

## SAFETY INFORMATION

### LUBRICANTS

Avoid prolonged and repeated contact with petroleum-based oils. Used oil may irritate the skin, and can cause skin cancer and other skin disorders.

Wash thoroughly after working with oil. We recommend water soluble hand cleaners. Do not use kerosene, gasoline, or any other solvent, to remove oil from your skin.

If repeated or prolonged contact with oil is necessary, wear protective clothing. Soiled clothing, particularly those soiled with used oils and greases containing lead, should be cleaned at regular intervals.

## HOW TO USE THIS MANUAL

### ADVISORY MESSAGES

You'll find several **Warnings**, **Cautions**, and **Notes** in this manual.

#### Warning

- A **Warning** indicates a situation in which serious injury or death could result if the warning is ignored.

#### Caution

- A **Caution** indicates a situation in which damage to the vehicle could result if the caution is ignored.

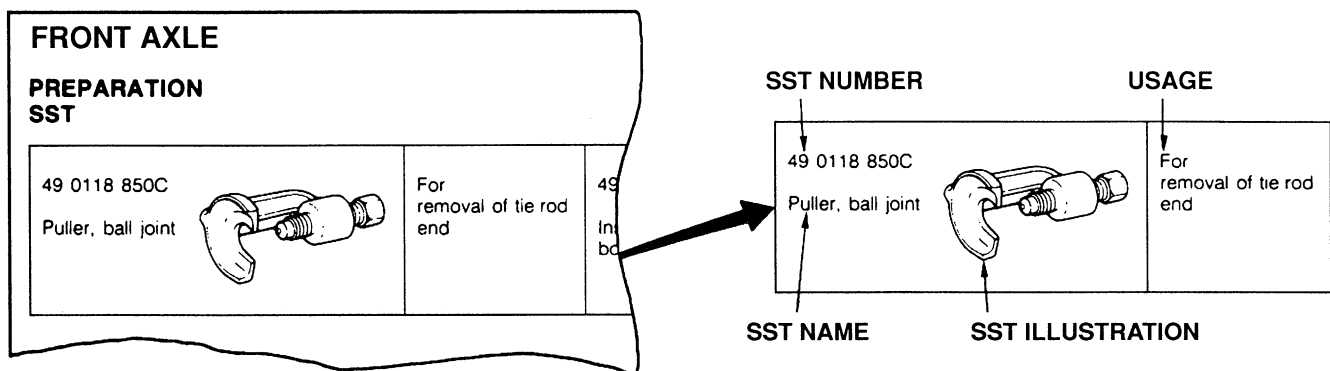
#### Note

- A **Note** provides added information that will help you to complete a particular procedure.

### PREPARATION

This points out the needed **SSTs** for the service operation. It is best to gather all necessary **SSTs** before beginning work.

#### Example:



### REPAIR PROCEDURE

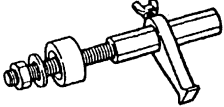
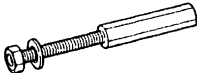


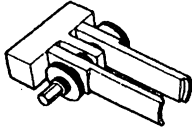
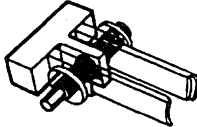
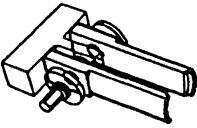
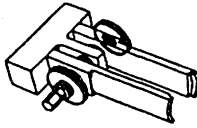
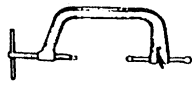
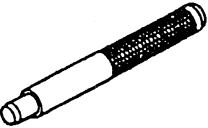
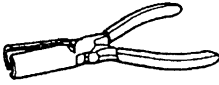
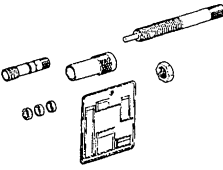

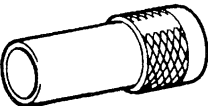

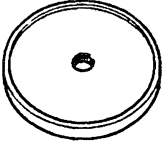
1. Most repair operations begin with an overview illustration. It identifies the components, shows how the parts fit together, and describes visual part inspection. If a damaged or worn part is found, repair or replace it as necessary.
2. Expendable parts, tightening torques, and symbols for oil, grease, and sealant are shown in the overview illustration.
3. Pages related to service procedures are shown under the illustration. Refer to this information when servicing the related part.

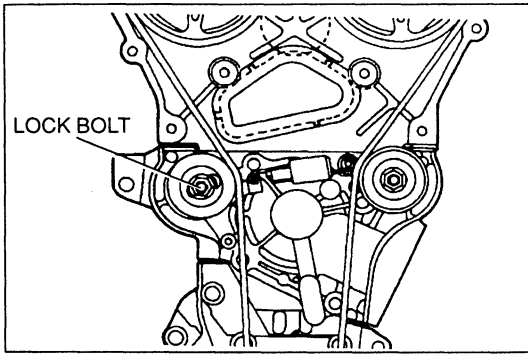
Previous Standard		SAE Standard		
Abbreviation	Name	Abbreviation	Name	Remark
—	IC Regulator	VR	Voltage Regulator	
—	Idle Speed Control	IAC	Idle Air Control	
—	Idle Switch	—	Closed Throttle Position Switch	
—	Igniter	ICM	Ignition Control Module	
—	Inhibitor Position	TR	Transmission (Transaxle) Range	
—	Intake Air Pressure	MAP	Manifold Absolute Pressure	
—	Intake Air Thermo	IAT	Intake Air Temperature	
—	Intercooler	CAC	Charge Air Cooler	
—	Knock Sensor	KS	Knock Sensor	
—	Line Pressure Solenoid Valve	—	Pressure Control Solenoid	
—	Lock-up Position	TCC	Torque Converter Clutch	
—	Malfunction Indicator Light	MIL	Malfunction Indicator Lamp	
—	Multiport Fuel Injection	MFI	Multiport Fuel Injection	
—	Open Loop	OL	Open Loop	
—	Overdrive	4GR	Fourth Gear	
—	Oxygen Sensor	HO2S	Heated Oxygen Sensor	With heater
		O2S	Oxygen Sensor	
—	Park/Neutral Range	PNP	Park/Neutral Position	
—	Power Steering Pressure	PSP	Power Steering Pressure	
—	Pulse Generator	—	Input/Turbine Speed Sensor	
—	Reed Valve	SAPV	Secondary Air Pulse Valve	
—	Secondary Air Injection System	PAIR	Pulsed Secondary Air Injection	Pulsed injection
		AIR	Secondary Air Injection	Inject with compressor
—	Sequential Fuel Injection	SFI	Sequential Multipoint Fuel Injection	
—	Service Code(s)	DTC	Diagnostic Trouble Code(s)	
—	Spark Ignition	DI	Distributor Ignition	
—	Stoplight Switch	—	Brake Switch	
—	Test Mode	DTM	Diagnostic Test Mode	#5
—	Throttle Body	TB	Throttle Body	
—	Throttle Sensor	TP	Throttle Position Sensor	
—	Turbocharger	TC	Turbocharger	
—	Vehicle Speed Sensor	VSS	Vehicle Speed Sensor	
—	Vehicle Speed Sensor 1	—	Output Speed Sensor	
—	Water Thermo	ECT	Engine Coolant Temperature	
—	1-2 Shift Solenoid Valve	—	Shift Solenoid A	
—	2-3 Shift Solenoid Valve	—	Shift Solenoid B	
—	3-4 Shift Solenoid Valve	—	Shift Solenoid C	
—	3rd Gear	3GR	Third Gear	
—	—	—	Incorrect Gear Ratio	

