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SERVICE MANUAL

MARINE DIESEL ENGINE

GM Series

1GM10 (C)

2GM20 (F) (C)

3GM30 (F) (C)

3HM35 (F) (C)

2000. 3. 10

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

1 GM10(C) 2 GM20(F)(C) 3 GM30(F)(C) 3 HM35(F)(C)

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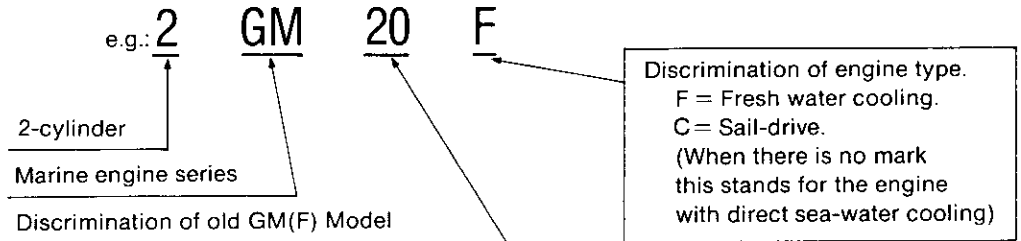
A. Engine Model Name

B. Engine Model Name Plate and Clutch Model Name Plate

SM/GM(F)(C)-HM(F)(C)

A. Engine Model Name

The nomenclature of the New GM(F)/HM(F) series follows the order shown below.



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 the 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.

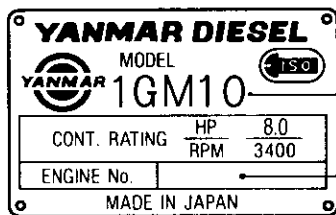
The specifications or components of the engine or clutch may have been partially altered to improve performance, and the components involved may not necessarily be interchangeable. Therefore, when parts are ordered, please furnish the item description in the blank spaces shown in the figures, using the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

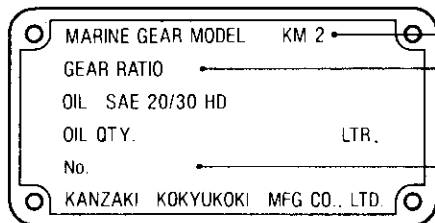


Your engine model

Your engine number

Clutch model name plate

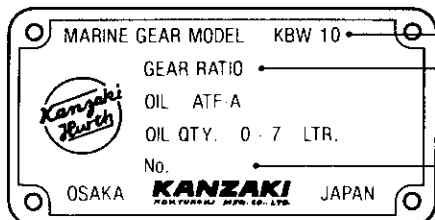
GM-series



Your clutch model

Your clutch gear ratio

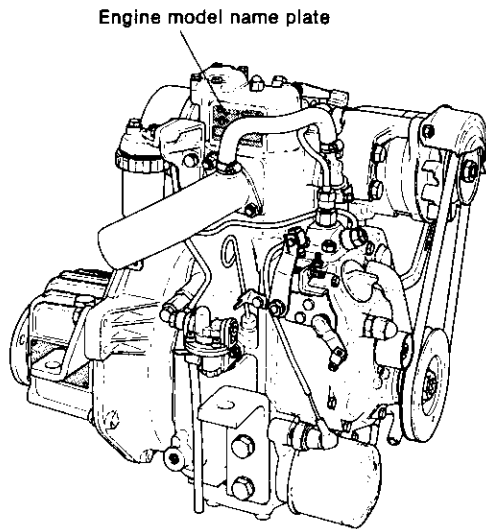
HM-series



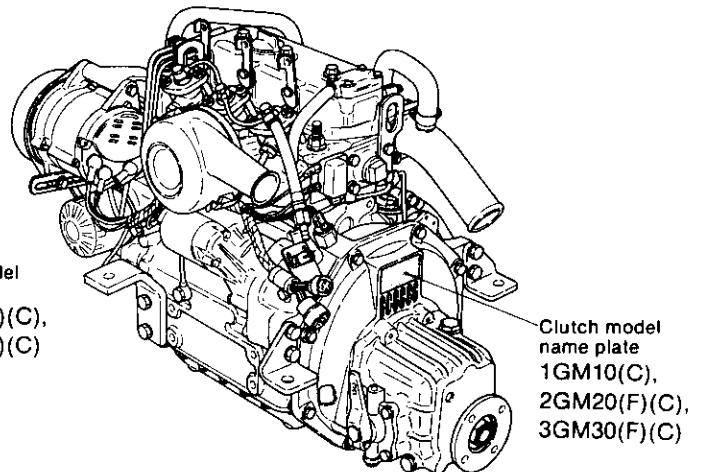
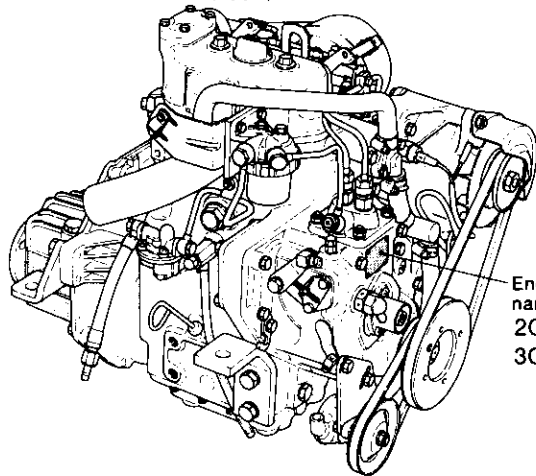
Your clutch number

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

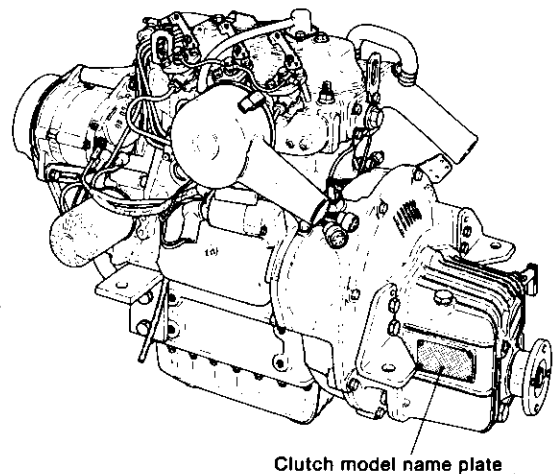
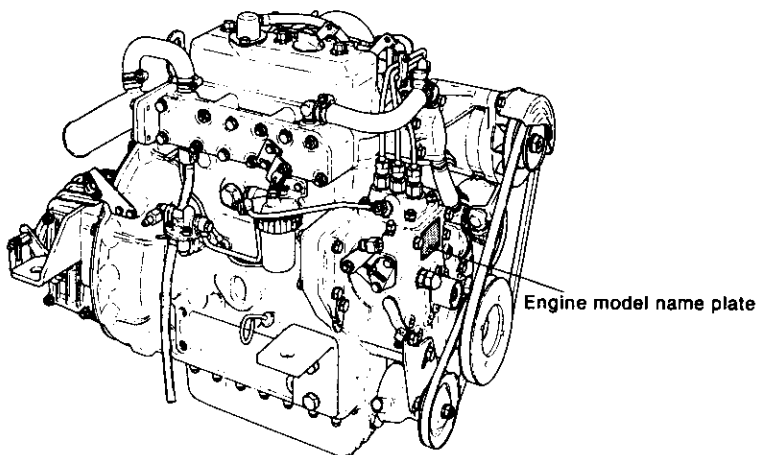
B-2.1 1GM10(C)



