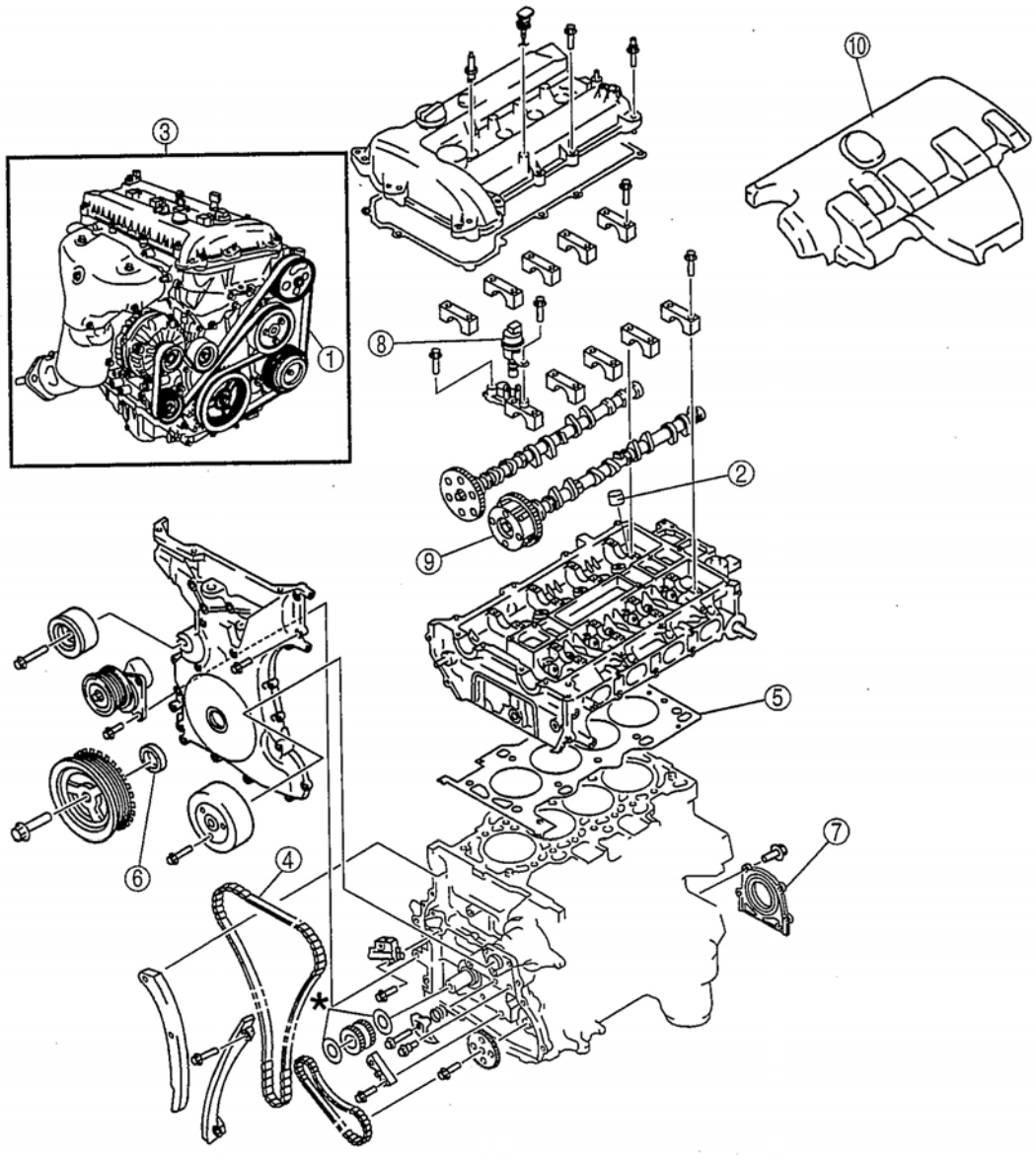
2007 ENGINE

Mechanical - MX-5

MECHANICAL LOCATION INDEX [LF]



*:IF EQUIPPED

1	Drive belt
2	Tappet
3	Engine
4	Timing Chain
5	Cylinder head gasket
6	Front oil seal
7	Rear oil seal
8	OCV
9	**Variable valve timing actuator**
10	Plug hole plate

Fig. 1: Identifying Location Of Engine Mechanical Components [LF]
Courtesy of MAZDA MOTORS CORP.

PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]

1. Remove the plug hole plate.

NOTE:

- **Lift off and remove the plug hole plate from the installation areas (rubber and clips) as shown in Fig. 2 .**

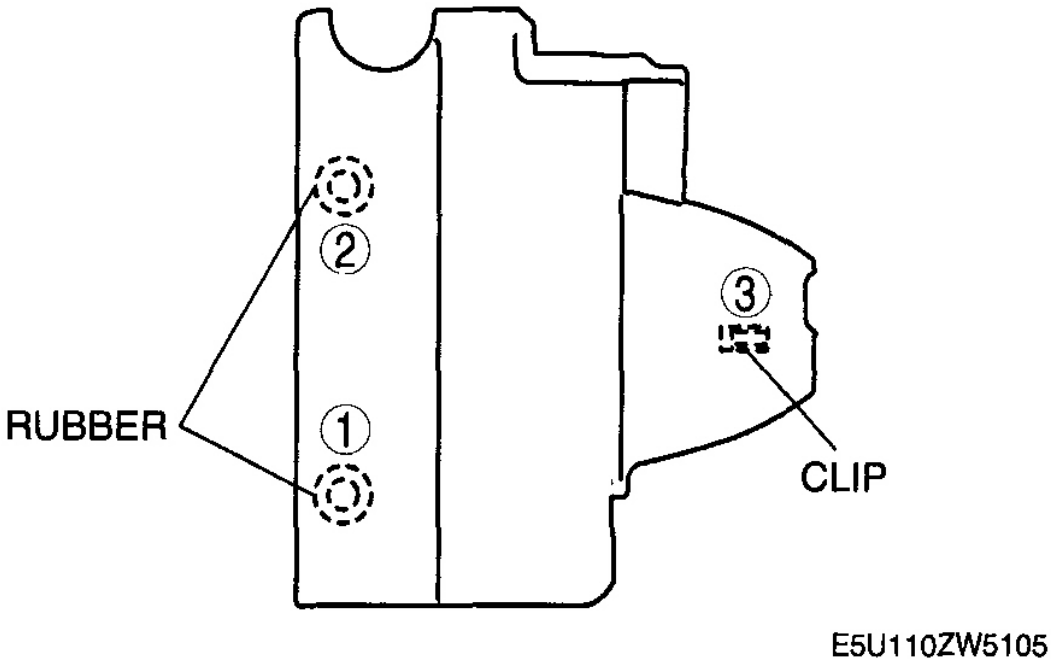


Fig. 2: Removing Plug Hole Plate From Installation Areas (Rubber & Clips)
Courtesy of MAZDA MOTORS CORP.

2. Install the plug hole plate.

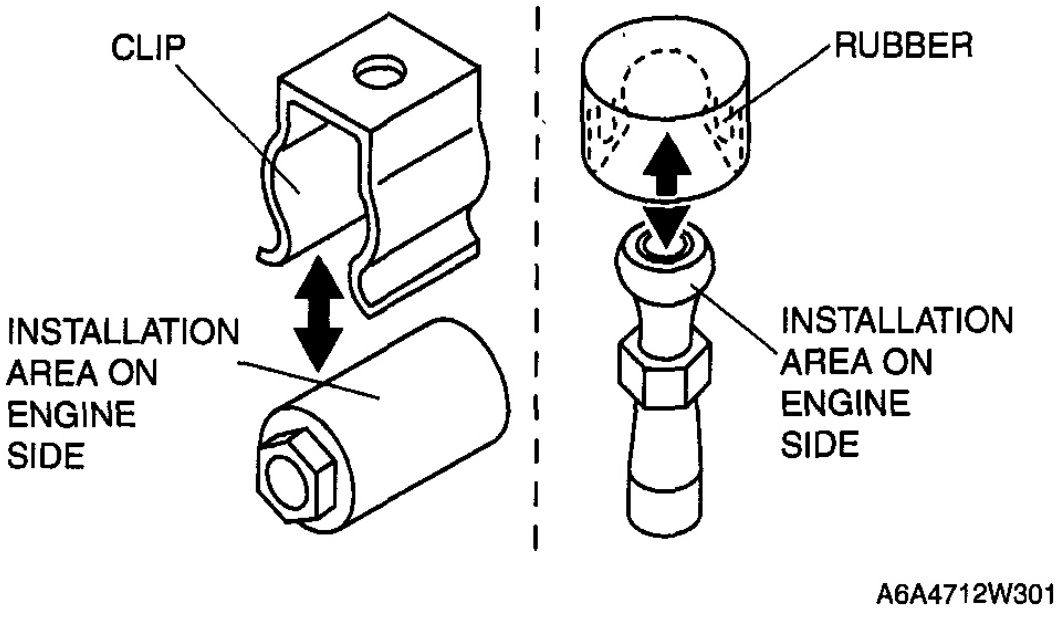


Fig. 3: Installing Plug Hole Plate
Courtesy of MAZDA MOTORS CORP.

1. To position the plug hole plate, grasp rubber 1 and 2, as shown in **Fig. 4** , with your hands and press them in.
2. Grasp clips 3 with your hands and press them in.

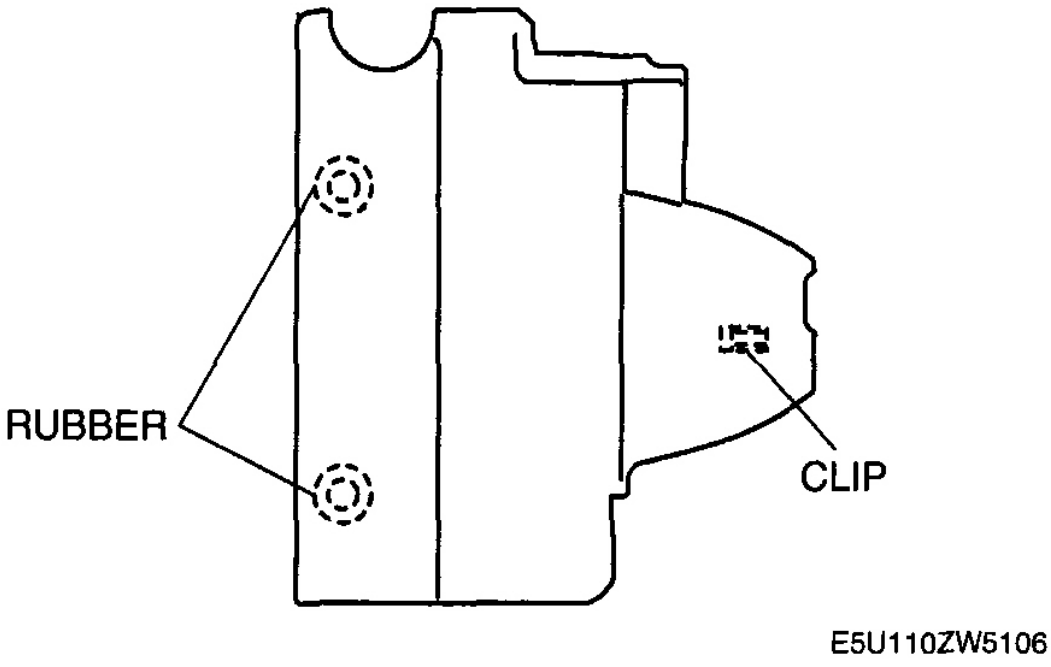


Fig. 4: Position Plug Hole Plate
Courtesy of MAZDA MOTORS CORP.

DRIVE BELT INSPECTION [LF]

NOTE:

- **Drive belt deflection/tension inspection is not necessary because of the use of the auto tensioner.**

1. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)

NOTE:

- **Use a mirror to see the position of the drive belt auto tensioner indicator mark.**

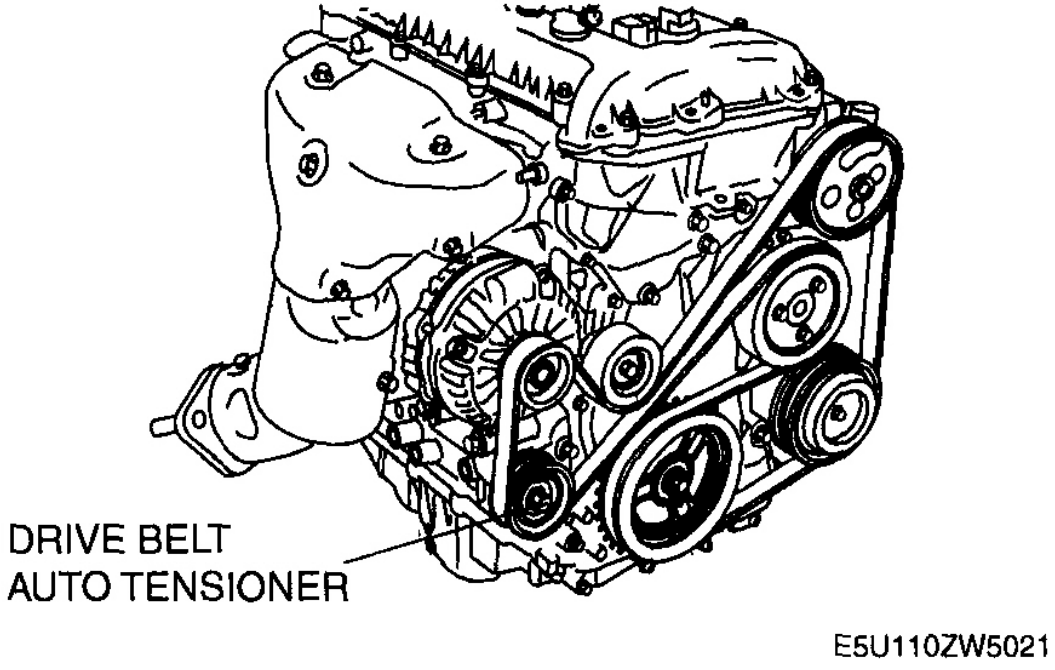


Fig. 5: Identifying Drive Belt Auto Tensioner
Courtesy of MAZDA MOTORS CORP.

2. Verify that the drive belt auto tensioner indicator mark does not exceed the limit.
   - If it exceeds the limit, replace the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)

AT

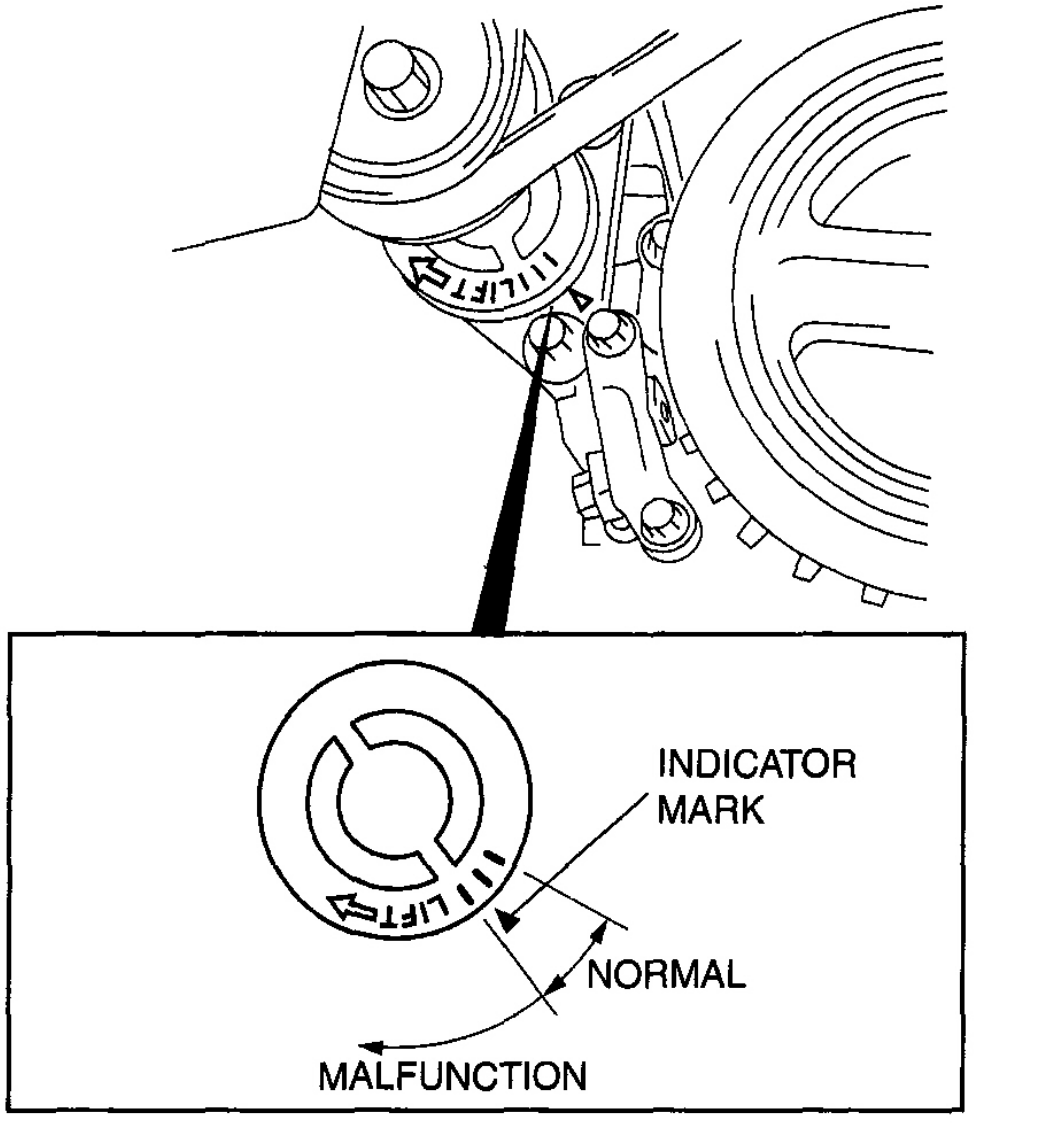


Fig. 6: Verifying Drive Belt Auto Tensioner Indicator Mark (AT)
Courtesy of MAZDA MOTORS CORP.

MT

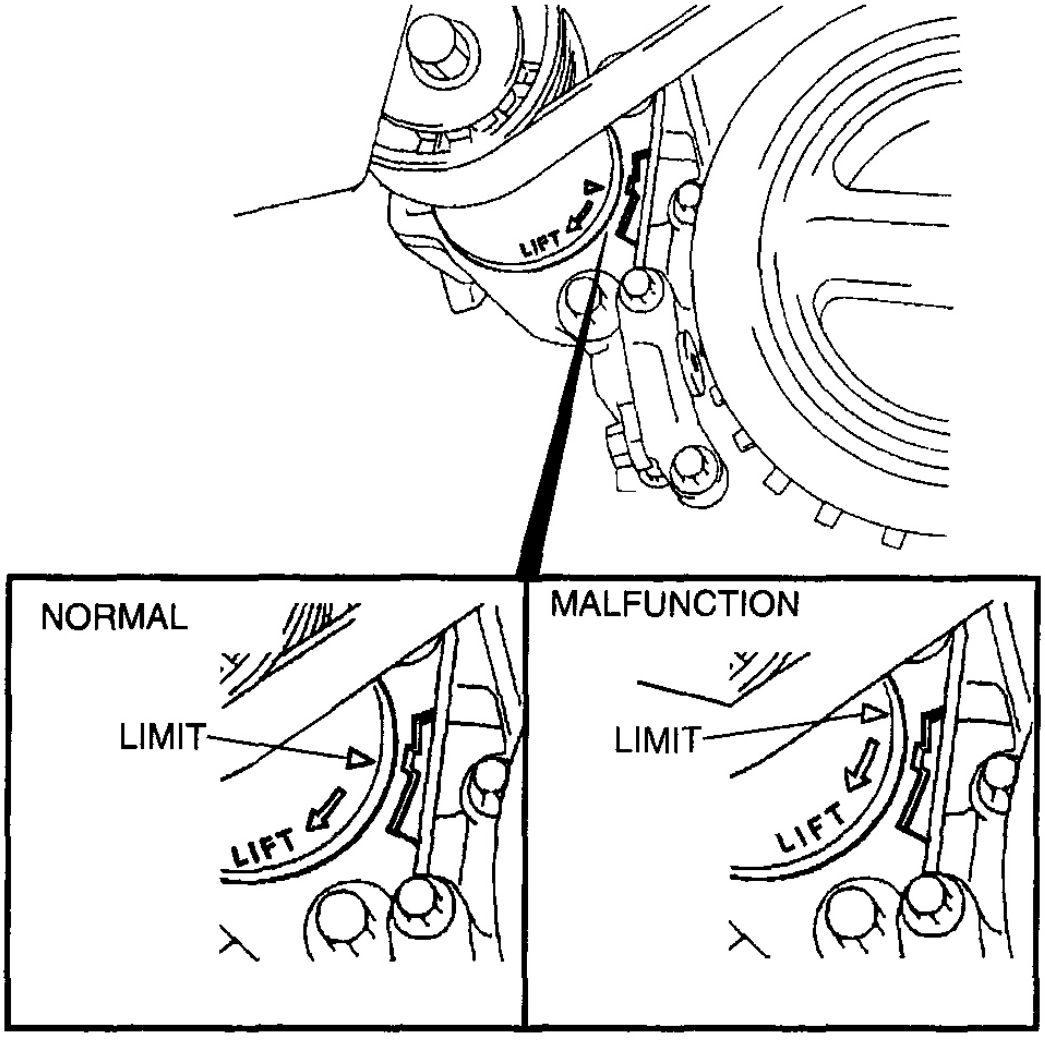


Fig. 7: Verifying Drive Belt Auto Tensioner Indicator Mark (MT)
Courtesy of MAZDA MOTORS CORP.

3. Install the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)

DRIVE BELT REPLACEMENT [LF]

1. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
2. Rotate the drive belt auto tensioner in the direction shown in **Fig. 8** and remove the drive belt.

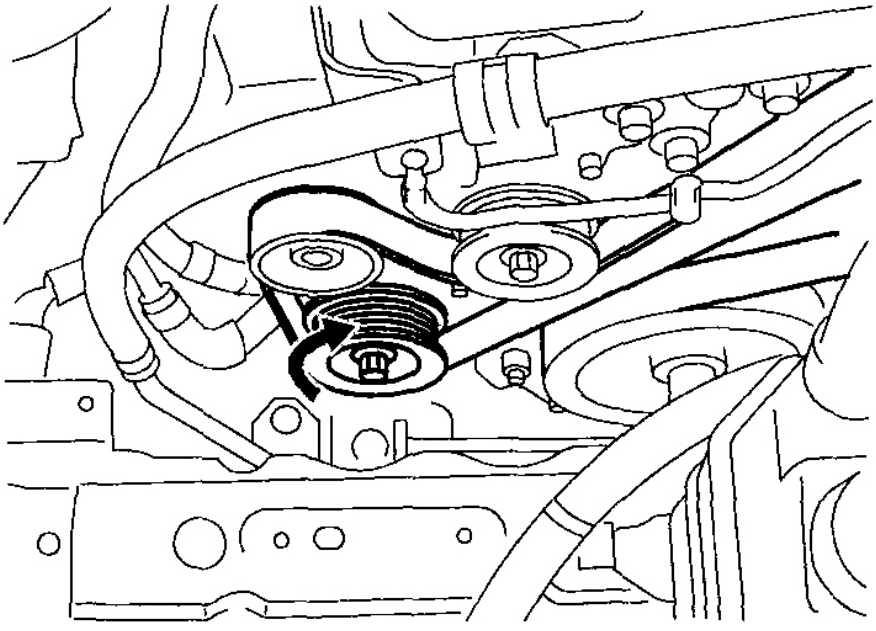


Fig. 8: Rotating Drive Belt Auto Tensioner & Removing Drive Belt
Courtesy of MAZDA MOTORS CORP.

3. Install a new drive belt.

NOTE:

- **Use a mirror to see the position of the drive belt auto tensioner indicator mark.**

4. Verify that the drive belt auto tensioner indicator mark does not exceed the limit. (See **DRIVE BELT INSPECTION [LF]** .)
   - If it exceeds the limit, replace the drive belt.
5. Install the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)

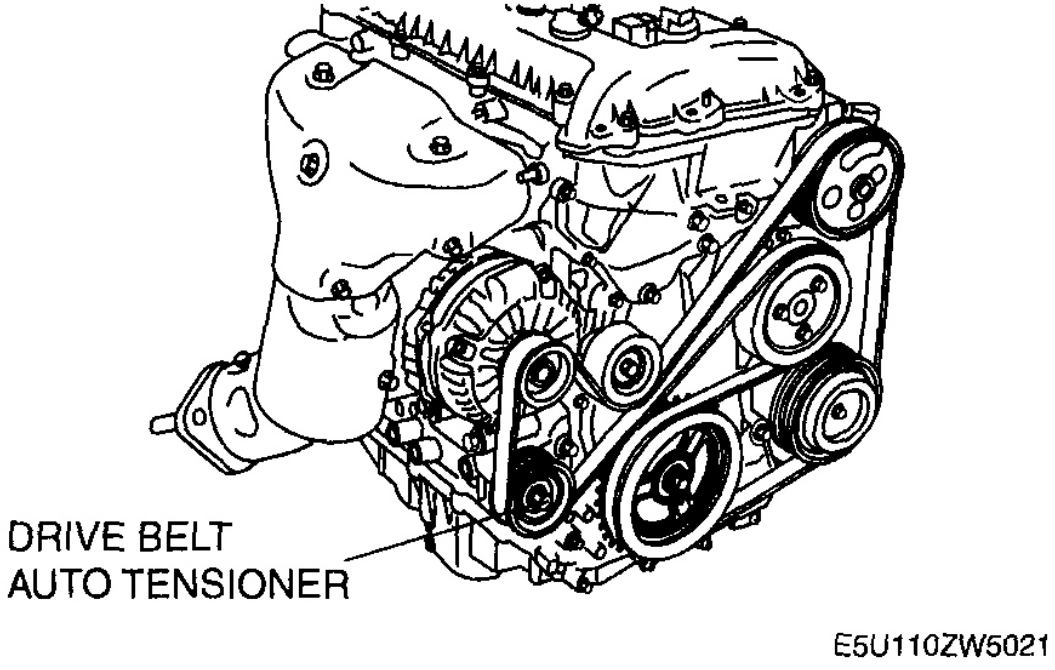


Fig. 9: Identifying Drive Belt Auto Tensioner
Courtesy of MAZDA MOTORS CORP.

DRIVE BELT AUTO TENSIONER INSPECTION [LF]

1. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
2. Remove the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)

NOTE:
- **Use a mirror to see the position of the drive belt auto tensioner indicator mark.**

3. Verify that the drive belt auto tensioner moves smoothly in the operational direction.
   - Replace the drive belt auto tensioner if necessary.

