

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 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 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

The contents of this service manual may not be copied or reproduced without permission.

MODELS

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

Chapter 1 GENERAL

- 1. Exterior Views1-1
- 2. Specifications1-3
- 3. Engine Outling1-6
- 4. Piping Diagrams1-10

Chapter 2 INSPECTION AND SERVICING OF BASIC ENGINE PARTS

- 1. Cylinder Block2-1
- 2. Cylinder Head2-4
- 3. Piston and Piston Pins2-11
- 4. Connecting Rod2-15
- 5. Crankshaft and Main Bearing2-18
- 6. Camshaft and Tappets2-21
- 7. Timing Gear2-24
- 8. Flywheel and Housing2-26

Chapter 3 FUEL INJECTION EQUIPMENT

- 1. Fuel injection Pump Service Data3-1
- 2. Governor3-4
- 3. Disassembly, Reassembly and Inspection of Fuel injection pump3-14
- 4. Adjustment of Fuel Injection Pump and Governor3-24
- 5. Fuel Feed Pump3-30
- 6. Fuel injection Nozzle3-32
- 7. Troubleshooting3-36
- 8. Tools3-38
- 9. Fuel Filter3-40
- 10. Fuel Tank3-41
- 11. Troubleshooting3-42

Chapter 4 INTAKE AND EXHAUST SYSTEM

- 1. Intank System4-1
- 2. Exhaust System4-2

Chapter 5 LUBRICATION SYSTEM

- 1. Lubrication System5-1
- 2. Lube Oil Pump5-2
- 3. Lube Oil Filter5-6
- 4. Lube Oil Cooler5-8
- 5. Rotary Waste Oil Pump (Optional)5-9

Chapter 6 COOLING WATER SYSTEM

- 1. Cooling Water System6-1
- 2. Sea Water Pump6-3
- 3. Fresh Water Pump6-5
- 4. Heat Exchanger6-8
- 5. Pressure Cap and Sub Tank6-10
- 6. Thermostat6-12
- 7. Bilge pump and Bilge Strainer (Optional)6-14

Chapter 7 REDUCTION AND REVERSING GEAR

Marine Gear Models [KM3A]

- 1. Construction7-1
- 2. Shifting Device7-7
- 3. Inspection and Servicing7-12
- 4. Disassembly7-20
- 5. Reassembly7-25

Marine Gear Models [KM3P]

- 1. Construction7-29
- 2. Shifting Device7-35
- 3. Inspection and Servicing7-40
- 4. Disassembly7-48
- 5. Reassembly7-53

Chapter 8 REMOTE CONTROL (OPTIONAL)

- 1. Remote Control System8-1
- 2. Remote Control Installation8-2
- 3. Remote Control Inspection8-4
- 4. Remote Control Adjust ment8-5

Chapter 9 ELECTRICAL SYSTEM

- 1. Electrical System9-1
- 2. Battery9-5
- 3. Starter Motor9-8
- 4. Alternator Standard, 12V/55A9-22
- 5. Alternator 12V/80A (OPTIONAL)9-30
- 6. Instrument Panel9-40
- 7. Warning Devices9-42
- 8. Air Heater (Optional)9-45
- 9. Electric type Engine Stopping Device (Optional)9-46
- 10. Tachometer9-48

Chapter 10 DISASSEMBLY AND REASSEMBLY

- 1. Disassembly and Reassembly Precautions10-1
- 2. Disassembly and Reassembly Tools10-2
- 3. Disassembly and Reassembly10-14
- 4. Table of Standard Measurements for Maintenance10-35
- 5. Tightening torque10-40
- 6. Test Running10-41