B-2.2 2GM20(F)(C), 3GM30(F)(C)

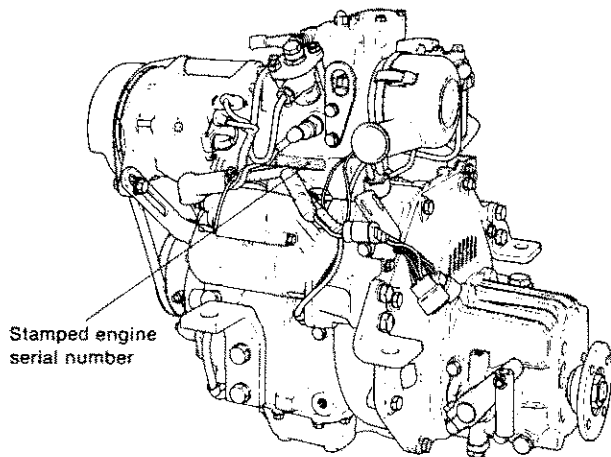


B-2.3 3HM35(F)(C)

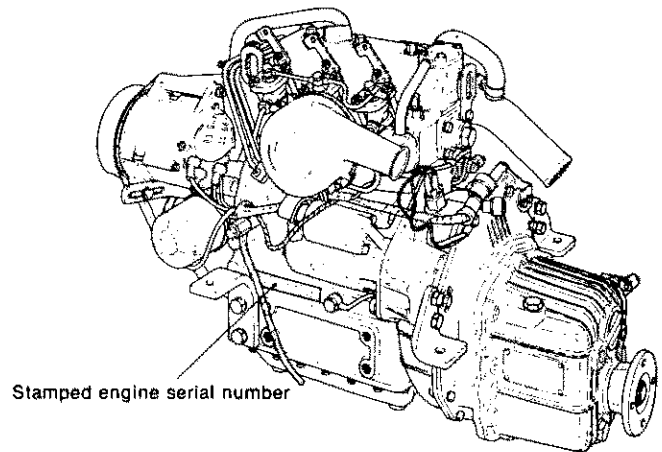


B-3 Location of stamped engine serial number

B-3.1 1GM10(C)

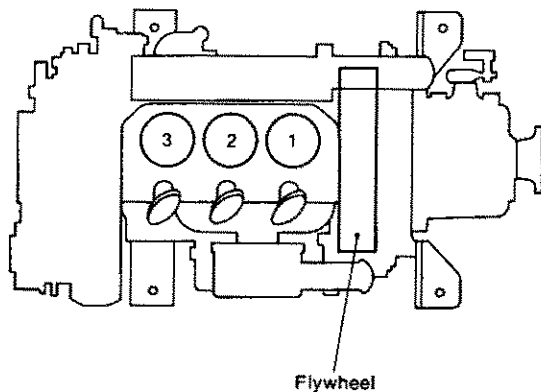


B-3.2 2GM20(F)(C), 3GM30(F)(C), 3HM35(F)(C)



C. Cylinder Number

The cylinder numbers of the 2 cylinder engine and 3 cylinder engine 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. Specifications

1-1. Direct Sea Water Cooling Type

Model		1GM10		2GM20		3GM30		3HM35						
Type		Vertical 4-cycle water cooled diesel engine												
Combustion chamber		Swirl pre-combustion chamber												
Number of cylinders		1		2		3		3						
Bore x stroke		mm (in.)		75 x 72 (2.95 x 2.83)				80 x 85 (3.15 x 3.35)						
Displacement		ℓ(in. ³)		0.318 (19.40)		0.636 (38.81)		0.954 (58.21)						
Continuous rating output (DIN6270A)	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	kgf/cm ² (lb/in. ²)		6.66 (94.71)		6.66 (94.71)		6.58 (93.57)						
	Piston speed	m/sec. (ft/sec.)		8.16 (26.77)		8.16 (26.77)		9.07 (29.76)						
One hour rating output (DIN6270B)	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	kgf/cm ² (lb/in. ²)		7.07 (100.54)		7.07 (100.54)		7.02 (99.82)						
	Piston speed	m/sec. (ft/sec.)		8.64 (28.35)		8.64 (28.35)		9.63 (31.59)						
Compression ratio				23.0		23.0		24.8						
Fuel injection timing (FID)		degree		b.TDC15±1		b.TDC15±1		b.TDC18±1						
Fuel injection pressure		kgf/cm ² (lb/in. ²)		170±5 (2347~2489)		170±5 (2347~2489)		160±5 (2204~2347)						
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		Electric and manual												
Clutch	Model	KM2C						KM3A			KBW10E			
	Type	Mechanical cone clutch with single stage for both ahead and astern										Wet multi-disc mechanical type		
	Reduction ratio (Ahead/A stern)	2.21/3.06		2.62/3.06		3.22/3.06		2.21/3.06		2.62/3.06		3.22/3.06		
	Propeller speed DIN A rating (Ahead/Astern)	rpm		1540/1113		1298/1113		1055/1113		1540/1113		1298/1113		
	Lubricating oil capacity	ℓ(in. ³)		0.25 (15.26)						0.3 (18.31)			0.7 (42.72)	
	Clutch weight	kg (lb.)		9.5 (20.95)						11.0 (24.26)			17.5 (38.58)	
Dimensions	Overall length	mm (in.)		547 (21.53)		638 (25.12)		735 (28.94)			786 (30.94)			
	Overall width	mm (in.)		410 (16.14)		455 (17.91)		455 (17.91)			485 (19.09)			
	Overall height	mm (in.)		485 (19.09)		495 (19.50)		495 (19.50)			617 (24.29)			
Lubricating oil capacity (rake angle 8°)	Total	ℓ(in. ³)		1.3 (79.33)		2.0 (122.05)		2.6 (158.65)			5.4 (329.51)			
	Effective	ℓ(in. ³)		0.6 (36.61)		1.3 (79.33)		1.6 (97.63)			2.7 (164.75)			
Engine weight with clutch (dry)		Kg (lb.)		76 (168)		106 (234)		130 (287)			158 (348)			

