KOBELCO

SERVICE MANUAL

MITSUBSHI DIESEL ENGINE

6D3

(For industrial use)

Applicable Machine: K907LC II

97821-04000-00 05/86

6D3

ENGINE

Shop Manual

FOREWORD

This shop manual contains the specification, construction, operation, adjustment and service procedures of the Model 6D31, 6D31-T diesel engine for service mechanics engaged in servicing of the Mitsubishi diesel engines.
Please make the most of this shop manual to perform correct servicing and wasteless operations.
Note that some of the contents of this shop manual are subject to change owing to improvements, etc. that may be introduced after publication of this shop manual.

May 1986

Applicable Engine Models
6D31
6D31-T } For industrial use

Applicable Engine No.
From the first production engine.

GROUP INDEX

1. GROUP CLASSIFICATION

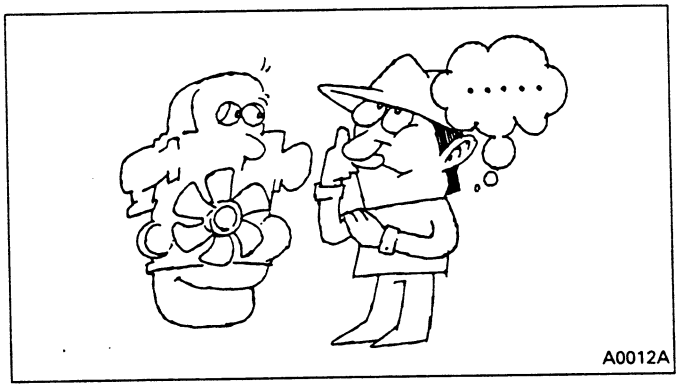
This manual is organized into several groups classified according to the engine basic elements.

No.	Group name	Description
00	General	External view, major specifications, engine outputs classified by application, engine numbers, caution plate, general bolts and nuts tightening torque table
11	Engine	Engine proper (cylinder head, valve mechanism, camshaft, piston, crankshaft, timing gear, flywheel), specifications, service standards, special tool, troubleshooting
12	Lubrication	Lubrication system (oil pump, oil filter, oil cooler), specifications, service standards, special tool, troubleshooting
13	Fuel and engine control	Fuel system (injection pump, injection nozzle, fuel filter), specifications, service standards, special tool, troubleshooting
14	Cooling	Cooling system (water pump, thermostat, radiator, cooling system cleaning procedures, fan), specifications, service standards, special tool, troubleshooting
15	Intake and exhaust	Air cleaner, turbocharger, specifications, service standards, troubleshooting
16	Engine electrical	Starter, alternator, preheating system, relays, automatic stop device, specifications, service standards, special tool, troubleshooting

NOTE:
Each group starts with page 1.

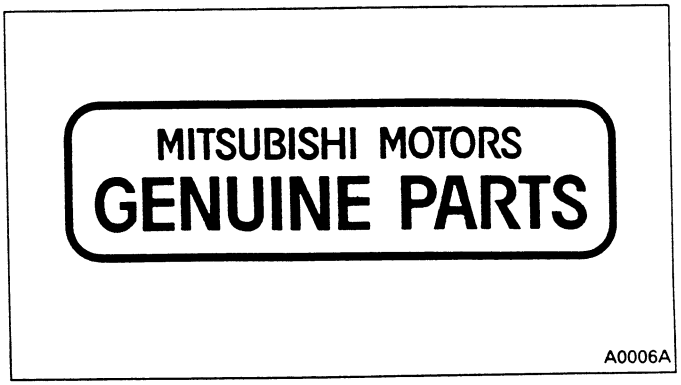
2. GENERAL PRECAUTIONS FOR SERVICING

Before starting the service procedures, check the vehicle for total time driven, use conditions, and user's complaints and requests to know exactly the engine conditions. Record information where necessary.
To ensure you are doing correct and efficient service jobs, observe the following precautions:


A0012A

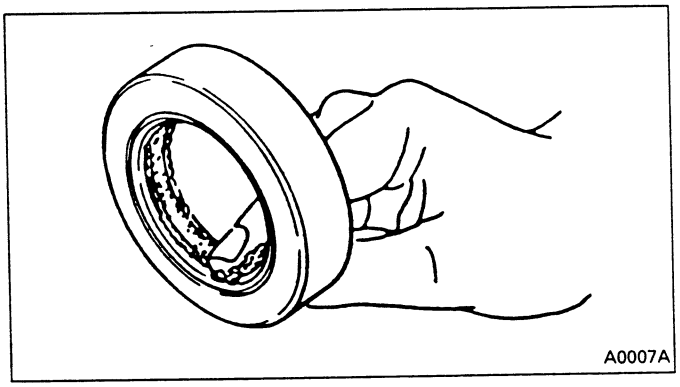
(1) Before performing the service procedures given in this manual, know the trouble spots and isolate the possible cause to determine whether the removal or disassembly procedure is required.
(2) Select a flat surface for the service job.
(3) When servicing the electrical system, be sure to disconnect the negative cable from the battery.
(4) Carefully check parts for oil leaks before cleaning. After cleaning, it may become difficult to spot defective areas.
(5) Ready and make the most of the special tools required for servicing. Use the right tools (specified special tools) in the right place to prevent damages to parts and personal injury.
(6) Make alignment marks and keep disassembled parts neatly arranged to ensure that they are reassembled into the right positions.

- Special care must be taken for assemblies involving a number of parts, similar parts, or parts identical at right- and left-hand sides to ensure correct reassembly.
- For alignment and punching markings, select a position that would not mar the appearance and function.
- Clearly distinguish parts to be replaced from those reused.



A0006A

(7) The oil seals, packings, O-rings, and other rubber parts, gaskets, and split pins must be replaced with a new one whenever they are removed. For replacement, use Mitsubishi Genuine parts.


