YANMAR

HINSHI-H7004

SERVICE MANUAL

6LY(M)-UTE・STE

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MARINE DIESEL ENGINE

MODEL 6LY(M)-UTE·STE

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1-1. Specification

Model			6LY(M)-UTE		6LY(M)-STE
Type			Vertical 4-cycle water cooled diesel engine		
Combustion system			Direct injection		
Aspiration			Turbocharger with intercooler		
Number of cylinder-bore×stroke		mm	6-100×110		
Displacement		ℓ	5.184		
Conti-nuousr ating	Output/crankshaft speed	KW/rpm (HP/rpm)	191.2/3100(260/3100)at flywheel		213.3/3100(290/3100)at flywheel
	Brake mean effective	MPa (kgf/cm²)	1.43(14.6)		1.59(16.2)
	Piston speed	m/s	11.4		
Maxi-mum rating	Output/crankshaft speed	KW/rpm (HP/rpm)	231.7/3300(315/3300)at flywheel		257.4/3300(350/3300)at flywheel
	Brake mean effective pressure	MPa (kgf/cm²)	1.62(16.6)		1.81(18.4)
	Piston speed	m/s	12.1		
Max speed at no lead		rpm	3720±25		
Min speed at no lead			700±25		
Starting system and capacity		kw	Electric starting;Starter motor : 12 VDC,4kw ; Alternator :12 VDC,800w		
Compression ratio			15.02 (Effective ratio : 13.83)		
Firing order			1-4-2-6-3-5-1		
Direction of rotation	Crankshaft		Counter clockwise viewed from stern side		
	Propeller shaft		Counter clockwise viewed from stern side for sailing ahead		
Oil pan	Total capacity	ℓ	20 (18 ℓ for replacement)		
	Effective capacity	ℓ	8		
Marine gear 1)	Model		KMH6A		
	Type		Constant mesh gear with hydraulic multi-disc clutch (wet type)		
	Reduction rate (ahead/astern)		1.58/1.58	1.92/1.92	2.26/2.26
	Propeller speed at maximum rating	rpm	2087	1718	1457
	Lubrication system		Forced lubrication using gear pump		
	Lube oil pan capacity	ℓ	Total : 4.0 ; Effective : 0.3		
	Cooling system		Seawater		
	Dry weight	kg	102		

1) The 6LYM-UTE-STE, does not have a marine gear.