Chapter 11 TROUBLESHOOTING

- 1. Troubleshooting11-1

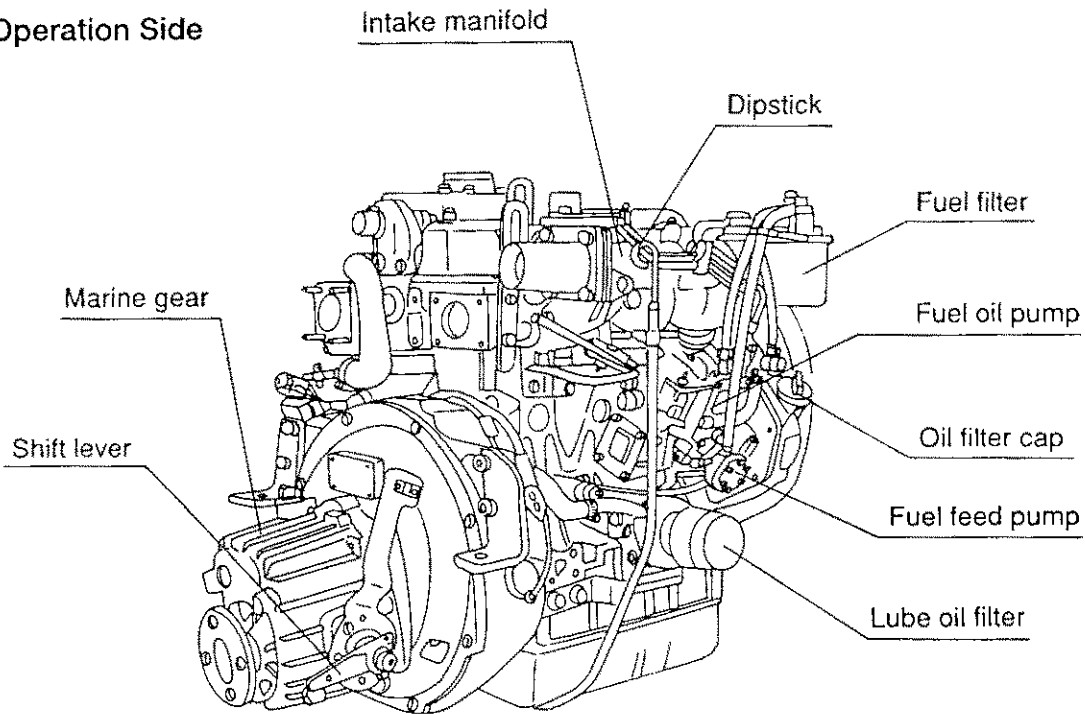
GENERAL

1. Exterior Views	1-1
1-1 3JH3E	1-1
1-2 4JH3E	1-2
2. Specifications	1-3
2-1 3JH3E, 3JH3BE, 3JH3CE	1-3
2-2 4JH3E, 4JH3BE, 4JH3CE	1-4
2-3 Sales condition, Marine gear	1-5
3. Engine Outline	1-6
3-1 3JH3E (with KM3P Marine gear)	1-6
3-2 3JH3BE (with KM3A Marine gear)	1-7
3-3 4JH3E (with KM3P Marine gear)	1-8
3-4 4JH3BE (with KM3A Marine gear)	1-9
4. Piping diagrams	1-10
4-1 3,4JH3(B)(C)E	1-10

