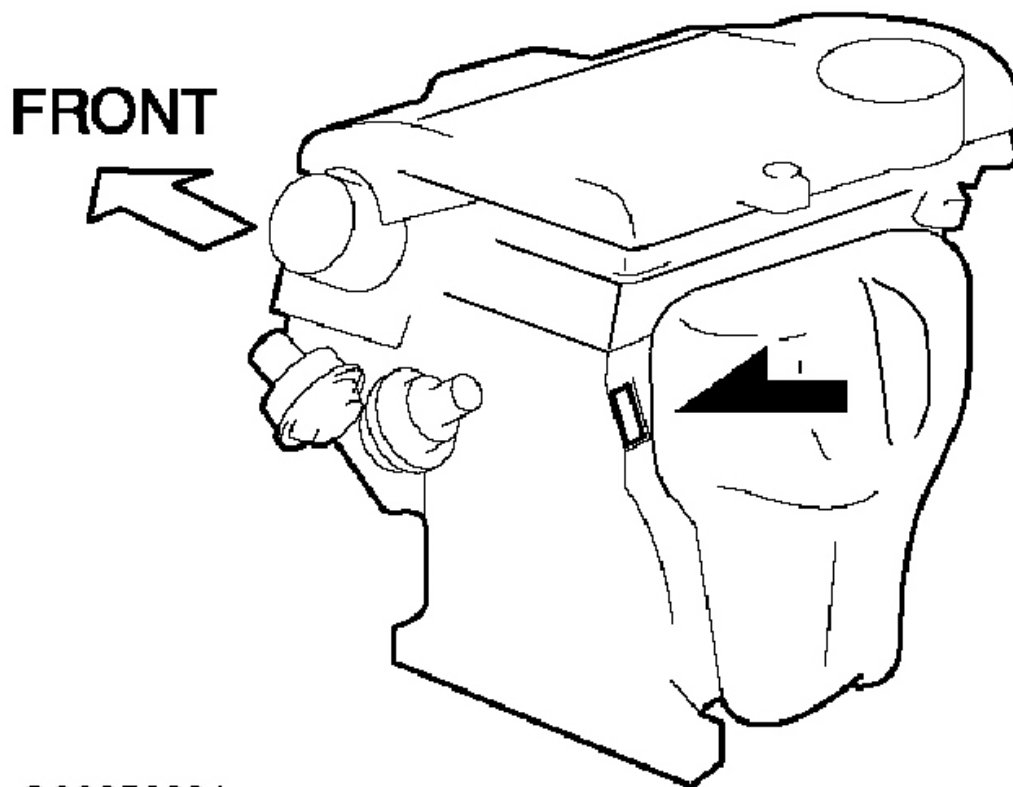


**2004-08 ENGINES****2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6****ENGINE IDENTIFICATION**

Engine can be identified by engine model and number. See **ENGINE IDENTIFICATION CODE** table. Engine model and number is stamped on left side of cylinder block. See [Fig. 1](#).

**ENGINE IDENTIFICATION CODE**

| Engine          | Code |
|-----------------|------|
| 2.0L 4-Cylinder | LF   |
| 2.3L 4-Cylinder | L3   |



G00356224

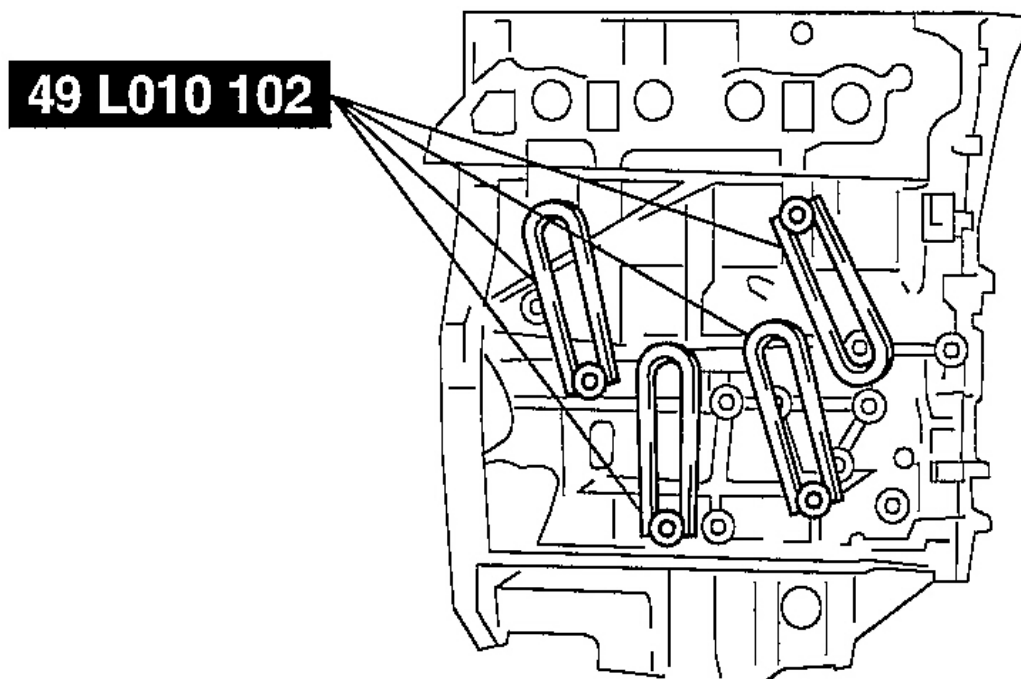
**Fig. 1: Locating Engine Identification Code**  
Courtesy of MAZDA MOTORS CORP.

## TROUBLE SHOOTING

To trouble shoot engine mechanical components, see ENGINE MECHANICAL in BASIC TROUBLE SHOOTING article in GENERAL INFORMATION.

## ENGINE MOUNTING/DISMOUNTING

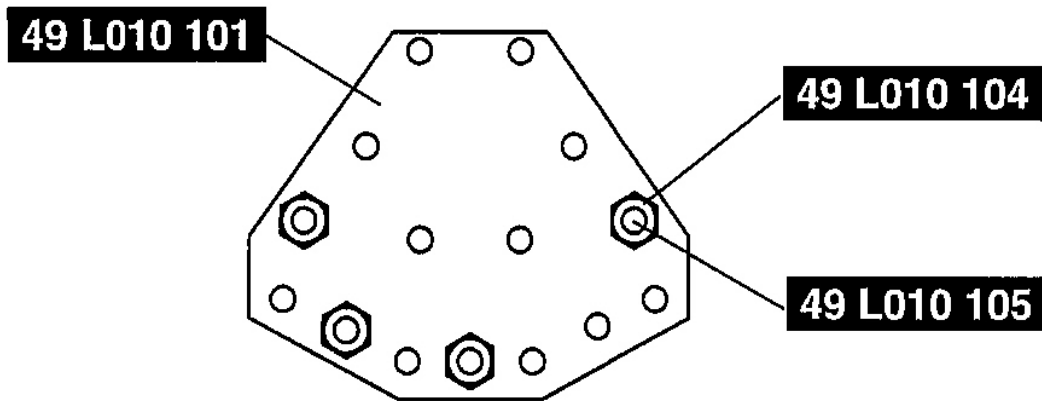
1. Install the SSTs (arms) to the cylinder block holes as shown, and hand-tighten the bolts (**part No.:** 9YA20-1003) or M10 x 1.5T length 90 mm {3.55 in} .



G02831558

**Fig. 2: Installing SSTs To Cylinder Block**  
Courtesy of MAZDA MOTORS CORP.

2. Assemble the SSTs (bolts, nuts and plate) to the specified positions.
3. Adjust the SSTs (bolts) so that less than **20 mm {0.79 in}** of thread is exposed.
4. Make the SSTs (arms and plate) parallel by adjusting the SSTs (bolts and nuts).



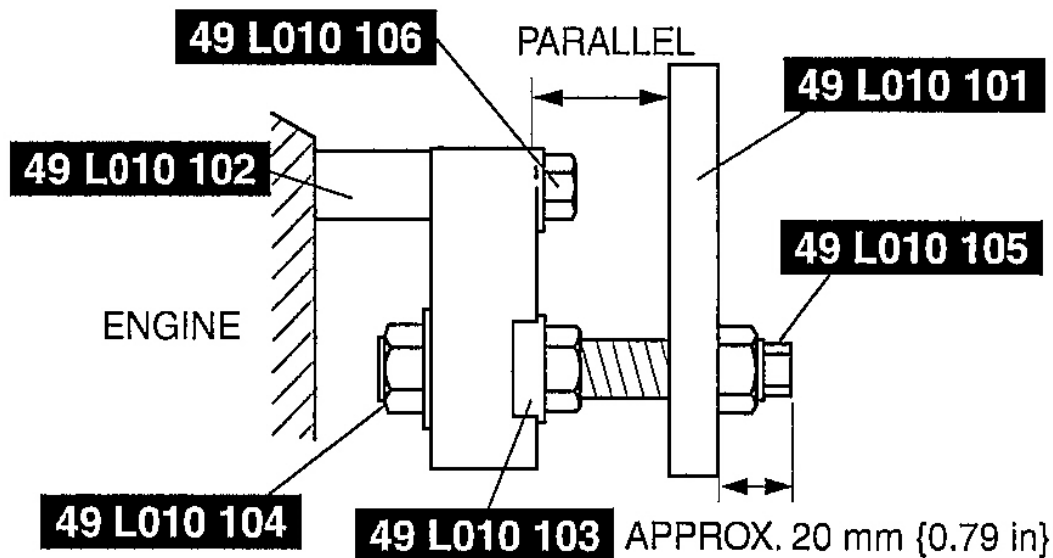
G02831559

**Fig. 3: Identifying SST Bolts/Nuts**  
Courtesy of MAZDA MOTORS CORP.

5. Tighten the SSTs (bolts and nuts) to affix the SSTs firmly.

**WARNING:**

- Self-locking brake system of the engine stand may not be effective when the engine is held in an unbalanced position. This could lead to sudden, rapid movement of the engine and mounting stand handle and cause serious injury. Never keep the engine in an unbalanced position, and always hold the rotating handle firmly when turning the engine.



G02831560

**Fig. 4: Tightening SST Bolt/Nuts**

Courtesy of MAZDA MOTORS CORP.

6. Mount the engine on the SST (engine stand).
7. Drain the engine oil into a container.
8. Install the oil pan drain plug.
  - With washer.
    1. Install the oil pan drain plug with a new washer.

**Tightening Torque****30-41 N.m {3.1-4.1 kgf.m, 23-30 ft.lbf}**

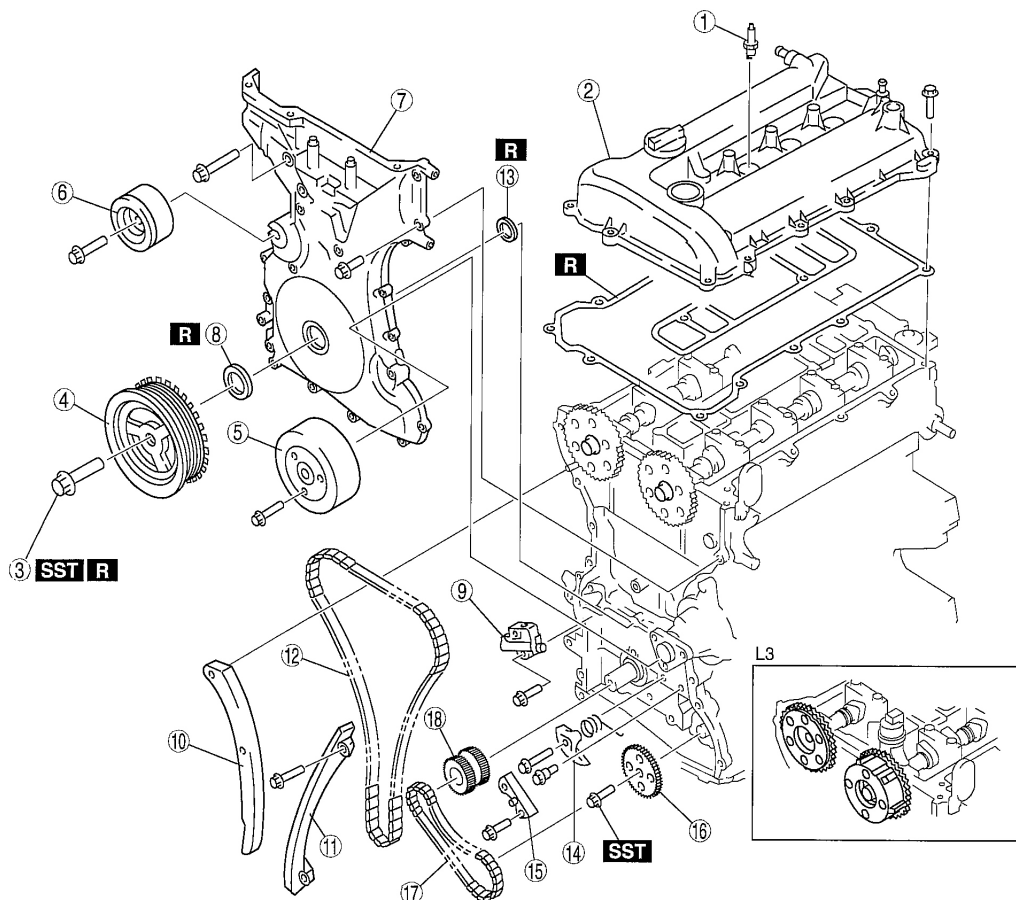
- Without washer.
  1. Inspect the seal rubber of the oil pan drain plug and make sure there are no cracks or damage.
    - If necessary, replace the oil pan drain plug.
  2. Clean the flange surface (seal rubber) on the oil pan drain plug, then install the oil pan drain plug.

**Tightening Torque****22-30 N.m {2.2-3.1 kgf.m, 16-22 ft.lbf}****DISMOUNTING**

- Dismount in the reverse order of mounting.

## TIMING CHAIN DISASSEMBLY

1. Disassemble in the order indicated in the figure.



|   |                                                                                       |
|---|---------------------------------------------------------------------------------------|
| 1 | Spark plug                                                                            |
| 2 | Cylinder head cover                                                                   |
| 3 | Crankshaft pulley lock bolt<br>(See Crankshaft Pulley Lock Bolt<br>Disassembly Note.) |
| 4 | Crankshaft pulley                                                                     |
| 5 | Water pump pulley                                                                     |
| 6 | Drive belt idler pulley (Without stretch-type A/C drive<br>belt)                      |
| 7 | Engine front cover                                                                    |
| 8 | Front oil seal<br>(See Front Oil Seal Disassembly Note.)                              |

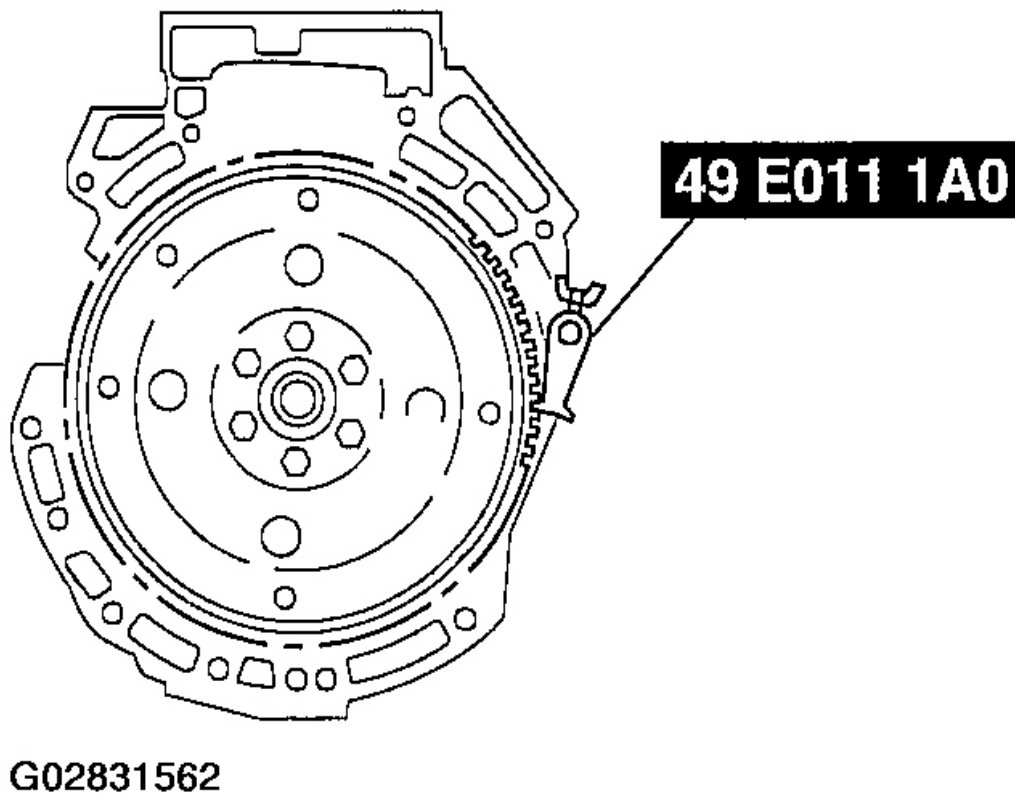
|    |                                                                   |
|----|-------------------------------------------------------------------|
| 9  | Chain tensioner<br>(See Chain Tensioner Disassembly Note.)        |
| 10 | Tensioner arm                                                     |
| 11 | Chain guide                                                       |
| 12 | Timing chain                                                      |
| 13 | Seal (L3)                                                         |
| 14 | Oil pump chain tensioner                                          |
| 15 | Oil pump chain guide                                              |
| 16 | Oil pump sprocket<br>(See Oil Pump Sprocket Disassembly<br>Note.) |
| 17 | Oil pump chain                                                    |
| 18 | Crankshaft sprocket                                               |

G02831561

**Fig. 5: Removing Timing Chain**  
Courtesy of MAZDA MOTORS CORP.

**CRANKSHAFT PULLEY LOCK BOLT DISASSEMBLY NOTE**

1. Hold the crankshaft using the SST .

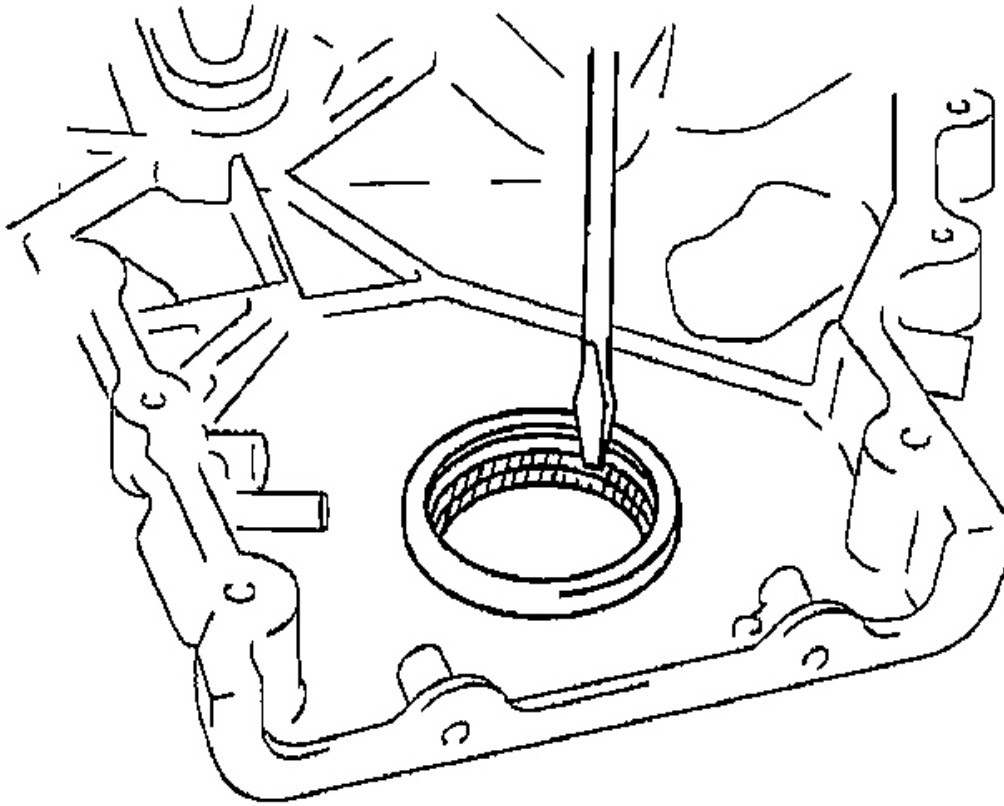


**Fig. 6: Holding Crankshaft**  
Courtesy of MAZDA MOTORS CORP.

2. Remove the crankshaft pulley lock bolt.

**FRONT OIL SEAL DISASSEMBLY NOTE**

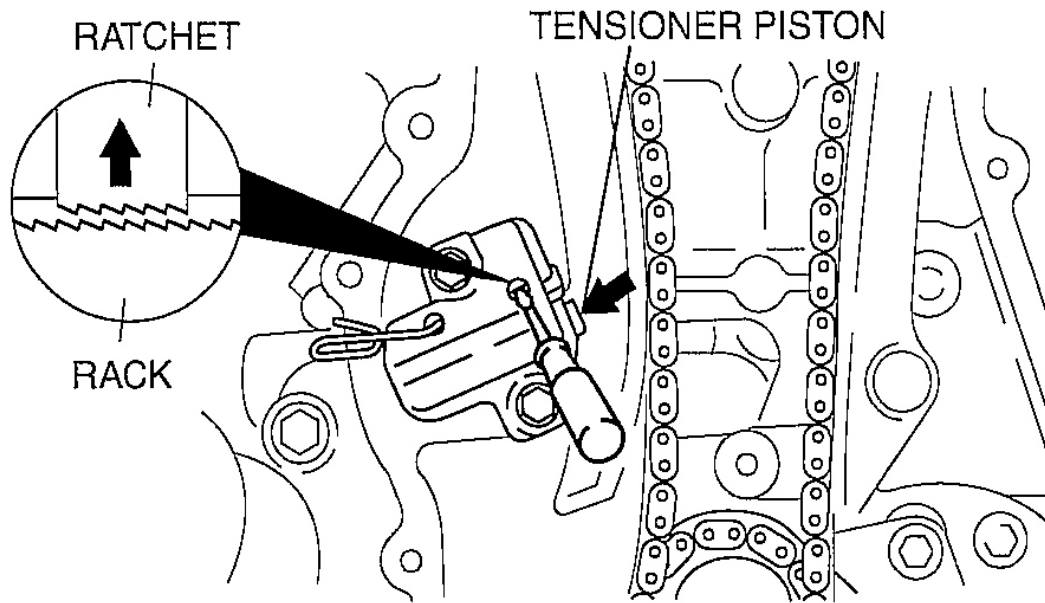
1. Remove the oil seal using a screwdriver.

**G02831563**

**Fig. 7: Removing Oil Seal**  
Courtesy of MAZDA MOTORS CORP.

**CHAIN TENSIONER DISASSEMBLY NOTE**

1. Unlock the chain tensioner ratchet using a suitable screw driver or equivalent tool.



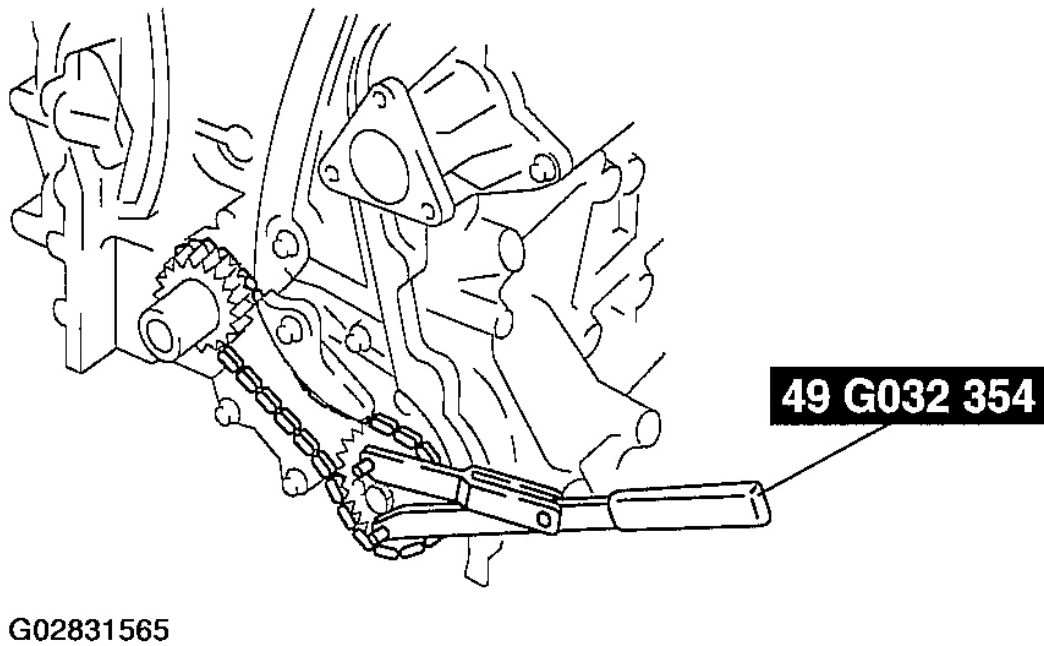
G02831564

**Fig. 8: Unlocking Chain Tensioner Ratchet**  
Courtesy of MAZDA MOTORS CORP.

2. Slowly press the tensioner piston.
3. Hold the chain tensioner piston with a **1.5 mm {0.06 in}** wire or paper clip.

#### **OIL PUMP SPROCKET DISASSEMBLY NOTE**

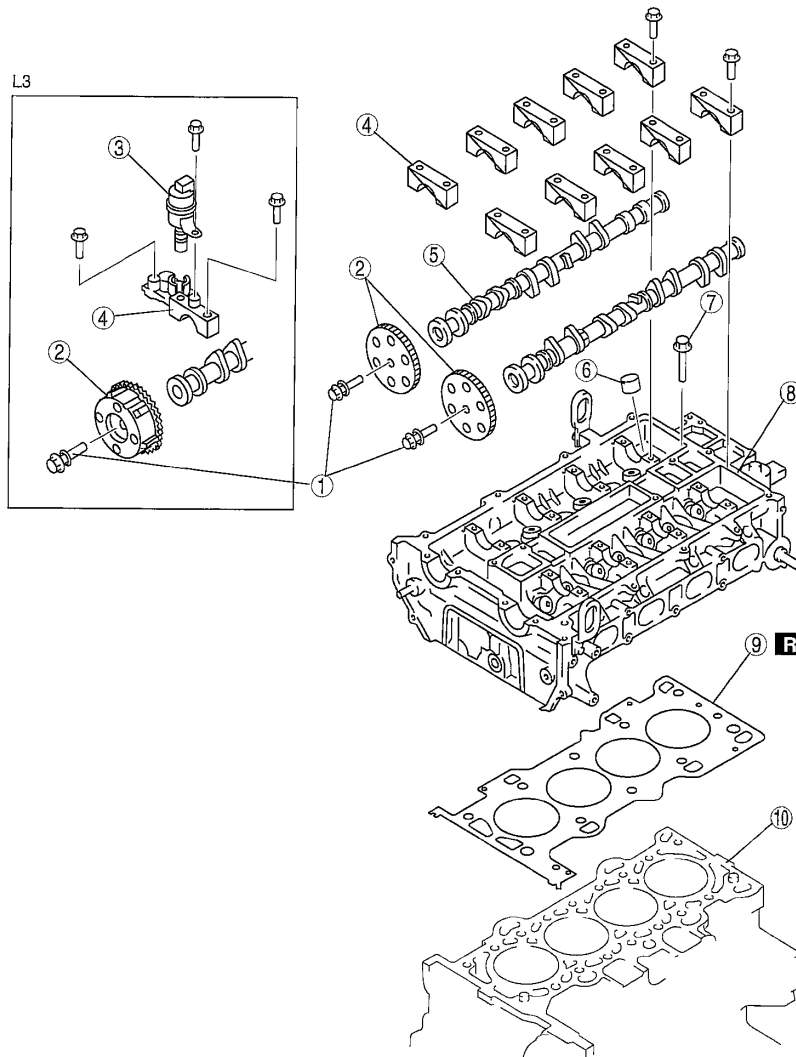
1. Hold the oil pump sprocket using the SST .



**Fig. 9: Holding Oil Pump Sprocket**  
Courtesy of MAZDA MOTORS CORP.

## CYLINDER HEAD (I) DISASSEMBLY

1. Disassemble in the order indicated in the figure.



|   |                                                                                                                                                                                  |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Camshaft sprocket lock bolt, variable valve timing actuator lock bolt (L3)<br>(See Camshaft Sprocket Lock Bolt, Variable Valve Timing Actuator Lock Bolt (L3) Disassembly Note.) |
| 2 | Camshaft sprocket, variable valve timing actuator (L3 (with variable valve timing mechanism))                                                                                    |
| 3 | Oil control valve (OCV) (L3 (with variable valve timing mechanism))                                                                                                              |
| 4 | Camshaft cap<br>(See Camshaft Cap Disassembly Note.)                                                                                                                             |

|    |                                                                  |
|----|------------------------------------------------------------------|
| 5  | Camshaft                                                         |
| 6  | Tappet<br>(See Tappet Disassembly Note.)                         |
| 7  | Cylinder head bolt<br>(See Cylinder Head Bolt Disassembly Note.) |
| 8  | Cylinder head                                                    |
| 9  | Cylinder head gasket                                             |
| 10 | Cylinder block                                                   |

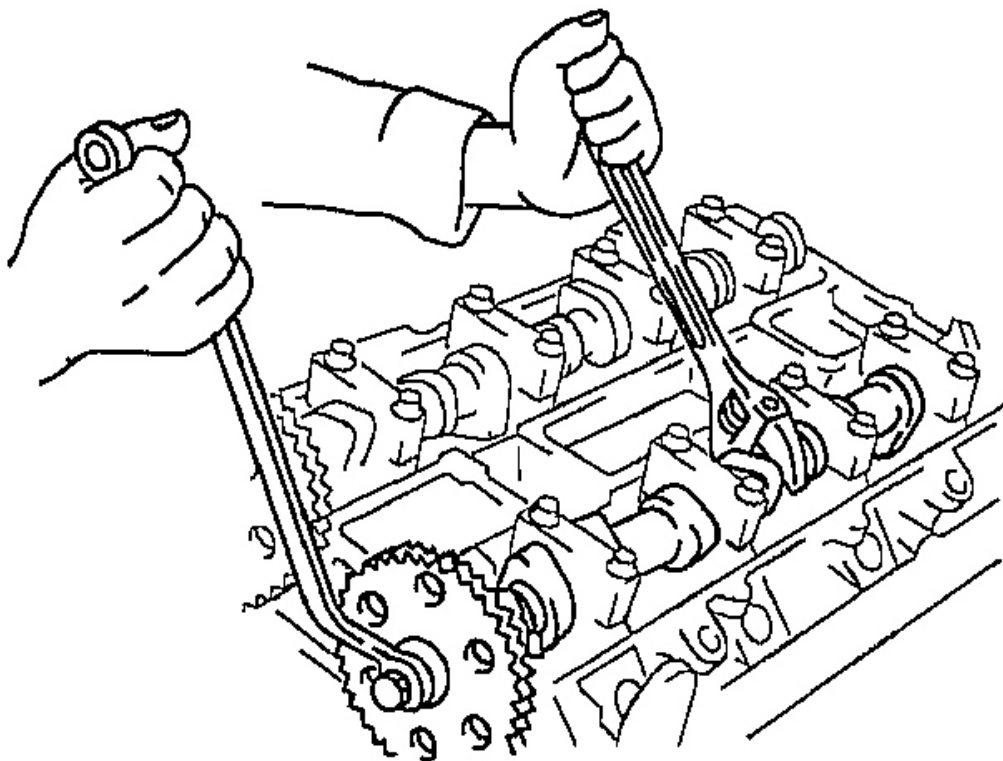
G02831566

**Fig. 10: Disassembling Cylinder Head (I)**  
Courtesy of MAZDA MOTORS CORP.

## CAMSHAFT SPROCKET LOCK BOLT, VARIABLE VALVE TIMING ACTUATOR LOCK BOLT (L3) DISASSEMBLY NOTE

1. Hold the camshaft by using a wrench on the cast hexagon as shown, and loosen the camshaft sprocket installation bolt or variable valve timing actuator installation bolt (L3).

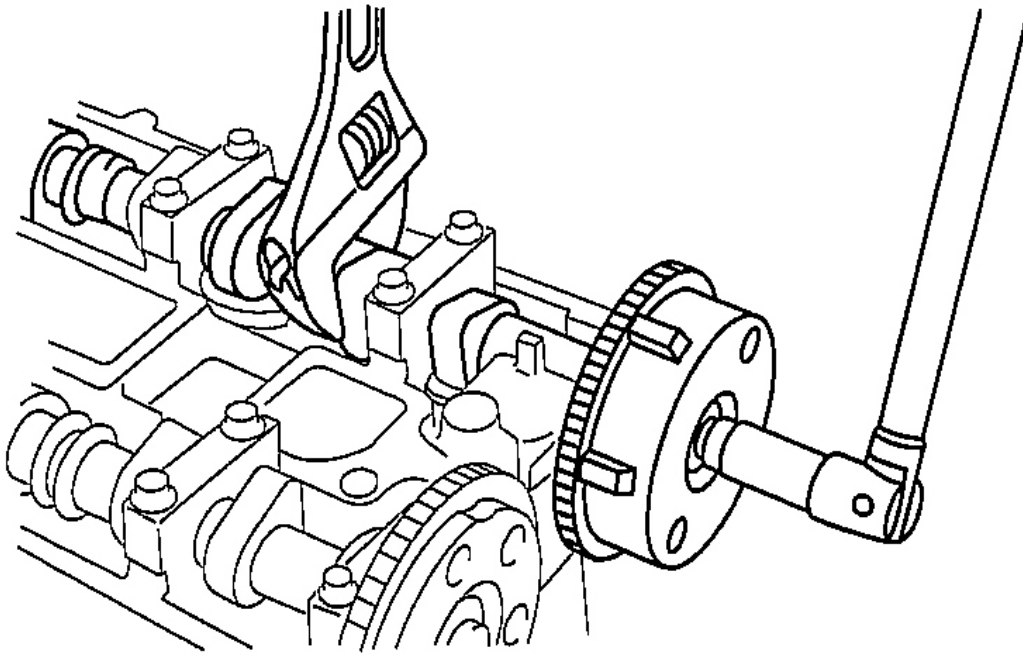
**LF**



**G02831567**

**Fig. 11: Removing Camshaft Sprocket Bolt (LF)**  
Courtesy of MAZDA MOTORS CORP.

**L3**



G02831568

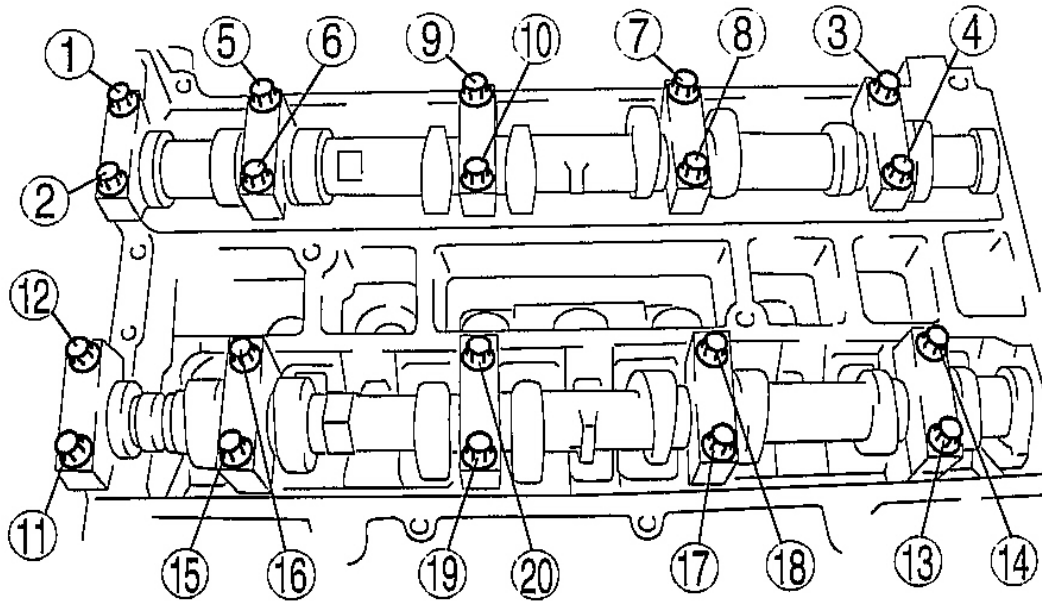
**Fig. 12: Removing Camshaft Sprocket Bolt (L3)**  
Courtesy of MAZDA MOTORS CORP.

#### CAMSHAFT CAP DISASSEMBLY NOTE

**NOTE:**

- The camshaft caps are numbered to make sure they are assembled in their original positions. When removed, keep the caps with the cylinder head they were removed from. Do not mix the caps.

1. Before removing the camshaft caps, inspect the following:
  - Camshaft end play and camshaft journal oil clearance (See **CAMSHAFT INSPECTION.**)
2. Loosen the camshaft caps bolts in 2-3 passes in the order shown in the figure.



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**Fig. 13: Camshaft Cap Bolt Removal Sequence**  
 Courtesy of MAZDA MOTORS CORP.

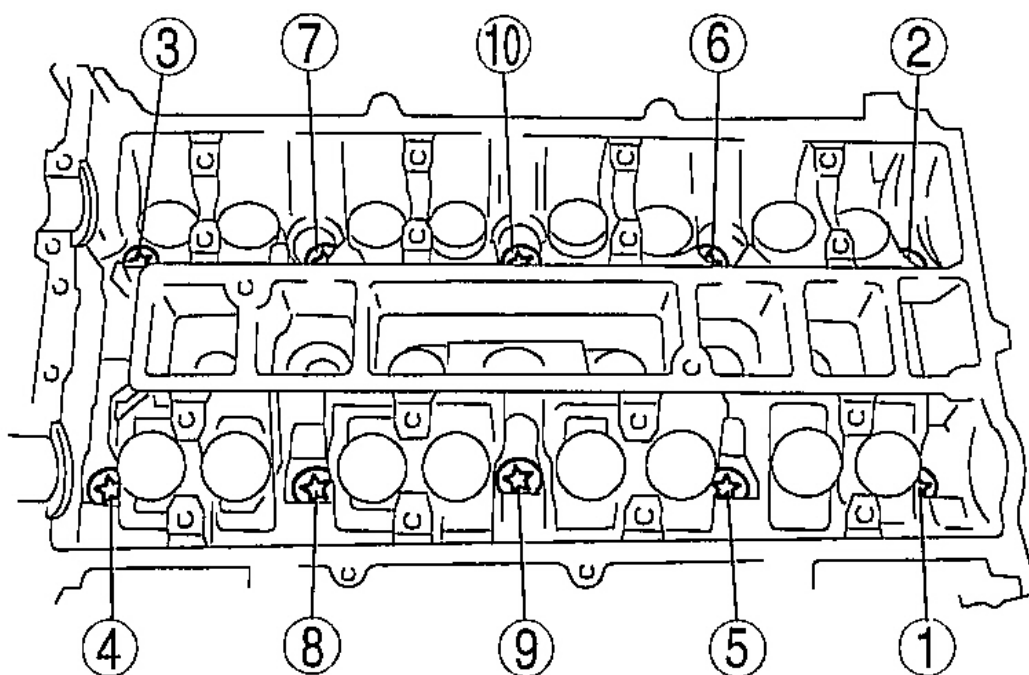
#### TAPPET DISASSEMBLY NOTE

**NOTE:**

- The tappets are numbered to make sure they are assembled in their original positions. When removed, keep the tappets with the cylinder head they were removed from. Do not mix the tappets.

#### CYLINDER HEAD BOLT DISASSEMBLY NOTE

1. Loosen the cylinder head bolts in 2-3 passes in the order shown in the figure.

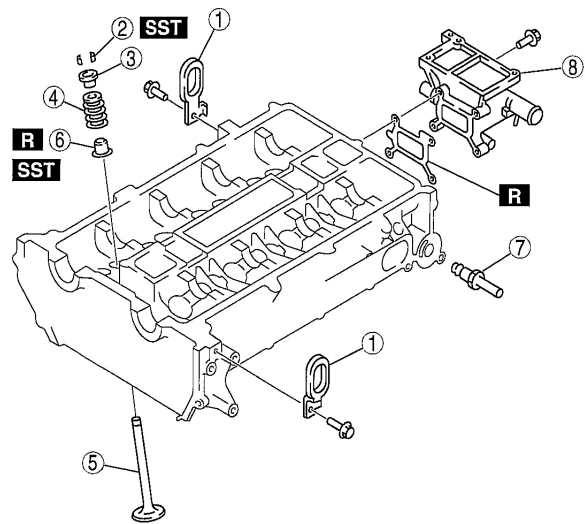


G02831570

**Fig. 14: Cylinder Head Bolt Removal Sequence**  
Courtesy of MAZDA MOTORS CORP.

## CYLINDER HEAD (II) DISASSEMBLY

1. Disassemble in the order indicated in the figure.



|   |                                                      |
|---|------------------------------------------------------|
| 1 | Engine hanger                                        |
| 2 | Valve keeper<br>(See Valve Keeper Disassembly Note.) |
| 3 | Upper valve spring seat                              |
| 4 | Valve spring                                         |

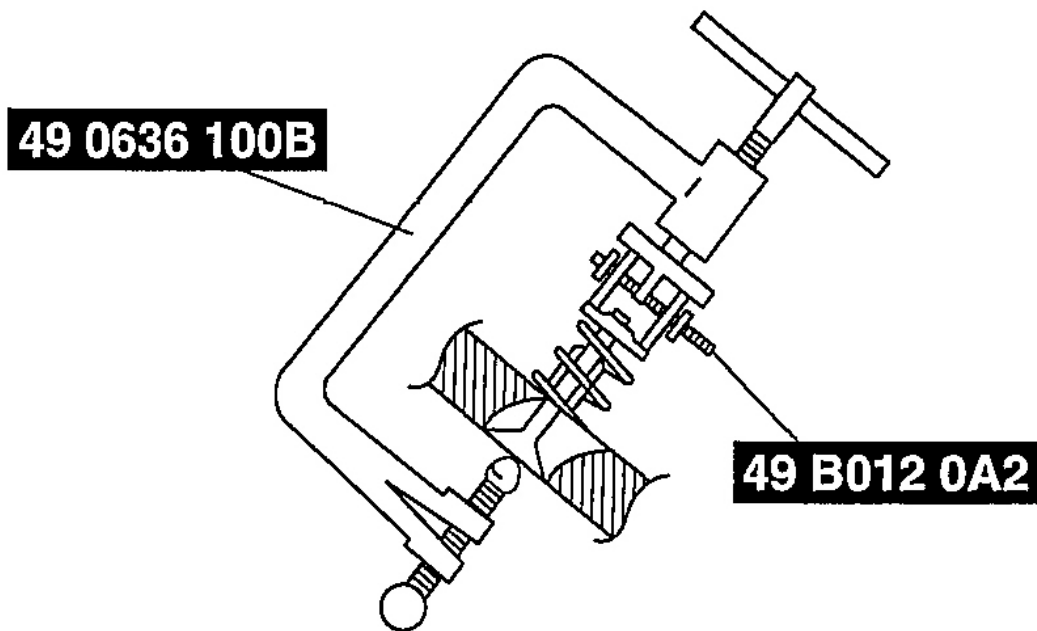
|   |                                                  |
|---|--------------------------------------------------|
| 5 | Valve                                            |
| 6 | Valve seal<br>(See Valve Seal Disassembly Note.) |
| 7 | EGR pipe                                         |
| 8 | Water outlet                                     |

G02831571

**Fig. 15: Disassembling Cylinder Head (II)**  
**Courtesy of MAZDA MOTORS CORP.**

**VALVE KEEPER DISASSEMBLY NOTE**

1. Remove the valve keeper using the SSTs .

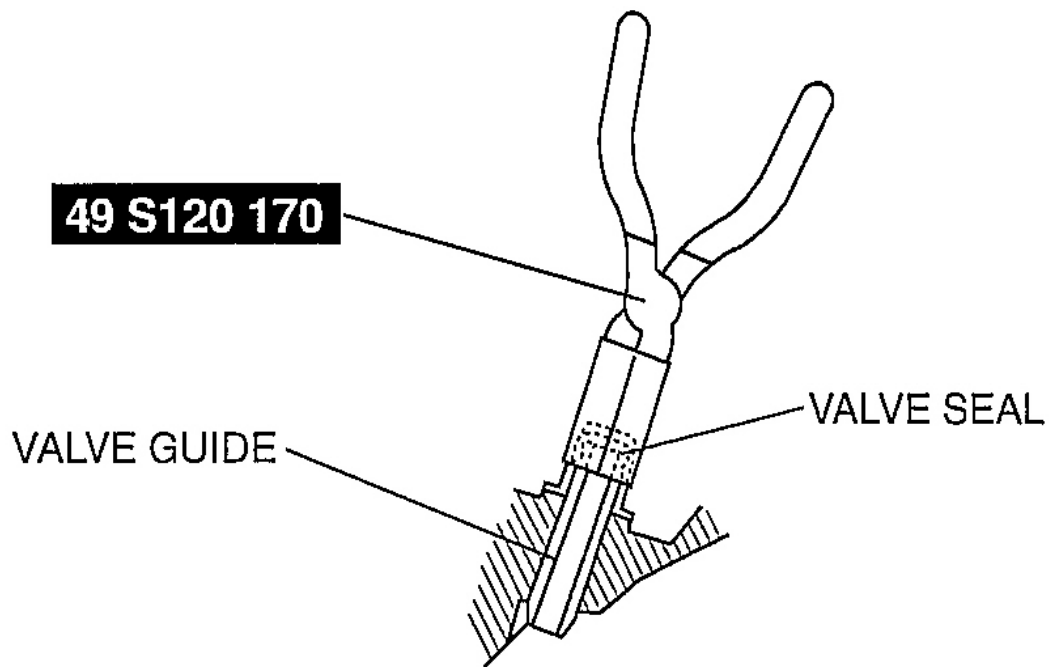


G02831572

**Fig. 16: Removing Valve Keeper**  
Courtesy of MAZDA MOTORS CORP.

#### VALVE SEAL DISASSEMBLY NOTE

1. Remove the valve seal using the SST .

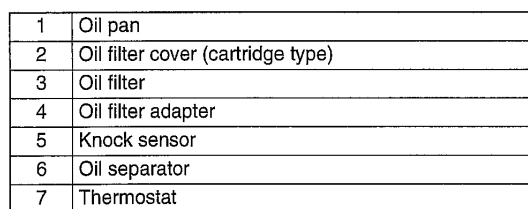


G02831573

**Fig. 17: Removing Valve Seal**  
Courtesy of MAZDA MOTORS CORP.

## CYLINDER BLOCK (I) DISASSEMBLY

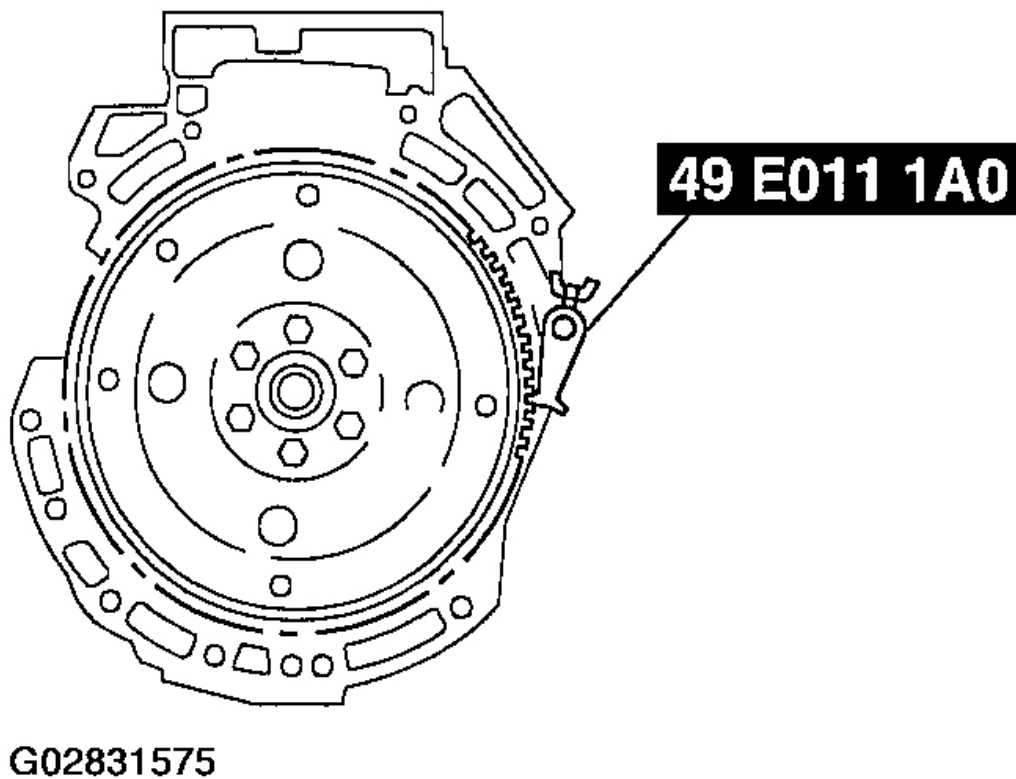
1. Disassemble in the order indicated in the figure.



|    |                                                                                            |
|----|--------------------------------------------------------------------------------------------|
| 8  | Water pump                                                                                 |
| 9  | Oil strainer                                                                               |
| 10 | Oil pump                                                                                   |
| 11 | Flywheel (MTX), Drive plate (ATX) (See Drive Plate (ATX), Flywheel (MTX) Disassembly Note) |
| 12 | Rear oil seal                                                                              |

**Fig. 18: Disassembling Cylinder Block (I)**  
**Courtesy of MAZDA MOTORS CORP.**

1. Hold the crankshaft using the **SST** .

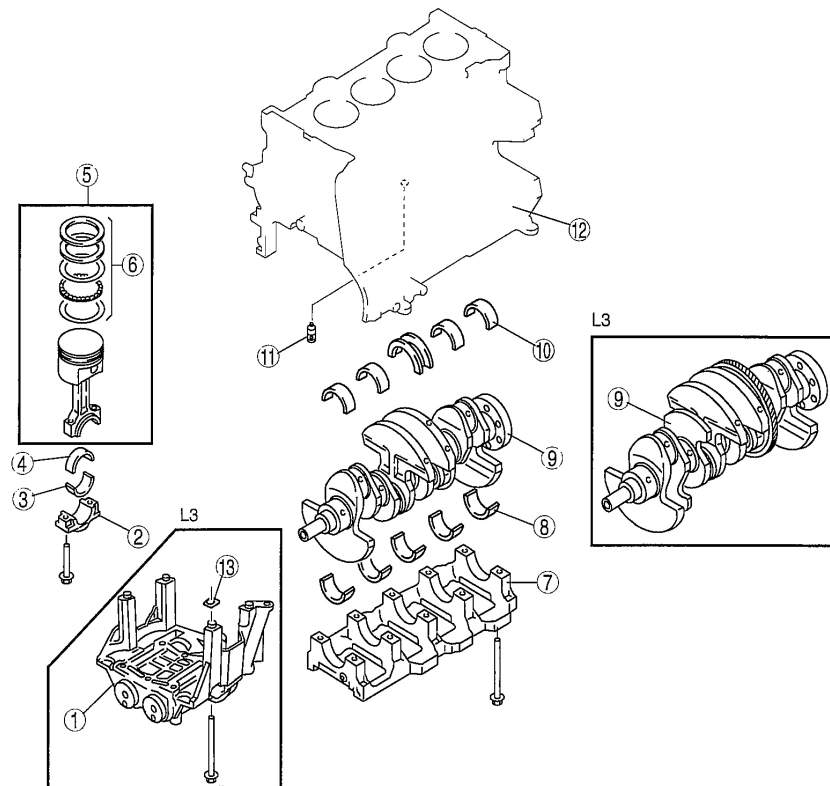


**Fig. 19: Holding Crankshaft**  
Courtesy of MAZDA MOTORS CORP.

2. Remove the bolts in several passes.

## CYLINDER BLOCK (II) DISASSEMBLY

1. Disassemble in the order indicated in the figure.



|   |                                                                  |
|---|------------------------------------------------------------------|
| 1 | Balancer unit (L3)                                               |
| 2 | Connecting rod cap<br>(See Connecting Rod Cap Disassembly Note.) |
| 3 | Lower connecting rod bearing                                     |
| 4 | Upper connecting rod bearing                                     |
| 5 | Connecting rod, Piston component                                 |
| 6 | Piston ring                                                      |

|    |                                                              |
|----|--------------------------------------------------------------|
| 7  | Main bearing cap<br>(See Main Bearing Cap Disassembly Note.) |
| 8  | Lower main bearing, thrust bearing                           |
| 9  | Crankshaft                                                   |
| 10 | Upper main bearing, thrust bearing                           |
| 11 | Oil jet valve                                                |
| 12 | Cylinder block                                               |
| 13 | Adjustment shim                                              |

G02831576

**Fig. 20: Identifying Cylinder Block (II) & Balancer Unit Components**  
Courtesy of MAZDA MOTORS CORP.

### CONNECTING ROD CAP DISASSEMBLY NOTE

1. Inspect the connecting rod side clearance. (See CONNECTING ROD INSPECTION.)

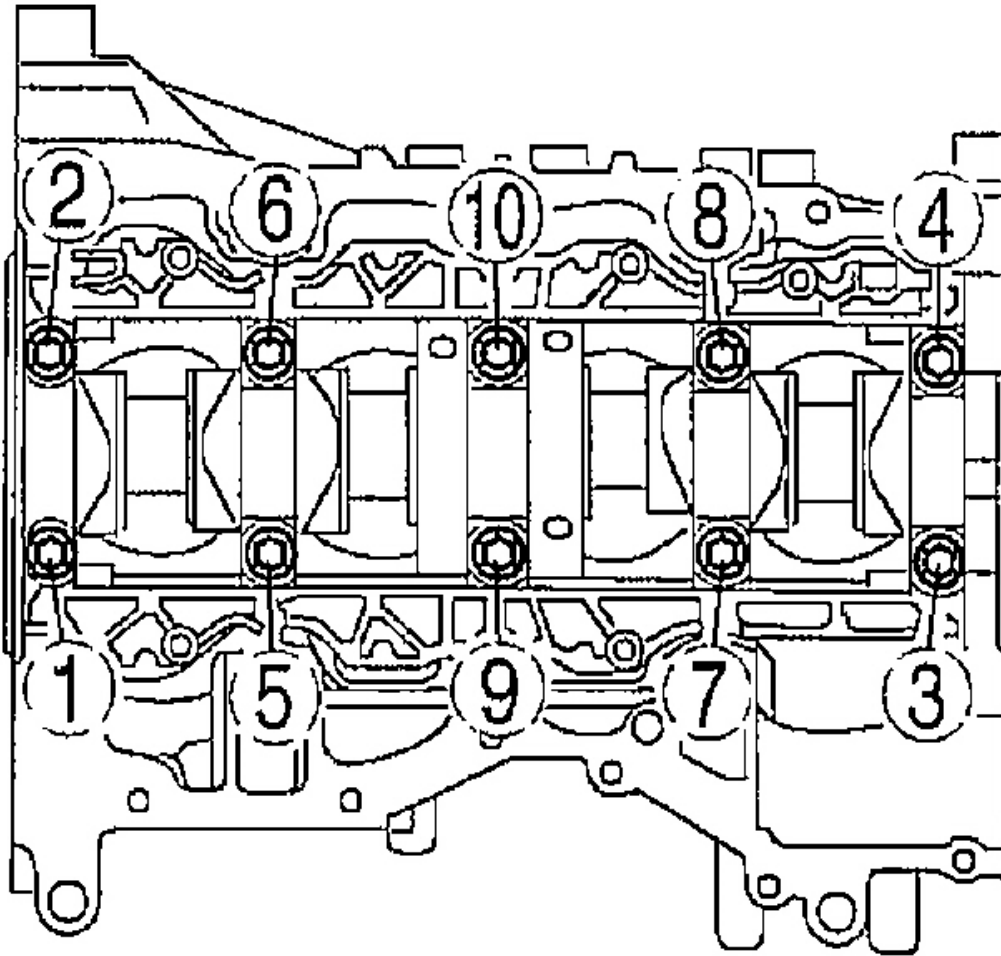
#### NOTE:

- The tappets are numbered to make sure they are assembled in their original positions. When removed, keep the tappets with the cylinder head they were removed from. Do not mix the tappets.

