2002-08 ENGINES

4.0L V6 Overhaul - B4000

ENGINE OVERHAUL SERVICE WARNING

WARNING:

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

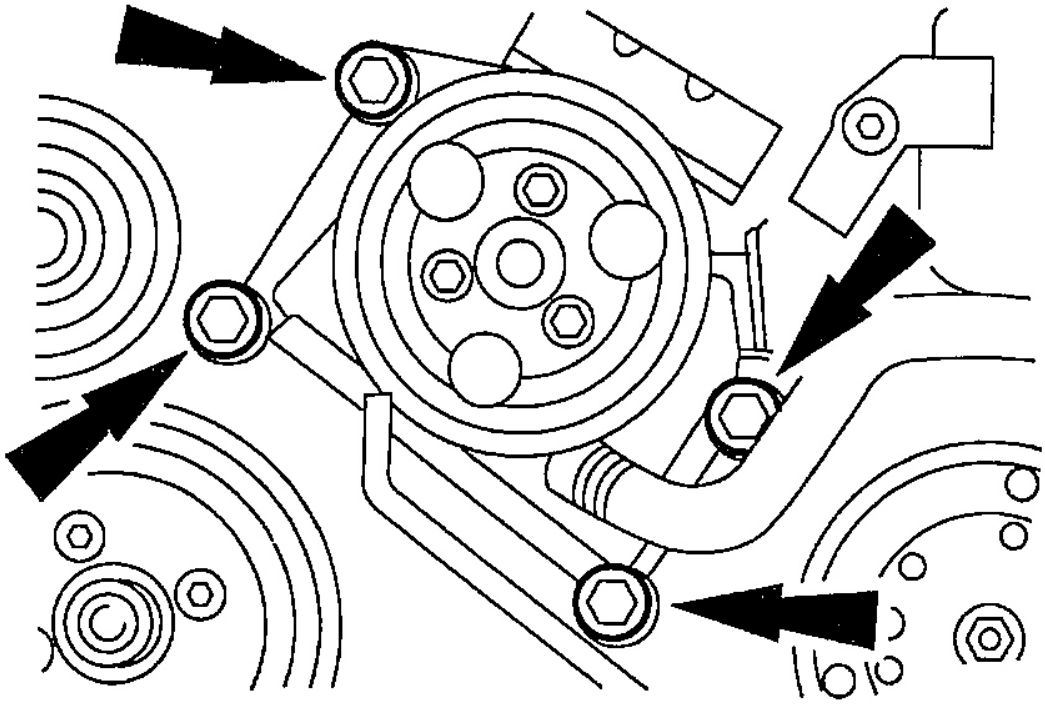
ENGINE DISASSEMBLY/ASSEMBLY

DISASSEMBLY NOTE

WARNING:

- **If the fuel rail is used as a leverage device, damage may occur to the fuel rail. Care must be taken when working around the fuel rail.**

1. Rotate the drive belt tensioner counterclockwise and remove the drive belt.
2. Remove the bolts and position the accessory bracket aside.



G02821136

Fig. 1: Removing Accessory Bracket
Courtesy of MAZDA MOTORS CORP.

3. Remove the generator mounting bracket.
    1. Remove the drive belt tensioner bolt.
    2. Remove the generator mounting bracket bolts.

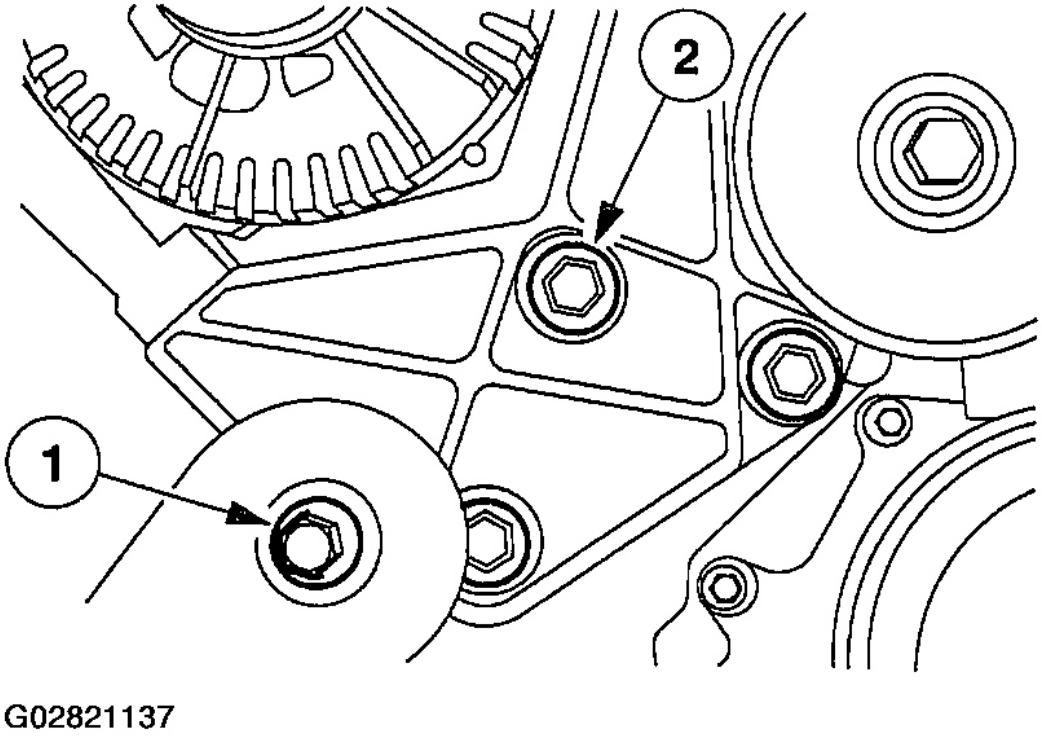


Fig. 2: Removing Generator Mounting Bracket
Courtesy of MAZDA MOTORS CORP.

4. Disconnect the Throttle Position (TP) sensor electrical connector.

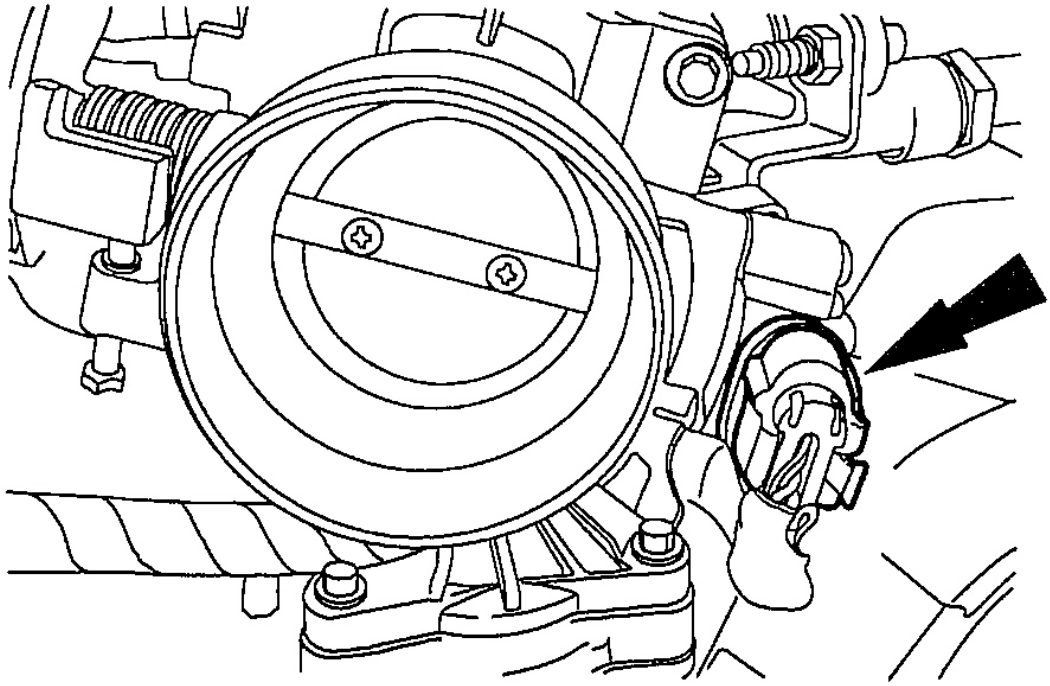


Fig. 3: Disconnecting Throttle Position Sensor
Courtesy of MAZDA MOTORS CORP.

5. Disconnect the Idle Air Control (IAC) valve electrical connector and disconnect the EGR valve vacuum hose.

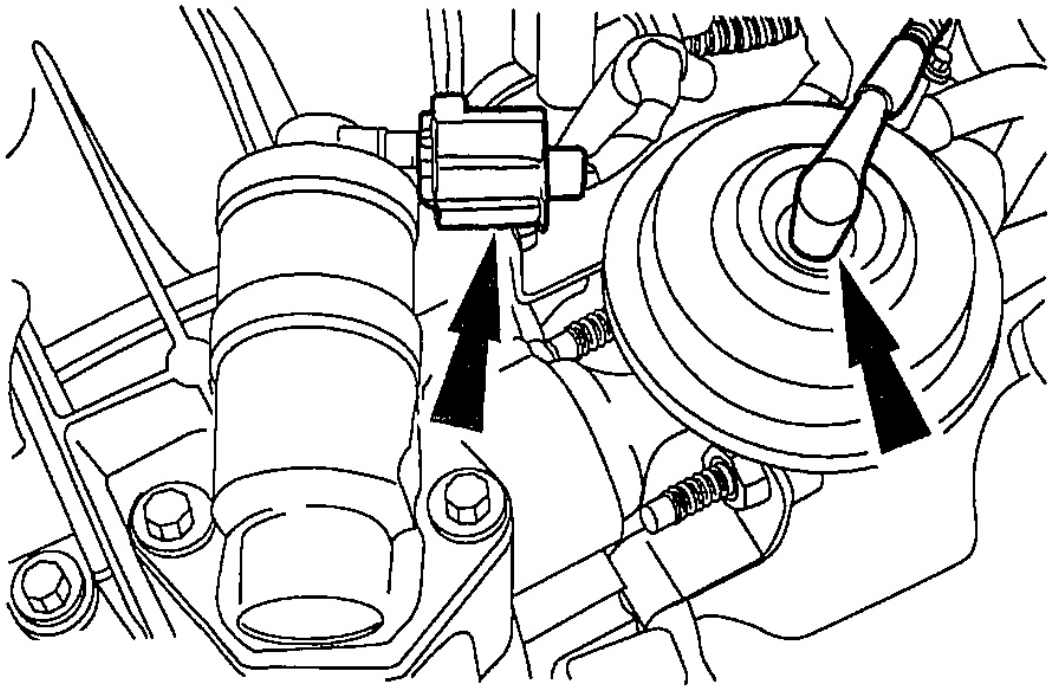


Fig. 4: Disconnecting IAC Valve Electrical Connector & EGR Valve Vacuum Hose
Courtesy of MAZDA MOTORS CORP.

6. Loosen the fitting and disconnect the exhaust manifold-to-EGR valve tube.

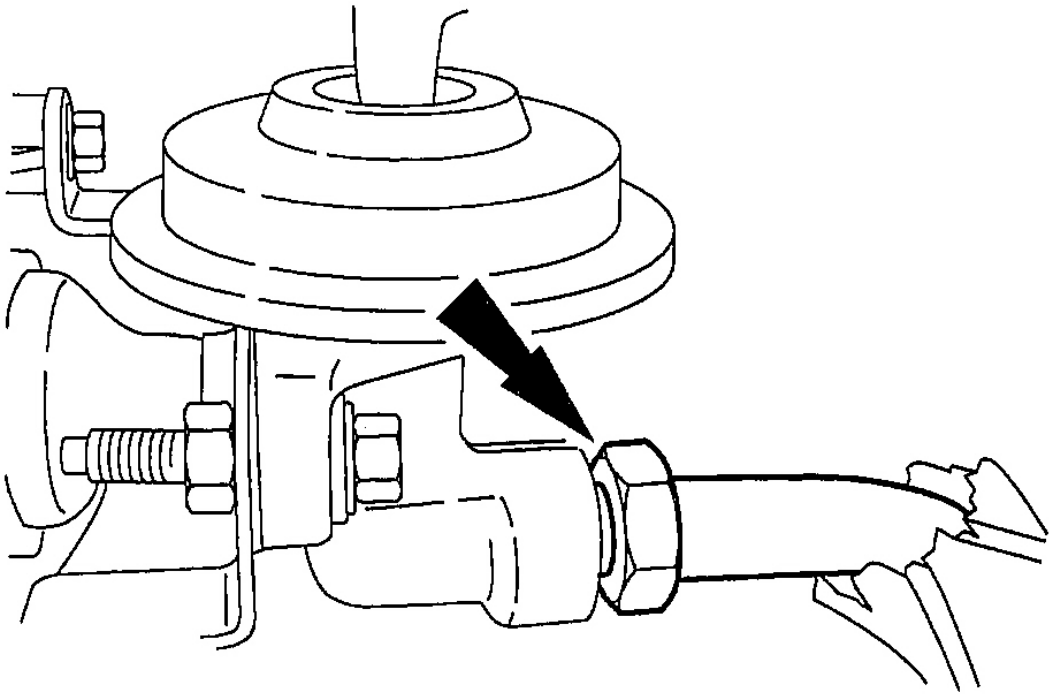
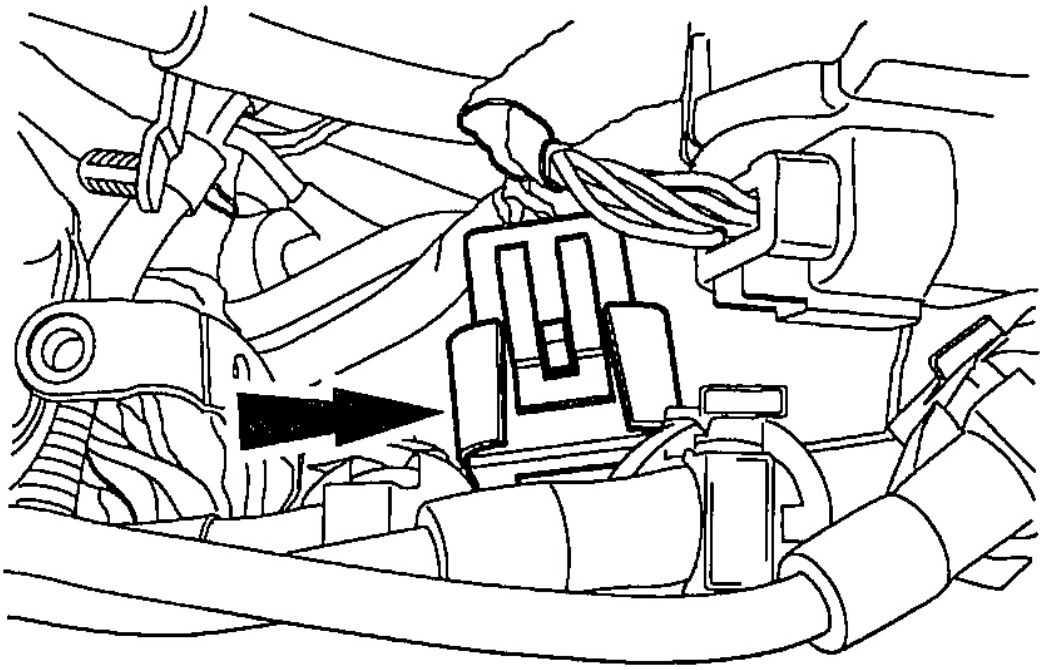


Fig. 5: Disconnecting Exhaust Manifold-To-EGR Valve Tube
Courtesy of MAZDA MOTORS CORP.

7. Disconnect the ignition coil electrical connector.



G02821141

Fig. 6: Disconnecting Ignition Coil Electrical Connector
Courtesy of MAZDA MOTORS CORP.

8. Disconnect the radio ignition interference capacitor electrical connector.

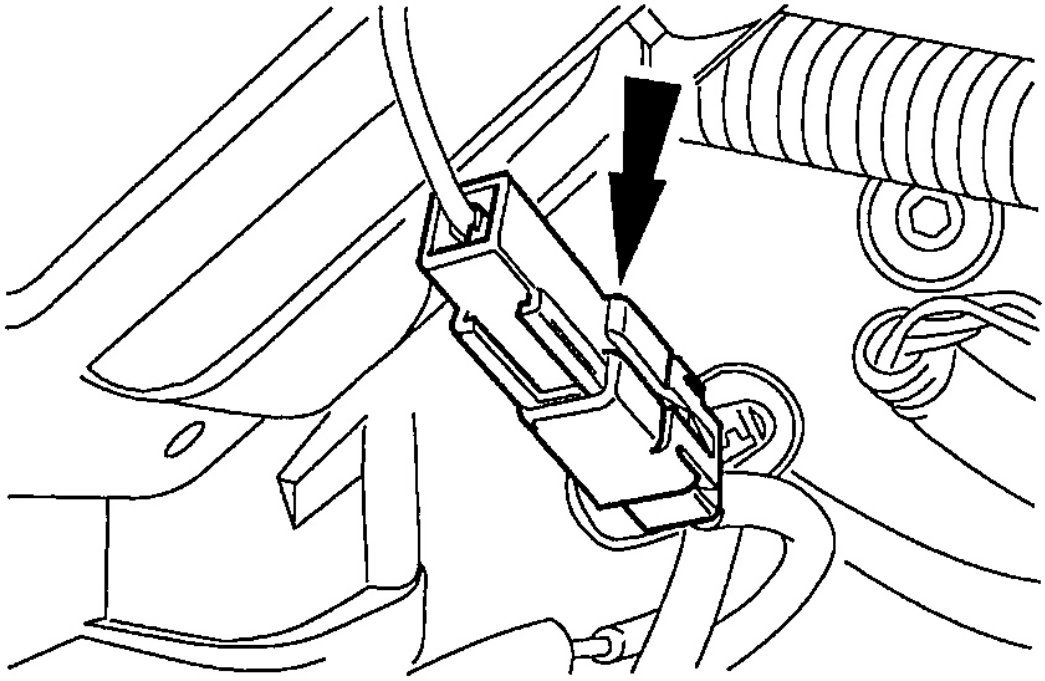
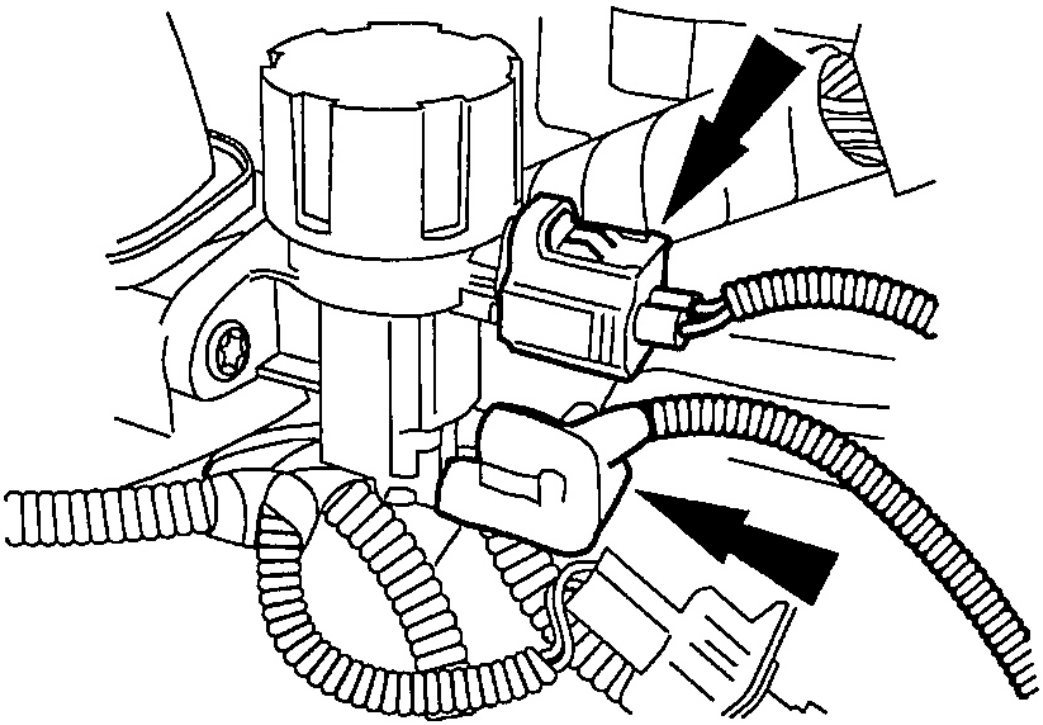


Fig. 7: Disconnecting Radio Ignition Interference Capacitor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

9. Disconnect the EGR vacuum regulator.



G02821143

Fig. 8: Disconnecting EGR Vacuum Regulator
Courtesy of MAZDA MOTORS CORP.

CAUTION:
- **Spark plug wires must be connected correctly. Mark the spark plug wires before removing them.**

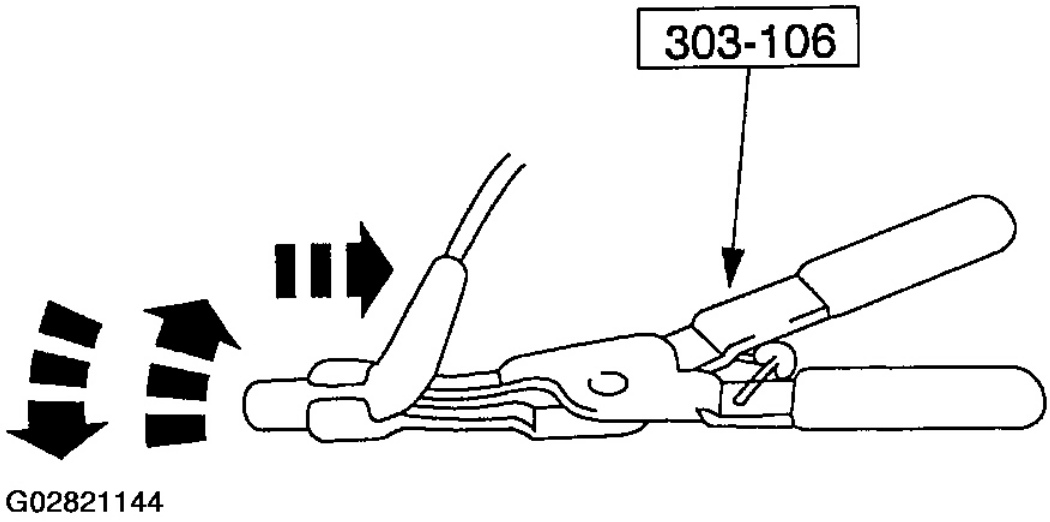


Fig. 9: Removing Spark Plug Wires
Courtesy of MAZDA MOTORS CORP.

10. Using spark plug wire remover SST 303-106, remove the spark plug wires from the spark plugs and all routing clips.
11. Remove the bolts.

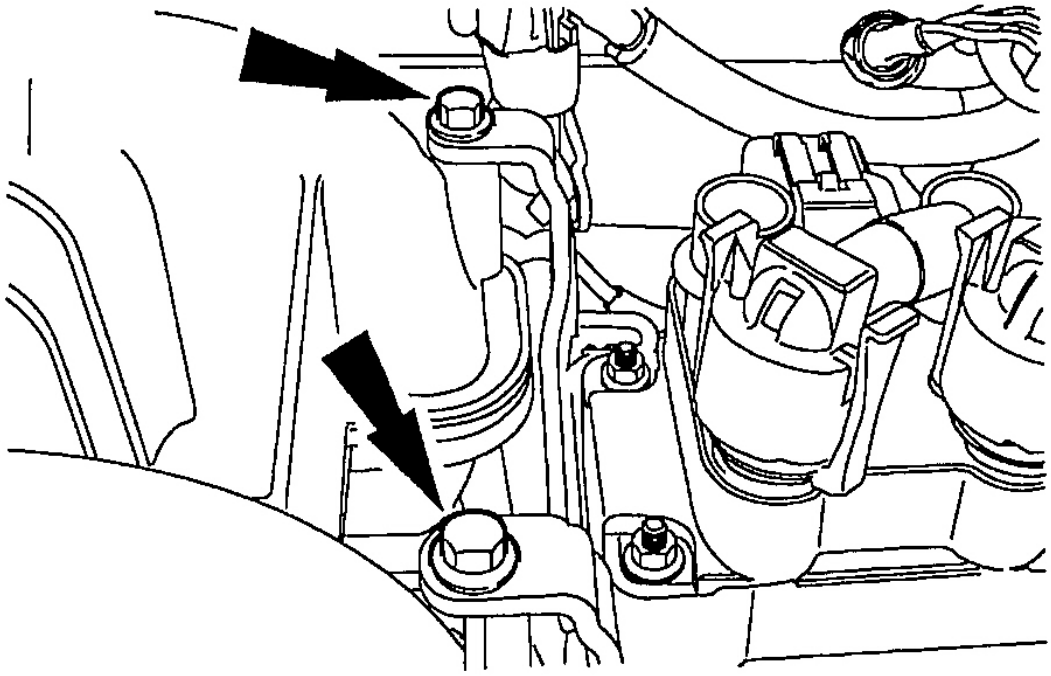


Fig. 10: Removing Ignition Coil Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

12. Remove the bolt and the coil and the ignition wires.

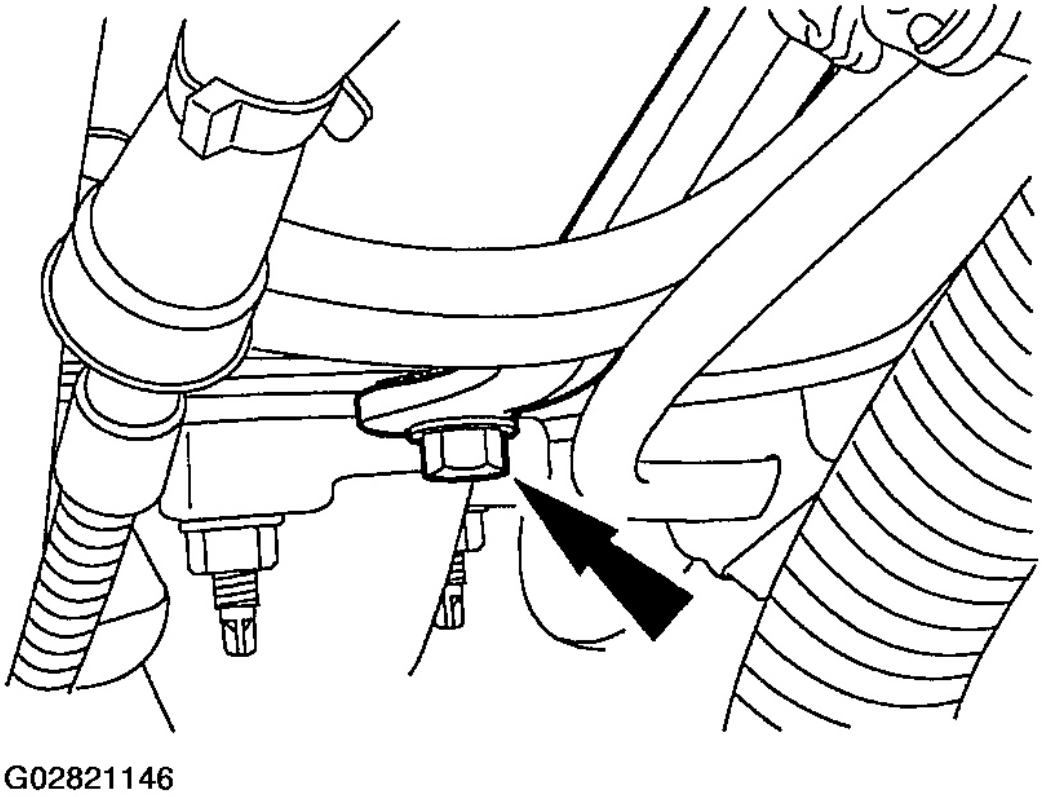
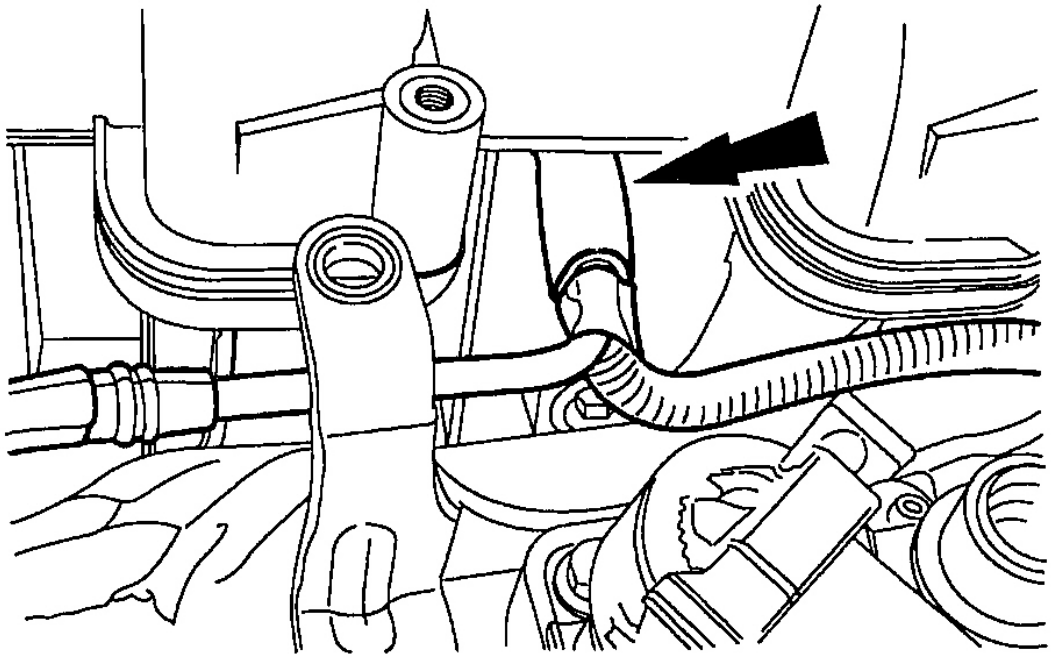


Fig. 11: Removing Bolt, Coil & Ignition Wires
Courtesy of MAZDA MOTORS CORP.

13. Disconnect the vacuum hoses.



G02821147

Fig. 12: Disconnecting Vacuum Hoses
Courtesy of MAZDA MOTORS CORP.

14. Detach and disconnect the electrical connector.

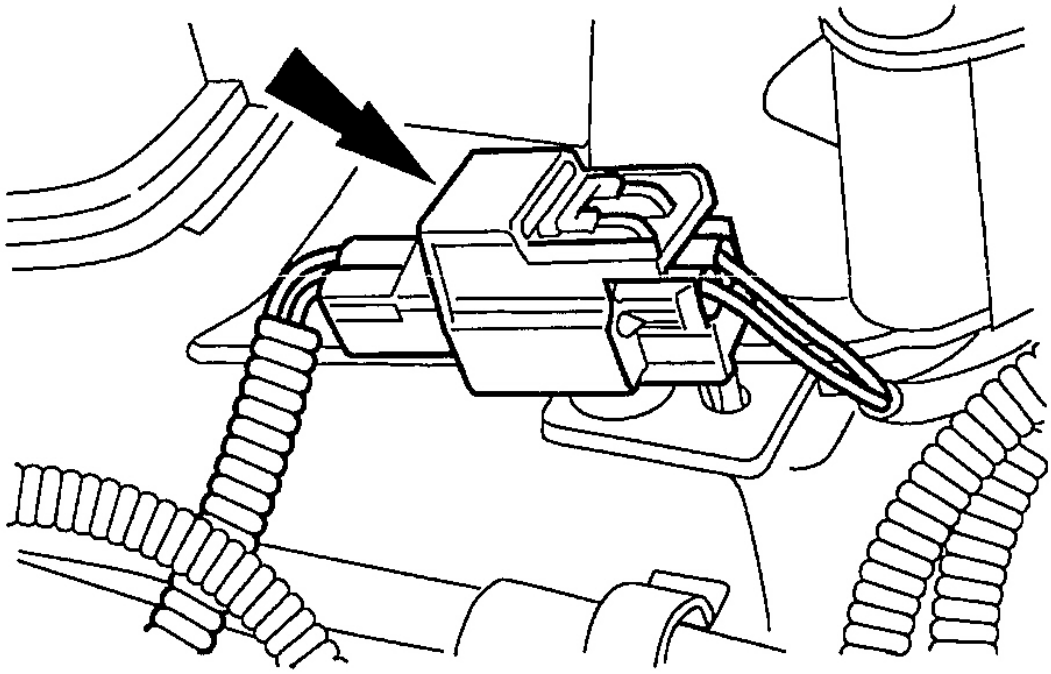


Fig. 13: Disconnecting Electrical Connector
Courtesy of MAZDA MOTORS CORP.

15. Remove the intake manifold bolts and lift up the intake manifold.

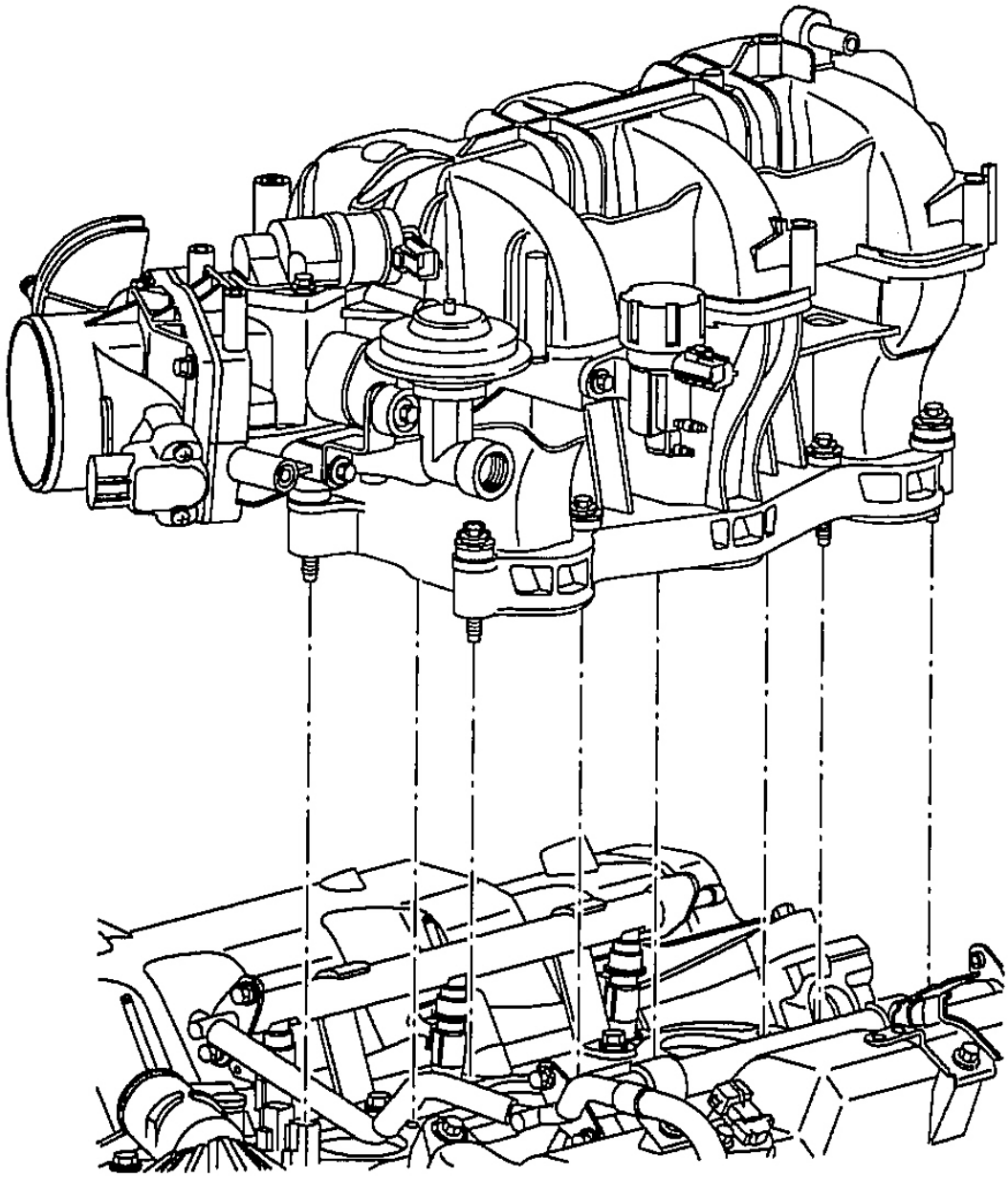
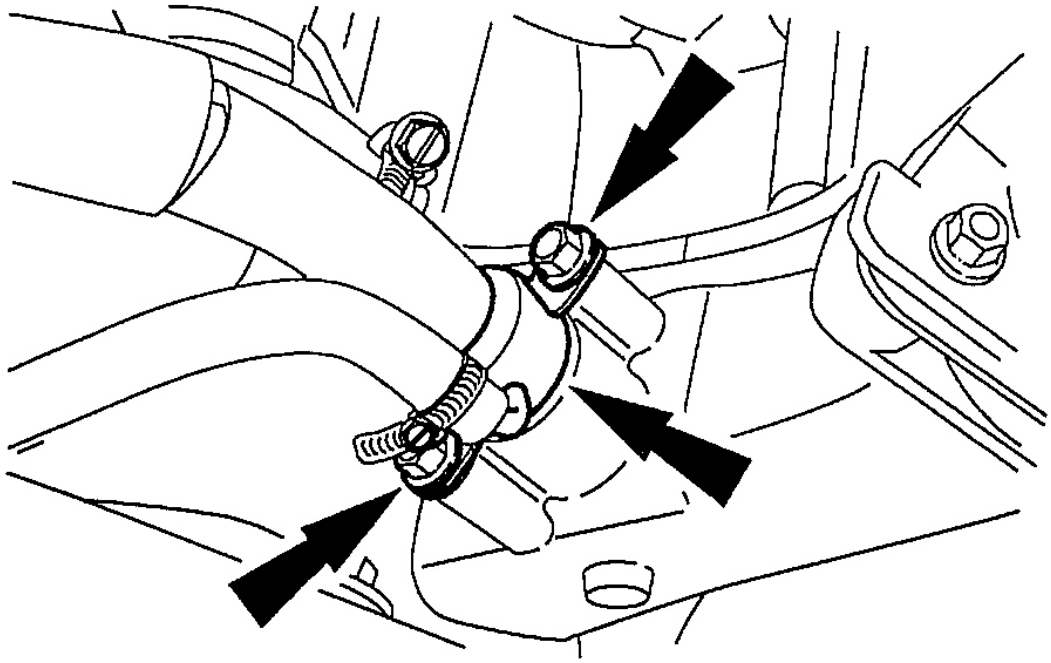


Fig. 14: Removing Intake Manifold
Courtesy of MAZDA MOTORS CORP.

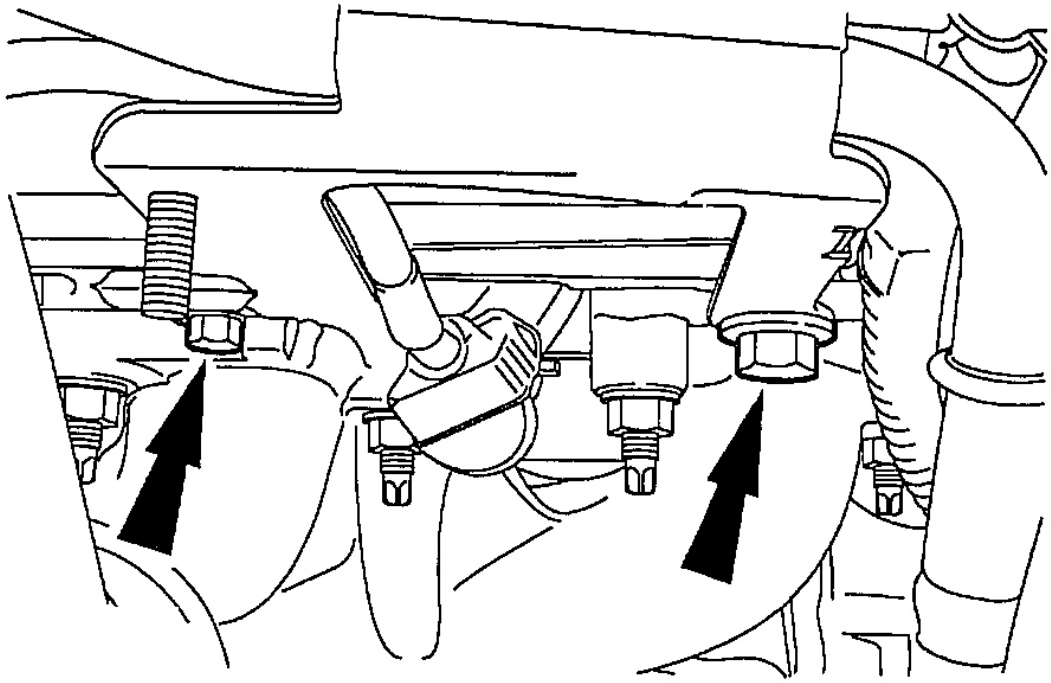
16. Remove the heated PCV hose retainers and remove the heated PCV fitting.



G02821150

Fig. 15: Removing Heated PCV Fitting
Courtesy of MAZDA MOTORS CORP.

17. Remove the intake manifold.
18. Remove the bolts.



G02821151

Fig. 16: Removing Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

19. Detach the wiring harness retainer and remove the heater tube and bracket assembly.

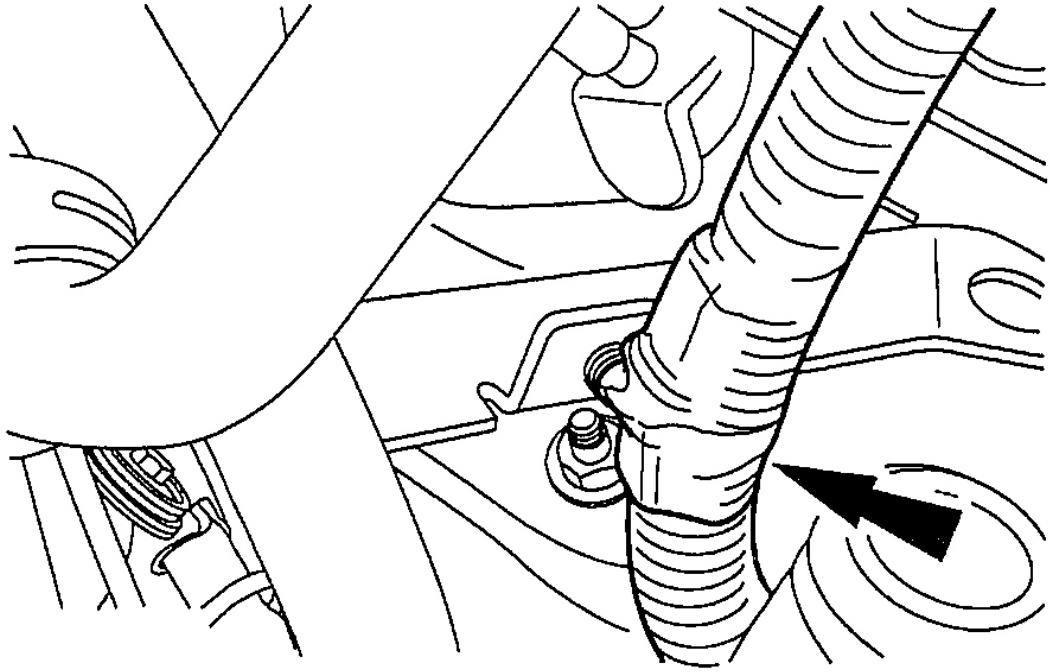
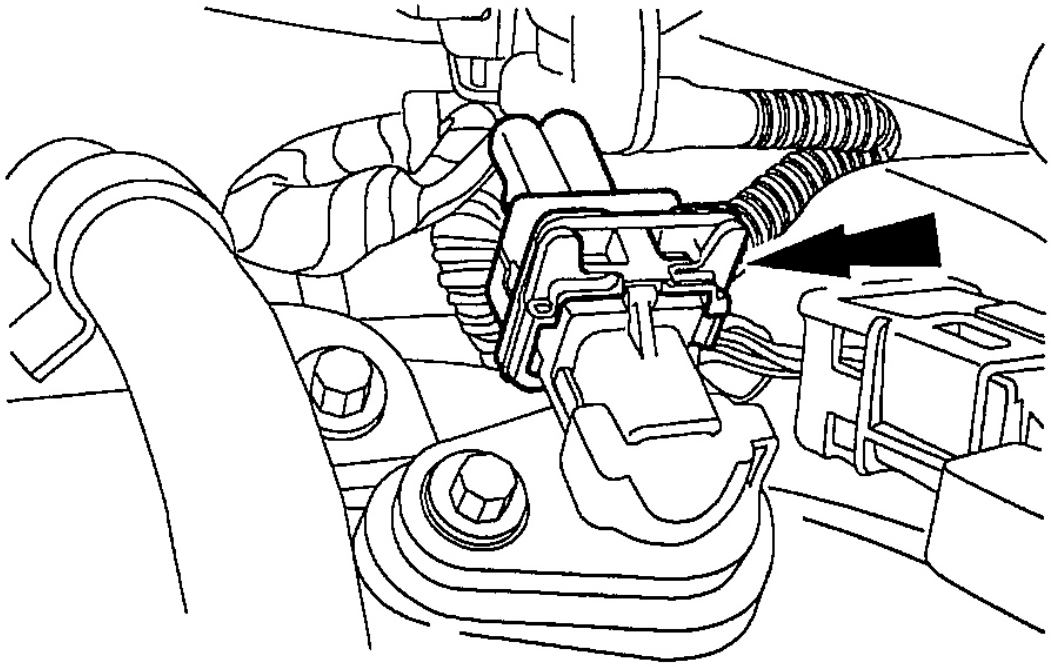


Fig. 17: Detaching Wiring Harness Retainer
Courtesy of MAZDA MOTORS CORP.

20. Disconnect the Camshaft Position (CMP) sensor electrical connector.



G02821153

Fig. 18: Disconnecting Camshaft Position sensor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

21. Disconnect the differential pressure feedback EGR transducer.

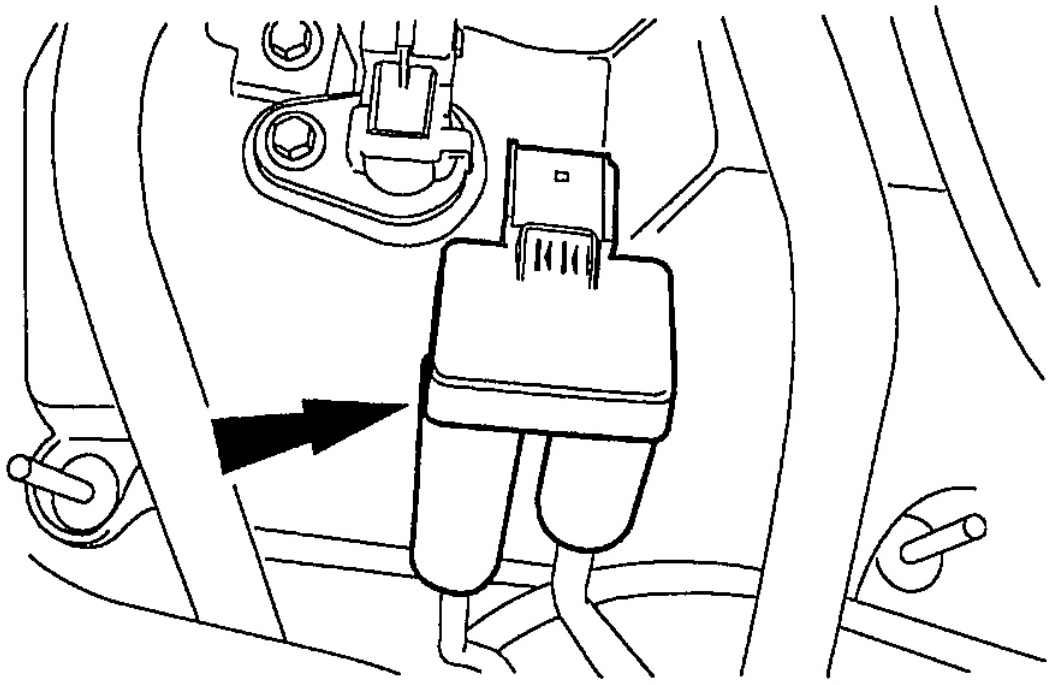


Fig. 19: Disconnecting Differential Pressure Feedback EGR Transducer
Courtesy of MAZDA MOTORS CORP.

22. Disconnect the Crankshaft Position (CKP) sensor electrical connector.

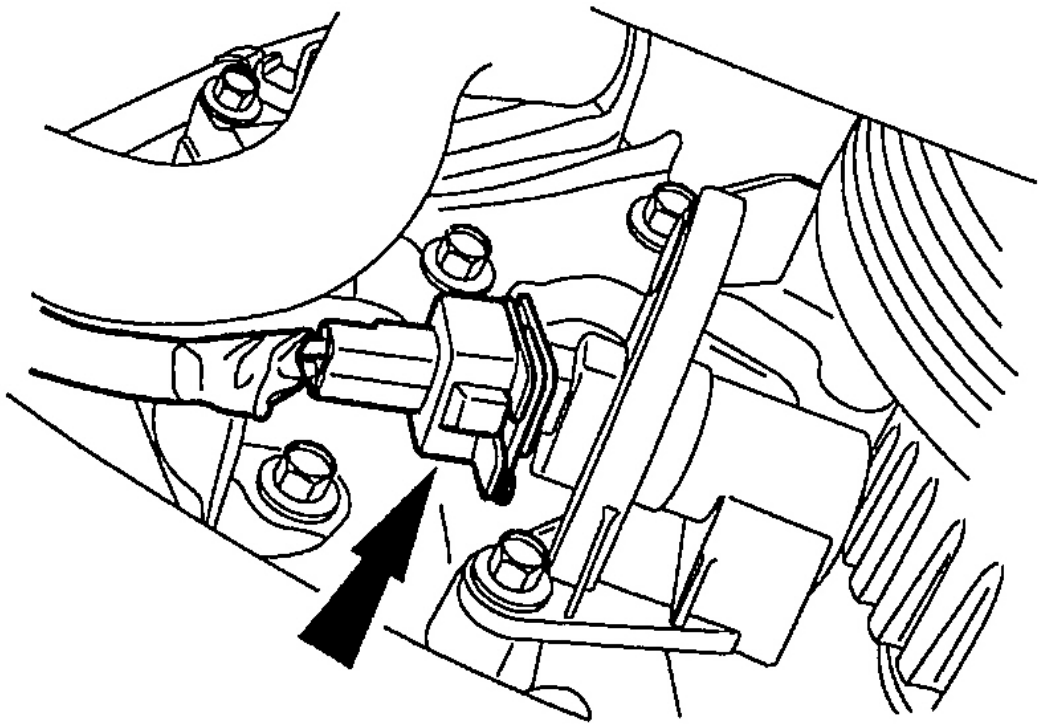
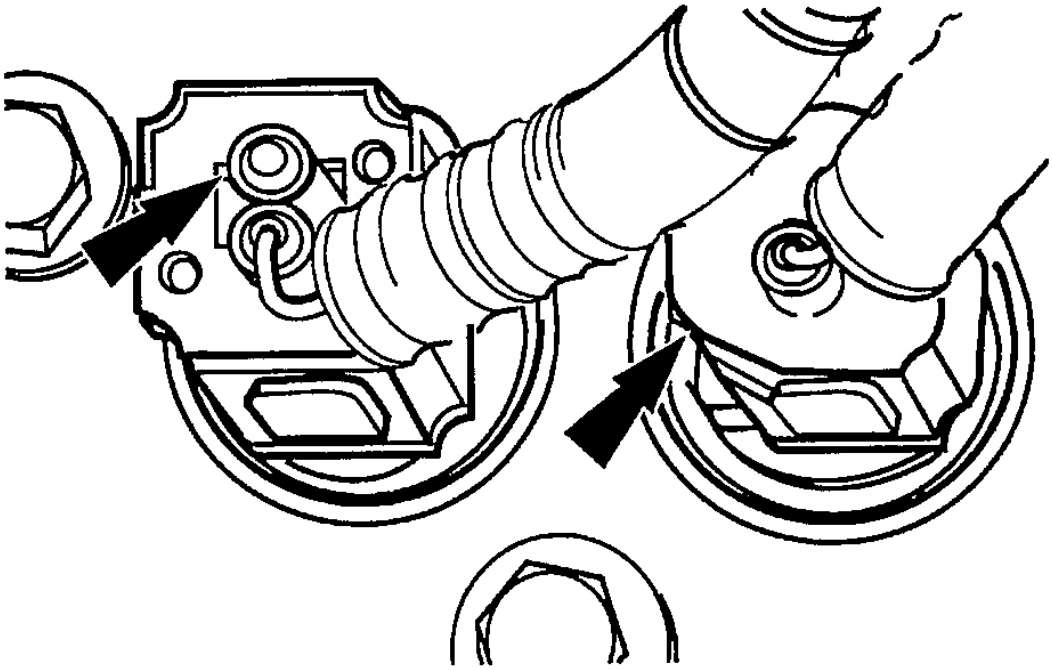


Fig. 20: Disconnecting Crankshaft Position Sensor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

23. Disconnect the water temperature indicator sender unit and the Engine Coolant Temperature (ETC) sensor electrical connectors.



G02821156

Fig. 21: Disconnecting Water Temperature Indicator Sender Unit & ETC Sensor Electrical Connectors
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **The LH side is shown, the RH side is similar.**

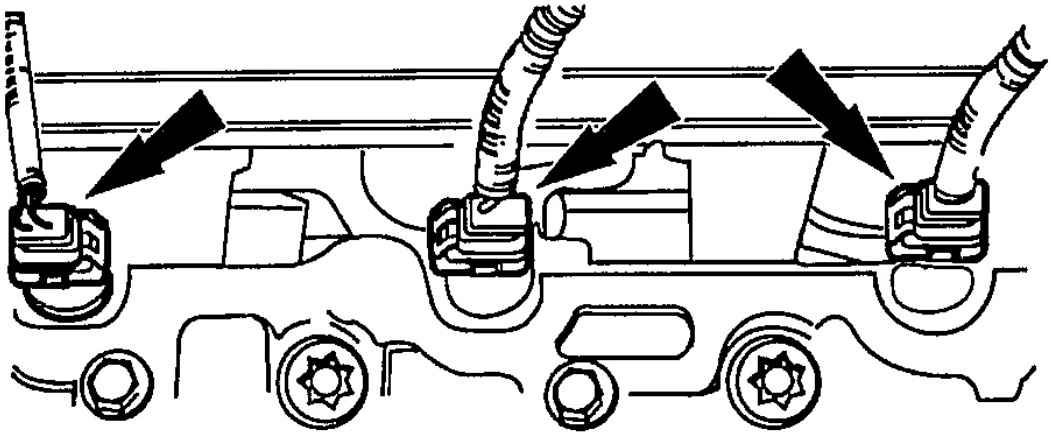


Fig. 22: Disconnecting Fuel Injector Electrical Connectors
Courtesy of MAZDA MOTORS CORP.

24. Disconnect the six fuel injector electrical connectors.
25. Remove the engine control/fuel charging wiring.

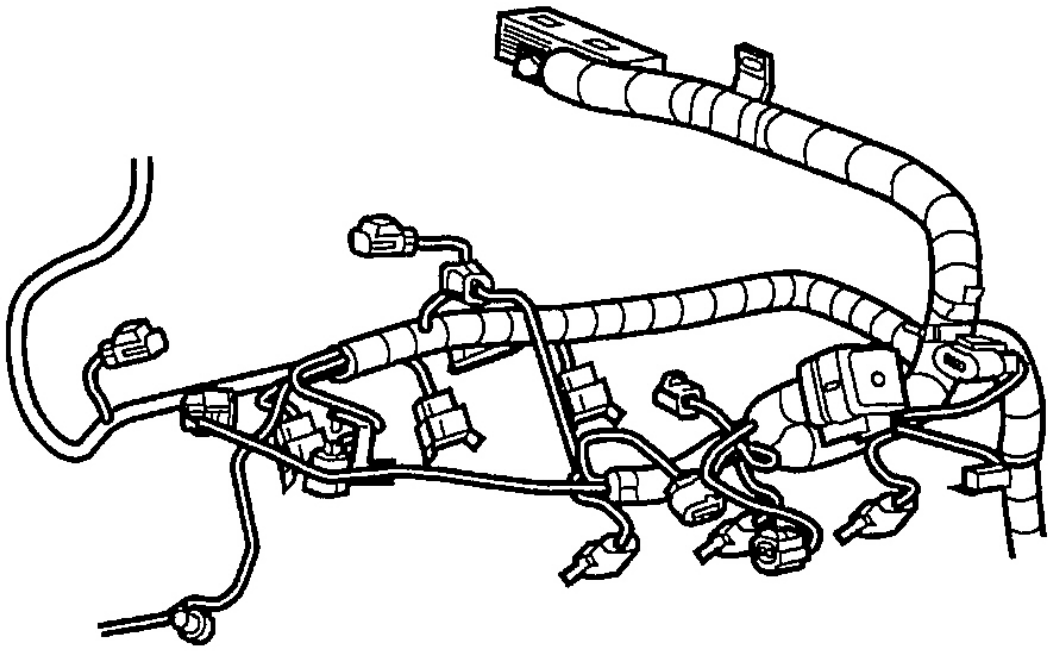


Fig. 23: Removing Engine Control/Fuel Charging Wiring
Courtesy of MAZDA MOTORS CORP.

26. Disconnect the EGR valve-to-exhaust manifold tube from the exhaust manifold.

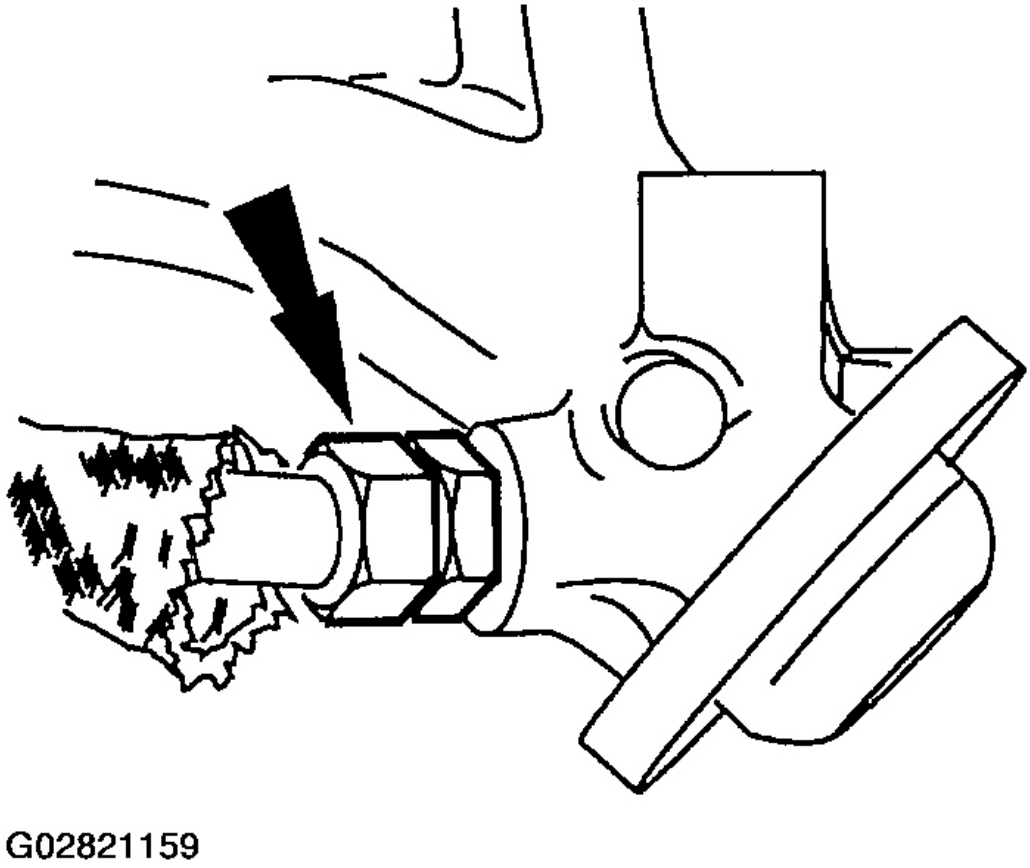


Fig. 24: Disconnecting EGR Valve-To-Exhaust Manifold Tube
Courtesy of MAZDA MOTORS CORP.

27. Remove the bolt and position the lower fuel line bracket aside.

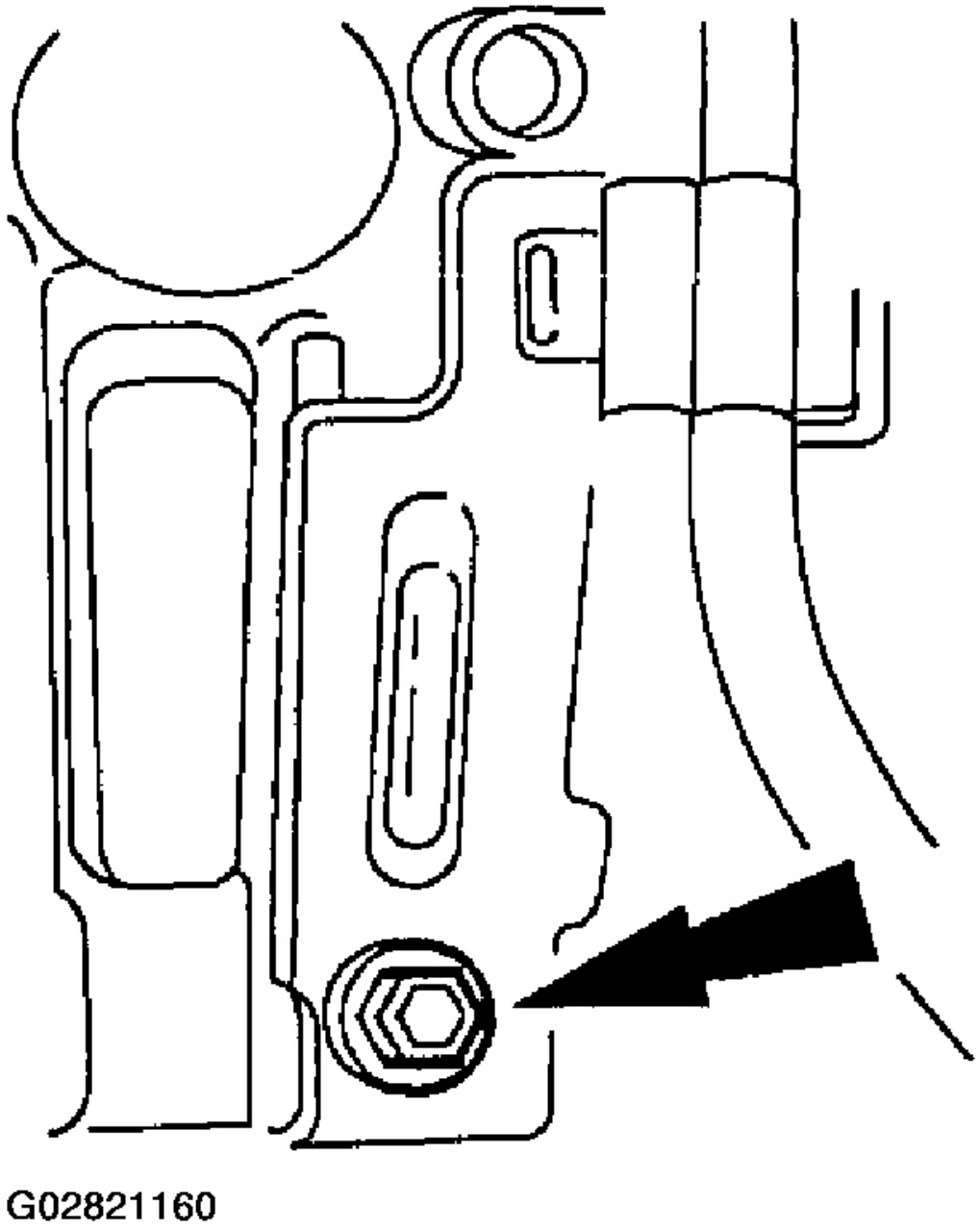
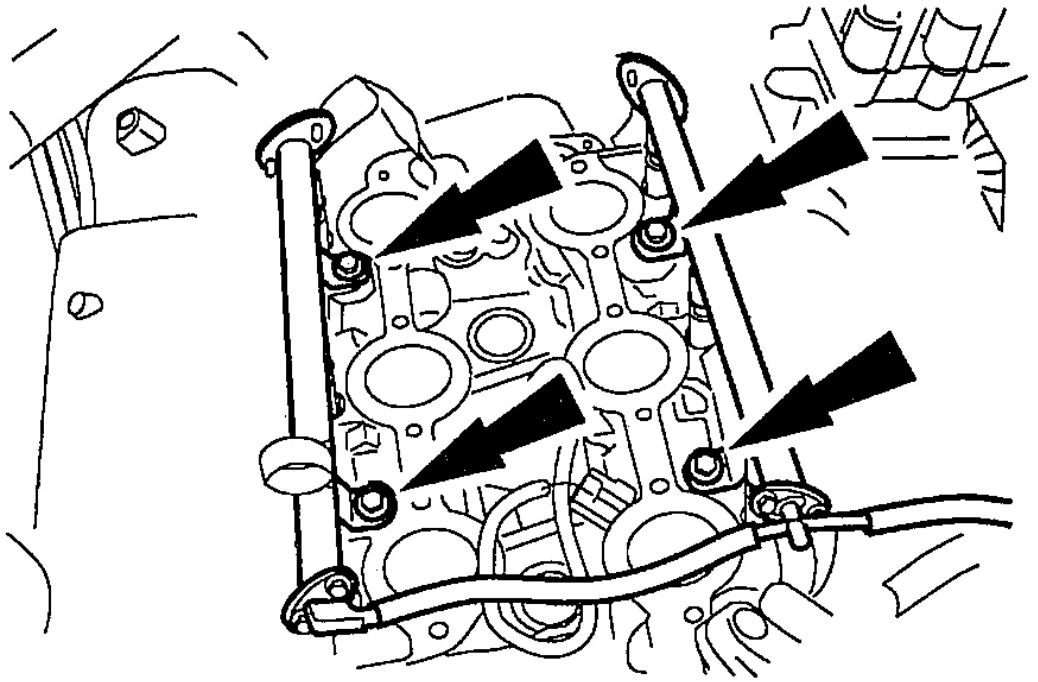


Fig. 25: Removing Lower Fuel Line Bracket
Courtesy of MAZDA MOTORS CORP.

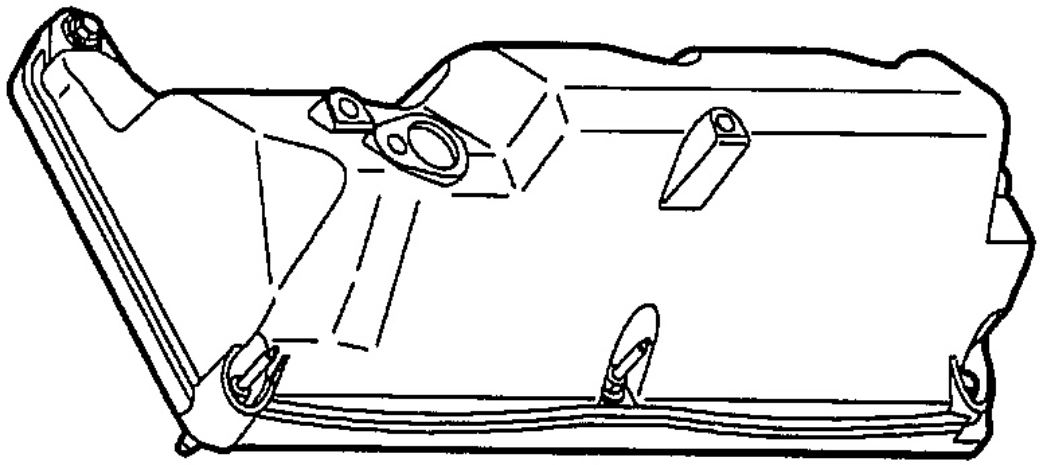
28. Remove the fuel rail.



G02821161

Fig. 26: Removing Fuel Rail
Courtesy of MAZDA MOTORS CORP.

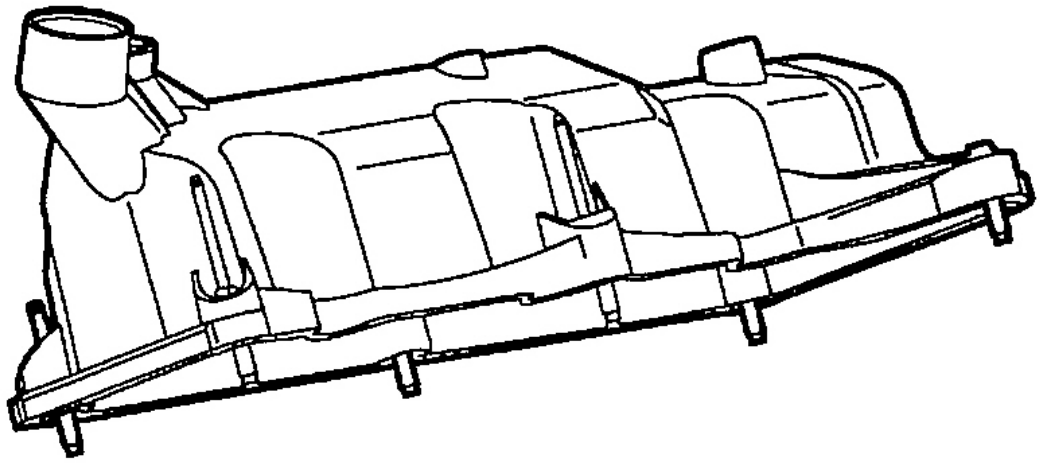
29. Remove the LH valve cover and the gasket.



G02821162

Fig. 27: Removing LH Valve Cover
Courtesy of MAZDA MOTORS CORP.

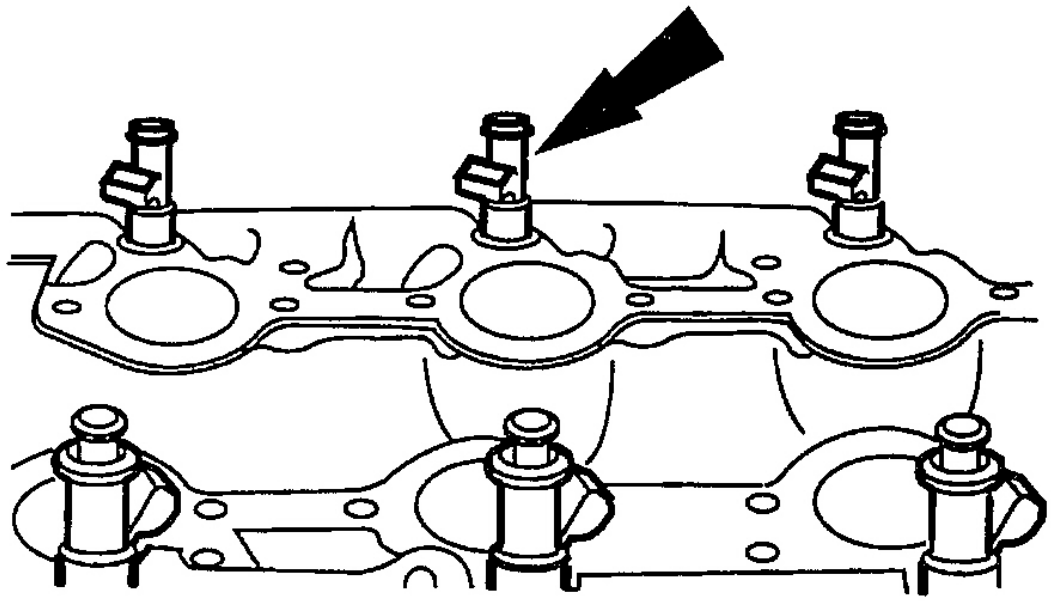
30. Remove the RH valve cover and the gasket.



G02821163

Fig. 28: Removing RH Valve Cover
Courtesy of MAZDA MOTORS CORP.

31. Remove the fuel injectors.



G02821164

Fig. 29: Removing Fuel Injectors
Courtesy of MAZDA MOTORS CORP.

32. Remove the thermostat housing.
    1. Remove the bolts.
    2. Release the bypass hose clamp.

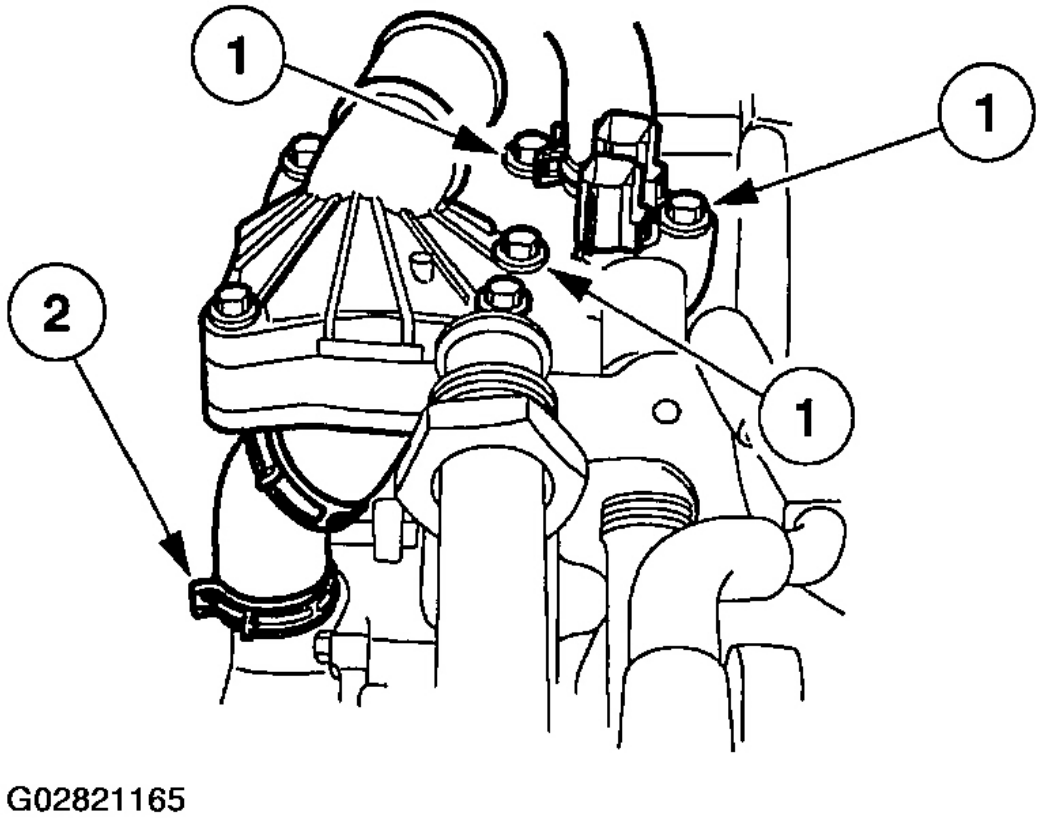
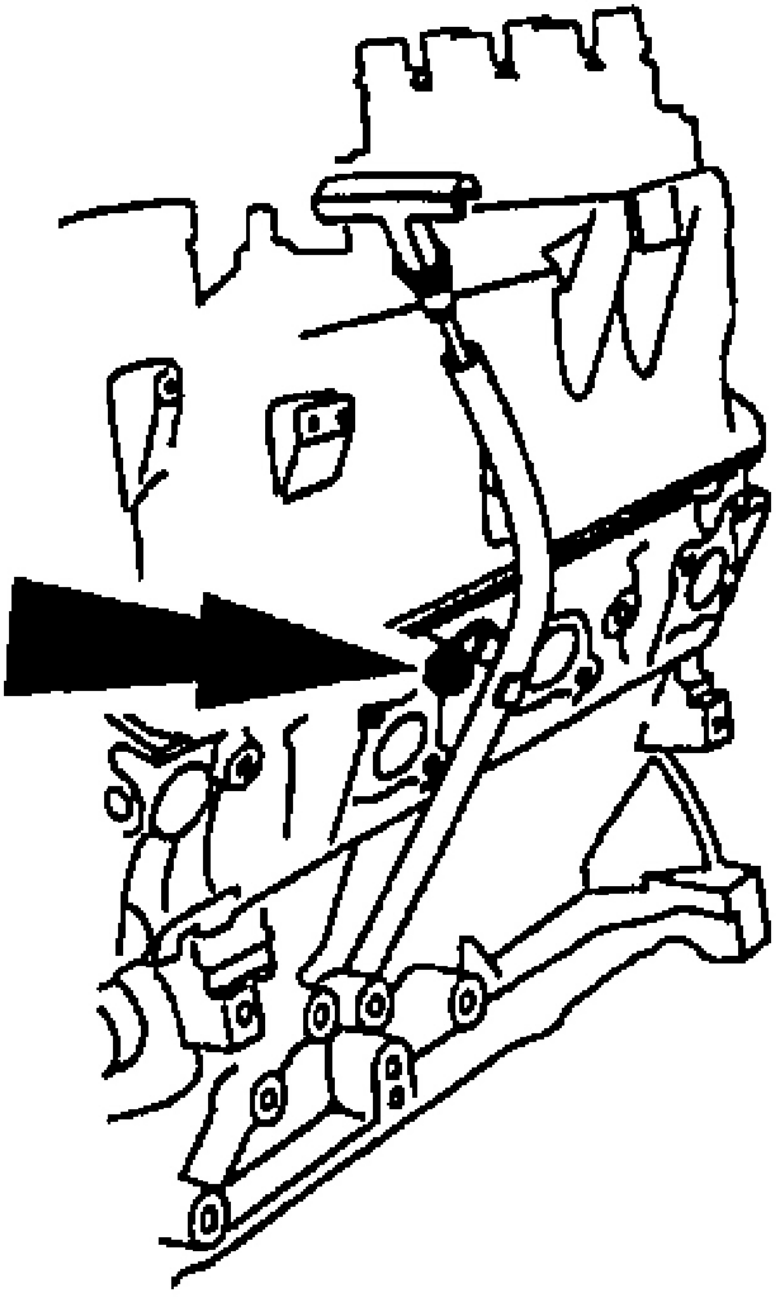


Fig. 30: Removing thermostat housing
Courtesy of MAZDA MOTORS CORP.

33. Remove the oil level indicator tube.



G02821166

Fig. 31: Removing Oil Level Indicator Tube
Courtesy of MAZDA MOTORS CORP.

34. Remove the knock sensor.

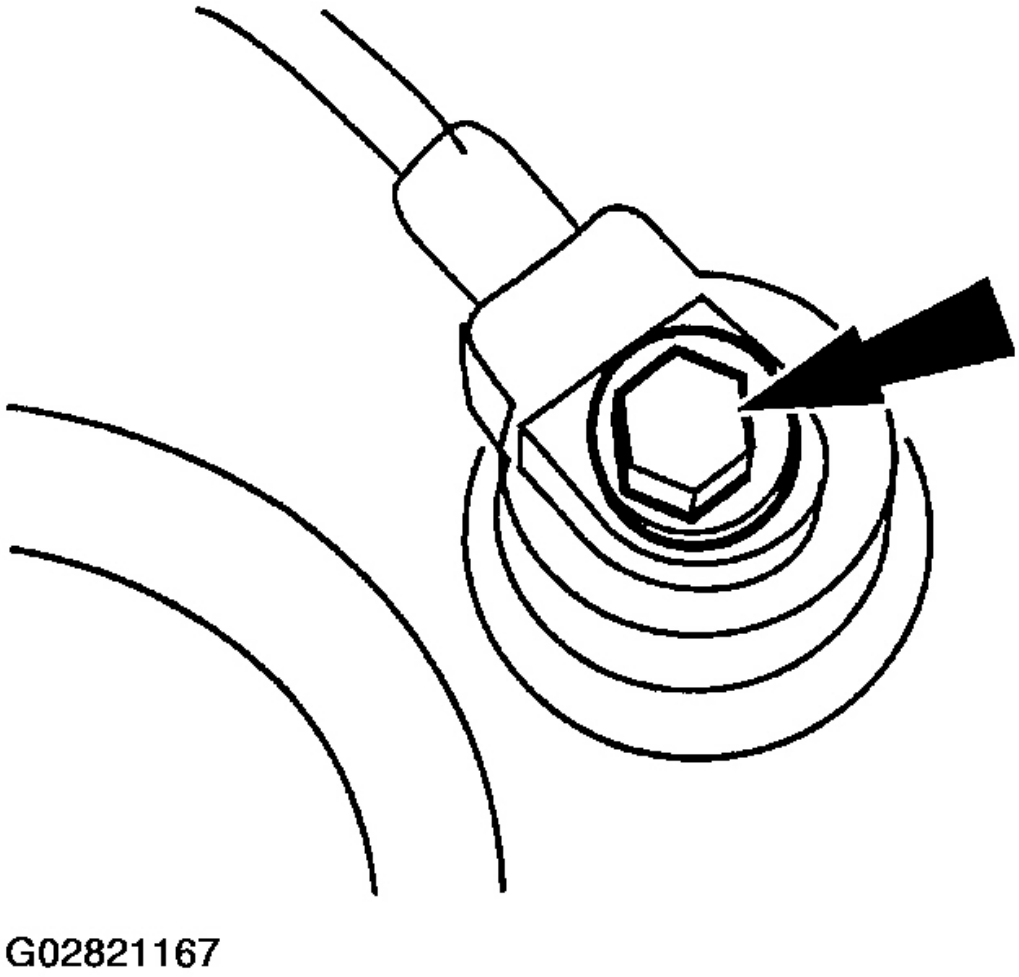
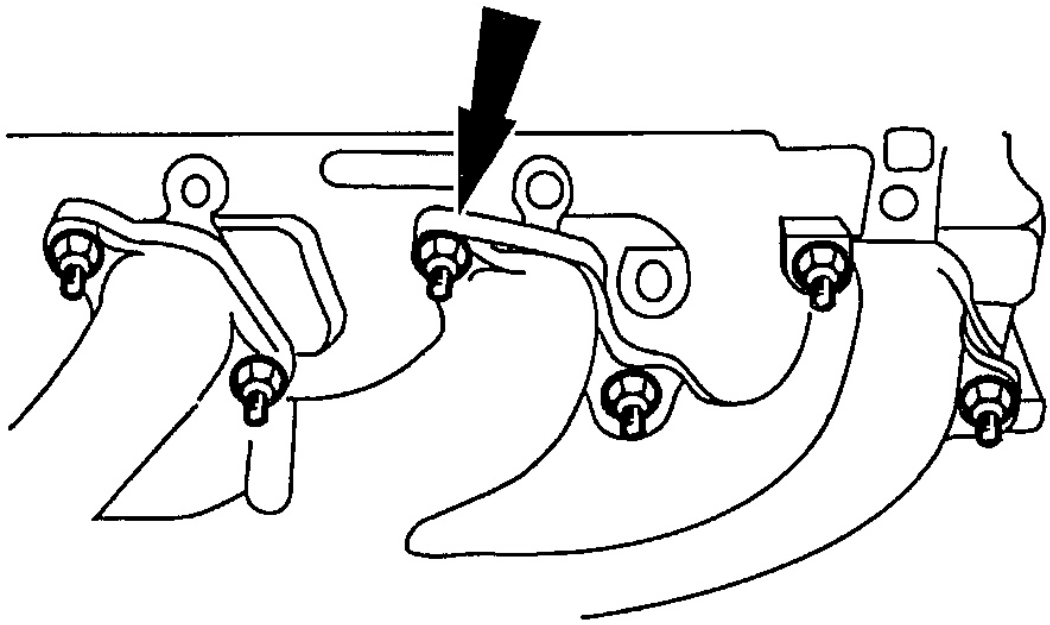


Fig. 32: Removing Knock Sensor
Courtesy of MAZDA MOTORS CORP.

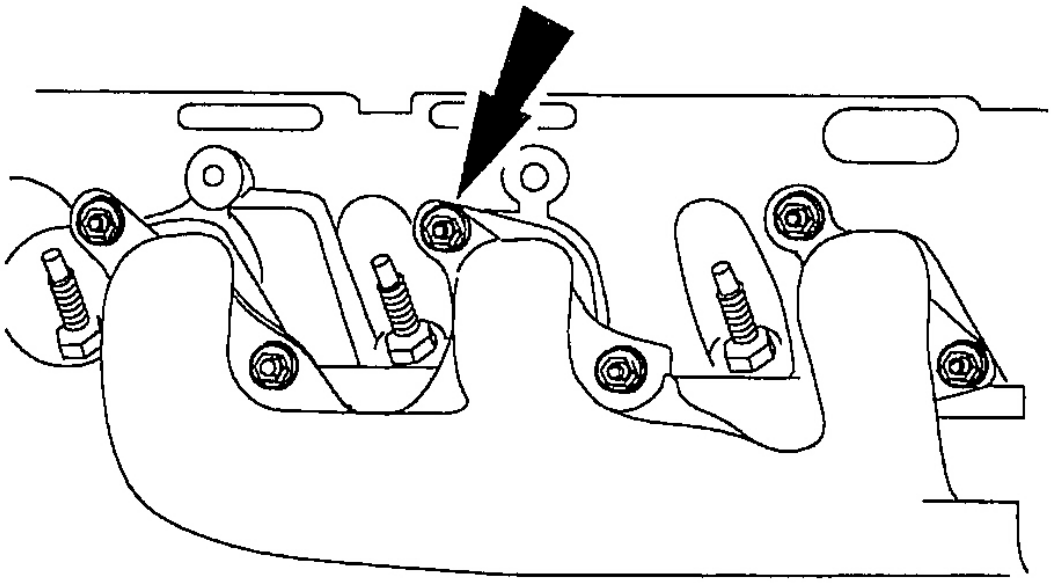
35. Remove the RH exhaust manifold and the gasket.



G02821168

Fig. 33: Removing RH Exhaust Manifold
Courtesy of MAZDA MOTORS CORP.

36. Remove the LH exhaust manifold and the gasket.



G02821169

Fig. 34: Removing LH Exhaust Manifold
Courtesy of MAZDA MOTORS CORP.

37. Remove the water pump.

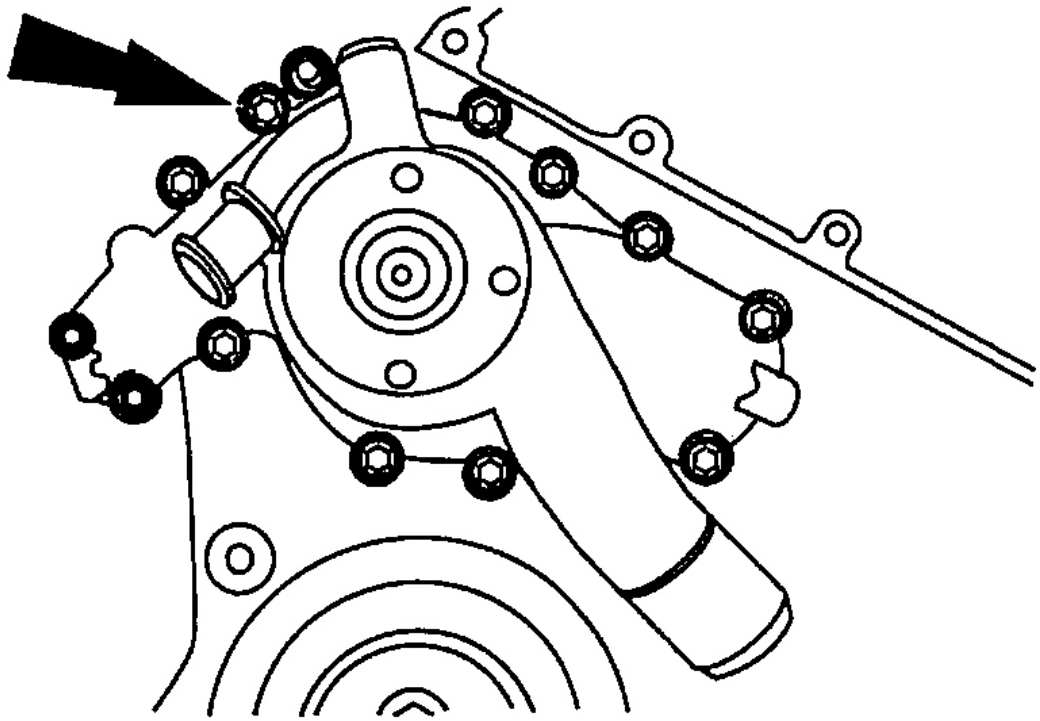


Fig. 35: Removing Water Pump
Courtesy of MAZDA MOTORS CORP.

38. Remove the bolt.

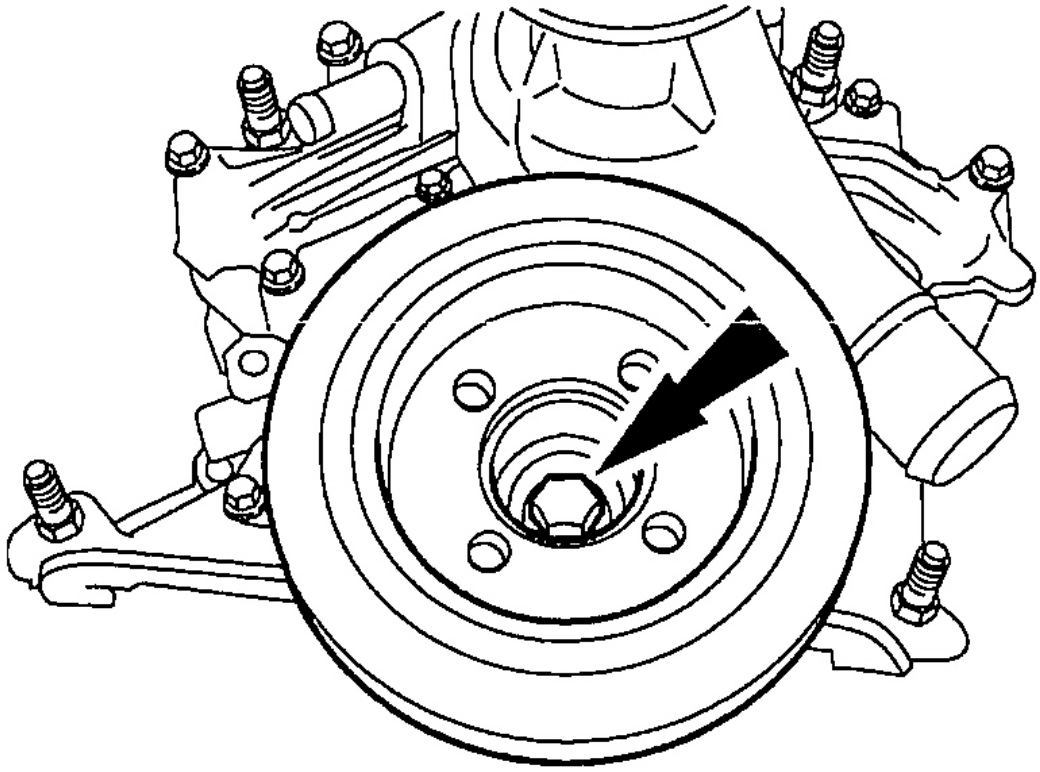


Fig. 36: Removing Crankshaft Pulley Bolt
Courtesy of MAZDA MOTORS CORP.

39. Using Crankshaft Damper Remover SST 303-101 (or 49UN-01-0010), remove the crankshaft pulley.

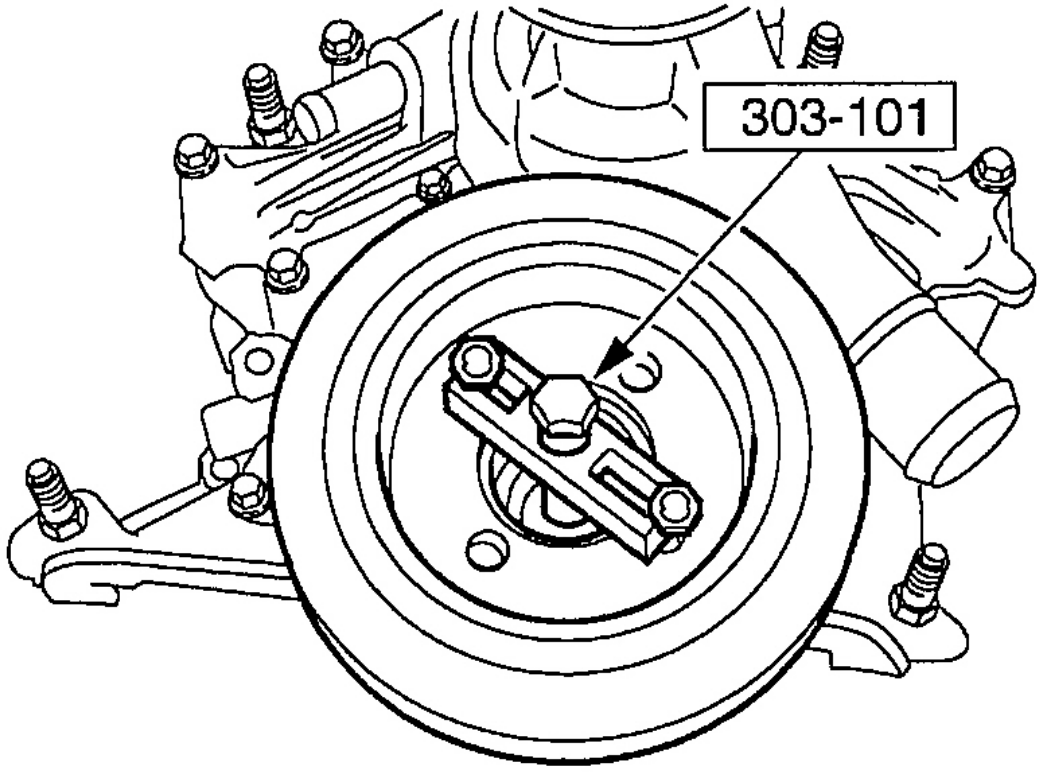
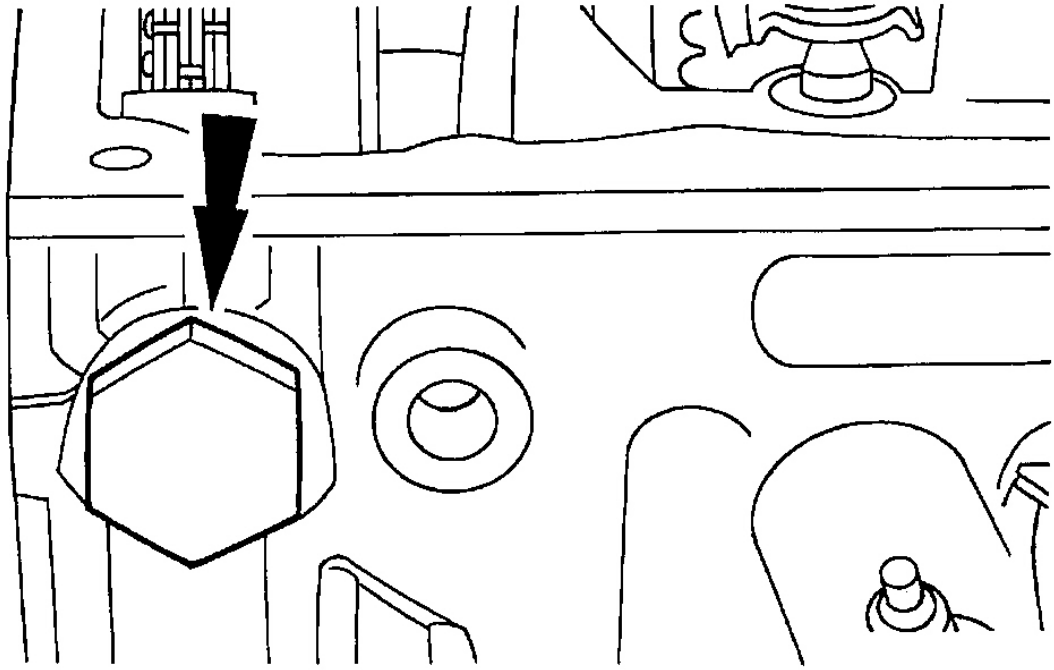


Fig. 37: Removing Crankshaft Pulley
Courtesy of MAZDA MOTORS CORP.

