ENGINE UNIT

COMPONENTS

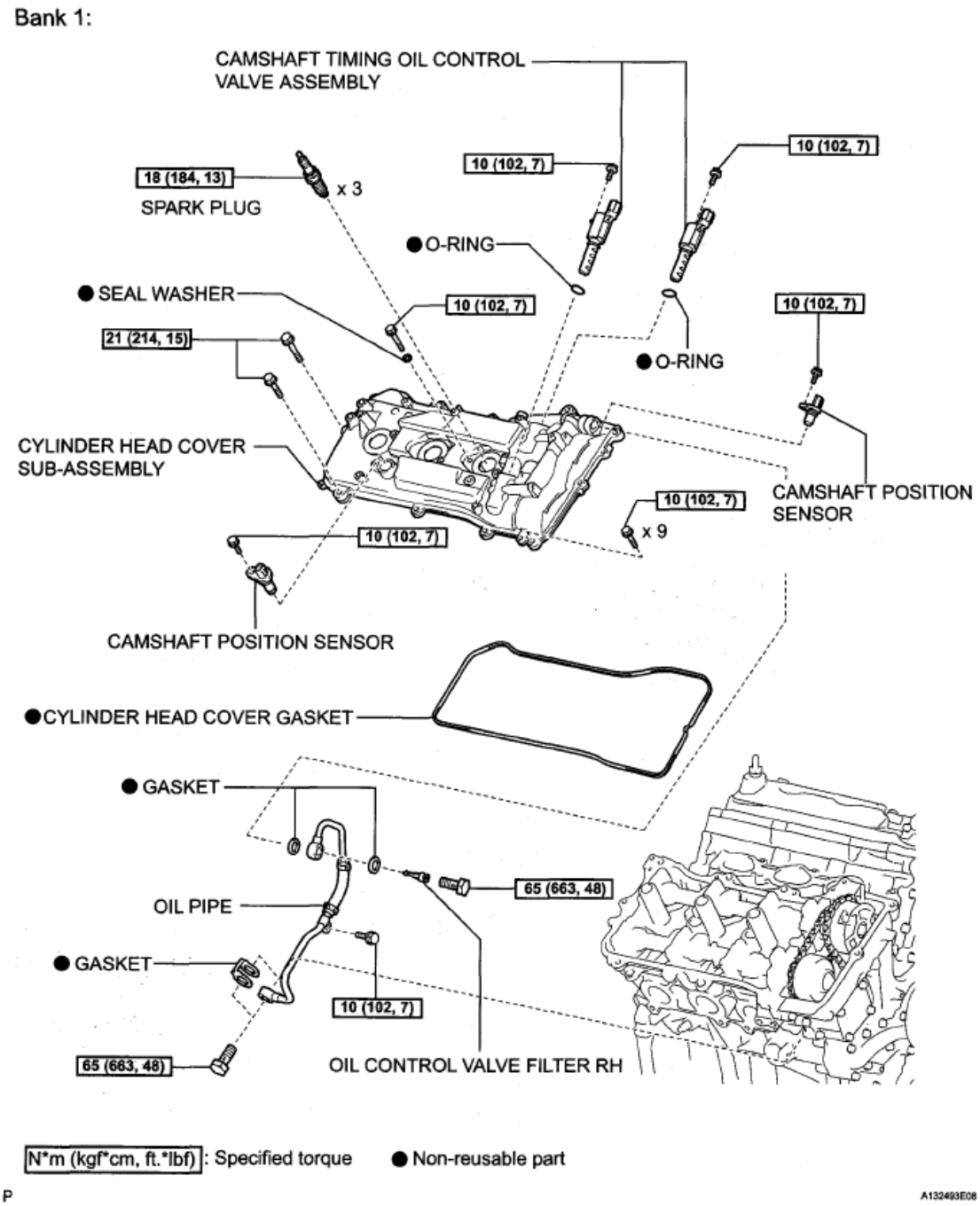

Fig. 180: Identifying Engine Unit Components With Torque Specifications (1 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

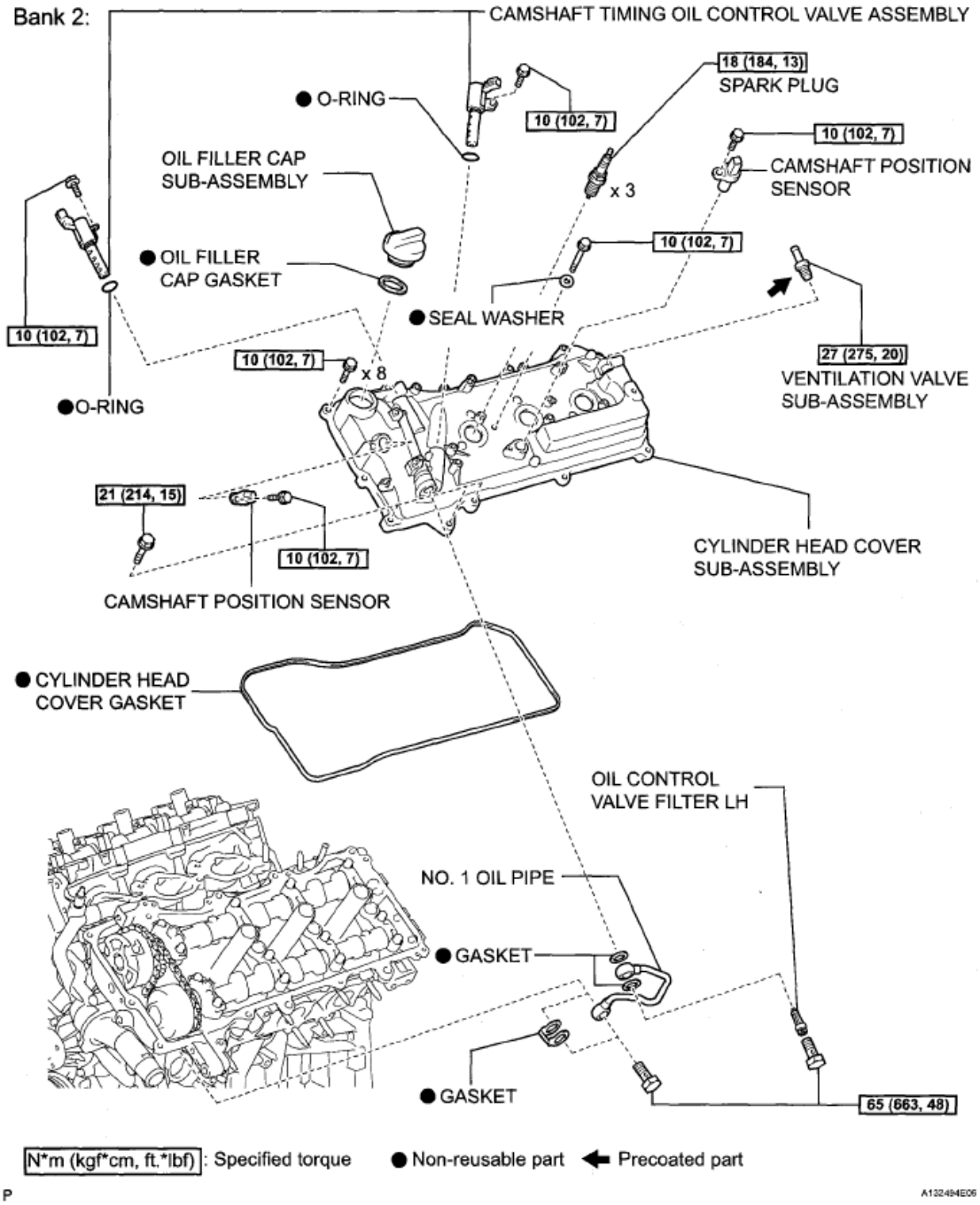

Fig. 181: Identifying Engine Unit Components With Torque Specifications (2 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

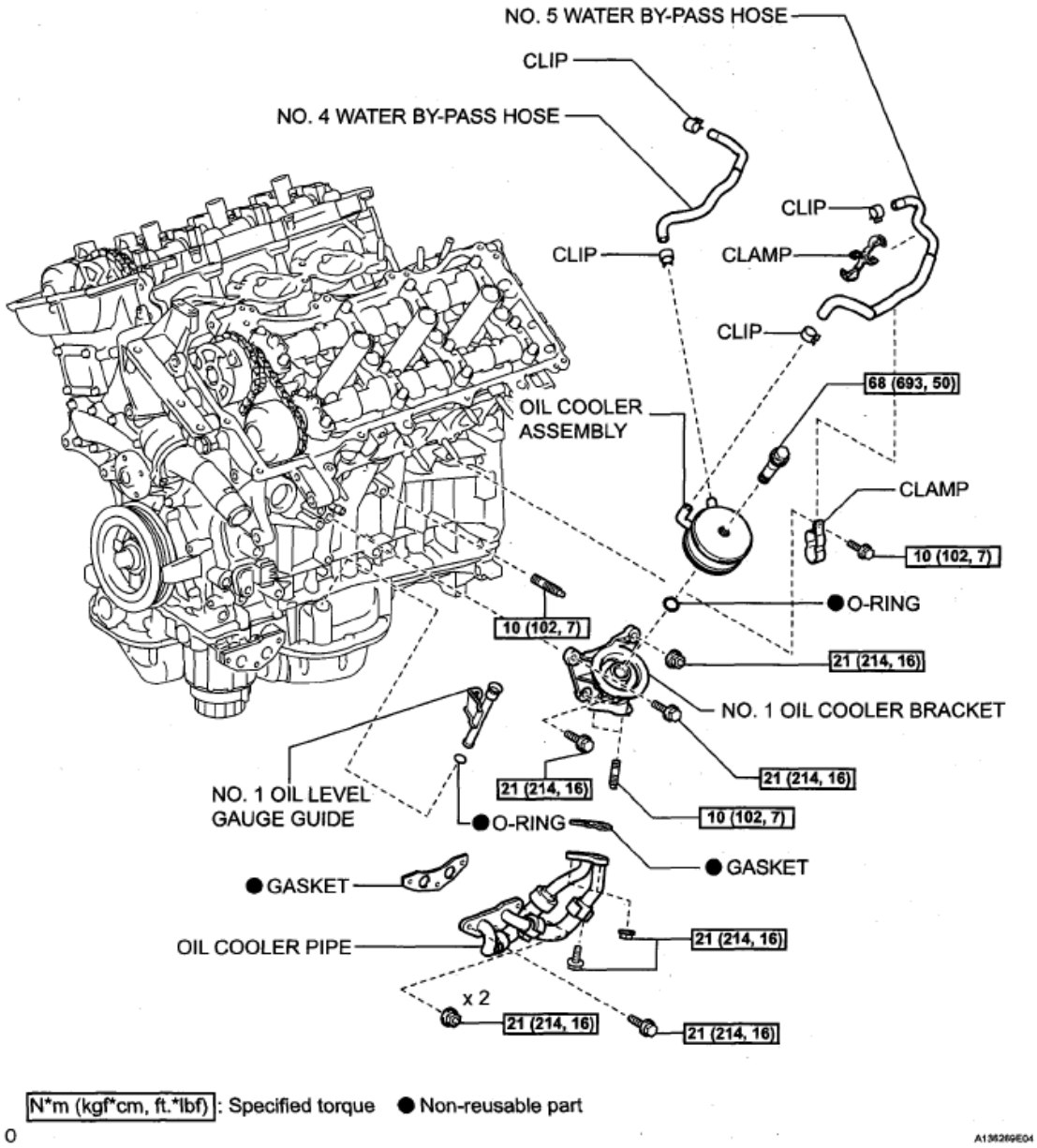

Fig. 182: Identifying Engine Unit Components With Torque Specifications (3 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

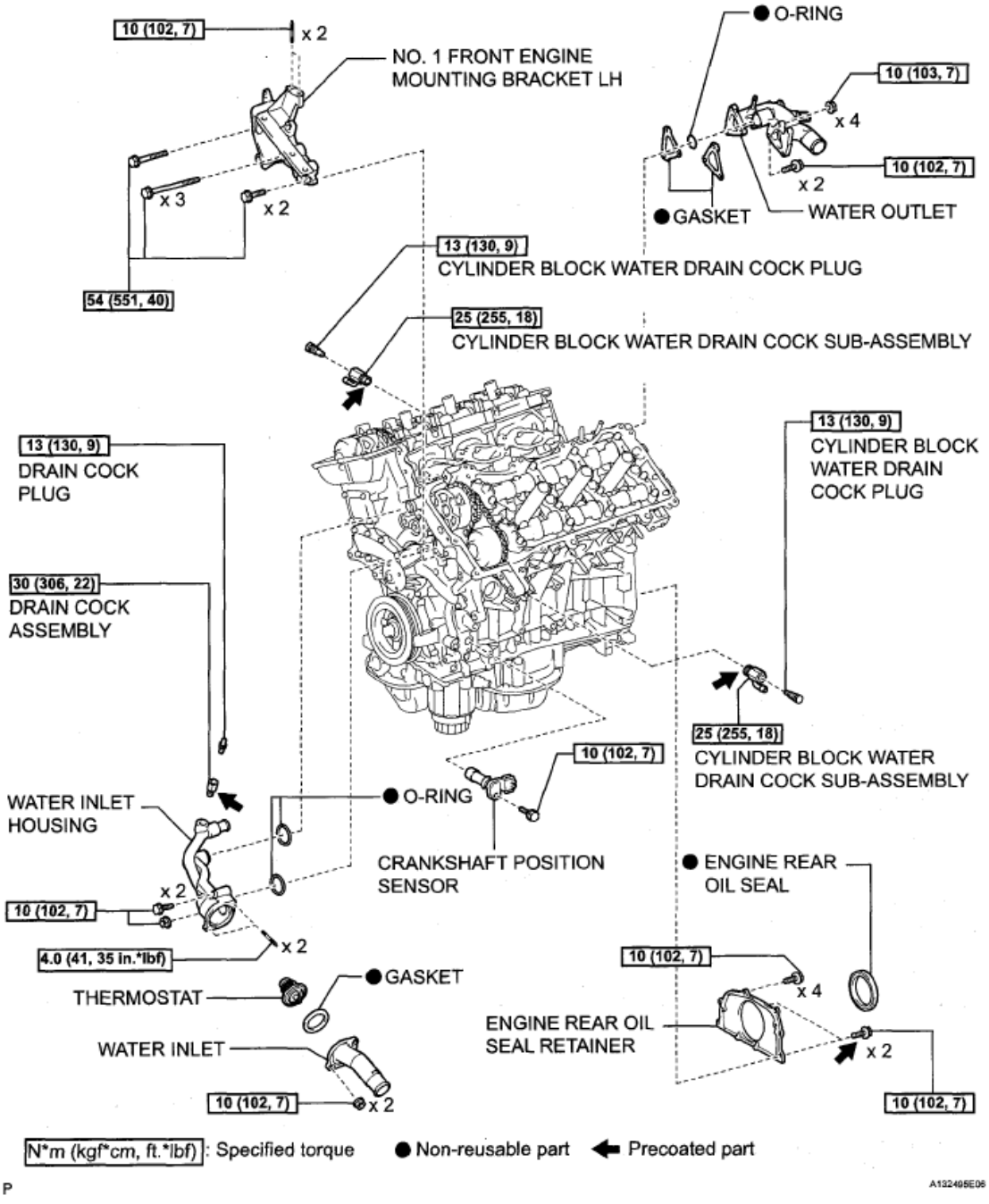

Fig. 183: Identifying Engine Unit Components With Torque Specifications (4 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

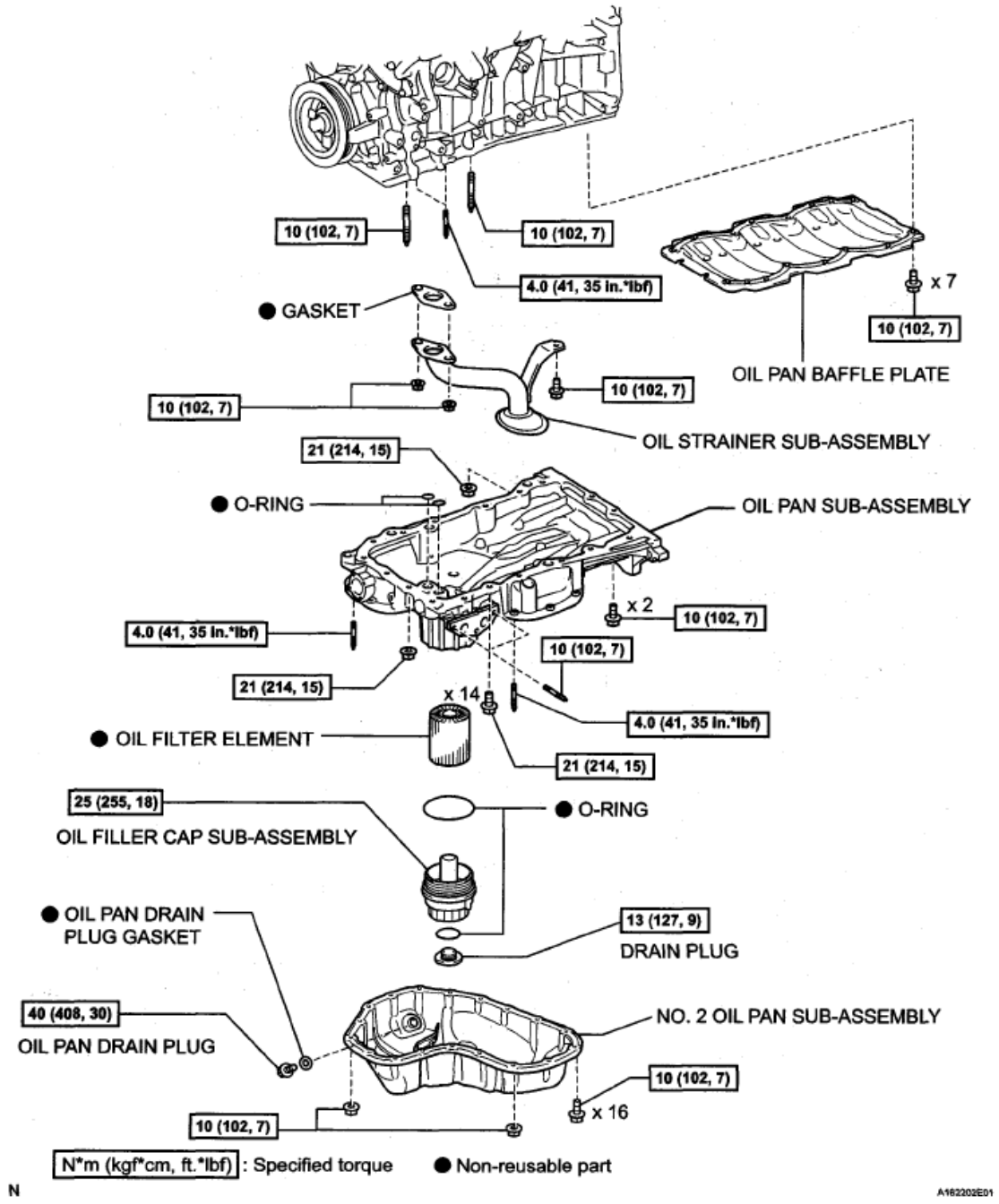

Fig. 184: Identifying Engine Unit Components With Torque Specifications (5 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

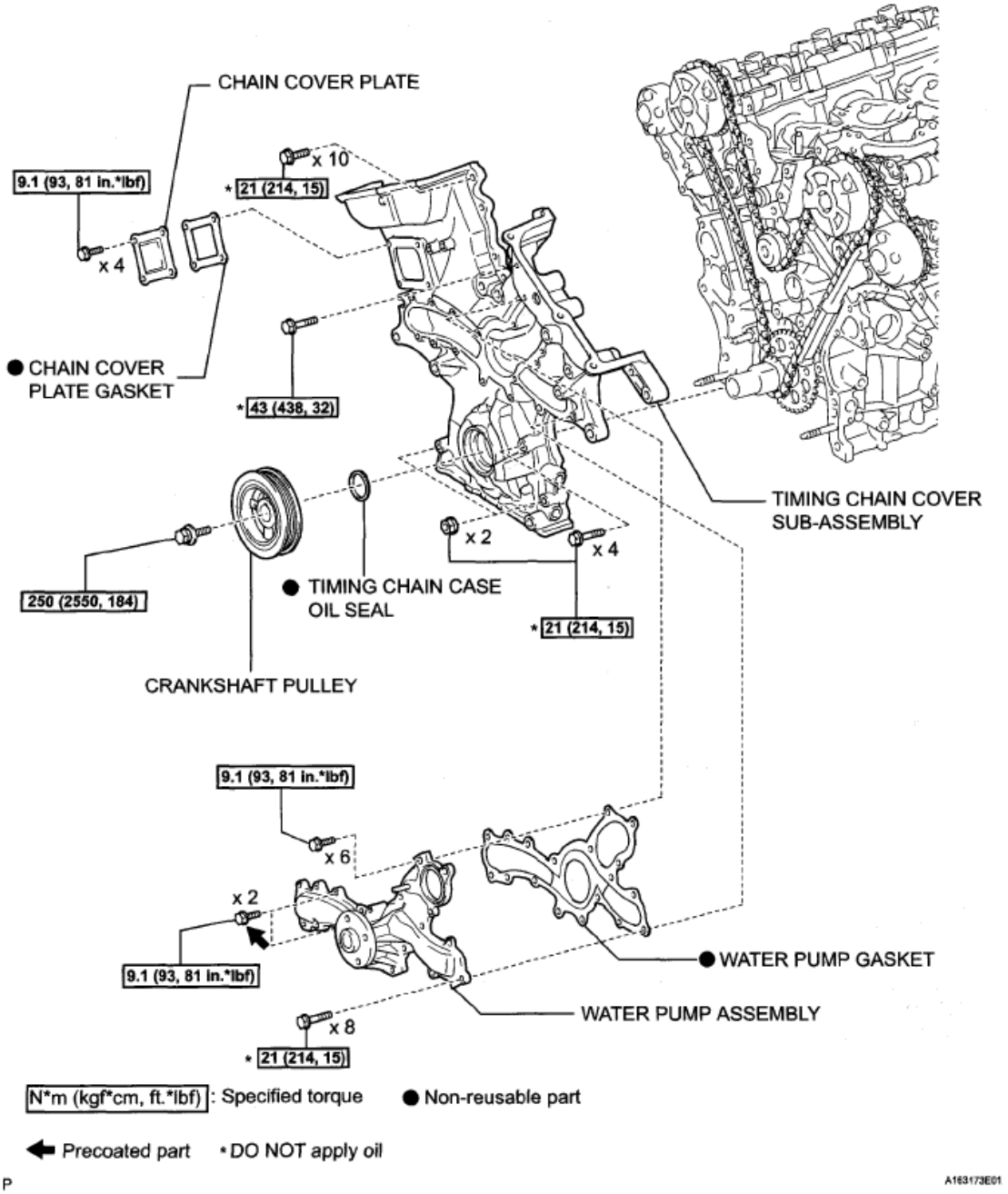

Fig. 185: Identifying Engine Unit Components With Torque Specifications (6 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

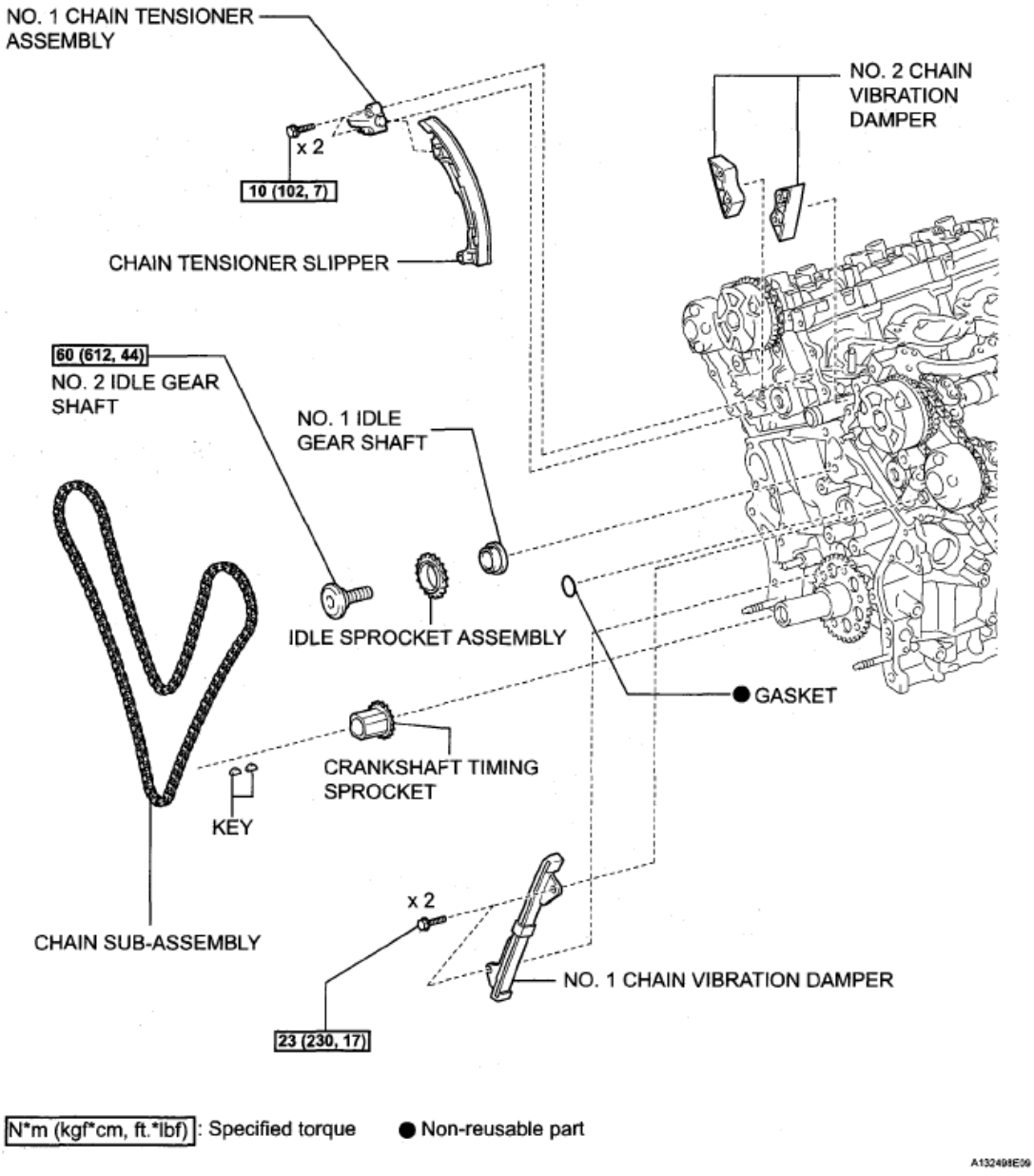

Fig. 186: Identifying Engine Unit Components With Torque Specifications (7 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

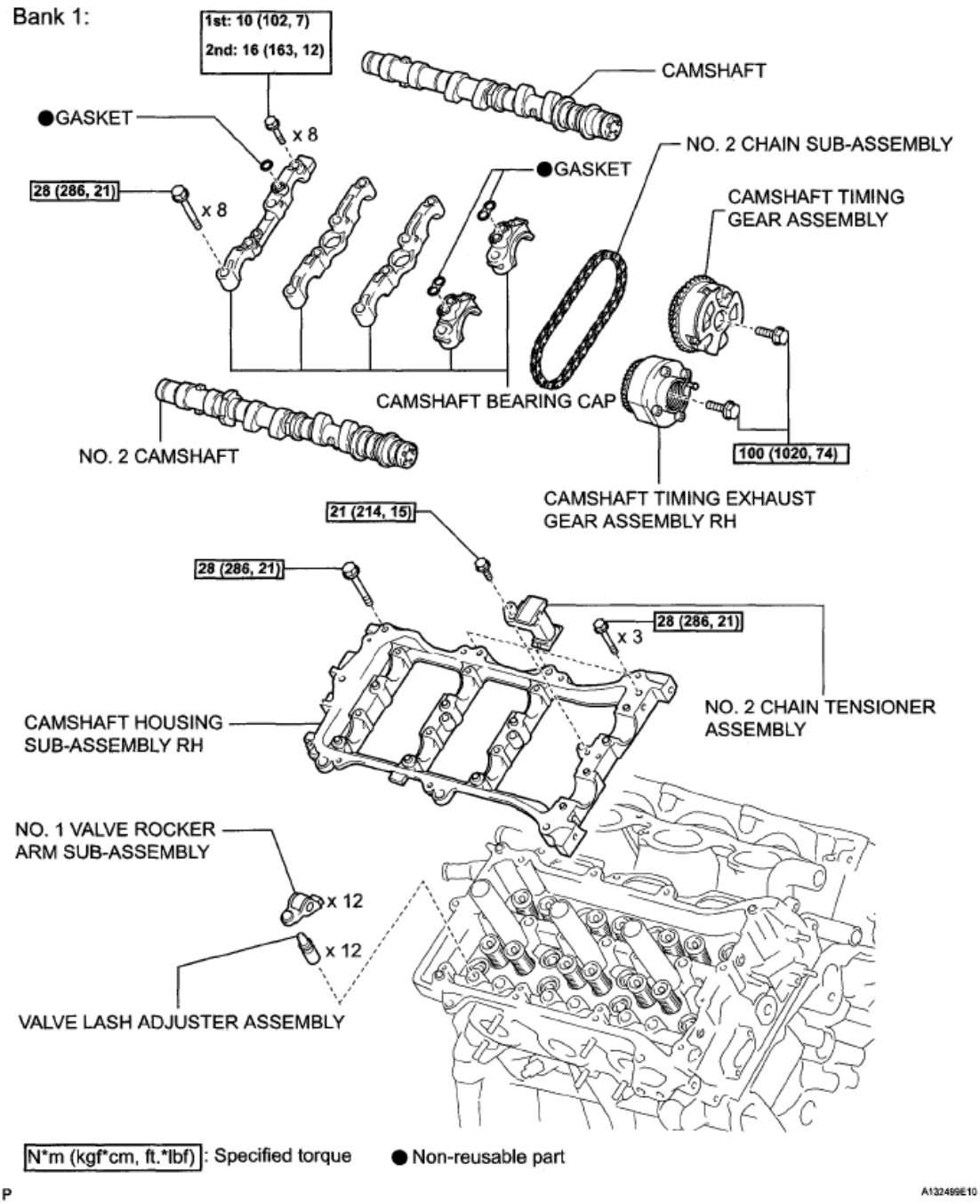

Fig. 187: Identifying Engine Unit Components With Torque Specifications (8 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

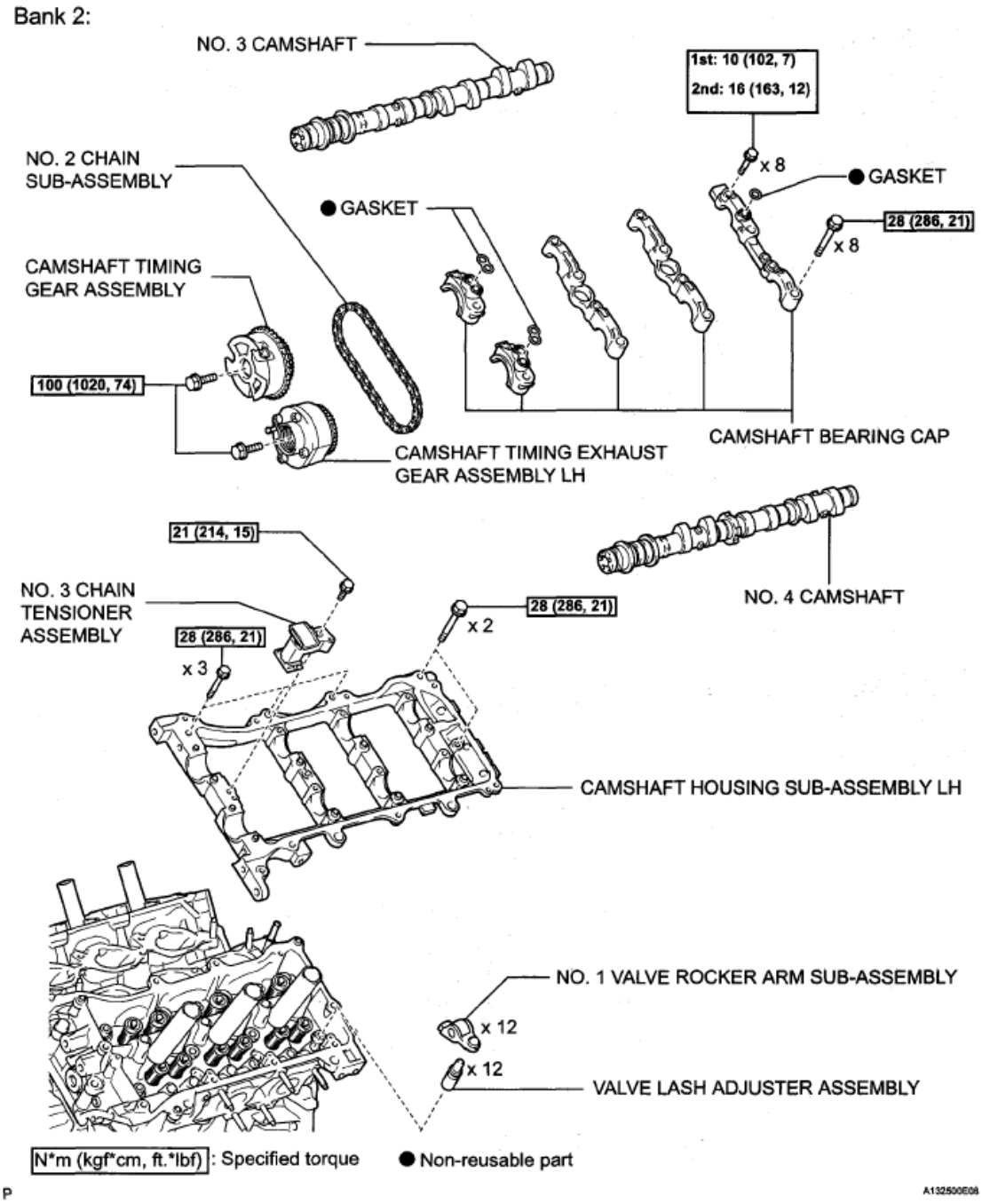

Fig. 188: Identifying Engine Unit Components With Torque Specifications (9 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

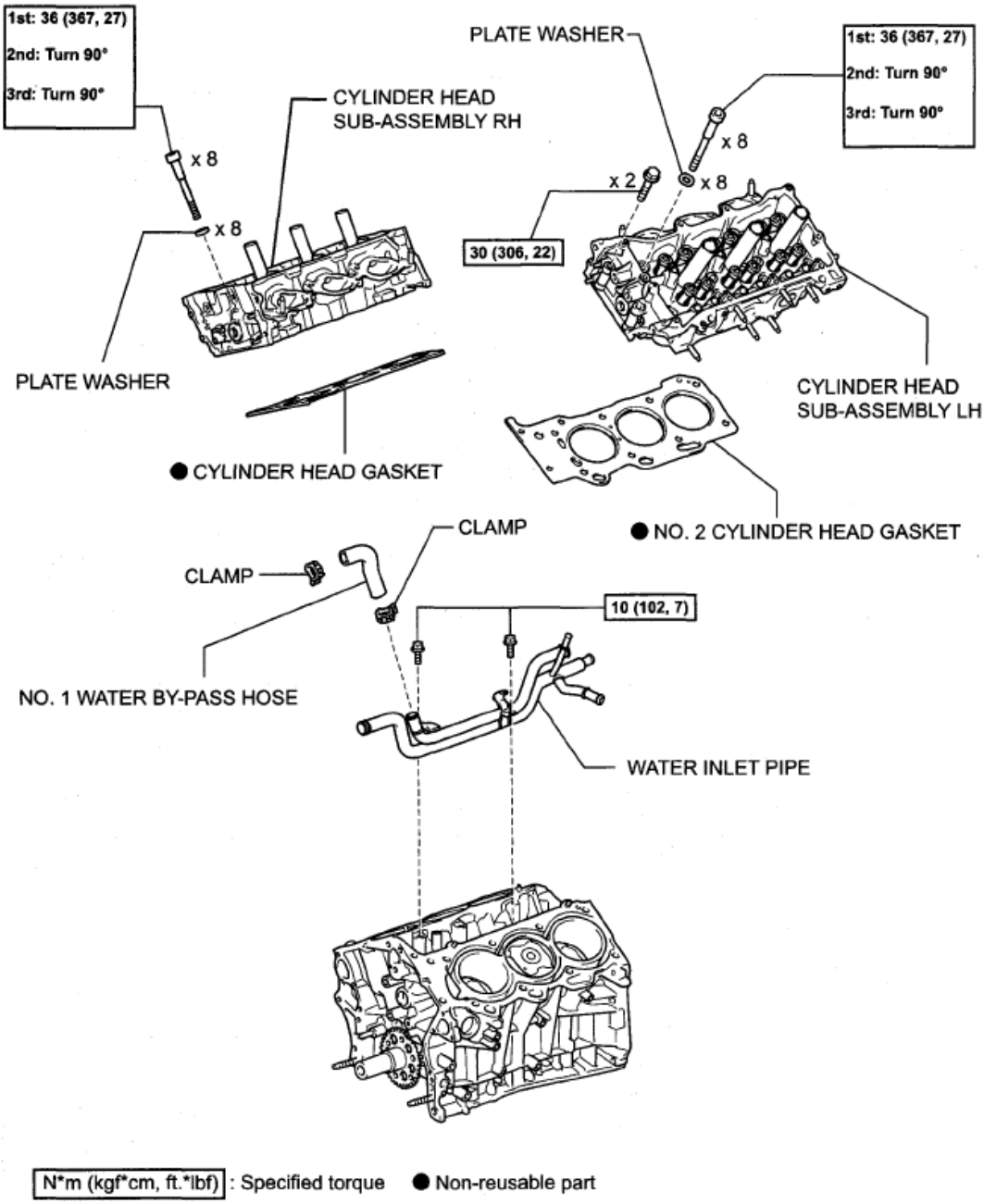

Fig. 189: Identifying Engine Unit Components With Torque Specifications (10 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

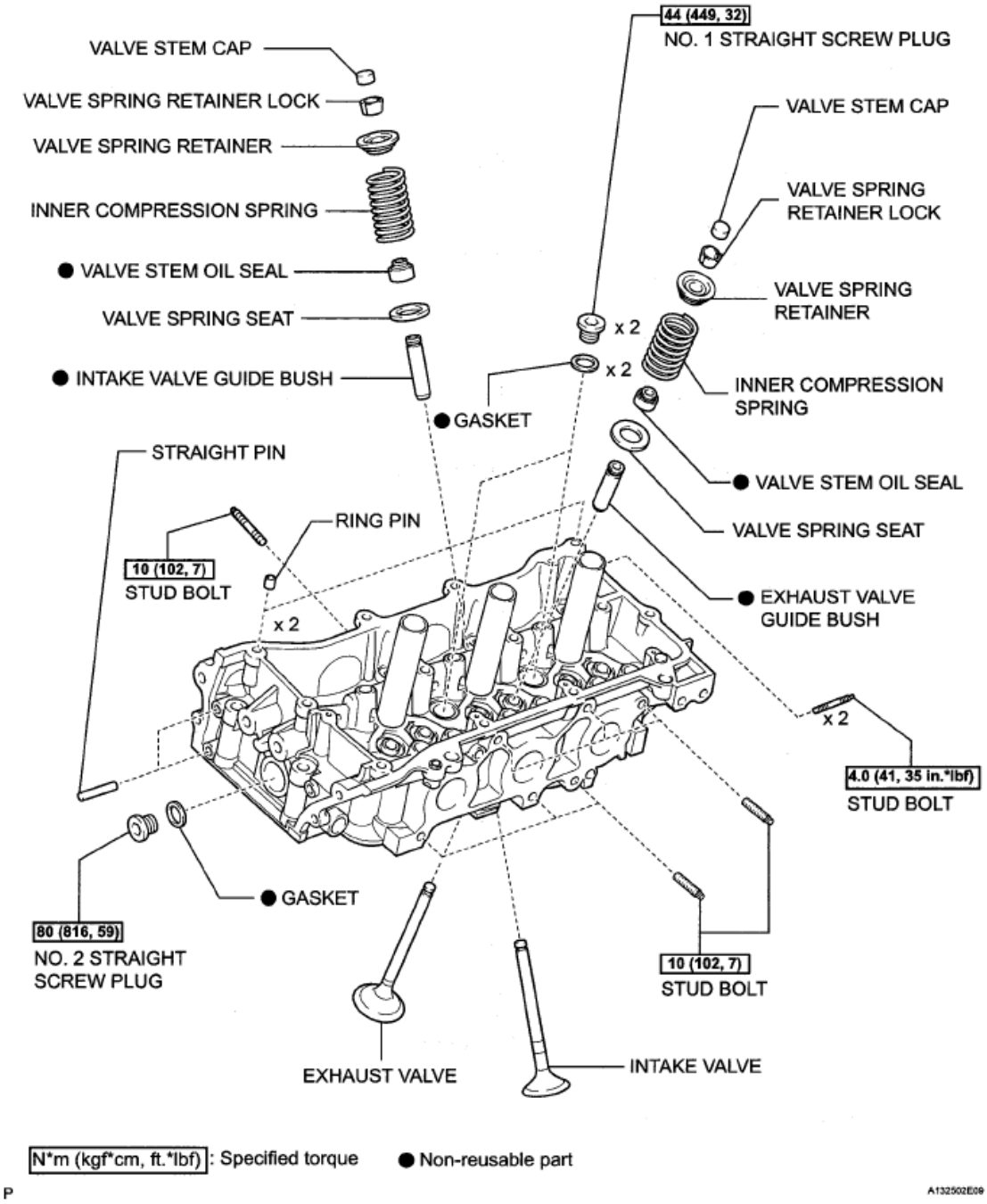

Fig. 190: Identifying Engine Unit Components With Torque Specifications (11 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

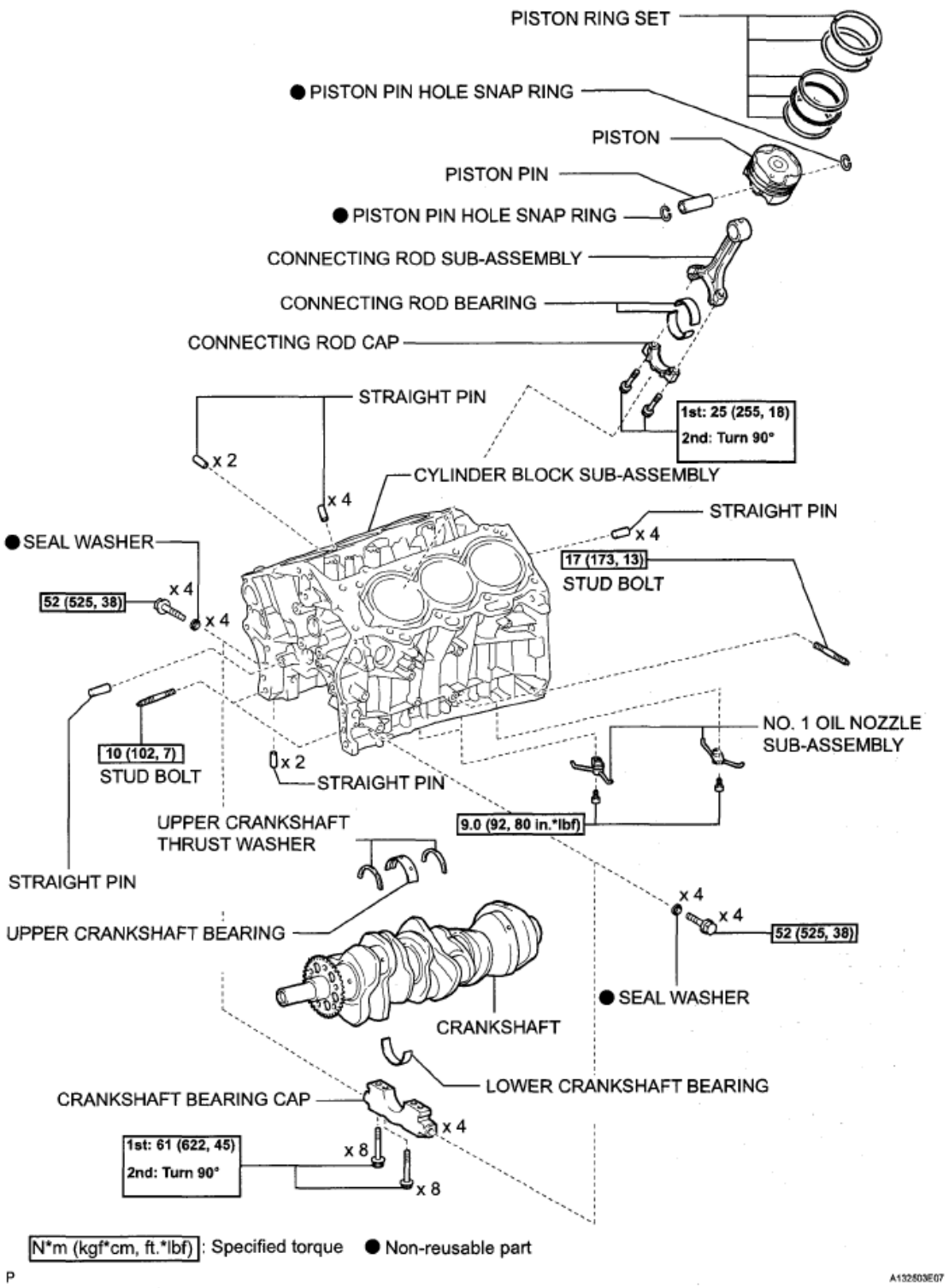

Fig. 191: Identifying Engine Unit Components With Torque Specifications (12 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

1. **REMOVE OIL FILLER CAP SUB-ASSEMBLY**
   a. Remove the oil filler cap sub-assembly and oil filler gasket.
2. **REMOVE SPARK PLUG**
   a. Remove the spark plugs.
3. **REMOVE OIL PAN DRAIN PLUG**
   a. Remove the oil pan drain plug and oil pan drain plug gasket.

