

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.

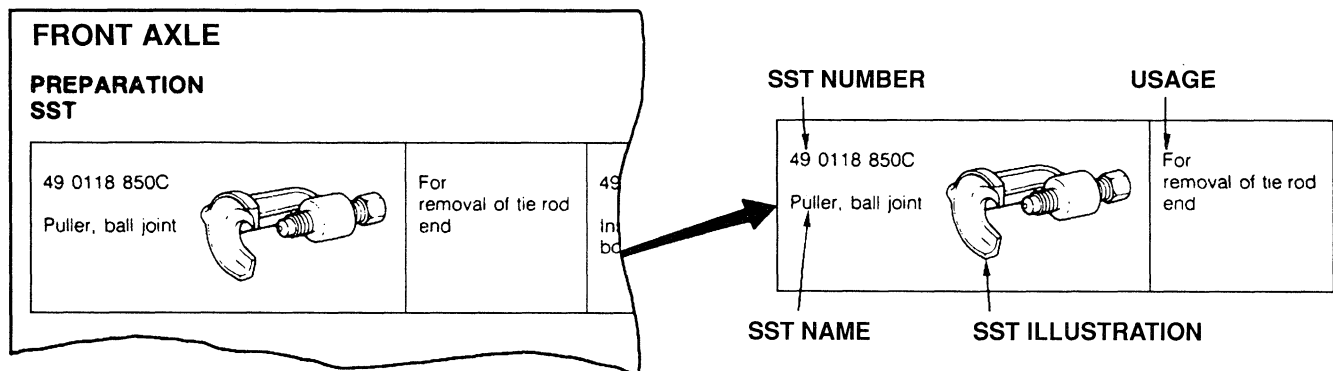
Note

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

PREPARATION

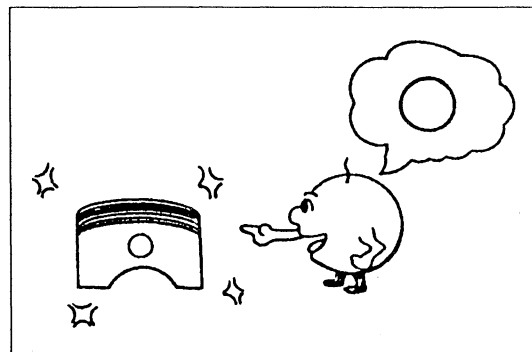
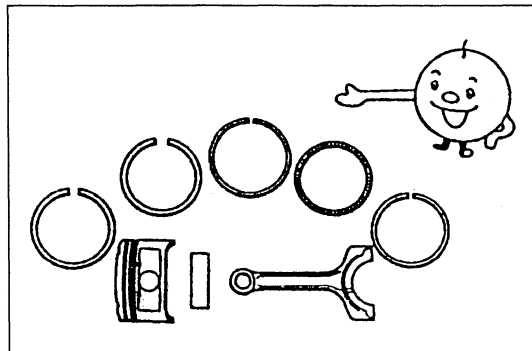
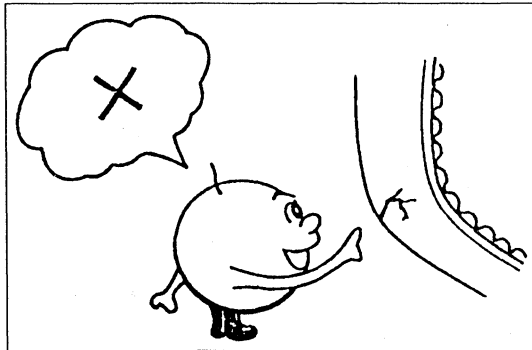
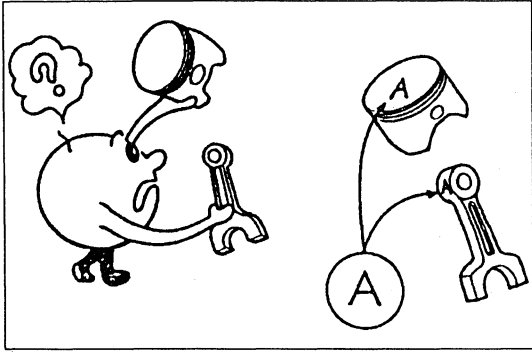
This points out the needed **SSTs** for the service operation. It is best to gather all necessary **SSTs** before beginning work.

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.



FUNDAMENTAL PROCEDURES

DISASSEMBLY

If the disassembly procedure is complex, requiring many parts to be disassembled, all parts should be identified in a way that will not affect their performance or appearance for easy reassembly.

1. Inspection of parts

When removed, each part should be carefully inspected for malfunctioning, deformation, damage, and other problems.

2. Arrangement of parts

All disassembled parts should be carefully arranged for reassembly. Be sure to separate or otherwise identify the parts to be replaced from those that will be reused.

3. Cleaning parts for reuse

All parts to be reused should be carefully and thoroughly cleaned in the appropriate method.

Warning

- Using compressed air can cause dirt and other particles to fly out, causing injury to the eyes. Wear protective eye wear whenever using compressed air.

REASSEMBLY

Standard values, such as tightening torques and adjustment values must be strictly observed in the reassembly of all parts.

If removed, these parts should be replaced with new ones:

- | | |
|----------------|-----------------|
| 1. Oil seals | 2. Gaskets |
| 3. O-rings | 4. Lock washers |
| 5. Cotter pins | 6. Nylon nuts |

UNITS

Electrical current	A (ampere)
Electric potential	V (volt)
Electric power	W (watt)
Length	mm (millimeter) in (inch)
Negative pressure	kPa (kilo Pascal) mmHg (millimeters of mercury) inHg (inches of mercury)
Positive pressure	kPa (kilo Pascal) kgf/cm ² (kilogram force per square centimeter) psi (pounds per square inch)
Resistance	Ω (ohm)
Torque	N·m (Newton meter) kgf·m (kilogram force per meter) kgf·cm (kilogram force per centimeter) ft·lbf (foot pound) in·lbf (inch pound)
Volume	L (liter) US qt (U.S. quart) Imp qt (Imperial quart) ml (milliliter) cc (cubic centimeter) cu in (cubic inch) fl oz (fluid ounce)
Weight	g (gram) oz (ounce)

Conversion to SI Units (Système International d'Unités)

All numerical values in this manual are based on SI units. Numbers shown in conventional units are converted from these values.

Rounding off

Converted values are rounded off to the same number of places as the SI unit value. For example, if the SI unit value is 17.2 and the value after conversion is 37.84, the converted value will be rounded off to 37.8.

