YANMAR

HINSHI-H8009

SERVICE MANUAL

MARINE DIESEL ENGINE

JH3 Series

3JH3(B)(C)E
4JH3(B)(C)E

2000.3.10

FOREWORD

This service manual has been complied 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 the applicability of 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 to 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.
Model 4JH3E has been used for the illustrations in this service manual, but they apply to models 3JH3E, 3JH3BE, 3JH3CE, 4JH3BE, and 4JH3CE as well.

METRIC
ALL DIMENSIONS IN MILLIMETERS
UNLESS OTHERWISE SPECIFIED

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MODELS

3JH3(B)(C)E, 4JH3(B)(C)E

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CHAPTER 1

GENERAL

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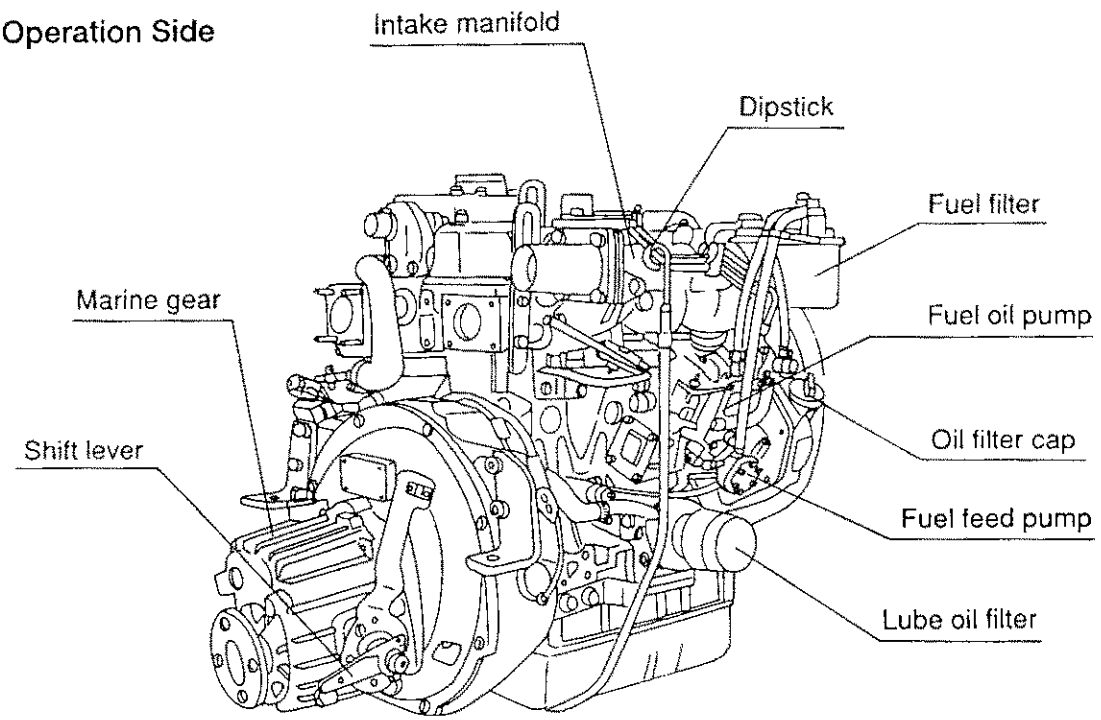
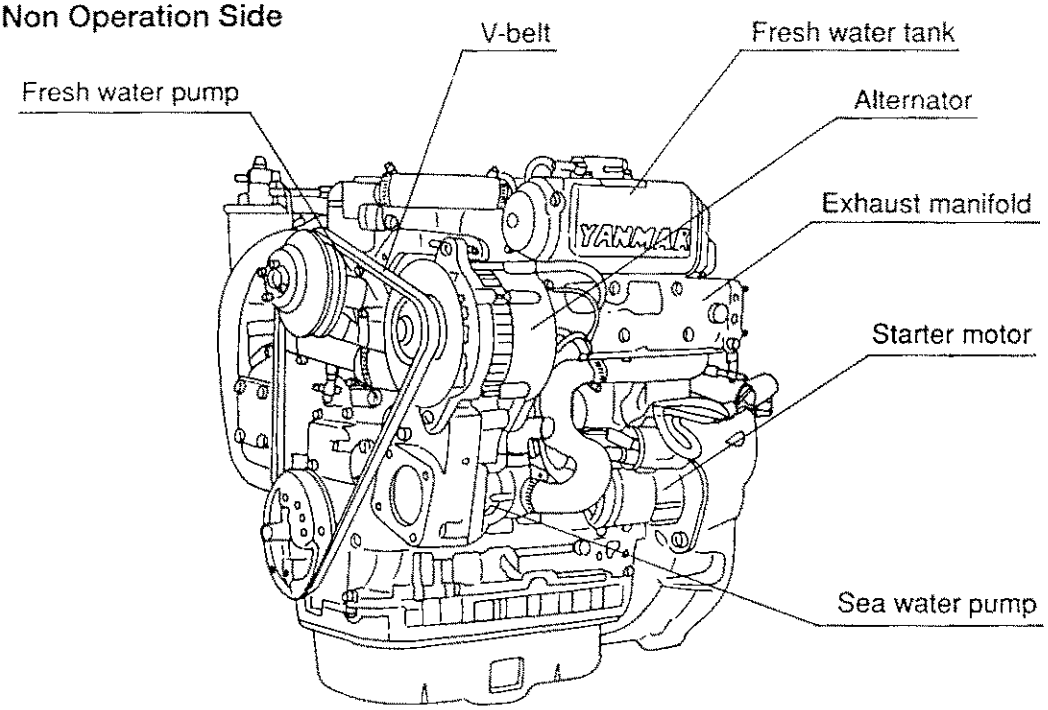
1. Exterior Views