40. Remove the RH hydraulic chain tensioner.



G02821173

Fig. 38: Removing RH Hydraulic Chain Tensioner
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Mark each camshaft roller follower to make sure of its original position during reassembly.**

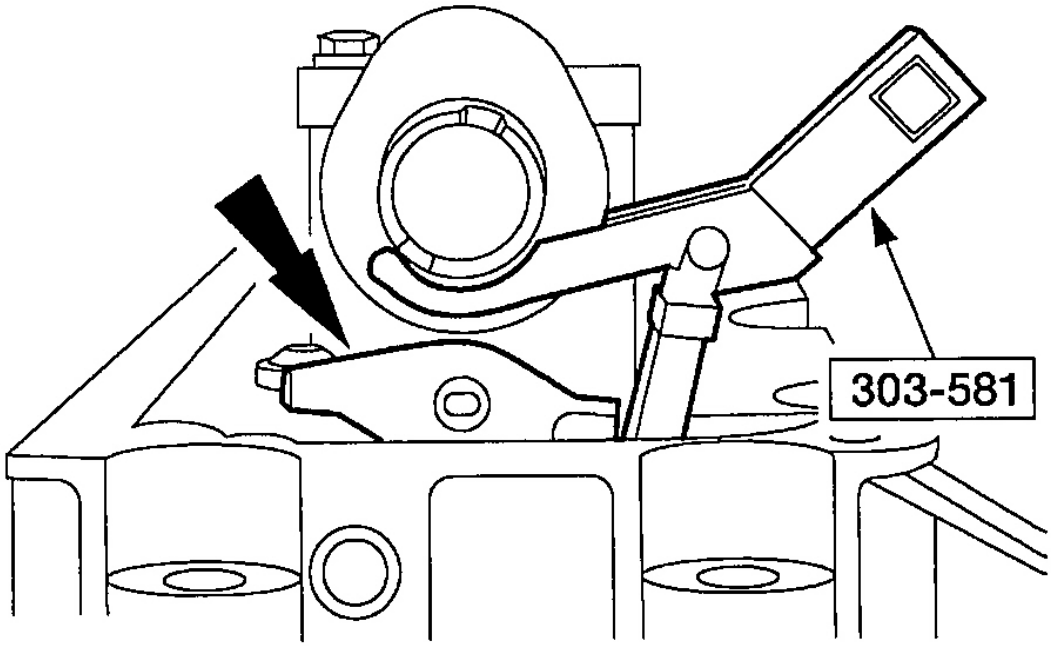
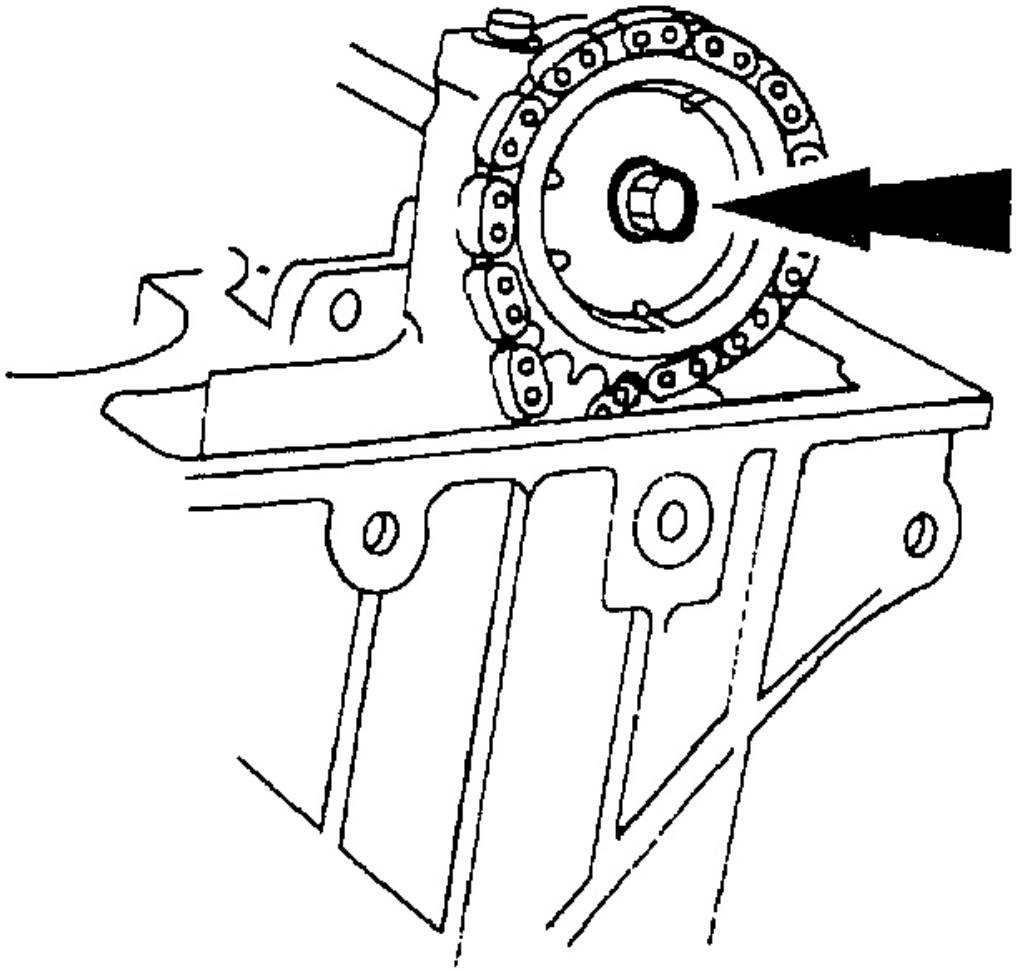


Fig. 39: Removing Camshaft Roller Followers
Courtesy of MAZDA MOTORS CORP.

41. Using Valve Spring Compressor SST 303-581, remove the camshaft roller followers.

CAUTION:
- **The right-hand camshaft sprocket bolt is a left-hand threaded bolt.**



G02821175

Fig. 40: Removing RH Camshaft Sprocket Bolt
Courtesy of MAZDA MOTORS CORP.

42. Remove the RH camshaft sprocket bolt.
43. Remove the camshaft sprocket from the camshaft and install a rubber band on the cassette to hold the chain and camshaft sprocket in place.

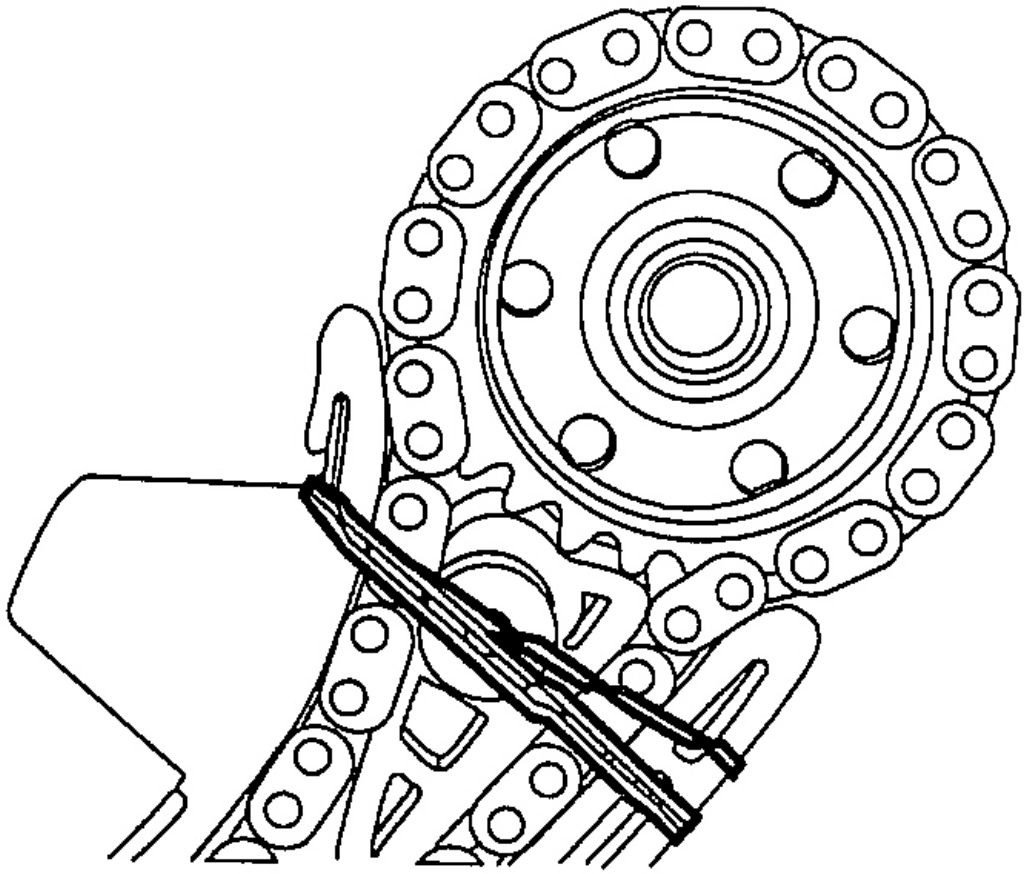


Fig. 41: Removing Camshaft Sprocket
Courtesy of MAZDA MOTORS CORP.

44. Remove the bolt.

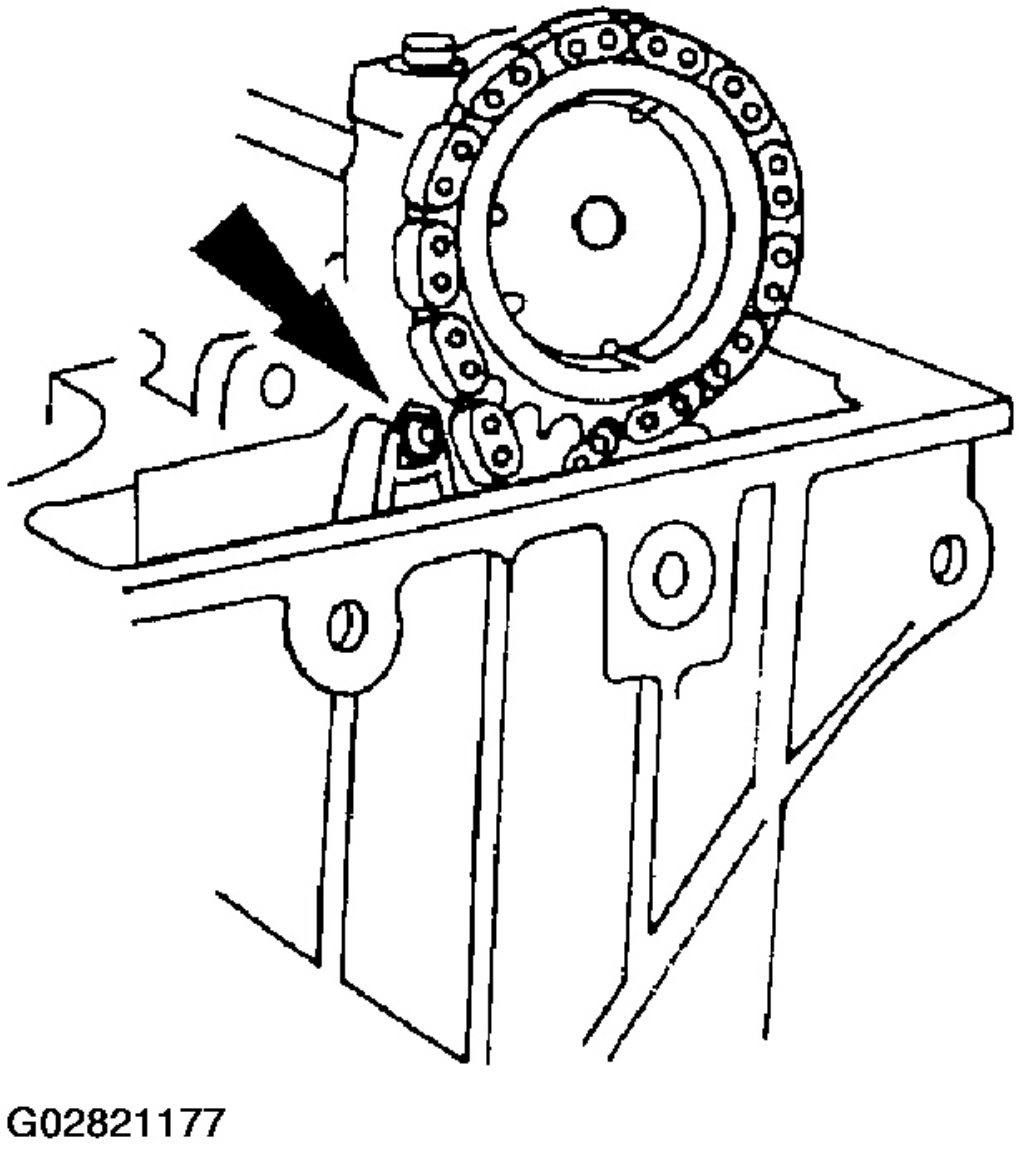
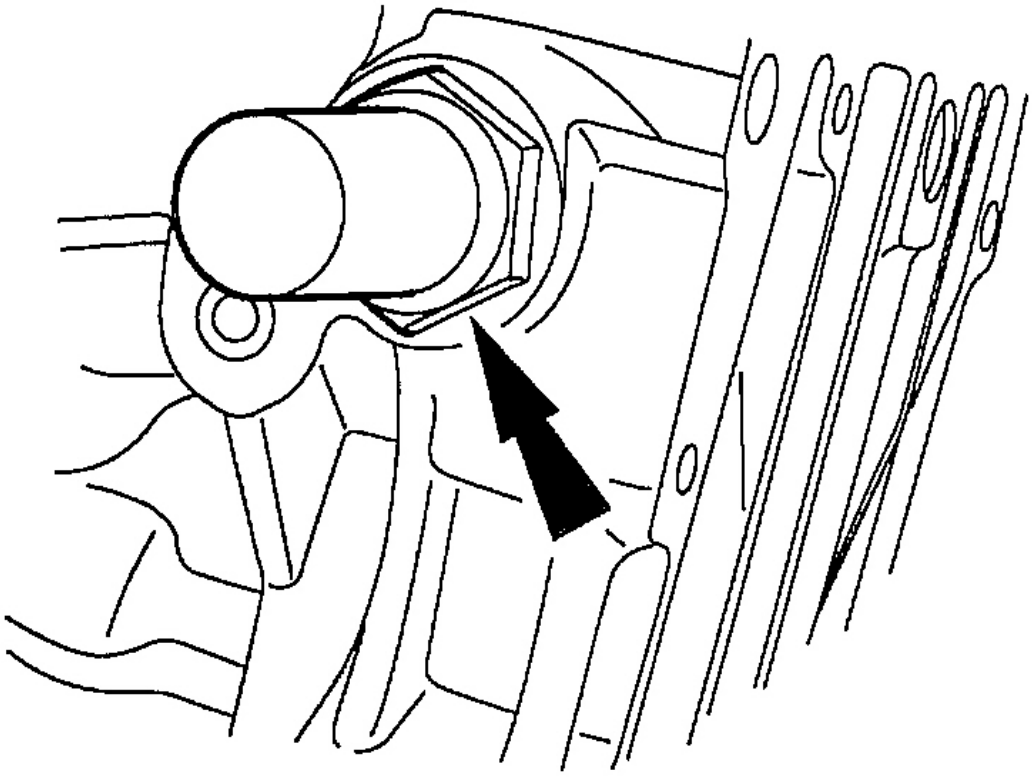


Fig. 42: Removing Hydraulic Chain Tensioner Bolt
Courtesy of MAZDA MOTORS CORP.

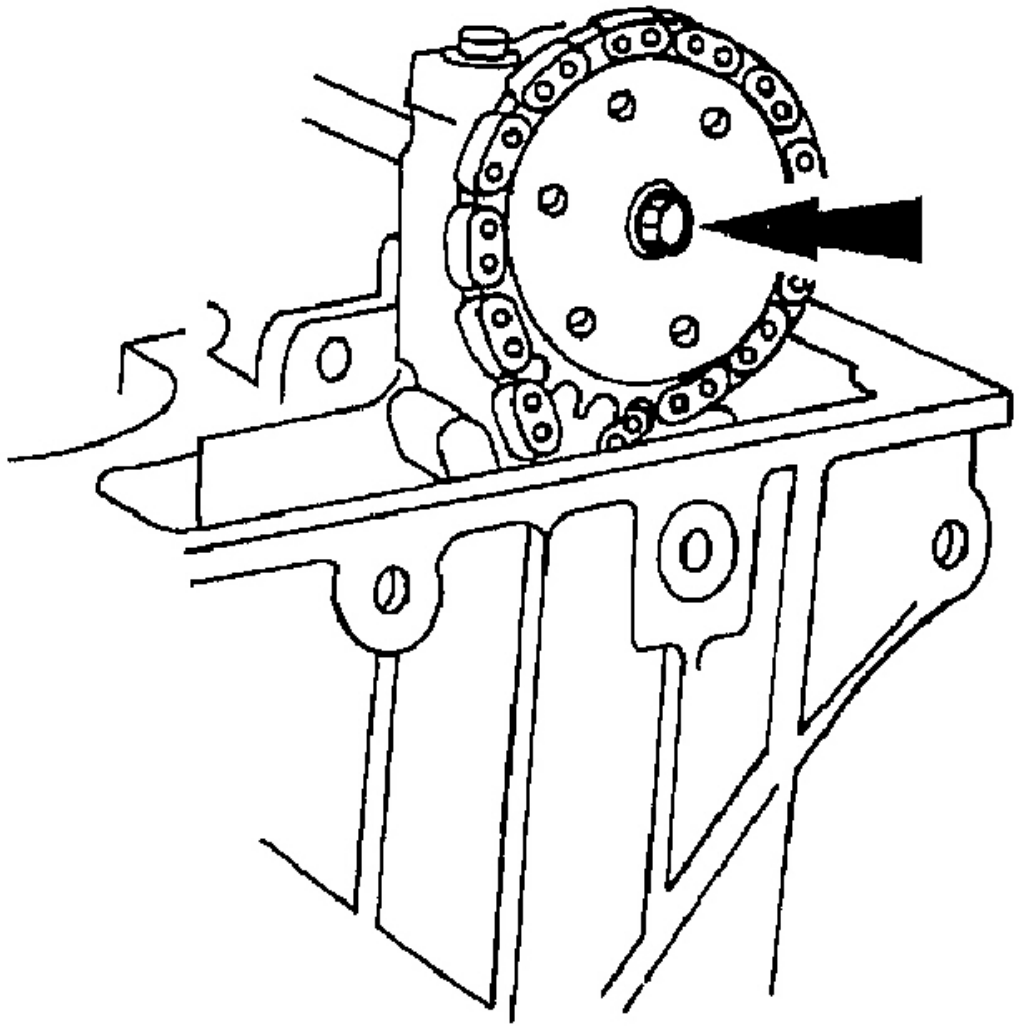
45. Remove the LH hydraulic chain tensioner.



G02821178

Fig. 43: Removing LH Hydraulic Chain Tensioner
Courtesy of MAZDA MOTORS CORP.

46. Remove the LH camshaft sprocket bolt.



G02821179

Fig. 44: Removing LH Camshaft Sprocket Bolt
Courtesy of MAZDA MOTORS CORP.

47. Remove the camshaft sprocket from the camshaft and instal a rubber band on the cassette to hold the chain and camshaft sprocket in place.

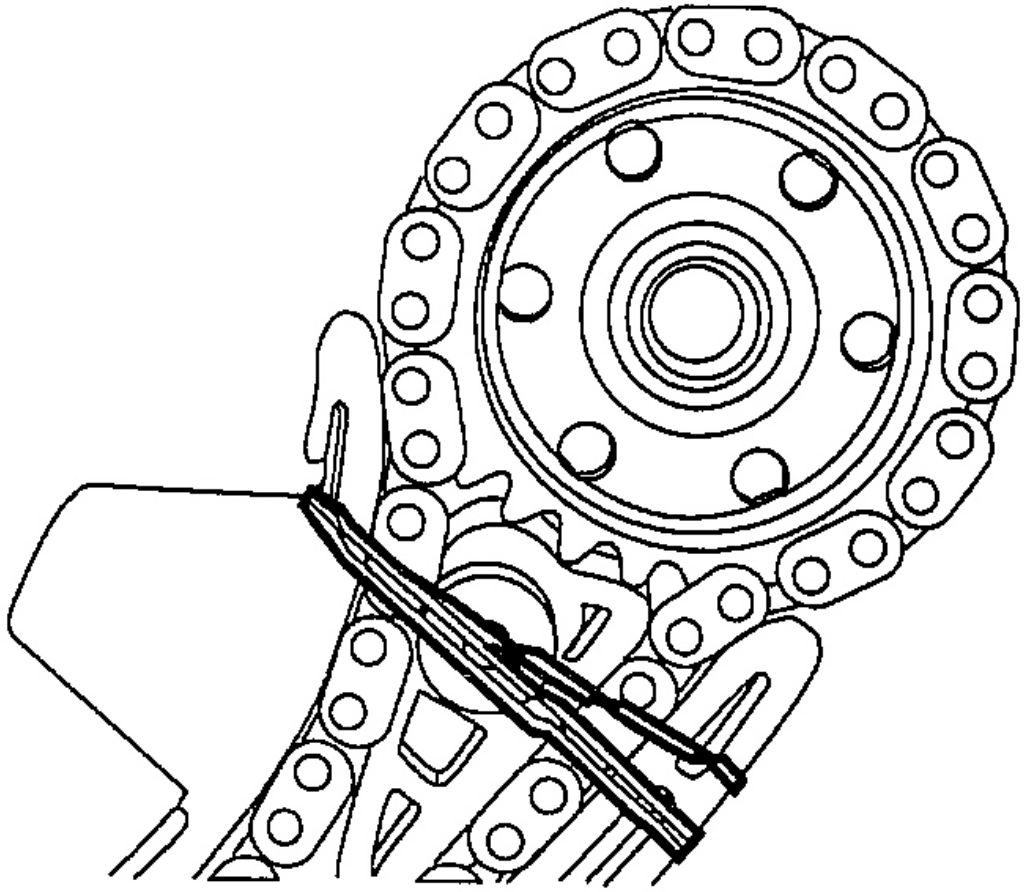


Fig. 45: Removing Camshaft Sprocket From Camshaft
Courtesy of MAZDA MOTORS CORP.

48. Remove the bolt.

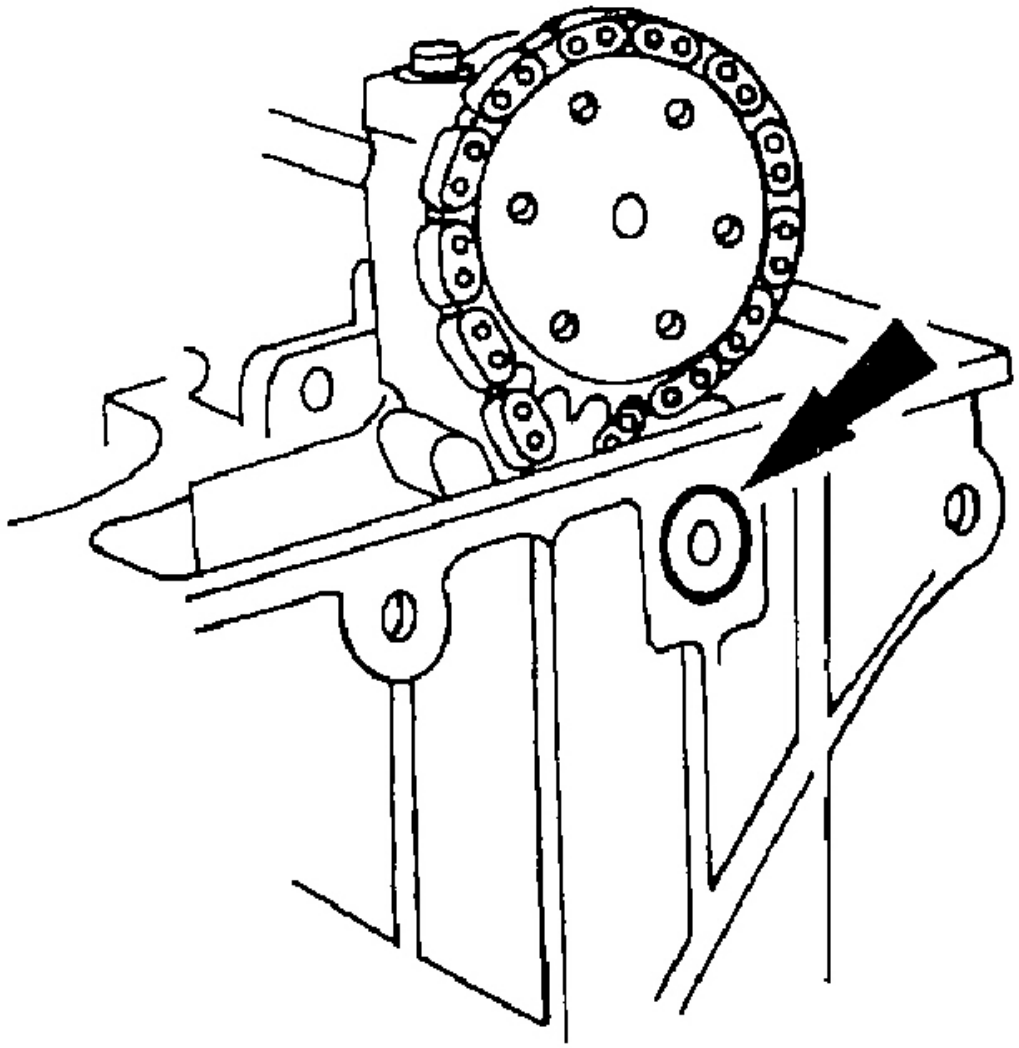


Fig. 46: Removing Bolt
Courtesy of MAZDA MOTORS CORP.

49. Remove the bolts in the sequence shown and remove the LH cylinder head.

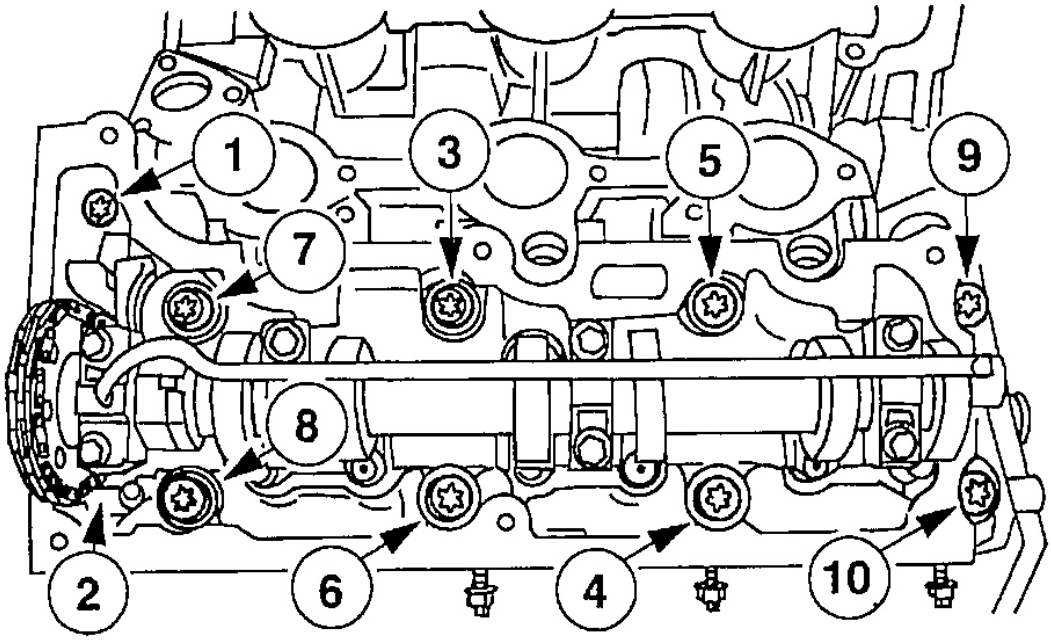


Fig. 47: LH Cylinder Head Bolt Removal Sequence
Courtesy of MAZDA MOTORS CORP.

50. Remove the bolts in the sequence shown and remove the RH cylinder head.

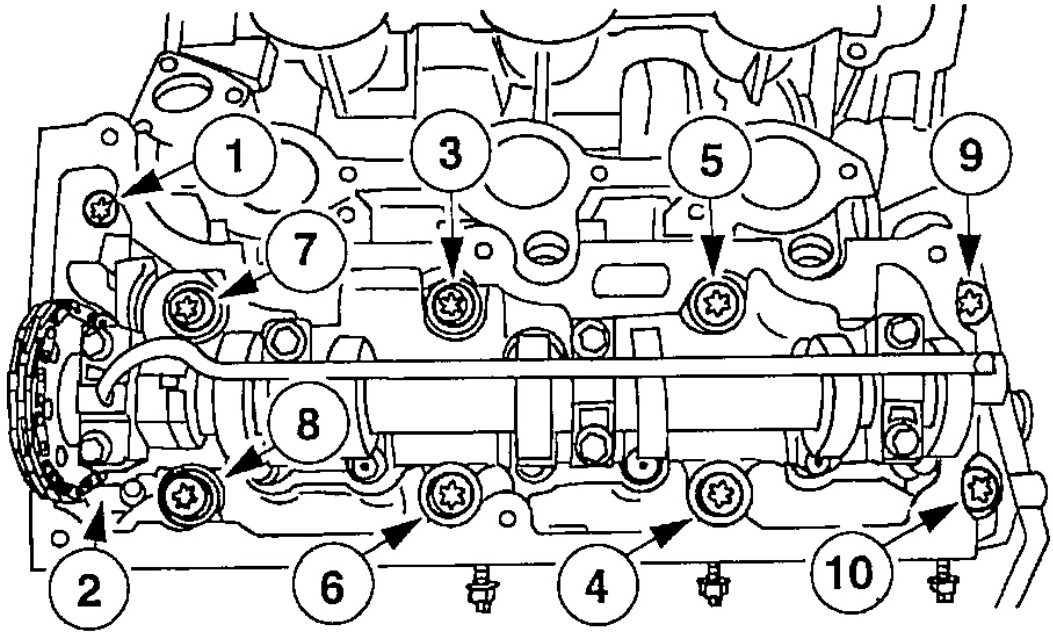
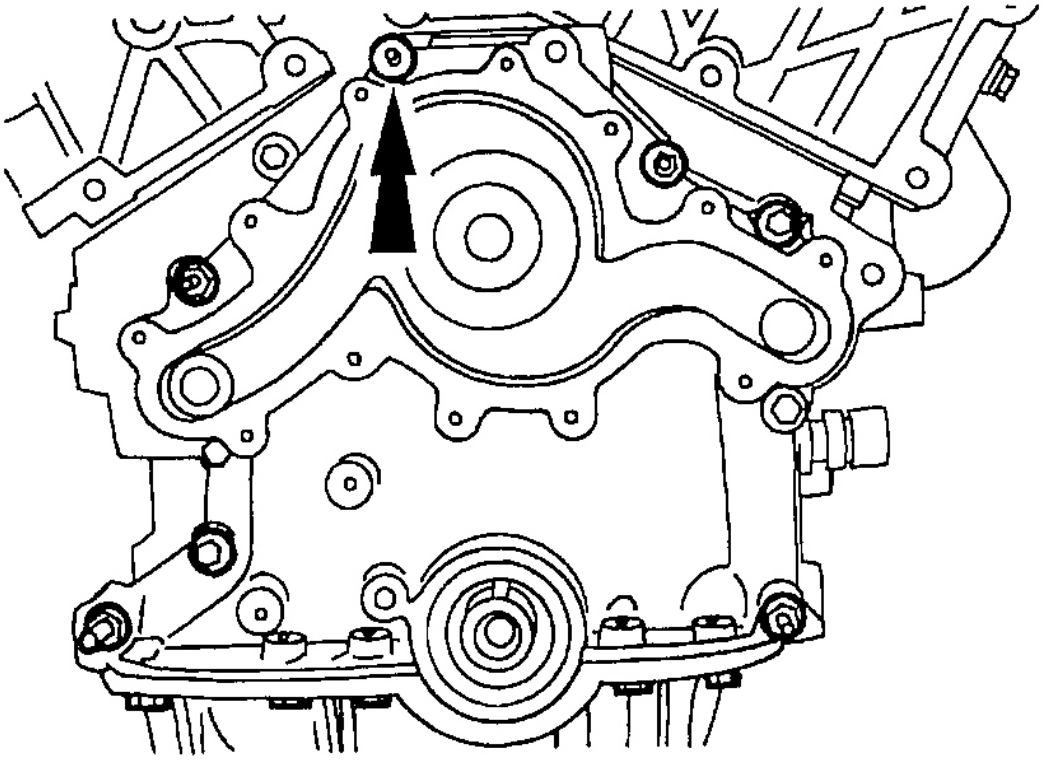


Fig. 48: RH Cylinder Head Bolt Removal Sequence
Courtesy of MAZDA MOTORS CORP.

51. Remove the engine front cover.



G02821184

Fig. 49: Removing Engine Front Cover
Courtesy of MAZDA MOTORS CORP.

52. Remove the oil pan.

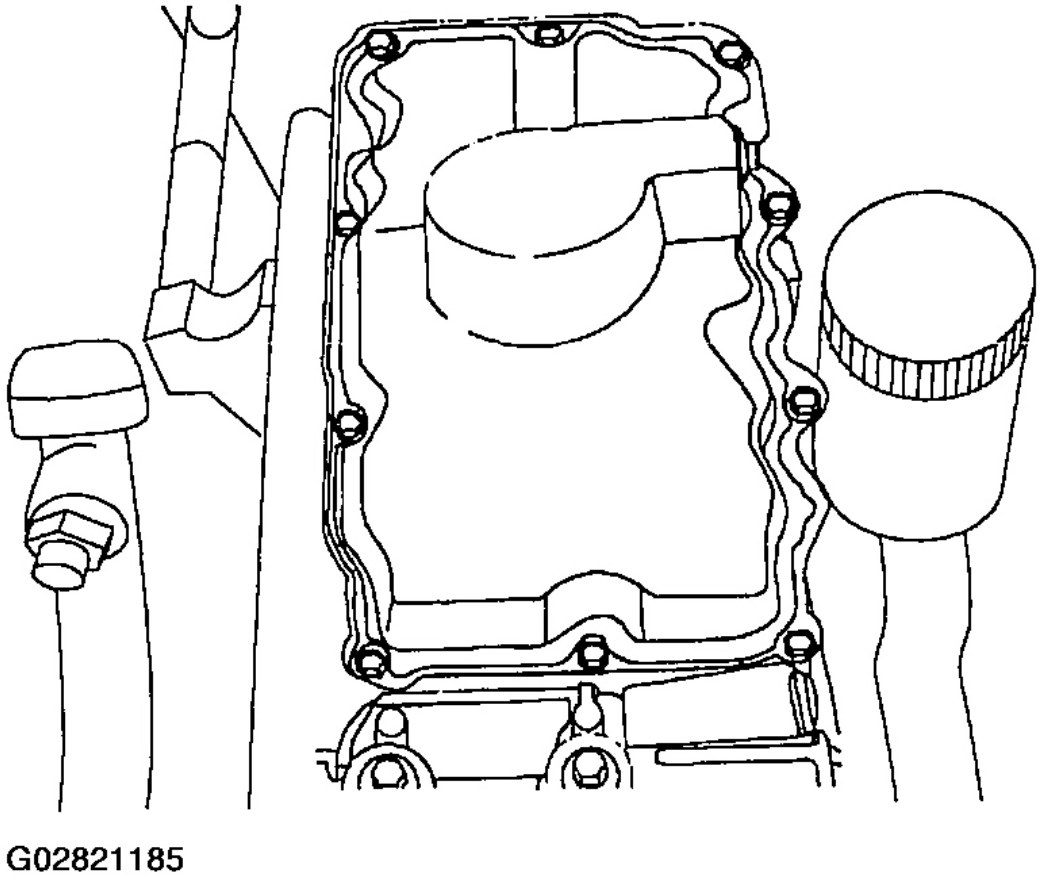


Fig. 50: Removing Oil Pan
Courtesy of MAZDA MOTORS CORP.

53. Remove the oil pump screen cover and tube.

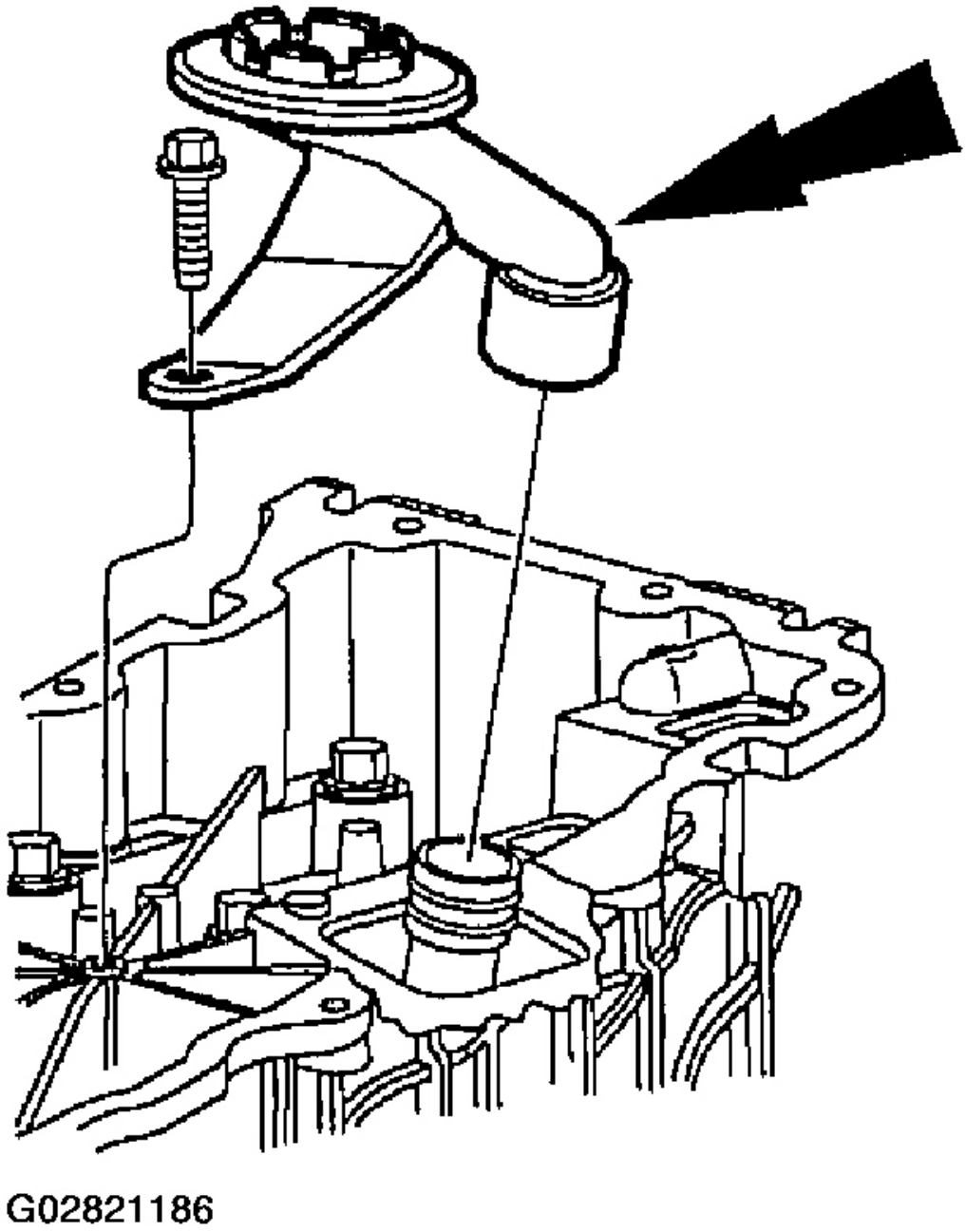
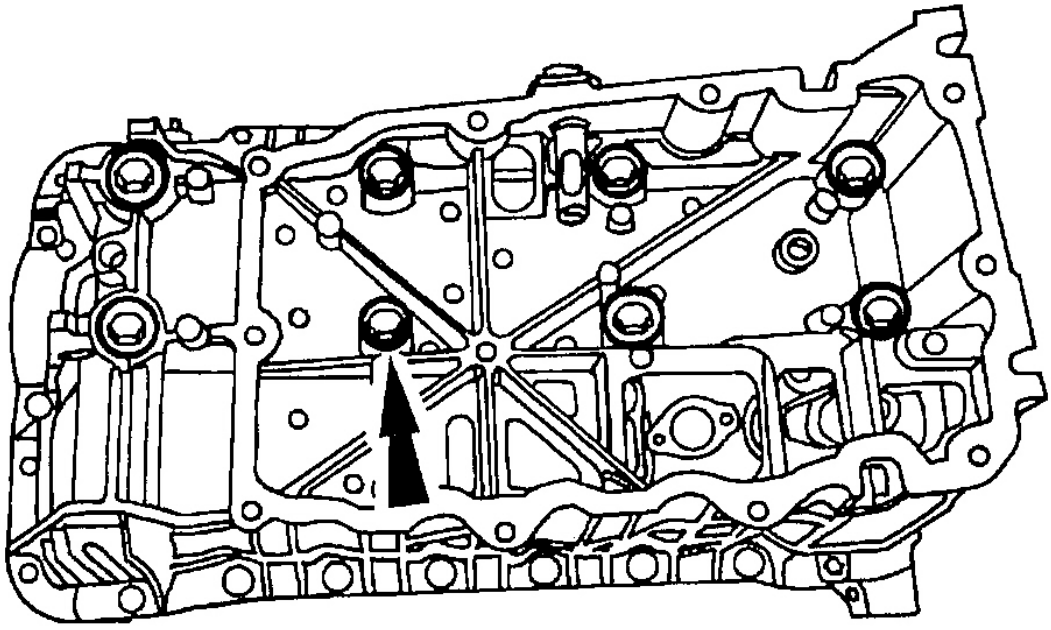


Fig. 51: Removing Oil Pump Screen Cover & Tube
Courtesy of MAZDA MOTORS CORP.

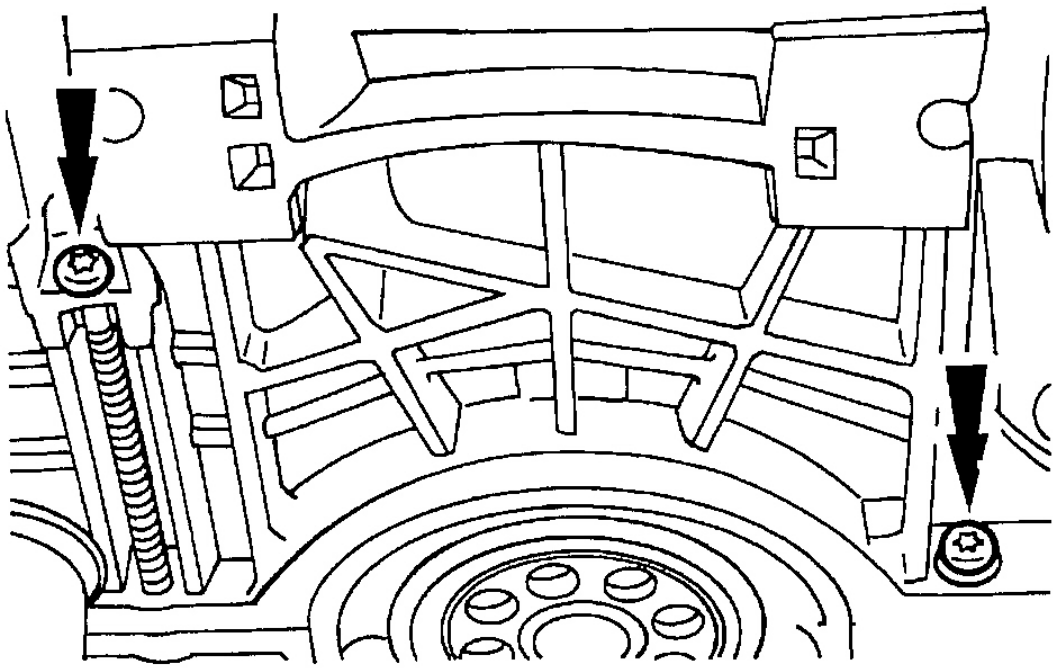
54. Remove the ladder frame bolts.



G02821187

Fig. 52: Removing Ladder Frame Bolts
Courtesy of MAZDA MOTORS CORP.

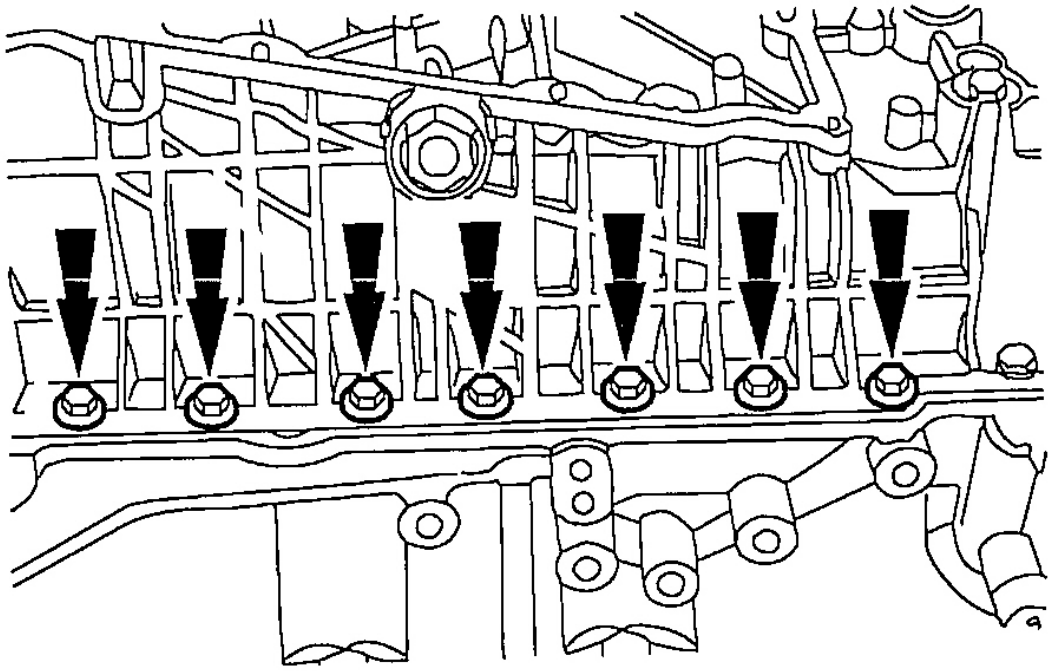
55. Remove the ladder frame bolts.



G02821188

Fig. 53: Removing Ladder Frame Bolts
Courtesy of MAZDA MOTORS CORP.

56. Remove the 15 bolts and the 2 nuts. Remove the ladder frame.



G02821189

Fig. 54: Removing Ladder Frame
Courtesy of MAZDA MOTORS CORP.

57. Remove the oil pump.

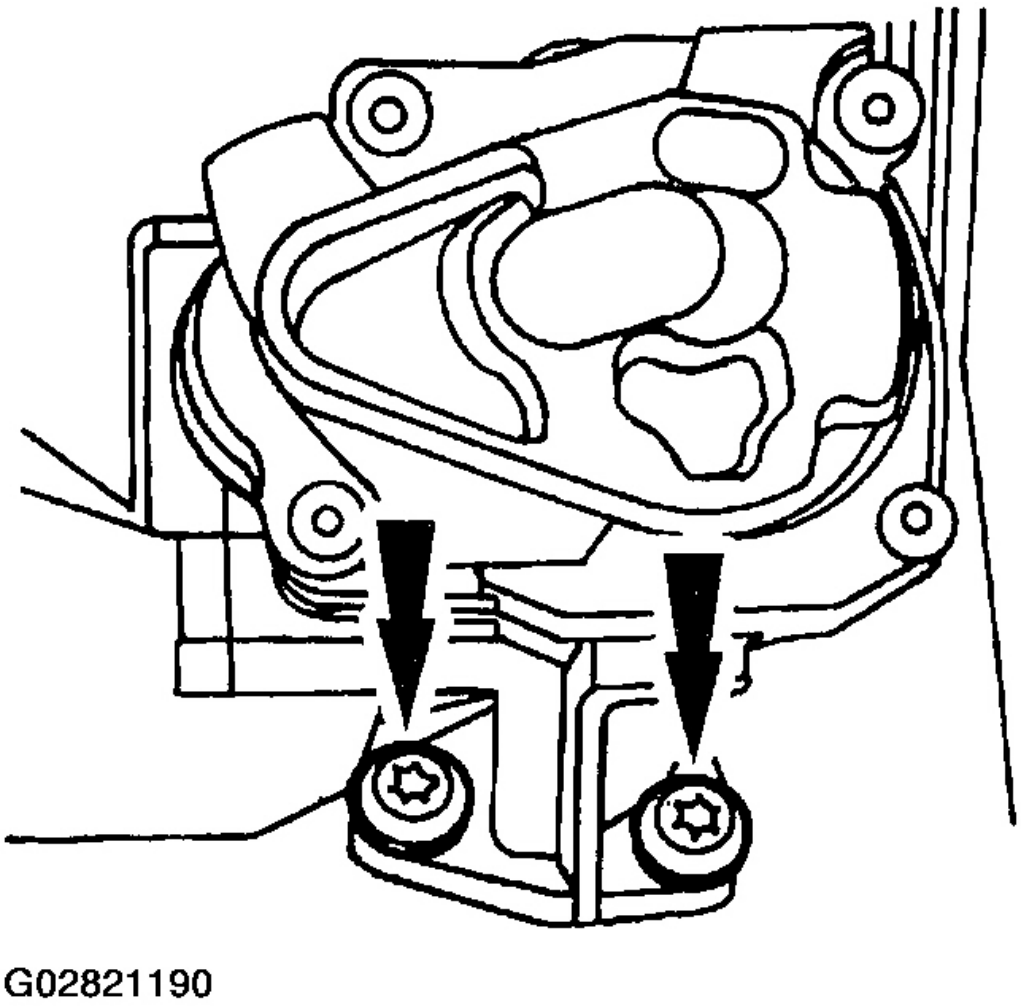


Fig. 55: Removing Oil Pump
Courtesy of MAZDA MOTORS CORP.

58. Remove the oil filter.
59. Remove the oil filter adapter.

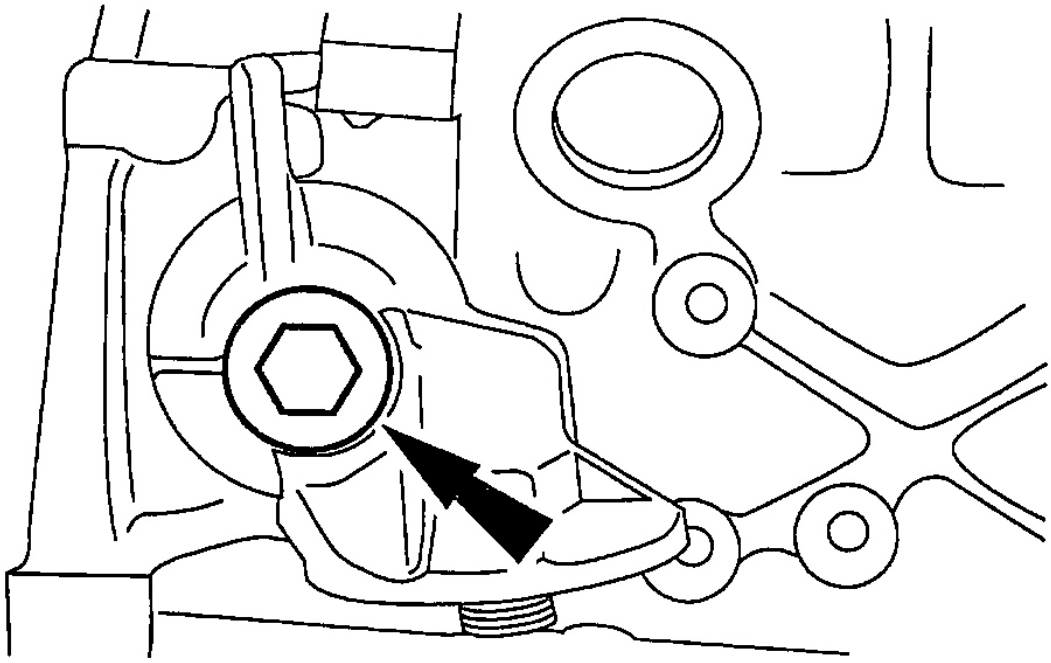


Fig. 56: Removing Oil Filter Adapter
Courtesy of MAZDA MOTORS CORP.

60. Inspect and install new O-ring seals if necessary.

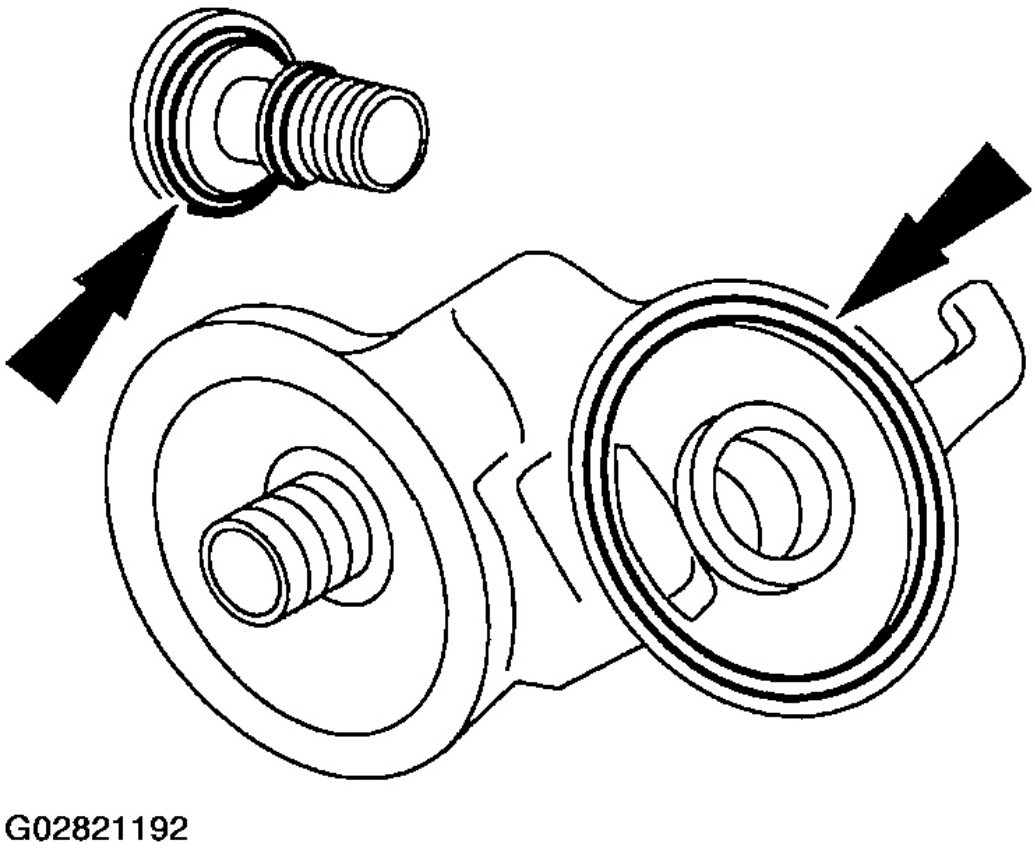
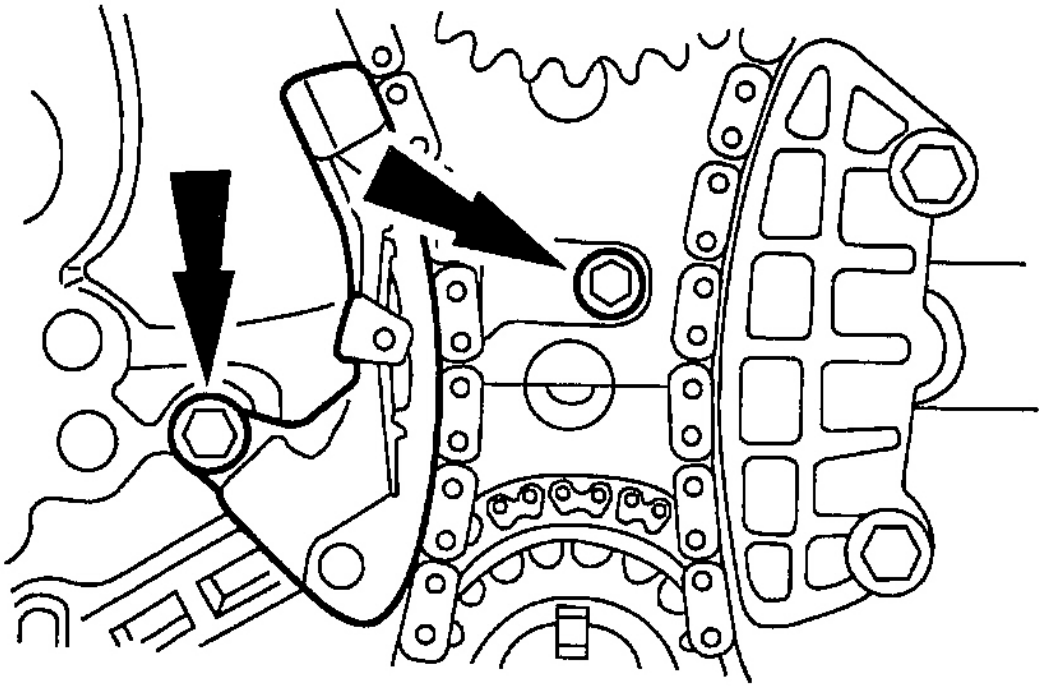


Fig. 57: Inspect O-ring Seals
Courtesy of MAZDA MOTORS CORP.

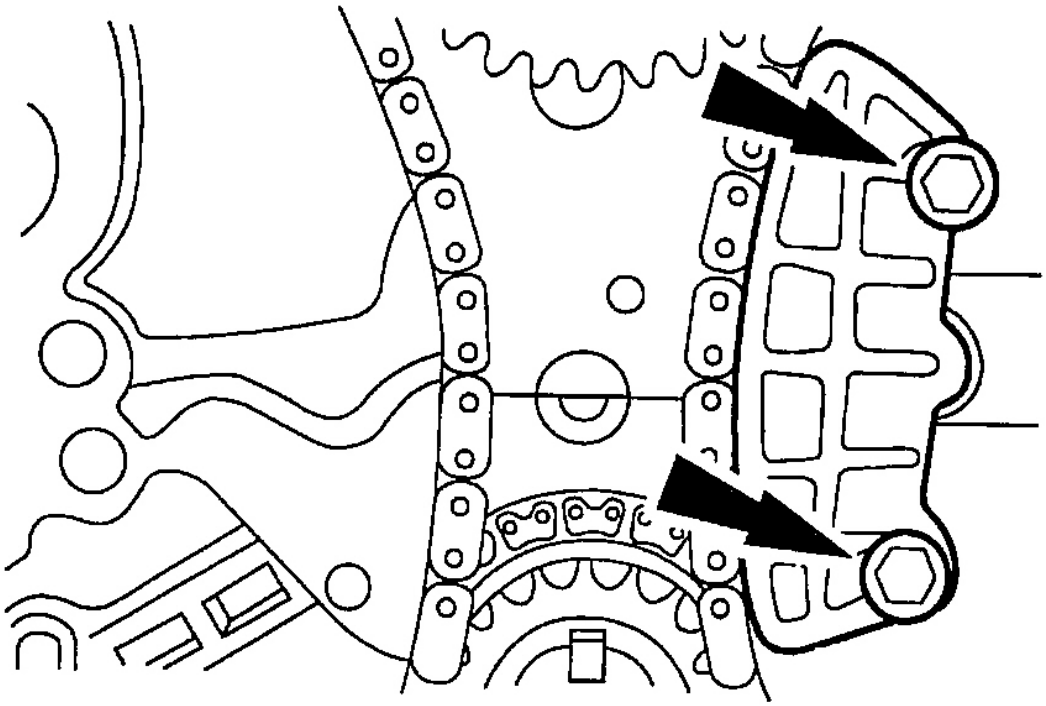
61. Remove the chain tensioner.



G02821193

Fig. 58: Removing Chain Tensioner
Courtesy of MAZDA MOTORS CORP.

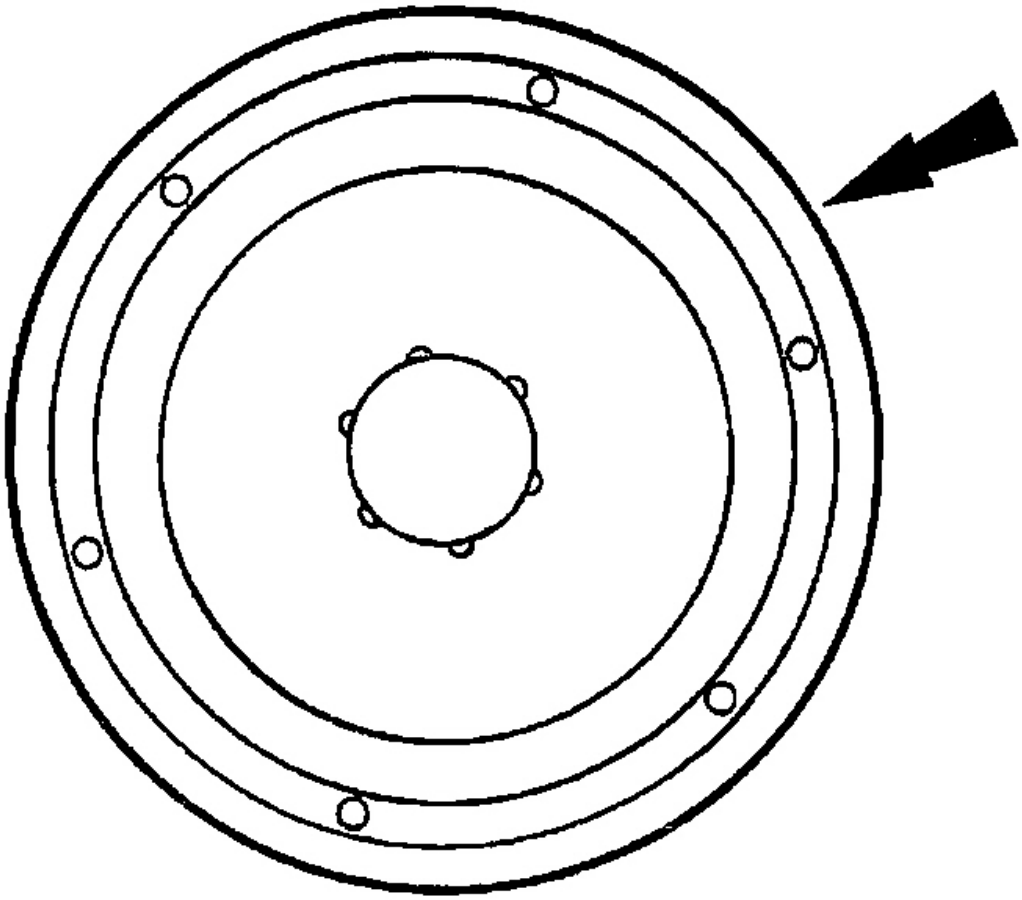
62. Remove the chain guide.



G02821194

Fig. 59: Removing Chain Guide
Courtesy of MAZDA MOTORS CORP.

63. Remove the rear jackshaft plug.



G02821195

Fig. 60: Removing Rear Jackshaft Plug
Courtesy of MAZDA MOTORS CORP.

64. Install the Rear Jackshaft Socket SST 303-634 at the rear of the jackshaft.

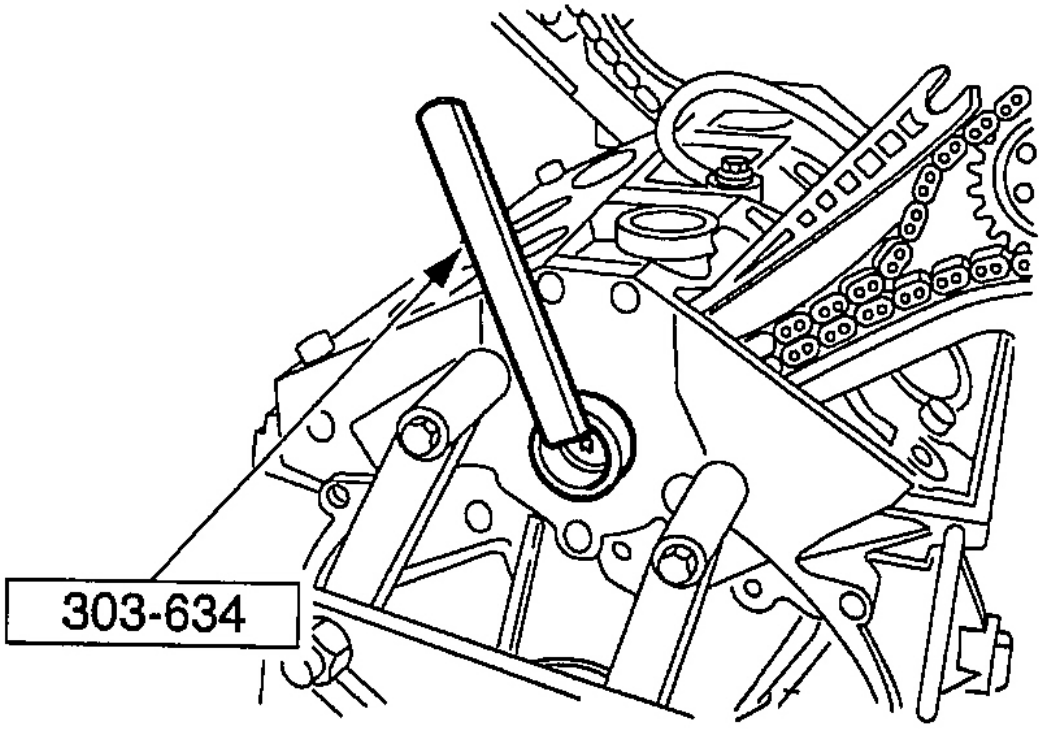


Fig. 61: Installing Rear Jackshaft Socket At Rear Of Jackshaft
Courtesy of MAZDA MOTORS CORP.

65. Loosen the front sprocket retaining bolt.

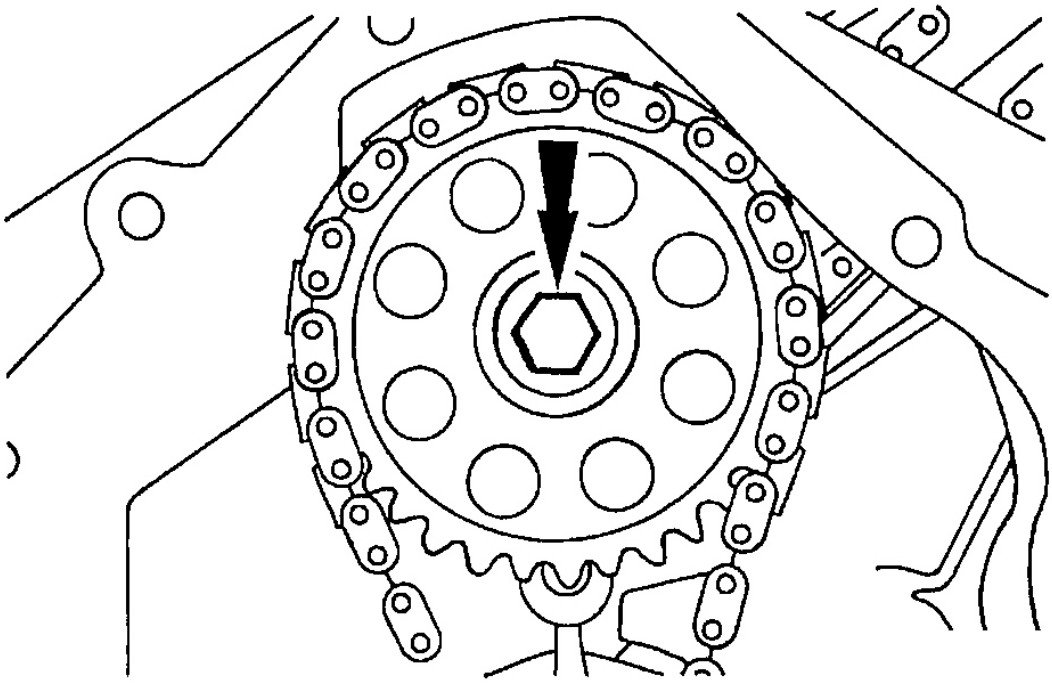


Fig. 62: Loosening Front Sprocket Retaining Bolt
Courtesy of MAZDA MOTORS CORP.

66. With the Rear Jackshaft Socket still in place, loosen the rear sprocket retaining bolt.
67. Remove the Rear Jackshaft Socket.

NOTE:

- **It may be required to hold the oil pump intermediate shaft, using an E-12 external TORX socket, in order to remove the bolts if bolts do not turn out easily at this time.**

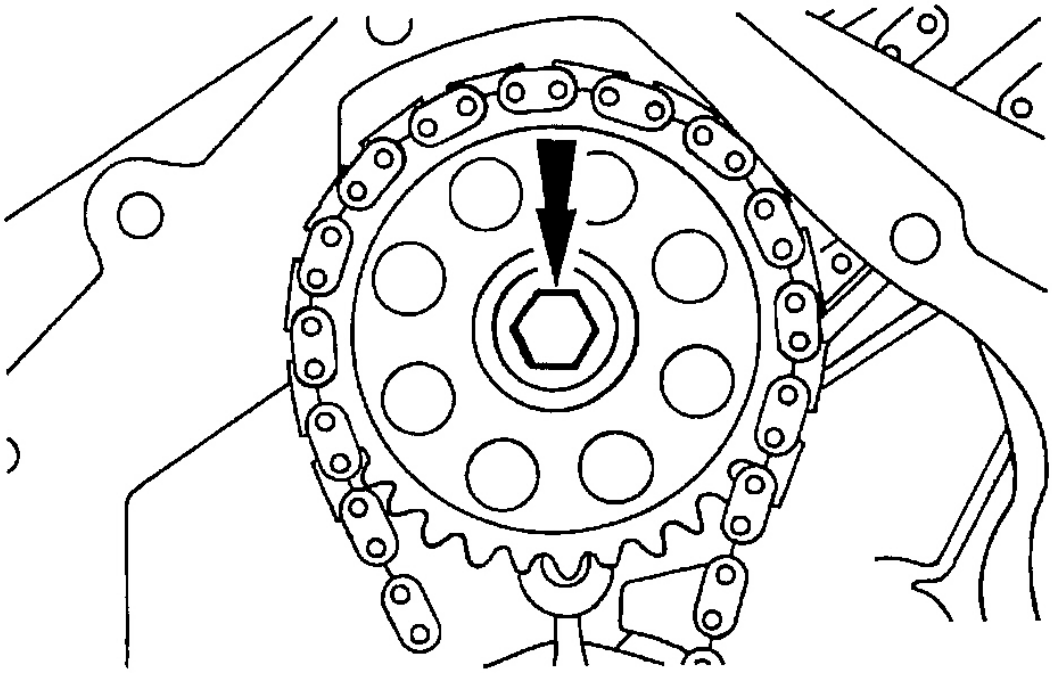


Fig. 63: Removing Front Sprocket Retaining Bolt
Courtesy of MAZDA MOTORS CORP.

68. Remove the front sprocket retaining bolt.
69. Remove the Jackshaft sprocket and chain.

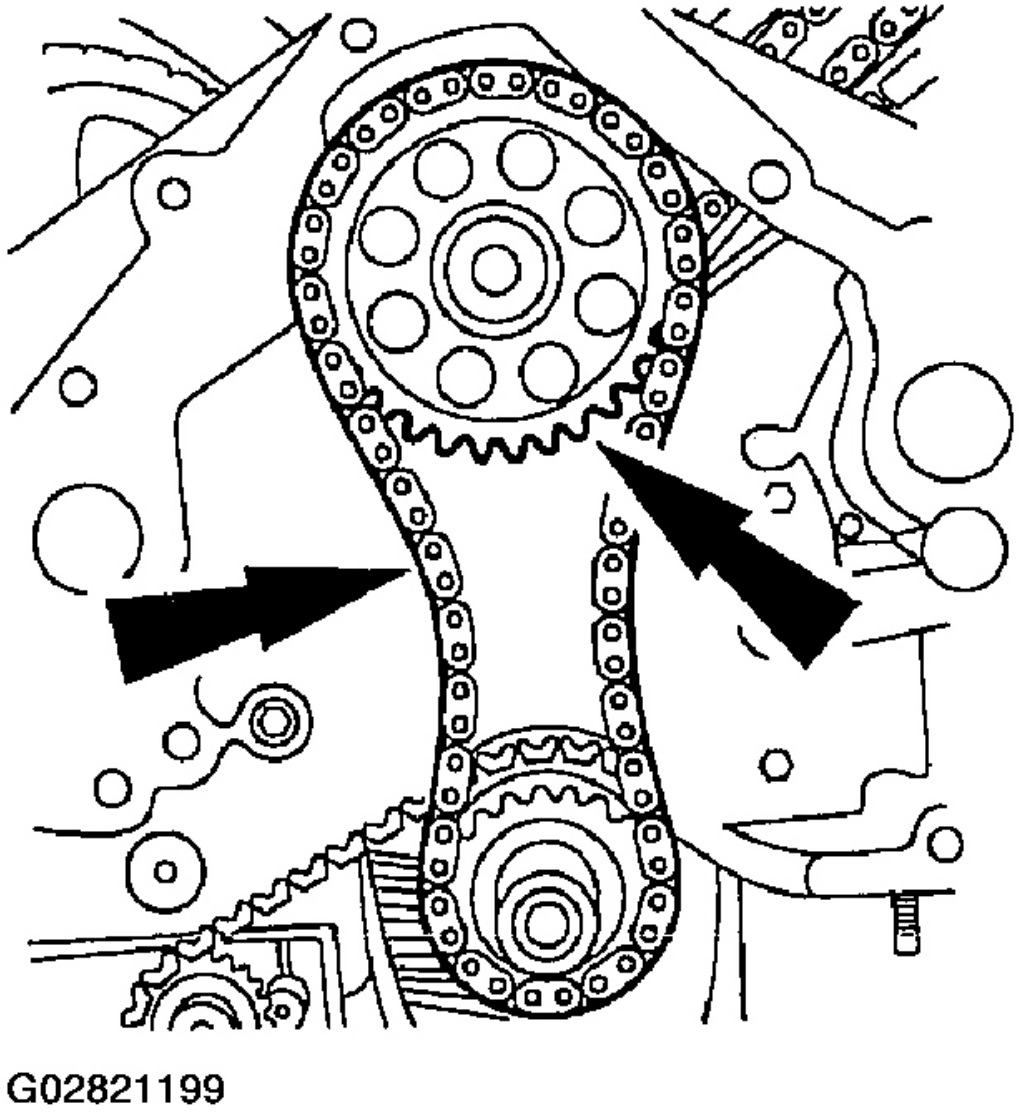


Fig. 64: Removing Jackshaft Sprocket & Chain
Courtesy of MAZDA MOTORS CORP.

70. Remove the bolt and front cassette with camshaft drive chain.

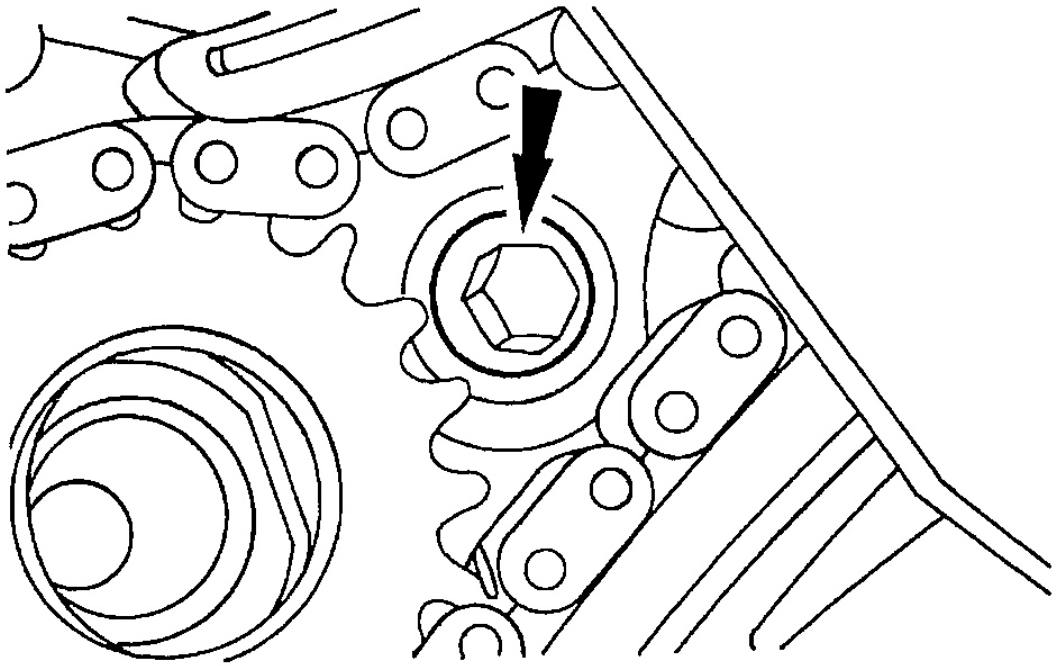


Fig. 65: Removing Front Cassette With Camshaft Drive Chain
Courtesy of MAZDA MOTORS CORP.

71. Remove the bolt and spacer.

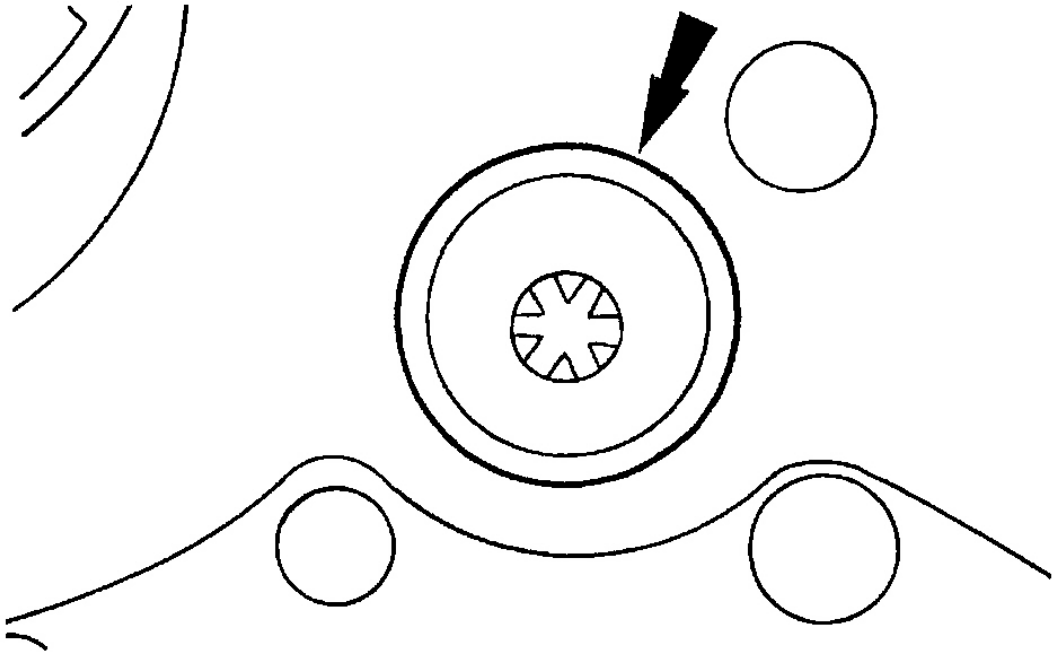


Fig. 66: Removing Bolt & Spacer
Courtesy of MAZDA MOTORS CORP.

72. Remove the bolt and rear cassette with camshaft drive chain.

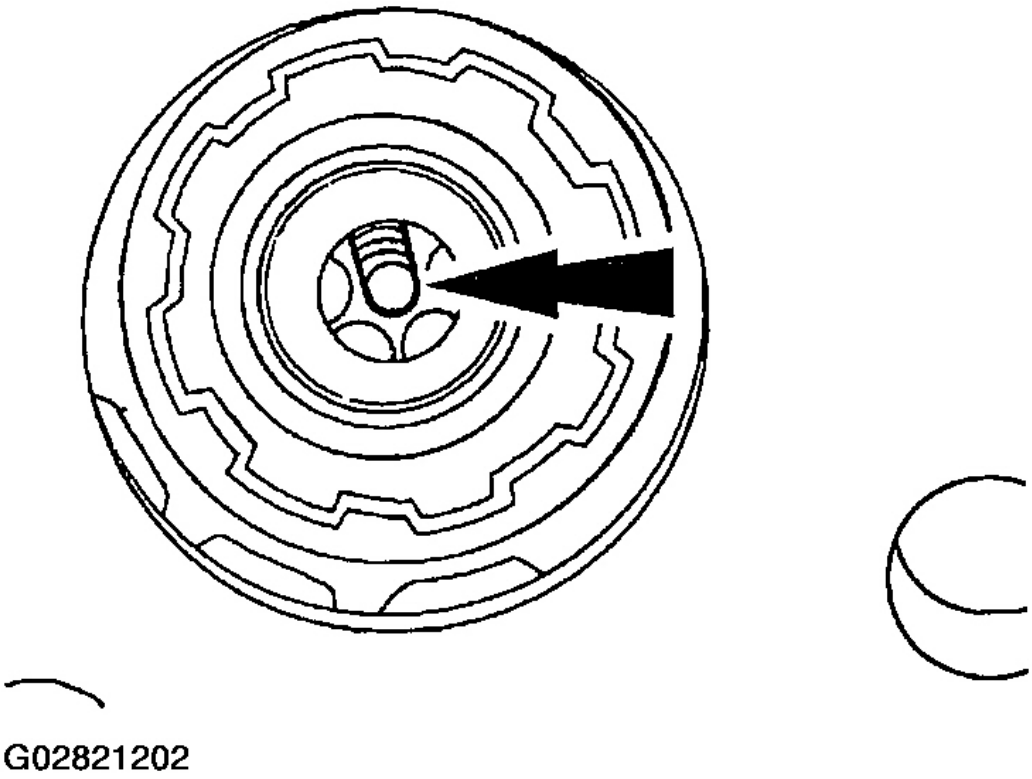
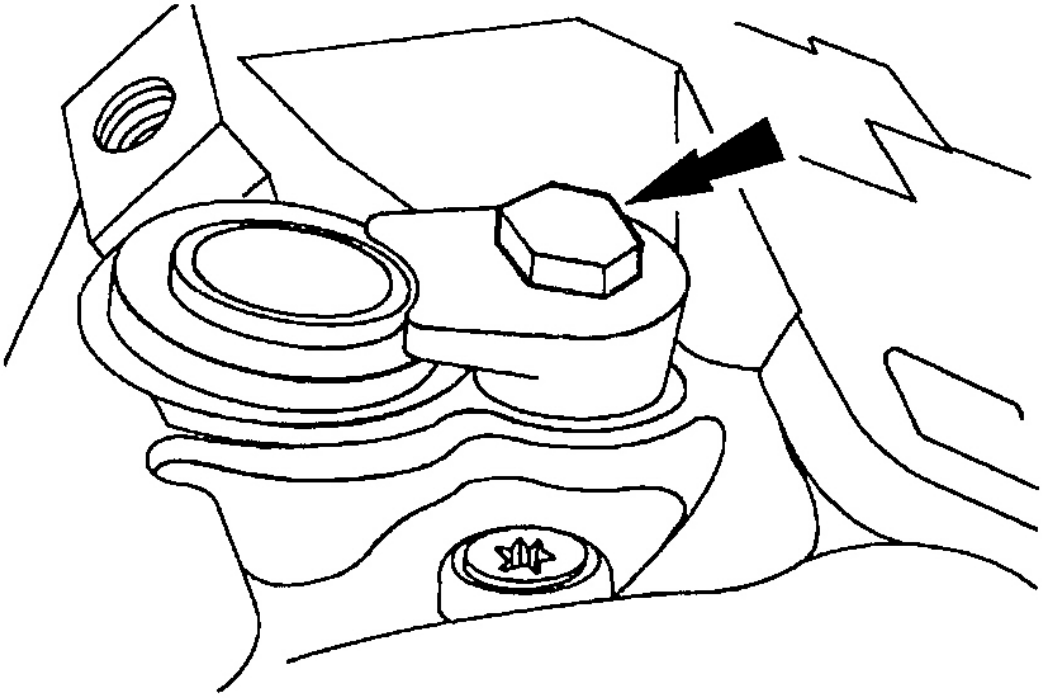


Fig. 67: Removing Rear Cassette With Camshaft Drive Chain
Courtesy of MAZDA MOTORS CORP.

73. Remove the oil pump drive.



G02821203

Fig. 68: Removing Oil Pump Drive
Courtesy of MAZDA MOTORS CORP.

74. Remove the Jackshaft thrust plate.

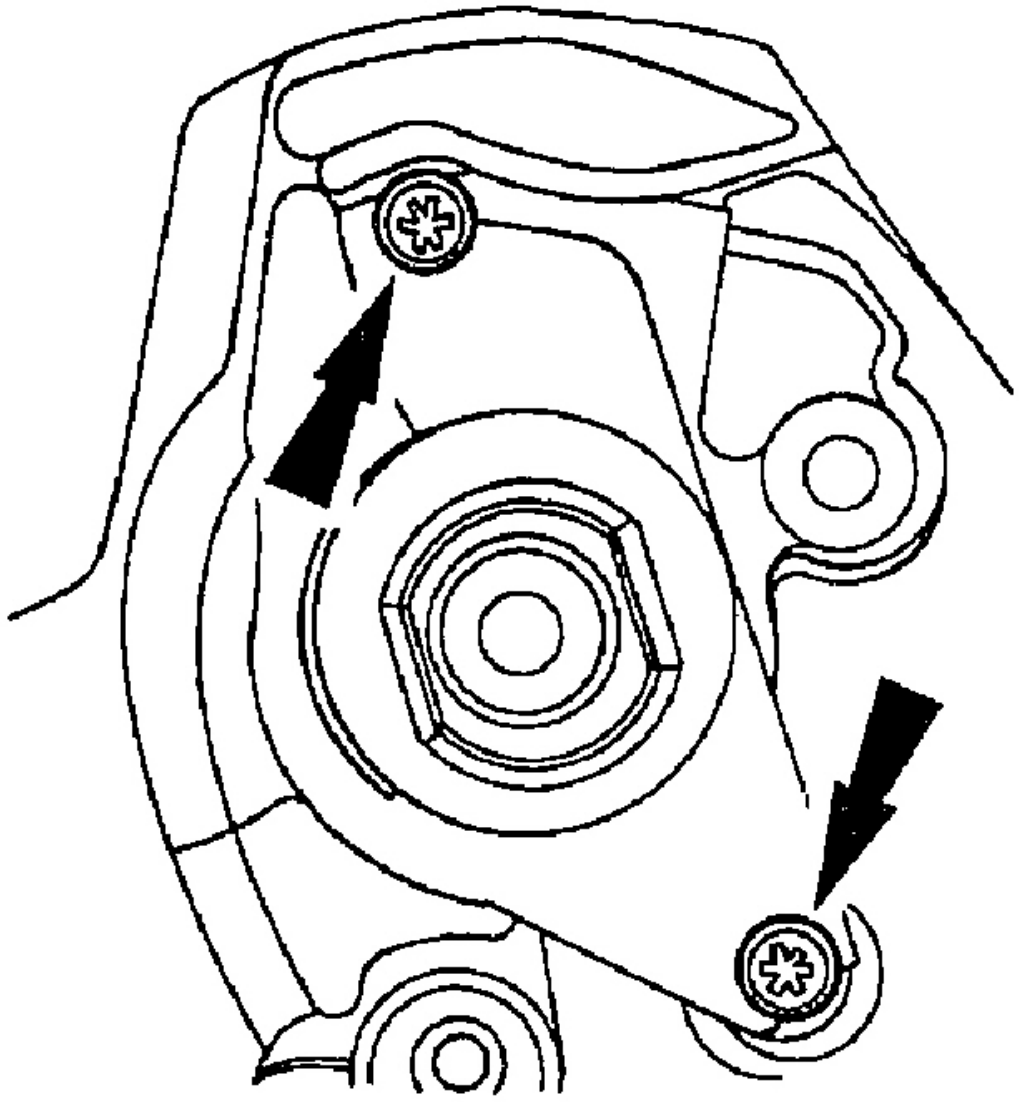
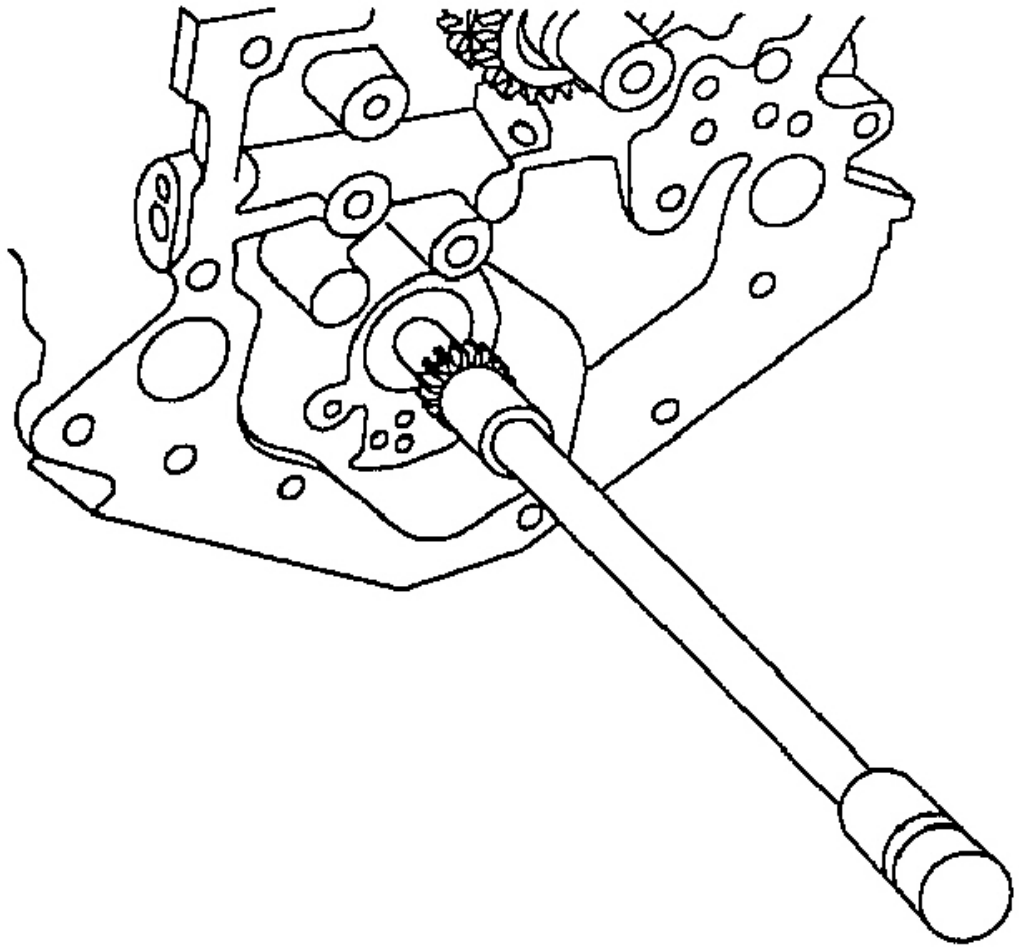


Fig. 69: Removing Jackshaft Thrust Plate
Courtesy of MAZDA MOTORS CORP.

75. Remove the jackshaft.



G02821205

Fig. 70: Removing Jackshaft
Courtesy of MAZDA MOTORS CORP.

76. On vehicles with a balance shaft, remove the balance shaft tensioner.
    1. Install a pin in the balance shaft tensioner.
    2. Remove the bolts.
    3. Remove the balance shaft tensioner.

