

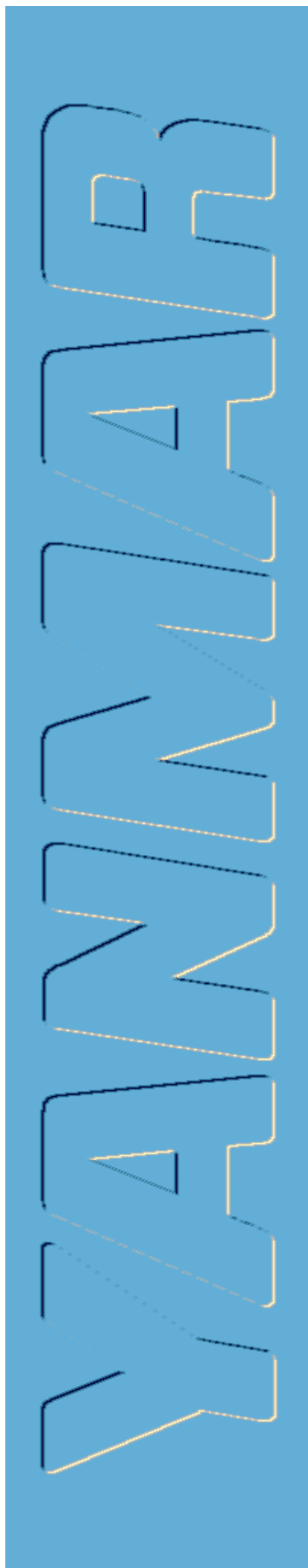
HINSHI-H8009

SERVICE MANUAL

MARINE DIESEL ENGINE

3JH3(B)(C)E(A),
4JH3(B)(C)E, 4JH3CE1

2002.4



YANMAR

SERVICE MANUAL

MARINE DIESEL ENGINE

MODEL

**3JH3(B)(C)E(A), 4JH3(B)(C)E
4JH3CE1**

History of Revision

Manual Name		Service Manual for Marine Diesel Engine			
Engine Model:		3JH3(B)(C)E(A), 4JH3(B)(C)E, 4JH3CE1			
Number of revision	Date of revision	Reason for correction	Outline of correction	Correction item No (page)	Corrected by
● New edition Oct.1995					
1 st	Oct.2000	For EPA certified engine 3JH3E (E/# A01158 and after)	<ul style="list-style-type: none"> ● "Fuel injection timing adjustment for EPA certified engine" added. ● Tightening torque for crankshaft V-pulley fastening bolt of 3JH3(B)(C)E changed. 	Added pages: -i-, -ii-, -iii-, 3-45~3-48. Revised pages: 1-3,10-28,10-40 and contents table.	Quality Assurance Dept.
2 nd	Mar.2001	Tightening torque	<ul style="list-style-type: none"> ● Added the tightening torque of the nut for the remote control cable connection of clutch shifting lever (for KBW20/21). ● Corrected the crankshaft V-pulley bolt tightening torque. 	8-2 10-40	Quality Assurance Dept.
3 rd	Apr.2002	For EPA/ARB certified engine(3JH3Eseries)	<ul style="list-style-type: none"> ● ARB(EPA)certified tamper resistance (cap type for fuel injection volume and wire and lead seal for high idling speed)and EPA/ARB emission control label added. ● Safe servicing information added. ● New marine gears KM35P/KM35A have been installed on 3.4JH3E (Feb.2002)(no torque limiter applied) ● 4JH3CE1×SD-40 sail drive added informaton (4JH3CE1 the same as 4JH3CE except rating output) ● 3JH3CE×SD-40 sail drive information added. 	Added and revised pages: -iv-,3-45,3-46,3-47,3-48. and contents Added pages: chapter 0,0-1, 0-2,0-3,0-4,0-5. Added and revised pages: 1-4-i,1-4-ii,1-5 1-9-i,1-9-ii,1-9-iii 1-9-iv,3-1,7-1, 7-2,7-3,7-12, 7-13,7-29,7-30, 7-31,7-40,7-41	Quality Assurance Dept.

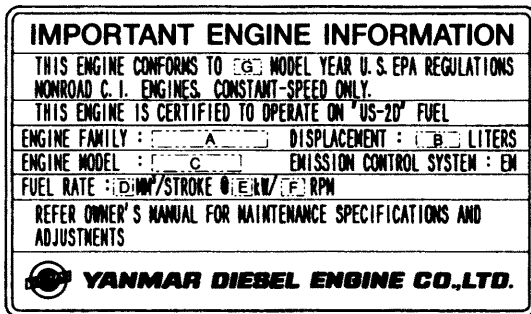
The EPA (U.S. Federal) and Air Resources Board (ARB, California) Off-road Compression Ignition engines regulations

The engines for EPA regulations will be used in the States, and the engines for ARB regulations will only be used in the State of California.

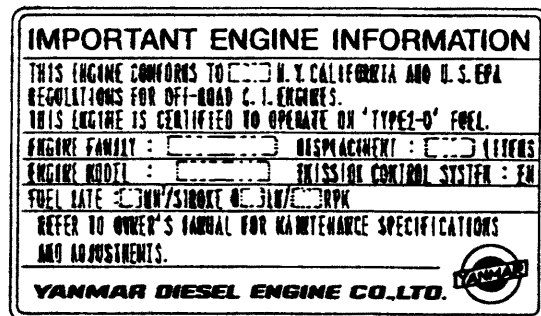
1. Engine identification (3JH3E series)

With the regulations on engine emission worldwide, it has become necessary to identify engines in a manner to determine which regulations they comply with, hence

a) Emission control label as shown below which will contain:



(EPA label)



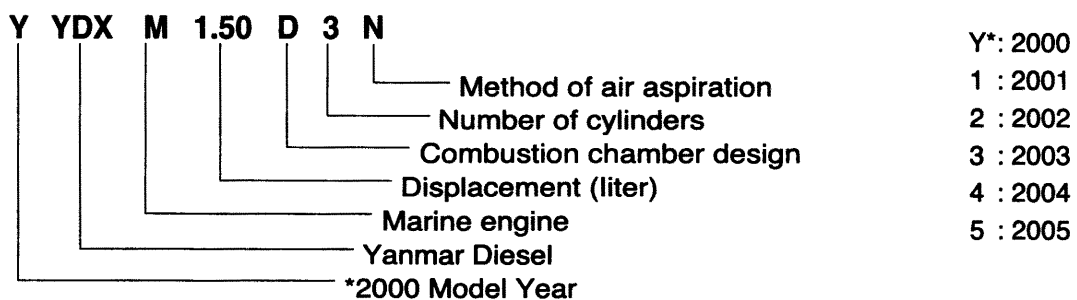
(EPA and ARB label)

*Emission Control is accomplished through Engine Modification (EM-Design)

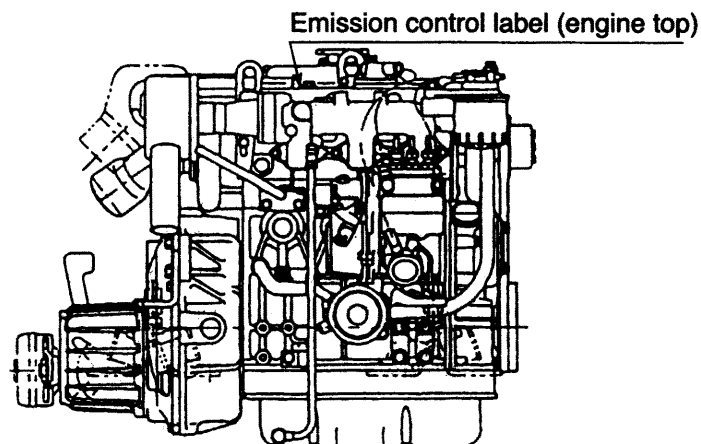
- EPA certified 3JH3E series engines : E/# A01158 and after.
- ARB(EPA)certified 3JH3E series engines : installed the tamper resistance device to prevent illegal change of fuel injection volume and high idling speed. (Fuel injection volume : cap type, High idling speed : wire and lead seal)

• Engine family name as assigned by EPA/ARB identifying engine family group

YYDXM1.50D3N and this identifies



b) Label location:



2. Exhaust Gas Regulations

This engine conforms to the EPA exhaust gas regulations (19kW and under 37kW) for a low emission engine.

The ARB standard is the same as the EPA's

Exhaust emission		EPA Standard (Tier 1) (Max.)		Condition
		Variable speed (EPA E3 Mode)		
NO _x +NMHC	g/kWh	19kW and under 37kW	9.5	· EPA recommended fuel is used.
CO			5.5	
PM			0.8	
Transit smoke ACC/LUG/PEAK	%	—		

3. Guarantee Conditions for Emission Standard

The following guarantee conditions are set down in the operation manual. In addition to making sure that these conditions are met, check for any deterioration that may occur before the required periodic maintenance times.

● Requirement on engine installation condition

(1) Air intake depression kPa (mmH₂O)

Permissible
≤ -0.49 (-50)

(2) Exhaust gas back pressure kPa (mmH₂O)

Permissible
≤ 7.84 (800)

● Fuel oil and lubricating oil

(1) Fuel : The diesel fuel oil [ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)]

(2) Lube oil : API grade, class CD

● Do not remove the seals restricting injection quantity and engine speed.

● Perform maintenance without fail.

Note: Inspections to be carried out by the user and by the maker are divided and set down in the "List of Periodic Inspections" on the operation manual and should be checked carefully.

EPA allows to apply Maintenance schedule for Emission related parts as follows.

—	Check Fuel Injection Nozzle and clean	Adjust, cleaning and repair of Fuel Injection Pump, Fuel Valve Nozzle and Turbocharger
kW \leq 130	1500 hours of use and at 1500-hour intervals thereafter	3000 hours of use and at 3000-hour intervals thereafter

● Quality guarantee period for exhaust emission related parts

For exhaust emission related parts, follow the inspections outlined in the "List of Periodic Inspections", on the operation manual, and use the table below to carry out inspections based on operation hours or time in years. Whichever comes first is the guarantee period.