1-2. Fresh Water Cooling Type

Model		2GM20F	3GM30F			3HM35F				
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)			80 x 85 (3.15 x 3.35)			
Displacement		ℓ(in. ³)		0.636 (38.81)		0.954 (58.21)	1.282 (78.23)			
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	kgf/cm ² (lb/in. ²)		6.66 (94.71)		6.58 (93.57)				
	Piston speed	m/sec. (ft/sec.)		8.16 (26.77)		9.07 (29.76)				
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	kgf/cm ² (lb/in. ²)		7.07 (100.54)		7.02 (99.82)				
	Piston speed	m/sec. (ft/sec.)		8.64 (28.35)		9.63 (31.59)				
Compression ratio				23.0		24.8				
Fuel injection timing (FID)		degree		b.TDC 15±1		b.TDC 18±1				
Fuel injection pressure		kgf/cm ² (lb/in. ²)		170±5 (2347~2489)		160±5 (2204~2347)				
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		Electric								
Clutch	Model	KM2-C			KM3A		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	2.36/3.16	2.61/3.16	3.20/3.16	2.14/2.50	2.83/2.50	
	Propeller speed DIN. A rating (Ahead/Astern)	rpm	1540/1113	1298/1113	1055/1113	1441/1076	1303/1076	1062/1076	1498/1280	1129/1280
	Lubricating oil capacity	ℓ(in. ³)	0.25 (15.26)			0.30 (18.31)		0.70 (42.72)		
	Clutch weight	kg (lb.)	9.5 (20.95)			11.0 (24.26)		17.5 (38.58)		
Dimensions	Overall length	mm (in.)		643 (25.31)		740 (29.13)		791 (31.14)		
	Overall width	mm (in.)		482 (19.00)		455 (17.91)		475 (18.70)		
	Overall height	mm (in.)		545 (21.46)		545 (21.46)		638 (25.12)		
Lubricating oil capacity (rake angle 8°)	Total	ℓ(in. ³)		2.0 (122.05)		2.6 (158.65)		5.4 (329.51)		
	Effective	ℓ(in. ³)		1.3 (79.33)		1.6 (97.63)		2.7 (164.75)		
Engine weight with clutch (dry)		kg (lb.)		114 (251)		138 (304)		167 (368)		

1-3. Direct Sea Water Colling Type (Sail-drive)

Model		1GM10C	2GM20C	3GM30C	3HM35C
Type		Vertical, 4-cycle water cooled diesel engine			
Combustion chamber		Swirl pre-combustion chamber			
Number of cylinders		1	2	3	
Bore x stroke		75 x 72 (2.95 x 2.83)			80 x 85 (3.15 x 3.35)
Displacement		ℓ (in. ³)		ℓ (in. ³)	
		0.318 (19.40)	0.636 (38.81)	0.954 (58.21)	1.282 (78.23)
Continuous rating output (DIN 6270A)	Output/Crankshaft speed	kW/rpm(HP/rpm)		kW/rpm(HP/rpm)	
	Brake mean effective pressure	kgf/cm ² (lb/in. ²)		kgf/cm ² (lb/in. ²)	
	Piston speed	m/sec. (ft/sec.)		m/sec. (ft/sec.)	
One hour rating output (DIN 6270B)	Output/Crankshaft speed	6.7/3600(9.1/3600)		13.4/3600(18.2/3600)	
	Brake mean effective pressure	kgf/cm ² (lb/in. ²)		kgf/cm ² (lb/in. ²)	
	Piston speed	m/sec. (ft/sec.)		m/sec. (ft/sec.)	
Compression ratio		23.0		24.8	
Fuel injection timing (FID)		Degree		Degree	
		b.TDC 15±1		b.TDC 18±1	
Fuel injection pressure		kgf/cm ² (lb/in. ²)		kgf/cm ² (lb/in. ²)	
		170±5 (2347~2489)		160±5 (2204~2347)	
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 (Sail-drive)	Counter-clockwise viewed from stern			
Cooling system		Direct sea water cooling (rubber impeller water pump)			
Lubrication system		Complete enclosed forced lubrication			
Starting system		Electric and manual		Electric	
		SD 20		SD 30	
Sail-drive	Model	SD 20			
	Reduction system	Constant mesh gear with dog clutch			
	Reduction ratio (Ahead/Astern)	2.64/2.64			
	Propeller speed DIN. A rating	rpm		rpm	
		1289		1212	
Lubricating capacity		ℓ (in. ³)		ℓ (in. ³)	
		2.2 (134.24)		2.2 (134.24)	
Dry weight		kg (lb.)		kg (lb.)	
		30 (66)		32 (70)	
Lubricating oil capacity (Engine side)	Total	ℓ (in. ³)		ℓ (in. ³)	
	Effective	ℓ (in. ³)		ℓ (in. ³)	
		1.3 (79.33)		1.6 (97.63)	
		0.6 (36.61)		2.7 (164.75)	
Engine weight with Sail-drive unit (Dry)		kg (lb.)		kg (lb.)	
		104 (229)		153 (337)	
		134 (295)		180 (397)	

