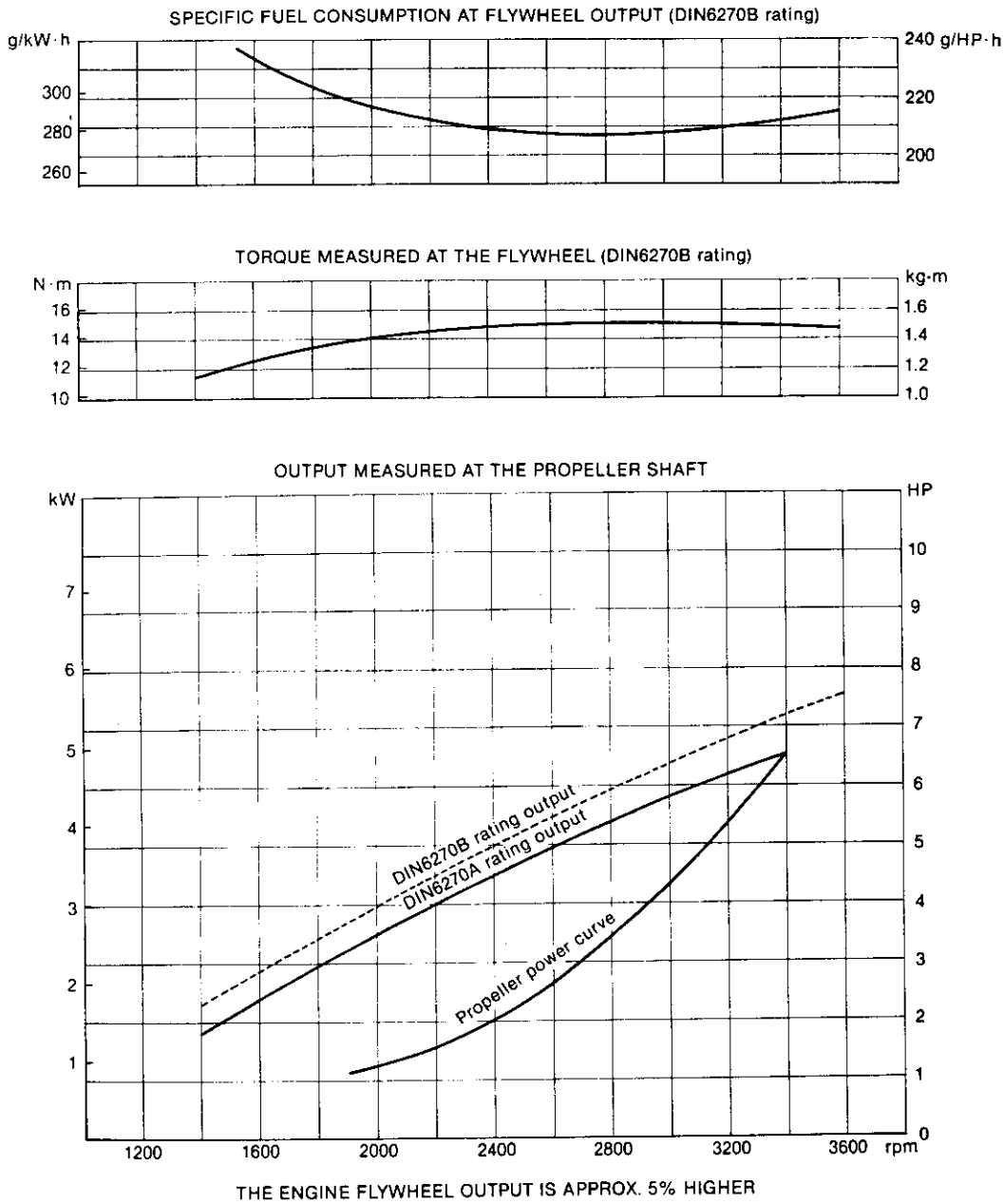
Model			1GM	2GM	3GMD	3GM	3HM
Type			Vertical 4-cycle water cooled diesel engine				
Combustion chamber			Swirl pre-combustion chamber				
Number of cylinders			1	2	3		3
Bore × stroke		mm	72 × 72				75 × 85
Displacement		ℓ	0.293	0.586	0.879		1.126
Continuous rating output (DIN6270A)	Output/Crankshaft speed	HP/rpm	6.5/3400	13/3400	20/3400		27/3200
	Brake mean effective pressure	kg/cm²	5.87	5.87	6.02		6.74
	Piston speed	m/sec.	8.16				9.07
One hour rating output (DIN6270B)	Output/crankshaft speed	HP/rpm	7.5/3600	15/3600	22.5/3600		30/3400
	Brake mean effective pressure	kg/cm²	6.40				7.05
	Piston speed	m/sec.	8.64				9.63
Compression ratio			23.0				22.7
Fuel injection timing (FID)		degree	bTDC15±1	bTDC15±1	bTDC18±1	bTDC18±1	bTDC±21
Fuel injection pressure		kg/cm²	170				160
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 (A head)		Clockwise viewed from stern				
Cooling system			Direct sea water cooling (rubber impeller water pump)				