19 \leq Range < 37	3000 hours or 5 years
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The specific emissions-related parts are (1) Fuel injection nozzle (2) Fuel injection pump (3) Turbocharger.(if installed)

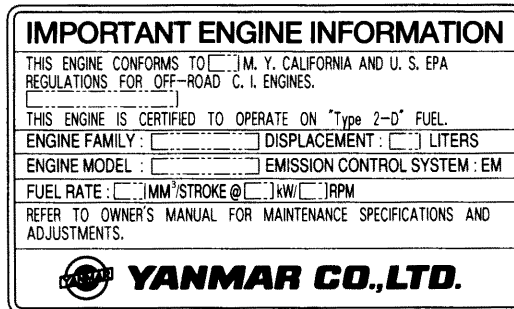
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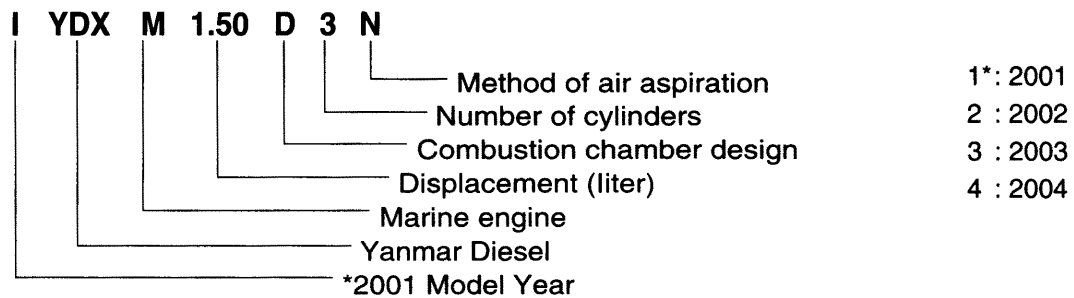
(EPA and ARB label)

*Emission Control is accomplished through Engine Modification (EM-Design)

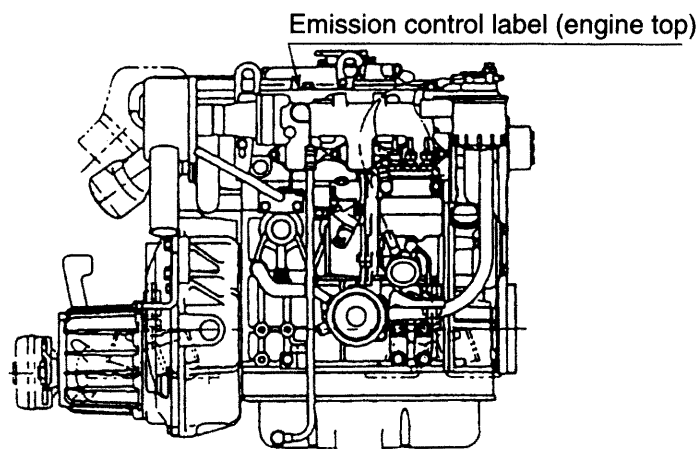
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- The emission standard is the same as the EPA's

• Engine family name as assigned by EPA/ARB identifying engine family group

IYDXM1.50D3N and this identifies



b) Label location:



MODELS

3JH3(B)(C)E(A), 4JH3(B)(C)E 4JH3CE1

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CHAPTER 0

FOR SAFETY

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1. For Safe Servicing

- Most accidents are caused by failing to observe basic safety rules and precautions. To prevent accidents, it is important to recognize the signs of approaching problems, and eliminate the problems in the early stage before they can cause accidents.
Please read this manual carefully before starting repairs or maintenance to fully understand safety precautions and appropriate inspection and maintenance procedures. Attempting a repair or maintenance job without sufficient knowledge may cause an unexpected accident.
- It is impossible to cover every possible danger in repair or maintenance in the manual. Sufficient consideration for safety is required in addition to the matters marked  CAUTION. Especially for safety precautions in a repair or maintenance job not described in this manual, receive instructions from a knowledgeable leader.
- Safety marks used in this manual and their meanings are as follows:



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

- Any matter marked [NOTICE] in this manual is especially important in servicing. If not observed, the product performance and quality may not be guaranteed.

2. Precaution for Safe Servicing

(A) Service Shop (place)

WARNING

● Place allowing sufficient ventilation

Jobs such as engine running, part welding and polishing the paint with sandpaper should be done in a well-ventilated place.

[Failure to Observe]

Very dangerous for human body due to the possibility of inhaling poisonous gas or dust.



CAUTION

● Sufficiently wide and flat place

The floor space of the service shop for inspection and maintenance should be sufficiently wide and flat without any holes.

[Failure to Observe]

An accident such as a violent fall may be caused.

CAUTION

● Clean, orderly arranged place

No dust, mud, oil or parts should be left on the floor surface.

[Failure to Observe]

An unexpected accident may be caused.

CAUTION

● Bright, safety illuminated place

The working place should be illuminated sufficiently and safely.

For a job in a dark place where it is difficult to see, use a portable safety lamp.

The bulb should be covered with a wire cage for protection.

[Failure to Observe]

The bulb may be broken accidentally causing ignition of leaking oil.



CAUTION

● Place equipped with a fire extinguisher

Keep a first aid kit and fire extinguisher close at hand in preparation for fire emergencies.



(B) Working Wear

▲ CAUTION

● Wears for safe operation



Wear a helmet, working clothes, safety shoes and other safety protectors suited to the job. It is especially important to wear well-fitting work clothes.

[Failure to Observe]

A serious accident such as trapping by a machine may occur.

(C) Tools to be Used

▲ WARNING

● Appropriate holding and lifting

Never operate when the engine is supported with blocks or wooden pieces or only with a jack.

To lift and hold the engine, always use a crane with a sufficient allowance in limit load or a rigid jack.

[Failure to Observe]

A serious accident may occur.

▲ WARNING

● Use of appropriate tools



Use tools appropriate for the jobs to be done. Use a correctly sized tool for loosening or tightening a machine part.

[Failure to Observe]

A serious injury or engine damage may occur.

(D) Use of Genuine Parts, Oil and Grease

▲ CAUTION

● Always use genuine parts.



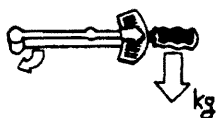
[Failure to Observe]

Shortening of engine life or an unexpected accident may arise.

(E) Bolt and Nut Tightening Torque

▲ WARNING

● Always tighten to the specified torque if designated in the manual.



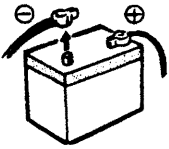
[Failure to Observe]

Loosening or falling may cause parts damage or injury.

(F) Electrical Parts

⚠ WARNING

● **Harness short-circuit**



Disconnect the battery negative (-) terminal before starting the service job.

[Failure to Observe]

Short-circuiting of a harness may occur to start a fire.

⚠ WARNING

● **Battery charging**



Since flammable gas is generated during battery charging, keep anything which could cause a fire away from the battery.

[Failure to Observe]

Explosions may occur.

⚠ WARNING

● **Battery electrolyte**



Since the electrolyte is diluted sulfuric acid, do not let it be splashed onto the clothes or skin.

[Failure to Observe]

The clothes or skin may be burnt.

(G) Waste Treatment

⚠ CAUTION

Observe the following instructions with regard to waste disposal. Negligence of each instruction will cause environmental pollution.

- Waste fluids such as engine oil and cooling water shall be discharged into a container without spillage onto the ground.
- Do not let waste fluids be discharged into the sewerage, a river or the sea.
- Harmful wastes such as oil, fuel, solvents, filter elements and battery shall be treated according to the respective laws and regulations.
Ask a qualified collecting company for example.

(H) Handling the Product

WARNING



● Supplying the Fuel

When supplying the fuel, always keep any fire source like a cigarette or match away.

[Failure to Observe]

A fire or explosion may arise.

WARNING



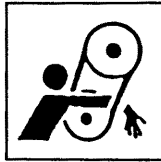
● Pay attention to hot portions.

Do not touch the engine during running or immediately after it is stopped.

[Failure to Observe]

Scalding may be caused by a high temperature.

WARNING



● Pay attention to the rotating part.

Never bring clothes or a tool close to the rotating part during engine running.

[Failure to Observe]

Injury may be caused by entrapping.

CAUTION

● Safety Label Check

Pay attention to the product safety label.

A safety label (caution plate) is affixed on the product for calling special attention to safety.

If it is missing or illegible, always affix a new one.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

California Proposition 65 Warning

Battery posts, terminals, and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm.

