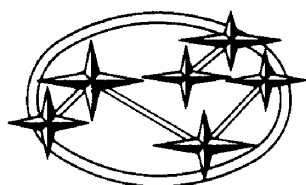


## SUBARU

### 1988



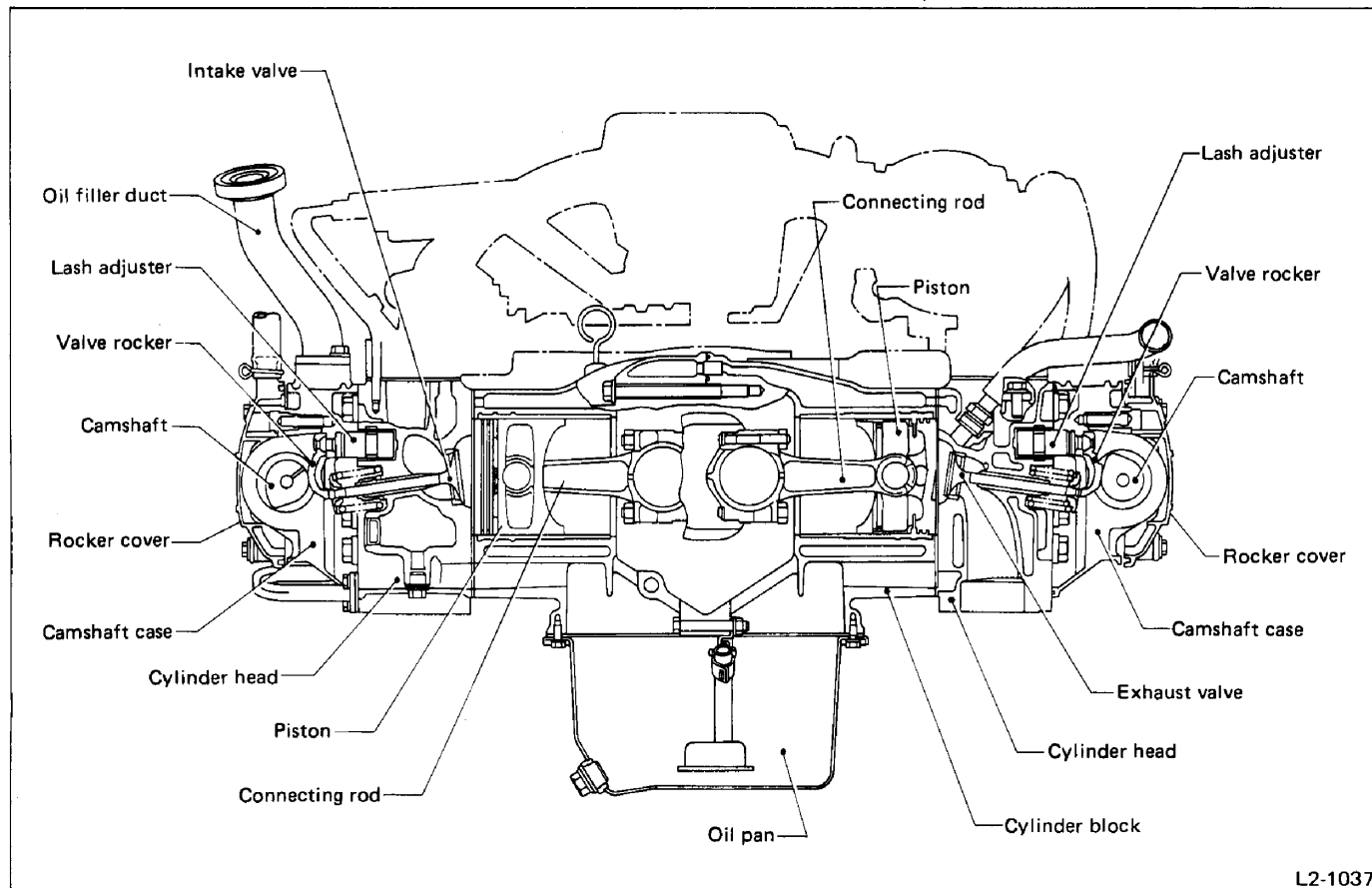
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# 1800 cc Engine MECHANISM AND FUNCTION

## General

The SUBARU XT houses a horizontally-opposed 4-cylinder, 4-stroke cycle, liquid cooled OHC gasoline engine. This well-balanced engine, adopting a horizontally opposed piston arrangement, is made of an aluminium alloy, and is light

weight and compact in construction. This engine also adopts the OHC (Over-Head Camshaft) system, hydraulic lash adjuster, and fuel injection system, attaining easier maintenances servicing, and reliability as well as low fuel consumption, low noise and powerful performance.



L2-1037

Fig. 1

## CYLINDER BLOCK

- 1) The cylinder block, made of an aluminium alloy, is light weight and provides good heat conduction, and is divided into two portions, left-side half and right-side half, due to the adoption of a horizontally opposed piston arrangement.
- 2) The rotor housing for the oil pump is built into the cylinder block in order to reduce the total length of the engine.
- 3) The cylinder liner is a cast and dry type.

## CYLINDER HEAD

- 1) The cylinder head, made of an aluminium alloy, forms a part of the bath-tub type combustion chamber which features higher combustion efficiency.
- 2) The intake and exhaust ports are laid out so as to minimize resistance for the intake air and exhaust gases, and they improve suction and discharge efficiencies.

**HEAD GASKET**

- 1) The cylinder head gaskets are provided with wire rings at the bore sections in order to increase pressure- and heat-resistant properties as well as an effective seal.
- 2) The oil passage is provided with an O-ring to improve sealing.

**CAMSHAFT CASE**

- 1) The camshaft case holds the camshaft, and is an aluminium die-casting.
- 2) The oil relief valve for the hydraulic lash adjuster is built into the cam case.

The oil filler duct is mounted on the right-hand camshaft case, and the distributor on the left-hand camshaft case.

- 3) The camshaft case has a groove all around the cylinder head mating surface, and fluid packing is filled into this groove for sealing.

**ROCKER COVER**

- 1) The rocker cover is a light-weight and compact aluminium die-casting.
- 2) This rocker cover adopts a float-supporting system with a rubber ring type gasket and an oil seal washer to reduce the noise level.

**CRANKSHAFT**

The crankshaft is made from special wrought iron which provides sturdiness. All corners of the journals are processed with "deep roll" treatment.

The horizontally opposed engine configuration provides greater strength against bending and torsional stresses while reducing the total length of the crankshaft.

**PISTON AND PISTON RING**

- 1) The piston is cast from aluminum alloy which features a small thermal expansion rate. Its top land is provided with valve relief and its skirt section has an elliptical, tapered design to provide heat- and wear-resistance.

The shaped piston and short piston pin effectively reduce the weight of the piston ASSY.

- 2) Three piston rings are used for each piston – two compression rings and one oil ring.

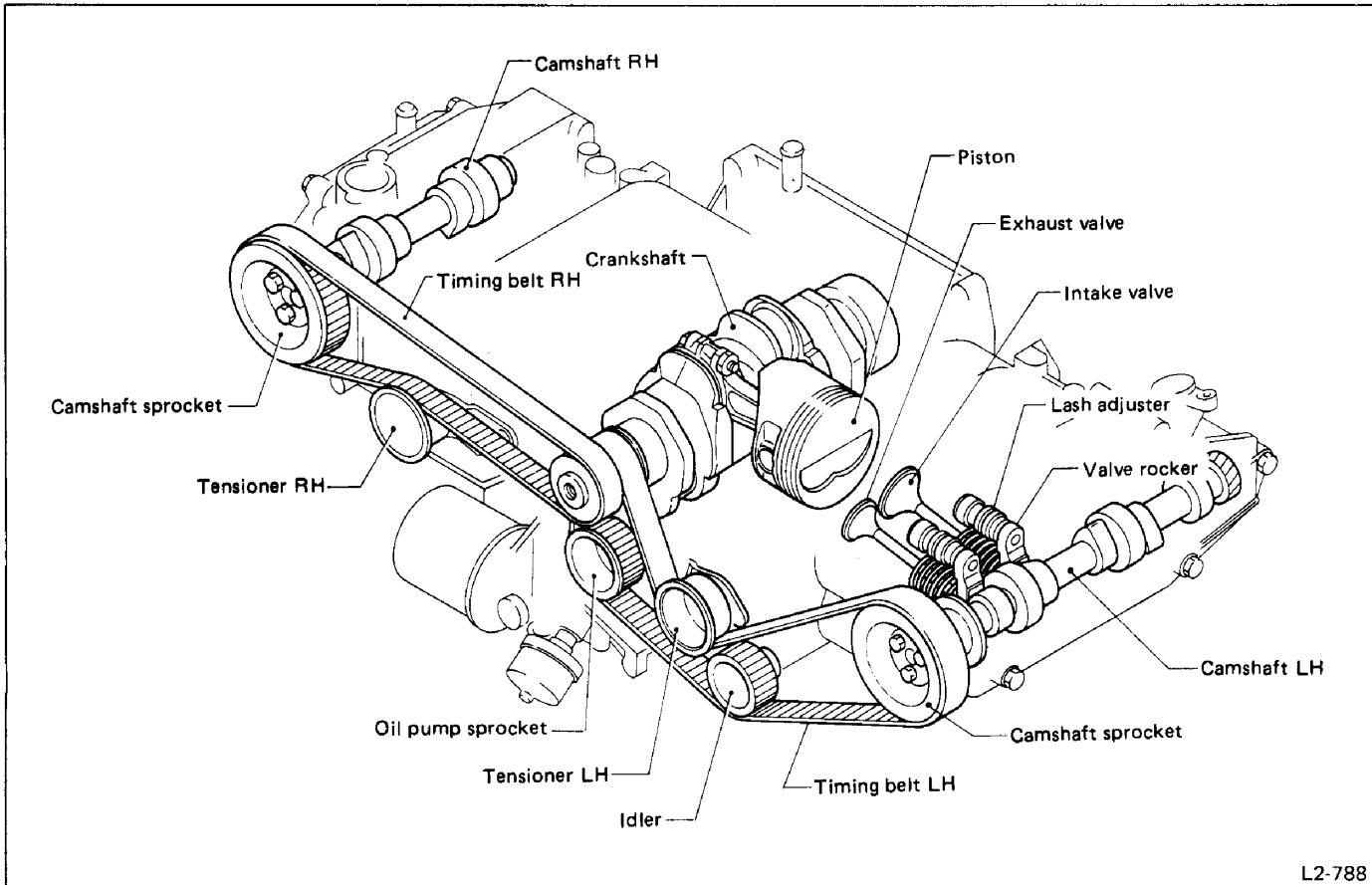
These piston rings have small wall thickness to reduce weight and oil consumption.

**OIL PAN**

The oil pan incorporates a double-layer baffle plate to stabilize the oil surface, and also improves rigidity along with reducing noise.

## Valve Mechanism

The valve mechanism adopts a timing belt driven over-head camshaft (OHC) type. This OHC features reduced inertia mass of the valve mechanism, and superior valve follow-up performance from low to high engine speeds. The valve mechanism is provided with the hydraulic lash adjusters for maintenance-free and noiseless valve operation.



L2-788

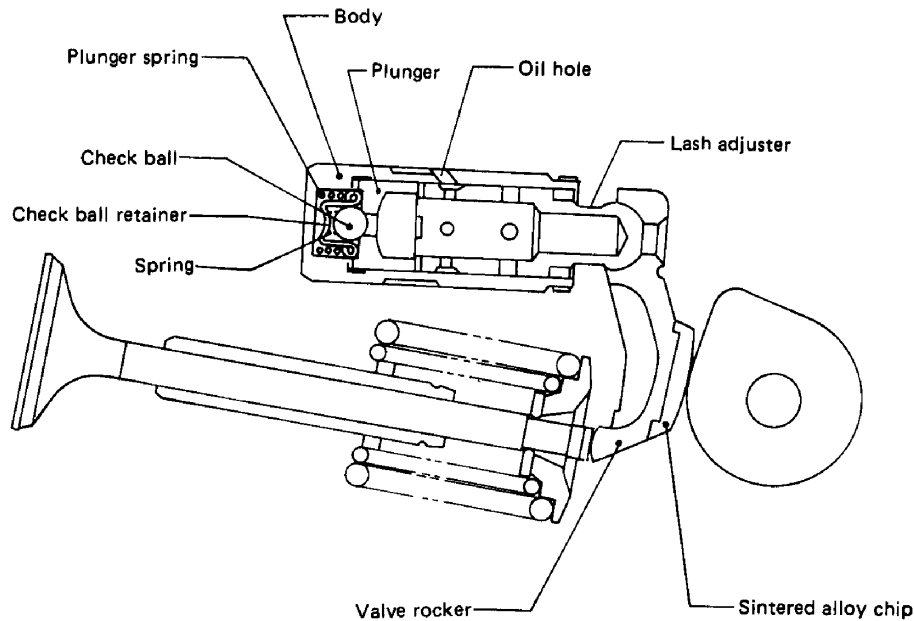
Fig. 2

### CAMSHAFT

- 1) The camshafts are made of special cast iron, and are completely treated with Lubrite except for the bearing portions to improve initial fitting to the rocker arms. The cam rubbed surface is chilled to increase wear-resistance.
- 2) The cam profile is specially designed for this OHC type, and features higher output and less fuel consumption.
- 3) The cam base circle has an oil hole for lubricating the rocker arm. The distributor drive gear is mounted on the left-hand camshaft.

### VALVE ROCKER AND VALVE LASH ADJUSTER

- 1) The rocker arms are special steel forgings having great strength and rigidity. Each arm is fitted with a sintered metal tip to improve wear resistance.
- 2) The hydraulic valve lash adjuster eliminates the need for valve clearance adjustment.
- 3) The rocker arms and valve lash adjusters are common between intake and exhaust valves.



L2-789

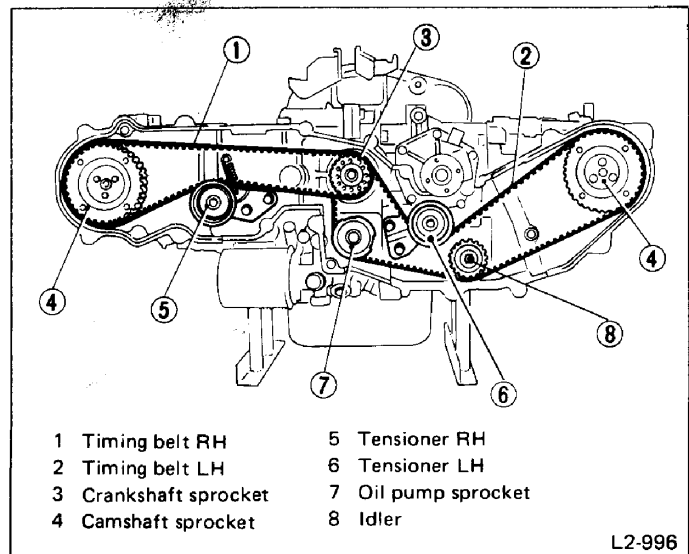
Fig. 3

### VALVE AND VALVE SPRING

- 1) The valve has a small valve stem diameter [7 mm (0.28 in dia.)] to reduce the valve weight. The variable pitch valve spring is adopted to improve valve follow-up performance at high engine speeds.
- 2) The valve has a large valve head diameter to increase engine output.

### TIMING BELT, TENSIONER AND SPROCKET

- 1) Two timing belts drive the left and right-hand camshafts. The timing belt is composed of a core featuring great strength and less elongation, canvas (tooth face portion) having superior wear resistance, and highly heat-resistant rubber.
- 2) The timing belt has special round teeth featuring positive engagement with sprocket teeth and smooth and low-noise operation. The crankshaft sprockets, oil pump sprocket and idler are made of sintered alloy.
- 3) The camshaft sprockets are made of sheet metal, and are common between right and left.
- 4) A grease-sealed type ball bearing is used in the tensioner. The tensioner spring gives the timing belt an initial tension which is adjustable by loosening the tensioner mounting bolt.



L2-996

Fig. 4

### TIMING BELT COVER

- 1) The resin-mold timing belt cover, consisting of six pieces, is used to protect the timing belt against dust and water.
- 2) Each of the left-hand and right-hand side covers has an access hole for belt tensioner adjustment.

# SPECIFICATIONS AND SERVICE DATA

## SPECIFICATIONS

		MPFI
ENGINE	Type	Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine
	Valve arrangement	Over-head camshaft type
	Bore x Stroke                      mm (in)	92 x 67 (3.62 x 2.64)
	Piston displacement                      cm <sup>3</sup> (cc, cu in)	1,781 (1,781, 108.68)
	Compression ratio	9.5
	Compression pressure (at 350 rpm)                      kPa (kg/cm <sup>2</sup> , psi)	1,157 (11.8, 168)
	Number of piston rings	Pressure ring: 2,   Oil ring: 1
	Intake valve timing	Opening                      16° BTDC
		Closing                      60° ABDC
	Exhaust valve timing	Opening                      60° BBDC
		Closing                      16° ATDC
	Idling speed (At neutral (or N) or P position)                      rpm	MT: 700 ± 100 AT: 800 ± 100
	Firing order	1 → 3 → 2 → 4
	Ignition timing                      BTDC/rpm	MT: 20°/700 AT: 20°/800

## SERVICE DATA

Cylinder head	Surface warpage limit			0.05 mm	(0.0020 in)
	Surface grinding limit			0.3 mm	(0.012 in)
	Standard height			90.6 mm	(3.567 in)
Valve set	Refacing angle			90°	
	Wear limit			0.5 mm	(0.020 in)
	Contacting width			Intake	1.2 – 1.8 mm (0.047 – 0.071 in)
				Exhaust	1.5 – 2.0 mm (0.059 – 0.079 in)
Valve guide	Inner diameter			7.000 – 7.015 mm	(0.2756 – 0.2762 in)
	Protrusion above head			17.5 – 18.5 mm	(0.689 – 0.728 in)
Valve stem	Head edge thickness	STD	Intake & Exhaust	1.3 mm	(0.051 in)
		Limit		0.8 mm	(0.031 in)
	Stem diameter		Intake	6.950 – 6.965 mm	(0.2736 – 0.2742 in)
			Exhaust	6.945 – 6.960 mm	(0.2734 – 0.2740 in)
	Stem oil clearance	STD	Intake	0.035 – 0.065 mm	(0.0014 – 0.0026 in)
			Exhaust	0.040 – 0.070 mm	(0.0016 – 0.0028 in)
		Limit	0.15 mm	(0.0059 in)	
	Overall length		Intake & Exhaust	107.58 mm	(4.2354 in)
Valve spring	Free length		Outer spring	50.7 mm	(1.996 in)
			Inner spring	50.3 mm	(1.980 in)
	Squareness		Outer spring	2.2 mm	(0.087 in)
			Inner spring	2.2 mm	(0.087 in)
	Tension/spring height		Outer spring	203.0 – 238.3 N (20.7 – 24.3 kg, 45.6 – 53.6 lb)/ 41.5 mm (1.634 in)	
				502.1 – 576.7 N (51.2 – 58.8 kg, 112.9 – 129.7 lb)/ 31.5 mm (1.240 in)	
			Inner spring	88.3 – 101.0 N (9.0 – 10.3 kg, 19.8 – 22.7 lb)/ 38.5 mm (1.516 in)	
				201.0 – 230.5 N (20.5 – 23.5 kg, 45.2 – 51.8 lb)/ 28.5 mm (1.122 in)	

STD: Standard

Valve lash adjuster	Outer diameter		21.380 – 21.393 mm (0.8417 – 0.8422 in)
	Cylinder head adjuster hole I.D.		21.413 – 21.470 mm (0.8430 – 0.8453 in)
	Adjuster-to-hole clearance	STD	0.020 – 0.090 mm (0.0008 – 0.0035 in)
		Limit	0.1 mm (0.004 in)
Cylinder block	Surface warpage limit (mating with cylinder head)		0.05 mm (0.0020 in)
	Surface grinding limit		0.4 mm (0.016 in)
	Metal housing I.D.		59.000 – 59.018 mm (2.3228 – 2.3235 in)
	Oil seal hole I.D.	Front and center	59.000 – 59.030 mm (2.3228 – 2.3240 in)
		Rear	93.000 – 93.035 mm (3.6614 – 3.6628 in)
	Cylinder bore	STD	91.985 – 92.015 mm (3.6214 – 3.6226 in)
		Taper limit	0.050 mm (0.0020 in)
	Out-of roundness limit		0.050 mm (0.0020 in)
	Piston clearance	STD	0.015 – 0.035 mm (0.0006 – 0.0014 in)
		Limit	0.060 mm (0.0024 in)
	Enlarging (boring) limit		0.3 mm (0.012 in)
Piston	Outer diameter		91.970 – 91.980 mm (3.6209 – 3.6213 in)
	0.25 mm (0.0098 in) OS		92.220 – 92.230 mm (3.6307 – 3.6311 in)
	0.50 mm (0.0197 in) OS		92.470 – 92.480 mm (3.6405 – 3.6409 in)
	Standard inner diameter of piston pin hole		20.999 – 21.009 mm (0.8267 – 0.8271 in)
Piston pin	Outer diameter		20.994 – 21.000 mm (0.8265 – 0.8268 in)
	Standard clearance between piston pin and hole in piston		0.001 – 0.015 mm (0.00004 – 0.00059 in)
	Degree of fit		Piston pin must be fitted into position with thumb at 20°C (68°F).
	Standard clearance between piston pin and hole in connecting rod		0 – 0.022 mm (0 – 0.0009 in)
Piston ring	Width	Top ring	1.17 – 1.19 mm (0.0461 – 0.0469 in)
		Second ring	1.47 – 1.49 mm (0.0579 – 0.0587 in)
	Radial wall thickness	Oil ring	Combination ring
		Top ring	3.2 – 3.4 mm (0.126 – 0.134 in)
		Second ring	3.6 – 3.8 mm (0.142 – 0.150 in)
		Oil ring	Combination ring
	Piston ring gap	Top & Second ring	STD
			0.2 – 0.35 mm (0.0079 – 0.0138 in)
			Limit
			1.5 mm (0.059 in)
		Oil ring	STD
			0.3 – 0.9 mm (0.012 – 0.035 in)
			Limit
			2.0 mm (0.079 in)
	Clearance between piston ring and piston ring groove	Top ring	STD
			0.040 – 0.080 mm (0.0016 – 0.0031 in)
			Limit
			0.15 mm (0.0059 in)
		Second ring	STD
			0.030 – 0.070 mm (0.0012 – 0.0028 in)
			Limit
			0.15 mm (0.0059 in)
		Oil ring	STD
			0 mm (0 in)
			Limit
			0 mm (0 in)

STD: Standard

OS: Oversize



Connecting rod	Distance between big end and small end hole		116.95 – 117.05 mm (4.6043 – 4.6083 in)
	Crank pin bore diameter		48.000 – 48.019 mm (1.8898 – 1.8905 in)
	Piston pin bore diameter		21.000 – 21.016 mm (0.8268 – 0.8274 in)
	Width at big end		19.35 – 19.43 mm (0.7618 – 0.7650 in)
	Side clearance	STD	0.070 – 0.330 mm (0.0028 – 0.0130 in)
		Limit	0.4 mm (0.016 in)
Connecting rod bearing	Bend twist per 100 mm (3.94 in) in length		Limit 0.10 mm (0.0039 in)
	Thickness at center portion	STD	1.485 – 1.490 mm (0.0585 – 0.0587 in)
		0.03 mm (0.0012 in) US	1.500 – 1.505 mm (0.0591 – 0.0593 in)
		0.05 mm (0.0020 in) US	1.510 – 1.515 mm (0.0594 – 0.0596 in)
		0.25 mm (0.0098 in) US	1.610 – 1.615 mm (0.0634 – 0.0636 in)
	Oil clearance	STD	0.010 – 0.054 mm (0.0004 – 0.0021 in)
Crankshaft		Limit	0.10 mm (0.0039 in)
	Bend limit		0.035 mm (0.0014 in)
	Thrust clearance	STD	0.010 – 0.095 mm (0.0004 – 0.0037 in)
		Limit	0.30 mm (0.0118 in)
	Crank journal outer diameter	Front	STD 54.957 – 54.972 mm (2.1637 – 2.1642 in)
			0.03 mm (0.0012 in) US 54.927 – 54.942 mm (2.1625 – 2.1631 in)
			0.05 mm (0.0020 in) US 54.907 – 54.922 mm (2.1617 – 2.1623 in)
			0.25 mm (0.0098 in) US 54.707 – 54.722 mm (2.1538 – 2.1544 in)
		Center	STD 54.954 – 54.970 mm (2.1635 – 2.1642 in)
			0.03 mm (0.0012 in) US 54.924 – 54.940 mm (2.1624 – 2.1630 in)
			0.05 mm (0.0020 in) US 54.904 – 54.920 mm (2.1616 – 2.1622 in)
			0.25 mm (0.0098 in) US 54.704 – 54.720 mm (2.1537 – 2.1543 in)
		Rear	STD 54.955 – 54.970 mm (2.1636 – 2.1642 in)
			0.03 mm (0.0012 in) US 54.925 – 54.940 mm (2.1624 – 2.1630 in)
			0.05 mm (0.0020 in) US 54.905 – 54.920 mm (2.1616 – 2.1622 in)
			0.25 mm (0.0098 in) US 54.705 – 54.720 mm (2.1537 – 2.1543 in)
	Width at center portion		25.970 – 26.015 mm (1.0224 – 1.0242 in)
	Oil clearance	Front & Rear	STD 0.003 – 0.036 mm (0.0001 – 0.0014 in)
			Limit 0.055 mm (0.0022 in)
		Center	STD 0.008 – 0.027 mm (0.0003 – 0.0011 in)
			Limit 0.045 mm (0.0018 in)
	Out-of roundness		0.030 mm (0.0012 in) or less
	Grinding limit		0.250 mm (0.0098 in)
	Crankpin outer diameter	STD	44.995 – 45.010 mm (1.7715 – 1.7720 in)
		0.03 mm (0.0012 in) US	44.965 – 44.980 mm (1.7703 – 1.7709 in)
		0.05 mm (0.0020 in) US	44.945 – 44.960 mm (1.7695 – 1.7701 in)
		0.25 mm (0.0098 in) US	44.745 – 44.760 mm (1.7616 – 1.7622 in)
	Width		19.50 – 19.68 mm (0.7677 – 0.7748 in)
	Oil clearance	STD	0.010 – 0.054 mm (0.0004 – 0.0021 in)
		Limit	0.10 mm (0.0039 in)
	Out-of roundness		0.030 mm (0.0012 in) or less
	Grinding limit		0.250 mm (0.0098 in)