1-1 3JH3E

• Operation Side



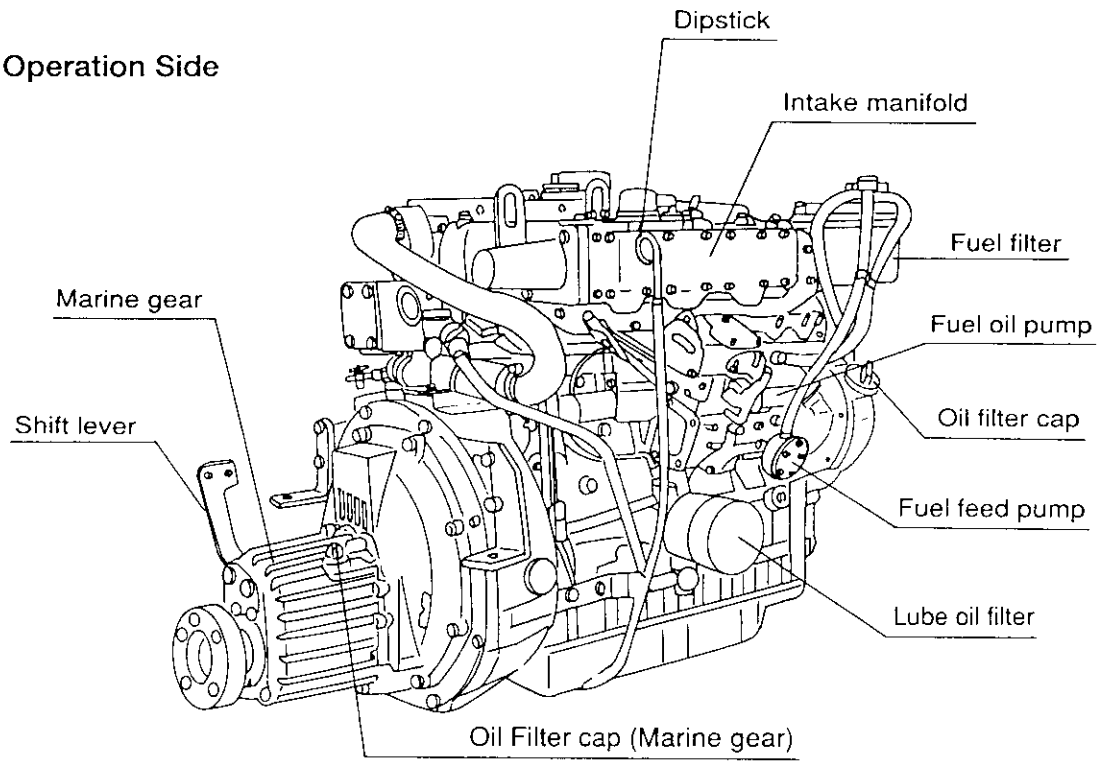
• Non Operation Side



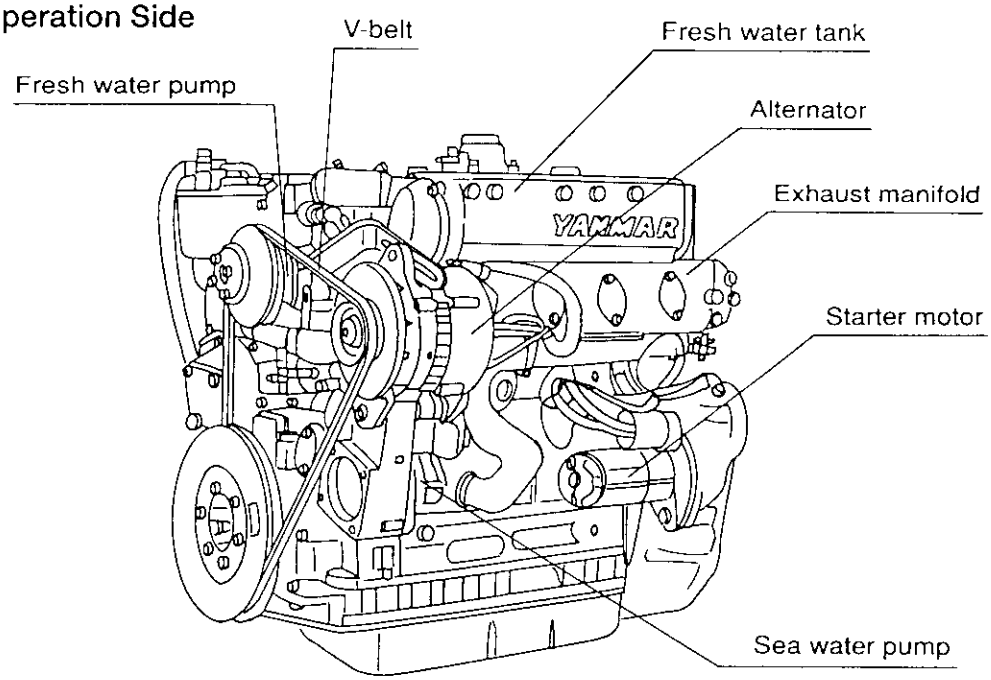
〈Note〉 This illustration shows Yanmar marine gear (Model : KM3P) when it has been attached.

1-2 4JH3E

● Operation Side



● Non Operation Side



〈**Note**〉 This illustration shows Yanmar marine gear (Model : KM3P) when it has been attached.

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2. Specifications

2-1 3JH3E, 3JH3BE, 3JH3CE

Model			3JH3E	3JH3BE	3JH3CE
Type			Vertical 4-cycle water cooled diesel engine		
Combustion system			Direct injection		
Aspiration			Normal aspiration		
Number of cylinders			3		
Bore × stroke		mm	84 × 90		
Displacement		ℓ	1.496		
One hour rating output (flywheel output)	Output/crankshaft speed	kW/rpm (HP/rpm)	26.5/3650 (36/3650)		
	Brake mean effective pressure	kgf/cm²	5.93		
	Piston speed	m/sec.	10.95		
Continuous rating outpot (DIN6270A) flywheel output	Output/crankshaft speed	kW/rpm (HP/rpm)	29.4/3800 (40/3800)		
	Brake mean effective pressure	kgf/cm²	0.621 (6.33)		
	Piston speed	m/sec.	11.4		
Compression ratio			17.7		
Fire order			240° 240° 240° 1 — 3 — 2 — 1		
Fuel injection pump			YPES-CL (with Timer)		
Fuel injection timing (b.T.D.C.)		degree	12°		
Fuel injection pressure		kg/cm²	200±5		
Fuel injection nozzle			Hole type		
Direction of rotation	(Crankshaft)		Counter-clock wise viewed from stern		
Power take off			At Flywheel side		
Cooling system			Constant high temperature fresh water cooling Fresh water : Centrifugal pump Sea water :Rubber impeller pump		
Lubrication system			Forced lubrication with trochoid pump		
Starting system	Starting motor		DC 12V,1.2kW		
	AC generato		12V,55A (12V80A : Option)		
Marine Gear	Model		KM3P	KM3A	(Sail Drive SD-31 can be used directly on location.)
	Type		Mechanical cone clutch	Mechanical cone clutch (torque limiter no angle)	
	Reduction rate (ahead/astern)	i/i	2.36/3.16 2.61/3.16 3.20/3.16	2.33/3.04 2.64/3.04	——
	Propeller speed (ahead/astern)	rpm	1610/1203 1457/1203 1188/1203	1629/1249 1441/1249	——
	Standard propeller (Dia. ×pitch×number)	mm	——		
	Propeller shaft dia. × Countershaft dia.	mm	——		
	Lubrication system		Splash		
	Lube oil pan Total capacity	ℓ	0.35	0.45	——
	Lube oil pan Effective capacity	ℓ	0.05	0.05	——
	Cooling system		——	——	——
	Weight	[kg]	[13]	[13]	——
Dimensions	Overall length	mm	755.6	752.8	545.8
	Overall width	mm	520.6		520.6
	Overall height	mm	628.6		628.6
Engine weight without marine gear (dry)		kg	186		173
Lubricating oil capacity Effect/max.		ℓ	4.4/1.8	4.9/2.1	4.9/2.1