2) Rating condition: ISO3046/1

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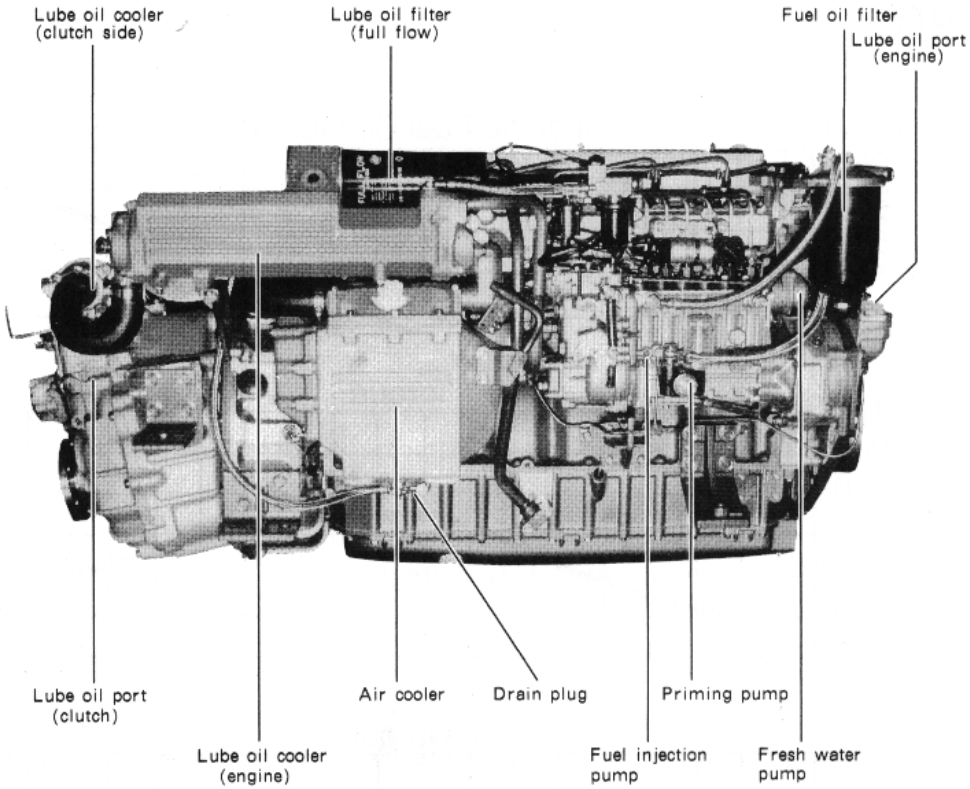
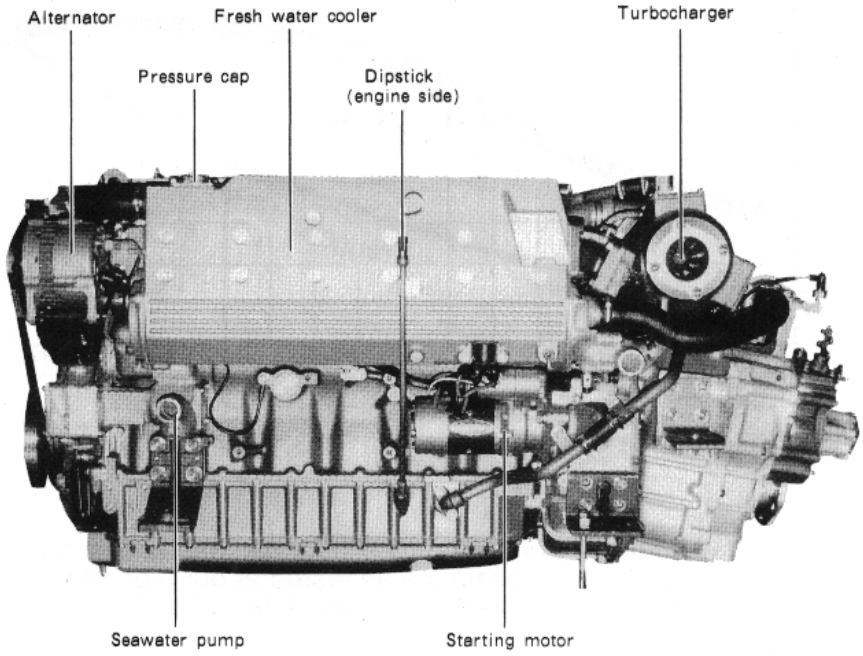
Model				6LY(M)-UTE	6LY(M)-STE
Fuel system	Injection pump			YPES-6AL ; Advance timer angle: 2.5° (cam angle)	YPES-6AL;Advance timer angle: 2.1° (cam angle)
	Injection timing		b.T.D.C	13°±1	
	Injection nozzle			YDLLA145° PL345KO	YDLLA145° PL355KO
	Injection pressure		MPa (kgf/cm²)	$23.52^{+0.98}_{0}$ $\left(240^{+10}_{0}\right)$	$25.48^{+0.98}_{0}$ $\left(260^{+10}_{0}\right)$
	Applicable fuel oil			Diesel oil	
	Fuel oil filter			Paper type (1piece)	
Engine lube system	Lubrication system			Forced lubrication with gear pump	
	Lube oil delivery		ℓ /h	≧5670 at 3200rpm	
	Lube oil pressure		MPa (kgf/cm²)	0.441±0.049(4.5±0.5) at 3000rpm	
	Lube oil filter			Paper type (full-flow,cartridge type)	
	Applicable lube oil			API Class CD (SAE J183 15w40)	
Cooling system	Cooling water pump	Seawater		Rubber impeller, gear driven	
		Fresh water		Centrifugal pump, V-belt driven	
	Cooling system			Constant high temperature fresh water cooling	
	Cooling water delivery		ℓ /h	Fresh water:17,000 at 3200rpm Seawater:8,300 at 3200rpm	
	Fresh water capacity of engine		ℓ	24	
	Fresh water capacity of subtank		ℓ	0.8	
Turb ocharger	Model			IHI (RHC7W)	
	Cooling system			Water cooling	
	Lubrication system			Forced lubrication,utilizing engine lube oil	
Intercooler	Type		m²	Corrugated fin	
	Cooling system			Seawater cooling	
Engine dimensions (L)×(W)×(H)			mm	1316×716×709 (with marine gear), 1013×716×709 (without marine gear)	
Engine dry weight			kg	620 (with marine gear), 518 (without marine gear)	