A0007A

(8) Apply the specified grease to U-packings, oil seals, dust seals, and bearings before installation.
(9) When work requires an assistant or two, always make sure of the safety each other. Never play with switches and levers.
(10) Make sure that your shoes are free from grease and oil especially when working on a heavy item.
(11) When checking or changing lubricants, wipe off grease and oil from parts immediately with a waste.
(12) Special care must be taken in handling sensors and relays which are suspectible to shocks and heat.
(13) Use care so that hands and fingers are not injured by sharp edges or corners of the parts.
(14) Wear safety goggles whenever handling a grinder or welding machine. Wear gloves as required to ensure utmost safety.

3. TERMS AND UNITS

The following terms and units are used throughout the entire texts of this manual.

(1) Front and Rear

The terms "front" is the fan side and "rear" the flywheel side of the engine.

(2) Right and Left

The terms "right" and "left" shall be used to indicate the side as viewed from the flywheel side of the engine.

(3) Service Standard Terms

- Nominal value
  Shows the nominal dimensions, dimension of an individual part, standard clearance between parts in an assembly, or the standard performance of an assembly.
- Limit
  Shows the value of a part at which the part is no longer serviceable from the performance as well as strength viewpoints, requiring replacement or repair.

(4) Tightening Torque

Over- or undertightening of bolts and nuts has critical effects on performance and functions.
Tightening torque is therefore specified for some tightening points.
All tightening torque specifications may be considered as "dry" unless "wet" is specified.
Where no tightening torque is specified, use a torque value specified in the General Bolts and Nuts Tightening Torque Table.

(5) Units

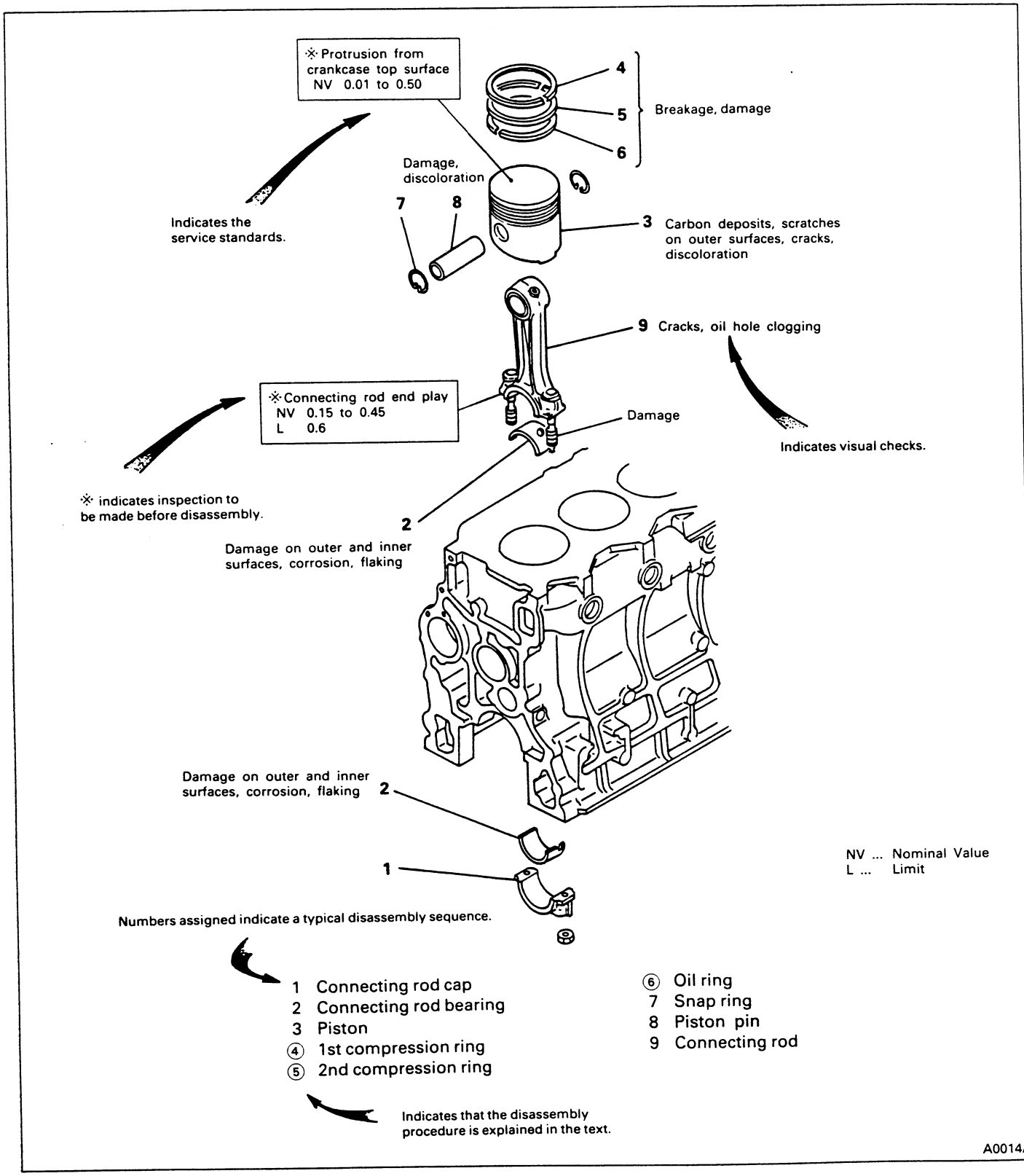
For length, weight, area, and volume, the SI unit (International System of Units) is used with the metric notation jointly shown in parentheses.
Temperature is shown in centigrade (°C).