(Note) Rating condition : ISO — 3046/1, 1HP ≒ 0.7355 kW

2-2 4JH3E, 4JH3BE, 4JH3CE

Engine Model			4JH3E	4JH3BE	4JH3CE
Type			Vertical 4-cycle water cooled diesel engine		
Combustion system			Direct injection		
Aspiration			Normal aspiration		
Number of cylinders			4		
Bore × stroke		mm	84 × 90		
Displacement		ℓ	1.995		
One hour rating output (flywheel output)	Output/crankshaft speed	kW/rpm (HP/rpm)	36.8/3650 (50/3650)		34.6/3650 (47/3650)
	Brake mean effective pressure	kgf/cm²	6.18		5.81
	Piston speed	m/sec.	10.95		
Continuous rating outpot (DIN6270A) flywheel output	Output/crankshaft speed	kW/rpm (HP/rpm)	41.2/3800 (56/3800)		38.2/3800 (52/3800)
	Brake mean effective pressure	kgf/cm²	6.65		
	Piston speed	m/sec.	11.4		
Compression ratio			17.7		
Fire order			180° 180° 180° 180° 1 — 3 — 4 — 2 — 1		
Fuel injection pump			In-line type YPES-CL (with Timer)		
Fuel injection timing (b.T.D.C.)		degree	(b.T.D.C.) 12°		
Fuel injection pressure		kg/cm²	220±5		
Fuel injection nozzle			Hole type		
Direction of rotation	(Crankshaft)		Counter-clock wise viewed from stern		
Power take off			At Flywheel side		
Cooling system			Constant high temperature fresh water cooling Fresh water : Centrifugal pump Sea water :Rubber impeller pump		
Lubrication system			Forced lubrication with trochoid pump		
Starting system	Starting motor		DC 12V,1.2kW		
	AC generato		12V,55A (12V, 80A : option)		
Marine Gear	Model		KM3P	KM3A	(Sail Drive SD-31 can be used directly on location.)
	Type		Mechanical cone clutch	Mechanical cone clutch (torque limiter no angle)	
	Reduction rate (ahead/astern)	i/i	2.36/3.16 2.61/3.16	2.33/3.04 2.64/3.04	——
	Propeller speed (ahead/astern)	rpm	1610/1203 1457/1203	1629/1249 1441/1229	——
	Standard propeller (Dia. ×pitch×number)	mm	——		
	Propeller shaft dia. × Countershaft dia.	mm	——		
	Lubrication system		Splash		
	Lube oil pan Total capacity	ℓ	0.35	0.45	——
	Lube oil pan Effective capacity	ℓ	0.05	0.05	——
	Cooling system		——	——	——
	Weight	[kg]	[13]	[13]	——
Dimensions	Overall length	mm	849.6		639.8
	Overall width	mm	563.1		563.6
	Overall height	mm	623.6		623.6
Engine weight without marine gear (dry)		kg	223		210
Lubricating oil capacity Effect/max.		ℓ	5.3/1.1 at engine installation angle 0°		

(Note) Rating condition : ISO — 3046/1, 1HP ≒ 0.7355 kW

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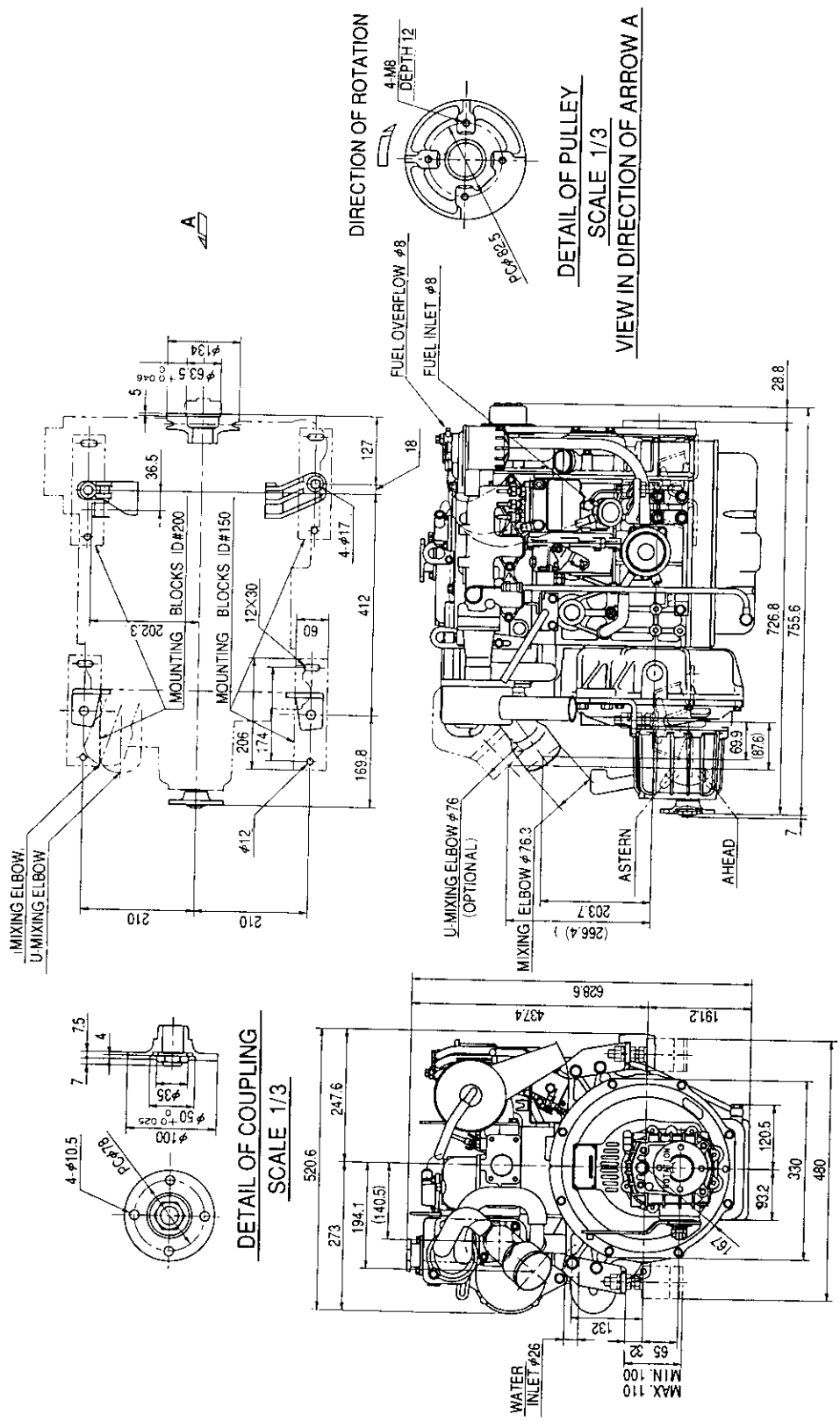
2-3 Sales condition, Marine gear