1-2. Identification of Important Parts

Operating side



Non-operating side



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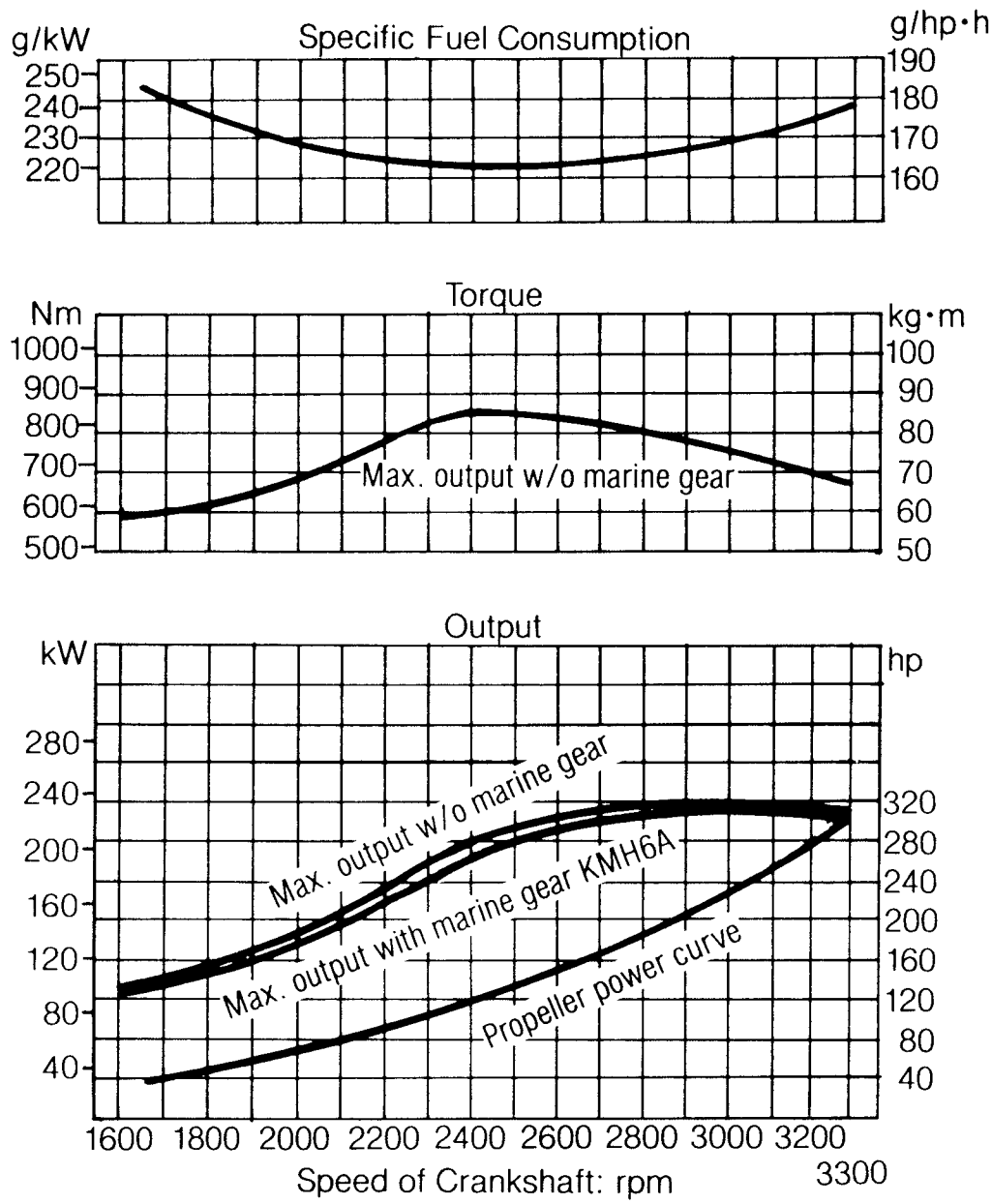
2. Performonce Curves