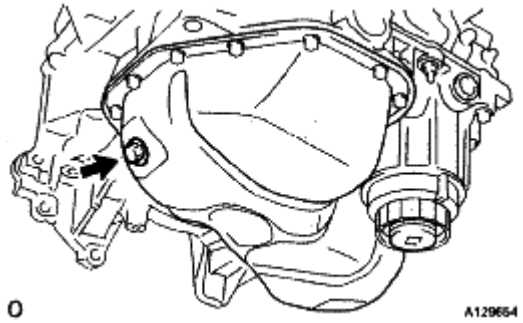

Fig. 192: Locating Oil Pan Drain Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **REMOVE VENTILATION VALVE SUB-ASSEMBLY**
   a. Remove the ventilation valve sub-assembly.

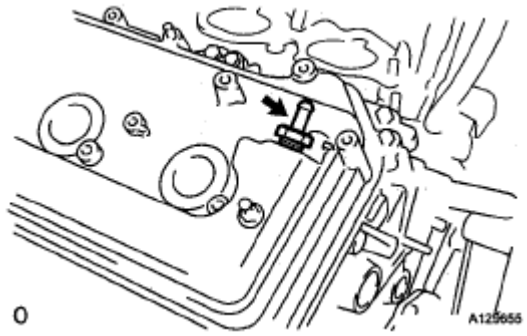

Fig. 193: Locating Ventilation Valve Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **REMOVE CAMSHAFT POSITION SENSOR**
   a. Remove the 4 bolts and 4 camshaft position sensors.

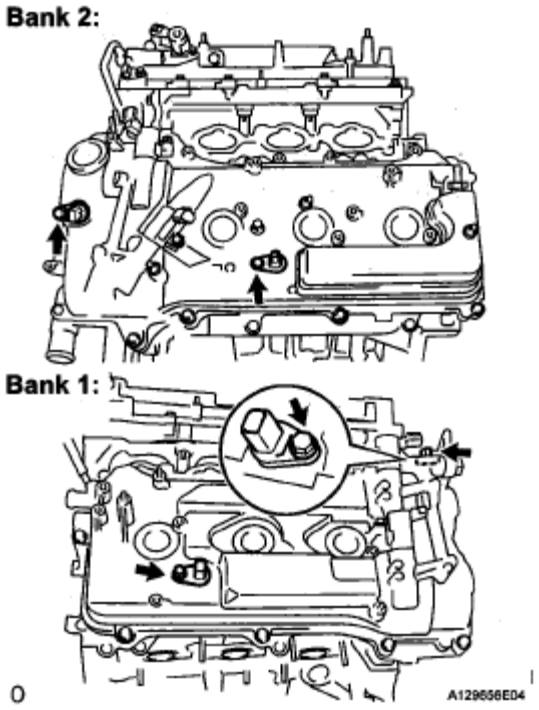

Fig. 194: Locating Bolts And Camshaft Position Sensors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
   a. Remove the 4 bolts and 4 camshaft oil control valves.

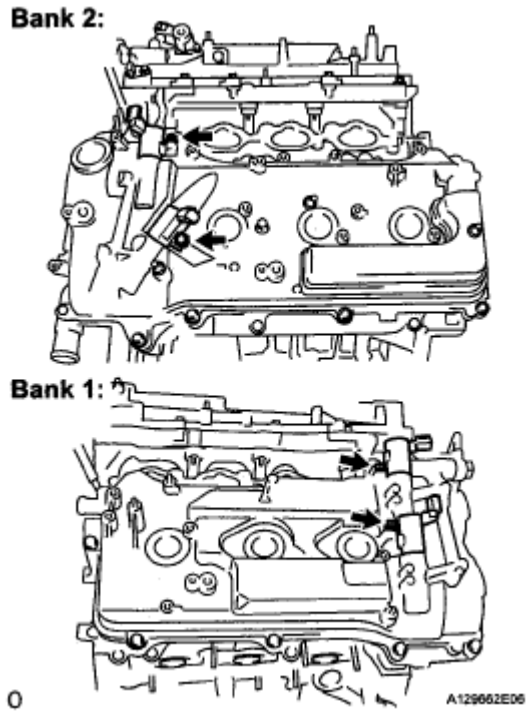

Fig. 195: Locating Bolts And Camshaft Oil Control Valves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **REMOVE CRANKSHAFT POSITION SENSOR**
   a. Remove the bolt and crankshaft position sensor.

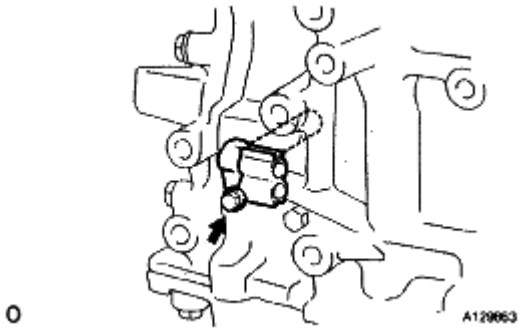

Fig. 196: Locating Crankshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **REMOVE NO. 1 OIL PIPE**
   a. Remove the 2 oil pipe unions, gaskets and oil pipe.
   b. Remove the oil control valve filter LH and gaskets.

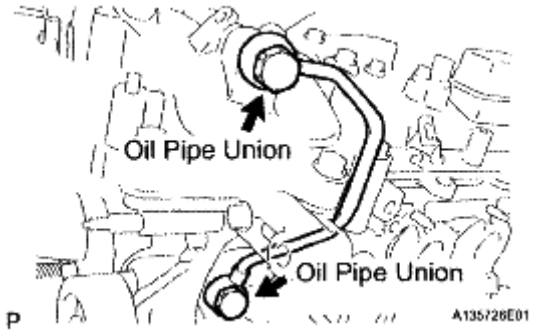

Fig. 197: Locating Oil Pipe Unions And Oil Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **REMOVE OIL PIPE**
   a. Remove the bolt.
   b. Remove the 2 oil pipe unions and oil pipe.
   c. Remove the oil control valve filter RH and gaskets.

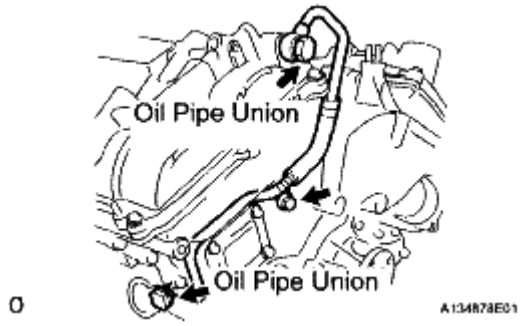

Fig. 198: Locating Oil Pipe Unions And Oil Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY**
    a. Remove the cylinder block water drain cocks from the cylinder block.
    b. Remove the cylinder block water drain cock plugs from the water drain cocks.

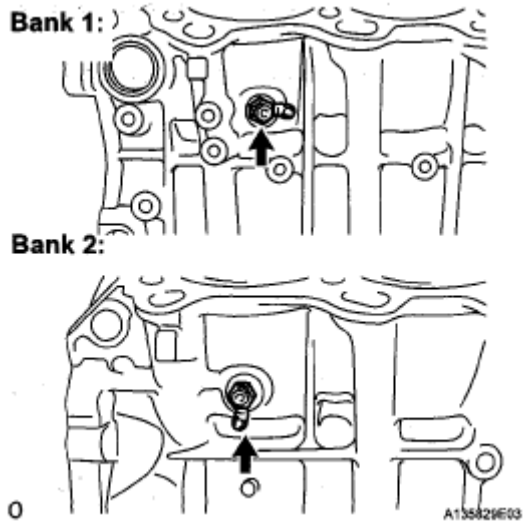

Fig. 199: Locating Cylinder Block Water Drain Cock Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **REMOVE OIL FILTER ELEMENT**
    a. Remove the drain plug.

NOTE: Do not remove the O-ring from the oil filter cap.

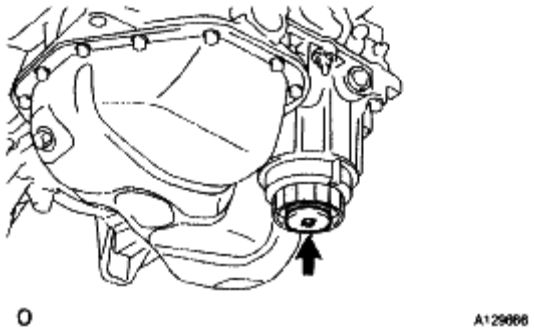

Fig. 200: Locating Drain Plug
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the hose to the pipe.
c. Insert the pipe with the hose into the oil filter cap.
d. Make sure that the oil is completely drained and remove the pipe and O-ring.

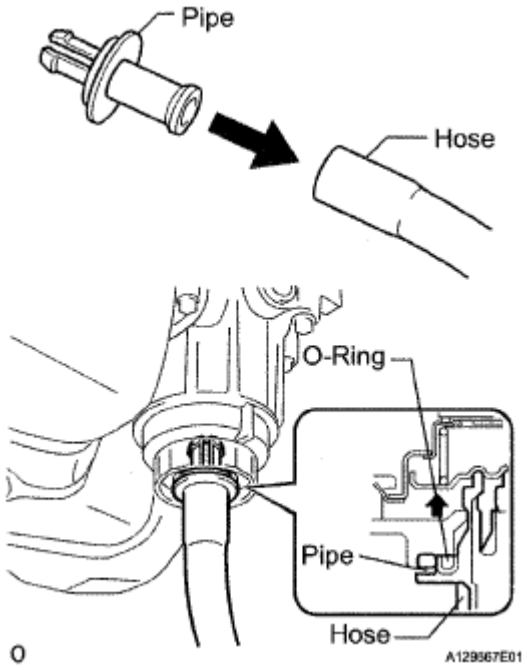

Fig. 201: Connecting Hose To Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using SST, remove the oil filter cap sub-assembly.

SST 09228-06501

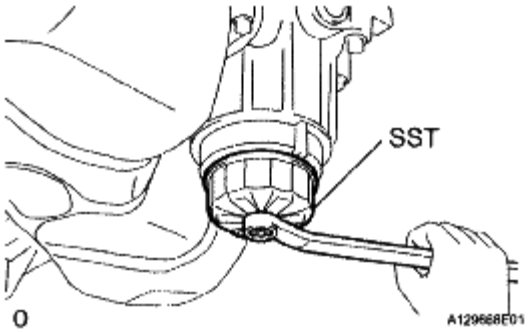

Fig. 202: Locating Oil Filter Cap Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Remove the oil filter element and 0-ring from the oil filter cap sub-assembly.

NOTE: Do not use any tools when removing the O-ring to prevent the O-ring groove from being damaged.

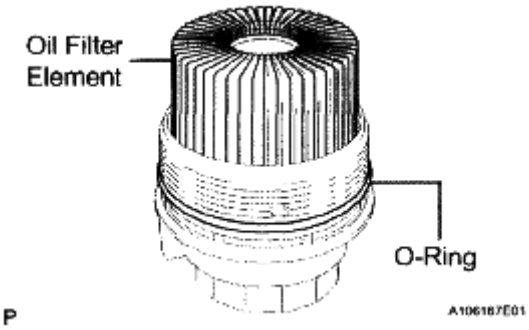

Fig. 203: View Of Oil Filter Element And O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **REMOVE CRANKSHAFT PULLEY**

a. Using SST, loosen the crankshaft pulley bolt.

SST 09213-70011 (09213-70020), 09330-00021

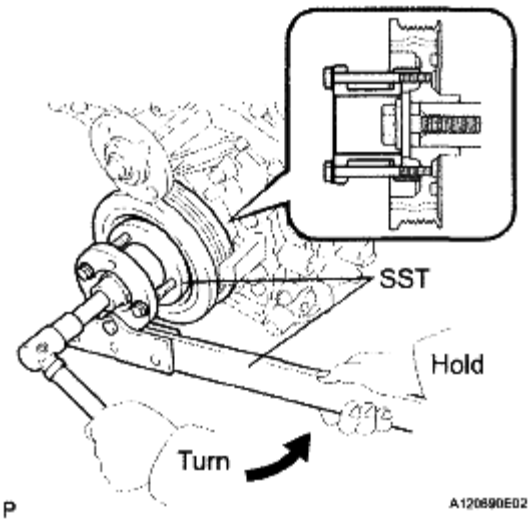

Fig. 204: Loosening Crankshaft Pulley Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, remove the crankshaft pulley bolt and crankshaft pulley.

SST 09950-50013 (09951 -05010, 09952-05010, 09953-05020, 09954-05021)

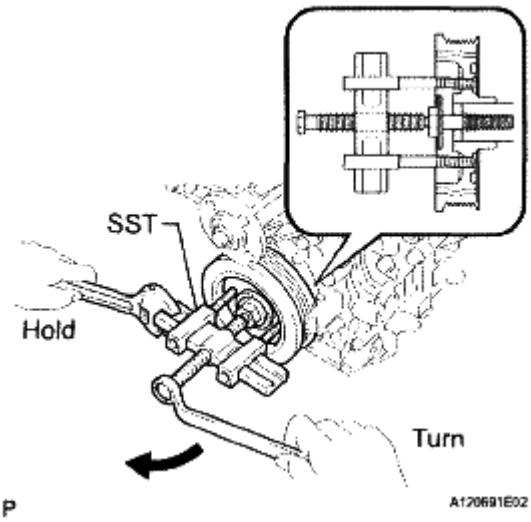

Fig. 205: Removing Crankshaft Pulley Bolt And Crankshaft Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **REMOVE OIL COOLER ASSEMBLY**
    a. Remove the bolt, 2 clamps, and 4 clips and disconnect the 2 water by-pass hoses.

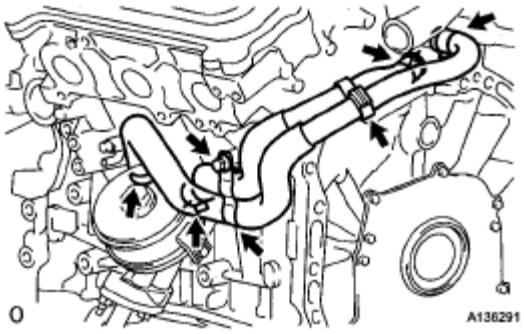

Fig. 206: Locating Bolt, Clamps, And Clips
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the union bolt, oil cooler assembly, and O-ring.

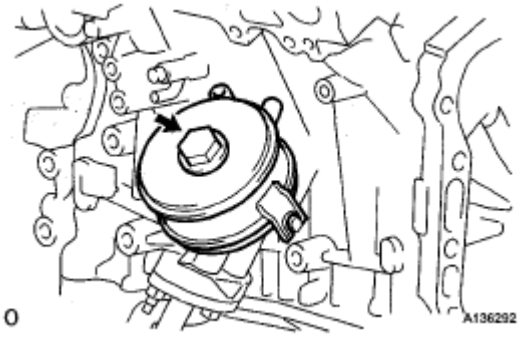

Fig. 207: Locating Oil Cooler Union Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **REMOVE NO. 1 OIL COOLER BRACKET**
    a. Remove the 3 bolts, 3 nuts, and oil cooler pipe with No. 1 oil cooler bracket.

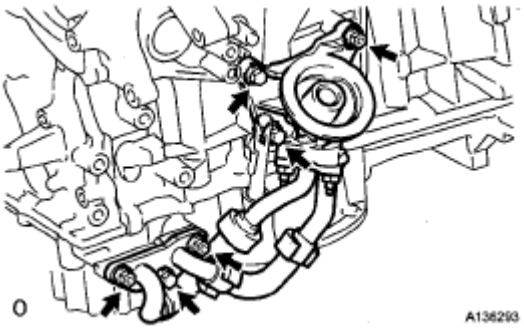

Fig. 208: Locating Bolts, Nuts, And Oil Cooler Pipe With No. 1 Oil Cooler Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the bolt, 2 nuts, No. 1 oil cooler bracket, and gasket.
    c. Using a "TORX" socket wrench E8, remove the 2 stud bolts.

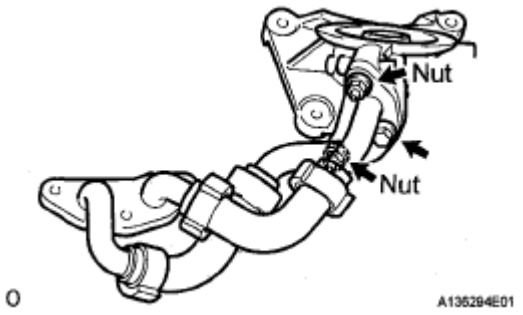

Fig. 209: Locating Bolt, Nuts, No. 1 Oil Cooler Bracket, And Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **REMOVE NO. 1 FRONT ENGINE MOUNTING BRACKET LH**
    a. Remove the 6 bolts and No. 1 front engine mounting bracket LH.
    b. Using a "TORX" socket wrench E8, remove the 2 stud bolts.

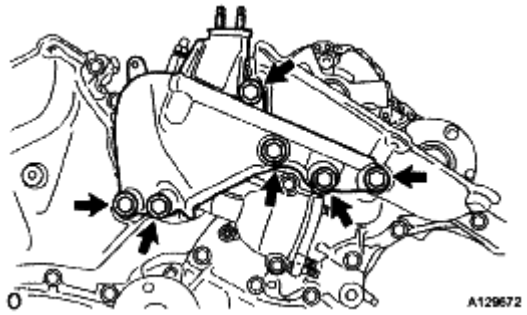

Fig. 210: Locating Engine Mounting Bracket Front And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **REMOVE WATER INLET HOUSING**
    a. Remove the 2 nuts, water inlet and thermostat.
    b. Remove the gasket.
    c. Remove the drain cock plug.
    d. Remove the drain cock assembly.
    e. Remove the 2 stud bolts.
    f. Separate the No. 1 water by-pass hose.

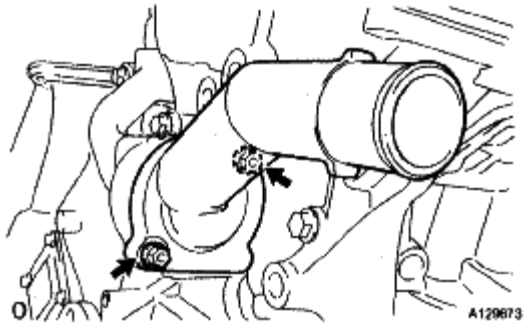

Fig. 211: Locating Water Inlet With Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Remove the 2 bolts, nut, and water inlet housing.

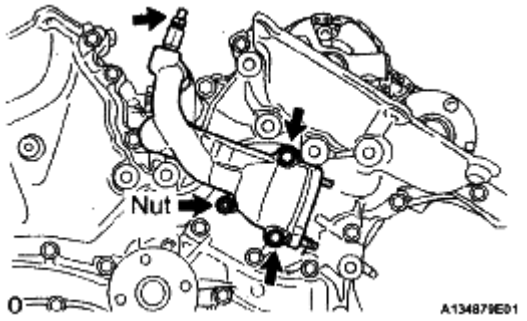

Fig. 212: Locating Bolts, Nut, And Water Inlet Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Remove the 2 O-rings.

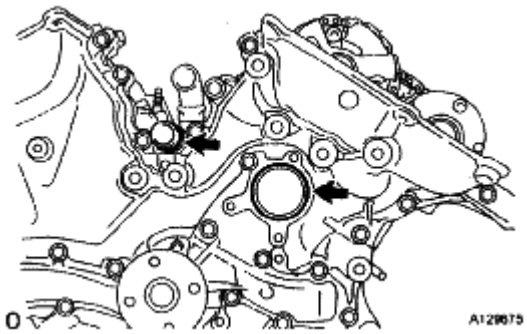

Fig. 213: Locating O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **REMOVE WATER OUTLET**
    a. Remove the 2 bolts, 4 nuts and water outlet.

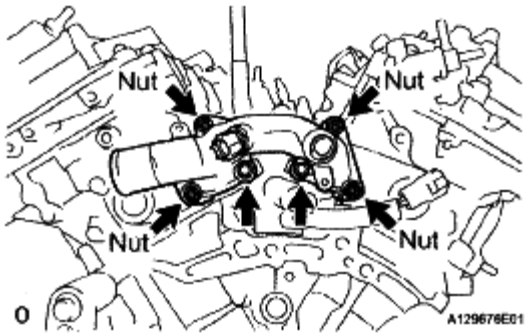

Fig. 214: Locating Bolts, Nuts And Water Outlet
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 2 gaskets and O-ring.

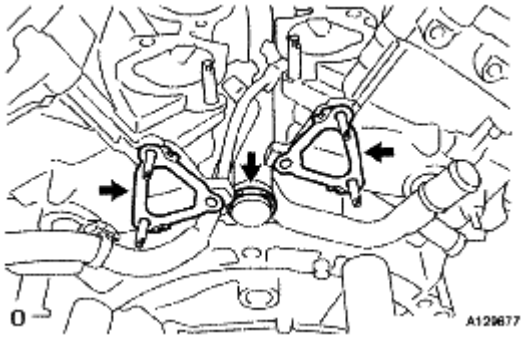

Fig. 215: Locating Gaskets And O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)**
    a. Remove the 12 bolts, seal washer, cylinder head cover sub-assembly and cylinder head cover gasket.

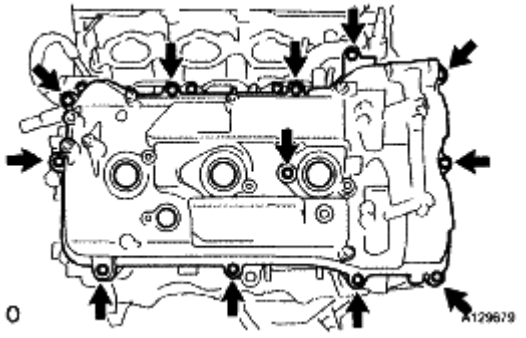

Fig. 216: Locating Bolts, Head Cover And Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 3 gaskets.

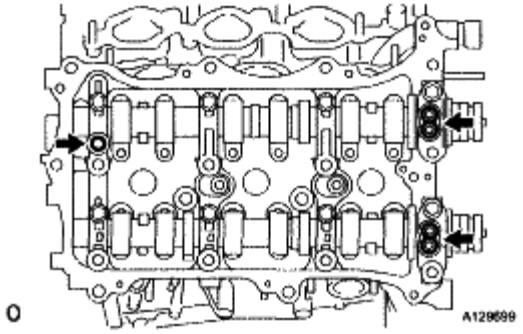

Fig. 217: Locating Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 2)**
    a. Remove the 12 bolts, seal washer, cylinder head cover sub-assembly and cylinder head cover gasket.

NOTE: The baffle plate is located on the back of the portion shown in the illustration. Do not damage the baffle plate when removing the head cover.

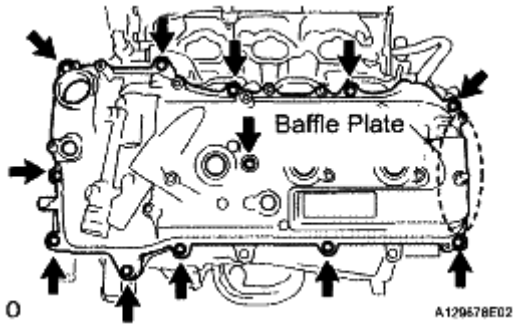

Fig. 218: Locating Bolts, Seal Washer, Head Cover And Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the 3 gaskets.

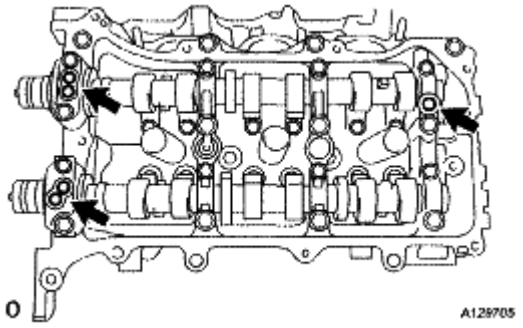

Fig. 219: Locating Gaskets

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **REMOVE NO. 2 OIL PAN SUB-ASSEMBLY**
    a. Remove the 16 bolts and 2 nuts.

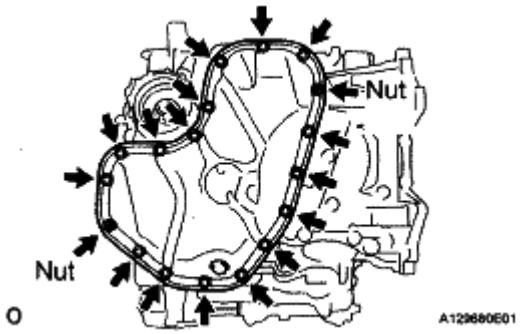

Fig. 220: Identifying Oil Pan With Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Insert the blade of SST between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan sub-assembly.

SST 09032-00100

NOTE: Be careful not to damage the contact surfaces of the oil pans.

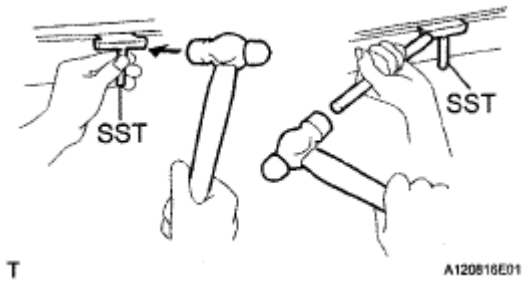

Fig. 221: Inserting Blade Of SST Between Oil Pans
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Using a "TORX" socket wrench E6, remove the 2 stud bolts.

21. **REMOVE OIL STRAINER SUB-ASSEMBLY**
    a. Remove the bolt, 2 nuts, oil strainer sub-assembly and gasket.
    b. Using a "TORX" socket wrench E6, remove the 2 stud bolts.

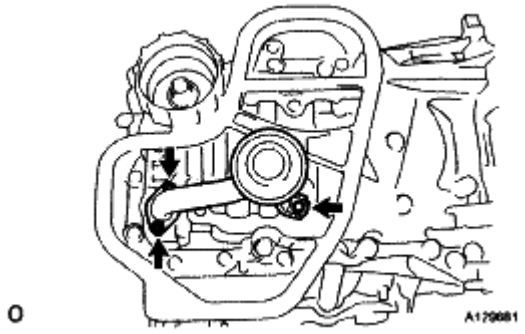

Fig. 222: Identifying Oil Strainer With Bolt And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **REMOVE OIL PAN SUB-ASSEMBLY**
    a. Remove the 16 bolts and 2 nuts.

       HINT:

       Be sure to clean the bolts and stud bolts and check the threads for cracks or other damage.

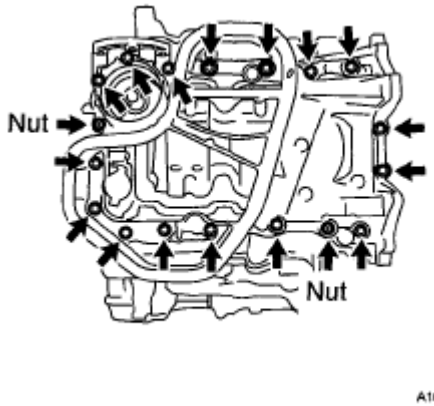

Fig. 223: Locating Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the oil pan sub-assembly by prying between the oil pan sub-assembly and cylinder block sub-assembly with a screwdriver.

       NOTE: Be careful not to damage the contact surfaces of the cylinder block and oil pan.

       HINT:

       Tape the screwdriver tip before use.

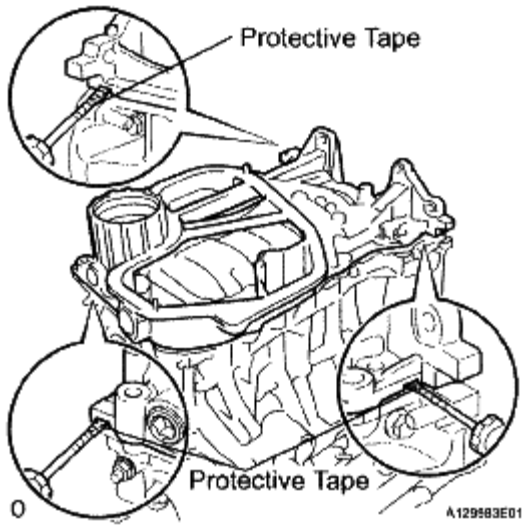

Fig. 224: Removing Oil Pan Sub-Assembly By Prying Oil Pan Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the 2 O-rings.
d. Using a "TORX" socket wrench E8, remove the 2 stud bolts.

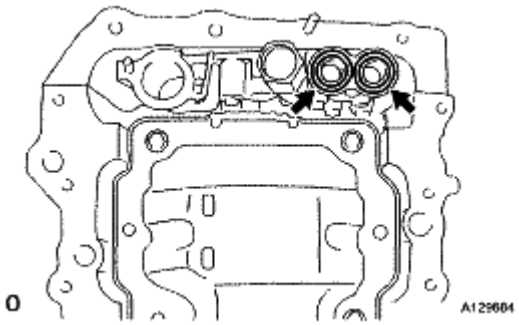

Fig. 225: Locating O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. **REMOVE OIL PAN BAFFLE PLATE**
    a. Remove the 7 bolts and oil pan baffle plate.

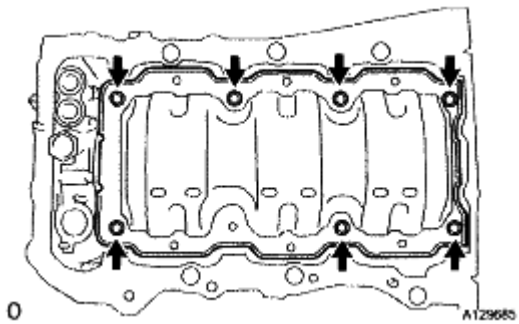

Fig. 226: Locating Oil Pan Baffle Plate Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **REMOVE ENGINE REAR OIL SEAL RETAINER**
    a. Remove the 6 bolts.

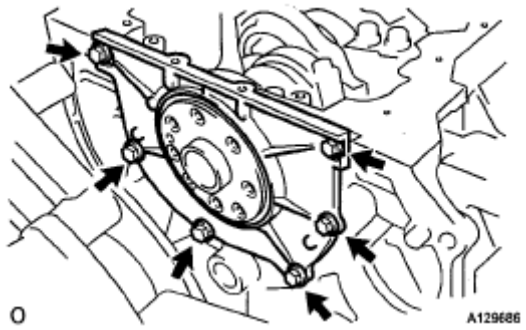

Fig. 227: Locating Engine Rear Oil Seal Retainer Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using a screwdriver, pry out the engine rear oil seal retainer.

NOTE: Be careful not to damage the engine rear oil seal retainer.

HINT:

Tape the screwdriver tip before use.

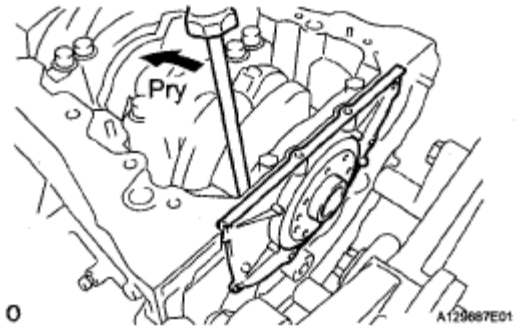

Fig. 228: Prying Out Oil Seal Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

25. **REMOVE ENGINE REAR OIL SEAL**
    a. Place the oil seal retainer on wooden blocks.

NOTE: Be careful not to damage the engine rear oil seal retainer.

    b. Using a screwdriver and a hammer, tap out the oil seal.

HINT:

Tape the screwdriver tip before use.

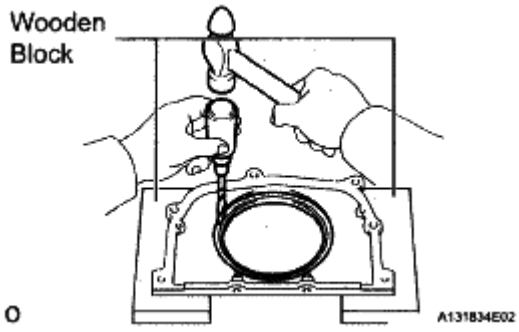

Fig. 229: Taping Out Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

26. **REMOVE WATER PUMP ASSEMBLY**
    a. Remove the 16 bolts, water pump assembly and gasket.

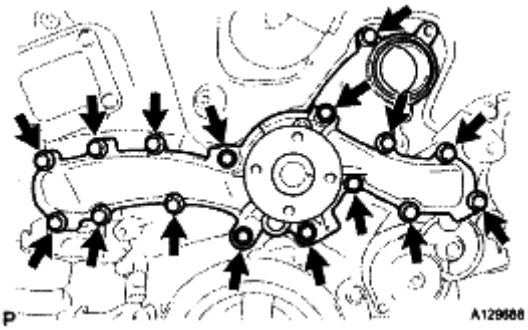

Fig. 230: Locating Bolts, Water Pump And Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

27. **REMOVE TIMING CHAIN COVER SUB-ASSEMBLY**
    a. Remove the 15 bolts and 2 nuts as shown in the illustration.

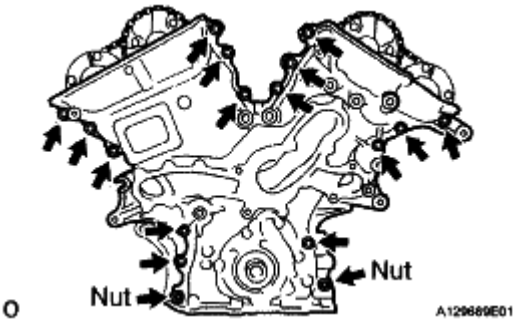

Fig. 231: Locating Timing Chain Cover Bolts And Nuts

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the timing chain cover sub-assembly by prying between the timing chain cover and cylinder head sub-assembly or cylinder block sub-assembly with a screwdriver.

NOTE: Be careful not to damage the contact surfaces of the cylinder head, cylinder block and chain cover.

HINT:

Tape the screwdriver tip before use.

c. Remove the 4 bolts, chain cover plate and chain cover plate gasket.

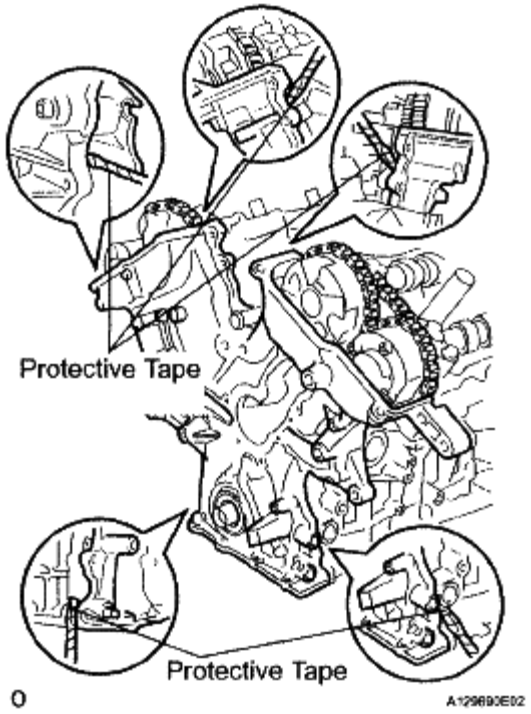

Fig. 232: Prying Between Timing Chain Cover And Cylinder Head Or Cylinder Block
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the gasket.

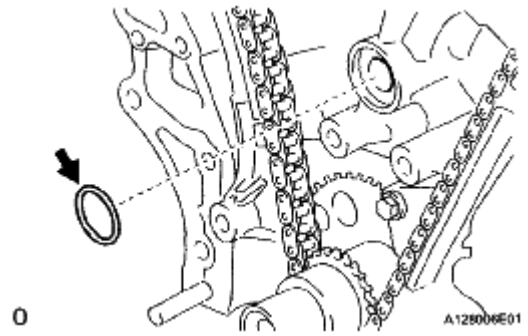

Fig. 233: Locating Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

28. **REMOVE TIMING CHAIN CASE OIL SEAL**
    a. Using a screwdriver, pry out the timing chain case oil seal.

       HINT:

       Tape the screwdriver tip before use.

29. **SET NO. 1 CYLINDER TO TDC / COMPRESSION**
    a. Temporarily tighten the pulley set bolt.

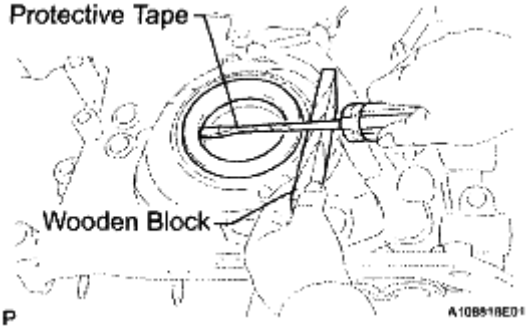

Fig. 234: Prying Out Oil Seal Using Screwdriver
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Set the timing mark on the crank angle sensor plate to the RH block bore center line (TDC / compression).

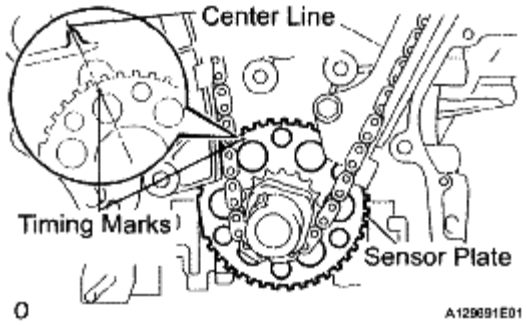

Fig. 235: Identifying Timing Mark On Crank Angle Sensor Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Check that the timing marks of the camshaft timing gears are aligned with those of the bearing cap as shown in the illustration.

If not, turn the crankshaft 1 revolution (360°) and align the timing marks as above.

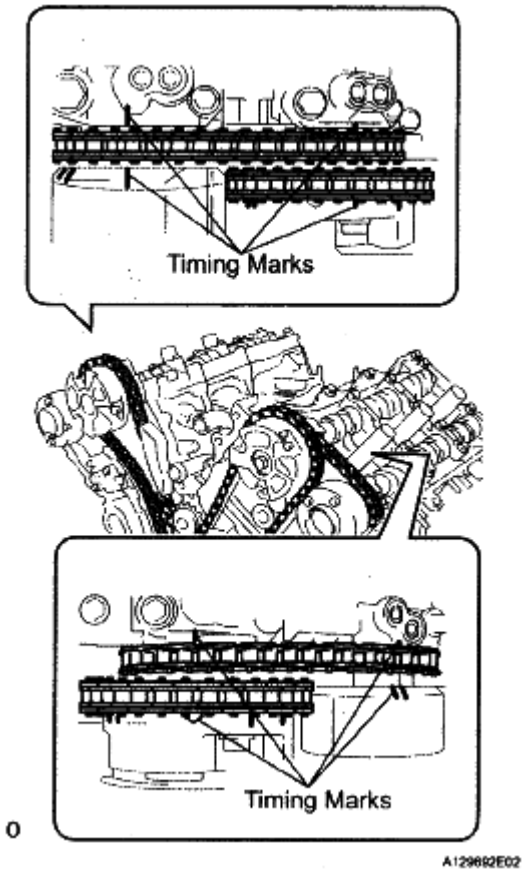

Fig. 236: Identifying Bearing Cap Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

30. **REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY**

a. Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.
b. Move the stopper plate downward to set the lock, and insert a pin of ø 1.27 mm (0.05 in.) into the stopper plate's hole.

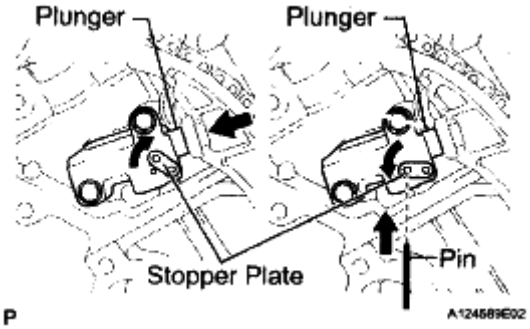

Fig. 237: Locating No.1 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the 2 bolts and No. 1 chain tensioner assembly.

31. **REMOVE CHAIN TENSIONER SLIPPER**
a. Remove the chain tensioner slipper.

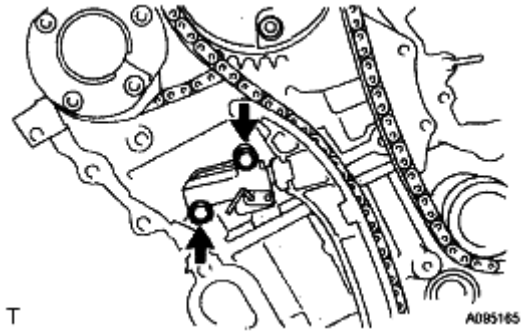

Fig. 238: Locating Chain Tensioner With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

32. **REMOVE CHAIN SUB-ASSEMBLY**
a. Turn the crankshaft counterclockwise 10° to loosen the chain sub-assembly of the crankshaft timing sprocket.
b. Remove the pulley set bolt.

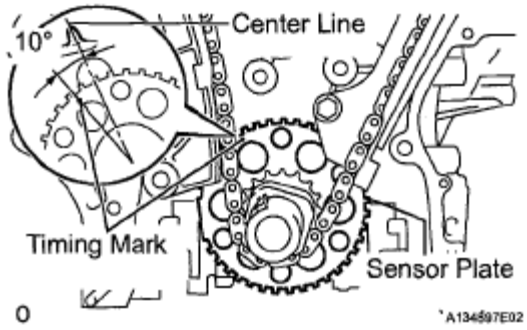

Fig. 239: Identifying Timing Mark On Crankshaft Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Remove the chain sub-assembly from the crankshaft timing sprocket and place it on the crankshaft.

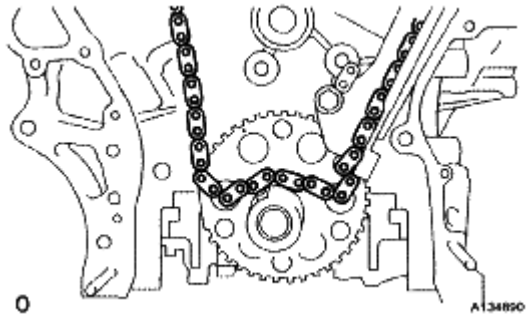

Fig. 240: Identifying Chain Set
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Turn the camshaft timing gear assembly on the bank 1 clockwise (approximately 60°) and set it as shown in the illustration. Be sure to loosen the chain between the banks.

e. Remove the chain.

Bank 1:

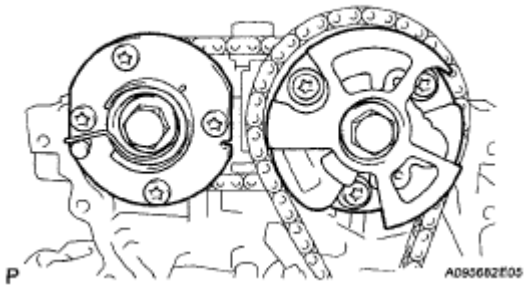

Fig. 241: Identifying Camshaft Timing Gear Assembly Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

33. **REMOVE IDLE SPROCKET ASSEMBLY**

a. Using a 10 mm hexagon wrench, remove the No. 2 idle gear shaft, idle sprocket assembly and No.

1 idle gear shaft.

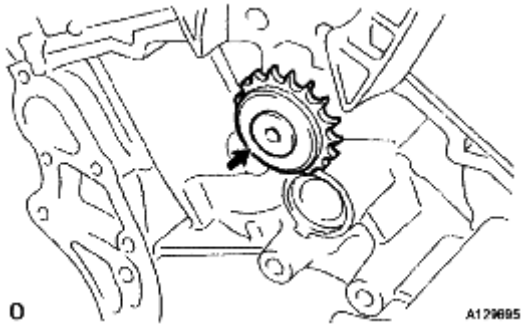

Fig. 242: Locating Idle Gear Shaft No. 2, Idle Sprocket And Idle Gear Shaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

34. **REMOVE NO. 1 CHAIN VIBRATION DAMPER**
    a. Remove the 2 bolts and No. 1 chain vibration damper.
35. **REMOVE NO. 2 CHAIN VIBRATION DAMPER**
    a. Remove the 2 No. 2 chain vibration dampers.

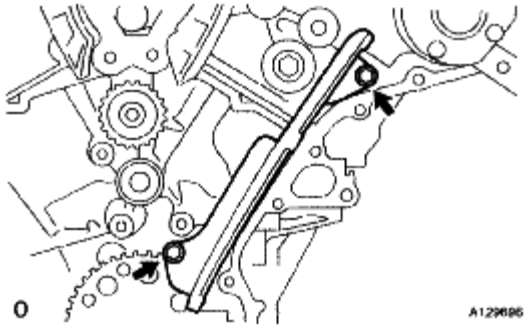

Fig. 243: Locating Chain Vibration Damper With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

36. **REMOVE CRANKSHAFT TIMING SPROCKET**
    a. Remove the crankshaft timing sprocket from the crankshaft.
    b. Remove the 2 keys from the crankshaft.

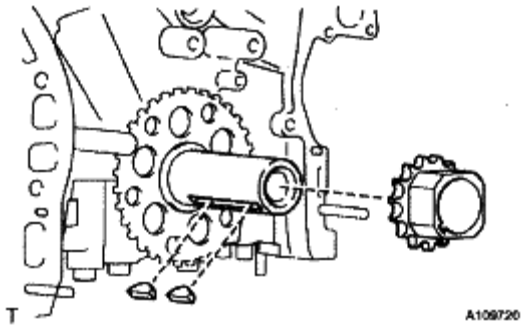

Fig. 244: Identifying Crankshaft Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

37. **REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)**
    a. While raising the No. 2 chain tensioner assembly, insert a pin of ø 1.0 mm (0.039 in.) into the hole to fix the No. 2 chain tensioner.