2. Principal Construction

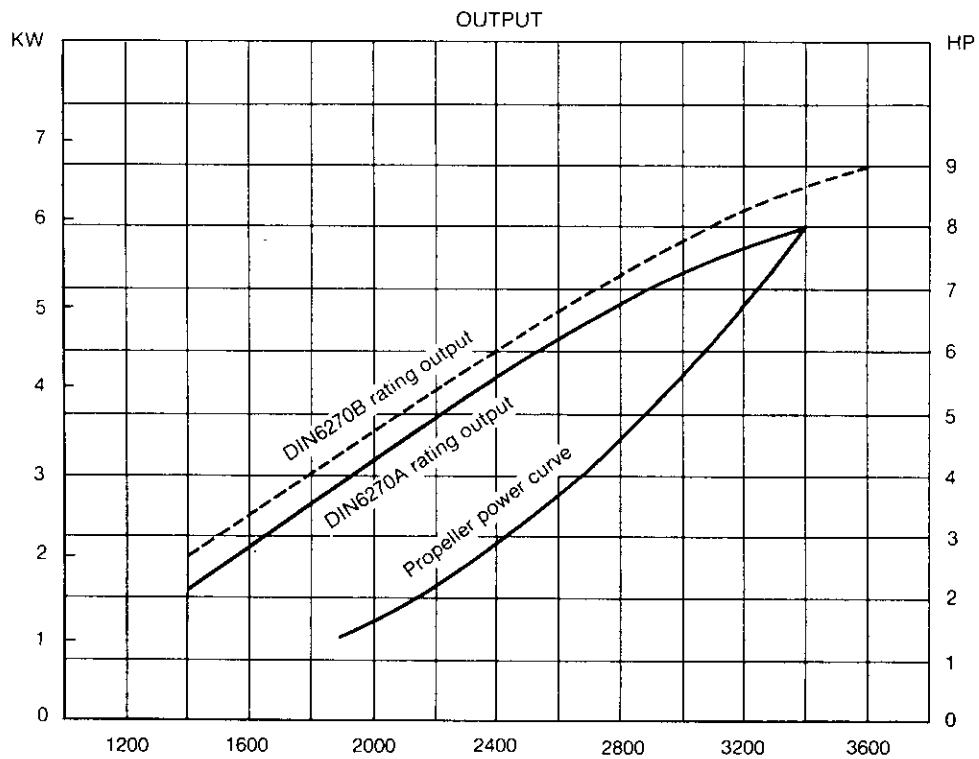
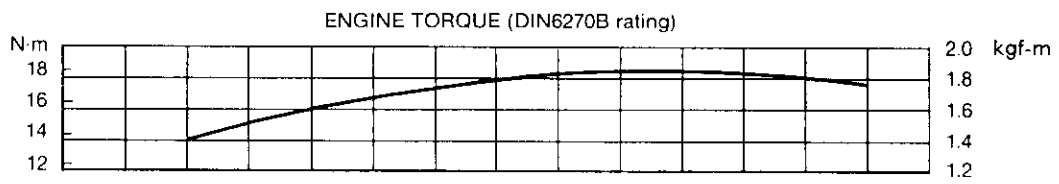
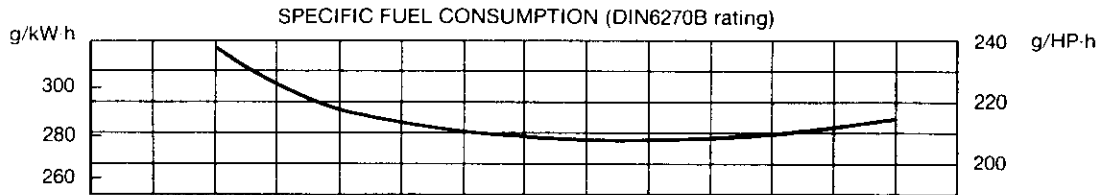
Engine model	1GM10	2GM20	3GM30	3HM35
Group	Part			
		Construction		
Engine block	Cylinder block	Integrally-cast water jacket and crankcase		
	Cylinder liner	Sleeveless		
	Main bearing	Metal housing type		
	Oil sump	Oil pan		
Intake and exhaust systems and valve mechanism	Cylinder head	Integrated type cylinders		
	Intake and exhaust valves	Poppet type, seat angle 90°		
	Exhaust manifold	—	Water-cooled type	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		
	Thermostat	Wax pellet type		
Fuel system	Fuel injection pump	YPFR-0707-1	YPFR-0707-2	YPFR-0707-3
	Fuel injection valve	Throttle valve, OSDYD1		
	Fuel feed pump	Mechanical type		
	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

Fresh-water cooling system (2GM20F, 3GM30F and 3HM35F)

Cooling system	Sea water pump	Rubber impeller type
	Fresh water pump	Centrifugal type
	Thermostat	Wax pellet type
	Heat exchanger	Multi-tube type

3. Performance Curves

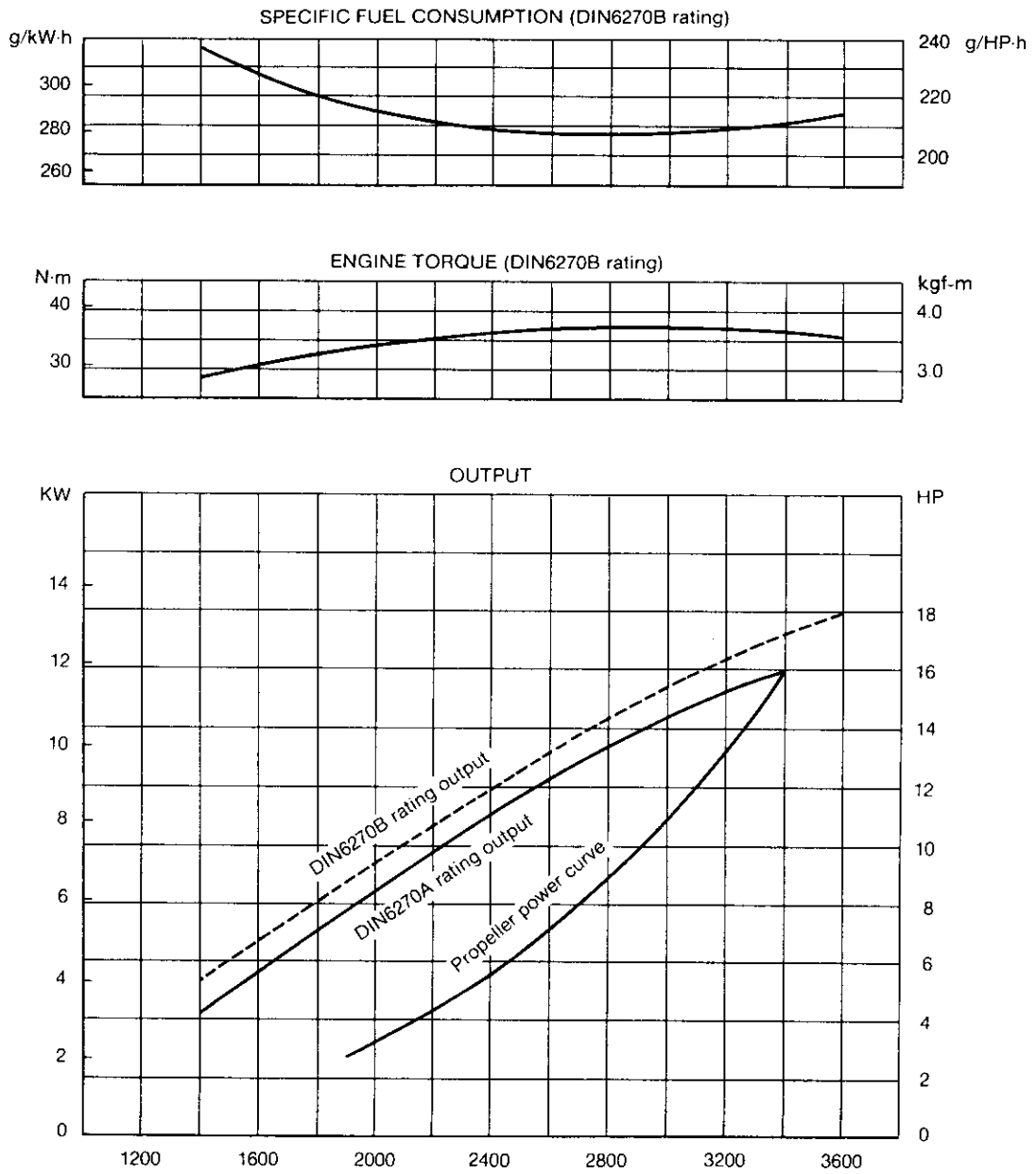
3-1. 1GM10(C)