Upper and lower limits

When the data indicates upper and lower limits, the converted values are rounded down if the SI unit value is an upper limit and rounded up if the SI unit value is a lower limit. Therefore, converted values for the same SI unit value may differ after conversion. For example, consider 2.7 kgf/cm² in the following specifications:

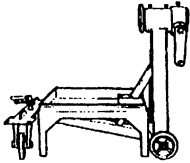

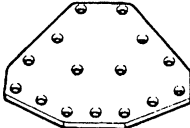
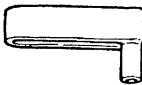


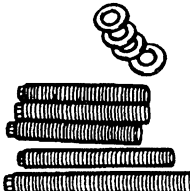

- 210—260 kPa { 2.1—2.7 kgf/cm² , 30—38 psi }
- 270—310 kPa { 2.7—3.2 kgf/cm² , 39—45 psi }

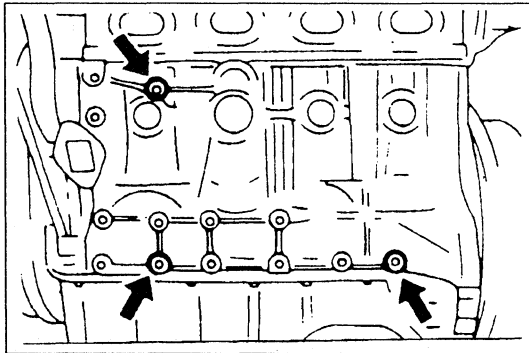
The actual converted values for 2.7 kgf/cm² are 264 kPa and 38.4 psi. In the top specification, 2.7 is used as an upper limit, so its converted values are rounded down to 260 and 38. In the bottom specification, 2.7 is used as a lower limit, so its converted values are rounded up to 270 and 39.

ENGINE STAND MOUNTING/DISMOUNTING

PREPARATION

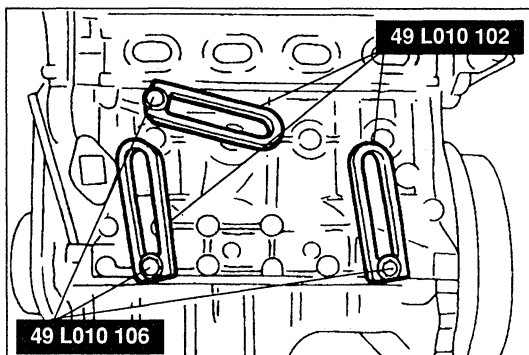
SST

<p>49 0107 680A Engine stand</p> 	<p>For disassembly and assembly of engine</p>	<p>49 L010 1A0 Hanger set, engine stand</p> 	<p>For disassembly and assembly of engine</p>
<p>49 L010 101 Plate (Part of 49 L010 1A0)</p> 	<p>For disassembly and assembly of engine</p>	<p>49 L010 102 Arms (Part of 49 L010 1A0)</p> 	<p>For disassembly and assembly of engine</p>
<p>49 L010 103 Hooks (Part of 49 L010 1A0)</p> 	<p>For disassembly and assembly of engine</p>	<p>49 L010 104 Nuts (Part of 49 L010 1A0)</p> 	<p>For disassembly and assembly of engine</p>
<p>49 L010 105 Bolts (Part of 49 L010 1A0)</p> 	<p>For disassembly and assembly of engine</p>	<p>49 L010 106 Bolts (Part of 49 L010 1A0)</p> 	<p>For disassembly and assembly of engine</p>



MOUNTING

1. Use the holes shown in the figure.



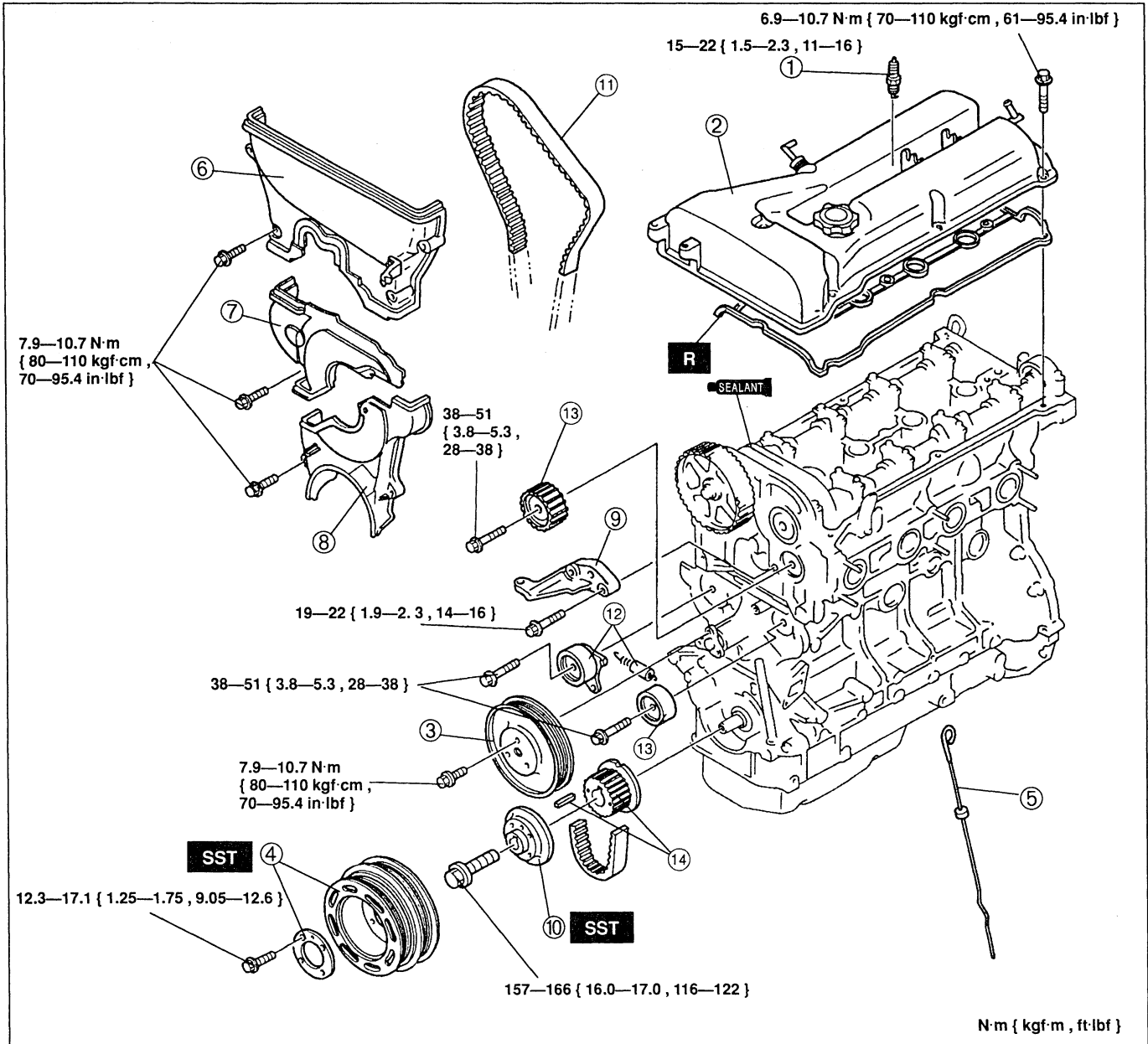
2. Install the **SST** (arms) to the holes as shown in the figure, and hand tighten the **SST** (bolts).

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.