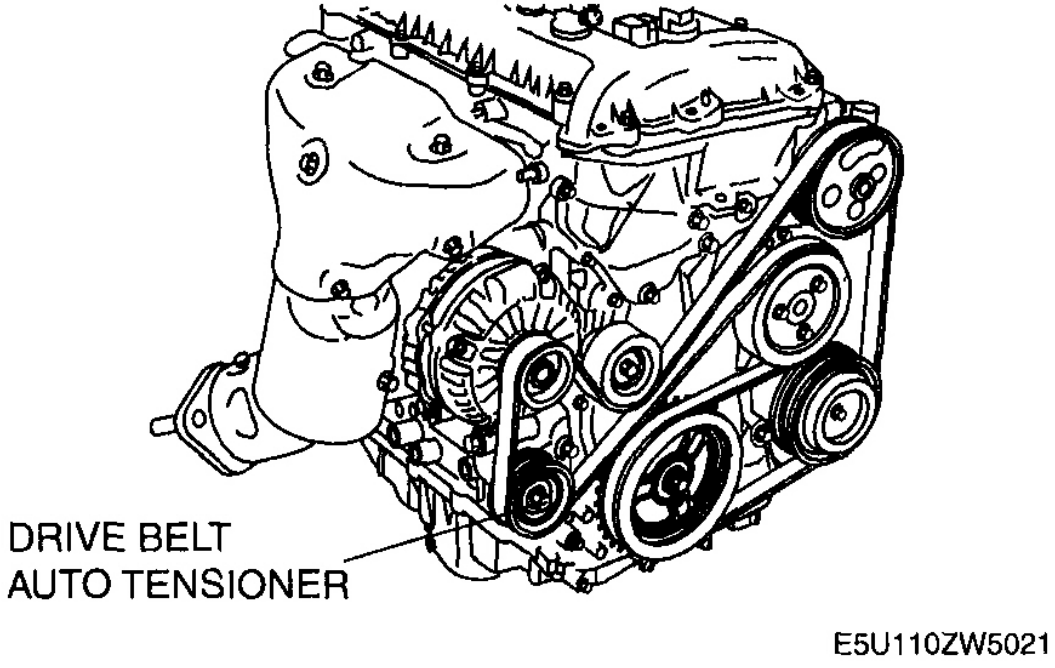


Fig. 10: Identifying Drive Belt Auto Tensioner
Courtesy of MAZDA MOTORS CORP.

4. Turn the drive belt auto tensioner pulley by hand and verify that it rotates smoothly.
    - Replace the drive belt auto tensioner if necessary.

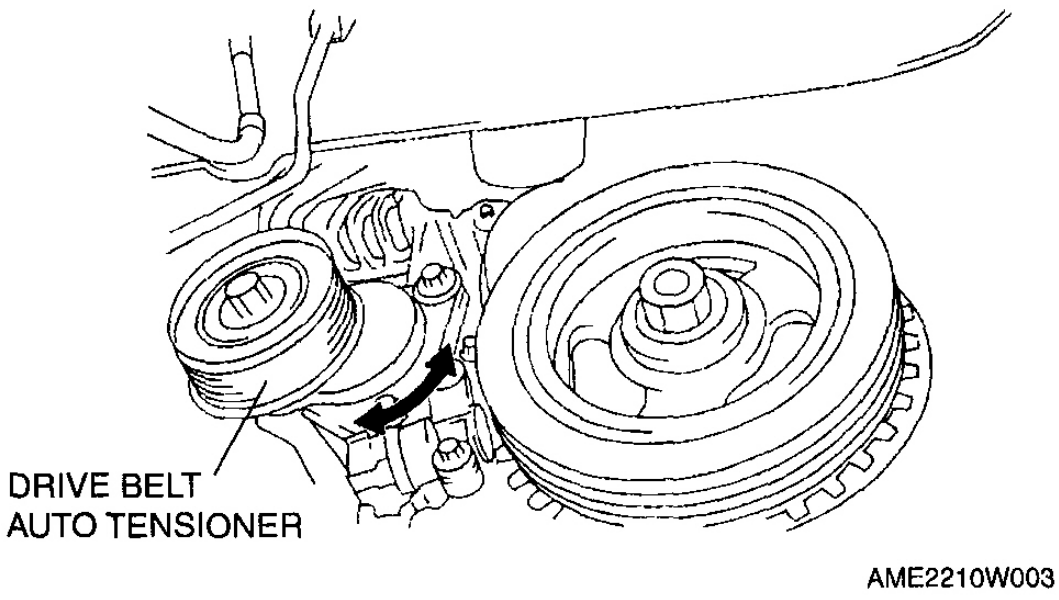


Fig. 11: Turning Drive Belt Auto Tensioner Pulley
Courtesy of MAZDA MOTORS CORP.

5. Install the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)
6. Install the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)

VALVE CLEARANCE INSPECTION [LF]

1. Remove the battery cover.
2. Disconnect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
3. Remove the plug hole plate. (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
4. Disconnect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
5. Remove the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
6. Remove the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
7. Disconnect the OCV connector.
8. Disconnect the P/S pressure switch connector.
9. Remove the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
10. Remove the cylinder head cover. (See **CYLINDER HEAD COVER INSTALLATION NOTE** .)
11. Measure the valve clearance.
    1. Turn the crankshaft clockwise so that the No.1 piston is at TDC of the compression stroke.

2. Measure the valve clearance at A in **Fig. 12** .
   - If the valve clearance is out of the specification, adjust it. (See **VALVE CLEARANCE ADJUSTMENT [LF]** .)

NOTE:

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

Valve clearance [Engine cold]

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

EX: 0.27-0.33 mm {0.0107-0.0129 in}

3. Turn the crankshaft **360°** clockwise so that the No.4 piston is at TDC of the compression stroke.
4. Measure the valve clearance at B in **Fig. 12** .
   - If the valve clearance is out of the specification, adjust it. (See **VALVE CLEARANCE ADJUSTMENT [LF]** .)

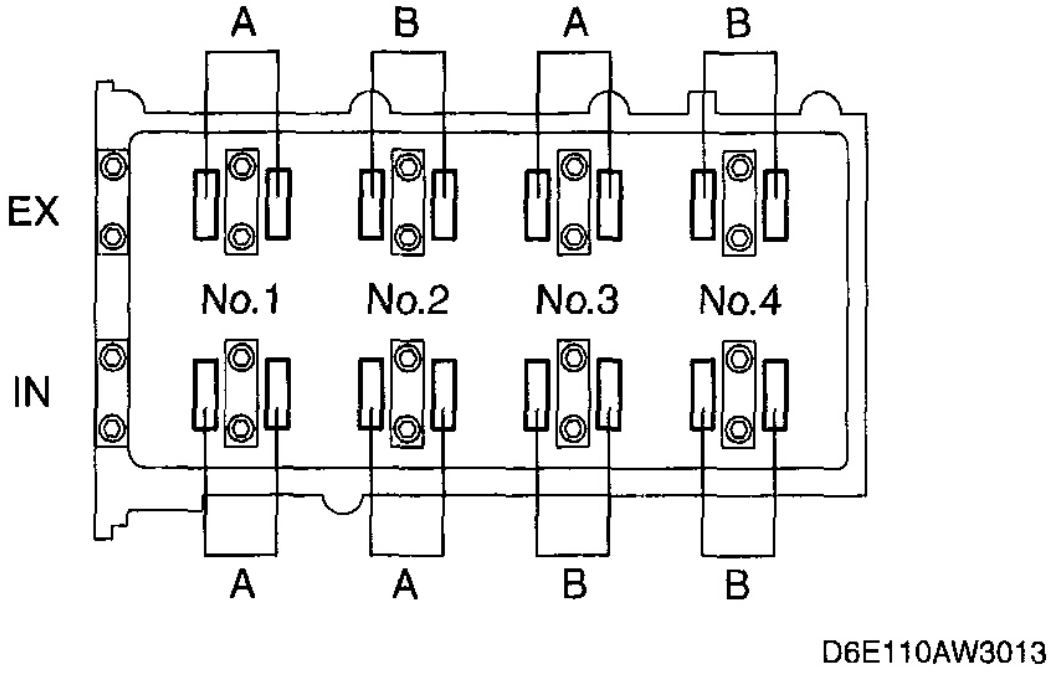


Fig. 12: Identifying Where To Measure Valve Clearance
Courtesy of MAZDA MOTORS CORP.

NOTE:

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

Valve clearance [Engine cold]

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

EX: 0.27-0.33 mm {0.0107-0.0129 in}

12. Install the cylinder head cover. (See **CYLINDER HEAD COVER INSTALLATION NOTE** .)
13. Install the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
14. Connect the P/S pressure switch connector.
15. Connect the OCV connector.
16. Install the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
17. Install the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
18. Connect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
19. Install the plug hole plate. (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
20. Connect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
21. Install the battery cover.

VALVE CLEARANCE ADJUSTMENT [LF]

1. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
2. Remove the plug hole plate. (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
3. Remove the air cleaner. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
4. Disconnect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
5. Remove the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
6. Remove the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
7. Disconnect the OCV connector.
8. Disconnect the P/S pressure switch connector.
9. Remove the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
10. Remove the cylinder head cover. (See **TIMING CHAIN REMOVAL/INSTALLATION [LF]** .)
11. Remove the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)
12. Remove the engine front cover lower blind plug.

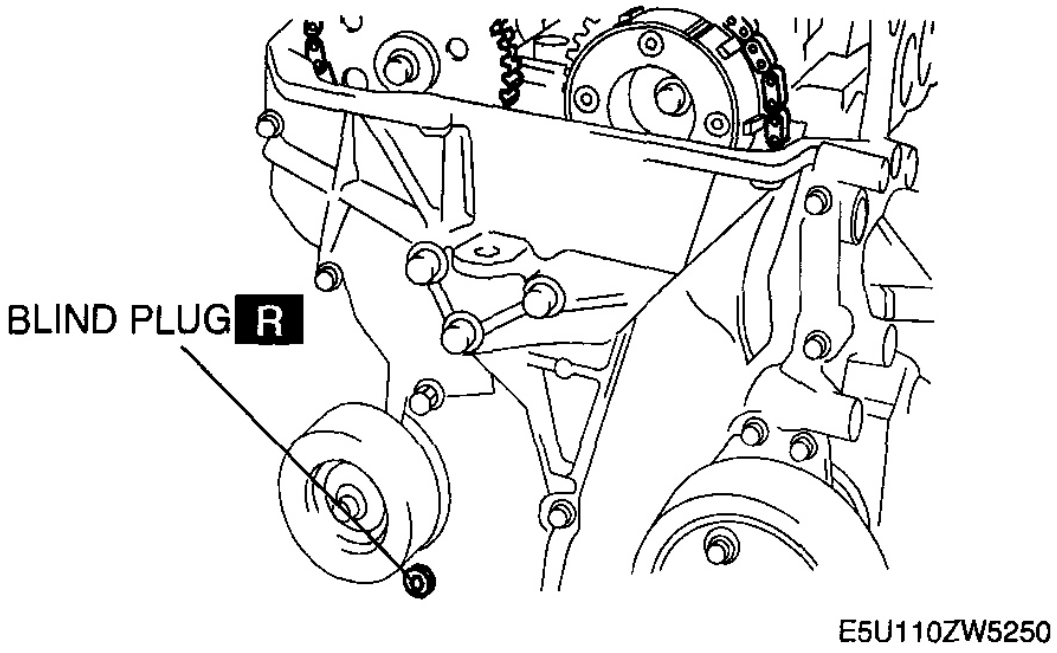


Fig. 13: Removing Engine Front Cover Lower Blind Plug
Courtesy of MAZDA MOTORS CORP.

13. Remove the engine front cover upper blind plug.

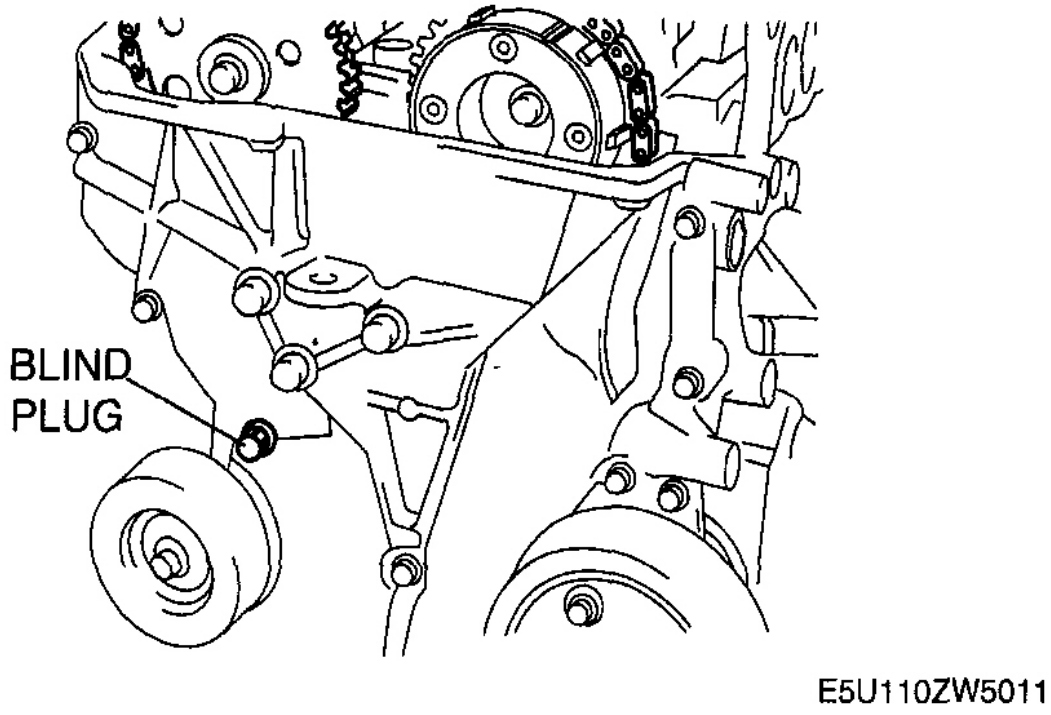


Fig. 14: Removing Engine Front Cover Upper Blind Plug
Courtesy of MAZDA MOTORS CORP.

14. Remove the cylinder block lower blind plug.
15. Install the **SST** as shown in **Fig. 15**.

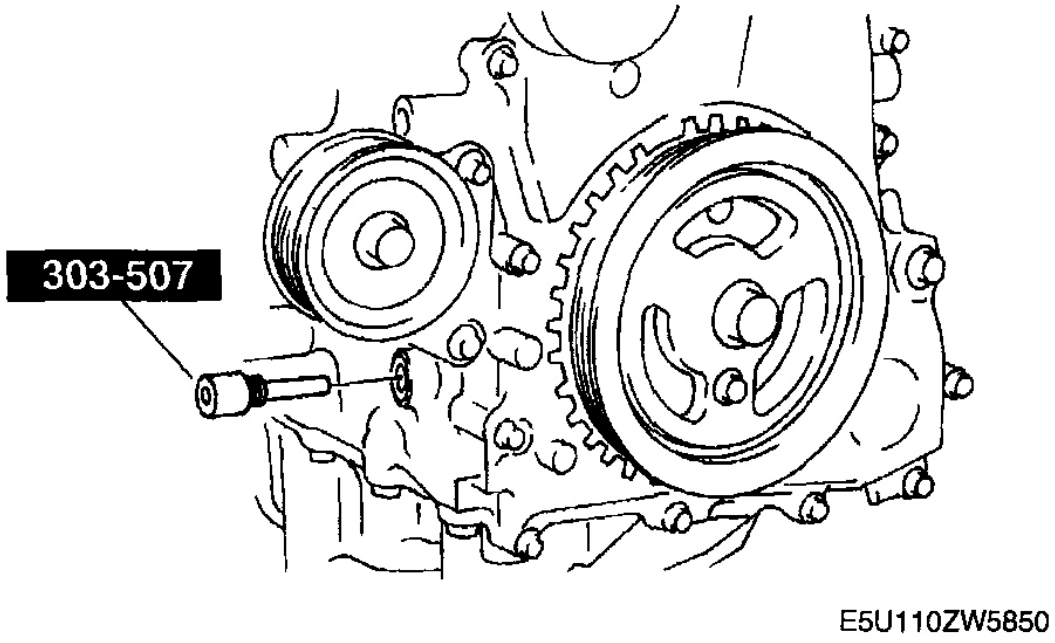


Fig. 15: Installing SST
Courtesy of MAZDA MOTORS CORP.

16. Turn the crankshaft clockwise until the crankshaft is in the No.1 cylinder TDC position.
17. 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 mm-35 mm {0.99 in-1.37 in})** at the engine front cover upper blind plug, secure the chain guide at the position where the tension is released.

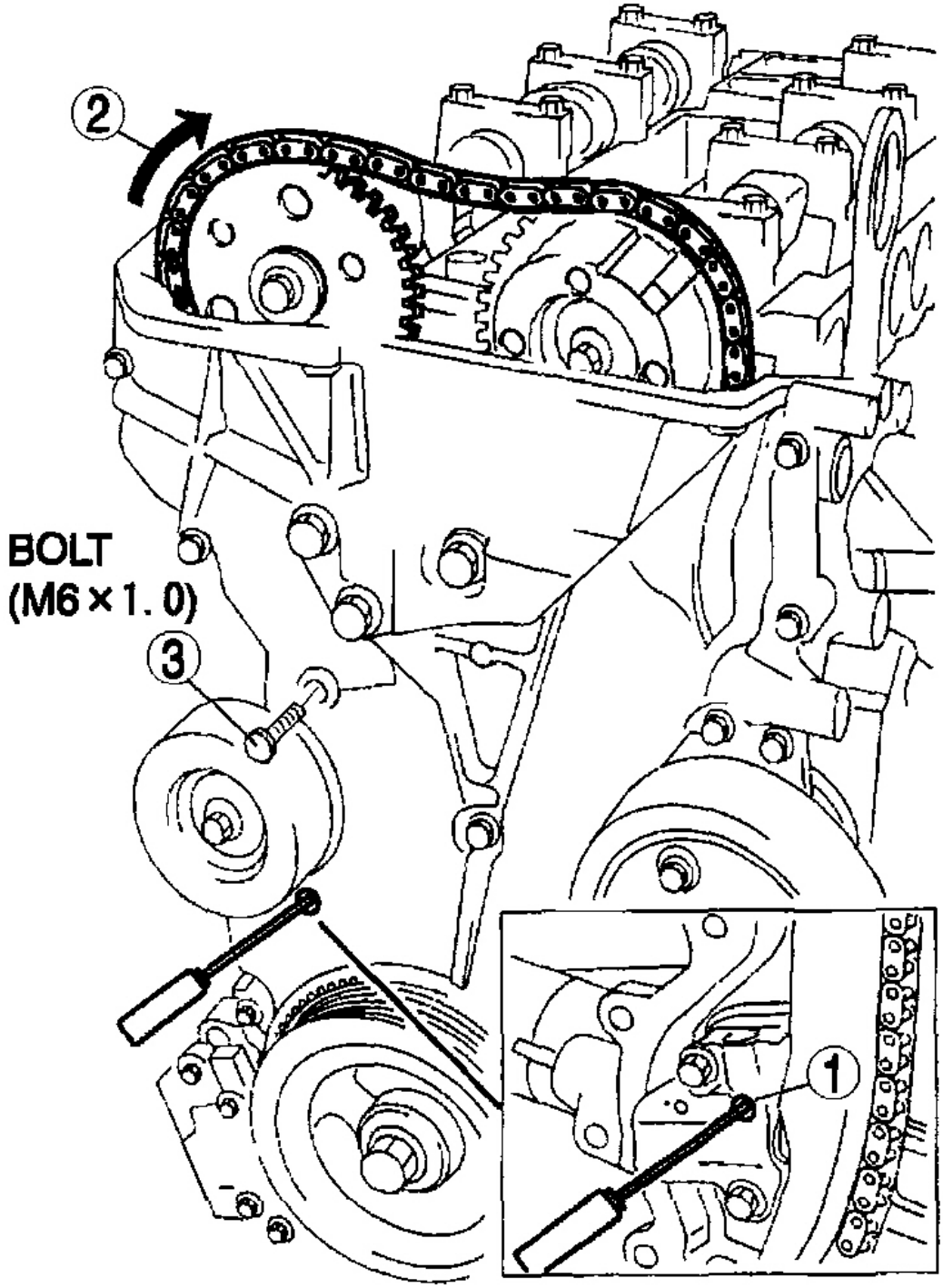


Fig. 16: Loosening Timing Chain
Courtesy of MAZDA MOTORS CORP.

18. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown in **Fig. 17**.

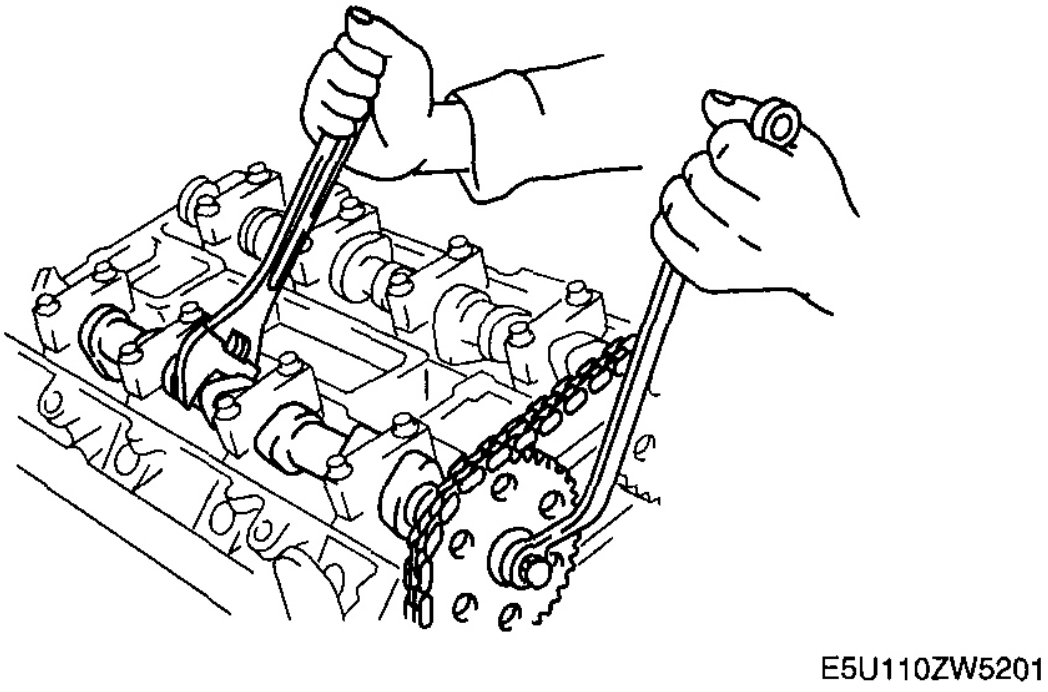


Fig. 17: Holding Exhaust Camshaft Using Wrench On Cast Hexagon
Courtesy of MAZDA MOTORS CORP.

19. Remove the exhaust camshaft sprocket.

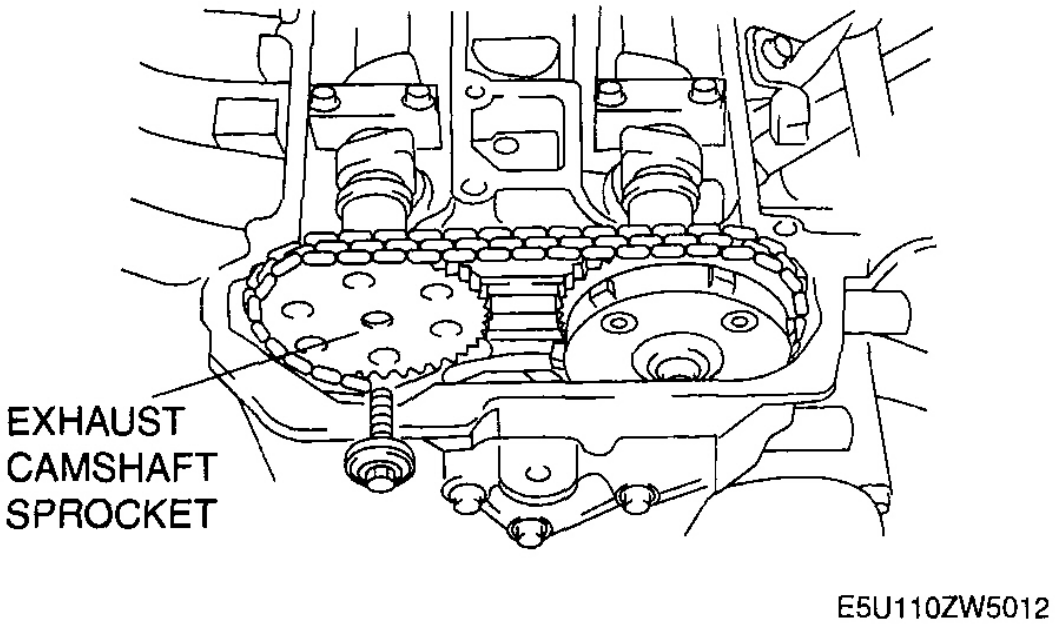


Fig. 18: Removing Exhaust Camshaft Sprocket
Courtesy of MAZDA MOTORS CORP.

20. Loosen the camshaft cap bolts in several passes in the order shown in **Fig. 19**.

NOTE:

- **The cylinder head and the camshaft caps are numbered to make sure they are reassembled in their original position. Do not mix the caps.**

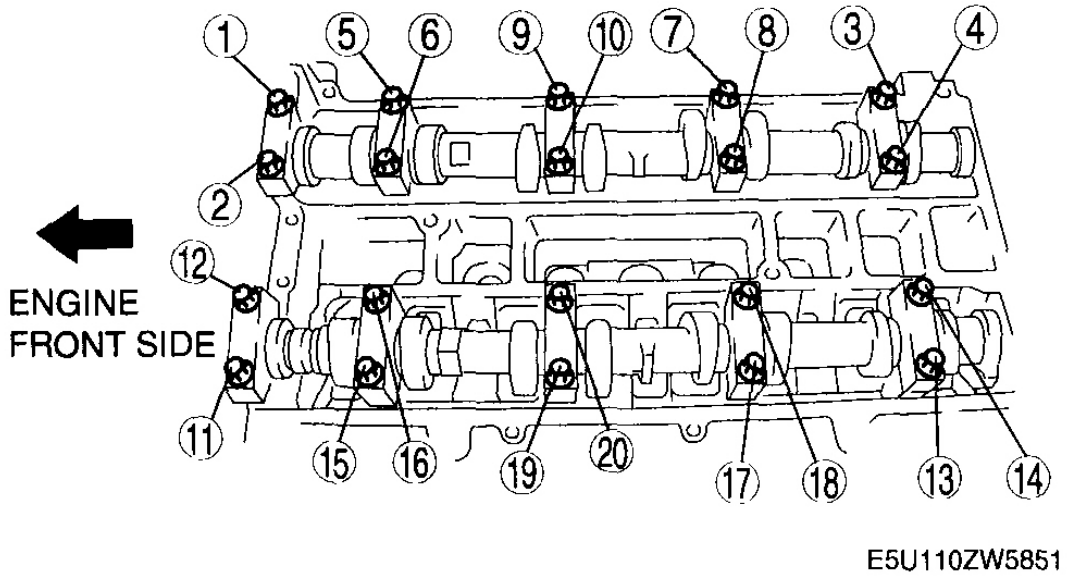


Fig. 19: Identifying Camshaft Cap Bolts Loosening Sequence
Courtesy of MAZDA MOTORS CORP.