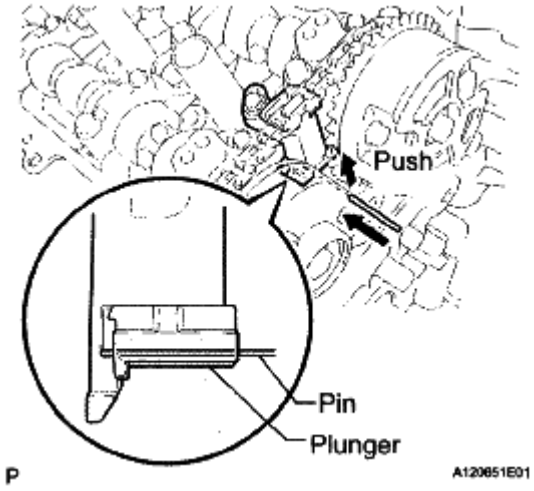

Fig. 245: Inserting Pin Into Hole For Fixing No 2 Chain Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts and 2 camshaft timing gear assemblies.

NOTE:
- **Be careful not to damage the cylinder head with the wrench.**
- **Do not disassemble the camshaft timing gear assemblies.**

    c. Remove the No. 2 chain assembly.

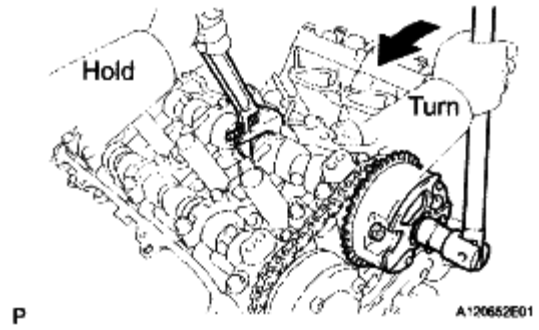

Fig. 246: Identifying Camshaft Timing Gear Assemblies
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

38. **REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY**
    a. Remove the bolt and No. 2 chain tensioner assembly.

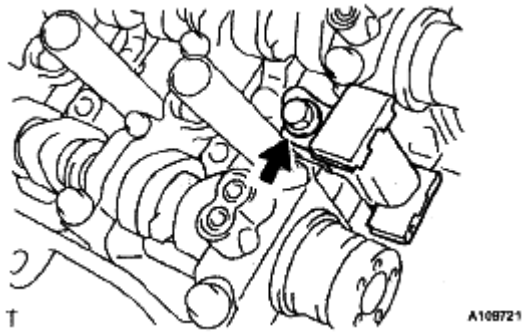

Fig. 247: Locating No.2 Chain Tensioner Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

39. **REMOVE CAMSHAFT BEARING CAP (for Bank 1)**
    a. Check that the camshafts are positioned as shown in the illustration.

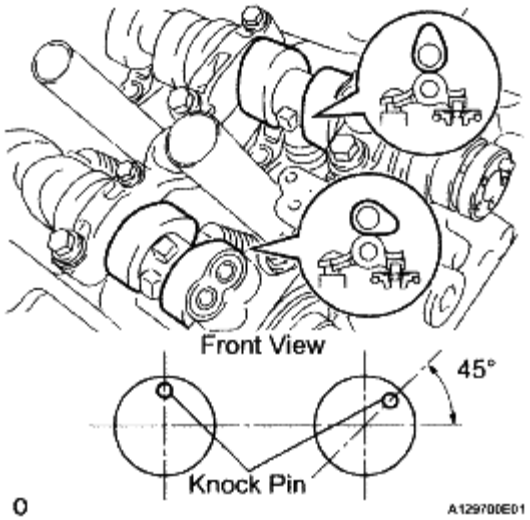

Fig. 248: Identifying Knock Pin Of Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

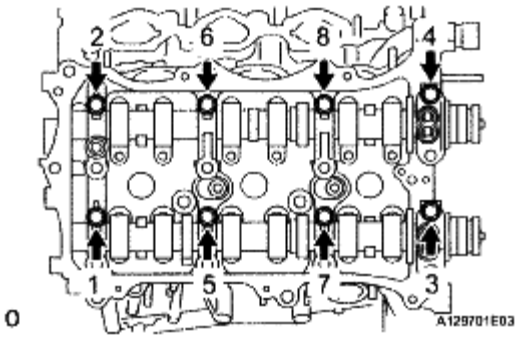

Fig. 249: Identifying Bearing Cap Bolts Loosening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Uniformly loosen and remove the 12 bearing cap bolts in the sequence shown in the illustration.

NOTE: Uniformly loosen the bolts while keeping the camshaft level.

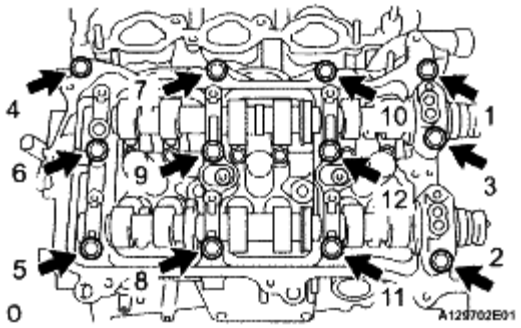

Fig. 250: Locating Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the 5 bearing caps.

40. **REMOVE CAMSHAFT**
    a. Remove the camshaft.
41. **REMOVE NO. 2 CAMSHAFT**
    a. Remove the No. 2 camshaft.
42. **REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH**
    a. Remove the camshaft housing sub-assembly RH by prying between the cylinder head and camshaft housing sub-assembly RH with a screwdriver.

NOTE: Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.

HINT:

Tape the screwdriver tip before use.

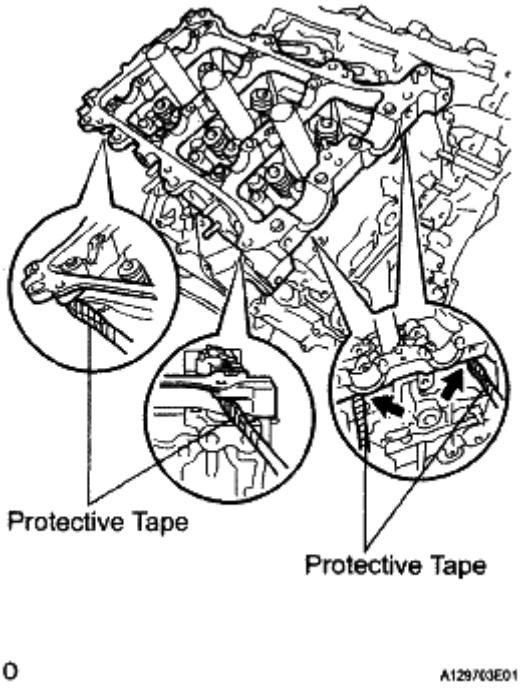

Fig. 251: Prying Between Cylinder Head And Camshaft Housing Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

43. **REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)**
    a. While pushing down the No. 3 chain tensioner assembly, insert a pin of ø 1.0 mm (0.039 in.) into the hole to fix the No. 3 chain tensioner assembly.

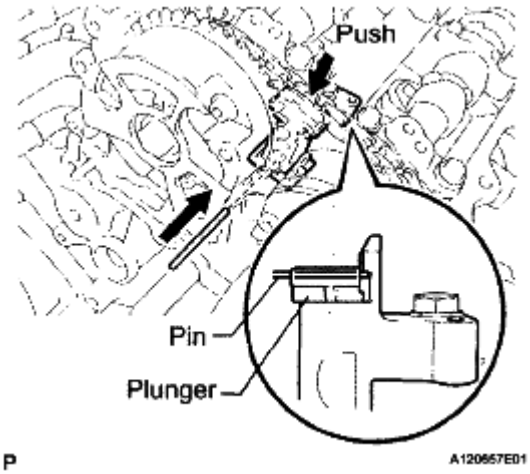

Fig. 252: Inserting Pin Into Hole For Fixing No 3 Chain Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts and 2 camshaft timing gear assemblies.

NOTE:

- **Be careful not to damage the cylinder head with the wrench.**
- **Do not disassemble the camshaft timing gear assemblies.**

c. Remove the No. 2 chain sub-assembly.

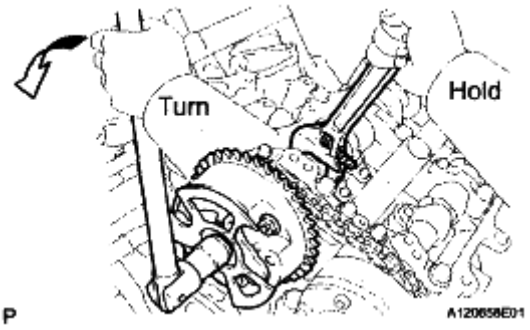

Fig. 253: Identifying Camshaft Timing Gears & No. 2 Chain (For Bank 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

44. **REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY**

a. Remove the bolt and No. 3 chain tensioner assembly.

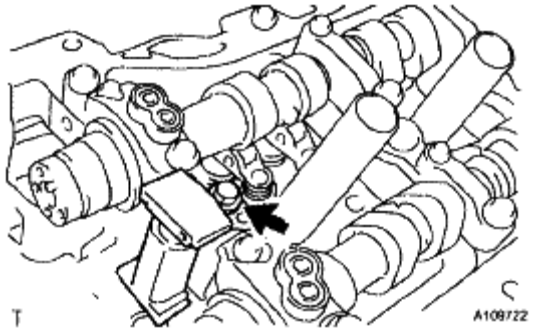

Fig. 254: Identifying No.3 Chain Tensioner Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

45. **REMOVE CAMSHAFT BEARING CAP (for Bank 2)**

a. Check that the camshafts are positioned as shown in the illustration.

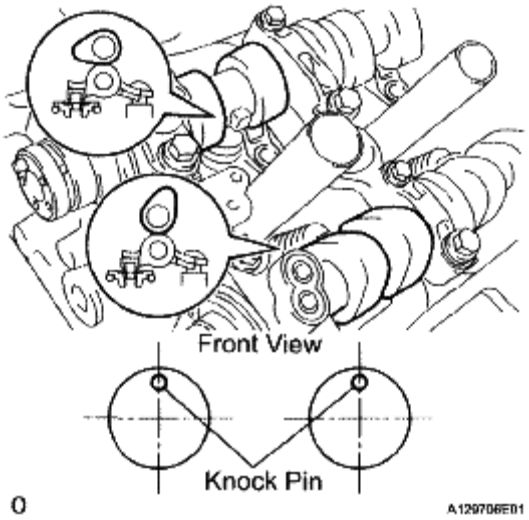

Fig. 255: Identifying Knock Pin Of Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

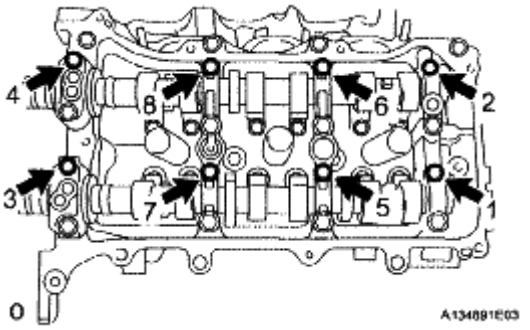

Fig. 256: Identifying Bearing Cap Bolts Loosening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Uniformly loosen and remove, the 13 bearing cap bolts in the sequence shown in the illustration.

NOTE: Uniformly loosen the bolts while keeping the camshaft level.

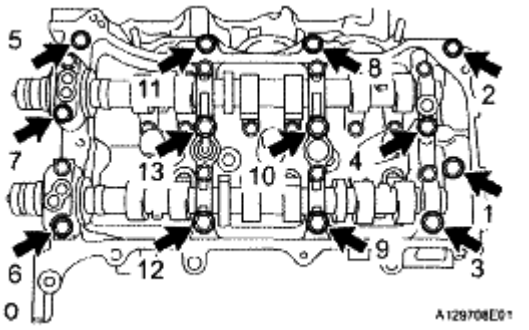

Fig. 257: Locating Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the 5 bearing caps.

46. **REMOVE NO. 3 CAMSHAFT**
    a. Remove the No. 3 camshaft.
47. **REMOVE NO. 4 CAMSHAFT**
    a. Remove the No. 4 camshaft.
48. **REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH**
    a. Remove the camshaft housing sub-assembly LH by prying between the cylinder head and camshaft housing sub-assembly LH with a screwdriver.

NOTE: Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.

HINT:

Tape the screwdriver tip before use.

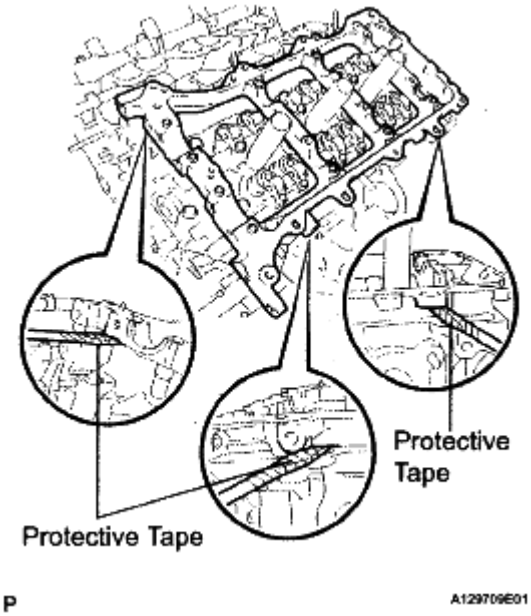

Fig. 258: Prying Between Cylinder Head And Camshaft Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

49. **REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY**
    a. Remove the 24 No. 1 valve rocker arm sub-assemblies.

HINT:

Arrange the removed parts in the correct order.

50. **REMOVE VALVE LASH ADJUSTER ASSEMBLY**
    a. Remove the 24 valve lash adjuster assemblies from the cylinder head.

    HINT:

    Arrange the removed parts in the correct order.

51. **REMOVE CYLINDER HEAD SUB-ASSEMBLY RH**
    a. Using a 10 mm bi-hexagon wrench, uniformly loosen the 8 bolts in the sequence shown in the illustration. Remove the 8 cylinder head bolts and plate washers.

    NOTE:
    - **Be careful not to drop washers into the cylinder head.**
    - **Cylinder head warpage or cracking could result from removing bolts in an incorrect order.**

    HINT:

    Be sure to keep separate the removed parts for each installation position.

    b. Remove the cylinder head sub-assembly RH and cylinder head gasket.

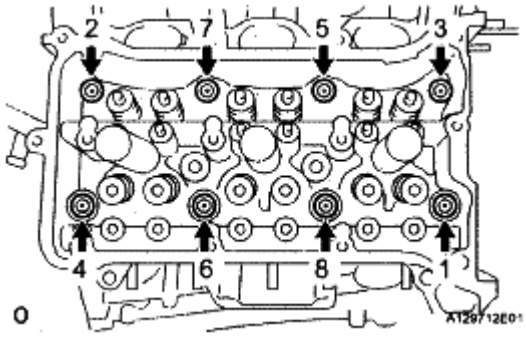

Fig. 259: Locating Cylinder Head Bolts And Plate Washers
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

52. **REMOVE CYLINDER HEAD SUB-ASSEMBLY LH**
    a. Uniformly loosen and remove the cylinder head set bolts in the sequence shown in the illustration.

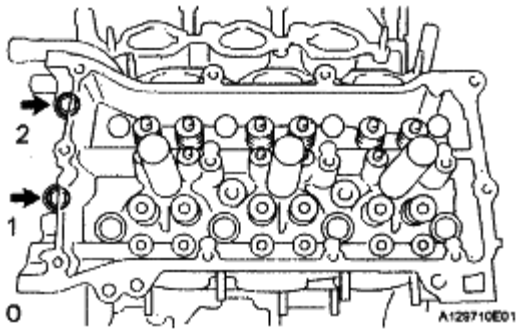

Fig. 260: Identifying Bolts In Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a 10 mm bi-hexagon wrench, uniformly loosen the 8 bolts in the sequence shown in the illustration. Remove the 8 cylinder head bolts and plate washers.

NOTE:

- **Be careful not to drop washers into the cylinder head.**
- **Cylinder head warpage or cracking could result from removing bolts in an incorrect order.**

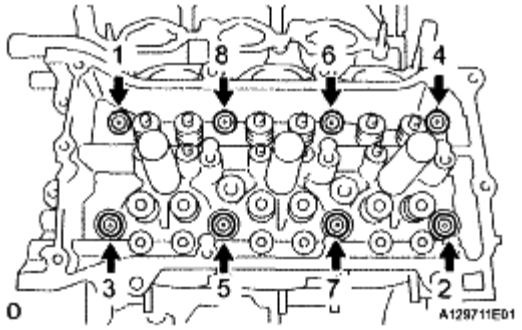

Fig. 261: Locating Cylinder Head Bolts And Plate Washers
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Be sure to keep separate the removed parts for each installation position.

c. Remove the cylinder head sub-assembly LH and No. 2 cylinder head gasket.

53. **REMOVE WATER INLET PIPE**

a. Remove 2 clamps and separate the No. 1 water bypass hose.
b. Remove the 2 bolts and water inlet pipe.

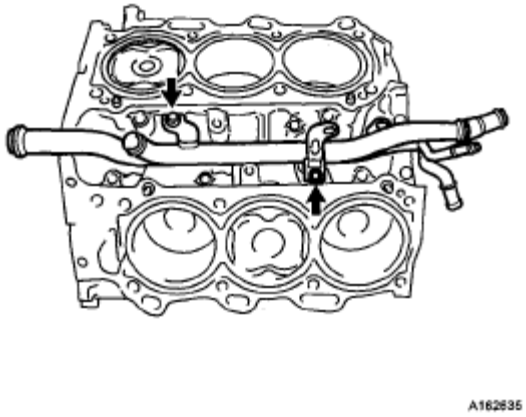

Fig. 262: Locating Bolts And Water Inlet Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

54. **REMOVE VALVE STEM CAP**
    a. Remove the valve stem caps from the cylinder heads.

       HINT:

       Arrange the removed parts in the correct order.

55. **REMOVE INTAKE VALVE**
    a. Using SST, compress the inner compression spring and remove the valve spring retainer locks.

       SST 09202-70020 (09202-00010)

    b. Remove the valve spring retainer, inner compression spring and intake valve.

       HINT:

       Arrange the removed parts in the correct order.

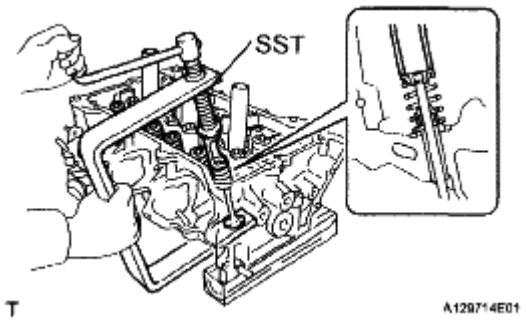

Fig. 263: Using SST To Compress Inner Compression Spring To Remove Intake Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

56. **REMOVE EXHAUST VALVE**

a. Using SST, compress the inner compression spring and remove the valve spring retainer locks.

SST 09202-70020 (09202-00010)

b. Remove the valve spring retainer, inner compression spring and exhaust valve.

HINT:

Arrange the removed parts in the correct order.

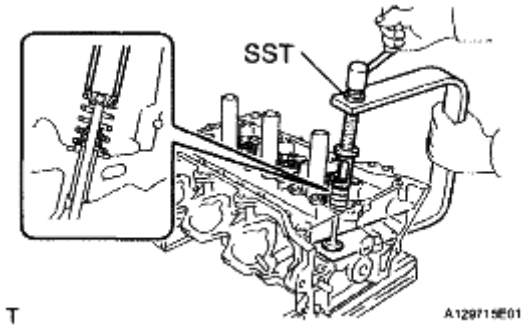

Fig. 264: Using SST To Compress Inner Compression Spring To Remove Exhaust Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

57. **REMOVE VALVE STEM OIL SEAL**

a. Using needle-nose pliers, remove the valve stem oil seals.

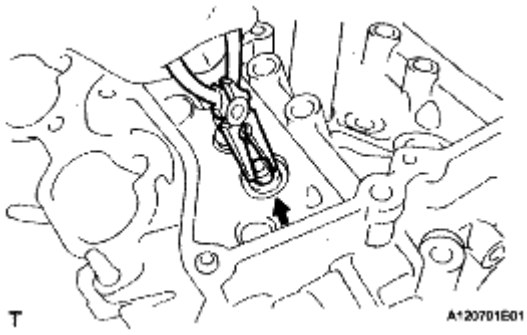

Fig. 265: Removing Valve Stem Oil Seal Using Needle-Nose Pliers
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

58. **REMOVE VALVE SPRING SEAT**

a. Using compressed air and a magnetic finger, remove the valve spring seats by blowing air onto them.

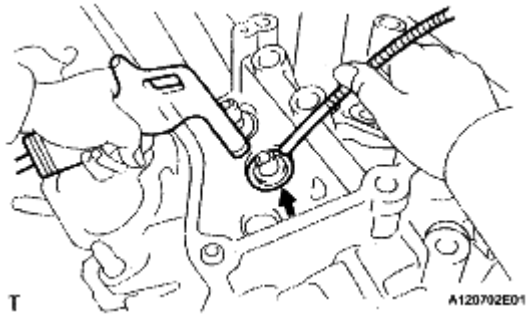

Fig. 266: Identifying Valve Spring Seat
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

59. **REMOVE NO. 1 STRAIGHT SCREW PLUG**
    a. Using a 10 mm hexagon wrench, remove the 4 No. 1 straight screw plugs and 4 gaskets.

NOTE: If water leaks from the straight screw plug or the plug corrodes, replace it.

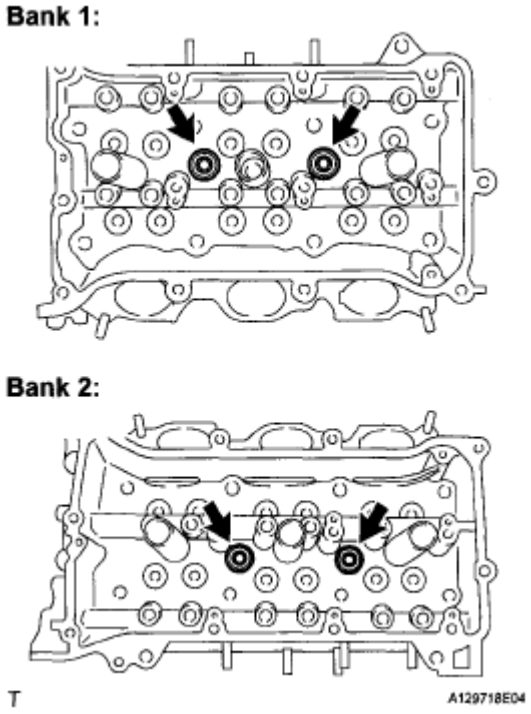

Fig. 267: Locating No. 1 Straight Screw Plugs And Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

60. **REMOVE NO. 2 STRAIGHT SCREW PLUG**
    a. Using a 14 mm hexagon wrench, remove the 2 No. 2 straight screw plugs and 2 gaskets.

NOTE: If water leaks from the straight screw plug or the plug corrodes,

replace it.

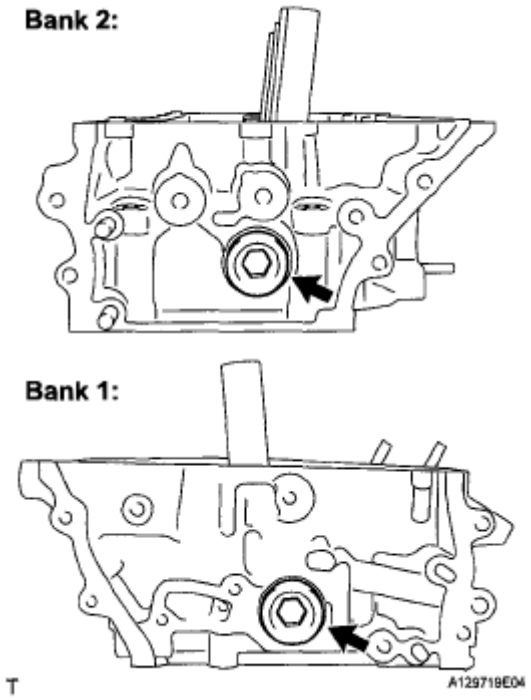

Fig. 268: Locating No. 2 Straight Screw Plugs And Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

61. **REMOVE RING PIN**

NOTE: It is not necessary to remove the ring pin unless it is being replaced.

62. **REMOVE STUD BOLT**

NOTE: If the stud bolt is deformed or the threads are damaged, replace it.

63. **REMOVE STRAIGHT PIN**

NOTE: If the straight pin is deformed or the threads are damaged, replace it.

64. **REMOVE INTAKE VALVE GUIDE BUSH**
    a. Heat the cylinder head to 80 to 100°C (176 to 212°F).
    b. Place the cylinder head on wooden blocks.
    c. Using SST and a hammer, tap out the intake valve guide bushes.

SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

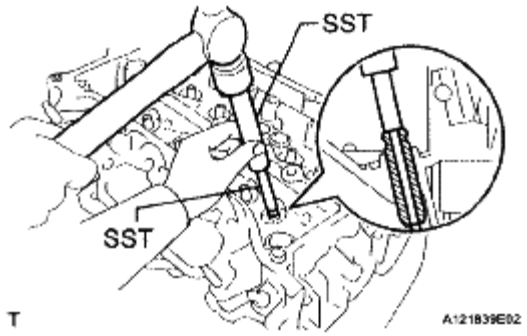

Fig. 269: Tapping Out Intake Valve Guide Bushes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

65. **REMOVE EXHAUST VALVE GUIDE BUSH**
    a. Heat the cylinder head to 80 to 100°C (176 to 212°F).
    b. Place the cylinder head on wooden blocks.
    c. Using SST and a hammer, tap out the exhaust valve guide bushes.

    SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

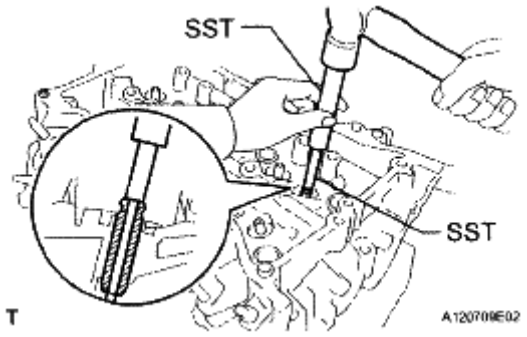

Fig. 270: Tapping Exhaust Valve Guide Bush
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

66. **REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD**
    a. Check that the matchmarks on the connecting rod sub-assembly and connecting rod cap are aligned.

    HINT:

    The matchmarks on the connecting rod sub-assembly and connecting rod cap are for ensuring the correct reassembly.

    b. Remove the 2 connecting rod cap bolts.

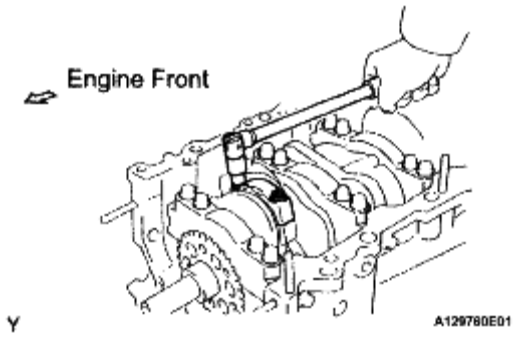

Fig. 271: Locating Connecting Rod Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

HINT:

Keep the lower bearing inserted to the connecting rod cap.

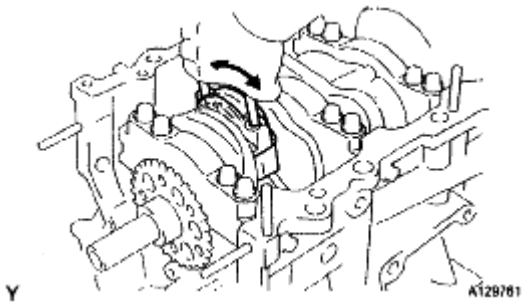

Fig. 272: Locating Connecting Rod Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a ridge reamer, remove all the carbon from the top of the cylinder.

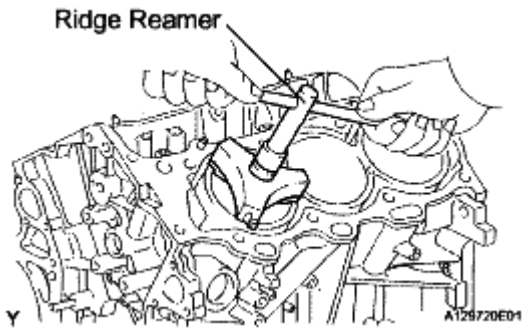

Fig. 273: Removing Carbon From Top Of Cylinder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

HINT:

- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

67. **REMOVE CONNECTING ROD BEARING**

HINT:

Arrange the removed parts in the correct order.

68. **REMOVE CRANKSHAFT**

a. Uniformly loosen and remove the 8 crankshaft bearing cap bolts and seal washers in several steps and in the sequence shown in the illustration.

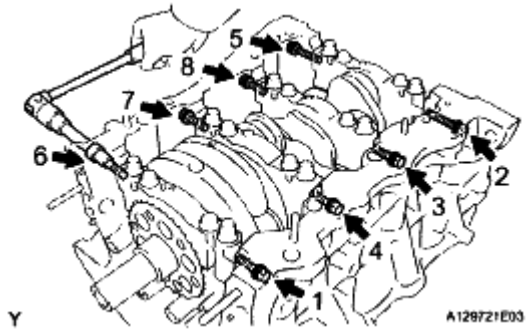

Fig. 274: Locating Connecting Rod Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Uniformly loosen the 16 crankshaft bearing cap bolts, in several steps and in the sequence shown in the illustration.

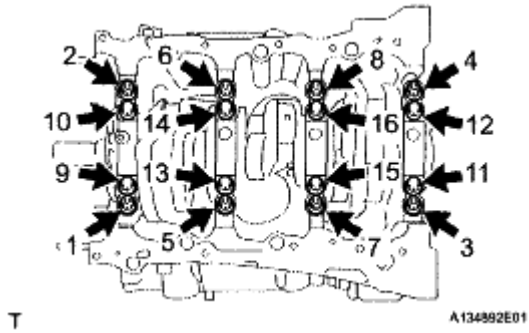

Fig. 275: Identifying Bearing Cap Bolts Loosening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a screwdriver, pry out the main bearing caps. Remove the 4 crankshaft bearing caps and

lower crankshaft bearings.

NOTE:

- **Push up on the cap little by little, from the right and left side alternately so that the cap can be removed.**
- **Be careful not to damage the joint surface of the cylinder block and the main bearing cap.**

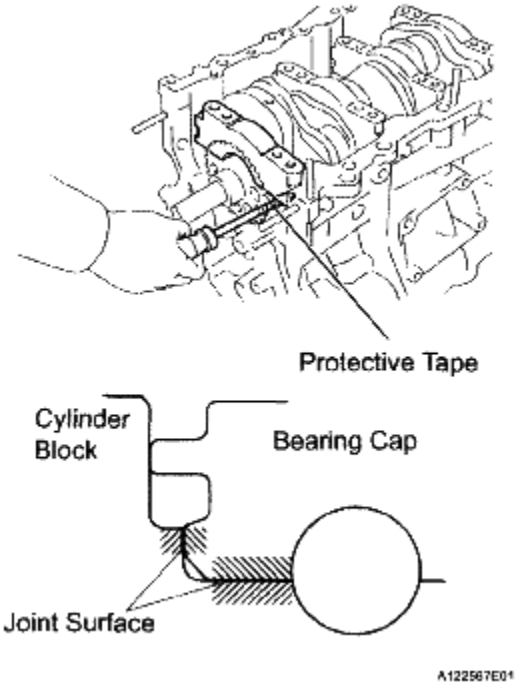

Fig. 276: Identifying Bearing Caps And Lower Bearings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the crankshaft.

69. **REMOVE CRANKSHAFT BEARING**

a. Remove the upper crankshaft bearing and lower crankshaft bearing.

HINT:

Arrange the removed parts in the correct order.

70. **REMOVE CRANKSHAFT THRUST WASHER SET**

a. Remove the upper crankshaft bearings and upper crankshaft thrust washers from the cylinder block sub-assembly.

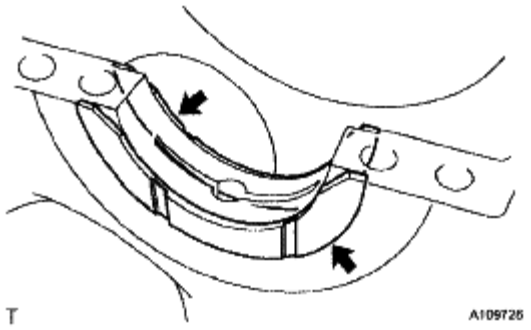

Fig. 277: Identifying Upper Bearings & Upper Thrust Washers
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

71. **REMOVE PISTON RING SET**
    a. Using a piston ring expander, remove the 2 compression rings.
    b. Remove the oil ring expander and 2 side rails by hand.

    HINT:

    Arrange the removed parts in the correct order.

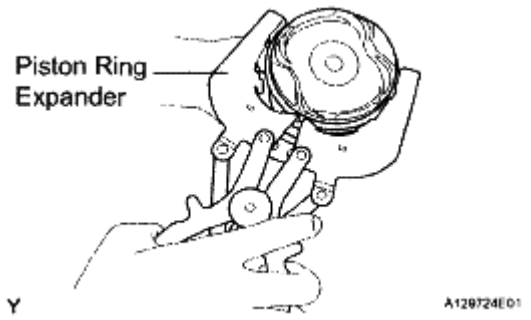

Fig. 278: Identifying Compression Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

72. **REMOVE PISTON SUB-ASSEMBLY WITH PIN**
    a. Check the fitting condition between the piston and piston pin.
        1. Try to move the piston back and forth on the piston pin.

        If any movement is felt, replace the piston and pin as a set.

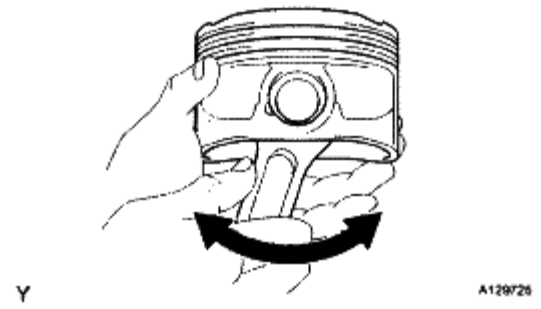

Fig. 279: Checking Fitting Condition Between Piston And Piston Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Disconnect the connecting rod from the piston.
   1. Using a screwdriver, pry off the piston pin hole snap rings from the piston.

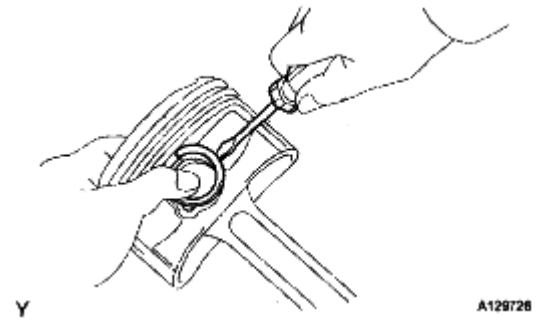

Fig. 280: Prying Off Snap Rings From Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   2. Gradually heat the piston to approximately 80°C(176°F).

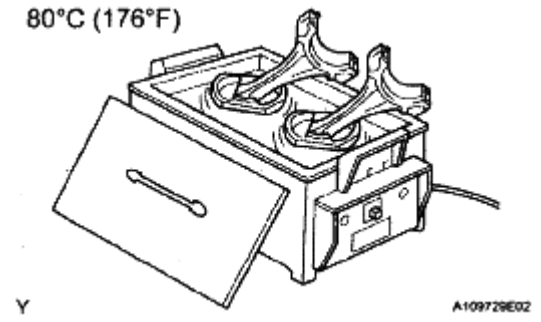

Fig. 281: Heating Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   3. Using a brass bar and plastic hammer, lightly tap out the piston pin and remove the connecting rod.

      HINT:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.

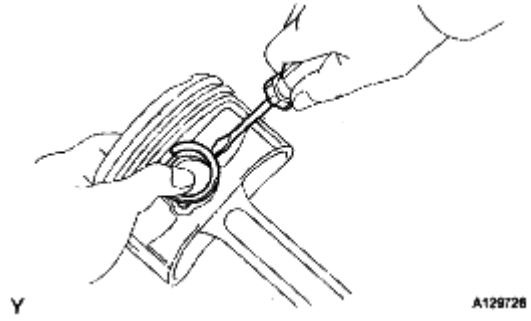

Fig. 282: Prying Off Snap Rings From Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a gasket scraper, remove the carbon from the piston top.

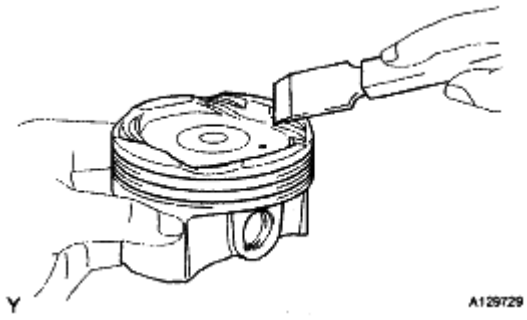

Fig. 283: Removing Carbon From Piston Top
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a groove cleaning tool or broken ring, clean the piston ring grooves.

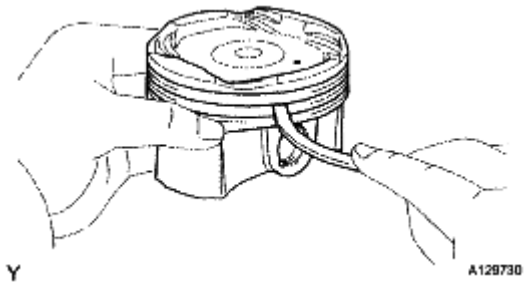

Fig. 284: Cleaning Piston Ring Grooves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

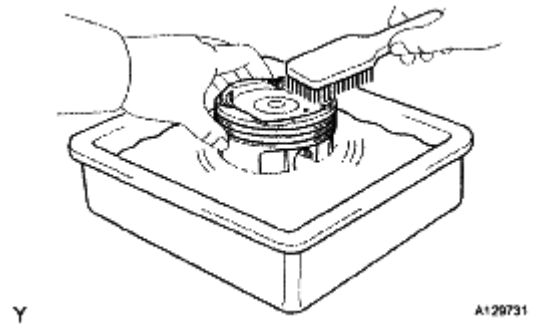

Fig. 285: Cleaning Piston Using Solvent And Brush
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

73. **REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY**
    a. Using a 5 mm hexagon wrench, remove the bolts and No. 1 oil nozzle sub-assembly.
    b. Check the 3 oil nozzles for damage or clogging. If necessary, replace the No. 1 oil nozzle sub-assembly.

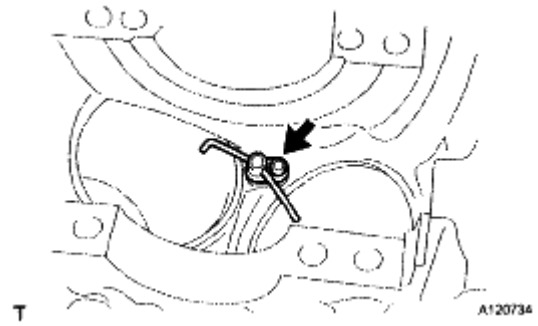

Fig. 286: Identifying Bolt And Oil Nozzle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

74. **CLEAN CYLINDER BLOCK**

INSPECTION

1. **INSPECT NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY**
    a. Turn the roller by hand to check that it turns smoothly.

    HINT:

    If the roller does not turn smoothly, replace the valve rocker arm sub-assembly.

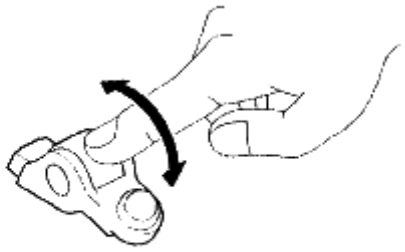

Fig. 287: Inspecting Valve Rocker Arm Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **INSPECT VALVE LASH ADJUSTER ASSEMBLY**

NOTE:
- **Keep the lash adjuster free of dirt and foreign objects.**
- **Only use clean engine oil.**

a. Place the valve lash adjuster assembly into a container filled with engine oil.
b. Insert SST's tip into the valve lash adjuster assembly's plunger and use the tip to press down on the check ball inside the plunger.

SST 09276-75010

c. Squeeze SST and valve lash adjuster assembly together to move the plunger up and down 5 to 6 times.
d. Check the movement of the plunger and bleed the air.

OK: Plunger moves up and down.

NOTE: When bleeding air from the high-pressure chamber, make sure that the tip of SST is actually pressing the check ball as shown in the illustration. If the check ball is not pressed, air will not bleed.

e. After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with a finger.

OK: Plunger is very difficult to move.

If the result is not as specified, replace the lash adjuster.

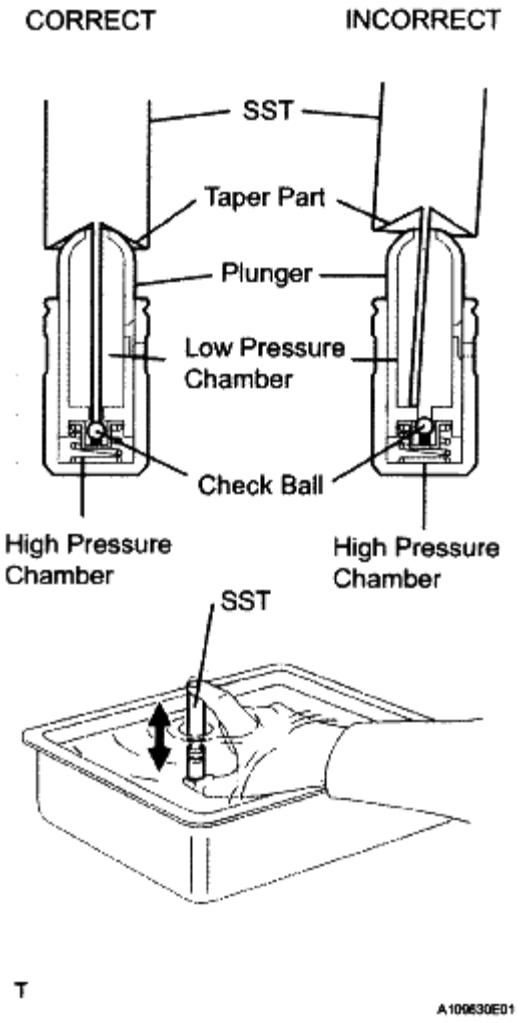

Fig. 288: Checking Valve Lash Adjuster Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **INSPECT CAMSHAFT**
   a. Inspect the camshaft for runout.
      1. Place the camshaft on V-blocks.
      2. Using a dial indicator, measure the circle runout at the center journal.

         Maximum circle runout: 0.04 mm (0.0016 in.)

         If the circle runout is greater than the maximum, replace the camshaft.

         HINT:

         Check the oil clearance after replacing the camshaft.

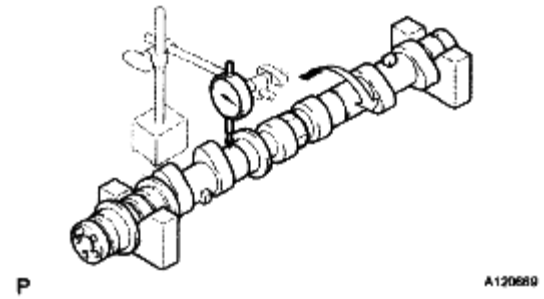

Fig. 289: Measuring Circle Runout At Center Journal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a micrometer, measure the cam lobe height.

Standard cam lobe height

STANDARD CAM LOBE HEIGHT SPECIFICATIONS

Item	Specification
Intake camshaft	44.316 to 44.416 mm (1.7447 to 1.7487 in.)
Exhaust camshaft	44.262 to 44.362 mm (1.7426 to 1.7465 in.)

Maximum cam lobe height

MAXIMUM CAM LOBE HEIGHT SPECIFICATIONS

Item	Specification
Intake camshaft	44.166 mm (1.7388 in.)
Exhaust camshaft	44.112 mm (1.7367 in.)

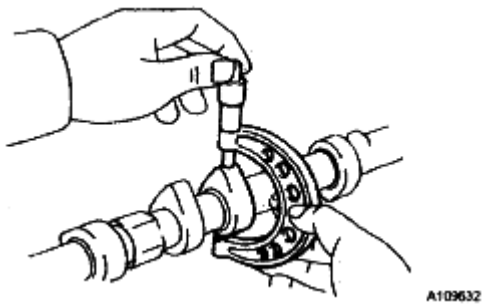

Fig. 290: Checking Cam Lobe Height
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a micrometer, measure the journal diameter.

Standard journal diameter

STANDARD JOURNAL DIAMETER SPECIFICATIONS

Item	Specification
No. 1 journal	35.946 to 35.960 mm (1.4152 to 1.4157 in.)
Other journals	25.959 to 25.975 mm (1.0220 to 1.0226 in.)

If the journal diameter is not as specified, check the oil clearance.

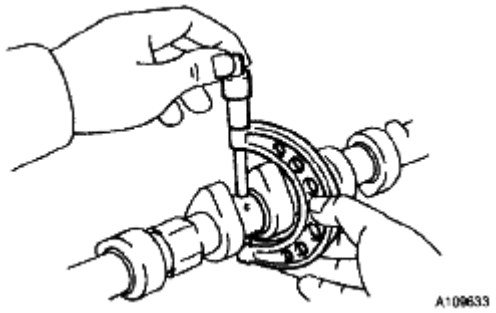

Fig. 291: Checking Journal Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY**
   a. Clamp the camshaft in a vise.

NOTE: Be careful not to damage the camshaft in the vise.

   b. Put the camshaft timing gear assembly and camshaft together by aligning the key groove and straight pin.
   c. Lightly press the camshaft timing gear assembly against the camshaft, and turn the camshaft timing gear assembly. Push further at the position where the pin enters the groove.

NOTE: Be sure not to turn the camshaft timing gear in the retard direction (the right angle).