Reduction ratio (Marine gear model)	No. of blades	Outer diameter of propeller	Moment of propeller inertia (GD^2kg-m^2)	Propeller materials	Engine application
3.20 (KM3P)	3	≦ ϕ 490	≦0.23	Bronze	3JH3(B)E
3.21 (KM3A)	4	≦ ϕ 460			
2.61 (KM3P)	3	≦ ϕ 470	≦0.19		3JH3(B)E
2.64 (KM3A)	4	≦ ϕ 440			
2.36 (KM3P)	3	≦ ϕ 450	≦0.15		4JH3(B)E
2.33 (KM3A)	4	≦ ϕ 425			

3. Engine Outline

3-1 3JH3E (with KM3P Marine gear)



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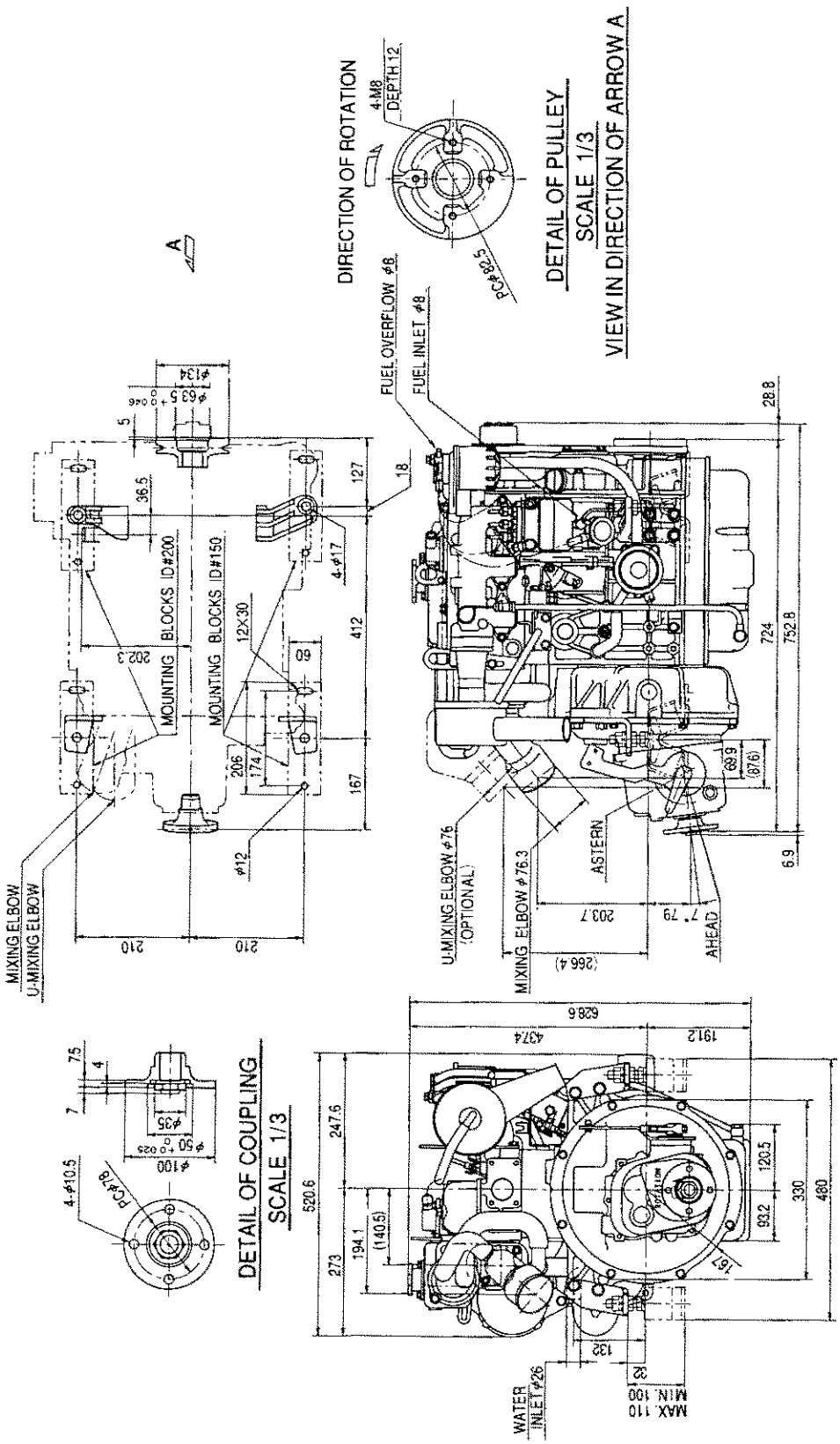
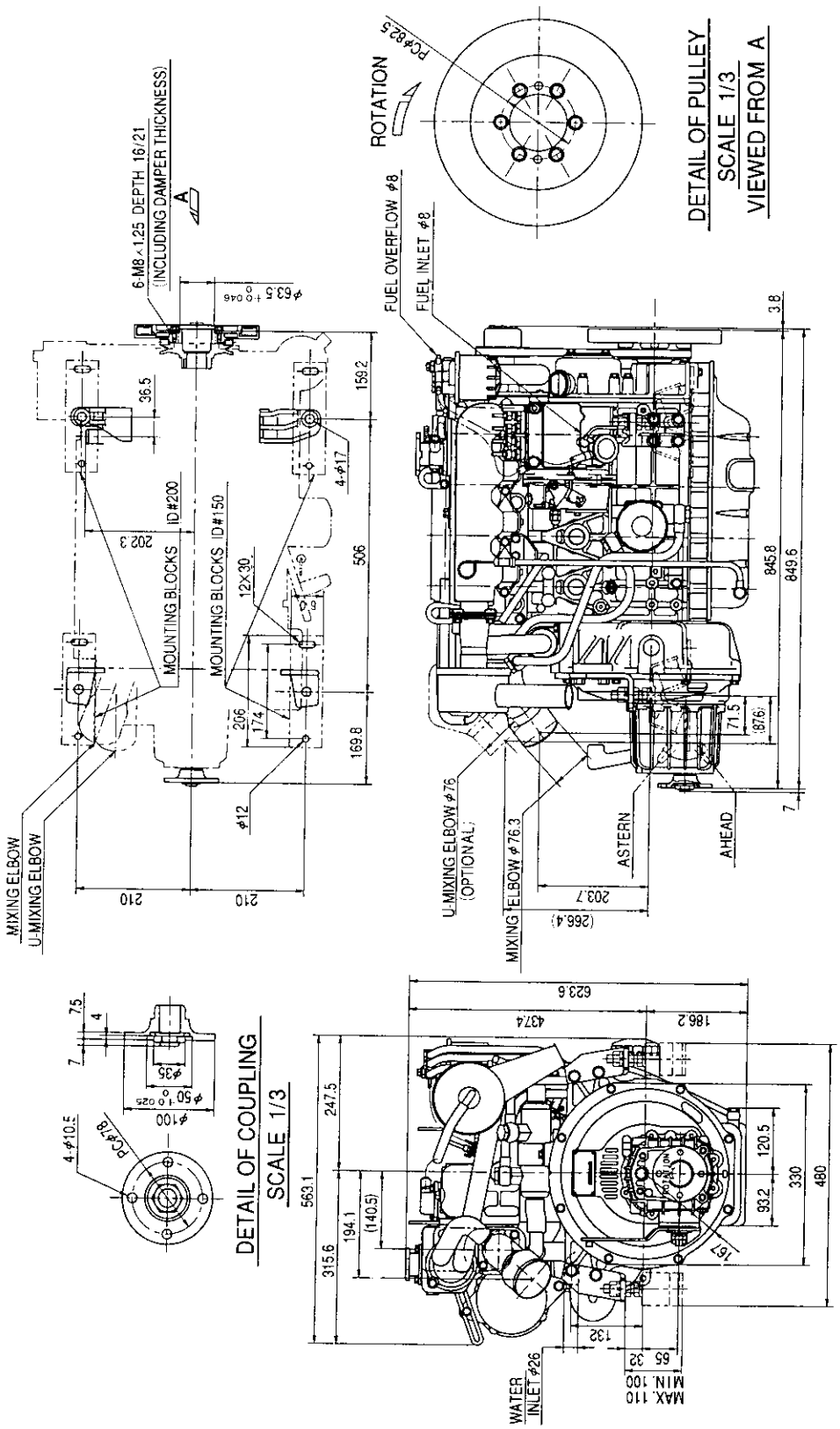
3-2 3JH3BE (with KM3A Marine gear)