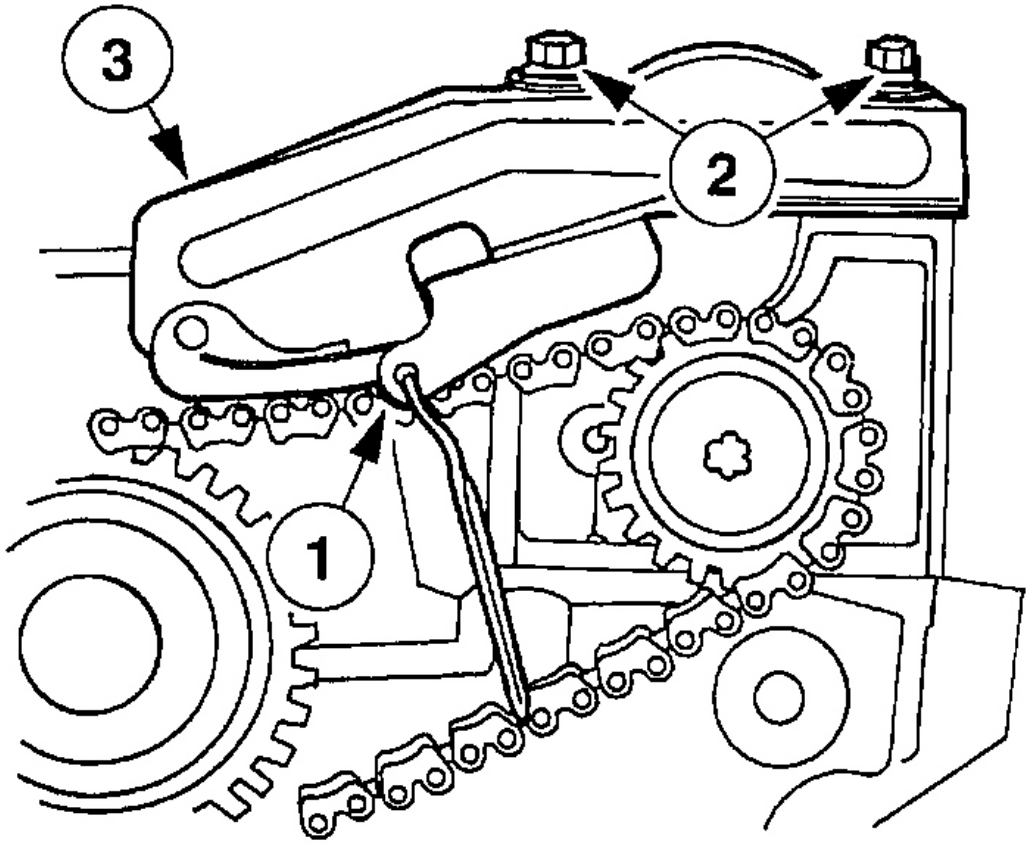
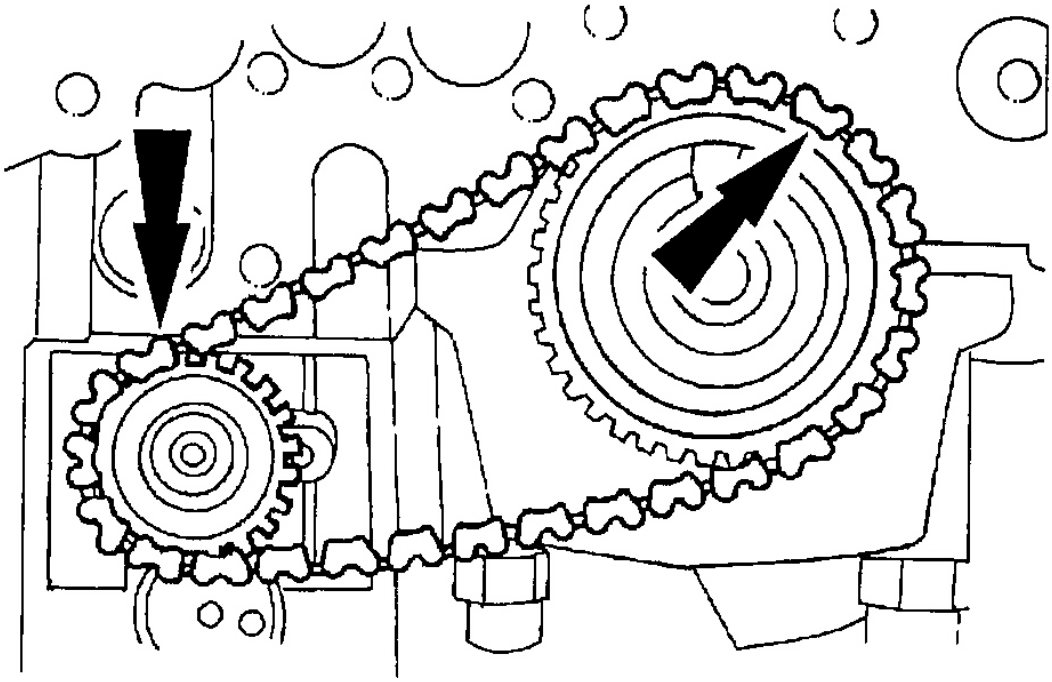


Fig. 71: Removing Balance Shaft Tensioner
Courtesy of MAZDA MOTORS CORP.

NOTE:

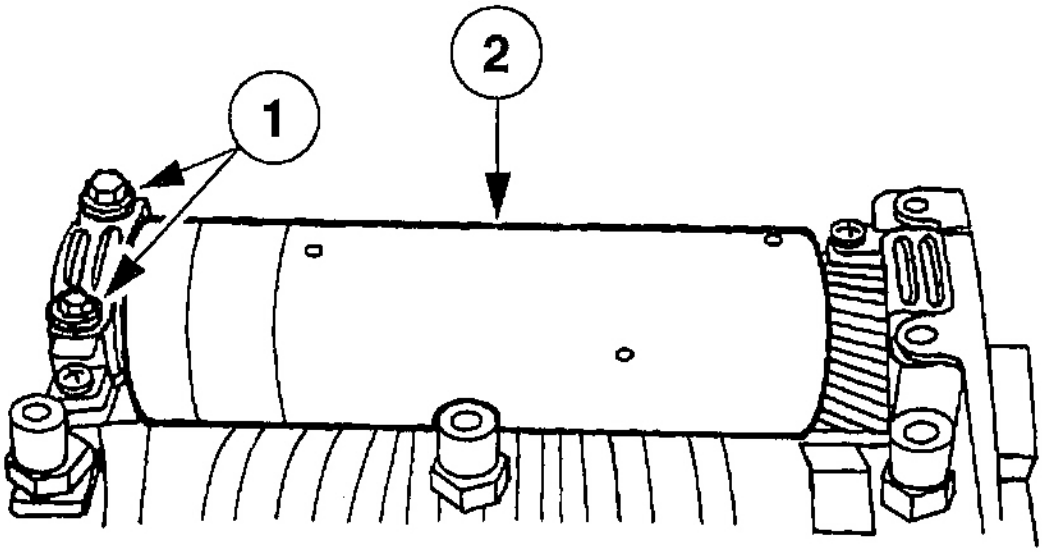
- **DO NOT remove the balance shaft sprocket bolt.**



G02821207

Fig. 72: Removing Balance Shaft Chain & Crankshaft Sprocket
Courtesy of MAZDA MOTORS CORP.

77. On vehicles with a balance shaft, remove the balance shaft chain and crankshaft sprocket.
78. On vehicles equipped with a balance shaft, remove the balance shaft.
    1. Remove the bolts.
    2. Remove the balance shaft.



G02821208

Fig. 73: Removing Balance Shaft
Courtesy of MAZDA MOTORS CORP.

79. Using the cylinder ridge reamer SST 303-016 (T64L-6011-EA), remove the ridge and carbon deposits from the top of each cylinder.

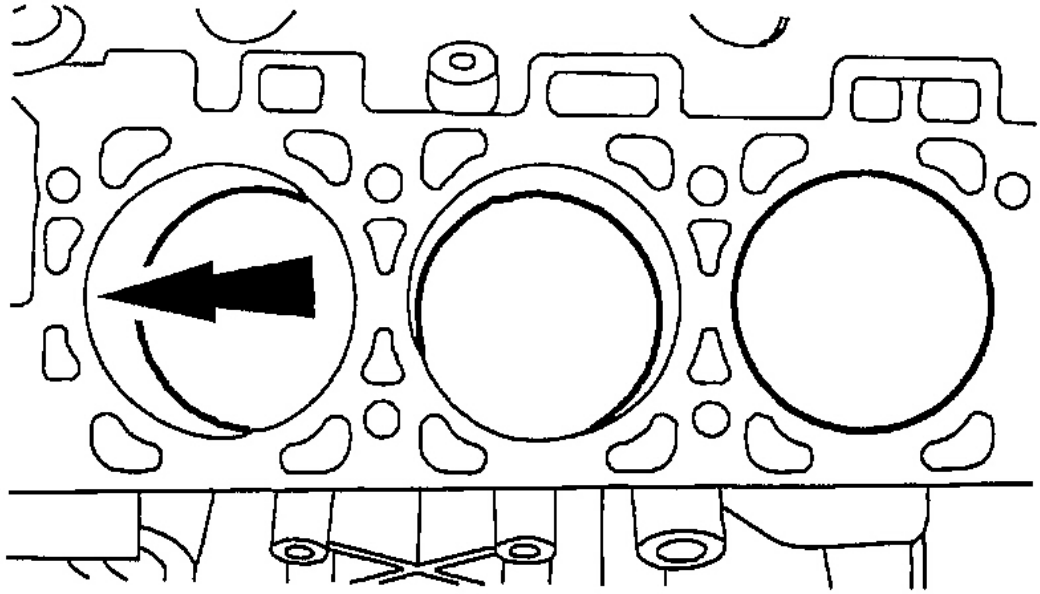


Fig. 74: Removing Ridge & Carbon Deposits From Top Of Cylinder
Courtesy of MAZDA MOTORS CORP.

80. Remove the piston and connecting rod assemblies.
    1. Remove the connecting rod nuts.
    2. Remove the connecting rod cap.

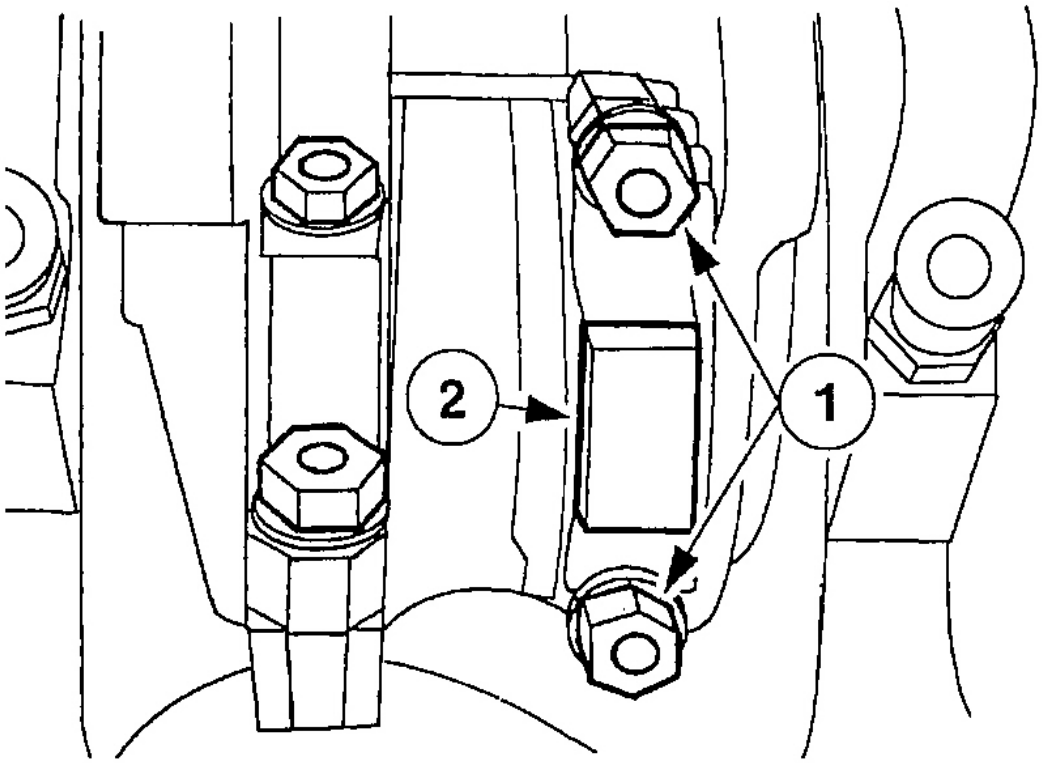


Fig. 75: Removing Connecting Rod Nuts & Cap
Courtesy of MAZDA MOTORS CORP.

81. Install rubber hose pieces on the bolts to protect the crankshaft and remove the pistons.

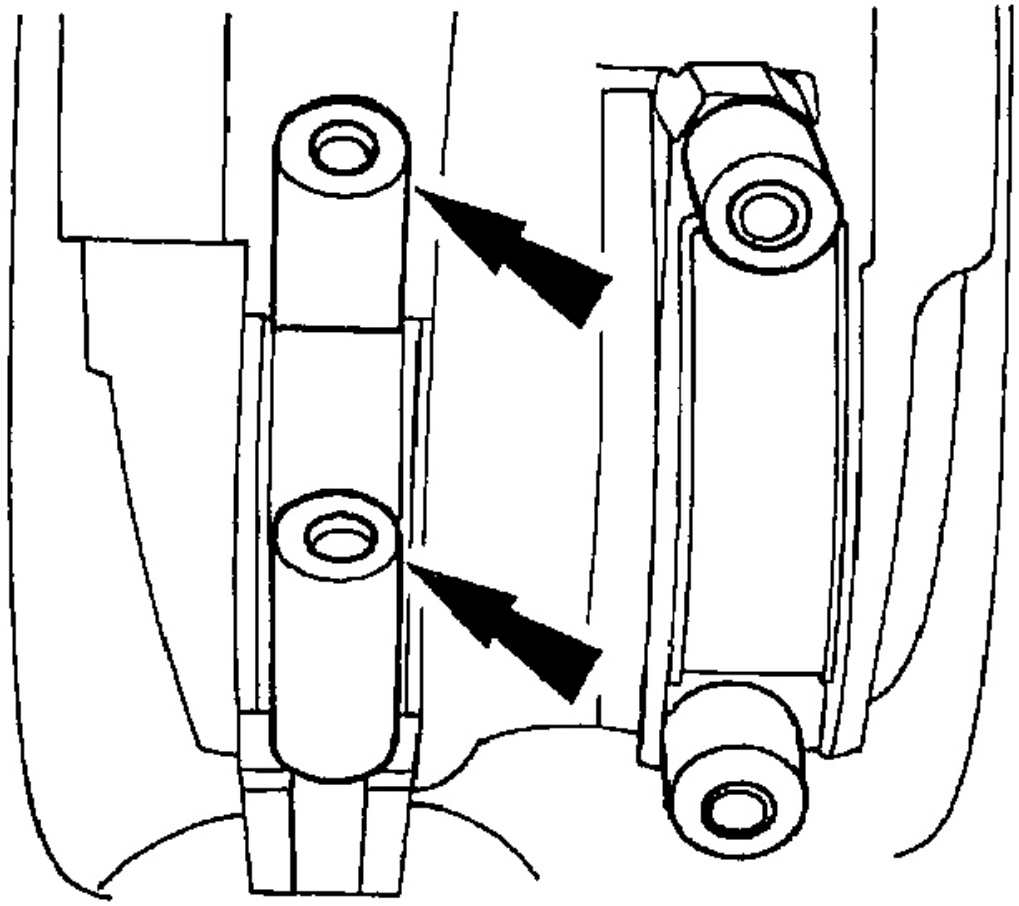
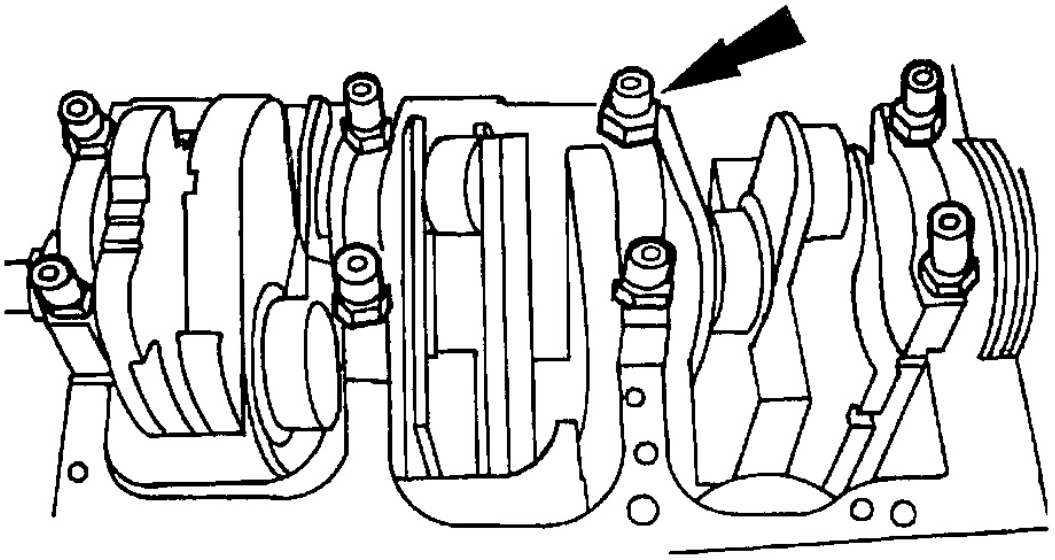


Fig. 76: Installing Rubber Hose Pieces On Bolts
Courtesy of MAZDA MOTORS CORP.

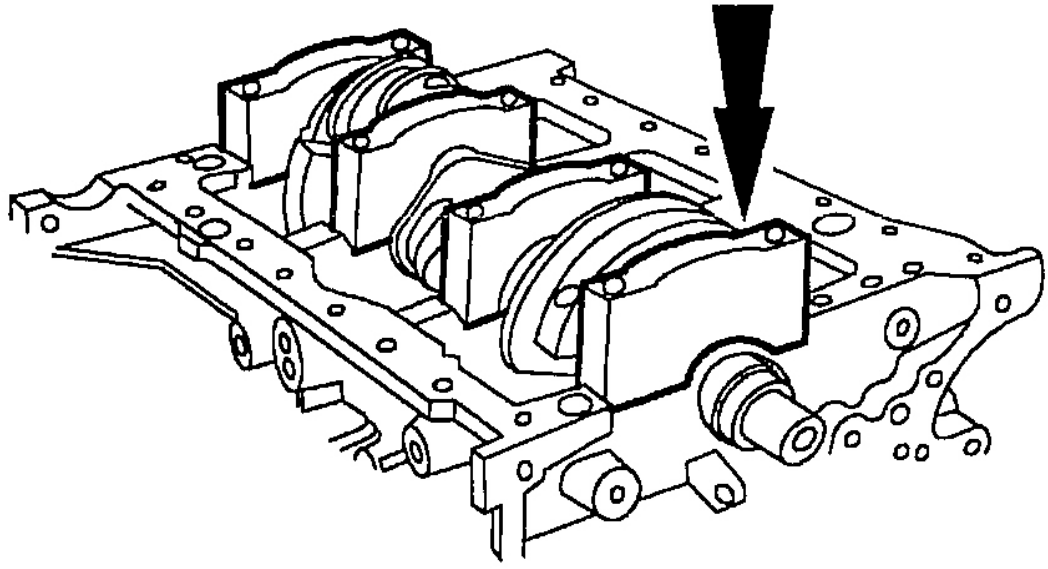
82. Remove the main bearing cap bolts.



G02821212

Fig. 77: Removing Main Bearing Cap Bolts
Courtesy of MAZDA MOTORS CORP.

83. Remove the crankshaft main bearing caps.



G02821213

Fig. 78: Removing Crankshaft Main Bearing Caps
Courtesy of MAZDA MOTORS CORP.

84. Remove the crankshaft rear oil seal from the crankshaft.

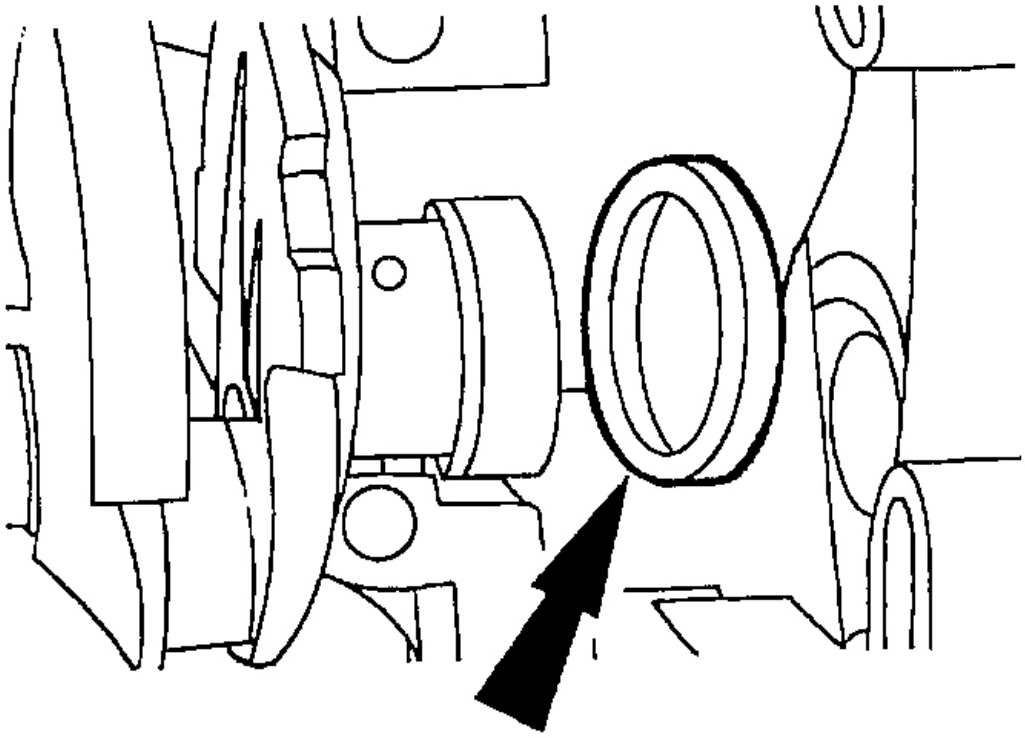
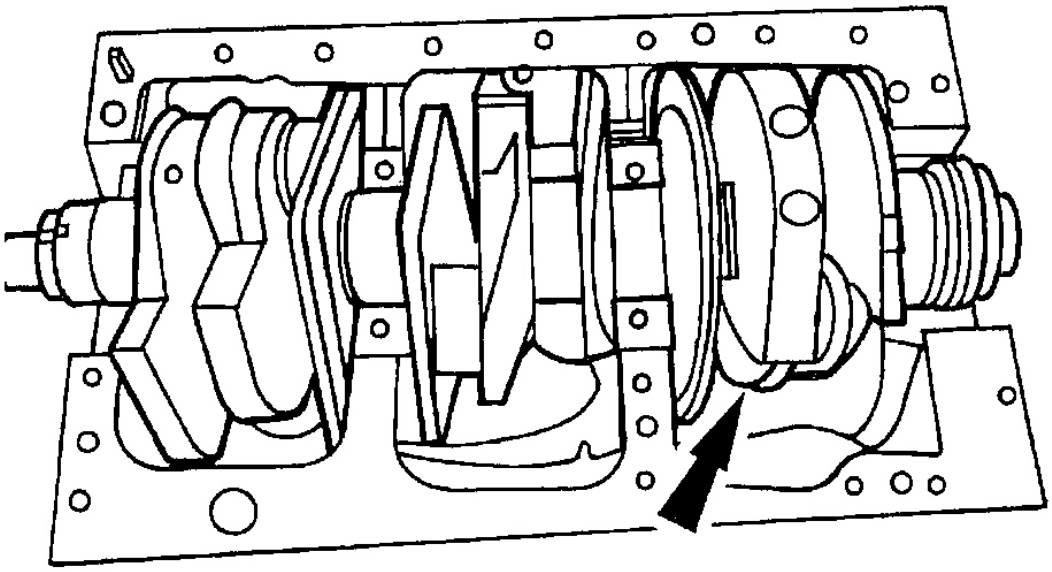


Fig. 79: Removing Crankshaft Rear Oil Seal
Courtesy of MAZDA MOTORS CORP.

85. Remove the crankshaft.



G02821215

Fig. 80: Removing Crankshaft
Courtesy of MAZDA MOTORS CORP.

86. Remove the crankshaft main bearings and the thrust bearing.

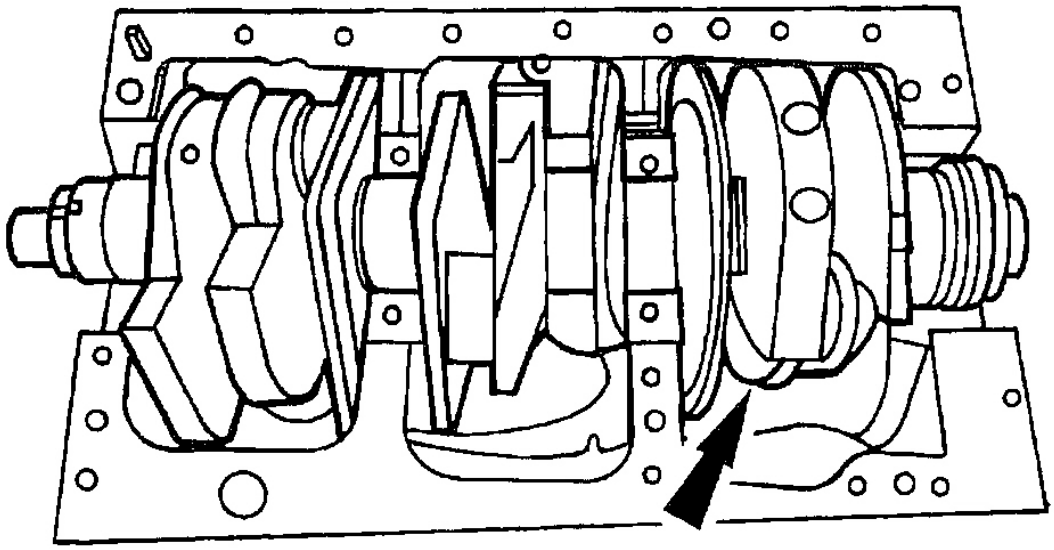
ASSEMBLY NOTE

CAUTION:
- **This vehicle is equipped with a composite material fuel rail. If the fuel rail is used as a leverage device, damage may occur to the fuel rail. Care must be taken when working around the fuel rail.**

NOTE:
- **Before engine assembly, use Metal Surface Cleaner and a suitable plastic or wooden scraper to clean the sealing surfaces. All sealing surfaces must be clean. Make sure coolant and oil passages are clear.**

NOTE:
- **The crankshaft bearings are precision selective fit. Inspect the bearing clearance.**

1. Install the crankshaft main bearings and the thrust bearing.
    1. Lubricate the crankshaft main bearings with clean engine oil.
2. Install the crankshaft.



G02821216

Fig. 81: Installing Crankshaft
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **The rear main bearing cap must be installed within four minutes after applying the silicone.**

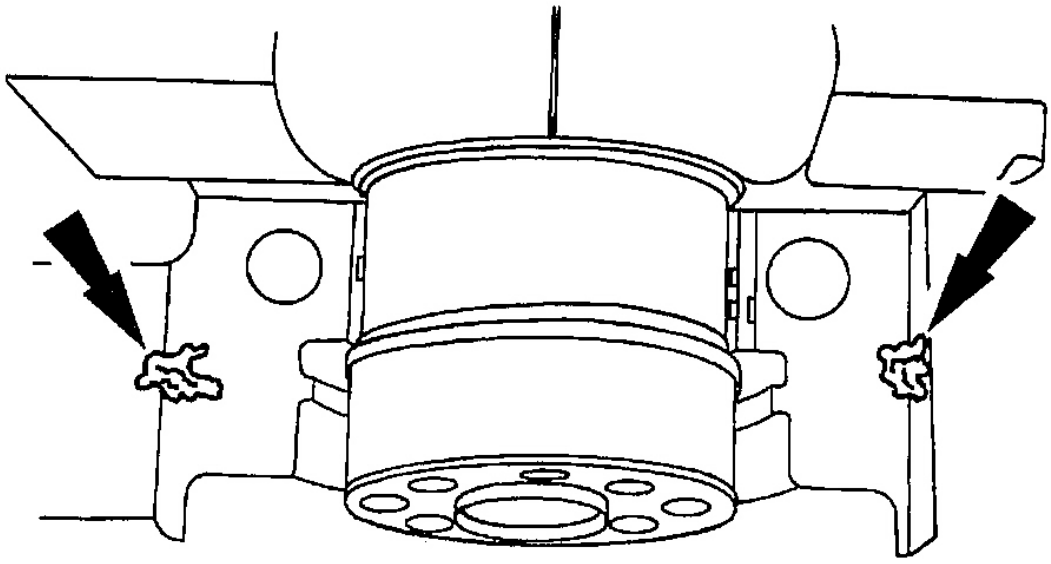
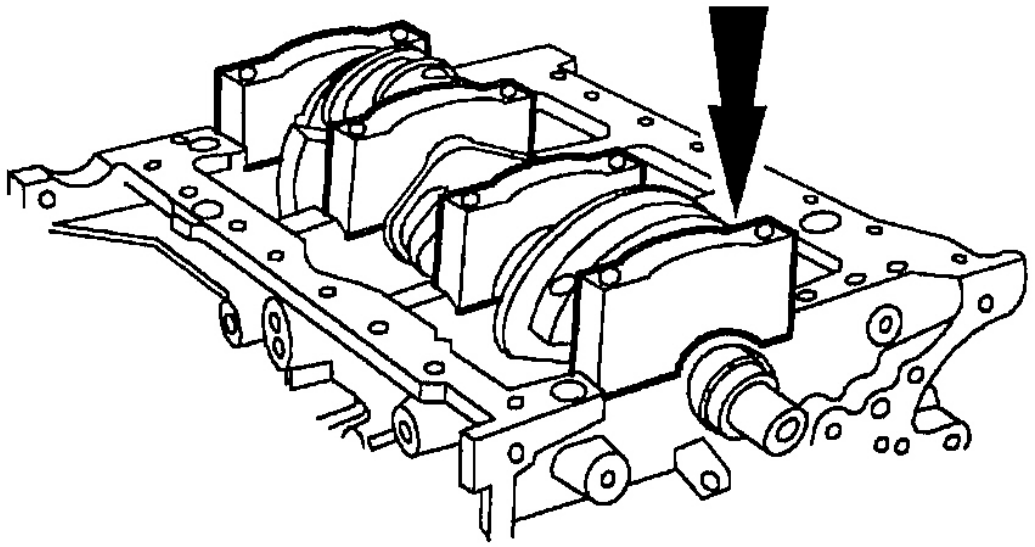


Fig. 82: Applying Silicone Gasket & Sealant
Courtesy of MAZDA MOTORS CORP.

3. Apply silicone gasket and sealant to the rear main bearing cap to cylinder block parting line.
4. Install the crankshaft lower main bearings in the main bearing caps.
5. Install the main bearing caps and bolts.



G02821218

Fig. 83: Installing Main Bearing Caps & Bolts
Courtesy of MAZDA MOTORS CORP.

6. Tighten the main bearing cap bolts.

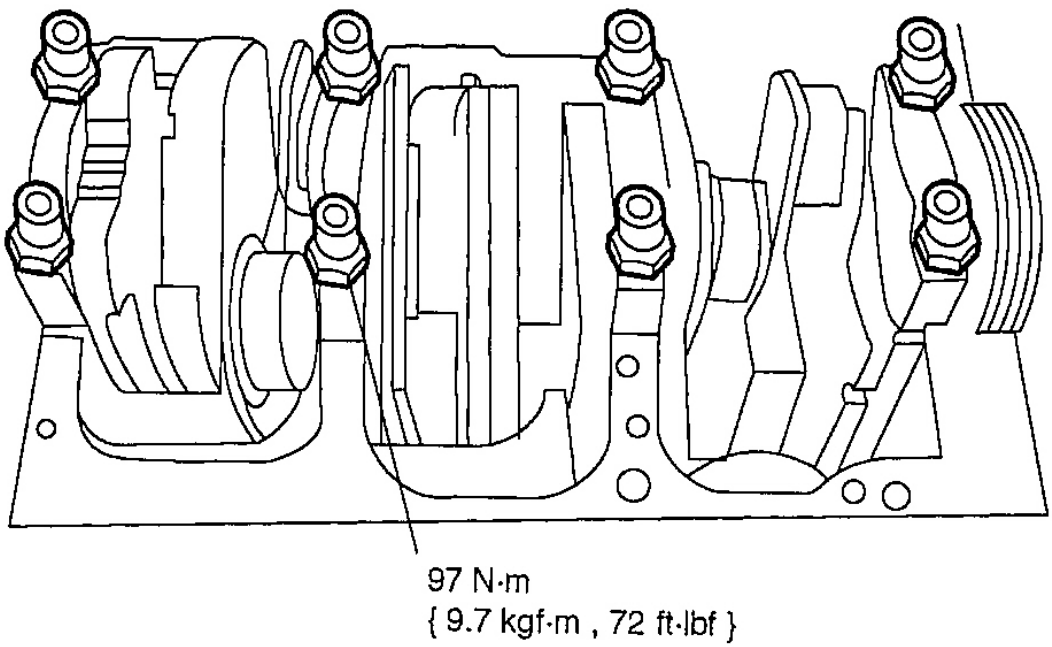


Fig. 84: Tightening Main Bearing Cap Bolts
Courtesy of MAZDA MOTORS CORP.

7. Lubricate the piston rings with clean engine oil.
8. Make sure that the piston rings are correctly spaced. Refer to **PISTON AND CONNECTING ROD DISASSEMBLY/ASSEMBLY**.
9. Install rubber hose pieces on the connecting rod bolts to protect the crankshaft.

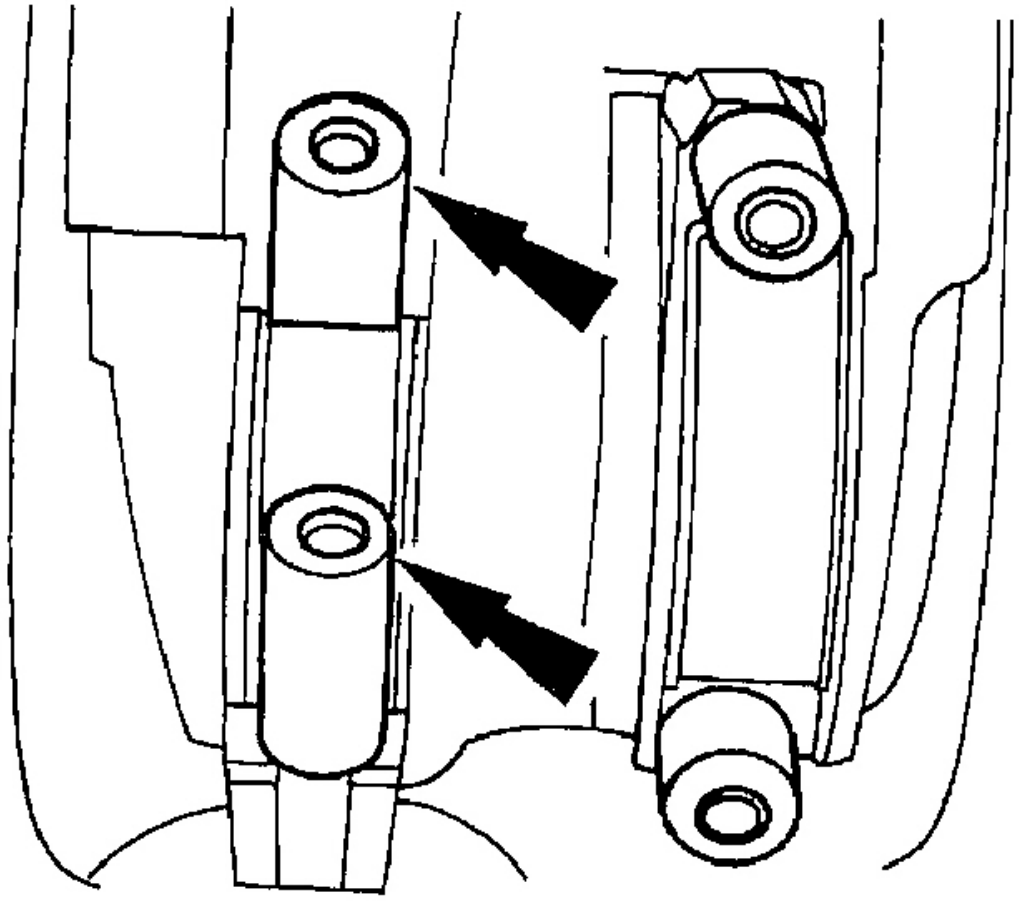


Fig. 85: Install Rubber Hose Pieces On Connecting Rod Bolts
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Position the piston with the indentation arrow toward the front of the cylinder block.**

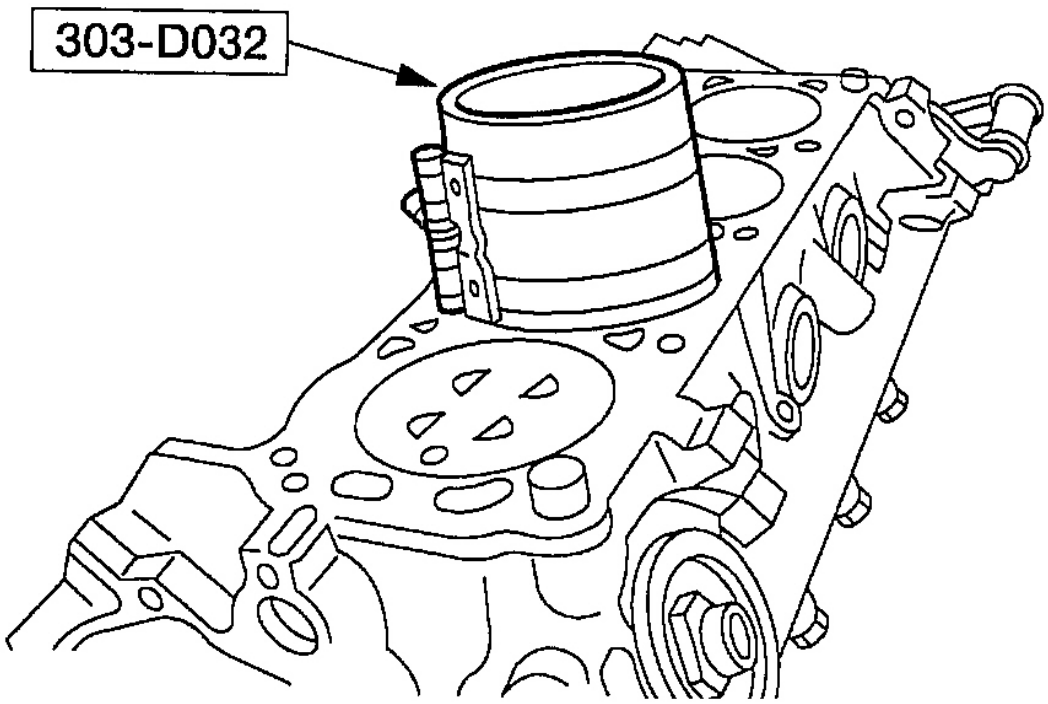


Fig. 86: Identifying Piston Ring Compressor
Courtesy of MAZDA MOTORS CORP.

10. Using Piston Ring Compressor SST 303-D032, install the pistons, connecting rod caps, and bolts and nuts (finger tight).

NOTE:
- **The old nuts and bolts are used for checking clearances. New nuts and bolts must be used for reassembly.**

11. Check the clearance of each connecting rod bearing.
12. Rotate the crankshaft until the piston is at the bottom of its stroke.

NOTE:
- **For cylinders 1, 2, and 3, remove the connecting rod nut at the oil split hole side first. For cylinders 4, 5, and 6, remove the opposite nut first.**

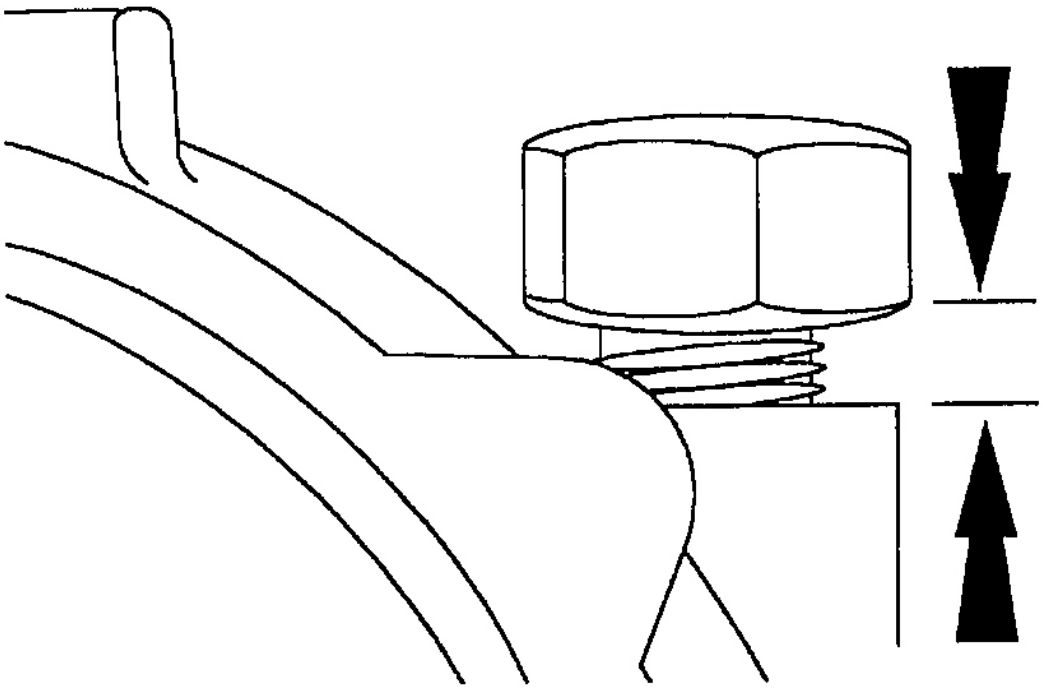


Fig. 87: Identifying Nut Face Approximately 2 mm (0.08 in) Over End Of Bolt
Courtesy of MAZDA MOTORS CORP.

13. Loosen the first nut until the face is approximately 2 mm (0.08 in) over the end of the bolt.
14. Tap the nut until the bolt can move by hand.

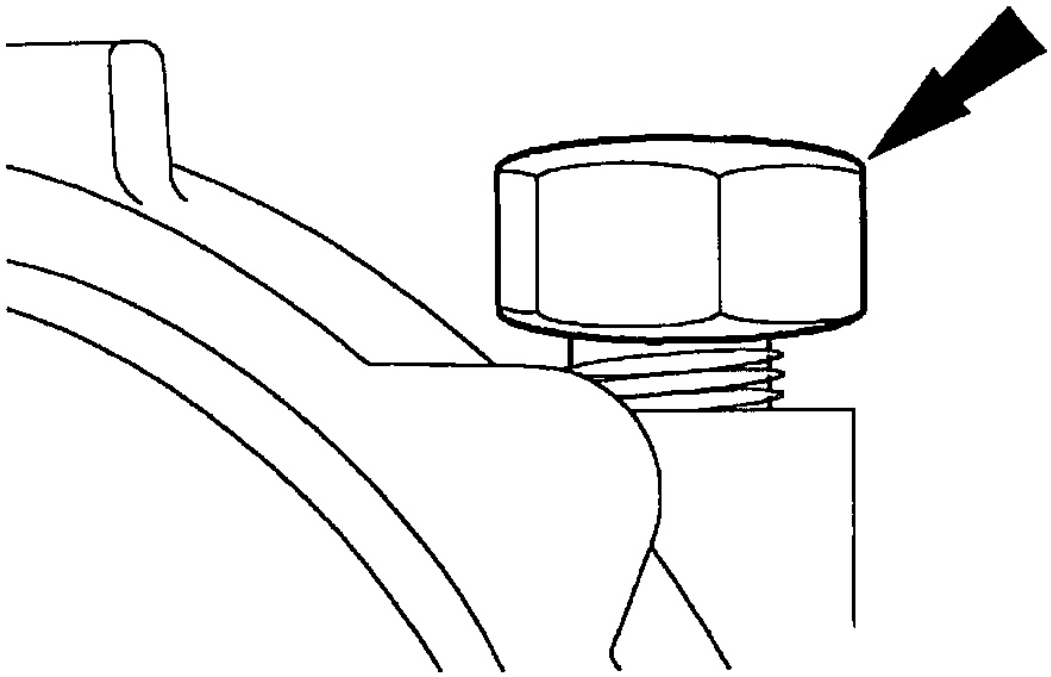
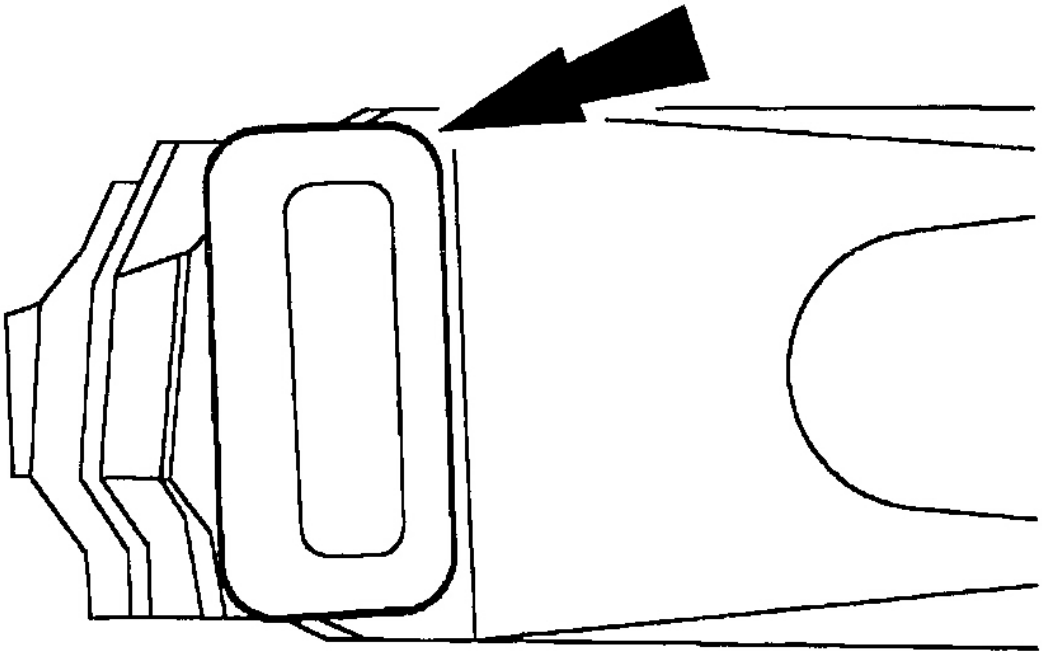


Fig. 88: Taping Nut
Courtesy of MAZDA MOTORS CORP.

15. Repeat the previous two steps for the opposite bolt and nut.
16. Install the new bolts making sure that the bolt head is parallel to the sideward face of the connecting rod.



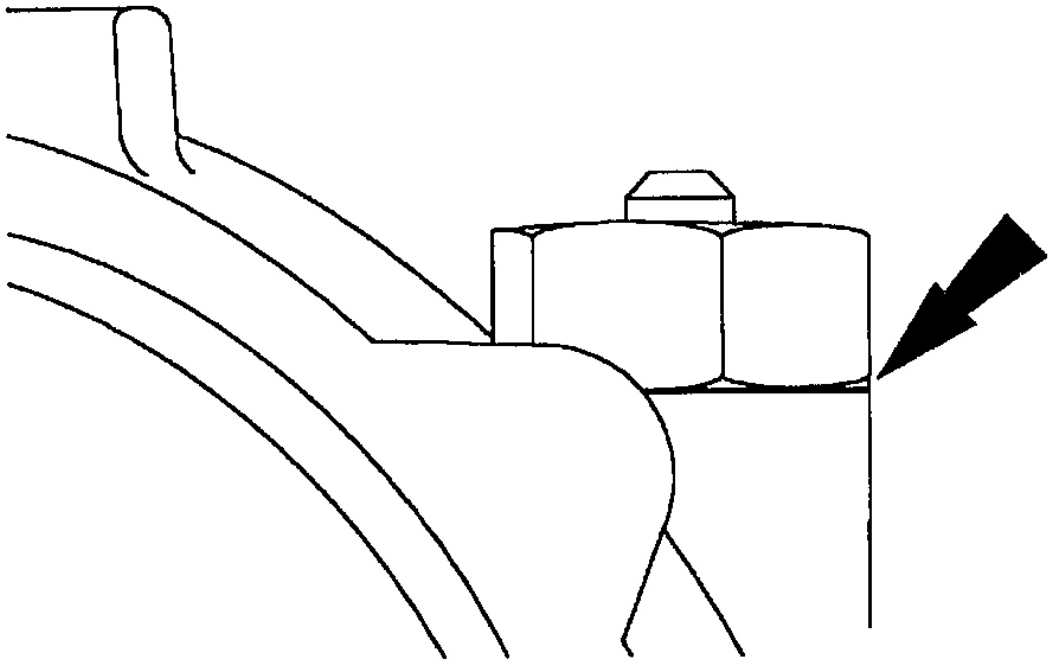
G02821224

Fig. 89: Installing Bolt Head Parallel To Sideward Face Of Connecting Rod
Courtesy of MAZDA MOTORS CORP.

17. Install the connecting rod cap in the original position.

NOTE:

- **Do not exceed 20 Nm (2 kgf-m, 15 lb-ft) when tightening the connecting rod nuts.**



G02821225

Fig. 90: Tightening Connecting Rod Nuts Finger Tight
Courtesy of MAZDA MOTORS CORP.

18. Install and tighten the connecting rod nuts finger tight.
19. Tighten the connecting rod nuts simultaneously in two stages:
    1. Stage 1: Tighten to 20 Nm (2kgf-m, 15 lb-ft).
    2. Stage 2: Tighten 90 degrees.
20. Repeat previous four steps for remaining connecting rods.
21. Rotate crankshaft until No. 1 piston is at top dead center.
22. On vehicles with a balance shaft, install the balance shaft.
    1. Install the balance shaft.
    2. Install the bolts and tighten.

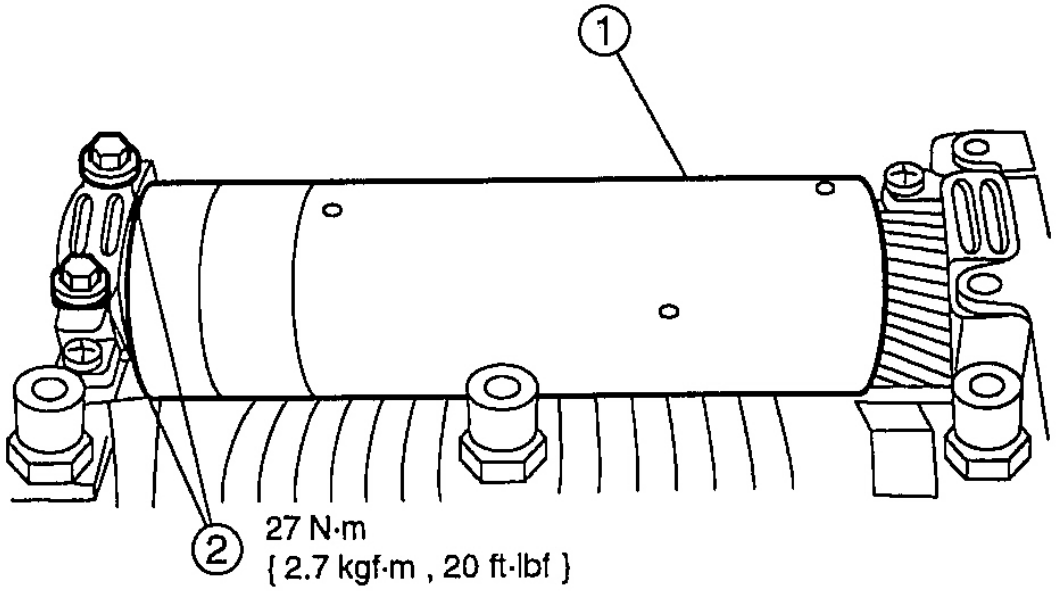
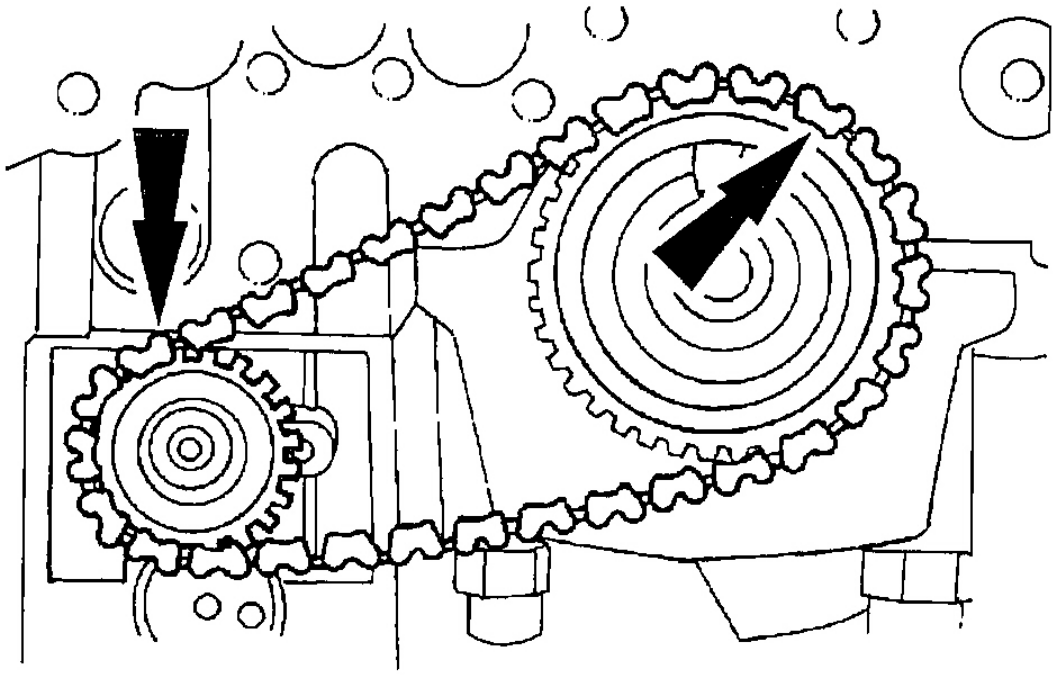


Fig. 91: Installing Balance Shaft
Courtesy of MAZDA MOTORS CORP.

23. On vehicles with a balance shaft, install the balance shaft chain and crankshaft sprocket.



G02821227

Fig. 92: Installing Balance Shaft Chain & Crankshaft Sprocket
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Due to the gear ratio between the reversal shaft and the balance shaft, up to seven complete turns of the balance shaft may be required to find the correct position.**

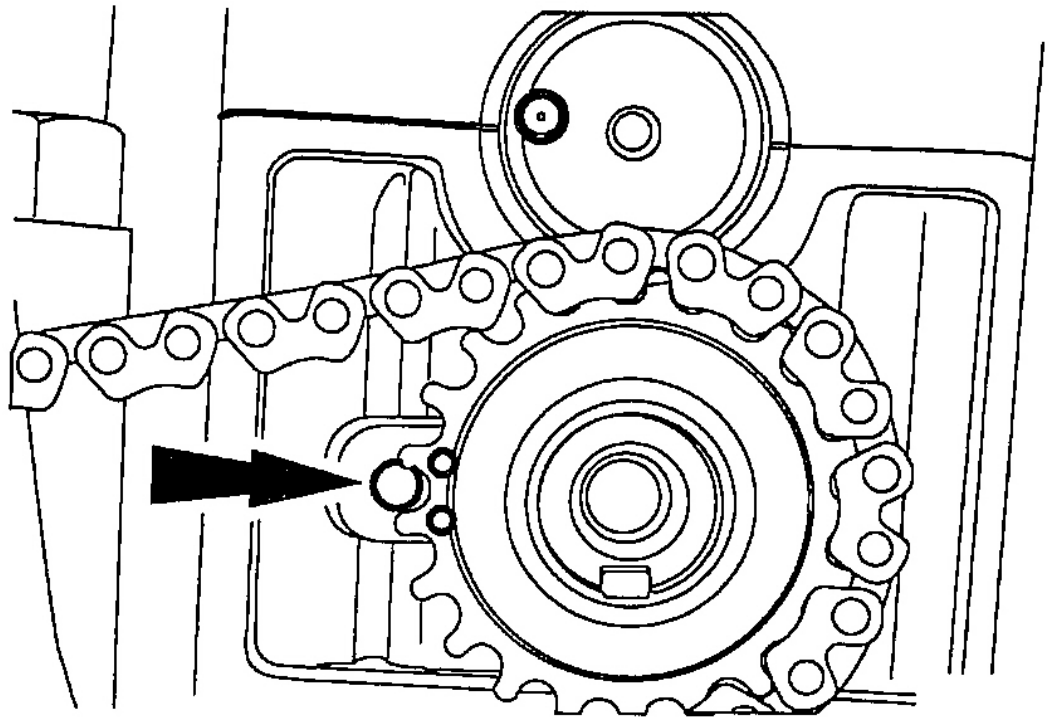


Fig. 93: Aligning Timing Marks
Courtesy of MAZDA MOTORS CORP.

24. On vehicles with a balance shaft, align the timing marks.
    1. Install the 4 mm pin to hold the shaft in place.
25. On vehicles with a balance shaft, install the balance shaft tensioner.
    1. Install the balance shaft tensioner.
    2. Install the balance shaft tensioner bolts and tighten.
    3. Position the balance shaft chain guide and install the two bolts. Tighten the bolts.
        - Remove the pin from the tensioner.

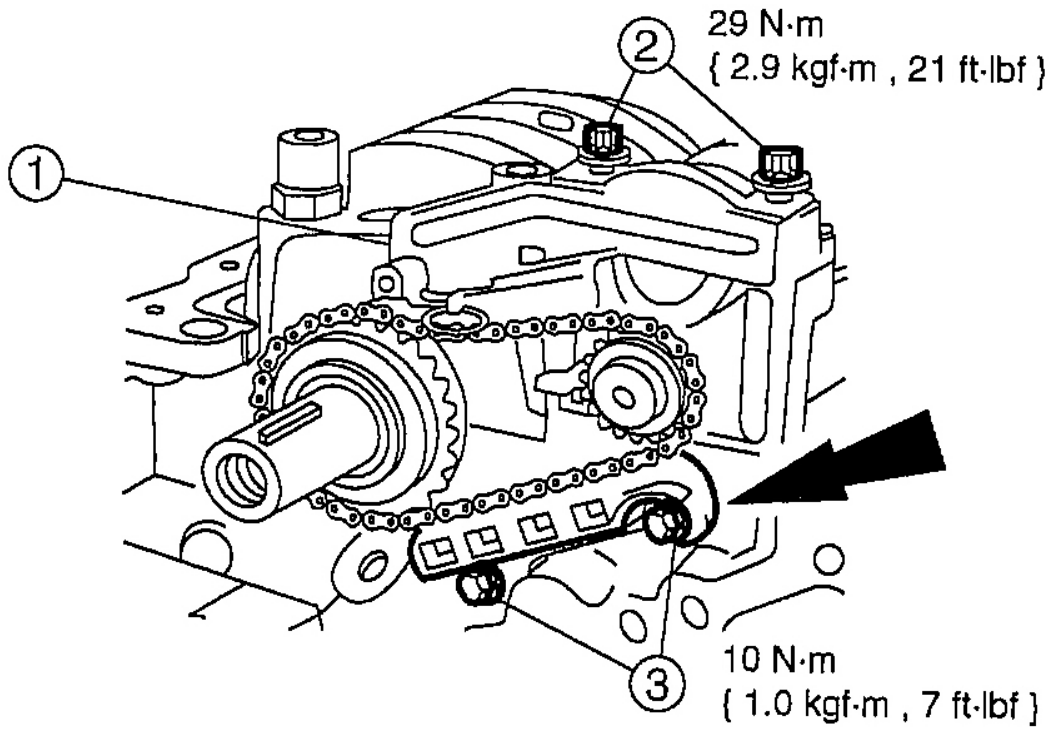


Fig. 94: Installing Balance Shaft Tensioner
Courtesy of MAZDA MOTORS CORP.

26. Install the oil pump and tighten the bolts.

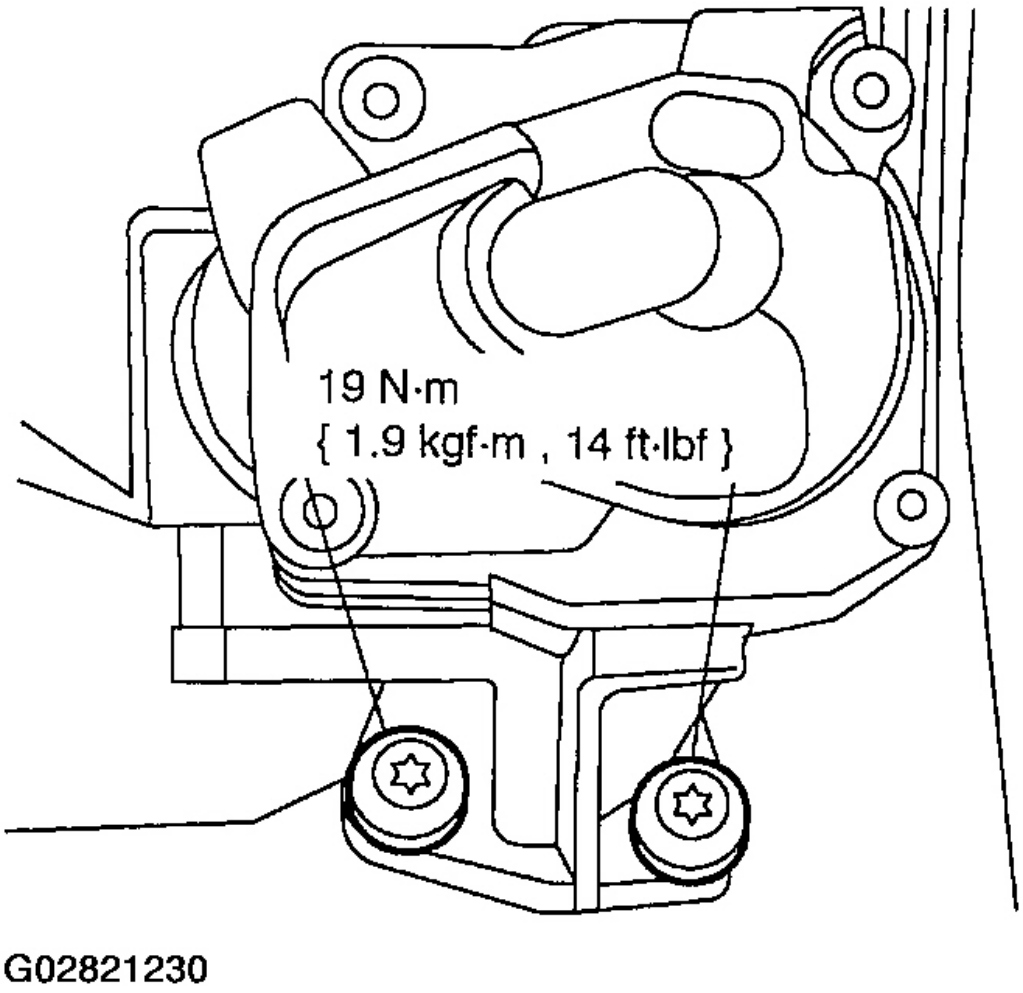


Fig. 95: Installing Oil Pump
Courtesy of MAZDA MOTORS CORP.

27. Install the jackshaft.

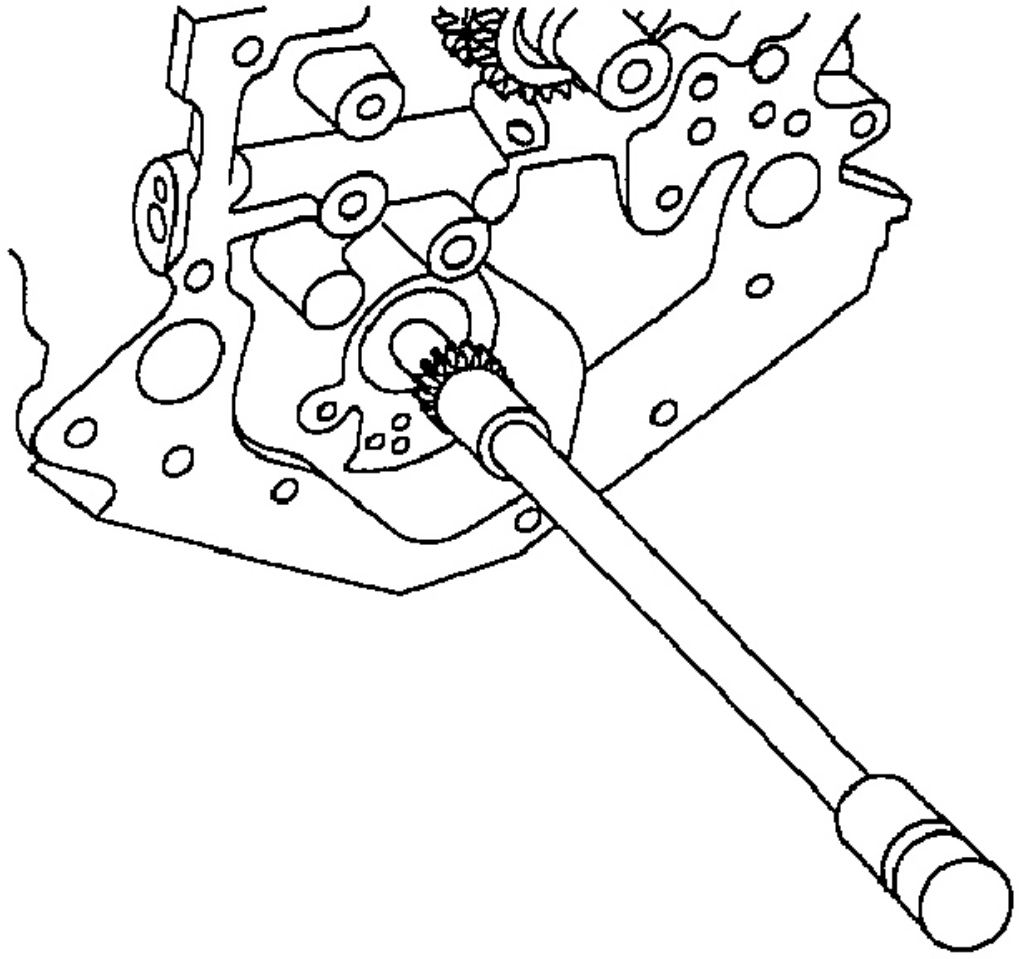


Fig. 96: Installing Jackshaft
Courtesy of MAZDA MOTORS CORP.

28. Install the jackshaft thrust plate and tighten the bolts.

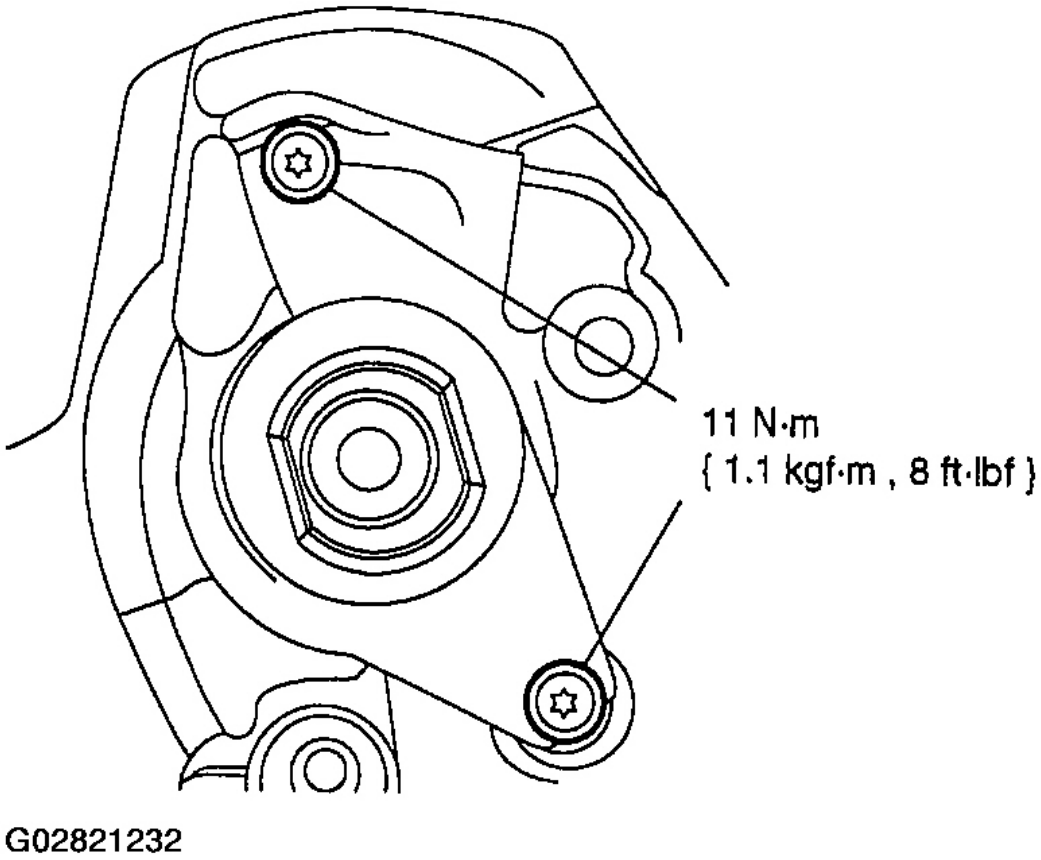


Fig. 97: Installing Jackshaft Thrust Plate
Courtesy of MAZDA MOTORS CORP.

29. Install the oil pump drive and tighten.

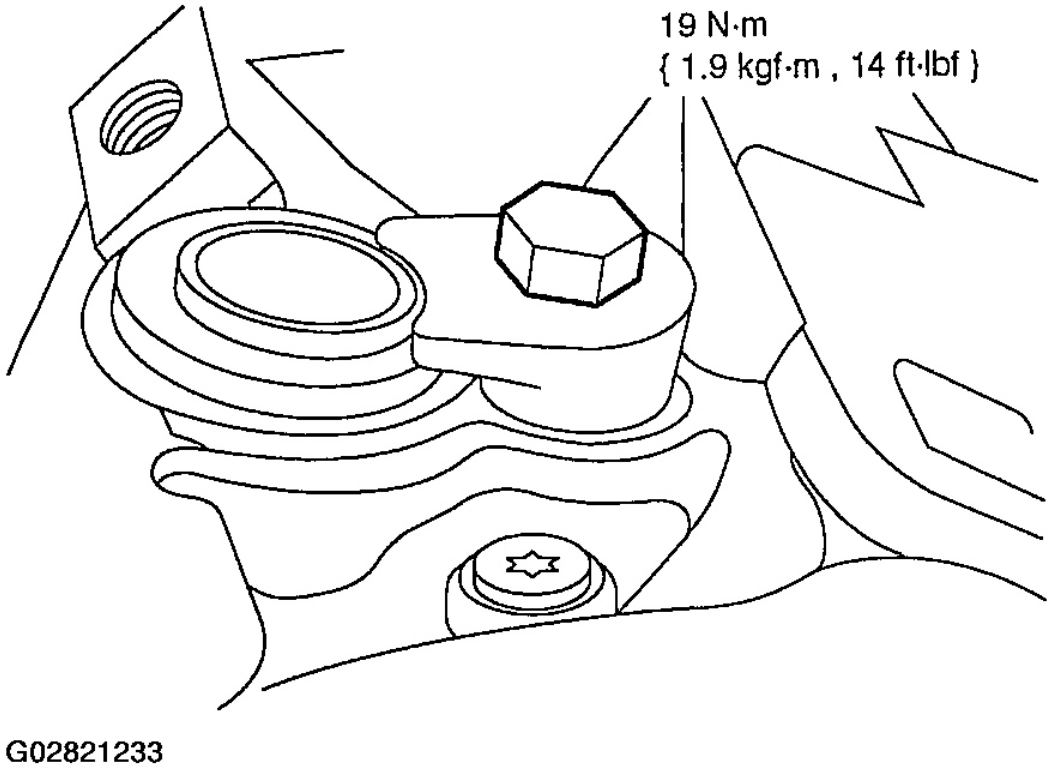


Fig. 98: Installing Oil Pump Drive
Courtesy of MAZDA MOTORS CORP.

30. Attach the rear cassette and sprocket to the bolt. Do not tighten at this time.

Fig. 99: Installing Rear Cassette & Sprocket
Courtesy of MAZDA MOTORS CORP.

31. Install the rear cassette and bolt with camshaft drive chains. Tighten the bolt.

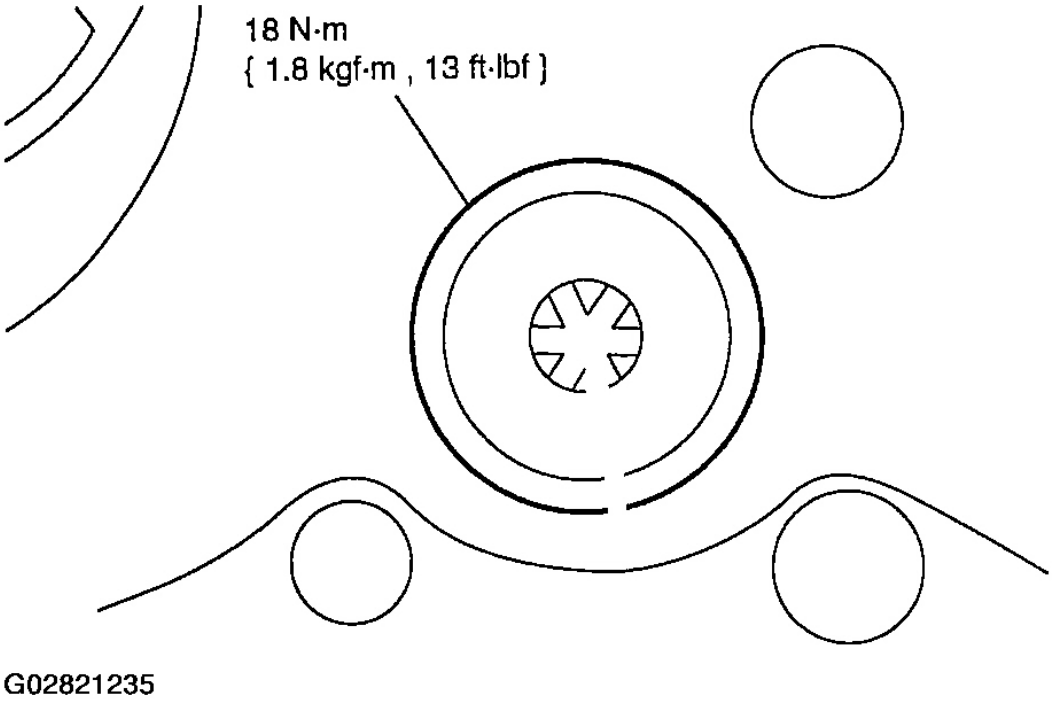


Fig. 100: Installing Rear Cassette & Bolt With Camshaft Drive Chains
Courtesy of MAZDA MOTORS CORP.

32. Install the front cassette and bolt with camshaft drive chains. Tighten the bolt.

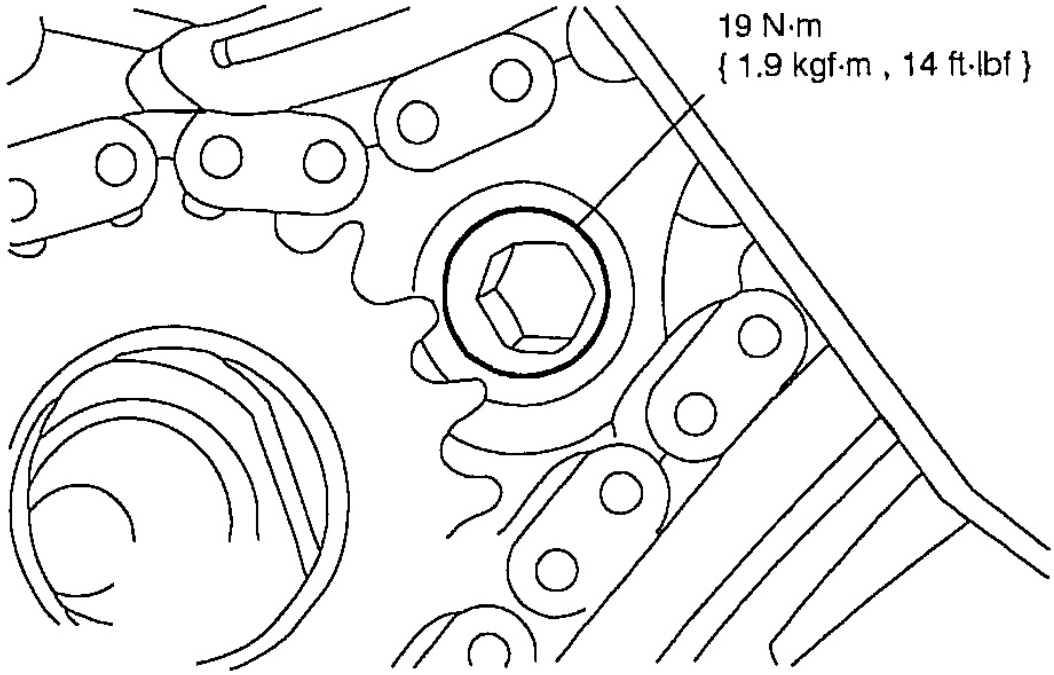


Fig. 101: Installing Front Cassette & Bolt With Camshaft Drive Chains
Courtesy of MAZDA MOTORS CORP.

33. Position the jackshaft sprocket and chain.

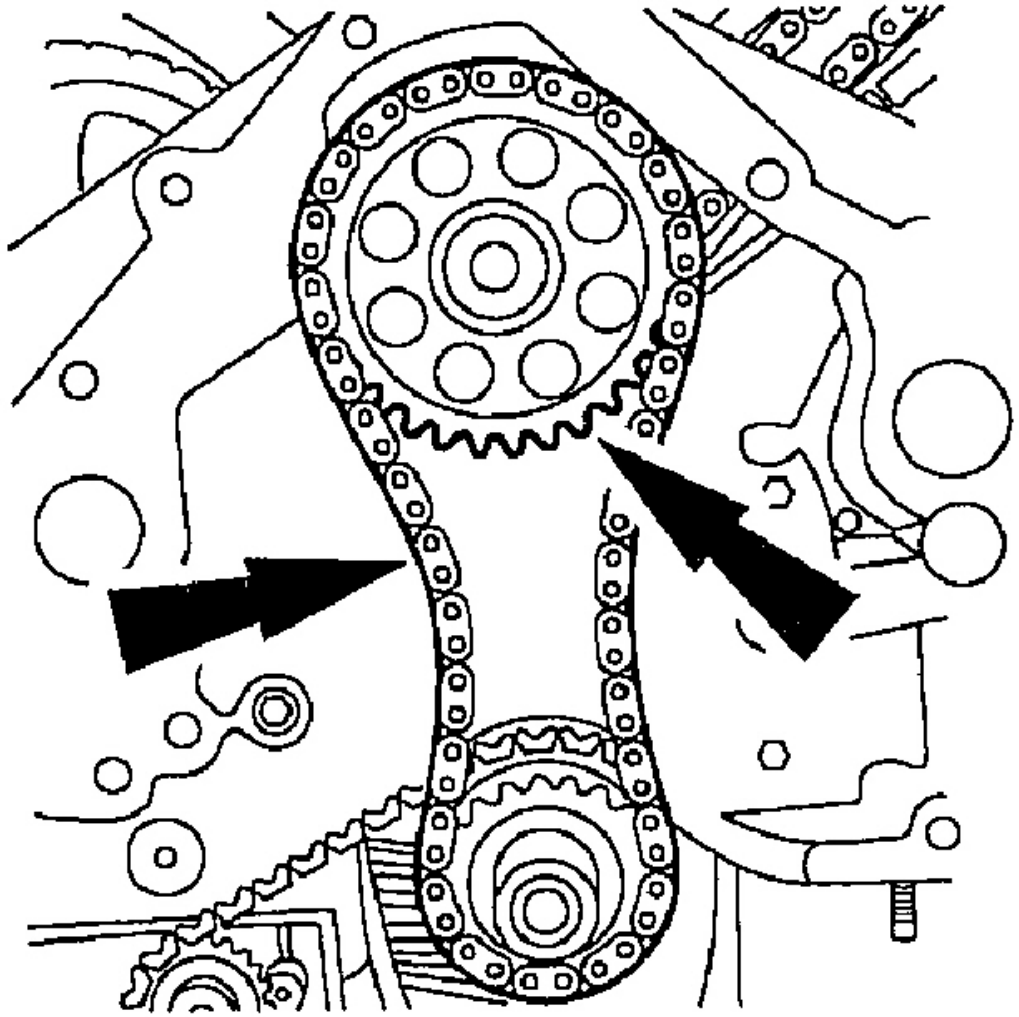


Fig. 102: Positioning Jackshaft Sprocket & Chain
Courtesy of MAZDA MOTORS CORP.

34. Install the chain guide and tighten the bolts.

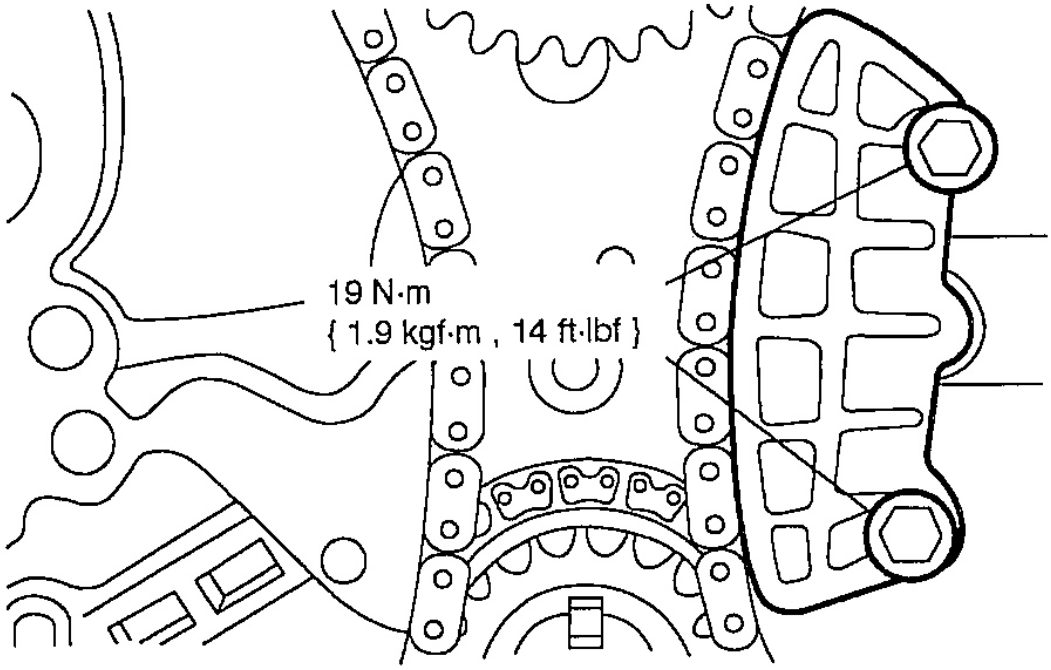


Fig. 103: Installing Chain Guide
Courtesy of MAZDA MOTORS CORP.

35. Install the chain tensioner and tighten the bolts.

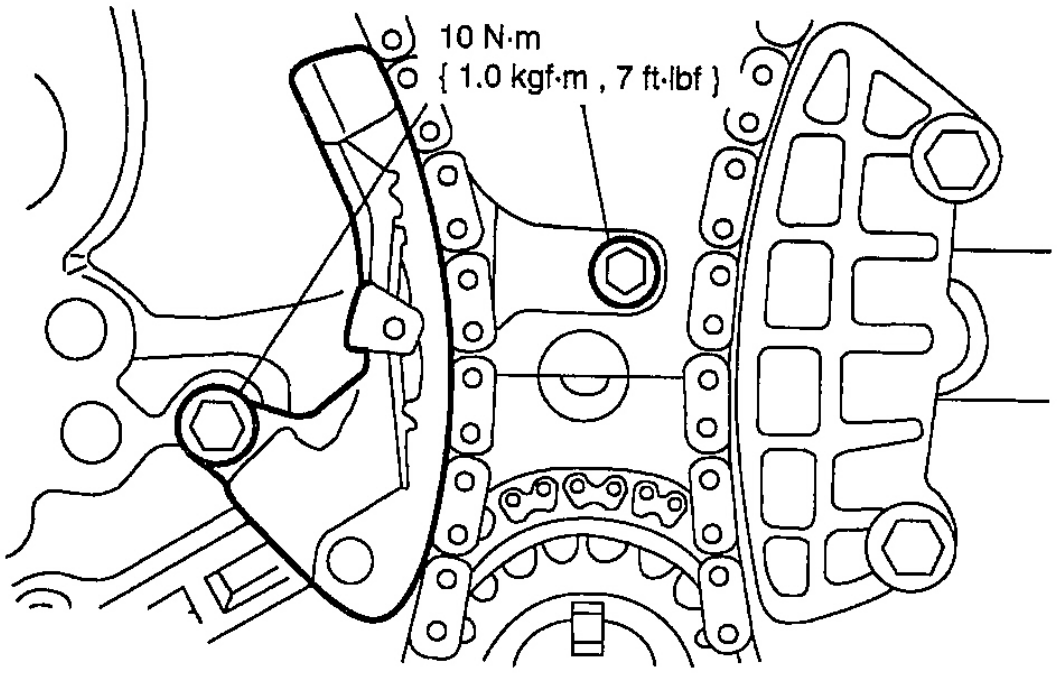
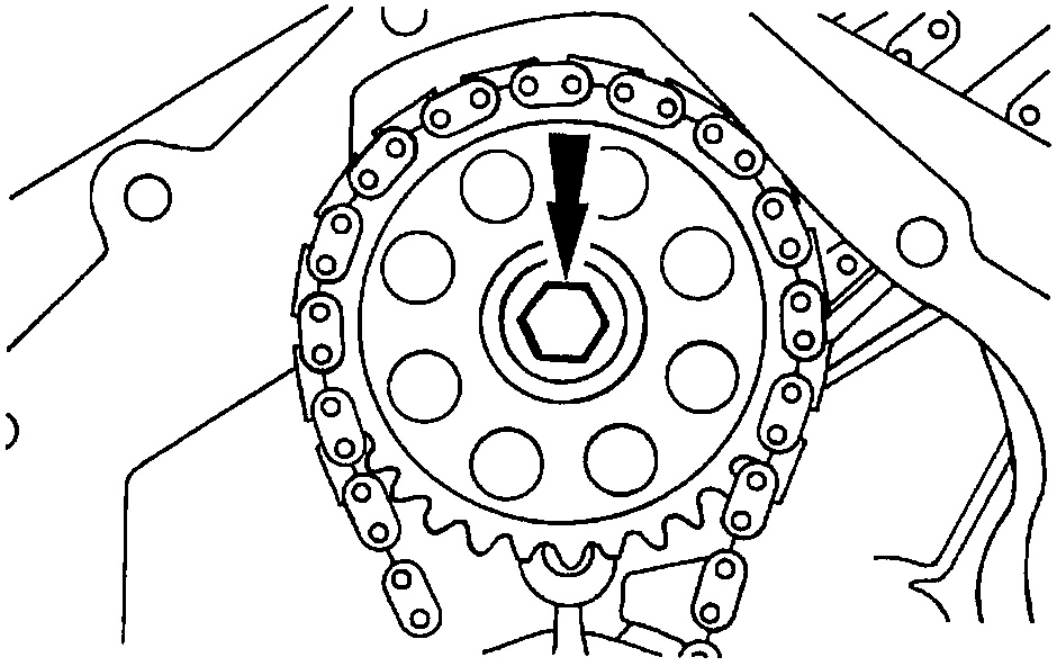


Fig. 104: Installing Chain Tensioner
Courtesy of MAZDA MOTORS CORP.

36. Install the front sprocket retaining bolt. Do not tighten at this time.



G02821240

Fig. 105: Installing Front Sprocket Retaining Bolt
Courtesy of MAZDA MOTORS CORP.

37. While holding the front jackshaft sprocket bolt secure, tighten the rear bolt to 20 Nm (2 kgf-m, 15 lb-ft).
38. Install the Rear Jackshaft Socket SST 303-634 on the rear of the jackshaft.

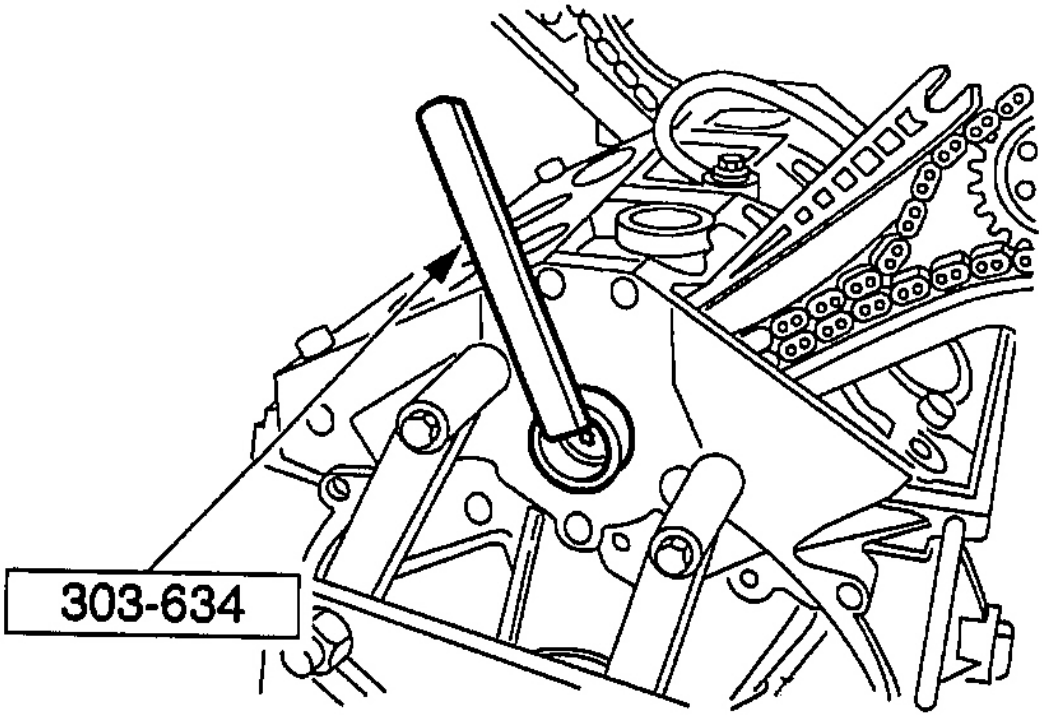


Fig. 106: Installing Rear Jackshaft Socket SST On Rear Of Jackshaft
Courtesy of MAZDA MOTORS CORP.

39. Tighten the rear bolt an additional 90 degrees.

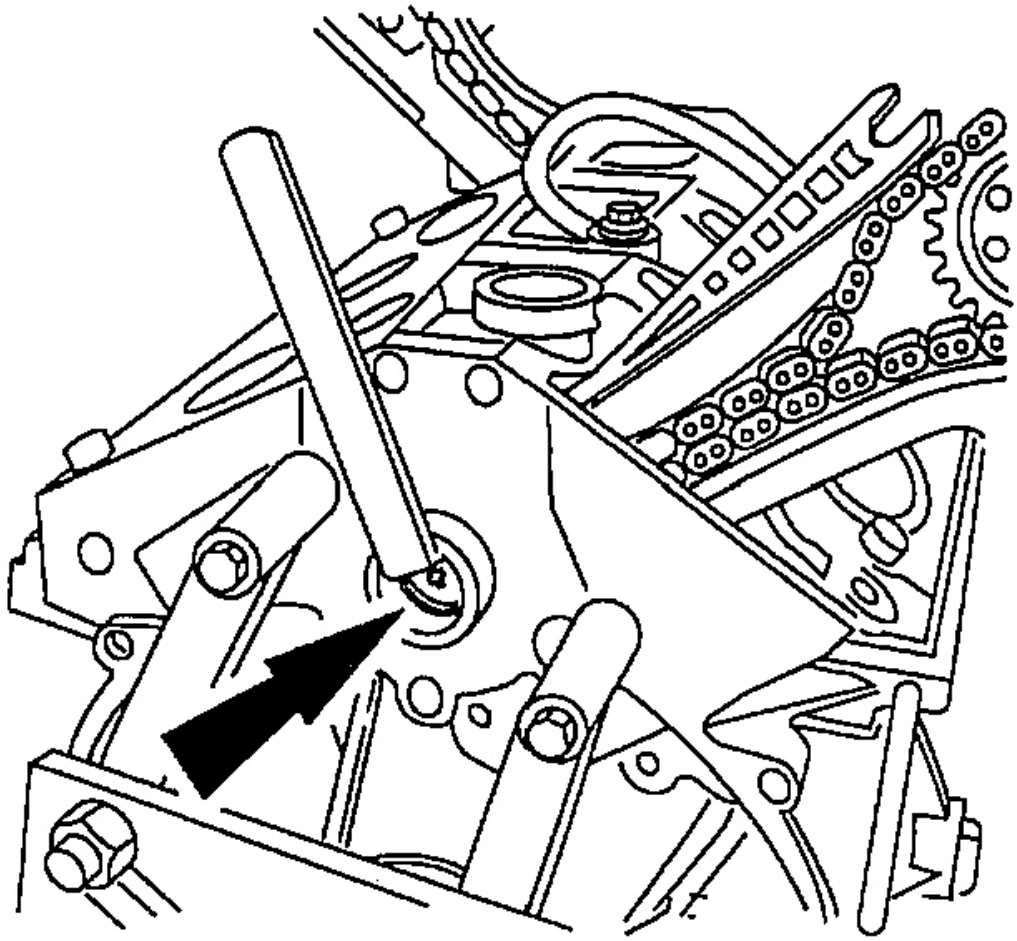


Fig. 107: Tightening Rear Bolt
Courtesy of MAZDA MOTORS CORP.

40. Tighten the front bolt in two stages.
    1. Stage 1: Tighten to 45 Nm (4.5 kgf-m, 33 lb-ft).
    2. Stage 2: Tighten 90 degrees.