2. Remove the connecting rod bolt from the connecting rod cap by tapping the bolt with a plastic hammer.

### MAIN BEARING CAP DISASSEMBLY NOTE

1. Inspect the crankshaft end play. (See **CRANKSHAFT INSPECTION**.)
2. Loosen the main bearing cap bolts in two or three steps in the order shown in the figure.



G02831577

**Fig. 21: Main Bearing Cap Bolt Loosening Sequence**  
Courtesy of MAZDA MOTORS CORP.

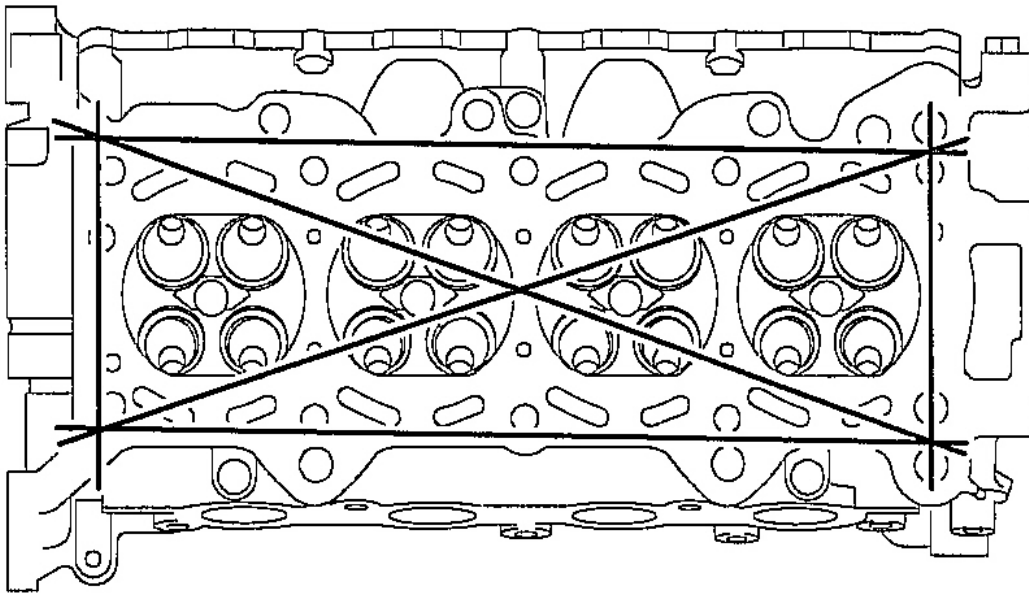
## CYLINDER HEAD INSPECTION

1. Perform color contrast penetrate examination on the cylinder head surface.
  - Replace the cylinder head if necessary.
2. Inspect for the following and repair or replace if necessary.

1. Sunken valve seats.
2. Excessive camshaft oil clearance and end play.
3. Measure the cylinder head for distortion in six directions as shown in the figure.
  - If it exceeds the maximum specification, replace the cylinder head.

**Maximum Distortion**

- 0.10 mm {0.004 in}



G02831578

**Fig. 22: Measuring Cylinder Head Distortion**

Courtesy of MAZDA MOTORS CORP.

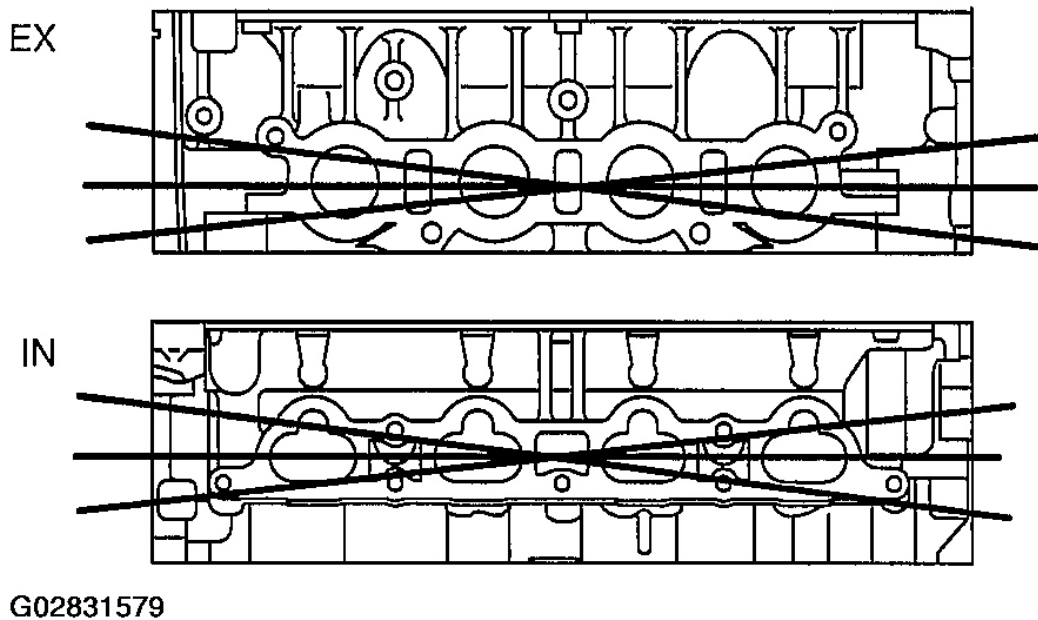
4. Measure the manifold contact surface distortion as shown in the figure.
  - If it exceeds the maximum specification, grind the surface or replace the cylinder head.

**Maximum Distortion**

0.10 mm {0.004 in}

**Maximum Grinding**

0.15 mm {0.006 in}



**Fig. 23: Measuring Manifold Contact Surface Distortion**  
Courtesy of MAZDA MOTORS CORP.

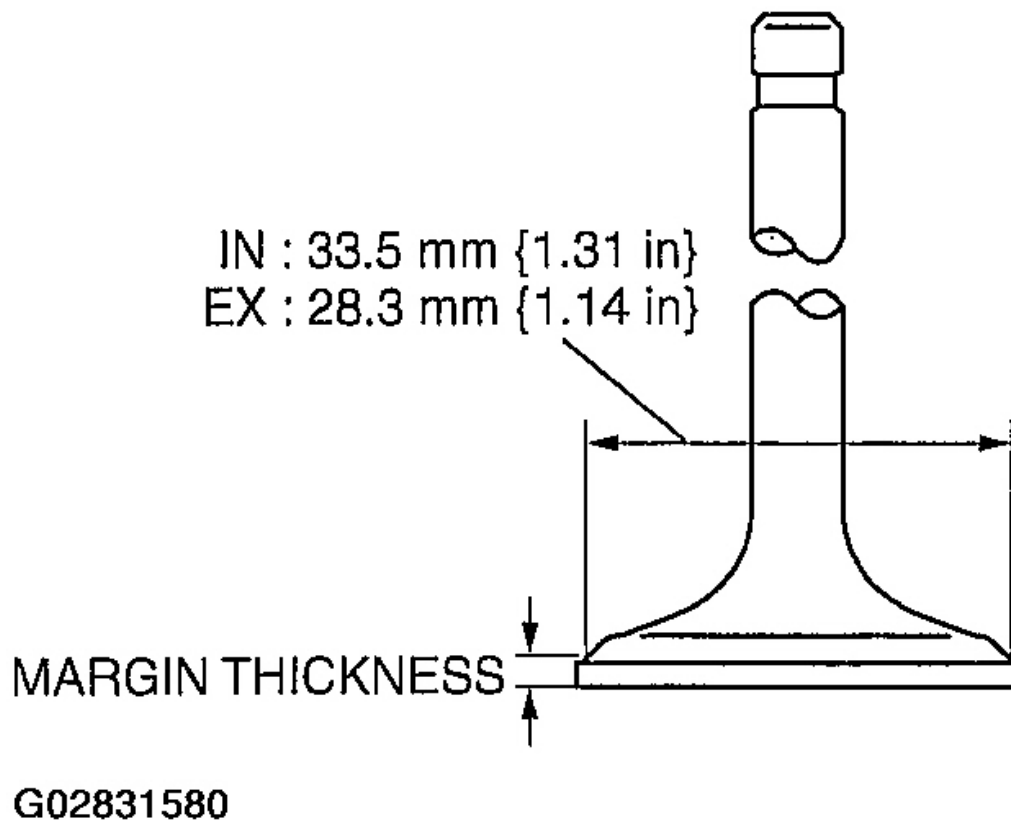
## VALVE, VALVE GUIDE INSPECTION

1. Measure the valve head margin thickness of each valve.
  - If it is less than the specification, replace the valve.

### Margin Thickness

**IN: 1.62 mm {0.0637 in}**

**EX: 1.82 mm {0.0716 in}**



**Fig. 24: Measuring Valve Head Margin Thickness**  
Courtesy of MAZDA MOTORS CORP.

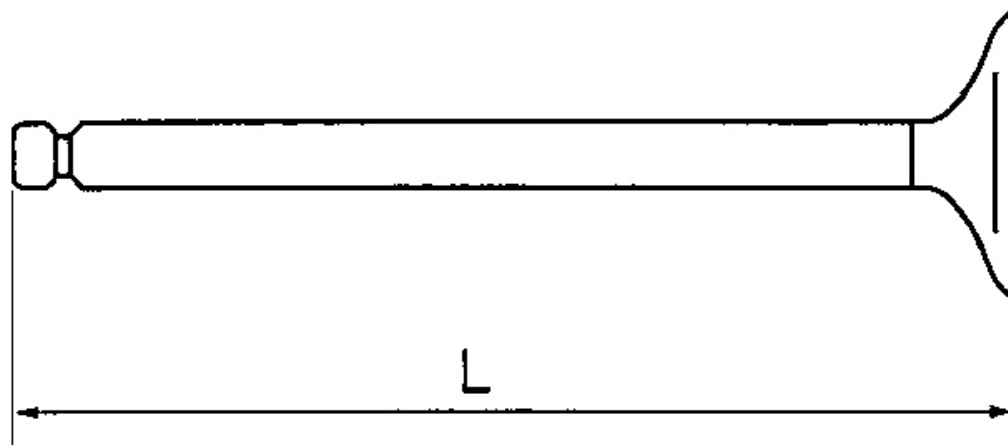
2. Measure the length of each valve. Replace the valve if necessary.
  - If it is less than the specification, replace the valve.

**Standard Length L**

IN: 102.99-103.79 mm {4.055-4.086 in}  
EX: 104.25-105.05 mm {4.105-4.135 in}

**Minimum Length L**

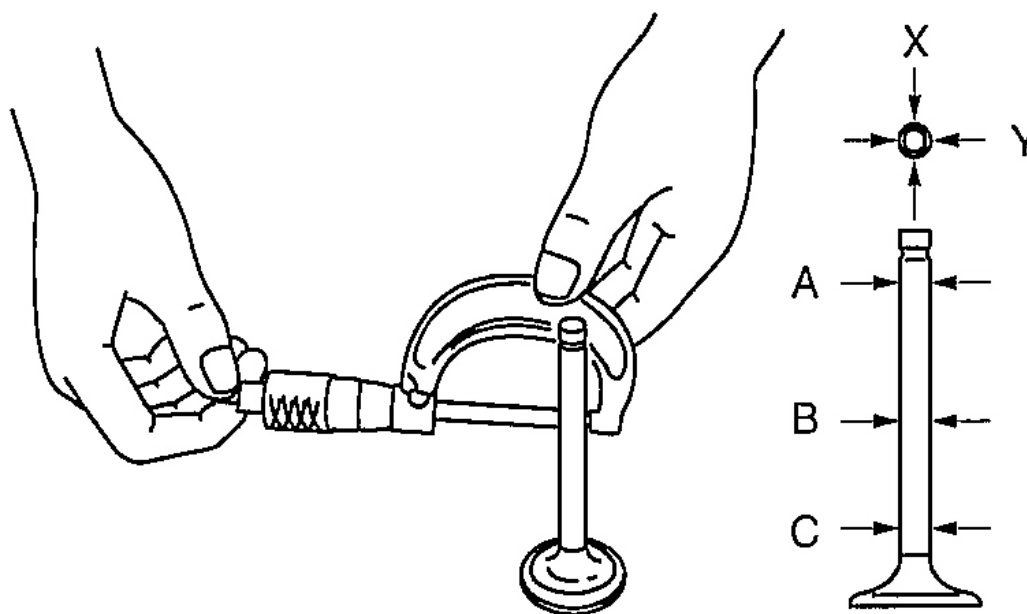
IN: 102.99 mm {4.055 in}  
EX: 104.25 mm {4.104 in}

**G02831581**

**Fig. 25: Measuring Valve Length**  
**Courtesy of MAZDA MOTORS CORP.**

3. Measure the stem diameter of each valve in X and Y directions at the three points (A, B, and C) as indicated in the figure.
  - If it exceeds the specification, replace the valve.

**Standard Diameter****IN: 5.470-5.485 mm {0.2154-0.2159 in}****EX: 5.465-5.480 mm {0.2152-0.2157 in}****Minimum Diameter****IN: 5.440 mm {0.2142 in}****EX: 5.435 mm {0.2140 in}**



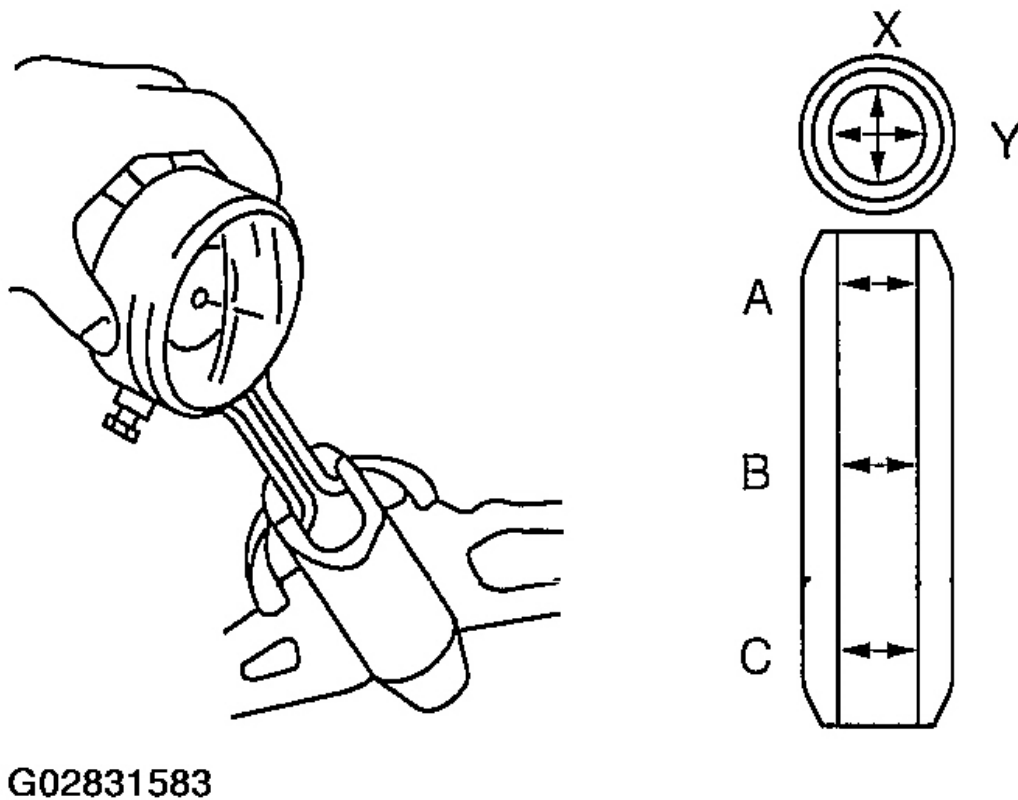
G02831582

**Fig. 26: Measuring Valve Stem Diameter**  
Courtesy of MAZDA MOTORS CORP.

4. Measure the inner diameter of each valve guide in X and Y directions at the three points (A, B, and C) as indicated in the figure.
  - If not as specified, replace the valve guide.

**Standard Inner Diameter**

**5.509-5.539 mm {0.2169-0.2180 in}**



G02831583

**Fig. 27: Measuring Valve Inner Diameter**  
**Courtesy of MAZDA MOTORS CORP.**

5. Calculate the valve stem to guide clearance by subtracting the outer diameter of the valve stem from the inner diameter of the corresponding valve guide.
  - If it exceeds the specification, replace the valve and/or the valve guide.

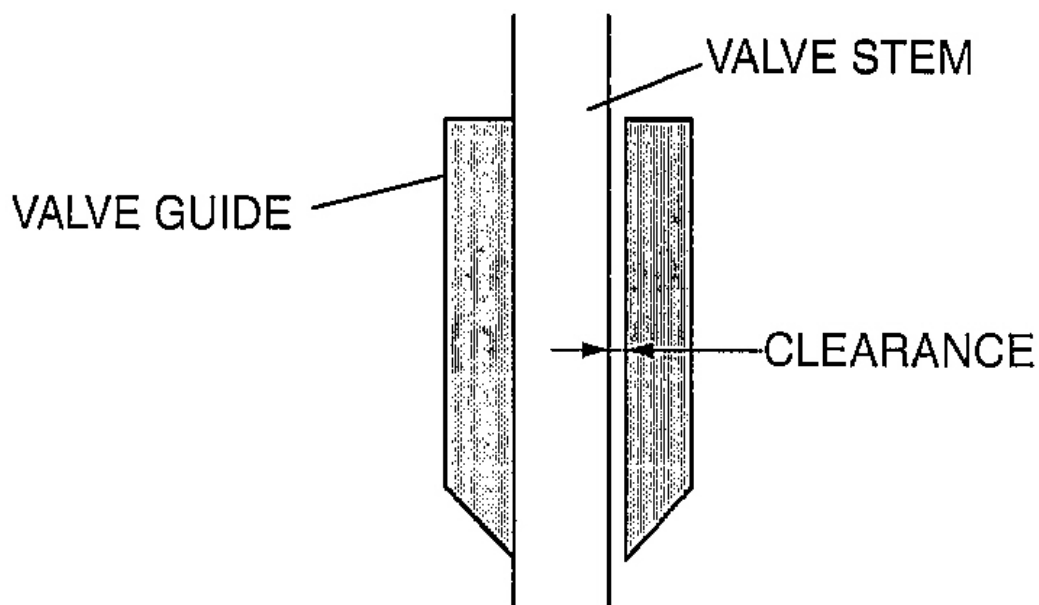
**Standard Clearance**

**IN: 0.024-0.069 mm {0.0009-0.0027 in}**

**EX: 0.029-0.074 mm {0.0012-0.0029 in}**

**Maximum Clearance**

**0.10 mm {0.004 in}**



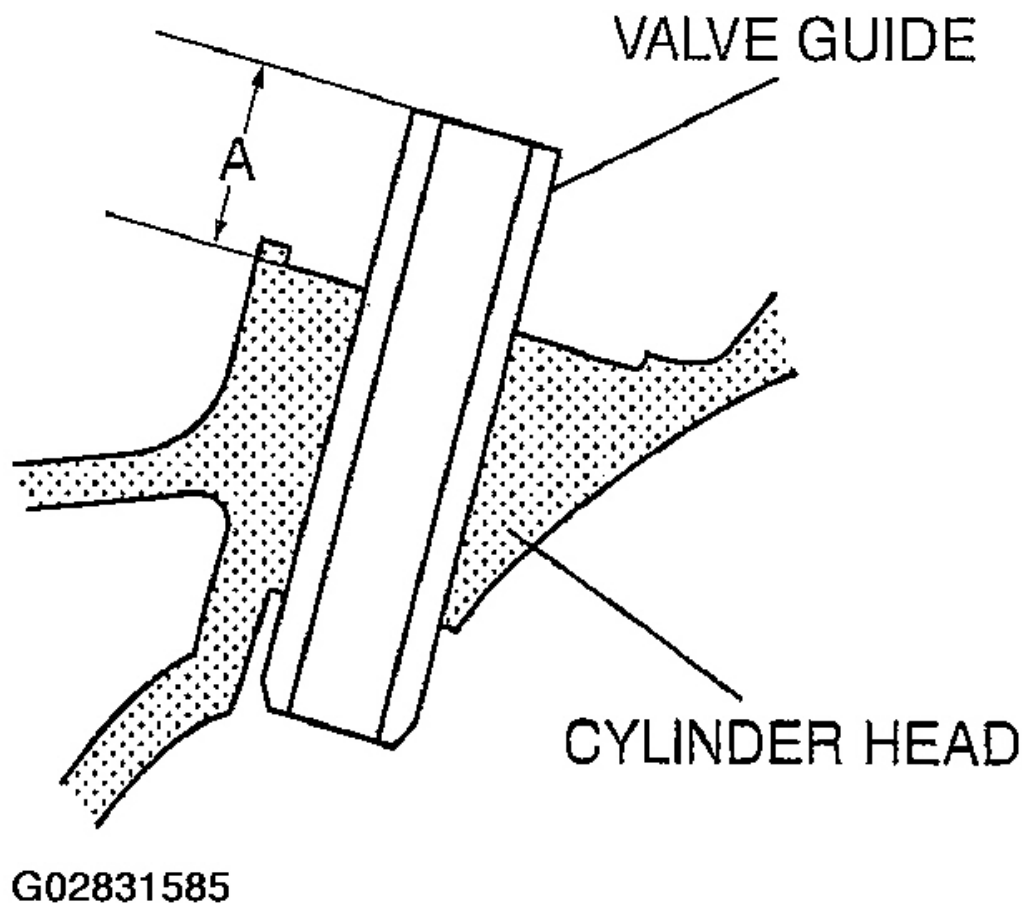
G02831584

**Fig. 28: Measuring Valve Stem Clearance**  
Courtesy of MAZDA MOTORS CORP.

6. Measure the protrusion height (dimension A) of each valve guide without lower valve spring seat.
  - If not within the specified, replace the valve guide.

**Standard Height**

**12.2-12.8 mm {0.481-0.503 in}**

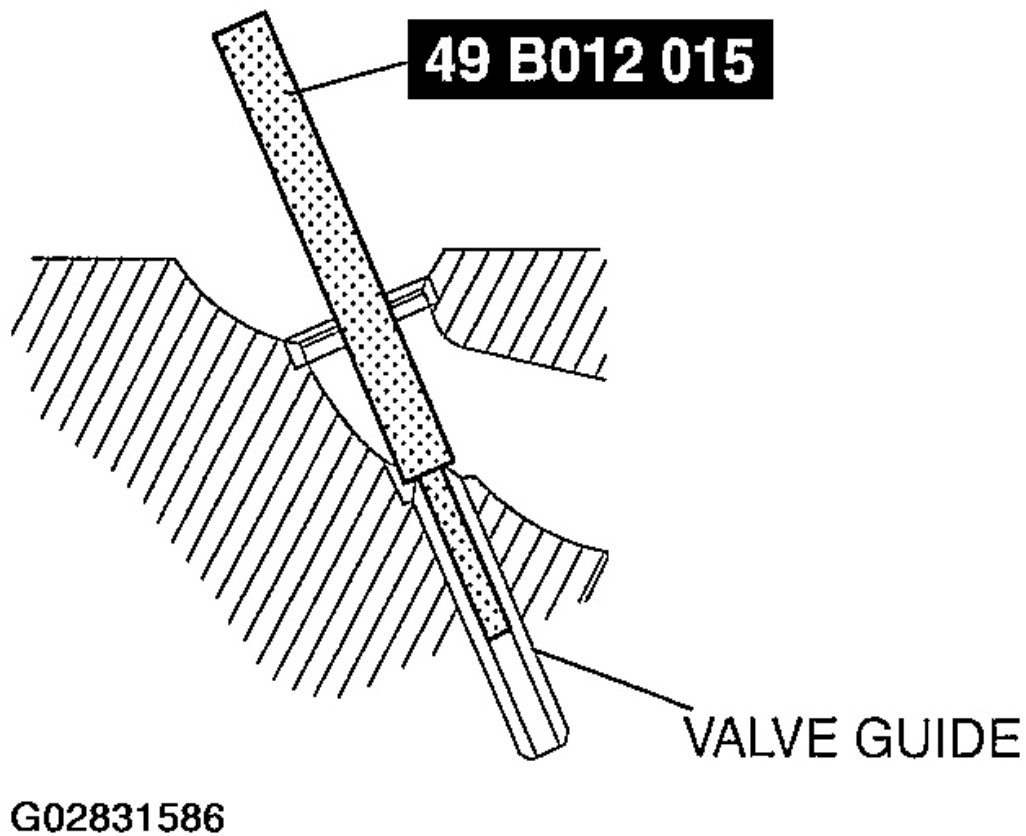


**Fig. 29: Measuring Valve Guide Protrusion Height**  
Courtesy of MAZDA MOTORS CORP.

## VALVE GUIDE REPLACEMENT

### VALVE GUIDE REMOVAL

1. Remove the valve guide from the combustion chamber side using the SST .



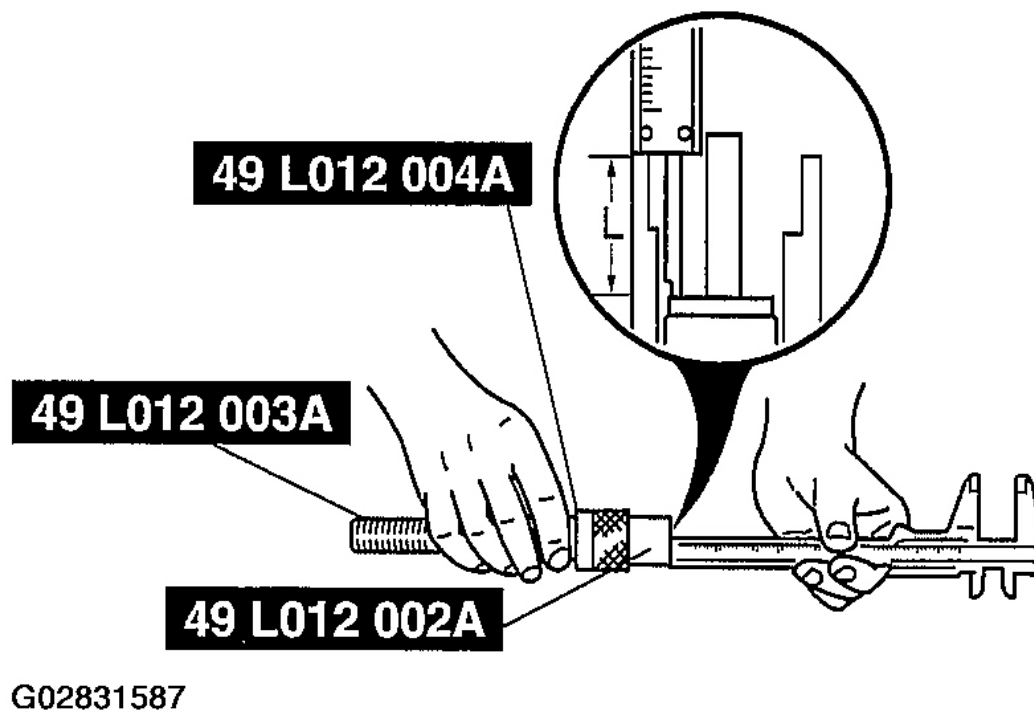
**Fig. 30: Removing Valve Guide**  
Courtesy of MAZDA MOTORS CORP.

### VALVE GUIDE INSTALLATION

1. Assemble the SSTs so that depth L is as specified.

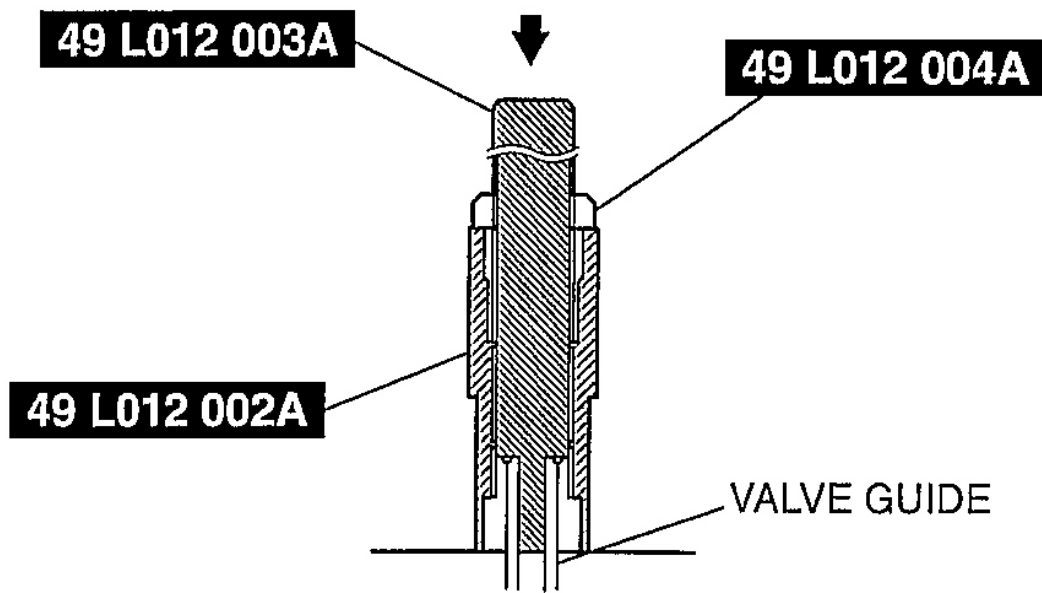
#### Depth L

12.2-12.8 mm {0.481-0.503 in}



**Fig. 31: Identifying Depth L**  
Courtesy of MAZDA MOTORS CORP.

2. Tap the valve guide in from the side opposite the camshaft side until the **SSTs** contacts the cylinder head.



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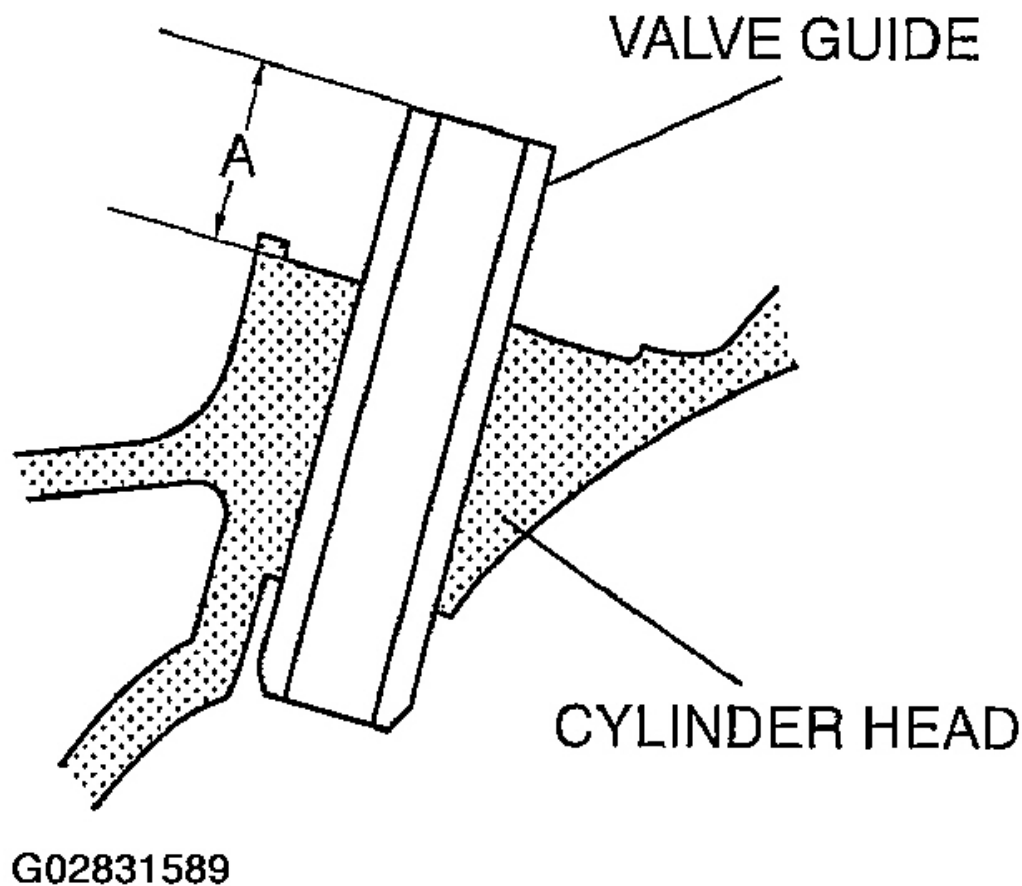
**Fig. 32: Installing Valve Guide**

Courtesy of MAZDA MOTORS CORP.

3. Verify that the valve guide protrusion height (dimension A) is within the specification.

**Standard Height**

12.2-12.8 mm {0.481-0.503 in}



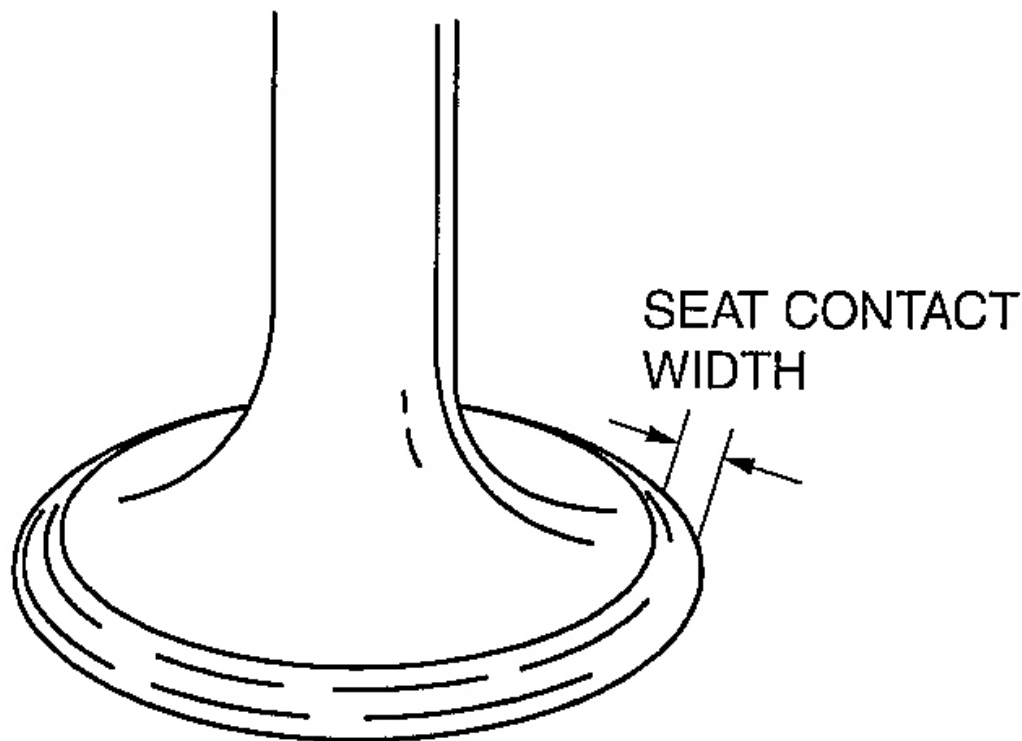
**Fig. 33: Measuring Valve Guide Protrusion Height**  
Courtesy of MAZDA MOTORS CORP.

## VALVE SEAT INSPECTION/REPAIR

1. Measure the seat contact width.
  - If not within the specification, resurface the valve seat using a  $45^\circ$  valve seat cutter and/or resurface the valve face.

### Standard Width

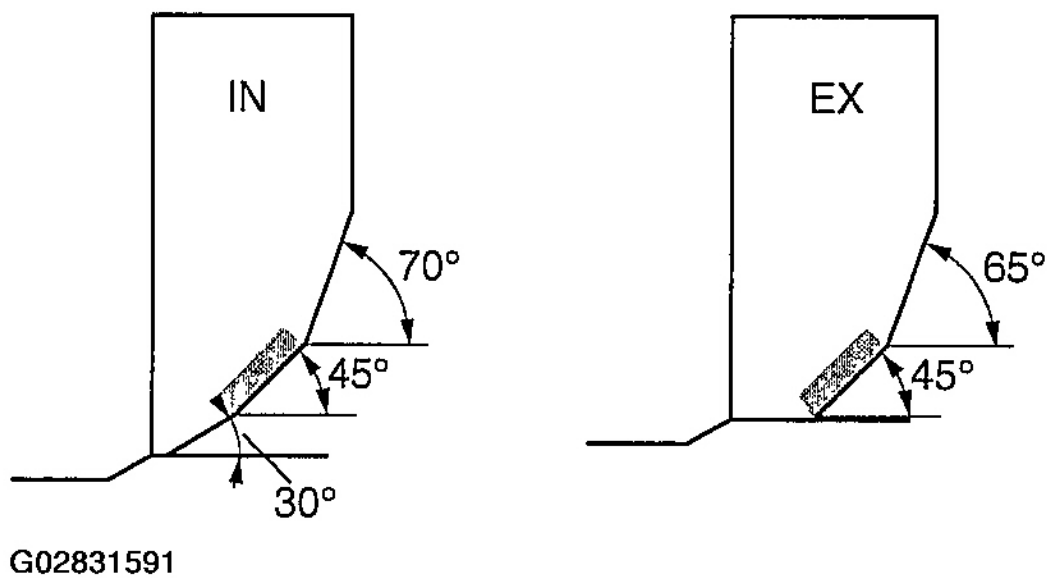
1.2-1.6 mm {0.048-0.062 in}



G02831590

**Fig. 34: Measuring Seat Contact Width**  
Courtesy of MAZDA MOTORS CORP.

2. Verify that the valve seating position is at the center of the valve face.
  1. If the seating position is too out side, correct the valve seat using a **70° (IN)** or **65° (EX)** cutter, and a **45°** cutter.
  2. If the seating position is too inner side, correct the valve seat using a **30° (IN)** cutter, and a **0° (EX)** cutter, and a **45°** cutter.



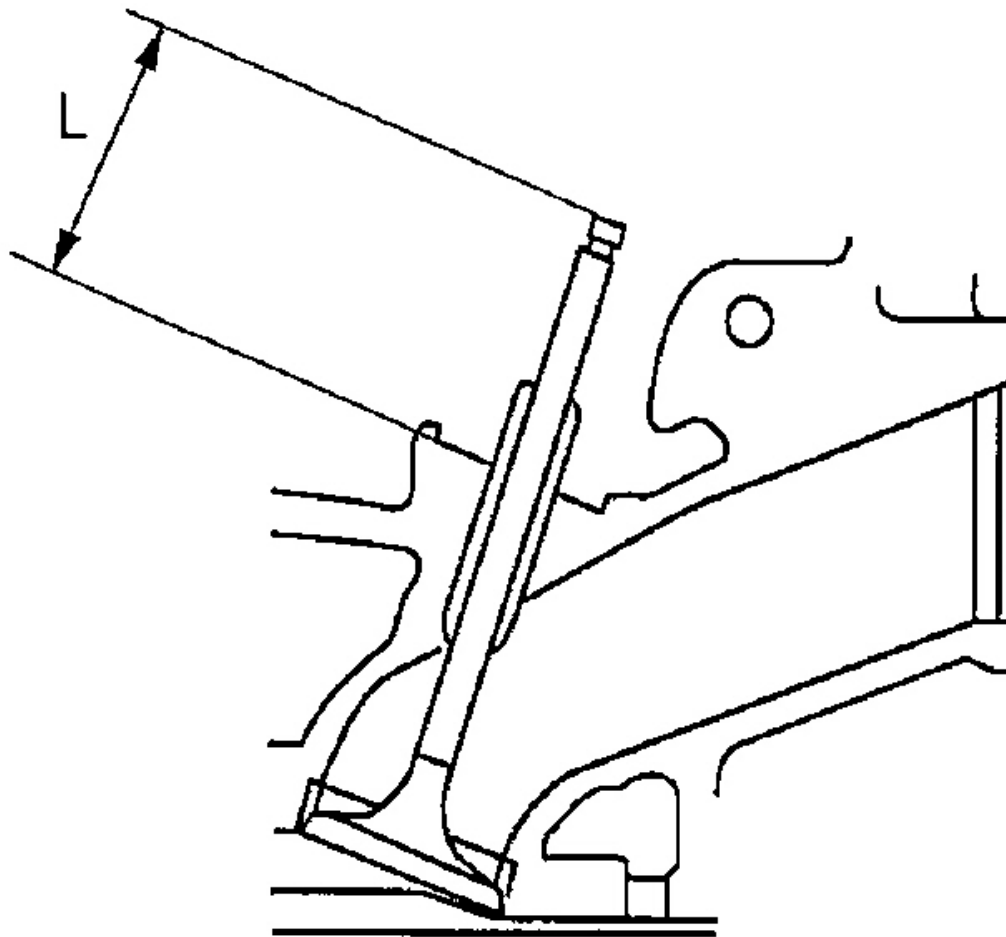
**Fig. 35: Centering Valve Seating Position**  
Courtesy of MAZDA MOTORS CORP.

3. Inspect the sinking of the valve seat. Measure the protruding length (dimension L) of the valve stem.
  - If not specified, replace the cylinder head.

**Standard Dimension L**

**IN:** 40.64-42.24 mm {1.600-1.662 in}

**EX:** 40.50-42.10 mm {1.595-1.657 in}



G02831592

**Fig. 36: Measuring Valve Stem Protruding Length**  
Courtesy of MAZDA MOTORS CORP.

## VALVE SPRING INSPECTION

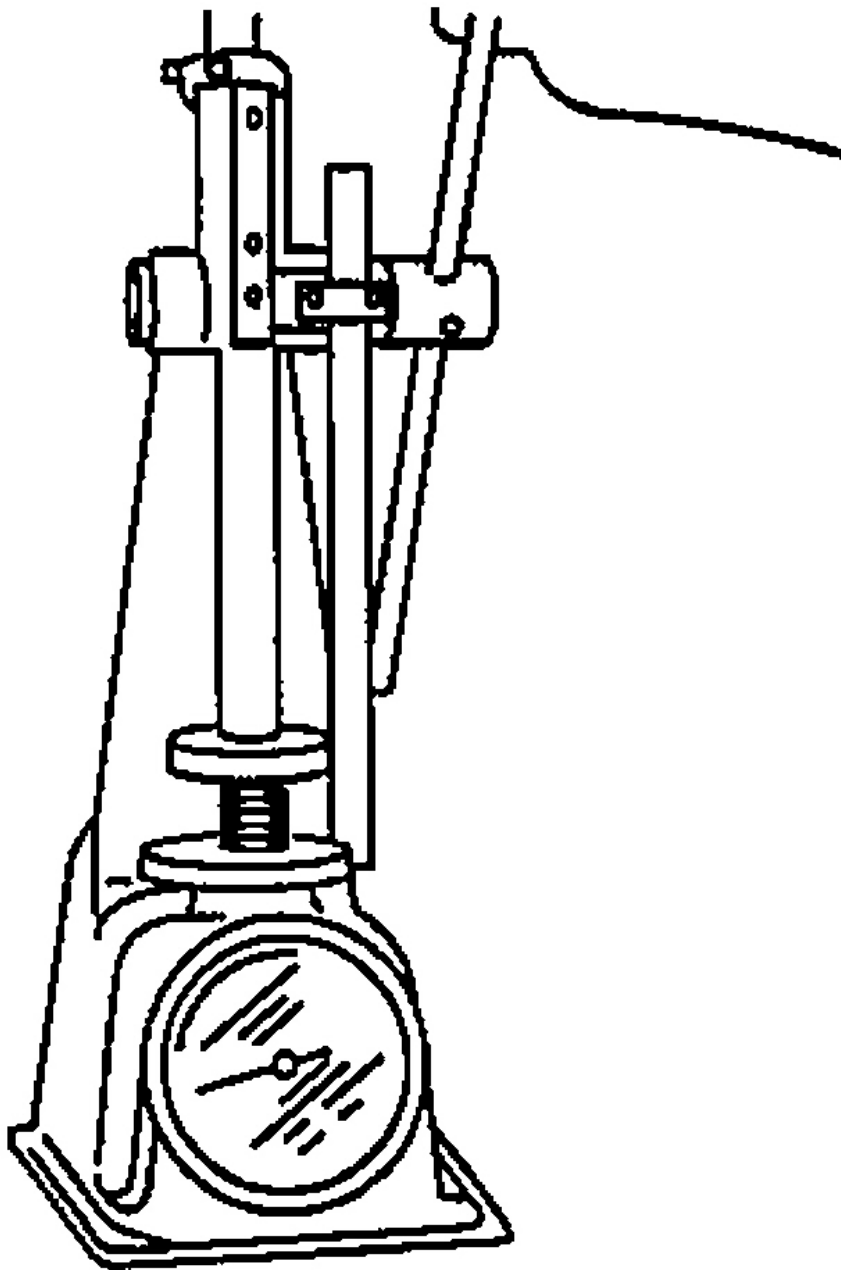
1. Apply pressing force to the pressure spring and inspect the spring height.
  - If it is less than the specification, replace the valve spring.