21. Remove the camshafts.
22. Remove the tappet.
23. Select proper adjustment tappet.

    New adjustment tappet

    = Removed tappet thickness + Measured valve clearance - Standard valve clearance (IN: 0.25 mm {0.0098 in}, EX: 0.30 mm {0.0118 in})

    Valve clearance [Engine cold]

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

    EX: 0.27-0.33 mm {0.0107-0.0129 in}

24. Install the camshaft with No.1 cylinder camshaft lobes aligned with the TDC position.
25. Tighten the camshaft cap bolt with the following two steps.
    1. Tighten to **5.0-9.0 N.m {51.0-91.7 kgf.cm, 44.3-79.6 in.lbf}.**
    2. Tighten to **14.0-17.0 N.m {1.5-1.7 kgf.m, 10.4-12.5 ft.lbf}.**

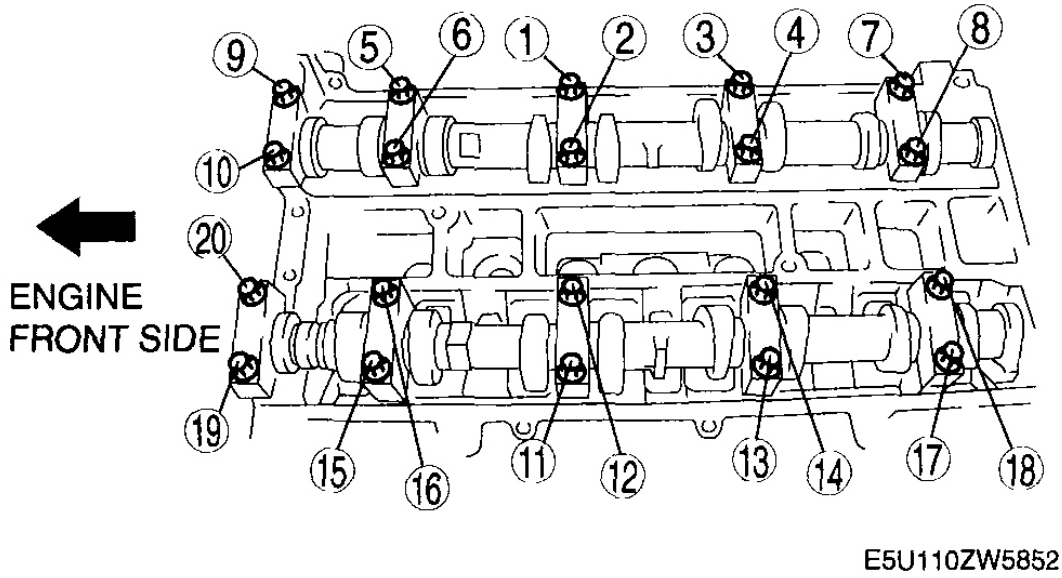


Fig. 20: Camshaft Cap Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

26. Install a new washer.

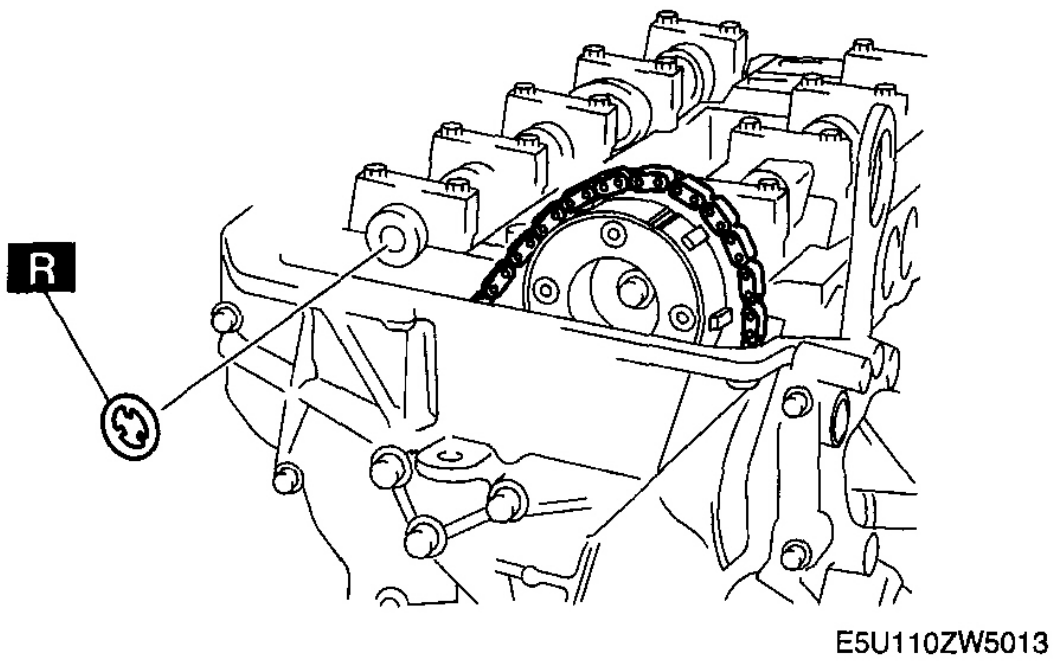


Fig. 21: Installing New Washer
Courtesy of MAZDA MOTORS CORP.

27. 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.**

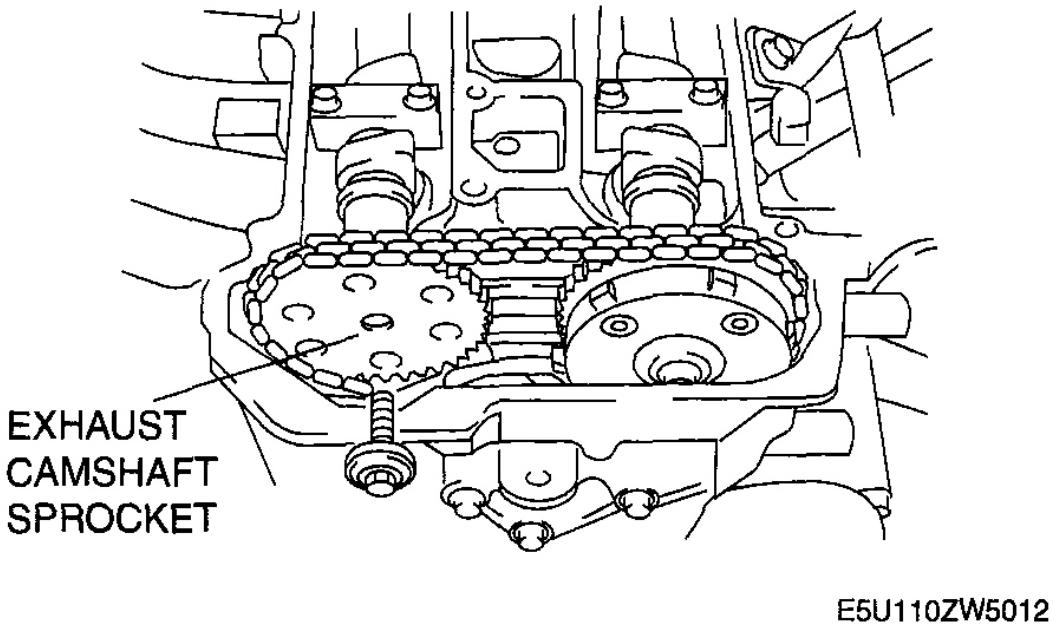


Fig. 22: Installing Exhaust Camshaft Sprocket
Courtesy of MAZDA MOTORS CORP.

28. Install the **SST** to the camshaft as shown in **Fig. 23**.

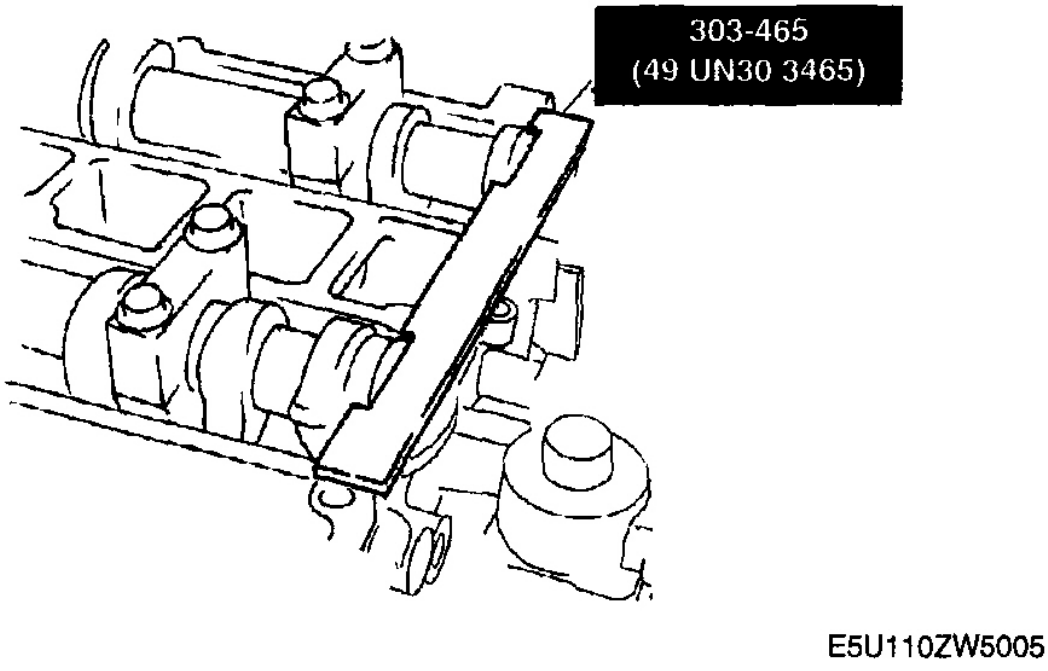


Fig. 23: Installing SST To Camshaft
Courtesy of MAZDA MOTORS CORP.

29. Remove the **M6 X 1.0 bolt (length 25 mm - 35 mm {0.99 in - 1.37 in})** from the engine front cover to apply tension to the timing chain.
30. Turn the crankshaft clockwise until the crankshaft is in the No.1 cylinder TDC position.
31. Hold the exhaust camshaft using a suitable wrench on the cast hexagon as shown in **Fig. 24**.

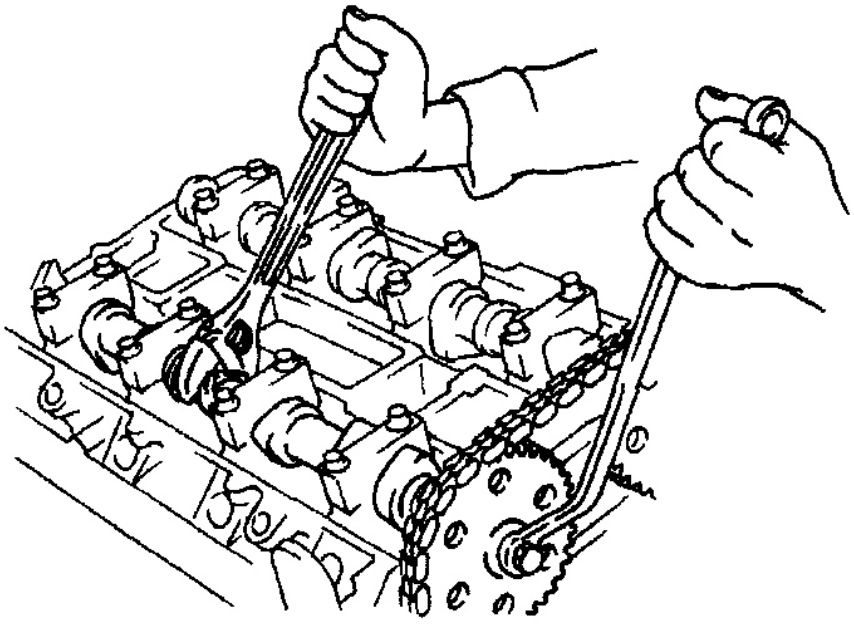


Fig. 24: Holding Exhaust Camshaft Using Wrench On Case Hexagon
Courtesy of MAZDA MOTORS CORP.

32. 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}

33. Remove the **SST** from the camshaft.
34. Remove the **SST** from the block lower blind plug.
35. Rotate the crankshaft clockwise two turns until the TDC position.
    - If not aligned, loosen the crankshaft pulley lock bolt and repeat from Step 16.
36. Apply silicone sealant to the engine front cover upper blind plug.
37. Install the engine front cover upper blind plug.

    Tightening torque

    8.0-11.5 N.m {82-117 kgf.cm, 71-101 ft.lbf}

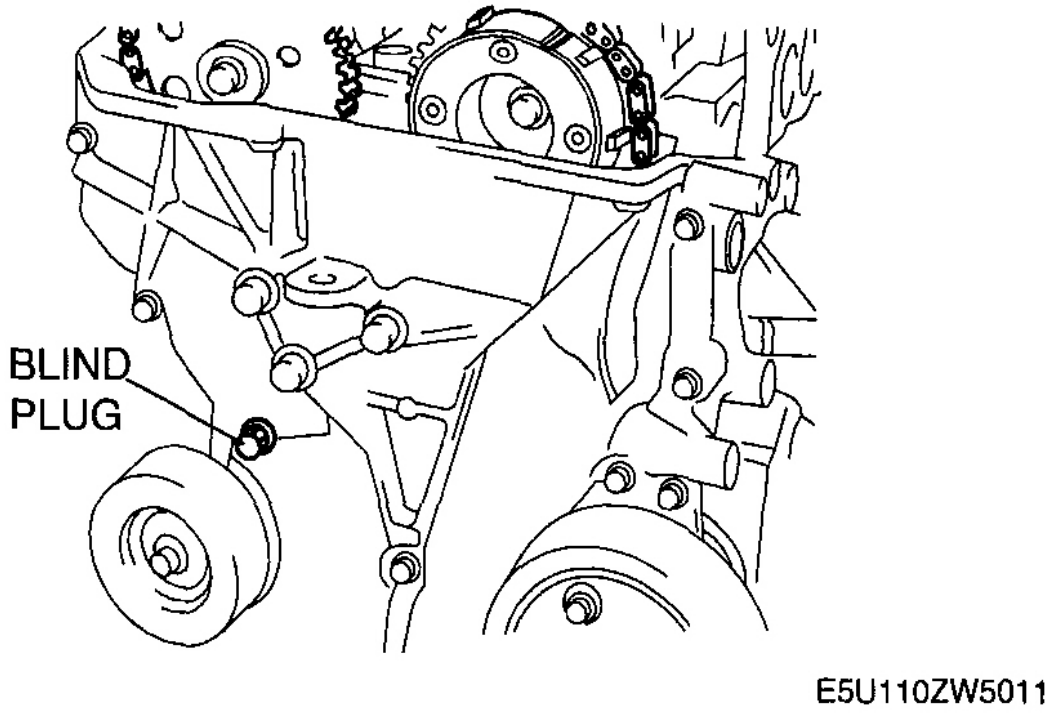


Fig. 25: Installing Engine Front Cover Upper Blind Plug
Courtesy of MAZDA MOTORS CORP.

38. 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}

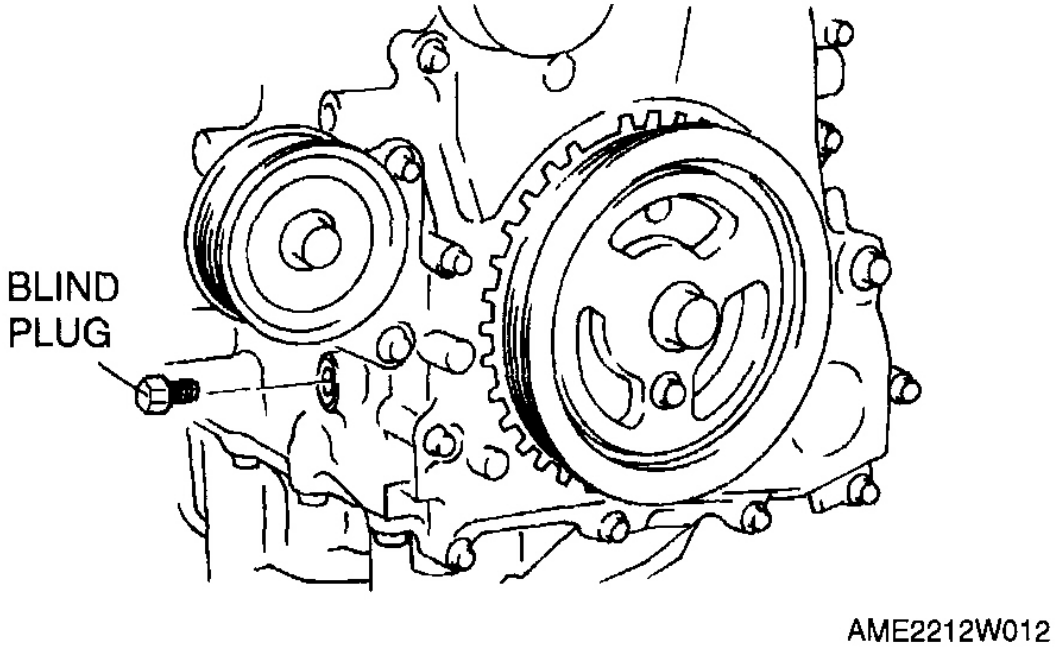


Fig. 26: Installing Cylinder Block Lower Blind Plug
Courtesy of MAZDA MOTORS CORP.

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

Tightening torque:

10-14 N.m {102-142 kgf.cm, 89-123 in.lbf}

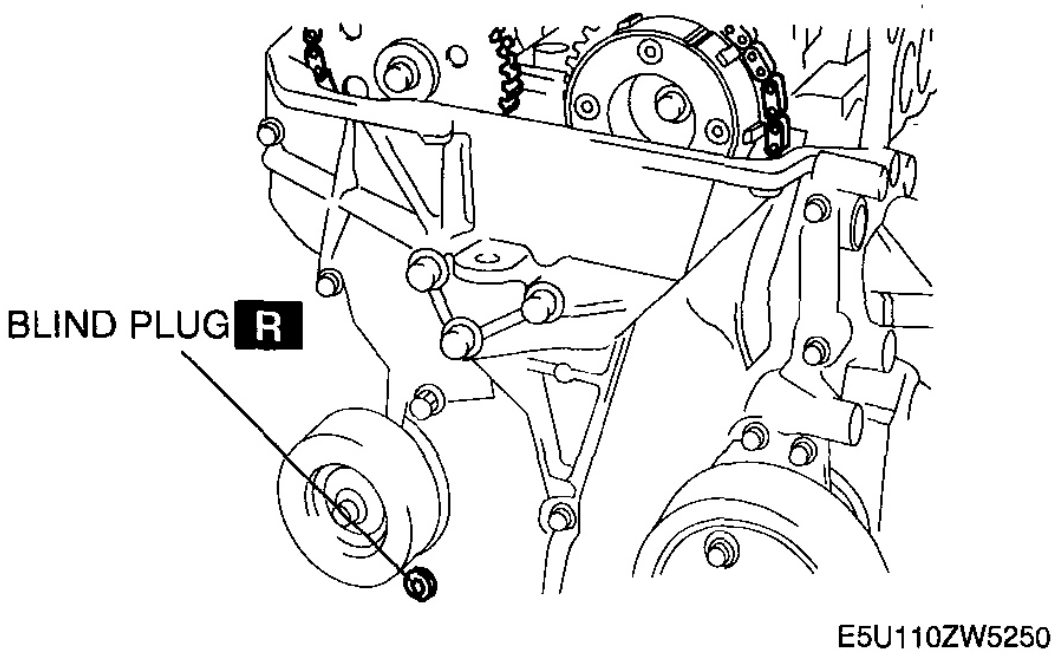


Fig. 27: Installing New Engine Front Cover Lower Blind Plug
Courtesy of MAZDA MOTORS CORP.

40. Install the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)
41. Measure the valve clearance.
    1. Turn the crankshaft clockwise so that the No.1 piston is at TDC of the compression stroke.
    2. Measure the valve clearance at A in **Fig. 28** .
        - If the valve clearance is out of the specification, adjust it. (See **VALVE CLEARANCE ADJUSTMENT [LF]** .)

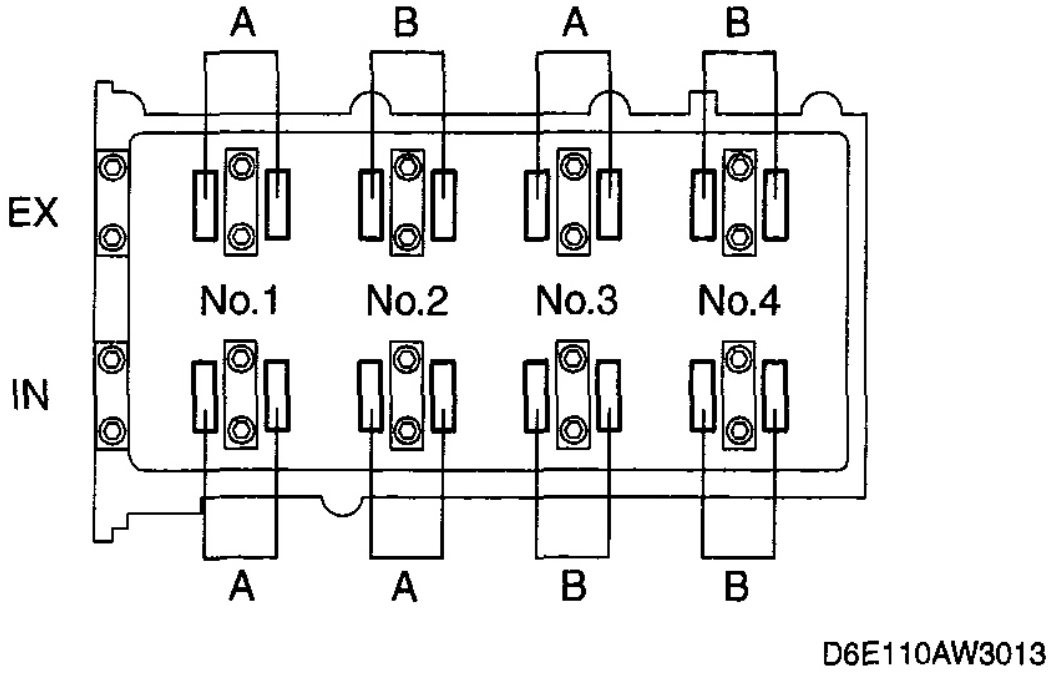


Fig. 28: Identifying Where To Measure Valve Clearance
Courtesy of MAZDA MOTORS CORP.

NOTE:

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

Valve clearance [Engine cold]

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

EX: 0.27-0.33 mm {0.0107-0.0129 in}

3. Turn the crankshaft **360°** clockwise so that the No. 4 piston is at TDC of the compression stroke.
4. Measure the valve clearance at B in **Fig. 28** .
   - If the valve clearance is out of the specification, adjust it. (See **VALVE CLEARANCE ADJUSTMENT [LF]** .)

NOTE:

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

Valve clearance [Engine cold]

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

EX: 0.27-0.33 mm {0.0107-0.0129 in}

42. Install the cylinder head cover. (See **CYLINDER HEAD COVER INSTALLATION NOTE** .)
43. Install the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
44. Connect the OCV connector.
45. Install the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
46. Install the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
47. Connect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
48. Install the air cleaner. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
49. Install the plug hole plate. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
50. Install the battery and battery tray. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)

COMPRESSION INSPECTION [LF]

WARNING:

- **Hot engines and oil can cause severe burns. Be careful not to burn yourself during removal/installation of each component.**

1. Verify that the battery is fully charged.
   - Recharge it if necessary. (See **BATTERY INSPECTION [LF]** .)
2. Warm up the engine to the normal operating temperature.
3. Stop the engine and allow it to cool down for **about 10 min.**
4. Perform "Fuel Line Safety Procedures". Leave the fuel pump relay removed. (See **BEFORE SERVICE PRECAUTION [LF]** .)

WARNING:

- **Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.**
- **Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injuries or death and damage. Fuel can also irritate skin and eyes. To prevent this, always complete the "Fuel Line Safety Procedure". (See BEFORE SERVICE PRECAUTION [LF] .)**

5. Remove the fuel pump relay.
6. Remove the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)

7. Remove the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
8. Remove the spark plugs. (See **SPARK PLUG REMOVAL/INSTALLATION [LF]** .)
9. Connect a compression gauge into the spark plug hole.
10. Fully depress the accelerator pedal and crank the engine.
11. Note the maximum gauge reading.
12. Inspect each cylinder as above.
    - If the measured value is less than the limited value, or there is a cylinder whose compression value varies from that of other cylinders by **196.1 kPa {2.0 kgf/cm^2 , 28.5 psi}** or more, add a small amount of engine oil through the spark plug hole. Then measure the compression pressure and perform the respective operations for the following cases.
      - If the compression increases, the piston, the piston rings, or cylinder wall may be worn and overhaul is required.
      - If the compression stays low, a valve may be stuck or improperly seated and overhaul is required.
      - If the compression in adjacent cylinders stays low, the cylinder head gasket may be damaged or the cylinder head distorted and overhaul is required.

    Compression

    Standard: 1,720 kPa {17.5391 kgf/cm^2 , 249.465 psi} [300 rpm]

    Minimum: 1,204 kPa {12.277 kgf/cm^2 , 174.58 psi} [300 rpm]

    Maximum difference between cylinders: 196.1 kPa {2.0 kgf/cm^2 , 28.5 psi}

13. Disconnect the compression gauge.
14. Install the spark plugs. (See **SPARK PLUG REMOVAL/INSTALLATION [LF]** .)
15. Install the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
16. Install the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
17. Install the fuel pump relay.
18. Complete the "AFTER SERVICE PRECAUTION". (See **AFTER SERVICE PRECAUTION [LF]** .)

TIMING CHAIN REMOVAL/INSTALLATION [LF]

WARNING:

- **Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.**
- **Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injures or death and damage. Fuel can also irritate skin and eyes. To prevent this, always complete the "Fuel Line Safety Procedure". (See BEFORE SERVICE PRECAUTION [LF] .)**

1. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
2. Remove the air cleaner. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
3. Disconnect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
4. Loosen the water pump pulley bolt and removal the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)
5. Remove the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
6. Remove the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
7. Disconnect the OCV connector.
8. Remove the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
9. Remove the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)
10. Remove the under cover. (See **TRANSVERSE MEMBER REMOVAL/INSTALLATION** .)
11. Remove the CKP sensor. (See **CRANKSHAFT POSITION (CKP) SENSOR REMOVAL/INSTALLATION [LF]** .)
12. Remove the P/S oil pump with the oil hose still connected and position the P/S oil pump so that it is out of the way. (See **POWER STEERING OIL PUMP REMOVAL/INSTALLATION** .)
13. Move the cooler pipe No.3 and heater pipe slightly out of the way.

