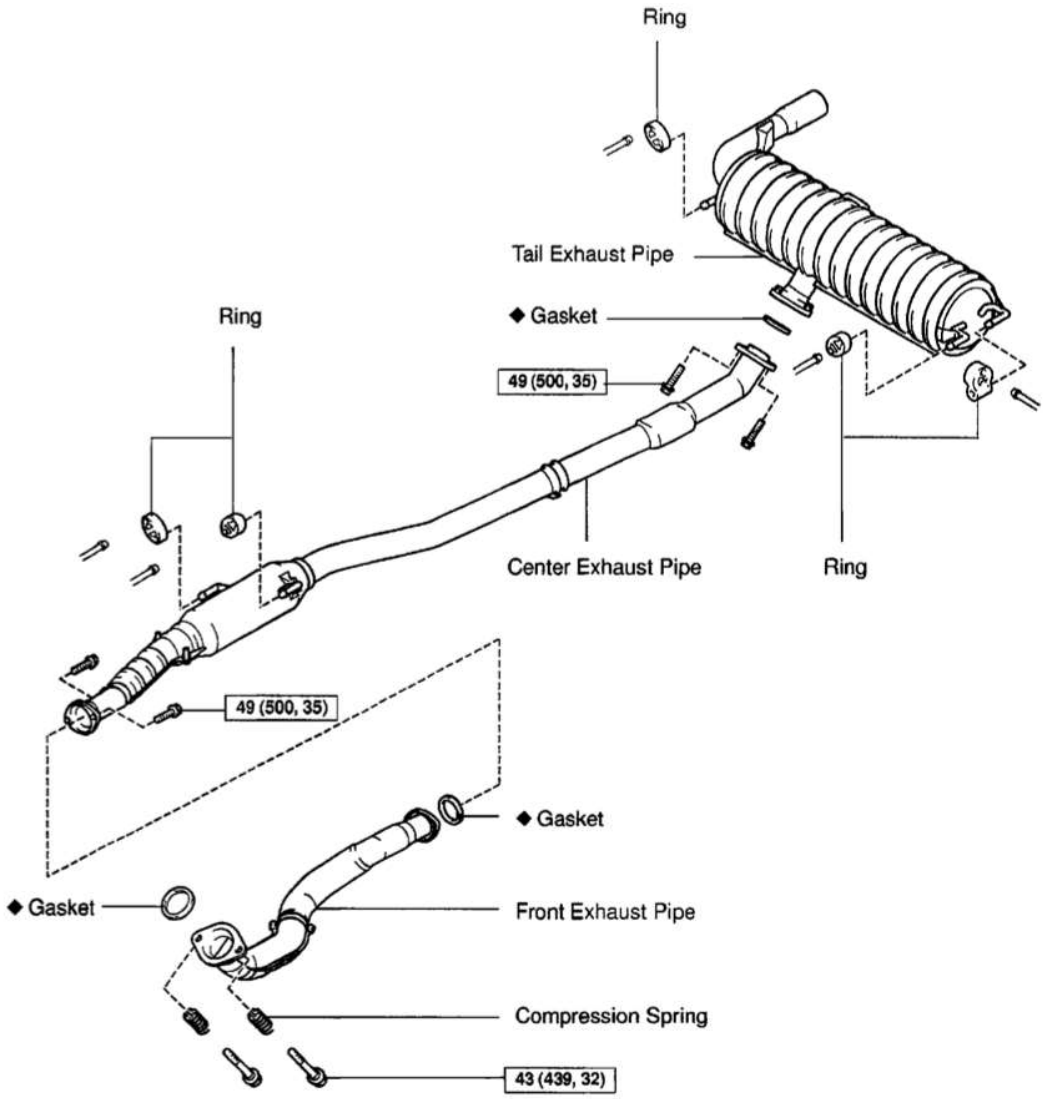
2002 ENGINE

Exhaust - RAV4

EXHAUST SYSTEM

COMPONENTS



N·m (kgf·cm, ft·lbf) : Specified torque
◆ Non–reusable part

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Fig. 1: Displaying Exhaust System Components
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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2002 ENGINE

Lubrication - RAV4

OIL AND FILTER

INSPECTION

1. **Check engine oil quality** .

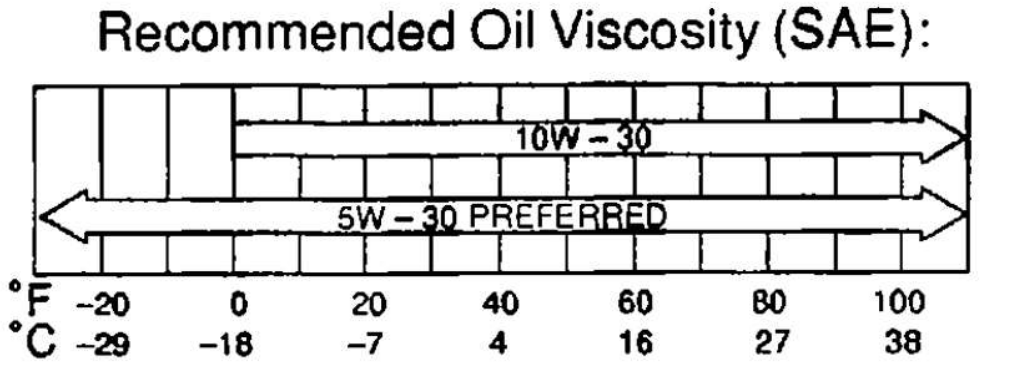


Fig. 1: Displaying Recommended Oil Viscosity
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Check the oil for deterioration, entry of water, discoloring or thinning.

If the quality is visibly poor, replace the oil.

Oil grade:

API grade or SJ, Energy-Conserving or ILSAC multigrade engine oil is recommended. SAE 5W-30 is the best choice for your vehicle, for good fuel economy, and good starting in cold weather .

2. **Check engine oil level** .

After warming up the engine and then 5 minutes after the engine stop, oil level should be between the upper and lower dot marks on the dipstick.

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If low, check for leakage and add oil up to the upper dot mark.

NOTE: Do not fill with engine oil above the upper dot mark.

3. **Remove oil pressure switch and install oil pressure gauge** .
   a. Remove the oil pressure switch.

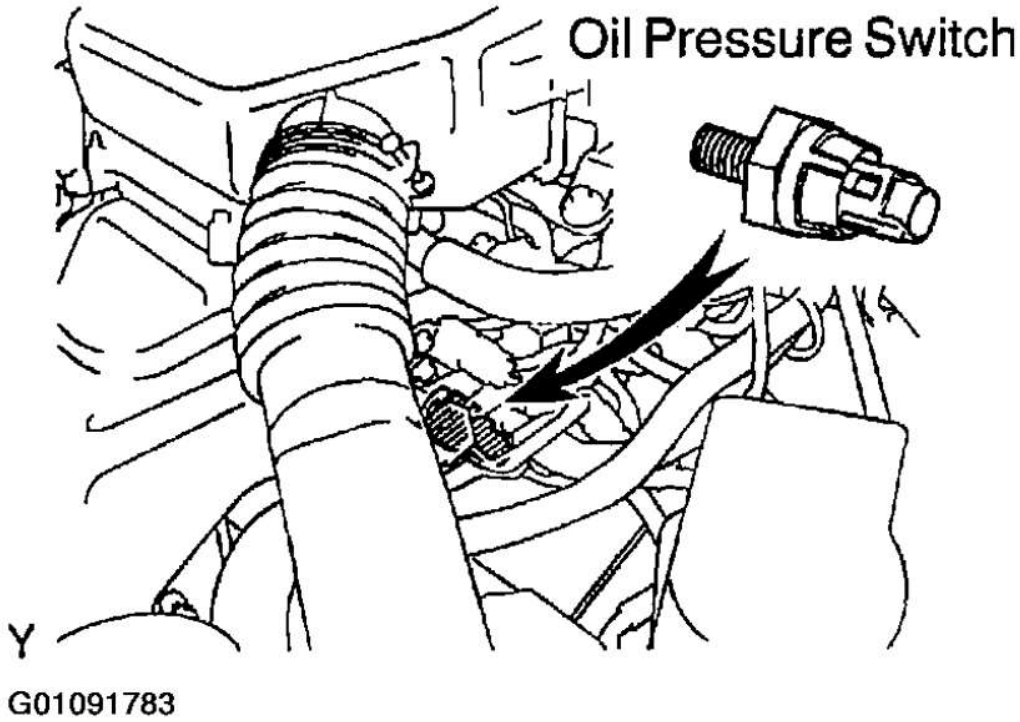
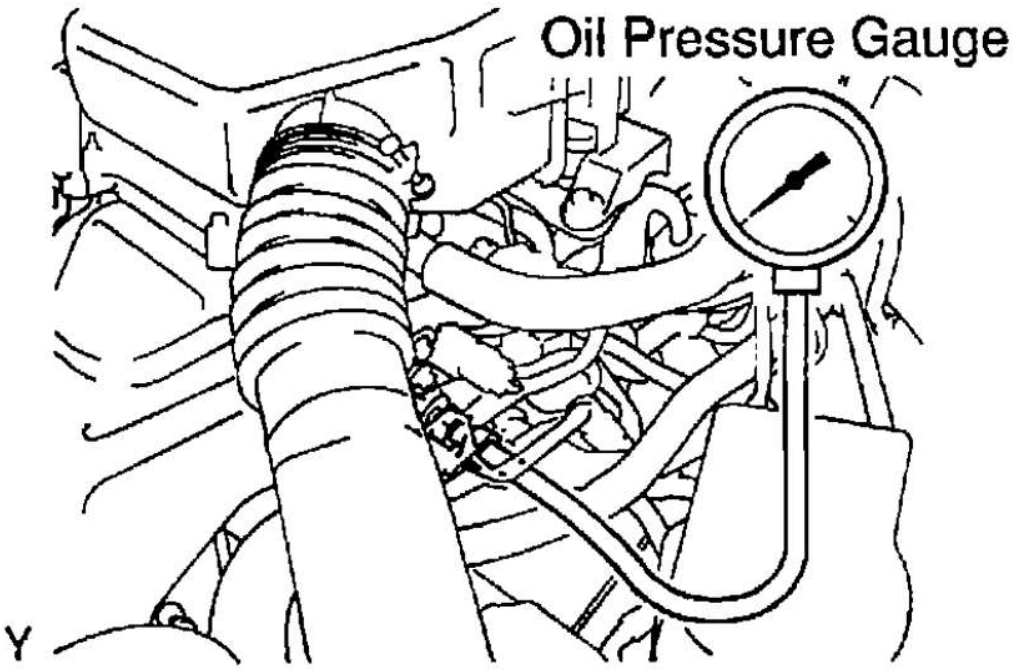


Fig. 2: Displaying Oil Pressure Switch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Install the oil pressure gauge.

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Fig. 3: Displaying Oil Pressure Gauge
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Warm up engine** .

   Allow the engine to warm up to normal operating temperature.

5. **Check oil pressure** .

Idle	29 kPa (0.3 kgf/cm^2, 4.3 psi) or more
3,000 rpm	245 – 539 kPa (2.5 – 5.5 kgf/cm^2, 36 – 78 psi)

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Fig. 4: Displaying Oil Pressure Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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6. **Remove oil pressure gauge and reinstall oil pressure switch** .
   a. Remove the oil pressure gauge.
   b. Apply adhesive to 2 or 3 threads of the oil pressure switch.
      Adhesive: Part No. 08833-00080, THREE BOND 1344, LOCTITE 242 or equivalent
   c. Install the oil pressure switch.
      Torque: 13 N.m (130 kgf.cm, 9 ft.lbf)
7. **Start engine and check for oil leaks** .

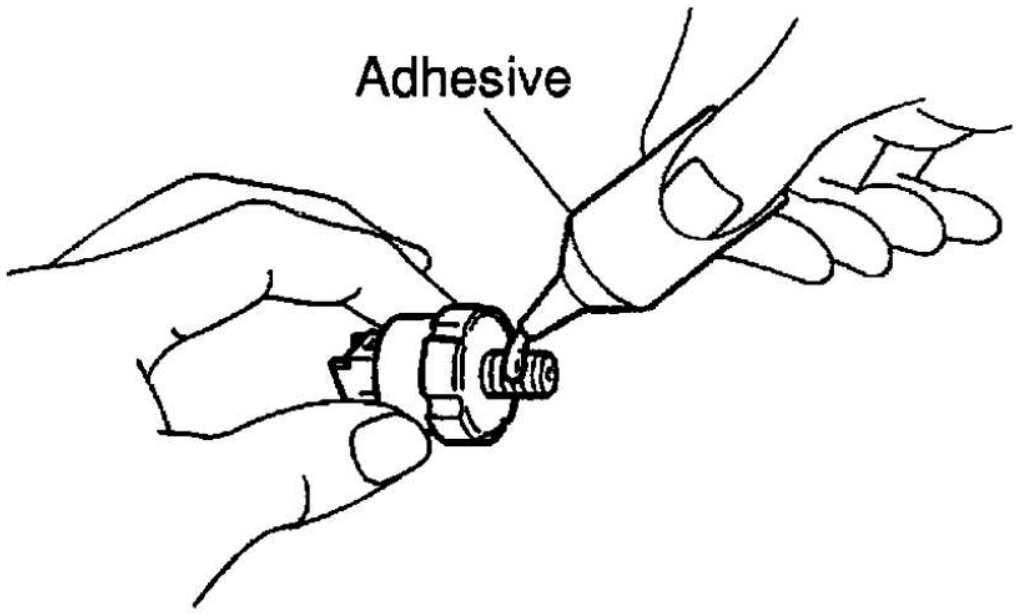


Fig. 5: Displaying Adhesive Proper Application To Oil Pressure Switch
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REPLACEMENT

CAUTION:

- **Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer.**
- **Exercise caution in order to minimize the length and frequency of contact of your skin to used oil. Wear protective clothing and gloves. Wash your skin thoroughly with soap and water, or use waterless**

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hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.

- **In order to preserve the environment, used oil and used oil filter must be disposed of only at designated disposal sites.**

1. **Remove center engine under cover** .
2. **Drain engine oil** .
   a. Remove the oil filter cap.
   b. Remove the oil drain plug, and drain the oil into a container.
3. **Replace oil filter** .
   a. Using SST, remove the oil filter.
      SST 09228-06501

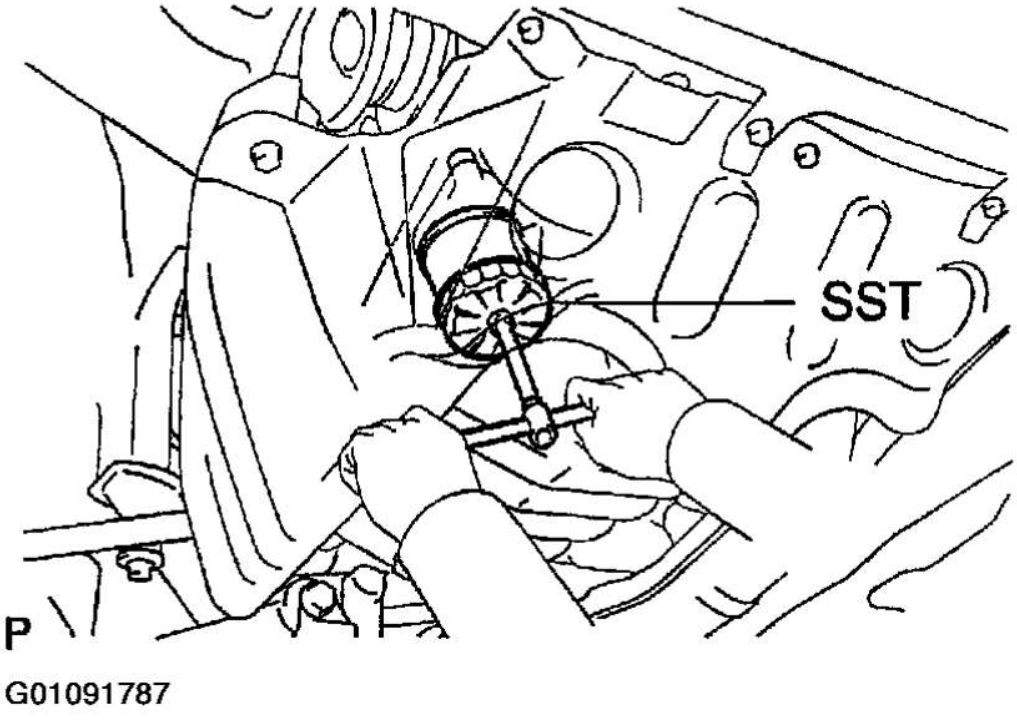


Fig. 6: Removing Oil Filter Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Check and clean the oil filter installation surface.
   c. Check the part number of the new oil filter is as same as old one.
   d. Apply clean engine oil to the gasket of a new oil filter.

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e. Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.

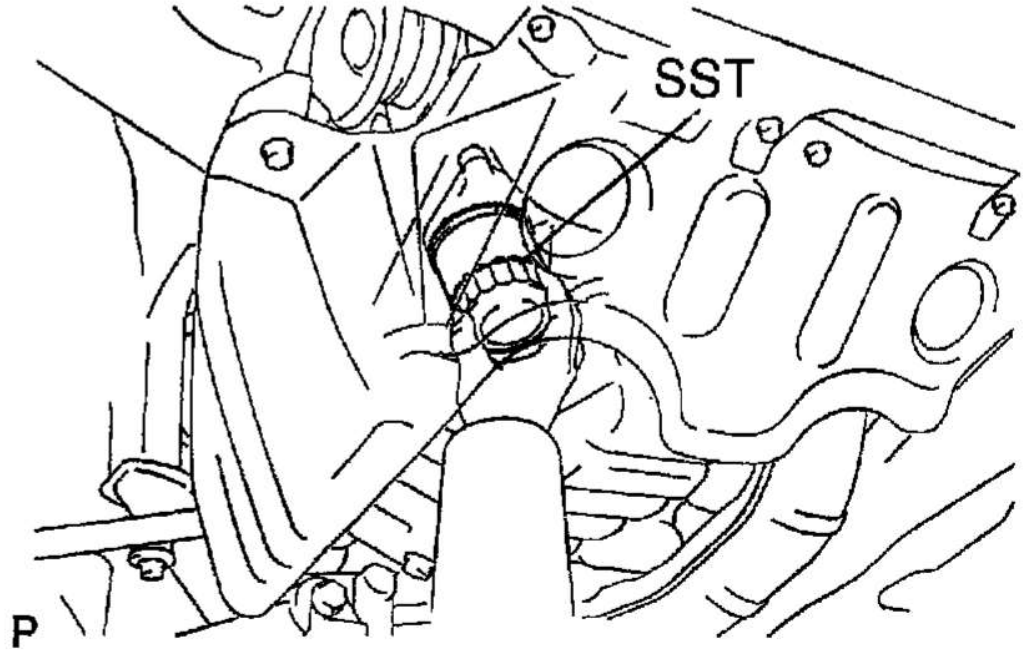
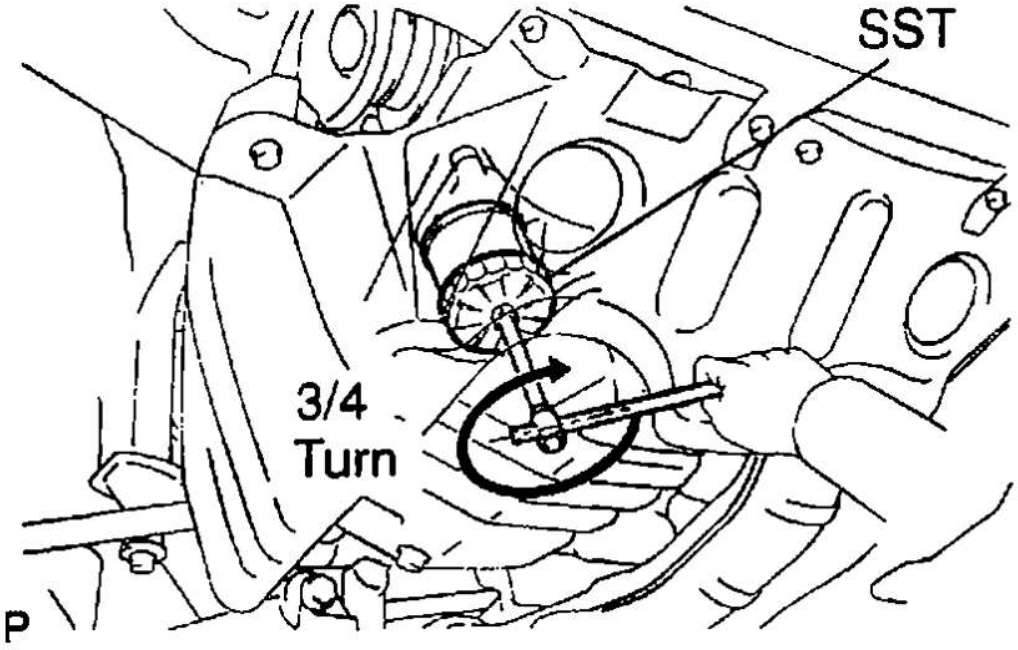


Fig. 7: Tightening Oil Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Using SST, tighten it an additional 3/4 turn.
SST 09228-06501

4. **Refill with engine oil** .
   a. Clean and install the oil drain plug with a new gasket.
   Torque: 24.5 N.m (250 kgf.cm, 18 ft.lbf)

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Fig. 8: Displaying Additional 3/4 Turn Tightening
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Fill with fresh engine oil.

Drain and refill	w/ Oil filter change	4.2 liters (4.6 US qts, 3.7 Imp. qts)
	w/o Oil filter change	4.0 liters (4.2 US qts, 3.5 Imp. qts)
Dry fill		4.9 liters (5.2 US qts, 4.3 Imp. qts)

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Fig. 9: Displaying Engine Oil Capacity
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the oil filter cap.

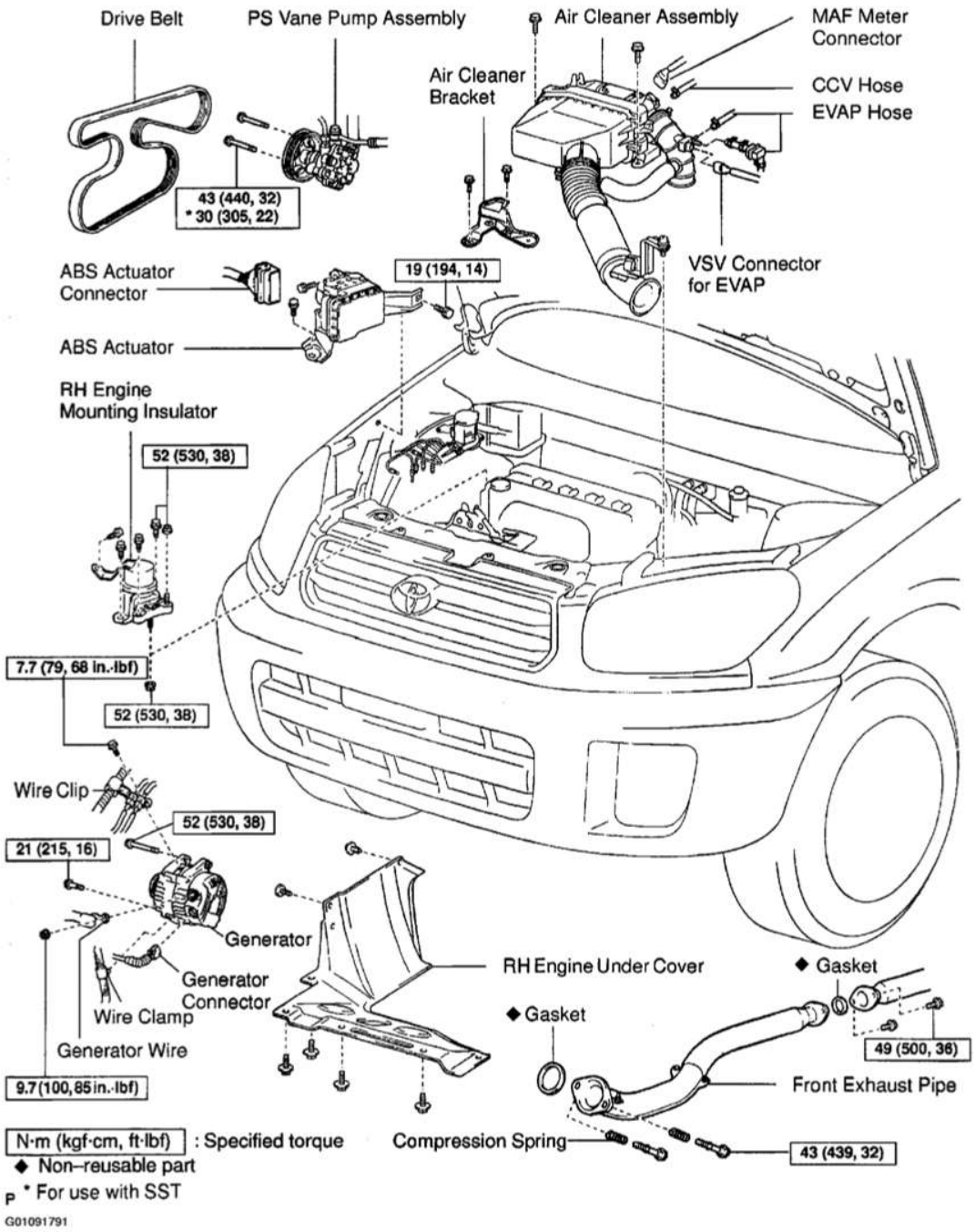
5. **Start engine and check for oil leaks** .
6. **Install center engine under cover** .

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7. **Recheck engine oil level** .

OIL PUMP

COMPONENTS



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Fig. 10: View Of Engine Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

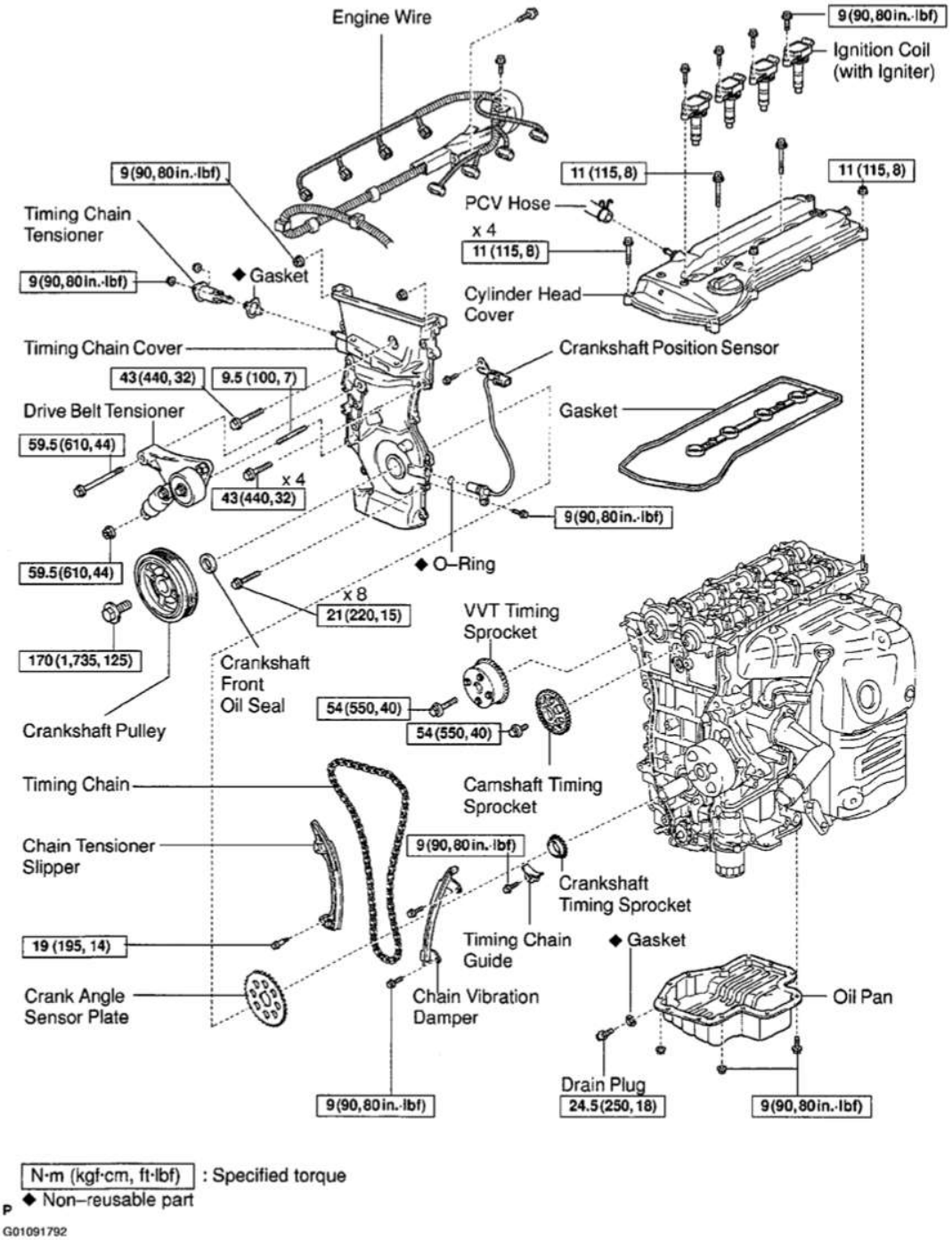


Fig. 11: View Of Engine Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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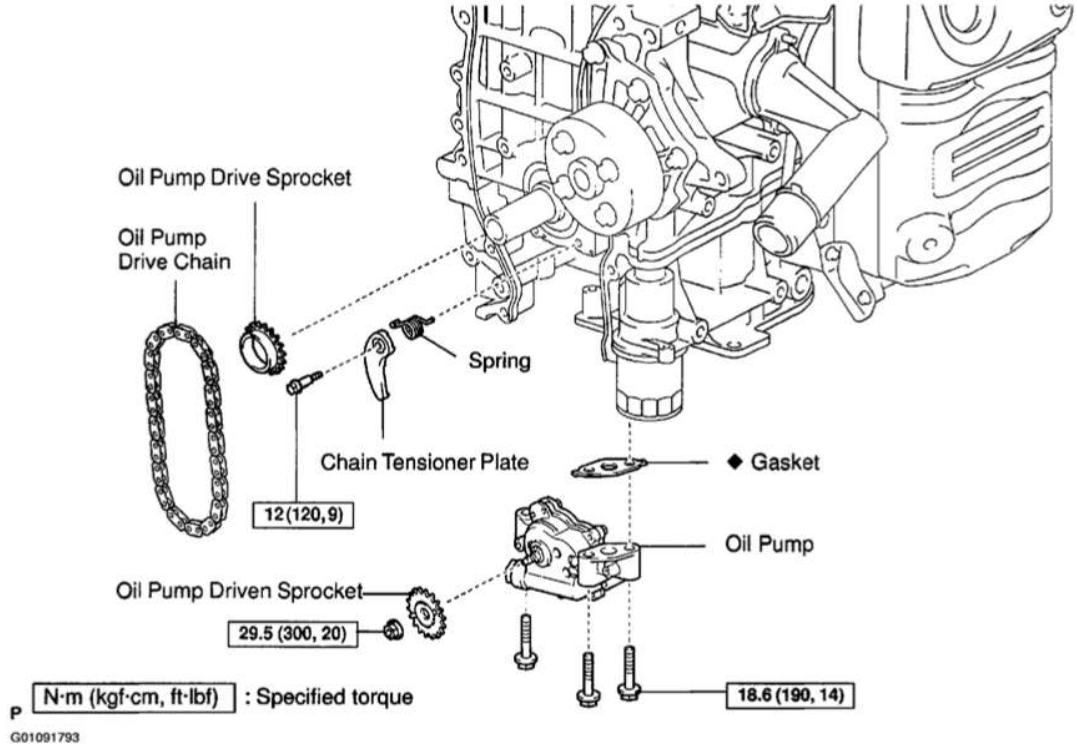


Fig. 12: Displaying Oil Pump Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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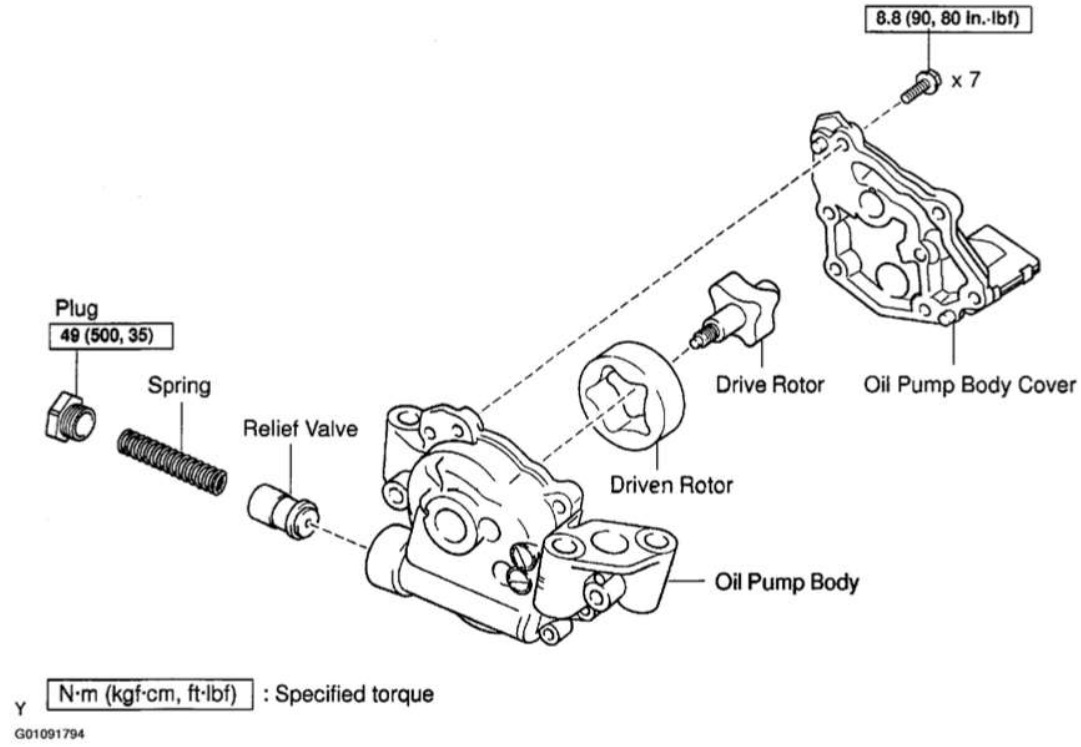


Fig. 13: Displaying Oil Pump Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

1. **Drain engine oil** .
2. **Remove front exhaust pipe** .

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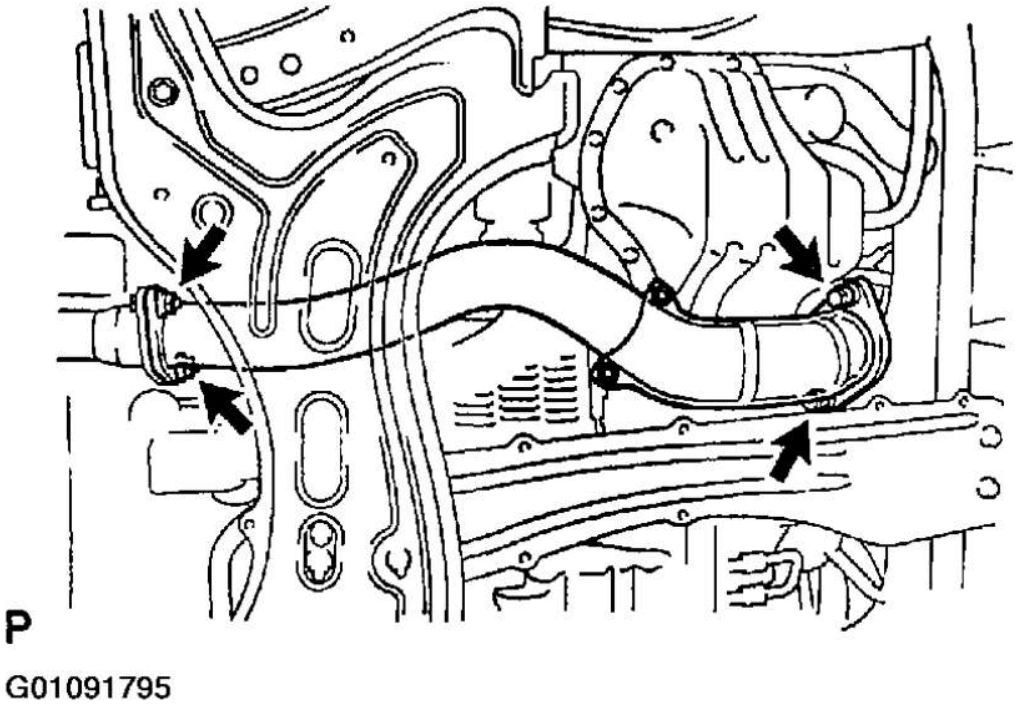


Fig. 14: Displaying Front Exhaust Pipe Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Remove 4 bolts, 2 compression springs, 2 gaskets and front exhaust pipe.

3. **Remove RH engine under cover.**
4. **Remove oil pan.**
   a. Remove the 12 bolts and 2 nuts.

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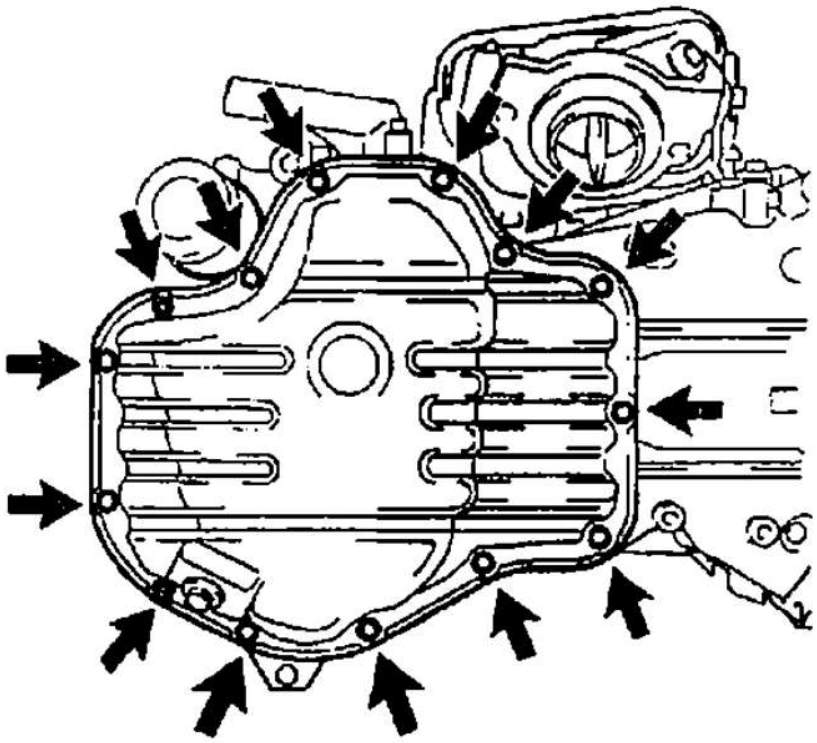


Fig. 15: Removing Oil Pan Bolts & Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Insert the blade of SST between the crank case and oil pan, and timing chain cover and oil pan, cut off applied sealer and remove the oil pan.

SST 09032-00100

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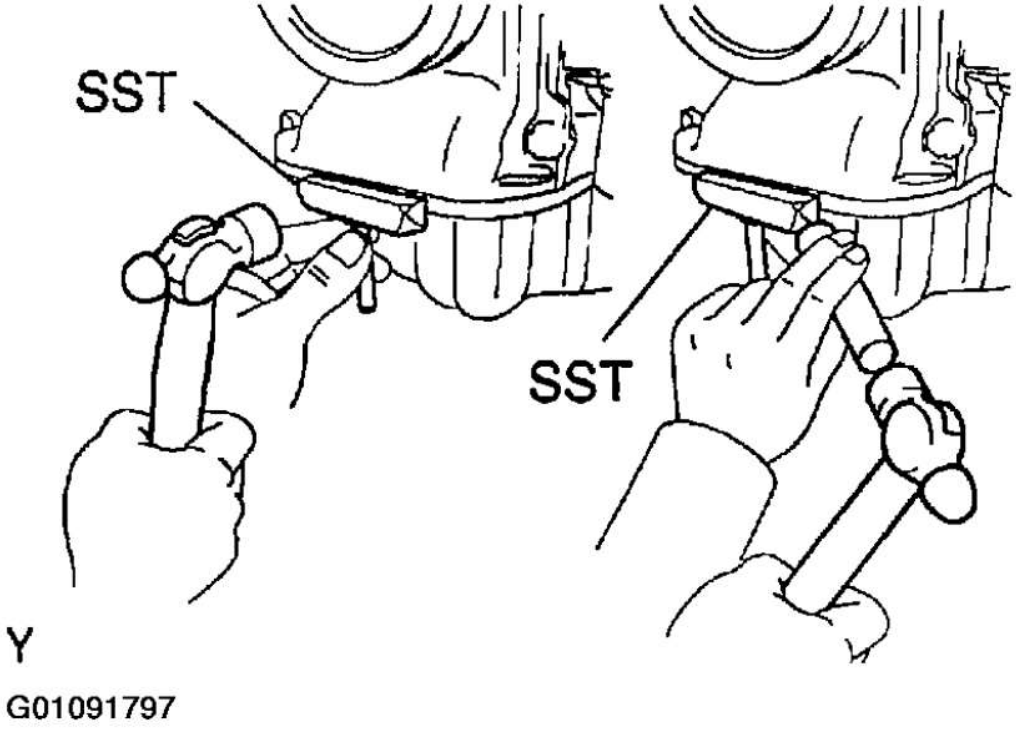


Fig. 16: Removing Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **Be careful not to damage the contact surface of the timing chain cover, crank case and oil pan.**

5. **Remove air cleaner assembly (See REMOVAL) .**
6. **Remove ABS actuator (See ACTUATOR/ABS ECU).**
7. **Remove RH engine mounting insulator (See REMOVAL) .**
8. **Remove timing chain and crankshaft timing sprocket (See REMOVAL) .**
9. **Remove oil pump drive chain and sprockets .**
   a. Set the crankshaft key into the left horizontal position.
   b. Remove the bolt, chain tensioner plate and spring.

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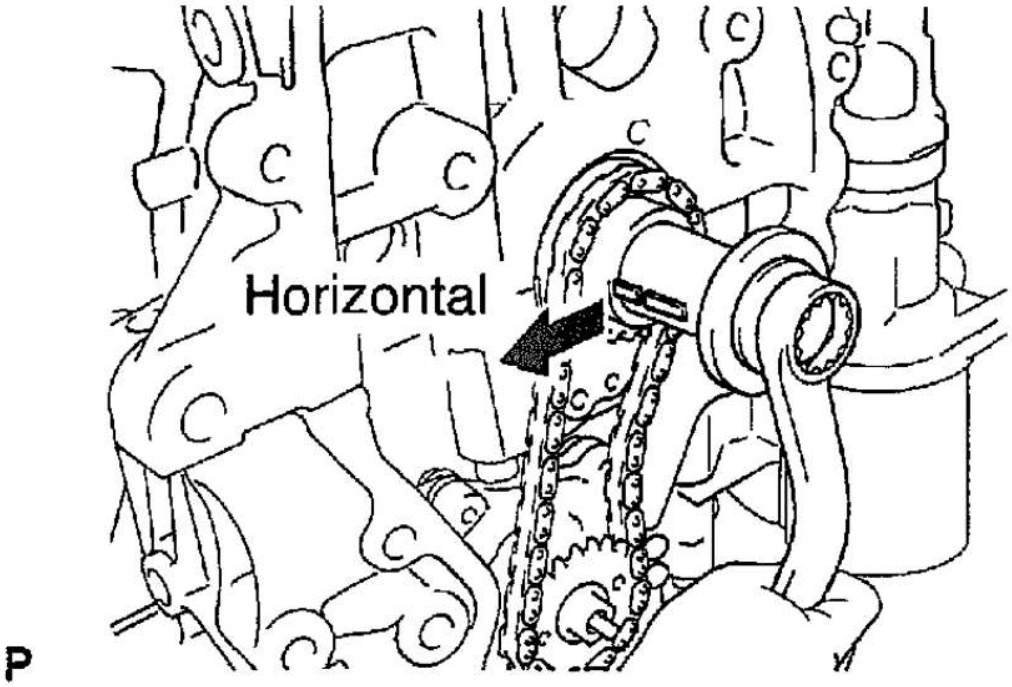


Fig. 17: Displaying Appropriate Crankshaft Setting
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a screwdriver, hold the oil pump drive shaft sprocket as shown in the illustration.
d. Remove the nut, 2 sprockets and drive chain.

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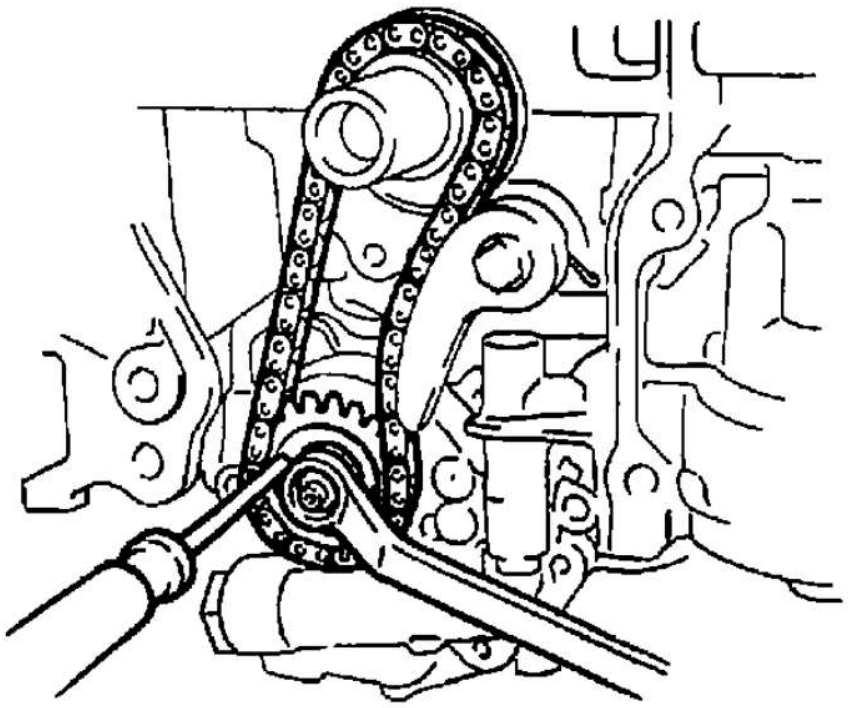


Fig. 18: Removing Sprockets & Drive Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **Remove oil pump** .

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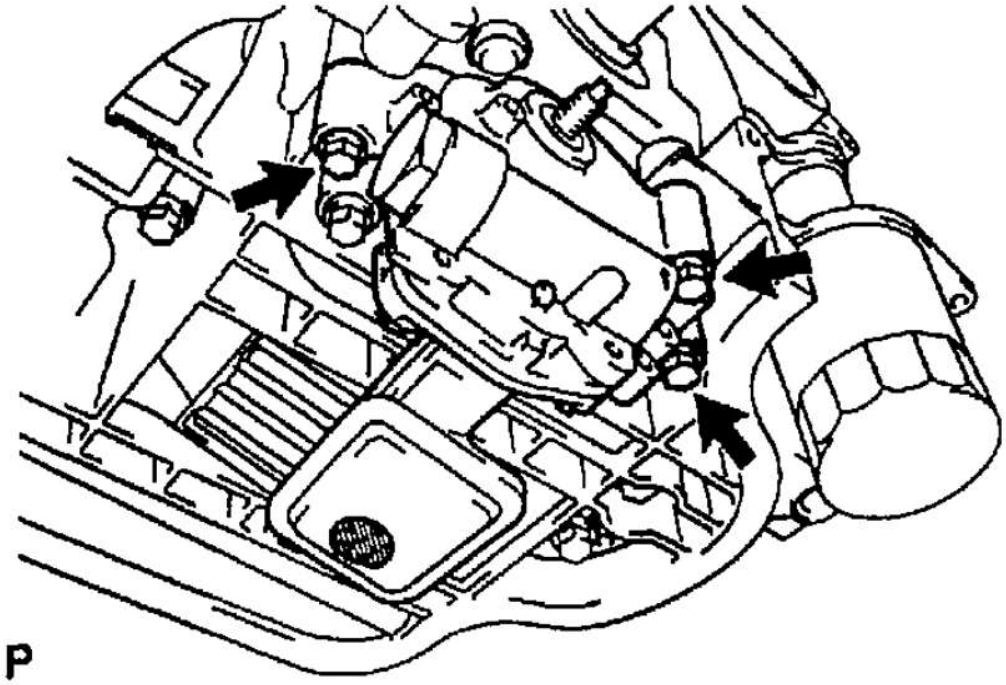


Fig. 19: Removing Oil Pump
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Remove the 3 bolts, oil pump and gasket.

DISASSEMBLY

1. **Remove relief valve** .

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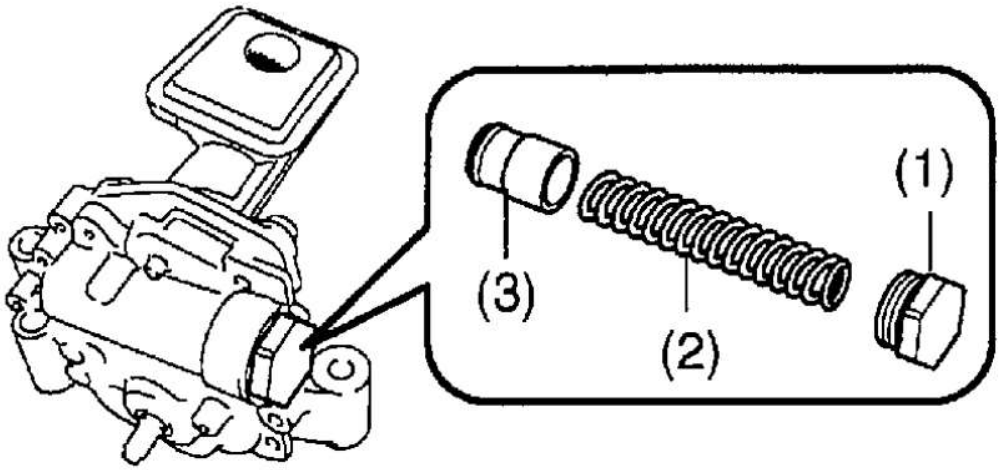


Fig. 20: Removing Relief Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Remove the plug (1), spring (2) and relief valve (3).

2. **Remove drive and driven rotors** .

Remove the 7 bolts, pump body cover, drive and driven rotors.

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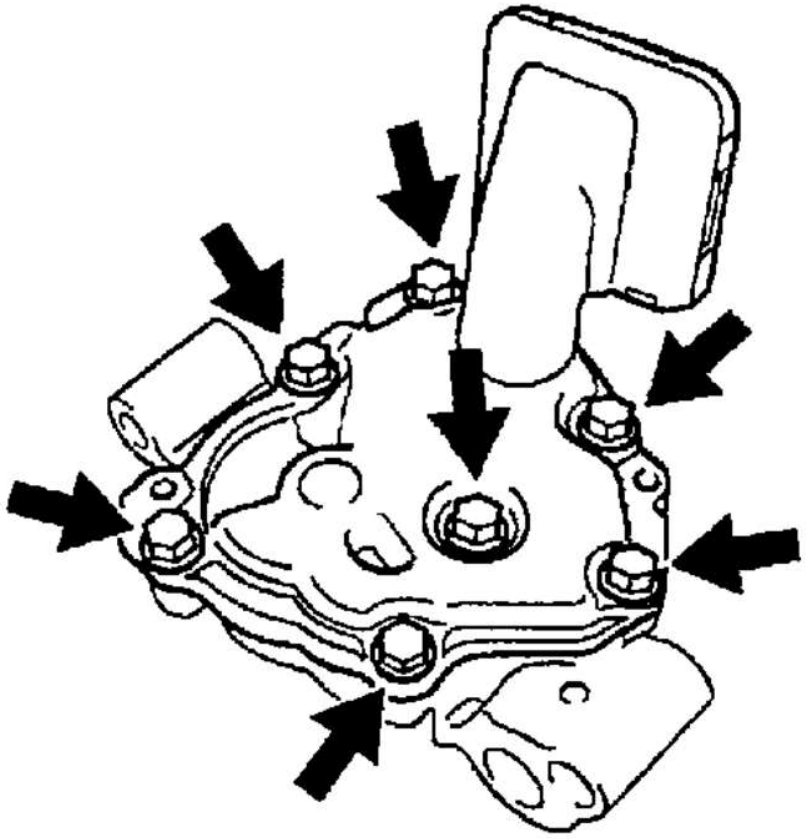


Fig. 21: Removing Drive & Driven Rotor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **Inspect oil jet.**

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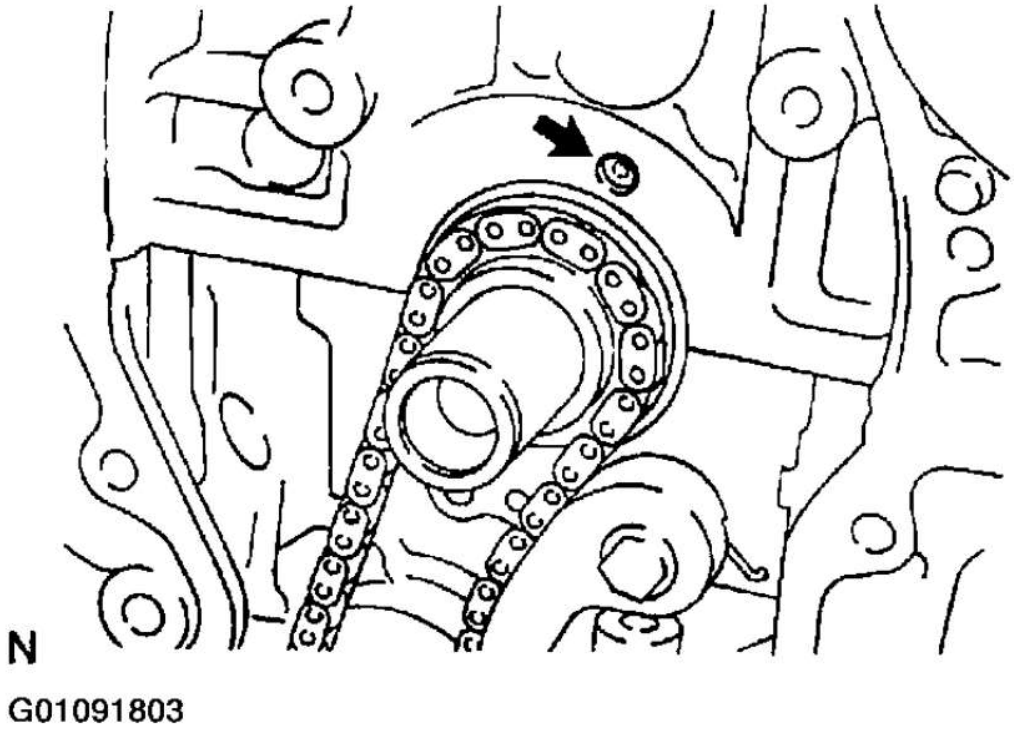


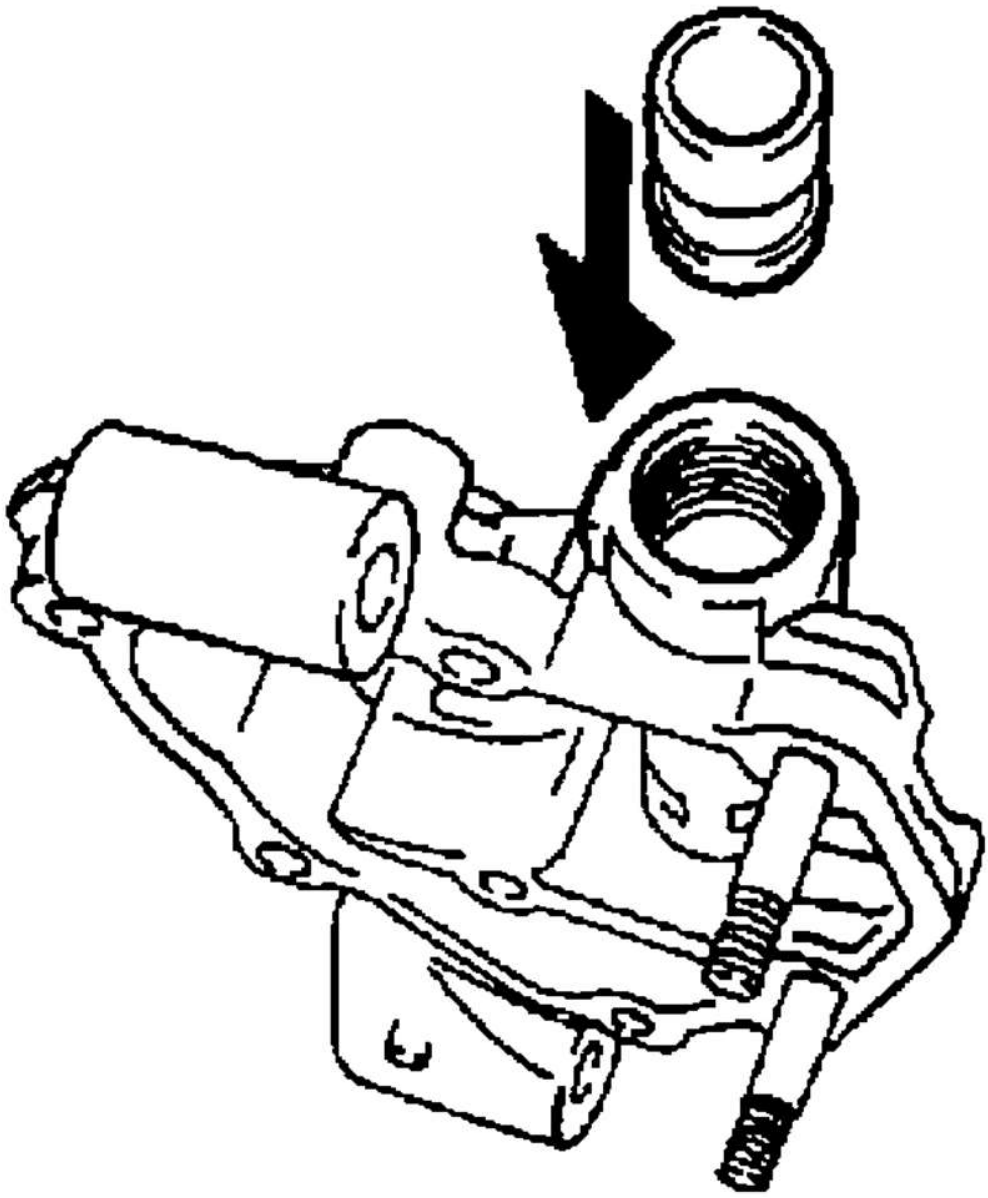
Fig. 22: Checking Oil Jet
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Check the oil jet for damage or clogging.

If necessary, replace the cylinder block.

2. **Inspect relief valve** .

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Fig. 23: Inspecting Relief Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Coat the valve with engine oil and check that it falls smoothly into the valve hole by its own weight.

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If it does not, replace the relief valve. If necessary, replace the oil pump assembly.

3. **Inspect drive and driven rotors** .
   a. Place the drive and driven rotors into the oil pump body. (See **REASSEMBLY**).
   b. Inspect for the tip clearance.

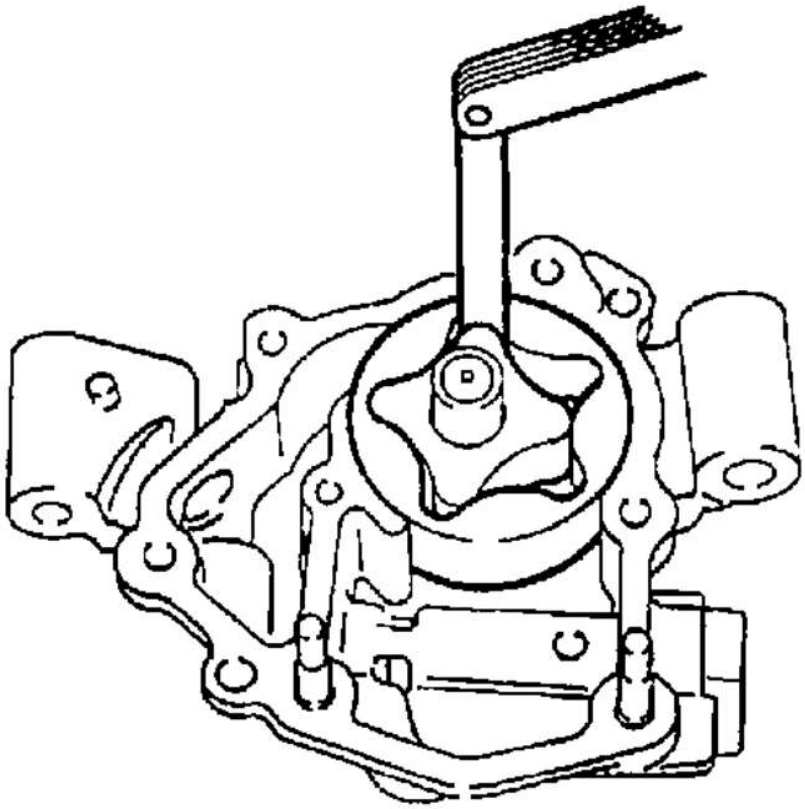


Fig. 24: Measuring Clearance Between Drive & Drive Rotor Tips
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a feeler gauge, measure the clearance between the drive and driven rotor tips.

Standard tip clearance: 0.080 - 0.160 mm (0.0031 - 0.0063 in.)
Maximum tip clearance: 0.35 mm (0.0138 in.)

If the tip clearance is greater than maximum, replace the rotors as a set.

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c. Inspect for the side clearance.

Using a feeler gauge and precision straight edge, measure the clearance between the rotors and precision straight edge.

Standard side clearance: 0.030 - 0.085 mm (0.0012 - 0.0033 in.)

Maximum side clearance: 0.16 mm (0.0063 in.)

If the side clearance is greater than maximum, replace the rotors as a set. If necessary, replace the oil pump assembly.

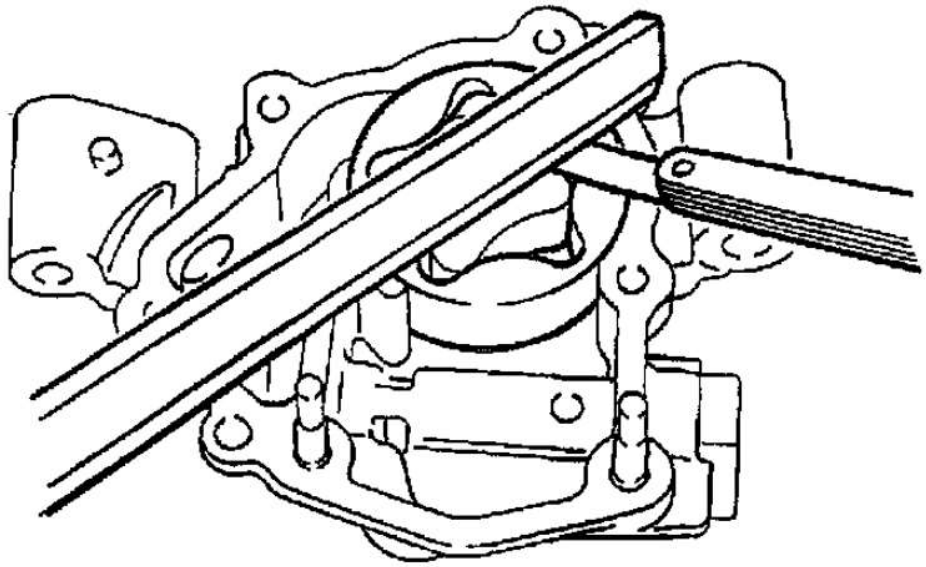


Fig. 25: Measuring Clearance Between Rotor & Precision Straight Edge
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Inspect for the body clearance.

Using a feeler gauge, measure the clearance between the driven rotor and body.

Standard body clearance: 0.100 - 0.170 mm (0.0039 - 0.067 in.)

Maximum body clearance: 0.325 mm (0.0128 in.)

If the body clearance is greater than maximum, replace the rotors as a set. If necessary, replace the

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oil pump assembly.

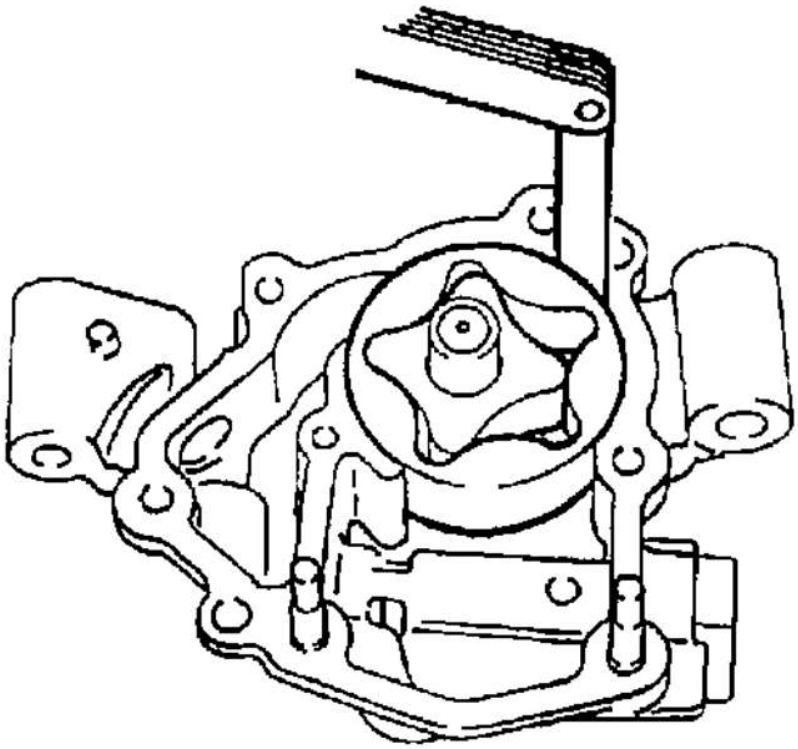


Fig. 26: Measuring Distance Between Driven Rotor & Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Inspect oil pump drive chain and oil pump sprockets** .
   a. Using vernier calipers, measure the length of the 8 links with the chain dully stretched.
      Maximum chain elongation: 52.4 mm (2.063 in.)

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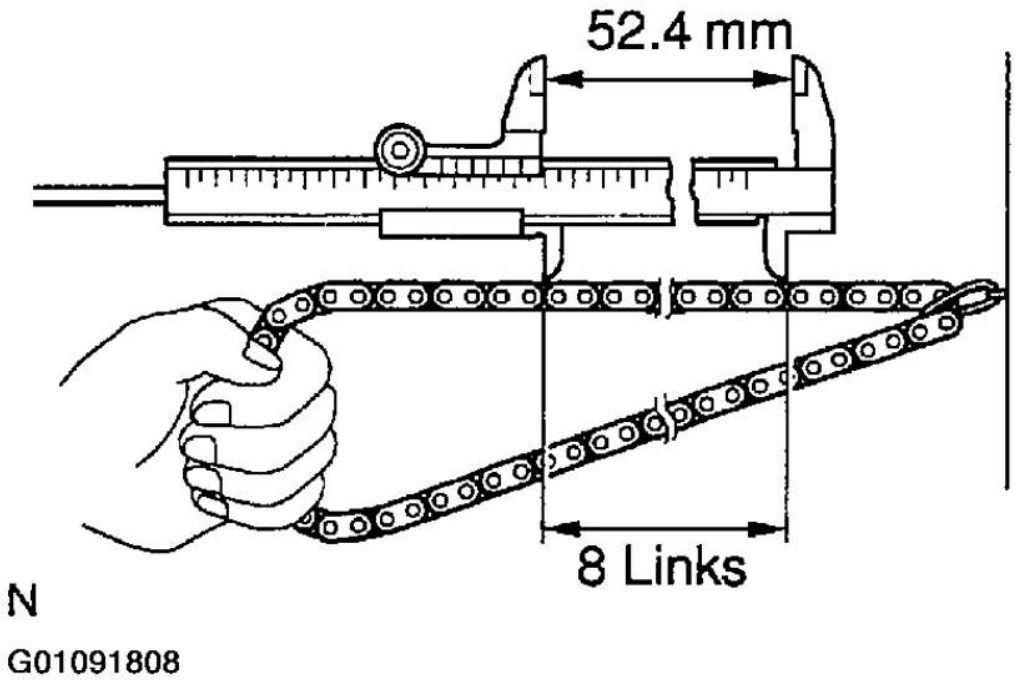


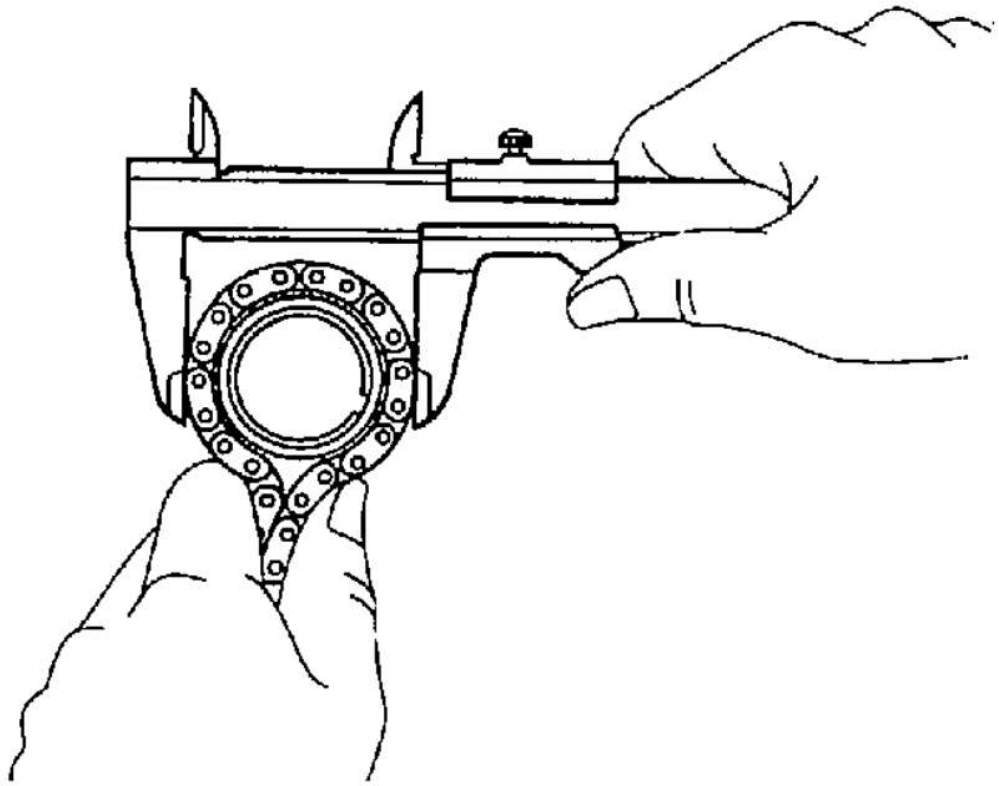
Fig. 27: Measuring Length Of The 8 Links
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

NOTE: Make the same measurements pulling at 3 or more places selected at random.

b. Wrap the chain around the oil pump sprocket.
c. Using vernier calipers, measure the sprocket diameter with the chain.

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Fig. 28: Measuring Sprocket Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Vernier calipers must contact the chain rollers for measuring

Minimum sprockets diameter (w/ chain): 48.2 mm (1.898 in.)

If the diameter is less than minimum, replace the chain and 2 sprockets.

5. **Inspect chain tensioner plate** .

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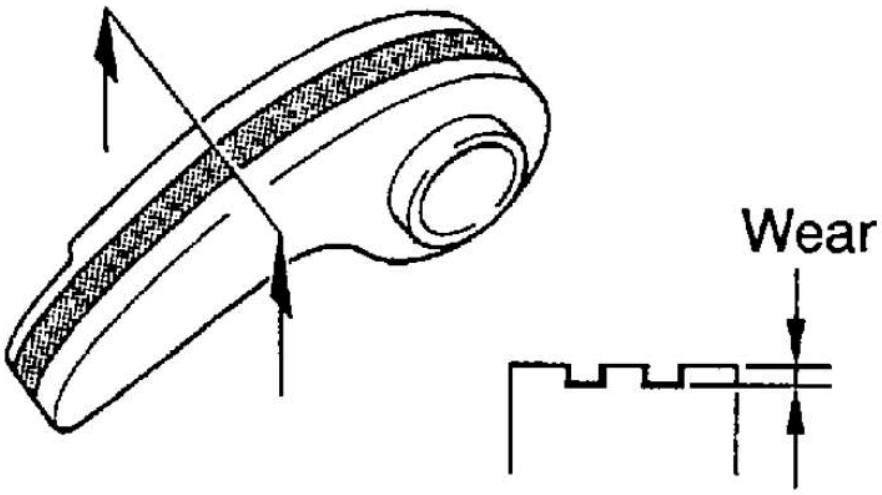


Fig. 29: Inspecting Chain Tensioner Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Measure the chain tensioner plate wear.

Maximum wear: 0.5 mm (0.020 in.)

If the wear is greater than maximum, replace the chain tensioner plate.

REASSEMBLY

1. **Install drive and driven rotors** .
   a. Place the drive and driven rotors into the pump body with the marks facing the pump body cover side.

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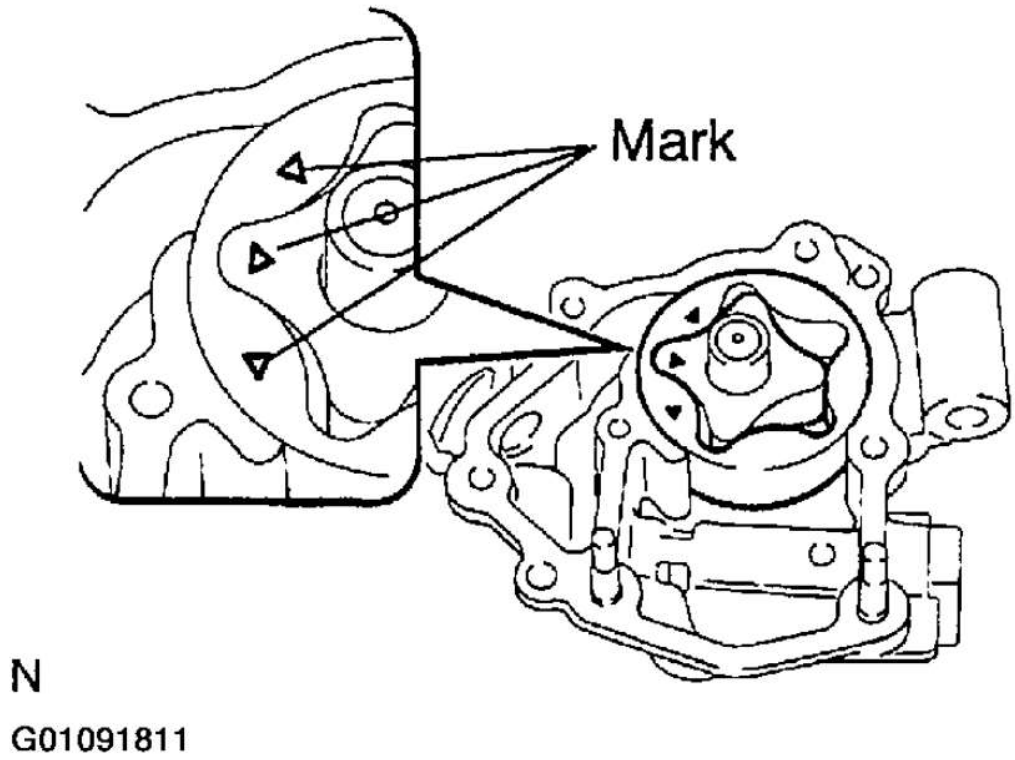


Fig. 30: Displaying Marks On Drive & Driven Rotor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the pump body cover with the 7 bolts.
Torque: 8.8 N.m (90 kgf.cm, 80 in..lbf)

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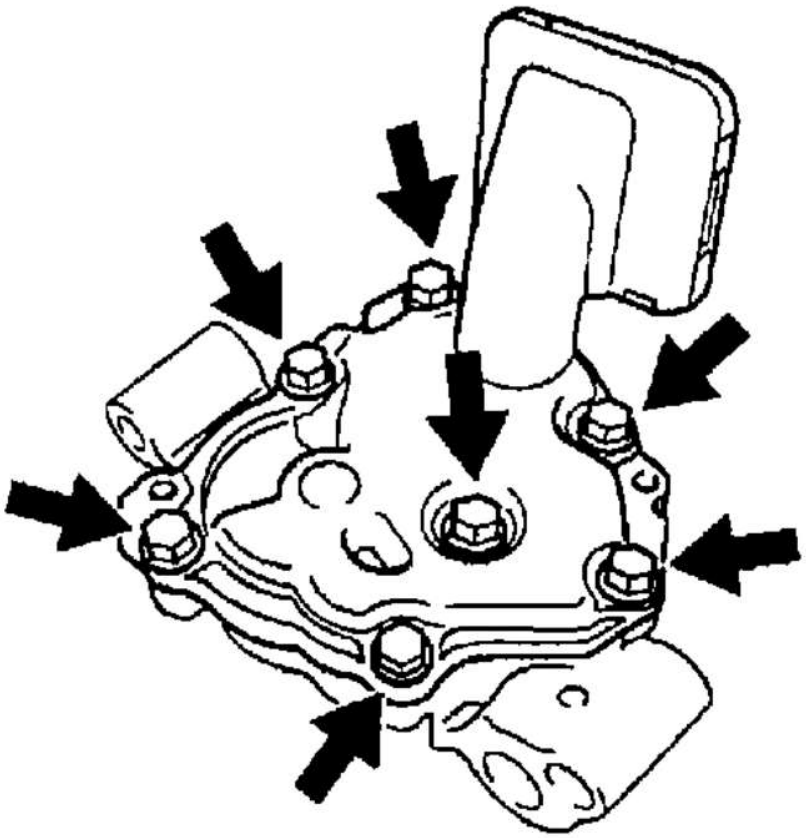


Fig. 31: Installing Pump Body Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **Install relief valve** .

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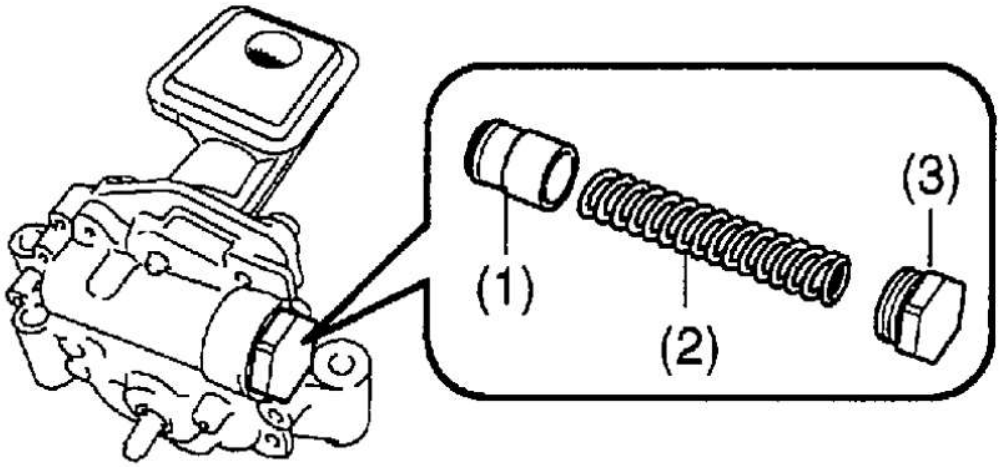


Fig. 32: Installing Relief Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Insert the relief valve (1) and spring (2) into the pump body hole, and install the plug (3).

Torque: 49 N.m (500 kgf.cm, 35 ft.lbf)

INSTALLATION

1. **Install oil pump** .

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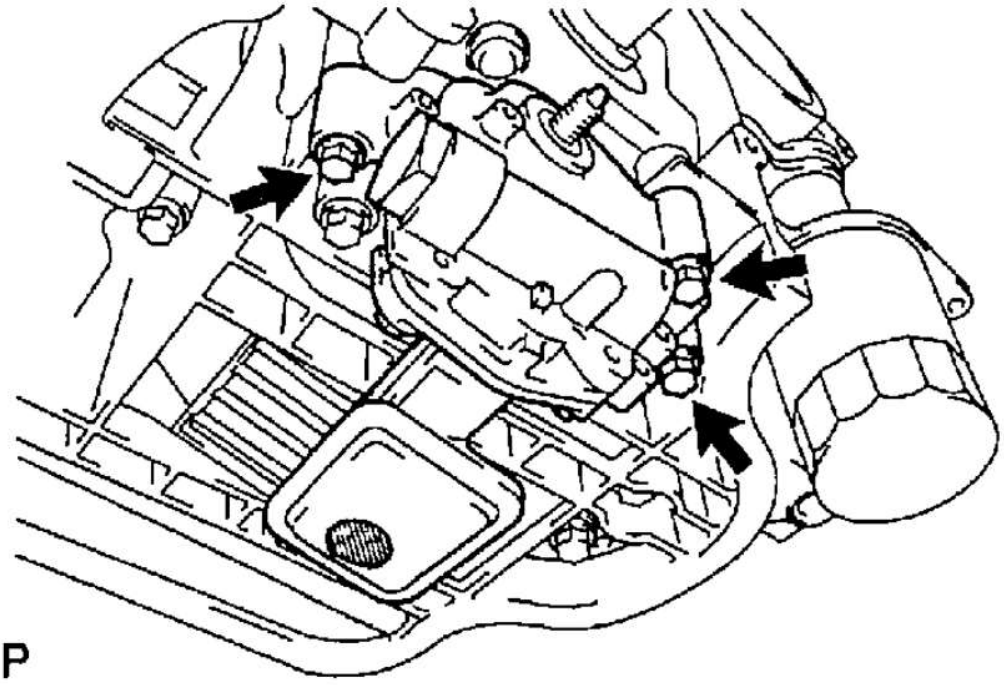


Fig. 33: Installing Oil Pump
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install a new gasket and the oil pump with the 3 bolts.

Torque: 18.6 N.m (190 kgf.cm, 14 ft.lbf)

2. **Install drive chain and sprockets** .
   a. Set the crankshaft key into the left horizontal position and turn the cutout of the drive shaft to the top.

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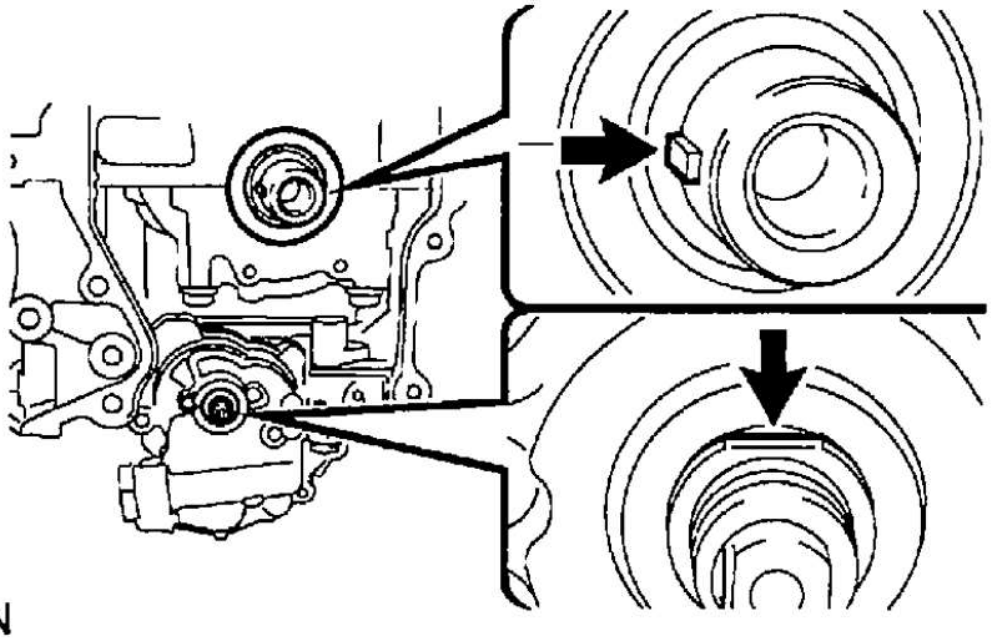


Fig. 34: Installing Drive & Sprockets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Set the chain on the 2 sprockets as shown in the illustration.

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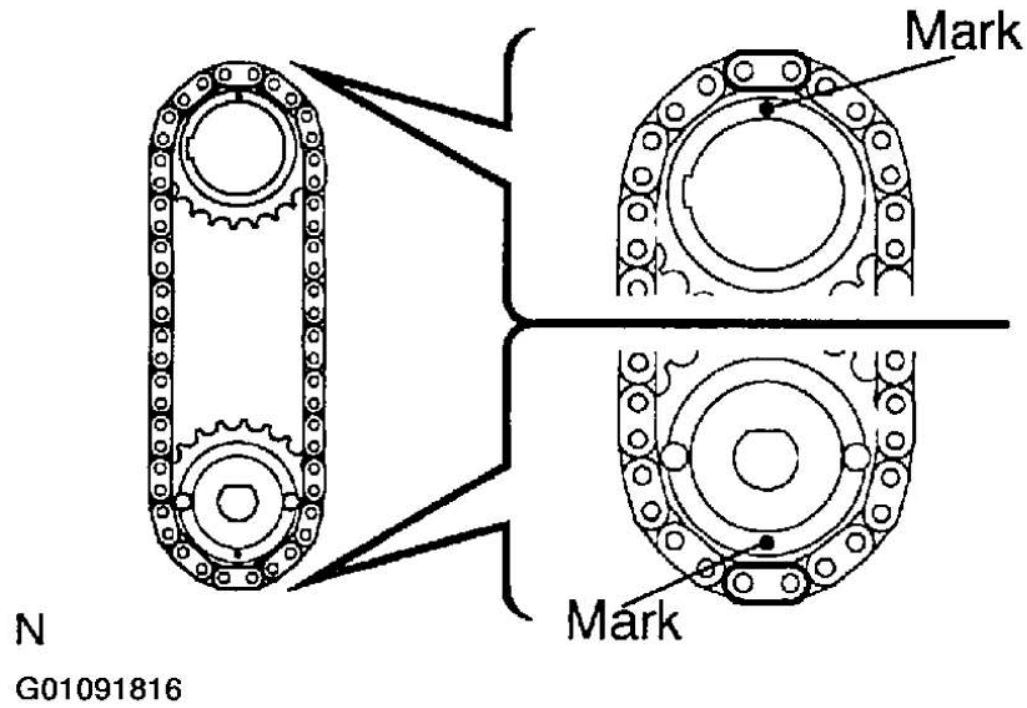


Fig. 35: Setting Chain On 2 Sprockets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **Set the mark on the oil pump drive sprocket at the colored link in the chain.**
- **Set the mark on the oil pump drive shaft sprocket at the colored link.**

c. Install the chain and 2 sprockets with the nut.

Torque: 29.5 N.m (300 kgf.cm, 20 ft.lbf)

3. **Install chain tensioner** .

Install the spring and plate with the bolt.

Torque: 12 N.m (120 kgf.cm, 9ft.lbf)

4. **Install oil pan** .
   a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing chain/crank case and oil pan.
      - Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the

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gasket surfaces and sealing grooves.

- Thoroughly clean all components to remove all the loose material.
- Using a non-residue solvent, clean both sealing surfaces.

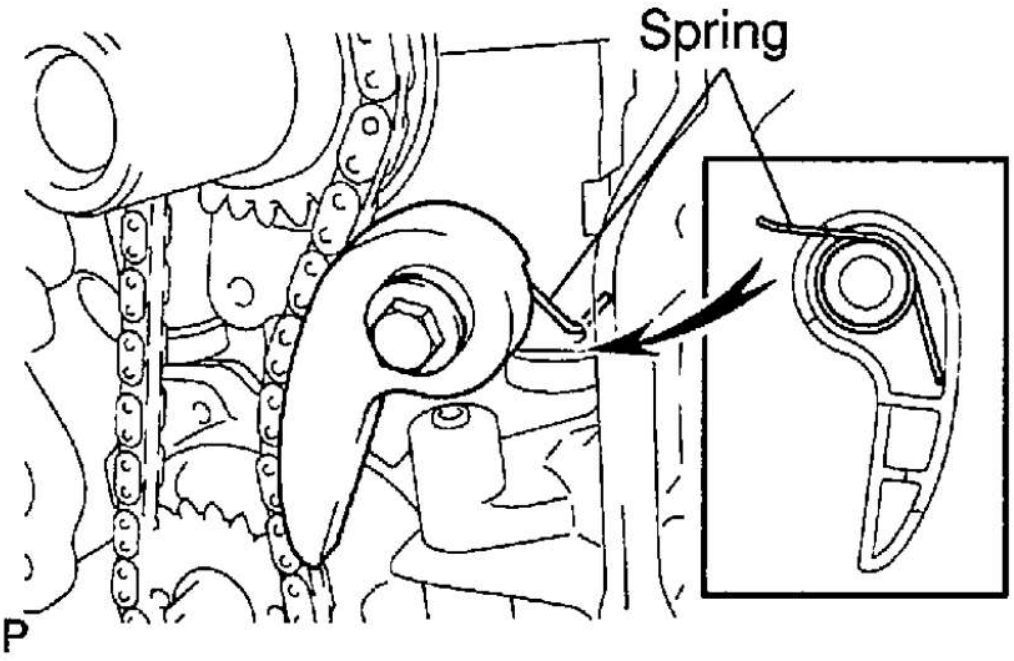


Fig. 36: Displaying Spring Proper Installation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not use a solvent which will affect the painted surfaces.

b. Apply seal packing to the oil pan as shown in the illustration.
Seal packing: Part No. 08826 - 00080 or equivalent

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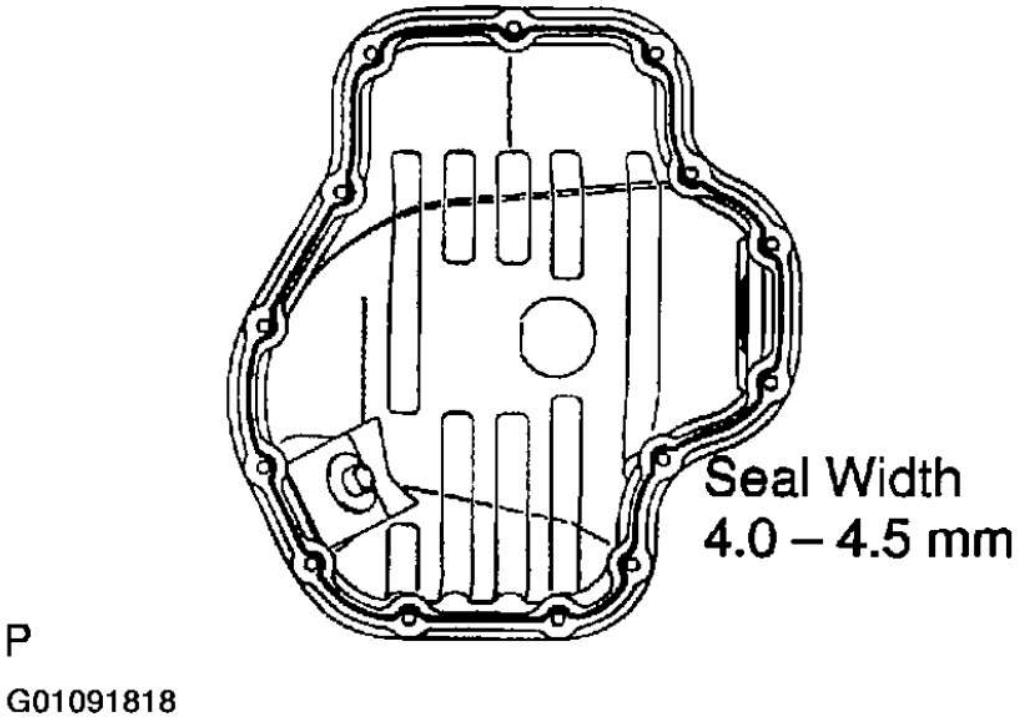


Fig. 37: Displaying Oil Pan & Seal Packing Width
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Install a nozzle that has been cut to a 4.0 - 4.5 mm (0.16 - 0.18 in.) opening.

NOTE: Avoid applying an excessive amount to the surface.

- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

c. Install the oil pan with the 12 bolts and 2 nuts.

Torque: 9 N.m (90 kgf.cm, 80 in..lbf)

5. **Install crankshaft timing sprocket and timing chain (See INSTALLATION) .**
6. **Install RH engine mounting insulator (See INSTALLATION) .**
7. **Install ABS actuator (See ACTUATOR/ABS ECU) .**
8. **Install air cleaner assembly (See INSTALLATION) .**

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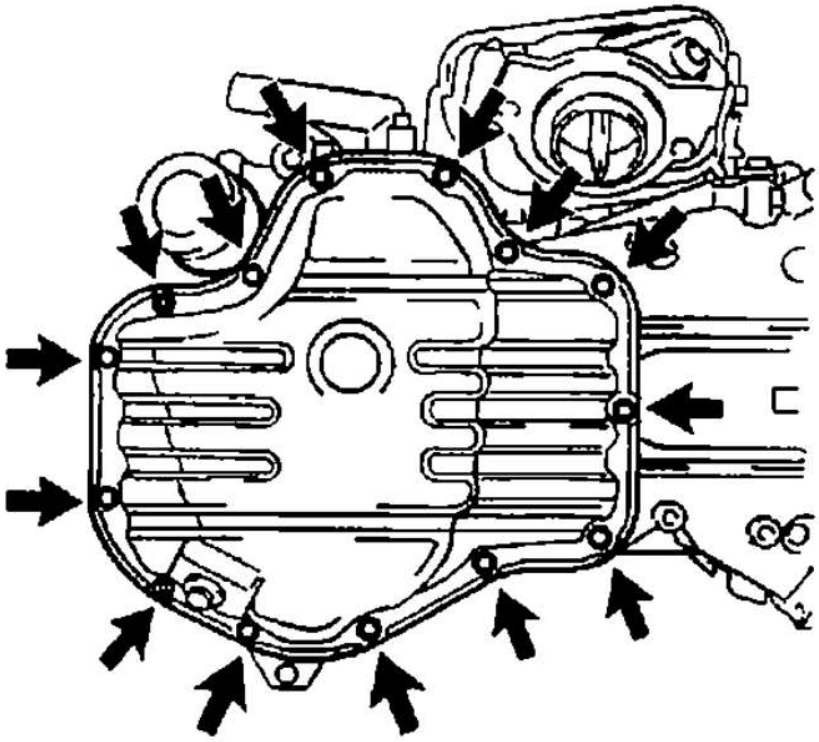


Fig. 38: Installing Oil Pan
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **Install front exhaust pipe** .

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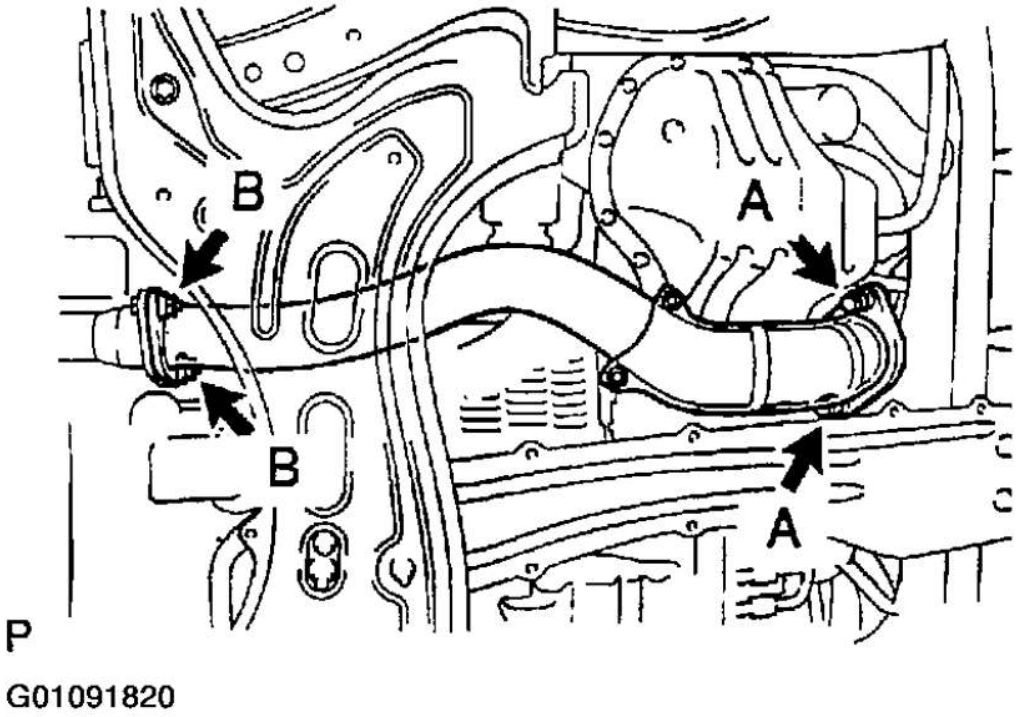


Fig. 39: Installing Front Exhaust Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install 2 new gaskets and front exhaust pipe with the 2 compression springs and 4 bolts.

Torque:

43 N.m (439 kgf.cm, 32 ft.lbf) for bolt A
49 N.m (500 kgf.cm, 36 ft.lbf) for bolt B

10. **Install engine under cover** .
11. **Fill engine with oil** .
12. **Start engine and check for leaks** .
13. **Recheck engine oil level** .

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2001-03 ENGINES

Engine Mechanical - 2.0L 4-Cylinder - RAV4

COMPRESSION

INSPECTION

NOTE: If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. **Warm up and stop engine** .

   Allow the engine to warm up to normal operating temperature.

2. **Remove ignition coils (See REMOVAL & INSTALLATION (RAV4))** .
3. **Remove spark plugs** .
4. **Inspect cylinder compression pressure** .
   a. Insert a compression gauge into the spark plug hole.
   b. Fully open the throttle.
   c. While cranking the engine, measure the compression pressure.

      NOTE: Always use a fully charged battery to obtain engine speed of 250 RPM or more.

   d. Repeat steps (a) through (c) for each cylinder.

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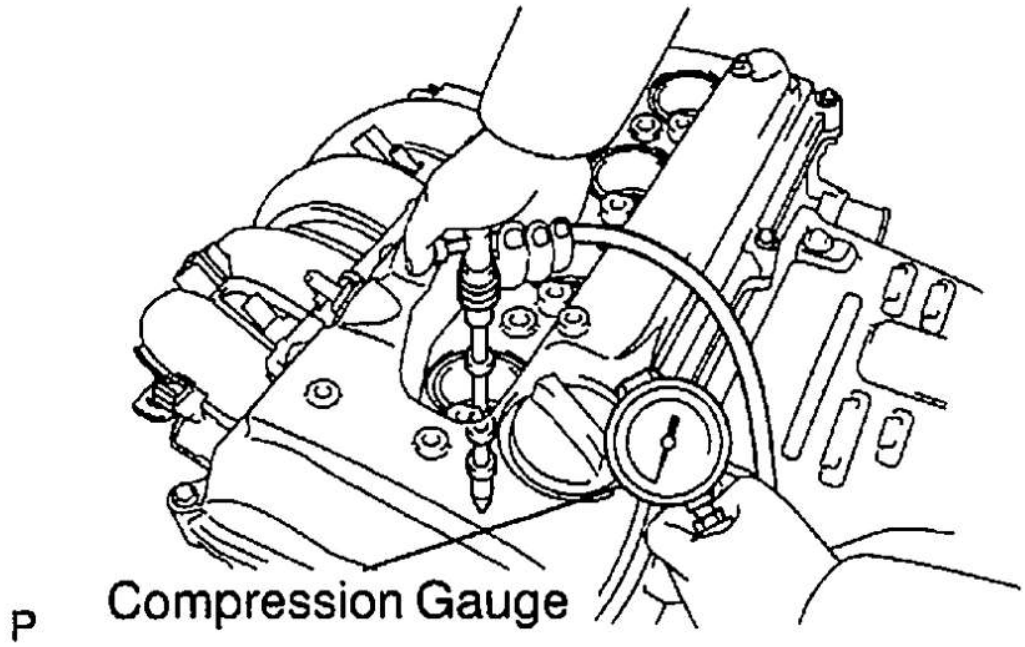


Fig. 1: Displaying Compression Gauge
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: This measurement must be done in as short a time as possible.