#5: Diagnostic trouble codes depend on the diagnostic test mode

### DISASSEMBLY / ASSEMBLY

#### PREPARATION SST

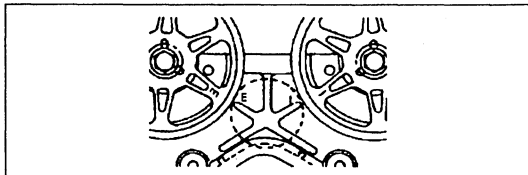
<p>49 E011 1A0</p> <p>Brake set, ring gear</p> 	<p>For prevention of crankshaft rotation</p>	<p>49 E011 103</p> <p>Shaft (Part of 49 E011 1A0)</p> 	<p>For prevention of crankshaft rotation</p>
<p>49 E011 104</p> <p>Collar (Part of 49 E011 1A0)</p> 	<p>For prevention of crankshaft rotation</p>	<p>49 E011 105</p> <p>Stopper (Part of 49 E011 1A0)</p> 	<p>For prevention of crankshaft rotation</p>
<p>49 B012 0A2</p> <p>Pivot</p> 	<p>For removal / installation of valves</p>	<p>49 B012 012</p> <p>Body (Part of 49 B012 0A2)</p> 	<p>For removal / installation of valves</p>
<p>49 B012 013</p> <p>Foot (Part of 49 B012 0A2)</p> 	<p>For removal / installation of valves</p>	<p>49 B012 014</p> <p>Locknut (Part of 49 B012 0A2)</p> 	<p>For removal / installation of valves</p>
<p>49 0636 100B</p> <p>Lifter arm, valve spring</p> 	<p>For removal / installation of valves</p>	<p>49 0221 061A</p> <p>Installer, piston pin</p> 	<p>For installation of piston pins</p>
<p>49 S120 170</p> <p>Remover, valve seal</p> 	<p>For removal of valve seals</p>	<p>49 L012 0A0</p> <p>Installer set, valve seal &amp; valve guide</p> 	<p>For installation of valve seals</p>
<p>49 L012 001</p> <p>Installer (Part of 49 L012 0A0)</p> 	<p>For installation of valve seals</p>	<p>49 L012 002</p> <p>Body (Part of 49 L012 0A0)</p> 	<p>For installation of valve seals</p>
<p>49 L012 005</p> <p>Spacer (Part of 49 L012 0A0)</p> 	<p>For installation of valve seals</p>	<p>49 W033 105</p> <p>Installer, oil seal</p> 	<p>For installation of rear oil seal</p>



2. Loosen the tensioner lock bolt to apply tension to the timing belt. Do not apply tension other than that of the tensioner spring.
3. Tighten the tensioner lock bolt.

**Tightening torque:**

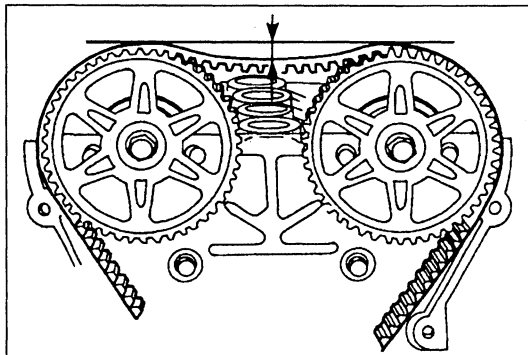
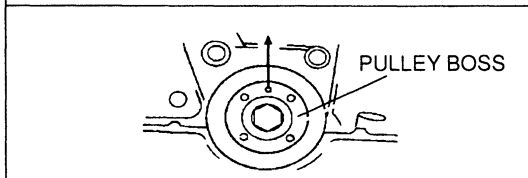
**38—51 N·m { 3.8—5.3 kgf·m , 28—38 ft·lbf }**



4. Turn the crankshaft clockwise 2 and 1/6 times, and verify that all timing marks are correctly aligned.

**Note**

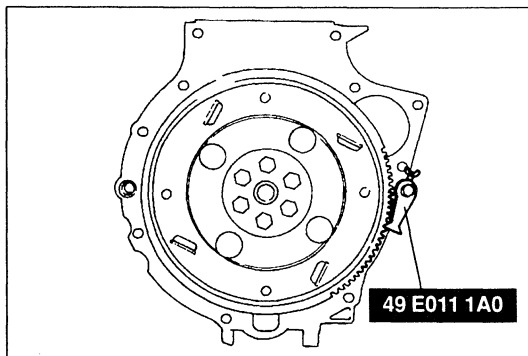
- For the crankshaft side, face the locating pin on the pulley boss straight up.