3-3 4JH3E (with KM3P Marine gear)



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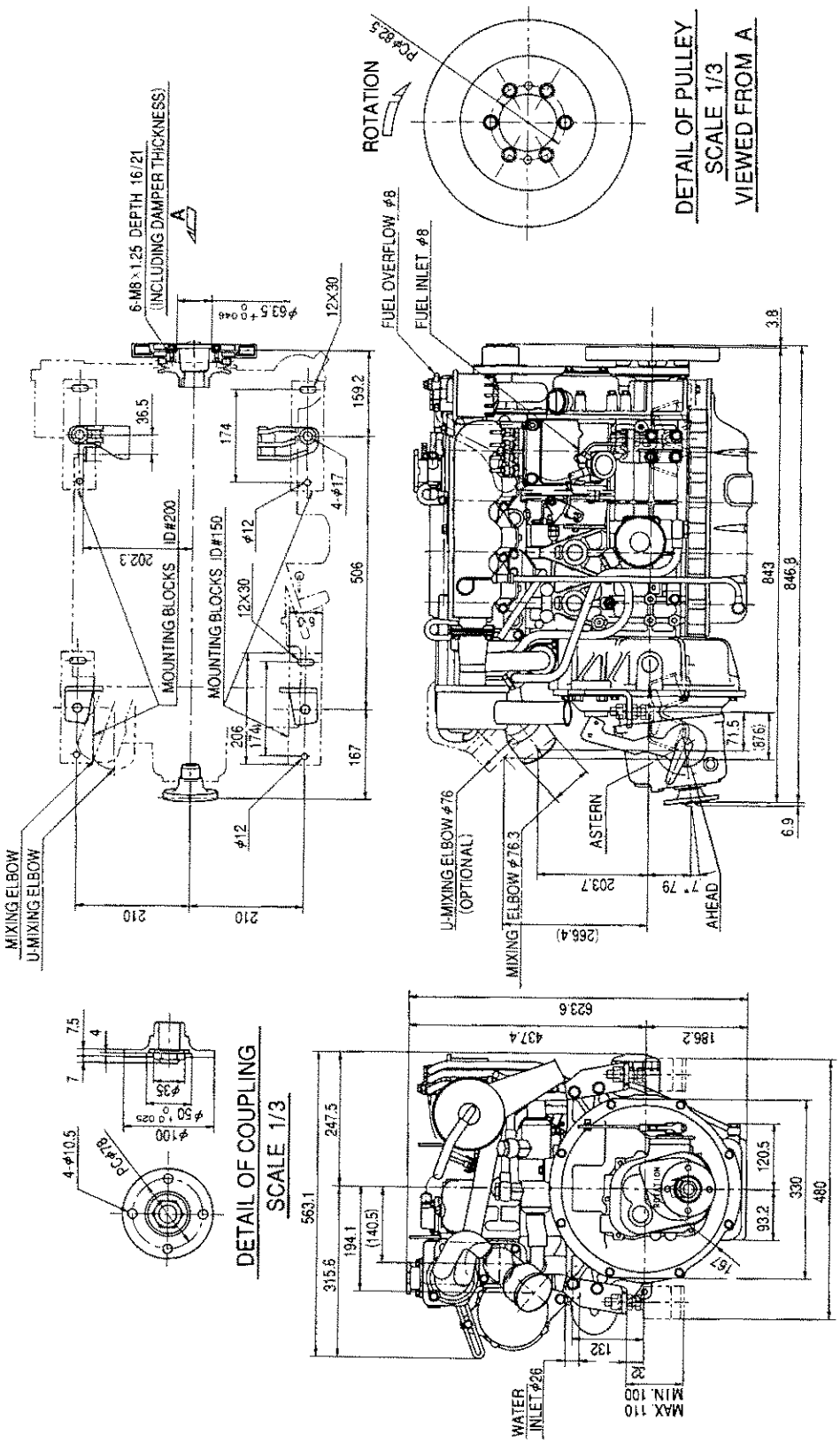
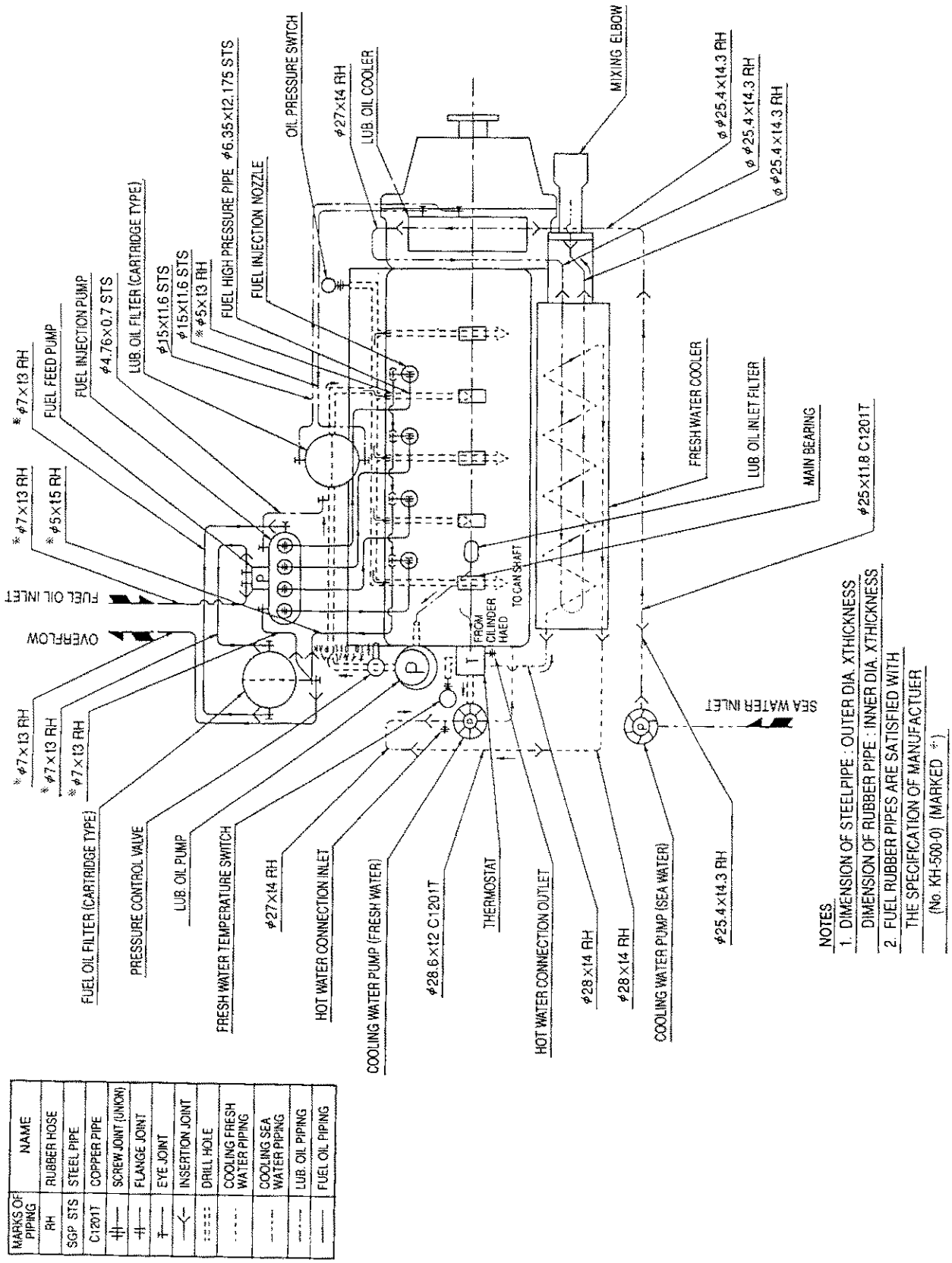
3-4 4JH3BE (with KM3A Marine gear)