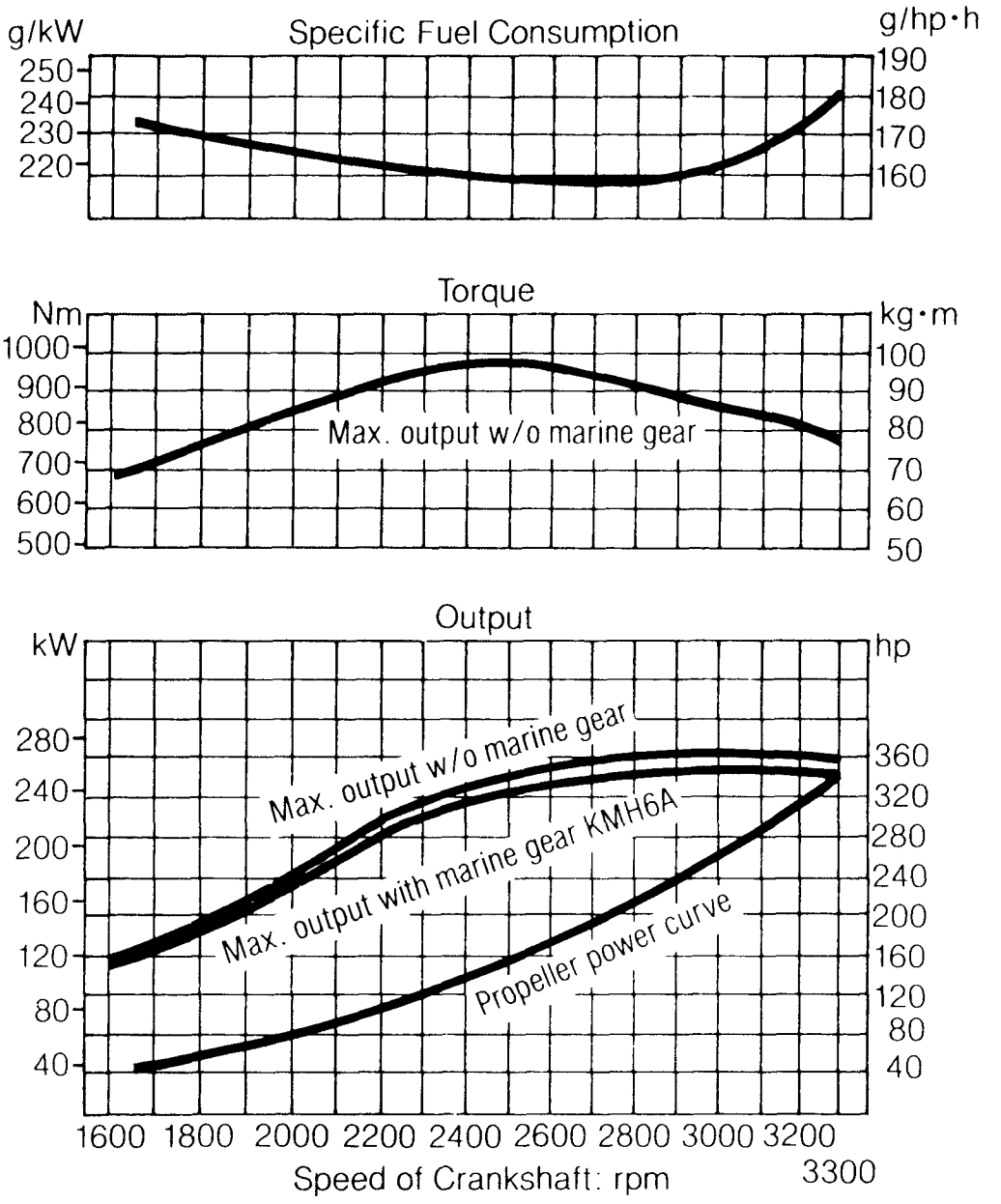
6LY(M)-UTE



Note : 1. Above data are measured at crankshaft and show the averaged performance as tested at our laboratory.
2. Power loss of the marine gear KMH6A is 3%.

6LY(M)-STE

6LY(M)-STE



Note : 1. Above data are measured at crankshaft and show the averaged performance as tested at our laboratory.
2. Power loss of the marine gear KMH6A is 3%.

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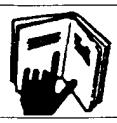
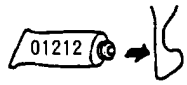
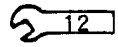
3. Disassembly and Reassembly

3-1. Preparation Before Disassembly and Reassembly

(1) Visual symbols for disassembly and reassembly

Visual symbol	Description	Visual symbol	Description
	Reference		*1 Application of liquid gasket
	Caution		Safety
	Measurement		Cleaning
	Oil supply		*2 Use of torque wrench

*1 Applicable liquid gasket:
THREE BOND TB1212, YANMAR code 977770-01212

*2 Numeric characters show width across flats.

Disassembly

- Prepare tools, instruments, and record sheets.
- Prepare a temporary stocking area and container for removed parts.
- Drain cooling water and lube oil from the engine.
- Carefully store the parts removed from the engine.
- The materials and dimensions of bolts and nuts differ from each other. To prevent mixing them up, insert them loosely in their positions after disassembly.
- If the engine malfunctions, determine the parts to be disassembled before.

Reassembly

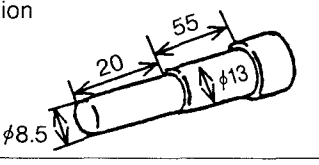
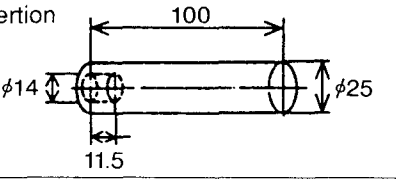
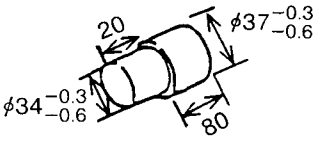
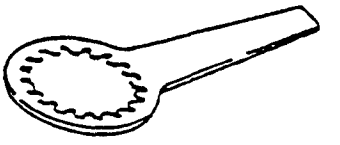
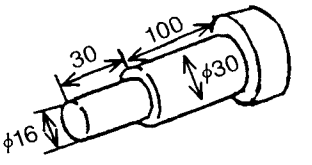
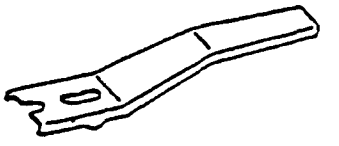
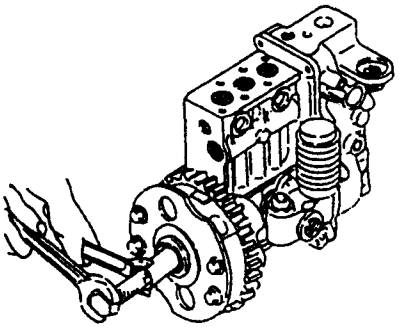
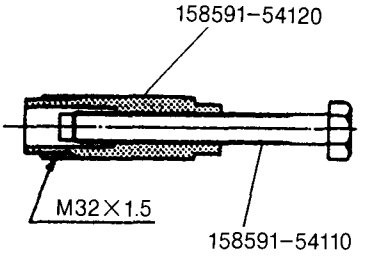
- Completely clean the parts, and then check their conditions before assembly.
- Apply new engine oil or specified lube oil to sliding parts or moving parts before assembly.
- Replace all gasket and copper packings with new ones.
- To prevent water or oil leakage, be sure to use the specified gaskets.
- For the parts having alignment marks. Fit the parts by aligning the alignment marks. For the parts to be selectively fit, carefully determine the fitting positions.
- Be sure to use specified bolts, nuts, and washers. Tighten the main bolts and nuts by applying the respective torque.
  In particular, tighten aluminum alloy parts carefully.
- For the main bolts and the torque-specified bolt, apply engine oil to the threaded parts and bearing surfaces, be sure to tighten the bolts with the specified torque using a torque wrench.