5. Check the belt deflection at the point indicated by applying moderate pressure **98 N { 10 kgf , 22 lbf }**.

**Deflection: 9.0—11.5 mm { 0.36—0.45 in }**

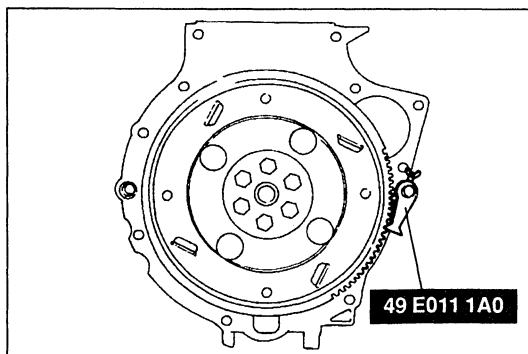
6. If the timing belt deflection is not correct, remove the timing belt and repeat from timing belt assembly note step 1.



7. Hold the drive plate (ATX) or flywheel (MTX) by using the **SST**.
8. Tighten the pulley lock bolt.

**Tightening torque: 157—166 N·m**

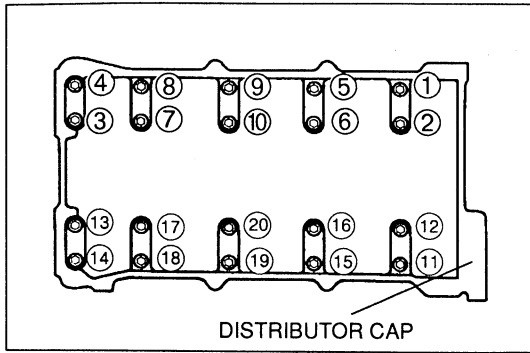
**{ 16.0—17.0 kgf·m , 116—122 ft·lbf }**

**Crankshaft pulley and plate**

1. Hold the drive plate (ATX) or flywheel (MTX) by using the **SST**.
2. Install the crankshaft pulley and plate.

**Tightening torque: 12.3—17.1 N·m**

**{ 1.25—1.75 kgf·m , 9.05—12.6 ft·lbf }**



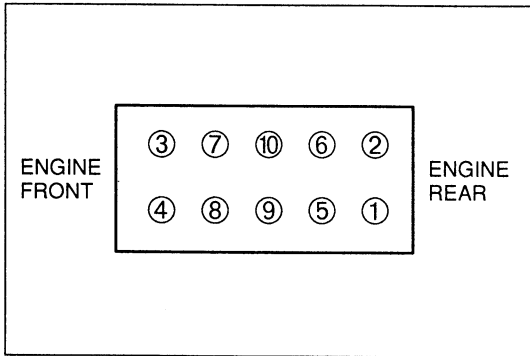
### Camshaft cap

1. Loosen the camshaft cap bolts in five or six steps in the order shown.
2. Remove the camshaft cap bolts and camshaft caps.

### Camshaft

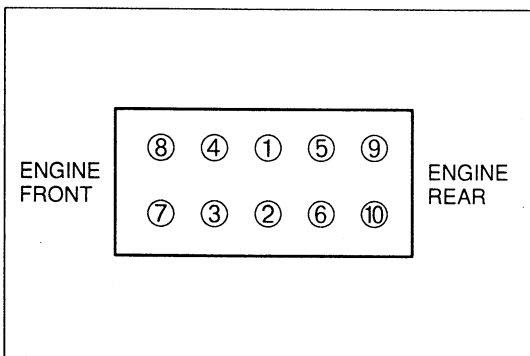
Before removing the camshaft, inspect the following.

- (1) Camshaft end play (Refer to page B-30.)
- (2) Camshaft journal oil clearance (Refer to page B-30.)



### Cylinder head

1. Loosen the cylinder head bolts in two or three steps in the order shown.
2. Remove the cylinder head.



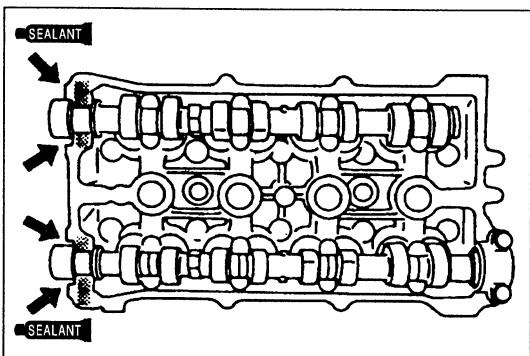
### Assembly Note

#### Cylinder head

Install the bolts and tighten them in two or three steps in the order shown.