STD: Standard

OS: Oversize

US: Undersize

Crankshaft bearing	Thickness	Front & Rear	STD	2.015 – 2.019 mm (0.0793 – 0.0795 in)
			0.03 mm (0.0012 in) US	2.030 – 2.034 mm (0.0799 – 0.0801 in)
			0.05 mm (0.0020 in) US	2.040 – 2.044 mm (0.0803 – 0.0805 in)
			0.25 mm (0.0098 in) US	2.140 – 2.144 mm (0.0843 – 0.0844 in)
		Center	STD	2.019 – 2.022 mm (0.0795 – 0.0796 in)
			0.03 mm (0.0012 in) US	2.034 – 2.037 mm (0.0801 – 0.0802 in)
			0.05 mm (0.0020 in) US	2.044 – 2.047 mm (0.0805 – 0.0806 in)
			0.25 mm (0.0098 in) US	2.144 – 2.147 mm (0.0844 – 0.0845 in)
	Width	Center	STD	25.920 – 25.960 mm (1.0205 – 1.0220 in)
Camshaft	Bend limit			0.025 mm (0.0010 in)
	Thrust clearance			0.030 – 0.260 mm (0.0012 – 0.0102 in)
	Cam lobe height		STD	39.75 – 39.85 mm (1.5650 – 1.5689 in)
			Wear limit	0.15 mm (0.0059 in)
	Cam journal outer diameter	Front		37.964 – 37.980 mm (1.4946 – 1.4953 in)
		Center		48.464 – 48.480 mm (1.9080 – 1.9087 in)
		Rear		47.964 – 47.980 mm (1.8883 – 1.8890 in)
		LH distributor		38.964 – 38.980 mm (1.5340 – 1.5346 in)
	Oil clearance		STD	0.020 – 0.054 mm (0.0008 – 0.0021 in)
			Limit	0.070 mm (0.0028 in)
Camshaft case	Camshaft journal inner diameter	Front (camshaft support inner diameter)		38.000 – 38.018 mm (1.4961 – 1.4968 in)
		Center		48.500 – 48.518 mm (1.9094 – 1.9102 in)
		Rear		48.000 – 48.018 mm (1.8898 – 1.8905 in)
		Distributor		39.000 – 39.018 mm (1.5354 – 1.5361 in)
	Camshaft support depth of spigot			19.00 – 19.08 mm (0.7480 – 0.7512 in)
Camshaft support	I.D.			38.000 – 38.018 mm (1.4961 – 1.4968 in)
	O.D.			57.971 – 59.990 mm (2.2823 – 2.3618 in)
	Height of spigot			14.95 – 15.00 mm (0.5886 – 0.5906 in)

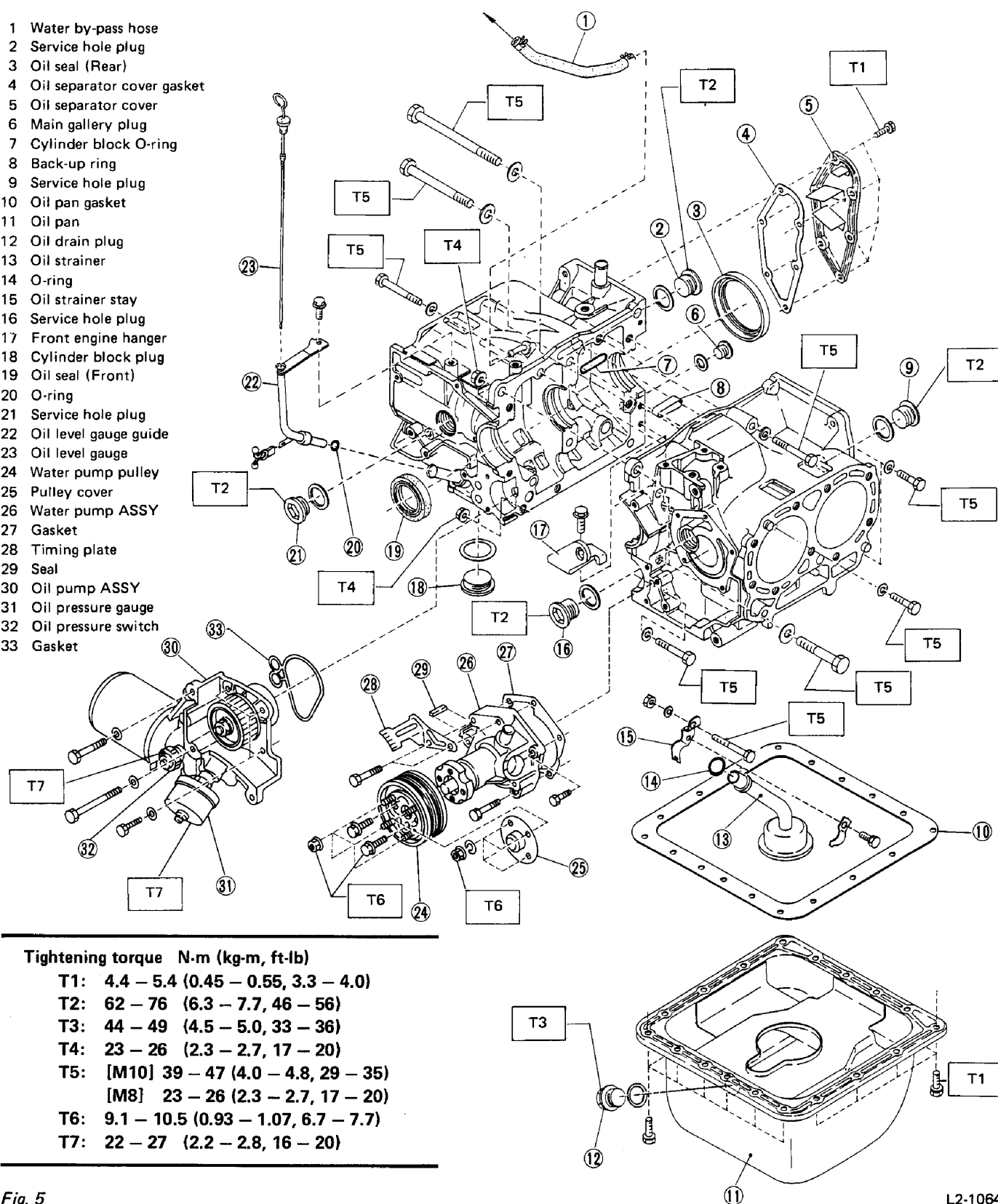
STD: Standard

US: Undersize

# COMPONENT PARTS

## Cylinder Block and Oil Pan

- 1 Water by-pass hose
- 2 Service hole plug
- 3 Oil seal (Rear)
- 4 Oil separator cover gasket
- 5 Oil separator cover
- 6 Main gallery plug
- 7 Cylinder block O-ring
- 8 Back-up ring
- 9 Service hole plug
- 10 Oil pan gasket
- 11 Oil pan
- 12 Oil drain plug
- 13 Oil strainer
- 14 O-ring
- 15 Oil strainer stay
- 16 Service hole plug
- 17 Front engine hanger
- 18 Cylinder block plug
- 19 Oil seal (Front)
- 20 O-ring
- 21 Service hole plug
- 22 Oil level gauge guide
- 23 Oil level gauge
- 24 Water pump pulley
- 25 Pulley cover
- 26 Water pump ASSY
- 27 Gasket
- 28 Timing plate
- 29 Seal
- 30 Oil pump ASSY
- 31 Oil pressure gauge
- 32 Oil pressure switch
- 33 Gasket



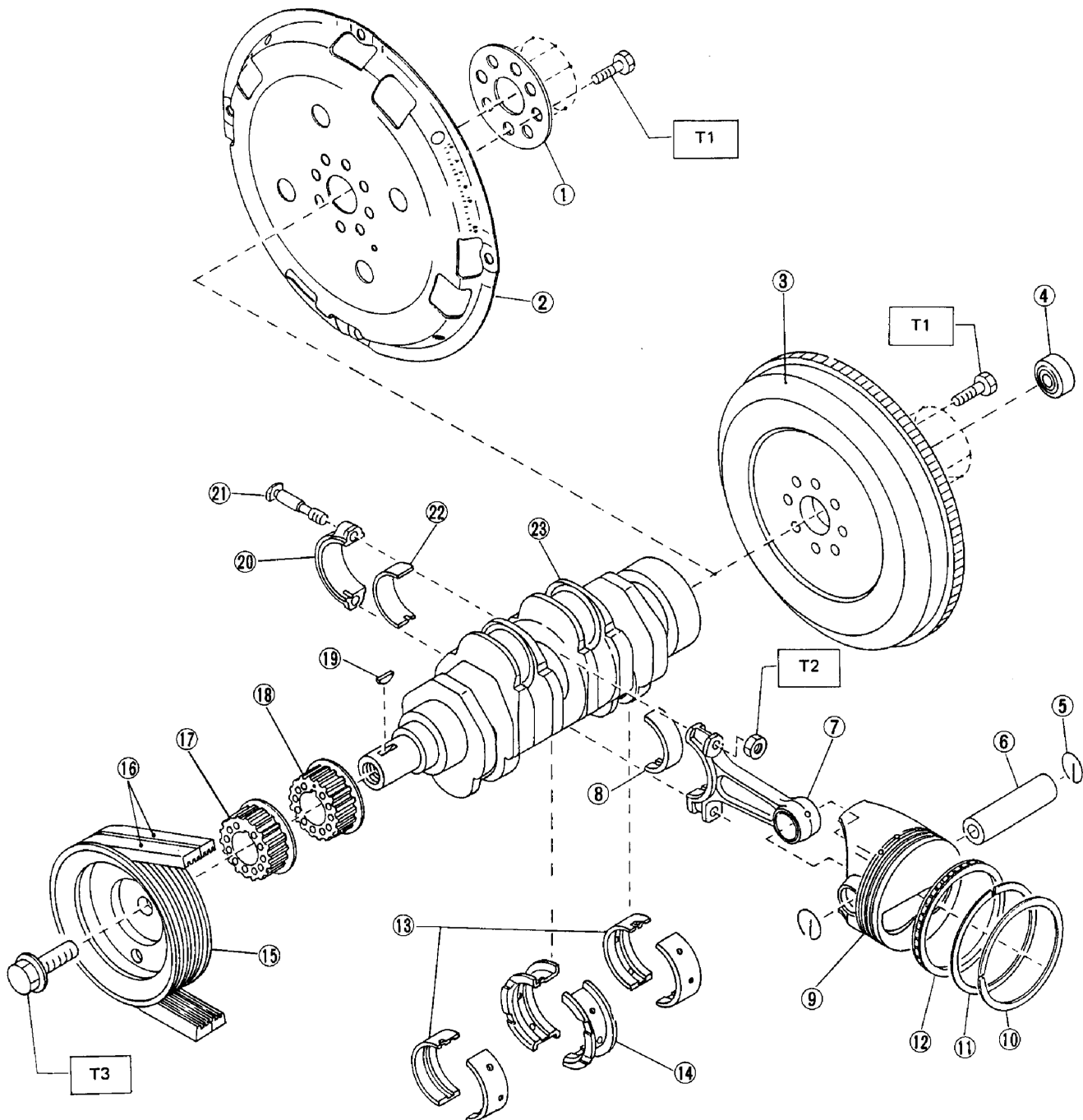
### Tightening torque N·m (kg·m, ft·lb)

- T1: 4.4 – 5.4 (0.45 – 0.55, 3.3 – 4.0)  
 T2: 62 – 76 (6.3 – 7.7, 46 – 56)  
 T3: 44 – 49 (4.5 – 5.0, 33 – 36)  
 T4: 23 – 26 (2.3 – 2.7, 17 – 20)  
 T5: [M10] 39 – 47 (4.0 – 4.8, 29 – 35)  
       [M8] 23 – 26 (2.3 – 2.7, 17 – 20)  
 T6: 9.1 – 10.5 (0.93 – 1.07, 6.7 – 7.7)  
 T7: 22 – 27 (2.2 – 2.8, 16 – 20)

Fig. 5

L2-1064

## Crankshaft and Piston



- |                          |  |
|--------------------------|--|
| 1 Reinforcement          | 12 Oil ring                            |
| 2 Drive plate            | 13 Crankshaft bearing (Front and rear) |
| 3 Flywheel               | 14 Crankshaft bearing (Center)         |
| 4 Ball bearing           | 15 Crankshaft pulley                   |
| 5 Circlip                | 16 V-belt                              |
| 6 Piston pin             | 17 Crankshaft sprocket CP              |
| 7 Connecting rod         | 18 Crankshaft sprocket No. 2           |
| 8 Connecting rod bearing | 19 Woodruff key                        |
| 9 Piston                 | 20 Connecting rod cap                  |
| 10 Top ring              | 21 Connecting rod cap bolt             |
| 11 Second ring           | 22 Connecting rod bearing              |
|                          | 23 Crankshaft                          |

### Tightening torque N·m (kg-m, ft-lb)

**T1: 69 – 75 (7.0 – 7.6, 51 – 55)**

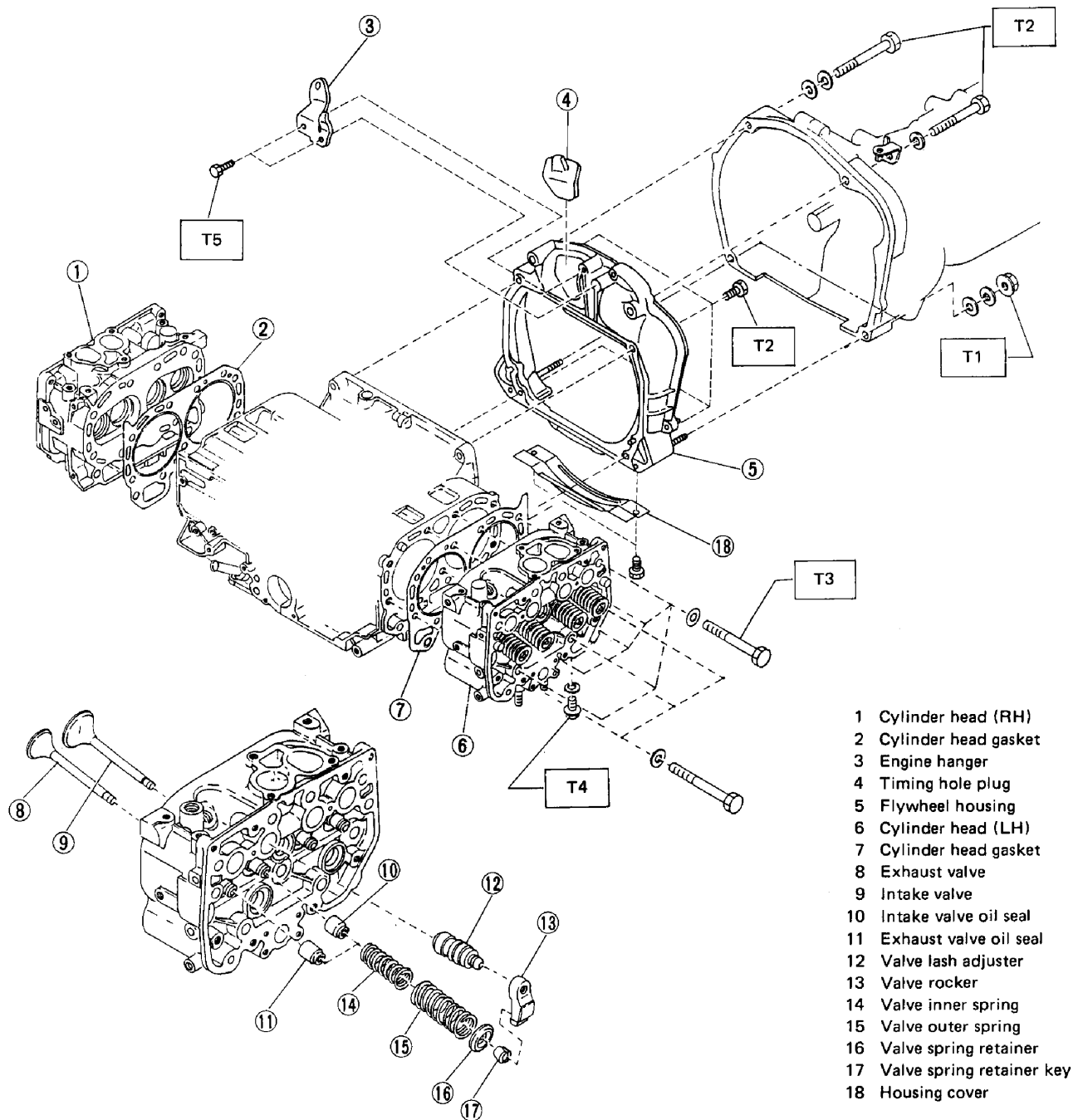
**T2: 39 – 42 (4.0 – 4.3, 29 – 31)**

**T3: 89 – 107 (9.1 – 10.9, 66 – 79)**

Fig. 6

L2-1038

# Cylinder Head and Flywheel Housing



## Tightening torque N·m (kg·m, ft·lb)

T1: 46 – 54 (4.7 – 5.5, 34 – 40)

T2: 34 – 40 (3.5 – 4.1, 25 – 30)

T3: 60 – 68 (6.1 – 6.9, 44 – 50)

T4: 22 – 27 (2.2 – 2.8, 16 – 20)

T5: 17.2 – 20.1 (1.75 – 2.05, 12.7 – 14.8)

Fig. 7

L2-1276



## Belt Cover

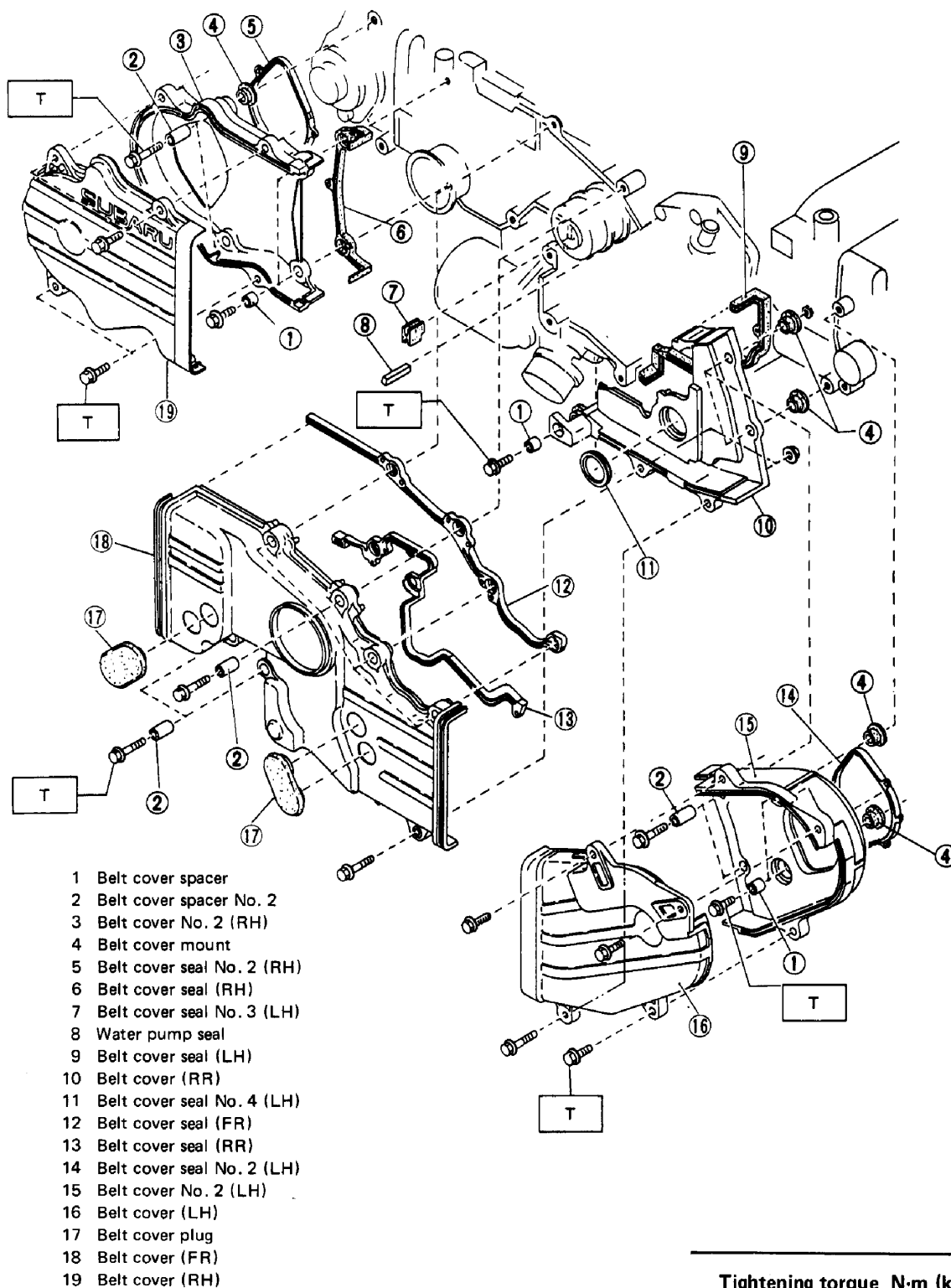


Fig. 9

L2-1277

# Electrical Equipment

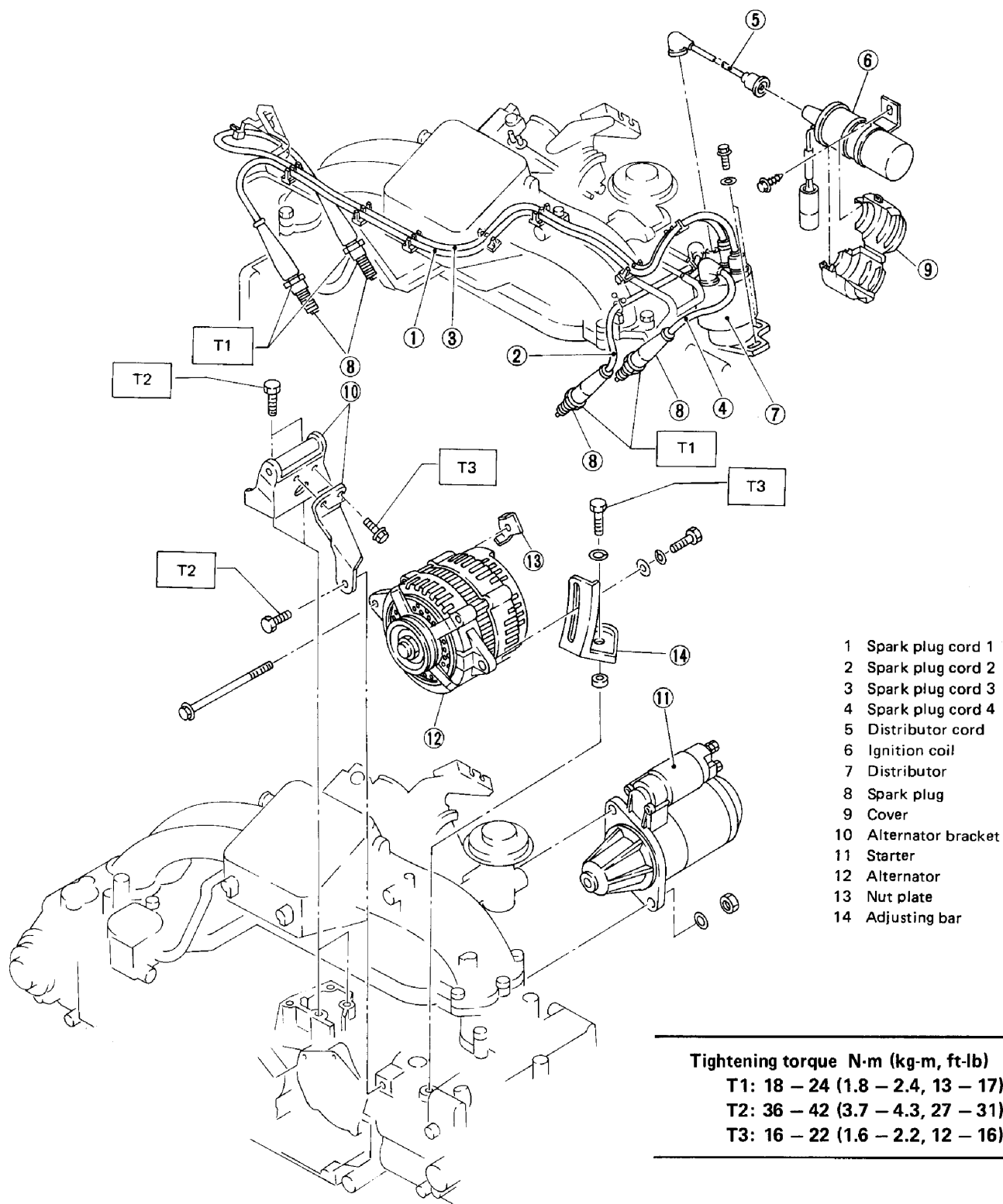


Fig. 10

L2-1278



# SERVICE PROCEDURE

## General Precautions

- Before disassembling engine, install ENGINE STAND 499817100 x 2.
- All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to ASSY.
- Be careful not to let oil, grease or coolant contact the timing belt and clutch disc.
- All removed parts, if to be reused, should be reinstalled in the original positions and directions.
- Gaskets and lock washers must be replaced with new ones. Liquid gasket should be used where specified to prevent leakage.
- Bolts, nuts and washers should be replaced with new ones as required.
- Even if necessary inspections have been made in advance, proceed with ASSY work while making rechecks.

