

HINSHI-H7004

SERVICE MANUAL

6LY (M) -UTE - STE

YANMAR

SERVICE MANUAL

MARINE DIESEL ENGINE



MODEL 6LY(M)-UTE·STE

Foreword

This service manual describes the construction and functions of the major parts of the 6LY(M)-UTE.STE engine and illustrates the disassembly and assembly procedures (standard servicing procedures) necessary for maintaining and servicing the engine.

Please read this manual carefully so that you are completely familiar with the construction and function of each part before you start actual servicing work.

The construction and servicing procedures described in this manual may be slightly modified for the improvement of quality and performance without prior notice. Please do not hesitate to contact us if you have any queries or suggestions.

Prepare before you work !

For accurate and efficient service work, check and prepare the following:

1. Check the customer's service ledger
 - 1) When was the machine last serviced?
 - 2) How many months or hours has the machine been used since the previous servicing?
 - 3) What was the previous trouble, and what parts were replaced?
 - 4) Which parts should you replace this time?
2. Prepare the parts
Check the stock of parts which are needed for servicing.
3. Prepare the recording forms
Check sheets, parts measurement record sheet, and operation test record sheet.
4. Prepare the servicing measurement tools, containers, etc.

MODEL 6LY(M)-UTE.STE

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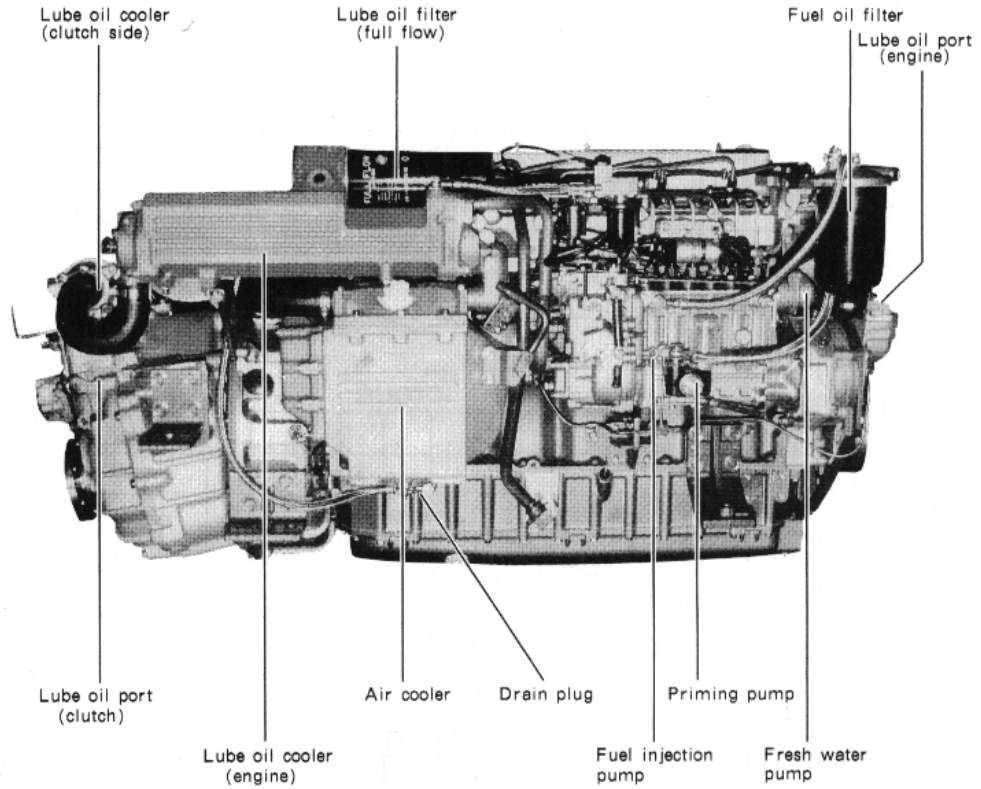
1-1. Specification

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		
Continuous rating	Output/crankshaft speed	KW/rpm (HP/rpm)	191.2/3100(260/3100)at flywheel	213.3/3100(290/3100)at flywheel	
	Brake mean effective pressure	MPa (kgf/cm ²)	1.43(14.6)	1.59(16.2)	
	Piston speed	m/s	11.4		
Maximum 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/cm ²)	1.62(16.6)	1.81(18.4)	
	Piston speed	m/s	12.1		
Max speed at no load		rpm	3720±25		
Min speed at no load			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			