TIMING BELT

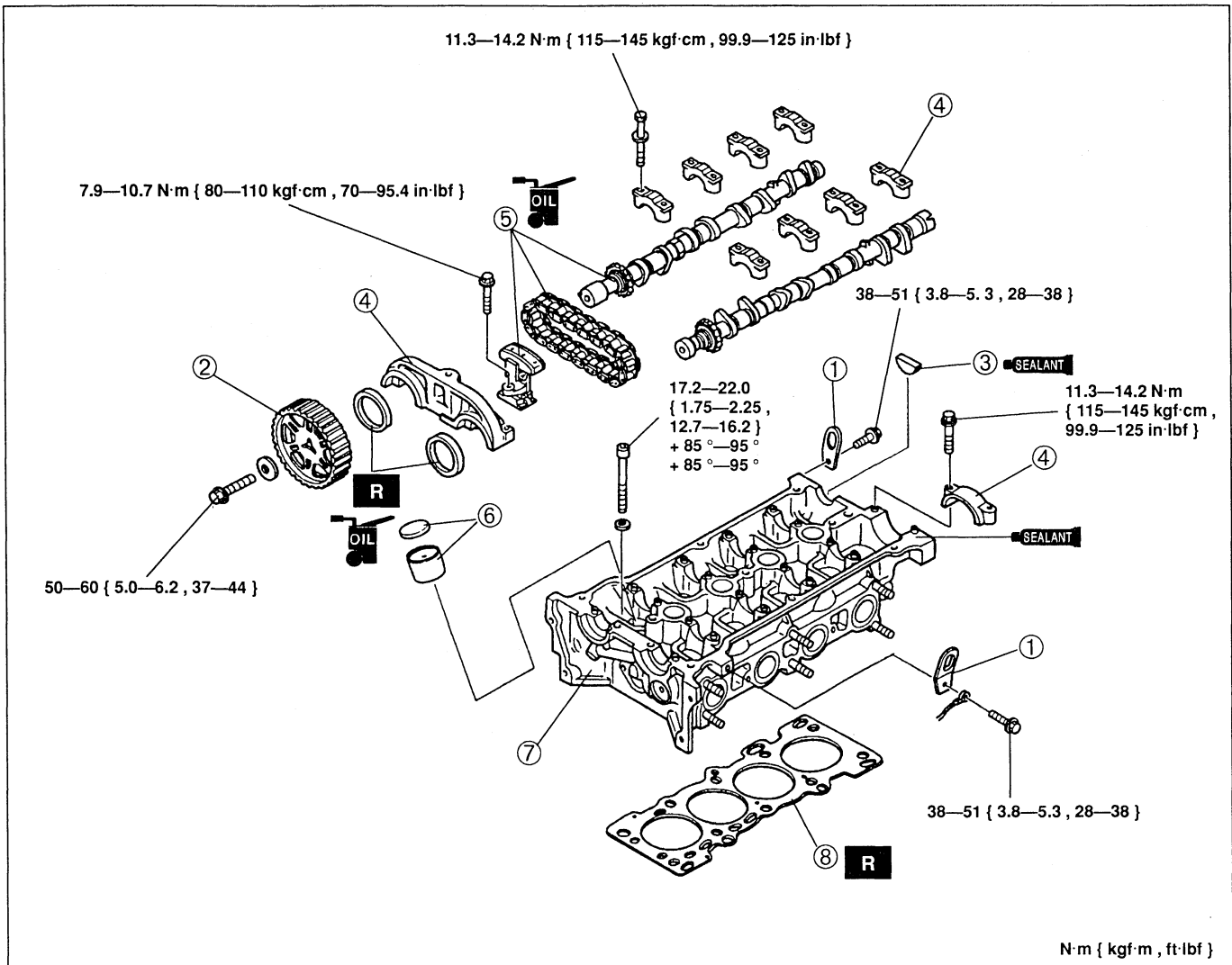
1. Disassemble in the order shown in the figure, referring to **Disassembly Note**.
2. Assemble in the reverse order of disassembly, referring to **Assembly Note**.



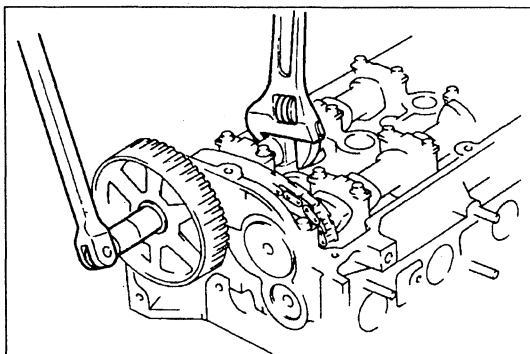
- | | |
|----------------------------------|------------------------------------|
| 1. Spark plug | 10. Pulley boss |
| 2. Cylinder head cover | Disassembly Note page B- 7 |
| Assembly Note page B-10 | Assembly Note page B- 8 |
| 3. Water pump pulley | 11. Timing belt |
| 4. Crankshaft pulley and plate | Disassembly Note page B- 7 |
| Disassembly Note page B- 7 | Assembly Note page B- 8 |
| Assembly Note page B- 9 | 12. Tensioner and tensioner spring |
| 5. Dipstick | Assembly Note page B- 8 |
| 6. Timing belt cover, upper | 13. Idler |
| 7. Timing belt cover, middle | 14. Timing belt pulley and key |
| 8. Timing belt cover, lower | Assembly Note page B- 8 |
| 9. No.3 engine mount bracket | |

CYLINDER HEAD (I)

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"> 1. Engine hanger 2. Camshaft pulley
Disassembly Note below
Assembly Note page B-14 3. Seal cap
Assembly Note page B-14 4. Camshaft cap
Disassembly Note page B-12
Assembly Note page B-13 | <ol style="list-style-type: none"> 5. Camshaft, timing chain, and chain adjuster
Disassembly Note page B-12
Assembly Note page B-13 6. Tappet and adjustment shim 7. Cylinder head
Disassembly Note page B-12
Assembly Note page B-12 8. Cylinder head gasket |
|--|---|