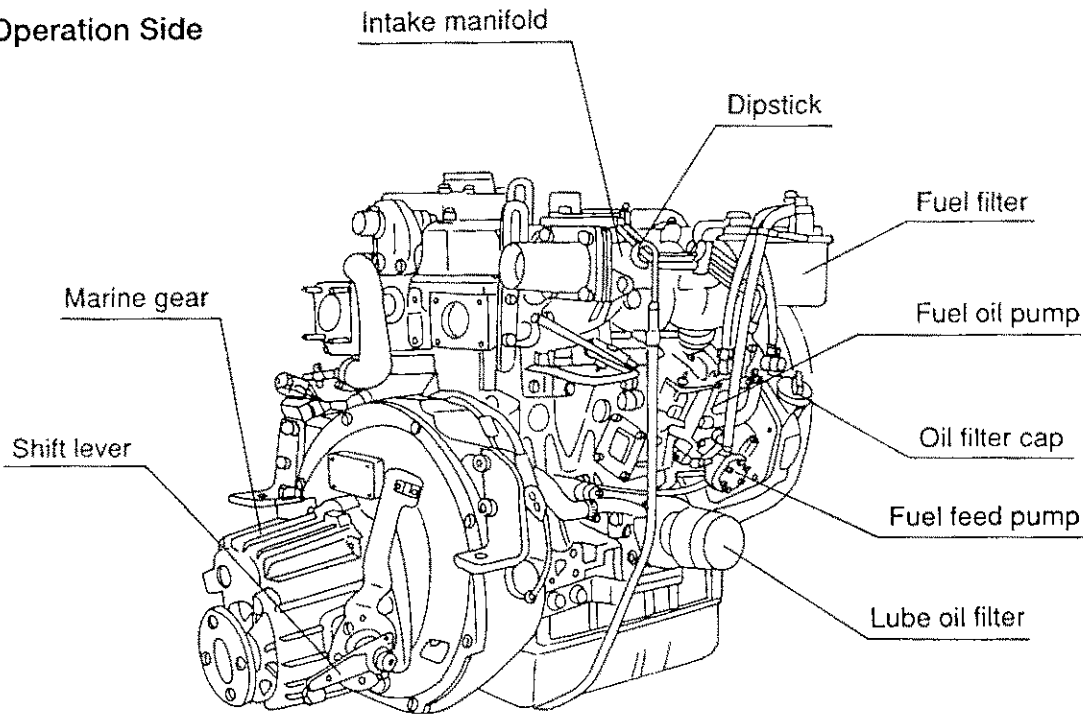
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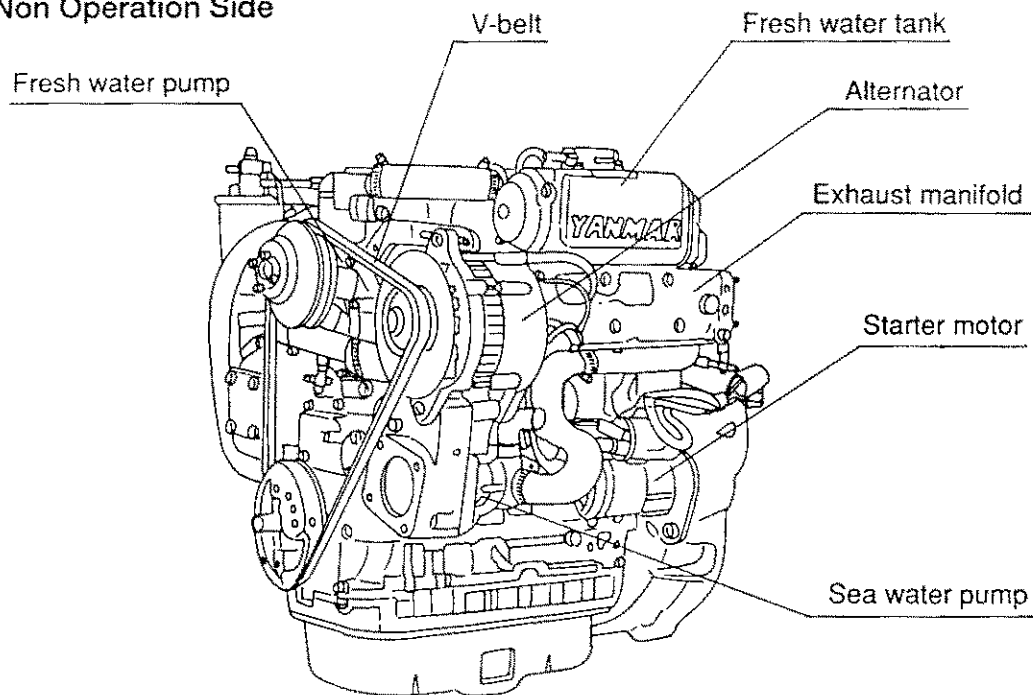
1. Exterior Views

1-1 3JH3E

• Operation Side

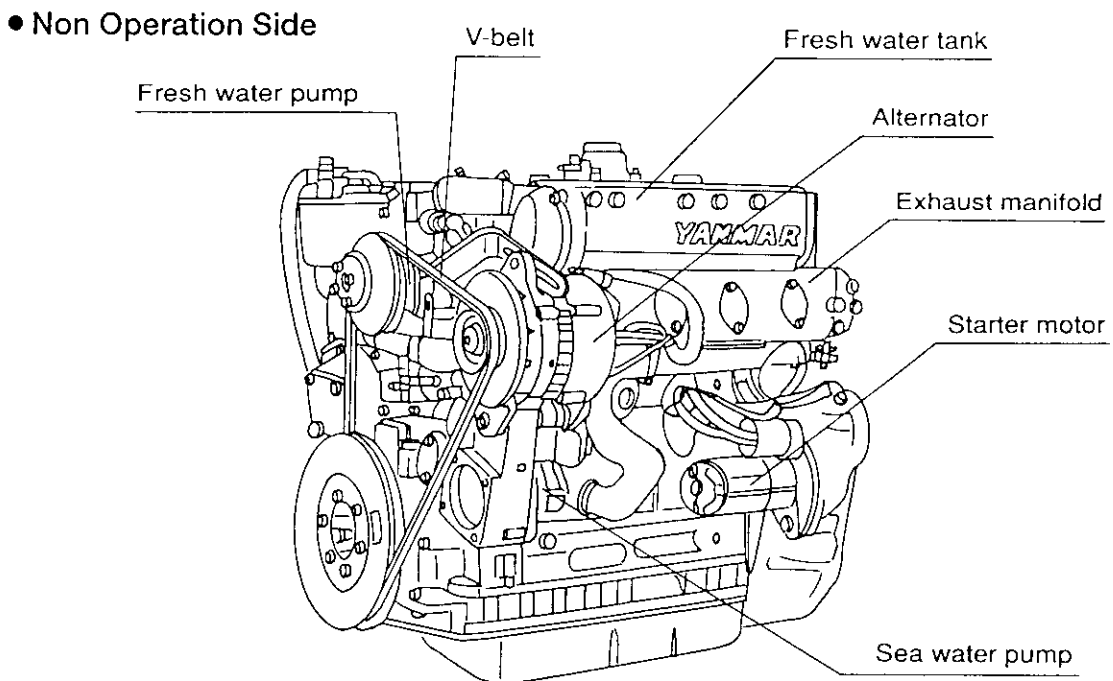
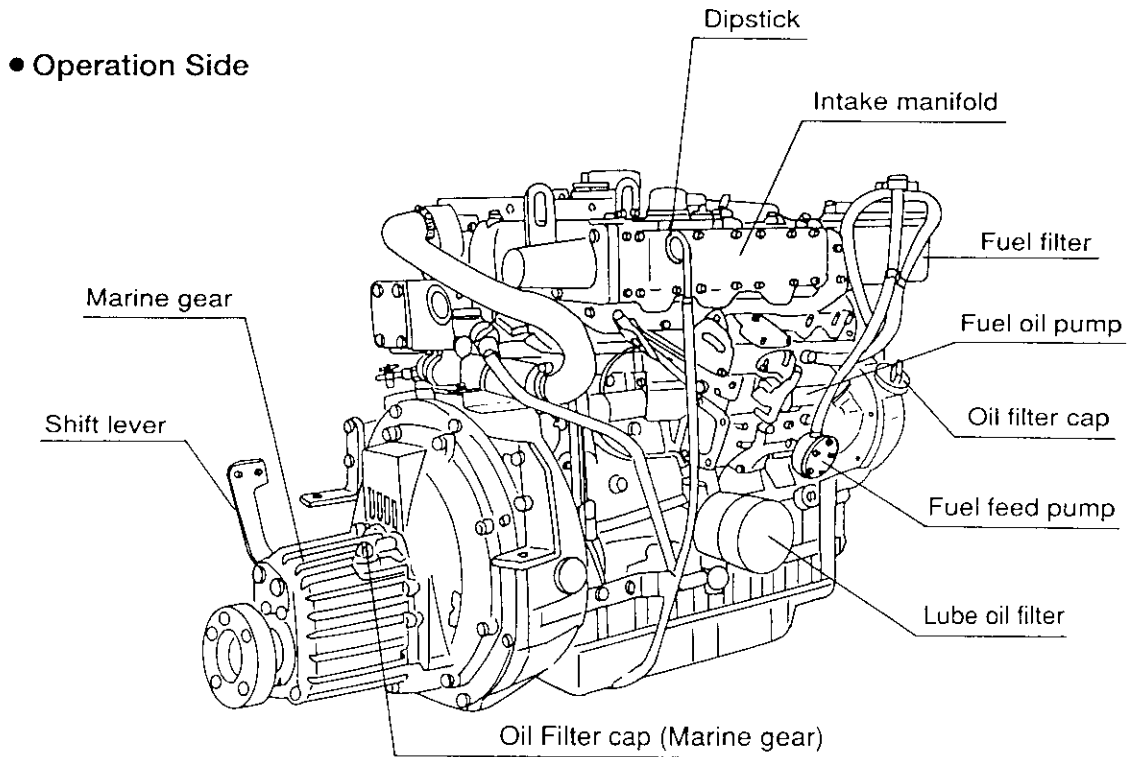


• Non Operation Side



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

1-2 4JH3E



<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		R 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 FID 12° [For EPA certified FIC :15±1, (FID:14±1)]				
Fuel injection pressure		kgf/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. XpitchXnumber)	mm	—			
	Propeller shaft dia. X Countershaft dia.	mm	—			
	Lubrication system	Splash				
	Lube oil pan	Total capacity	R	0.35	0.45	—
		Effective capacity	R	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.		R	4.4/1.8	4.9/2.1	4.9/2.1	

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

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		kgf/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 3JH3E A, 3JH3BE A, 3JH3CE A

(Note) Engine name 3JH3E A, designated by engine factory.
Shown as 3JH3E, 3JH3CE in the name plate.

Model			3JH3E A	3JH3BE A	3JH3CE A	
Type			Vertical 4-cycle water cooled diesel engine			
Combustion system			Direct injection			
Aspiration			Natural aspiration			
Number of cylinders			3			
Bore × stroke		mm	84 × 90			
Displacement		L	1.496			
Continuous output (flywheel output)	Output/crankshaft speed	kW/min ⁻¹ (PS/min ⁻¹)	26.5/3650 (36/3650)			
	Brake mean effective pressure	MPa (kgf/cm ²)	0.581 (5.93)			
	Piston speed	m/sec.	10.95			
Max. output (flywheel output)	Output/crankshaft speed	kW/min ⁻¹ (PS/min ⁻¹)	*29.4/3800 (40/3800)	**28.7/3800 (39.1/3800)		
	Brake mean effective pressure	MPa (kgf/cm ²)	0.621 (at 25°C fuel oil temp) (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	FID 12 { For EPA certified FIC:15±1,(FID:14±1) }			
Fuel injection pressure		MPa(kgf/cm ²)	21.6±0.5(220±5)			
Fuel injection nozzle			Hole type			
Direction of rotation	(Crankshaft)		Counter-clockwise 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		KM35P	KM35A		
	Type		Mechanical cone clutch	Mechanical cone clutch		
	Reduction rate(ahead/astern)		2.36/3.16 2.61/3.16	2.33/3.04 2.64/3.04		
	Propeller speed (ahead/astern)	min ⁻¹	1610/1203 1457/1203	1629/1249 1441/1249		
	Lubrication system		Splash			
	Lube oil pan	Total capacity	L	0.5	0.65	
		Effective capacity	L	0.05	0.15	
	Cooling system		—————			
Mass		kg	12	13		
Dimensions	Overall length		mm	762.1	760.7	545.8
	Overall width		mm	520.6		520.6
	Overall height		mm	624.9		624.9
Engine mass without marine gear (dry)		kg	185	186		173
Lubricating oil capacity max/effect. (oilpan)		L	4.5/1.1(rake 8°)	5.0/1.2(rake 0°)		5.0/1.2(rake 0°)

(Note) 1. Rating condition : ISO 3046-1,8665 2. IPS=0.7355kW
3. Fuel oil condition : Density at 15°C=0.860, Fuel oil temp.