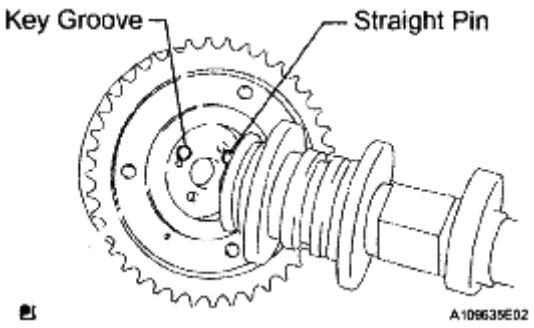

Fig. 292: Identifying Key Groove And Straight Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   d. Check that there is no clearance between the camshaft timing gear assembly's flange and the

camshaft.

e. Tighten the flange bolt with the camshaft timing gear fixed.

Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

f. Check the lock of the camshaft timing gear assembly.
   1. Clamp the camshaft in a vise, and confirm that the camshaft timing gear assembly is locked.

NOTE: Be careful not to damage the camshaft.

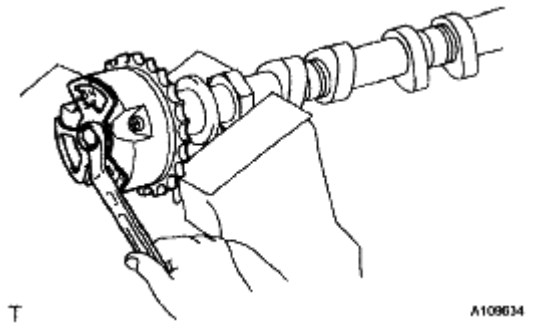

Fig. 293: Checking Lock Of Camshaft Timing Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Release the lock pin.
   1. Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

      HINT:

      2 advance side paths are provided in the groove of the camshaft. Plug one of the paths with a rubber piece.

   2. Break through the tape of the advance side path and the retard side path on the opposite side to the hole of the advance side path, as shown in the illustration.

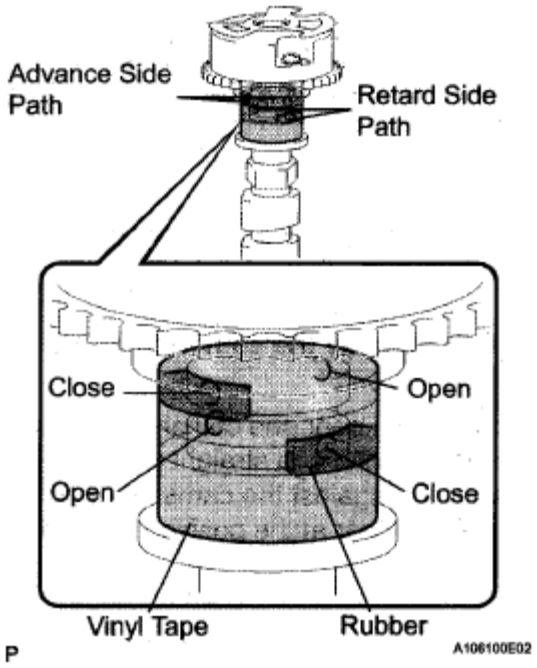

Fig. 294: Covering Oil Paths Of Cam Journal With Vinyl Tape
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Apply approximately 200 kPa (2.0 kgf/cm^2 28 psi) of air pressure to the 2 broken paths.

CAUTION: Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.

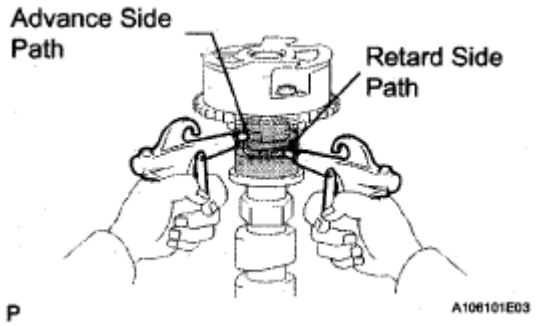

Fig. 295: Applying Air Pressure To Two Broken Paths
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Check that the camshaft timing gear assembly revolves in the advance direction when reducing the air pressure applied to the retard side path.

   HINT:

   This operation releases the lock pin for the most retarded position.

5. When the camshaft timing gear assembly reaches the most advanced position, release the air pressure from the retard side path and advance side path, in that order.

NOTE: Do not release the air pressure from the advance side path first. The gear may abruptly shift in the retard direction and break the lock pin.

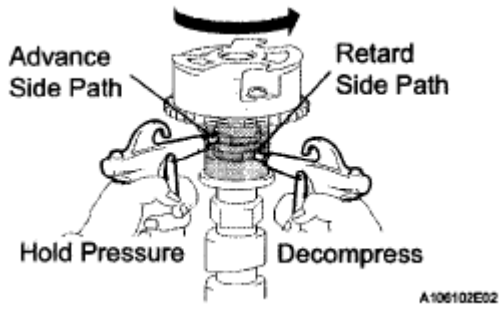

Fig. 296: Checking Camshaft Timing Gear Revolves In Advance Direction
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Check for smooth rotation.
   1. Turn the camshaft timing gear assembly within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.

NOTE: Do not use air pressure to perform the smooth operation check.

i. Check the lock in the most retarded position.
   1. Confirm that the camshaft timing gear assembly is locked at the most retarded position.
j. Remove the flange bolt and camshaft timing gear assembly.

NOTE:
- **Do not remove the other 3 bolts.**
- **If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.**

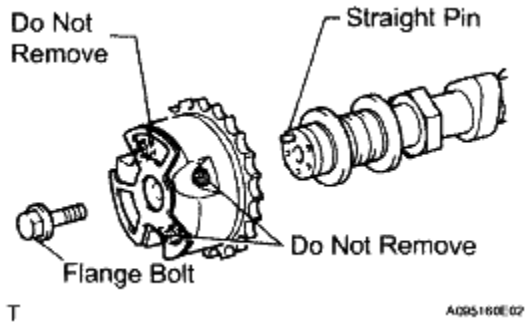

Fig. 297: Removing Flange Bolt And Camshaft Timing Gear

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **INSPECT CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY**
   a. Clamp the camshaft in a vise.

      NOTE: Be careful not to damage the camshaft in the vise.

   b. Put the camshaft timing exhaust gear assembly and camshaft together by aligning the key groove and straight pin.
   c. Lightly press the camshaft timing gear against the camshaft, and turn the camshaft timing gear assembly. Push further at the position where the pin enters the groove.

      NOTE: Be sure not to turn the camshaft timing exhaust gear in the retard direction (the right angle).

   d. Check that there is no clearance between the gear's flange and the camshaft.

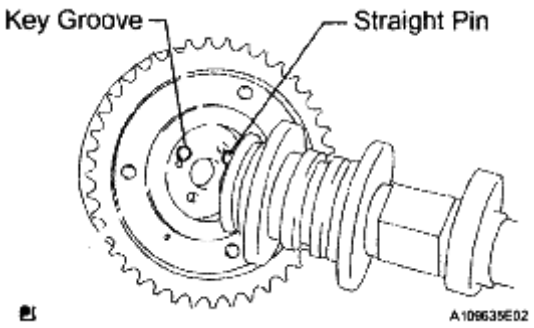

Fig. 298: Identifying Key Groove And Straight Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   e. Tighten the flange bolt with the camshaft timing exhaust gear assembly fixed.

      Torque: 100 N*m (1020 kgf*cm, 74 ft.*lbf)

   f. Check the camshaft timing exhaust gear lock.
      1. Make sure that the camshaft timing exhaust gear assembly is locked.

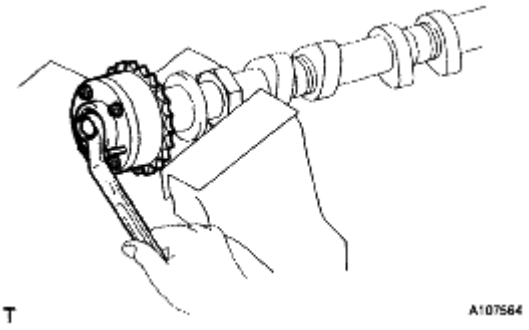

Fig. 299: Checking Camshaft Timing Exhaust Gear Lock
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Release the lock pin.
   1. Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.

      HINT:

      4 oil paths are provided in the groove. Plug 2 paths with rubber pieces.

   2. Prick a hole in the tape placed on the advance side path. Prick a hole in the tape placed on the retard side path, on the opposite side to that of the advance side path, as shown in the illustration.

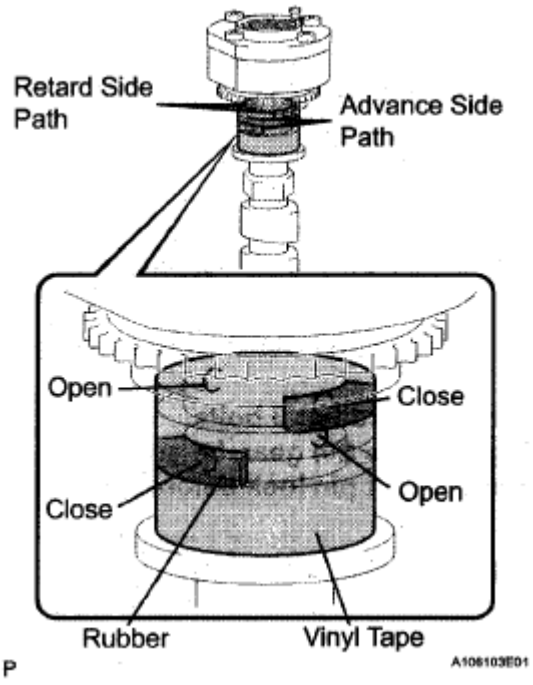

Fig. 300: Covering Oil Paths Of Cam Journal With Vinyl Tape
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Apply approximately 200 kPa (2.0 kgf/cm^2 , 28 psi) of air pressure to the 2 broken paths (the advance side path and the retard side path).

CAUTION: Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.

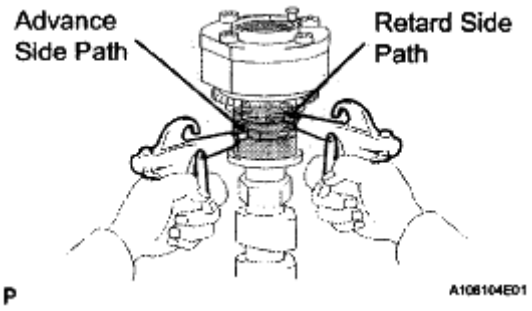

Fig. 301: Applying Air Pressure To Two Broken Paths
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Make sure that the camshaft timing exhaust gear turns in the retard direction when reducing the air pressure applied to the advance side path.

HINT:

The lock pin is released and the camshaft timing exhaust gear turns in the retard direction.

5. When the camshaft timing exhaust gear moves to the most retarded position, release the air pressure from the advance side path, and then release the air pressure from the retard side path.

NOTE: Be sure to release the air pressure from the advance side path first. If the air pressure of the retard side path is released first, the camshaft timing exhaust gear may abruptly shift in the advance direction and break the lock pin or other parts.

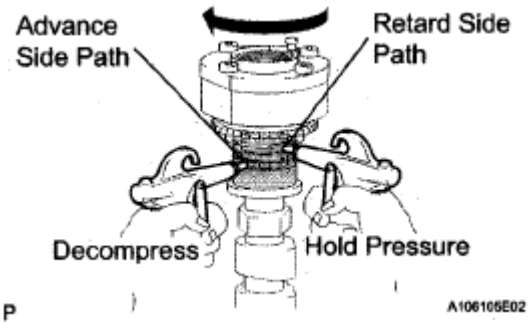

Fig. 302: Checking Camshaft Timing Exhaust Gear Turns In Retard Direction

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Check for smooth rotation.
   1. Turn the camshaft timing exhaust gear within its movable range (18.5°) 2 or 3 times, but do not turn it to the most advanced position. Make sure that the gear turns smoothly.

NOTE: **When the air pressure is released from the advance side path and then from the retard side path, the gear automatically returns to the most advanced position due to the advance assist spring operation and locks. Gradually release the air pressure from the retard side path before performing the smooth rotation check.**

i. Check the lock at the most advanced position.
   1. Make sure that the camshaft timing exhaust gear is locked at the most advanced position.
j. Remove the flange bolt and camshaft timing exhaust gear.

NOTE:
- **Be sure not to remove the other 4 bolts.**
- **If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.**

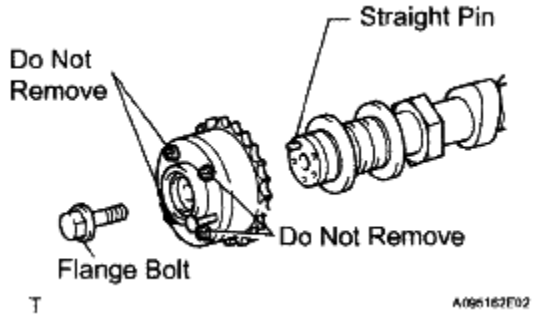

Fig. 303: Removing Flange Bolt And Camshaft Timing Exhaust Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSPECT CYLINDER HEAD SET BOLT**
   a. Using vernier calipers, measure the minimum diameter of the elongated thread at the measuring point.

Standard outside diameter: 10.85 to 11.00 mm (0.4272 to 0.4331 in.)

Minimum outside diameter: 10.70 mm (0.4213 in.)

Measuring Point: 103 mm (4.06 in.)

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt and find the area that has the lowest diameter.

If the diameter is less than the minimum, replace the cylinder head bolt.

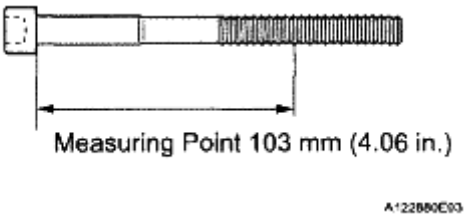

Fig. 304: Identifying Cylinder Head Bolt Dimension
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSPECT CHAIN SUB-ASSEMBLY**
   a. Pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.
   b. Using vernier calipers, measure the length of 15 links.

   Maximum chain elongation: 136.9 mm (5.390 in.)

   NOTE: Perform the measurement at 3 random places. Use the average of the measurements.

   If the elongation is greater than the maximum, replace the chain.

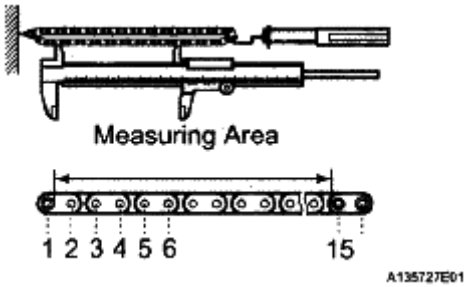

Fig. 305: Measuring Chain Elongation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSPECT NO. 2 CHAIN SUB-ASSEMBLY**
   a. Pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.
   b. Using vernier calipers, measure the length of 15 links.

   Maximum chain elongation: 137.6 mm (5.417 in.)

NOTE: Perform the measurement at 3 random places. Use the average of the measurements.

If the elongation is greater than the maximum, replace the chain.

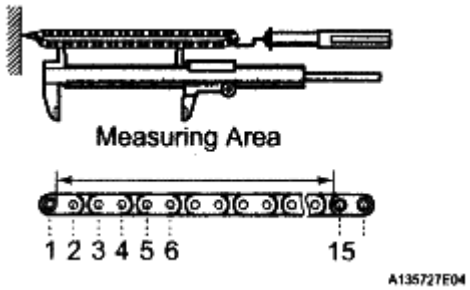

Fig. 306: Measuring No. 2 Chain Elongation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **INSPECT CRANKSHAFT TIMING SPROCKET**
   a. Wrap the chain around the sprocket.
   b. Using vernier calipers, measure the sprocket diameter with the chain.

   Minimum sprocket diameter (with chain): 61.4 mm (2.417 in.)

   HINT:

   The vernier calipers must contact the chain rollers for the measurement.

   If the diameter is less than the minimum, replace the chain and sprocket.

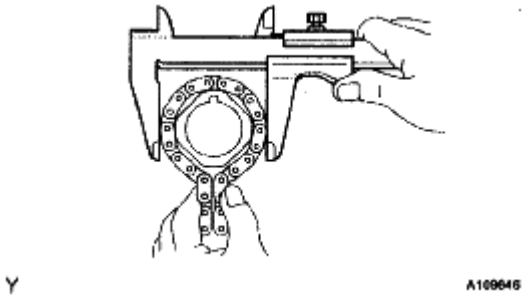

Fig. 307: Checking Crankshaft Timing Sprocket Diameter With Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **INSPECT IDLE SPROCKET ASSEMBLY**
    a. Wrap the chain around the sprocket.
    b. Using vernier calipers, measure the sprocket diameter with the chain.

    Minimum sprocket diameter (with chain): 61.4 mm (2.417 in.)

HINT:

The vernier calipers must contact the chain rollers for the measurement.

If the diameter is less than the minimum, replace the chain and sprocket.

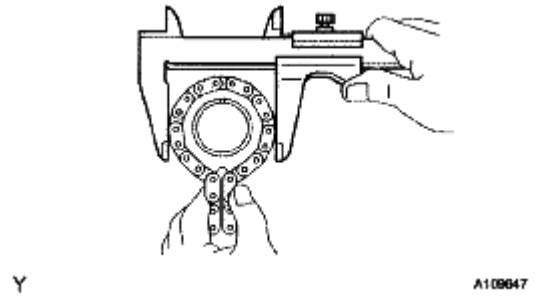

Fig. 308: Checking Idle Sprocket Diameter With Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **INSPECT IDLE GEAR SHAFT OIL CLEARANCE**
    a. Using a micrometer, measure the idle gear shaft diameter.

    Idle gear shaft diameter: 22.987 to 23.000 mm (0.9050 to 0.9055 in.)

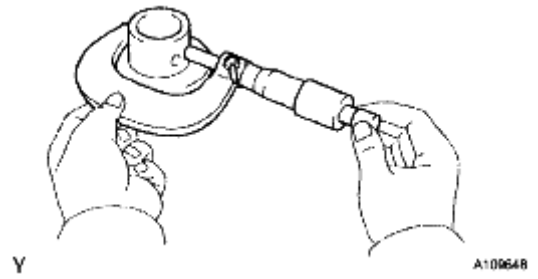

Fig. 309: Checking Idle Gear Shaft Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using a caliper gauge, measure the inside diameter of the idle sprocket.

    Idle gear inside diameter: 23.020 to 23.030 mm (0.9063 to 0.9067 in.)

    c. Subtract the idle gear shaft diameter measurement from the idle sprocket inside diameter measurement.

    Standard oil clearance: 0.020 to 0.043 mm (0.0008 to 0.0017 in.)

    Maximum oil clearance: 0.093 mm (0.0037 in.)

    If the thrust oil clearance is greater than the maximum, replace the idle gear shaft and idle sprocket.

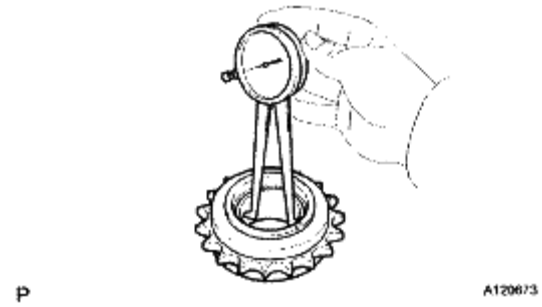

Fig. 310: Checking Inside Diameter Of Idle Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY**
    a. Move the stopper plate upward to release the lock. Push the plunger and check that it moves smoothly. If necessary, replace the No. 1 chain tensioner assembly.

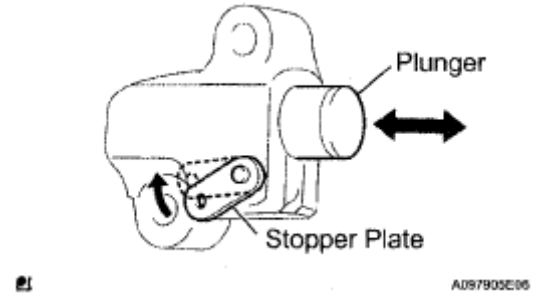

Fig. 311: Inspecting No. 1 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY**
    a. Check that the plunger moves smoothly.
    b. Measure the worn depth of the No. 2 chain tensioner.

    Maximum depth: 0.9 mm (0.035 in.)

    If the depth is greater than the maximum, replace the No. 2 chain tensioner assembly.

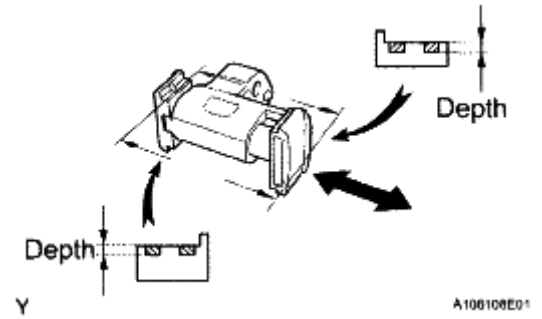

Fig. 312: Checking No 2 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY**
    a. Check that the plunger moves smoothly.
    b. Measure the worn depth of the No. 3 chain tensioner.

    Maximum depth: 0.9 mm (0.035 in.)

    If the depth is greater than the maximum, replace the No. 3 chain tensioner assembly.

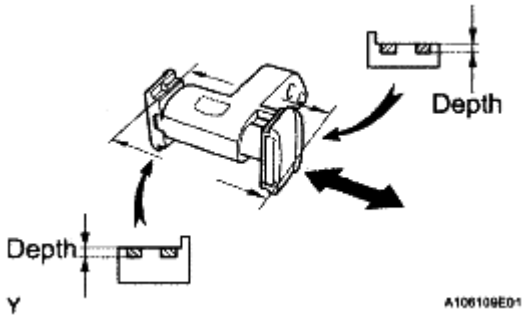

Fig. 313: Checking No 3 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **INSPECT CHAIN TENSIONER SLIPPER**
    a. Measure the worn depth of the chain tensioner slipper.

    Maximum depth: 1.0 mm (0.039 in.)

    If the depth is greater than the maximum, replace the chain tensioner slipper.

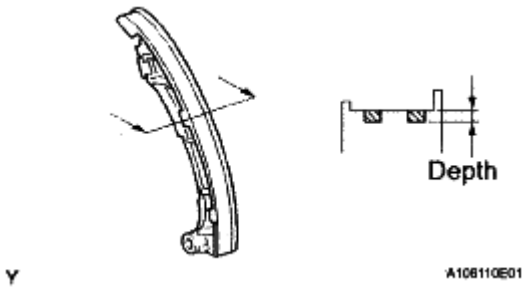

Fig. 314: Inspecting Chain Tensioner Slipper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **INSPECT NO. 1 CHAIN VIBRATION DAMPER**
    a. Measure the worn depth of the No. 1 chain vibration damper.

    Maximum depth: 1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the No. 1 chain vibration damper.

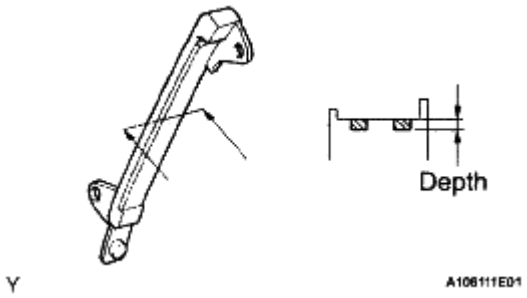

Fig. 315: Inspecting No. 1 Chain Vibration Damper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **INSPECT NO. 2 CHAIN VIBRATION DAMPER**
    a. Measure the worn depth of the No. 2 chain vibration damper.

    Maximum depth: 1.0 mm (0.039 in.)

    If the depth is greater than the maximum, replace the No. 2 chain vibration damper.

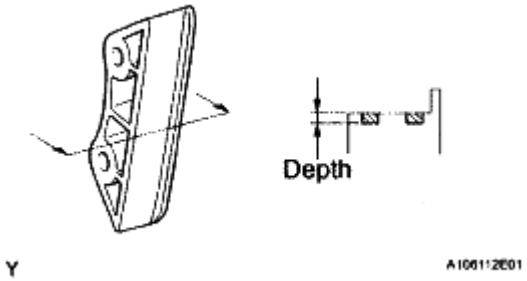

Fig. 316: Inspecting No. 2 Chain Vibration Damper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **INSPECT CYLINDER HEAD SUB-ASSEMBLY**
    a. Using a precision straight edge and feeler gauge, measure the warpage of the contact surface of the cylinder block and manifolds.

    Standard warpage

    WARPAGE SPECIFICATIONS

Item	Warpage
Cylinder head lower	0.05 mm (0.0020 in.)
Intake	0.08 mm (0.0031 in.)
Exhaust	0.08 mm (0.0031 in.)

    Maximum warpage

WARPAGE SPECIFICATIONS

Item	Warpage
Cylinder head lower	0.10 mm (0.0039 in.)
Intake	0.10 mm (0.0039 in.)
Exhaust	0.10 mm (0.0039 in.)

If the warpage is greater than the maximum, replace the cylinder head assembly.

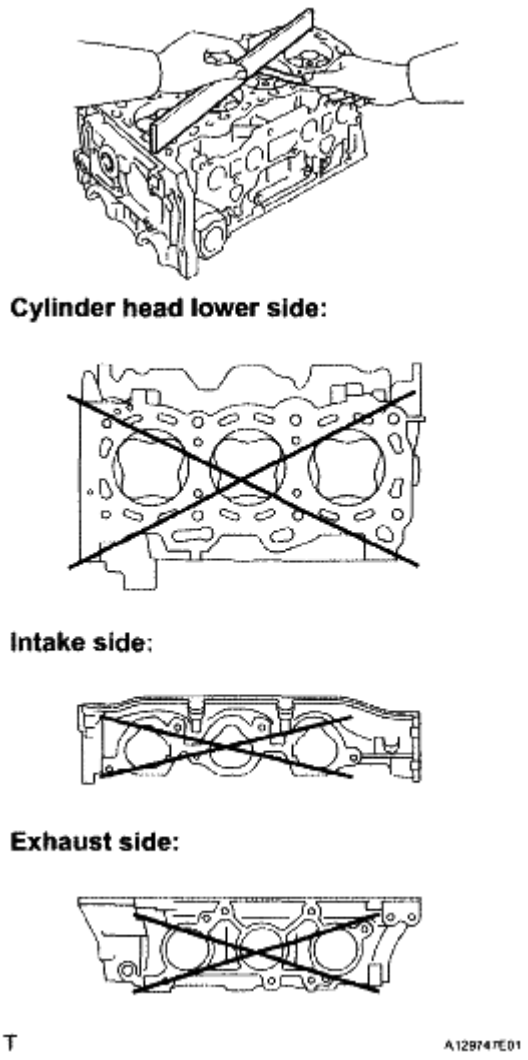

Fig. 317: Measuring Warpage Of Contact Surface Of Cylinder Block And Manifolds
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks. If cracked, replace the cylinder head assembly.

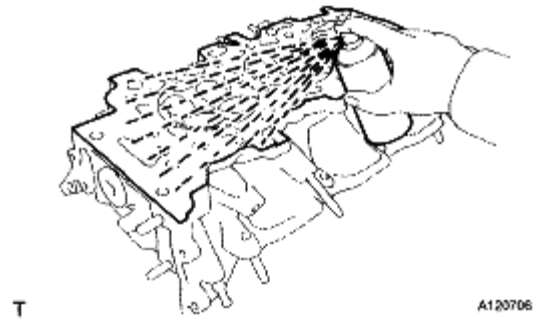

Fig. 318: Checking Intake Ports, Exhaust Ports And Cylinder Surface For Cracks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

19. **INSPECT INTAKE VALVE**
    a. Using a micrometer, measure the diameter of the valve stem.

       Valve stem diameter: 5.470 to 5.485 mm (0.2154 to 0.2159 in.)

       If the valve stem is not as specified, check the oil clearance.

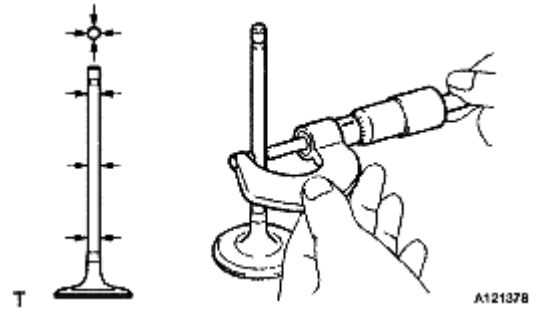

Fig. 319: Checking Valve Stem Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using vernier calipers, measure the valve head margin thickness.

       Standard margin thickness: 1.0 mm (0.039 in.)

       Minimum margin thickness: 0.5 mm (0.0197 in.)

       If the margin thickness is less than the minimum, replace the intake valve.

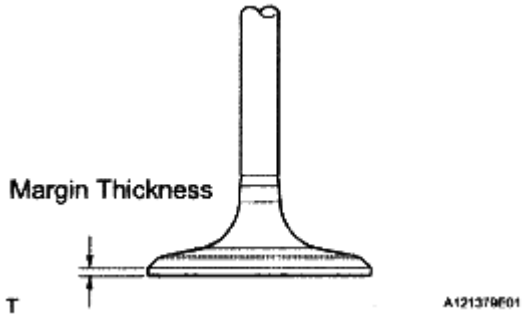

Fig. 320: Inspecting Head Margin Thickness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using vernier calipers, measure the valve's overall length.

Standard overall length: 105.85 mm (4.1673 in.)

Minimum overall length: 105.35 mm (4.1476 in.)

If the overall length is less than the minimum, replace the intake valve.

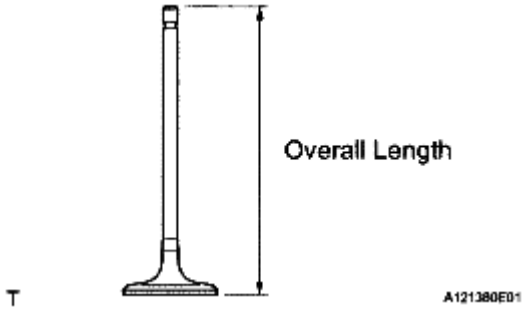

Fig. 321: Inspecting Valve Overall Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **INSPECT EXHAUST VALVE**

a. Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter: 5.465 to 5.480 mm (0.2151 to 0.2157 in.)

If the valve stem is not as specified, check the oil clearance.

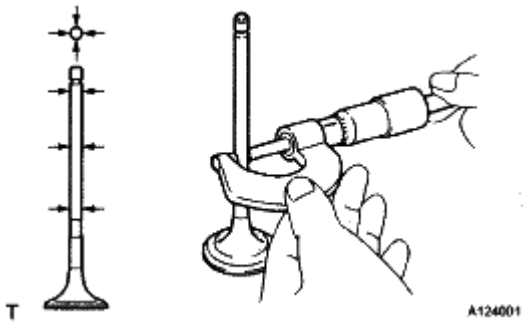

Fig. 322: Checking Diameter Of Exhaust Valve Stem
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using vernier calipers, measure the valve head margin thickness.

Standard margin thickness: 1.0 mm (0.039 in.)

Minimum margin thickness: 0.5 mm (0.0197 in.)

If the margin thickness is less than the minimum, replace the exhaust valve.

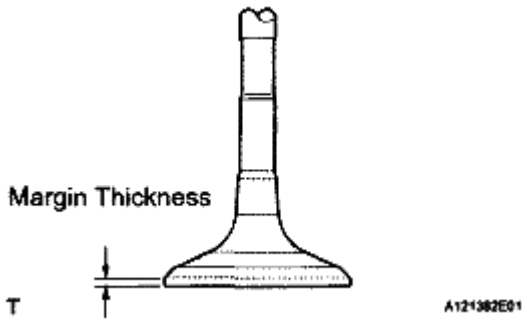

Fig. 323: Inspecting Valve Head Margin Thickness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using vernier calipers, measure the valve's overall length.

Standard overall length: 110.40 mm (4.3464 in.)

Minimum overall length: 109.90 mm (4.3268 in.)

If the overall length is less than the minimum, replace the exhaust valve.

21. **INSPECT INTAKE VALVE SEAT**
    a. Apply a light coat of Prussian blue to the valve face.

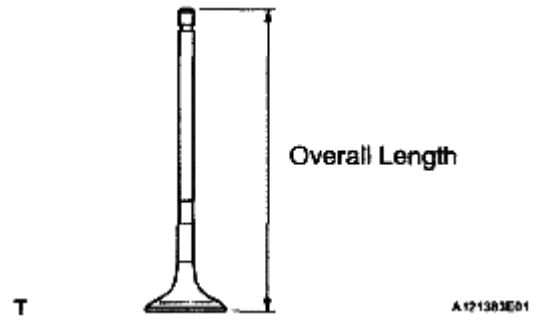

Fig. 324: Identifying Valve Overall Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Lightly press the valve face against the valve seat.
c. Check the valve face and valve spring seat by using the following procedure:
    1. If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
    2. If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve spring seat.
    3. Check that the valve spring seat contacts in the middle of the valve face with the width between 1.1 and 1.5 mm (0.043 and 0.059 in.).

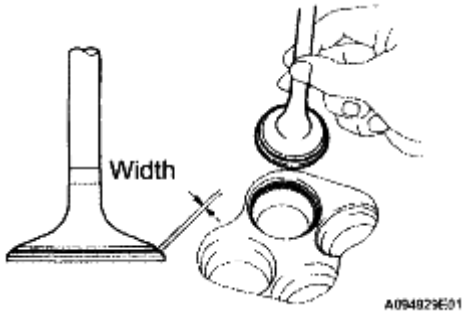

Fig. 325: Applying Light Coat Of Prussian Blue (Or White Lead) To Valve Face
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **INSPECT EXHAUST VALVE SEAT**
    a. Apply a light coat of Prussian blue to the valve face.
    b. Lightly press the valve face against the valve spring seat.
    c. Check the valve face and valve spring seat by using the following procedure:
        1. If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
        2. If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve spring seat.
        3. Check that the valve spring seat contacts in the middle of the valve face with the width between 1.1 and 1.5 mm (0.043 and 0.059 in.).

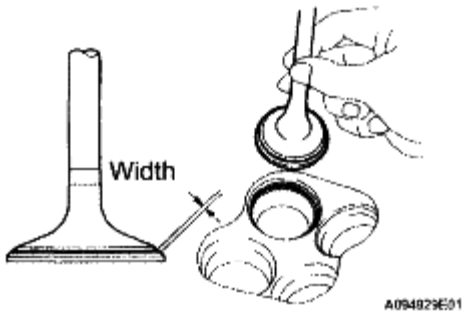

Fig. 326: Applying Light Coat Of Prussian Blue (Or White Lead) To Valve Face
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. **REPAIR INTAKE VALVE SEAT**

NOTE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**

a. Using a 45° cutter, resurface the valve spring seat so that the valve spring seat width is more than the specification.

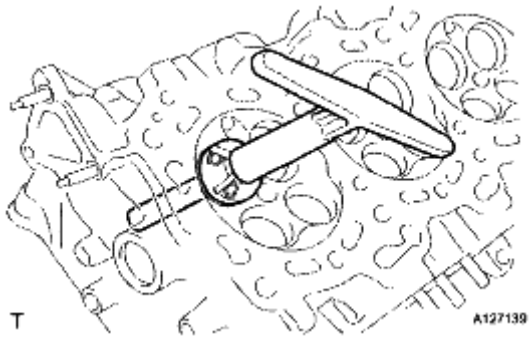

Fig. 327: Surfacing Valve Seat
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using 30° and 60° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve spring seat, and the valve spring seat width should be maintained within the specified range around the entire circumference of the seat.

Width: 1.1 to 1.5 mm (0.043 to 0.059 in.)

c. Handrub the valve and valve seat with an abrasive compound.
d. Check the valve seating position.

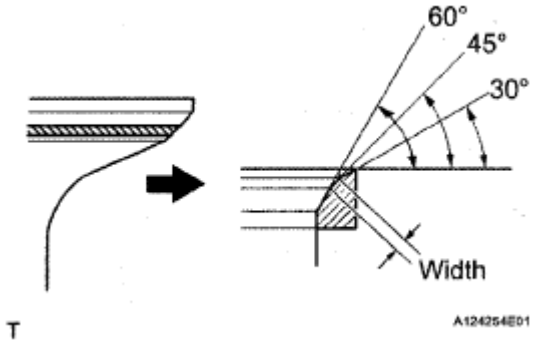

Fig. 328: Identifying Valve Seat Width
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **REPAIR EXHAUST VALVE SEAT**

NOTE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**

a. Using a 45° cutter, resurface the valve spring seat so that the valve spring seat width is more than the specification.

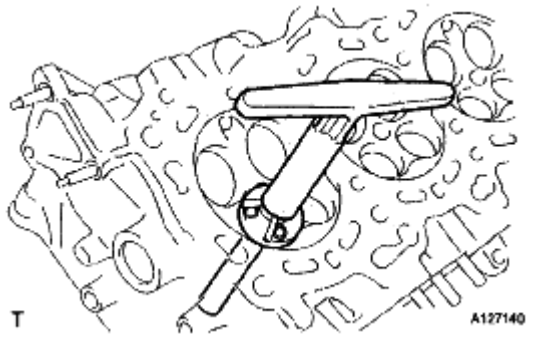

Fig. 329: Surfacing Valve Seat
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using 30° and 75° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve seat, and the valve seat width should be maintained within the specified range around the entire circumference of the seat.

Width: 1.1 to 1.5 mm (0.043 to 0.059 in.)

c. Handrub the valve and valve seat with an abrasive compound.
d. Check the valve seating position.

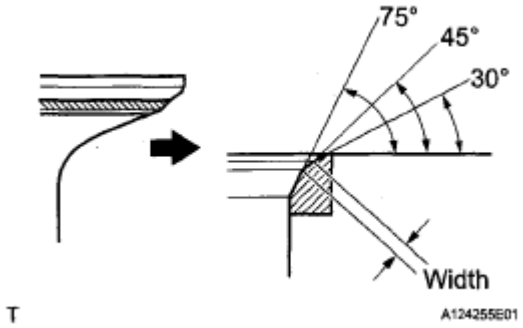

Fig. 330: Checking Valve Seating Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

25. **INSPECT INNER COMPRESSION SPRING**
    a. Using vernier calipers, measure the free length of the inner compression spring.

    Free length: 45.46 mm (1.7898 in.)

    If the free length is not as specified, replace the inner compression spring.

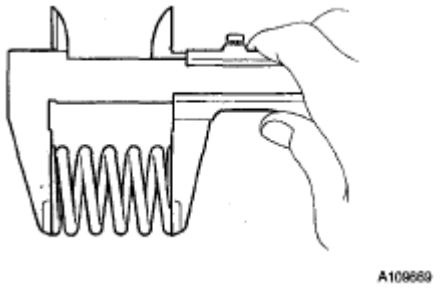

Fig. 331: Checking Inner Compression Spring Free Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using a steel square, measure the deviation of the inner compression spring.

    Maximum deviation: 1.0 mm (0.039 in.)

    Maximum angle (reference): 2°

    If the deviation is greater than the maximum, replace the inner compression spring.

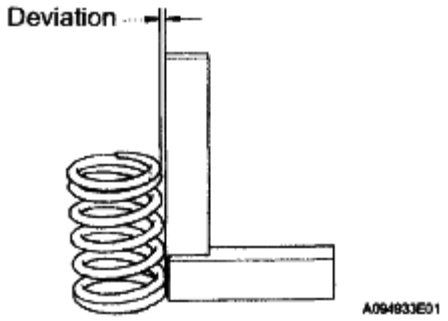

Fig. 332: Measuring Deviation Of Inner Compression Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

26. **INSPECT VALVE GUIDE BUSH OIL CLEARANCE**
    a. Using a caliper gauge, measure the inside diameter of the valve guide bush.

       Bush inside diameter: 5.510 to 5.530 mm (0.2169 to 0.2177 in.)

    b. Subtract the valve stem diameter measurement from the valve guide bush inside diameter measurement.

       Standard clearance

       CLEARANCE SPECIFICATIONS

Item	Clearance
Intake	0.025 to 0.060 mm (0.0010 to 0.0024 in.)
Exhaust	0.030 to 0.065 mm (0.0012 to 0.0026 in.)

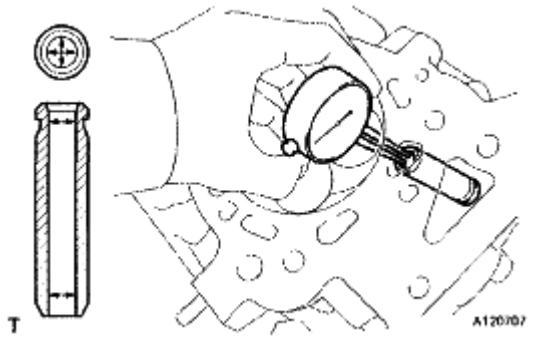

Fig. 333: Checking Inside Diameter Of Guide Bush
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum oil clearance

MAXIMUM OIL CLEARANCE

Item	Clearance
Intake	0.08 mm (0.0032 in.)

Exhaust	0.10 mm (0.0039 in.)

For intake side:

If the clearance is greater than the maximum, replace the intake valve and intake valve guide bush.

For exhaust side:

If the clearance is greater than the maximum, replace the exhaust valve and exhaust valve guide bush.

27. **INSPECT CAMSHAFT THRUST CLEARANCE**

a. Inspect the bank 1 camshaft thrust clearance.

1. Install the bank 1 camshaft (See **REASSEMBLY**).
2. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance: 0.08 to 0.13 mm (0.0031 to 0.0051 in.)

Maximum thrust clearance: 0.15 mm (0.006 in.)

If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.

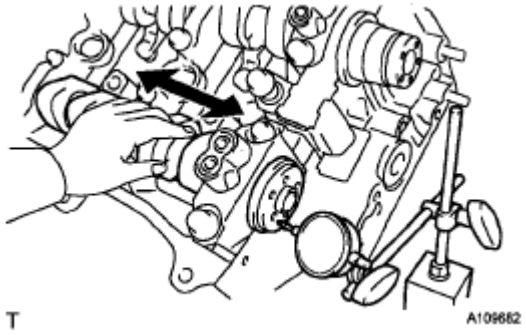

Fig. 334: Checking Camshaft Thrust Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Inspect the bank 2 camshaft thrust clearance.

1. Install the bank 2 camshaft (See **REASSEMBLY**).
2. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance: 0.08 to 0.13 mm (0.0031 to 0.0051 in.)

Maximum thrust clearance: 0.15 mm (0.006 in.)

If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.

28. **INSPECT CAMSHAFT OIL CLEARANCE**
    a. Clean the camshaft bearing caps, camshaft housing and camshaft journals.
    b. Place the camshafts on the camshaft housing.
    c. Lay a strip of Plastigage across each of the camshaft journals.
    d. Install the camshaft bearing caps (See **REASSEMBLY**).

NOTE: Do not turn the camshaft.

    e. Remove the camshaft bearing caps (See **DISASSEMBLY**).

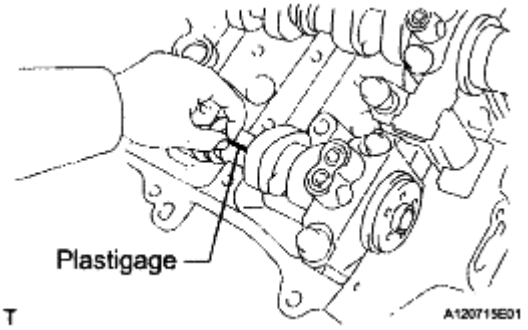

Fig. 335: Checking Camshaft Oil Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    f. Measure the Plastigage at its widest point.

Standard oil clearance

STANDARD OIL CLEARANCE

Item	Oil Clearance
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journals	0.025 to 0.062 mm (0.00098 to 0.0024 in.)

Maximum oil clearance

MAXIMUM OIL CLEARANCE

Item	Oil Clearance
No. 1 journal	0.10 mm (0.0039 in.)
Other journals	0.09 mm (0.0035 in.)

If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the camshaft housing.

g. Clean the camshaft bearing caps, camshaft housing and camshaft journals.
h. Place the camshafts on the camshaft housing.

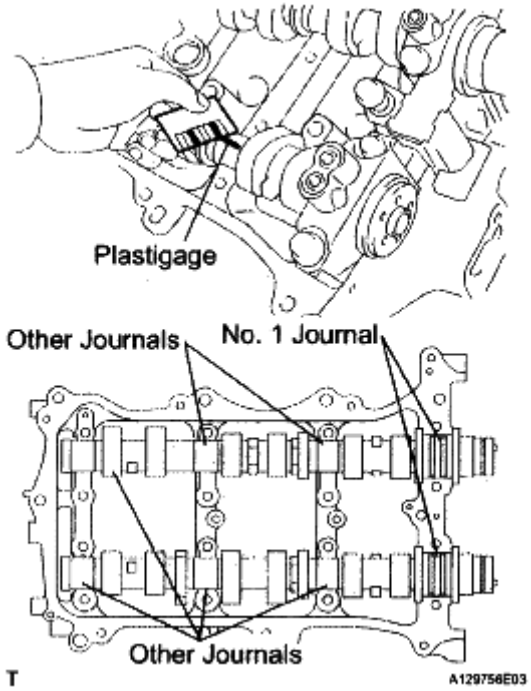

Fig. 336: Measuring Plastigage At Camshaft Widest Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

i. Lay a strip of Plastigage across each of the camshaft journals.
j. Install the bearing caps (See **REASSEMBLY**).

NOTE: Do not turn the camshaft.

k. Remove the bearing caps (See **DISASSEMBLY**).

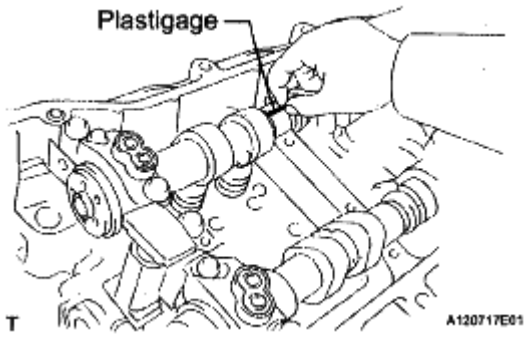

Fig. 337: Laying Strip Of Plastigage Across Each Of Camshaft Journals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

l. Measure the Plastigage at its widest point.