3-2. Tools, Measurement Instruments, and Other Equipment Required for Service

The standard tools supplied with the engine enable disassembly and reassembly of the main parts of the engine. For more effective and appropriate service work and more accurate measurement and diagnosis, it is recommended that the tools and equipment listed below should be prepared in addition to the standard tools.

3-2-1. Special tools

Regarding special tools1 without code number, you are kindly requested to make them according to the specified dimen-

No.	Tool	Application	Schematic drawing
1	Valve guide tool	Extraction and insertion of valve guide	Extraction  Insertion 
2	Connecting rod bush tool	Extraction and insertion of connecting rod bush	
3	Filter wrench	Removal of filter	
4	Piston pin tool	Extraction and insertion of piston pin	
5	Valve spring compressor	Extraction and insertion of valve	
6	Timer removal tool		

Note : For piston insertion, use a band tightening type tool.

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3-2-2. Other material

Items		Usual Contents	Features and application
Liquid gasket	Three Bond No.1 TB1101	200g (1kg also aviable)	Non-drying liquid gasket; solventless type, easy to remove, superior in seawater resistance, applicable to various mating surfaces.
	Three Bond No.2 TB1102	200g (1kg also aviable)	Non-drying liquid gasket; easy to apply, superior in water resistance and oil resistance, especially superior in gasoline resistance.
	Three Bond No.3 TB1103	150g	Drying film, low viscosity and forming of thin film, appropriate for mating surface of precision parts.
	Three Bond No.4 TB1104	200g (1kg also aviable)	Semi-drying viscoelastic material, applicable to non-flat surface having many indentations and protrusions, superior in heat resistance, water resistance, and oil resistance.
	Three Bond No.10 TB1211	100g	Solventless type silicone-base sealant, applicable to high temperature areas. (−50℃ to 250)
	Three Bond TB1212	100g	Silicone-base, non-fluid type, thick application possible.
Adhesive	Lock tight TB1401	200g	Prevention of loose bolts, gas leakage, and corrosion. Torque required to loosen bolt: 10 to 20% larger than tightening torque.
	Lock tight SUPER TB1330B	50g	Excellent adhesive strength locks bolt semipermanently.
Seal Tape		5m round tape	Sealing material for threaded parts of various pipes. Ambient temperature range: −150℃ to 200℃
O-ring kit		ϕ 1.92-m dia.:1 ϕ 2.42-m dia.:1 ϕ 3.12-m dia.:1 ϕ 3.52-m dia.:1 ϕ 5.72-m dia.:1	O-ring of any size can be prepared, whenever required. (Including adhesive, release agent, cutter, and jig)
EP lubricant (molybdenum disulfate)	Brand name (LOWCOL PASTE)	50g	For assembly of engine cylinders, pistons, metals, shafts, etc. Spray type facilitates application work.
	Brand name (PASTE SPRAY)	330g	
	Brand name (MOLYPASTE)	50g	Prevention of seizure of threaded parts at high temperature. Applicable to intake and exhaust valves. (stem, guide, face)

Items		Usual Contents	Features and application
Scale solvent	Scale solvent	1 box (4kg×4removers)	• The scale solvent removes scale in a short time. (1 to 10 hours) • Prepare water (seawater is possible) in an amount that is about 10 times the weight of the solvent. Mix the solvent with water. • Just dipping disassembled part into remover mixture removes scale. To shorten removal time, stir remover mixture. • If cleaning performance drops, replace remover mixture with new remover mixture. Neutralize used mixture, and then dispose of it. To judge cleaning performance of mixture, put pH test paper into mixture. If test paper turns red, remover mixture is still effective.
	Neutralizer (caustic soda)	1 box (2kg×4 neutralizers)	
	pH test paper		
Antirust		2 ℓ	Add antirust to fresh water system. Then operate engine for approximately 5 minutes. Antirust will be effective for 6 months.
Anti freeze		2 ℓ	Add antirust to fresh water system at the cold area to engine operate.
Cleaning agent		1kg×20	• The cleaning agent removes even carbon adhering to disassembled parts. • If a cleaning machine is used, prepare 4 to 6% mixture of 60° to 80℃ to ensure more effective cleaning.

