

2005 Mazda MX-5 Miata

2005 ENGINE Mechanical - MX-5 Miata

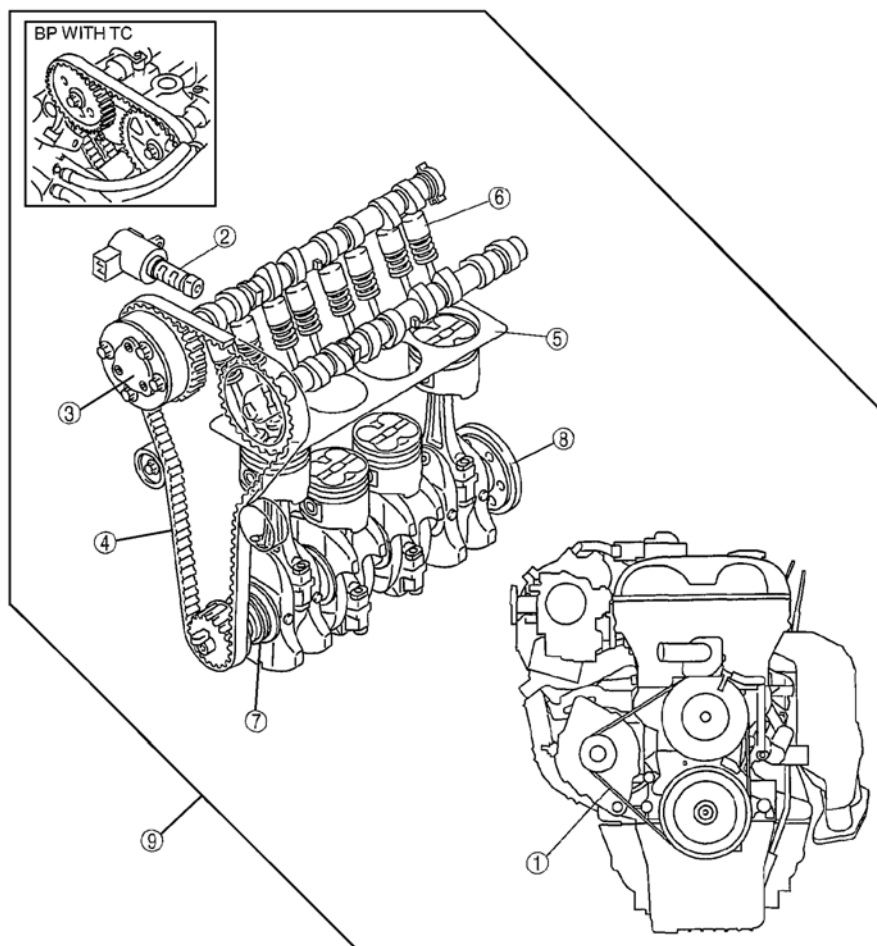
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Mechanical - MX-5 Miata

MECHANICAL LOCATION INDEX

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1	Drive belt (See DRIVE BELT INSPECTION) (See DRIVE BELT ADJUSTMENT)
2	Oil control valve (OCV) (BP) (See OIL CONTROL VALVE (OCV) REMOVAL/INSTALLATION [BP]) (See OIL CONTROL VALVE (OCV) INSPECTION [BP])
3	Variable valve timing actuator (BP) (See VARIABLE VALVE TIMING ACTUATOR INSPECTION [BP])
4	Timing belt (See TIMING BELT REMOVAL/ INSTALLATION)
5	Cylinder head gasket (See CYLINDER HEAD GASKET REPLACEMENT)

6	Tappet and adjustment shim (See TAPPET AND ADJUSTMENT SHIM REMOVAL/INSTALLATION)
7	Front oil seal (See FRONT OIL SEAL REPLACEMENT)
8	Rear oil seal (See REAR OIL SEAL REPLACEMENT)
9	Engine (See ENGINE REMOVAL/ INSTALLATION [BP]) (See ENGINE REMOVAL/ INSTALLATION [BP WITH TC]) (See ENGINE DISASSEMBLY/ ASSEMBLY)

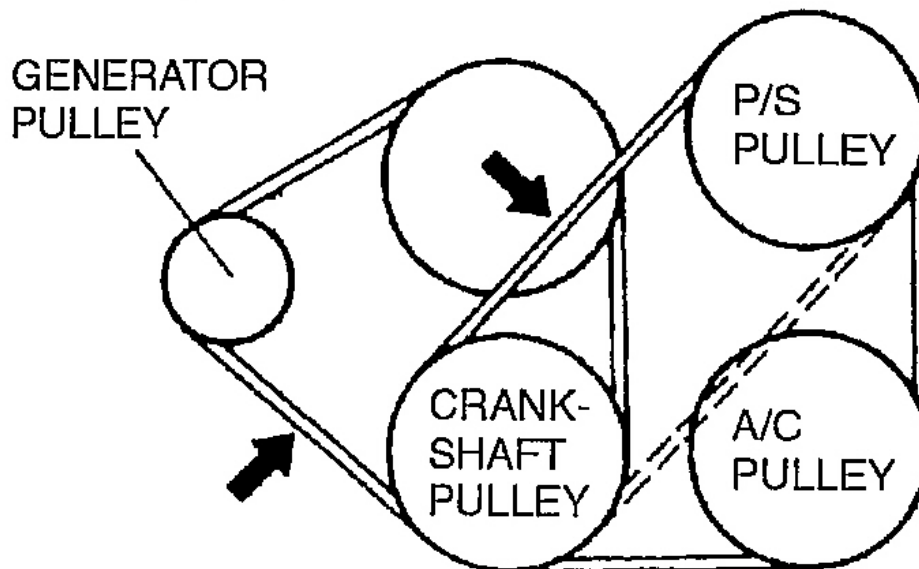
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Fig. 1: Locating Mechanical Component
Courtesy of MAZDA MOTORS CORP.

DRIVE BELT INSPECTION

DRIVE BELT DEFLECTION CHECK

1. Verify the drive belt deflection when the engine is cold, or at least **30 min** after the engine has stopped. Apply moderate pressure **98 N {10 kgf, 22 lbf}** midway between the specified pulleys.
 - If the deflection is not within the specification, adjust it. (See **DRIVE BELT ADJUSTMENT**.)

GENERATOR, P/S, P/S+A/C

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Fig. 2: Identifying Generator, P/S, P/S+A/C Pulley
 Courtesy of MAZDA MOTORS CORP.

DRIVE BELT DEFLECTION SPECIFICATION

Deflection		mm {in}	
Drive belt	(1)New	Used	Limit
Generator	5.5-7.0 {0.22-0.27}	6.0-7.5 {0.24-0.29}	8.0 {0.31}
P/S, P/S+A/C	7.0-8.0 {0.28-0.31}	9.0-10.0 {0.36-0.39}	11.5 {0.45}

(1) A belt that has been on a running engine for less than **5 min**

DRIVE BELT TENSION CHECK

1. Belt tension can be verified in place of belt deflection.
2. Verify the drive belt tension when the engine is cold, or at least **30 min** after the engine has stopped.

3. Using the **SST** , verify the belt tension between any two pulleys.
 - If the tension is not within the specification, adjust it. (See **DRIVE BELT ADJUSTMENT**.)

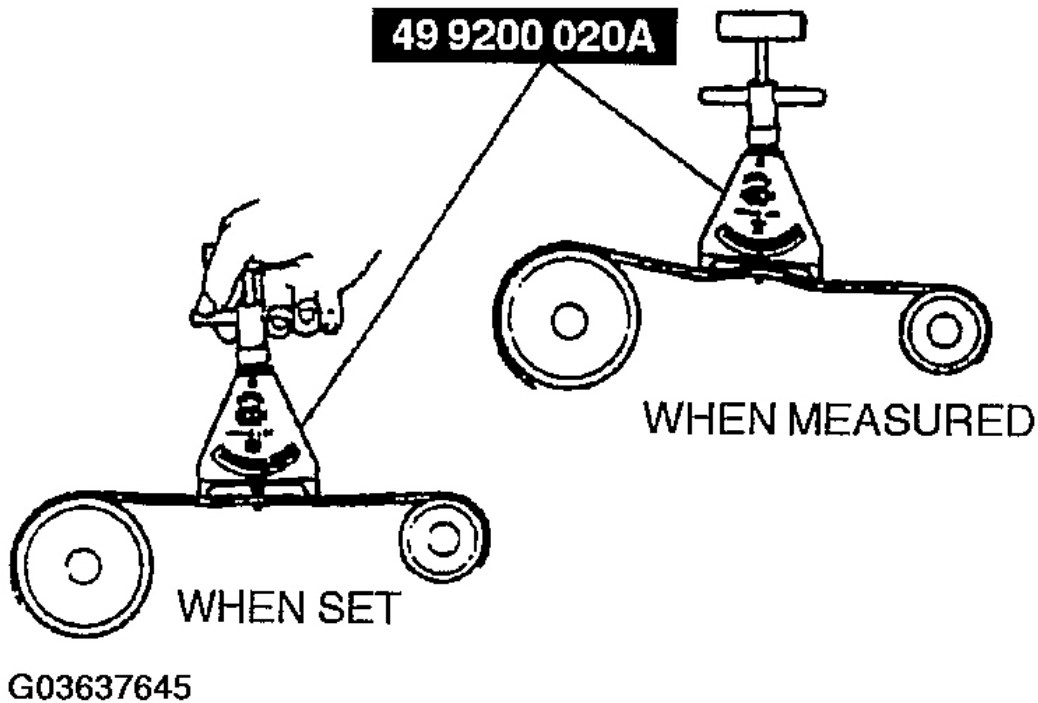


Fig. 3: Verifying Drive Belt Tension
 Courtesy of MAZDA MOTORS CORP.

DRIVE BELT TENSION SPECIFICATION

Tension		N {kgf, lbf}	
Drive belt	(1)New	Used	Limit
Generator	491-745 {50-76, 111-167}	491-706 {50-72, 111-158}	343 {35, 77}
P/S, P/S+A/C	588-686 {59-70, 130-154}	422-490 {43-50, 95-110}	245 {25, 55}

(1) A belt that has been on a running engine for less than **5 min**

DRIVE BELT ADJUSTMENT

1. Loosen mounting bolts A, B and nut C.
2. Adjust the belt deflection or tension by turning the adjusting bolt D. (See **DRIVE BELT**

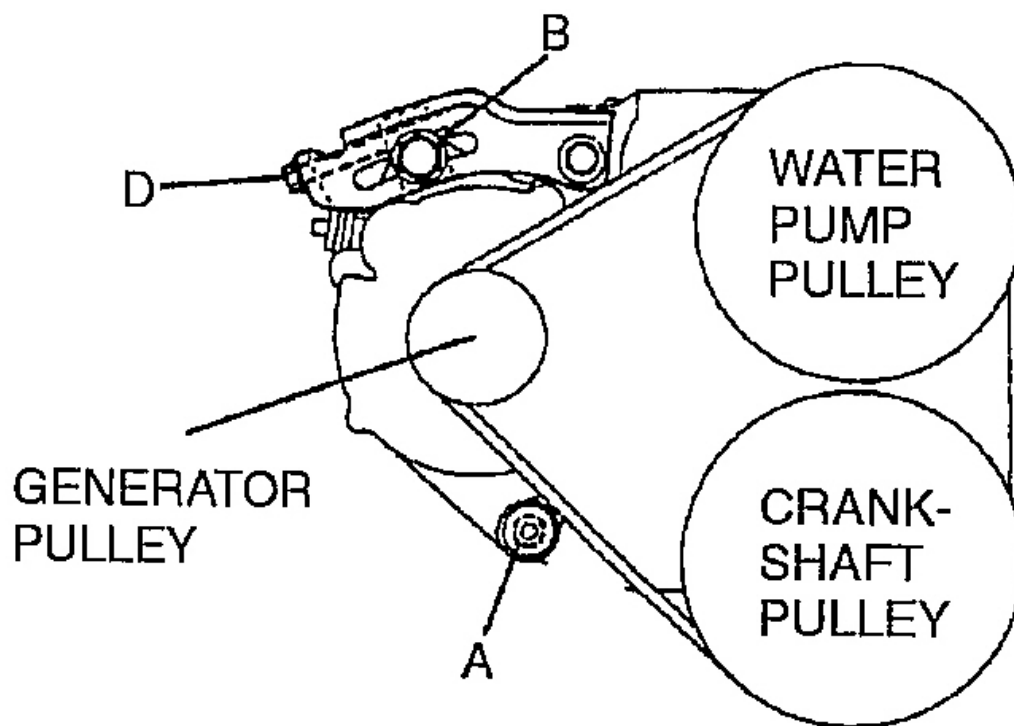
INSPECTION.)

3. Tighten mounting bolts A, B and nut C.

GENERATOR**Tightening torque**

A:38-52 N.m {3.8-5.3 kgf.m, 28-38 ft.lbf}

B:19-25 N.m {1.9-2.6 kgf.m, 14-18 ft.lbf}



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Fig. 4: Tightening Generator Mounting Bolts And Nut
Courtesy of MAZDA MOTORS CORP.

P/S, P/S+A/C

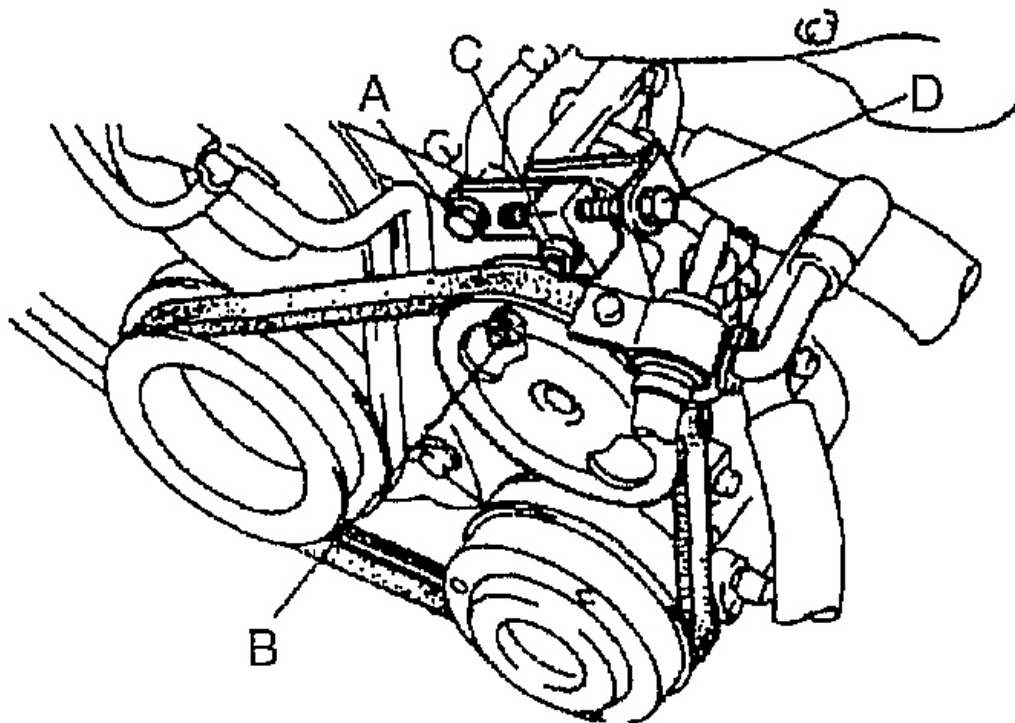
Tightening torque

A:38-51 N.m {3.8-5.3 kgf.m, 28-38 ft.lbf}

B:37-53 N.m {3.7-5.5 kgf.m, 27-39 ft.lbf}

C:19-25 N.m {1.9-2.6 kgf.m, 14-18 ft.lbf}

4. Verify the belt deflection or tension. (See **DRIVE BELT INSPECTION**.)



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Fig. 5: Verifying Belt Deflection Or Tension
Courtesy of MAZDA MOTORS CORP.

VALVE CLEARANCE INSPECTION

1. Remove the cylinder head cover.
2. Verify that the engine is in cold condition.
3. Measure the valve clearance.
 1. Turn the crankshaft clockwise so that the No.1 piston is at TDC of the compression stroke.

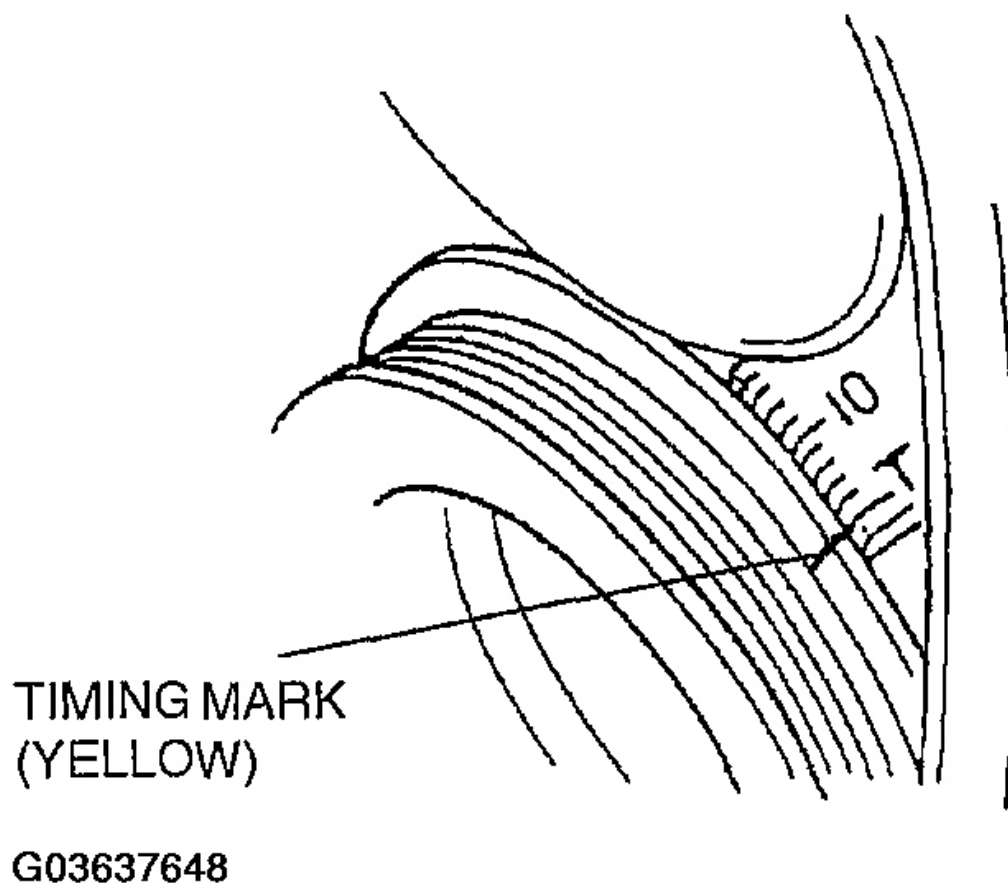


Fig. 6: Measuring Valve Clearance
Courtesy of MAZDA MOTORS CORP.

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

Standard [Engine cold]

IN:0.18-0.24 mm {0.007-0.009 in} (0.21+/-0.03 mm {0.008+/-0.0012 in})

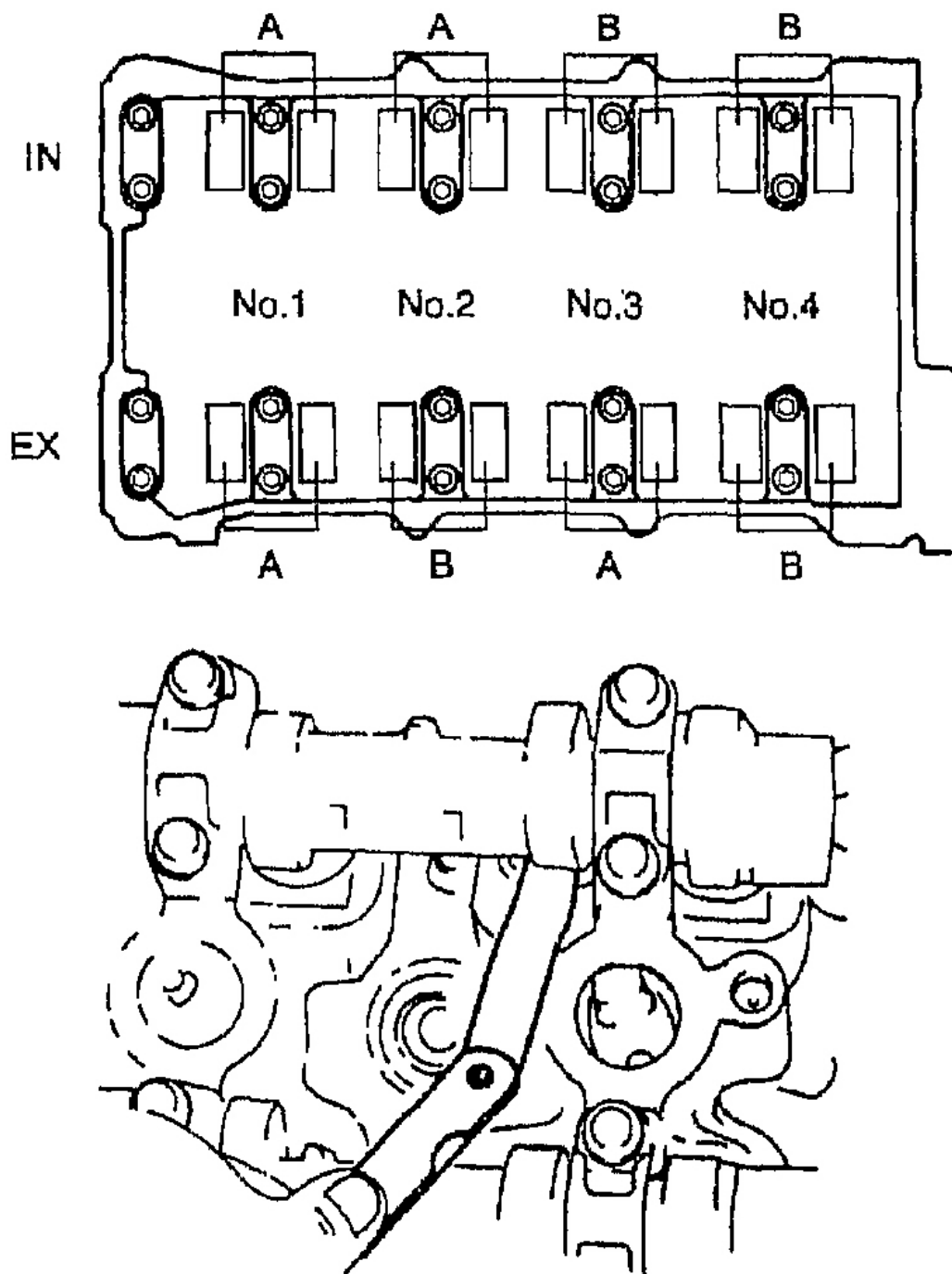
EX:0.28-0.34 mm {0.011-0.013 in} (0.31+/-0.03 mm {0.012+/-0.0012 in})

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 the figure.

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



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Fig. 7: Measuring Valve Clearance With Feeler Gauge

Courtesy of MAZDA MOTORS CORP.

Standard [Engine cold]

IN:0.18-0.24 mm {0.007-0.009 in} (0.21+/-0.03 mm {0.008+/-0.0012 in})

EX:0.28-0.34 mm {0.011-0.013 in} (0.31+/-0.03 mm {0.012+/-0.0012 in})

4. Install the cylinder head cover. (See CYLINDER HEAD COVER INSTALLATION NOTE.)

VALVE CLEARANCE ADJUSTMENT

NOTE:

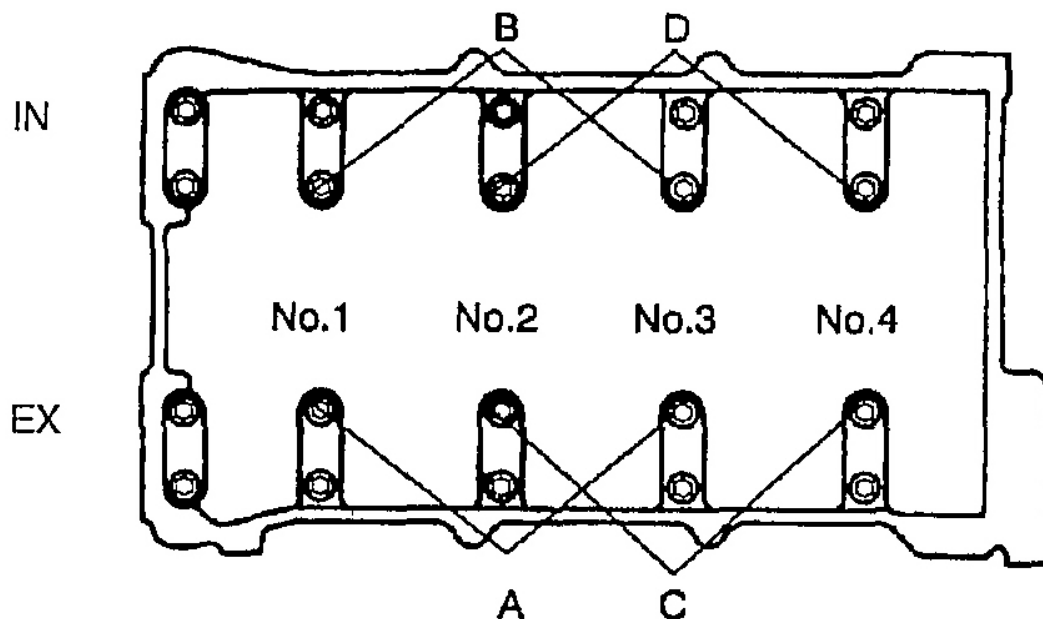
- Perform this same procedure for all camshafts requiring valve clearance adjustment.

1. Turn the crankshaft clockwise so that the cams on the camshaft requiring valve clearance adjustment are positioned straight up.
2. Remove the camshaft cap bolts if necessary.

Remove only one pair of cap bolts at a time.

Install the cap bolts before removing the next pair.

- A. For EX side No.1, 2, 3 cylinder adjustment shim removal
- B. For IN side No.1, 2, 3 cylinder adjustment shim removal
- C. For EX side No.2, 3, 4 cylinder adjustment shim removal
- D. For IN side No.2, 3, 4 cylinder adjustment shim removal



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Fig. 8: Identifying Cylinder Adjustment Shim
 Courtesy of MAZDA MOTORS CORP.