Compression pressure: 1,270 kPa (13.0 kgf/cm^2 , 184 psi)

Minimum pressure: 1,000 kPa (10.2 kgf/cm^2 , 145 psi)

Difference between each cylinder: 100 kPa (1.0 kgf/cm^2 , 15 psi) or less

e. If the cylinder compression in one more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for cylinders with low compression.
   - If adding oil helps the compression, it is likely that the piston rings and/or cylinder bore are worn or damaged.
   - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage through the gasket.

5. **Reinstall spark plugs** .
6. **Reinstall ignition coils (See REMOVAL & INSTALLATION (RAV4))** .

VALVE CLEARANCE

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ADJUSTMENT

NOTE: Inspect and adjust the valve clearance when the engine is cold.

1. **Remove RH engine under cover** .
2. **Remove air cleaner assembly (See REMOVAL).**
3. **Remove cylinder head cover (See REMOVAL) .**
4. **Set No. 1 cylinder to TDC/compression** .
   a. Turn the crankshaft pulley, and align its groove with timing mark 0 of the timing chain cover.

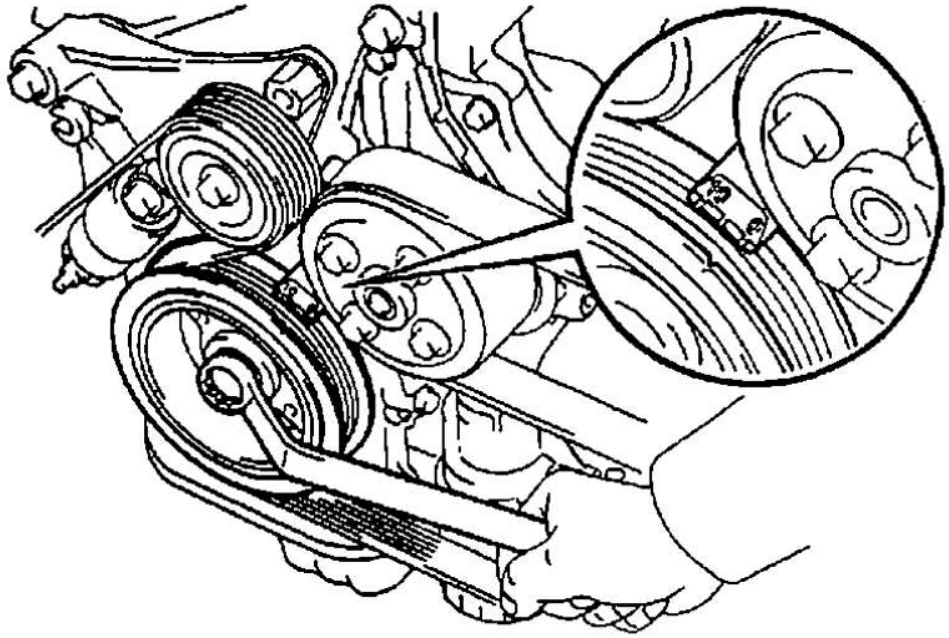


Fig. 2: Aligning Crankshaft Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Check that the timing marks of the camshaft timing sprocket and VVT timing sprocket are aligned with the timing marks of the No. 1 and No. 2 bearing caps as shown in the illustration.

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

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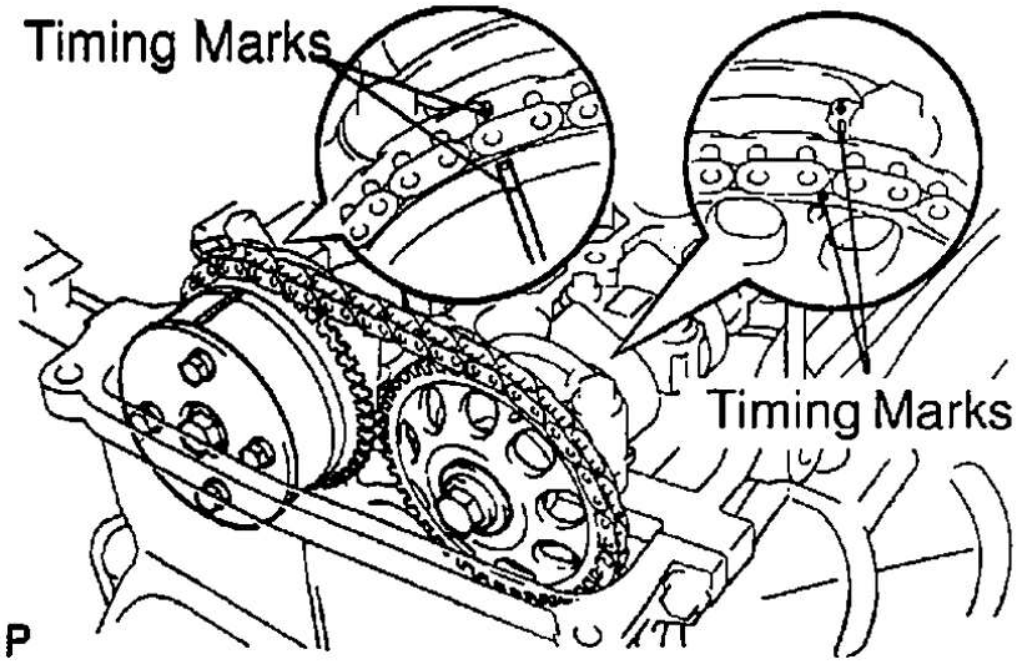


Fig. 3: Checking Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **Inspect valve clearance** .

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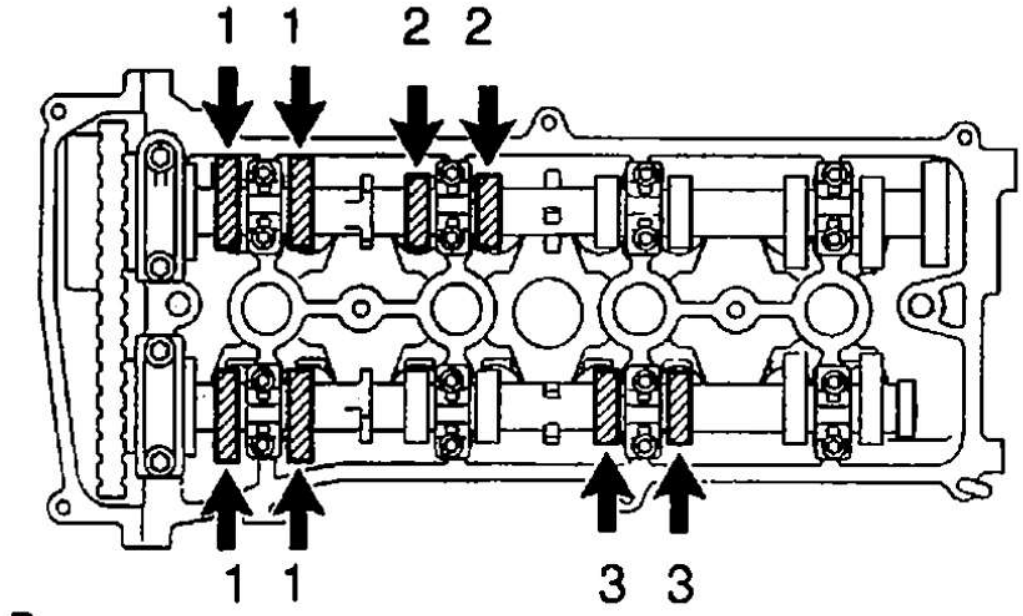


Fig. 4: Locating Valves Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Check only the valves indicated.
   1. Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
   2. Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting valve lifter.

Valve clearance (Cold):

Intake	0.19 – 0.29 mm (0.008 – 0.011 in.)
Exhaust	0.30 – 0.40 mm (0.012 – 0.016 in.)

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Fig. 5: Displaying Valve Clearance Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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b. Turn the crankshaft 1 revolution (360°) and align the mark as above (See step4).
c. Check only the valves indicated as shown. Measure the valve clearance (See a).

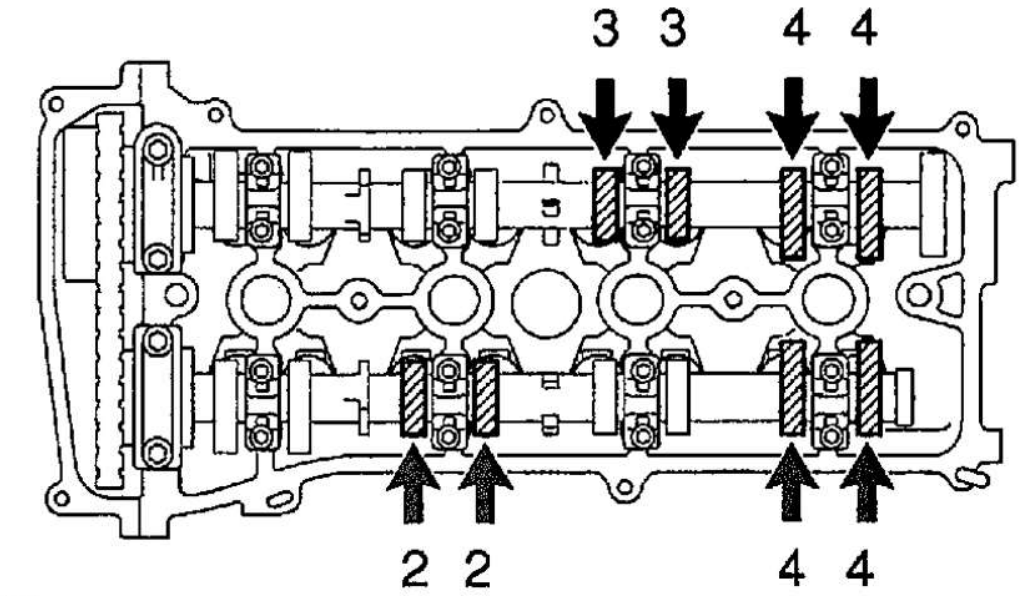


Fig. 6: Locating Indicated Valves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **Adjust valve clearance** .
   a. Set the No. 1 cylinder to the TDC/compression (See step4).

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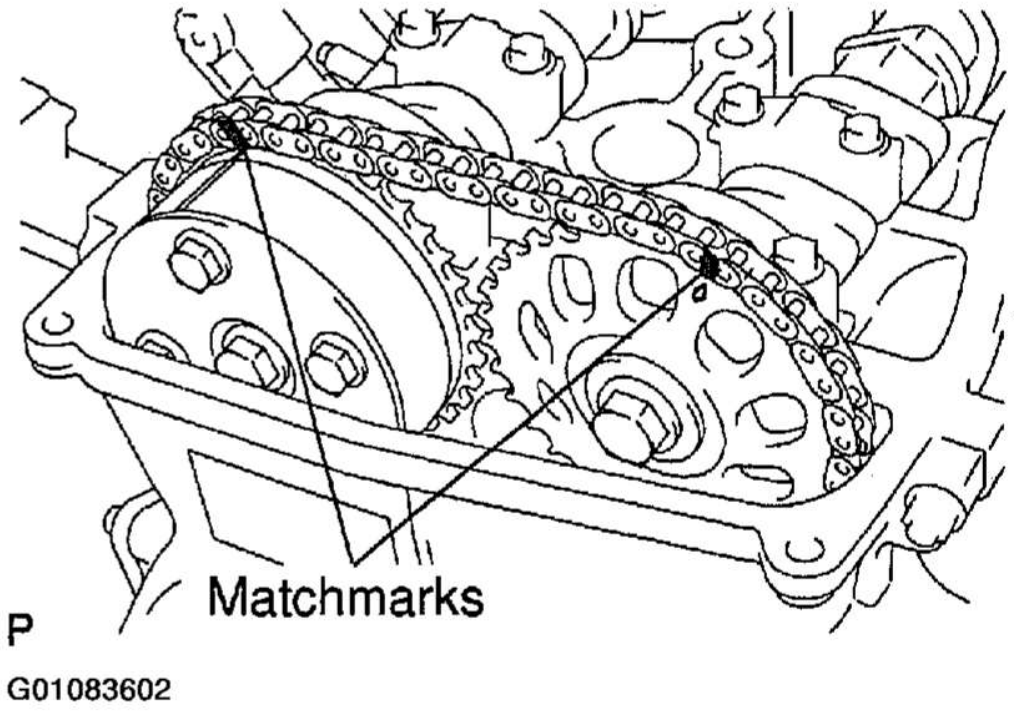


Fig. 7: Locating Timing Chain Match Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Place matchmarks on the timing chain and camshaft timing sprockets.
c. Remove the 2 nuts, gasket and chain tensioner.
d. Hold the hexagonal head portion of the camshaft with a wrench, and loosen the camshaft timing sprocket bolt.

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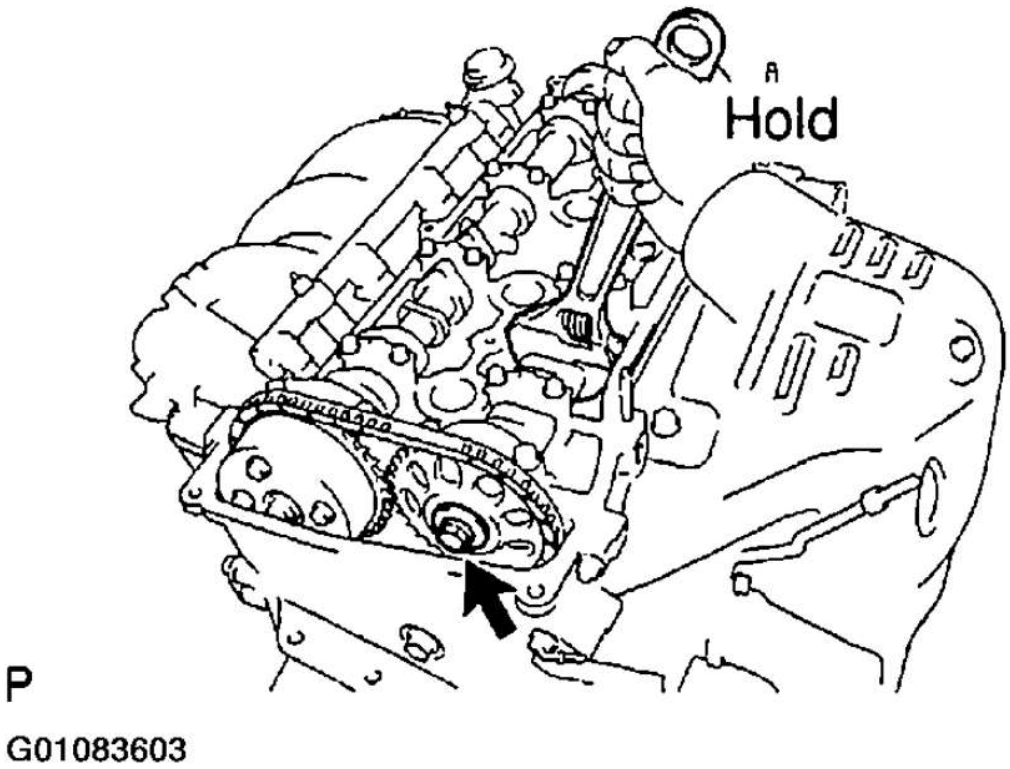


Fig. 8: Locating Camshaft Timing Sprocket Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to damage the cylinder head and valve lifter with the wrench.

e. Uniformly loosen and remove the 10 camshaft bearing cap bolts in several passes, in the sequence shown.

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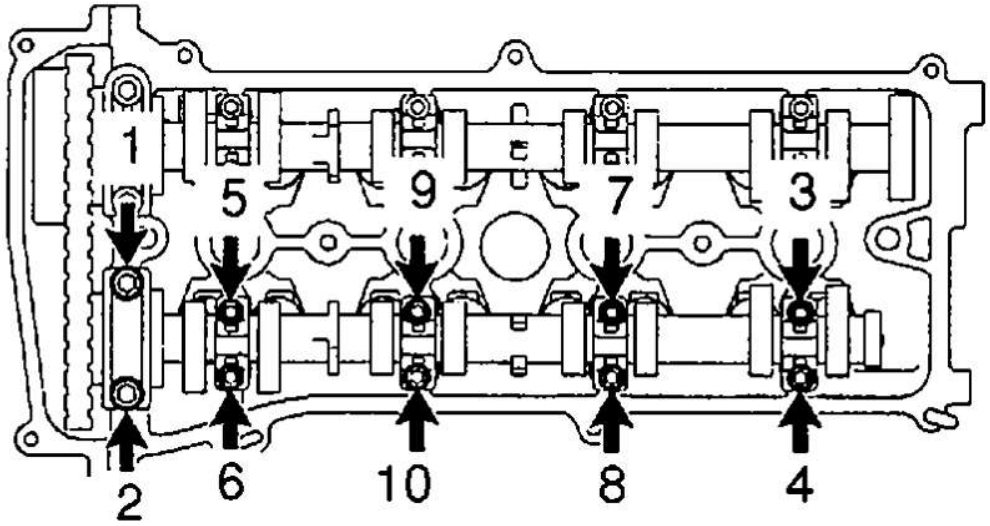


Fig. 9: Locating Camshaft Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Remove the 5 camshaft bearing caps.
g. Raising the camshaft, remove the camshaft timing sprocket bolt.

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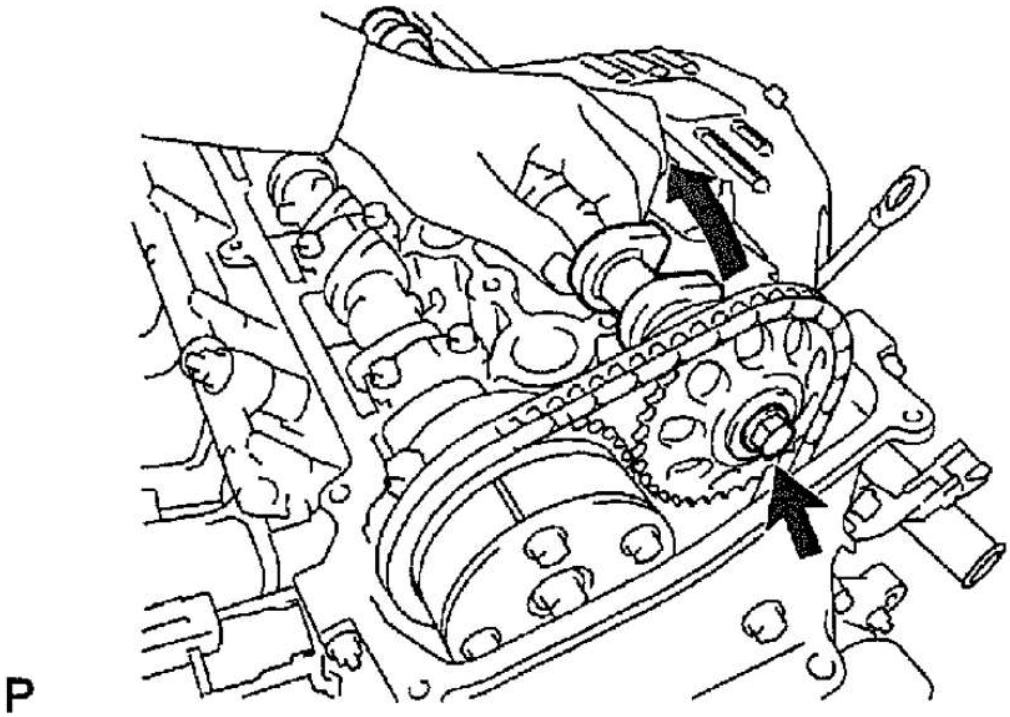


Fig. 10: Removing Camshaft Timing Sprocket Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Disconnect the camshaft timing sprocket together with the timing chain from the exhaust camshaft.
i. Remove the camshaft timing sprocket from the timing chain.
j. Uniformly loosen and remove the 10 camshaft bearing cap bolts in several passes, in the sequence shown.

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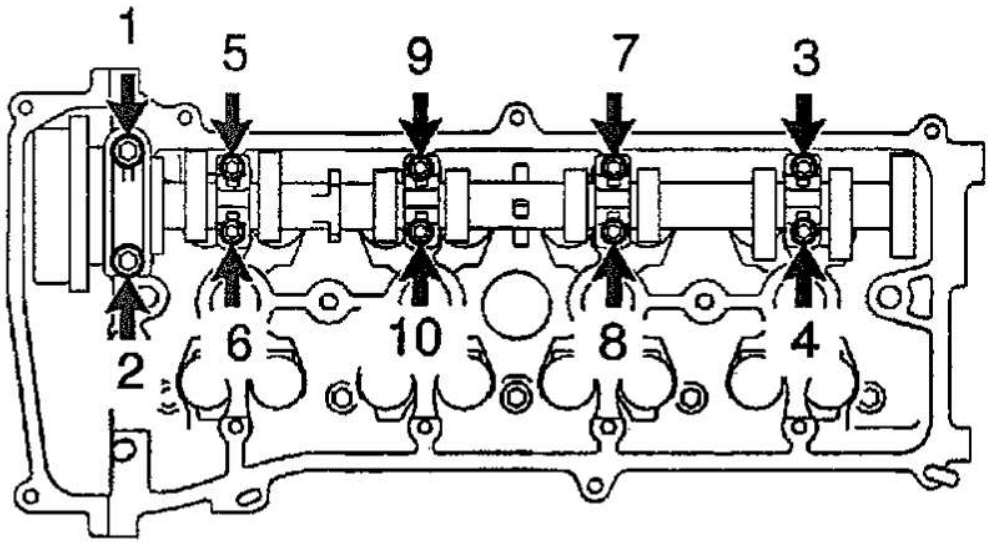


Fig. 11: Removing Camshaft Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

k. Remove the 5 camshaft bearing caps.
l. Disconnect the timing chain from the VVT timing sprocket, and remove the intake camshaft with the VVT timing sprocket.
m. Tie the timing chain as shown in the illustration.

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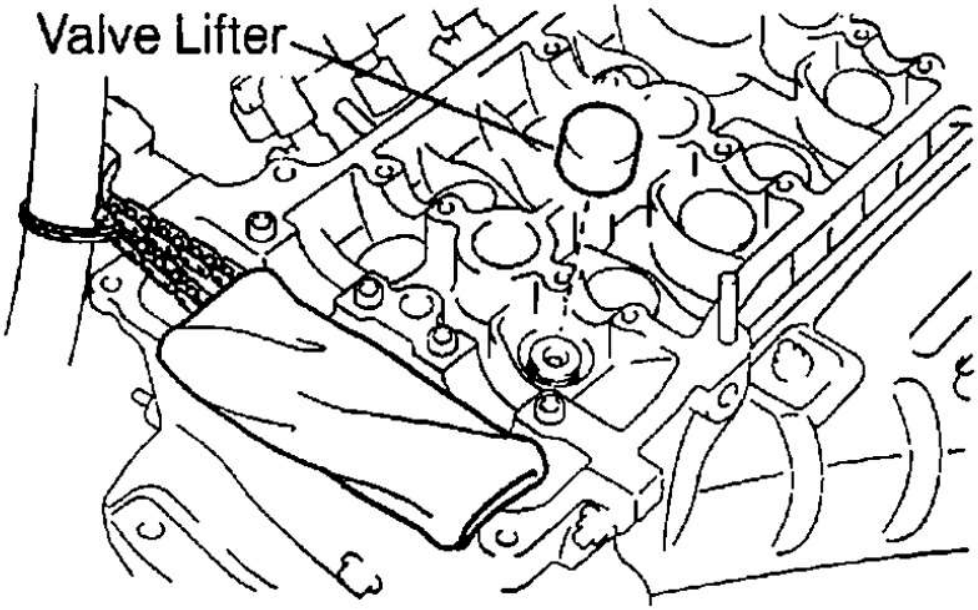


Fig. 12: Locating Valve Lifter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

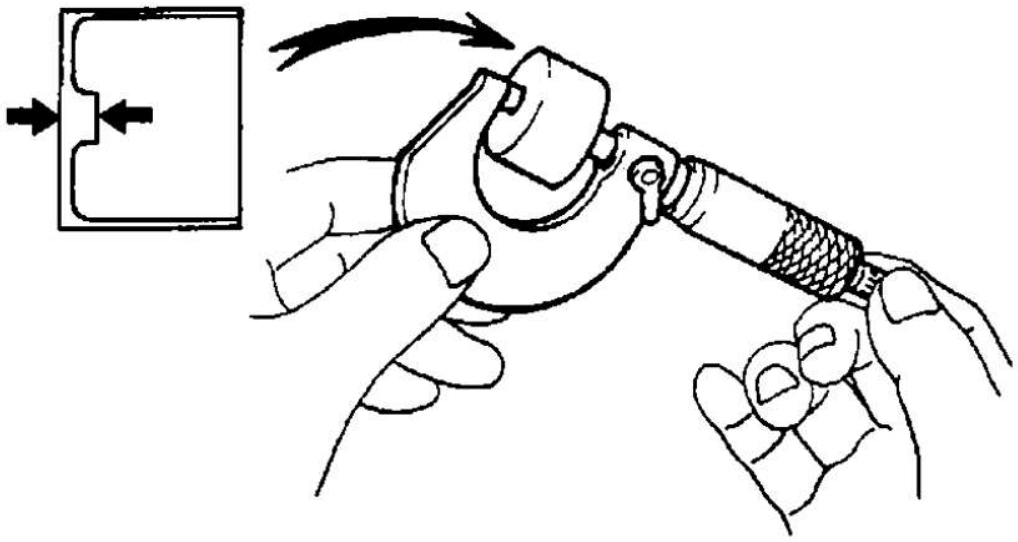
NOTE:

- **Be careful not to drop anything inside the timing chain cover.**
- **Do not allow the chain to come into contact with water or dust.**

n. Remove the valve lifter.
o. Determine the replacement valve lifter size according to these Formula or Charts:
   - Using a micrometer, measure the thickness of the removed lifter.
   - Calculate the thickness of a new lifter so the valve clearance comes within the specified value.

     Thickness of used lifter
     Measured valve clearance
     Thickness of new lifter

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Fig. 13: Measuring Valve Lifter Thickness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Intake	N = T + (A – 0.24 mm (0.009 in.))
Exhaust	N = T + (A – 0.35 mm (0.014 in.))

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Fig. 14: Displaying Valve Lifter Size Formulas
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Select a new lifter with a thickness as close as possible to the calculated values.

NOTE:

- **Valve lifters are available in 35 sizes in increments of 0.020 mm (0.0008 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).**
- **Identification number inside the valve lifter shows the value of the 2 decimal places. (The illustration shows 5.380 mm (0.2118 in.)**

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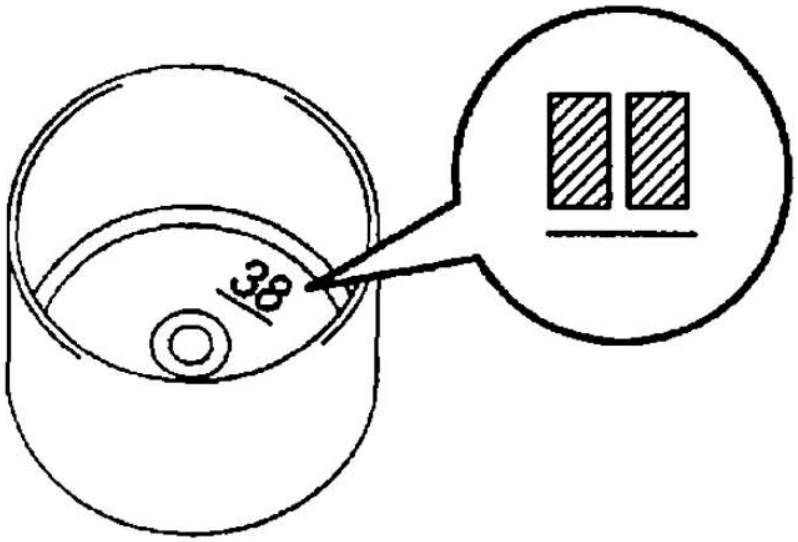
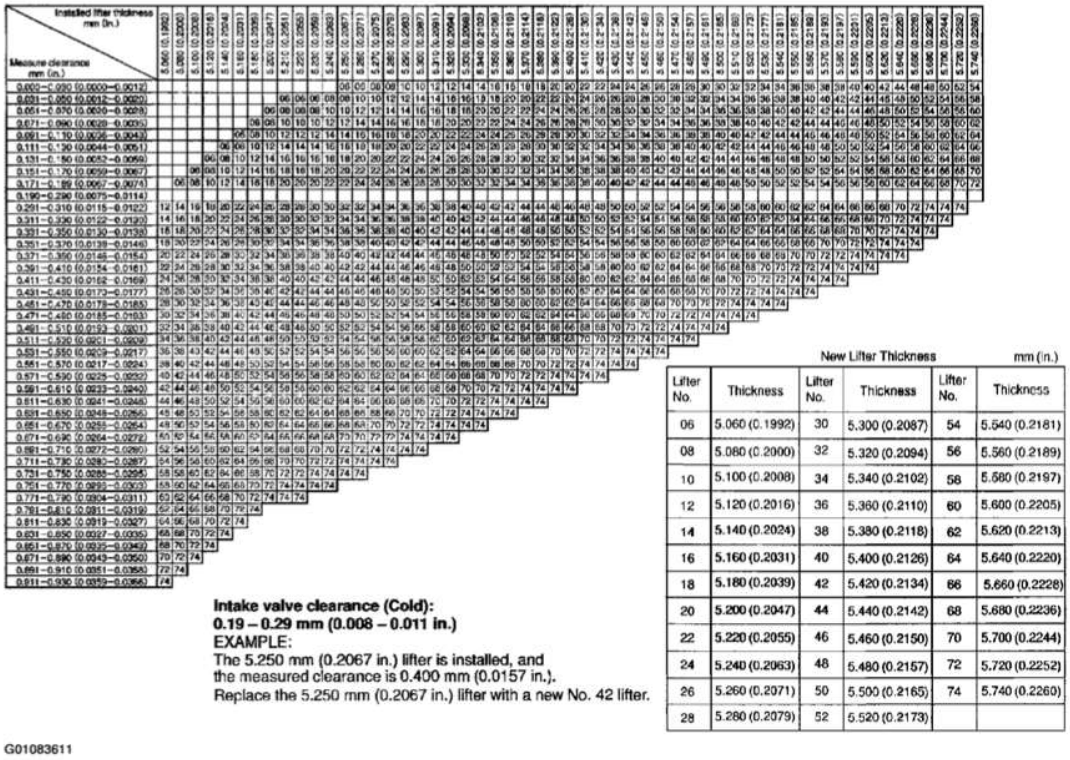


Fig. 15: Identifying Number Inside Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Valve Lifter Selection Chart (Intake)

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Intake valve clearance (Cold):
0.19 – 0.29 mm (0.008 – 0.011 in.)
EXAMPLE:
The 5.250 mm (0.2067 in.) lifter is installed, and
the measured clearance is 0.400 mm (0.0157 in.).
Replace the 5.250 mm (0.2067 in.) lifter with a new No. 42 lifter.

New Lifter Thickness mm (in.)

Lifter No.	Thickness	Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 (0.1992)	30	5.300 (0.2087)	54	5.540 (0.2181)
08	5.080 (0.2000)	32	5.320 (0.2094)	56	5.560 (0.2189)
10	5.100 (0.2008)	34	5.340 (0.2102)	58	5.580 (0.2197)
12	5.120 (0.2016)	36	5.360 (0.2110)	60	5.600 (0.2205)
14	5.140 (0.2024)	38	5.380 (0.2118)	62	5.620 (0.2213)
16	5.160 (0.2031)	40	5.400 (0.2126)	64	5.640 (0.2220)
18	5.180 (0.2039)	42	5.420 (0.2134)	66	5.660 (0.2228)
20	5.200 (0.2047)	44	5.440 (0.2142)	68	5.680 (0.2236)
22	5.220 (0.2055)	46	5.460 (0.2150)	70	5.700 (0.2244)
24	5.240 (0.2063)	48	5.480 (0.2157)	72	5.720 (0.2252)
26	5.260 (0.2071)	50	5.500 (0.2165)	74	5.740 (0.2260)
28	5.280 (0.2079)	52	5.520 (0.2173)		

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Fig. 16: Displaying Valve Lifter Selection Chart (Intake)
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Valve Lifter Selection Chart (Exhaust)

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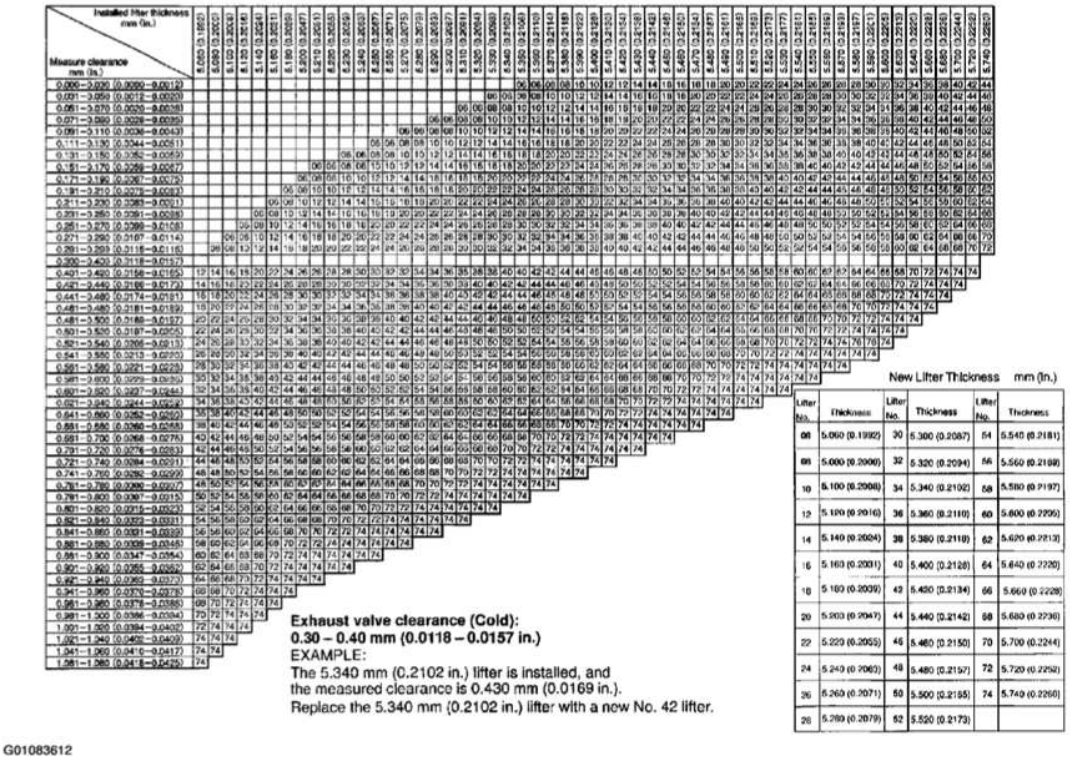


Fig. 17: Displaying Valve Lifter Selection Chart (Exhaust)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

p. Apply a light coat engine oil to new valve lifter.

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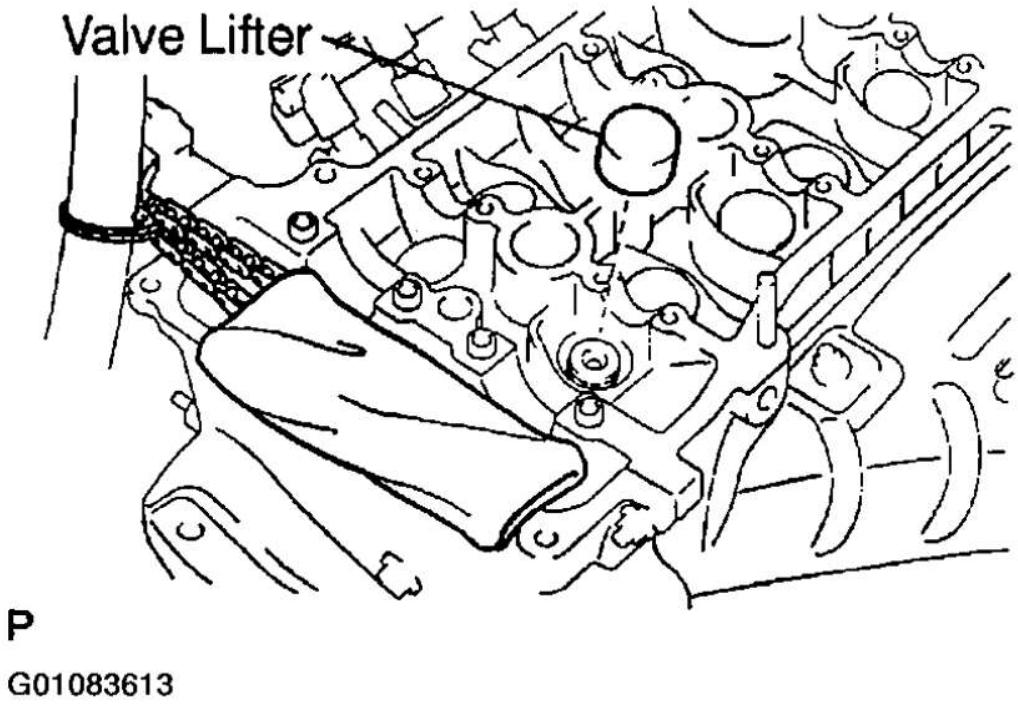


Fig. 18: Locating Valve Lifter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

q. Reinstall the valve lifter.
r. Align the crankshaft pulley groove with timing mark 0 of the timing chain cover.

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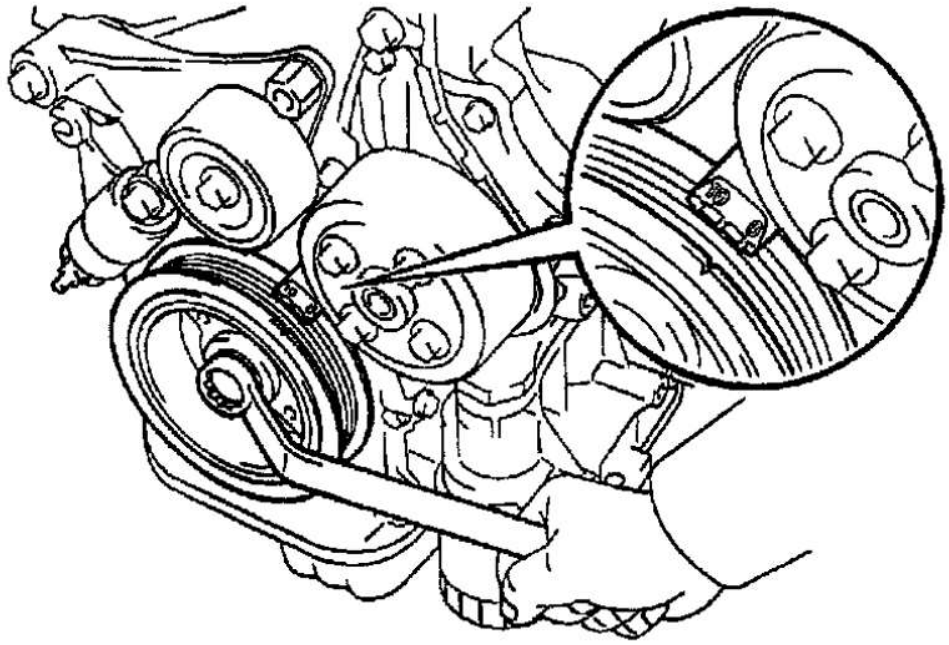


Fig. 19: Aligning Crankshaft Pulley & Timing Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

s. Hold the timing chain.

7. **Reinstall intake camshaft** .
   a. Align the matchmarks on the timing chain and VVT timing sprocket (See b under step 6), and place the intake camshaft on the cylinder head.
   b. Apply a light coat engine oil on the threads and under the camshaft bearing cap bolts.
   c. Install the 5 intake camshaft bearing caps in their proper locations (See **INSTALLATION**).
   d. Uniformly tighten the 10 bearing cap bolts in several passes, in the sequence shown.

      Torque: 29.5 N.m (300 kgf. cm, 22 ft. lbf) for bolt A 9 N.m (90 kgf. cm, 80 in. .lbf) for others

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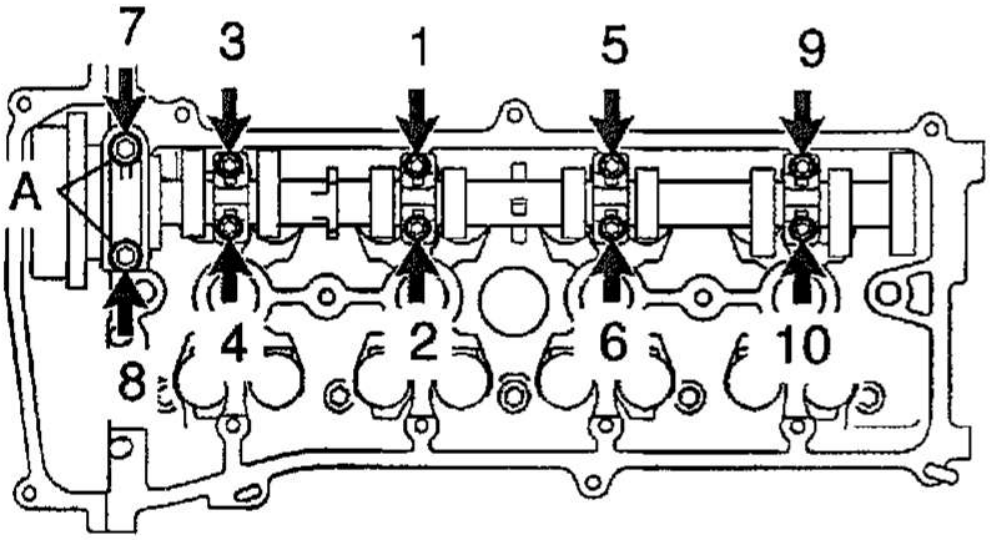


Fig. 20: Locating Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Align the matchmarks on the timing chain and camshaft timing sprocket (See b under step 6), and install them.

8. **Reinstall exhaust camshaft.** .
   a. Temporarily install the camshaft timing sprocket with the timing chain to the exhaust camshaft with the bolt.
   b. Place the exhaust camshaft on the cylinder head.
   c. Apply a light coat engine oil on the threads and under the camshaft bearing cap bolts.
   d. Install the 5 exhaust camshaft bearing caps in their proper locations (See **INSTALLATION**).
   e. Uniformly tighten the 10 bearing cap bolts in several passes, in the sequence shown.

      Torque: 29.5 N.m (300 kgf. cm, 22 ft. lbf) for bolt A 9 N.m (90 kgf. cm, 80 in. .lbf) for others

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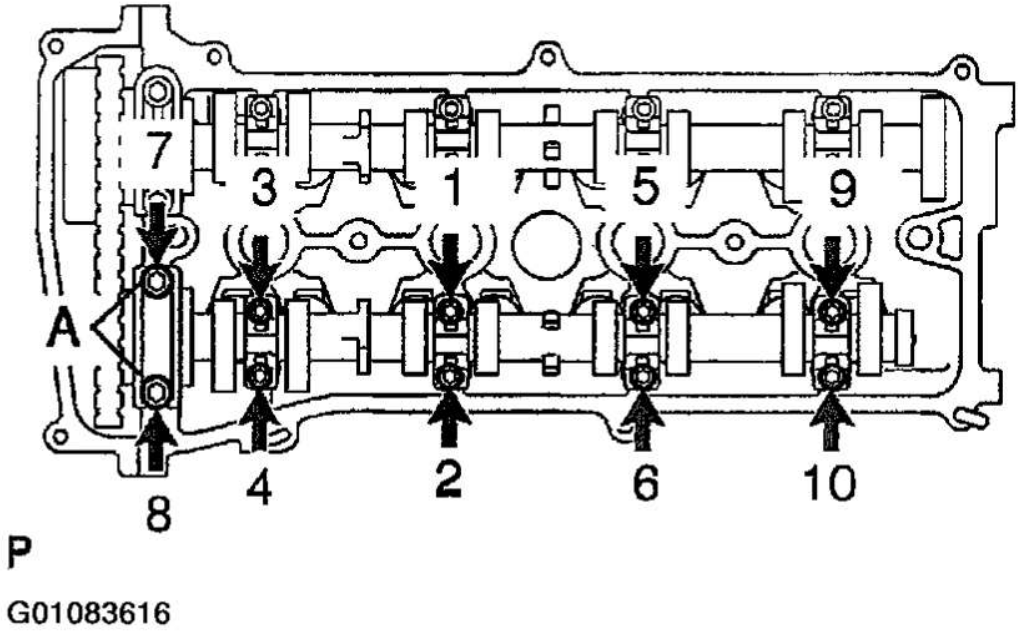


Fig. 21: Tightening Indicated Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Hold the hexagon head portion of the exhaust camshaft with a wrench, and tighten the bolt.
Torque: 54 N.m (550 kgf. cm, 40 ft. lbf)

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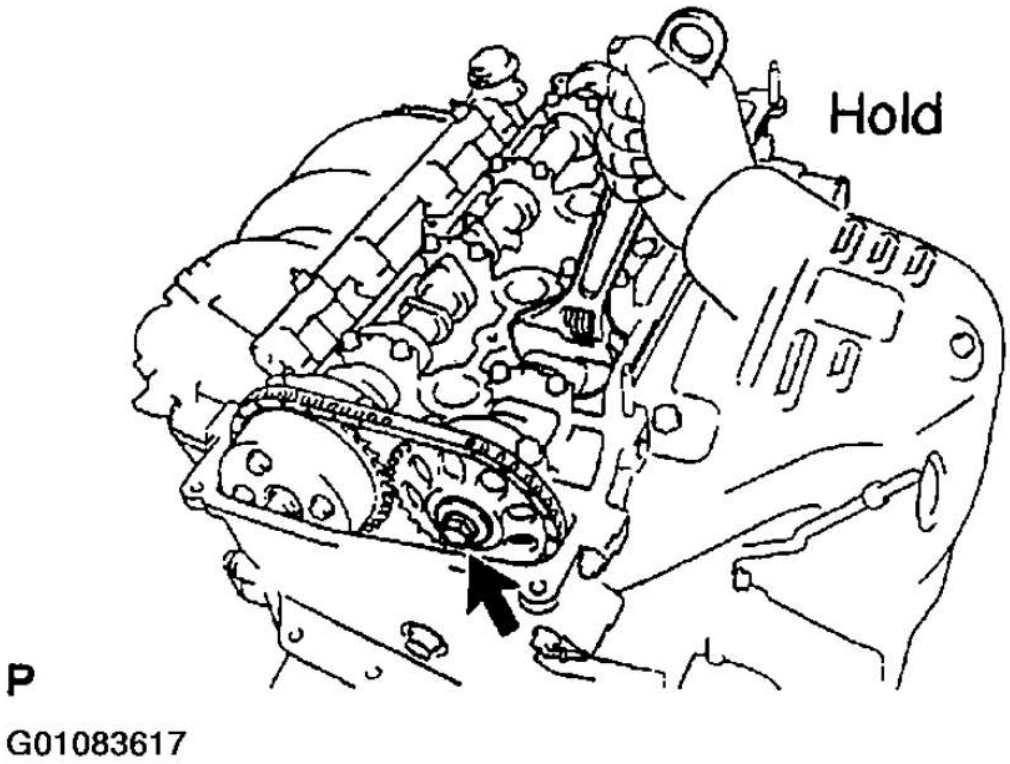


Fig. 22: Locating Exhaust Camshaft Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Check that each sprocket aligns with the matchmarks as shown.

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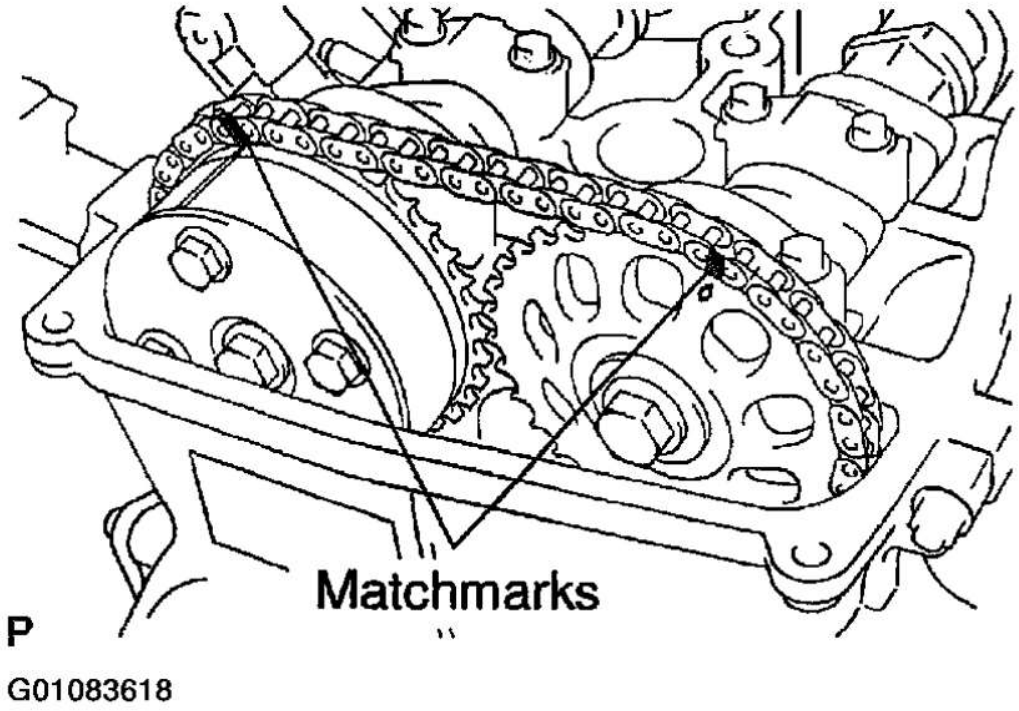


Fig. 23: Locating Match Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

h. Install the chain tensioner (See **INSTALLATION**).
i. Recheck the valve clearance (See step 5).
j. Check the valve timing (See **INSTALLATION**).

9. **Reinstall cylinder head cover (See INSTALLATION) .**
10. **Reinstall air cleaner assembly (See REMOVAL) .**
11. **Reinstall RH engine under cover .**

TIMING CHAIN

COMPONENTS

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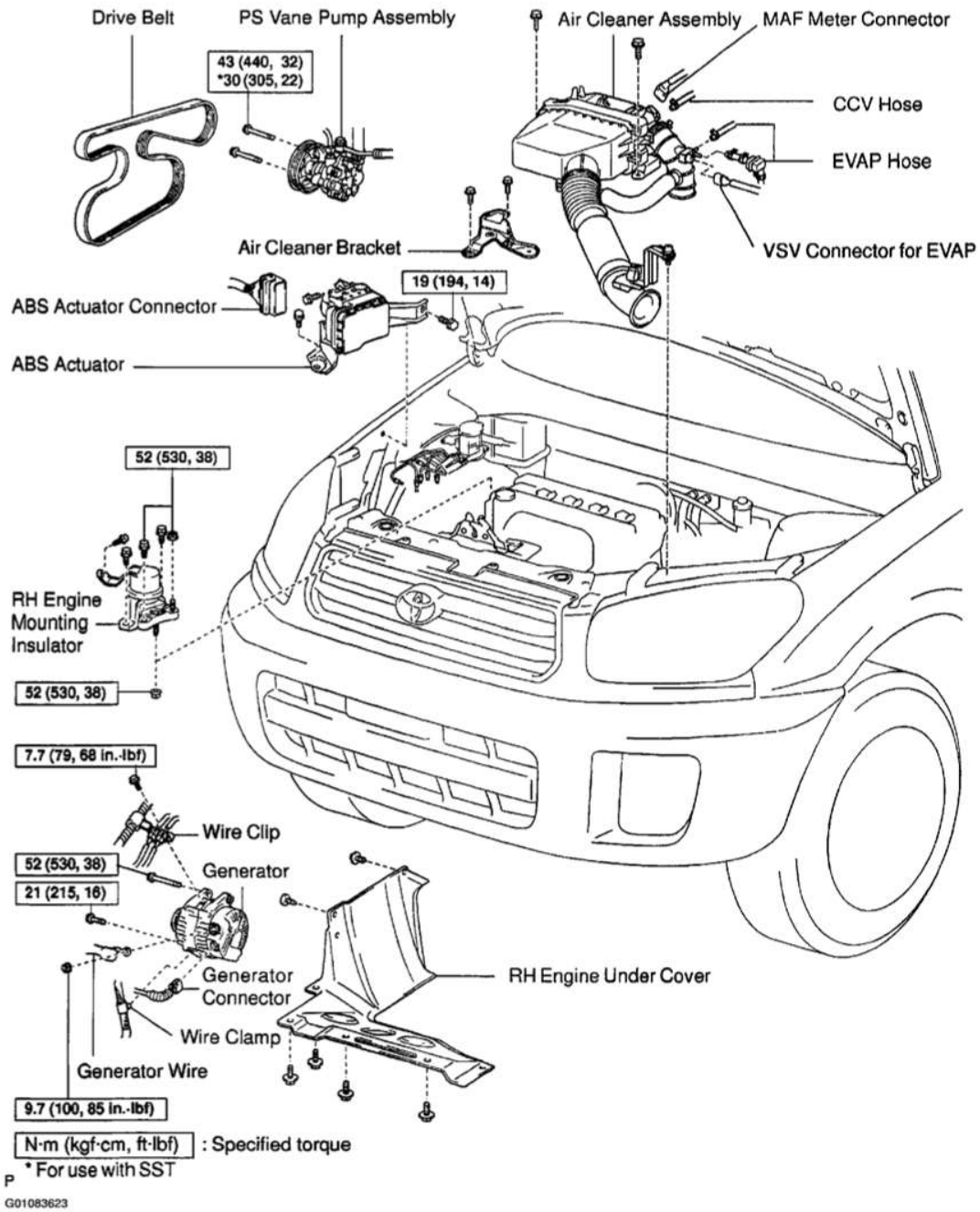


Fig. 24: Displaying Timing Chain Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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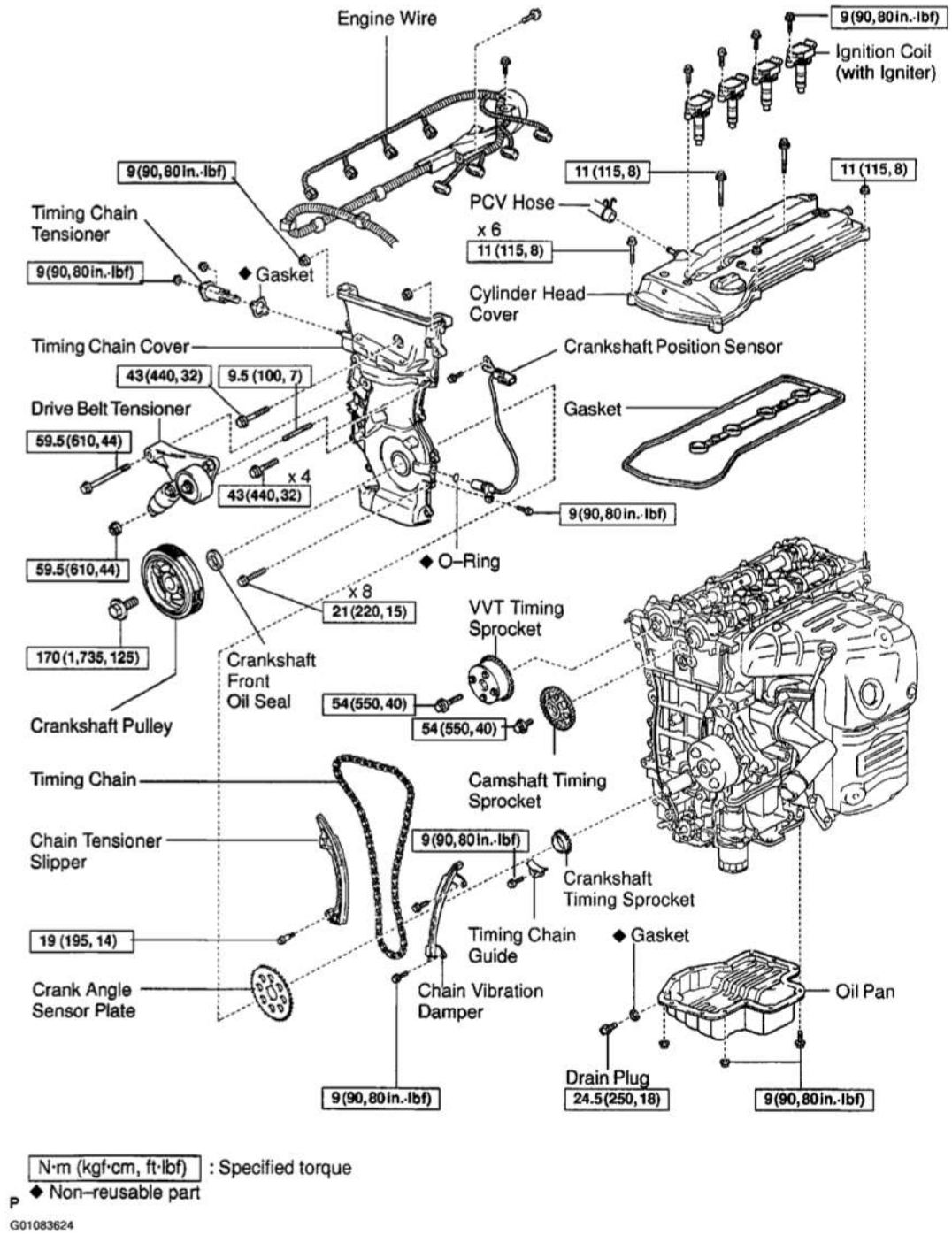


Fig. 25: Displaying Timing Chain Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

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NOTE: **Under the condition with the timing chain cover removed, in case of rotating the camshafts, make the position of the crankshaft rotated clockwise by about 45° from TDC/compression of No. 1 cylinder.**

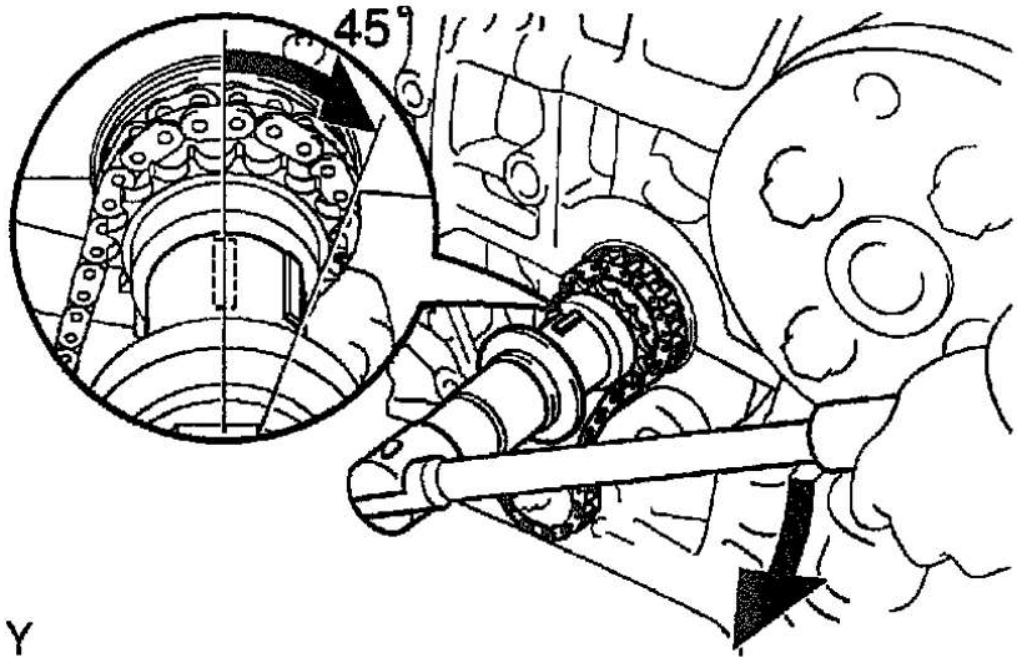


Fig. 26: Rotating Camshaft 45 degrees
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. **Drain engine oil** .
2. **Remove RH engine under cover** .
3. **Remove PS vane pump (See POWER STEERING VANE PUMP) .**
4. **Remove ABS actuator (See ACTUATOR/ABS ECU) .**
5. **Remove RH engine mounting insulator (See REMOVAL) .**
6. **Remove drive belt (See CHARGING SYSTEM) .**
7. **Remove generator (See REMOVAL) .**
8. **Remove air cleaner assembly (See REMOVAL) .**
9. **Remove ignition coils (See REMOVAL & INSTALLATION (RAV4)) .**
10. **Remove cylinder head cover** .
    a. Disconnect the 2 PCV hoses from the cylinder head cover.

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b. Remove the 8 bolts, 2 nuts, cylinder head cover and gasket.

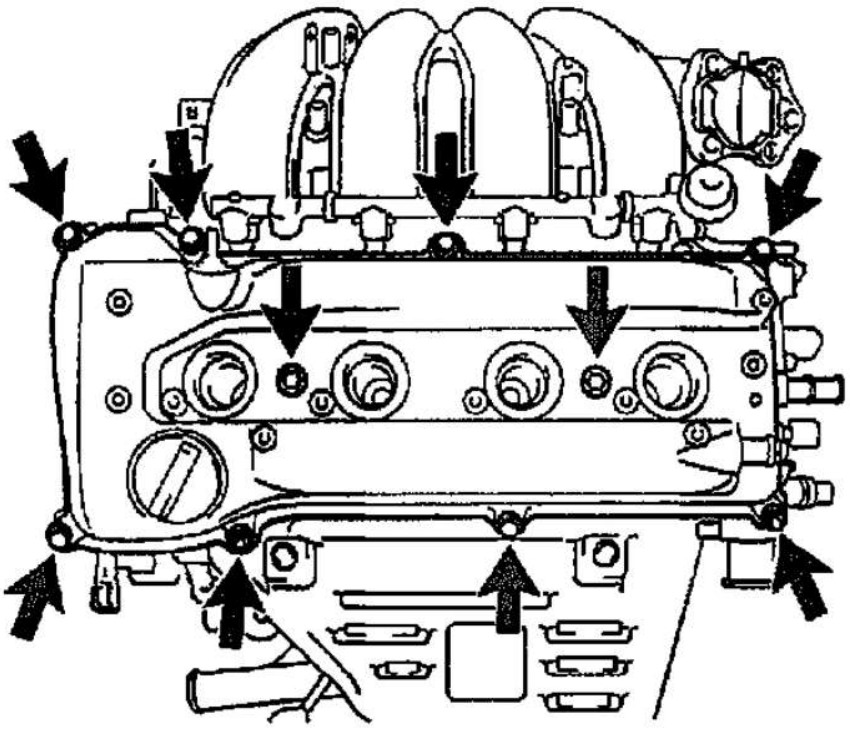


Fig. 27: Locating Cylinder Head Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **Set No. 1 cylinder to TDC/compression** .
    a. Turn the crankshaft pulley, and align its groove with timing mark 0 of the timing chain cover.

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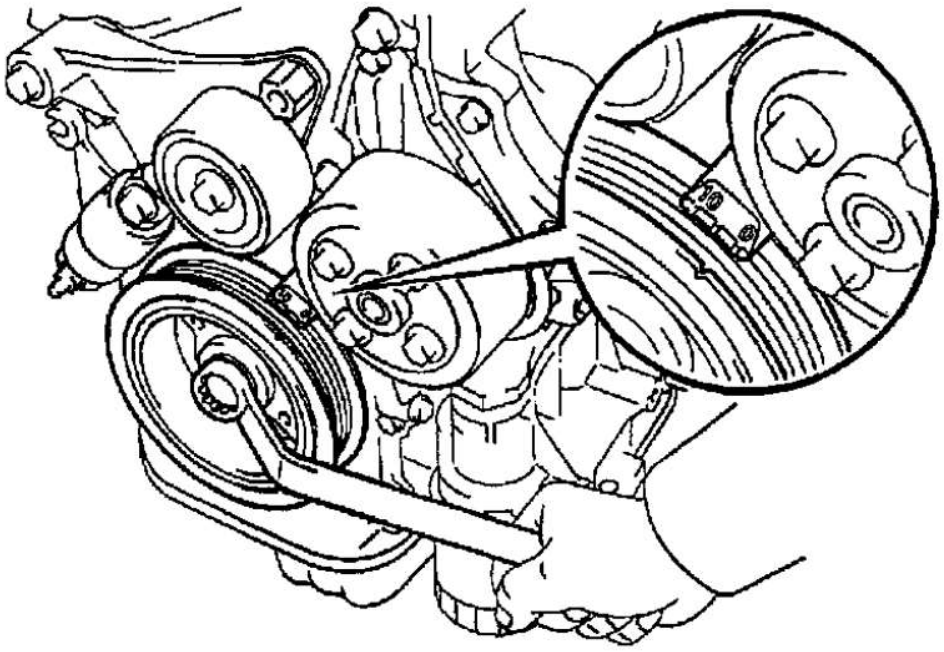


Fig. 28: Aligning Crankshaft Pulley & Timing Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check that the timing marks of the camshaft timing sprocket and VVT timing sprocket aligned with the timing marks of the No. 1 and No. 2 bearing caps as shown in the illustration.

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

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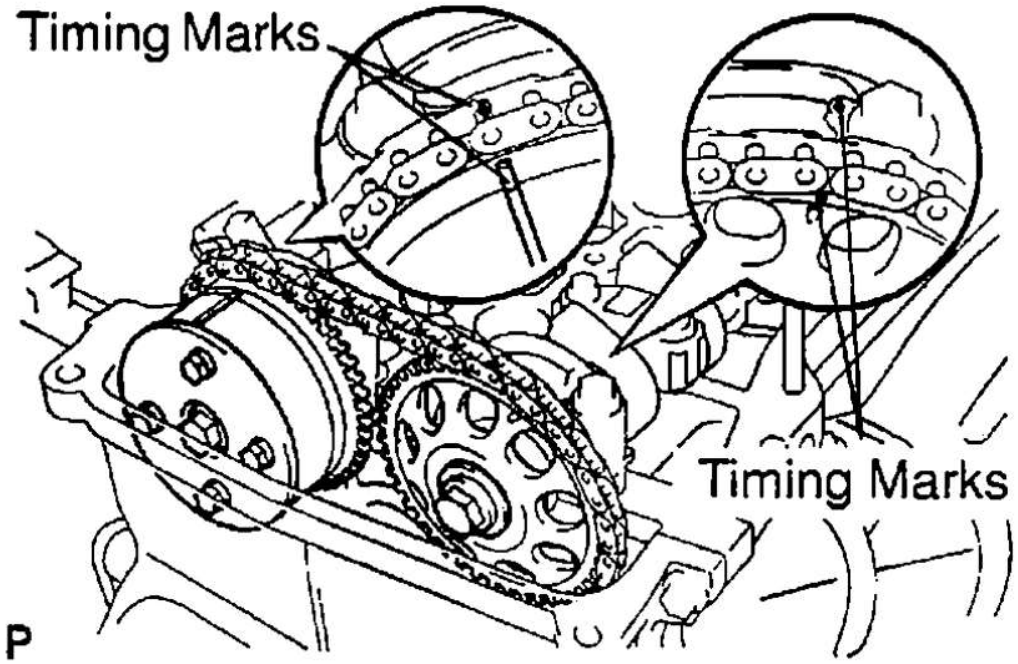


Fig. 29: Checking Timing Marks Align
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **Remove crankshaft pulley** .
    a. Using SST, loosen the pulley bolt.
       SST 09213-54015, 09330-00021
    b. Remove the pulley bolt and crankshaft pulley.

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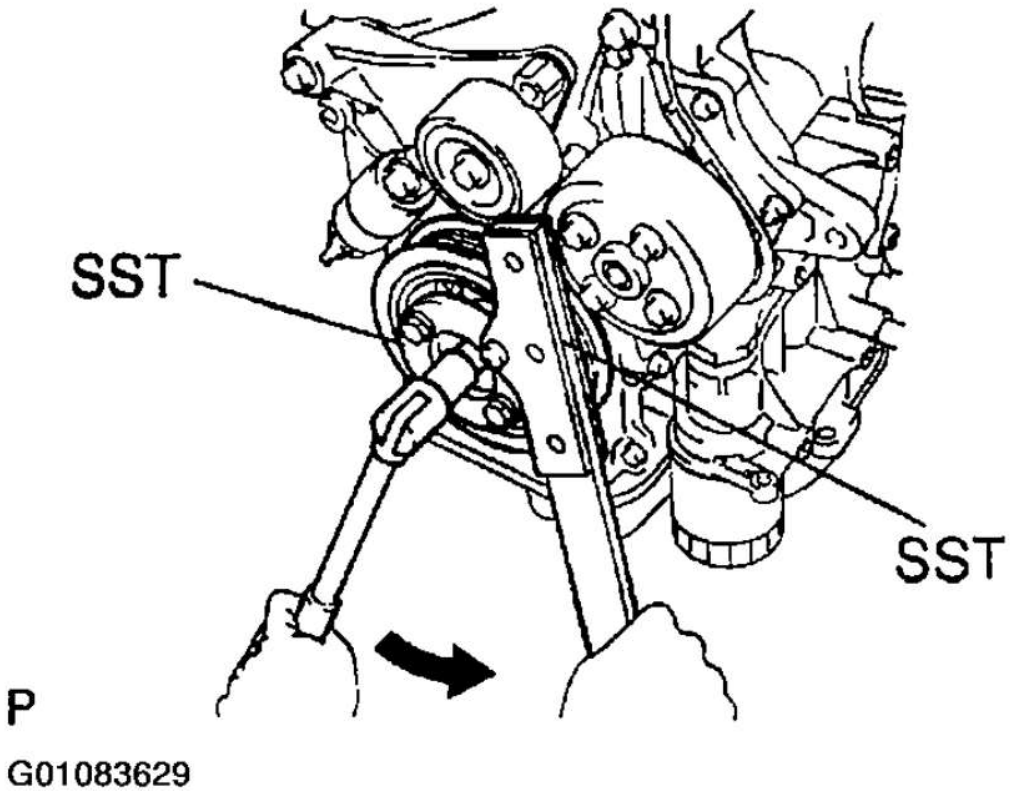


Fig. 30: Loosening Pulley Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **If necessary, remove the pulley with SST.**

SST 09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05021), 09950- 40011 (09957-04010)

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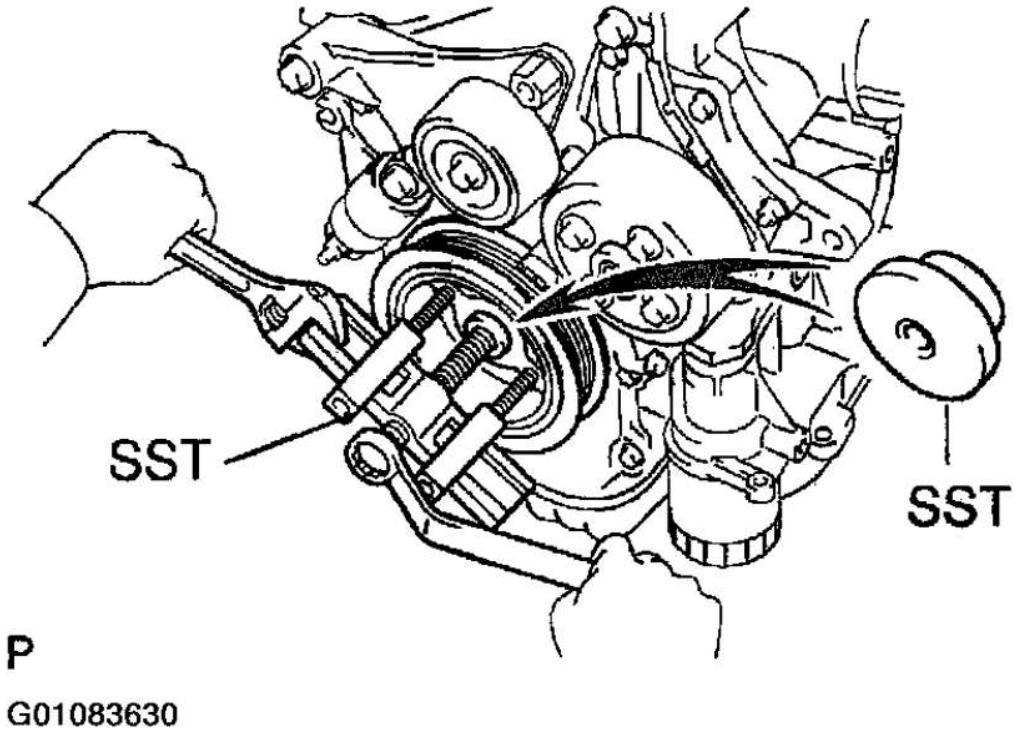


Fig. 31: Displaying SST Removal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **Remove chain tensioner** .

Remove the 2 nuts, chain tensioner and gasket.

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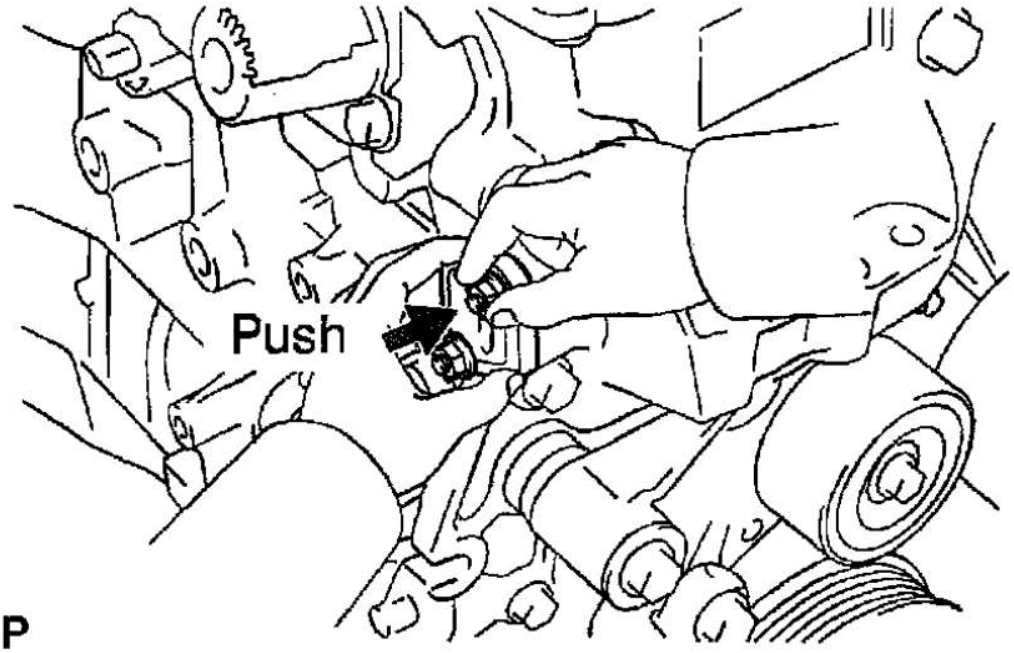


Fig. 32: Displaying Proper Chain Tensioner Removal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **Remove drive belt tensioner** .

    Remove the bolt, nut and drive belt tensioner.

15. **Remove crankshaft position sensor (See CAMSHAFT POSITION SENSOR) .**
16. **Remove oil pan (See REMOVAL) .**

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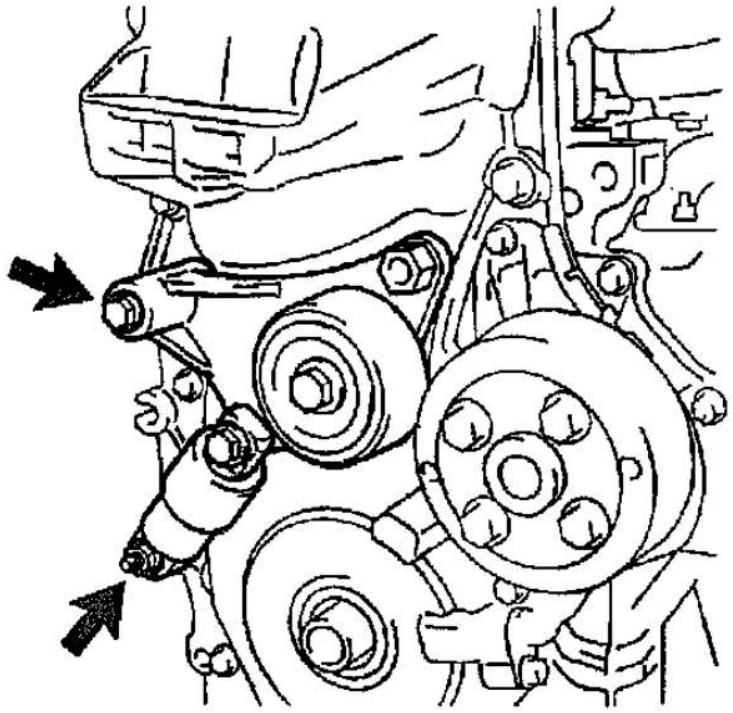


Fig. 33: Locating Drive Belt Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **Remove timing chain cover** .
    a. Using a Torx socket wrench (E10), remove the stud bolt for the drive belt tensioner.

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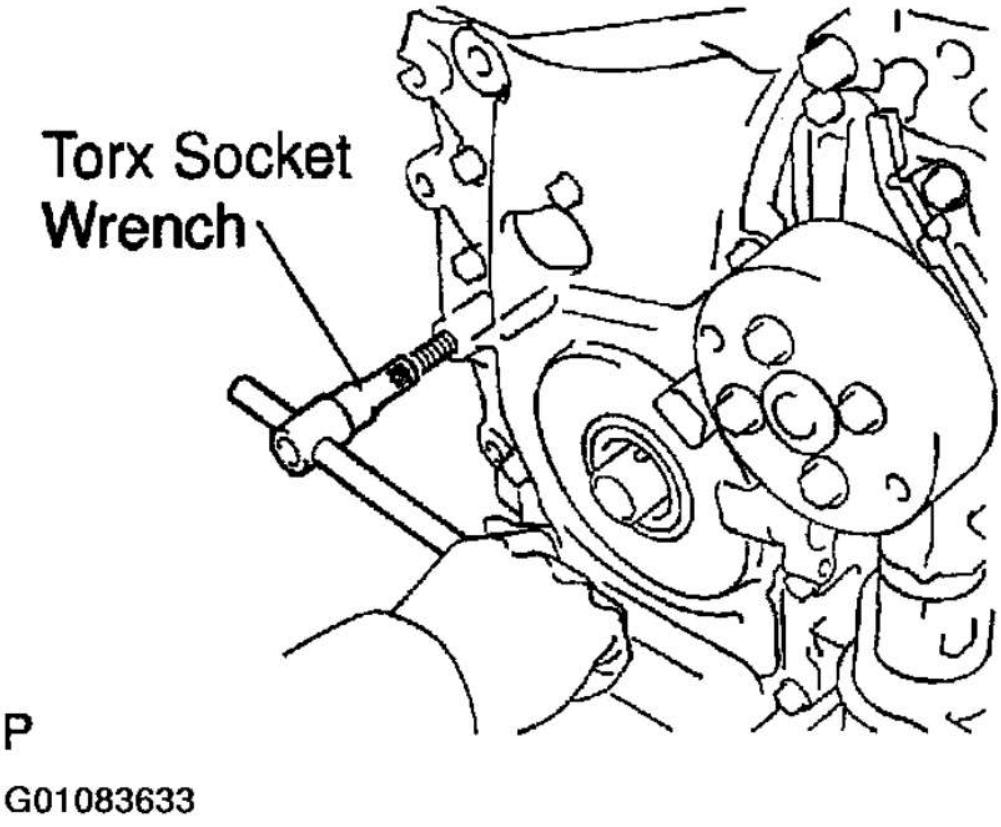


Fig. 34: Removing Stud Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the 14 bolts and 2 nuts.

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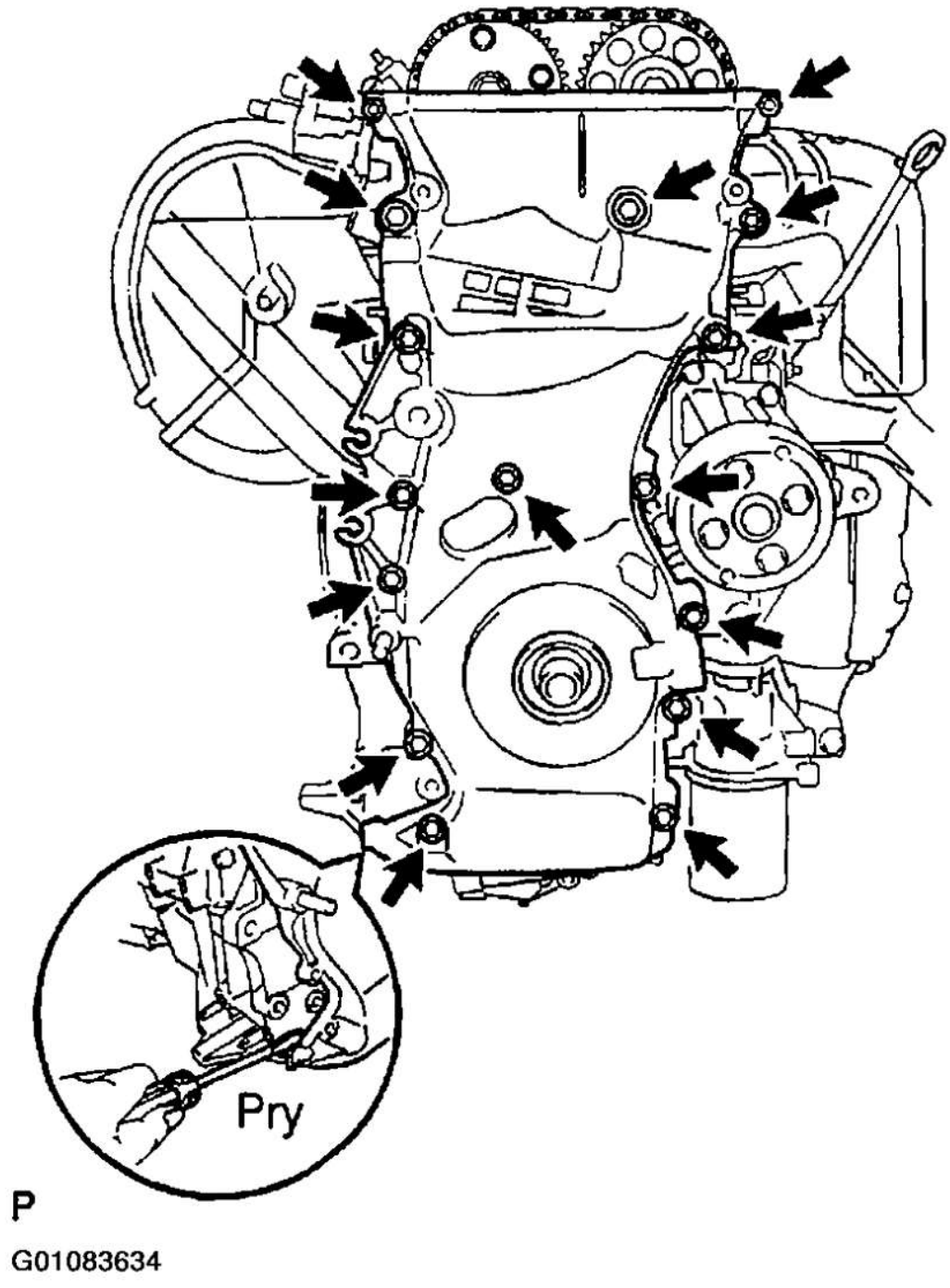


Fig. 35: Locating Chain Cover Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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c. Using a screwdriver, pry between the timing chain cover and cylinder head or cylinder block.
d. Remove the timing chain cover.

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

18. **Remove crank angle sensor plate** .
19. **Remove chain tensioner slipper** .

Remove the bolt and slipper.

20. **Remove chain vibration damper** .

Remove the 2 bolts and damper.

21. **Remove timing chain guide** .

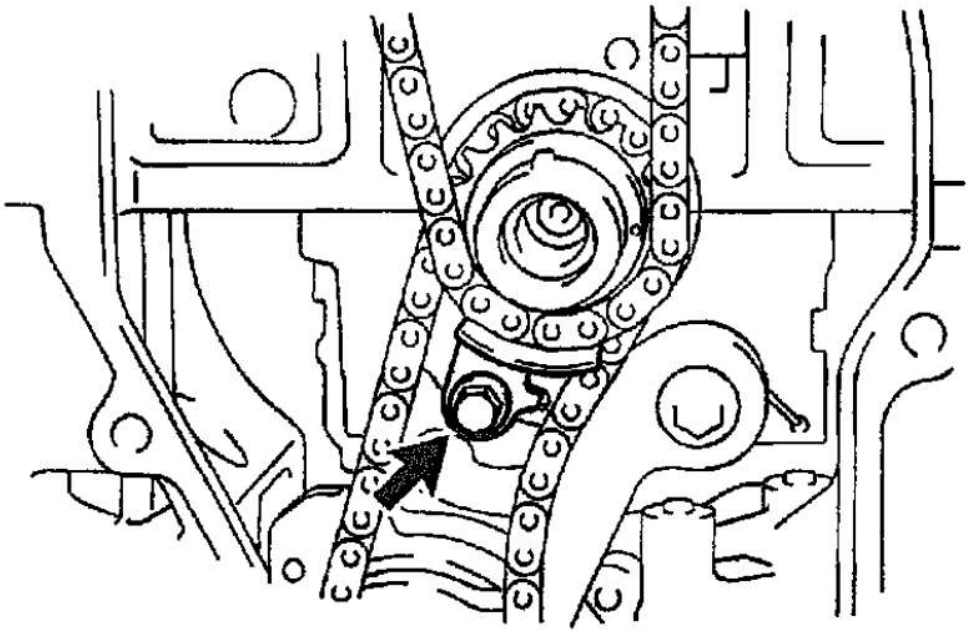


Fig. 36: Removing Timing Chain Guide
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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Remove the bolt and chain guide.

22. **Remove timing chain** .
23. **Remove crankshaft timing sprocket** .
24. **Remove camshaft timing sprocket and VVT timing sprocket** .
    a. Hold the hexagonal head wrench portion of the camshaft with a wrench, and loosen the sprocket bolts.

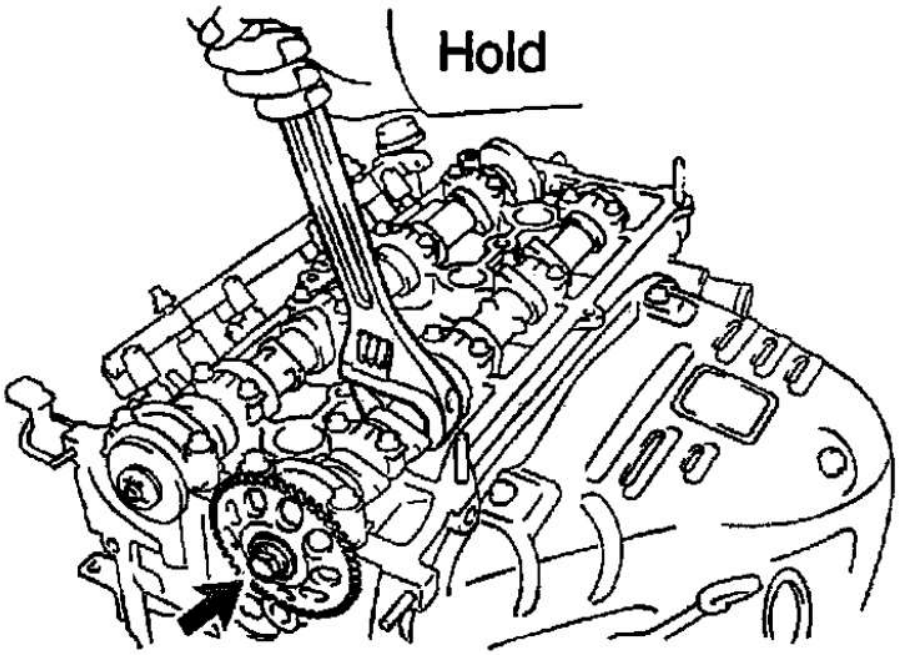


Fig. 37: Removing Camshaft Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to damage the cylinder head and valve lifter by a wrench.

    b. Remove the bolt and exhaust camshaft timing sprocket.
    c. Remove the bolt and VVT timing sprocket.

NOTE: Do not disassemble the VVT timing sprocket.

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INSPECTION

1. **Inspect timing chain and timing sprockets** .
   a. Using vernier calipers, measure the length of the 16 links with the chain fully stretched.
      Maximum chain elongation: 122.6 mm (4.827 in.)

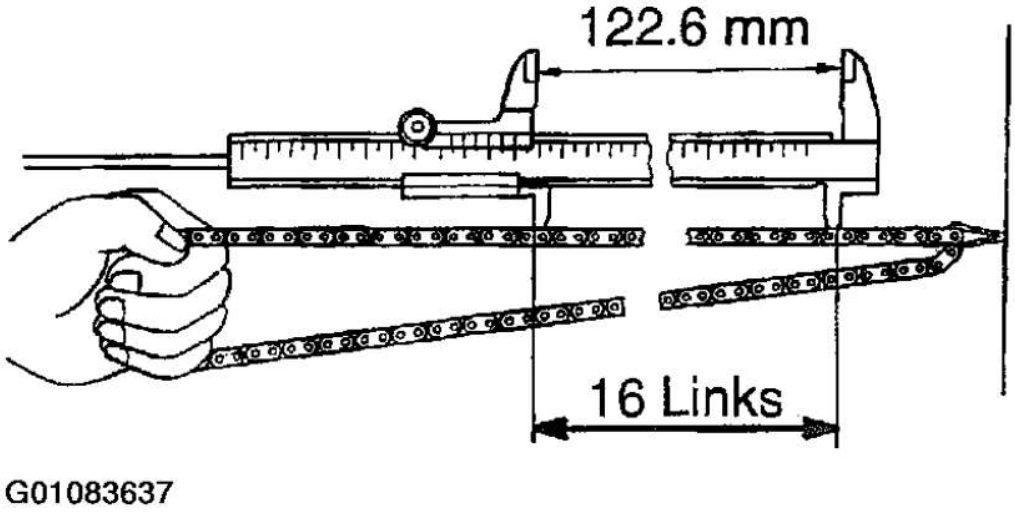


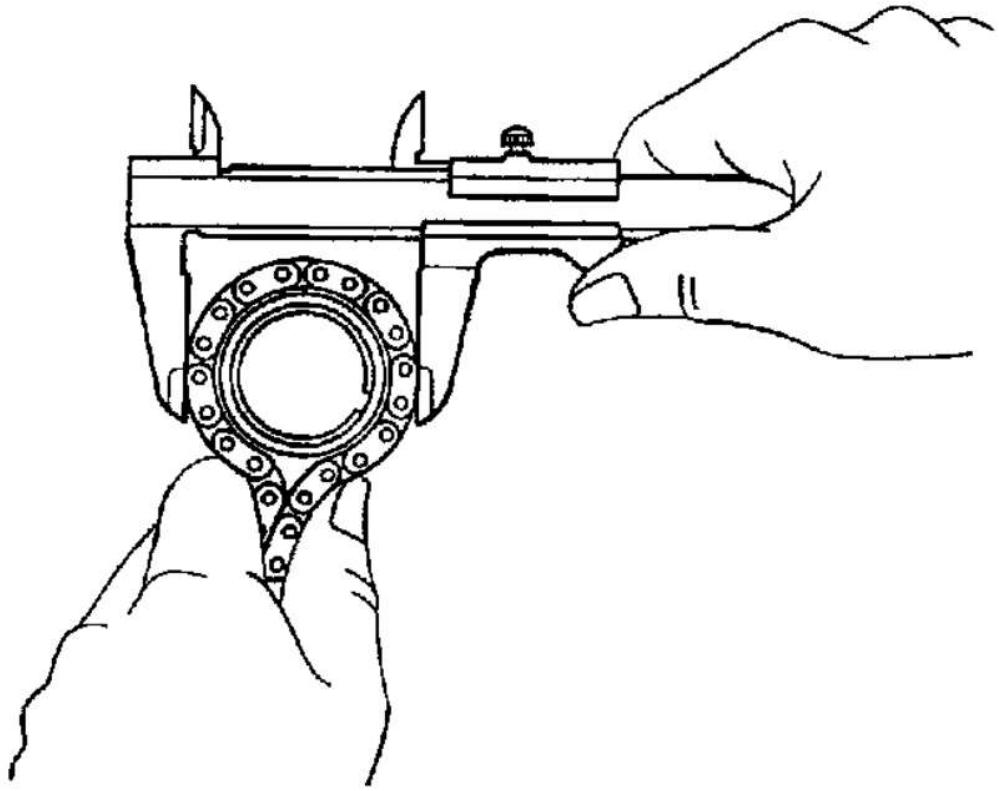
Fig. 38: Measuring Length Of The 16 Links
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

NOTE: Make the same pulling measurements at 3 or more places selected at random.

   b. Wrap the chain around the timing sprocket.

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Fig. 39: Measuring Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using vernier calipers, measure the timing sprocket diameter with the chain.

NOTE: Vernier calipers must contact the chain rollers for measuring.

Minimum sprocket diameter (w/ Chain):

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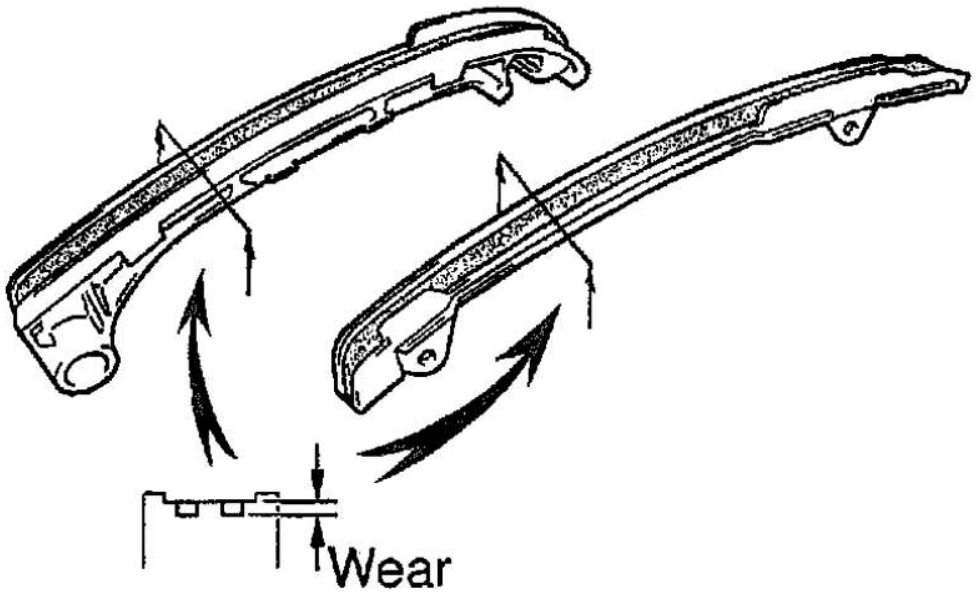
Camshaft	97.3 mm (3.831 in.)
Crankshaft	51.6 mm (2.031 in.)

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Fig. 40: Displaying Camshaft Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

2. **Inspect chain tensioner slipper and vibration damper** .



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Fig. 41: Measuring Tension Slipper & Vibration Damper Wear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Measure the chain tensioner slipper and vibration damper wears.

Maximum wear: 1.0 mm (0.039 in.)

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If the wear is greater than maximum, replace the slipper and/or damper.

3. **Inspect chain tensioner** .
   a. Check that the plunger moves smoothly when the ratchet pawl is raised with your finger.
   b. Release the ratchet pawl and check that the plunger is locked in place by the ratchet pawl and does not move when pushed with your finger.

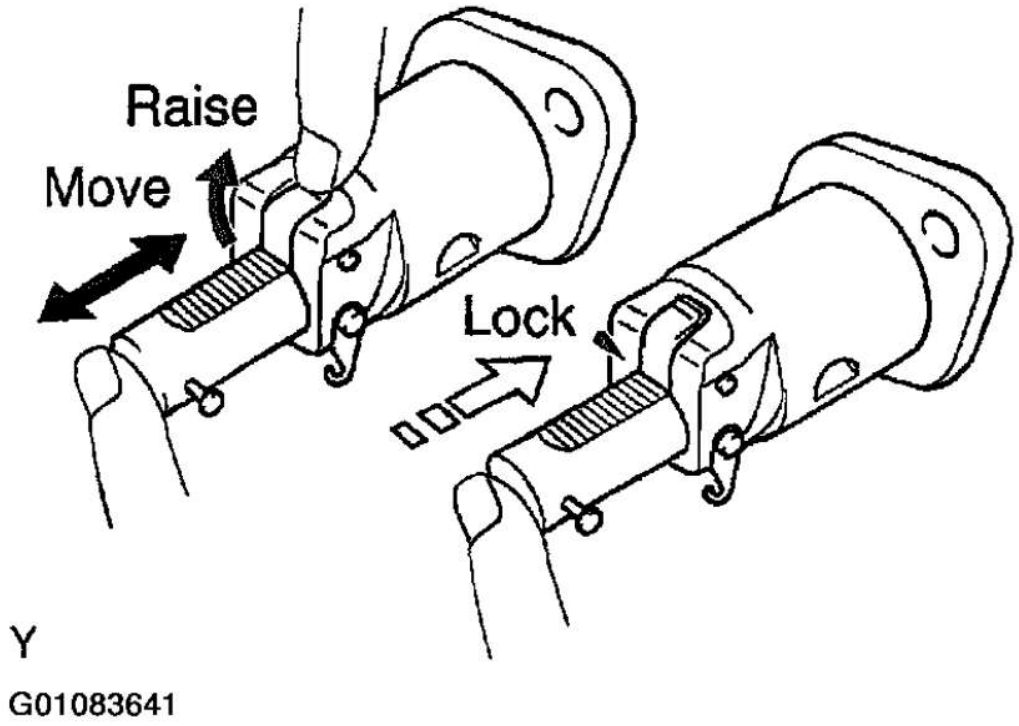


Fig. 42: Inspecting Chain Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Inspect drive belt tensioner** .

   Check the oil leakage and crack.

   If necessary, replace the drive belt tensioner.

REPLACEMENT

Replace Crankshaft Front Oil Seal

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NOTE: There are 2 methods ((a) and (b)) to replace the oil seal.

a. If the timing chain cover is removed from the cylinder head and block.
   1. Using a screwdriver and a hammer, tap out the oil seal.