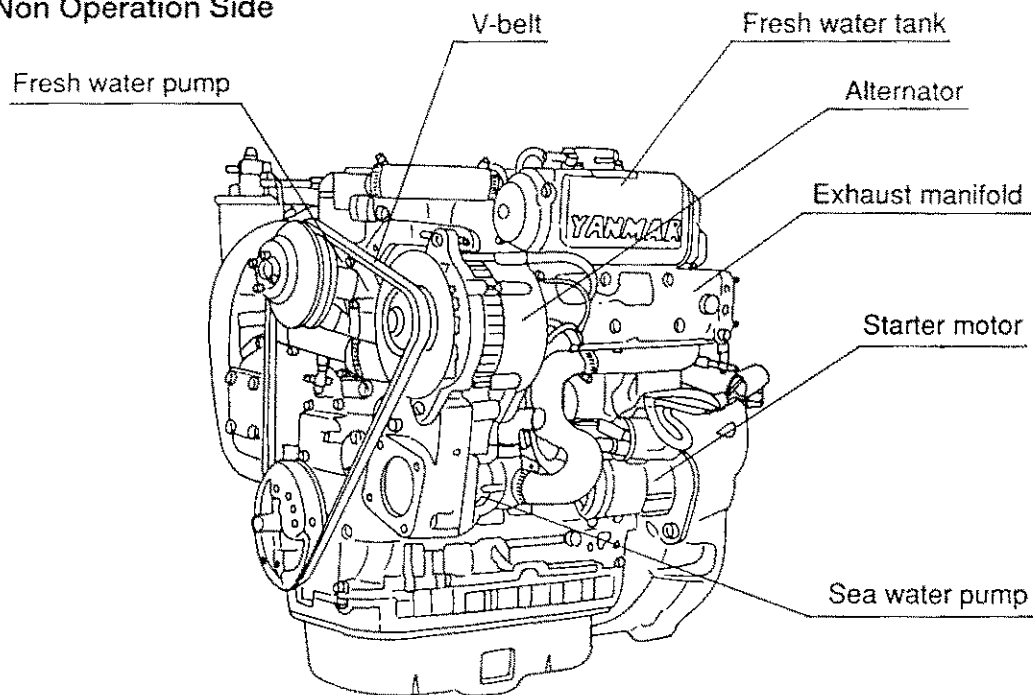
1. Exterior Views

1-1 3JH3E

● Operation Side

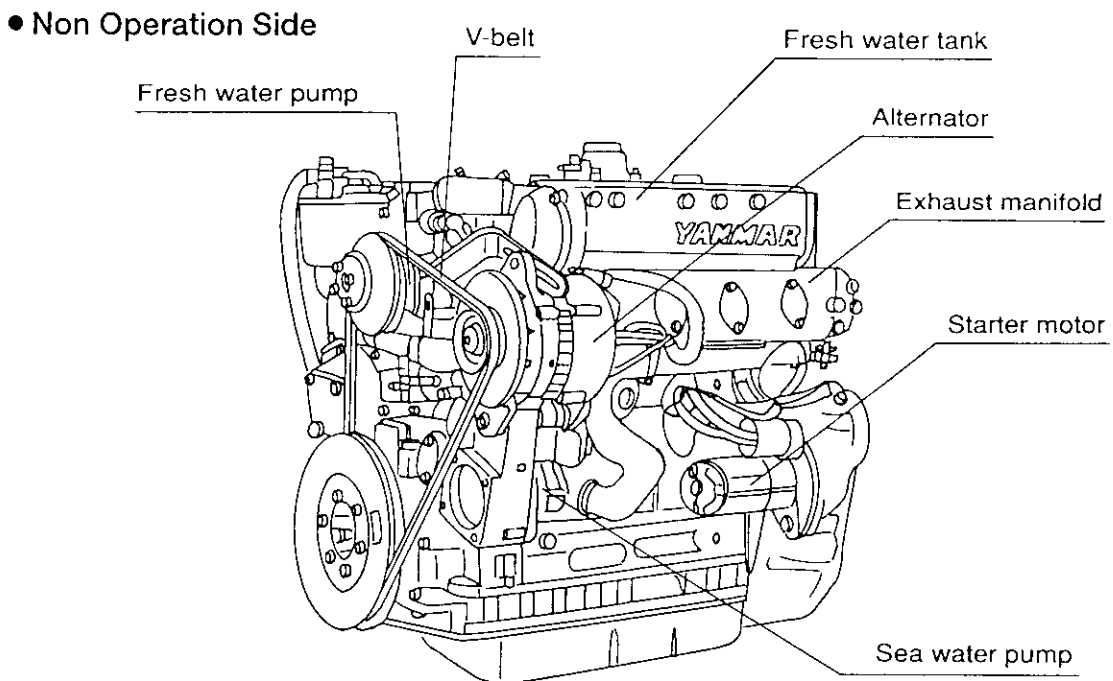
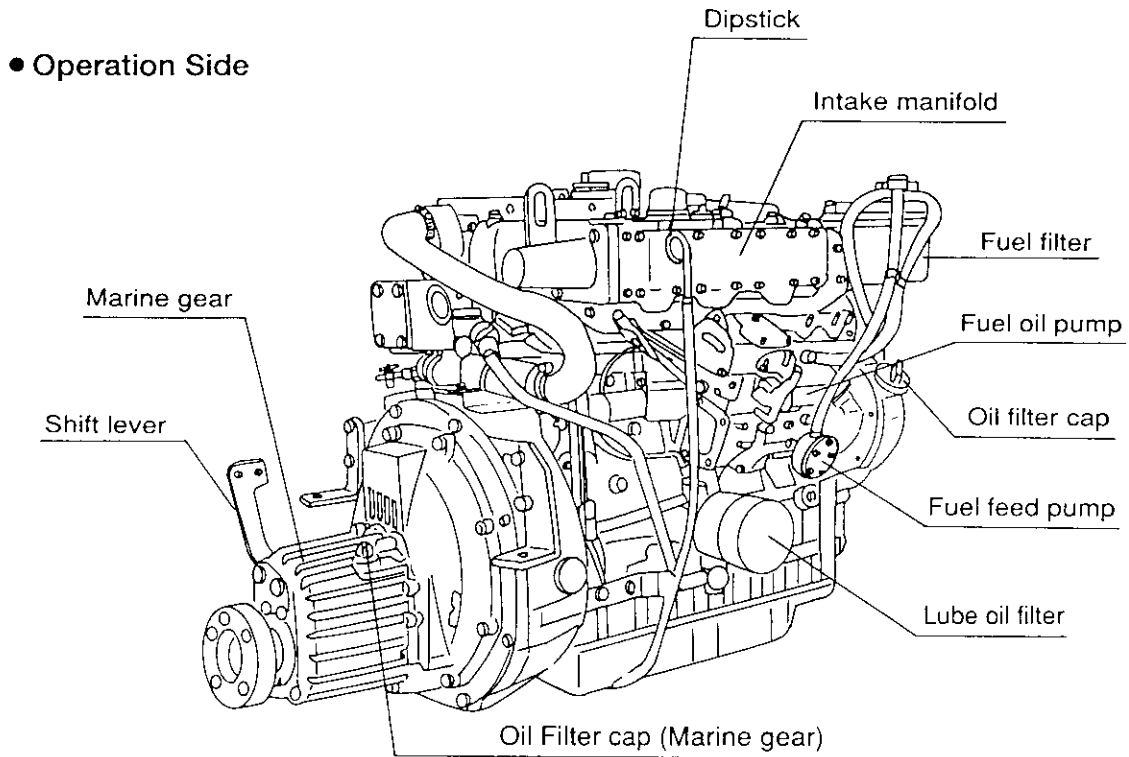


● Non Operation Side



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

1-2 4JH3E



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

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 X stroke		mm 84 X 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/cm ² 5.93				
	Piston speed	m/sec. 10.95				
Continuous rating output (DIN6270A) flywheel output	Output/crankshaft speed	kW/rpm (HP/rpm) 29.4/3800 (40/3800)				
	Brake mean effective pressure	kgf/cm ² 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/cm ² 200±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. Xpitch Xnumber)	mm	—			
	Propeller shaft dia. X Countershaft dia.	mm	—			
	Lubrication system		Splash			
	Lube oil pan	Total capacity	ℓ	0.35	0.45	—
		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/cm ² 6.18		5.81	
	Piston speed	m/sec. 10.95			
Continuous rating output (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/cm ² 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/cm ² 220±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		
	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	
		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°		