4. TABLE OF CONVERSION RATE FOR FOOT-POUND UNITS INTO SI UNITS

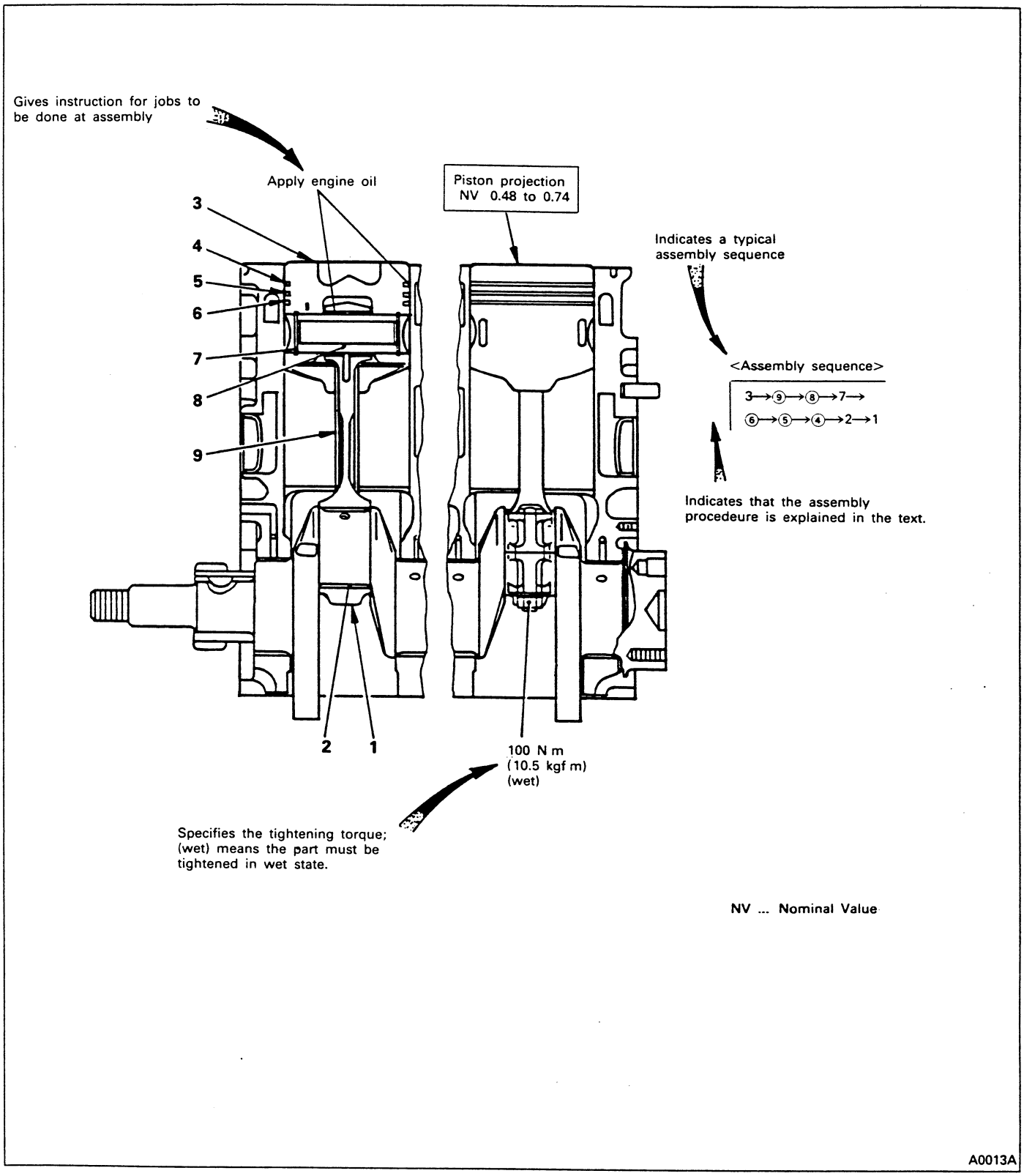
Unit	Sign of SI unit	Sign of foot-pound unit	Conversion rate
Mass quantity of matter	kg g	lb oz	1 kg = 2.2046 lb 1 g = 0.035274 oz
Dimension	m mm	ft. in.	1 m = 3.2808 ft. 1 mm = 0.03937 in.
Capacity	lit. cc	gal. oz	1 lit. = 0.2642 gal. (U.S.) 1 lit. = 0.220 gal. (Imp.) 1 cc = 0.033814 oz (U.S.) 1 cc = 0.035195 oz (Imp.)
Force	N (Newton)	lbf	1 N = 0.2248 lbf
Pressure	kPa (kilopascal)	lbf/in.^{2}	1 kPa = 0.145 lbf/in.^{2} 1 kPa = 0.2953 in.Hg
Stress	N/cm^2	lbf/in.^{2}	1 N/cm^2 = 1.45 lbf/in.^{2}
Moment of force	N m	ft. lbf	1 N m = 0.7375 ft. lbf
Output	kW (kilowatt)	HP	1 kW = 1.34 HP
Temperature	°C	°F	t°C = (1.8t°C + 32)°F

5. READING THE ILLUSTRATION

(Ex. 1: Disassembly and Inspection)



(Ex. 2: Reassembly)



(1) Illustrations (exploded views and assembly drawings) show a typical service procedures if it is identical among various types of available systems and units.