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Items	Usual Contents	Features and application
Cleaning agent for turbocharger	4 ℓ×4	Special cleaning agent that requires no watar, specially designed for blower of turbocharger and intercooler.
	18 ℓ×1	
	15sets : 1, 500cc×6	

Cautions:

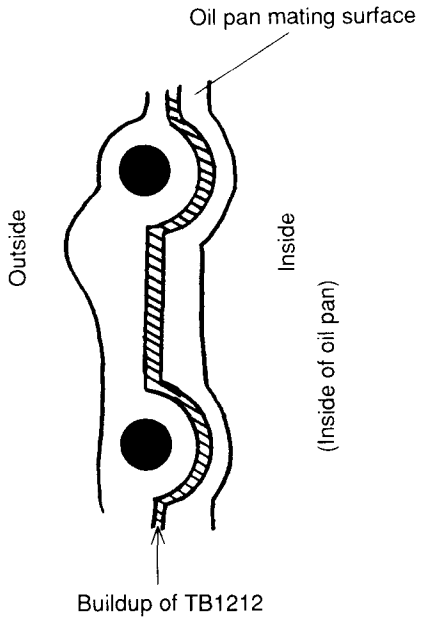
It is recommended that the liquid gasket of Three Bond TB1212 should be used for service work.
Before providing service, observe the cautions below:

(1) Build up each gasket equally.

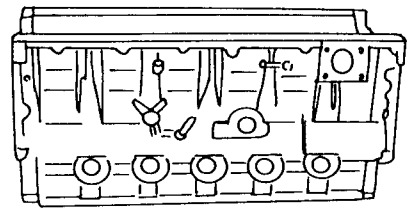
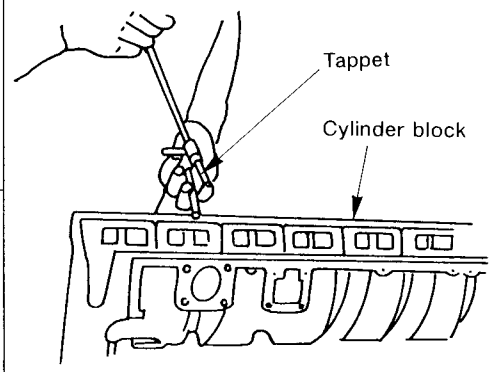
(2) For a bolt hole, apply liquid gasket to the inside surface of the hole.

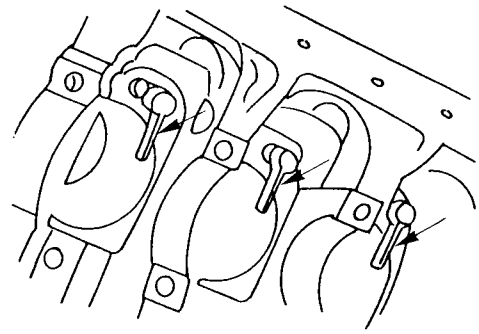
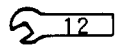
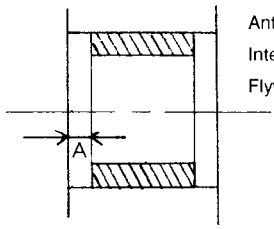
(3) Conventionally, Three Bond TB1104(gray) or Three Bond TB1102(yellow) is used for paper packings though single use of one of these bonds is not effective.

(4) If conventional packings are used, do not use a liquid packing.



3-3. Assembly Procedure

<table>
<tr><th></th><th>Part</th><th>Description</th><th>Symbol</th><th>Illustration</th></tr>
<tr><td>1</td><td>Cylinder block</td><td>Completely clean each oil hole. After cleaning, check that no scaling remains on cylinder block.</td><td>  </td><td rowspan="4"> 
cylinder block
 

Tappet fitting
 
Piston cooling nozzle</td></tr>
<tr><td>2</td><td>Tappet</td><td>Fit each tappet.
Check that each tappet is fitted to appropriate cylinder and valve (exhaust or intake).
Before fitting, apply engine oil to each tappet.After fitting, check that each tappet operates smoothly.</td><td>  </td></tr>
<tr><td>3</td><td>Piston cooling nozzle</td><td>Fit each cooling nozzle to piston.
Check that nozzle end is positioned on piston head side. Also check that nozzle does not touch cylinder block.Tightening torque : 2.0kgf-m</td><td>  </td></tr>
<tr><td>4</td><td>Cam shaft bearing</td><td>1) Fit each cam shaft bearing as follows:
(1) Apply engine oil to outer surface of each bearing and fitting area of cylinder block, and then press-fit metal into its position using driving tool.
Check position of each oil hole. More than 2/3 area of hole should be aligned.
 