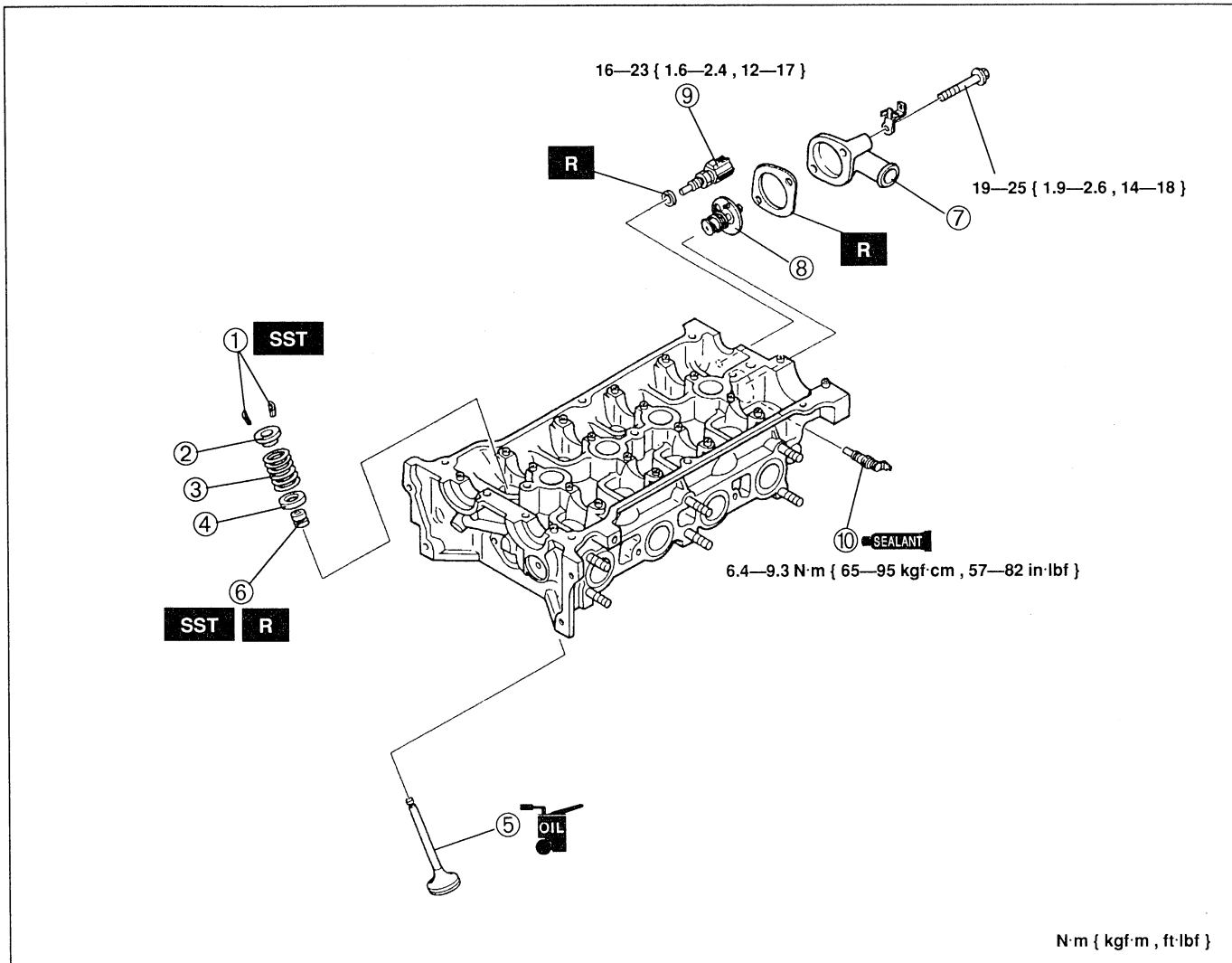


Disassembly Note
Camshaft pulley

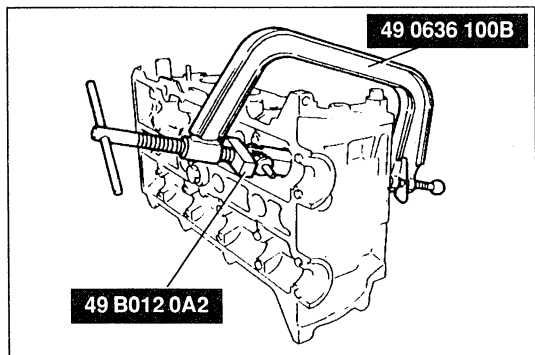
1. Hold the camshaft by using a wrench on the cast hexagon as shown, and loosen the camshaft pulley lock bolt.
2. Remove the camshaft pulley.

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**.



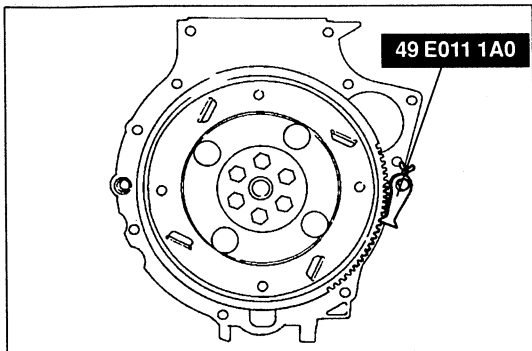
- | | |
|--|--|
| 1. Valve keeper
Disassembly Note below
Assembly Note page B-17 | 6. Valve seal
Disassembly Note page B-16
Assembly Note page B-16 |
| 2. Valve spring seat, upper | 7. Thermostat cover |
| 3. Valve spring
Assembly Note page B-17 | 8. Thermostat
Assembly Note page B-16 |
| 4. Valve spring seat, lower | 9. Engine coolant temperature sensor |
| 5. Valve | 10. Water temperature sender unit
Assembly Note page B-16 |



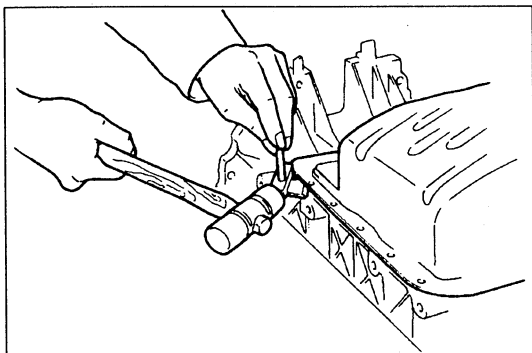
Disassembly Note

Valve keeper

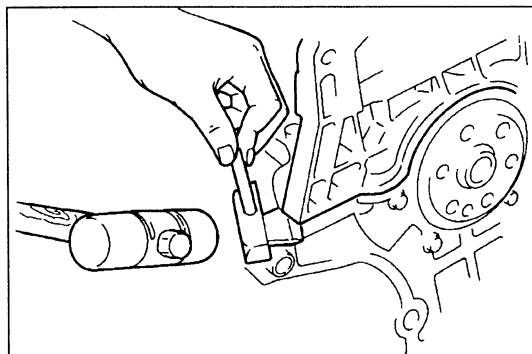
1. Set the **SST** against the upper valve spring seat as shown.
2. Remove the valve keepers.

**Disassembly Note****Backing plate, drive plate, adapter (ATX), flywheel (MTX)**

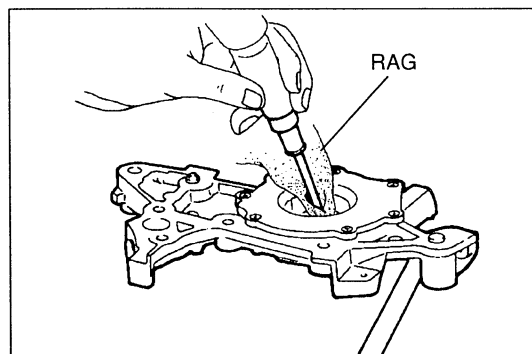
1. Hold the drive plate (ATX) or flywheel (MTX) by using the SST.
2. Remove the drive plate lock bolts and remove the backing plate and adapter. (ATX)
3. Remove the flywheel lock bolts and remove the flywheel. (MTX)

**Oil pan**

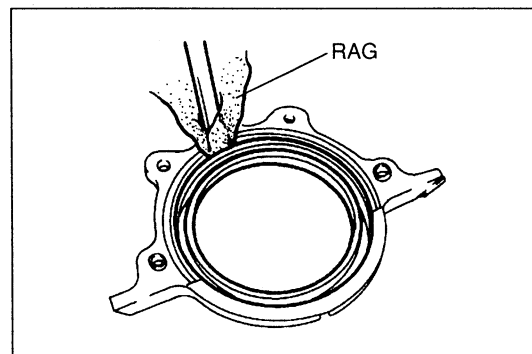
Separate the oil pan from the VRAS by using a scraper or a separator tool.