*: 25°C at the fuel injection pump inlet.
**: 40°C at the fuel injection pump inlet.

2-4 4JH3E(KM35P), 4JH3BE(KM35P), 4JH3CE1

(Note) Engine name 4JH3BE designated by engine factory.
Shown as 4JH3E in the name plate.

Engine Model			4JH3E(KM35A)	4JH3BE(KM35A)	4JH3CE1	
Type			Vertical 4-cycle water cooled diesel engine			
Combustion system			Direct injection			
Aspiration			Natural aspiration			
Number of cylinders			4			
Bore X stroke		mm	84 X 90			
Displacement		L	1.995			
Continuous output (flywheel output)	Output/crankshaft speed	kW/min ⁻¹ (PS/min ⁻¹)	36.8/3650 (50/3650)			
	Brake mean effective pressure	MPa (kgf/cm ²)	0.606 (6.18)			
	Piston speed	m/sec.	10.95			
Max. output (flywheel output)	Output/crankshaft speed	kW/min ⁻¹ (PS/min ⁻¹)	*41.2/3800 (56/3800)	**40.3/3800 (54.7/3800)		
	Brake mean effective pressure	MPa (kgf/cm ²)	0.652 (6.65) (at 25°C fuel oil temp)			
	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	FID 12			
Fuel injection pressure		MPa(kgf/cm ²)	21.6±0.5(220±5)			
Fuel injection nozzle			Hole type			
Direction of rotation	(Crankshaft)		Counter-clockwise 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		KM35P	KM35A	(Sail Drive SD-40 can be used directly on location.)	
	Type		Mechanical cone clutch	Mechanical cone clutch		
	Reduction rate(ahead/astern)		2.36/3.16 2.61/3.16	2.33/3.04 2.64/3.04	—	
	Propeller speed (ahead/astern)		min ⁻¹ 1610/1203 1457/1203	1629/1249 1441/1249	—	
	Lubrication system		Splash			
	Lube oil pan	Total capacity	L	0.5	0.65	—
		Effective capacity	L	0.05	0.15	—
	Cooling system		—			
Mass		kg	12	13	—	
Dimensions	Overall length		mm	856.1	639.8	
	Overall width		mm	563.1	563.1	
	Overall height		mm	619.9	619.9	
Engine mass without marine gear (dry)		kg	223	210		
Lubricating oil capacity max/effect. (oilpan)		L	4.5/1.2(rake 8°)	5.0/1.4(rake 0°)		

(Note) 1. Rating condition : ISO 3046-1, 8665 2. IPS=0.7355kW
3. Fuel oil condition : Density at 15°C=0.860, Fuel oil temp.

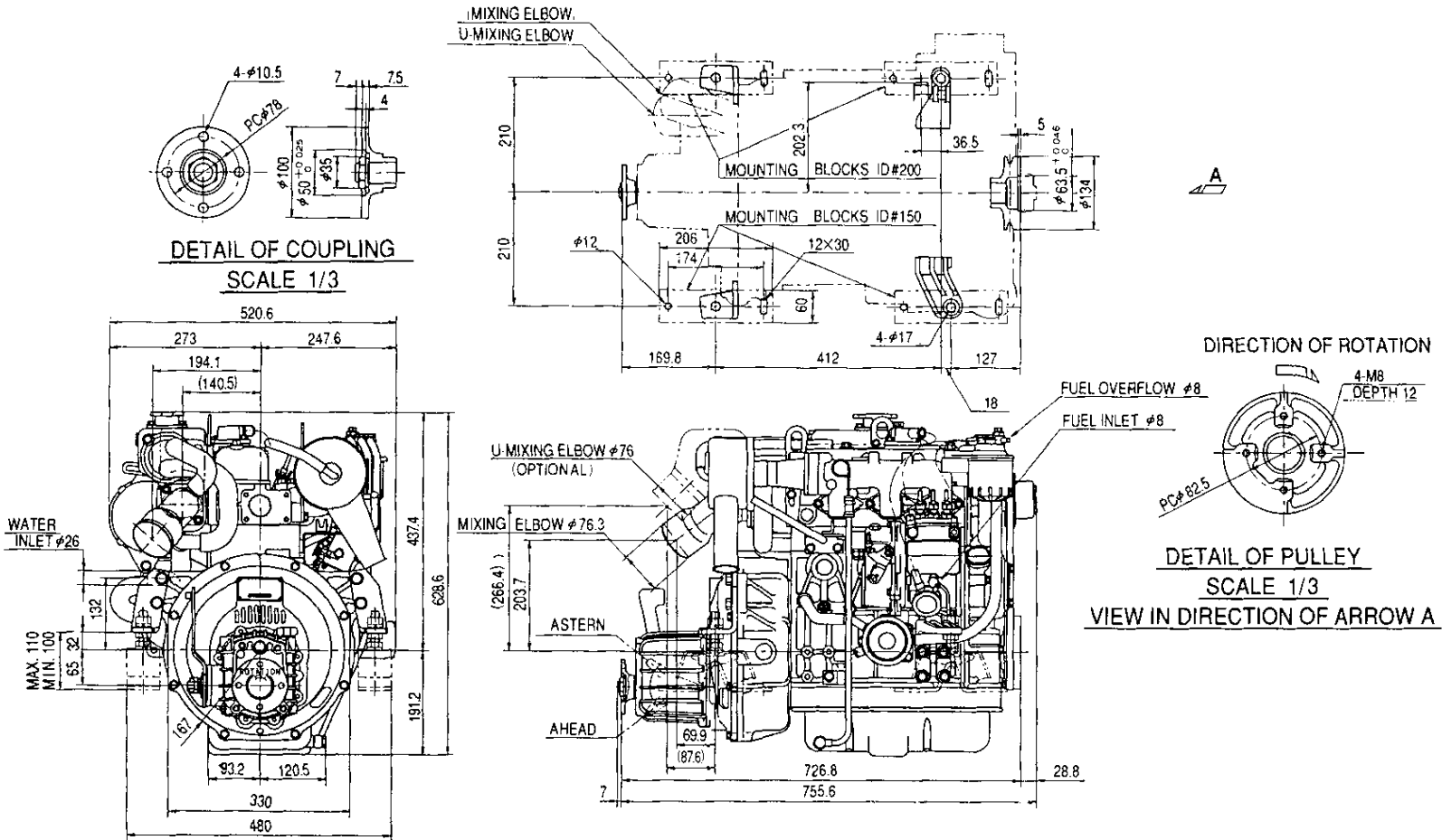
*: 25°C at the fuel injection pump inlet.
**: 40°C at the fuel injection pump inlet.

2-5 Sales condition, Marine gear

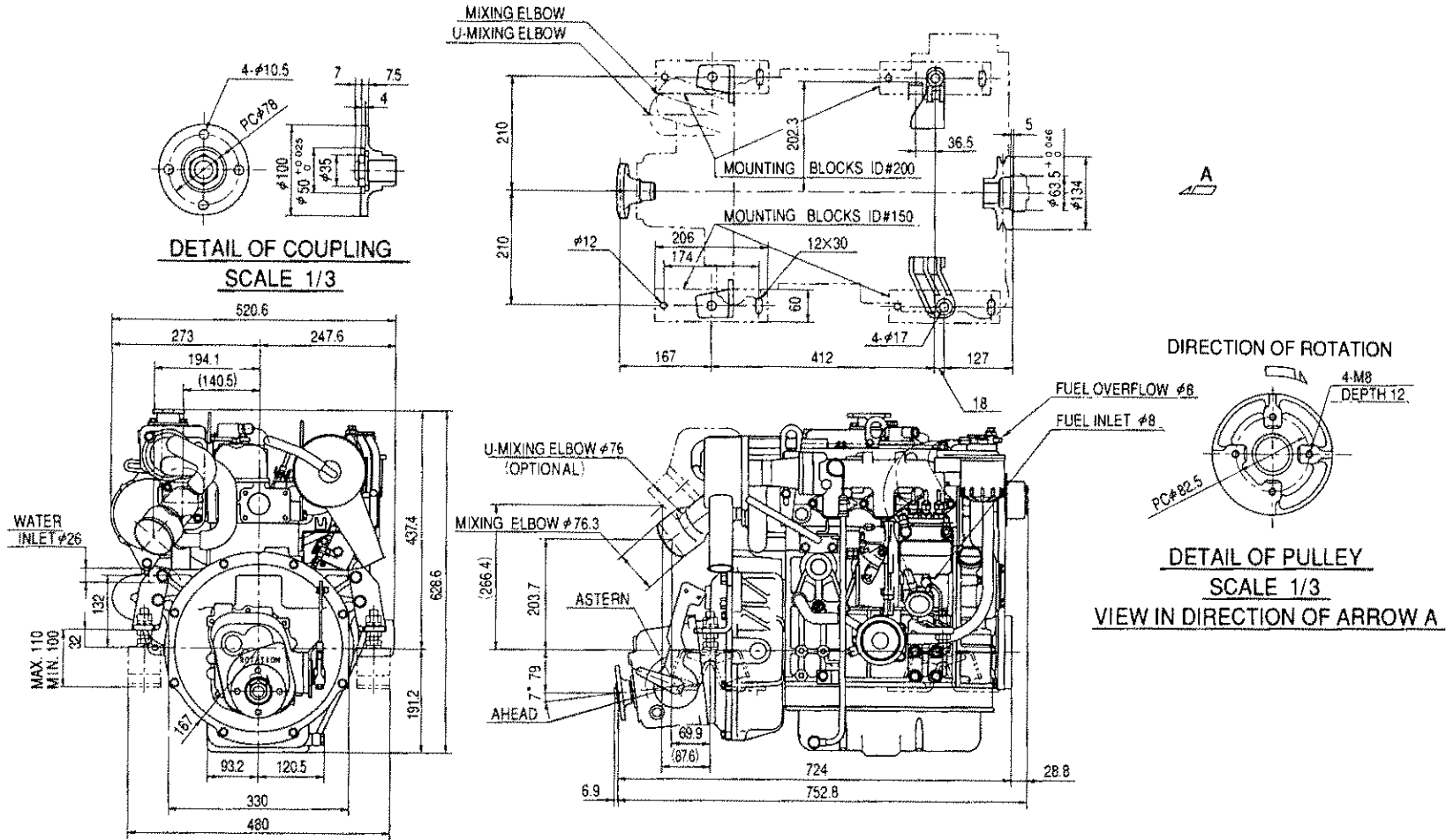
Reduction ratio (Marine gear model)	No. of blades	Outer diameter of propeller	Moment of propeller inertia $N \cdot m^2(kgf \cdot m^2=GD^2)$	Propeller materials	Engine application		
3.20 (KM3P)	3	≤ 490	$\leq 2.25(0.23)$	Bronze	3JH3(B)E		
	4	≤ 460					
2.61 (KM3P) (KM35P) 2.64 (KM3A) (KM35A)	3	≤ 470	$\leq 1.86(0.19)$		Bronze	3JH3(B)E(A)	
	4	≤ 440					
2.36 (KM3P) (KM35P) 2.33 (KM3A) (KM35A)	3	≤ 450	$\leq 1.47(0.15)$			Bronze	4JH3(B)E
	4	≤ 425					