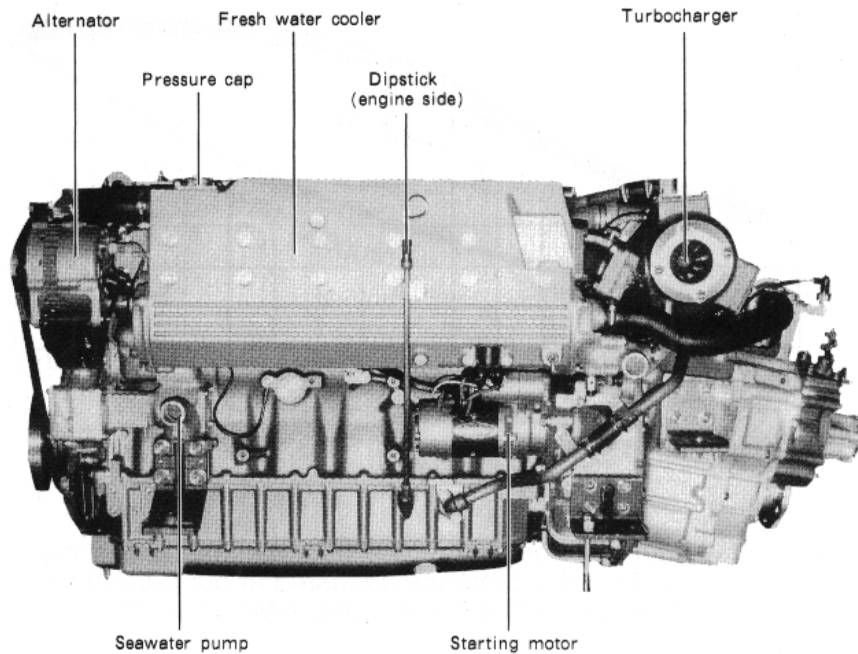
- 1) The 6LYM-UTE-STE, does not have a marine gear.
- 2) Rating condition: ISO3046/1

Model		6LY(M)-UTE		6LY(M)-STE	
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/cm ²)	23.52 ⁰ +0.98 (240+10 ⁰)		25.48 ⁰ +0.98 (260+10 ⁰)	
Applicable fuel oil		Diesel oil			
Fuel oil filter		Paper type (1 piece)			
Lubrication system		Forced lubrication with gear pump			
Lube oil delivery	ℓ/h	≥5670 at 3200rpm			
Lube oil pressure	MPa (kgf/cm ²)	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)			
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			
Model		IHI (RHG7W)			
Cooling system		Water cooling			
Lubrication system		Forced lubrication, utilizing engine lube oil			
Type	m ²	Corrugated fin			
Cooling system		Seawater cooling			
Intercooler					
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