### Pressing Force

390 N {39.76 kgf, 87.67 lbf}

### Standard Height

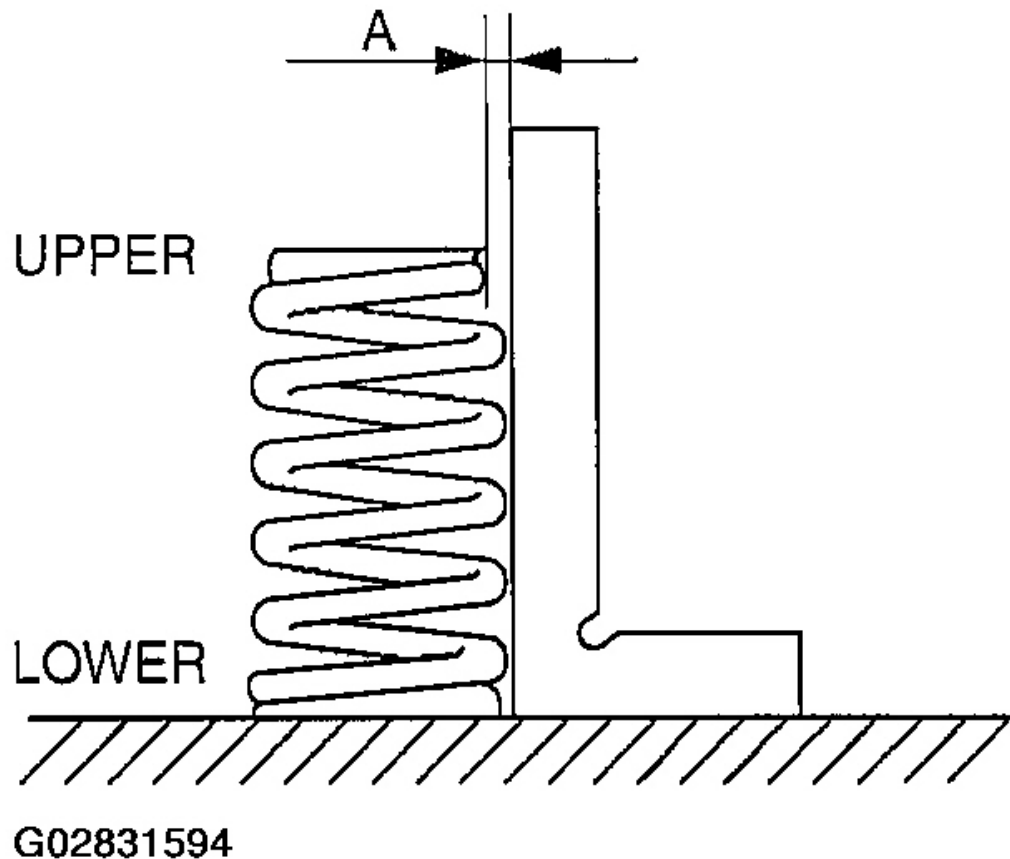
28.68 mm {1.129 in}



G02831593

**Fig. 37: Inspecting Spring Height Under Pressing Force**  
Courtesy of MAZDA MOTORS CORP.

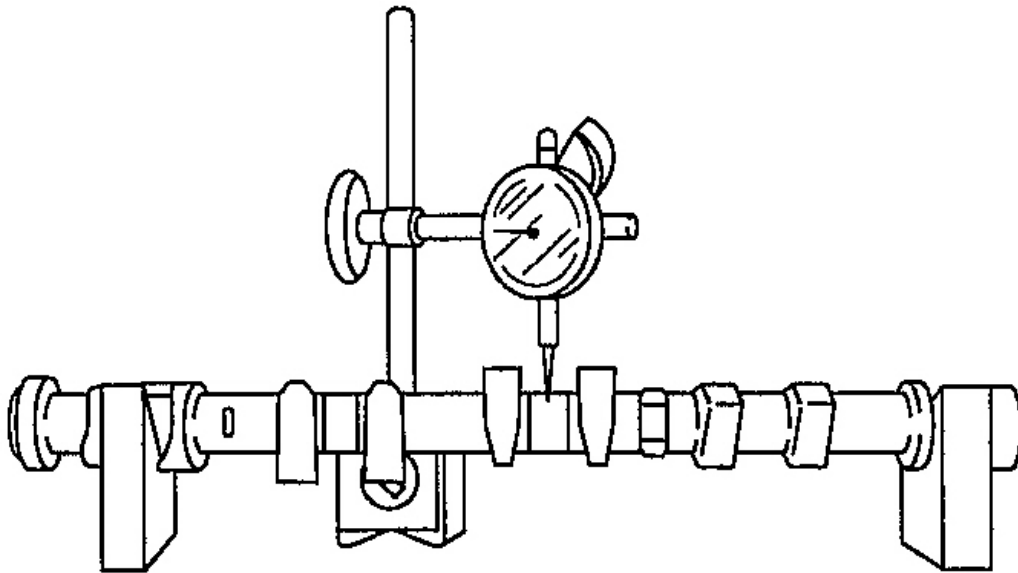
2. Measure the out-of-square of the valve spring, using a square, as shown in the figure.
  1. Rotate the valve spring one full turn and measure "A" at the point where the gap is the largest.
    - If it exceeds the specification, replace the valve spring.

**Valve Spring Maximum Out-Of-Square****1% (2.23 mm {0.0877 in})**

**Fig. 38: Measuring Valve Spring Out-Of-Square**  
Courtesy of MAZDA MOTORS CORP.

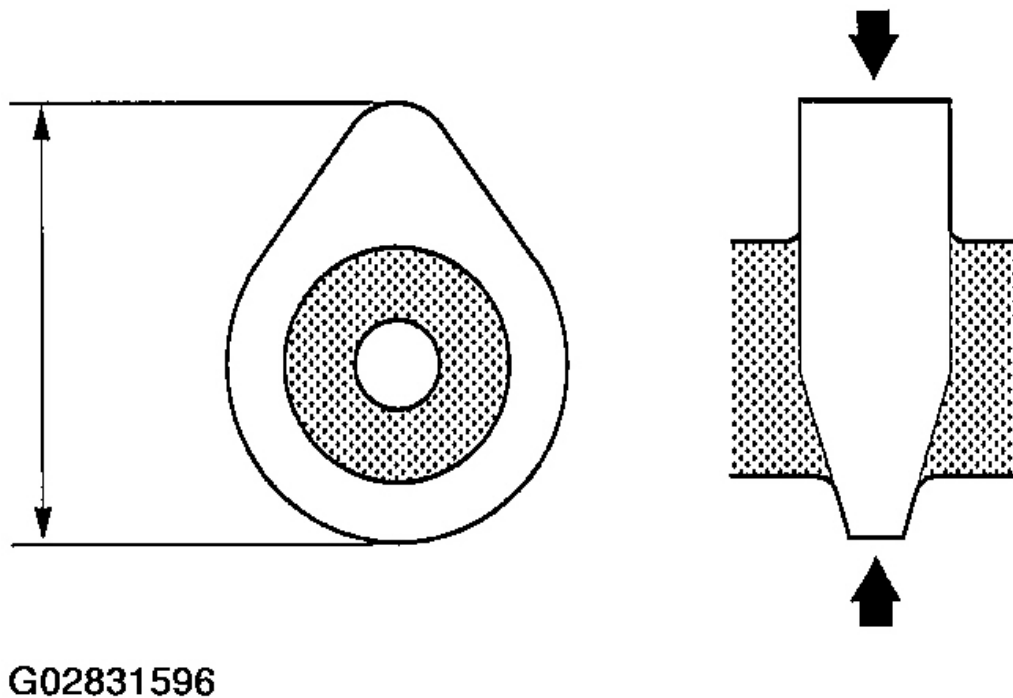
**CAMSHAFT INSPECTION**

1. Set the No.1 and No.5 journals on V-blocks.
2. Measure the camshaft runout.
  - If it exceeds the specification, replace the camshaft.

**Maximum Runout****0.03 mm {0.0012 in}****G02831595**

**Fig. 39: Measuring Camshaft Runout**  
**Courtesy of MAZDA MOTORS CORP.**

3. Measure the cam lobe height at the two points as shown in the figure.
  - If it is less than the specification, replace the camshaft.



**Fig. 40: Measuring Cam Lobe Height**  
 Courtesy of MAZDA MOTORS CORP.

#### CAMSHAFT LOBE STANDARD HEIGHT SPECIFICATIONS

| Camshaft | LF (mm {in})  | L3 (mm {in})  |
|----------|---------------|---------------|
| IN       | 42.12 {1.659} | 42.44 {1.671} |
| EX       | 41.08 {1.618} | 41.18 {1.622} |

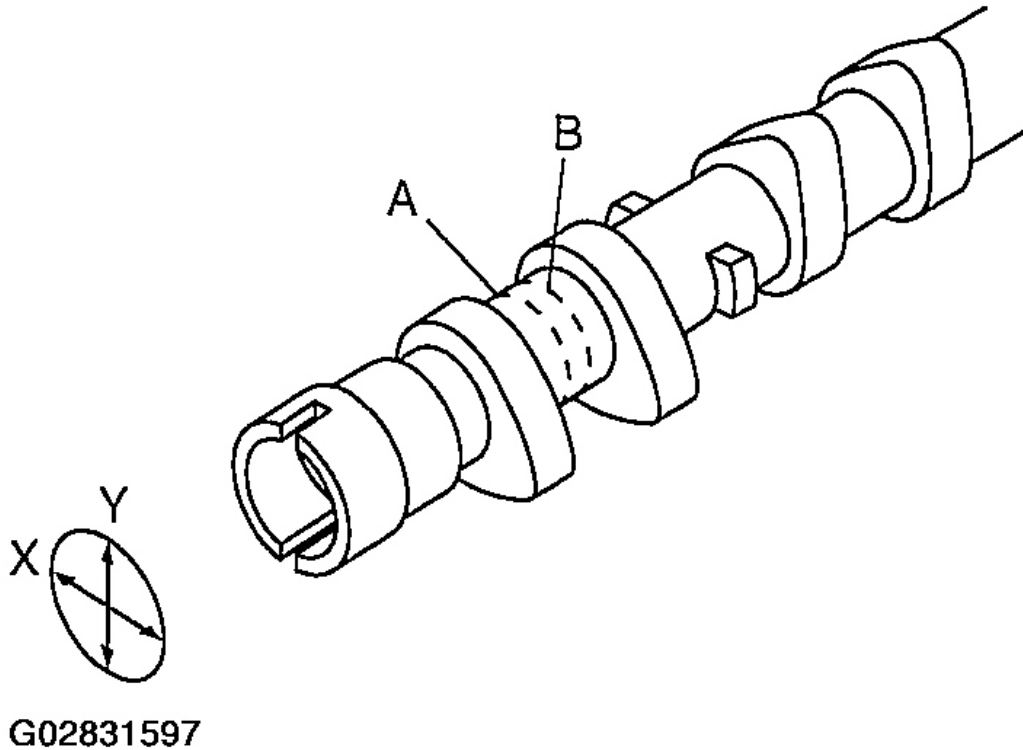
#### CAMSHAFT LOBE MINIMUM HEIGHT SPECIFICATIONS

| Camshaft | LF (mm {in})   | L3 (mm {in})   |
|----------|----------------|----------------|
| IN       | 42.022 {1.655} | 42.342 {1.667} |
| EX       | 40.982 {1.614} | 41.082 {1.618} |

4. Measure the journal diameters in X and Y directions at the two points (A and B) as indicated in the figure.
  - If it is less than the specification, replace the camshaft.

#### Standard Diameter

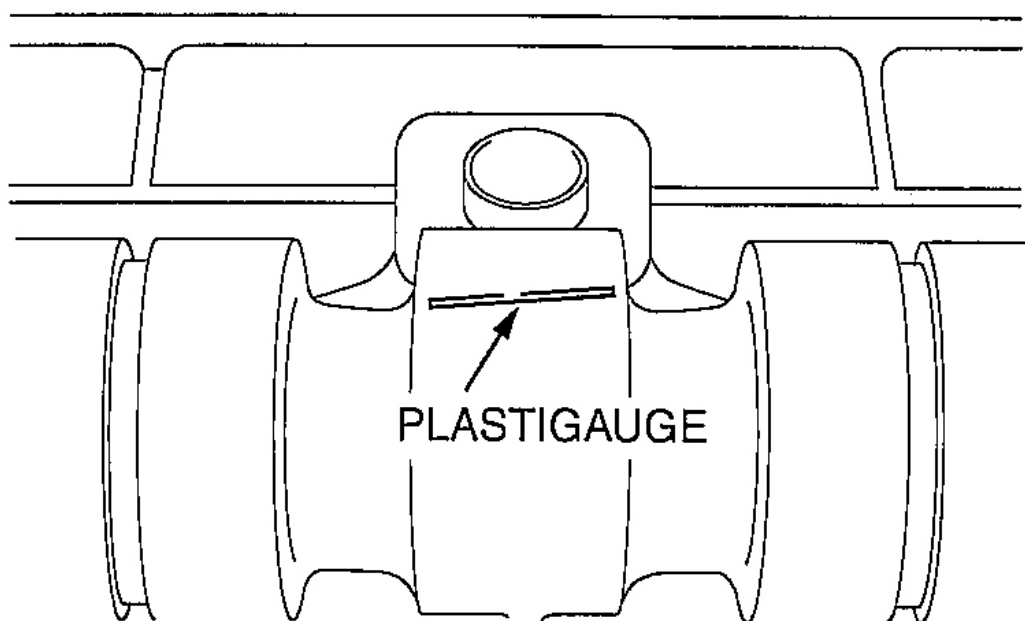
**24.96-24.98 mm {0.9827-0.9834 in}**

**Minimum Diameter****24.95 mm {0.982 in}**

**Fig. 41: Measuring Camshaft Journal Diameters**  
**Courtesy of MAZDA MOTORS CORP.**

5. Remove the tappet.
6. Position a plastigage atop the journals in the axial direction.
7. Install the camshaft cap. (See **CAMSHAFT ASSEMBLY NOTE.**)
8. Remove the camshaft cap. (See **CAMSHAFT CAP DISASSEMBLY NOTE.**)
9. Measure the oil clearance.
  - If it exceeds the specification, replace the cylinder head.

**Standard Clearance****0.035-0.080 mm {0.0014-0.0031 in}**



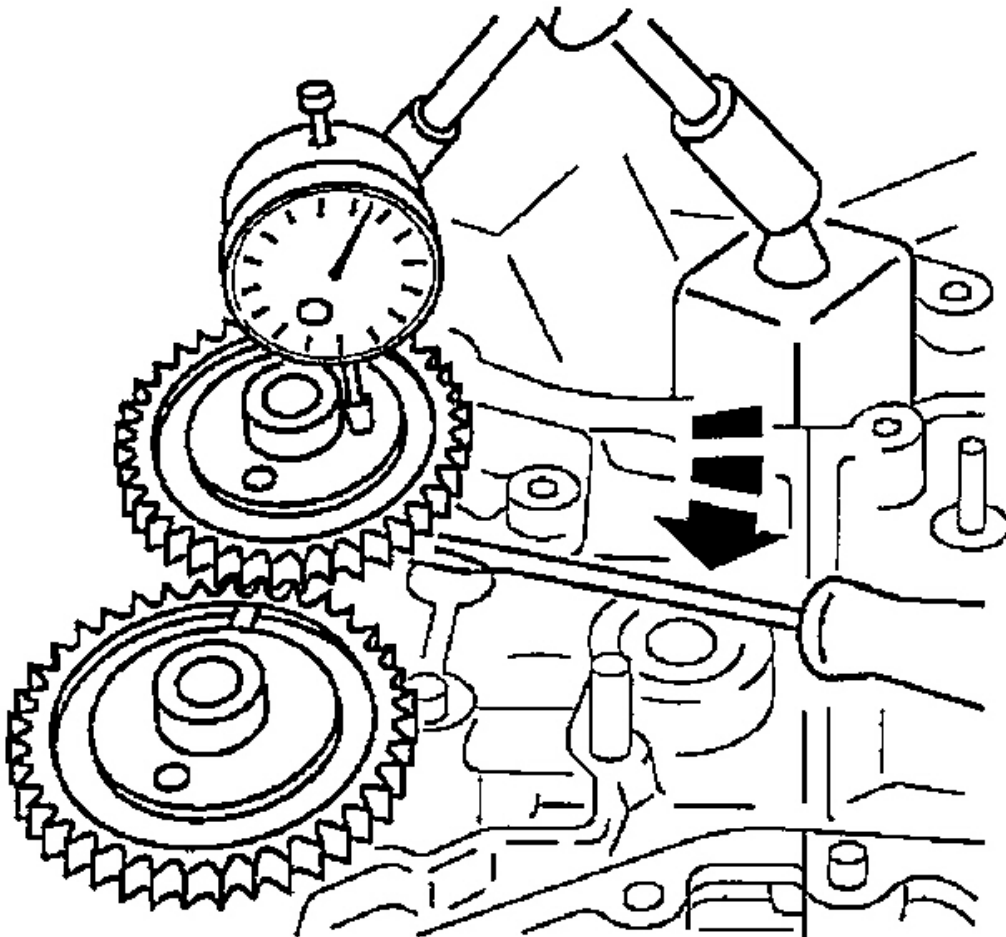
G02831598

**Fig. 42: Measuring Oil Clearance**  
Courtesy of MAZDA MOTORS CORP.

**Maximum Clearance****0.09 mm {0.0035 in}**

10. Install the camshaft cap. (See CAMSHAFT ASSEMBLY NOTE.)
11. Measure the camshaft end play.
  - If it exceeds the specification, replace the cylinder head or camshaft.

**Standard End Play****0.09-0.24 mm {0.0035-0.0094 in}****Maximum End Play****0.25 mm {0.0098 in}**



G02831599

**Fig. 43: Measuring Camshaft End Play**  
Courtesy of MAZDA MOTORS CORP.

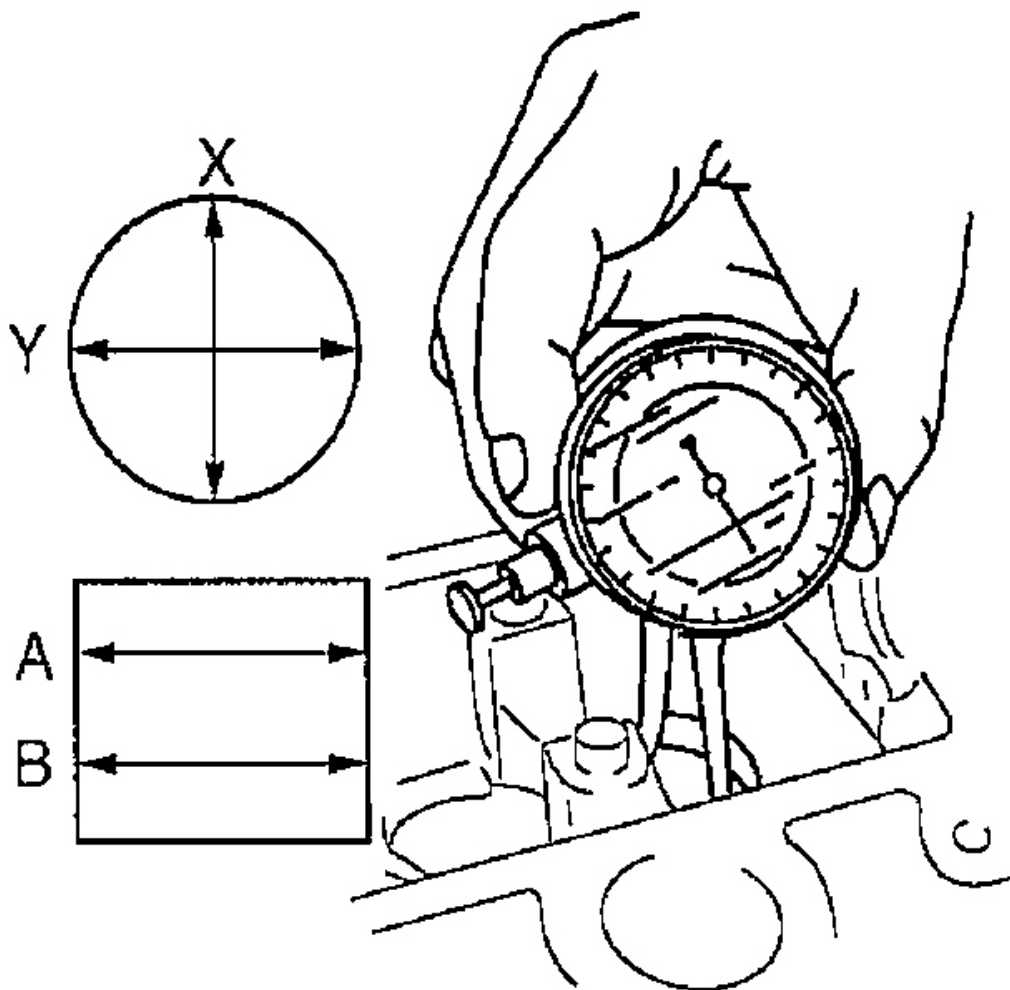
12. Remove the camshaft cap. (See CAMSHAFT CAP DISASSEMBLY NOTE.)

## TAPPET INSPECTION

1. Measure the tappet hole inner diameter in X and Y directions at the two points (A and B) shown in the figure.

### Inner Diameter

31.000-31.030 mm {1.2205-1.2216 in}



**G02831600**

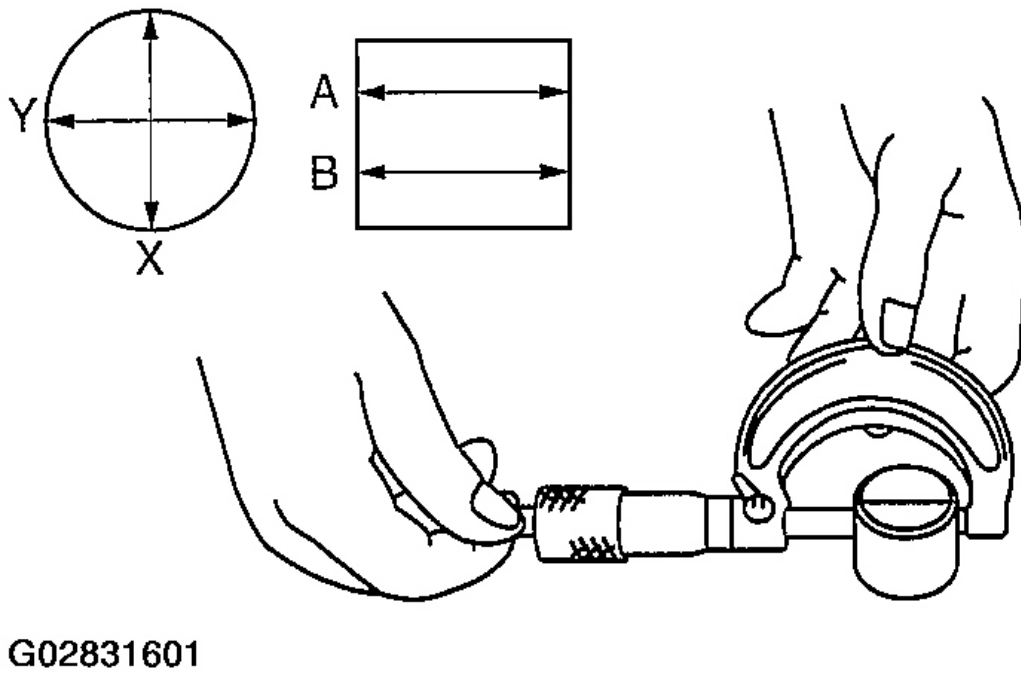
**Fig. 44: Measuring Tappet Hole Inner Diameter**  
Courtesy of MAZDA MOTORS CORP.

2. Measure the tappet body outer diameter in X and Y directions at the two points (A and B) shown in the figure.

**Outer Diameter**

**30.970-30.980 mm {1.2193-1.2196 in}**

3. Subtract the tappet body outer diameter from the tappet hole inner diameter.
  - If it exceeds the specification, replace the tappet or cylinder head.



**Fig. 45: Measuring Tappet Body Outer Diameter & Tappet Hole Inner Diameter**  
Courtesy of MAZDA MOTORS CORP.

**Standard Clearance**

**0.02-0.06 mm {0.0008-0.0023 in}**

**Maximum Clearance**

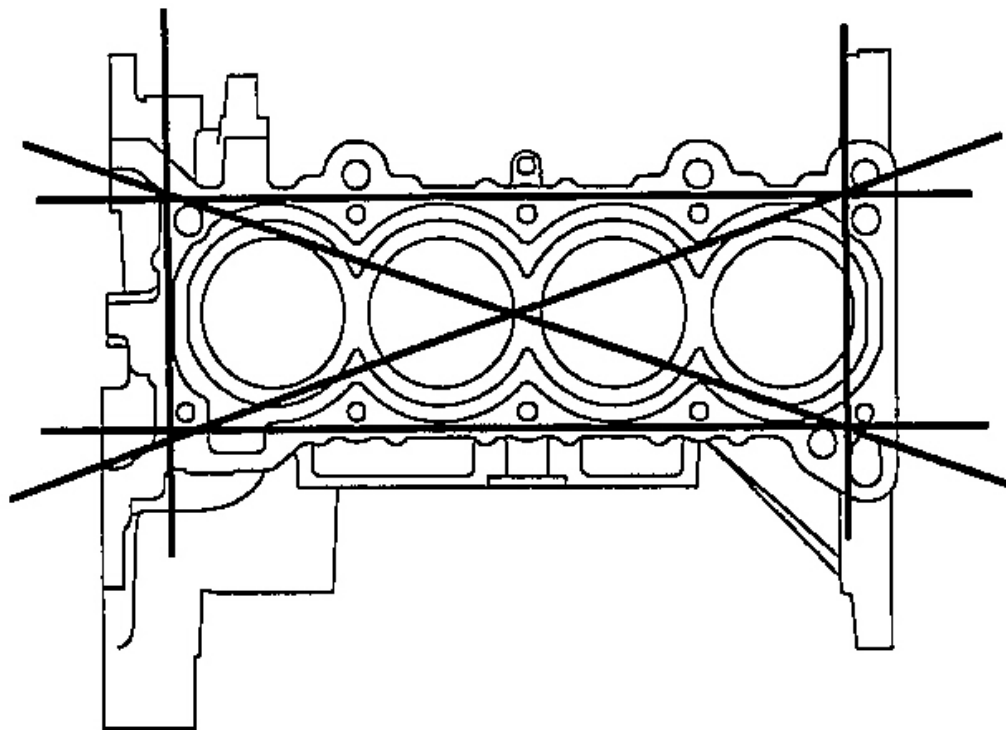
**0.15 mm {0.006 in}**

## CYLINDER BLOCK INSPECTION

1. Measure the distortion of the cylinder block top surface in six directions as indicated in the figure.
  - If it exceeds the maximum, replace the cylinder block.

**Maximum Cylinder Block Distortion**

**0.10 mm {0.004 in}**

**G02831602**

**Fig. 46: Measuring Cylinder Block Distortion**  
Courtesy of MAZDA MOTORS CORP.

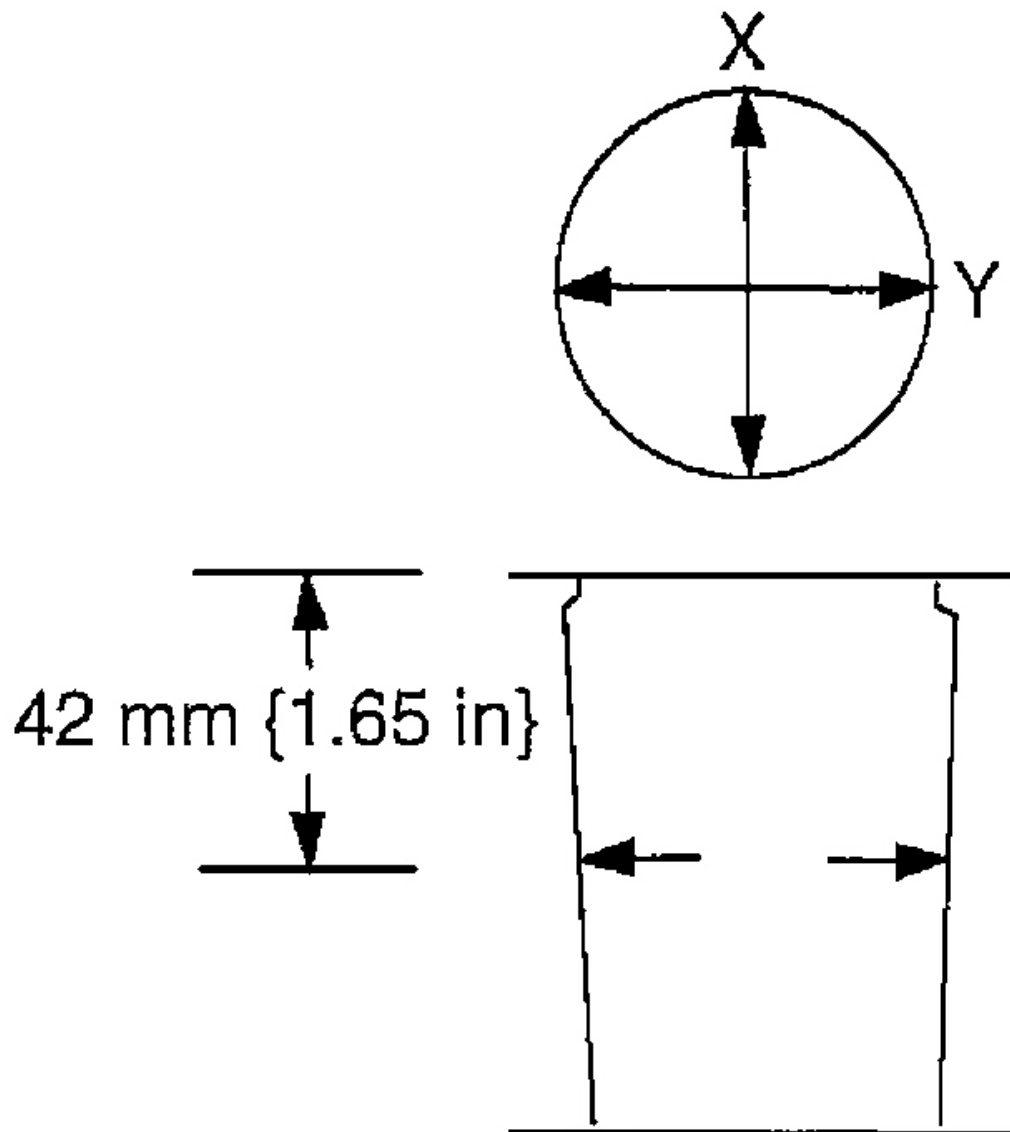
2. Measure the cylinder bores in X and Y directions at **42 mm {1.65 in}** below the top surface.
  - If not within the specification, replace the cylinder block.

**Standard Diameter Limit**

**87.500-87.530 mm {3.4449-3.4460 in}**

**Minimum/Maximum Bore Diameter Limit**

**87.440-87.590 mm {3.4425-3.4484 in}**

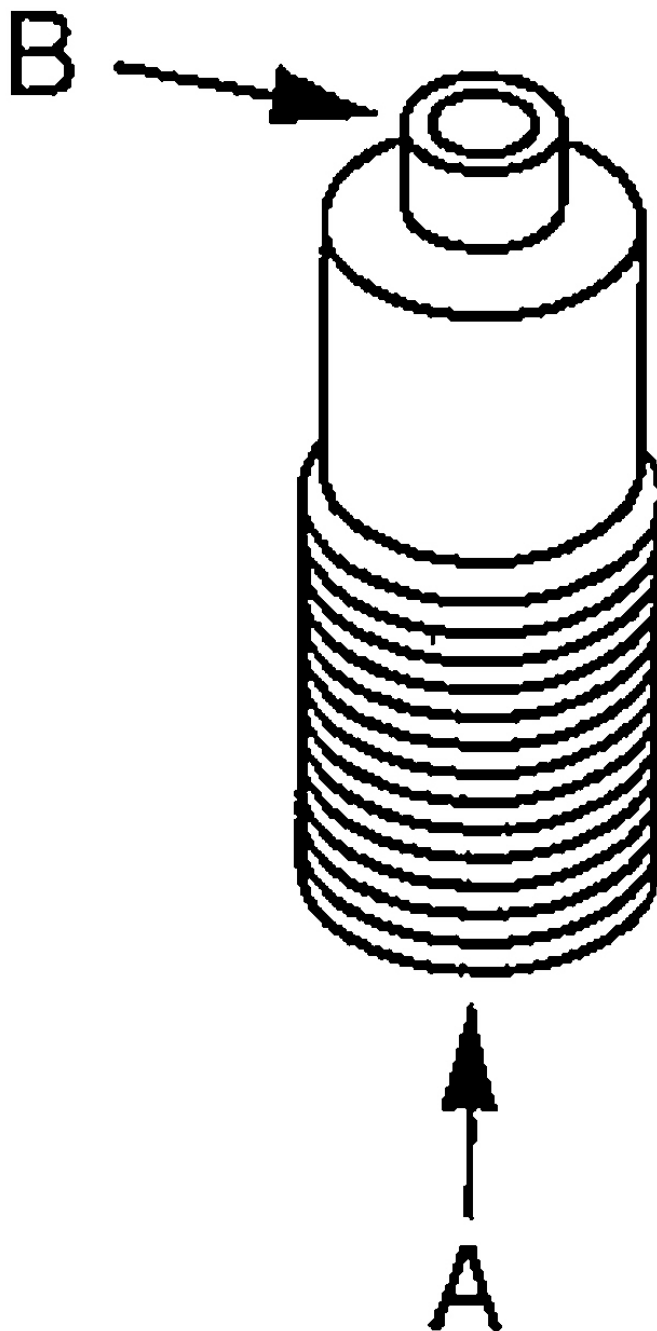


G02831603

**Fig. 47: Measuring Cylinder Bores**  
Courtesy of MAZDA MOTORS CORP.

## OIL JET VALVE INSPECTION

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

**Air Pressure**216-274 kPa {2.2-2.7 kgf.cm<sup>2</sup> 31.4-39.7 psi}

G02831604

**Fig. 48: Identifying Jet Valves A & B**

Courtesy of MAZDA MOTORS CORP.

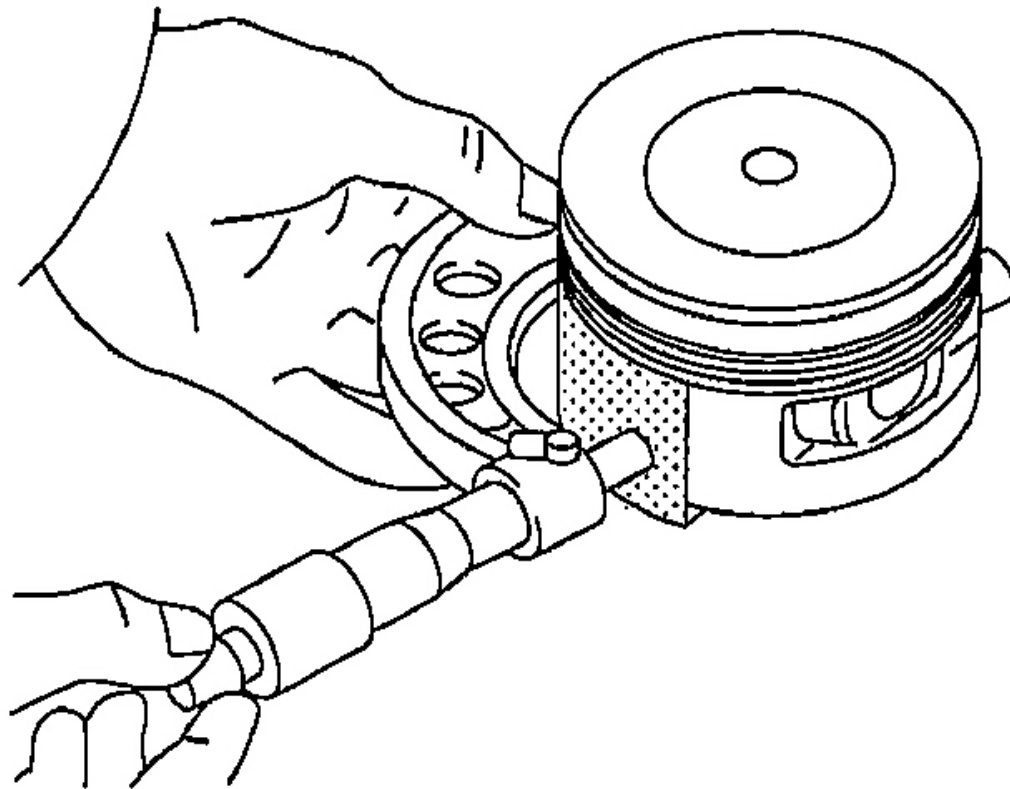
## PISTON INSPECTION

- CAUTION:**
- The piston, piston ring and connecting rod cannot be disassembled.
  - When replacing the piston, piston pin, piston ring and connecting rod, replace them together as a single unit.

1. Measure the outer diameter of each piston at right angle 90° to the piston pin, **10.0 mm {0.40 in}** above the under of the piston.
  - If not within the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

### Piston Diameter

**87.465-87.495 mm {3.4435-3.4446 in}**



**G02831605**

**Fig. 49: Measuring Piston Diameter**  
Courtesy of MAZDA MOTORS CORP.

2. Measure the piston-to-cylinder clearance.
  - If not within the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

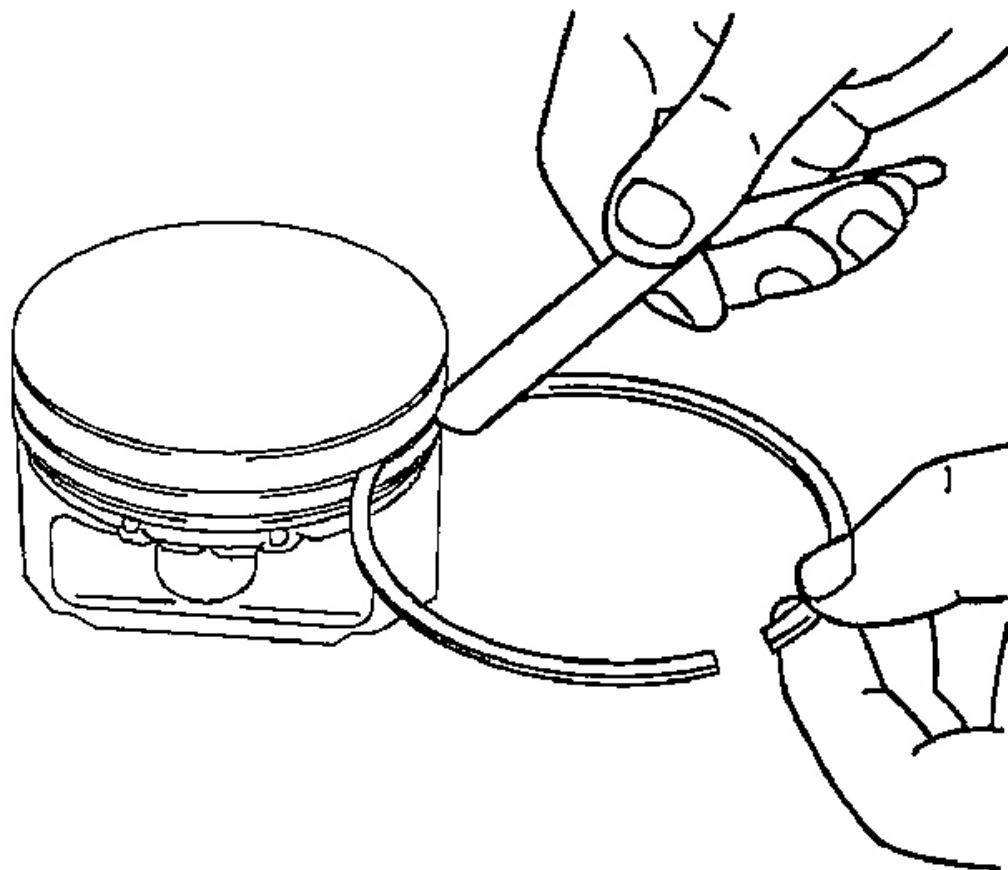
**Standard Clearance**

**0.025-0.045 mm {0.0010-0.0017 in}**

**Maximum Clearance**

**0.11 mm {0.0043 in}**

3. Measure the piston ring-to-ring groove clearance around the entire circumference.
  - If it exceeds the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

**Standard Clearance****Top: 0.03-0.08 mm {0.0012-0.0031 in}****Second: 0.03-0.07 mm {0.0012-0.0027 in}****Oil: 0.03-0.07 mm {0.0012-0.0027 in}****Maximum Clearance****Top: 0.17 mm {0.0067 in}****Second, Oil: 0.15 mm {0.0059 in}****G02831606**

**Fig. 50: Measuring Piston Ring-To-Ring Groove Clearance**  
**Courtesy of MAZDA MOTORS CORP.**

4. Insert the piston ring into the cylinder by hand and use the piston to push it to the bottom of the ring

travel.

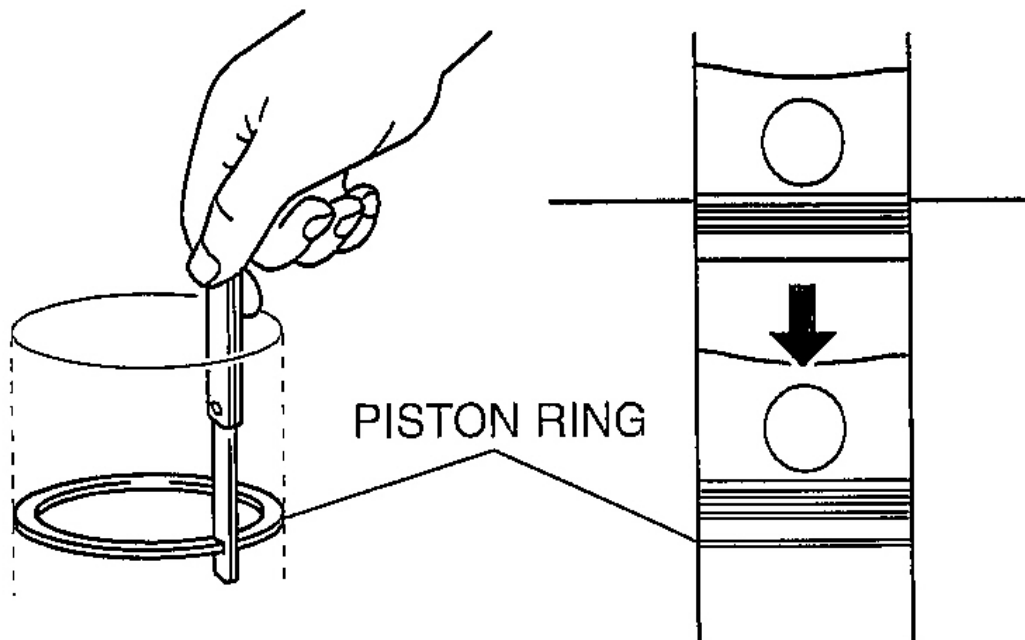
5. Measure each piston ring end gap with a feeler gauge.
  - If it exceeds the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

#### Standard End Gap

Top: 0.16-0.31 mm {0.0063-0.0122 in}

Second: 0.33-0.48 mm {0.0130-0.0189 in}

Oil (Rail): 0.20-0.70 mm {0.0079-0.0275 in}



G02831607

**Fig. 51: Measuring Piston Ring End Gap**  
Courtesy of MAZDA MOTORS CORP.

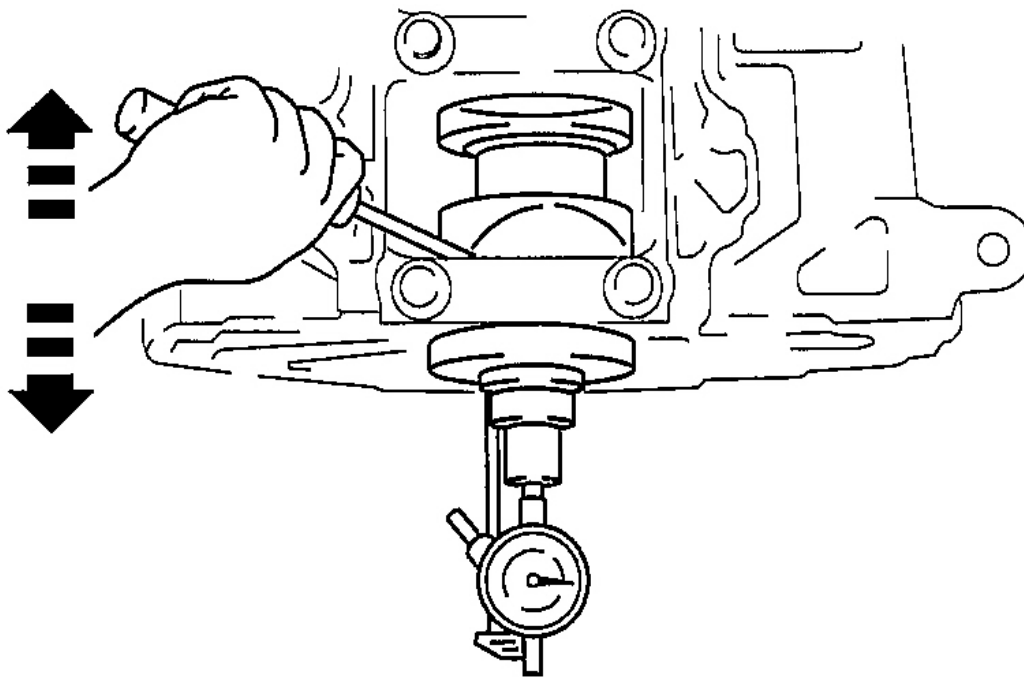
#### Maximum End Gap

1.0 mm {0.0393 in}

## CRANKSHAFT INSPECTION

1. Install the main bearing cap. (See MAIN BEARING CAP ASSEMBLY NOTE.)
2. Measure the crankshaft end play.

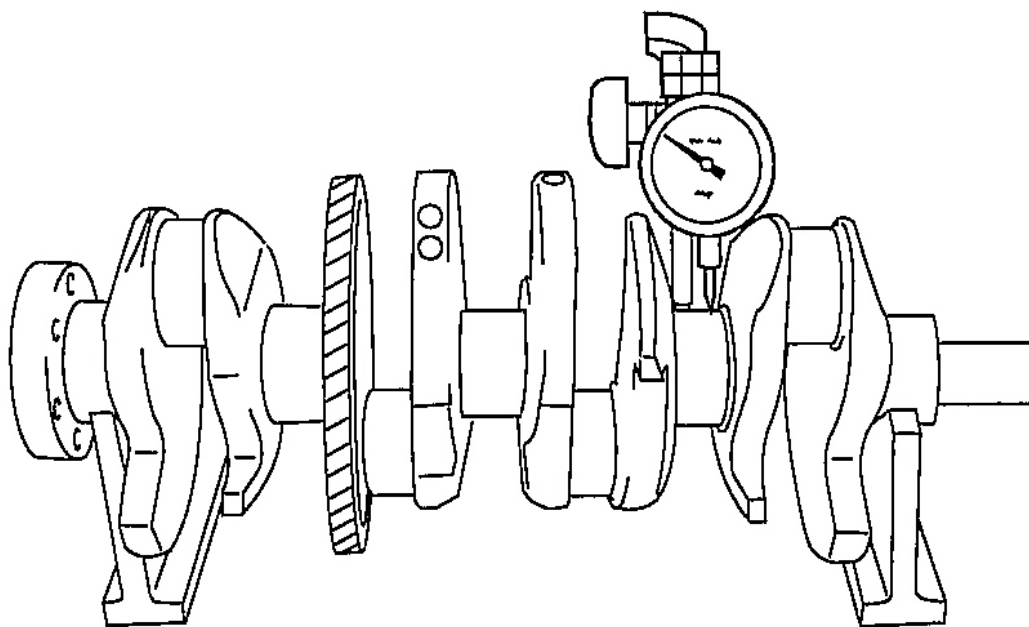
- If it exceeds the specification, replace the thrust bearing or crankshaft so that the specified end play is obtained.

**Standard End Play****0.22-0.45 mm {0.0087-0.0177 in}****Maximum End Play****0.55 mm {0.0216 in}****G02831608**

**Fig. 52: Measuring Crankshaft End Play**  
**Courtesy of MAZDA MOTORS CORP.**

3. Remove the main bearing cap. (See **MAIN BEARING CAP DISASSEMBLY NOTE**.)
4. Measure the crankshaft runout.
  - If it exceeds the specification, replace the crankshaft.