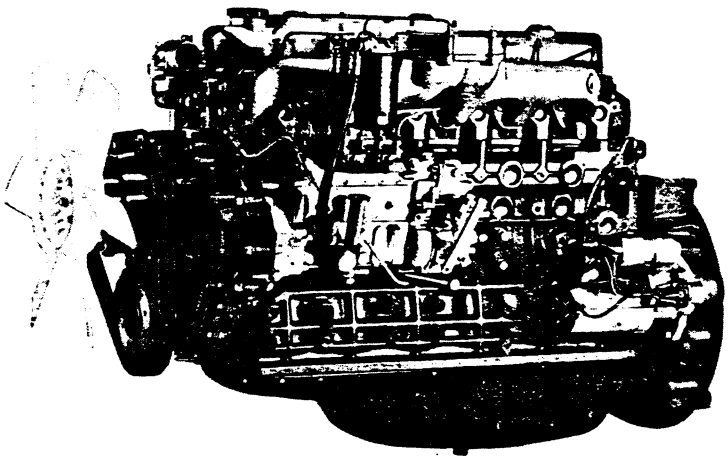
GENERAL

CONTENTS

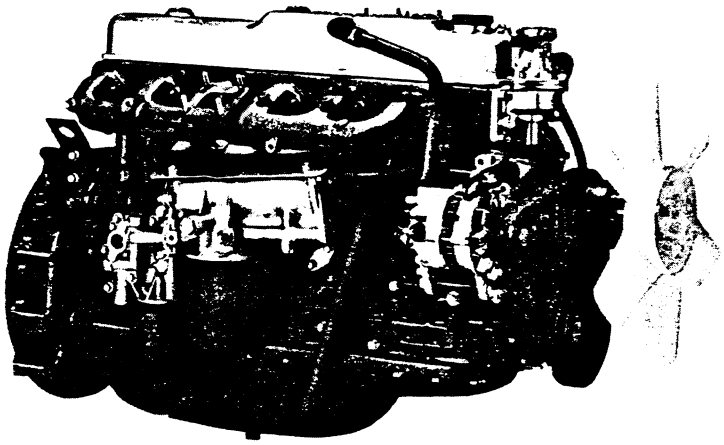
1. EXTERNAL VIEW

1.1 EXTERNAL VIEW PHOTOGRAPHS

6D31 Model

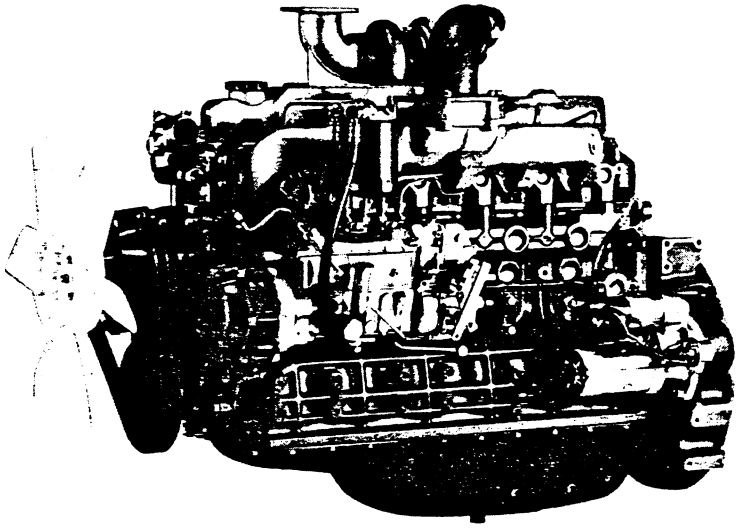


PE1025

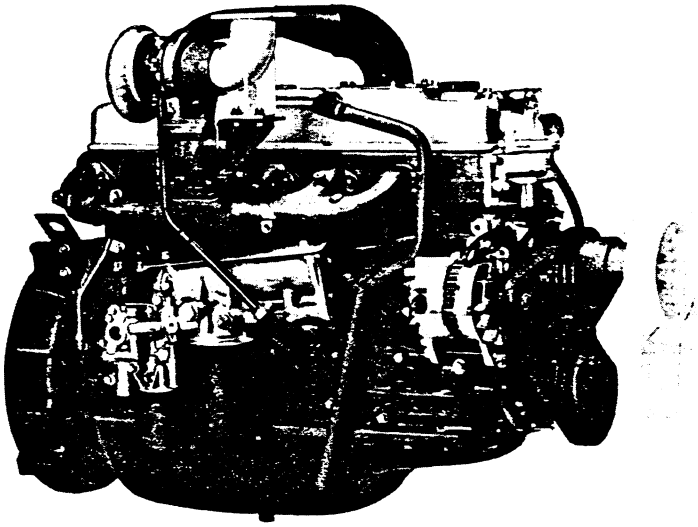


PE1026

6D31-T Model



PE1027



PE1028

2. MAJOR SPECIFICATIONS

2.1 MAJOR SPECIFICATIONS

Item / Model		Specifications	
		6D31	6D31-T
Combustion method		Direct injection	Direct injection (with turbocharger)
No. and arrangement of cylinder		6 in-line	6 in-line
Cylinder bore x stroke	mm	100 x 105	100 x 105
Total displacement	cc	4 948	4 948
Empty weight	kg*	435	450

* Empty weight as measured according to Mitsubishi Motors Corporation standard

2.2 ENGINE OUTPUTS CLASSIFIED BY APPLICATION

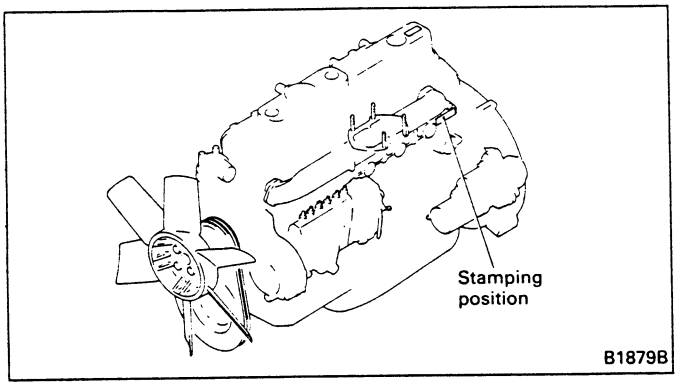
Application / Engine model		6D31	6D31-T	
			Medium speed	High speed
Intermittent rated output	kW (HP)/rpm	50 (67)/1 500	65 (87.1)/1 500	65 (87.1)/1 500
		60.5 (81.1)/1 800	79 (105.9)/1 800	79 (105.9)/1 800
		66.5 (85.1)/2 000	87 (116.6)/2 000	87 (116.6)/2 000
		72.5 (97.2)/2 200	95 (127.3)/2 200	95 (127.3)/2 200
		80.5 (107.9)/2 500	102 (136.7)/2 500	105 (140.8)/2 500
		84.5 (113.3)/2 800		111.5 (149.5)/2 800
		87 (116.6)/3 000		114 (152.8)/3 000
Continuous rated output	kW (HP)/rpm	45 (60.3)/1 500	59 (79.1)/1 500	59 (79.1)/1 500
		54.5 (73.1)/1 800	71 (95.2)/1 800	71 (95.2)/1 800
		60.5 (81.1)/2 000	78.5 (105.2)/2 000	78.5 (105.2)/2 000
		66 (88.5)/2 200	86 (115.3)/2 200	86 (115.3)/2 200
		72.5 (97.2)/2 500	93 (124.7)/2 500	95.5 (128)/2 500
		76.5 (102.5)/2 800		101.5 (136.1)/2 800
		79 (105.9)/3 000		104 (139.4)/3 000

NOTE:

1. **The output (SAE, gross) is corrected to standard ambient conditions based on SAE J1349.**
2. **The continuous rated output allows 10% (one hour) overload operation.**

3. ENGINE NUMBERS AND CAUTION PLATE

(1) Engine Number



The engine number is stamped on the position as illustrated.