#### Tightening torque:

76—81 N·m { 7.7—8.3 kgf·m , 56—60 ft·lbf }

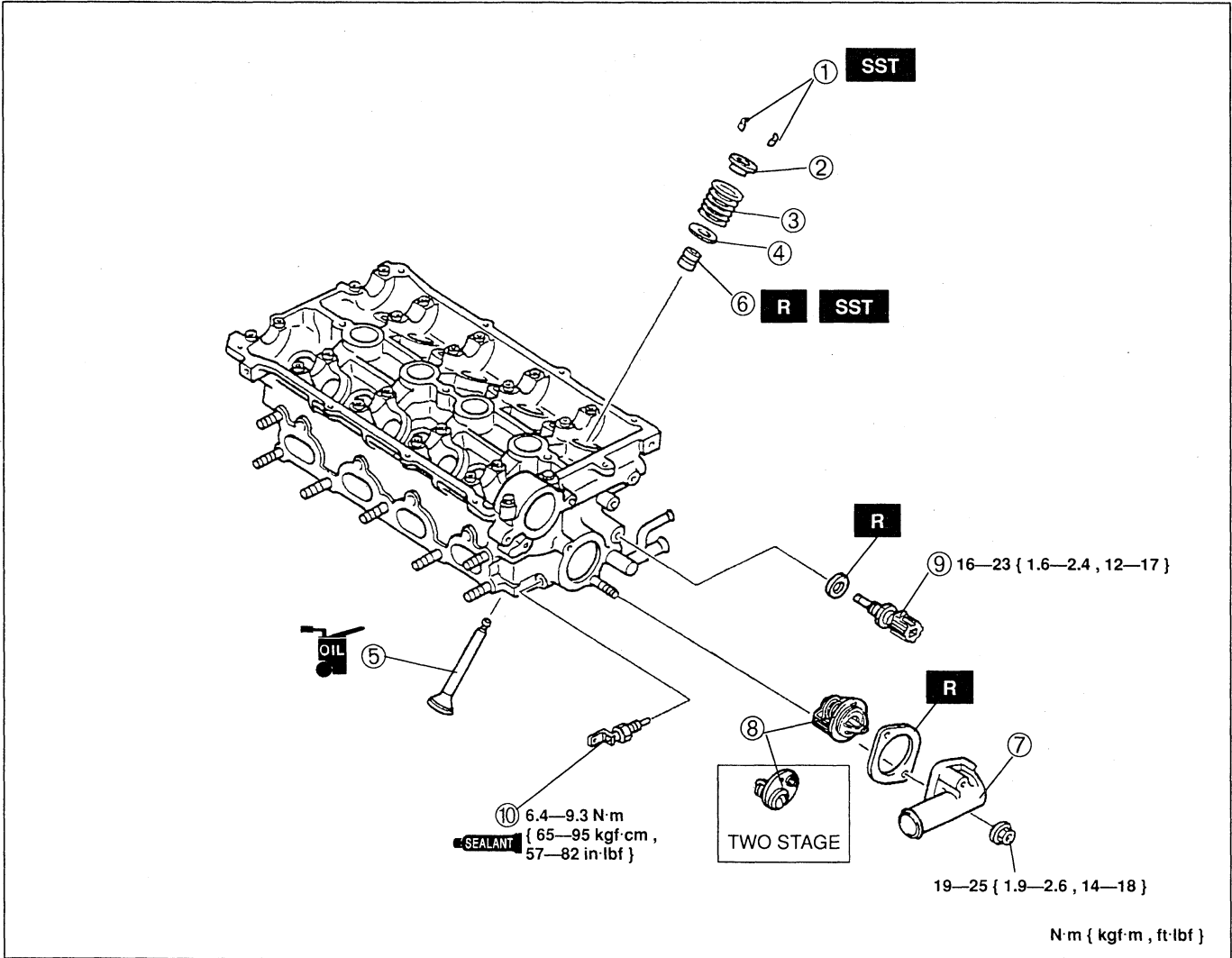


### Camshaft cap

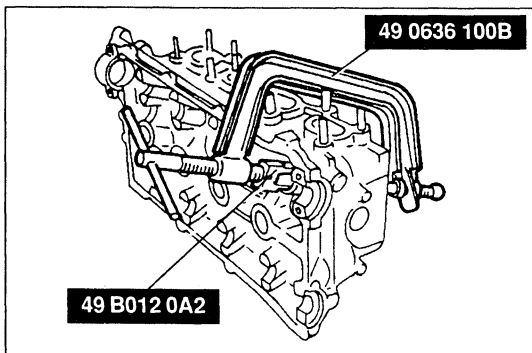
1. Apply silicone sealant to the shaded areas shown in the figure.

**CYLINDER HEAD (II)**

1. Disassemble in the order shown in the figure, referring to **Disassembly Note**.
2. Assemble in the reverse order of disassembly, referring to **Assembly Note**.



- |                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Valve keeper<br/>Disassembly Note ..... below<br/>Assembly Note ..... page B-16</li> <li>2. Valve spring seat, upper</li> <li>3. Valve spring<br/>Assembly Note ..... page B-16</li> <li>4. Valve spring seat, lower</li> <li>5. Valve</li> </ol> | <ol style="list-style-type: none"> <li>6. Valve seal<br/>Disassembly Note ..... page B-15<br/>Assembly Note ..... page B-15</li> <li>7. Thermostat cover</li> <li>8. Thermostat<br/>Assembly Note ..... page B-15</li> <li>9. Engine coolant temperature sensor</li> <li>10. Water temperature sender unit<br/>Assembly Note ..... page B-15</li> </ol> |
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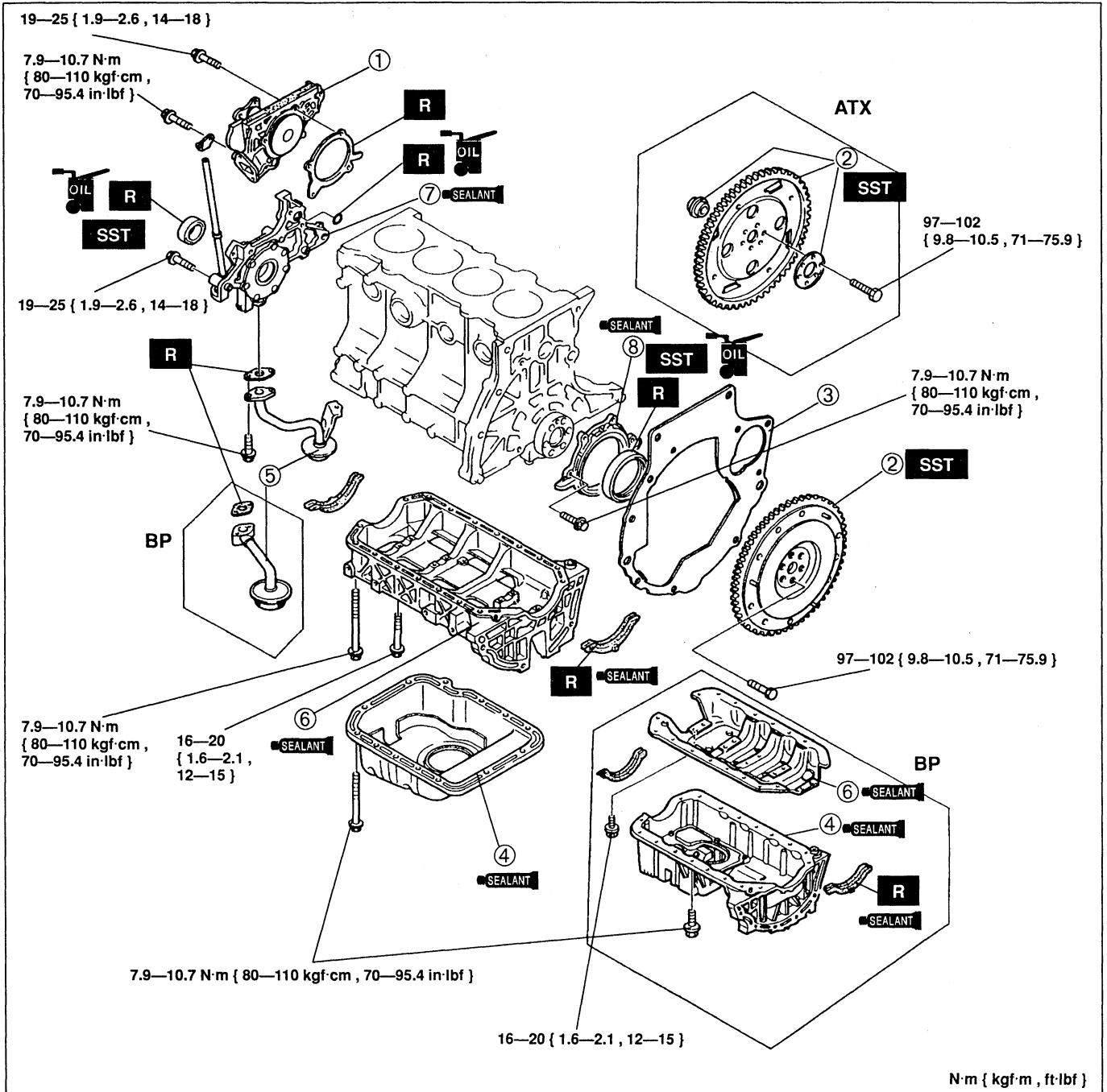