**VRAS**

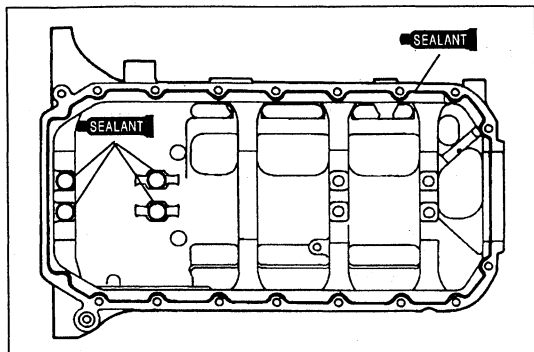
Separate the VRAS from the cylinder block by using a scraper or a separator tool.

**Oil pump**

Remove the oil seal by using a screwdriver protected with a rag.

**Rear cover**

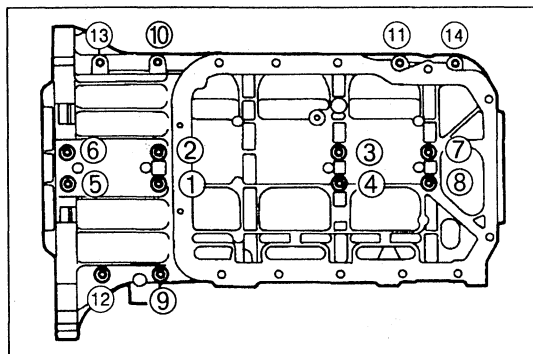
Remove the oil seal by using a screwdriver protected with a rag.



2. Apply silicone sealant to the VRAS as shown.

Thickness: ϕ 2—3 mm { 0.079—0.118 in }

3. Install the VRAS.



4. Tighten the bolts in the order shown.

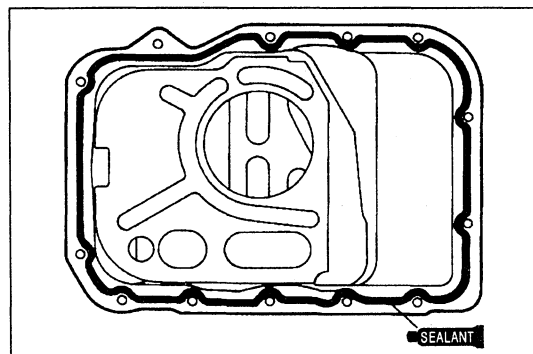
Tightening torque

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 }



Oil pan

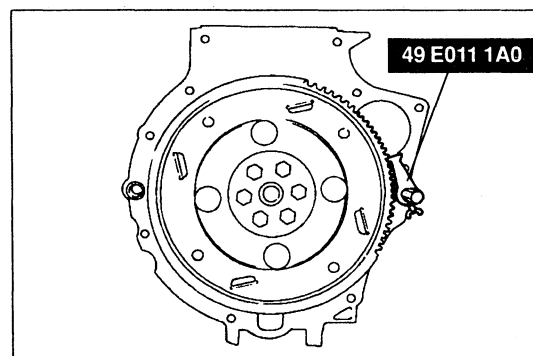
1. Apply silicone sealant to the oil pan as shown.

Thickness: ϕ 2—3 mm { 0.079—0.118 in }

2. Install the oil pan.

Tightening torque:

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

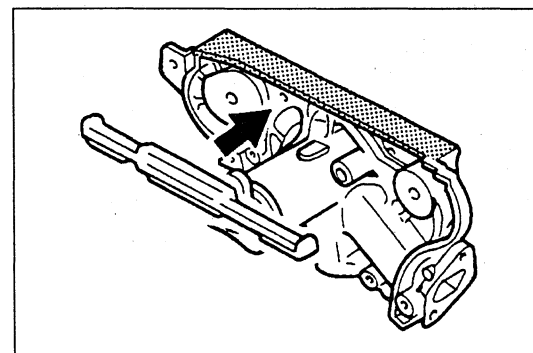


Backing plate, drive plate, adapter (ATX), flywheel (MTX)

1. Hold the drive plate (ATX) or flywheel (MTX) by using the SST.
2. Install the drive plate. (ATX)
3. Install the flywheel. (MTX)

Tightening torque:

97—102 N·m { 9.8—10.5 kgf·m , 71—75.9 ft·lbf }

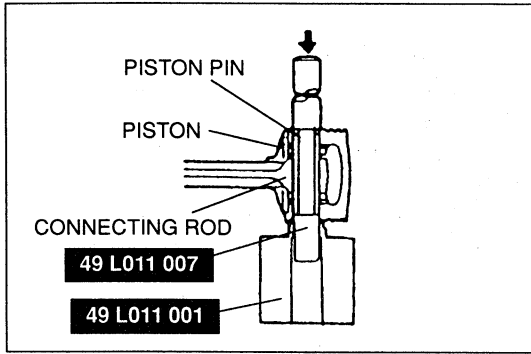


Water pump

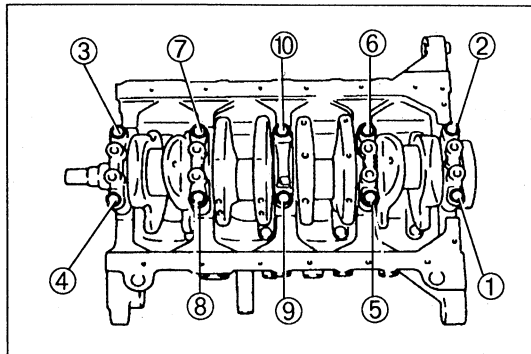
1. Verify that the rubber seal is securely fixed onto the water pump.
2. If not, remove the rubber seal and reinstall it with the bonding agent.
3. Install the water pump.

Tightening torque:

19—25 N·m { 1.9—2.6 kgf·m , 14—18 ft·lbf }



4. Press out the piston pin.

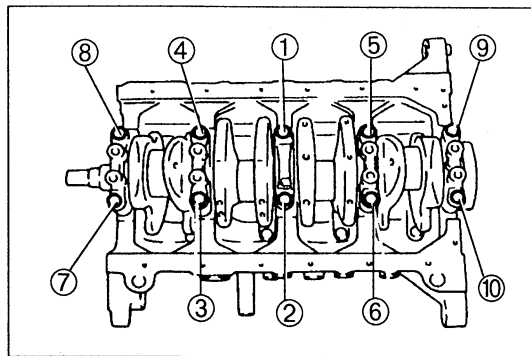


Main bearing cap

1. Before removing the main bearing caps, measure the crankshaft end play. (Refer to page B-36.)
2. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.
3. Remove the main bearing caps.

Crankshaft

Before removing the crankshaft, measure the main bearing oil clearances. (Refer to page B-37.)