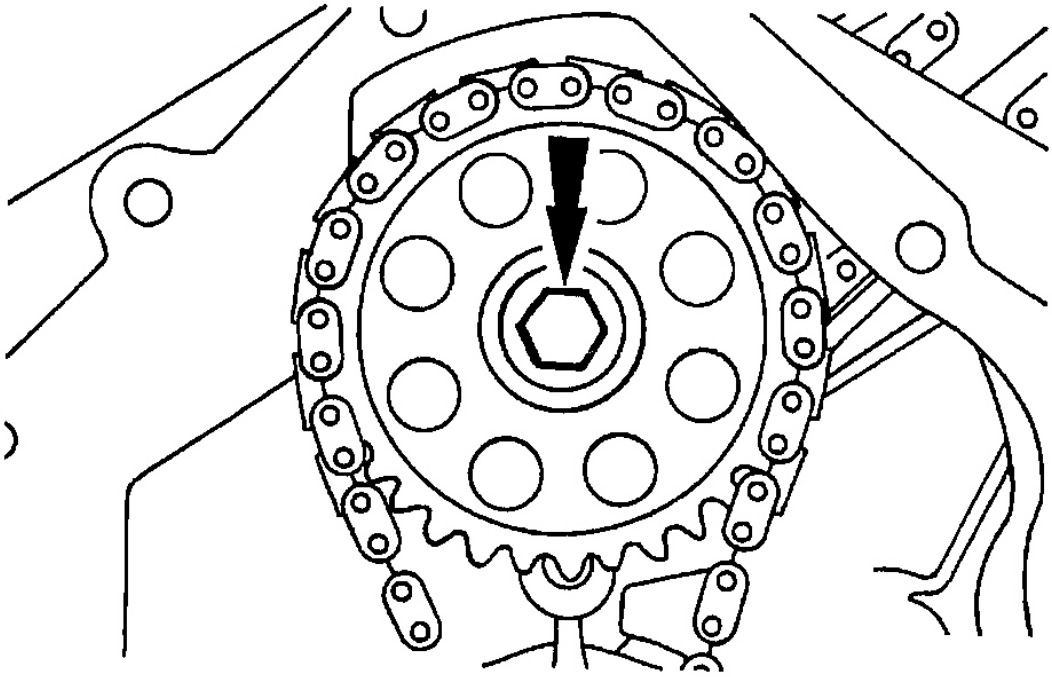
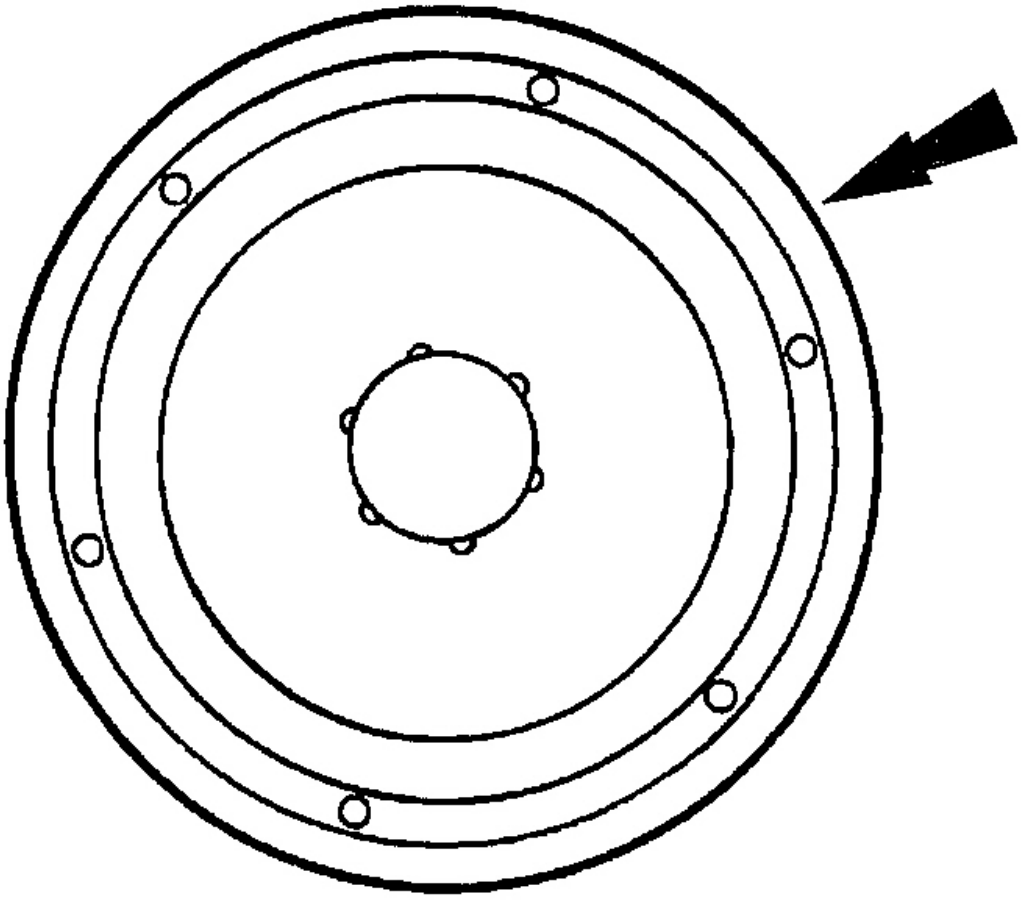


Fig. 108: Tightening Front Bolt
Courtesy of MAZDA MOTORS CORP.

41. Remove the Rear Jackshaft Socket SST 303-634 and install the rear jackshaft plug.



G02821244

Fig. 109: Installing Rear Jackshaft Plug
Courtesy of MAZDA MOTORS CORP.

42. Position the front cover gasket and install the front cover. Tighten the bolts.

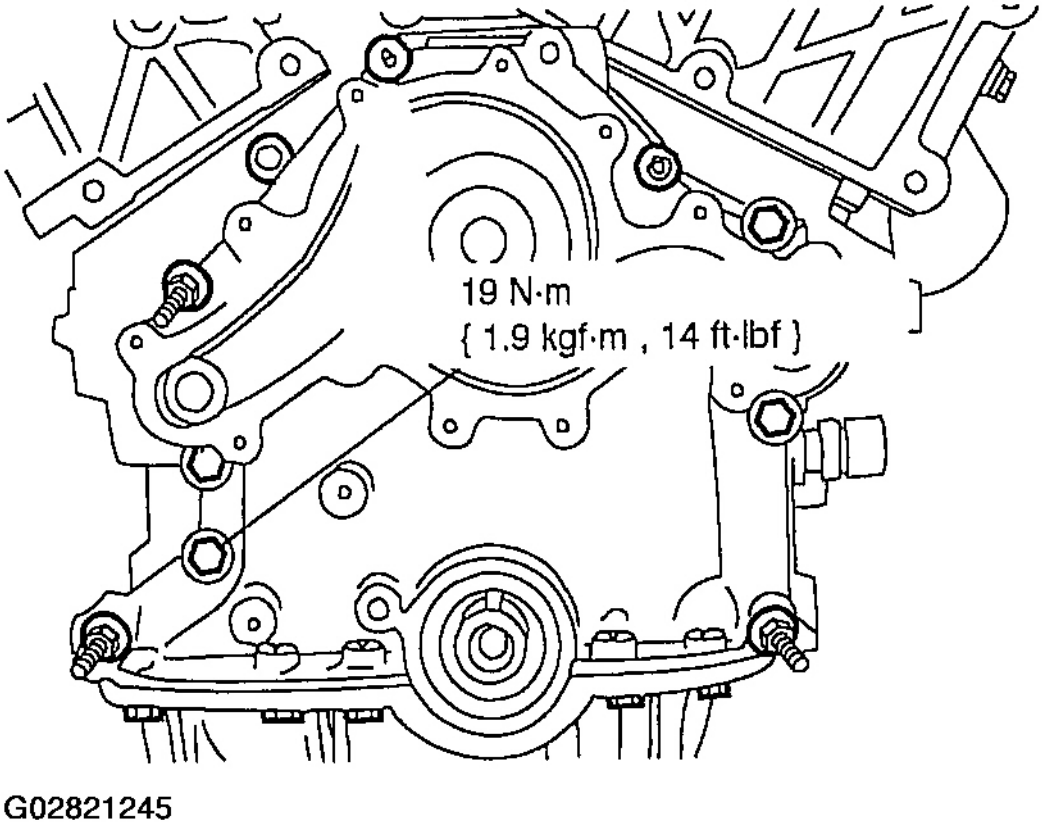
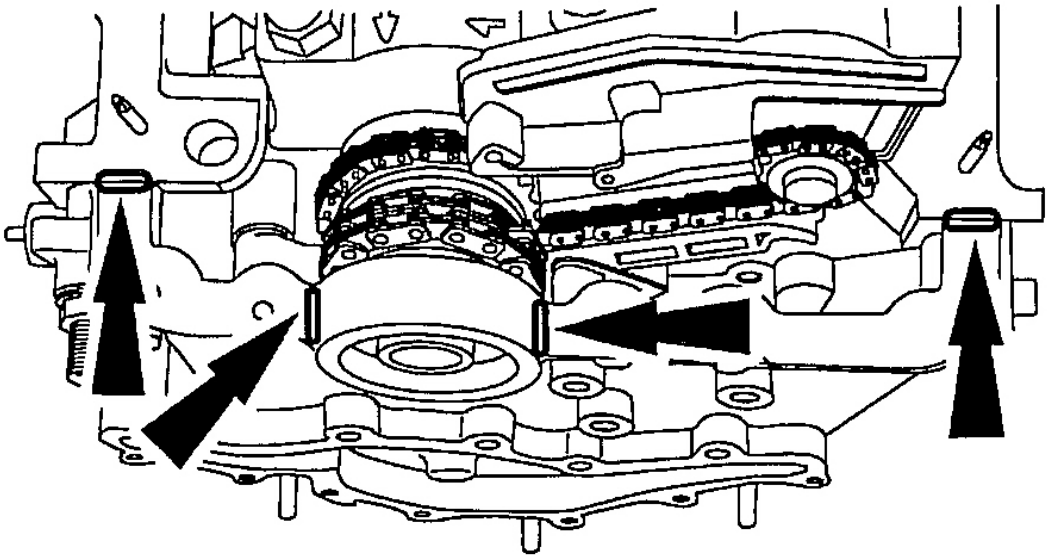


Fig. 110: Installing Front Cover
Courtesy of MAZDA MOTORS CORP.

43. Apply sealant to the front cover in four places.



G02821246

Fig. 111: Applying Sealant To Front Cover
Courtesy of MAZDA MOTORS CORP.

44. Apply silicone gasket and sealant to the rear main bearing cap as shown.
    1. Position the ladder frame gasket.

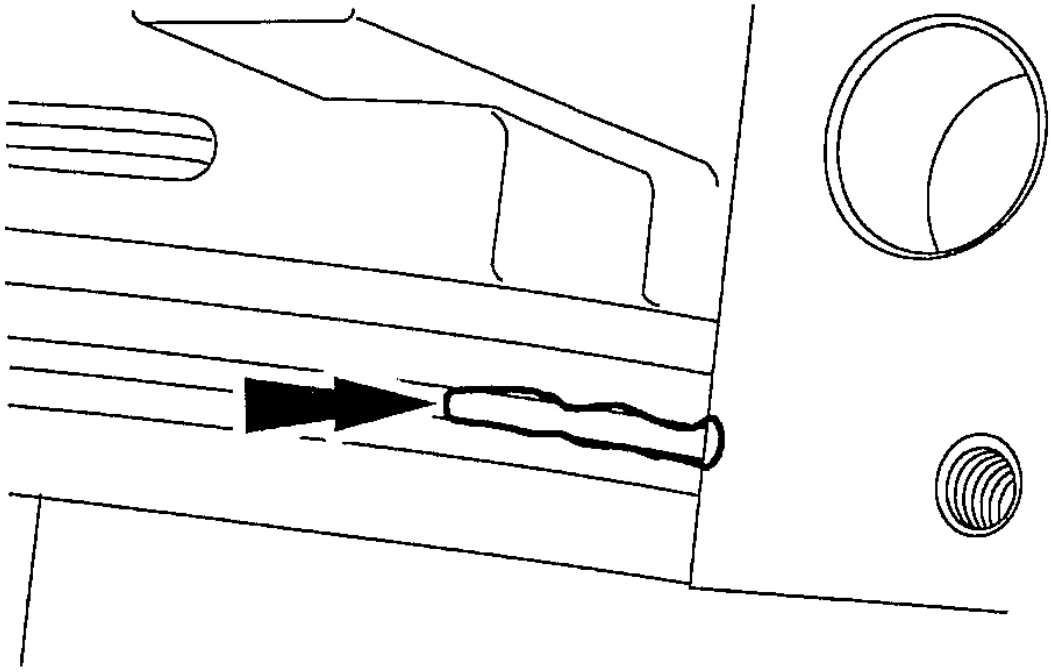


Fig. 112: Applying Silicone Gasket & Sealant To Rear Main Bearing Cap
Courtesy of MAZDA MOTORS CORP.

CAUTION:
- **The ladder frame inserts must be loosened completely or damage to the ladder frame and/or oil leaks may result.**

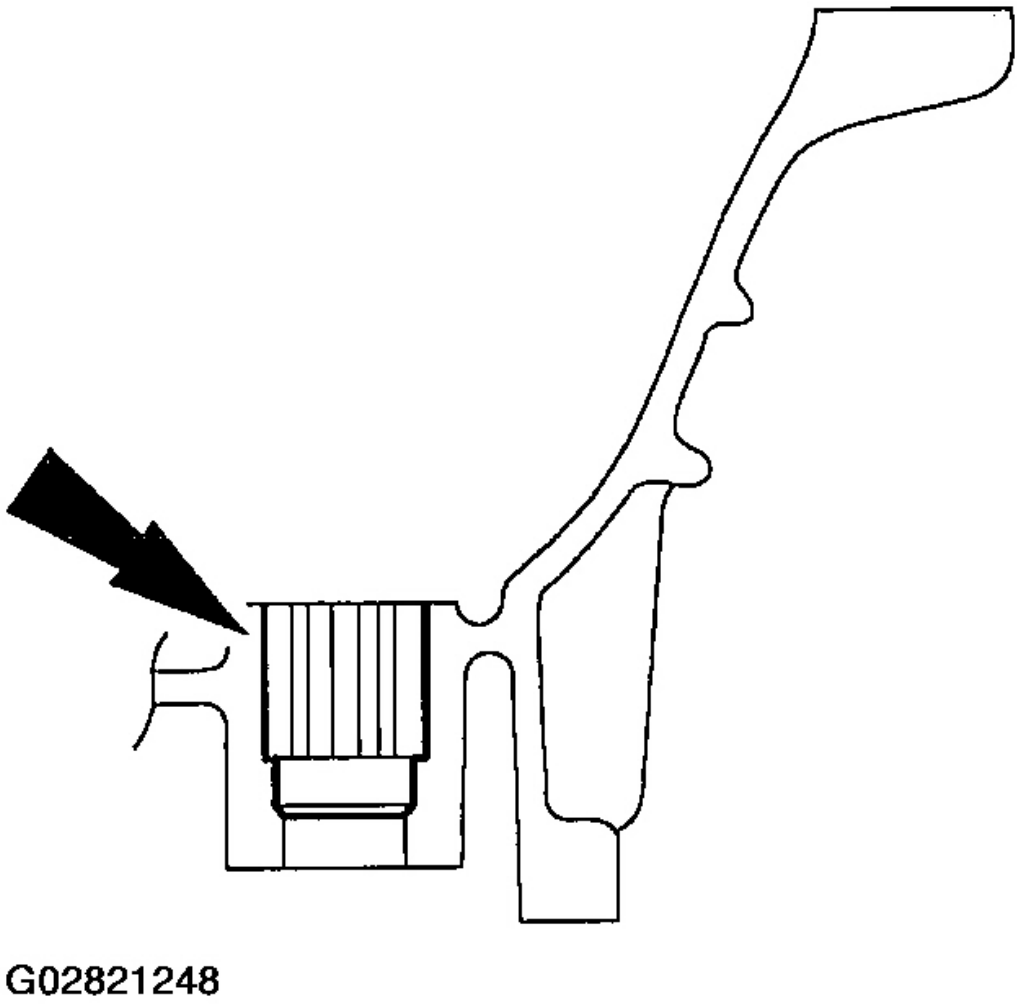


Fig. 113: Loosening Ladder Frame Inserts
Courtesy of MAZDA MOTORS CORP.

45. Loosen the ladder frame inserts.
46. Position the ladder frame and gasket assembly.

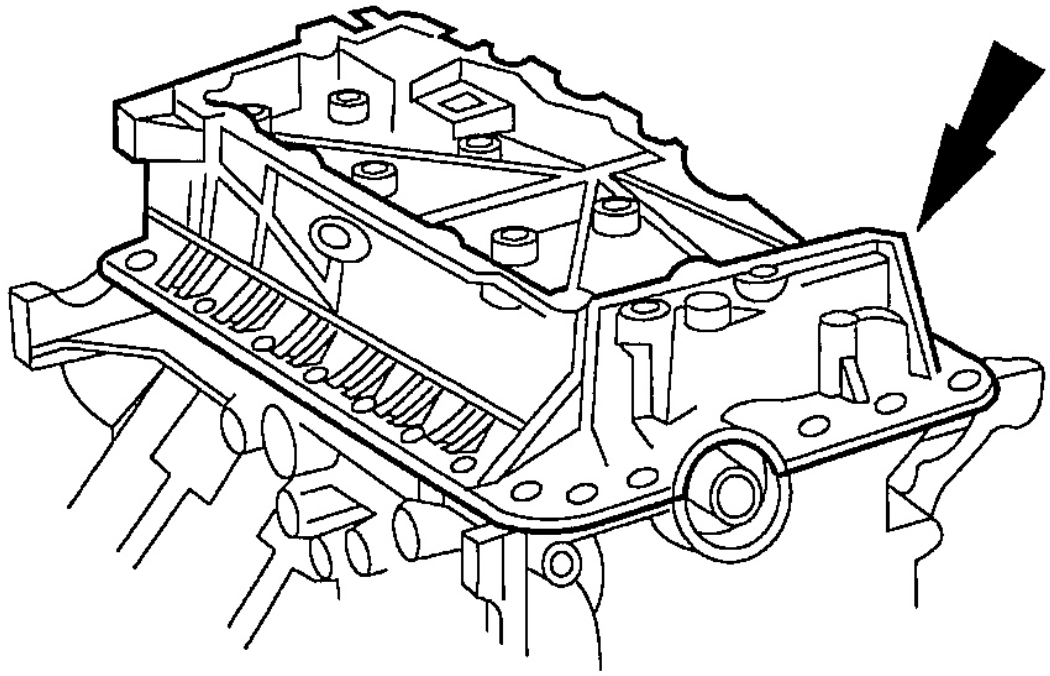
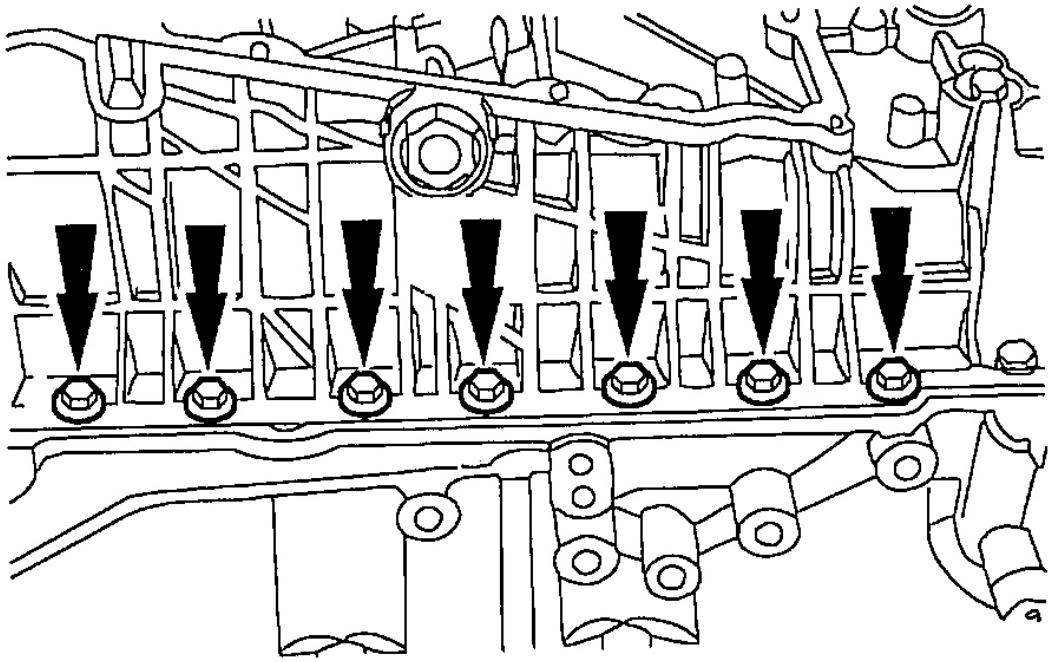


Fig. 114: Positioning Ladder Frame & Gasket Assembly
Courtesy of MAZDA MOTORS CORP.

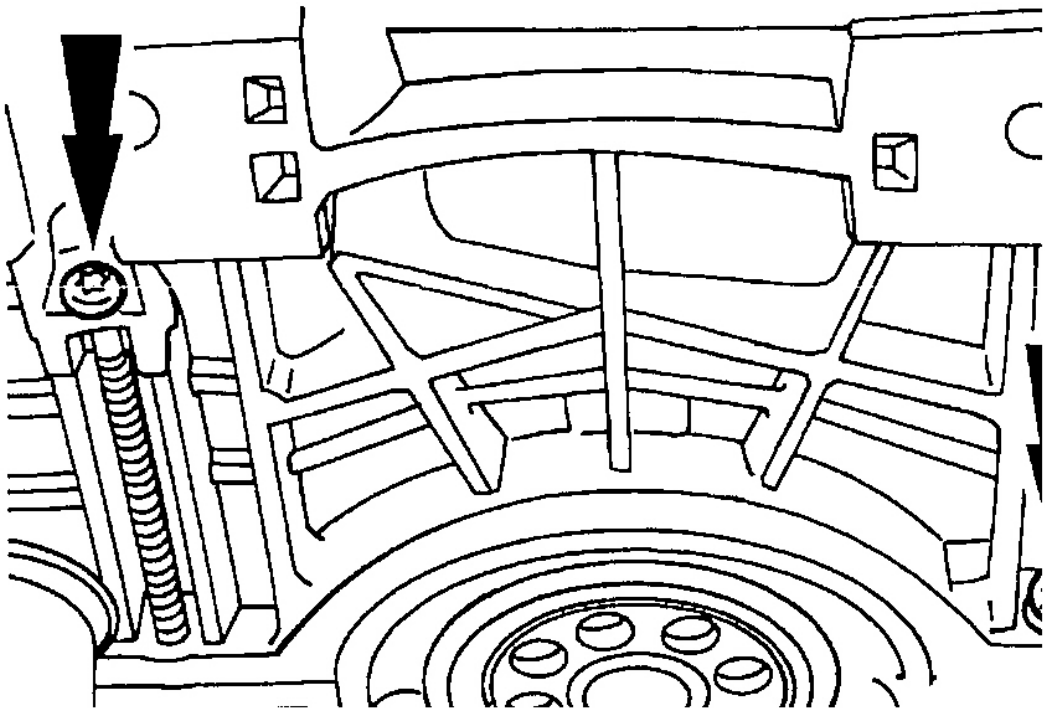
47. Install and hand tighten the 15 bolts and 2 nuts.



G02821250

Fig. 115: Installing & Hand Tightening Bolts & Nuts
Courtesy of MAZDA MOTORS CORP.

48. Install and hand tighten the ladder frame bolts.



G02821251

Fig. 116: Installing & Hand Tightening Ladder Frame Bolts
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **The ladder frame to cylinder block alignment must be within a maximum mismatch of 0.25 mm (0.01 in) ladder frame under flush or 0.05 mm (0.00196 in) ladder frame protrusion.**

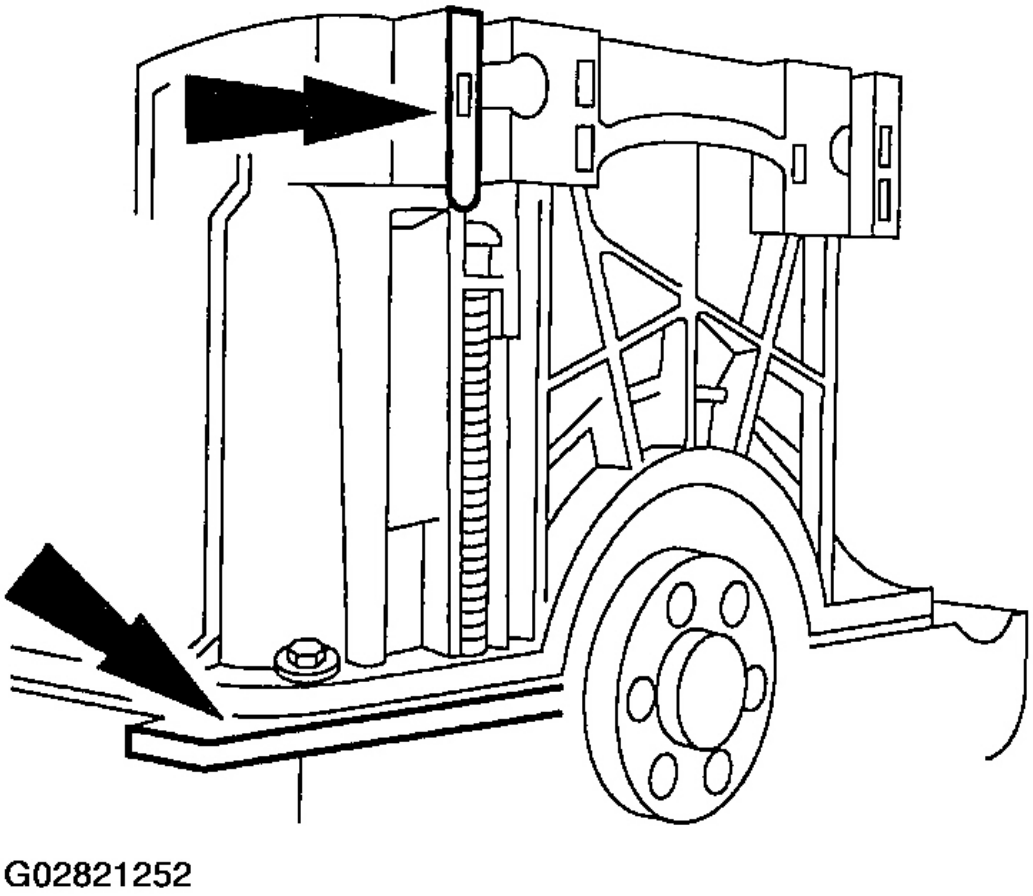


Fig. 117: Aligning Transmission Face Of Ladder Frame With Rear Of Cylinder Block
Courtesy of MAZDA MOTORS CORP.

49. Using a straight edge, align the transmission face of the ladder frame with the rear of the cylinder block.
50. Tighten the 15 bolts and 2 nuts.

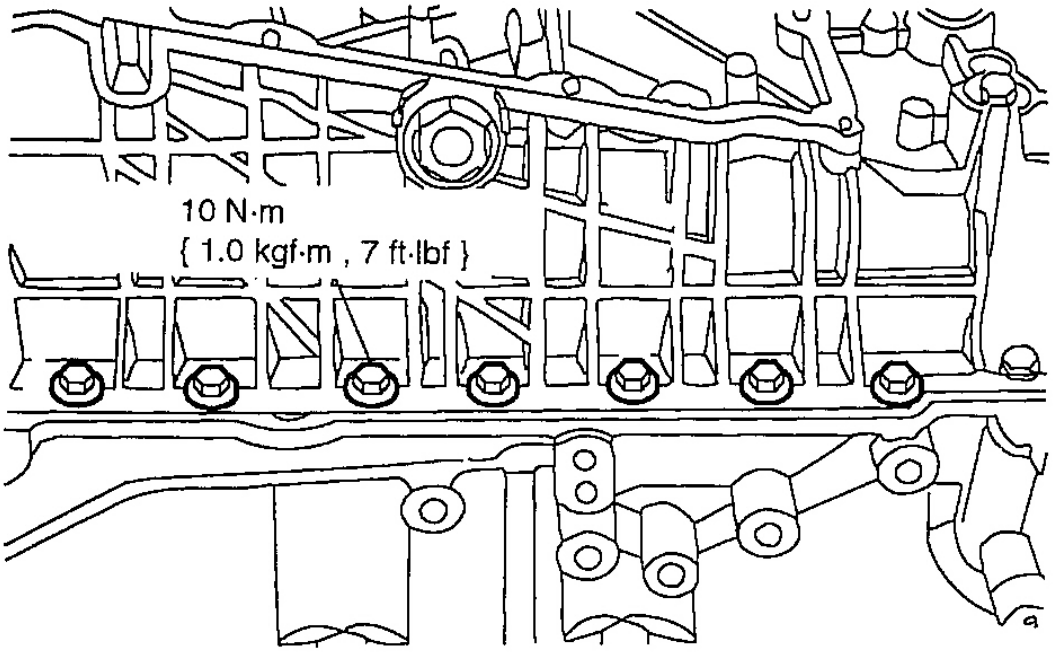
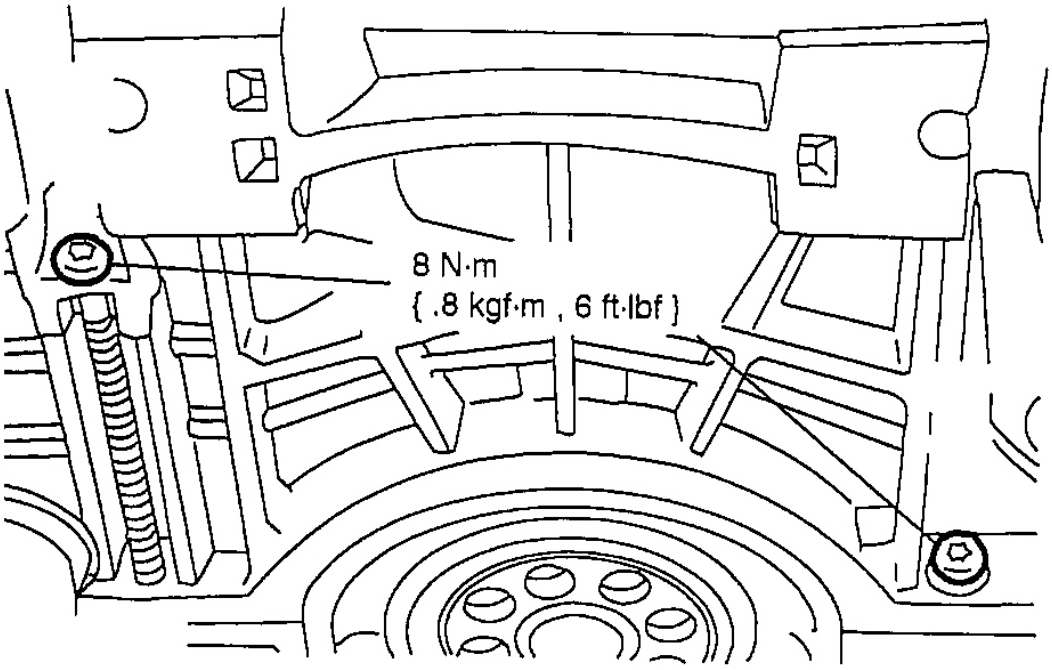


Fig. 118: Tightening Ladder Frame Bolts & Nuts
Courtesy of MAZDA MOTORS CORP.

51. Tighten the ladder frame bolts.



G02821254

Fig. 119: Tightening Ladder Frame Bolts
Courtesy of MAZDA MOTORS CORP.

52. Tighten the inserts.

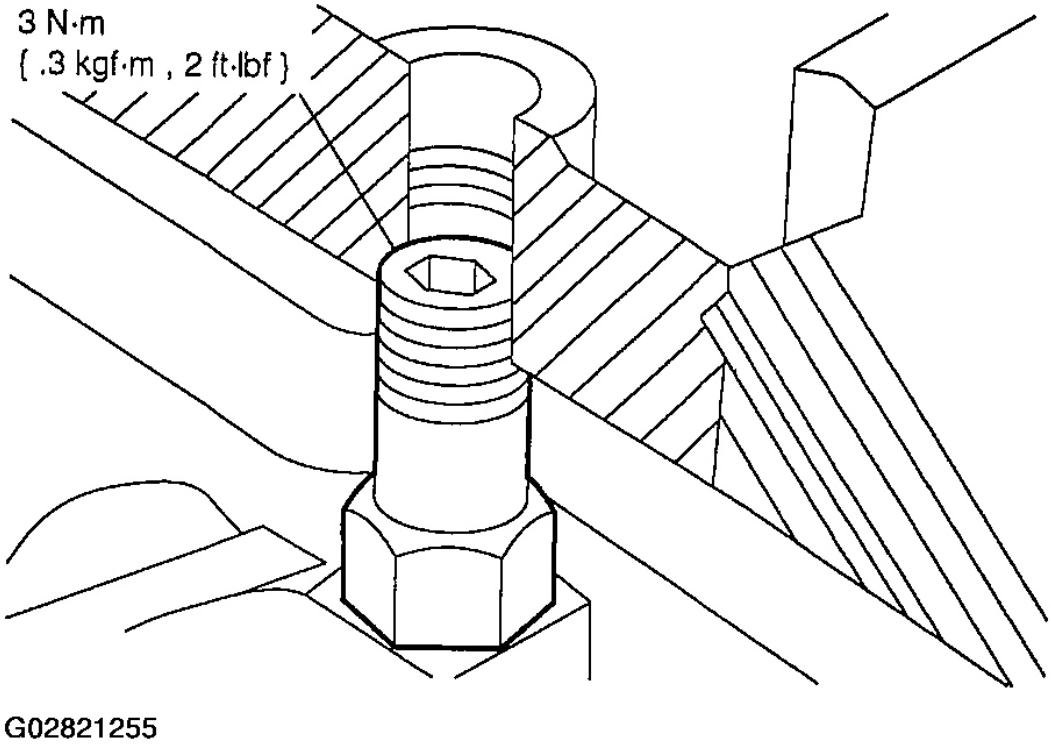


Fig. 120: Tightening Inserts
Courtesy of MAZDA MOTORS CORP.

53. Install new seals on the two silver bolts and position them in the ladder frame.

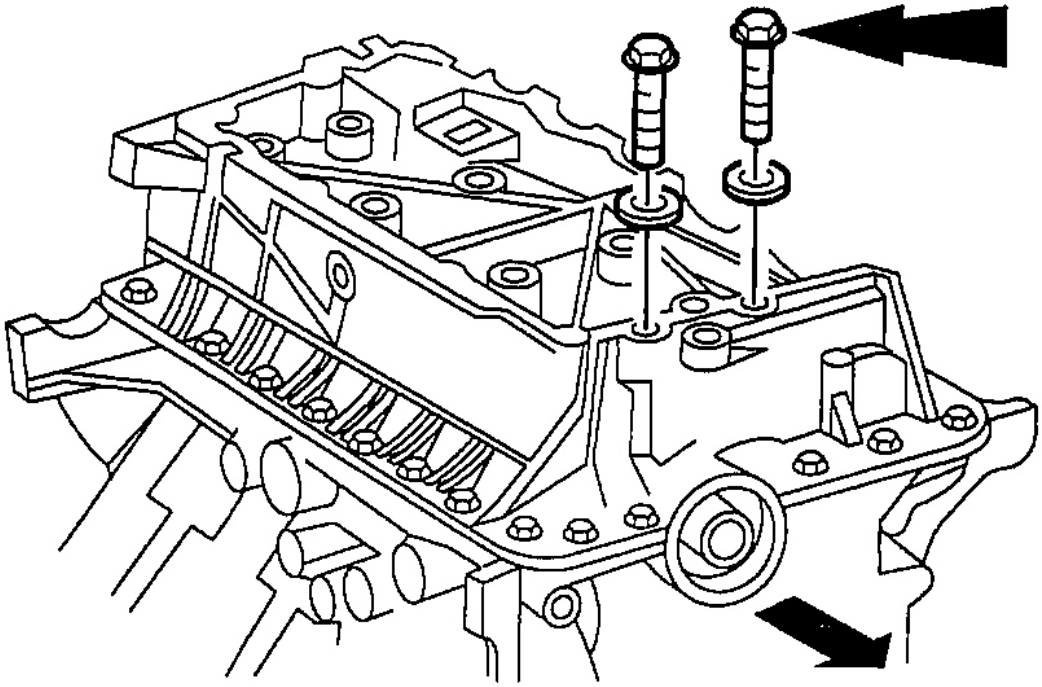


Fig. 121: Installing New Seals On Two Silver Bolts
Courtesy of MAZDA MOTORS CORP.

54. Position the six remaining bolts.

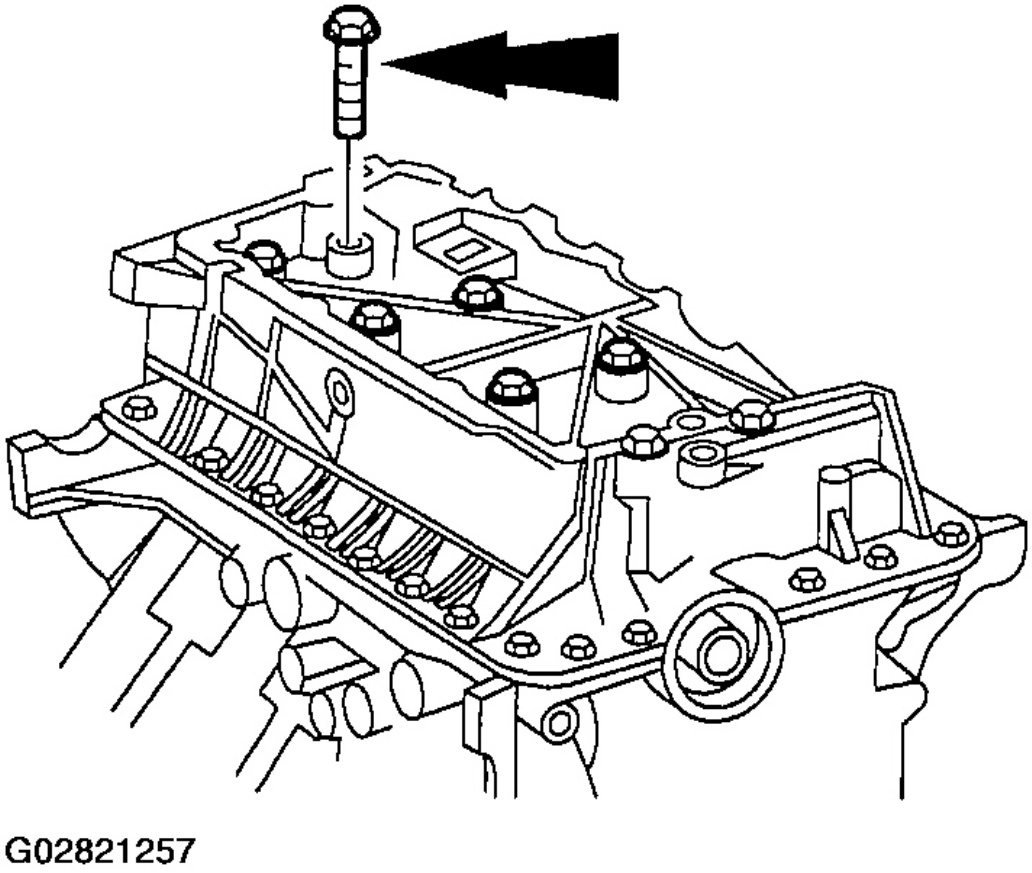


Fig. 122: Positioning Six Remaining Bolts
Courtesy of MAZDA MOTORS CORP.

55. Tighten the ladder frame bolts in two stages.
    1. Stage 1: Tighten to 15 Nm (1.5 kgf-m, 11 lb-ft).
    2. Stage 2: Tighten to 33 Nm (3.3 kgf-m, 24 lb-ft).

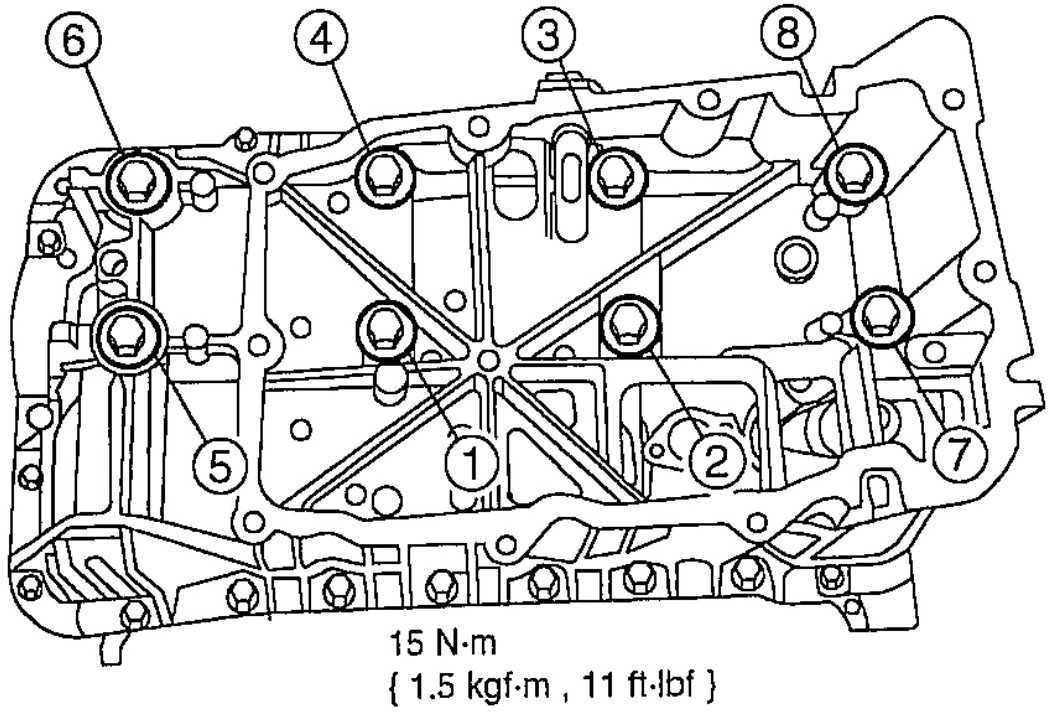


Fig. 123: Tightening Ladder Frame Bolts
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Assemblies that measure out of specification must have the entire assembly procedure repeated.**

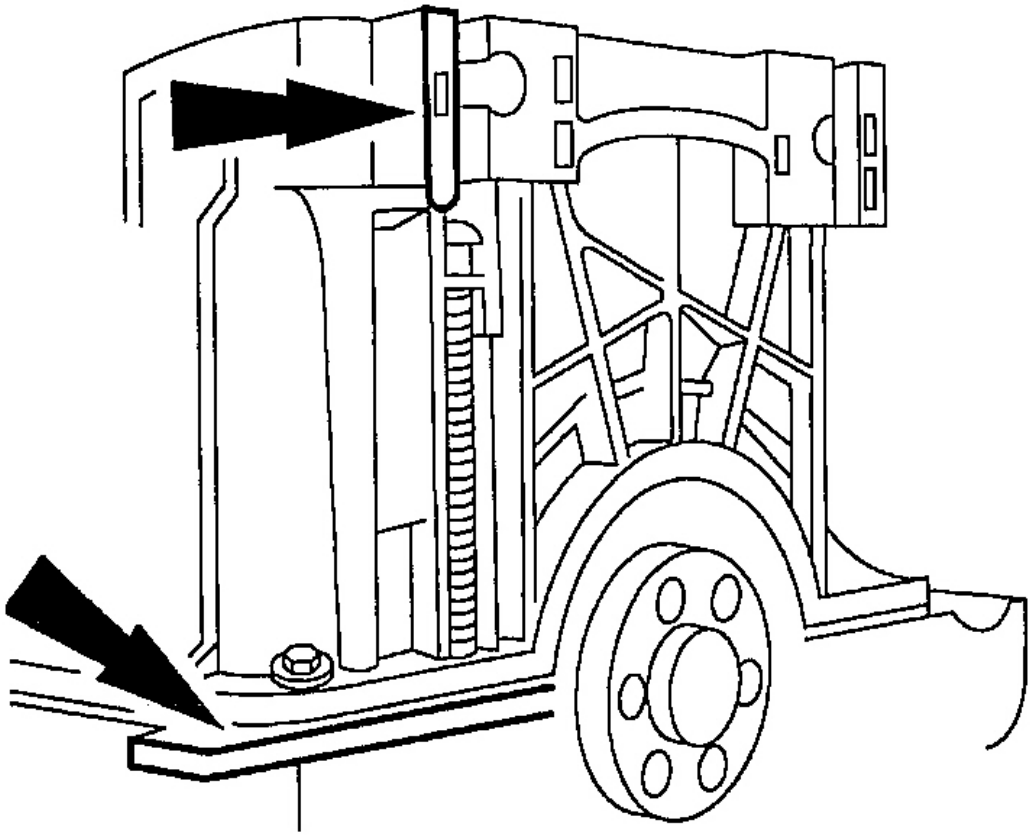


Fig. 124: Identifying Step Between Rear Face Of Cylinder Block And Transmission Face Of Ladder Frame
Courtesy of MAZDA MOTORS CORP.

56. Measure the step between the rear face of the cylinder block and the transmission face of the ladder frame.
57. Repair all assemblies that exceed under-flush specification by installing shims on one or both sides of the ladder frame.

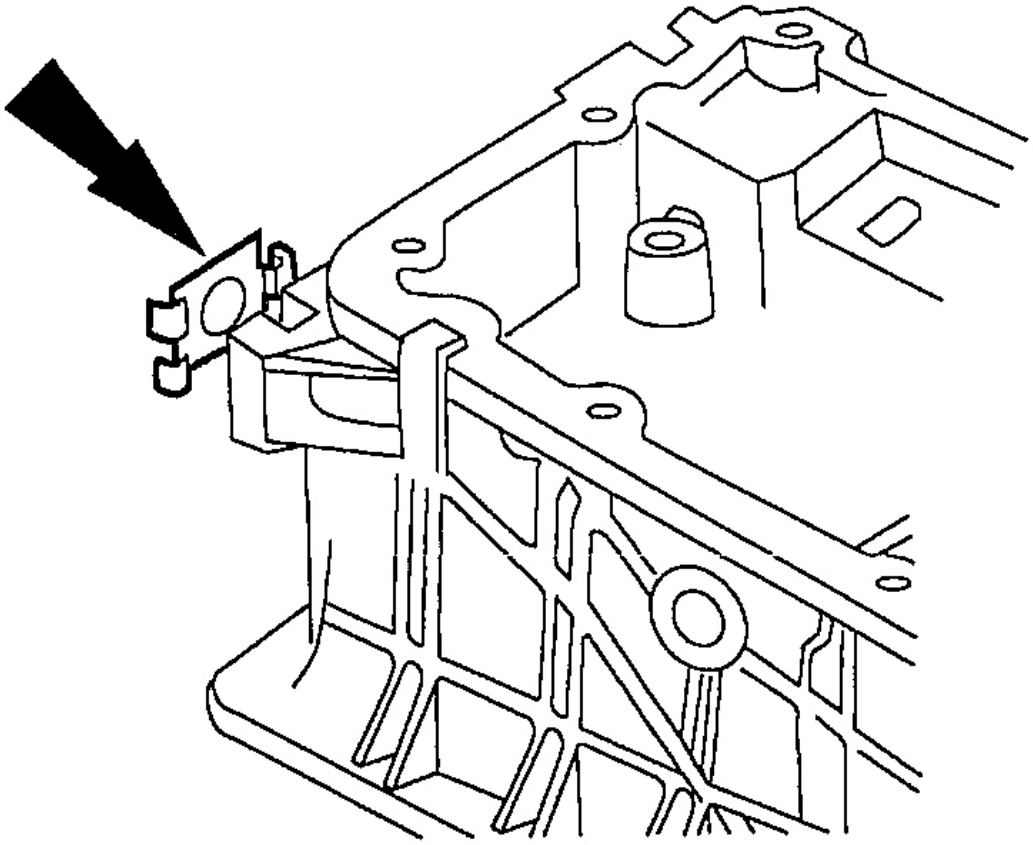


Fig. 125: Installing Shims On Sides Of Ladder Frame
Courtesy of MAZDA MOTORS CORP.

58. Install the oil pump screen cover and tube.

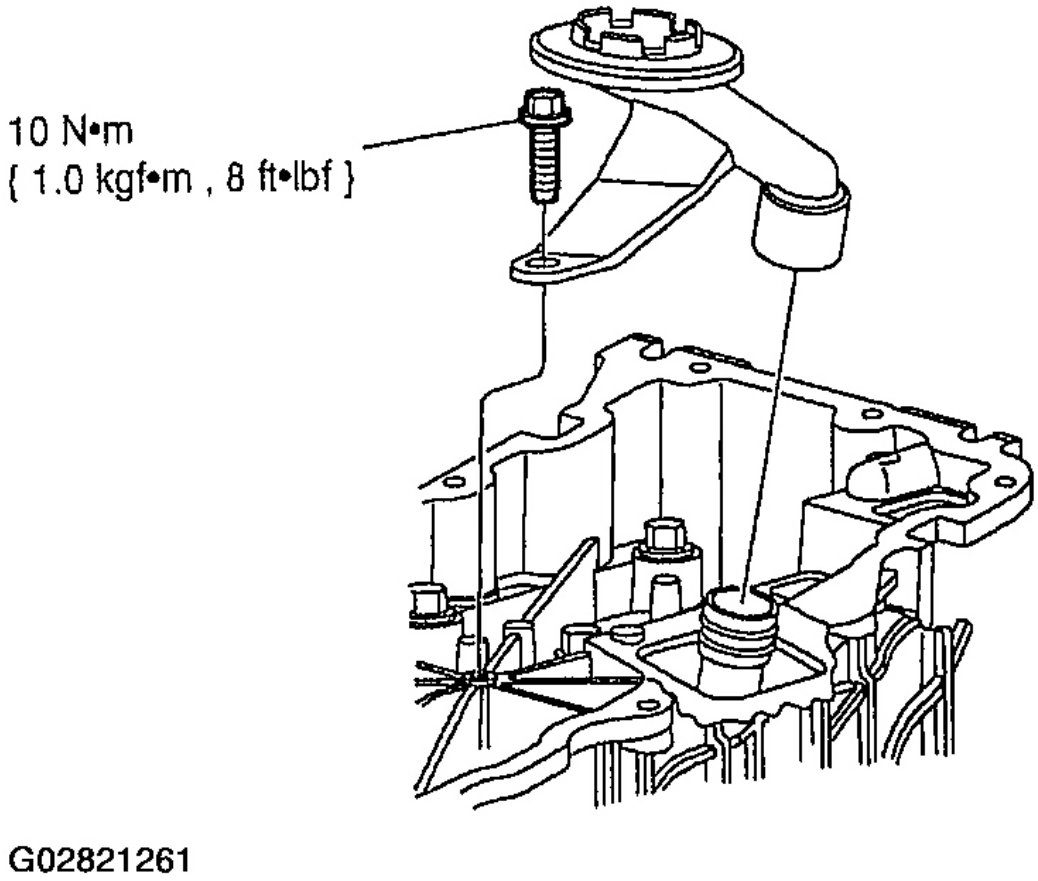


Fig. 126: Installing Oil Pump Screen Cover & Tube
Courtesy of MAZDA MOTORS CORP.

59. Install the gasket, and the oil pan. Tighten the bolts.

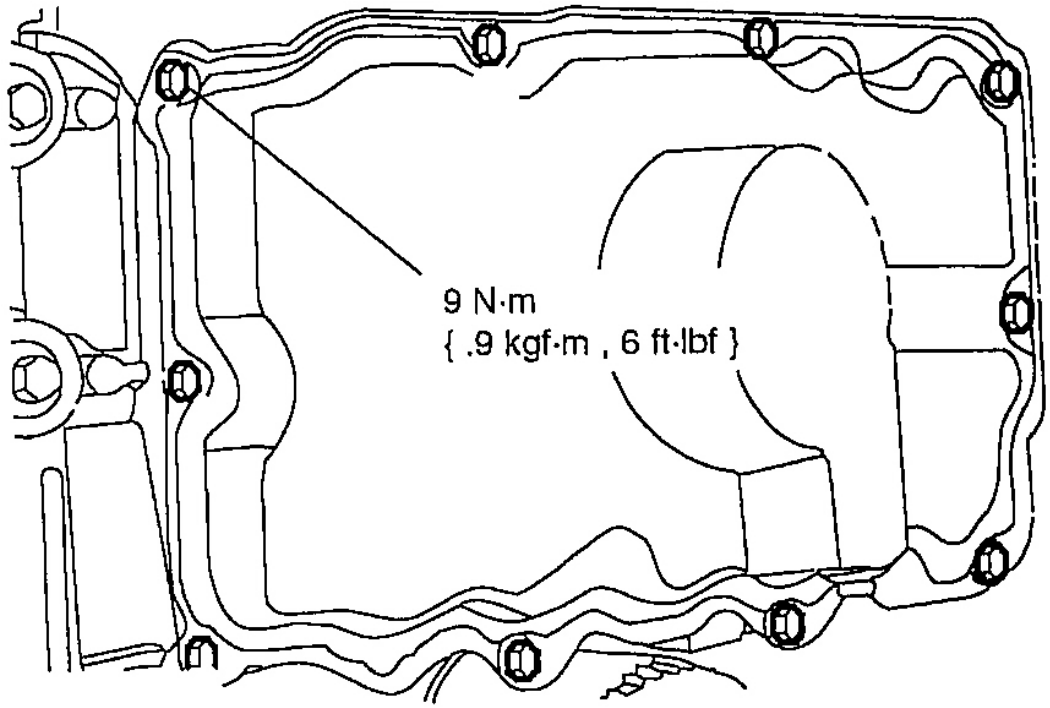


Fig. 127: Installing Oil Pan
Courtesy of MAZDA MOTORS CORP.

60. Install the oil filter adapter and tighten.

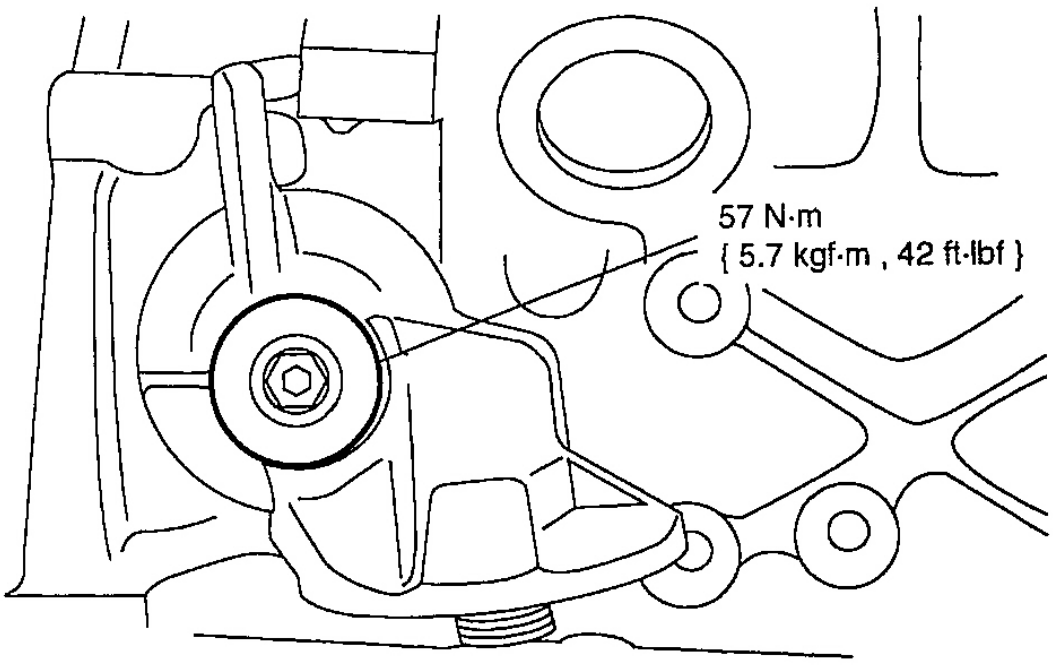


Fig. 128: Installing Oil Filter Adapter
Courtesy of MAZDA MOTORS CORP.

61. Install the oil filter and tighten.

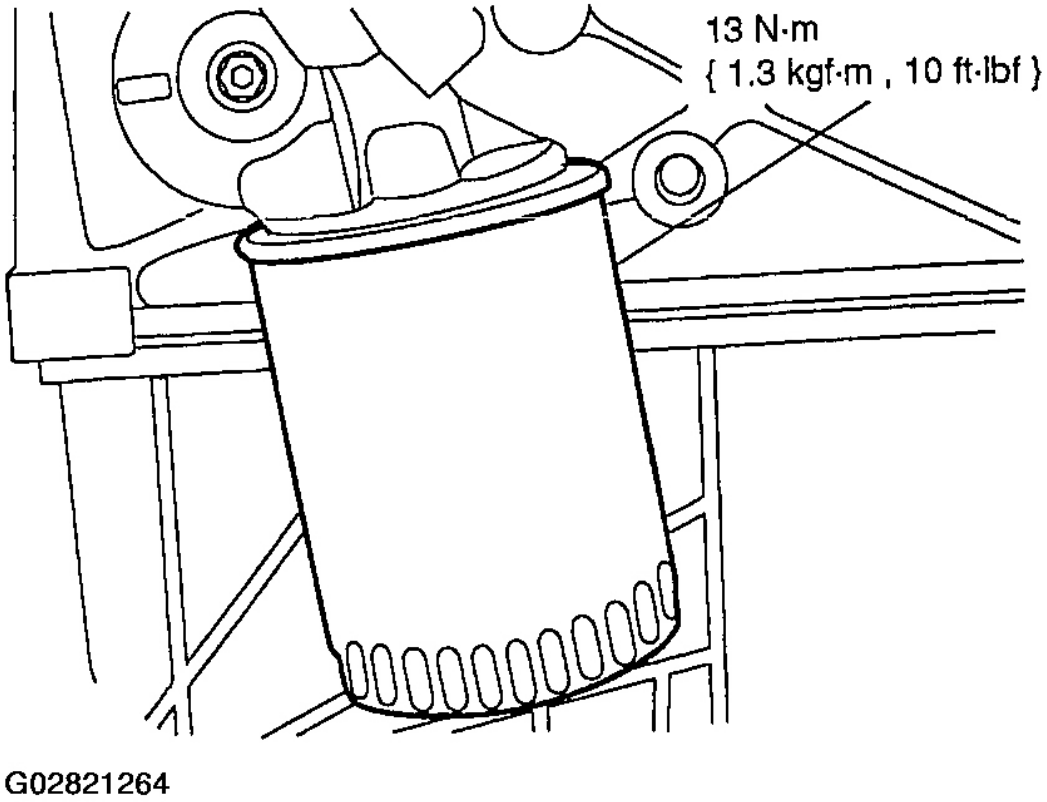


Fig. 129: Installing Oil Filter
Courtesy of MAZDA MOTORS CORP.

62. Install the water pump and tighten the bolts.

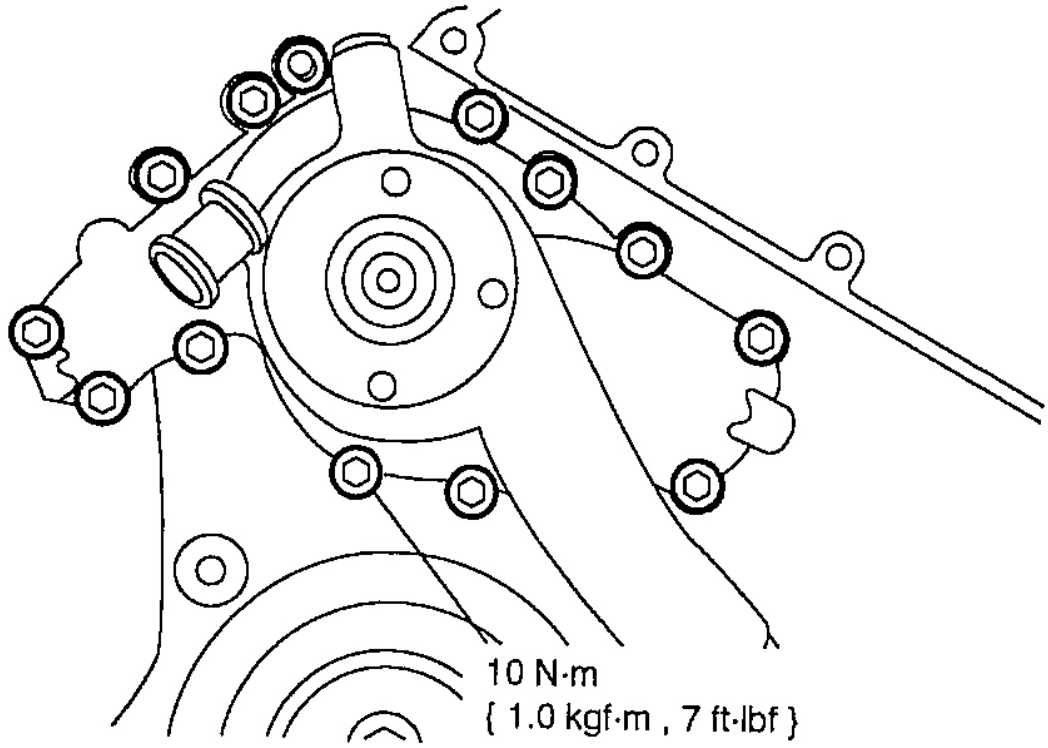
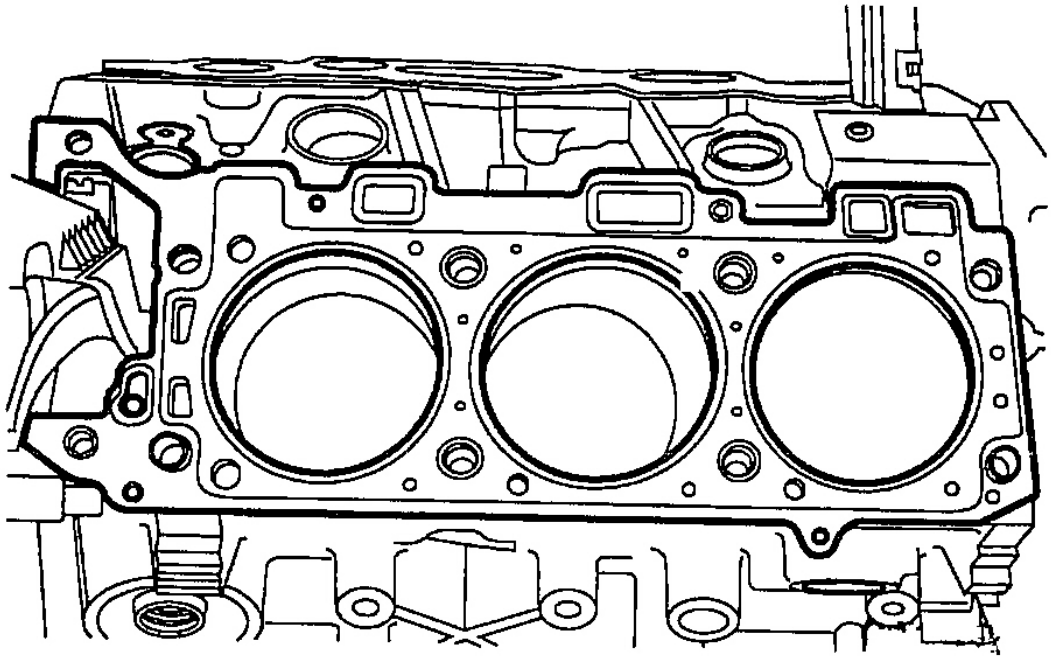


Fig. 130: Installing Water Pump
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **LH shown, RH similar.**



G02821266

Fig. 131: Installing Cylinder Head Gasket
Courtesy of MAZDA MOTORS CORP.

63. Install the cylinder head gasket.

NOTE:

- **LH shown, RH similar.**

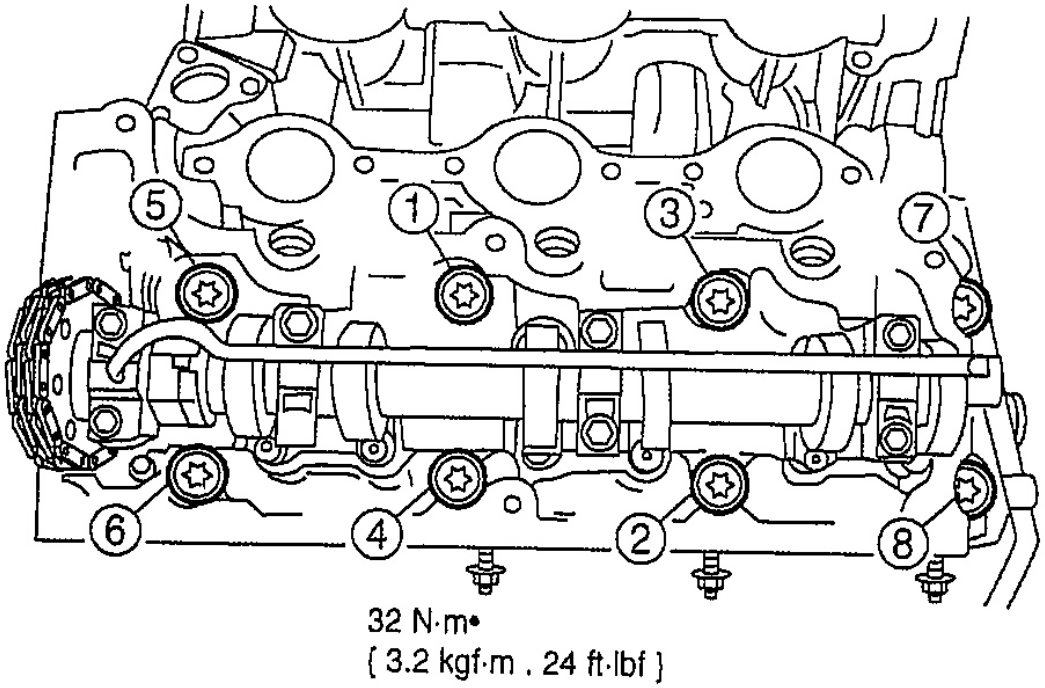


Fig. 132: Cylinder Head Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

64. Install the cylinder head and tighten the bolts in the sequence shown.

NOTE:
- **LH shown, RH similar.**

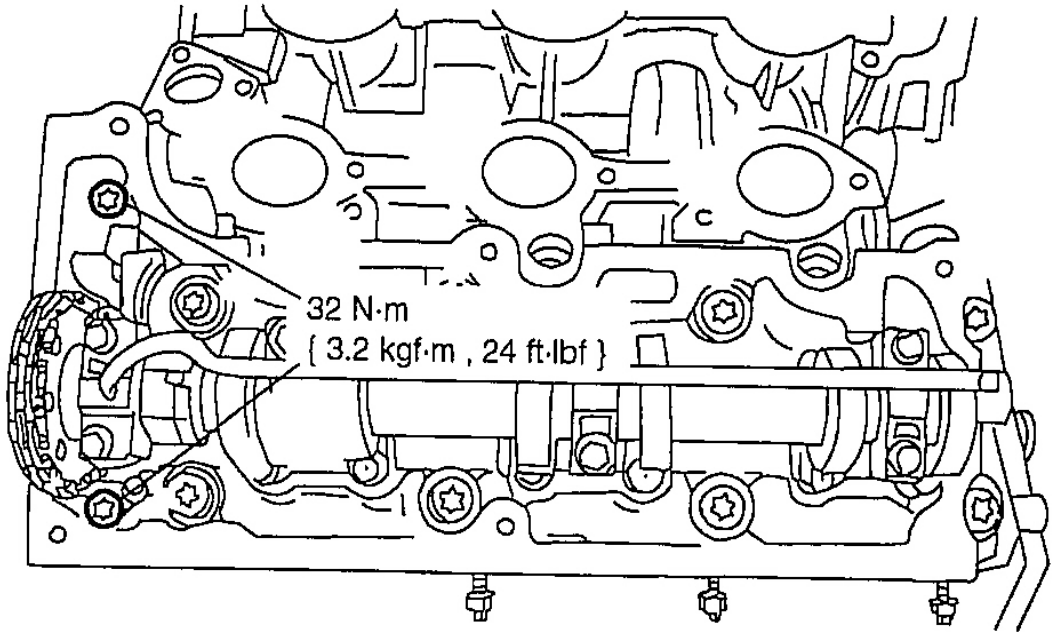
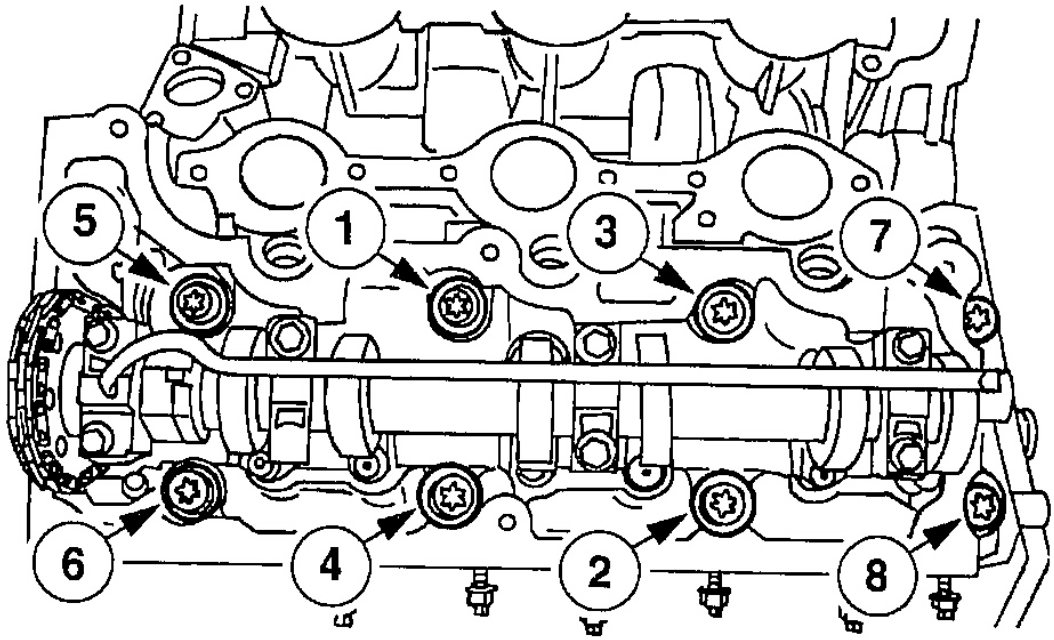


Fig. 133: Installing Two 8 mm Bolts
Courtesy of MAZDA MOTORS CORP.

65. Install the two 8 mm bolts and tighten.

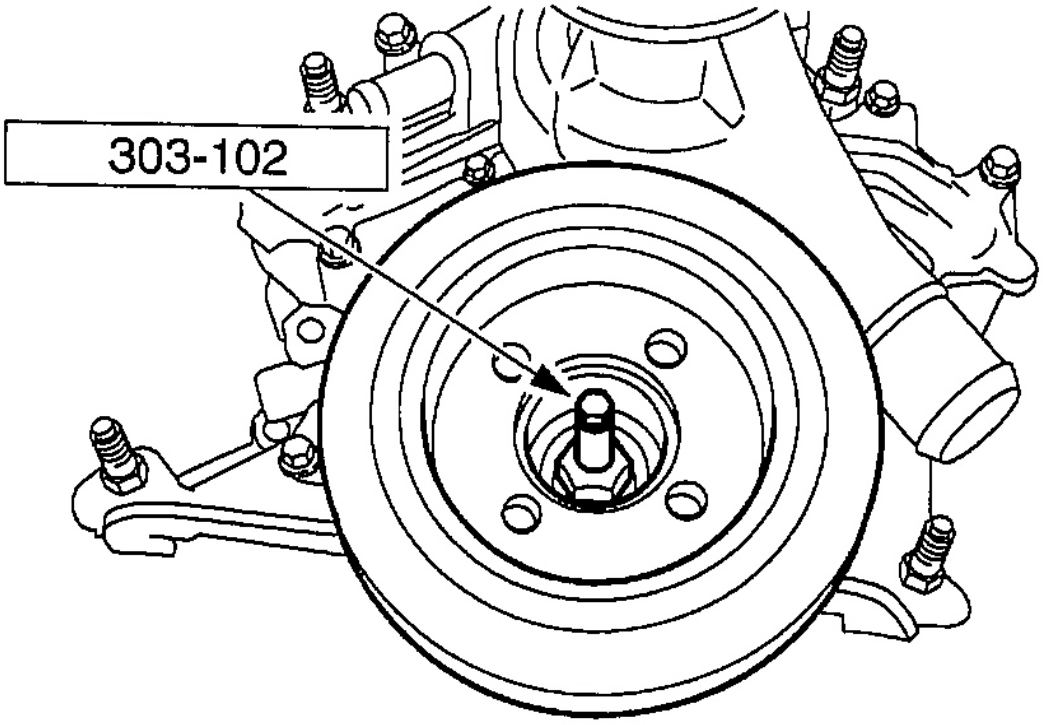
NOTE:
- **LH shown, RH similar.**



G02821269

Fig. 134: Cylinder Head Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

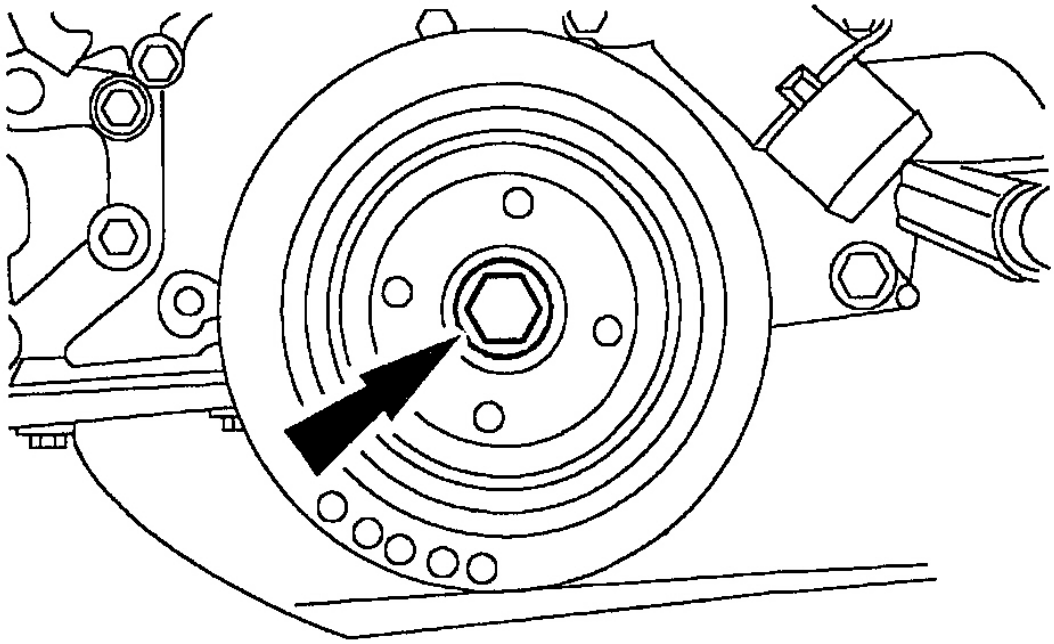
66. Tighten the cylinder head bolts in the sequence shown in two stages.
    1. Stage 1: Rotate 80 degrees.
    2. Stage 2: Rotate an additional 80 degrees.
67. Using the Crankshaft Damper Replacer SST 303-102 (or 49UN-01-0020), install the crankshaft pulley.



G02821270

Fig. 135: Installing Crankshaft Pulley
Courtesy of MAZDA MOTORS CORP.

CAUTION:
- **A new bolt must be used each time it is removed.**

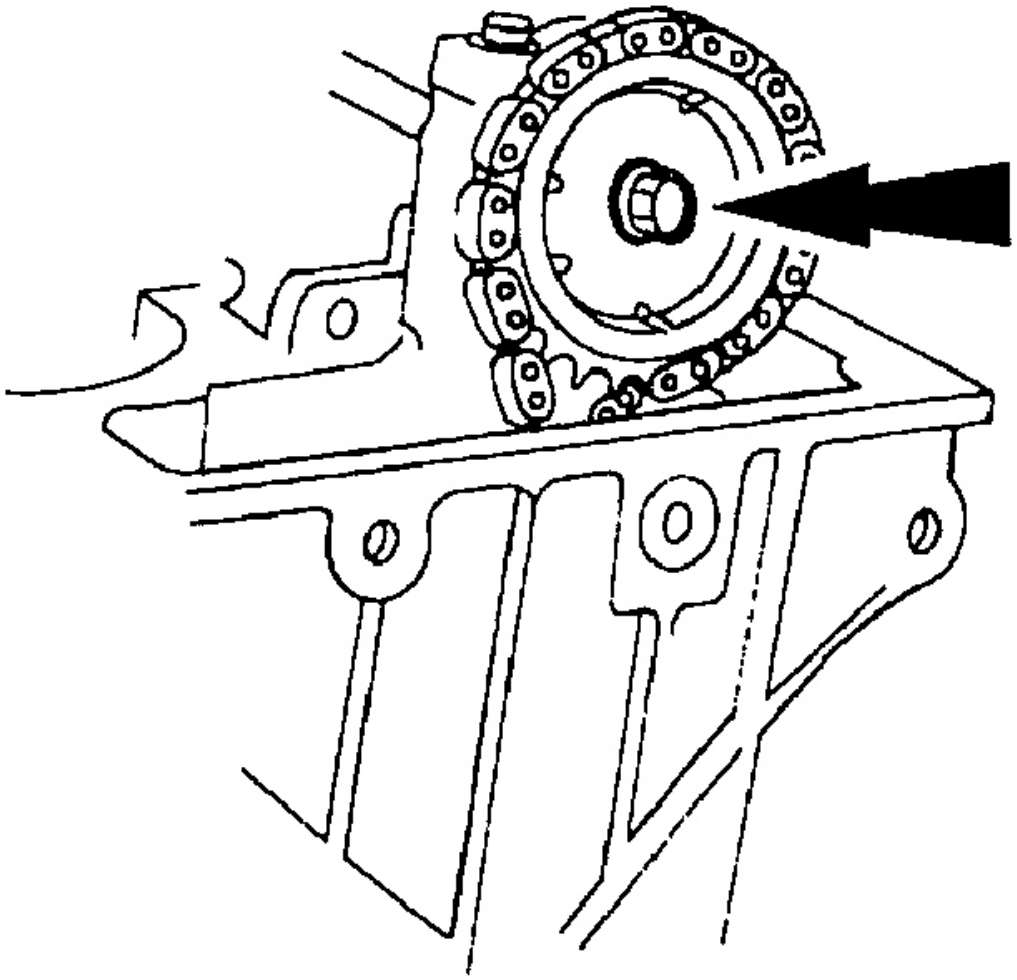


G02821271

Fig. 136: Tightening Crankshaft Pulley Bolt
Courtesy of MAZDA MOTORS CORP.

68. Tighten the bolt in two stages.
    1. Stage 1: Tighten to 50 N.m (5.0 kgf-m, 37 lb-ft).
    2. Stage 2: Rotate an additional 90 degrees.

CAUTION:
- **The camshaft sprocket must turn freely on the camshaft. DO NOT tighten the bolt.**



G02821272

Fig. 137: Installing RH Camshaft Sprocket Bolt
Courtesy of MAZDA MOTORS CORP.

69. Install the RH camshaft bolt.
70. Install the bolt and tighten.

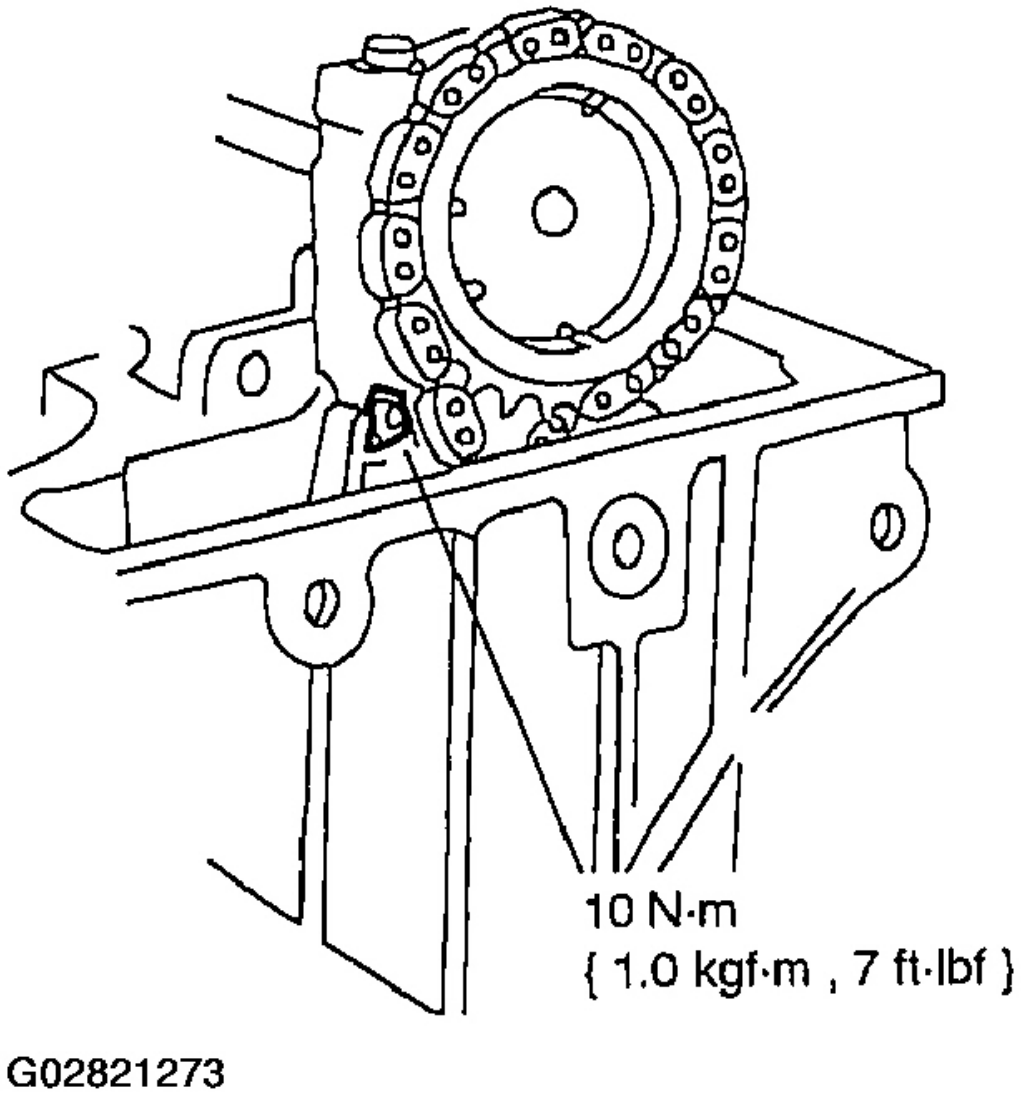


Fig. 138: Tightening RH Camshaft Sprocket Bolt
Courtesy of MAZDA MOTORS CORP.

CAUTION:
- **The camshaft sprocket must turn freely on the camshaft. DO NOT tighten the bolt.**

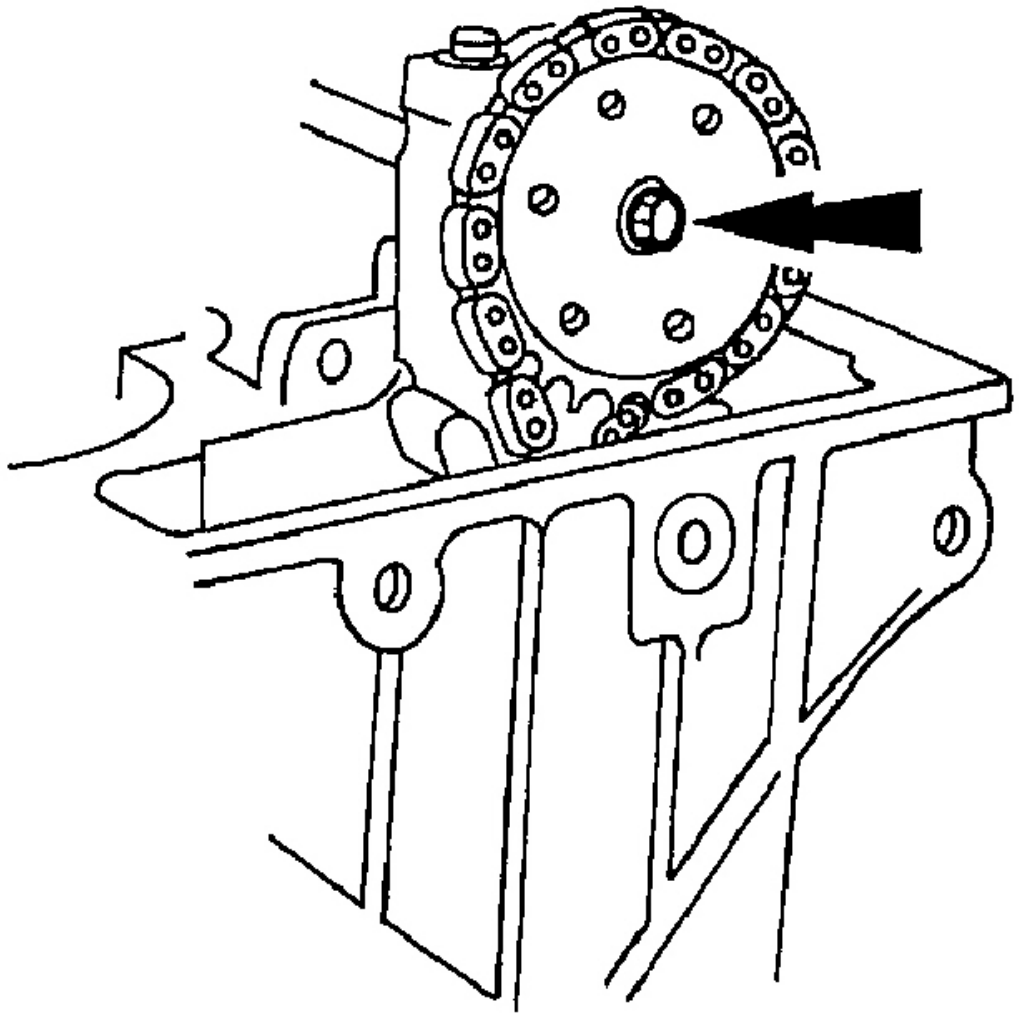


Fig. 139: Installing LH Front Camshaft Sprocket Bolt
Courtesy of MAZDA MOTORS CORP.

71. Install the LH front camshaft bolt.
72. Install the bolt and tighten.

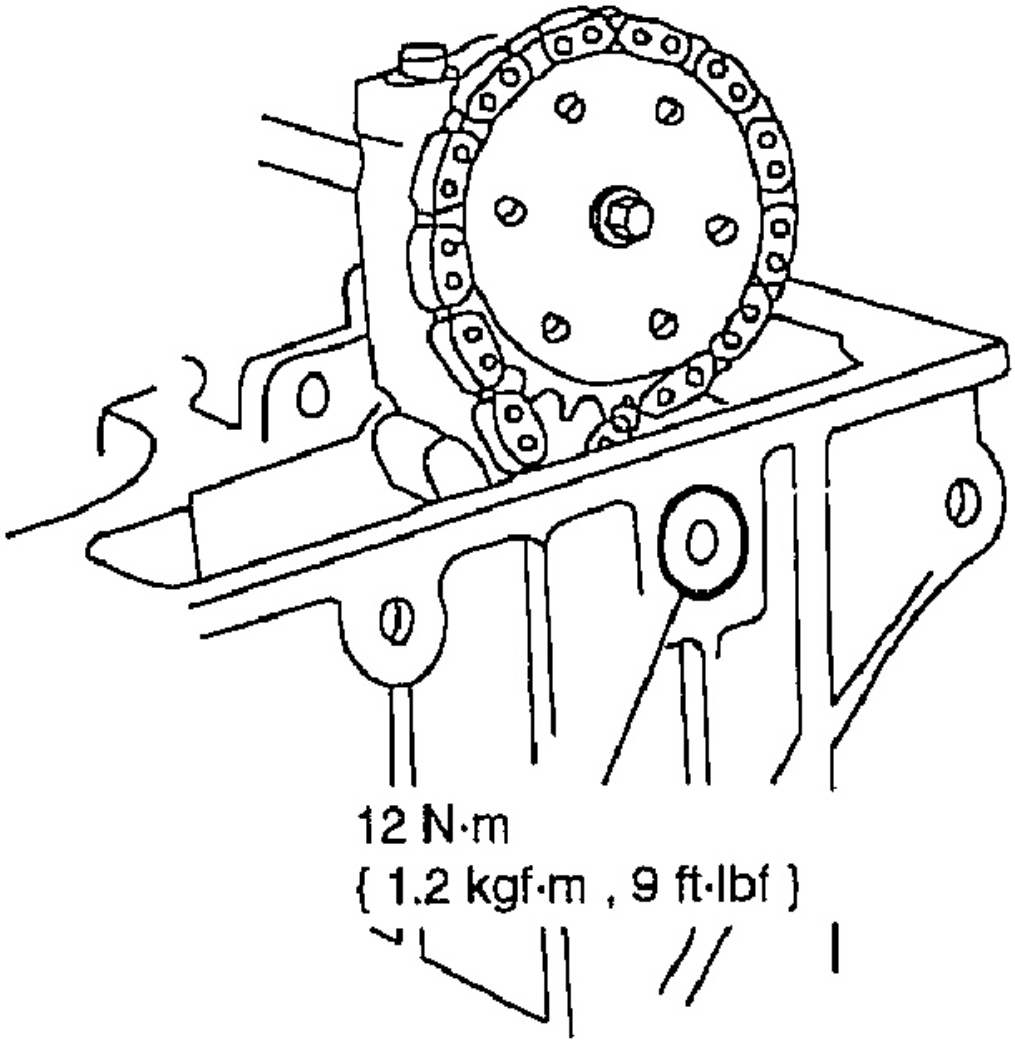


Fig. 140: Tightening LH Front Camshaft Sprocket Bolt
Courtesy of MAZDA MOTORS CORP.

73. Turn the crankshaft one revolution clockwise.

NOTE:

- **The crankshaft holding tool must be installed on the damper and should contact the engine block, this positions the engine at top dead center (TDC).**

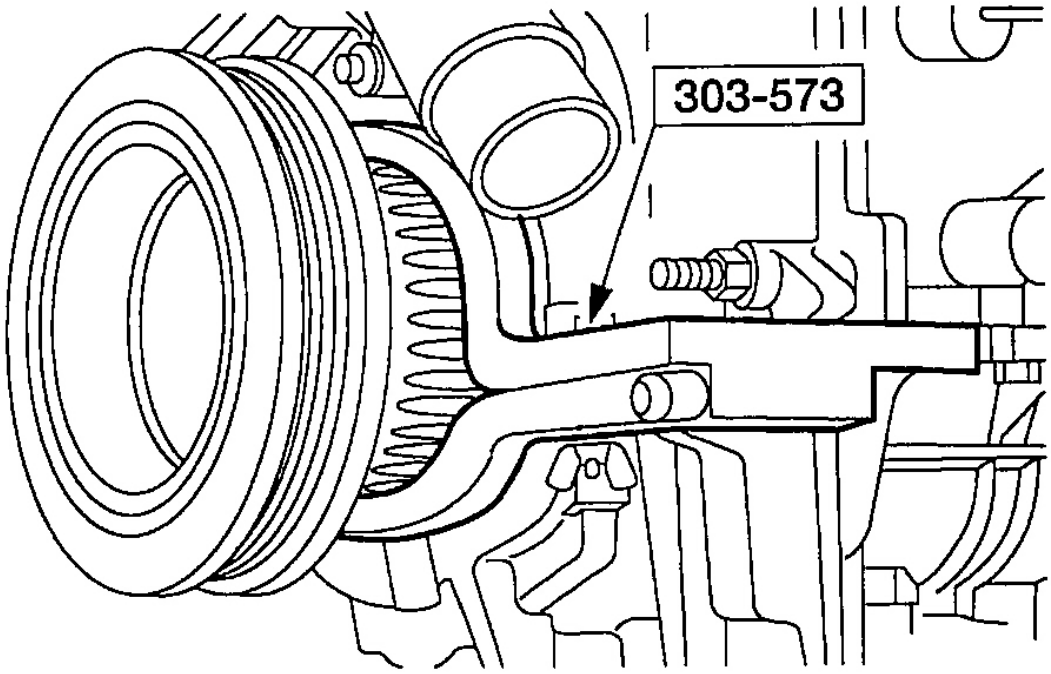
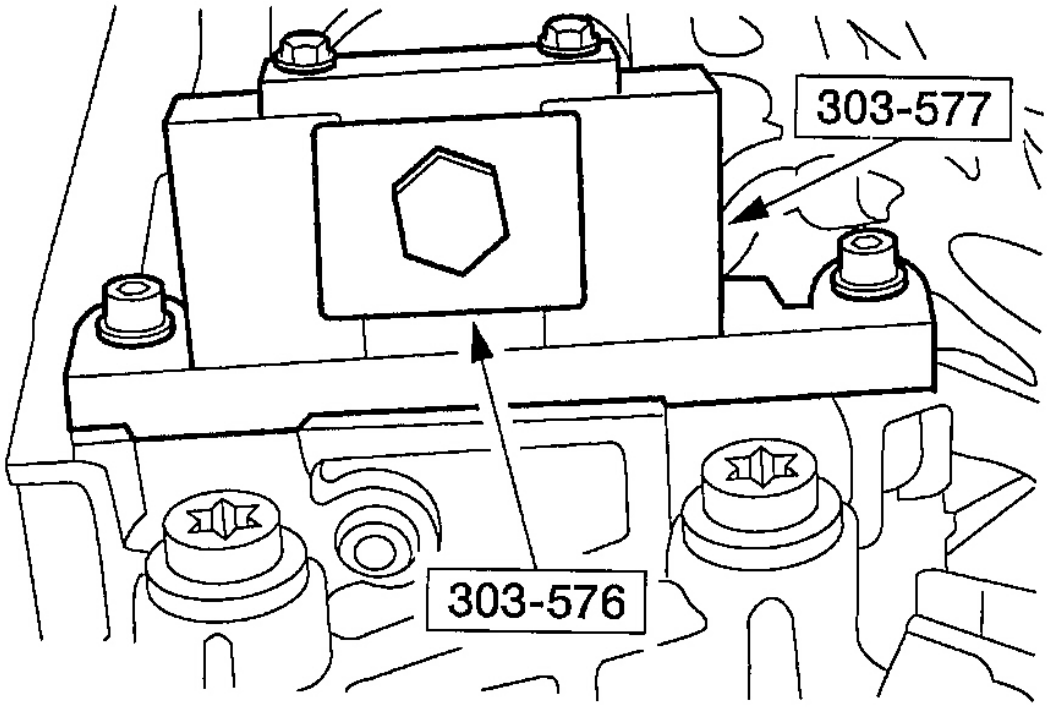


Fig. 141: Installing Crankshaft Holding Tool
Courtesy of MAZDA MOTORS CORP.

74. Install the Crankshaft Holding Tool SST 303-573.

NOTE:
- **Camshaft timing slots are off-center.**

NOTE:
- **Position the camshaft tinning slots below centerline of the camshaft to correctly fit the special tools.**



G02821277

Fig. 142: Installing Camshaft Holding Tool & Adapter
Courtesy of MAZDA MOTORS CORP.

75. Install the Camshaft Holding Tool SST 303-577 and Camshaft Holding Tool Adapter SST 303-576 on the front of the RH cylinder head.

NOTE:
- **Leave the top two special tool clamp bolts loose.**

NOTE:
- **If cam is not in the correct position, the top of SST 303-576 will not sit flush with the top of SST 303-577. Rotate the cam 180° to set correctly.**

76. Install the RH camshaft chain tensioner, but do not tighten.
77. Tighten the camshaft bolt to 85 Nm (8.5 kgfm, 63lb-ft).
78. Tighten RH camshaft tensioner.

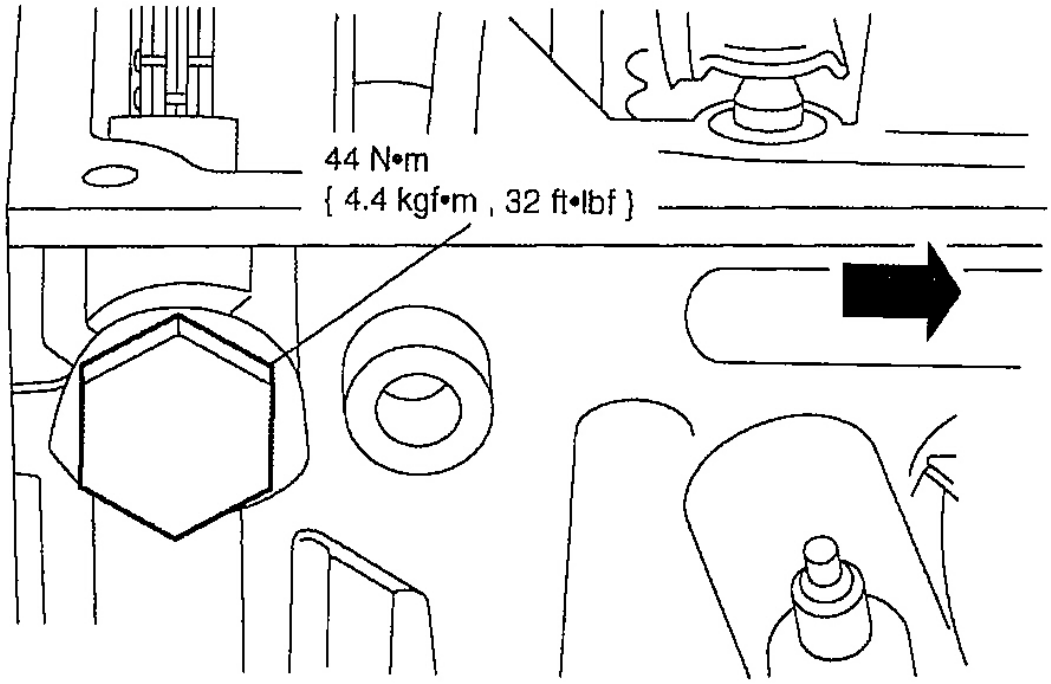


Fig. 143: Tightening RH Camshaft Tensioner
Courtesy of MAZDA MOTORS CORP.