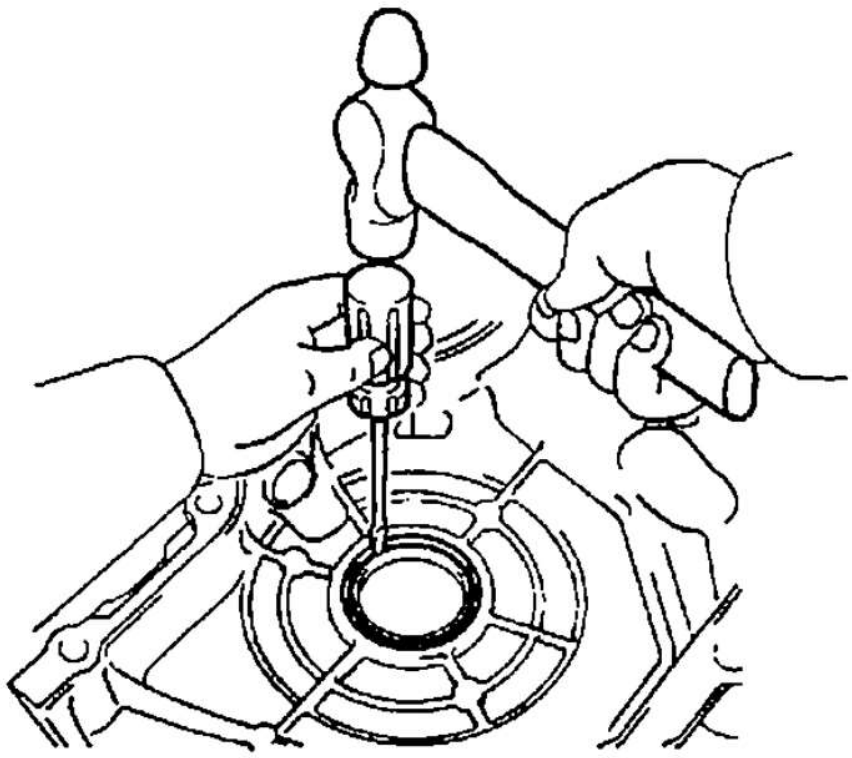


Fig. 43: Displaying Oil Seal Tap Out
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   2. Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

      SST 09309-37010

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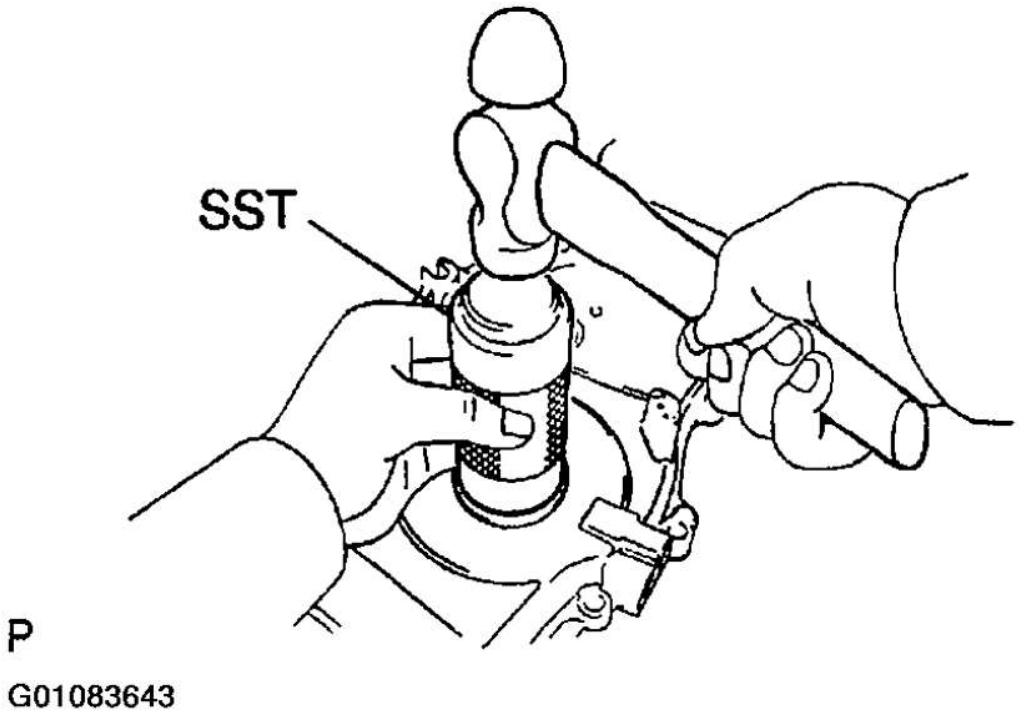


Fig. 44: Tapping In New Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Apply MP grease to the oil seal lip.

b. If the timing chain cover is installed to the cylinder head and block.
   1. Using SST, remove the oil seal.
      SST 09308-10010, 09950-60010 (09951-00200)

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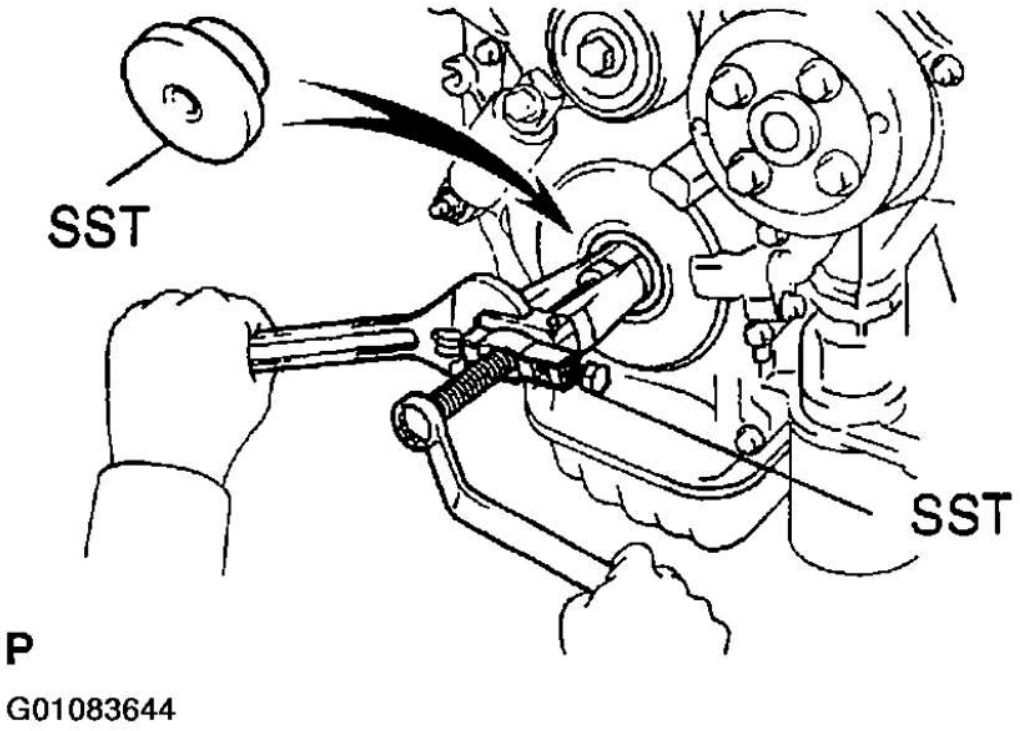


Fig. 45: Installing Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

   SST 09309-37010

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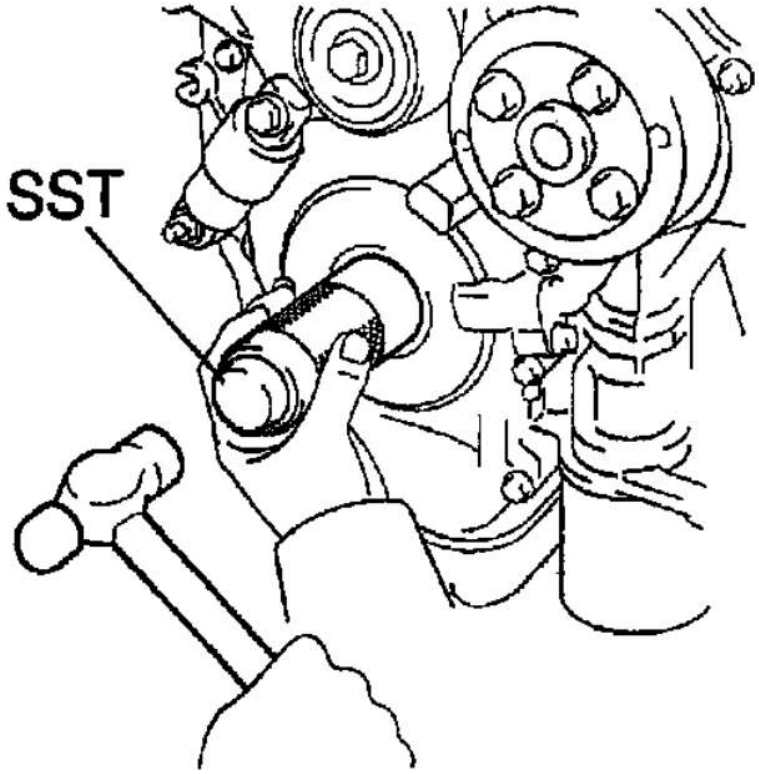


Fig. 46: Taping In New Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSTALLATION

1. **Install camshaft timing sprocket and VVT timing sprocket** .
    a. Install the camshaft timing sprocket.
        1. Face the timing mark of the sprocket outward

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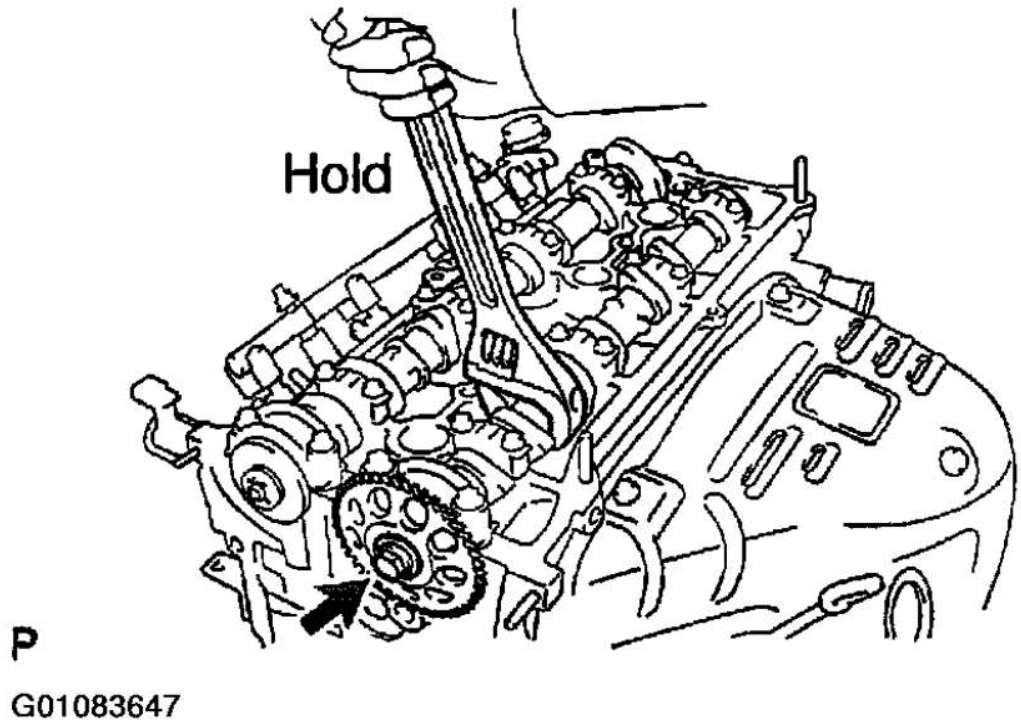


Fig. 47: Installing Camshaft Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Align the camshaft knock pin with the knock pin groove on the sprocket side with the timing mark, and slide on the camshaft timing sprocket and VVT timing sprocket.
3. Temporarily install the camshaft timing sprocket set bolt.

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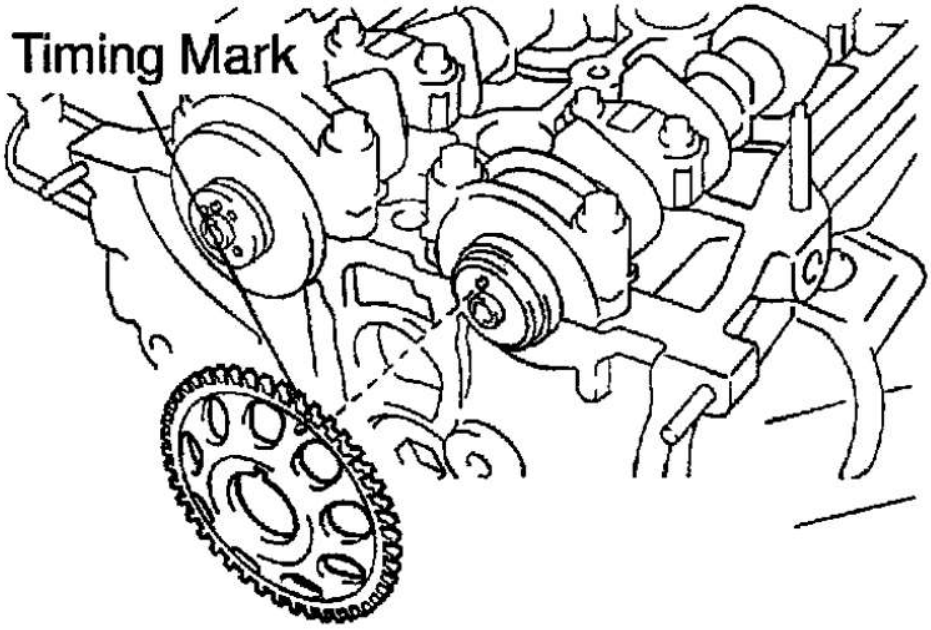


Fig. 48: Displaying Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Hold the hexagon wrench head portion of the exhaust camshaft with a wrench, and tighten the bolt.

   Torque: 54 N.m (550 kgf. cm, 40 ft. lbf)

b. Install the VVT timing sprocket.
   1. Holding the VVT timing sprocket in the position where the VVT timing sprocket pin groove is slightly to right of the camshaft pin looking from the front side, install the VVT timing sprocket to the camshaft, lightly pressing and turning it counter clockwise. Check that there is virtually no clearance between the VVT timing sprocket and camshaft flange.

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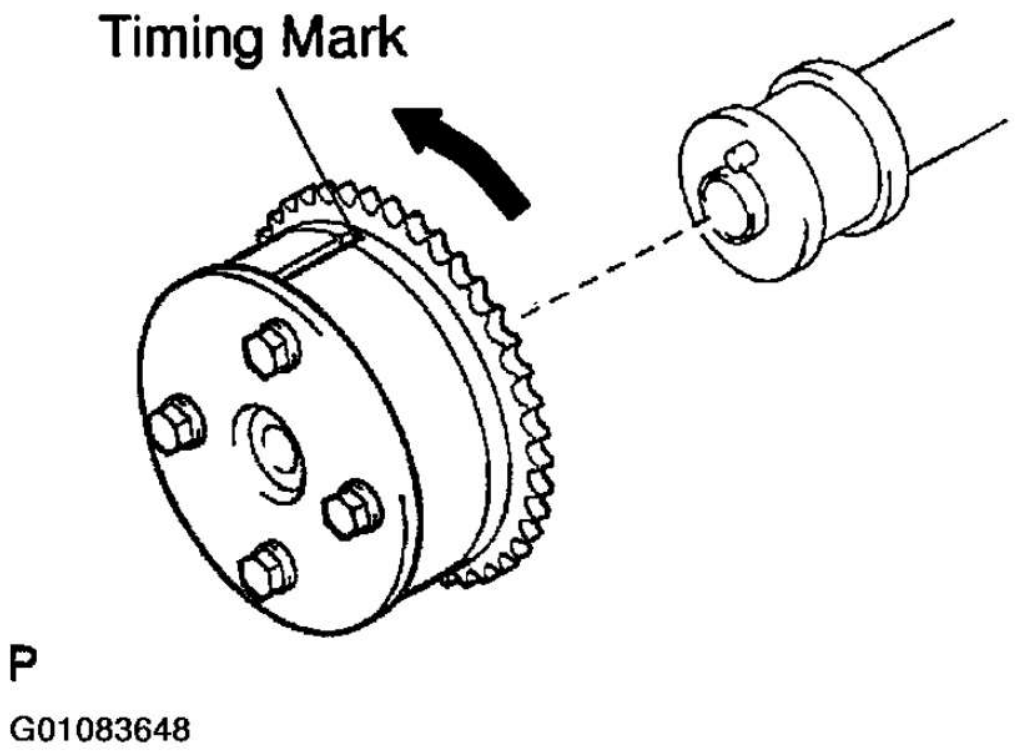


Fig. 49: Installing VVT Timing Sprocket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to turn the VVT timing sprocket clockwise when installing it.

2. Temporarily install the VVT timing sprocket bolt.
3. Hold the hexagon wrench head portion of the intake camshaft with a wrench.
4. Take care to install the VVT timing sprocket with the bolt

   Torque: 54 N.m (550 kgf. cm, 40 ft. lbf)
5. Check that the valve timing controller turns clockwise and that it is locked securely when the lock pin in hole is at the locking point.

2. **Set No. 1 cylinder to TDC/compression** .
   a. Turn the hexagonal wrench head portion of the camshafts, and align the timing marks of the camshaft timing sprocket and VVT timing sprocket with the timing marks of No 1 and No. 2 bearing caps as shown in the illustration.

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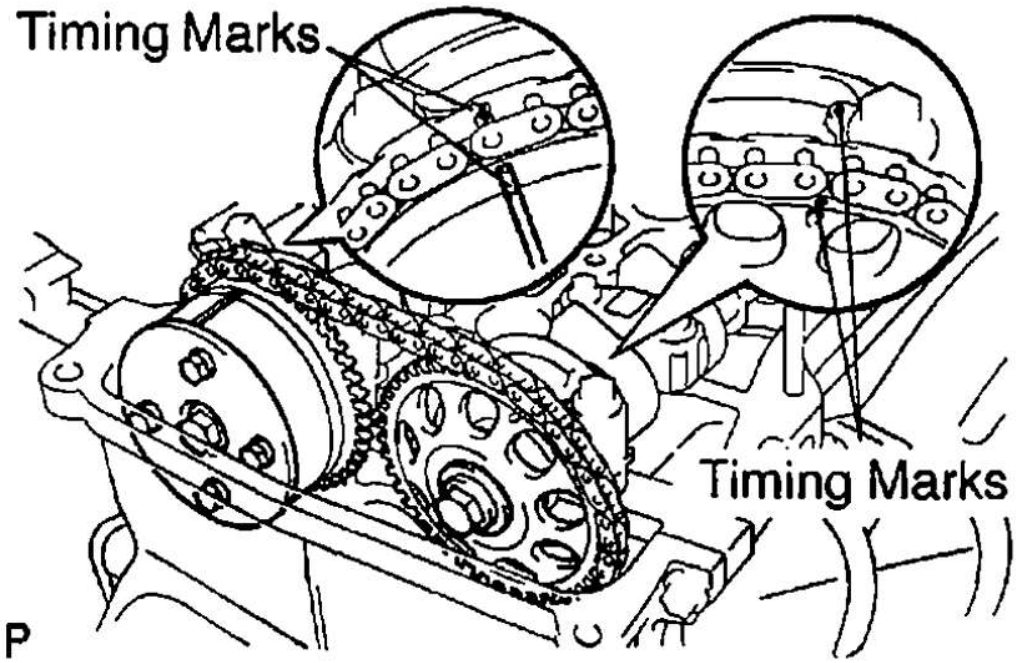


Fig. 50: Locating Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using the crankshaft pulley bolt, turn the crankshaft and set the set key on the crankshaft upward.

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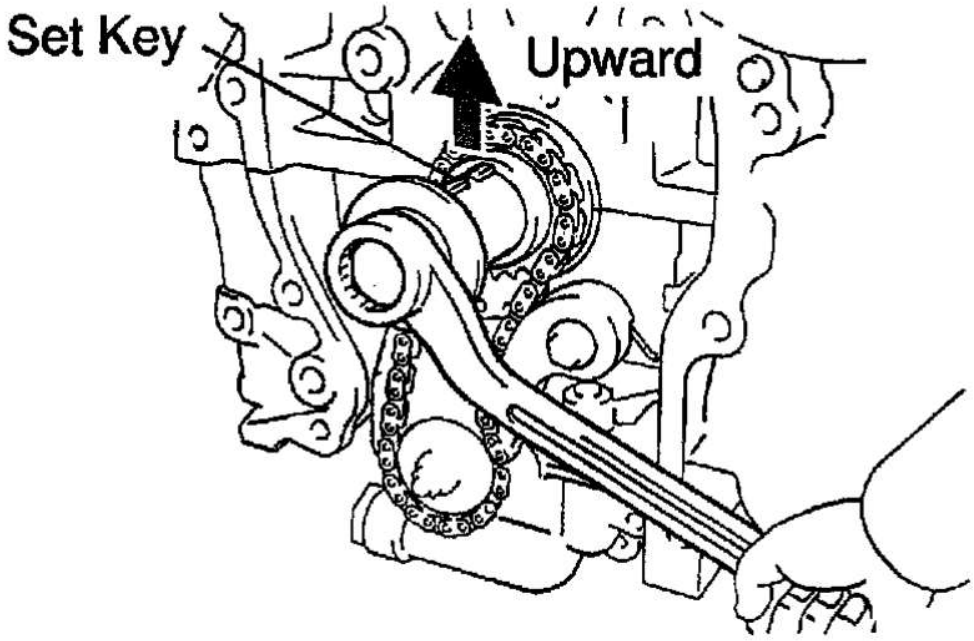


Fig. 51: Locating Set Key & Upward Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **Install chain vibration damper** .

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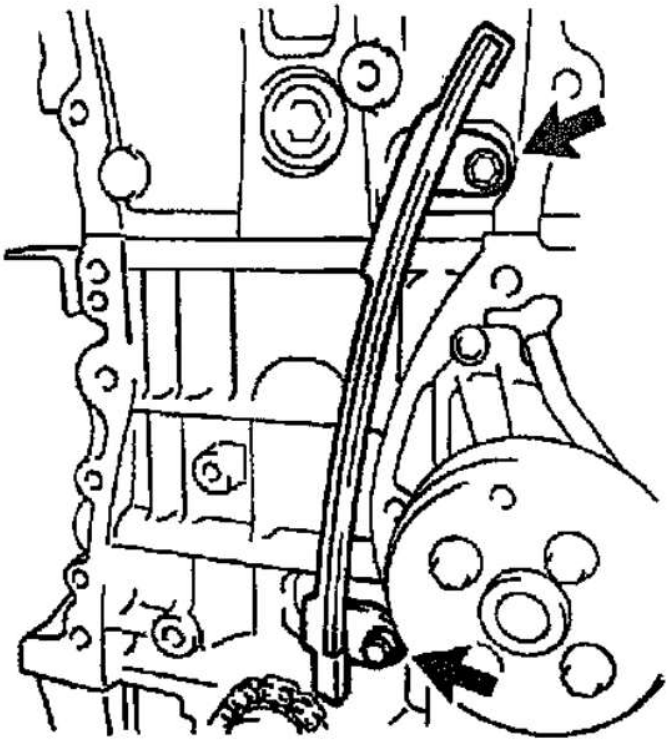


Fig. 52: Locating Chain Vibration Damper Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install the damper with the 2 bolts.

Torque: 9 N.m (90 kgf. cm, 80 in. .lbf)

4. **Install crankshaft timing sprocket** .

   Align the sprocket set key with the key groove of the sprocket, slide on the sprocket.

5. **Install timing chain** .
   a. Install the timing chain on the crankshaft timing sprocket with the blue or orange mark link aligned with the timing mark on the crankshaft timing sprocket.

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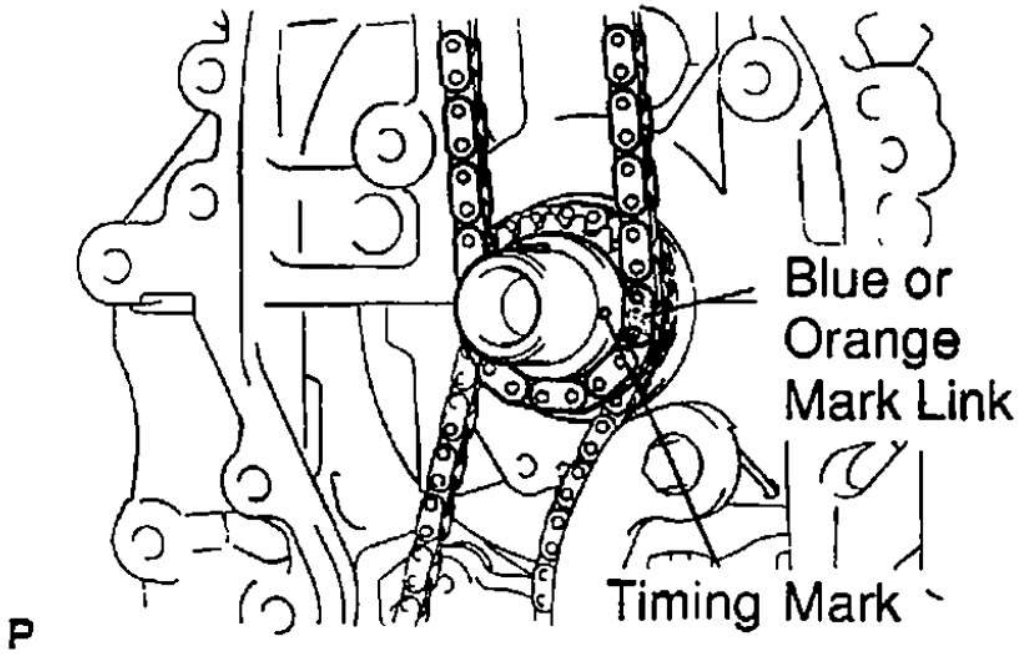


Fig. 53: Identifying Blue & Orange Mark Link
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the timing chain on the camshaft timing sprocket and VVT timing sprocket with the gold or yellow mark links aligned with the timing marks on the camshaft timing sprocket and VVT timing sprocket.

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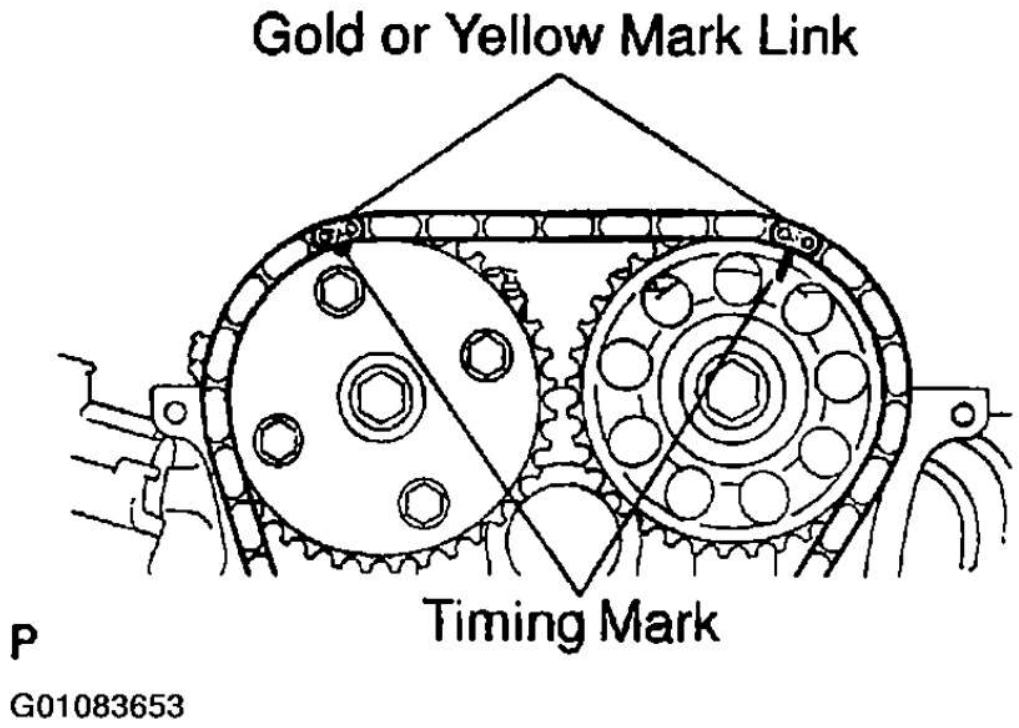


Fig. 54: Identifying Gold Or Yellow Mark Link
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **Install timing chain guide** .

Install the timing chain guide with the bolt.

Torque: 9 N.m (90 kgf. cm, 80 in. .lbf)

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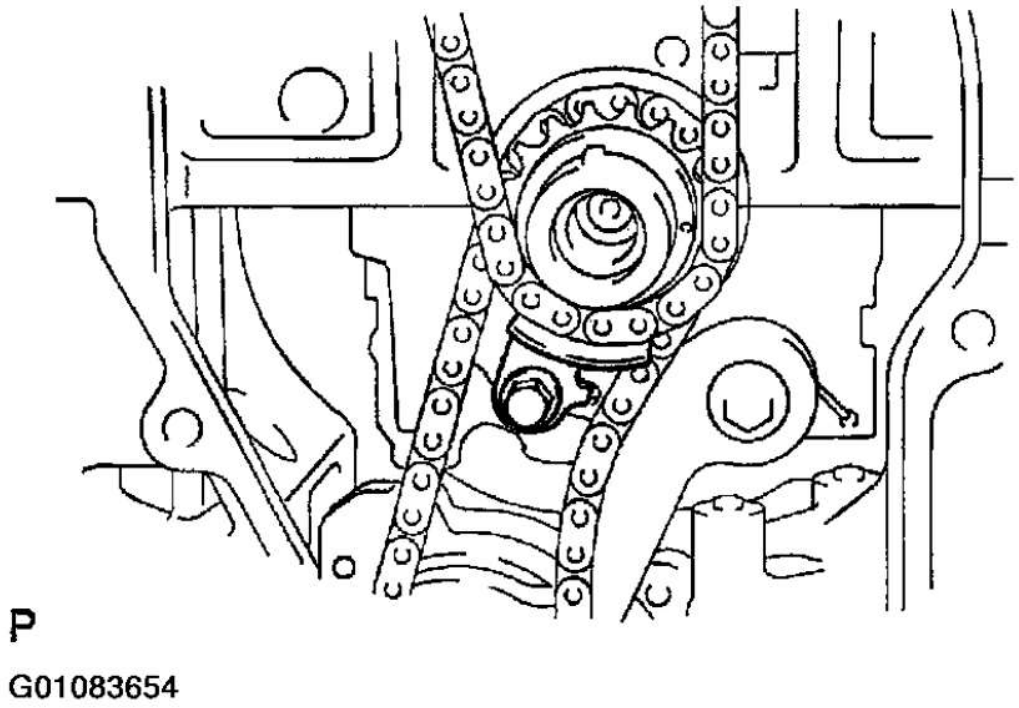


Fig. 55: Installing Timing Chain Guide
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **Install chain tensioner slipper** .
   a. Install the slipper with the bolt.
      Torque: 19 N.m (195 kgf. cm, 14 ft. lbf)
   b. Check that the slipper is hold on the cylinder block stopper.

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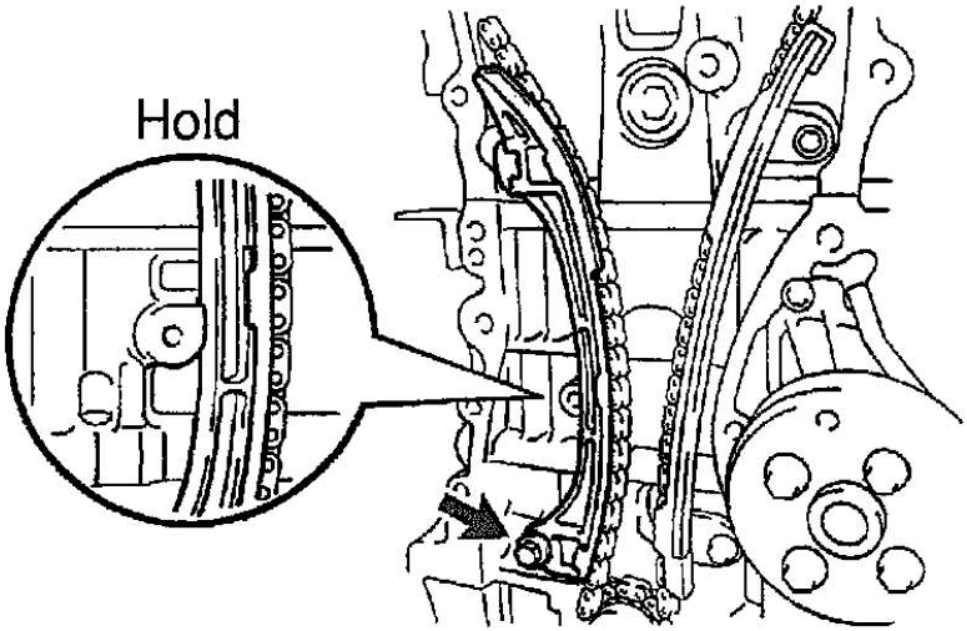


Fig. 56: Installing Chain Tensioner Slipper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **Install crank angle sensor plate** .

   Install the plate with the F mark facing forward.

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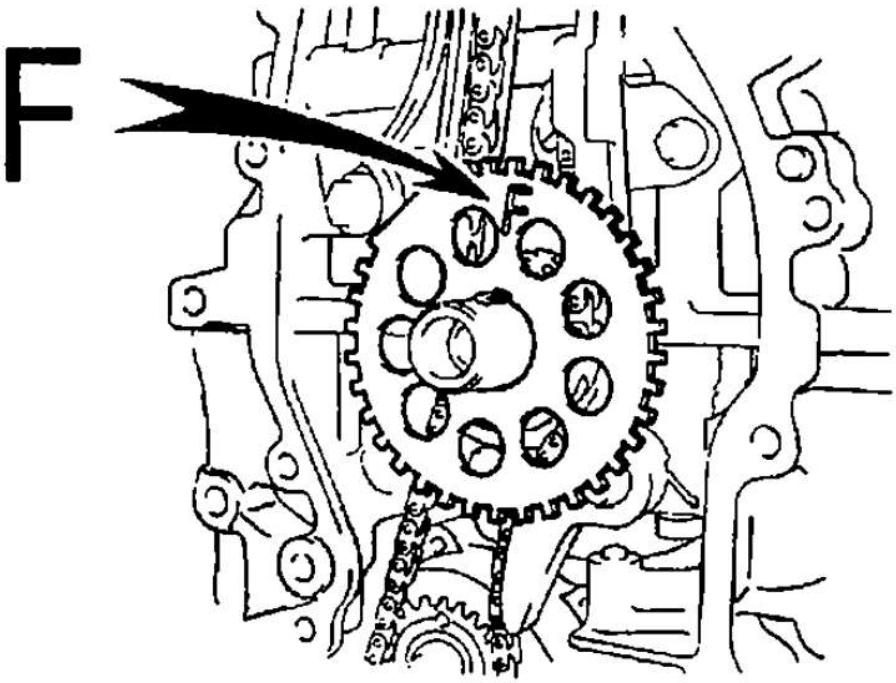


Fig. 57: Installing Crank Angle Sensor Plate
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **Install timing chain cover** .
   a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the timing chain cover and cylinder head/block/crank case.
      - Using a razor blade and a gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing grooves.
      - Thoroughly clean all components to remove all the loose material.
      - Using a non-residue solvent, clean both sealing surfaces.

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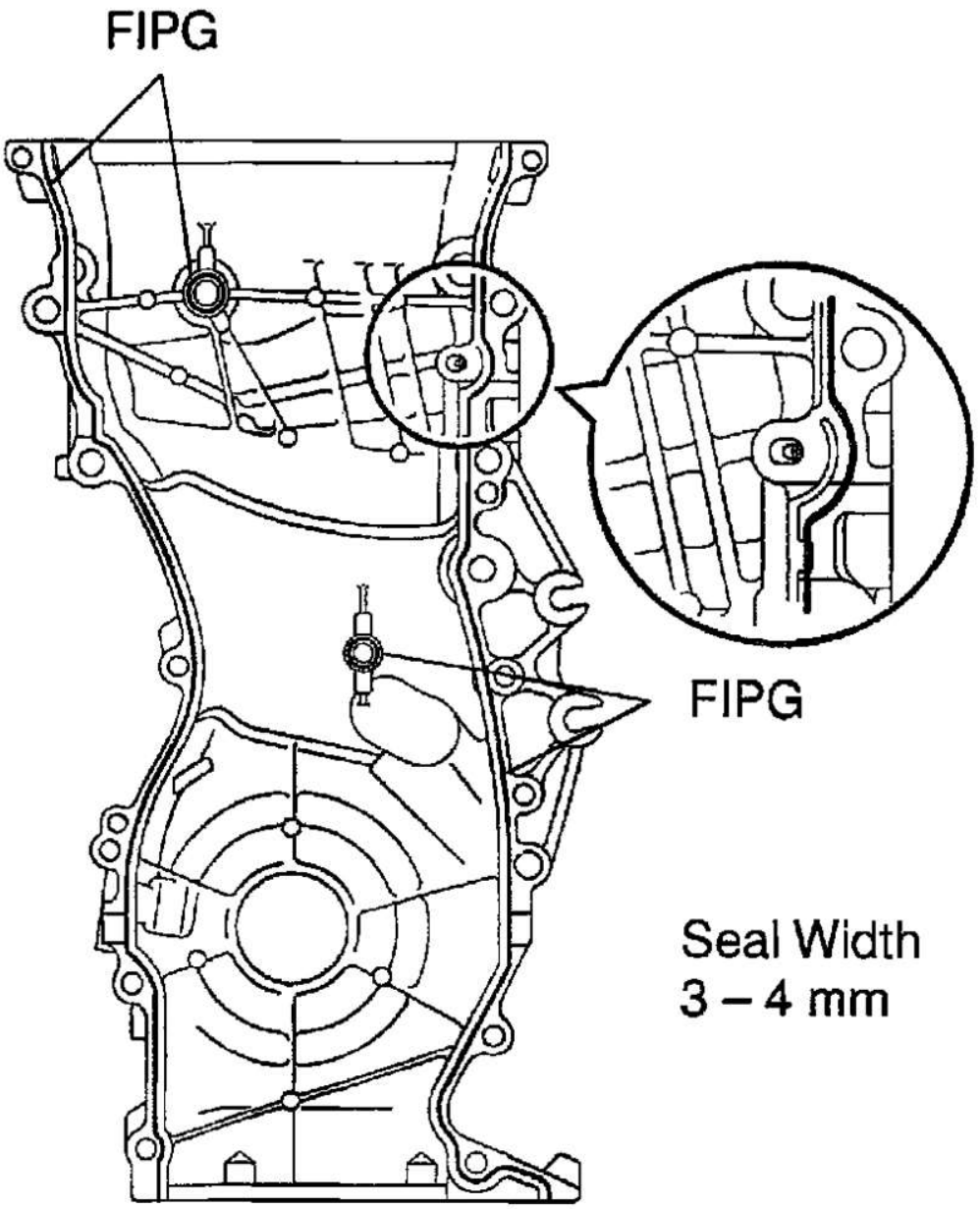


Fig. 58: Installing Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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b. Apply seal packing to the timing chain cover as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 3 - 4 mm (0.12 - 0.16 in.) opening.

NOTE: Avoid applying an excessive amount to the surface.

- **Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.**
- **Immediately remove nozzle from the tube and reinstall cap.**

c. Apply seal packing to 2 locations as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

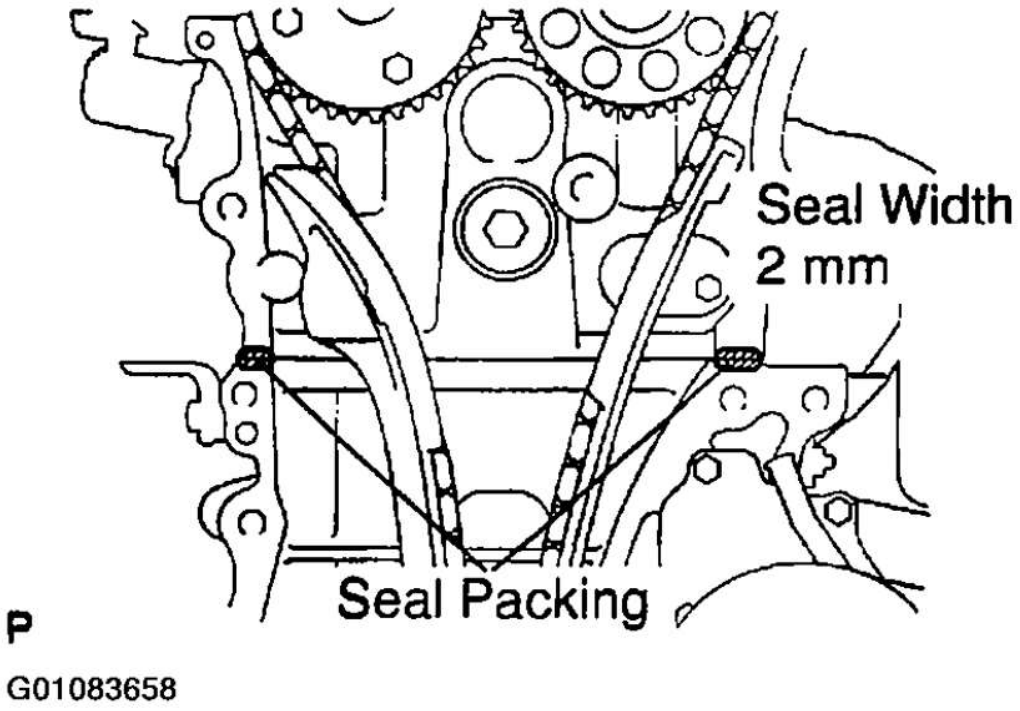


Fig. 59: Identifying Locations For Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Install a nozzle that has been cut to a 2 mm (0.08 in.) opening.

NOTE: Avoid applying an excessive amount to the surface.

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- Parts must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

d. Install the timing chain cover with the 14 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque:

9 N.m (90 kgf. cm, 80 in. .lbf) for bolt A

21 N.m (220 kgf. cm, 15 ft. .lbf) for bolt B

43 N.m (440 kgf. cm, 32 ft. .lbf) for bolt C

43 N.m (440 kgf. cm, 32 ft. .lbf) for bolt D

9 N.m (90 kgf. cm, 80 ft. lbf) for nuts

NOTE: Each bolt length in indicated in the illustration.

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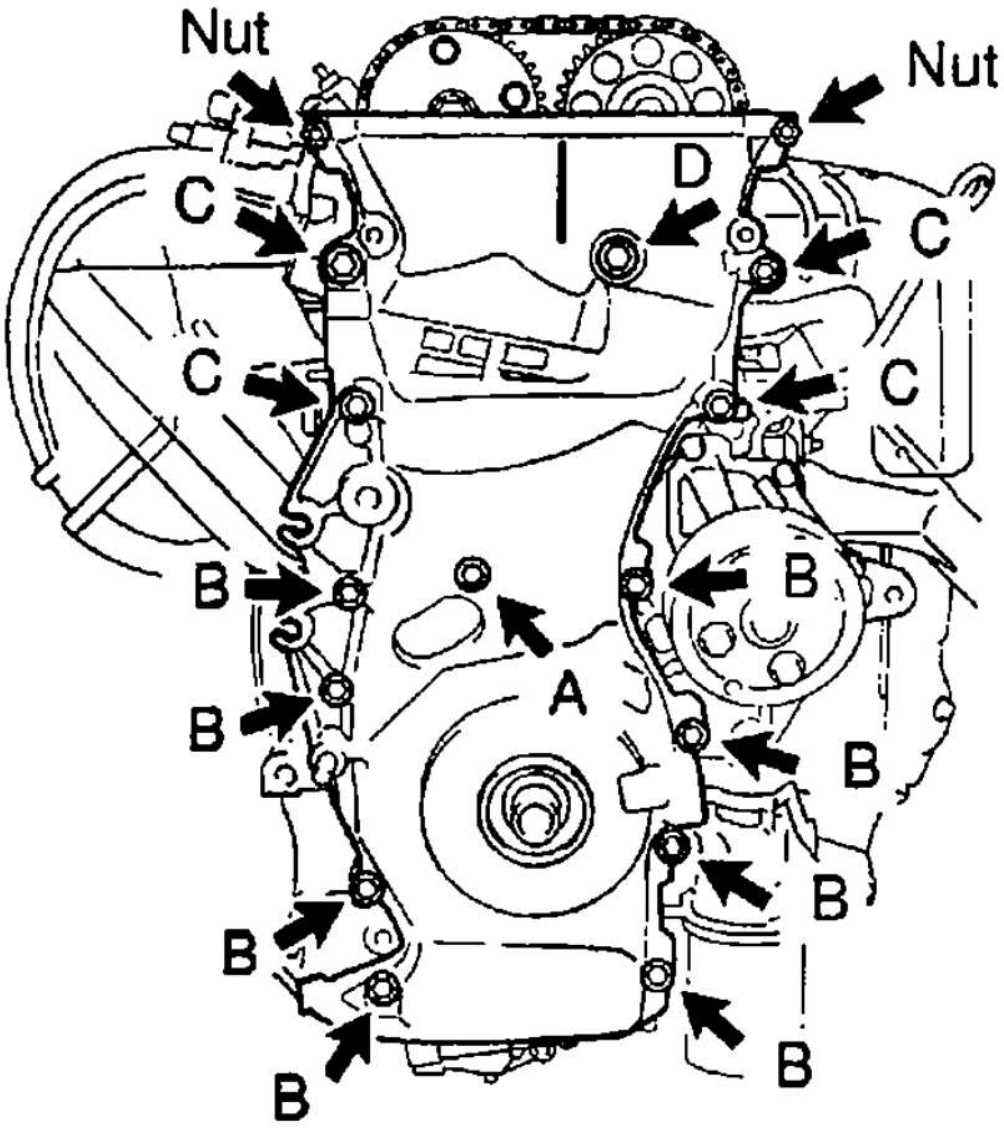


Fig. 60: Locating Timing Chain Cover Bolts & Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

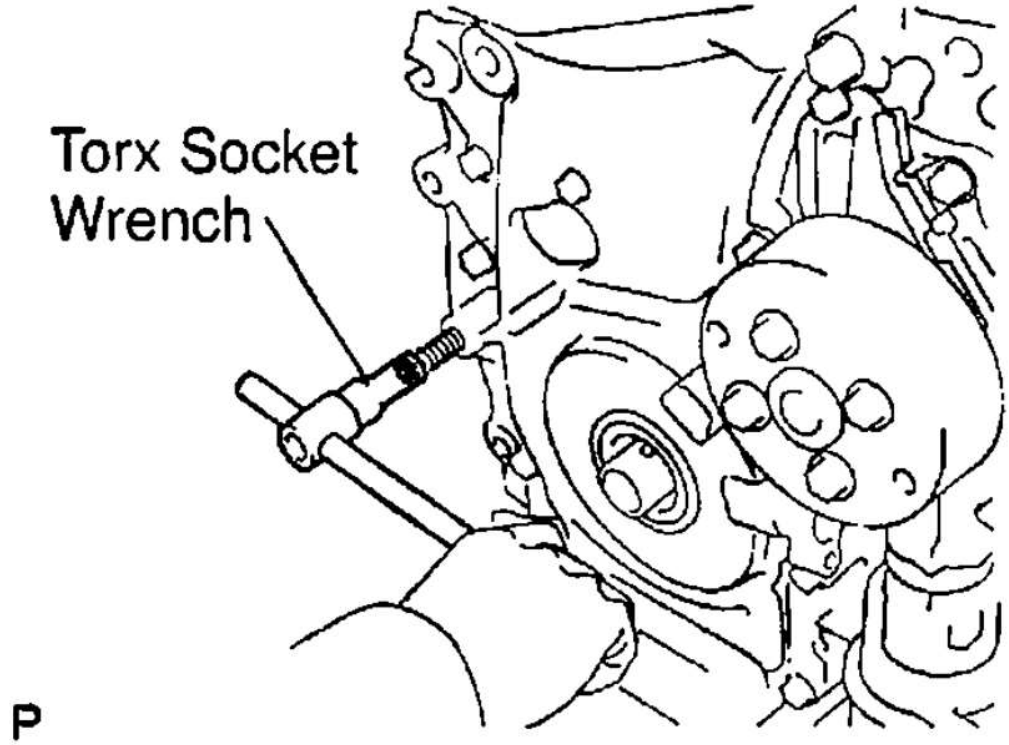
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Bolt A	30 mm (1.18 in.) length for 10 mm head
Bolt B	30 mm (1.18 in.) length for 12 mm head
Bolt C	40 mm (1.57 in.) length for 14 mm head
Bolt D	65 mm (2.56 in.) length for 14 mm head

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Fig. 61: Displaying Bolt Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using a Torx socket wrench (E10), install the stud bolt for the drive belt tensioner.
Torque: 9.5 N.m (90 kgf. cm, 84 in. .lbf)



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Fig. 62: Installing Stud Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **Install drive belt tensioner** .

Install the drive belt tensioner with the bolt and nut.

Torque: 59.5 N.m (610 kgf. cm, 44 ft. lbf)

NOTE: As the drive belt tensioner should be torqued together with the timing chain cover, so be sure install it with in 15 minutes after the timing chain cover is installed.

11. **Install crankshaft position sensor (See CAMSHAFT POSITION SENSOR) .**

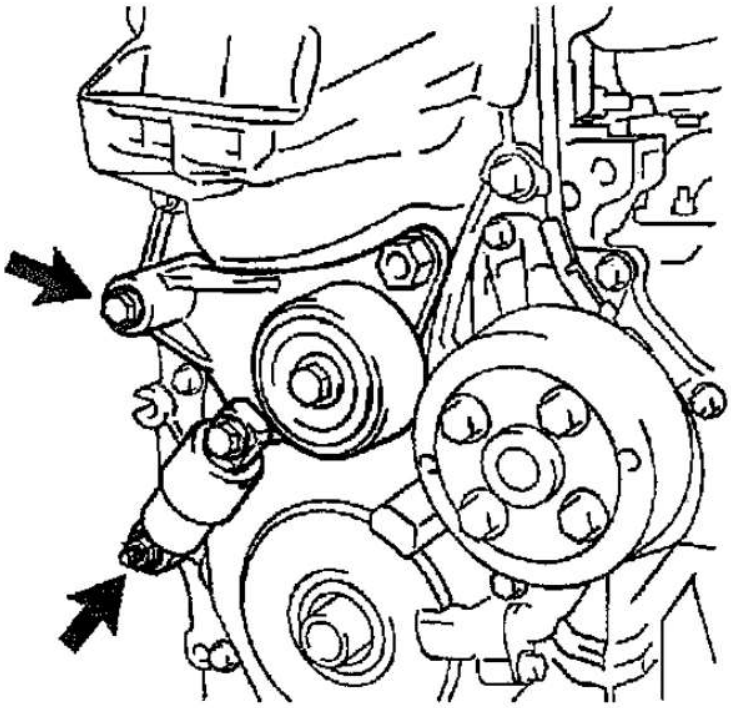


Fig. 63: Installing Drive Belt Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **Install oil pan (See INSTALLATION) .**

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13. **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 09213-54015, 09330-00021
        Torque: 170 N.m (1,735 kgf. cm, 125 ft. lbf)

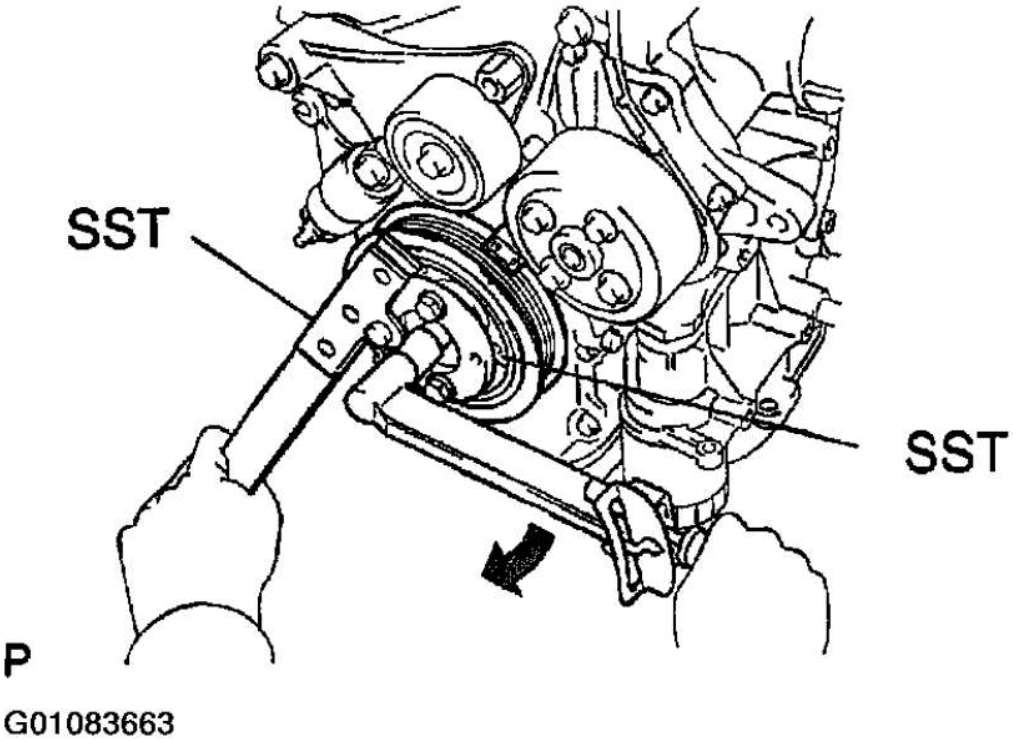


Fig. 64: Installing Crankshaft Pulley
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **Install chain tensioner** .
    a. Release the ratchet pawl, fully push in the plunger and apply the hook to the pin so that the plunger cannot spring out.

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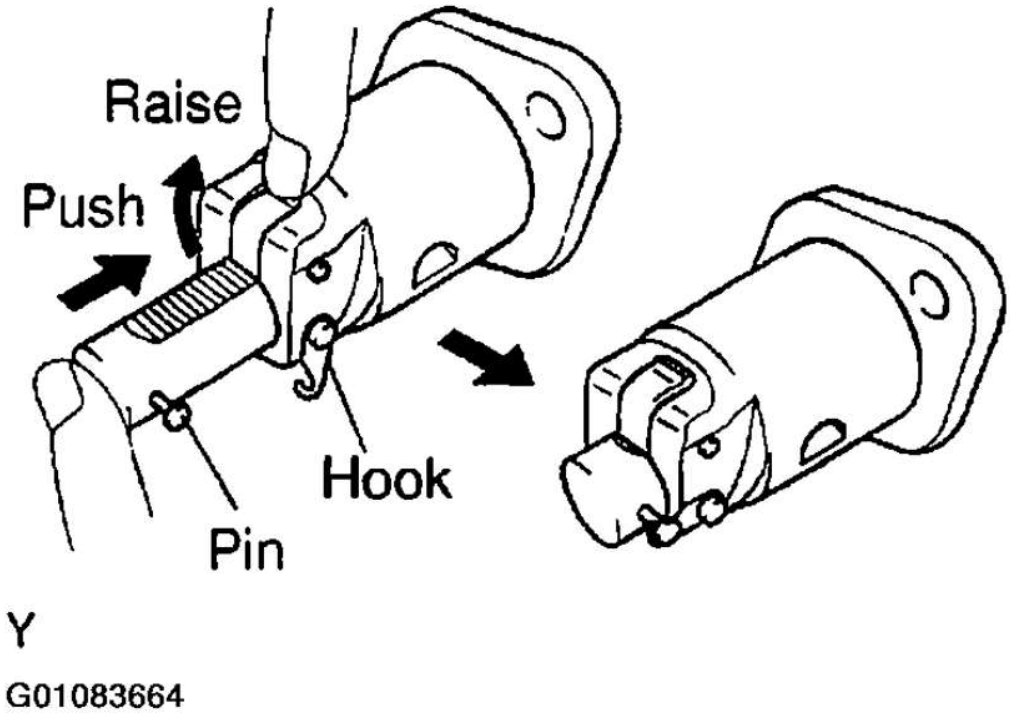


Fig. 65: Installing Chain Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Place a new gasket on the timing chain cover with portion A facing as shown in the illustration.

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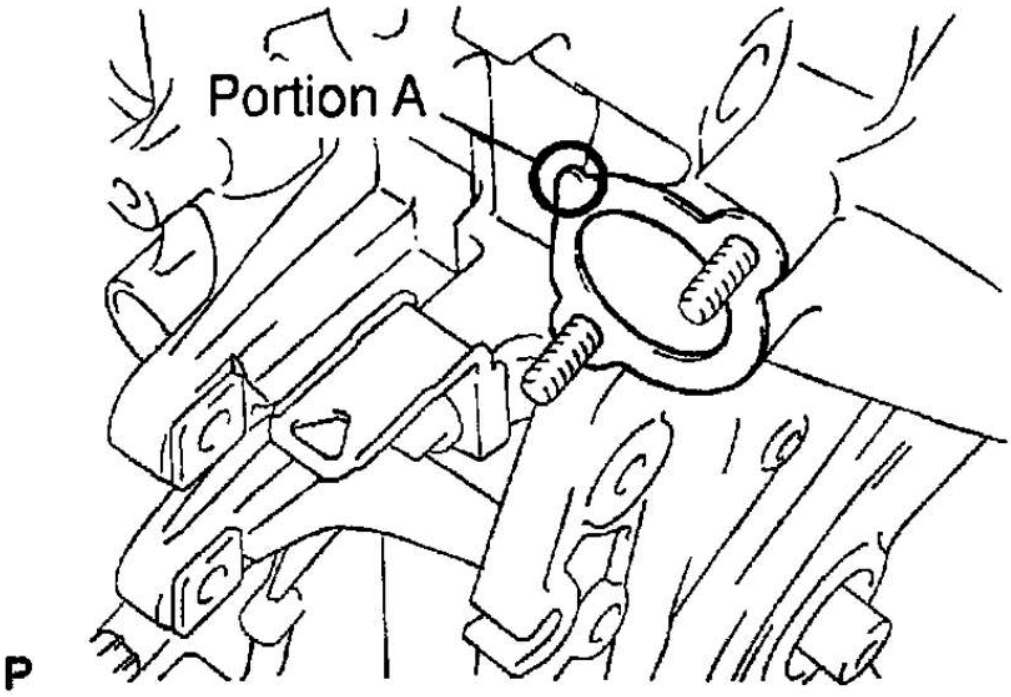


Fig. 66: Identifying Portion A
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Push the chain tensioner into the timing chain cover, and install the 2 nuts.
Torque: 9 N.m (90 kgf. cm, 80 in. .lbf)

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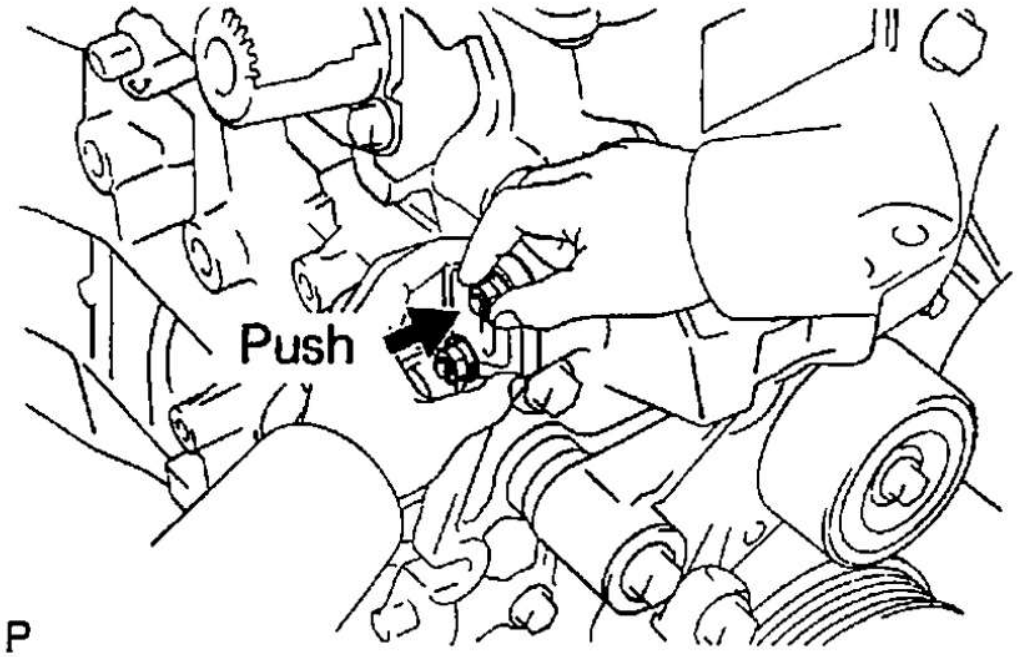


Fig. 67: Pushing Chain Tensioner
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **Set chain tension** .
    a. Turn the crankshaft counterclockwise, and disconnect the plunger knock pin from the hook.

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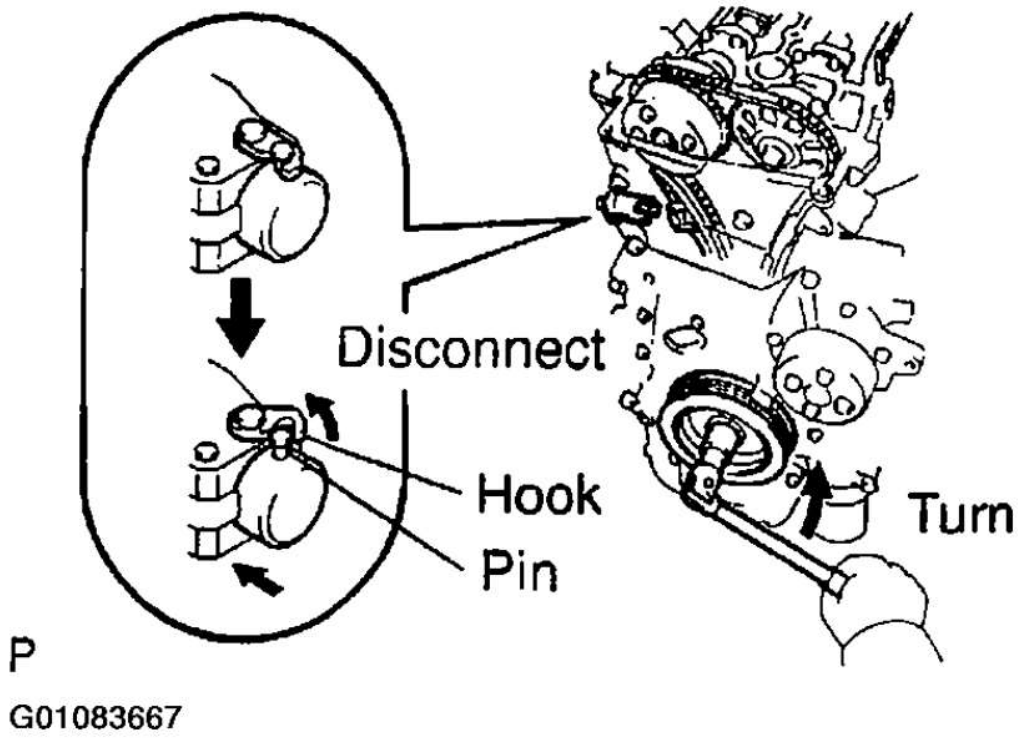


Fig. 68: Disconnecting Plunger Knock Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Turn the crankshaft clockwise, and check that the slipper is pushed by the plunger.

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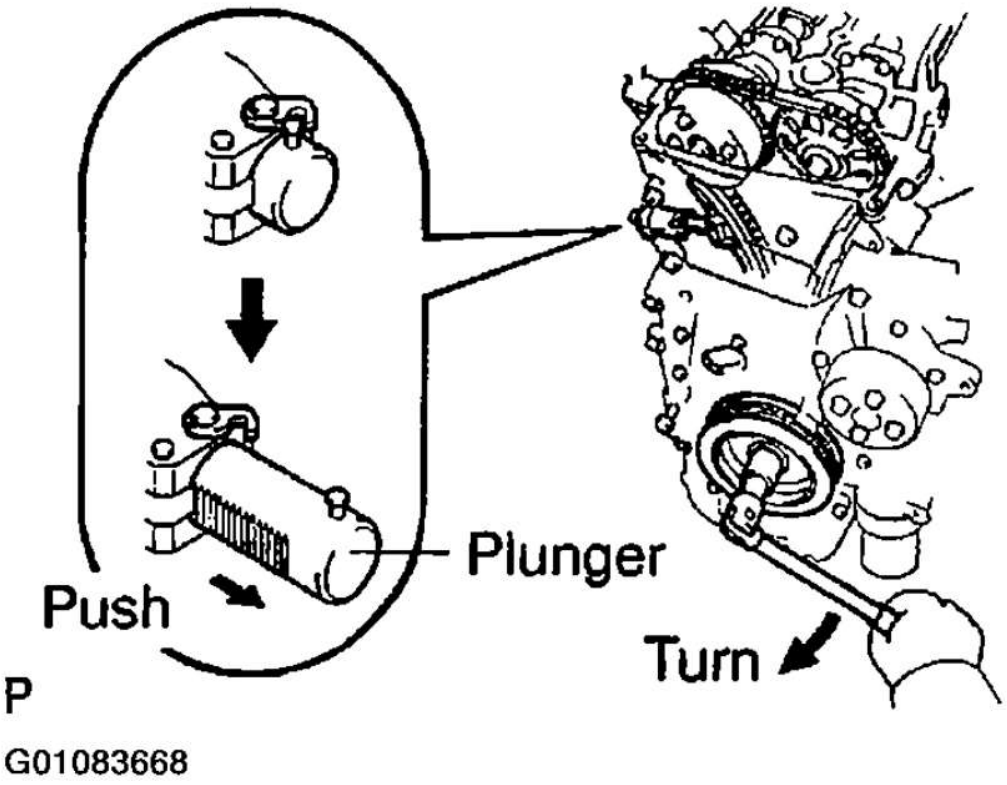


Fig. 69: Checking Slipper Is Being Pushed
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **Check valve timing** .
    a. Turn the crankshaft pulley, and align its groove with timing mark 0 of the timing chain cover.

NOTE: **Always turn the crankshaft clockwise.**

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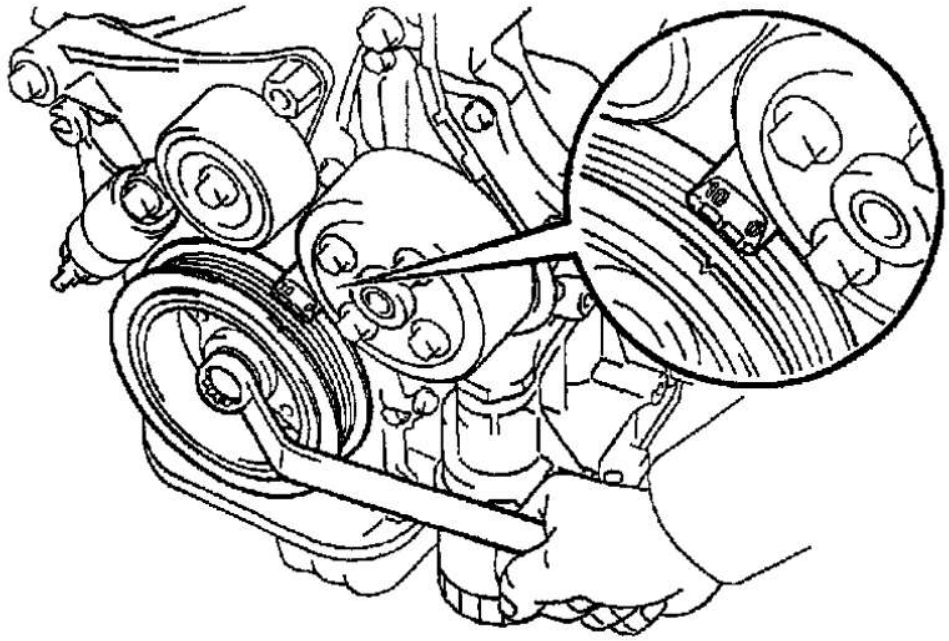


Fig. 70: Aligning Time Crankshaft Pulley To Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check that the timing marks of the camshaft timing sprocket and VVT timing sprocket are aligned with the timing marks of the No. 1 and No. 2 bearing caps as shown in the illustration.

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

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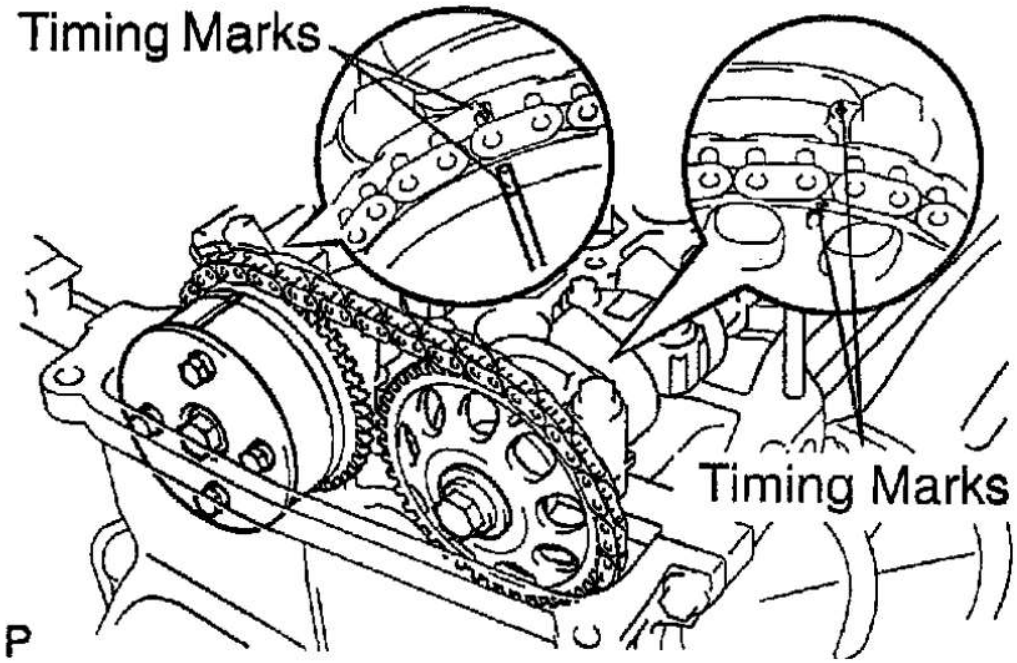


Fig. 71: Checking Timing Marks Align
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **Install cylinder head cover** .
    a. Remove any old packing (FIPG) material.
    b. Apply seal packing to 2 locations as shown in the illustration.
    Seal packing: Part No. 08826-00080 or equivalent

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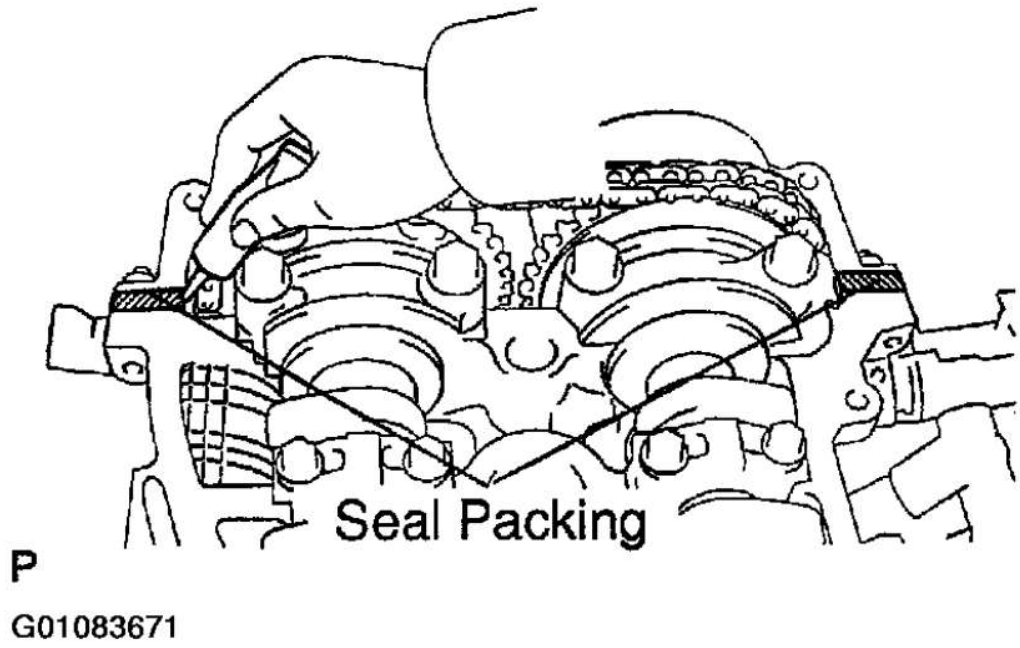


Fig. 72: Applying Seal Packing To Identified Locations
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the gasket to the cylinder head cover.

If the gasket has damage, replace a new one.

NOTE: Part must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.

d. Install the cylinder head cover with the 8 bolts and 2 nuts.

Torque: 11 N.m (115 kgf. cm, 8 ft. lbf)

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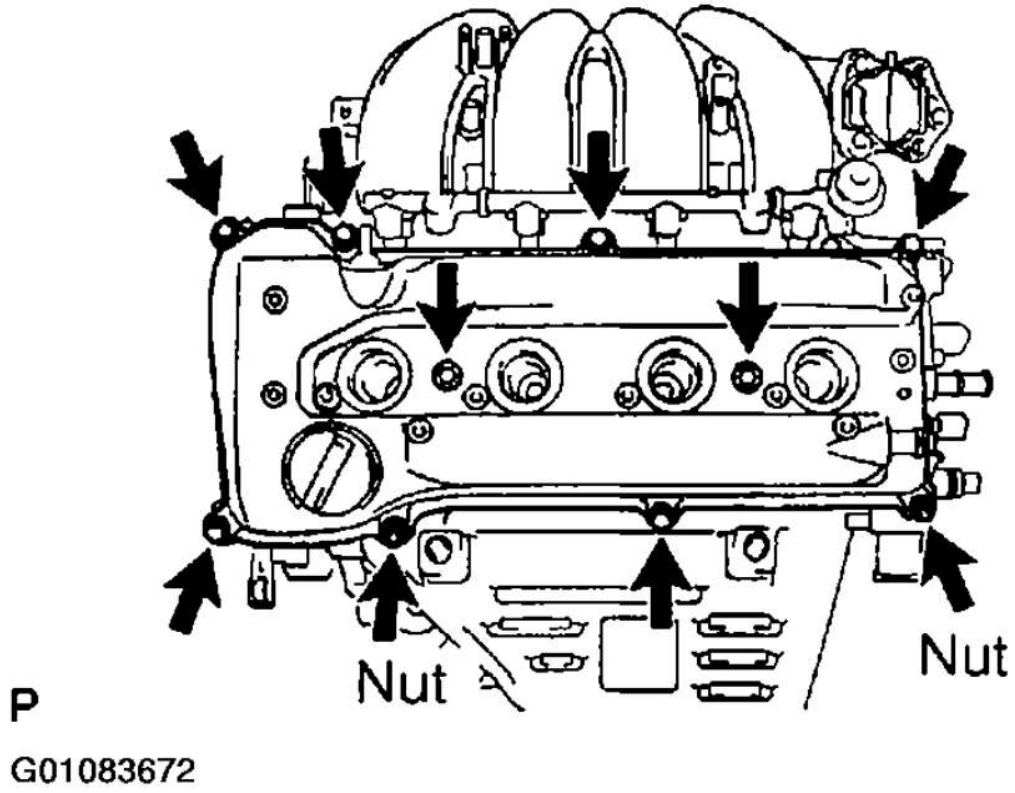


Fig. 73: Locating Cylinder Head Cover Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Install the noise filter.
f. Disconnect the oxygen sensor (bank 1 sensor 1) connector.
g. Connect the 2 PCV hoses to the cylinder head cover.

18. **Install ignition coils (See REMOVAL & INSTALLATION (RAV4)) .**
19. **Install vane pump (See REASSEMBLY) .**
20. **Install generator (See INSTALLATION) .**
21. **Install RH engine mounting insulator (See REMOVAL) .**
22. **Install drive belt (See CHARGING SYSTEM) .**
23. **Install ABS actuator (See ACTUATOR/ABS ECU) .**
24. **Install air cleaner assembly (See INSTALLATION) .**
25. **Install engine under cover .**
26. **Fill with engine oil (See REPLACEMENT) .**

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27. **Start engine and check for leak .**
28. **Recheck engine oil level .**

CYLINDER HEAD

COMPONENTS

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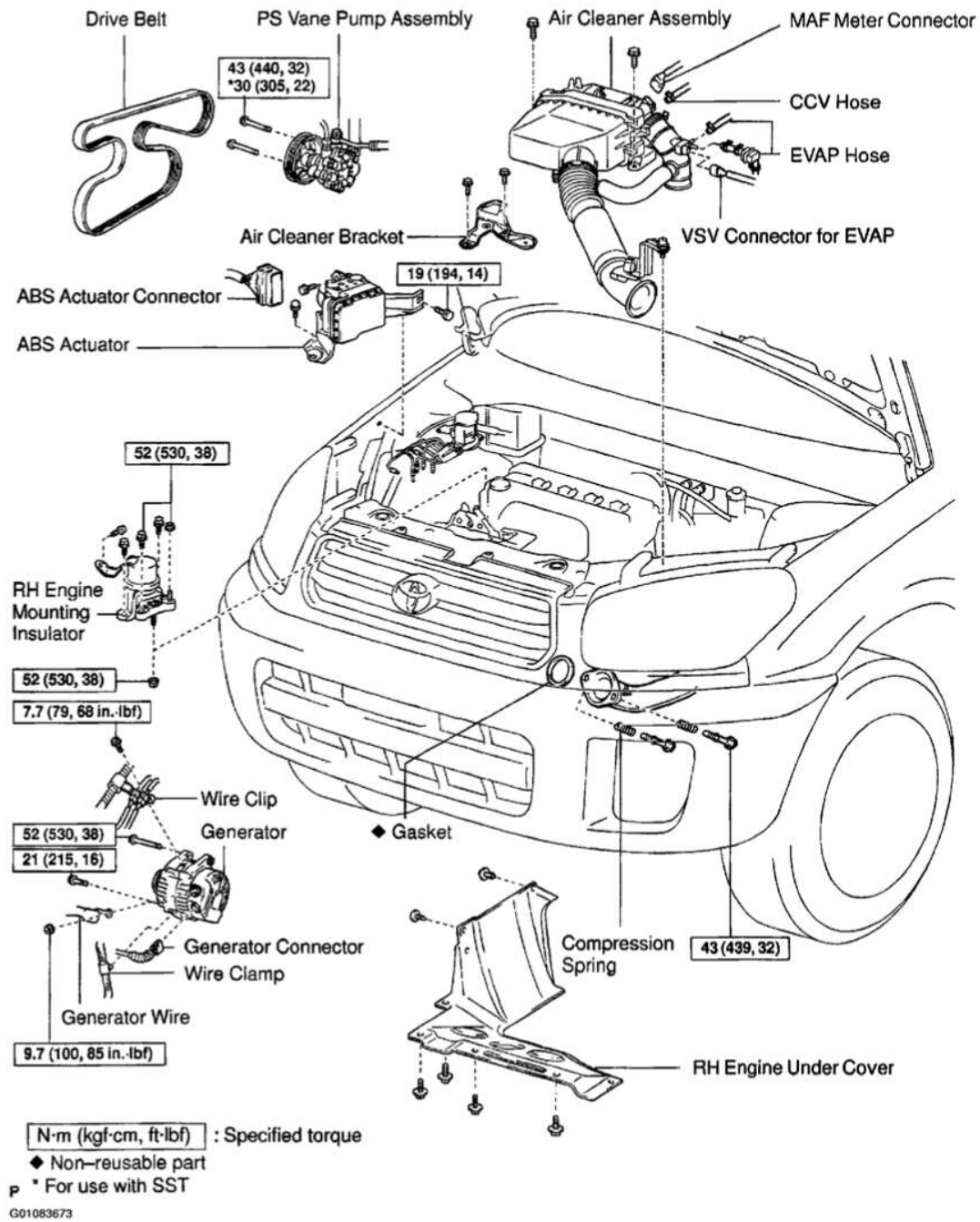


Fig. 74: Displaying Cylinder Head Components (1 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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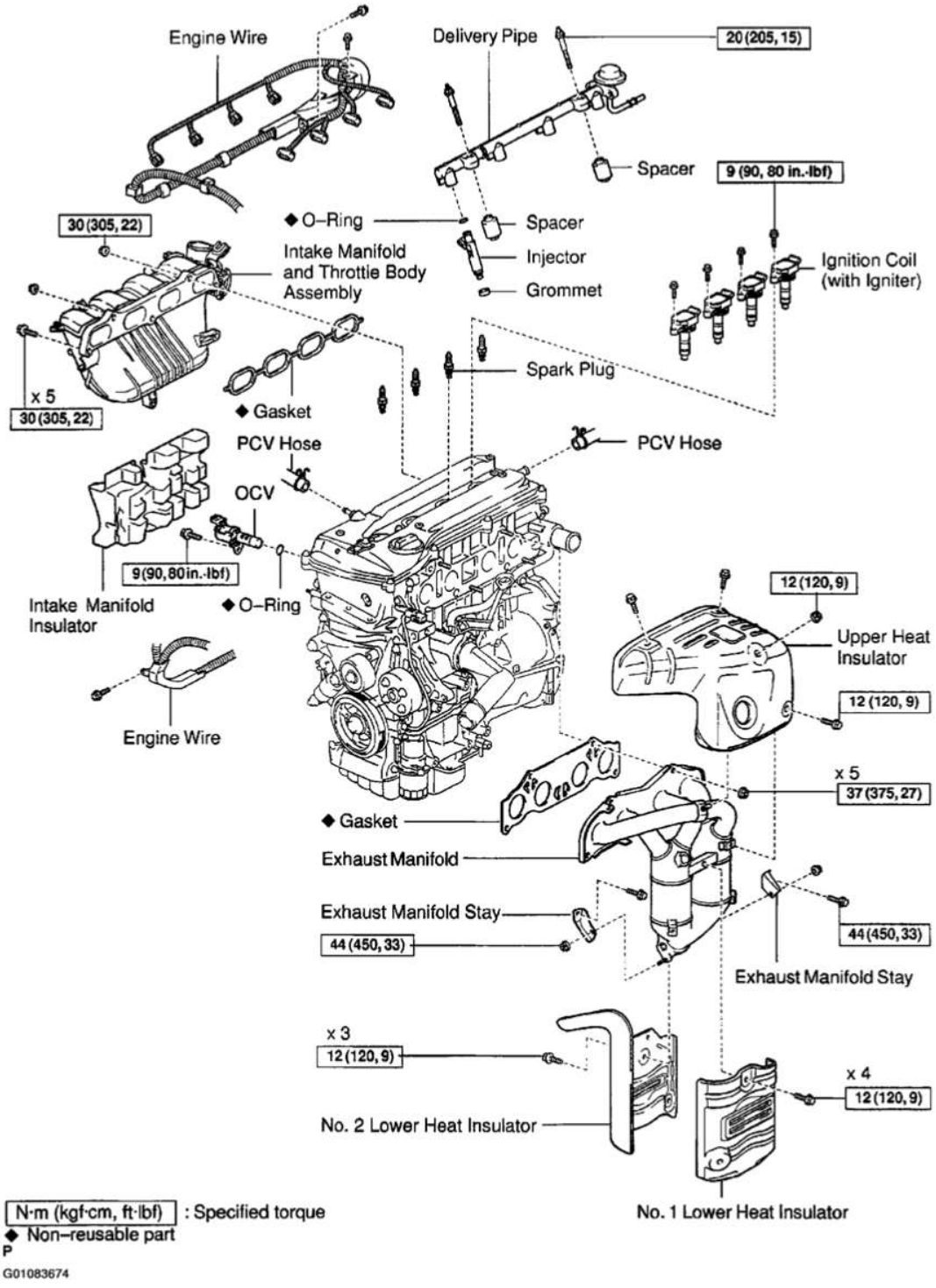


Fig. 75: Displaying Cylinder Head Components (2 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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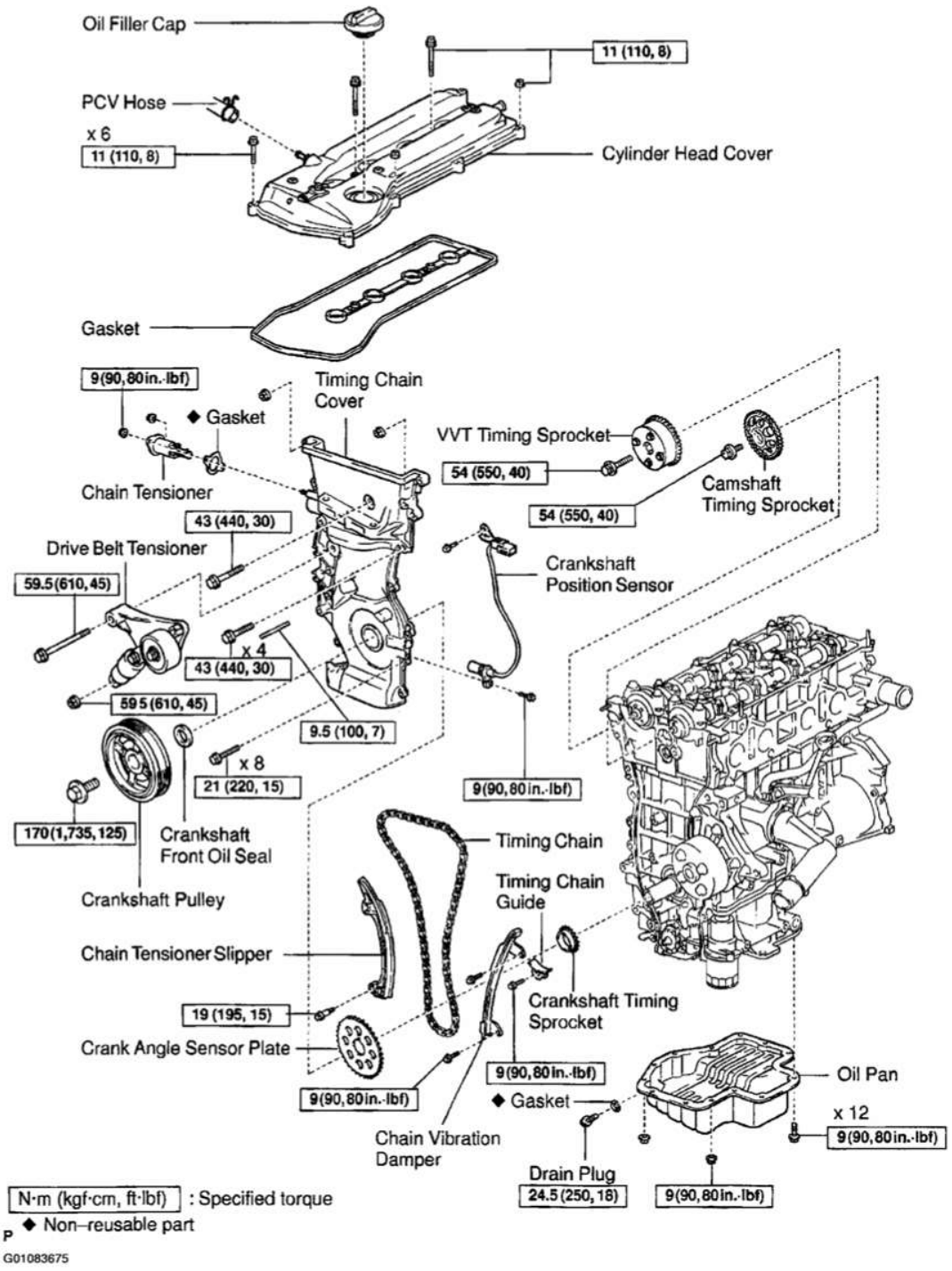


Fig. 76: Displaying Cylinder Head Components (3 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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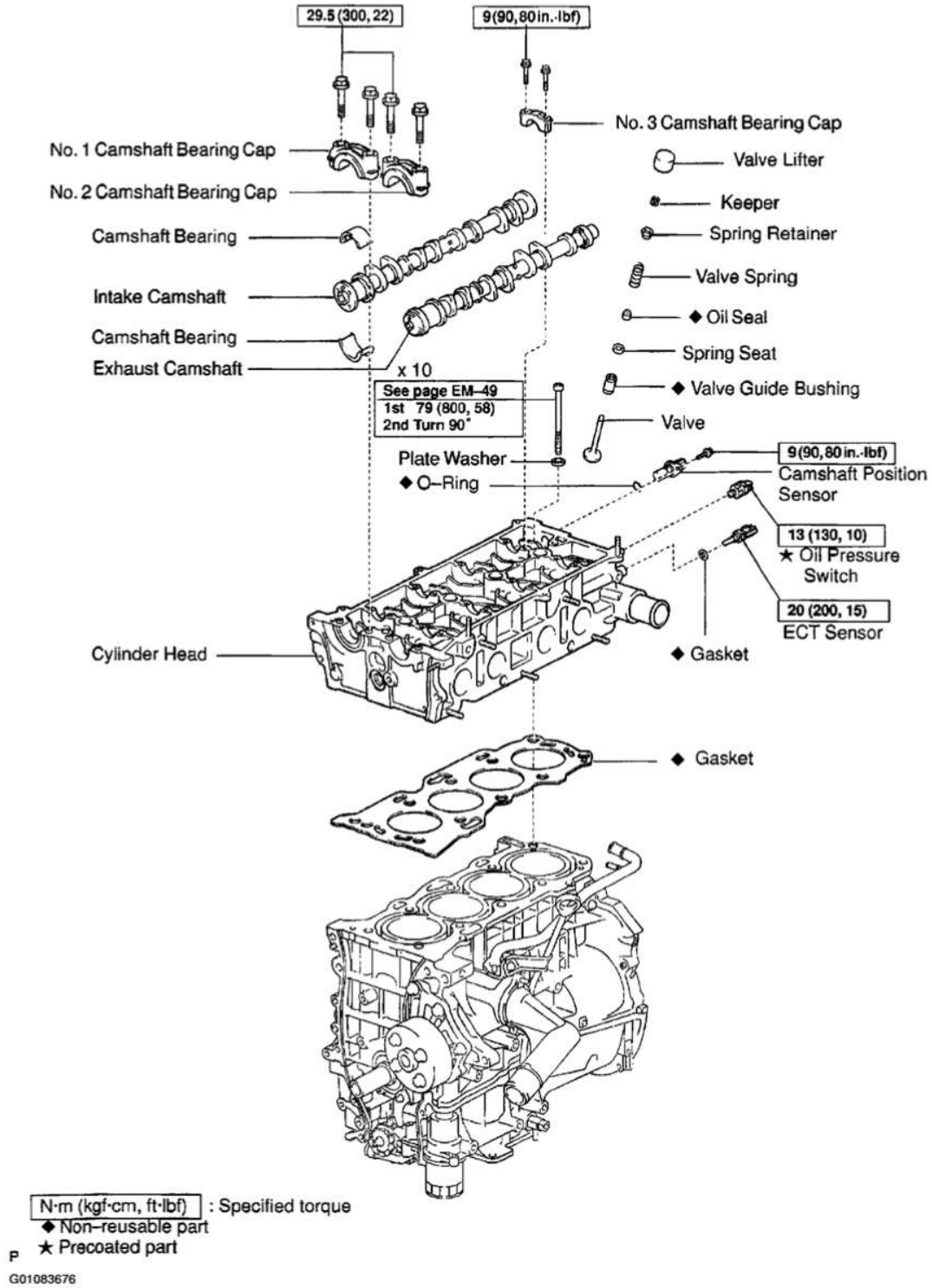


Fig. 77: Displaying Cylinder Head Components (4 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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REMOVAL

1. **Remove RH engine under cover** .
2. **Drain engine coolant**
3. **Drain engine oil** .
4. **Remove air cleaner assembly** .

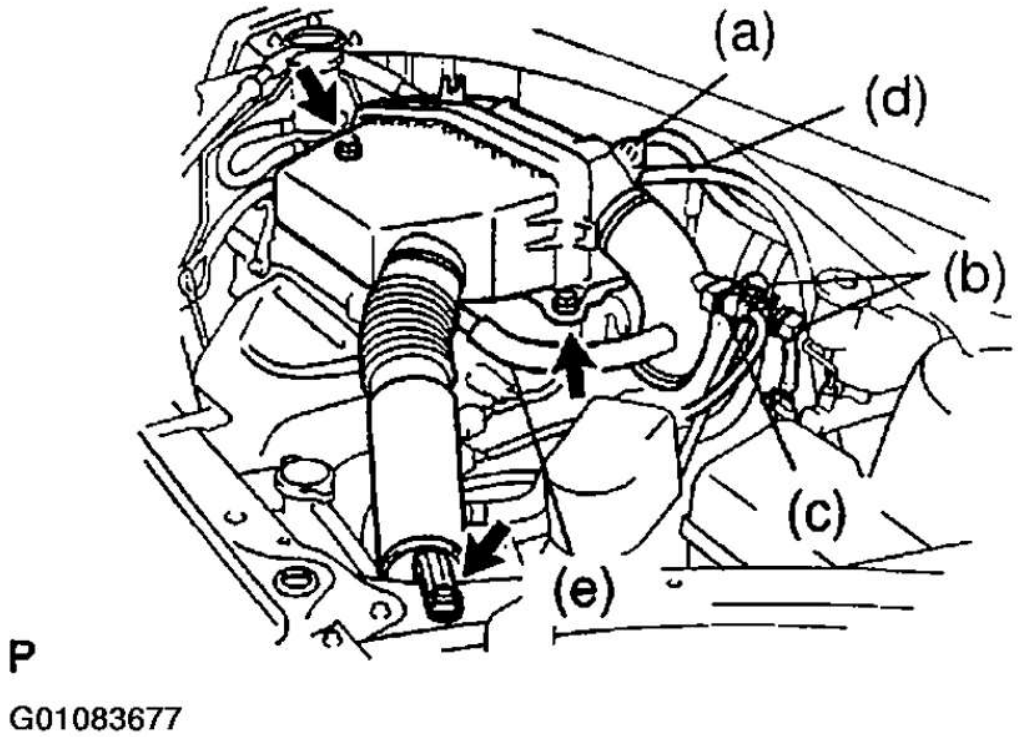


Fig. 78: Disconnecting Air Cleaner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Disconnect the MAF meter connector.
b. Disconnect the 2 EVAP hoses from the VSV.
c. Disconnect VSV connector for EVAP.
d. Disconnect the CCV hose from the air cleaner.
e. Disconnect the PCV hose from the cylinder head cover.

5. **Remove drive belt (See CHARGING SYSTEM) .**
6. **Remove generator (See REMOVAL) .**
7. **Remove PS vane pump (See REMOVAL) .**

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8. **Remove ignition coils (See REMOVAL & INSTALLATION (RAV4)) .**
9. **Remove spark plugs (See RAV4) .**
10. **Remove injectors (See FUEL INJECTORS (CELICA, COROLLA, ECHO, HIGHLANDER, RAV4)) .**
11. **Remove exhaust manifold assembly .**

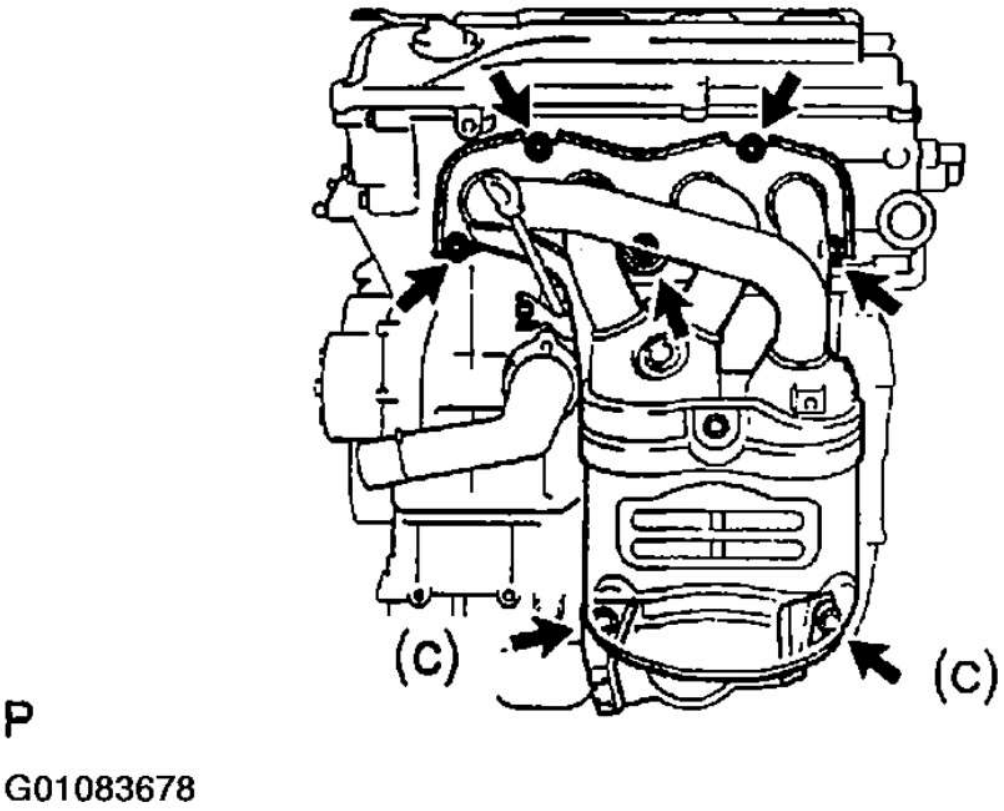


Fig. 79: Removing Exhaust Manifold Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Disconnect the 2 A/F sensor connectors.
b. Disconnect the 2 heated oxygen sensor connectors.
c. Remove the 3 bolts, nut and upper heat insulator.
d. Remove the 2 bolts holding the exhaust manifold stays and crank case.
e. Remove the 5 nuts, 2 bolts, 2 compression springs, the exhaust manifold assembly and 2 gaskets.

12. **Remove heat insulators from exhaust manifold .**

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a. Remove the 3 bolts and No. 1 lower heat insulator.
b. Remove the 4 bolts and No. 2 lower heat insulator.
c. Remove the 2 nuts, No. 1 and No. 2 exhaust manifold stays.

13. **Remove oil filler cap** .
14. **Remove PCV hoses and valve** .
    a. Remove the 2 PCV hoses.
    b. Remove the PCV valve and grommet.
15. **Remove intake manifold and throttle body assembly** .
    a. Disconnect the throttle position sensor connector.
    b. Disconnect the IAC valve connector.
    c. Disconnect the 2 water hoses from the throttle body.
    d. Disconnect the 2 vacuum hoses from the intake manifold.
    e. Disconnect the engine wire harness from the clamp.
    f. Remove the 5 bolts, 2 nuts, the intake manifold and throttle body assembly, and gasket.
    g. Remove the intake manifold insulator.

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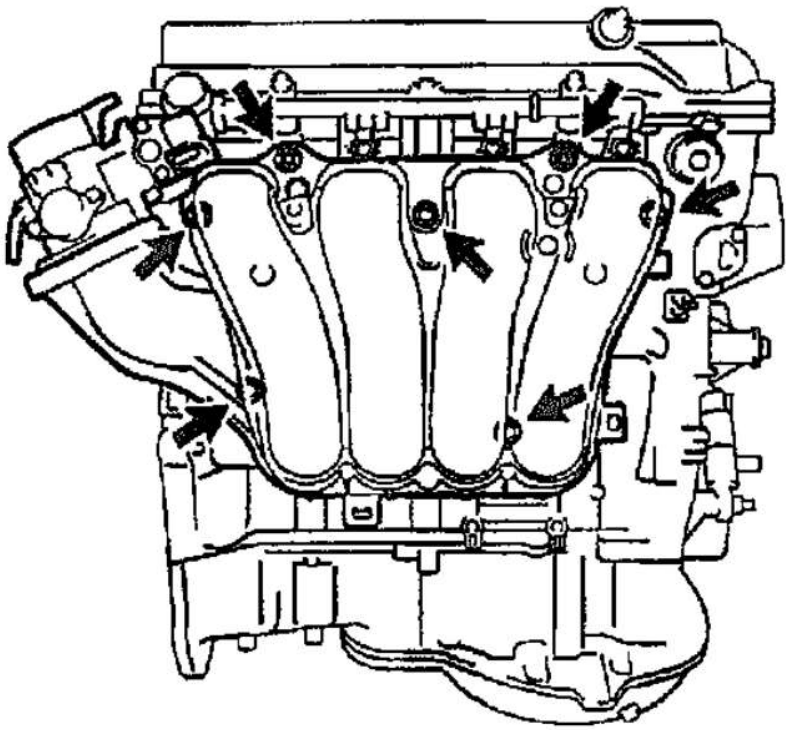


Fig. 80: Removing Intake Manifold & Throttle Body Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **Disconnect engine wire** .
    a. Disconnect the OCV connector.
    b. Disconnect the crankshaft position sensor connector.
    c. Disconnect the oil pressure switch connector and wire.
    d. Disconnect the camshaft position sensor connector.
    e. Disconnect the ECT sensor connector.
    f. Disconnect the noise filter.
17. **Remove camshaft timing chain (See REMOVAL) .**
18. **Remove timing sprocket and VVT sprocket (See REMOVAL) .**
19. **Remove camshaft timing oil control valve (OCV) (See VARIABLE VALVE TIMING CAMSHAFT TIMING OIL CONTROL VALVE) .**
20. **Remove camshafts .**

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a. Uniformly loosen and remove the 20 bearing cap bolts in several passes, in the sequence shown.
b. Remove the 10 bearing caps, intake camshaft and exhaust camshaft.
c. Remove the camshaft bearings from the No. 1 camshaft bearing cap and intake camshaft No. 1 journal part of the cylinder head.