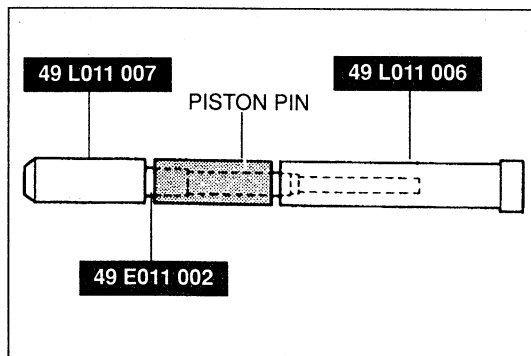
Assembly Note

Main bearing cap

Tighten the main bearing cap bolts in two or three steps in the order shown.

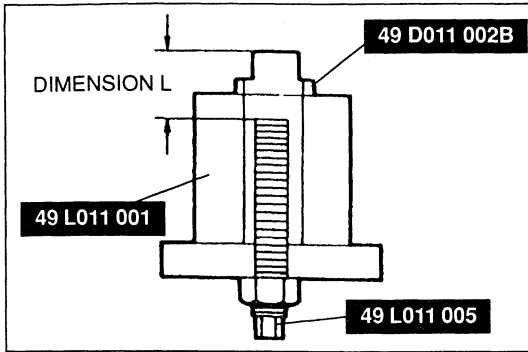
Tightening torque:

54—58 N·m { 5.5—6.0 kgf·m , 40—43 ft·lbf }



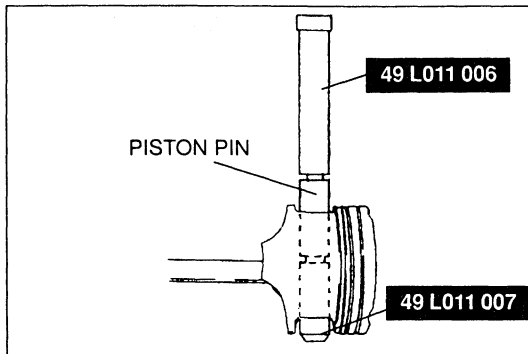
Piston pin

1. Set the piston pin on the SST as shown.

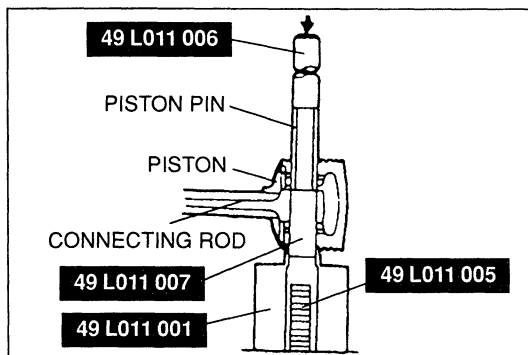


2. Apply clean engine oil to the piston pin.
3. Set the stopper bolt so that dimension L is as specified.

Dimension L: 61.4 mm { 2.42 in }



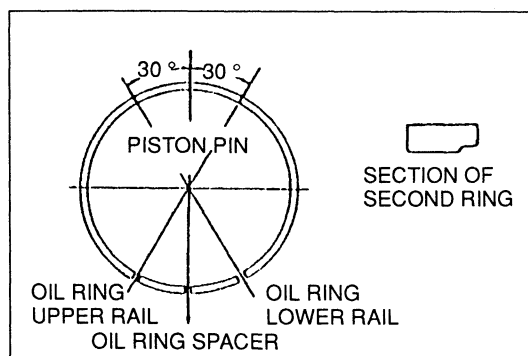
4. Insert the piston pin and **SST** assembled in step 1 into the piston and connecting rod assembly.



5. Press the piston pin into the piston and connecting rod until the **SST** (guide) contacts the **SST** (stopper bolt).
6. While inserting the piston pin, check the pressure force. If it is less than specification, replace the piston pin or the connecting rod.

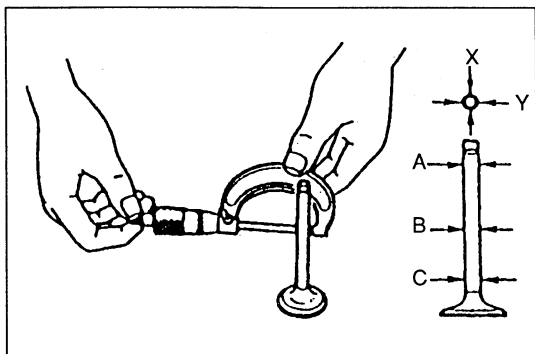
Pressure force: 4.91—14.70 kN
{ 500—1,500 kgf , 1,100—3,300 lbf }

7. Check the oscillation torque of the connecting rod.
 (Refer to page B-23.)



Piston and connecting rod assembly

1. Verify that the second ring is installed with the scraper face downward.
2. Position the end gap of each ring as shown.



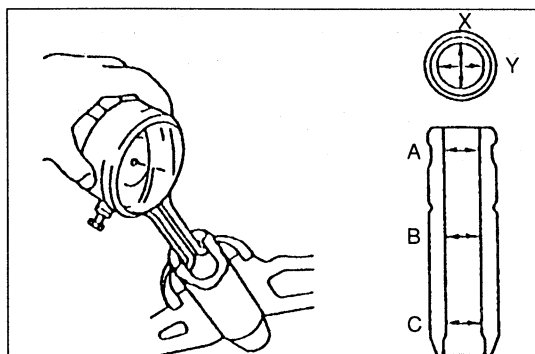
3. Measure the stem diameter of each valve in X and Y directions at the three points (A, B, and C) shown. Replace the valve if necessary.

Diameter
IN

Standard: 5.470—5.485 mm { 0.2154—0.2159 in }
Minimum: 5.420 mm { 0.2134 in }

EX

Standard: 5.465—5.480 mm { 0.2152—0.2157 in }
Minimum: 5.415 mm { 0.2132 in }



4. Measure the inner diameter of each valve guide in X and Y directions at the three points (A, B, and C) shown. Replace the valve guide if necessary.

Inner diameter:

IN: 5.51—5.53 mm { 0.2170—0.2177 in }

EX: 5.52—5.54 mm { 0.2174—0.2181 in }

(Service parts)

5. Calculate the valve stem-to-valve guide clearance. Subtract the outer diameter of the valve stem from the inner diameter of the corresponding valve guide.