Lubrication system			Complete enclosed forced lubrication				
Starting system			Electric and/or manual				Electric
Clutch	Model		KM2A		KM3A	KBW10D	KBW10E
	Type		Mechanical cone clutch with single stage for both ahead and astern			Wet multi-disc mechanical type	
	Reduction ratio (Ahead/Astern)		2.21/3.06	2.62/3.06	3.22/3.06	2.21/3.06	2.62/3.06	3.22/3.06	2.36/3.16	2.61/3.16	3.20/3.16	2.14/2.50	2.63/2.50	2.83/2.50	2.14/2.50	2.83/2.50
	Propeller speed DINA rating (Ahead/Astern)	rpm	1540/1113	1296/1113	1055/1113	1540/1113	1298/1113	1055/1113	1441/1076	1303/1076	1062/1076	1591/1360	1292/1360	1200/1360	1498/1280	1129/1280
	Lubricating oil capacity	ℓ	0.25			0.3			0.7							
	Clutch weight	kg	9.3			10.8			17			19				
Dimensions	Overall length	mm	527		623	740			755			791				
	Overall width	mm	410		410	410			410			451				
	Overall height	mm	485		495	495			502			612				
Lubricating oil capacity (rake angle 8°)	Total	ℓ	1.3		2.0	2.7						5.5				
	Effective	ℓ	0.6		1.3	1.8						3.0				
Engine weight with clutch (dry)		kg	70		100	130			130			158				