4. Piping Diagrams

4-1 3,4JH3(B)(C)E

Note : The following piping diagram is for the 4JH3E model. The piping diagram for the 3JH3E model is the same with the exception that this model has 3 cylinders.



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CHAPTER 2

INSPECTION AND SERVICING OF BASIC ENGINE PARTS

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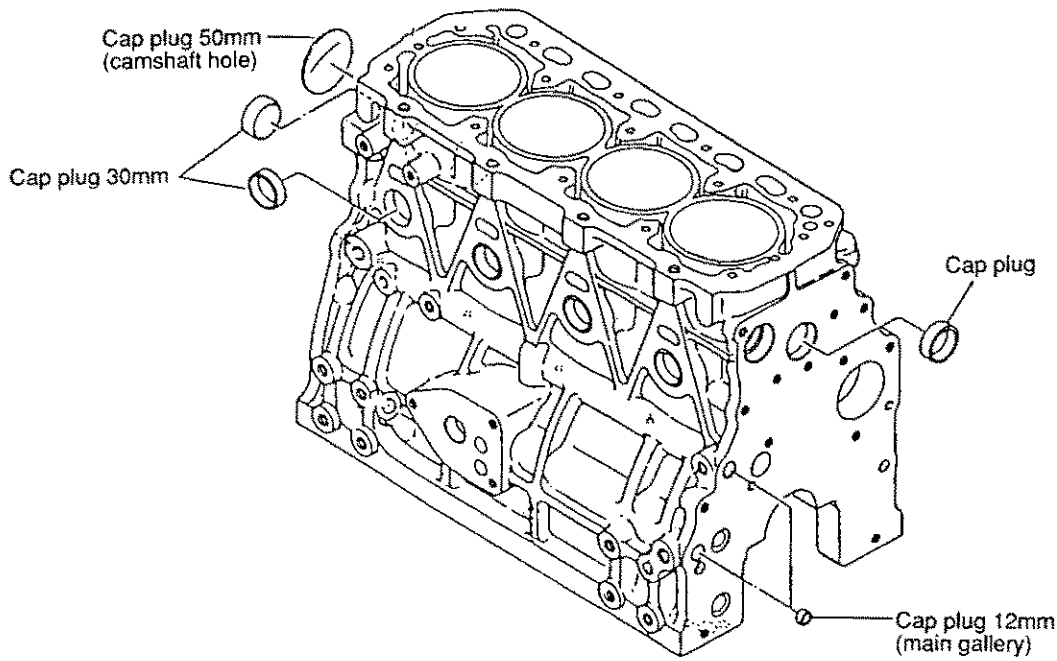
1. Cylinder Block

The cylinder block is a thin-skinned, (low-weight), short skirt type with rationally placed ribs. The side walls are wave shaped to maximize ridigity for strength and low noise.



1-1 Inspection of parts

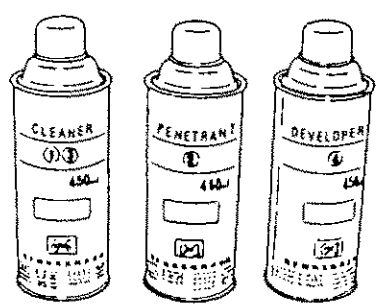
Make a visual inspection to check for cracks on engines that have frozen up, overturned or otherwise been subjected to undue stress. Perform a color check on any portions that appear to be cracked, and replace the cylinder block if the crack is not repairable.

1-2 Cleaning of oil holes

Clean all oil holes, making sure that none are clogged up and the blind plugs do not come off.