79. Remove the special tools from the RH cylinder head.

NOTE:
- **Camshaft timing slots are off-center.**

NOTE:
- **Position the camshaft timing slots below centerline of the camshaft to correctly fit the special tools.**

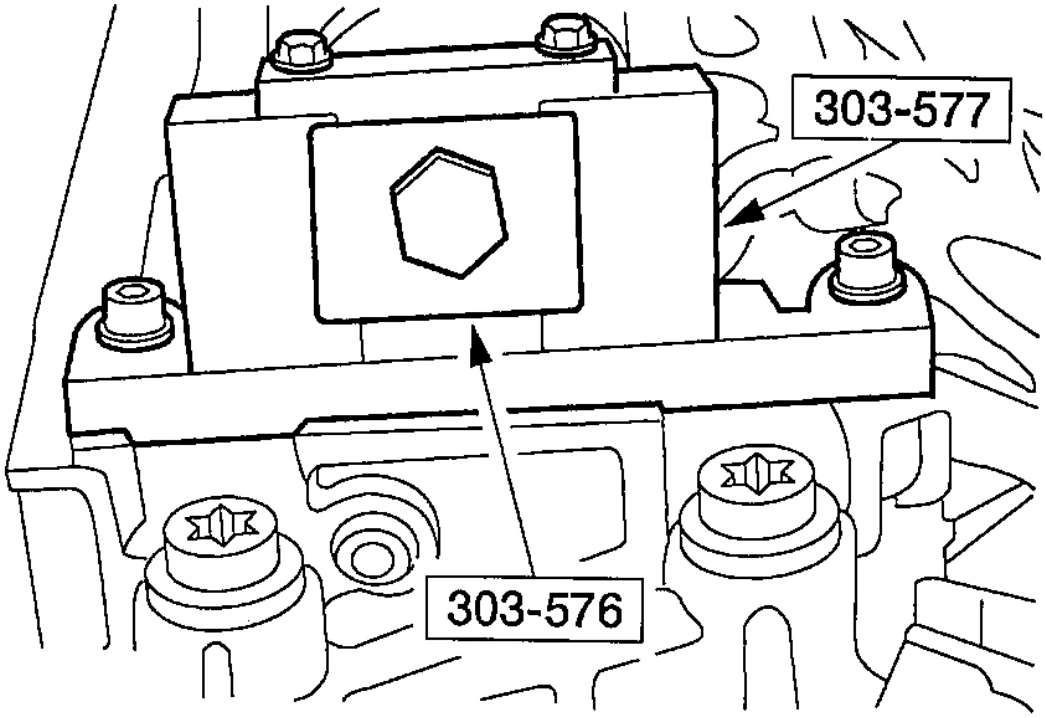


Fig. 144: Install the Camshaft Holding Tool & Adapter
Courtesy of MAZDA MOTORS CORP.

80. Install the Camshaft Holding Tool SST 303-577 and Camshaft Holding Tool Adapter SST 303-576 on the rear of the LH cylinder head.

NOTE:
- **Leave the top two special tool clamp bolts loose.**

NOTE:
- **If cam is not in the correct position, the top of SST 303-576 will not sit flush with the top of SST 303-577. Rotate the cam 180° to set correctly.**

81. Install the LH camshaft chain tensioner, but do not tighten.
82. Tighten the camshaft bolt to 85 Nm (8.5 kgf-m, 63 lb-ft).

NOTE:
- **When using a new washer, the camshaft tensioner must be tightened to 44 N.m (4.4 kgf-m, 32 lb-ft).**

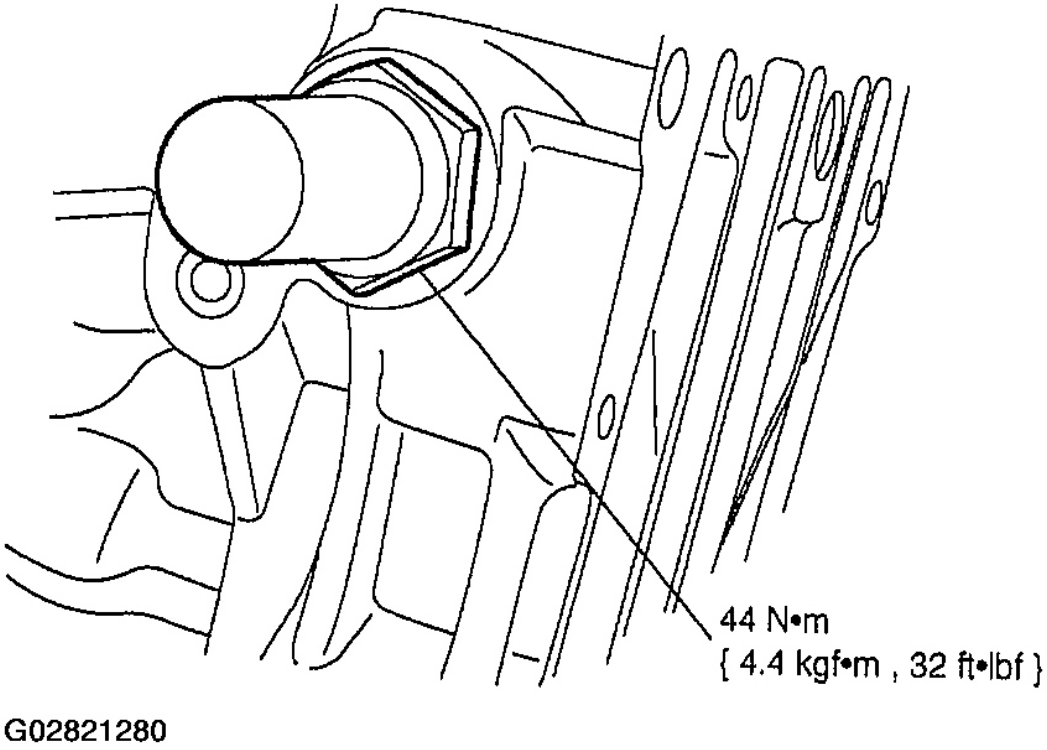
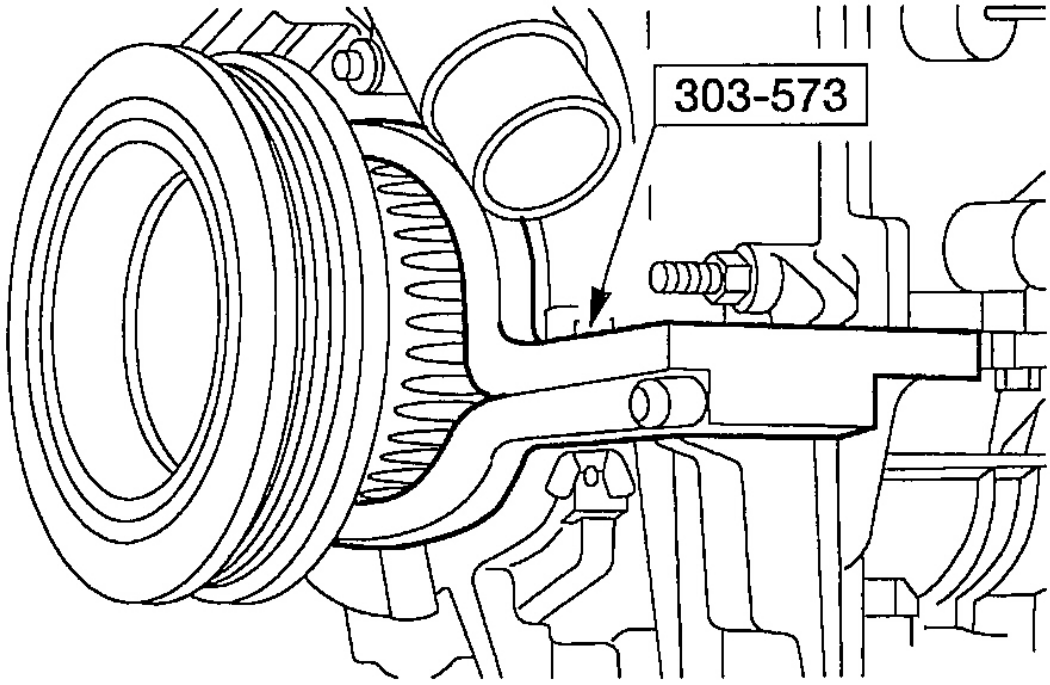


Fig. 145: Tightening LH Camshaft Tensioner
Courtesy of MAZDA MOTORS CORP.

83. Tighten the LH camshaft tensioner.
84. Remove the special tools from the LH cylinder head.
85. Remove the crankshaft holding tool.

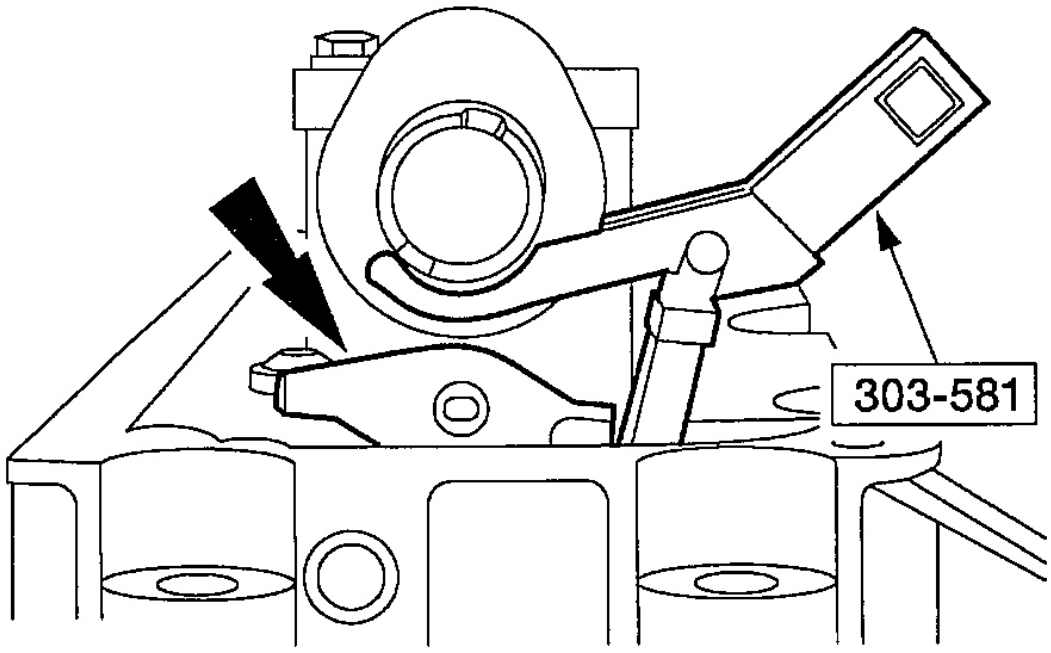


G02821281

Fig. 146: Removing Crankshaft Holding Tool
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Lubricate the parts with clean engine oil prior to installing.**



G02821282

Fig. 147: Installing Roller Followers
Courtesy of MAZDA MOTORS CORP.

86. Using the Valve Spring Compressor SST 303-581, install the roller followers in their original position.
87. Install the gasket and the RH exhaust manifold. Tighten the bolts.

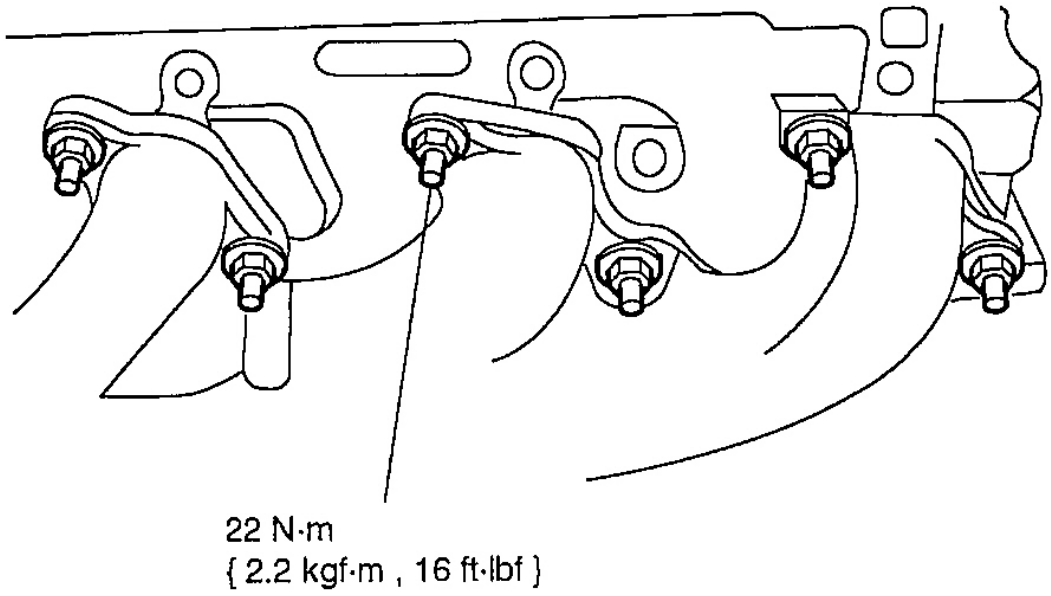


Fig. 148: Installing RH Exhaust Manifold
Courtesy of MAZDA MOTORS CORP.

88. Install the gasket and the LH exhaust manifold. Tighten the bolts.

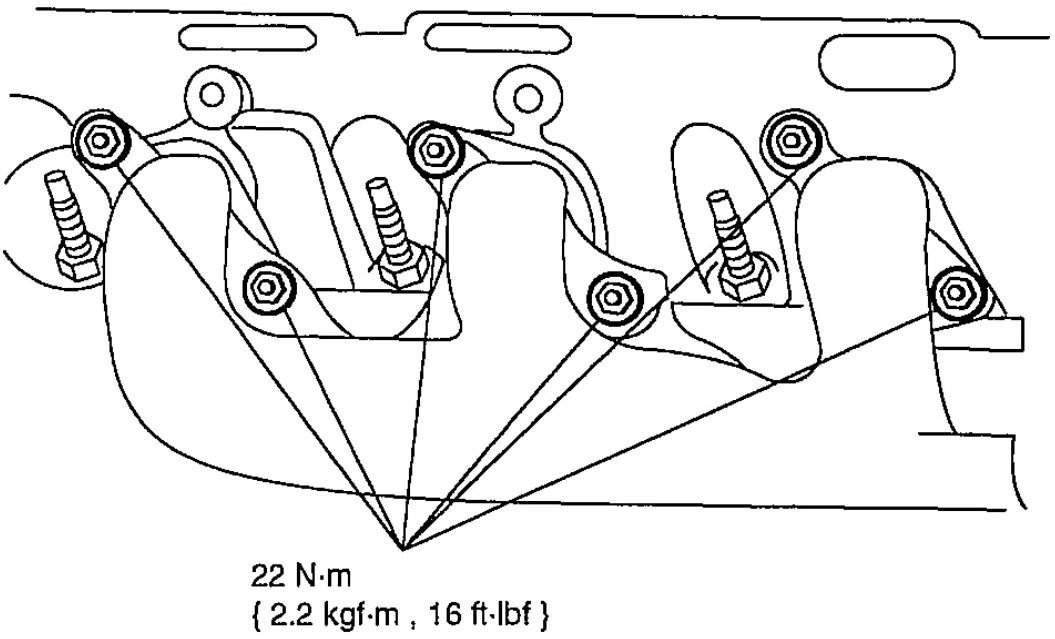


Fig. 149: Installing LH Exhaust Manifold
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Prior to installation, use Metal Surface Cleaner to clean mating surfaces.**

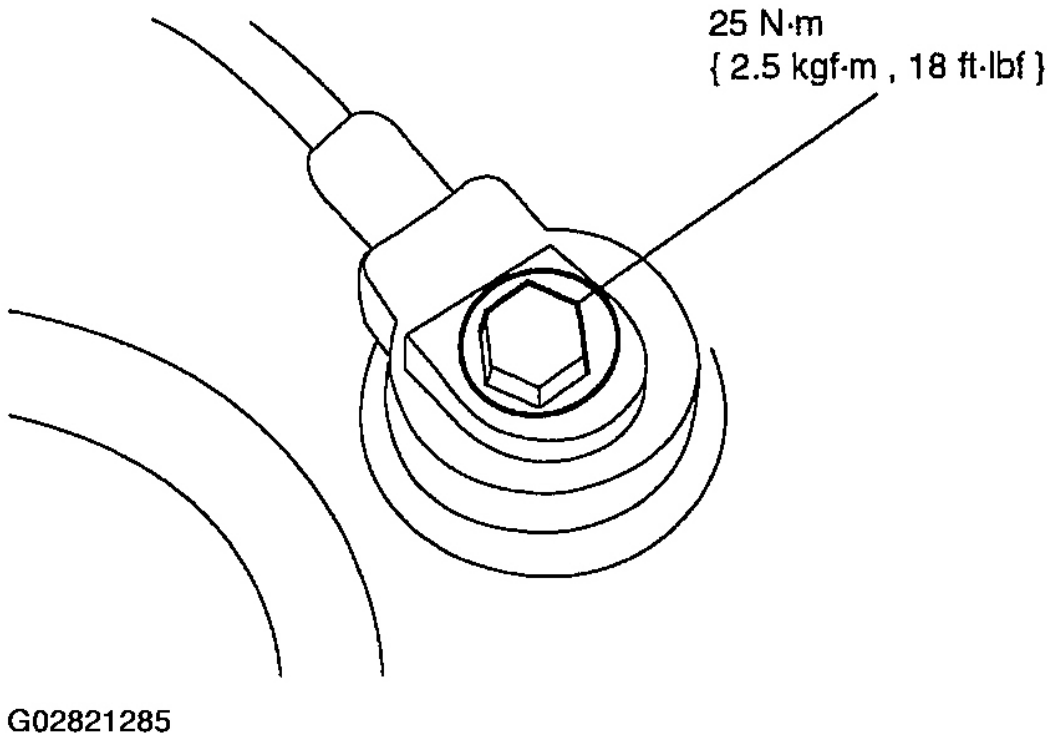


Fig. 150: Installing Knock Sensor
Courtesy of MAZDA MOTORS CORP.

89. Install the knock sensor and tighten the bolt.
90. Install the oil level indicator tube.

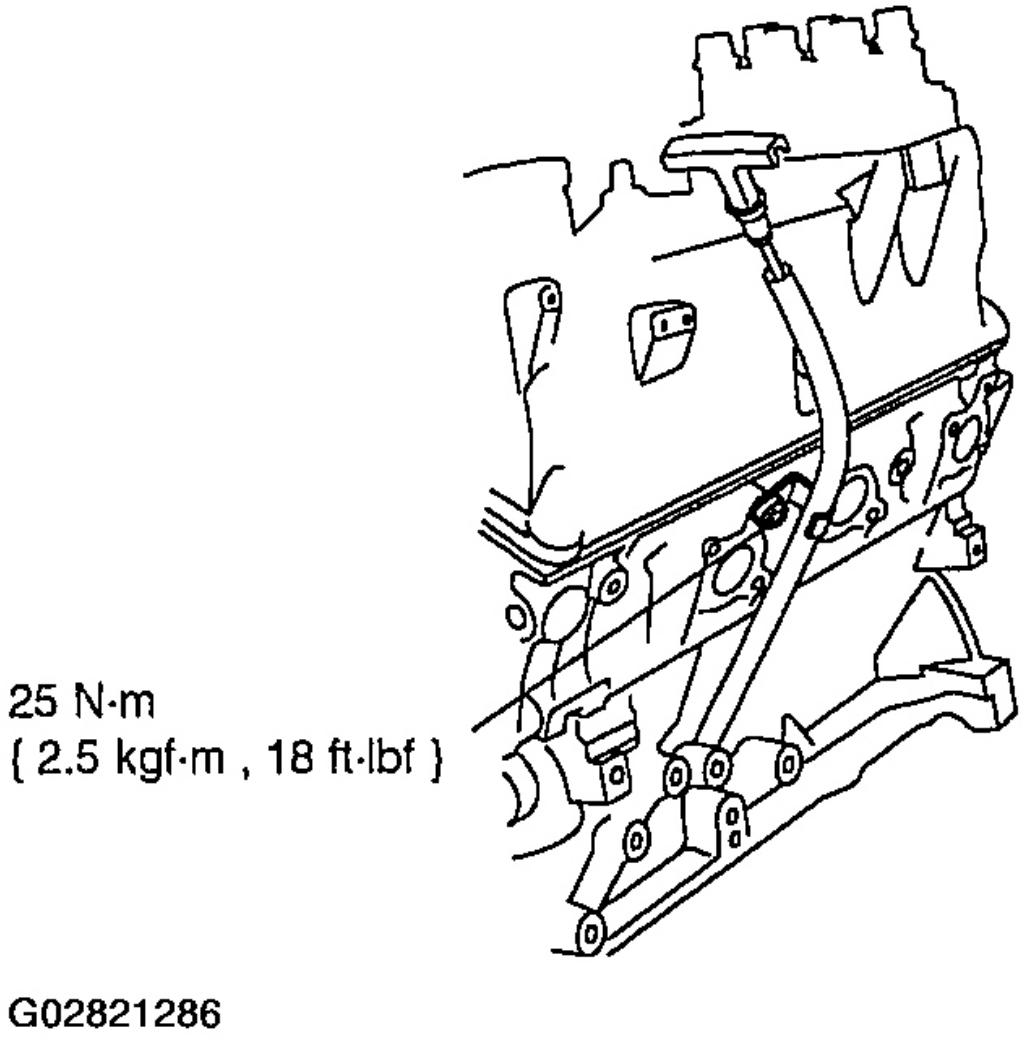


Fig. 151: Installing Oil Level Indicator Tube
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **If the oil level indicator tube is not installed flush with the cylinder block, false readings of the oil level may occur.**

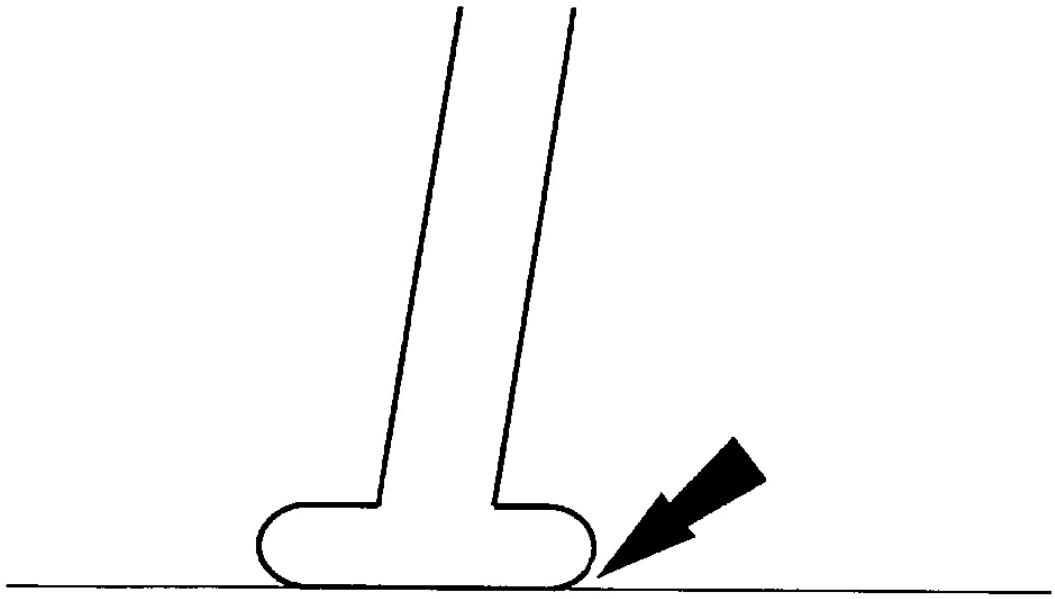


Fig. 152: Identifying Oil Level Indicator Tube Flush With Cylinder Block
Courtesy of MAZDA MOTORS CORP.

91. Make sure the oil level indicator tube is flush with the cylinder block.
92. Install the thermostat housing.
    1. Install the housing into the bypass hose.
    2. Install the bolts and tighten.
    3. Position the bypass hose clamp.

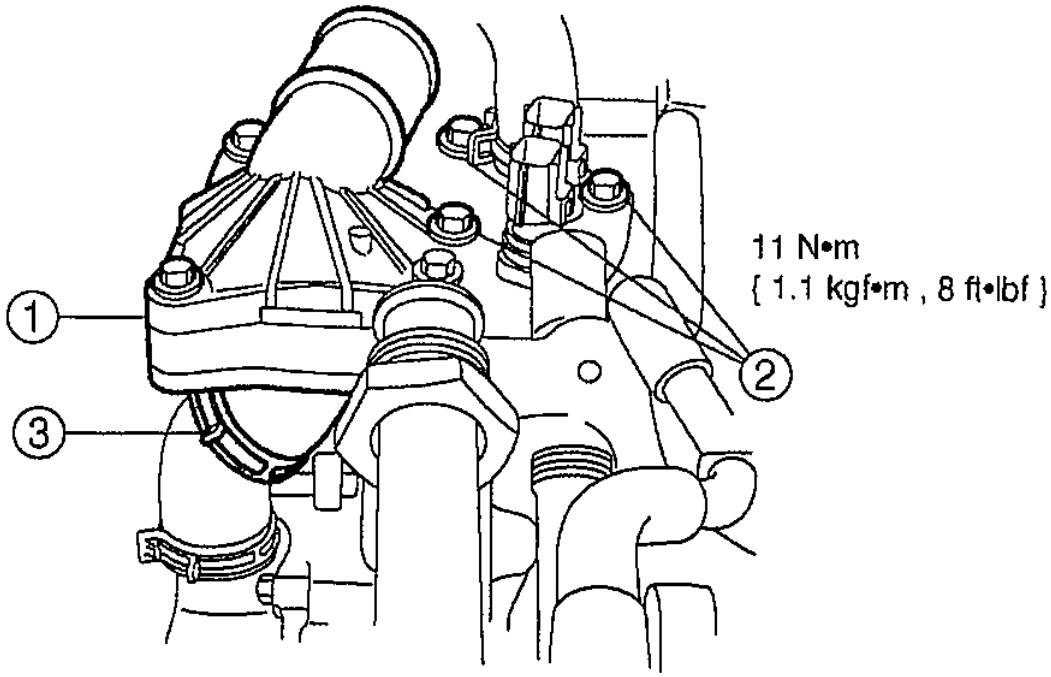


Fig. 153: Installing Thermostat Housing
Courtesy of MAZDA MOTORS CORP.

93. Install the fuel injectors.
    1. Lubricate the fuel injector O-ring seals with engine oil.

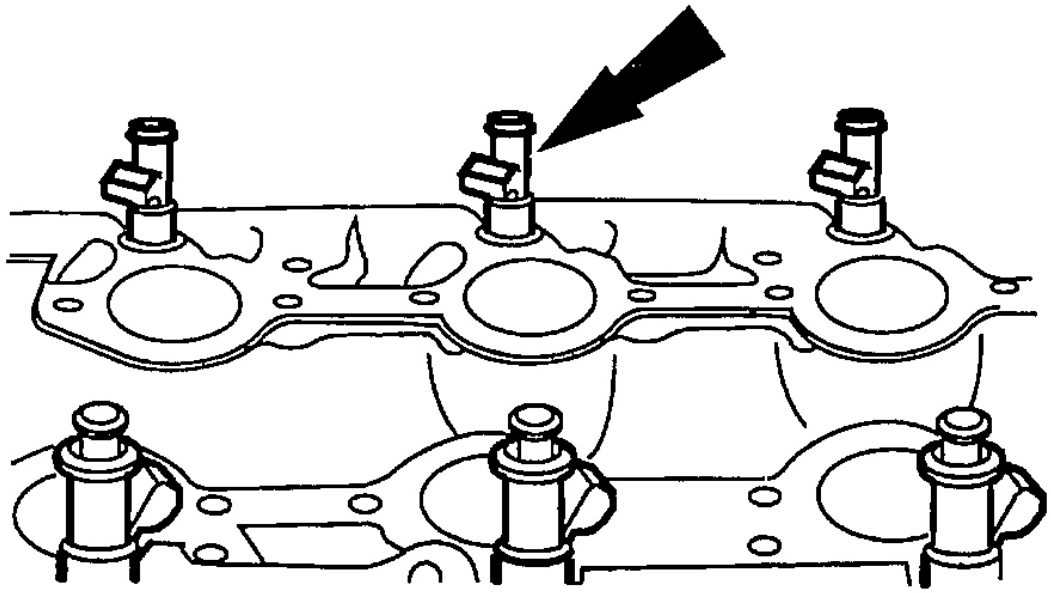


Fig. 154: Installing Fuel Injectors
Courtesy of MAZDA MOTORS CORP.

94. Install the gasket and the RH valve cover and tighten the bolts.

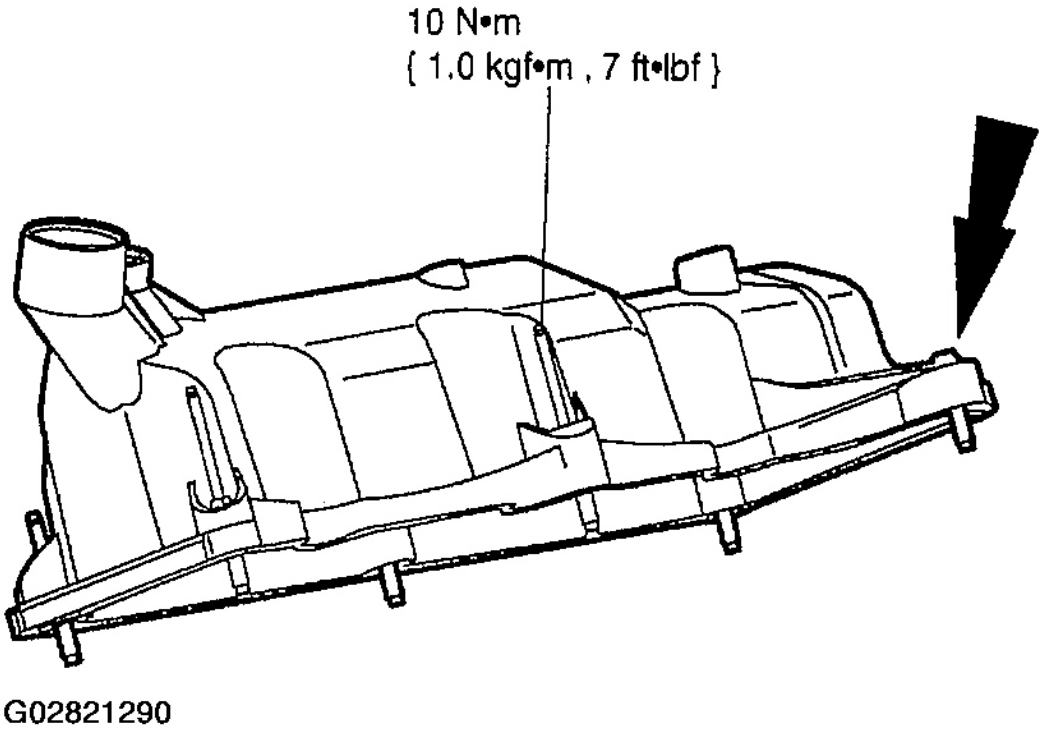


Fig. 155: Installing RH Valve Cover
Courtesy of MAZDA MOTORS CORP.

95. Install the gasket and the LH valve cover and tighten the bolts.

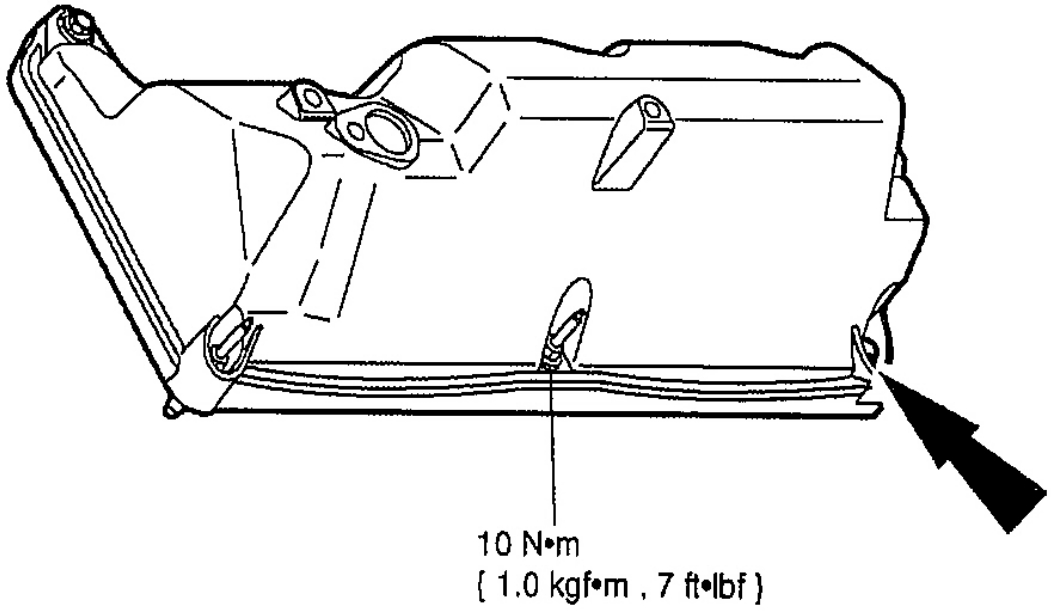


Fig. 156: Installing LH Valve Cover
Courtesy of MAZDA MOTORS CORP.

96. Install the fuel rail and tighten the bolts.

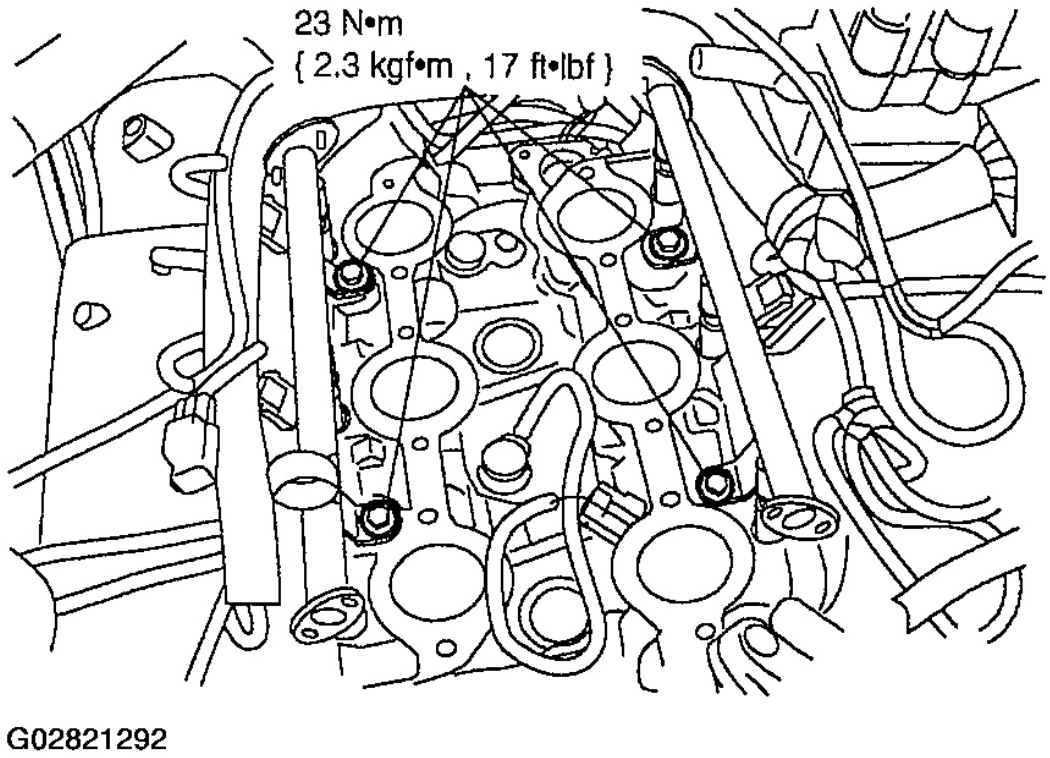


Fig. 157: Installing Fuel Rail
Courtesy of MAZDA MOTORS CORP.

97. Install the lower fuel line bracket and tighten the bolt.

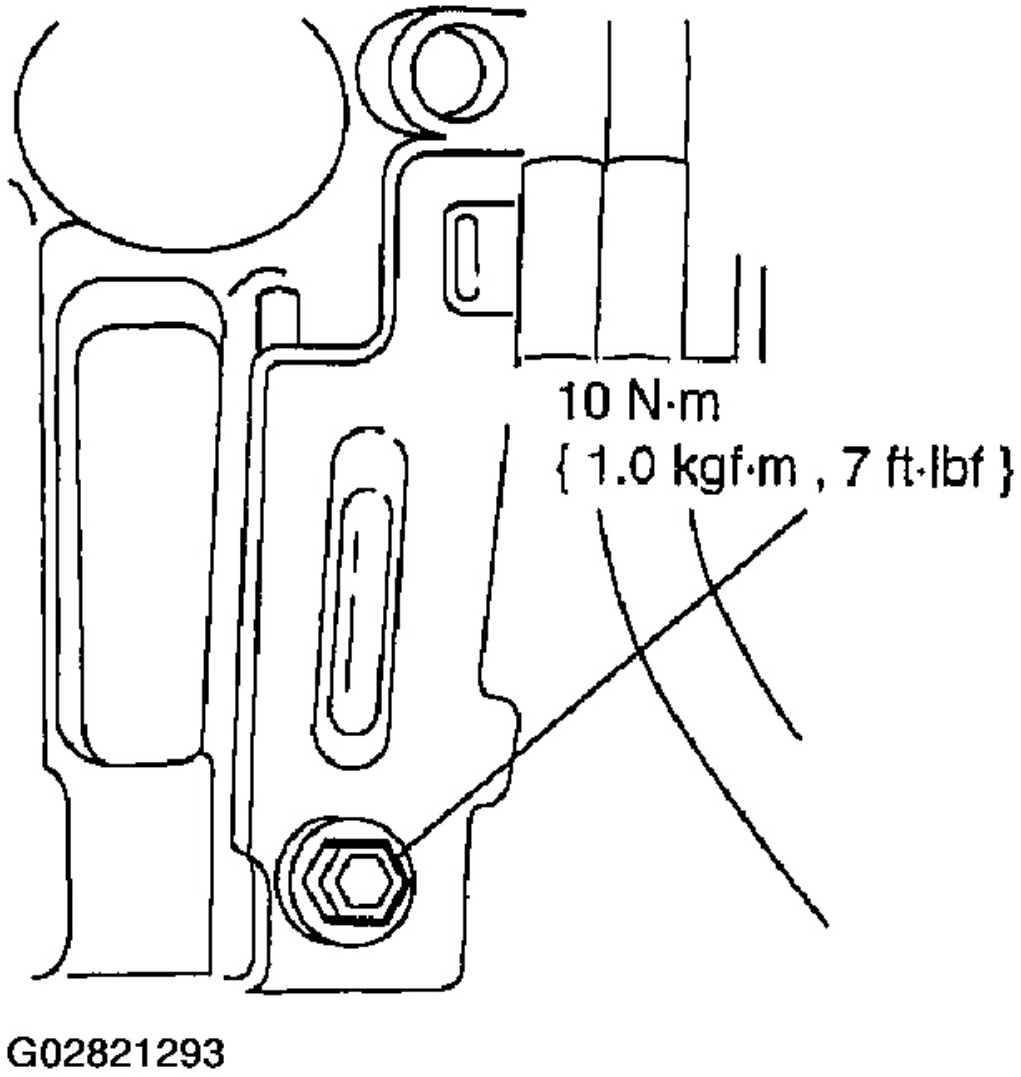


Fig. 158: Installing Lower Fuel Line Bracket
Courtesy of MAZDA MOTORS CORP.

98. Connect the EGR valve-to-the exhaust manifold tube to the exhaust manifold and tighten.

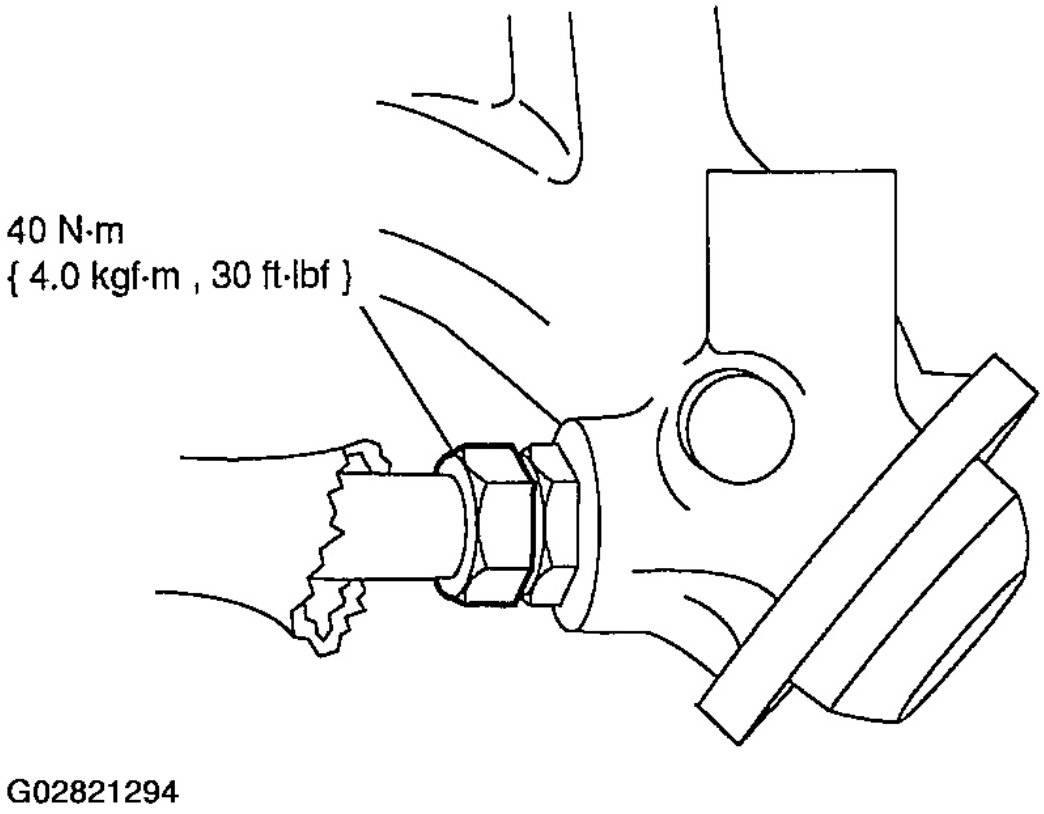
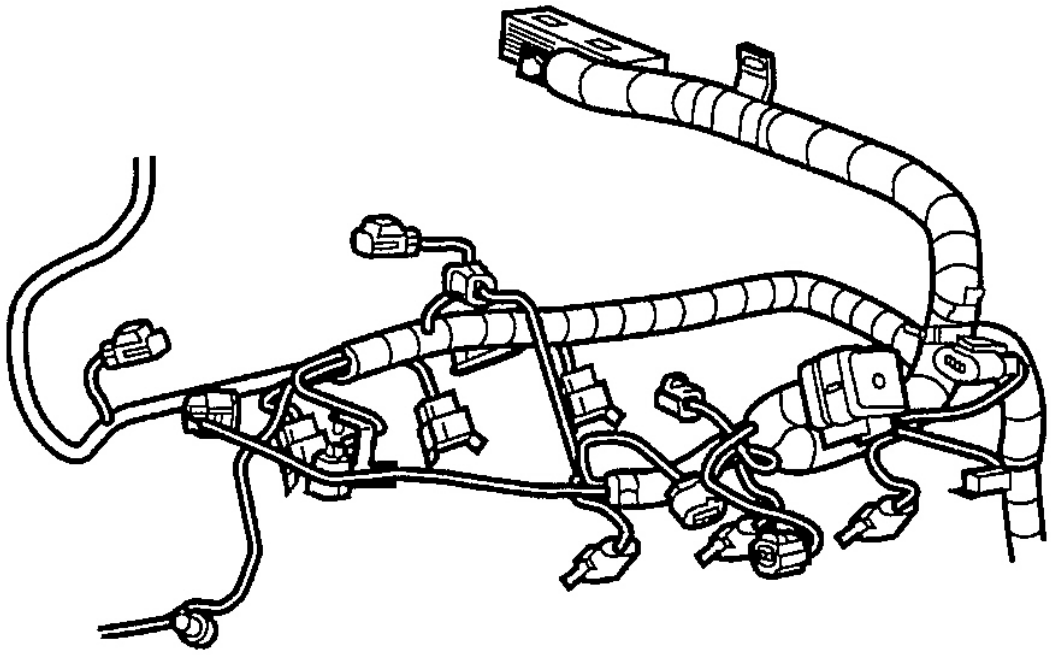


Fig. 159: Connecting EGR Valve Exhaust Manifold Tube
Courtesy of MAZDA MOTORS CORP.

99. Connect the EGR valve-to-exhaust manifold tube to the EGR valve and tighten to 34 N.m {3.4 kgf-m, 25 lb-ft}.
100. Install the fuel charging wiring.



G02821295

Fig. 160: Installing Fuel Charging Wiring
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **LH shown, RH similar.**

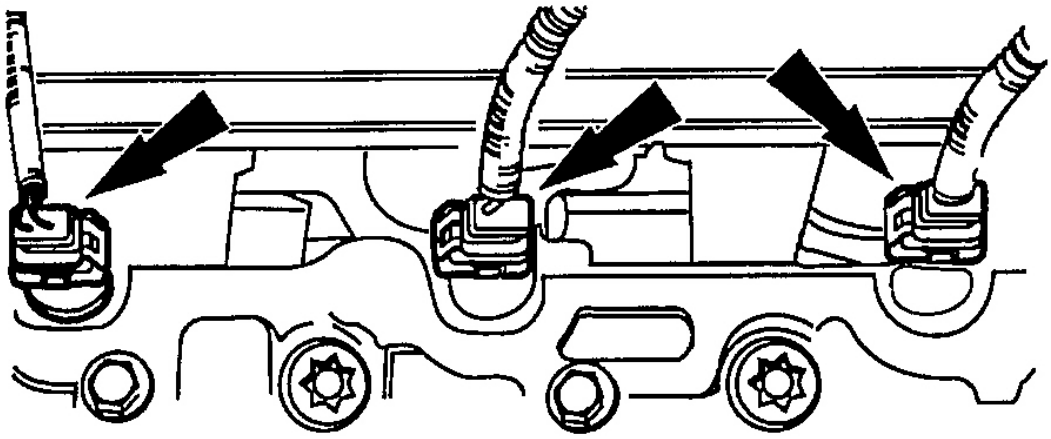
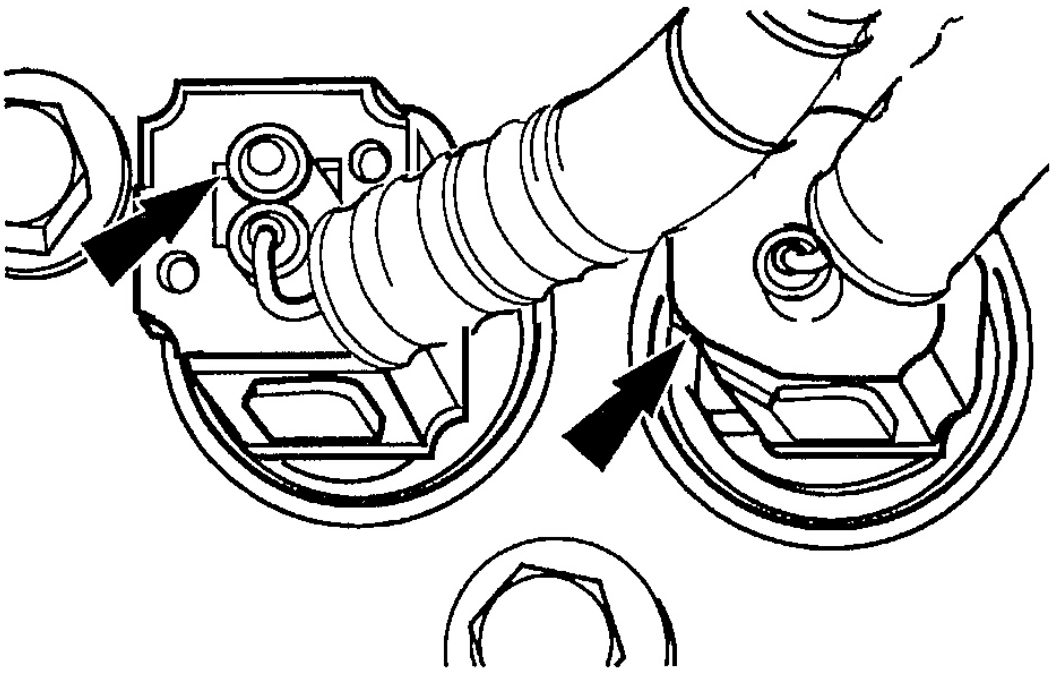


Fig. 161: Connecting Fuel Injector Electrical Connectors
Courtesy of MAZDA MOTORS CORP.

101. Connect the six fuel injector electrical connectors.
102. Connect the water temperature sender unit and the Engine Coolant Temperature (ECT) sensor electrical connectors.



G02821297

Fig. 162: Connecting Water Temperature Sender Unit & ECT Sensor Electrical Connectors
Courtesy of MAZDA MOTORS CORP.

103. Connect the Crankshaft Position (CKP) sensor electrical connector.

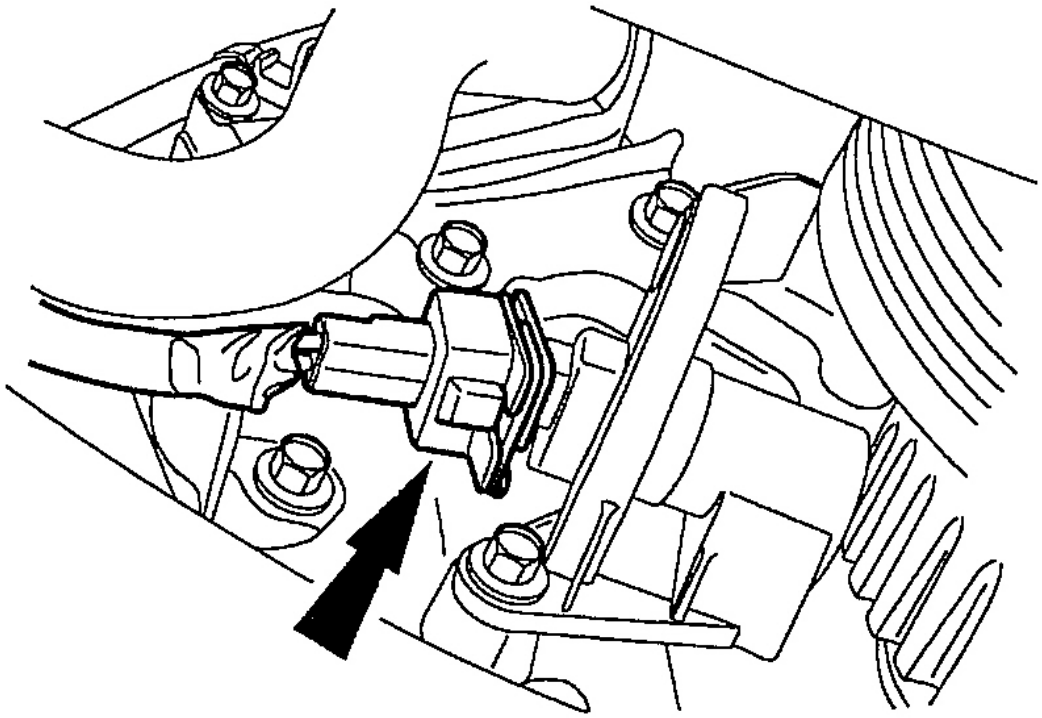


Fig. 163: Connecting CKP Sensor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

104. Connect the differential pressure feedback EGR transducer.

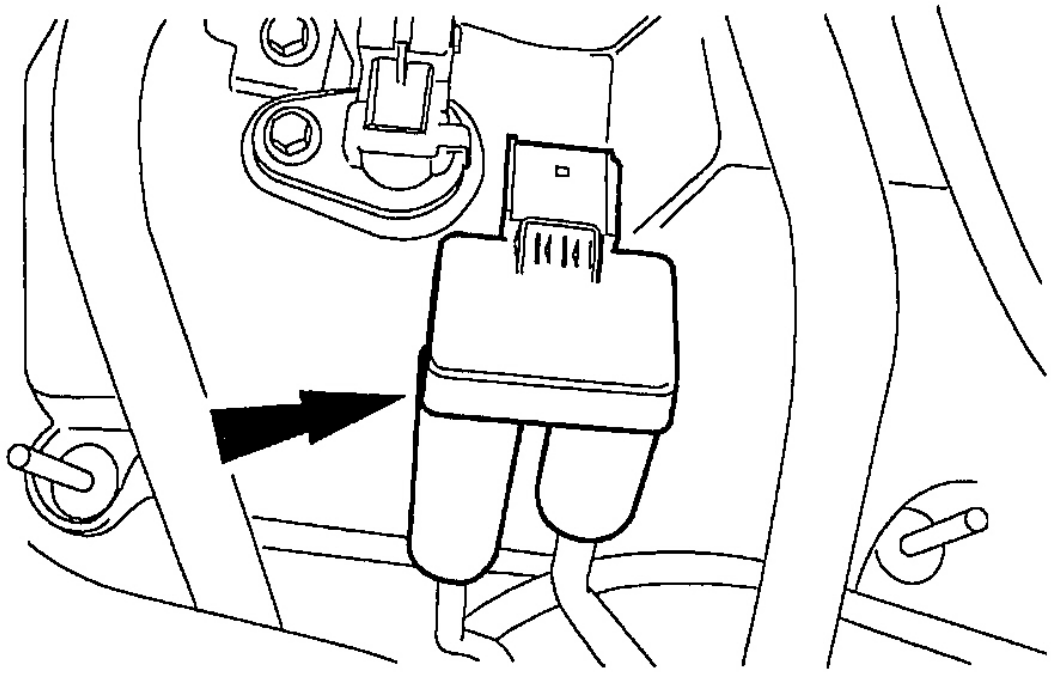


Fig. 164: Connecting Differential Pressure Feedback EGR Transducer
Courtesy of MAZDA MOTORS CORP.

105. Connect the Camshaft Position (CMP) sensor electrical connector.

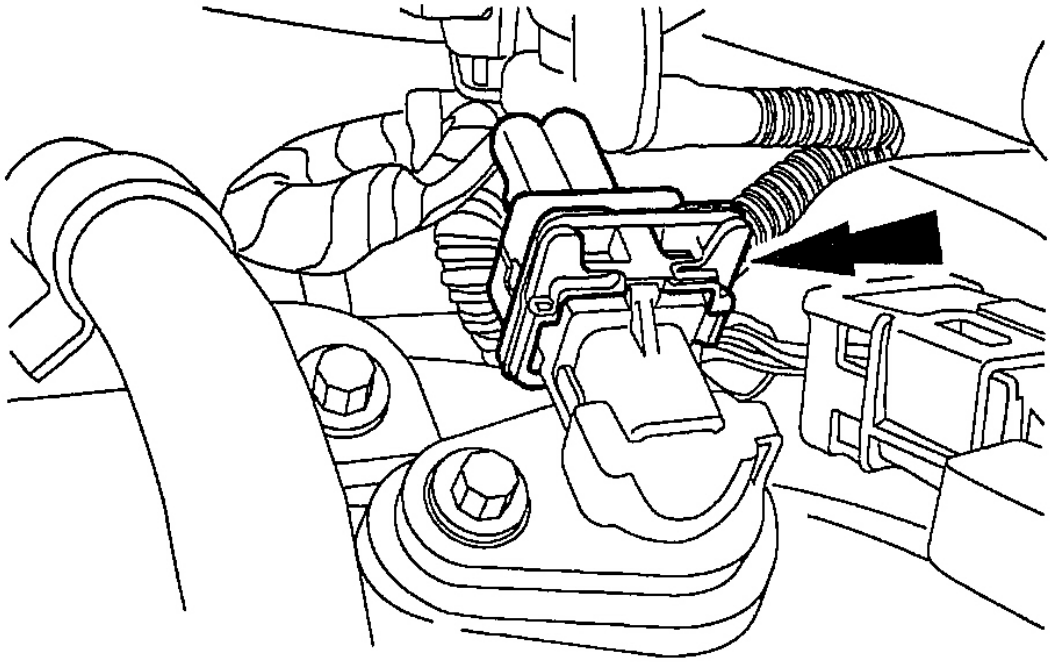


Fig. 165: Connecting CMP Sensor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

106. Attach the wiring harness retainer and install the heater tube bracket assembly.

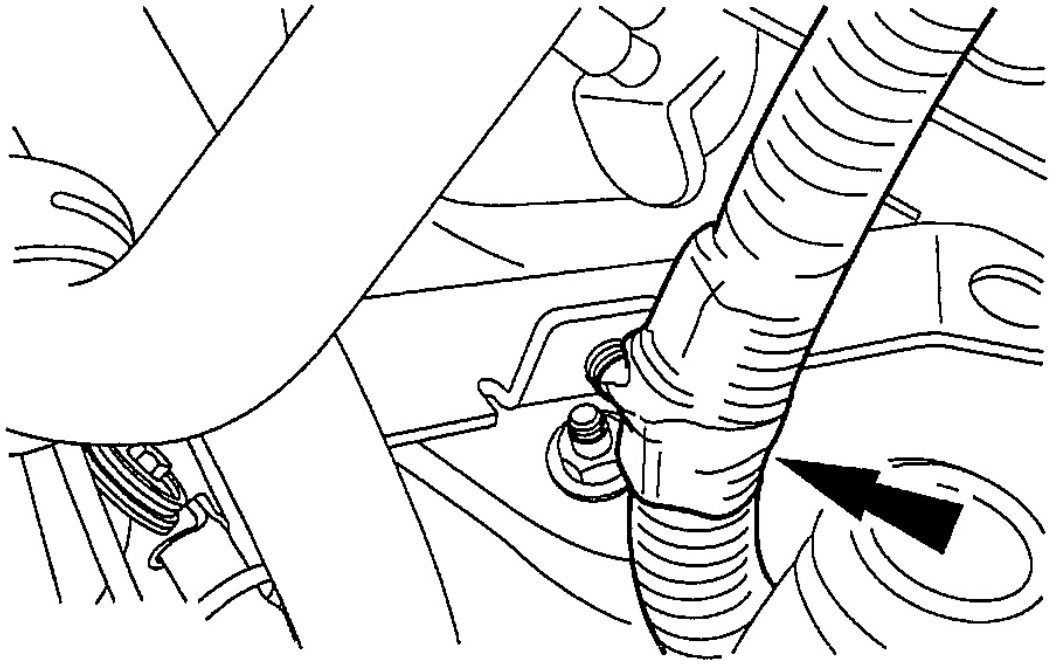


Fig. 166: Attaching Wiring Harness Retainer
Courtesy of MAZDA MOTORS CORP.

107. Install the bolts and tighten.

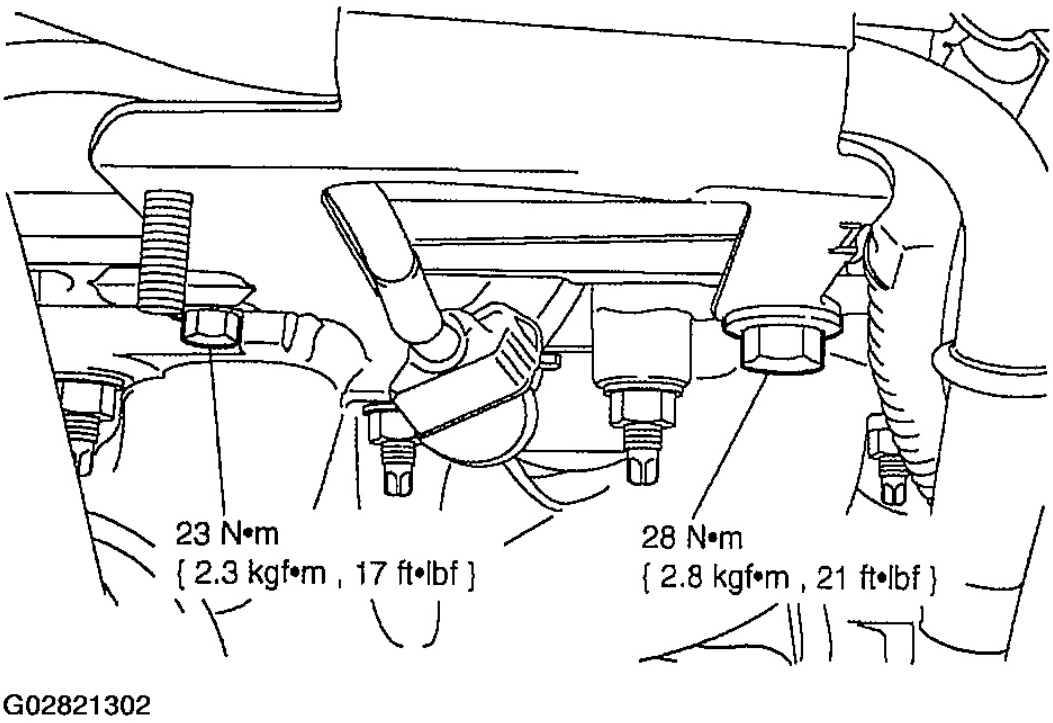
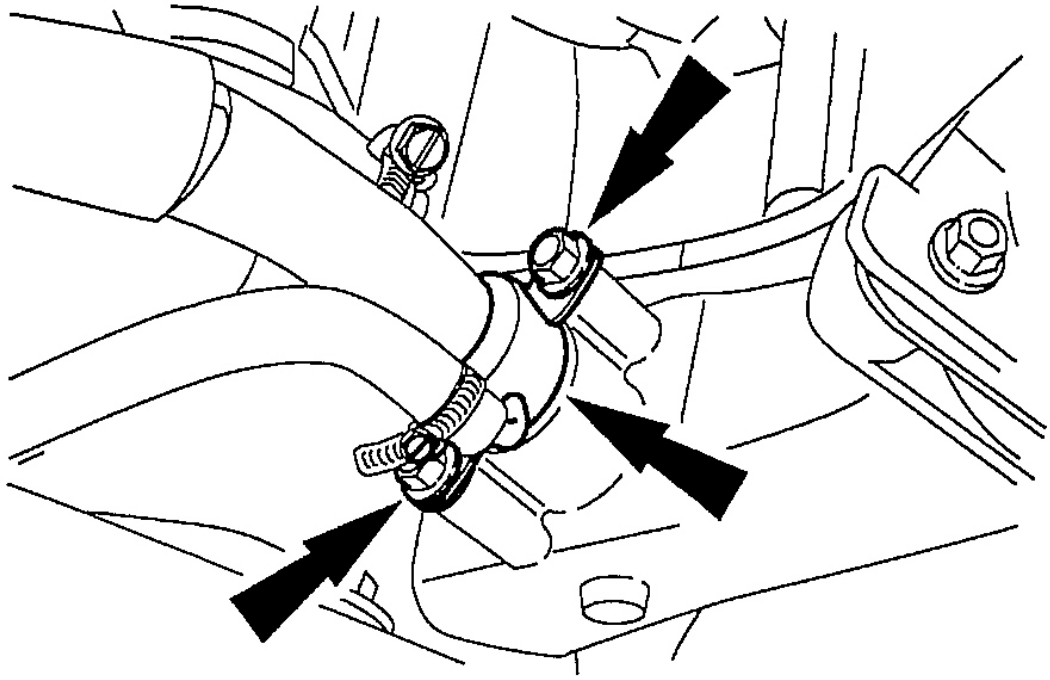


Fig. 167: Installing Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

108. Position the intake manifold close to the installed position.
109. Install the heated PCV fitting.



G02821303

Fig. 168: Installing Heated PCV Fitting
Courtesy of MAZDA MOTORS CORP.

110. Install the intake manifold and tighten the bolts.

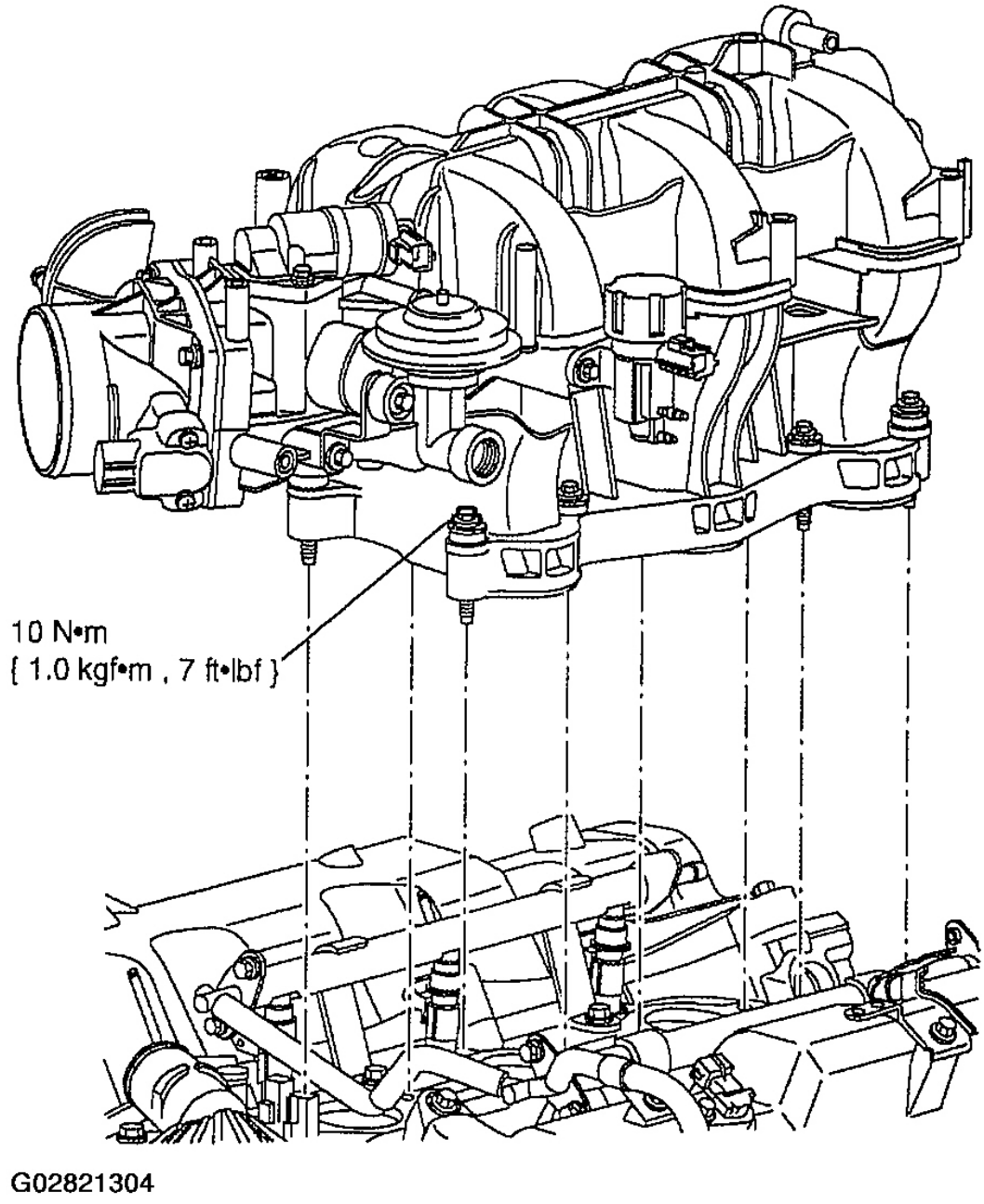


Fig. 169: Installing Intake Manifold
Courtesy of MAZDA MOTORS CORP.

111. Connect and attach the electrical connector.

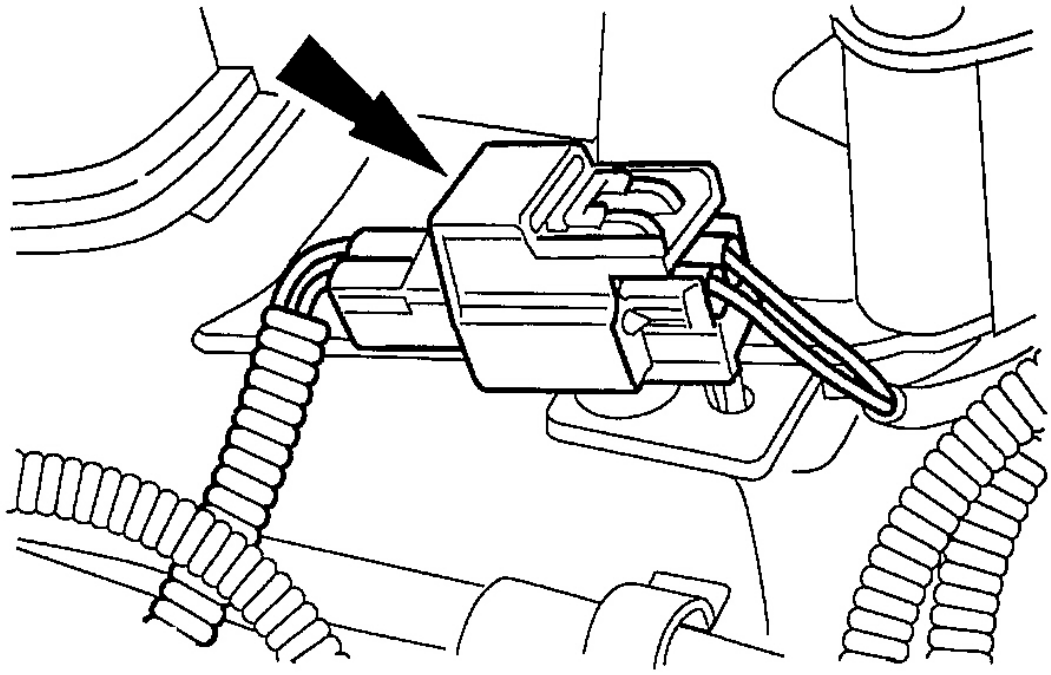


Fig. 170: Connecting Electrical Connector
Courtesy of MAZDA MOTORS CORP.

112. Connect the vacuum hoses.

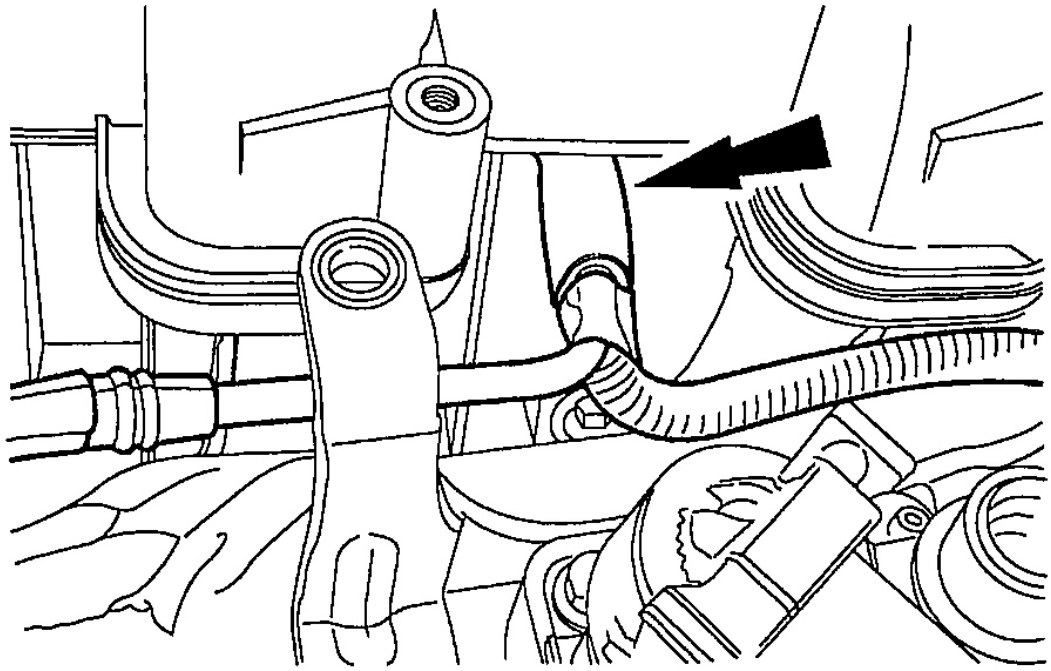


Fig. 171: Connecting Vacuum Hoses
Courtesy of MAZDA MOTORS CORP.

113. Install the coil and ignition wire. Install the bolt and tighten.

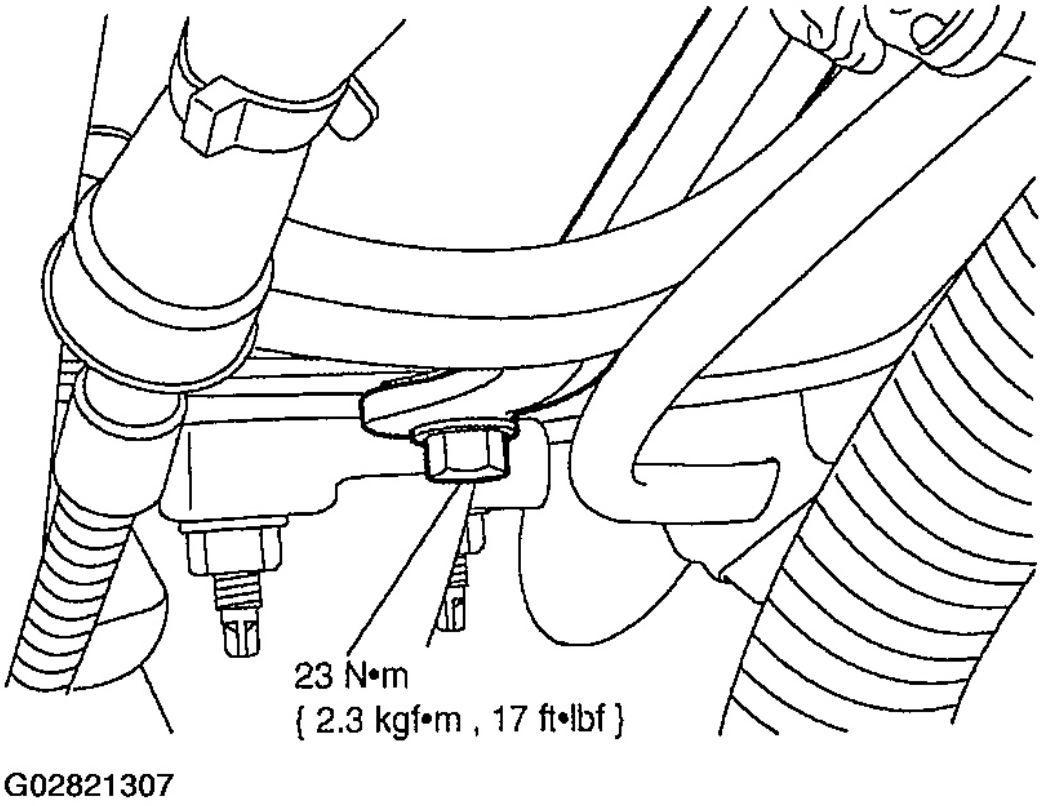


Fig. 172: Installing Coil & Ignition Wire
Courtesy of MAZDA MOTORS CORP.

114. Install the bolts and tighten.

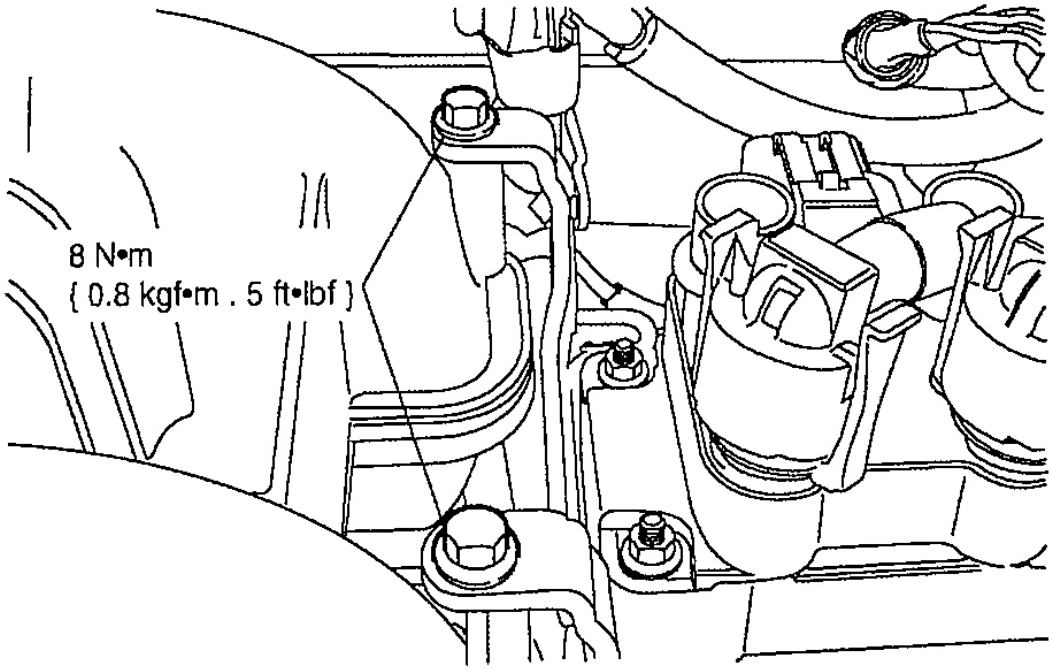


Fig. 173: Installing Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

CAUTION:
- **Make sure to orient the spark plug boots so the spark plug wires do not contact the exhaust manifolds. Wire contact can send voltage spikes to other electronic modules.**

NOTE:
- **Apply dielectric compound to the inside of the spark plug boots.**

115. Connect the spark plug wires to the spark plugs.
116. Connect the Exhaust Gas Recirculation (EGR) vacuum regulator electrical connector.

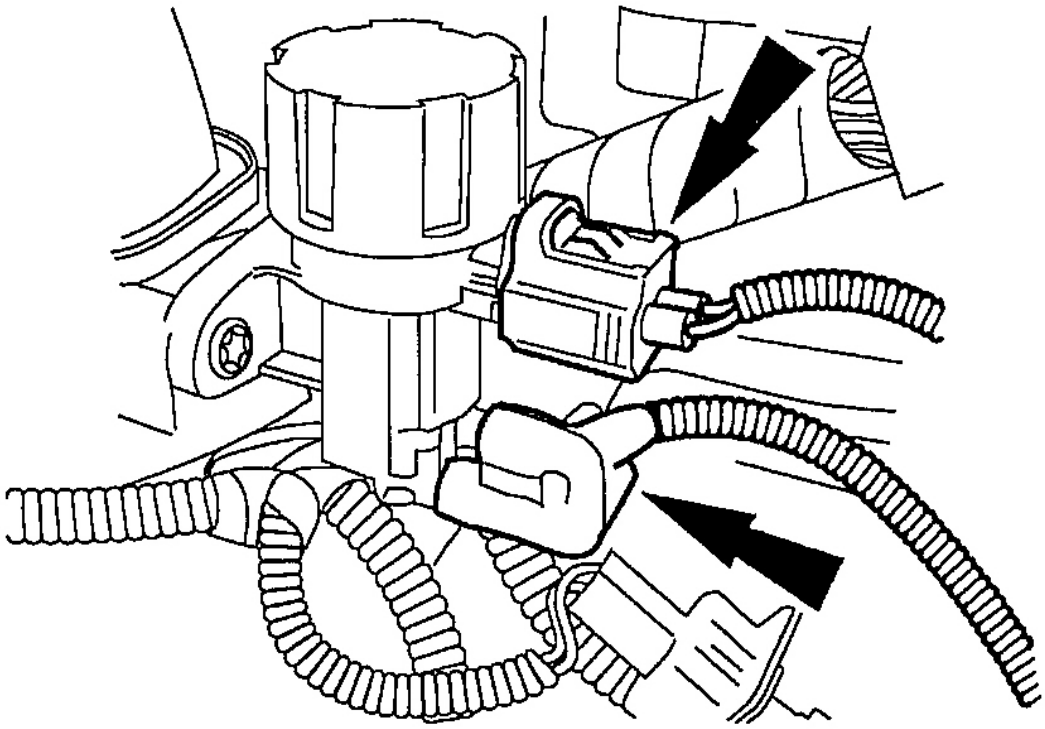


Fig. 174: Connecting EGR Vacuum Regulator Electrical Connector
Courtesy of MAZDA MOTORS CORP.

117. Connect the radio ignition interference capacitor electrical connector.

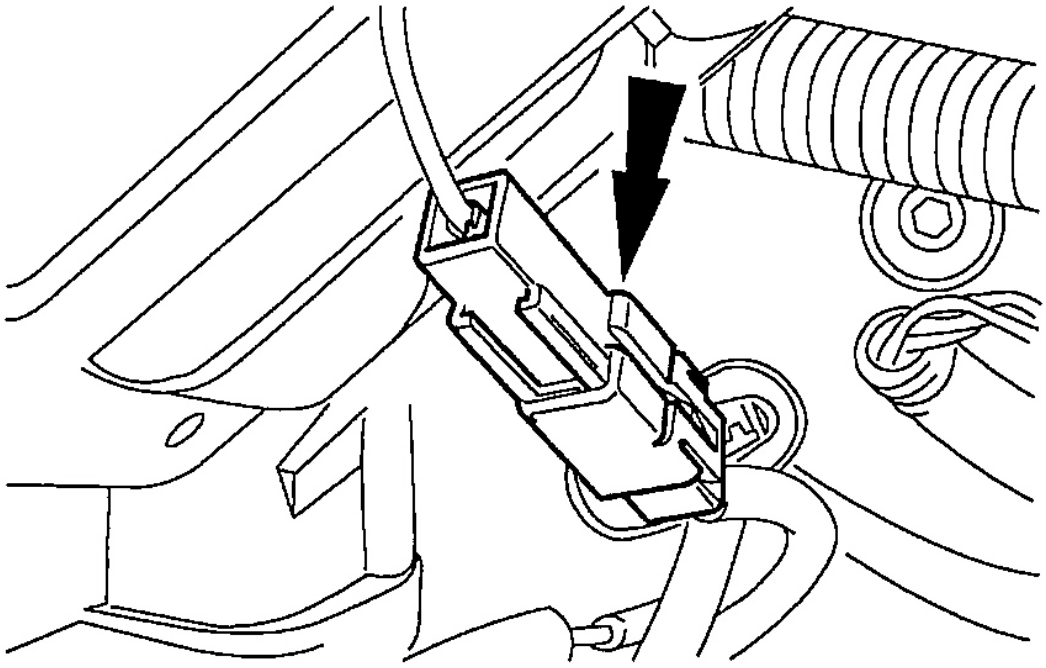
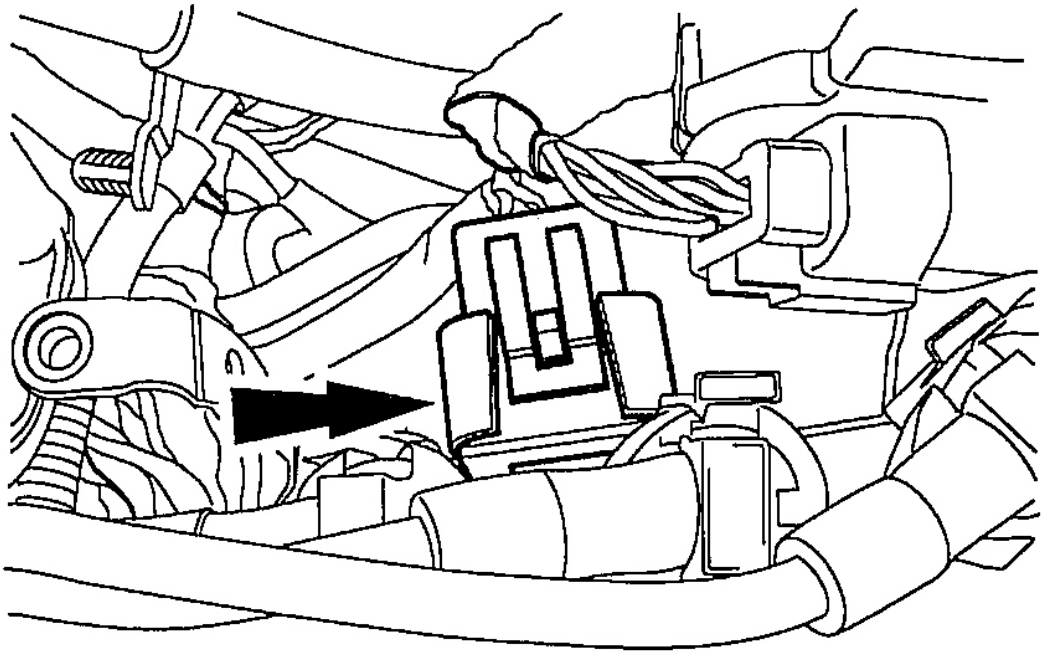


Fig. 175: Connecting Radio Ignition Interference Capacitor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

118. Connect the ignition coil electrical connector.



G02821311

Fig. 176: Connecting Ignition Coil Electrical Connector
Courtesy of MAZDA MOTORS CORP.

119. Connect the EGR valve-to-exhaust manifold tube to the EGR valve.

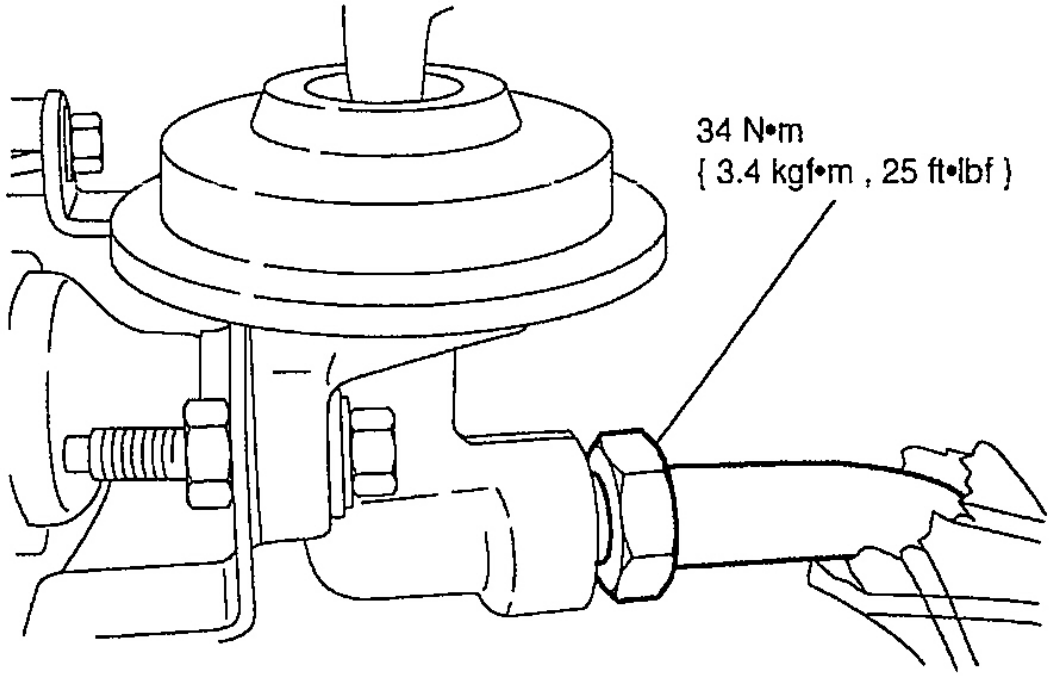


Fig. 177: Connecting EGR Valve-To-Exhaust Manifold Tube
Courtesy of MAZDA MOTORS CORP.

120. Connect the Idle Air Control (IAC) valve electrical connector and connect the EGR valve vacuum hose.

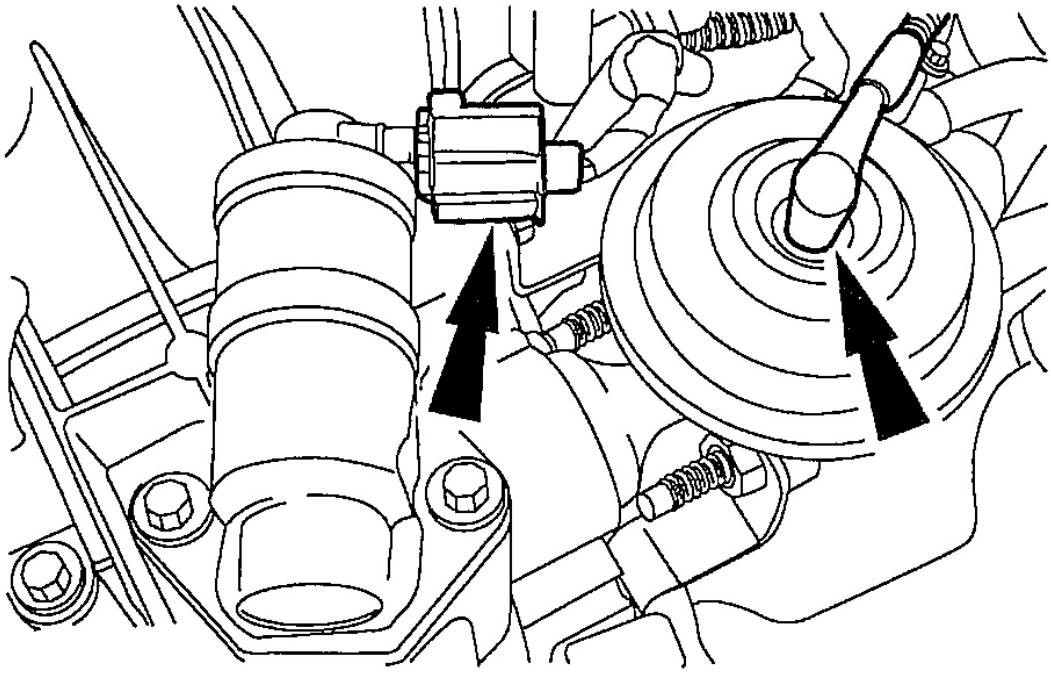


Fig. 178: Connecting IAC Valve Electrical Connector
Courtesy of MAZDA MOTORS CORP.

121. Connect the Throttle Position (TP) sensor electrical connector.

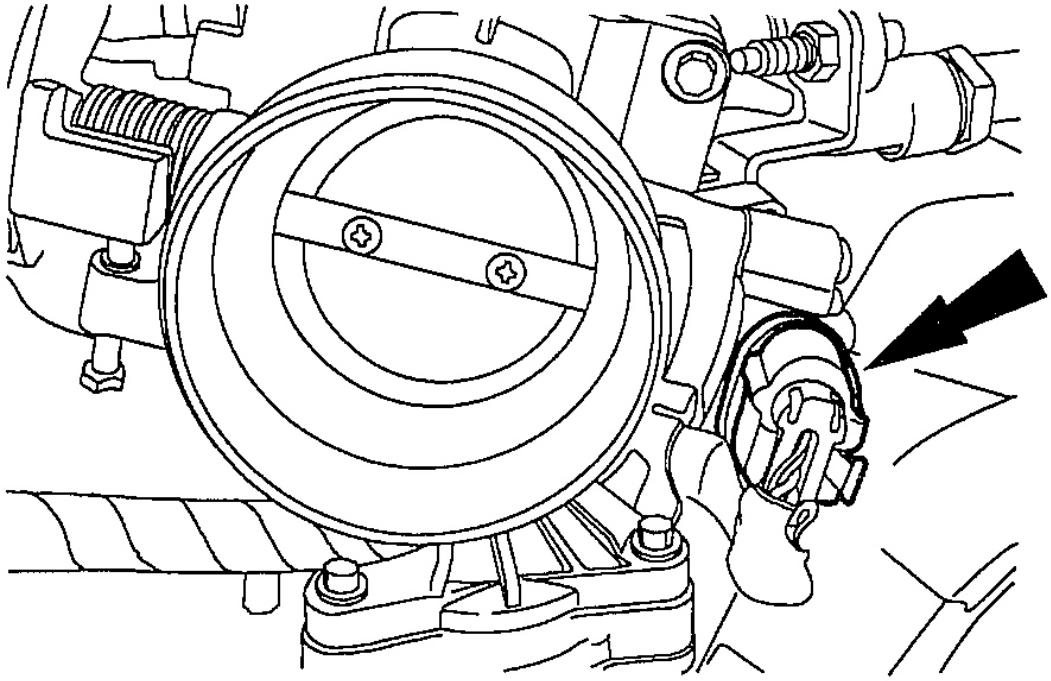


Fig. 179: Connecting TP Sensor Electrical Connector
Courtesy of MAZDA MOTORS CORP.

122. Install the generator mounting bracket and tighten the bolts.
    1. Install the generator mounting bracket bolts.
    2. Install the drive belt tensioner bolt and tighten.