NOTE:

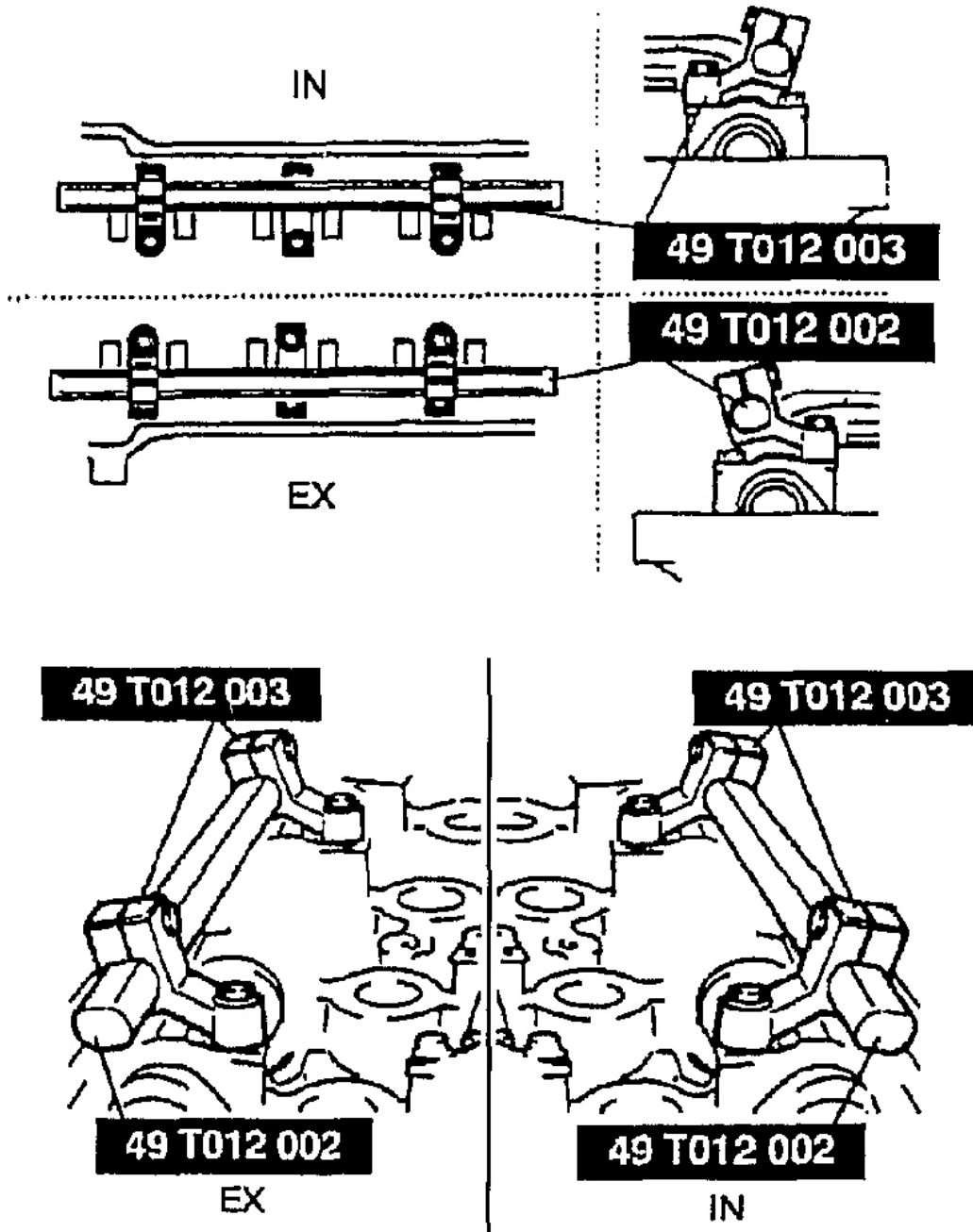
- For EX side No.2, 3 cylinder adjustment shim removal, remove bolts either A or C.
- For IN side No.2, 3 cylinder adjustment shim removal, remove bolts either B or D.

3. Install the SSTs on the camshaft using the camshaft cap bolt holes.

Tightening torque

11.3-14.2 N.m {115-145 kgf.cm, 100-125 in.lbf}

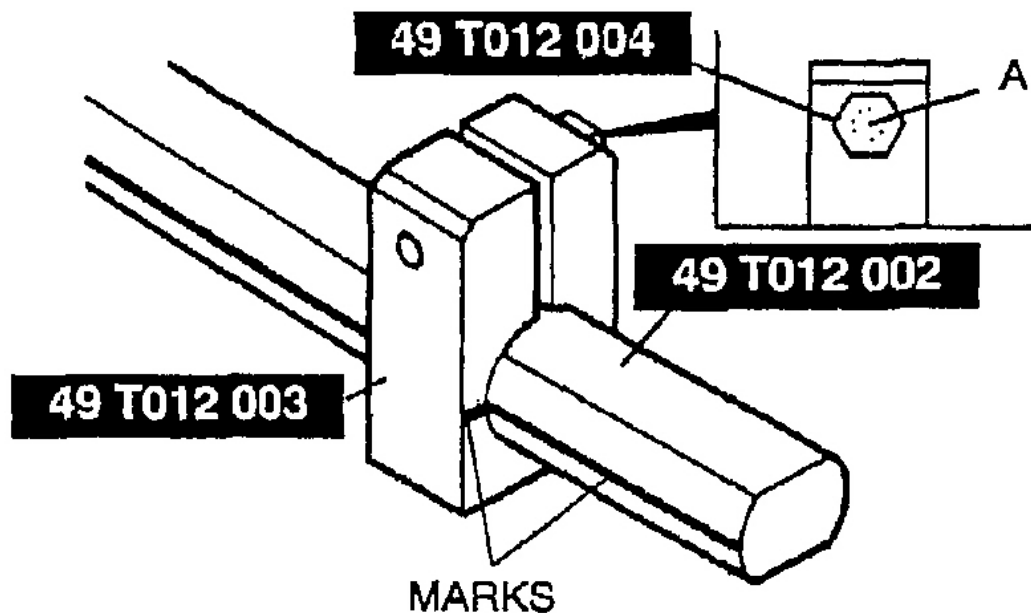
4. Align the marks on the SSTs (shaft and shaft clamp).



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Fig. 9: Installing SSTs On Camshaft Using Camshaft Cap Bolt Holes
Courtesy of MAZDA MOTORS CORP.

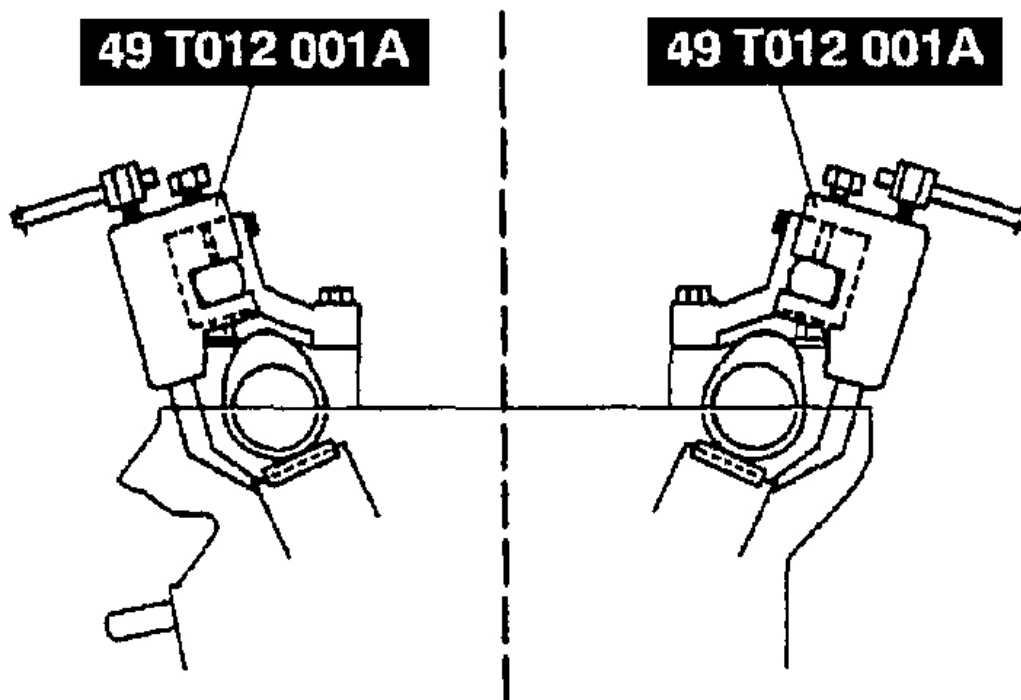
5. Tighten bolts A to secure the SST (shaft).



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Fig. 10: Tightening Bolts To Securing SST
Courtesy of MAZDA MOTORS CORP.

6. Face the SST (body) outside of the cylinder head, and mount it on the SST (shaft) at the point of the adjustment shim to be replaced.



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Fig. 11: Mounting SST At Point Of Adjustment Shim
Courtesy of MAZDA MOTORS CORP.

7. Face the notch of the tappet so that a small screwdriver can be inserted.
8. Set the **SST** on the tappet by its notch.

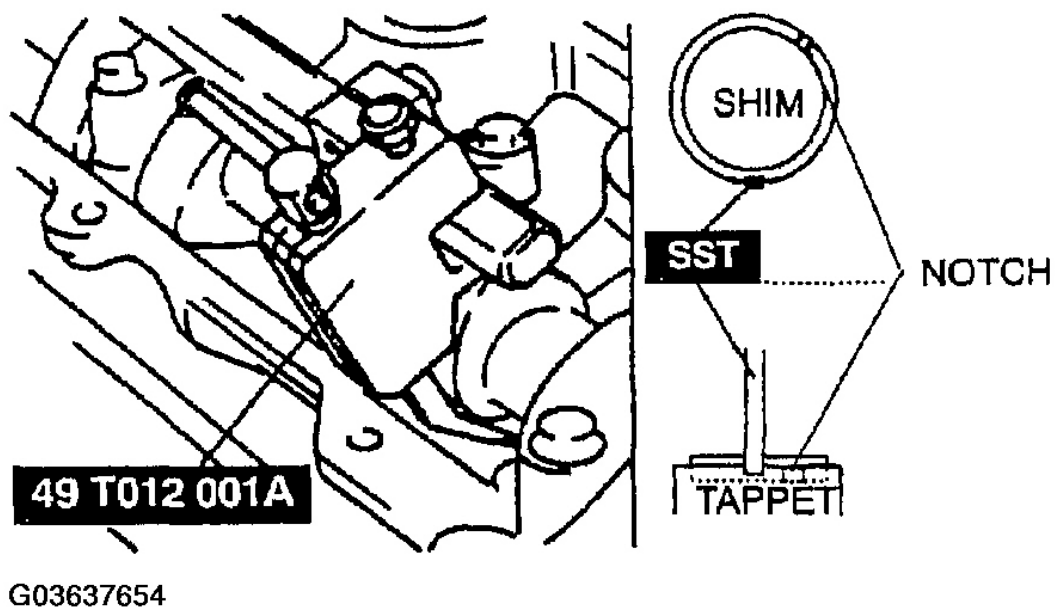


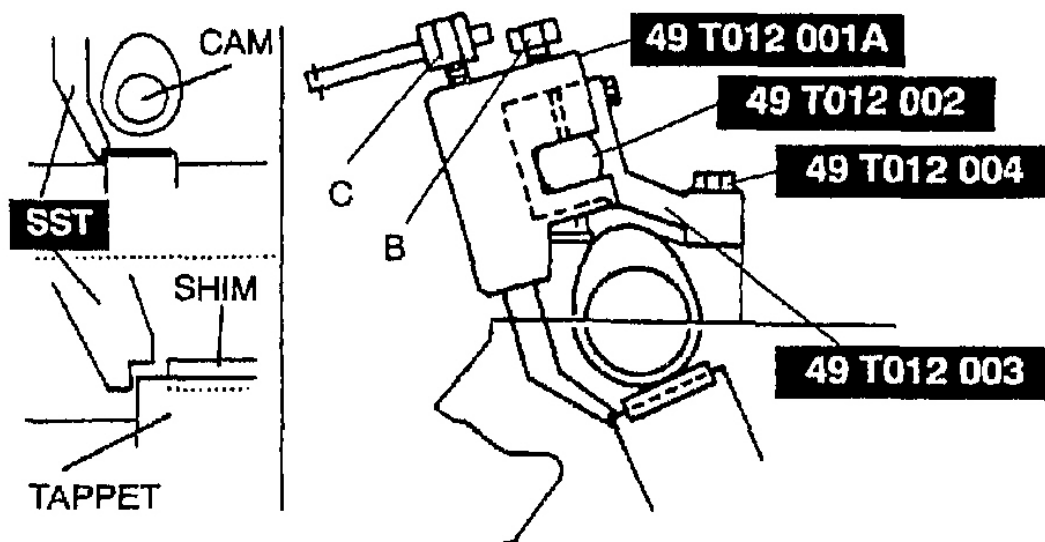
Fig. 12: Setting SST On Tappet By Notch
Courtesy of MAZDA MOTORS CORP.

9. Tighten bolt B to secure the SST (body).

CAUTION:

- Cylinder head can be damaged when the tappet is pressed down.

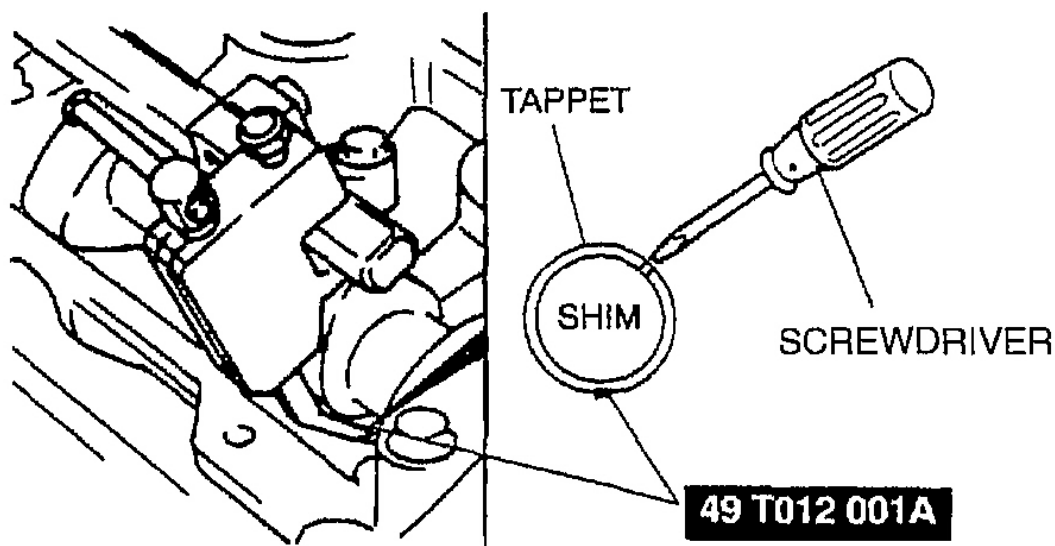
10. Tighten bolt C, and press down the tappet.



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Fig. 13: Tightening Bolt And Pressing Down Tappet
Courtesy of MAZDA MOTORS CORP.

11. Using a fine screwdriver, pry up the adjustment shim through the notch on the tappet.



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Fig. 14: Prying Up Adjustment Shim Using Screwdriver
 Courtesy of MAZDA MOTORS CORP.

12. Remove the shim using a magnet.
13. Select a proper adjustment shim.

New adjustment shim

= Removed shim thickness + Measured valve clearance - Standard valve clearance (IN:0.21 mm {0.008 in}, EX:0.31 mm {0.012 in})

14. Push the selected shim into the tappet.
15. Loosen bolt C to allow the tappet to move up.
16. Loosen bolt B and remove the SST (body).
17. Remove the SSTs and tighten the camshaft cap bolts.

Tightening torque

11.3-14.2 N.m {115-145 kgf.cm, 100-125 in.lbf}

18. Verify the valve clearance. (See VALVE CLEARANCE INSPECTION.)

COMPRESSION INSPECTION

WARNING:

- Hot engines and engine oil can cause severe burns. Be careful not

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to burn yourself during removal/installation of each component.

- 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 [BP, BP WITH TC]** .)

1. Verify that the battery is fully charged.
2. Charge it again if necessary. (See **BATTERY INSPECTION** .)
3. Warm up the engine to the normal operating temperature.
4. Stop the engine and allow it to cool off for about **10 min.**
5. Perform "Fuel Line Safety Procedure". (See **BEFORE SERVICE PRECAUTION [BP, BP WITH TC]** .)
6. Leave the fuel pump relay removed.
7. Remove the spark plugs. (See **SPARK PLUG REMOVAL/INSTALLATION** .)
8. Disconnect the ignition coil connector.
9. Connect a compression gauge into the No.1 spark plug hole.
10. Fully depress the accelerator pedal and crank the engine.
11. Record the maximum gauge reading.
12. Inspect each cylinder as above.
 - If the compression in one or more cylinders is low or the compression difference between cylinders exceeds the maximum, pour a small amount of clean engine oil into the cylinder and inspect the compression again.
 - 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 is distorted and overhaul is required.

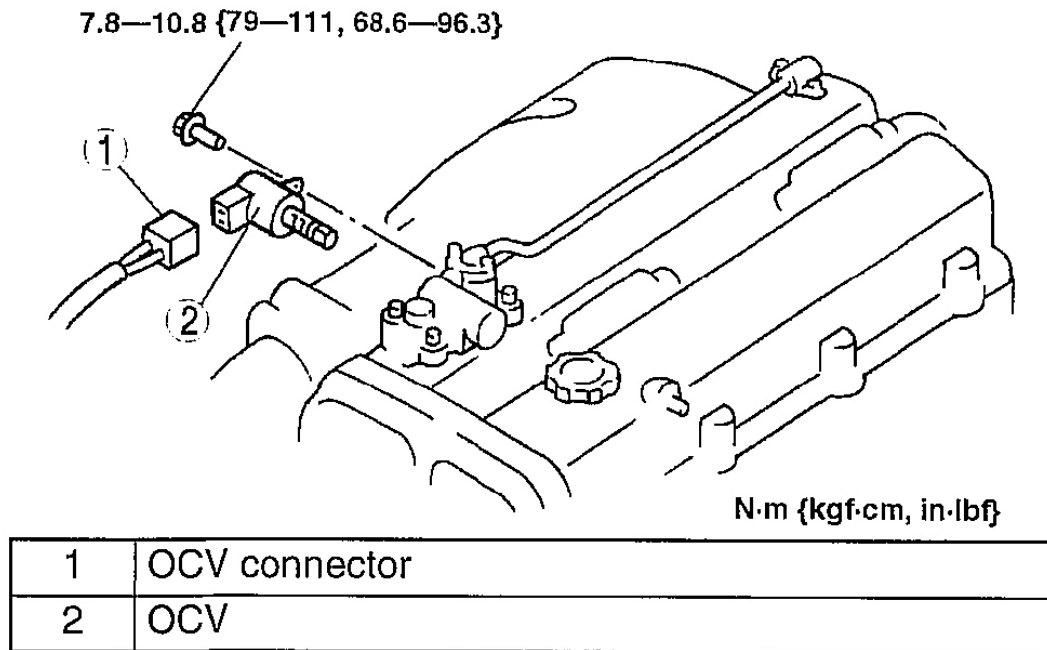
ENGINE COMPRESSION SPECIFICATIONS

Compression	kPa {kgf/cm ² , psi} [RPM]	
	Engine	
	BP	BP with TC
Standard	1363 {13.9, 198} [300]	1442 {14.7, 209} [300]
Minimum	1009 {10.29, 146} [300]	
Maximum difference between cylinders	196 kPa {2.0 kgf/cm ² , 28 psi}	

13. Disconnect the compression gauge.
14. Connect the ignition coil connector.
15. Install the fuel pump relay.
16. Install the spark plugs. (See SPARK PLUG REMOVAL/INSTALLATION .)

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

1. Disconnect the negative battery cable.
2. Remove in the order indicated in the table.



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Fig. 15: Identifying OCV And Connector With Torque Specifications
 Courtesy of MAZDA MOTORS CORP.

3. Install in the reverse order of removal.

OIL CONTROL VALVE (OCV) INSPECTION [BP]

COIL RESISTANCE

1. Disconnect the OCV connector.
2. Verify that the resistance between terminals A and B is within the specification.

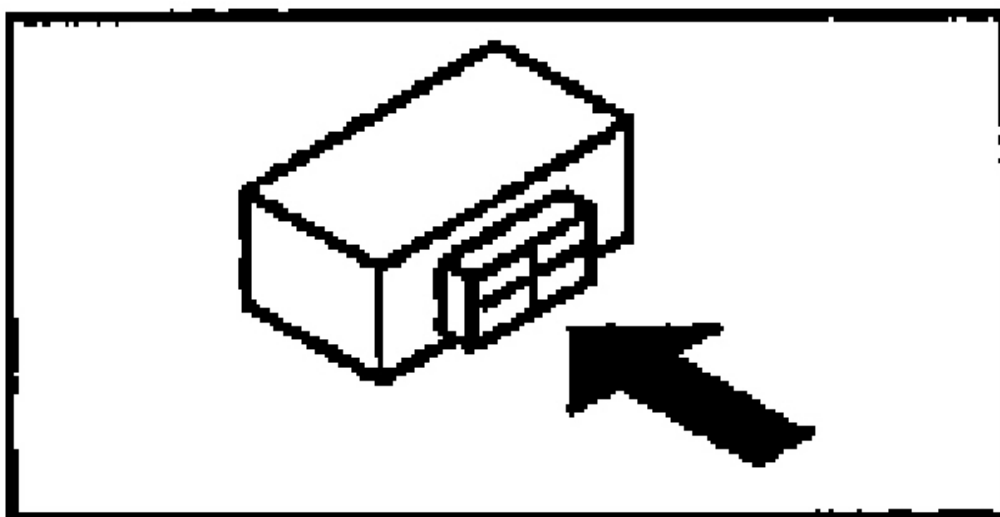
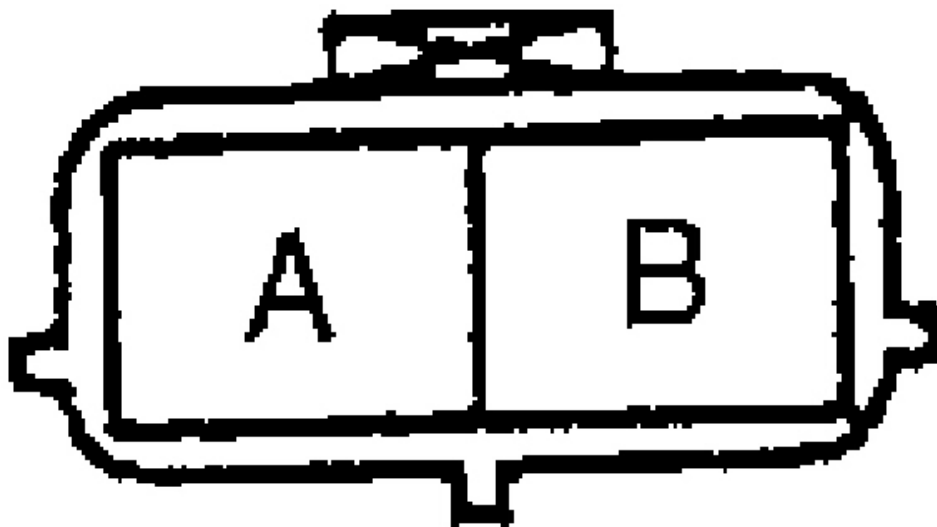
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- If not as specified, replace the OCV.

Specification (20°C {68°F})

6.9-7.9 ohms

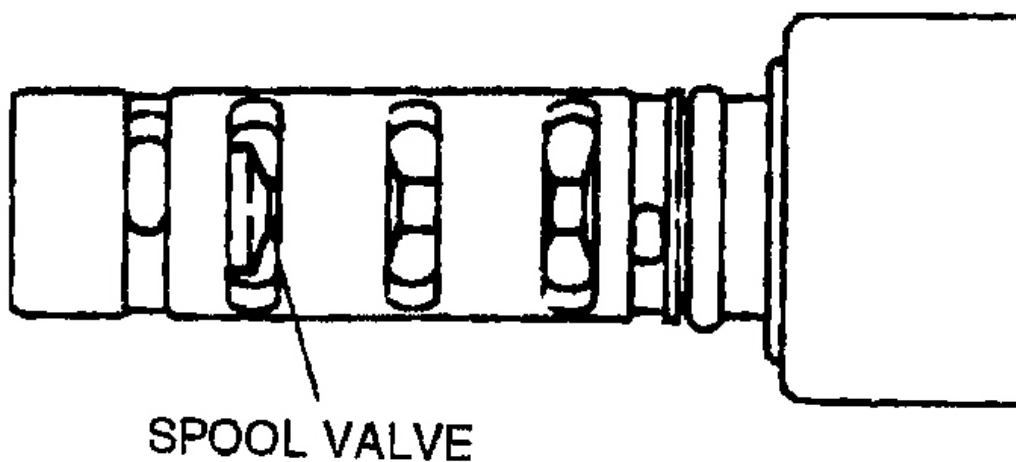


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Fig. 16: Identifying OCV Connector Terminals
Courtesy of MAZDA MOTORS CORP.

SPOOL VALVE OPERATION

1. Remove the OCV. (See **OIL CONTROL VALVE (OCV) REMOVAL/INSTALLATION [BP].**)
2. Verify that the spool valve in the OCV is the maximum valve timing retard position.
 - If not as specified, replace the OCV.
3. Verify that the battery is fully charged.



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Fig. 17: Verifying Spool Valve In OCV Is Maximum Valve Timing Retard Position
Courtesy of MAZDA MOTORS CORP.

4. Apply battery positive voltage between the OCV terminals and verify that the spool valve operates and moves to the maximum valve timing advance position.

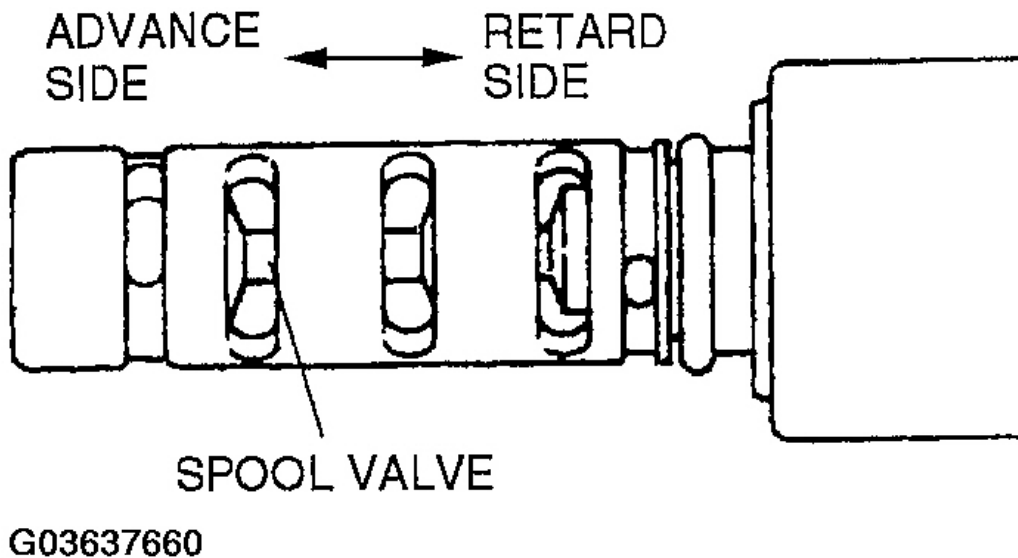


Fig. 18: Verifying Spool Valve Operates
 Courtesy of MAZDA MOTORS CORP.