Color check kit

	Quantity
Penetrant	1
Developer	2
Cleaner	3



1-3 Color check procedure

(1) Clean the area to be inspected.
(2) Color check kit
The color check test kit consists of an aerosol cleaner, penetrant and developer.
(3) Clean the area to be inspected with the cleaner.
Either spray the cleaner on directly and wipe, or wipe the area with a cloth moistened with cleaner.
(4) Spray on red penetrant
After cleaning, spray on the red penetrant and allow 5 ~10 minutes for penetration. Spray on more red penetrant if it dries before it has been able to penetrate.
(5) Spray on developer
Remove any residual penetrant on the surface after the penetrant has penetrated, and spray on the developer. If there are any cracks in the surface, red dots or a red line will appear several minutes after the developer dries.
Hold the developer 300~400mm away from the area being inspected when spraying, making sure to coat the surface uniformly.
(6) Clean the surface with the cleaner.

NOTE : Without fail, read the instructions for the color check kit before use.

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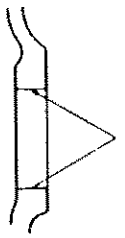
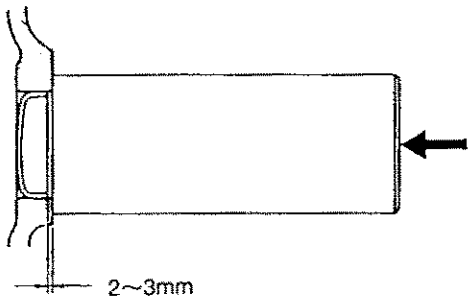
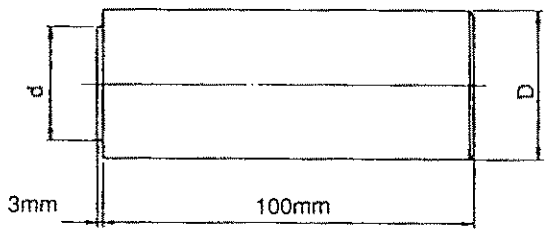
1-4 Replacement of cup plugs

Step No.	Description	Procedure	Tool or material used
1	Clean and remove grease from the hole into which the cup plug is to be driven. (Remove scale and sealing material previously applied.)	 Remove foreign materials with a screw driver or saw blade.	• Screw driver or saw blade • Thinner
2	Remove grease from the cup plug.	Visually check the nick around the plug.	• Thinner
3	Apply Threebond No. 4 to the seat surface where the plug is to be driven in.	Apply over the whole outside of the plug.	• Threebond No. 4
4	Insert the plug into the hole.	Insert the plug so thal it sits conectly.	
5	Place a driving tool on the cup plug and drive it in using a hammer.  2~3mm *Using the special tool, drive the cup plug so that the edge of the plug is 2mm (0.0787in.) below the cylinder surface.	Drive in the plug parallel to the seating surface.  d D 3mm 100mm mm Plug dia. / d / D ϕ12 / ϕ11.9~12.0 / ϕ20 ϕ30 / ϕ29.9~30.0 / ϕ40	• Driving tool • Hammer

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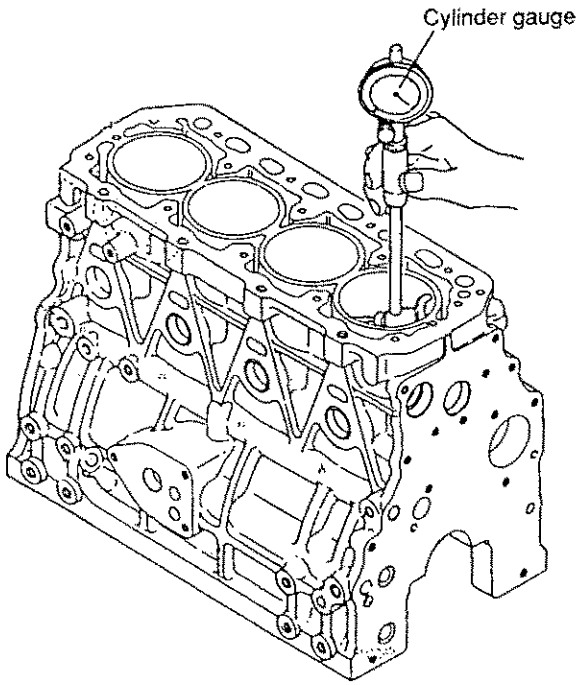
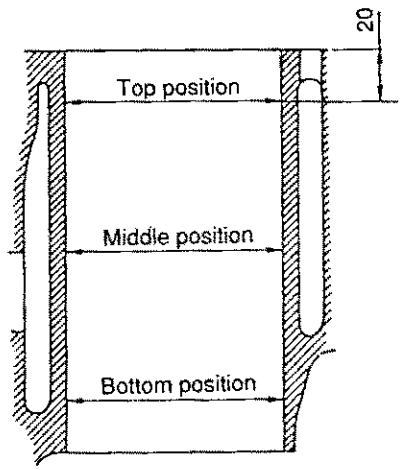
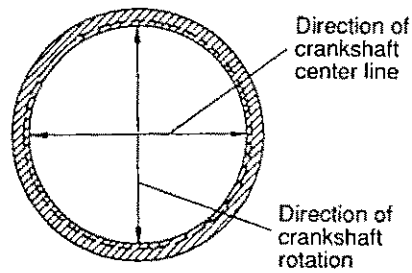
1-5 Cylinder bore measurement

Measure the bore diameter with a cylinder gauge at the positions shown in the figure.
Replace the cylinder bore when the measured value exceeds the wear limit. Measurement must be done at least at 3 positions as shown in the figure, namely, top, middle and bottom positions in both directions along the crankshaft rotation and crankshaft center lines.