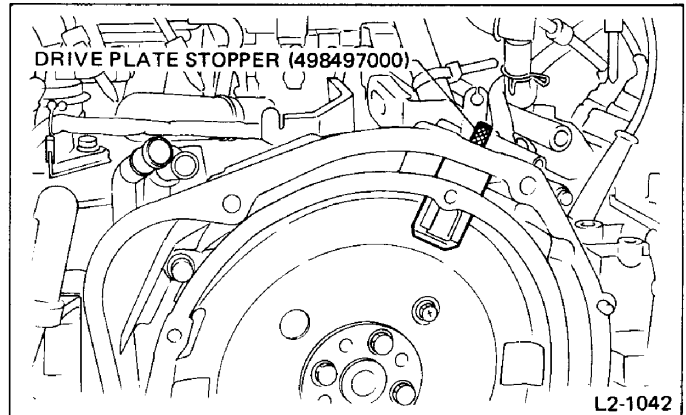


Fig. 12

## Timing Belt and Belt Cover

### REMOVAL

- 1) Loosen water pump pulley mounting nuts or bolts.
- 2) Loosen two alternator mounting bolts, and detach V-belt. [Except air conditioner equipped model]
- 3) Remove water pump pulley and pulley cover.
- 4) Disconnect lead from oil pressure switch.
- 5) Remove oil level gauge guide together with gauge.
- 6) Remove crankshaft pulley. To lock crankshaft, use FLYWHEEL STOPPER [manual transmission model] or DRIVE PLATE STOPPER [automatic transmission model].

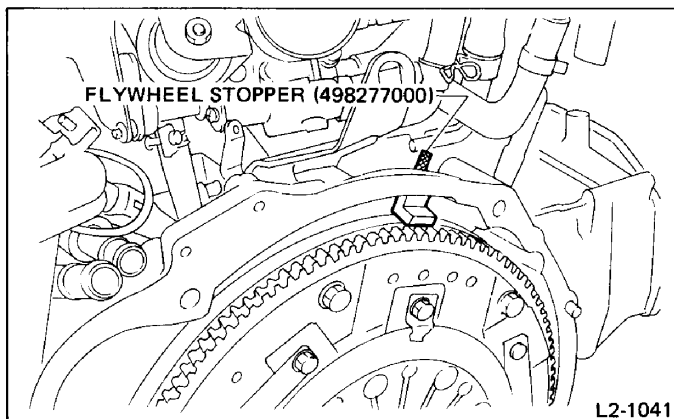


Fig. 11

- 7) Remove belt covers LH, RH and FR.
- 8) Removing timing belt
  - (1) Loosen tensioner mounting bolts on #1 cylinder by 1/2 turn.
  - (2) With tensioner fully turned to slacken belt, tighten mounting bolts.

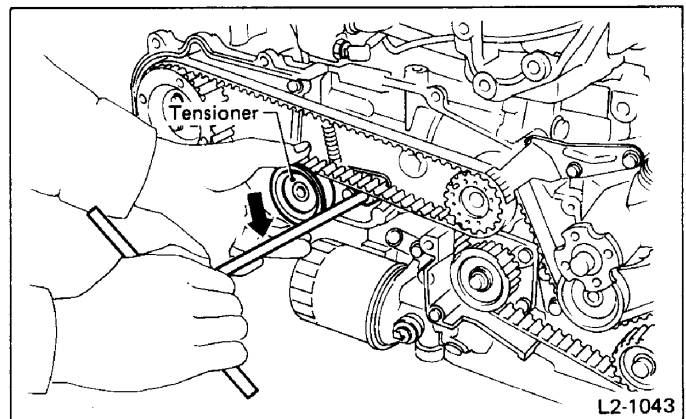


Fig. 13

- (3) Mark rotating direction of timing belt, then remove belt.
- (4) Loosen tensioner No. 2 mounting bolts on #2 cylinder by 1/2 turn.
- (5) With tensioner fully rotated to slacken belt by using TENSIONER WRENCH, tighten tensioner mounting bolts.

Cover TENSIONER WRENCH clamping tips with a rubber hose or waste cloth to prevent crankshaft or pulley from being damaged.

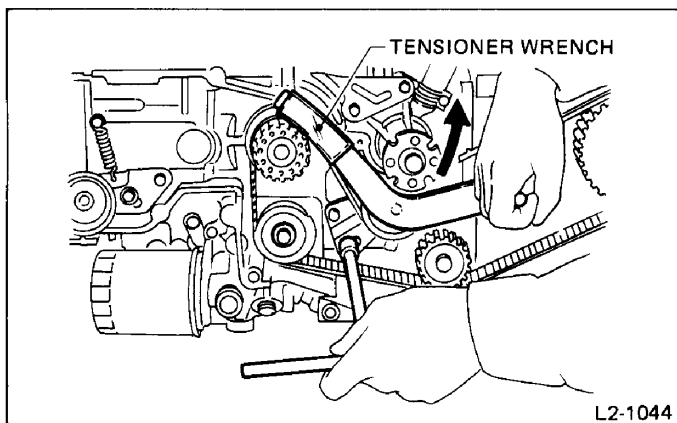


Fig. 14

- (6) Remove crankshaft sprocket.
- (7) Remove timing belt after marking rotating direction of belt.
- (8) Remove crankshaft sprocket No. 2.
- 9) Remove tensioner and tensioner No. 2 together with tensioner spring.
- 10) Remove belt idler.
- 11) Remove camshaft sprockets by using CAMSHAFT SPROCKET WRENCH.

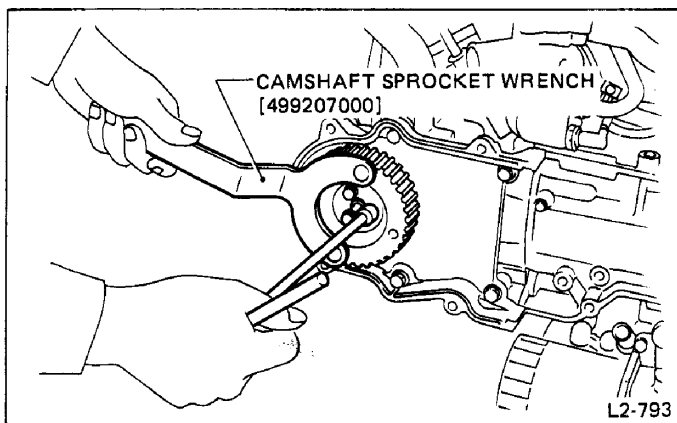


Fig. 15

- 12) Remove right-hand belt cover No. 2, left-hand belt cover No. 2 and belt cover RR.

## INSPECTION

### TIMING BELT

- 1) Check timing belt teeth for breaks, cracks, and wear. If any fault is found, replace belt.
- 2) Check the condition of back side of belt; if any crack is found, replace belt.

- a. Be careful not to let oil, grease or coolant contact the belt. Remove quickly and thoroughly if this happens.
- b. Do not bend the belt sharply. [The bending radius must be greater than 60 mm (2.36 in).]
- c. When replacing belt, be sure to replace both belts as a matched set.

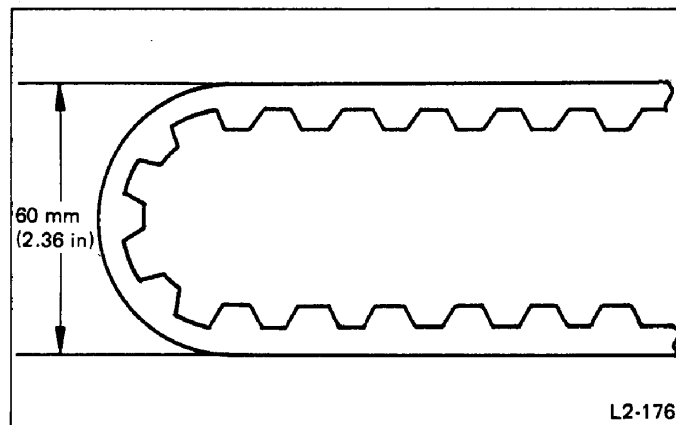


Fig. 16

### TIMING BELT TENSIONER

- 1) Check tensioner roller for smooth rotation. Replace roller if noise or excessive play is noted.
- 2) Measure the out-of-squareness of tensioner roller H. If it exceeds 0.5 mm (0.020 in), replace roller.

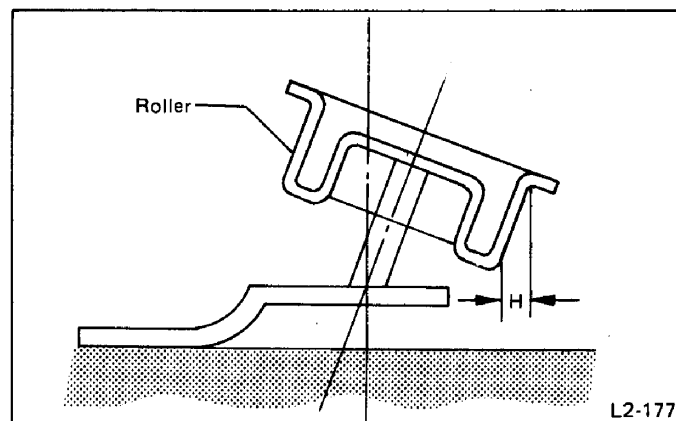


Fig. 17

### BELT IDLER

Check idler for smooth rotation. Replace if noise or excessive play is noted.

## INSTALLATION

- 1) Install belt cover seal LH No. 3 to cylinder block.
- 2) Install belt cover LH seal, belt cover No. 4 LH seal, and belt cover mount to belt cover RR, then install to cylinder block.

### Tightening torque:

4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

- 3) Install belt cover No. 2 LH seal and belt cover mounts to belt cover No. 2 LH, then install to cylinder head and camshaft case.

### Tightening torque:

4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

- 4) Install belt cover RH seal, belt cover No. 2 RH seal, and belt cover mounts to belt cover No. 2 RH, then install to cylinder head and camshaft case.

### Tightening torque:

4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

- 5) Install camshaft sprockets to right and left camshafts. To lock camshaft, use CAMSHAFT SPROCKET WRENCH. Tighten bolts gradually in two or three steps until the specified torque is attained.

### Tightening torque:

9.1 – 10.5 N·m (0.93 – 1.07 kg-m, 6.7 – 7.7 ft-lb)

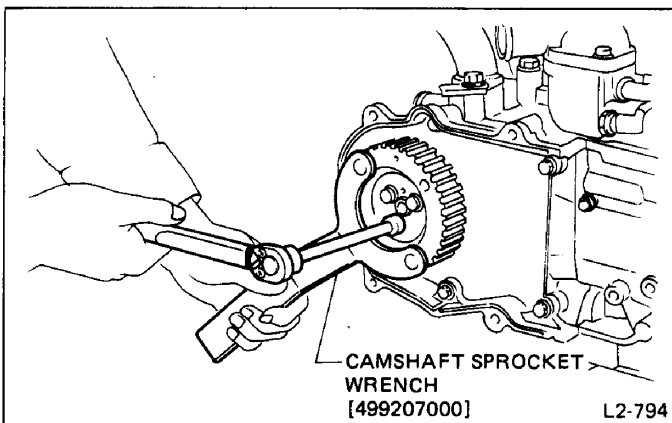


Fig. 18

- 6) Installing tensioner
  - (1) Attach tensioner spring to tensioner, then install to cylinder block RH. Tighten bolts temporarily by hand.
  - (2) Attach tensioner spring to bolt, tighten bolt (a), and then loosen 1/2 turn.
  - (3) Push down tensioner until it stops, then tighten temporarily bolt (b).

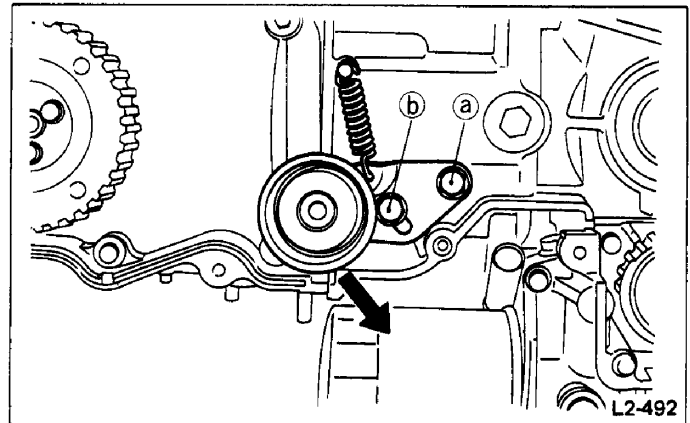


Fig. 19

- 7) Installing tensioner No. 2
  - (1) Attach tensioner spring to tensioner No. 2, then install the tensioner No. 2 to cylinder block LH. Tighten bolts temporarily by hand.
  - (2) Attach tensioner spring to bolt, tighten bolt (c), then loosen 1/2 turn.
  - (3) Raise tensioner No. 2 using TENSIONER WRENCH (499007000) until it stops, then tighten bolt (d) temporarily.

Cover the tip of tensioner wrench with a rubber hose or waste cloth to prevent crankshaft or pulley from being damaged.

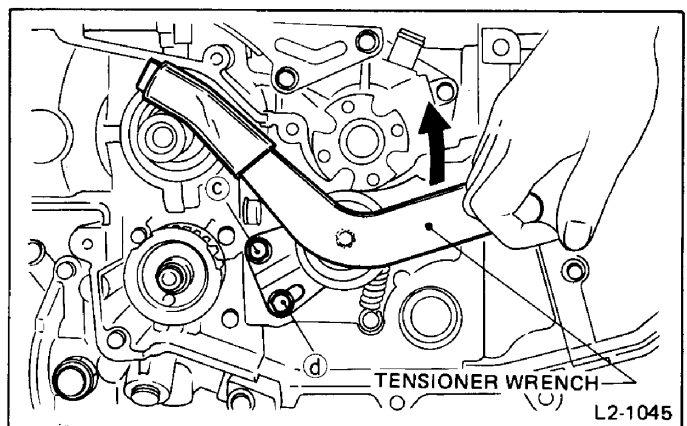


Fig. 20

- 8) Install belt idler to cylinder block, using care not to turn over seal.

### Tightening torque:

39 – 47 N·m (4.0 – 4.8 kg-m, 29 – 35 ft-lb)

- 9) Install timing belt.  
 (1) Install sprocket No. 2 and sprocket to crankshaft.

**Sprocket No. 2 can be identified by the absence of dowel pin.**

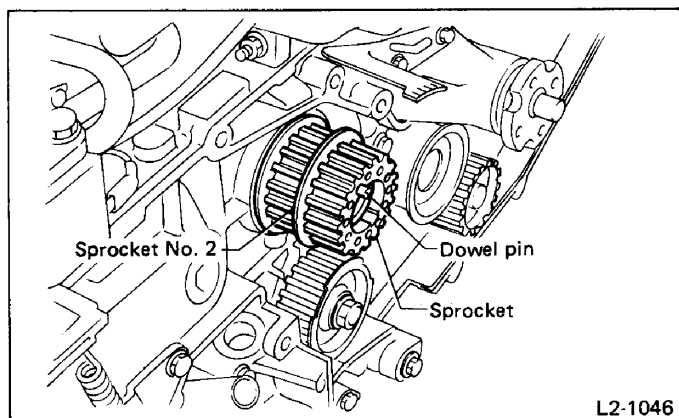


Fig. 21

- (2) Install crankshaft pulley to crankshaft, and tighten bolt temporarily.

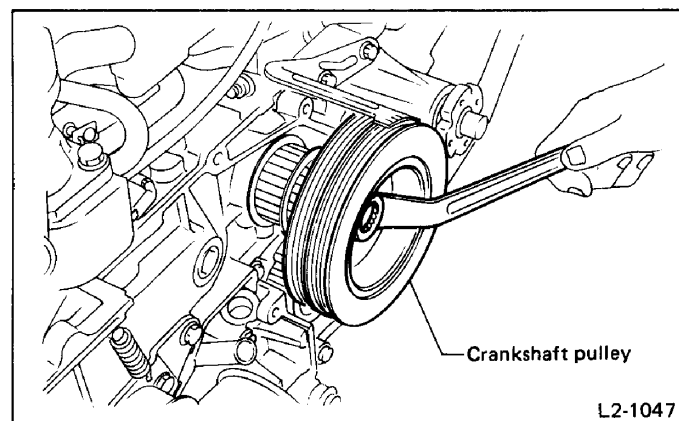


Fig. 22

- (3) Align the center of three lines scribed on the flywheel with timing mark on flywheel housing.

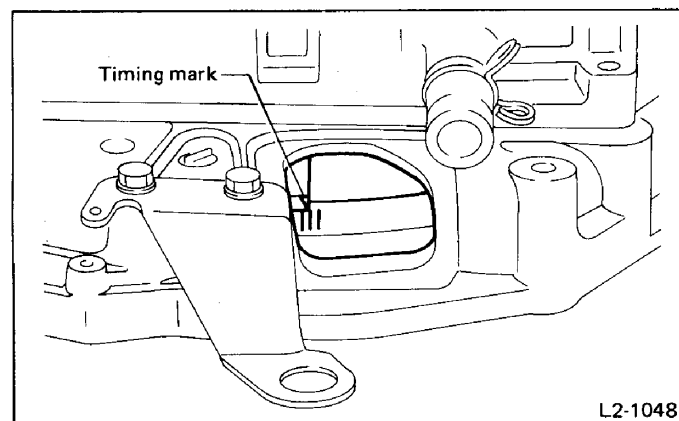


Fig. 23

- (4) Align timing mark on camshaft sprocket LH with notch in belt cover.

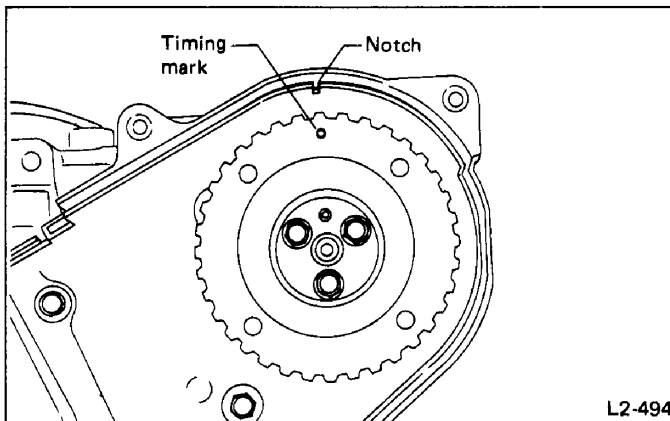


Fig. 24

- (5) Attach timing belt No. 2 to crankshaft sprocket No. 2, oil pump sprocket, belt idler, camshaft sprocket, in that order, avoiding downward slackening of the belt.

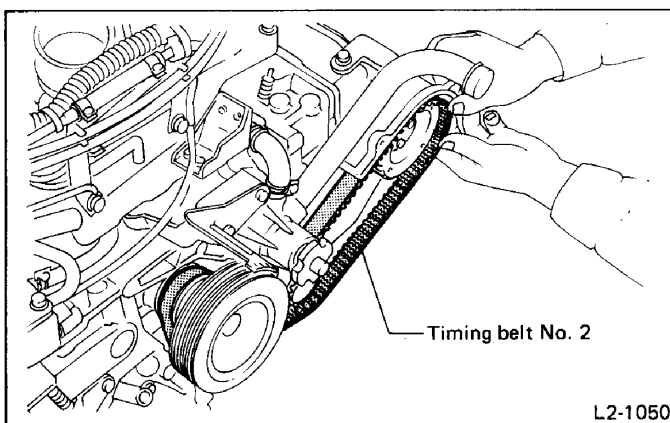


Fig. 25

- (6) Loosen tensioner No. 2 tightening bolt ④ by 1/2 turn to apply tension to belt.

- (7) Push timing belt by hand to ensure smooth movement of tensioner.

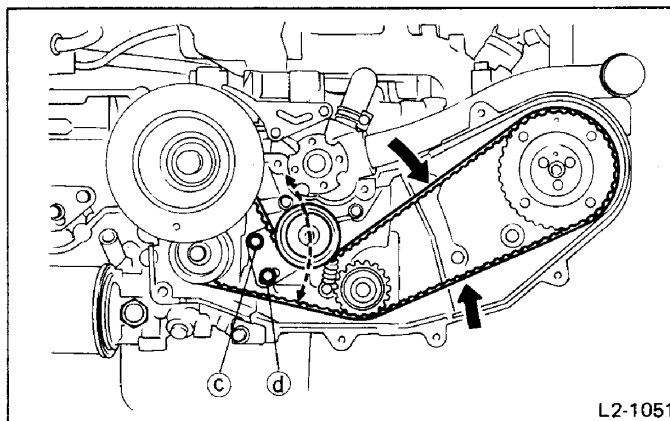


Fig. 26

(8) Apply the specified torque to camshaft sprocket in counterclockwise direction using BELT TENSION WRENCH. While applying torque, tighten tensioner No. 2 bolt ④ temporarily, then tighten bolt ③ temporarily.

**When torquing sprocket, be extremely careful not to apply excessive force to it. Excessive belt tension will greatly reduce belt life.**

Belt tension	Torque to cam sprocket
147 – 245 N (15 – 25 kg, 33 – 55 lb)	24 – 25 N·m (2.4 – 2.6 kg·m, 17 – 19 ft·lb)

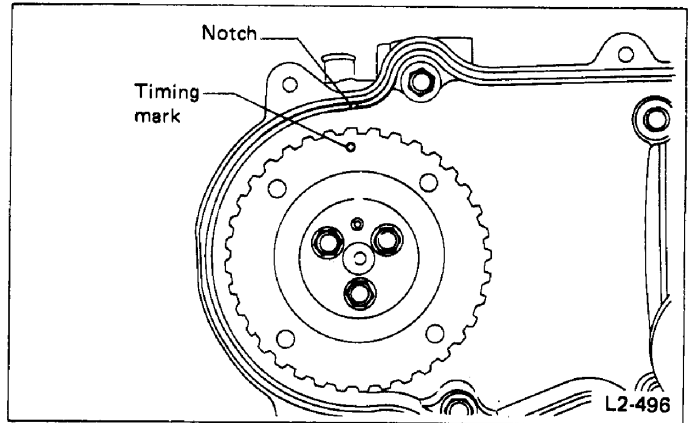


Fig. 28

(13) Attach timing belt to crankshaft sprocket and camshaft sprocket, avoiding slackening of belt on the upper side.

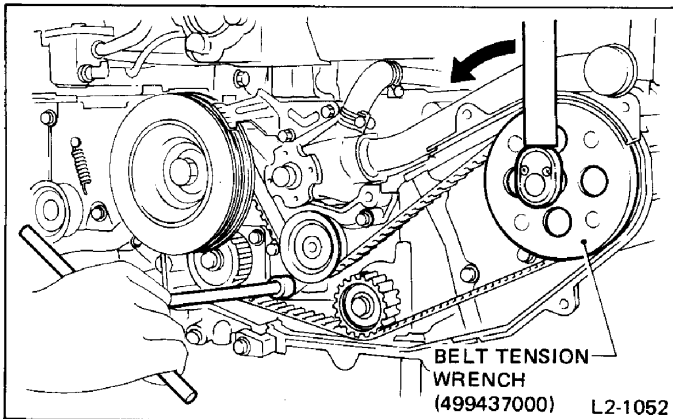


Fig. 27

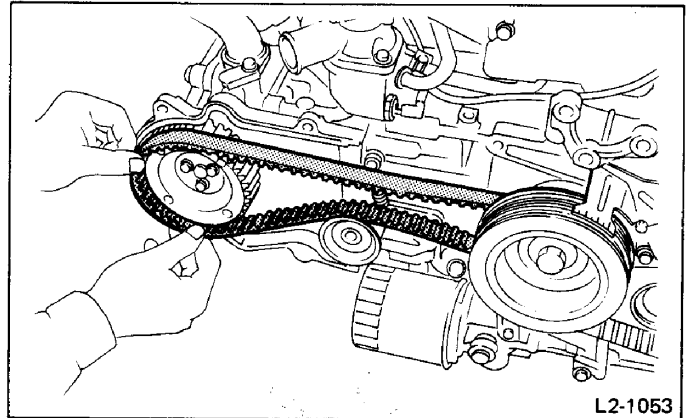


Fig. 29

(9) Tighten bolt ④ and bolt ③, in that order, to the specified torque.

#### Tightening torque:

17.2 – 20.1 N·m (1.75 – 2.05 kg·m, 12.7 – 14.8 ft·lb)

(10) Ascertain that flywheel timing mark and camshaft sprocket LH timing mark are in their normal positions.

(11) Turn crankshaft one turn clockwise from the position where timing belt No. 2 was installed, and align the center of three lines scribed on the flywheel with timing mark on flywheel housing.

(12) Align timing mark on camshaft sprocket RH with the notch in belt cover.

(14) Loosen tensioner bolt ⑥ 1/2 turn to apply tension to belt.

(15) Push timing belt by hand to ensure smooth tensioner movement.

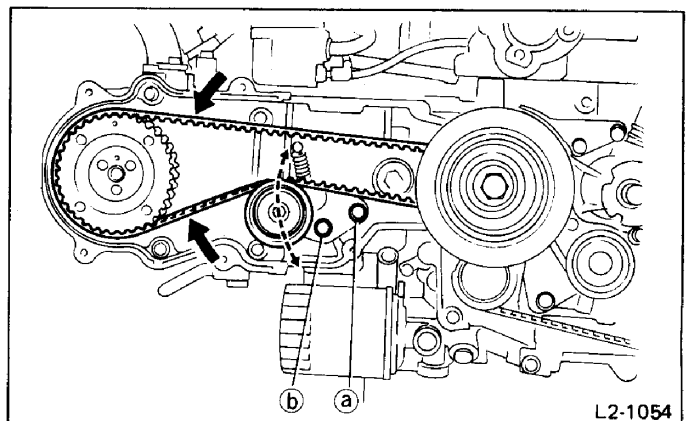


Fig. 30

(16) Apply the specified torque (same as camshaft sprocket LH) to camshaft sprocket RH in counterclockwise direction using BELT TENSION WRENCH. While applying torque, tighten tensioner No. 2 bolt ⑥ temporarily, then tighten bolt ⑤ temporarily.