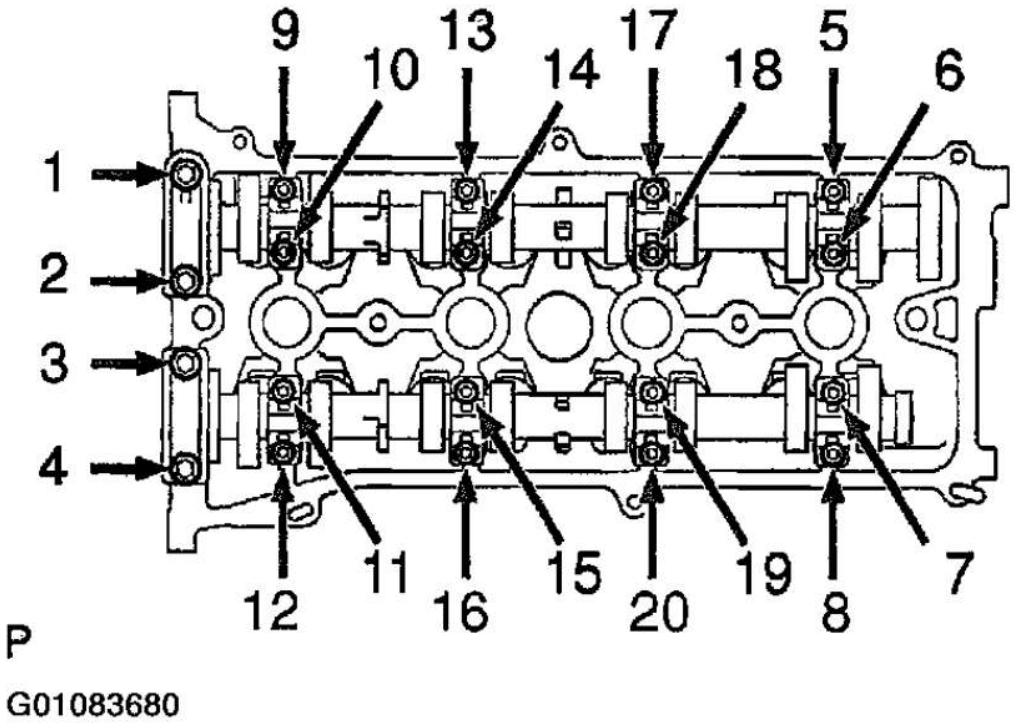


Fig. 81: Locating & Removing Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

21. **Remove cylinder head** .
    a. Using a 10 mm bi-hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts in several passes, in the sequence shown.

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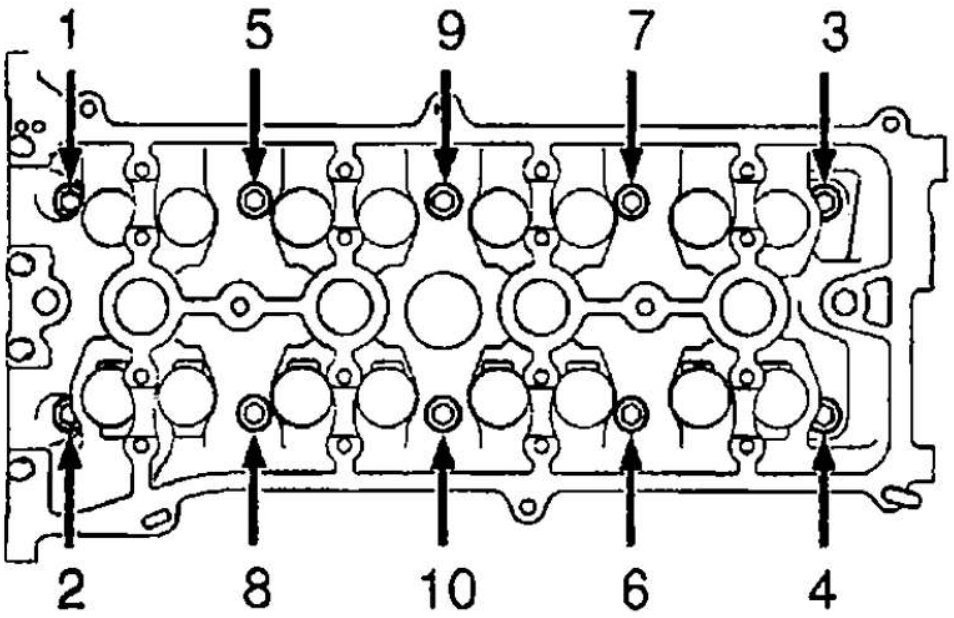
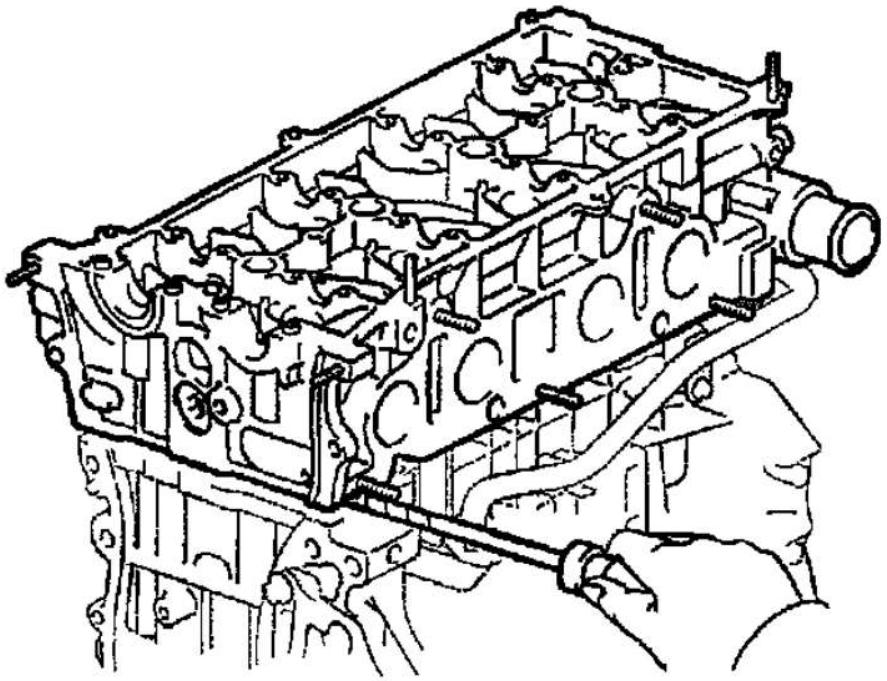


Fig. 82: Locating & Removing Cylinder Head Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Head warpage or cracking could result from removing bolts in an incorrect order.

b. Remove the 10 plate washers.
c. Using a screwdriver, pry between the cylinder head and cylinder block, and remove the cylinder head.

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Fig. 83: Removing Cylinder Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

DISASSEMBLY

1. **Remove oil pressure switch** .

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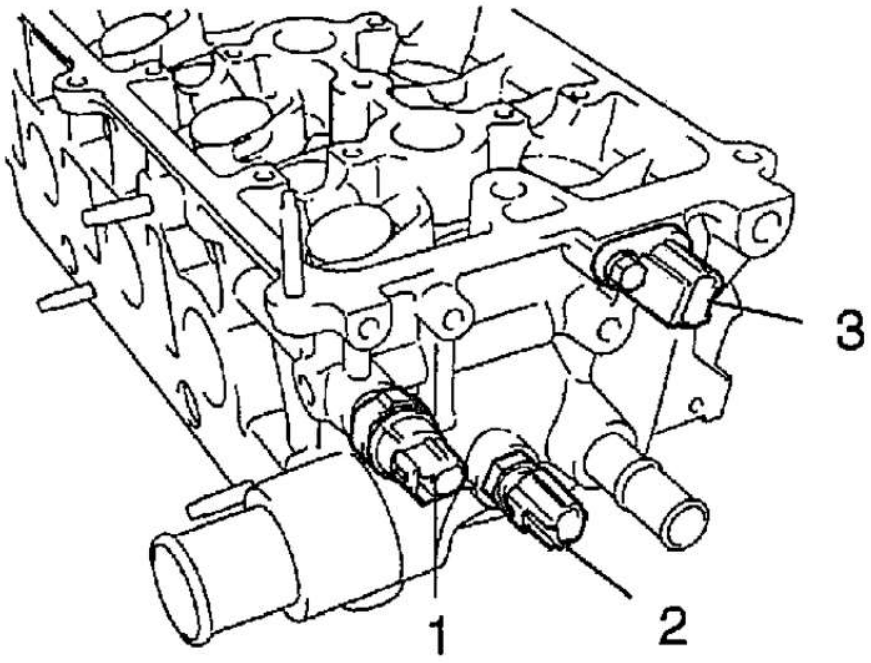


Fig. 84: Locating Steps 1, 2 & 3
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **Remove ECT sensor** .
3. **Remove camshaft position sensor** .

   Remove the bolt, camshaft position sensor and O-ring.

4. **Remove valve lifters** .

   NOTE: Arrange the valve lifters in the correct order.

5. **Remove valves** .
   a. Using SST, compress the valve spring and remove the 2 keepers.
      SST 09202-70020 (09202-00010)

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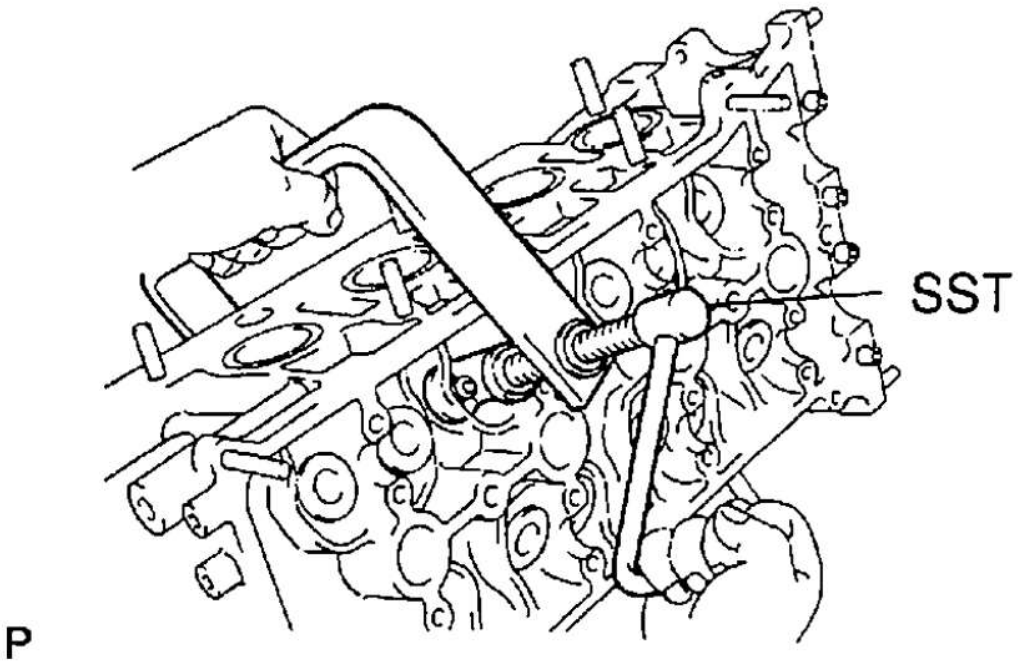


Fig. 85: Removing Keeps Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the spring retainer, valve spring and valve.
c. Using needle-nose pliers, remove the oil seal.

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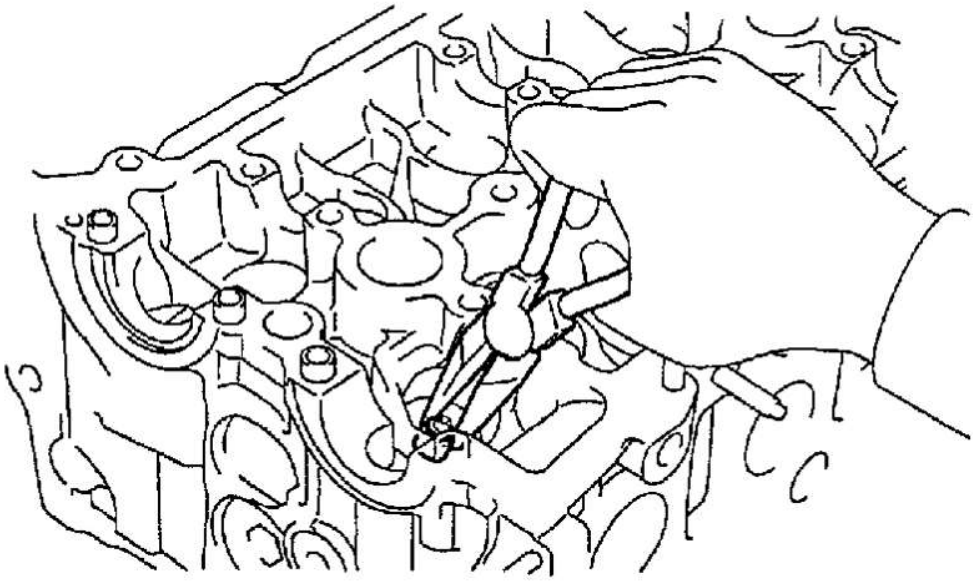


Fig. 86: Removing Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using compressed air and a magnetic finger, remove the spring seat by blowing air.

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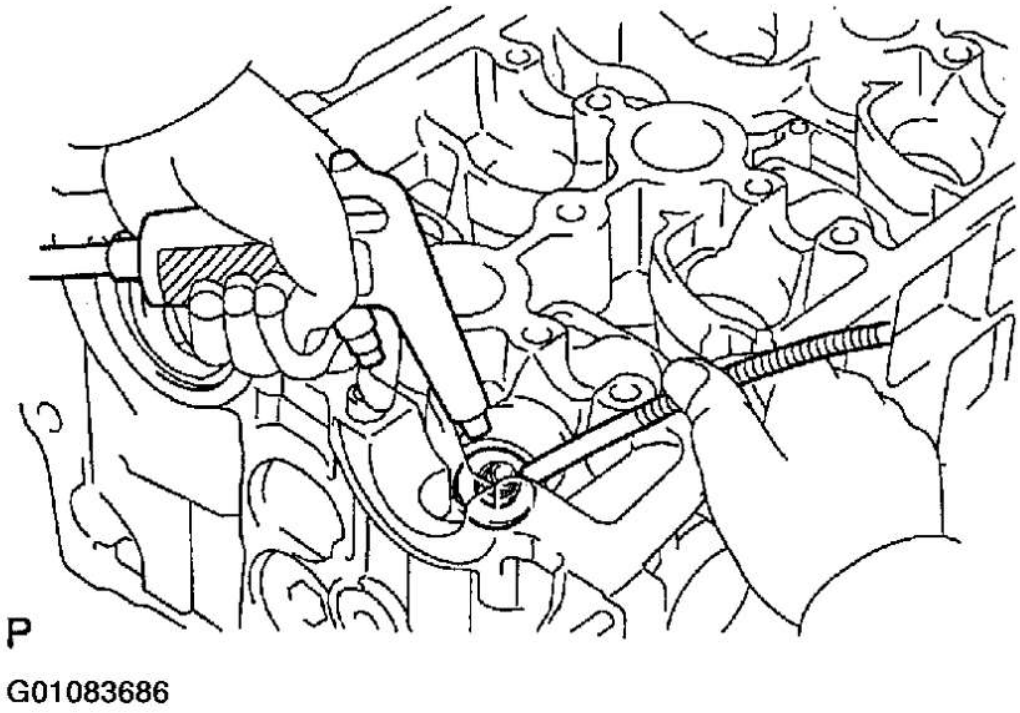


Fig. 87: Displaying Spring Seat Removal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Arrange the valves, valve springs, spring seats and spring retainers in the correct order.

INSPECTION

1. **Clean top surfaces of pistons and cylinder block** .
   a. Turn the crankshaft, and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston surface.

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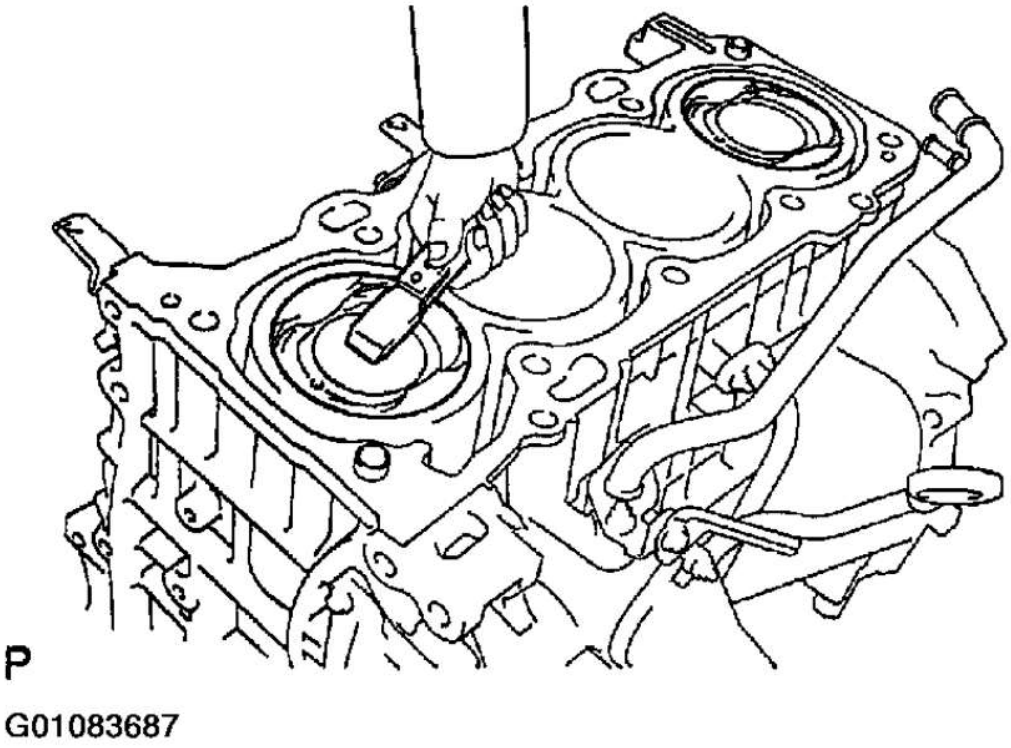


Fig. 88: Removing Carbon From Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a gasket scraper, remove all the gasket material from the cylinder block surface.

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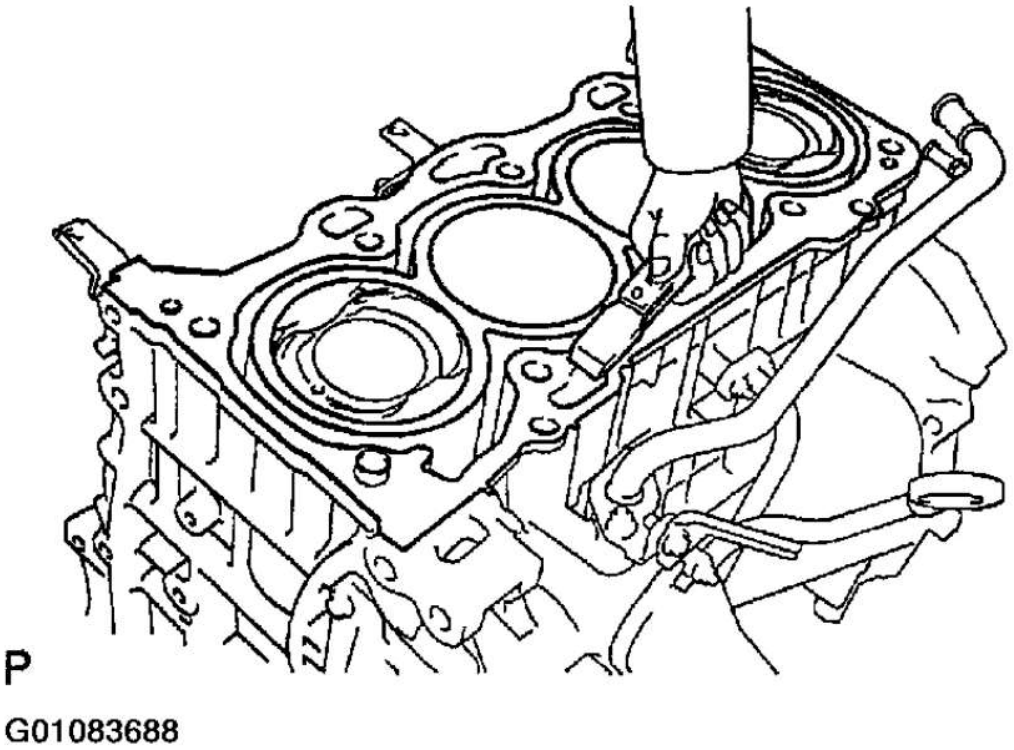


Fig. 89: Removing Gasket Material
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using compressed air, blow carbon and oil from the bolt holes.

CAUTION: Protect your eyes when using high pressure compressed air.

NOTE: Be careful not to scratch the cylinder head contact surface.

2. **Inspect cylinder block for flatness (See INSPECTION) .**
3. **Clean cylinder head .**
   a. Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

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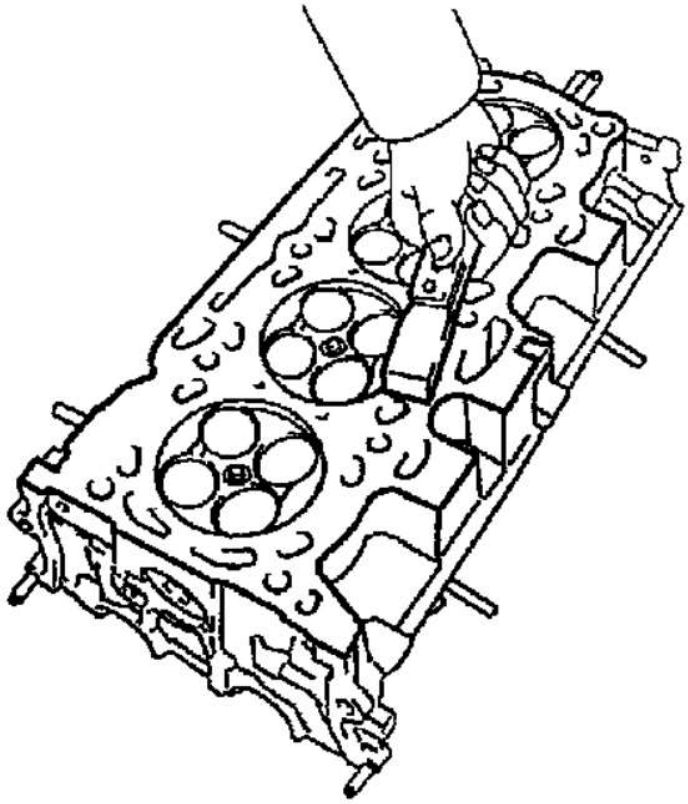


Fig. 90: Scrapping Cylinder Block Surface
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to scratch the cylinder block contact surface.

b. Using a wire brush, remove all the carbon from the combustion chambers.

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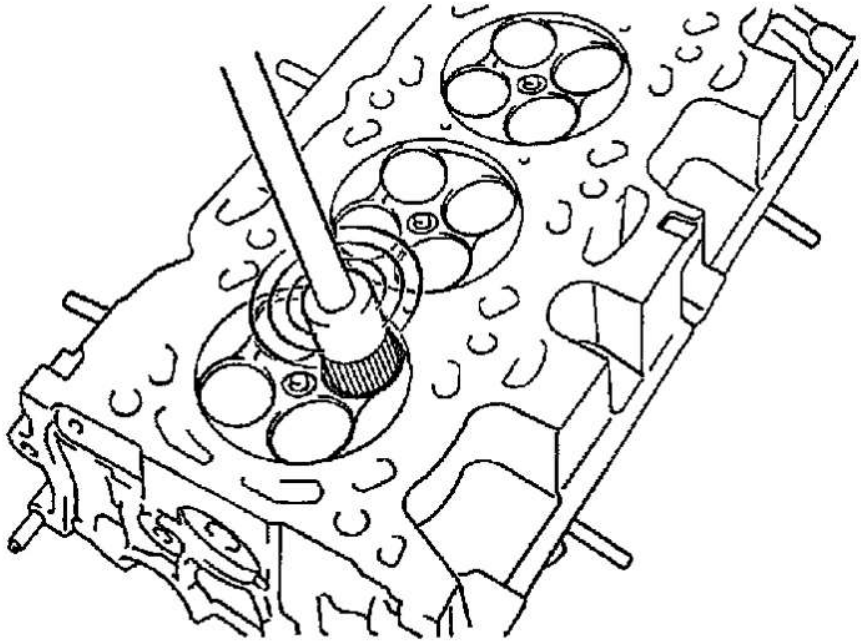


Fig. 91: Cleaning Combustion Chambers
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to scratch the cylinder block contact surface.

c. Using a soft brush and solvent, thoroughly clean the cylinder head.

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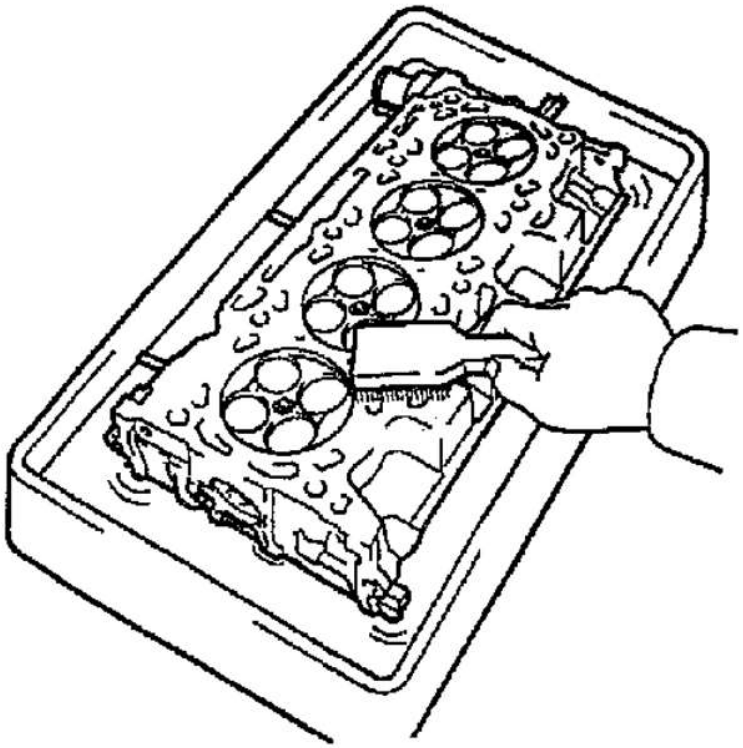


Fig. 92: Cleaning Cylinder Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a valve guide bushing brush and solvent, clean all the guide bushings.

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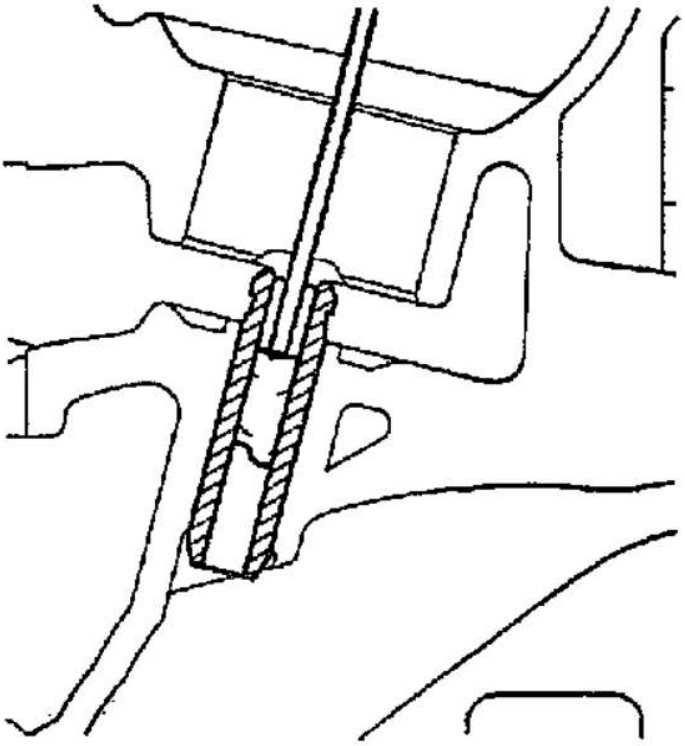


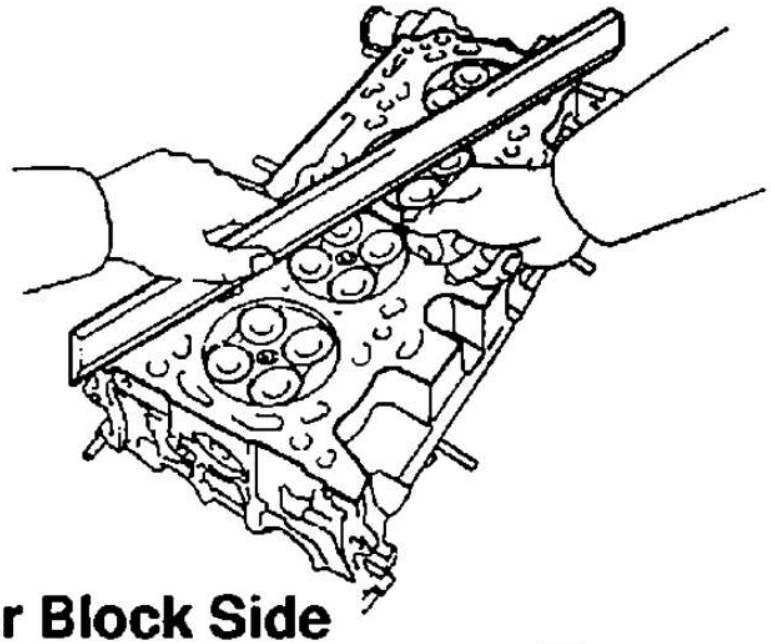
Fig. 93: Cleaning Guide Bushings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Inspect cylinder head** .
   a. Inspect for flatness.

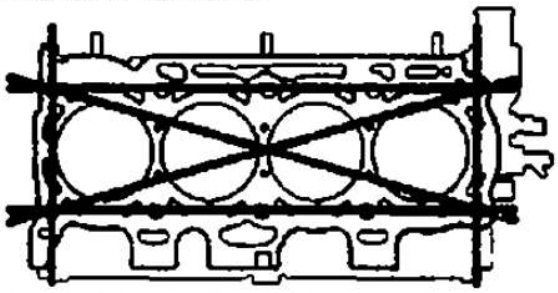
      Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder block and the manifolds for warpage.

      Maximum warpage: 0.08 mm (0.0031 in.)

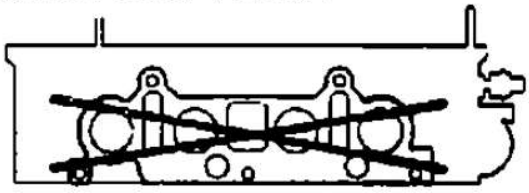
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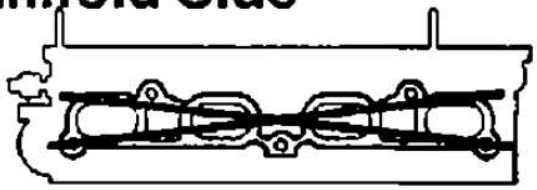
Cylinder Block Side



Exhaust Manifold Side



Intake Manifold Side



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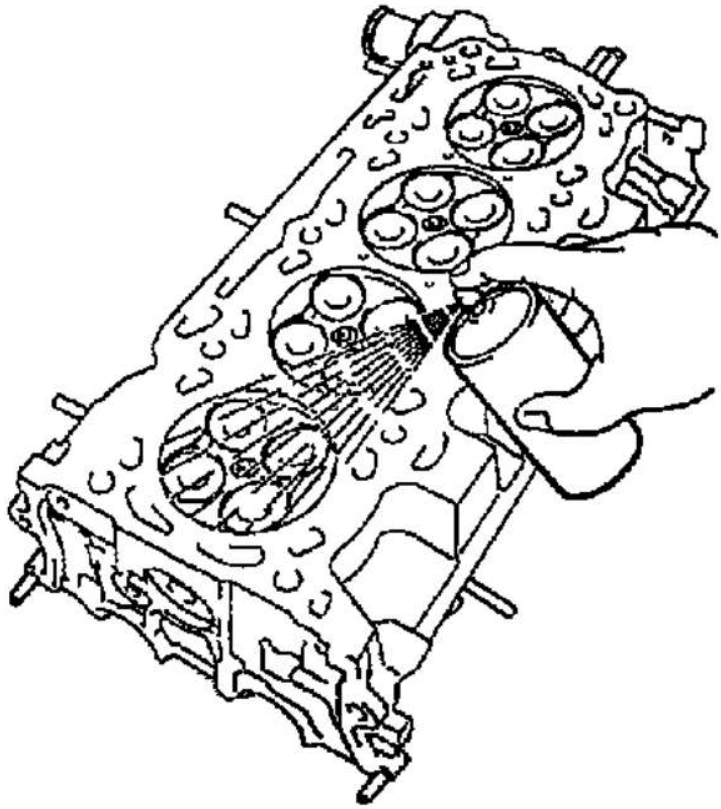
Fig. 94: Inspecting Cylinder Head For Flatness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

b. Inspect for cracks.

Using a dye penetrate, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.

If cracked, replace the cylinder head.



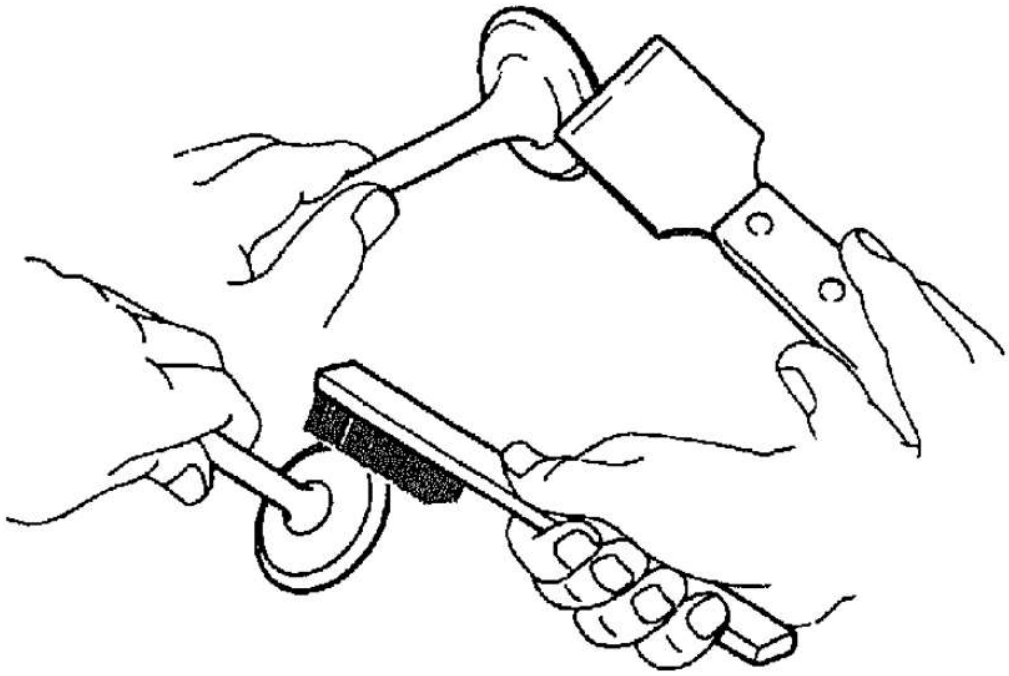
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Fig. 95: Inspecting Cylinder Head For Cracks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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5. **Clean valves** .
   a. Using a gasket scraper, chip off any carbon from the valve head.
   b. Using a wire brush, thoroughly clean the valve.



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Fig. 96: Cleaning The Valve Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. **Inspect valve stems and guide bushings** .
   a. Using a caliper gauge, measure the inside diameter of the guide bushing.
      Bushing inside diameter: 5.510 - 5.530 mm (0.2169 - 0.2177 in.)

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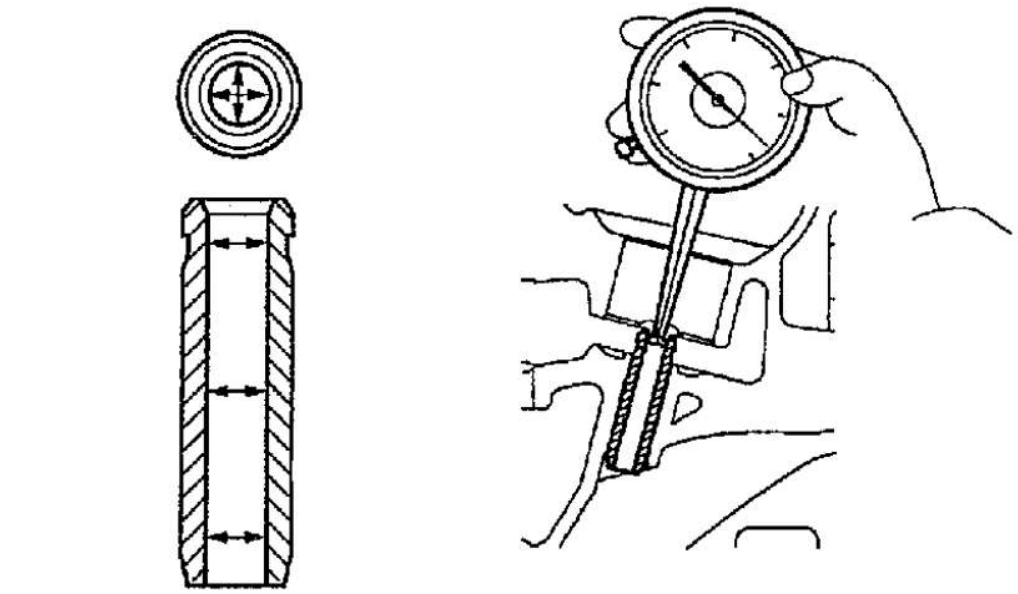
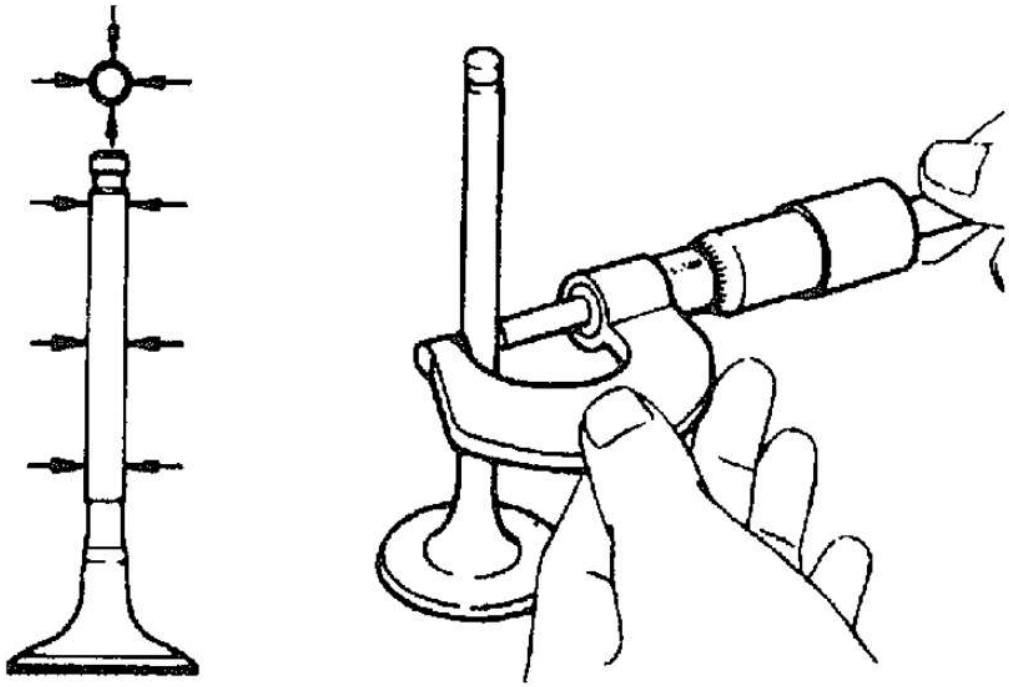


Fig. 97: Measuring Guide Bushing Inside Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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Fig. 98: Measuring Valve Stem Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Valve stem diameter:

Intake	5.470 – 5.485 mm (0.2154 – 0.2159 in.)
Exhaust	5.465 – 5.480 mm (0.2152 – 0.2157 in.)

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Fig. 99: Displaying Stem Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.

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Standard oil clearance:

Intake	0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Exhaust	0.030 – 0.065 mm (0.0012 – 0.0026 in.)

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Fig. 100: Displaying Standard Oil Clearance Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum oil clearance:

Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

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Fig. 101: Displaying Maximum Oil Clearance Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the clearance is greater than maximum, replace the valve and guide bushing (See **REPLACEMENT**).

7. **Inspect valves** .
   a. Check the valve is ground to the correct valve face angle.
      Valve face angle: 44.5°

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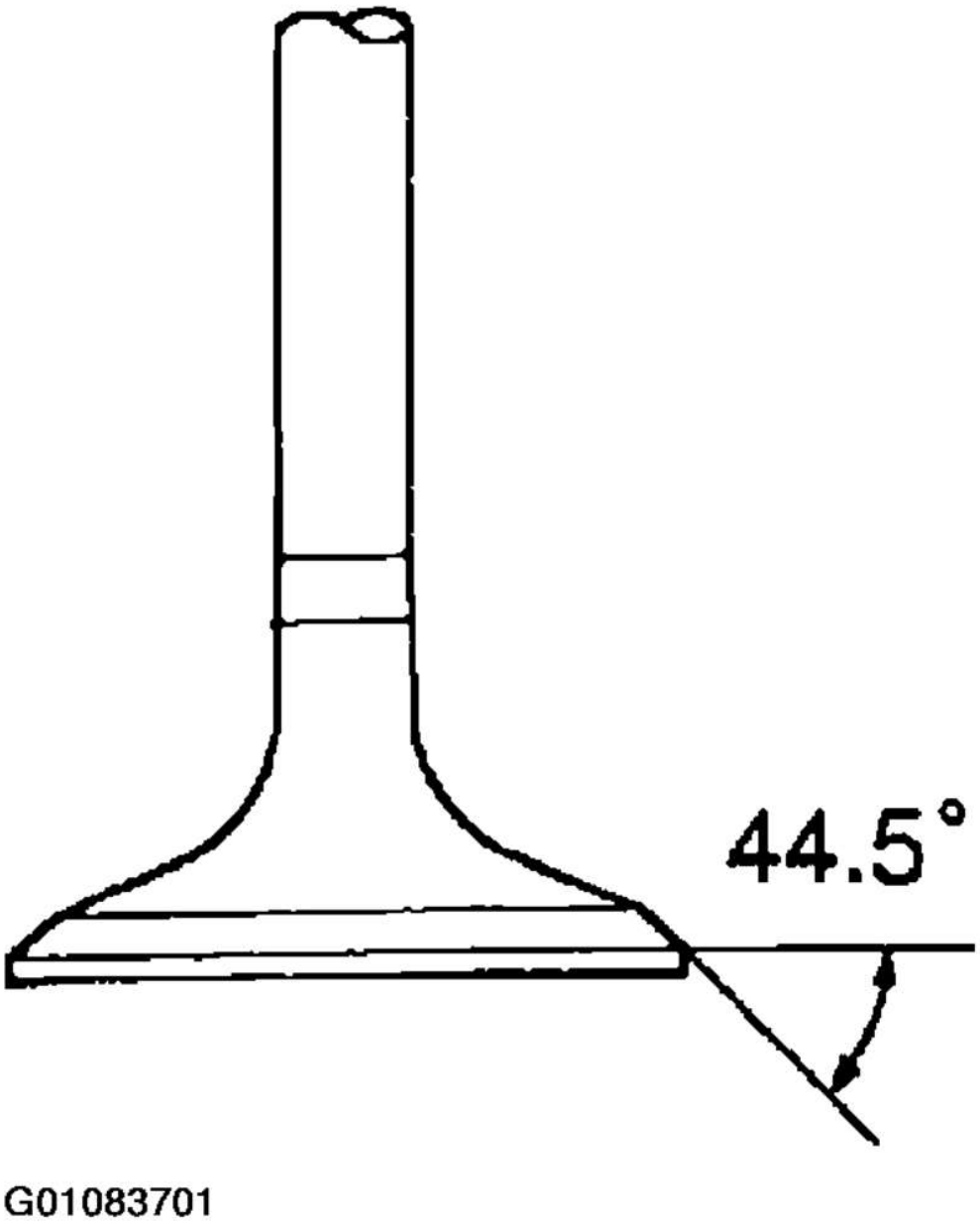


Fig. 102: Checking Valve Face Angle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Check that the surface of the valve for wear.

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If the valve face is worn, replace the valve.

c. Check the valve head margin thickness.

Standard margin thickness: 1.0 mm (0.039 in.)
Minimum margin thickness: 0.5 mm (0.028 in.)

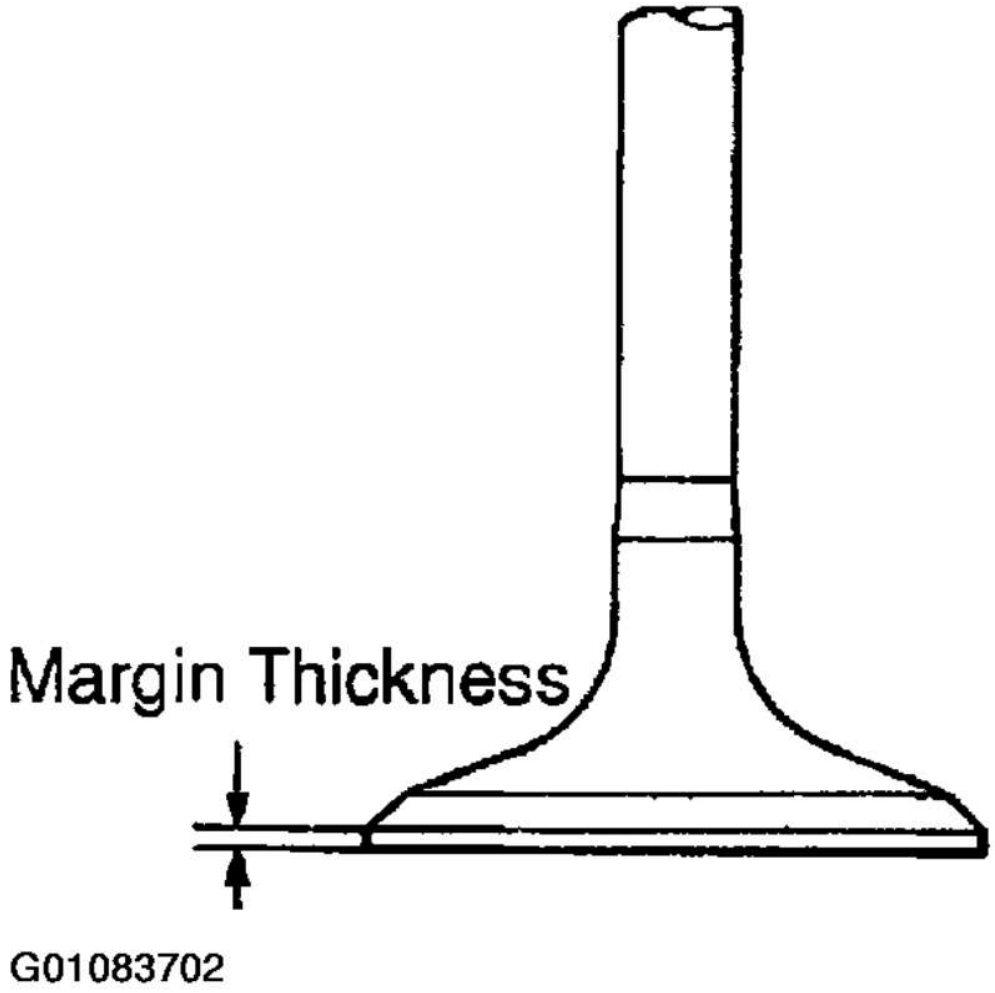


Fig. 103: Checking Valve Head Margin Thickness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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d. Check the valve overall length.

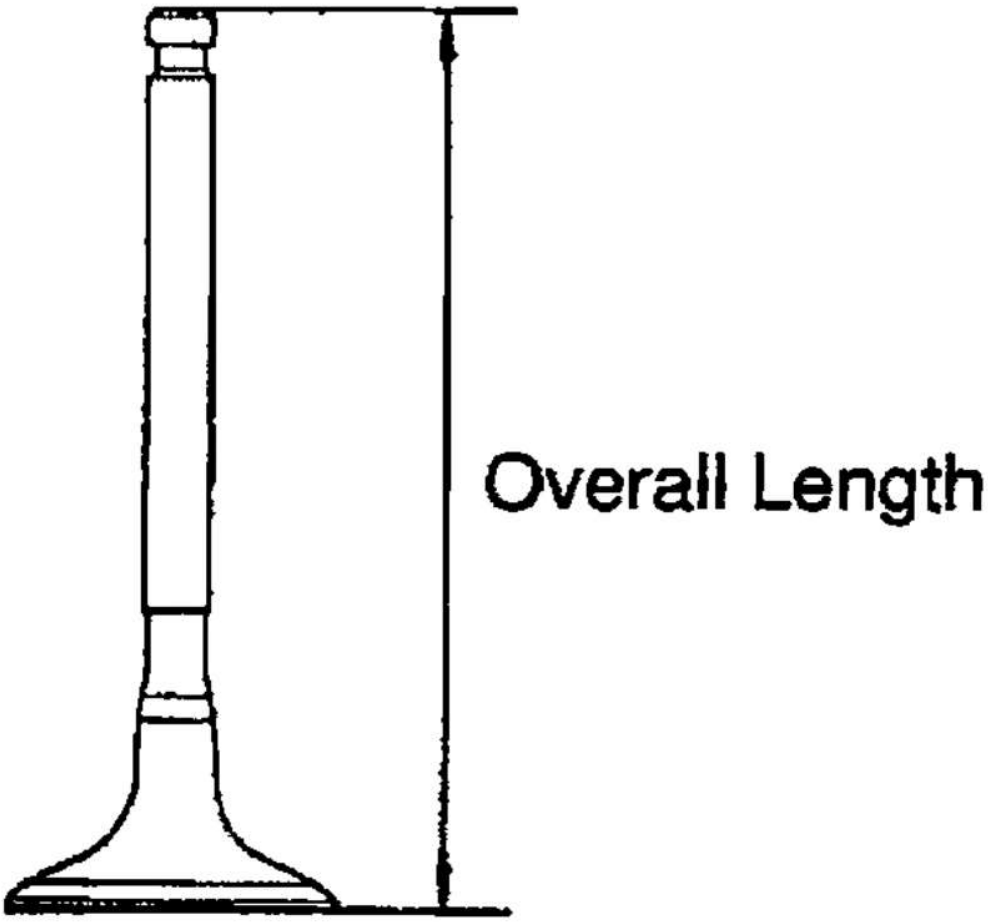


Fig. 104: Checking Valve Overall Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard overall length:

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Intake	101.71 mm (4.0043 in.)
Exhaust	101.15 mm (3.9823 in.)

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Fig. 105: Displaying Standard Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Minimum overall length:

Intake	101.21 mm (3.9846 in.)
Exhaust	100.70 mm (3.9646 in.)

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Fig. 106: Displaying Minimum Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

e. Check the surface of the valve stem tip for wear. If the valve stem tip is worn, replace the valve.

8. **Inspect and clean valve seats** .
   a. Using a 45° carbide cutter, resurface the valve seats.

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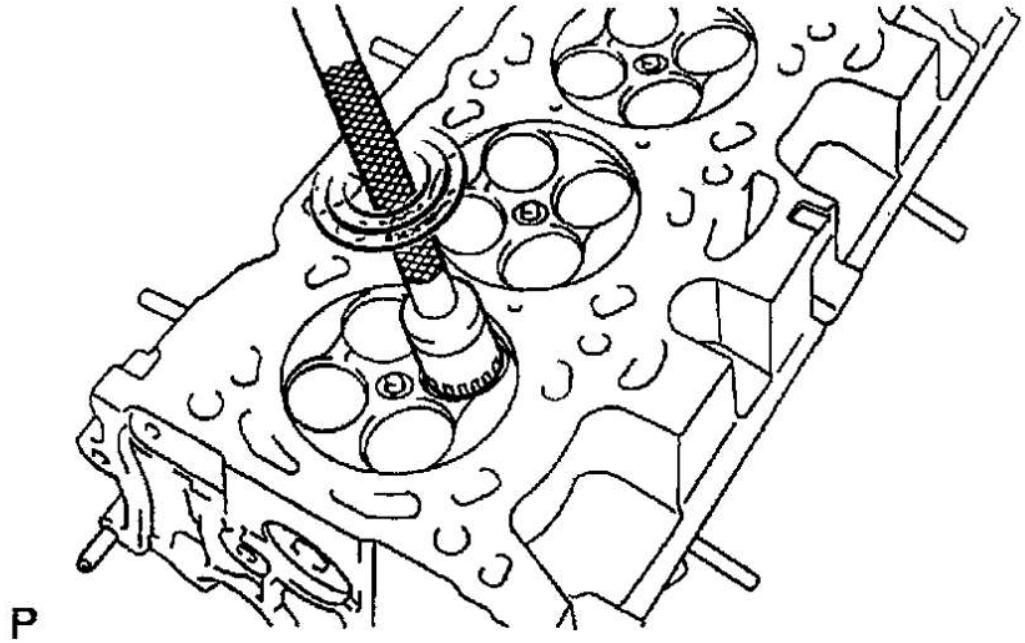


Fig. 107: Cleaning Valve Seats
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove only enough metal to clean the seats.
c. Check the valve seating position.

Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.

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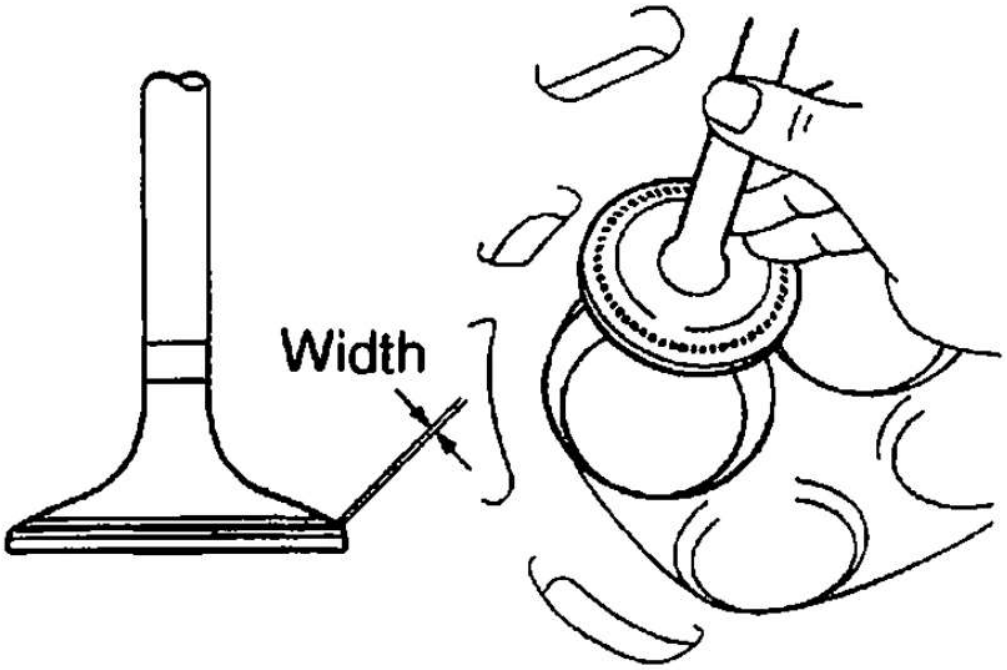


Fig. 108: Cleaning Valve Seats
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Check the valve face and seat for the following:
   - If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
   - If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
   - Check that the seat contact is in the middle of the valve face with the following width:

     1.0 -1.4 mm (0.039 - 0.055 in.)

   If not, correct the valve seats as follows:

   1. If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

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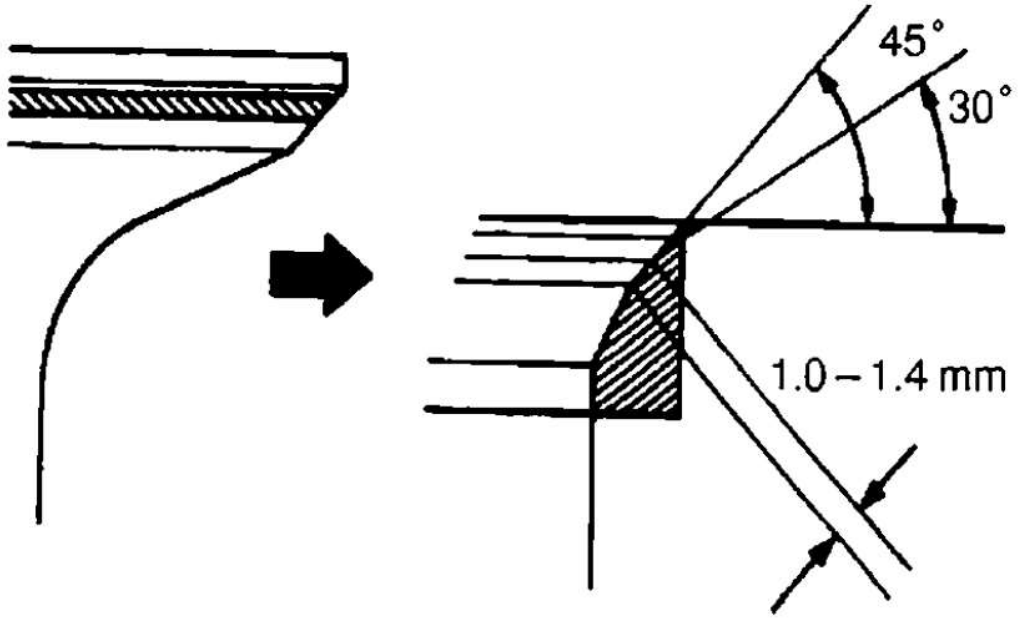


Fig. 109: Displaying Cutters To Correct High Seating
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.

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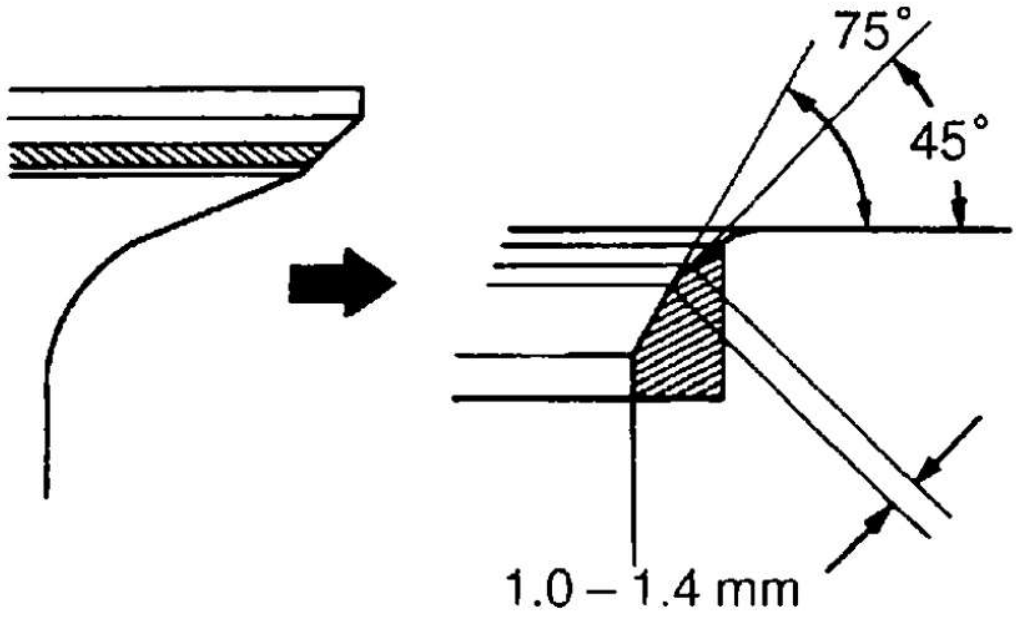


Fig. 110: Displaying Cutters To Correct Low Seating
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Hand-lap the valve and valve seat with an abrasive compound.

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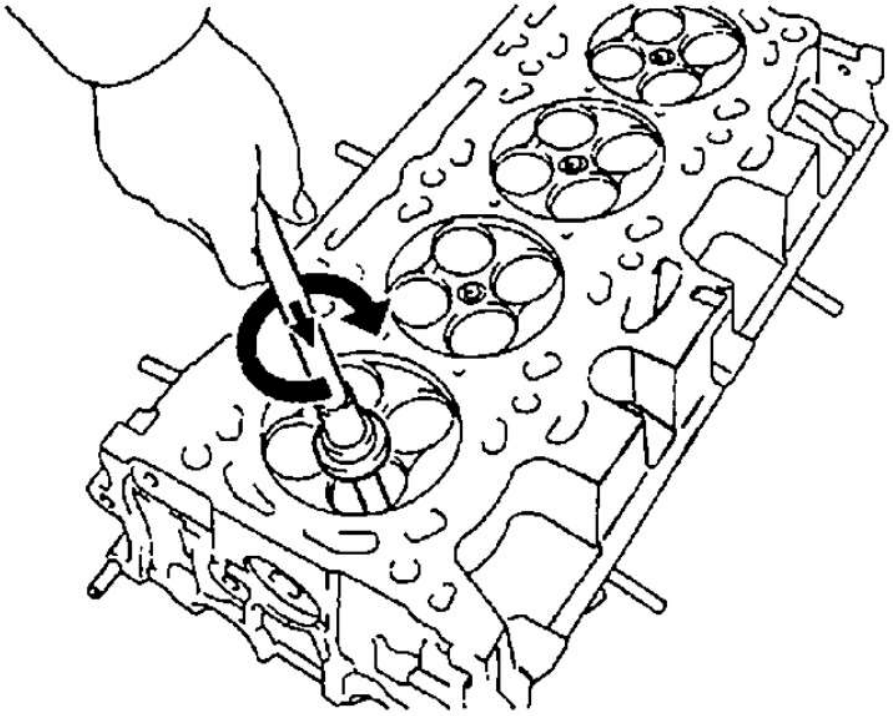


Fig. 111: Displaying Hand-Lap Valve & Valve Seat
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. After hand-lapping, clean the valve and valve seat.

9. **Inspect valve springs** .
   a. Using a steel square, measure the deviation of the valve spring.
      Maximum deviation: 1.6 mm (0.063 in.)
      Maximum angle (Reference): 2°

      If the deviation is greater than maximum, replace the valve spring.

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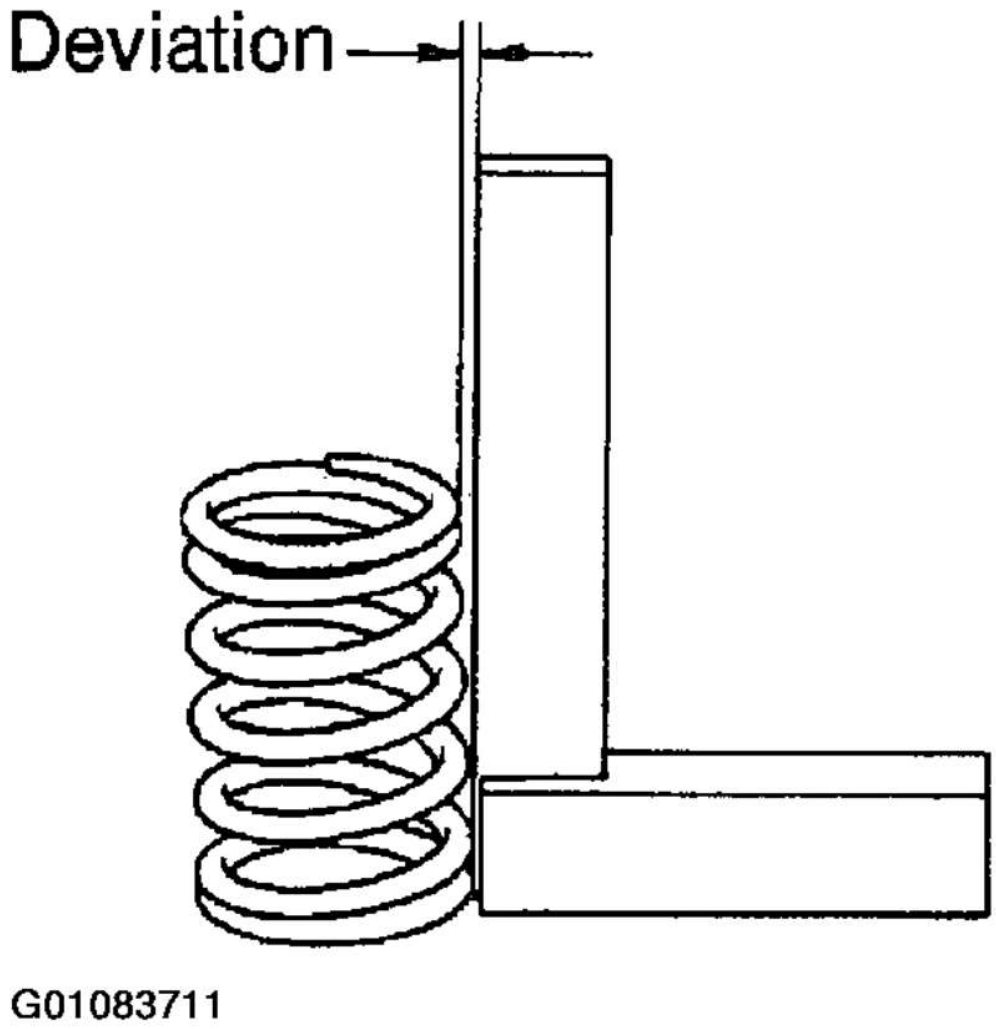
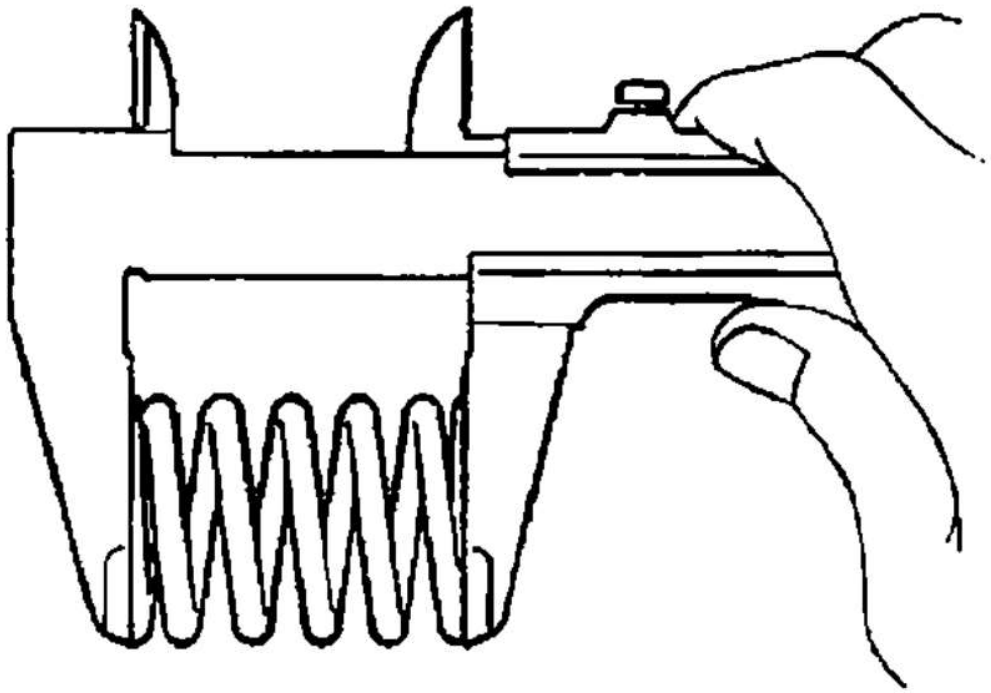


Fig. 112: Checking Valve Spring Deviation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using vernier calipers, measure the free length of the valve spring.
Free length: 45.7 mm (1.799 in.)

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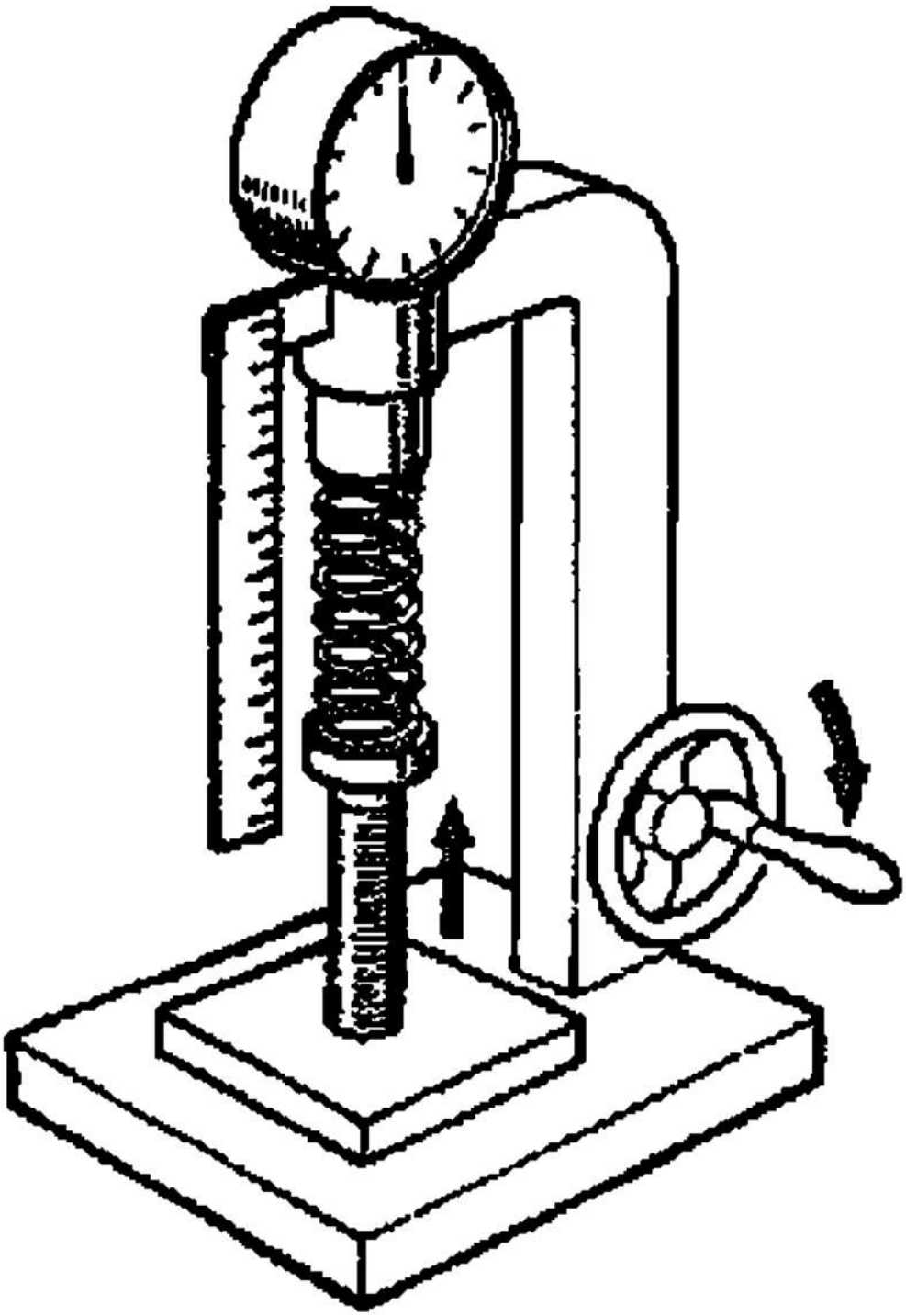
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Fig. 113: Measuring Valve Springs Free Length
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

c. Using a spring tester, measure the tension of the valve spring at the specified installed length.

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Fig. 114: Identifying Spring Tester
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

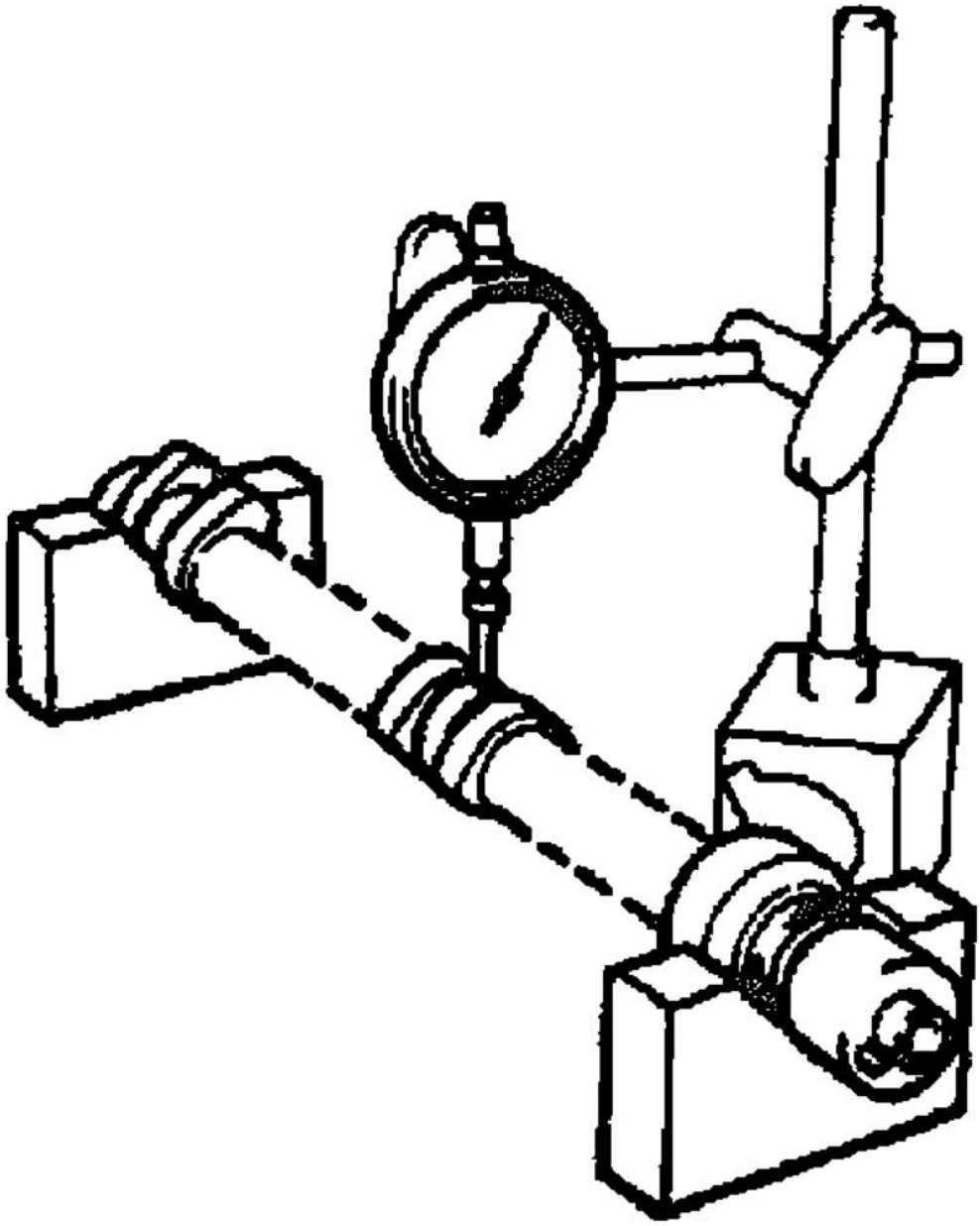
Installed tension: 184.3 - 203.7 N (18.8 - 20.8 kgf, 41.4 - 45.9 lbf) at 34.0 mm (1.339 in.)

Maximum working tension: 344.8 - 381.2 N (35.2 - 38.9 kgf, 77.4 - 85.8 lbf) at 24.0 mm (0.969 in.)

If the tension is not as specified, replace the valve spring.

10. **Inspect camshafts** .
    a. Inspect for runout.
        1. Place the camshaft on V-blocks.

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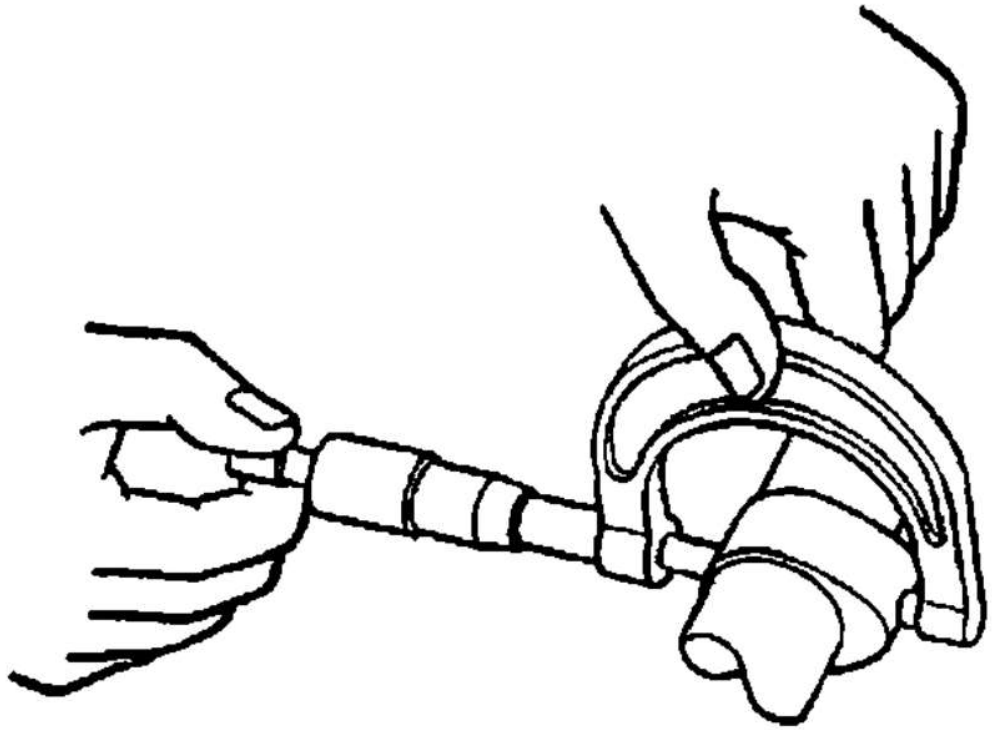
Fig. 115: Inspecting Camshaft Runout
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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2. Using a dial indicator, measure the circle runout at the center journal.
Maximum circle runout: 0.03 mm (0.0012 in.)

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

b. Inspect the cam lobes.



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Fig. 116: Measuring Cam Lobe Height
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

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Intake	46.495 – 46.595 mm (1.8305 – 1.8345 in.)
Exhaust	45.983 – 46.083 mm (1.8106 – 1.8143 in.)

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Fig. 117: Displaying Standard Cam Lobe Height Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Minimum cam lobe height:

Intake	46.385 mm (1.8262 in.)
Exhaust	45.873 mm (1.8060 in.)

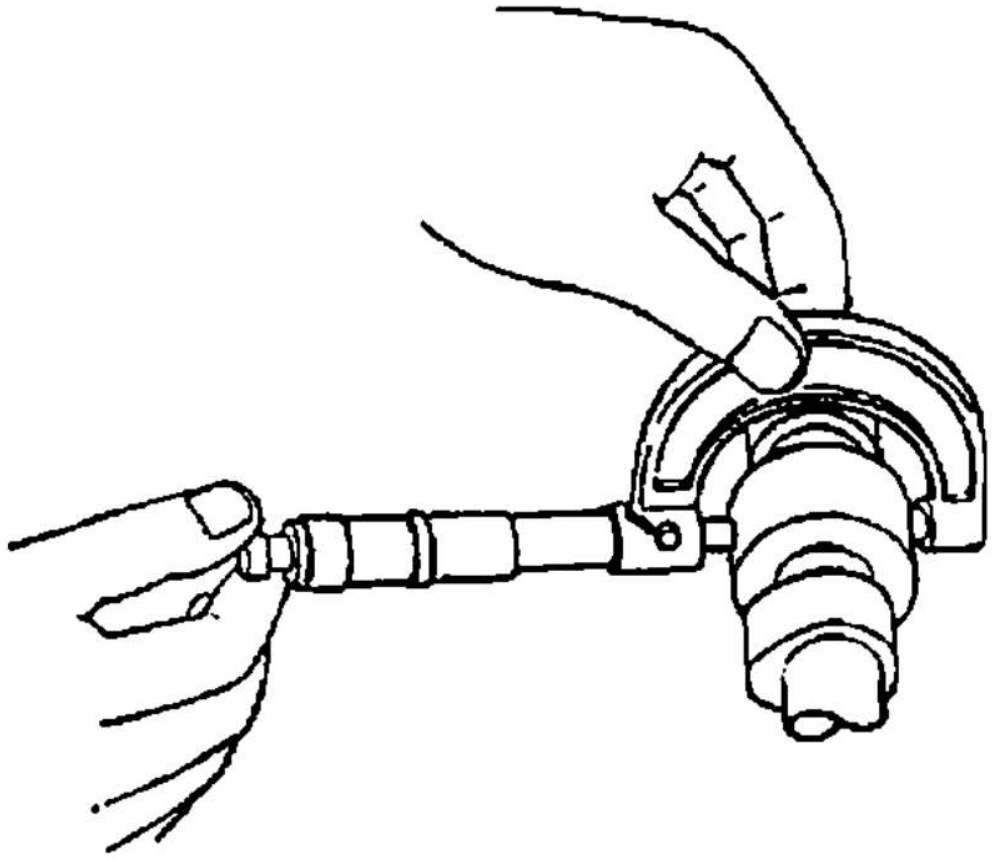
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Fig. 118: Displaying Minimum Cam Lobe Height Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the lobe height is less than minimum, replace the camshaft.

c. Inspect the camshaft journals.

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Fig. 119: Measuring Journal Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a micrometer, measure the journal diameter.

Journal diameter:

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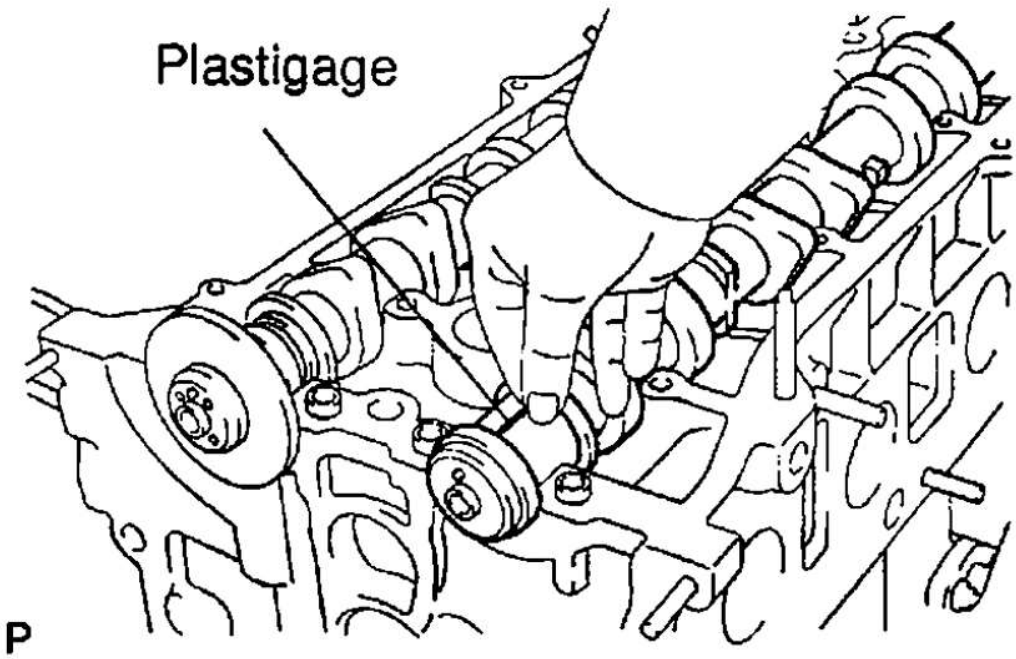
No. 1	35.971 – 35.985 mm (1.4162 – 1.4167 in.)
Others	22.959 – 22.975 mm (0.9040 – 0.9045 in.)

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Fig. 120: Displaying Journal Diameter Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

d. Inspect the journal clearance.
   1. Clean the bearings, bearing caps and camshaft journals.
   2. Install the bearings (See step 7).
   3. Place the camshafts on the cylinder head.
   4. Lay a strip of Plastigage across each of the cam shaft journal.

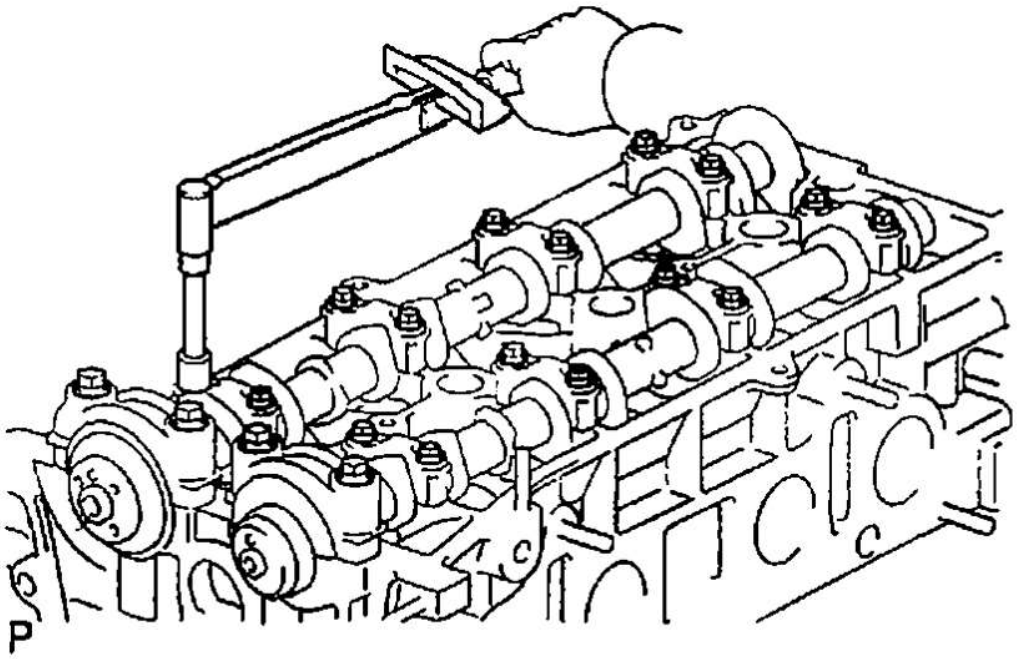


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Fig. 121: Locating Plastigage In Camshaft Journal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Install the bearing caps (See **INSTALLATION**).
6. Remove the bearing caps.

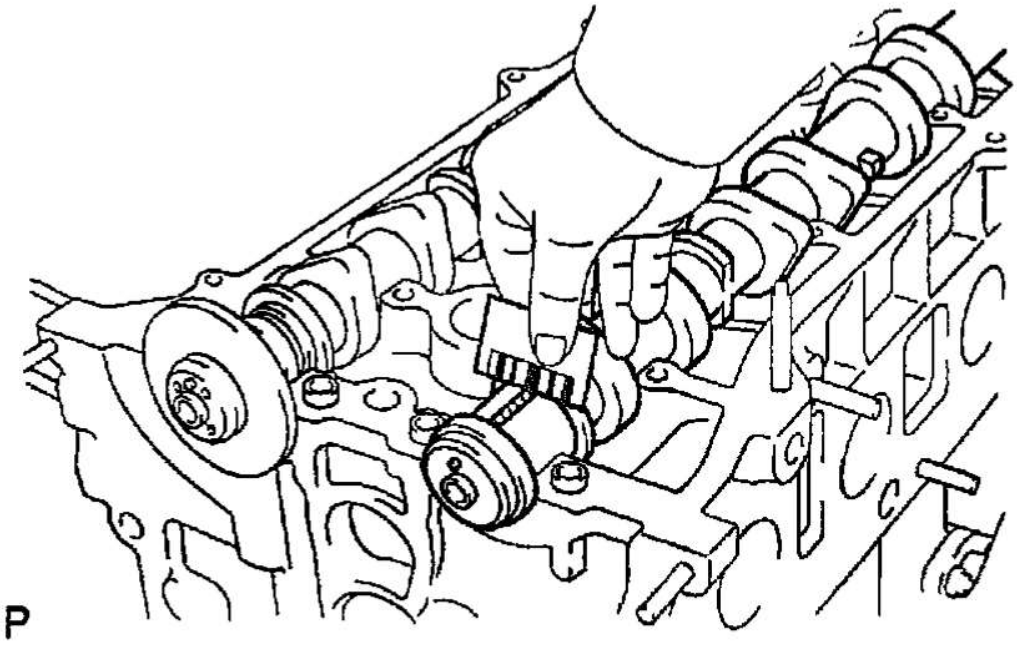


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Fig. 122: Removing Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. Measure the Plastigage at its widest point.

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Fig. 123: Measuring Plastigage
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard oil clearance:

Intake	No. 1	0.007 – 0.038 mm (0.0003 – 0.0015 in.)
	Others	0.025 – 0.062 mm (0.0010 – 0.0024 in.)
Exhaust	No. 1	0.015 – 0.054 mm (0.0006 – 0.0021 in.)
	Others	0.025 – 0.062 mm (0.0010 – 0.0024 in.)

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Fig. 124: Displaying Standard Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum oil clearance:

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Intake No. 1	0.07 mm (0.0028 in.)
Others	0.10 mm (0.0039 in.)

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Fig. 125: Displaying Minimum Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the oil clearance is greater than maximum, replace the bearing and/or camshaft. If necessary, replace the bearing caps and cylinder head as a set.

NOTE: If using a standard bearing, replace it with one have the same number.

Reference

Cylinder head journal bore diameter:

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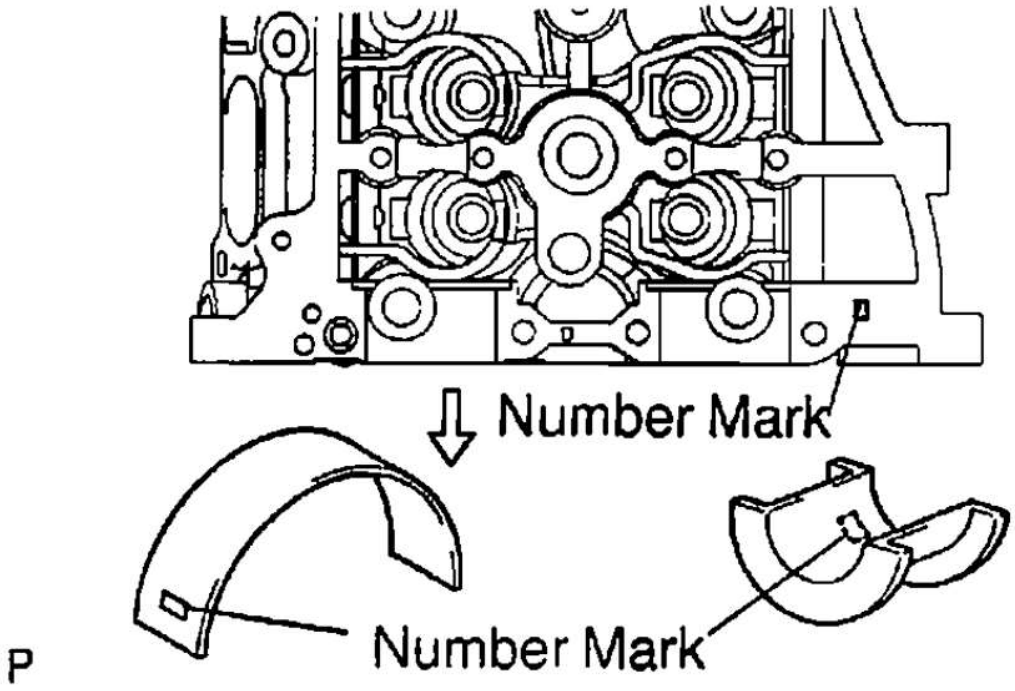


Fig. 126: Identifying Number Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Mark 1	40.000 – 40.008 mm (1.5748 – 1.5751 in.)
Mark 2	40.009 – 40.017 mm (1.5752 – 1.5755 in.)
Mark 3	40.018 – 40.025 mm (1.5755 – 1.5758 in.)

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Fig. 127: Displaying Cylinder Head Journal Mark Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard bearing center wall thickness:

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Mark "1"	2.000 – 2.004 mm (0.0787 – 0.0789 in.)
Mark "2"	2.005 – 2.008 mm (0.0789 – 0.0791 in.)
Mark "3"	2.009 – 2.012 mm (0.0791 – 0.0792 in.)

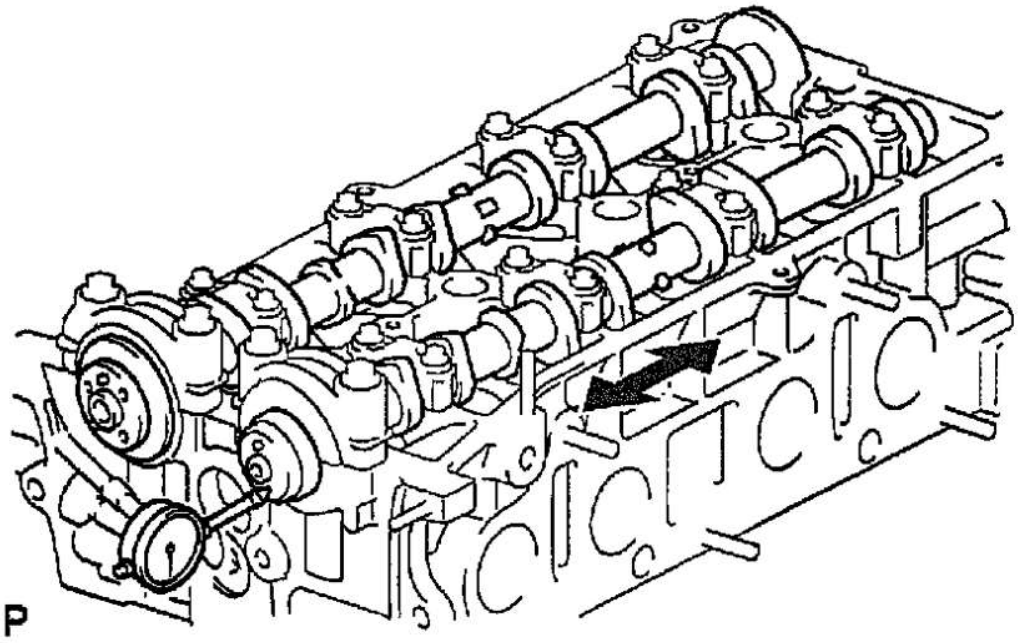
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Fig. 128: Displaying Standard Bearing Center Wall Thickness Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Camshaft journal diameter: 35.971 - 35.985 mm (1.4165 -1.4167 in.)

8. Remove the Plastigage completely.
9. Remove the camshafts.
10. Remove the bearings.

e. Inspect the thrust clearance.



G01083730

Fig. 129: Inspecting Thrust Clearance

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

1. Install the bearings.
2. Install the camshafts (See **INSTALLATION**).
3. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:

Intake	0.040 – 0.095 mm (0.0016 – 0.0037 in.)
Exhaust	0.080 – 0.135 mm (0.0032 – 0.0053 in.)

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Fig. 130: Displaying Standard Thrust Clearance Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum thrust clearance:

Intake	0.11 mm (0.0043 in.)
Exhaust	0.15 mm (0.0059 in.)

G01083729

Fig. 131: Displaying Minimum Thrust Clearance Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

4. Remove the bearings.
5. Remove the camshafts.

11. **Inspect VVT timing sprocket (valve timing controller assembly)** .
    a. Apply vinyl tape to all the ports except the one.
    b. Install the VVT timing sprocket.

    Torque: 54 N.m (550 kgfcm, 40 ft. lbf)

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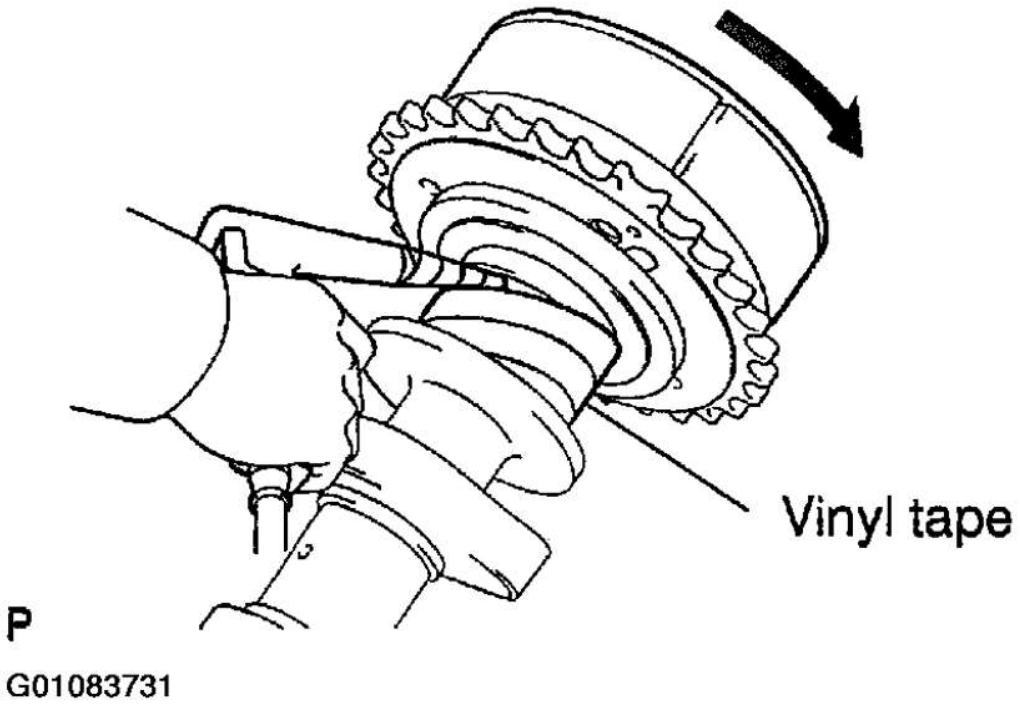


Fig. 132: Displaying Vinyl Tape Application
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not push VVT timing sprocket to the camshaft forcibly when installing it.

c. Check that the VVT timing sprocket will not turn.

d. Wind tape around the tip of the air gun and apply air of approx. 100 kPa (1 kgf/cm^2 ,14 psi) to the port of the camshaft.

NOTE: When the oil splashes, wipe it off with a shop rag and the likes.

NOTE: Perform this in order to release the lock pin for the maximum delay angle locking.

e. Under the condition of (d), turn the VVT timing sprocket to the advance angel side (the arrow marked direction in the illustration) with your hand.

Standard: Must turn

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NOTE: **Depending on the air pressure, the VVT timing sprocket will turn to the advance angle side without applying force by hand. Also, under the condition that the pressure can be hardly applied because of the air leakage from the port, there may be the case that the lock pin could be hardly released.**

f. Except the position where the lock pin meets at the maximum delay angle, let the VVT timing sprocket turn back and forth and check the movable range and that there is no disturbance.