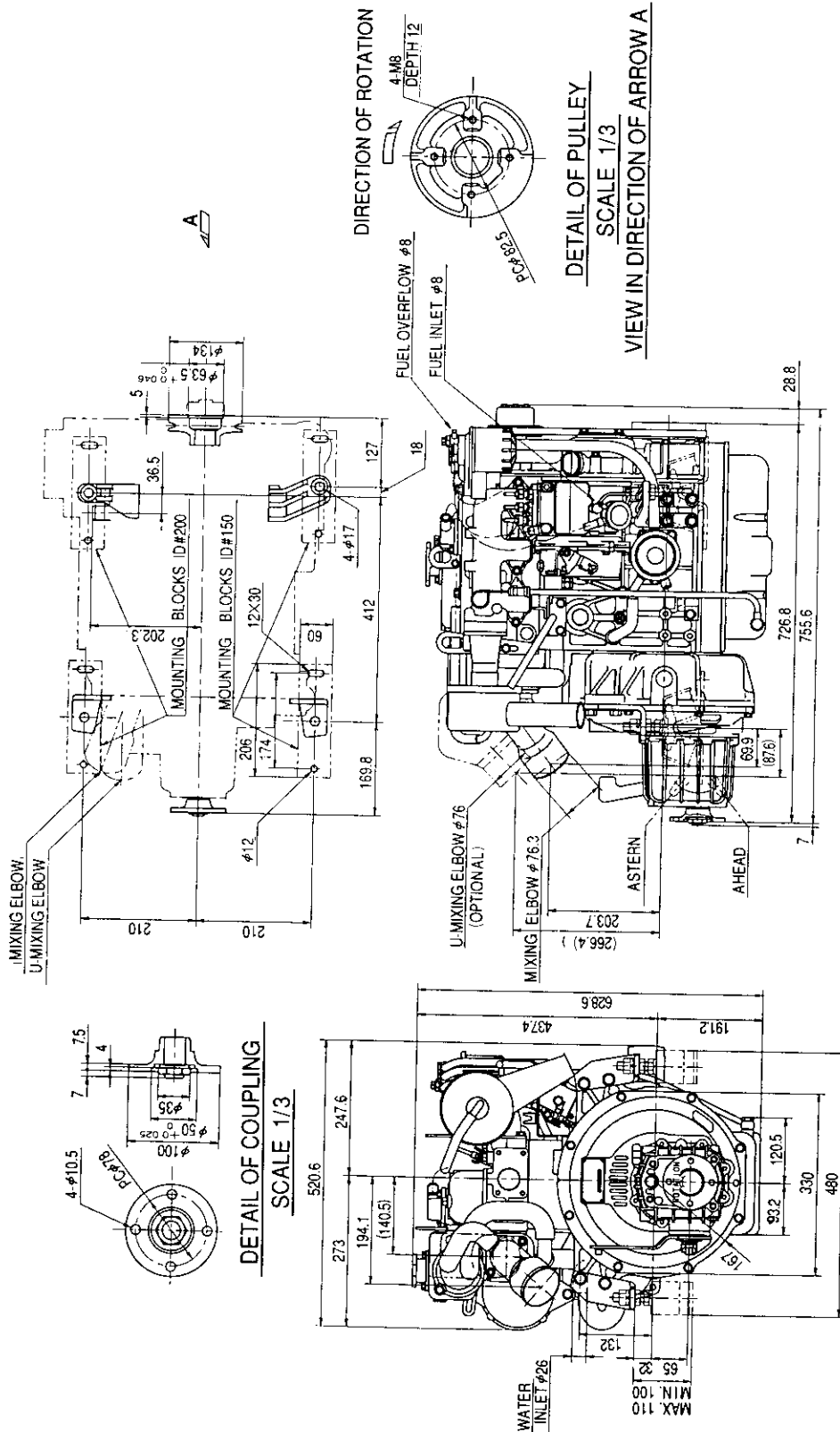
(Note) Rating condition : ISO — 3046/1, 1HP ≅ 0.7355 kW

2-3 Sales condition, Marine gear

Reduction ratio (Marine gear model)	No. of blades	Outer diameter of propeller	Moment of propeller inertia (GD ² kg-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		Bronze	3JH3(B)E	
2.64 (KM3A)	4	≦ φ 440					
2.36 (KM3P)	3	≦ φ 450	≦0.15			Bronze	4JH3(B)E
2.33 (KM3A)	4	≦ φ 425					