SPEED OF CRANKSHAFT: rpm
THE ENGINE FLYWHEEL OUTPUT IS APPROX 3% HIGHER.

NOTE: These curves show the average performance of respective engine in test operation at our plant.

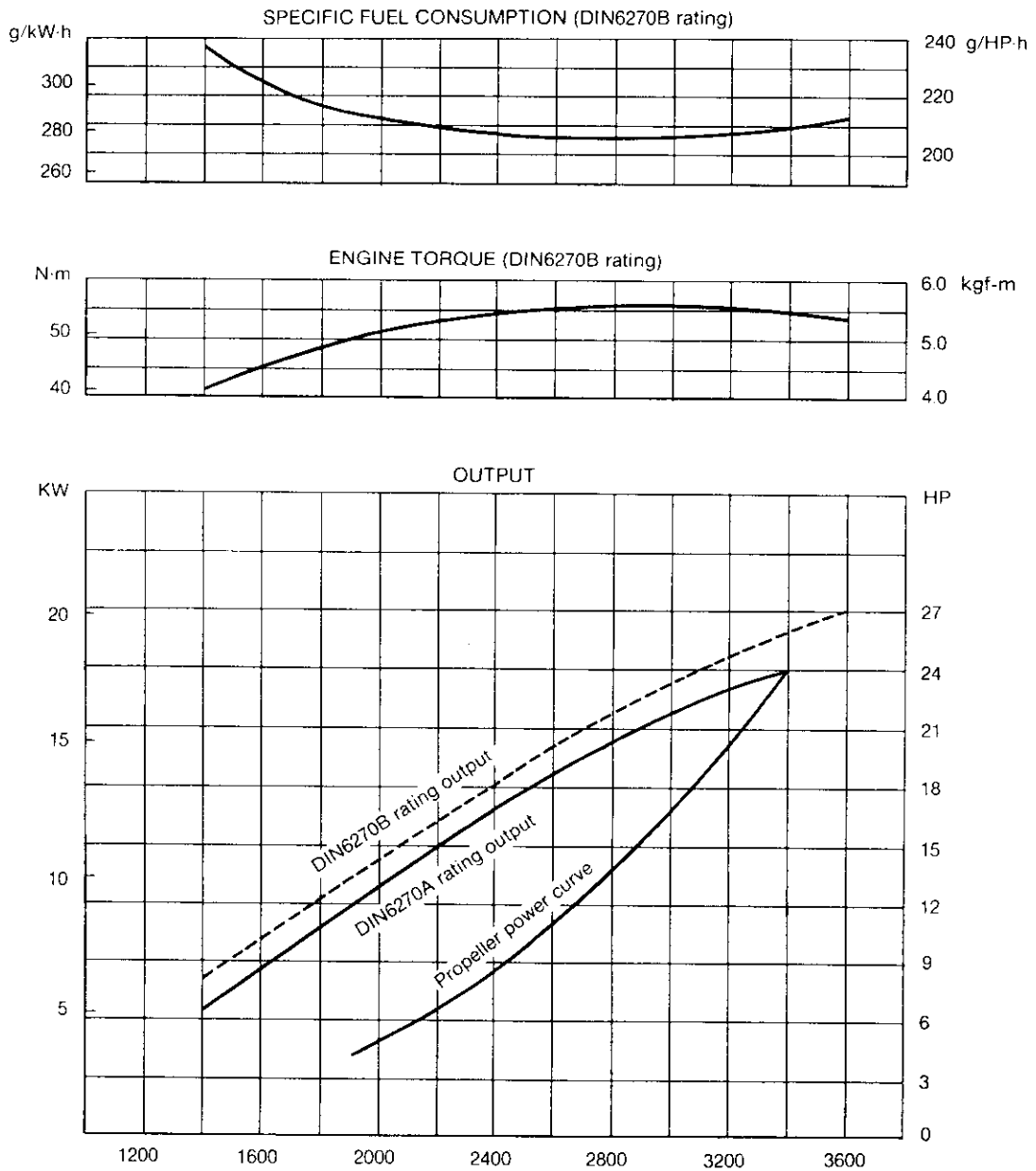
3-2 2GM20(F)(C)



SPEED OF CRANKSHAFT: rpm
THE ENGINE FLYWHEEL OUTPUT IS APPROX 3% HIGHER.

NOTE: These curves show the average performance of respective engine in test operation at our plant.