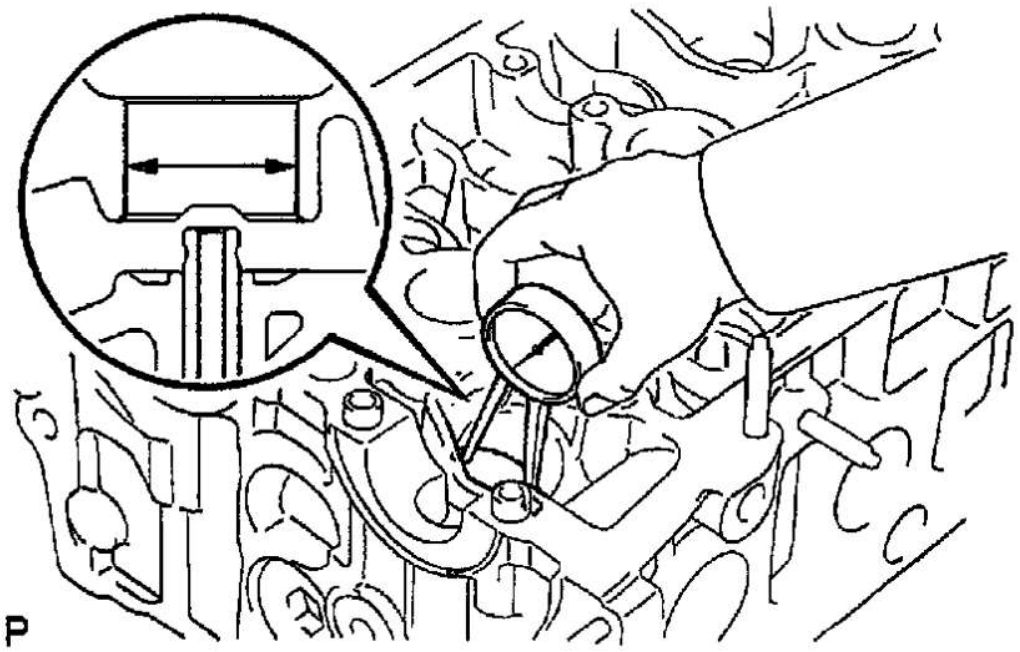
Standard: Movable smoothly in the range about 30°

g. Turn the VVT timing sprocket with your hand and lock it at the maximum delay angel position.

12. **Inspect valve lifters and lifter bores** .

a. Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Lifter bore diameter: 31.009 - 31.025 mm (1.2208 -1.2215 in.)



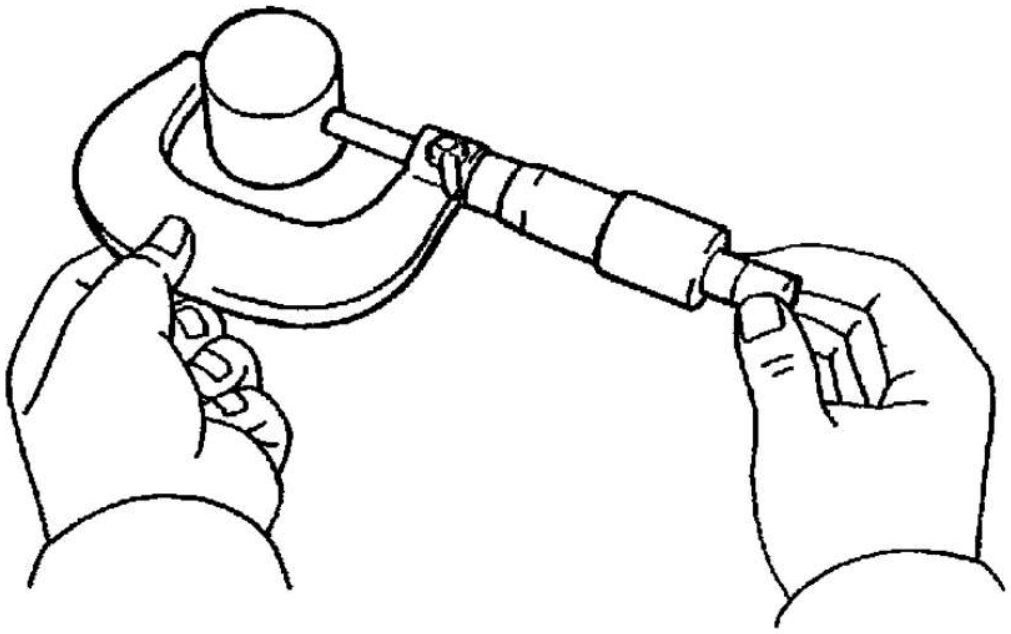
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Fig. 133: Measuring Lifter Bore Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a micrometer, measure the lifter diameter.

Lifter diameter: 30.966 - 30.976 mm (1.2191 -1.2195 in.)

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G01083733

Fig. 134: Measuring Lifter Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance: 0.033 - 0.059 mm (0.0013 - 0.0023 in.)

Maximum oil clearance: 0.079 mm (0.0031 in.)

If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.

13. **Inspect exhaust manifold** .

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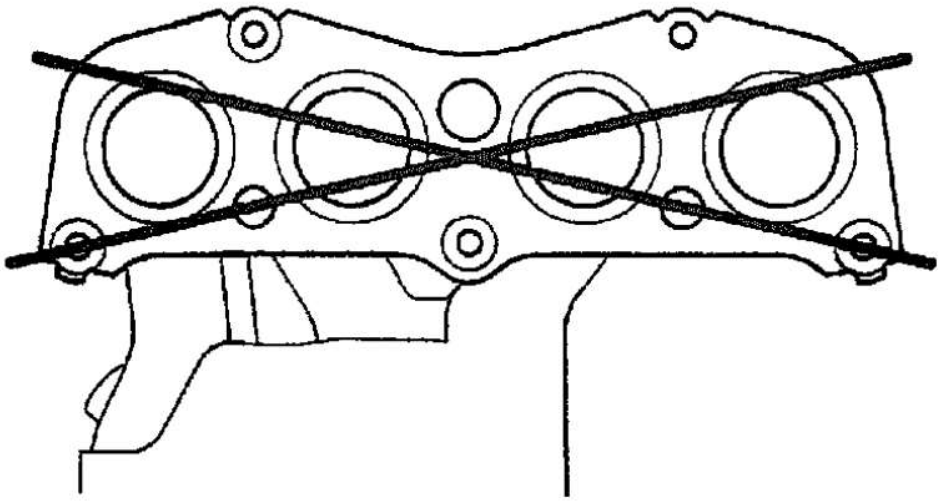


Fig. 135: Inspecting Exhaust Manifold
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder head for warpage.

Maximum warpage: 1.5 mm (0.0590 in.)

If warpage is greater than maximum, replace the exhaust manifold.

14. **Inspect cylinder head bolts** .

Standard nominal length: 161.3 -162.7 mm (6.350 - 6.405 in.)

Maximum nominal length: 164.2 mm (6.4646 in.)

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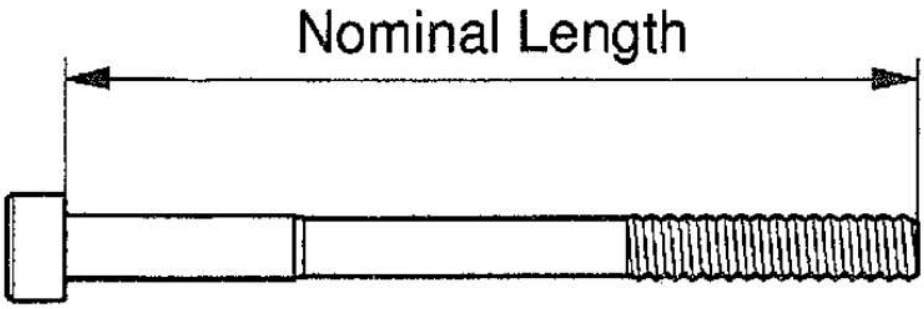


Fig. 136: Inspecting Cylinder Head Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the length is greater than maximum, replace the bolt.

REPLACEMENT

Replace Valve Guide Bushings

a. Gradually heat the cylinder head to 80 - 100°C (176 212°F).

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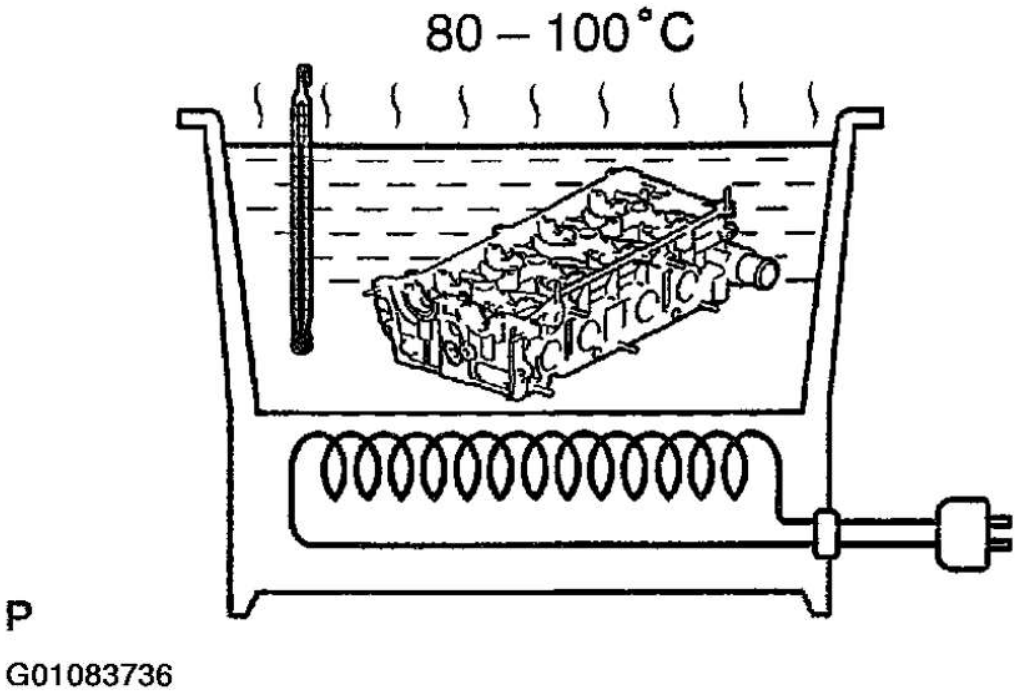


Fig. 137: Displaying Cylinder Head Heating
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using SST and a hammer, tap out the guide bushing.
SST 09201-01055, 09950-70010(09951-07100)

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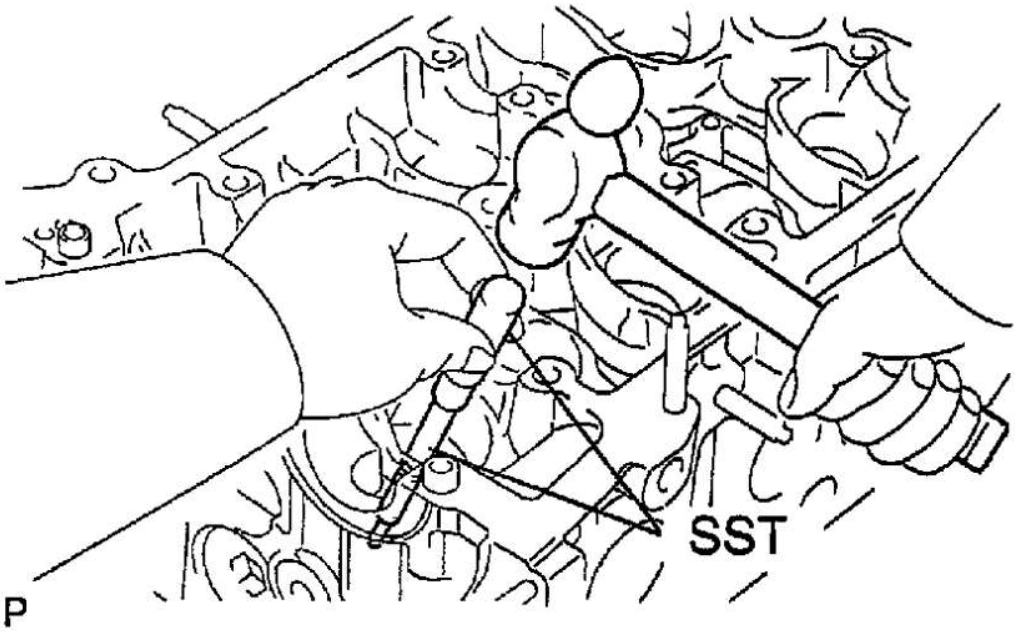


Fig. 138: Tapping Out Guide Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

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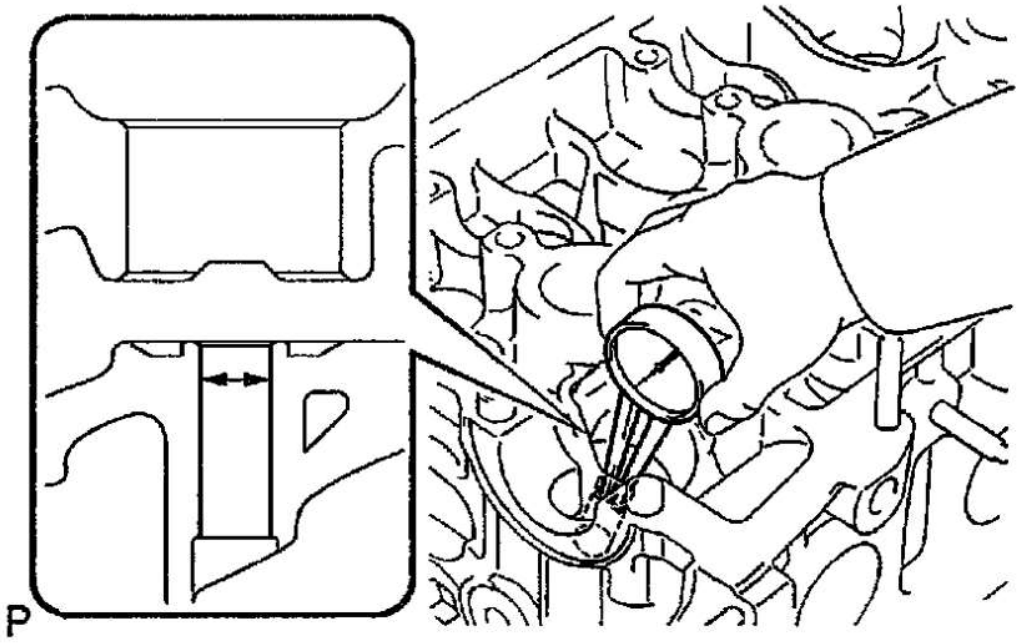


Fig. 139: Measuring Bushing Bore Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Select a new guide bushing (STD or O/S 0.05).

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Bushing bore diameter mm (in.)	Bushing size
10.285 – 10.306 (0.4049 – 0.4057)	Use STD
10.335 – 10.356 (0.4068 – 0.4077)	Use O/S 0.05

G01083739

Fig. 140: Displaying Intake & Exhaust Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the bushing bore diameter of the cylinder head is greater than 10.306 mm (0.4057 in.), machine the bushing bore to the following dimension:

10.285 -10.306 mm (0.4049 - 0.4057 in.)

If the bushing bore diameter of the cylinder head is greater than 10.306 mm (0.4057 in.), replace the cylinder head.

e. Gradually heat the cylinder head to 80 - 100°C (176 -212°F).
f. Using SST and a hammer, tap in a new guide bushing to the specified protrusion height.
SST 09201-01055, 09950-70010 (09951-07100)

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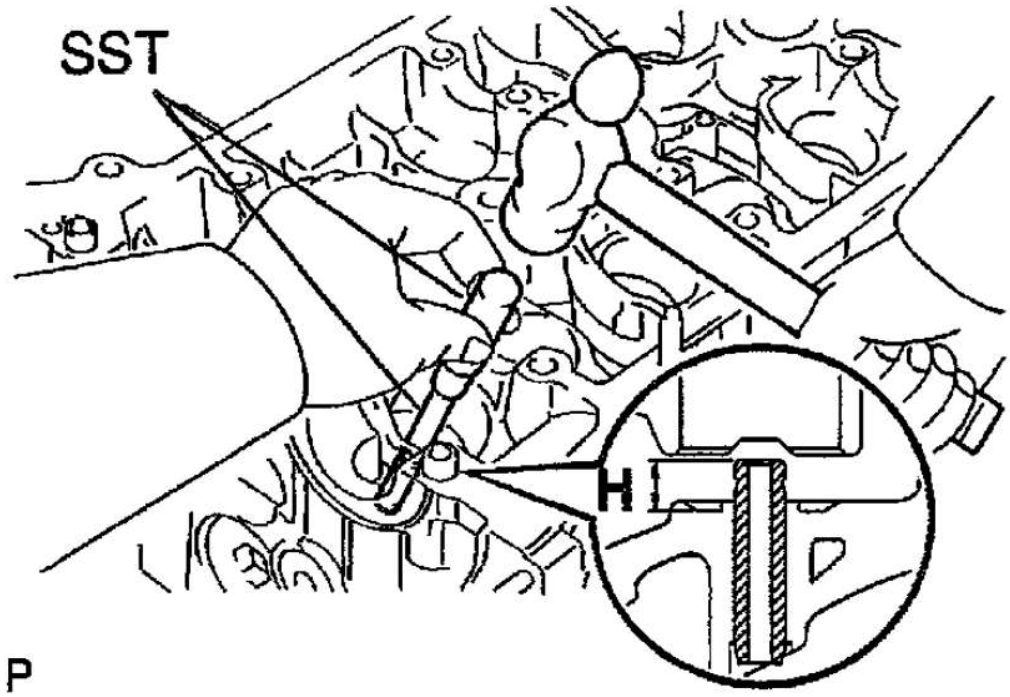


Fig. 141: Tapping In New Guide Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Protrusion height (H): 9.6 -10.0 mm (0.380 - 0.394 in.)

g. Using a sharp 5.5 mm reamer, ream the guide bushing to obtain the standard specified clearance (See **INSPECTION**) between the guide bushing and valve stem.

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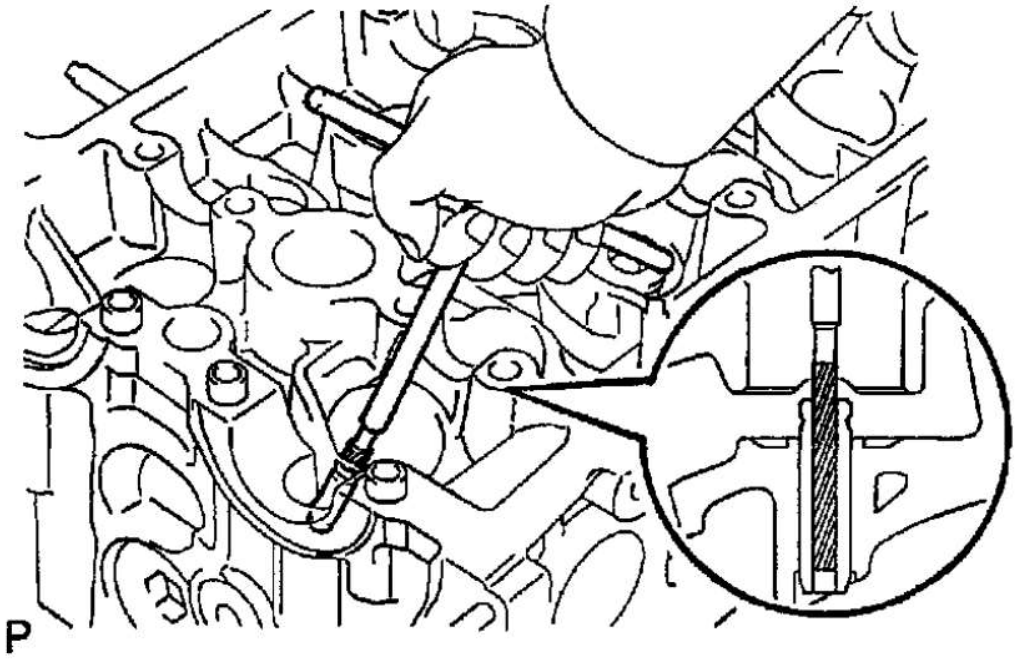


Fig. 142: Reaming Guide Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

NOTE:

- **Thoroughly clean all parts to be assembled.**
- **Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.**
- **Replace oil seals with new ones.**

1. **Install valves** .
   a. Using SST, push in a new oil seal.
      SST 09201-41020

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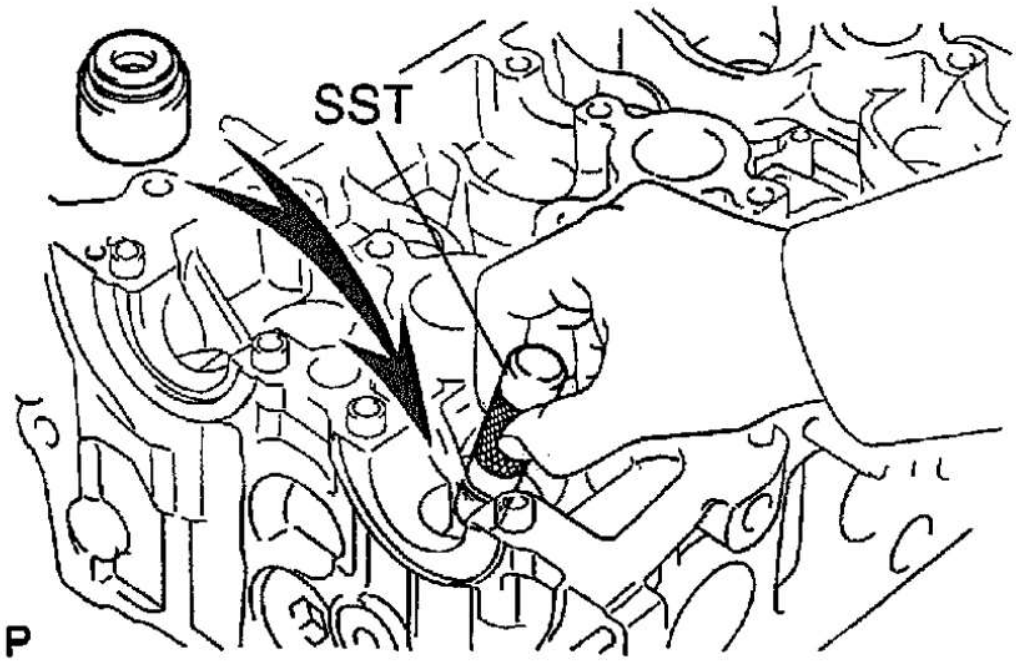


Fig. 143: Pushing In New Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: The intake valve oil seal is light brown and the exhaust valve oil seal is gray.

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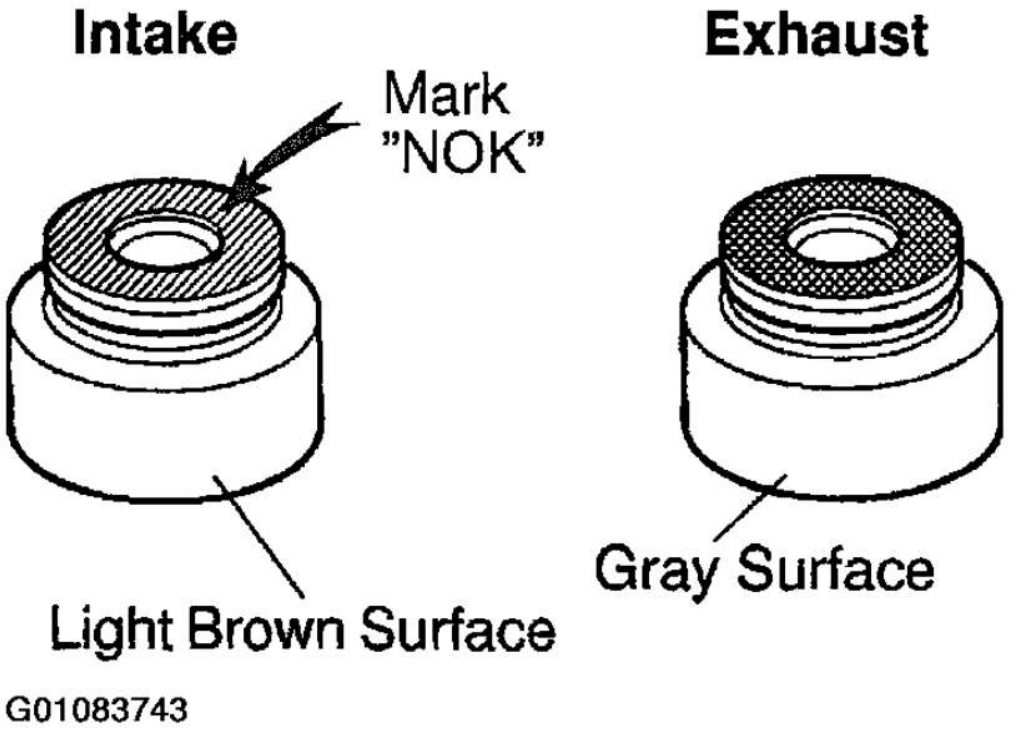


Fig. 144: Identifying Intake & Exhaust Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Pay much attention to assemble the oil seal for intake and exhaust. Assembling the wrong one may cause a failure.

b. Install the valve (1), spring seat (2), valve spring (3) and spring retainer (4).

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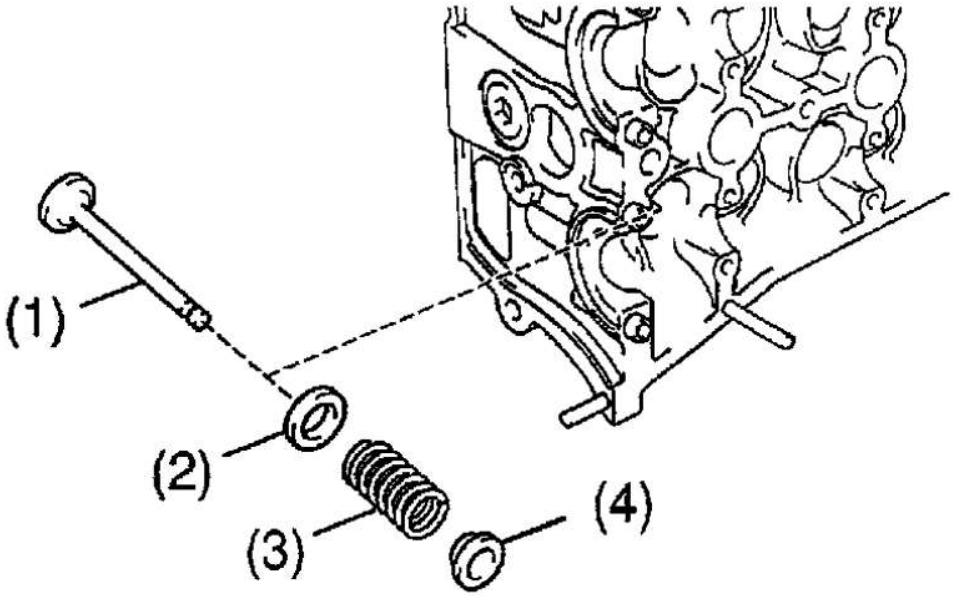


Fig. 145: Identifying Valve Components For Installation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST, compress the valve spring and place the 2 keepers around the valve stem.
SST 09202-70020 (09202-00010)

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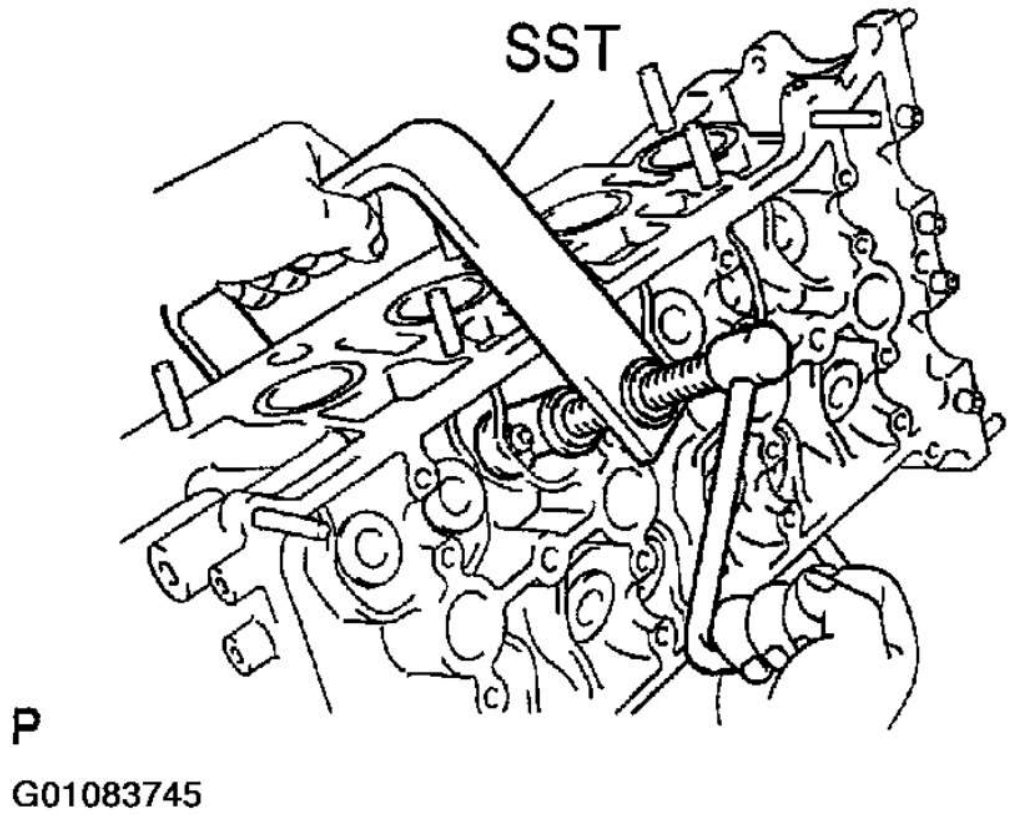


Fig. 146: Compressing Valve Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Using a plastic-faced hammer and the valve stem (not in use) tip wound with vinyl tape, lightly tap the valve stem tip to ensure a proper fit.

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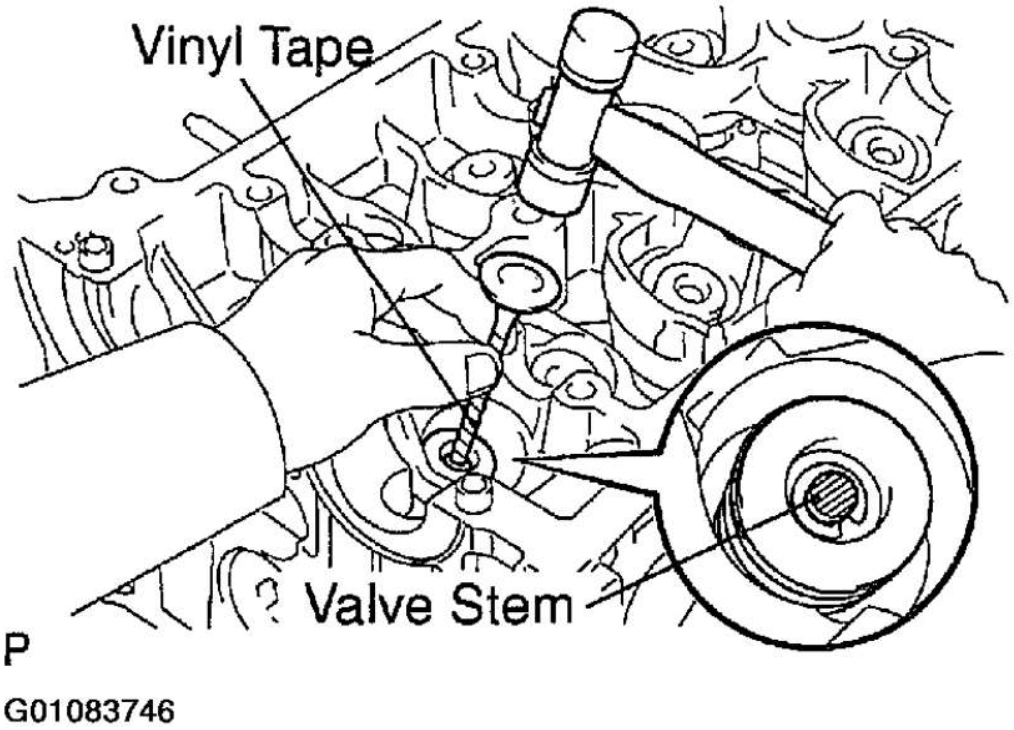


Fig. 147: Locating Valve Stem
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to damage the valve stem tip.

2. **Install valve lifters** .
   a. Install the valve lifter.
   b. Check that the valve lifter rotates smoothly by hand.
3. **Install camshaft position sensor** .

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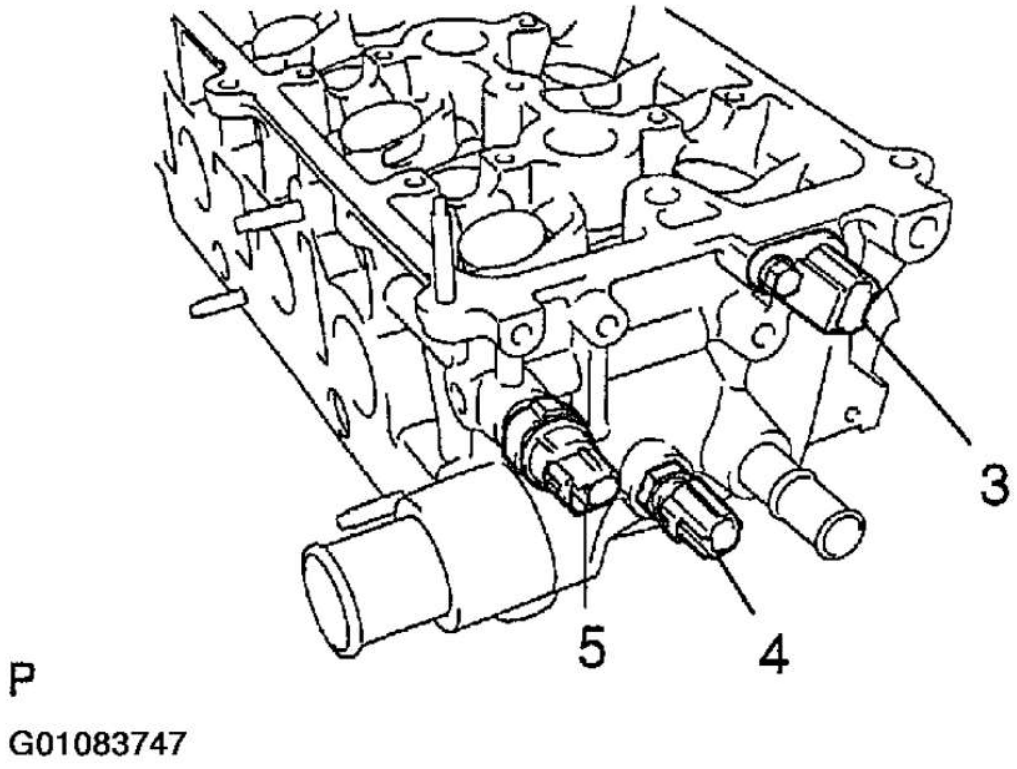


Fig. 148: Displaying Steps 1, 2 & 3 Installation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install the camshaft position sensor with the bolt.

Torque: 9.0 N.m (90 kgf. cm, 80 in. lbf)

4. **Install ECT sensor** .

Install a new gasket and the ECT sensor.

Torque: 20 N.m (200 kgf. cm, 15 ft. lbf)

5. **Install oil pressure switch** .
   a. Apply adhesive to 2 or 3 threads of the oil pressure switch.

      Adhesive: Part No.08833-00080, THREE BOND 1344, LOCTITE 242 or equivalent.
   b. Install the oil pressure switch.

      Torque: 13 N.m (130 kgf. cm, 10 ft. lbf)

INSTALLATION

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NOTE:

- **Thoroughly clean all parts to be assembled.**
- **Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.**
- **Replace all gaskets and oil seals with new ones.**

1. **Install cylinder head** .
   a. Place the cylinder head on the cylinder block.
      1. Apply seal packing to the cylinder head gasket as shown in the illustration

         Seal packing: Part No. 08826-00080 or equivalent

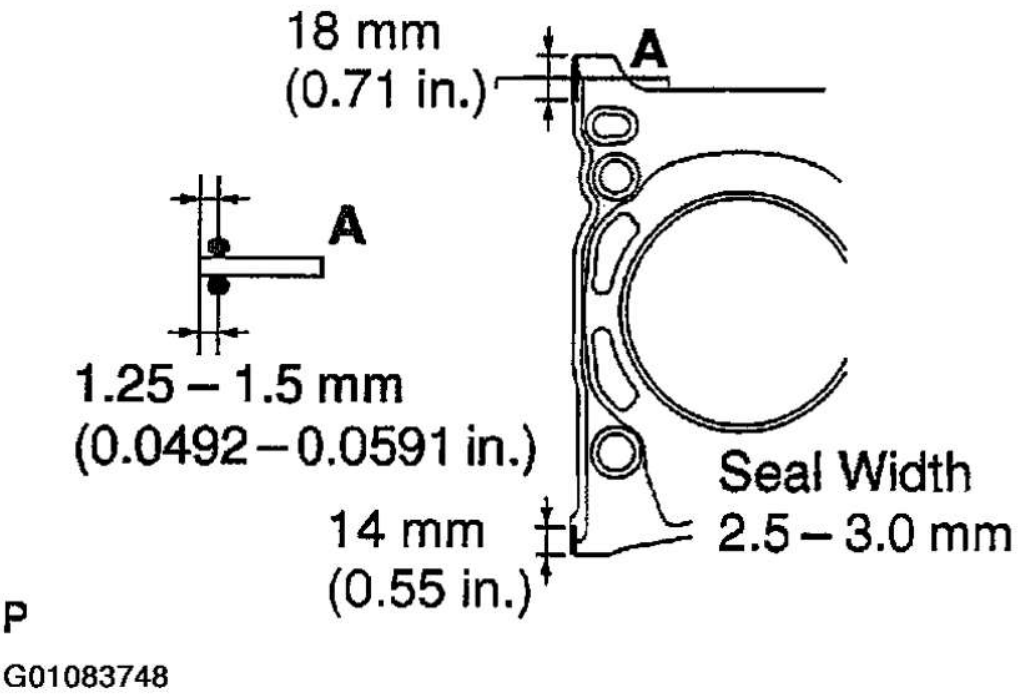


Fig. 149: Installing Cylinder Head
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Install a nozzle that has been cut to a 2.5 - 3.0 mm (0.10-0.12 in.) opening.

NOTE: **Avoid applying an excessive amount to the surface.**

- Part must be assembled within 3 minutes of application. Otherwise the material must be removed and reapplied.

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- Immediately remove nozzle from the tube and reinstall cap.

2. Place a new cylinder head gasket on the cylinder block surface with the lot No. upward.

NOTE: Be careful of the installation direction.

3. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the head.

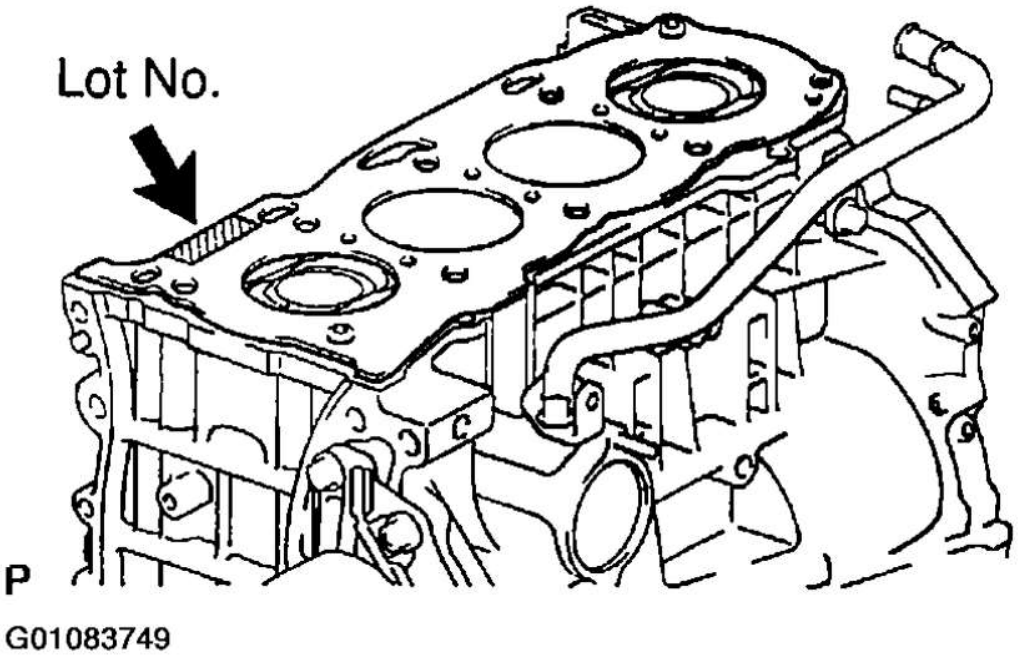


Fig. 150: Locating Lot Number Position
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the cylinder head bolts.

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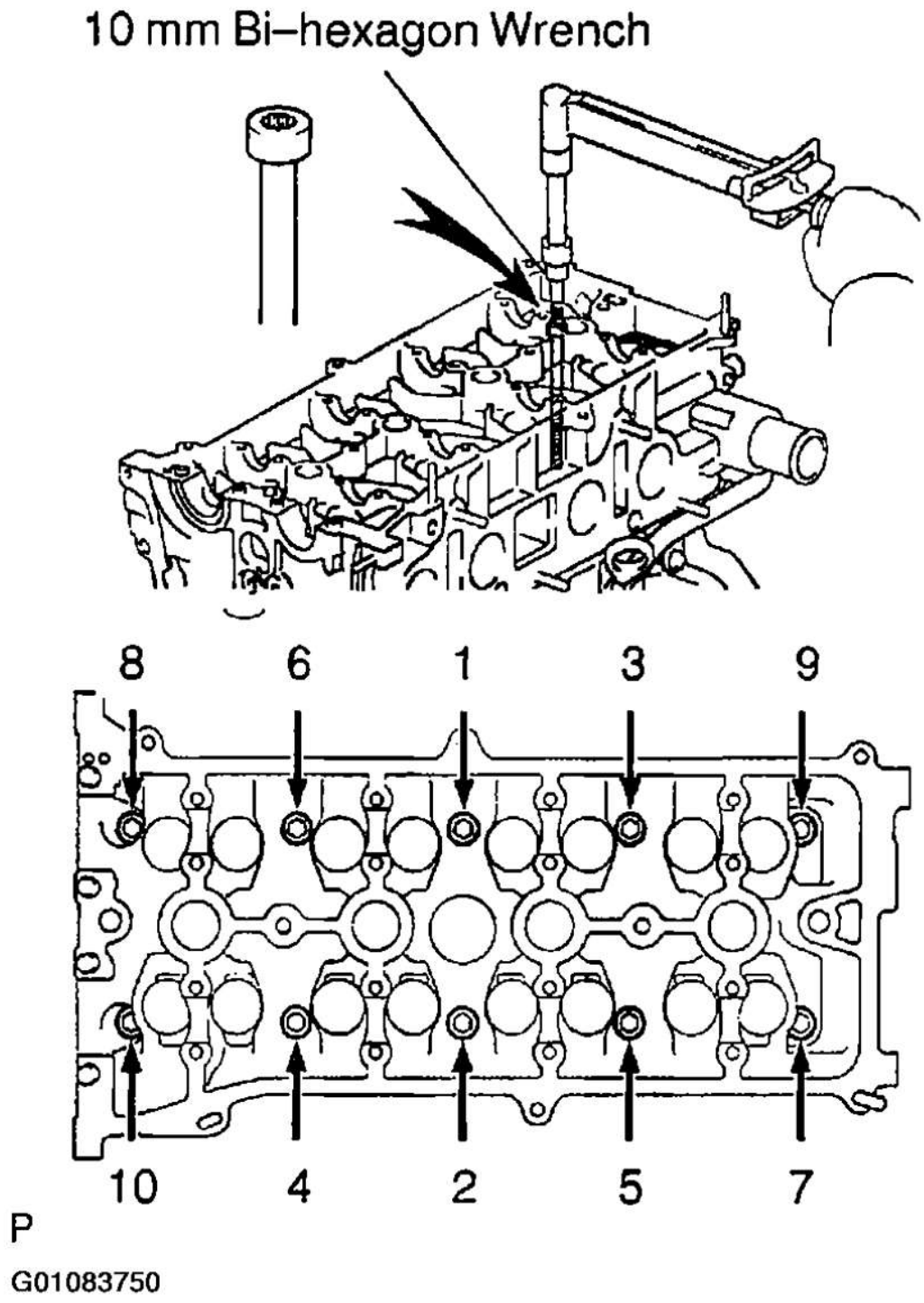


Fig. 151: Locating Cylinder Head Bolts For Installation

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

NOTE:

- The cylinder head bolts are tightened in 2 steps (steps (2) and (4)).
- If any cylinder head bolt is broken or deformed, replace it.

1. Apply a light coat of engine oil on the threads and under the head cylinder head bolts.
2. Using a 10 mm bi-hexagon wrench, install and uniformly tighten tl cylinder head bolts and plate washers in several passes, in the se shown.

   Torque: 79 N.m (800 kg. fcm, 58 ft. lbf)

   If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

3. Mark the front of the cylinder head bolt with paint.
4. Retighten the cylinder head bolts 90° in the numerical order show

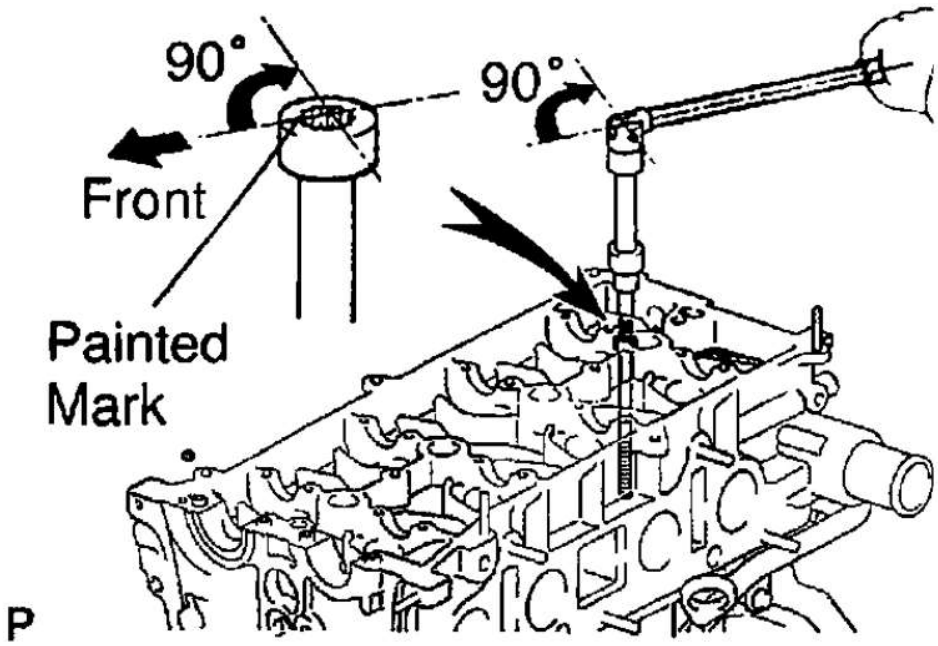


Fig. 152: Displaying Proper Cylinder Head Bolts Retightening
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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5. **Check that the painted mark is now at a 90° angle to the front.**

2. **Install camshafts** .
   a. Install the lower camshaft bearing to the cylinder head.

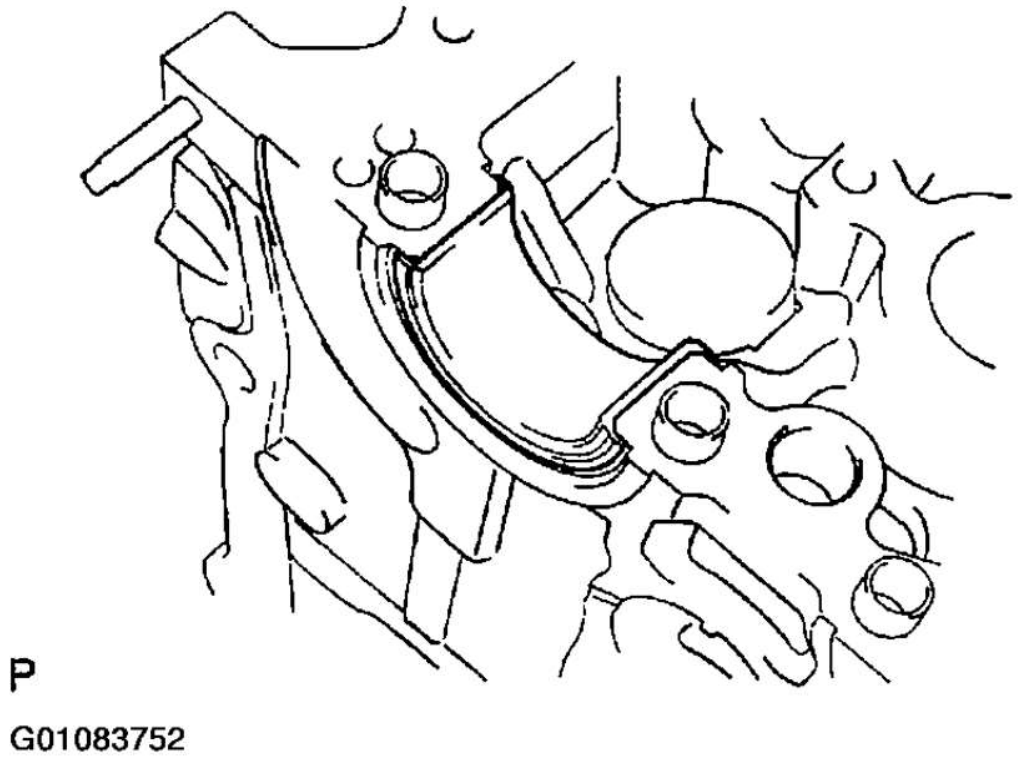


Fig. 153: Locating Lower Camshaft Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

   b. Align the bearing claw with the claw groove of No. 1 bearing cap, and push in the upper camshaft bearing.

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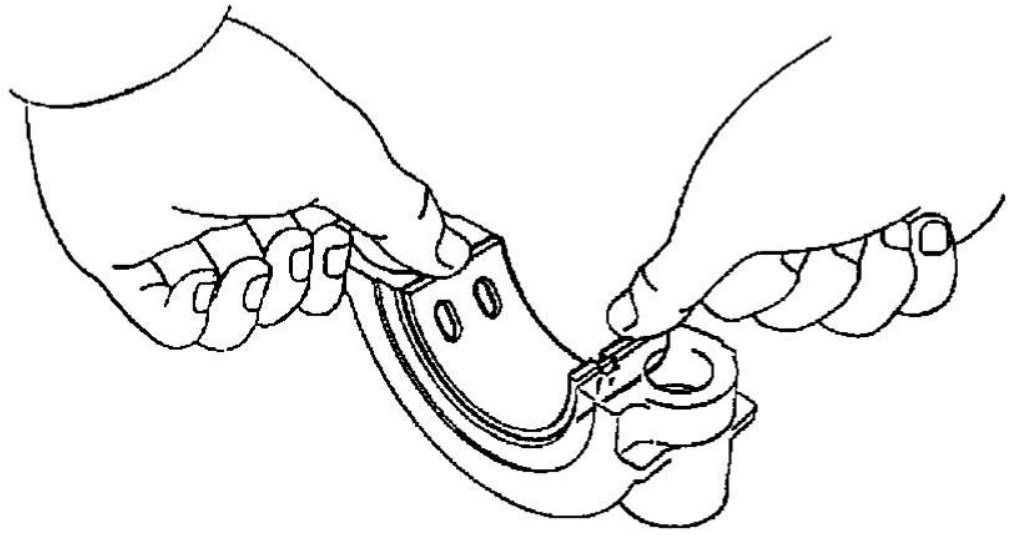


Fig. 154: Identifying Upper Camshaft Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Place the 2 camshafts on the cylinder head with the No. 1 cam lobes facing as shown the illustration.

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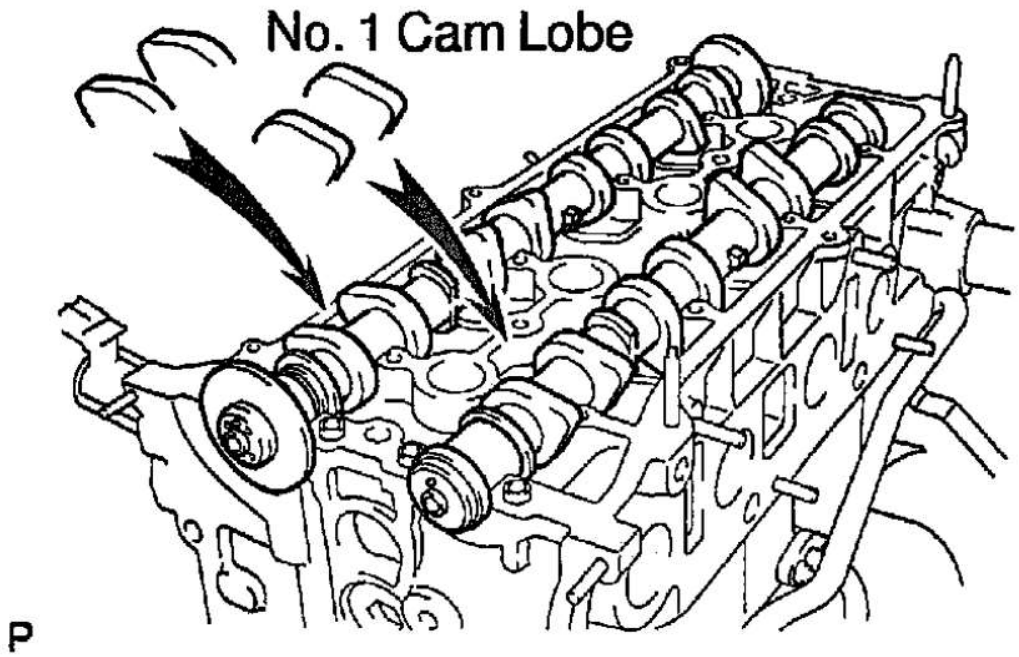


Fig. 155: Identifying No. 1 Cylinder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the bearing caps in their proper locations.

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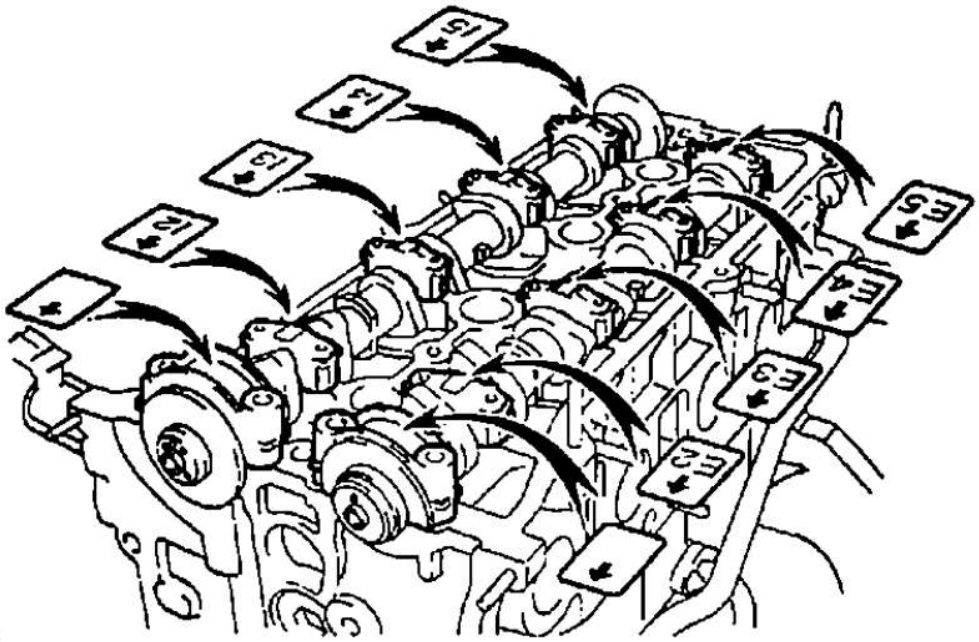


Fig. 156: Installing Bearing Caps In Proper Location
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **Each of No. 3 camshaft bearing cap has a number and front mark.**
- **The No. 1 and No. 2 bearing caps has a front marks.**

e. Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
f. Install and uniformly tighten the 20 bearing cap bolts in several passes, in the sequence shown.

Torque: 29.5 N.m (300 kgf. cm, 22 ft. lbf) for No. 1 and No. 2 9 N.m (90 kgf. cm, 80 in. .lbf) for others

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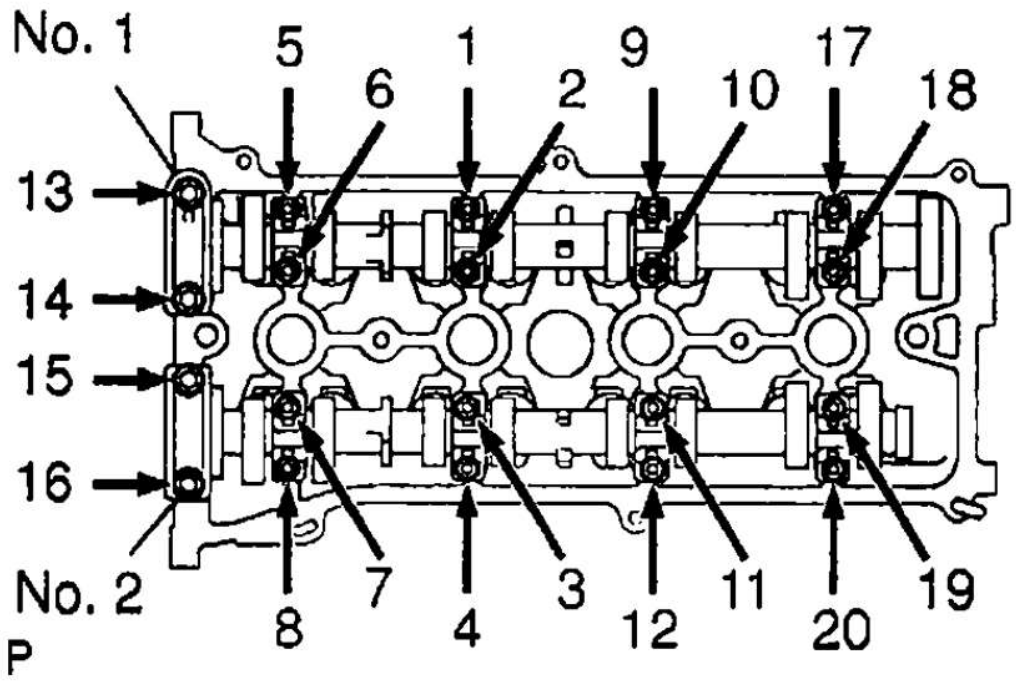


Fig. 157: Installing & Tightening Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **Check and adjust valve clearance (See ADJUSTMENT) .**

NOTE: Under the condition with the timing chain cover removed, in case of rotating the camshafts, make the position of the crankshaft rotated clockwise by about 45° from TDC/compression of No. 1 cylinder.

Turn the camshafts and position the cam lobe upward, and check and adjust the valve clearance.

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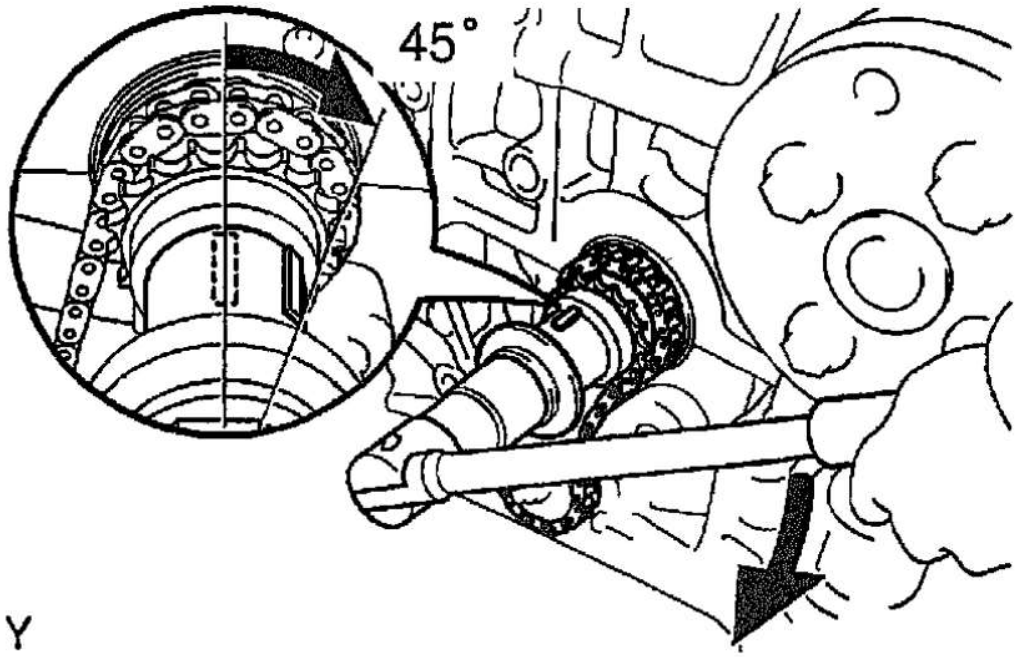


Fig. 158: Displaying Crankshaft Proper Rotation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Install camshaft timing sprocket and VVT timing sprocket (See INSTALLATION) .**
5. **Install timing chain (See INSTALLATION) .**
6. **Install camshaft position sensor (See CAMSHAFT POSITION SENSOR) .**
7. **Install camshaft timing oil control valve (OCV) (See VARIABLE VALVE TIMING CAMSHAFT TIMING OIL CONTROL VALVE) .**
8. **Install oil filler cap .**
9. **Install intake manifold and throttle body assembly**

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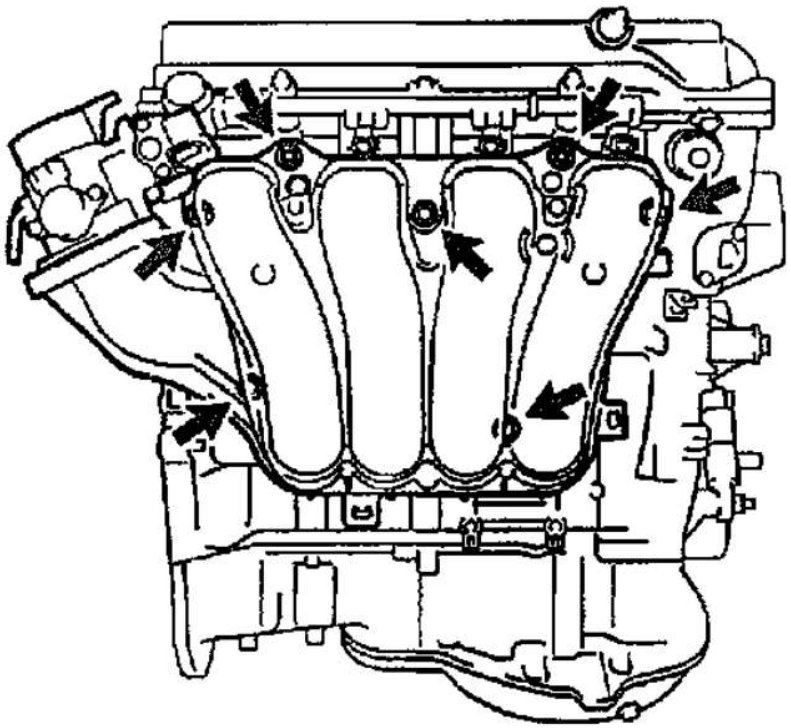


Fig. 159: Locating Intake Manifold & Throttle Body Bolts & Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Install a new gasket to the intake manifold.
b. Install intake manifold insulator.
c. Install the intake manifold and throttle body assembly with the 5 bolts and 2 nuts. Uniformly tighten the bolts and nuts in several passes.

Torque: 30 N.m (305 kgf. cm, 22 ft. lbf)

d. Connect the engine wire harness to the clamp.
e. Connect the 2 vacuum hoses to the intake manifold.
f. Connect the 2 water hoses to the throttle body.
g. Connect the IAC valve connector.
h. Connect the throttle position sensor connector.

10. **Install PCV valve and hoses** .
    a. Install the PCV valve with the grommet.

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b. Install the PCV hoses.

11. **Connect engine wire** .
    a. Connect the noise filter.
    b. Connect the ETC sensor connector.
    c. Connect the camshaft position sensor connector.
    d. Connect the oil pressure switch connector and wire.
    e. Connect the crankshaft position sensor.
    f. Connect the OCV connector.
    g. Install the engine wire with the 2 bolts.
12. **Install heat insulators to exhaust manifold** .
    a. Temporary install the No. 1 and No. 2 exhaust manifold stays to the exhaust manifold with the 2 nuts.
    b. Install the No. 2 lower heat insulator to the exhaust manifold with the 4 bolts.

       Torque: 12 N.m (120 kgf. cm, 9 ft. lbf)
    c. Install the No. 1 lower heat insulator to the exhaust manifold with the 3 bolts.

       Torque: 12 N.m (120 kgf. cm, 9 ft. lbf)
13. **Install exhaust manifold assembly** .
    a. Install a new gasket and the exhaust manifold with the 5 nuts.

       Torque: 37 N.m (375 kgf. cm, 27 ft. lbf)

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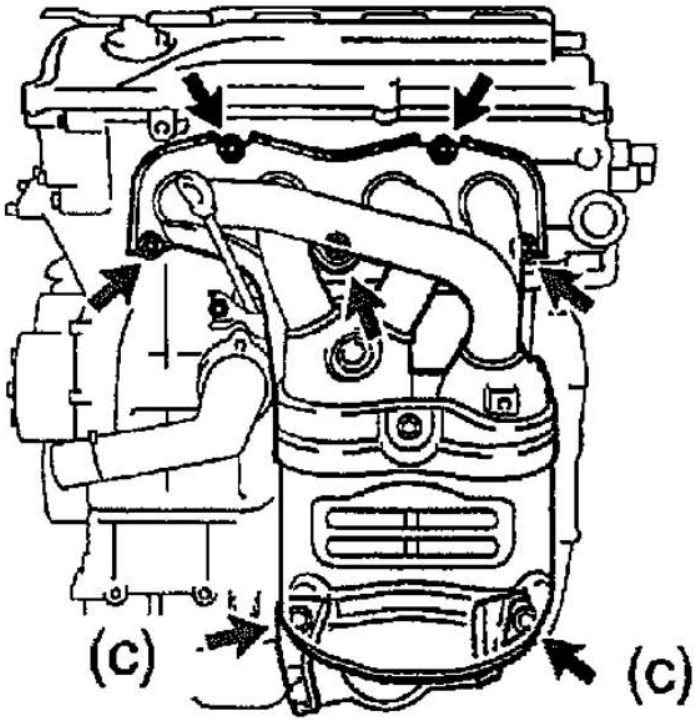


Fig. 160: Locating New gasket & Exhaust Manifold Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the 2 exhaust manifold stays with the 2 bolts.
Torque: 44 N.m (450 kgf. cm, 33 ft. lbf)
c. Tighten the 2 nuts holding the exhaust manifold stays to crank case.
Torque: 44 N.m (450 kgf. cm, 33 ft. lbf)
d. Install the 2 compression springs and 2 bolts holding the exhaust manifold and front exhaust pipe.
Torque: 43 N.m (439 kgf. cm, 32 ft. lbf)
e. Install the upper heat insulator with the 3 bolts and nut.
Torque: 12 N.m (120 kgf. cm, 9 ft. lbf)
f. Connect the 2 A/F sensor connectors.
g. Connect the 2 heated oxygen sensor wires to the wire bracket.

14. **Install injectors (See INSTALLATION) .**
15. **Install spark plugs (See SPARK TEST) .**

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16. **Install ignition coils (See REMOVAL & INSTALLATION (RAV4)) .**
17. **Install PS vane pump (See INSTALLATION) .**
18. **Install generator (See INSTALLATION)**
19. **Install drive belt (See INSTALLATION) .**
20. **Install air cleaner assembly .**

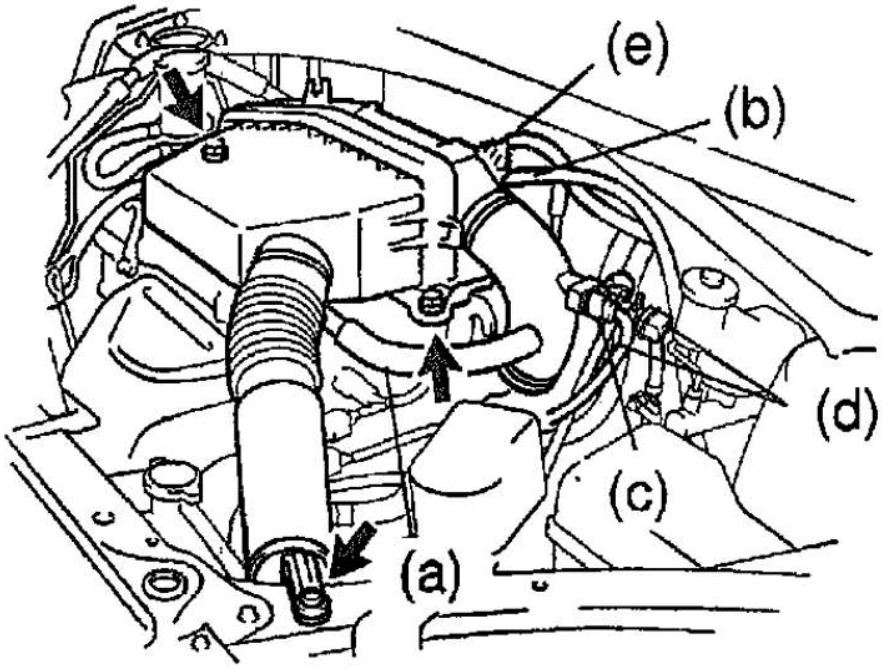


Fig. 161: Installing Air Cleaner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect the PCV hose to the cylinder head cover.
b. Connect the CCV hose to the air cleaner.
c. Connect the VSV connect for EVAP.
d. Connect the 2 EVAP hoses to the VSV.
e. Connect the MAF meter connector.

21. **Fill with engine oil (See REPLACEMENT) .**
22. **Fill with engine coolant .**
23. **Start engine and check for leak .**

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24. **Recheck engine oil and coolant level .**
25. **Install RH engine under cover .**

ENGINE UNIT

COMPONENTS

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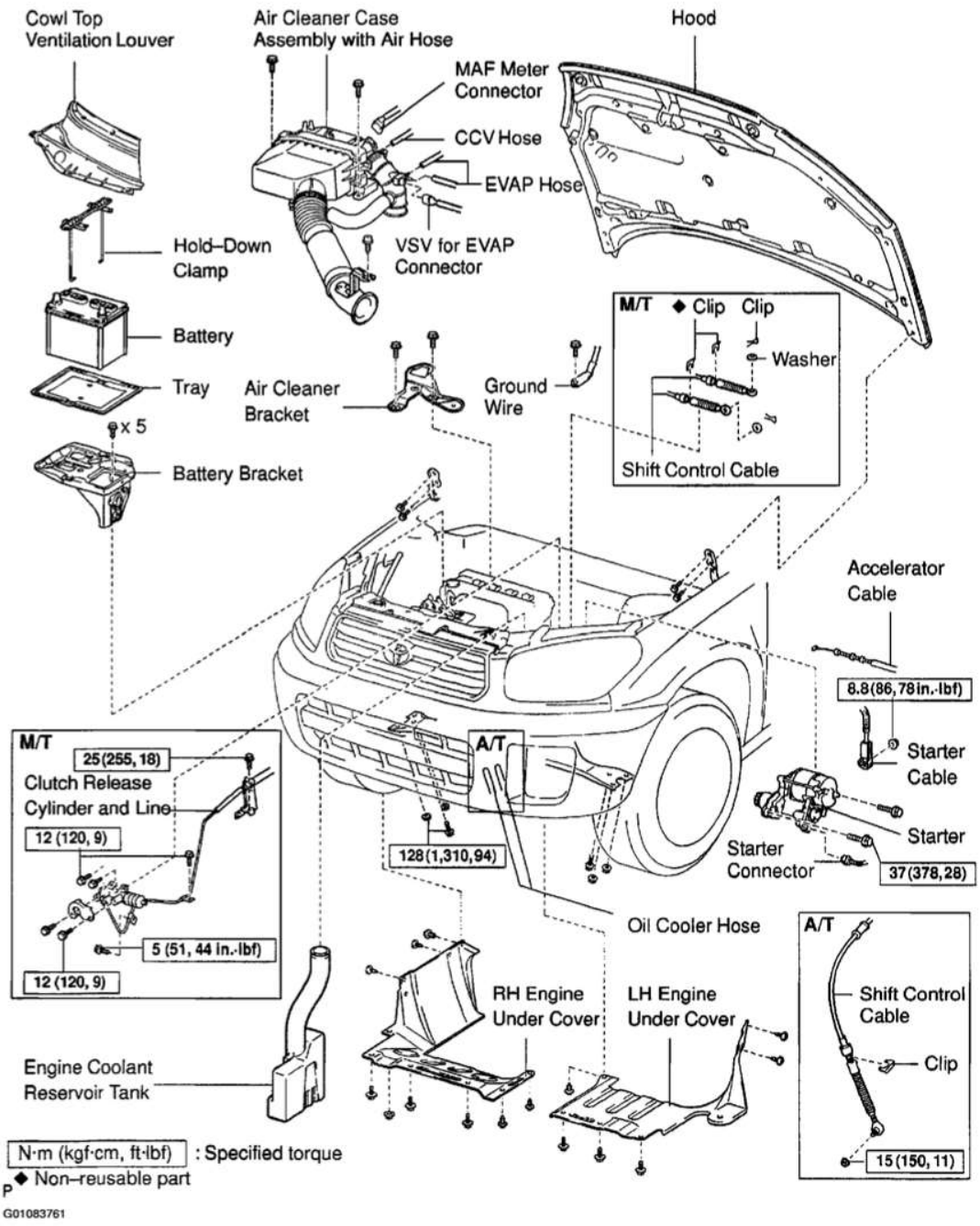


Fig. 162: Displaying Air Unit Components (1 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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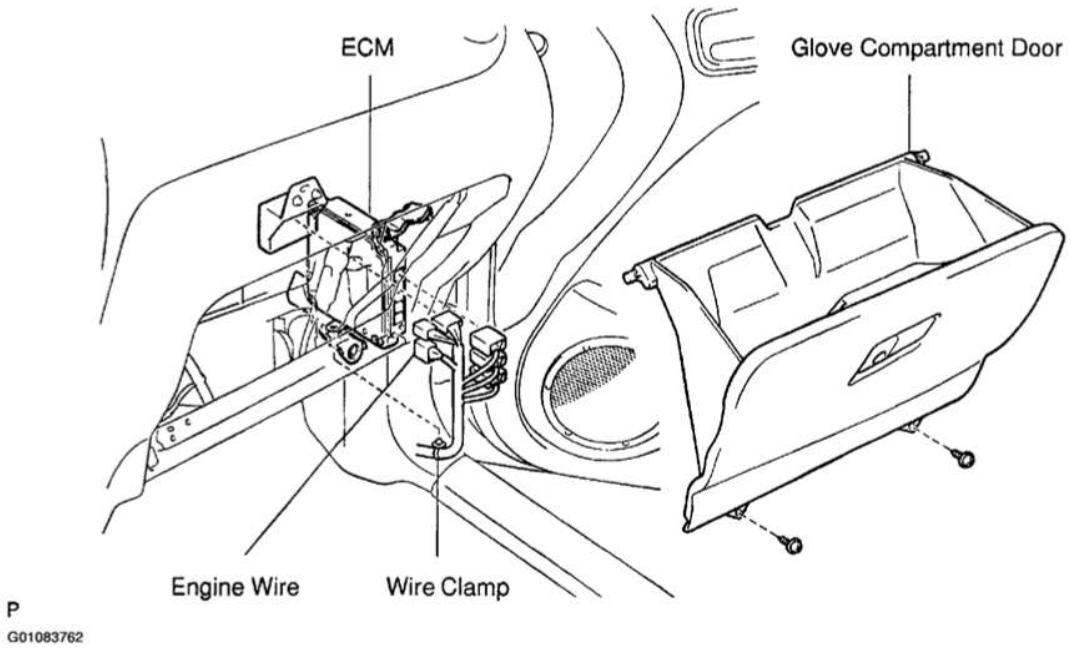


Fig. 163: Displaying Air Unit Components (2 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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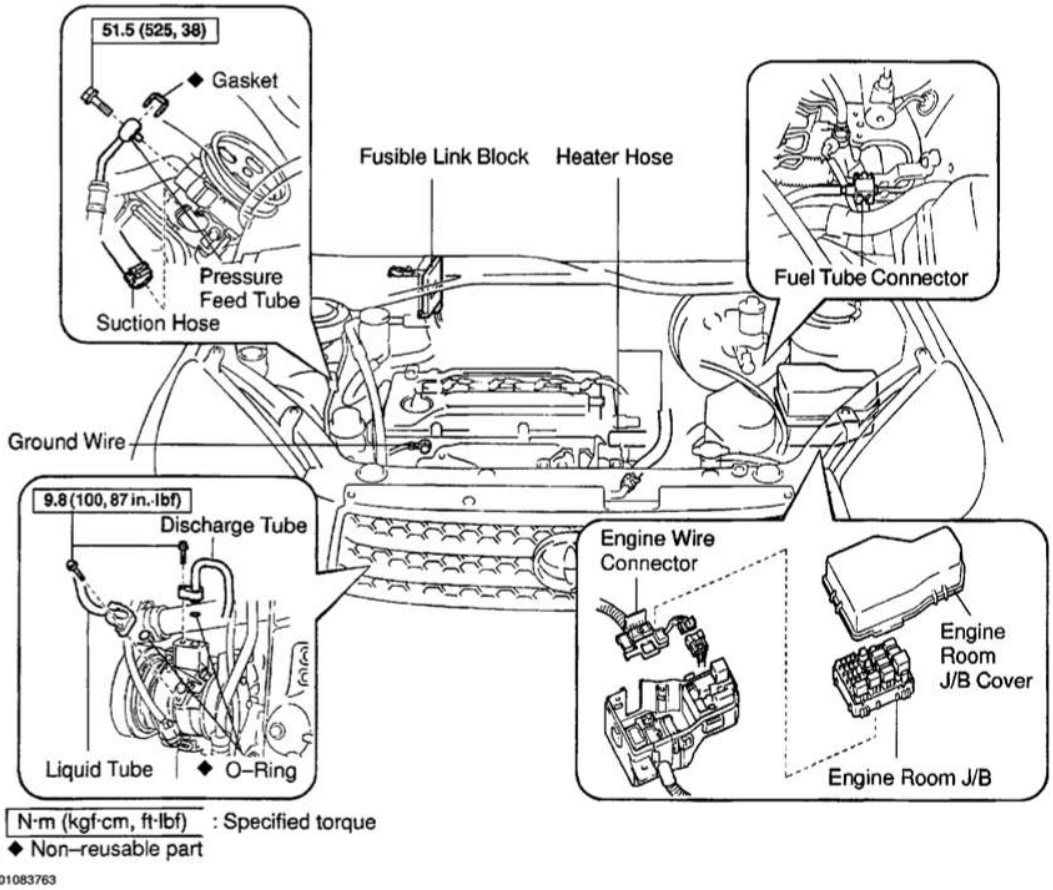


Fig. 164: Displaying Air Unit Components (3 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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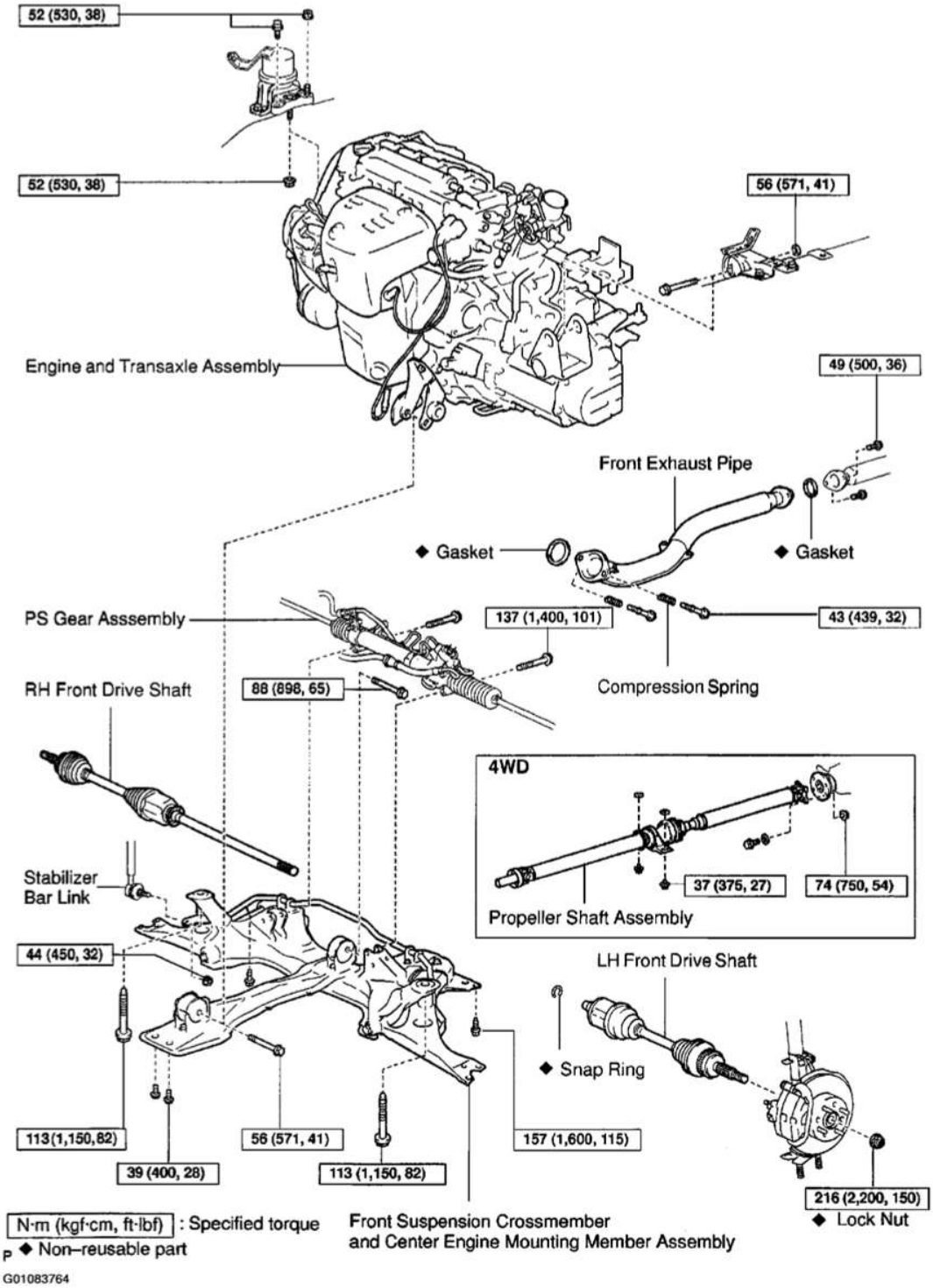


Fig. 165: Displaying Air Unit Components (4 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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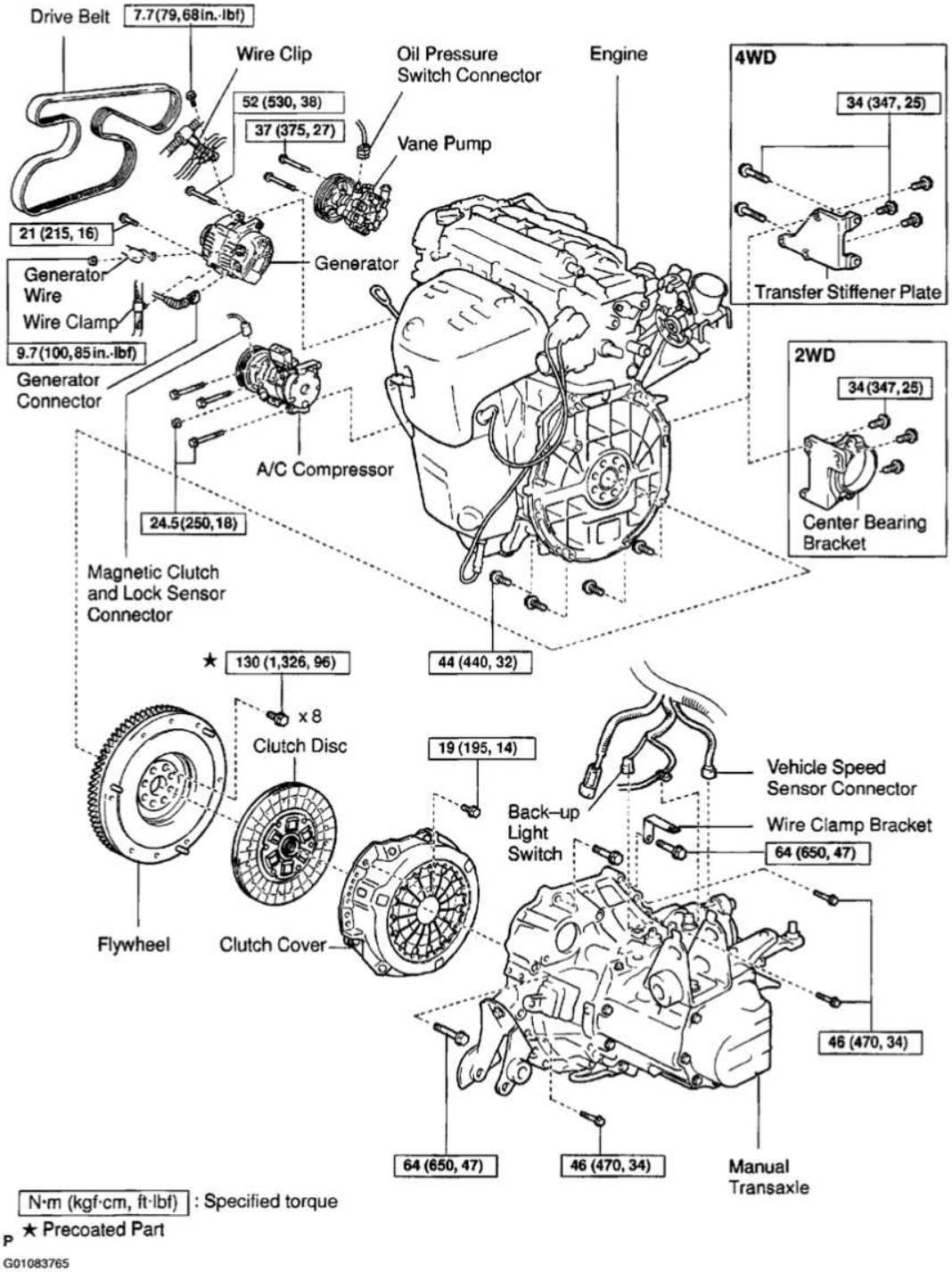


Fig. 166: Displaying Air Unit Components (5 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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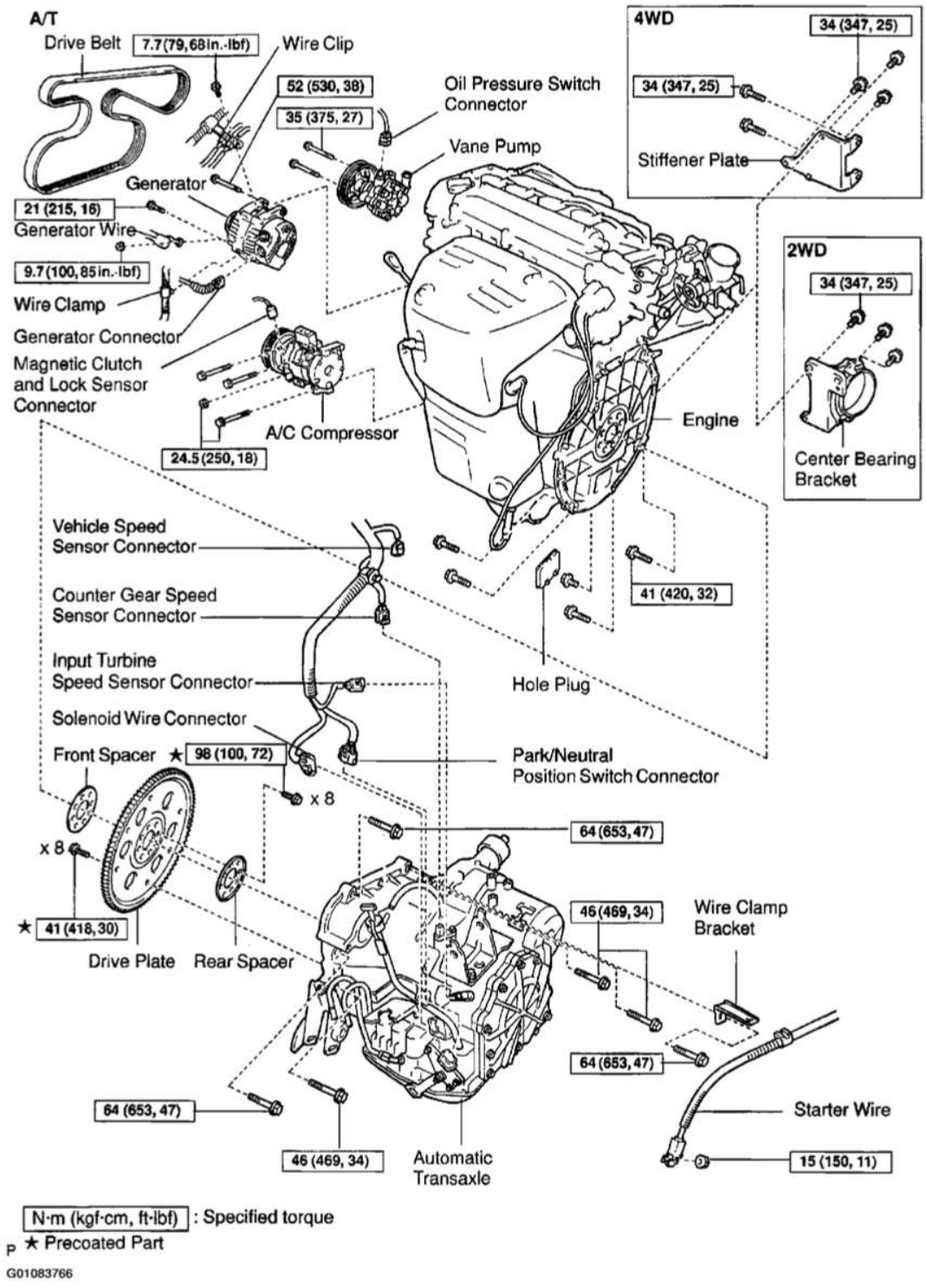


Fig. 167: Displaying Air Unit Components (6 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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REMOVAL

1. **Remove engine under covers** .
2. **Drain transaxle oil** .
3. **Drain transfer oil** .
4. **Drain engine oil** .
5. **Drain engine coolant** .
6. **Remove hood** .
7. **Remove radiator reservoir** .
8. **Remove battery and tray** .
   a. Remove the cowl top ventilation louver (See **REMOVAL**).
   b. Remove the hold-down clamp, battery and tray.
   c. Remove the 5 bolts and battery bracket.

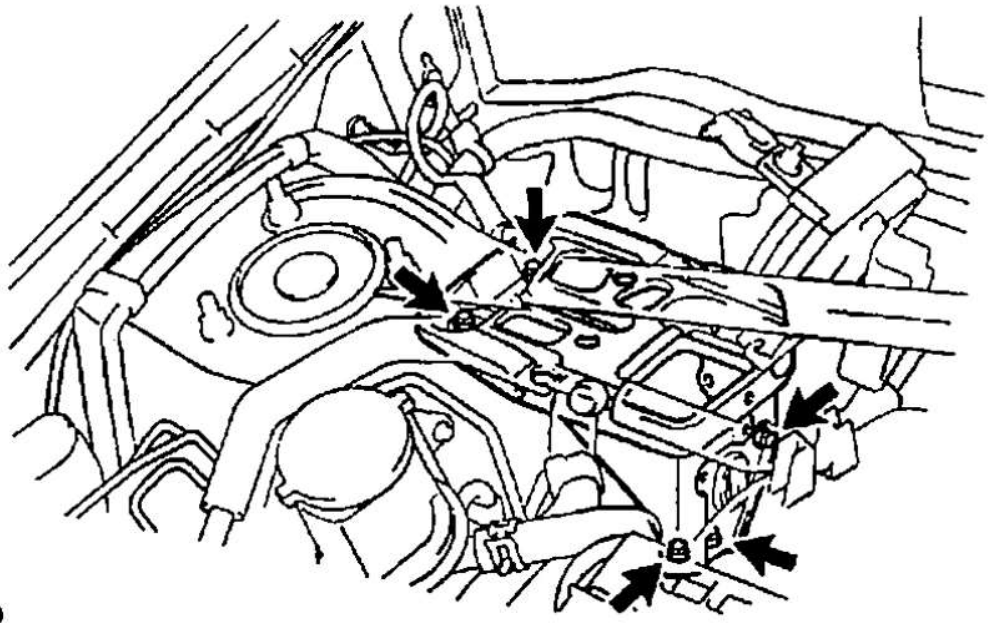


Fig. 168: Locating Bolts & Battery Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **Remove air cleaner assembly** .

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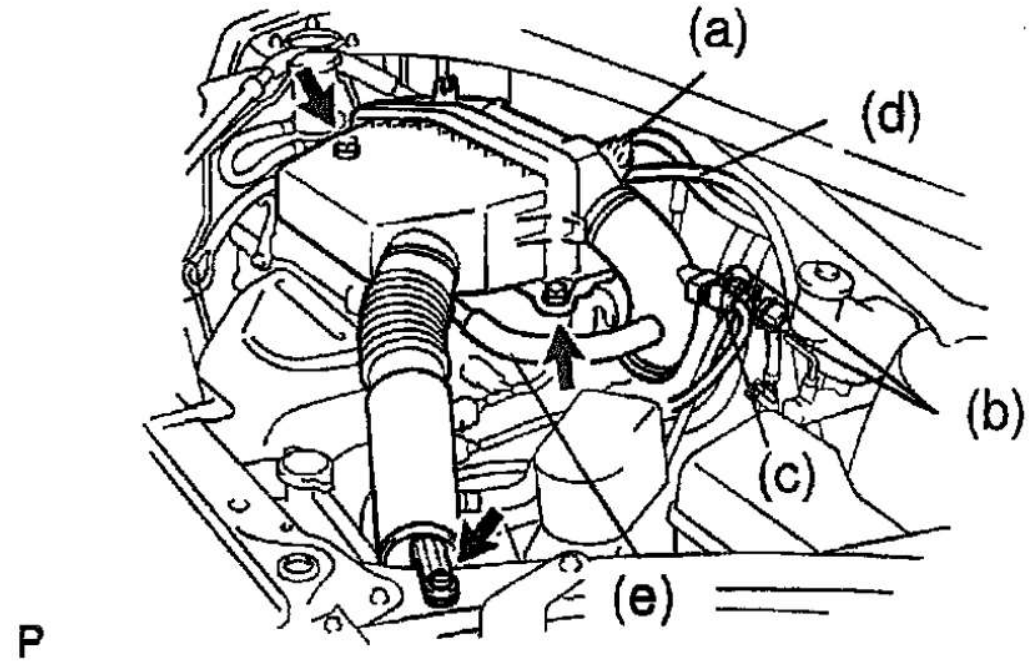


Fig. 169: Removing Air Cleaner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Disconnect the MAF meter connector.
b. Disconnect the 2 EVAP hoses from the VSV.
c. Disconnect VSV connector for EVAP.
d. Disconnect the CCV hose from the air cleaner.
e. Disconnect the PCV hose from the cylinder head cover.
f. Disconnect the air cleaner hose from the throttle body, and remove the 3 bolts and the air cleaner assembly.

10. **Remove engine room J/B** .
    a. Remove the engine room J/B cover.
    b. Loosen the bolt.
    c. Remove the engine room J/B.
    d. Pull out the engine wire connector.

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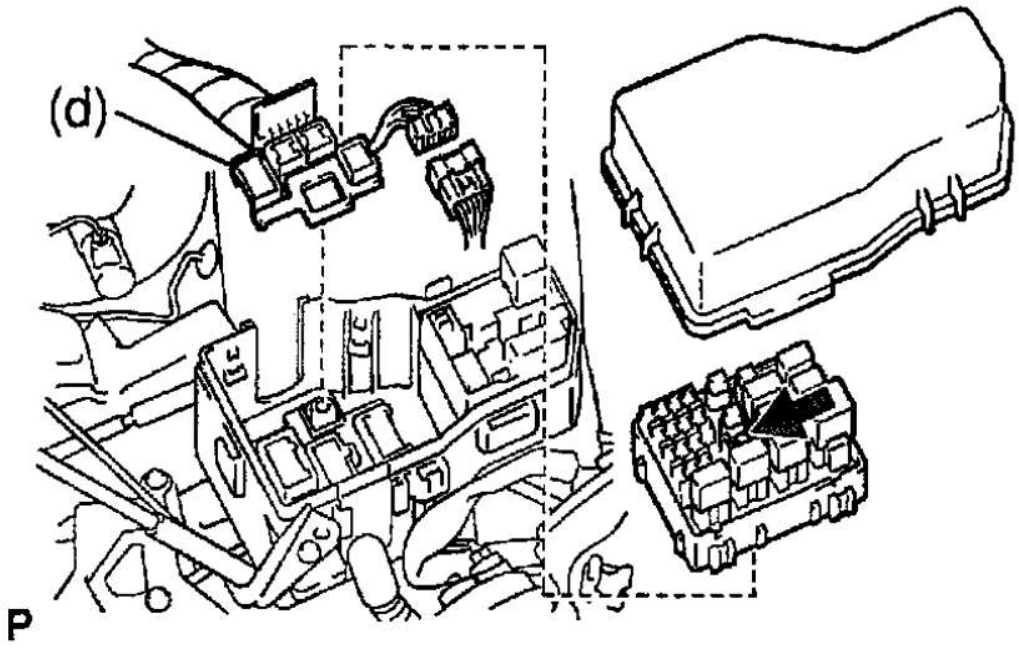


Fig. 170: Identifying Engine Wire Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Disconnect the connector.
f. Disconnect the engine wire clamp.

11. **Disconnect engine wire from cabin** .
    a. Remove the 2 screws and glove compartment door.
    b. Disconnect the 6 engine wire connectors from the ECM and instrument panel wire.
    c. Pull out the engine wire from the cabin.
12. **Disconnect tubes, hoses, connector, cable and wire** .
    a. Disconnect the accelerator cable.
    b. Disconnect the ground wire from the cylinder head.
    c. Disconnect the discharge and liquid tubes from the compressor, and remove the 2 O-rings (See **REMOVAL**).