**Disassembly Note**  
**Valve keeper**

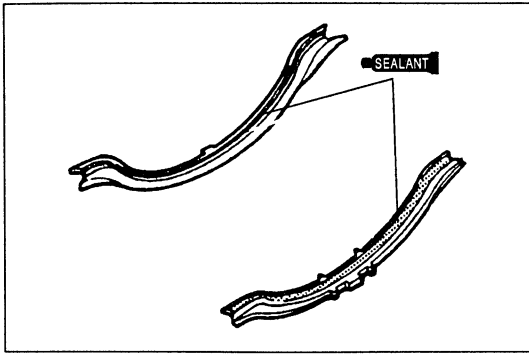
1. Set the **SST** against the upper valve spring seat as shown.
2. Remove the valve keepers.

**CYLINDER BLOCK (EXTERNAL PARTS)**

1. Disassemble in the order shown in the figure, referring to **Disassembly Note**.
2. Assemble in the reverse order of disassembly, referring to **Assembly Note**.

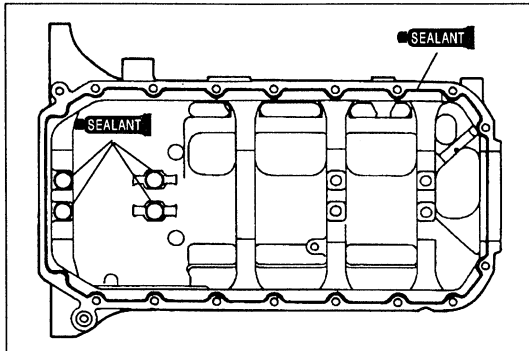


- |                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Water pump<br/>Assembly Note ..... page B-21</li> <li>2. Backing plate, drive plate, adapter (ATX),<br/>flywheel (MTX)<br/>Disassembly Note ..... page B-18<br/>Assembly Note ..... page B-21</li> <li>3. End plate</li> <li>4. Oil pan<br/>Disassembly Note ..... page B-18<br/>Assembly Note ..... page B-21</li> <li>5. Oil strainer</li> </ol> | <ol style="list-style-type: none"> <li>6. VRAS (B6)<br/>MBSP (BP)<br/>Disassembly Note ..... page B-18<br/>Assembly Note ..... page B-20</li> <li>7. Oil pump<br/>Disassembly Note ..... page B-18<br/>Assembly Note ..... page B-19<br/>Disassembly / Inspection /<br/>Assembly ..... section D</li> <li>8. Rear cover<br/>Disassembly Note ..... page B-19<br/>Assembly Note ..... page B-19</li> </ol> |
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### VRAS (B6)

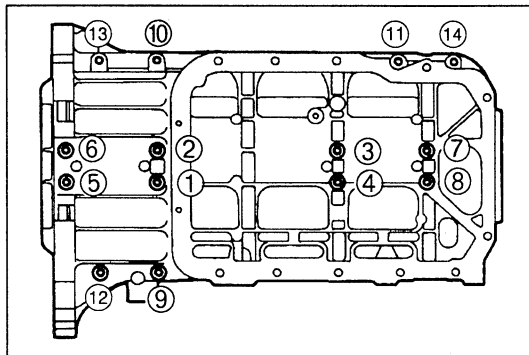
1. Apply silicone sealant to the oil pump and rear cover mounting surfaces of the new oil pan gaskets, and install them.