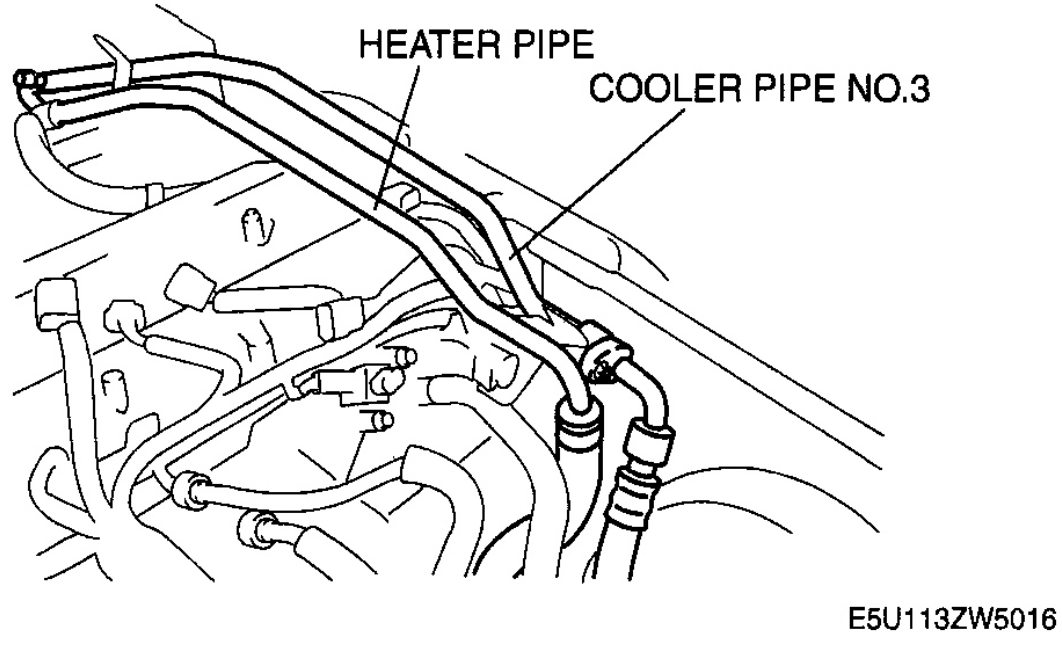
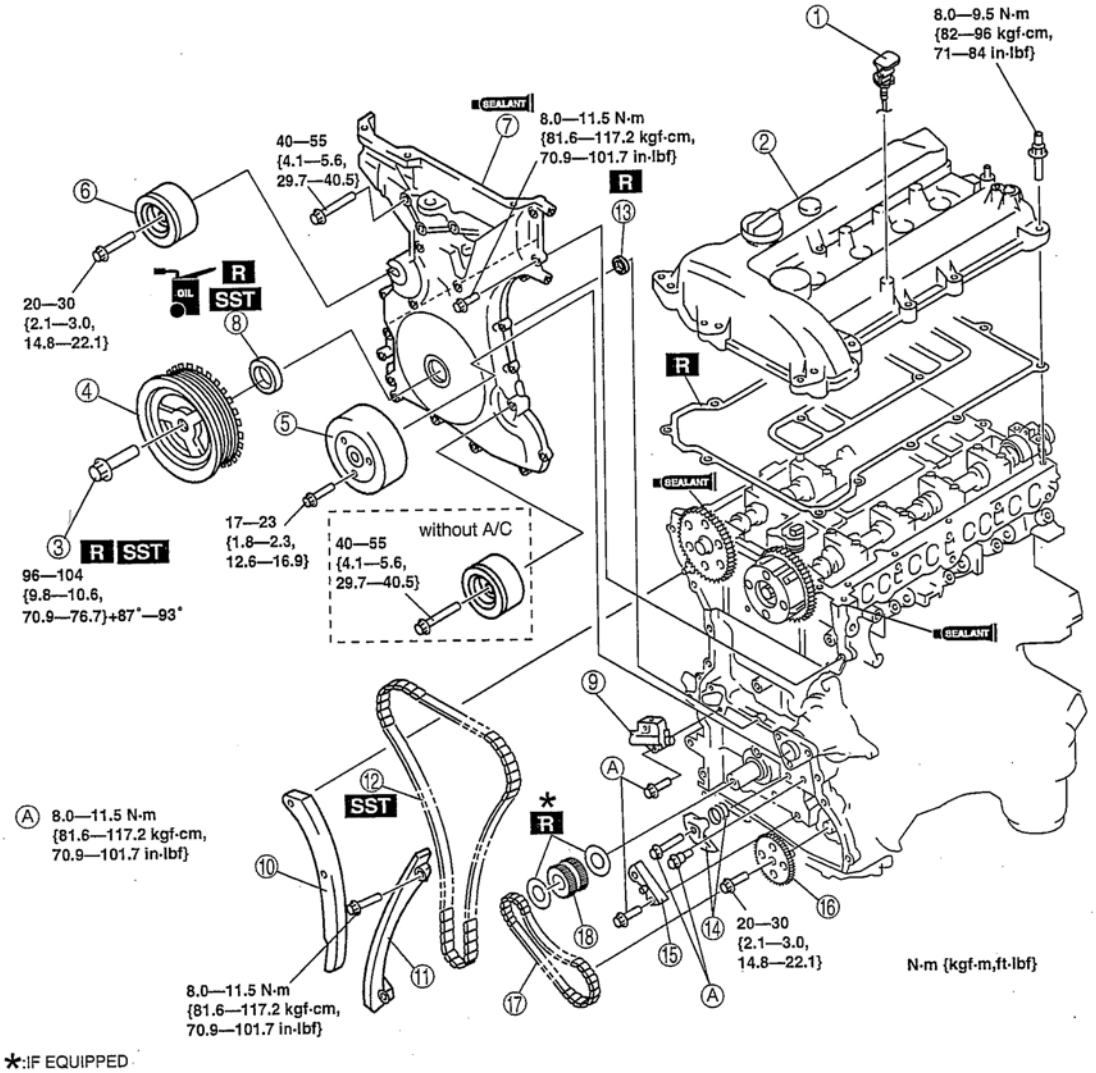


Fig. 29: Moving Cooler Pipe No. 3 & Heater Pipe

Courtesy of MAZDA MOTORS CORP.

14. Remove in the order indicated in **Fig. 30** .
15. Install in the reverse order of removal.
16. Start the engine and:
    - Verify the ignition timing, idle speed and idle mixture. (See **ENGINE TUNE-UP [LF]** .)
17. Perform a road test.



*:IF EQUIPPED

1	Dipstick
2	Cylinder head cover
3	Crankshaft pulley lock bolt
4	Crankshaft pulley
5	Water pump pulley
6	Drive belt idler pulley
7	Engine front cover
8	Front oil seal
9	Chain tensioner
10	Tensioner arm
11	Chain guide
12	Timing chain
13	Seal
14	Oil pump chain tensioner
15	Oil pump chain guide
16	Oil pump sprocket
17	Oil pump chain
18	Crankshaft sprocket

Fig. 30: Exploded View Of Timing Chain Components (With Torque Specifications)
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT PULLEY LOCK BOLT REMOVAL NOTE

1. Remove the cylinder block lower blind plug.
2. Install the **SST.**

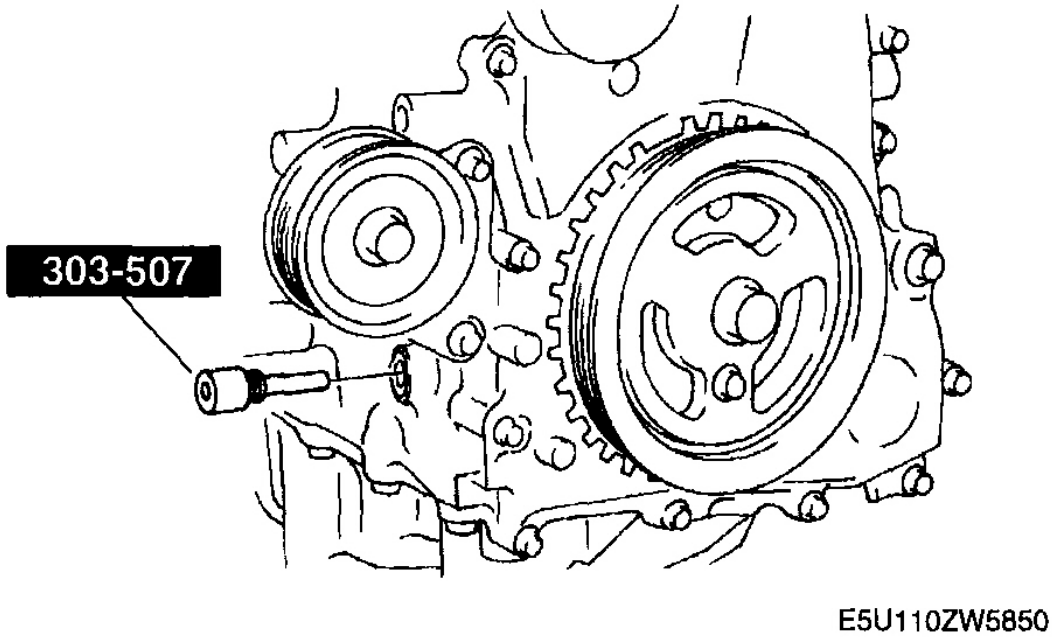


Fig. 31: Installing SST
Courtesy of MAZDA MOTORS CORP.

3. Turn the crankshaft clockwise until the crankshaft is in the No.1 cylinder TDC position (until the balance weight contacts the **SST**).
4. Hold the crankshaft pulley by using the **SSTs.**

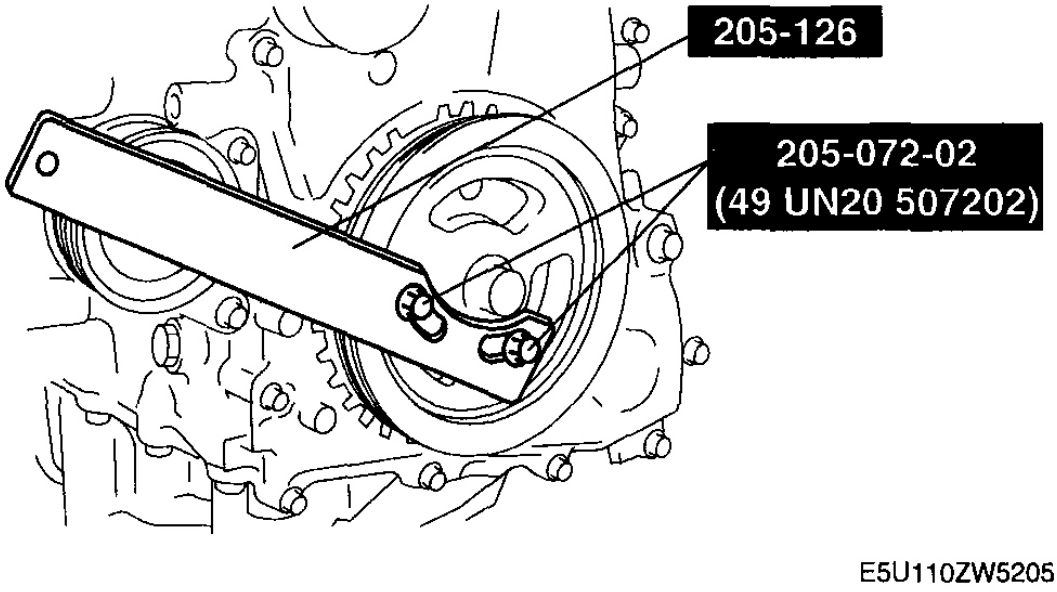


Fig. 32: Holding Crankshaft Pulley By Using SST
Courtesy of MAZDA MOTORS CORP.

5. Remove the crankshaft pulley lock bolt.

FRONT OIL SEAL REMOVAL NOTE

1. Remove the oil seal using a screwdriver as shown in **Fig. 33**.

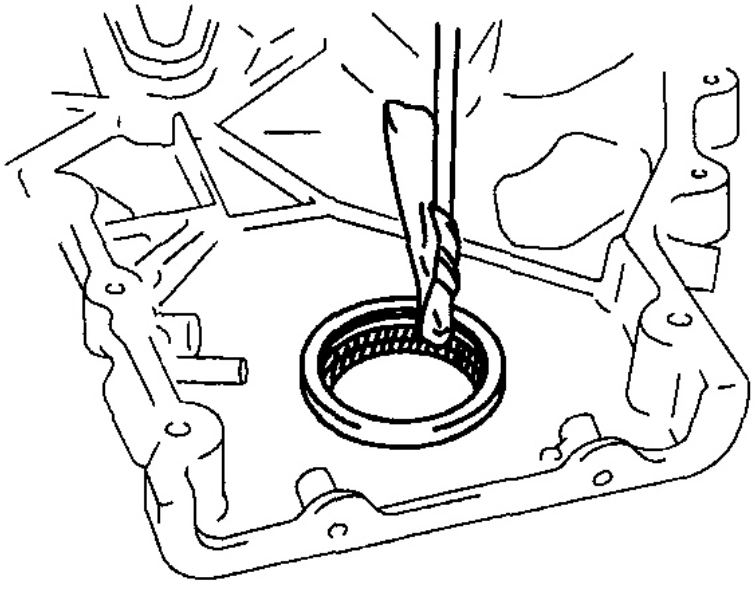


Fig. 33: Removing Oil Seal Using Screwdriver
Courtesy of MAZDA MOTORS CORP.

CHAIN TENSIONER REMOVAL NOTE

1. Using a thin screwdriver, hold the chain tensioner ratchet lock mechanism away from the ratchet stem.
2. Slowly compress the tensioner piston.
3. Hold the tensioner piston using a **1.5 mm {0.059 in}** wire or paper clip.

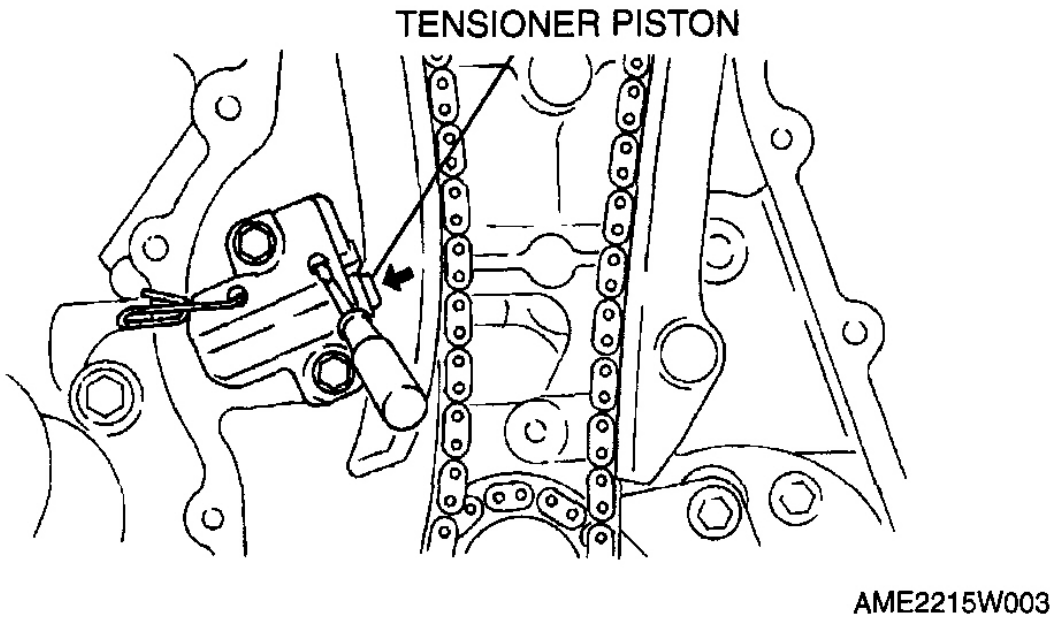


Fig. 34: Holding Chain Tensioner Ratchet Lock Mechanism And Tensioner Piston
Courtesy of MAZDA MOTORS CORP.

OIL PUMP SPROCKET REMOVAL NOTE

1. Temporarily install the crankshaft pulley and crankshaft pulley lock bolt to the crankshaft, and lock the oil pump against rotation as shown in figure.
2. Remove the oil pump sprocket, and then remove the crankshaft pulley and crankshaft pulley lock bolt.

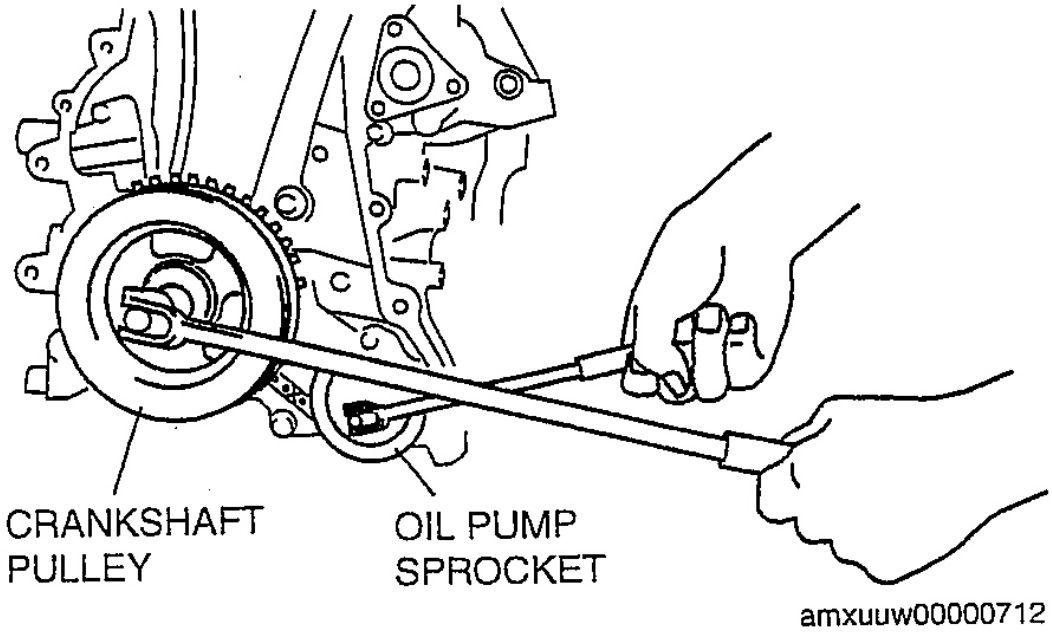


Fig. 35: Removing/Installing Oil Pump Sprocket And Crankshaft Pulley
Courtesy of MAZDA MOTORS CORP.

OIL PUMP SPROCKET INSTALLATION NOTE

1. Temporarily install the crankshaft pulley and crankshaft pulley lock bolt to the crankshaft, and lock the oil pump against rotation as shown in **Fig. 36**

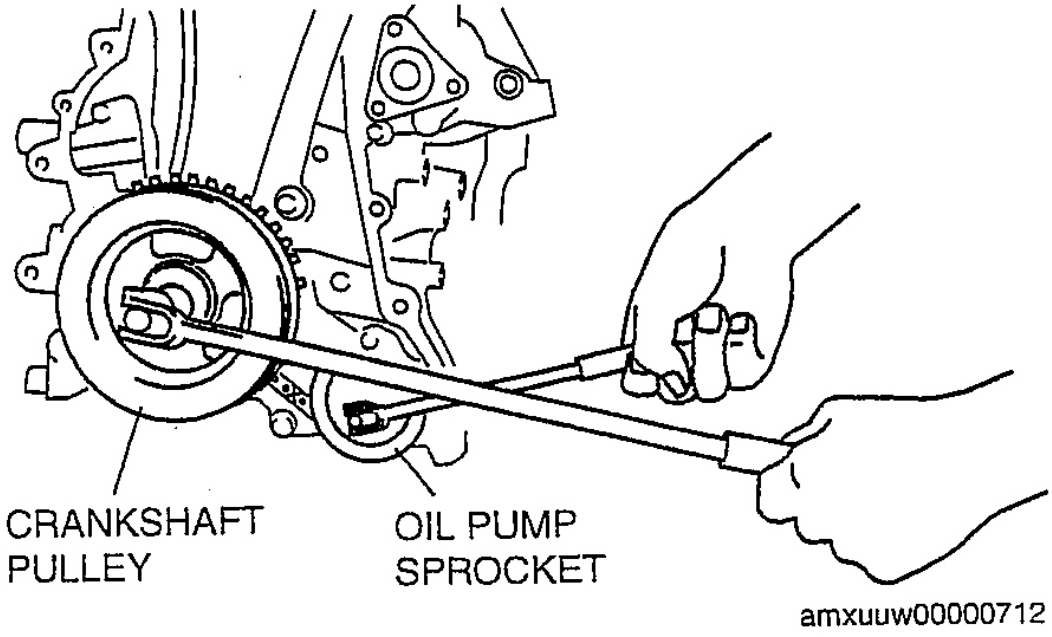


Fig. 36: Removing/Installing Oil Pump Sprocket And Crankshaft Pulley
Courtesy of MAZDA MOTORS CORP.

2. Install the oil pump sprocket, and then remove the crankshaft pulley and crankshaft pulley lock bolt.

   Tightening torque

   20-30 N.m {2.1-3.0 kgf.m, 14.8-22.1 ft.lbf}

TIMING CHAIN INSTALLATION NOTE

1. Install the **SST** to the camshaft as shown in **Fig. 37**.
2. Install the timing chain.

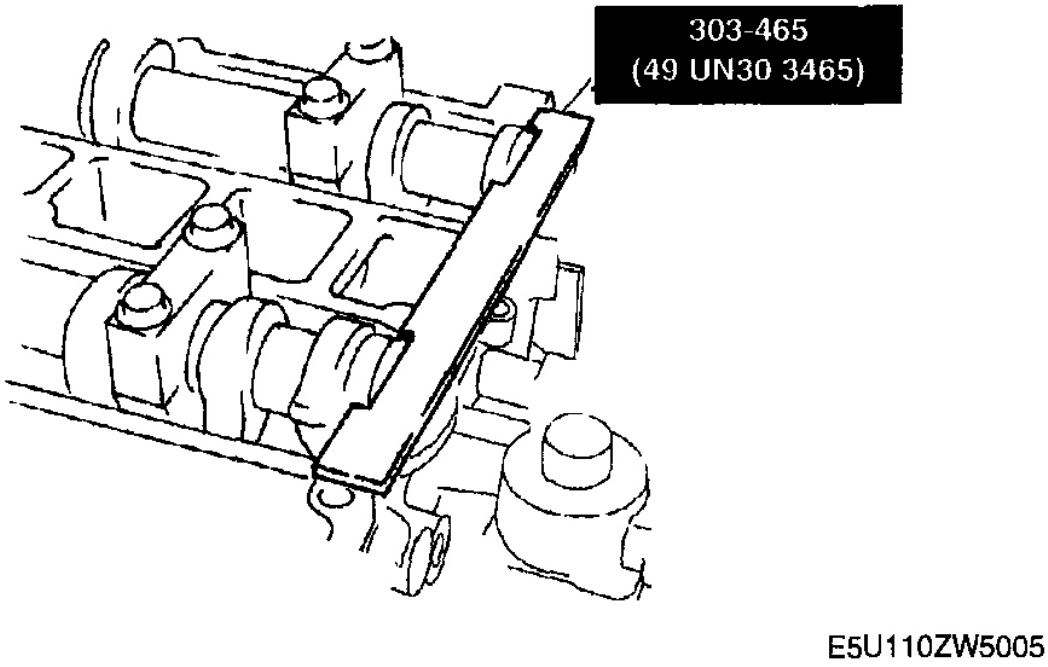


Fig. 37: Installing SST To Camshaft
Courtesy of MAZDA MOTORS CORP.

3. Remove the retaining wire or paper clip from the chain tensioner to apply tension to the timing chain.

ENGINE FRONT COVER INSTALLATION NOTE

NOTE:
- **Install the front oil seal before performing the following procedure.**

1. Apply silicone sealant to the engine front cover as shown in **Fig. 38**.

CAUTION:
- **Install the engine front cover within 10 minutes of applying the silicone sealant.**
- **Silicone sealant is not need in area C as indicated below due to an existing.**

Thickness

A: 2.0-3.0 mm {0.079-0.118 in}

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

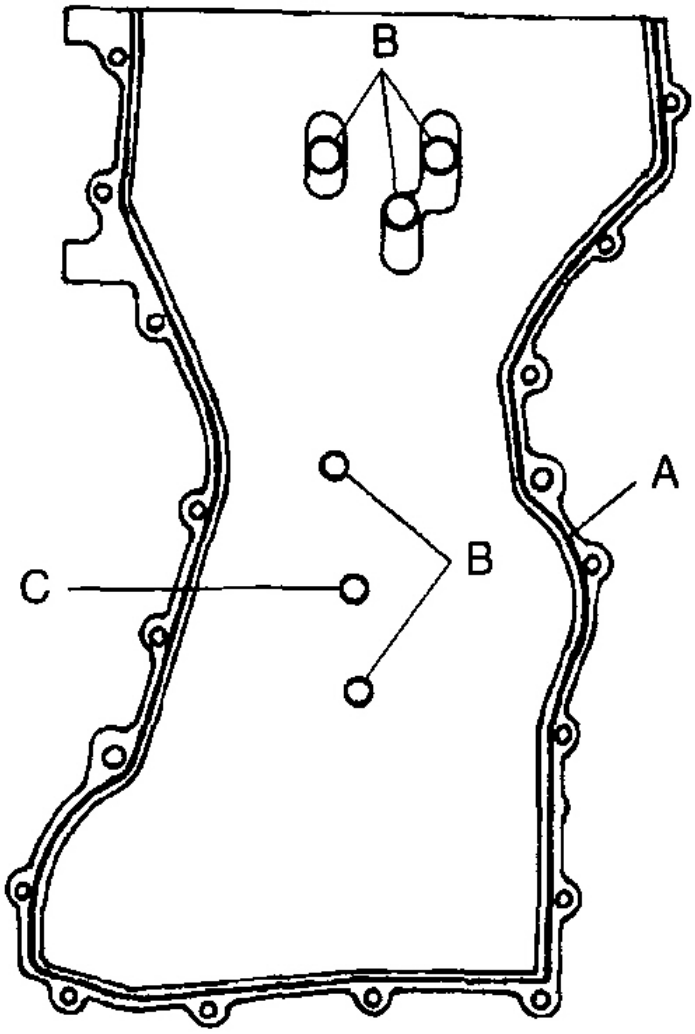


Fig. 38: Applying Silicone Sealant To Engine Front Cover
Courtesy of MAZDA MOTORS CORP.