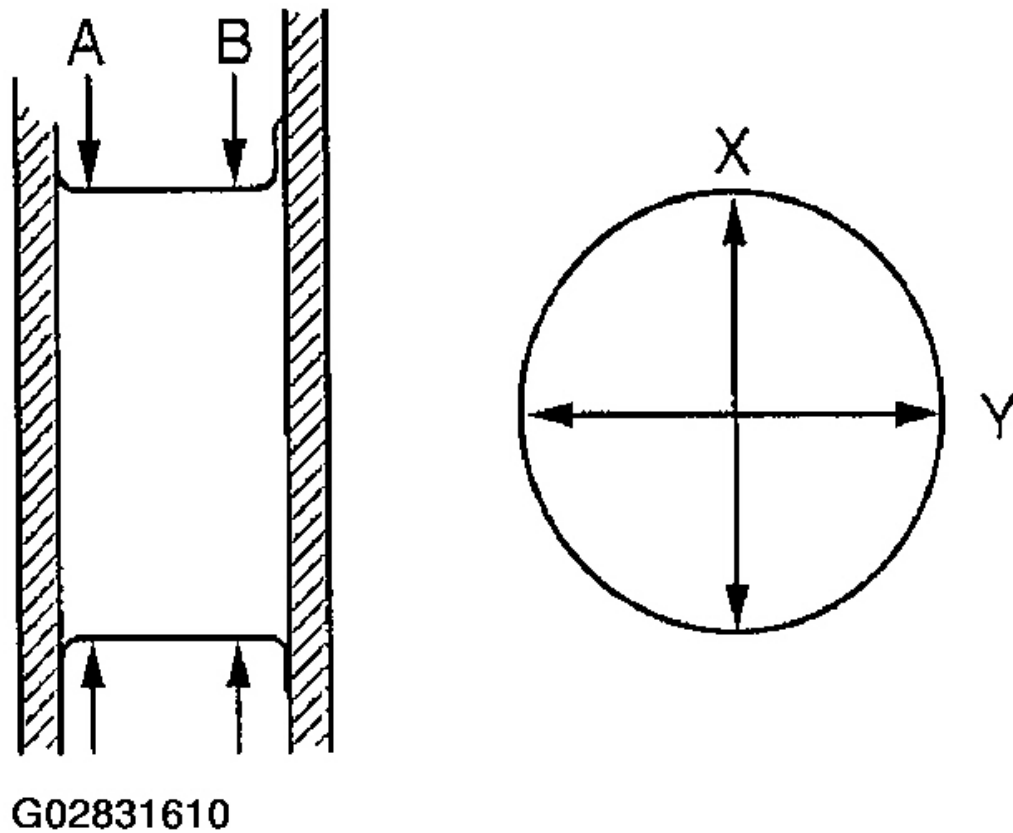
**Maximum Runout****0.05 mm {0.0019 in}**



G02831609

**Fig. 53: Measuring Crankshaft Runout**  
Courtesy of MAZDA MOTORS CORP.

5. Measure the journal diameter in X and Y directions at the two points (A and B) as indicated in the figure.
  - If it exceeds the specification, replace the crankshaft or grind the journal and install the undersize bearing.



**Fig. 54: Measuring Crankshaft Journal Diameter**  
 Courtesy of MAZDA MOTORS CORP.

#### MAIN JOURNAL BEARING SPECIFICATION

| Bearing Size (mm {in}) | Standard Diameter (mm {in})   |
|------------------------|-------------------------------|
| Standard               | 51.980-52.000 {2.0464-2.0472} |
| 0.25 {0.01}            | 51.730-51.750 {2.0366-2.0373} |

#### Maximum Out-Of-Round

**0.05 mm {0.0019 in}**

#### CRANK PIN

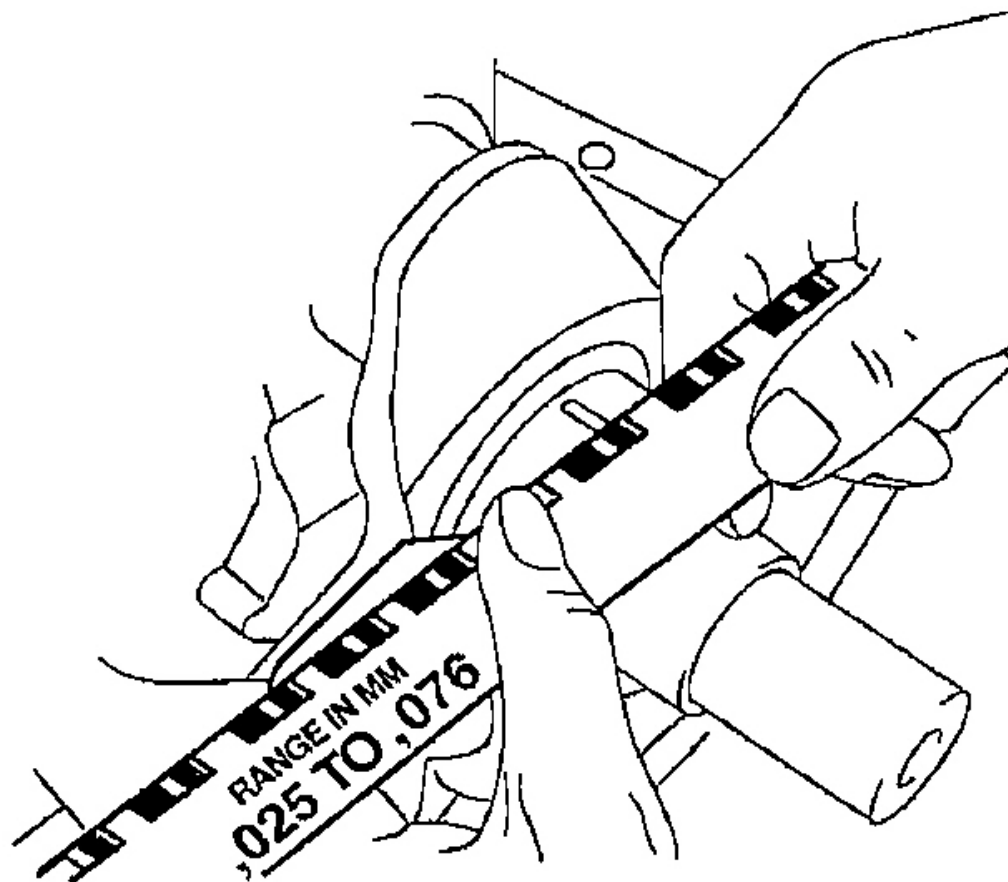
| Type | Bearing Size (mm {in}) | Standard Diameter (mm {in})   |
|------|------------------------|-------------------------------|
| LF   | Standard               | 46.980-47.000 {1.8497-1.8503} |
| LF   | 0.25 {0.01} Undersize  | 46.730-46.750 {1.8398-1.8405} |
| L3   | Standard               | 49.980-50.000 {1.9677-1.9685} |

|    |                       |                               |
|----|-----------------------|-------------------------------|
| L3 | 0.25 {0.01} Undersize | 49.730-49.750 {1.9579-1.9586} |
|----|-----------------------|-------------------------------|

**Maximum Out-Of-Round****0.05 mm {0.0019 in}**

6. Install the main bearing caps and crankshaft.
7. Position a plastigage atop the journals in the axial direction.
8. Install the main bearing caps and cylinder block. (See **MAIN BEARING CAP ASSEMBLY NOTE**.)
9. Remove the main bearing caps. (See **MAIN BEARING CAP DISASSEMBLY NOTE**.)
10. Measure the main journal oil clearance.
  - If it exceeds the specification, replace the main bearing using the main bearing selection table or grind the main journal and install the oversize bearings so that the specified oil clearance is obtained.

**Standard Clearance****0.019-0.035 mm {0.0007-0.0013 in}****Maximum Clearance****0.10 mm {0.0039 in}**



G02831611

**Fig. 55: Measuring Main Journal Oil Clearance (Plastigage)**  
 Courtesy of MAZDA MOTORS CORP.

#### MAIN BEARING SPECIFICATIONS

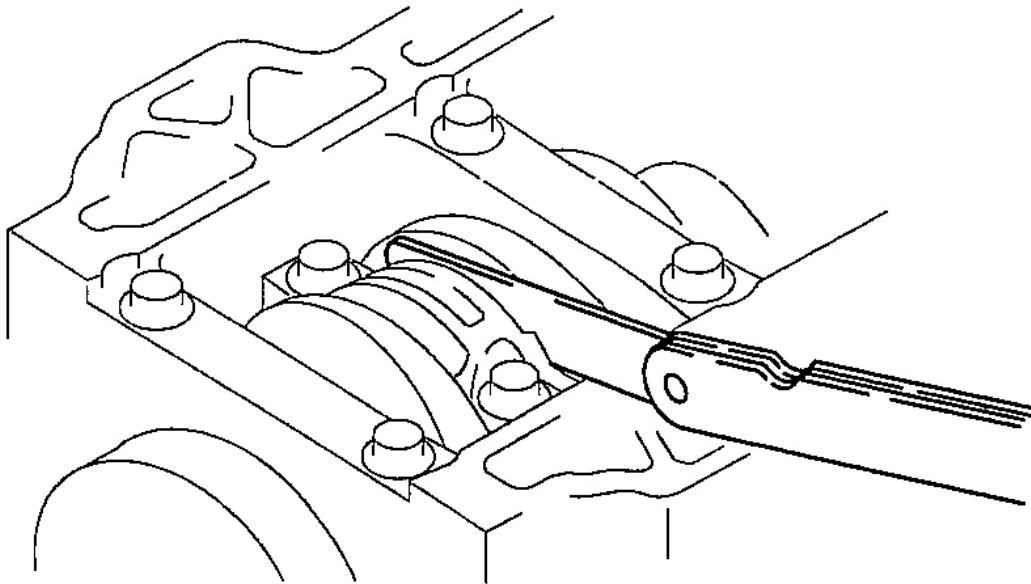
| Bearing Size (mm {in}) | Bearing Thickness (mm {in}) |
|------------------------|-----------------------------|
| Standard               | 2.506-2.509 {0.0987-0.0988} |
| 0.25 {0.01} Oversize   | 2.628-2.634 {0.1034-0.1037} |
| 0.50 {0.02} Oversize   | 2.753-2.759 {0.1084-0.1086} |

## CONNECTING ROD INSPECTION

**CAUTION:** • The piston, piston ring and connecting rod cannot be disassembled.

- When replacing the piston, piston pin, piston ring and connecting rod, replace them together as a single unit.

1. Install the connecting rod cap. (See **CONNECTING ROD CAP ASSEMBLY NOTE**.)
2. Measure the connecting rod large end side clearance.
  - If it exceeds the specification, replace the piston, piston pin, piston ring and connecting rod as a single unit.

**Standard Clearance****0.14-0.36 mm {0.0056-0.0141 in}****Maximum Clearance****0.435 mm {0.0172 in}****G02831612**

**Fig. 56: Measuring Connecting Rod Large End Side Clearance**  
Courtesy of MAZDA MOTORS CORP.

3. Remove the connecting rod cap.
4. Position plastigage atop the journals in the axial direction.
5. Install the connecting rod bearing and connecting rod cap. (See **CONNECTING ROD CAP ASSEMBLY NOTE**.)
6. Remove the connecting rod cap.

7. Measure the connecting rod oil clearance.

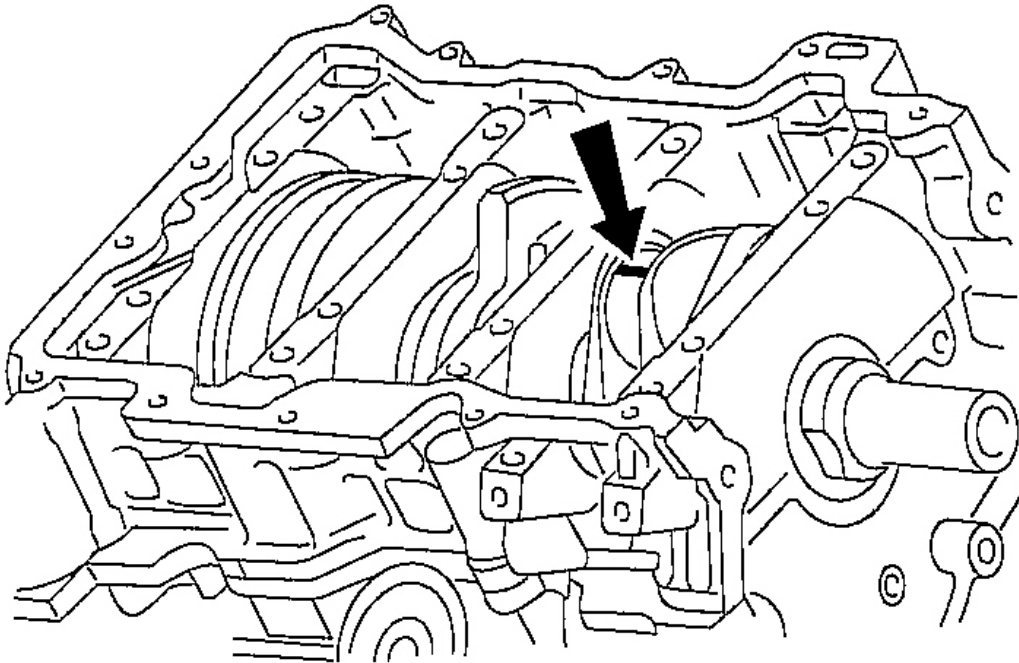
- If it exceeds the specification, replace the connecting rod bearing or grind the crank pin and use oversize bearings so that the specified clearance is obtained.

**Standard Clearance**

**0.026-0.052 mm {0.0011-0.0020 in}**

**Maximum Clearance**

**0.10 mm {0.0039 in}**



**G02831613**

**Fig. 57: Measuring Connecting Rod Oil Clearance (Plastigage)**  
**Courtesy of MAZDA MOTORS CORP.**

| Bearing size            | Bearing thickness (mm {in})    |                                |
|-------------------------|--------------------------------|--------------------------------|
|                         | LF                             | L3                             |
| Standard                | 1.498—1.504<br>{0.0589—0.0592} | 1.496—1.502<br>{0.0589—0.0591} |
| 0.50 {0.02}<br>oversize | 1.748—1.754<br>{0.0689—0.0690} | 1.746—1.752<br>{0.0688—0.0690} |
| 0.25 {0.01}<br>oversize | 1.623—1.629<br>{0.0639—0.0641} | 1.621—1.627<br>{0.0639—0.0641} |

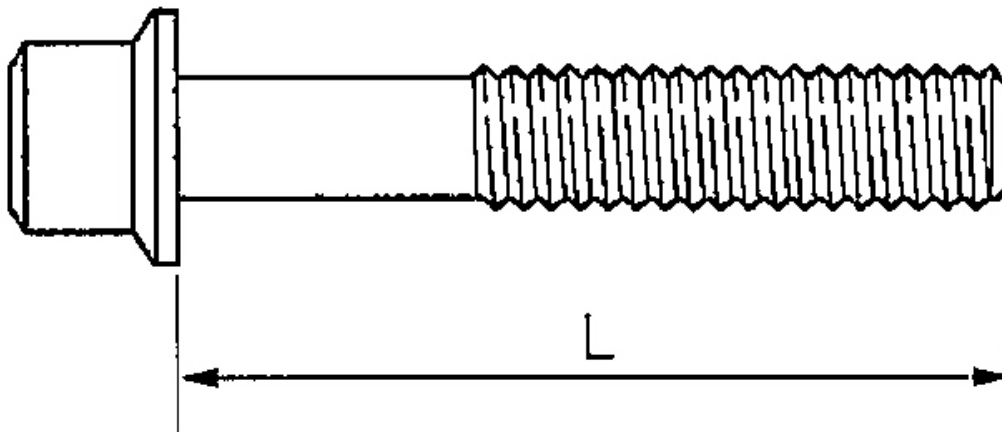
G02831614

**Fig. 58: Connecting Rod Bearing Specifications**  
 Courtesy of MAZDA MOTORS CORP.

## BOLT INSPECTION

1. Measure the length of each bolt.
  - If it exceeds the specification, replace the bolt.

**Length L**



G02831615

**Fig. 59: Measuring Bolt Length**  
 Courtesy of MAZDA MOTORS CORP.

| Bolt                  |                   | Standard<br>(mm) {in}      | Maximum<br>(mm) {in} |
|-----------------------|-------------------|----------------------------|----------------------|
| Cylinder<br>head bolt | With washer       | 149.2—149.8<br>{5.87—5.90} | 150.5 {5.91}         |
|                       | Without<br>washer | 145.2—145.8<br>{5.72—5.74} | 146.5 {5.76}         |
| Connecting rod bolt   |                   | 44.7—45.3<br>{1.75—1.78}   | 46.0 {1.81}          |
| Main bearing cap bolt |                   | 110.0—110.6<br>{4.33—4.35} | 111.3 {4.38}         |

G02831616

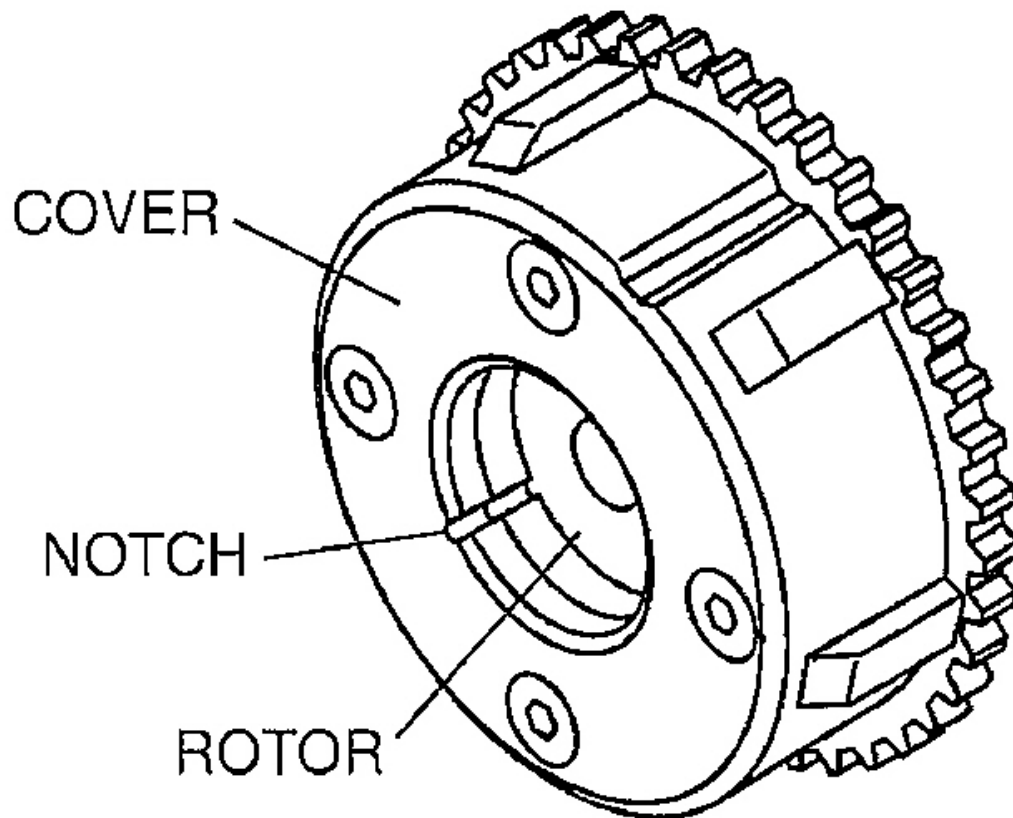
**Fig. 60: Bolt Specifications**  
 Courtesy of MAZDA MOTORS CORP.

## VARIABLE VALVE TIMING ACTUATOR INSPECTION [L3]

**CAUTION:**

- Variable valve timing actuator cannot be disassembled because it is a precision unit.

1. Confirm that the groove of the rotor and notch of the cover at the variable valve timing actuator are aligned and fixed.
  - If the notch and the bump are not aligned, rotate the rotor toward the valve timing retard position by hand until they are in place.
  - If the rotor and cover are not fixed even though their notch and groove are aligned, replace the variable valve timing actuator.



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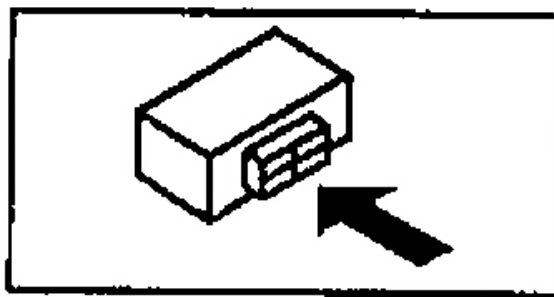
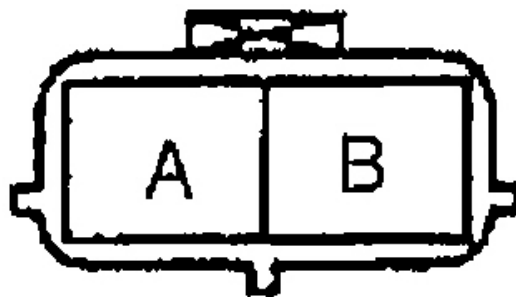
**Fig. 61: Identifying Rotor Groove & Notch**  
Courtesy of MAZDA MOTORS CORP.

## OIL CONTROL VALVE (OCV) INSPECTION [L3]

### COIL RESISTANCE INSPECTION

1. Disconnect the negative battery cable.
2. Disconnect the Oil Control Valve (OCV) connector.
3. Measure the resistance between terminals A and B using an ohmmeter.
  - If not as specified, replace the Oil Control Valve (OCV).

## OIL CONTROL VALVE (OCV)



G02831618

**Fig. 62: Identifying Oil Control Valve Connector Terminals**  
Courtesy of MAZDA MOTORS CORP.

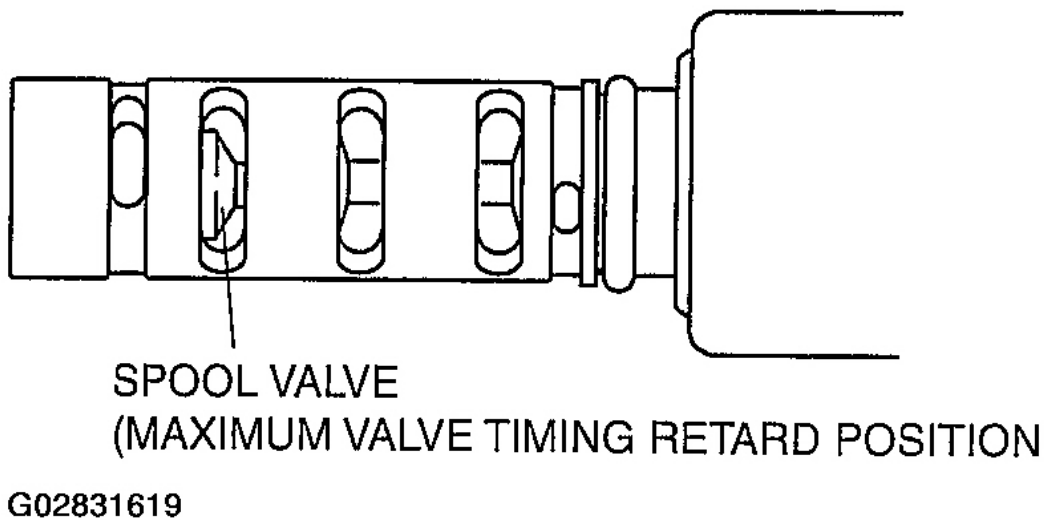
### Specification

6.9-7.9 ohms [20 °C {68 °F}]

4. Connect the Oil Control Valve (OCV) connector.

### SPOOL VALVE OPERATION INSPECTION

1. Disconnect the negative battery cable.
2. Remove the Oil Control Valve (OCV).
3. Verify that the spool valve in the Oil Control Valve (OCV) is in the maximum valve timing retard position as indicated in the figure.
  - If it exceeds the specification, replace the Oil Control Valve (OCV).
4. Verify that the battery is fully charged.
  - If it is less than specification, recharge the battery.
5. Apply battery positive voltage between the Oil Control Valve (OCV) terminals and verify that the spool valve operates and moves to the maximum valve timing advance position.
  - If it exceeds the specification, replace the Oil Control Valve (OCV).

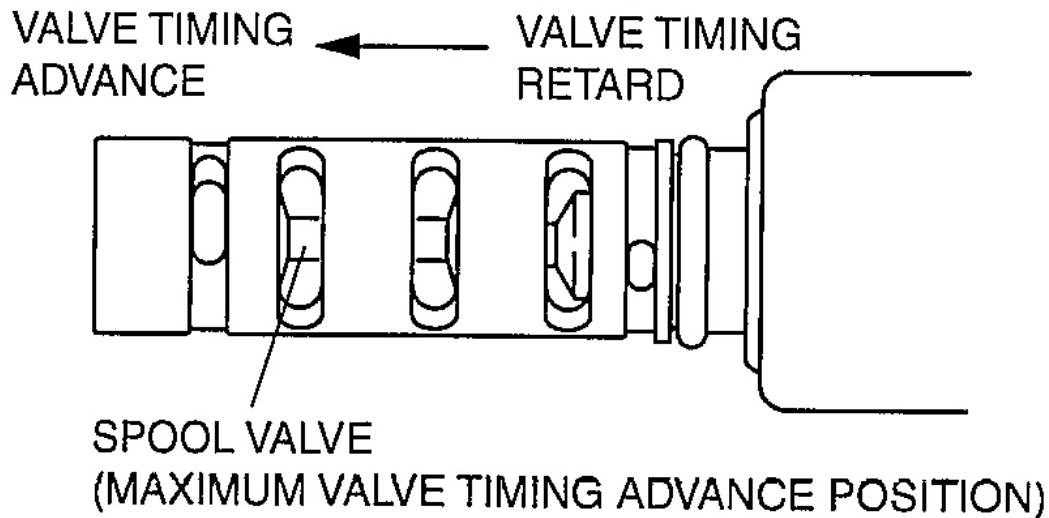


**Fig. 63: Identifying Spool Valve In Maximum Valve Timing Advance Position**  
Courtesy of MAZDA MOTORS CORP.

**NOTE:**

- When applying battery positive voltage between the Oil Control Valve (OCV) terminals, the connection can be either of the following:
  - Positive battery cable to terminal A, negative battery cable to terminal B
  - Positive battery cable to terminal B, negative battery cable to terminal A

6. Stop applying battery positive voltage and verify that the spool valve returns to the maximum valve timing retard position.
  - If it exceeds the specification, replace the Oil Control Valve (OCV).



G02831620

**Fig. 64: Identifying Spool Valve In Maximum Valve Timing Retard Position**  
 Courtesy of MAZDA MOTORS CORP.

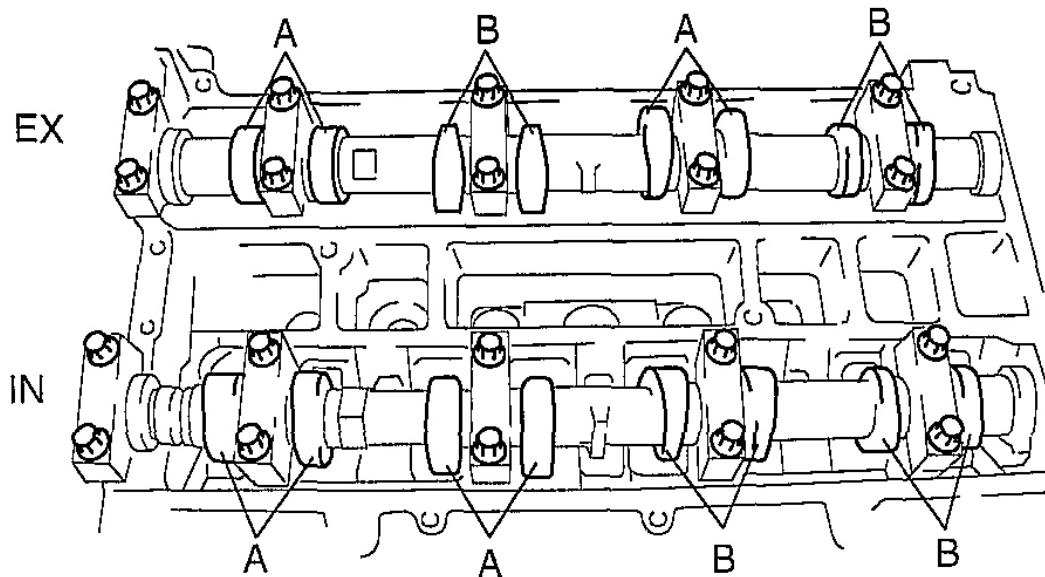
## VALVE CLEARANCE INSPECTION

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.

**NOTE:**

- **Make sure to note the measured values for choosing the suitable replacement tappets.**

2. Measure the valve clearance at A in the figure.
  - If the valve clearance exceeds the standard, replace the tappet. (See **VALVE CLEARANCE ADJUSTMENT**.)



G02831621

**Fig. 65: Identifying Valves A & B**  
 Courtesy of MAZDA MOTORS CORP.

**Standard [Engine Cold]**

**IN: 0.22-0.28 mm {0.0087-0.0110 in}**

**EX: 0.27-0.33 mm {0.0106-0.0130 in}**

- Turn the crankshaft **360°** clockwise so that the No.4 piston is at TDC of the compression stroke.

**NOTE:**

- **Make sure to note the measured values for choosing the suitable replacement tappets.**

- Measure the valve clearance at B in the figure.

- If the valve clearance exceeds the standard, replace the tappet. (See **VALVE CLEARANCE ADJUSTMENT**.)

**Standard [Engine Cold]**

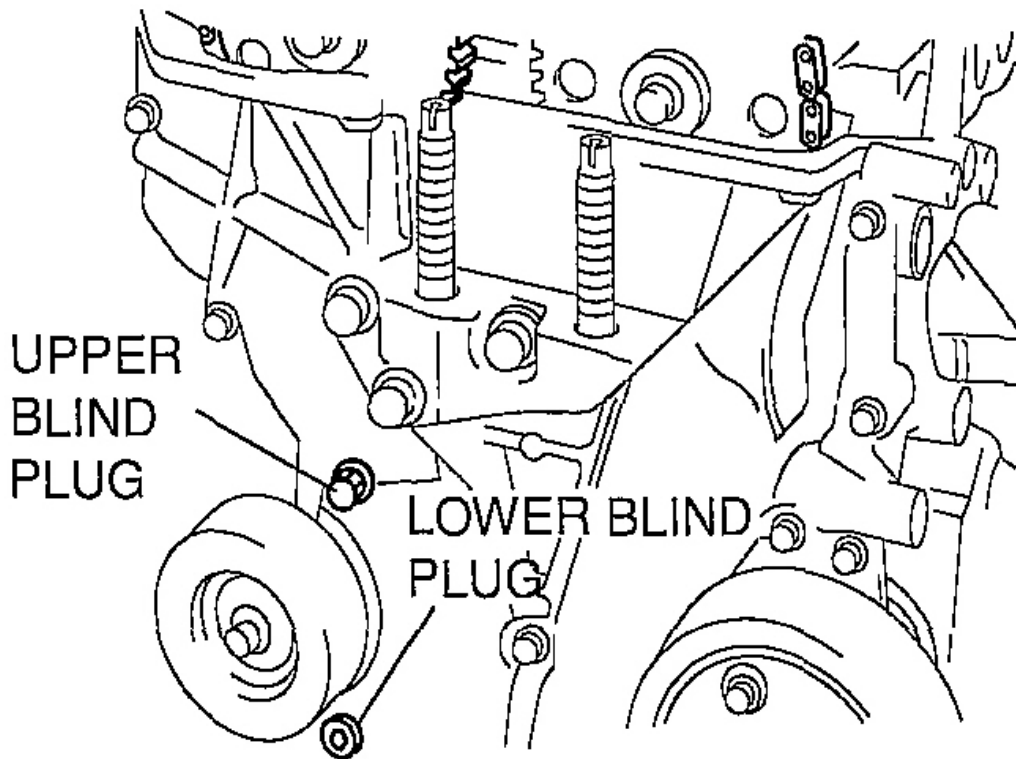
**IN: 0.22-0.28 mm {0.0087-0.0110 in}**

**EX: 0.27-0.33 mm {0.0106-0.0130 in}**

## VALVE CLEARANCE ADJUSTMENT

- Remove the engine front cover lower blind plug.

2. Remove the engine front cover upper blind plug.



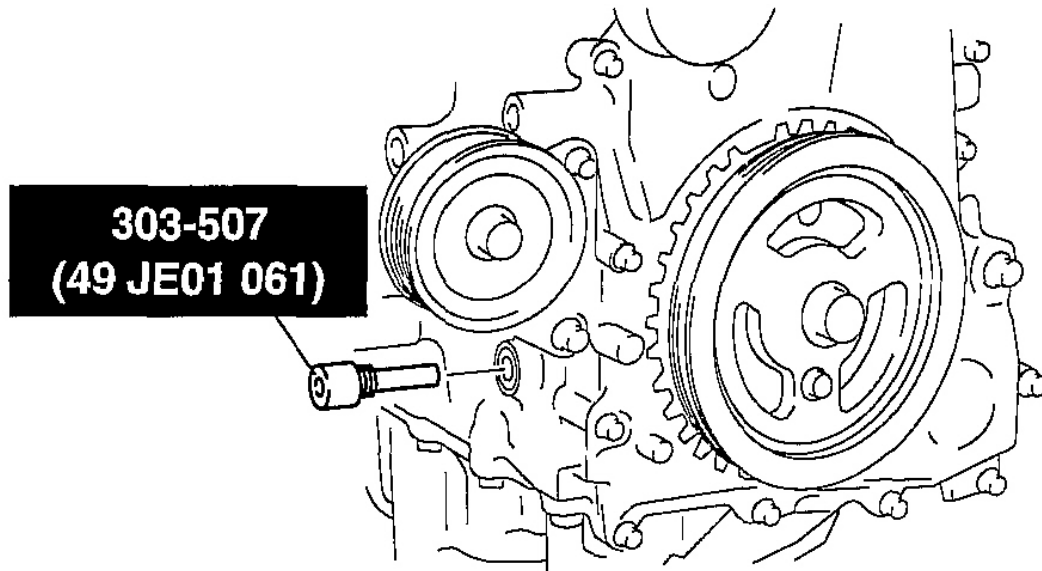
G02831622

**Fig. 66: Identifying Upper & Lower Blind Plug**  
Courtesy of MAZDA MOTORS CORP.

3. Remove the cylinder block lower blind plug.

**CAUTION:**

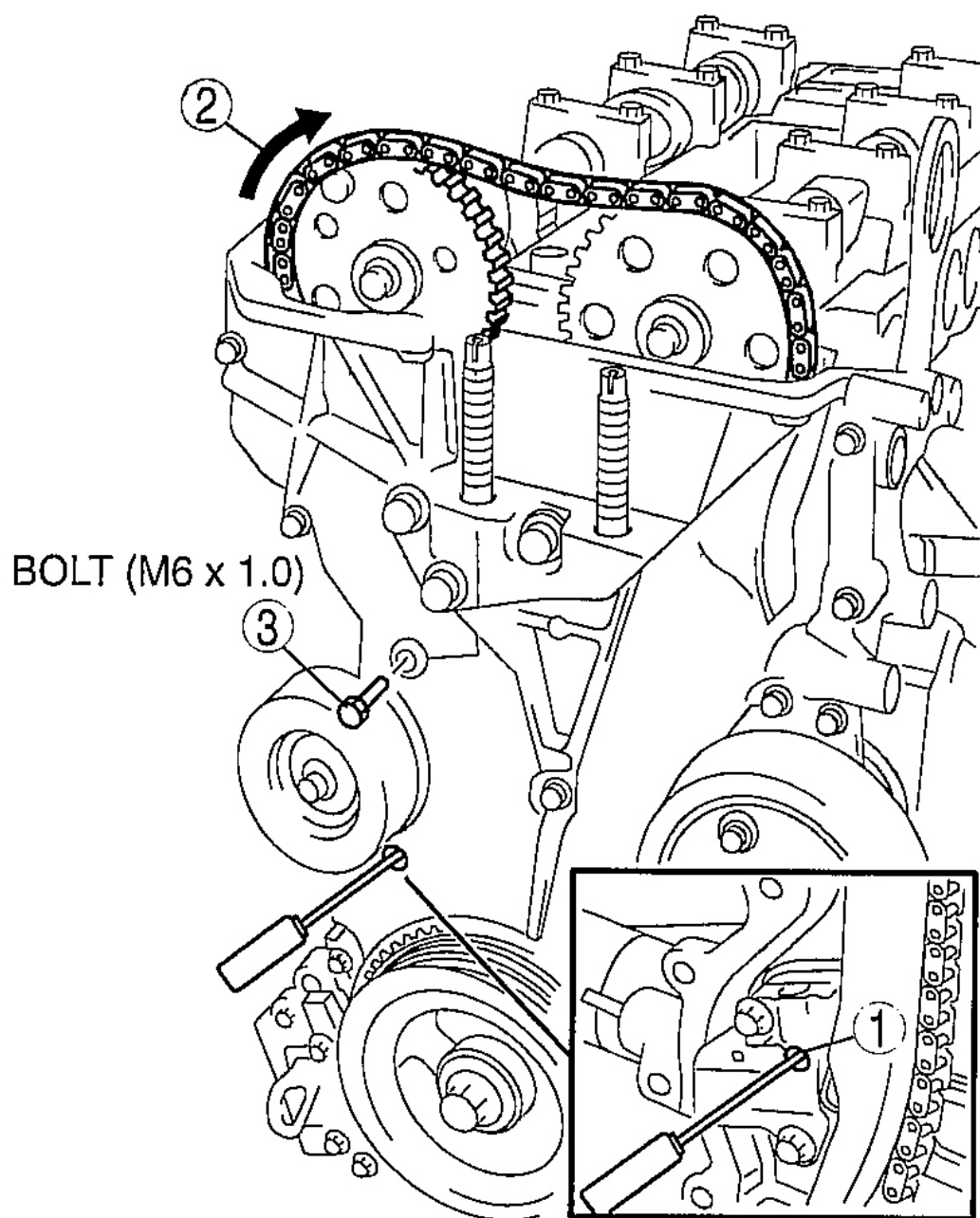
- Removal of this SST is extremely important. If you crank the engine with this SST installed, the cylinder block will be damaged.



G02831623

**Fig. 67: Installing SST**  
Courtesy of MAZDA MOTORS CORP.

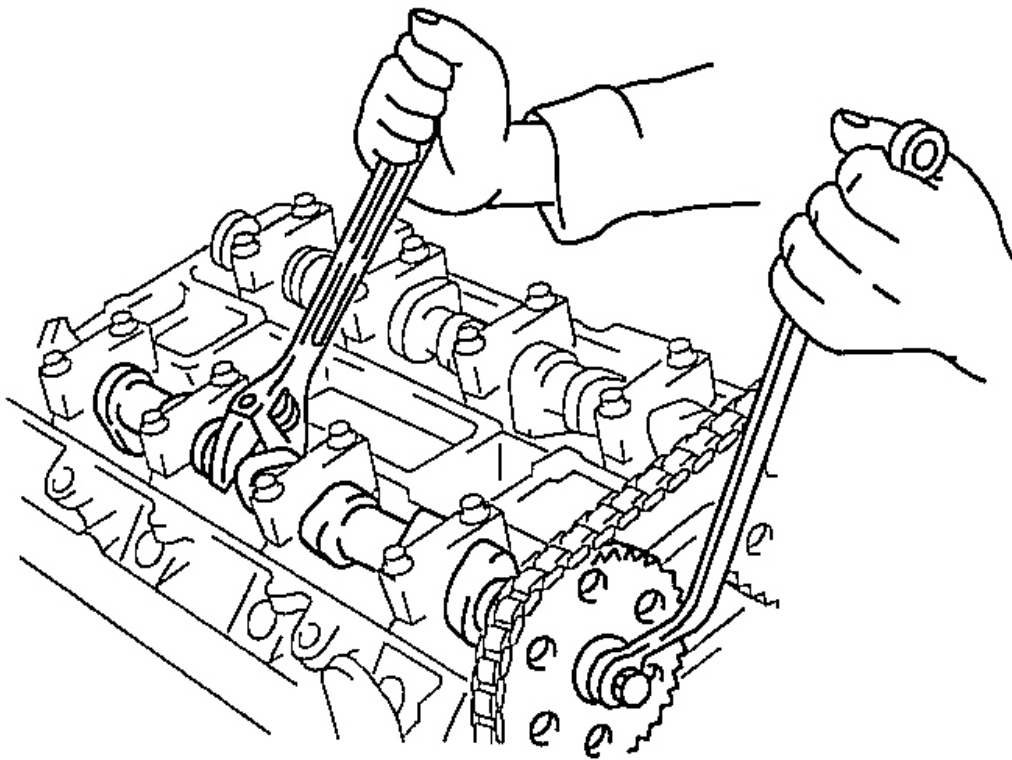
4. Install the **SST** as shown in the figure.
5. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.
6. Loosen the timing chain.
  1. Using a suitable screwdriver or equivalent tool, unlock the chain tensioner ratchet.
  2. Turn the exhaust camshaft clockwise using a suitable wrench on the cast hexagon and loosen the timing chain.
  3. Placing the suitable bolt (**M6 x 1.0 Length 25-35 mm {0.9-1.3 in}**) at the engine front cover upper blind plug, secure the chain guide at the position where the tension is released.



G02831624

**Fig. 68: Loosening Timing Chain Tension**  
Courtesy of MAZDA MOTORS CORP.

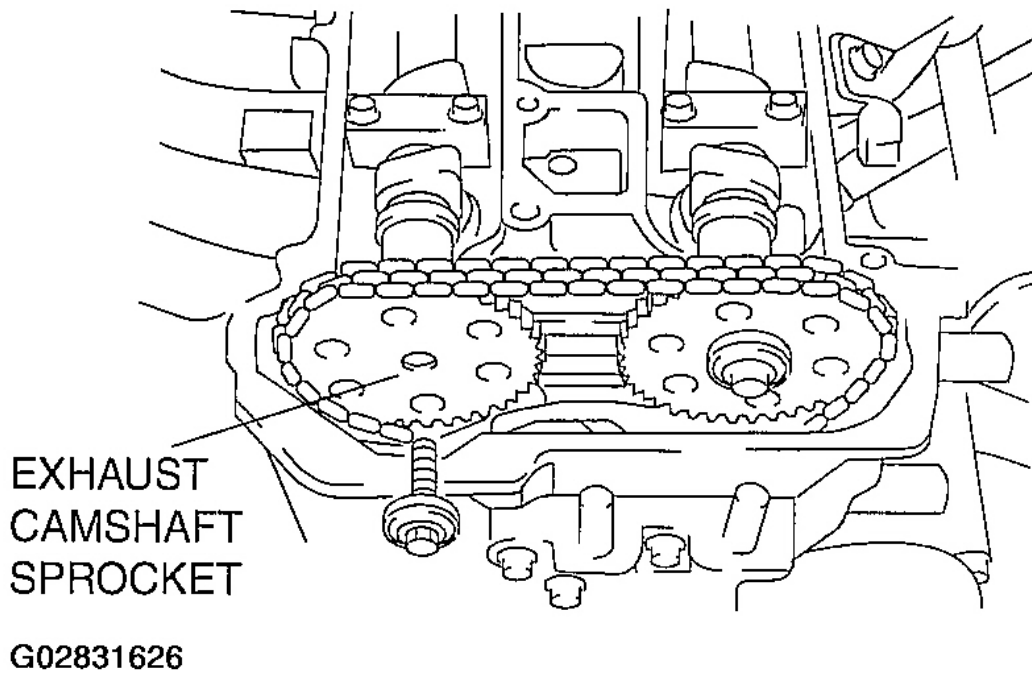
7. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown in the figure.



G02831625

**Fig. 69: Removing Exhaust Camshaft Sprocket Bolt**  
Courtesy of MAZDA MOTORS CORP.

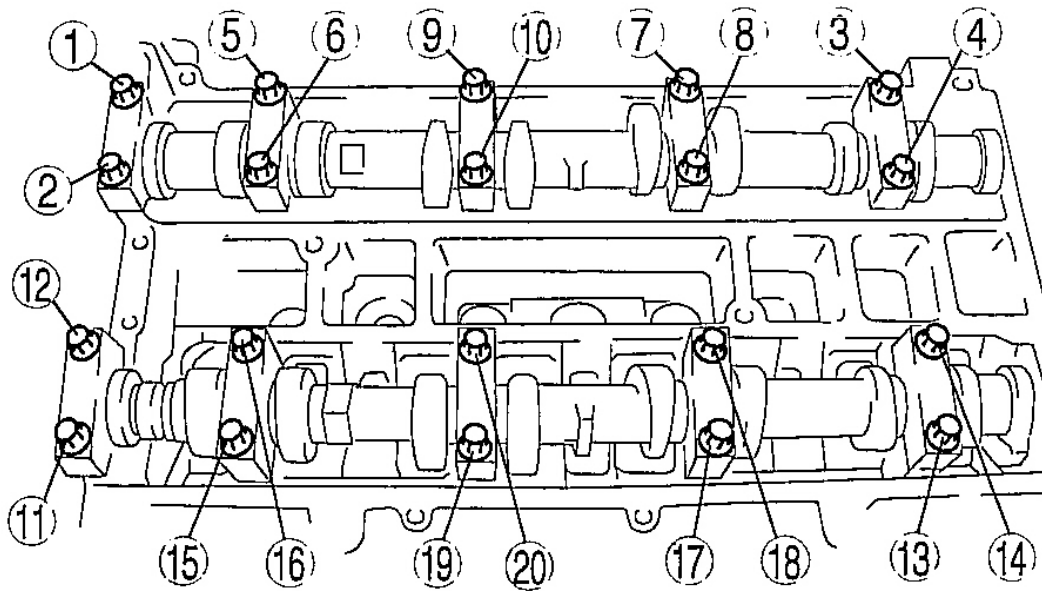
8. Remove the exhaust camshaft sprocket.



**Fig. 70: Removing Exhaust Camshaft Sprocket**  
Courtesy of MAZDA MOTORS CORP.

**NOTE:**

- The cylinder head and the camshaft caps are numbered to make sure they are reassembled in their original position. When removed, keep the caps with the cylinder head they were removed from. Do not mix the caps.



G02831627

**Fig. 71: Camshaft Cap Bolt Loosening Sequence**  
 Courtesy of MAZDA MOTORS CORP.

9. Loosen the camshaft cap bolts in several passes in the order shown in the figure.
10. Remove the camshaft.
11. Remove the tappet.
12. Select proper adjustment shim.

#### New Adjustment Shim

= Removed Shim Thickness + Measured Valve Clearance - Standard Valve Clearance (IN: 0.25 mm {0.0098 in}, EX: 0.30 mm {0.0118 in})

#### Standard [Engine Cold]

IN: 0.22-0.28 mm {0.0087-0.0110 in}

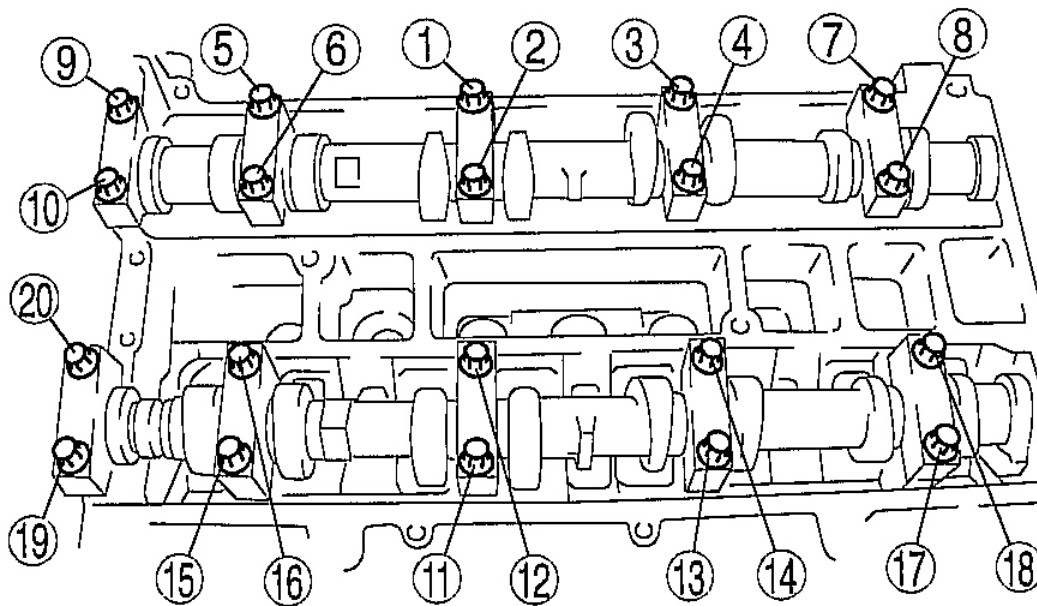
EX: 0.27-0.33 mm {0.0106-0.0130 in}

13. Install the camshaft with No.1 cylinder aligned with the TDC position.
14. Tighten the camshaft cap bolt using the following two steps.