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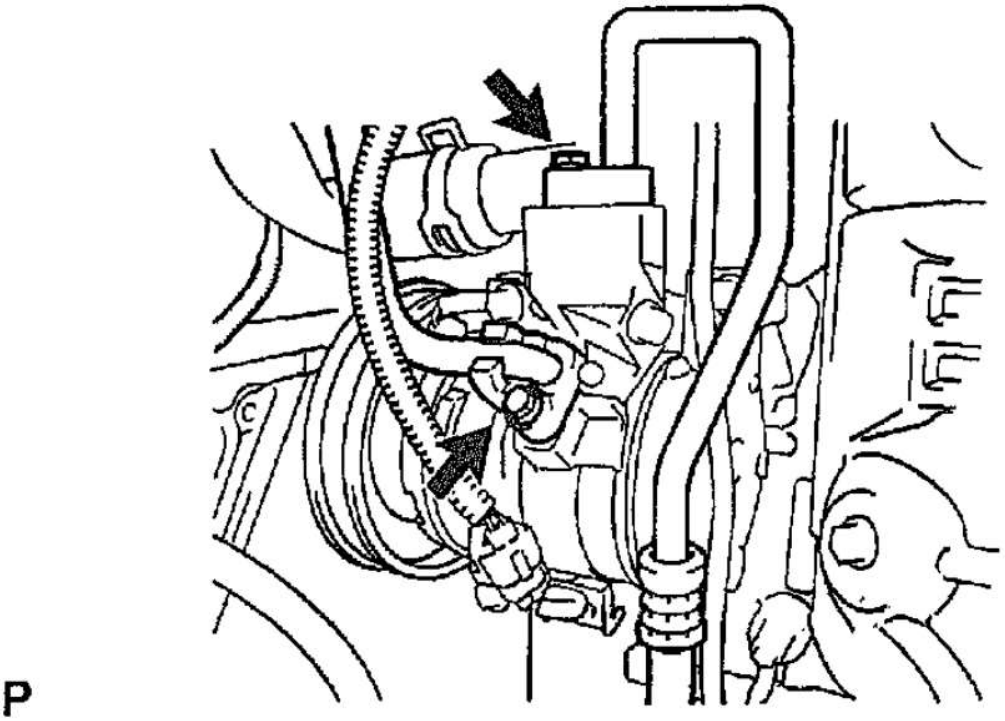


Fig. 171: Locating Discharge & Liquid Tubes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Disconnect the suction hose, pressure feed tube and gasket from the PS vane pump.
e. Disconnect the upper radiator hose.
f. Disconnect the lower radiator hose.
g. Disconnect the fuel tube connector.
h. Disconnect the 2 heater hoses.

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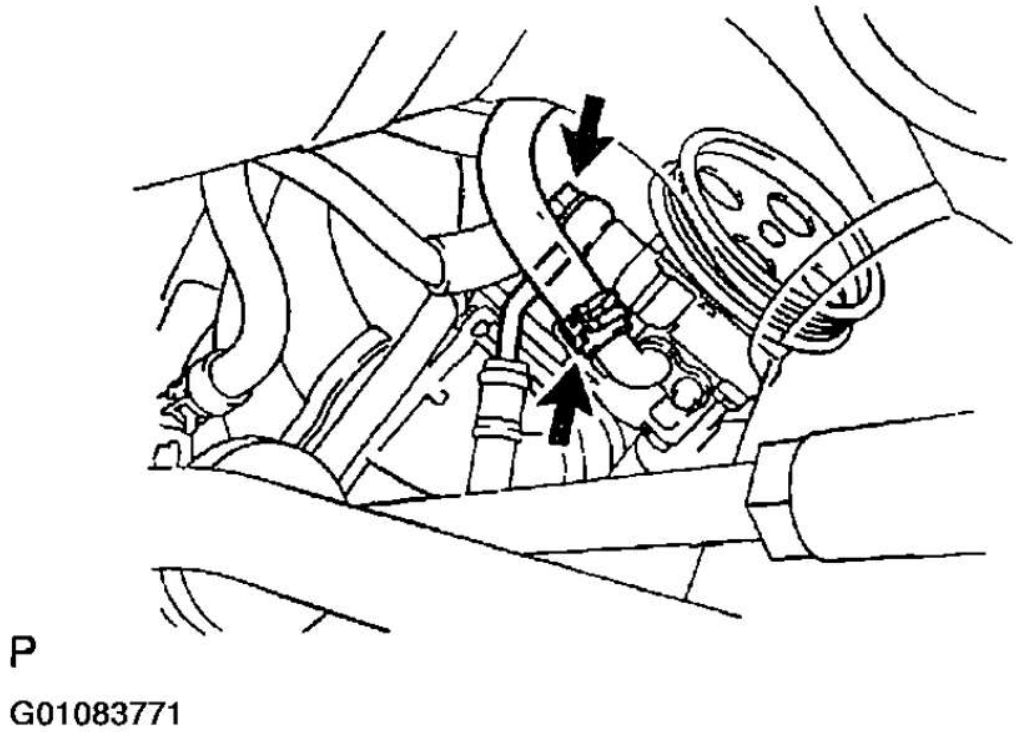


Fig. 172: Locating Heater Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

i. Disconnect the connector from the fusible link block.

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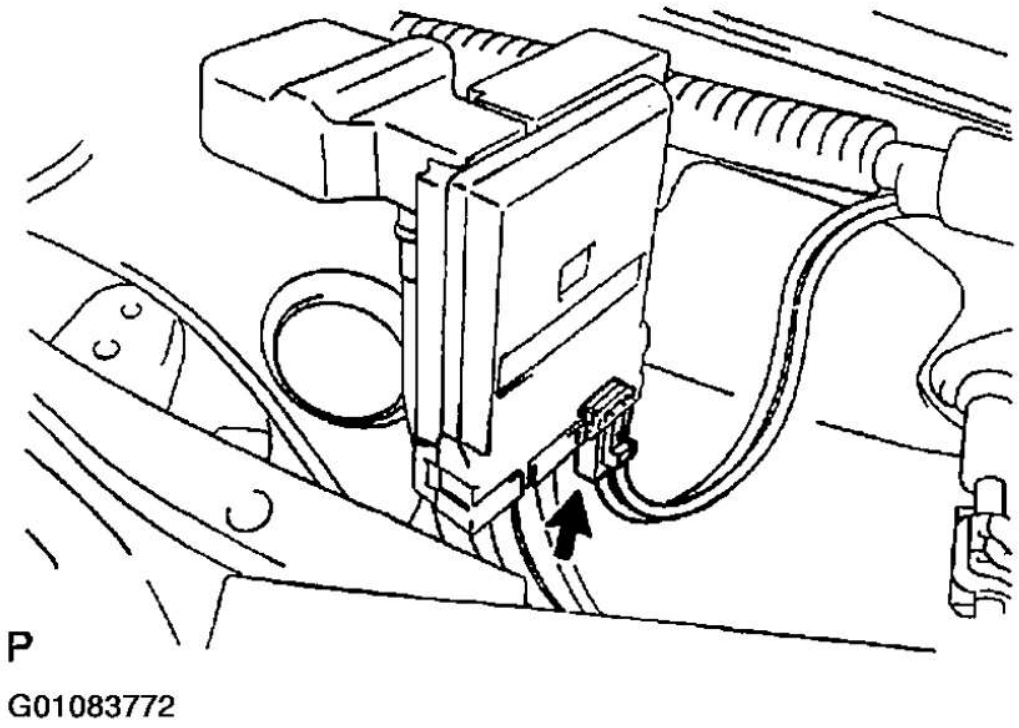


Fig. 173: Locating Fusible Link Block Connector
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **M/T: Disconnect shift control cables from transaxle.**
    a. Remove the 2 clips and 2 washers.
    b. Remove the 2 clips, and disconnect the 2 control cables.

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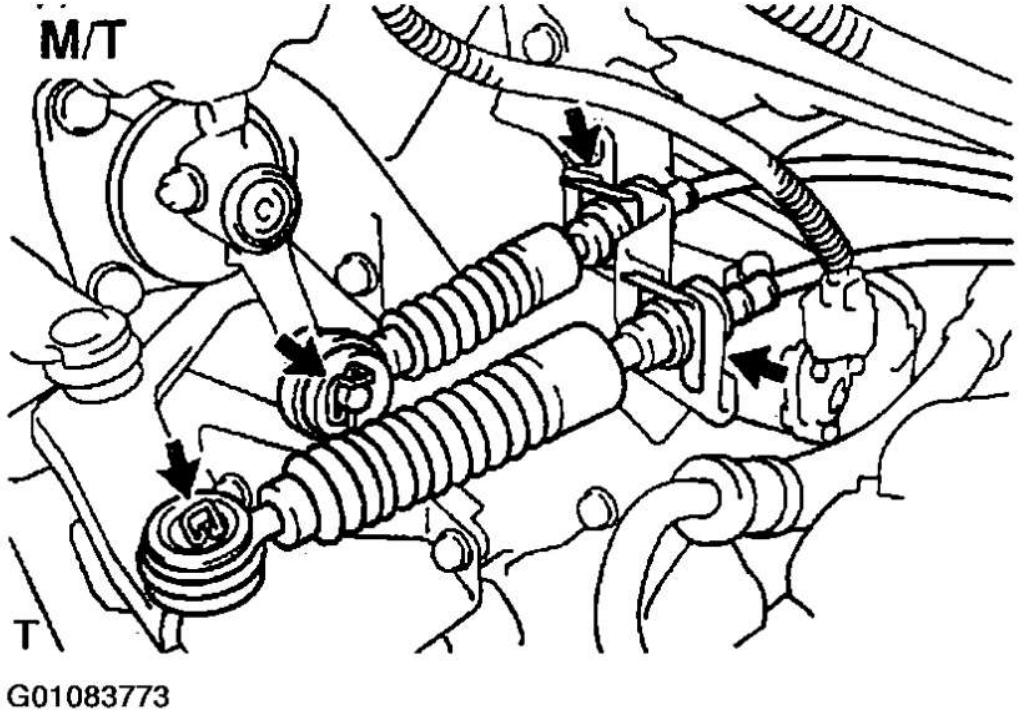


Fig. 174: Locating Clips & Washer & Control Cables
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

14. **Remove starter** .
    a. A/T: Disconnect the hose from the dipstick guide.
    b. Disconnect the connector.
    c. Remove the 2 bolts, and disconnect the starter.
    d. Remove the nut, and disconnect the starter cable.
    e. Remove the starter.

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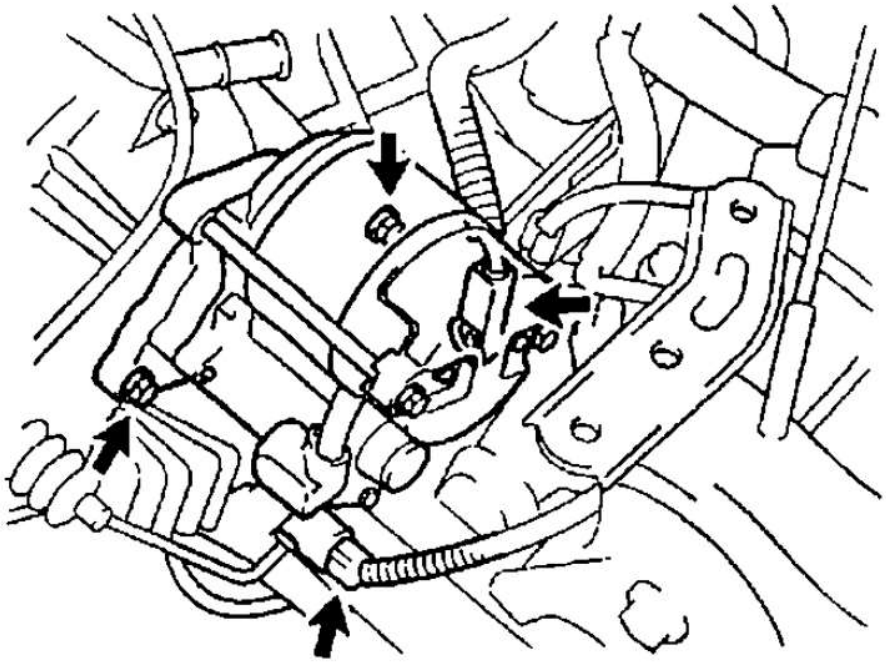


Fig. 175: Locating Starter Bolts & Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **M/T: Disconnect clutch release cylinder and line from transaxle**
    a. Remove the 2 bolts and heat insulator.
    b. Remove the 5 bolts and disconnect the release cylinder.

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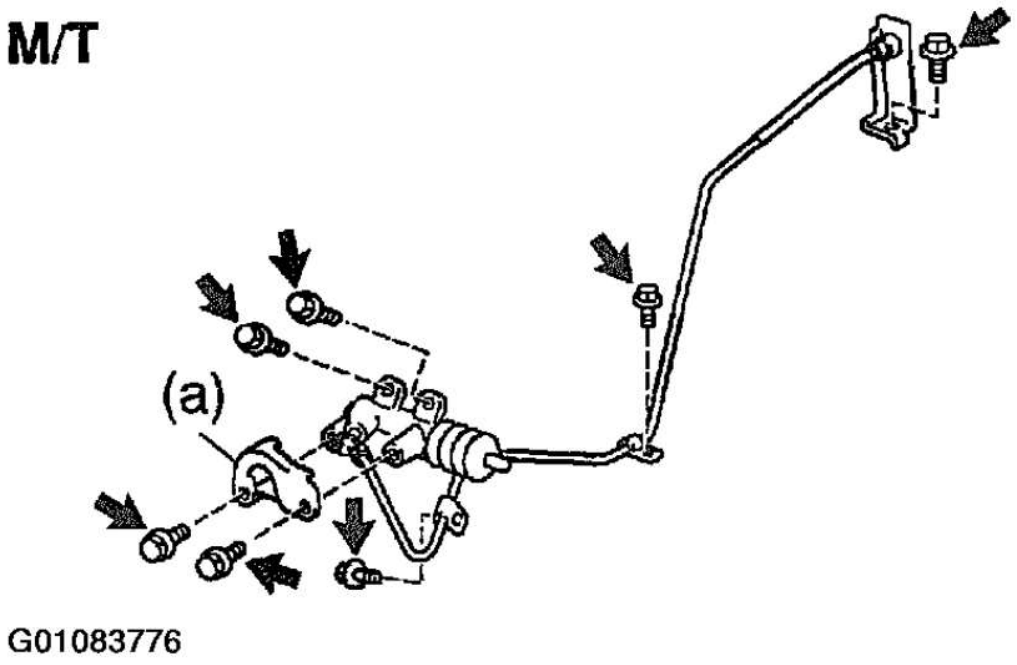


Fig. 176: Locating Heat Insulator Bolts & Release Cylinder Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

16. **A/T: Disconnect shift control cable from transaxle**
    a. Remove the nut holding the control shift lever to the control cable.
    b. Remove the clip, and disconnect the control cable.
    c. Disconnect the control cable from the cable clamp.

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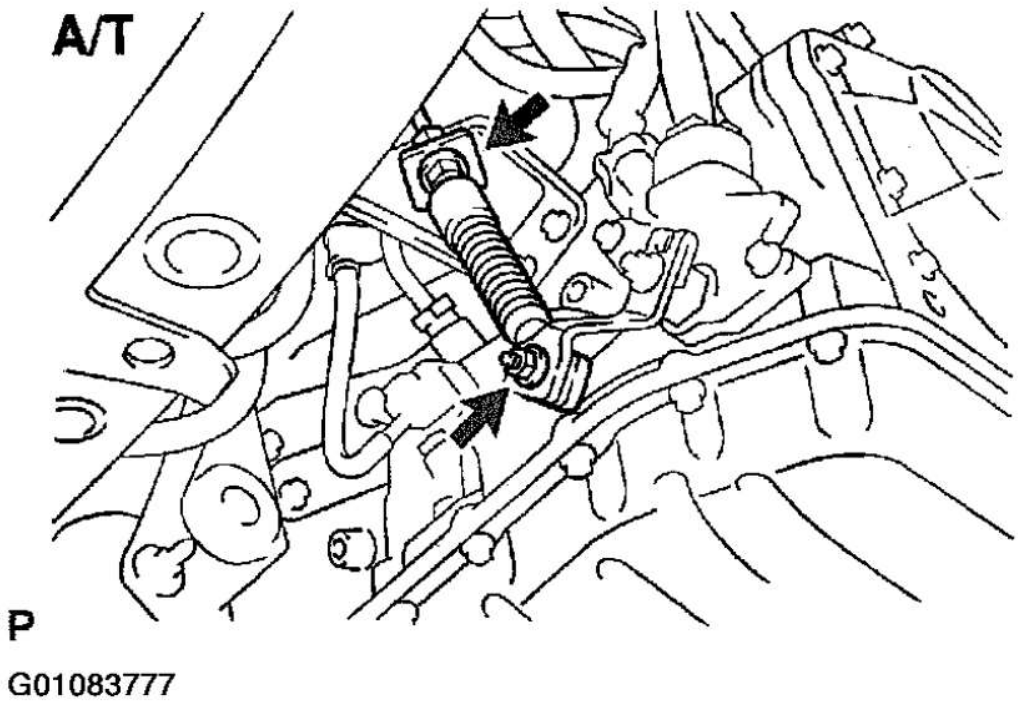


Fig. 177: Disconnecting Shift Control Cable
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **A/T: Disconnect oil cooler hoses** .

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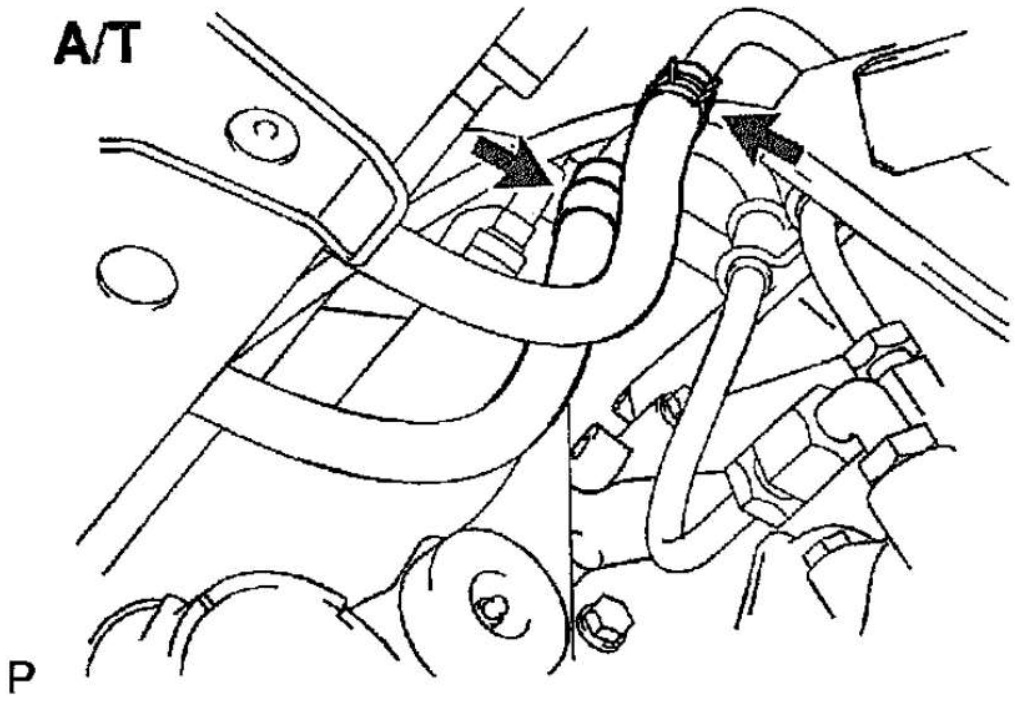


Fig. 178: Disconnecting Oil Cooler Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **Disconnect ground cable from transaxle .**
19. **4WD: Remove propeller shaft (See REMOVAL) .**
20. **Remove front drive shafts (See REMOVAL) .**
21. **Remove front exhaust pipe .**

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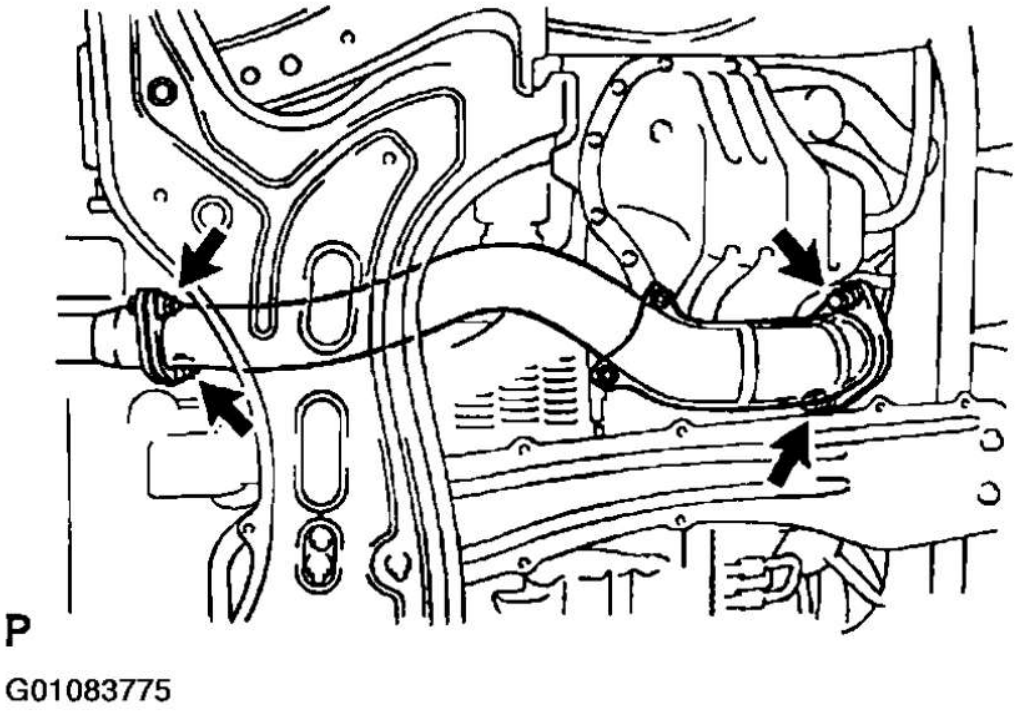


Fig. 179: Locating Front Exhaust Pipe Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Remove the 4 bolts, 2 compression rings, 2 gaskets and exhaust pipe.

22. **Disconnect stabilizer bar links** .

Remove the 2 nuts, and disconnect the LH and RH stabilizer links.

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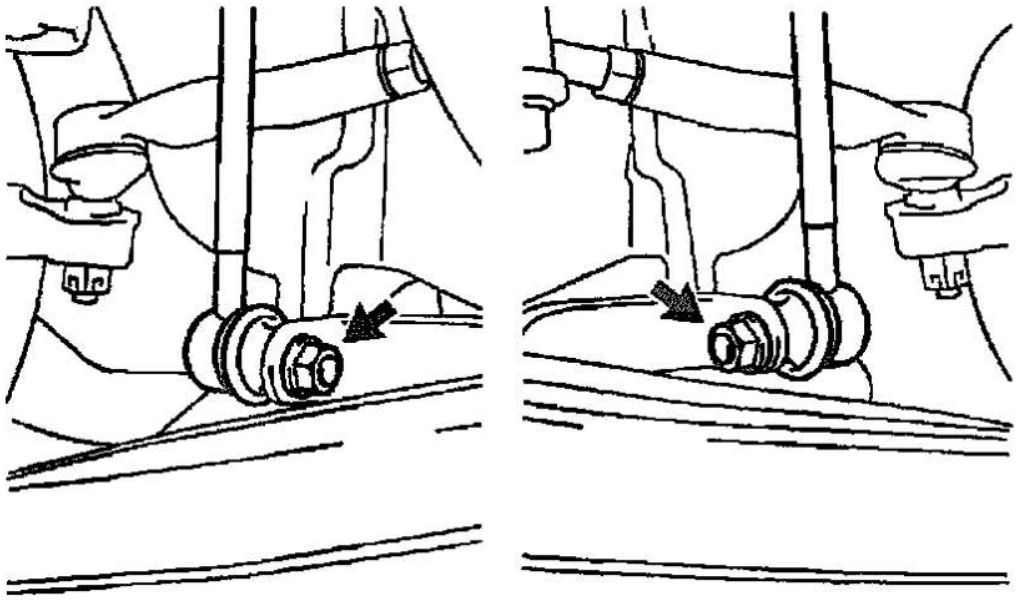


Fig. 180: Displaying LH & RH Stabilizer Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

23. **Disconnect PS gear assembly** .

Remove the 2 bolts of the PS gear assembly.

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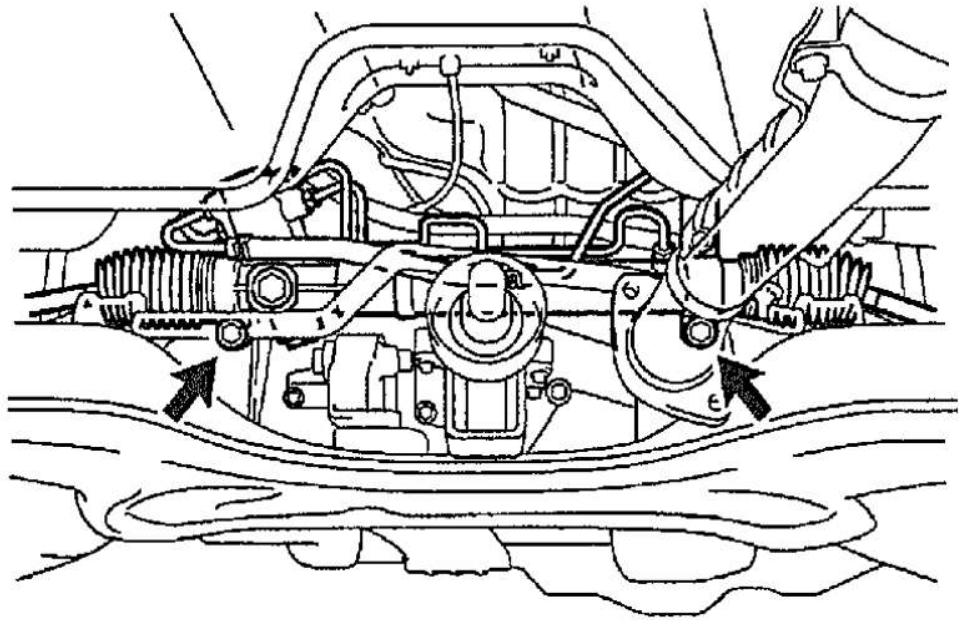


Fig. 181: Disconnect PS Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

24. **Attach engine sling device to engine hangers** .
    a. Install No. 1 and No. 2 engine hangers in the correct direction.

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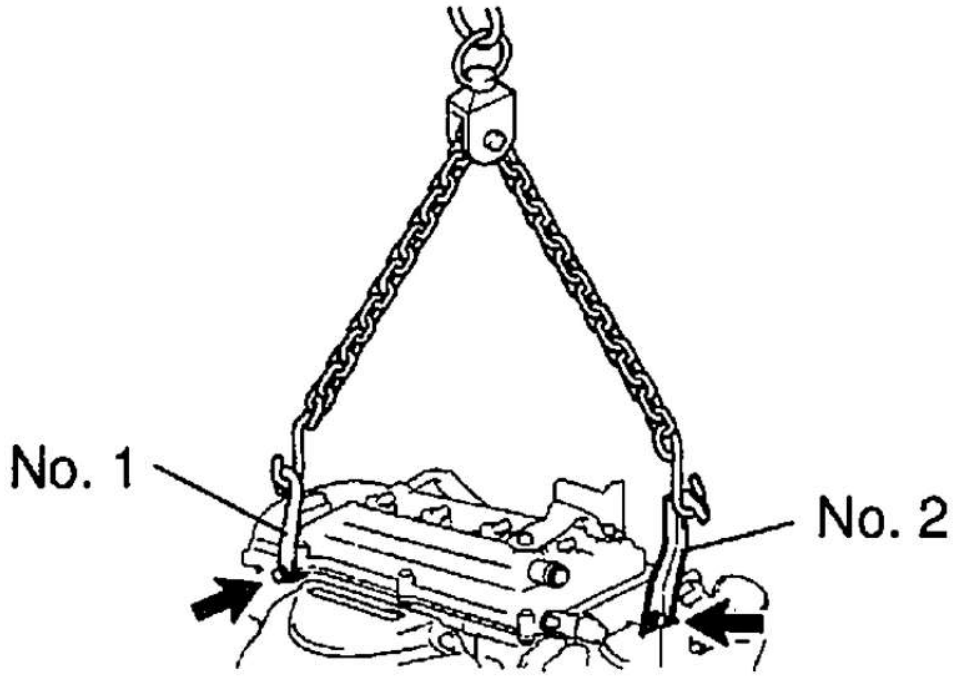


Fig. 182: Installing No. 1 & 2 Engine Hangers
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Item	Part No.
No. 1 and No. 2 engine hangars	12281–28010, 12281–28020 or 12281–28030
bolt	91512–61020 x 2

G01083781

Fig. 183: Displaying Installing Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 38 N.m (390 kgf. cm, 28 ft. lbf)

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b. Attach the sling device to the engine hangers.

CAUTION: Do not attempt to hang the engine by hooking the chain to any other part.

25. **Remove engine, transaxle, front suspension crossmember and center engine mounting member assembly**
    a. Remove the 2 nuts and bolt holding the RH engine mounting insulator to the tinning chain cover.

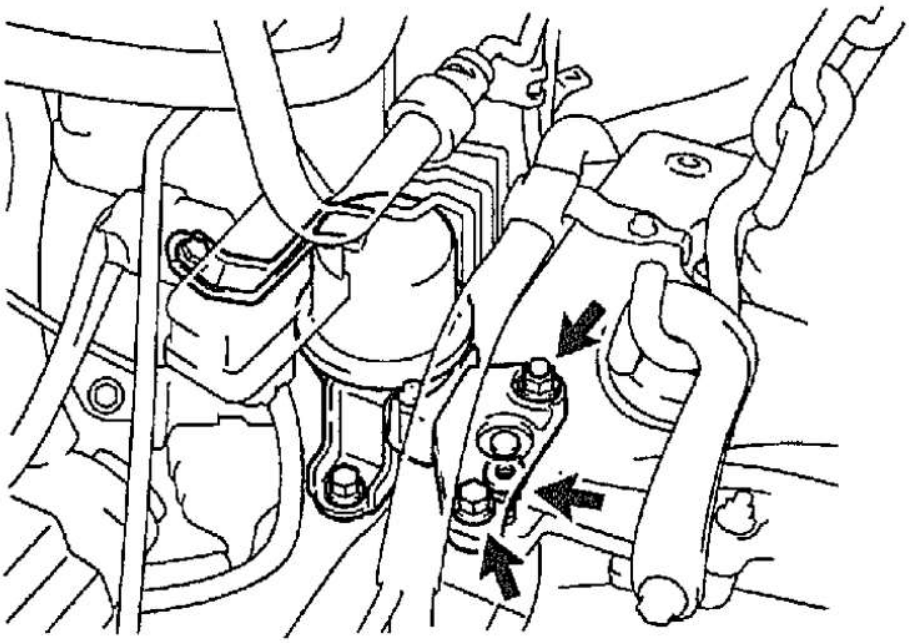


Fig. 184: Removing RH Nuts & Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

    b. Remove the bolt holding the LH engine mounting insulator to the mounting bracket.

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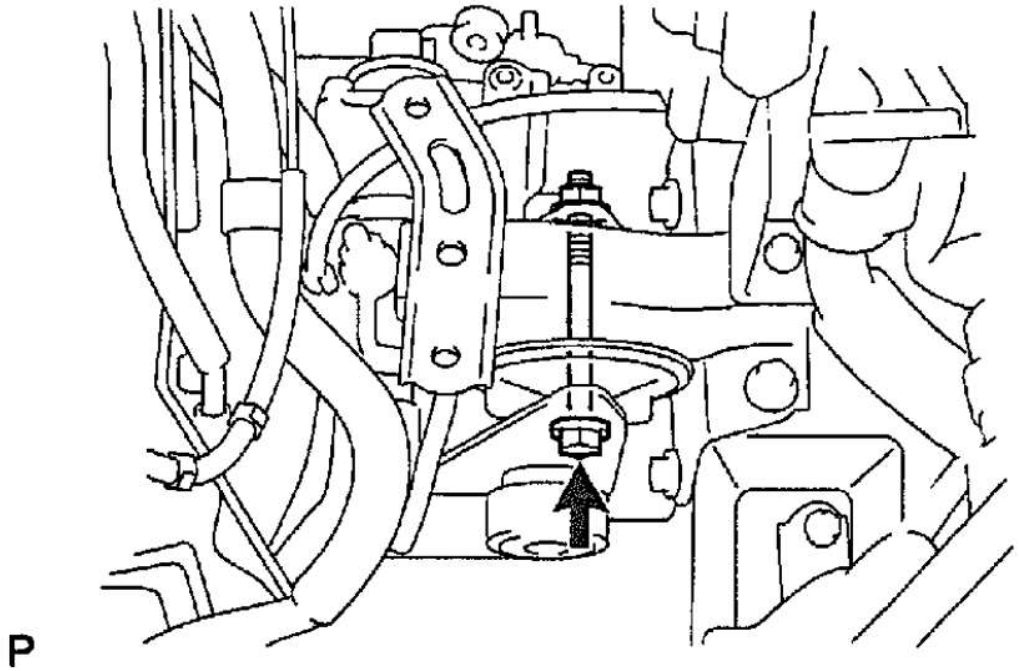


Fig. 185: Removing LH Nuts & Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Support the suspension crossmember with a jack.
d. Remove the 6 bolts holding the suspension crossmember engine mounting member to the body.

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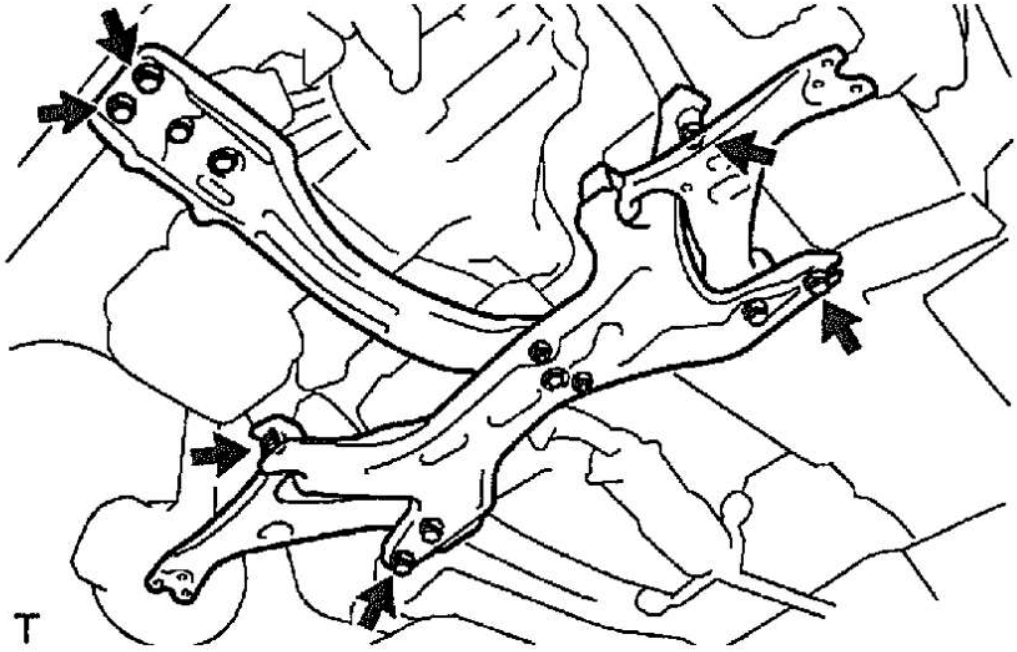


Fig. 186: Removing Crossmember Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Lower the engine out of the vehicle slowly and carefully.

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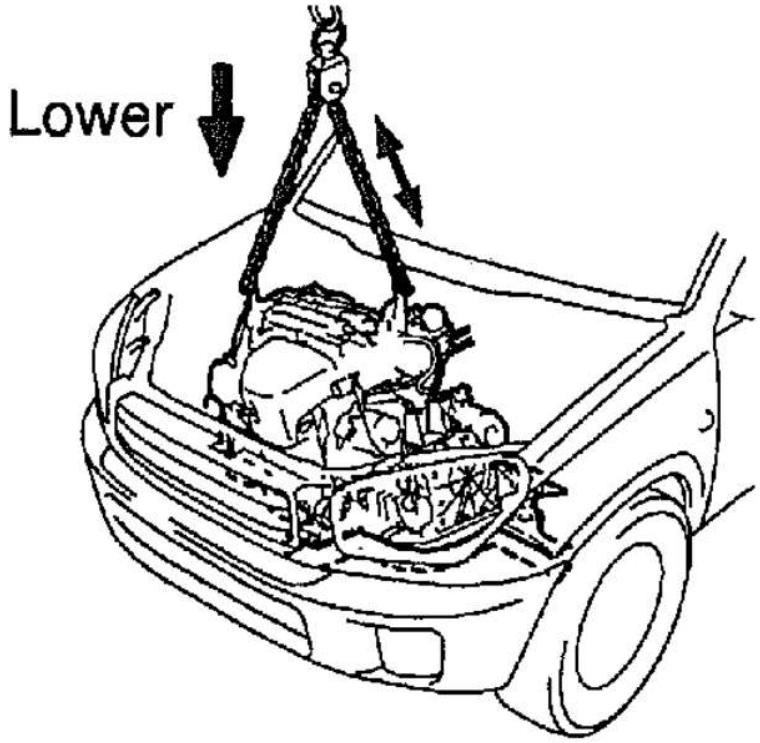


Fig. 187: Displaying Engine Lowering
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Make sure the engine is clear of all wiring, hoses and cables.

26. **Remove engine and transaxle assembly from front suspension crossmember and center engine mounting member**
    a. Remove the bolt holding the front engine mounting bracket to the mounting insulator.

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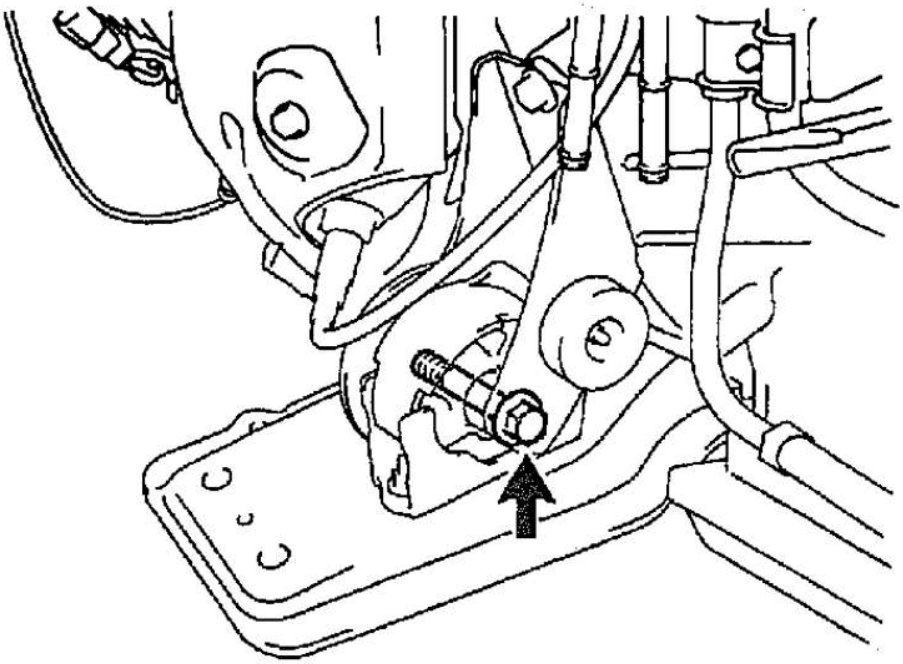


Fig. 188: Removing Bolt Holding Front Engine Mounting Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Remove the bolt holding the rear engine mounting bracket to the mounting insulator.

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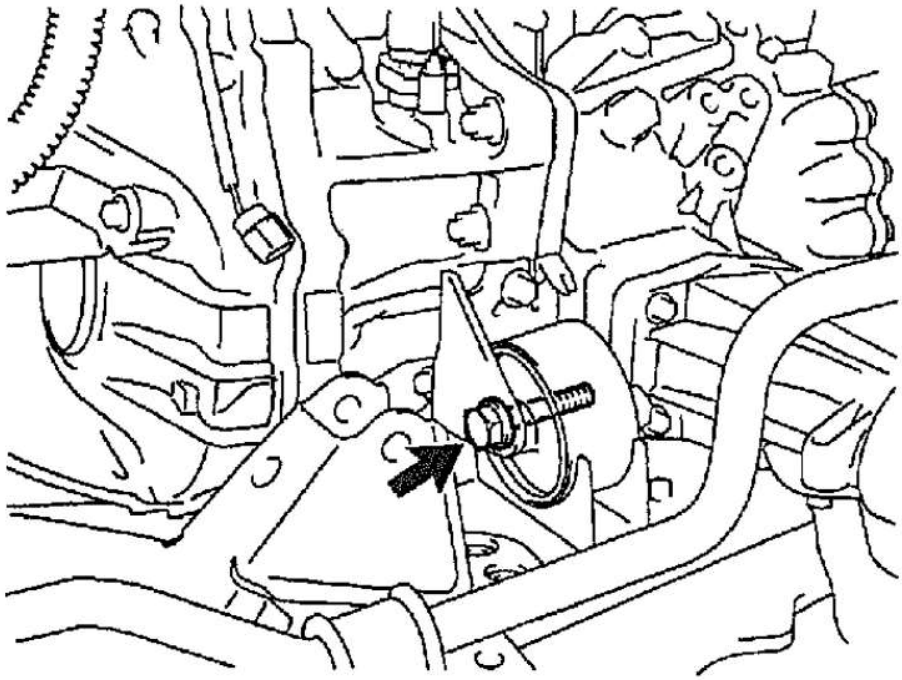


Fig. 189: Removing Bolt Holding Rear Engine Mounting Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Separate the engine and transaxle assembly from the suspension crossmember and engine mounting member.

27. **4WD: Remove stiffener plate** .

Remove the 5 bolts and stiffener plate.

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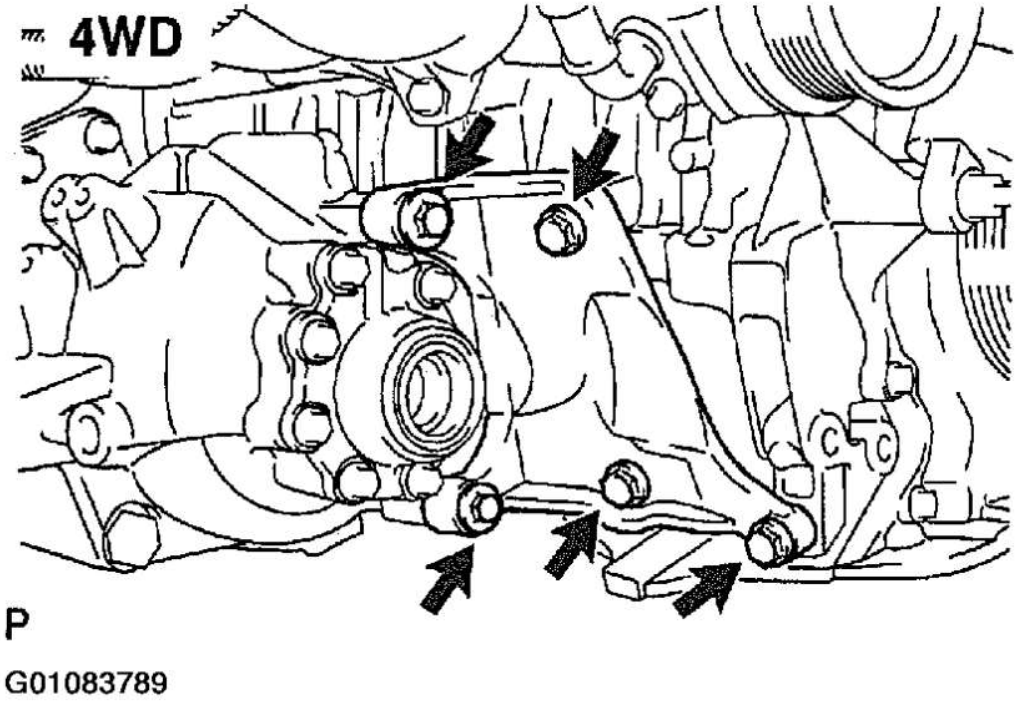


Fig. 190: Locating Stiffener Plate Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

28. **2WD: Remove center bearing bracket** .

Remove the 3 bolts and bearing bracket.

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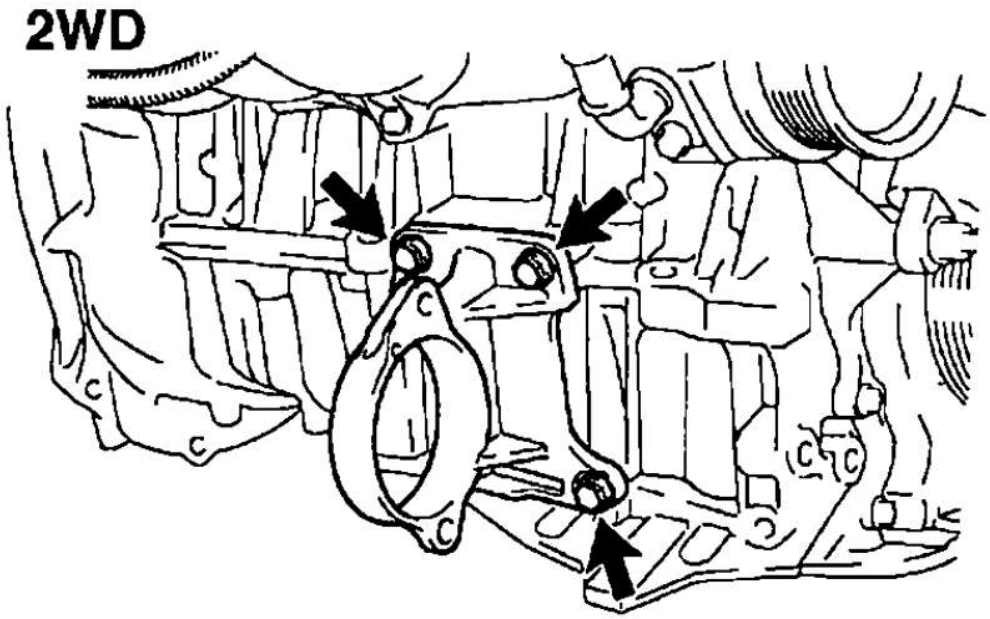


Fig. 191: Removing Center Bearing Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

29. **A/T: Remove torque converter clutch bolts** .
    a. Remove the hole plug.
    b. Turn the crankshaft to gain access to each bolt.
    c. Hold the crankshaft pulley bolt with a wrench, and remove the 6 bolts.

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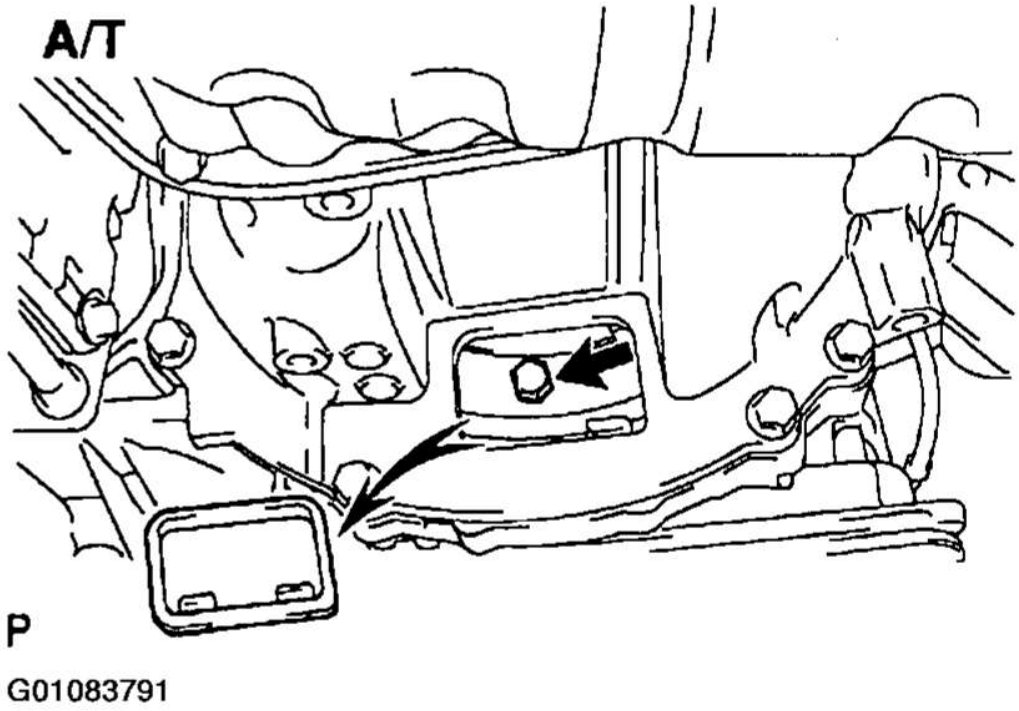


Fig. 192: Removing Torque Converter Clutch Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

30. **Remove transaxle from engine** .
    a. Remove the 4 lower bolts holding the engine to the transaxle.

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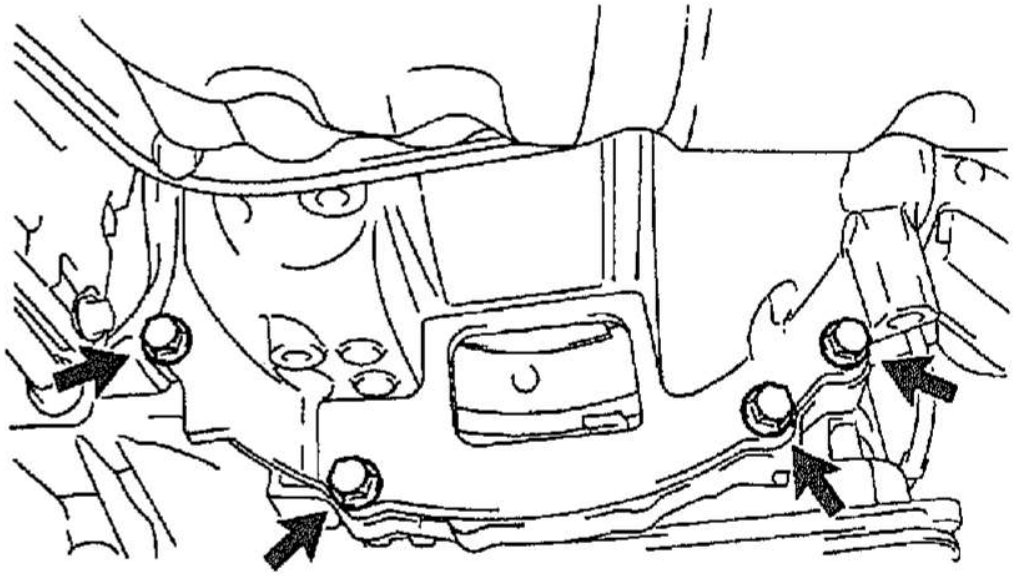


Fig. 193: Removing Engine Lower Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. M/T: Disconnect the connectors.
    1. Disconnect the vehicle speed sensor connector.
    2. Disconnect the back-up light switch connector.

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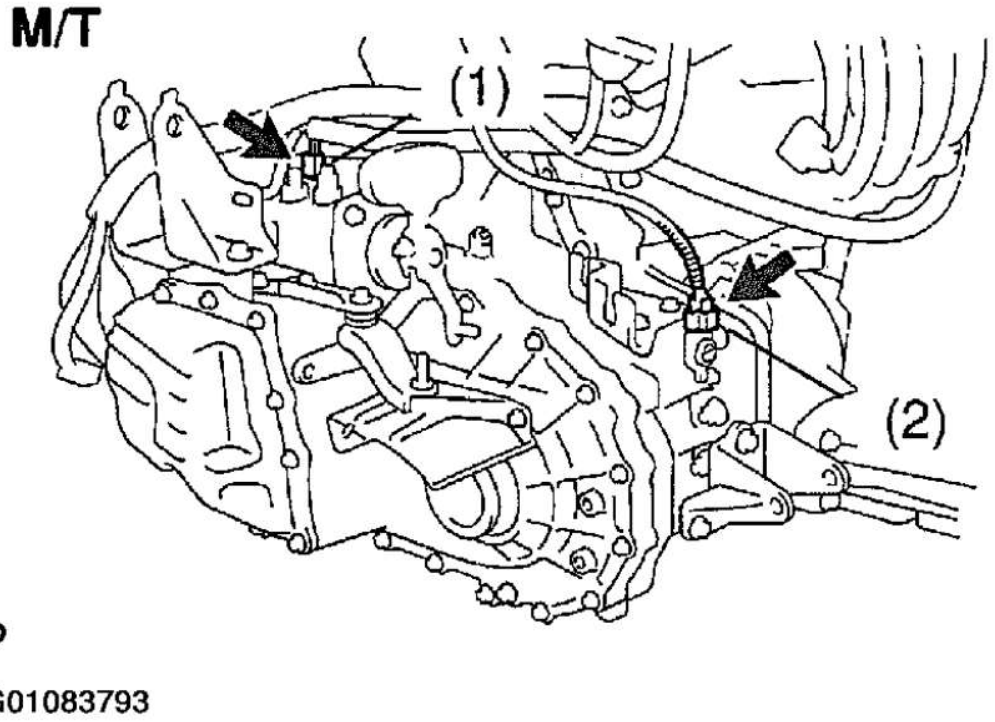


Fig. 194: Locating M/T Connectors
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. A/T: Disconnect the connectors and clamps.
   1. Disconnect the park/neutral position switch connector.
   2. Disconnect the solenoid wire connector.
   3. Disconnect the input turbine speed sensor connector.
   4. Disconnect the counter gear speed sensor connector.
   5. Disconnect the vehicle speed sensor.

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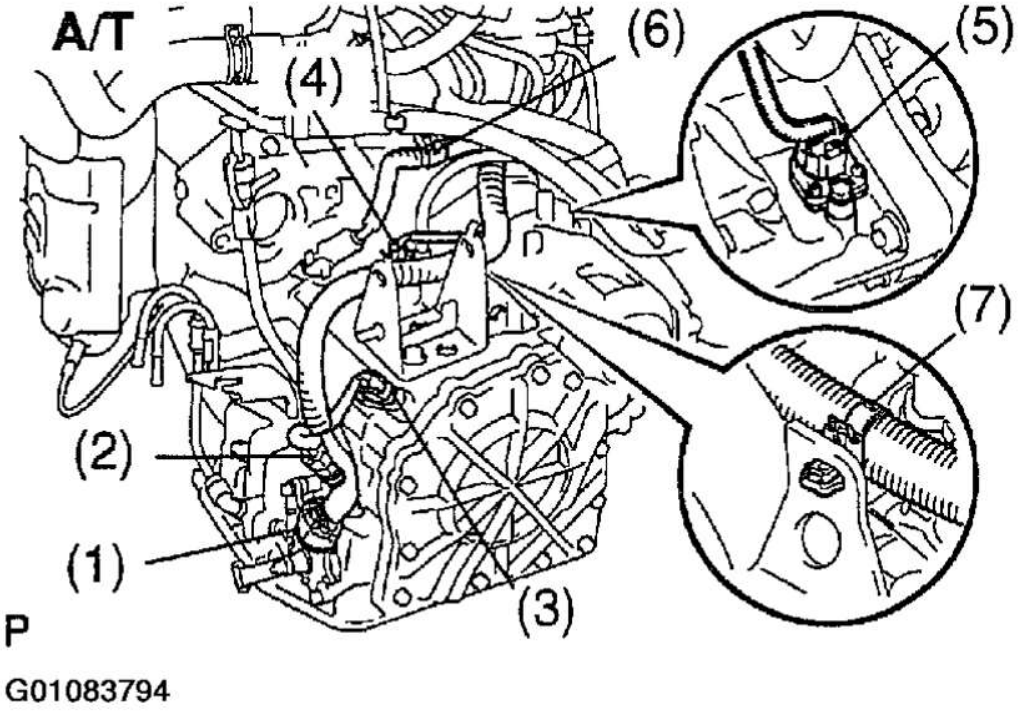


Fig. 195: Locating A/T Connectors & Clamp
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Disconnect the wire clamp from the bracket.
7. Disconnect the wire clamp from the engine mounting bracket.

d. Remove the 6 upper bolts holding the transaxle to the engine.

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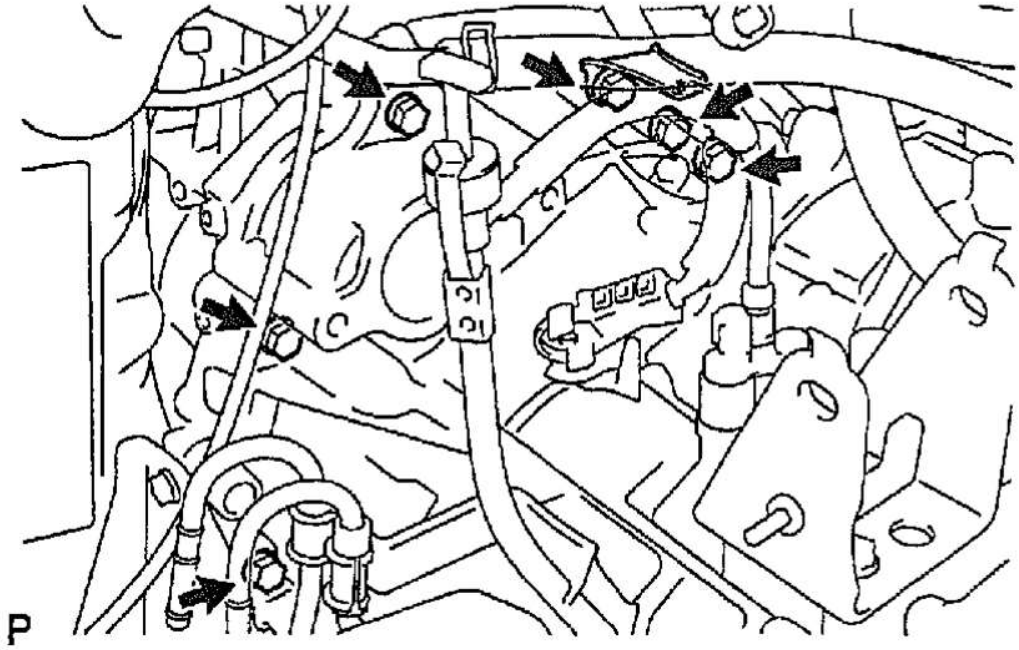


Fig. 196: Locating Bolts Holding Transaxle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Remove the transaxle together with the torque converter clutch (A/T) from the engine.

31. **Remove drive belt (See CHARGING SYSTEM) .**
32. **M/T: Remove clutch cover and disc .**
33. **A/T: Remove drive plate .**
34. **M/T: Remove flywheel .**
35. **Remove A/C compressor .**
    a. Disconnect the magnetic clutch and lock sensor connector from the compressor.
    b. Remove the 3 bolts, nut and compressor.

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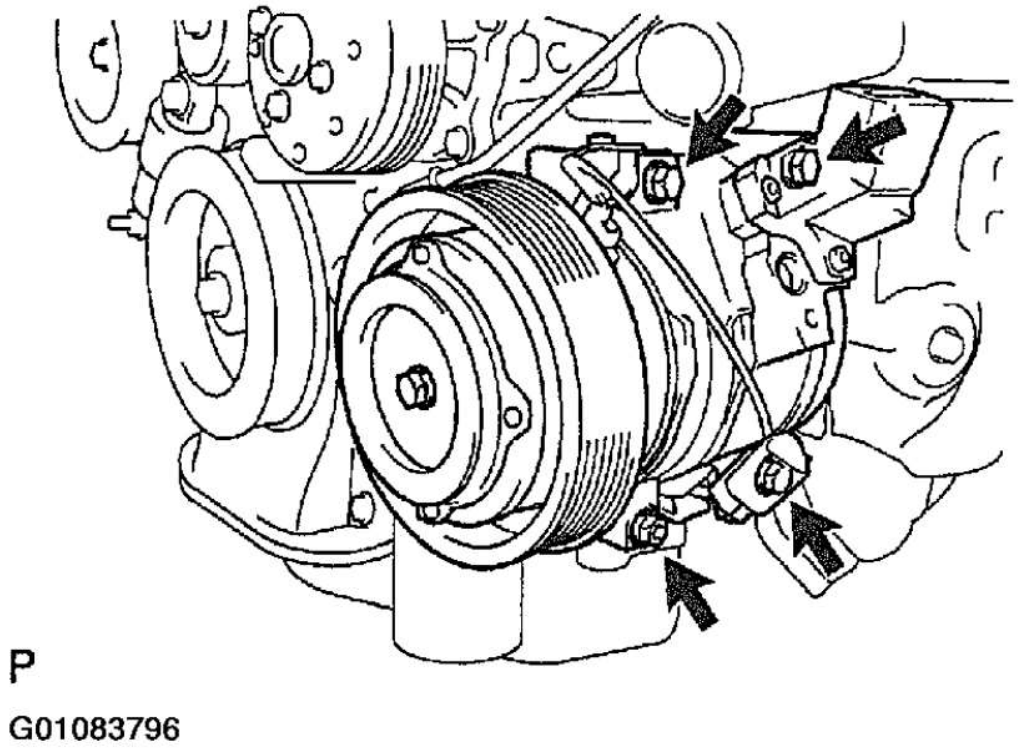


Fig. 197: Removing A/C Compressor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

36. **Remove PS vane pump** .
    a. Disconnect the oil pressure switch connector.
    b. Remove the 2 bolts and vane pump.

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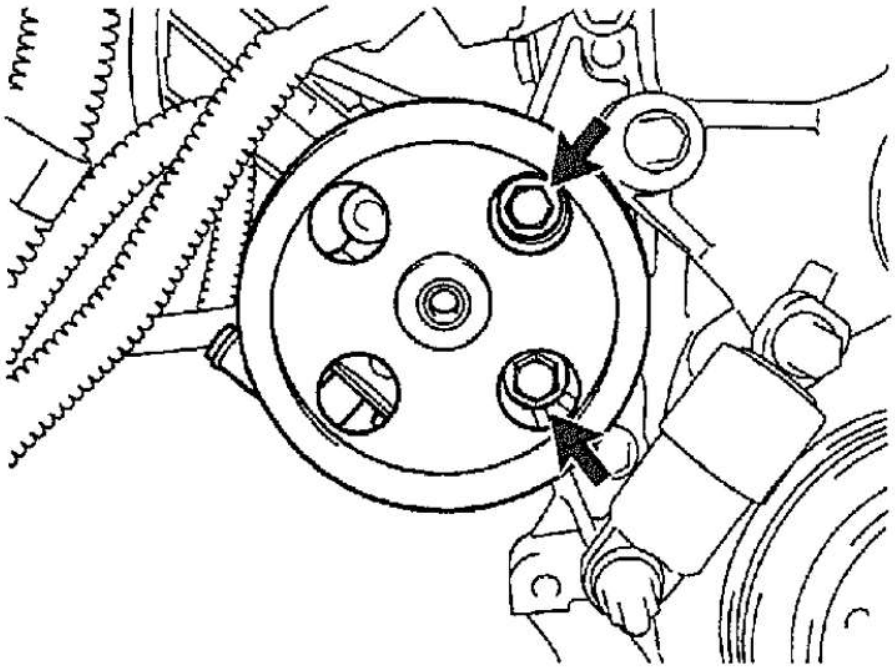


Fig. 198: Removing PS Vane Pump
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

37. **Remove generator** .

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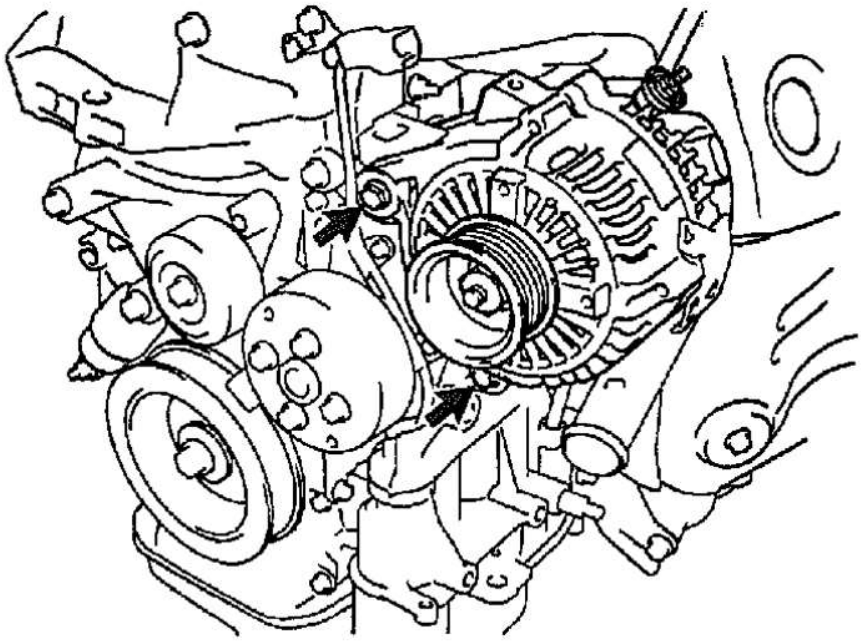


Fig. 199: Locating & Removing Generator
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Remove the terminal cover and nut, and disconnect the generator wire.
b. Disconnect the generator connector.
c. Disconnect the A/C wire.
d. Remove the 2 bolts and generator.

INSTALLATION

1. **Install generator** .

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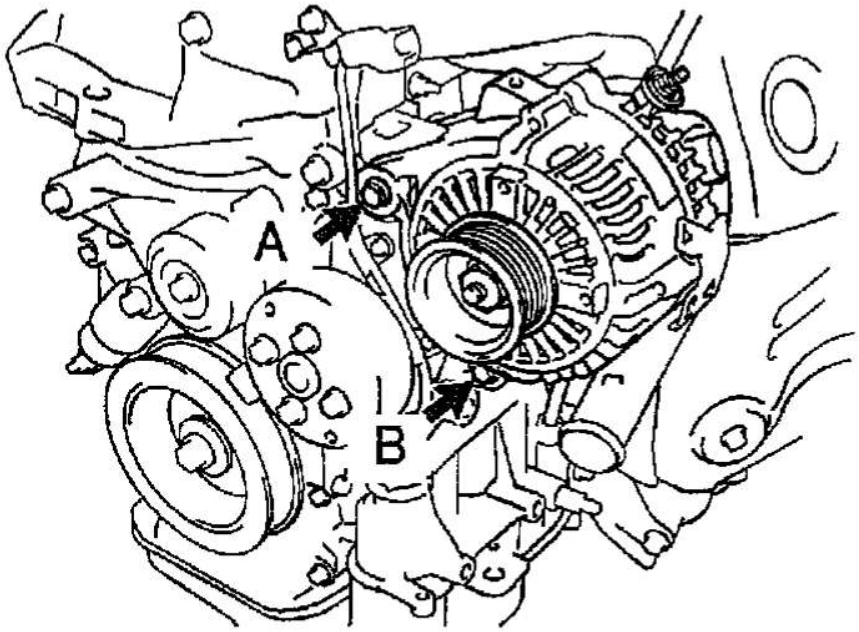


Fig. 200: Locating & Installing Generator
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Install the generator with the 2 bolts.

   Torque: 52 N.m (530 kgf. cm, 38 ft. lbf) for bolt A 21 N.m (214 kgf. cm, 16 ft. lbf) for bolt B

b. Connect the A/C wire.
c. Connect the generator connector.
d. Connect the generator wire with the nut, and install the cover.

   Torque: 9.7 N.m (100 kgf. cm, 85 in. .lbf)

2. **Install PS vane pump** .
   a. Install the vane pump with the 2 bolts.

      Torque: 43 N.m (440 kgf. cm, 32 ft. lbf)

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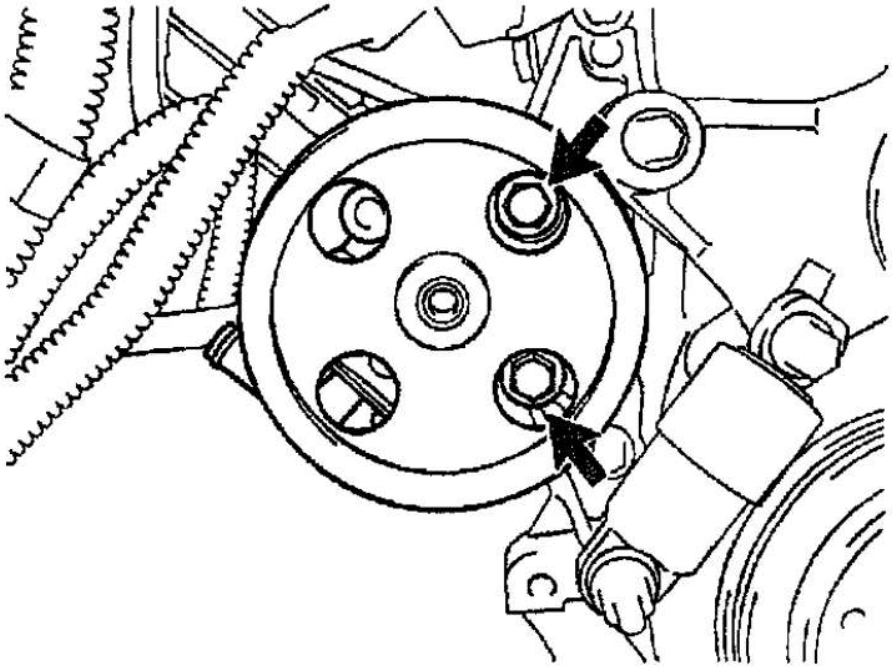


Fig. 201: Locating Vane Pump Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the oil pressure switch connector.

3. **Install A/C compressor** .
   a. Install the compressor with the 3 bolts and nut.
      Torque: 24.5 N.m (250 kgf. cm, 18 ft. lbf)

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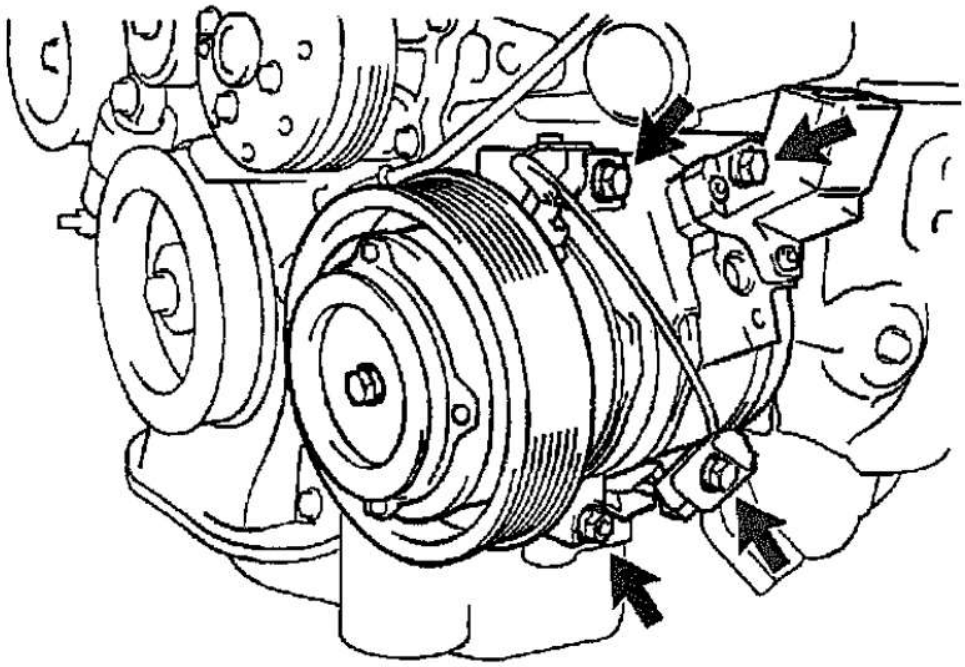


Fig. 202: Installing A/C Compressor
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the magnetic clutch and lock sensor connector.

4. **Install drive belt (See CHARGING SYSTEM) .**
5. **A/T: Install drive plate**
   a. Apply adhesive to 2 or 3 threads of the bolt end.
      Adhesive: Part No. 08833-00070, THREE BOND 1324 or equivalent

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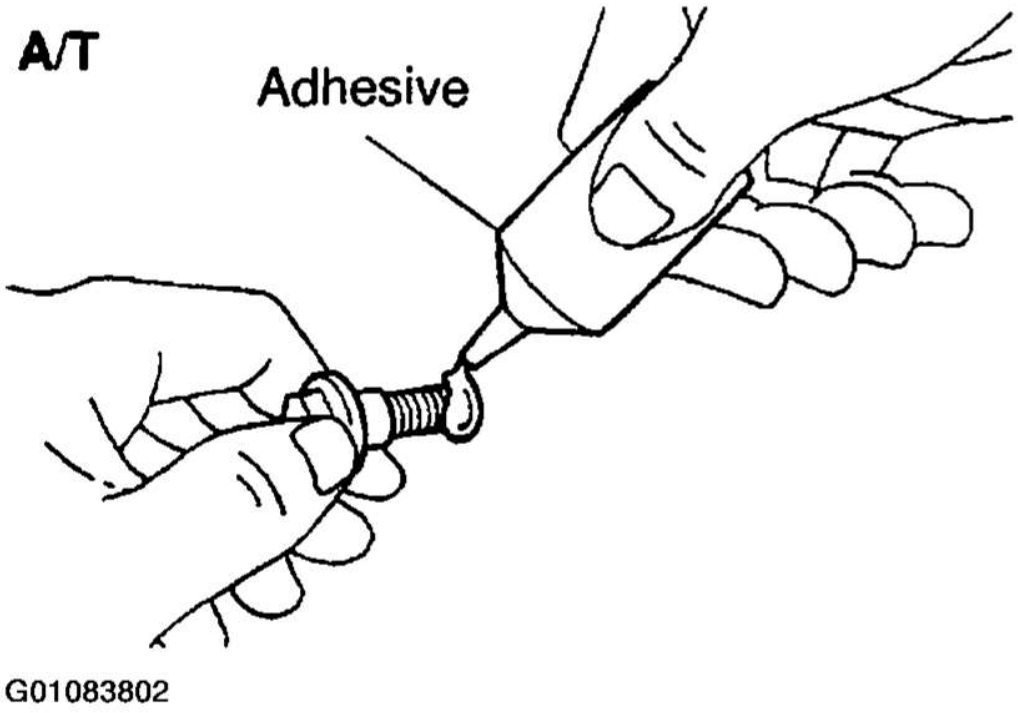


Fig. 203: Displaying Adhesive Application
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Align the pin of the front spacer with the pin hole of the crankshaft, and install the front spacer.

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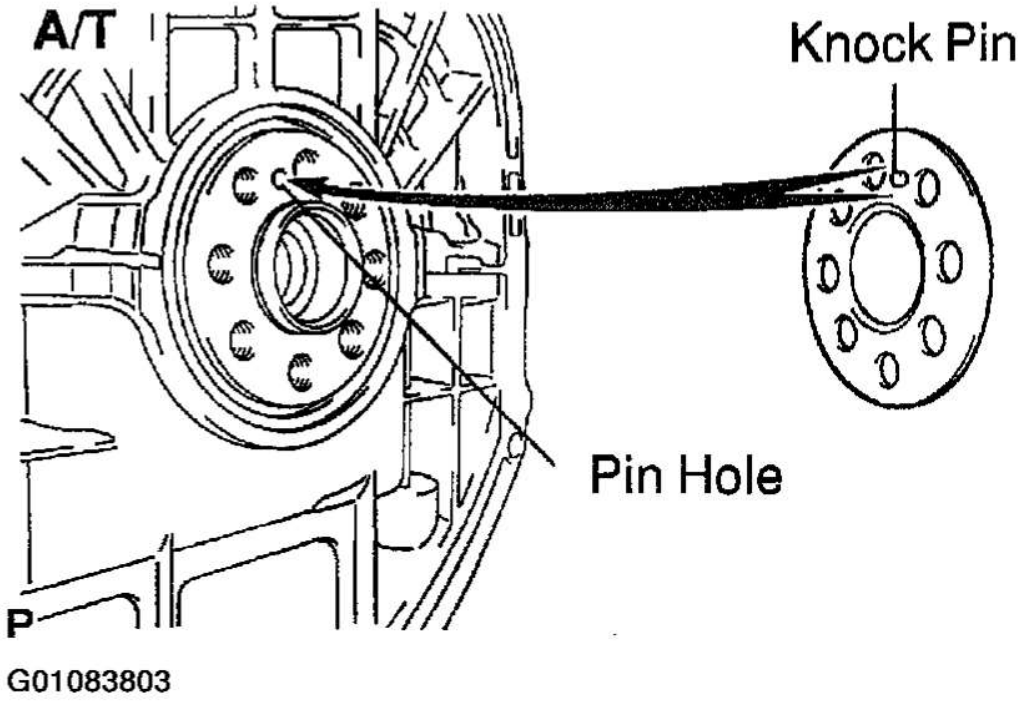


Fig. 204: Locating lock Pin & Pin Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the drive plate and rear spacer as shown in the illustration.

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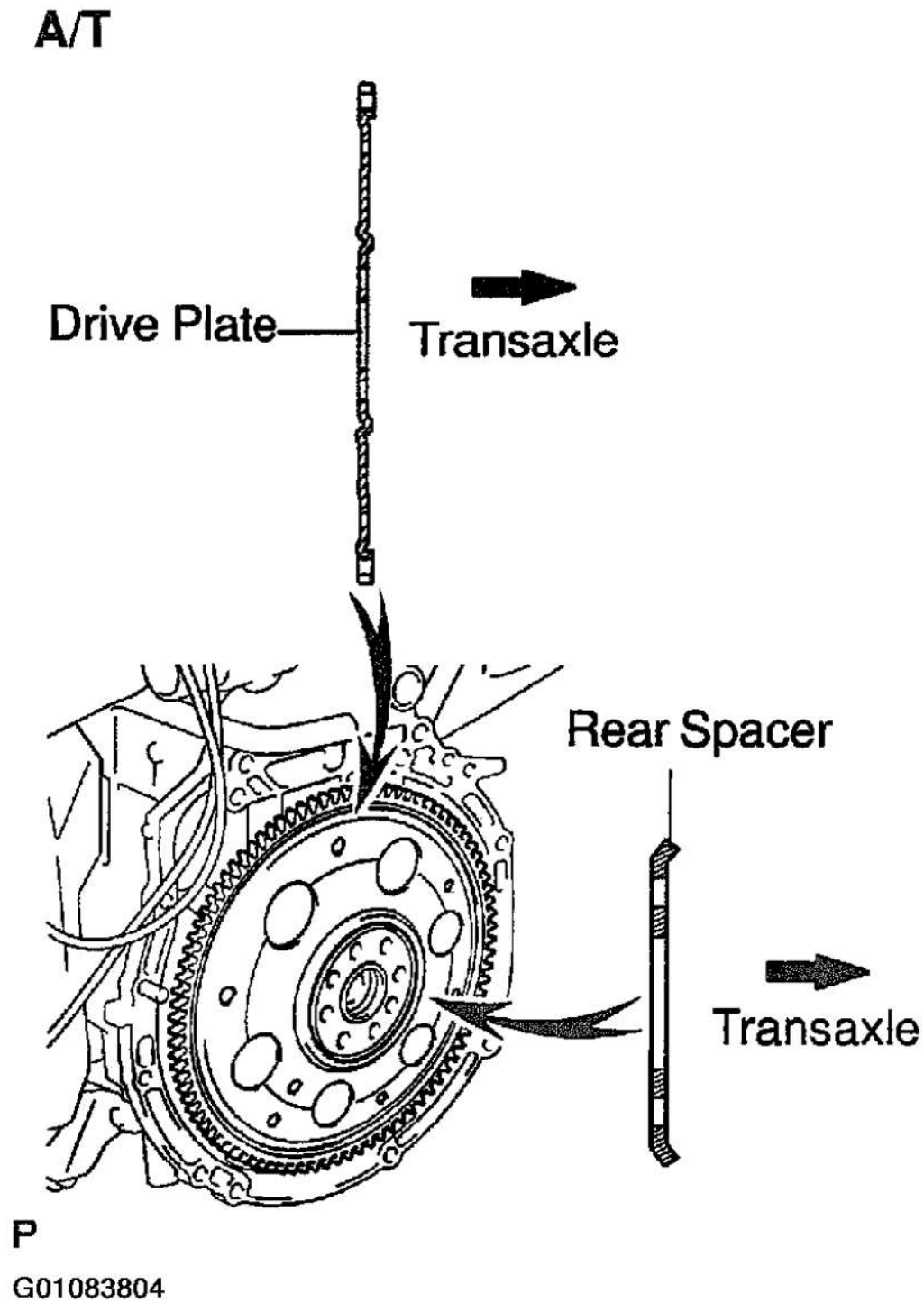


Fig. 205: Identifying Drive Plate & Rear Spacer

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

d. Install and uniformly tighten the 8 bolts in several passes, in the sequence shown.
Torque: 98 N.m (100 kgf. cm, 72 ft. lbf)

6. **M/T: Install flywheel (See procedure in step 5) .**
Torque: 130 N.m (1,326 kgf. cm, 96 ft. lbf)
7. **MT: Install clutch disc and cover (See CLUTCH ASSEMBLY) .**

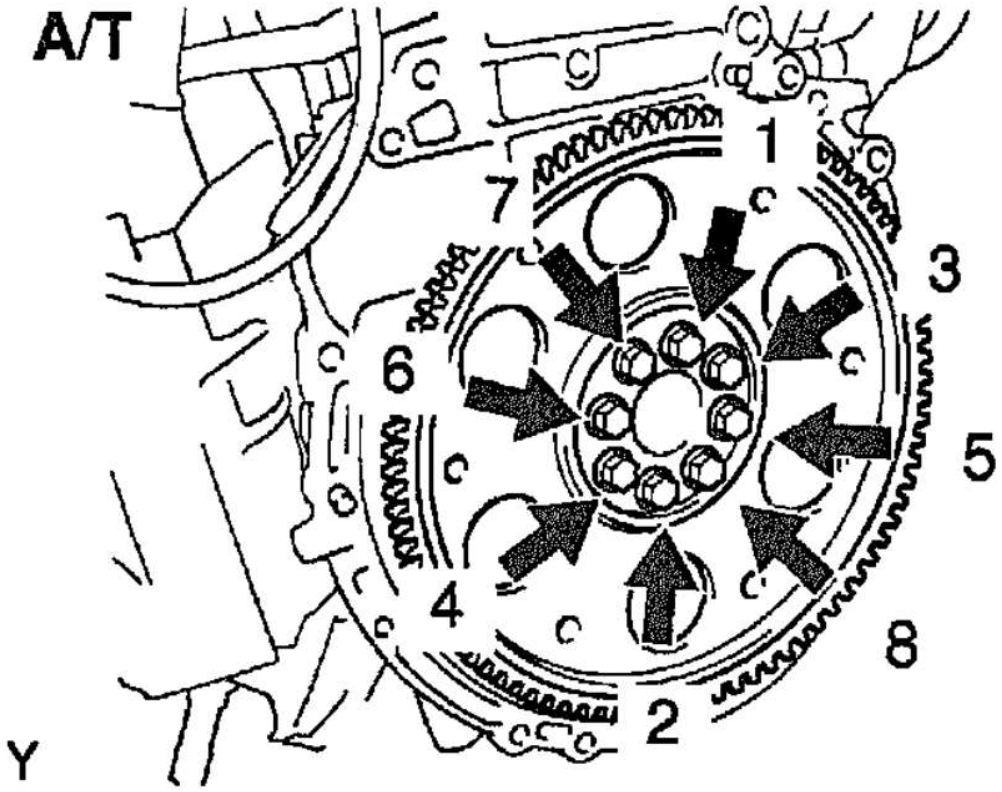
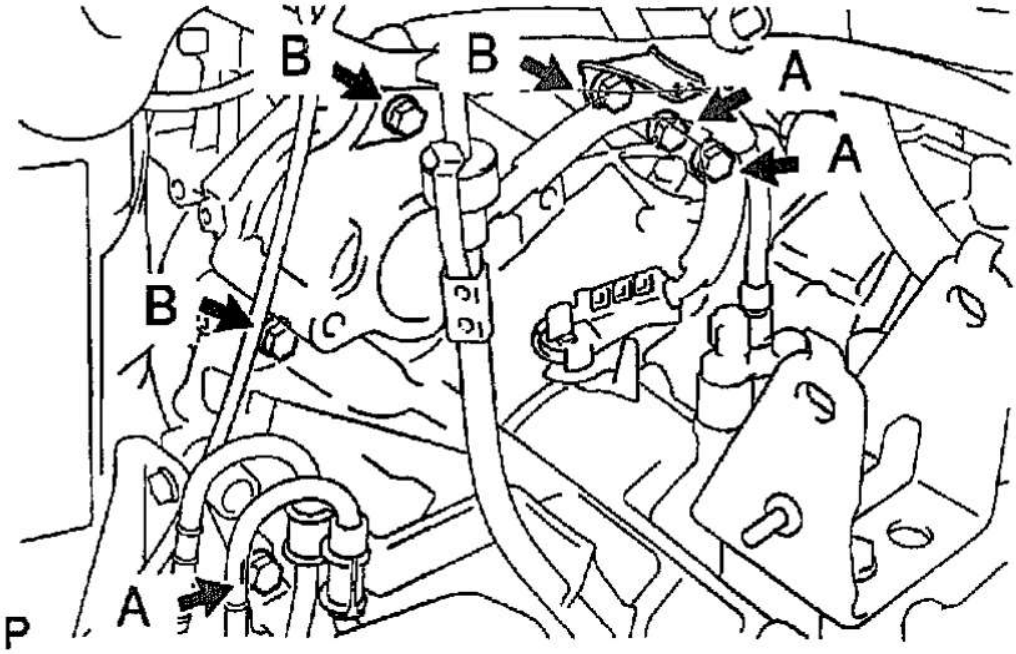


Fig. 206: Locating & Tightening Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **Install engine to transaxle .**
a. Install the 6 upper bolts holding the transaxle to the engine.
Torque: 46 N.m (470 kgf. cm, 34 ft. lbf) for bolt A 64 N.m (650 kgf. cm, 47 ft. lbf) for

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bolt B



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Fig. 207: Installing Engine To Transaxle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. A/T: Connect the connectors and clamps.
   1. Connect the park/neutral position switch connector.
   2. Connect the solenoid wire connector.
   3. Connect the input turbine speed sensor connector.
   4. Connect the counter gear speed sensor connector.
   5. Connect the vehicle speed sensor.
   6. Connect the wire clamp from the bracket.
   7. Connect the wire clamp to the engine mounting bracket.

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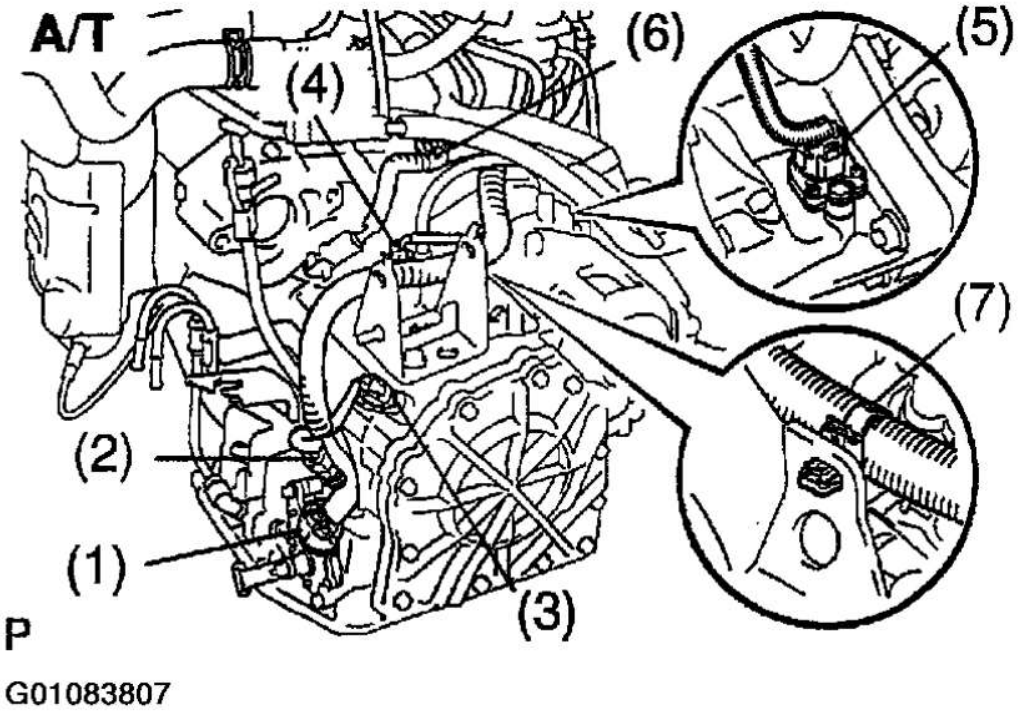


Fig. 208: Locating A/T Connectors & Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. M/T: Connect the connectors.
Connect the vehicle speed sensor connector.
Connect the back-up light switch connector.

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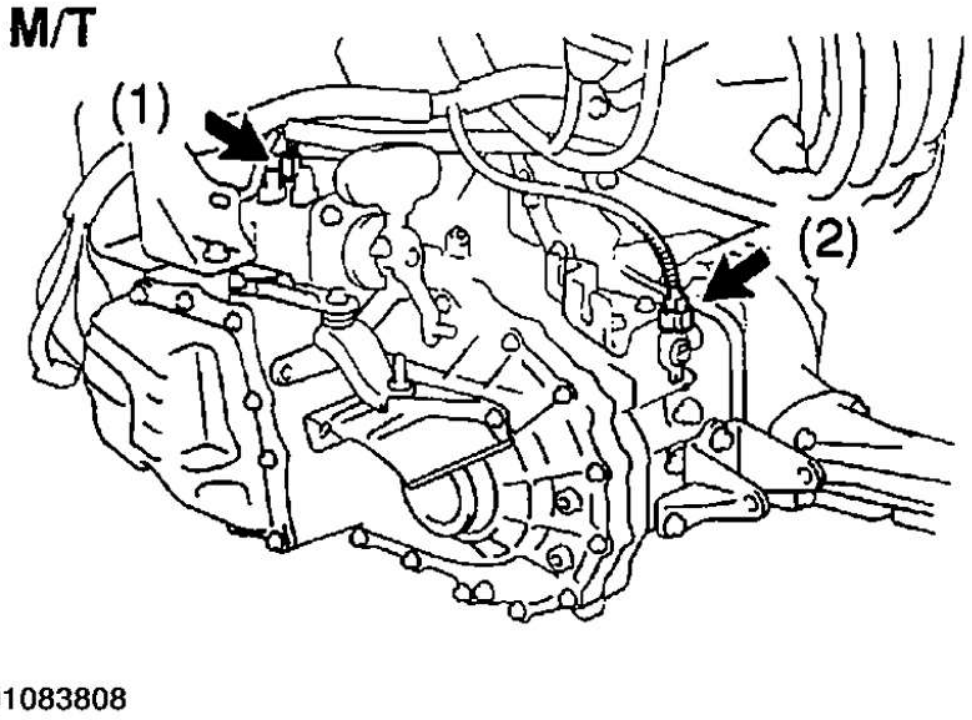


Fig. 209: Locating M/T Connectors & Clamps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the 4 lower bolts holding the engine to the transaxle.
Torque: 44 N.m (450 kgf. cm, 32 ft. lbf)

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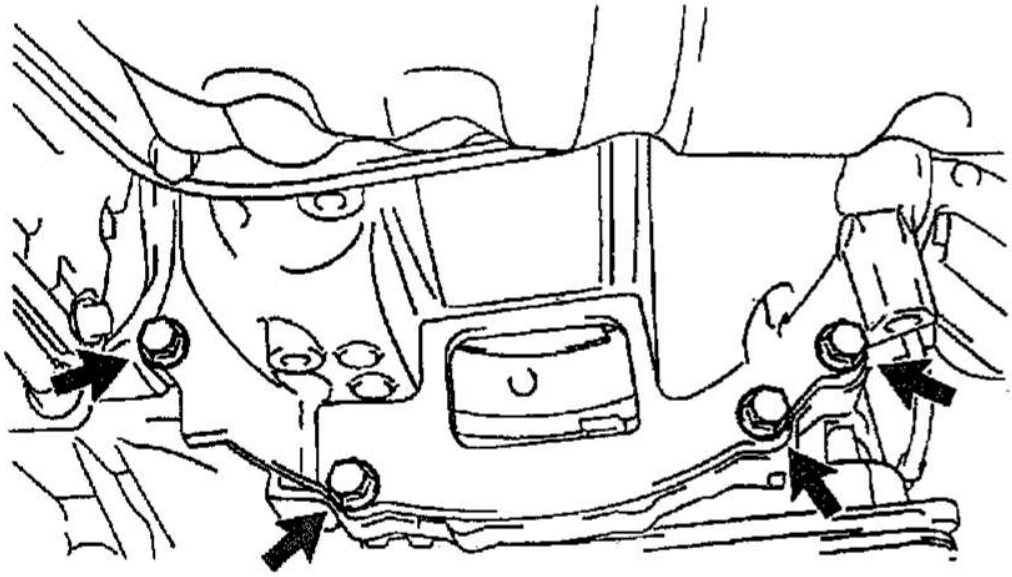


Fig. 210: Locating Lower Engine Holding Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **A/T: Install torque converter clutch bolts** .
   a. Apply adhesive to 2 or 3 threads of the bolt end.
      Adhesive: Part No. 08833-00070, THREE BOND 1324 or equivalent

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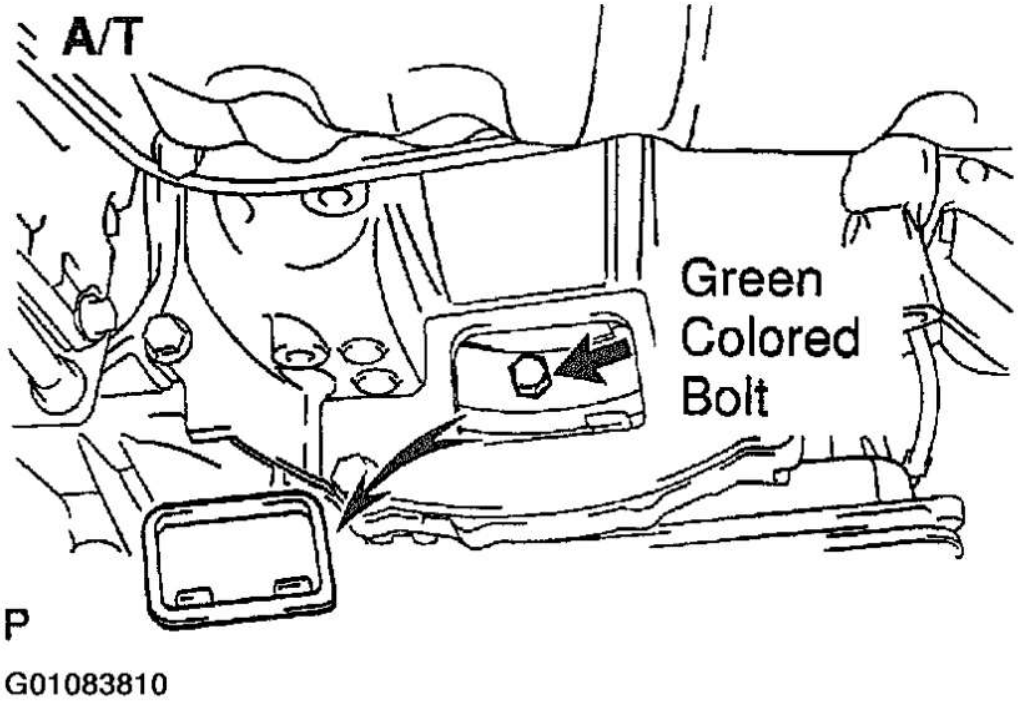


Fig. 211: Installing Converter Clutch Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Hold the crankshaft pulley bolt with a wrench, and install the 6 bolts evenly.
Torque: 41 N.m (418 kgf. cm, 30 ft. lbf)

NOTE: First tighten the green colored bolt, install the other bolts.

10. **2WD: Install center bearing bracket** .

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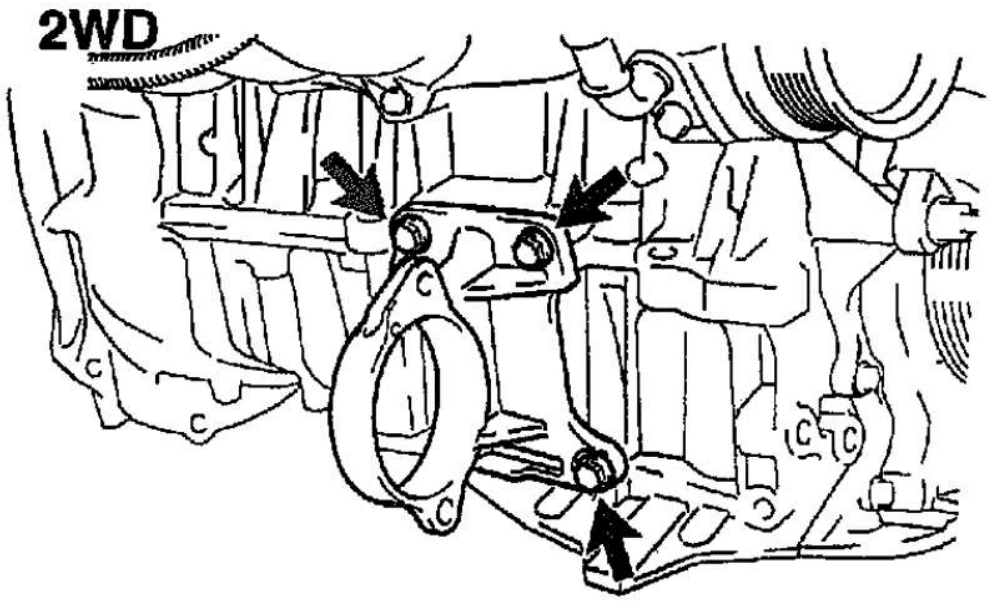


Fig. 212: Locating Bearing Brackets
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install the bearing bracket with the 3 bolts.

Torque: 34 N.m (347 kgf. cm, 25 ft. lbf)

11. **4WD: Install stiffener plate**

Install the stiffener plate with the 5 bolts.