2. Install the engine front cover bolts in the order as shown in **Fig. 39**.

ENGINE FRONT COVER BOLTS TIGHTENING TORQUE

Bolt No.	Tightening torque
1-18	**8.0-11.5 N.m {81.6-117.2 kgf.cm, 70.9-101.7 in.lbf}**
19-22	**40-55 N.m {4.1-5.6 kgf.m, 29.7-40.5 ft.lbf}**

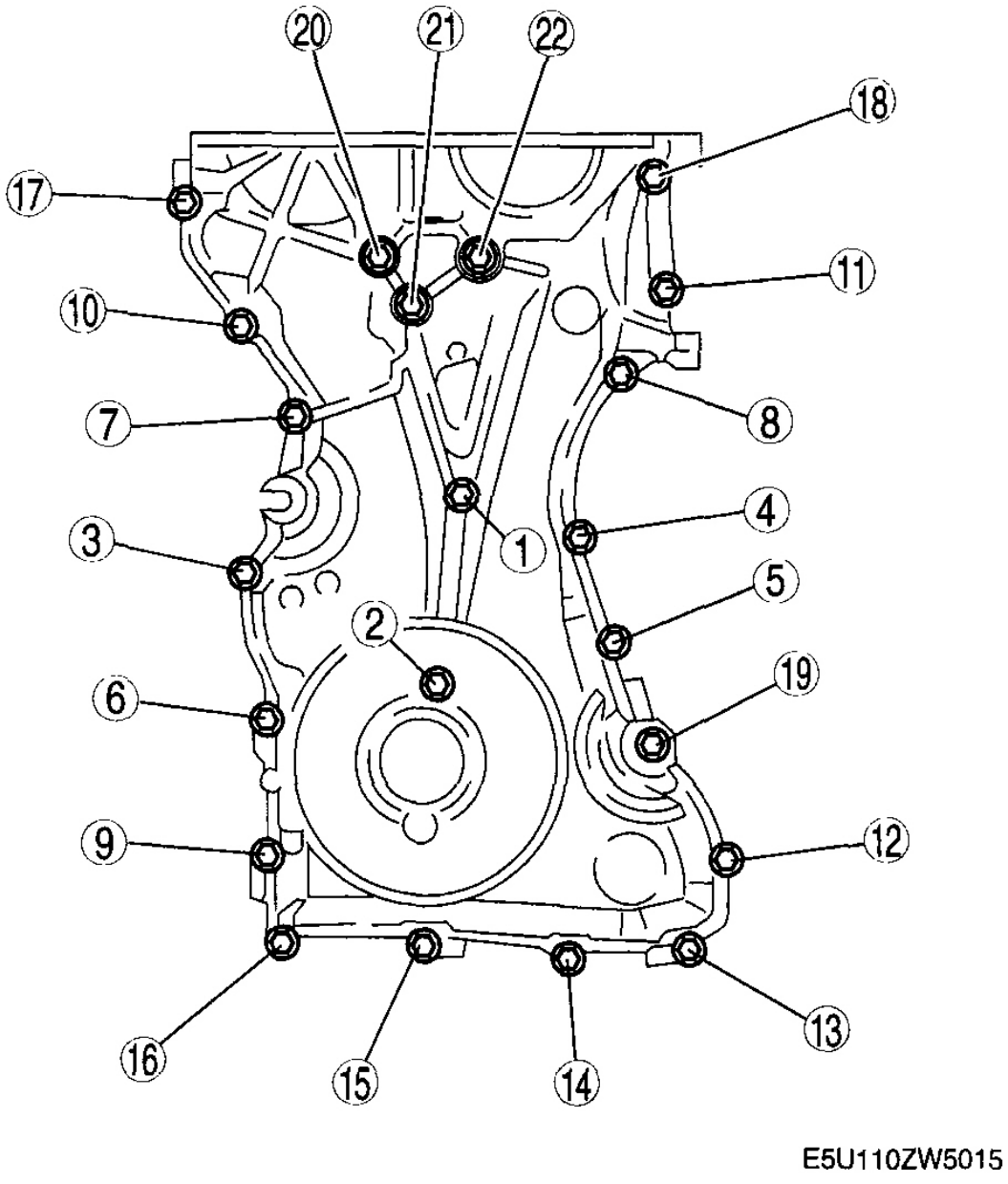


Fig. 39: Identifying Engine Front Cover Bolts Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

FRONT OIL SEAL INSTALLATION NOTE

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

Front oil seal press-in amount

0-1.0 mm {0-0.039 in}

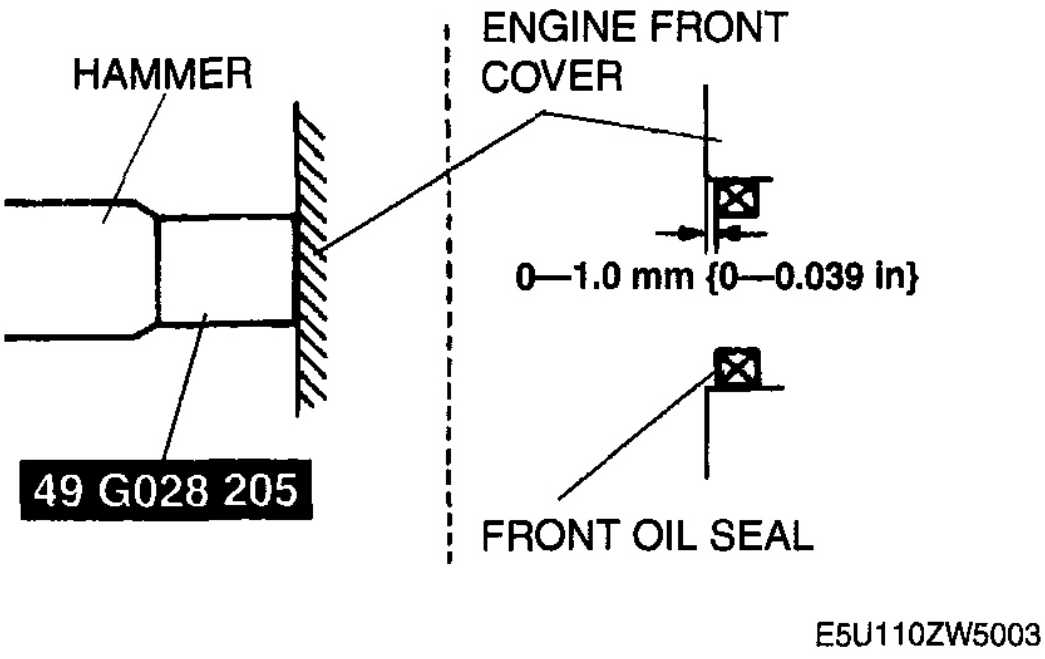


Fig. 40: Compressing Oil Seal Using SST & Hammer
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT PULLEY LOCK BOLT INSTALLATION NOTE

1. Install the **SST** to the camshaft as shown in **Fig. 41**.

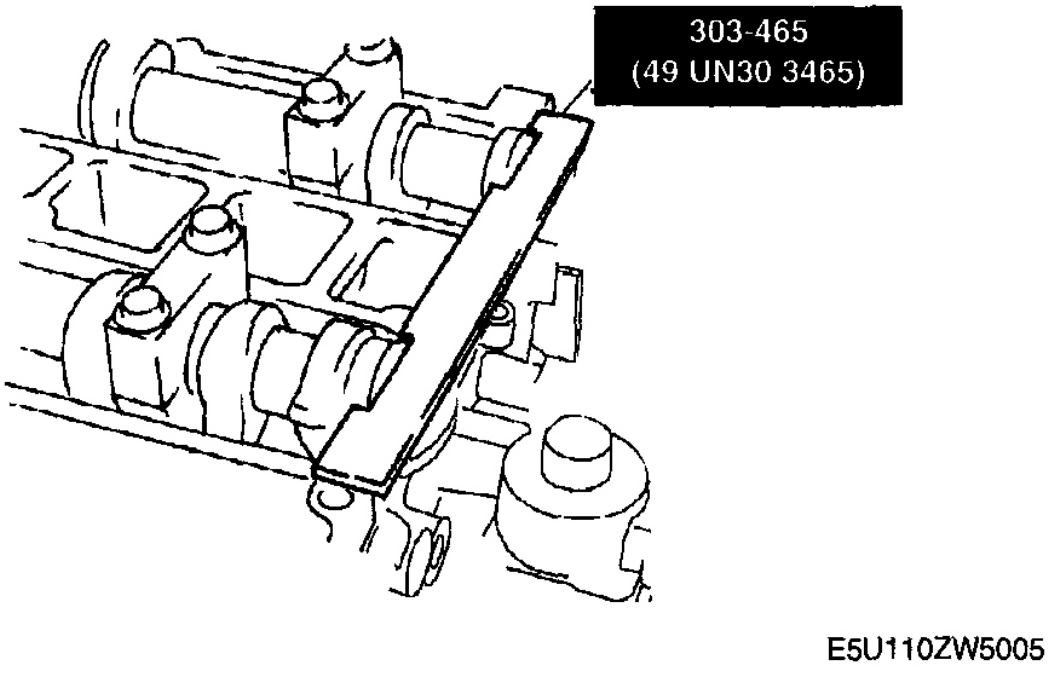


Fig. 41: Installing SST To Camshaft
Courtesy of MAZDA MOTORS CORP.

2. Verify that cylinder No.1 is at TDC of the compression stroke. (Crankshaft balance weight contacts **SST.**)
3. To position the crankshaft pulley, temporarily tighten it and, using a suitable bolt **(M6 X 1.0 length 25 mm-35 mm {0.99 in-1.37 in}),** fix the crankshaft pulley to the engine front cover.

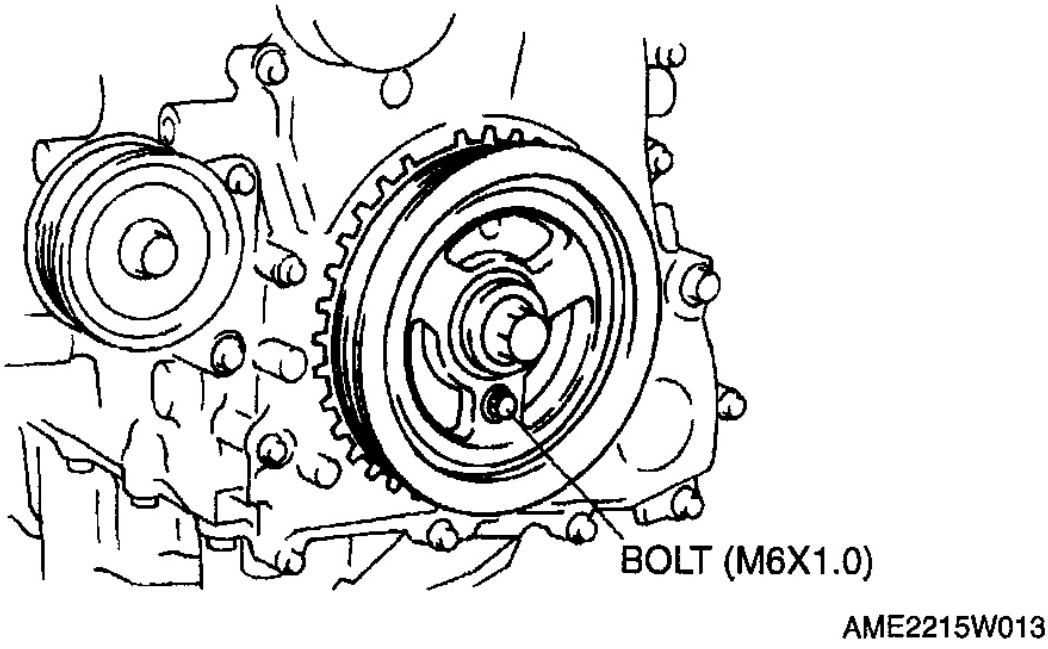


Fig. 42: Identifying Crankshaft Pulley Bolt
Courtesy of MAZDA MOTORS CORP.

4. Install the **SSTs** to the crankshaft pulley, lock the crankshaft against rotation.
5. Tighten the crankshaft pulley lock bolt using the following two steps.

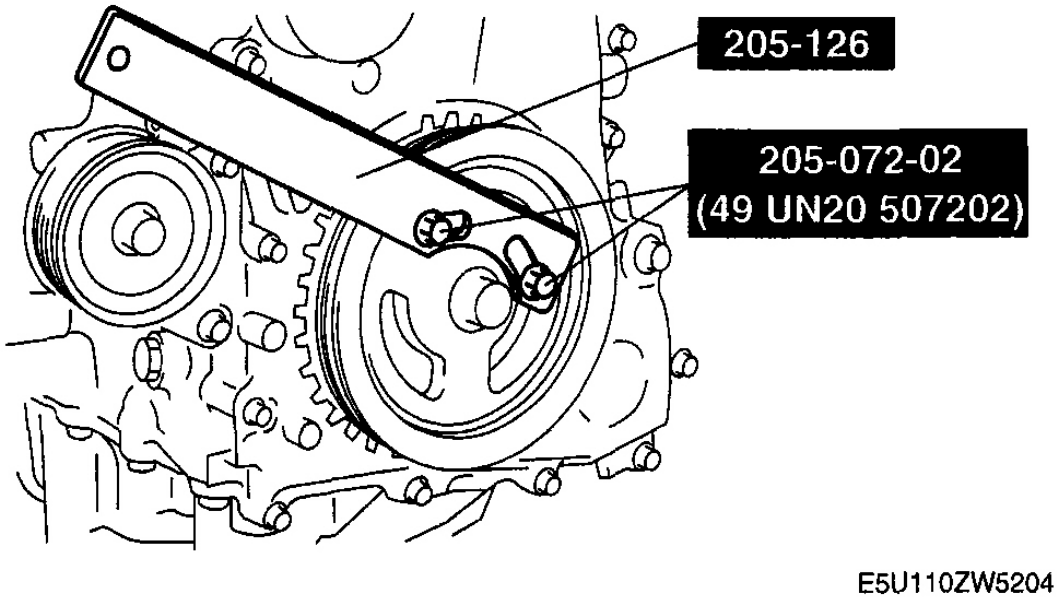


Fig. 43: Installing SSTs To Crankshaft Pulley
Courtesy of MAZDA MOTORS CORP.

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

6. Remove the **M6 x 1.0 bolt.**
7. Remove the **SST** from the camshaft.
8. Remove the **SST** from the cylinder block lower blind plug.
9. Remove the **SST** from the crankshaft pulley.
10. Rotate the crankshaft clockwise two turns until the TDC position.
    - If not aligned, loosen the crankshaft pulley lock bolt and repeat from Step 1.
11. 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}

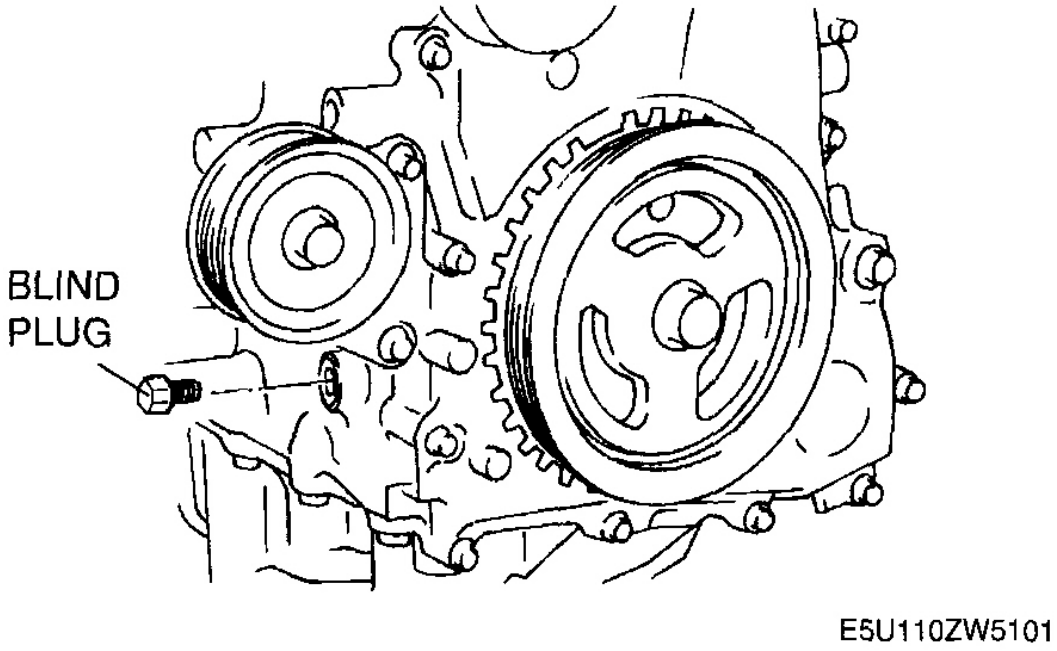


Fig. 44: Identifying Cylinder Block Lower Blind Plug
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD COVER INSTALLATION NOTE

1. Apply silicone sealant to the mating surfaces as shown in **Fig. 45**.

CAUTION:
- **Install the cylinder head cover within 10 minutes of applying the silicone sealant.**

Thickness:

4.0-6.0 mm {0.16-0.23 in}

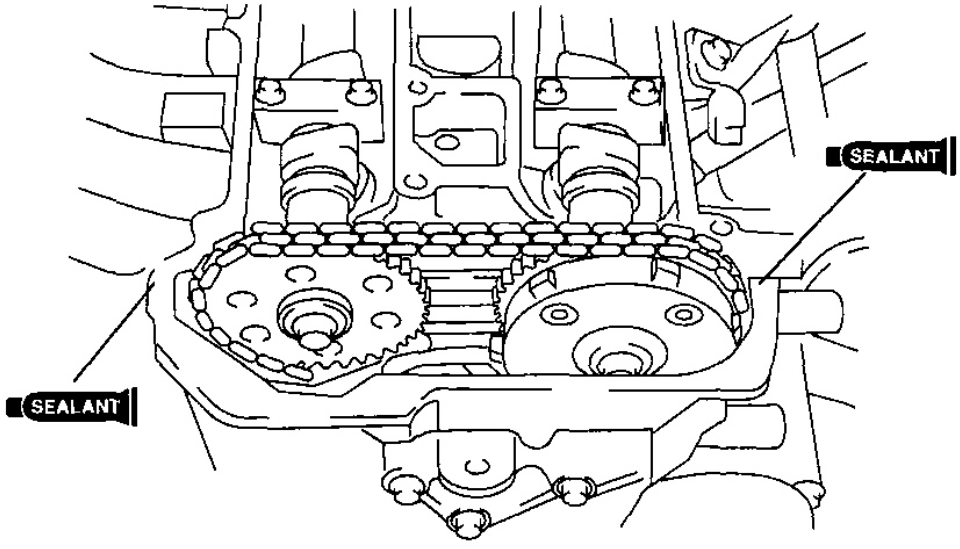


Fig. 45: Applying Silicone Sealant To Mating Surfaces
Courtesy of MAZDA MOTORS CORP.

2. Install the cylinder head cover with a new gasket.
3. Tighten the bolts in the order shown in **Fig. 46**.

Tightening torque:

8.0-10.5 N.m {81.6-107.1 kgf.cm, 70.8-92.9 in.lbf}

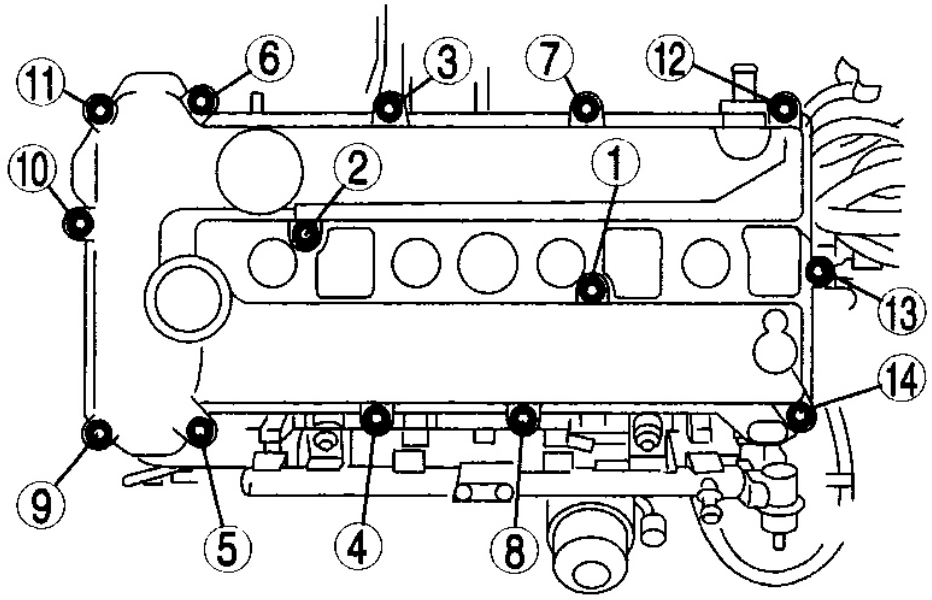


Fig. 46: Cylinder Head Cover Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

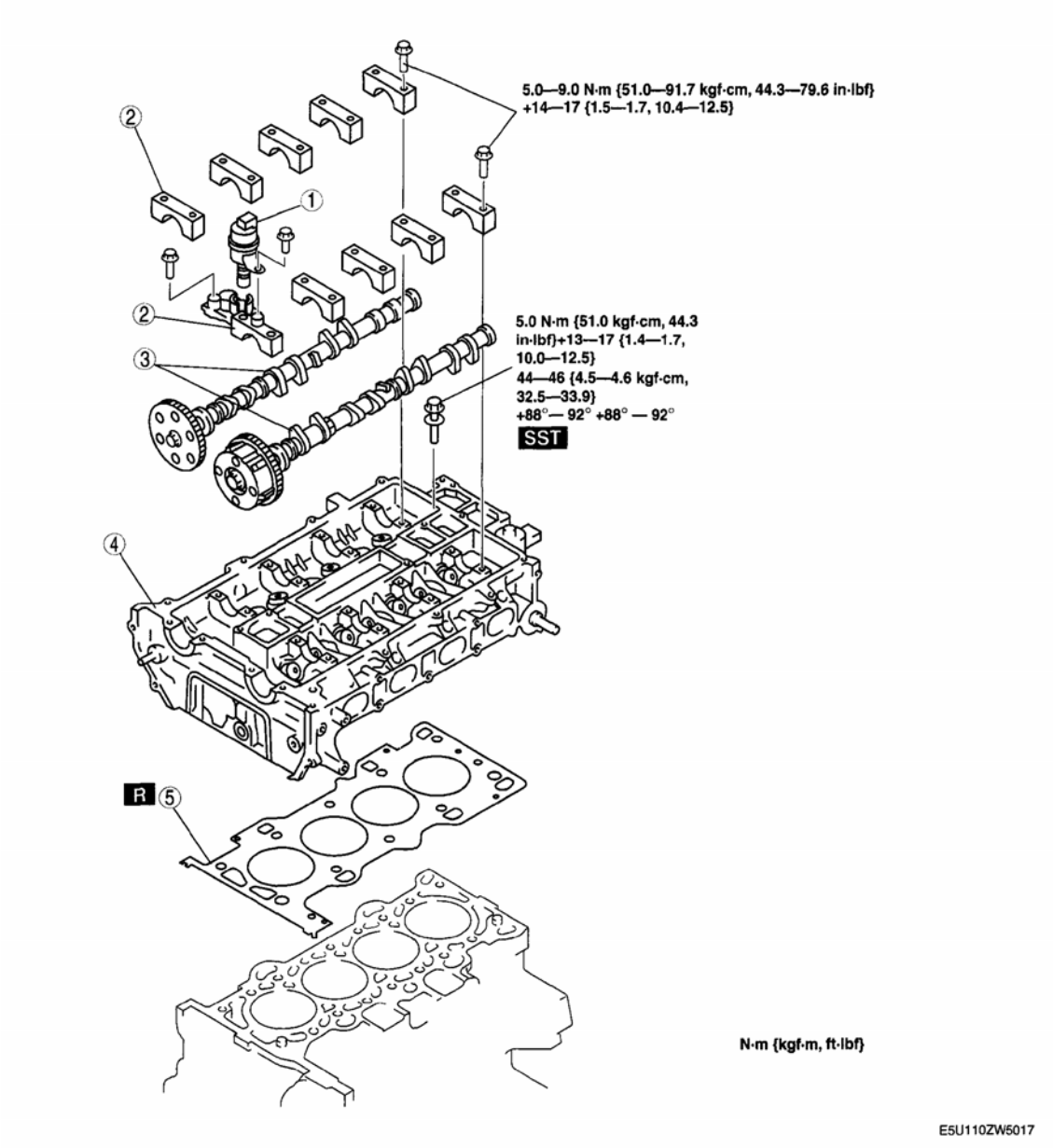
CYLINDER HEAD GASKET REPLACEMENT [LF]

WARNING:

- **Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.**
- **Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injuries or death and damage. Fuel can also irritate skin and eyes. To prevent this, always complete the "Fuel Line Safety Procedure". (See BEFORE SERVICE PRECAUTION [LF] .)**

1. Perform "Fuel Line Safety Procedures". Leave the fuel pump relay removed. (See **BEFORE SERVICE PRECAUTION [LF]** .)
2. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
3. Drain the engine coolant. (See **ENGINE COOLANT REPLACEMENT [LF]** .)
4. Remove the front suspension tower bar (joint, right side, left side). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
5. Remove the air cleaner. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)

6. Remove the dynamic chamber. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
7. Remove the ignition coil. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
8. Remove the drive belt. (See **TIMING CHAIN REMOVAL/INSTALLATION [LF]** .)
9. Remove the CKP sensor. (See **CRANKSHAFT POSITION (CKP) SENSOR REMOVAL/INSTALLATION [LF]** .)
10. Remove the P/S oil pump with the oil hose still connected and position the P/S oil pump so that it is out of the way. (See **POWER STEERING OIL PUMP REMOVAL/INSTALLATION** .)
11. Remove the timing chain. (See **TIMING CHAIN REMOVAL/INSTALLATION [LF]** .)
12. Remove the wiper arm. (See **WIPER ARM AND BLADE REMOVAL/INSTALLATION** .)
13. Remove the cowl grille. (See **COWL GRILLE REMOVAL/INSTALLATION** .)
14. Remove the side cowl grille. (See **SIDE COWL GRILLE REMOVAL/INSTALLATION** .)
15. Remove the service hole cover. (See **EGR VALVE REMOVAL/INSTALLATION [LF]** .)
16. Disconnect the generator, but do not remove it from the vehicle. Fix the generator using a rope to prevent it from falling. (See **GENERATOR REMOVAL/INSTALLATION [LF]** .)
17. Remove the exhaust manifold. (See **EXHAUST SYSTEM REMOVAL/INSTALLATION [LF]** .)
18. Remove in the order indicated in **Fig. 47** .
19. Install in the reverse order of removal.
20. Inspect the compression. (See **COMPRESSION INSPECTION [LF]** .)
21. Start the engine and:
    - Inspect for the engine coolant leakage.
    - Verify the ignition timing, idle speed and idle mixture. (See **ENGINE TUNE-UP [LF]** .)



1	OCV (With variable valve timing mechanism.)
2	Camshaft cap
3	Camshaft
4	Cylinder head
5	Cylinder head gasket

Fig. 47: Identifying Cylinder Head Components (With Torque Specifications)
Courtesy of MAZDA MOTORS CORP.

CAMSHAFT REMOVAL NOTE

NOTE:

- **The cylinder head and the camshaft caps are numbered to make sure they**

are reassembled in their original position. Do not mix the caps.

1. Loosen the camshaft cap bolts in several passes in the order shown in **Fig. 48**.

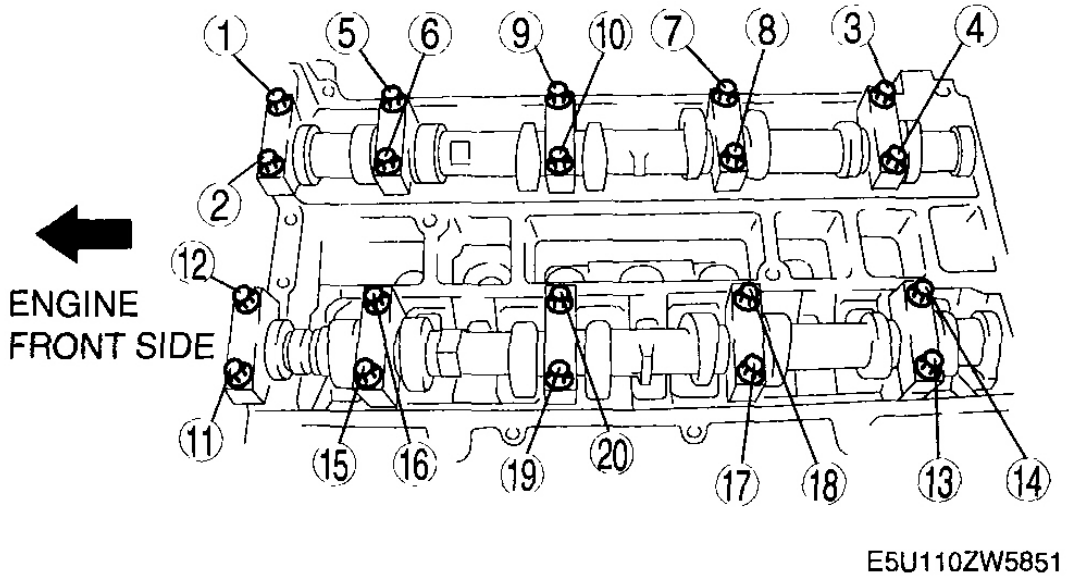


Fig. 48: Loosening Sequence Of Camshaft Cap Bolts
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD REMOVAL NOTE

1. Loosen the cylinder head bolts in two or three steps in the order shown in **Fig. 49**.

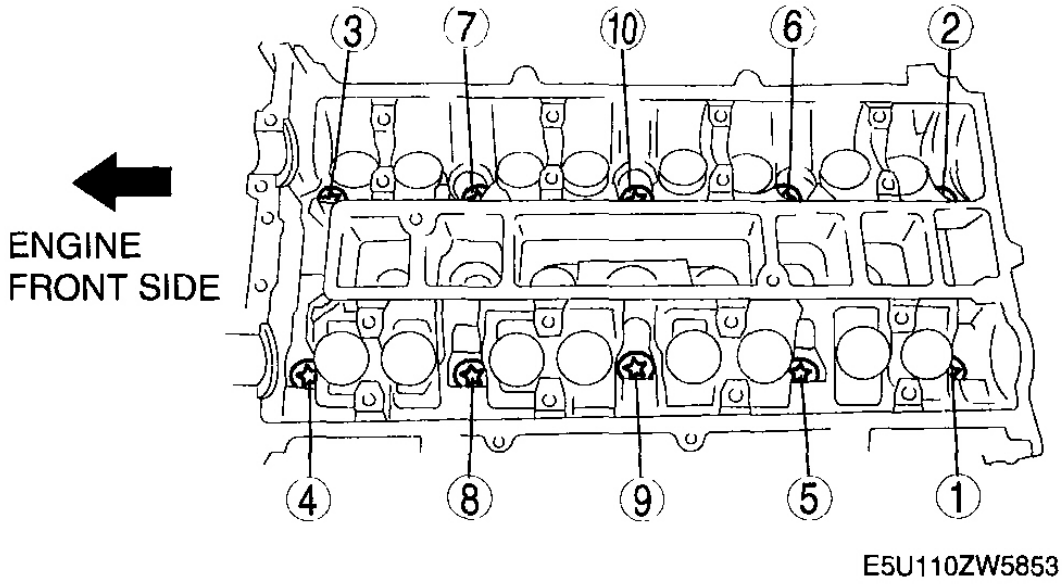


Fig. 49: Loosening Sequence Of Cylinder Head Bolts
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD INSTALLATION NOTE

1. Measure the length of each cylinder head bolt.
   - Replace any that exceed the maximum length.

   Cylinder Head Bolt Length L

   145.2-145.8 mm {5.72-5.74 in}

   Cylinder Head Bolt Maximum

   146.5 mm {5.77 in}

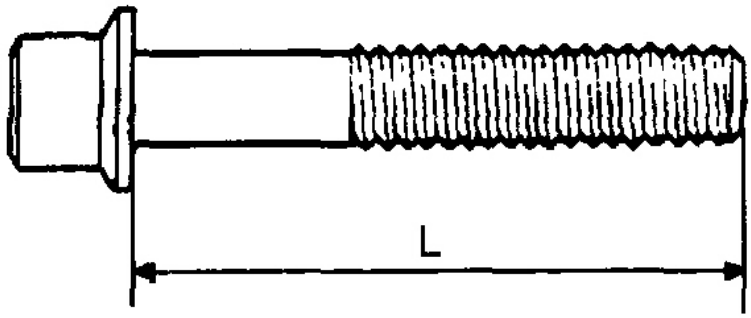


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Fig. 50: Measuring Length Of Cylinder Head Bolt
Courtesy of MAZDA MOTORS CORP.