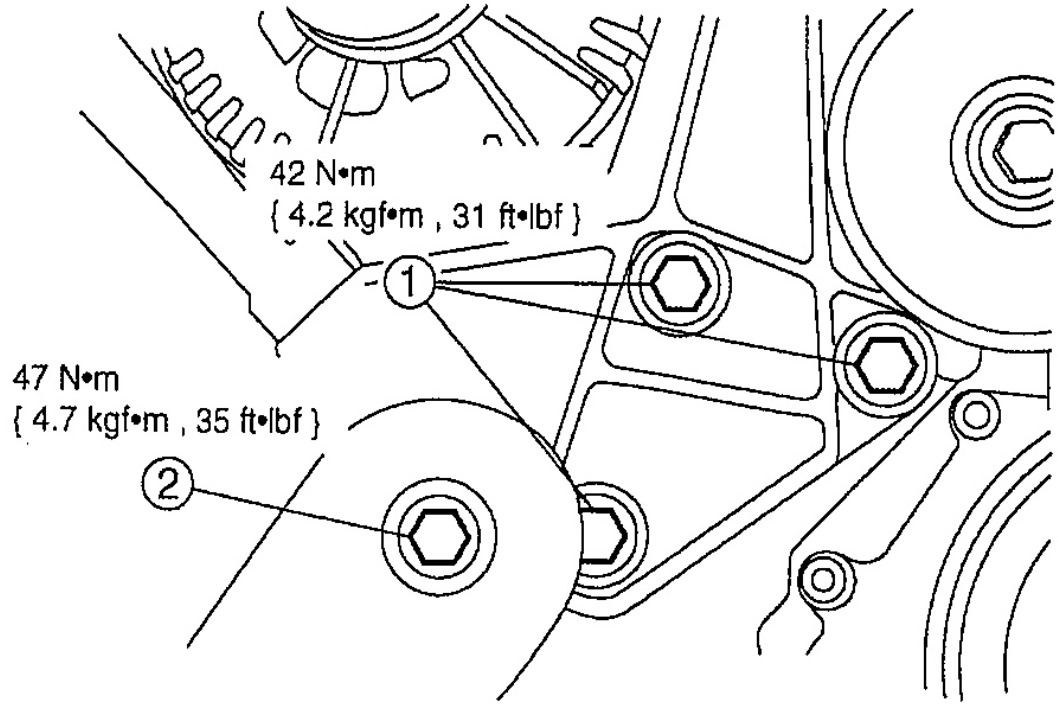


Fig. 180: Installing Generator Mounting Bracket
Courtesy of MAZDA MOTORS CORP.

123. Install the accessory bracket and tighten the bolts.
124. Rotate the drive belt tensioner counterclockwise and install the drive belt.

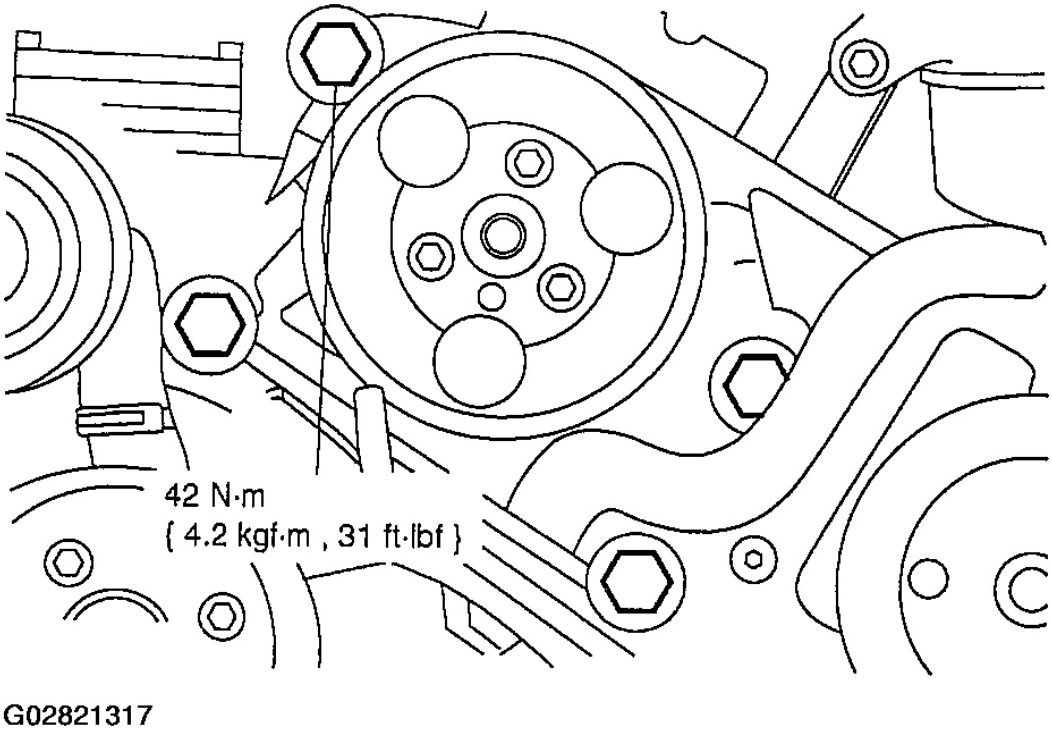
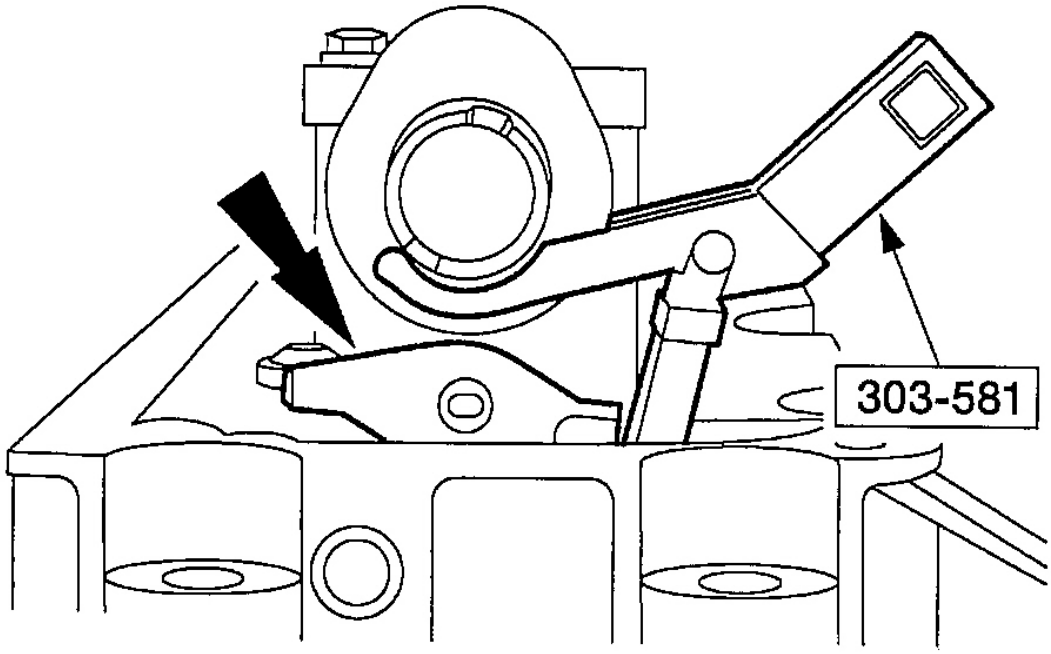


Fig. 181: Rotating Drive Belt Tensioner Counterclockwise
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD DISASSEMBLY/ASSEMBLY

DISASSEMBLY NOTE

1. Remove the spark plugs.
2. Using Valve Spring Compressor SST 303-581 or equivalent, remove the camshaft roller followers.



G02821315

Fig. 182: Removing Camshaft Roller Followers
Courtesy of MAZDA MOTORS CORP.

3. Using Valve Spring Compressor **SST** 303-581 or equivalent, remove the valve spring retainer keys, the valve spring and the retainer.

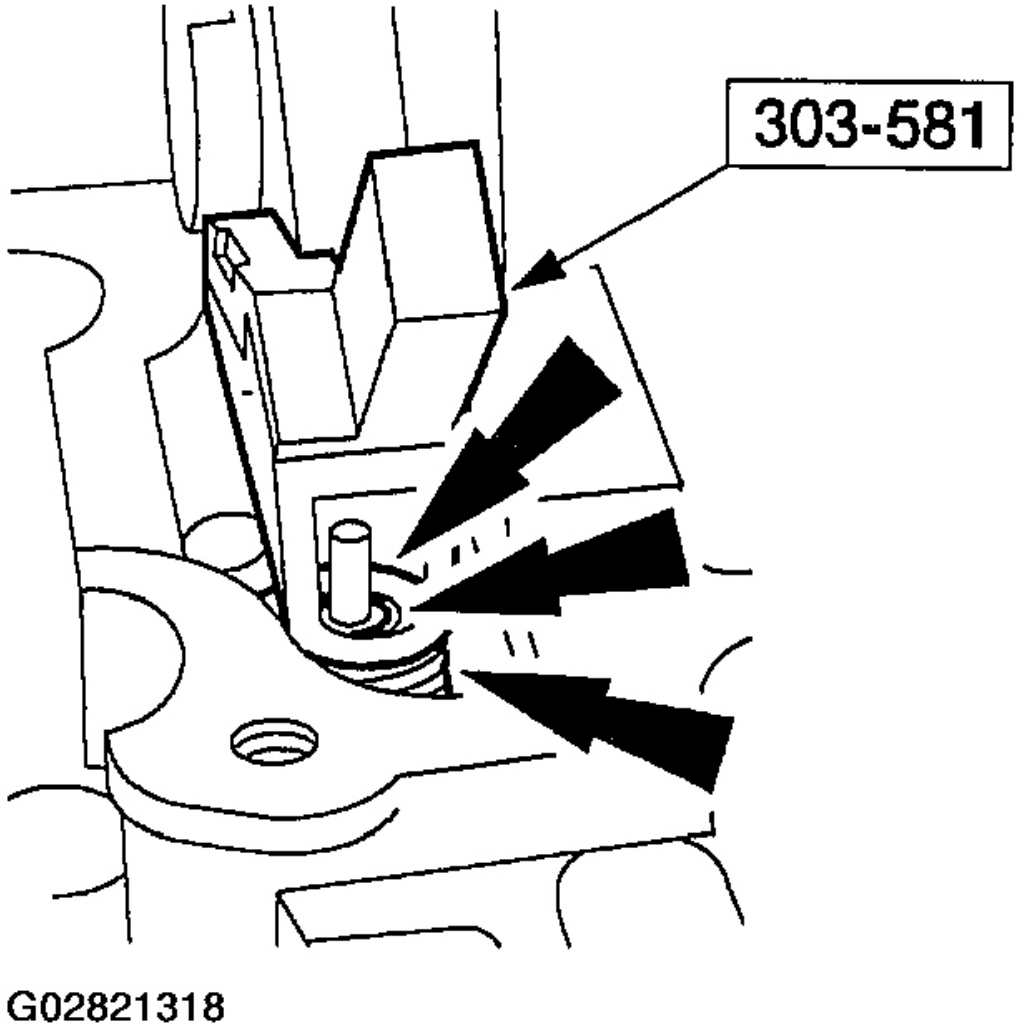


Fig. 183: Removing Valve Spring Retainer Keys, Valve Spring & Retainer
Courtesy of MAZDA MOTORS CORP.

4. Remove the valve.
5. Repeat the procedure until all of the valves are removed.
6. Remove the valve stem seals.

NOTE:

- **Mark the positions of the camshaft bearing caps so they can be installed in the original position.**

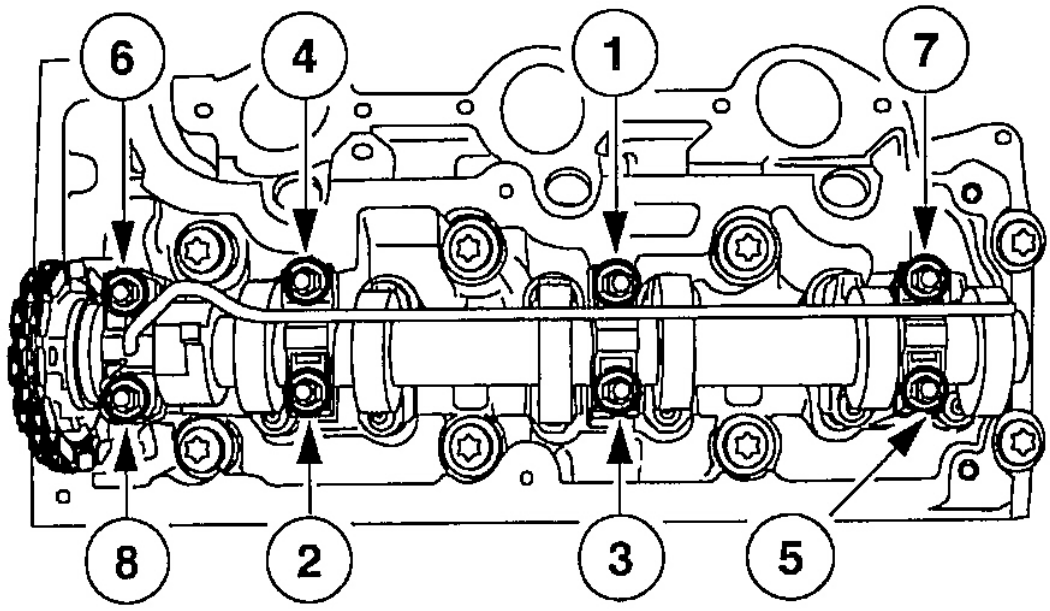
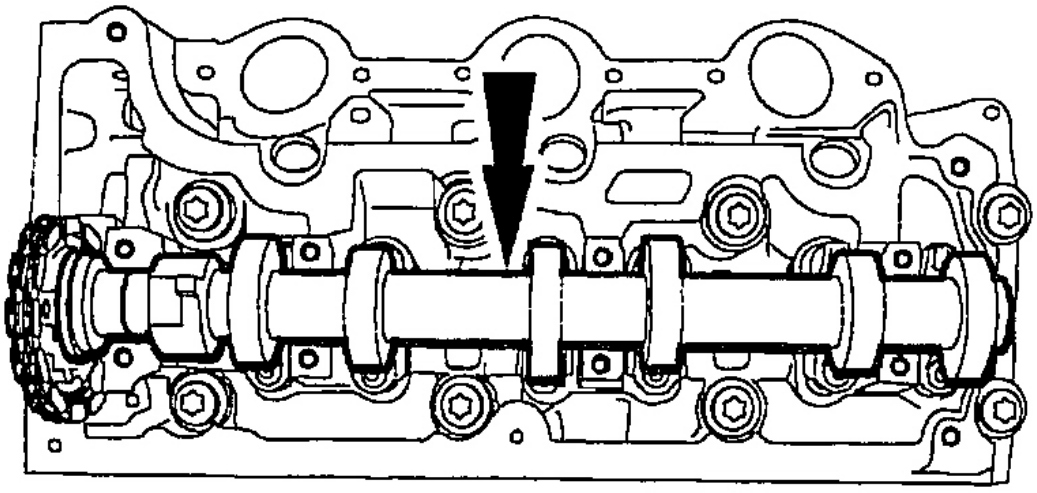


Fig. 184: Camshaft Bearing Cap Bolt Removal Sequence
Courtesy of MAZDA MOTORS CORP.

7. Remove the bolts in the sequence shown and remove the camshaft bearing caps.
8. Remove the camshaft.



G02821320

Fig. 185: Removing Camshaft
Courtesy of MAZDA MOTORS CORP.

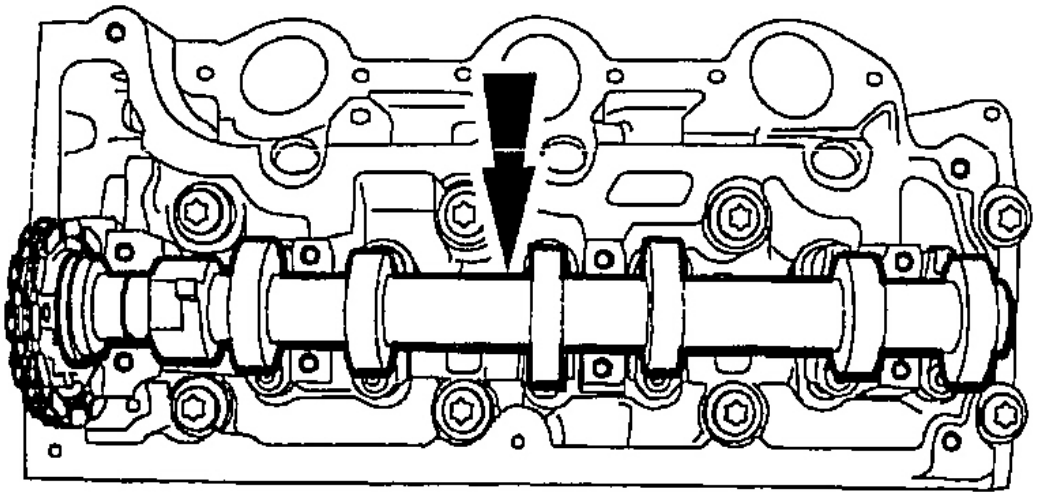
9. Inspect the cylinder head. For additional information, refer to **CYLINDER HEAD INSPECTION**.

ASSEMBLY NOTE

NOTE:

- **Prior to assembly, coat all of the valve train components with clean 5W-30 engine oil.**

1. Install the camshaft.

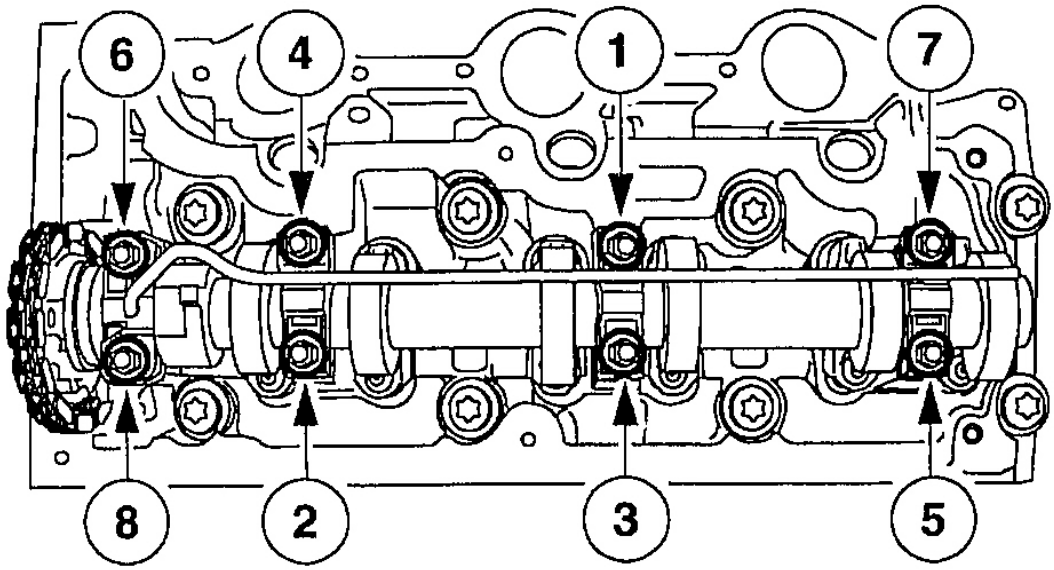


G02821321

Fig. 186: Installing Camshaft
Courtesy of MAZDA MOTORS CORP.

NOTE: • **The camshaft bearing caps must be installed in the original position.**

NOTE: • **After installing the bolts, check the camshaft for free rotation.**



G02821322

Fig. 187: Camshaft Cap Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

2. Position the oil supply tube, the camshaft bearing caps, and the bolts.
    - Tighten in the sequence shown in two stages:
        1. Stage 1: Tighten to 6 Nm (0.6 kgf-m, 53 lb-in).
        2. Stage 2: Tighten to 16 Nm (1.6 kgf-m, 12 lb-ft).
3. Install the valve.
4. Using Valve Stem Seal Replacer SST 303-370 or equivalent, install the valve stem seals.

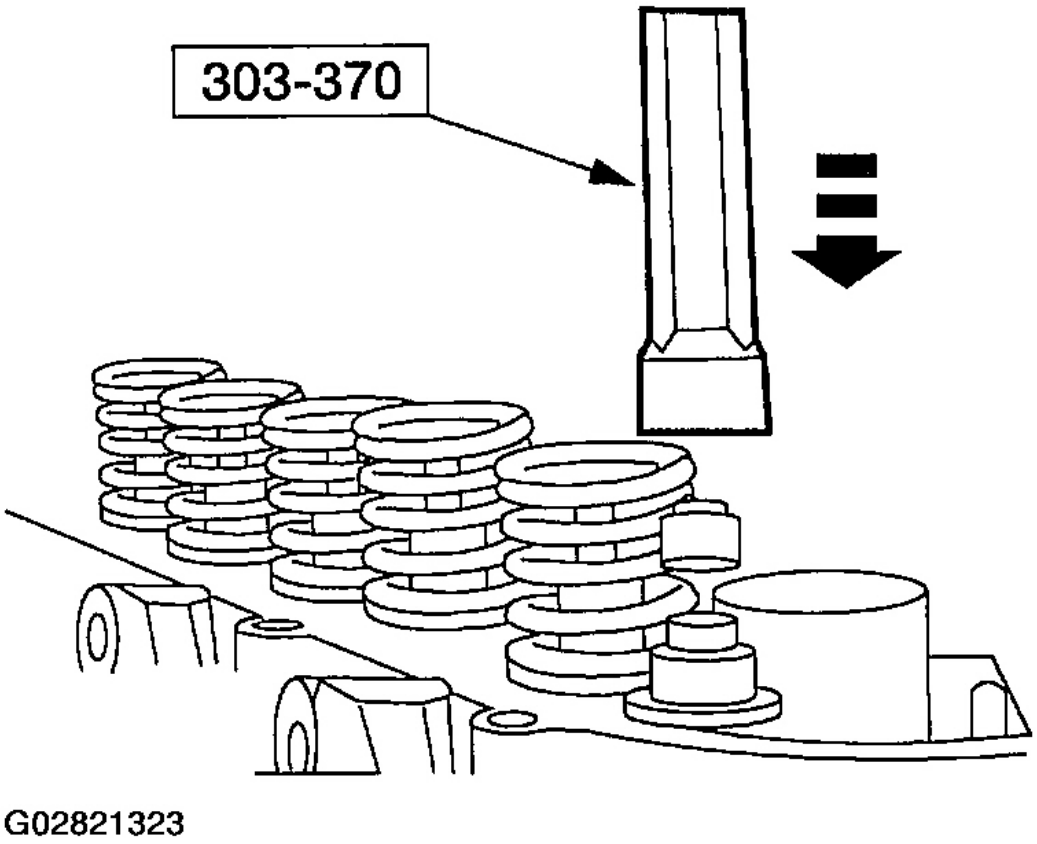


Fig. 188: Installing Valve Stem Seals
Courtesy of MAZDA MOTORS CORP.

5. Using Valve Spring Compressor SST 303-581 or equivalent, install the valve spring, the retainer and the retainer keys.
6. Repeat the procedure until all of the valves are installed.
7. Install the spark plugs.

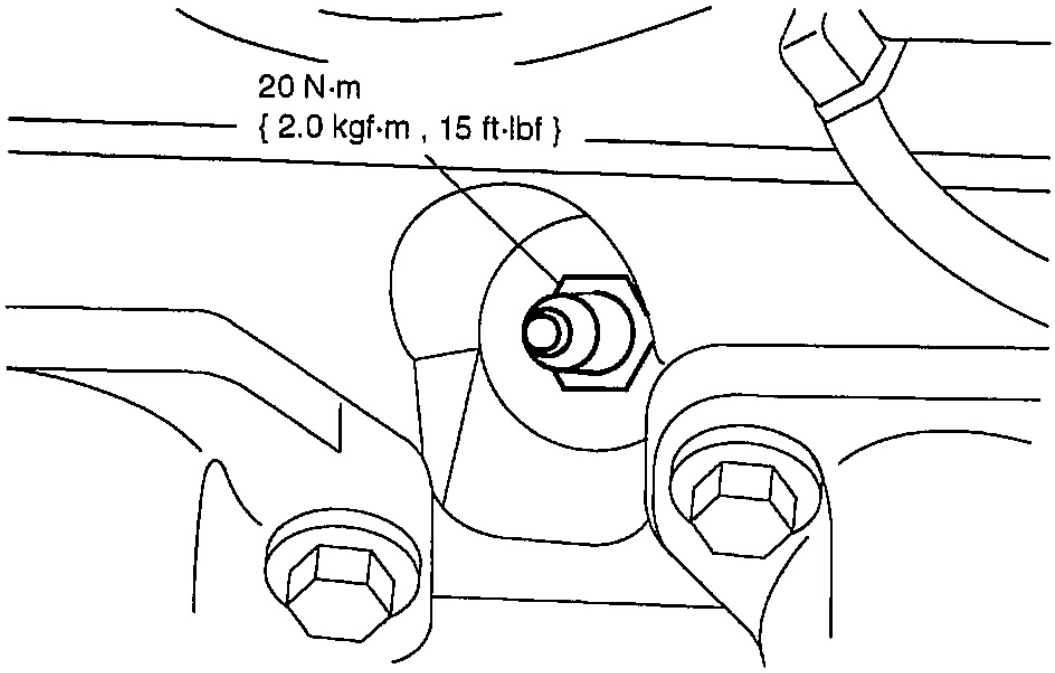


Fig. 189: Installing Spark Plugs
Courtesy of MAZDA MOTORS CORP.

8. Install the camshaft roller followers only when the cylinder head is installed in the vehicle and the timing procedure has been carried out.

PISTON AND CONNECTING ROD DISASSEMBLY/ASSEMBLY

DISASSEMBLY NOTE

NOTE:

- **Use a suitable ring expander to remove piston rings to prevent damage.**

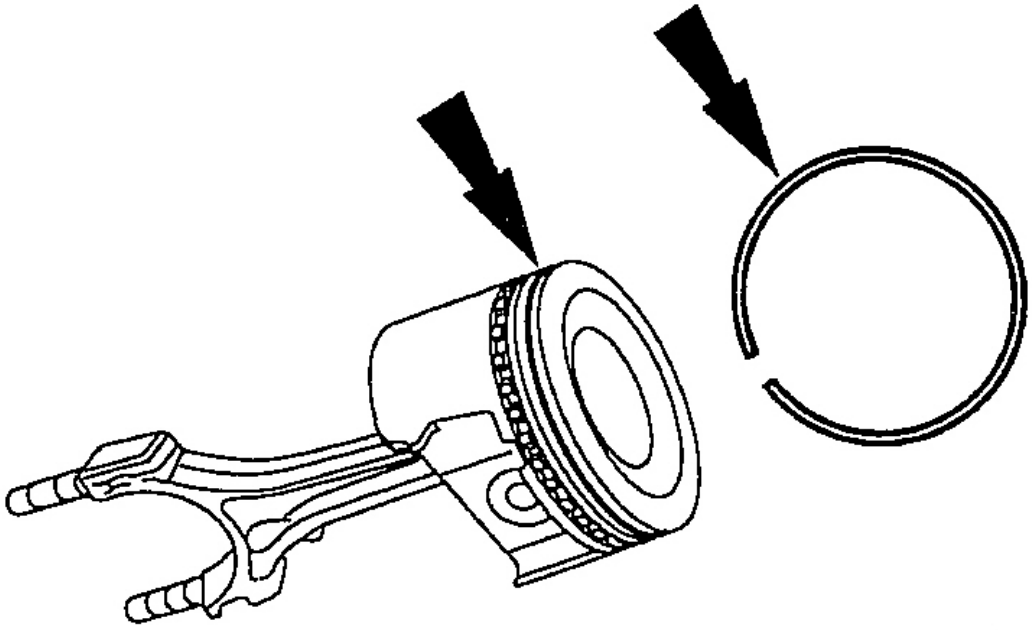


Fig. 190: Removing Top Compression Ring
Courtesy of MAZDA MOTORS CORP.

1. Remove the top compression ring.
2. Remove the second compression ring.

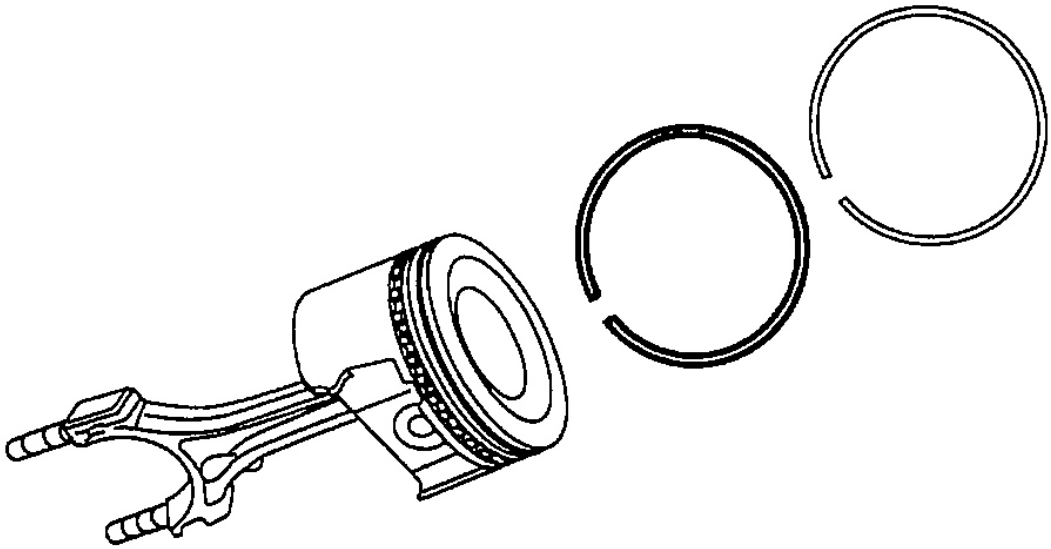


Fig. 191: Removing Second Compression Ring
Courtesy of MAZDA MOTORS CORP.

3. Remove the first oil control ring.

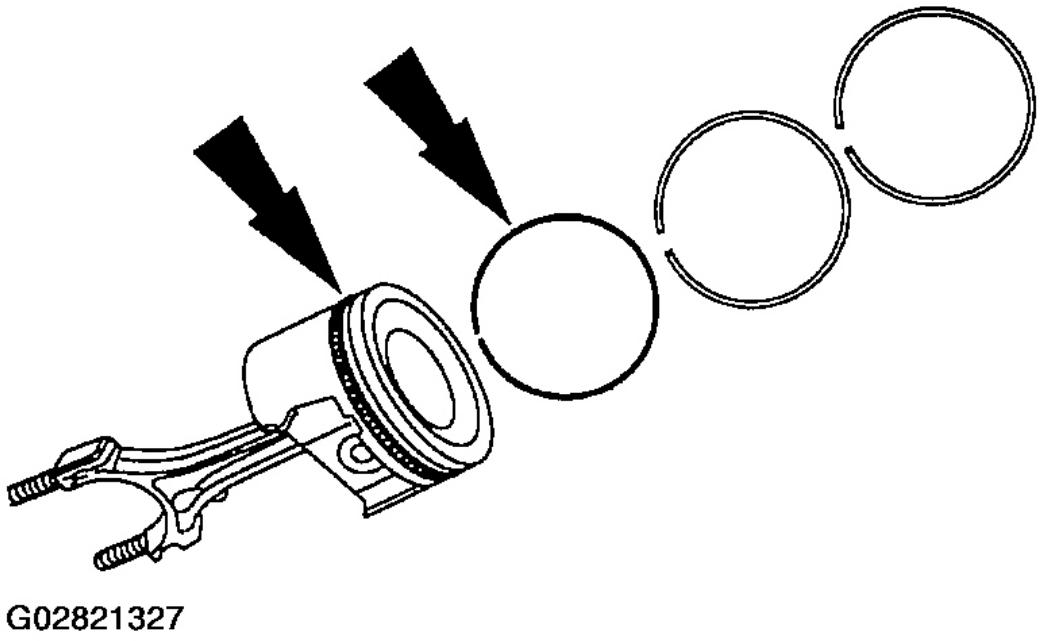


Fig. 192: Removing First Oil Control Ring
Courtesy of MAZDA MOTORS CORP.

4. Remove the oil control spacer ring.

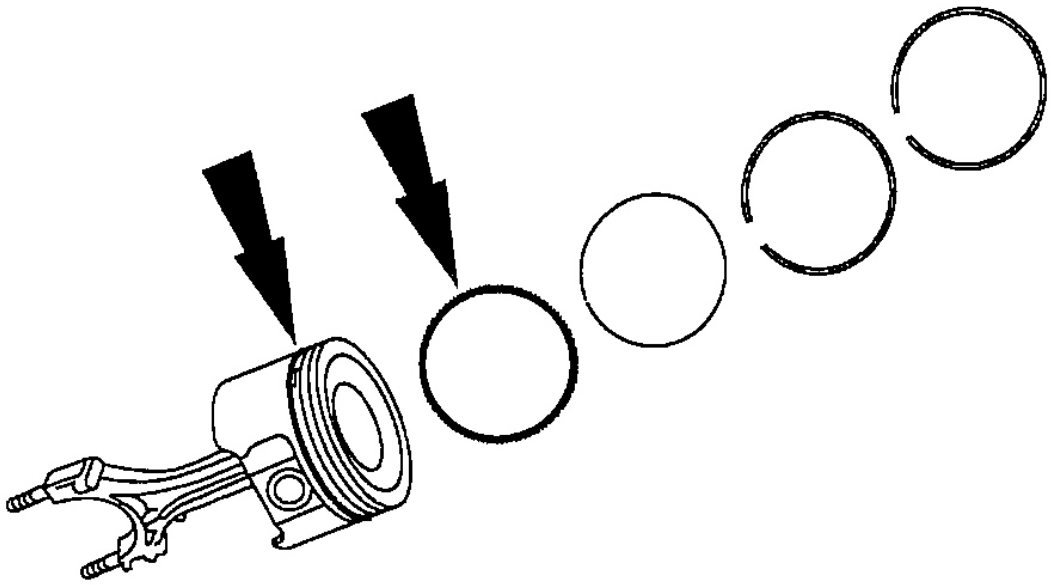


Fig. 193: Removing Oil Control Spacer Ring
Courtesy of MAZDA MOTORS CORP.

5. Remove the second oil control ring.

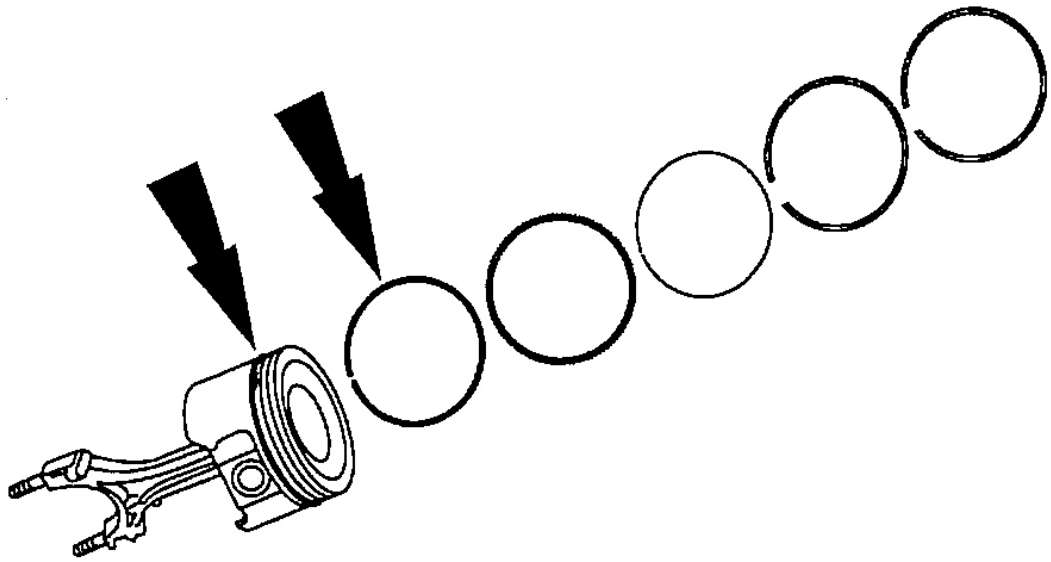
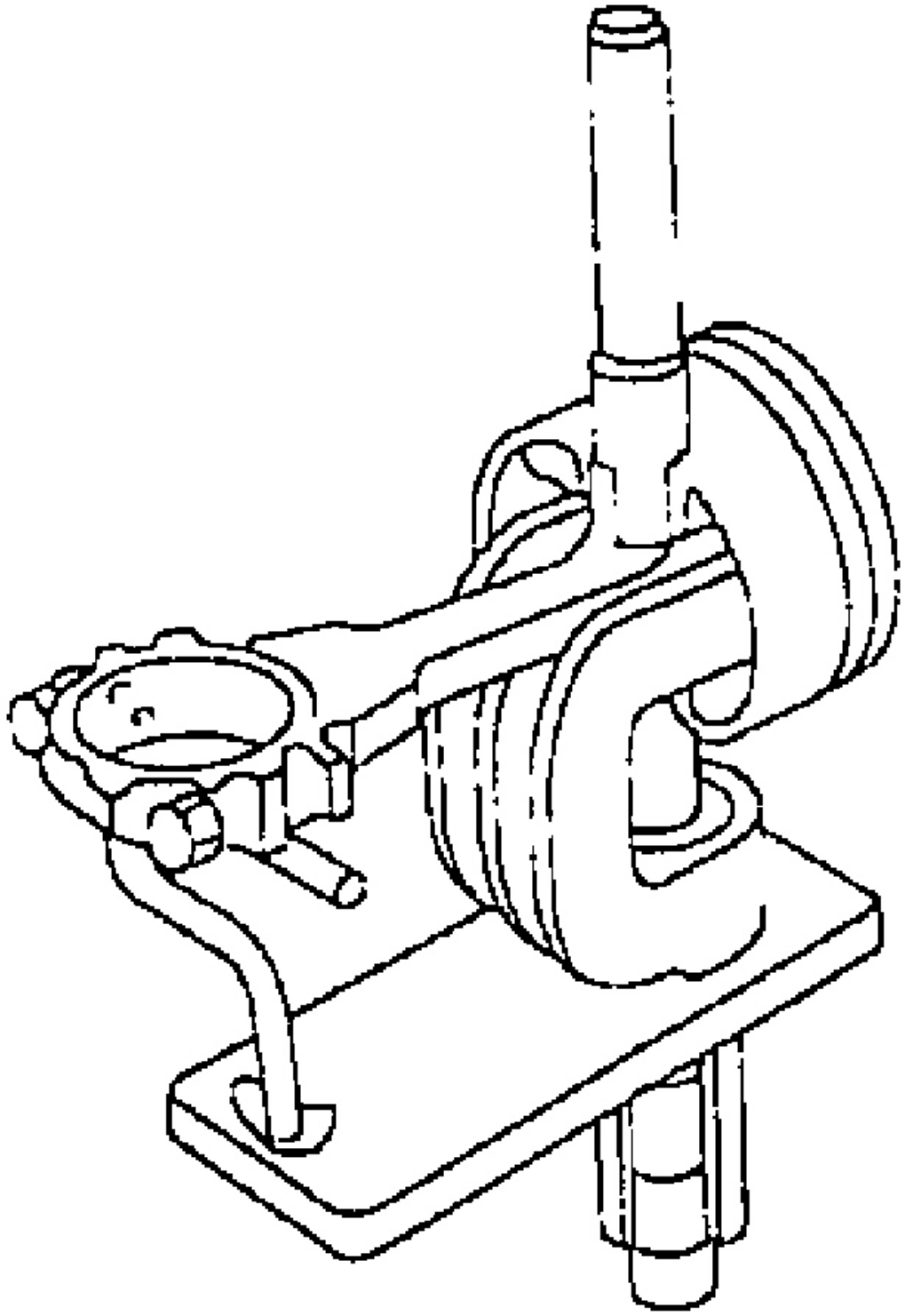


Fig. 194: Removing Second Oil Control Ring
Courtesy of MAZDA MOTORS CORP.

CAUTION:
- **Do not reuse the piston or pin if removed or damage to the engine may occur.**



G02821330

Fig. 195: Pressing Out Piston Pin
Courtesy of MAZDA MOTORS CORP.

6. Using Piston Pin Tool SST 303-D034 or equivalent, press the piston pin out of the piston connecting rod assembly.

NOTE:

- **Take note of piston connecting rod assembly and mark the connecting rod and piston to ensure proper orientation during reassembly.**

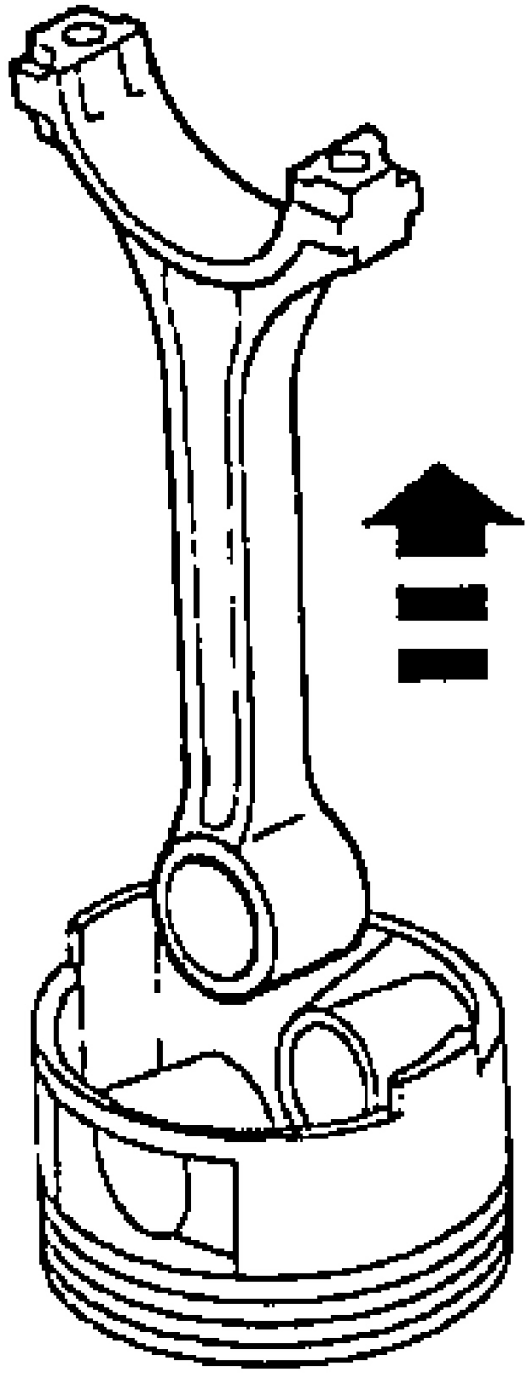


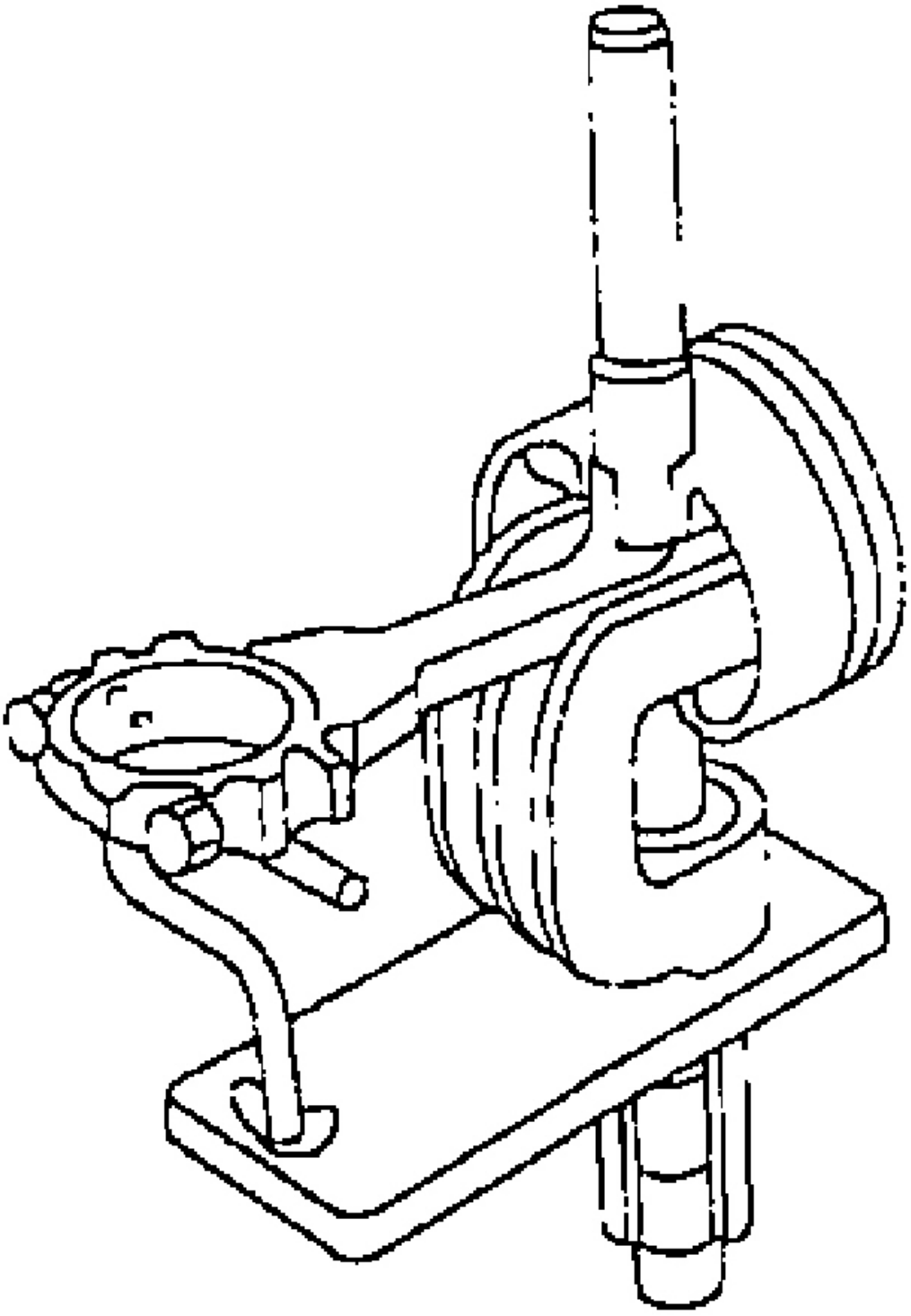
Fig. 196: Removing Connecting Rod From Piston
Courtesy of MAZDA MOTORS CORP.

7. Remove the connecting rod from the piston.
8. Clean and inspect the connecting rod and the piston. Refer to **CONNECTING ROD INSPECTION** or

PISTON INSPECTION.

ASSEMBLY NOTE

1. Lubricate the new piston pin and new piston pin bore.
    - Use SAE 5W20 engine oil.

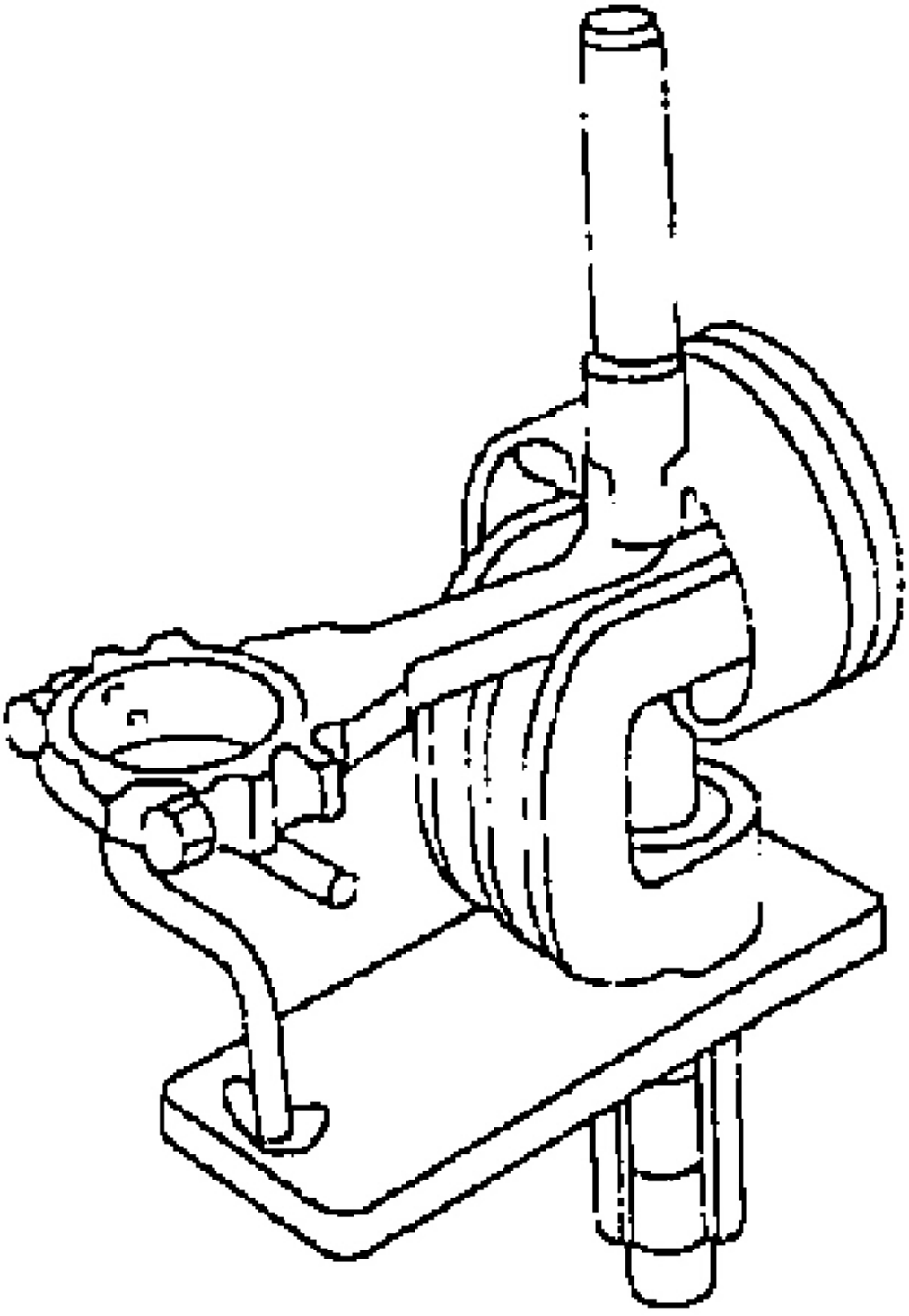


G02821332

Fig. 197: Lubricating Piston Pin For Installation
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **During assembly the small end of the connecting rod must be heated to 232°-316°C (450°-600°F).**



G02821333

Fig. 198: Pressing Piston Pin Into Piston & Connecting Rod
Courtesy of MAZDA MOTORS CORP.

2. Using Piston Pin Tool SST 303-D034 or equivalent, press the piston pin into the piston and the connecting rod.

NOTE:

- **Lubricate the piston and the piston rings with SAE engine oil 5W20.**

NOTE:

- **Use a suitable ring expander to install the piston rings. Ensure ring end gaps are equally spaced around the circumference of the piston for all piston rings.**

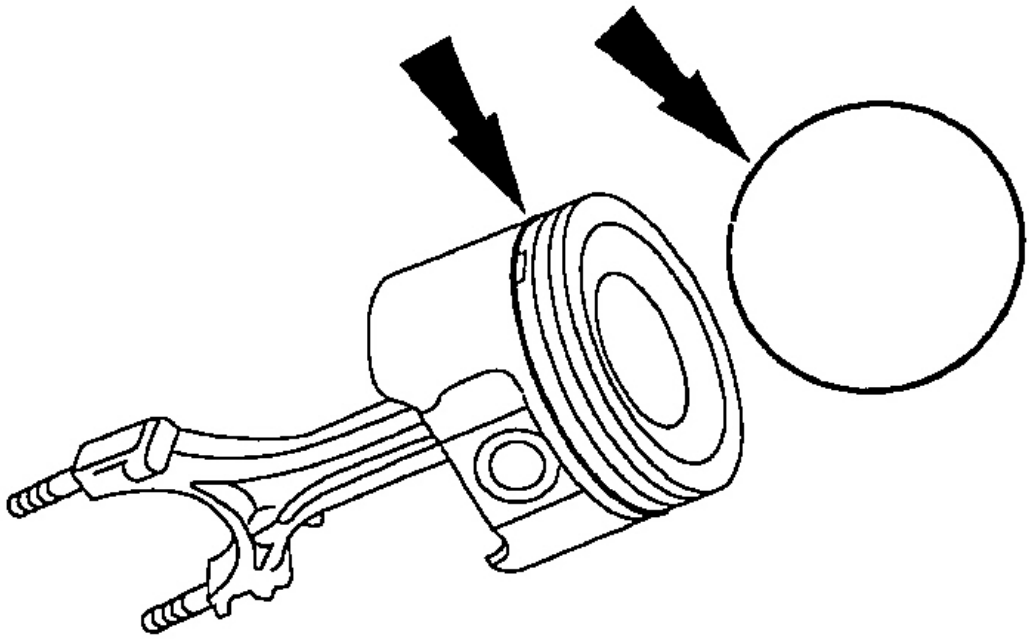


Fig. 199: Installing Second Oil Control Ring
Courtesy of MAZDA MOTORS CORP.

3. Install the second oil control ring.
4. Install the oil control spacer ring.

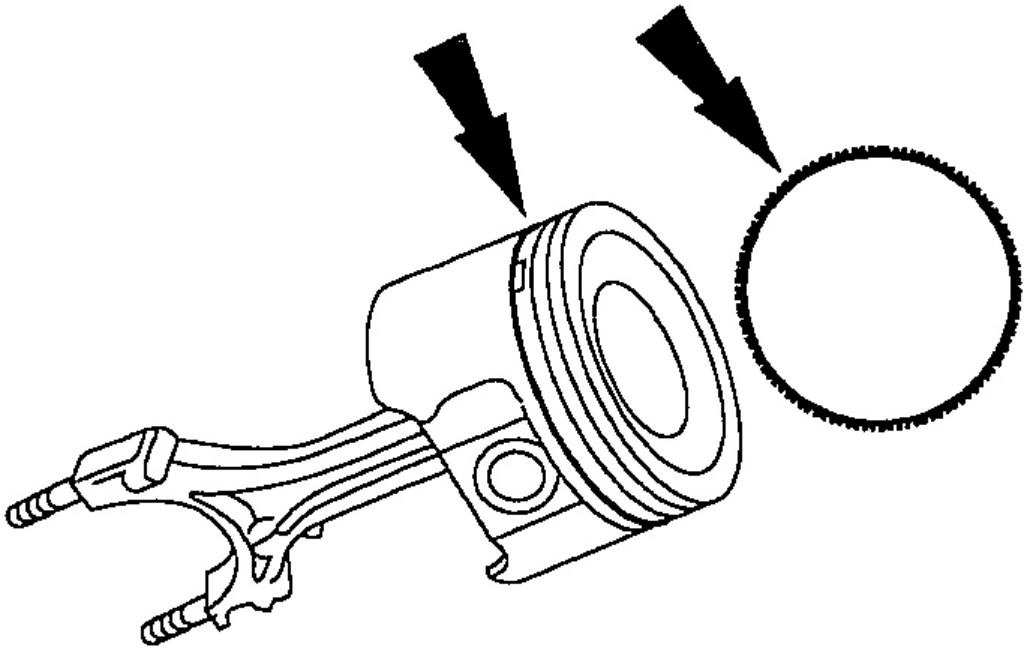


Fig. 200: Installing Oil Control Spacer Ring
Courtesy of MAZDA MOTORS CORP.

5. Install the first oil control ring.

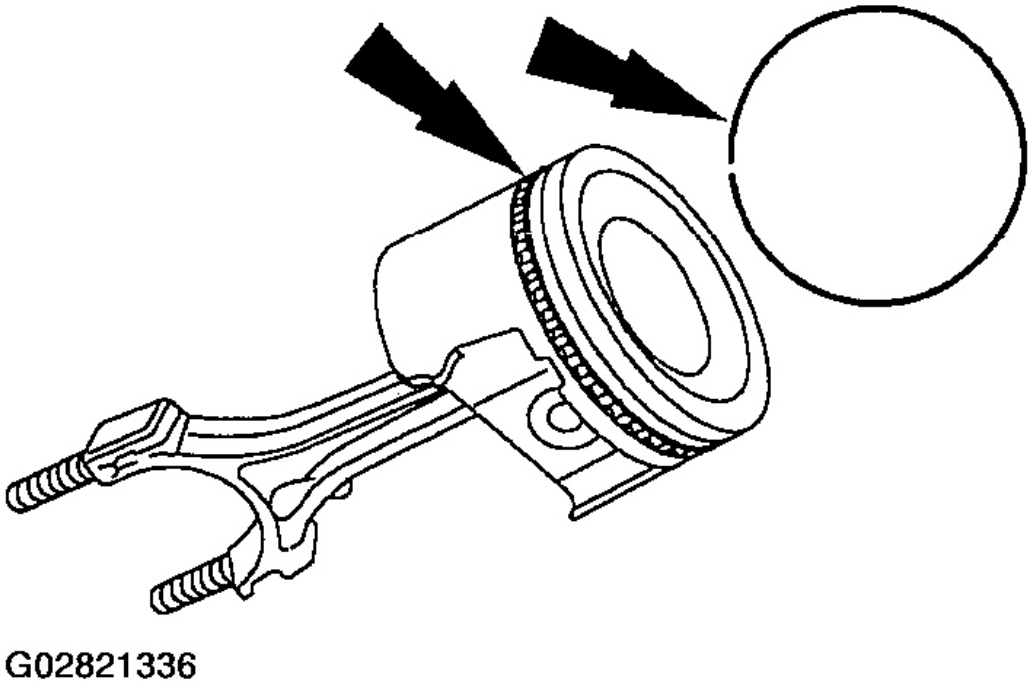


Fig. 201: Installing First Oil Control Ring
Courtesy of MAZDA MOTORS CORP.

6. Install the second compression ring.

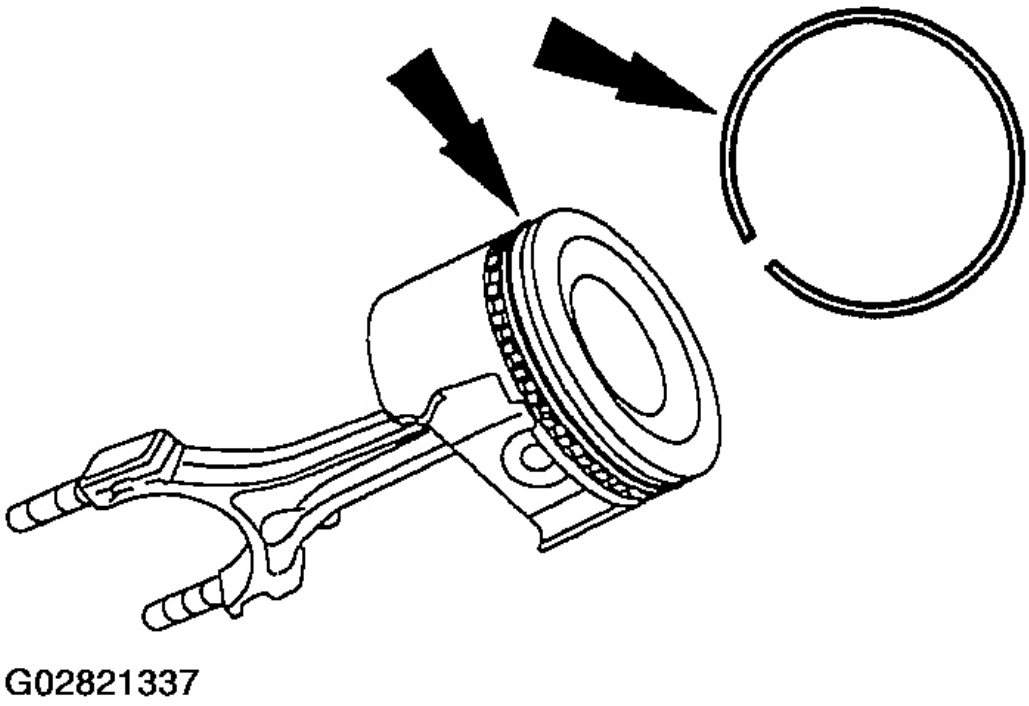


Fig. 202: Installing Second Compression Ring
Courtesy of MAZDA MOTORS CORP.

7. Install the top compression ring.

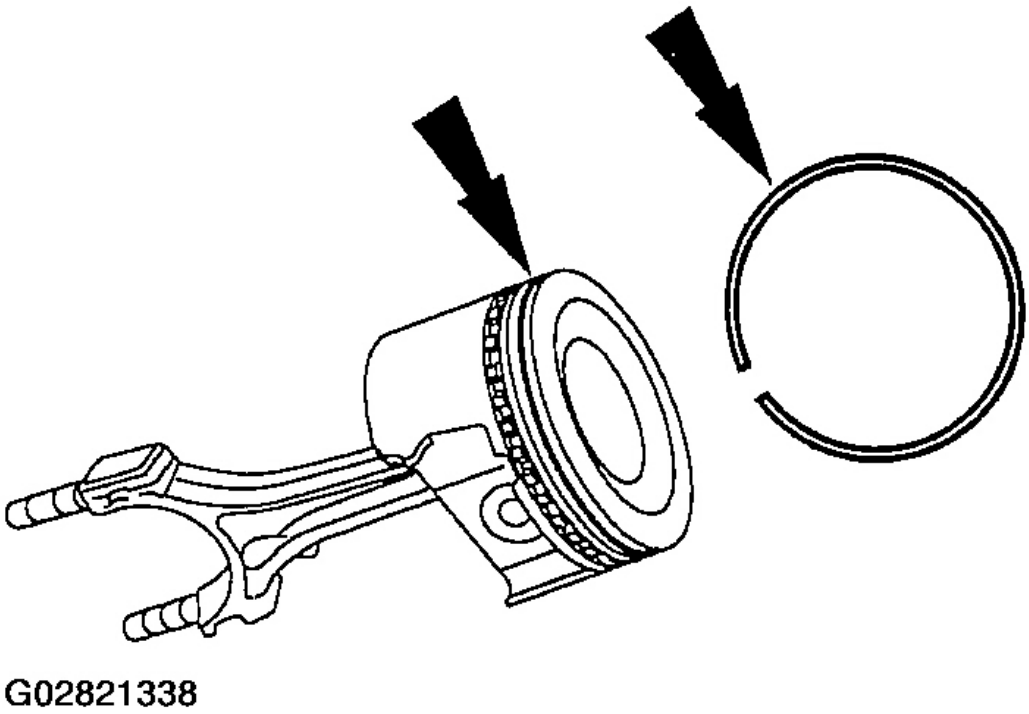


Fig. 203: Installing Top Compression Ring
Courtesy of MAZDA MOTORS CORP.

8. Check piston ring end gap and ring-to-groove side clearance. Refer to **PISTON INSPECTION**.

SPROCKET INSPECTION

WARNING:

- **To avoid the possibility of personal injury or damage to the vehicle, do not operate the engine with the hood open until the fan blade has been examined for possible cracks and separation.**

NOTE:

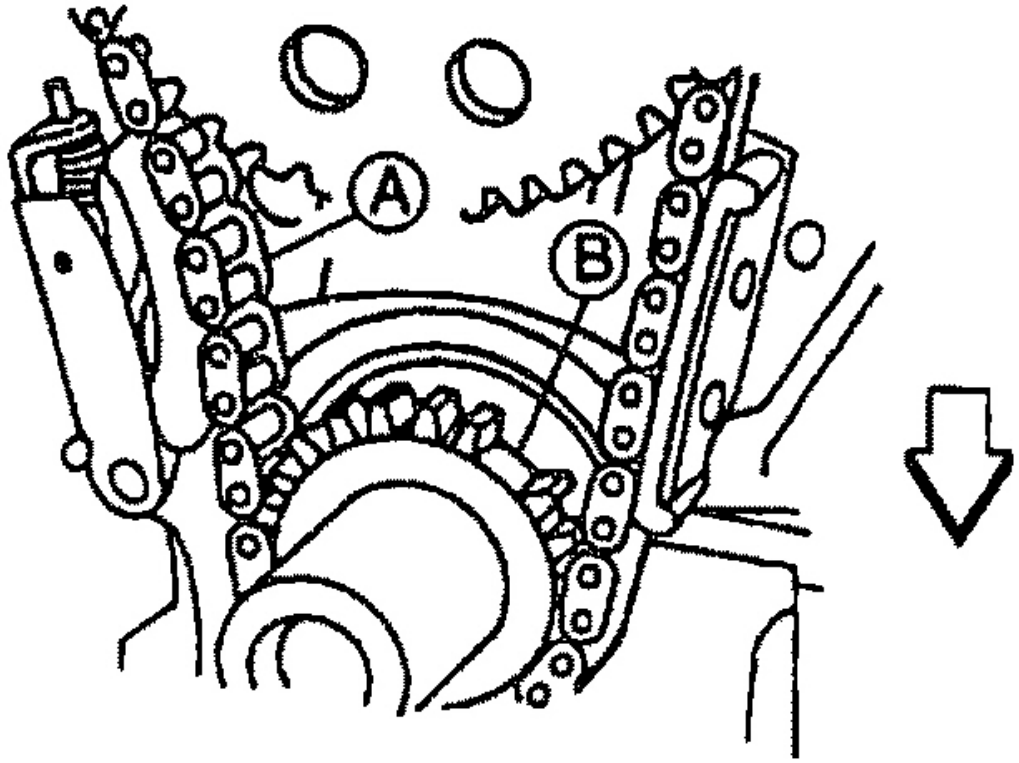
- **Specifications show the expected minimum or maximum condition.**

NOTE:

- **If a component fails to meet the specifications, it is necessary to replace or refinish. If the component can be refinished, wear limits are provided as an aid to making a decision. Any component that fails to meet specifications and cannot be refinished must be replaced.**

1. Inspect the (A) timing chain/belt and the (B) sprockets.

- Replace as necessary.



G02821339

Fig. 204: Inspecting Timing Chain/Belt & Sprockets
Courtesy of MAZDA MOTORS CORP.

CYLINDER HEAD INSPECTION

NOTE:

- **Do not remove more than 0.25 mm (0.010) of material from cylinder head.**

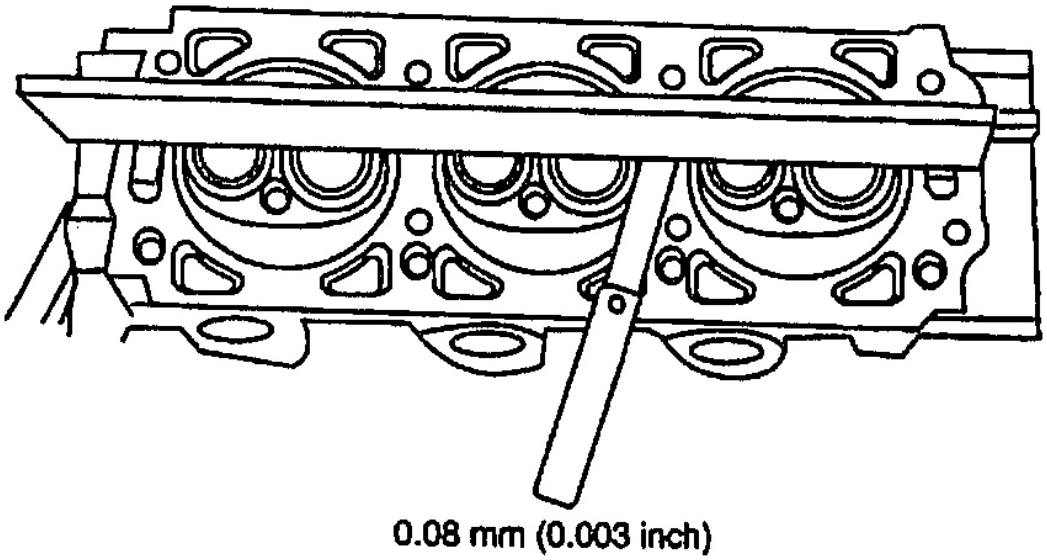


Fig. 205: Inspecting Cylinder Head For Flatness
Courtesy of MAZDA MOTORS CORP.

1. Inspect the cylinder head for flatness using a flat edge **SST** 303-D039 or equivalent and a feeler gauge.

VALVE INSPECTION

VALVE INSPECTION

1. Measure the diameter of each intake valve stem at the points shown. Verify the diameter is within specification. Refer to **SPECIFICATIONS**.

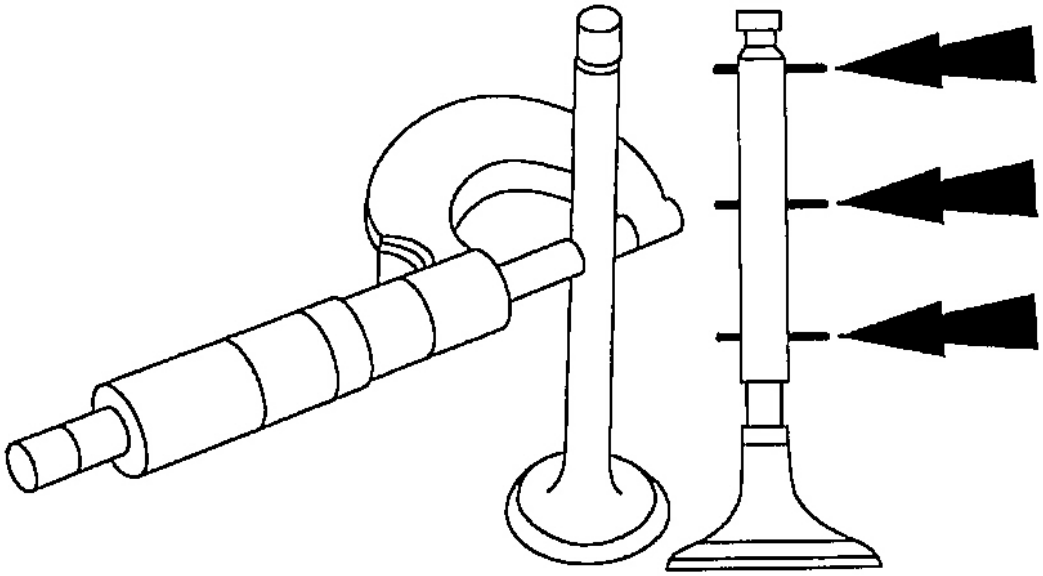


Fig. 206: Measuring Valve Stem Diameter
Courtesy of MAZDA MOTORS CORP.

2. Measure the diameter of each exhaust valve stem at the points shown. Verify the diameter is within specification. Refer to **CYLINDER HEAD & VALVE SPECIFICATIONS**.
3. Inspect the following valve areas:
    - The (A) end of the stem for grooves or scoring.
    - The (B) valve face for pits, grooves or scores.
    - The (C) valve head for signs of burning, erosion, warpage and cracking. Minor pits, grooves and other abrasions may be removed.
    - The (D) valve face angle for wear.

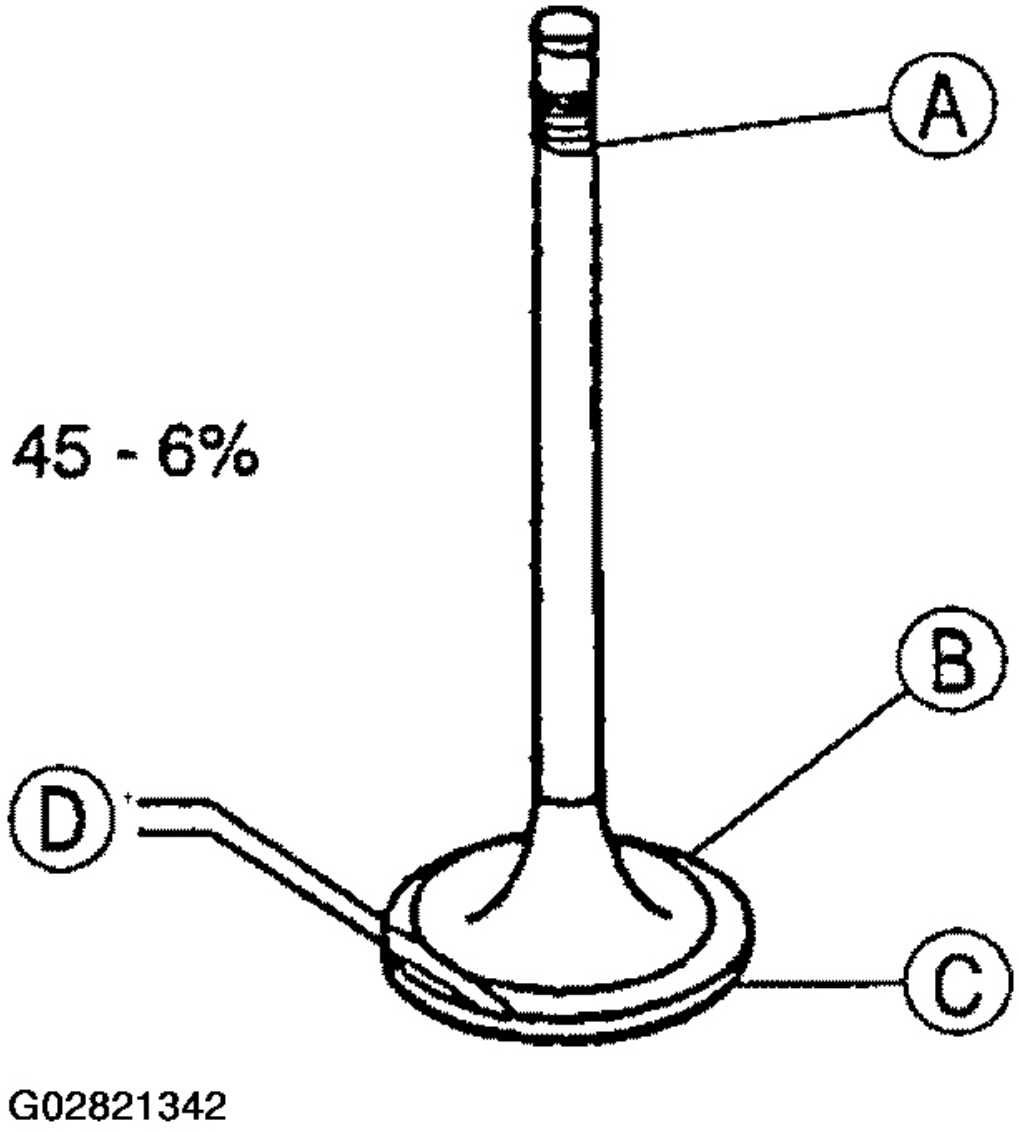


Fig. 207: Inspecting Valves
Courtesy of MAZDA MOTORS CORP.

VALVE STEM OIL CLEARANCE INSPECTION

NOTE:

- **The valve stem diameter must be within specification before checking valve stem-to-valve guide clearance.**

1. Install the Valve Stem Checking Tool **SST** 303-004 or equivalent on the valve stem and install Dial

Indicator With Bracketry **SST** 100-002 or equivalent. Lower the valve until the Valve Stem Checking Tool contacts the upper surface of the valve guide.

2. Move the Valve Stem Checking Tool toward the Dial Indicator and zero the Dial Indicator. Move the Valve Stem Checking Tool away from the Dial Indicator and note the reading. The reading will be double the valve stem-to-valve guide clearance. Valves with oversize stems will need to be installed if out of specification.

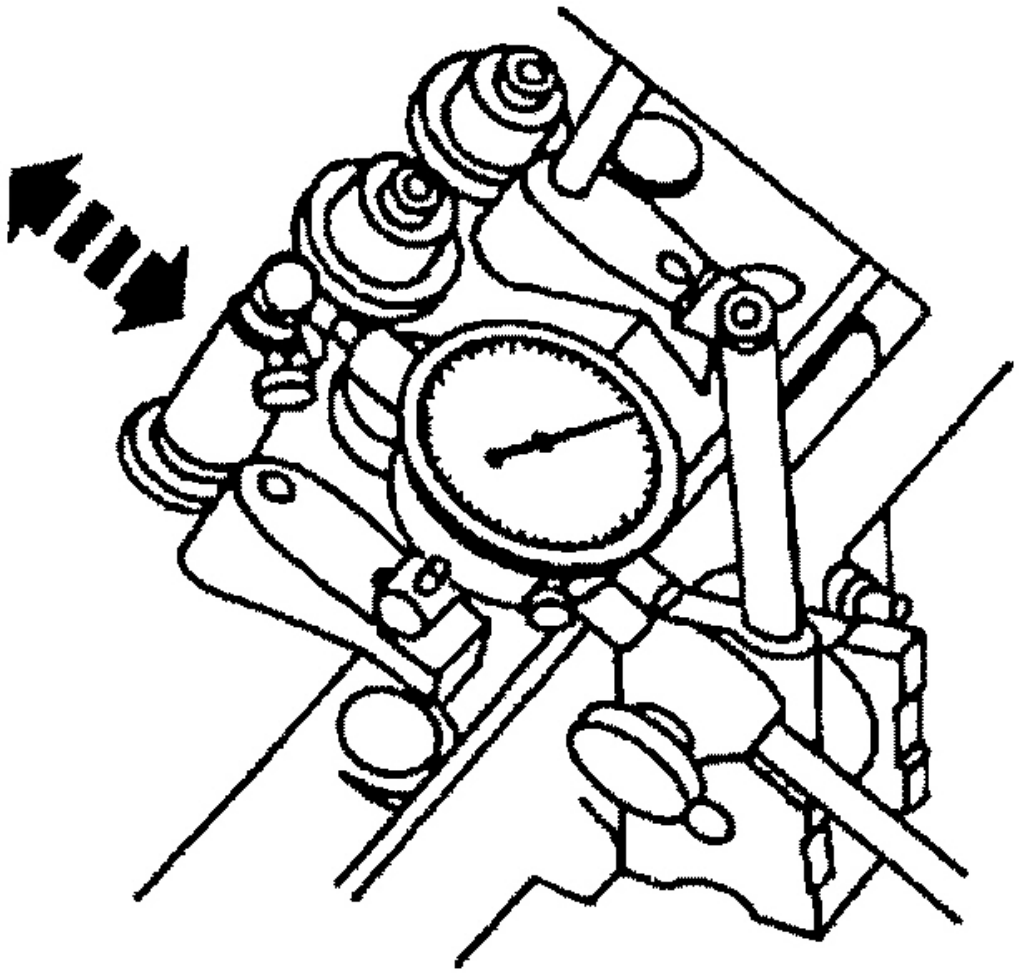


Fig. 208: Checking Valve Stem-To-Valve Guide Clearance
Courtesy of MAZDA MOTORS CORP.

VALVE CLEARANCE INSPECTION

1. The 4.0L SOHC engine uses non-adjustable tappets and non-adjustable roller followers. If the valve tappets are found to be excessively worn or noisy, they should be replaced.

VALVE GUIDE INSPECTION/REPAIR

VALVE GUIDE INSPECTION

1. Measure the inner diameter of the valve guides in two directions where indicated. Verify the diameter is within specification. Refer to **CYLINDER HEAD & VALVE SPECIFICATIONS**.
2. If the valve guide is not within specifications, ream the valve guide and install a valve with an oversize stem or remove the valve guide and install a new valve guide.

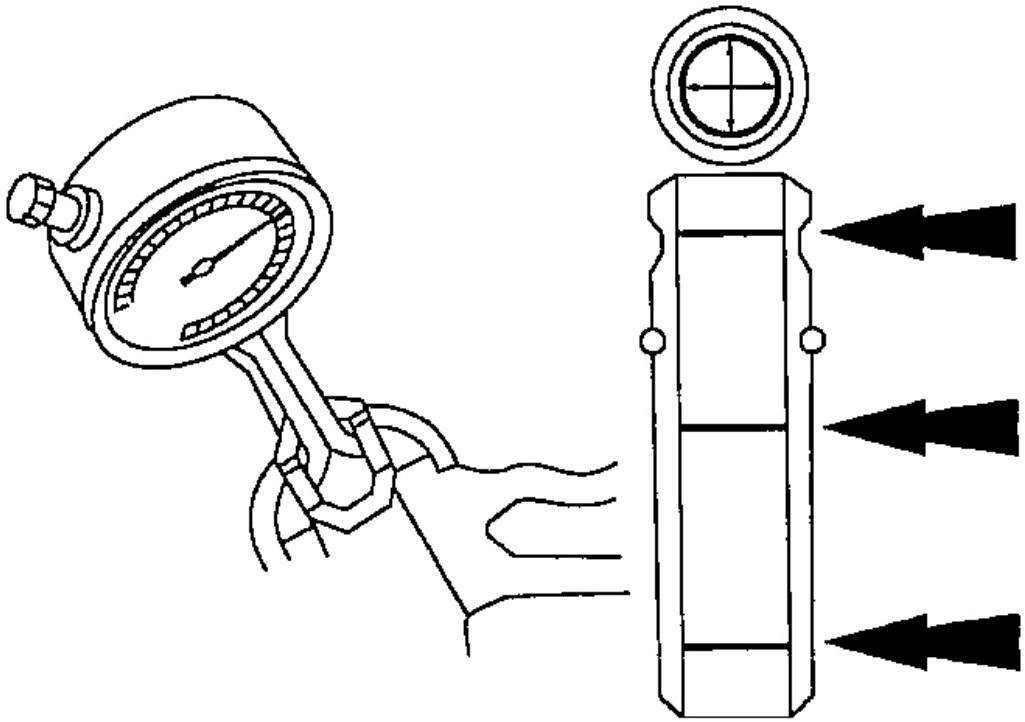


Fig. 209: Measuring Valve Guide Inner Diameter
Courtesy of MAZDA MOTORS CORP.

VALVE GUIDE REPAIR

CAUTION:
- **Always reface the valve seat after the valve guide has been reamed,**

and use a suitable scraper to break the sharp corner (ID) left by the reamer at the top of the valve guide.

The interference angle of the valve and seat should not be lapped out. Remove grooves or score marks from the end of the valve stem, and chamfer it as necessary. Do not remove more than 0.254 mm (0.010 in) from the end of the valve stem.

NOTE:

- **If oversize valve stems and oversize stem seals are not available, bore out original guide and install service bushing. Ream ID for specified clearance for standard size valve. Reface valve seat as required. Install standard size valve stem seal.**

1. Use a hand-reaming kit to ream the valve guide.

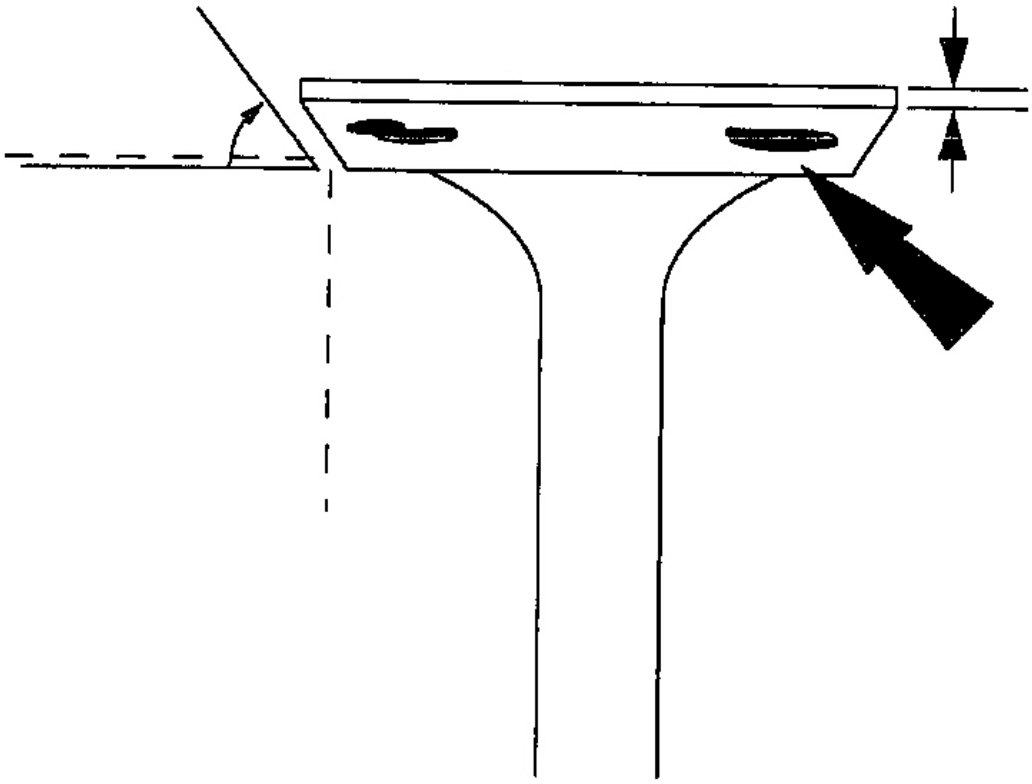


Fig. 210: Reaming Valve Guide
Courtesy of MAZDA MOTORS CORP.

2. Reface the valve seat.
3. Clean the sharp edges of the valve guide inner diameter left by reaming.

VALVE SEAT INSPECTION

VALVE AND SEAT REFACING MEASUREMENTS

CAUTION:
- **After grinding valves or valve seats, check valve clearance.**

1. Check the valve head and seat.
    1. Check valve angles.
    2. Check margin width.
    3. For additional information, refer to **CYLINDER HEAD & VALVE SPECIFICATIONS**.
    4. Be sure margin width is within specification.

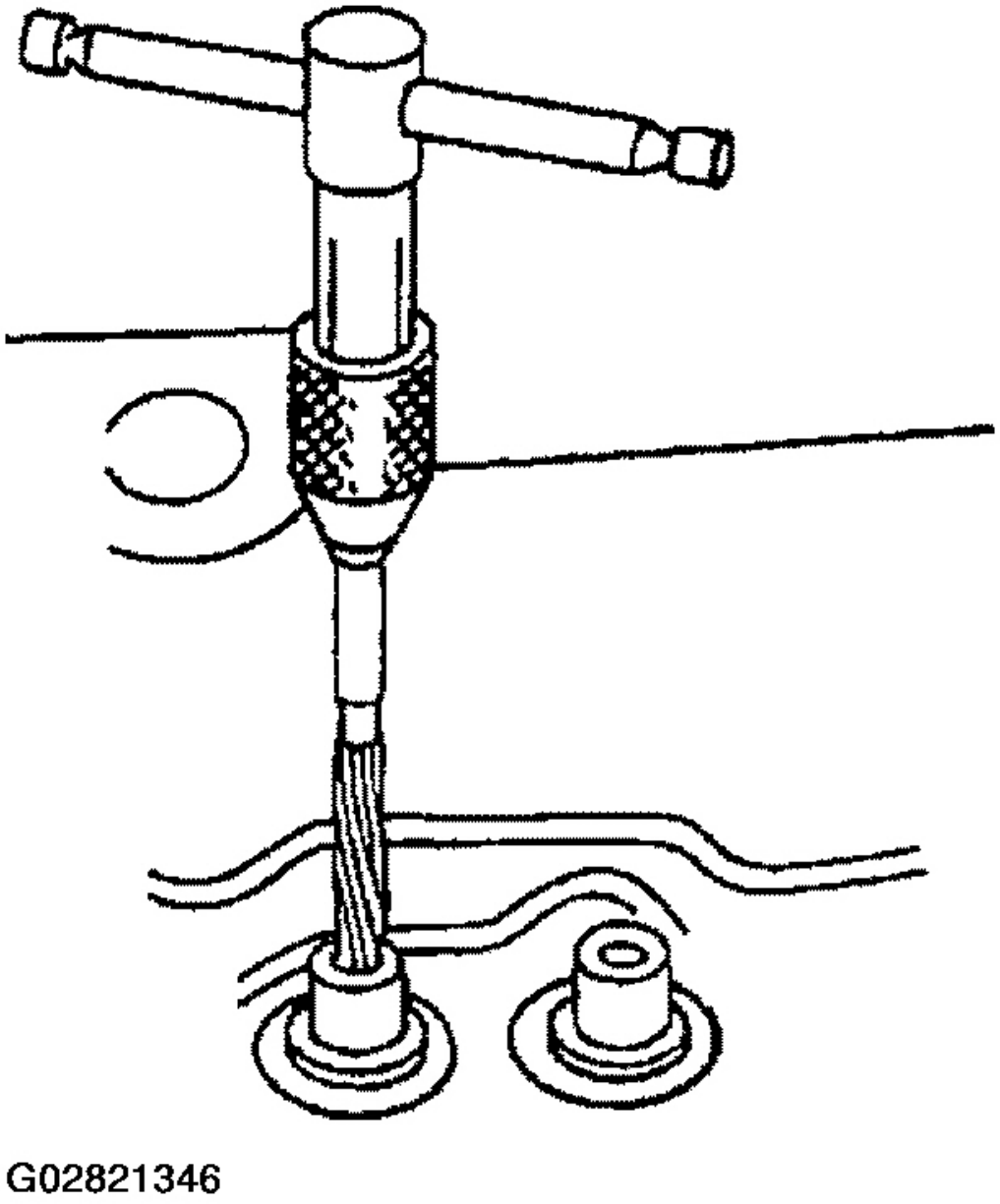


Fig. 211: Checking Valve Head & Seat
Courtesy of MAZDA MOTORS CORP.

2. Inspect for abnormalities on the valve face and seat.

VALVE SEAT WIDTH

1. Measure the valve seat width. If necessary, grind the valve seat to specification.
    1. Measure the intake valve seat width.
    2. Measure the exhaust valve seat width.
    3. Recheck the valve spring installed length after the seats have been ground, and shim the valve springs as necessary to achieve the correct installed spring length.
    4. For additional information, refer to **CYLINDER HEAD & VALVE SPECIFICATIONS**.

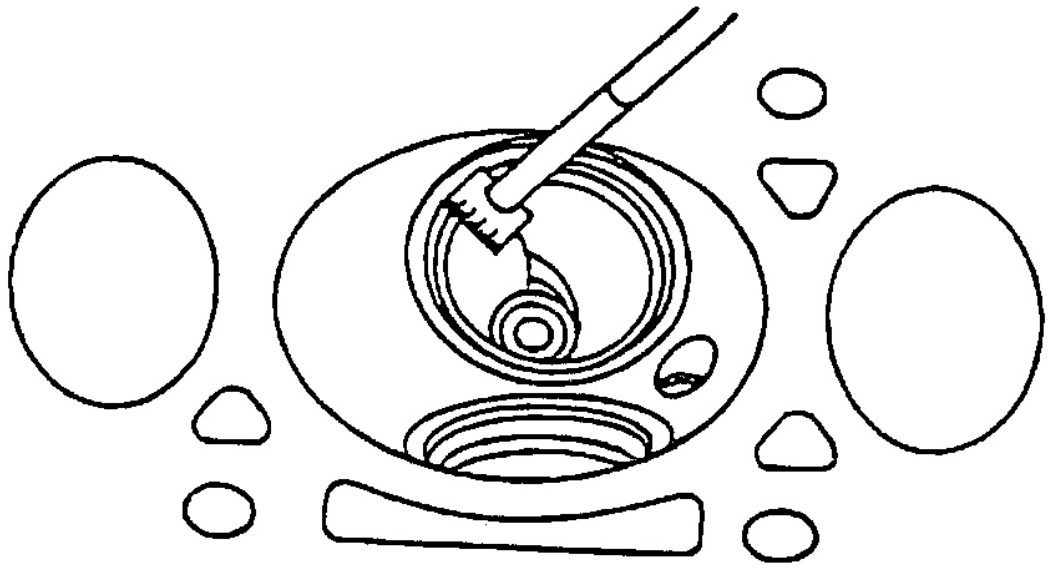
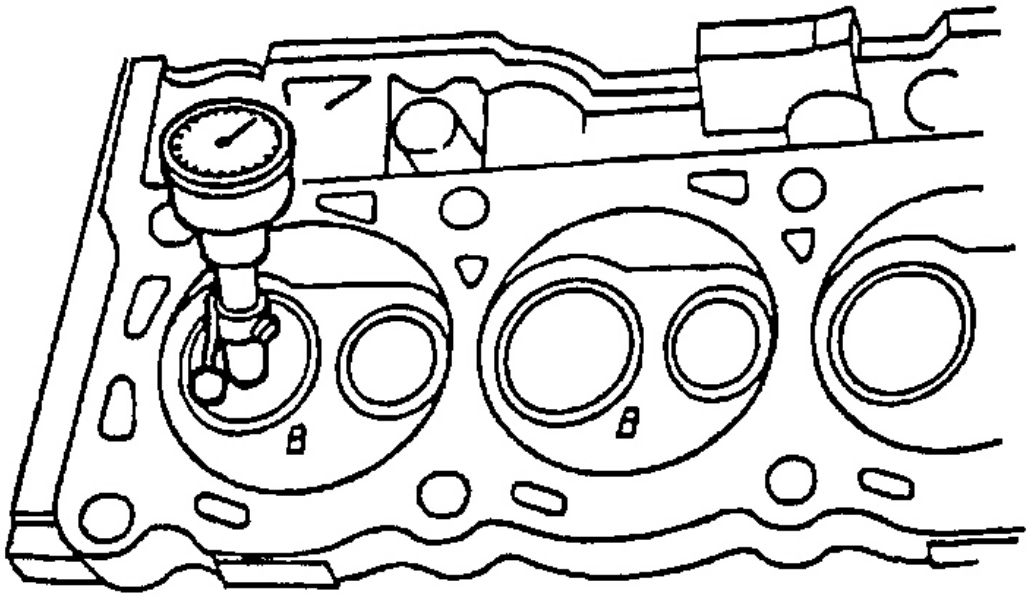


Fig. 212: Measuring Valve Seat Width
Courtesy of MAZDA MOTORS CORP.

VALVE SEAT RUNOUT

1. Use the Valve Seat Runout Gauge to check valve seat runout.



G02821348

Fig. 213: Checking Valve Seat Runout
Courtesy of MAZDA MOTORS CORP.

VALVE SPRING INSPECTION

1. Measure the installed length of each valve spring. Verify the length is within specification. Refer to **SPECIFICATIONS**.
2. Measure the free length of each valve spring. Verify the length is within specification. Refer **SPECIFICATIONS**.

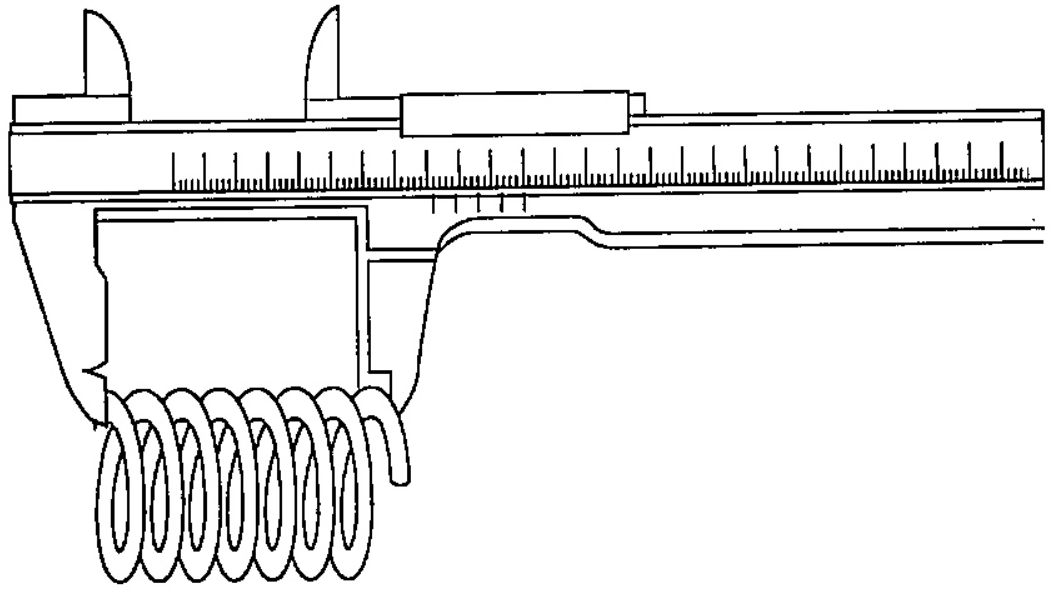


Fig. 214: Measuring Valve Spring Free Length
Courtesy of MAZDA MOTORS CORP.