Clearance

IN: 0.025—0.060 mm { 0.0010—0.0023 in }

0.035—0.070 mm { 0.0014—0.0027 in }

(Service parts)

EX: 0.030—0.065 mm { 0.0012—0.0025 in }

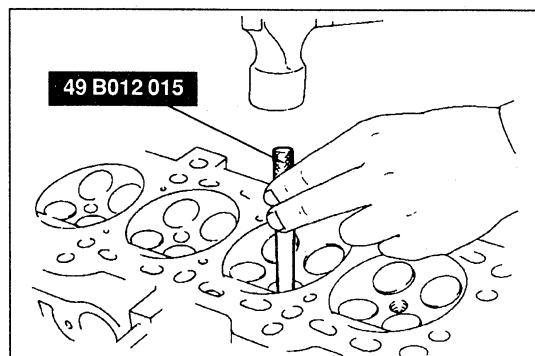
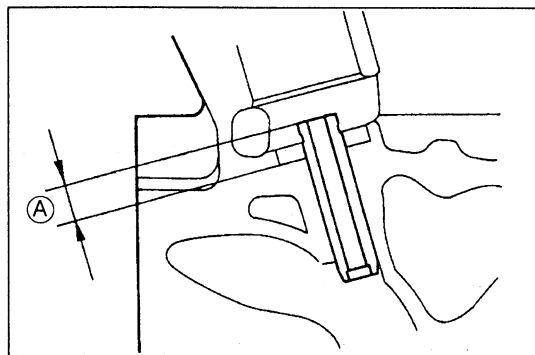
0.040—0.075 mm { 0.0016—0.0029 in }

(Service parts)

Maximum: 0.2 mm { 0.008 in }

6. If the clearance exceeds the specification, replace the valve and/or valve guide.
7. Measure the protrusion height (dimension A) of each valve guide without valve spring seat, low. Replace the valve guide if necessary.

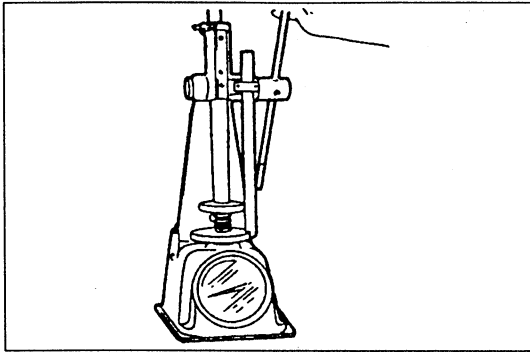
Height: 9.22—9.82 mm { 0.363—0.386 in }



Replacement of valve guide

Removal

Using the SST, remove the valve guide from the combustion chamber side.

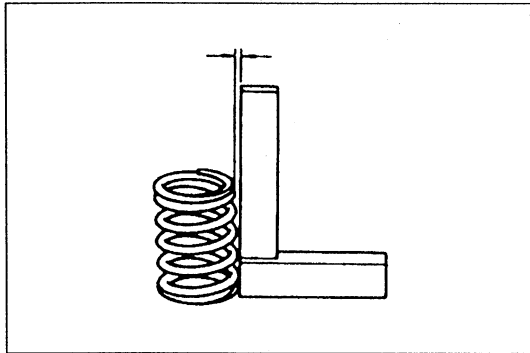


VALVE SPRING

1. Apply pressing force of **126.7—143.3 N { 12.92—14.62 kgf , 29—32 lbf }** to the valve spring and check the spring height.

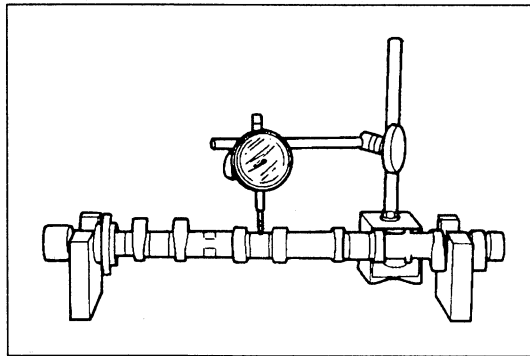
Height: 31.5 mm { 1.24 in }

2. Replace the valve spring if necessary.



3. Measure the out-of-square of the valve spring. Replace the valve spring if necessary.

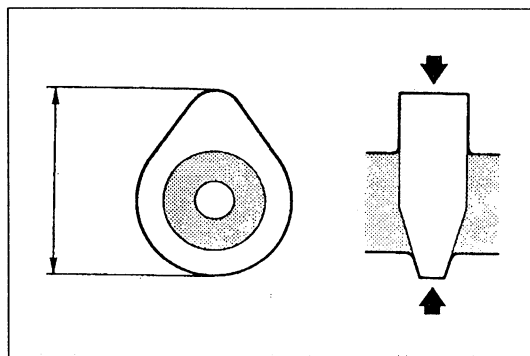
Out-of-square: 1.33 mm { 0.052 in } max.



CAMSHAFT

1. Set the No.1 and No.5 journals on V-blocks.
2. Measure the camshaft runout. Replace the camshaft if necessary.

Runout: 0.03 mm { 0.0012 in } max.

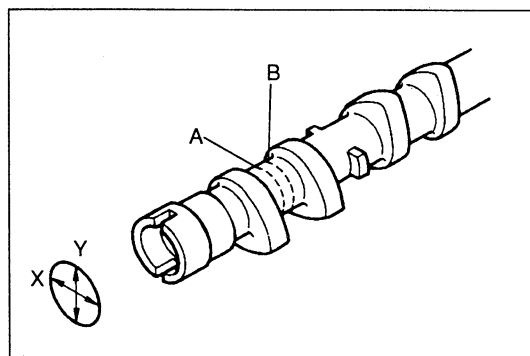


3. Measure the cam lobe heights at the point as shown.

Height

mm { in }

IN	Standard	40.900 { 1.6102 }
	Minimum	40.700 { 1.6024 }
EX	Standard	40.900 { 1.6102 }
	Minimum	40.700 { 1.6024 }



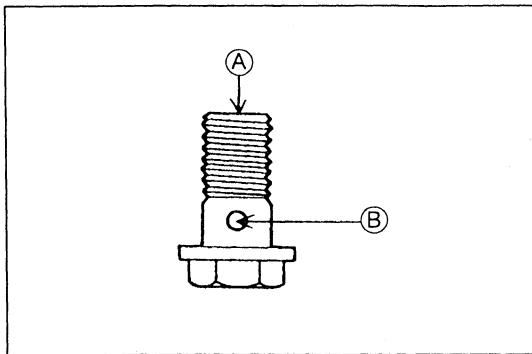
4. Measure the journal diameters in X and Y directions at the two points (A and B) shown. Replace the camshaft if necessary.

Diameter

Standard:

25.940—25.965 mm { 1.0213—1.0222 in }

Minimum: 25.910 mm { 1.0201 in }



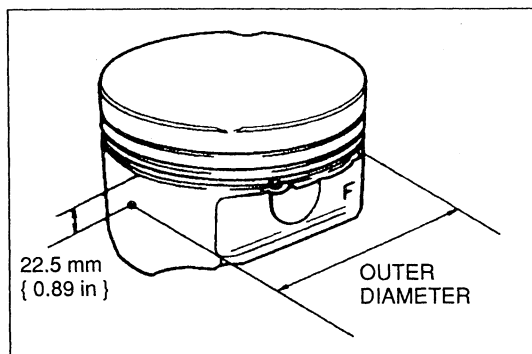
OIL JET

1. Apply compressed air to oil jet valve (A) and verify that air passes through oil jet valve (B). If not, replace the oil jet valve.

Air pressure:

167—225 kPa { 1.7—2.3 kgf/cm² , 25—32 psi }

2. Check the oil jet nozzle for clogs. Replace the nozzle if necessary.



PISTON, PISTON RING, AND PISTON PIN

1. Measure the outer diameter of each piston at a right angle (90°) to the piston pin, 22.5 mm { 0.89 in } below the oil ring land lower edge.