3. Engine Outline

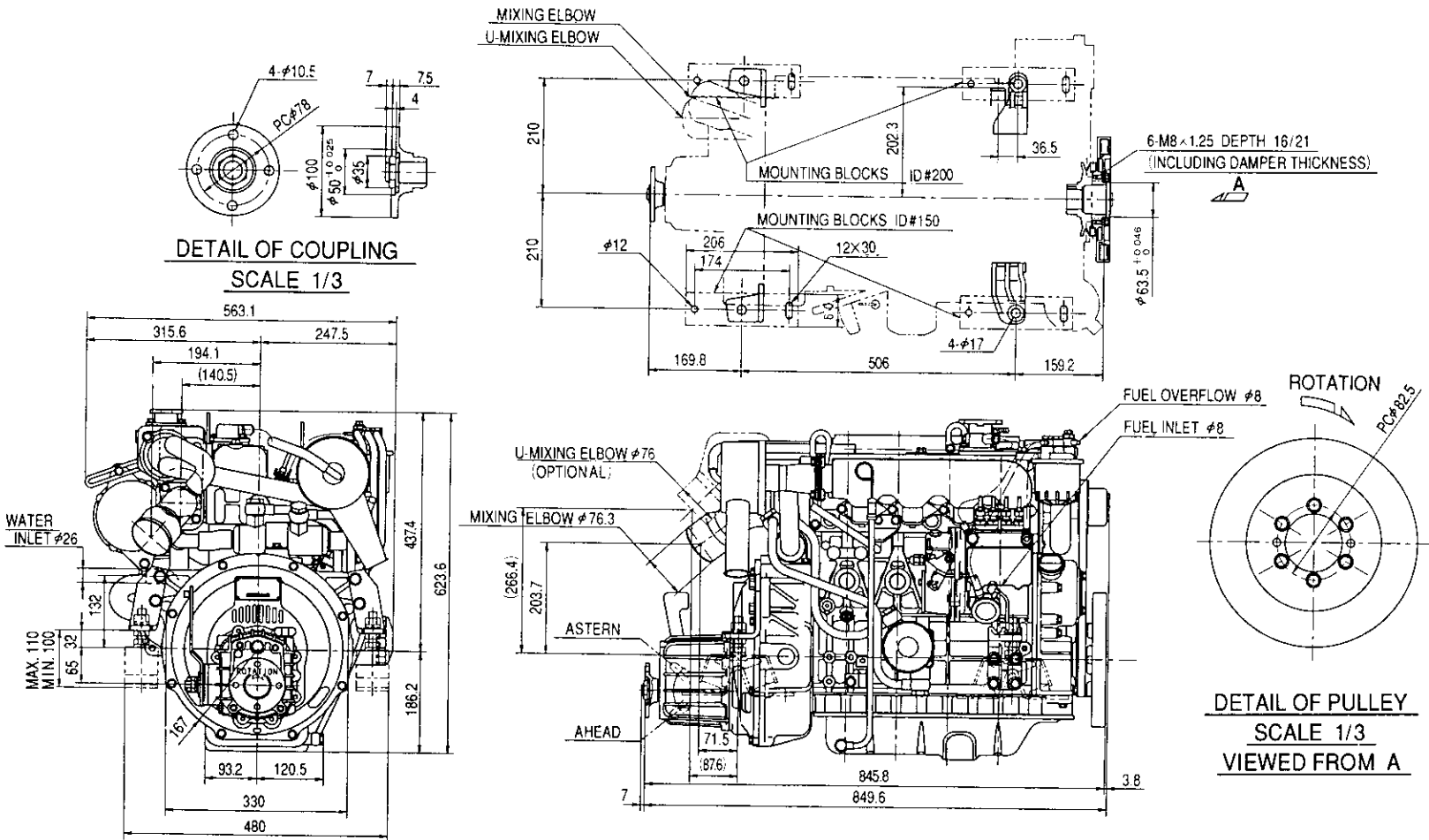
3-1 3JH3E (with KM3P Marine gear)



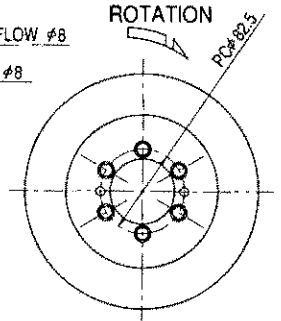
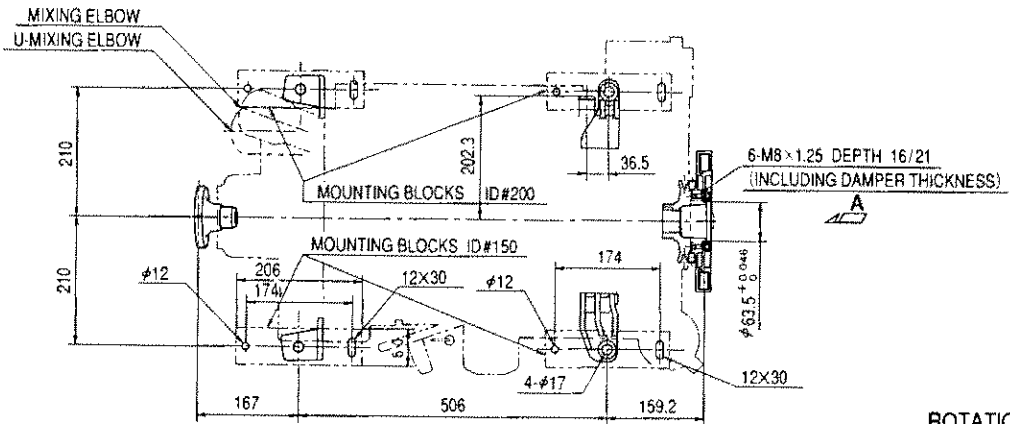
3-2 3JH3BE (with KM3A Marine gear)



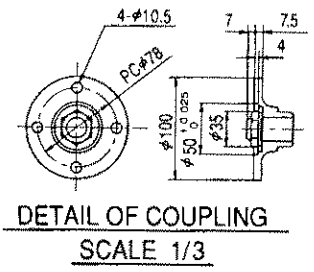
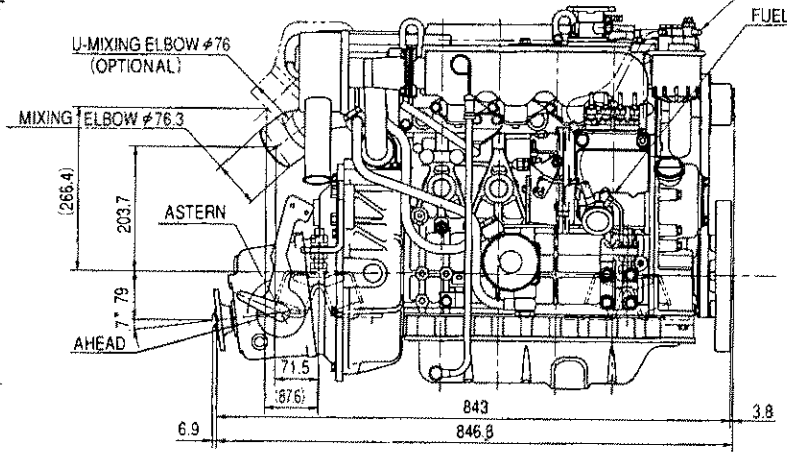
3-3 4JH3E (with KM3P Marine gear)



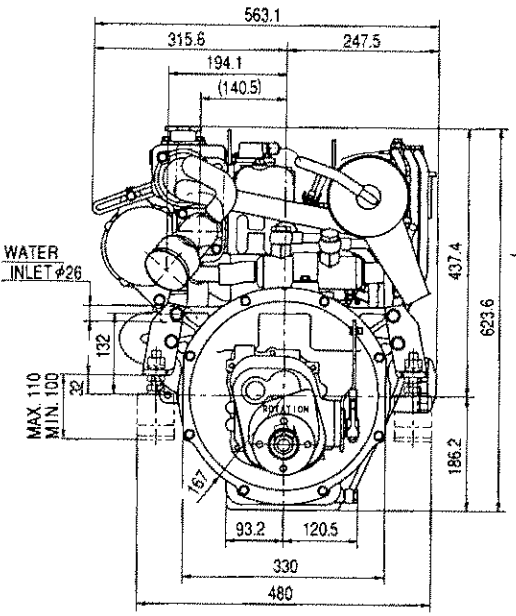
3-4 4JH3BE (with KM3A Marine gear)