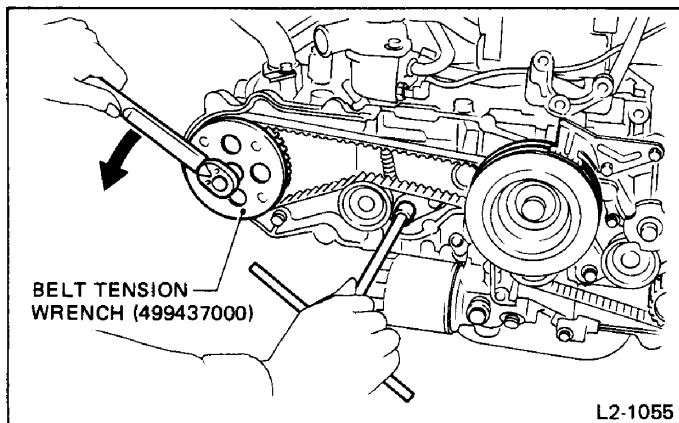


Fig. 31

(17) Tighten bolt ⑥ and bolt ⑤, in that order, to the specified torque.

#### Tightening torque:

17.2 – 20.1 N·m (1.75 – 2.05 kg·m, 12.7 – 14.8 ft·lb)

(18) Make sure that flywheel timing mark and camshaft sprocket RH timing mark are in their normal positions.

(19) Remove crankshaft pulley.

#### Do not remove sprocket with crankshaft pulley.

10) Install belt cover FR seal, belt cover RR seal, and belt cover plug to belt cover FR, then install belt cover FR to cylinder block.

Before installing belt cover, ensure that no foreign matter such as nut or washer is in it.

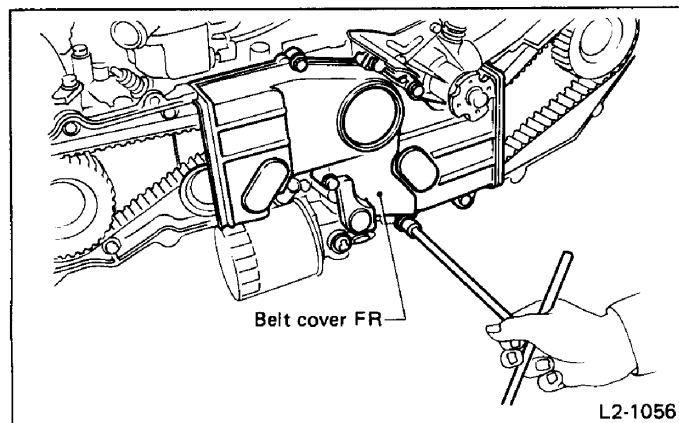


Fig. 32

11) Install belt covers LH and RH.

12) Insert crank pulley to crankshaft using FLYWHEEL STOPPER (498277000) [manual transmission model] or DRIVE PLATE STOPPER (498497000) [automatic transmission model] to lock crankshaft.

#### Tightening torque:

89 – 107 N·m (9.1 – 10.9 kg·m, 66 – 79 ft·lb)

13) Install water pump pulley and pulley cover to water pump ASSY, and tighten nuts temporarily.

14) Install oil level gauge and gauge guide. Apply engine oil to O-ring beforehand.

15) Connect lead to oil pressure switch.

16) Install V-belt and apply proper tension to the belt.

17) Tighten water pump pulley mounting nuts or bolts to the specified torque.

#### Tightening torque:

9.1 – 10.5 N·m (0.93 – 1.07 kg·m, 6.7 – 7.7 ft·lb)

## Camshaft and Valve Rocker

### REMOVAL

- 1) Removing distributor
  - (1) Disconnect spark plug cords from distributor.
  - (2) Remove distributor by removing mounting bolts.
- 2) Remove timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
- 3) Remove water pipe.
- 4) Remove oil filler duct.
- 5) Remove PCV hoses from rocker cover.

- 6) Remove valve rocker covers and gaskets.
- 7) Remove camshaft cases, camshaft support, and camshaft as a unit.

When removing camshaft case, valve rockers may come off. To prevent them from being damaged, be sure to place waste cloth or rubber mat under cylinder head.

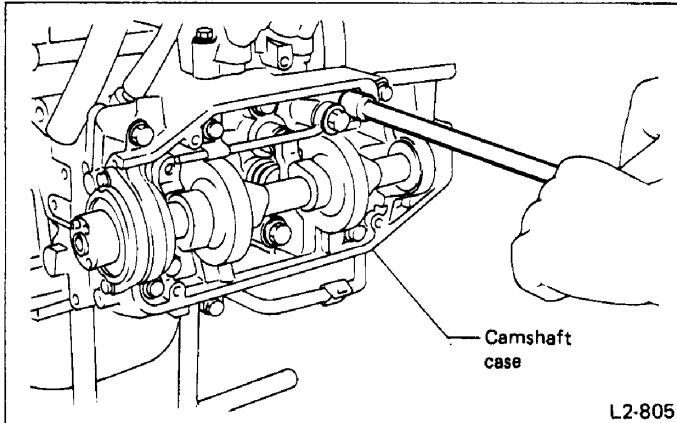


Fig. 33

- 8) Remove valve lash adjusters from cylinder head.

- a. Do not lay down removed adjusters; keep them erect.
- b. Retain removed valve rockers and adjusters in the order of their removal so that they can be reinstalled correctly.

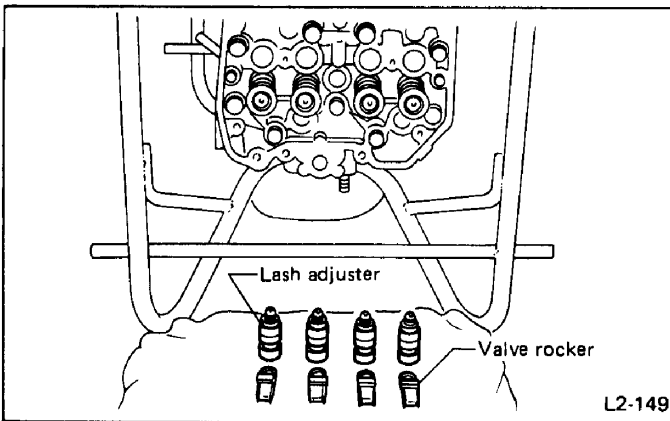


Fig. 34

## DISASSEMBLY

- 1) Remove camshaft support.
- 2) Remove camshaft.

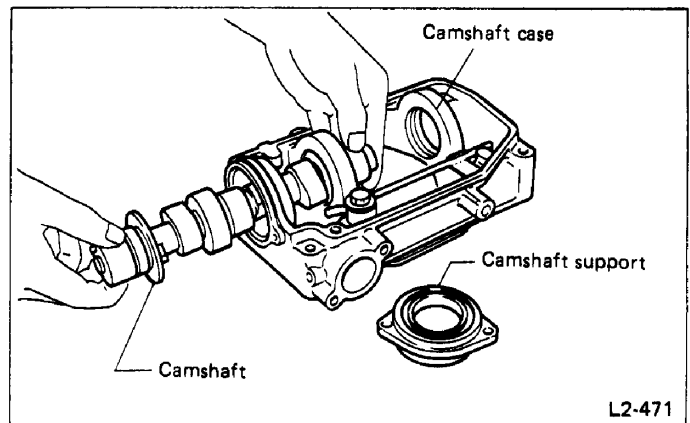


Fig. 35

- 3) Remove oil relief plug, then remove oil relief pipe, relief valve spring, and relief valve.

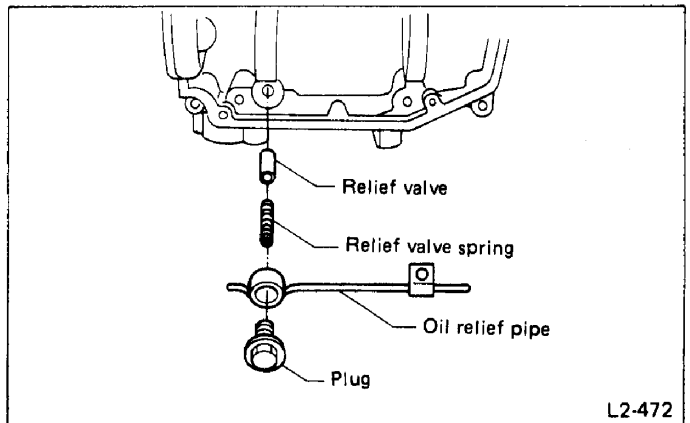


Fig. 36

## INSPECTION

### CAMSHAFT

- 1) Measure the bend, and repair or replace if necessary.

Limit:

0.025 mm (0.0010 in)

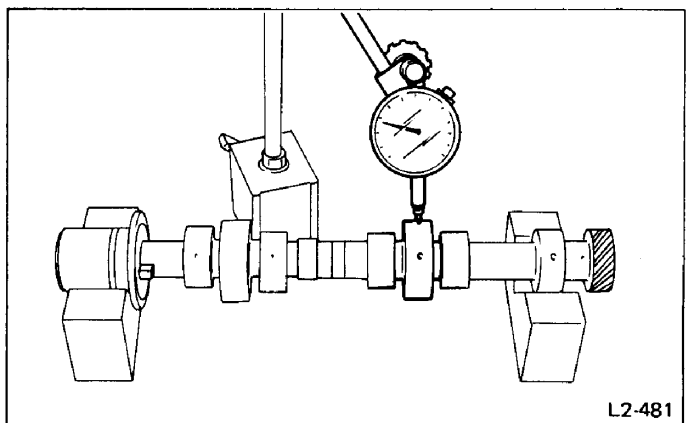


Fig. 37

2) Check journal for damage and wear. Replace if faulty.

Item		Front	Center	Rear	LH distributor
Cam case journal hole I.D.		38.000 – 38.018 mm (1.4961 – 1.4968) *1	48.500 – 48.518 mm (1.9094 – 1.9102 in)	48.000 – 48.018 mm (1.8898 – 1.8905 in)	39.000 – 39.018 mm (1.5354 – 1.5361 in)
Camshaft journal O.D.		37.964 – 37.980 mm (1.4946 – 1.4953 in)	48.464 – 48.480 mm (1.9080 – 1.9087 in)	47.964 – 47.980 mm (1.8883 – 1.8890 in)	38.964 – 38.980 mm (1.5340 – 1.5346 in)
Clearance at journal	Standard	0.020 – 0.054 mm (0.0008 – 0.0021 in)			
	Limit	0.070 mm (0.0028 in)			

\*1: Camshaft support I.D.

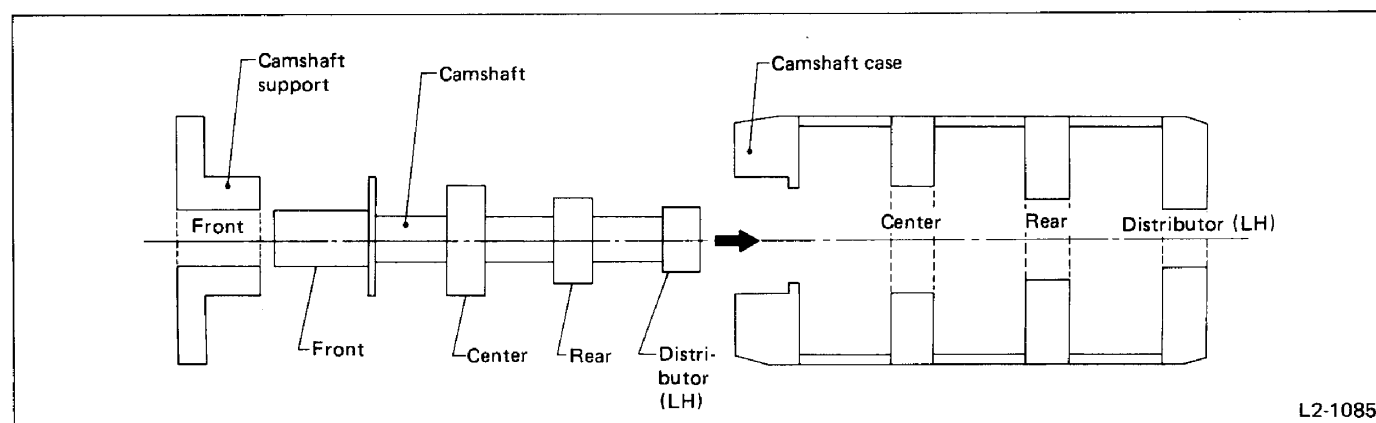


Fig. 38

3) Check cam face condition; remove minor faults by grinding with oil stone. Measure the cam height H; replace if the limit has been exceeded.

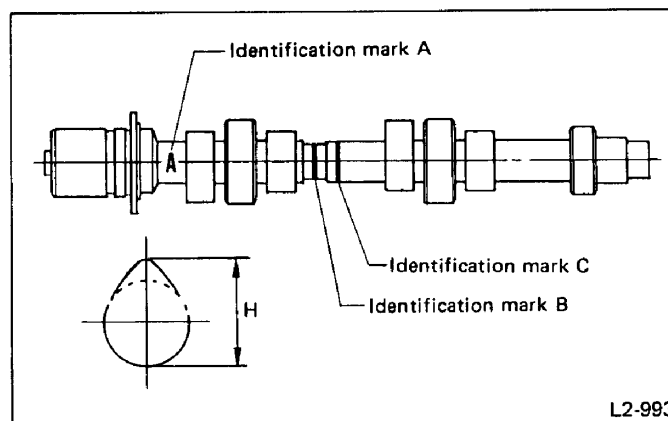


Fig. 39

Identification mark A	Identification mark B	Identification mark C	Height H mm (in)	Wear limit mm (in)
A	0	1	39.80 ± 0.05 (1.5669 ± 0.0020)	0.15 (0.0059)



4) Measure backlash between distributor drive gear and distributor driven gear. If the limit is exceeded, replace distributor drive gear.

**Backlash:**

**Standard**

0.015 – 0.126 mm (0.0006 – 0.0050 in)

**Limit**

0.180 mm (0.0071 in)

5) Replace gear using a press and CAMSHAFT HOLDER (498027000).

## VALVE ROCKER

If cam or valve contact surface of valve rocker is worn or dented, repair by removing the minimum necessary amount. If worn heavily, replace valve rocker.

## VALVE LASH ADJUSTER

1) With adjuster set in vertical position, push adjuster pivot quick and hard by hand.

If pivot is depressed more than 0.5 mm (0.020 in), put adjuster in a container filled with light oil, and move plunger up and down until the depression is less than 0.5 mm (0.020 in).

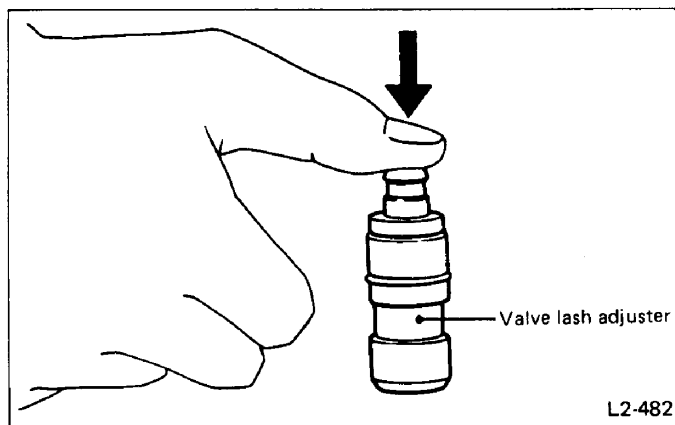


Fig. 40

2) If pivot is depressed more than 0.5 mm (0.020 in) even after repeating the above procedure, replace adjuster.

**The new adjuster is provided with a pin which must be removed before using.**

## ASSEMBLY

1) Press-fit oil seal into camshaft support by using INSTALLER (498037000), then attach O-ring.

2) Install oil relief valve, relief valve spring, oil relief pipe, and oil relief plug to camshaft case.

**Tightening torque:**

23 – 26 N·m (2.3 – 2.7 kg-m, 17 – 20 ft-lb)

3) Install woodruff key to camshaft, then press-fit distributor drive gear by using CAMSHAFT HOLDER (498027000).

4) Insert camshaft into camshaft case, and install camshaft support.

**Tightening torque:**

5.9 – 6.9 N·m (0.60 – 0.70 kg-m, 4.3 – 5.1 ft-lb)

## INSTALLATION

1) Insert valve lash adjusters into cylinder head.

**Be sure to insert each valve lash adjuster to its original position.**

2) Apply grease to spherical surface and sliding surface of each valve rocker, then secure valve rockers to the respective valve adjusters and valves.

**Be sure to apply grease; otherwise, valve rocker will drop off.**

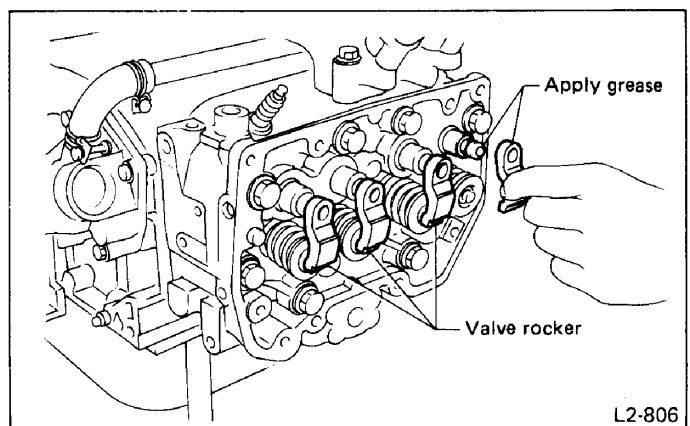


Fig. 41

- 3) Install O-ring to camshaft case by setting camshaft so that camshaft straight pin is oriented as shown.

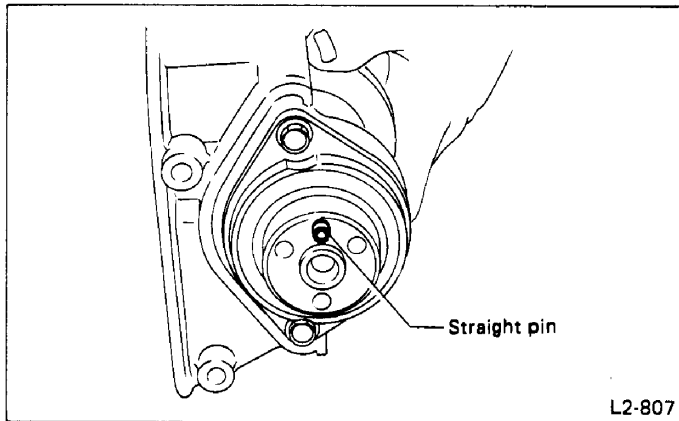


Fig. 42

- 4) Apply fluid packing (Three-bond 1215, or equivalent) to groove of each camshaft case, then install to cylinder head.

After installing, abundantly apply engine oil to sliding surfaces of cam and valve rocker.

**Tightening torque:**

17.2 – 20.1 N·m (1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

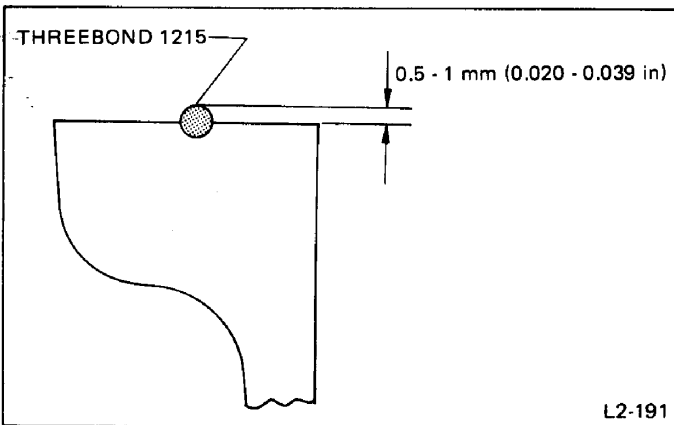


Fig. 43

- 5) Attach gaskets to valve rocker covers, and install the covers to camshaft cases with rocker cover washers and bolts.

Be extremely careful not to cause oil to leak from mating faces of valve rocker cover and camshaft case.

**Tightening torque:**

4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

- 6) Install PCV hoses.  
 7) Install oil filler duct.  
 8) Install water pipe.  
 9) Install timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)  
 10) Install distributor, proceeding as follows:  
 (1) Bring #1 cylinder piston to its top dead center on compression stroke. Set camshaft sprocket to the position shown in Figure.

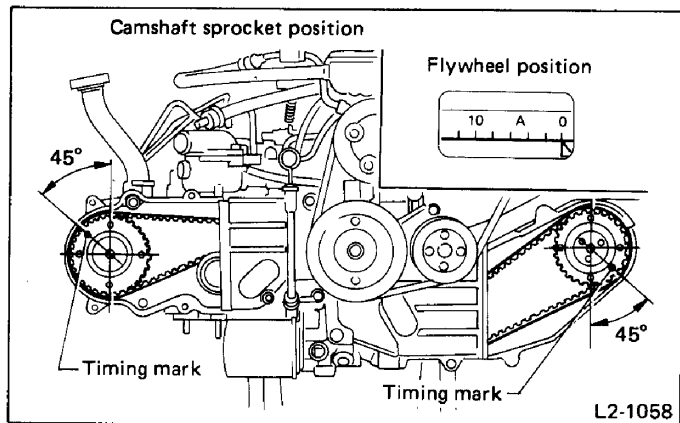


Fig. 44

- (2) Align distributor housing match mark with pinion gear match mark to set #1 cylinder at igniting position.

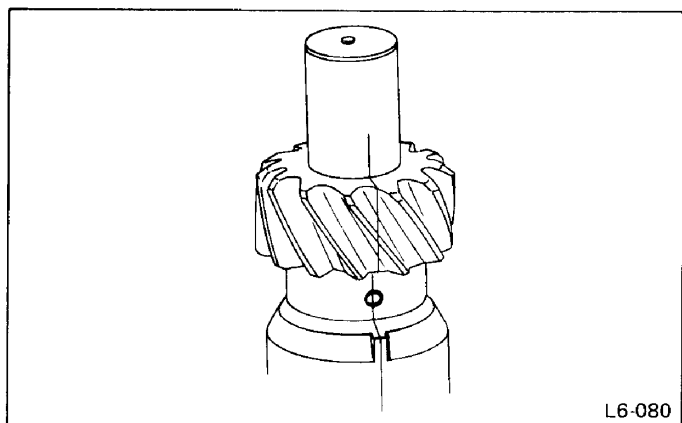


Fig. 45

- (3) Install distributor to camshaft case.  
 (4) Connect lead wires.  
 (5) Install plug cord and high-tension cord.  
 11) Install right and left belt covers.

## Cylinder Head

### REMOVAL

- 1) Remove timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
- 2) Remove camshaft cases, lash adjuster and related parts. (Refer to "Camshaft and Valve Rocker".)
- 3) Remove bolt attaching alternator bracket to cylinder head. [Except air conditioner model]
- 4) Remove bolt attaching adjusting bar to cylinder head. [Except air conditioner model]
- 5) Remove bolts attaching intake manifold to cylinder head, and then lift intake manifold from cylinder head.

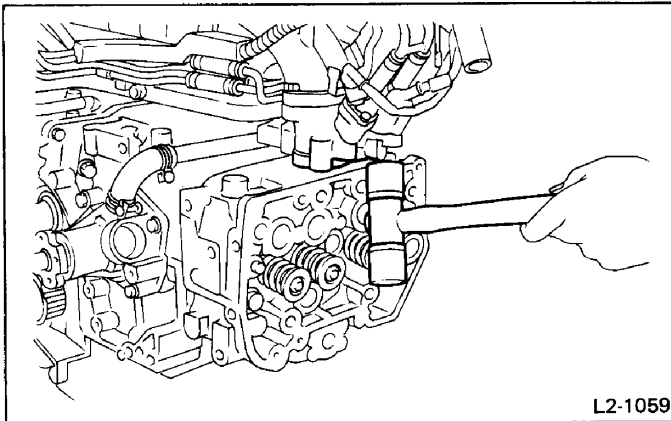


Fig. 46

- 6) Remove bolt attaching water by-pass pipe bracket to cylinder head.

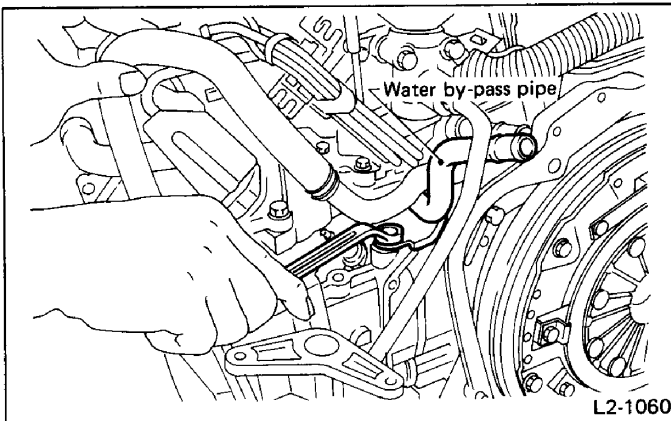


Fig. 47

- 7) Remove spark plugs.
- 8) Remove cylinder heads and gaskets from cylinder block.
- 9) Using VALVE SPRING PRESS ASSY (899724100), compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

a. Mark each valve to prevent confusion.

b. Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.

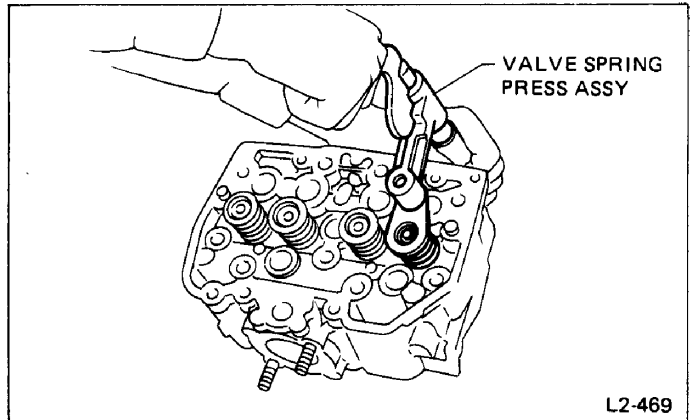


Fig. 48

### INSPECTION

#### CYLINDER HEAD

- 1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect important areas by means of red check.
- 2) Measure the warping of the cylinder head surface that mates with crankcase by using a straight edge and thickness gauge.

If the warping exceeds 0.05 mm (0.0020 in), regrind the surface with a surface grinder.