2. Apply silicone sealant to the VRAS as shown.

**Thickness:  $\phi$  2—3 mm { 0.079—0.118 in }**

3. Install the VRAS.



4. Tighten the bolts in the order shown.

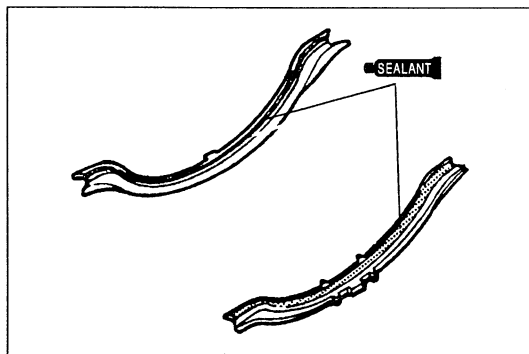
### Tightening torque

①—⑧:

**16—20 N·m { 1.6—2.1 kgf·m , 12—15 ft·lbf }**

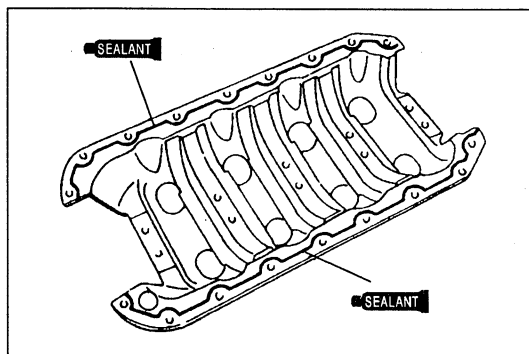
⑨—⑭:

**7.9—10.7 N·m { 80—110 kgf·cm , 70—95.4 in·lbf }**



### MBSP (BP)

1. Apply silicone sealant to the oil pump and rear cover mounting surfaces of the new oil pan gaskets, and install them.



2. Apply silicone sealant to the MBSP as shown.

**Thickness:  $\phi$  2.5—3.5 mm { 0.099—0.137 in }**

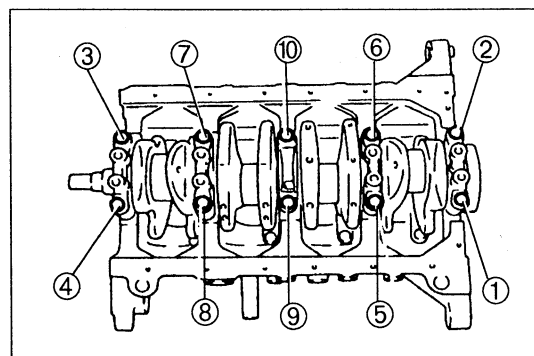
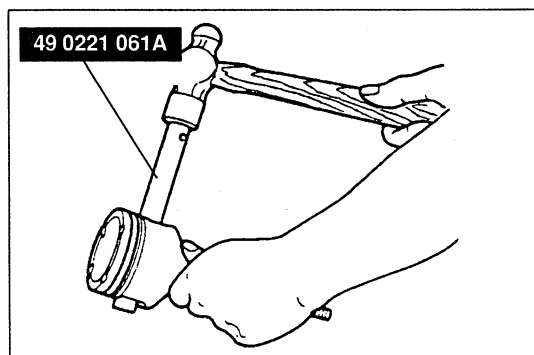
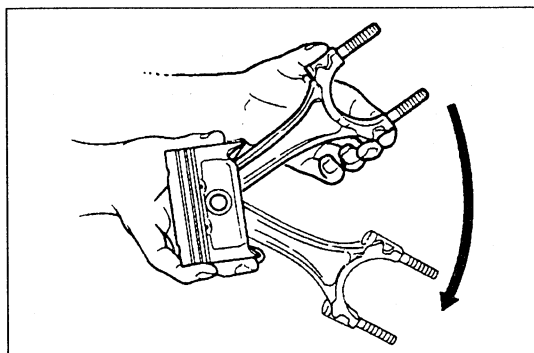
3. Install the MBSP.



**Disassembly Note****Piston and connecting rod assembly**

Before removing the piston and connecting rod assembly, inspect the following.

- (1) Connecting rod large end side clearance  
(Refer to page B-33.)
- (2) Connecting rod bearing oil clearance  
(Refer to page B-33.)

**Piston pin****Caution**

- The connecting rods must be reinstalled in the same positions from which they were removed. If they are not, it can cause premature and uneven wear.

**Note**

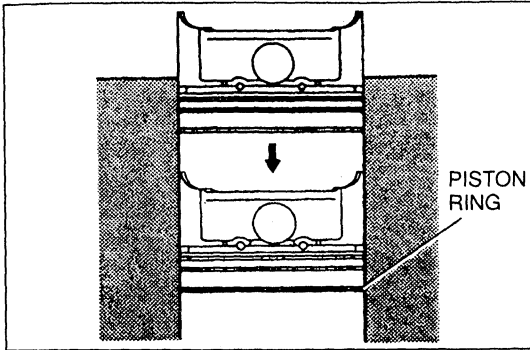
- Mark the connecting rods to show their original positions.
1. Before disassembling the piston and connecting rod, check the oscillation torque as shown. If the large end does not drop by its own weight, replace the piston or the piston pin.
  2. Remove the piston pin by using the **SST**.

**Main bearing cap**

1. Before removing the main bearing caps, measure the crankshaft end play. (Refer to page B-35.)
2. Loosen the main bearing cap bolts in two or three steps in the order shown.
3. Remove the main bearing caps.

**Crankshaft**

Before removing the crankshaft, measure the main bearing oil clearances. (Refer to page B-36.)



6. If the clearance exceeds the maximum, replace the piston and piston ring.
7. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring travel.
8. Measure each piston ring end gap with a feeler gauge. Replace the piston ring if necessary.

**End gap**

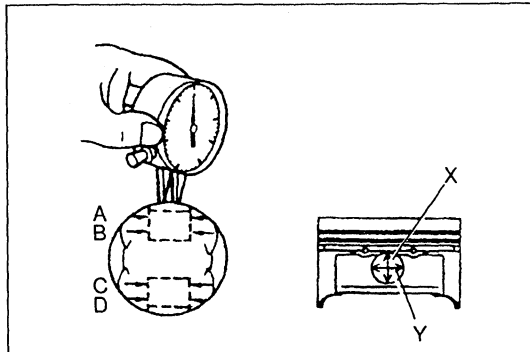
**Top:** 0.15—0.30 mm { 0.006—0.011 in }

**Second:** 0.30—0.45 mm { 0.012—0.017 in } (B6)

0.15—0.30 mm { 0.006—0.011 in } (BP)