3. Principal Construction

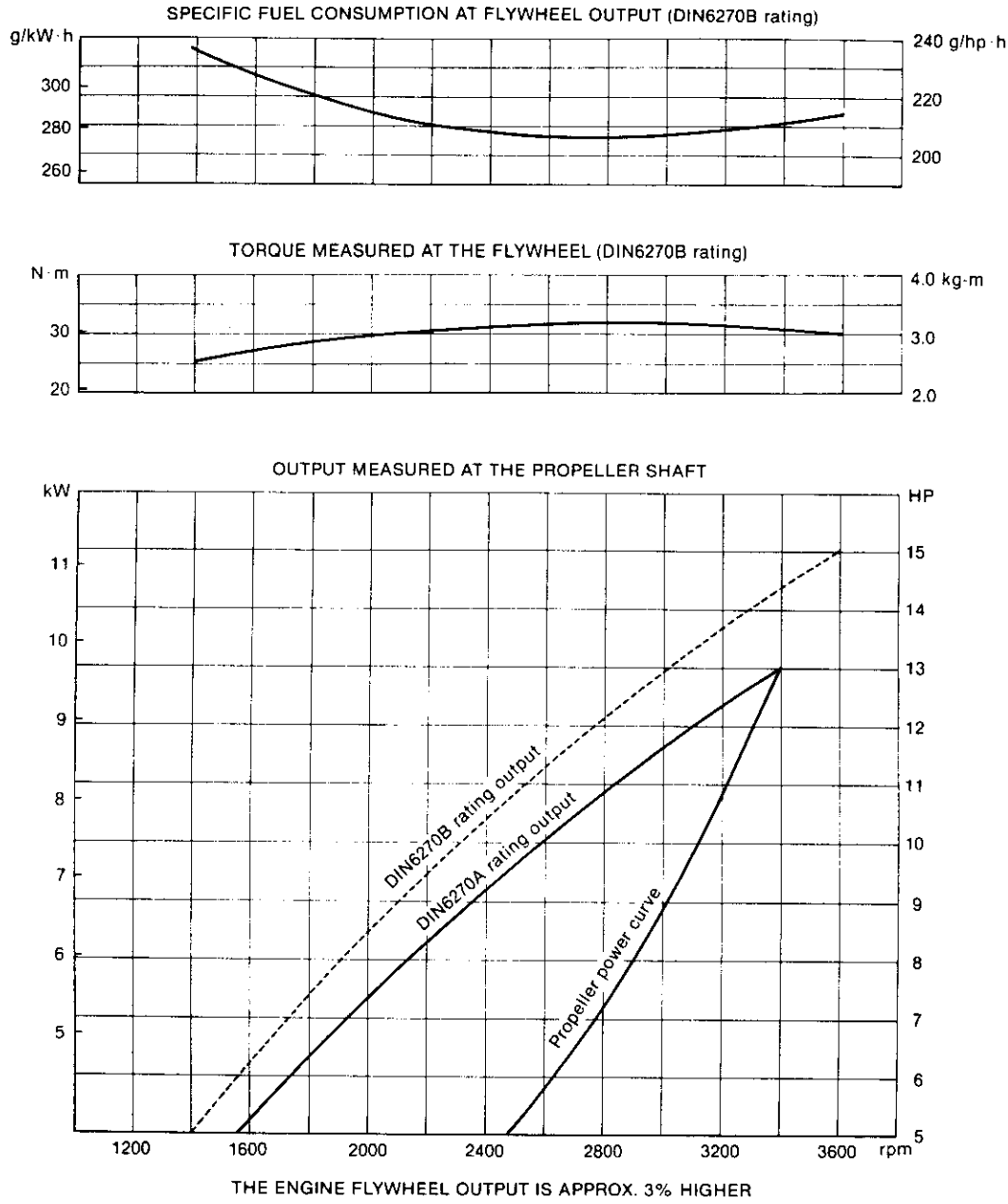
Engine model		1GM	2GM	3GMD	3GM	3HM
Group	Part	Construction				
Engine block	Cylinder block	Integrally-cast water jacket and crankcase				
	Cylinder liner	Sleeveless	Dry sleeve type			
	Main bearing	Metal housing type				
	Oil sump	Oil pan				
Intake and exhaust systems and valve mechanism	Cylinder head	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

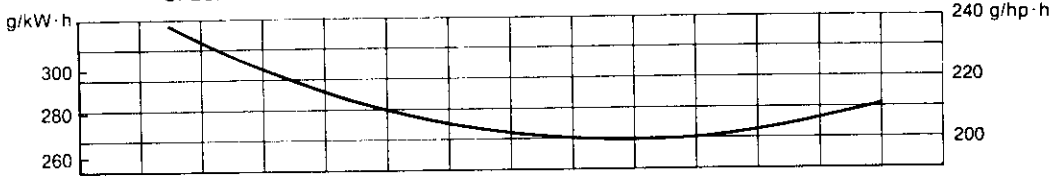


4-2 2GM (F)