Piston diameter

mm { in }

Standard	75.263—75.283 { 2.9632—2.9638 }
0.25 { 0.01 } oversize	75.513—75.533 { 2.9730—2.9737 }
0.50 { 0.02 } oversize	75.763—75.783 { 2.9828—2.9835 }

2. Calculate the piston-to-cylinder clearance. Subtract the piston diameter from the cylinder bore of the corresponding cylinder.

Clearance: 0.030—0.043 mm { 0.0012—0.0016 in }
Maximum: 0.10 mm { 0.0039 in }

3. If the clearance exceeds the maximum, replace the piston or rebore the cylinders to fit oversize pistons.
4. If the piston is replaced, the piston rings must also be replaced.

5. Measure the piston ring-to-ring land clearance around the entire circumference using a new piston ring.

Clearance

Top: 0.035—0.065 mm { 0.0014—0.0025 in }

Second: 0.030—0.065 mm { 0.0012—0.0025 in }

Oil: 0.07—0.16 mm { 0.003—0.006 in }

Maximum: 0.15 mm { 0.006 in }

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.

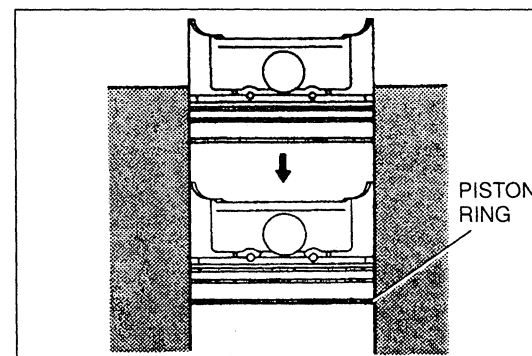
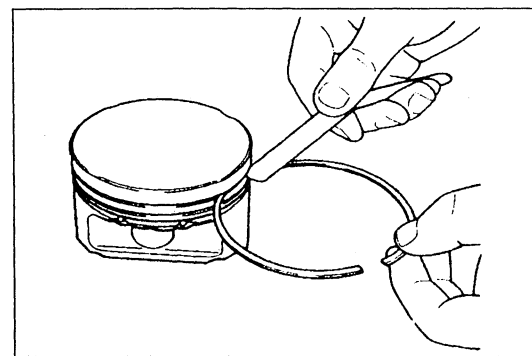
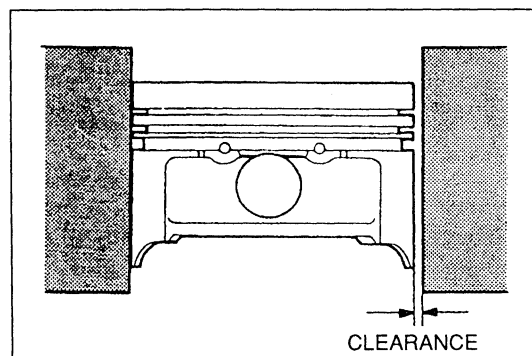
End gap

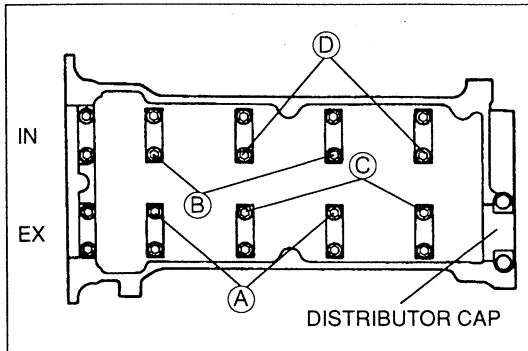
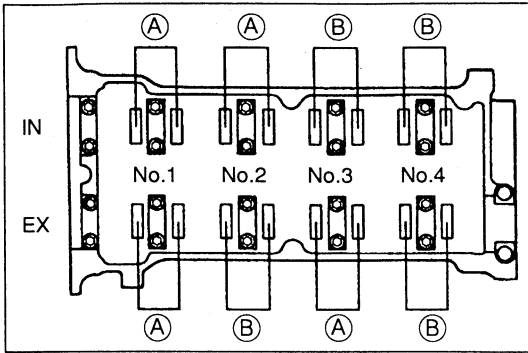
Top: 0.15—0.30 mm { 0.006—0.011 in }

Second: 0.25—0.40 mm { 0.010—0.015 in }

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

Maximum: 1.0 mm { 0.039 in }



**VALVE CLEARANCE**

1. Measure the valve clearance as follows.
 - (1) Turn the crankshaft clockwise so that the No.1 piston is at TDC of the compression stroke.
 - (2) Measure the valve clearance at (A) in the figure.
 - (3) Turn the crankshaft 360° clockwise so that the No.4 piston is at TDC of the compression stroke.
 - (4) Measure the valve clearance at (B) in the figure.

Standard (Engine cold)

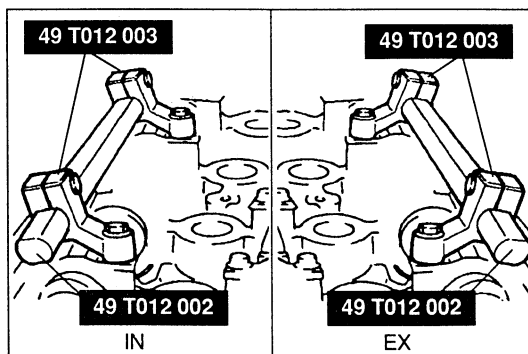
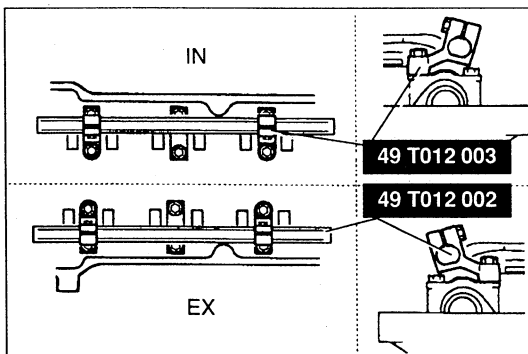
IN: 0.25—0.31 mm { 0.010—0.012 in }

EX: 0.25—0.31 mm { 0.010—0.012 in }

2. If the valve clearance exceeds the standard, replace the adjustment shim
3. Turn the crankshaft clockwise so that the cam on the camshaft requiring adjustment shim replacement are positioned straight up.
4. Remove the camshaft cap bolts as necessary.
 - (A): For EX side No.1, 2, 3 cylinder adjustment shim removal
 - (B): For IN side No.1, 2, 3 cylinder adjustment shim removal
 - (C): For EX side No.2, 3, 4 cylinder adjustment shim removal
 - (D): For IN side No.2, 3, 4 cylinder adjustment shim removal

Note

- To replace the shim of the EX side No.2 and/or No.3 cylinder, removal the bolts marked either (A) or (C).
- To replace the shim of the IN side No.2 and/or No.3 cylinder, removal the bolts marked either (B) or (D).



5. Install the **SSTs** as shown, using the camshaft cap bolt holes.

Tightening torque: 11.3—14.2 N·m

{ 115—145 kgf·cm , 99.9—125 in·lbf }