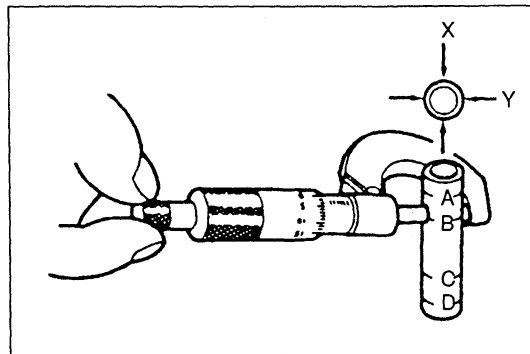
**Oil rail:** 0.20—0.70 mm { 0.008—0.027 in }

**Maximum:** 1.0 mm { 0.039 in }



9. Measure each piston pin hole diameter in X and Y direction at the four points (A, B, C, and D) as shown.

**Diameter:** 19.988—20.000 mm { 0.7870—0.7874 in }



10. Measure each piston pin diameter in X and Y directions at the four points (A, B, C, and D) as shown.

**Diameter:** 19.987—19.993 mm { 0.7869—0.7871 in }

11. Calculate the piston pin-to-piston pin bore clearance.

**Clearance:**

—0.005—0.013 mm { —0.0001—0.0005 in }

12. If the clearance exceeds the specification, replace the piston and/or piston pin.

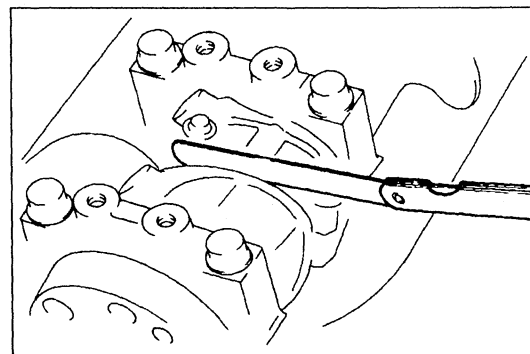
**CONNECTING ROD**

1. Measure the connecting rod large end side clearance.

**Clearance:** 0.110—0.262 mm { 0.0044—0.0103 in }

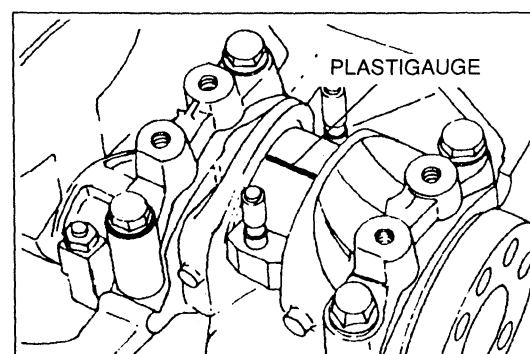
**Maximum:** 0.3 mm { 0.0118 in }

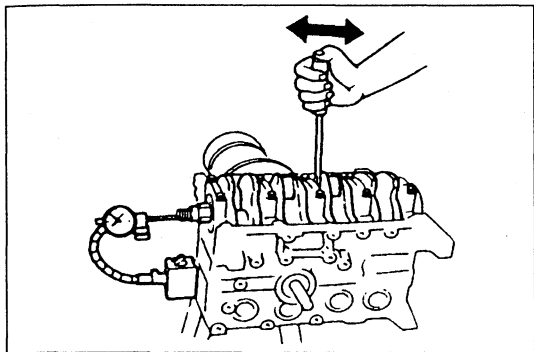
2. If the clearance exceeds the maximum, replace the connecting rod and cap assembly.



3. Measure the connecting rod large end oil clearances as follows.

- (1) Position plastigauge atop the crankshaft in the axial direction.
- (2) Install the connecting rod caps and tighten the connecting rod cap nuts. (Refer to page B-24.)
- (3) Remove the connecting rod cap nuts and connecting rod cap.
- (4) Measure the plastigauge at each crank pin.



**CRANKSHAFT**

1. Measure the crankshaft end play.

**End play: 0.080—0.282 mm { 0.0032—0.0111 in }**

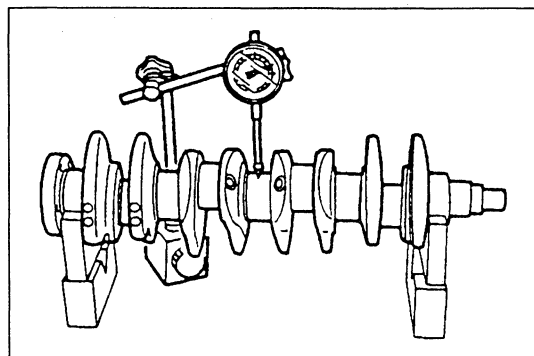
**Maximum: 0.3 mm { 0.01 in }**

2. If the end play exceeds the maximum, replace the thrust bearing or grind the crankshaft and install an oversize thrust bearing.

**Journal width**

mm { in }

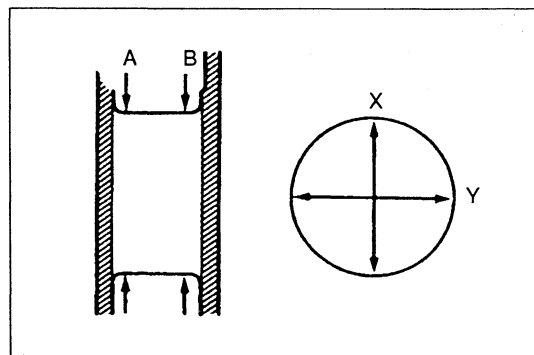
Bearing	No.4 journal width
Standard	24.07—24.12 { 0.948—0.949 }
0.25 { 0.01 } oversize	24.32—24.37 { 0.958—0.959 }
0.50 { 0.02 } oversize	24.57—24.62 { 0.968—0.969 }
0.75 { 0.03 } oversize	24.82—24.87 { 0.978—0.979 }