Warping limit:

0.05 mm (0.0020 in)

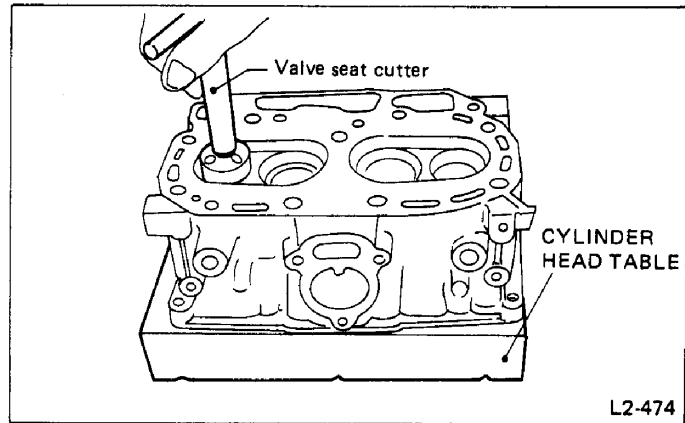
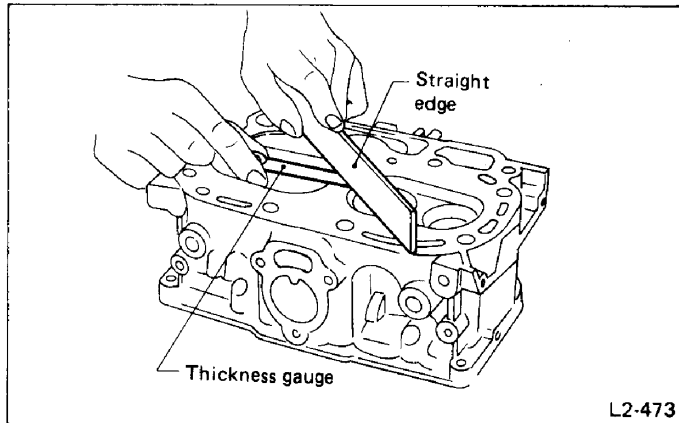
Grinding limit:

0.3 mm (0.012 in)

Standard height of cylinder head:

90.6 mm (3.567 in)

Uneven torque for the cylinder head nuts can cause warping. When reassembling, pay special attention to the torque so as to tighten evenly.



## VALVE GUIDE

1) Check the clearance between valve guide and stem. The clearance can be checked by measuring the outside diameter of valve stem and the inside diameter of valve guide with outside and inside micrometers respectively.

Specifications for valve stem and valve guide		
Standard clearance between valve guide and valve stem	Intake	0.035 – 0.065 mm (0.0014 – 0.0026 in)
	Exhaust	0.040 – 0.070 mm (0.0016 – 0.0028 in)
Limit of clearance between valve guide and valve stem		0.15 mm (0.0059 in)
Standard inside diameter of valve guide		7.000 – 7.015 mm (0.2756 – 0.2762 in)
Standard diameter of valve stem	Intake	6.950 – 6.965 mm (0.2736 – 0.2742 in)
	Exhaust	6.945 – 6.960 mm (0.2734 – 0.2740 in)

2) If the clearance between valve guide and stem exceeds the specification, replace guide as follows:

- (1) Place cylinder head on CYLINDER HEAD TABLE with the combustion chamber upward so that valve guides enter the holes in CYLINDER HEAD TABLE.
- (2) Insert VALVE GUIDE REMOVER into valve guide and press it down to remove valve guide.

3) Inspect intake and exhaust valve seats, and correct the contact surfaces with valve seat cutter if they are defective or when valve guides are replaced.

### Contacting width: W

#### Intake

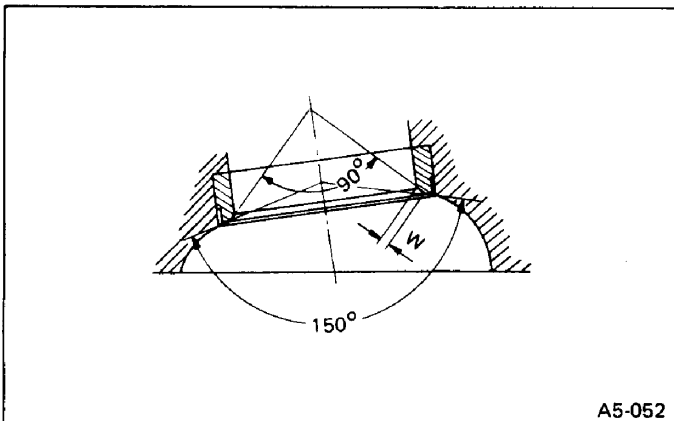
1.2 – 1.8 mm (0.047 – 0.071 in)

#### Exhaust

1.5 – 2.0 mm (0.059 – 0.079 in)

Wear limit of valve seat (measured in direction of valve axis):

0.5 mm (0.020 in) for both intake and exhaust valves



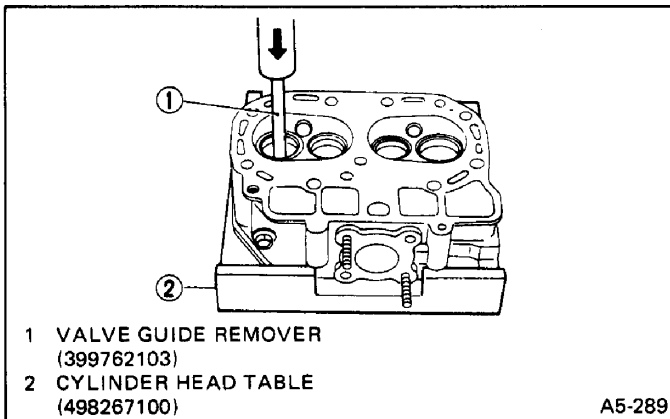


Fig. 52

(3) Turn cylinder head upside down and place VALVE GUIDE ADJUSTER as shown in the figure.

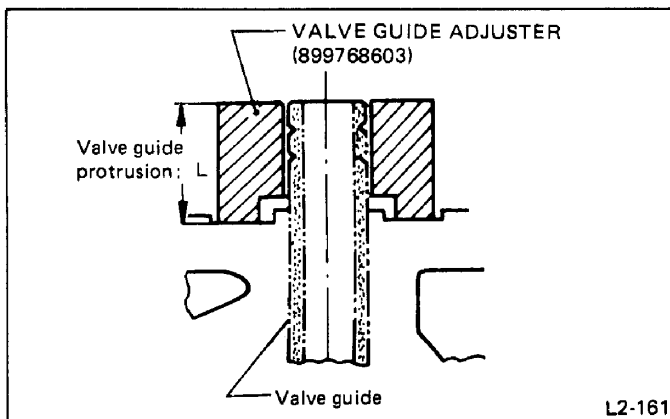


Fig. 53

(4) Before installing new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.

(5) Put new valve guide, coated with sufficient oil, in cylinder, and insert VALVE GUIDE REMOVER into valve guide. Press in until the valve guide upper end is flush with the upper surface of VALVE GUIDE ADJUSTER.

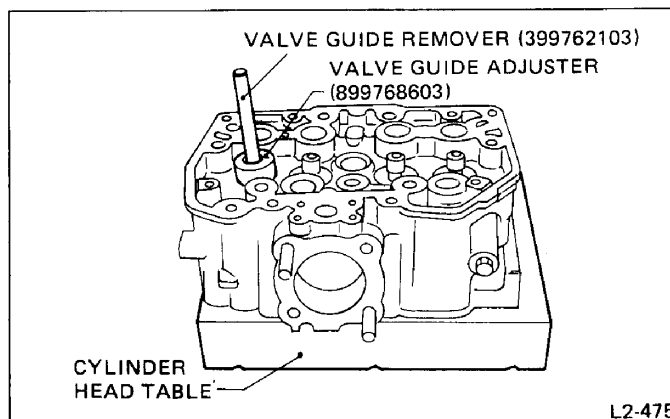


Fig. 54

(6) Check the valve guide protrusion.

Valve guide protrusion: L  
17.5 – 18.5 mm (0.689 – 0.728 in)

(7) Ream the inside of valve guide with VALVE GUIDE REAMER (399762104). Gently rotate the reamer clockwise while pressing it lightly into valve guide, and return it also rotating clockwise. After reaming, clean valve guide to remove chips.

a. Apply engine oil to the reamer when reaming.

b. If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.

c. If the inner surface of the valve guide becomes lustrous and the reamer does not cut chips, use a new reamer or remedy the reamer.

(8) Recheck the contact condition between valve and valve seat after replacing valve guide.

## INTAKE AND EXHAUST VALVE OIL SEAL

Replace oil seal with new one, if lip is damaged or spring is out of place, or when the surfaces of intake valve and valve seat are reconditioned or intake valve guide is replaced.

Press in oil seal to the specified dimension indicated in the figure, using OIL SEAL INSTALLER.

a. Apply engine oil to oil seal before force-fitting.

b. Differentiate between intake valve oil seal and exhaust valve oil seal by noting their difference in height.

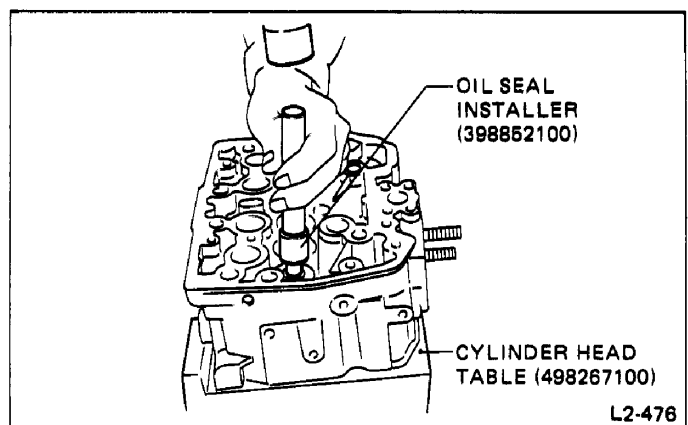


Fig. 55

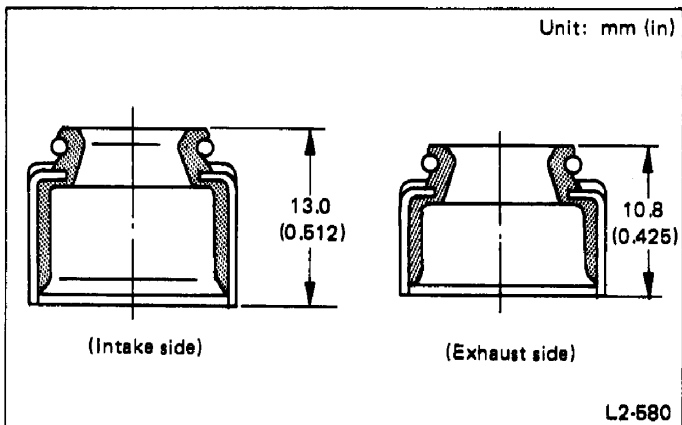


Fig. 56

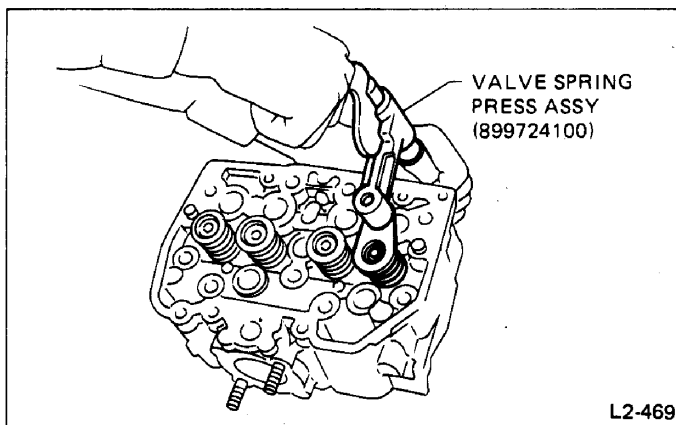


Fig. 58

## INSTALLATION

1) Install the oil seals to the valve guides using OIL SEAL INSTALLER.

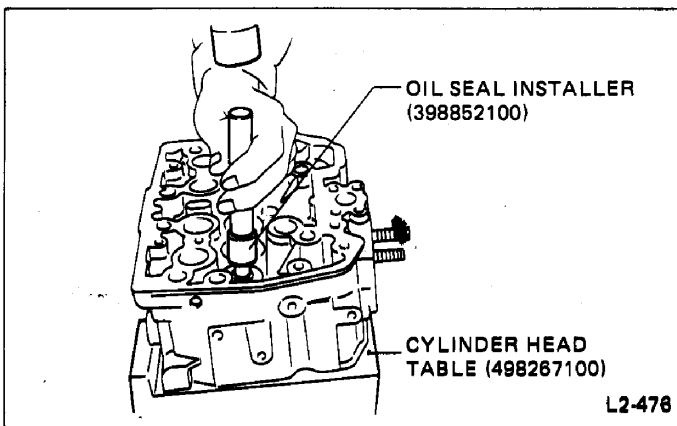


Fig. 57

3) Install cylinder heads to cylinder block with new gaskets.

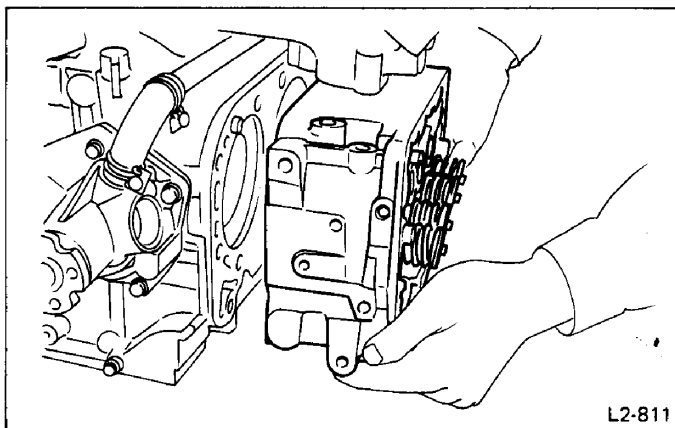


Fig. 59

2) Coat the stem of each valve with engine oil and insert the valve into the valve guide. Attach the valve springs and retainer. Then compress the valve springs using VALVE SPRING PRESS and fit the valve spring retainer key.

- a. After installing, tap the valve spring retainers lightly with a wooden hammer for better seating.
- b. When inserting the valve into the valve guide, use special care not to damage the oil seal lip.
- c. Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

When tightening bolts, apply oil to the threads and tighten them in two or three successive steps until the final tightening is at the specified torque.

In each step, tighten them in the specified sequence.

1st step:

29 N·m (3.0 kg-m, 22 ft-lb)

2nd step:

59 N·m (6.0 kg-m, 43 ft-lb)

3rd (final) step:

64 N·m (6.5 kg-m, 47 ft-lb)

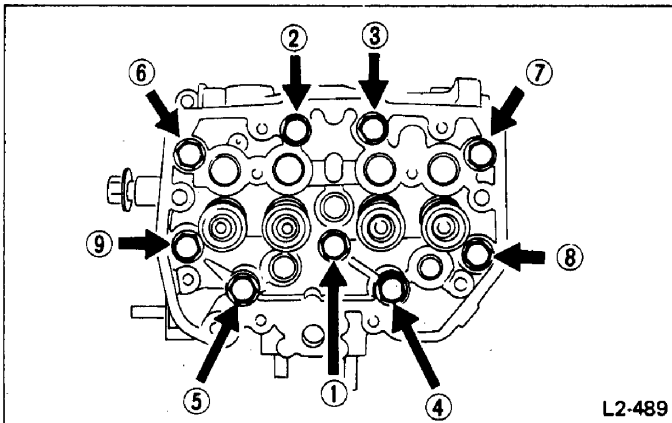


Fig. 60

- 4) Install spark plugs.

**Tightening torque:**

18 – 24 N·m (1.8 – 2.4 kg-m, 13 – 17 ft-lb)

- 5) Install bolt attaching water by-pass pipe bracket to cylinder head.  
 6) Install bolts attaching intake manifold collector to intake manifold.  
 7) Install bolts attaching intake manifold to cylinder head.

**Tightening torque:**

18 – 22 N·m (1.8 – 2.2 kg-m, 13 – 16 ft-lb)

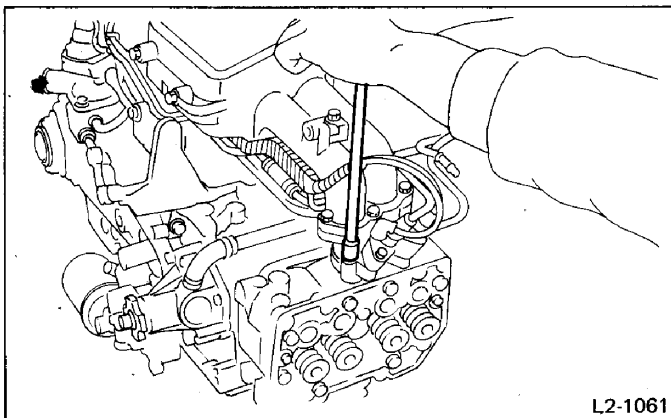


Fig. 61

- 8) Install bolt attaching adjusting bar to cylinder head.

**Tightening torque:**

16 – 22 N·m (1.6 – 2.2 kg-m, 12 – 16 ft-lb)

- 9) Install bolts attaching alternator bracket to cylinder head.

**Tightening torque:**

36 – 42 N·m (3.7 – 4.3 kg-m, 27 – 31 ft-lb)

- 10) Install camshaft cases, lash adjuster and related parts. (Refer to "Camshaft and Valve Rocker".)

- 11) Install timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)

**After completing engine ASSY and mounting engine on car, be sure to retighten cylinder head bolts. (Refer to "2-2 ON-CAR SERVICES".)**

## Valve and Valve Spring

### REMOVAL

- 1) Remove cylinder head from engine ASSY. (Refer to "Cylinder Head".)
- 2) Using VALVE SPRING PRESS ASSY, compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

- a. Mark each valve to prevent confusion.
- b. Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.

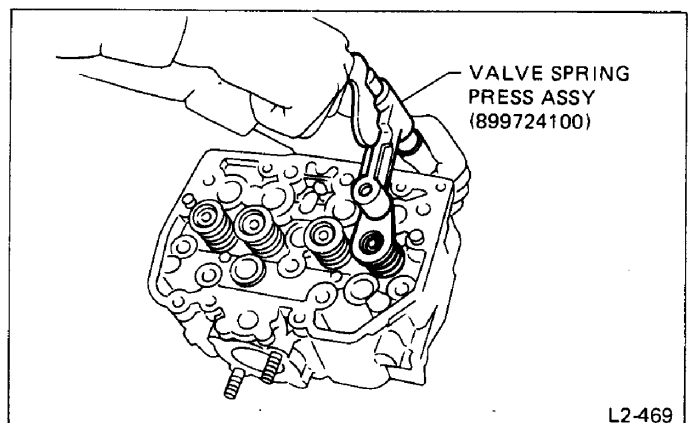


Fig. 62

## INSPECTION

### INTAKE AND EXHAUST VALVE

1) Inspect the flange and stem of valve, and replace if damaged, worn, or deformed, or if "H" is less than the specified limit.

Head edge thickness: H

Intake & Exhaust

Standard

1.3 mm (0.051 in)

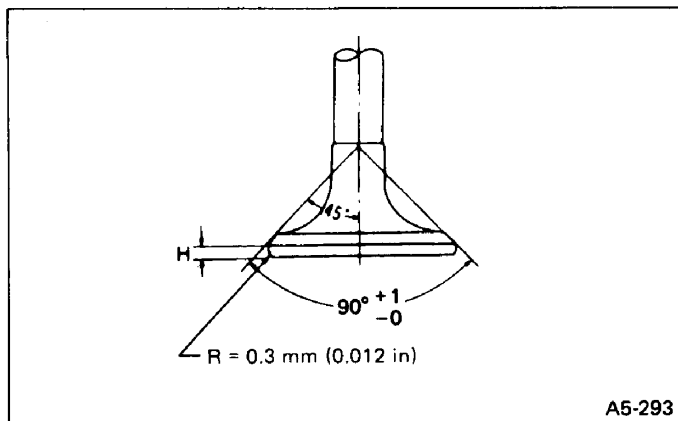
Limit

0.8 mm (0.031 in)

Valve overall length:

Intake & Exhaust

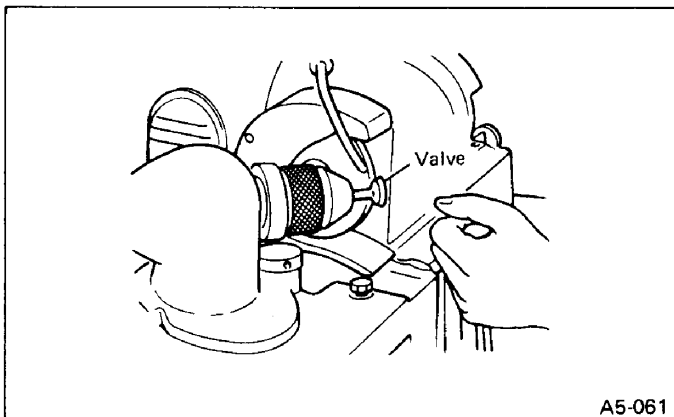
107.58 mm (4.235 in)



A5-293

Fig. 63

2) If the contact surface of valve is damaged, or if the stem end is recessed, correct with a valve refacer, grinding as little as possible. The contact surface should be at right angle with the Valve axis. [Intake valve only]



A5-061

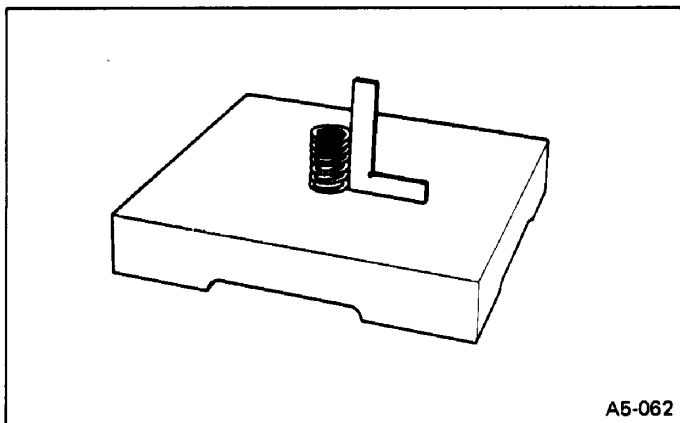
Fig. 64

3) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. Also refer to "Cylinder Head" 3) at this time. Install a new intake valve oil seal after lapping.

### VALVE SPRINGS

1) Check valve springs for damage, free length, and tension. Replace valve spring if it is not to the specifications presented below.

2) To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.



A5-062

Fig. 65

	Outer spring	Inner spring
Free length	50.7 mm (1.996 in)	50.3 mm (1.980 in)
Tension/ spring height	203.0 – 238.3 N (20.7 – 24.3 kg, 45.6 – 53.6 lb)/ 41.5 mm (1.634 in)	88.3 – 101.0 N (9.0 – 10.3 kg, 19.8 – 22.7 lb)/ 38.5 mm (1.516 in)
Squareness	2.2 mm (0.087 in)	2.2 mm (0.087 in)

## ASSEMBLY

Coat the stem of each valve with engine oil and insert the valve into the valve guide. Attach the valve springs and retainer. Then compress the valve springs using VALVE SPRING PRESS (899724100) and fit the valve spring retainer key.



- a. After installing, tap the valve spring retainers lightly with a wooden hammer for better seating.
- b. When inserting the valve into the valve guide, use special care not to damage the oil seal lip.
- c. Be sure to install the valve springs with their close-coiled end facing the seat on the cylinder head.

## Cylinder Block

### REMOVAL

- 1) Remove distributor and plug cord.

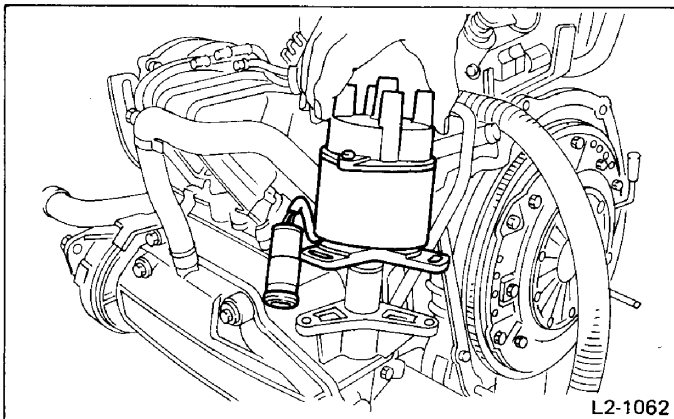


Fig. 66

- 2) Loosen water pump pulley mounting nuts or bolts.
- 3) Remove alternator and V-belt. [Except air conditioner equipped model]
- 4) Removal of intake manifold ASSY
  - (1) Remove hoses and tubes from cylinder block side.
  - (2) Disconnect each harness.
  - (3) Remove intake manifold ASSY from engine.
- 5) Remove power steering oil pump bracket from cylinder block. [Power steering model]
- 6) Remove alternator brackets and adjusting bar. [All except air-conditioner models]
- 7) Remove air bleed hose.
- 8) Remove oil filler duct.
- 9) Remove water pipe.
- 10) Remove crankshaft pulley. To lock crankshaft, use FLYWHEEL STOPPER (498277000) [manual transmission model] or DRIVE PLATE STOPPER (498497000) [automatic transmission model].