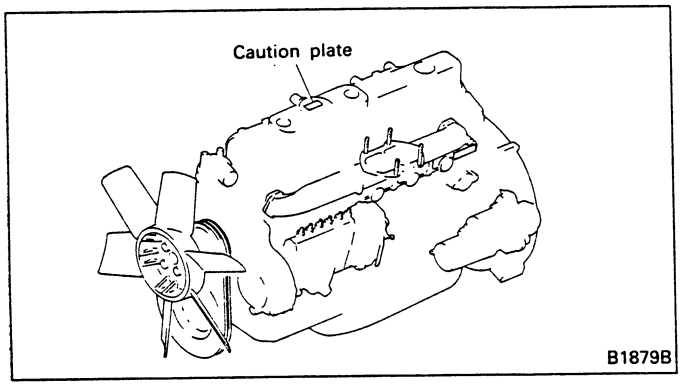
Ex.: 6 D 3 1 - 0 0 0 0 0 1

Engine number

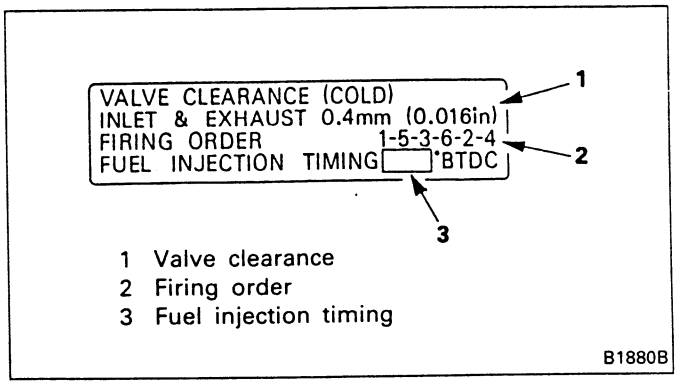
Engine model

The engine number is important in knowing the history of the engine.

(2) Caution Plate



The caution plate is located as illustrated. The caution plate bears the valve clearance, fuel injection sequence and timing.



4. GENERAL BOLTS AND NUTS TIGHTENING TORQUE TABLE

Unless otherwise specified, the parts and equipment of vehicle must be tightened by the following standard bolts and nuts. Tightening torques for these bolts and nuts are shown below.

NOTE:
Threads and seat surfaces must be in dry state.

Standard bolts and nuts

Unit: N m (kgf m)

Dia. mm	Pitch mm	4T (Head mark 4 or ○)	7T (Head mark 7 or ⊘)	8T (Head mark 8 or ⊕)
5	0.8	2.0 to 2.9 (0.2 to 0.3)	3.9 to 5.9 (0.4 to 0.6)	4.9 to 6.9 (0.5 to 0.7)
6	1.0	3.9 to 5.9 (0.4 to 0.6)	6.9 to 10.8 (0.7 to 1.1)	7.8 to 11.8 (0.8 to 1.2)
8	1.25	8.8 to 13.7 (0.9 to 1.4)	16.7 to 25.5 (1.7 to 2.6)	19.6 to 29.4 (2.0 to 3.0)
10	1.25	18.6 to 27.5 (1.9 to 2.8)	34.3 to 53.9 (3.5 to 5.5)	44.1 to 58.8 (4.5 to 6.0)
	1.5	17.7 to 26.5 (1.8 to 2.7)	32.4 to 49.0 (3.3 to 5.0)	42.1 to 58.8 (4.3 to 6.0)
12	1.25	33.3 to 49.0 (3.4 to 5.0)	68.6 to 93.2 (7.0 to 9.5)	83.4 to 108 (8.5 to 11)
	1.75	30.4 to 46.1 (3.1 to 4.7)	63.7 to 83.4 (6.5 to 8.5)	73.5 to 98.1 (7.5 to 10)
14	1.5	58.8 to 83.4 (6.0 to 8.5)	118 to 157 (12 to 16)	127 to 177 (13 to 18)
	2.0	53.9 to 73.5 (5.5 to 7.5)	108 to 137 (11 to 14)	118 to 167 (12 to 17)
16	1.5	93.2 to 127 (9.5 to 13)	177 to 235 (18 to 24)	196 to 265 (20 to 27)
	2.0	88.3 to 118 (9.0 to 12)	157 to 216 (16 to 22)	186 to 255 (19 to 26)

Flange bolts and nuts

Unit: N m (kgf m)

Dia. mm	Pitch mm	4T (Head mark 4 or ○)	7T (Head mark 7 or ⊘)	8T (Head mark 8 or ⊕)
6	1.0	3.9 to 5.9 (0.4 to 0.6)	7.8 to 11.8 (0.8 to 1.2)	8.8 to 13.7 (0.9 to 1.4)
8	1.25	9.8 to 14.7 (1.0 to 1.5)	18.6 to 27.5 (1.9 to 2.8)	21.6 to 32.4 (2.2 to 3.3)
10	1.25	20.6 to 30.4 (2.1 to 3.1)	38.2 to 58.8 (3.9 to 6.0)	49.0 to 63.7 (5.0 to 6.5)
12	1.25	37.3 to 53.9 (3.8 to 5.5)	78.5 to 108 (8.0 to 11)	88.3 to 118 (9.0 to 12)