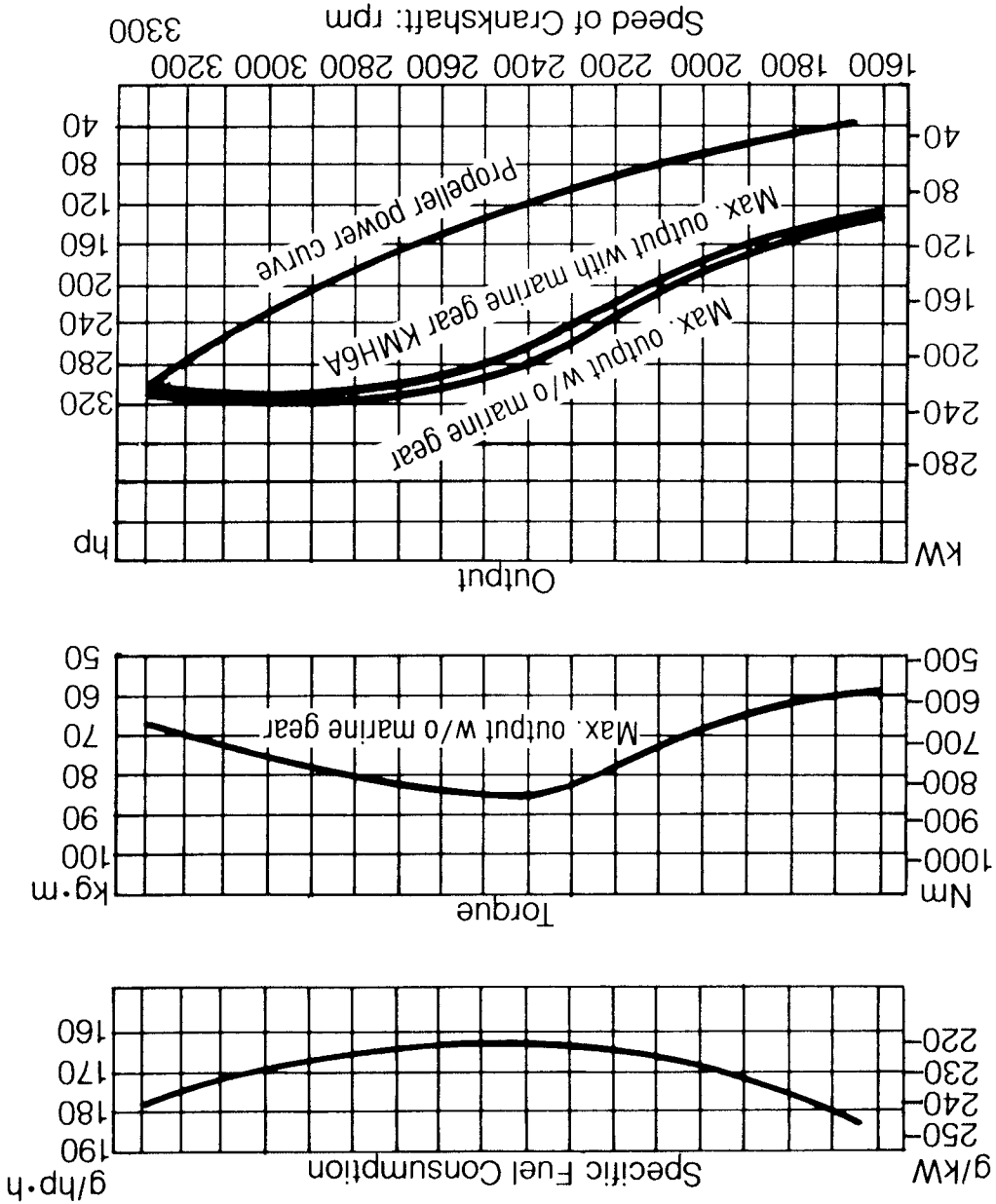


Non-operating side



2. Performance Curves

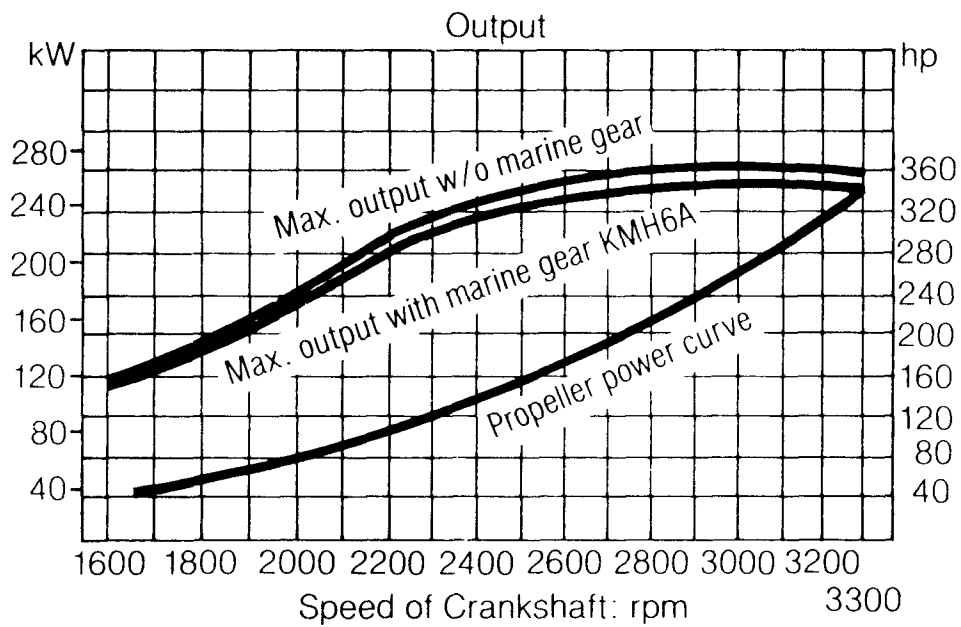
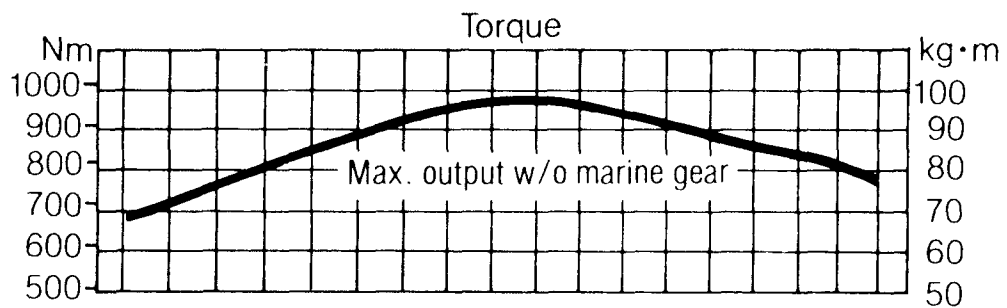
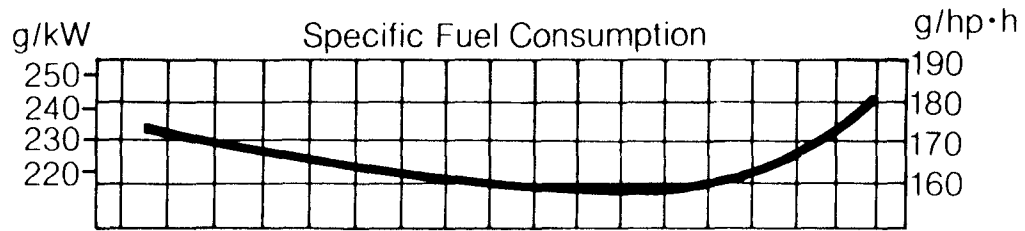
6LY(M)-UTE