3. Measure the out-of-square on each valve spring.
    1. Turn the valve spring and observe the space between the top of the valve spring and the square.
    2. Replace the valve spring if out of specification. Refer to **CYLINDER HEAD & VALVE SPECIFICATIONS**.

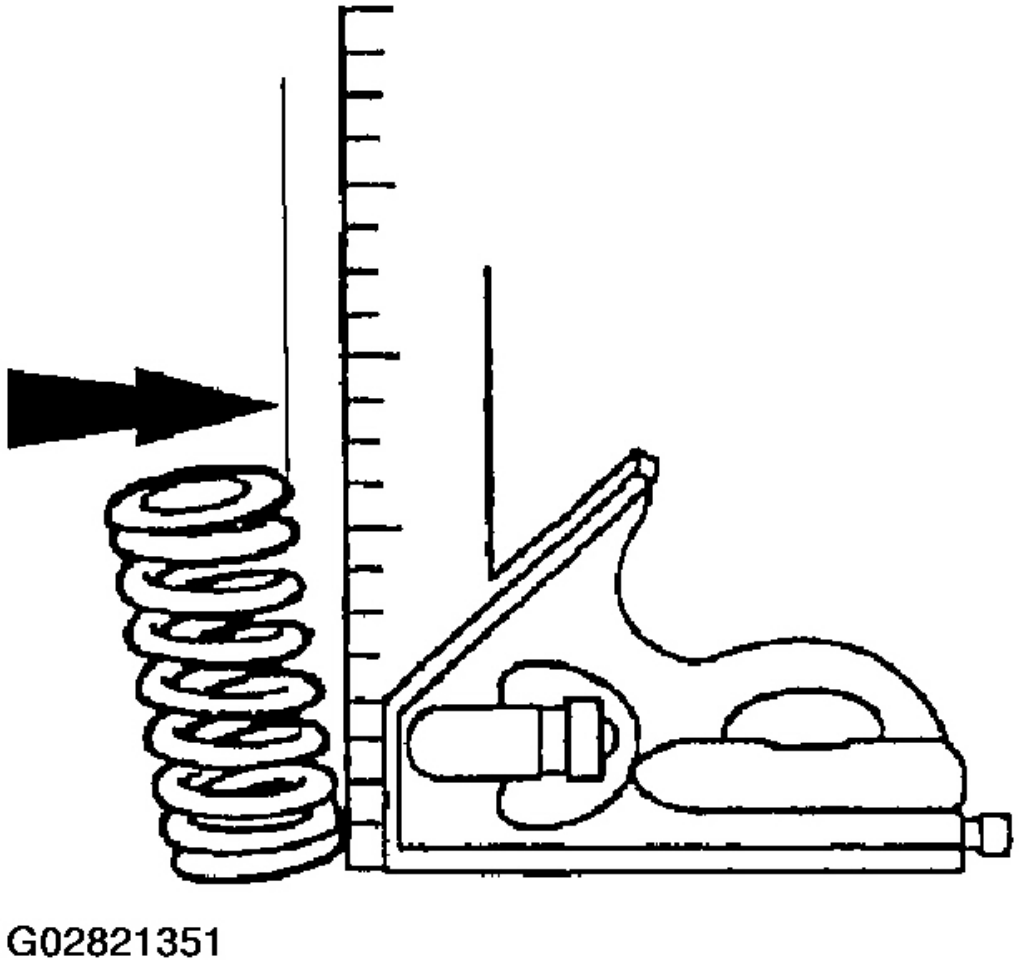


Fig. 215: Measuring Valve Spring Out-Of-Square
Courtesy of MAZDA MOTORS CORP.

4. Check the valve springs for proper strength at the specified valve spring length.

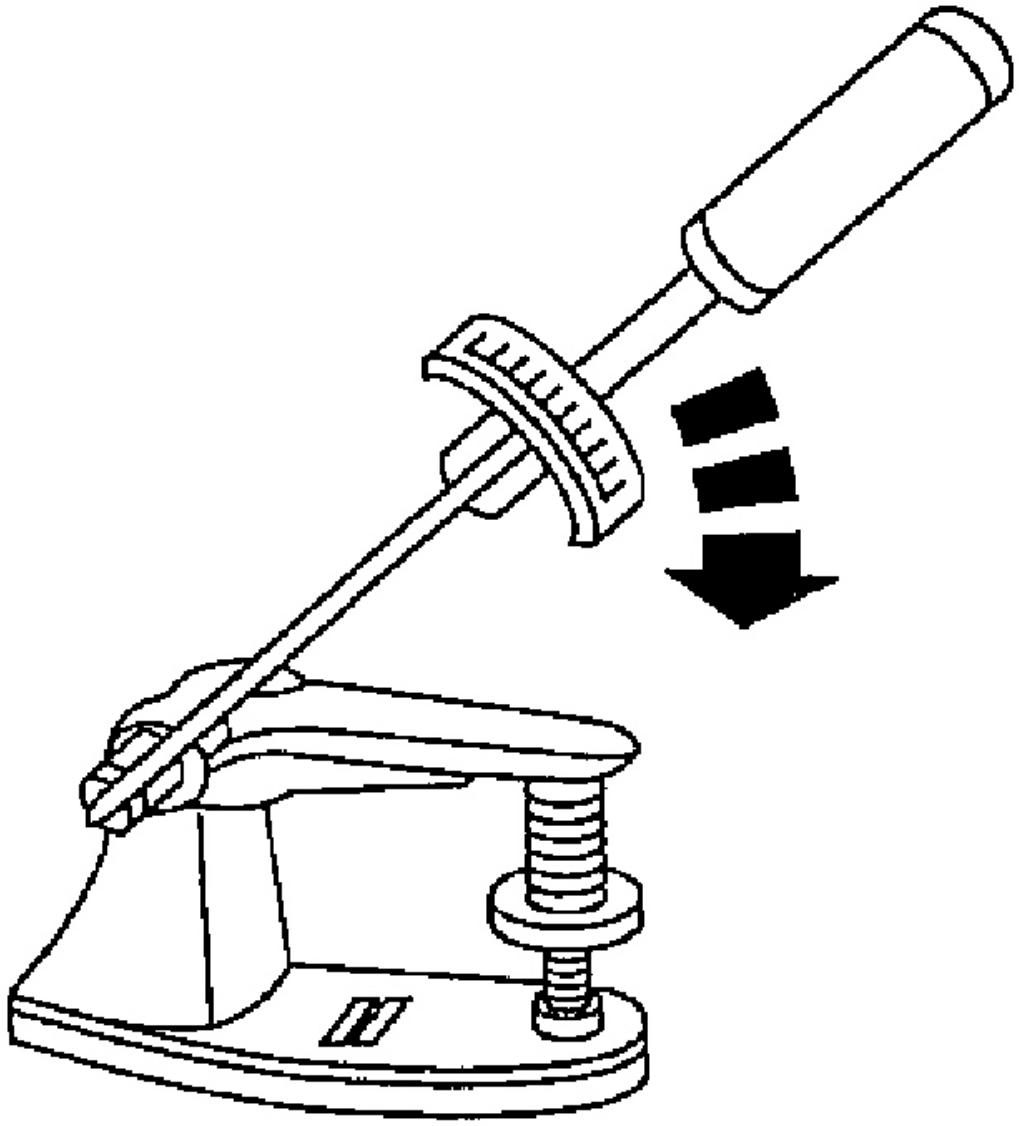


Fig. 216: Measuring Valve Spring Strength
Courtesy of MAZDA MOTORS CORP.

SPARK PLUG HOLE THREAD REPAIR

CAUTION:

- **The cylinder head must be removed from the engine before installing a tapersert. If this procedure is done with the cylinder head on the**

engine, the cylinder walls can be damaged by metal chips produced by the thread-cutting process.

Do not use power or air-driven tools for installing taperserts. Cylinder head damage may occur.

NOTE:

- **This repair is permanent and will have no effect on the cylinder block or spark plug life.**

1. Clean the spark plug seat and threads.

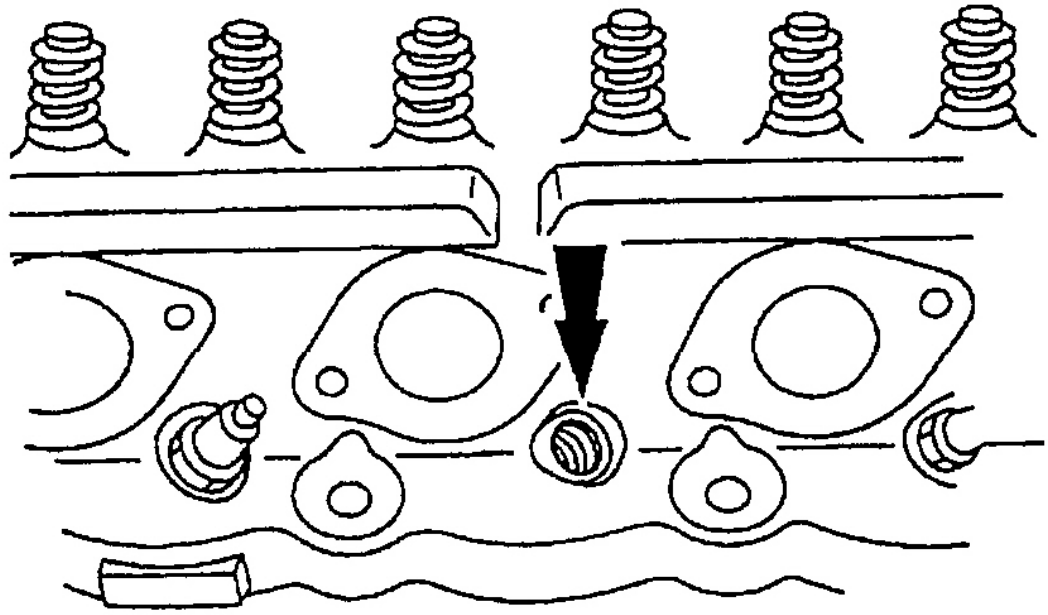
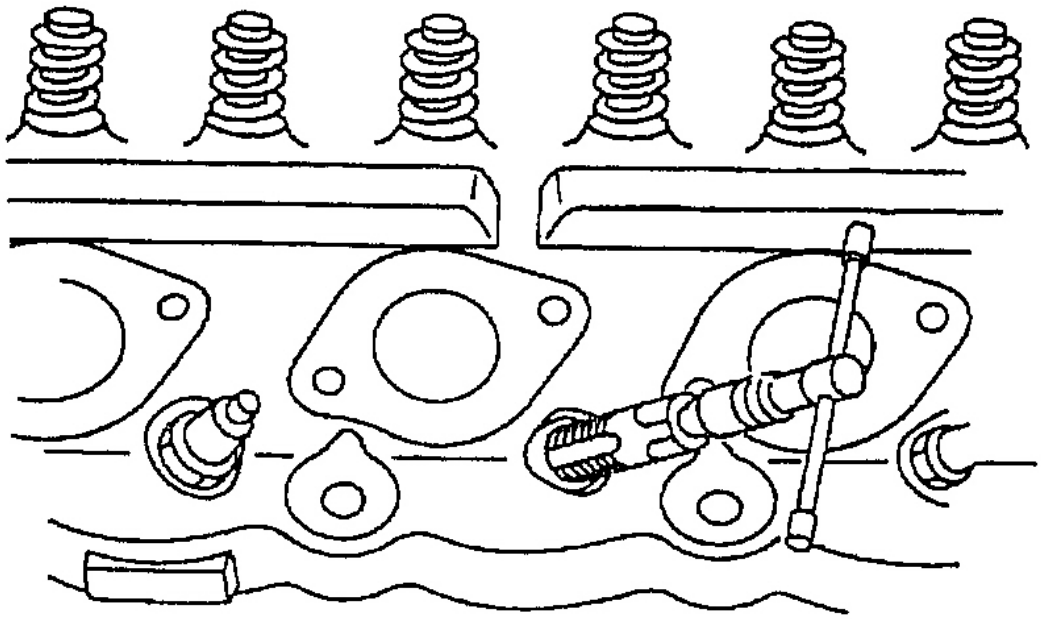


Fig. 217: Cleaning Spark Plug Seat & Threads
Courtesy of MAZDA MOTORS CORP.

2. Start the tap into the spark plug hole, being careful to keep it properly aligned. As the tap begins to cut new threads, apply cutting oil.



G02821354

Fig. 218: Tapping Into Spark Plug Hole
Courtesy of MAZDA MOTORS CORP.

3. Continue cutting the threads and applying oil until the stop ring bottoms against the spark plug seat.
4. Remove the tap and metal chips.
5. Coat the threads of the mandrel with cutting oil. Thread the tapersert onto the mandrel until one thread of the mandrel extends beyond the tapersert.

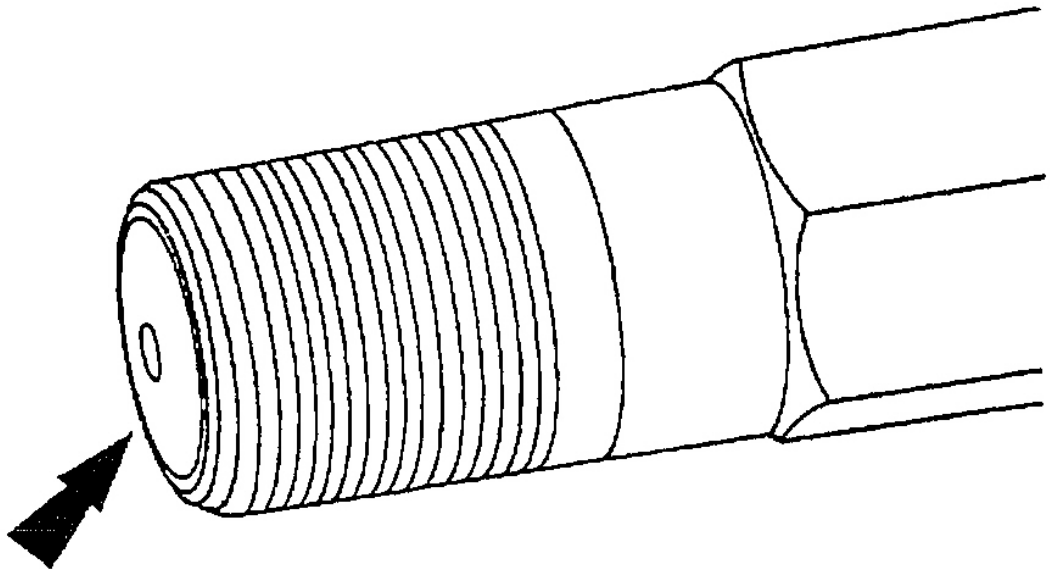


Fig. 219: Identifying Tapersert
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **A properly installed tapersert will be either flush with or 1.0 mm (0.039 in) below the spark plug gasket seat.**

6. Tighten the tapersert into the spark plug hole.
7. Turn the mandrel body approximately one-half turn counterclockwise and remove.

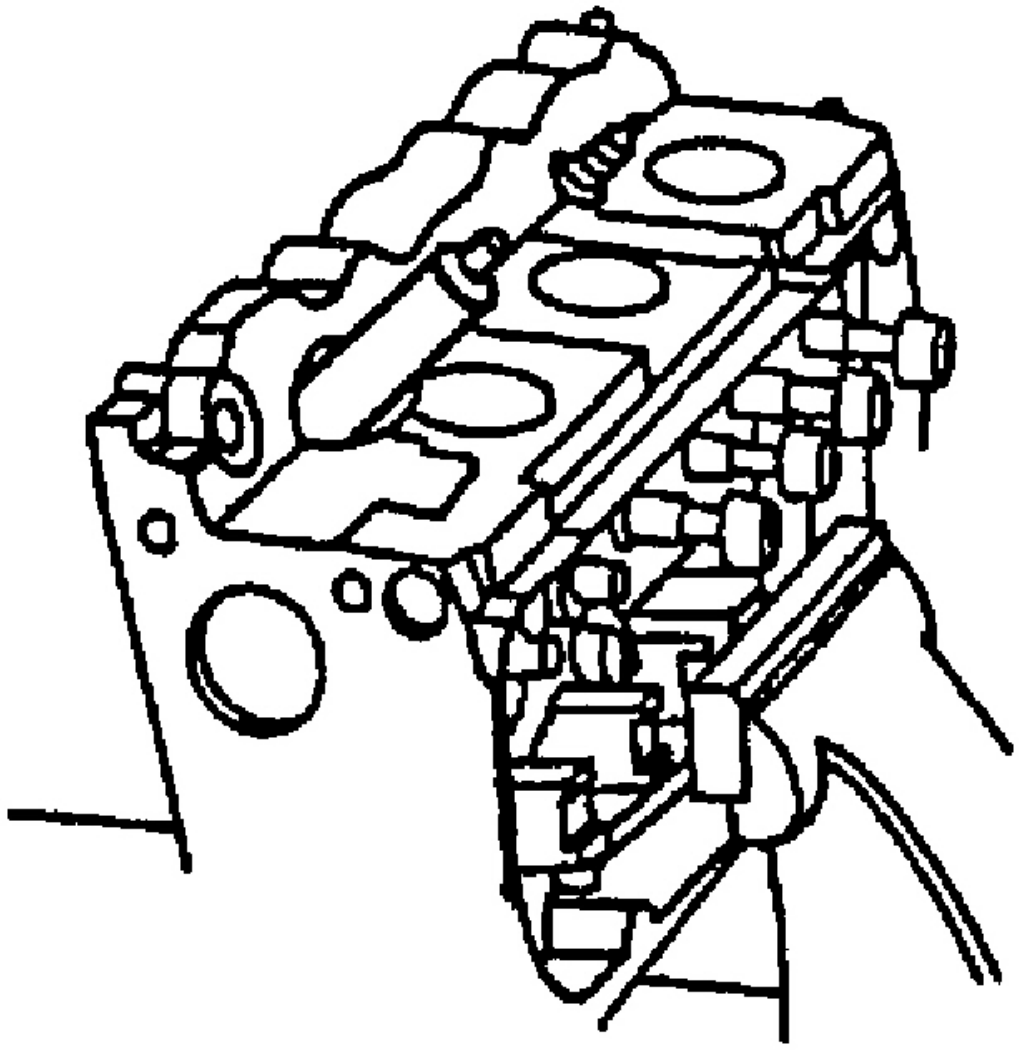


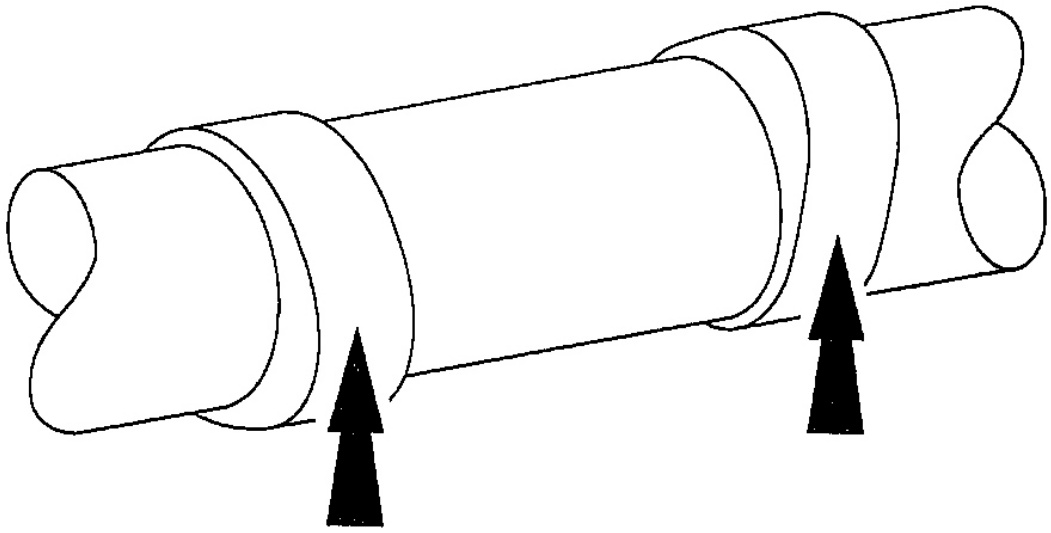
Fig. 220: Identifying Taperset In Spark Plug Hole
Courtesy of MAZDA MOTORS CORP.

8. Use a feeler gauge and straightedge to check for cylinder head flatness. Refer to **CYLINDER HEAD INSPECTION**.

CAMSHAFT INSPECTION

CAMSHAFT LOBE SURFACE

1. Inspect camshaft lobes for pitting or damage in the contact area. Minor pitting is acceptable outside the contact area.



G02821357

Fig. 221: Inspecting Camshaft Lobes
Courtesy of MAZDA MOTORS CORP.

1. If excessive pitting or damage is present, install new components as necessary. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.

CAMSHAFT LOBE LIFT

1. Using Dial Indicator with Bracketry SST 100-002 or equivalent, measure camshaft intake lobe lift and exhaust lobe lift.

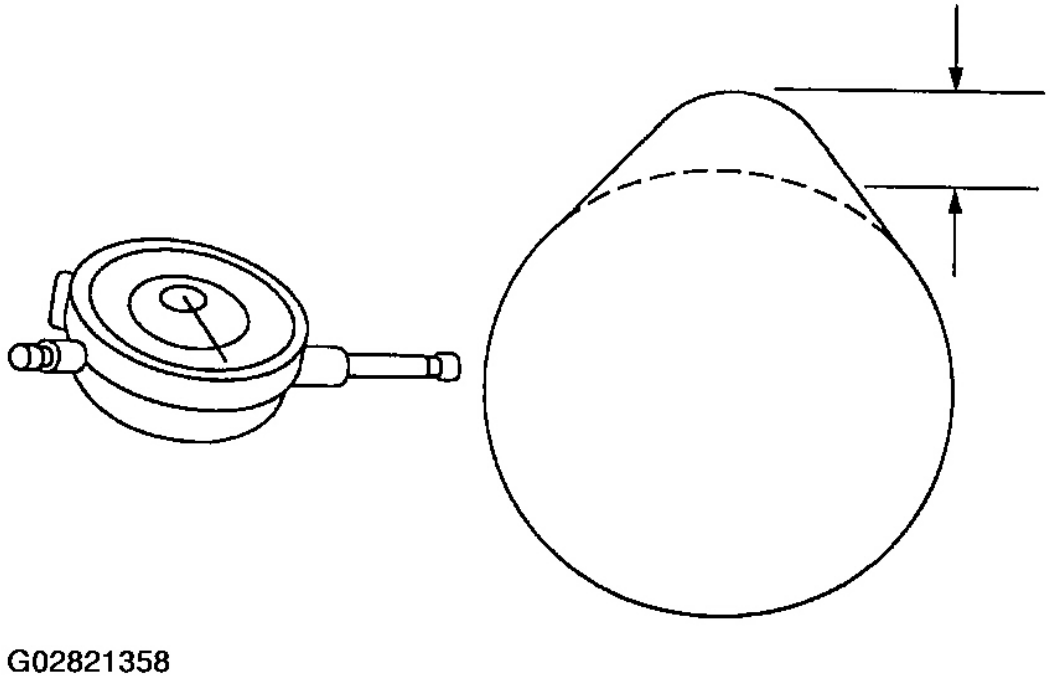


Fig. 222: Measuring Camshaft Lobe Lift
Courtesy of MAZDA MOTORS CORP.

2. Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading to figure the camshaft lobe lift.
3. For additional information, refer to **CAMSHAFT SPECIFICATIONS**.

CAMSHAFT JOURNAL DIAMETER

1. Measure each camshaft journal in two directions.
    1. For additional information, refer to **CAMSHAFT SPECIFICATIONS**.
    2. If out of specification, install new components as necessary.

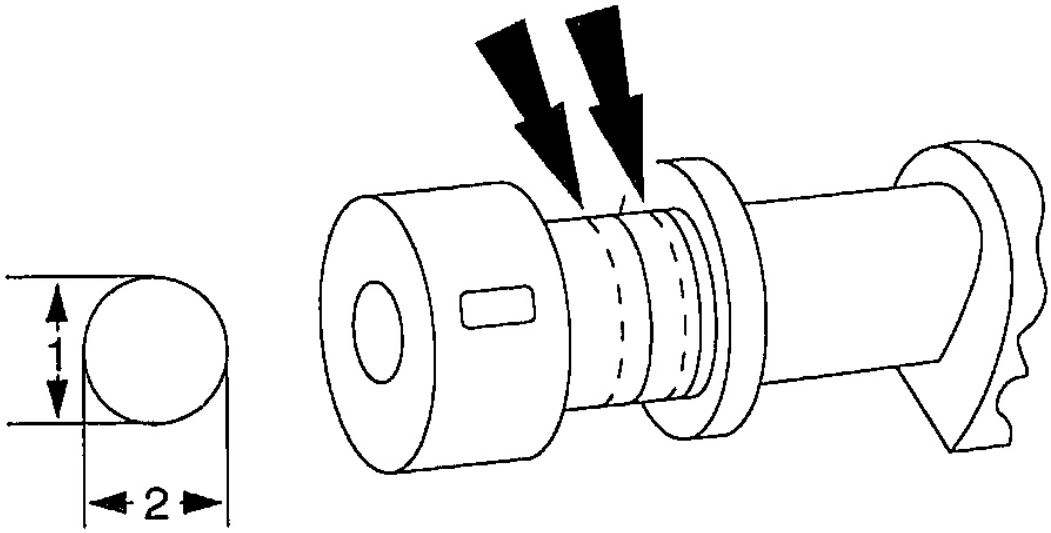


Fig. 223: Measuring Camshaft Journal
Courtesy of MAZDA MOTORS CORP.

CAMSHAFT RUNOUT

NOTE:

- **Camshaft journals must be within specifications before checking runout.**

1. Using Dial Indicator with Bracketry SST 100-002 or equivalent, measure the camshaft runout.
    1. Rotate the camshaft and subtract the lowest indicator reading from the highest indicator reading.
    2. For additional information, refer to **CAMSHAFT SPECIFICATIONS**.
    3. If out of specification, install new components as necessary. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.

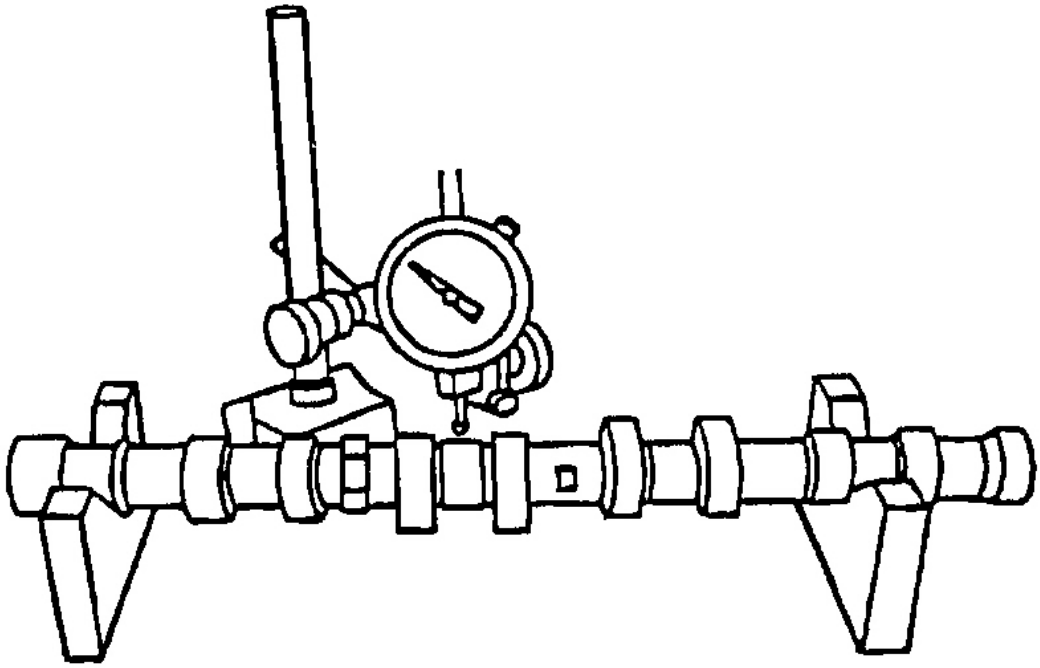


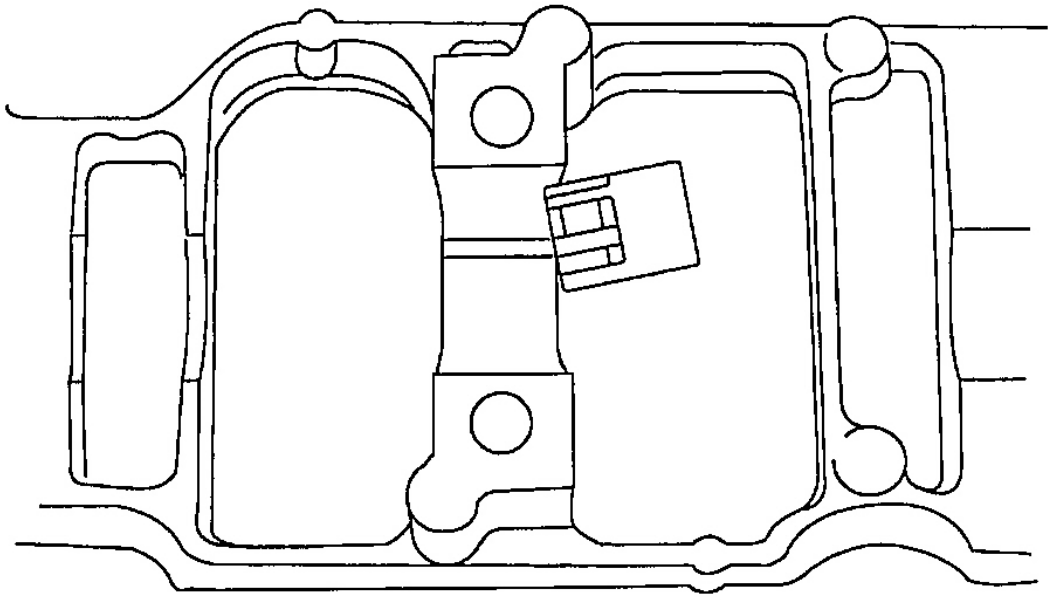
Fig. 224: Measuring Camshaft Runout
Courtesy of MAZDA MOTORS CORP.

CAMSHAFT JOURNAL CLEARANCE

1. Remove the camshaft bearing cap and lay Plastigage **SST** 303-D031 or equivalent across the surface.

NOTE:
- **Do not turn the camshaft while carrying out this procedure.**

2. Position the camshaft bearing cap and install the bolts.



G02821361

Fig. 225: Using Plastigage To Measure Camshaft Journal Clearance
Courtesy of MAZDA MOTORS CORP.

3. Use Plastigage to verify the camshaft journal clearance.
    1. For additional information, refer to **CAMSHAFT SPECIFICATIONS**.
    2. If out of specification, install new components as necessary. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.

CAMSHAFT END PLAY INSPECTION

1. Remove the roller followers. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.
2. Use Dial Indicator with Bracketry SST 100-002 or equivalent to measure camshaft endplay.
3. Position the camshaft to the rear of the cylinder head.
4. Zero the indicator.
5. Move the camshaft to the front of the cylinder head. Note and record the camshaft endplay.
    1. If camshaft endplay exceeds specification, refer to **CAMSHAFT SPECIFICATIONS**. Install a new camshaft and recheck endplay. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.
    2. If camshaft endplay exceeds specification after camshaft installation, install a new cylinder head. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.

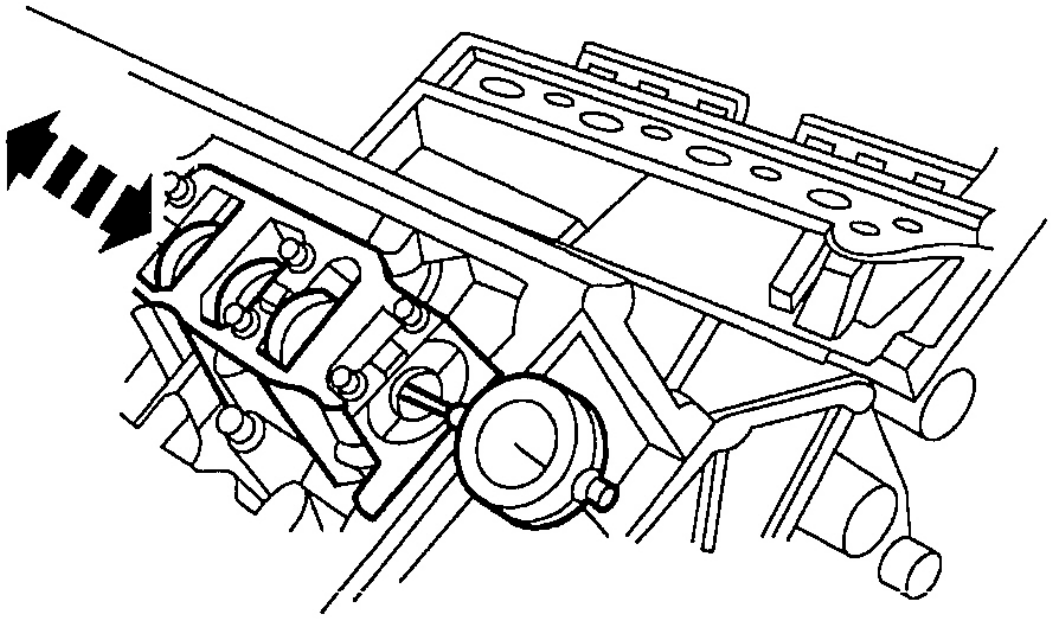


Fig. 226: Measuring Camshaft Endplay
Courtesy of MAZDA MOTORS CORP.

ROLLER FOLLOWER INSPECTION

ROLLER FOLLOWER INSPECTION

1. Inspect the roller for flat spots or scoring. If any damage is found, inspect the camshaft lobes and valve tappet for damage.

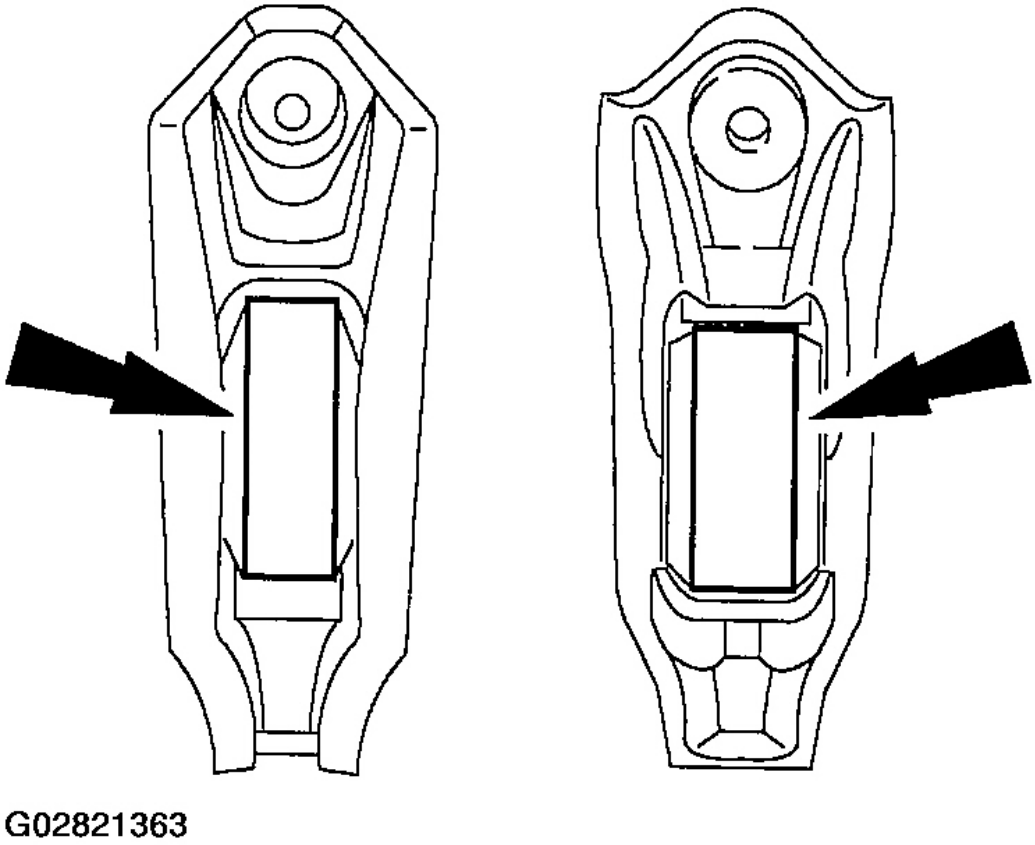


Fig. 227: Inspecting Roller
Courtesy of MAZDA MOTORS CORP.

2. Replace parts as necessary.

TAPPET INSPECTION

TAPPET INSPECTION

1. Inspect the valve tappet for damage. If any damage is found, inspect the camshaft lobes and valves for damage.

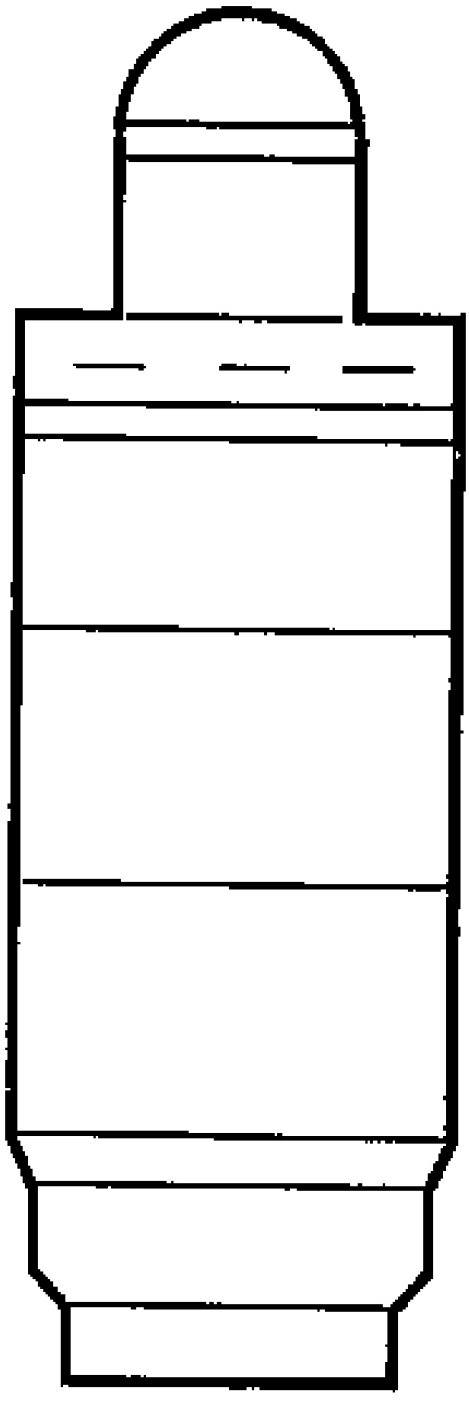


Fig. 228: Inspecting Tappet
Courtesy of MAZDA MOTORS CORP.

2. Replace parts as necessary.

CYLINDER BLOCK INSPECTION/REPAIR

CYLINDER BLOCK INSPECTION

1. Measure the cylinder bore at the top and bottom. Verify the cylinder bore is within the wear limit. The difference indicates the cylinder taper; bore the cylinder to the next oversize.

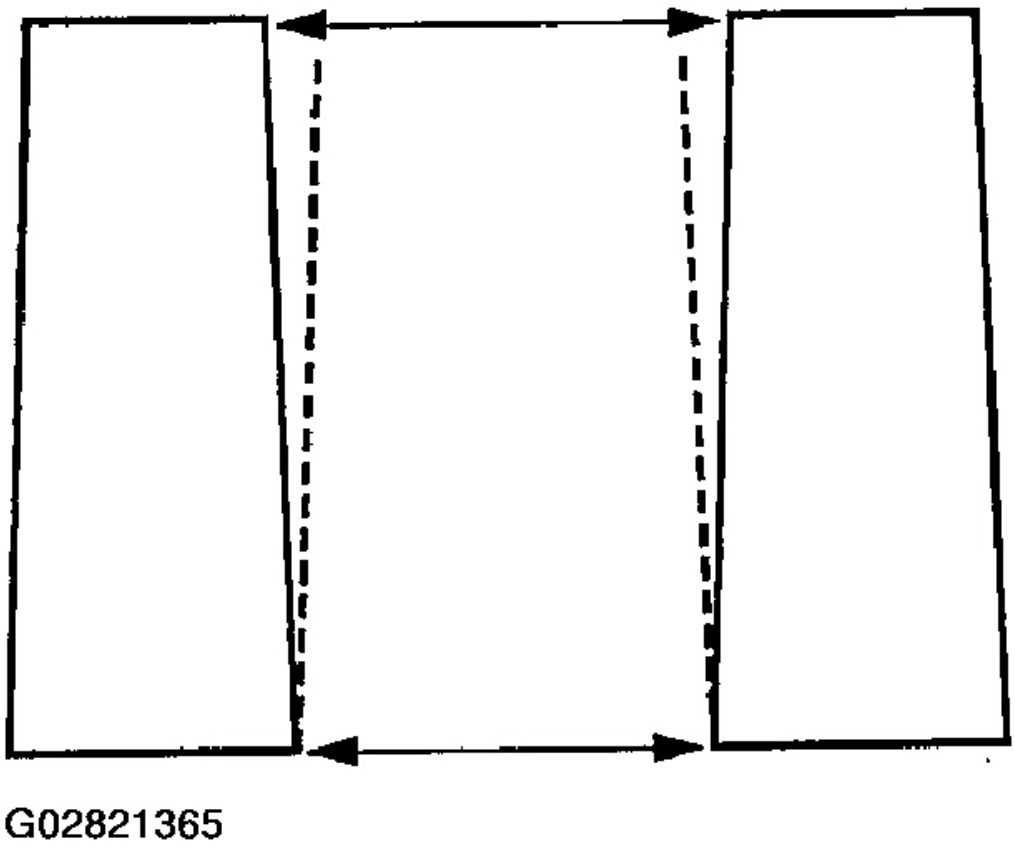


Fig. 229: Measuring Cylinder Bore Taper
Courtesy of MAZDA MOTORS CORP.

2. Measure the cylinder bore in two directions. The difference is the out-of-round. Verify the out-of-round is within the wear limit and bore the cylinder to the next oversize limit. Refer to **ENGINE SPECIFICATIONS**.

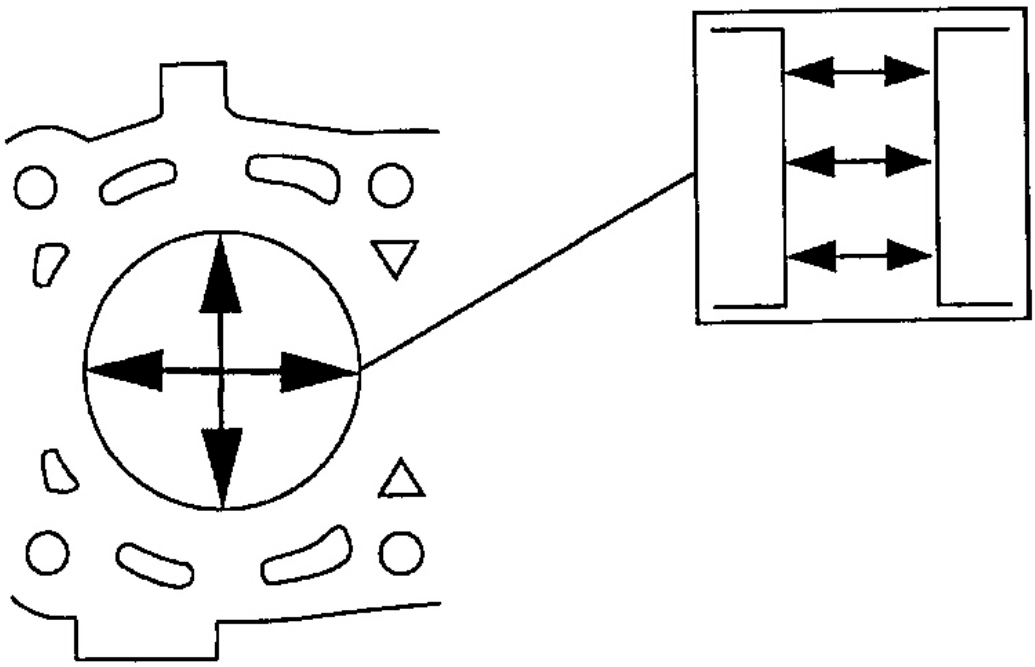
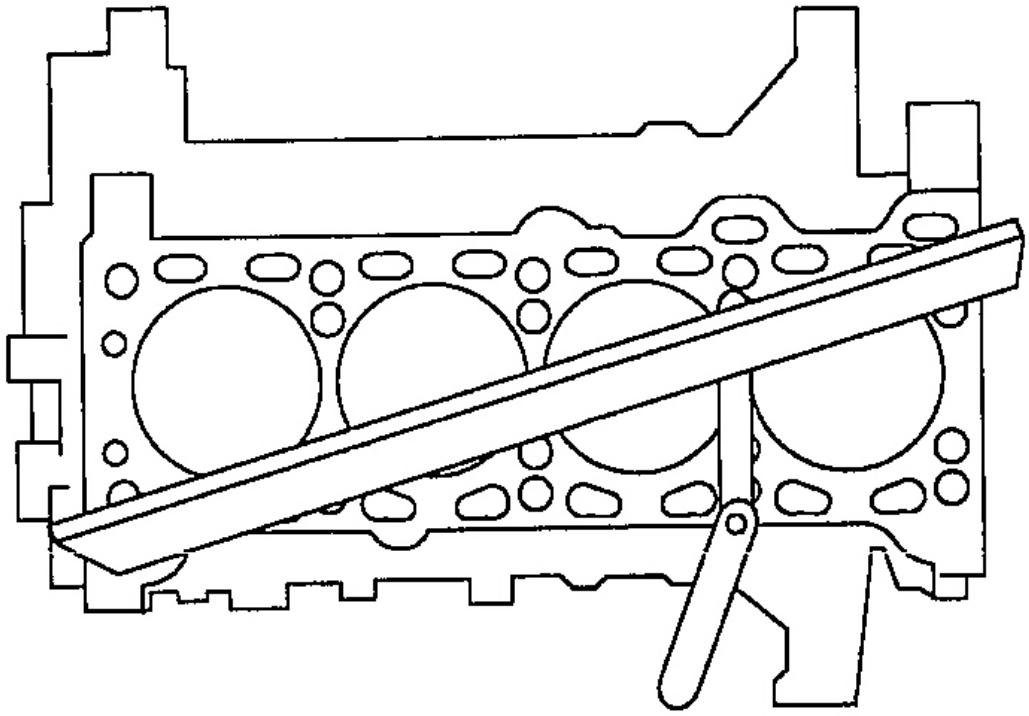


Fig. 230: Measuring Cylinder Out-Of-Round
Courtesy of MAZDA MOTORS CORP.

3. Use a straightedge SST 303-D039 or equivalent and a feeler gauge to inspect the head gasket surface for flatness. If the cylinder block is distorted, resurface the cylinder block within specification.
    - The head gasket surface is measured in six straight line directions for flatness.



G02821367

Fig. 231: Inspecting Head Gasket Surface For Flatness
Courtesy of MAZDA MOTORS CORP.

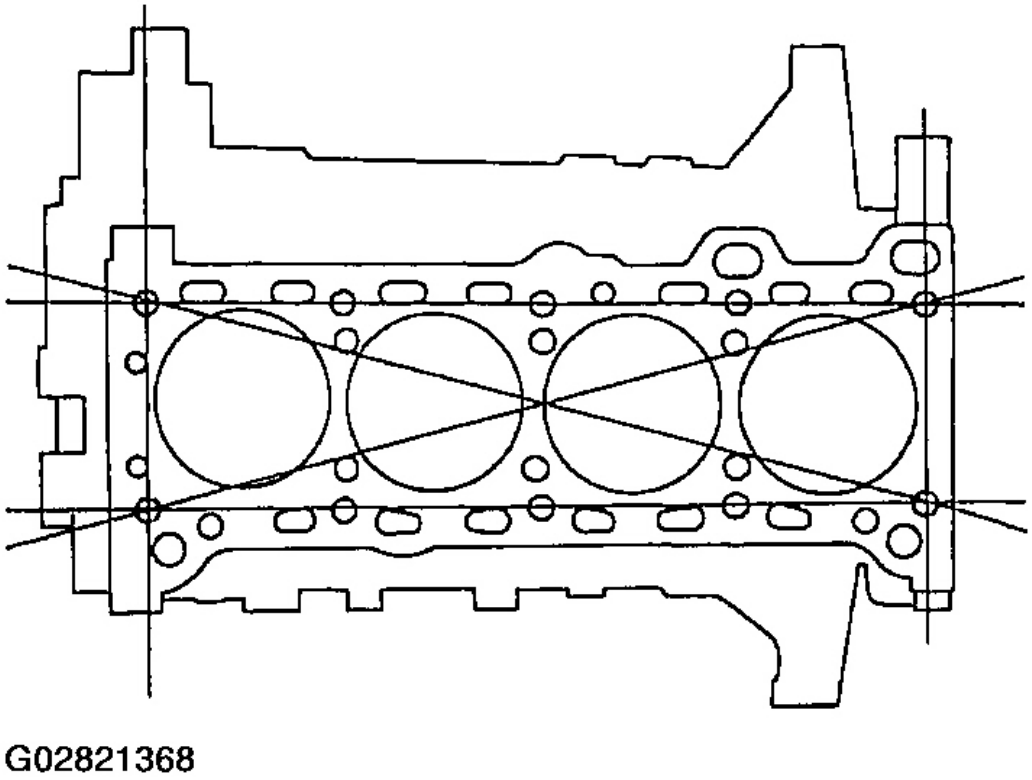


Fig. 232: Measuring Head Gasket Surface In Six Straight Line Directions
Courtesy of MAZDA MOTORS CORP.

CYLINDER BLOCK HONING

CAUTION:

- **After the final honing and prior to checking the piston fit, thoroughly clean the cylinder bore with a detergent and water solution. Then lightly coat the cylinder bore with Premium SAE 10W-30 Motor Oil.**

  When honing the cylinder bores, use a lubricant mixture of equal parts of kerosene and Premium SAE 10W-30 Motor Oil.

NOTE:

- **Before any cylinder bore is honed, all main bearing caps must be installed so that the crankshaft bearing bores will not become distorted.**

  To correct taper out-of-round, bore the cylinder block.

  Honing should be done when fitting new piston rings or removing minor surface imperfections.

1. Hone with the Engine Cylinder Hone Set T73L-6011-A or equivalent at a speed of 300-500 RPM and a hone grit of 180-200, to provide the desired cylinder bore surface finish of 18-38 AA.

CAUTION:
- **If these procedures are not followed, rusting of the cylinder bores may occur.**

2. Clean the cylinder bores with soap or detergent and water.
3. Thoroughly rinse with clean water and wipe dry with a clean, lint-free cloth.
4. Use a clean, lint-free cloth to lubricate the cylinder bores.
    - Use Super Premium 5W-30 SAE Motor Oil.

CYLINDER BLOCK CORE PLUG REPLACEMENT

1. Drill a small hole in the center of the engine block plug, then use the Impact Slide Hammer **SST** 211-5060 (T78P-3504-N) or equivalent to remove it.

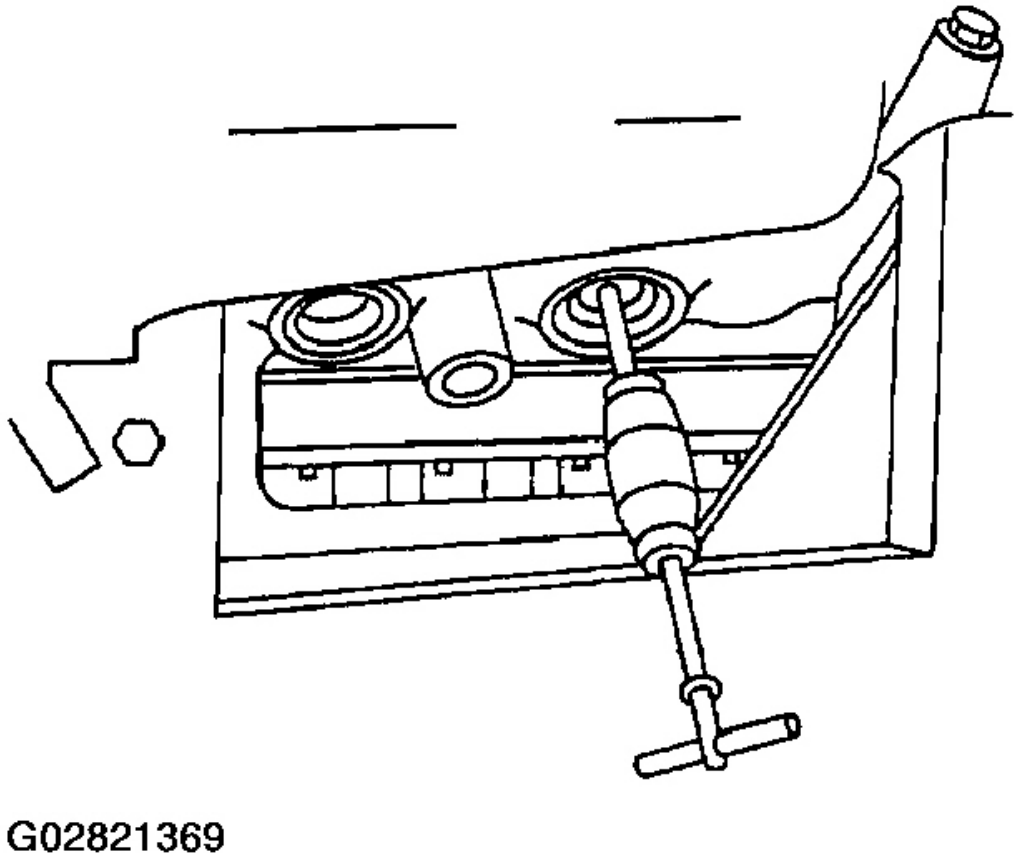
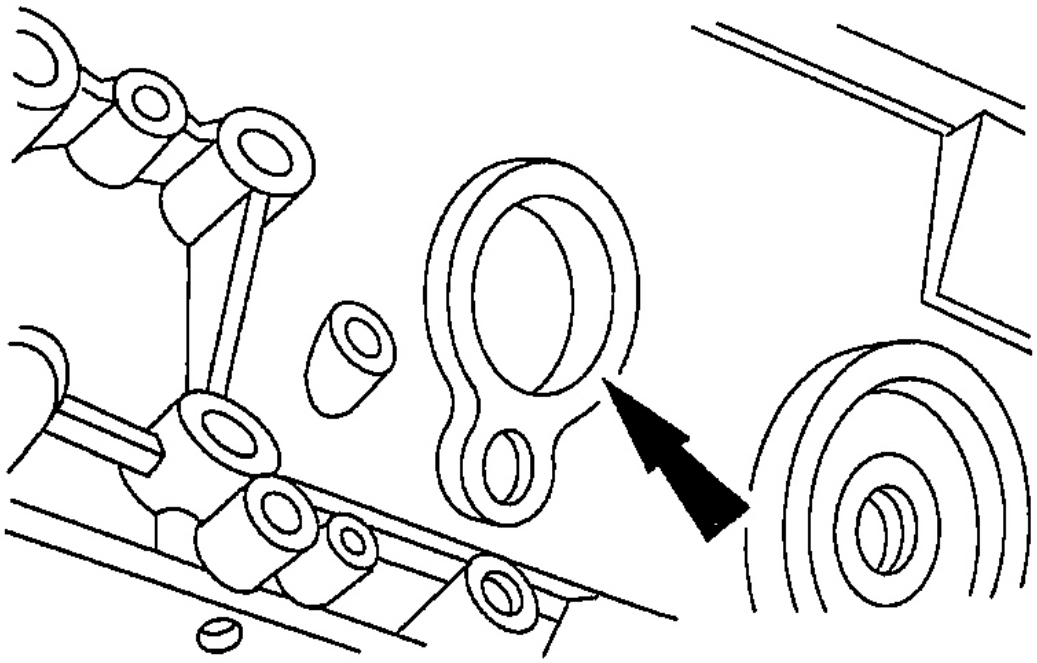


Fig. 233: Removing Engine Block Plug
Courtesy of MAZDA MOTORS CORP.

2. Inspect the cylinder block plug bore for any damage that would interfere with the proper sealing of the plug. If the cylinder block plug bore is damaged, bore for the next oversize plug.



G02821370

Fig. 234: Inspecting Cylinder Block Plug Bore
Courtesy of MAZDA MOTORS CORP.

NOTE:
- **Oversize plugs are identified by the "OS" stamped in the flat located on the cup side of the plug.**

3. Coat the engine block plug and bore lightly with an oil-resistant (oil galley) Stud and Bearing Mount and install the engine block plug.

CYLINDER BLOCK CORE PLUG INSTALLATION (CUP TYPE)

CAUTION:
- **Use care during this procedure so as not to disturb or distort the cup sealing surface.**

  When installed, the flanged edge must be below the chamfered edge of the bore to effectively seal the bore.

1. Use a cup-type core plug replacer tool to seat the cup-type engine block plug.

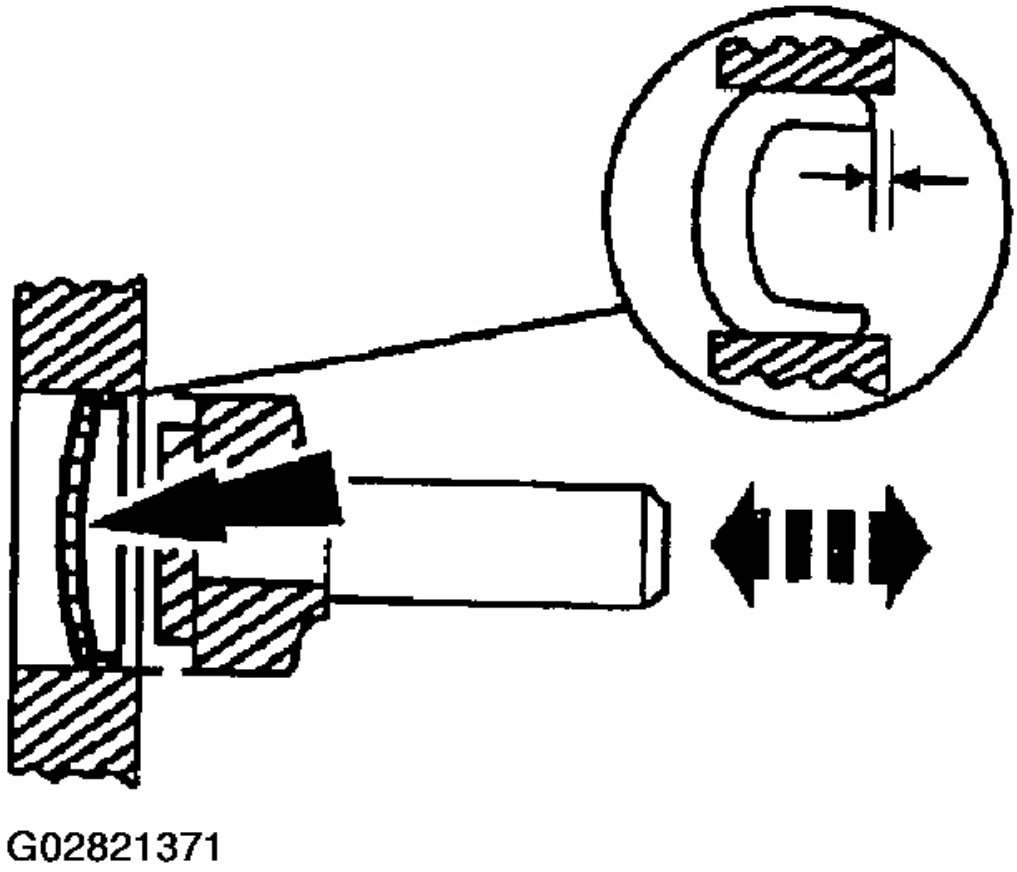


Fig. 235: Installing Cup-Type Core Plug
Courtesy of MAZDA MOTORS CORP.

CYLINDER BLOCK CORE PLUG INSTALLATION (EXPANSION TYPE)

CAUTION:
- **Do not contact the crown when installing a cup-type engine block plug. This could expand the plug before seating and result in leakage.**

1. Use an expansion-type core plug replacer tool to seat the expansion-type engine block plug.

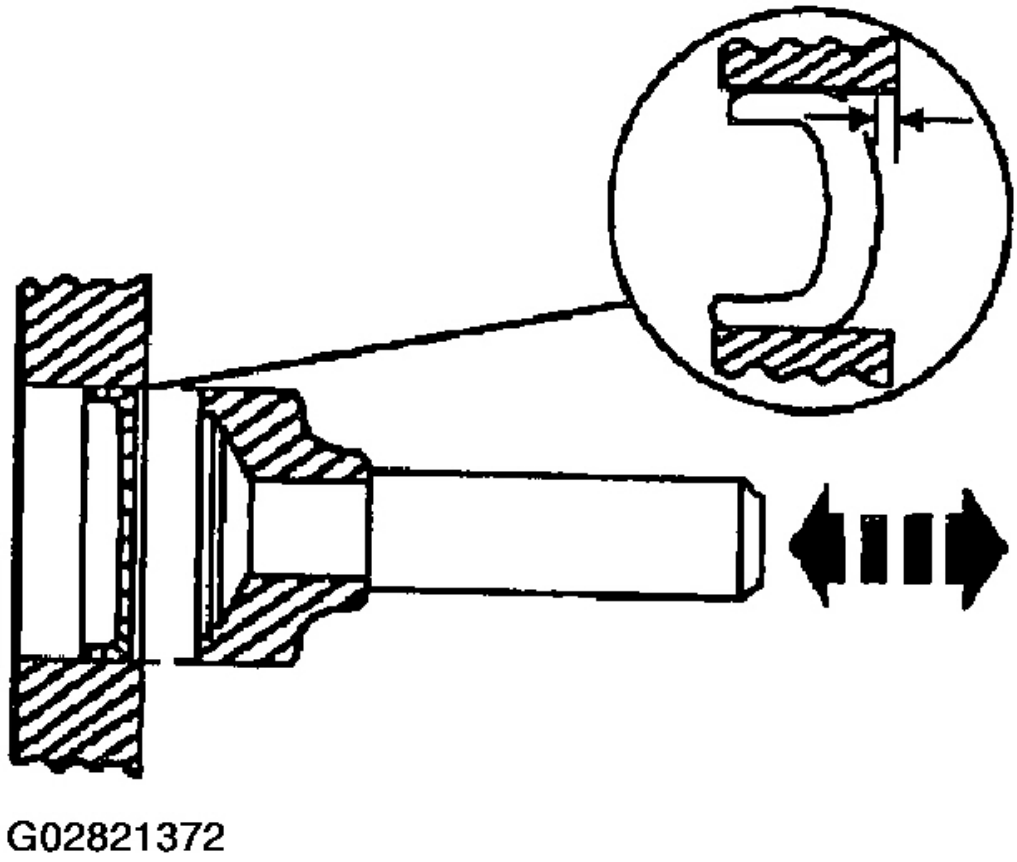


Fig. 236: Installing Expansion-Type Core Plug
Courtesy of MAZDA MOTORS CORP.

PISTON INSPECTION

PISTON INSPECTION

CAUTION:
- **Do not use a caustic cleaning solution or a wire brush to clean the pistons or damage may occur.**

1. Clean and inspect the (A) ring lands, (B) skirts, (C) pin bosses, and the (D) top of the pistons. If wear marks or polishing are found on the piston skirt, check for a bent or twisted connecting rod.

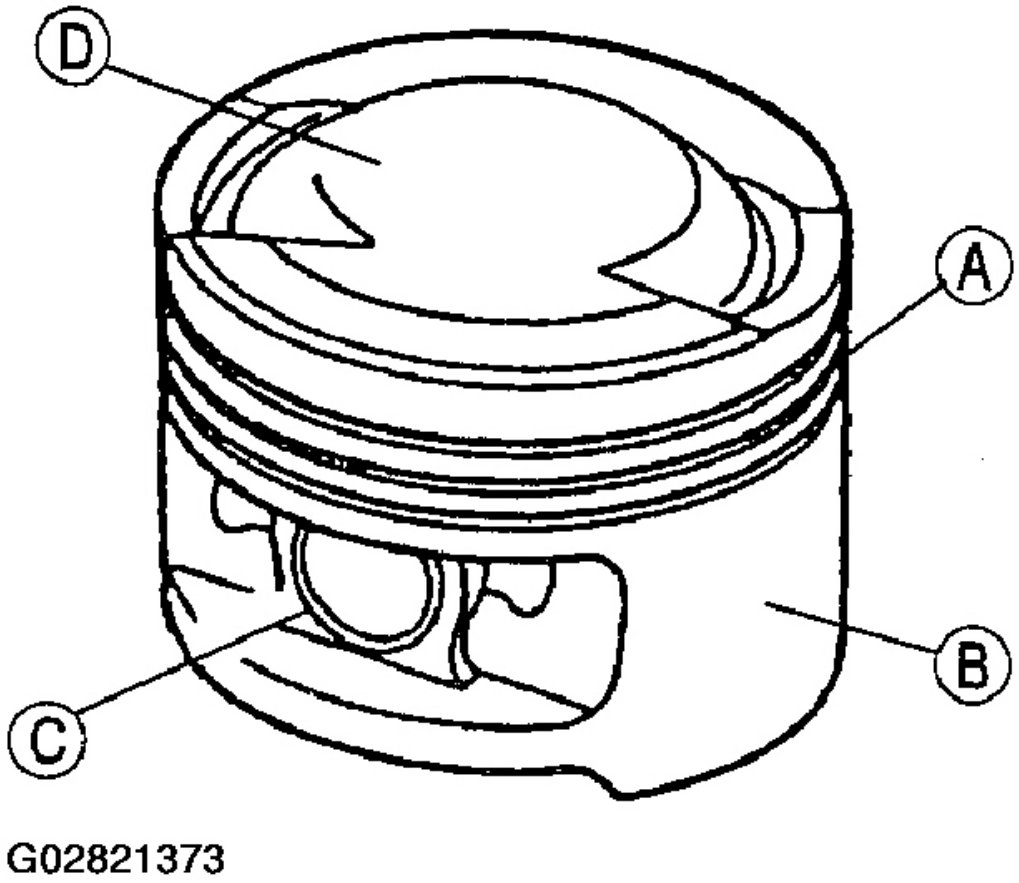
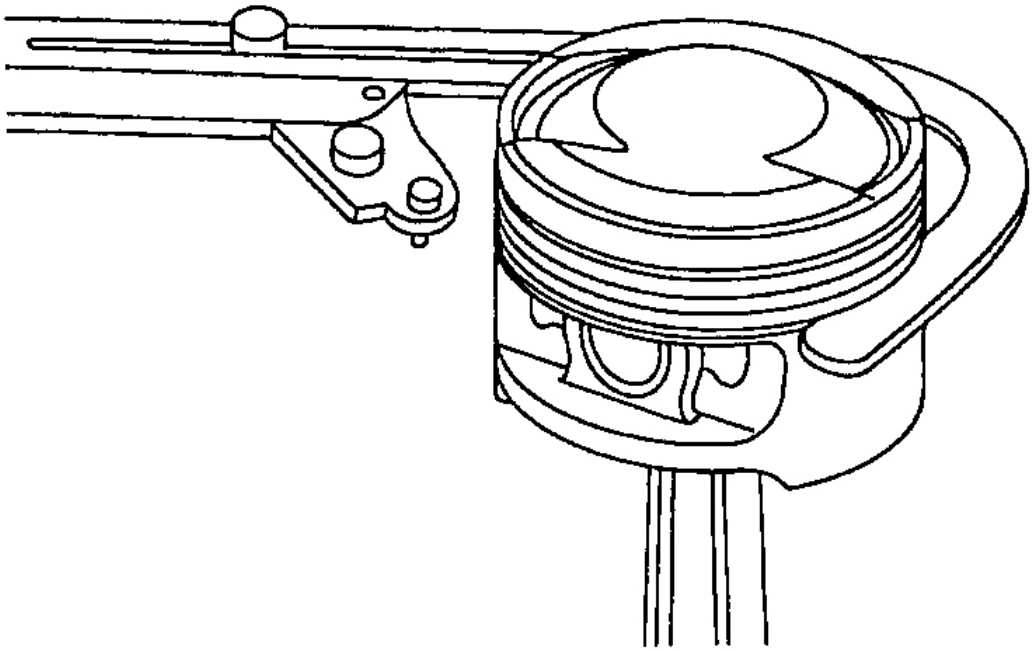


Fig. 237: Inspecting Piston
Courtesy of MAZDA MOTORS CORP.

2. Clean the piston ring grooves using **SST** 303-D033 or equivalent.
    - Make sure the oil ring holes are clean.



G02821374

Fig. 238: Cleaning Piston Ring Grooves
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Piston and piston pins are a matched set and cannot be interchanged.**

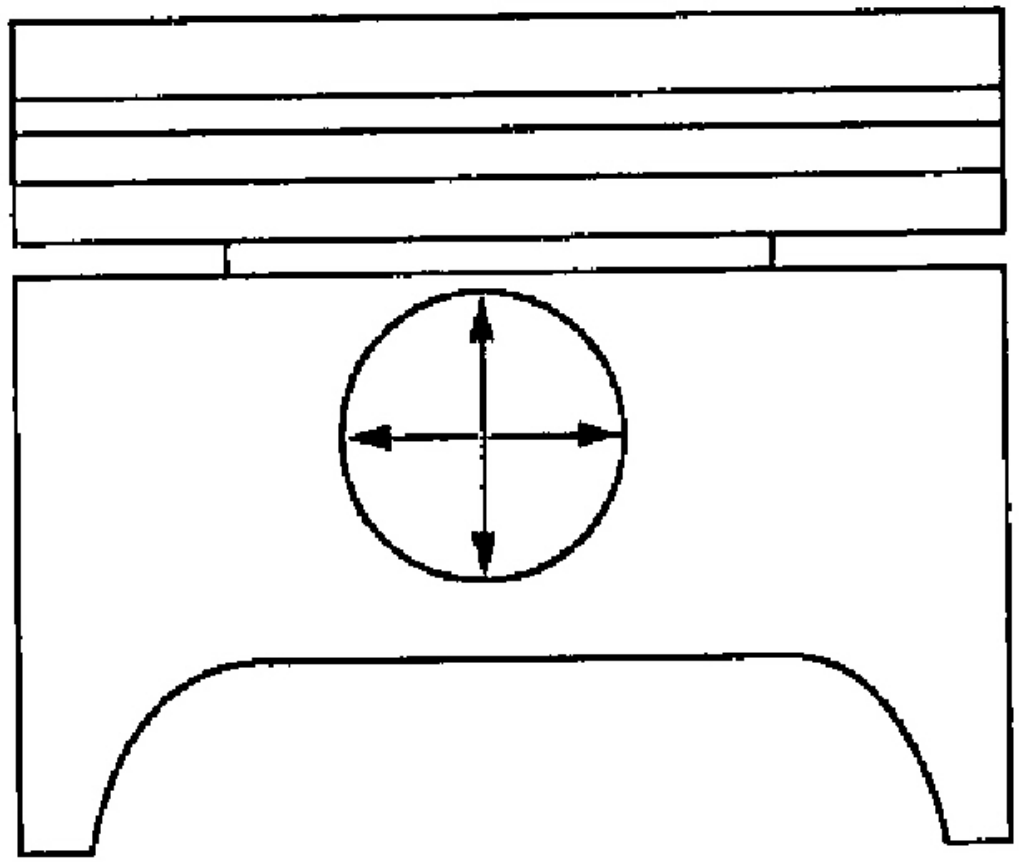


Fig. 239: Measuring Piston Pin Bore Diameter
Courtesy of MAZDA MOTORS CORP.

3. Measure the piston pin bore diameter in two directions on each side. Verify the diameter is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.
4. Measure the piston dome and skirt diameter 90 degrees from the piston pin as indicated.

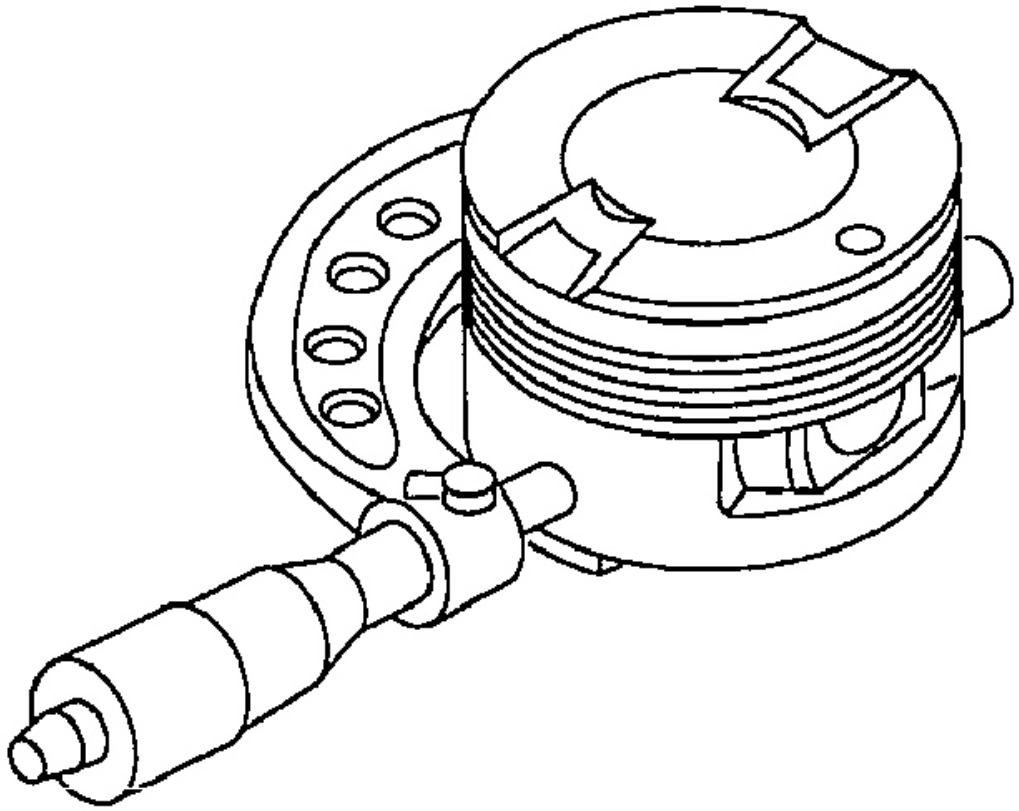


Fig. 240: Measuring Piston Dome & Skirt
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Always install the piston in the same cylinder bore from which it was removed.**

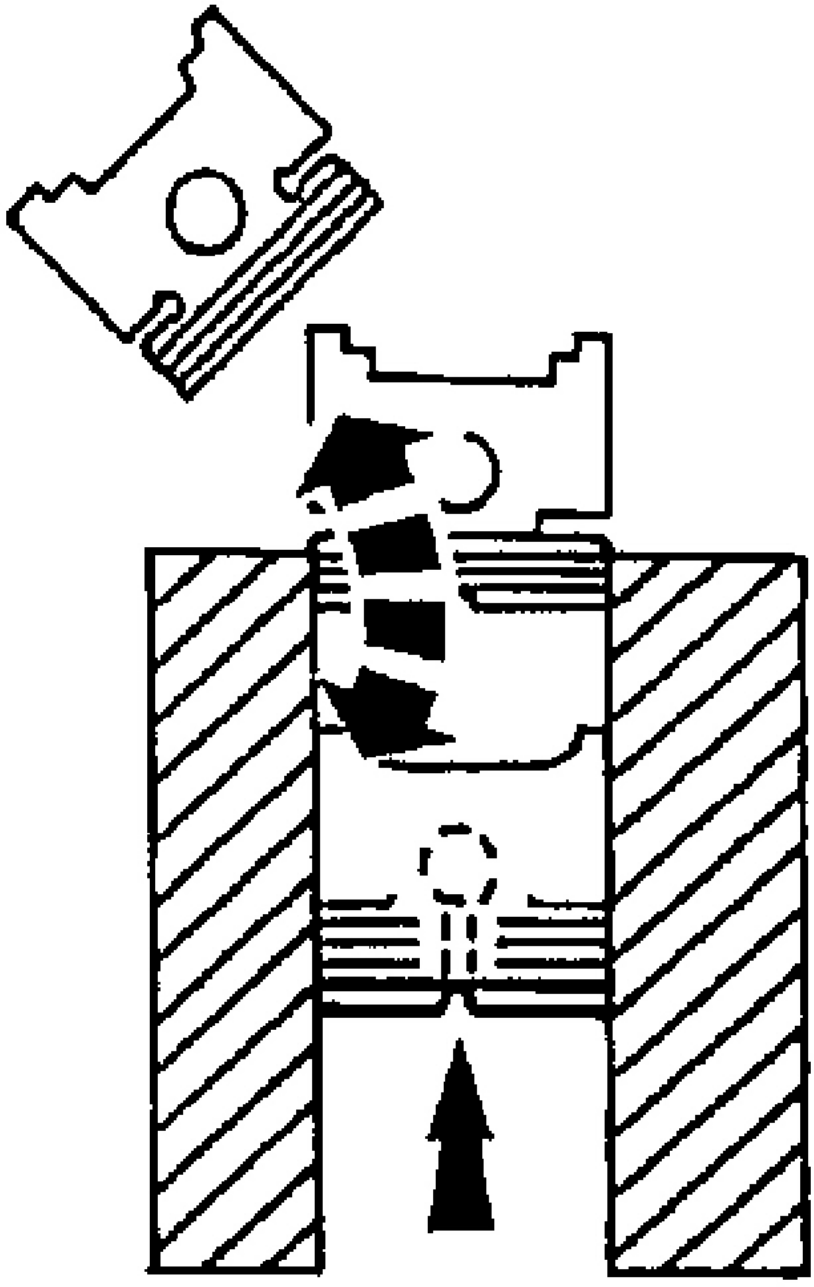
CAUTION:

- **Use care when fitting piston rings to avoid possible damage to the piston ring or the cylinder bore.**

  Piston rings should not be transferred from one piston to another.

NOTE:

- **The cylinder bore must be within specifications for taper and out-of-round before fitting a piston.**



G02821377

Fig. 241: Pushing Piston Into Cylinder To Bottom Of Ring Travel
Courtesy of MAZDA MOTORS CORP.

5. Push a piston into a cylinder to the bottom of ring travel using a piston without rings. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

6. Measure the top piston ring end gap and second ring end gap using the Feeler Gauge.

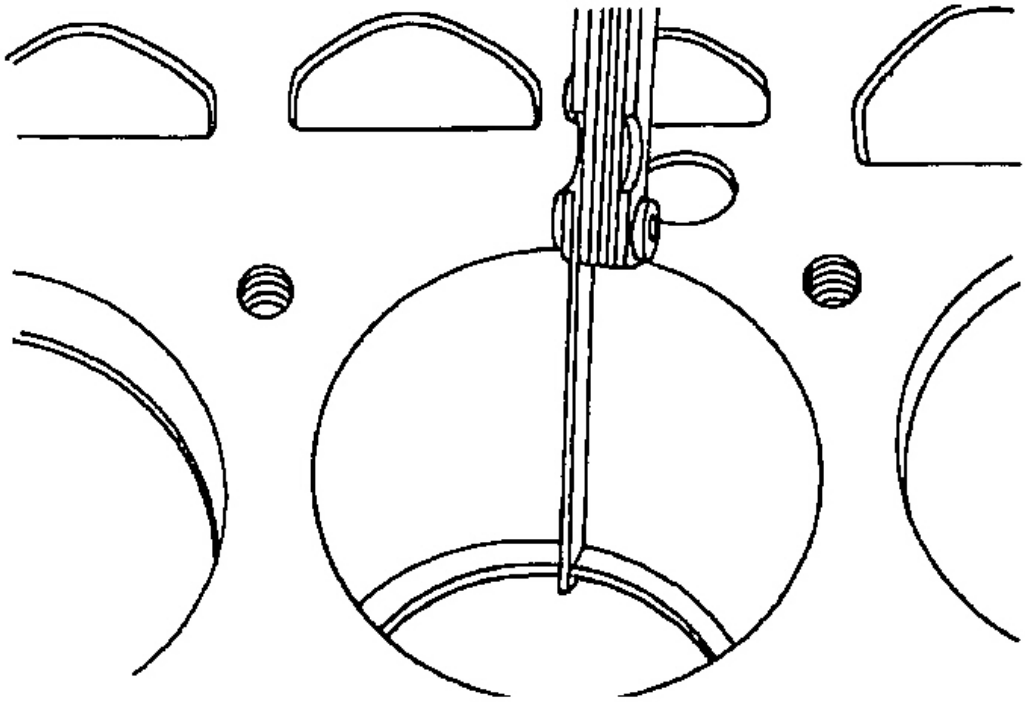


Fig. 242: Measuring Piston Ring End Gap
Courtesy of MAZDA MOTORS CORP.

PISTON REPLACEMENT INSPECTION

NOTE:
- **Cylinder bore must be within specifications for taper and out-of-round before fitting a piston.**

1. Select a piston size based on the cylinder bore.
2. Choose the piston with the proper paint color.
   - Red - in the lower third of the size range.
   - Blue - in the middle third of the size range.
   - Yellow - in the upper third of the size range.

NOTE:
- **For precision fit, new pistons are divided into three categories**

within each size range based on their relative position within the range. A paint spot on the new pistons indicates the position within the size range.

PISTON CLEARANCE INSPECTION

1. Subtract the piston diameter from the cylinder bore diameter to find the piston-to-cylinder bore clearance.

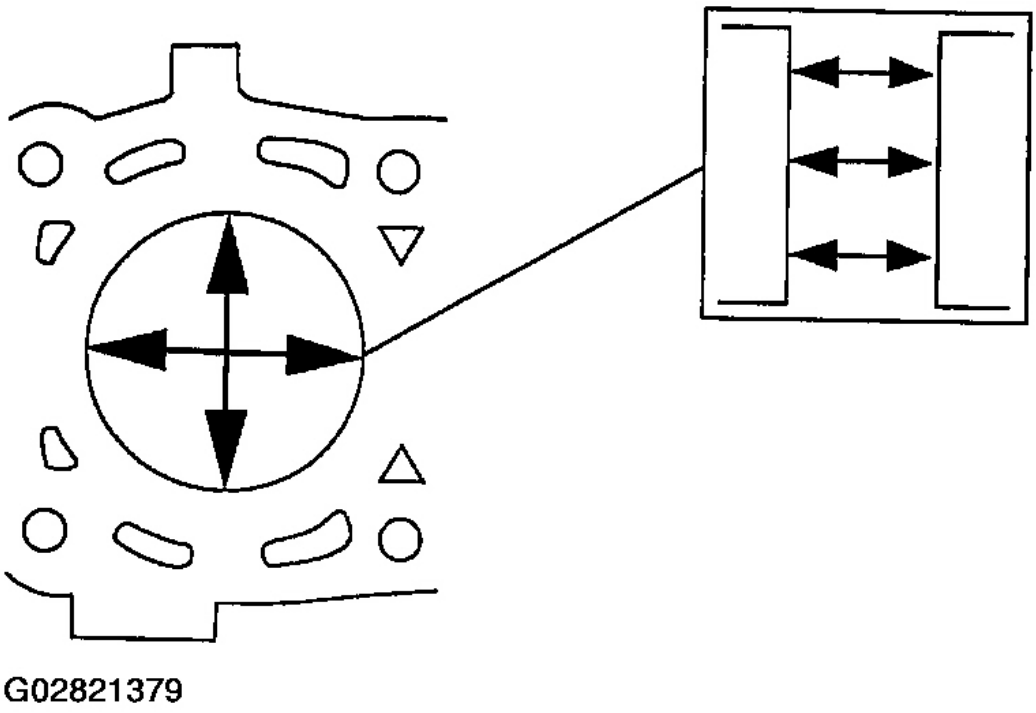


Fig. 243: Measuring Cylinder Bore Diameter
Courtesy of MAZDA MOTORS CORP.

PISTON RING CLEARANCE INSPECTION

1. Inspect for wear in the grooves.
2. Measure the piston ring-to-groove clearance all the way around the piston.

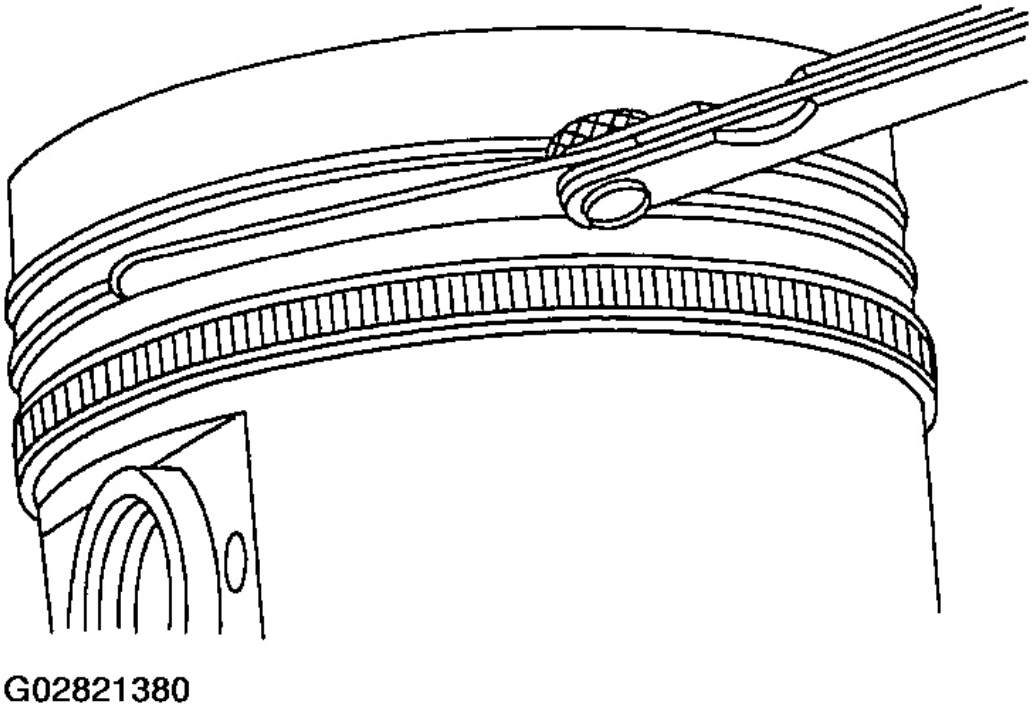


Fig. 244: Measuring Piston Ring-To-Groove Clearance
Courtesy of MAZDA MOTORS CORP.

PISTON PIN INSPECTION

1. Measure the piston pin diameter in two directions at points shown. Verify the diameter is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

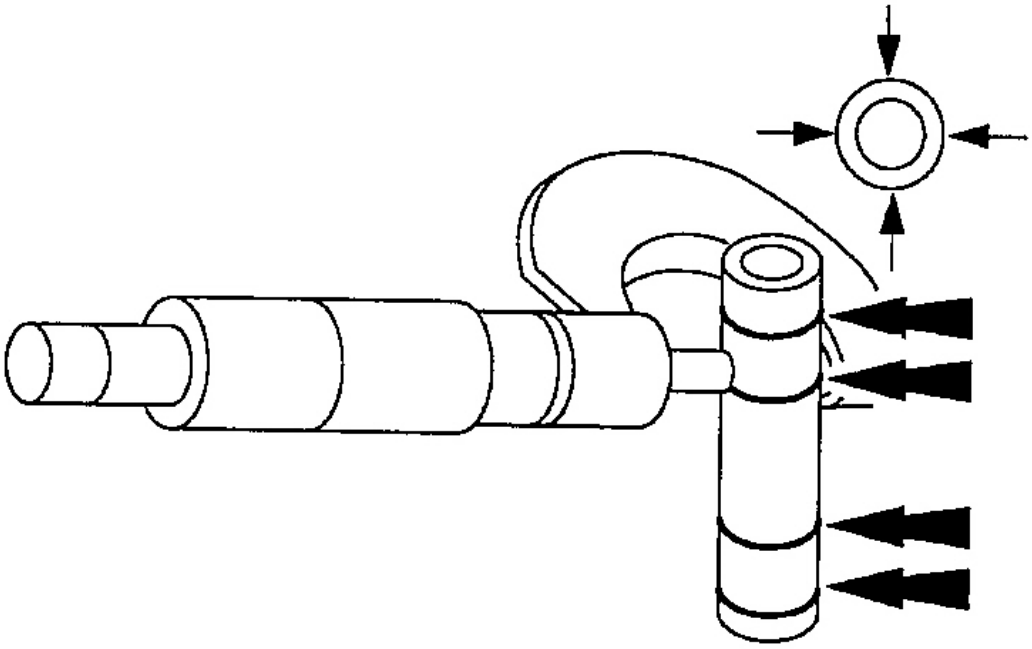


Fig. 245: Measuring Piston Pin Diameter
Courtesy of MAZDA MOTORS CORP.

CONNECTING ROD INSPECTION

CONNECTING ROD CLEANING

CAUTION:
- **Do not use a caustic cleaning solution or damage to the connecting rods may occur.**

1. Mark and separate the parts and clean with solvent. Clean the oil passages.

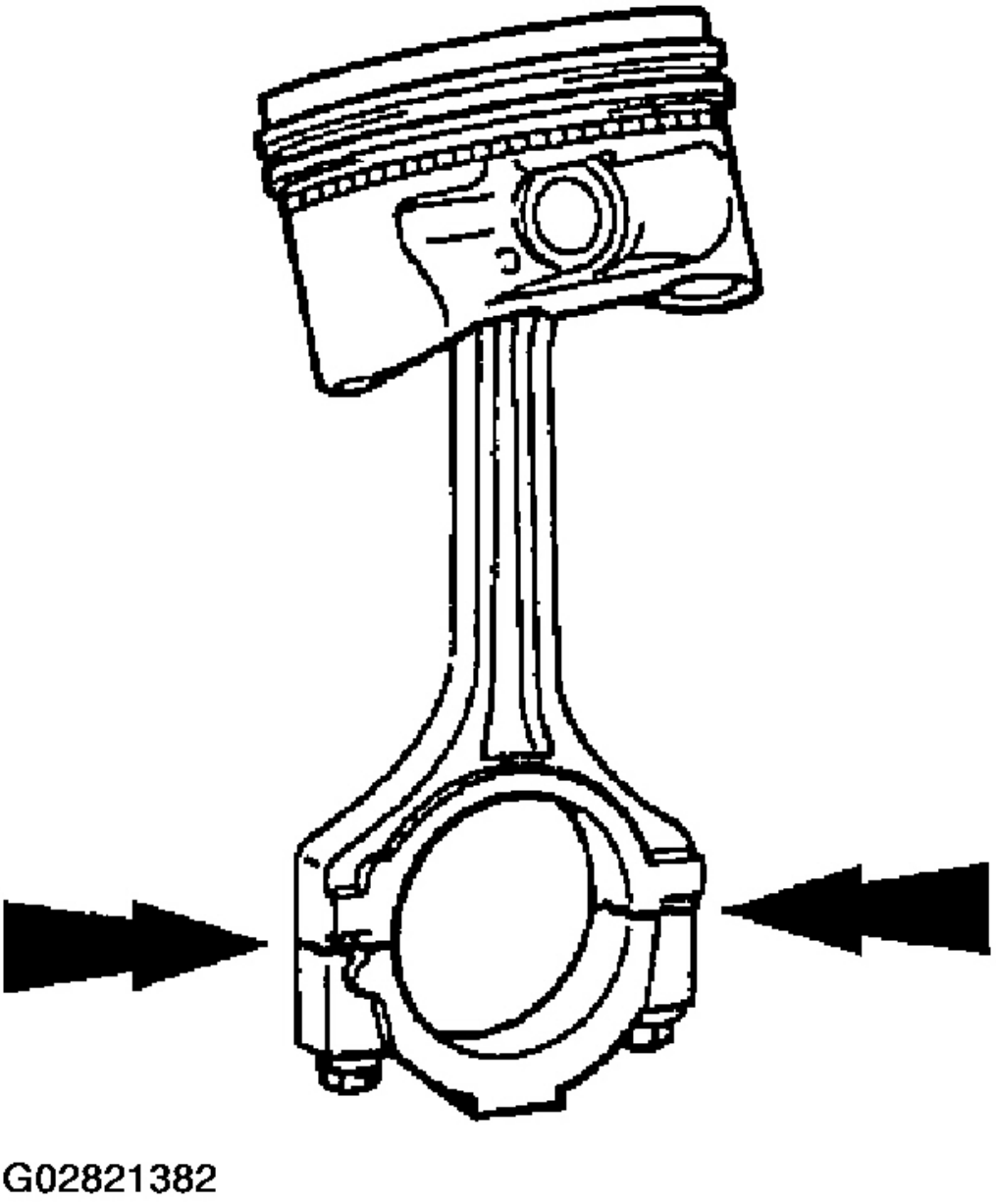


Fig. 246: Marking & Separating Parts & Clean
Courtesy of MAZDA MOTORS CORP.

CONNECTING ROD INSPECTION

1. Measure the bearing bore in two directions. The difference is the connecting rod bore out-of-round. Verify the out-of-round is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

2. Measure the bearing bore diameter in two directions. Verify the bearing bore is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

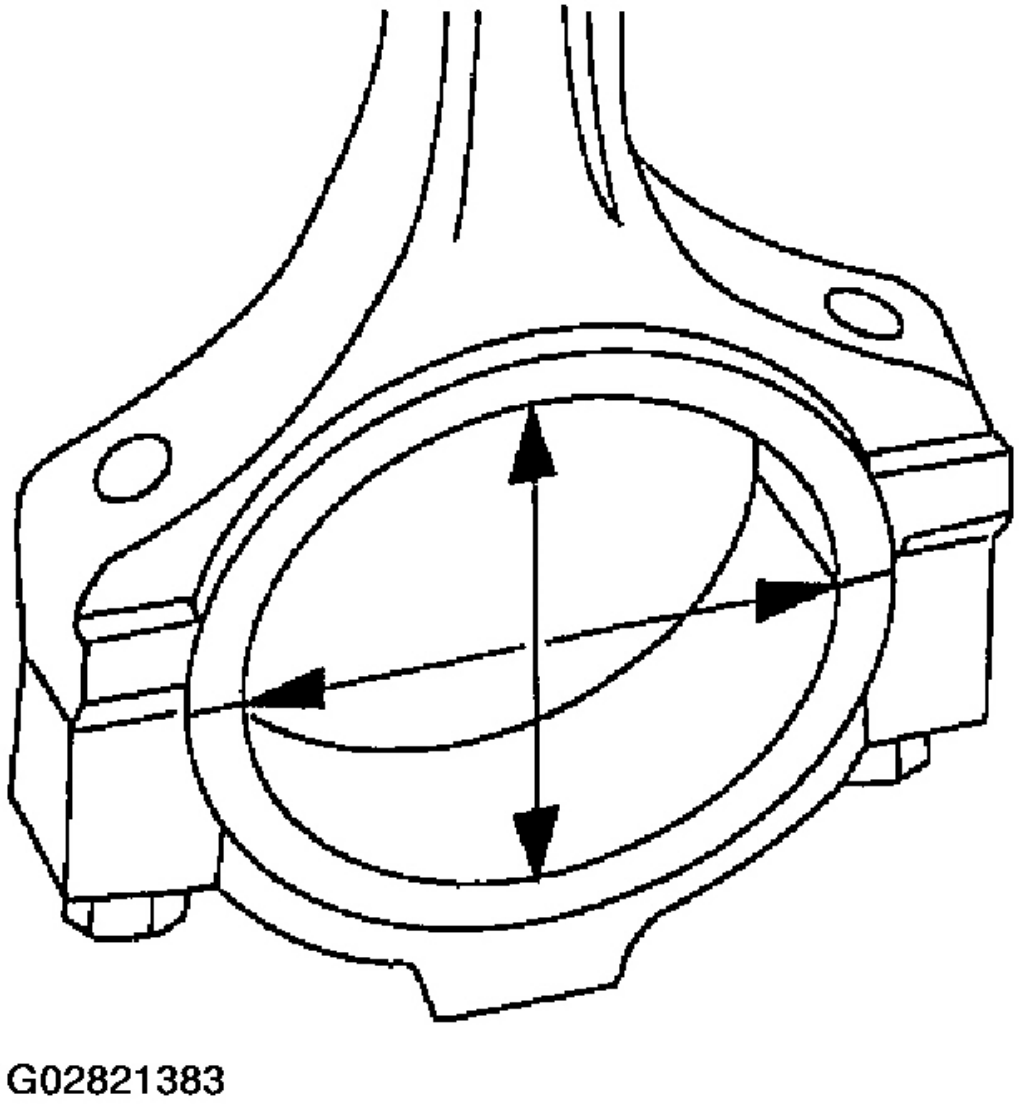


Fig. 247: Measuring Connecting Rod Bearing Bore Diameter
Courtesy of MAZDA MOTORS CORP.