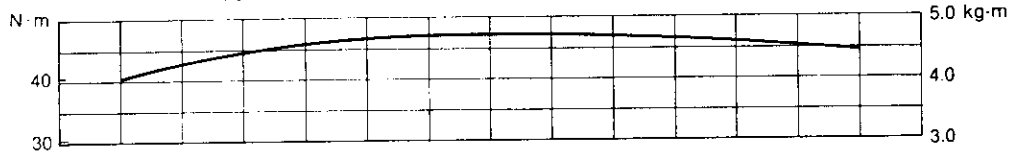

SPECIFIC FUEL CONSUMPTION AT FLYWHEEL OUTPUT (DIN6270B rating)
g/kW·h
300
280
260
240 g/hp·h
220
200
TORQUE MEASURED AT THE FLYWHEEL (DIN6270B rating)
N·m
30
20
4.0 kg·m
3.0
2.0
OUTPUT MEASURED AT THE PROPELLER SHAFT
kW
11
10
9
8
7
6
5
HP
15
14
13
12
11
10
9
8
7
6
5
DIN6270B rating output
DIN6270A rating output
Propeller power curve
1200
1600
2000
2400
2800
3200
3600
rpm
THE ENGINE FLYWHEEL OUTPUT IS APPROX. 3% HIGHER

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

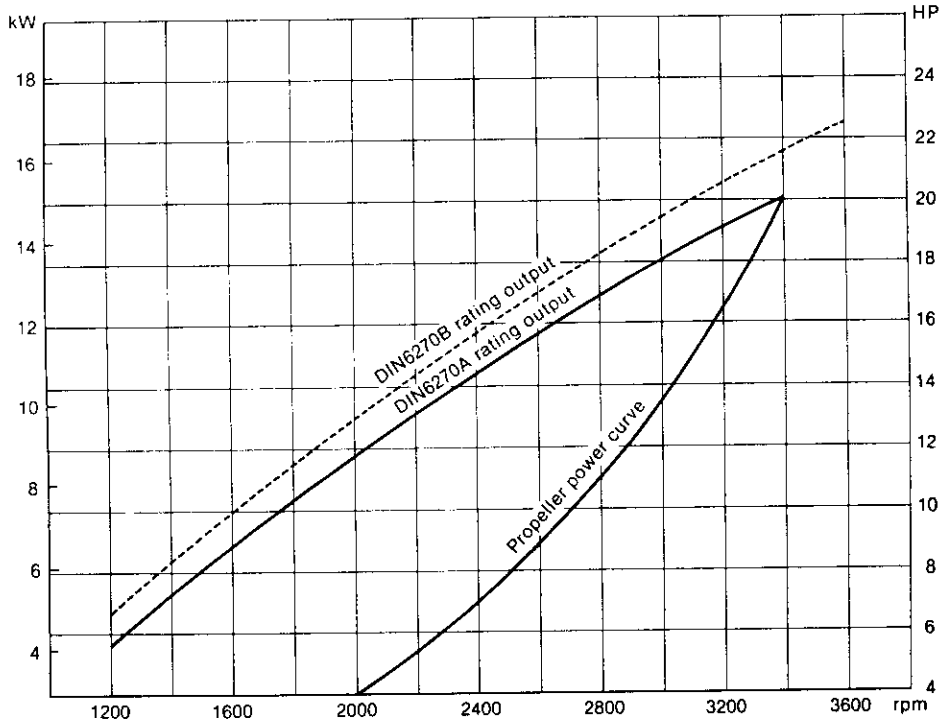
SPECIFIC FUEL CONSUMPTION AT FLYWHEEL OUTPUT (DIN6270B rating)



TORQUE MEASURED AT THE FLYWHEEL (DIN6270B rating)