3. Engine Outline

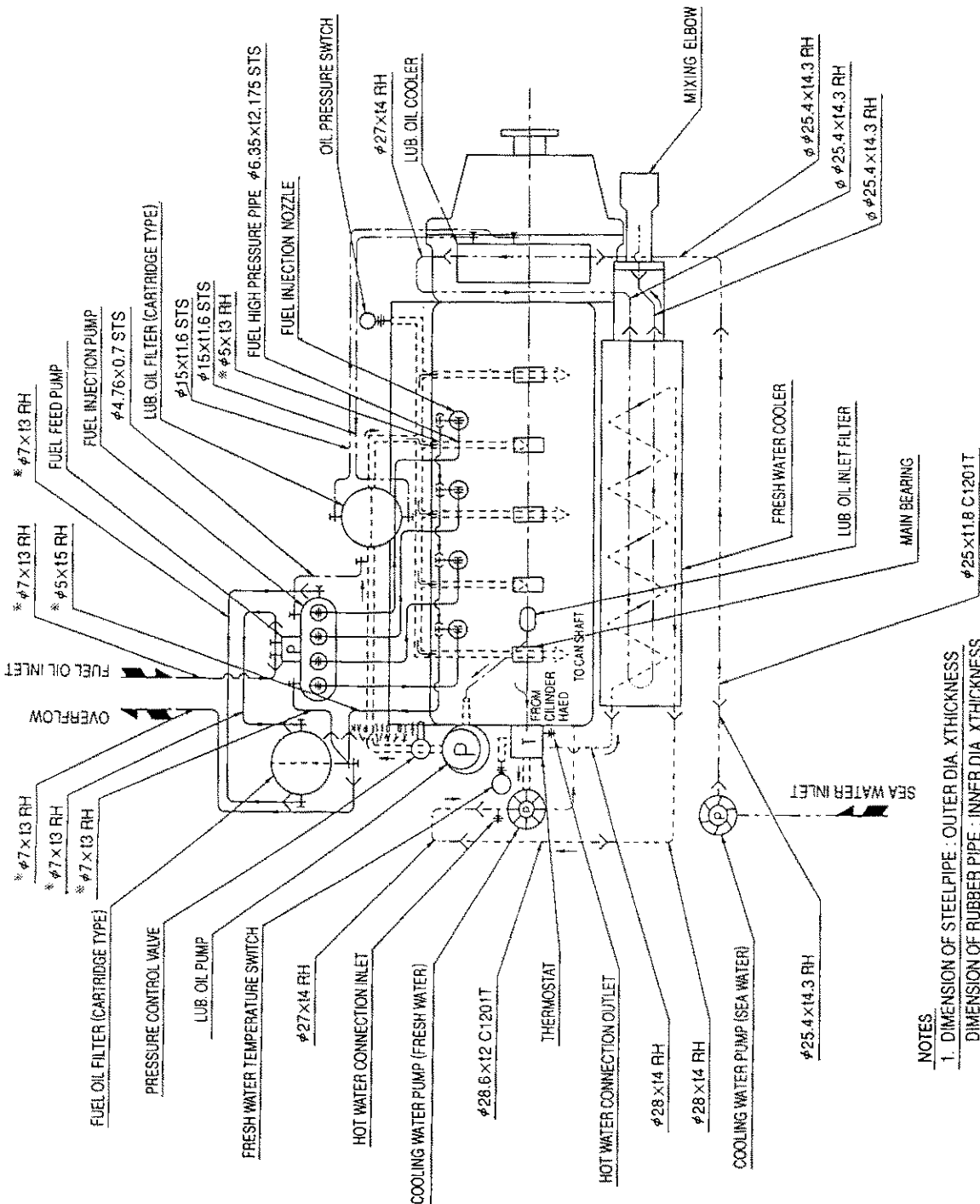
3-1 3JH3E (with KM3P Marine gear)



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.



MARKS OF PIPING	NAME
RH	RUBBER HOSE
SGP STS	STEEL PIPE
C1201T	COPPER PIPE
⊕	SCREW JOINT (UNION)
⊕	FLANGE JOINT
⊕	EYE JOINT
⊕	INSERTION JOINT
⋮	DRILL HOLE
⋮	COOLING FRESH WATER PIPING
⋮	COOLING SEA WATER PIPING
⋮	LUB. OIL PIPING
⋮	FUEL OIL PIPING

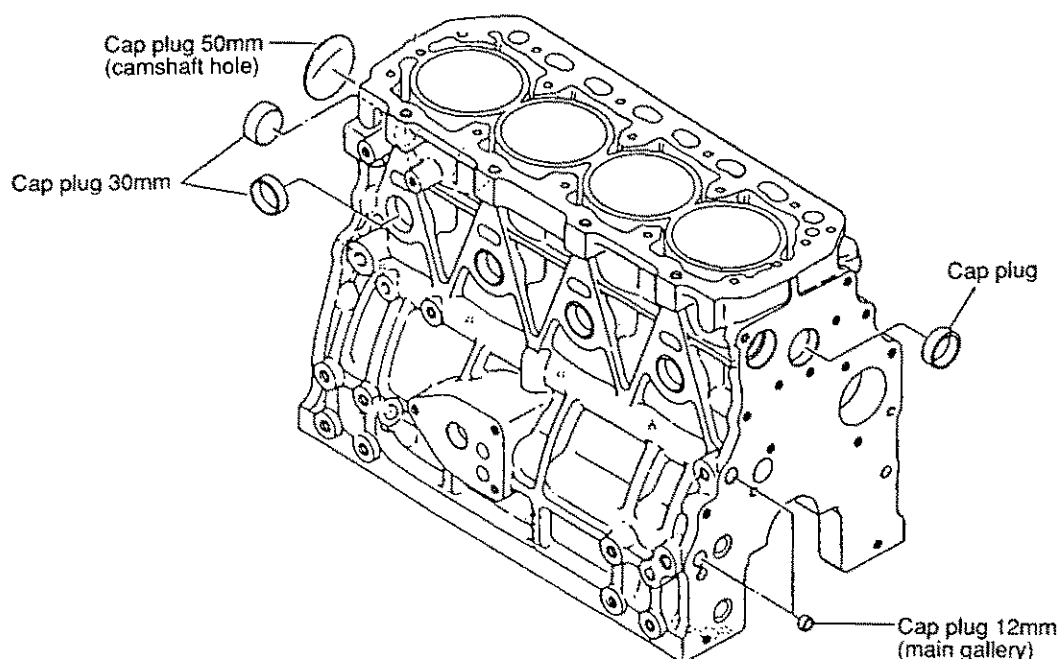
- NOTES
1. DIMENSION OF STEELPIPE : OUTER DIA. XTHICKNESS
DIMENSION OF RUBBER PIPE : INNER DIA. XTHICKNESS
 2. FUEL RUBBER PIPES ARE SATISFIED WITH THE SPECIFICATION OF MANUFACTURER (No. KH-500-0) (MARKED *)