#### Tightening Torque

(1) 5.0-9.0 N.m {51.0-91.7 kgf.cm, 44.3-79.5 in.lbf}

(2) 14.0-17.0 N.m {1.5-1.7 kgf.m, 10.4-12.5 ft.lbf}



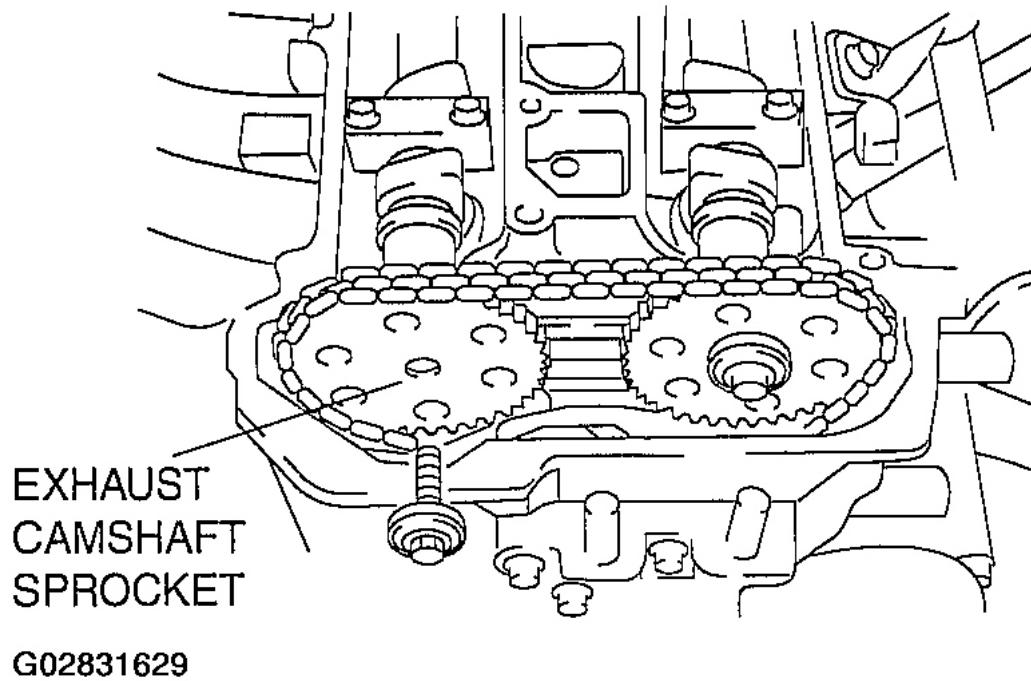
G02831628

**Fig. 72: Camshaft Cap Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

15. Install the exhaust camshaft sprocket.

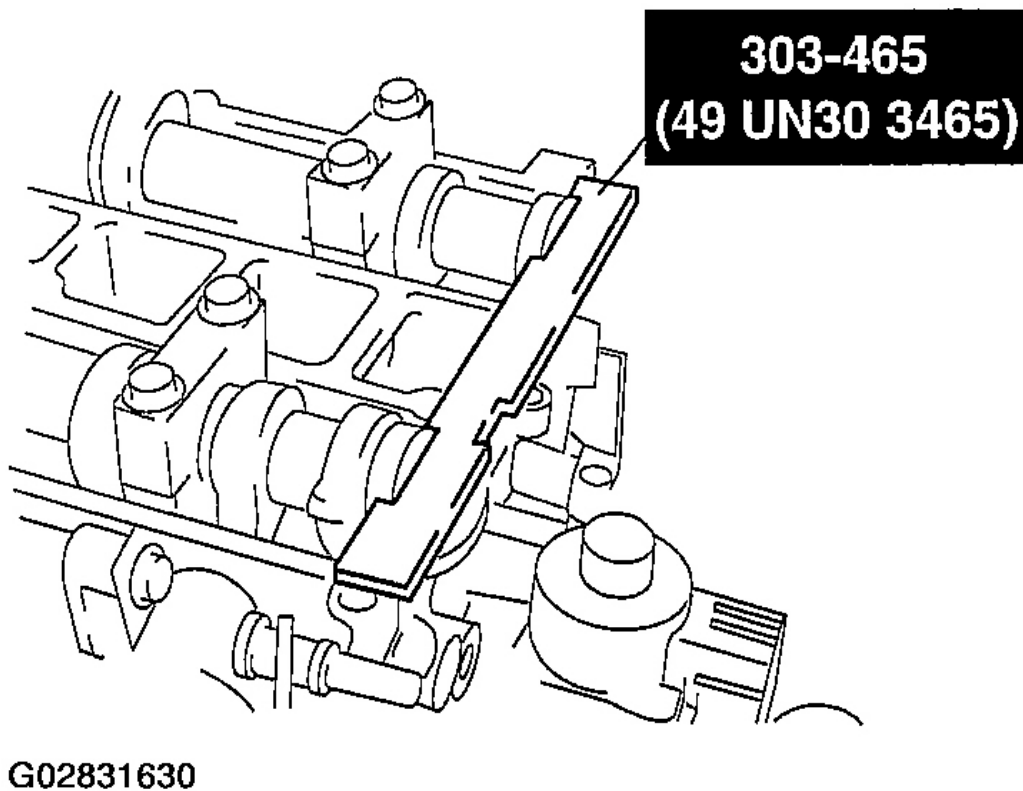
**NOTE:**

- Do not tighten the bolt for the camshaft sprocket during this step. First confirm the valve timing, then tighten the bolt.



**Fig. 73: Installing Exhaust Camshaft Sprocket**  
Courtesy of MAZDA MOTORS CORP.

16. Install the SST to the camshaft as shown in the figure.

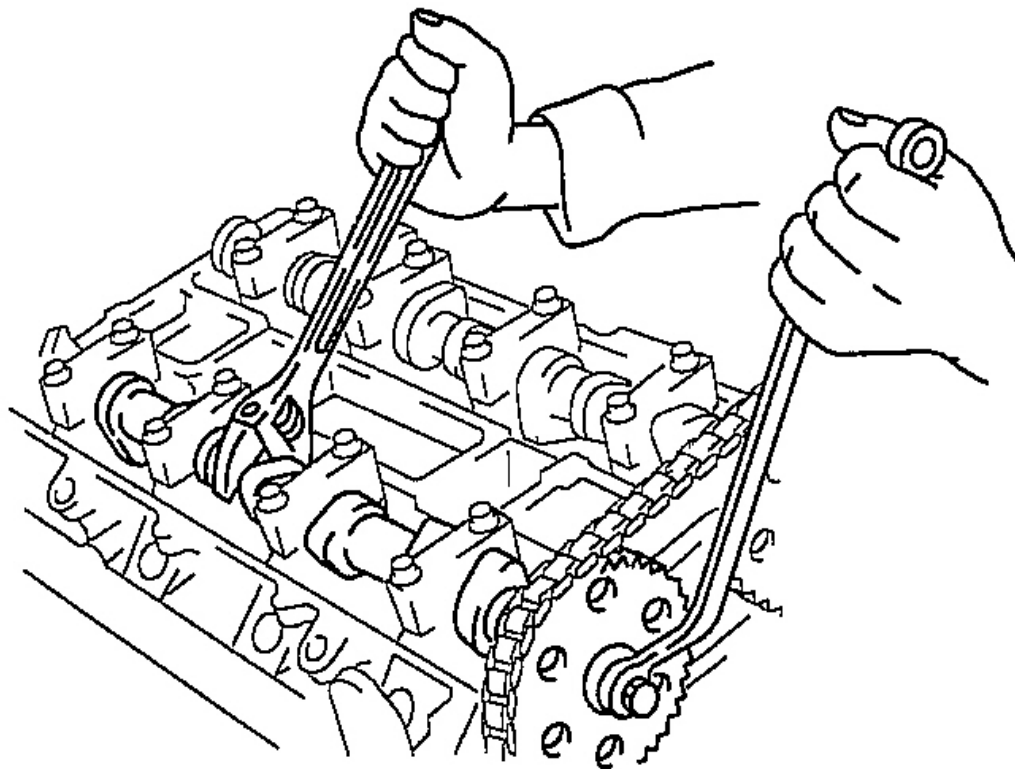


**Fig. 74: Installing Camshaft SST**  
Courtesy of MAZDA MOTORS CORP.

17. Remove the M6 x 1.0 bolt from the engine front cover to apply tension to the timing chain.
18. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.
19. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown in the figure.
20. Tighten the exhaust camshaft sprocket lock bolt.

**Tightening Torque**

**69-75 N.m {7.1-7.6 kgf.m, 50.9-55.3 ft.lbf}**

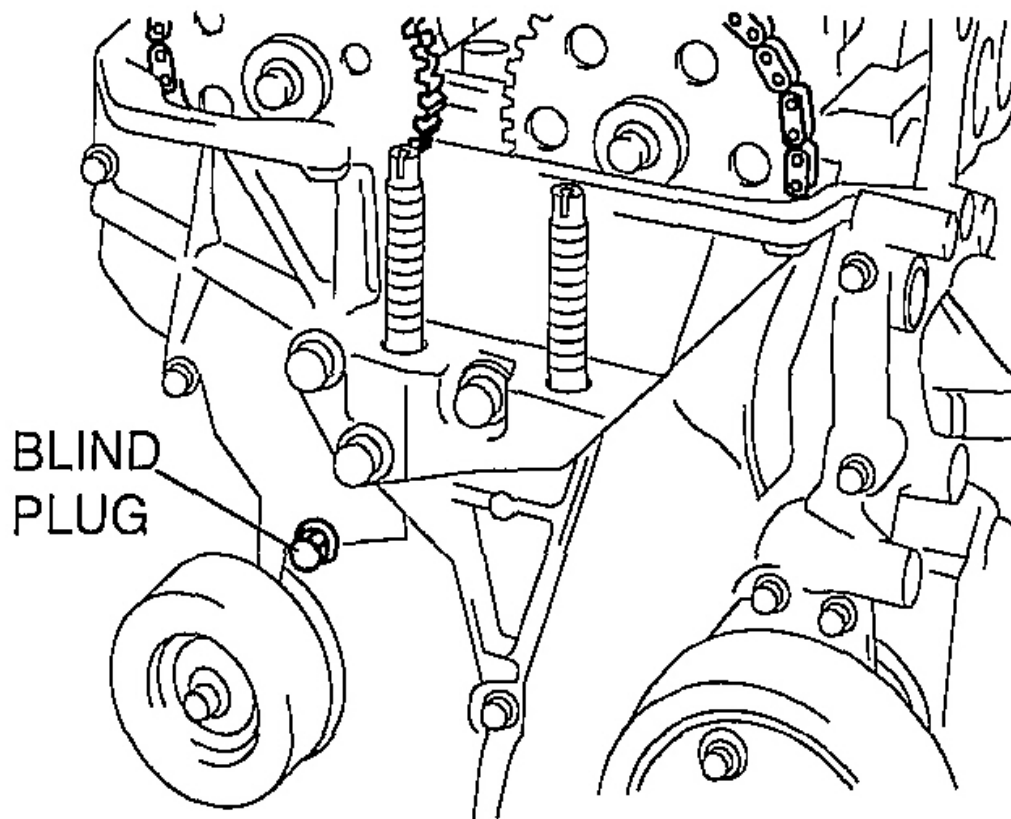
**G02831631**

**Fig. 75: Tightening Exhaust Camshaft Sprocket Lock Bolt**  
Courtesy of MAZDA MOTORS CORP.

21. Remove the SST from the camshaft.
22. Remove the SST from the block lower blind plug.
23. Rotate the crankshaft clockwise two turns until the TDC position.
  - If not aligned, loosen the crankshaft pulley lock bolt and repeat from Step 14.
24. Install the new engine front cover upper blind plug.

**Tightening Torque**

**8.0-11.5 N.m {81.6-117.2 kgf.cm, 70.9-101.7 in.lbf}**



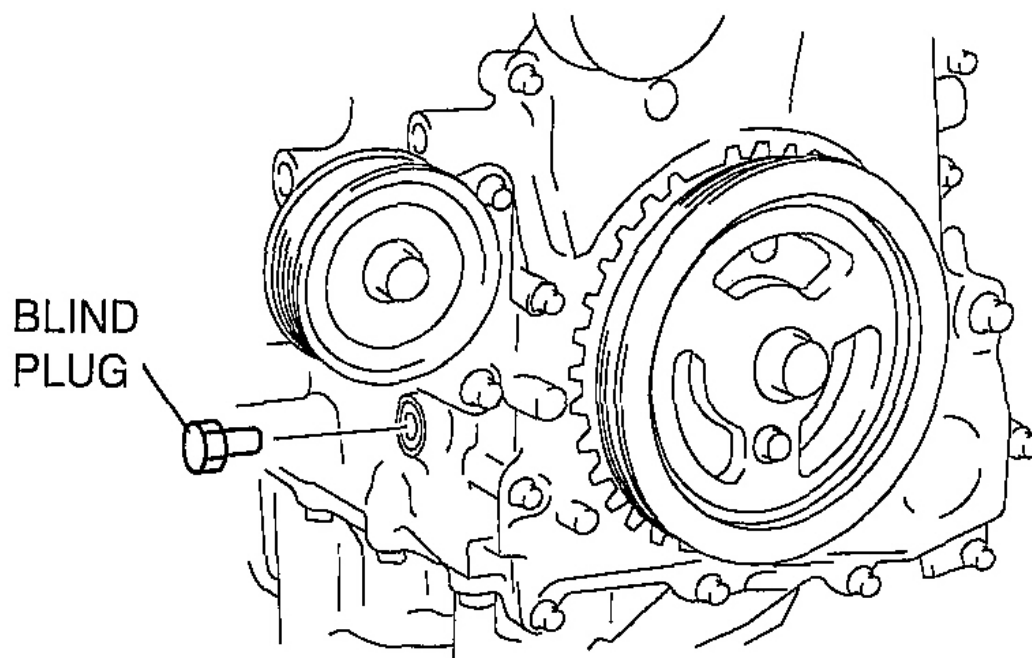
G02831632

**Fig. 76: Installing Engine Front Cover Upper Blind Plug**  
Courtesy of MAZDA MOTORS CORP.

25. Install the cylinder block lower blind plug.

**Tightening Torque**

18-22 N.m {1.9-2.2 kgf.m, 13.3-16.2 ft.lbf}



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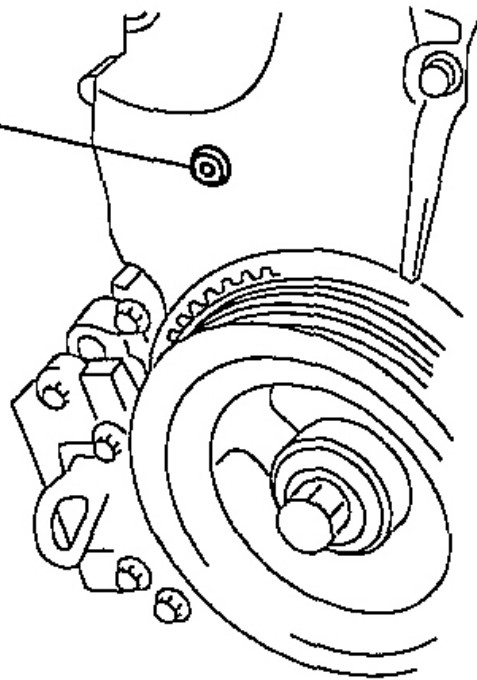
**Fig. 77: Installing Cylinder Block Lower Blind Plug**  
Courtesy of MAZDA MOTORS CORP.

26. Install the new engine front cover lower blind plug.

**Tightening Torque**

**10-14 N.m {1.1-1.4 kgf.m, 7.4-10.3 ft.lbf}**

ENGINE FRONT  
COVER LOWER  
BLIND PLUG

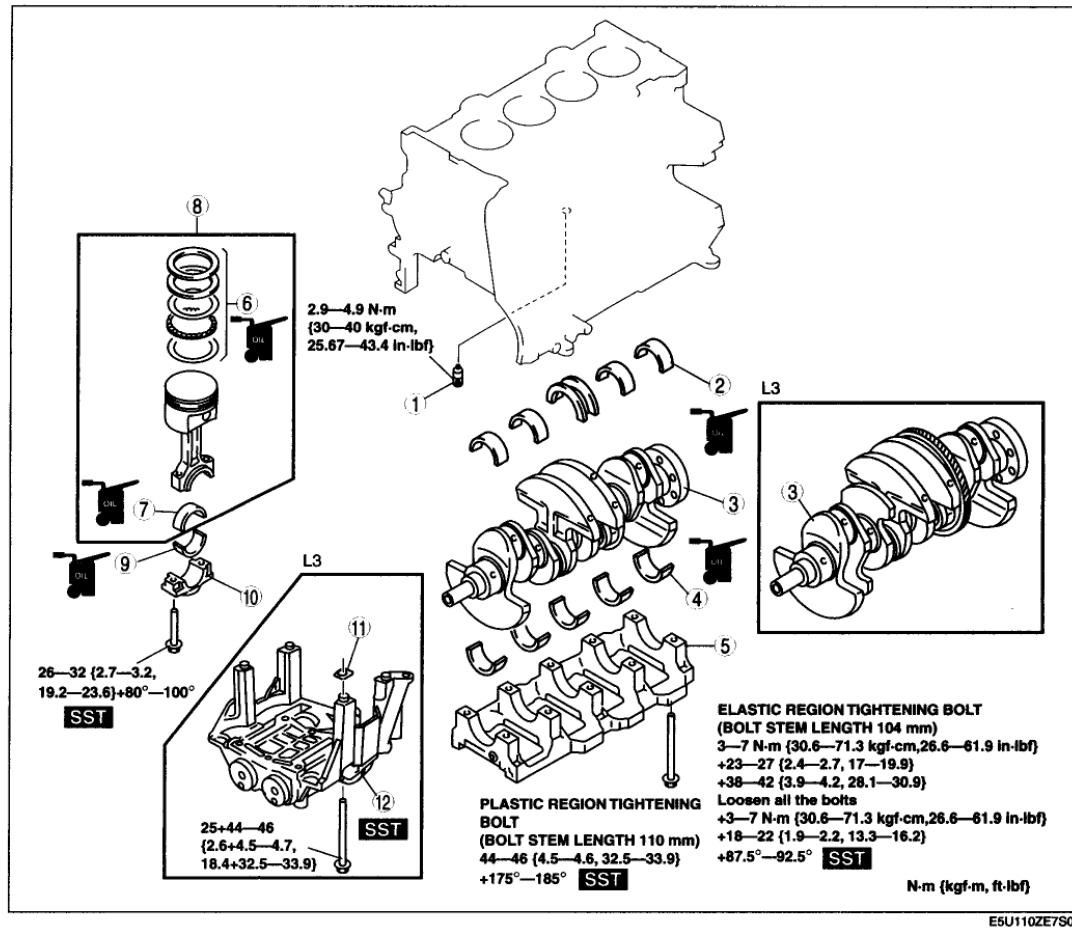


G02831634

**Fig. 78: Installing Engine Front Cover Lower Blind Plug**  
Courtesy of MAZDA MOTORS CORP.

## CYLINDER BLOCK (I) ASSEMBLY

1. Assemble in the order indicated in the figure.



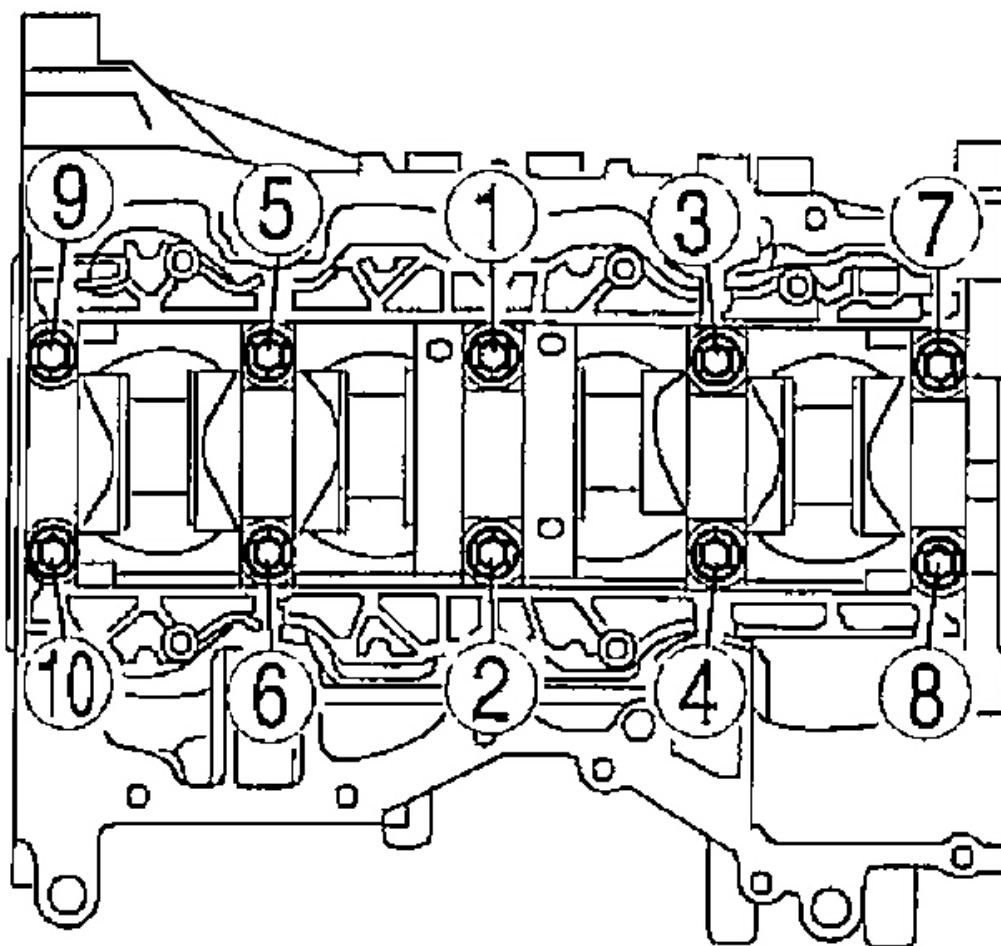
|   |                                                                            |
|---|----------------------------------------------------------------------------|
| 1 | Oil jet valve                                                              |
| 2 | Upper main bearing, thrust bearing                                         |
| 3 | Crankshaft                                                                 |
| 4 | Lower main bearing, thrust bearing                                         |
| 5 | Main bearing cap<br>(See Main Bearing Cap Assembly Note)                   |
| 6 | Piston ring<br>(See Piston Ring Assembly Note)                             |
| 7 | Upper connecting rod bearing<br>(See Connecting Rod Bearing Assembly Note) |

|    |                                                                            |
|----|----------------------------------------------------------------------------|
| 8  | Connecting rod, piston assembly<br>(See Piston Assembly Note)              |
| 9  | Lower connecting rod bearing<br>(See Connecting Rod Bearing Assembly Note) |
| 10 | Connecting rod cap<br>(See Connecting Rod Cap Assembly Note)               |
| 11 | Adjustment shim                                                            |
| 12 | Balancer unit<br>(See Balancer Unit Assembly Note)                         |

**Fig. 79: Assembling Cylinder Block & Engine Balancer - With Torque Specifications**  
Courtesy of MAZDA MOTORS CORP.

## MAIN BEARING CAP ASSEMBLY NOTE

1. Install the main bearing caps in the order indicated in the figure.



G02831636

**Fig. 80: Main Bearing Cap Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

2. Tighten the main bearing cap bolts using the SST (49 D032 316). See **Fig. 136**.

#### **Tightening Torque**

Plastic region tightening bolt (Bolt stem length 110 mm)

(1) 44-46 N.mn {4.5-4.6 kgf.m, 32.5-33.9 ft.lbf}

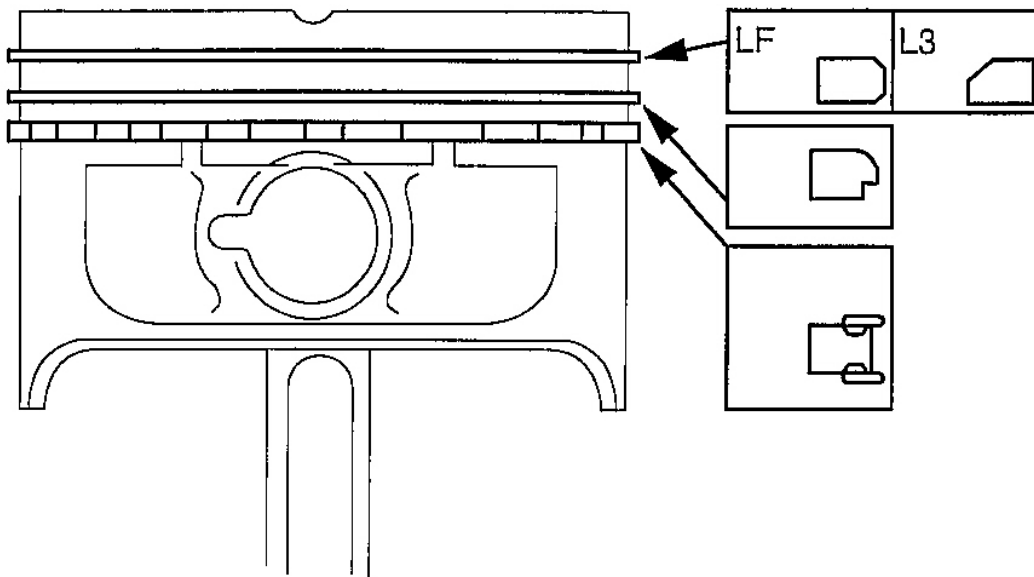
(2) plus 175°-185°

**Elastic region tightening bolt (Bolt stem length 104 mm)**

- (1) Apply engine oil to all bolts.
- (2) 3-7 Nm {30.6-71.3 kgfcm, 26.6-61.9 inlbf}
- (3) plus 23-27 Nm {2.4-2.7 kgfm, 17-19.9 ftlbt}
- (4) plus 38-42 Nm {3.9-4.2 kgfm, 28.1-30.9 ftlbt}
- (5) Loosen all the bolts. (no remaining torque.)
- (6) plus 3-7 Nm {30.6-71.3 kgfcm, 26.6-61.9 inlbt}
- (7) plus 18-22 Nm {1.9-2.2 kgfm, 13.3-16.2 ftlbt}
- (8) plus 87.5°-92.5°

**PISTON RING ASSEMBLY NOTE**

1. Install the two oil control ring segments and spacer.
2. Verify that the second ring is installed with scraper face side downward.
3. Verify that the top ring is installed with scraper face side inner of upper.

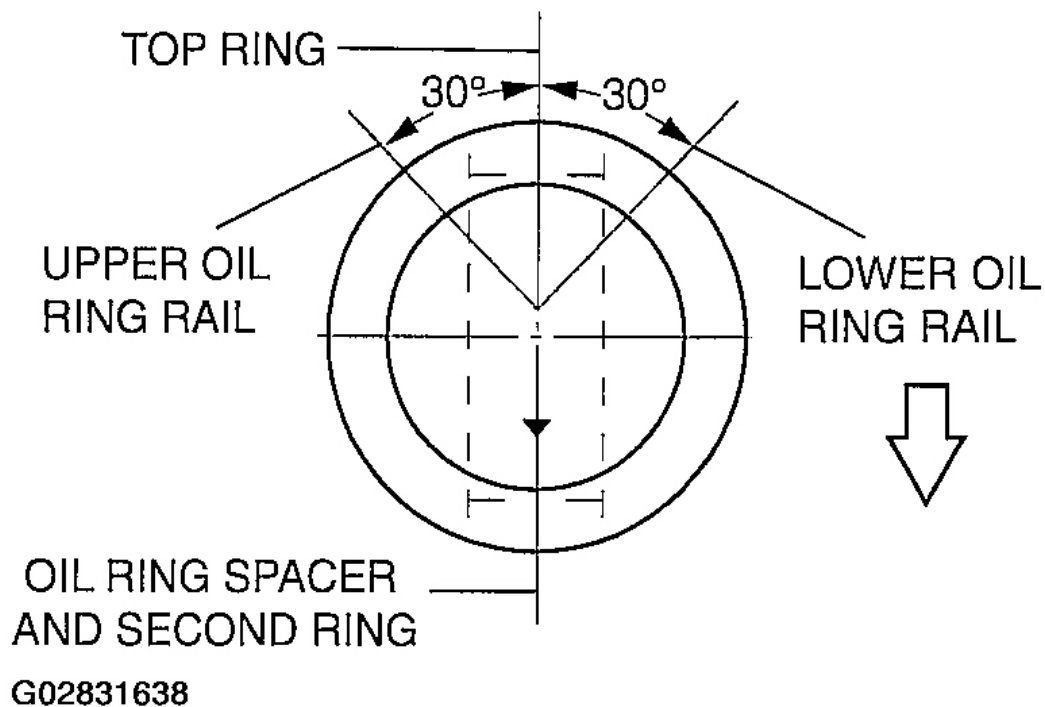


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**Fig. 81: Installing Piston Rings**  
Courtesy of MAZDA MOTORS CORP.

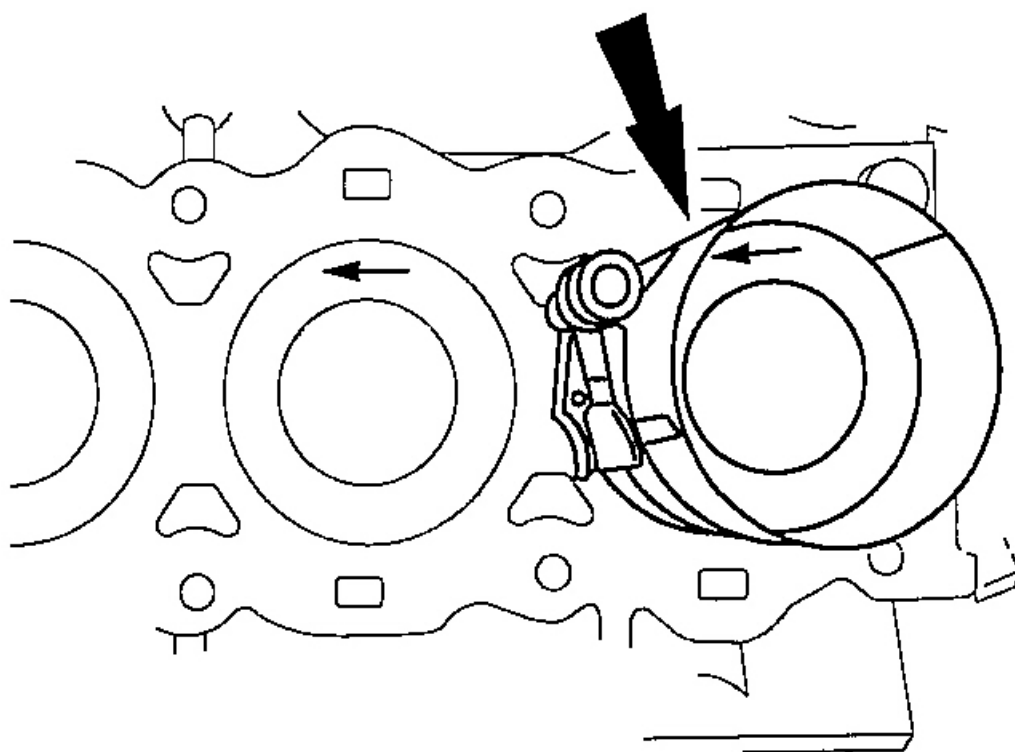
**PISTON ASSEMBLY NOTE**

1. Position the end gap of each ring as indicated in the figure.



**Fig. 82: Positioning Piston Ring End Gaps**  
Courtesy of MAZDA MOTORS CORP.

2. Insert the piston and connecting rod into the cylinder with the arrow mark to front of the engine.



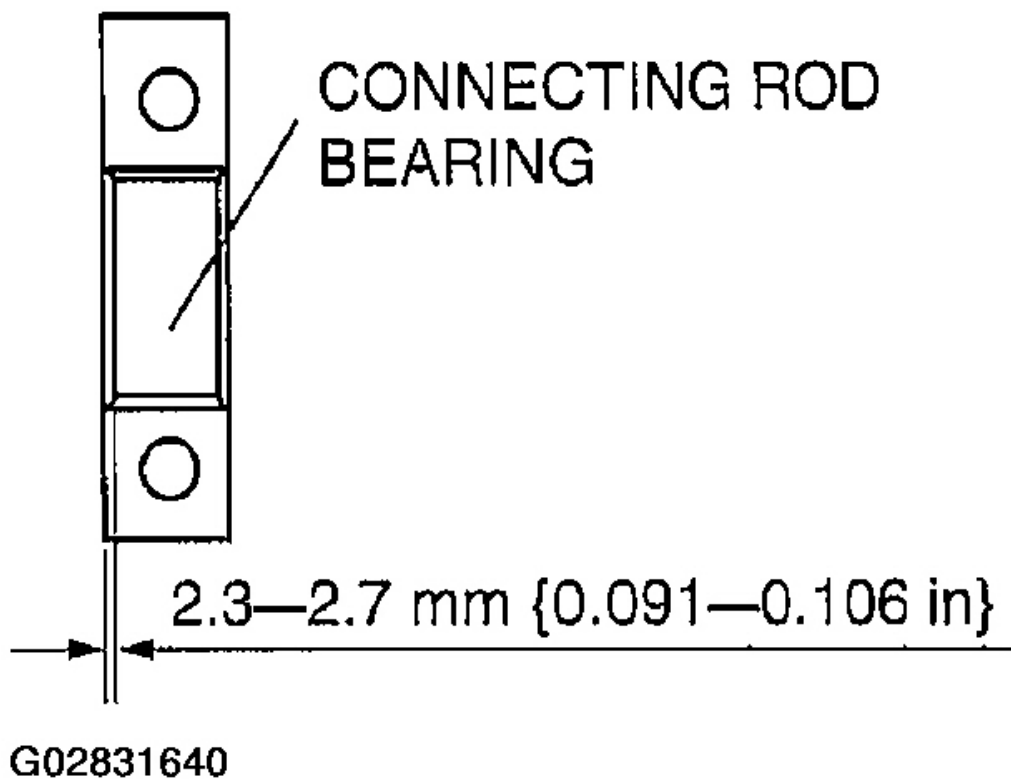
G02831639

**Fig. 83: Installing Piston**

Courtesy of MAZDA MOTORS CORP.

**CONNECTING ROD BEARING ASSEMBLY NOTE**

1. Install the connecting rod bearing to the connecting rod and connecting rod caps, as shown in the figure.



**Fig. 84: Installing Connecting Rod Bearing & Cap**  
 Courtesy of MAZDA MOTORS CORP.

#### CONNECTING ROD CAP ASSEMBLY NOTE

**CAUTION:**

- When assembling the connecting rod caps, align the broken, rough faces of the connecting rods and connecting rod caps.

1. Tighten the connecting rod bolts in two steps using the SST (49 D032 316) .

#### Tightening Torque

- (1) 26-32 N.m {2.7-3.2 kgf.m, 19.2-23.6 ft.lbf}
- (2) 80°-100°

#### BALANCER UNIT ASSEMBLY NOTE

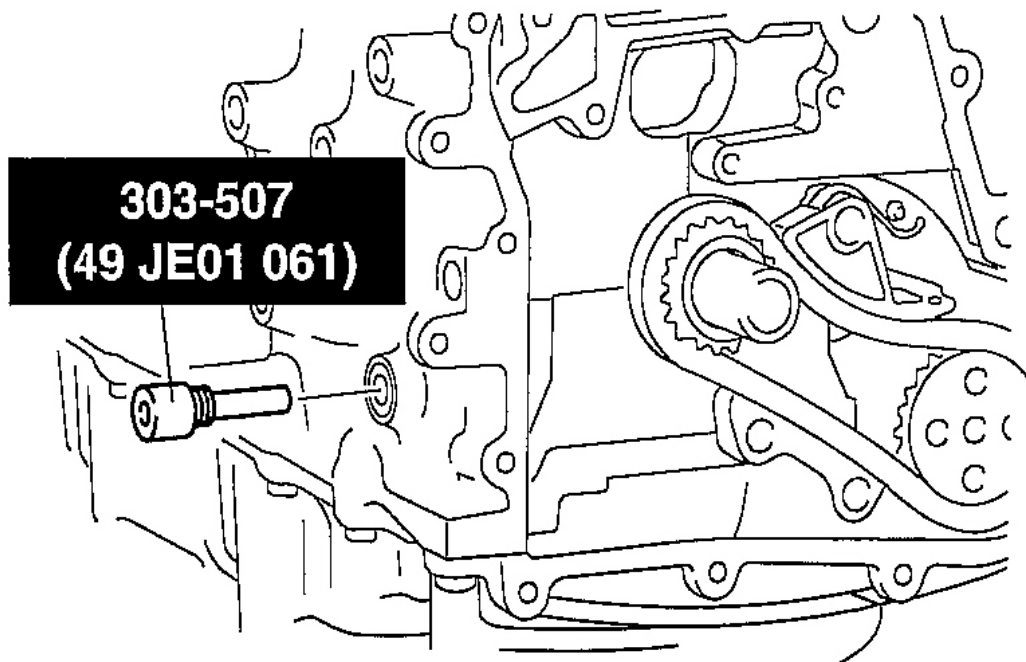
1. Confirm by visual inspection that there is no damage to the balancer unit gear (see **Fig. 79**) and verify that the shaft turns smoothly.

- If there is any damage or malfunction, replace the balancer unit.

**CAUTION:**

- Due to the precision interior construction of the balancer unit, it cannot be disassembled.

2. Install the SST as shown in the figure.

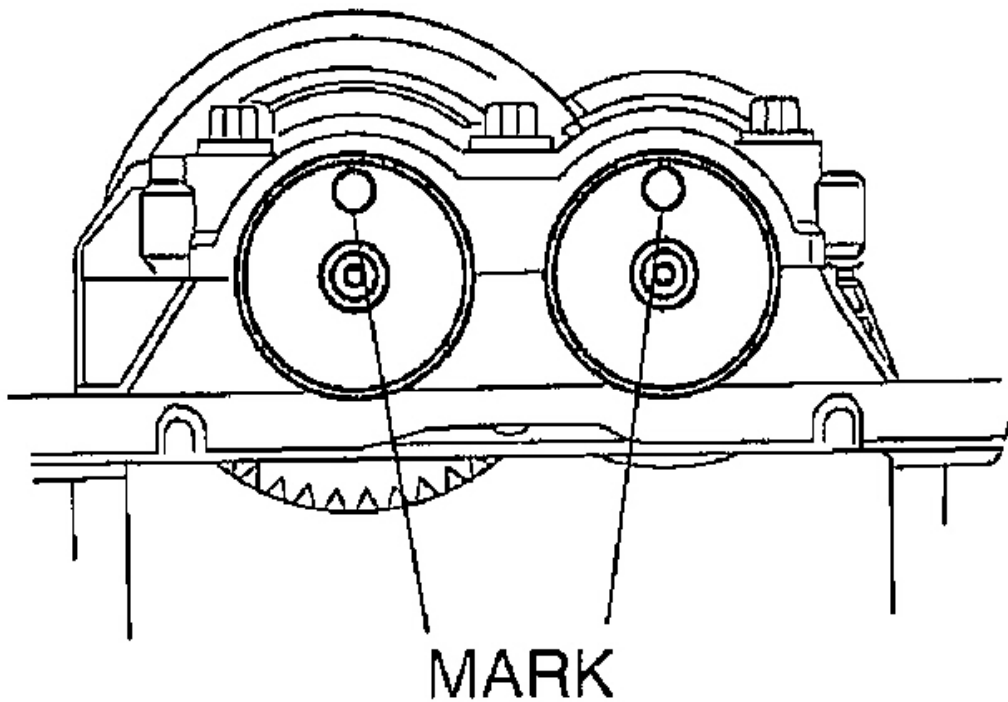


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**Fig. 85: Installing SST**

Courtesy of MAZDA MOTORS CORP.

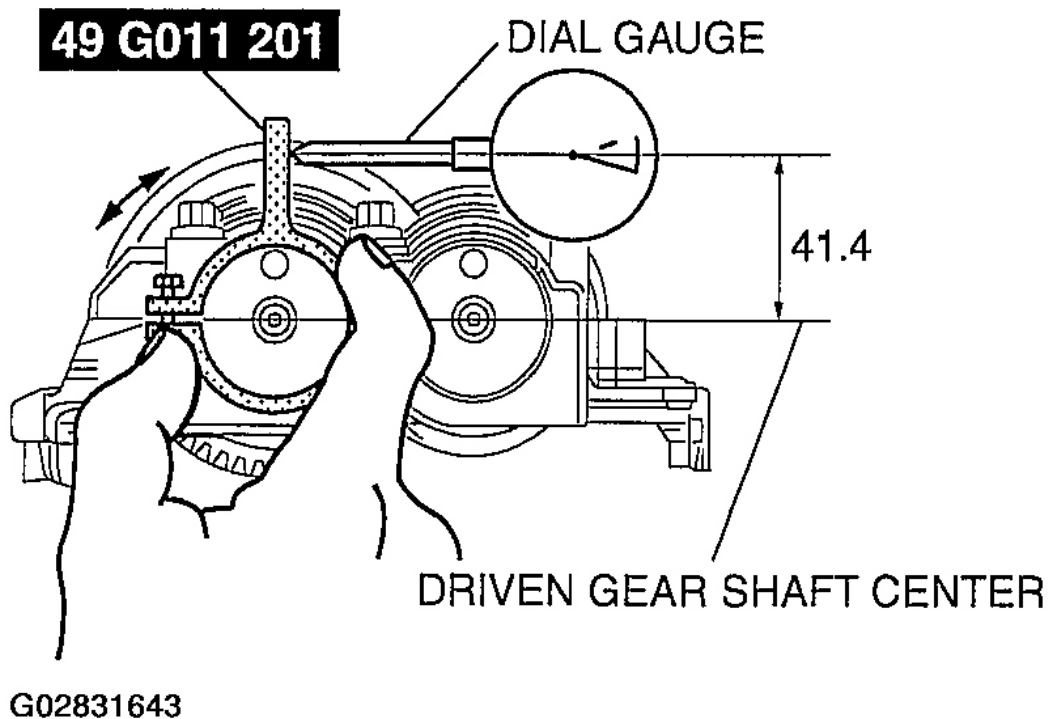
3. Turn the crankshaft clockwise the crankshaft is in the No.1 cylinder TDC position (until the balance weight is attached to the SST ).
4. Install the adjustment shim to the seat face of the balancer unit.
5. With the balancer unit marks at the exact top center, assemble the unit to the cylinder block.



G02831642

**Fig. 86: Identifying Balancer Unit Marks**  
Courtesy of MAZDA MOTORS CORP.

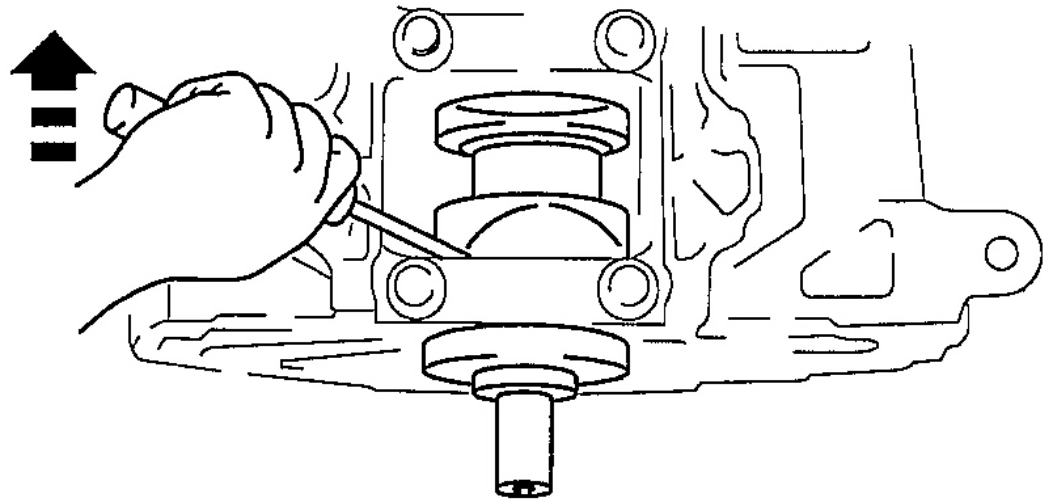
6. Set the SST as shown, then measure the gear backlash using a dial gauge.



**Fig. 87: Measuring Gear Backlash**  
Courtesy of MAZDA MOTORS CORP.

**NOTE:**

- For an accurate measurement of gear backlash, insert a screwdriver into the crankshaft No. 1 balance weight area and set both the rotation and the thrust direction with the screwdriver, using a prying action, as shown in the figure.



G02831644

**Fig. 88: Measuring Gear Backlash Using Screwdriver**  
 Courtesy of MAZDA MOTORS CORP.

- If the backlash exceeds the specified range, remeasure the backlash and, using the adjustment shim selection table, select the proper shim, according to the following procedure.

**CAUTION:**

- When measuring the backlash, rotate the crankshaft one full rotation and verify that it is within the specified range at all of the following six positions: 10°, 30°, 100°, 190°, 210°, 280° ATDC.

**Value Range**

**0.005-0.101 mm {0.00019-0.0039 in}**

1. Using master adjustment shim (No.50), assemble the balancer unit to the cylinder block, then measure the backlash.
2. Select the proper adjustment shim according to the measured value.
3. Install the selected adjustment shim to the balancer unit, then assemble the balancer unit to the cylinder block. See **TORQUE SPECIFICATIONS** table.

**ADJUSTMENT SHIM SELECTION TABLE**

# 2005 B2300

2004-08 ENGINES 2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6

| Backlash<br>mm {in}                  | Selection shim<br>(No.) | Shim thickness<br>mm {in} | Backlash<br>mm {in}                       | Selection shim<br>(No.) | Shim thickness<br>mm {in} |
|--------------------------------------|-------------------------|---------------------------|-------------------------------------------|-------------------------|---------------------------|
| 0.256—0.262<br>{0.0100—0.01031}      | 15                      | 1.15 {0.0452}             | 0.116—0.122<br>{0.00456—<br>0.00480}      | 35                      | 1.35 {0.0531}             |
| 0.249—0.255<br>{0.0098—<br>0.010039} | 16                      | 1.16 {0.0456}             | 0.109—0.115<br>{0.00429—<br>0.00452}      | 36                      | 1.36 {0.0535}             |
| 0.242—0.248<br>{0.0096—0.00976}      | 17                      | 1.17 {0.0460}             | 0.102—0.108<br>{0.00401—<br>0.00425}      | 37                      | 1.37 {0.0539}             |
| 0.235—0.241<br>{0.0093—0.00948}      | 18                      | 1.18 {0.0464}             | 0.095—0.101<br>{0.00374—<br>0.00397}      | 38                      | 1.38 {0.0543}             |
| 0.228—0.234<br>{0.00897—<br>0.00921} | 19                      | 1.19 {0.0468}             | 0.088—0.094<br>{0.00346—<br>0.00370}      | 39                      | 1.39 {0.0547}             |
| 0.221—0.227<br>{0.00870—<br>0.00893} | 20                      | 1.20 {0.0472}             | 0.081—0.087<br>.087 {0.00318—<br>0.00342} | 40                      | 1.40 {0.0551}             |
| 0.214—0.220<br>{0.00842—<br>0.00874} | 21                      | 1.21 {0.0476}             | 0.074—0.080<br>{0.00291—<br>0.00314}      | 41                      | 1.41 {0.0555}             |
| 0.207—0.213<br>{0.00814—<br>0.00838} | 22                      | 1.22 {0.0480}             | 0.067—0.073<br>{0.00263—<br>0.00287}      | 42                      | 1.42 {0.0559}             |
| 0.200—0.206<br>{0.00787—<br>0.00811} | 23                      | 1.23 {0.0484}             | 0.060—0.066<br>{0.00236—<br>0.00259}      | 43                      | 1.43 {0.0562}             |
| 0.193—0.199<br>{0.00759—<br>0.00783} | 24                      | 1.24 {0.0488}             | 0.053—0.059<br>{0.00208—<br>0.00232}      | 44                      | 1.44 {0.0566}             |
| 0.186—0.192<br>{0.00732—<br>0.00755} | 25                      | 1.25 {0.492}              | 0.046—0.052<br>{0.00181—<br>0.00204}      | 45                      | 1.45 {0.0570}             |
| 0.179—0.185<br>{0.00704—<br>0.00728} | 26                      | 1.26 {0.496}              | 0.039—0.045<br>{0.00153—<br>0.00177}      | 46                      | 1.46 {0.0574}             |
| 0.172—0.178<br>{0.00677—<br>0.00700} | 27                      | 1.27 {0.499}              | 0.032—0.038<br>{0.00125—<br>0.00149}      | 47                      | 1.47 {0.0578}             |
| 0.165—0.171<br>{0.00649—<br>0.00673} | 28                      | 1.28 {0.503}              | 0.025—0.031<br>{0.000984—<br>0.00122}     | 48                      | 1.48 {0.0582}             |
| 0.158—0.164<br>{0.00622—0.00645}     | 29                      | 1.29 {0.507}              | 0.018—0.024<br>{0.000708—<br>0.000944}    | 49                      | 1.49 {0.0586}             |
| 0.151—0.157<br>{0.00594—<br>0.00618} | 30                      | 1.30 {0.511}              | 0.011—0.017<br>{0.000433—<br>0.000669}    | 50 (master)             | 1.50 {0.0590}             |
| 0.144—0.150<br>{0.0566—0.0590}       | 31                      | 1.31 {0.515}              | 0.004—0.010<br>{0.00015—<br>0.000393}     | 51                      | 1.51 {0.0594}             |
| 0.137—0.143<br>{0.00539—<br>0.00562} | 32                      | 1.32 {0.519}              | 0.000—0.004<br>{0.000—0.000157}           | 52                      | 1.52 {0.0598}             |
| 0.130—0.136<br>{0.00511—<br>0.00535} | 33                      | 1.33 {0.523}              | 0.000—0.000<br>{0.000—0.000}              | 53                      | 1.53 {0.0602}             |
| 0.123—0.129<br>{0.00484—<br>0.00507} | 34                      | 1.34 {0.527}              | 0.000—0.000<br>{0.000—0.000}              | 54                      | 1.54 {0.0606}             |

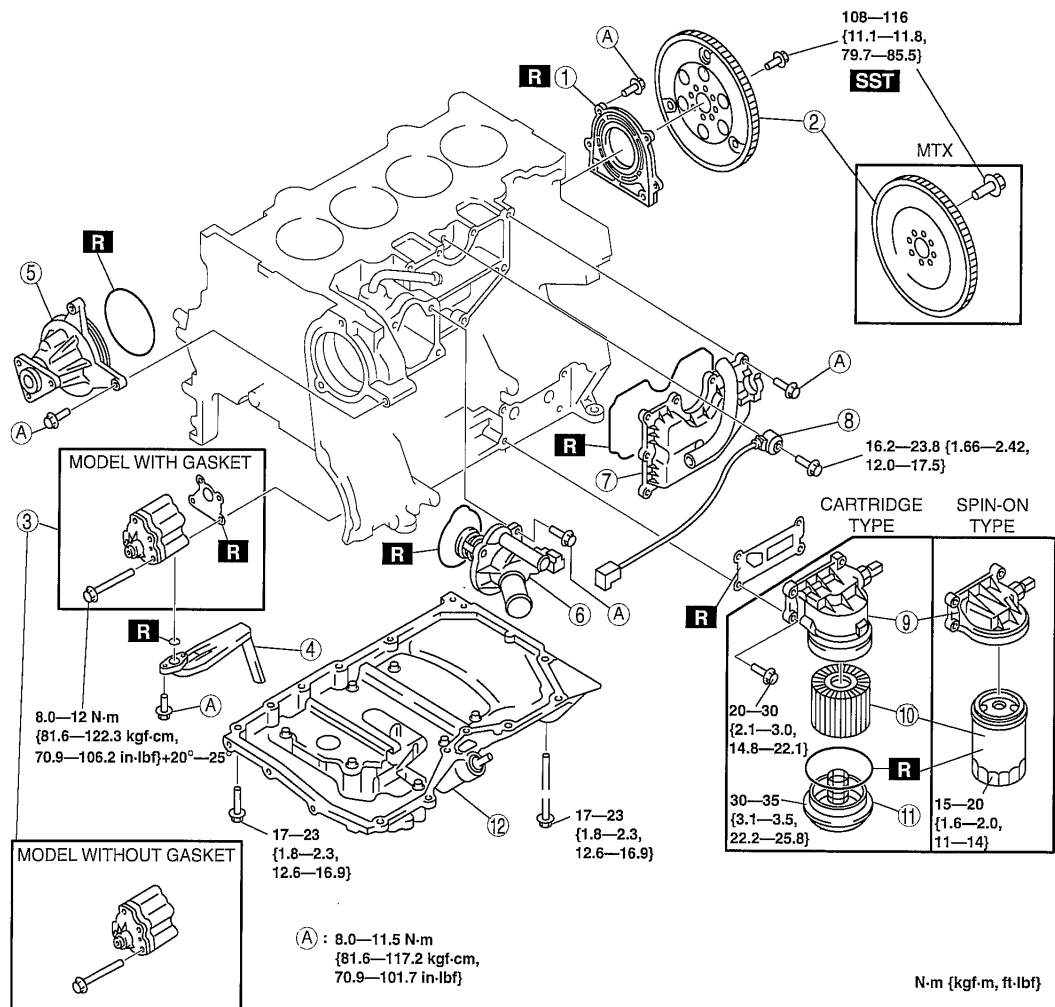
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**Fig. 89: Adjustment Shim Selection Table**

Courtesy of MAZDA MOTORS CORP.