- If not as specified, replace the OCV.

NOTE:

- When applying battery positive voltage between the 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.

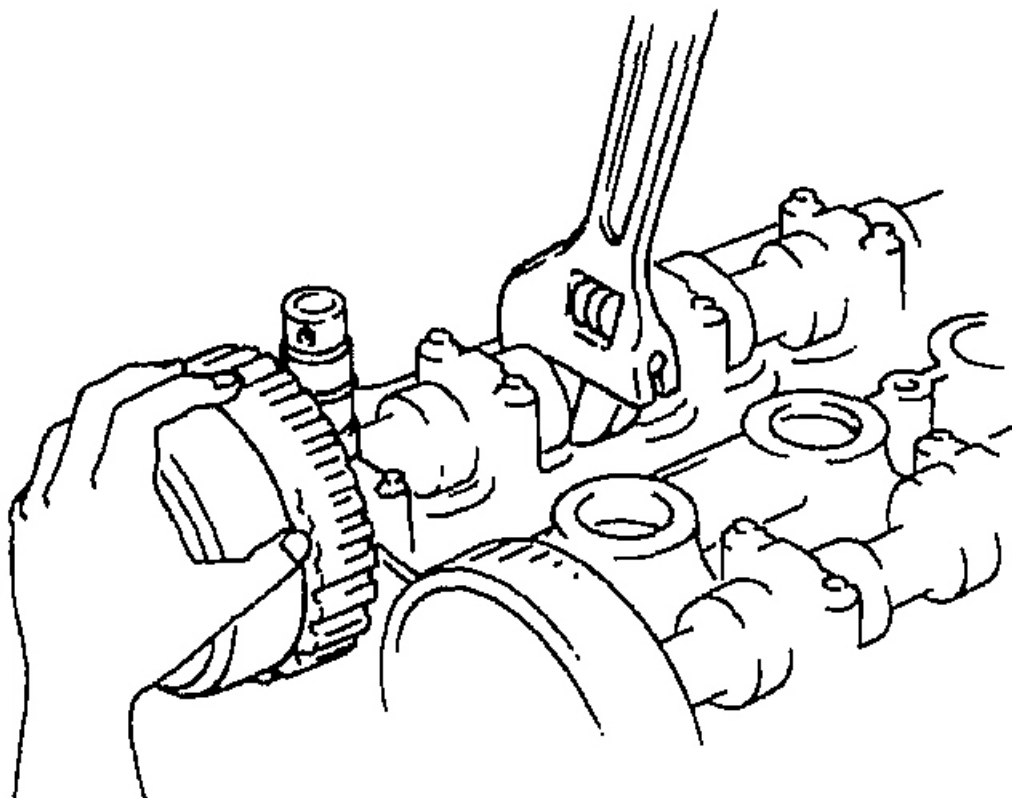
5. Stop applying battery positive voltage and verify that the spool valve returns to the maximum valve timing retard position.
 - If not as specified, replace the OCV.

VARIABLE VALVE TIMING ACTUATOR INSPECTION [BP]

STOPPER PIN

1. Disconnect the negative battery cable.
2. Remove the timing belt. (See **TIMING BELT REMOVAL/INSTALLATION.**)
3. Hold a hexagonal part of the intake camshaft with an adjustable wrench to prevent the camshaft from

rotating. Attempt to rotate the variable timing actuator by hand and verify that it does not move.



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Fig. 19: Holding Hexagonal Part Of Intake Camshaft With Adjustable Wrench
Courtesy of MAZDA MOTORS CORP.

- If the variable valve timing actuator moves, the stopper pin in the variable valve timing actuator is not operating. Replace the variable valve timing actuator.
4. Install in the timing belt. (See **TIMING BELT REMOVAL/INSTALLATION.**)

EXTREME SPARK RETARD POSITION

1. Disconnect the negative battery cable.
2. Remove the variable valve timing actuator.

CAUTION: • If engine oil gets on parts, they may not function properly.

When removing the variable valve timing actuator, be sure to cover the other parts with a cloth to protect them from the oil.

3. Verify that the camshaft dowel pin hole on the variable valve timing actuator is aligned with the top of the third tooth, by counting back 3 teeth to the sprocket gap which is aligned with the alignment mark.

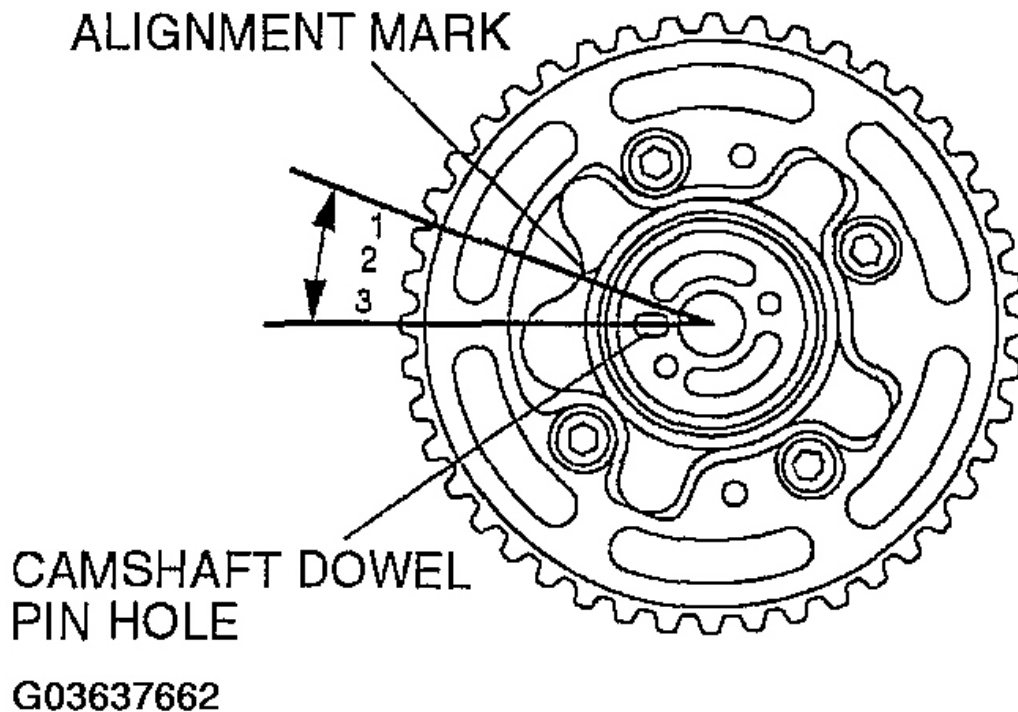


Fig. 20: Identifying Camshaft Dowel Pin Hole Alignment Mark
 Courtesy of MAZDA MOTORS CORP.

- If not as specified, the stopper pin in the variable valve timing actuator is not engaged at the position of maximum valve timing retard. Replace the variable valve timing actuator.
4. Install the variable valve timing actuator.

TIMING BELT REMOVAL/INSTALLATION

1. Disconnect the negative battery cable.
2. Drain the engine coolant. (See **ENGINE COOLANT REPLACEMENT** .)
3. Remove the front strut bar. (See **FRONT STRUT BAR REMOVAL/INSTALLATION [BP]** .) (See **FRONT STRUT BAR REMOVAL/INSTALLATION [BP WITH TC]** .)

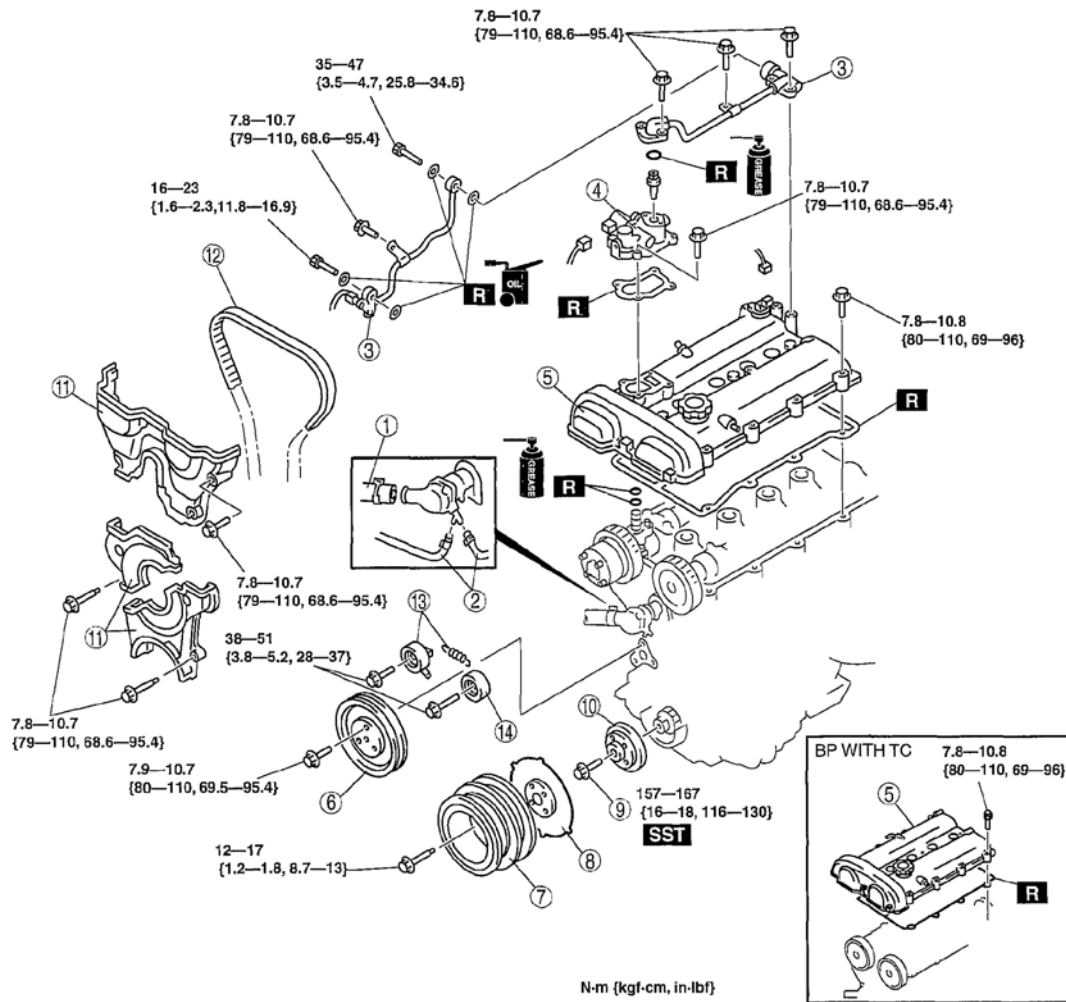
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4. Remove the air hose No.2, air hose No.1, air cleaner cover, and air pipe No.1 installation bolt. (BP with TC) (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP WITH TC]** .)
5. Remove the air pipe. (BP) (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP]** .)
6. Remove the drive belt. (See **DRIVE BELT ADJUSTMENT.**)
7. Remove the CMP sensor. (BP with TC)
8. Remove the CKP sensor.
9. Remove the high-tension lead and ignition coil. (See **IGNITION COIL REMOVAL/INSTALLATION** .)
10. Remove the spark plug. (See **SPARK PLUG REMOVAL/INSTALLATION** .)
11. Remove in the order indicated in the table.
12. Install in the reverse order of removal.
13. Inspect the air gap between the crankshaft position sensor.
14. Inspect the engine oil level.
15. Start the engine, and inspect the following and adjust if necessary:
 - Pulley and belt for runout or contact
 - Engine oil and engine coolant for leakage
 - Ignition timing
 - Operation of auxiliary parts

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1	Upper radiator hose
2	Water hose
3	Oil pipe (BP) (See Oil Pipe Removal Note (BP)) (See Oil Pipe Installation Note (BP))
4	Oil control valve (OCV) case (BP) (See Oil Control Valve (OCV) Case Installation Note (BP))
5	Cylinder head cover (See Cylinder Head Cover Installation Note)
6	Water pump pulley
7	Crankshaft pulley

8	Plate
9	Pulley lock bolt (See Pulley Lock Bolt Removal/ Installation Note)
10	Pulley boss
11	Timing belt cover (See Timing Belt Cover Installation Note)
12	Timing belt (See Timing Belt Removal Note) (See Timing Belt Installation Note)
13	Tensioner and tensioner spring (See Tensioner and Tensioner Spring Installation Note)
14	Idler

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Fig. 21: Identifying Mechanical Component & Torque Specifications
 Courtesy of MAZDA MOTORS CORP.

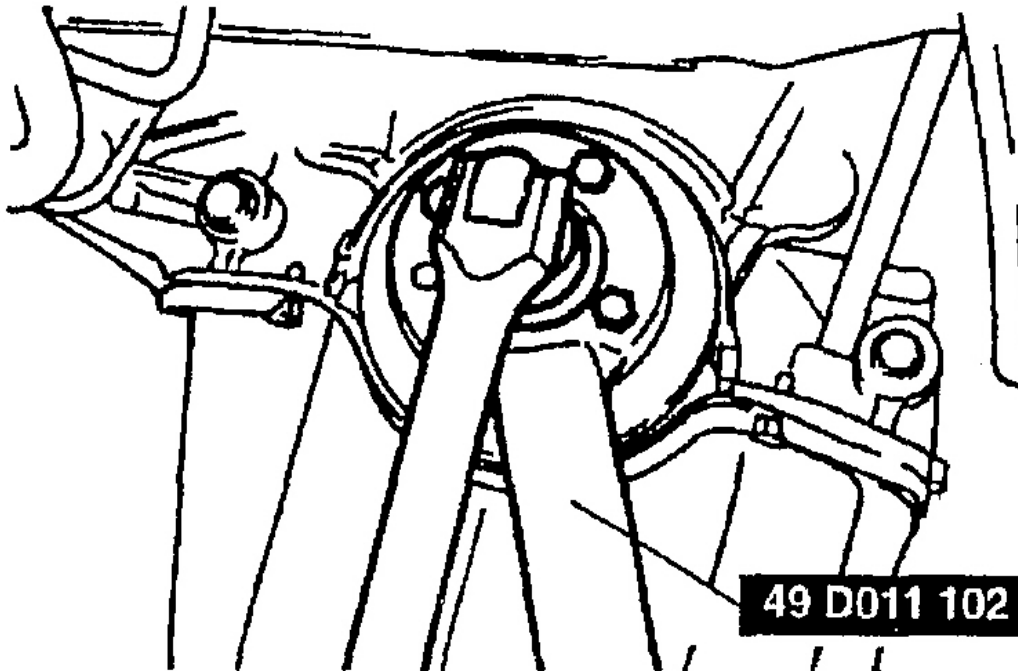
OIL PIPE REMOVAL NOTE (BP)

- CAUTION:**
- If the engine oil get spilled on other components, it may cause malfunction of the components. Cover with a rag to prevent engine oil from spilling whenever removing the oil pipe.

- NOTE:**
- Keep the oil pipe of engine side with the bolt removed.

PULLEY LOCK BOLT REMOVAL/INSTALLATION NOTE

1. Install SST on the pulley boss to prevent the crankshaft from rotating.



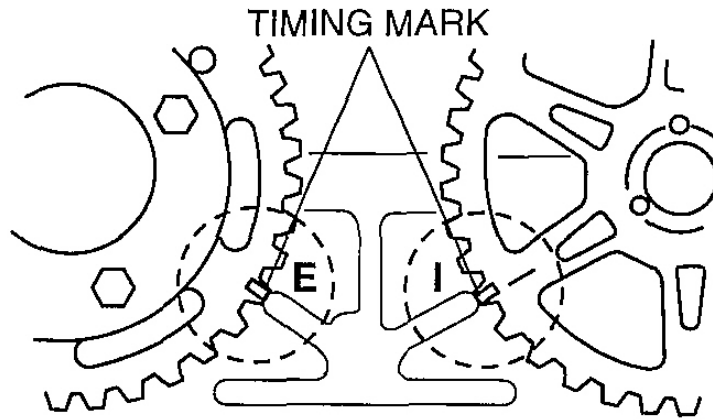
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Fig. 22: Installing SST On Pulley Boss To Prevent Crankshaft From Rotating
Courtesy of MAZDA MOTORS CORP.

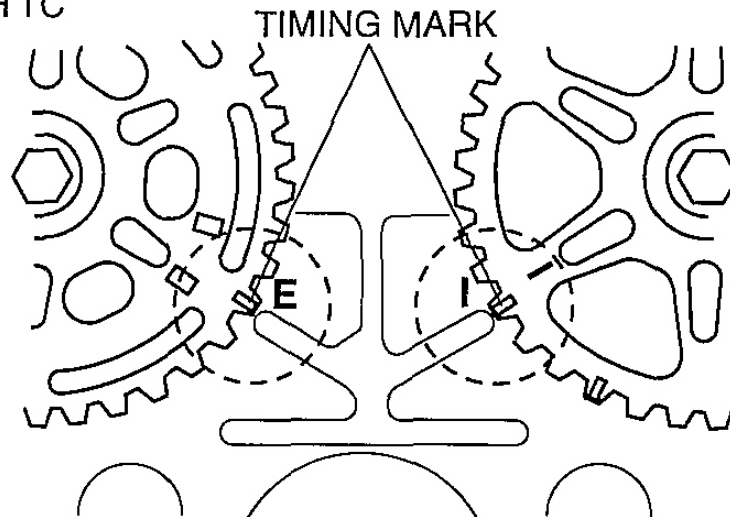
TIMING BELT REMOVAL NOTE

1. Install the pulley boss on the crankshaft to temporarily tighten with pulley lock bolt.
2. Rotate the crankshaft in the appropriate direction to meet the timing mark.

BP



BP WITH TC



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Fig. 23: Rotating Crankshaft Of Appropriate Direction Timing Mark
Courtesy of MAZDA MOTORS CORP.

NOTE:

- It is preferable that the positioning pins of the pulley boss are just above the timing marks.

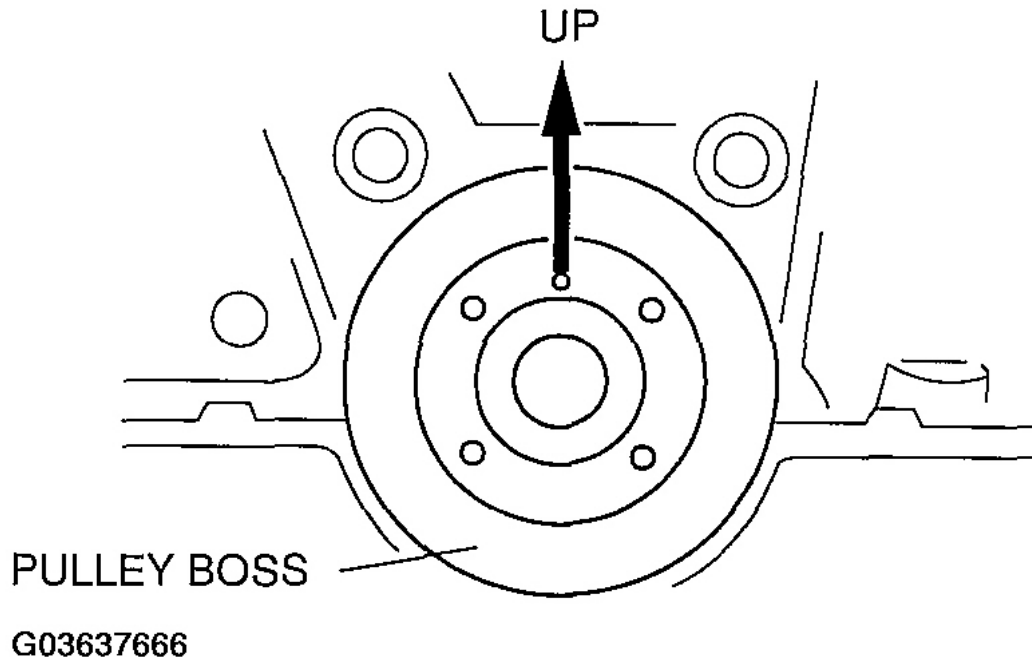
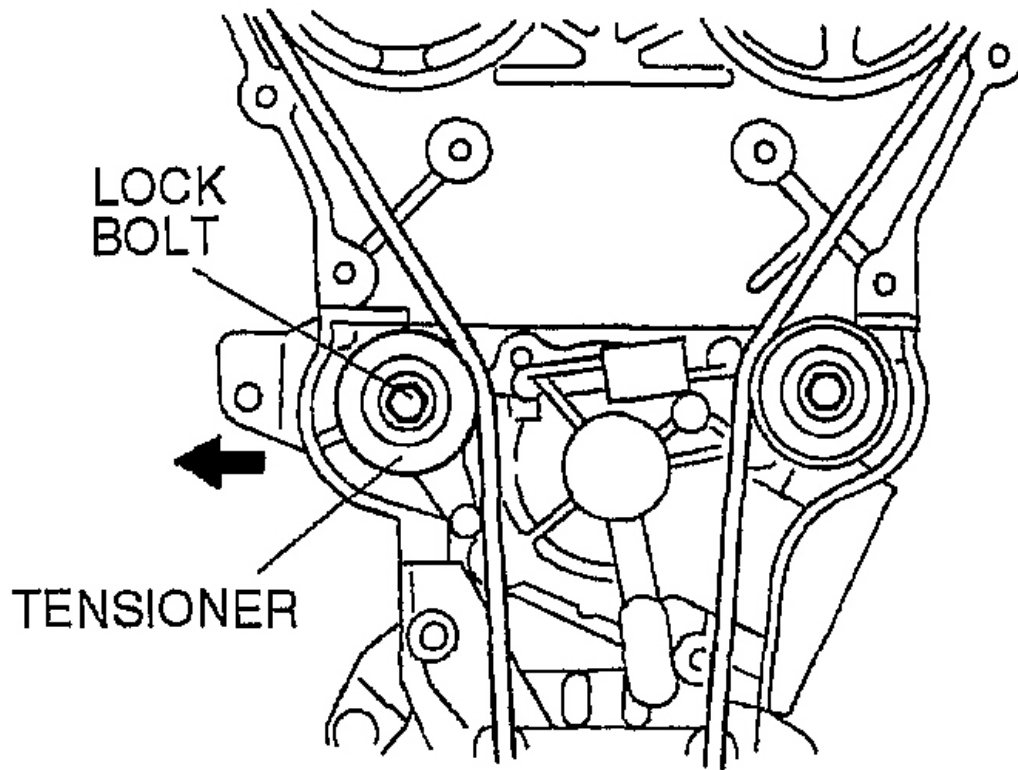


Fig. 24: Positioning Pins Of Pulley Boss
Courtesy of MAZDA MOTORS CORP.

3. Loosen the tensioner lock bolt and temporarily tighten the tensioner lock bolt while pulling the tensioner to the left.



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Fig. 25: Loosening Tensioner Lock Bolt
Courtesy of MAZDA MOTORS CORP.

CAUTION:

- The following will damage the belt and shorten its life; forcefully it, turning it inside out, or allowing oil or grease on it.

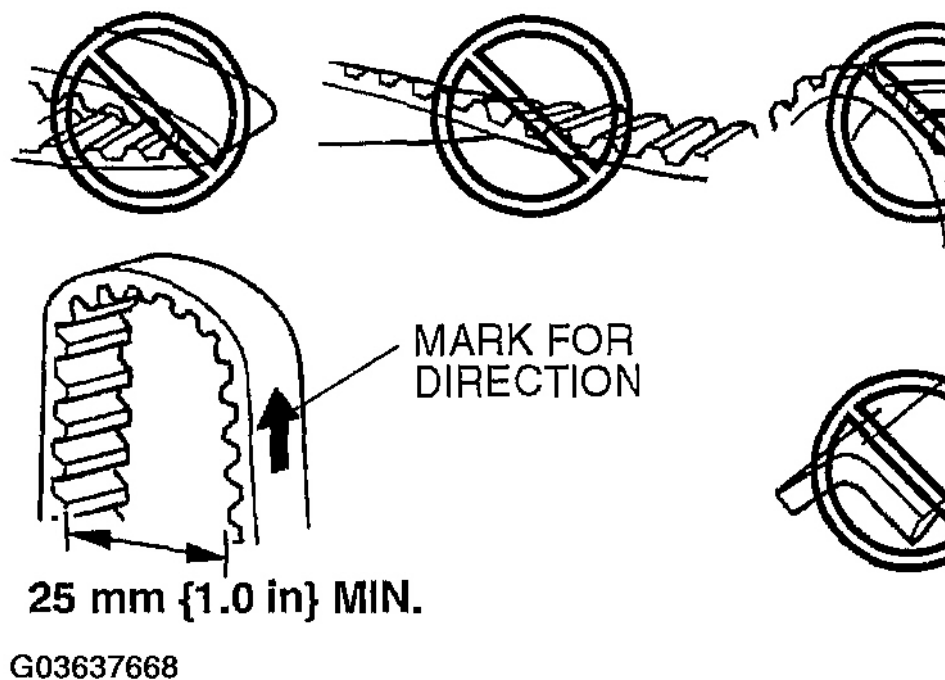


Fig. 26: Locating Timing Belt Mark Direction
Courtesy of MAZDA MOTORS CORP.

NOTE:

- Mark the timing belt rotation on the belt for proper reinstallation.