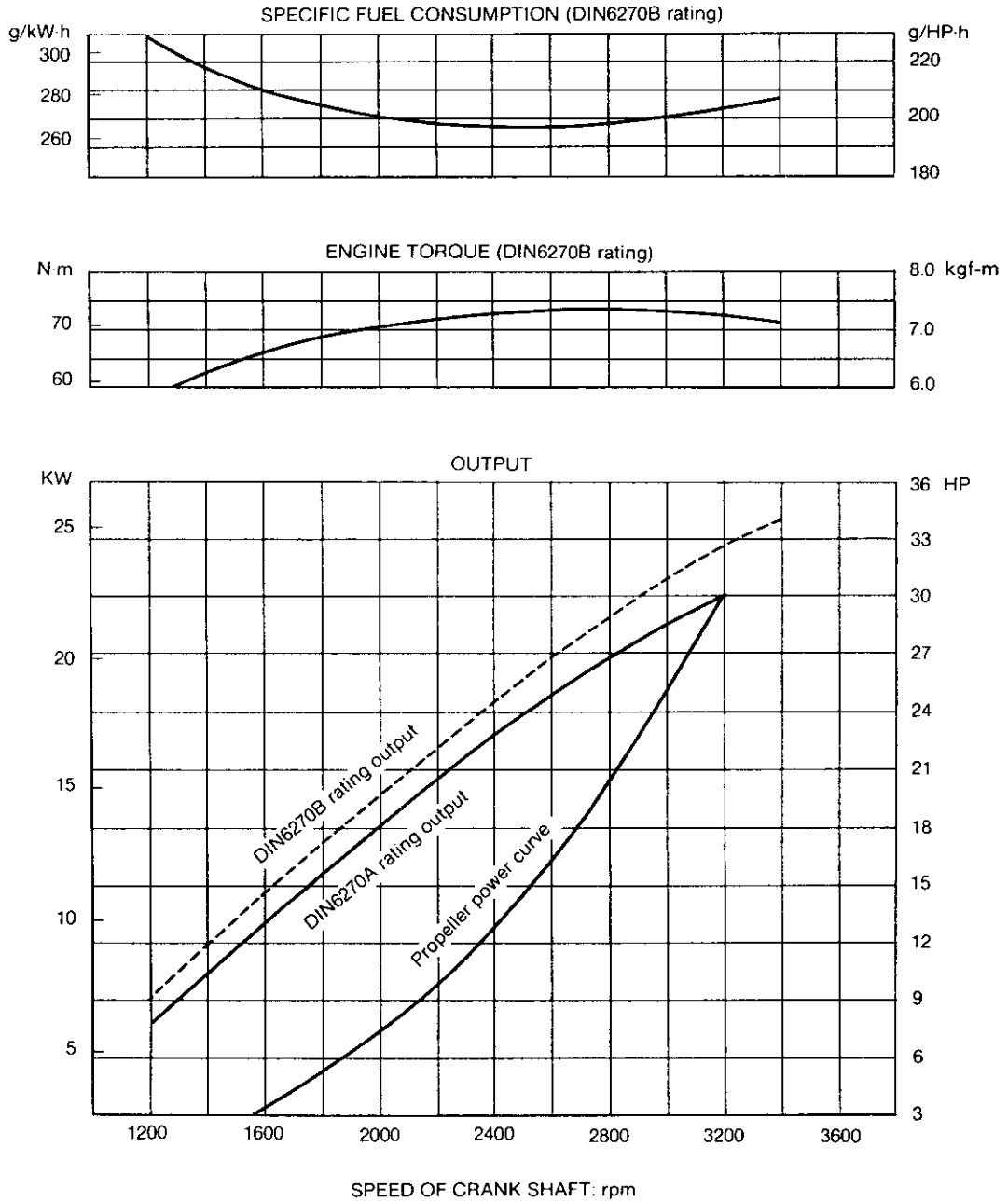
3-3 3GM30(F)(C)



SPEED OF CRANKSHAFT: rpm
THE ENGINE FLYWHEEL OUTPUT IS APPROX 3% HIGHER.

NOTE: These curves show the average performance of respective engine in test operation at our plant.

3-4 3HM35(F)(C)



THE ENGINE FLYWHEEL OUTPUT IS APPROX 3% HIGHER

NOTE: These curves show the average performance of respective engine in test operation at our plant.

4. Features

4-1 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.

4-2 Low operating costs

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

4-3 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.

4-4 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.

4-5 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.

4-6 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.

4-7 Superior matching to the hull

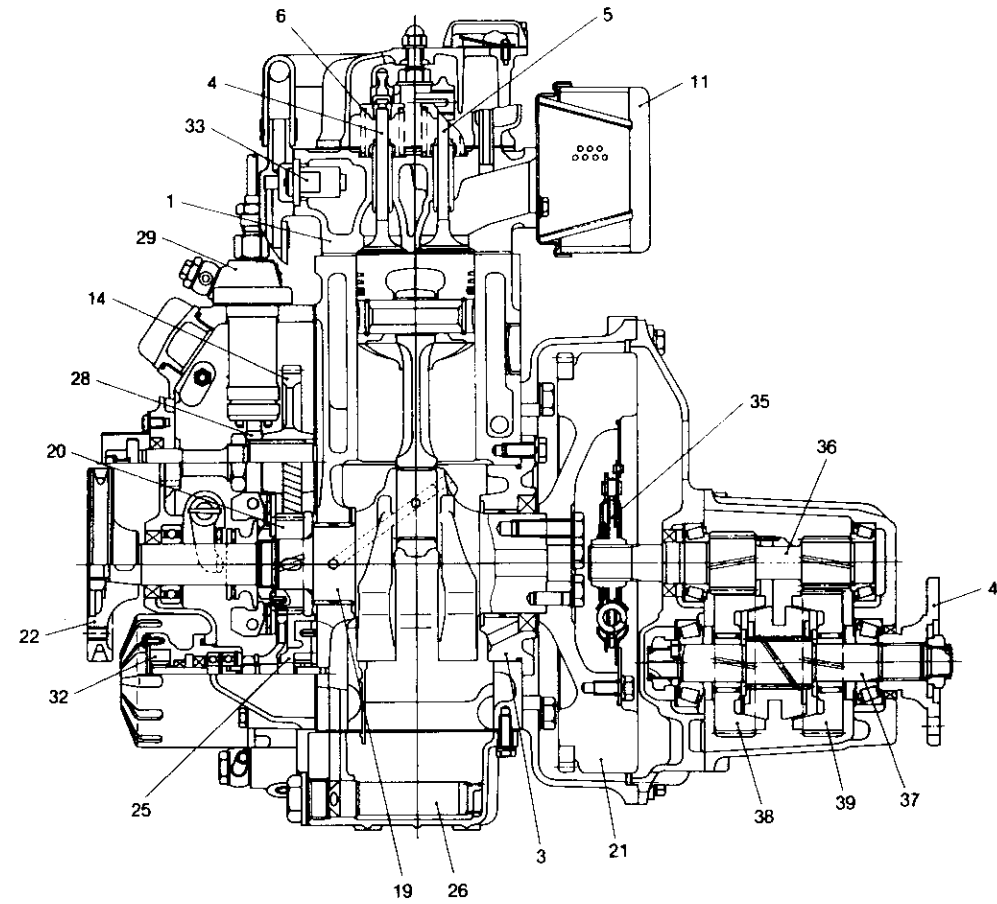
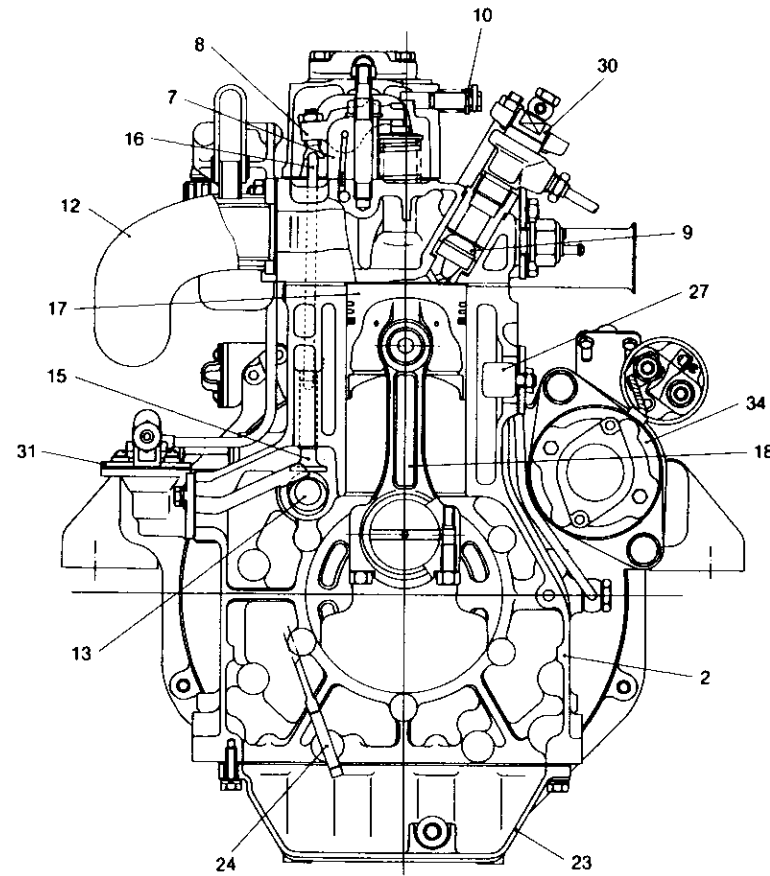
- (1) Four-point support engine installation feet make installation easy.
- (2) Mist intake system prevents contamination of the engine room.
- (3) Since the fuel pump is mounted on the engine, the fuel tank can be installed anywhere.
- (4) Water-cooled manifold prevents a rise in the engine room temperature.
- (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.