## CYLINDER BLOCK (II) ASSEMBLY

1. Assemble in the order indicated in the figure.



|   |                                                                                            |
|---|--------------------------------------------------------------------------------------------|
| 1 | Rear oil seal<br>(See Rear Oil Seal Assembly Note)                                         |
| 2 | Flywheel (MTX), Drive plate (ATX) (See<br>Drive Plate (ATX), Flywheel (MTX) Assembly Note) |
| 3 | Oil pump                                                                                   |
| 4 | Oil strainer                                                                               |
| 5 | Water pump                                                                                 |
| 6 | Thermostat                                                                                 |

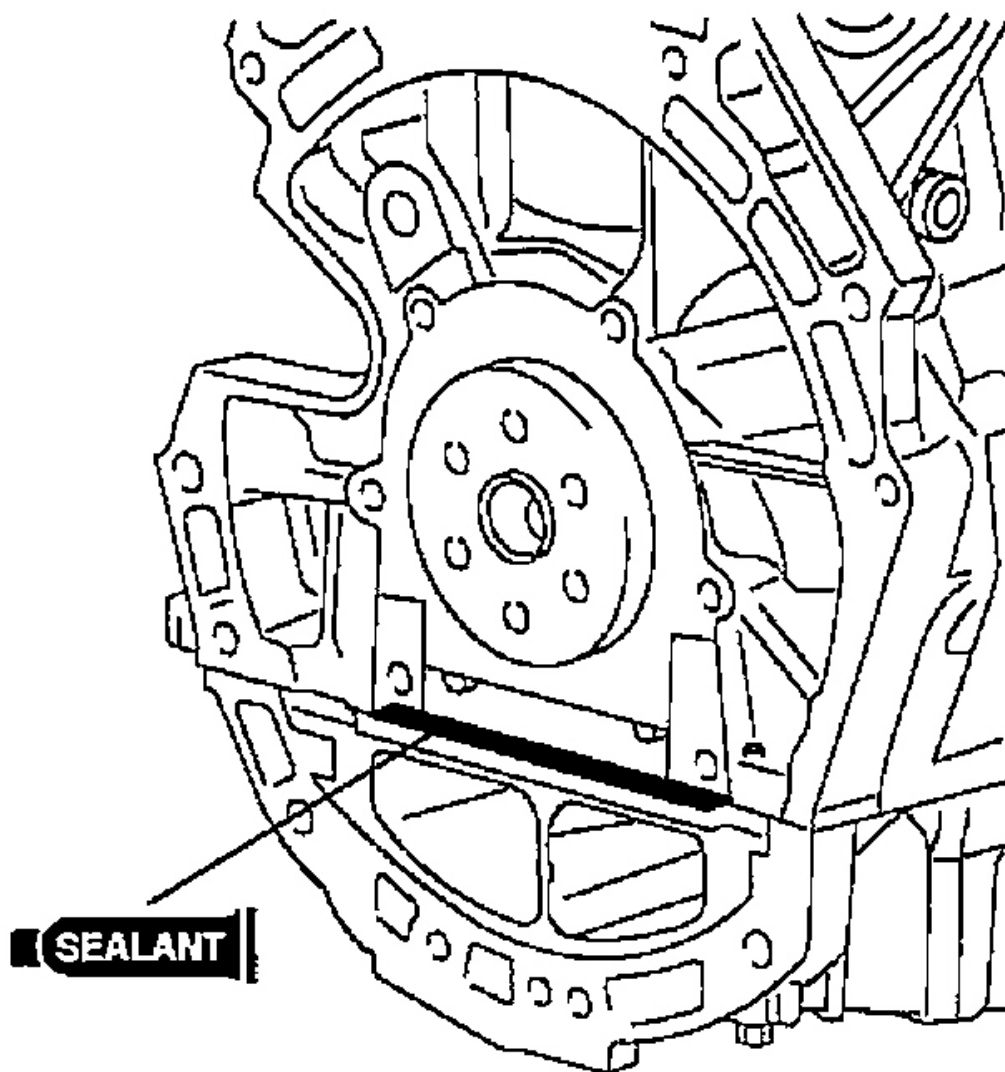
|    |                                        |
|----|----------------------------------------|
| 7  | Oil separator                          |
| 8  | Knock sensor                           |
| 9  | Oil filter adapter                     |
| 10 | Oil filter                             |
| 11 | Oil filter cover (cartridge type)      |
| 12 | Oil pan<br>(See Oil pan Assembly Note) |

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**Fig. 90: Assembling Cylinder Block (II)**  
Courtesy of MAZDA MOTORS CORP.

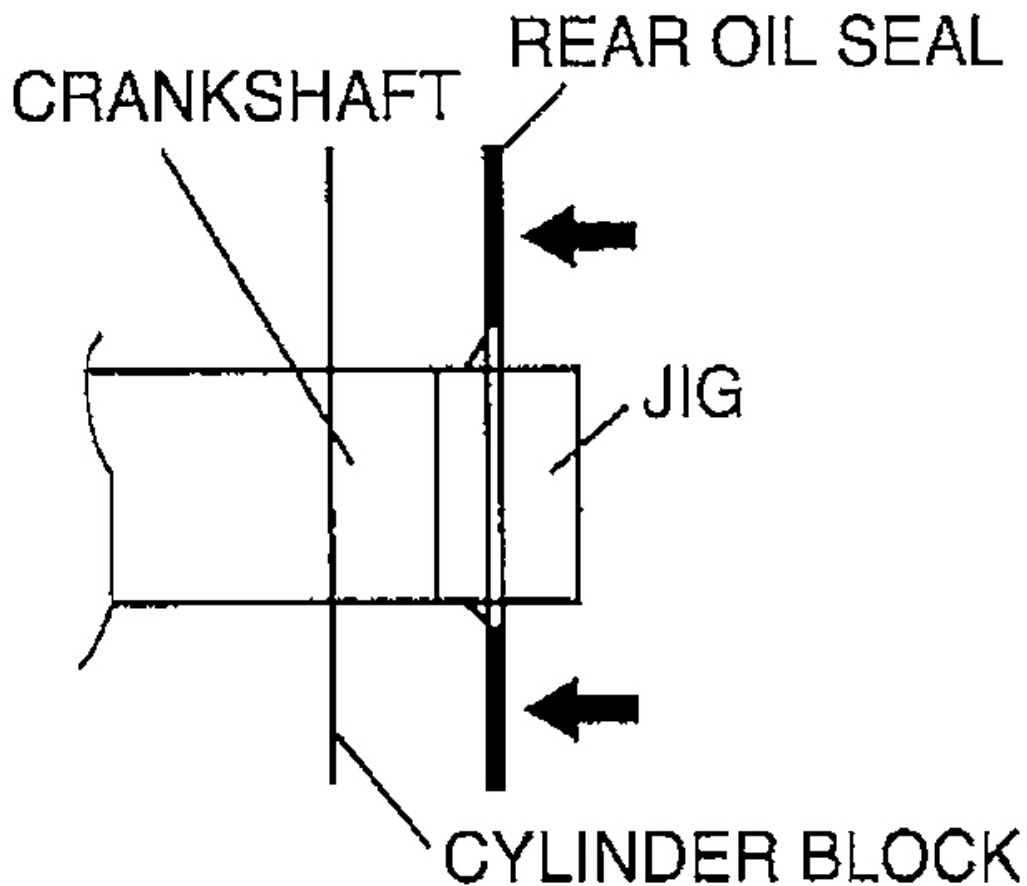
**REAR OIL SEAL ASSEMBLY NOTE**

1. Apply silicone sealant to the mating faces as shown in the figure.

**Thickness****4.0-6.0 mm {0.16-0.23 in}****G02831647**

**Fig. 91: Applying Silicone Sealant**  
**Courtesy of MAZDA MOTORS CORP.**

2. Apply clean engine oil to the new oil seal lip.
3. Install the rear oil seal using the jig as shown in the figure.



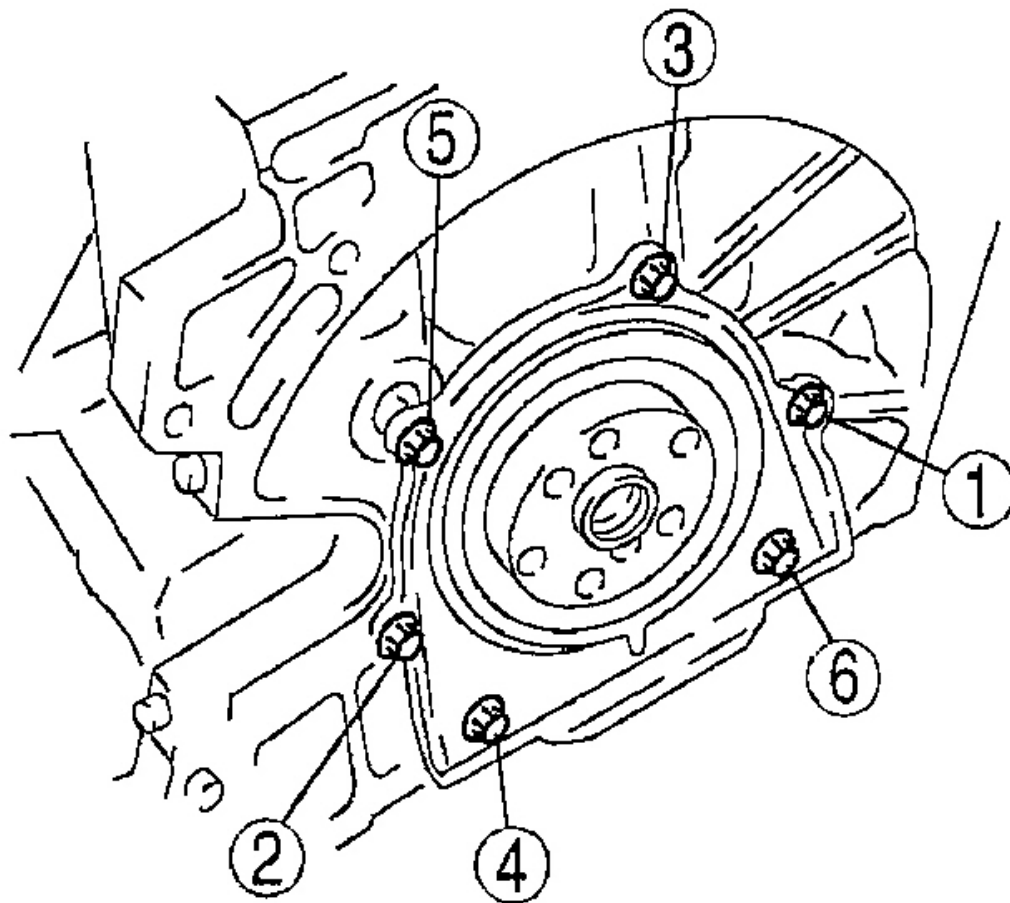
G02831648

**Fig. 92: Installing Rear Oil Seal**

Courtesy of MAZDA MOTORS CORP.

4. Tighten the rear oil seal bolts in the order as shown in the figure.

**Tightening Torque****8.0-11.5 N.m {81.6-117.2 kgf.cm, 70.9-101.7 in.lbf}**



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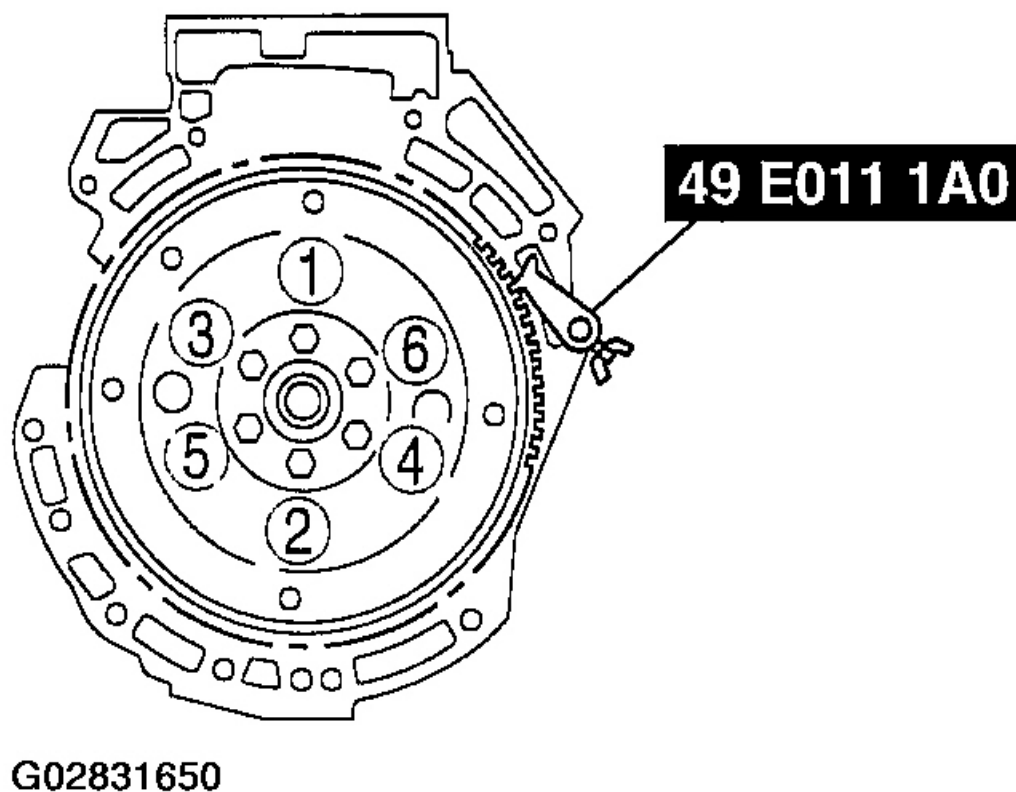
**Fig. 93: Rear Oil Seal Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

#### **DRIVE PLATE (ATX), FLYWHEEL (MTX) ASSEMBLY NOTE**

1. Hold the crankshaft using the SST .
2. Tighten the bolts in the 3 steps in the figure.

#### **Tightening Torque**

- (1) 46-54 N.m {4.70-5.50 kgf.m, 34.0-39.8 ft.lbf}
- (2) 76-84 N.m {7.75-8.56 kgf.m, 56.1-61.9 ft.lbf}
- (3) 108-116 N.m {11.1-11.8 kgf.m, 79.7-85.5 ft.lbf}



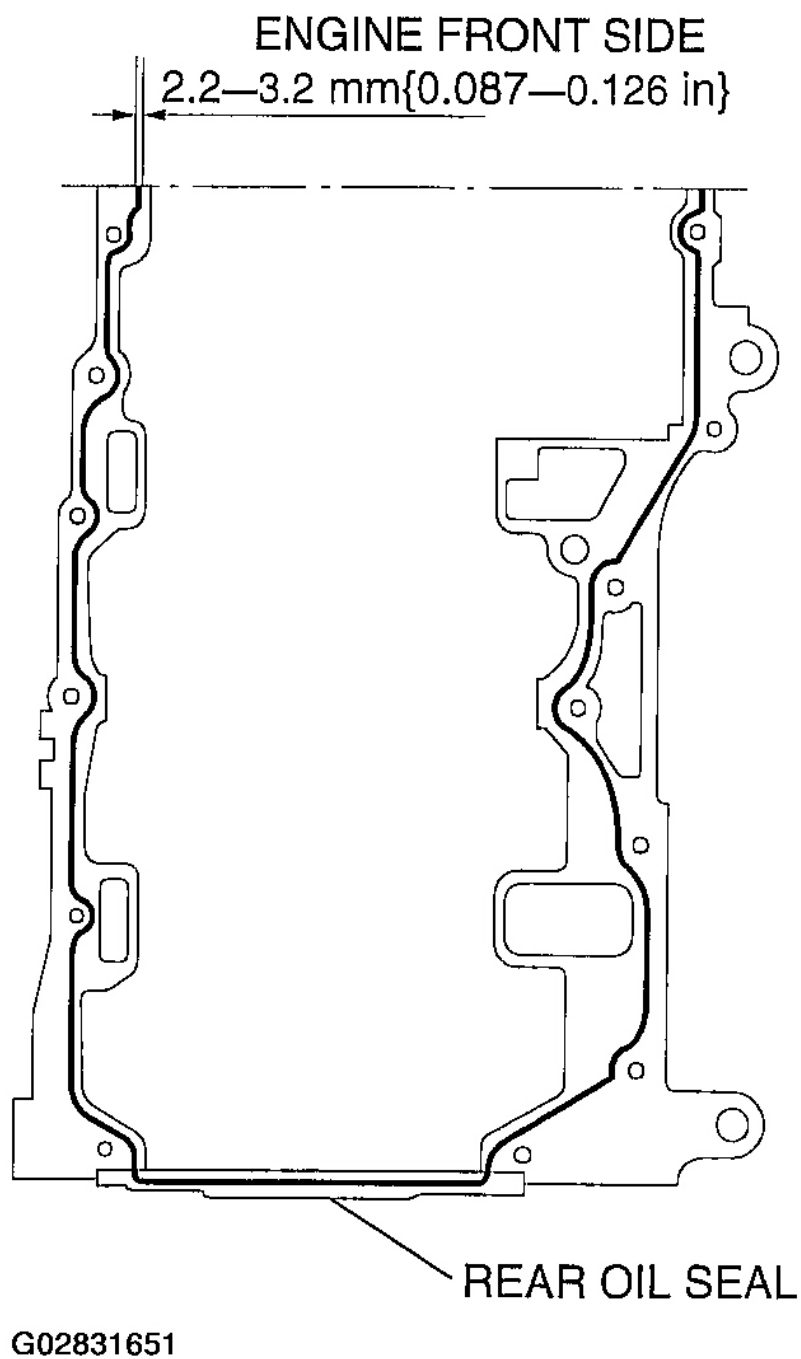
**Fig. 94: Drive Plate/Flywheel Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

#### OIL PAN ASSEMBLY NOTE

1. Apply a continuous bead of silicone sealant to the oil pan as indicated in the figure.

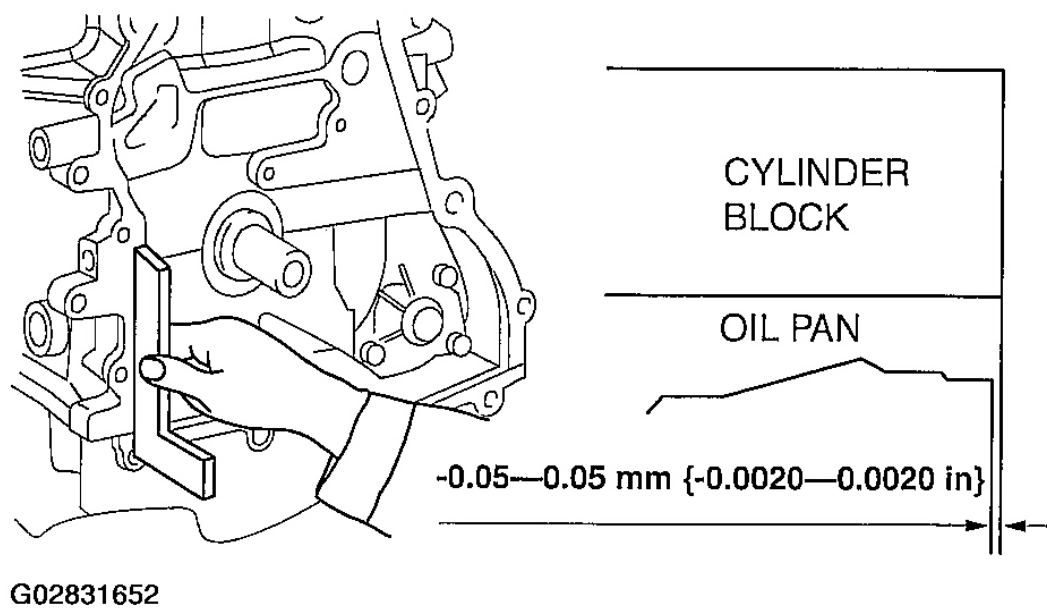
**CAUTION:**

- Install the oil pan within 10 min. of applying the silicone sealant.
- Make sure that there is no oil or dust on the seal side of oil pan.



**Fig. 95: Applying A Continuous Bead Of Silicone Sealant**  
Courtesy of MAZDA MOTORS CORP.

2. Use a square ruler to unite the oil pan and the cylinder block junction side on the engine front cover side.

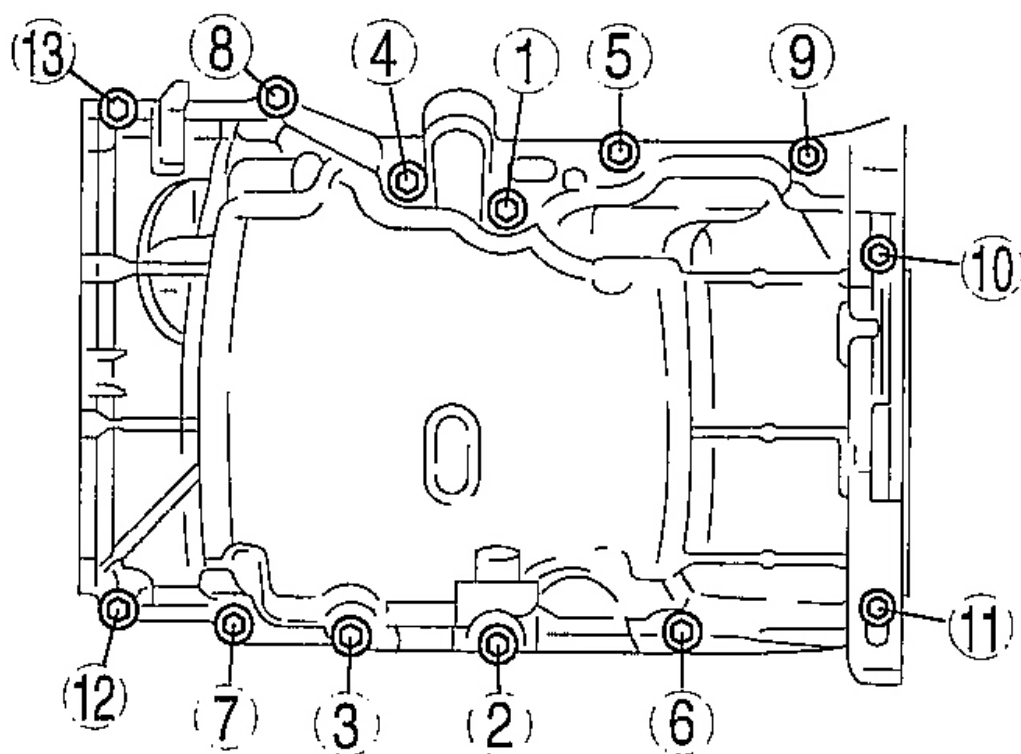


**Fig. 96: Aligning Oil Pan To Cylinder Block**  
Courtesy of MAZDA MOTORS CORP.

3. Tighten the rear oil pan bolts in the order as shown in the figure.

#### **Tightening Torque**

**17-23 N.m {1.8-2.3 kgf.m, 12.6-16.9 ft.lbf}**

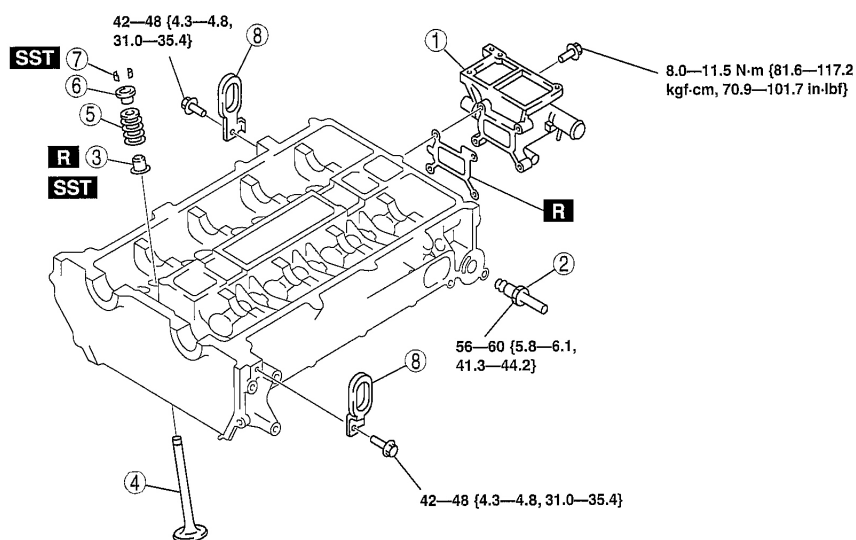


G02831653

**Fig. 97: Rear Oil Pan Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

## CYLINDER HEAD (I) ASSEMBLY

1. Assemble in the order indicated in the figure.



|   |                                              |
|---|----------------------------------------------|
| 1 | Water outlet                                 |
| 2 | EGR pipe                                     |
| 3 | Valve seal<br>(See Valve Seal Assembly Note) |
| 4 | Valve                                        |

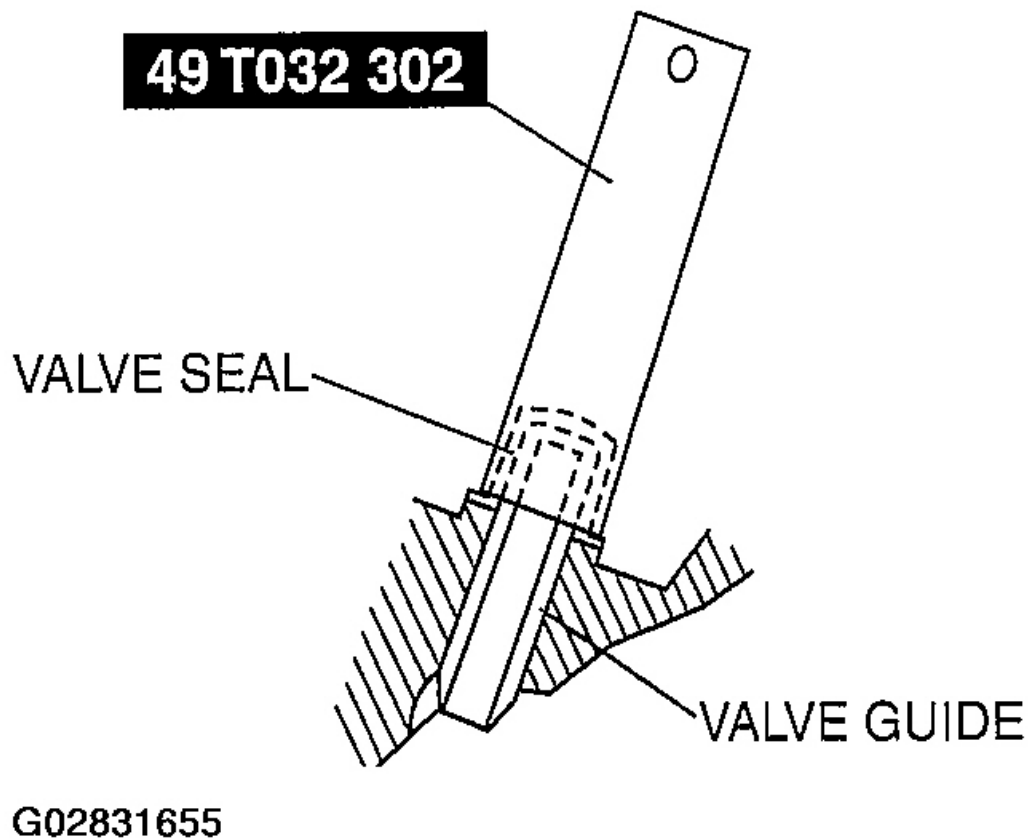
|   |                                                  |
|---|--------------------------------------------------|
| 5 | Valve spring                                     |
| 6 | Upper valve spring seat                          |
| 7 | Valve keeper<br>(See Valve Keeper Assembly Note) |
| 8 | Engine hanger                                    |

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**Fig. 98: Assembling Cylinder Head (I)**  
 Courtesy of MAZDA MOTORS CORP.

### VALVE SEAL ASSEMBLY NOTE

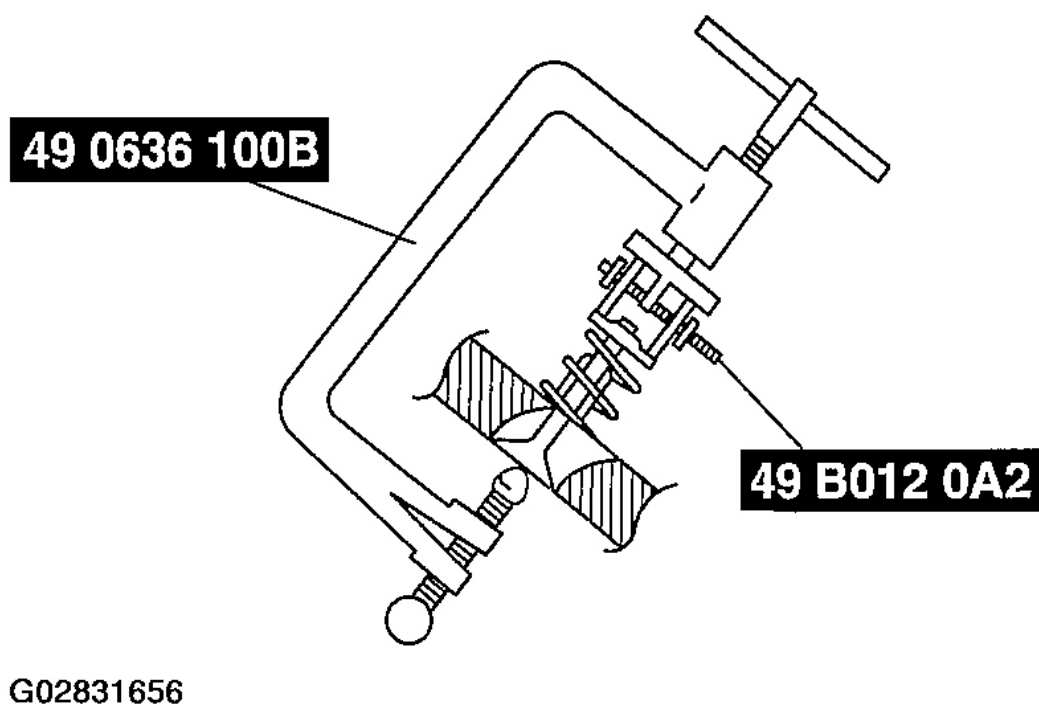
1. Press the valve seal onto the valve guide by hand.
2. Lightly tap the SST using a plastic hammer.



**Fig. 99: Installing Valve Seal**  
Courtesy of MAZDA MOTORS CORP.

#### VALVE KEEPER ASSEMBLY NOTE

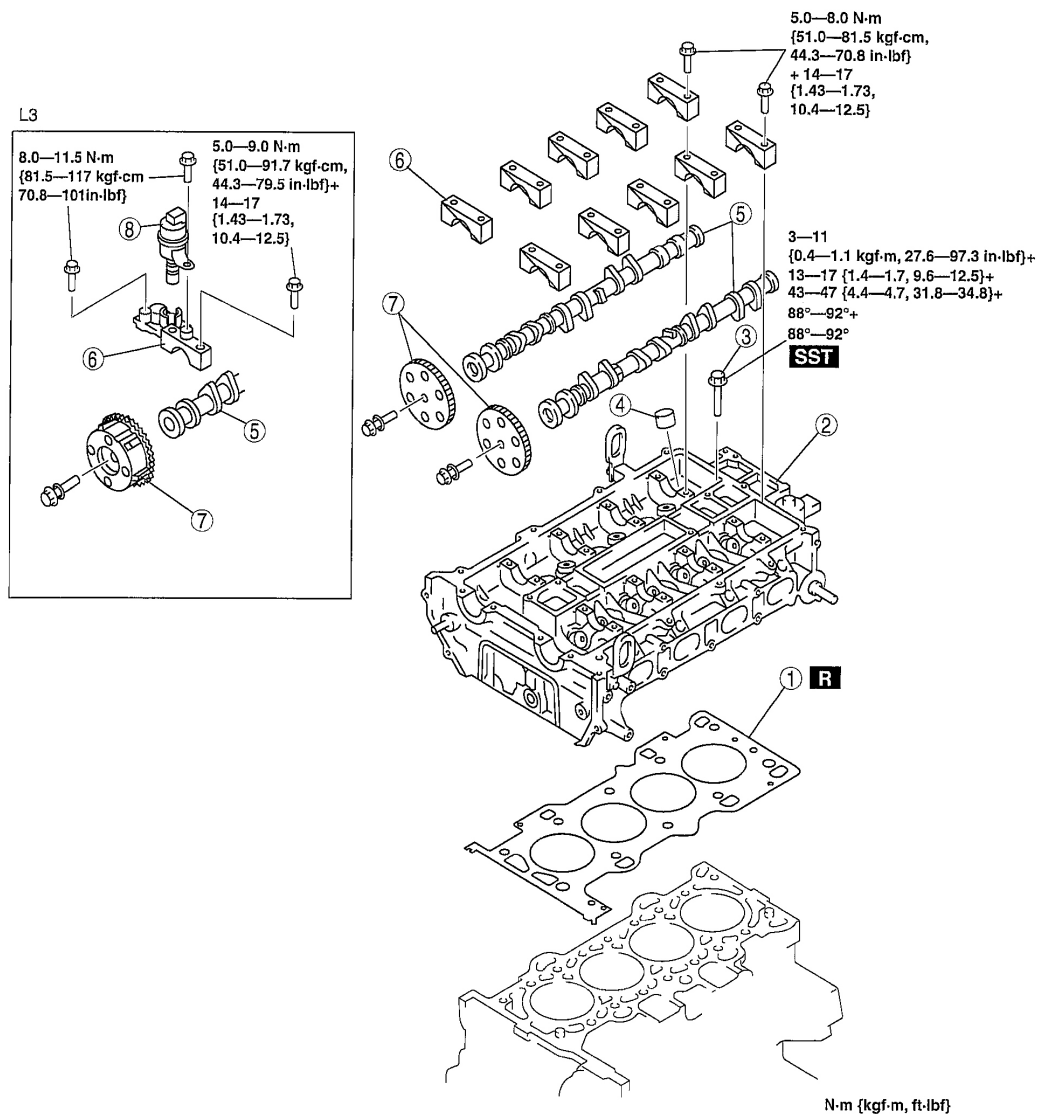
1. Install the valve keeper using the SSTs .



**Fig. 100: Installing Valve Keeper**  
Courtesy of MAZDA MOTORS CORP.

## CYLINDER HEAD (II) ASSEMBLY

1. Assemble in the order indicated in the figure.



|   |                                                              |
|---|--------------------------------------------------------------|
| 1 | Cylinder head gasket                                         |
| 2 | Cylinder head                                                |
| 3 | Cylinder head bolt<br>(See Cylinder Head Bolt Assembly Note) |
| 4 | Tappet                                                       |
| 5 | Camshaft<br>(See Camshaft Assembly Note)                     |

|   |                                                                                                                                            |
|---|--------------------------------------------------------------------------------------------------------------------------------------------|
| 6 | Camshaft cap                                                                                                                               |
| 7 | Camshaft sprocket, variable valve timing actuator<br>(L3)<br>(See Camshaft Sprocket, Variable Valve<br>Timing Actuator (L3) Assembly Note) |
| 8 | Oil control valve (OCV) (L3)                                                                                                               |

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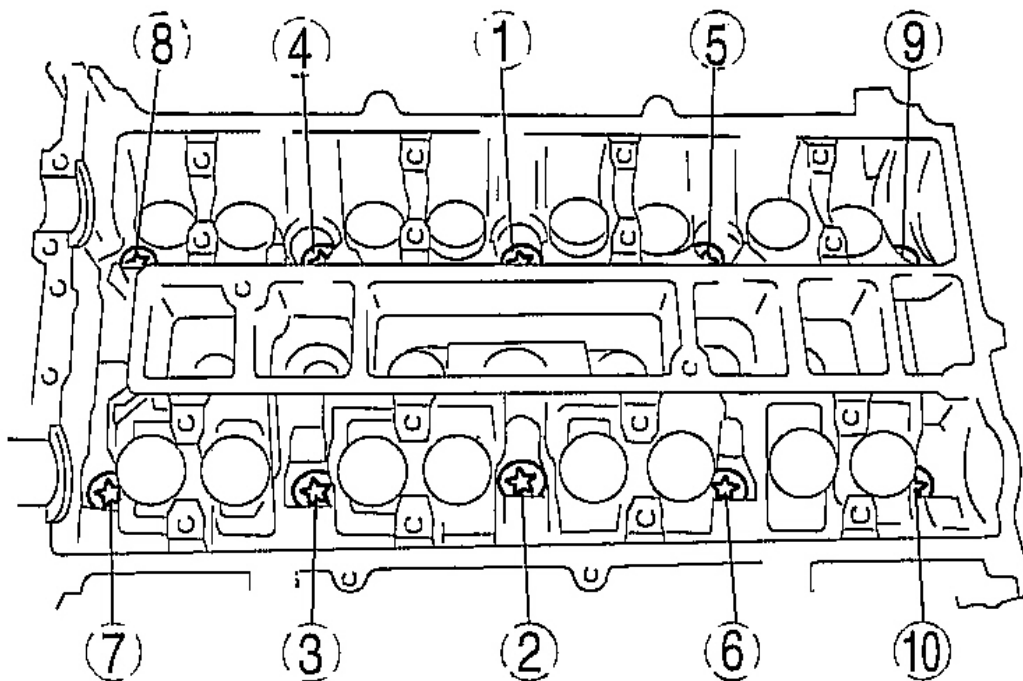
**Fig. 101: Assembling Cylinder Head (II)**  
Courtesy of MAZDA MOTORS CORP.

### CYLINDER HEAD BOLT ASSEMBLY NOTE

1. Tighten the cylinder head bolts in the order indicated in the figure in 5 steps using the SST (49 D032 316) .

**Tightening Torque**

- (1) 3-11 N.m {30.6-112 kgf.cm, 26.6-97.3 in.lbf}
- (2) 13-17 N.m {1.4-1.7 kgf.m, 9.6-12.5 ft.lbf}
- (3) 43-47 N.m {4.4-4.7 kgf.m, 31.8-34.6 ft.lbf}
- (4) 88°-92°
- (5) 88°-92°



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**Fig. 102: Cylinder Head Bolt Tightening Sequence**  
 Courtesy of MAZDA MOTORS CORP.

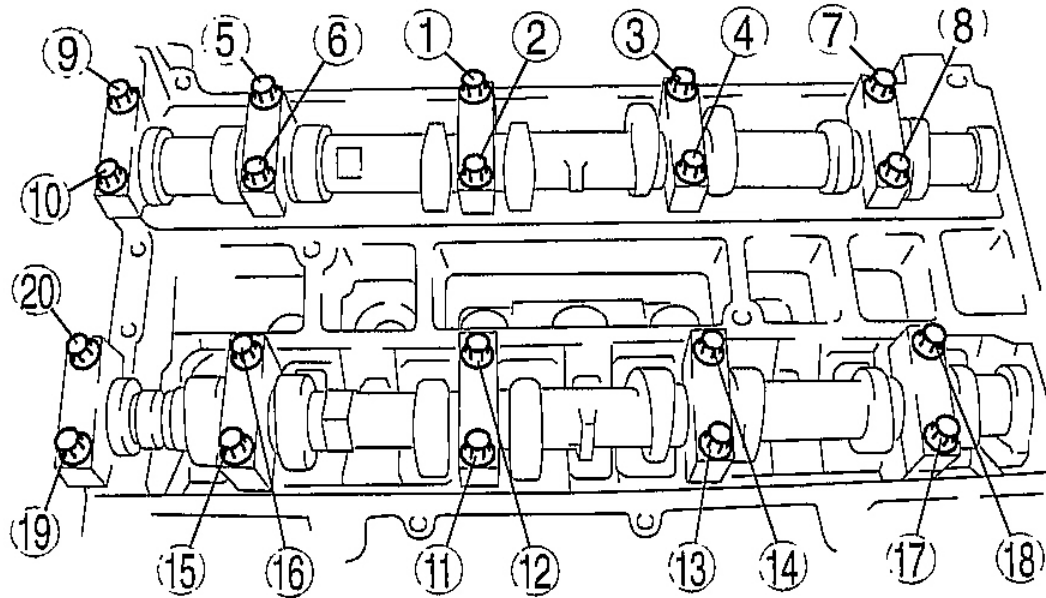
**CAMSHAFT ASSEMBLY NOTE**

1. Set the cam position of No.1 cylinder at the Top Dead Center (TDC) and install the camshaft.
2. Temporarily tighten the camshaft bearing caps evenly in 2-3 passes.
3. Tighten the camshaft cap bolt in the order shown two steps.

**Tightening Torque**

- (1) 5.0-8.0 N.m {51.0-81.5 kgf.cm, 44.3-70.8 in.lbf}

(2) 14-17 N.m {1.43-1.73 kgf.m, 10.4-12.5 ft.lbf}



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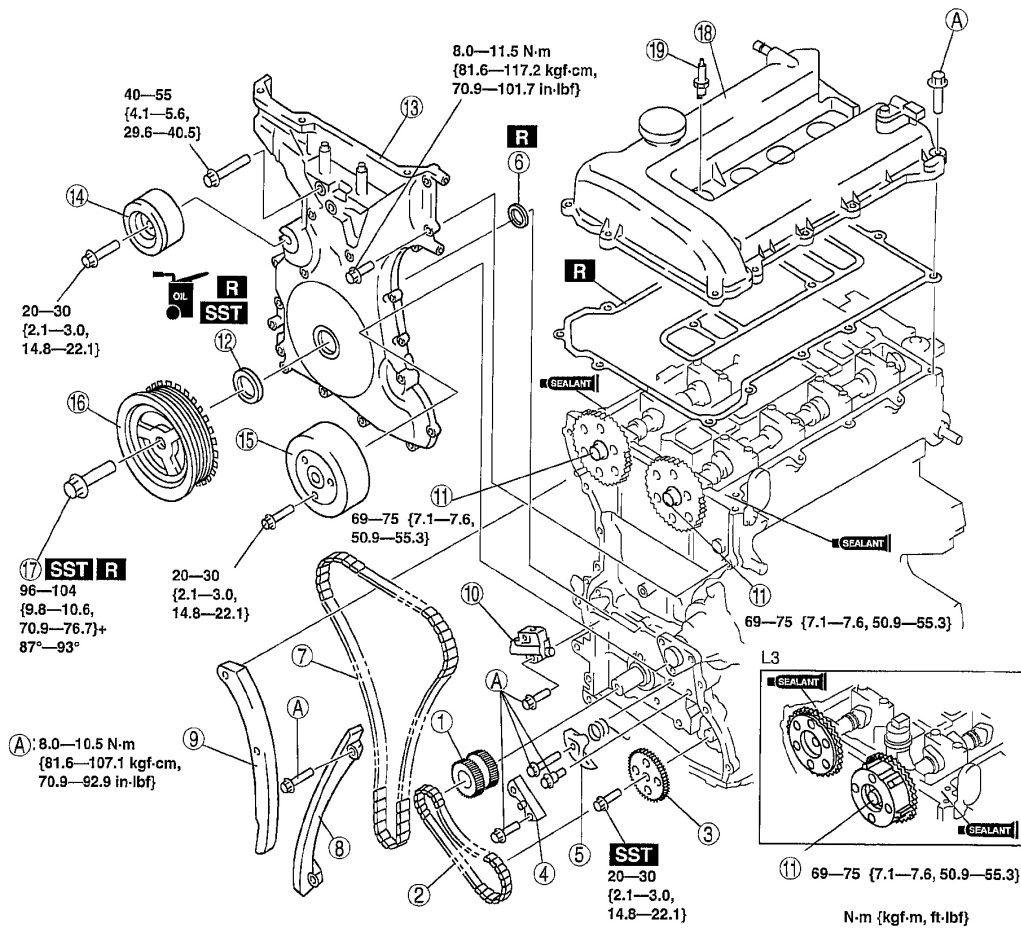
**Fig. 103: Camshaft Cap Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

#### **CAMSHAFT SPROCKET, VARIABLE VALVE TIMING ACTUATOR (L3) ASSEMBLY NOTE**

1. Temporarily tighten the camshaft sprocket or variable valve timing actuator (L3) installation bolts by hand until the timing chain is installed.
2. Fully tighten the camshaft sprocket or variable valve timing actuator (L3) installation bolts after timing chain installation.

#### **TIMING CHAIN ASSEMBLY**

1. Assemble in the order indicated in the figure.



|    |                                                                                                                                             |
|----|---------------------------------------------------------------------------------------------------------------------------------------------|
| 1  | Crankshaft sprocket                                                                                                                         |
| 2  | Oil pump chain                                                                                                                              |
| 3  | Oil pump sprocket<br>(See Oil Pump Sprocket Assembly Note.)                                                                                 |
| 4  | Oil pump chain guide                                                                                                                        |
| 5  | Oil pump chain tensioner                                                                                                                    |
| 6  | Seal (L3)                                                                                                                                   |
| 7  | Timing chain<br>(See Timing Chain Assembly Note.)                                                                                           |
| 8  | Chain guide                                                                                                                                 |
| 9  | Tensioner arm                                                                                                                               |
| 10 | Chain tensioner                                                                                                                             |
| 11 | Camshaft sprocket, variable valve timing actuator<br>(L3)<br>(See Camshaft Sprocket, Variable Valve<br>Timing Actuator (L3) Assembly Note.) |

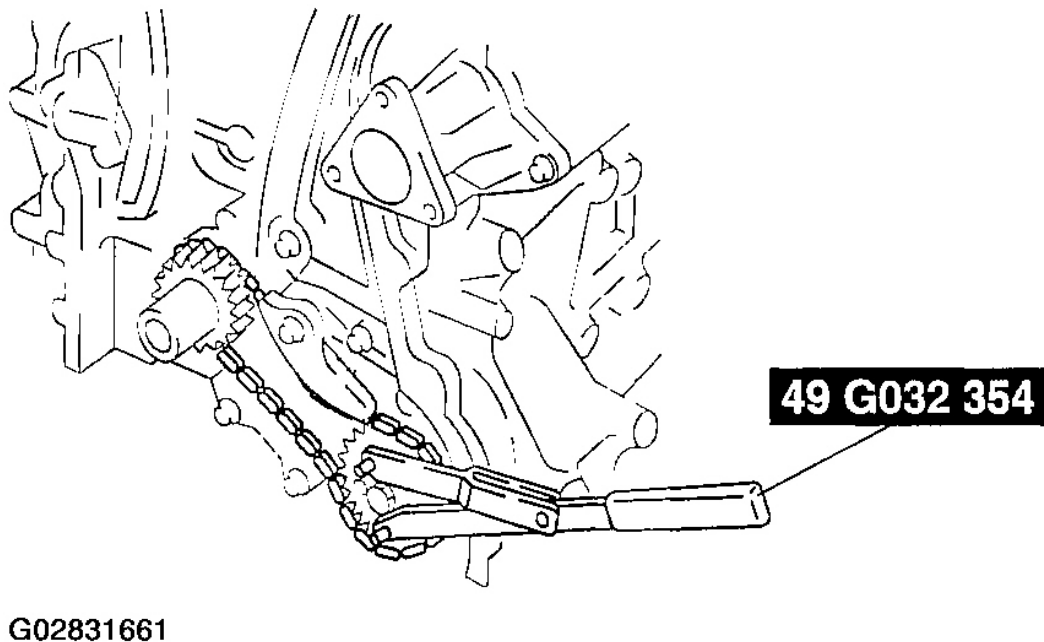
|    |                                                                                    |
|----|------------------------------------------------------------------------------------|
| 12 | Front oil seal<br>(See Front Oil Seal Assembly Note.)                              |
| 13 | Engine front cover<br>(See Engine Front Cover Assembly<br>Note.)                   |
| 14 | Drive belt idler pulley (Without stretch-type A/C drive<br>belt)                   |
| 15 | Water pump pulley                                                                  |
| 16 | Crankshaft pulley                                                                  |
| 17 | Crankshaft pulley lock bolt<br>(See Crankshaft Pulley Lock Bolt<br>Assembly Note.) |
| 18 | Cylinder head cover<br>(See Cylinder Head Cover Assembly<br>Note)                  |
| 19 | Spark plug                                                                         |

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**Fig. 104: Installing Timing Chains**  
Courtesy of MAZDA MOTORS CORP.