Standard oil clearance

STANDARD OIL CLEARANCE

Item	Oil Clearance
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journals	0.025 to 0.062 mm (0.00098 to 0.0024 in.)

Maximum oil clearance

MAXIMUM OIL CLEARANCE

Item	Oil Clearance
No. 1 journal	0.10 mm (0.0039 in.)
Other journals	0.09 mm (0.0035 in.)

If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the camshaft housing.

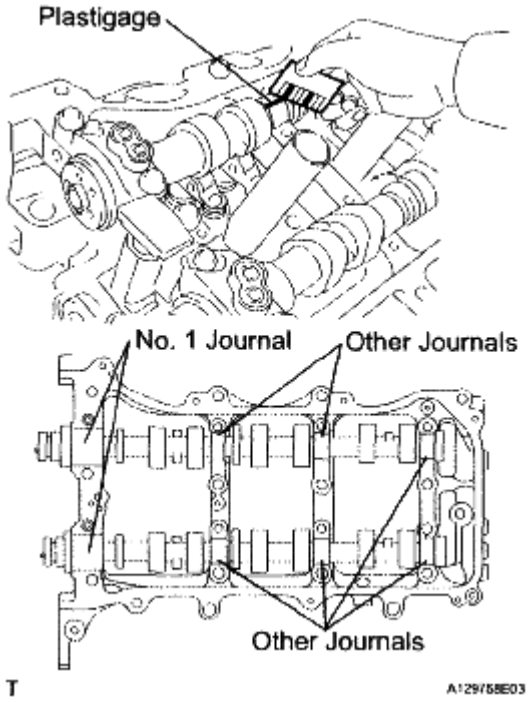

Fig. 338: Measuring Plastigage At Camshaft Widest Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

29. **INSPECT CONNECTING ROD THRUST CLEARANCE**
    a. Install the connecting rod cap (See **REASSEMBLY**).
    b. Using a dial indicator, measure the thrust clearance while moving the connecting rod back and

forth.

Standard thrust clearance: 0.15 to 0.40 mm (0.0059 to 0.0157 in.)

Maximum thrust clearance: 0.50 mm (0.020 in.)

If the thrust clearance is greater than the maximum, replace the connecting rod assemblies as necessary. If necessary, replace the crankshaft.

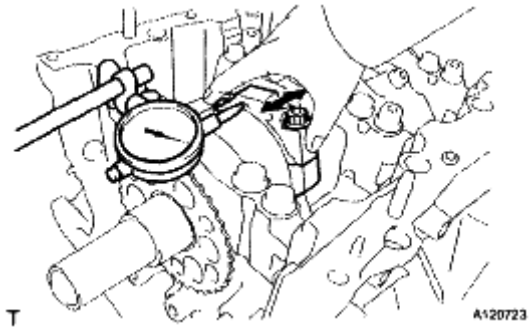

Fig. 339: Checking Connecting Rod Thrust Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

30. **INSPECT CONNECTING ROD OIL CLEARANCE**
    a. Clean the crank pin and bearing.
    b. Check the crank pin and bearing for pitting and scratches.
    c. Lay a strip of Plastigage on the crank pin.

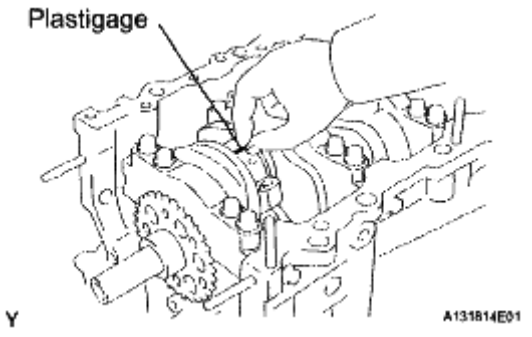

Fig. 340: Laying Strip Of Plastigage On Crank Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    d. Check that the front mark of the connecting rod cap is facing forward.
    e. Install the connecting rod cap (See **REASSEMBLY**).

NOTE: Do not turn the crankshaft.

    f. Remove the 2 bolts and connecting rod cap (See **DISASSEMBLY**).

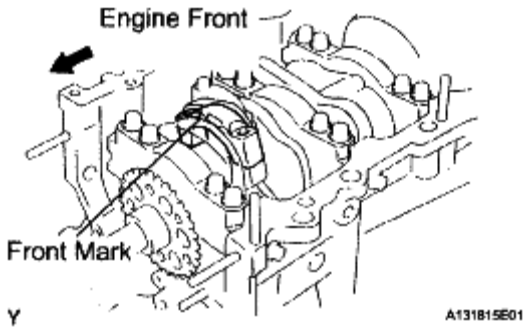

Fig. 341: Checking Front Mark Of Connecting Rod Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Measure the Plastigage at its widest point.

Standard oil clearance: 0.045 to 0.067 mm (0.0018 to 0.0026 in.)

Maximum oil clearance: 0.070 mm (0.0028 in.)

If the oil clearance is greater than the maximum, replace the connecting rod bearings. If necessary, inspect the crankshaft.

HINT:

If replacing a bearing, replace it with one that has the same number as its respective connecting rod cap. Each bearing's standard thickness is indicated by a 1, 2, 3 or 4 mark on its surface.

Connecting rod diameter

CONNECTING ROD DIAMETER

Mark	Diameter
1	56.000 to 56.006 mm (2.2047 to 2.2050 in.)
2	56.007 to 56.012 mm (2.2050 to 2.2052 in.)
3	56.013 to 56.018 mm (2.2052 to 2.2054 in.)
4	56.019 to 56.024 mm (2.2055 to 2.2057 in.)

Connecting rod bearing center wall thickness

CONNECTING ROD BEARING CENTER WALL THICKNESS

Mark	Thickness
1	1.481 to 1.484 mm (0.0583 to 0.0584 in.)
2	1.484 to 1.487 mm (0.0584 to 0.0585 in.)
3	1.487 to 1.490 mm (0.0585 to 0.0587 in.)
4	1.490 to 1.493 mm (0.0587 to 0.0588 in.)

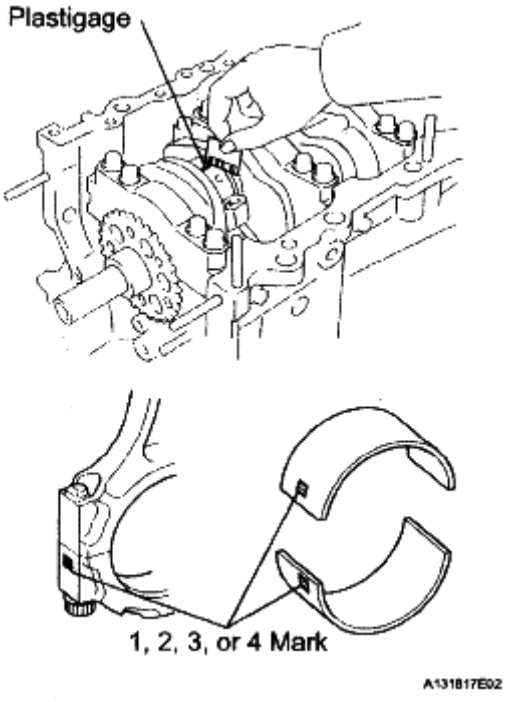

Fig. 342: Measuring Plastigage Widest Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Crankshaft pin diameter: 52.992 to 53.000 mm (2.0863 to 2.0866 in.)

NOTE: Completely remove the Plastigage after the measurement.

31. **INSPECT CRANKSHAFT THRUST CLEARANCE**
    a. Install the crankshaft bearing cap (See **REASSEMBLY**).
    b. Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

    Standard thrust clearance: 0.04 to 0.24 mm (0.0016 to 0.0094 in.)

    Maximum thrust clearance: 0.30 mm (0.0118 in.)

    If the thrust clearance is greater than the maximum, replace the thrust washers as a set. If necessary, replace the crankshaft.

    Thrust washer thickness: 2.43 to 2.48 mm (0.0957 to 0.0976 in.)

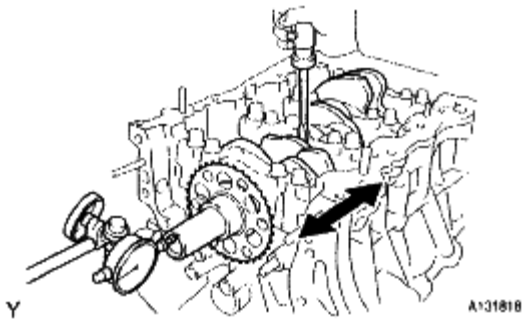

Fig. 343: Measuring Crankshaft Thrust Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

32. **INSPECT CYLINDER BLOCK FOR WARPAGE**
    a. Using a precision straight edge and feeler gauge, measure the warpage of the contact surface of the cylinder head gasket.

       Maximum warpage: 0.07 mm (0.0028 in.)

       If the warpage is greater than the maximum, replace the cylinder block.

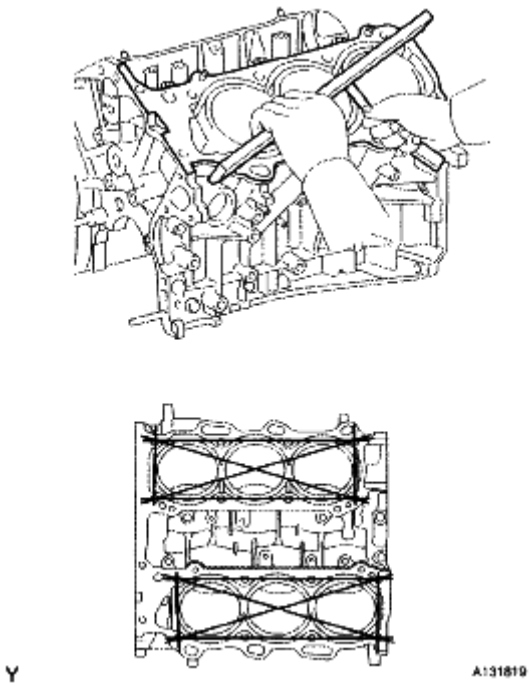

Fig. 344: Measuring Warpage Of Contact Surface Of Cylinder Head Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

33. **INSPECT CYLINDER BORE**
    a. Visually check the cylinder for vertical scratches. If deep scratches are present, rebore all the 6 cylinders. If necessary, replace the cylinder block.

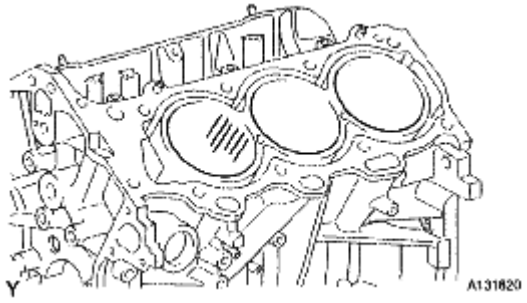

Fig. 345: Checking Cylinder For Vertical Scratches
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a cylinder gauge, measure the cylinder bore diameter at positions A and B in the thrust and axial directions.

Standard diameter: 94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter: 94.200 mm (3.7087 in.)

If the average diameter of 4 positions is greater than the maximum, replace the cylinder block.

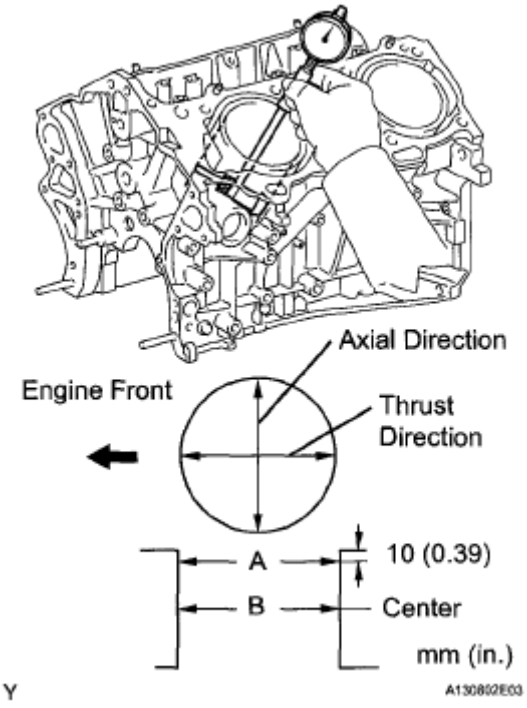

Fig. 346: Measuring Cylinder Bore Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

34. **INSPECT PISTON SUB-ASSEMBLY WITH PIN**

a. Using a micrometer, measure the piston diameter at right angles to the piston center line where the

distance from the piston end is as specified.

Distance: 9.8 mm (0.3858 in.)

Standard diameter: 93.960 to 93.980 mm (3.6992 to 3.7000 in.)

Maximum diameter: 93.830 mm (3.6941 in.)

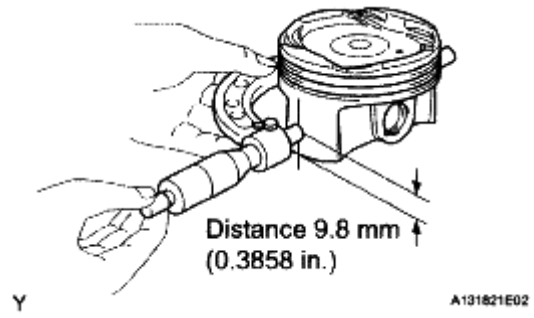

Fig. 347: Checking Piston Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

35. **INSPECT PISTON OIL CLEARANCE**
    a. Measure the cylinder bore diameter in the thrust directions.
    b. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

    Standard oil clearance: 0.020 to 0.052 mm (0.0008 to 0.0020 in.)

    Maximum oil clearance: 0.060 mm (0.0024 in.)

    If the oil clearance is greater than the maximum, replace all the pistons. If necessary, replace the cylinder block.

36. **INSPECT RING GROOVE CLEARANCE**
    a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

    Ring groove clearance

    RING GROOVE CLEARANCE

Item	Clearance
No. 1	0.020 to 0.070 mm (0.0008 to 0.0028 in.)
No. 2	0.020 to 0.060 mm (0.0008 to 0.0024 in.)
Oil	0.070 to 0.150 mm (0.0028 to 0.0059 in.)

    If the clearance is not as specified, replace the piston.

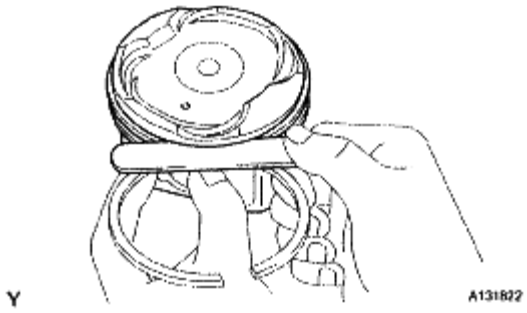

Fig. 348: Measuring Ring Groove
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

37. **INSPECT PISTON RING END GAP**
    a. Insert the piston ring into the cylinder bore.
    b. Using a piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.

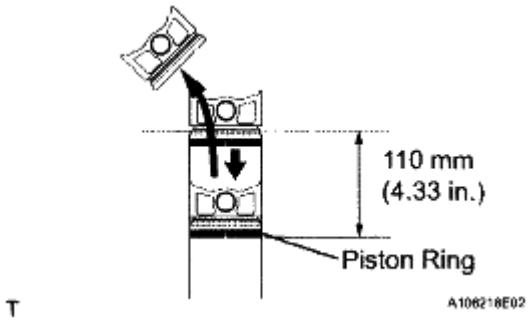

Fig. 349: Inserting Piston Ring Into Cylinder Bore
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Using a feeler gauge, measure the end gap.

Standard end gap

STANDARD END GAP SPECIFICATIONS

Item	End Gap
No. 1	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
No. 2	0.50 to 0.60 mm (0.0197 to 0.0236 in.)
Oil	0.10 to 0.40 mm (0.0039 to 0.0157 in.)

Maximum end gap

MAXIMUM END GAP

Item	End Gap
No. 1	0.50 mm (0.0197 in.)

No. 2	0.85 mm (0.0335 in.)
Oil	0.60 mm (0.0236 in.)

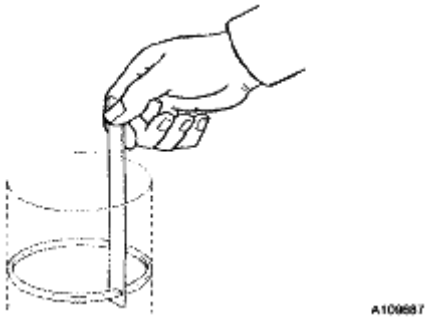

Fig. 350: Checking End Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the end gap is greater than the maximum, replace the piston ring. If the end gap is greater than the maximum even with a new piston ring, rebore all the 6 cylinders or replace the cylinder block.

38. **INSPECT PISTON PIN OIL CLEARANCE**
    a. Using a caliper gauge, measure the inside diameter of the piston pin hole.

Piston pin hole inside diameter

PISTON PIN HOLE INSIDE DIAMETER

Mark	Diameter
A	22.001 to 22.004 mm (0.8662 to 0.8663 in.)
B	22.004 to 22.007 mm (0.8663 to 0.8664 in.)
C	22.007 to 22.010 mm (0.8664 to 0.8665 in.)

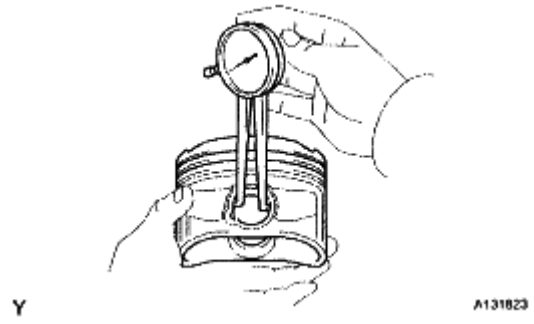

Fig. 351: Measuring Inside Diameter Of Piston Pin Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Using a micrometer, measure the piston pin diameter.

Piston pin diameter

PISTON PIN DIAMETER

Mark	Diameter
A	21.997 to 22.000 mm (0.8660 to 0.8661 in.)
B	22.000 to 22.003 mm (0.8661 to 0.8663 in.)
C	22.003 to 22.006 mm (0.8663 to 0.8664 in.)

c. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance: 0.001 to 0.007 mm (0.00004 to 0.00028 in.)

Maximum oil clearance: 0.015 mm (0.0006 in.)

If the oil clearance is greater than the maximum, replace the piston and piston pin as a set.

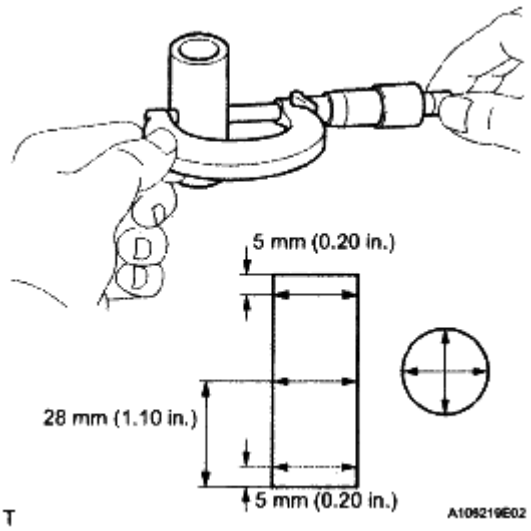

Fig. 352: Checking Piston Pin Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

Bushing inside diameter

BUSHING INSIDE DIAMETER

Mark	Diameter
A	22.005 to 22.008 mm (0.8663 to 0.8665 in.)
B	22.009 to 22.011 mm (0.8665 to 0.8666 in.)
C	22.012 to 22.014 mm (0.8666 to 0.8667 in.)

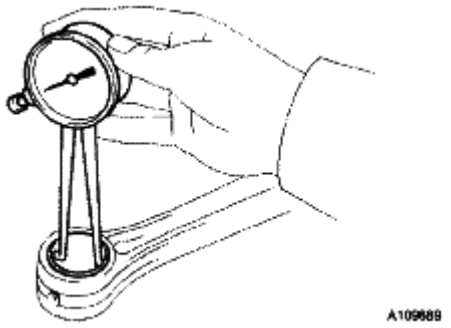

Fig. 353: Checking Inside Diameter Of Connecting Rod Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

Standard oil clearance: 0.005 to 0.011 mm (0.0002 to 0.0004 in.)

Maximum oil clearance: 0.030 mm (0.0012 in.)

If the oil clearance is greater than the maximum, replace the bushing. If necessary, replace the connecting rod and piston pin as a set.

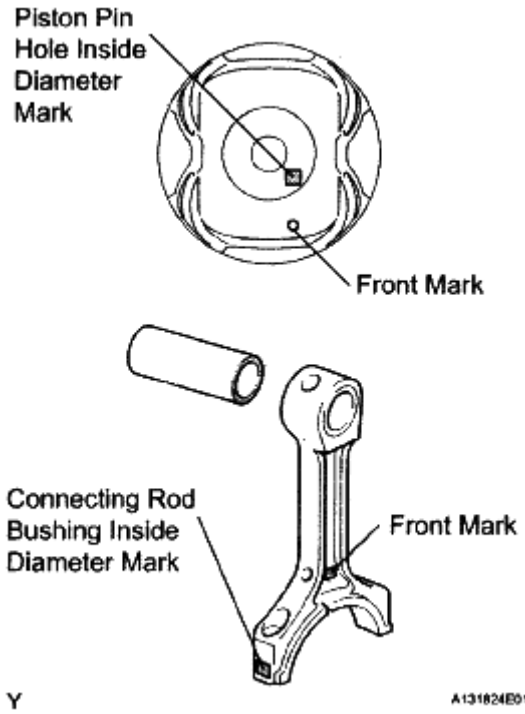

Fig. 354: Identifying Front Mark Of Piston Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

39. **INSPECT CONNECTING ROD**

a. Using a rod aligner and feeler gauge, check the connecting rod alignment.

1. Check for out-of-alignment.

   Maximum out-of-alignment: 0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

   If the out-of-alignment is greater than the maximum, replace the connecting rod assembly.

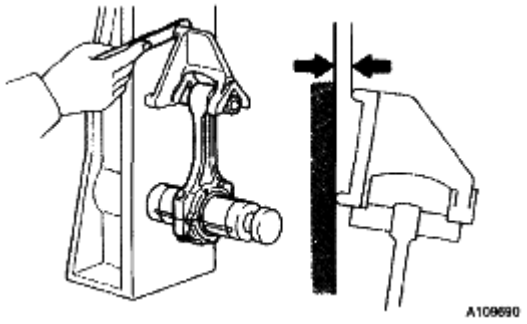

Fig. 355: Checking Connecting Rod Alignment
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Check for twist.

   Maximum twist: 0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

   If the twist is greater than the maximum, replace the connecting rod assembly.

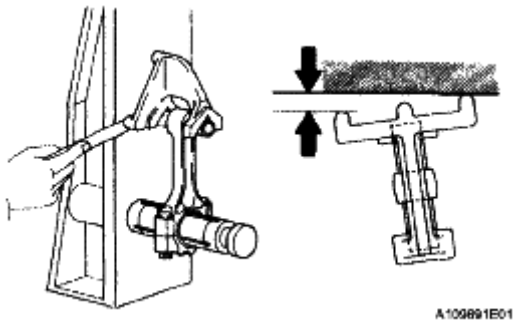

Fig. 356: Checking Connecting Rod For Twist
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

40. **INSPECT CONNECTING ROD BOLT**
    a. Using vernier calipers, measure the tension portion diameter of the bolt.

       Standard diameter: 7.2 to 7.3 mm (0.284 to 0.287 in.)

       Minimum diameter: 7.0 mm (0.276 in.)

       If the diameter is less than the minimum, replace the bolt.

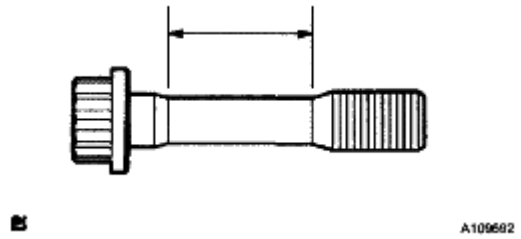

Fig. 357: Identifying Tension Portion Diameter Of Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

41. **INSPECT CRANKSHAFT**
    a. Inspect for circle runout.
        1. Clean the crank journal.
        2. Place the crankshaft on V-blocks.
        3. Using a dial indicator, measure the circle runout at the center journal.

           Maximum circle runout: 0.06 mm (0.0024 in.)

           If the circle runout is greater than the maximum, replace the crankshaft.

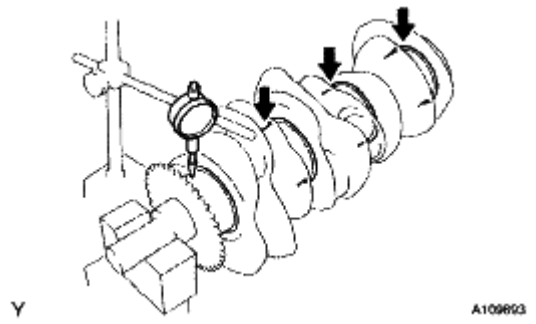

Fig. 358: Checking Circle Runout At Center Journal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Inspect the main journals.
        1. Using a micrometer, measure the diameter of each main journal.

           Standard journal diameter: 60.988 to 61.000 mm (2.4011 to 2.4016 in.)

           If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

        2. Check each main journal for taper and out-of-round as shown in the illustration.

           Maximum taper and out-of-round: 0.02 mm (0.0008 in.)

           If the taper and out-of-round is greater than the maximum, replace the crankshaft.

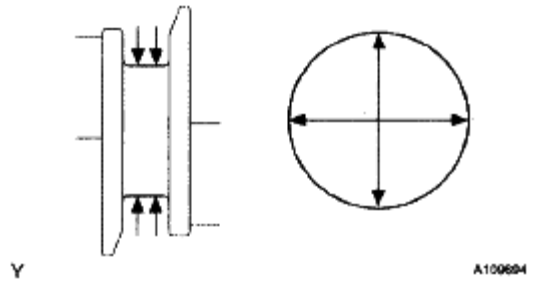

Fig. 359: Checking Main Journal For Taper And Out-Of Round
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Inspect the crank pin.
   1. Using a micrometer, measure the diameter of each crank pin.

      Crankshaft pin diameter: 52.992 to 53.000 mm (2.0863 to 2.0866 in.)

      If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

   2. Check each crank pin for taper and out-of-round as shown in the illustration.

      Maximum taper and out-of-round: 0.02 mm (0.0008 in.)

      If the taper and out-of-round is greater than the maximum, replace the crankshaft.

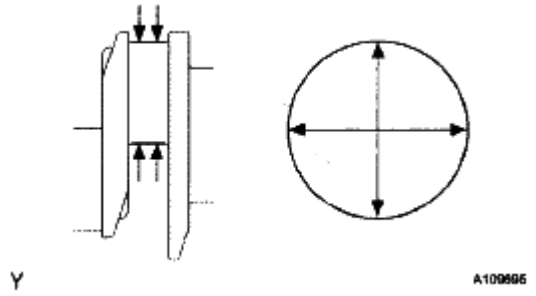

Fig. 360: Checking Crank Pin For Taper And Out-Of Round
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

42. **INSPECT CRANKSHAFT OIL CLEARANCE**
   a. Check the crank journal and bearing for pitting and scratches.
   b. Install the crankshaft bearing (See **REASSEMBLY**).
   c. Place the crankshaft on the cylinder block.
   d. Lay a strip of Plastigage across each journal.
   e. Examine the front marks and numbers and install the bearing caps on the cylinder block.

      HINT:

A number is marked on each main bearing cap to indicate the installation position.

f. Install the main bearing cap (See **REASSEMBLY**).

NOTE: Do not turn the crankshaft.

g. Remove the main bearing caps (See **DISASSEMBLY**).

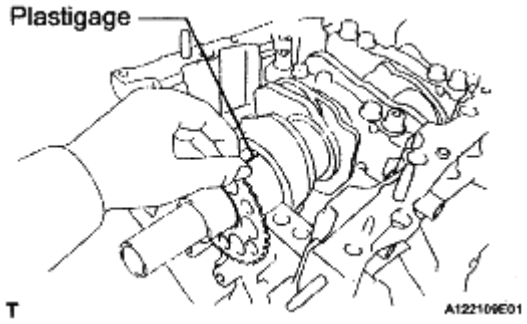

Fig. 361: Laying Strip Of Plastigage Across Each Journal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Measure the Plastigage at its widest point.

Standard oil clearance: 0.026 to 0.047 mm (0.0010 to 0.0019 in.)

Maximum oil clearance: 0.050 mm (0.0020 in.)

If the oil clearance is greater than the maximum, replace the bearings. If necessary, replace the crankshaft.

NOTE: Completely remove the Plastigage after the measurement.

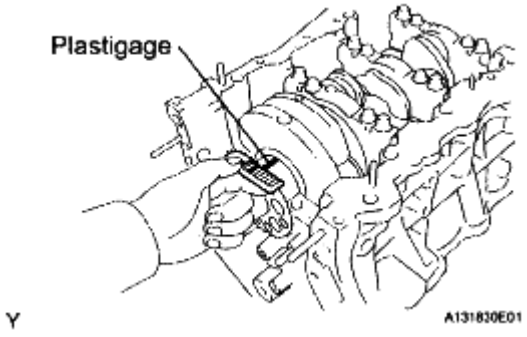

Fig. 362: Measuring Plastigage At Widest Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

i. If replacing a bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the

cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 sizes of standard bearings, marked "1", "2", "3", "4" and "5" accordingly.

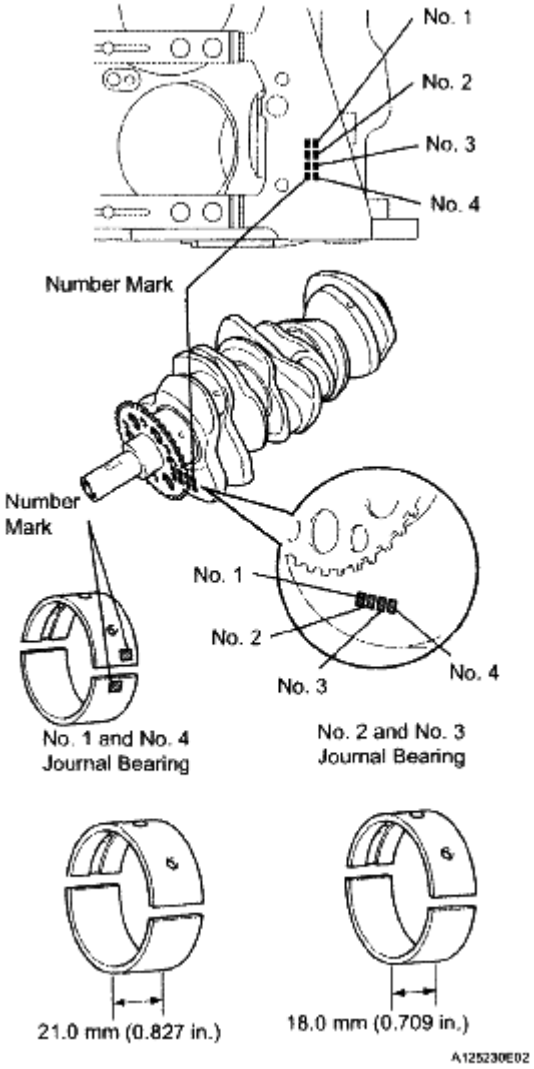

Fig. 363: Identifying Journal Bearing Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Journal bearings:

JOURNAL BEARINGS SPECIFICATIONS

Cylinder block + Crankshaft	0 - 5	6 - 11	12 - 17	18 - 23	24 - 28
Bearing to be used	"1"	"2"	"3"	"4"	"5"

HINT:

EXAMPLE: Cylinder block "11" + Crankshaft "06" Total number 17 (Use bearing "3")

Crankshaft main journal diameter

CRANKSHAFT MAIN JOURNAL DIAMETER

Mark	Diameter
"00"	60.999 to 61.000 mm (2.4015 to 2.4016 in.)
"01"	60.998 to 60.999 mm (2.4015 to 2.4015 in.)
"02"	60.997 to 60.998 mm (2.4015 to 2.4015 in.)
"03"	60.996 to 60.997 mm (2.4014 to 2.4015 in.)
"04"	60.995 to 60.996 mm (2.4014 to 2.4014 in.)
"05"	60.994 to 60.995 mm (2.4013 to 2.4014 in.)
"06"	60.993 to 60.994 mm (2.4013 to 2.4013 in.)
"07"	60.992 to 60.993 mm (2.4013 to 2.4013 in.)
"08"	60.991 to 60.992 mm (2.4012 to 2.4013 in.)
"09"	60.990 to 60.991 mm (2.4012 to 2.4012 in.)
"10"	60.989 to 60.990 mm (2.4011 to 2.4012 in.)
"11"	60.988 to 60.989 mm (2.4011 to 2.4011 in.)

Standard upper bearing center wall thickness (No. 1 and No. 4 journal)

STANDARD UPPER BEARING CENTER WALL THICKNESS (NO. 1 AND NO. 4 JOURNAL)

Mark	Thickness
"1"	2.500 to 2.503 mm (0.0984 to 0.0985 in.)
"2"	2.503 to 2.506 mm (0.0985 to 0.0987 in.)
"3"	2.506 to 2.509 mm (0.0987 to 0.0988 in.)
"4"	2.509 to 2.512 mm (0.0988 to 0.0989 in.)
"5"	2.512 to 2.515 mm (0.0989 to 0.0990 in.)

Standard lower bearing center wall thickness (No. 1 and No. 4 journal)

STANDARD LOWER BEARING CENTER WALL THICKNESS (NO. 1 AND NO. 4 JOURNAL)

Mark	Thickness
"1"	2.478 to 2.481 mm (0.0976 to 0.0977 in.)
"2"	2.481 to 2.484 mm (0.0977 to 0.0978 in.)
"3"	2.484 to 2.487 mm (0.0978 to 0.0979 in.)
"4"	2.487 to 2.490 mm (0.0979 to 0.0980 in.)
"5"	2.490 to 2.493 mm (0.0980 to 0.0981 in.)

Standard upper bearing center wall thickness (No. 2 and No. 3 journal)

STANDARD UPPER BEARING CENTER WALL THICKNESS (NO. 2 AND NO. 3 JOURNAL)

Mark	Thickness
"1"	2.478 to 2.481 mm (0.0976 to 0.0977 in.)
"2"	2.481 to 2.484 mm (0.0977 to 0.0978 in.)
"3"	2.484 to 2.487 mm (0.0978 to 0.0979 in.)
"4"	2.487 to 2.490 mm (0.0979 to 0.0980 in.)
"5"	2.490 to 2.493 mm (0.0980 to 0.0981 in.)

Standard lower bearing center wall thickness (No. 2 and No. 3 journal)

STANDARD LOWER BEARING CENTER WALL THICKNESS (NO. 2 AND NO. 3 JOURNAL)

Mark	Thickness
"1"	2.500 to 2.503 mm (0.0984 to 0.0985 in.)
"2"	2.503 to 2.506 mm (0.0985 to 0.0987 in.)
"3"	2.506 to 2.509 mm (0.0987 to 0.0988 in.)
"4"	2.509 to 2.512 mm (0.0988 to 0.0989 in.)
"5"	2.512 to 2.515 mm (0.0989 to 0.0990 in.)

43. **INSPECT CRANKSHAFT BEARING CAP SET BOLT**
    a. Using vernier calipers, measure the minimum diameter of the compressed thread at the measuring point.

    Standard diameter: 10.8 to 11.0 mm (0.4252 to 0.4331 in.)

    Minimum diameter: 10.7 mm (0.4213 in.)

    Measuring Point: 40 mm (1.57 in.)

    If the diameter is less than the minimum, replace the bolt.

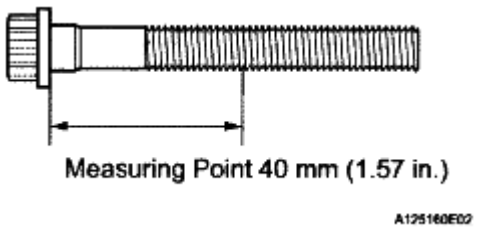

Fig. 364: Identifying Crankshaft Bearing Cap Bolt Dimension
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

1. **INSTALL STRAIGHT PIN**
    a. Using a plastic hammer, tap in new straight pins to the cylinder block.

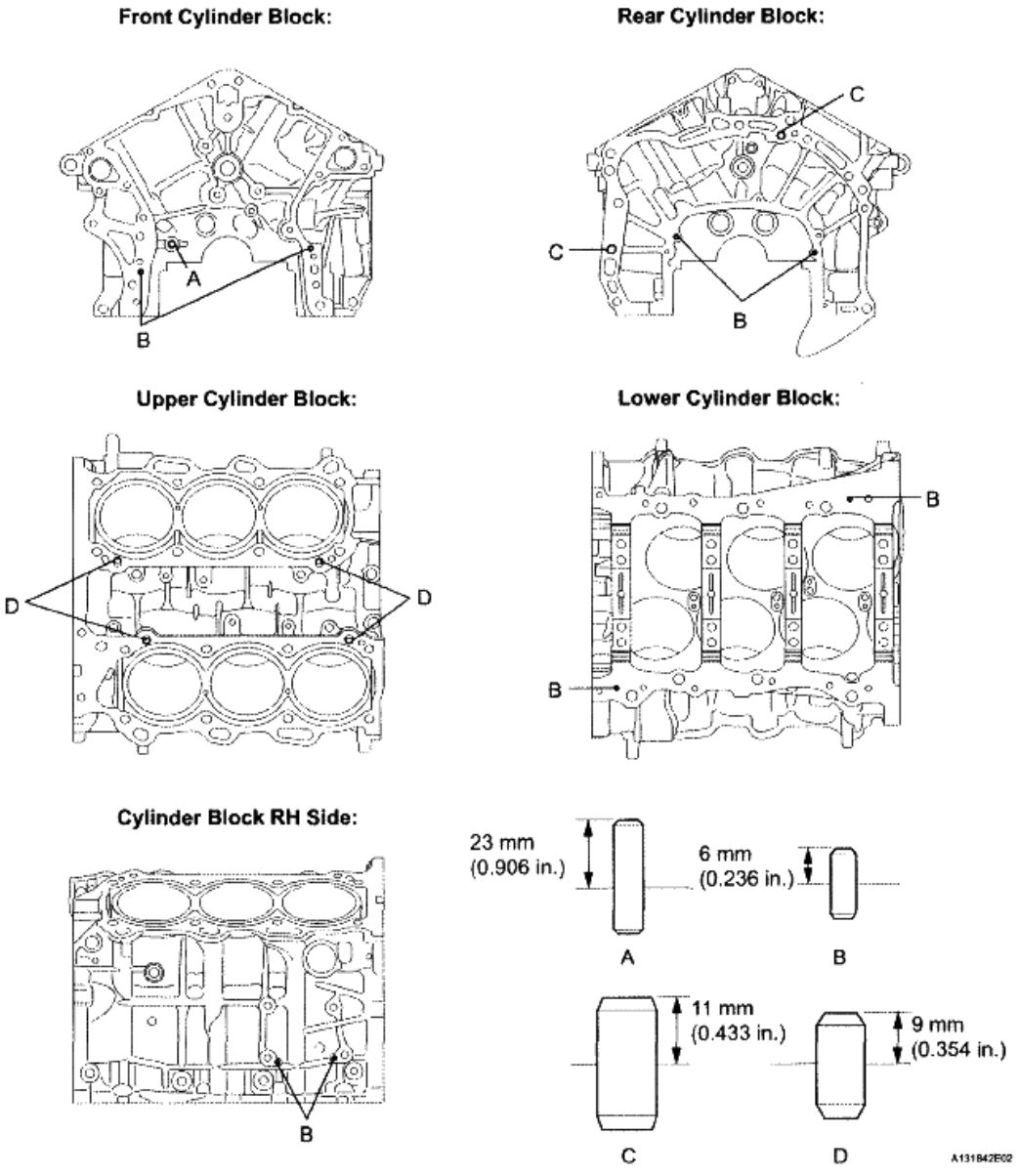

Fig. 365: Identifying Straight Pin Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard protrusion

STANDARD PROTRUSION

Item	Protrusion
Pin A	23 mm (0.906 in.)
Pin B	6 mm (0.236 in.)
Pin C	11 mm (0.433 in.)
Pin D	9 mm (0.354 in.)

2. **INSTALL STUD BOLT**
   a. Using E8 and E10 "TORX" sockets, install the stud bolts.

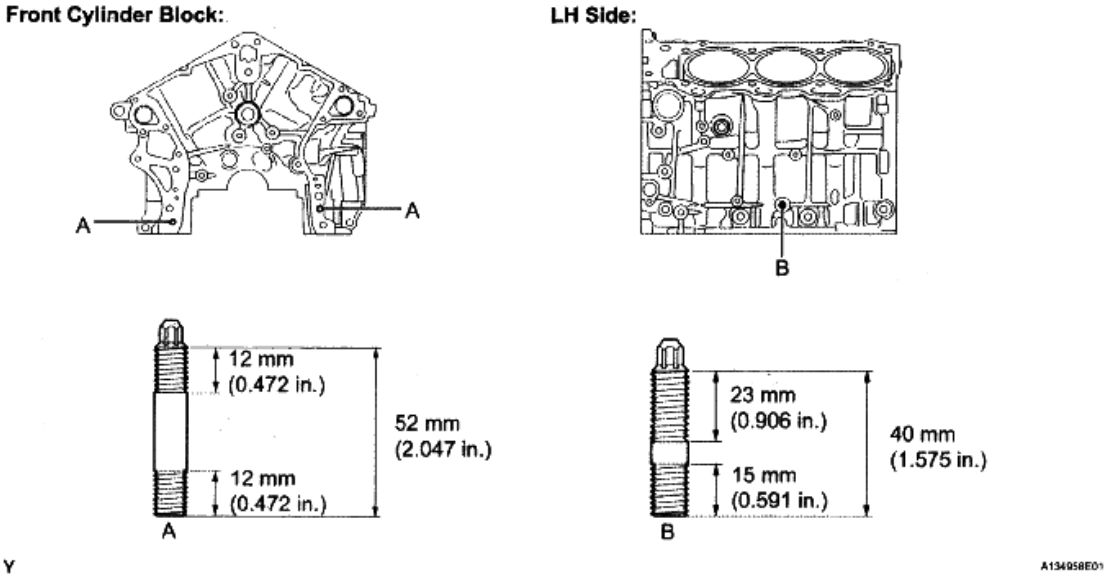

Fig. 366: Identifying Stud Bolt Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf) for bolt A

17 N*m (173 kgf*cm, 13 ft.*lbf) for bolt B

3. **INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY**
   a. Using a 5 mm hexagon wrench, install the No. 1 oil nozzle sub-assembly.

Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

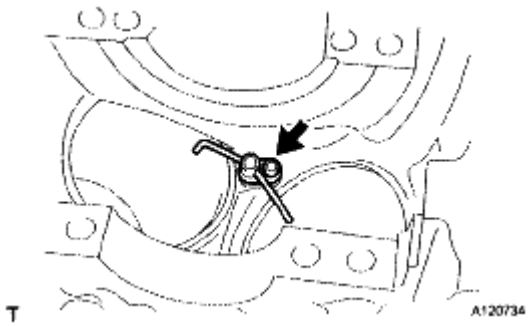

Fig. 367: Identifying Bolt And Oil Nozzle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **INSTALL PISTON SUB-ASSEMBLY WITH PIN**
   a. Using a screwdriver, install a new piston pin hole snap ring at one end of the piston pin hole.

HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.

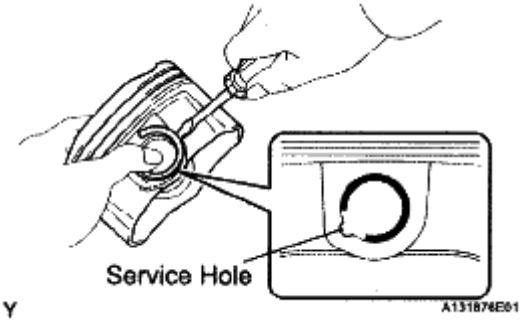

Fig. 368: Aligning Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Gradually heat the piston to approximately 80°C (176°F).
c. Coat the piston pin with engine oil.

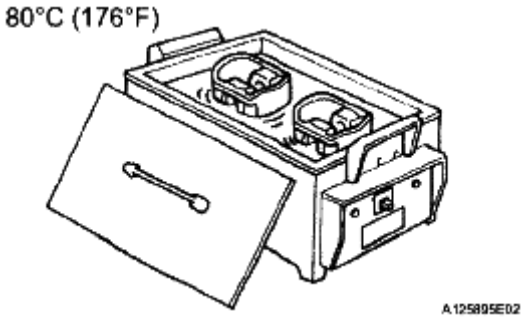

Fig. 369: Heating Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.

HINT:

The piston and pin are a matched set.

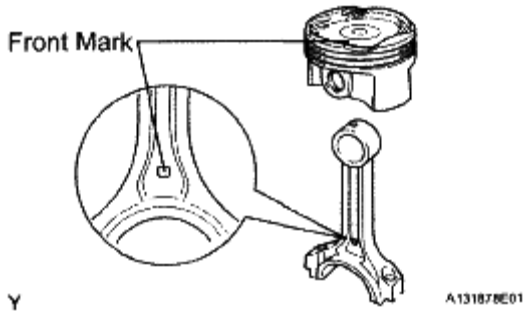

Fig. 370: Aligning Front Marks Of Piston And Connecting Rod
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.

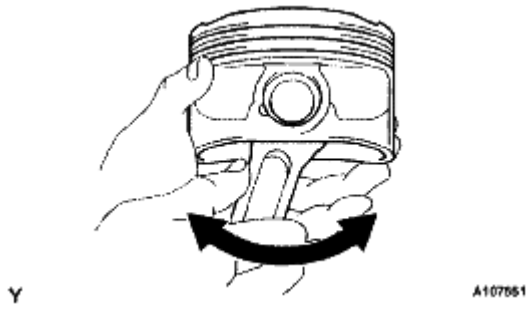

Fig. 371: Checking Fitting Condition Between Piston And Piston Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Using a screwdriver, install a new piston pin hole snap ring at the other end of the piston pin hole.

HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.