Torque: 34 N.m (347 kgf. cm, 25 ft. lbf)

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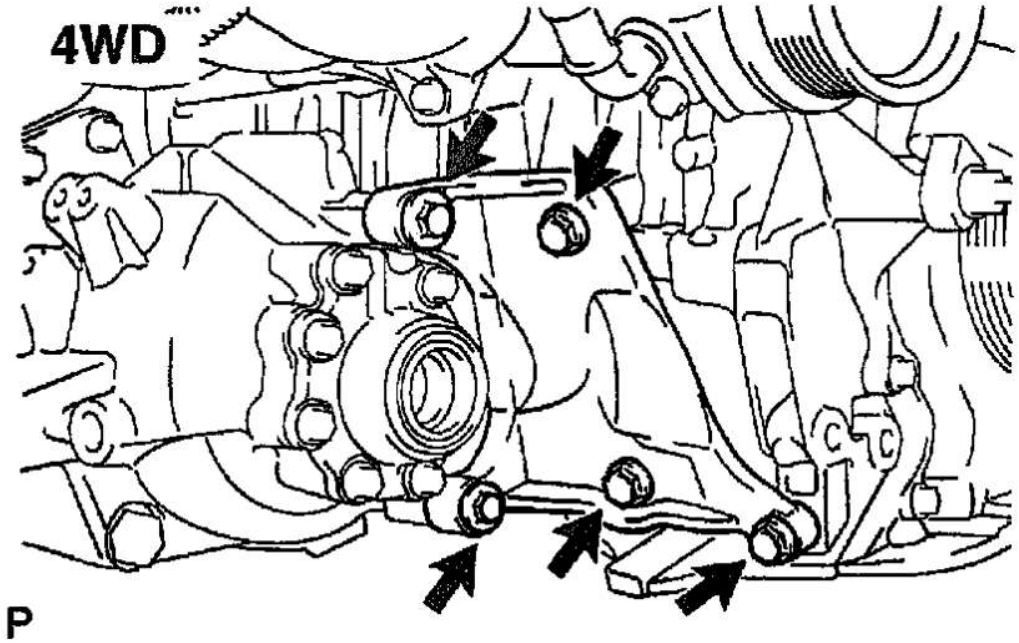


Fig. 213: Locating Stiffener Plate Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **Install engine and transaxle assembly to front suspension crossmember and center engine mounting member**
    a. Attach the engine and transaxle assembly to the suspension crossmember and engine mounting member.
    b. Install the bolt holding the rear engine mounting bracket to the mounting insulator.
       Torque: 88 N.m (898 kgf. cm, 65 ft. lbf)

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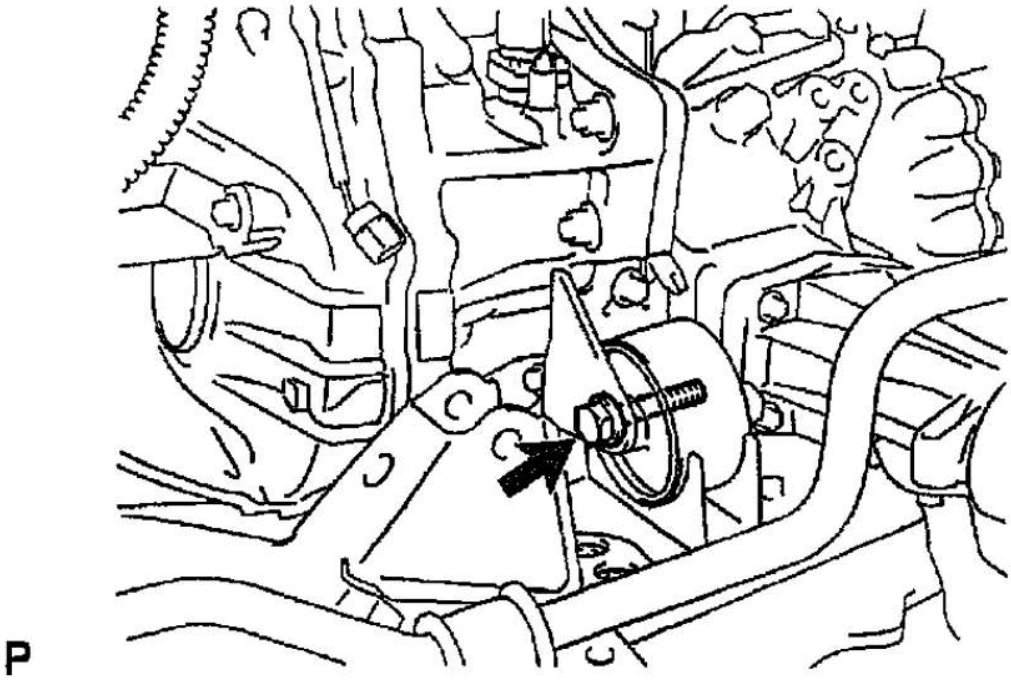


Fig. 214: Installing Bolt Holding Rear Engine Mounting Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the bolt holding the front engine mounting bracket to the mounting insulator.
Torque: 56 N.m (571 kgf. cm, 41 ft. lbf)

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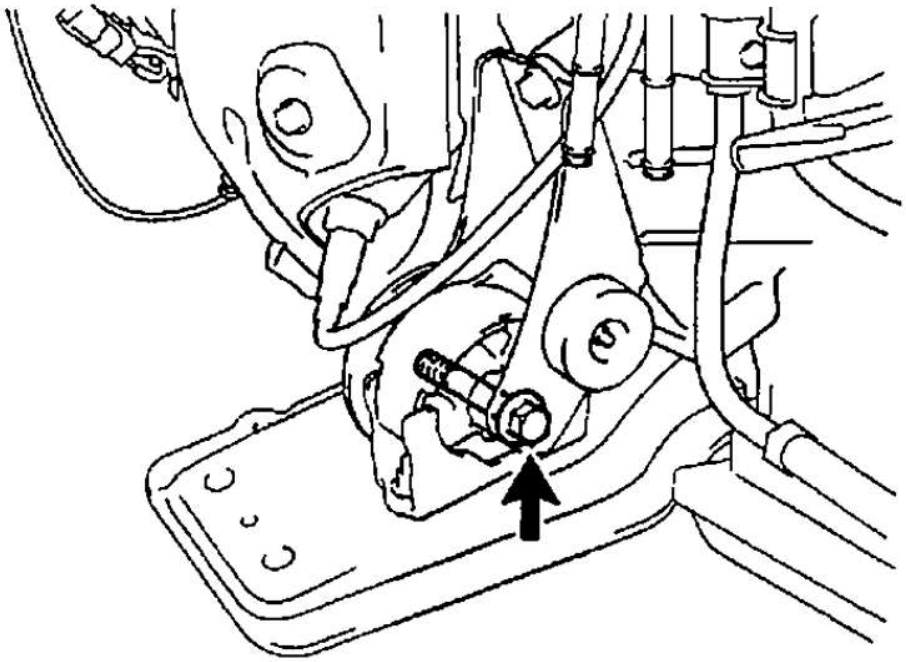


Fig. 215: Installing Bolt Holding Front Engine Mounting Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **Install engine, transaxle, front suspension crossmember and center engine mounting member assembly in vehicle** .
    a. Attach the engine sling device to the engine hangers.
    b. Lift the engine into the engine compartment.

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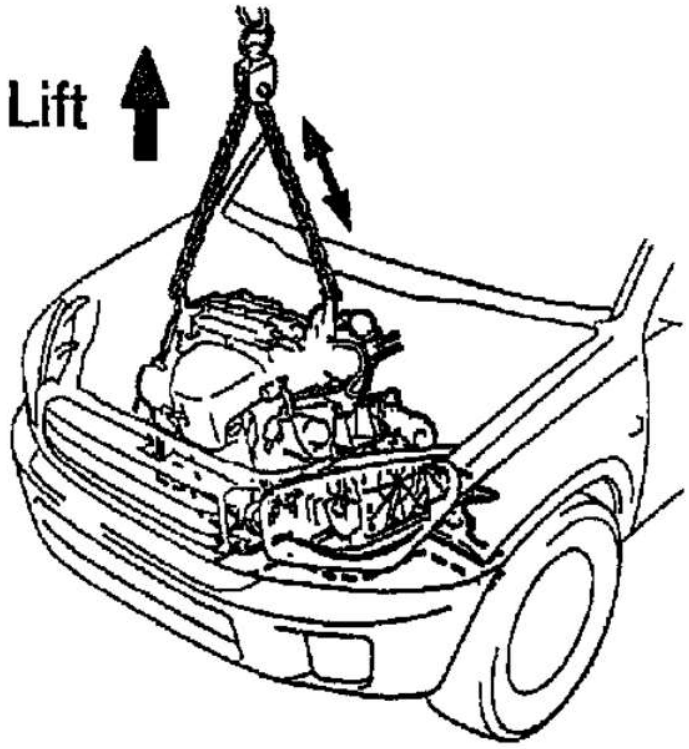


Fig. 216: Displaying Engine Lifting
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Install the bolt and 2 nuts holding the RH engine mounting insulator to the timing chain cover.
Torque: 52 N.m (530 kgf. cm, 38 ft. lbf)

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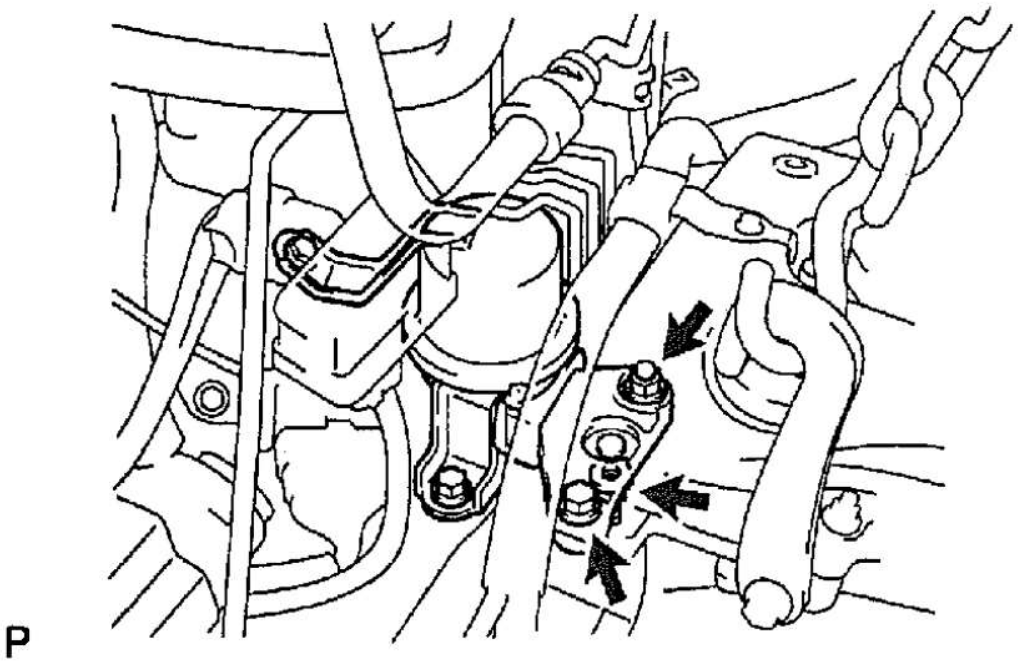


Fig. 217: Locating RH Engine Mounting Insulator
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install the bolt holding the LH engine mounting bracket to the mounting insulator.
Torque: 56 N.m (571 kgf. cm, 41 ft. lbf)

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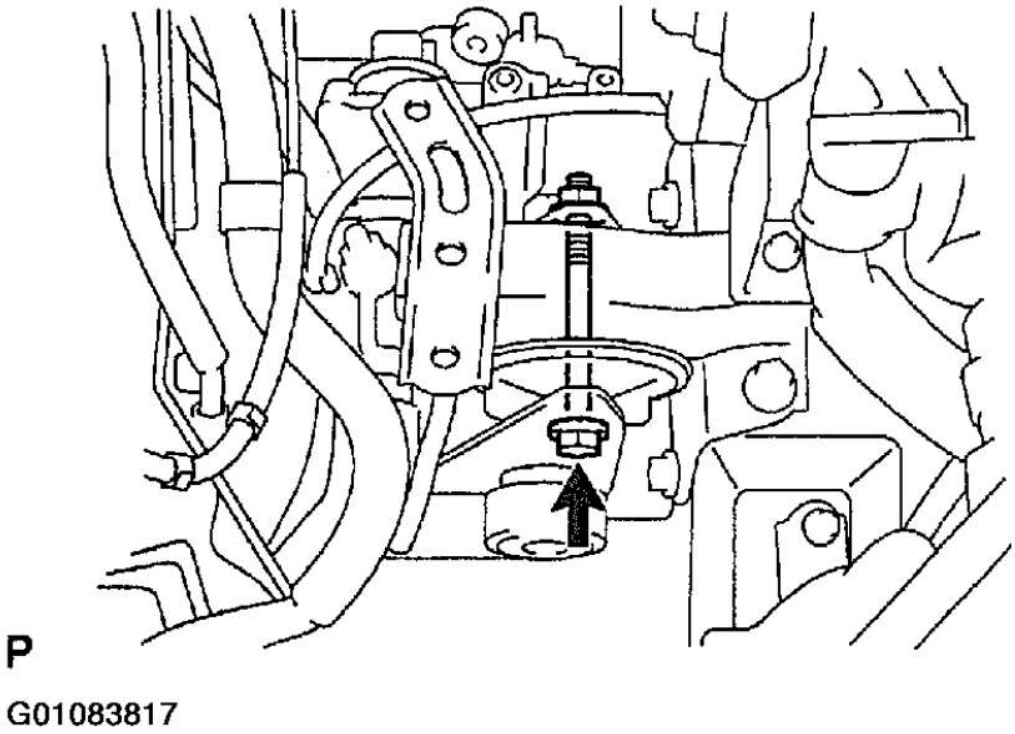


Fig. 218: Locating LH Engine Mounting Bracket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Support the suspension crossmember with a jack.

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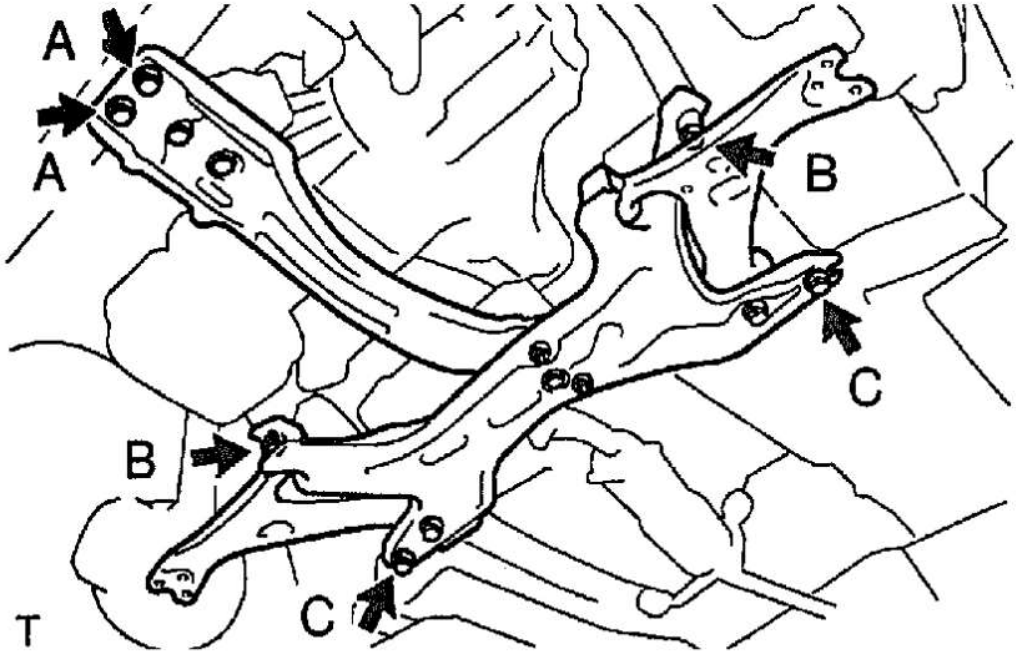


Fig. 219: Locating & Installing Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

f. Install the 6 bolts holding the suspension crossmember engine mounting member to the body.

Torque: 39 N.m (400 kgf. cm, 28 ft. lbf) for bolt A, 113 N.m (1,150 kgf. cm, 82 ft. lbf) for bolt B, 157 N.m (1,600 kgf. cm, 115 ft. lbf) for bolt C

14. **Install PS gear assembly** .

Install the PS gear assembly with the 2 bolts.

Torque: 137 N.m (1,400 kgf. cm, 101 ft. lbf)

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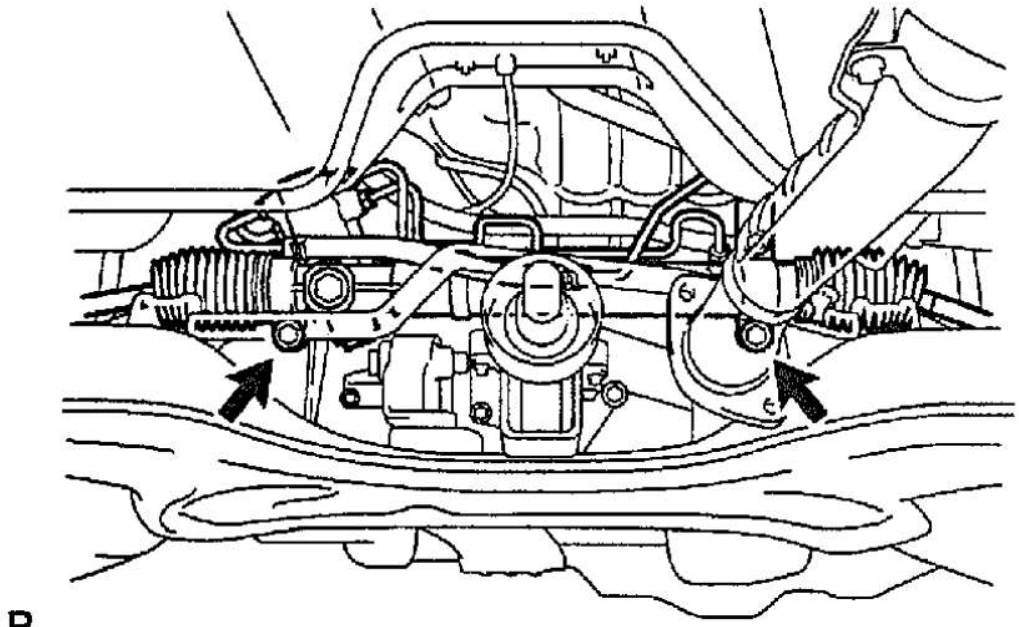


Fig. 220: Installing PS Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

15. **Remove No. 1 and No. 2 engine hangers** .
16. **Connect stabilizer bar links** .

Connect the LH and RH stabilizer links with the 2 nuts.

Torque: 44 N.m (450 kgf. cm, 32 ft. lbf)

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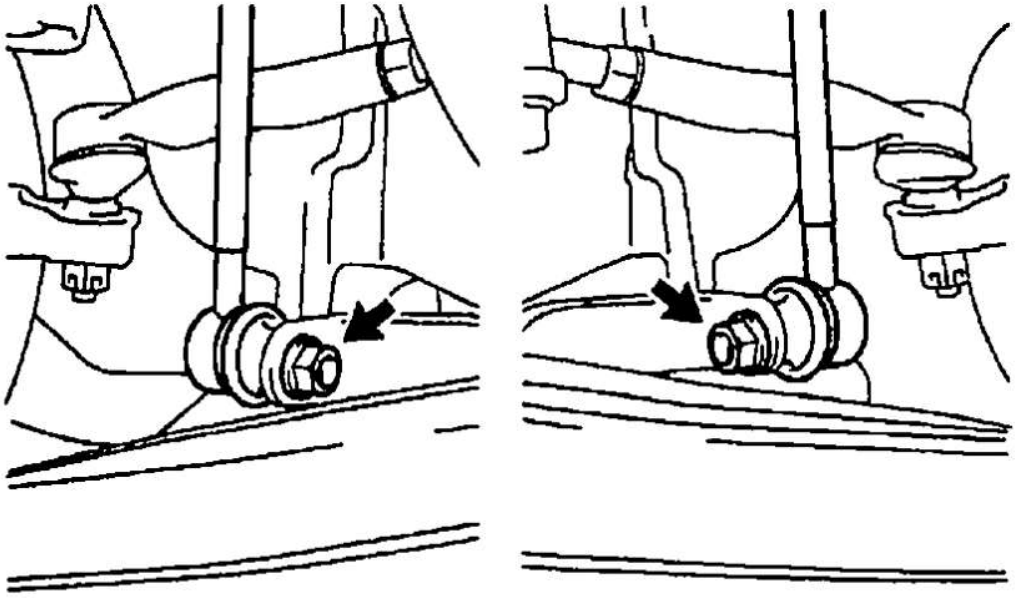


Fig. 221: Connecting RH & LH Stabilizer Links
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

17. **Install front exhaust pipe** .

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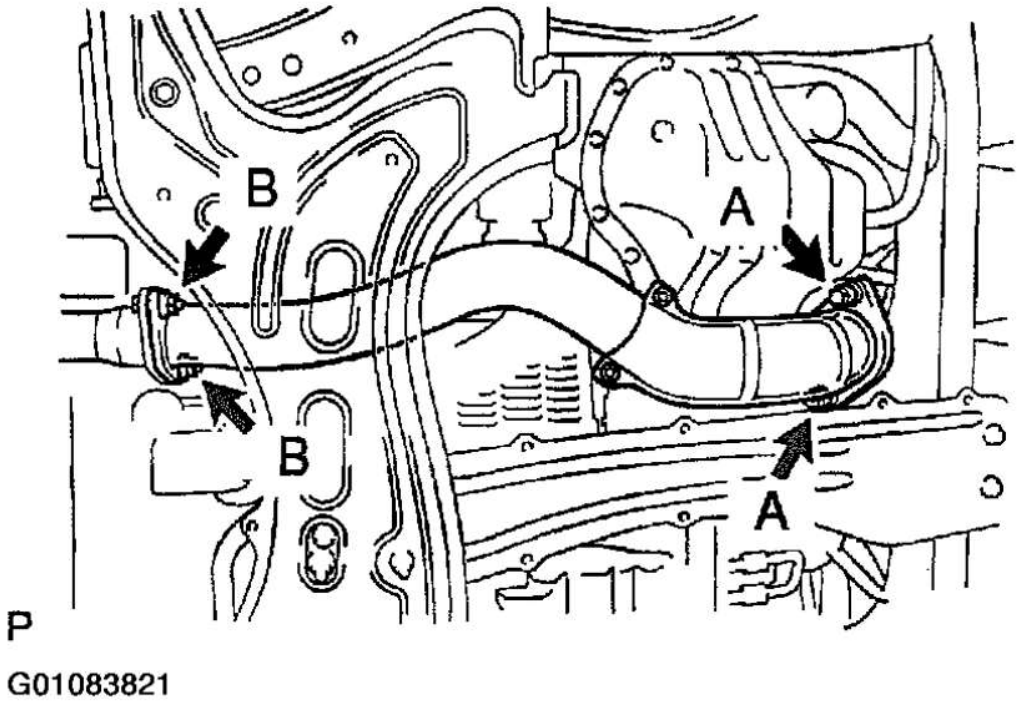


Fig. 222: Installing Front Exhaust Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install 2 new gaskets and the exhaust pipe, with the 2 compression rings and 4 bolts.

Torque: 43 N.m (439 kgf. cm, 32 ft. lbf) for bolt A, 49 N.m (500 kgf. cm, 36 ft. lbf) for bolt B

18. **Install LH and RH front drive shafts (See REASSEMBLY) .**
19. **4WD: Install propeller shaft (See INSTALLATION) .**
20. **Connect ground cable to transaxle .**

    Torque: 19 N.m (195 kgf. cm, 14 ft. lbf)
21. **A/T: Connect oil cooler hoses .**

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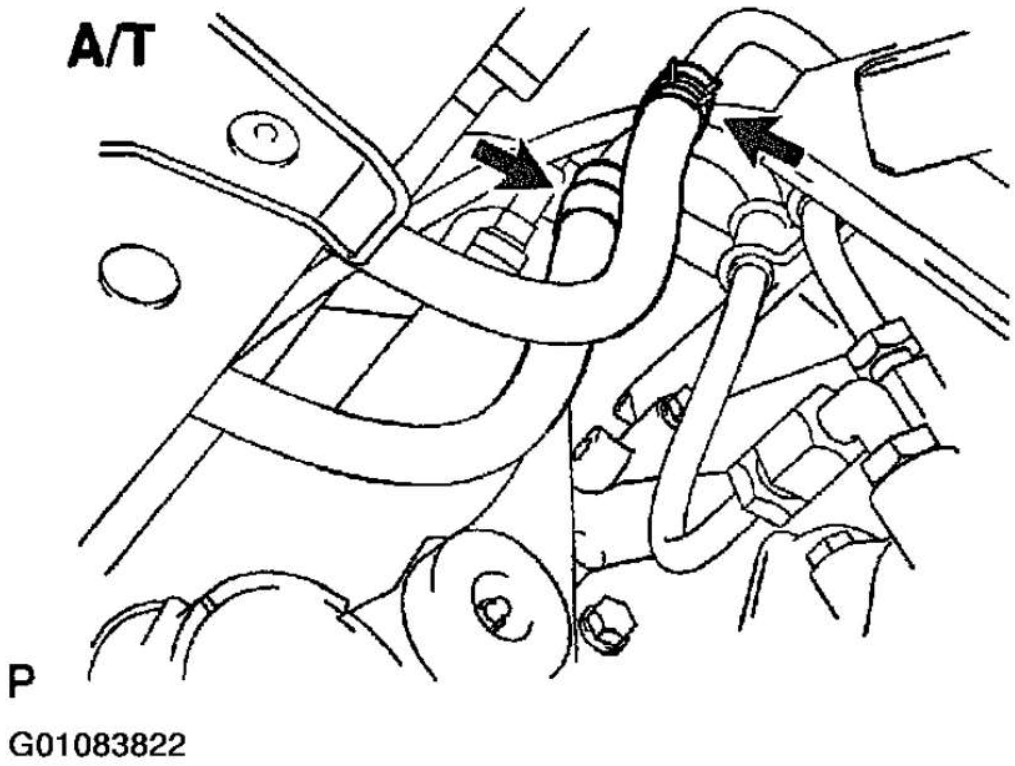


Fig. 223: Connecting Oil Cooler Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

22. **A/T: Connect shift control cable to transaxle** .
    a. Connect the control cable with the nut.
       Torque: 15 N.m (150 kgf. cm, 11 ft. lbf)

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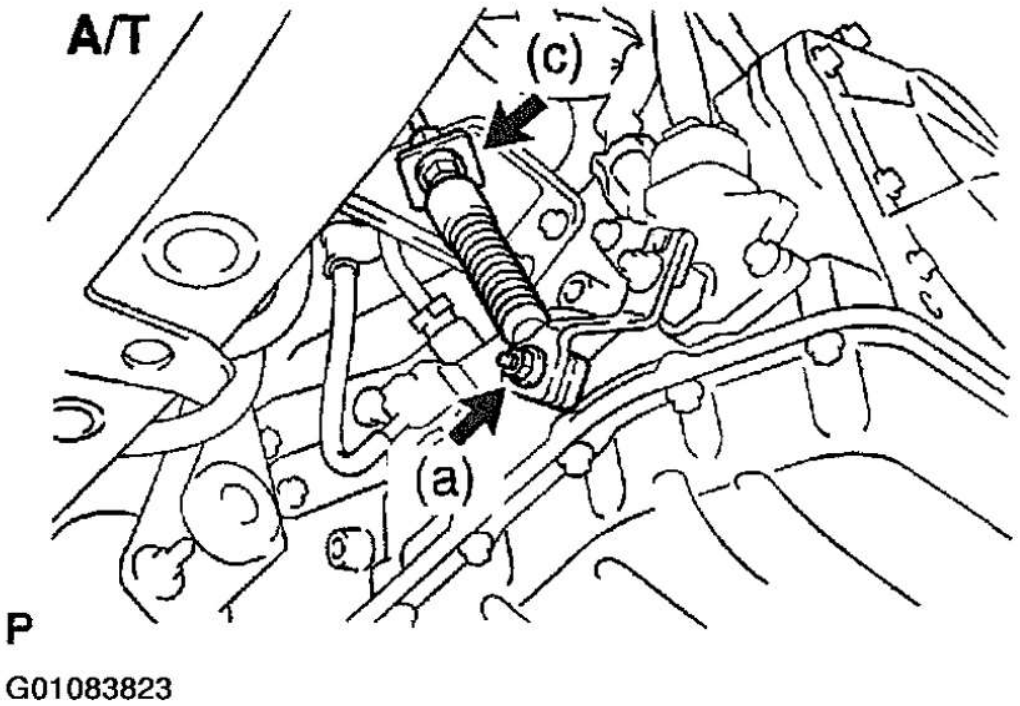


Fig. 224: Connecting Shift Control Cable
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the control cable with the clip.
c. Connect the control cable to the cable clamp.

23. **M/T: Install clutch release cylinder and tube** .
    a. Install the release cylinder with the 5 bolts.

       Torque: 25 N.m (255 kgf. cm, 18 ft. lbf) for bolt A, 12 N.m (120 kgf. cm, 9 ft. lbf) for bolt B, 5 N.m (51 kgf. cm, 44 in. .lbf) for bolt C

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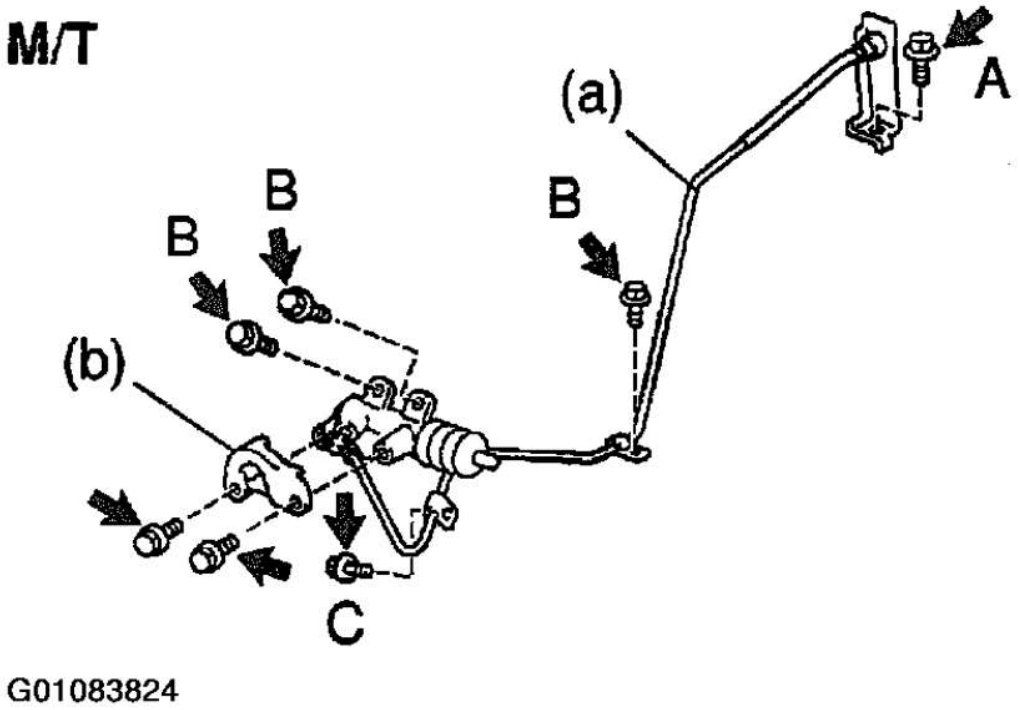


Fig. 225: Installing Clutch Release Cylinder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the heat insulator with the 2 bolts.
Torque: 12 N.m (120 kgf. cm, 44 ft. lbf)

24. **Install starter** .

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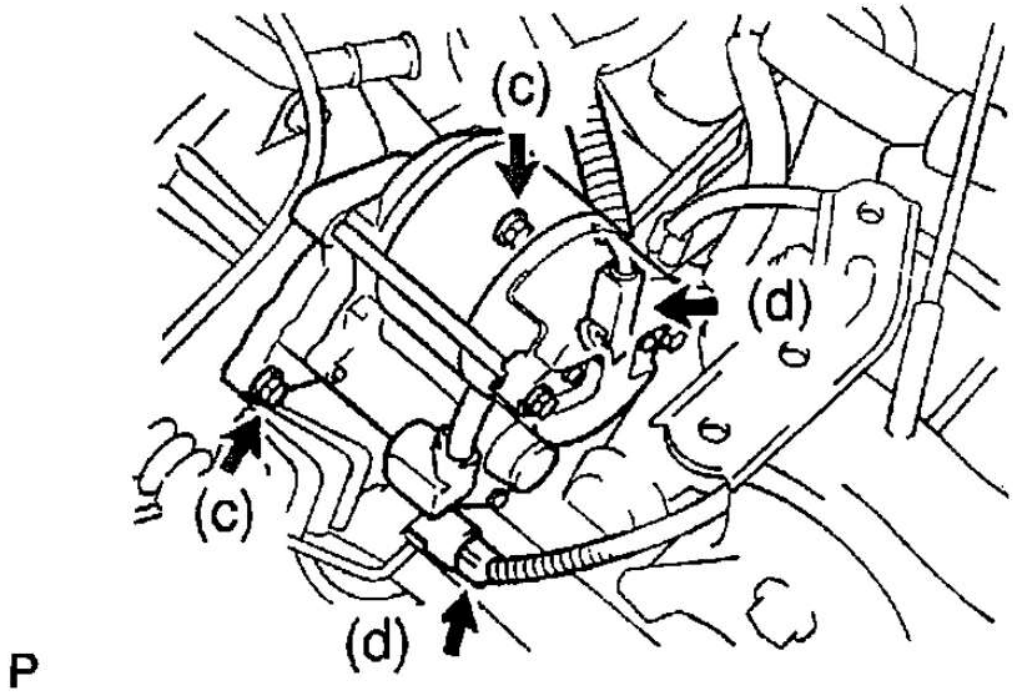


Fig. 226: Locating & Installing Starter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Install the starter.
b. Connect the starter cable with the nut.

Torque: 8.8 N.m (86 kgf. cm, 78 in. .lbf)

c. Install the starter with the 2 bolts.

Torque: 37 N.m (378 kgf. cm, 28 ft. lbf)

d. Connect the connector.
e. Connect the hose to the dipstick guide.

25. **M/T: Connect shift control cables to transaxle** .
    a. Connect the 2 control cables with the 2 clips.
    b. Install the 2 washers and 2 clips.

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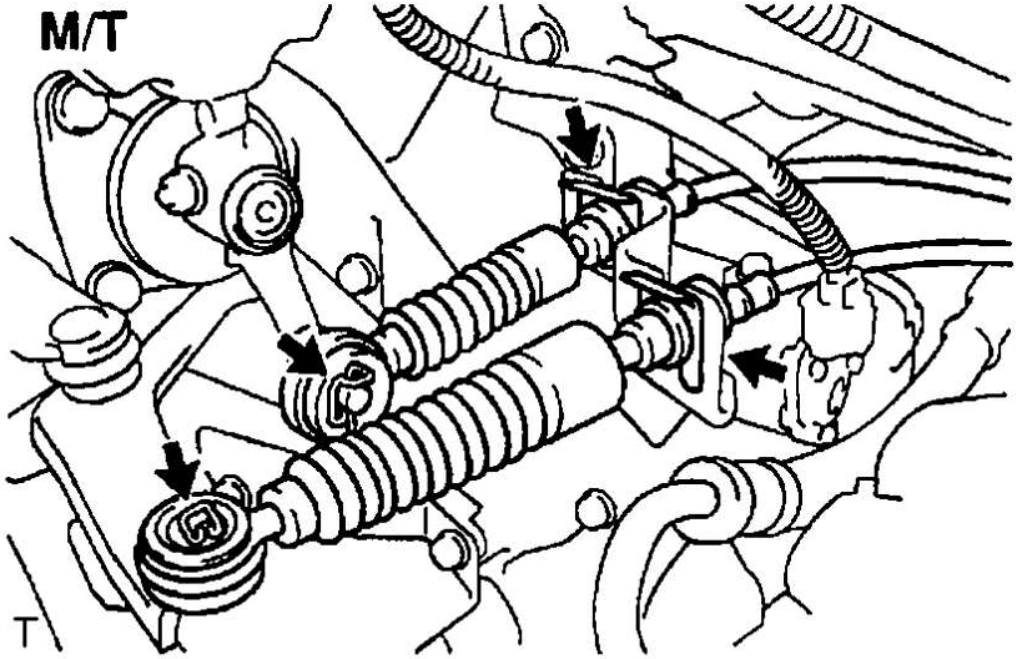


Fig. 227: Identifying & Locating Shift Control Cables
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

26. **Disconnect tubes, hoses, connector, cable and wire** .
    a. Install 2 new O-rings, and connect the discharge and liquid tubes to the compressor (See **REMOVAL**).
    b. Connect the accelerator cable.
    c. Connect the ground wire to the cylinder head.

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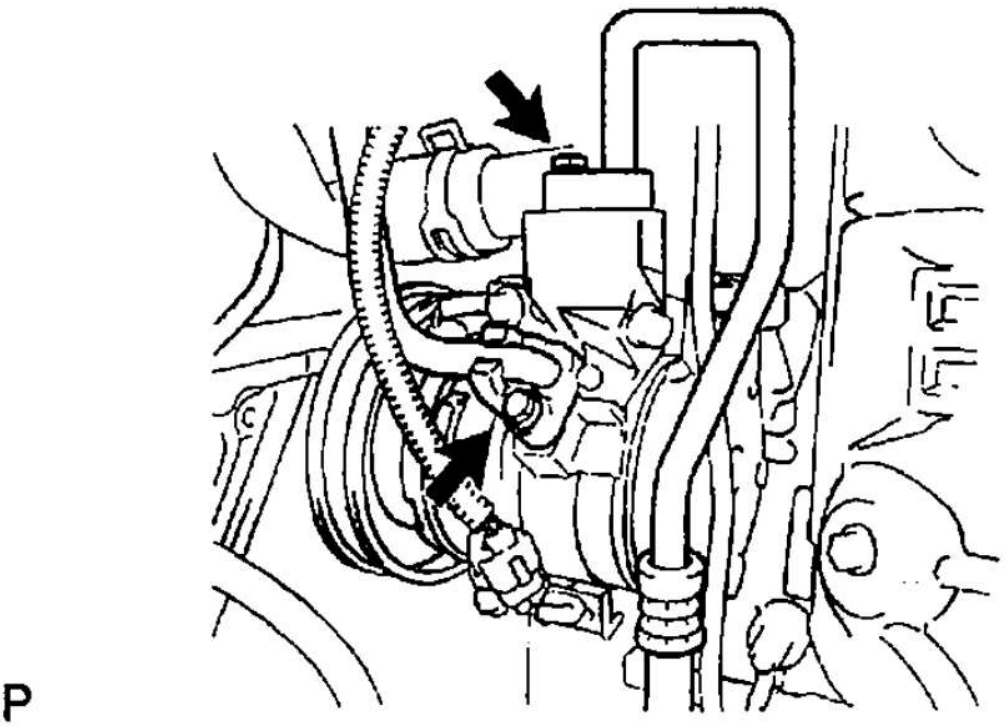


Fig. 228: Locating O-Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Install a new gasket, and connect the suction hose and pressure feed tube to the PS vane pump.

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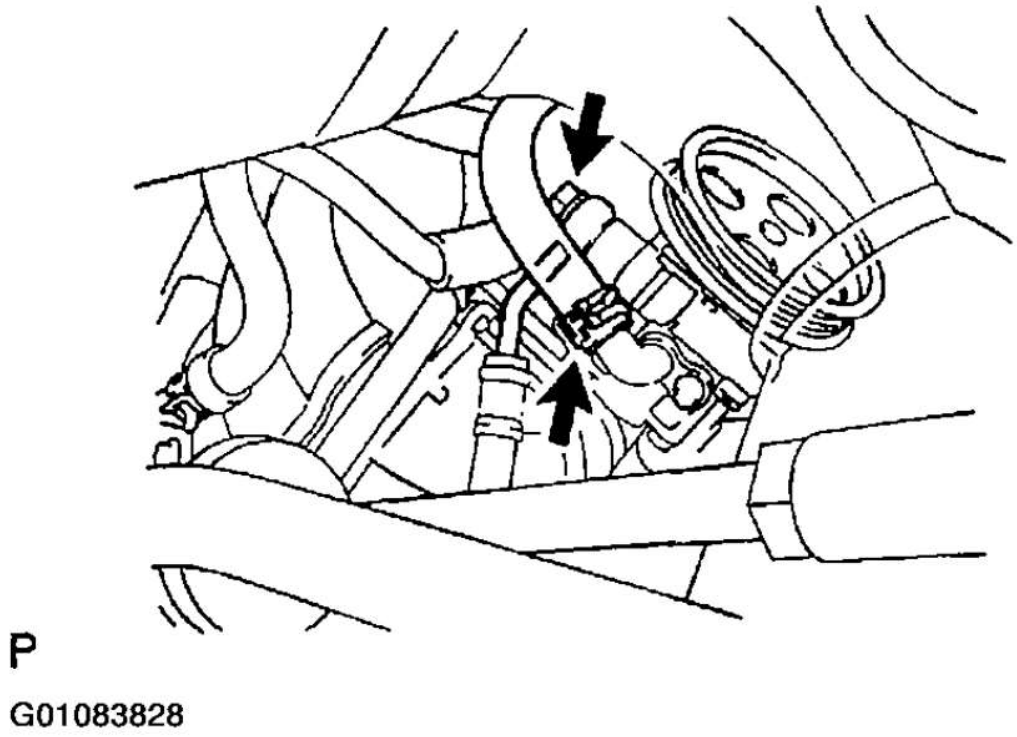


Fig. 229: Installing New Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Connect the upper radiator hose.
f. Connect the lower radiator hose.
g. Connect the fuel tube connector.
h. Connect the 2 heater hoses.
i. Connect the connector to the fusible link block.

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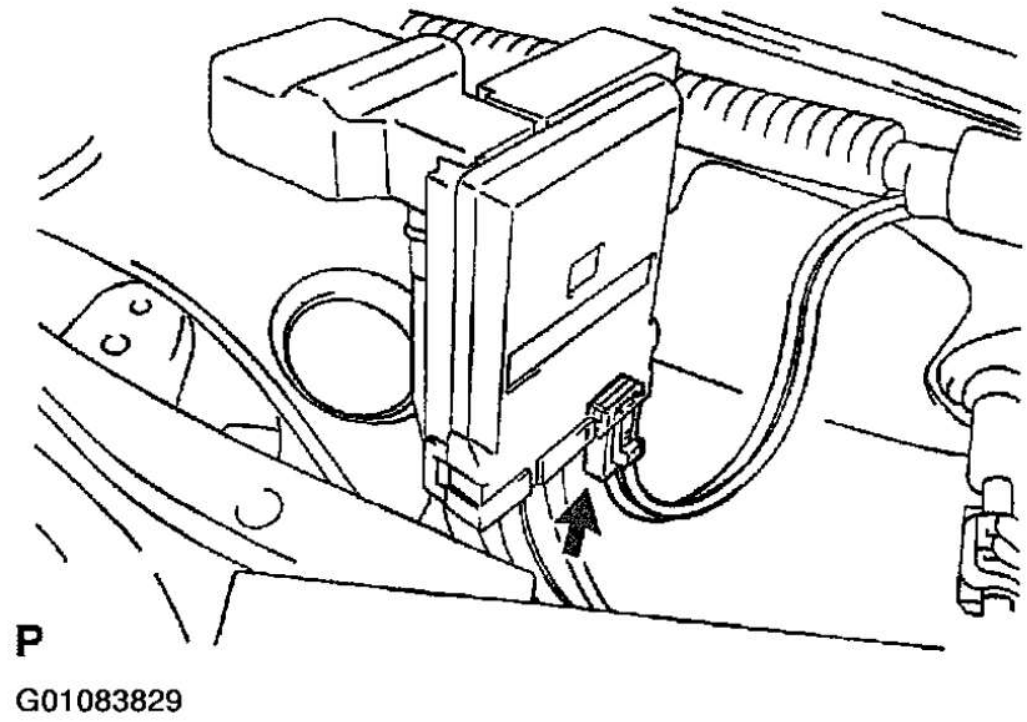


Fig. 230: Connecting Connector To Fusible Link Block
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

27. **Connect engine wire to cabin** .
    a. Push in engine wire through the cabin.
    b. Connect the 6 engine wire connectors to the ECM and instrument panel wire.
    c. Install the glove compartment door with the 2 screws.
28. **Install engine room J/B** .

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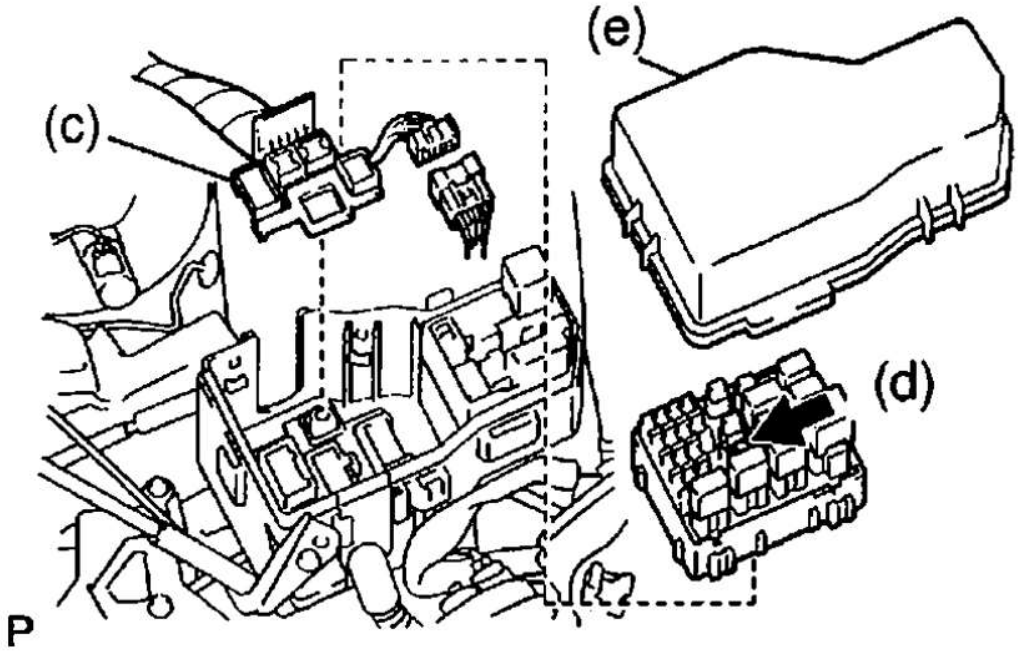


Fig. 231: Installing Engine Room J/B
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect the engine wire clamp.
b. Connect the connector.
c. Push into the engine wire connector.
d. Install the engine room J/B, and tighten the bolt until it fails to catch.
e. Install the engine room J/B cover.

29. **Install air cleaner assembly** .

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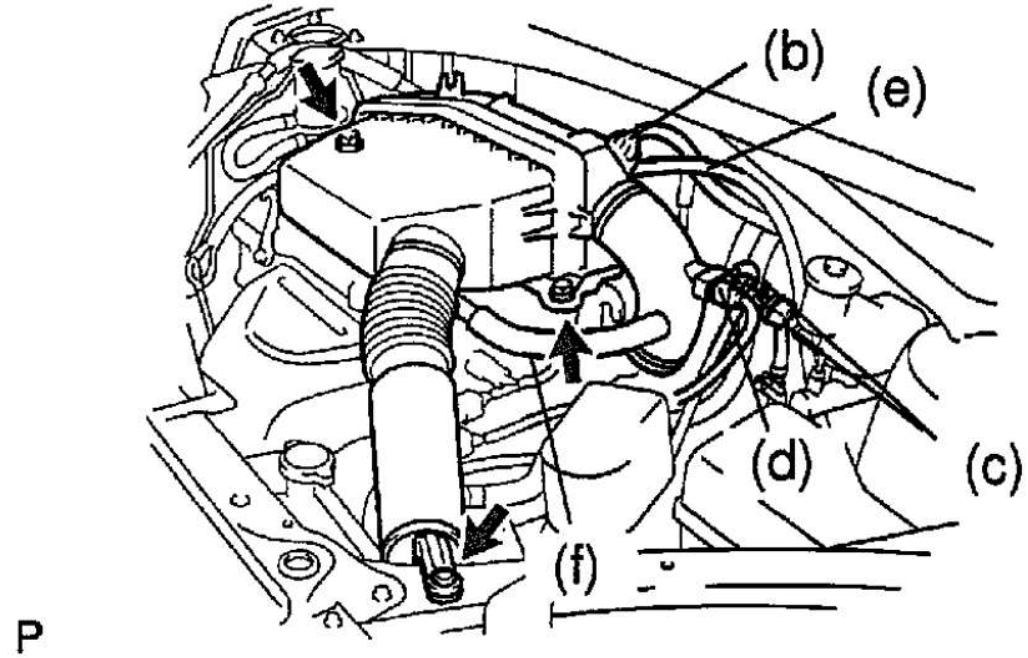


Fig. 232: Installing Air Cleaner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Connect the air cleaner hose to the throttle body, and install the air cleaner assembly with the 3 bolts.
b. Connect the MAF meter connector.
c. Connect the 2 EVAP hoses to the VSV.
d. Connect the VSV connector for EVAP.
e. Connect the CCV hose to the air cleaner.
f. Connect the PCV hose to the cylinder head cover.

30. **Install battery and tray** .
    a. Install the battery bracket with the 5 bolts.

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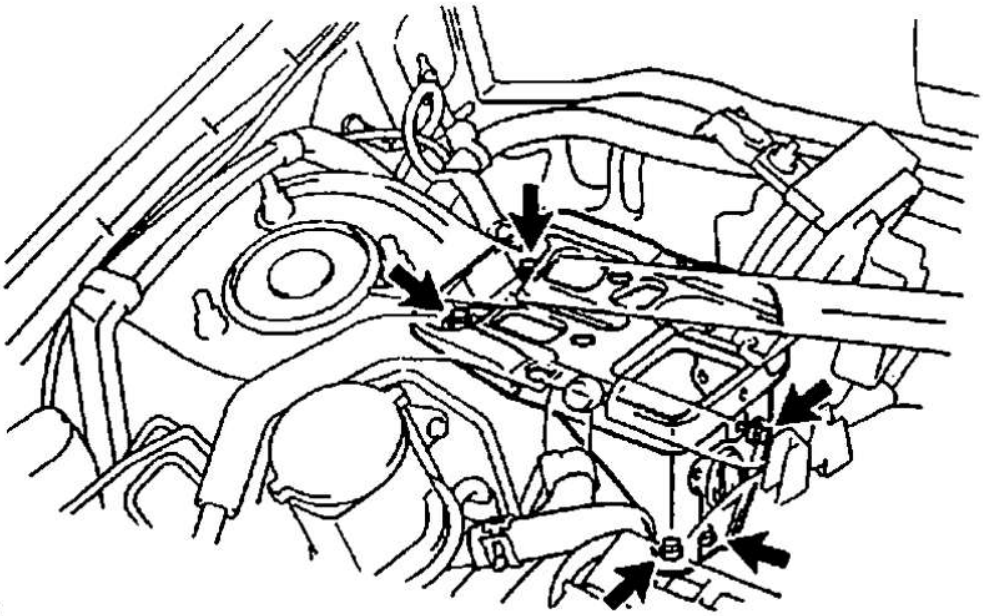


Fig. 233: Installing Battery & Tray
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the battery tray and battery with the hold-down clamp.
c. Install the cowl top ventilation louver (See **INSTALLATION**).

31. **Install radiator reservoir tank** .
32. **Install hood** .
33. **Fill with engine coolant** .
34. **Fill with engine oil** .
35. **Fill with transfer oil** .
36. **Fill with transaxle oil** .
37. **Start engine and check for leaks** .
38. **Bleed power steering system (See POWER STEERING FLUID)** .
39. **Perform road test** .

Check for abnormal noise, shock, slippage, correct shift points and smooth operation.

40. **Recheck engine coolant and oil levels** .
41. **Install engine under covers** .

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CYLINDER BLOCK

COMPONENTS

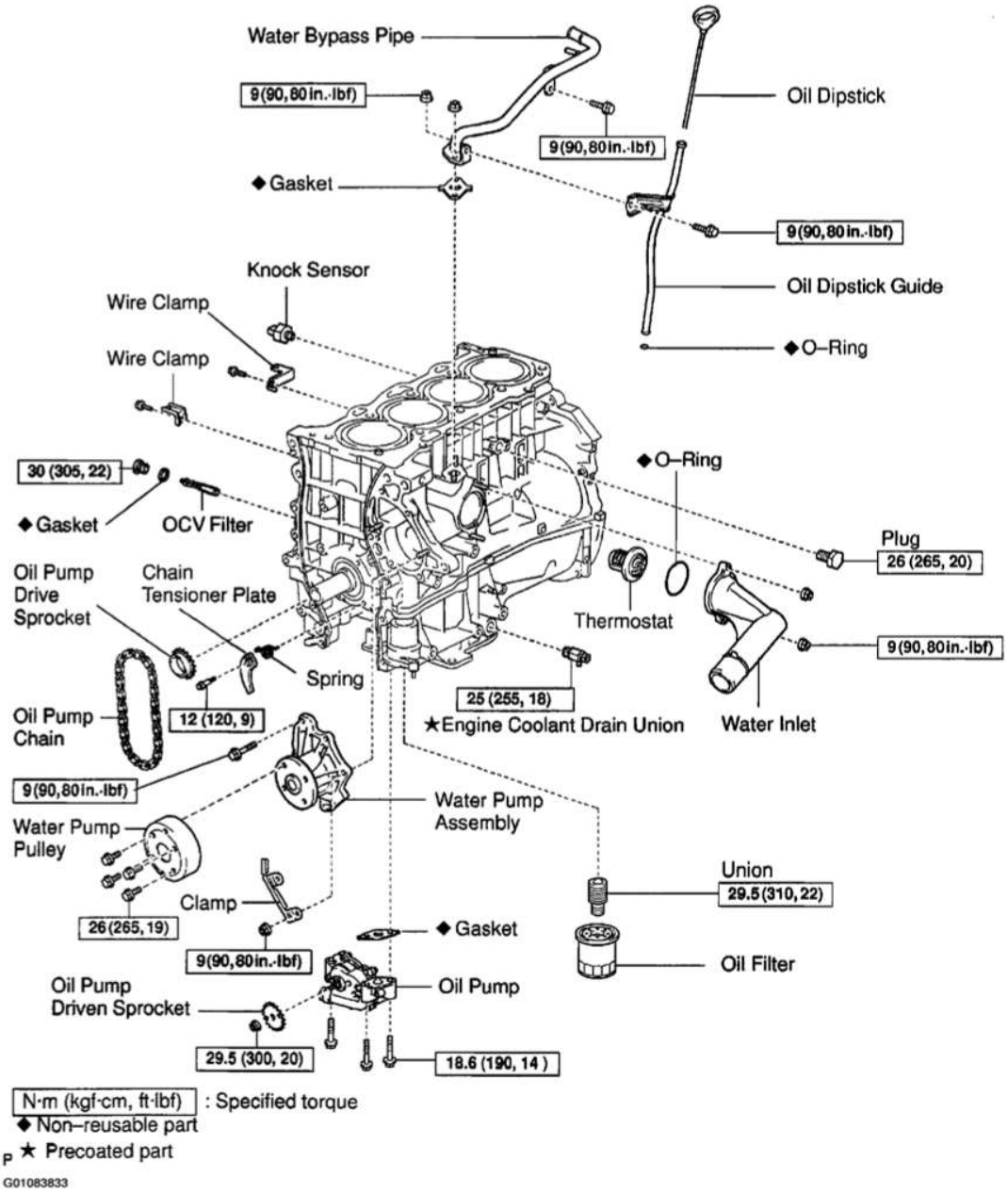


Fig. 234: Displaying Cylinder Block Components (1 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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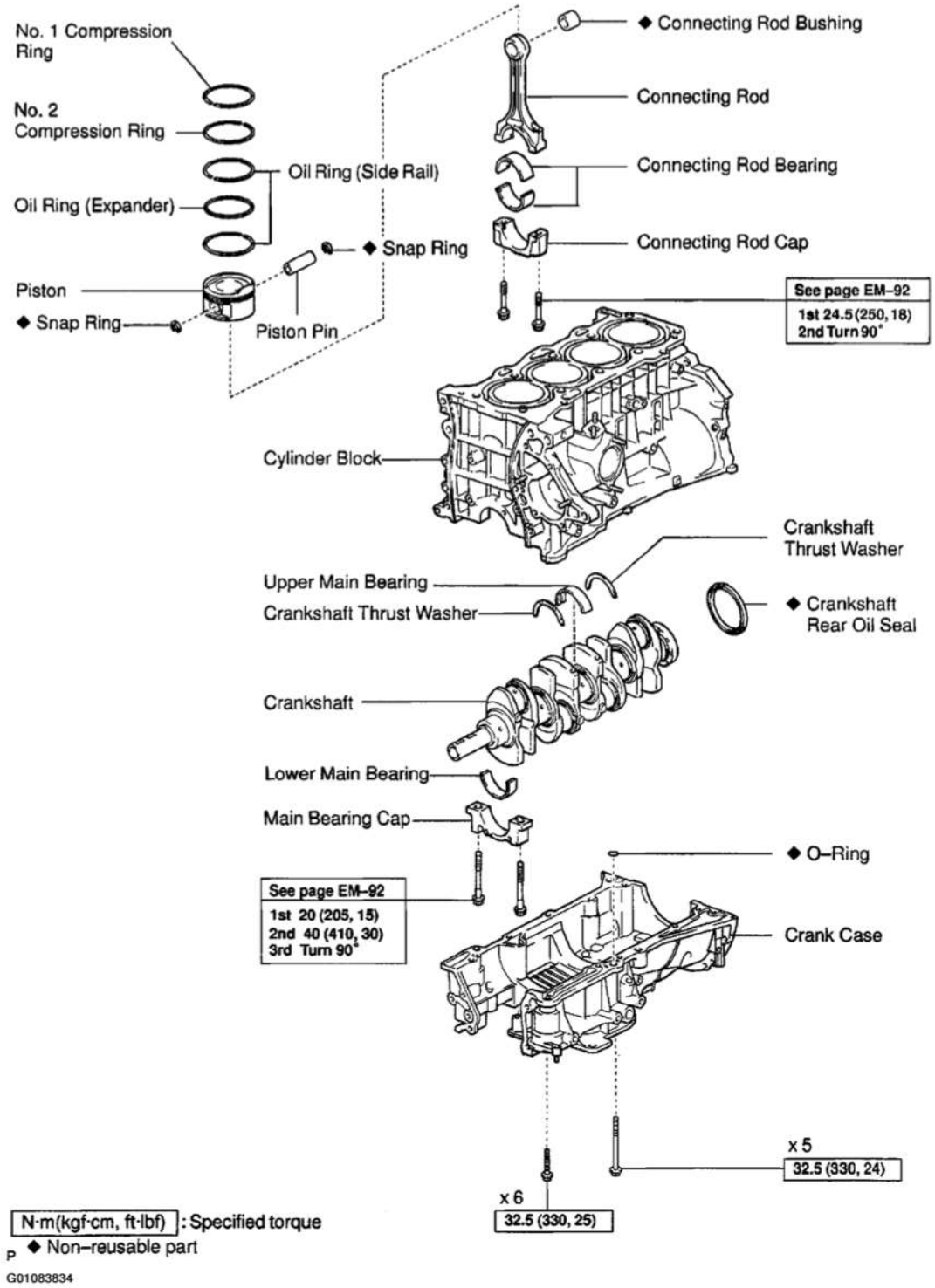


Fig. 235: Displaying Cylinder Block Components (2 Of 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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DISASSEMBLY

1. **Install engine to engine stand for disassembly .**
2. **Remove timing chain (See REMOVAL) .**
3. **Remove cylinder head (See REMOVAL) .**
4. **Remove knock sensor (See REMOVAL (RAV4)) .**
5. **Remove engine wire clamps .**
6. **Remove plug .**
7. **Remove OCV filter .**

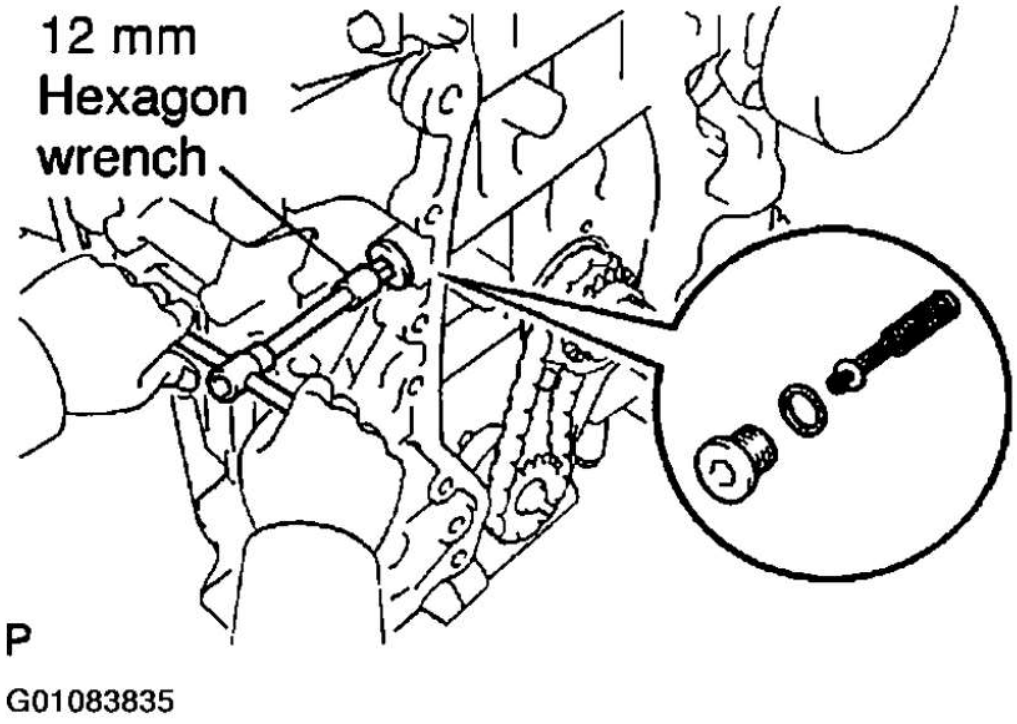


Fig. 236: Removing OCV Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a 12 mm hexagon wrench, remove the plug, gasket and OCV filter.

8. **Remove water pump (See REMOVAL) .**
9. **Remove thermostat (See REMOVAL) .**
10. **Remove engine coolant drain union .**
11. **Remove oil dipstick and guide .**

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a. Remove the bolt, oil dipstick and guide.
b. Remove the O-ring from the oil dipstick.

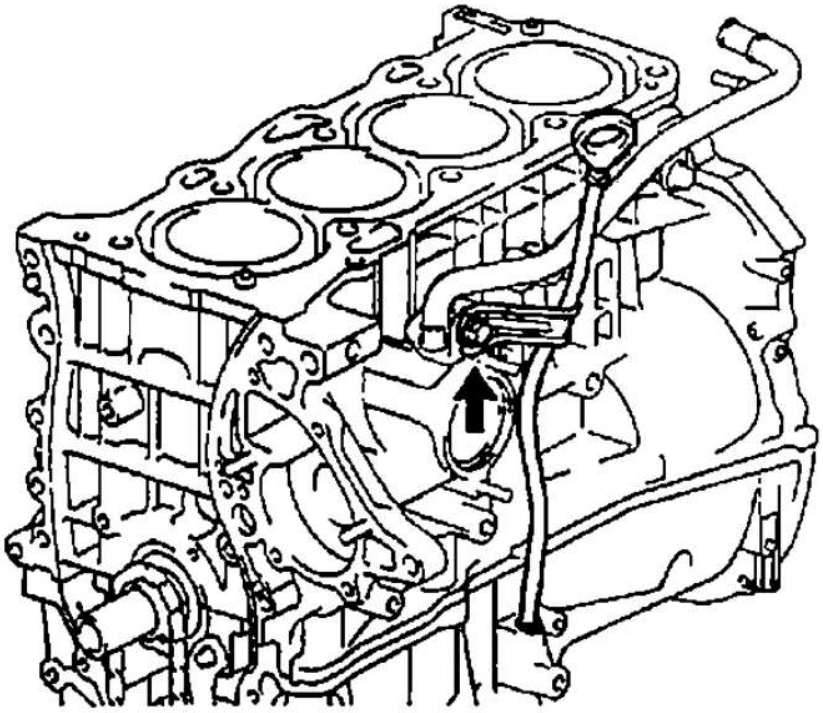


Fig. 237: Removing Oil Dipstick & Guide
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **Remove water bypass pipe** .

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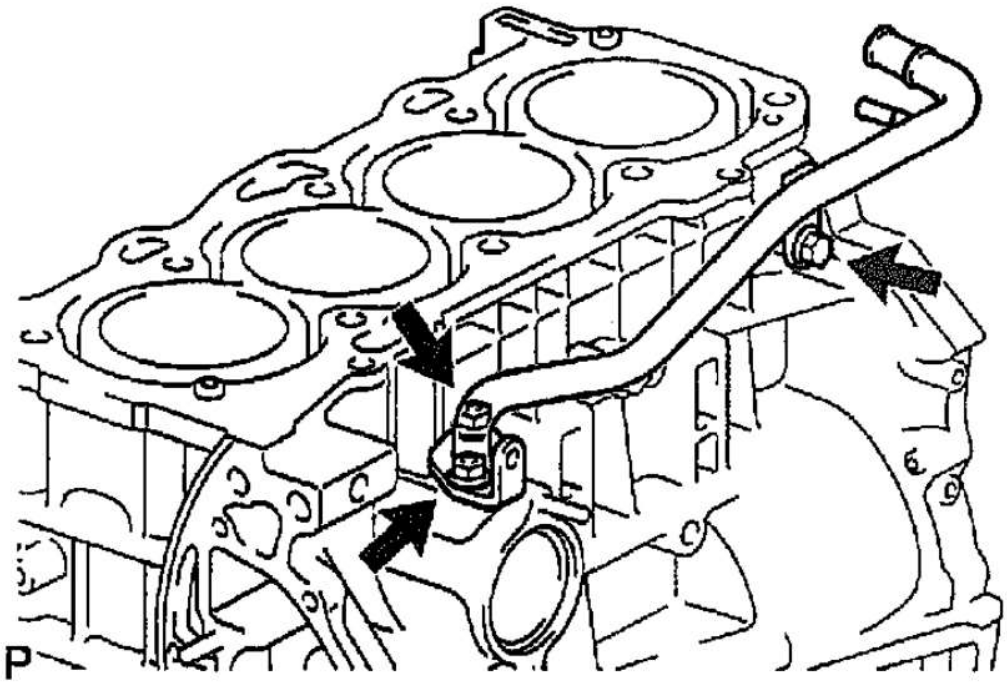


Fig. 238: Removing Water Bypass Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Remove the 2 nuts, bolt, water bypass pipe and gasket.

13. **Remove oil pump (See REMOVAL) .**
14. **Remove oil filter (See REPLACEMENT) .**
15. **Remove oil filter union .**

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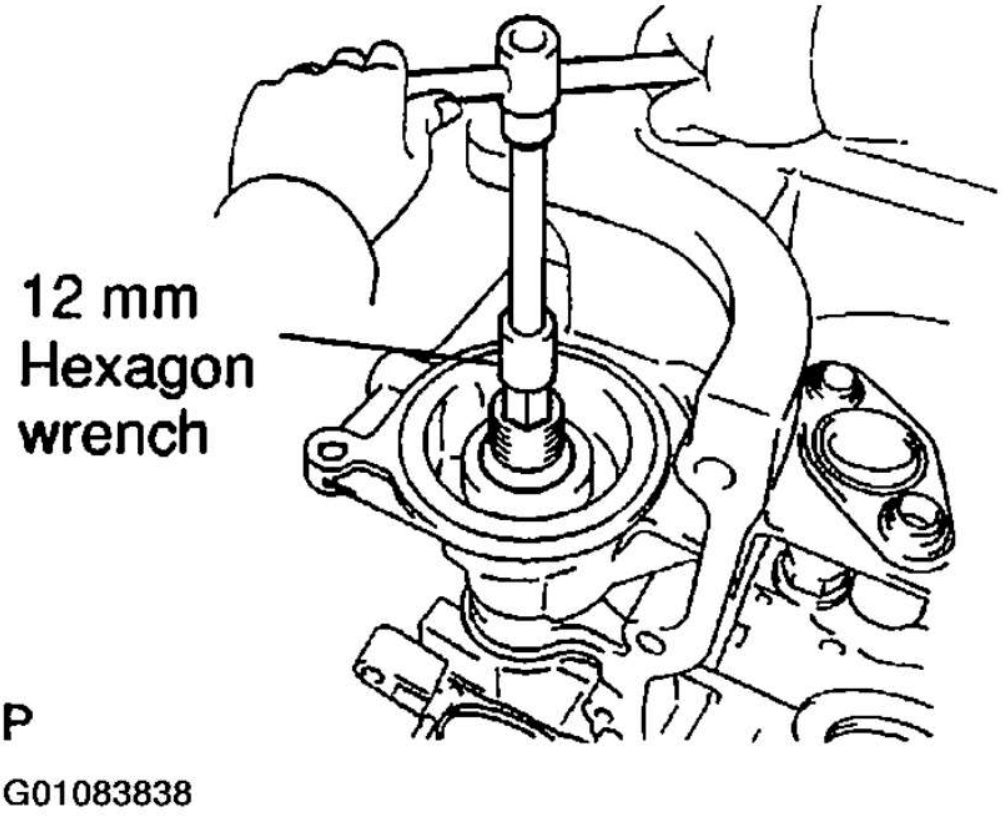


Fig. 239: Removing Oil Filter Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a 12 mm hexagon wrench, remove the oil filter union.

16. **Remove crank case** .
    a. Uniformly loosen and remove the 11 bolts in several passes, in the sequence shown.

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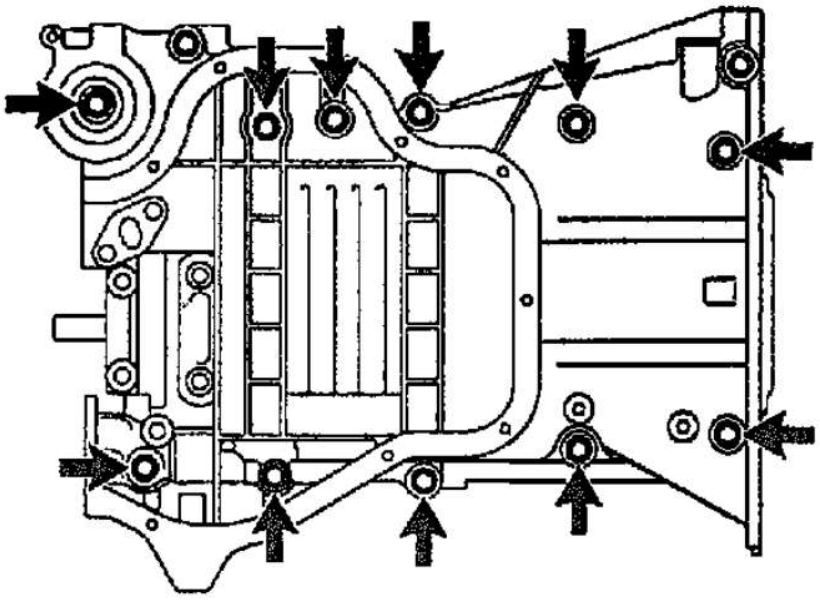


Fig. 240: Locating Crank Case Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using a screwdriver, remove the crank case by prying the portions between the crank case and cylinder block.

NOTE: Be careful not to damage the contact surfaces of the crank case and cylinder block.

c. Remove the O-ring.

17. **Remove crankshaft rear oil seal** .

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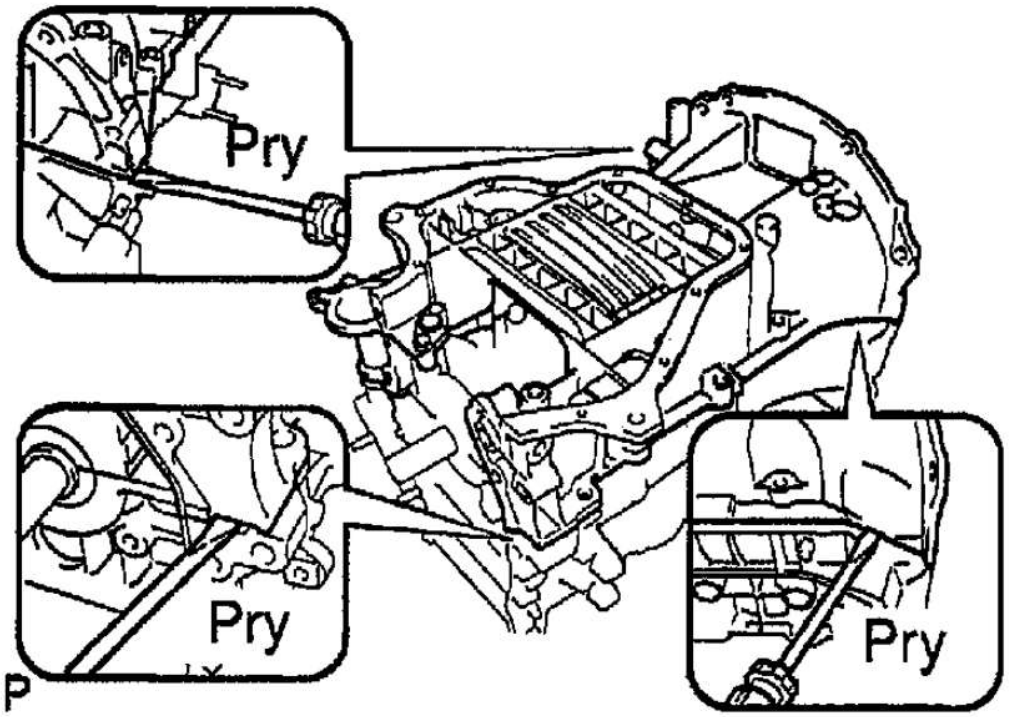


Fig. 241: Removing Crank Case
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **Check connecting rod thrust clearance** .

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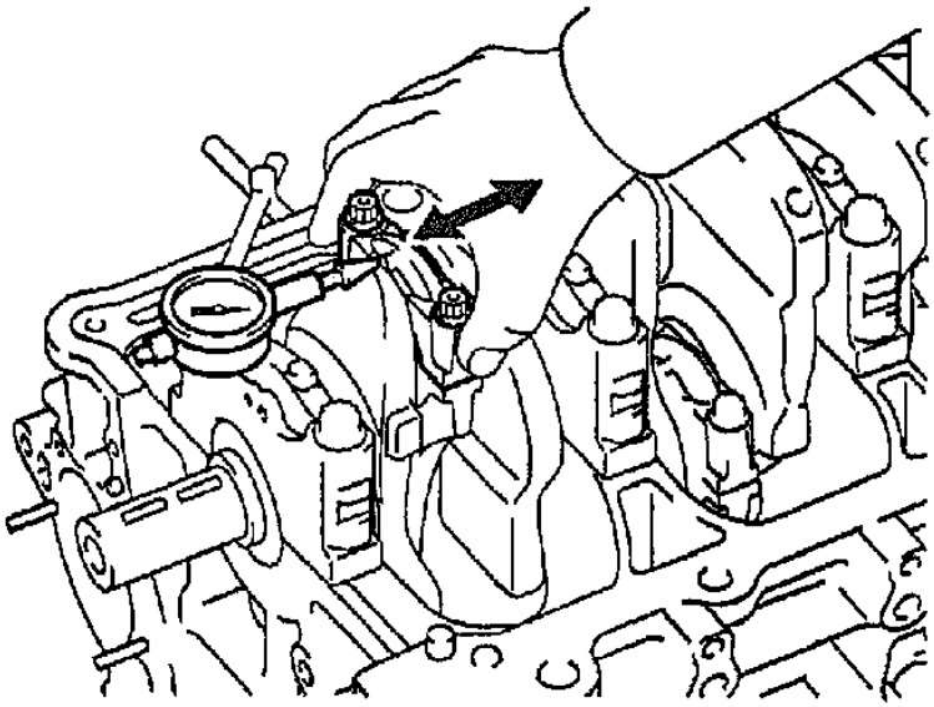


Fig. 242: Checking Connecting Rod Thrust Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.

Standard thrust clearance: 0.160 - 0.362 mm (0.0063 - 0.0143 in.)

Maximum thrust clearance: 0.362 mm (0.0143 in.)

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

Connecting rod thickness: 19.788 - 19.840 mm (0.7791 - 0.7811 in.)

19. **Remove connecting rod caps and check oil clearance** .
    a. Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.
    b. Remove the 2 connecting rod cap bolts.

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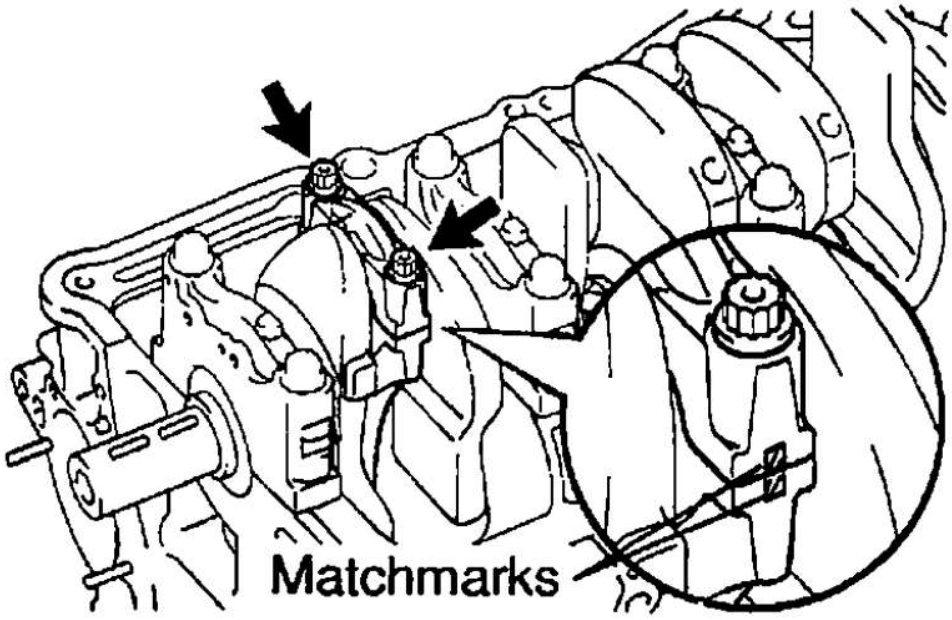


Fig. 243: Removing Connecting Rod Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.

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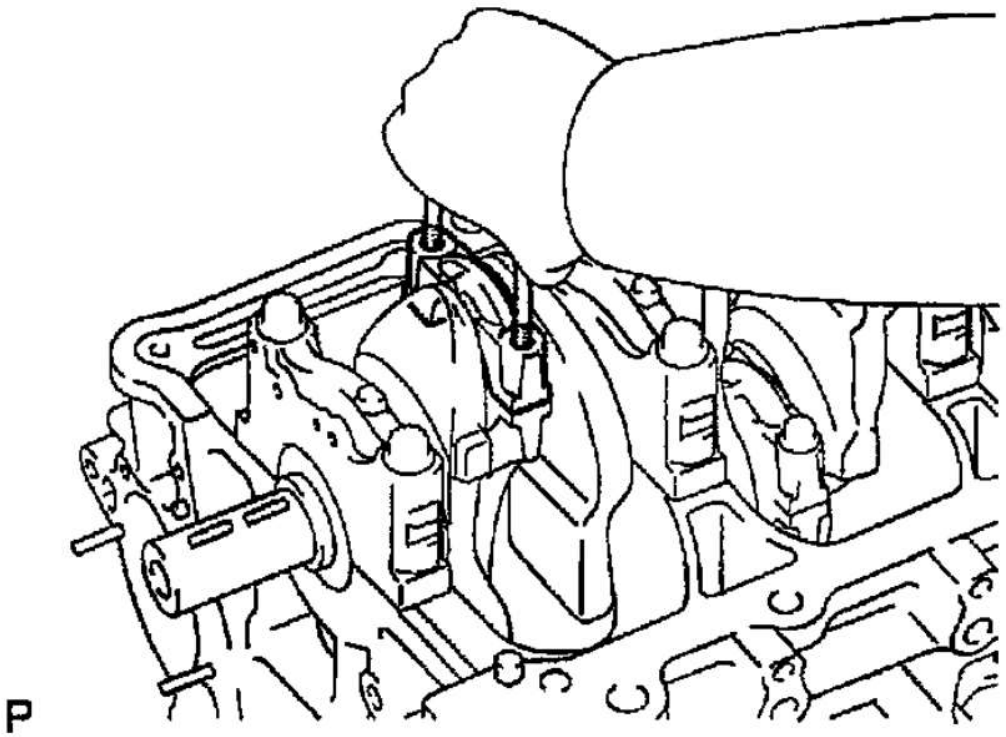


Fig. 244: Removing Connecting Rod Cap & Lower Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Keep the lower bearing inserted with the connecting rod cap.

d. Clean the crank pin and bearing.
e. Check the crank pin and bearing for pitting and scratches.

   If the crank pin or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

f. Lay a strip of Plastigage on the crank pin.

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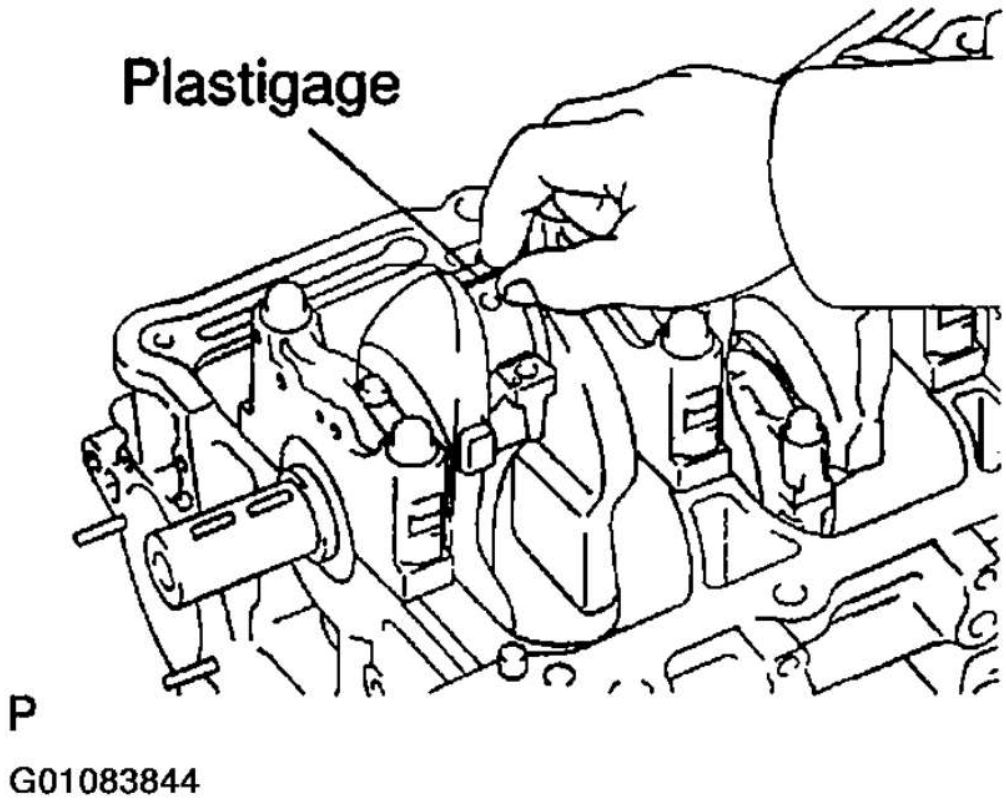


Fig. 245: Locating Crank Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

g. Install the connecting rod cap (See **REASSEMBLY**).

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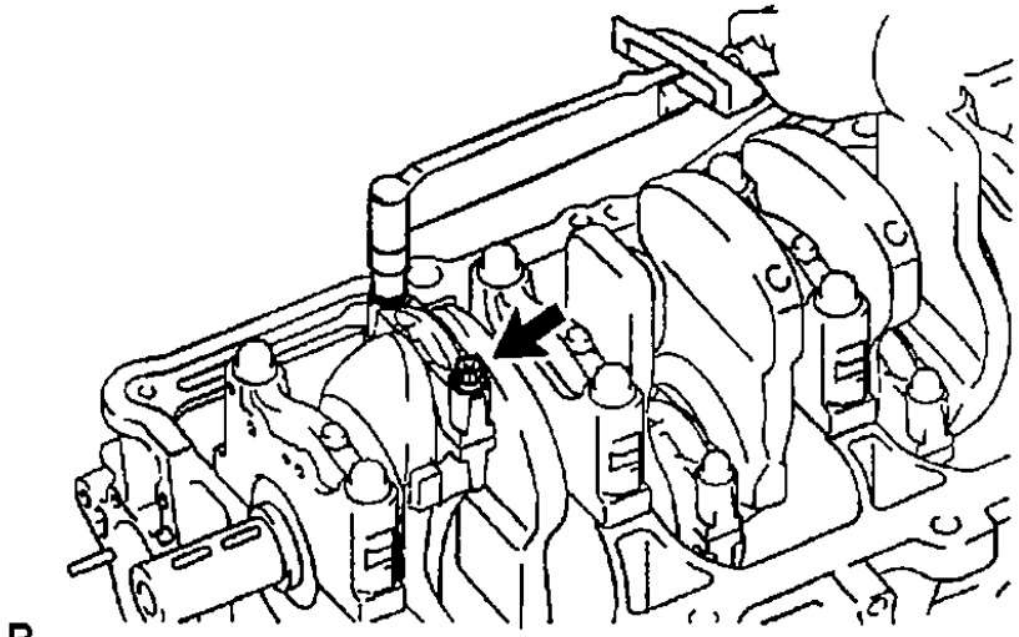


Fig. 246: Installing Connecting Rod Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not turn the crankshaft.

h. Remove the connecting rod cap (See procedure b and c above).
i. Measure the Plastigage at its widest point.

Standard oil clearance: 0.024 - 0.048 mm (0.0009 - 0.0019 in.)
Maximum oil clearance: 0.08 mm (0.0031 in.)

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

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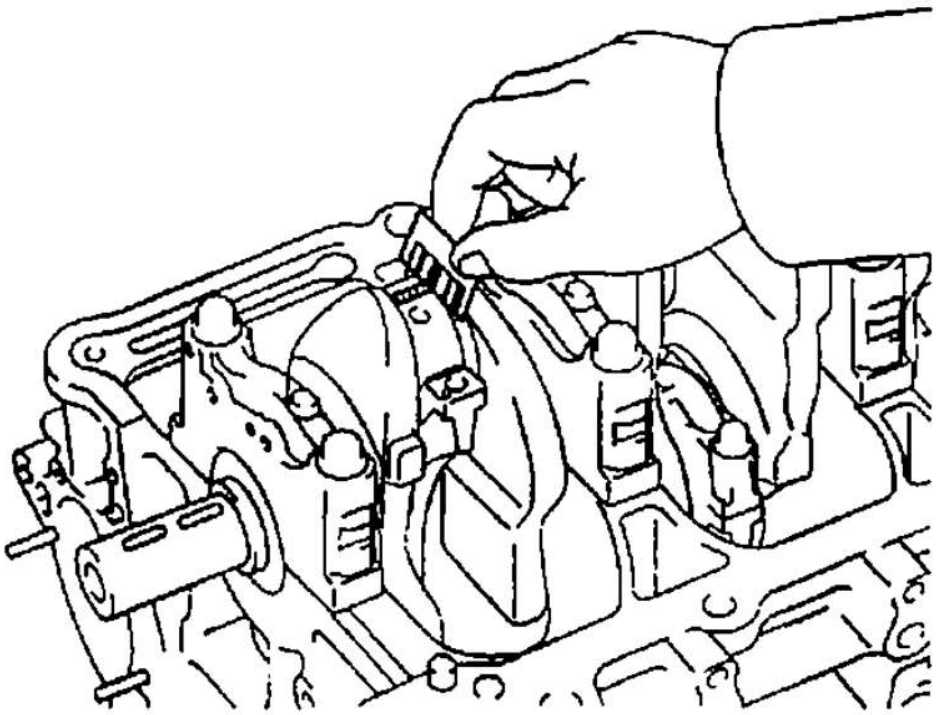


Fig. 247: Measuring Plastigage
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **If replacing a bearing, replace it with one having the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked "1", "2" and "3" accordingly.**

Reference

Standard bearing center wall thickness:

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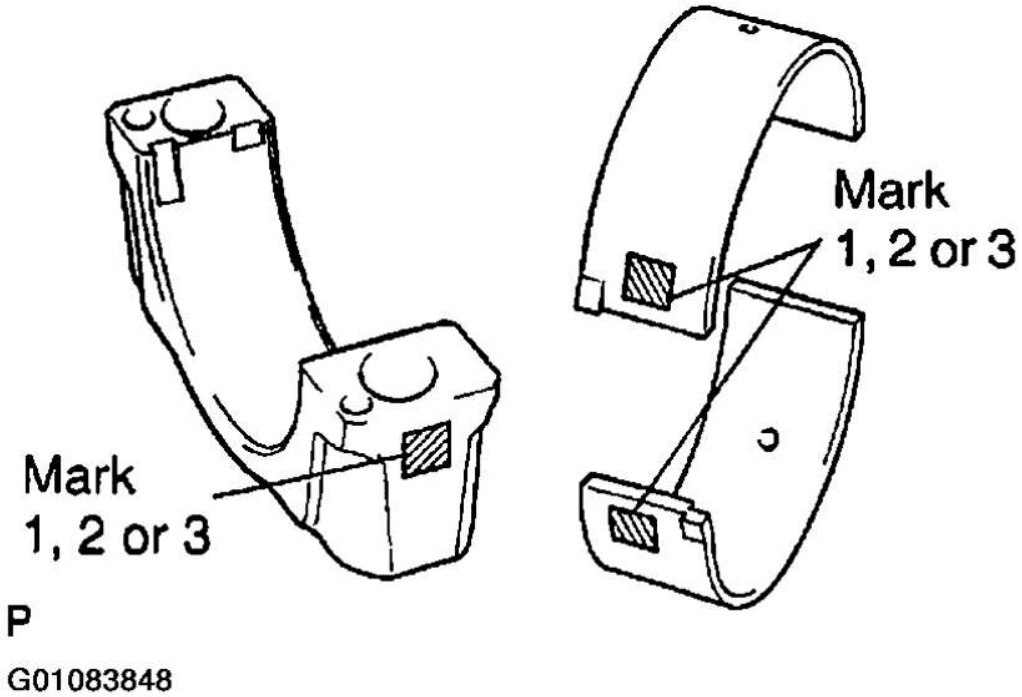


Fig. 248: Identifying Number Marked On Connecting Rod
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Mark 1	1.485 – 1.488 mm (0.0585 – 0.0586 in.)
Mark 2	1.488 – 1.491 mm (0.0586 – 0.0587 in.)
Mark 3	1.491 – 1.494 mm (0.0587 – 0.0588 in.)

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Fig. 249: Displaying Standard Bearing Center Wall Thickness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. Completely remove the Plastigage.

20. **Remove piston and connecting rod assemblies** .
    a. Using a ridge reamer, remove all the carbon from the top of the cylinder.
    b. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

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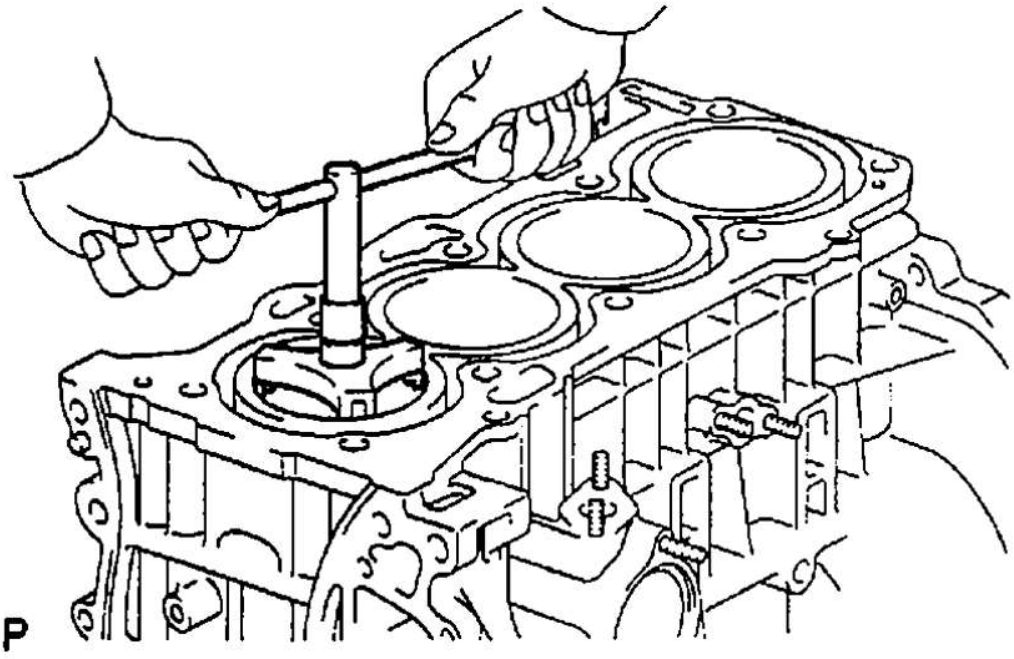


Fig. 250: Removing Piston & Connecting Rod Assemblies
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

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

21. **Check crankshaft thrust clearance** .

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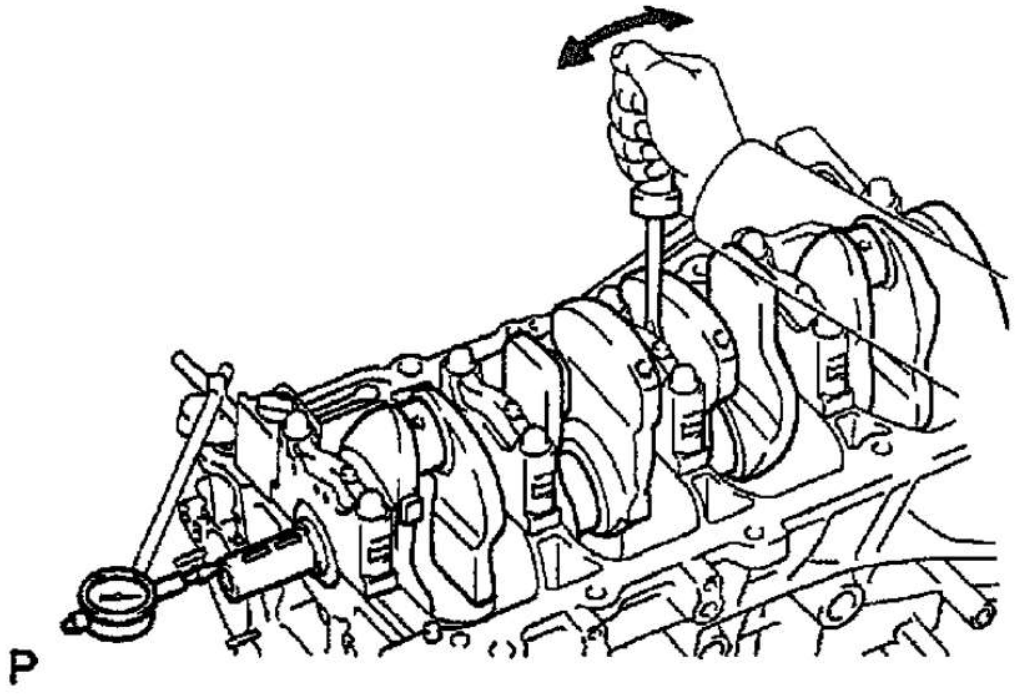


Fig. 251: Checking Crankshaft Thrust Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.

Standard thrust clearance: 0.040 - 0.240 mm (0.0016 - 0.0094 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

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

Thrust washer thickness: 1.930 - 1.980 mm (0.0760 - 0.0780 in.)

22. **Remove main bearing caps and check oil clearance** .
    a. Uniformly loosen and remove the 10 main bearing cap bolts in several passes, in the sequence shown.

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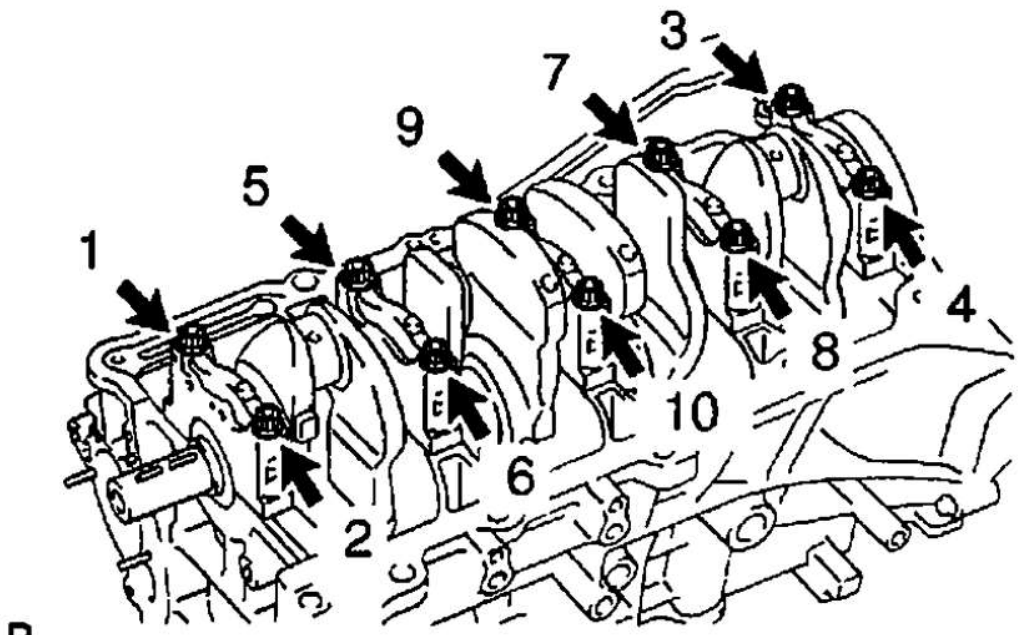


Fig. 252: Locating & Removing Main Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Using the 2 removed main bearing cap bolts, remove the 5 main bearing caps and 5 lower bearings.

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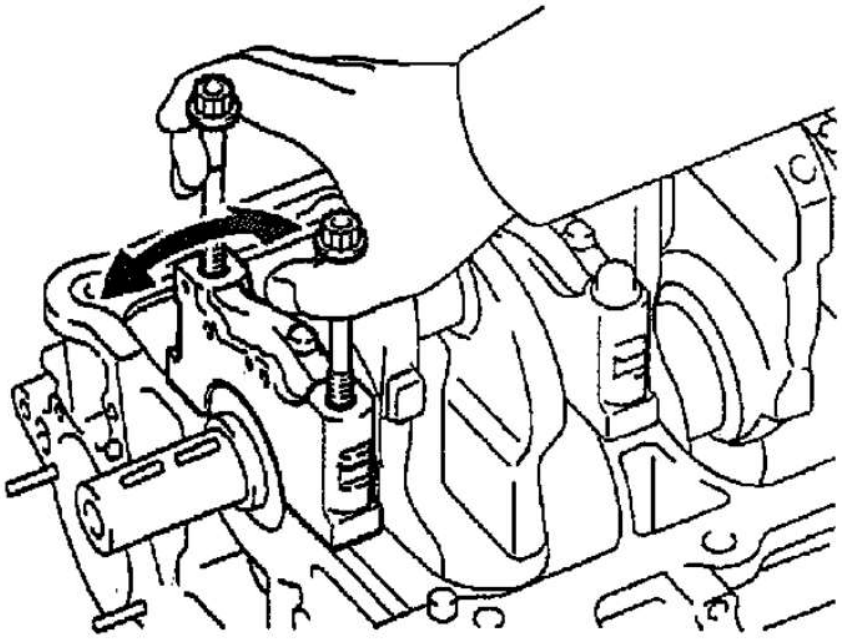


Fig. 253: Removing Bearing Caps & Lower Bearings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: **Be careful not to damage the cylinder block.**

NOTE:
- **Keep the lower bearing and main bearing cap together.**
- **Arrange the main bearing caps in the correct order.**

c. Lift out the crankshaft.

NOTE: **Keep the main bearings and thrust washers together with the cylinder block.**

d. Place the crankshaft on the cylinder block.
e. Lay a strip of Plastigage across each journal.