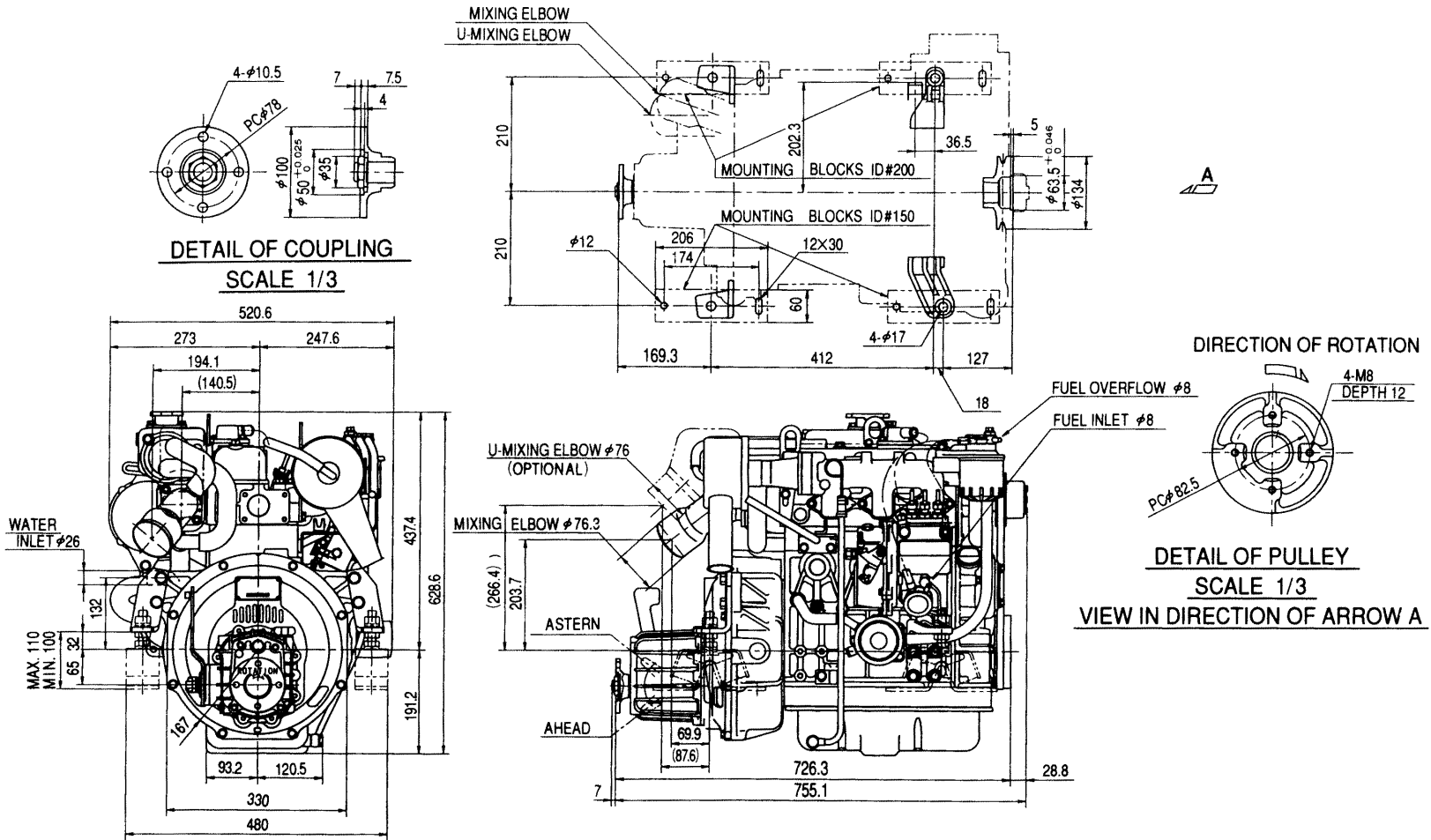
DETAIL OF PULLEY
 SCALE 1/3
 VIEWED FROM A



DETAIL OF COUPLING
 SCALE 1/3

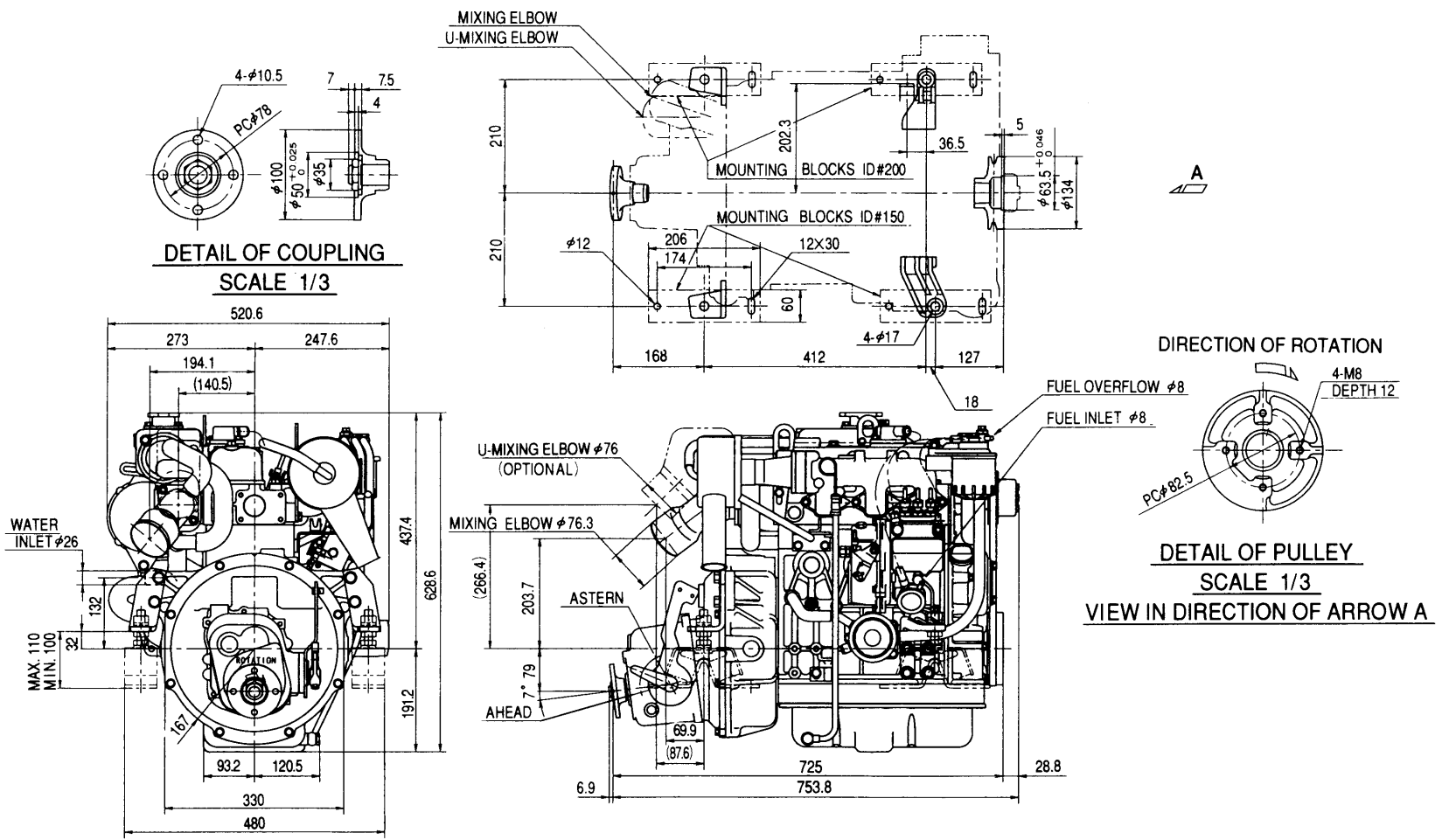


3-5 3JH3E A (with KM35P Marine gear)



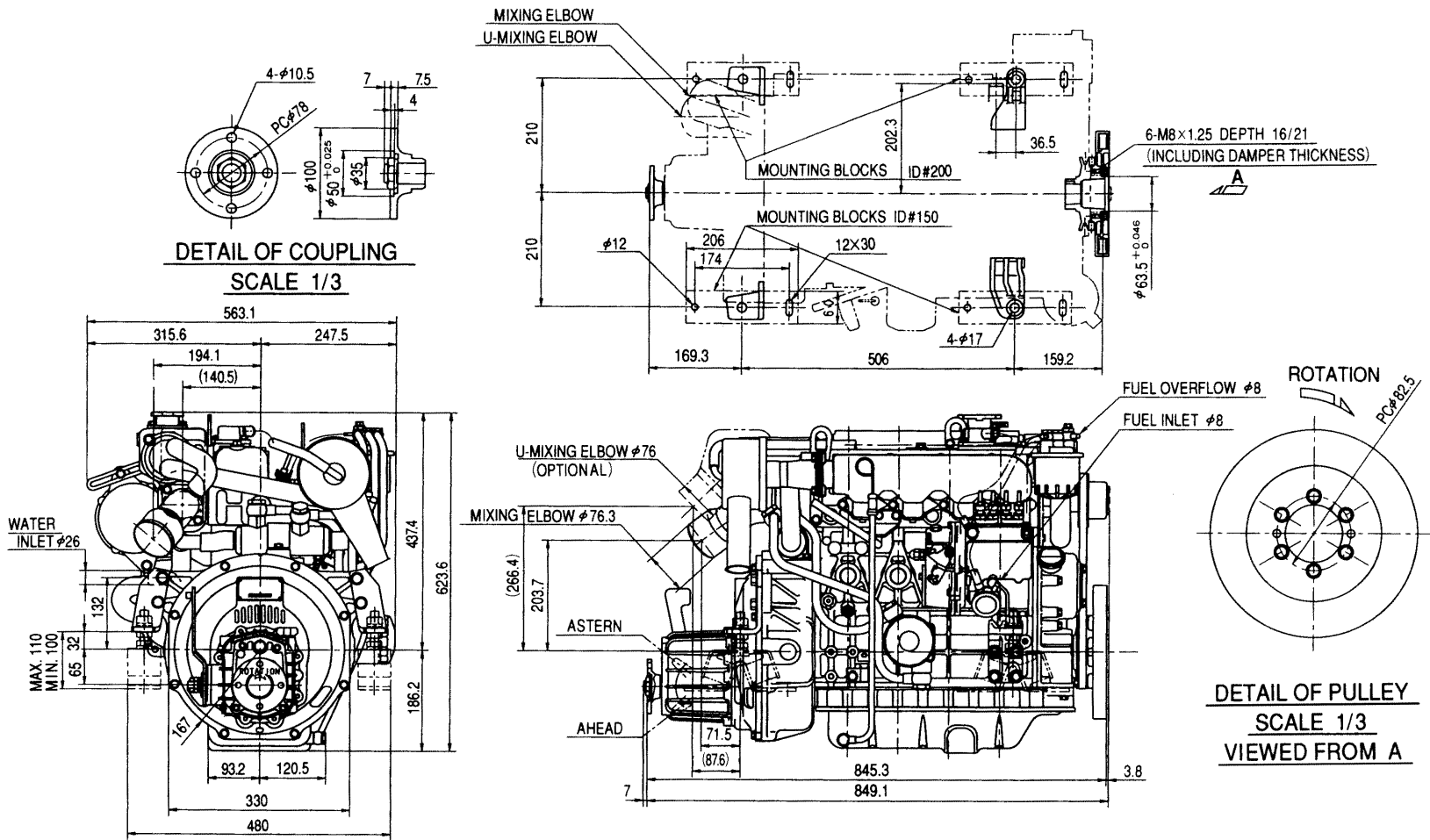
〈Note〉 No torque limiter applied to KM35P.