Anti-flywheel side: A=2
Intermediate position: A=1.5
Flywheel side: A=0.5
(2) After press-fitting, check each bearing for distortion by measuring, inner diameter of bearing.
(mm)
<table><tr><td>Inner diameter after press-fitting</td><td>$\phi 57^{+0.05}_{+0.02}$</td></tr></table>
Note :
To remove cam shaft bearing
1. Attach plate to cam shaft bearing, and tap off bearing using copper hammer.
2. Completely clean each bearing hole on cylinder block before press-fitting each bearing.</td><td> 
  </td></tr>
</table>

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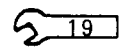
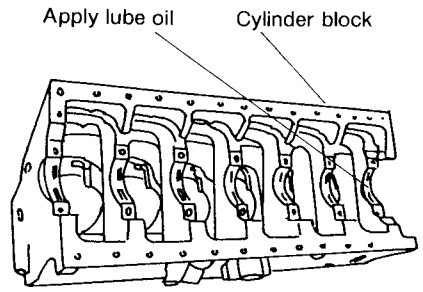
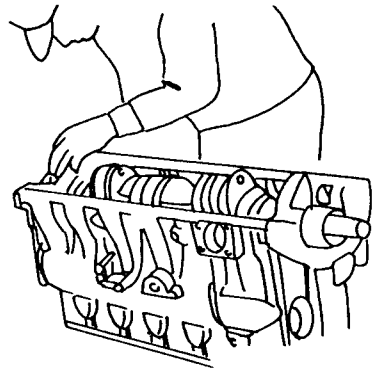
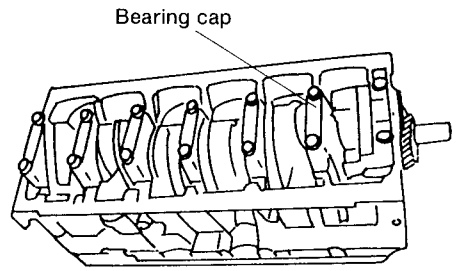
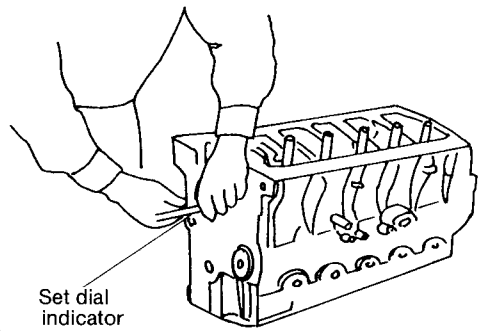
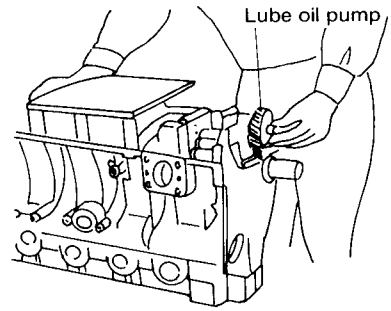
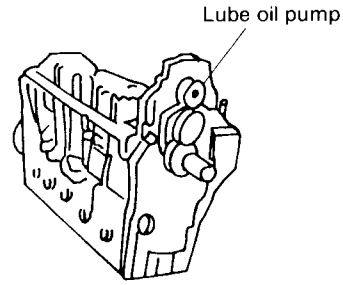
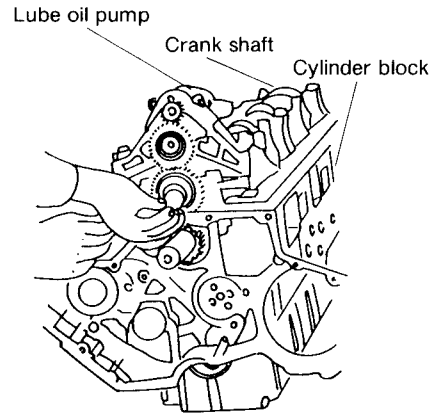
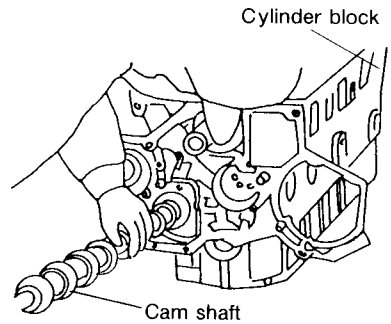
	Part	Description	Symbol	Illustration
5	Crankshaft	1) Apply engine oil to each crank journal hole of cylinder block and each block side main bearing, and then fit shaft to cylinder block. Bearings having an oil groove should be positioned on upper side (block side). Fit thrust metal so that oil grooves are respectively positioned outside. 2) Apply engine oil to each crank pin and crank journal, and fit each journal to main bearing. 3) Fitting caps (1) Apply engine oil to both surfaces of each cap side main bearing, and then fit each main bearing to the cap. (2) Apply engine oil to bolt bearing surfaces and threaded parts of each bearing cap. Fit each bearing cap to each journal of crankshaft, and apply specified torque to tighten each bearing cap bolt. Check that each bolt is equally tightened Bearing cap bolt (M15, 14 bolts) tightening torque : $24^{\pm 1}$kgf-m Check that arrow marked on each bearing cap is positioned on flywheel side, and matchmark on each cylinder is correctly aligned. (3) Check that crankshaft rotates smoothly. (4) Measure side clearance of crankshaft. (mm) Side clearance of crankshaft: 0.132~0.223	  	 Fitting of upper bearings  Fitting of thrust bearings  Fitting of bearing caps  Measurement of side clearance