mm



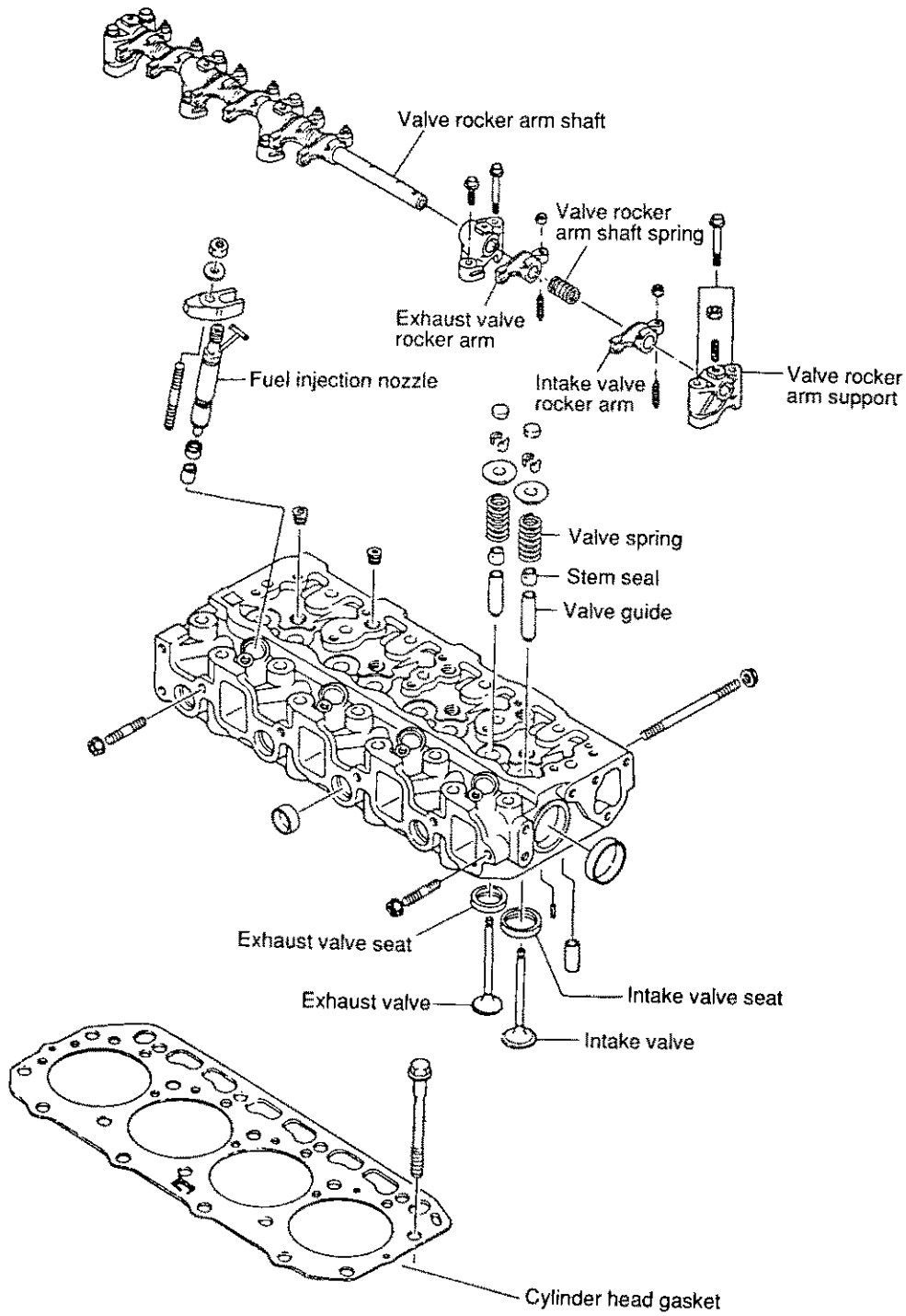


mm

	Standard	Wear limit
Cylinder bore dia.	ϕ84.00~ϕ84.03	ϕ84.20
Cylinder roundness	0~0.01	0.03

2. Cylinder Head

The cylinder head is of 4-cylinder integral construction, mounted with 18 bolts. Special alloy stellite with superior resistance to heat and wear is fitted on the seats, and the area between the valves is cooled by a water jet.



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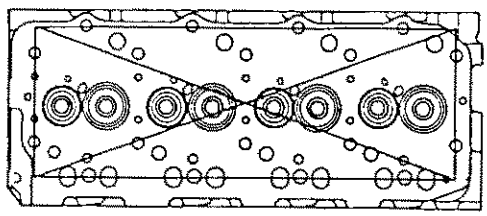
2-1 Inspecting the cylinder head

The cylinder head is subjected to very severe operating conditions with repeated high pressure, high temperature and cooling. Thoroughly remove all the carbon and dirt after disassembly and carefully inspect all parts.

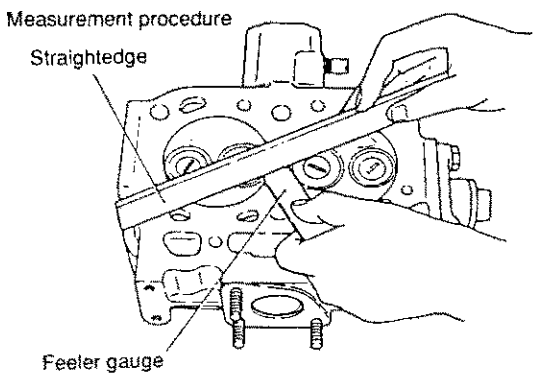


2-1.1 Distortion of the combustion surface

Carefully check for cylinder head distortion as this leads to gasket damage and compression leaks.

(1) Clean the cylinder head surface.

(2) Place a straight-edge along each of the four sides and each diagonal. Measure the clearance between the straight-edge and combustion surface with a feeler gauge.

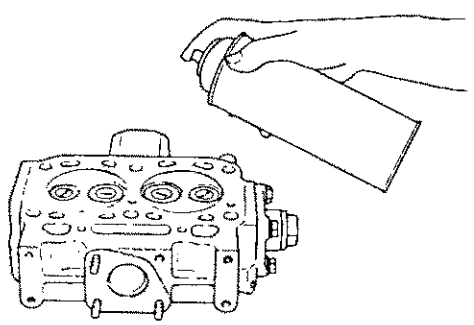


mm

	Standard	Wear limit
Cylinder head distortion	0.05 or less	0.15

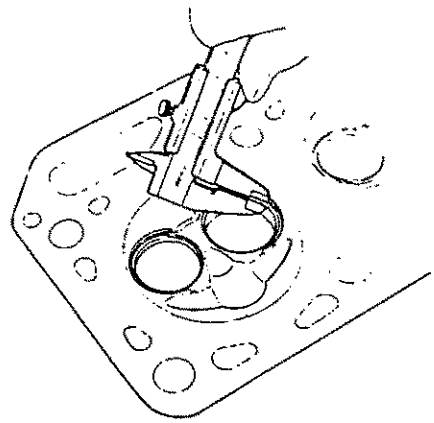
2-1.2 Checking for cracks in the combustion surface

Remove the fuel injection nozzle, intake and exhaust valve and clean the combustion surface. Check for discoloration or distortion and conduct a color check test to check for any cracks.



2-1.3 Checking the intake and exhaust valve seats

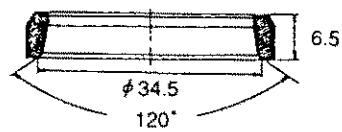
Check the surface and width of the valve seats.
If they are too wide, or if the surfaces are rough, correct to the following standards:



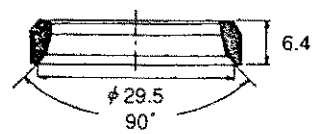
Seat angle	Intake	120°
	Exhaust	90°

Seat width	Standard	Wear limit
Intake	1.07 ~1.24	1.74
Exhaust	1.24~1.45	1.94

Intake valve seat



Exhaust valve seat



Standard dimension