## OIL PUMP SPROCKET ASSEMBLY NOTE

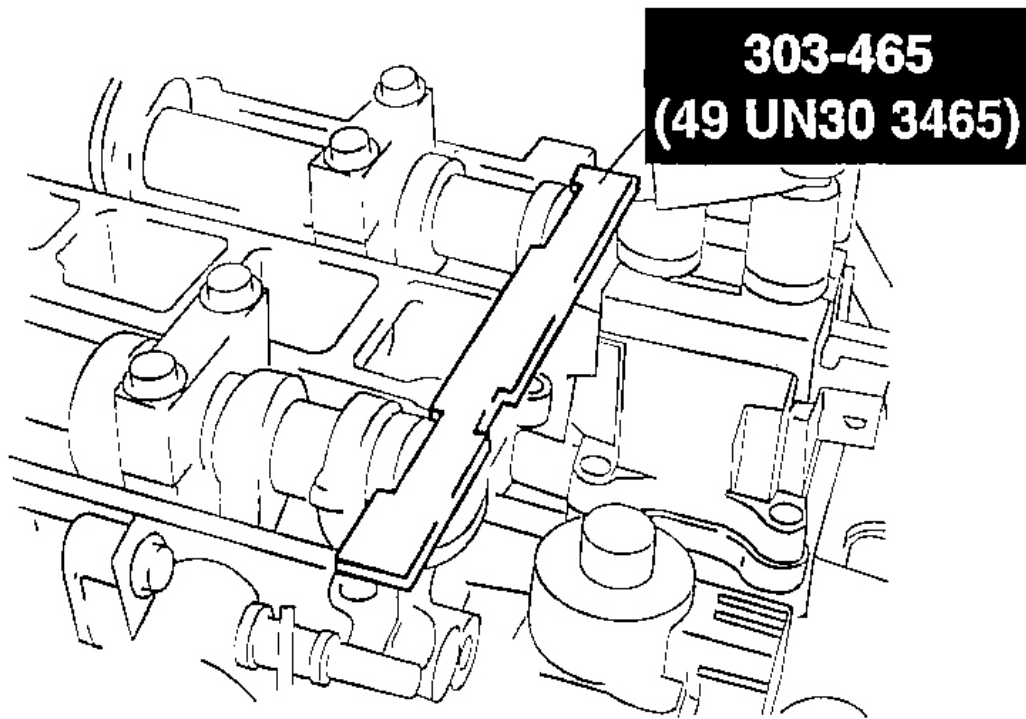
1. Hold the oil pump sprocket using the SST .



**Fig. 105: Holding Oil Pump**  
Courtesy of MAZDA MOTORS CORP.

#### TIMING CHAIN ASSEMBLY NOTE

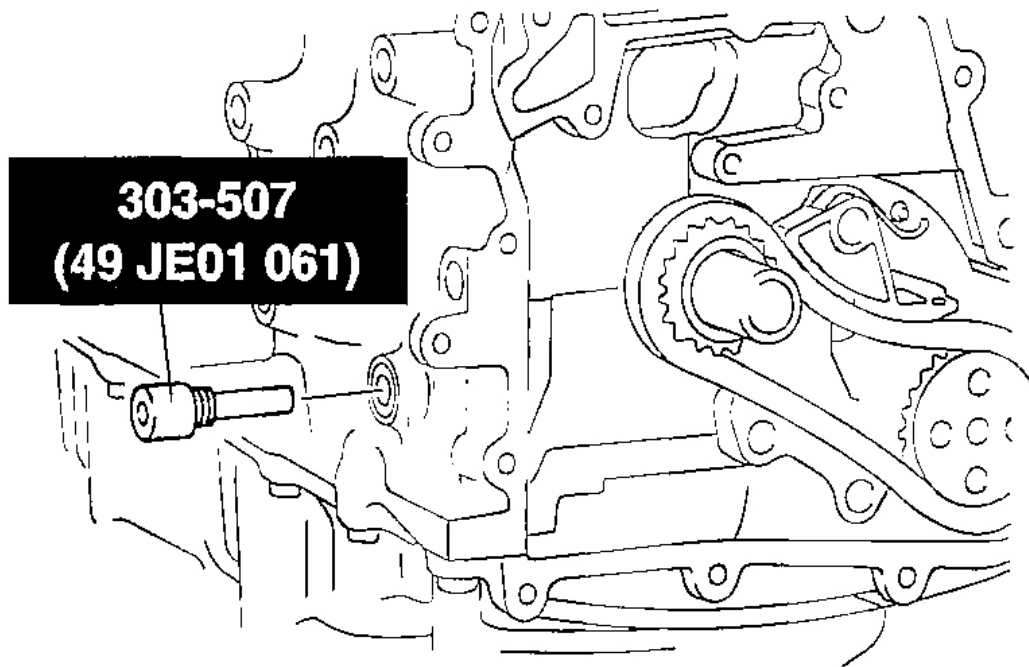
1. Install the SST to the camshaft, then align the No. 1 camshaft position with the TDC.
2. Remove the cylinder block lower blind plug.



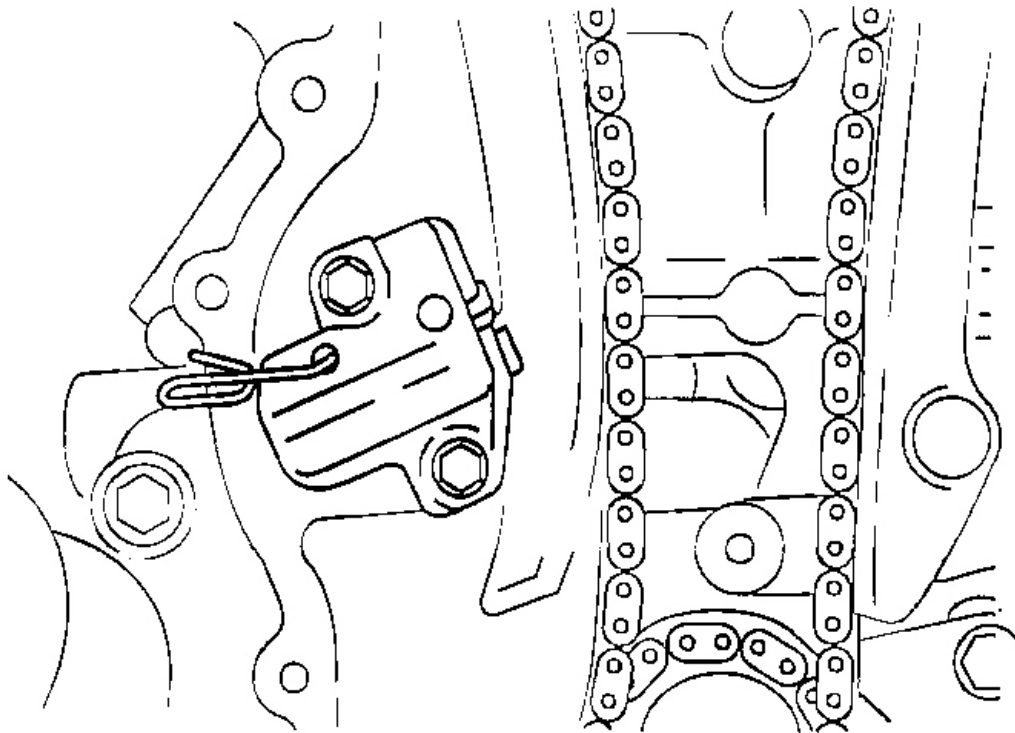
G02831662

**Fig. 106: Removing Cylinder Block Lower Blind Plug**  
Courtesy of MAZDA MOTORS CORP.

3. Install the SST as shown in the figure.

**G02831663****Fig. 107: Installing SST****Courtesy of MAZDA MOTORS CORP.**

4. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.
5. Install the timing chain.
6. Install the chain tensioner and remove the retaining wire.



**G02831664**

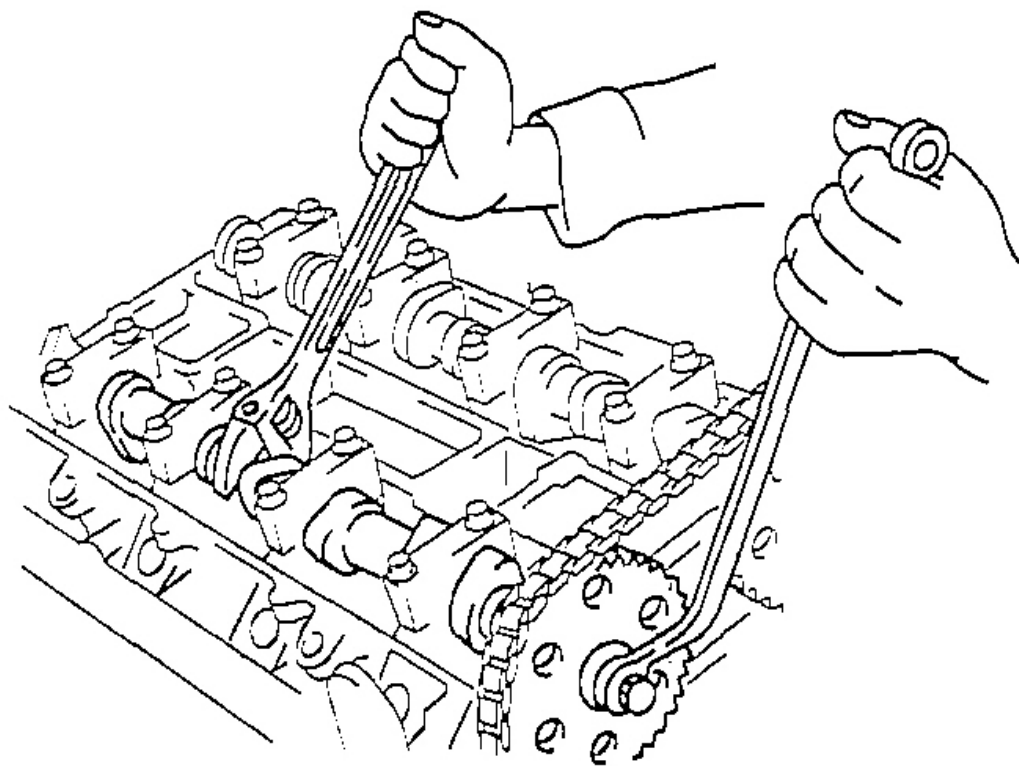
**Fig. 108: Installing Timing Chain Tensioner**  
Courtesy of MAZDA MOTORS CORP.

**CAMSHAFT SPROCKET, VARIABLE VALVE TIMING ACTUATOR (L3) ASSEMBLY NOTE**

1. Hold the camshaft using a suitable wrench on the cast hexagon as shown in the figure.
2. Tighten the camshaft sprocket lock bolt.

**Tightening Torque**

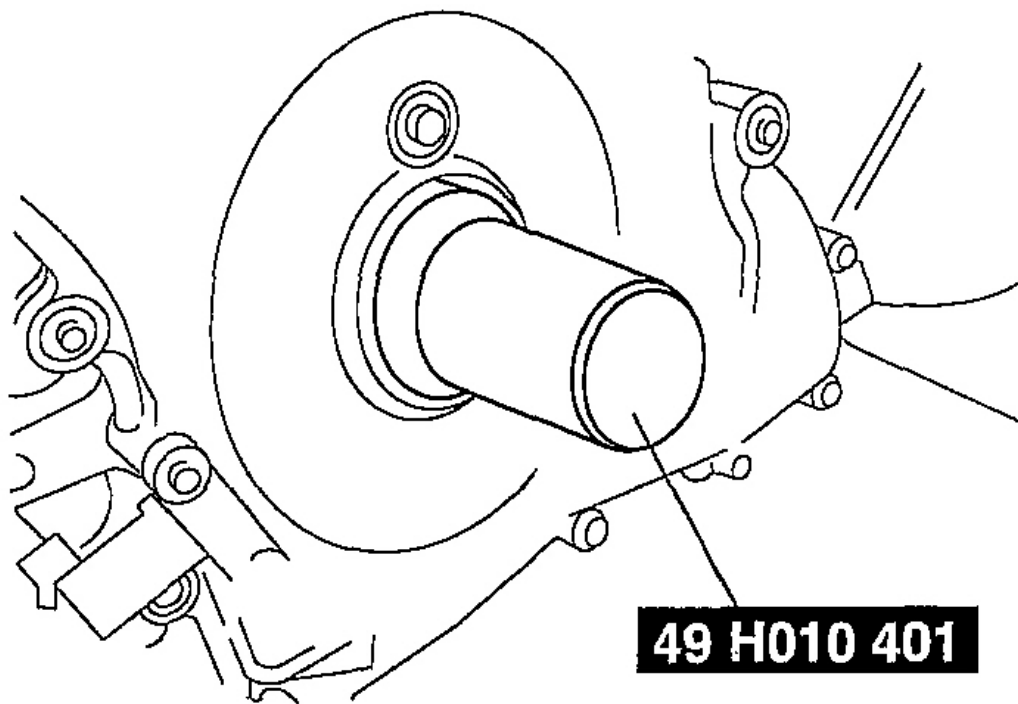
**69-75 N.m {7.1-7.6 kgf.m, 50.9-55.3 ft.lbf}**

**G02831665**

**Fig. 109: Tightening Camshaft Sprocket Lock Bolt**  
Courtesy of MAZDA MOTORS CORP.

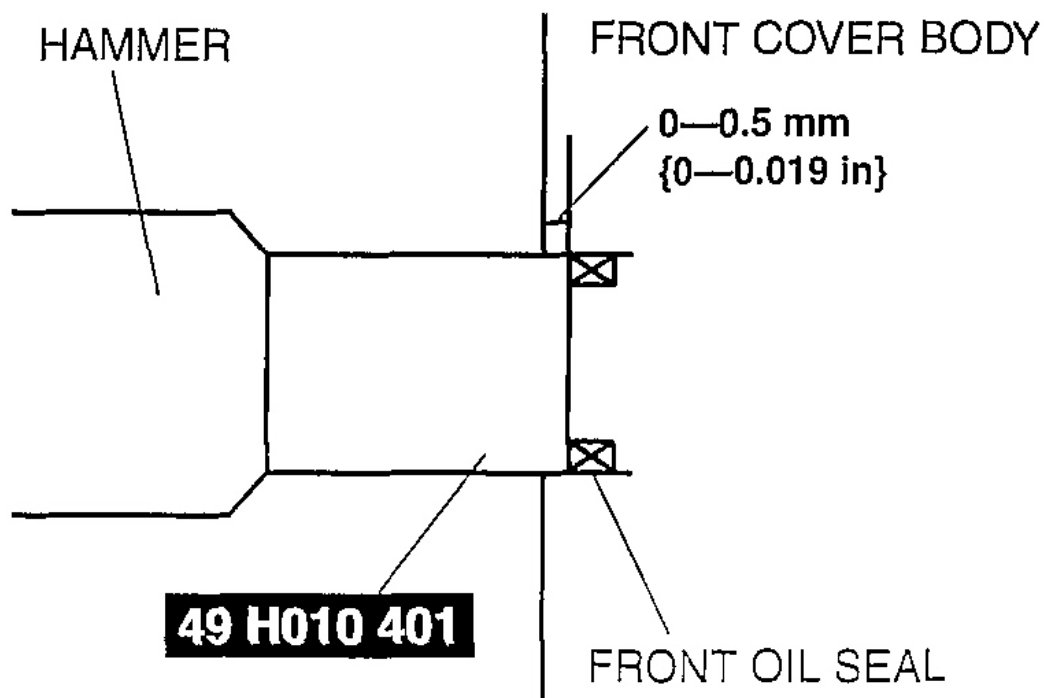
#### **FRONT OIL SEAL ASSEMBLY NOTE**

1. Apply clean engine oil to the oil seal.
2. Push the oil seal slightly in by hand.
3. Compress the oil seal using the **SST** and a hammer.



G02831666

**Fig. 110: Compressing Oil Seal**  
Courtesy of MAZDA MOTORS CORP.



G02831667

**Fig. 111: Installing Oil Seal**  
 Courtesy of MAZDA MOTORS CORP.

#### ENGINE FRONT COVER ASSEMBLY NOTE

1. Apply silicone sealant to the engine front cover as shown in the figure.

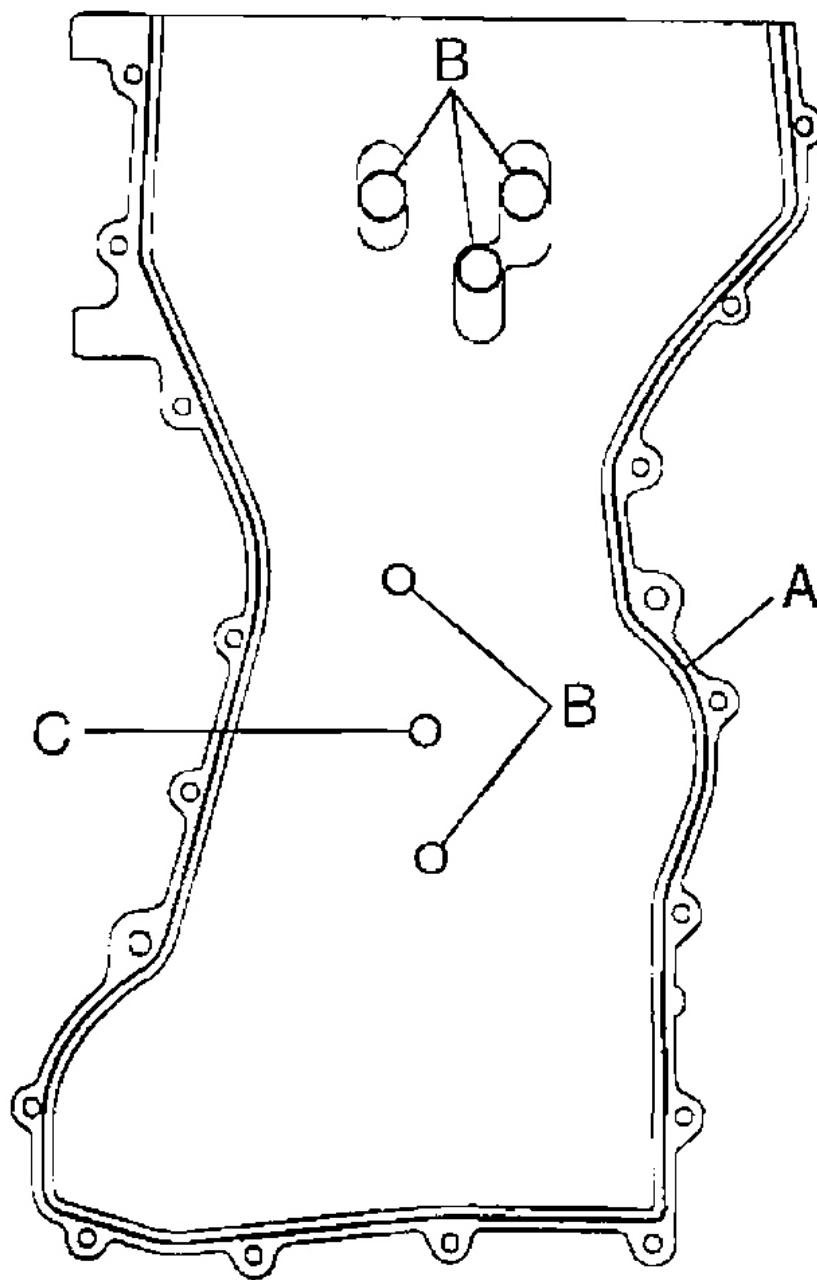
#### CAUTION:

- Install the cylinder head cover within 10 min. of applying the silicone sealant.
- Silicone sealant is not need in area C as indicated below due to an existing. (L3)
- Make sure that there is no oil or dust on the seal side of oil pan.

#### Thickness

A: 2.2-3.2 mm {0.087-0.125 in}

B: 1.5-2.5 mm {0.059-0.098 in}



G02831668

**Fig. 112: Identifying Silicone Application Areas**  
Courtesy of MAZDA MOTORS CORP.

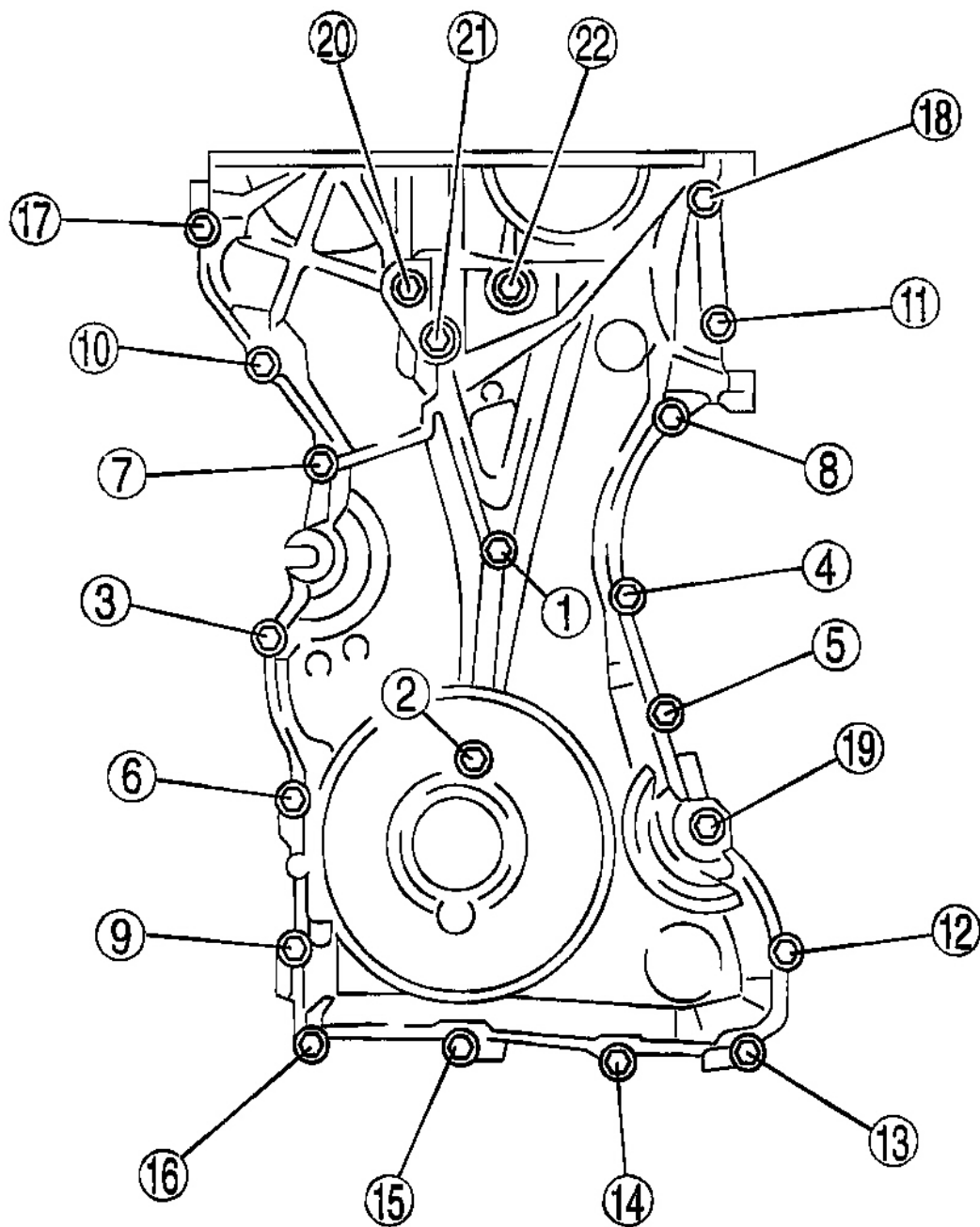
2. Install the front cover bolts in the order as shown in the figure.

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2004-08 ENGINES 2.0L &amp; 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 &amp; Mazda6

**FRONT COVER BOLT TORQUE SPECIFICATIONS**

| <b>Bolt No.</b> | <b>Tightening Torque - N.m {kgf.m, ft.lbf}</b> |
|-----------------|------------------------------------------------|
| 1-18            | 8.0-11.5 {81.6-117.2 70.9-101.7}               |
| 19-22           | 40-55 {4.1-5.6, 29.7-40.5}                     |

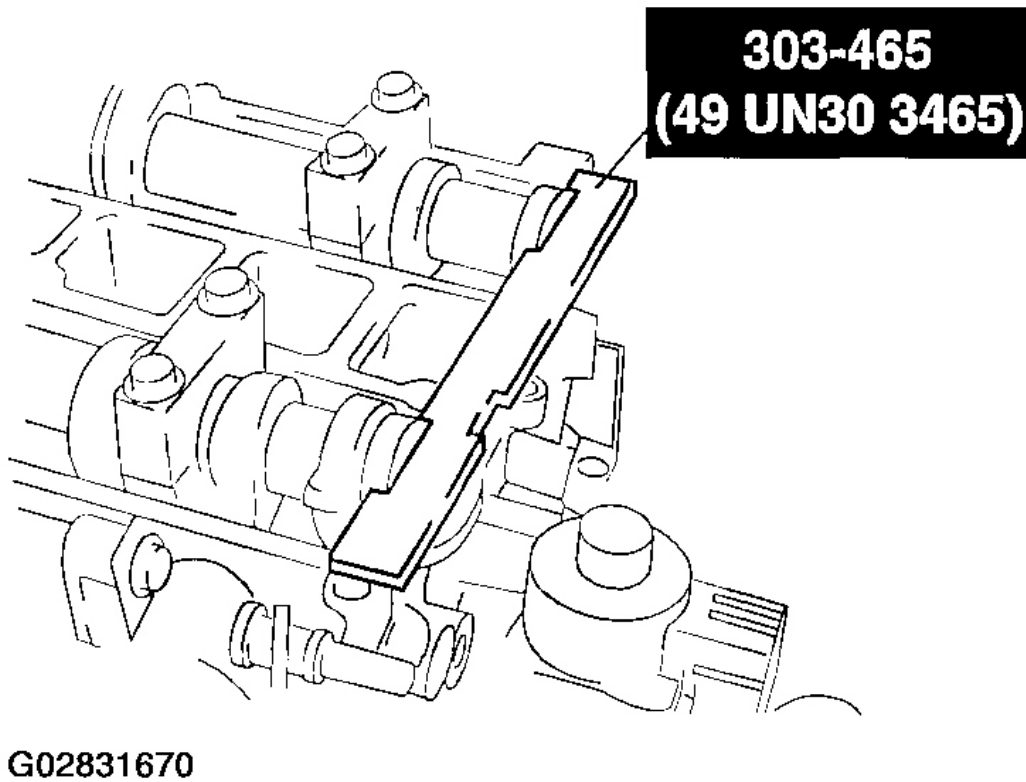


G02831669

**Fig. 113: Front Cover Bolt Tightening Sequence**  
 Courtesy of MAZDA MOTORS CORP.

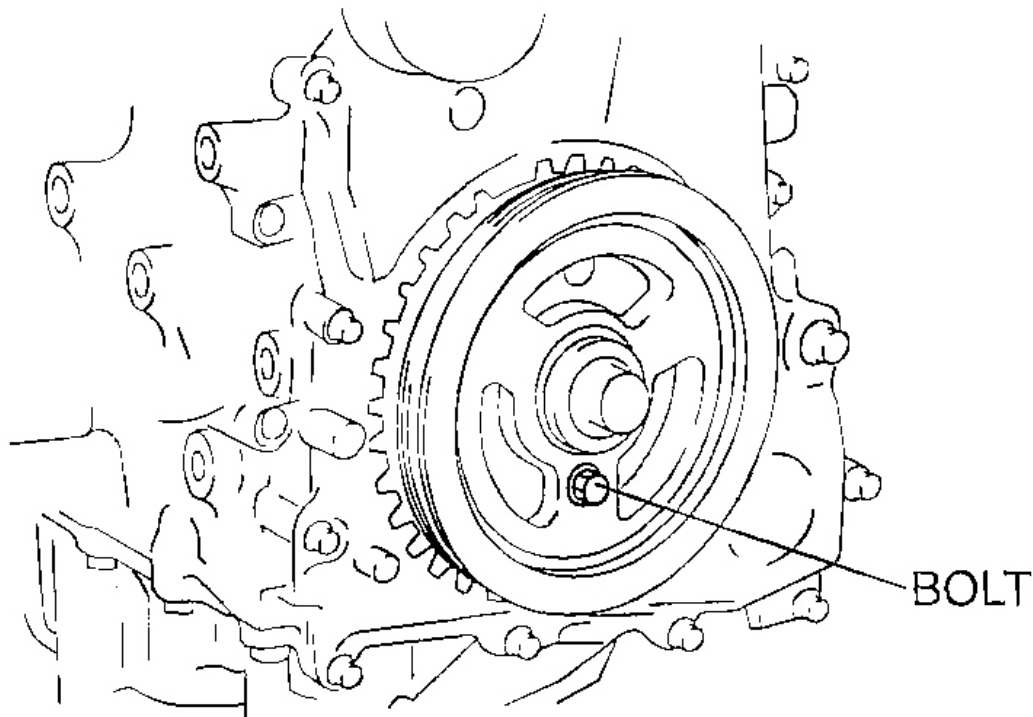
#### CRANKSHAFT PULLEY LOCK BOLT ASSEMBLY NOTE

1. Install the **SST** to the camshaft as shown in the figure.



**Fig. 114: Installing SST**  
**Courtesy of MAZDA MOTORS CORP.**

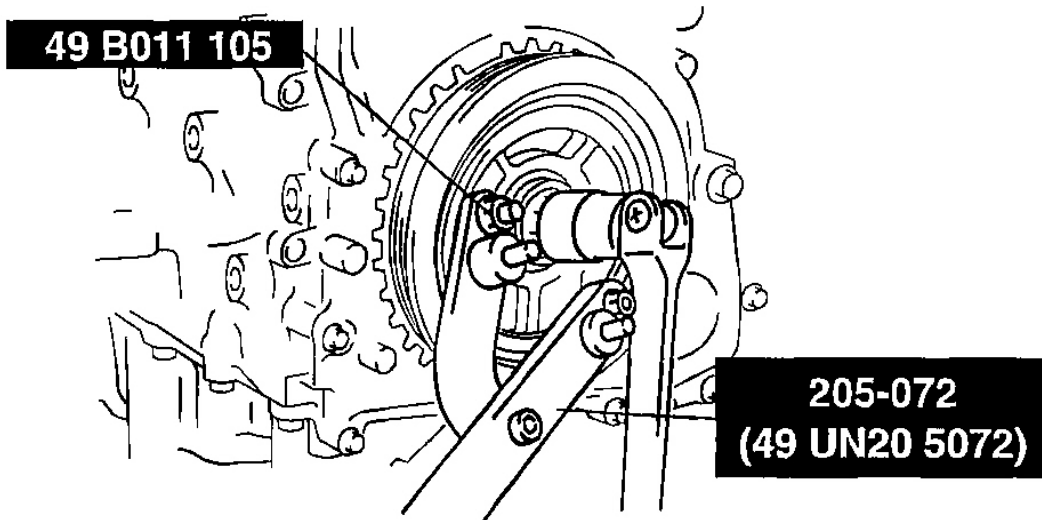
2. Install the M6 x 1.0 bolt in by hand.

**G02831671**

**Fig. 115: Installing M6 x 1.0 Bolt**  
**Courtesy of MAZDA MOTORS CORP.**

3. Turn the crankshaft clockwise so that the crankshaft is in the No.1 cylinder TDC position.
4. Hold the crankshaft pulley using the SST .

WITH STRETCH-TYPE A/C DRIVE BELT



G02831672

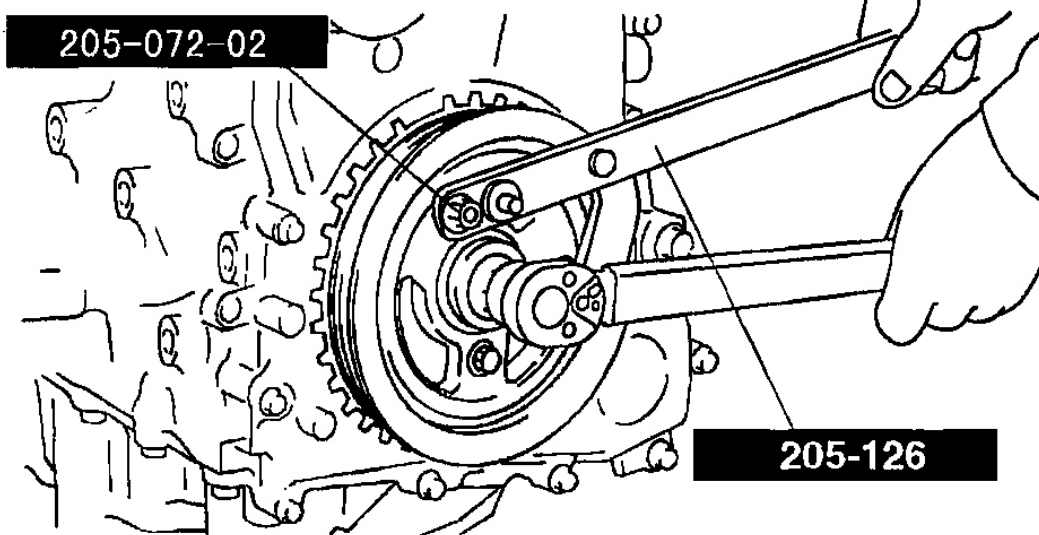
**Fig. 116: Holding Crankshaft Pulley**  
Courtesy of MAZDA MOTORS CORP.

5. Tighten the crankshaft pulley lock bolt in the order shown following two steps using the SST (49 D032 316) .

**Tightening Torque**

- (1) 96-104 N.m {9.8-10.6 kgf.m, 70.9-76.7 ft.lbf}
- (2) 87°-93°

WITHOUT STRETCH-TYPE A/C DRIVE BELT



G02831673

**Fig. 117: Tightening Crankshaft Pulley Lock Bolt**  
 Courtesy of MAZDA MOTORS CORP.

6. Remove the M6 x 1.0 bolt.
7. Remove the SST from the camshaft.
8. Remove the SST from the block lower blind plug.
9. Rotate the crankshaft clockwise two turns until the TDC position.
  - If not aligned, loosen the crankshaft pulley lock bolt and repeat from step 1.
10. Install the cylinder block lower blind plug.

#### **Tightening Torque**

**20 N.m {2.0 kgf.m, 14.8 ft.lbf}**

#### **CYLINDER HEAD COVER ASSEMBLY NOTE**

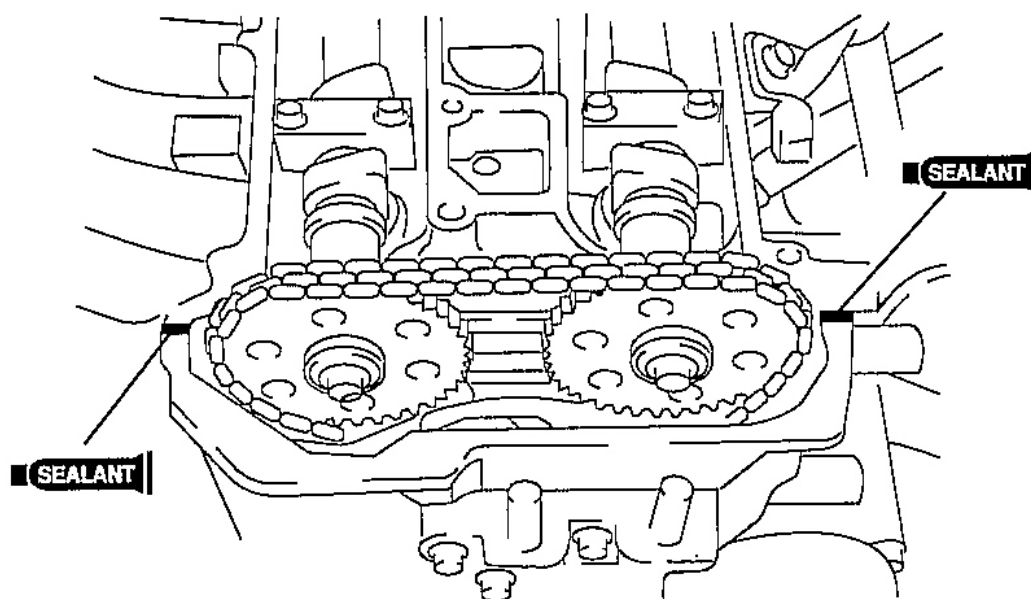
1. Apply silicone sealant to the mating faces as shown in the figure.

#### **CAUTION:**

- **Install the cylinder head cover within 10 min. of applying the silicone sealant.**

#### **Dot Diameter**

**4.0-6.0 mm {0.16-0.23 in}**



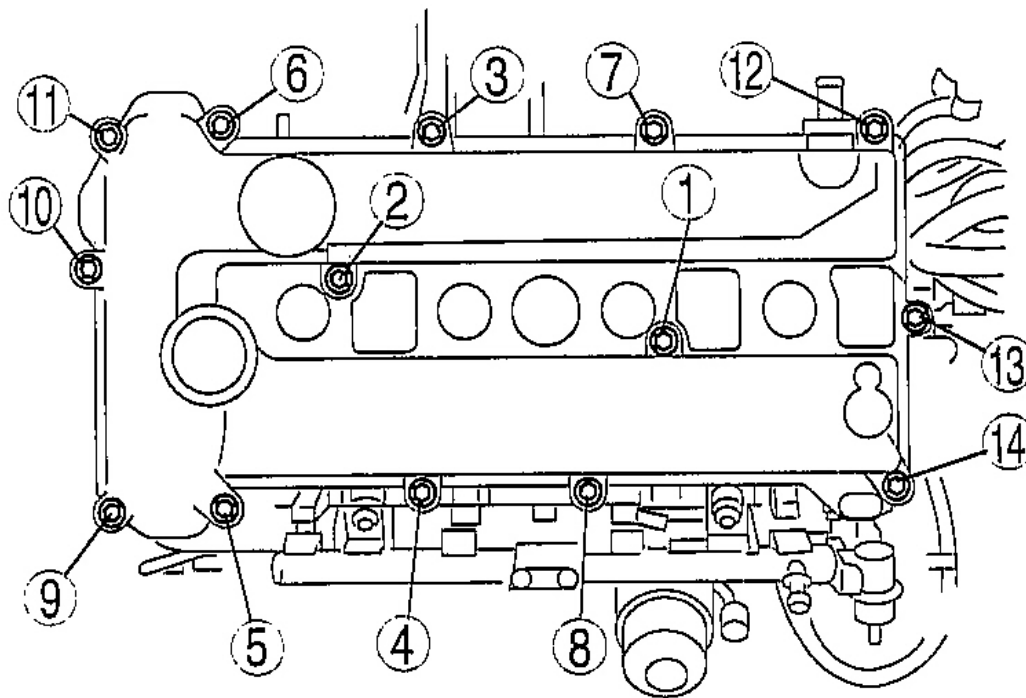
G02831674

**Fig. 118: Applying Silicone Sealant**  
Courtesy of MAZDA MOTORS CORP.

2. Install the cylinder head cover with a new gasket.
3. Tighten the bolts in the order shown in the figure.

#### **Tightening Torque**

**8.0-10.5 N.m {81.6-107.1 kgf.cm, 70.9-92.9 in.lbf}**



G02831675

**Fig. 119: Cylinder Head Cover Bolt Tightening Sequence**  
 Courtesy of MAZDA MOTORS CORP.

## TORQUE SPECIFICATIONS

### TORQUE SPECIFICATIONS

| Application                         | Ft. Lbs. (N.m)                                 |
|-------------------------------------|------------------------------------------------|
| A/C Compressor Bracket              | 13-19.5 (17.6-26.5)                            |
| Balancer Unit                       | 19 (25)<br>Tighten An Additional 35-39 (47-53) |
| Camshaft Bearing Cap <sup>(1)</sup> |                                                |
| Step 1                              | (2)                                            |
| Step 2                              | 10.4-12.5 (14-17)                              |
| Camshaft Position Sensor Bolt       | 49-66 (5.5-7.5)                                |
| Camshaft Pulley                     | 50.9-55.3 (69-75)                              |
| Clutch Cover Bolt                   | 18.5-24.4 (25-33)                              |
| Connecting Rod Caps                 |                                                |
| Step 1                              | 19.2-23.6 (26-32)                              |

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|                                             |                                        |
|---------------------------------------------|----------------------------------------|
| Step 2                                      | Tighten An Additional 80-100 Degrees   |
| Crankshaft Main Bearing Caps <sup>(3)</sup> |                                        |
| Step 1                                      | 32.5-33.9 (44-46)                      |
| Step 2                                      | Tighten An Additional 175-185 Degrees  |
| Crankshaft Pulley Bolt                      |                                        |
| Step 1                                      | 70.9-76.7 (96-104)                     |
| Step 2                                      | Tighten An Additional 87-93 Degrees    |
| Cylinder Block Lower Blind Plug             | 13.3-16.2 (18-22)                      |
| Cylinder Head <sup>(4)</sup>                |                                        |
| Step 1                                      | (5)                                    |
| Step 2                                      | 9.59-12.5 (13-17)                      |
| Step 3                                      | 31.8-34.6 (43-47)                      |
| Step 4                                      | Tighten An Additional 88-92 Degrees    |
| Step 5                                      | Tighten An Additional 88-92 Degrees    |
| Drive Belt Auto Tensioner Bolt              | 14-18 (18.6-26.6)                      |
| Drive Plate/Flywheel (A/T)                  | <sup>(6)</sup> 70.9-75.9 (96.1-103)    |
| EGR Bolt                                    | 13-16 (17-23)                          |
| Engine Front Cover Bolt <sup>(7)</sup>      |                                        |
| Bolts 1-18                                  | (8)                                    |
| Bolts 19-22                                 | 29.7-40.5 (40-55)                      |
| Bolt 23                                     | 14.8-22.1 (20-30)                      |
| Exhaust Manifold Bracket Bolt               | 14-19 (18-27)                          |
| Exhaust Manifold Nut                        | <sup>(9)</sup> 32-47 (43-63)           |
| Exhaust Manifold-To-Exhaust Pipe Nut        | 29-37 (38-51)                          |
| Flywheel Bolt (M/T)                         | 79.7-85.5 (108-116)                    |
| Front/Rear Tunnel Crossmember Bolt          | 13-19.5 (17.6-26.5)                    |
| Fuel Distributor Bolt                       | 15-19 (20-26)                          |
| Generator Bolt                              | 16-22 (21.6-30.4)                      |
| Intake Manifold Bolt                        | 11.8-14.8 (16-20)                      |
| Knock Sensor                                | 12-17 (16-24)                          |
| No. 1 Engine Mount Bolt                     | <sup>(10)</sup> 68.7-85.9 (93.1-116.6) |
| No. 3 Engine Mount                          | 55-76.6 (74.5-104.9)                   |
| No. 4 Engine Mount/Battery Bracket          |                                        |
| Rubber Installation Bolt                    | 61.7-83.4 (83.6-113.1)                 |
| Nut 1                                       | 32.5-45 (44-61)                        |
| Battery Bracket Bolt 2                      | (11)                                   |
| Oil Drain Plug                              | 22-30 (30-41)                          |
| Oil Filter (Spin On Type)                   | 11-14 (15-20)                          |
| Oil Filter Cover (Cartridge Type)           | 22.2-25.8 (30-35)                      |

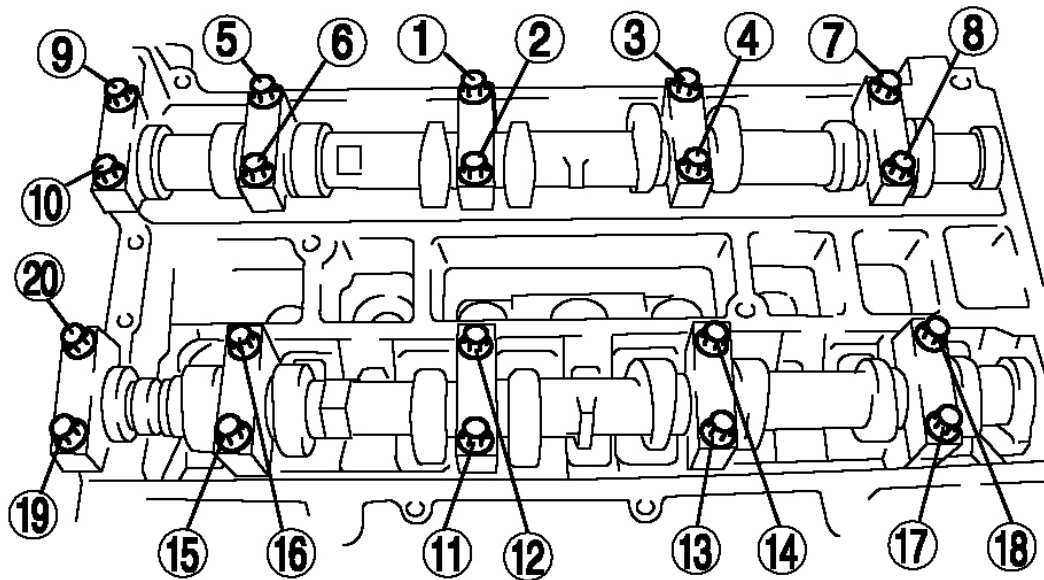
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2004-08 ENGINES 2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6

|                                          |                          |
|------------------------------------------|--------------------------|
| Oil Pan Bolt                             | (12) 12.6-16.9 (17-23)   |
| Oil Pressure Switch                      | 9-13 (12-18)             |
| Oil Pump Bolt <sup>(13)</sup>            |                          |
| Step 1                                   | (14)                     |
| Step 2                                   | 177-221 (20-25)          |
| Oil Pump Sprocket Bolt                   | 15.2-21.6 (20-30)        |
| Oxygen Sensor                            | 22-36 (29-49)            |
| Starter Bolt                             | 28-38 (38-51)            |
| Transaxle Mounting Bolt                  | 28-38 (37-52)            |
| Transaxle-To-Oil Pan Bolt                | 23.6-38.3 (32-52)        |
| Variable Valve Timing Actuator Bolt      | 50.9-55.3 (69-75)        |
| Water Pump Pulley Bolt                   | 12.6-16.9 (17-23)        |
|                                          | <b>INCH Lbs. (N.m)</b>   |
| Air Hose Clamps                          | 23-30 (2.5-3.4)          |
| BARO Sensor                              | 62-88 (7-10)             |
| Battery Clamp Nut                        | 35-61 (3.9-6.9)          |
| Battery Tray Bolt                        | 70-94 (7.9-10.7)         |
| Chain Guide Bolt                         | 70.9-101.7 (8-11.5)      |
| Cylinder Head Cover Bolt <sup>(15)</sup> | 70.9-92.9 (8-10.5)       |
| Engine Front Cover Upper Blind Plug      | 70.9-101.7 (8-11.5)      |
| Exhaust Manifold Insulator Bolt/Nut      | 69.1-95.5 (7.8-10.8)     |
| Fresh Air Duct Bolt                      | 69.1-95.5 (7.8-10.8)     |
| Generator "B" Terminal Nut               | 87-130 (9.8-14.7)        |
| Ignition Coil Bolt                       | 54-70 (6-8)              |
| MAF Sensor                               | 24-32 (2.7-3.7)          |
| No. 3 Engine Mount Bracket Stud Bolt     | 62-115 (7-13)            |
| Oil Control Valve Bolt                   | 70.9-101.7 (8-11.5)      |
| Oil Filter Cover Drain Plug              | 79.6-88.4 (9-10)         |
| Oil Level Dipstick                       | 71-101 (8-11.5)          |
| Oil Pump Chain Guide Bolt                | 71-101 (8-11.5)          |
| Oil Strainer                             | 71-101 (8-11.5)          |
| Radiator Drain Plug                      | 11-13 (1.2-1.5)          |
| Rear Oil Seal Bolt                       | (16) 70.9-101.7 (8-11.5) |
| Resonance Chamber Screw                  | 5.76-8.4 (0.65-0.95)     |
| Resonance Chamber-To-Air Hose Clamp      | 15-21 (1.6-2.4)          |
| Spark Plug                               | 88.5-101.2 (10-14)       |
| Starter Terminal "B" Cable Nut           | 87-104 (9.8-11.7)        |
| Starter Wiring Harness Bracket Bolt      | 70-104 (7.9-11.7)        |
| Tensioner Arm Bolt                       | 70.9-101.7 (8-11.5)      |
| Thermostat Housing Bolt                  | 71-101 (8-11.5)          |

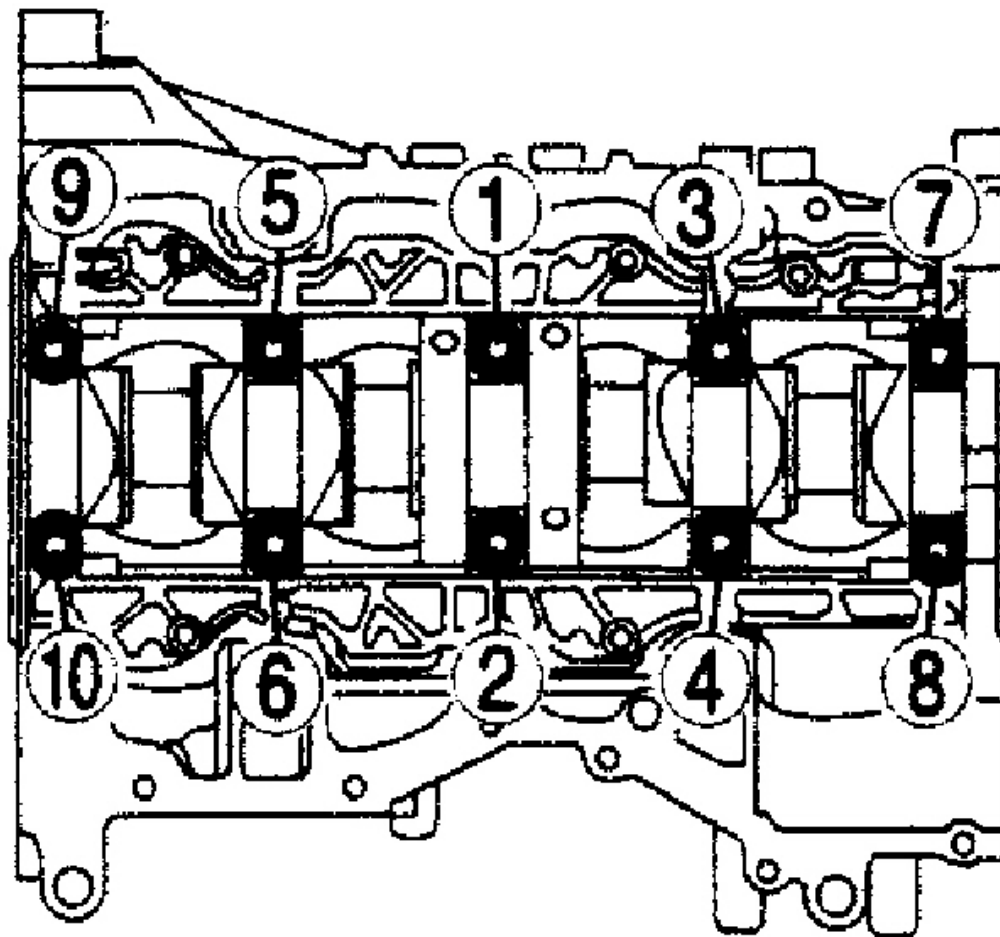
|                                          |                 |
|------------------------------------------|-----------------|
| Throttle Body Bolt                       | 71-101 (8-11.5) |
| Variable Intake-Air Solenoid Valve Screw | 45-61 (5-7)     |
| Variable Tumble Solenoid Valve Screw     | 45-61 (5-7)     |
| Water Pump Bolt                          | 71-101 (8-11.5) |

- (1) Tighten in sequence. See **Fig. 120**.
- (2) Tighten to 44.3-70.8 INCH Lbs. (5-8 N.m).
- (3) Tighten in sequence. See **Fig. 121**.
- (4) Tighten in sequence. See **Fig. 122**.
- (5) Tighten to 27.6-97.3 INCH Lbs. (3-11 N.m).
- (6) Tighten in sequence. See **Fig. 123**.
- (7) Tighten in sequence. See **Fig. 124**.
- (8) Tighten to 70.9-101.7 INCH Lbs. (8-11.5 N.m)
- (9) Tighten in sequence. See **Fig. 125**.
- (10) Tighten in sequence. See **Fig. 126**.
- (11) Tighten in sequence. See **Fig. 127**.
- (12) Tighten in sequence. See **Fig. 128**.
- (13) Tighten in sequence. See **Fig. 130**.
- (14) Tighten to 71-88 INCH Lbs. (8-10 N.m).
- (15) Tighten in sequence. See **Fig. 129**.
- (16) Tighten in sequence. See **Fig. 131**.