<table>
<tr><th></th><th>Part</th><th>Description</th><th>Symbol</th><th>Illustration</th></tr>
<tr><td>6</td><td>Lube oil pump</td><td>1) Fit lube oil pump idle gear.
Side clearance: 0.10 to 0.30mm
<table><tr><td>Tightening torque</td><td>11±1.0kgf-m</td></tr></table>2) Fit lube oil pump while adjusting position of positioning pin.
Secure pump by tightening 3 bolts of M10×55mm
3) Measure gear backlash between lube oil pump and idle gear, and check that backlash satisfies value specified below:
(mm)<table><tr><td>Gear backlash</td><td>0.17±0.09</td></tr></table></td><td>Torque wrench
14</td><td> 
Fitting of lube oil pump idle gear
 
Fitting of lube oil pump</td></tr>
<tr><td>7</td><td>Gear case</td><td>Apply liquid gasket to gear case, and then fit gear case to cylinder body while adjusting position of dowel pin.
Secure gearcase by tightening bolt listed below:
M8×20mm, 5 bolts
M8×45mm, 1 bolt</td><td>1212
12</td><td> 
Fitting of gear case</td></tr>
<tr><td>8</td><td>Cam shaft</td><td>1) Apply engine oil to bearing of cam shaft, and then fit cam shaft.
2) Fit thrust plate, and secure it by tightening 2 bolts of M8×16mm
(mm)<table><tr><td>Side clearance</td><td>0.05~0.20</td></tr></table>Note:
If cam gear is removed from cam shaft, fit thrust metal before fitting gear.
Heat cam gear to between 180˚ and 200˚C,and then press-fit it.
Interference: 0.023 to 0.060mm</td><td>12</td><td> 
Fitting of cam shaft</td></tr>
</table>

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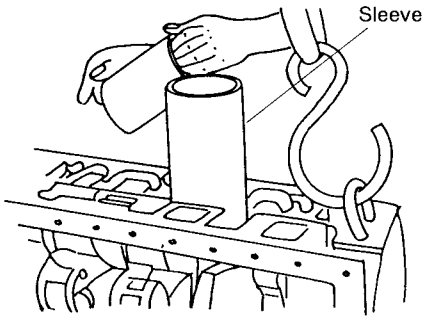
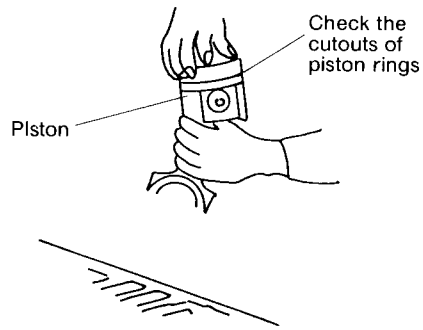
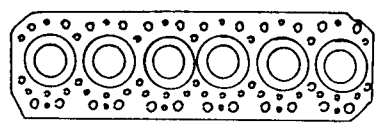
<table>
<tr><th></th><th>Part</th><th>Description</th><th>Symbol</th><th>Illustration</th></tr>
<tr><td>9</td><td>Cylinder sleeve</td><td>1) Completely clean sleeve fitting area of each cylinder block.
2) Completely clean outer surface of each cylinder sleeve.Then tapcylinder sleeve into cylinder block
Note:
1. Before inserting each cylinder sleeve, check cylinder No. and fitting direction. Insert sleeve into position on which identical size, such as A, B, or C, is marked. Size is marked on each sleeve and lower side of cylinder block on operating side. For detailed description on size mark, refer to Sec. 4-3.
2. After completing cylinder sleeve insertion, do not turn cylinder block upside down to face cylinder head side downward.
3) Measure projection of each cylinder sleeve, and check that protrusion length satisfies value specified below:
(mm)
Sleeve projection: 0.025~0.09</td><td>Torque wrench</td><td> 

Insertion of cylinder sleeve</td></tr>
<tr><td>10</td><td>Piston assembly</td><td>1) Fit connecting rod to each piston while checking direction of piston. For detailed description, refer to Sec. 3-3-4.
2) Fit piston rings and oil ring to each piston while checking that cutouts of rings are offset 120° from each other.
3) Apply engine oil to sleeve, outer surface of piston, and rod metal.
4) Adjust crankshaft pin of corresponding piston to top position.
5) Check direction of piston.
6) Insert piston into cylinder using piston insertion tool.
7) After insertion, remove tool. Then rotate crankshaft by pressing piston edge using hammer until piston reaches bottom dead center.
8) Install cap on big end while checking matchmarks, and then tighten rod bolts. Before tightening rod bolts, apply lube oil to bolt bearing surface.
Note:
Selectively fit each piston and sleeve.</td><td>17</td><td> 

Insertion of piston assembly
 
Fitting of piston assembly</td></tr>
</table>