5. **INSTALL PISTON RING SET**
   a. Install the oil ring expander and 2 side rails by hand.

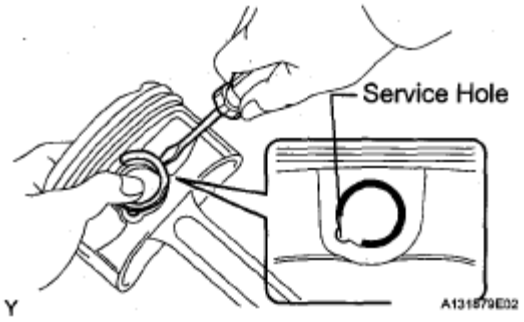

Fig. 372: Identifying Piston Pin Hole Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a piston ring expander, install the compression ring as shown in the illustration.

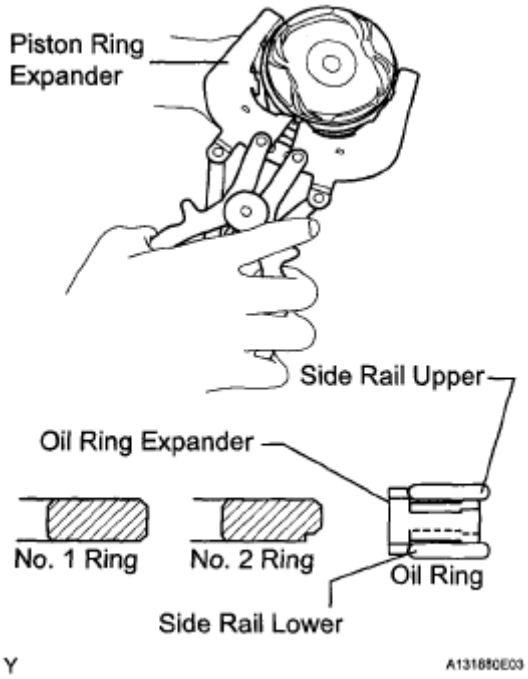

Fig. 373: Identifying Compression Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Position the piston rings so that the ring ends are as shown in the illustration.

NOTE: Do not align the ring ends.

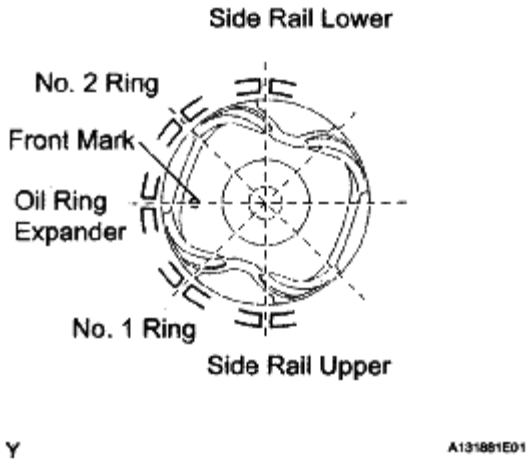

Fig. 374: Identifying Piston Rings Gap Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **INSTALL CRANKSHAFT BEARING**
   a. Clean the main journal and both surfaces of the bearing.

NOTE: **Main bearings come in widths between 18.0 mm (0.709 in.) and 21.0 mm (0.827 in.). Install the 21.0 mm (0.827 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing cap. Install the 18.0 mm (0.709 in.) bearings in the No. 2 and No. 3 positions.**

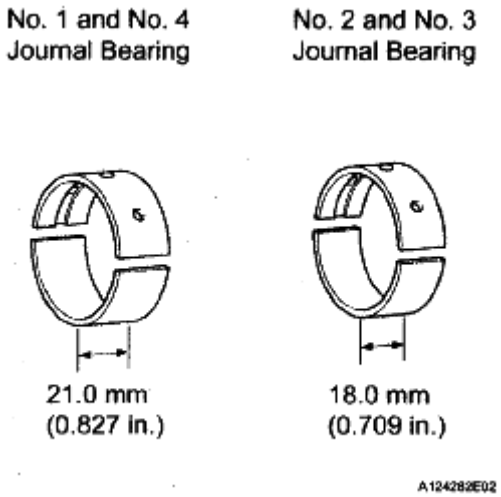

Fig. 375: Inspecting Journal Bearings Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the upper bearing.
      1. Install the upper crankshaft bearings to the cylinder block as shown in the illustration.

NOTE:

- **Do not apply engine oil to the bearings and the contact surfaces.**
- **Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be equal.**

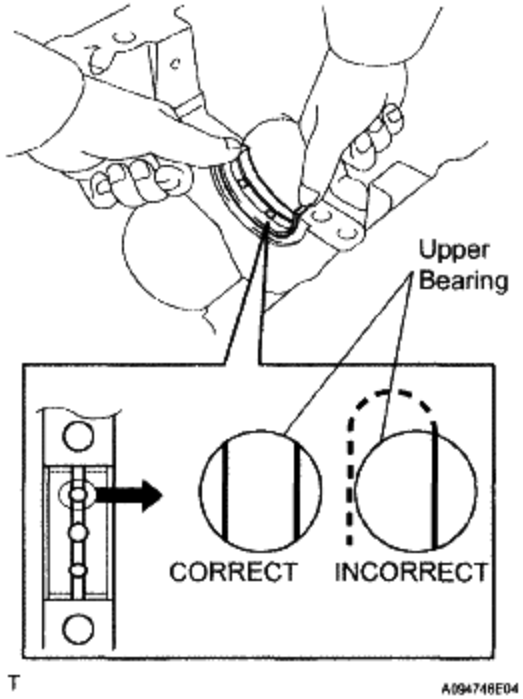

Fig. 376: Identifying Upper Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the lower crankshaft bearing.
   1. Install the lower crankshaft bearings to the crankshaft bearing caps.
   2. Using vernier calipers, measure the distance between the crankshaft bearing cap's edge and the lower crankshaft bearing's edge.

      Dimension (A - B): 0.7 mm (0.0276 in.) or less

      NOTE: Do not apply engine oil to the crankshaft bearings and the contact surfaces.

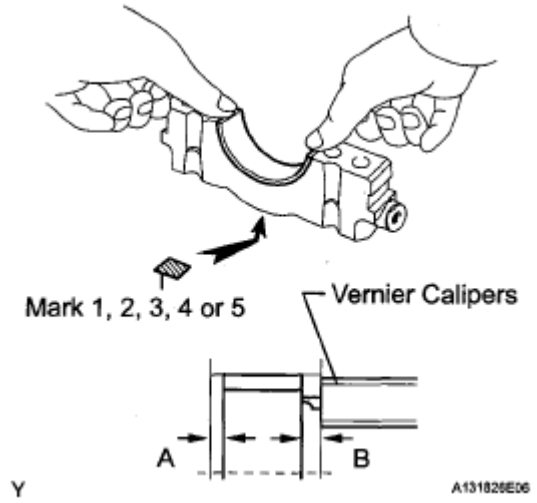

Fig. 377: Locating Lower Crankshaft Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **INSTALL CRANKSHAFT THRUST WASHER SET**
   a. Apply engine oil to the crankshaft thrust washer.
   b. Install the 2 upper crankshaft thrust washers under the No. 2 journal position of the cylinder block sub-assembly with the oil grooves facing outward.

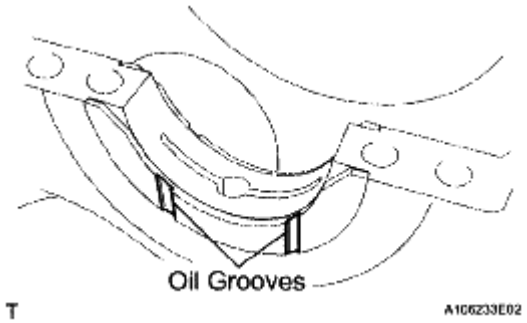

Fig. 378: Identifying Oil Grooves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **INSTALL CRANKSHAFT**
   a. Apply engine oil to the upper bearing, then place the crankshaft on the cylinder block.
   b. Confirm the projection and numbers of the main bearing caps and install the bearing caps on the cylinder block.

      HINT:

      A number is marked on each main bearing cap to indicate the installation position.

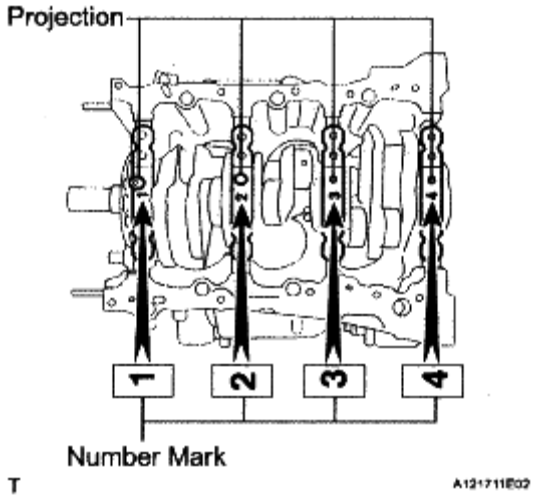

Fig. 379: Identifying Projection And Numbers Of Main Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Apply a light coat of engine oil to the threads and under the heads of the crankshaft bearing cap bolts.
d. Temporarily install the 8 crankshaft bearing cap bolts to the inside positions.
e. Insert the crankshaft bearing cap with your hand until the clearance between the crankshaft bearing cap and the cylinder block is less than 6 mm (0.23 in.) by marking the 2 internal crankshaft bearing cap bolts as a guide.

Bolt length: 100 to 102 mm (3.94 to 4.02 in.)

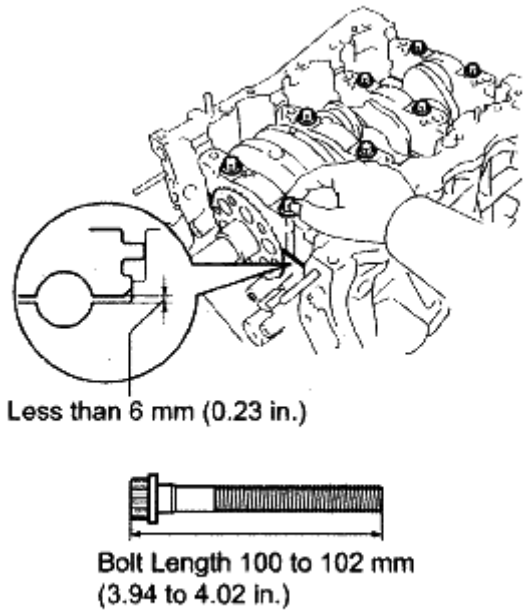

Fig. 380: Identifying Bolt Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Using a plastic hammer, lightly tap the crankshaft bearing cap to ensure a proper fit.
g. Apply a light coat of engine oil to the threads and under the heads of the 8 crankshaft bearing cap bolts.

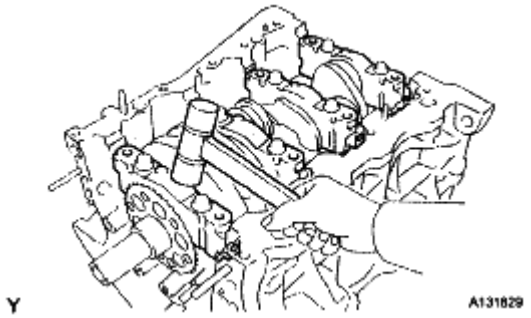

Fig. 381: Tapping Bearing Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Install the 8 crankshaft bearing cap bolts to the outside positions.
i. Install the crankshaft bearing cap bolts.

HINT:

The crankshaft bearing cap bolts are tightened in 2 progressive steps.

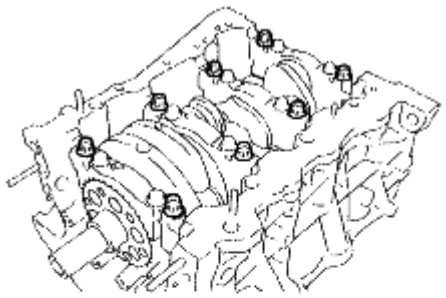

Fig. 382: Identifying Main Bearing Cap Bolt Length

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. Step 1
   1. Install and uniformly tighten the 16 crankshaft bearing cap bolts in the sequence shown in the illustration.

      Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)

      If any of the crankshaft bearing cap bolts does not meet the torque specified, replace it.

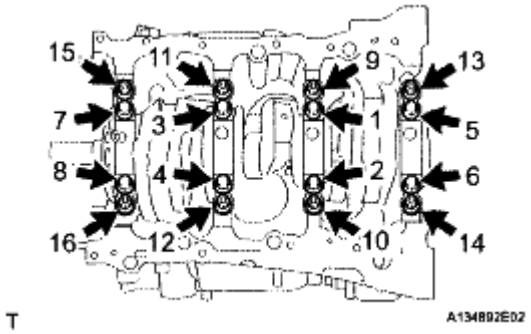

Fig. 383: Locating Main Bearing Cap Bolts Loosening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

k. Step 2
   1. Mark the front of the bearing cap bolts with paint.
   2. Retighten the bearing cap bolts 90° in the order above.
   3. Check that the painted mark is now at a 90° angle to the front.

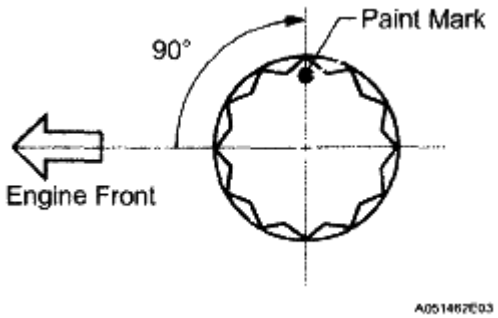

Fig. 384: Identifying Paint Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

l. Install 8 new seal washers and uniformly tighten the 8 crankshaft bearing cap bolts in several steps and in the sequence shown in the illustration.

   Torque: 52 N*m (525 kgf*cm, 38 ft.*lbf)

Bolt length

BOLT LENGTH

Item	Length
Bolt A	45 mm (1.77 in.)
Except bolt A	30 mm (1.18 in.)

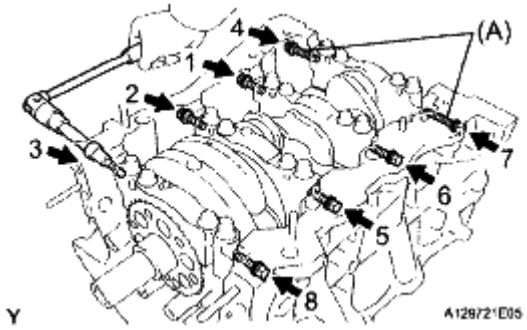

Fig. 385: Locating Connecting Rod Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

m. Check that the crankshaft turns smoothly.
n. Check the crankshaft thrust clearance (See **INSPECTION**).

9. **INSTALL CONNECTING ROD BEARING**
   a. Install the connecting rod bearing to the connecting rod and connecting rod cap.
   b. Using vernier calipers, measure the distance between the connecting rod's and bearing cap's edges and the connecting rod bearing's edge.

Dimension (A - B): 0.7 mm (0.0276 in.) or less

NOTE: Do not apply engine oil to the bearings and the contact surfaces.

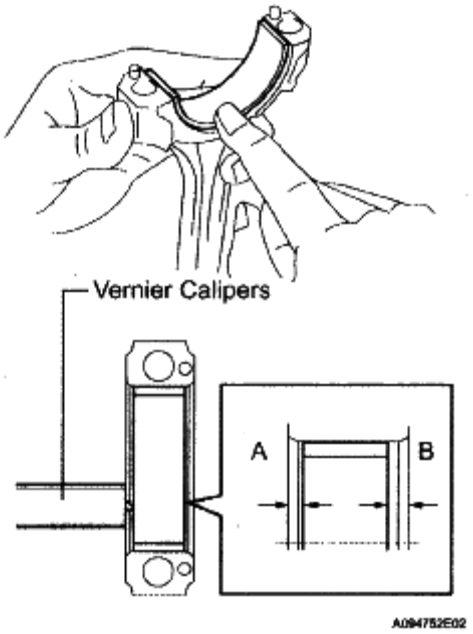

Fig. 386: Measuring Distance Between Connecting Rod And Bearing Cap Edges
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD**
    a. Apply engine oil to the cylinder walls, the pistons, and the surfaces of the connecting rod bearings.
    b. Position the piston rings so that the ring ends are as shown in the illustration.

NOTE: Do not align the ring ends.

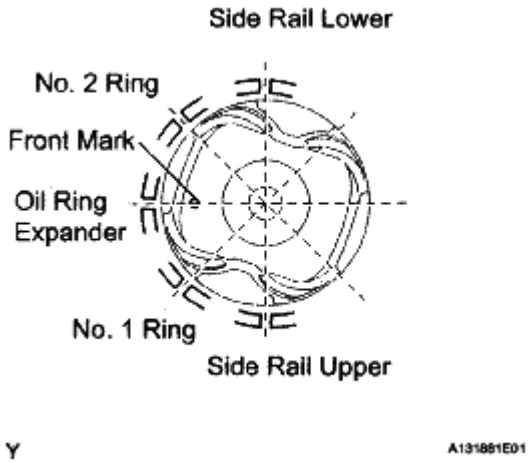

Fig. 387: Identifying Piston Rings Gap Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Using a piston ring compressor, push the correctly numbered piston and connecting rod assembly into the cylinder with the front mark of the piston facing forward.

NOTE: Match the numbered connecting rod cap with the connecting rod.

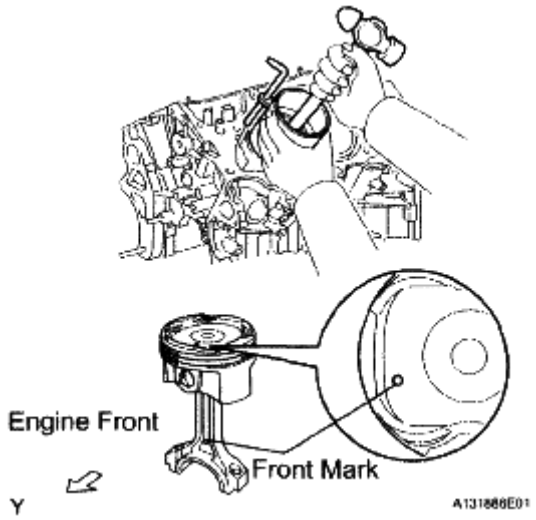

Fig. 388: Pushing Piston And Connecting Rod Assembly Into Cylinder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Check that the front mark of the connecting rod cap is facing forward.
e. Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.
f. Install the connecting cap bolts.

HINT:

The connecting cap bolts are tightened in 2 progressive steps.

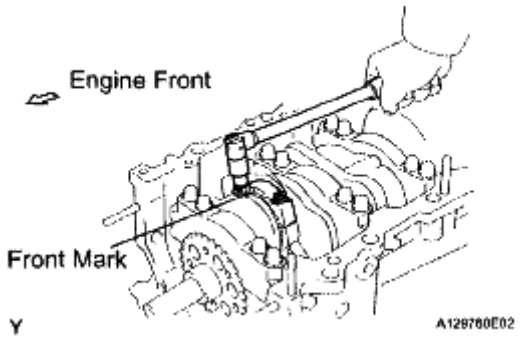

Fig. 389: Locating Connecting Rod Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Step 1
   1. Install and alternately tighten the bolts of the connecting rod cap in several steps.

      Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

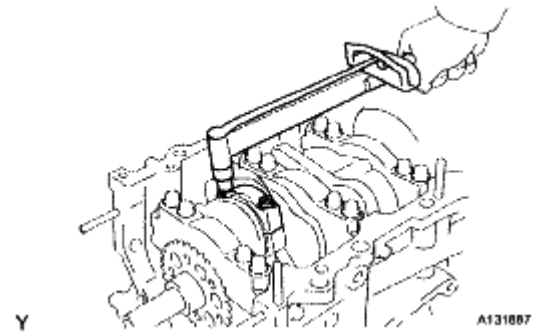

Fig. 390: Tightening Connecting Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Step 2
   1. Mark the front side of each connecting cap bolt with paint.
   2. Retighten the cap bolts 90° as shown in the illustration.
   3. Check the painted mark is now at a 90° angle to the front.

i. Check that the crankshaft turns smoothly.

j. Check the connecting rod thrust clearance (See **INSPECTION**).

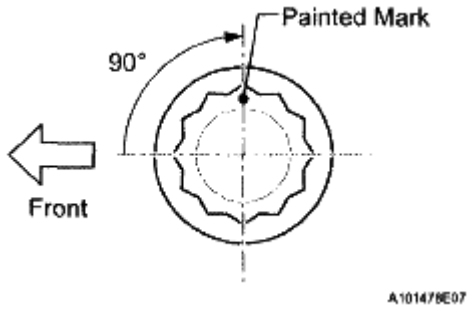

Fig. 391: Identifying Retightening Angle Of Connecting Rod Cap Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **INSTALL INTAKE VALVE GUIDE BUSH**

a. Using a caliper gauge, measure the intake valve guide bush bore diameter of the cylinder head.

Cylinder bore diameter: 10.285 to 10.306 mm (0.4049 to 0.4057 in.)

Select a new guide bush (STD or O/S 0.05)

BUSH BORE DIAMETER

Bush size	Bush bore diameter
STD	10.285 to 10.306 mm (0.4049 to 0.4057 in.)
O/S 0.05	10.335 to 10.356 mm (0.4069 to 0.4077 in.)

Fig. 392: Checking Bush Bore Diameter Of Cylinder Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the bush bore diameter of the cylinder head is greater than 10.306 mm (0.4057 in.), machine the bush bore to the dimension of 10.335 to 10.356 mm (0.4069 to 0.4077 in.) to install an O/S 0.05 valve guide bush.

If the bush bore diameter of the cylinder head is greater than 10.356 mm (0.4077 in.), replace the cylinder head.

b. Heat the cylinder head to 80 to 100°C (176 to 212°F).
c. Place the cylinder head on wooden blocks.
d. Using SST, tap in new intake valve guide bushes to the specified protrusion height.

SST 09201 -10000 (09201 -01050), 09950-70010 (09951-07100)

Protrusion height: 9.30 to 9.70 mm (0.3661 to 0.3819 in.)

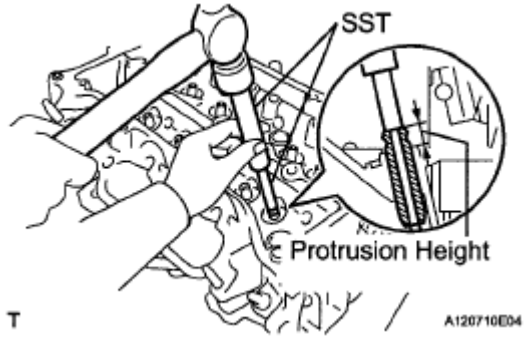

Fig. 393: Tapping In Intake Valve Guide Bushes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using a sharp 5.5 mm reamer, ream the valve guide bushings to obtain the Specified clearance.

Standard oil clearance: 0.025 to 0.060 mm (0.0010 to 0.0023 in.)

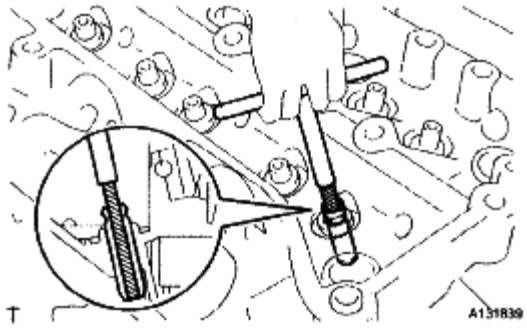

Fig. 394: Reaming Valve Guide Bush
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **INSTALL EXHAUST VALVE GUIDE BUSH**
    a. Using a caliper gauge, measure the exhaust valve guide bush bore diameter of the cylinder head.

    Cylinder bore diameter: 10.285 to 10.306 mm (0.4049 to 0.4057 in.)

    Select a new guide bush (STD or O/S 0.05)

    BUSH BORE DIAMETER

Bush size	Bush bore diameter
STD	10.285 to 10.306 mm (0.4049 to 0.4057 in.)
O/S 0.05	10.335 to 10.356 mm (0.4069 to 0.4077 in.)

Fig. 395: Checking Bush Bore Diameter Of Cylinder Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the bush bore diameter of the cylinder head is greater than 10.306 mm (0.4057 in.), machine the bush bore to the dimension of 10.335 to 10.356 mm (0.4069 to 0.4077 in.) to install an O/S 0.05 valve guide bush.

If the bush bore diameter of the cylinder head is greater than 10.356 mm (0.4077 in.), replace the cylinder head.

    b. Heat the cylinder head to 80 to 100°C (176 to 212°F).

c. Place the cylinder head on wooden blocks.

d. Using SST, tap in new exhaust valve guide bushes to the specified protrusion height.

SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

Protrusion height: 9.30 to 9.70 mm (0.3661 to 0.3819 in.)

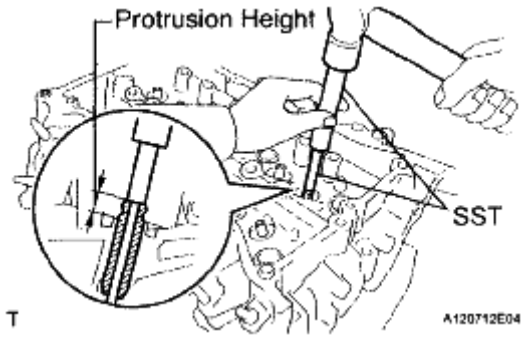

Fig. 396: Tapping Valve Guide Bushes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using a sharp 5.5 mm reamer, ream the valve guide bushings to obtain the specified clearance.

Standard oil clearance: 0.030 to 0.065 mm (0.0012 to 0.0026 in.)

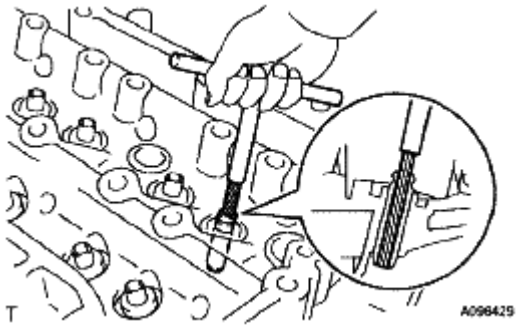

Fig. 397: Reaming Valve Guide Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **INSTALL RING PIN**

a. Using a plastic hammer, tap in new ring pins to the specified protrusion height.

Specified protrusion height: 2.5 to 3.5 mm (0.098 to 0.138 in.)

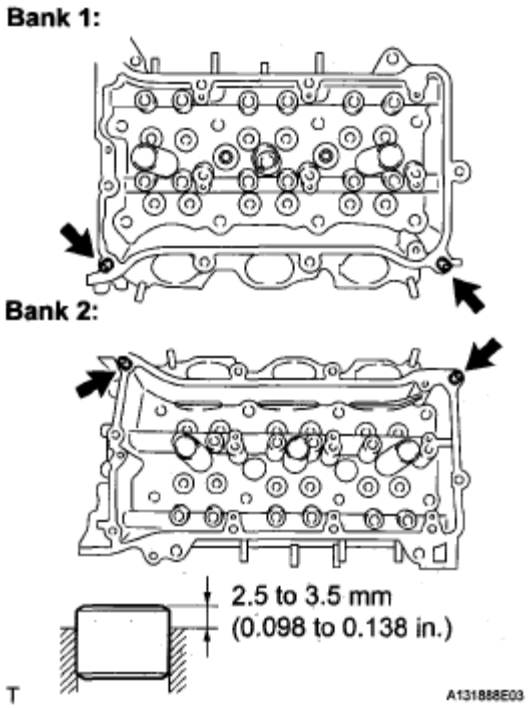

Fig. 398: Identifying Protrusion Height
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **INSTALL NO. 1 STRAIGHT SCREW PLUG**
    a. Using a 10 mm hexagon wrench, install 4 new gaskets and the 4 No. 1 straight screw plugs.

       Torque: 44 N*m (449 kgf*cm, 32 ft.*lbf)

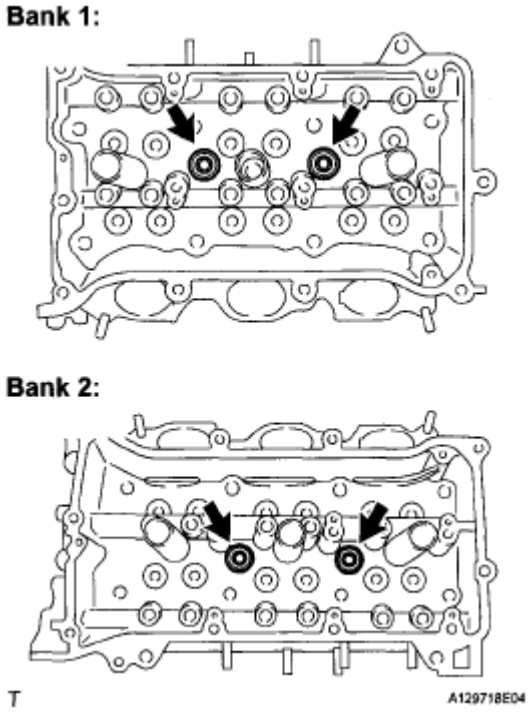

Fig. 399: Locating No. 1 Straight Screw Plugs And Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **INSTALL NO. 2 STRAIGHT SCREW PLUG**
    a. Using a 14 mm hexagon wrench, install 2 new gaskets and the 2 No. 2 straight screw plugs.

       Torque: 80 N*m (816 kgf*cm, 59 ft.*lbf)

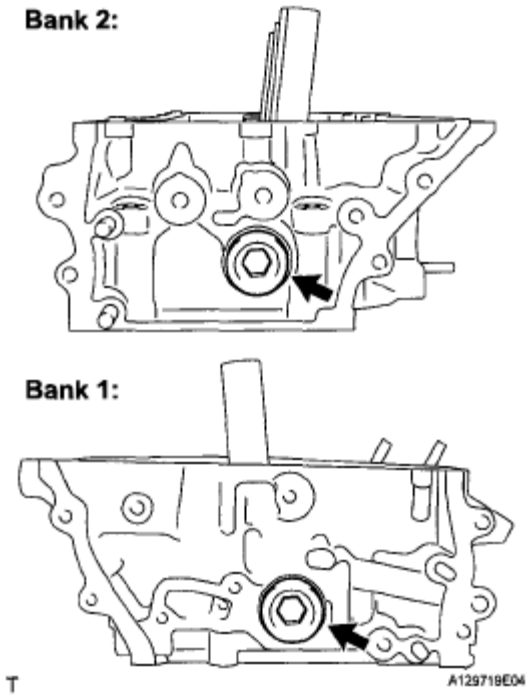

Fig. 400: Locating No. 2 Straight Screw Plugs And Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **INSTALL STUD BOLT**

NOTE: If the stud bolt is deformed or the threads are damaged, replace it.

a. Using E6 and E8 "TORX" sockets, install the stud bolts.

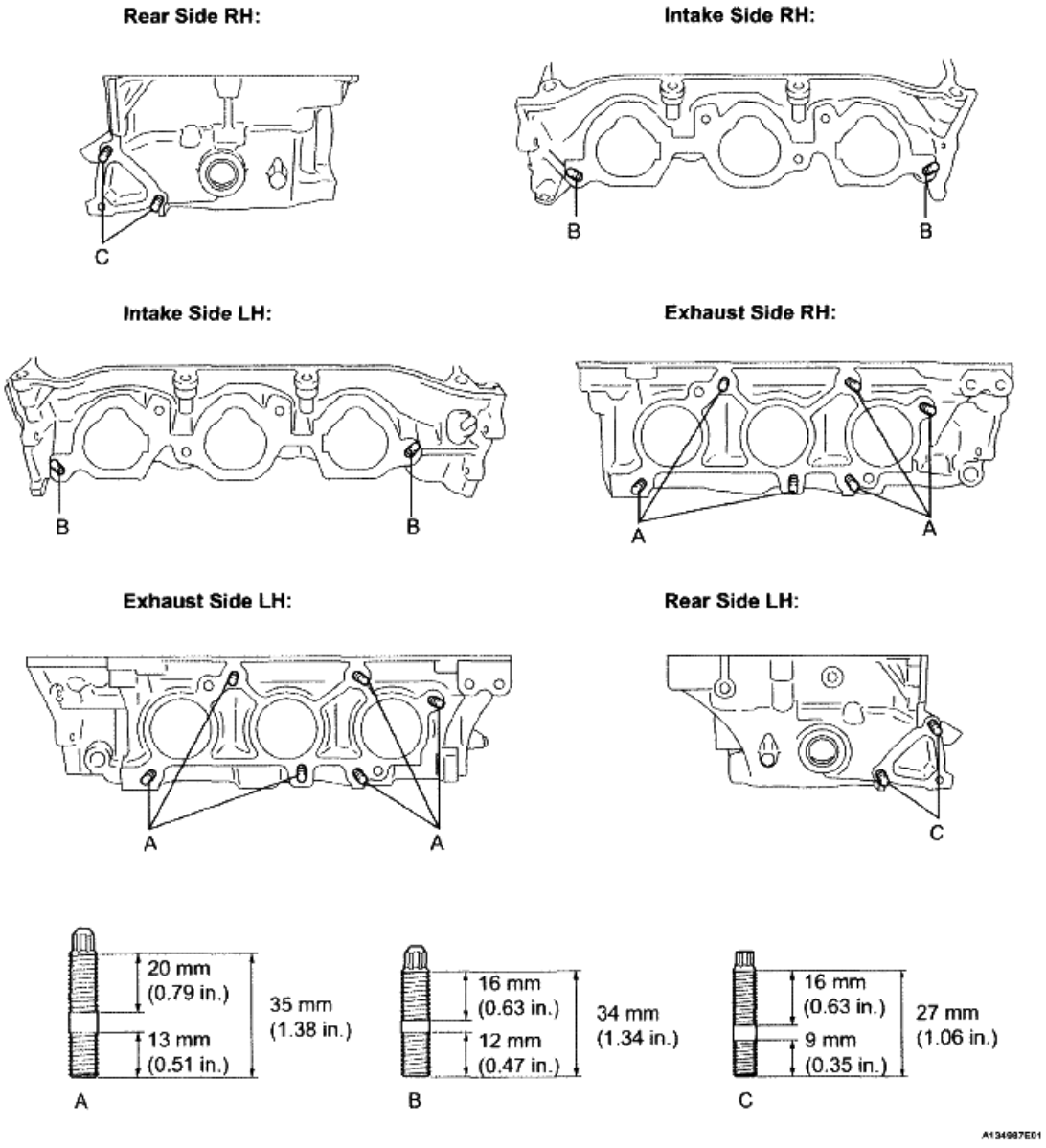

Fig. 401: Identifying Stud Bolts Installation Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf) for bolts A and B

4.0 N*m (41 kgf*cm, 35 in.*lbf) for bolt C

17. **INSTALL STRAIGHT PIN**
    a. Using a plastic hammer, tap in new straight pins as shown in the illustration.

Fig. 402: Identifying Straight Pin Installation Procedure
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Protrusion height: 17.5 to 19.5 mm (0.689 to 0.768 in.)

18. **INSTALL VALVE SPRING SEAT**
    a. Install the valve spring seats to the cylinder head.
19. **INSTALL VALVE STEM OIL SEAL**
    a. Apply a light coat of engine oil to new valve stem oil seals.

NOTE: Pay attention when installing the intake and exhaust valve stem oil seals. For example, installing the intake valve stem oil seal into the exhaust side or installing the exhaust valve stem oil seal to the intake side can cause installation problems later.

HINT:

The intake valve oil seals are gray and the exhaust valve oil seals are black.

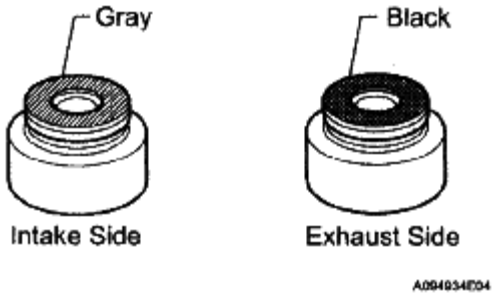

Fig. 403: Identifying Intake And Exhaust Valve Oil Seals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST, push in the oil seals.

SST 09201-41020

NOTE: Failure to use SST will cause the seal to be damaged or improperly seated.

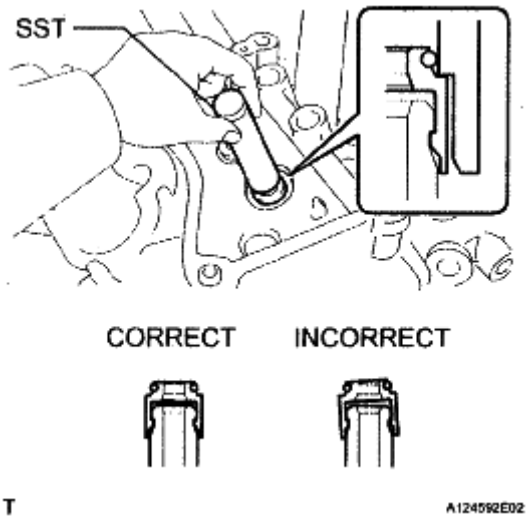

Fig. 404: Pushing In Oil Seals Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **INSTALL EXHAUST VALVE**
    a. Apply a sufficient coat of engine oil to the tip area of the exhaust valve shown in the illustration.
    b. Install the exhaust valve, inner compression spring and valve spring retainer to the cylinder head.

NOTE: Install the same parts in the same combination to the original locations.

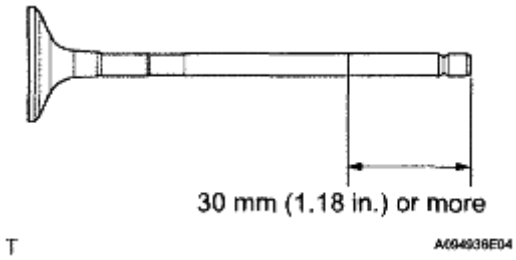

Fig. 405: Identifying Intake Valve Tip Area Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Using SST, compress the inner compression spring and install the 2 valve spring retainer locks.

SST 09202-70020 (09202-00010)

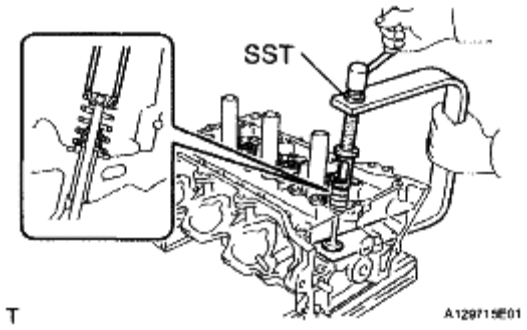

Fig. 406: Using SST To Compress Inner Compression Spring To Install Exhaust Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a plastic hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTE: Be careful not to damage the retainer.

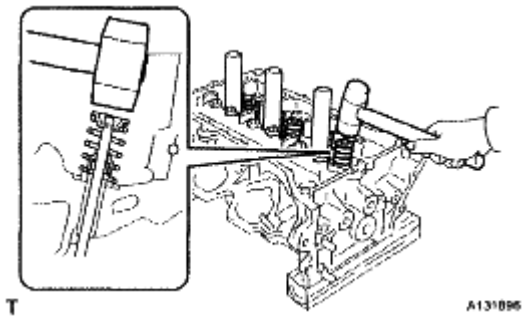

Fig. 407: Tapping Valve Stem Tip To Ensure Proper Fit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

21. **INSTALL INTAKE VALVE**
    a. Apply a sufficient coat of engine oil to the tip area of the intake valve shown in the illustration.
    b. Install the intake valve, inner compression spring and valve spring retainer to the cylinder head.

NOTE: Install the same parts in the same combination to the original locations.

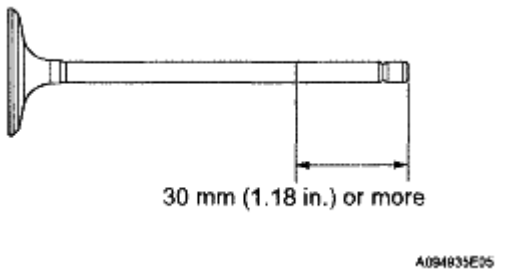

Fig. 408: Identifying Intake Valve Tip Area Length

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST, compress the inner compression spring and install the 2 valve spring retainer locks.

SST 09202-70020 (09202-00010)

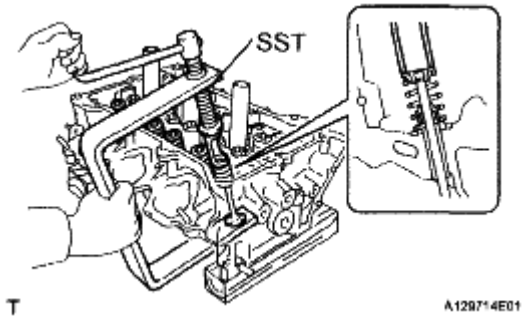

Fig. 409: Using SST To Compress Inner Compression Spring To Install Intake Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a plastic hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTE: Be careful not to damage the retainer.

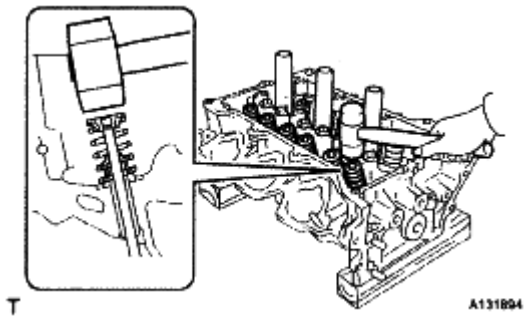

Fig. 410: Tapping Valve Stem Tip To Ensure Proper Fit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **INSTALL VALVE STEM CAP**
    a. Apply a light coat of engine oil to the valve stem caps.
    b. Install the valve stem caps on the valves.
23. **INSTALL ENGINE REAR OIL SEAL**
    a. Place the oil seal retainer on wooden blocks.
    b. Using SST, tap in a new engine rear oil seal until its surface is flush with the engine rear oil seal retainer edge.

SST 09223-15030, 09950-70010 (09951 -07100)

NOTE:

- **Keep the lip free of foreign matter.**
- **Do not tap on the oil seal at an angle.**

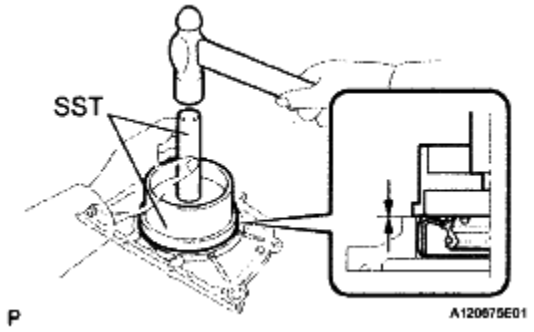

Fig. 411: Identifying Engine Rear Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **INSTALL ENGINE REAR OIL SEAL RETAINER**

a. Apply seal packing in a continuous line as shown in the illustration.

Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Seal Diameter: 2.0 to 3.0 mm (0.079 to 0.118 in.)

NOTE:

- **Remove any oil from the contact surface.**
- **Install the oil seal retainer within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installation.**

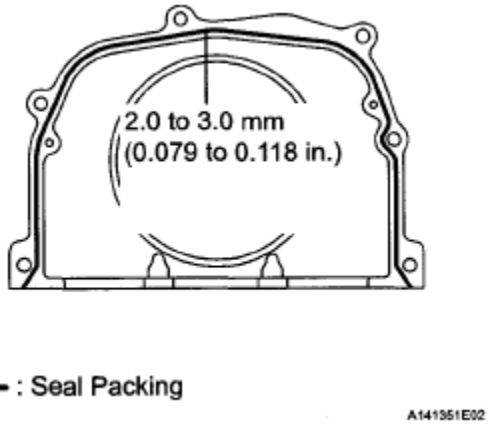

Fig. 412: Identifying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the engine rear oil seal retainer with the 6 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTE: Be sure to apply adhesive 1324 to the bolts in the places indicated by A before installing them.

Adhesive: Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

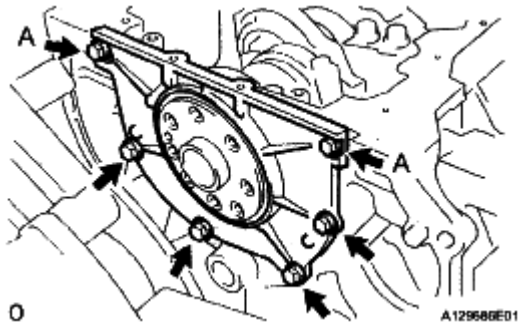

Fig. 413: Locating Oil Seal Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

25. **INSTALL WATER INLET PIPE**
    a. Install the water inlet pipe with the 2 bolts.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

    b. Install the No. 1 water by-pass hose.

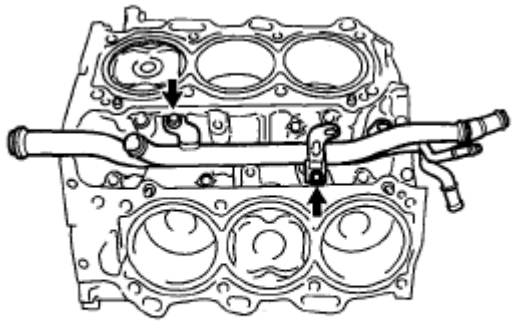

Fig. 414: Locating Bolts And Water Inlet Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

26. **INSTALL CYLINDER HEAD SUB-ASSEMBLY RH**
    a. Place the cylinder head gasket on the cylinder block surface with the Lot No. stamp upward.

    NOTE:

- **Be careful of the installation direction.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.**

b. Place the cylinder head on the cylinder block.

NOTE: Be careful not to allow oil to adhere to the bottom part of the cylinder head.

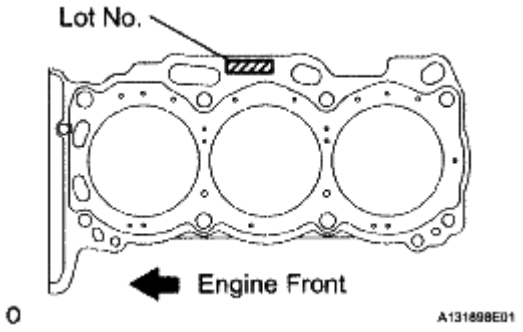

Fig. 415: Identifying Cylinder Head Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.
d. Step 1
   1. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 8 cylinder head bolts with the plate washers in several steps and in the sequence shown in the illustration.

      Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)

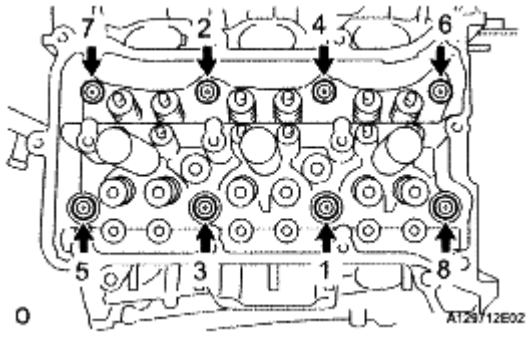

Fig. 416: Locating Cylinder Head Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Step 2
   1. Mark the cylinder head bolt head with paint as shown in the illustration.
   2. Tighten the cylinder head bolts another 90°.

f. Step 3
   1. Tighten the cylinder head bolts an additional 90°.
   2. Check that the painted mark is now facing rearward.

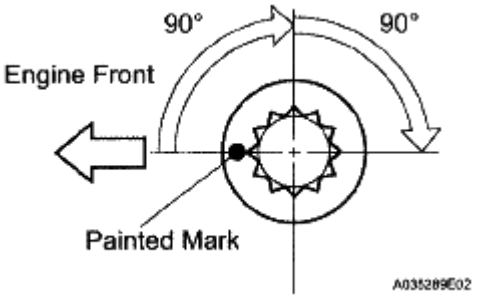

Fig. 417: Identifying Painted Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

27. **INSTALL CYLINDER HEAD SUB-ASSEMBLY LH**

a. Place the cylinder head gasket on the cylinder block surface with the Lot No. stamp upward.

NOTE:
- **Be careful of the installation direction.**
- **Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.**

b. Place the cylinder head on the cylinder block.

NOTE: Be careful not to allow oil to adhere to the bottom part of the cylinder head.

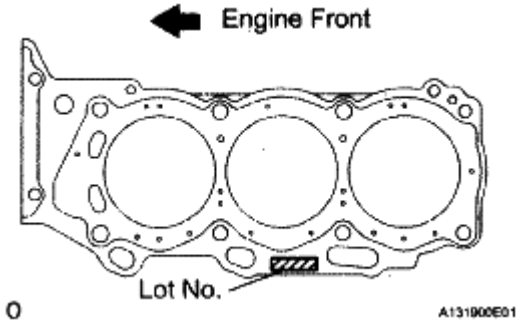

Fig. 418: Identifying Cylinder Head Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

c. Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.
d. Step 1
    1. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 8 cylinder head bolts with the plate washers in several steps in the sequence shown in the illustration.

    Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)

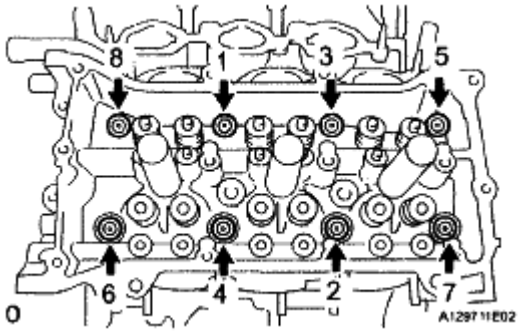

Fig. 419: Locating Cylinder Head Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Step 2
    1. Mark the cylinder head bolt head with paint as shown in the illustration.
    2. Tighten the cylinder head bolts another 90°.
f. Step 3
    1. Tighten the cylinder head bolts an additional 90°.
    2. Check that the painted mark is now facing rearward.

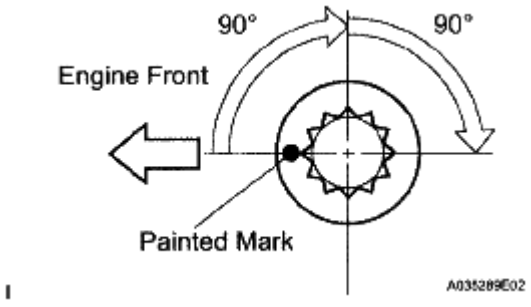

Fig. 420: Identifying Painted Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Tighten the 2 bolts in the order shown in the illustration.

Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

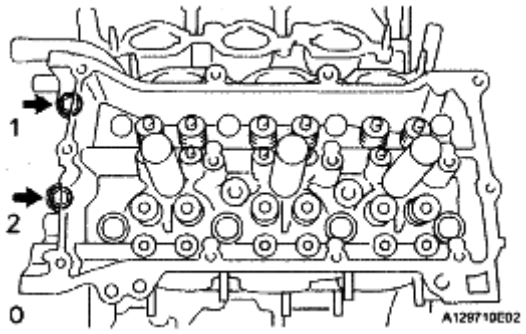

Fig. 421: Identifying Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

28. **INSTALL VALVE LASH ADJUSTER ASSEMBLY**

NOTE:

- **Keep the lash adjuster free of dirt arid foreign objects.**
- **Only use clean engine oil.**

a. Place the lash adjuster into a container filled with engine oil.
b. Insert SST's tip into the lash adjuster's plunger and use the tip to press down on the check ball inside the plunger.

SST 09276-75010

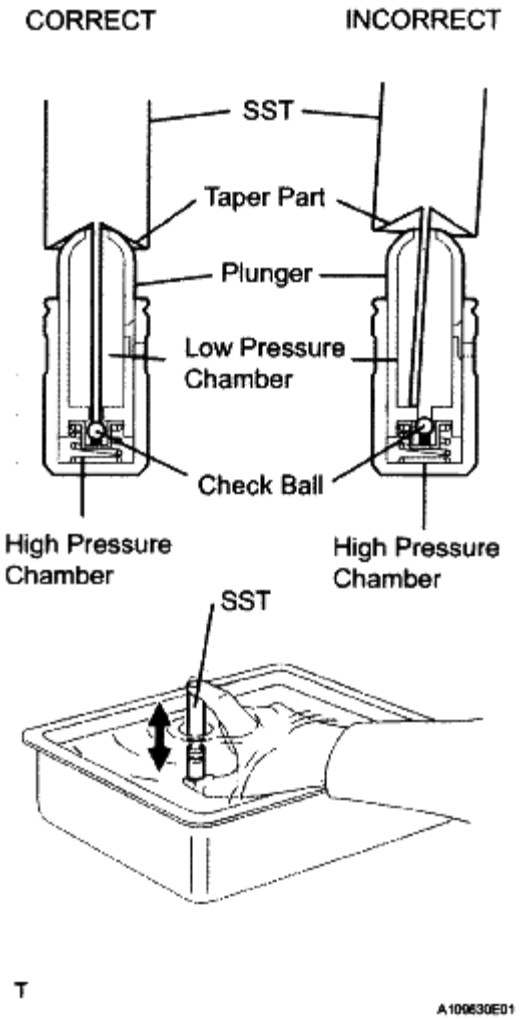

Fig. 422: Pressing Check Ball Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Squeeze SST and lash adjuster together to move the plunger up and down 5 to 6 times.
d. Check the movement of the plunger and bleed the air.

OK: Plunger moves up and down.

NOTE: When bleeding air from the high-pressure chamber, make sure that the tip of SST is actually pressing the check ball as shown in the illustration. If the check ball is not pressed, air will not bleed.

e. After bleeding the air, remove SST. Then, try to press the plunger quickly and firmly with a finger.

OK: Plunger is very difficult to move.

If the result is not as specified, replace the lash adjuster.

f. Install the lash adjusters.

NOTE: Install the lash adjuster to the same place where it was removed from.

29. **INSTALL NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY**
    a. Apply engine oil to the lash adjuster tip and valve stem cap end.
    b. Make sure that the 24 No. 1 valve rocker arms are installed as shown in the illustration.

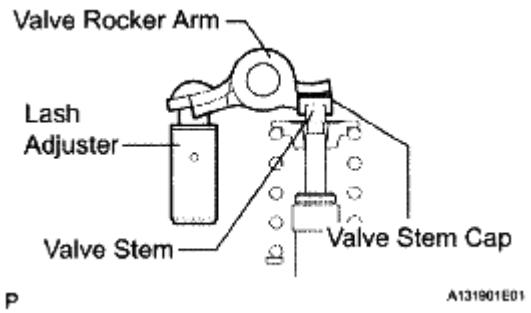

Fig. 423: Identifying Valve Rocker Arm Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

30. **INSTALL CAMSHAFT BEARING CAP (for Bank 1)**
    a. Apply engine oil to the camshaft journals, camshaft housing sub-assembly RH and camshaft bearing caps.
    b. Install the camshaft and No. 2 camshaft to the camshaft housing sub-assembly RH.
    c. Make sure of the marks and numbers on the camshaft bearing caps and place them in each proper position and direction.

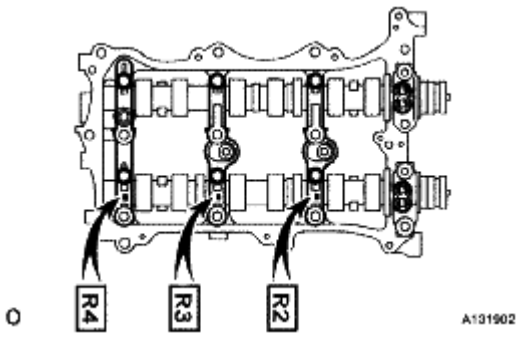

Fig. 424: Identifying Marks And Numbers On Camshaft Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    d. Temporarily tighten the 8 bolts in the order shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

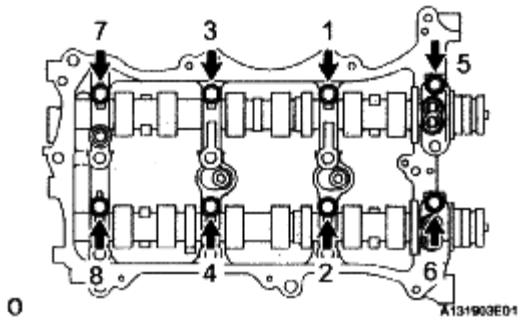

Fig. 425: Identifying Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

31. **INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH**
    a. Make sure that the valve rocker arm is installed as shown in the illustration.

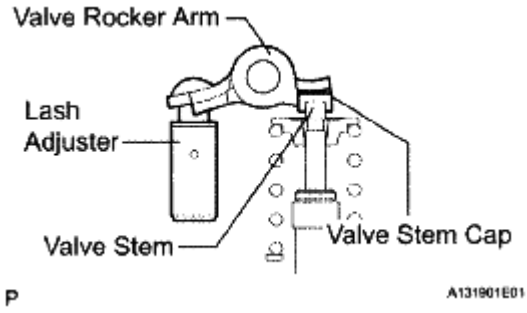

Fig. 426: Identifying Valve Rocker Arm Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Apply seal packing in a continuous line as shown in the illustration.

Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Seal diameter: 3.5 to 4.5 mm (0.138 to 0.177 in.)

NOTE:

- **Remove any oil from the contact surface.**
- **Install the camshaft housing sub-assembly RH within 3 minutes.**
- **Do not start the engine for at least 2 hours after installing.**

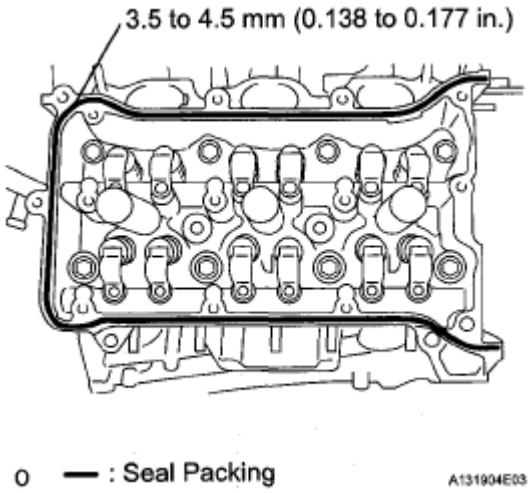

Fig. 427: Identifying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the camshaft housing sub-assembly RH and tighten the 12 bolts in the order shown in the illustration.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

NOTE:

- **When installing the camshaft housing RH, it is necessary to correctly position the camshafts as shown in the illustration. Failure to correctly position these parts may result in damage due to contact between the pistons and valves. If a camshaft is rotated with a piston at TDC, valve contact will occur.**
- **If any of the bolts are loosened during installation, remove the camshaft housing, clean the installation surfaces, and reapply seal packing.**
- **If the camshaft housing is removed because any of the bolts are loosened during installation, make sure that the previously applied seal packing does not enter any oil passages.**

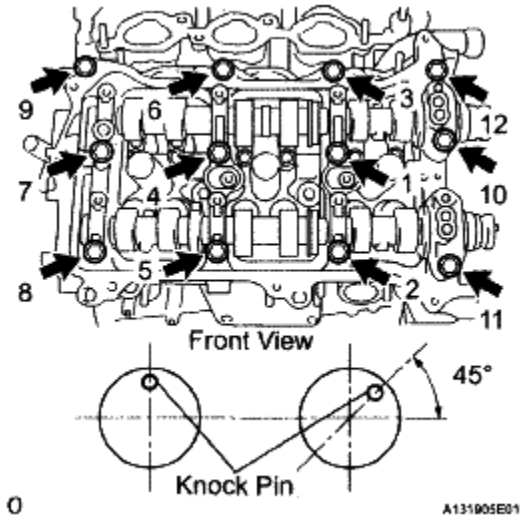

Fig. 428: Identifying Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Tighten the 8 bolts in the order shown in the illustration.

Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

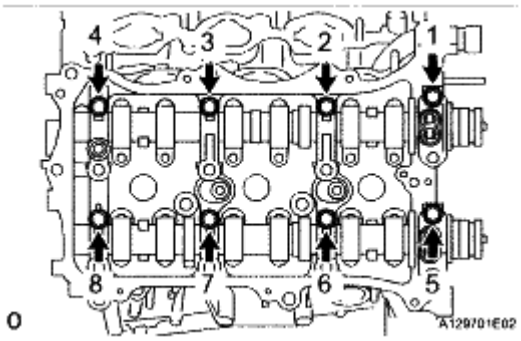

Fig. 429: Identifying Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

32. **INSTALL CAMSHAFT BEARING CAP (for Bank 2)**
    a. Apply engine oil to the camshaft journals, camshaft housing sub-assembly LH and camshaft bearing caps.
    b. Install the No. 3 camshaft and No. 4 camshaft to the camshaft housing LH.
    c. Make sure of the marks and numbers on the camshaft bearing caps and place them in each proper position and direction.

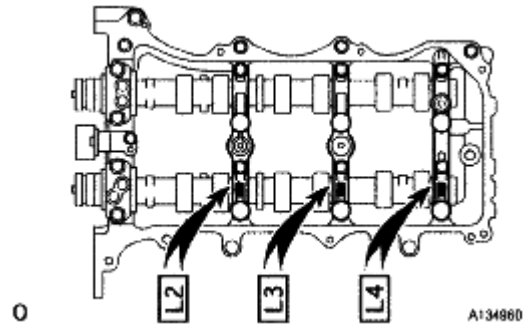

Fig. 430: Identifying Marks And Numbers On Camshaft Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Temporarily tighten the 8 bolts in the order shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

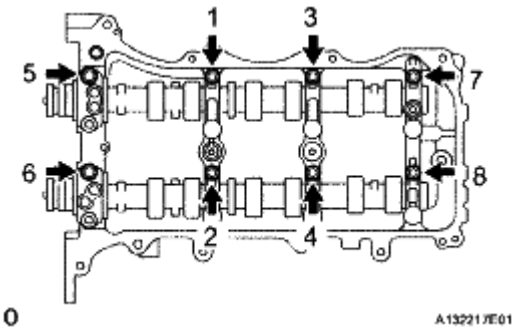

Fig. 431: Identifying Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

33. **INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH**

a. Make sure that the valve rocker arm is installed as shown in the illustration.

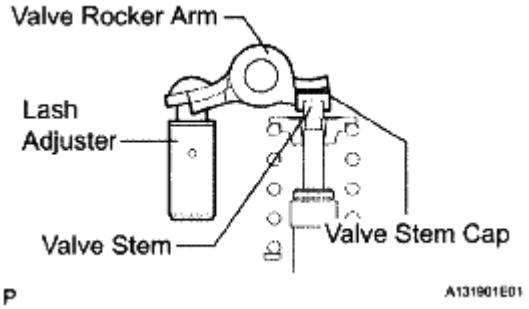

Fig. 432: Identifying Valve Rocker Arm Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Apply seal packing in a continuous line as shown in the illustration.

Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Seal diameter: 3.5 to 4.5 mm (0.138 to 0.177 in.)

NOTE:

- **Remove any oil from the contact surface.**
- **Install the camshaft housing sub-assembly LH within 3 minutes.**
- **Do not start the engine for at least 2 hours after installing.**

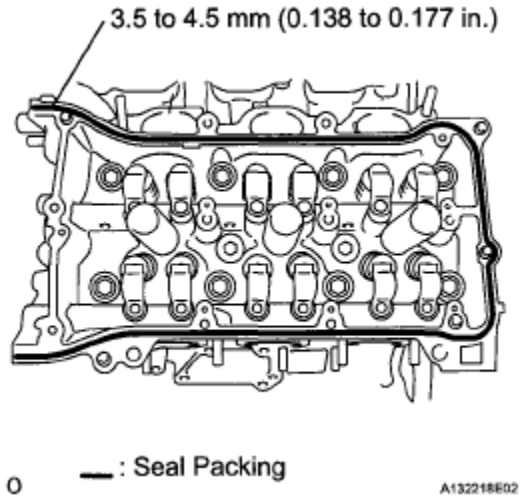

Fig. 433: Identifying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the camshaft housing sub-assembly LH and tighten the 13 bolts in the order shown in the illustration.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

NOTE:

- **When installing the camshaft housing LH, it is necessary to correctly position the camshafts as shown in the illustration. Failure to correctly position these parts may result in damage due to contact between the pistons and valves. If a camshaft is rotated with a piston at TDC, valve contact will occur.**
- **If any of the bolts are loosened during installation, remove the camshaft housing, clean the installation surfaces, and reapply seal packing.**
- **If the camshaft housing is removed because any of the bolts are loosened during installation, make sure that the previously applied seal packing does not enter any oil passages.**

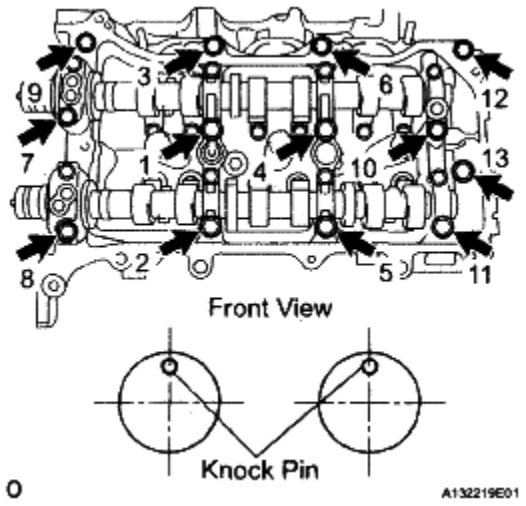

Fig. 434: Identifying Bolts Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Tighten the 8 bolts in the order shown in the illustration.

Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

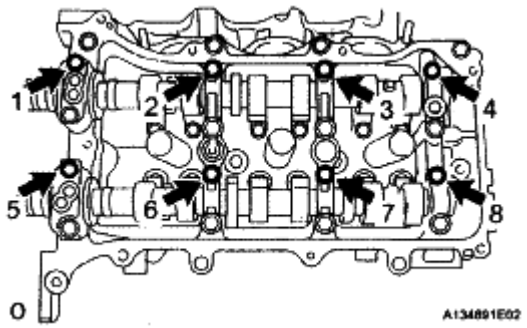

Fig. 435: Locating Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

34. **INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY**

a. Install the No. 2 chain tensioner assembly with the bolt.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

b. While pushing in the tensioner, insert a pin of ø 1.0 mm (0.039 in.) into the hole to fix it.

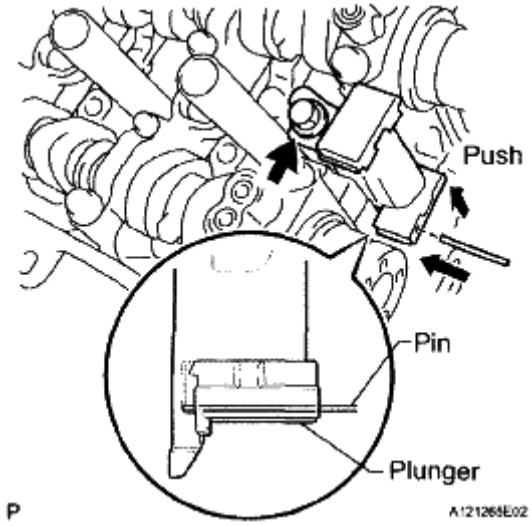

Fig. 436: Installing No 2 Chain Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

35. **INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)**
    a. Align the mark plate (yellow) with the timing marks (1-dot mark) of the camshaft timing gears as shown in the illustration.
    b. Apply a light coat of engine oil to the bolt threads and bolt-seating surface.
    c. Align the knock pin of the camshaft with the pin hole of the camshaft timing gear. Install the camshaft timing gear and camshaft timing exhaust gear RH with the No. 2 chain sub-assembly installed.

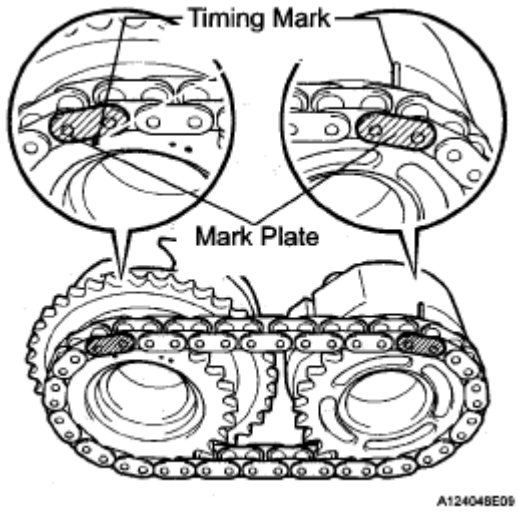

Fig. 437: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    d. Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts and camshaft timing gear assemblies.

Torque: 100 N*m (1020 kgf*cm, 74 ft.*lbf)

e. Remove the pin from the No. 2 chain tensioner assembly.

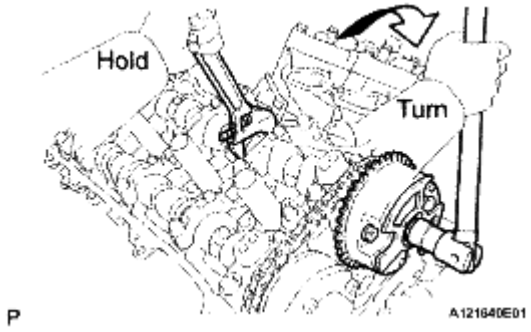

Fig. 438: Tightening Camshaft Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

36. **INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY**
    a. Install the No. 3 chain tensioner assembly with the bolt.

    Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

    b. While pushing in the tensioner, insert a pin of ø 1.0 mm (0.039 in.) into the hole to hold it.

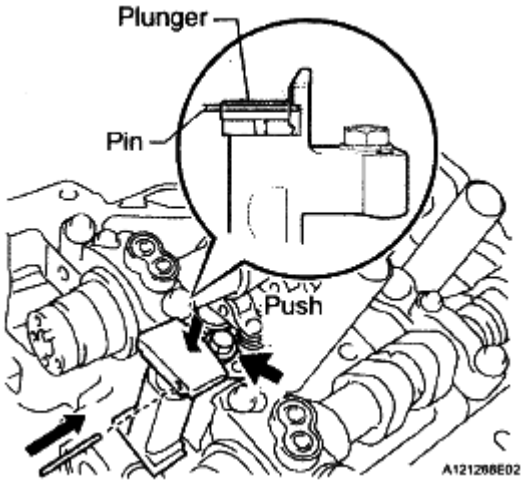

Fig. 439: Identifying No.3 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

37. **INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)**
    a. Align the mark plate (yellow) with the timing marks (2-dot mark) of the camshaft timing gears as shown in the illustration.
    b. Apply a light coat of engine oil to the bolt threads and bolt-seating surface.
    c. Align the knock pin of the camshaft with the pin hole of the camshaft timing gear. Install the

camshaft timing gear and camshaft timing exhaust gear LH with the No. 2 chain sub-assembly installed.

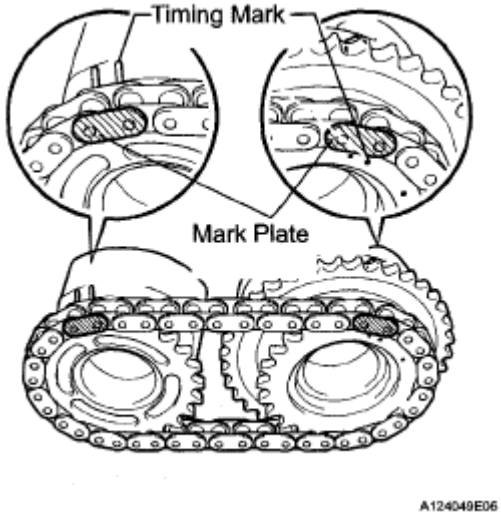

Fig. 440: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.

Torque: 100 N*m (1020 kgf*cm, 74 ft.*lbf)

e. Remove the pin from the No. 3 chain tensioner assembly.

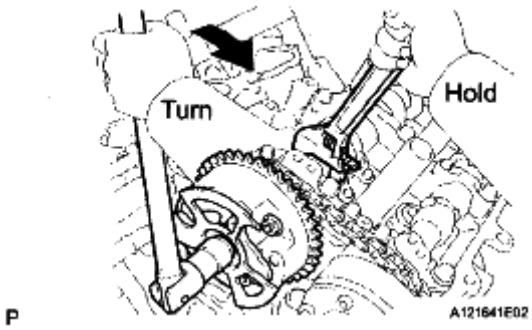

Fig. 441: Holding Hexagonal Portion Of Camshaft Using Wrench
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

38. **INSTALL NO. 1 CHAIN VIBRATION DAMPER**
    a. Install the No. 1 chain vibration damper with the 2 bolts.

Torque: 23 N*m (230 kgf*cm, 17 ft.*lbf)

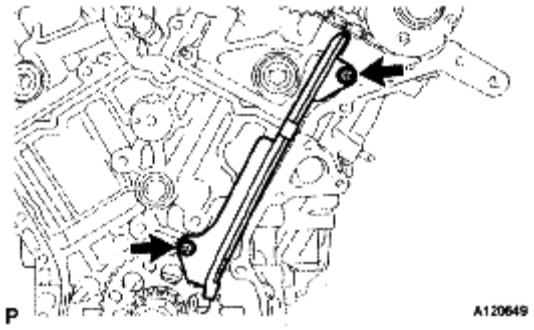

Fig. 442: Identifying No.1 Chain Vibration Damper Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

39. **INSTALL NO. 2 CHAIN VIBRATION DAMPER**
    a. Install the 2 No. 2 chain vibration dampers.
40. **INSTALL CRANKSHAFT TIMING SPROCKET**
    a. Install the 2 keys and crankshaft timing sprocket as shown in the illustration.

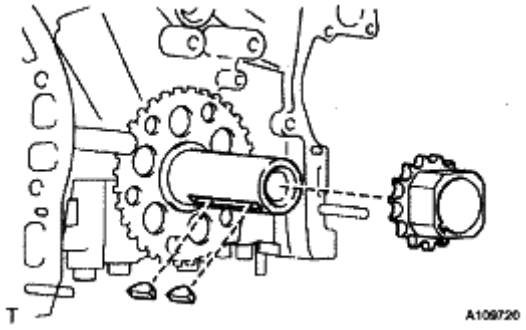

Fig. 443: Identifying Crankshaft Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

41. **INSTALL IDLE SPROCKET ASSEMBLY**
    a. Apply a light coat of engine oil to the rotating surface of the No. 1 idle gear shaft.
    b. Temporarily install the No. 1 idle gear shaft and idle sprocket with the No. 2 idle gear shaft while aligning the knock pin of the No. 1 idle gear with the knock pin groove of the cylinder block.

NOTE: Be careful of the idle gear direction.

HINT:

Check that no foreign objects are on the No. 1 and No. 2 idle gear shafts.

    c. Using a 10 mm hexagon wrench, tighten the No. 2 idle gear shaft.

Torque: 60 N*m (612 kgf*cm, 44 ft.*lbf)

HINT:

After installing the idle sprocket assembly, check that the idle sprocket turns smoothly.

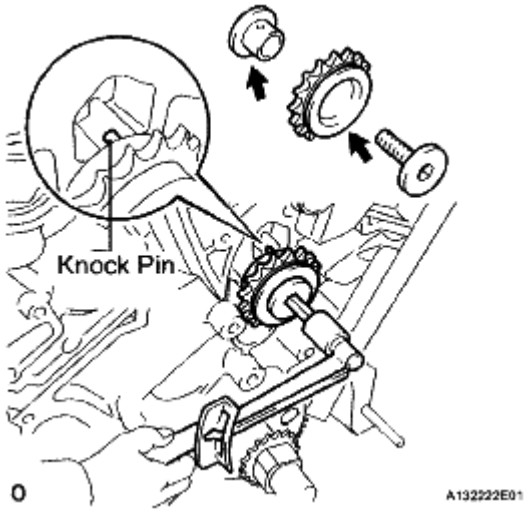

Fig. 444: Installing Idle Sprocket Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

42. **INSTALL CHAIN SUB-ASSEMBLY**
    a. Align the mark plate and timing marks as shown in the illustration and install the chain.

    HINT:

    The camshaft mark plate is orange.

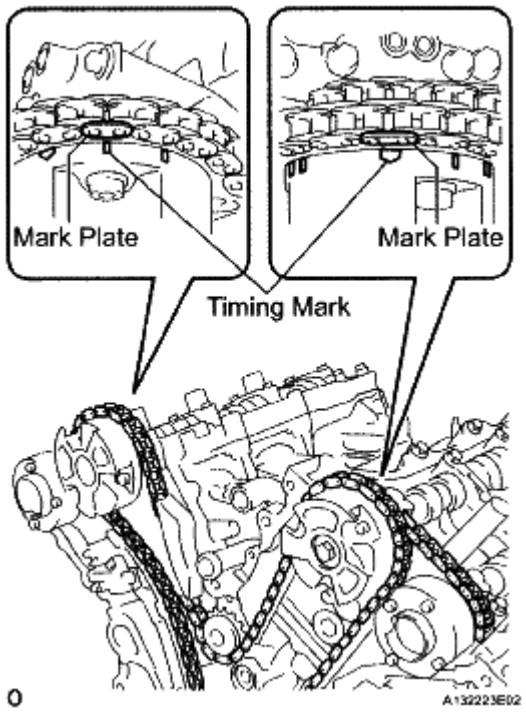

Fig. 445: Identifying Timing Mark On Marking Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Do not pass the chain over the crankshaft, just put it on it.

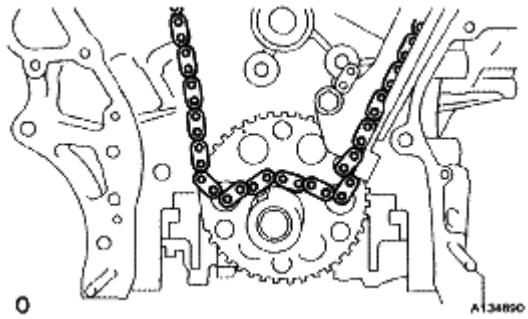

Fig. 446: Identifying Chain Set
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Turn the camshaft timing gear assembly on the bank 1 counterclockwise to tighten the chain between the banks.

NOTE: When the idle sprocket is reused, align the chain plate with the mark where the plate had been in order to tighten the chain between the banks.

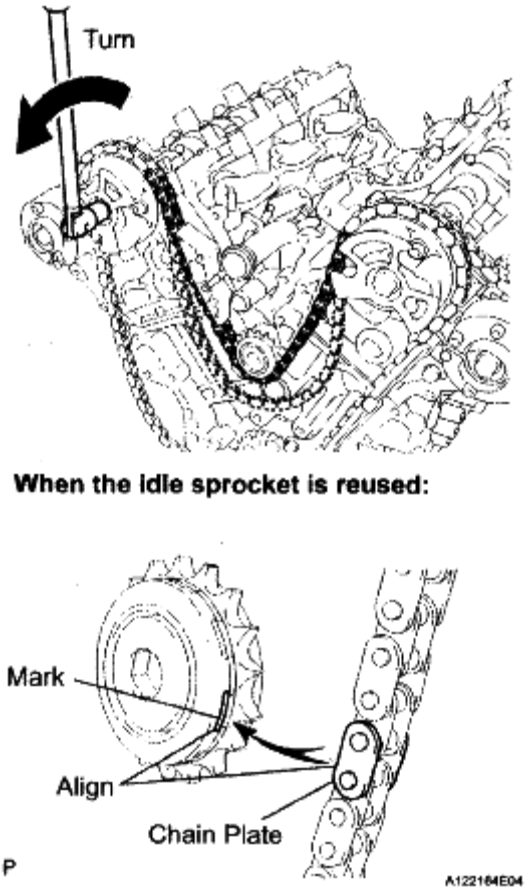

Fig. 447: Turning Camshaft Timing Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Align the mark plate and timing marks as shown in the illustration and install the chain onto the crankshaft timing sprocket.

HINT:

The crankshaft mark plate is yellow.

e. Temporarily tighten the pulley set bolt.

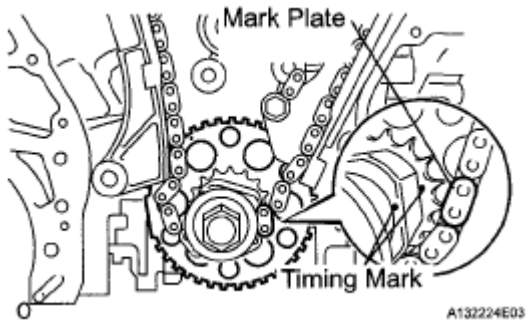

Fig. 448: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Turn the crankshaft clockwise to set it to the RH block bore center line (TDC / compression).

43. **INSTALL CHAIN TENSIONER SLIPPER**

a. Install the chain tensioner slipper.

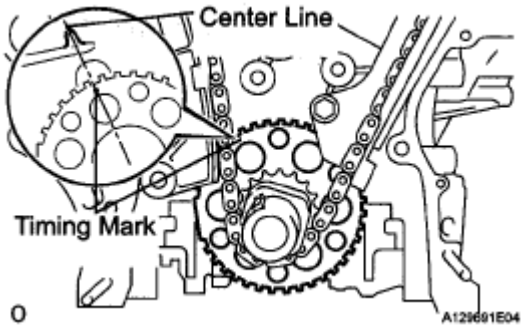

Fig. 449: Identifying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

44. **INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY**

a. Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.
b. Move the stopper plate downward to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

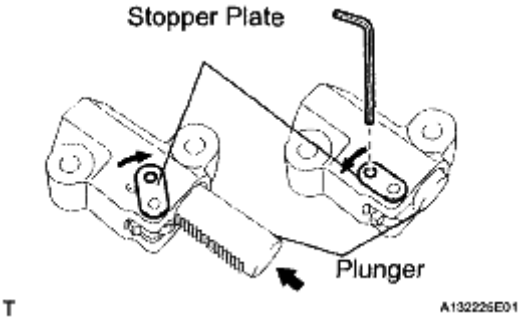

Fig. 450: Identifying Stopper Plate And Plunger
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the chain tensioner with the 2 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

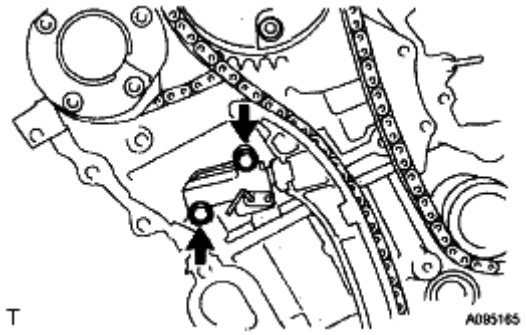

Fig. 451: Locating Chain Tensioner With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Remove the hexagon wrench of the chain tensioner. Check that each timing mark is aligned with the crankshaft at the TDC / compression.
e. Remove the pulley set bolt.

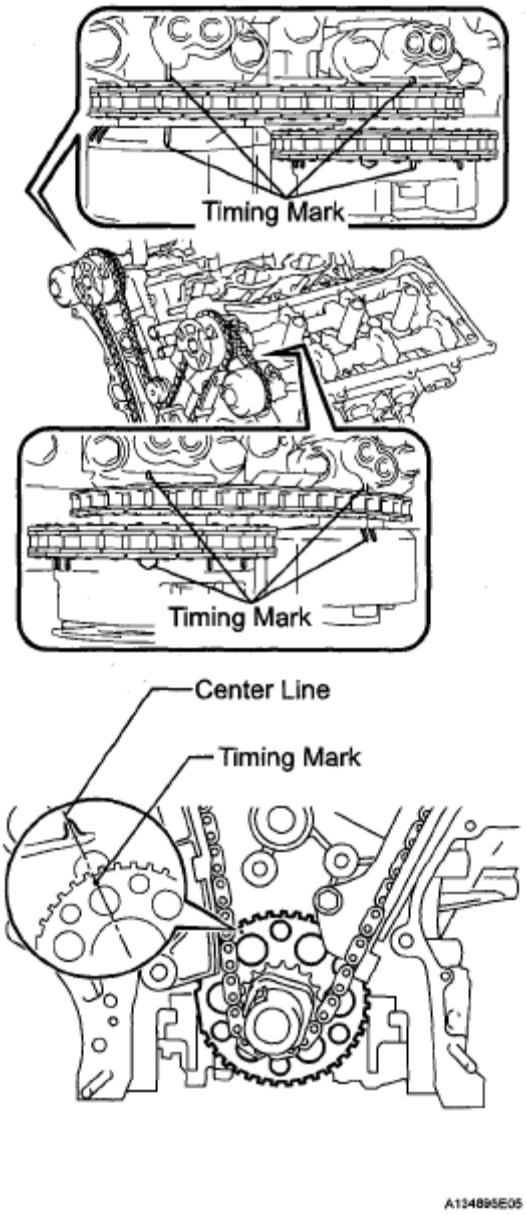

Fig. 452: Identifying Timing Mark Alignment
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

45. **INSTALL TIMING CHAIN CASE OIL SEAL**
    a. Using SST, tap in a new oil seal until its surface is flush with the timing gear case edge.

    SST 09223-22010,09506-35010

    NOTE:
    - **Keep the lip free of foreign matter.**
    - **Do not tap on the oil seal at an angle.**
    - **Make sure that the oil seal edge does not stick out of the timing**

chain case.

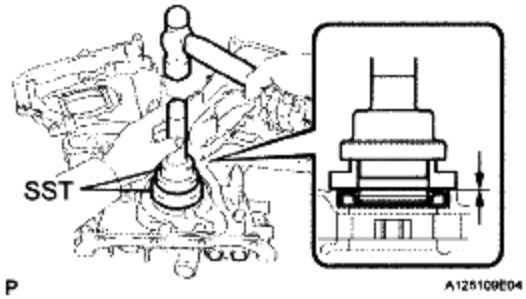

Fig. 453: Installing Timing Chain Case Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

46. **INSTALL WATER PUMP ASSEMBLY**
    a. Install a new gasket and the water pump assembly with the 8 bolts.

    Torque: 9.1 N*m (93 kgf*cm, 81 in.*lbf)

    NOTE: Be sure to replace the bolts indicated by A with new ones or reuse them after applying adhesive 1344.

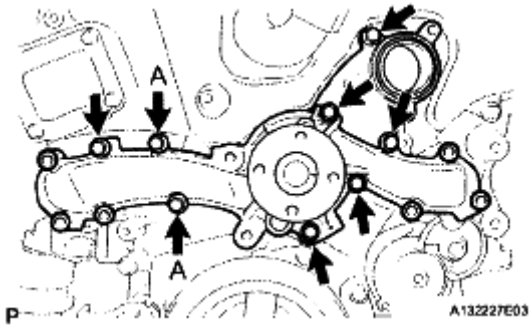

Fig. 454: Locating Water Pump With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

47. **INSTALL TIMING CHAIN COVER SUB-ASSEMBLY**
    a. Apply seal packing in a continuous line to the engine unit as shown in the following illustration.

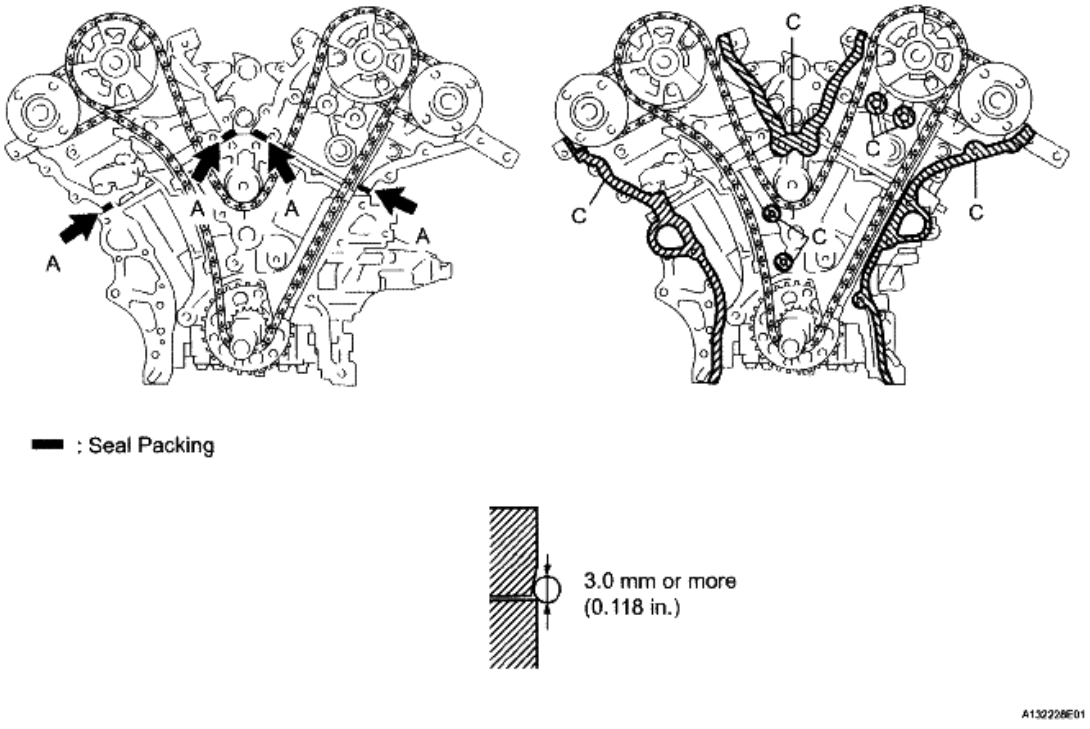

Fig. 455: Applying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Seal diameter: 3.0 mm (0.118 in.)

NOTE:

- **Be sure to clean and degrease the contact surfaces, especially the surfaces indicated by C in the illustration.**
- **When the contact surfaces are wet, wipe them with an oil-free cloth before applying seal packing.**
- **Install the chain cover within 3 minutes.**
- **Do not start the engine for at least 2 hours after installing.**

b. Apply seal packing in a continuous line to the timing chain cover as shown in the following illustration.

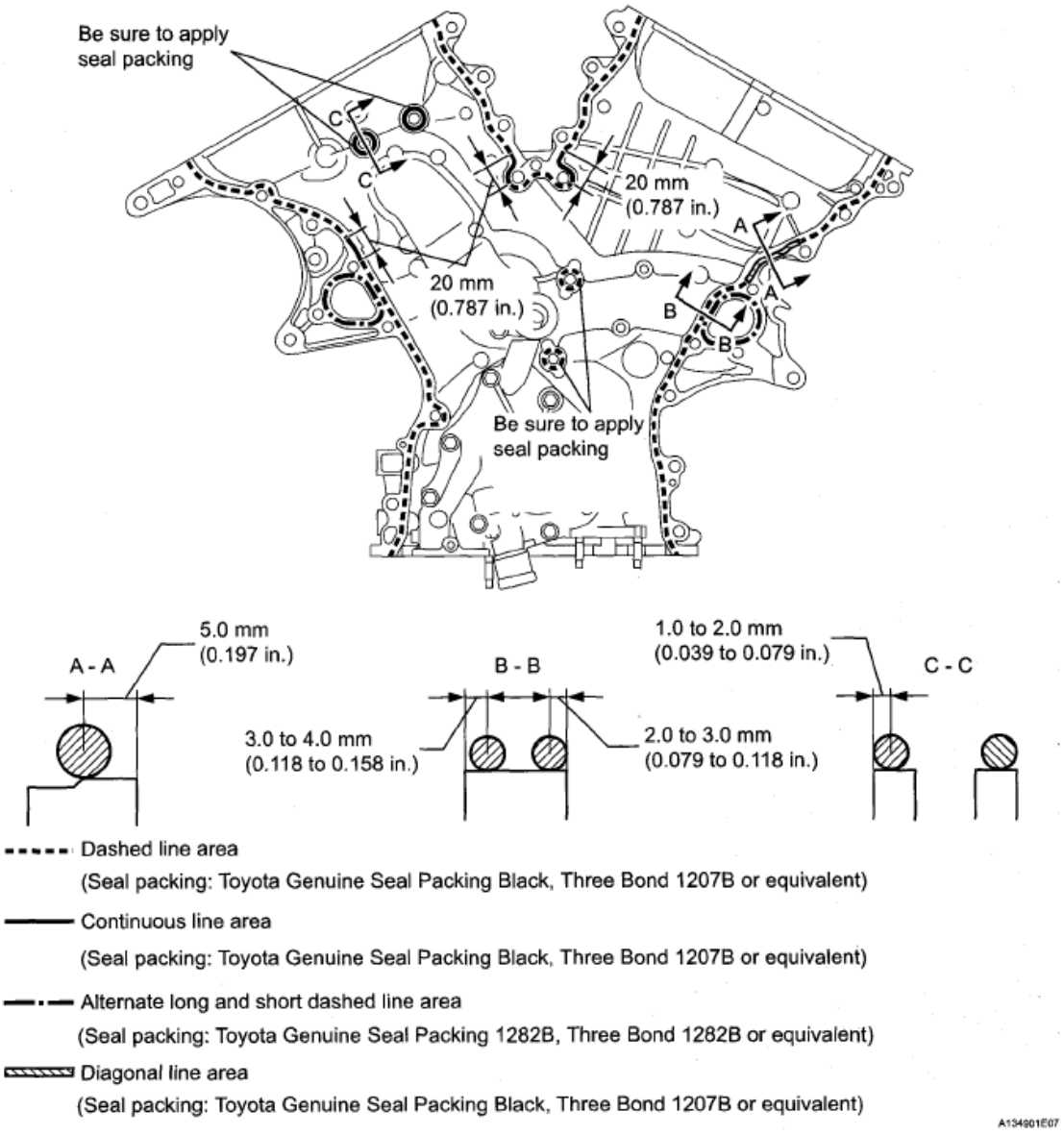

Fig. 456: Applying Seal Packing In Continuous Line To Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing:

Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Toyota Genuine Seal Packing 1282B, Three Bond 1282B or equivalent

NOTE:

- **When the contact surfaces are wet, wipe them with an oil-free cloth before applying seal packing.**
- **Install the chain cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.**

- **Do not start the engine for at least 2 hours after installing.**

Apply seal packing as follows

SEAL SPECIFICATIONS

Area	Seal Packing Diameter	Application Position from Inside Seal Line
Continuous Line Area	4.5 mm or more (0.177 in.)	3.0 to 4.0 mm (0.118 to 0.158 in.)
Alternate Long and Dashed Line Area	3.5 mm or more (0.138 in.)	2.0 to 3.0 mm (0.079 to 0.118 in.)
Dashed Line Area	3.5 mm or more (0.138 in.)	3.0 to 4.0 mm (0.118 to 0.158 in.)
Diagonal Line Area	6.0 mm or more (0.236 in.)	5.0 mm (0.197 in.)

c. Install a new gasket.