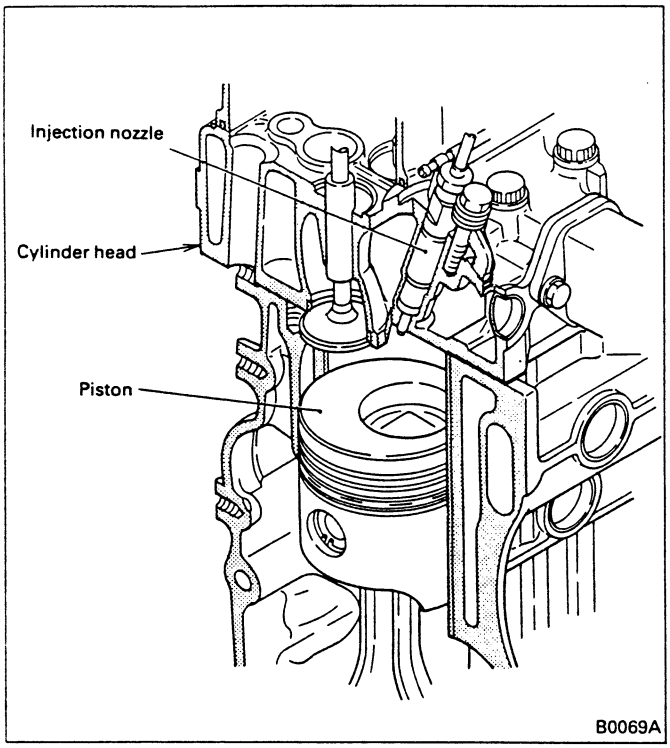
ENGINE

CONTENTS

1. GENERAL

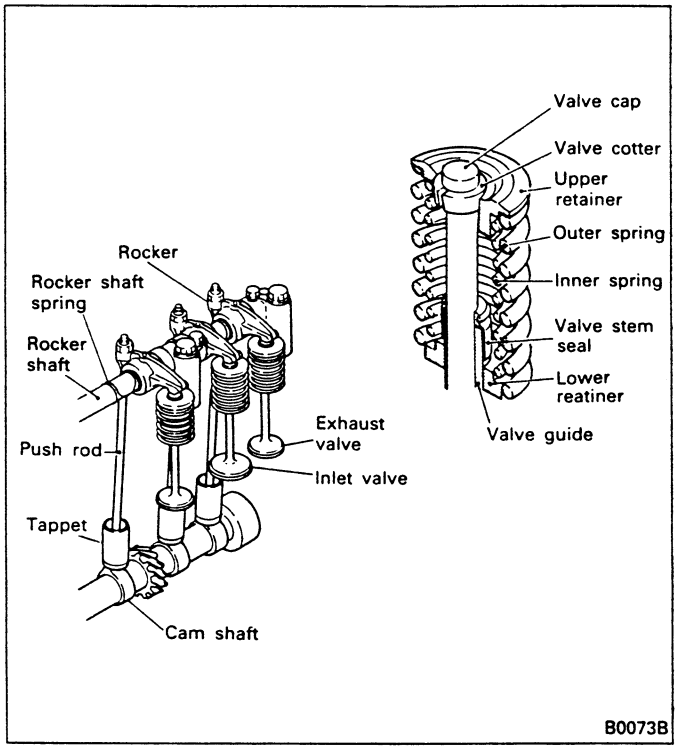
1.1 ENGINE PROPER

(1) Combustion Chamber



The combustion chamber consists of the cylinder head and toroidal pistons, hole type injection nozzles being installed in the cylinder head.
Combustion occurs when the fuel is directly injected into the combustion chamber with the power operating the piston directly.

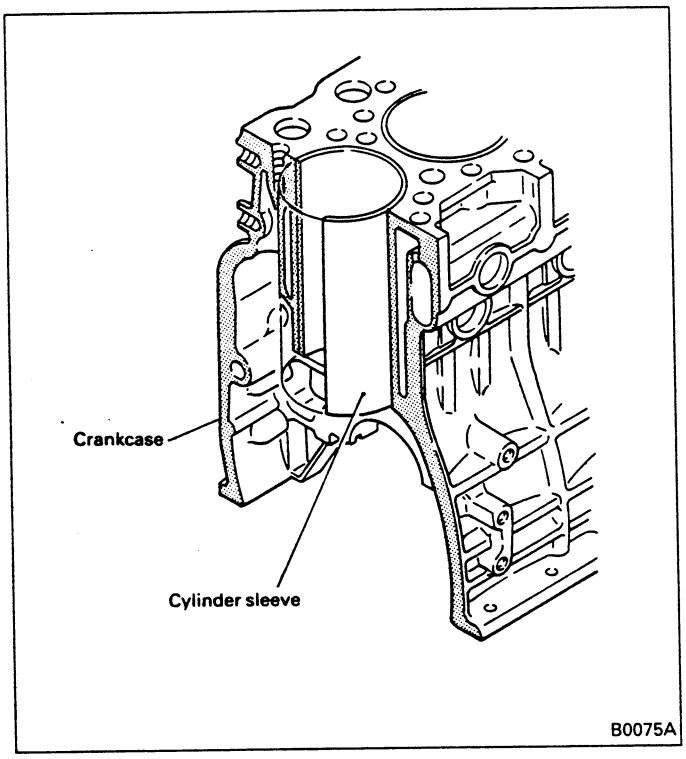
(2) Valve Mechanism



The valve mechanism is an overhead valve type.
(a) Both the inlet and exhaust valves are made of surface-treated heat-resistant steel. The valve seat angle is 45° in both valves.
Valve stem seal is mounted to the valve stem, which controls the amount of lubricant on the sliding surfaces between the valve and valve guide.
A valve guide with carbon cutter is used for the exhaust side.
(b) Two unevenly pitched valve springs are used, the inner and outer with coil directions opposite to each other.
(c) The rocker has an induction-hardened surface in contact with the valve cap. A bushing is used in the hole, into which the rocker shaft is fitted. Because of them, wear resistance is improved.
(d) The rocker shaft is a hollow round rod with sealing caps at both ends to seal it off. Its inside is an engine oil passage.
(e) The push rod has a steel ball welded to its bottom end and a spherical or depressed piece welded to its top end. Both ends are carburized case-hardened.

(f) The tappet is of cylindrical shape. Its mating surface with the camshaft is a large-diameter sphere to prevent local wear.
(g) The camshaft is provided with an oil pump drive gear, with its journals, cams, and gear induction-hardened.