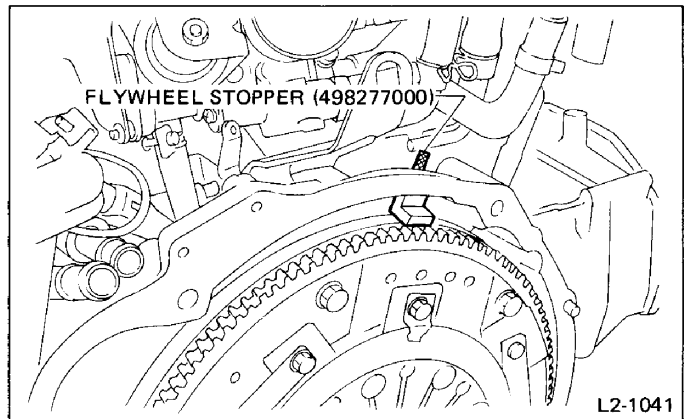


Fig. 67

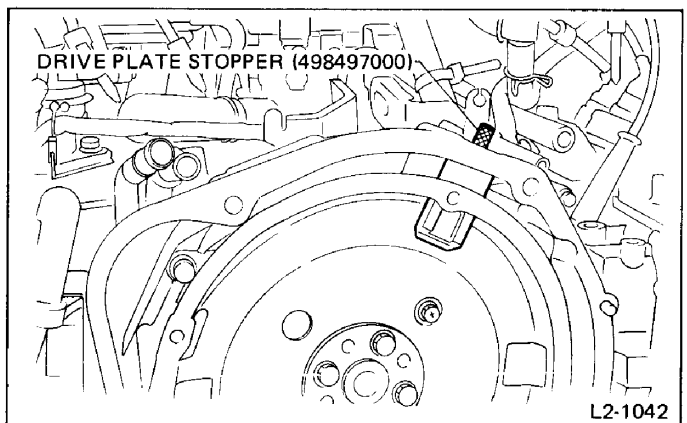


Fig. 68

- 11) Remove water pump pulley and pulley cover.
- 12) Remove oil level gauge guide together with gauge.
- 13) Remove timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)
- 14) Remove water pump together with hose, pipe and timing plate.
- 15) Remove oil pump by aligning notch in oil pump pulley with bolt position, then remove pump outer rotor from cylinder block.

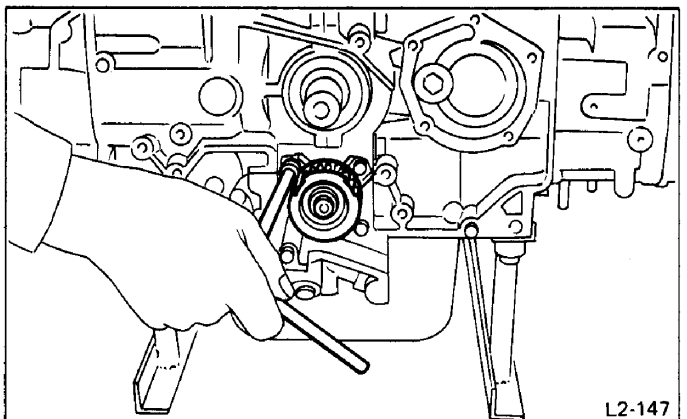


Fig. 69

16) Removing clutch cover and clutch disc. [All except automatic transmission model]

**Be careful not to let oil, grease or coolant contact the clutch disc.**

17) Remove flywheel [manual transmission model] or drive plate [automatic transmission model], and take out flywheel housing with housing cover. To lock crankshaft, use FLY-WHEEL STOPPER (498277000) or DRIVE PLATE STOPPER (498497000).

18) Remove camshaft, valve rocker and related parts. (Refer to "Camshaft and Valve Rocker".)

19) Remove cylinder heads and gaskets.

20) Remove oil pan.

21) Remove oil strainer and strainer stays.

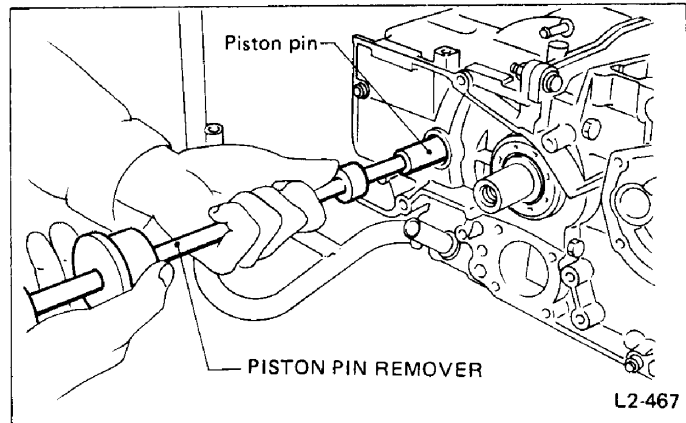


Fig. 71

6) Similarly remove piston pins from #3 and #4 pistons.

**Be careful not to confuse original combination of piston, piston pin and cylinder.**

7) Remove all of cylinder block connecting bolts except one 10-mm bolt under center journal. Loosen this 10-mm bolt until it can be turned by hand. (Cylinder block connecting bolts: six 10-mm bolts and six 8-mm bolts.)

8) Set up cylinder block so that #1 and #3 cylinders are on the upper side, then separate left-hand and right-hand cylinder blocks.

**When separating cylinder block, do not allow the connecting rod to fall and damage the cylinder block.**

9) Remove coolant passage O-ring and back-up ring from left-hand cylinder block.

## DISASSEMBLY

- 1) Remove oil separator cover.
- 2) Remove service hole plugs from cylinder block using hexagon wrench (14 mm).
- 3) Rotate crankshaft to bring #1 and #2 pistons to TDC position.
- 4) Remove piston circlip through service hole of #1 and #2 cylinders.

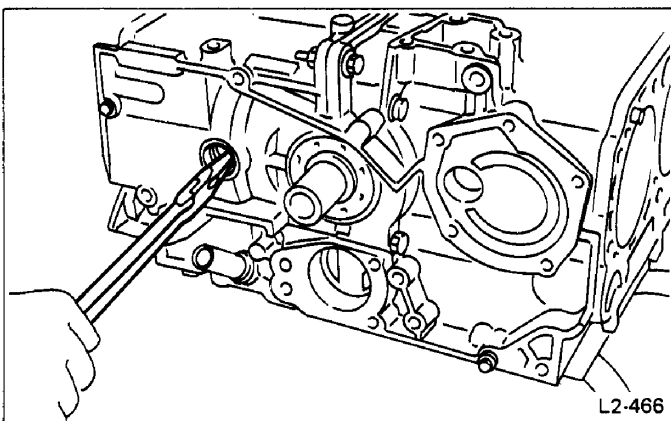


Fig. 70

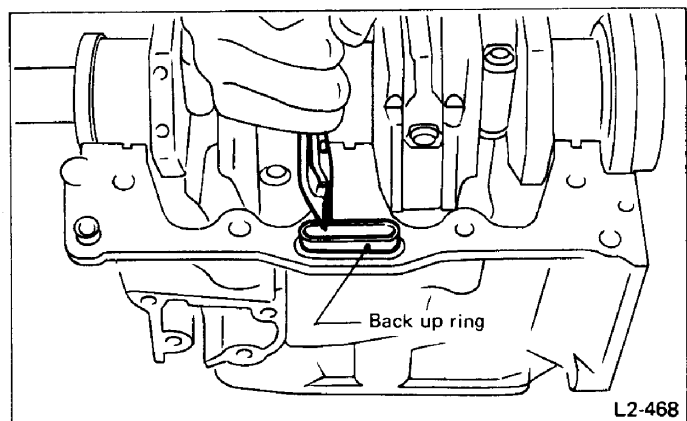


Fig. 72

5) Draw out piston pin from #1 and #2 pistons using PISTON PIN REMOVER (399094310).

10) Remove front oil seal and rear oil seal from crankshaft.

11) Remove crankshaft together with connecting rod from cylinder block.

12) Draw out each piston from cylinder block using wooden bar or hammer handle.

**Do not confuse combination of piston and cylinder.**

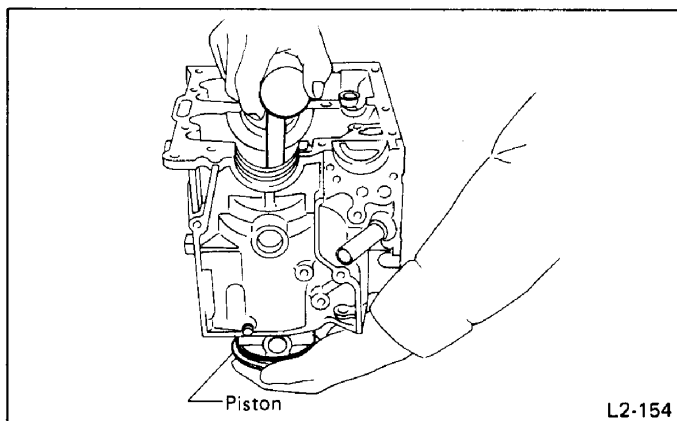


Fig. 73

13) Remove crankshaft bearings from cylinder block using hammer handle.

- a. Do not confuse combination of crankshaft bearings. Press bearing at the end opposite to locking lip.
- b. Do not confuse combination of crankshaft bearings.

## INSPECTION

### CYLINDER BLOCK

Check cylinder block for the following items, and correct or replace if defective.

- 1) Check for cracks and damage visually. Especially, inspect important parts by means of red check.
- 2) Check the oil passages for clogging.
- 3) Inspect the crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

**Warping limit:**  
0.05 mm (0.0020 in)

**Grinding limit:**  
0.4 mm (0.016 in)

### CYLINDER AND PISTON

- 1) Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in the figure, using a cylinder bore gauge.

**Measurement should be performed at a temperature of 20°C (68°F).**

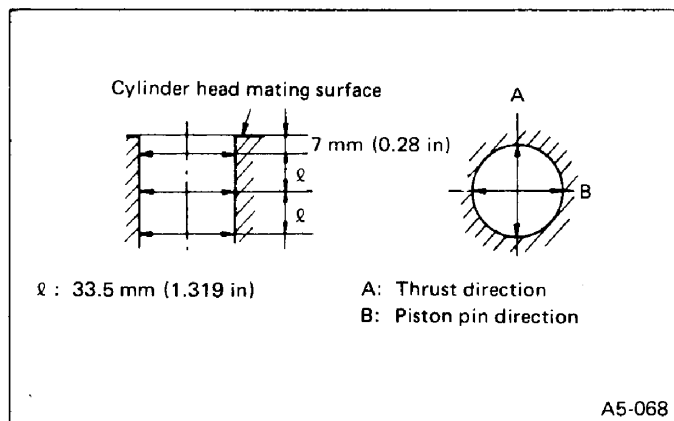


Fig. 74

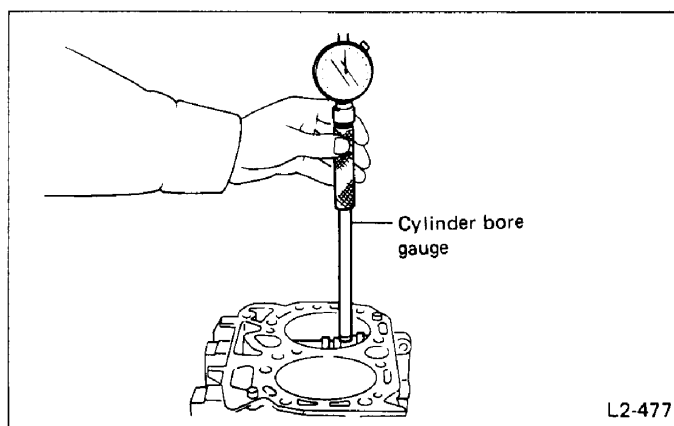


Fig. 75

Cylinder bore		
Standard diameter		91.985 – 92.015 mm (3.6214 – 3.6226 in)
Taper	Standard	0.015 mm (0.0006 in)
	Limit	0.050 mm (0.0020 in)
Out-of roundness	Standard	0.010 mm (0.0004 in)
	Limit	0.050 mm (0.0020 in)
Cylinder to piston clearance at 20°C (68°F)	Standard	0.015 – 0.035 mm (0.0006 – 0.0014 in)
	Limit	0.060 mm (0.0024 in)

## 2) Boring and honing

- (1) If the value of taper, out-of-roundness, or cylinder-to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.

- (2) Get four of the oversize pistons and measure the outer diameter of each piston at the height shown in the figure. (Thrust direction)

Measurement should be performed at a temperature of 20°C (68°F).

## Piston outer diameter:

## Standard

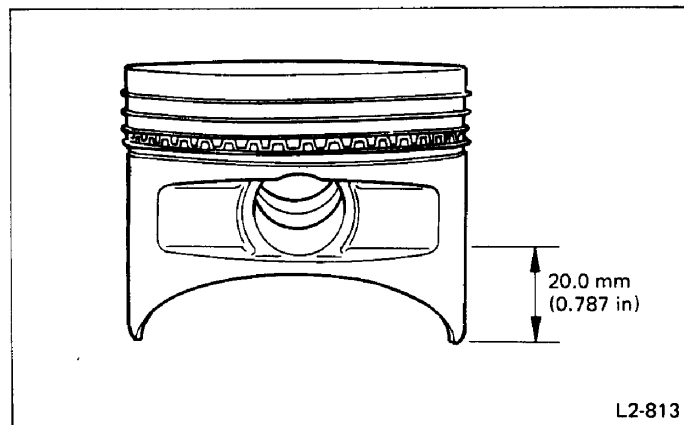
91.970 – 91.980 mm (3.6209 – 3.6213 in)

## 0.25 mm (0.0098 in) oversize

92.220 – 92.230 mm (3.6307 – 3.6311 in)

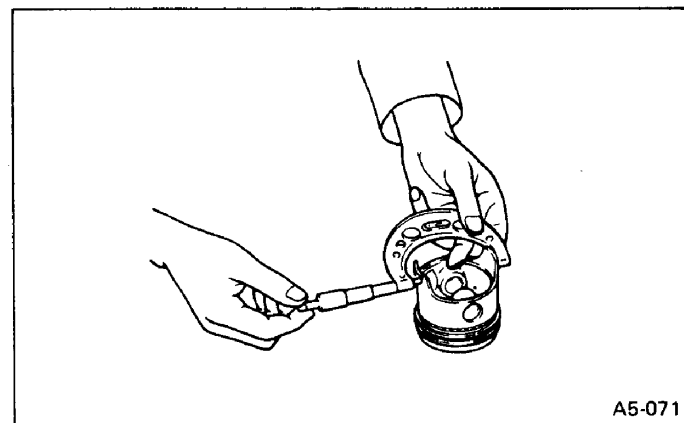
## 0.50 mm (0.0197 in) oversize

92.470 – 92.480 mm (3.6405 – 3.6409 in)



L2-813

Fig. 76



A5-071

Fig. 77

- (3) If the cylinder inner diameter exceeds the following enlarging limit after boring and honing, replace the crankcase.

Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.

## Enlarging limit of cylinder inner diameter:

0.30 mm (0.0118 in)

- (4) Inspect the cylinder bore for taper, out-of-roundness, and diameter differences.

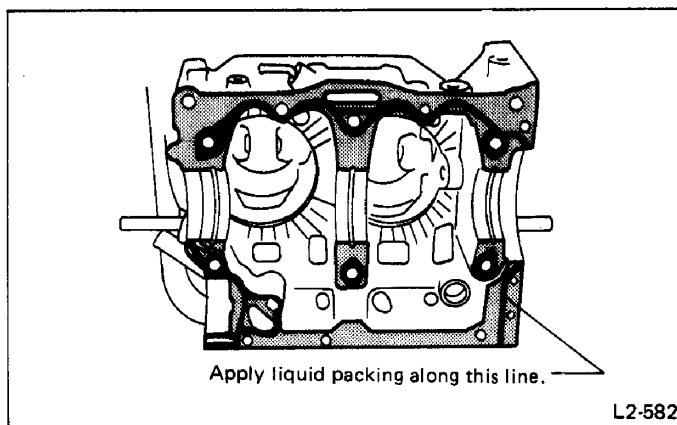
Measure the inner diameter of the cylinder when the temperature is 20°C (68°F).

## Diameter difference between cylinders:

0.050 mm (0.0020 in) or less

## ASSEMBLY

- 1) Install ENGINE STANDS (499817100) to cylinder blocks. When installing ENGINE STANDS, fit bolts to the holes marked with "R" on the #1 and #3 cylinder sides, and to the holes marked with "L" on the #2 and #4 cylinder sides.
- 2) Install crankshaft bearings to cylinder blocks.
- 3) Install crankshaft to left-hand cylinder block.
- 4) Fit O-ring and back-up ring to coolant passage of left-hand cylinder block.
- 5) Apply fluid packing (Three-bond 1215, or equivalent) to mating surface of cylinder block.



L2-582

Fig. 78

6) With left-hand cylinder block facing down, install right-hand cylinder block. After tightening bolts temporarily, lay cylinder block down, then tighten bolts to the specified torque.

**Make sure O-ring is fitted correctly in groove.**

**Tightening torque:**

10 mm bolt

39 – 47 N·m (4.0 – 4.8 kg-m, 29 – 35 ft-lb)

8 mm bolt

23 – 26 N·m (2.3 – 2.7 kg-m, 17 – 20 ft-lb)

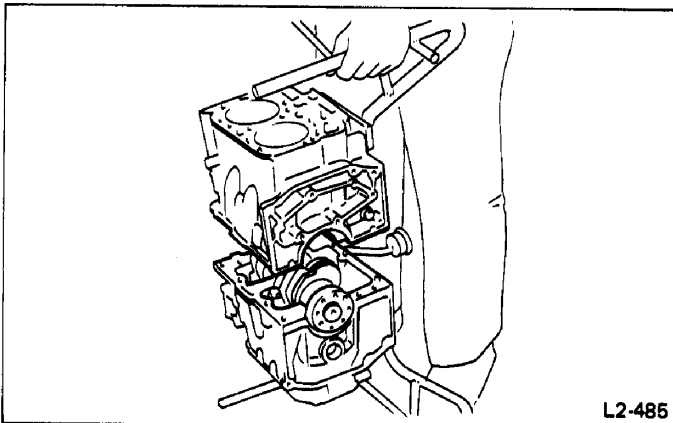


Fig. 79

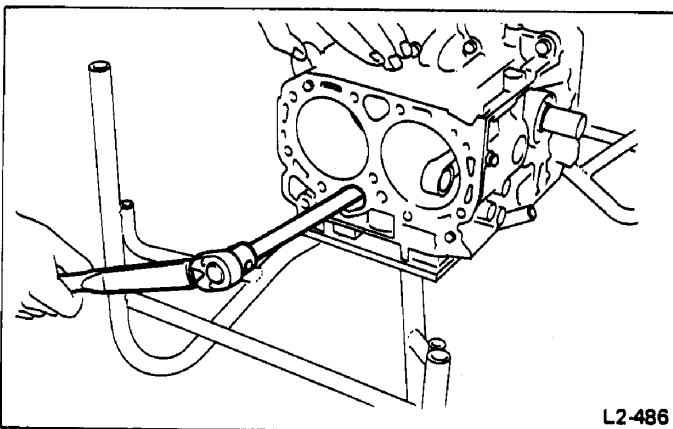


Fig. 80

7) Check thrust clearance of crankshaft.

**Thrust clearance:**

Standard

0.010 – 0.095 mm (0.0004 – 0.0037 in)

Limit

0.3 mm (0.012 in)

8) Position the gaps of the piston rings and oil ring as shown in the figure.

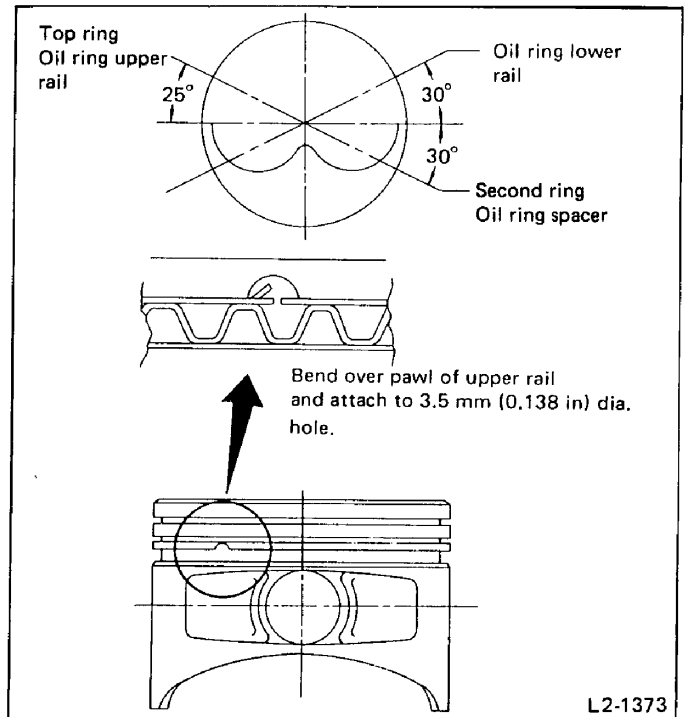


Fig. 81

9) Install pistons in cylinder as follows.

(1) Apply oil to the circumference of piston and the inner surface of cylinder.

(2) With the #3 and #4 cylinders facing downwards, turn crankshaft until the #1 and #2 connecting rod comes to the bottom dead center. Then insert the #1 and #2 piston into cylinder by using PISTON GUIDE (398744300).

**If any of the pistons are reused, be sure to direct them in the same way as before they were disassembled.**

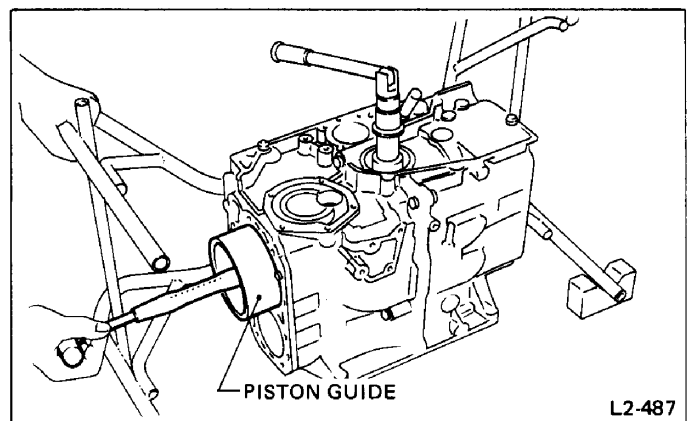


Fig. 82

(3) Install piston pin and circlip through the service hole after aligning the service hole, piston pin hole, and connecting rod small end with PISTON PIN GUIDE (399284300).

**Circlip must be installed in correct direction with its end facing out.**

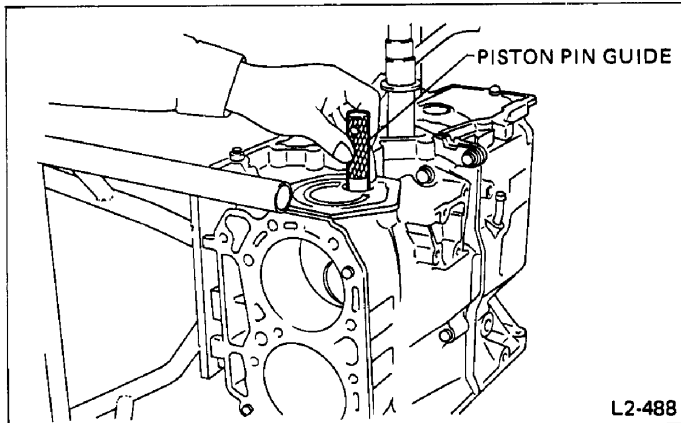


Fig. 83

(4) With #1 and #2 cylinders facing down, turn crankshaft until #3 and #4 piston connecting rods are at the bottom dead center position. Similarly to #1 and #2 cylinders, install pistons, piston pins, and circlips to #3 and #4 connecting rods.

#### Install crankshaft bolt to turn crankshaft.

(5) Turn crankshaft, and check whether pistons are assembled correctly.

10) Apply fluid packing (Fuji-bond C, or equivalent) to plugs, and tighten it with aluminium gasket placed in between.

**Tightening torque:**  
62 – 76 N·m (6.3 – 7.7 kg-m, 46 – 56 ft-lb)

11) Install rear oil seal to cylinder block using INSTALLER (499587000).

**Coat oil seal lips with grease.**

**Coat the outside surface of oil seal with engine oil.**

**Max. allowable out-of-squareness of oil seal:**  
0.3 mm (0.012 in)

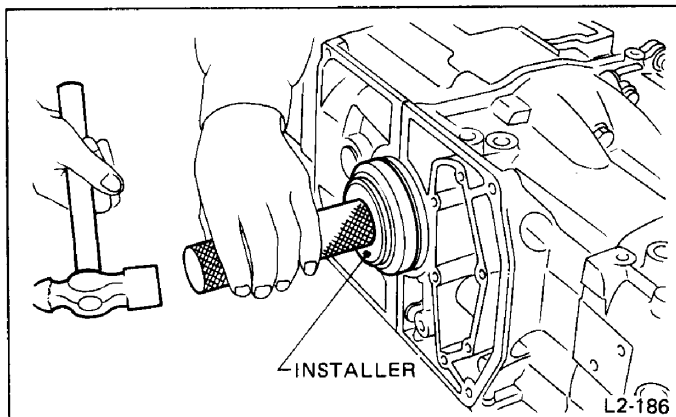


Fig. 84

12) Install oil separator cover with gasket placed in between.

**Tightening torque:**  
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

13) Install front oil seal to cylinder block using OIL SEAL INSTALLER (499567000) or (499567100).

**Coat the outside surface of oil seal with engine oil, and oil seal lip with grease. Force-fit oil seal squarely into position.**

**Max. allowable out-of-squareness of oil seal:**  
0.2 mm (0.008 in)

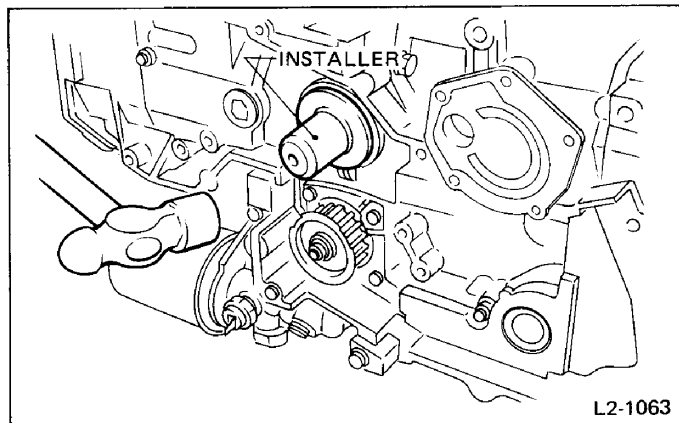


Fig. 85

## INSTALLATION

- 1) Secure oil strainer to cylinder block with oil strainer stays.
- 2) install oil pan.