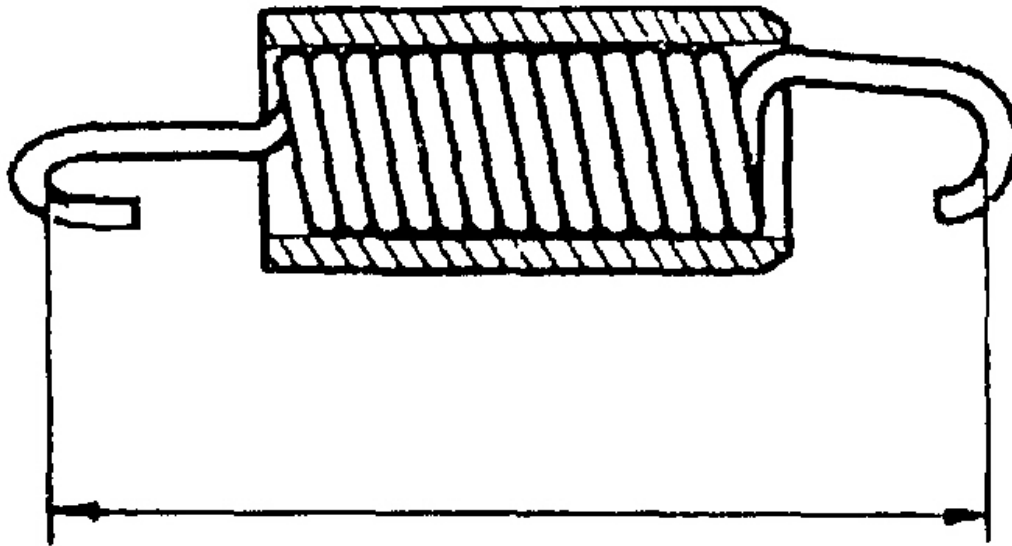
TENSIONER AND TENSIONER SPRING INSTALLATION NOTE

1. Measure the tensioner spring free length.
 - If not within the specification, replace the tensioner spring.

Free length

59.2 mm {2.33 in}

2. Install the tensioner.



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Fig. 27: Measuring Tensioner Spring Free Length
Courtesy of MAZDA MOTORS CORP.

3. Install the tensioner spring with the damper rubber closing face on the right side.
4. Temporarily secure the tensioner with the spring fully extended.

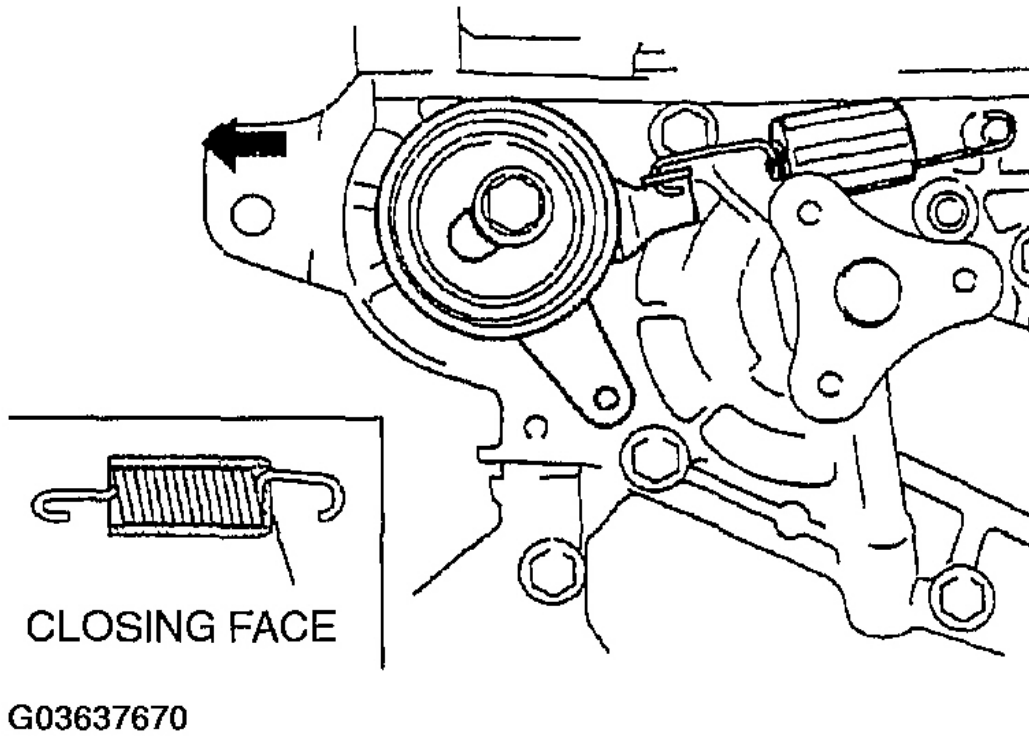
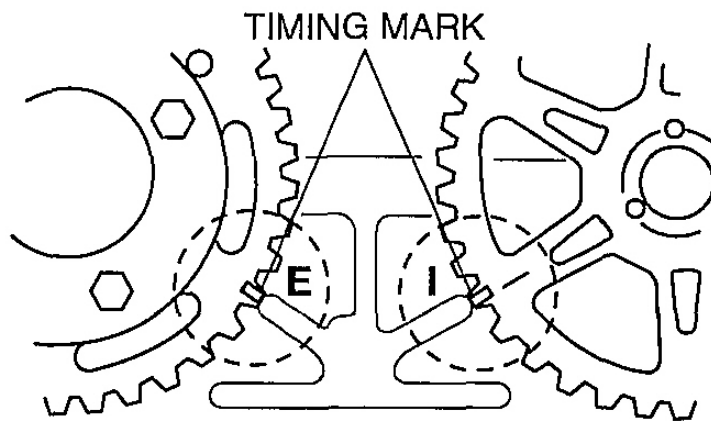


Fig. 28: Installing Tensioner Spring With Damper Rubber
Courtesy of MAZDA MOTORS CORP.

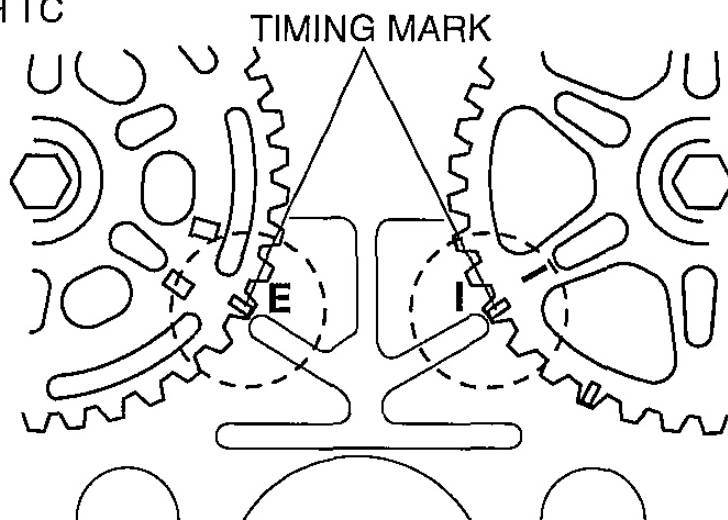
TIMING BELT INSTALLATION NOTE

1. Verify that the timing belt pulley mark and camshaft pulley marks are aligned with the timing marks as shown.

BP

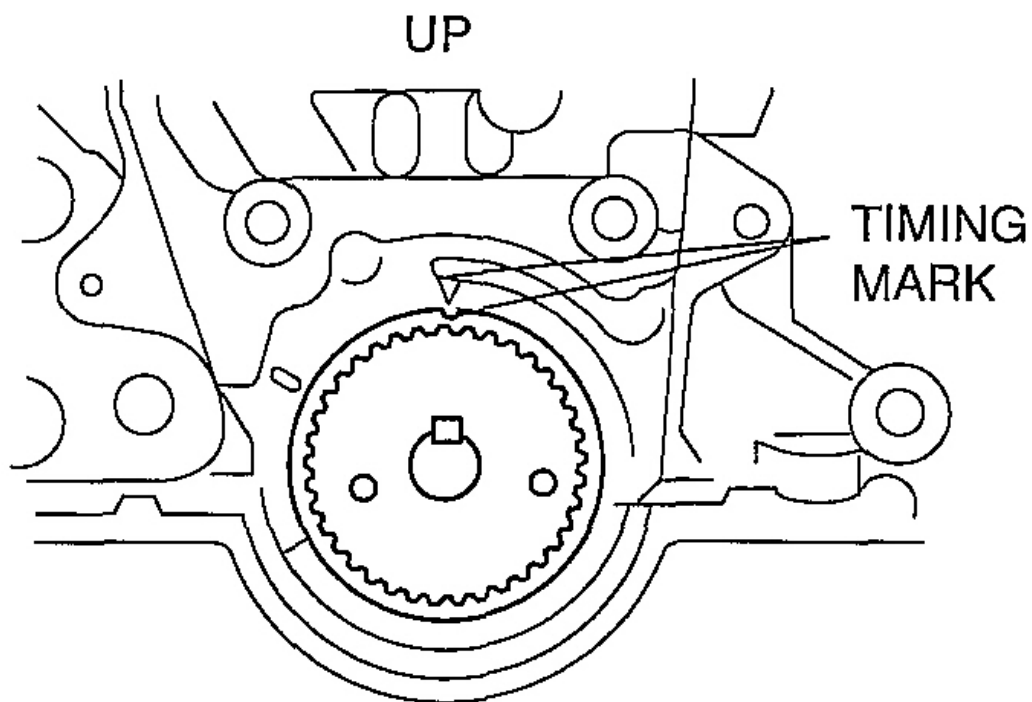


BP WITH TC



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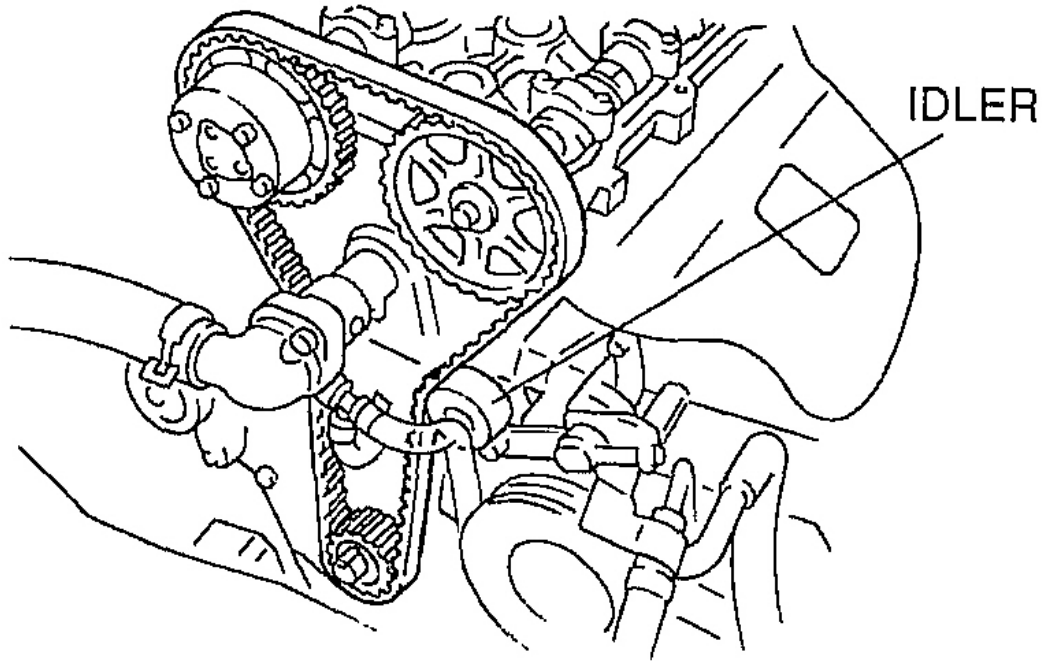
Fig. 29: Aligning With Timing Marks
Courtesy of MAZDA MOTORS CORP.



G03637672

Fig. 30: Identifying Timing Marks
Courtesy of MAZDA MOTORS CORP.

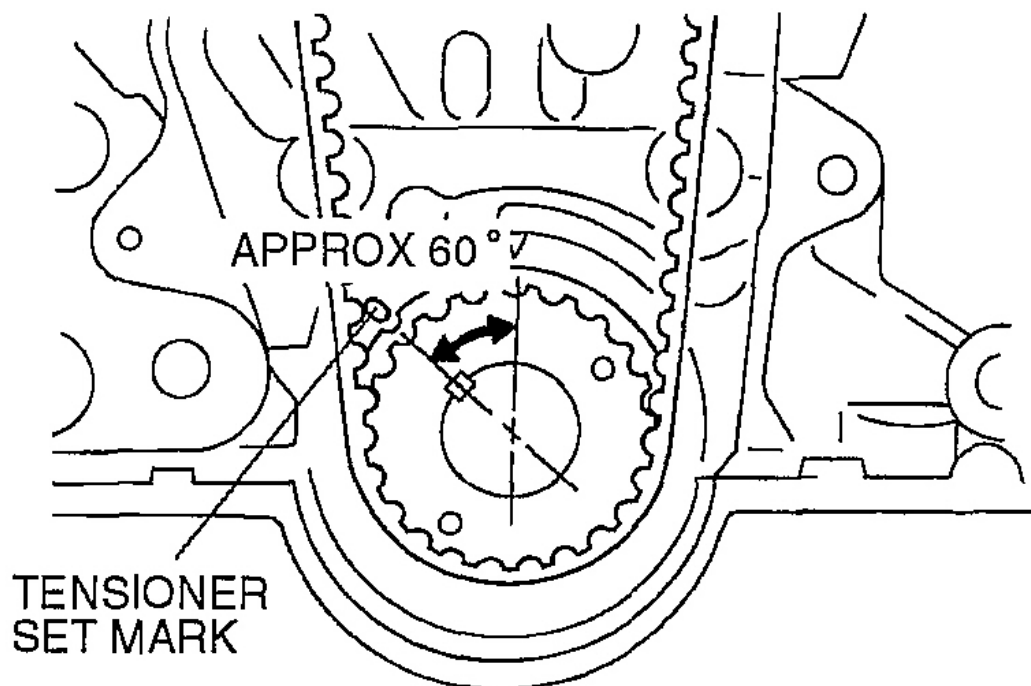
2. Install the timing belt so that there is no looseness at the idler side and between the camshaft pulleys.
3. Install the pulley boss and pulley lock bolt.



G03637673

Fig. 31: Installing Timing Belt No Looseness At Idler Side
Courtesy of MAZDA MOTORS CORP.

4. Turn the crankshaft clockwise **1 and 5/6 times** , and align the timing belt pulley mark with the tensioner set mark for proper timing belt tension adjustment.



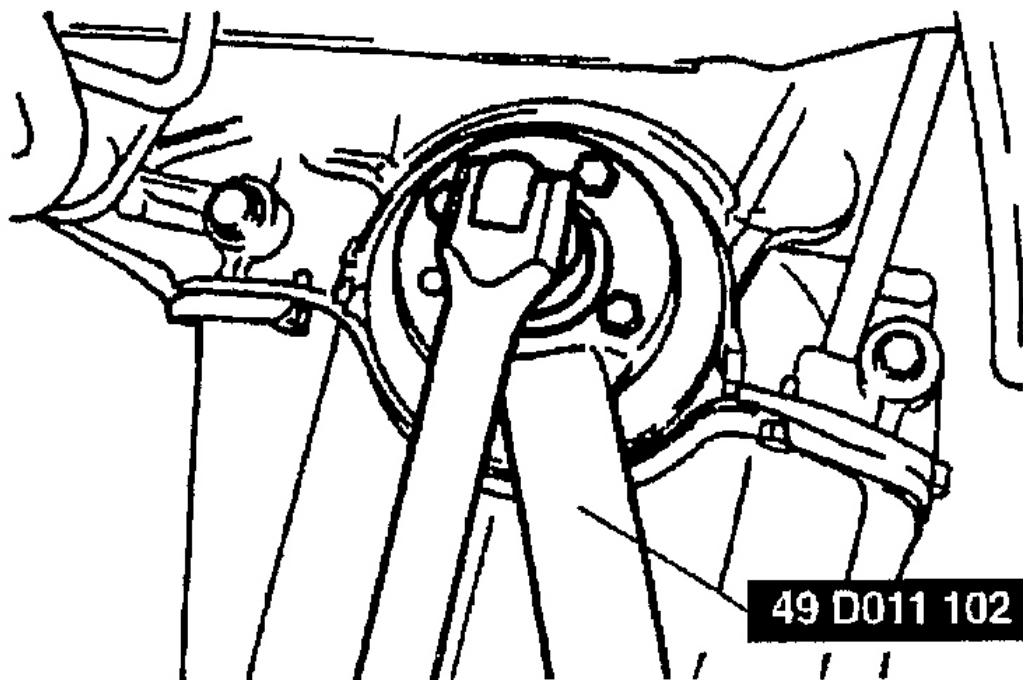
G03637674

Fig. 32: Aligning Timing Belt Pulley Mark With Tensioner Set Mark
Courtesy of MAZDA MOTORS CORP.

5. Hold the crankshaft using the SST , and remove the pulley lock bolt and the pulley boss.
6. Verify that the timing belt pulley mark is aligned with the tensioner set mark.
7. Loosen the tensioner lock bolt to apply tension to the timing belt.
8. Tighten the tensioner lock bolt.

CAUTION:

- Avoid the tensioner from moving with the tensioner lock bolt as it is turned.



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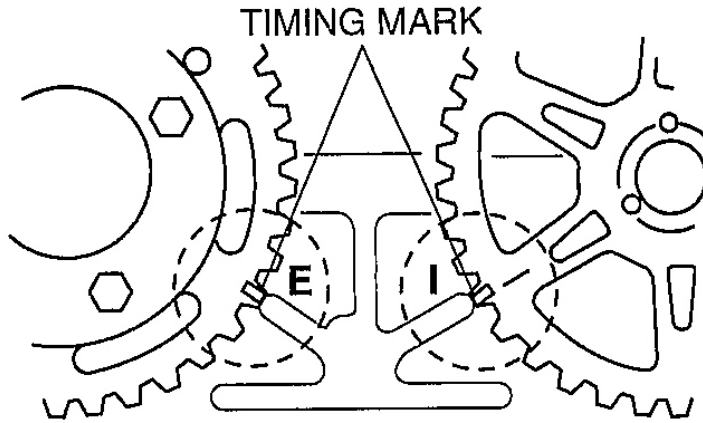
Fig. 33: Removing Pulley Lock Bolt And Pulley Boss
Courtesy of MAZDA MOTORS CORP.

9. Install the pulley boss and the pulley lock bolt.
10. Turn the crankshaft **2 and 1/6 times** , and face the pin on the pulley boss straight up.
11. Verify that the camshaft pulley marks are aligned with the timing marks as shown.
 - If not, repeat from "Timing Belt Removal Note". (See **TIMING BELT REMOVAL NOTE**.)

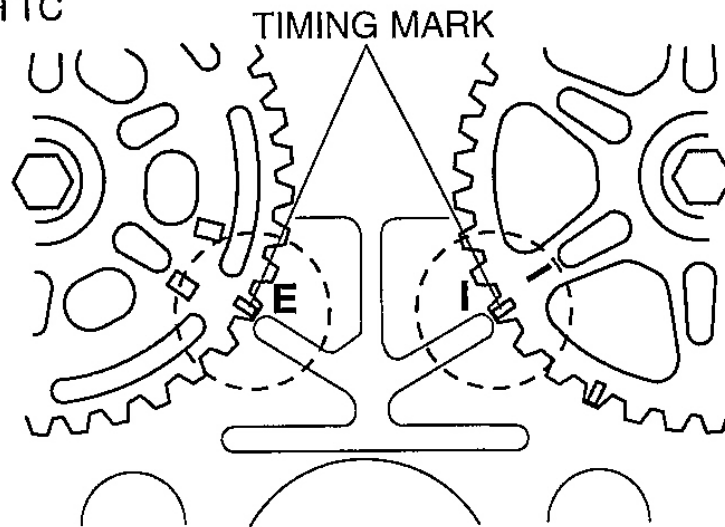
NOTE:

- It is preferable that the positioning pins of the pulley boss are just above the timing marks.

BP



BP WITH TC



G03637676

Fig. 34: Verifying Camshaft Pulley Marks And Aligning With Timing Marks
Courtesy of MAZDA MOTORS CORP.

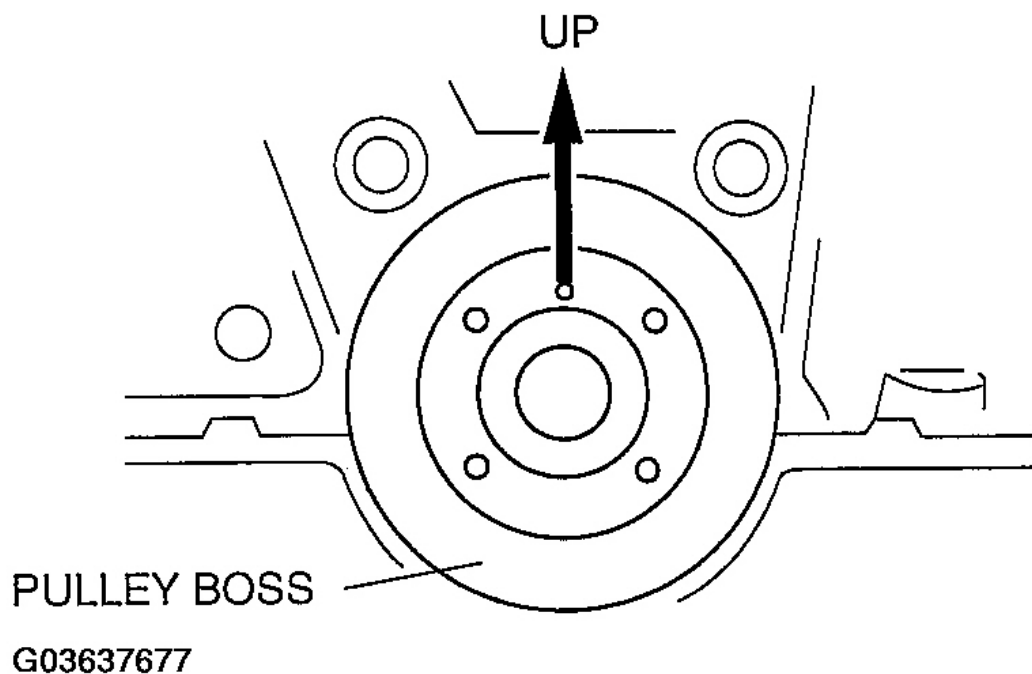
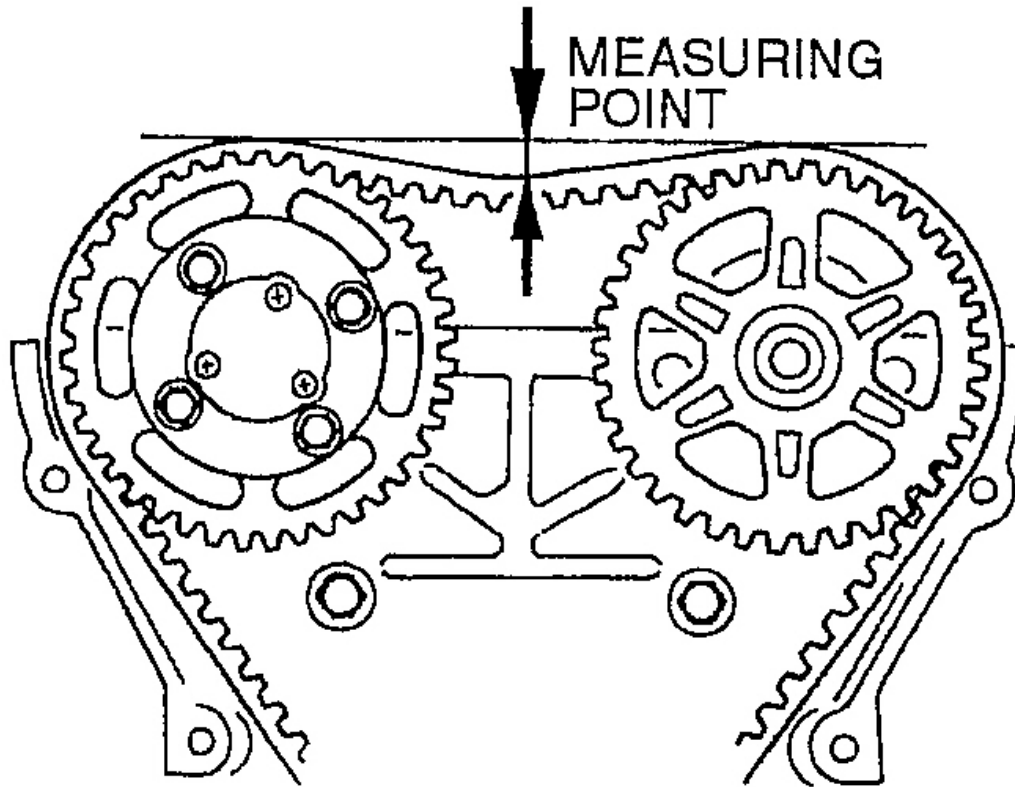


Fig. 35: Identifying Pulley Boss
Courtesy of MAZDA MOTORS CORP.

12. Measure the belt deflection at the point shown in **Fig. 36**.
 - If not as specified, repeat from Step 4.

Timing belt deflection

8.5-11.5 mm {0.34-0.45 in}

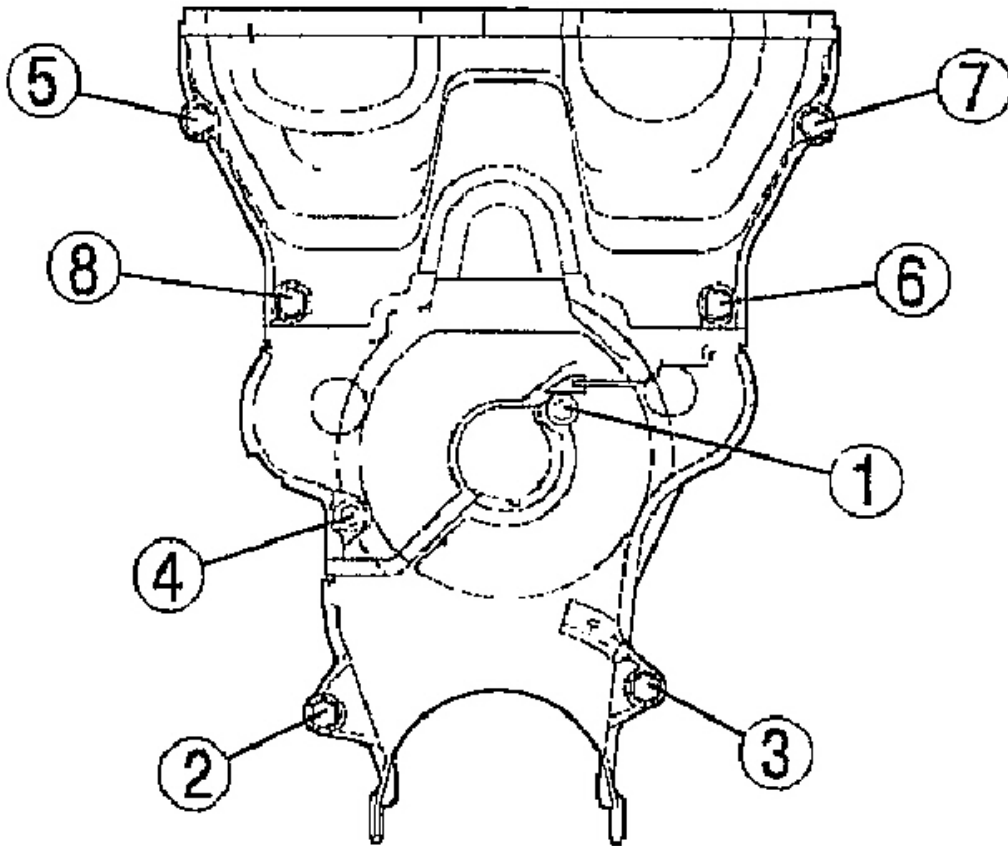


G03637678

Fig. 36: Measuring Belt Deflection Point
Courtesy of MAZDA MOTORS CORP.