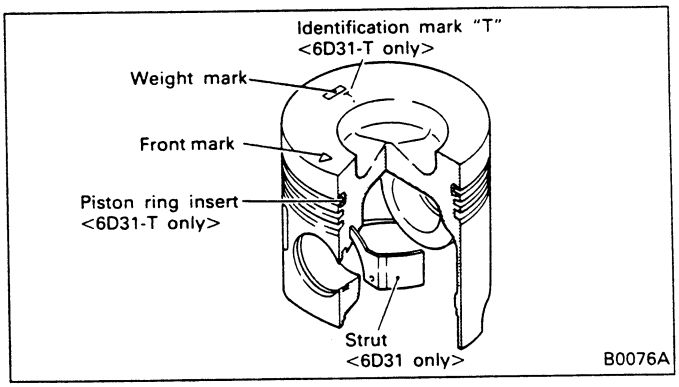
(3) Crankcase and Cylinder Sleeve



(a) The crankcase is made of cast iron and built rigid with minimum stress concentration and deformation.
(b) Four camshaft bushings are installed in the camshaft bearings of the crankcase. To facilitate insertion and removal of the camshaft from the front end of the crankcase, the bushing I.D. is made smaller toward the rear.
(c) The special cast-iron cylinder sleeve, that is highly resistance to wear, is press-fitted into the crankcase.

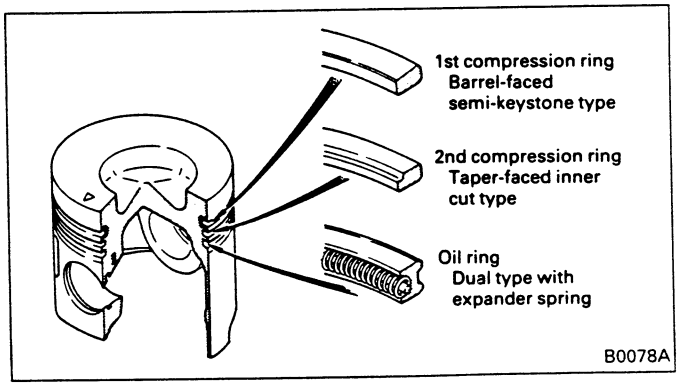
(4) Piston and Piston Ring

(a) Piston



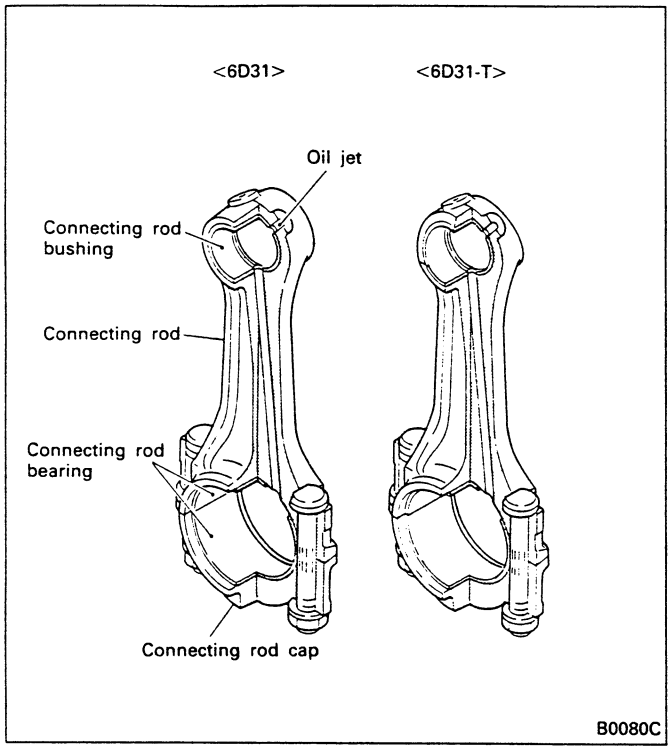
The piston, made of aluminum alloy casting, has a strut inside (no strut installed on 6D31-T) that ensures an adequate clearance between the piston and cylinder sleeve.
The piston pin arrangement is full-floating. The piston pin is offset toward the thrust side, which, together with the effect of the strut, minimizes piston slap. Stamped on the top surface of the piston is the piston weight mark, plus the front mark "◁". On 6D31-T, an ID mark "T" stamped on top and a Niresist piston ring insert is cast in the top ring groove for increased durability.

(b) Piston ring



There are three piston rings installed: two compression rings and one oil ring. The sliding surface of each ring is hard chrome plated.
Piston rings are shaped as illustrated.

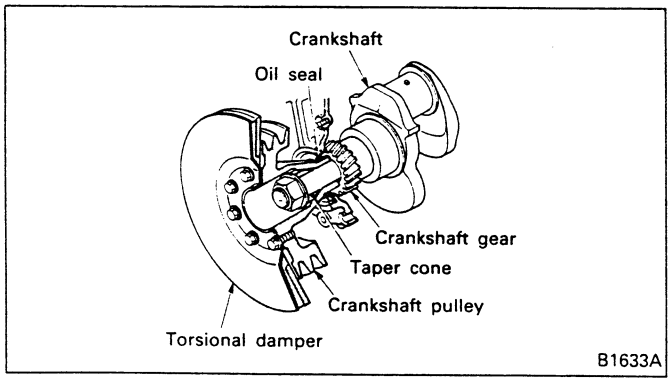
(5) Connecting Rod and Connecting Rod Bearing