INSPECTION AND SERVICING OF BASIC ENGINE PARTS

1. Cylinder Block	2-1
1-1 Inspection of parts	2-1
1-2 Cleaning of oil holes	2-1
1-3 Color check procedure	2-1
1-4 Replacement of cup plugs	2-2
1-5 Cylinder bore measurement	2-3
2. Cylinder Head	2-4
2-1 Inspecting the cylinder head	2-5
2-2 Valve seat correction procedure	2-6
2-3 Intake/exhaust valves, valve guides	2-6
2-4 Valve springs	2-8
2-5 Assembling the cylinder head	2-9
2-6 Measuring top clearance	2-9
2-7 Intake and exhaust valve arms	2-9
2-8 Adjustment of valve head clearance	2-10
3. Piston and Piston Pins	2-11
3-1 Piston	2-12
3-2 Piston pin	2-12
3-3 Piston rings	2-13
4. Connecting Rod	2-15
4-1 Inspecting the connection rod	2-15
4-2 Crank pin bushing	2-16
4-3 Piston pin bushing	2-16
4-4 Assembling piston and connecting rod	2-17
5. Crankshaft and Main Bearing	2-18
5-1 Crankshaft	2-18
5-2 Main bearing	2-20
6. Camshaft and Tappets	2-21
6-1 Camshaft	2-21
6-2 Tappets	2-22
7. Timing gear	2-24
7-1 Inspecting the gears	2-24
7-2 Gear timing marks	2-25
8. Flywheel and Housing	2-26
8-1 Specifications of flywheel	2-26
8-2 Dimensions of flywheel and mounting flange	2-27
8-3 Ring gear	2-28
8-4 Position of top dead center and fuel injection timing	2-28
8-5 Damper disc and cooling fan	2-29

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 rigidity for strength and low noise.



1-1 Inspection of parts

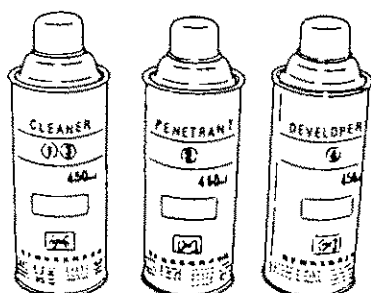
Make a visual inspection to check for cracks on engines that have frozen up, overturned or otherwise been subjected to undue stress. Perform a color check on any portions that appear to be cracked, and replace the cylinder block if the crack is not repairable.

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

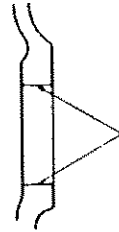
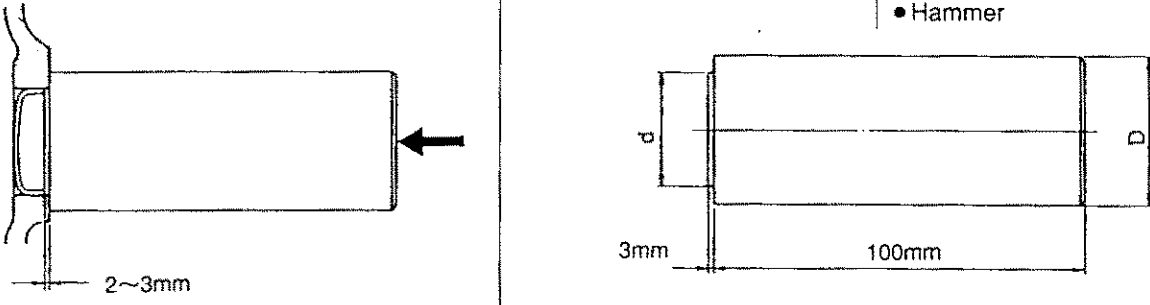


1-3 Color check procedure

- (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.