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

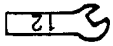


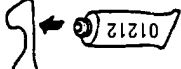

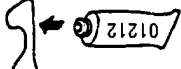


Note : 1. Above data are measured at crankshaft and show the averaged performance as tested at our laboratory.
 2. Power loss of the marine gear KMH6A is 3%.

3. Disassembly and Reassembly

3-1. Preparation Before Disassembly and Reassembly

(1) Visual symbols for disassembly and reassembly

Visual symbol	Description	Visual symbol	Description
	Use of torque wrench * 2		Cleaning
	Safety		* 1 Application of liquid gasket
	Reference		* 1 Applicable liquid gasket: THREE BOND TB1212, YANMAR code 977770-01212 * 2 Numeric characters show width across flats.

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.

Disassembly

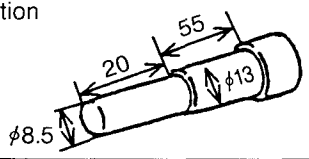
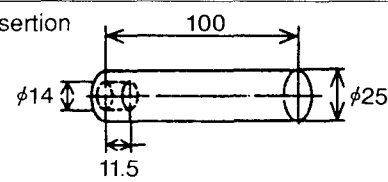
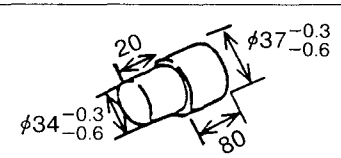

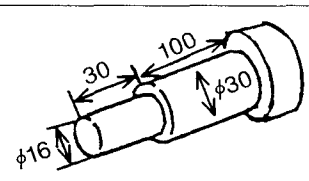
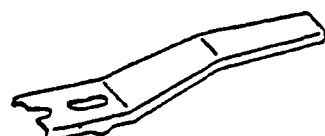
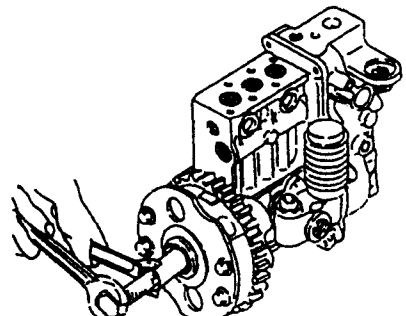
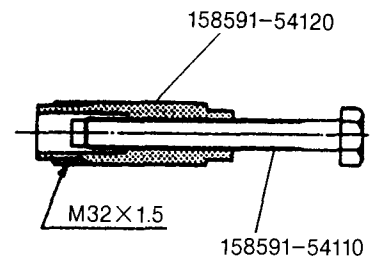
- Prepare tools, instruments, and record sheets.
- Prepare a temporary stocking area and container for removed parts.
- Drain cooling water and lube oil from the engine.
- Carefully store the parts removed from the engine.
- The materials and dimensions of bolts and nuts differ from each other. To prevent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

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.