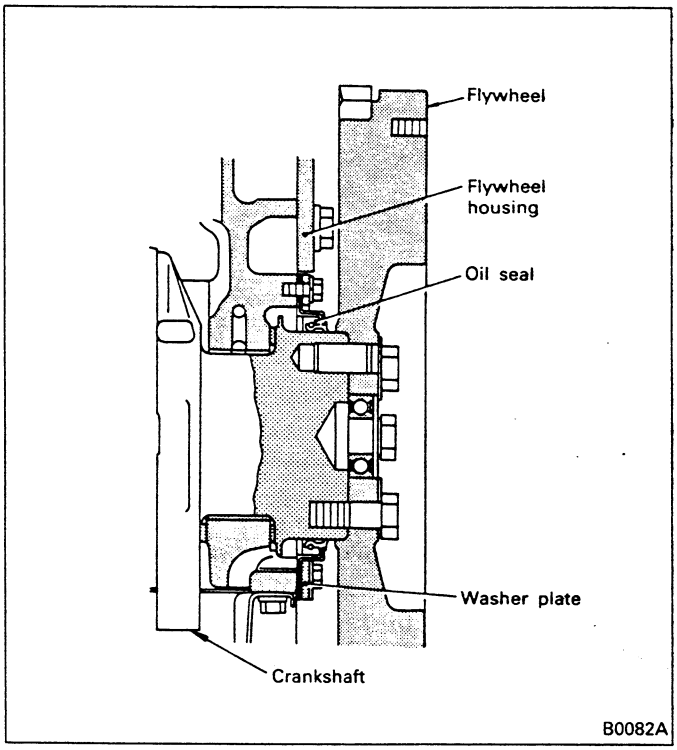
The connecting rod is a die forging with an I cross section ensuring high rigidity. A lead bronze bushing is press-fitted into its small end, while a split-style plain bearing is used in its big end.
An oil passage is provided obliquely through the stem and an oil jet at the small-end to lubricate the small-end bushing and cool the piston. The connecting rod small end of 6D31-T is wedge-shaped.

(6) Crankshaft and Main Bearing

(a) Crankshaft

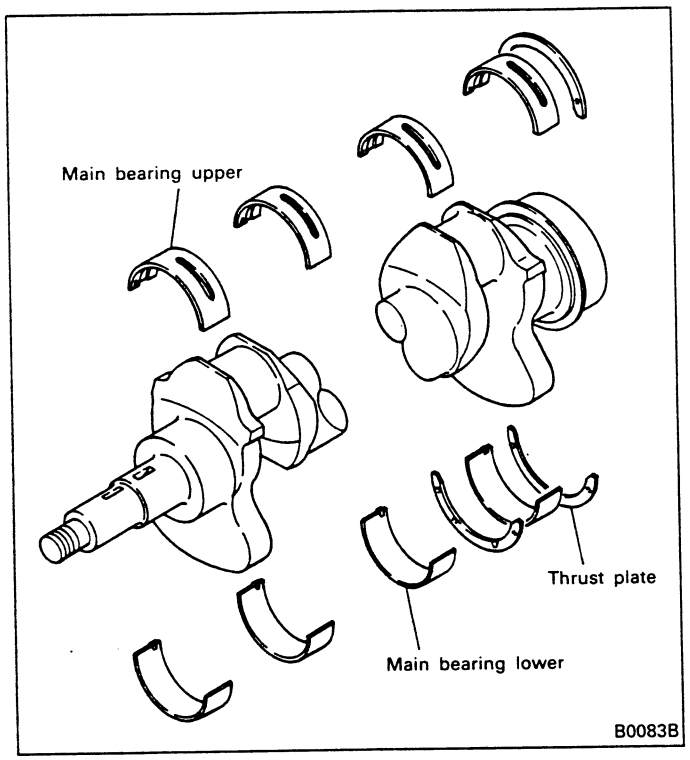


The crankshaft is a highly-rigid die forging integral with the balance weights. The pins, journals, and rear oil seal sliding surfaces are induction-hardened for improved wear resistance.
By means of oil passages drilled through the pins and journals, part of the main bearing lubricating oil is fed to pins for lubrication of the connecting rod bearing.
At the front end of the crankshaft, there are a crankshaft pulley and crankshaft gear attached with a nut. The crankshaft pulley drives the alternator and water pump through the V-belt and the crankshaft gear drives the camshaft and injection pump.
A torsional damper may be installed that absorbs torsional vibration of the crankshaft.



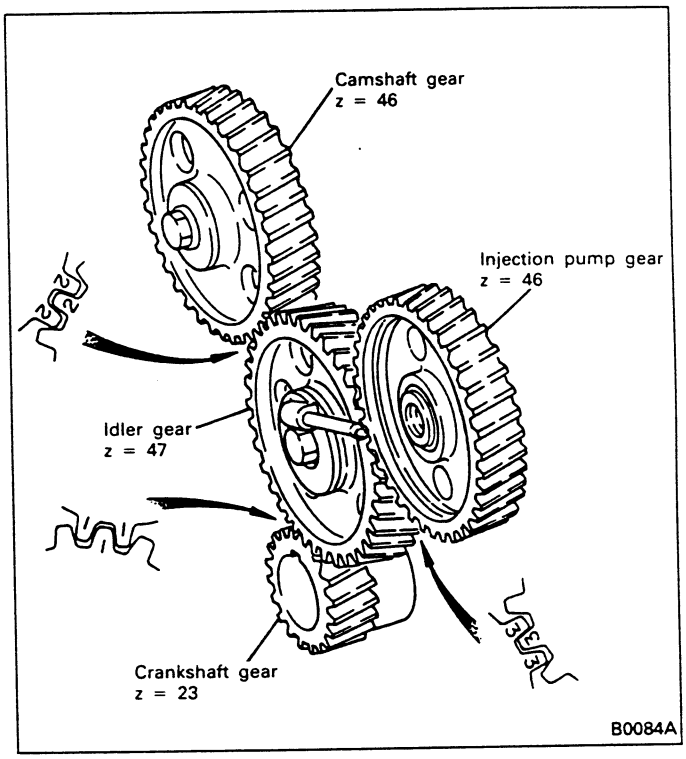
The flywheel is mounted in the rear of the crankshaft. An oil seal is installed at front and rear of the crankshaft.

(b) Main bearing



The main bearing is a split-style plain bearing made of special alloy plated kelmet metal with a steel back.
The upper main bearing has an internal oil groove and oil hole which is aligned with the oil hole in the crankshaft.
Seven pairs of main bearings are used. Split-style thrust plates are mounted with the rear pair of main bearings.

(7) Timing Gear



The timing gears are housed in the timing gear case at the front of the engine. Illustration shows the gear train.
Each gear is a helical gear machined by a shaving machine to high precision and surface-treated for enhanced durability.
A timing mark is stamped on each gear. At reassembly, correct meshing can be achieved by aligning these marks.

Thank you so much for reading.

Please click the “Buy Now!” button below to download the complete manual.

After you pay.

You can download the most perfect and complete manual in the world immediately.

Our support email:

ebooklibonline@outlook.com