4-8 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 3HM35(C) and fresh water cooling type)
- (3) Positive clutch engagement and disengagement; propeller shaft does not rotate when clutch is placed in neutral position.

5. Engine Cross-Sections

5-1 1GM10



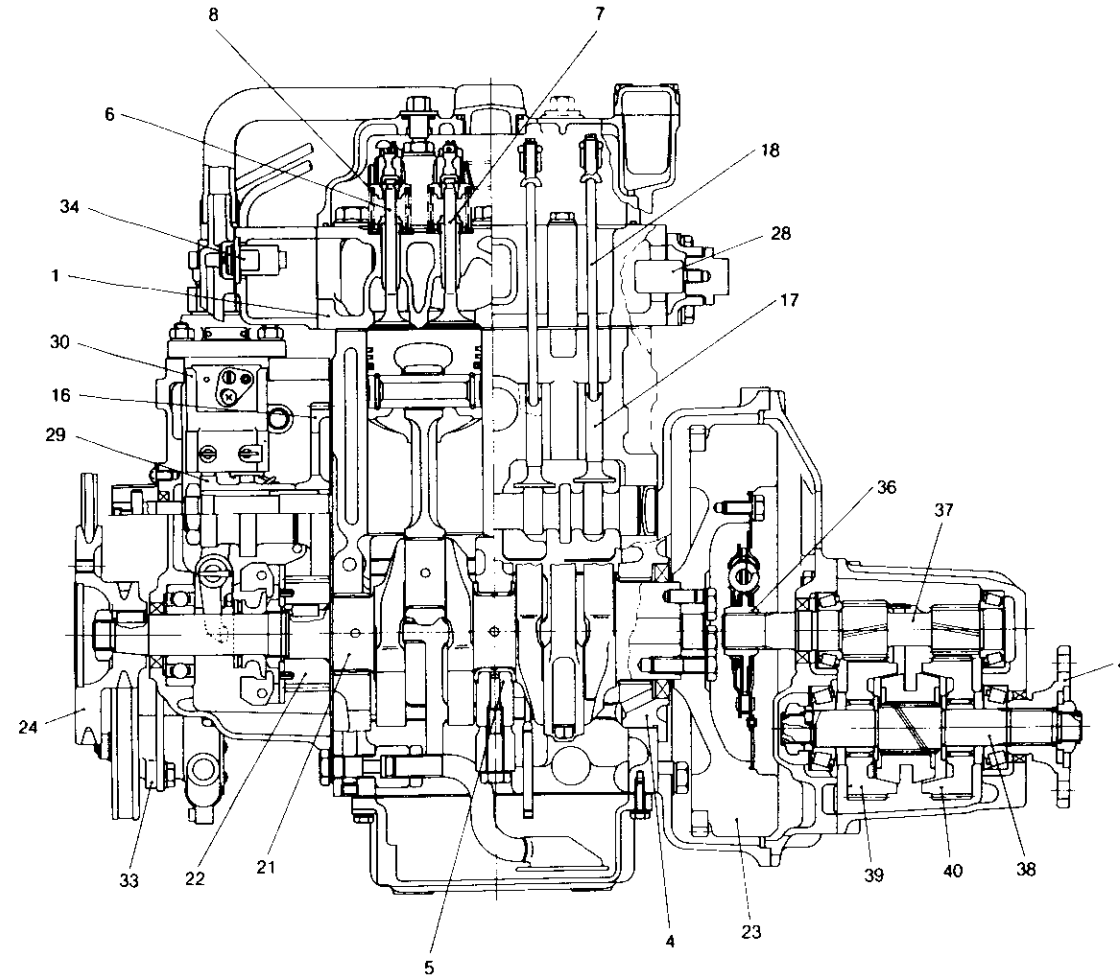
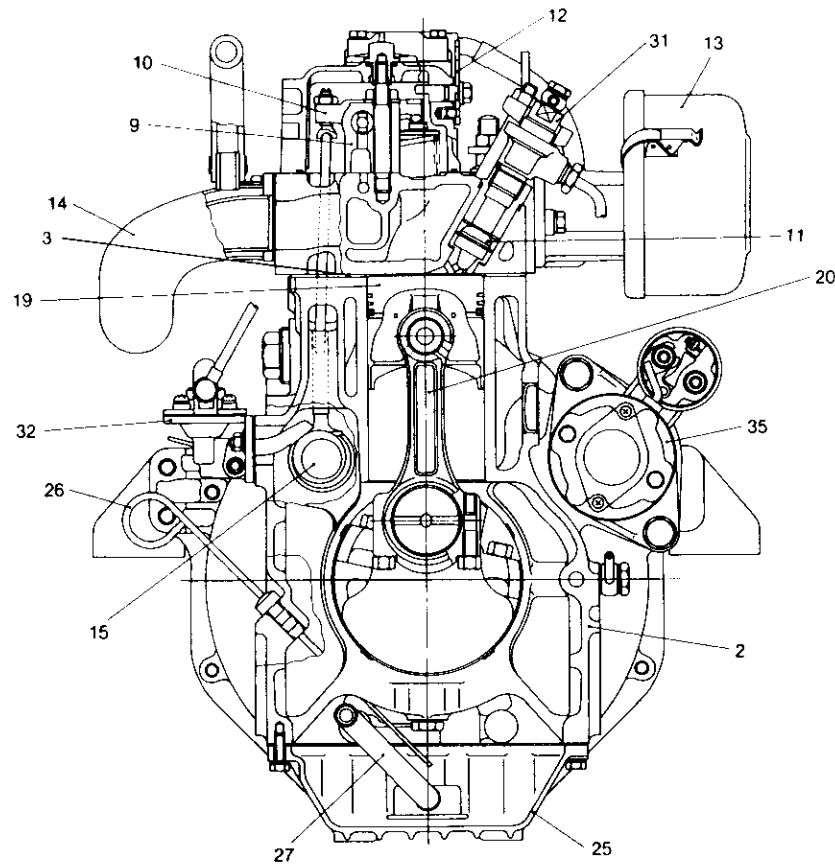
- 1. Cylinder head
- 2. Cylinder body
- 3. Main bearing housing
- 4. Exhaust valve
- 5. Intake valve
- 6. Valve spring
- 7. Valve rocker arm support
- 8. Valve rocker arm
- 9. Precombustion chamber
- 10. Decompression lever