3-6 3JH3BE A (with KM35A Marine gear)



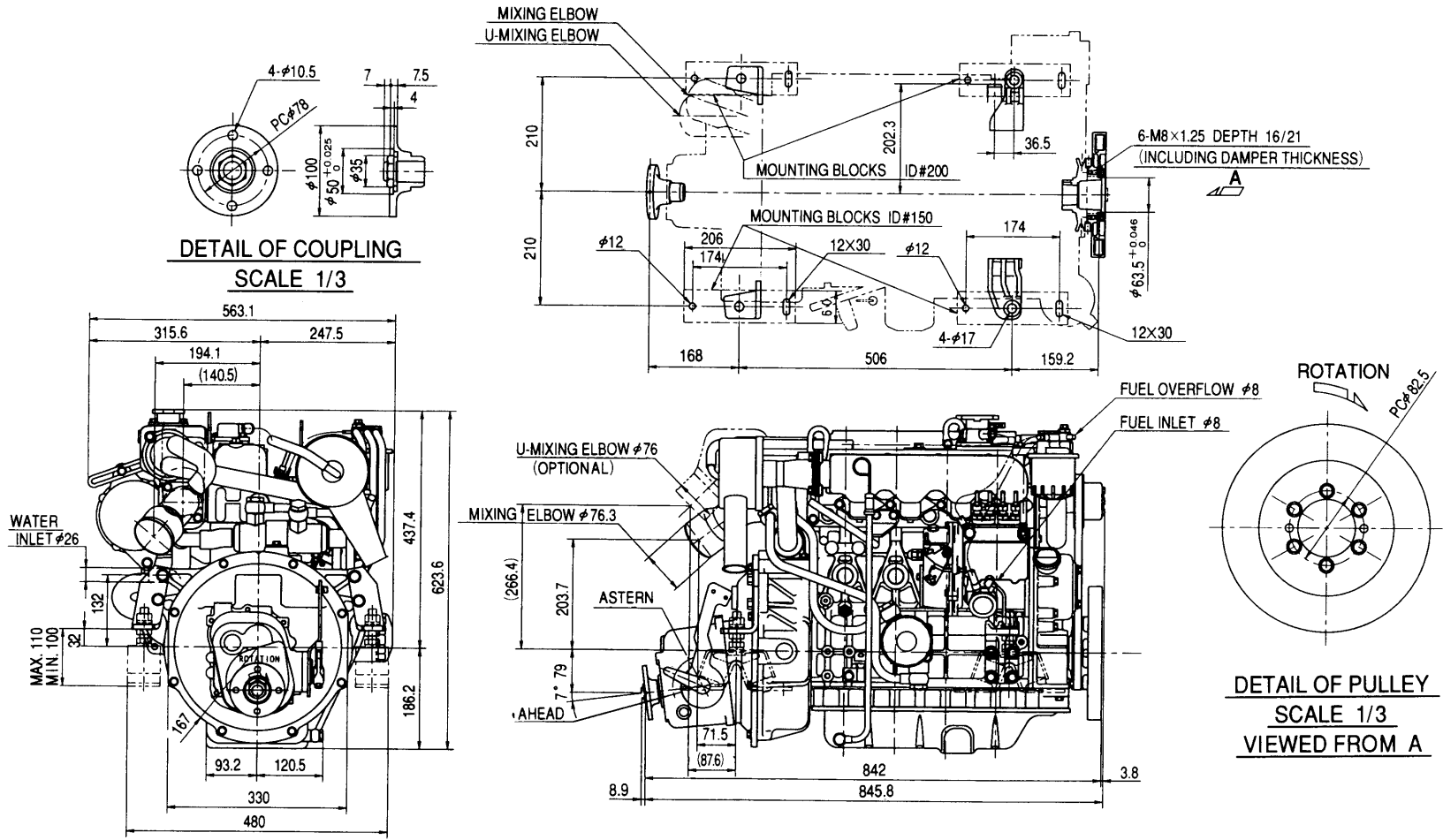
<Note> No torque limiter applied to KM35A.

3-7 4JH3E (with KM35P Marine gear)



<Note> No torque limiter applied to KM35P.

3-8 4JH3BE (with KM35A Marine gear)



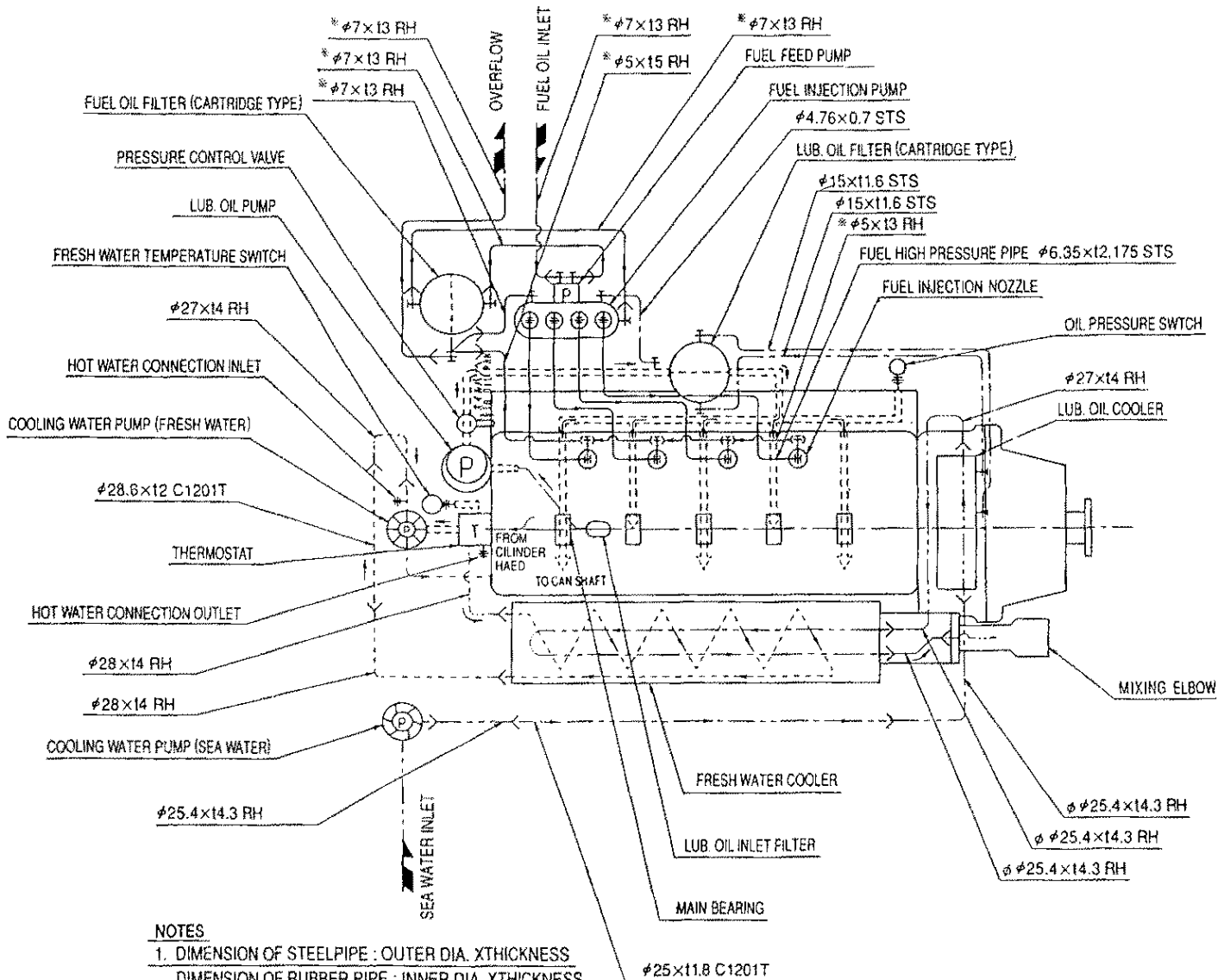
〈Note〉 No torque limiter applied to KM35A.

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

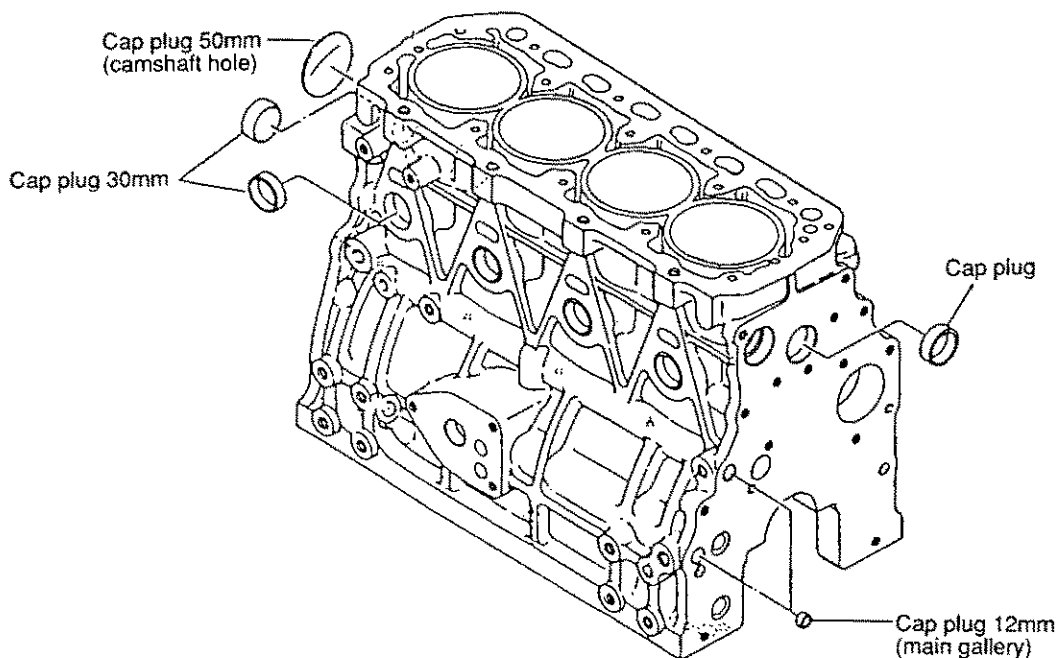
1. DIMENSION OF STEELPIPE : OUTER DIA. XTHICKNESS
DIMENSION OF RUBBER PIPE : INNER DIA. XTHICKNESS
2. FUEL RUBBER PIPES ARE SATISFIED WITH
THE SPECIFICATION OF MANUFACTUER
(No. KH-500-0) (MARKED *)

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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 rigidity for strength and low noise.