**Tightening torque:**  
4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

3) Install cylinder heads to cylinder blocks with gaskets placed between.

When tightening bolts, apply oil to the threads and tighten them in two or three successive steps until the final tightening is at the specified torque.

In each step, tighten them in the specified sequence.

**1st step:**  
29 N·m (3.0 kg-m, 22 ft-lb)

**2nd step:**  
59 N·m (6.0 kg-m, 43 ft-lb)

**3rd (final) step:**  
64 N·m (6.5 kg-m, 47 ft-lb)

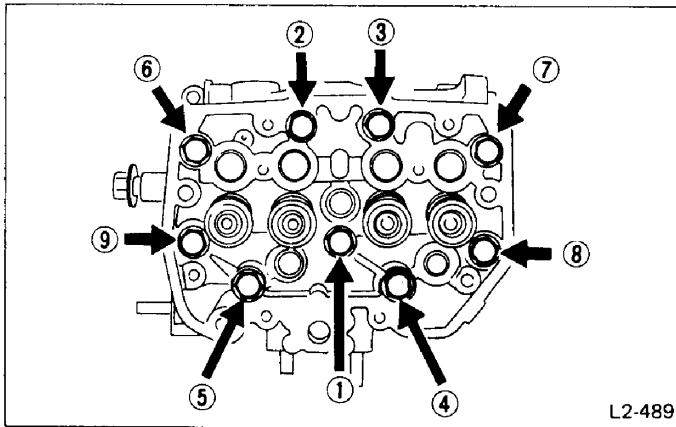


Fig. 86

- 4) Install flywheel housing with housing cover and pitching stopper bracket.

**Tightening torque:**

34 – 40 N·m (3.5 – 4.1 kg·m, 25 – 30 ft·lb)

- 5) Install flywheel to crankshaft using FLYWHEEL STOPPER (498277000) for locking crankshaft. [Manual transmission model]

**Tightening torque:**

69 – 75 N·m (7.0 – 7.6 kg·m, 51 – 55 ft·lb)

- 6) Install drive plate and reinforcement using DRIVE PLATE STOPPER (498497000) for locking crankshaft. [Automatic transmission model]

**Tightening torque:**

69 – 75 N·m (7.0 – 7.6 kg·m, 51 – 55 ft·lb)

- 7) Position the clutch cover so that the "●" marks on the flywheel and clutch cover are spaced 120° or more. Install clutch disc and clutch cover with bolts and spring washers, aligning clutch disc with flywheel by inserting CLUTCH DISC GUIDE (499747000) into needle bearing fitted in flywheel. [Manual transmission model]

**Tightening torque:**

16 N·m (1.6 kg·m, 12 ft·lb)

- 8) Install seal to water pump, then install the water pump and timing plate to cylinder block with gasket placed between.

- 9) Install oil pump ASSY, proceeding as follows:

- (1) Thoroughly remove excess fluid packing from rotor housing of cylinder block.
- (2) Apply a small amount of fluid packing (Three-bond 1215, or equivalent) to the portion indicated by arrow in figure in cylinder block.
- (3) Apply ample engine oil to rotor housing, then insert outer rotor into rotor housing by setting it as shown.
- (4) Set oil pump pulley as shown, and install oil pump ASSY to cylinder block with gasket placed between. After installing, make sure pulley can be rotated smoothly.

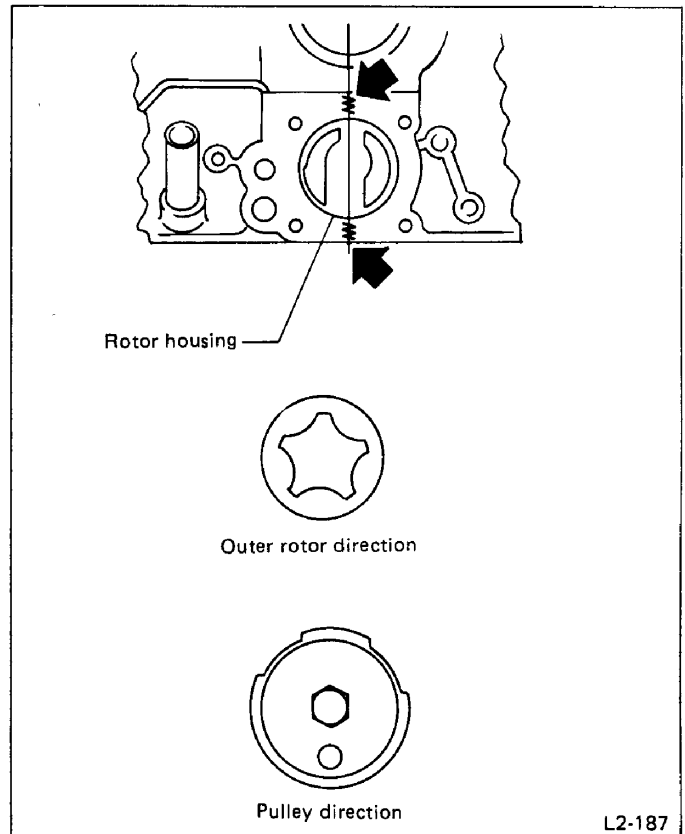


Fig. 87

- (5) Install oil pressure switch or oil pressure gauge to oil pump ASSY. Loosen oil pressure gauge lead clamping screw and route the lead on the side of #1 and #3 cylinders.

**Tightening torque:**

22 – 27 N·m (2.7 – 2.8 kg·m, 16 – 20 ft·lb)

- 10) Insert valve lash adjusters into cylinder head.

**Be sure to insert each valve lash adjuster to its original position.**

- 11) Apply grease to spherical surface and sliding surface of each valve rocker, then secure valve rockers to the respective valve adjusters and valves.

Be sure to apply grease; otherwise, valve rocker will drop off.

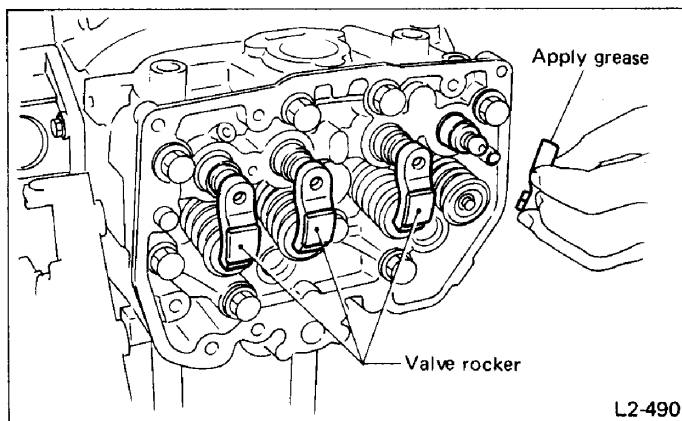


Fig. 88

12) Install O-ring to camshaft case by setting camshaft so that camshaft straight pin is oriented as shown.

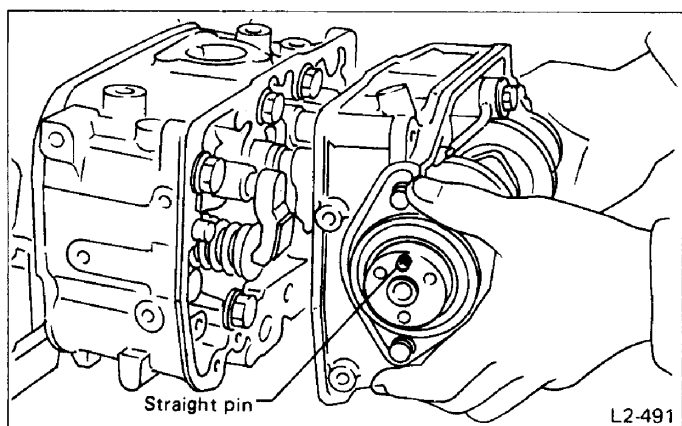


Fig. 89

13) Apply fluid packing (Three-bond 1215, or equivalent) to groove of each camshaft case, then install to cylinder head.

After installing, abundantly apply engine oil to sliding surfaces of cam and valve rocker.

Tightening torque:

17.2 – 20.1 N·m (1.75 – 2.05 kg-m, 12.7 – 14.8 ft-lb)

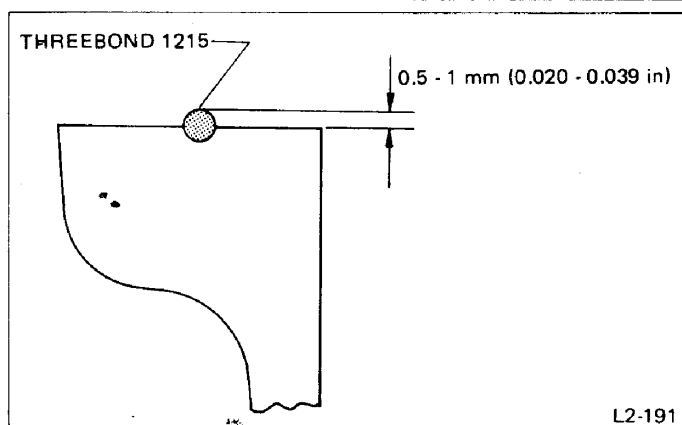


Fig. 90

14) Attach gaskets to valve rocker covers, and install the covers to camshaft cases with rocker cover washers and bolts.

Be extremely careful not to cause oil to leak from mating faces of valve rocker cover and camshaft case.

Tightening torque:

4.4 – 5.4 N·m (0.45 – 0.55 kg-m, 3.3 – 4.0 ft-lb)

15) Install timing belt, belt cover and related parts. (Refer to "Timing Belt and Belt Cover".)

16) Install crank pulley to crankshaft using FLYWHEEL STOPPER (498277000) [manual transmission model] or DRIVE PLATE STOPPER (498497000) [automatic transmission model] to lock crankshaft.

Tightening torque:

89 – 107 N·m (9.1 – 10.9 kg-m, 66 – 79 ft-lb)

17) Install water pump pulley and pulley cover to water pump ASSY, and tighten bolts temporarily.

18) Install oil level gauge and gauge guide. Apply engine oil to O-ring beforehand.

19) Install oil filler duct and bracket.

20) Install water by-pass pipe, hose, and water pipe. Apply coolant to O-rings beforehand.

21) Install air bleed hose.

22) Install alternator bracket, proceeding as follows. [All except air conditioner model]

(1) Assemble bracket (A) and bracket (B) temporarily with bolt (C) so that these two parts contact each other.

(2) Install assembled brackets (A) and (B) to engine, and hand-tighten bolts (E) and (D).

(3) Tighten bolt (D) to the specified torque, then tighten bolt (E) to the specified torque.

(4) Tighten bolt (C) to the specified torque.

Tightening torque:

Bolt (C)

16 – 22 N·m (1.6 – 2.2 kg-m, 12 – 16 ft-lb)

Bolts (D) and (E)

36 – 42 N·m (3.7 – 4.3 kg-m, 27 – 31 ft-lb)



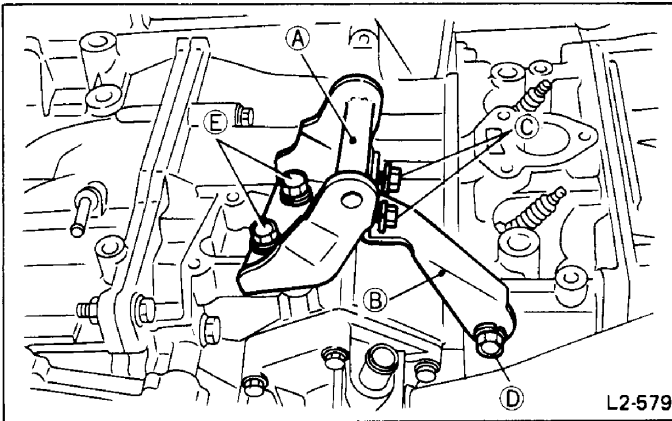


Fig. 91

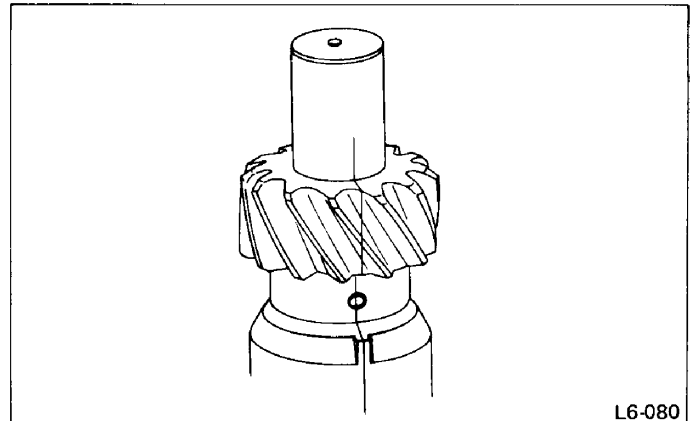


Fig. 93

- 23) Install power steering oil pump bracket to cylinder block.  
[Power steering model]
- 24) Install harnesses.
- 25) Install hoses and tubes.
- 26) Install alternator to bracket, and tighten bolts temporarily.  
[Except air conditioner model]
- 27) Install distributor, proceeding as follows:
  - (1) Bring #1 cylinder piston to its top dead center on compression stroke. Set camshaft sprocket to the position shown in Figure.

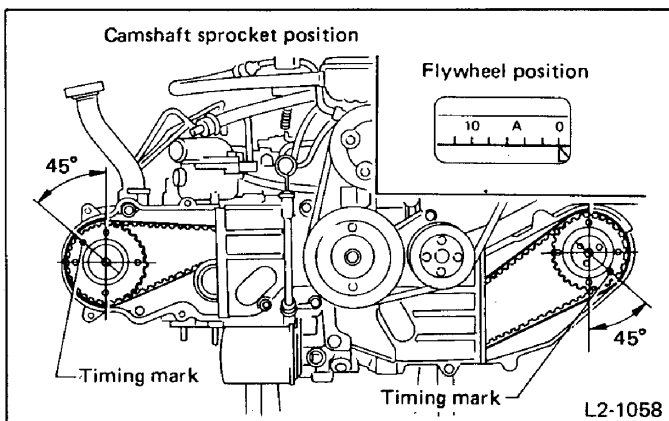


Fig. 92

- (2) Align distributor housing match mark with pinion gear match mark to set #1 cylinder at igniting position.

- (3) Install distributor to camshaft case.
- (4) Connect lead wires.
- (5) Install plug cord and high-tension cord.
- 28) Install right and left belt covers.
- 29) Remove ENGINE STAND (499817100).
- 30) Install air duct and boots.

After completing engine ASSY and mounting engine on car, be sure to retighten cylinder head bolts.  
(Refer to "2-2 ON-CAR SERVICES".)

## Crankshaft and Piston

### DISASSEMBLY

#### PISTON

- 1) Remove the piston rings using the piston ring expander.

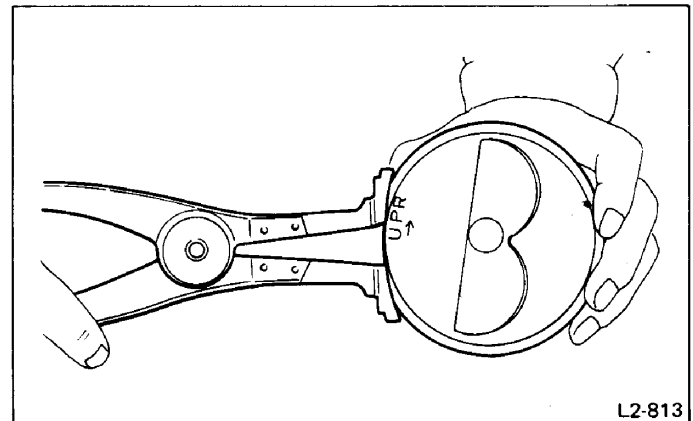


Fig. 94

- 2) Remove the oil ring by hand.

Arrange the removed piston rings in good order to prevent confusion.

## CONNECTING ROD

Remove connecting rod cap mounting nuts, and take out connecting rod from crankshaft.

Arrange removed connecting rod and connecting rod cap in good order to prevent confusion.

## INSPECTION

### PISTON AND PISTON PIN

- 1) Check pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
- 2) Measure the piston-to-cylinder clearance at each cylinder as instructed in CYLINDER AND PISTON. If any of the clearances is not to specification, replace the piston or bore the cylinder to use an oversize piston.
- 3) Make sure that piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if defective.

#### Specifications for piston and piston pin:

Standard outer diameter of piston pin

20.994 – 21.000 mm (0.8265 – 0.8268 in)

Standard inner diameter of piston pin hole

20.999 – 21.009 mm (0.8267 – 0.8271 in)

Standard clearance between piston pin and hole in piston

0.001 – 0.015 mm (0.00004 – 0.00059 in)

Standard clearance between piston pin and hole in connecting rod

0 – 0.022 mm (0 – 0.0009 in)

### PISTON RING

- 1) If piston ring is broken, damaged, or worn, or if its tension is insufficient, or when the piston is replaced, replace piston ring with a new one of the same size as the piston.

**"R" or "N" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.**

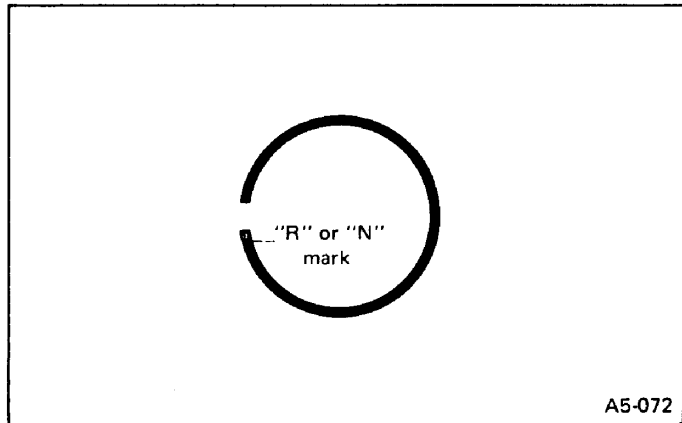


Fig. 95

The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be careful not to make misassembly.

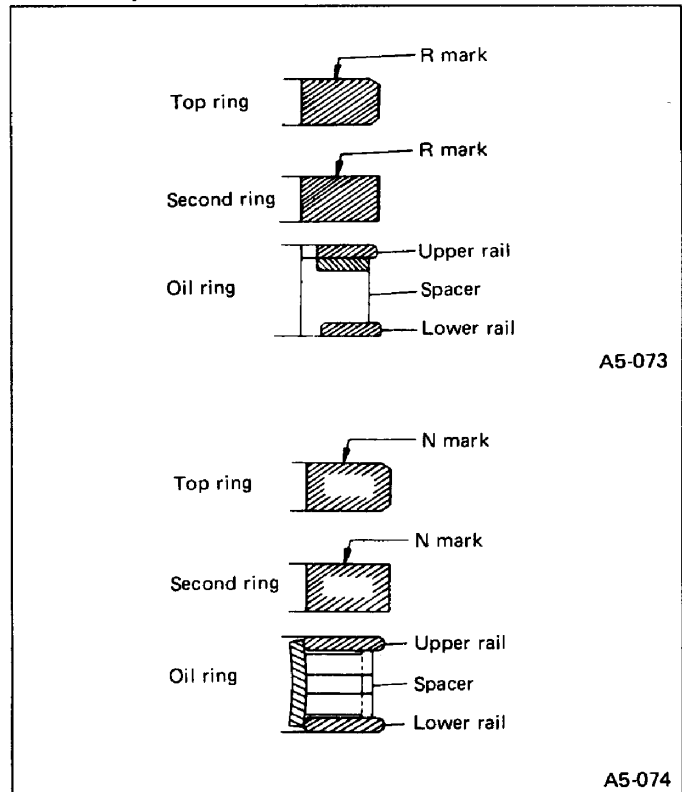


Fig. 96

- 2) Squarely place piston ring in cylinder and measure the piston ring gap with a thickness gauge.

		Standard	Limit
Piston ring gap	Top ring	0.20 – 0.35 mm (0.0079 – 0.0138 in)	1.5 mm (0.059 in)
	Second ring	0.20 – 0.35 mm (0.0079 – 0.0138 in)	1.5 mm (0.059 in)
	Oil ring rail	0.3 – 0.90 mm (0.012 – 0.0354 in)	2.0 mm (0.079 in)

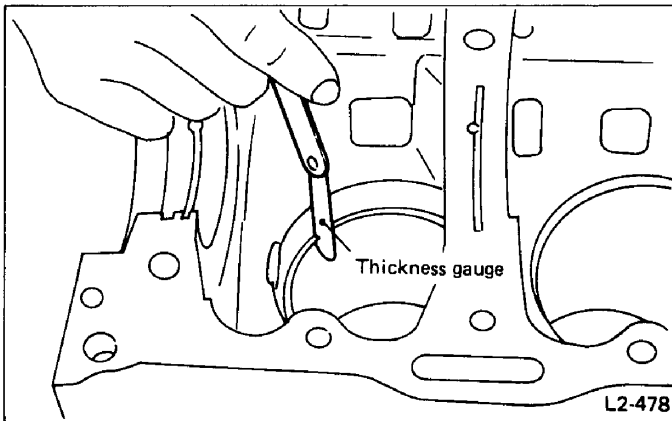


Fig. 97

3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

**Before measuring the clearance, clean the piston ring groove and piston ring.**

		Standard	Limit
Clearance between piston ring and piston ring groove	Top ring	0.04 – 0.08 mm (0.0016 – 0.0031 in)	0.15 mm (0.0059 in)
	Second ring	0.03 – 0.07 mm (0.0012 – 0.0028 in)	0.15 mm (0.0059 in)
	Oil ring	0	0

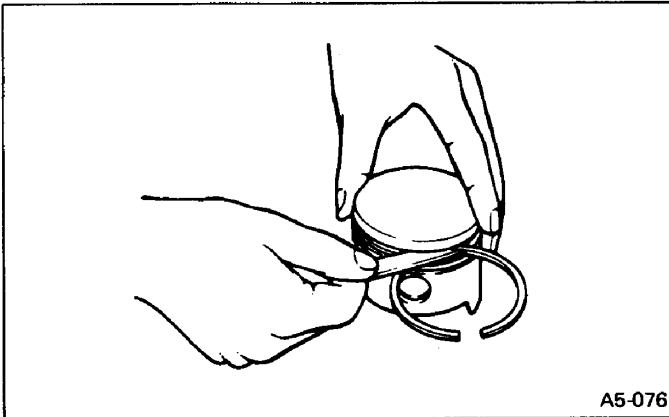


Fig. 98

### CONNECTING ROD

- 1) Replace connecting rod, if the large end thrust surface is damaged.
- 2) Check for bend or twist using a connecting rod aligner. Replace connecting rod if the bend or twist exceeds the limit.

**Limit of bend or twist per 100 mm (3.94 in) in length:  
0.10 mm (0.0039 in)**

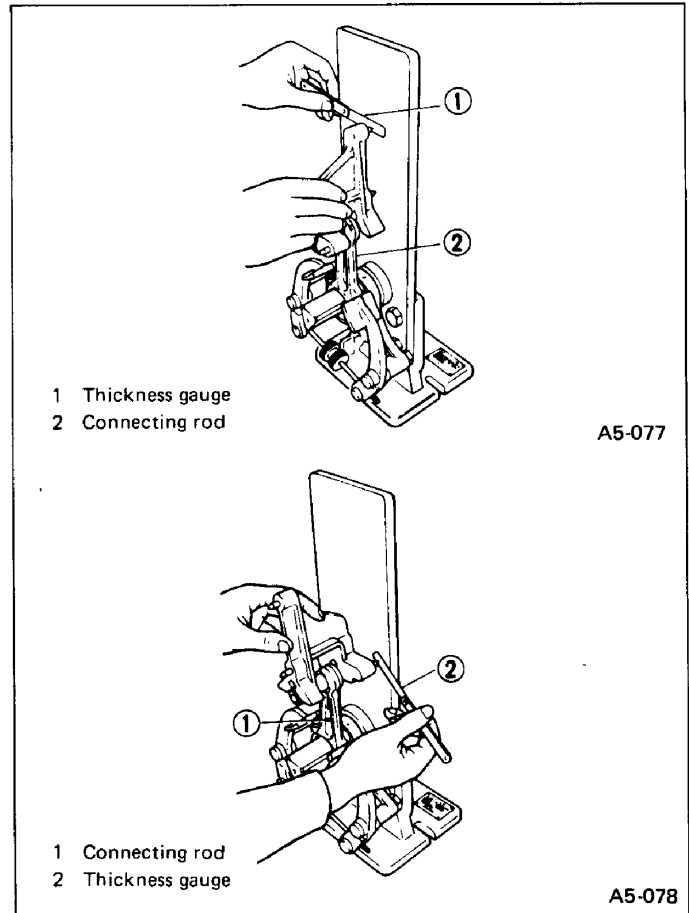


Fig. 99

3) Install connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). Replace connecting rod if the side clearance exceeds the specified limit.

#### Connecting rod side clearance:

##### Standard

0.070 – 0.330 mm (0.0028 – 0.0130 in)

##### Limit

0.4 mm (0.016 in)

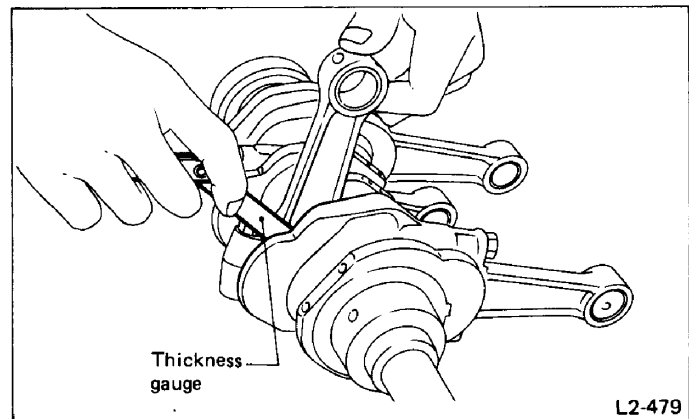


Fig. 100

4) Inspect connecting rod bearing for scar, peeling, seizure, melting, wear, etc.

5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge according to the following procedure.