TIMING BELT COVER INSTALLATION NOTE

1. Tighten the timing belt cover bolts in the numerical order shown in **Fig. 37**.



G03637679

Fig. 37: Tightening Timing Belt Cover Bolts
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD COVER INSTALLATION NOTE

1. Apply liquid gasket to the portions shown in **Fig. 38**.

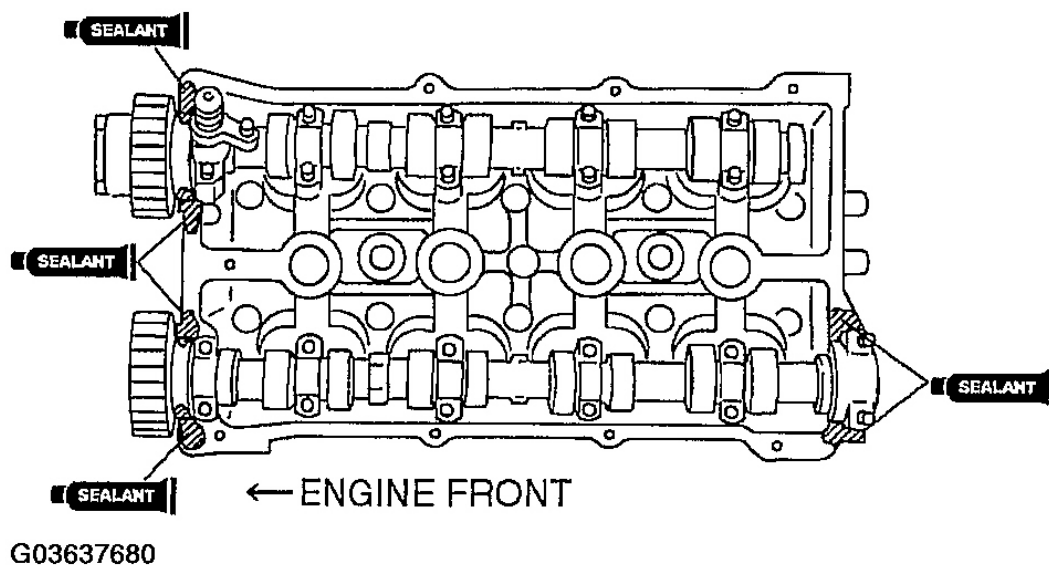


Fig. 38: Applying Liquid Gasket
Courtesy of MAZDA MOTORS CORP.

2. Temporarily tighten the cylinder head cover bolt on the portion A shown in **Fig. 39**.

CAUTION:

- Do not damage the O-ring while installing the OCV case. If the O-ring of the OCV adapter on camshaft cap is damaged, it may cause hydraulic leakage.

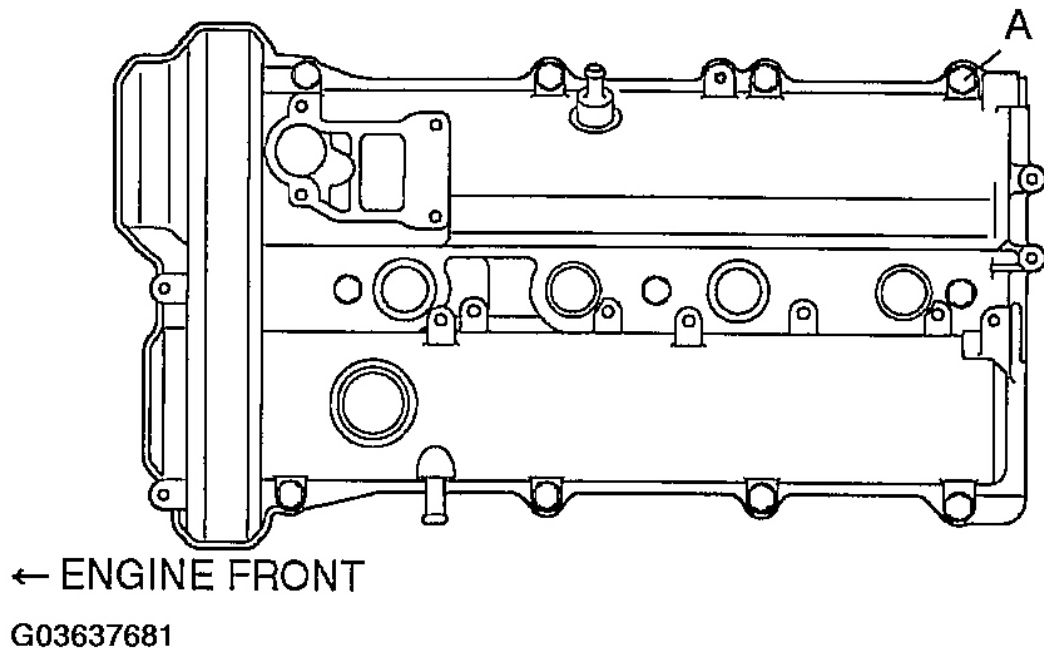


Fig. 39: Tightening Cylinder Head Cover Bolt On Portion Of Cylinder Head
Courtesy of MAZDA MOTORS CORP.

3. Tighten the cylinder head cover bolts for several times in the numerical order shown in **Fig. 40**.

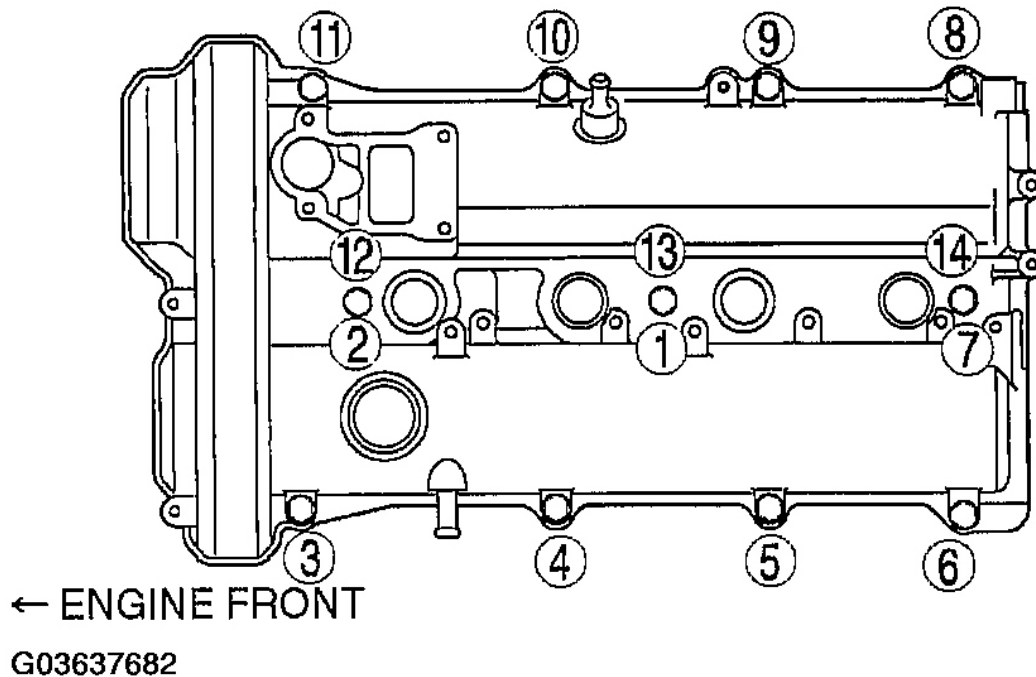


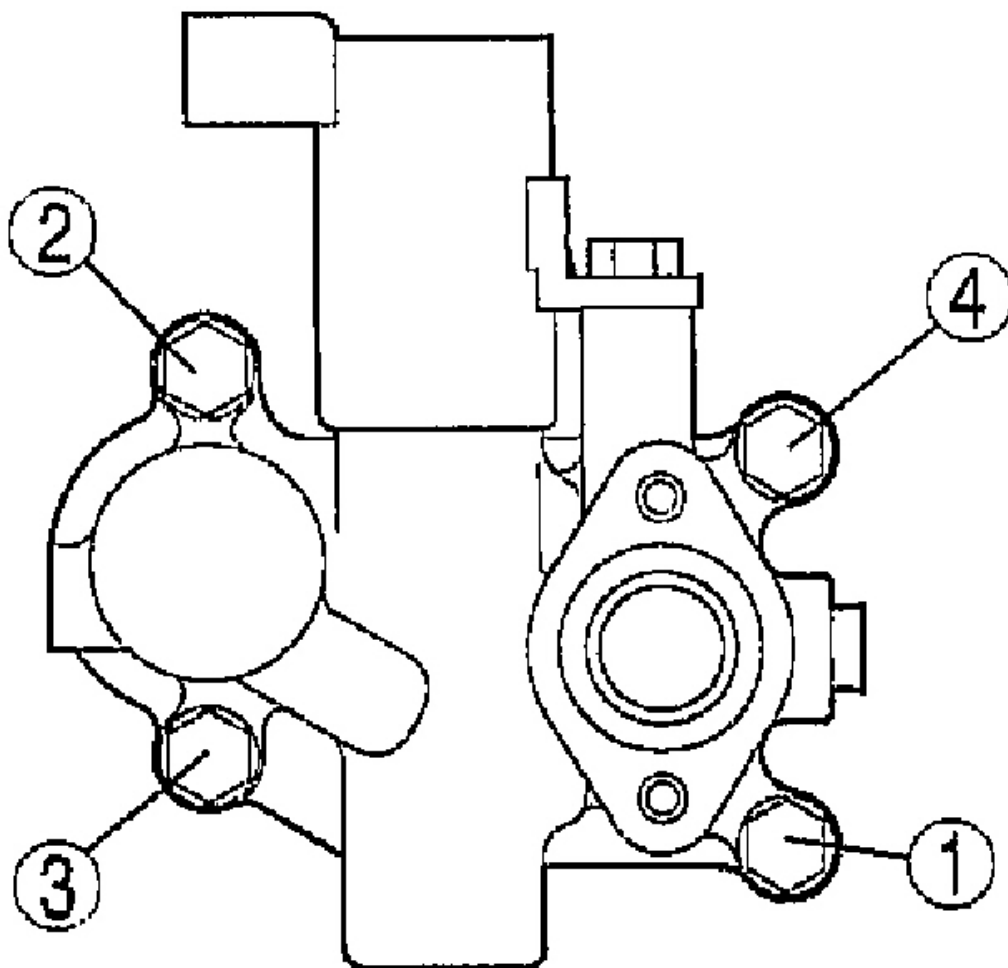
Fig. 40: Tightening Sequence Of Cylinder Head Cover Bolts
Courtesy of MAZDA MOTORS CORP.

OIL CONTROL VALVE (OCV) CASE INSTALLATION NOTE (BP)

1. Tighten the OCV case bolts for several times in the numerical order shown in **Fig. 41**.

CAUTION:

- Do not damage the O-ring while installing the OCV case. If the O-ring of the OCV adapter on camshaft cap is damaged, it may cause hydraulic leakage.



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Fig. 41: Tightening OCV Case Bolts
Courtesy of MAZDA MOTORS CORP.

OIL PIPE INSTALLATION NOTE (BP)

- CAUTION:**
- Perform the following procedures so that there is no load applied on each connection part while installing the oil pipe as it may cause oil leakage.

1. Hold the frame of the OCV filter and install the OCV so as to align with the projected part on flange end

of the oil pipe.

2. Apply engine oil to the new washer.
3. Temporarily install the upper and side oil pipe and position the oil pipe.

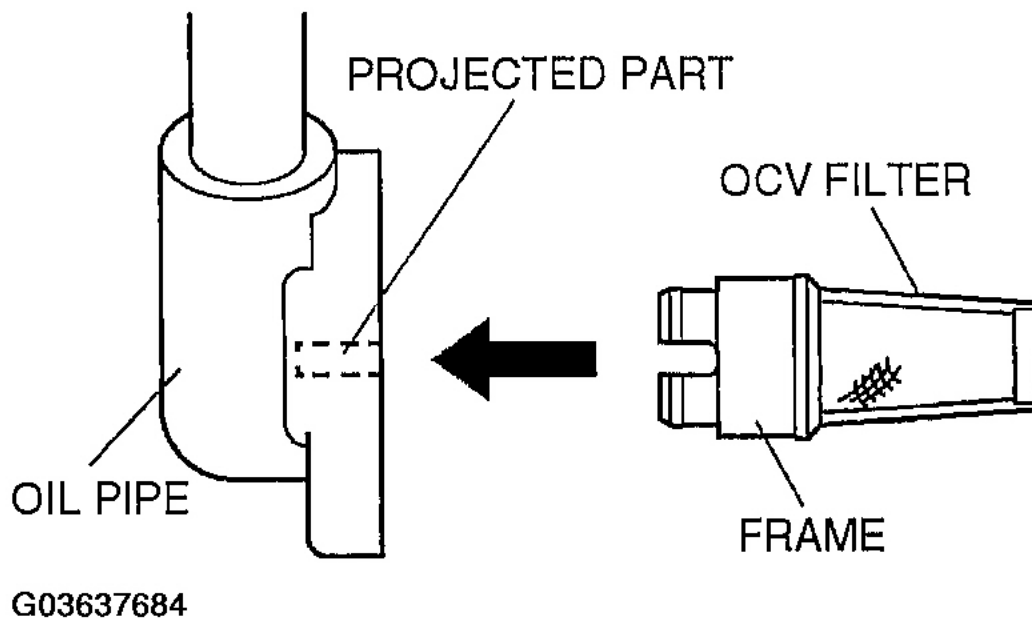
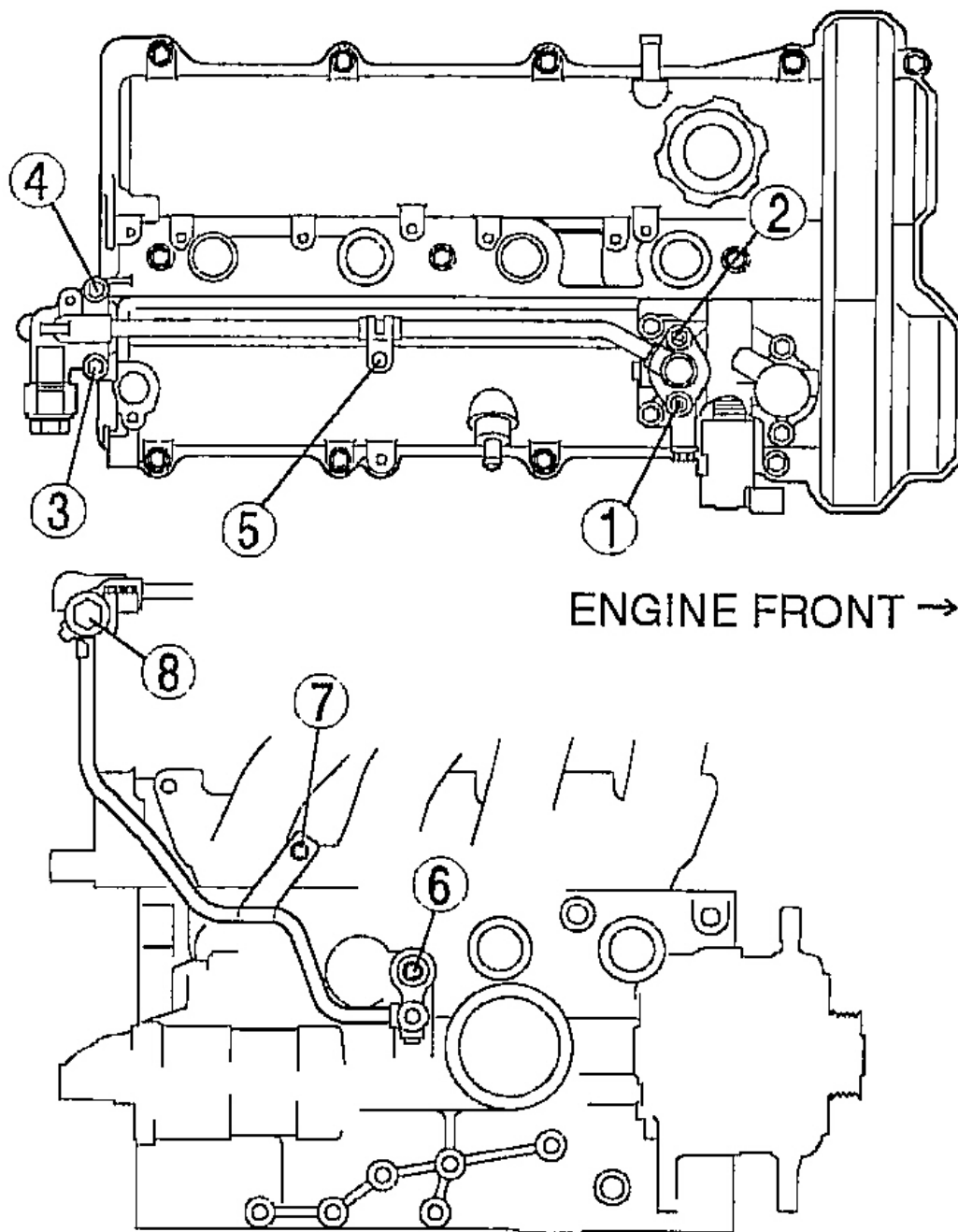


Fig. 42: Installing Upper And Side Oil Pipe
Courtesy of MAZDA MOTORS CORP.

4. Tighten the oil pipe bolts for several times in the numerical order shown in **Fig. 43**.



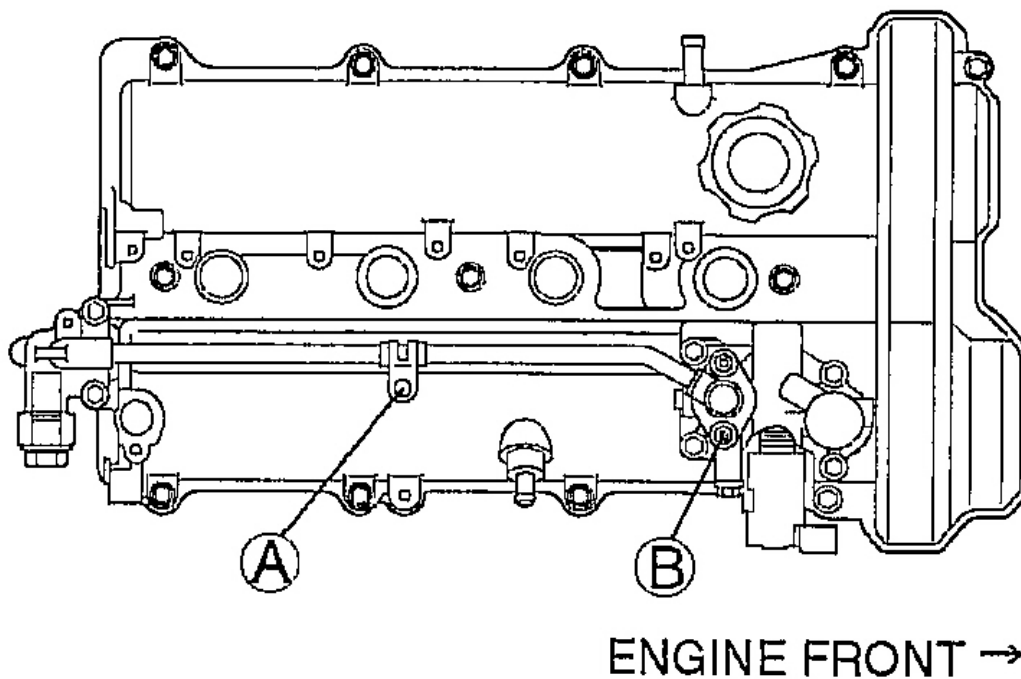
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Fig. 43: Tightening Oil Pipe Bolts
Courtesy of MAZDA MOTORS CORP.

5. Tighten the oil pipe bolts for several times on the portion A shown in **Fig. 44**.

Tightening torque

7.8-10.8 N.m {80-110 kgf.cm, 70-95 in.lbf}



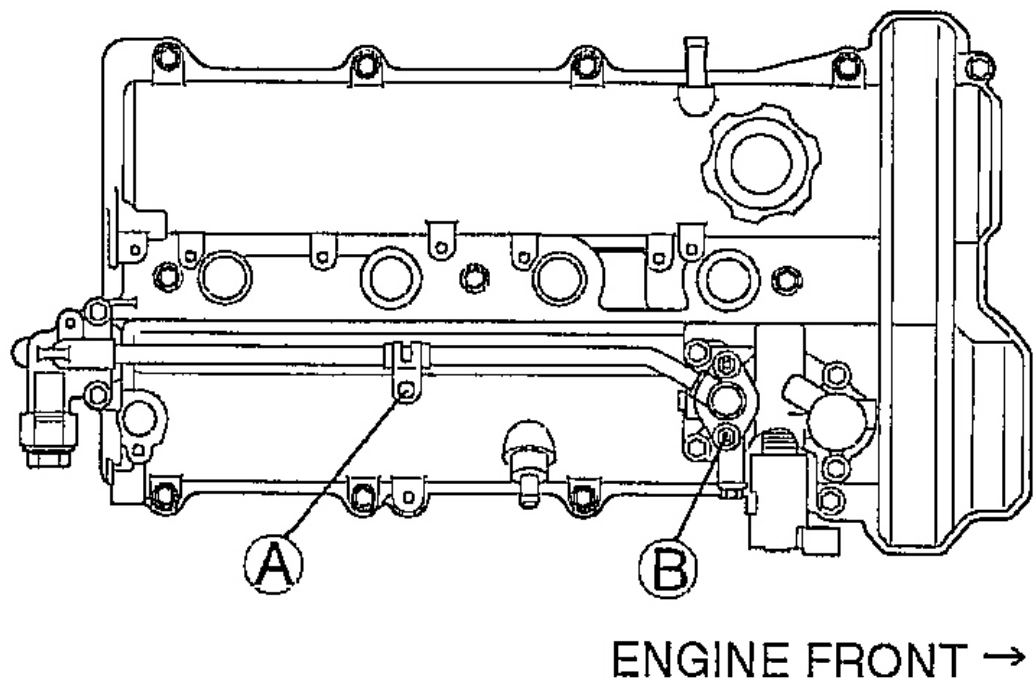
G03637686

Fig. 44: Tightening Oil Pipe Bolts
Courtesy of MAZDA MOTORS CORP.

6. Temporarily tighten the oil pipe bolt on the portion B shown in **Fig. 45**.

Tightening torque

2.9-6.9 N.m {26-61 kgf.cm, 26-61 in.lbf}



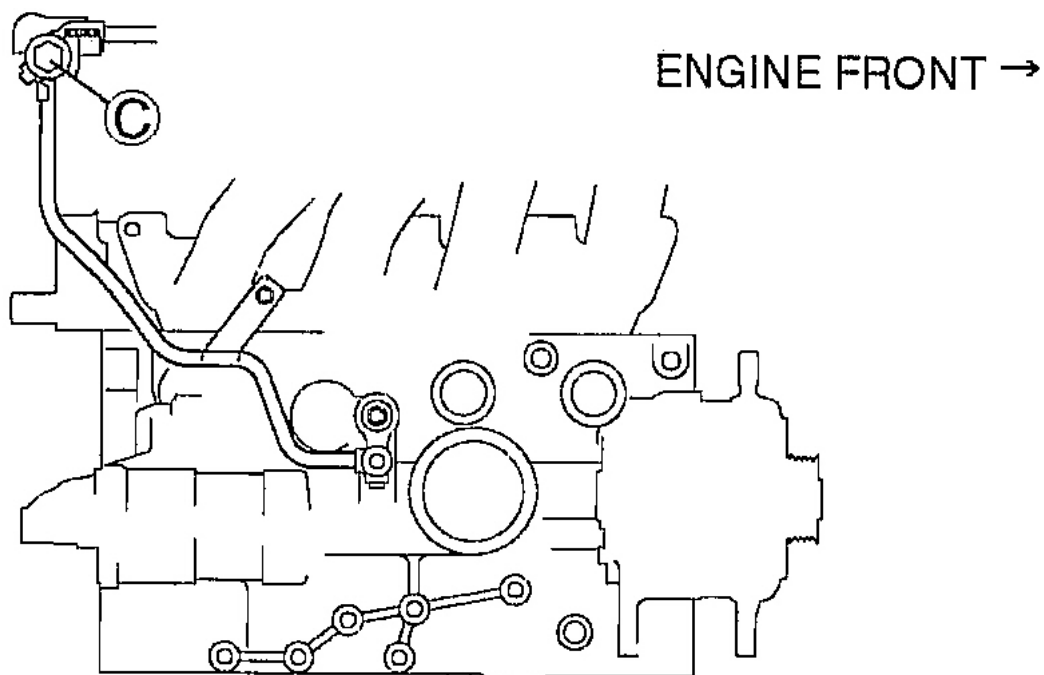
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Fig. 45: Tightening Oil Pipe Bolt
Courtesy of MAZDA MOTORS CORP.

7. Temporarily tighten the oil pipe bolt on the portion C shown in **Fig. 46**.

Tightening torque

11.8-17.6 N.m {1.2-1.8 kgf.m, 8.7-13 ft.lbf}



G03637688

Fig. 46: Tightening Oil Pipe Bolt
Courtesy of MAZDA MOTORS CORP.