1-1 Inspection of parts

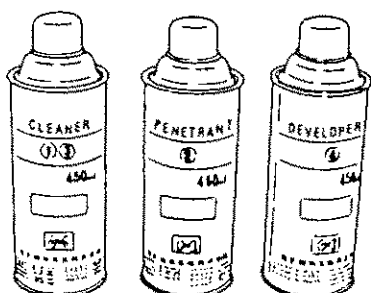
Make a visual inspection to check for cracks on engines that have frozen up, overturned or otherwise been subjected to undue stress. Perform a color check on any portions that appear to be cracked, and replace the cylinder block if the crack is not repairable.

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

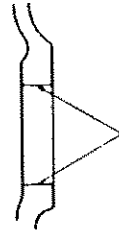
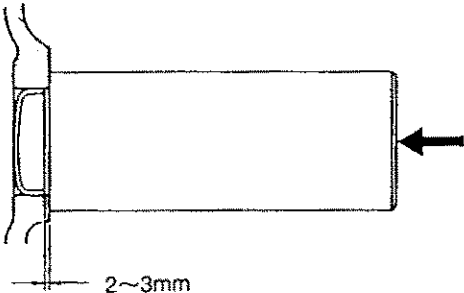
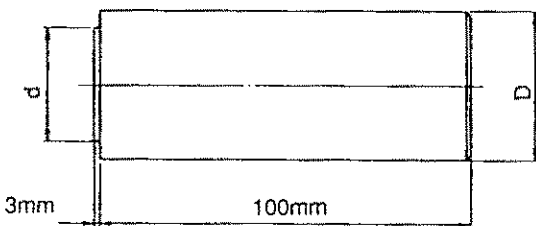


1-3 Color check procedure

- (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

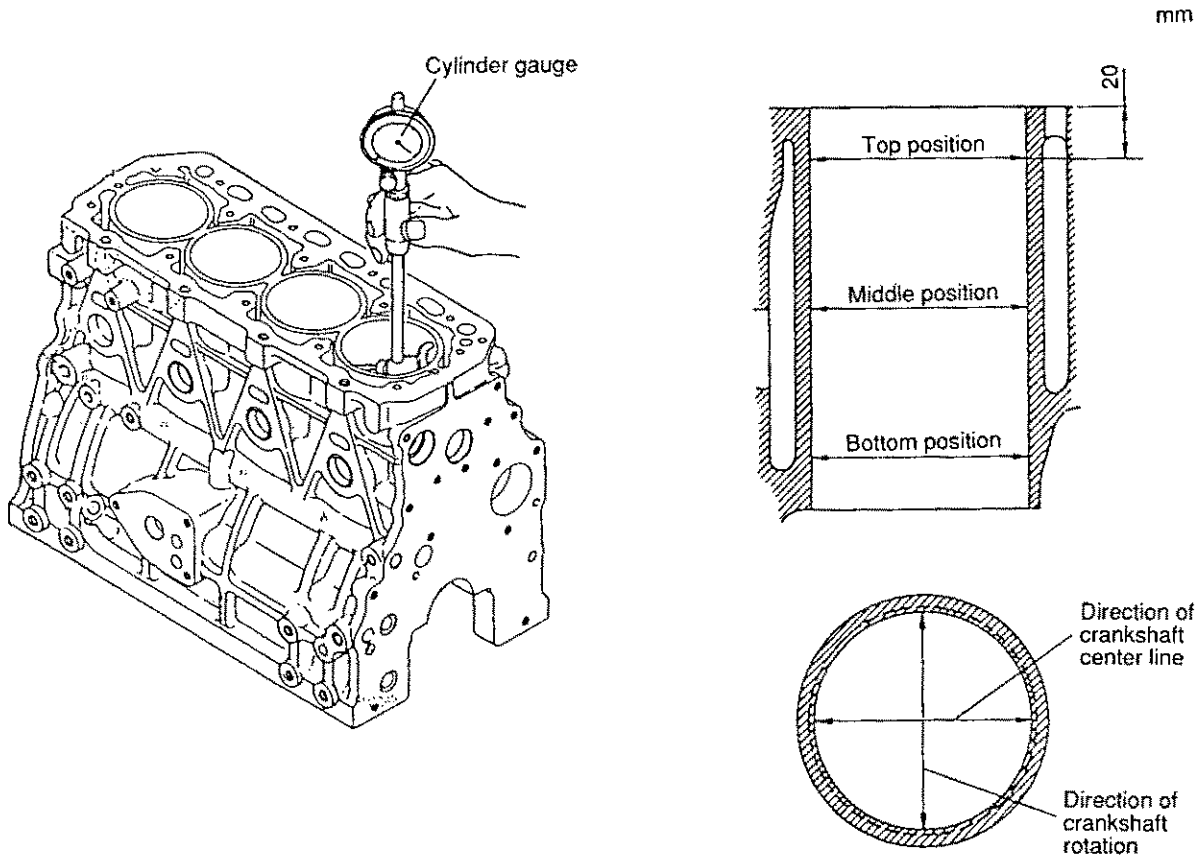
Step No.	Description	Procedure	Tool or material used									
1	Clean and remove grease from the hole into which the cup plug is to be driven. (Remove scale and sealing material previously applied.)	 <p>Remove foreign materials with a screw driver or saw blade.</p>	<ul style="list-style-type: none"> • 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.

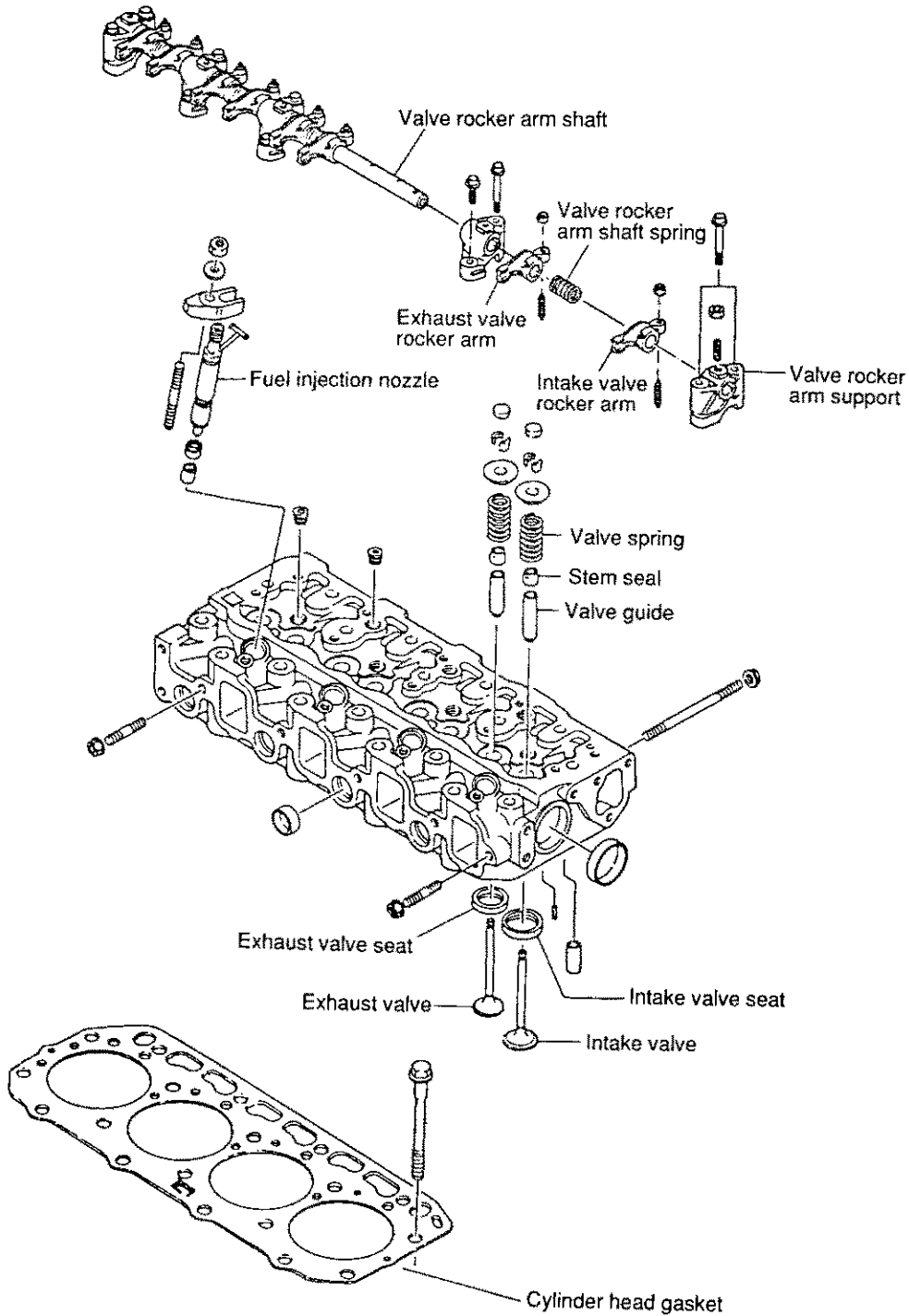
Replace the cylinder bore when the measured value exceeds the wear limit. Measurement must be done at least at 3 positions as shown in the figure, namely, top, middle and bottom positions in both directions along the crankshaft rotation and crankshaft center lines.



	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.





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