1-4 Replacement of cup plugs

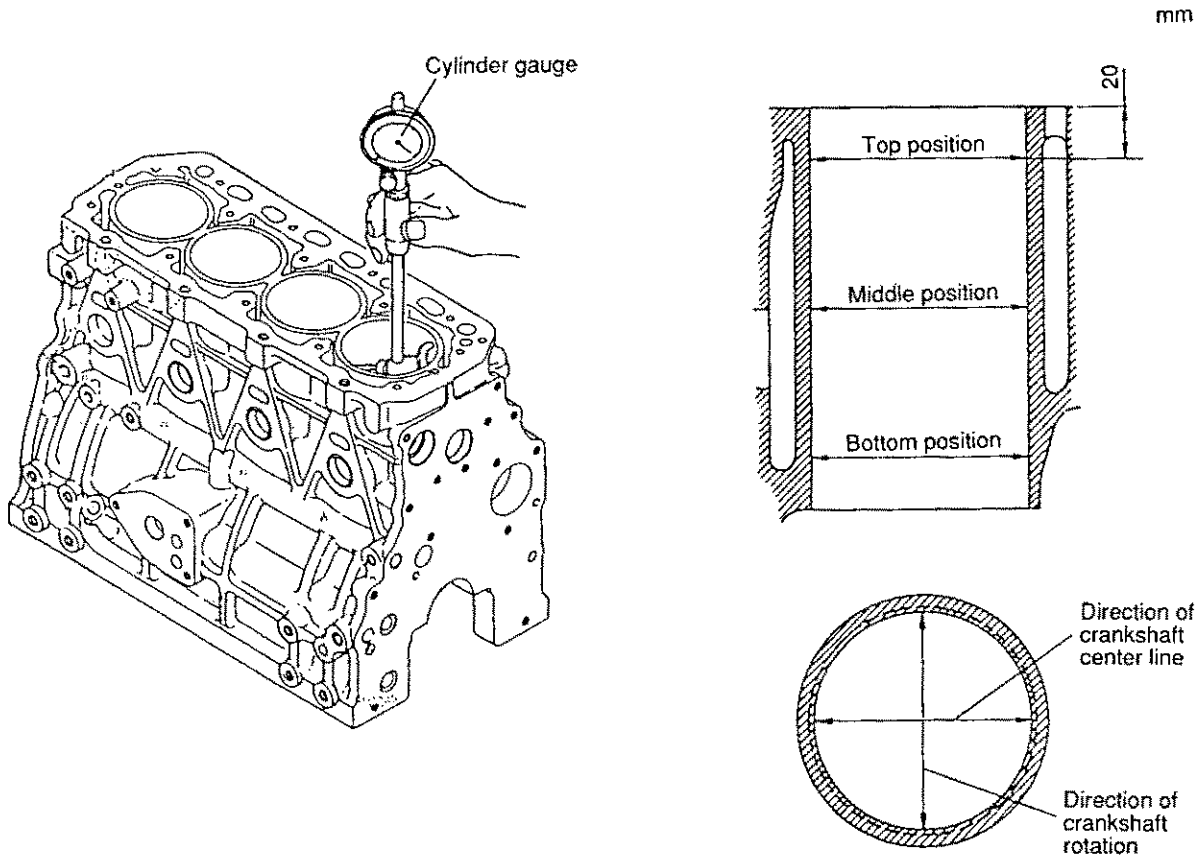
Step No.	Description	Procedure	Tool or material used									
1	Clean and remove grease from the hole into which the cup plug is to be driven. (Remove scale and sealing material previously applied.)	 <p>Remove foreign materials with a screw driver or saw blade.</p>	<ul style="list-style-type: none"> • Screw driver or saw blade • Thinner 									
2	Remove grease from the cup plug.	Visually check the nick around the plug.	<ul style="list-style-type: none"> • 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.	<ul style="list-style-type: none"> • Threebond No. 4 									
4	Insert the plug into the hole.	Insert the plug so that it sits correctly.										
5	Place a driving tool on the cup plug and drive it in using a hammer.	<p>Drive in the plug parallel to the seating surface.</p>  <p>2~3mm</p> <p>3mm 100mm</p> <p style="text-align: right;">mm</p> <table border="1" data-bbox="710 1332 1452 1444"> <thead> <tr> <th>Plug dia.</th> <th>d</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>φ 12</td> <td>φ 11.9~12.0</td> <td>φ 20</td> </tr> <tr> <td>φ 30</td> <td>φ 29.9~30.0</td> <td>φ 40</td> </tr> </tbody> </table>	Plug dia.	d	D	φ 12	φ 11.9~12.0	φ 20	φ 30	φ 29.9~30.0	φ 40	<ul style="list-style-type: none"> • Driving tool • Hammer
Plug dia.	d	D										
φ 12	φ 11.9~12.0	φ 20										
φ 30	φ 29.9~30.0	φ 40										

*Using the special tool, drive the cup plug so that the edge of the plug is 2mm (0.0787in.) below the cylinder surface.

1-5 Cylinder bore measurement

Measure the bore diameter with a cylinder gauge at the positions shown in the figure.