- (1) Wipe off oil, dust, etc. on the surfaces to be measured.
- (2) Cut the plastigauge to the width of the bearing, place it on the crankpin parallel with the crankshaft axis, and install connecting rod. Tighten connecting rod nuts to 41 N·m (4.2 kg-m, 30 ft-lb).

**During this measurement, do not allow relative movement between the crankpin and connecting rod.**

- (3) Remove connecting rod and measure the width of the plastigauge with the scale printed on the plastigauge case. If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary, and replace or recondition the crankshaft as necessary. (See the table below.)

**Connecting rod oil clearance:**

**Standard**

0.010 – 0.054 mm (0.0004 – 0.0021 in)

**Limit**

0.10 mm (0.0039 in)

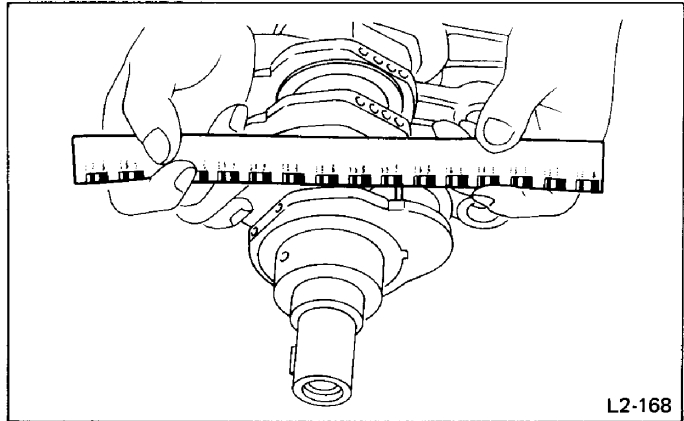


Fig. 101

- 6) Inspect bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

**Standard clearance between piston pin and bushing in connecting rod:**

0 – 0.022 mm (0 – 0.0009 in)

Replacement procedure is as follows.

- (1) Remove bushing from connecting rod with REMOVER & REPLACER (499037000) and press.
- (2) Press bushing with REMOVER & REPLACER (499037000) after applying oil on the periphery of bushing.
- (3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.

**Bushing bore:**

21.000 – 21.016 mm (0.8268 – 0.8274 in)

- (4) After completion of reaming, clean bushing to remove chips.

Connecting rod bearing	
Bearing size	Thickness at center of bearing
Standard	1.485 – 1.490 mm (0.0585 – 0.0587 in)
0.03 mm (0.0012 in) undersize	1.500 – 1.505 mm (0.0591 – 0.0593 in)
0.05 mm (0.0020 in) undersize	1.510 – 1.515 mm (0.0594 – 0.0596 in)
0.25 mm (0.0098 in) undersize	1.610 – 1.615 mm (0.0634 – 0.0636 in)

**CRANKSHAFT AND CRANKSHAFT BEARING**

- 1) Clean crankshaft completely and check for cracks by means of red check etc., and replace if defective.
- 2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

**When measuring, place both the front and rear journals on blocks located on a surface plate, and apply a dial gauge to the center journal.**

**Crankshaft bend limit:**

0.035 mm (0.0014 in)

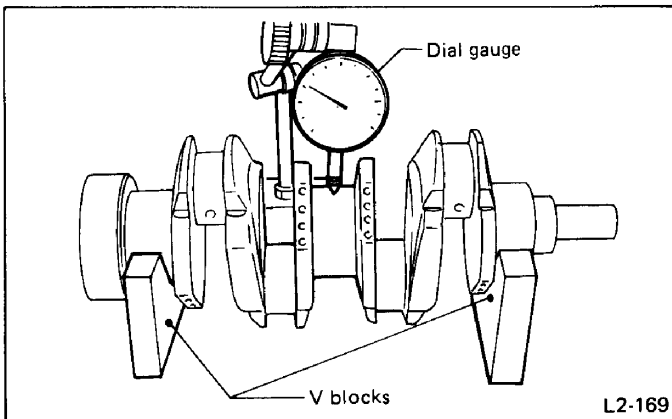


Fig. 102

3) Inspect the crank journal and crankpin for wear. If not to specifications, replace bearing with an undersize one, and replace or recondition crankshaft as necessary. When grinding crank journal or crankpin, finish them to the specified dimensions according to the undersize bearing to be used.

#### Crankpin and crank journal:

##### Out-of-roundness

0.03 mm (0.0012 in) or less

##### Taper limit

0.07 mm (0.0028 in)

##### Grinding limit

0.25 mm (0.0098 in)

	Crankpin O.D.	Crank journal O.D.		
		Front	Center	Rear
Standard	44.995 – 45.010 mm (1.7715 – 1.7720 in)	54.957 – 54.972 mm (2.1637 – 2.1642 in)	54.954 – 54.970 mm (2.1635 – 2.1642 in)	54.955 – 54.970 mm (2.1636 – 2.1642 in)
0.03 mm (0.0012 in) undersize	44.965 – 44.980 mm (1.7703 – 1.7709 in)	54.927 – 54.942 mm (2.1625 – 2.1631 in)	54.924 – 54.940 mm (2.1624 – 2.1630 in)	54.925 – 54.940 mm (2.1624 – 2.1630 in)
0.05 mm (0.0020 in) undersize	44.945 – 44.960 mm (1.7695 – 1.7701 in)	54.907 – 54.922 mm (2.1617 – 2.1623 in)	54.904 – 54.920 mm (2.1616 – 2.1622 in)	54.905 – 54.920 mm (2.1616 – 2.1622 in)
0.25 mm (0.0098 in) undersize	44.745 – 44.760 mm (1.7616 – 1.7622 in)	54.707 – 54.722 mm (2.1538 – 2.1544 in)	54.704 – 54.720 mm (2.1537 – 2.1543 in)	54.705 – 54.720 mm (2.1537 – 2.1543 in)

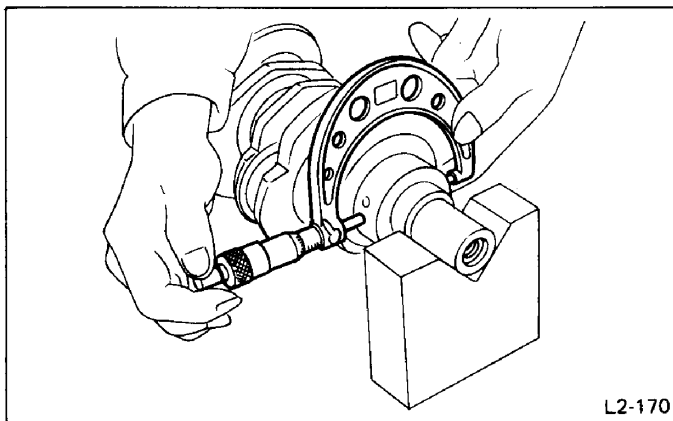


Fig. 103

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace bearing.

#### Crankshaft thrust clearance

##### Standard

0.010 – 0.095 mm (0.0004 – 0.0037 in)

##### Limit

0.3 mm (0.0118 in)

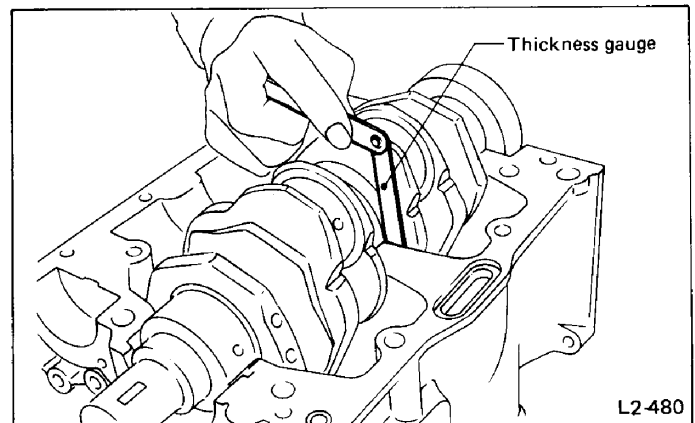


Fig. 104

5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.

6) Measure the oil clearance on each crankshaft bearing by means of plastigauge as follows:

- (1) Wipe off oil, dust, etc. on the surfaces to be measured.
- (2) Install bearings in crankcase and set crankshaft in position.

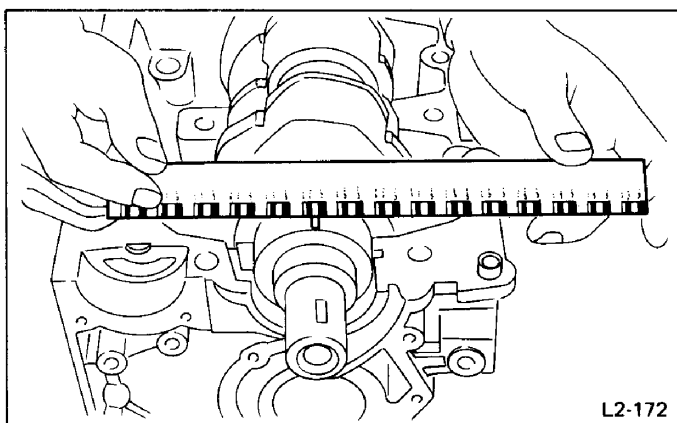
(3) Cut the plastigauge to the bearing width and place it on journal parallel with the crankshaft axis. Be careful not to put it on the oil hole or groove. Bring together the crankcase halves and tighten bolts to the specified torque.

**During the work, the crankshaft must not be turned nor the crankcase inverted.**

**Torque:**

**39 – 47 N·m (4.0 – 4.8 kg-m, 29 – 35 ft-lb)**

(4) Remove all bolts and separate crankcase. Measure the plastigauge width with the scale printed on the plastigauge case.



L2-172

Fig. 105

(5) If the measurement is not within the specification, replace defective bearing with an undersize one, and replace or recondition crankshaft as necessary.

Crankshaft oil clearance		
Standard	Center	0.008 – 0.027 mm (0.0003 – 0.0011 in)
	Front & Rear	0.003 – 0.036 mm (0.0001 – 0.0014 in)
Limit	Center	0.045 mm (0.0018 in)
	Front & Rear	0.055 mm (0.0022 in)

Dimensions of bearing		
Crankshaft bearing size	Thickness of bearing at center	
	Front & Rear	Center
Standard	2.015 – 2.019 mm (0.0793 – 0.0795 in)	2.019 – 2.022 mm (0.0795 – 0.0796 in)
0.03 mm (0.0012 in) undersize	2.030 – 2.034 mm (0.0799 – 0.0801 in)	2.034 – 2.037 mm (0.0801 – 0.0802 in)
0.05 mm (0.0020 in) undersize	2.040 – 2.044 mm (0.0803 – 0.0805 in)	2.044 – 2.047 mm (0.0805 – 0.0806 in)
0.25 mm (0.0098 in) undersize	2.140 – 2.144 mm (0.0843 – 0.0844 in)	2.144 – 2.147 mm (0.0844 – 0.0845 in)

## ASSEMBLY

### CRANKSHAFT


1) Install connecting rod bearings on connecting rods and connecting rod caps.

**Apply oil to the surfaces of the connecting rod bearings.**

2) Install connecting rods and connecting rod caps on crankshaft with connecting rod bolts and nuts.

**Torque (Connecting rod nut):**

**39 – 42 N·m (4.0 – 4.3 kg-m, 29 – 31 ft-lb)  
with oil on threads**

- Position each connecting rod with the side marked  facing forward.
- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.
- When tightening the connecting rod nuts, apply oil on the threads.

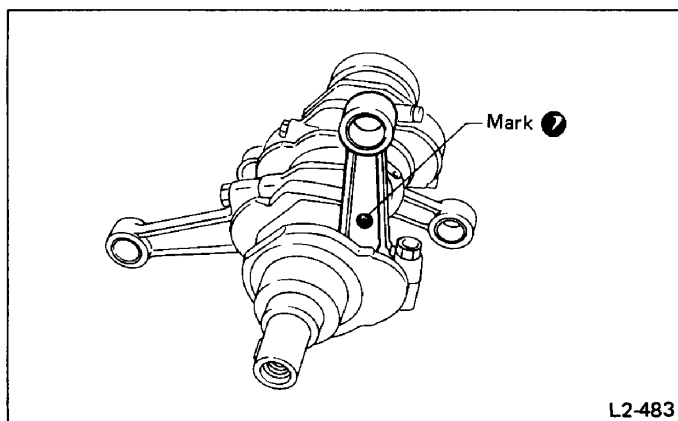


Fig. 106

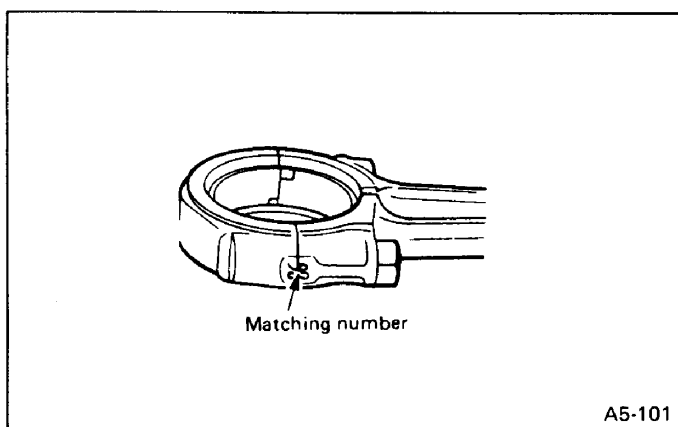


Fig. 107

## PISTON

1) Install piston rings on pistons as follows.  
Install oil ring spacer, upper rail and lower rail in this order by hand. Then install second ring and top ring with a piston ring expander.

2) Position the gaps of the piston rings and oil ring as shown in the figure.

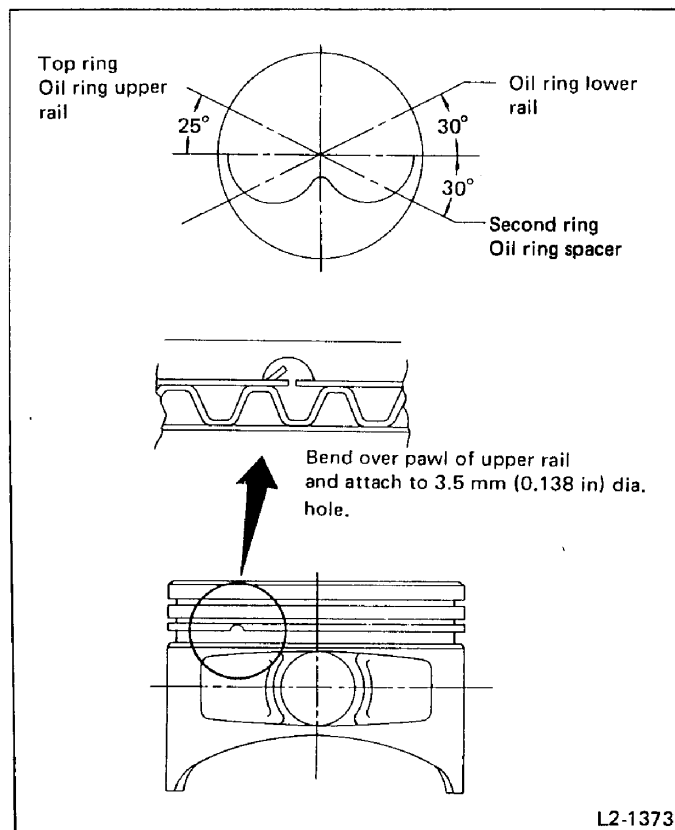


Fig. 108

3) Install circlip to piston.

The circlip must be fitted to the end that faces inside of crankcase when piston is inserted.

**Circlip must be installed in correct direction with its end facing out.**

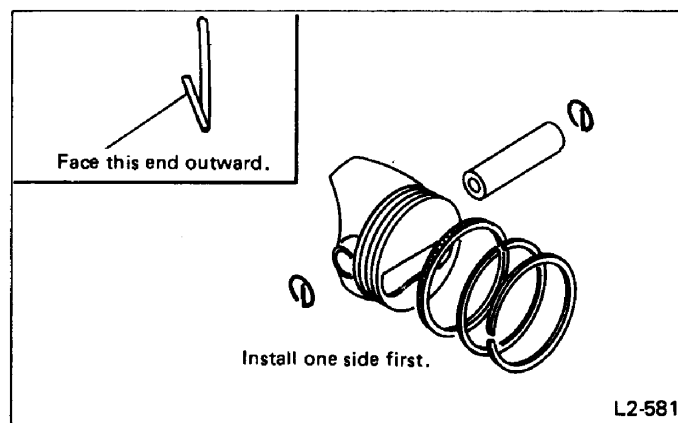


Fig. 109

## TROUBLESHOOTING

## Engine Trouble in General

Symbols shown in the chart refer to the possibility of reason for the trouble in order ("Very often" to "Rarely")

- ◎ – Very often  
 ○ – Sometimes  
 △ – Rarely

													No.	TROUBLE	
<div>Symbols shown in the chart refer to the possibility of reason for the trouble in order ("Very often" to "Rarely")</div> <div>◎ – Very often</div> <div>○ – Sometimes</div> <div>△ – Rarely</div>													1	Engine will not start.	Starter does not turn.
													2		Initial combustion does not occur.
													3		Initial combustion occurs.
													4		Engine stalls after initial combustion.
													5	Rough idle and engine stall.	
													6	Low output, hesitation and poor acceleration.	
													7	Surging.	
													8	Engine does not return to idle.	
													9	Dieseling (Run-on).	
													10	Afterburning in exhaust system.	
													11	Knocking.	
													12	Excessive engine oil consumption.	
													13	Excessive fuel consumption.	
TROUBLE No.													POSSIBLE CAUSE		
1	2	3	4	5	6	7	8	9	10	11	12	13			
○ △ △ ○	△													STARTER <ul style="list-style-type: none"><li>● Defective battery-to-starter harness.</li><li>● Defective starter switch.</li><li>● Defective inhibitor switch.</li><li>● Defective starter.</li></ul>	
◎ ◎ ○														BATTERY <ul style="list-style-type: none"><li>● Poor terminal connection.</li><li>● Run-down battery.</li><li>● Defective charging system.</li></ul>	
	◎	◎	◎	◎	◎	◎	◎	◎	◎	◎		◎		MPFI SYSTEM (See Chap. 2-7.)	
	○ ○ ○ ○ ○ ○ ○	○ ◎    ○ ○	○     ○ ○	◎ ○ △ △ △ △ ◎	◎ ○ ◎ △ △ ○ ○	◎ ○ ◎ ○ △ ○ ◎	◎ ○     △	◎       	◎       	◎ △ ◎    ○	◎       	◎ △     		IGNITION SYSTEM <ul style="list-style-type: none"><li>● Incorrect ignition timing.</li><li>● Disconnection of spark plug cord.</li><li>● Defective distributor.</li><li>● Defective ignition coil.</li><li>● Defective cord or wiring.</li><li>● Leakage of spark plug cord.</li><li>● Defective spark plug.</li><li>● Incorrect cam timing.</li></ul>	
1	2	3	4	5	6	7	8	9	10	11	12	13			



TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
		○	○	◎	○	○	◎	○	○	△	◎	◎	<b>INTAKE SYSTEM</b> <ul style="list-style-type: none"> <li>● Improper idle adjustment.</li> <li>● Loosened or cracked intake boot.</li> <li>● Loosened or cracked intake duct.</li> <li>● Loosened or cracked blow-by hose.</li> <li>● Loosened or cracked vacuum hose.</li> <li>● Defective intake manifold gasket.</li> <li>● Defective throttle body gasket.</li> <li>● Defective PCV valve.</li> <li>● Loosened oil filler cap.</li> <li>● Dirty air cleaner element.</li> </ul>
			○	◎	◎	◎			△	◎			
			○	◎	◎	◎			△	◎			
			△	◎	◎	◎			△	◎	◎		
			△	◎	○	◎	◎		○	◎			
		○	○	○	○	○				◎			
		○	○	○	○	○				◎			
				△	○	○			○	○	○		
				○	○	○			△	○	△		
			△	△	◎	○				○		◎	
	◎	△		△	○	○							<b>FUEL LINE</b> <ul style="list-style-type: none"> <li>● Defective fuel pump.</li> <li>● Clogged fuel line.</li> <li>● Lack of or insufficient fuel.</li> </ul>
		△	△	△	○	○							
	○	○	○	○	△	△							
	○	○	○										<b>BELT</b> <ul style="list-style-type: none"> <li>● Defective.</li> <li>● Defective timing.</li> </ul>
	○	○	○	△	○	○			○	○		○	
△													<b>FRICTION</b> <ul style="list-style-type: none"> <li>● Seizure of crankshaft and connecting-rod bearing.</li> <li>● Seized camshaft.</li> <li>● Seized or stuck piston and cylinder.</li> </ul>
△													
△													
	△	△	△	○	○	○			○	△		○	<b>COMPRESSION</b> <ul style="list-style-type: none"> <li>● Incorrect valve clearance.</li> <li>● Loosened spark plugs or defective gasket.</li> <li>● Loosened cylinder head nuts or defective gasket.</li> <li>● Improper valve seating.</li> <li>● Defective valve stem.</li> <li>● Worn or broken valve spring.</li> <li>● Worn or stuck piston rings, cylinder and piston.</li> <li>● Incorrect valve timing.</li> <li>● Improper engine oil (low viscosity).</li> </ul>
	△	△	△	○	○	△			△			△	
	△	△	△	○	○	△			△			△	
	△	△	△	○	○	△			○			○	
	△	△	△	△	△	△			△		◎	△	
	○	○	○	○	○	△			△		◎	△	
	△	△	△	○	△	△			△		◎	○	
	○	○	○	◎	◎	◎			◎	○		○	
	○	○	○	○	○	○							
				○	○				△			△	<b>LUBRICATION SYSTEM</b> <ul style="list-style-type: none"> <li>● Incorrect oil pressure.</li> <li>● Loosened oil pump attaching bolts and defective gasket.</li> <li>● Defective oil filter seal.</li> <li>● Defective crankshaft oil seal.</li> <li>● Defective rocker cover gasket.</li> <li>● Loosened oil drain plug or defective gasket.</li> <li>● Loosened oil pan fitting bolts or defective oil pan.</li> </ul>
				△							○		
											○		
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1	2	3	4	5	6	7	8	9	10	11	12	13	

TROUBLE No.													POSSIBLE CAUSE
1	2	3	4	5	6	7	8	9	10	11	12	13	
				△	△ △	○		○	△	⊙		△	COOLING SYSTEM ● Overheating. ● Over cooling.
				⊙	⊙	△			△				OTHERS ● Malfunction of Evaporative Emission Control System. (See Chap. 2-1) ● Stuck or damaged throttle valve. ● Dashpot out of adjustment. ● Accelerator cable out of adjustment. ● FICD out of adjustment. ● Malfunction of FICD.
				○			⊙					○	
				△			○					○	
				△			○	○				○	
				○			○	○				○	
				○			○						
1	2	3	4	5	6	7	8	9	10	11	12	13	

## Engine Noise

In case of 1800 cc OHC engine, valve lash adjuster may make clicking noise once engine starts. It is normal if clicking noise ceases after a few seconds.

If clicking noise continues after several seconds, check engine oil level and add oil if necessary. Then allow engine to idle for 10 to 20 minutes while maintaining engine speed at 1,500 to 2,000 rpm.

Type of sound	Condition	Possible cause
Regular clicking sound.	Sound increases as engine speed increases.	Valve mechanism is defective <ul style="list-style-type: none"> <li>● Broken lash adjuster.</li> <li>● Worn valve rocker.</li> <li>● Worn camshaft.</li> <li>● Broken valve spring.</li> <li>● Worn valve lifter hole.</li> </ul>
Heavy and dull metallic knock.	Oil pressure is low.	<ul style="list-style-type: none"> <li>● Worn crankshaft main bearing.</li> <li>● Worn connecting rod bearing (big end).</li> </ul>
	Oil pressure is normal.	<ul style="list-style-type: none"> <li>● Loose flywheel mounting bolts.</li> <li>● Damaged engine mounting.</li> </ul>
High-pitched metallic knock. (Engine knocking)	Sound is noticeable when accelerating with an overload.	<ul style="list-style-type: none"> <li>● Ignition timing advanced.</li> <li>● Accumulation of carbon inside combustion chamber.</li> <li>● Wrong spark plug.</li> <li>● Improper gasoline.</li> </ul>
Metallic knock when engine speed is medium (1,000 to 2,000 rpm).	Sound is reduced when spark plug in noisy cylinder is shortened out.	<ul style="list-style-type: none"> <li>● Worn crankshaft main bearing.</li> <li>● Worn bearing at crankshaft end of connecting rod.</li> </ul>
Knocking sound when engine is operating under idling speed and engine is warm.	Sound is reduced when spark plug in noisy cylinder is shortened out.	<ul style="list-style-type: none"> <li>● Worn cylinder liner and piston ring.</li> <li>● Broken or stuck piston ring.</li> <li>● Worn piston pin and hole at piston end of connecting rod.</li> </ul>
	Sound is not reduced if each spark plug is shortened out in turn.	<ul style="list-style-type: none"> <li>● Unusually worn valve lifter.</li> <li>● Worn cam gear.</li> <li>● Worn camshaft journal bore in crankcase.</li> </ul>
Squeaky sound.		<ul style="list-style-type: none"> <li>● Insufficient alternator lubrication.</li> </ul>
Rubbing sound.		<ul style="list-style-type: none"> <li>● Defective alternator brush and rotor contact.</li> </ul>

Type of sound	Condition	Possible cause
Gear scream when starting engine.		<ul style="list-style-type: none"><li>● Defective ignition starter switch.</li><li>● Worn ring gear and starter pinion.</li></ul>
Sound like polishing glass with a dry cloth.		<ul style="list-style-type: none"><li>● Loose drive belt.</li><li>● Defective water pump shaft.</li></ul>
Hissing sound.		<ul style="list-style-type: none"><li>● Loss of compression.</li><li>● Air leakage in air intake system, hoses, connections or manifolds.</li></ul>
Timing belt noise.		<ul style="list-style-type: none"><li>● Loose timing belt.</li><li>● Belt contacting case/adjacent part.</li></ul>
Distributor gear noise.		<ul style="list-style-type: none"><li>● Worn gear.</li></ul>