2. Tighten the cylinder head bolts in the order shown in **Fig. 51** with the following 5 steps using the **SST (49 D032 316).**
    1. Tighten to **5.0 N.m {51.0 kgf.cm, 44.3 in.lbf}**
    2. Tighten **13-17 N.m {1.4-1.7 kgf.m, 10.0-12.5 ft.lbf}**
    3. Tighten **44-46 N.m {4.5-4.6 kgf.m, 32.5-33.9 ft.lbf)**
    4. Tighten **88+/-92°**
    5. Tighten **88+/-92°**

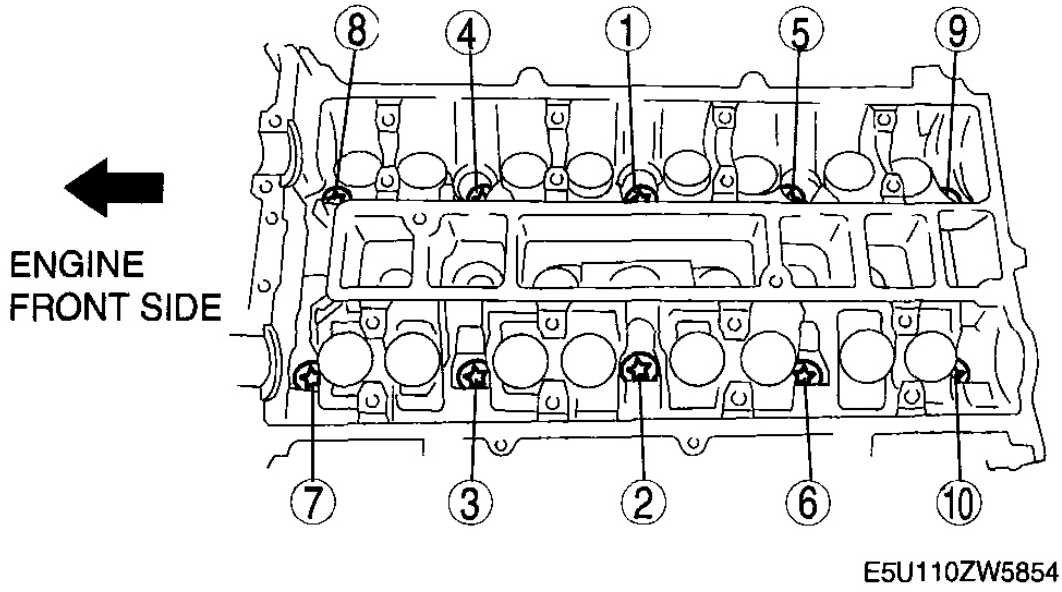


Fig. 51: Cylinder Head Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

CAMSHAFT INSTALLATION 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 two or three steps.
3. Tighten the camshaft cap bolts in the order shown in **Fig. 52** with the following two steps.
    1. Tighten to **5.0-9.0 N.m {51.0-91.7 kgf.cm, 44.3-79.6 in.lbf}**
    2. Tighten to **14.0-17.0 N.m {1.5-1.7 kgf.m, 10.4-12.5 ft.lbf}**

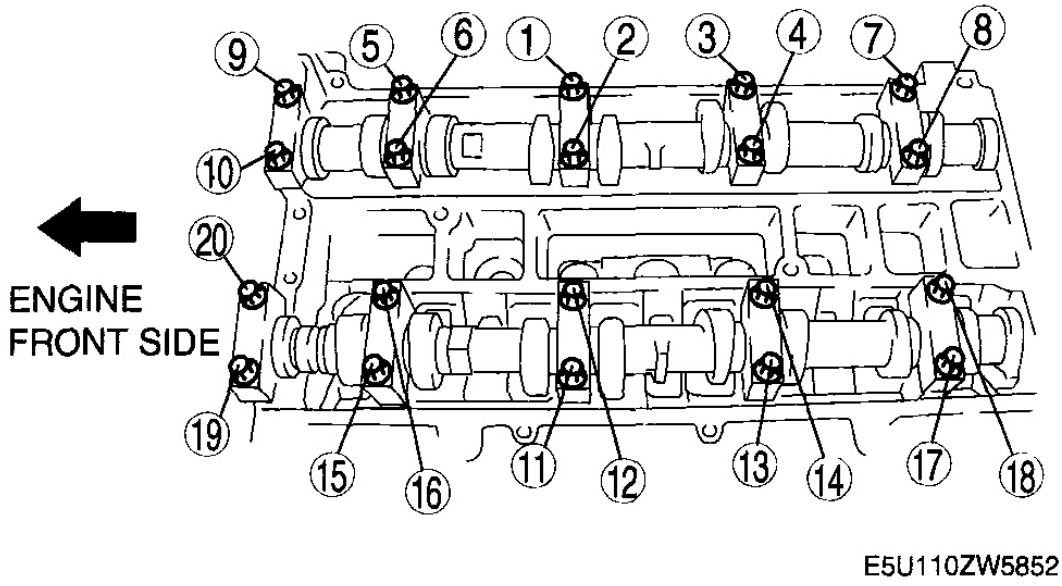
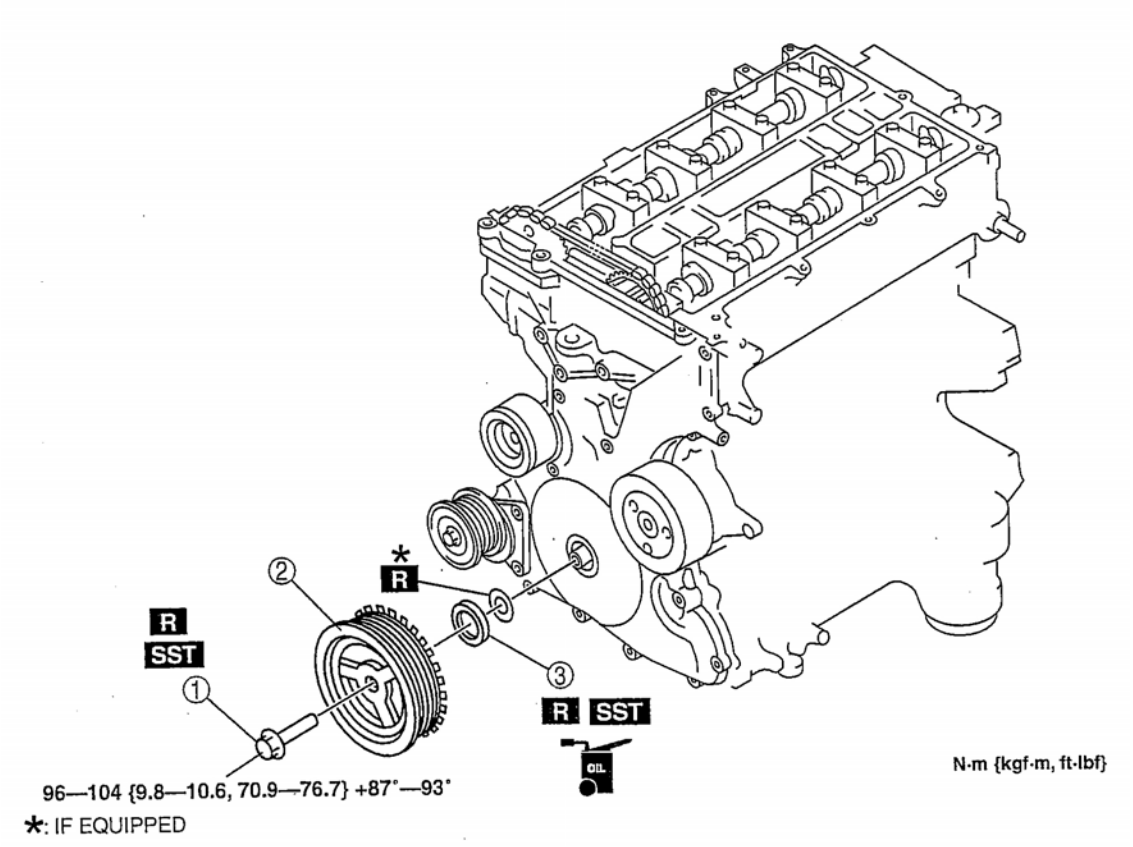


Fig. 52: Tightening Sequence Of Camshaft Cap Bolts
Courtesy of MAZDA MOTORS CORP.

FRONT OIL SEAL REPLACEMENT [LF]

1. Remove the battery and battery tray. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
2. Remove the air cleaner. (See **AIR CLEANER ELEMENT INSPECTION [LF]** .)
3. Remove the drive belt. (See **DRIVE BELT INSPECTION [LF]** .)
4. Remove the under cover. (See **TRANSVERSE MEMBER REMOVAL/INSTALLATION** .)
5. Remove the front suspension tower bar. (joint)
6. Remove the ignition coil. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
7. Remove the OCV connector.
8. Remove the cylinder head cover. (See **TIMING CHAIN REMOVAL/INSTALLATION [LF]** .)
9. Remove the CKP sensor. (See **CRANKSHAFT POSITION (CKP) SENSOR REMOVAL/INSTALLATION [LF]** .)
10. Remove in the order indicated in **Fig. 53** .
11. Install in the reverse order of removal.



1	Crankshaft pulley lock bolt
2	Crankshaft pulley
3	Front oil seal

Fig. 53: Identifying Front Oil Seal Components (With Torque Specifications)
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT PULLEY LOCK BOLT REMOVAL NOTE

1. Remove the cylinder block lower blind plug.
2. Install the **SST.**

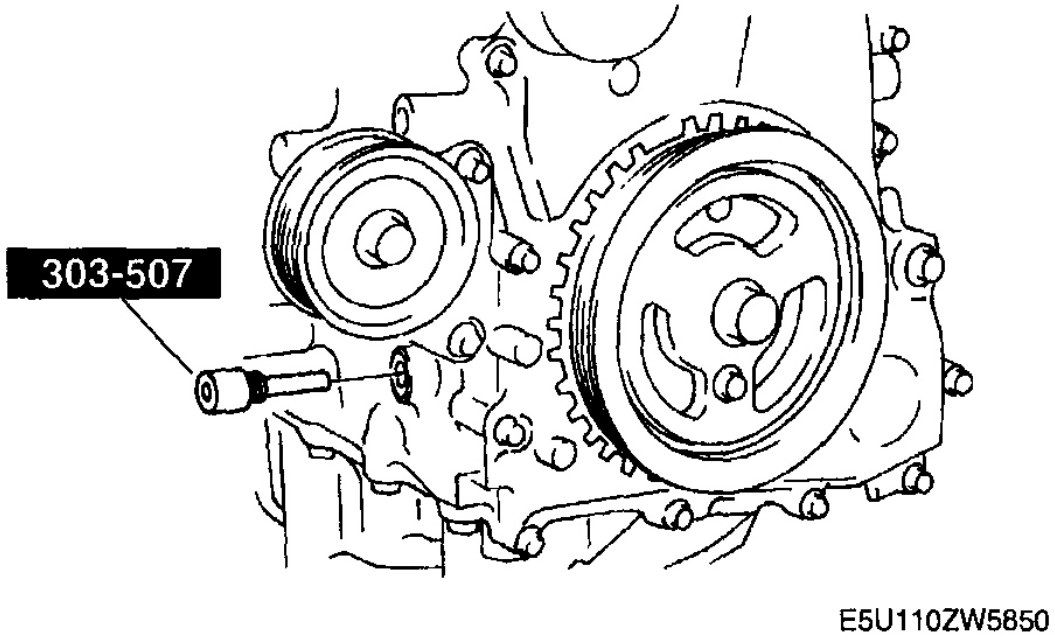


Fig. 54: Installing SST
Courtesy of MAZDA MOTORS CORP.

3. Turn the crankshaft clockwise until the crankshaft is in the No.1 cylinder TDC position (until the balance weight contacts the **SST**).
4. Hold the crankshaft pulley using the **SSTs.**

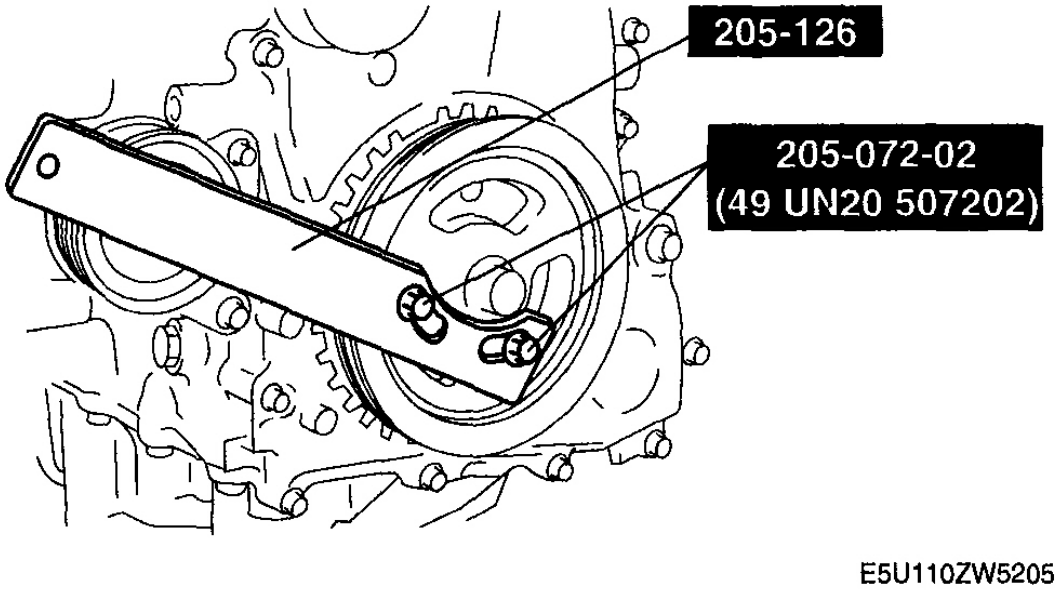


Fig. 55: Holding Crankshaft Pulley Using SST
Courtesy of MAZDA MOTORS CORP.

5. Remove the crankshaft pulley lock bolt.

FRONT OIL SEAL REMOVAL NOTE

1. Cut the oil seal lip using a razor knife.
2. Remove the oil seal using a screwdriver wrapped with a rag.

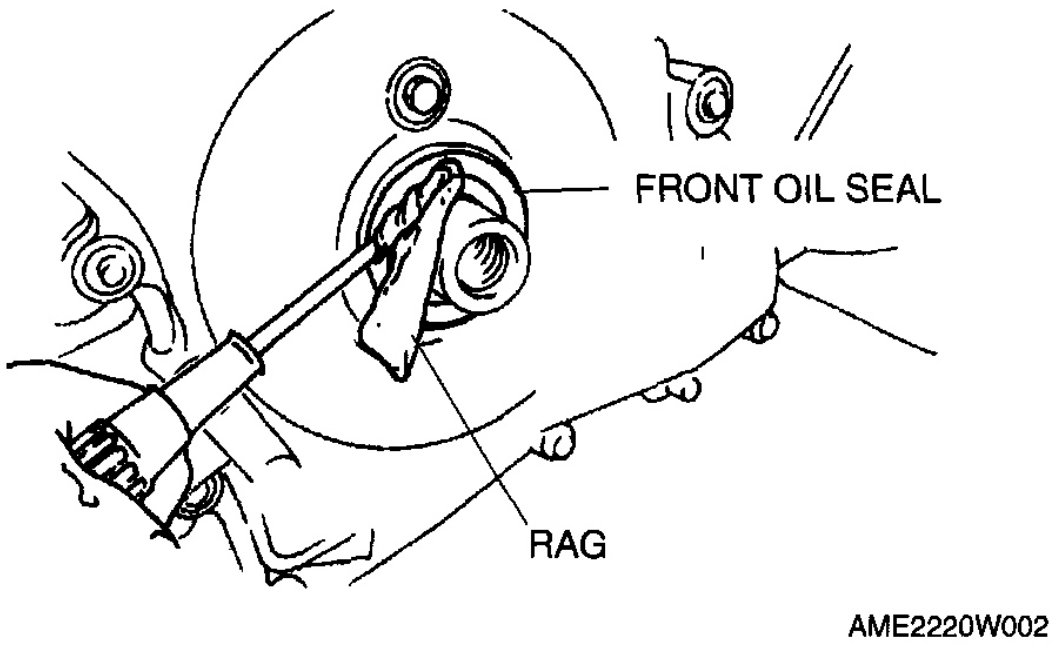


Fig. 56: Removing Front Oil Seal Using Screwdriver Wrapped With Rag
Courtesy of MAZDA MOTORS CORP.

FRONT OIL SEAL INSTALLATION NOTE

1. Apply clean engine oil to a new oil seal.
2. Push the front oil seal in the engine front cover by hand.
3. Tap the oil seal in evenly using the **SST** and a hammer.

Front oil seal press-in amount

0-1.0 mm {0-0.039 in}

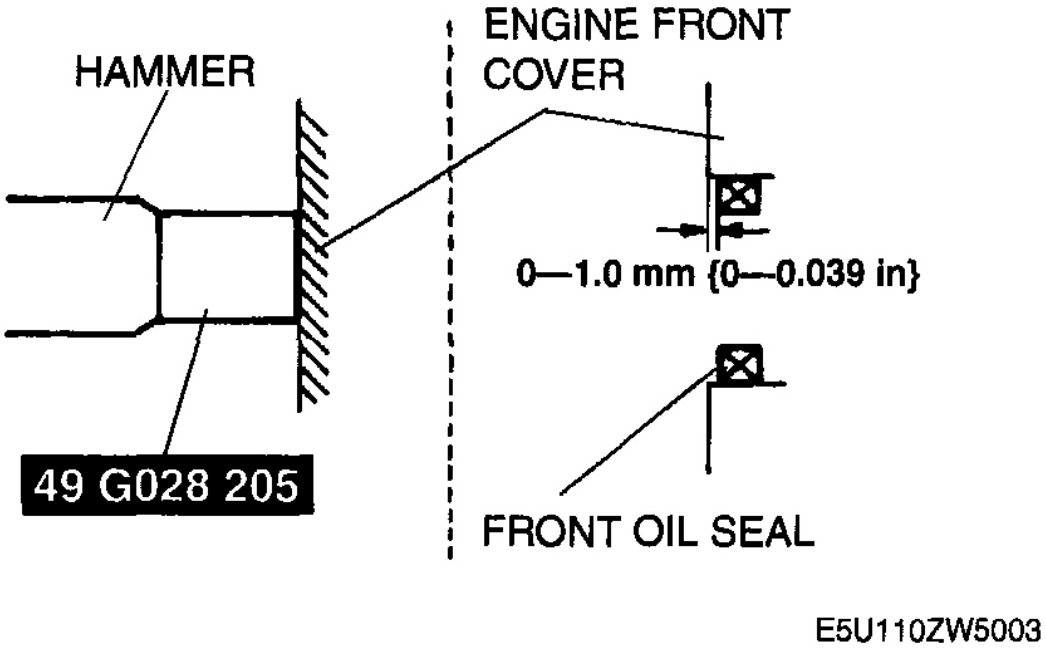


Fig. 57: Tapping Front Oil Seal In Evenly Using SST & Hammer
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT PULLEY LOCK BOLT INSTALLATION NOTE

1. Install the **SST** on the camshaft as shown in **Fig. 58**.
2. Verify that cylinder No.1 is at TDC of the compression stroke. (Crankshaft balance weight contacts **SST.**)

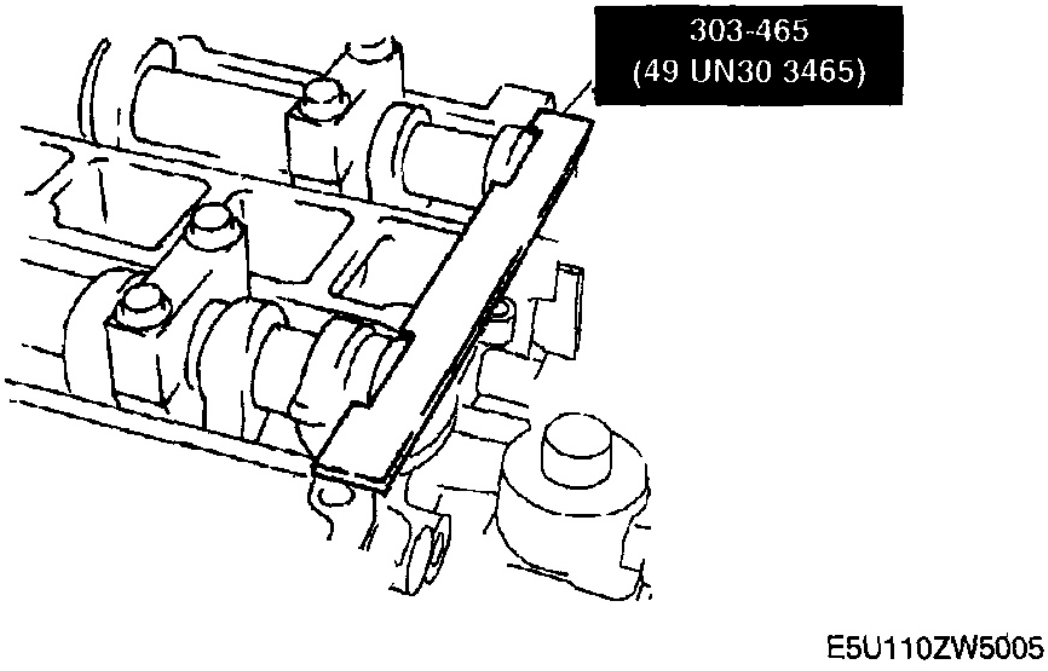


Fig. 58: Installing SST On Camshaft
Courtesy of MAZDA MOTORS CORP.

3. To position the crankshaft pulley, temporarily tighten it and, using a suitable bolt **(M6 X 1.0 length 25 mm - 35 mm {0.99 in - 1.37 in}),** fix the crankshaft pulley to the engine front cover.

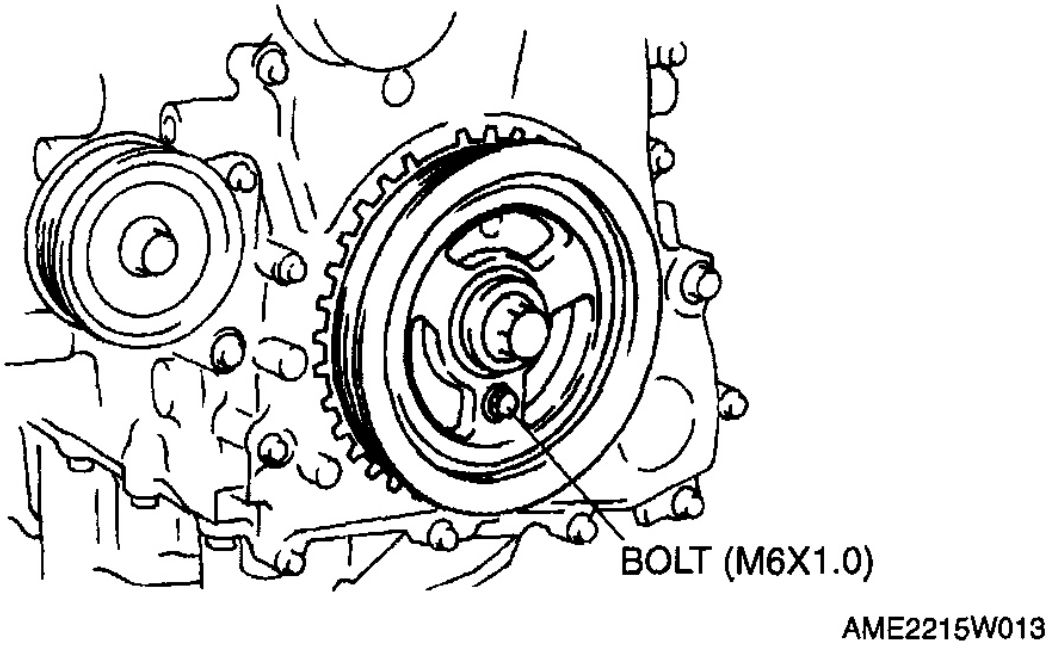


Fig. 59: Identifying Crankshaft Pulley Bolt
Courtesy of MAZDA MOTORS CORP.

4. Install the **SSTs** to the crankshaft pulley, lock the crankshaft against rotation.
5. Tighten the crankshaft pulley lock bolt in the order shown in **Fig. 60** using the following two steps.
    1. Tighten to **96-104 N.m {9.8-10.6 kgf.m, 70.9-76.7 ft.lbf}**
    2. Tighten **87°-93°**

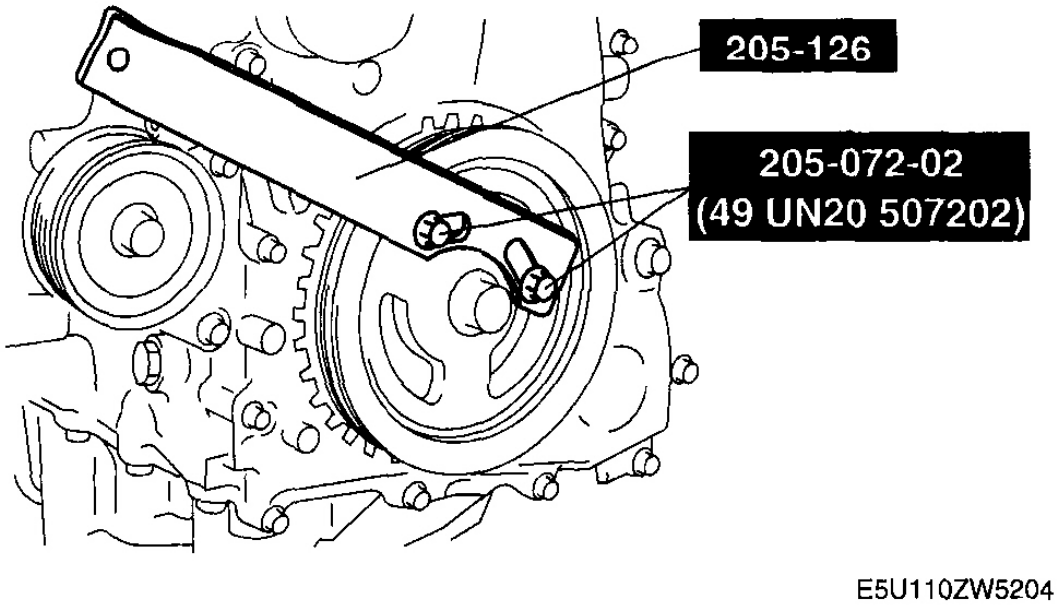


Fig. 60: Installing SSTs To Crankshaft Pulley
Courtesy of MAZDA MOTORS CORP.