3-2-2. Other material

Items	Usual Contents	Features and application
Liquid gasket	Three Bond No.1 TB1101 200g (1kg also available)	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 available)	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 available)	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°C to 250)
	Three Bond TB1212 100g	Silicone-base, non-fluid type, thick application possible.
	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 TB130B 50g	Excellent adhesive strength locks bolt semipermanently.
	Seal Tape	5m round tape
EP Lubricant (molybdenum disulfate)	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)
	Brand name (LOWCOL PASTE) 50g	For assembly of engine cylinders, pistons, metals, shafts, etc. Spray type facilitates application work.
	Brand name (MOLYPASTE) 50g	Prevention of seizure of threaded parts at high temperature. Applicable to intake and exhaust valves. (stem, guide, face)

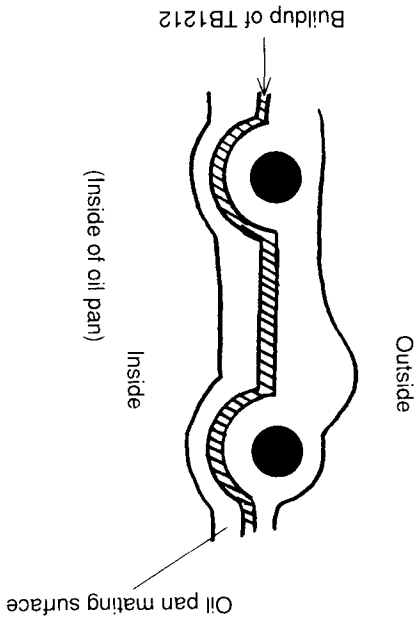
Items		Usual Contents	Features and application
Scale solvent	Scale solvent	1 box (4kg×4removers)	<ul style="list-style-type: none"> • The scale solvent removes scale in a short time. (1 to 10 hours) • Prepare water (seawater is possible) in an amount that is about 10 times the weight of the solvent. 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	<ul style="list-style-type: none"> • 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°C to ensure more effective cleaning.

Items	Usual Contents	Cleaning agent for turbocharger
Features and application	4 ℓ × 4	
	18 ℓ × 1 15sets : 1, 500cc × 6	


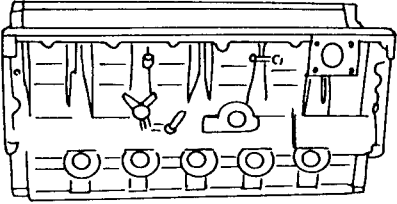

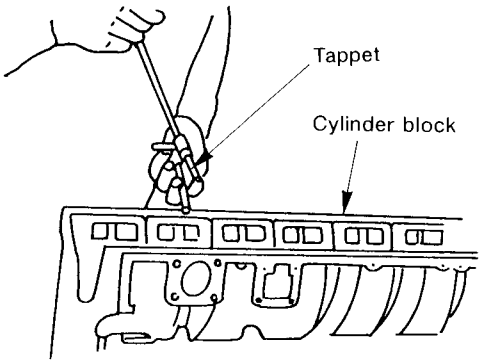
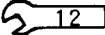
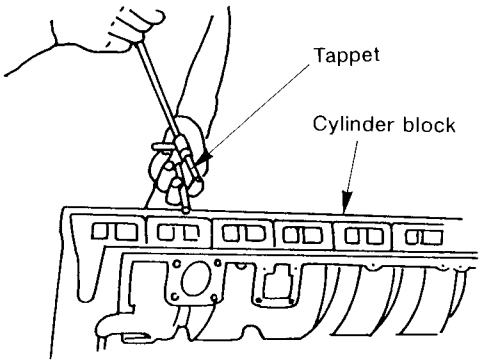
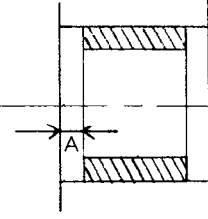


Cautions:


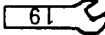

It is recommended that the liquid gasket of Three Bond TB1212 should be used for service work. Before providing service, observe the cautions below:

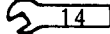

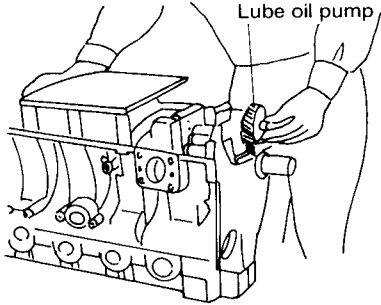
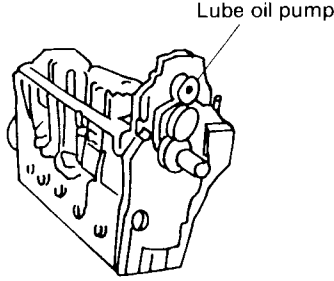
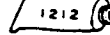
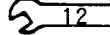
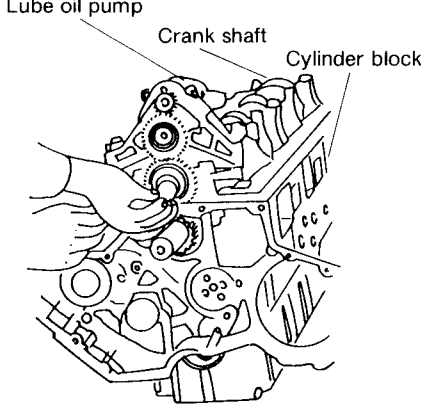

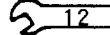

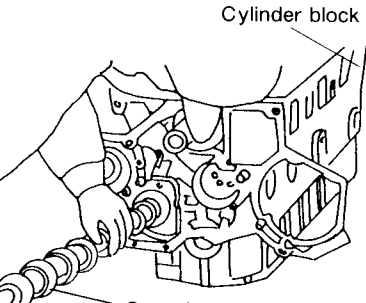
- (1) Build up each gasket equally.
- (2) For a bolt hole, apply liquid gasket to the inside surface of the hole.
- (3) Conventionally, Three Bond TB1104(gray) or Three Bond TB1102(yellow) is used for paper packings though single use of one of these bonds is not effective.
- (4) If conventional packings are used, do not use a liquid packing.



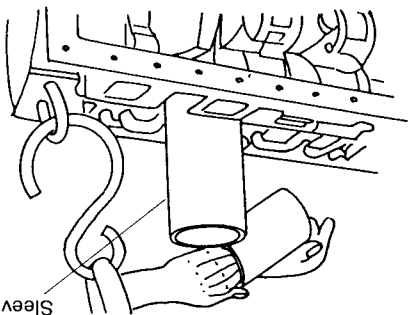



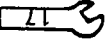
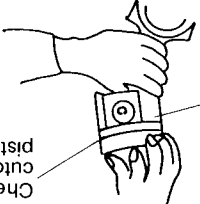
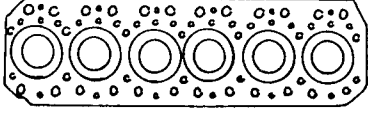


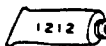
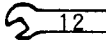
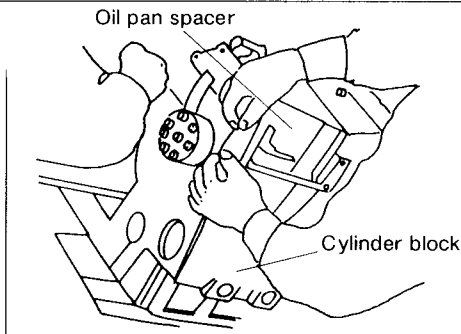
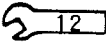
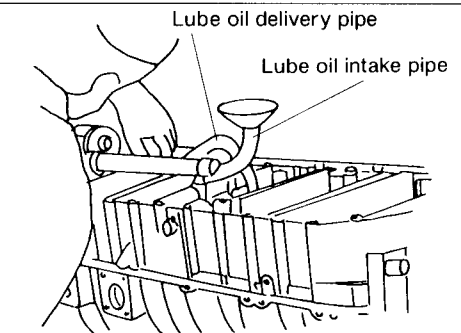

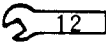
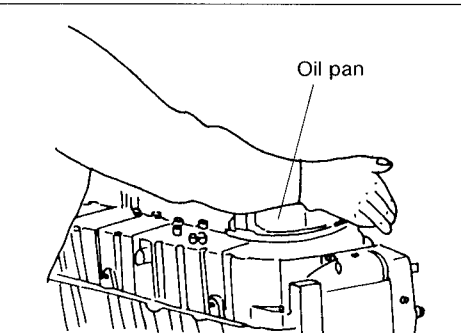
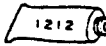
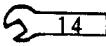