8. Tighten the oil pipe bolts for several times in the numerical order shown in **Fig. 47**.

Tightening torque

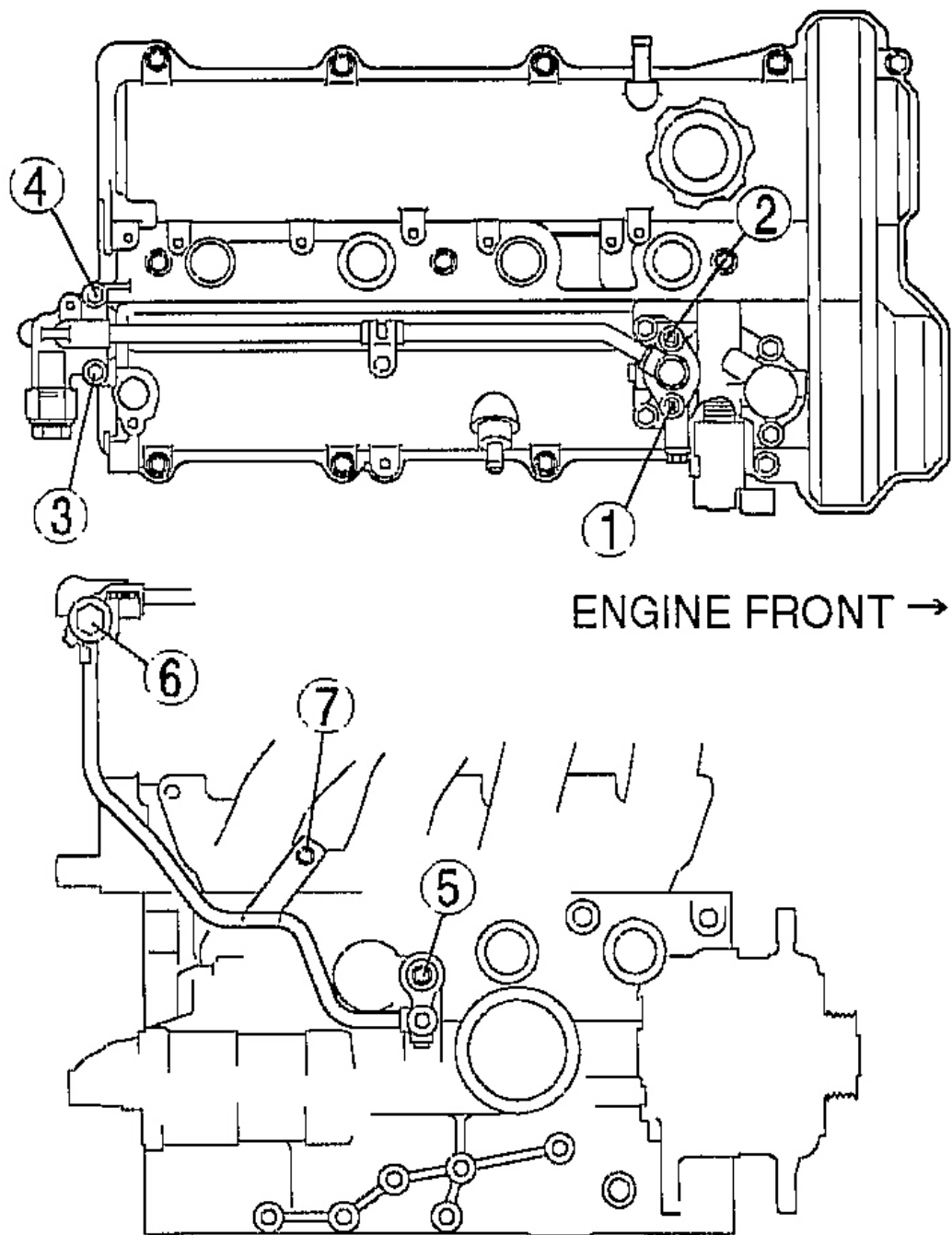
No.1, 2, 3, 4, 7:7.8-10.8 N.m
{80-110 kgf.cm, 70-95 in.lbf}

No.5:15.7-23.5 N.m

{1.6-2.3 kgf.m, 11.6-17.3 ft.lbf}

No.6:34.4-47.0 N.m

{3.5-4.7 kgf.m, 25.4-34.6 ft.lbf}



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Fig. 47: Tightening Sequence Of Oil Pipe Bolt
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD GASKET REPLACEMENT

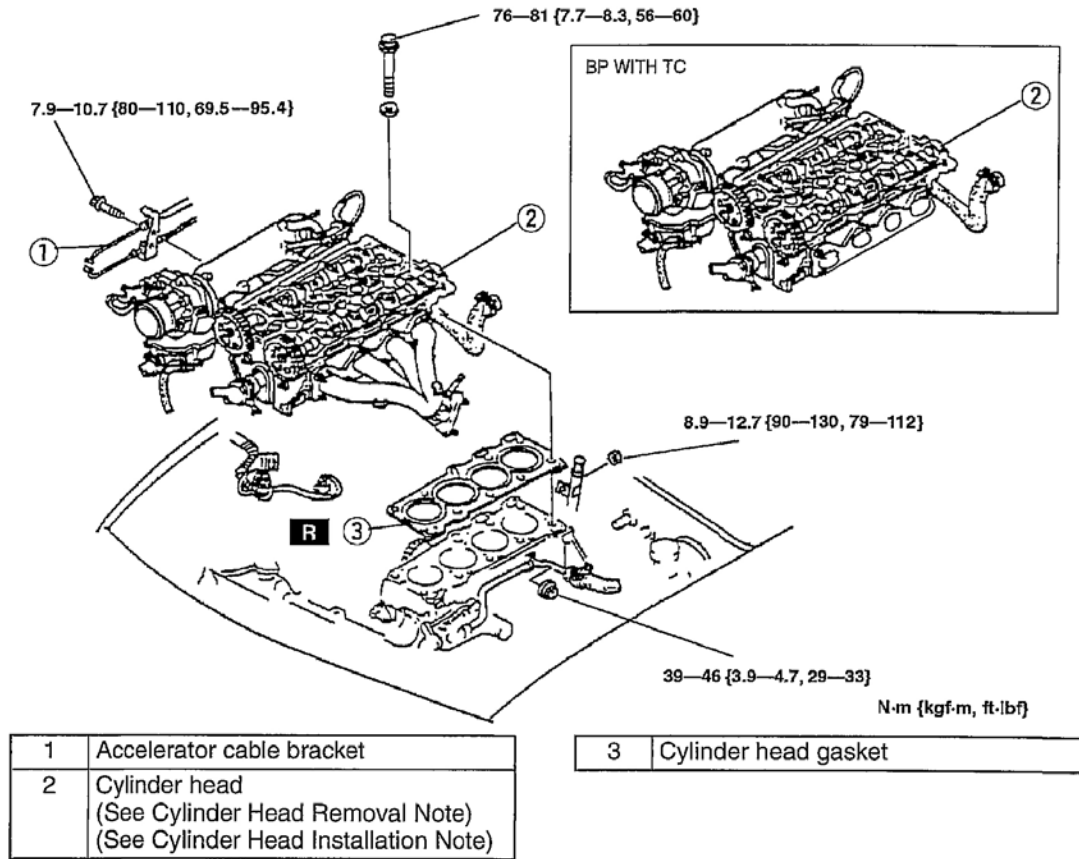
WARNING:

- 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 [BP, BP WITH TC] .)

1. Remove the timing belt. (See TIMING BELT REMOVAL/INSTALLATION.)
2. Remove the front pipe and exhaust manifold insulator. (See EXHAUST SYSTEM REMOVAL/INSTALLATION [BP] .) (See EXHAUST SYSTEM REMOVAL/INSTALLATION [BP WITH TC] .)
3. Remove the air cleaner. (See INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP] .) (See INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP WITH TC] .)
4. Remove the turbocharger, exhaust manifold, engine coolant pipe (out side), joint pipe. (BP with TC) (See EXHAUST SYSTEM REMOVAL/INSTALLATION [BP WITH TC] .)
5. Remove the air pipe No.6 and air hose No.8 as a single unit. (BP with TC) (See INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP WITH TC] .)
6. Disconnect the vacuum hose and engine harness connectors.
7. Disconnect the fuel hose. (See BEFORE SERVICE PRECAUTION [BP, BP WITH TC] .) (See AFTER SERVICE PRECAUTION [BP, BP WITH TC] .)
8. Remove the intake manifold bracket.
9. Remove in the order indicated in the table.
10. Install in the reverse order of removal.
11. Verify the engine oil level. (See ENGINE OIL LEVEL INSPECTION .)
12. Inspect for the engine oil, engine coolant, and fuel leakage.
13. Verify the compression. (See COMPRESSION INSPECTION.)
14. Start the engine and verify the idle speed. (See IDLE SPEED ADJUSTMENT.)

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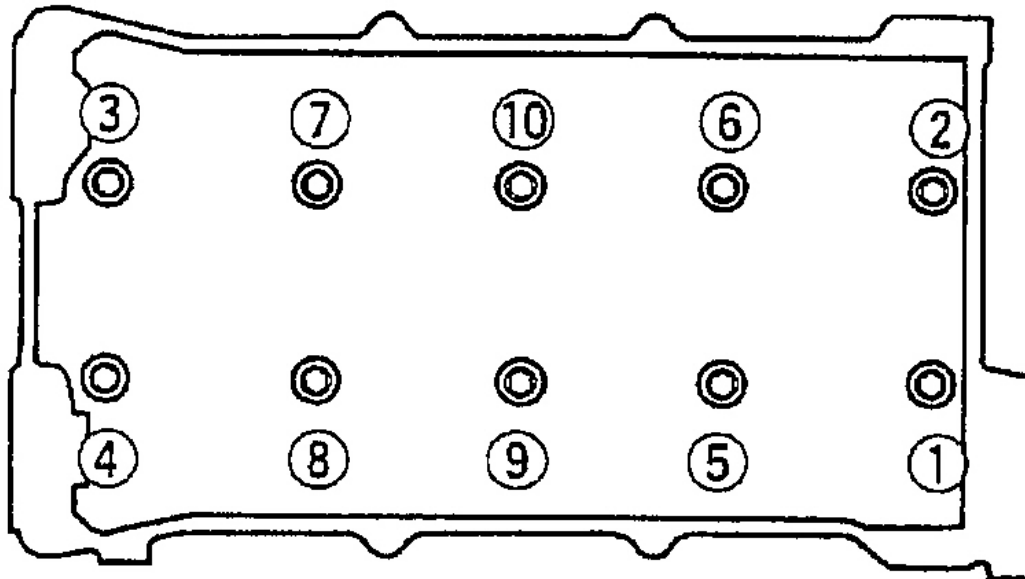


G03637690

Fig. 48: Replacing Cylinder Head Gasket
 Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD REMOVAL NOTE

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

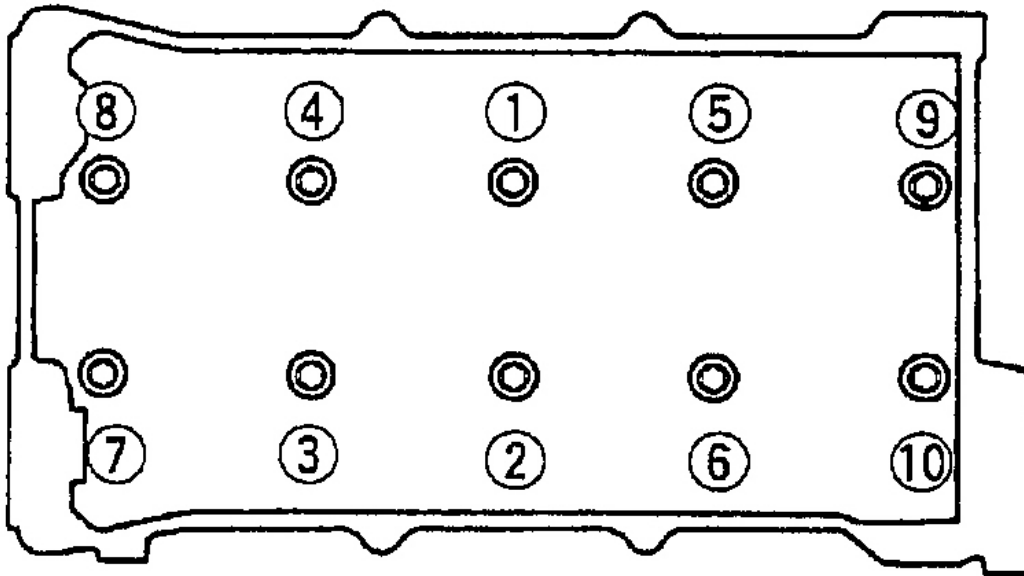


G03637691

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

CYLINDER HEAD INSTALLATION NOTE

1. Tighten the cylinder head bolts in two or three steps in the order shown.



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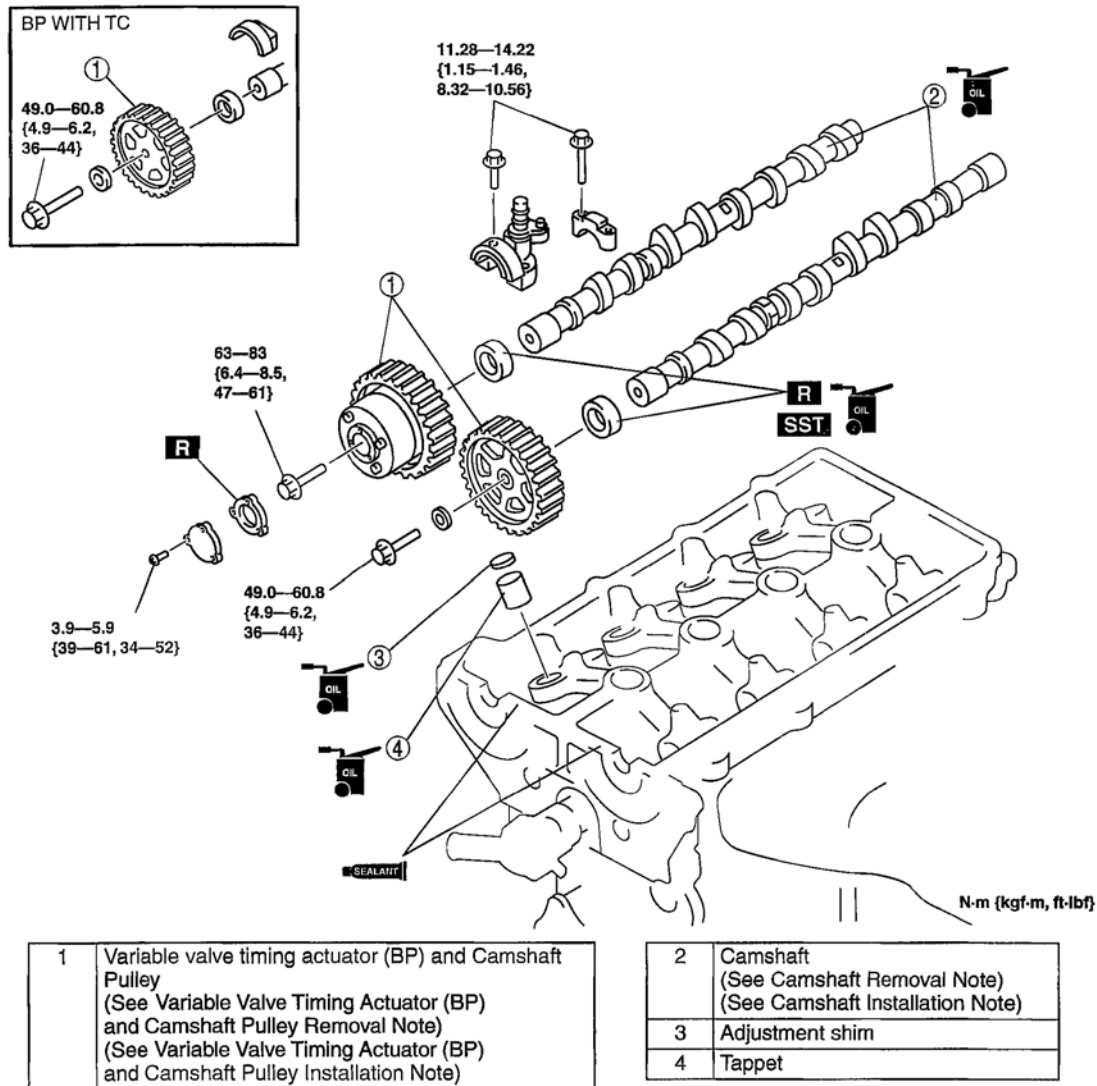
Fig. 50: Tightening Cylinder Head Bolts
Courtesy of MAZDA MOTORS CORP.

TAPPET AND ADJUSTMENT SHIM REMOVAL/INSTALLATION

1. Disconnect the negative battery cable.
2. Remove the timing belt. (See **TIMING BELT REMOVAL/INSTALLATION.**)
3. Remove in the order indicated in the table.
4. Install in the reverse order of removal.
5. Inspect the air gap between the crankshaft position sensor.
6. Inspect the engine oil level.
7. Start the engine, and inspect the following and adjust if necessary:
 - Pulley and belt for runout or contact
 - Engine oil and engine coolant for leakage
 - Ignition timing
 - Operation of auxiliary parts

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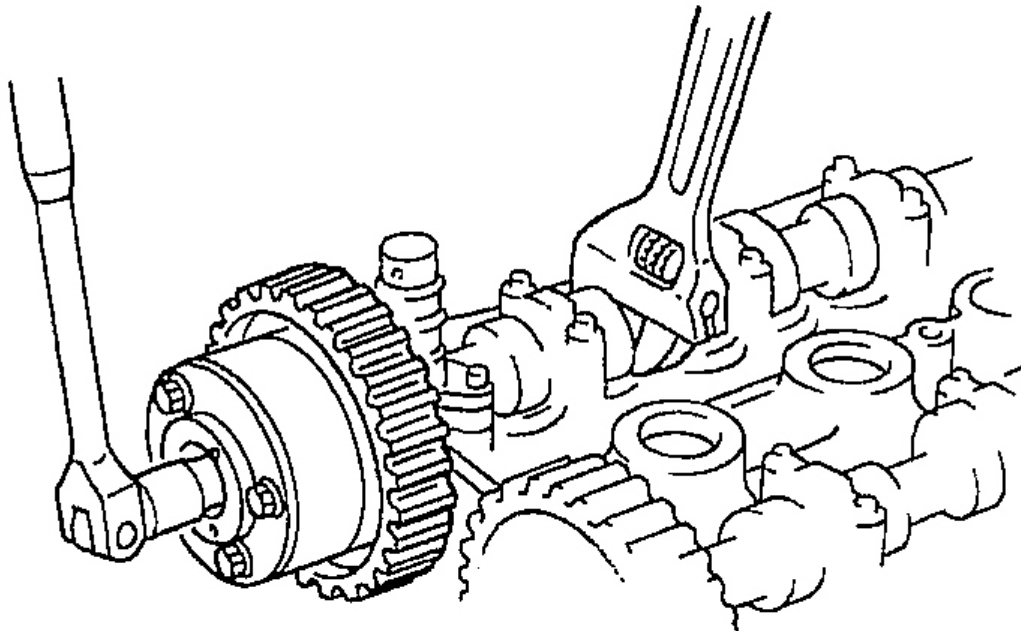
Fig. 51: Exploded View Of Tappet And Adjustment Shim
Courtesy of MAZDA MOTORS CORP.

VARIABLE VALVE TIMING ACTUATOR (BP) AND CAMSHAFT PULLEY REMOVAL NOTE

CAUTION:

- If the engine oil get spilled on other components, it may cause malfunction of the components. Cover with a rag to prevent engine oil from spilling whenever removing the blind cap and variable valve timing actuator.

1. Hold the hexagonal part of the camshaft with an adjustable wrench or the like to prevent the camshaft from rotating, and loosen the lock bolt.



G03637694

Fig. 52: Holding Hexagonal Part Of Camshaft With Adjustable Wrench
Courtesy of MAZDA MOTORS CORP.

CAMSHAFT REMOVAL NOTE

1. Loosen the camshaft cap bolts in two or three steps in the order shown.
2. Remove the camshaft caps.

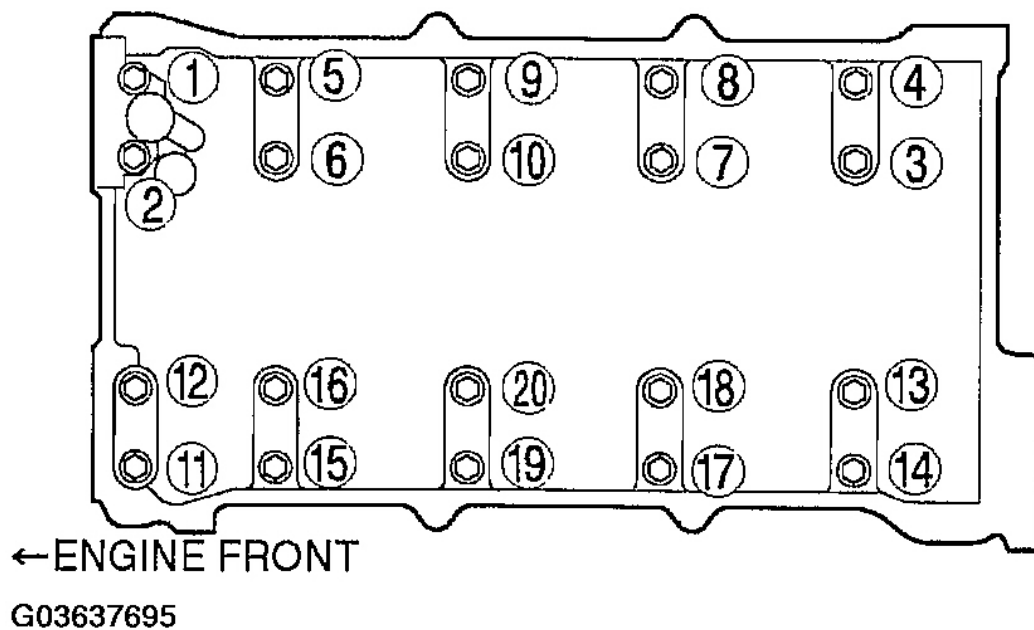
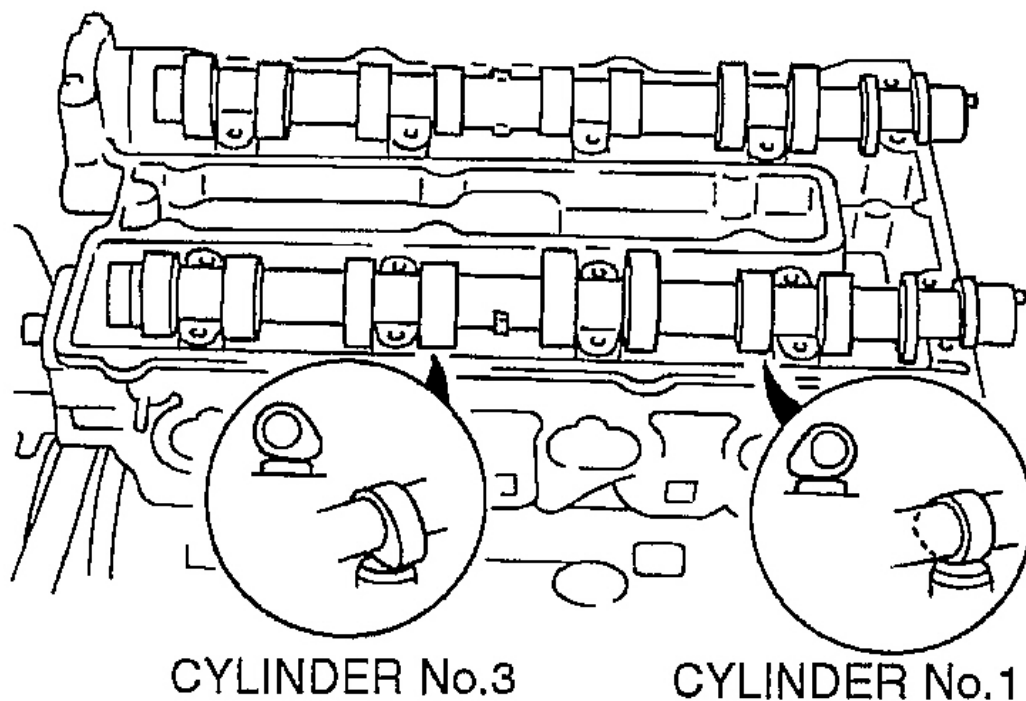


Fig. 53: Removing Camshaft Caps
Courtesy of MAZDA MOTORS CORP.

CAMSHAFT INSTALLATION NOTE

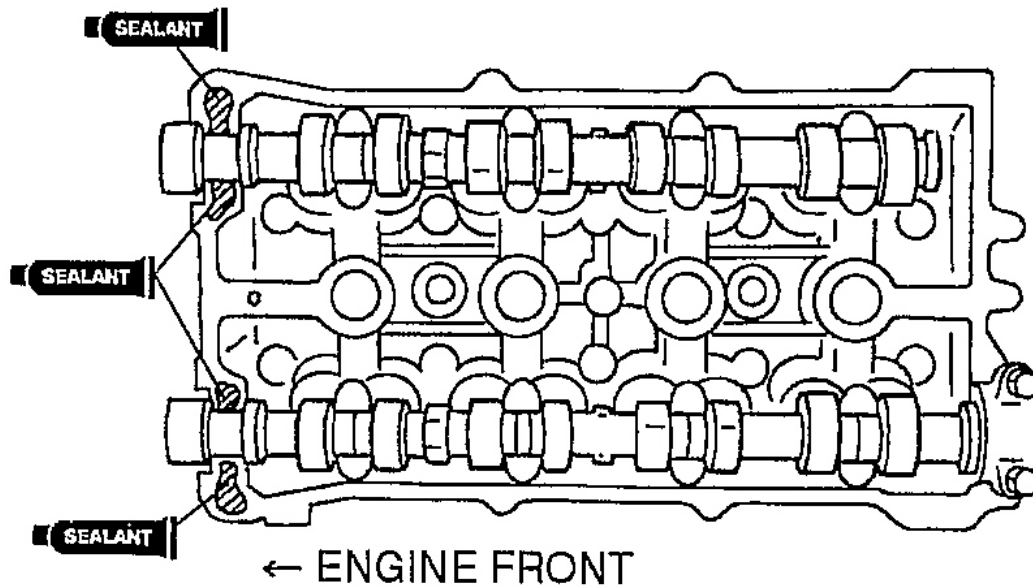
1. Apply engine oil to the camshaft and journal receiving part of cylinder head.
2. Install the camshaft so that the cam projections of cylinder No.1 and 3 face the direction as shown in **Fig. 54**.



G03637696

Fig. 54: Identifying Cam Projections Of Cylinder No.1 And 3 Face
Courtesy of MAZDA MOTORS CORP.

3. Apply liquid gasket to the sliding surface of cylinder head shown in the figure so as not to be projected out.
4. Install the camshaft cap to its original position.



G03637697

Fig. 55: Applying Liquid Gasket To Sliding Surface Of Cylinder Head
Courtesy of MAZDA MOTORS CORP.

5. Tighten the camshaft cap bolts for several times in the numerical order shown in the figure.

CAUTION:

- Install the camshaft while keeping horizontally as the camshaft thrust clearance is small. Otherwise, excessive force may be applied on the thrust part and cause burrs to the thrust part of cylinder head. Therefore, confirm that the camshaft lowers horizontally in accordance with tightening the 2 camshaft cap bolts on the No.3 journal part while tightening the camshaft cap bolts.