3. Measure the bushing bore diameter of the connecting rod. Verify the diameter is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

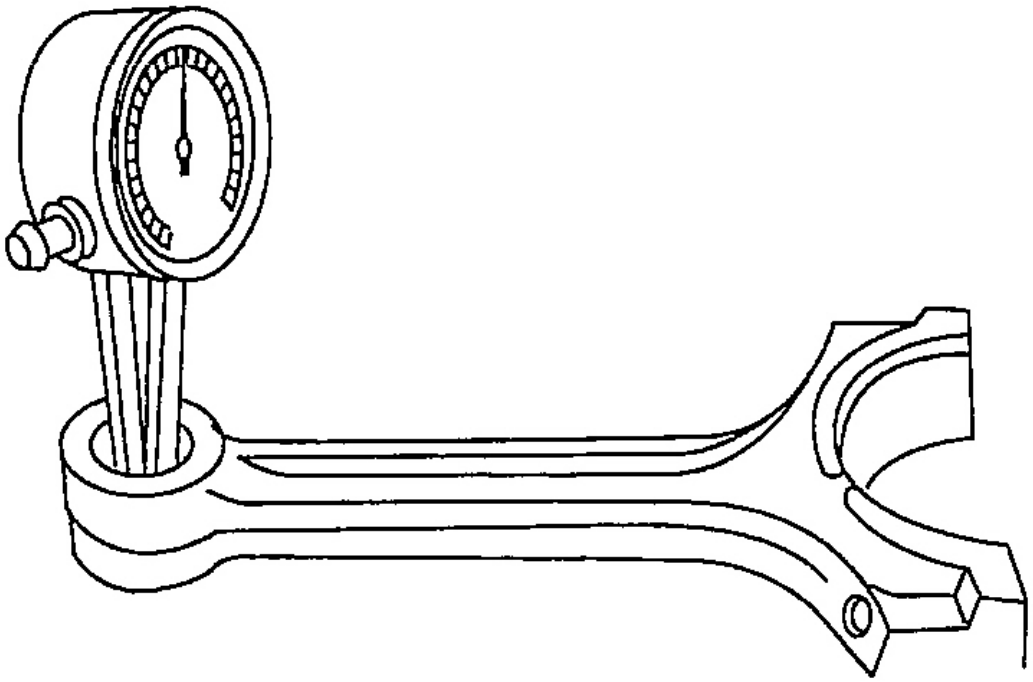


Fig. 248: Measuring Connecting Rod Bushing Bore Diameter
Courtesy of MAZDA MOTORS CORP.

4. Measure the connecting rod bend on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the bend measurement is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.
5. Measure the connecting rod twist on a suitable alignment fixture. Follow the instructions of the fixture manufacturer. Verify the measurement is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

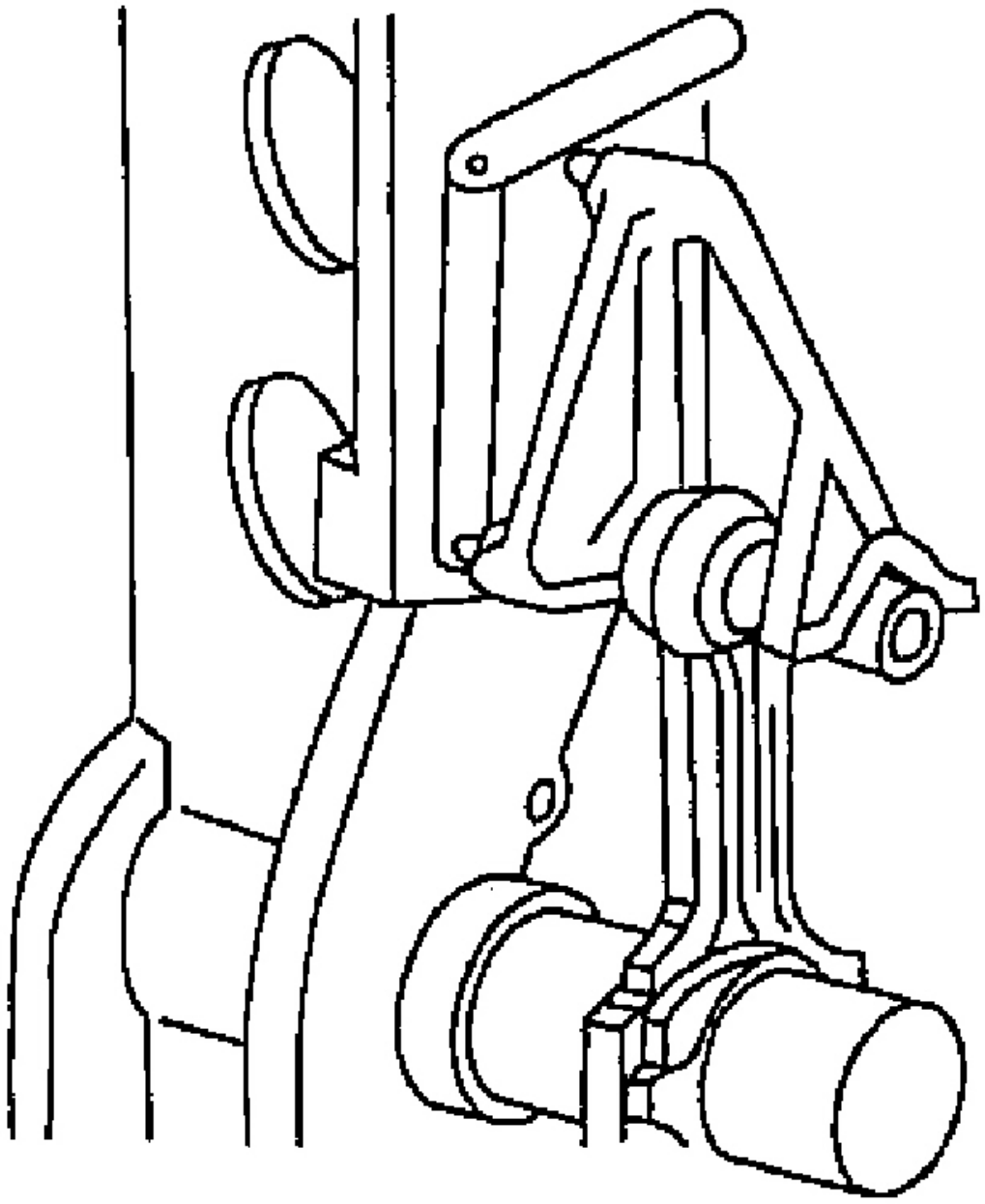


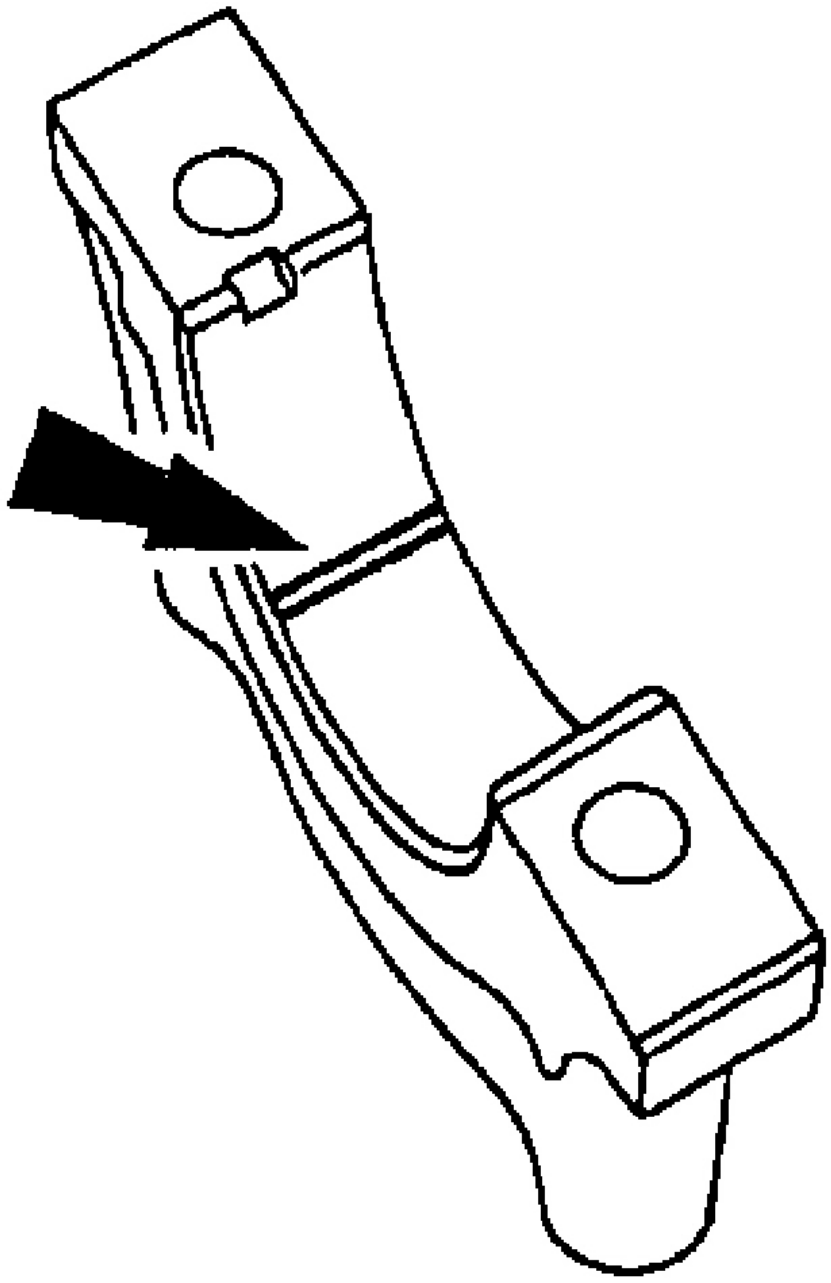
Fig. 249: Measuring Connecting Rod Twist
Courtesy of MAZDA MOTORS CORP.

CONNECTING ROD OIL CLEARANCE INSPECTION

NOTE:

- **The crankshaft connecting rod journals must be within specification to check the connecting rod bearing journal clearance.**

1. Position a piece of Plastigage across the bearing surface.



G02821386

Fig. 250: Positioning Plastigage Across Bearing Surface
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Do not turn the crankshaft during this step.**

2. Install and tighten to specification; refer to **CYLINDER BLOCK SPECIFICATIONS**. Remove the connecting rod bearing cap. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.
3. Measure the Plastigage to get the connecting rod bearing journal clearance. The Plastigage should be smooth and flat. A changing width indicates a tapered or damaged crankshaft main bearing or connecting rod.

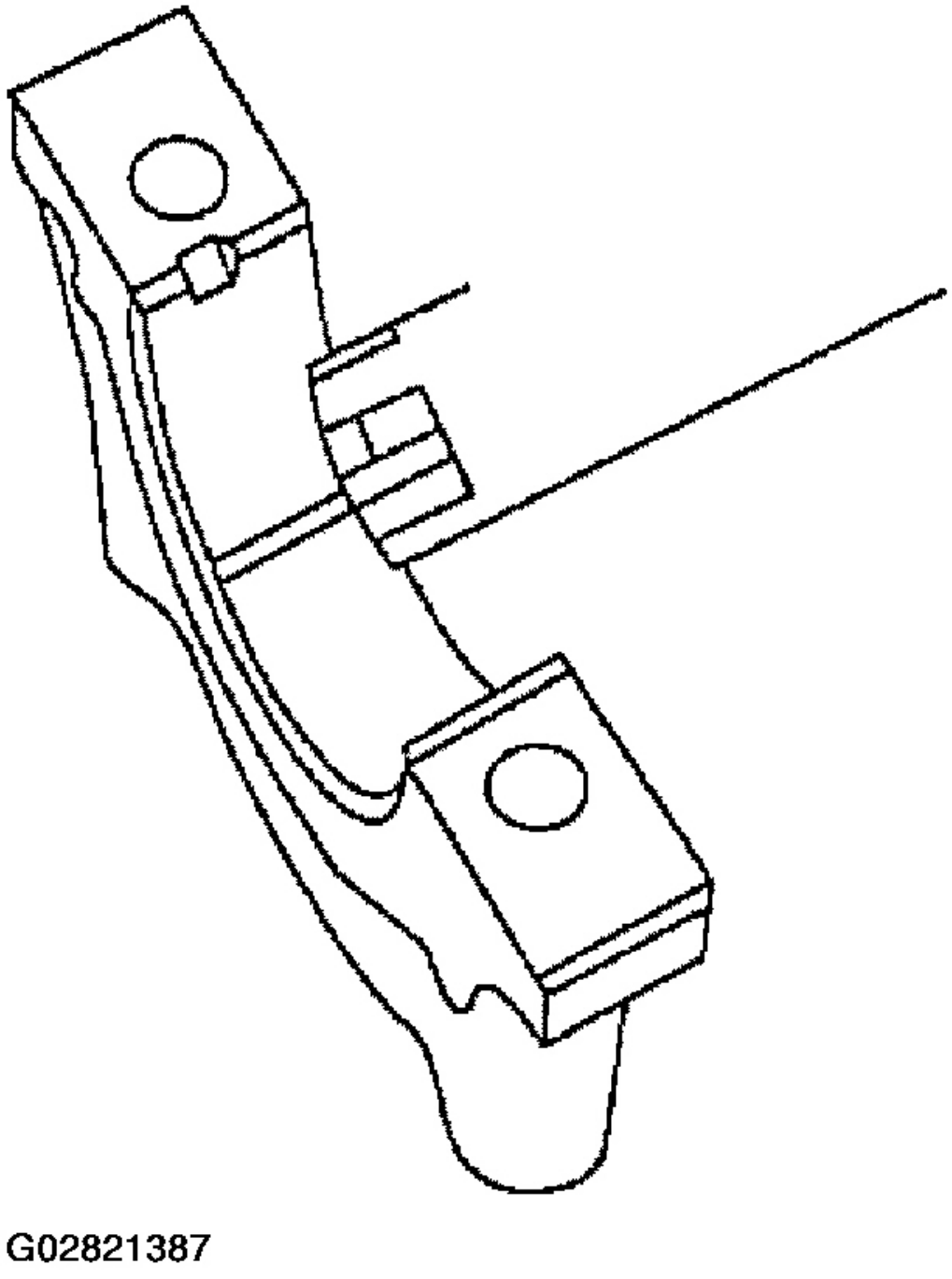


Fig. 251: Measuring Plastigage For Connecting Rod Bearing Journal Clearance
Courtesy of MAZDA MOTORS CORP.

CONNECTING ROD SIDE CLEARANCE INSPECTION

1. Measure the clearance between the connecting rod and the piston. Verify the measurement is within specification. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.

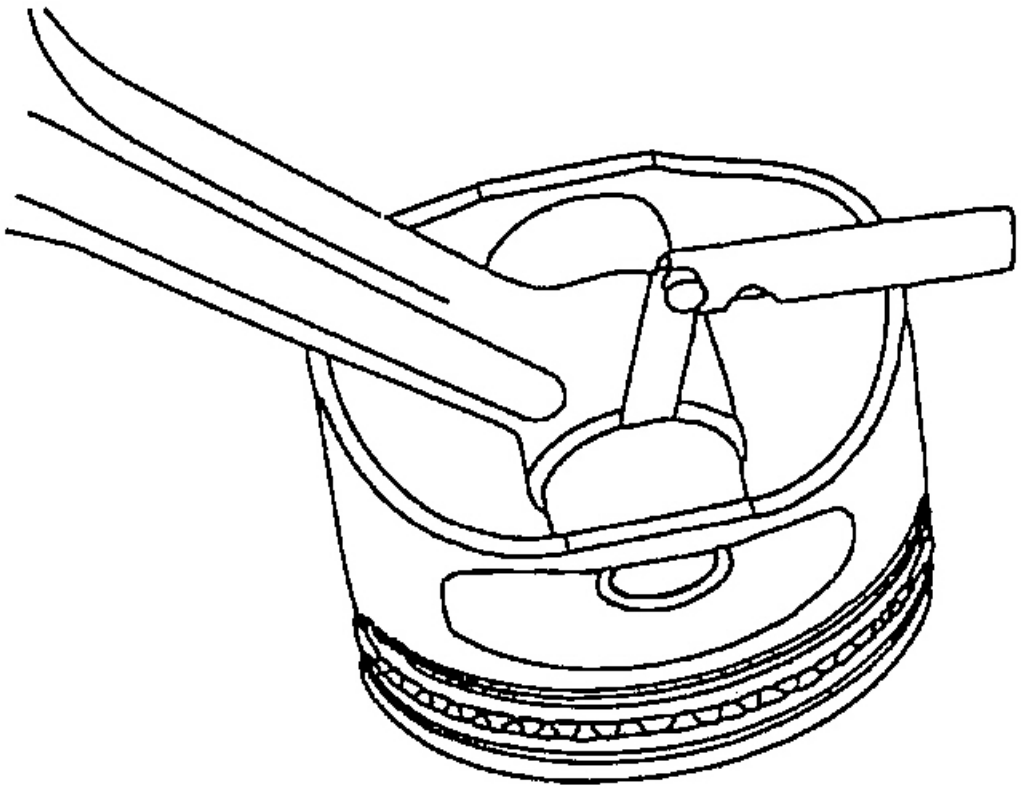


Fig. 252: Measuring Clearance Between Connecting Rod & Piston
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT INSPECTION

CRANKSHAFT INSPECTION

1. Measure each of the crankshaft main bearing journal diameters in at least two directions. Verify the journal is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.
    1. If out of specification, replace as necessary.

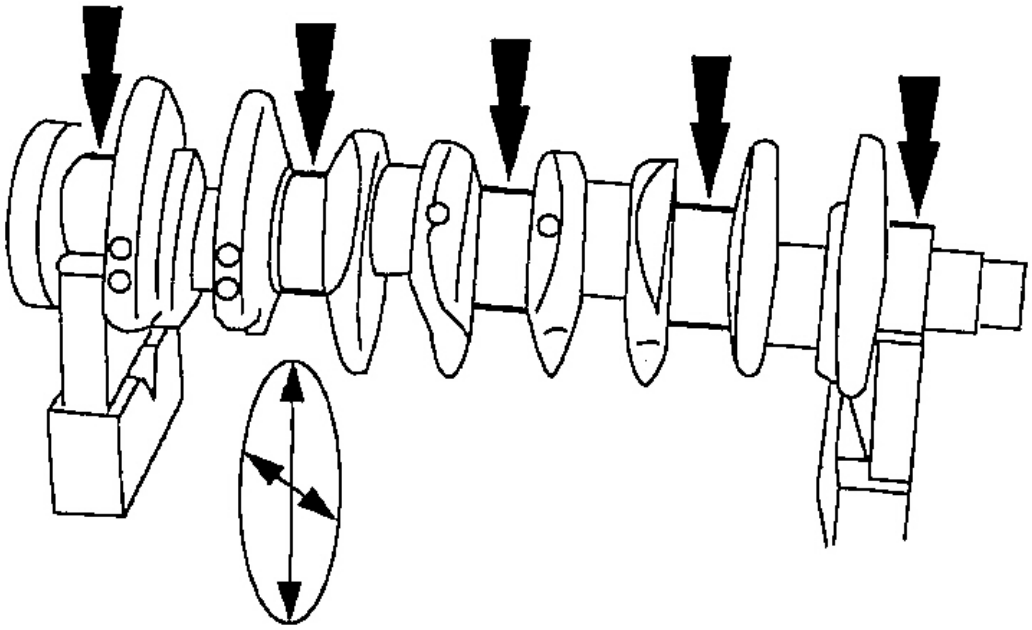


Fig. 253: Identifying Crankshaft Main Bearing Journals
Courtesy of MAZDA MOTORS CORP.

2. Measure each of the crankshaft main bearing journal diameters in at least two directions at each end of the main bearing journal. Verify the journal is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.
    1. If out of specification, replace as necessary.

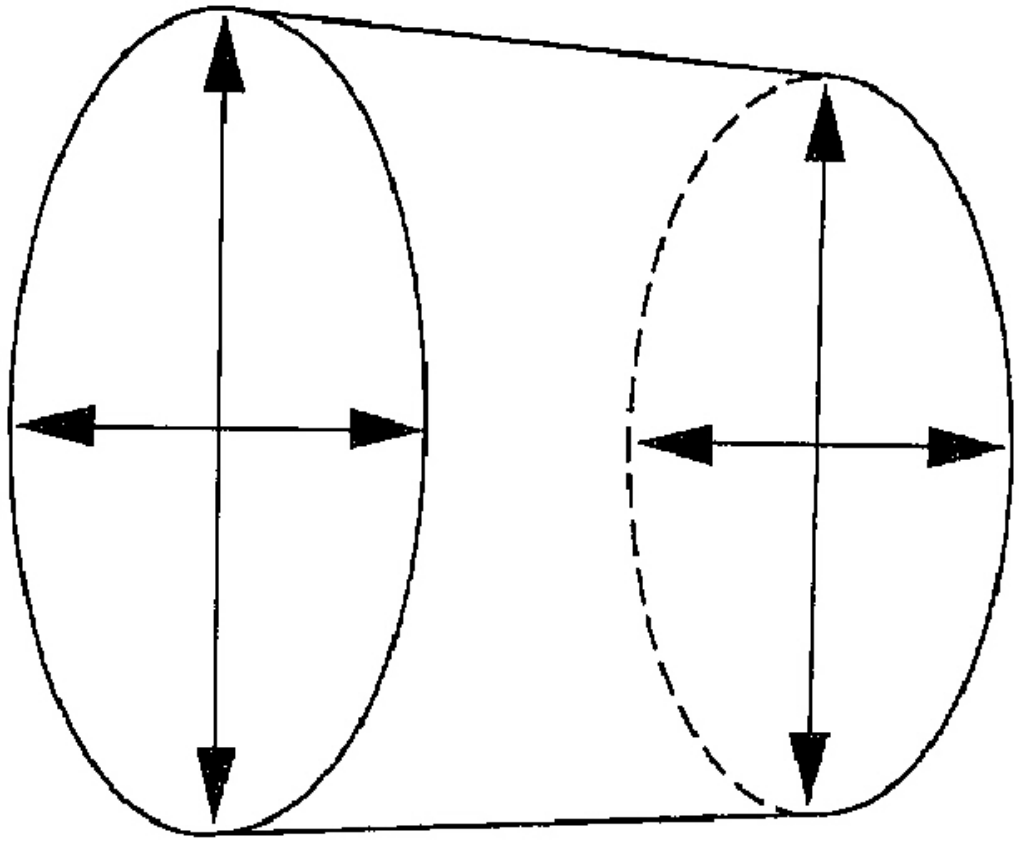
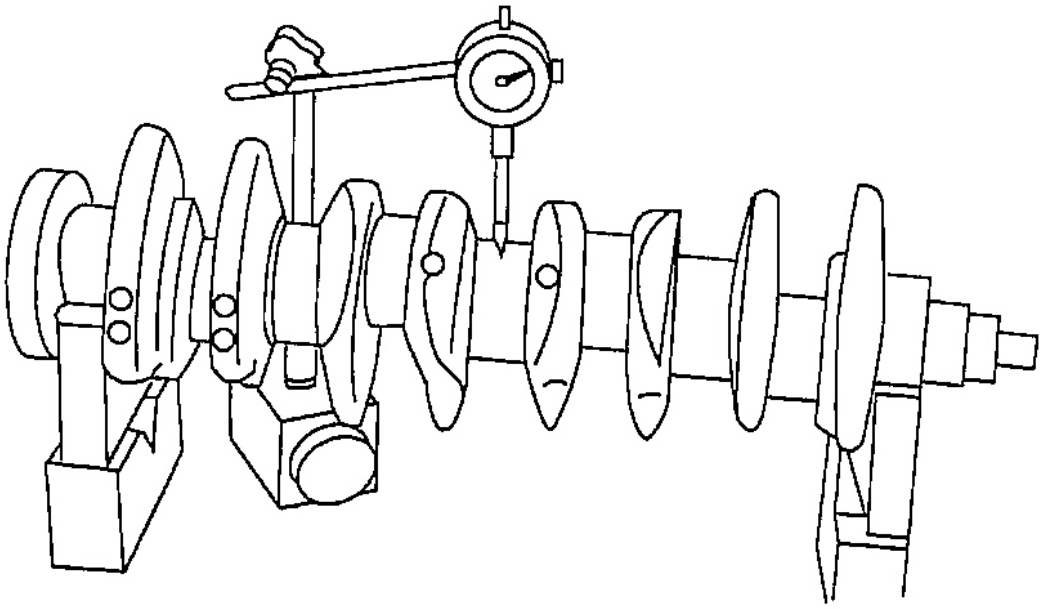


Fig. 254: Measuring Crankshaft Main Bearing Journal Diameters At Each End
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Crankshaft main bearing journals must be within specifications before checking runout.**



G02821391

Fig. 255: Measuring Crankshaft Runout
Courtesy of MAZDA MOTORS CORP.

3. Use the Dial Indicator With Bracketry to measure the crankshaft runout. Verify this is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.
    1. Rotate the crankshaft and subtract the lowest dial indicator reading from the highest dial indicator reading to figure the crankshaft runout. If it is out of specification, replace as necessary.
4. Measure the crankshaft connecting rod journal diameters in at least two directions perpendicular to one another. Verify the journal is within specification. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

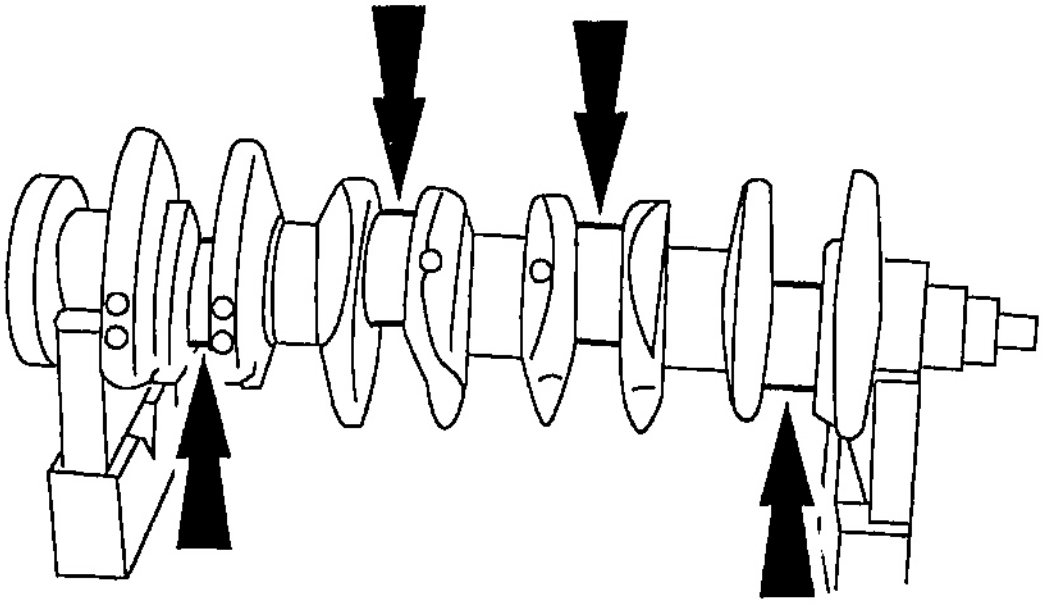


Fig. 256: Measuring Crankshaft Connecting Rod Journal Diameters
Courtesy of MAZDA MOTORS CORP.

5. Measure the crankshaft connecting rod journal diameters in two directions perpendicular to one another at each end of the connecting rod journal. The difference in the measurements from one end to the other is the taper. Verify the taper is within the wear limit. Refer to **CYLINDER BLOCK SPECIFICATIONS**.

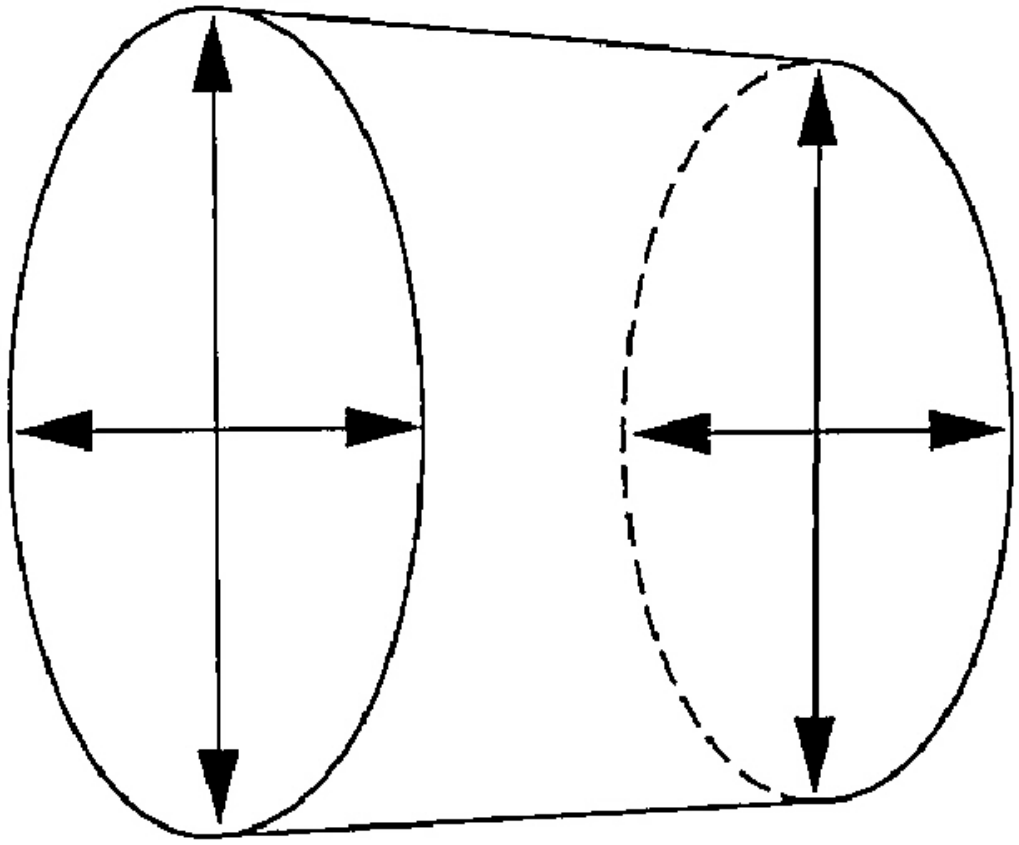


Fig. 257: Measuring Crankshaft Connecting Rod Journal Taper
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT OIL CLEARANCE INSPECTION/REPAIR

NOTE:

- **Crankshaft main bearing journals must be within specification before checking journal clearance.**

1. Remove the crankshaft main bearing caps and bearings. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.
2. Lay a piece of Plastigage off-center and fully across the face of each crankshaft main bearing surface.

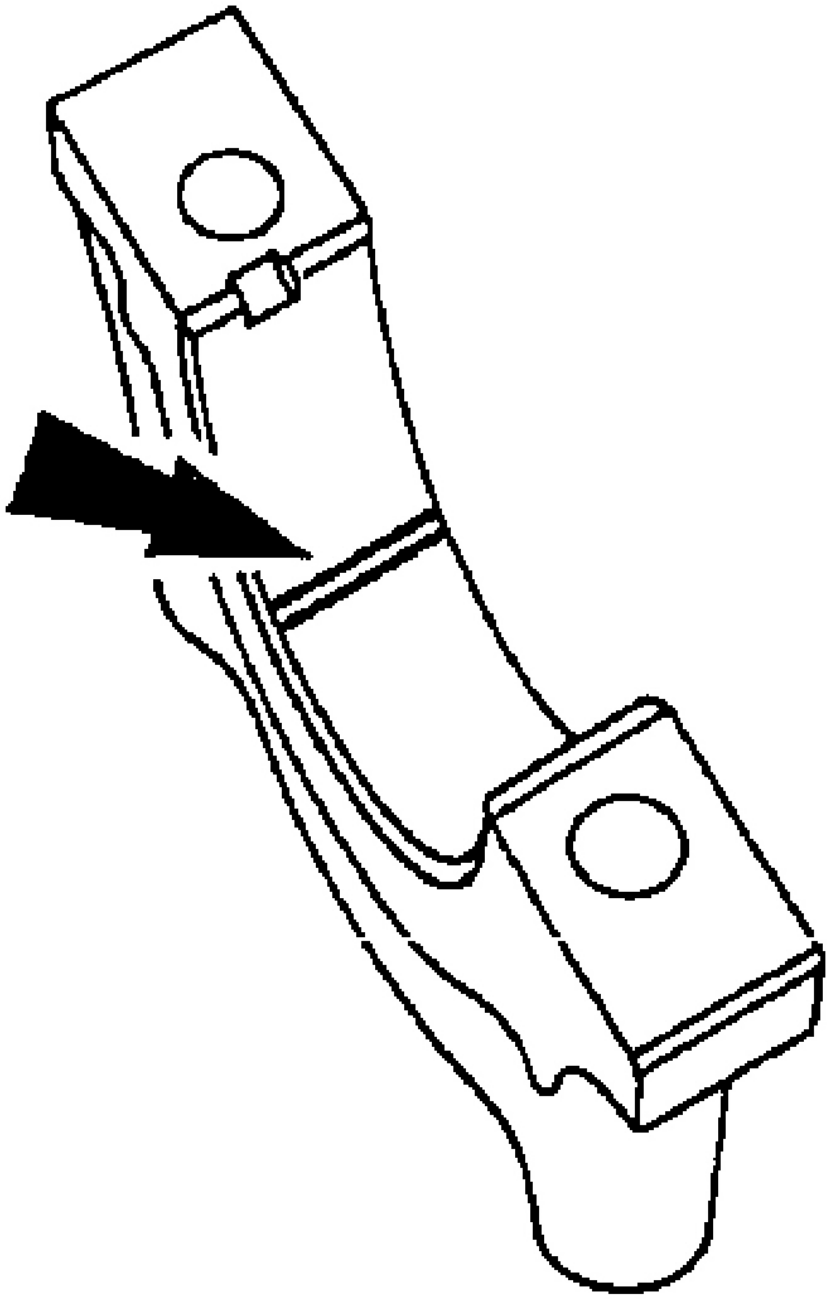


Fig. 258: Laying Plastigage Across Face Of Each Crankshaft Main Bearing
Courtesy of MAZDA MOTORS CORP.

NOTE:

- **Do not turn the crankshaft while doing this procedure.**

3. Install and remove the crankshaft main bearing cap. Refer to **ENGINE DISASSEMBLY/ASSEMBLY**.
4. Verify the crankshaft journal clearance. Refer to **CYLINDER BLOCK SPECIFICATIONS**.
    1. If out of specification, replace as necessary.

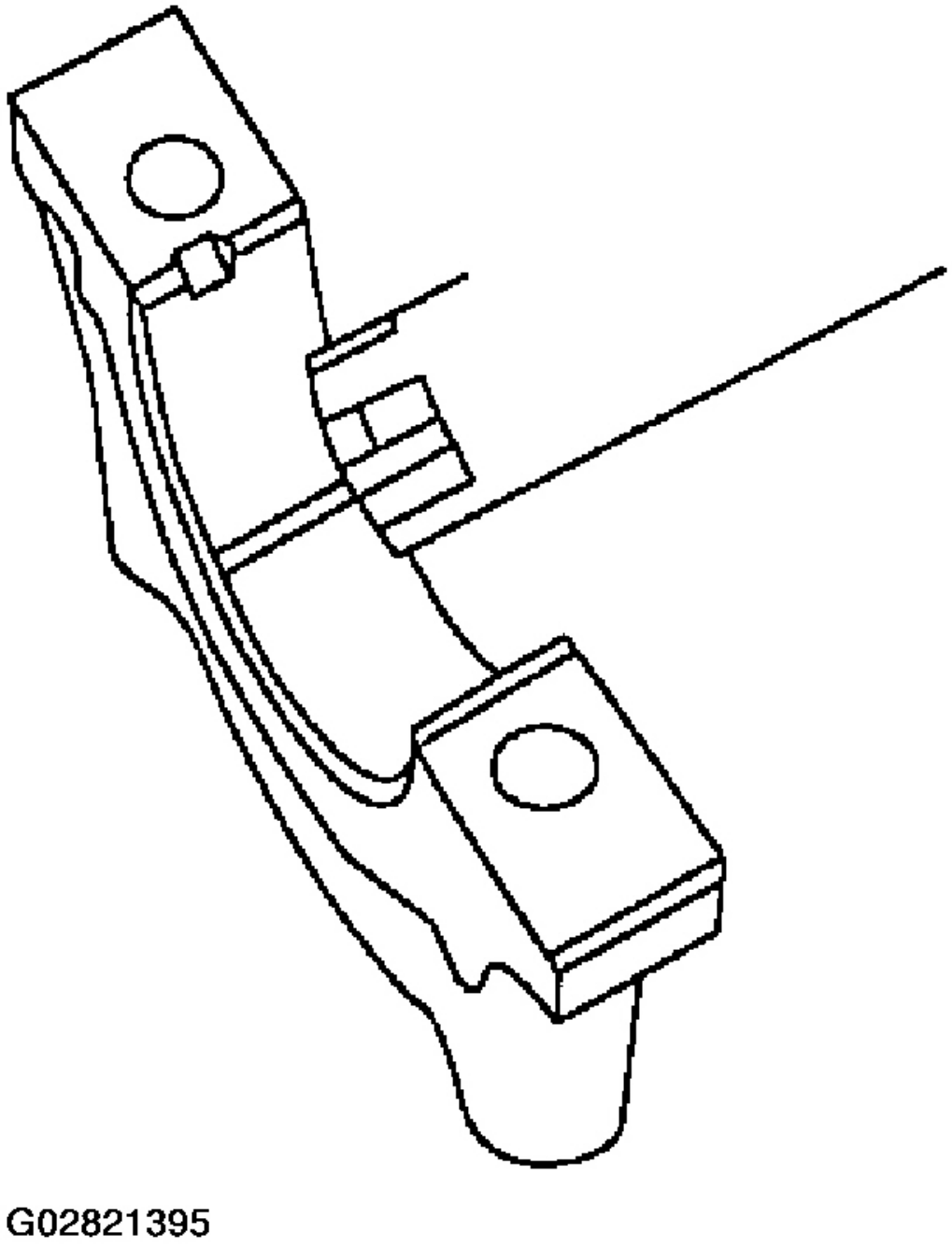


Fig. 259: Crankshaft Journal Clearance
Courtesy of MAZDA MOTORS CORP.

CRANKSHAFT END PLAY INSPECTION/REPAIR

1. Use the Dial Indicator With Bracketry to measure crankshaft end play.
2. Position the crankshaft to the rear of the cylinder block.

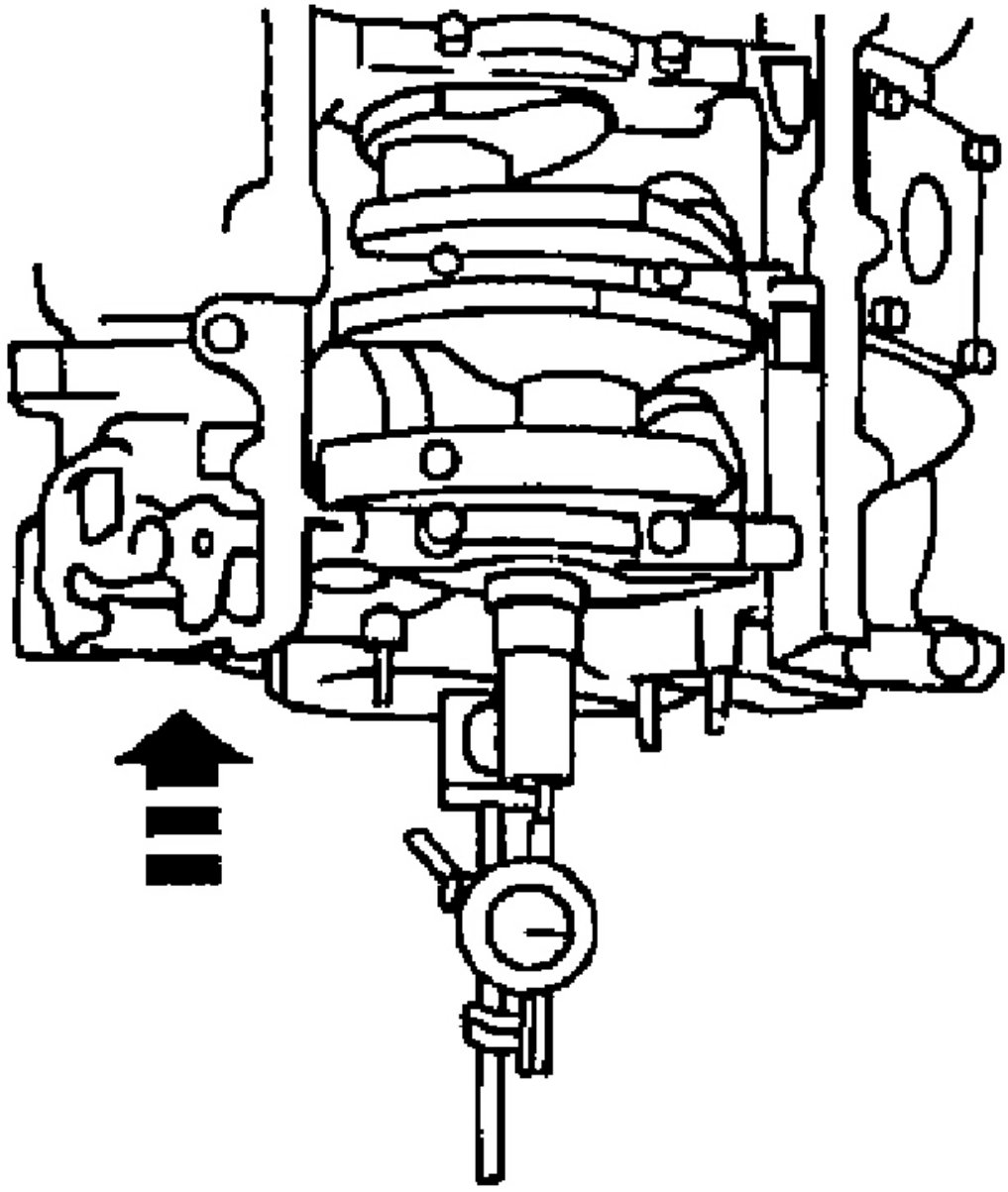
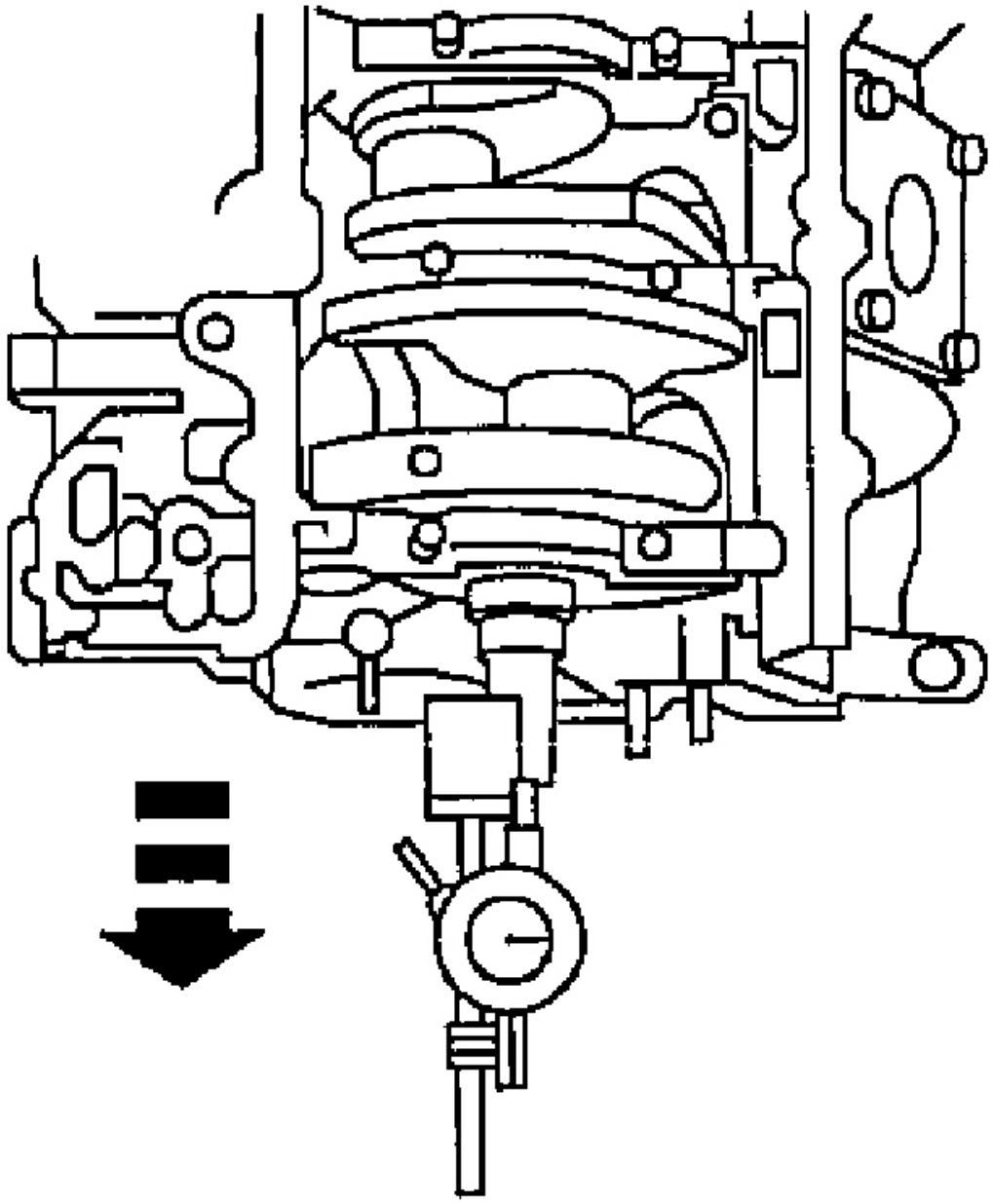


Fig. 260: Measuring Crankshaft End Play (Rear)
Courtesy of MAZDA MOTORS CORP.

3. Zero the Dial Indicator With Bracketry.
4. Move the crankshaft to the front of the cylinder block. Note and record the crankshaft endplay. Refer to**CYLINDER BLOCK SPECIFICATIONS**.
    1. If crankshaft endplay exceeds specifications, replace the crankshaft thrust washers or thrust bearing. Refer to specification chart.



G02821397

Fig. 261: Measuring Crankshaft End Play (Front)
Courtesy of MAZDA MOTORS CORP.

BEARING INSPECTION

1. Inspect the bearings for the following defects. Possible causes are shown:
    - Cratering - fatigue failure (1)
    - Spot polishing - improper seating (2)
    - Imbedded dirt engine oil - dirty (3)
    - Scratching - dirty engine oil (4)
    - Base exposed - poor lubrication (5)
    - Both edges worn - journal damaged (6)
    - One edge worn - journal tapered or bearing not seated (7)

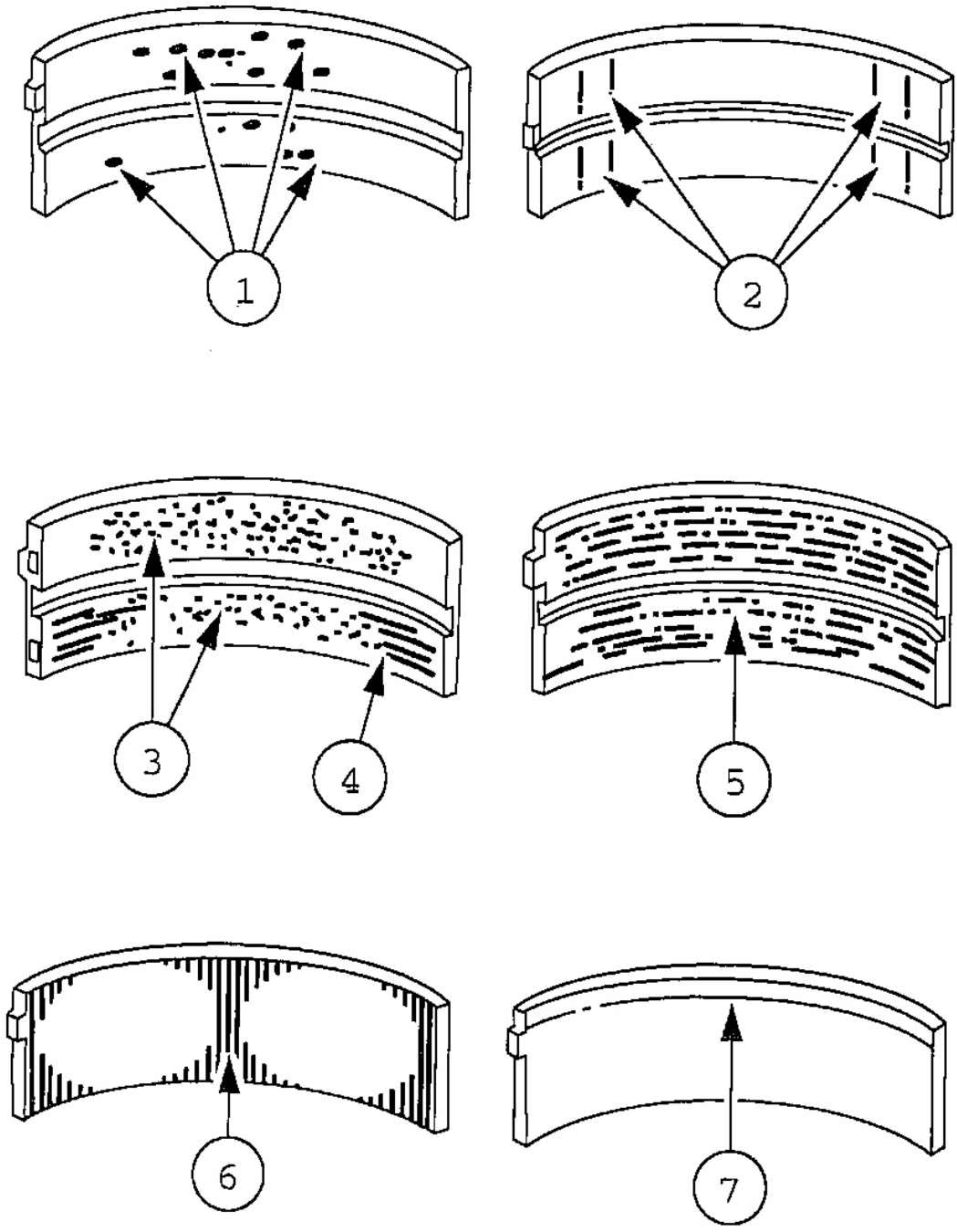


Fig. 262: Identifying Bearing Defects
Courtesy of MAZDA MOTORS CORP.

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

Application	Ft. Lbs. (N.m)
Accessory Bracket Bolt	31 (42)
A/C Compressor Bracket/Bolt (1)	
Bolt/Nut 1	30-46 (40-55)
Bolt/Nut 2	30-40 (40-62)
A/C Compressor Manifold Bolt	15 (20)
A/C Tube Bracket Bolt	15 (20)
A/T Transmission Fluid Level Tube Bolt	30-41 (40-55)
Battery Tray Bolt	19-26 (26-34)
Camshaft Sprocket Bolt	63 (85)
Camshaft Tensioner Bolt	32 (44)
Connecting Rod Bolts	(2)
Crankshaft Main Bearing Bolts	(2)
Crankshaft Position Sensor Accessory Bracket Bolt	31 (42)
Coolant Tube Bracket Bolt (3)	
Bolt 1	21 (28)
Bolt 2	17 (23)
Crankshaft Pulley Bolt	
Step 1	37 (50)
Step 2	Additional 90 Degrees
Cylinder Head Bolts (4)	
8 mm	(5) 24 (32)
12 mm (4)	
Step 1	24 (32)
Step 2	Additional 80 Degrees
Step 3	Additional 80 Degrees
Drive Belt Idler Pulley Bolt	35 (47)
Drive Belt Tensioner Bolt	30-40 (40-55)
EGR-To-Intake Manifold	25 (34)
EGR Tube-To-Exhaust Manifold	25 (34)
Engine Coolant Temperature Sensor	12-17 (16-24)
Engine Front Cover Bolts	14 (19)
Engine Insulator Nuts	81 (110)
Engine Support Insulator Nuts	59 (80)
Exhaust Manifold (6)	15-18 (20-25)

Exhaust-To-"Y" Pipe Nut	30 (40)
Flywheel/Flexplate [7]	
Step 1	[8]
Step 2	52 (71)
Front Axle Bolt	49 (66)
Fuel Supply Manifold	18 (25)
Generator Mounting Bolt	35 (47)
Generator Mounting Bracket Bolts	31 (42)
Heated Oxygen Sensor	27-33 (36-46)
Ignition Coil Bracket Lower Bolts [9]	
Bolt 1	17 (23)
Bolt 2	21 (28)
Knock Sensor	15 (20)
Oil Filter Adapter Bolts	18 (25)
Oil Pan Bolts	[10] 18 (25)
Oil Pan Drain Plug	18 (25)
Oil Pressure Switch	15 (20)
Power Steering Pressure Hose Nut	13 (18)
Spark Plug	7-15 (9-20)
Starter Motor Bolt/Stud Bolt	18 (25)
Starter Motor Ground Cable Nut	15-28 (21.2-38.8)
Torque Converter Nut	35 (47)
Transmission Bolt	35 (47)
Transmission Cooling Tube Bracket Bolt	35 (47)
Water Temperature Sensor	13 (18)
Water Pump Pulley Bolt	18 (25)
	INCH Lbs. (N.m)
A/C Cable Routing Clip Bolts	71 (8)
Air Cleaner Tube-To-MAF Sensor Screw	28-38 (3.1-4.3)
Battery Cable Clamp	62-89 (7-10)
Battery Hold Down Bolt	62-89 (7-10)
Block Heater-To-Core Plug Bolt	14-16 (1.6-1.8)
Camshaft Position Sensor Nut	71 (8)
Coolant Recovery Reservoir Bolts	62 (7)
Crankshaft Position Sensor Bolts	89 (10)
Engine Bulkhead Electrical Connector Bolt	53 (6)
Engine Ground Wire	89 (10)
Fan Shroud Bolts	62 (7)
Front Camshaft Bolt	106 (12)
Fuel Filter Nut	115 (13)

Generator Terminal "B" Nut	71 (8)
Heated PCV Fitting Bolt	71 (8)
Idle Air Control Solenoid	89 (10)
Ignition Coil Bolt	44-62 (5-7)
Ignition Coil Bracket Upper Bolts	71 (8)
Intake Manifold Bolts	89 (10)
Oil Filter	115 (13)
Oil Level Indicator Tube Bolt	89 (10)
PCM Electrical Connector Bolt	53 (6)
PCM Ground Wire Nut	89 (10)
Pressure Relief Valve	71 (8)
Pulse Damper Bolt	53 (6)
Radiator Bolt	54-70 (6-8)
Radiator Coolant Recovery Reservoir Bolt	54-70 (6-8)
Starter Solenoid Cable Nut	40-56 (4.5-6.3)
Starter Motor Positive Cable Nut	60-82 (6.8-9.2)
Thermostat Housing Bolts	89 (10)
Throttle Body Bolts	80 (9)
Throttle Position Sensor Bolts	35 (4)
Valve Cover Bolts	89 (10)
Water Pump Bolts	89 (10)
Wiring Harness Bolts	89 (10)

(1) For bolt identification, see **Fig. 263**.

(2) Information not available from manufacturer.

(3) For bolt identification, see **Fig. 264**.

(4) Tighten cylinder head bolts in sequence. See **Fig. 265**.

(5) For 8 mm bolt identification, see **Fig. 266**.

(6) Tighten exhaust manifold bolts in sequence. See **Fig. 267** and **Fig. 268** .

(7) Tighten in sequence. See **Fig. 269**.

(8) Tighten to 115 INCH Lbs. (13 N.m).

(9) For ignition coil bracket lower bolt identification, see **Fig. 270**.

(10) Tighten in sequence. See **Fig. 271**.

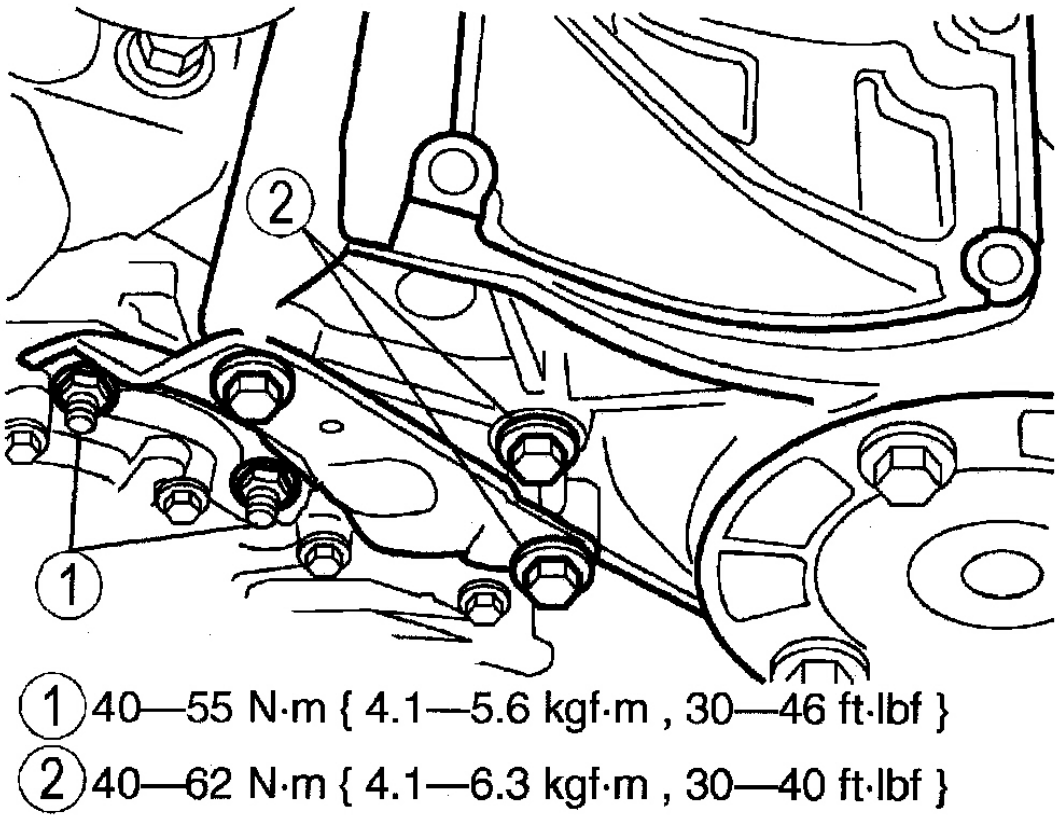


Fig. 263: Identifying A/C Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

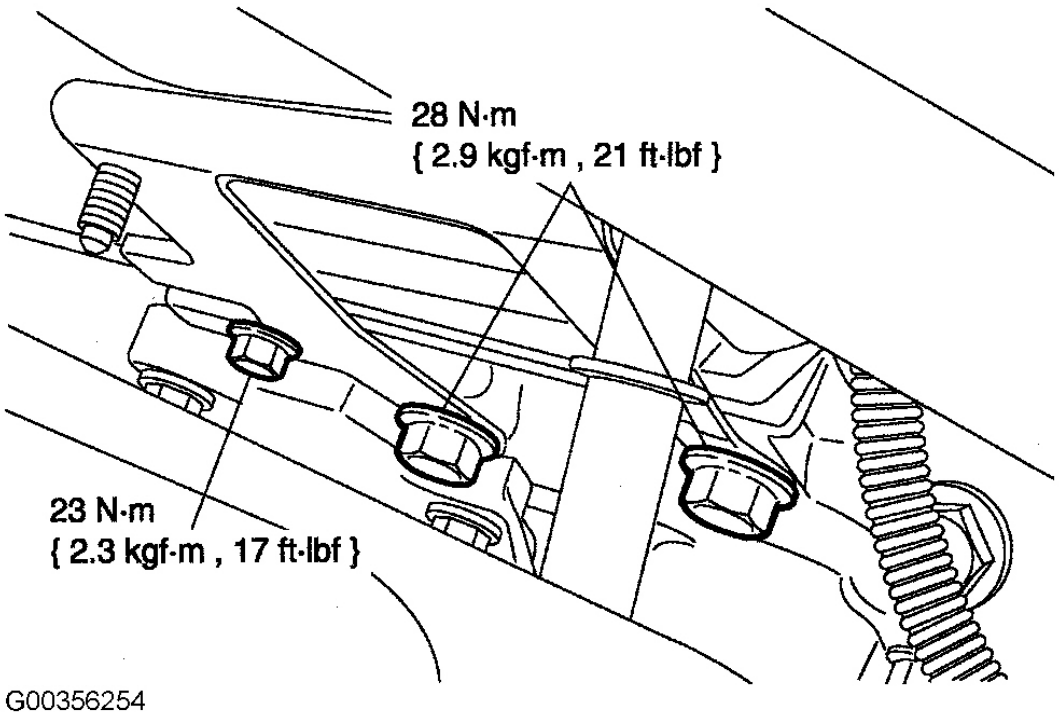


Fig. 264: Identifying Coolant Tube Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

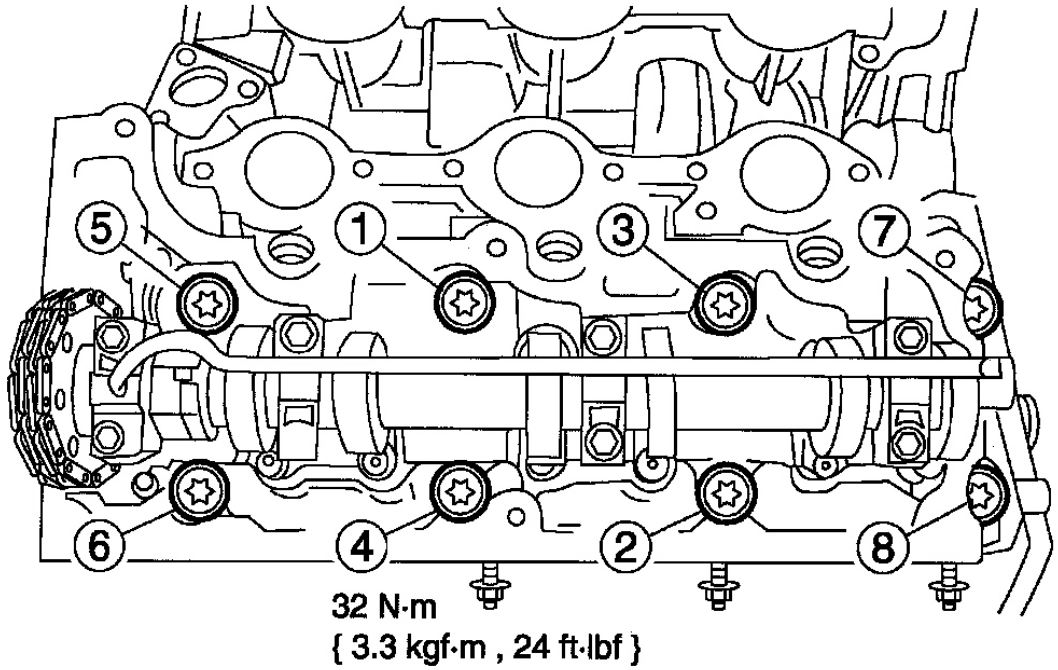


Fig. 265: Identifying Cylinder Head Bolt (12 mm) Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

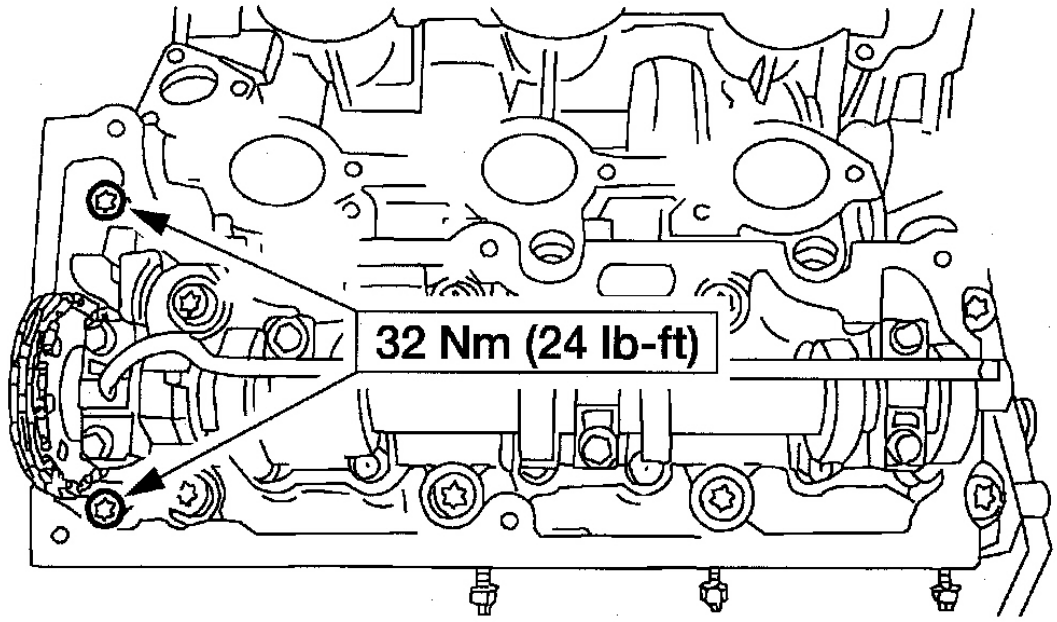


Fig. 266: Identifying Cylinder Head 8 mm Bolts
Courtesy of MAZDA MOTORS CORP.

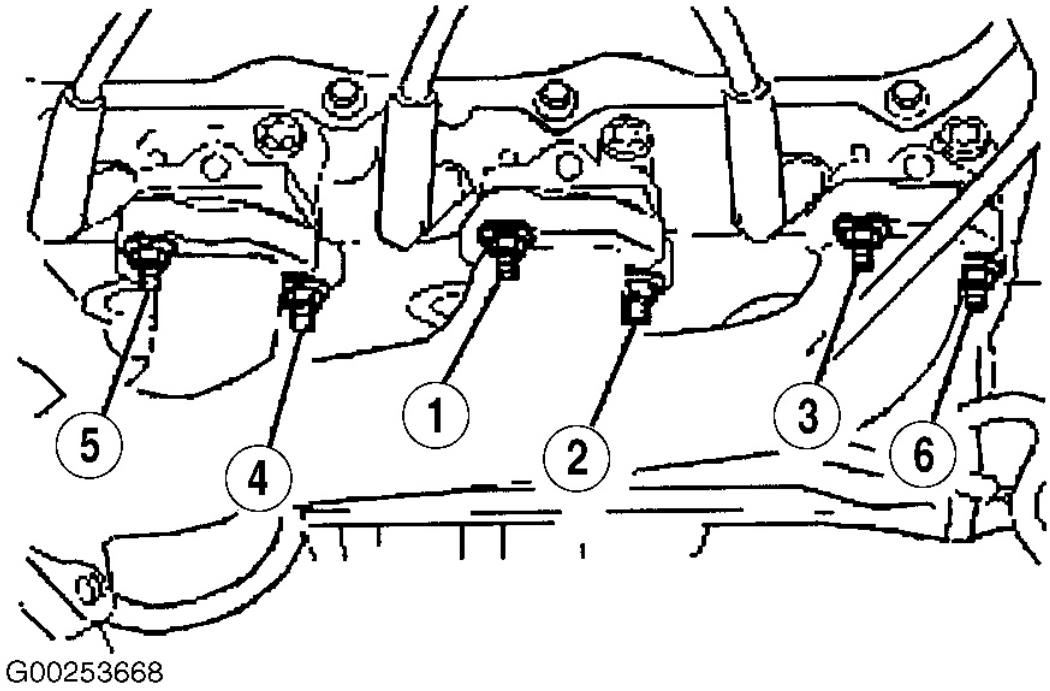


Fig. 267: Exhaust Manifold Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

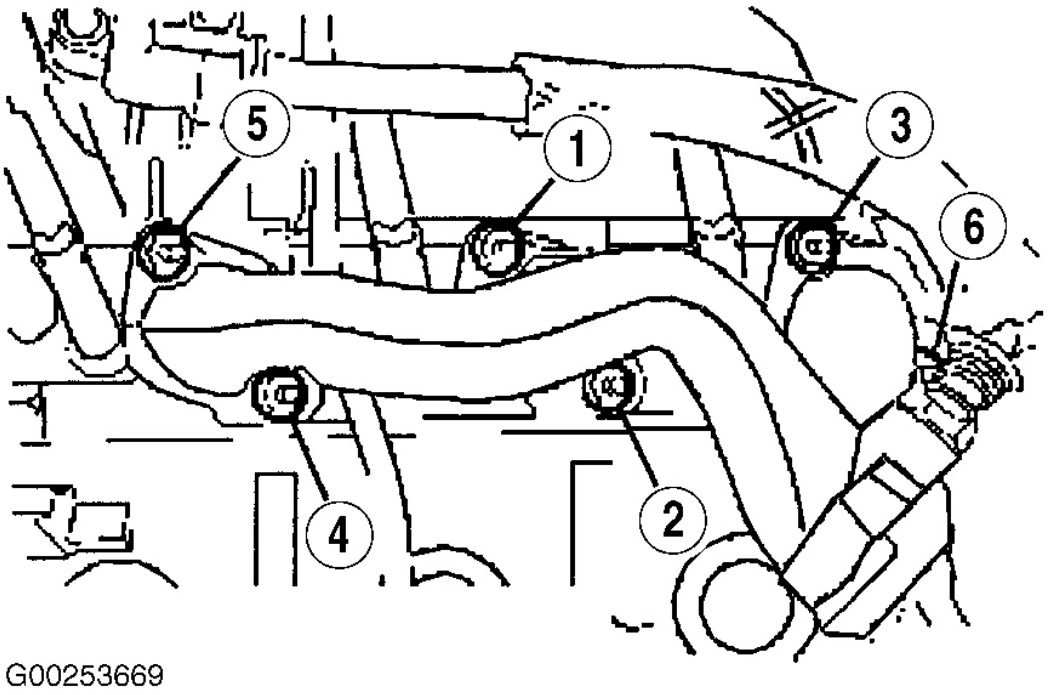


Fig. 268: Exhaust Manifold Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

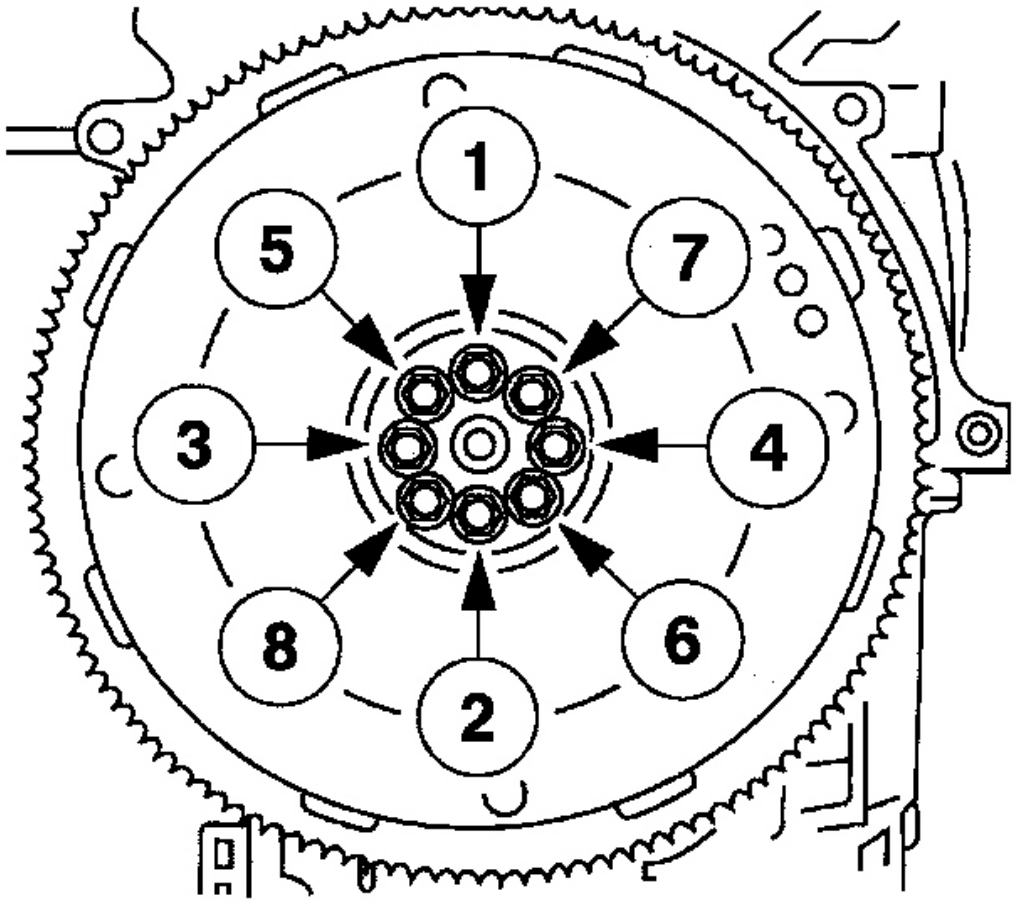


Fig. 269: Flywheel/Flexplate Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

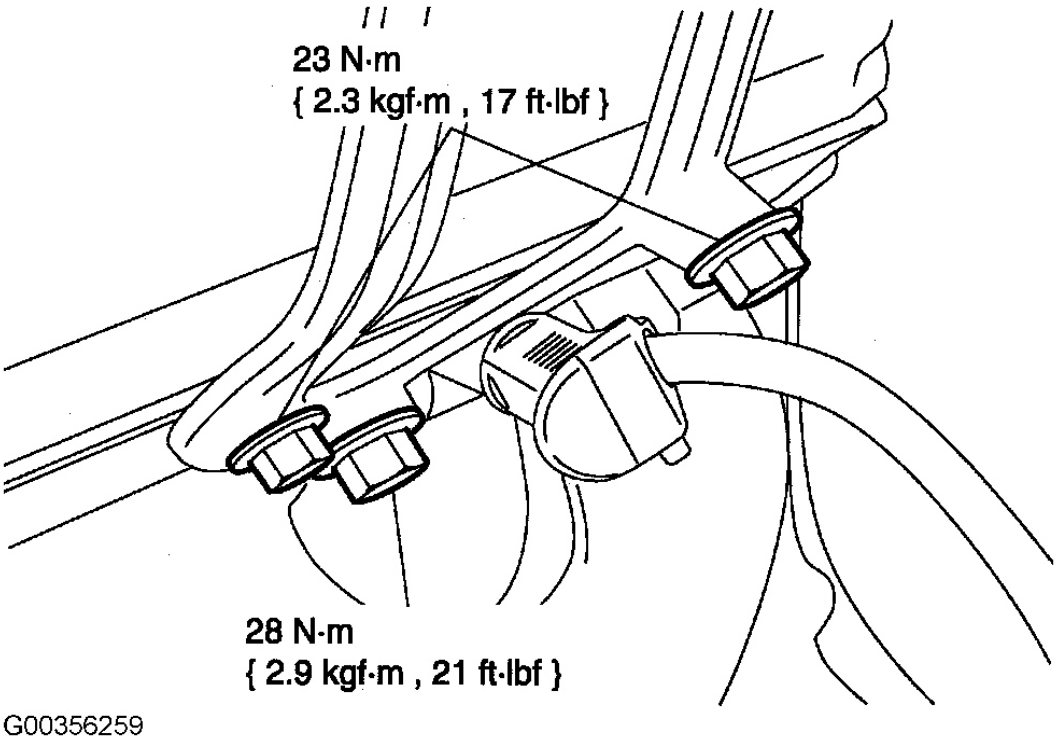


Fig. 270: Identifying Ignition Coil Bracket Bolts
Courtesy of MAZDA MOTORS CORP.

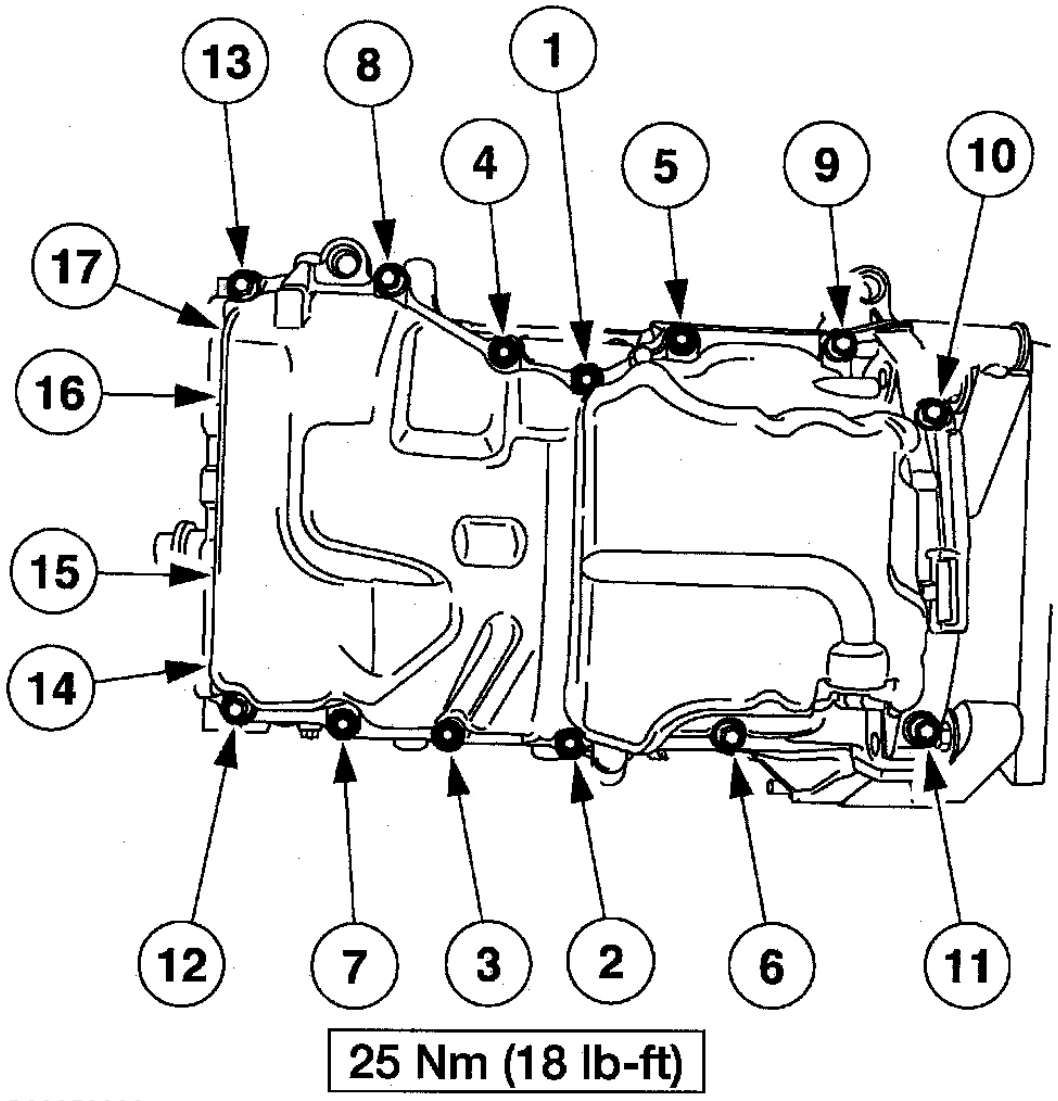


Fig. 271: Oil Pan Bolt Tightening Sequence
Courtesy of MAZDA MOTORS CORP.

SPECIFICATIONS

ENGINE SPECIFICATIONS

ENGINE SPECIFICATIONS

Item	Specification
Displacement	4.0L (4000 cc)
Number of Cylinders	6

Bore and Stoke	100.4 x 84.4 mm (3.953 x 3.31 inch)
Firing Order	1-4-2-5-3-6
Oil Pressure (Hot @ 2000 RPM)	276-414 kPa (40-60 psi)

CYLINDER HEAD & VALVE SPECIFICATIONS

CYLINDER HEAD & VALVE SPECIFICATIONS

Item	Specification
Valve Guide Bore Diameter - mm)	7.00-7.018
Combustion Chamber Volume (cc)	65.197 +/- 2.068-2.01 8
Valve Arrangement (Front To Rear)	LH = I-E-I-E-I-E RH=E-l-E-l-E-l
Gasket Surface Flatness - mm (inch)	.08 (.003)
Valve Seat	
Width (Exhaust and Intake) - mm (inch)	1.556-2.404 (0.06-0.094) 1.273-2.121 (0.05-0.083)
Angle Degrees	45°
Runout TIR Maximum - mm (inch)	0.059 (0.002)
Valves	
Valve Stem Diameter Intake - mm (inch)	6.965-6.98 (0.274-0.275)
Valve Stem Diameter Exhaust - mm (inch)	6.95-6.965 (0.274)
Valve Stem to Guide Clearance Exhaust - mm (inch)	0.035-0.068 (0.001-0.003)
Valve Stem to Guide Clearance Intake - mm (inch)	0.020-0.053 (0.001-0.002)
Head Diameter Intake - mm (inch)	45.9-46.1 (1.807-1.815)
Head Diameter Exhaust - mm (inch)	38.9-39.1 (1.531-1.539)
Valve Face Angle - Degrees	45°
Valve Face Runout Limits - mm (inch)	0.03 (0.001)
Valve Springs	
Intake Valve Spring Compression Pressure at Specified Height (lbs)	275-305 Nm At 35.9-36.7 mm (202.84-224.968 lb/ft at 1.41 3-1.445 inch)
Exhaust Valve Spring Compression Pressure at Specified Height (lbs)	275-305 Nm At 35.9-36.7 mm (202.84-224.968 lb/ft At 1.41 3-1.445 inch)
Intake Valve Spring Free Length - mm (inch)	43.1 (1.7)

Exhaust Valve Spring Free Length - mm (inch)	43.1 (1.7)
Intake Valve Spring Assembled Height - mm (inch)	39.86-40.86 (1.569-1.601)
Exhaust Valve Spring Assembled Height - mm (inch)	39.86-40.86 (1.569-1.601)

CAMSHAFT SPECIFICATIONS

CAMSHAFT SPECIFICATIONS

Item	Specification
Intake Lobe Lift - mm (inch)	6.584 (0.259)
End Play - mm (inch)	0.075-0.185 (0.0003-0.007)
Exhaust Lobe Lift - mm (inch)	6.584 (0.259)
Maximum Allowable Lobe Lift Loss - mm (inch)	0.127 (0.005)
Journal to Bearing Clearance - mm (inch) ((1))	0.04-0.095 (0.002-0.004)
Journal to Bearing Clearance	
Service Limit - mm (inch) ((1))	0.152 (0.006)
Camshaft Drive	
Journal Diameter - mm (inch)	27.935-27.96 (1.099-1.101)
Bearing Inside Diameter - mm (inch) All	28.0-28.03 (1.102-1.104)
Maximum Camshaft Journal Runout - mm (inch)	0.05 (0.002)
(1) Tighten Camshaft bearing cap bolts to 15 Nm (1.5 kgf-m, 11 lb-ft) when measuring journal clearance.	

CYLINDER BLOCK SPECIFICATIONS

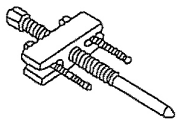
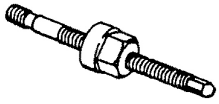
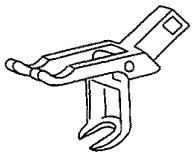
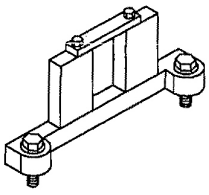
CYLINDER BLOCK SPECIFICATIONS

Item	Specification
Cylinder Bore Diameter - mm (inch)	100.4 (3.953)
Maximum Cylinder Out-of-Round - mm (inch)	0.025 (0.001)
Maximum Cylinder Taper - mm (inch)	0.025 (0.001)
Main Bearing Bore Diamater - mm (inch)	60.634-60.620 (2.387-2.387)
Crankshaft to Rear Face of Block Runout TIR Maximum - mm (inch)	0.127 (0.005)
Distributor Shaft Bearing Bore Diamater - mm (inch)	72.43-72.473 (2.852-2.853)
Head Gasket Surface Flatness - mm (inch)	0.1 (0.004) Overall
Head Gasket Surface Finish - RMS	60-150
Crankshaft & Flywheel	

Main Bearing Journal Diameter - mm (inch)	56.980-57.0 (2.243-2.244)
Main Bearing Journal Runout Limit - mm (inch)	0.05 (0.002)
Main Bearing Journal Taper Maximum Per Inch - mm (inch)	0.008 (0.0003)
Connecting Rod Journal Maximum Out-of-Round - mm (inch)	0.008 (0.0003)
Crankshaft Free End Play - mm (inch)	0.05-0.32 (0.002-0.0126)
Main Bearing Journal Out-of-Round - mm (inch)	0.008 (0.0003)
Main Bearing Journal Runout TIR Maximum - mm (inch)	0.05 (0.002)
Main Bearing Journal Runout Service Limit - mm (inch)	0.0127(0.005)
Main Bearing Thrust Face Runout TIR Maximum - mm (inch)	0.0254(0.010)
Thrust Bearing Journal Length - mm (inch)	26.39-26.44 (1.039-1.041)
Main and Rod Bearing Journal Finish - RMS Maximum	72 & 88
Main Bearing Thrust Face Finish - RMS Maximum	20
Connecting Rod Journal Diameter - mm (inch)	53.98-54.0 (2.125-2.126)
Connecting Rod Journal Taper per Inch Maximum - mm (inch)	0.008 (0.0003)
Clearance to Crankshaft Desired - mm (inch)	0.008-0.061 (0.0003-0.0024)
Connecting Rod Bearings	
Clearance to Crankshaft Allowable - mm (inch)	0.013-0.048 (0.0005-0.002)
Bearing Wall Thickness - mm (inch)	1.4-1.408 (0.0551-0.0554)
Main Bearings	
Clearance to Crankshaft - mm (inch)	0.021-0.039 (0.0008-0.0015)
Clearance to Crankshaft Allowable -mm (inch)	0.013-0.048 (0.0005-0.002)
Bearing Wall Thickness - mm (inch)	1.8-1.806 (0.0709-0.0711)
Connecting Rod, Piston and Rings	
Side Clearance (Assembled to Crankshaft) - mm (inch)	0.092-0.268 (0.0036-0.0106)
Piston Pin Bore or Bushing I.D. - mm (inch)	23.958-23.976 (0.943-0.944)
Rod Bearing Bore I.D. - mm (inch)	56.82-56.84 (2.237)
Rod Bearing Bore Out-of-Round - mm (inch)	0.01 (0.0004)
Rod Length Certer to Center - mm (inch)	145.965-146.035 (5.746-5.749)
Alignment (Bore-to-Bore Max. Diff.) Twist - mm (inch)	0.038 (0.001 5) per 25.4 mm (1.000)
Alignment (Bore-to-Bore Max. Diff.) Bend - mm (inch)	0.0125 (0.00049) per 25.4 mm (1.000)
Piston Pin	
Length - mm (inch)	72.0-72.8 (2.835-2.866)
Diameter (Red) - mm (inch)	23.994-23.997 (.9446-9447)
Diameter (Blue) - mm (inch)	23.997-24.000 (0.9447-0.9449)
To Piston Pin Bore Clearance - mm (inch)	0.01-0.016 (0.0004-0.0006)
To Connecting Rod Bushing Clearance - mm (inch)	Press Fit -0.018 to -0.042 (-0.0007 to -

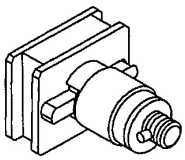
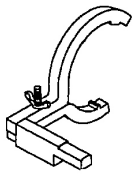
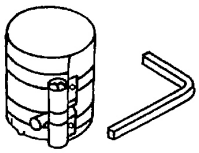
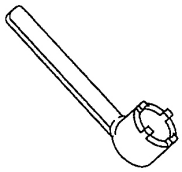
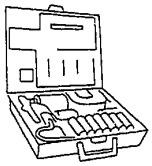
	0.0017)
Piston	
Bore Clearance Selective Fit - mm (inch)	0.030-0.060 (0.001 2-.002)
Diameter - Coded STD - mm (inch)	100.300-100.400 (3.952-3.9528)
Diameter Coded 0.5 - mm (inch)	100.880-100.900(3.972)
Diameter Coded 1.0 - mm (inch)	101.350-101.370 (3.990-3.991)
Pin Bore Diameter (Red) - mm (inch)	24.007-24.010(0.945)
Pin Bore Diameter (Blue) - mm (inch)	24.010-24.013 (0.945)
Top Ring Groove Width - mm (inch)	1.64-1.66 (0.0645-0.0654)
Bottom Ring Groove Width - mm (inch)	1.79-1.81 (0.0705-0.0713)
Oil Ring Groove Width - mm (inch)	3.5-3.53 (0.1378-0.1399)
Piston Rings	
Top Compression Ring Width - mm (inch)	1.578-1.598 (0.062-0.063)
Bottom Compression Ring Width - mm (inch)	1.728-1.74 (0.068-0.069)
Top Comression Side Clearance - mm (inch)	0.050-0.082 (0.002-0.003)
Bottom Compression Side Clearance - mm (inch)	0.050-0.082 (0.002-0.003)
Top Compression Ring Gap - mm (inch)	0.200-0.450 (0.008-0.018)
Bottom Compression Ring Gap - mm (inch)	0.450-0.700 (0.018-0.028)
Lubrication System	
Relief Valve Spring Pressure Lbs. at 35.3 - mm (1.39 in)	61.3-66.3 Nm (6.13-6.63 kgf-m, 45.100-48.730 lb-ft)
Driveshaft to Housing Clearance - mm (inch)	0.02-0.031 (0.0007-0.0012)
Relief Valve to Housing Clearance - mm (inch)	0.015-0.03 (0.0007-0.0012)
Rotor Assembly End Clearance Max. - mm (inch)	0.014-0.044 (0.0006-0.0017)
Outer Race to End Clearance - mm (inch)	0.06-0.12 (0.0002-0.0004)
Engine Oil Capacity - Liters (Quarts)	3.8 (4)

SPECIAL TOOLS

Crankshaft Damper Remover 49UN-01–0010	
Spark Plug Wire Remover 303–106	
Crankshaft Damper Replacer 49un-01–0020	
Valve Stem Seal Replacer 303–370	
Valve Spring Compressor 303–581	
Camshaft Holding Tool 303–577	

G02821399

Fig. 272: Identifying Special Service Tools (1 Of 3)
Courtesy of MAZDA MOTORS CORP.

Camshaft Holding Tool Adapter 303–576	
Crankshaft Holding Tool 303–573	
Piston Ring Compressor 303–D032	
Rear Jackshaft Socket 303–634	
Piston Pin Tool 303–D034	
Impace Slide Hammer 211–S060	

G02821400

Fig. 273: Identifying Special Service Tools (2 Of 3)
Courtesy of MAZDA MOTORS CORP.

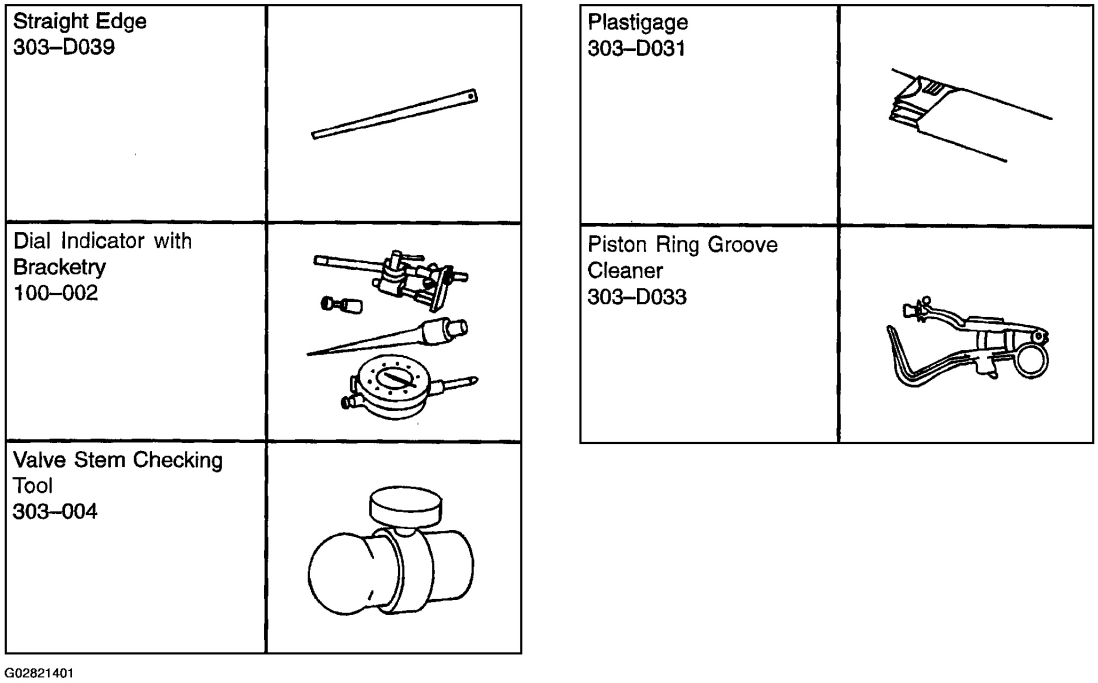


Fig. 274: Identifying Special Service Tools (3 Of 3)
Courtesy of MAZDA MOTORS CORP.