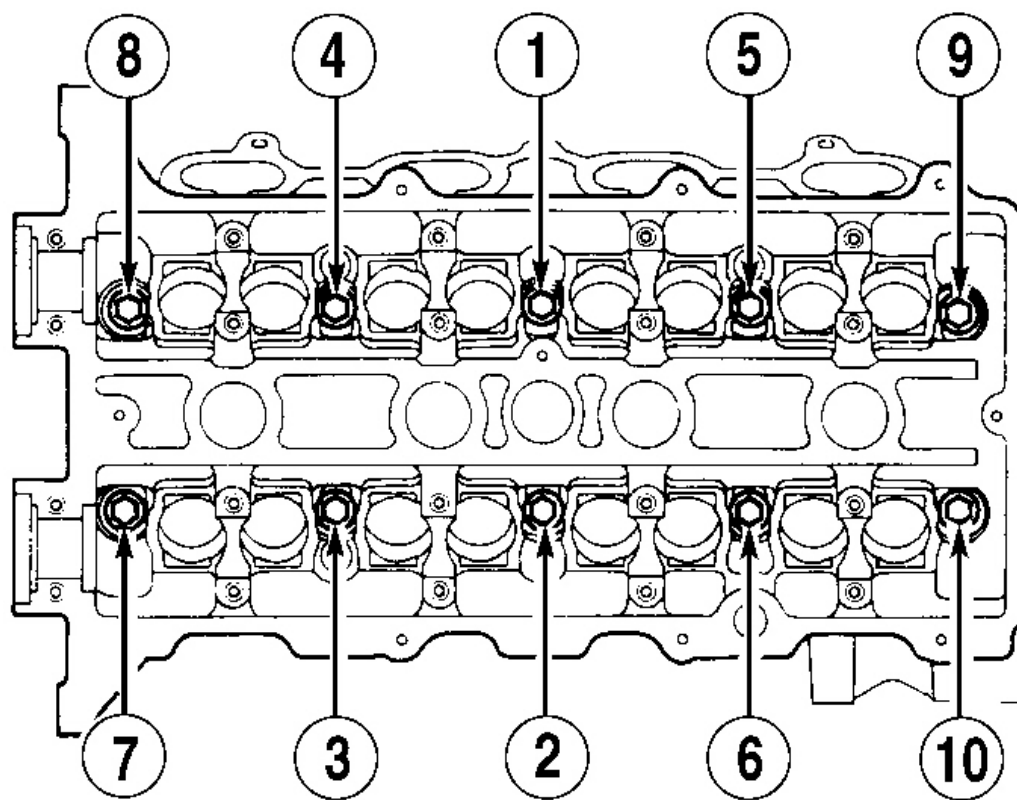
G00356226

**Fig. 120: Camshaft Bearing Cap Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



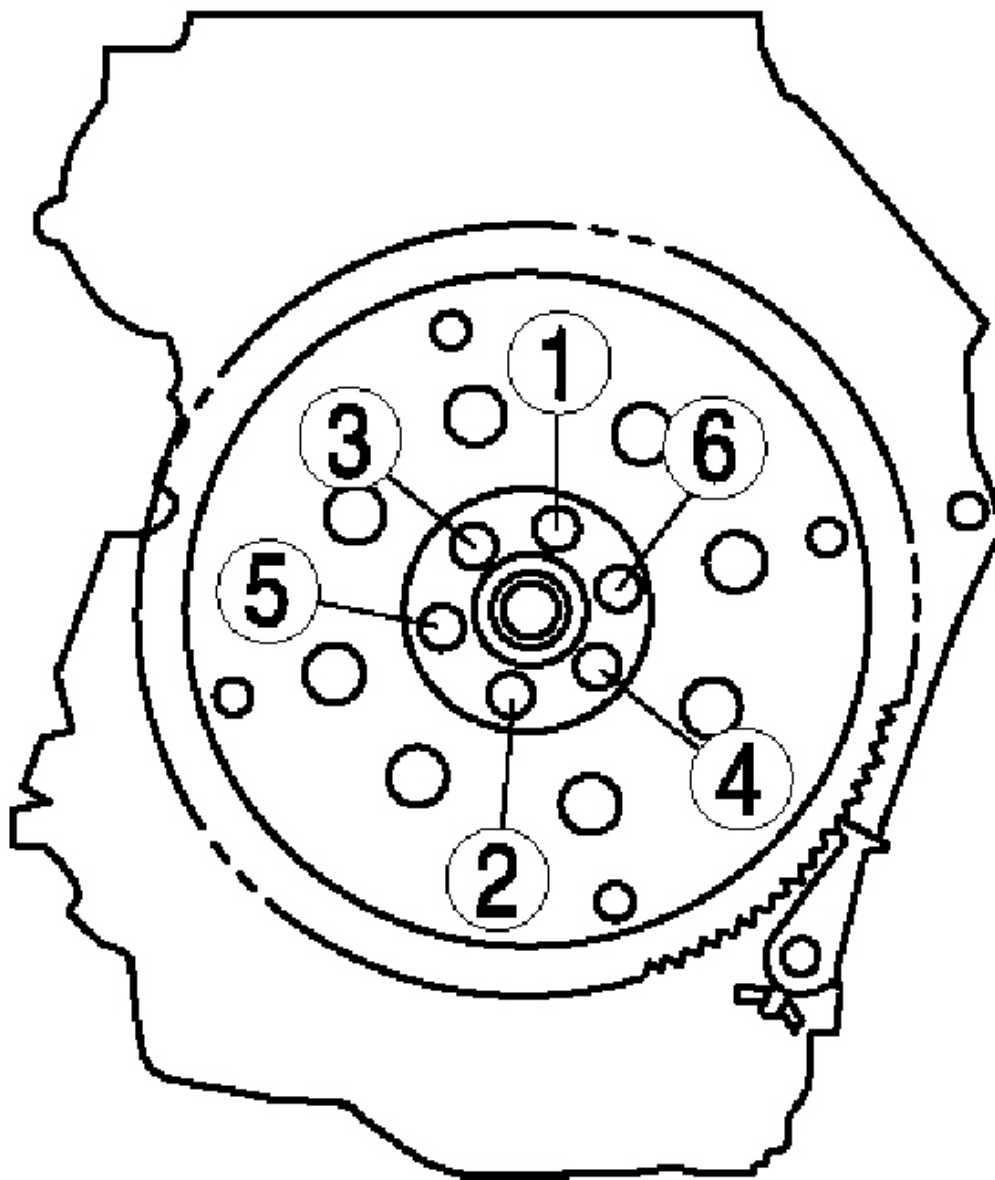
G00356261

**Fig. 121: Crankshaft Main Bearing Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



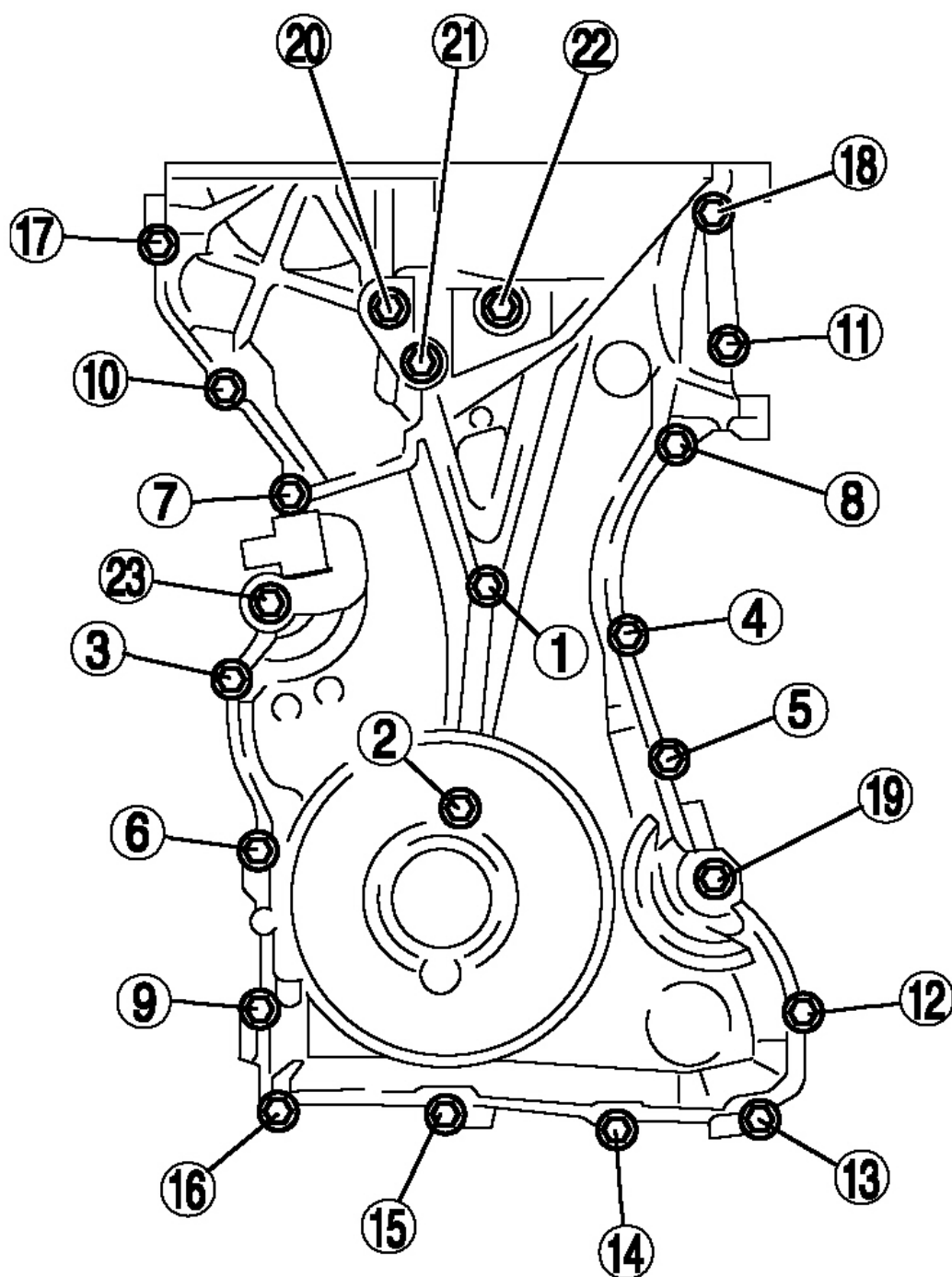
G93E84503

**Fig. 122: Cylinder Head Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



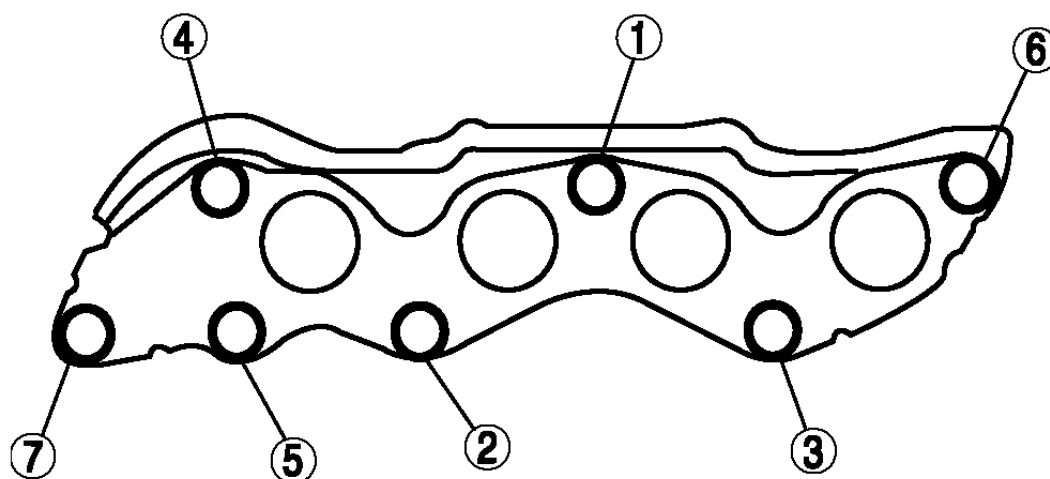
G00356227

**Fig. 123: Drive Plate Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



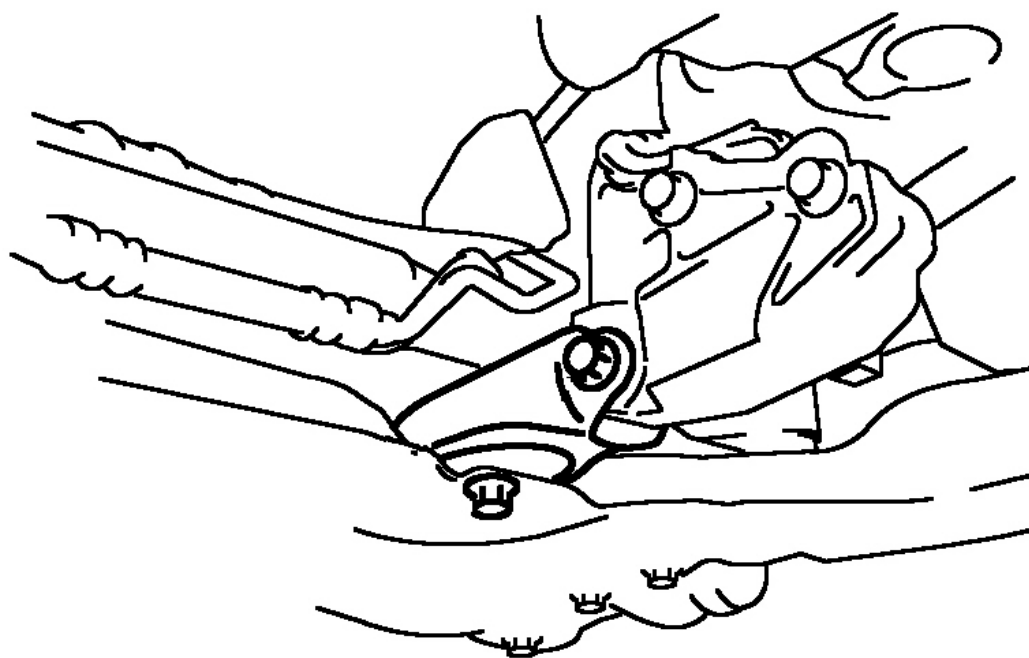
G00356228

**Fig. 124: Engine Front Cover Tightening Sequence**  
 Courtesy of MAZDA MOTORS CORP.



G00356225

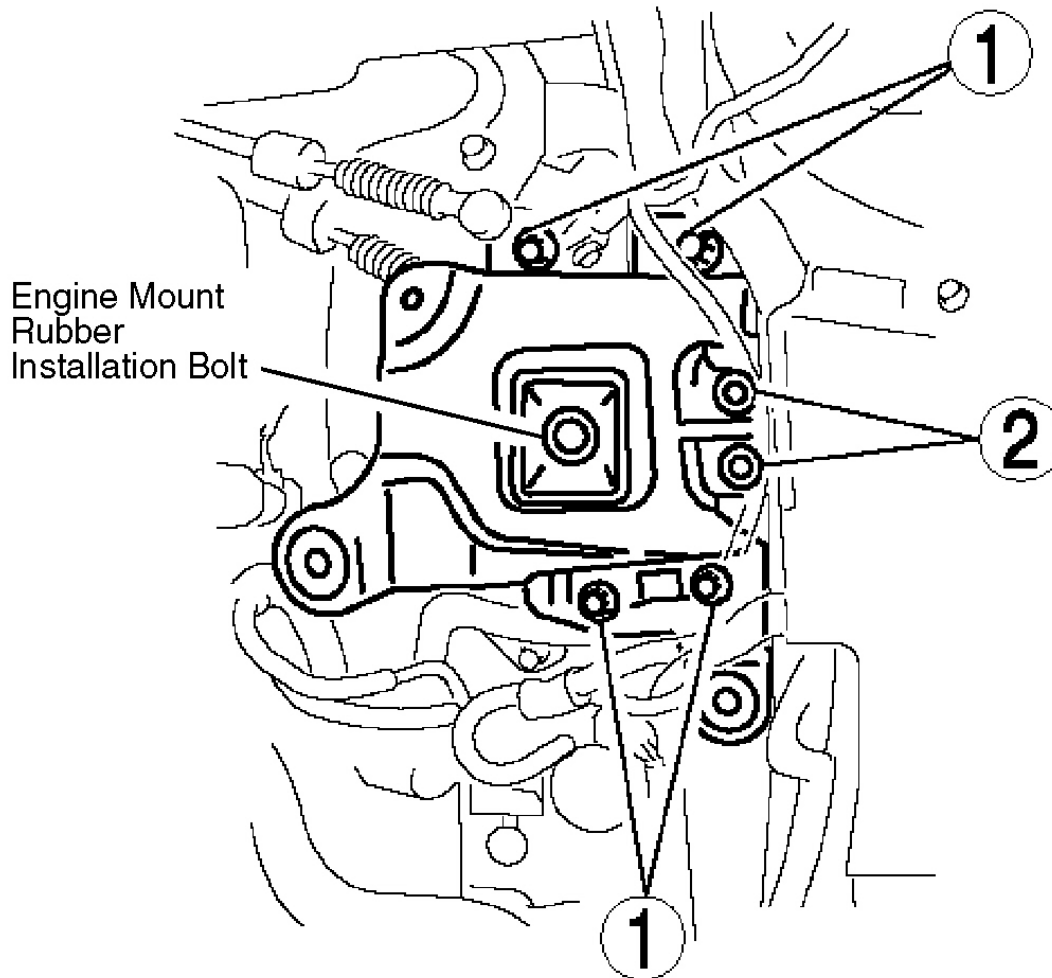
**Fig. 125: Exhaust Manifold Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



G00356230

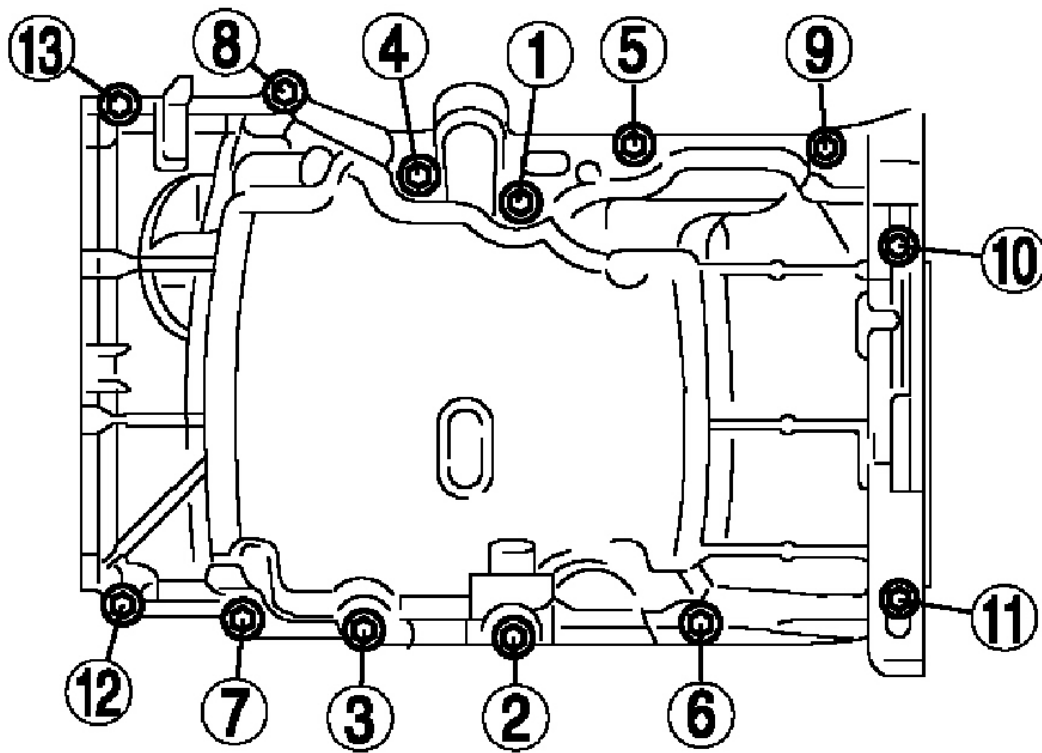
**Fig. 126: No. 1 Engine Mount Tightening Sequence**

Courtesy of MAZDA MOTORS CORP.



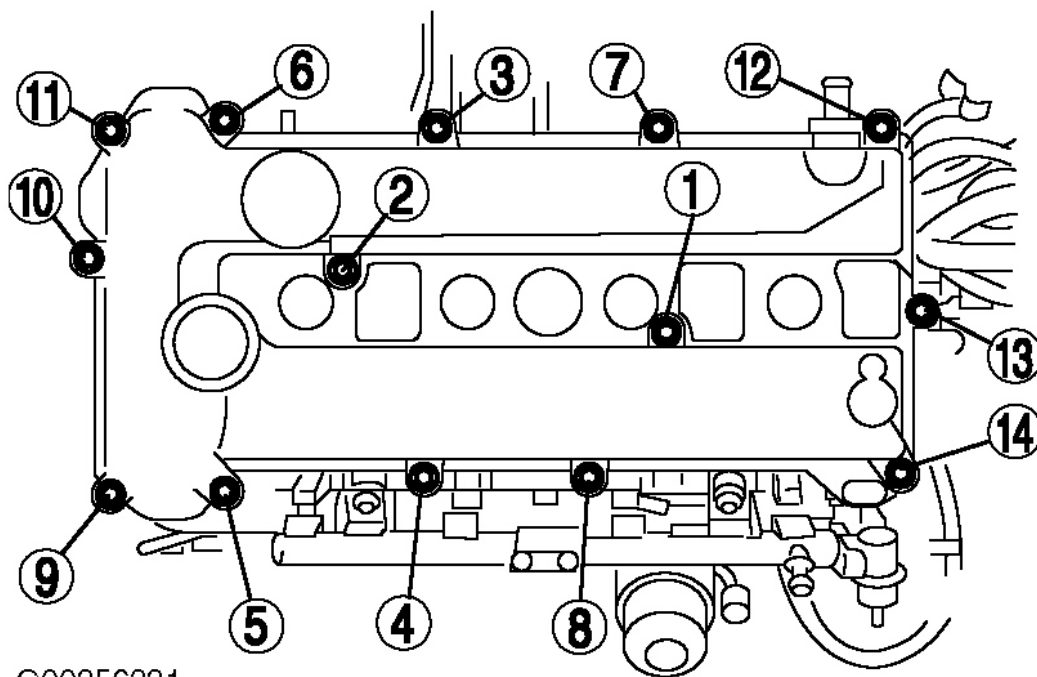
G00356229

**Fig. 127: No. 4 Engine Mount/Battery Bracket Bolt/Nut Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

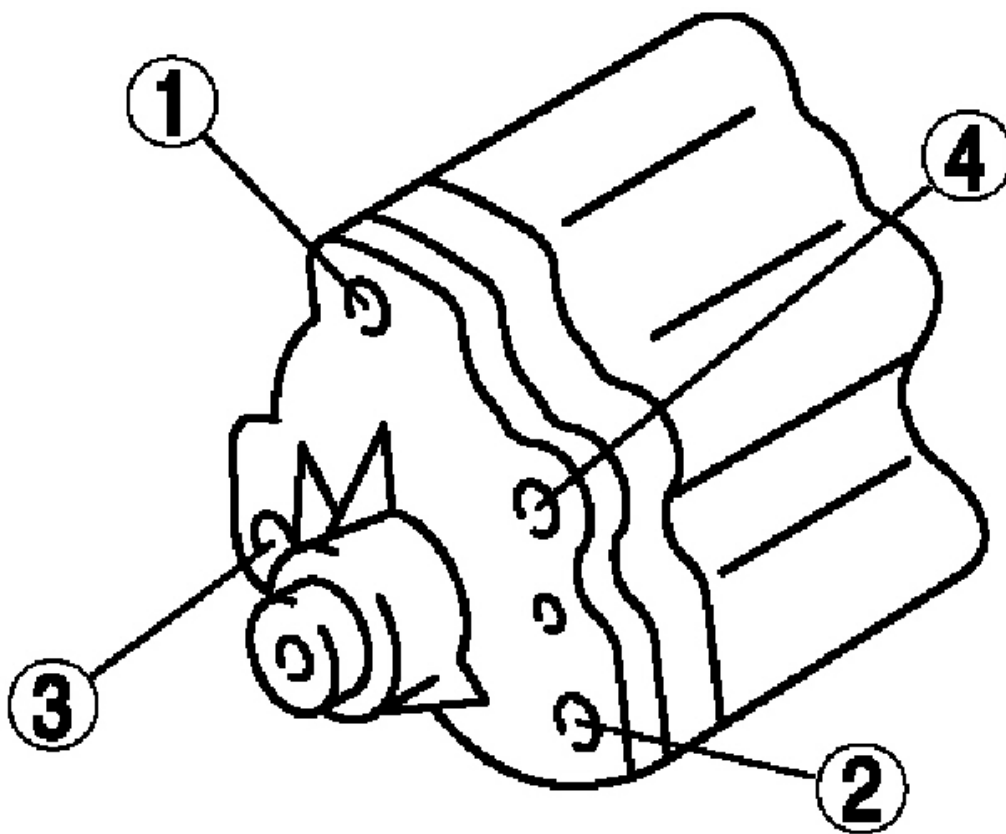


G00356232

**Fig. 128: Oil Pan Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

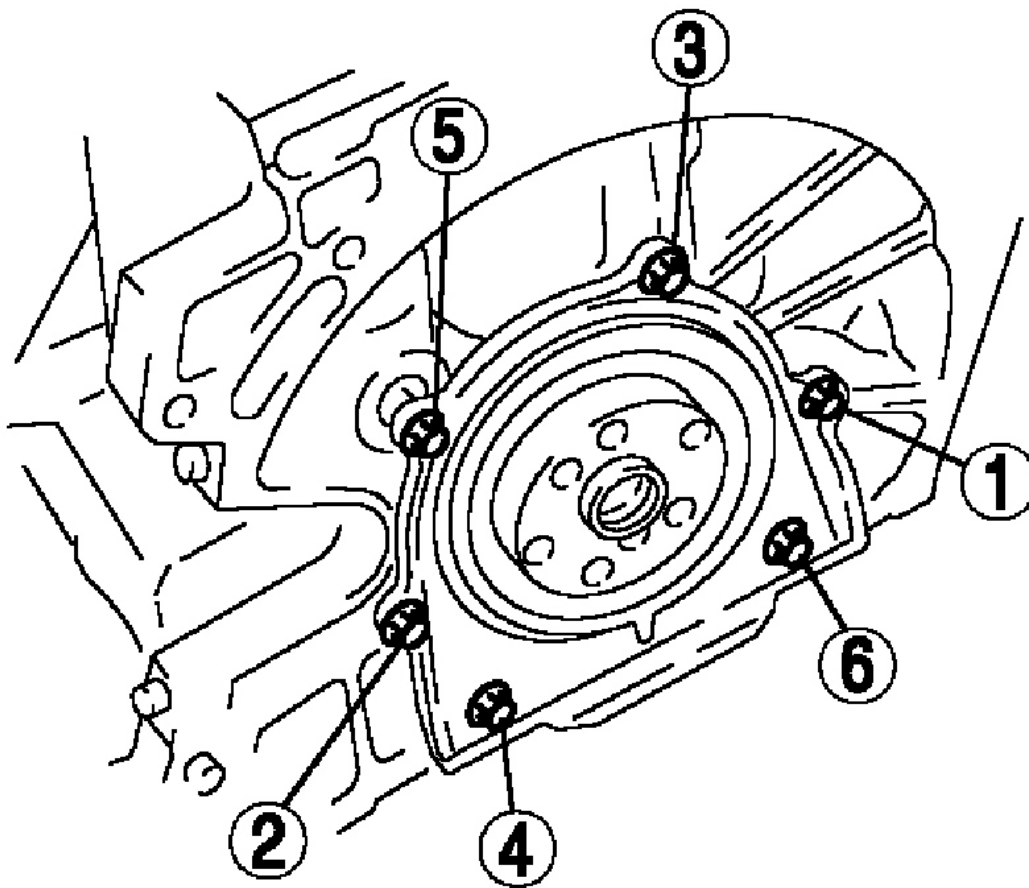


**Fig. 129: Cylinder Head Cover Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



G00356233

**Fig. 130: Oil Pump Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.



G00356234

**Fig. 131: Rear Oil Seal Bolt Tightening Sequence**  
Courtesy of MAZDA MOTORS CORP.

## ENGINE TECHNICAL DATA

# 2005 B2300

2004-08 ENGINES 2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6

| Item                                             |                          |                   | Engine                             |                             |                |
|--------------------------------------------------|--------------------------|-------------------|------------------------------------|-----------------------------|----------------|
|                                                  |                          |                   | LF (2.0 L)                         | L3 (2.3 L)                  |                |
| Cylinder head                                    |                          |                   |                                    |                             |                |
| Cylinder head gasket contact surfaces distortion | (mm {in})                | Maximum           | 0.10 {0.004}                       |                             |                |
| Manifold contact surfaces distortion             | (mm {in})                | Maximum           | 0.10 {0.004}                       |                             |                |
|                                                  |                          | Maximum grinding  | 0.15 {0.006}                       |                             |                |
| Valve clearance [Engine cold]                    | (mm {in})                | IN                | 0.22—0.28 {0.0087—0.0110}          |                             |                |
|                                                  |                          | EX                | 0.27—0.33 {0.0106—0.0130}          |                             |                |
| Valve and valve guide                            |                          |                   |                                    |                             |                |
| Valve stem diameter                              | (mm {in})                | Standard          | IN                                 | 5.470—5.485 {0.2154—0.2159} |                |
|                                                  |                          |                   | EX                                 | 5.465—5.480 {0.2152—0.2157} |                |
|                                                  |                          | Minimum           | IN                                 | 5.440 {0.2142}              |                |
|                                                  |                          |                   | EX                                 | 5.435 {0.2140}              |                |
| Valve stem to guide clearance                    | (mm {in})                | Standard          | IN                                 | 0.024—0.069 {0.0009—0.0027} |                |
|                                                  |                          |                   | EX                                 | 0.029—0.074 {0.0012—0.0029} |                |
|                                                  |                          | Maximum           | IN                                 | 0.10 {0.004}                |                |
|                                                  |                          |                   | EX                                 | 0.10 {0.004}                |                |
| Valve length                                     | (mm {in})                | Standard          | IN                                 | 102.99—103.79 {4.055—4.086} |                |
|                                                  |                          |                   | EX                                 | 104.25—105.05 {4.105—4.135} |                |
|                                                  |                          | Minimum           | IN                                 | 102.99 {4.055}              |                |
|                                                  |                          |                   | EX                                 | 104.25 {4.104}              |                |
| Valve guide inner diameter                       | (mm {in})                | Standard          | IN                                 | 5.509—5.539 {0.2169—0.2180} |                |
|                                                  |                          |                   | EX                                 | 5.509—5.539 {0.2169—0.2180} |                |
| Valve guide protrusion height                    | (mm {in})                | Standard          | IN                                 | 12.2—12.8 {0.481—0.503}     |                |
|                                                  |                          |                   | EX                                 | 12.2—12.8 {0.481—0.503}     |                |
| Valve head margin thickness                      | (mm {in})                | Minimum           | IN                                 | 1.62 {0.0637}               |                |
|                                                  |                          |                   | EX                                 | 1.82 {0.0716}               |                |
| Valve seat                                       |                          |                   |                                    |                             |                |
| Valve seat contact width                         | (mm {in})                | Standard          | IN                                 | 1.2—1.6 {0.048—0.062}       |                |
|                                                  |                          |                   | EX                                 | 1.2—1.6 {0.048—0.062}       |                |
| Valve seat angle                                 |                          | (°)               | IN                                 | 45                          |                |
|                                                  |                          |                   | EX                                 | 45                          |                |
| Valve protrusion height                          | (mm {in})                | Standard          | IN                                 | 40.64—42.24 {1.600—1.662}   |                |
|                                                  |                          |                   | EX                                 | 40.50—42.10 {1.595—1.657}   |                |
| Valve spring                                     |                          |                   |                                    |                             |                |
| Out-of-square                                    | (mm {in})                | Maximum           | 1% (2.23 {0.0877})                 |                             |                |
| Pressing force                                   | (N {kgf, lbf}) [mm {in}] | Standard height H | 390 {39.76, 87.67} [28.68 {1.129}] |                             |                |
| OCV (Oil control valve)                          |                          |                   |                                    |                             |                |
| Coil resistance [20° C {68°F}]                   | (ohm)                    | Standard          | — 6.9—7.9                          |                             |                |
| Camshaft                                         |                          |                   |                                    |                             |                |
| Camshaft runout                                  | (mm {in})                | Maximum           | 0.03 {0.0012}                      |                             |                |
| Cam lobe height                                  | (mm {in})                | Standard          | IN                                 | 42.12{1.659}                | 42.44{1.671}   |
|                                                  |                          |                   | EX                                 | 41.08{1.618}                | 41.18 {1.622}  |
|                                                  |                          | Minimum           | IN                                 | 42.022{1.655}               | 42.342 {1.667} |
|                                                  |                          |                   | EX                                 | 40.982{1.614}               | 41.082 {1.618} |
| Journal diameter                                 | (mm {in})                | Standard          | 24.96—24.98 {0.9827—0.9834}        |                             |                |
|                                                  |                          | Minimum           | 24.95 {0.982}                      |                             |                |

G02831676

**Fig. 132: Engine Technical Data (1 Of 3)**  
**Courtesy of MAZDA MOTORS CORP.**

# 2005 B2300

2004-08 ENGINES 2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6

| Item                                                                                           |           |                       | Engine                        |                             |
|------------------------------------------------------------------------------------------------|-----------|-----------------------|-------------------------------|-----------------------------|
|                                                                                                |           |                       | LF (2.0 L)                    | L3 (2.3 L)                  |
| Journal oil clearance                                                                          | (mm {in}) | Standard              | 0.035—0.080 {0.0014—0.0031}   |                             |
|                                                                                                |           | Maximum               | 0.09 {0.0035}                 |                             |
| End play                                                                                       | (mm {in}) | Standard              | 0.09—0.24 {0.0035—0.0094}     |                             |
|                                                                                                |           | Maximum               | 0.25 {0.0098}                 |                             |
| Tappet                                                                                         |           |                       |                               |                             |
| Tappet bore diameter                                                                           | (mm {in}) | Standard              | 31.000—31.030 {1.2205—1.2216} |                             |
| Tappet diameter                                                                                | (mm {in}) | Standard              | 30.970—30.980 {1.2193—1.2196} |                             |
| Tappet-to-Tappet bore oil clearance                                                            | (mm {in}) | Standard              | 0.02—0.06 {0.0008—0.0023}     |                             |
|                                                                                                |           | Maximum               | 0.15 {0.006}                  |                             |
| Cylinder block                                                                                 |           |                       |                               |                             |
| Cylinder head gasket contact surfaces distortion                                               | (mm {in}) | Maximum               | 0.10 {0.004}                  |                             |
| Cylinder bore diameter<br>[Measure the cylinder bore at 42 mm {1.65 in} below the top surface] | (mm {in}) | Standard              | 87.500—87.530 {3.4449—3.4460} |                             |
| Minimum / maximum bore diameter Limit                                                          | (mm {in}) |                       | 87.440—87.590 {3.4425—3.4484} |                             |
| Piston                                                                                         |           |                       |                               |                             |
| Piston diameter                                                                                | (mm {in}) | Standard              | 87.465—87.495 {3.4435—3.4446} |                             |
| Piston-to-cylinder clearance                                                                   | (mm {in}) | Standard              | 0.025—0.045 {0.0010—0.0017}   |                             |
|                                                                                                |           | Maximum               | 0.11 {0.0043}                 |                             |
| Piston ring                                                                                    |           |                       |                               |                             |
| Piston ring-to-ring groove clearance                                                           | (mm {in}) | Standard              | Top                           | 0.03—0.08 {0.0012—0.0031}   |
|                                                                                                |           |                       | Second                        | 0.03—0.07 {0.0012—0.0027}   |
|                                                                                                |           |                       | Oil (rail)                    | 0.03—0.07 {0.0012—0.0027}   |
|                                                                                                |           | Maximum               | Top                           | 0.17 {0.0067}               |
|                                                                                                |           |                       | Second                        | 0.15 {0.0059}               |
|                                                                                                |           |                       | Oil (rail)                    | 0.15 {0.0059}               |
| End gap<br>(measured in cylinder)                                                              | (mm {in}) | Standard              | Top                           | 0.16—0.31 {0.0063—0.0122}   |
|                                                                                                |           |                       | Second                        | 0.33—0.48 {0.0130—0.0189}   |
|                                                                                                |           |                       | Oil (rail)                    | 0.20—0.70 {0.0079—0.0275}   |
|                                                                                                |           | Maximum               | Top                           | 1.0 {0.0393}                |
|                                                                                                |           |                       | Second                        | 1.0 {0.0393}                |
|                                                                                                |           |                       | Oil (rail)                    | 1.0 {0.0393}                |
| Connecting rod and connecting rod bearing                                                      |           |                       |                               |                             |
| Connecting rod side clearance                                                                  | (mm {in}) | Standard              | 0.14—0.36 {0.0056—0.0141}     |                             |
|                                                                                                |           | Maximum               | 0.435 {0.0172}                |                             |
| Connecting rod bearing size                                                                    | (mm {in}) | Standard              | 1.498—1.504 {0.0589—0.0592}   | 1.496—1.502 {0.0589—0.0591} |
|                                                                                                |           | 0.25 {0.01} Oversize  | 1.623—1.629 {0.0639—0.0641}   | 1.621—1.627 {0.0639—0.0641} |
|                                                                                                |           | 0.50 {0.02} Oversize  | 1.748—1.754 {0.0689—0.0690}   | 1.746—1.752 {0.0688—0.0690} |
|                                                                                                |           |                       |                               |                             |
| Connecting rod bearing oil clearance                                                           | (mm {in}) | Standard              | 0.026—0.052 {0.0011—0.0020}   |                             |
|                                                                                                |           | Maximum               | 0.10 {0.0039}                 |                             |
| Crankshaft                                                                                     |           |                       |                               |                             |
| Crankshaft runout                                                                              | (mm {in}) | Maximum               | 0.05 {0.0019}                 |                             |
| Main journal diameter                                                                          | (mm {in}) | Standard              | 51.980—52.000 {2.0464—2.0472} |                             |
|                                                                                                |           | 0.25 {0.01} undersize | 51.730—51.750 {2.0366—2.0373} |                             |
| Main journal oil clearance                                                                     | (mm {in}) | Standard              | 0.019—0.035 {0.0007—0.0013}   |                             |
|                                                                                                |           | Maximum               | 0.10 {0.0039}                 |                             |
| Main journal out of round                                                                      | (mm {in}) | Maximum               | 0.05 {0.0019}                 |                             |

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**Fig. 133: Engine Technical Data (2 Of 3)**  
Courtesy of MAZDA MOTORS CORP.

## 2005 B2300

2004-08 ENGINES 2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6

| Item                                                                             |           |                       | Engine                        |                               |
|----------------------------------------------------------------------------------|-----------|-----------------------|-------------------------------|-------------------------------|
|                                                                                  |           |                       | LF (2.0 L)                    | L3 (2.3 L)                    |
| Main bearing size                                                                | (mm {in}) | Standard              | 2.506—2.509 {0.0987—0.0988}   |                               |
|                                                                                  |           | 0.25 {0.01} Oversize  | 2.628—2.634 {0.1034—0.1037}   |                               |
|                                                                                  |           | 0.50 {0.02} Oversize  | 2.753—2.759 {0.1084—0.1086}   |                               |
| Crank pin journal diameter                                                       | (mm {in}) | Standard              | 46.980—47.000 {1.8497—1.8503} | 49.980—50.000 {1.9677—1.9685} |
|                                                                                  |           | 0.25 {0.01} undersize | 46.730—46.750 {1.8398—1.8405} | 49.730—49.750 {1.9579—1.9586} |
| Crank pin out of round                                                           | (mm {in}) | Maximum               | 0.05 {0.019}                  |                               |
| Crankshaft end play                                                              | (mm {in}) | Standard              | 0.22—0.45 {0.0087—0.0177}     |                               |
|                                                                                  |           | Maximum               | 0.55 {0.0216}                 |                               |
| Front oil seal                                                                   |           |                       |                               |                               |
| Pushing distance of the front oil seal [from the edge of the engine front cover] |           | (mm {in})             | 0—0.5 {0—0.019}               |                               |
| Bolt                                                                             |           |                       |                               |                               |
| Cylinder head bolt length                                                        | (mm {in}) | With washer           | Standard                      | 149.2—149.8 {5.87—5.90}       |
|                                                                                  |           |                       | Maximum                       | 150.5 {5.91}                  |
|                                                                                  |           | Without washer        | Standard                      | 145.2—145.8 {5.72—5.74}       |
|                                                                                  |           |                       | Maximum                       | 146.5 {5.76}                  |
| Connecting rod bolt length                                                       |           | Standard              | 44.7—45.3 {1.75—1.78}         |                               |
|                                                                                  |           | Maximum               | 46.0 {1.81}                   |                               |
| Main bearing cap bolt length                                                     |           | Standard              | 110.0—110.6 {4.33—4.35}       |                               |
|                                                                                  |           | Maximum               | 111.3 {4.38}                  |                               |
| Balance shaft                                                                    |           |                       |                               |                               |
| Gear backlash                                                                    | (mm {in}) | Maximum               | —                             | 0.005-0.101 {0.00019—0.0039}  |

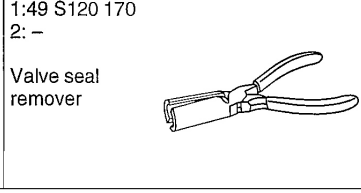
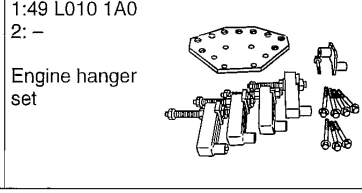
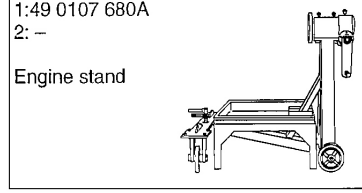
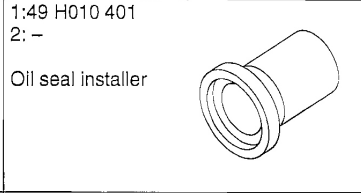
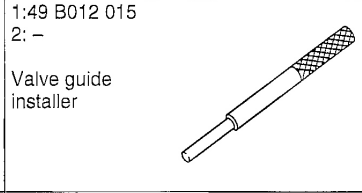
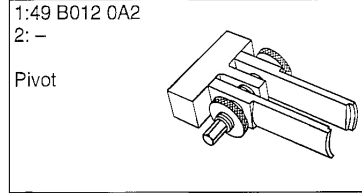
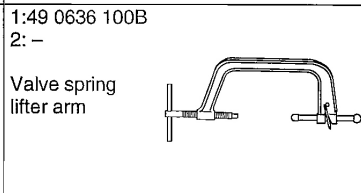
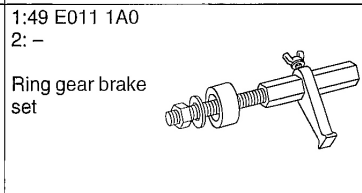
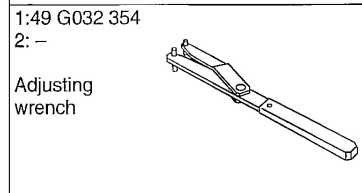
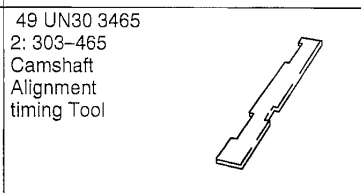
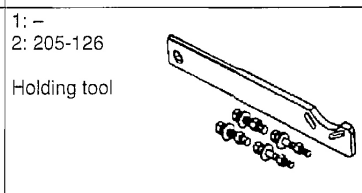
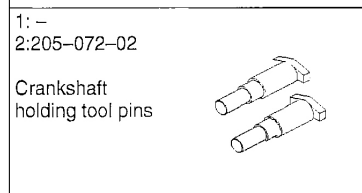
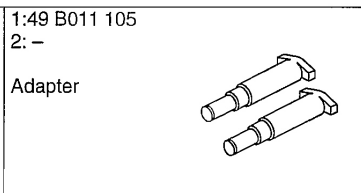
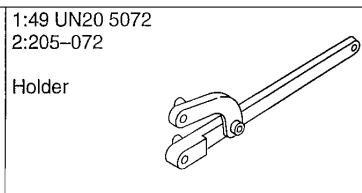
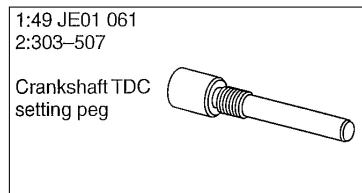
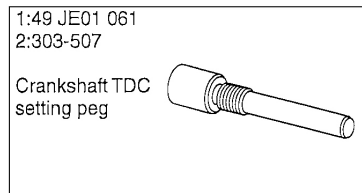
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**Fig. 134: Engine Technical Data (3 Of 3)**  
Courtesy of MAZDA MOTORS CORP.

## ENGINE SST

### Engine SST identification example

1. Mazda SST number
2. Global SST number

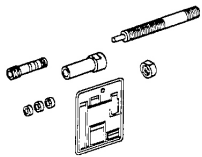
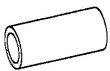
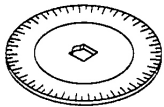
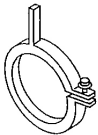


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**Fig. 135: Identifying Engine SSTs (Example Shown)**  
Courtesy of MAZDA MOTORS CORP.

## 2005 B2300

2004-08 ENGINES 2.0L & 2.3L 4-Cylinder - Overhaul - CX-7, Mazda3, Mazda5 & Mazda6

|                                                                                                                                                                  |                                                                                                                                          |                                                                                                                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|
| <p>1:49 L012 0A0B<br/>2: —</p> <p>Valve seal and valve guide installer set</p>  | <p>1:49 T032 302<br/>2: —</p> <p>Bearing installer</p>  | <p>1:49 D032 316<br/>2: —</p> <p>Protractor</p>  |
| <p>1:49 G011 201<br/>2: —</p> <p>Attachment</p>                                 | <p>—</p>                                                                                                                                 | <p>—</p>                                                                                                                            |

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**Fig. 136: Identifying Engine SSTs**  
Courtesy of MAZDA MOTORS CORP.