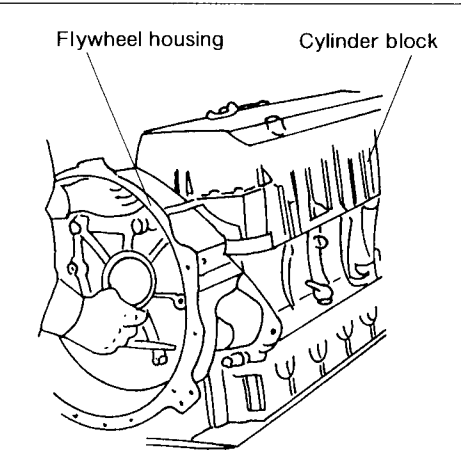
3-3. Assembly Procedure

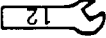
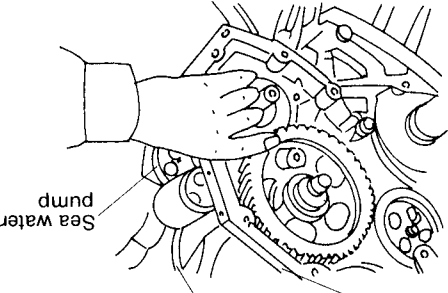
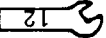


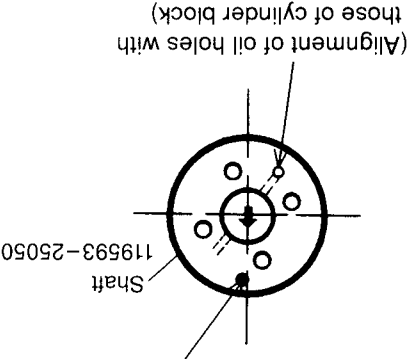
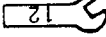
	Part	Description	Symbol	Illustration		
1	Cylinder block	Completely clean each oil hole. After cleaning, check that no scaling remains on cylinder block.				
2	Tappet	Fit each tappet. Check that each tappet is fitted to appropriate cylinder and valve (exhaust or intake). Before fitting, apply engine oil to each tappet. After fitting, check that each tappet operates smoothly.		cylinder block 		
3	Piston cooling nozzle	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				
4	Cam shaft bearing	<p>1) Fit each cam shaft bearing as follows:</p> <p>(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.</p> <div data-bbox="391 1144 866 1361">  <p>Anti-flywheel side: A=2 Intermediate position: A=1.5 Flywheel side: A=0.5</p> </div> <p>(2) After press-fitting, check each bearing for distortion by measuring, inner diameter of bearing.</p> <table border="1" data-bbox="411 1487 842 1592"> <tr> <td>Inner diameter after press-fitting</td> <td>$\phi 57 \begin{matrix} +0.05 \\ +0.02 \end{matrix}$ (mm)</td> </tr> </table> <p>Note :</p> <div data-bbox="391 1637 863 1850"> <p>To remove cam shaft bearing</p> <ol style="list-style-type: none"> 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. </div>	Inner diameter after press-fitting	$\phi 57 \begin{matrix} +0.05 \\ +0.02 \end{matrix}$ (mm)	 	<p>Tappet fitting</p> <p>Piston cooling nozzle</p>
Inner diameter after press-fitting	$\phi 57 \begin{matrix} +0.05 \\ +0.02 \end{matrix}$ (mm)					

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

Part	Description	Symbol	Illustration				
6	Lube oil pump 1) Fit lube oil pump idle gear. Side clearance: 0.10 to 0.30mm <table border="1" data-bbox="408 309 839 387"> <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: <table border="1" data-bbox="408 678 839 757"> <tr> <td>Gear backlash</td> <td>0.17±0.09 (mm)</td> </tr> </table>	Tightening torque	11±1.0kgf-m	Gear backlash	0.17±0.09 (mm)	Torque wrench  	 <p>Fitting of lube oil pump idle gear</p>  <p>Fitting of lube oil pump</p>
Tightening torque	11±1.0kgf-m						
Gear backlash	0.17±0.09 (mm)						
7	Gear case 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	 	 <p>Fitting of gear case</p>				
8	Cam shaft 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 <table border="1" data-bbox="408 1619 839 1697"> <tr> <td>Side clearance</td> <td>0.05~0.20 (mm)</td> </tr> </table> <p>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</p>	Side clearance	0.05~0.20 (mm)	  	 <p>Fitting of cam shaft</p>		
Side clearance	0.05~0.20 (mm)						