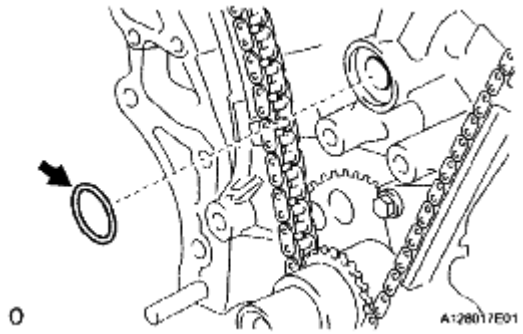

Fig. 457: Locating Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Align the oil pump's drive rotor spline and the crankshaft as shown in the illustration. Install the spline and chain cover to the crankshaft.

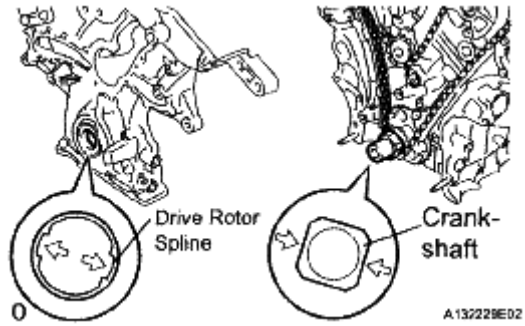

Fig. 458: Aligning Oil Pump Drive Rotor Spline And Crankshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Temporarily tighten the timing chain cover with the 23 bolts and 2 nuts.

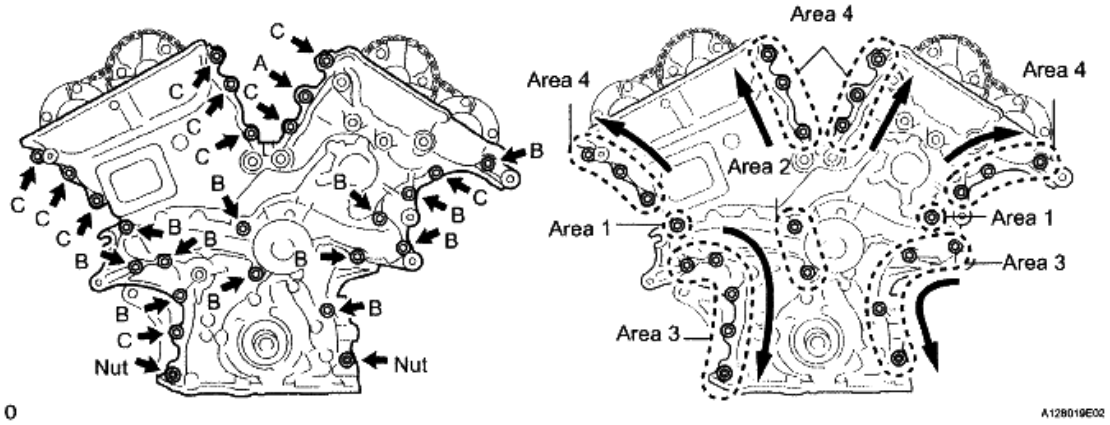

Fig. 459: Locating Timing Chain Cover With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Bolt length

BOLT LENGTH

Item	Length
Bolt A	40 mm (1.57 in.)
Bolt B	55 mm (2.17 in.)
Bolt C	25 mm (0.98 in.)

NOTE: Make sure that there is no oil on the bolt and nut threads.

f. Fully tighten the bolts in this order: Area 1 and Area 2.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

g. Fully tighten the bolts in Area 3.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

HINT:

Tighten the bolts and nuts in the order of upper to lower as shown in the illustration.

h. Fully tighten the bolts in Area 4.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf) for bolt A

21 N*m (214 kgf*cm, 15 ft.*lbf) for bolts except bolt A

HINT:

Tighten the bolts in the order of lower to upper as shown in the illustration.

i. Install a new chain cover plate gasket and the chain cover plate with the 4 bolts.

Torque: 9.1 N*m (93 kgf*cm, 81 in.*lbf)

48. **INSTALL WATER INLET HOUSING**

a. Install 2 new O-rings.

HINT:

Apply a small amount of water or soapy water to O-ring (A) in the illustration before installing it.

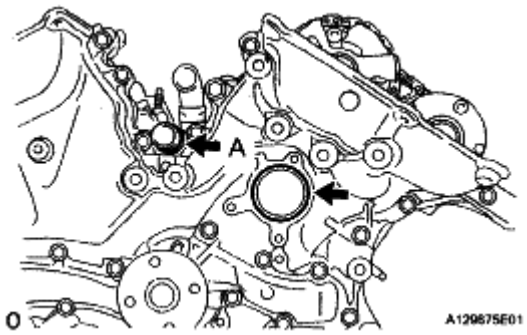

Fig. 460: Locating O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the stud bolts.

Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)

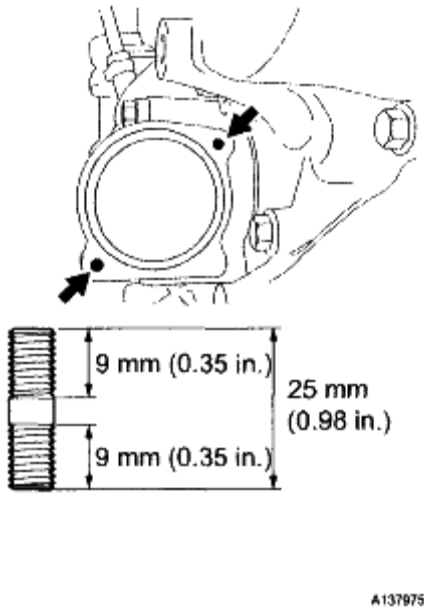

Fig. 461: Identifying Stud Bolt Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the water inlet housing with the 2 bolts and nut.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTE: Be careful that the O-ring does not get caught between the parts.

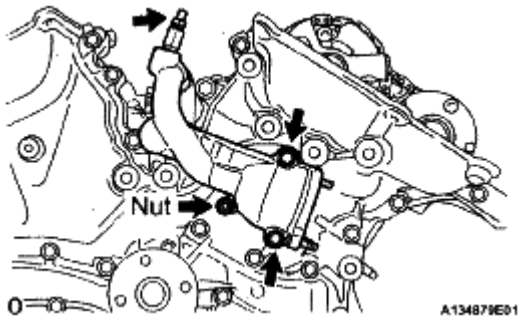

Fig. 462: Locating Bolts, Nut, And Water Inlet Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Connect the No. 1 water by-pass hose.
e. Apply adhesive around the drain cock.

Adhesive: Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

f. Install the drain cock assembly to the water inlet housing.

Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

g. Install the drain cock plug to the water drain cock assembly.

Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

h. Install a new gasket to the thermostat.

i. Align the thermostat jiggle valve with the upper stud bolt, and insert the thermostat in the water inlet housing.

HINT:

The jiggle valve may be set within 10° of either side of the prescribed positions.

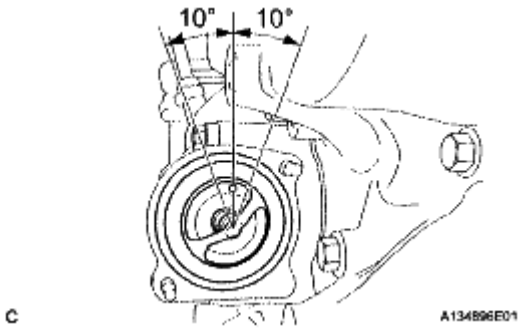

Fig. 463: Identifying Jiggle Valve Angles
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. Install the water inlet with the 2 nuts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

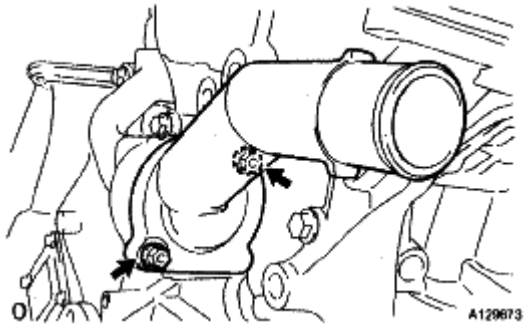

Fig. 464: Locating Water Inlet With Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

49. **INSTALL NO. 1 FRONT ENGINE MOUNTING BRACKET LH**

a. Install the No. 1 front engine mounting bracket LH with the 6 bolts.

Torque: 54 N*m (551 kgf*cm, 40 ft.*lbf)

NOTE:

- **Install the water inlet and mounting bracket within 15 minutes after installing the chain cover.**
- **Do not start the engine for at least 2 hours after installation.**

b. When replacing a stud bolt, install it by using an E8 "TORX" socket wrench.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

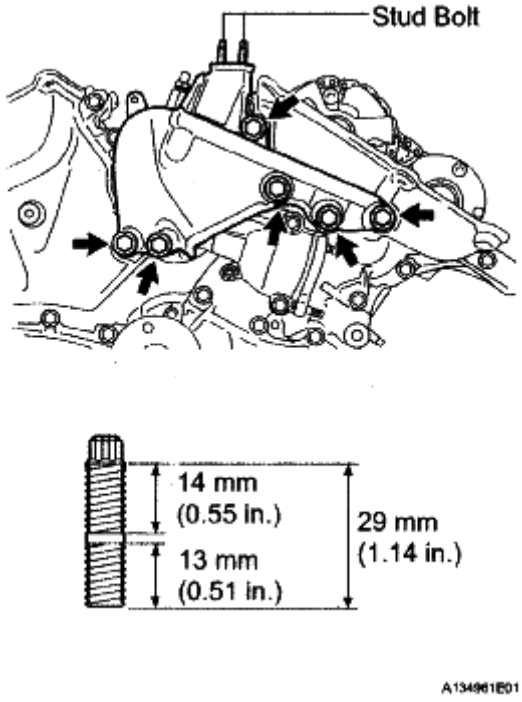

Fig. 465: Identifying Stud Bolt Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

50. **INSTALL OIL PAN BAFFLE PLATE**

a. Install the oil pan baffle plate with the 7 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

HINT:

Temporarily tighten the 7 bolts. Fully tighten 2 bolts (A) as shown in the illustration before tightening the other bolts.

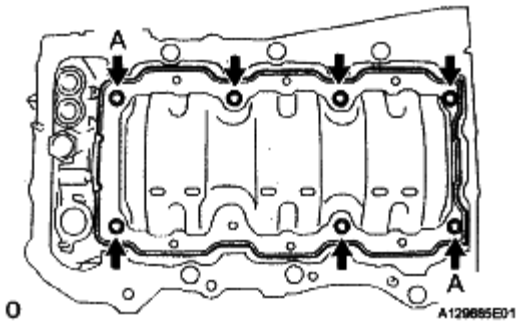

Fig. 466: Locating Oil Pan Baffle Plate Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

51. **INSTALL OIL PAN SUB-ASSEMBLY**
    a. When replacing a stud bolt, install it by using an E8 "TORX" socket wrench.

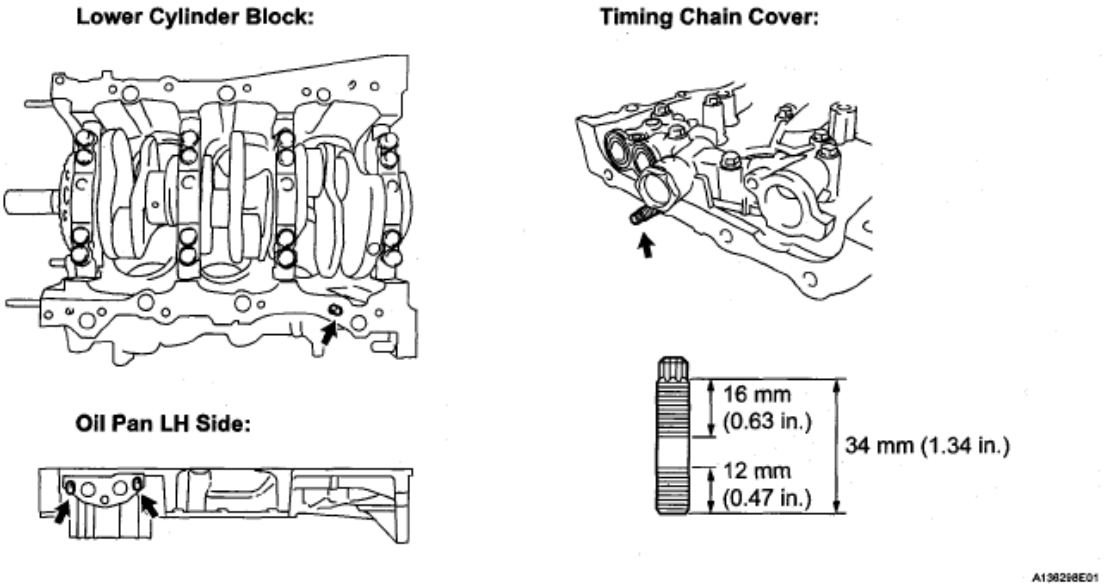

Fig. 467: Identifying Stud Bolt Installation Procedure
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

    b. Install 2 new O-rings.

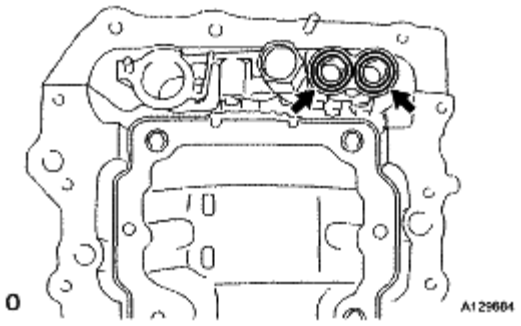

Fig. 468: Locating O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Apply seal packing in a continuous line as shown in the illustration.

Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

Seal diameter: 3.0 to 4.0 mm (0.118 to 0.156 in.)

NOTE:

- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installing.**

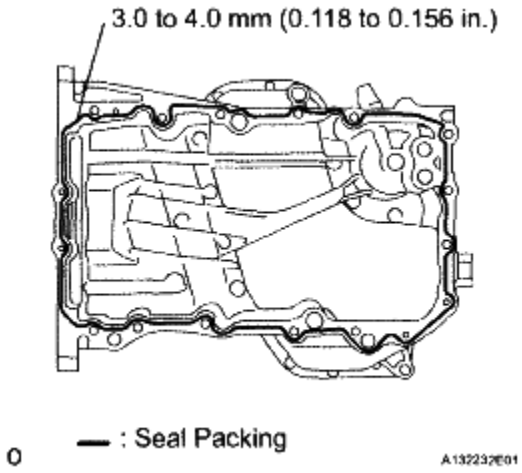

Fig. 469: Applying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the oil pan with the 16 bolts and 2 nuts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf) for bolt A

21 N*m (214 kgf*cm, 15 ft.*lbf) for bolts except A

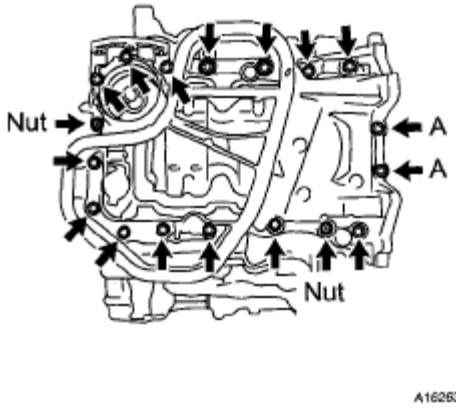

Fig. 470: Locating Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

52. **INSTALL OIL STRAINER SUB-ASSEMBLY**
    a. Using an E6 "TORX" socket, install the stud bolts as shown in the illustration.

    Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)

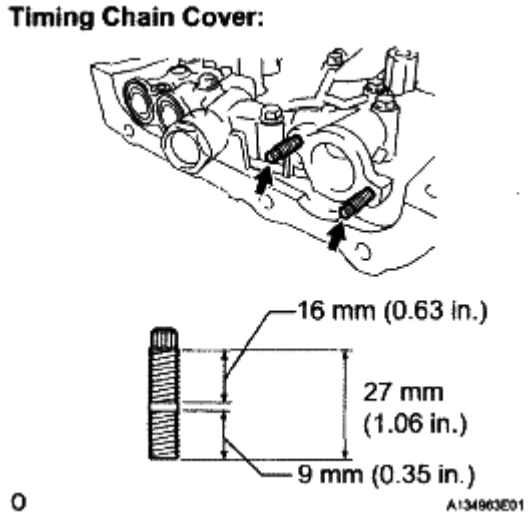

Fig. 471: Locating Stud Bolts And Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Install a new gasket and the oil strainer sub-assembly with the bolt and 2 nuts.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

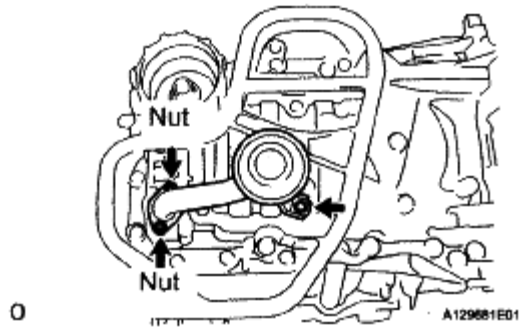

Fig. 472: Locating Gasket And Oil Strainer With Bolt And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

53. **INSTALL NO. 2 OIL PAN SUB-ASSEMBLY**
    a. Using an E6 "TORX" socket, install the stud bolts as shown in the illustration.

    Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)

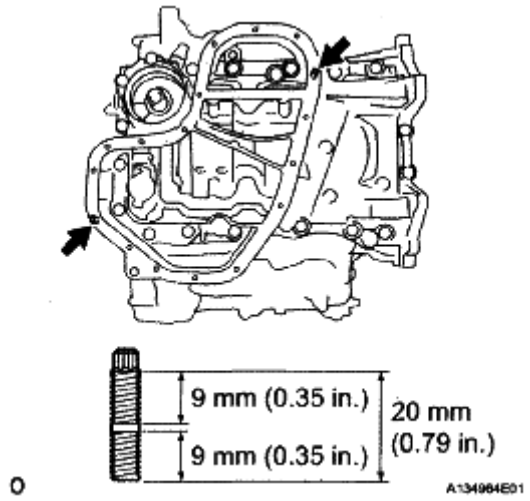

Fig. 473: Locating No. 2 Oil Pan Sub-Assembly Stud Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Apply seal packing in a continuous line as shown in the illustration.

    Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

    Seal diameter: 3.0 to 4.0 mm (0.118 to 0.158 in.)

NOTE:

- **Remove any oil from the contact surface.**
- **Install the oil pan No. 2 within 3 minutes after applying seal packing.**
- **Do not start the engine for at least 2 hours after installing.**

Fig. 474: Identifying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the oil pan with the 16 bolts and 2 nuts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

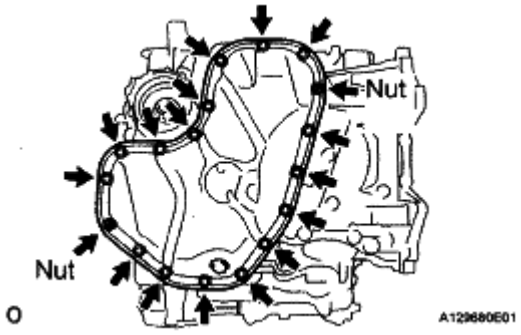

Fig. 475: Identifying Oil Pan With Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

54. **INSTALL OIL PAN DRAIN PLUG**

a. Install a new oil pan drain plug gasket and the oil pan drain plug.

Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)

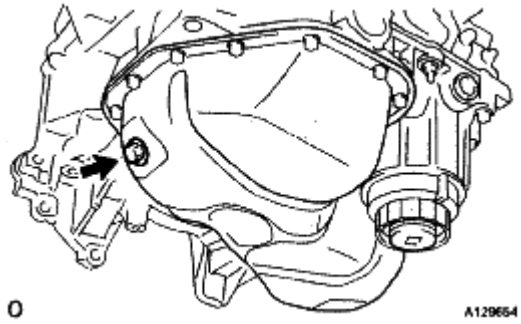

Fig. 476: Locating Oil Pan Drain Plug

Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

55. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)**
    a. Apply seal packing as shown in the illustration.

    Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

    NOTE:
    - **Remove any oil from the contact surface.**
    - **Install the head cover within 3 minutes after applying seal packing.**
    - **Do not start the engine for at least 2 hours after installing.**

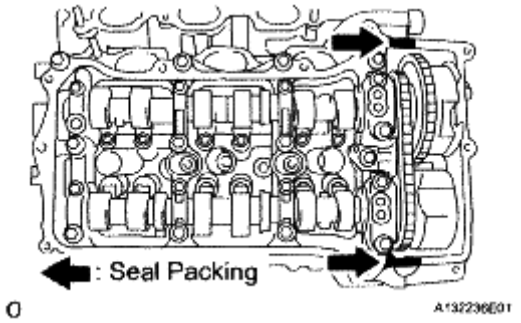

Fig. 477: Identifying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Install 3 new gaskets as shown in the illustration.
    c. Install a new gasket to the head cover.

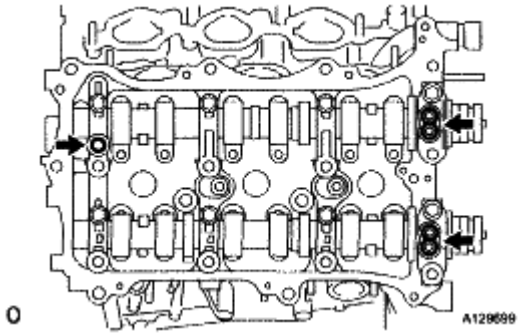

Fig. 478: Locating Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    d. Install a head cover with the 12 bolts and a new washer.

    Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt A

    10 N*m (102 kgf*cm, 7 ft.*lbf) for bolts except A

HINT:

After tightening all bolts, check the tightening torque of 1 and 11. Retighten the bolt if necessary.

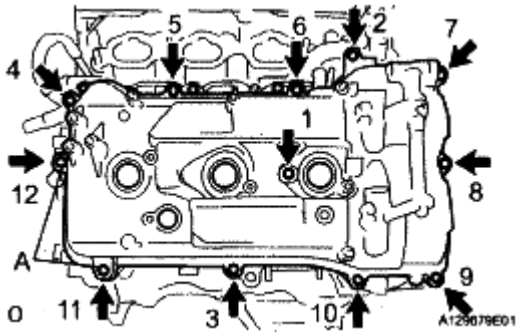

Fig. 479: Identifying Head Cover With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

56. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 2)**
    a. Apply seal packing as shown in the illustration.

    Seal packing: Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

    NOTE:
    - **Remove any oil from the contact surface.**
    - **Install the head cover within 3 minutes after applying seal packing.**
    - **Do not start the engine for at least 2 hours after installing.**

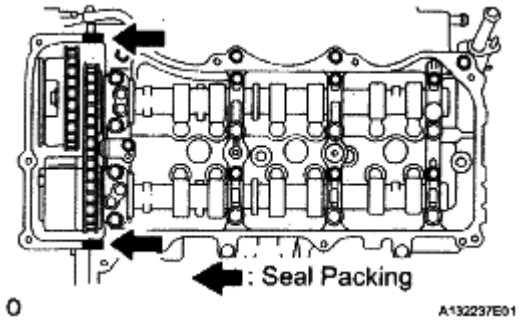

Fig. 480: Identifying Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Install 3 new gaskets as shown in the illustration.
    c. Install a new cylinder head cover gasket to the cylinder head cover sub-assembly.

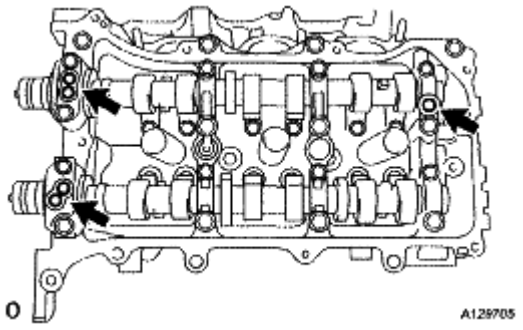

Fig. 481: Locating Gaskets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the cylinder head cover with the 12 bolts and a new washer.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt A

10 N*m (102 kgf*cm, 7 ft.*lbf) for bolts except A

HINT:

After tightening all bolts, check the tightening torque of 1 and 10. Retighten the bolt if necessary.

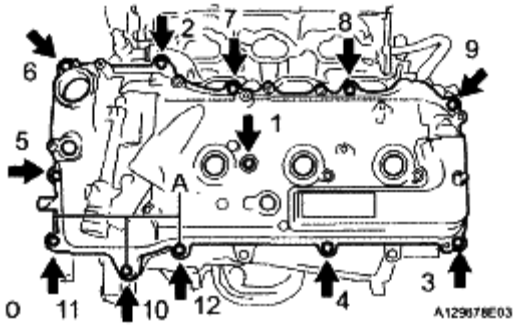

Fig. 482: Locating Head Cover With Bolts And Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

57. **INSTALL WATER OUTLET**

a. Install 2 new gaskets and a new O-ring.

HINT:

Apply soapy water to the O-ring.

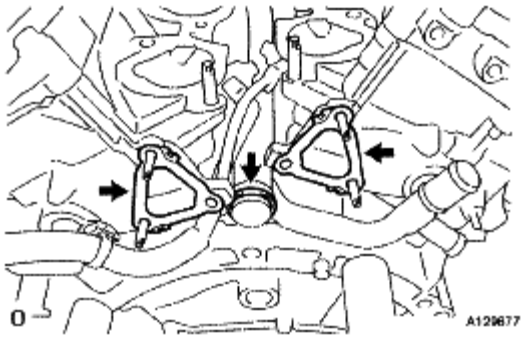

Fig. 483: Locating Water Outlet Gaskets And O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the water outlet with the 2 bolts and 4 nuts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf) for bolts

10 N*m (103 kgf*cm, 7 ft.*lbf) for nuts

NOTE: Be careful that the O-ring does not get caught between the parts.

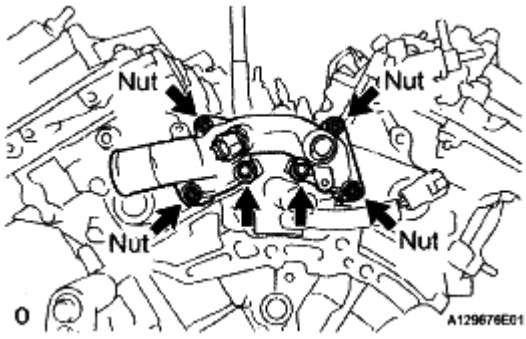

Fig. 484: Locating Bolts, Nuts And Water Outlet
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

58. **INSTALL NO. 1 OIL COOLER BRACKET**

a. Using an E8 "TORX" socket, install the stud bolts as shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

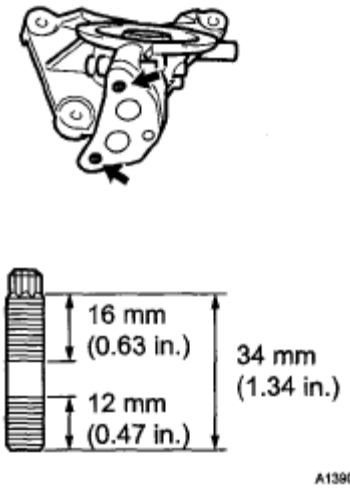

Fig. 485: Locating Stud Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install a new gasket to the No. 1 oil cooler bracket.
c. Install the oil cooler pipe with the bolt and 2 nuts.

Torque: 21 N*m (214 kgf*cm, 16 ft.*lbf)

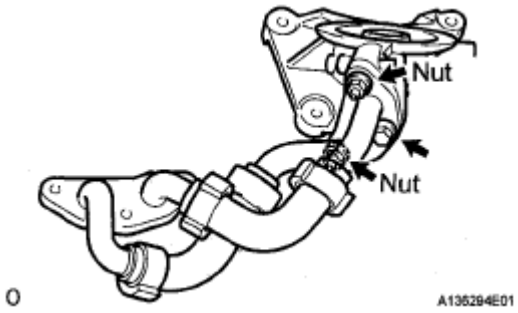

Fig. 486: Locating Bolt, Nuts, No. 1 Oil Cooler Bracket, And Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install a new gasket to the No. 1 oil pan.
e. Install the No. 1 oil cooler bracket with oil cooler pipe with the 3 bolts and 3 nuts.

Torque: 21 N*m (214 kgf*cm, 16 ft.*lbf)

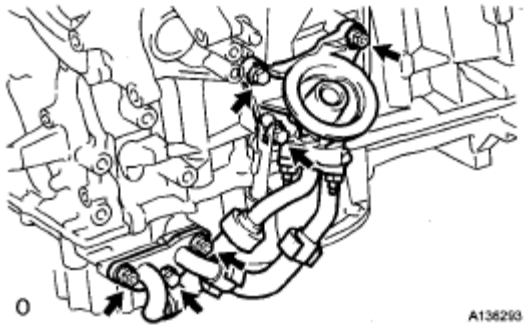

Fig. 487: Locating Bolts, Nuts, And Oil Cooler Pipe With No. 1 Oil Cooler Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

59. **INSTALL OIL COOLER ASSEMBLY**
    a. Install a new O-ring.
    b. Install the oil cooler assembly with the union bolt.

    Torque: 68 N*m (693 kgf*cm, 50 ft.*lbf)

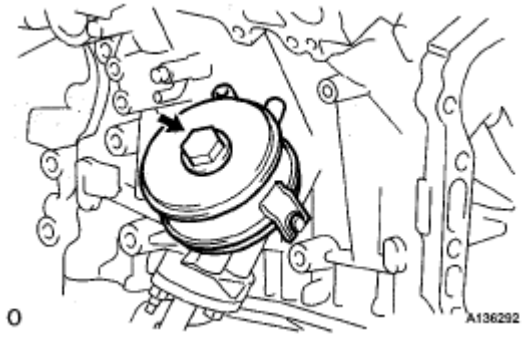

Fig. 488: Locating Oil Cooler Union Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    c. Install the 2 water by-pass hoses with the bolt, 2 clamps, and 4 clips.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

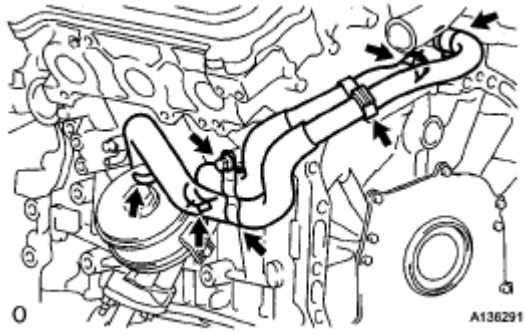

Fig. 489: Locating Bolt, Clamps, And Clips
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

60. **INSTALL CRANKSHAFT PULLEY**
    a. Align the pulley set key with the key groove of the pulley, and slide on the pulley.
    b. Using SST, install the pulley bolt.

    SST 09213-70011 (09213-70020), 09330-00021

    Torque: 250 N*m (2550 kgf*cm, 184 ft.*lbf)

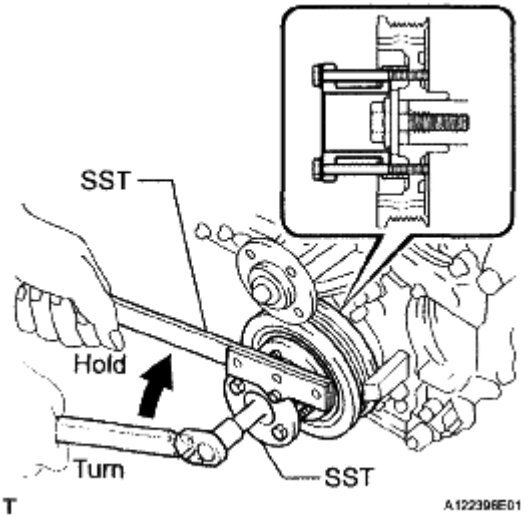

Fig. 490: Installing Crankshaft Pulley Bolt Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

61. **INSTALL OIL FILTER ELEMENT**
    a. Clean the inside of the oil filter cap sub-assembly, the threads and O-ring groove.
    b. Apply a light coat of engine oil to a new O-ring and install it to the oil filter cap sub-assembly.
    c. Set a new oil filter element to the oil filter cap.
    d. Remove dirt or foreign matter from the installation surface of the engine.
    e. Apply a light coat of engine oil to the O-ring again and install the oil filter cap sub-assembly.

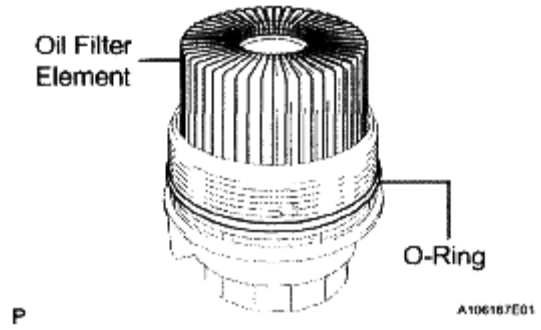

Fig. 491: View Of Oil Filter Element And O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:
- **Be careful that the O-ring does not get caught between the parts.**
- **The O-ring must not be twisted on the groove.**

f. Using SST, tighten the oil filter cap.

SST 09228-06501

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

NOTE: Make sure that the oil filter is installed securely as shown in the illustration.

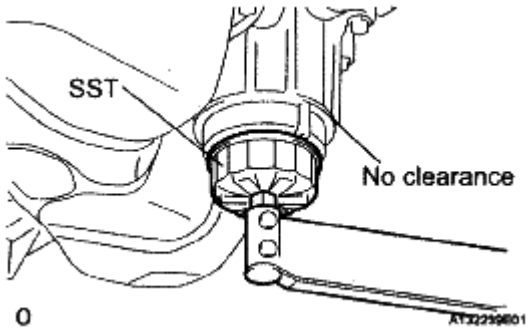

Fig. 492: Tightening Oil Filter Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Apply a light coat of engine oil to a new O-ring and install it to the oil filter cap.

NOTE: Remove all dirt and foreign matter from the installation surface.

h. Install the oil filter drain plug to the oil filter cap.

Torque: 13 N*m (127 kgf*cm, 9 ft.*lbf)

NOTE: Make sure that the O-ring does not get caught between the parts.

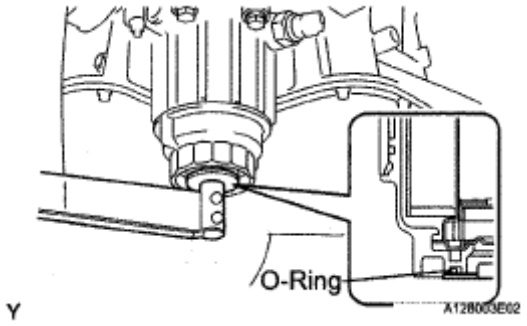

Fig. 493: Locating Oil Filter Drain Plug To Oil Filter Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

62. **INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY**
    a. Apply adhesive around the drain cocks.

    Adhesive: Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

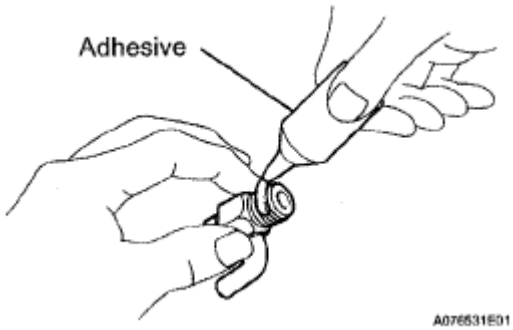

Fig. 494: Applying Adhesive Around Drain Cocks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Install the water drain cocks as shown in the illustration.

    Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

    NOTE: Do not rotate the drain cocks more than 1 revolution (360°) after tightening the drain cocks with the specified torque.

    c. Install the water drain cock plugs to the water drain cocks.

    Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

63. **INSTALL NO. 1 OIL PIPE**
    a. Make sure that there is no foreign matter on the mesh of the oil control valve filter LH.

NOTE: Do not touch the mesh when installing the oil control valve filter.

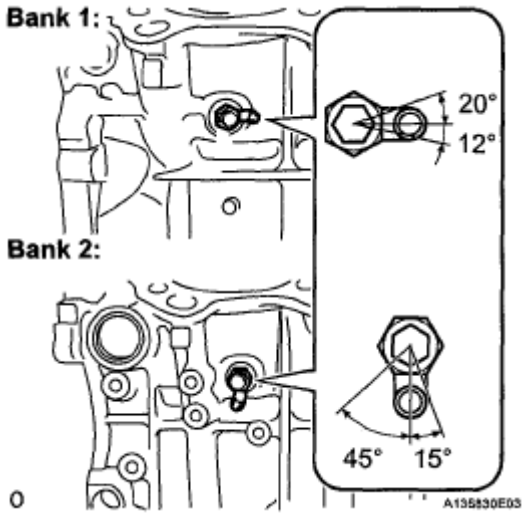

Fig. 495: Installing Water Drain Cocks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the oil control valve filter LH to the oil pipe union. Install new gaskets and temporarily install the oil pipe (on the head cover side).
c. Install a new gasket and temporarily install the oil pipe (on the cylinder head side) with the oil check valve bolt.
d. Tighten the oil pipe union (on the head cover side).

Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)

e. Tighten the oil pipe union (on the cylinder head side).

Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)

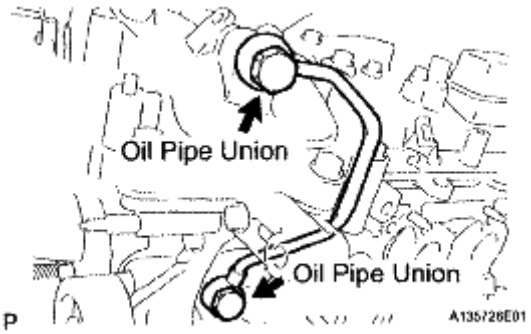

Fig. 496: Locating Oil Pipe Unions And Oil Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If the link that connects the gaskets is broken, remove the

connecting link by using nippers or similar tools.

64. **INSTALL OIL PIPE**
    a. Make sure that there is no foreign matter on the mesh of the oil control valve filter RH.

    NOTE: Do not touch the mesh when installing the oil control valve filter.

    b. Install the oil control valve filter RH to the oil pipe union. Install new gaskets and temporarily install the oil pipe (on the head cover side).
    c. Install a new gasket and temporarily install the oil pipe (on the cylinder head side) with the oil check valve bolt.
    d. Install the bolt (A) to the cylinder head.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

    e. Tighten the oil pipe union (on the head cover side).

    Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)

    f. Tighten the oil pipe union (on the cylinder head side).

    Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)

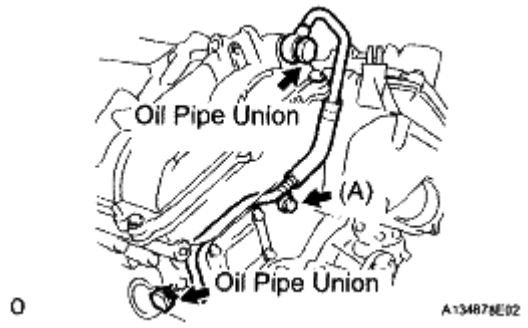

Fig. 497: Locating Oil Pipe Unions
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If the link that connects the gaskets is broken, remove the connecting link by using nippers or similar tools.

65. **INSTALL CRANKSHAFT POSITION SENSOR**
    a. Install the crankshaft position sensor with the bolt.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

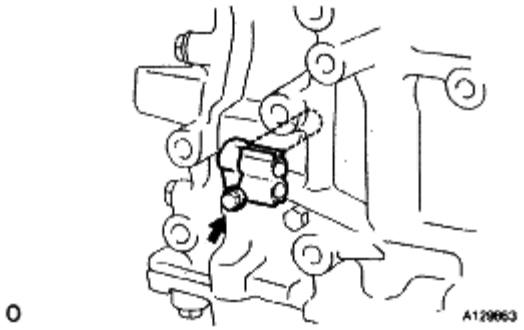

Fig. 498: Locating Crankshaft Position Sensor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

66. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**
    a. Install the 4 camshaft timing oil control valves with the 4 bolts.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

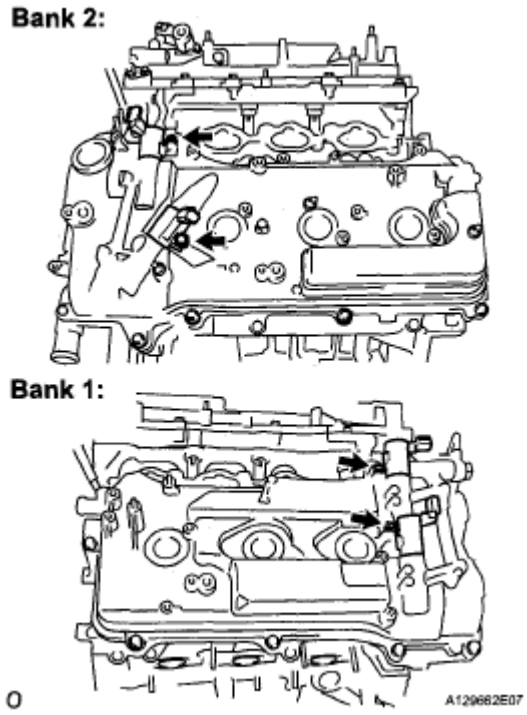

Fig. 499: Locating Bolts And Camshaft Oil Control Valves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

67. **INSTALL CAMSHAFT POSITION SENSOR**
    a. Install the 4 camshaft position sensors with the 4 bolts.

    Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

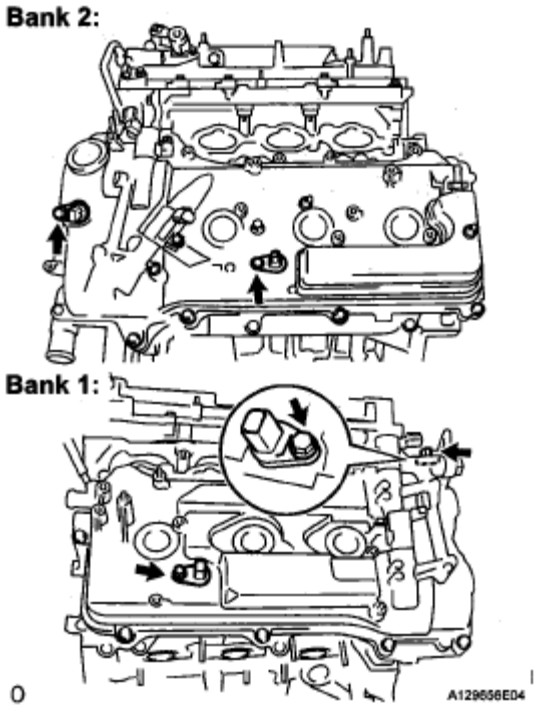

Fig. 500: Locating Bolts And Camshaft Position Sensors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

68. **INSTALL VENTILATION VALVE SUB-ASSEMBLY**
    a. Apply adhesive around the ventilation valve sub-assembly.

       Adhesive: Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

    b. Install the ventilation valve sub-assembly.

       Torque: 27 N*m (275 kgf*cm, 20 ft.*lbf)

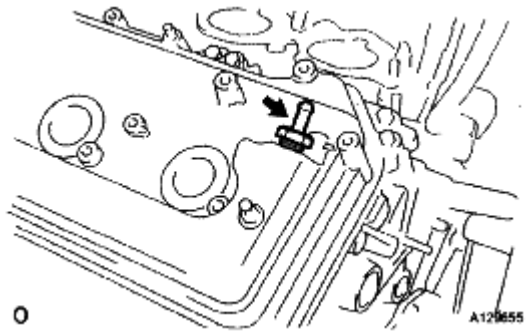

Fig. 501: Identifying Ventilation Valve Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

69. **INSTALL SPARK PLUG**

a. Install the 6 spark plugs.

Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)

70. **INSTALL OIL FILLER CAP SUB-ASSEMBLY**
    a. Install a new oil filler gasket.
    b. Install the oil filler cap sub-assembly.