6. Remove the **M6 x 1.0** bolt.
7. Remove the **SST** from the camshaft.
8. Remove the **SST** from the cylinder block lower blind plug.
9. Remove the **SST** from the crankshaft pulley.
10. Rotate the crankshaft clockwise two turns until the TDC position.
    - If not aligned, loosen the crankshaft pulley lock bolt and repeat from Step 4.
11. 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}

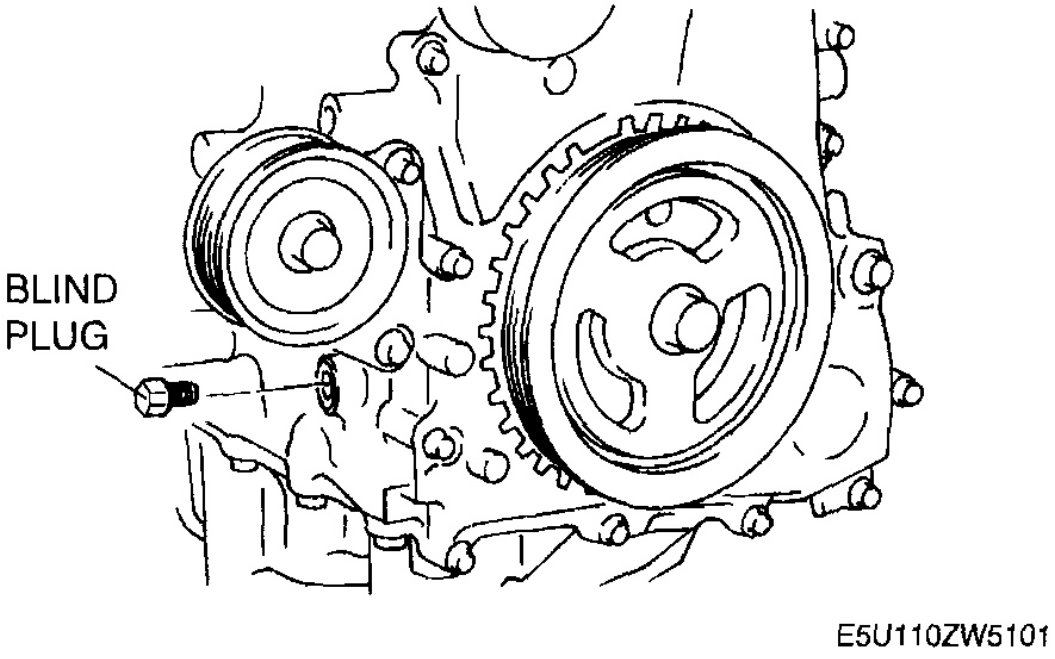
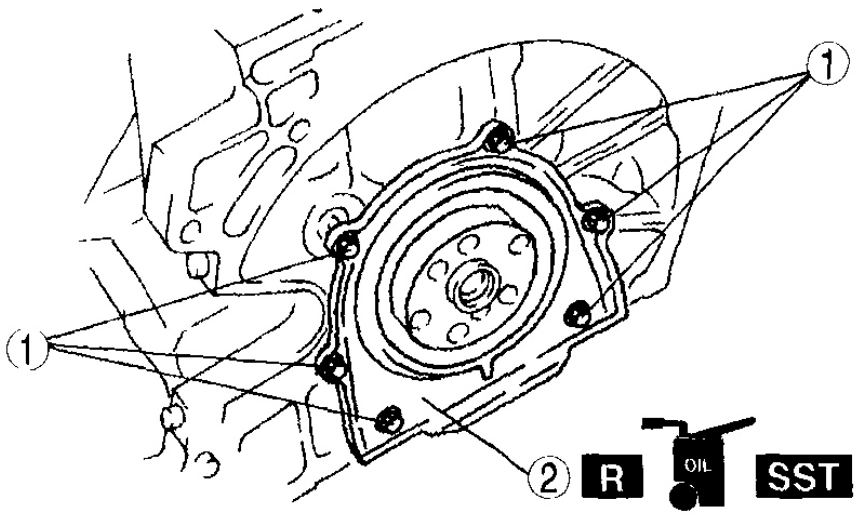


Fig. 61: Installing Cylinder Block Lower Blind Plug
Courtesy of MAZDA MOTORS CORP.

REAR OIL SEAL REPLACEMENT [LF]

1. Remove the flywheel (MT) or Remove the drive plate (AT). (See **CLUTCH UNIT REMOVAL/INSTALLATION** .) (See **DRIVE PLATE REMOVAL/INSTALLATION [SJ6A-EL]** .)
2. Remove in the order indicated in **Fig. 62** .
3. Install in the reverse order of removal.



AME2222W001

1	Bolt
2	Rear oil seal

Fig. 62: Installing Rear Oil Seal With Bolts
Courtesy of MAZDA MOTORS CORP.

REAR OIL SEAL INSTALLATION NOTE

1. Apply silicone sealant to the mating faces as shown in **Fig. 63**.

   Thickness:

   4.0-6.0 mm {0.16-0.23 in}

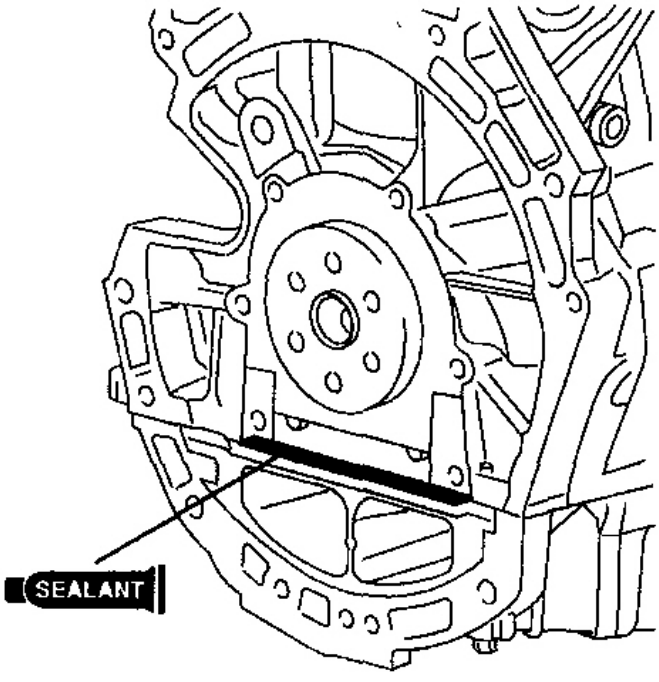


Fig. 63: Applying Silicone Sealant To Mating Faces
Courtesy of MAZDA MOTORS CORP.

2. Apply clean engine oil to the new oil seal lip.
3. Install the **SST** to the non-woven fabric side of the rear oil seal.

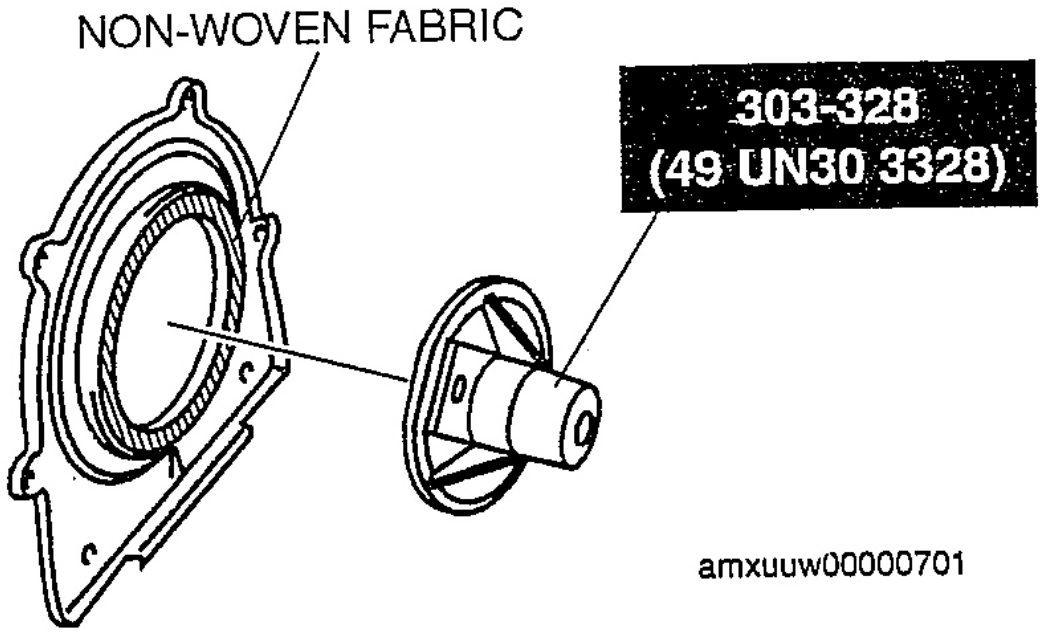


Fig. 64: Installing SST To Non-Woven Fabric Side Of Rear Oil Seal
Courtesy of MAZDA MOTORS CORP.

4. From the back side of the rear oil seal, verify that there is no damage or separation in the lip area of the rear oil seal.

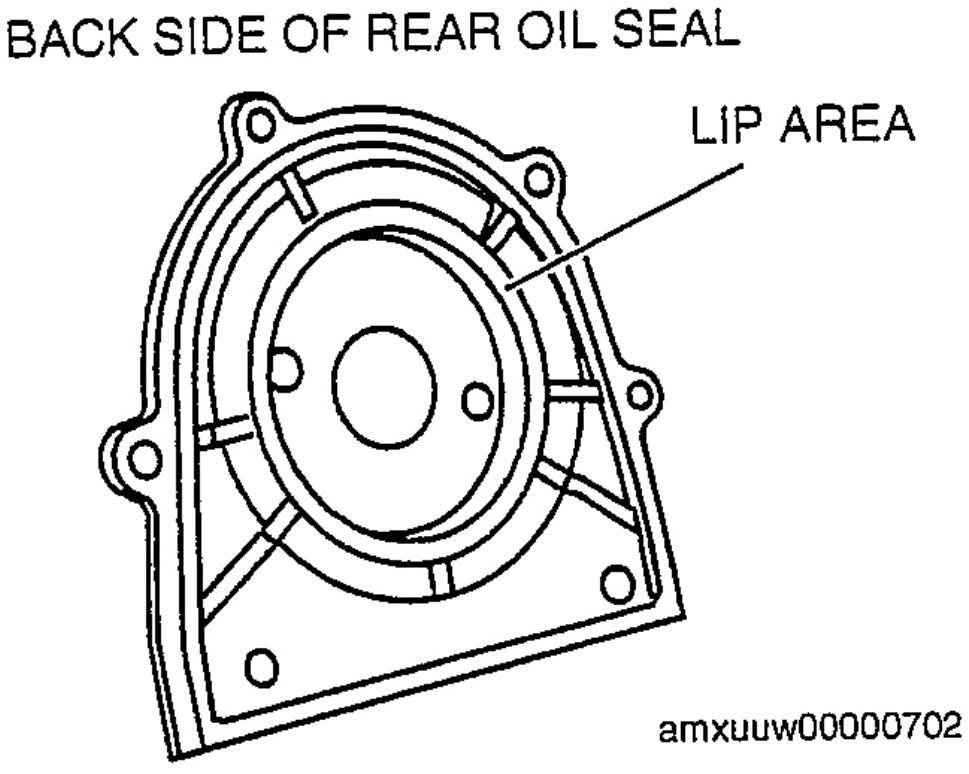


Fig. 65: Identifying Back Side Of Rear Oil Seal And Lip Area
Courtesy of MAZDA MOTORS CORP.

5. Install the rear oil seal to the engine as shown in **Fig. 66**

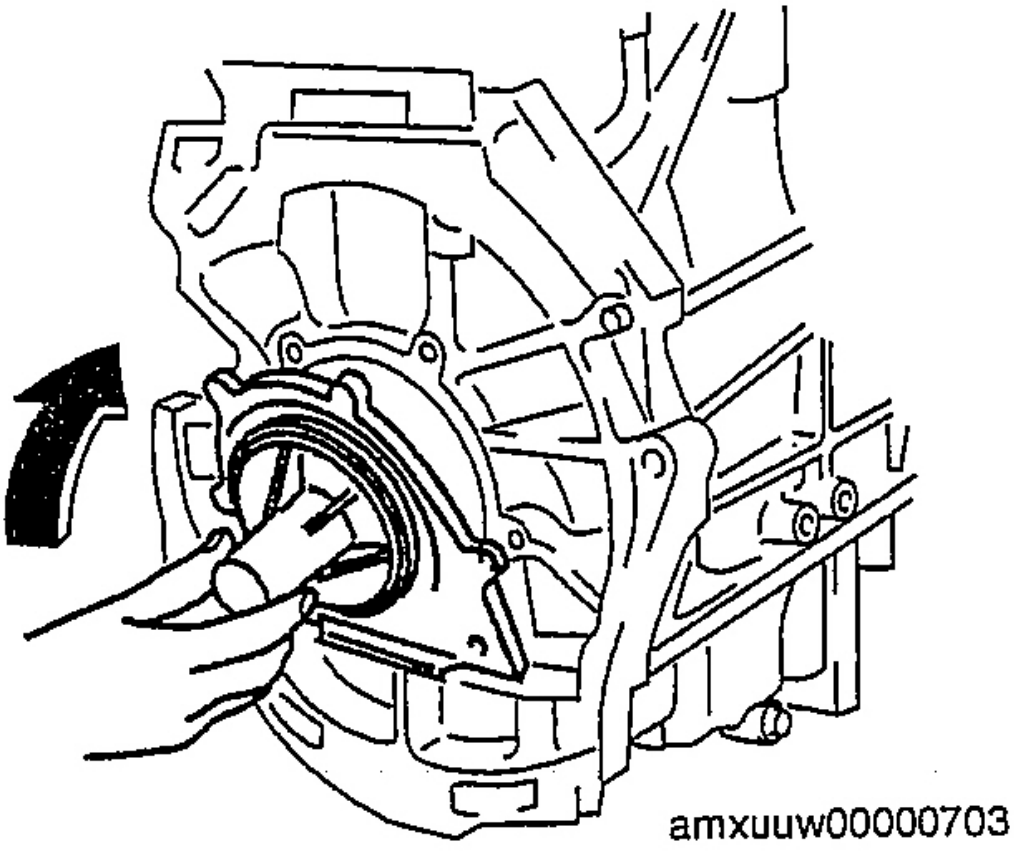


Fig. 66: Installing Rear Oil Seal
Courtesy of MAZDA MOTORS CORP.

6. Tighten the rear oil seal bolts in the order as shown.

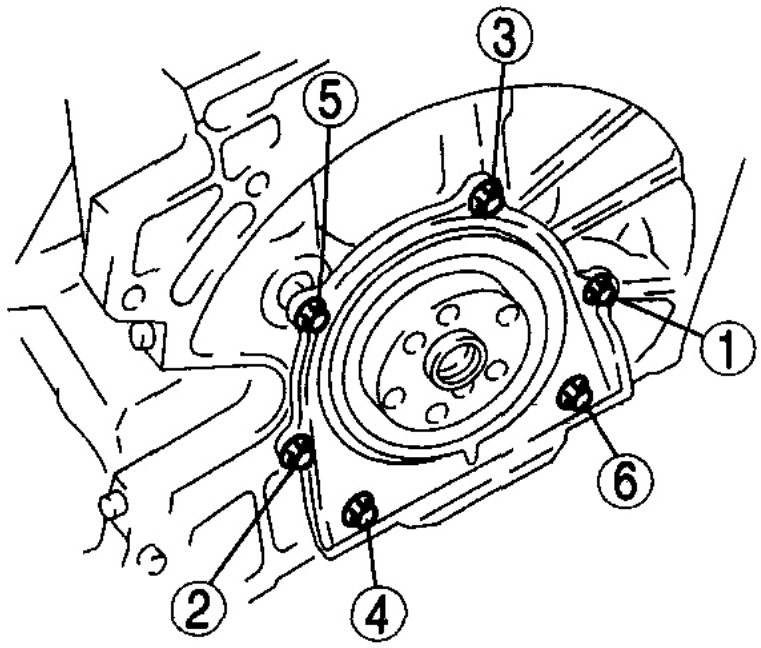


Fig. 67: Installing Rear Oil Seal Bolts

Tightening torque:

8.0-11.5 N.m {81.6-1117.2 kgf.m, 70.9-101.7 in.lbf}

ENGINE REMOVAL/INSTALLATION [LF]

WARNING:

- **Fuel is very flammable liquid. If fuel spills or leaks from the pressurized fuel system, it will cause serious injury or death and facility breakage. Fuel can also irritate skin and eyes. To prevent this, always complete the "Fuel Line Safety Procedure", while referring to the BEFORE SERVICE PRECAUTION [LF] .**

NOTE:

- **Remove the engine, transmission, and crossmember component as a single unit from under the vehicle.**

1. Perform "Fuel Line Safety Procedures". Leave the fuel pump relay removed. (See **BEFORE SERVICE PRECAUTION [LF]** .)
2. Drain the engine coolant. (See **ENGINE COOLANT REPLACEMENT [LF]** .)

3. Remove the following parts:
    1. The front wheel and tires (See **GENERAL PROCEDURES (SUSPENSION)** .)
    2. The plug hole plate (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
    3. The battery cover, battery, battery box, battery tray and battery duct (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
    4. The air cleaner (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
    5. The throttle body (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
    6. The PCM, PCM duct and air cleaner insulator (See **PCM REMOVAL/INSTALLATION [LF]** .)
    7. The coolant reserve tank (See **COOLANT RESERVE TANK REMOVAL/INSTALLATION [LF]** .)
    8. The console (See **CONSOLE REMOVAL/INSTALLATION** .)
4. Disconnect the P/S oil pump hoses and drain the P/S fluid reservoir. (See **POWER STEERING OIL PUMP REMOVAL/INSTALLATION** .)
5. Remove the splash shield, under cover and mud guards.
6. Remove the generator duct. (See **GENERATOR REMOVAL/INSTALLATION [LF]** .)
7. Drain the transmission oil (MT) or ATF (AT). (See **TRANSMISSION OIL REPLACEMENT [M15M-D]** .) (See **TRANSMISSION OIL REPLACEMENT [P66M-D]** .) (See **AUTOMATIC TRANSMISSION FLUID (ATF) REPLACEMENT [SJ6A-EL]** .)
8. Disconnect the brake vacuum hose.
9. Disconnect the quick release connector from the dynamic chamber. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
10. Disconnect the quick release connector from the fuel distributor. (See **BEFORE SERVICE PRECAUTION [LF]** .) (See **QUICK RELEASE CONNECTOR (FUEL SYSTEM) REMOVAL/INSTALLATION [LF]** .)
11. Remove the drive belt. (See **DRIVE BELT REPLACEMENT [LF]** .)
12. Remove the A/C compressor with the pipes connected and secure the A/C compressor using wire or rope so that it is out of the way.
13. Disconnect the water hose and heater hose.
14. Secure the caliper (front) using wire or rope so that it is out of the way.
15. Disconnect the wiring harness.
16. Disconnect front ABS wheel-speed sensor connector. (See **FRONT ABS WHEEL-SPEED SENSOR REMOVAL/INSTALLATION** .)
17. Remove the radiator. (See **RADIATOR REMOVAL/INSTALLATION [LF]** .)
18. AT
    - Disconnect the manual shaft lever component. (See **AUTOMATIC TRANSMISSION REMOVAL/INSTALLATION [SJ6A-EL]** .)

    MT

    - Remove the clutch release cylinder with the pipes connected and secure the clutch release cylinder

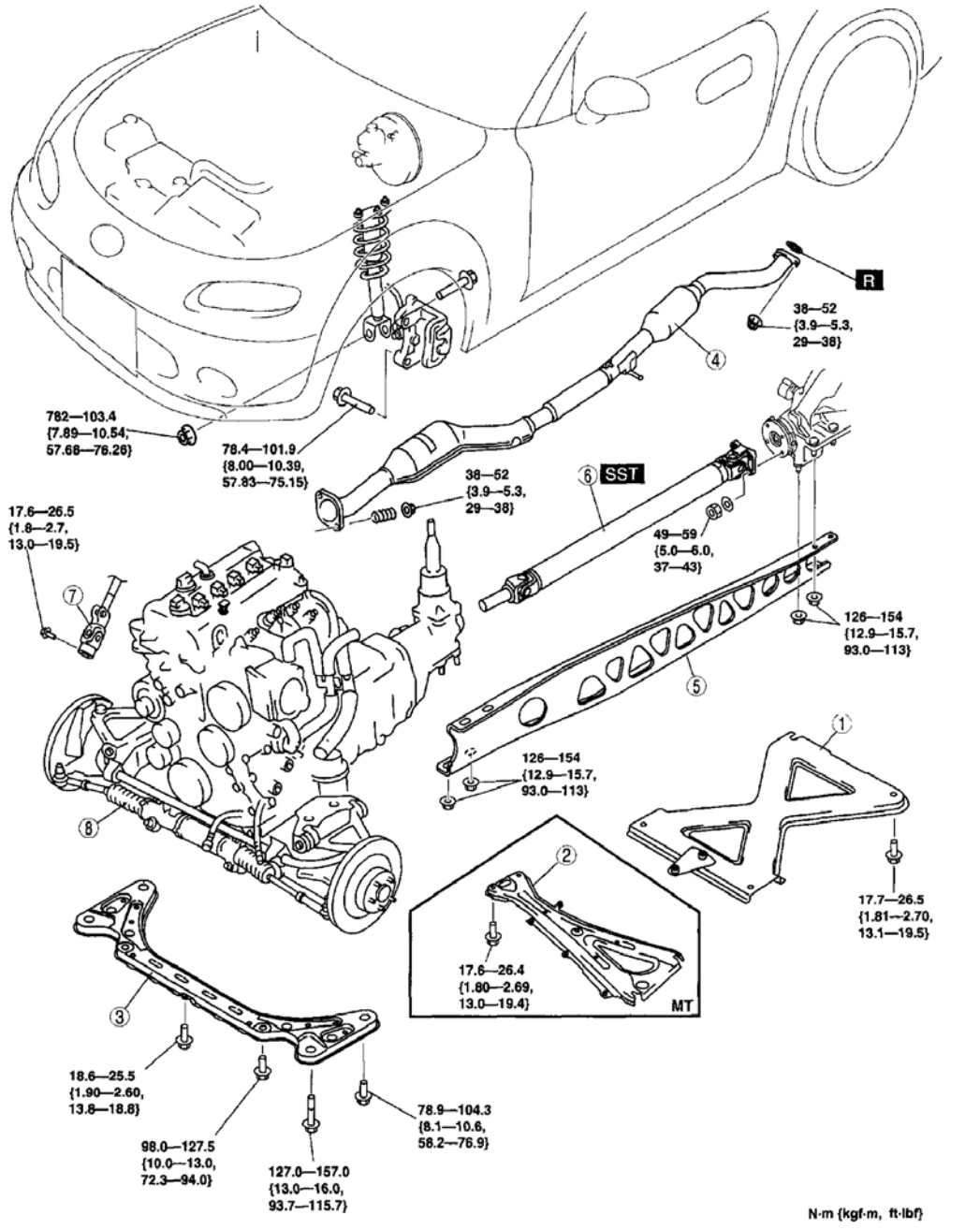
using wire or rope so that it is out of the way. (See **CLUTCH RELEASE CYLINDER REMOVAL/INSTALLATION** .)

- Remove the shift lever knob. (See **TRANSMISSION REMOVAL/INSTALLATION [M15M-D]** .)

19. Remove the engine, transmission, and crossmember component using an engine lifter in the order indicated in **Fig. 68** .

WARNING:

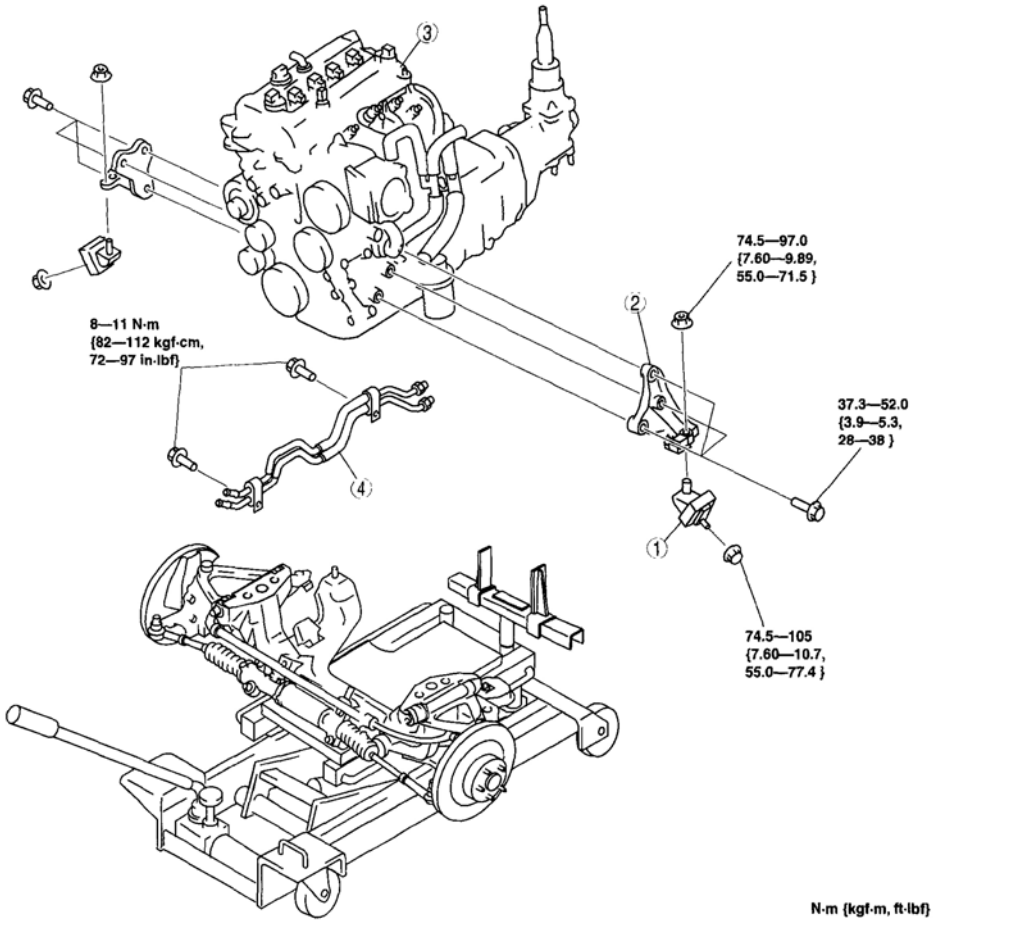
- **Remove the engine, transmission and crossmember carefully, holding it steady. If the transmission falls it could be damaged or cause injury.**



1	Tunnel member
2	Member bracket
3	Transverse member
4	Middle pipe
5	Power plant frame
6	Propeller shaft
7	Bolt (Intermediate Shaft)
8	Engine, transmission, crossmember component

Fig. 68: Identifying Engine, Transmission & Crossmember Components (With Torque Specifications)
Courtesy of MAZDA MOTORS CORP.