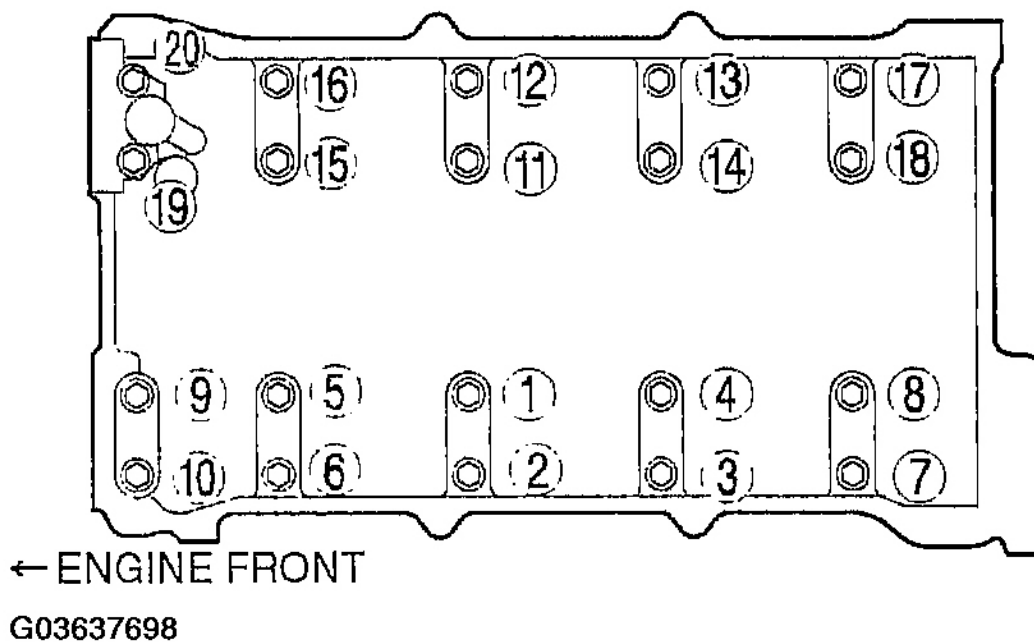
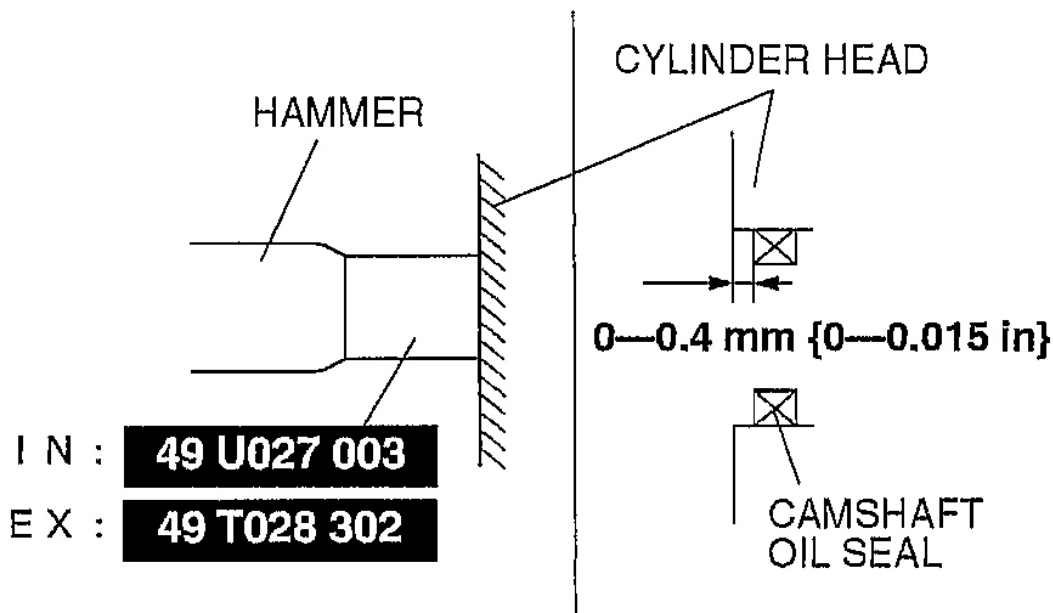


Fig. 56: Tightening Camshaft Cap Bolts
Courtesy of MAZDA MOTORS CORP.

6. Apply engine oil to the camshaft oil seal.
7. Slightly insert the camshaft oil seal by hand.
8. Tap the camshaft oil seal with the **SST**.

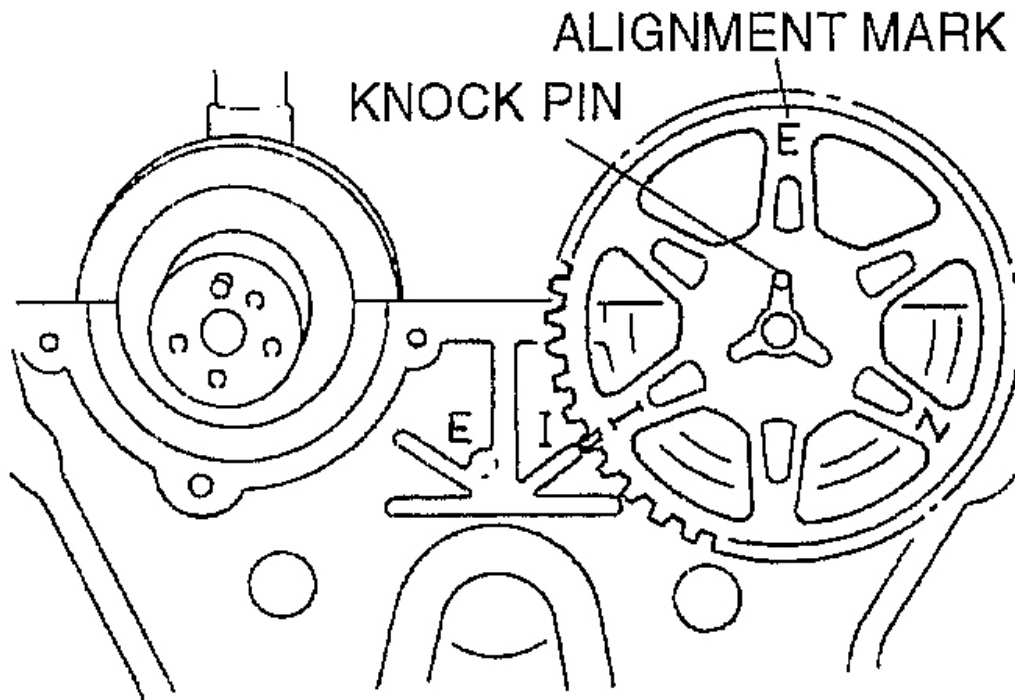


G03637699

Fig. 57: Applying Engine Oil To Camshaft Oil Seal
Courtesy of MAZDA MOTORS CORP.

VARIABLE VALVE TIMING ACTUATOR (BP) AND CAMSHAFT PULLEY INSTALLATION NOTE

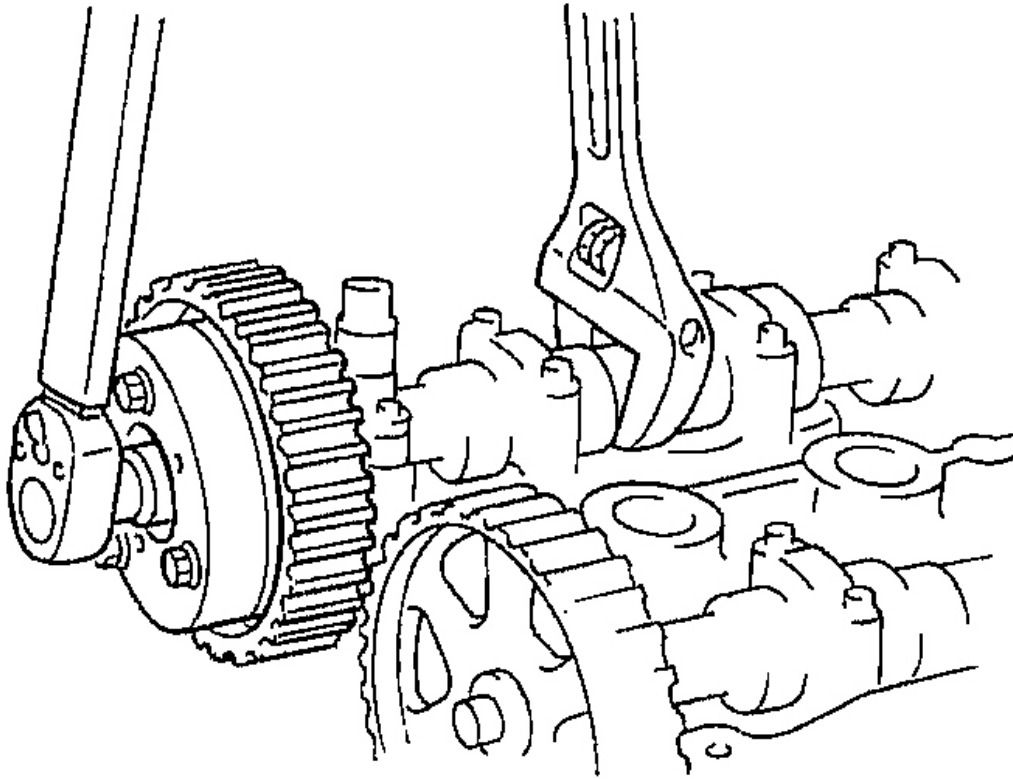
1. Rotate the camshaft and face the knock pin to the just above position.
2. Install the camshaft so that the alignment mark of camshaft pulley faces to the just above position.
3. Install the camshaft so that the knock pin of camshaft is connected with the camshaft knock pin hole of variable valve timing actuator.



G03637700

Fig. 58: Installing Camshaft And Alignment Mark Of Camshaft Pulley
Courtesy of MAZDA MOTORS CORP.

4. Hold the hexagonal part of the camshaft with an adjustable wrench or the like to prevent the camshaft from rotating, and tighten the lock bolt.

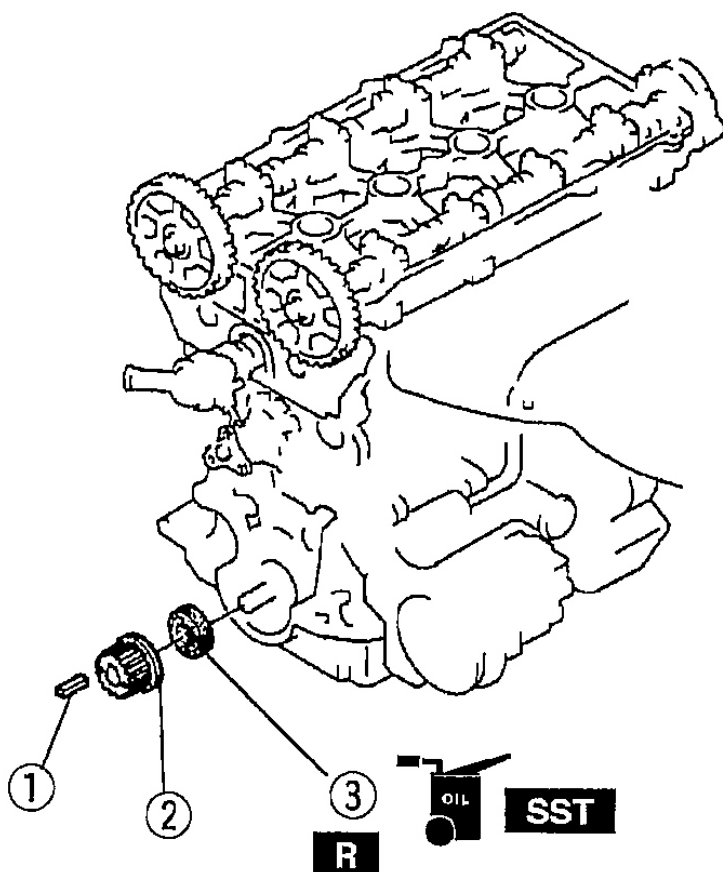


G03637701

Fig. 59: Holding Hexagonal Part Of Camshaft With An Adjustable Wrench
Courtesy of MAZDA MOTORS CORP.

FRONT OIL SEAL REPLACEMENT

1. Remove the timing belt. (See **TIMING BELT REMOVAL/INSTALLATION.**)
2. Remove in the order indicated in the table.



1	Key
2	Timing belt pulley
3	Front oil seal (See Front Oil Seal Removal Note) (See Front Oil Seal Installation Note)

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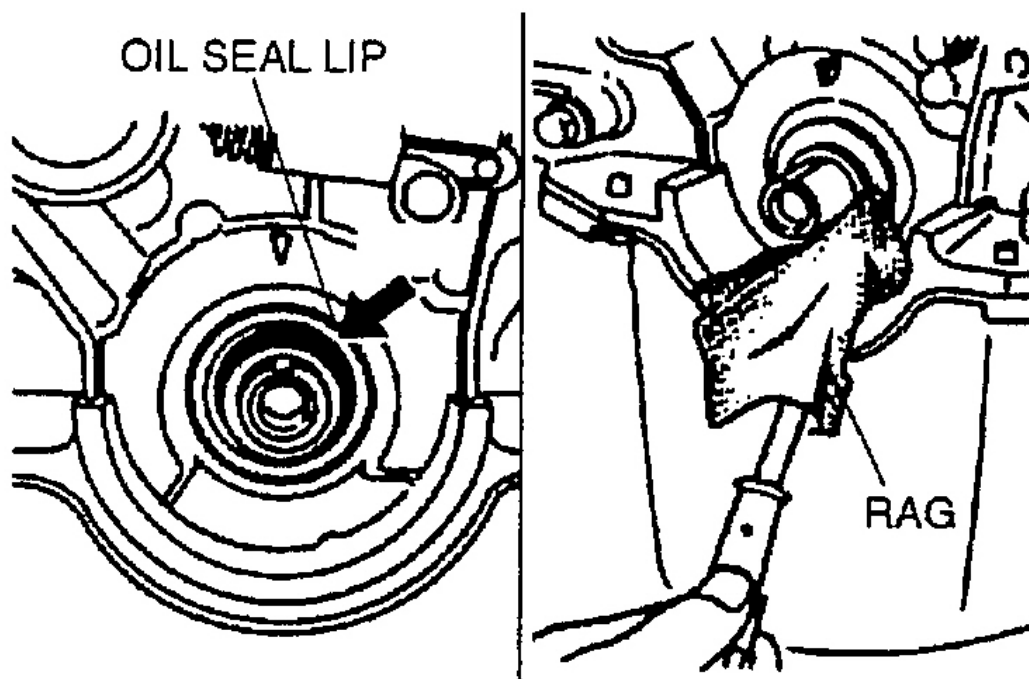
Fig. 60: Removing Timing Belt
Courtesy of MAZDA MOTORS CORP.

3. Install in the reverse order of removal.

FRONT OIL SEAL REMOVAL NOTE

1. Cut the oil seal lip using a razor.

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

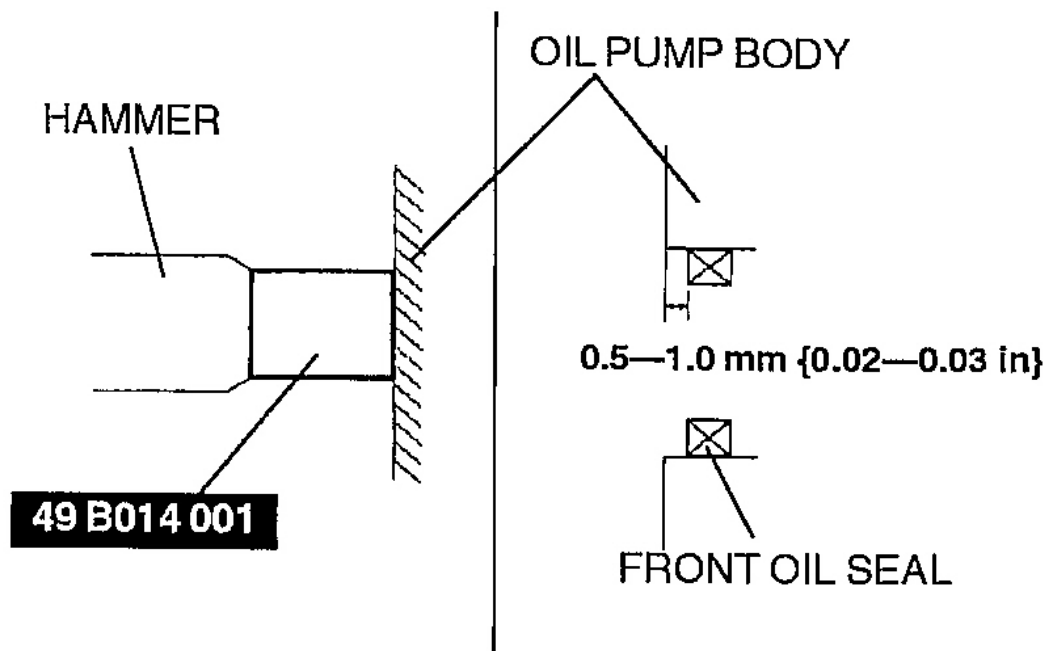


G03637703

Fig. 61: Removing Oil Seal Using Screwdriver Protected With Rag
Courtesy of MAZDA MOTORS CORP.

FRONT OIL SEAL INSTALLATION NOTE

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

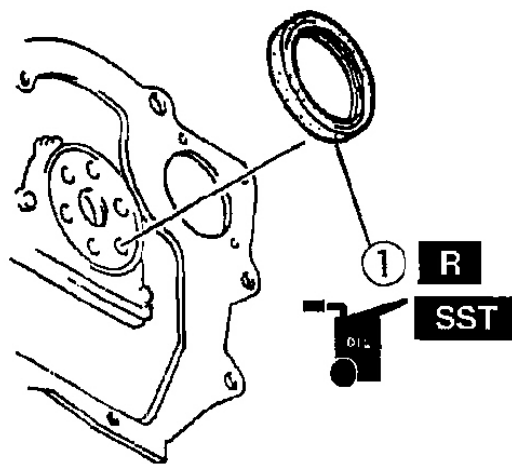


G03637704

Fig. 62: Installing Front Oil Seal
Courtesy of MAZDA MOTORS CORP.

REAR OIL SEAL REPLACEMENT

1. Remove the flywheel. (MT) (See **CLUTCH UNIT REMOVAL/INSTALLATION** .)
2. Remove the drive plate. (AT) (See **DRIVE PLATE REMOVAL/INSTALLATION** .)
3. Remove in the order indicated in the table.



1	Rear oil seal (See Rear Oil Seal Removal Note) (See Rear Oil Seal Installation Note)
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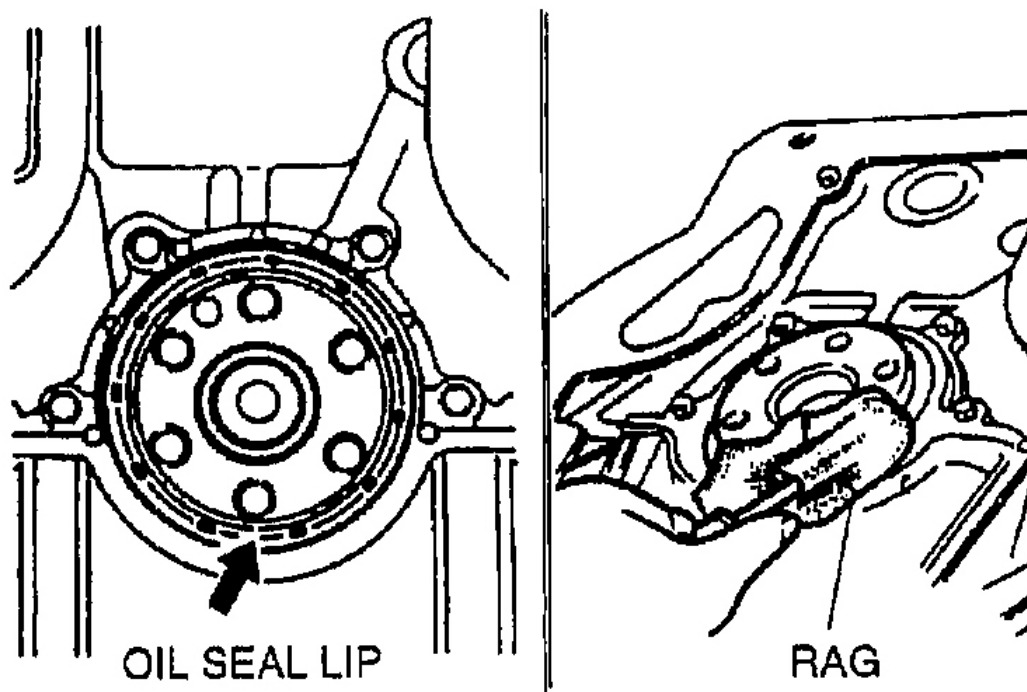
G03637705

Fig. 63: Identifying Rear Oil Seal
Courtesy of MAZDA MOTORS CORP.

4. Install in the reverse order of removal.

REAR OIL SEAL REMOVAL NOTE

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

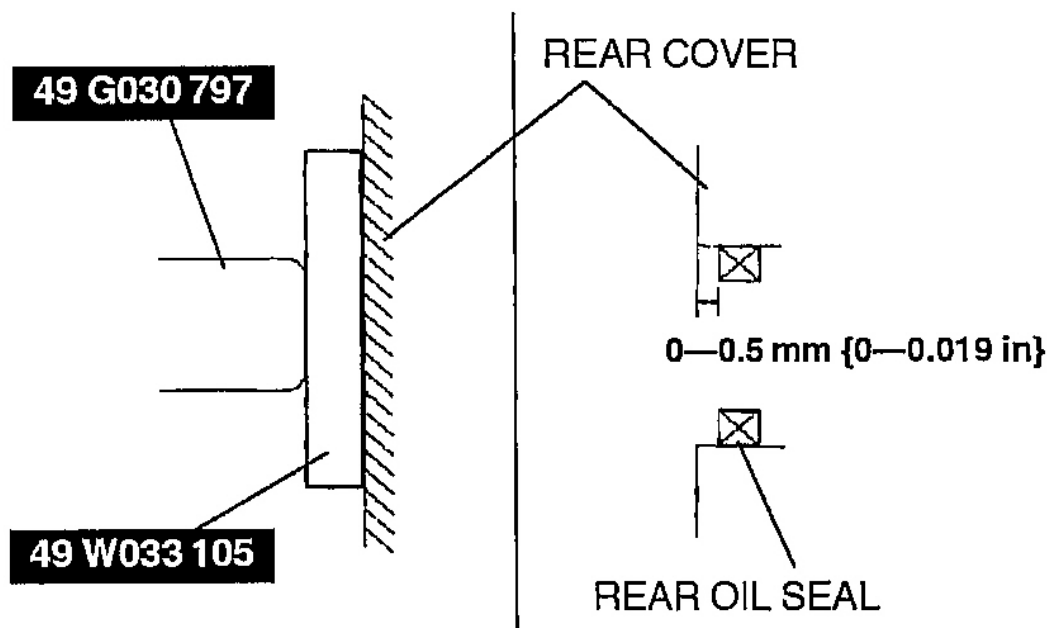


G03637706

Fig. 64: Removing Oil Seal Using Screwdriver Protected With Rag
Courtesy of MAZDA MOTORS CORP.

REAR OIL SEAL INSTALLATION NOTE

1. Apply clean engine oil to the new oil seal lip.
2. Push the oil seal slightly in hand.
3. Tap the oil seal in evenly using the SST and a hammer.



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Fig. 65: Taping Oil Seal Using SST
 Courtesy of MAZDA MOTORS CORP.

ENGINE REMOVAL/INSTALLATION [BP]

WARNING:

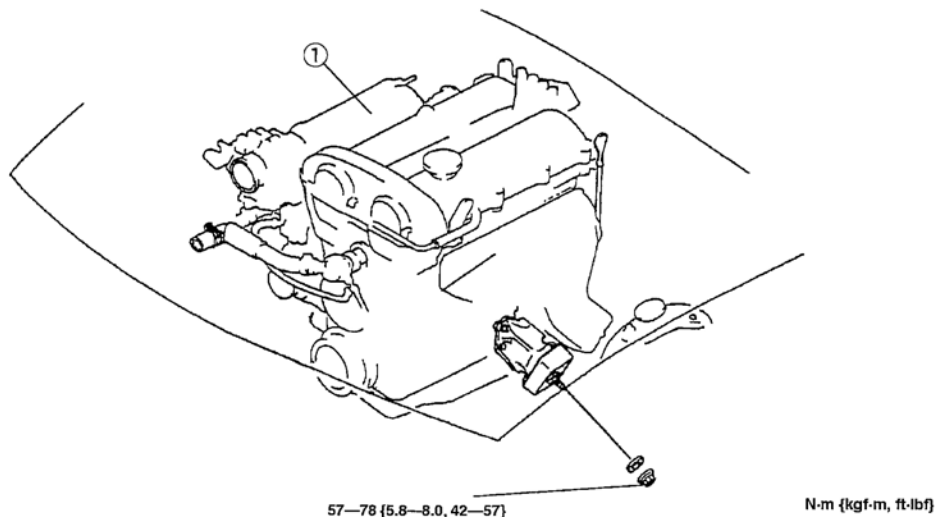
- Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.
- Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injuries or death and damage. Fuel can also irritate skin and eyes. To prevent this, always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

1. Disconnect the negative battery cable.
2. Remove the radiator. (See **RADIATOR REMOVAL/INSTALLATION [BP]** .) (See **RADIATOR REMOVAL/INSTALLATION [BP WITH TC]** .)
3. Remove the air cleaner.
4. Disconnect the accelerator cable and bracket.
5. Disconnect the fuel hose. (See **BEFORE SERVICE PRECAUTION [BP, BP WITH TC]** .) (See **AFTER SERVICE PRECAUTION [BP, BP WITH TC]** .)

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6. Disconnect the vacuum hose and engine harness connectors.
7. Disconnect the heater hose.
8. Remove the drive belt. (See **DRIVE BELT ADJUSTMENT**.)
9. Remove the P/S oil pump with the oil hose still connected.
10. Position the P/S oil pump so that it is out of the way. (Vehicles with P/S oil pump)
11. Remove the P/S oil pump with the oil hose still connected.
12. Position the A/C compressor so that it is out of the way. (Vehicles with A/C compressor)
13. Remove the transmission. (See **MANUAL TRANSMISSION REMOVAL/INSTALLATION [M15M-D]**.) (See **AUTOMATIC TRANSMISSION REMOVAL/INSTALLATION**.)
14. Remove in the order indicated in the table.
15. Install in the reverse order of removal.
16. Start the engine and
 1. Inspect for the engine oil, engine coolant, transmission oil and fuel leakage.
 2. Verify the ignition timing. (See **IGNITION TIMING INSPECTION**.)
 3. Verify the idle speed. (See **IDLE SPEED ADJUSTMENT**.)
 4. Verify the idle mixture. (See **IDLE MIXTURE INSPECTION**.)
17. If the engine is overhauled and installed to the vehicle, perform the road test and verify that there is no abnormality.