3. Set the crankshaft No.1 and No.5 main journals on V-blocks.

4. Measure the crankshaft runout at the No.3 main journals. Replace the crankshaft if necessary.

**Runout: 0.04 mm { 0.0016 in } max.**



5. Measure journal diameter in X and Y directions at two points (A and B) as shown.

**Main journal**

**Diameter:**

**49.938—49.956 mm { 1.9661—1.9667 in }**

**Minimum: 49.904 mm { 1.9647 in }**

**Out-of-round: 0.05 mm { 0.0020 in } max.**

**Crank pin journal**

**Diameter:**

**44.940—44.956 mm { 1.7693—1.7699 in }**

**Minimum: 44.908 mm { 1.7680 in }**

**Out-of-round: 0.05 mm { 0.0020 in } max.**

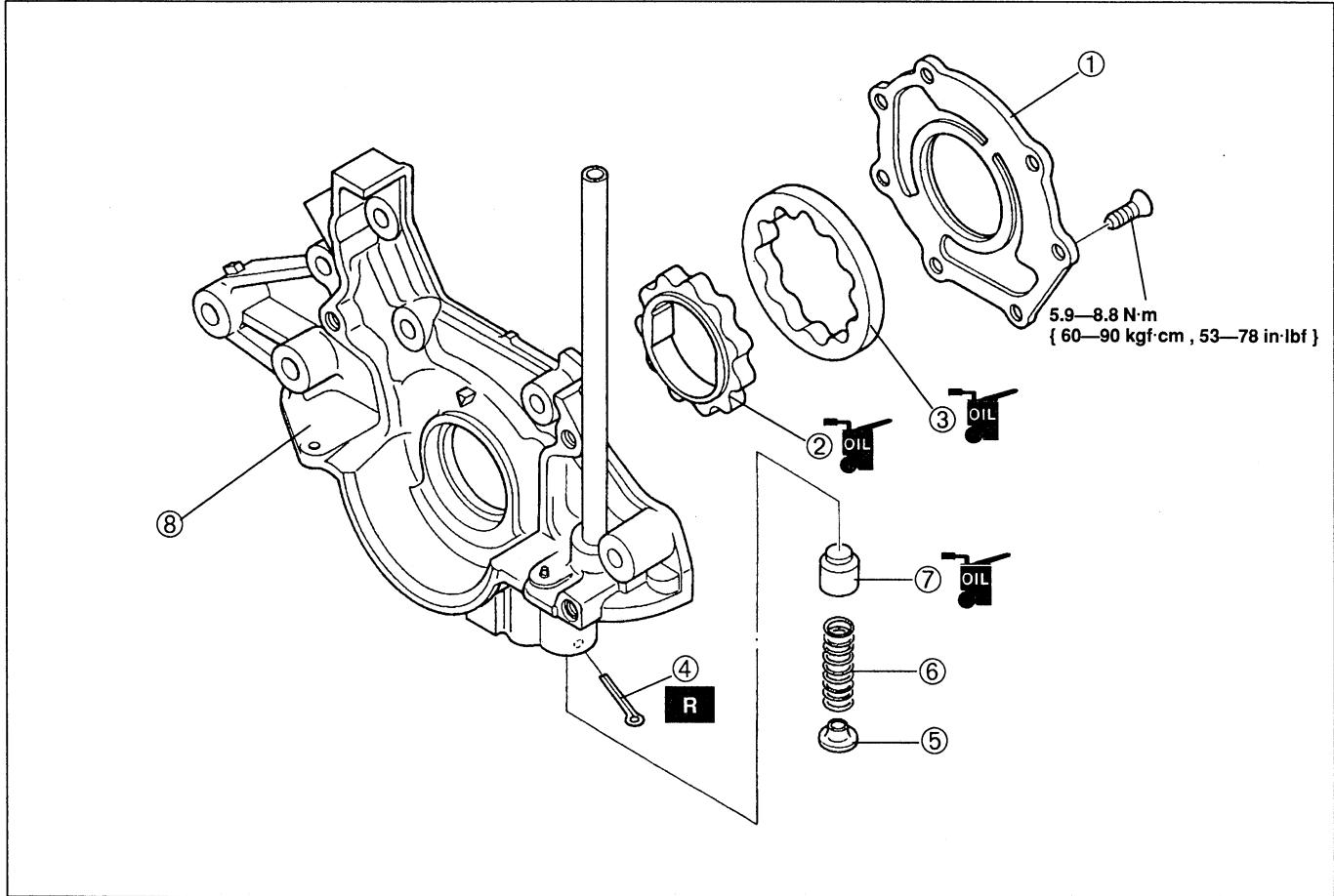
OIL PUMP

DISASSEMBLY / INSPECTION / ASSEMBLY

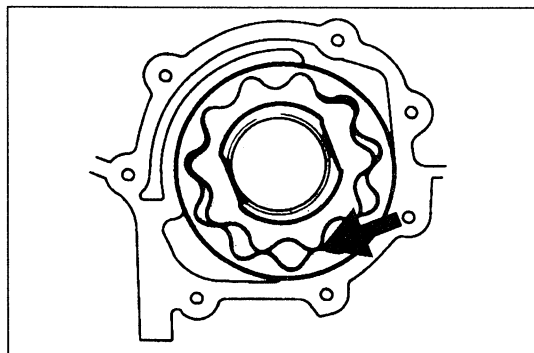
Warning

- Continuous exposure with USED engine oil has caused skin cancer in laboratory mice. Protect your skin by washing with soap and water immediately after this work.

1. Disassemble in the order shown in the figure.
2. Assemble in the reverse order of disassembly, referring to **Assembly Note**.



- |                              |                           |
|------------------------------|---------------------------|
| 1. Oil pump cover            | 5. Spring seat            |
| 2. Inner rotor               | 6. Pressure spring        |
| Inspection ..... below       | Inspection ..... page D-3 |
| 3. Outer rotor               | 7. Control plunger        |
| Inspection ..... below       | 8. Oil pump body          |
| 4. Cotter pin                | Inspection ..... below    |
| Assembly Note ..... page D-3 |                           |



**Inspection**

**Inner rotor, outer rotor, and oil pump body**

Measure the following clearances. Replace the rotor or oil pump body if necessary.

**Tooth tip clearance:**

0.02—0.16 mm { 0.0008—0.0062 in }

**Maximum: 0.20 mm { 0.0079 in }**