Part	Description	Symbol	Illustration		
9	<p>1) Completely clean sleeve fitting area of each cylinder block.</p> <p>2) Completely clean outer surface of each cylinder sleeve. Then tap cylinder sleeve into cylinder block.</p> <p>Note:</p> <p>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.</p> <p>2. After completing cylinder sleeve insertion, do not turn cylinder head upside down to face cylinder head side downward.</p> <p>3) Measure projection of each cylinder sleeve, and check that protrusion length satisfies value specified below:</p> <table border="1" data-bbox="778 1120 1209 1220"> <tr> <td>Sleeve projection (mm)</td> <td>0.025~0.09</td> </tr> </table>	Sleeve projection (mm)	0.025~0.09	 	<p>Insertion of cylinder sleeve</p>  <p>Sleeve</p>
Sleeve projection (mm)	0.025~0.09				
10	<p>1) Fit connecting rod to each piston while checking direction of piston.</p> <p>For detailed description, refer to Sec. 3-3-4.</p> <p>2) Fit piston rings and oil ring to each piston while checking that cutouts of rings are offset 120° from each other.</p> <p>3) Apply engine oil to sleeve, outer surface of piston, and rod metal.</p> <p>4) Adjust crankshaft pin of corresponding piston to top position.</p> <p>5) Check direction of piston.</p> <p>6) Insert piston into cylinder using piston insertion tool.</p> <p>7) After insertion, remove tool. Then rotate crankshaft by pressing piston edge using hammer until piston reaches bottom dead center.</p> <p>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.</p> <p>Note:</p> <p>Selectively fit each piston and sleeve.</p>	   	<p>Insertion of piston assembly</p>  <p>Piston</p> <p>Check the cutouts of piston rings</p> <p>Fitting of piston assembly</p> 		

	Part	Description	Symbol	Illustration				
11	Oil pan spacer	Apply liquid gasket to oil pan spacer, and then fit spacer. To prevent difference in height, use fitting jig (see photo). Secure spacer by tightening 4 bolts of M8×35mm	 	 <p style="text-align: center;">Fitting of oil pan spacer using fitting jig</p>				
12	Lube oil intake pipe and delivery pipe	1) Fit lube oil delivery pipe first, and then intake pipe. Secure delivery and intake pipes by tightening bolts listed below: M8×25mm , 2 bolts M8×16mm , 2 bolts 2) Insert other end of lube oil delivery pipe into oil pan spacer. Secure pipe by tightening bolts of M8×25mm .		 <p style="text-align: center;">Fitting of lube oil delivery pipe</p>				
13	Oil pan	Apply liquid gasket to oil pan, and then fit oil pan. Secure oil pan by tightening bolts listed below: M8×25mm , 4 bolts M8×120mm , 26 bolts M8×190mm , 2 bolts M8×90mm , 2 bolts	 	 <p style="text-align: center;">Fitting of oil pan</p>				
14	Flywheel housing	Fit flywheel housing while adjusting position of 2 parallel pins. Secure housing by tightening bolts listed below: M10×25mm , 8 bolts M10×30mm , 4 bolts <div style="text-align: right;">(mm)</div> <table border="1" data-bbox="379 1713 810 1803" style="width: 100%;"> <tr> <td>Spigot joint runout</td> <td>less than 0.25</td> </tr> <tr> <td>Surface runout</td> <td>less than 0.15</td> </tr> </table>	Spigot joint runout	less than 0.25	Surface runout	less than 0.15	  	 <p style="text-align: center;">Fitting of flywheel housing</p>
Spigot joint runout	less than 0.25							
Surface runout	less than 0.15							

Part	Description	Symbol	Illustration
15	<p>Fit seawater pump to gear case. Secure pump by tightening bolts and nuts listed below:</p> <p>M8×20mm, 2 bolts M8, 2 nuts</p>		<p>Fitting of seawater pump</p> 
16	<p>1) Fit idle gear and shaft, and secure them by tightening 2 bolts of M8×25mm. 2) Measure side clearance of idle gear, and check that clearance satisfies value specified below:</p> <p><i>Note:</i> Align oil holes with those of cylinder block (see figure).</p>	  	<p>Mark positioned on top</p> 
17	<p>Fit lube oil pressure regulating valve assembly, and secure it by tightening bolts listed below:</p> <p>M8×40mm, 1 bolt M8×45mm, 4 bolts Lube oil pressure of engine: 4.5+0.5kgf-cm² Oil temperature: 85°C at 3,000r.p.m.</p>		<p>Fitting of adjustment valve</p> 