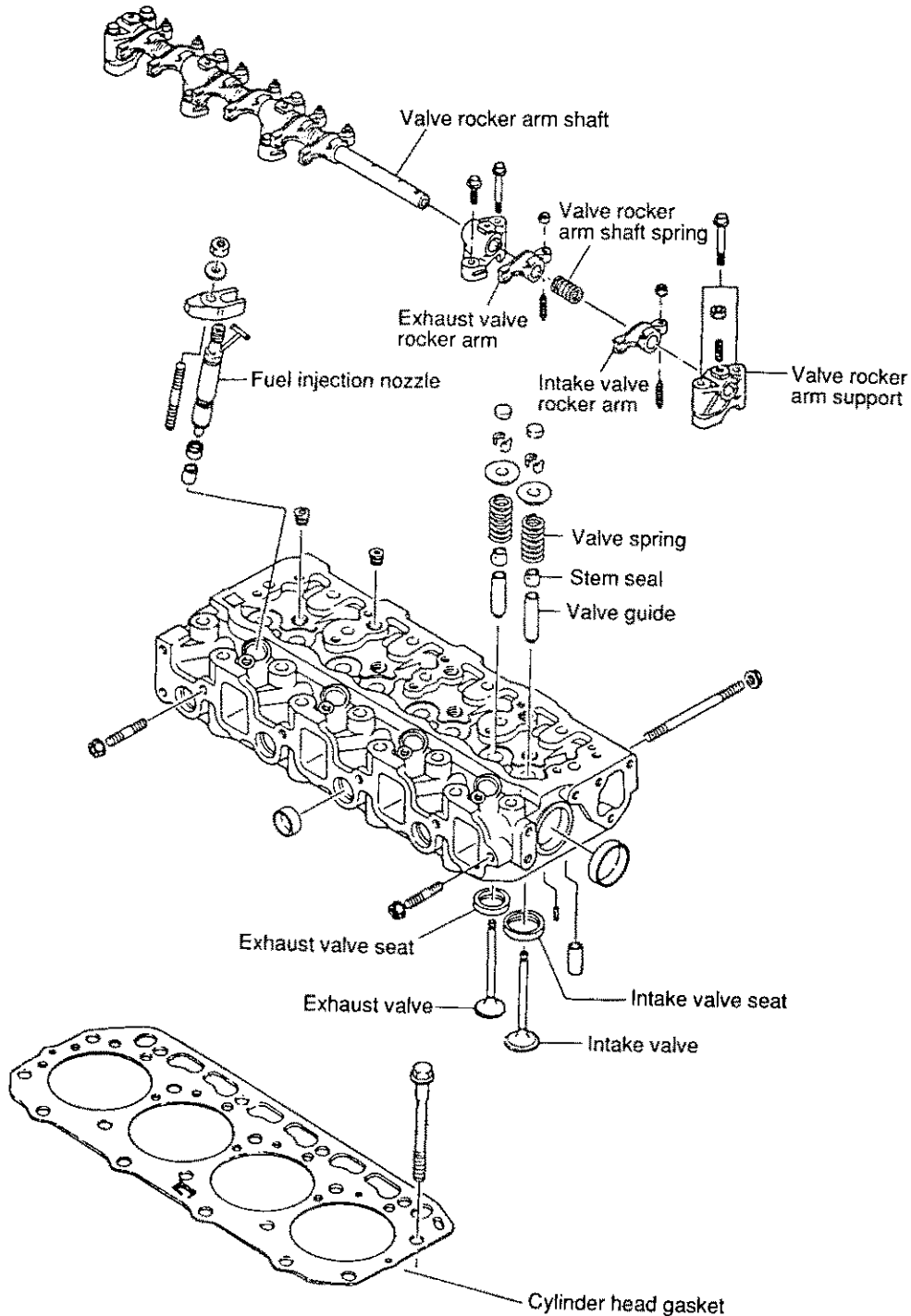
Replace the cylinder bore when the measured value exceeds the wear limit. Measurement must be done at least at 3 positions as shown in the figure, namely, top, middle and bottom positions in both directions along the crankshaft rotation and crankshaft center lines.



	Standard	Wear limit
Cylinder bore dia.	$\phi 84.00 \sim \phi 84.03$	$\phi 84.20$
Cylinder roundness	0~0.01	0.03

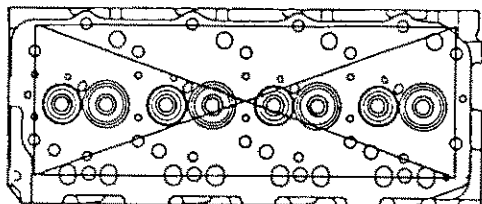
2. Cylinder Head

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.



2-1 Inspecting the cylinder head

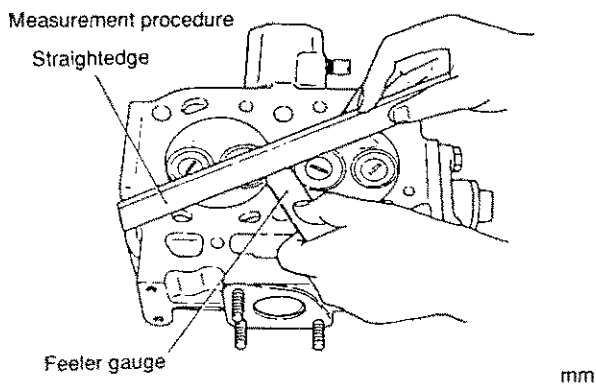
The cylinder head is subjected to very severe operating conditions with repeated high pressure, high temperature and cooling. Thoroughly remove all the carbon and dirt after disassembly and carefully inspect all parts.



2-1.1 Distortion of the combustion surface

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

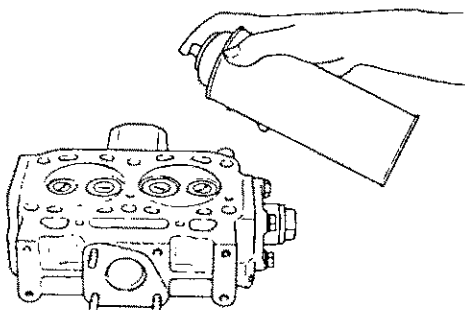
- (1) Clean the cylinder head surface.
- (2) Place a straight-edge along each of the four sides and each diagonal. Measure the clearance between the straight-edge and combustion surface with a feeler gauge.



	Standard	Wear limit
Cylinder head distortion	0.05 or less	0.15

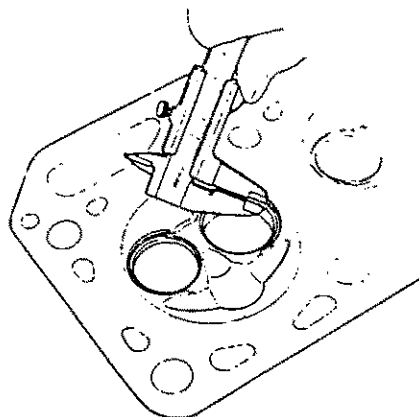
2-1.2 Checking for cracks in the combustion surface

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