- 11. Intake silencer
- 12. Mixing elbow
- 13. Camshaft
- 14. Camshaft 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 inlet pipe
- 27. Anticorrosion zinc
- 28. Fuel injection pump cam
- 29. Fuel injection pump
- 30. Fuel injection nozzle

- 31. Fuel feed pump
- 32. Cooling water pump
- 33. Thermostat
- 34. Starter motor
- 35. Damper disc
- 36. Input shaft
- 37. Output shaft
- 38. Forward large gear
- 39. Reverse large gear
- 40. Output shaft coupling

5-2 2GM20



- 1. Cylinder head
- 2. Cylinder body
- 3. Cylinder head gasket
- 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

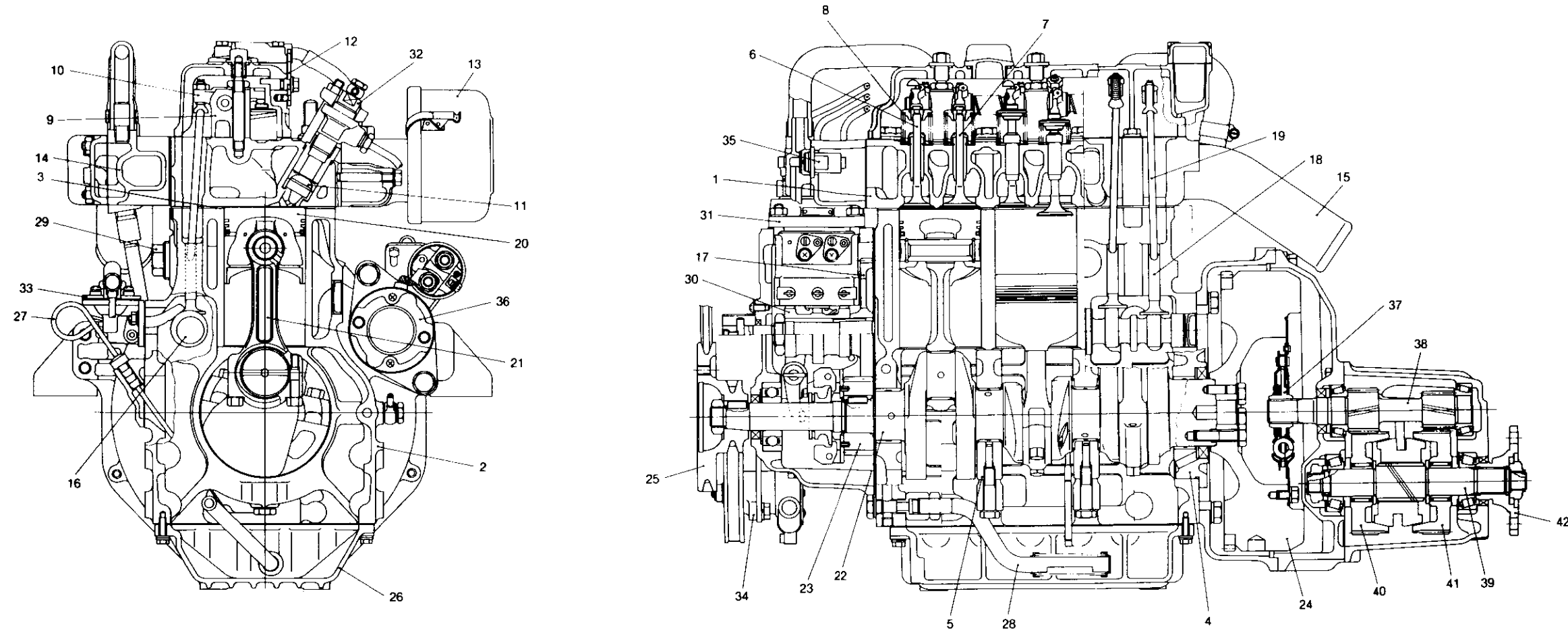
- 11. Precombustion chamber
- 12. Decompression lever
- 13. Intake silencer
- 14. Exhaust manifold
- 15. Camshaft
- 16. Camshaft gear
- 17. Tappet
- 18. Push rod
- 19. Piston
- 20. Connecting rod

- 21. Crankshaft
- 22. Crankshaft gear
- 23. Flywheel
- 24. Crankshaft V-pulley
- 25. Oil pan
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- 27. Lubricating oil inlet pipe
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- 31. Fuel injection nozzle
- 32. Fuel feed pump
- 33. Cooling water 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

5-3 3GM30



- 1. Cylinder head
- 2. Cylinder body
- 3. Cylinder head gasket
- 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. Intake silencer
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- 41. Reverse large gear
- 42. Output shaft coupling