1	Engine
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Fig. 66: Identifying Engine (BP) Torque Specification
Courtesy of MAZDA MOTORS CORP.

ENGINE REMOVAL/INSTALLATION [BP WITH TC]

WARNING:

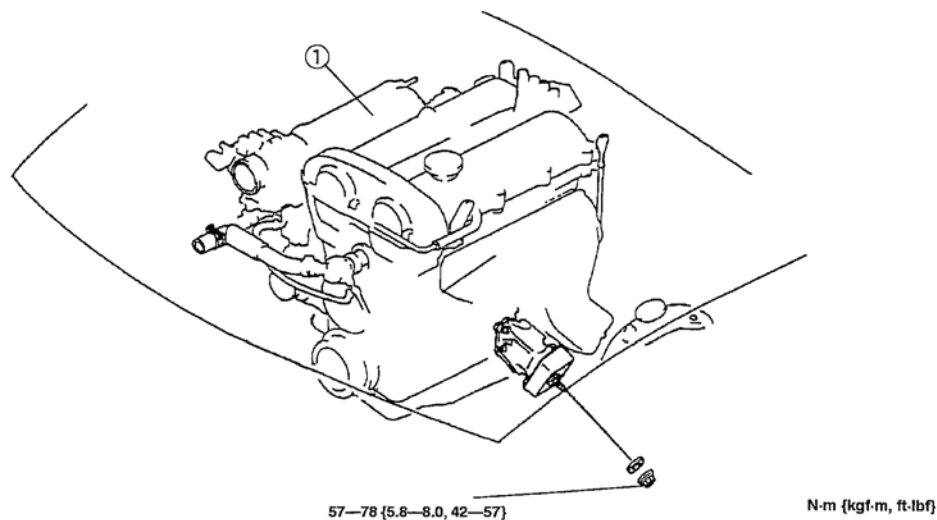
- Fuel vapor is hazardous. It can very easily ignite, causing serious injury and damage. Always keep sparks and flames away from fuel.
- Fuel line spills and leakage are dangerous. Fuel can ignite and cause serious injuries or death and damage. Fuel can also irritate skin and eyes. To prevent this, always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

1. Disconnect the negative battery cable.
2. Remove the under cover.
3. Drain the engine coolant. (See ENGINE COOLANT REPLACEMENT .)
4. Remove the front strut bar. (See FRONT STRUT BAR REMOVAL/INSTALLATION [BP WITH TC] .)
5. Remove the washer tank with the hose still connected.
6. Remove the washer tank bracket.
7. Remove the air hose No.2, air cleaner, and air pipe No.1. (See INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP WITH TC] .)
8. Remove the air pipe No.3 and air pipe No.5, air pipe No.6 and air hose No.8, air pipe No.5 and air hose No.7. (See INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP WITH TC] .)
9. Disconnect the upper radiator hose.
10. Remove the cooling fan assembly. (See RADIATOR REMOVAL/INSTALLATION [BP WITH TC] .)
11. Disconnect the lower radiator hose.
12. Remove the radiator. (See RADIATOR REMOVAL/INSTALLATION [BP WITH TC] .)
13. Remove the drive belt. (See DRIVE BELT ADJUSTMENT .)
14. Remove the P/S oil pump with the oil hose still connected.
15. Position the P/S oil pump so that it is out of the way.
16. Remove the A/C compressor with the pipe still connected.
17. Position the A/C compressor so that it is out of the way.
18. Disconnect the fuel hose.
19. Disconnect the vacuum hose and engine harness connectors.
20. Disconnect the heater hose.
21. Remove the transmission. (See MANUAL TRANSMISSION REMOVAL/INSTALLATION [M15M-D] .) (See AUTOMATIC TRANSMISSION REMOVAL/INSTALLATION .)
22. Remove in the order indicated in the table.
23. Install in the reverse order of removal.
24. Start the engine and
 1. Inspect for the engine oil, engine coolant, transmission oil and fuel leakage.

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2. Verify the ignition timing. (See **IGNITION TIMING INSPECTION**.)
 3. Verify the idle speed. (See **IDLE SPEED ADJUSTMENT**.)
 4. Verify the idle mixture. (See **IDLE MIXTURE INSPECTION**.)
25. If the engine is overhauled and installed to the vehicle, perform the road test and verify that there is no abnormality.



1	Engine (See Engine Removal Note.)
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Fig. 67: Identifying Engine (BP With TC) & Torque Specification
Courtesy of MAZDA MOTORS CORP.

ENGINE REMOVAL NOTE

1. Install the **SST** to the position shown in **Fig. 68** using the suitable washer and air pipe No.1 installation bolt.

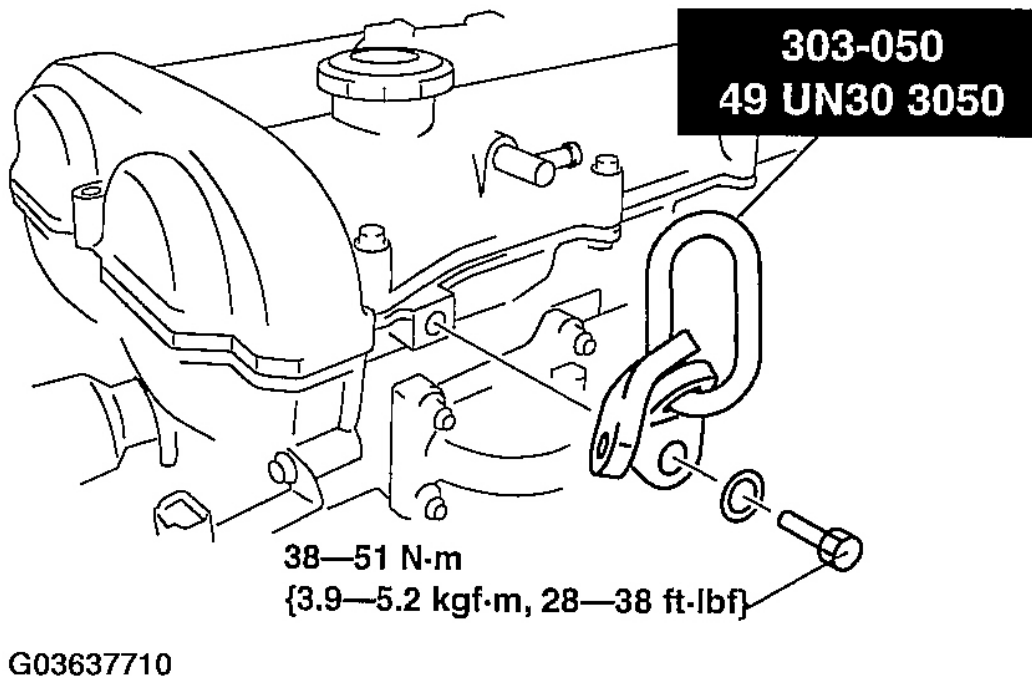


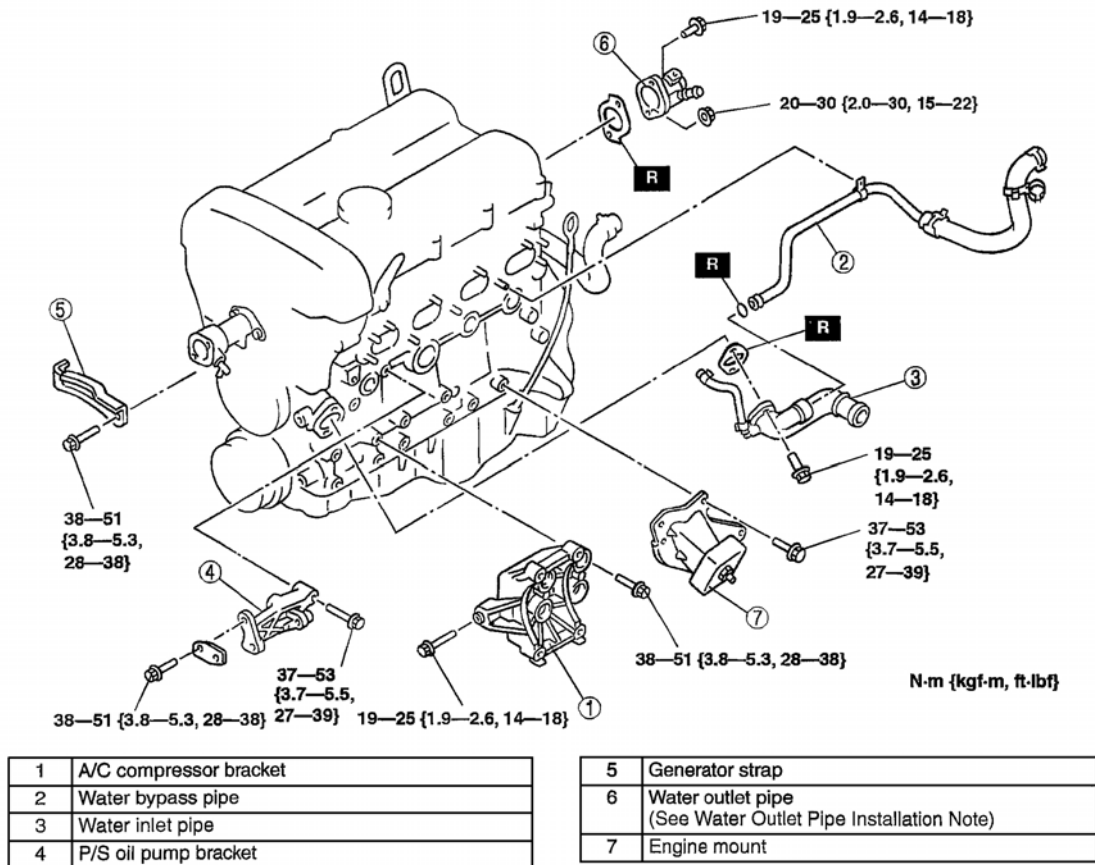
Fig. 68: Installing Bolt Using Suitable Washer And Air Pipe & Torque Specification
Courtesy of MAZDA MOTORS CORP.

ENGINE DISASSEMBLY/ASSEMBLY

1. Remove the oil pressure switch. (See **OIL PRESSURE INSPECTION** .)
2. Remove the OCV. (BP) (See **OIL CONTROL VALVE (OCV) REMOVAL/INSTALLATION [BP]**.)
3. Remove the oil pipe. (BP) (See **TIMING BELT REMOVAL/INSTALLATION**.)
4. Remove the camshaft position sensor.
5. Remove the crankshaft position sensor.
6. Remove the intake-air system. (See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP]** .)
(See **INTAKE-AIR SYSTEM REMOVAL/INSTALLATION [BP WITH TC]** .)
7. Remove the exhaust system. (See **EXHAUST SYSTEM REMOVAL/INSTALLATION [BP]** .) (See **EXHAUST SYSTEM REMOVAL/INSTALLATION [BP WITH TC]** .)
8. Remove the generator.
9. Remove the oil filter. (See **OIL FILTER REPLACEMENT** .)
10. Remove the oil cooler.
11. Remove the thermostat. (See **THERMOSTAT REMOVAL/INSTALLATION** .)
12. Disassemble in the order indicated in the table.
13. Assemble in the reverse order of disassembly.

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Fig. 69: Disassembling Engine Assembly & Torque Specifications
 Courtesy of MAZDA MOTORS CORP.

WATER OUTLET PIPE INSTALLATION NOTE

1. Install the water outlet pipe gasket so that the print area faces the cylinder head.

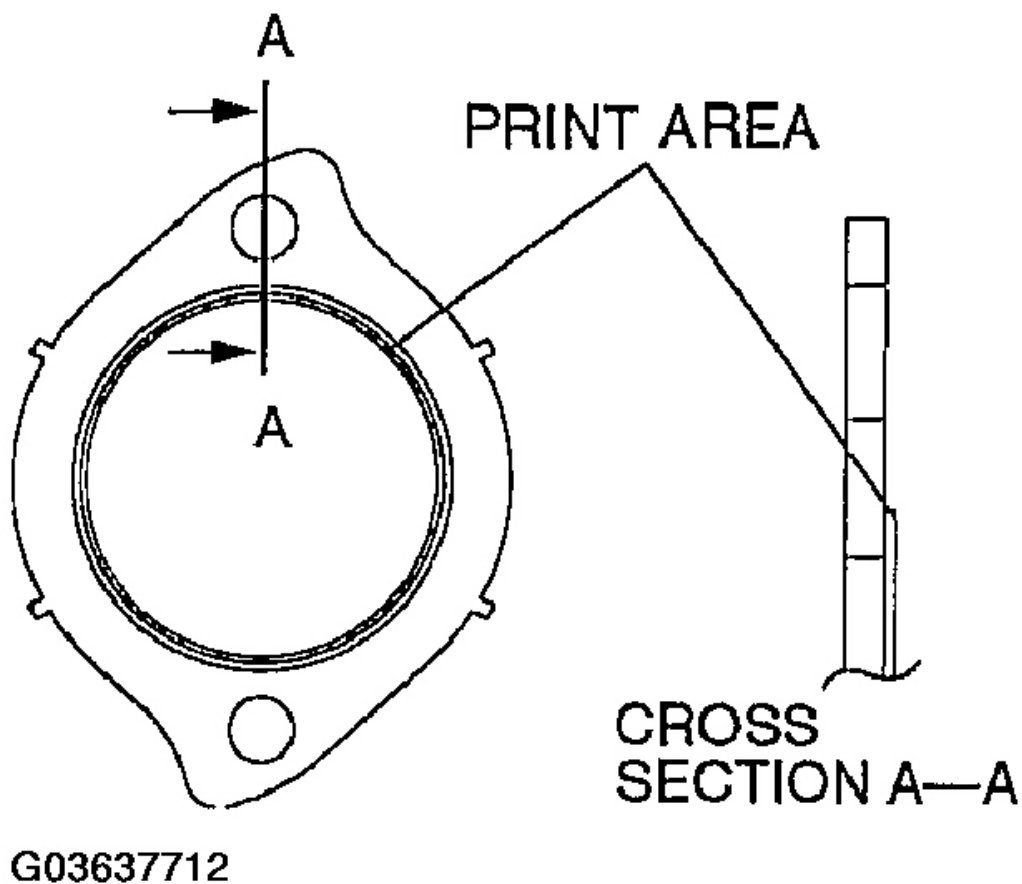


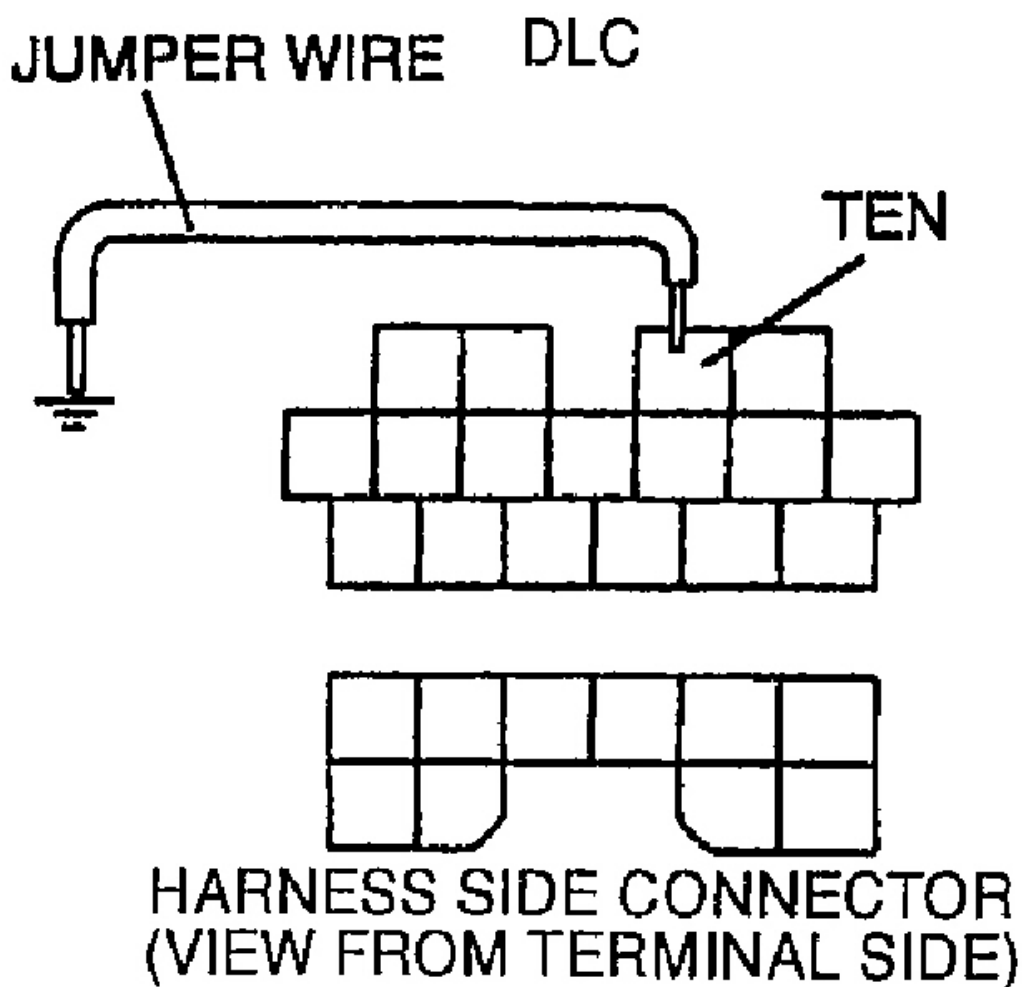
Fig. 70: Identifying Print Area Faces Cylinder Head
Courtesy of MAZDA MOTORS CORP.

ENGINE TUNE-UP

ENGINE TUNE-UP PREPARATION

1. Warm up the engine to normal operating temperature.
2. Shift transmission into Neutral (MT) or P position (AT).
3. Turn off all electrical loads.
 - Headlight
 - Blower
 - Rear window defroster
4. Verify that the battery is fully charged. (See **BATTERY INSPECTION** .)

5. Wait until the electrical fan stops.
6. Connect the **SST** (WDS or equivalent) to the DLC-2.
7. Access RPM PID.
8. Short the DLC terminal TEN to body GND using a jumper wire.
9. Select "START" to begin.



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Fig. 71: Shorting DLC Terminal Ten To Body Gnd Using Jumper Wire
Courtesy of MAZDA MOTORS CORP.

IGNITION TIMING INSPECTION

1. Perform **ENGINE TUNE-UP PREPARATION**.
2. Verify that the idle speed is within the specification.
 - If not as specified, adjust the idle speed. (See **IDLE SPEED ADJUSTMENT**.)

Specification

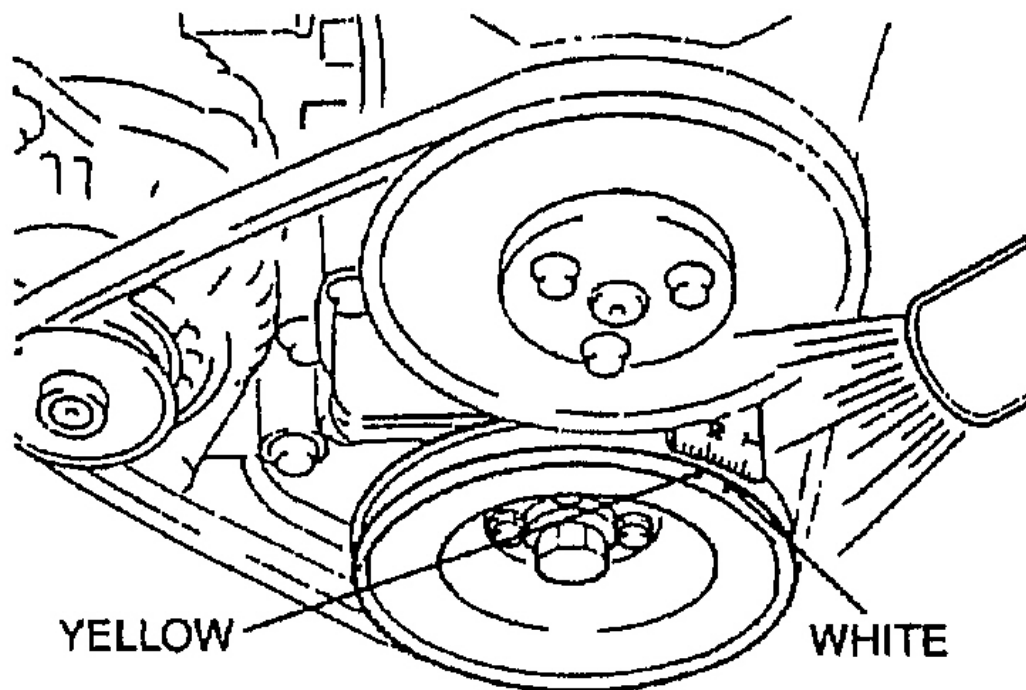
750-850 (800 +/- 50) RPM

3. Connect a timing light to the high-tension lead of the No.1 cylinder.
4. Verify that the timing mark (white) on the crankshaft pulley and the T mark on the timing belt cover are aligned.

Ignition timing

BTDC 9°--11° (10° +/- 1°) (TIMING MARK [YELLOW])

5. Disconnect the jumper wire.
6. Press "CANCEL".
7. Verify that the timing mark (yellow) is within the specification.



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Fig. 72: Verifying Timing Mark Within Specification
Courtesy of MAZDA MOTORS CORP.

- If not as specified, inspect the following.
 - CMP sensor
 - CKP sensor
 - TP sensor
 - ECT sensor
 - Neutral switch (MT)
 - Clutch switch (MT)
 - TR switch (AT)
- If the devices are normal, replace the PCM.

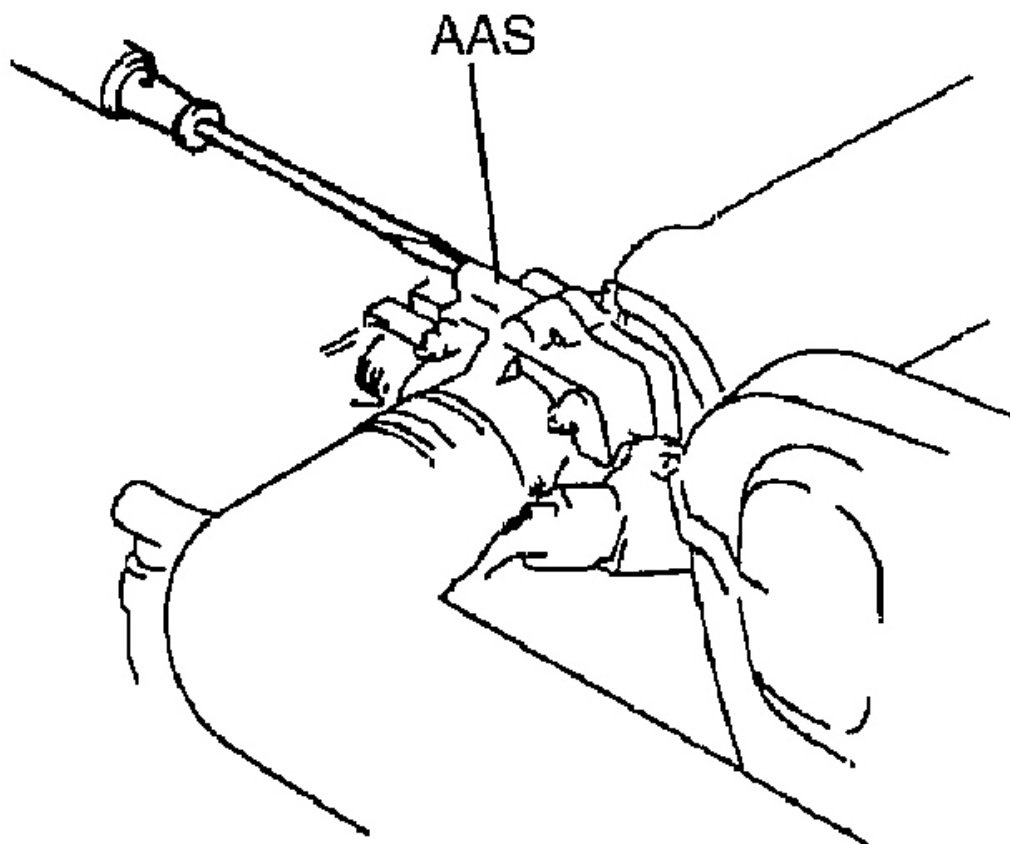
Specification

BTDC 6°--18°

1. Perform **ENGINE TUNE-UP PREPARATION**.
2. Verify that the idle speed is within the specification.
 - If not within the specification, adjust the idle speed by turning the AAS.

CAUTION:

- The TAS is set at the factory and must not be adjusted. Any adjustment will negatively affect the engine performance.



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Fig. 73: Adjusting Idle Speed By Turning AAS
Courtesy of MAZDA MOTORS CORP.

Specification

750-850 (800 +/- 50) RPM

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3. Disconnect the jumper wire.
4. Press "CLEAR" to clear previously selected items.
5. Disconnect the **SST** (WDS or equivalent).

IDLE-UP SPEED INSPECTION

1. Perform **ENGINE TUNE-UP PREPARATION**, and **IDLE SPEED ADJUSTMENT**.
2. Verify "RPM" PID is selected.
3. Press "START".
4. Verify that the idle speed is normal.
5. Verify that the idle-up speed is within the specification.
 - If not as specified under all load conditions, inspect the IAC valve.
 - If not as specified under some load conditions, inspect related input switches, harnesses and connectors.

IDLE-UP SPEED SPECIFICATION

Load condition	Idle-up speed (RPM) ⁽¹⁾			
	BP			BP WITH TC
	MT	AT		MT
		N, P position	D range	
E/L ON ⁽²⁾	750-850 (800 +/- 50)	750-850 (800 +/- 50)	700-800 (750 +/- 50)	800-900 (850 +/- 50)
P/S ON ⁽³⁾				750-850 (800 +/- 50)
A/C ON ⁽⁴⁾	950-1050 (1000 +/- 50)			950-1050 (1000 +/- 50)

(1) Excludes temporary idle speed drop just after the electrical loads (E/L) are turned on.

(2) Headlight is on, fan switch (above 1st), cooling fan are operating, rear window defroster is on.

(3) Steering wheel is fully turned.

(4) A/C switch and fan switch are on.

IDLE MIXTURE INSPECTION

1. Perform **ENGINE TUNE-UP PREPARATION**.
2. Verify that the idle speed and ignition timing are within the specification.
3. Insert an exhaust gas analyzer to the tailpipe.
4. Verify that the CO and HC concentrations are within the regulation.
 - If not, inspect the following.
 - OBD system

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- HO2S
- Intake manifold vacuum
- Fuel line pressure
- Ignition timing control
- If the systems are normal, replace the TWC.