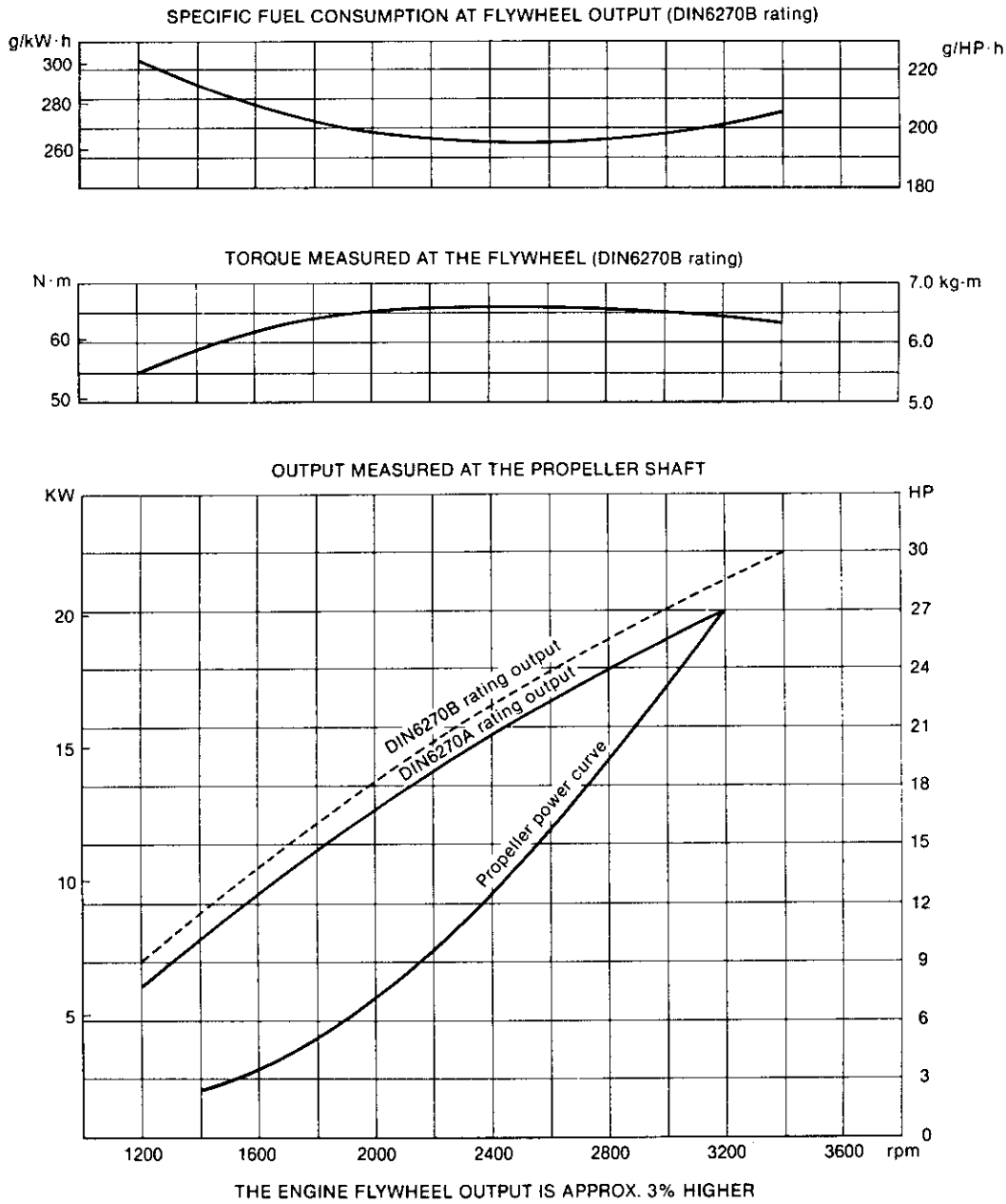


OUTPUT MEASURED AT THE PROPELLER SHAFT



THE ENGINE FLYWHEEL OUTPUT IS APPROX. 3% HIGHER

4-4 3HM (F)


SPECIFIC FUEL CONSUMPTION AT FLYWHEEL OUTPUT (DIN6270B rating)
g/kW·h
300
280
260
g/HP·h
220
200
180
TORQUE MEASURED AT THE FLYWHEEL (DIN6270B rating)
N·m
60
50
7.0 kg-m
6.0
5.0
OUTPUT MEASURED AT THE PROPELLER SHAFT
KW
20
15
10
5
HP
30
27
24
21
18
15
12
9
6
3
0
DIN6270B rating output
DIN6270A rating output
Propeller power curve
1200
1600
2000
2400
2800
3200
3600
rpm
THE ENGINE FLYWHEEL OUTPUT IS APPROX. 3% HIGHER

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.