20. Remove the engine and transmission from the crossmember component lifter in the order indicated in **Fig. 69** by suspending them with a crane.



1	Engine mount rubber
2	Engine mount bracket
3	Engine, transmission
4	Oil pipe, oil hose

Fig. 69: Identifying Engine & Transmission From Crossmember Components (With Torque Specifications)
Courtesy of MAZDA MOTORS CORP.

21. Install in the reverse order of removal.
22. Start the engine and inspect and adjust the following:
    - Pulley and belt for runout, tension, and contact

- Leakage of engine oil, engine coolant, ATF, MT oil, and fuel
- Ignition timing, idle speed, and idle mixture (CO and HC) (See **ENGINE TUNE-UP [LF]** .)
- Front wheel alignment (See **FRONT WHEEL ALIGNMENT** .)
- Engine-driven accessories operation

23. Perform the on-road test and verify that there is no vibration or noise.

ENGINE, TRANSMISSION, CROSSMEMBER COMPONENT REMOVAL NOTE

1. Secure the engine, transmission, and crossmember component using an engine lifter.

ENGINE DISASSEMBLY/ASSEMBLY [LF]

1. Remove the transmission from the engine. (See **TRANSMISSION REMOVAL/INSTALLATION [M15M-D]** .) (See **TRANSMISSION REMOVAL/INSTALLATION [P66M-D]** .) (See **AUTOMATIC TRANSMISSION REMOVAL/INSTALLATION [SJ6A-EL]** .)
2. Remove the following parts:
    1. The clutch unit (MT) (See **CLUTCH UNIT REMOVAL/INSTALLATION** .)
    2. The ignition coil (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
    3. The CMP sensor (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
    4. The power steering oil pump (See **POWER STEERING OIL PUMP REMOVAL/INSTALLATION** .)
    5. The fuel distributor and fuel injector (See **FUEL INJECTOR REMOVAL/INSTALLATION [LF]** .)
    6. The intake-air system (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [LF]** .)
    7. The exhaust system (See **EXHAUST SYSTEM REMOVAL/INSTALLATION [LF]** .)
    8. The CKP sensor (See **CRANKSHAFT POSITION (CKP) SENSOR REMOVAL/INSTALLATION [LF]** .)
3. Remove in the order indicated in **Fig. 70** .
4. Install in the reverse order of removal.

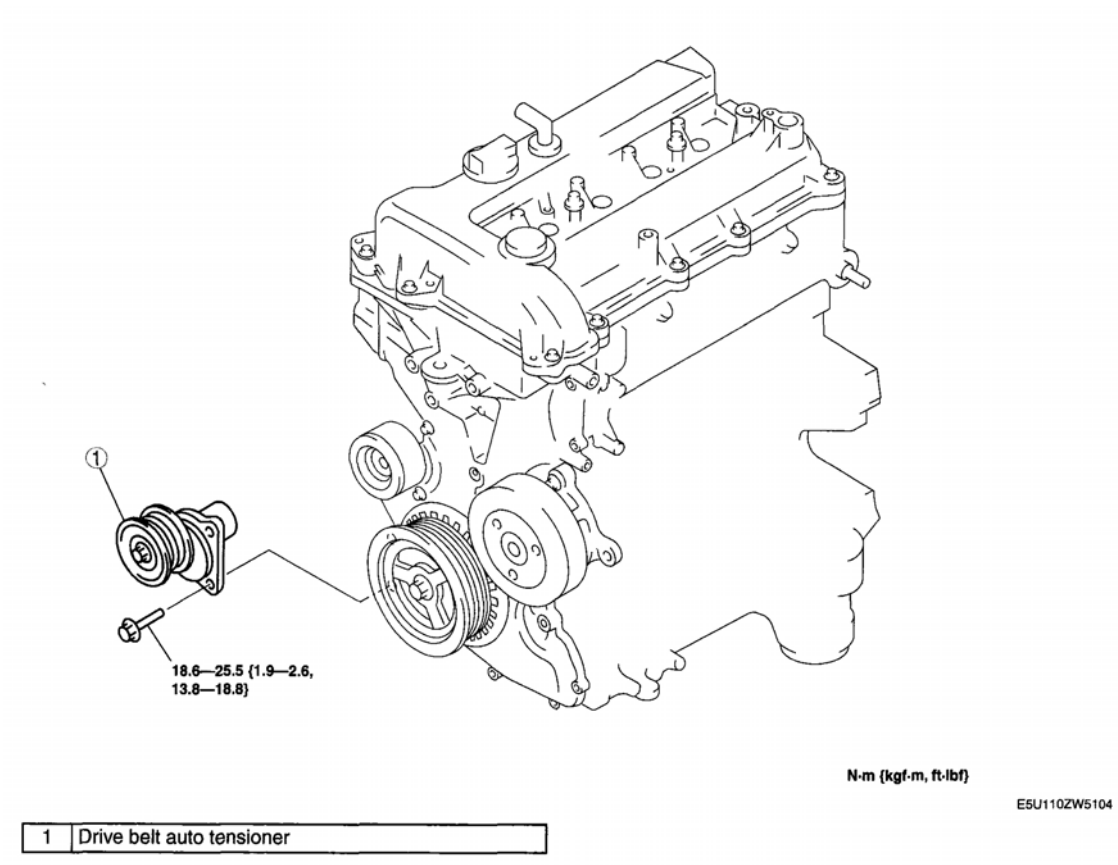


Fig. 70: Removing/Installing Drive Belt Auto Tensioner [LF] (With Torque Specifications) Courtesy of MAZDA MOTORS CORP.

VARIABLE VALVE TIMING ACTUATOR INSPECTION [LF]

CAUTION:
- **Variable valve timing actuator can not be disassembled it is a precision unit.**

1. Remove the battery cover.
2. Disconnect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
3. Remove the plug hole plate. (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
4. Disconnect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
5. Remove the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
6. Remove the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
7. Disconnect the OCV connector.
8. Disconnect the P/S pressure switch connector.

9. Remove the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
10. Remove the cylinder head cover. (See **CYLINDER HEAD COVER INSTALLATION NOTE** .)
11. Confirm that notch of the rotor and bump of the cover at the variable valve timing actuator are aligned and fitted.
    - If the notch and the bump are not aligned, turn the crankshaft clockwise two rotations. Verify that the bump and the notch are aligned.

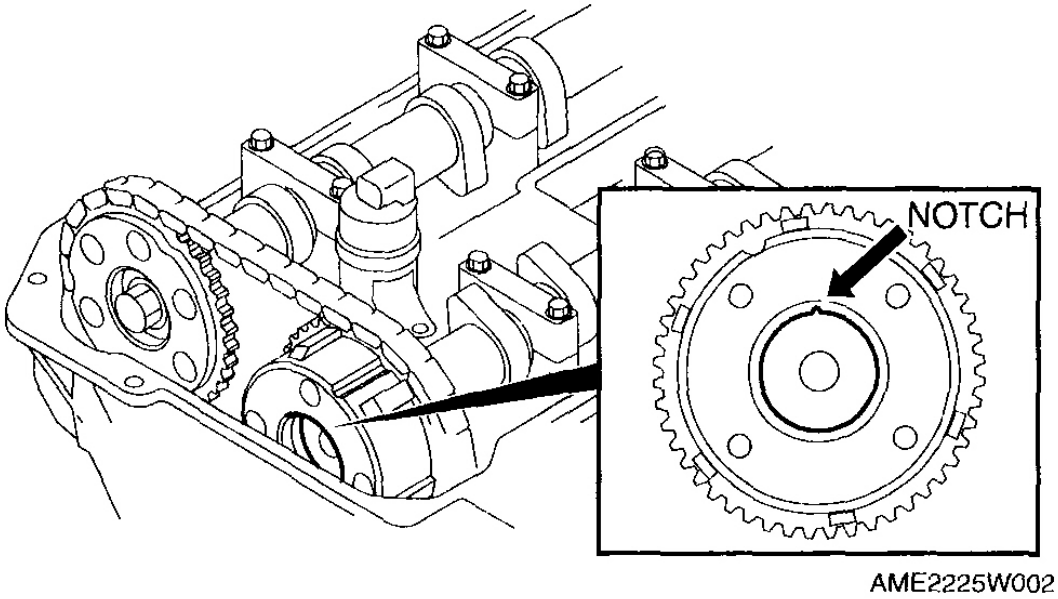


Fig. 71: Verifying Bump & Notch Are Aligned
Courtesy of MAZDA MOTORS CORP.

    - If the bump and notch are still not aligned, replace the variable valve timing actuator.
    - If, when turning the crankshaft, there is a hitting noise from the variable valve timing actuator each time the cam passes the fully lifted position, it means that the actuator is not secured. Replace the actuator.
12. Install the cylinder head cover. (See **CYLINDER HEAD COVER INSTALLATION NOTE** .)
13. Install the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
14. Connect the P/S pressure switch connector.
15. Connect the OCV connector.
16. Install the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
17. Install the front suspension tower bar (joint). (See **FRONT SUSPENSION TOWER BAR REMOVAL/INSTALLATION** .)
18. Connect the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM)**

REMOVAL/INSTALLATION [LF] .)

19. Install the plug hole plate. (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
20. Install the battery cover.
21. Connect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)

VARIABLE VALVE TIMING ACTUATOR REMOVAL/INSTALLATION [LF]

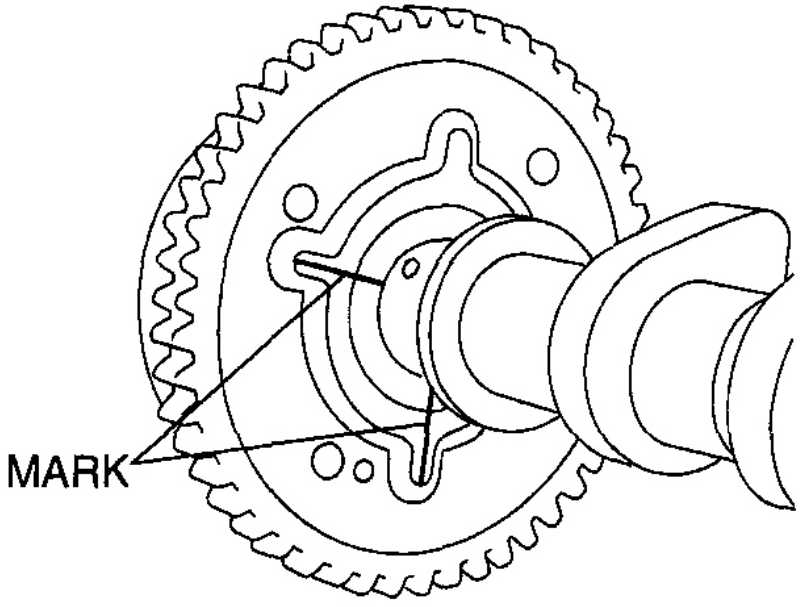
CAUTION:

- **Variable valve timing actuator can not be disassembled because it is a precision unit.**

NOTE:

- **Intake camshaft sprocket is integrated with the variable valve timing actuator and cannot be disassembled.**

1. Follow the valve clearance adjustment procedure from 1 to 21 and remove the intake camshaft and variable valve timing actuator as a single unit. (See **VALVE CLEARANCE ADJUSTMENT [LF]** .)
2. Remove the variable valve timing actuator.
    1. Mark the camshaft and variable valve timing actuator as shown in **Fig. 72** to make sure they are installed in their original position.



B6A110ZWA001

Fig. 72: Identifying Mark Camshaft & Variable Valve Timing Actuator
Courtesy of MAZDA MOTORS CORP.

2. Secure the camshaft in a vise.
3. Loosen the variable valve timing actuator tightening bolt.

3. Install a new washer.

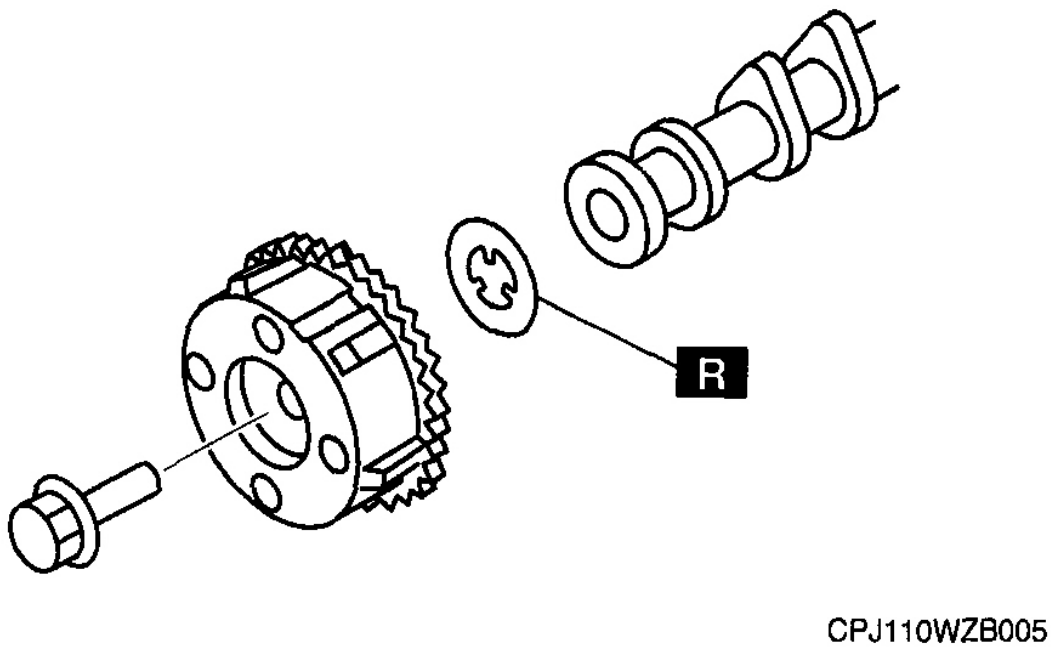


Fig. 73: Installing New Washer
Courtesy of MAZDA MOTORS CORP.

4. Install the variable valve timing actuator.
   1. Secure the camshaft in a vise.
   2. Align the marks of the camshaft and variable valve timing actuator.

CAUTION:
- **When the variable valve timing actuator is replaced with a new one, mark it in the same location as the old one.**

   3. Tighten the variable valve timing actuator tightening bolt.

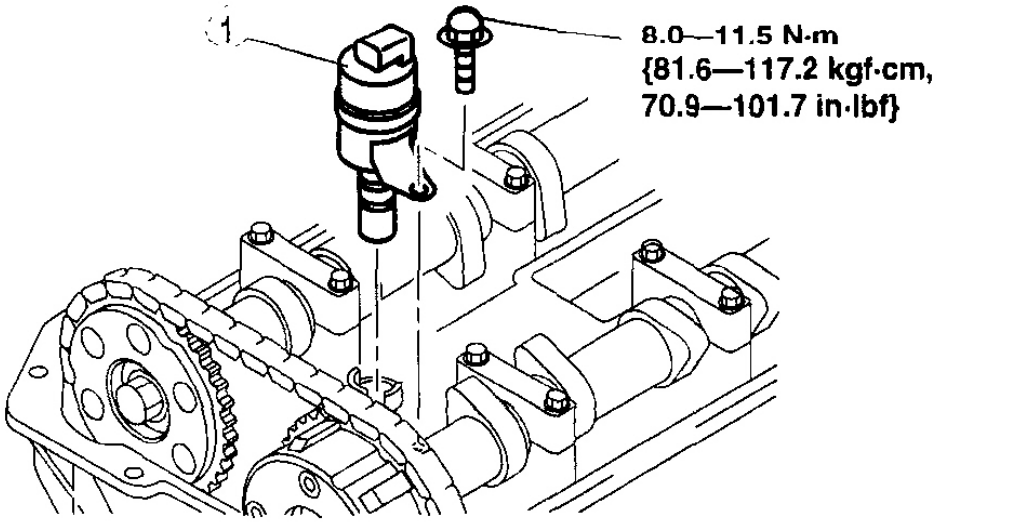
Tightening torque

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

5. Follow the valve clearance adjustment procedure from 21 to 50 and install the intake camshaft and variable valve timing actuator. (See **VALVE CLEARANCE ADJUSTMENT [LF]** .)

OIL CONTROL VALVE (OCV) REMOVAL/INSTALLATION [LF]

1. Remove the battery cover.
2. Disconnect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
3. Remove the plug hole plate. (See **PLUG HOLE PLATE REMOVAL/INSTALLATION [LF]** .)
4. Remove the ignition coils. (See **IGNITION COIL REMOVAL/INSTALLATION [LF]** .)
5. Remove the CMP sensor. (See **CAMSHAFT POSITION (CMP) SENSOR REMOVAL/INSTALLATION [LF]** .)
6. Remove the OCV connector.



1	OCV

Fig. 74: Identifying Oil Control Valve (OCV) [LF] (With Torque Specifications)
Courtesy of MAZDA MOTORS CORP.

7. Remove the ventilation hose. (See **QUICK RELEASE CONNECTOR (EMISSION SYSTEM) REMOVAL/INSTALLATION [LF]** .)
8. Remove the cylinder head cover. (See **CYLINDER HEAD COVER INSTALLATION NOTE** .)
9. Remove in the order indicated in **Fig. 74** .
10. Install in the reverse order of removal.

OIL CONTROL VALVE (OCV) INSPECTION [LF]

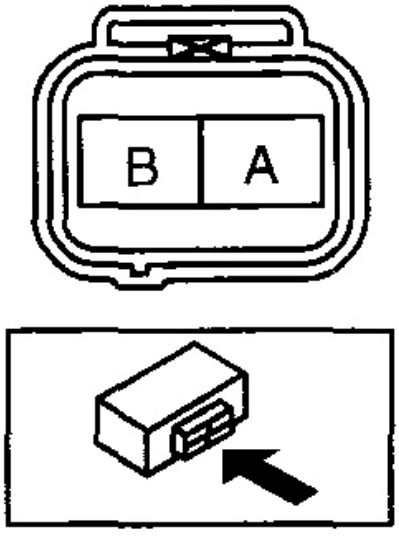
COIL RESISTANCE INSPECTION

1. Remove the battery cover.
2. Disconnect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
3. Disconnect the oil control valve connector.
4. Measure the resistance between terminals A and B using an ohmmeter.
   - If not as specified, replace the oil control valve. (See **OIL CONTROL VALVE (OCV) REMOVAL/INSTALLATION [LF]** .)

   Oil control valve resistance

   6.9-7.9 ohms [20°C {68°F}]

5. Connect the oil control valve connector.



E5U110ZW5899

Fig. 75: Oil Control Valve Connector

Courtesy of MAZDA MOTORS CORP.

SPOOL VALVE OPERATION INSPECTION

1. Remove the battery cover.
2. Disconnect the negative battery cable. (See **BATTERY REMOVAL/INSTALLATION [LF]** .)
3. Remove the oil control valve.
4. Verify that the spool valve in the oil control valve is in the maximum valve timing retard position as indicated in **Fig. 76** .
   - If not as specified, replace the oil control valve. (See **OIL CONTROL VALVE (OCV) REMOVAL/INSTALLATION [LF]** .)

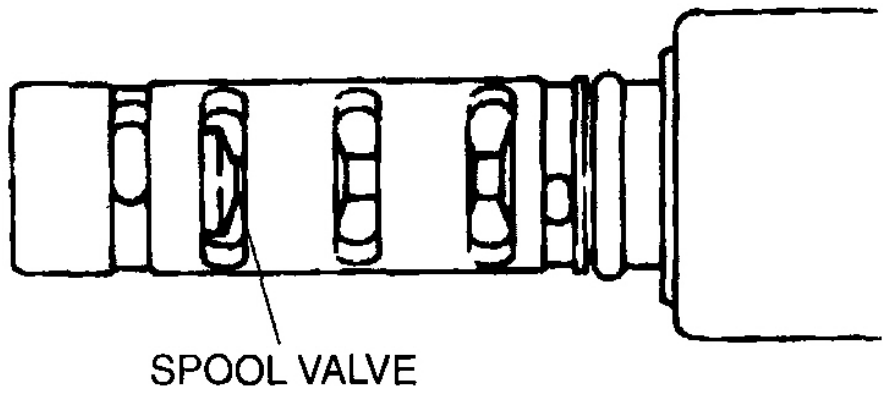


Fig. 76: Identifying Spool Valve
Courtesy of MAZDA MOTORS CORP.

5. Verify that the battery is fully charged.
   - If not as specified, recharge the battery. (See **BATTERY INSPECTION [LF]** .)
6. Apply battery positive voltage between the oil control valve terminals and verify that the spool valve operates and moves to the maximum valve timing advance position.
   - If not as specified, replace the oil control valve.

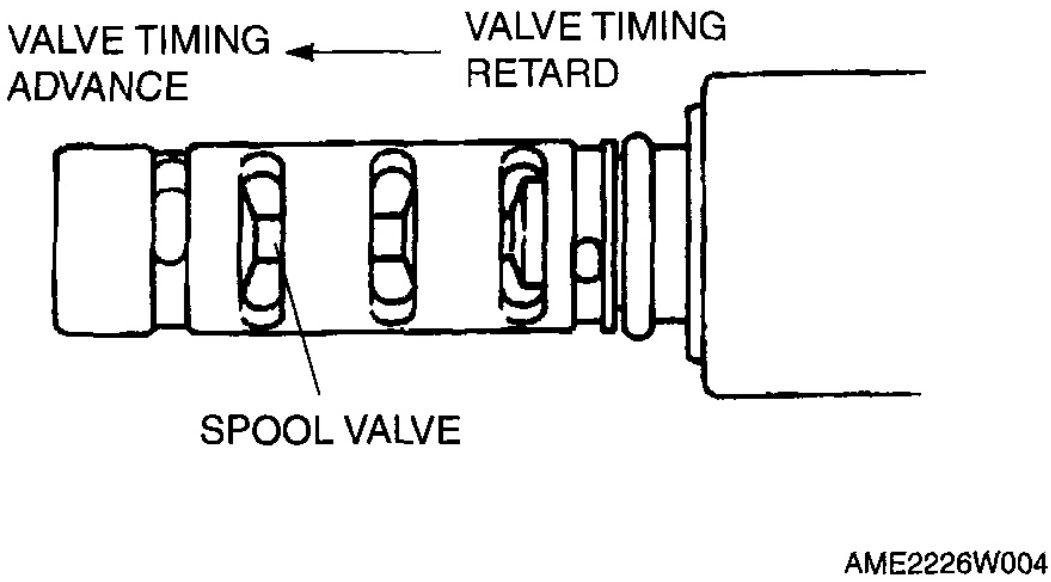


Fig. 77: Verifying Spool Valve Operates & Moves To Maximum Valve Timing Advance Position
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **When applying battery positive voltage between the oil control valve 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**

7. Stop applying battery positive voltage and verify that the spool valve returns to the maximum valve timing retard position.
   - If not as specified, replace the oil control valve.

ENGINE TUNE-UP [LF]

ENGINE TUNE-UP PREPARATION

1. Verify the following:
   - AT: Selector lever is in P or N position.
   - MT: Shift lever is in neutral position.
2. Verify that no DTCs are available.
3. Warm up the engine (ECT is **approx. 80°C {176°F} or more)** as follows.

1. Start the engine.
2. Racing at the engine speed **2,500-3,000 rpm** for 3 min.

4. Turn off the electrical loads.
5. Wait until the cooling fans stop.
6. Connect the **SST** (M-MDS or equivalent) to the DLC-2.

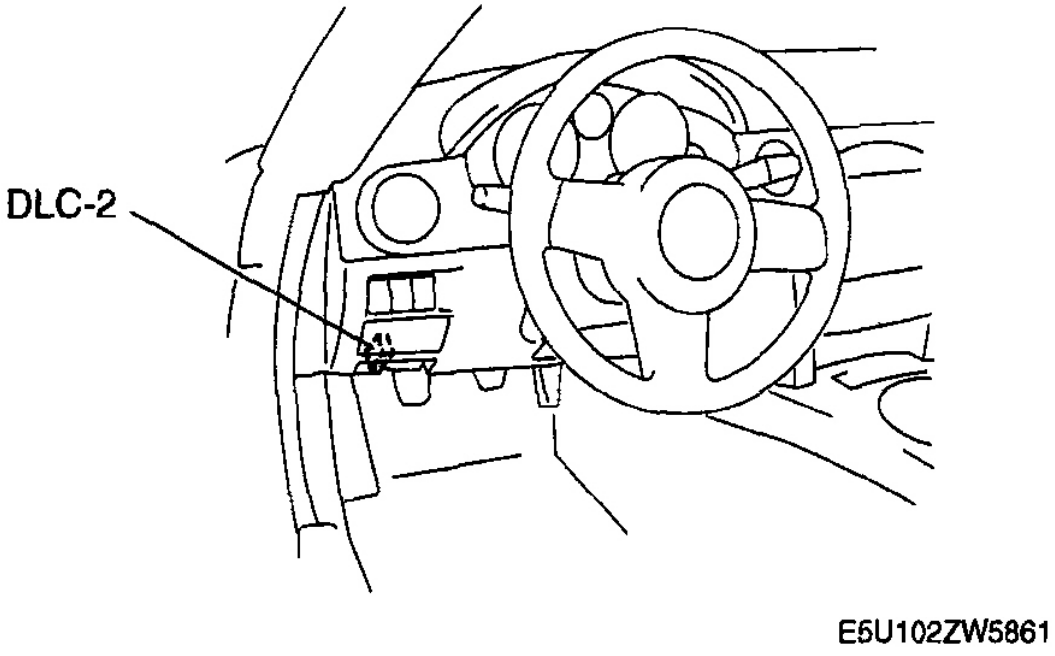


Fig. 78: Locating DLC-2 Connector
Courtesy of MAZDA MOTORS CORP.

7. Verify that the idling speed (M-MDS: RPM PID) is within the specification using the M-MDS or equivalent function.

Standard

AT: 700-800 rpm

MT: 670-770 rpm

IGNITION TIMING INSPECTION

NOTE:

- **Ignition timing is not adjustable.**
- **Ignition timing verification requires M-MDS or equivalent.**

1. Verify that the ignition timing (M-MDS: SPARKADV PID) is within the specification using M-MDS or equivalent.

   Ignition timing

   Approx. BTDC 8°

2. Verify that ignition timing advances when the engine speed increases gradually.
   - If there is malfunction, refer to "**ENGINE SYMPTOM TROUBLESHOOTING [LF]** ".

IDLE SPEED INSPECTION

NOTE:
- **Idle speed is not adjustable.**
- **Idle speed verification requires M-MDS or equivalent.**

1. Verify that the idle speed (M-MDS: RPM PID) is within the specification using M-MDS or equivalent.
   - If there is malfunction, refer to "**ENGINE SYMPTOM TROUBLESHOOTING [LF]** ".

   Idle speed

   No load: 670-770 rpm (MT), 700-800 rpm (AT)

   Electrical loads (38-48 A): 700-800 rpm

   Electrical loads (more than 48 A): 800-900 rpm

   P/S ON: 700-800 rpm (MT), 750-850 rpm (AT)

   A/C ON: 825-925 rpm (MT), 775-875 rpm (AT)

IDLE MIXTURE INSPECTION

1. Verify that the idle speed and ignition timing are within the specification. (See **IDLE SPEED INSPECTION** .) (See **IGNITION TIMING INSPECTION** .)
2. Insert an exhaust gas analyzer to the tailpipe.
3. Verify that the CO and HC concentrations are within the regulation.
   - If there is malfunction, refer to "**ENGINE SYMPTOM TROUBLESHOOTING [LF]** ".

   Idle mixture

   HC concentration: Within the regulation

   CO concentration: Within the regulation