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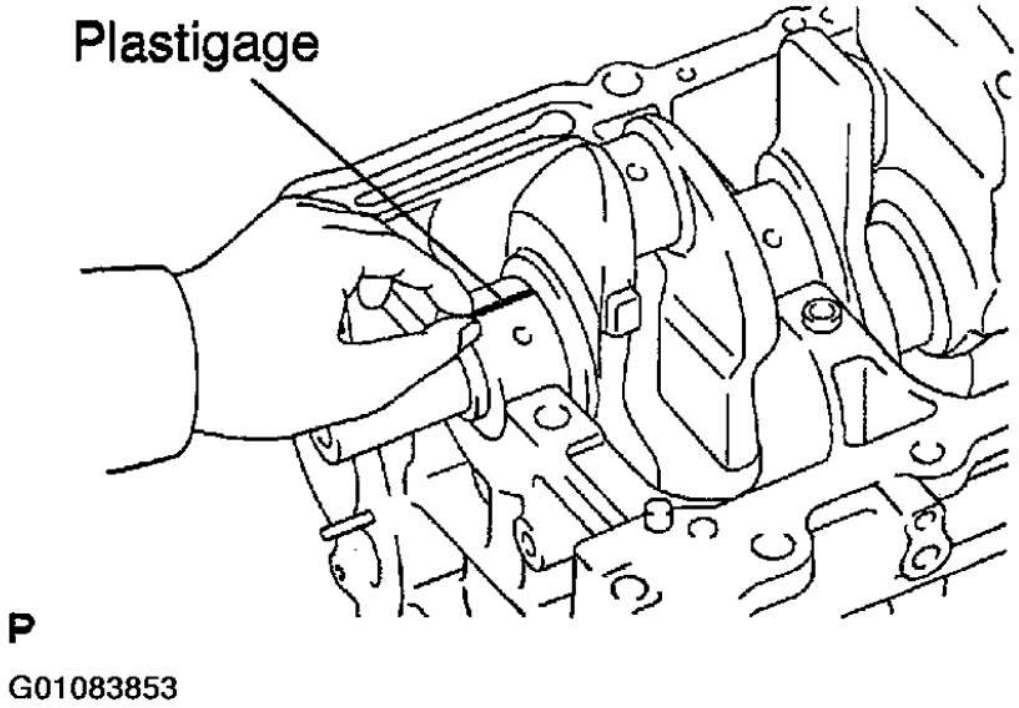


Fig. 254: Laying Plastigage On Each Journal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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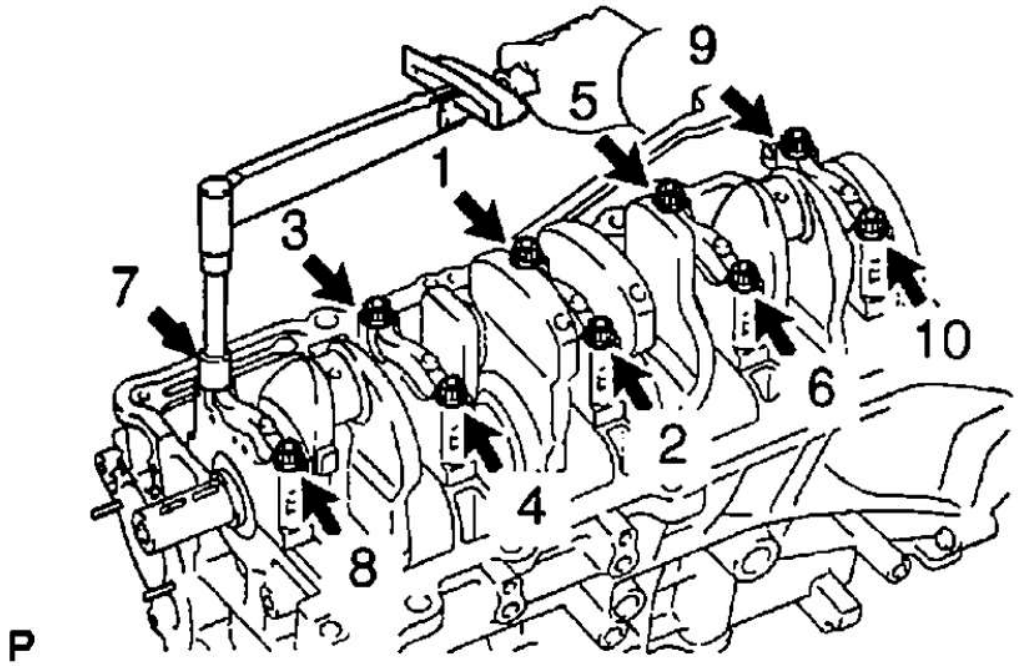


Fig. 255: Installing Main Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not turn the crankshaft.

g. Remove the main bearing cap (See procedure a and b above).
h. Measure the Plastigage at its widest point.

Standard oil clearance: 0.017 - 0.040 mm (0.0007 - 0.0016 in.)
Maximum oil clearance: 0.050 mm (0.0020 in.)

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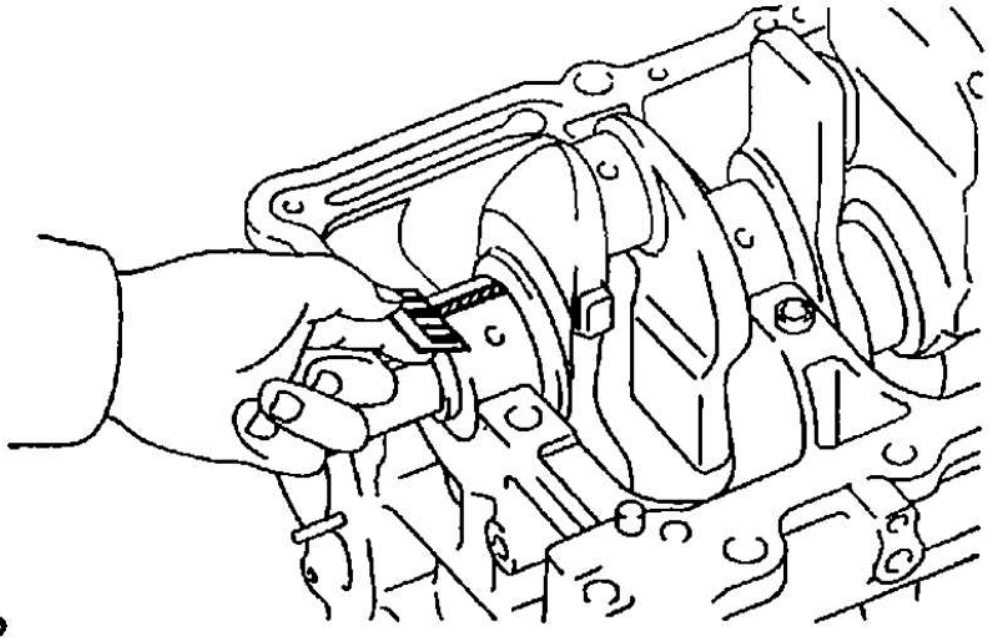
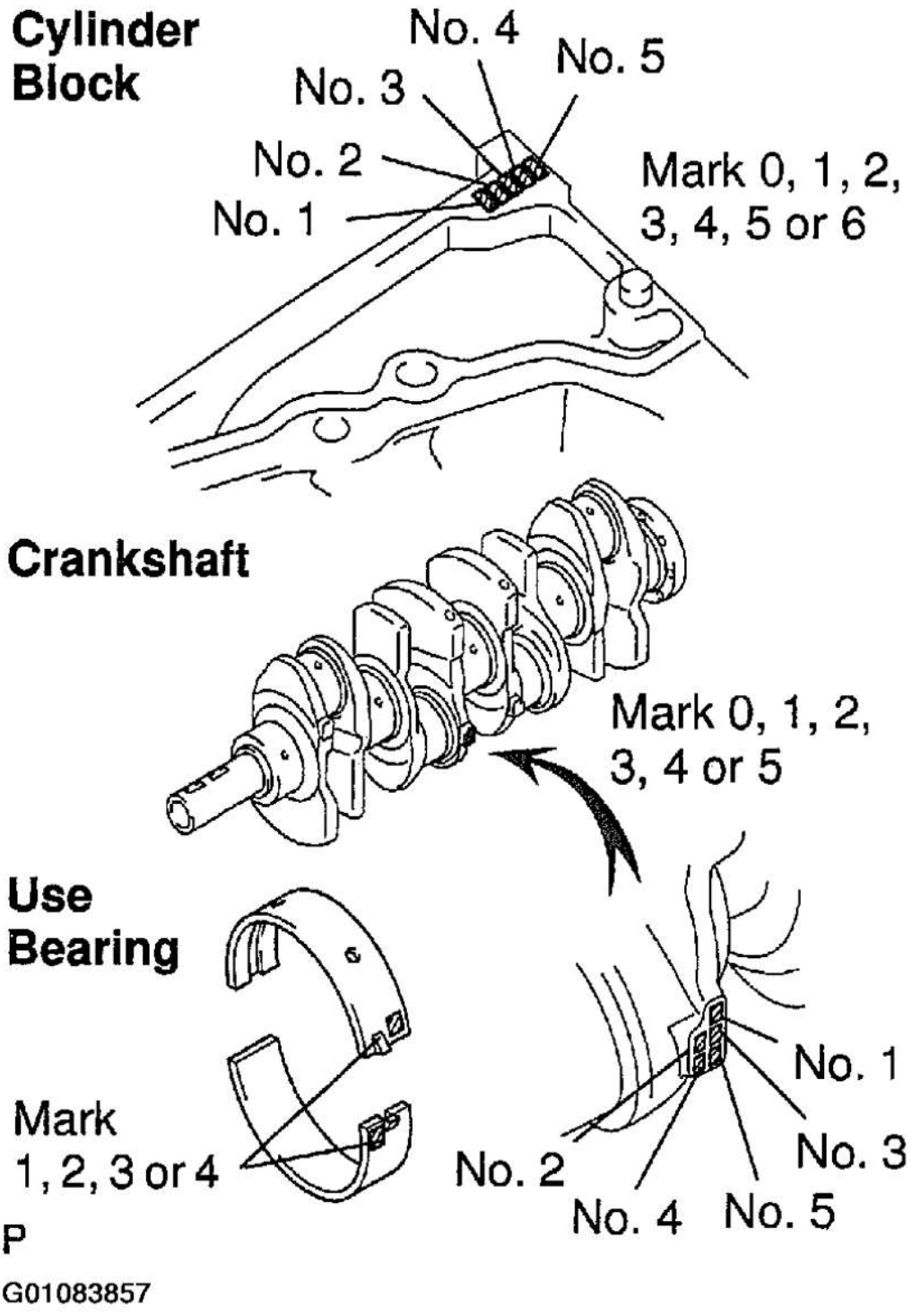


Fig. 256: Measuring Plastigage At Widest Point
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

i. If using a standard 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 selecting the bearing with the same number as the total. There are 4 sizes of standard bearings, marked "1", "2", "3" and "4" accordingly.

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Fig. 257: Displaying Cylinder Block & Crankshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

	Total number			" ": Number mark
Cylinder block + Crankshaft	0 – 2	3 – 5	6 – 8	9 –11
Use bearing	"1"	"2"	"3"	"4"

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Fig. 258: Displaying Standard Bearing Sizes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

EXAMPLE:

Cylinder block "4"

+ Crankshaft "3"

= Total number 7 (Use bearing "3")

Reference

Item	Mark	mm(in.)
Cylinder block main journal bore diameter	0	59.000 – 59.002 (2.0868 – 2.3229)
	1	59.003 – 59.004 (2.0869 – 2.3230)
	2	59.005 – 59.006 (2.0870 – 2.3231)
	3	59.007 – 59.009 (2.0871 – 2.3232)
	4	59.010 – 59.011 (2.0872 – 2.3233)
	5	59.012 – 59.013 (2.0873 – 2.3233)
	6	59.014 – 59.016 (2.0873 – 2.3235)
Crankshaft main journal diameter	0	54.998 – 55.000 (1.9453 – 2.1654)
	1	54.996 – 54.998 (1.9452 – 2.1653)
	2	54.994 – 54.996 (1.9451 – 2.1652)
	3	54.992 – 54.994 (1.9451 – 2.1651)
	4	54.990 – 54.992 (1.9450 – 2.1650)
	5	54.988 – 54.990 (1.9449 – 2.1650)
Standard bearing center wall thickness	1	1.993 – 1.996 (0.0785 – 0.0786)
	2	1.996 – 1.999 (0.0786 – 0.0787)
	3	2.000 – 2.002 (0.0787 – 0.0788)
	4	2.003 – 2.005 (0.0789 – 0.0790)

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Fig. 259: Displaying Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

j. Completely remove the Plastigage.

23. **Remove crankshaft** .
    a. Lift out the crankshaft.
    b. Remove the 5 upper main bearings and 2 thrust washers from the cylinder block.

NOTE: Arrange the main bearings and thrust washers in the correct order.

24. **Check fit between piston and piston pin** .

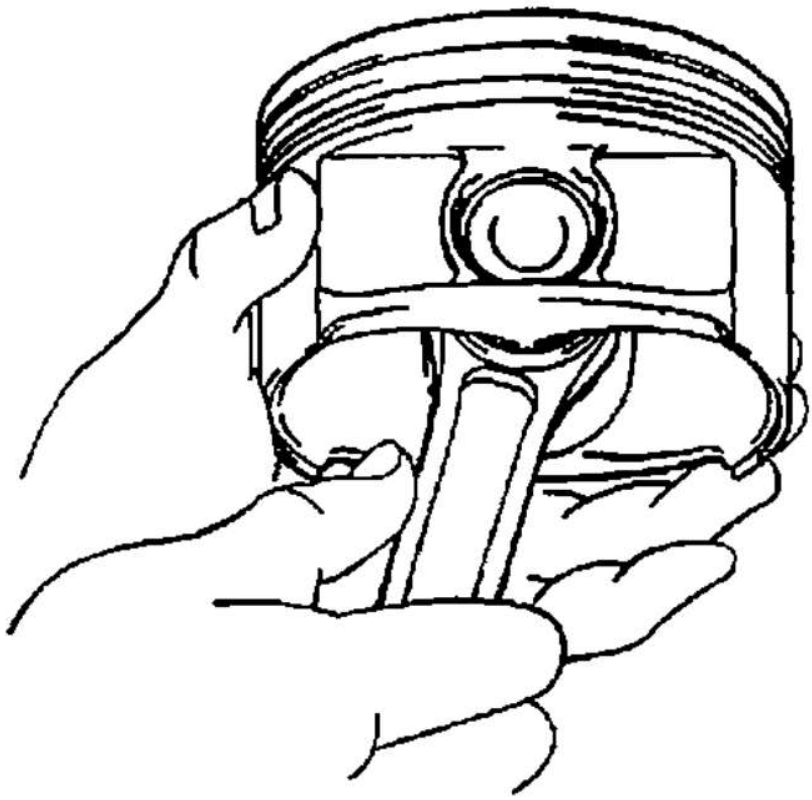


Fig. 260: Checking Fit Between Piston & Piston Pin

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

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.

25. **Remove piston rings** .
    a. Using a piston ring expander, remove the 2 compression rings.
    b. Remove the 2 side rails and oil ring by hand.

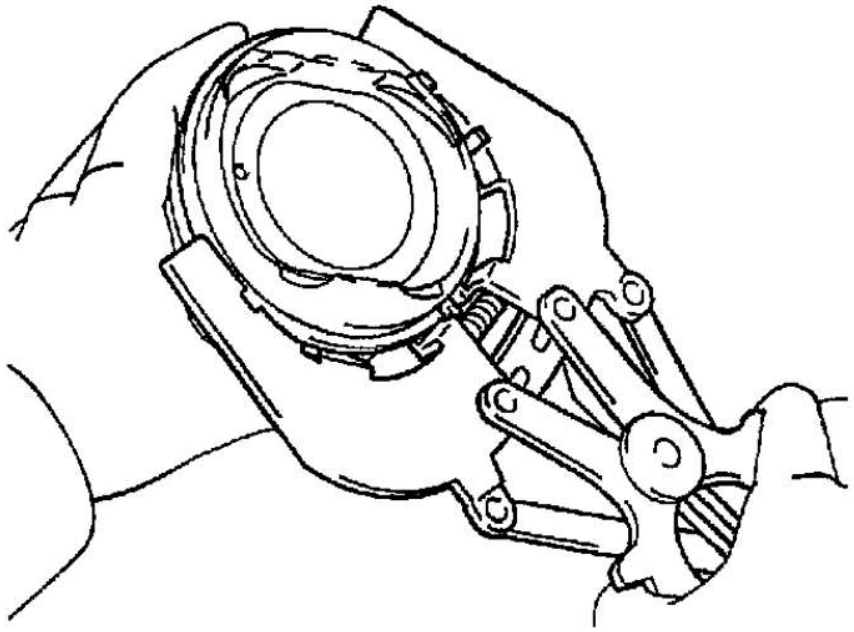


Fig. 261: Removing Piston Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Arrange the piston rings in the correct order only.

26. **Disconnect connecting rod from piston** .
    a. Using a small screwdriver, pry out the 2 snap rings.

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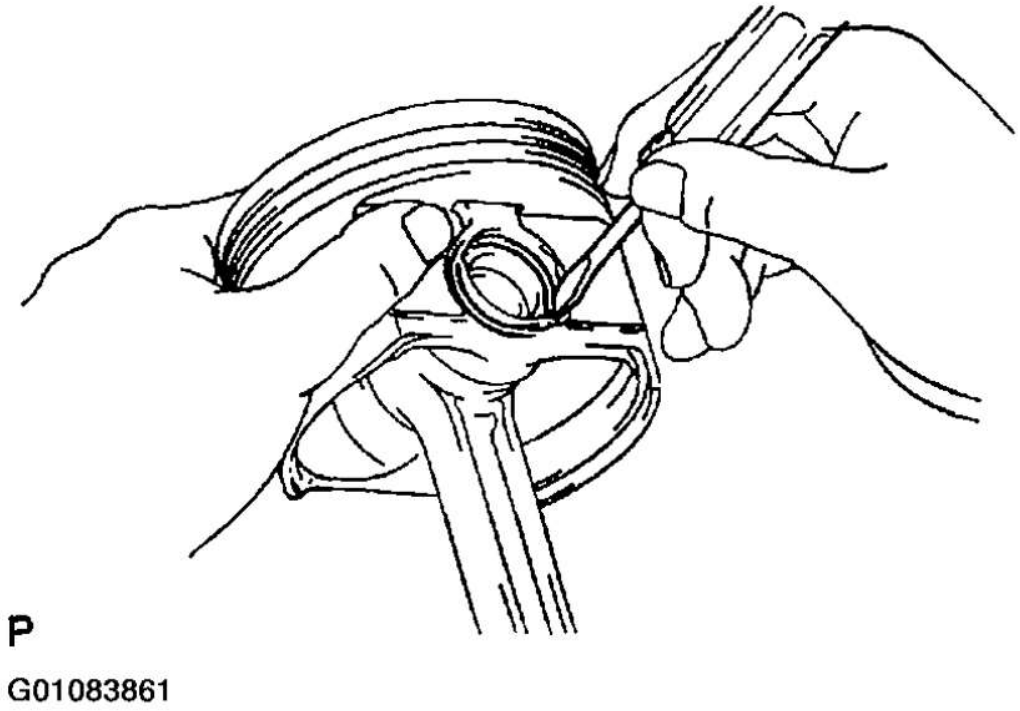


Fig. 262: Disconnecting Connecting Rod From Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Gradually heat the piston to 80 - 90°C (176 - 194°).

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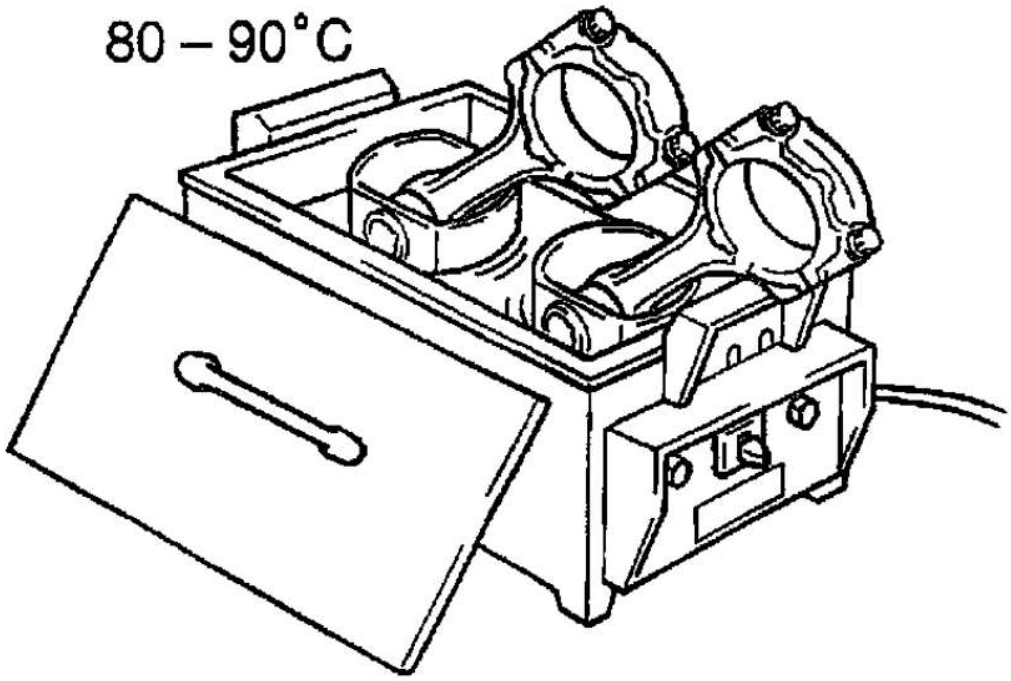


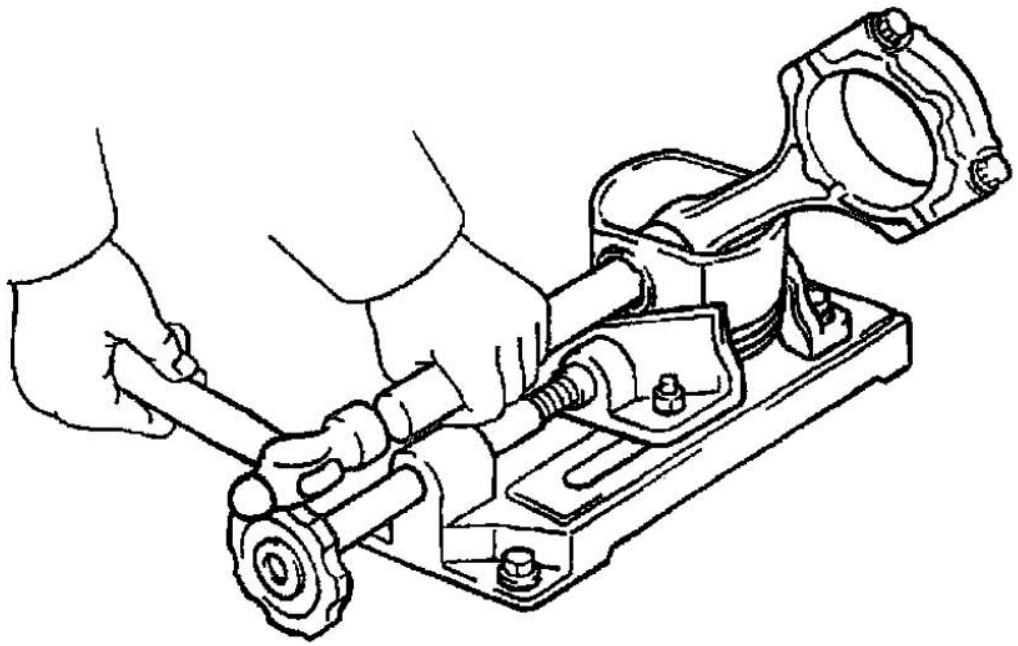
Fig. 263: Heating Pistons
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

NOTE:

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

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Fig. 264: Removing Connecting Rod From Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

INSPECTION

1. **Clean cylinder block** .
   a. Remove the gasket material.

      Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

   b. Clean the cylinder block.

      Using a soft brush and solvent, thoroughly clean the cylinder block.

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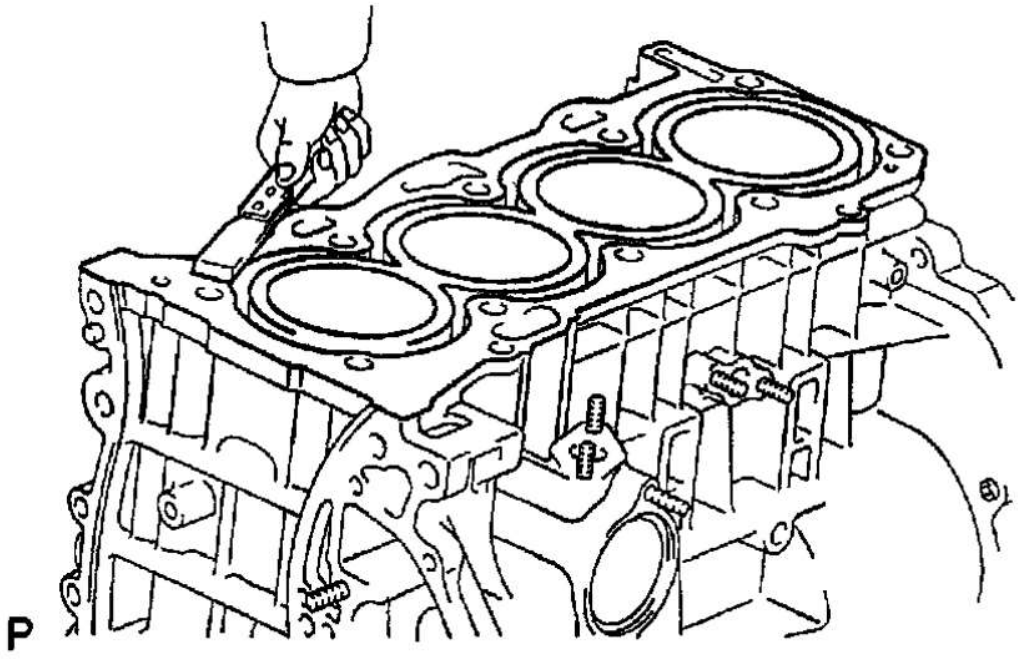


Fig. 265: Cleaning Cylinder Block
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

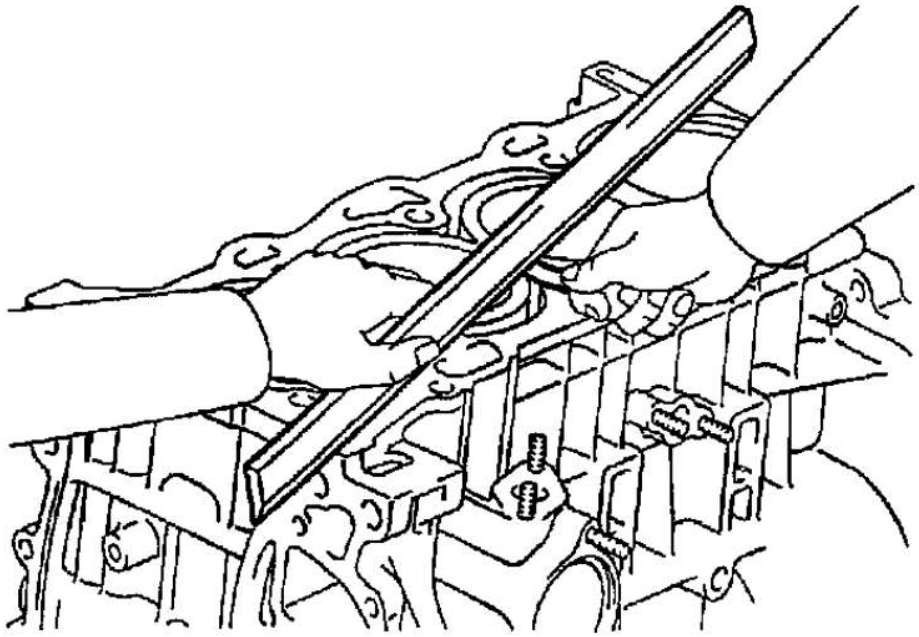
NOTE: If the cylinder is washed at high temperatures, the cylinder liner sticks out beyond the cylinder block, so always wash the cylinder block at a temperature of 45°C (133°F) or less.

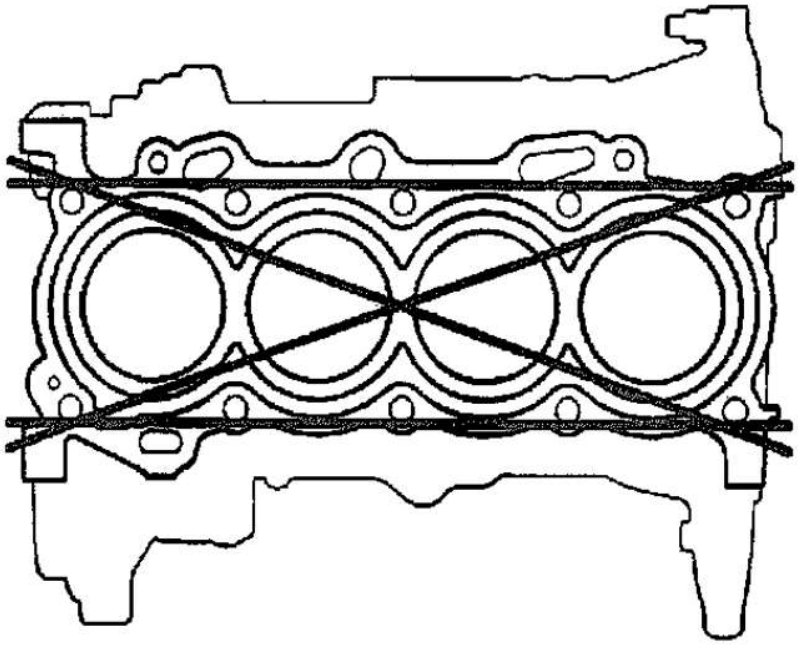
2. **Inspect cylinder block** .
   a. Inspect for flatness.

   Using a precision straight edge and a feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

   Maximum warpage: 0.08 mm (0.0031 in.)

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Fig. 266: Inspecting For Flatness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

b. Visually check the cylinder for vertical scratches.

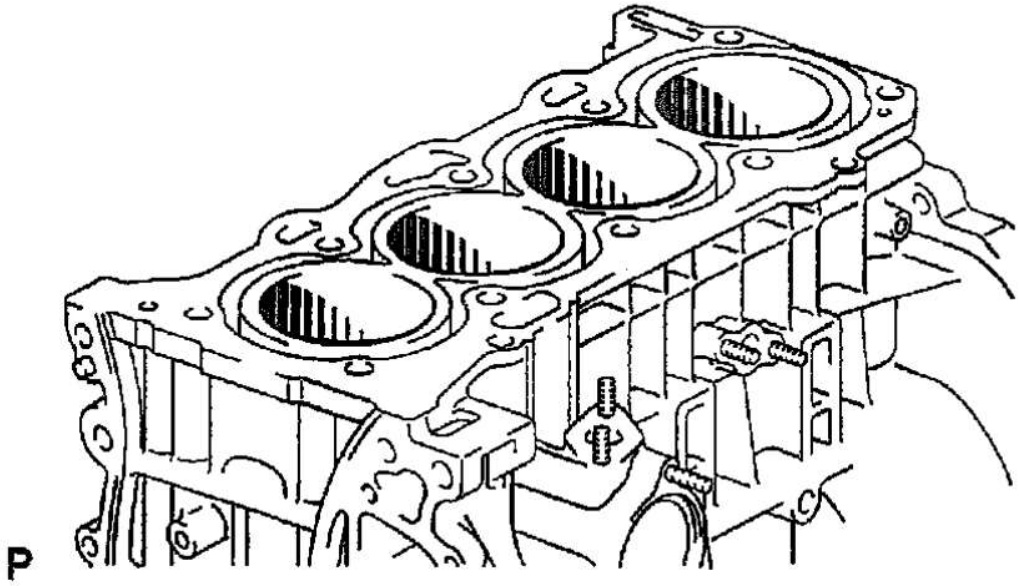


Fig. 267: Checking For Vertical Scratches
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If deep scratches are present, replace the cylinder block.

c. Inspect the cylinder bore diameter.

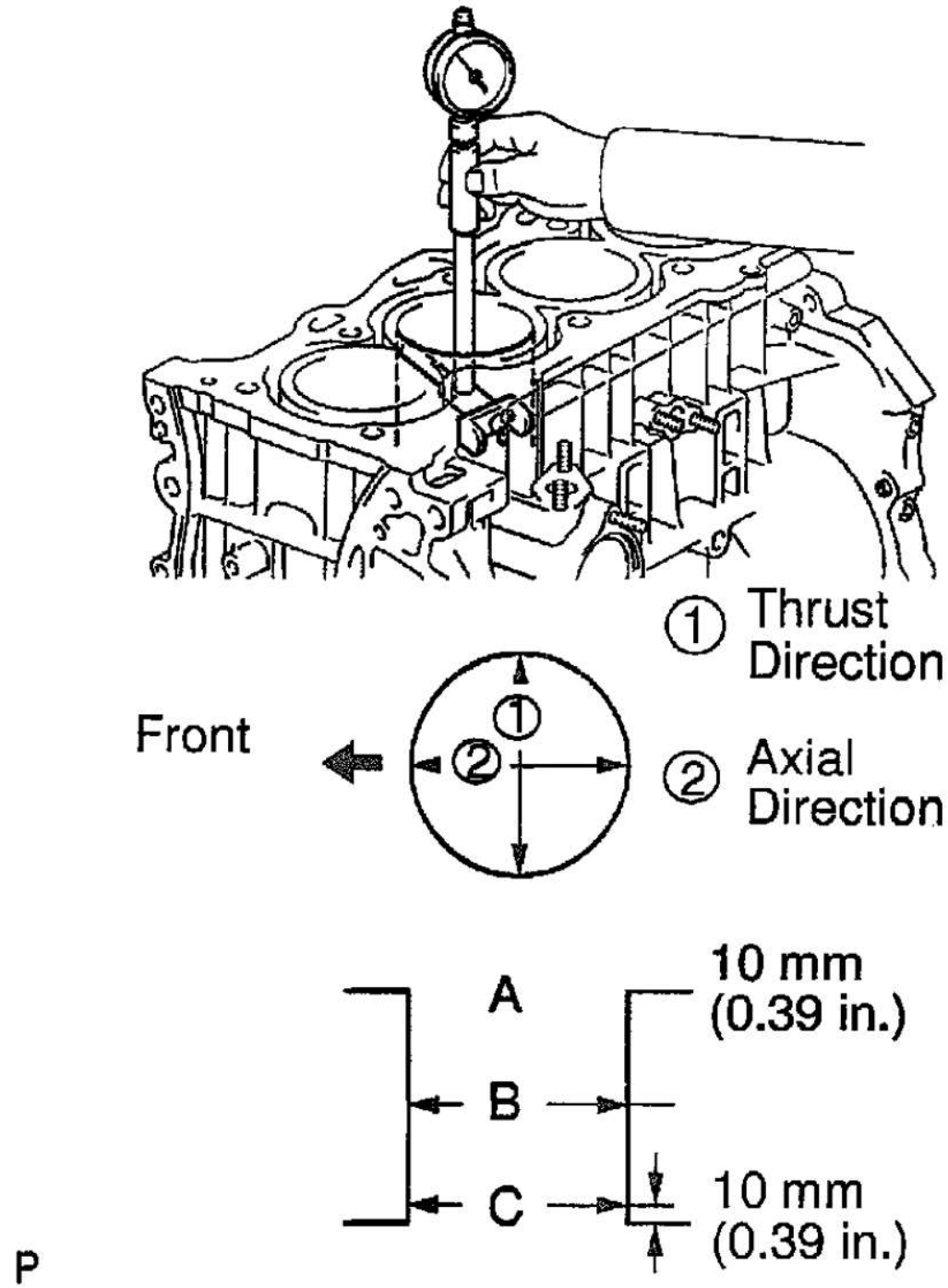
Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

Standard diameter: 86.000 - 86.013 mm (3.3858 - 3.3863 in.)

Maximum diameter: 86.013 mm (3.3863 in.)

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

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Fig. 268: Measuring Cylinder Bore Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **Remove cylinder ridge** .

   If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.

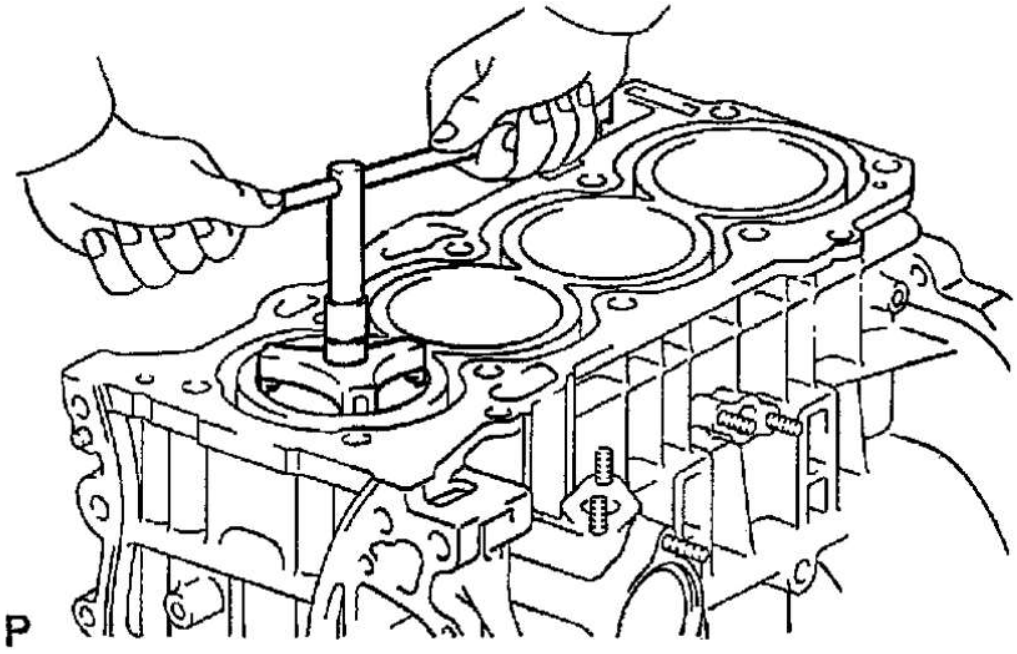
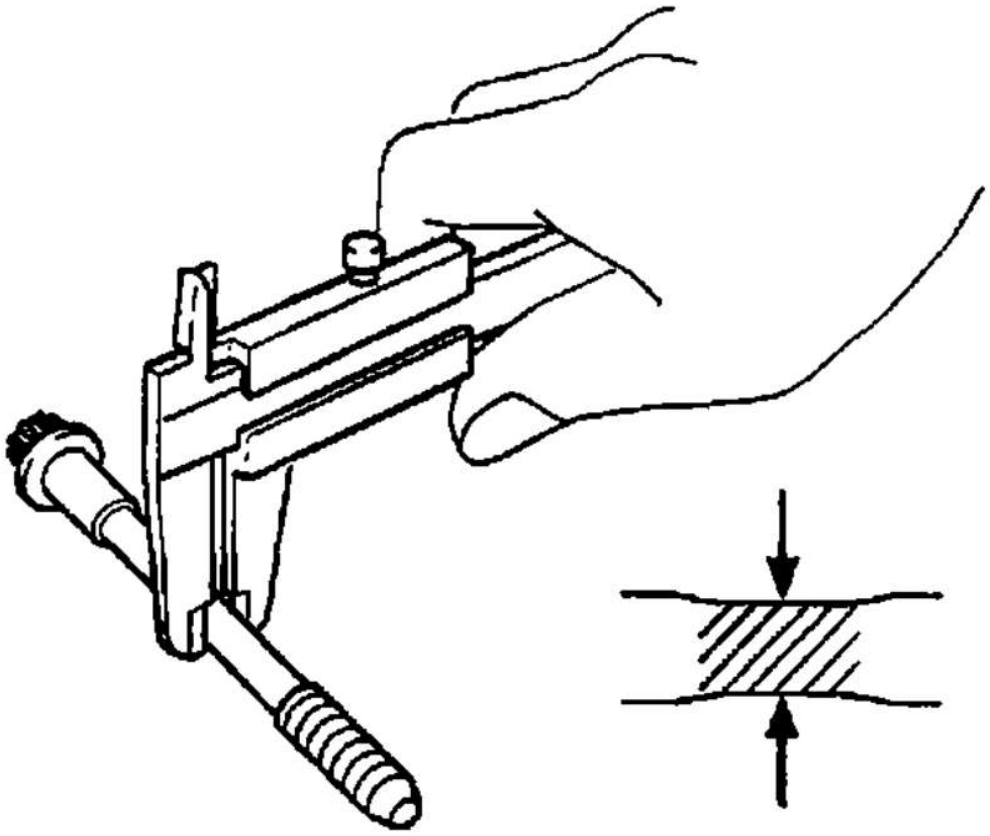


Fig. 269: Removing Cylinder Ridge
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Inspect crankshaft bearing cap bolts** .

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Fig. 270: Measuring Tension Portion Diameter Of Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using vernier calipers, measure the tension portion diameter of the bolt.

Standard diameter: 7.5 - 7.6 mm (0.2953 - 0.2992 in.)

Minimum diameter: 7.2 mm (0.284 in.)

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

5. **Clean piston** .
   a. Using a gasket scraper, remove the carbon from the piston top.

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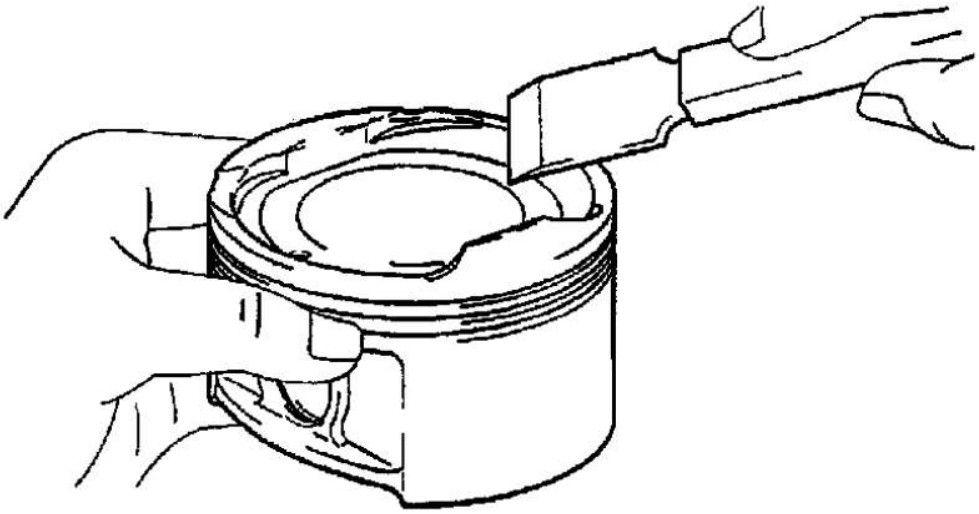


Fig. 271: Displaying Piston Top
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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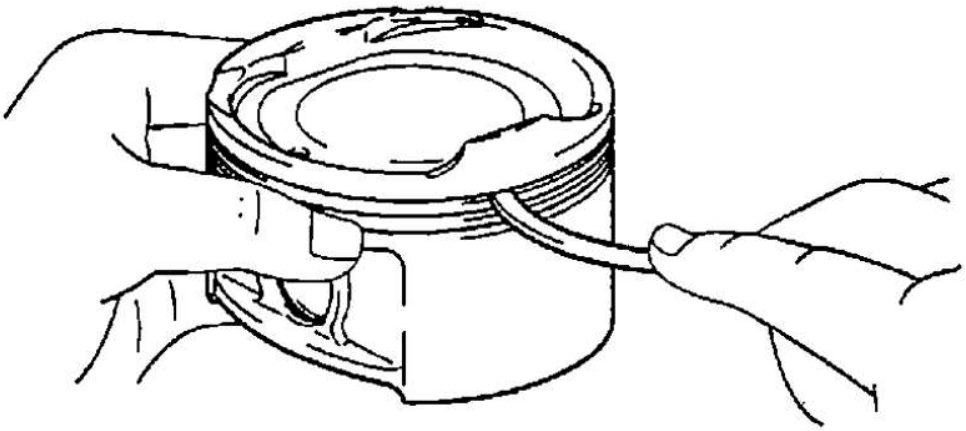


Fig. 272: Cleaning Piston Ring Grooves
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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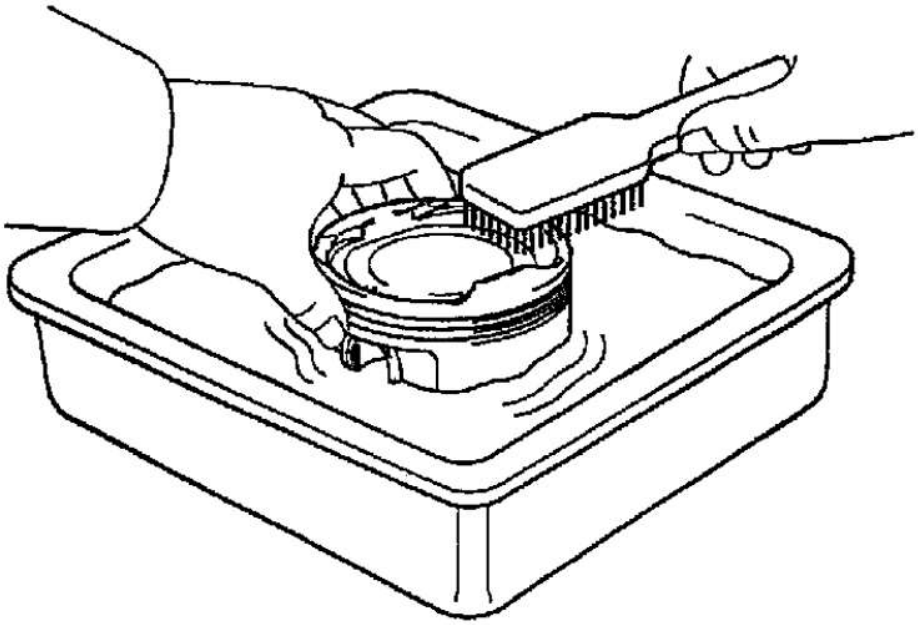


Fig. 273: Cleaning Piston
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not use a wire brush.

6. **Inspect piston** .
   a. Inspect the piston oil clearance.
      1. Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 30.4 mm (1.1968 in.) from the piston head.

         Piston diameter: 85.927 - 85.937 mm (3.3829 - 3.3833 in.)
      2. Measure the cylinder bore diameter in the thrust directions (See step 2).

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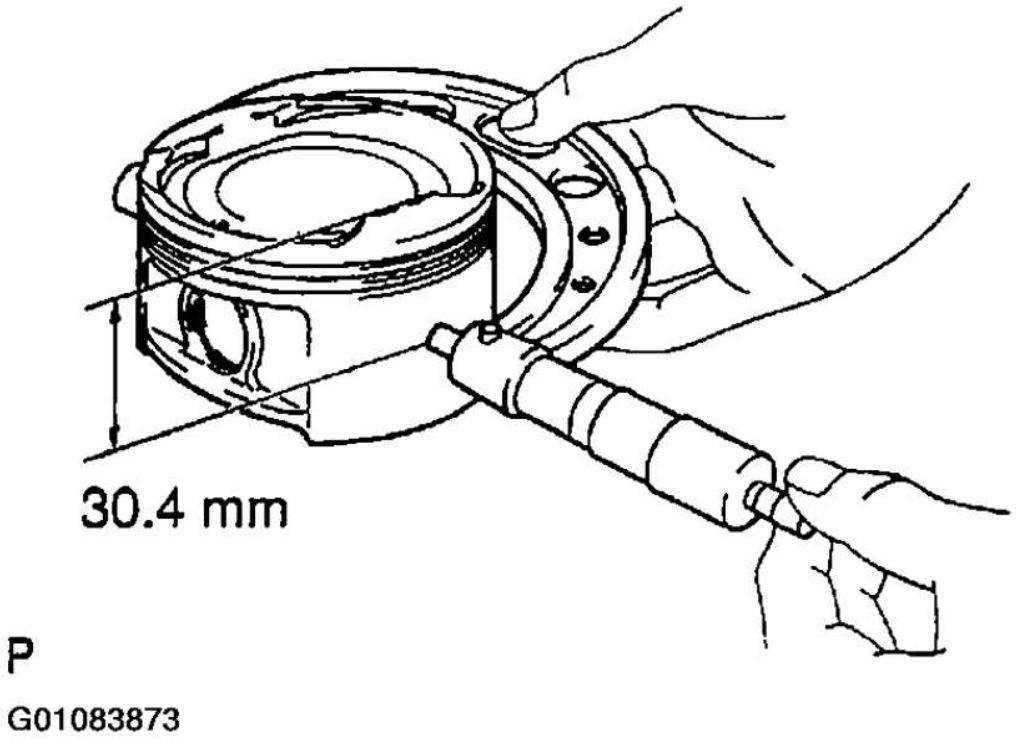


Fig. 274: Inspecting Piston Oil Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

   Standard oil clearance: 0.063 - 0.086 mm (0.0025 - 0.0034 in.)

   Maximum oil clearance: 0.10 mm (0.0039 in.)

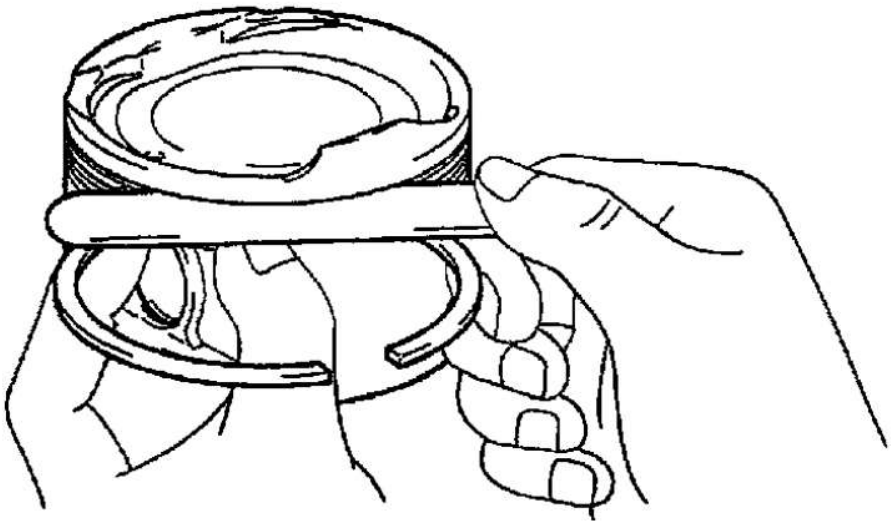
   If the oil clearance is greater than maximum, replace all the 4 pistons. If necessary, replace the cylinder block.

b. Inspect the piston ring groove clearance.

   Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

   Ring groove clearance:

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Fig. 275: Displaying Piston Ring Groove
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

No. 1	0.020 – 0.070 mm (0.0008 – 0.0028 in.)
No. 2	0.020 – 0.060 mm (0.0008 – 0.0024 in.)
Oil (Side rail)	0.070 – 0.150 mm (0.0028 – 0.0059 in.)

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Fig. 276: Ring Groove Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

c. Inspect the piston ring end gap.
   1. Insert the piston ring into the cylinder bore.
   2. Using the 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.

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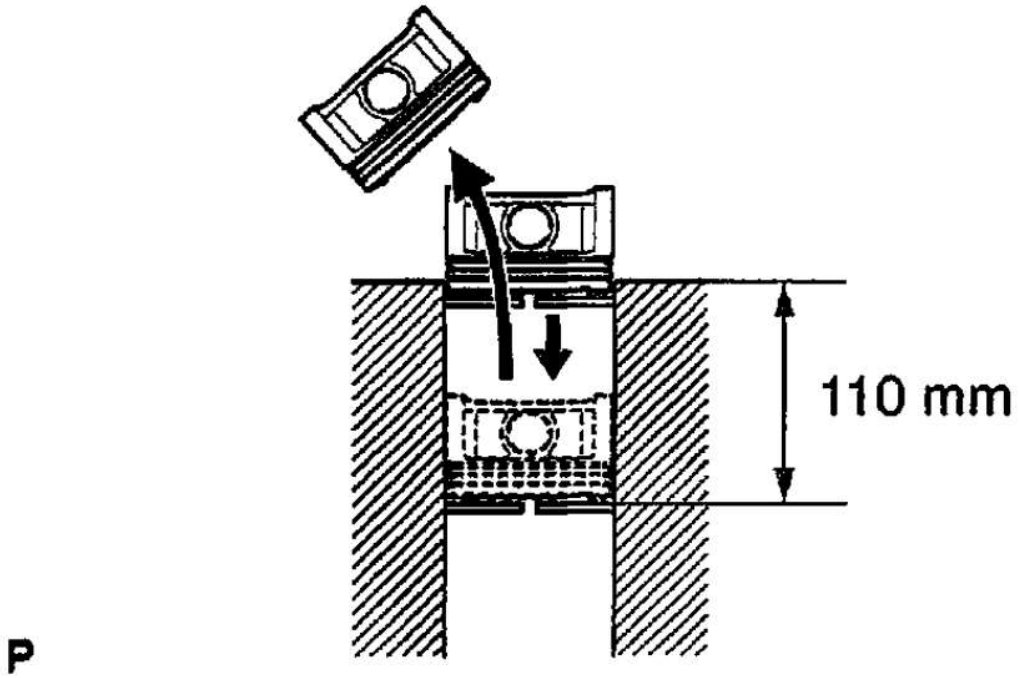
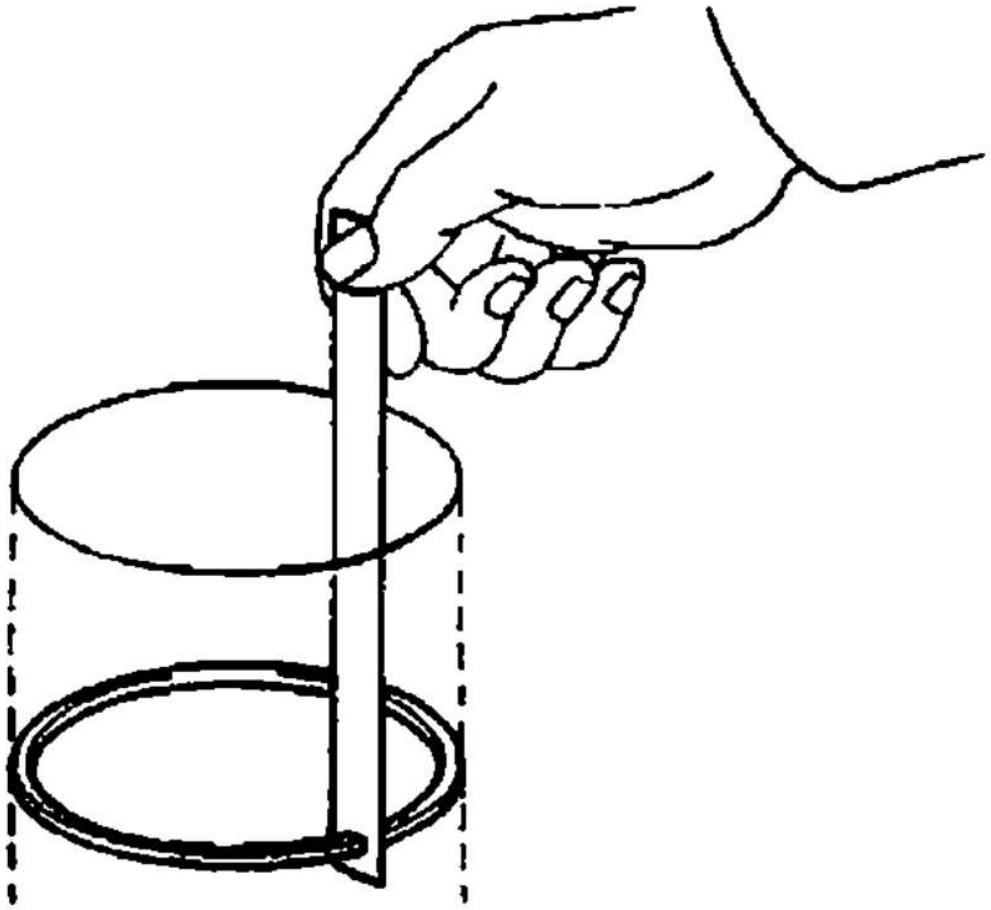


Fig. 277: Inspecting Piston Ring End Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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Fig. 278: Measuring End Gap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard end gap:

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No. 1	0.30 – 0.40 mm (0.0118 – 0.0157 in.)
No. 2	0.47 – 0.62 mm (0.0185 – 0.0244 in.)
Oil (side rail)	0.10 – 0.35 mm (0.0039 – 0.0138 in.)

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Fig. 279: Displaying Standard End Gap Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum end gap:

No. 1	0.89 mm (0.0350 in.)
No. 2	1.37 mm (0.0539 in.)
Oil (side rail)	0.73 mm (0.0287 in.)

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Fig. 280: Displaying Maximum End Gap Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the end gap is greater than maximum, replace the piston ring. If the end gap is greater than maximum, even with a new piston ring, replace the cylinder block.

d. Inspect the piston pin fit.

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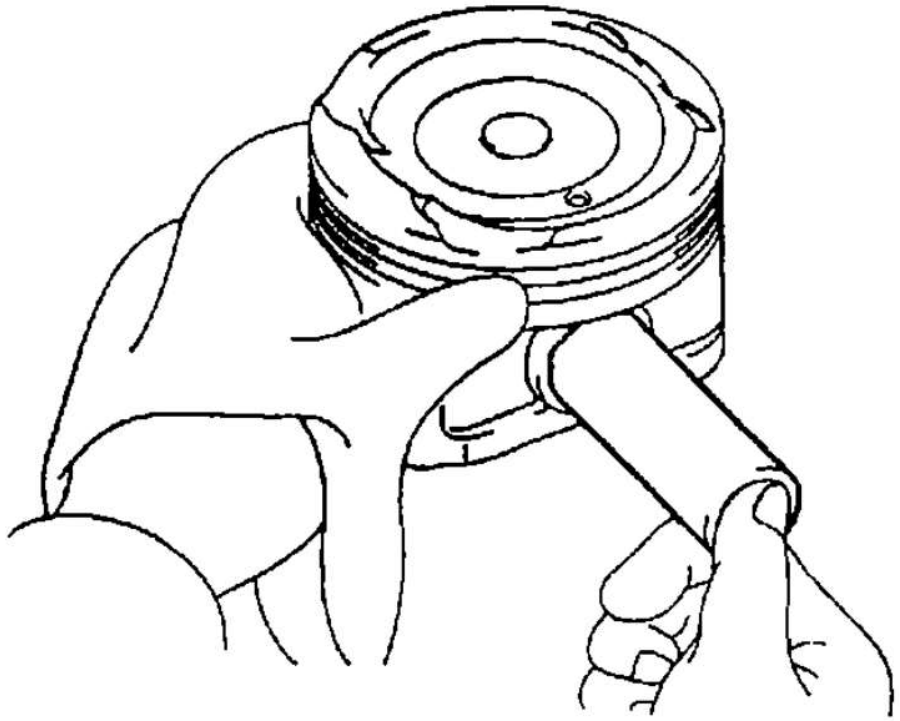


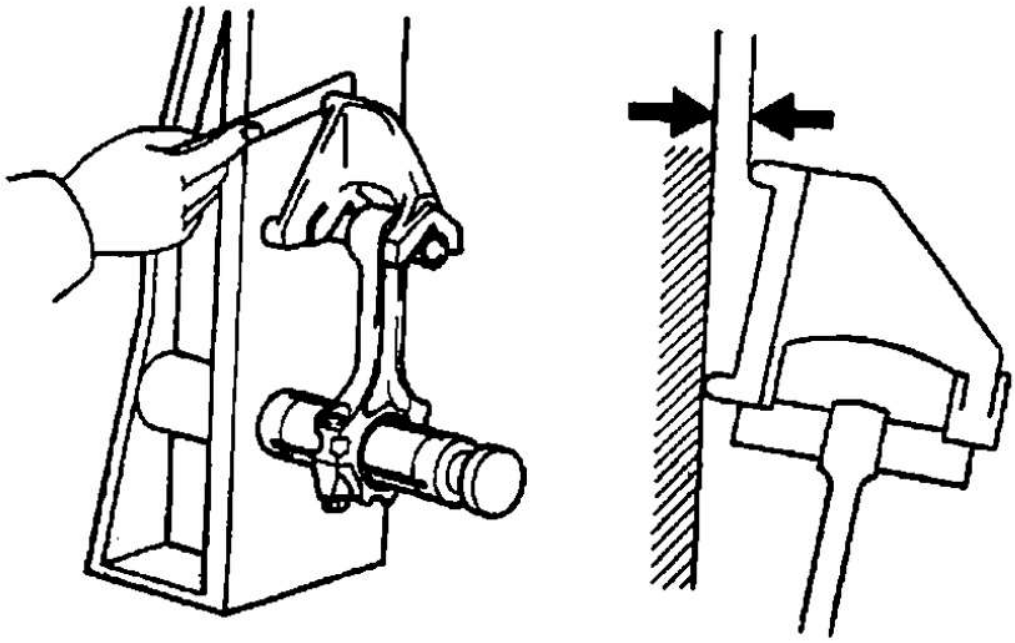
Fig. 281: Inspecting Piston Pin Fit
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

At 80 - 90°C (176 - 194°F), you should be able to push the piston pin into the piston pin hole with your thumb.

7. **Inspect connecting rod** .
   a. Using a rod aligner and a 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.)

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Fig. 282: Inspecting For Out Of Alignment
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

2. Check for twist.

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

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

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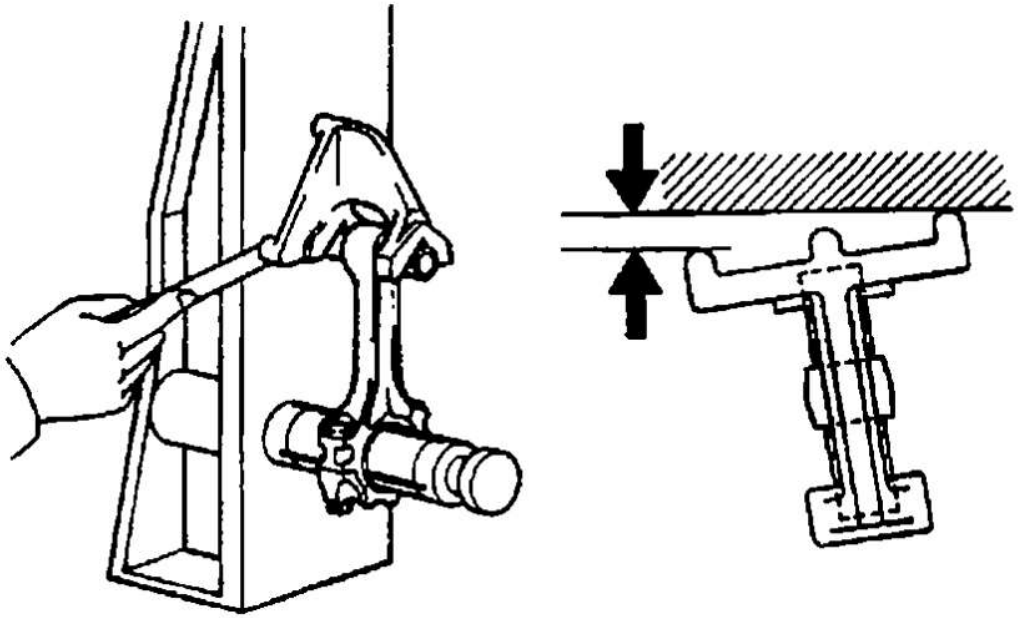


Fig. 283: Checking For Twist
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Inspect the piston pin oil clearance.
   1. Using a caliper gauge, measure the inside diameter of the connecting rod bushing.
      Bushing inside diameter: 22.005 - 22.014 mm (0.8663 - 0.8667 in.)

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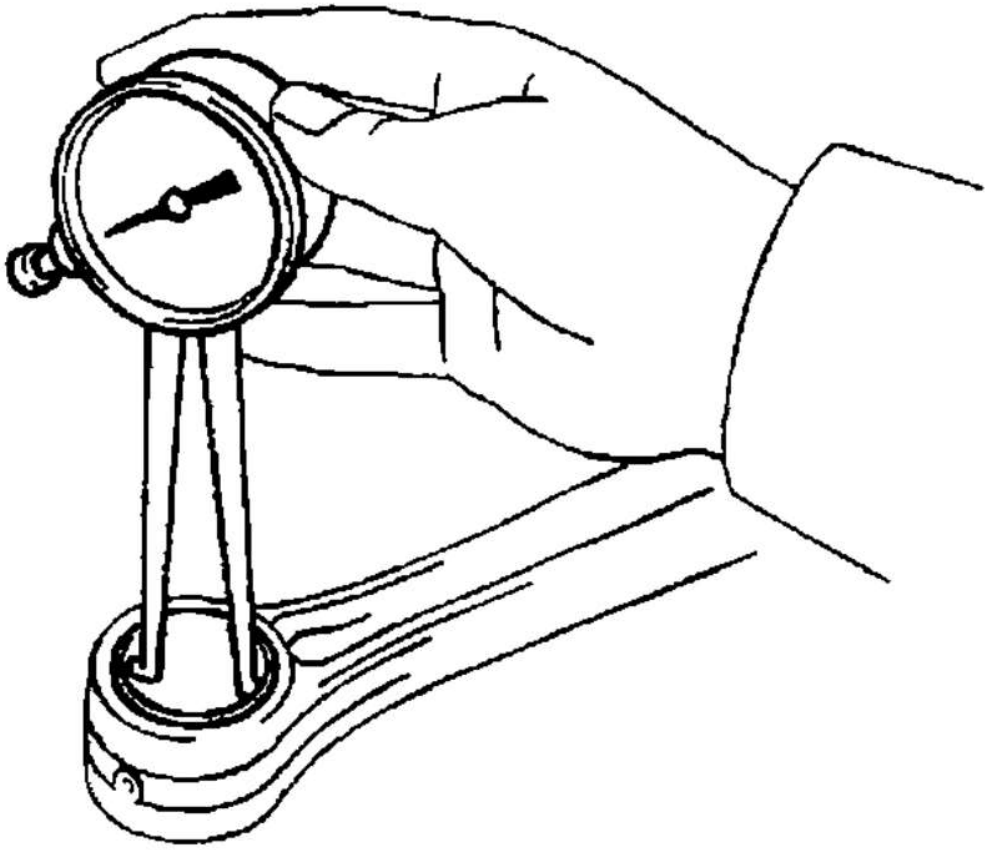


Fig. 284: Inspecting Piston Pin Oil Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

   Piston pin diameter: 21.997 - 22.006 mm (0.8660 - 0.8664 in.)

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

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

   Maximum oil clearance: 0.05 mm (0.0020 in.)

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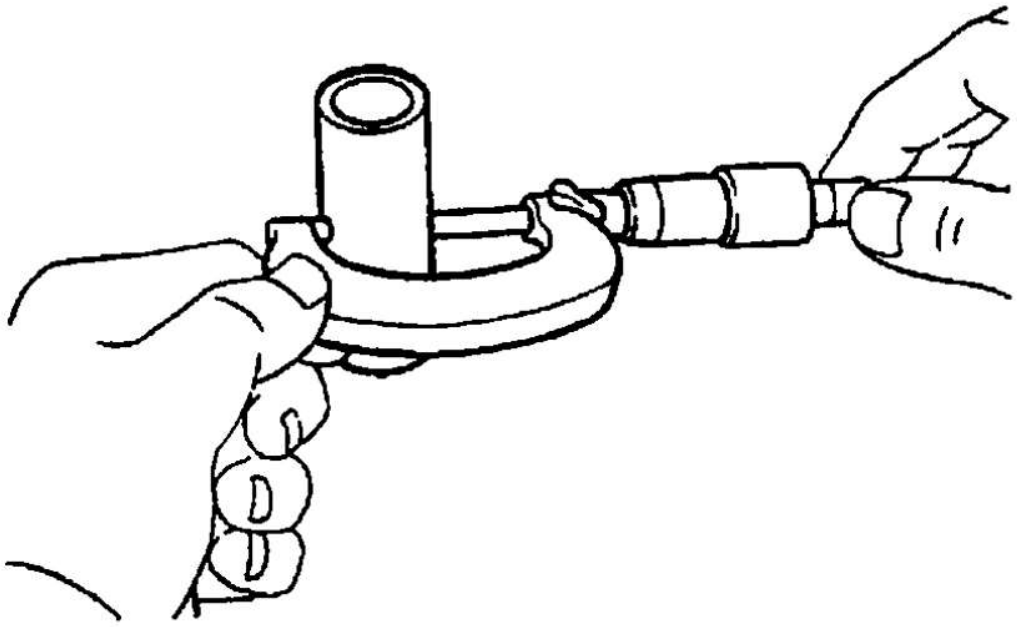
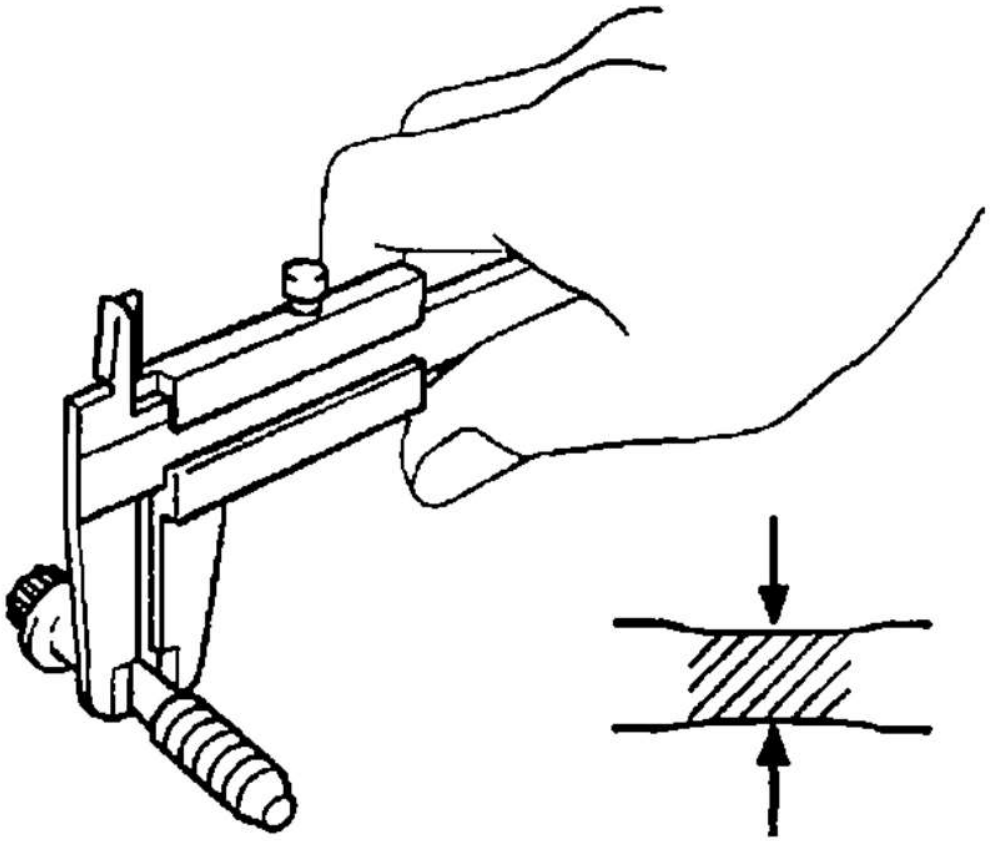


Fig. 285: Measuring Piston Pin Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the oil clearance is greater than maximum, replace the bushing (See **REPLACEMENT**). If necessary, replace the piston and piston pin as a set.

8. **Inspect connecting rod bolts** .

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Fig. 286: Inspecting Connecting Rod Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using vernier calipers, measure the tension portion diameter of the bolt.

Standard diameter: 7.2 - 7.3 mm (0.283 - 0.287 in.)
Minimum diameter: 7.0 mm (0.276 in.)

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

9. **Inspect crankshaft** .
   a. Inspect for circle runout.
      1. Place the crankshaft on V-blocks.
      2. Using a dial indicator, measure the circle runout, as shown in the illustration.

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Maximum circle runout: 0.03 mm (0.0012 in.)

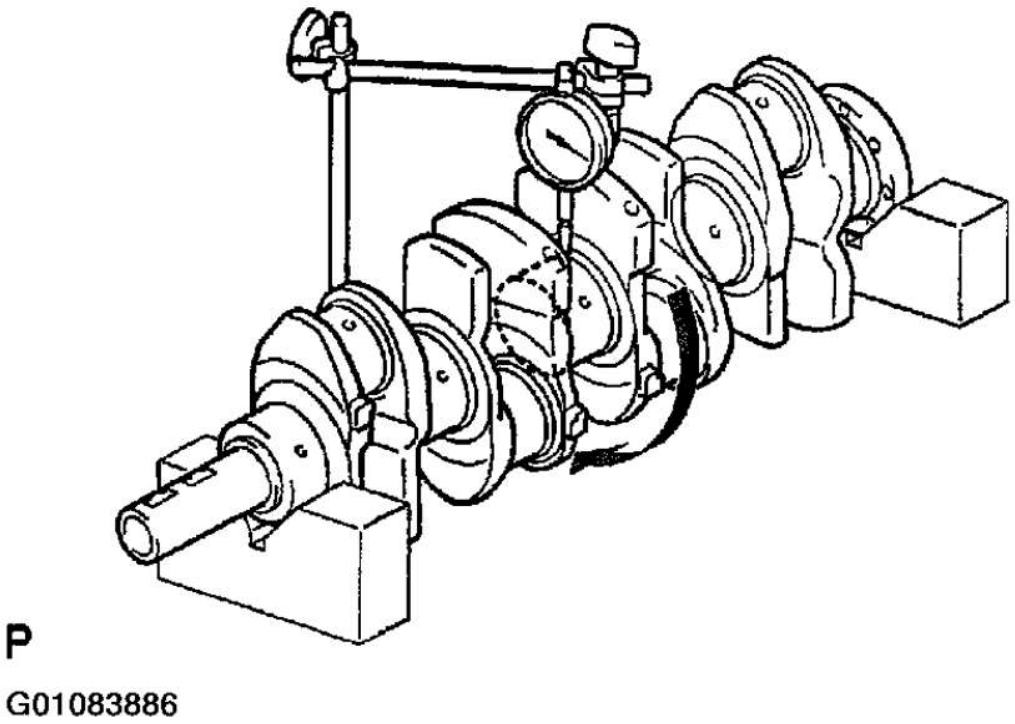


Fig. 287: Measuring Circle Runout
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

b. Inspect the main journals and crank pins.

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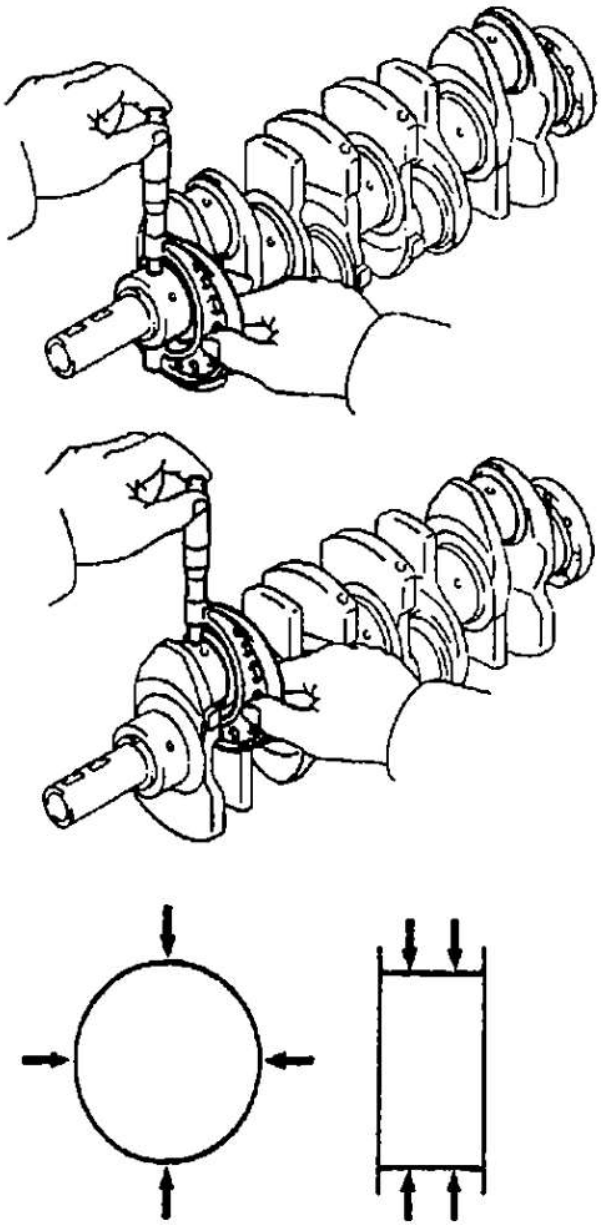


Fig. 288: Inspecting Main Journals & Crank Pins
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a micrometer, measure the diameter of each main journal and crank pin.

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Diameter:

Main journal	54.988 – 55.000 mm (2.1649 – 2.1654 in.)
Crank pin	47.990 – 48.000 mm (1.8894 – 1.8898 in.)

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Fig. 289: Displaying Diameter Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the diameter is not as specified, check the oil clearance (See **DISASSEMBLY**). If necessary, replace the crankshaft.

Check each main journal and crank pin for taper and out-of-round as shown.

Maximum taper and out-of-round: 0.003 mm (0.0001 in.)

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

REPLACEMENT

1. **Replace connecting rod bushings** .
   a. Using SST and a press, press out the bushing.
      SST 09222-30010

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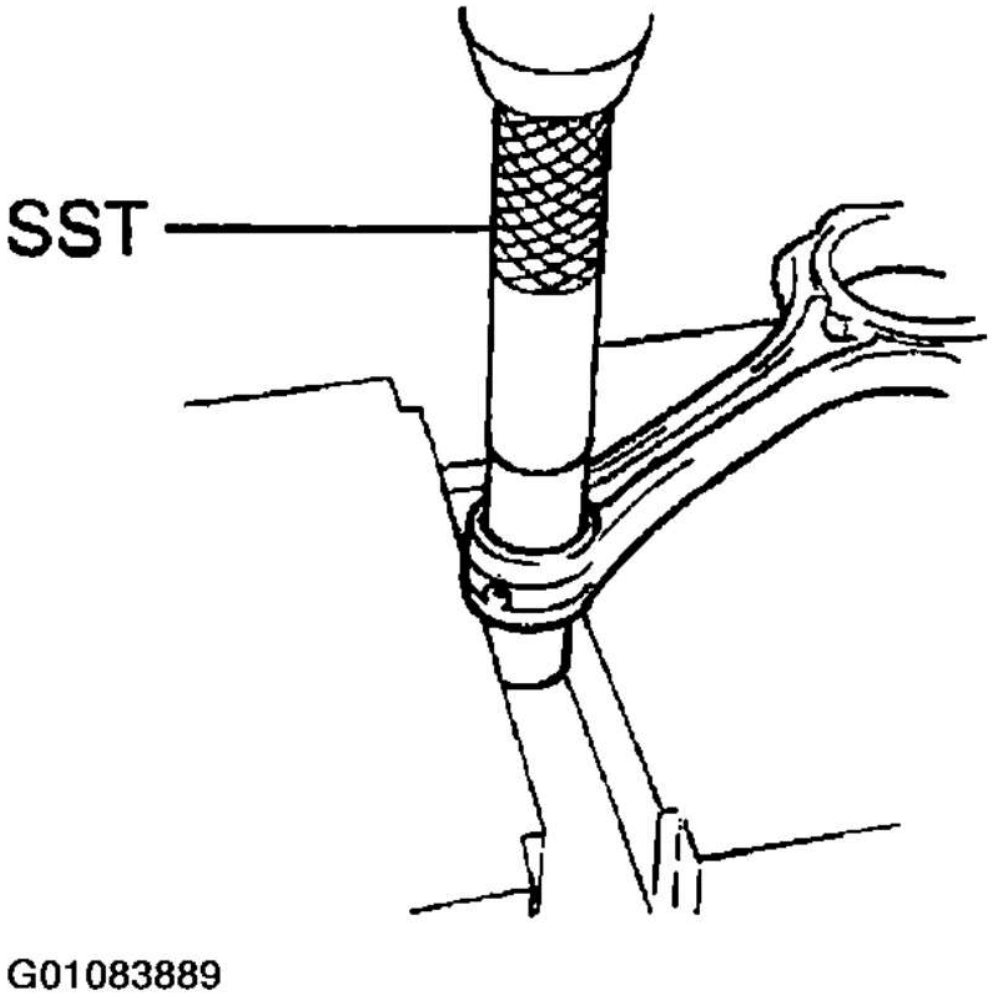


Fig. 290: Pressing Out The Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Align the oil hoses of a new bushing and the connecting rod.

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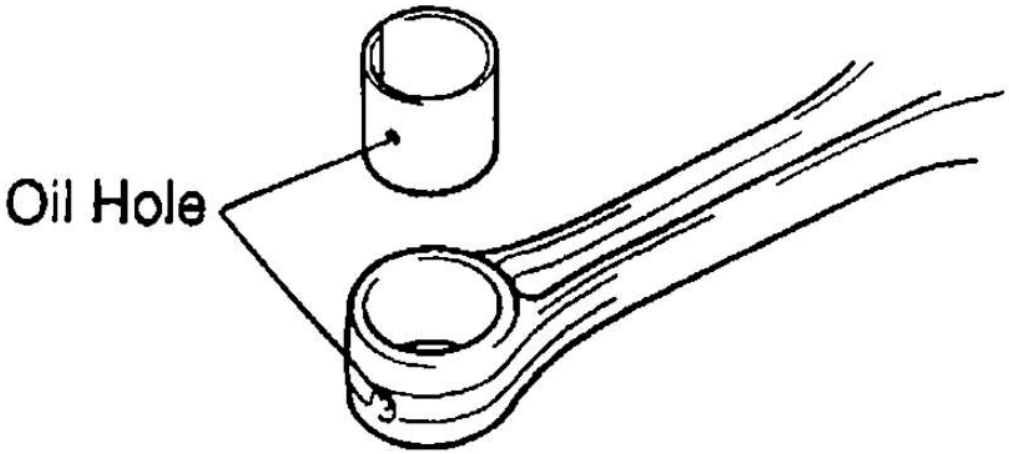


Fig. 291: Identifying Oil Hole
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Using SST and a press, press in the bushing.
SST 09222-30010

d. Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (See **INSPECTION**) between the bushing and piston pin.

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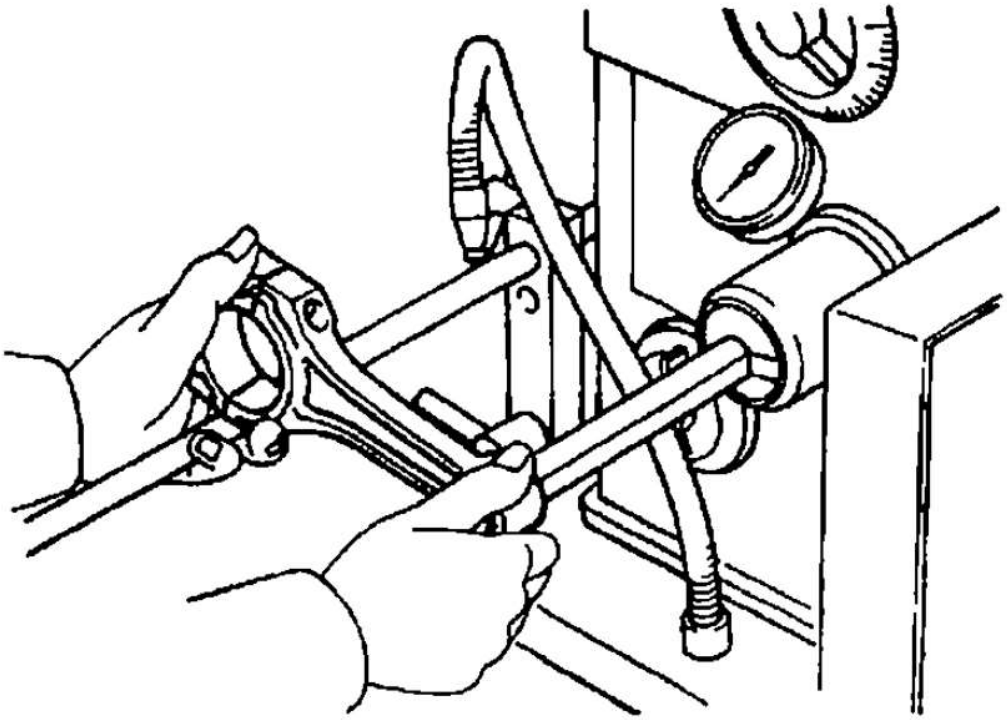
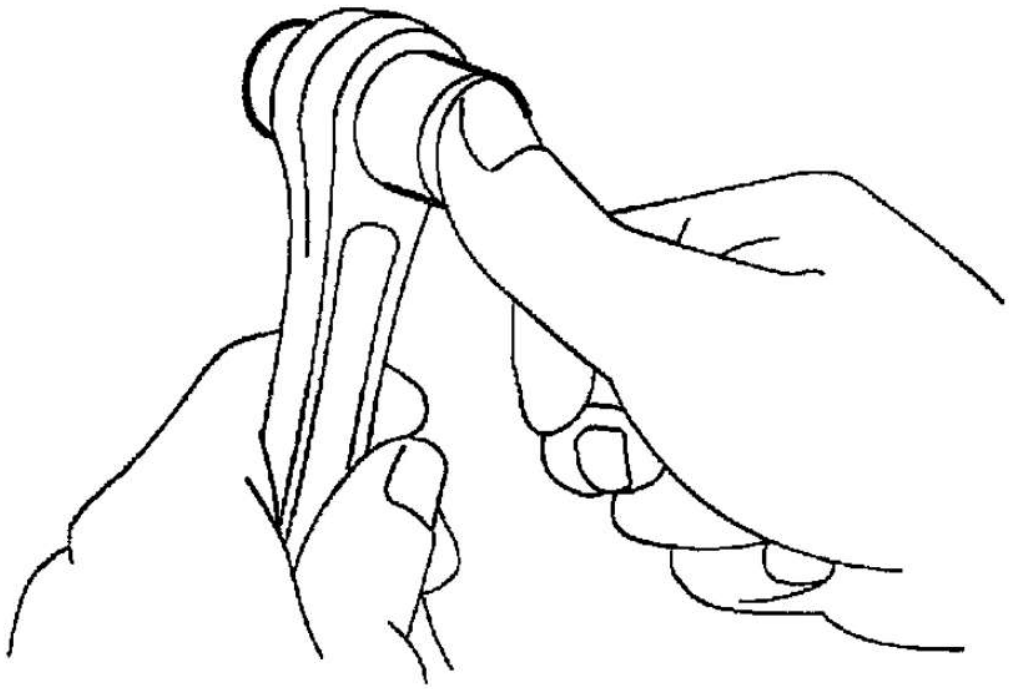


Fig. 292: Displaying Pin Hole Grinder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.

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Fig. 293: Checking Piston Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. **Replace crankshaft rear oil seal** .

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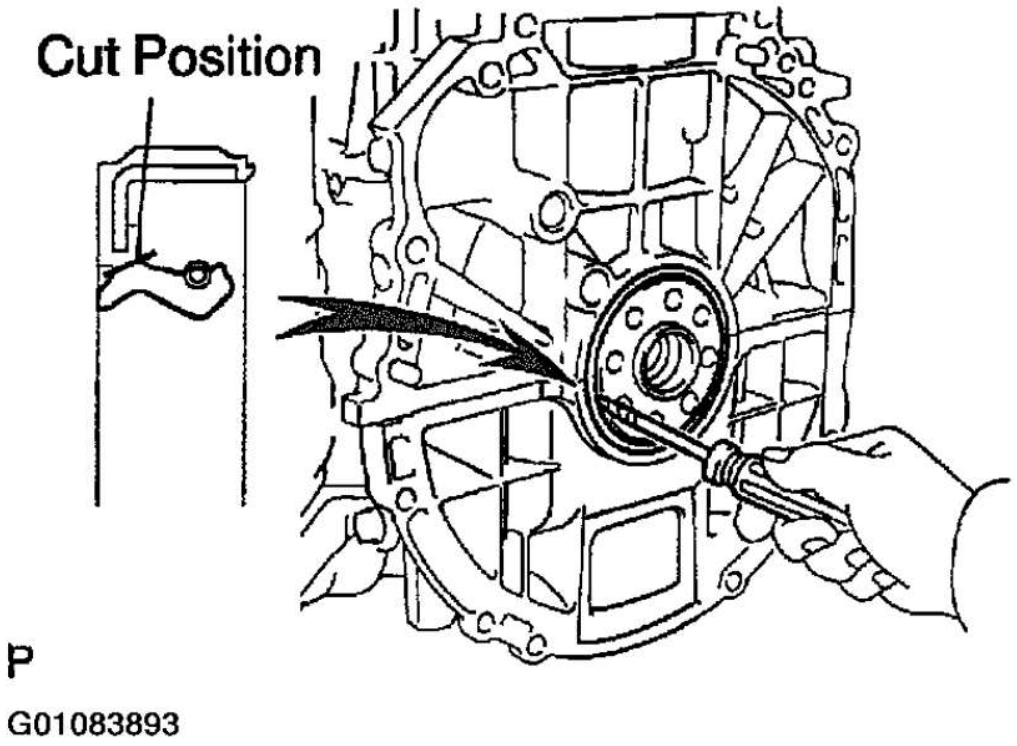


Fig. 294: Replacing Crankshaft Rear Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If the rear oil seal is installed to the cylinder block.

1. Using a knife, cut off the oil seal lip.
2. Using a screwdriver, pry out the oil seal.

NOTE: Be careful not to damage the crankshaft. Tape the screwdriver tip.

3. Apply MP grease to a new oil seal lip.
4. Using SST and a hammer, tap in the oil seal until its surface is flush with the oil seal retainer edge.
   SST 09223-15030, 09950-70010 (09951-07100)

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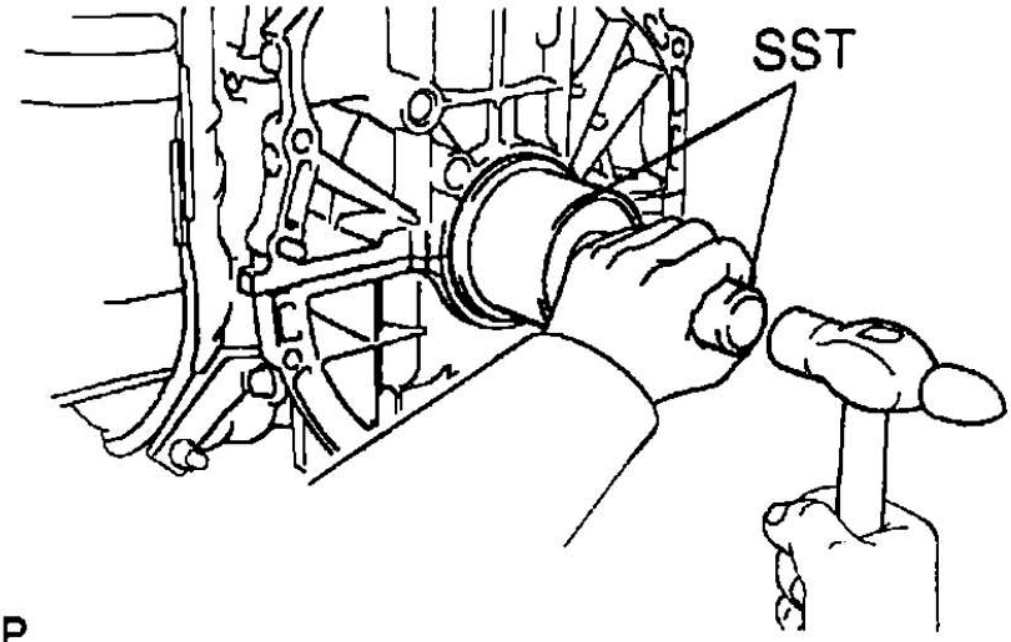


Fig. 295: Tapping In Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REASSEMBLY

NOTE:

- **Thoroughly clean all parts to be assembled.**
- **Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.**
- **Replace all gaskets, O-rings and oil seals with new parts.**

1. **Assemble piston and connecting rod** .
   a. Using a small screwdriver, install a new snap ring at one end of the piston pin hole.

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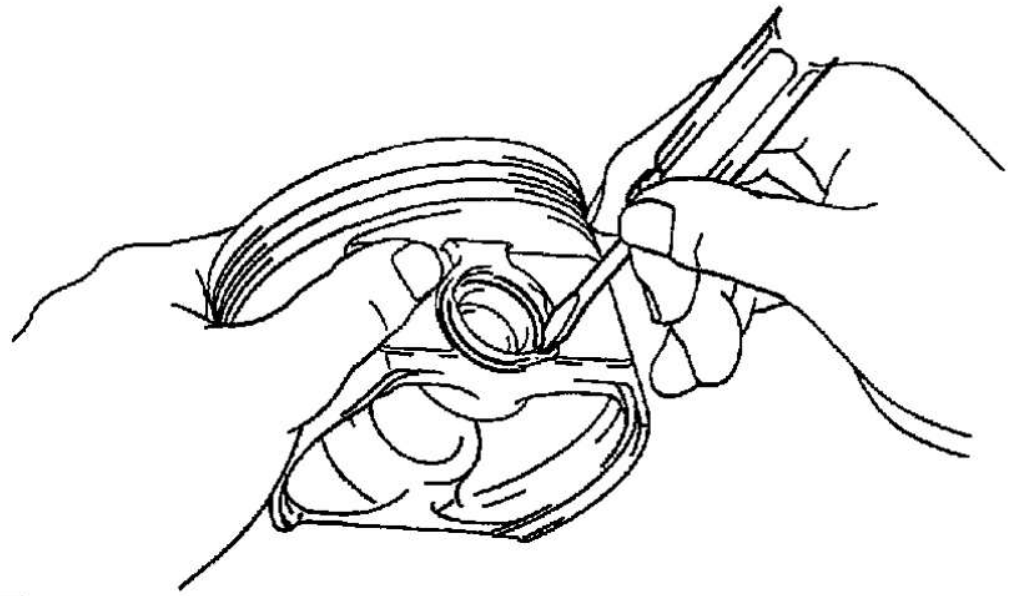


Fig. 296: Installing New Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

b. Gradually heat the piston to 80 - 90°C (176 - 194°F).

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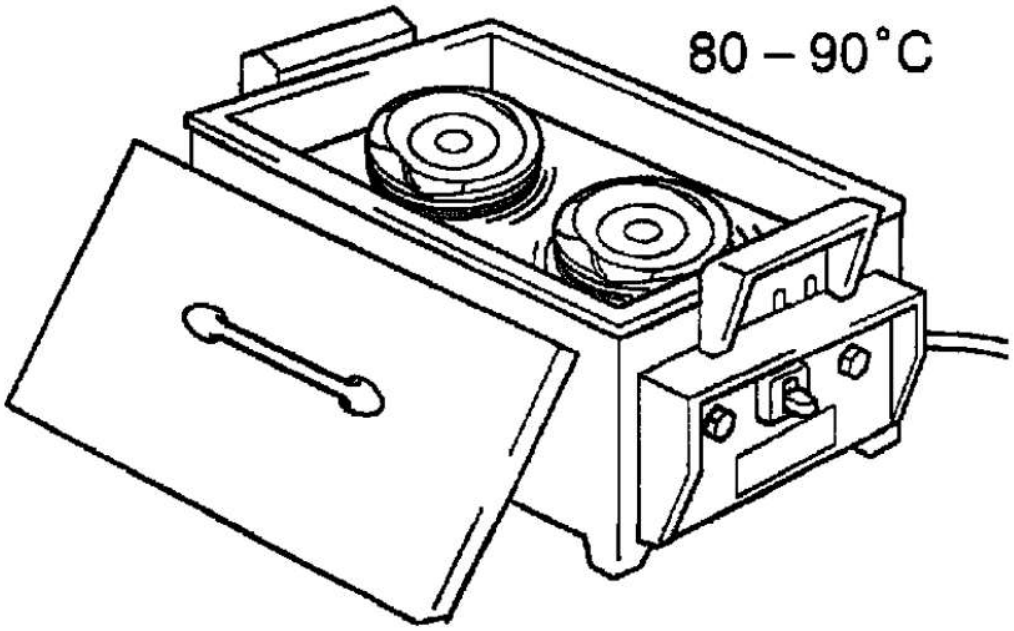


Fig. 297: Heating Piston To Appropriate Temperature
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

c. Coat the piston pin with engine oil.
d. Align the front marks on the piston and connecting rod, and push in the piston with your thumb.

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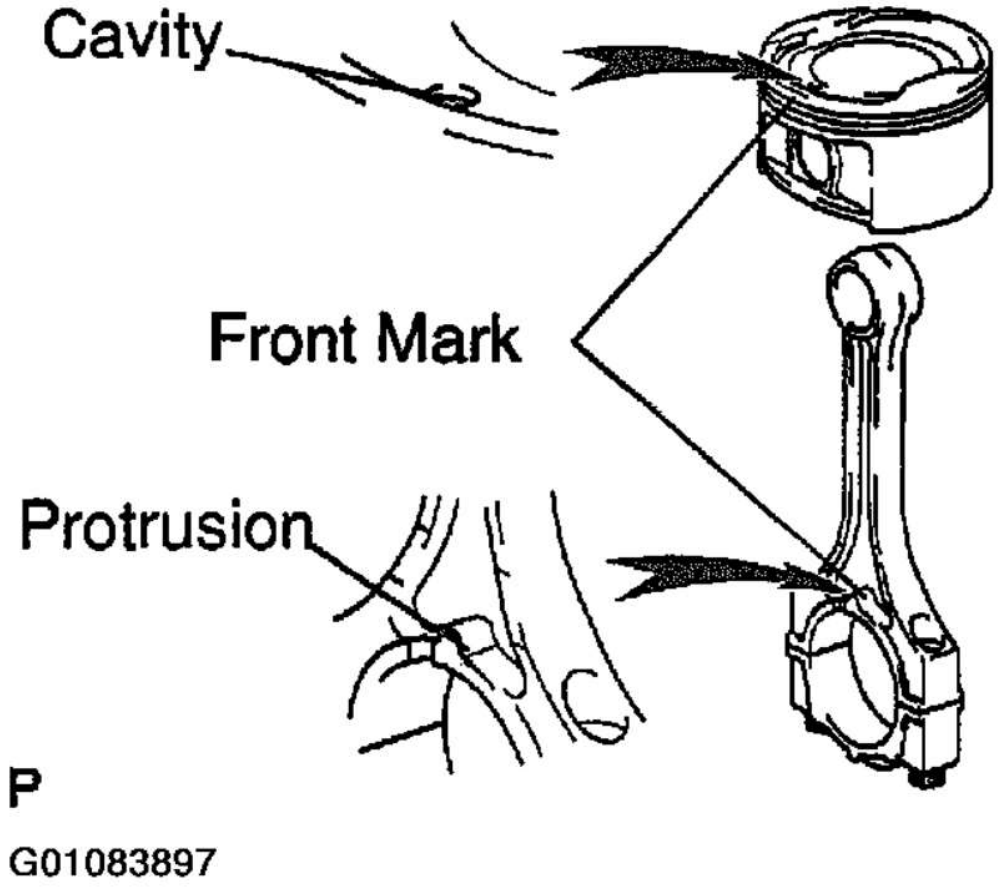


Fig. 298: Aligning Piston & Connecting Rod
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Using a small screwdriver, install a new snap ring on the other end of the piston pin hole.

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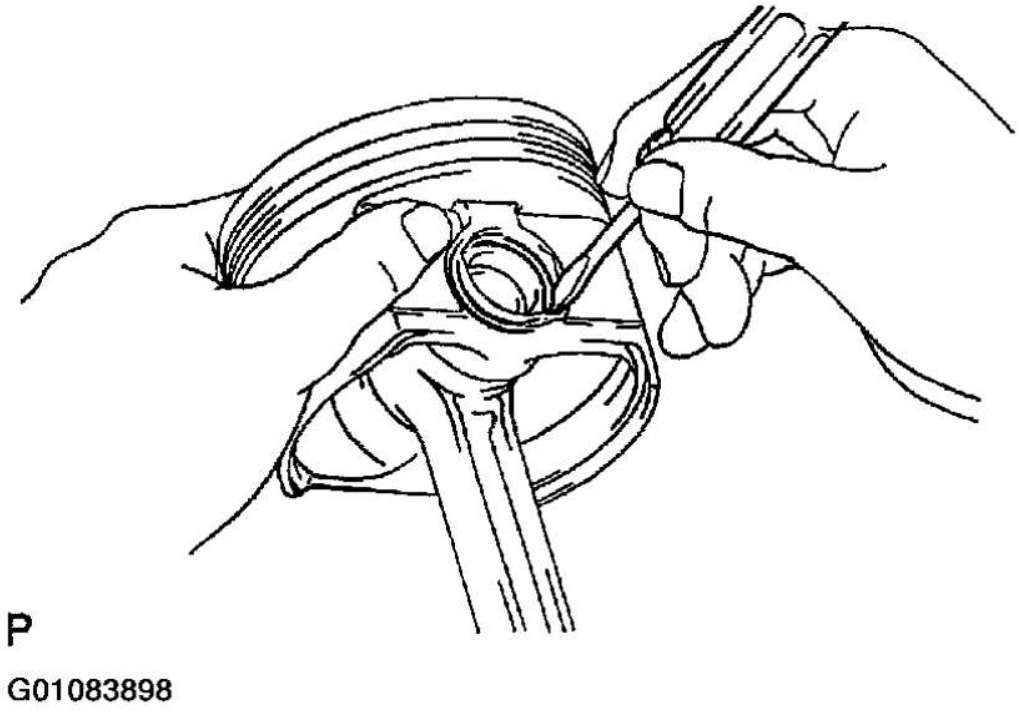
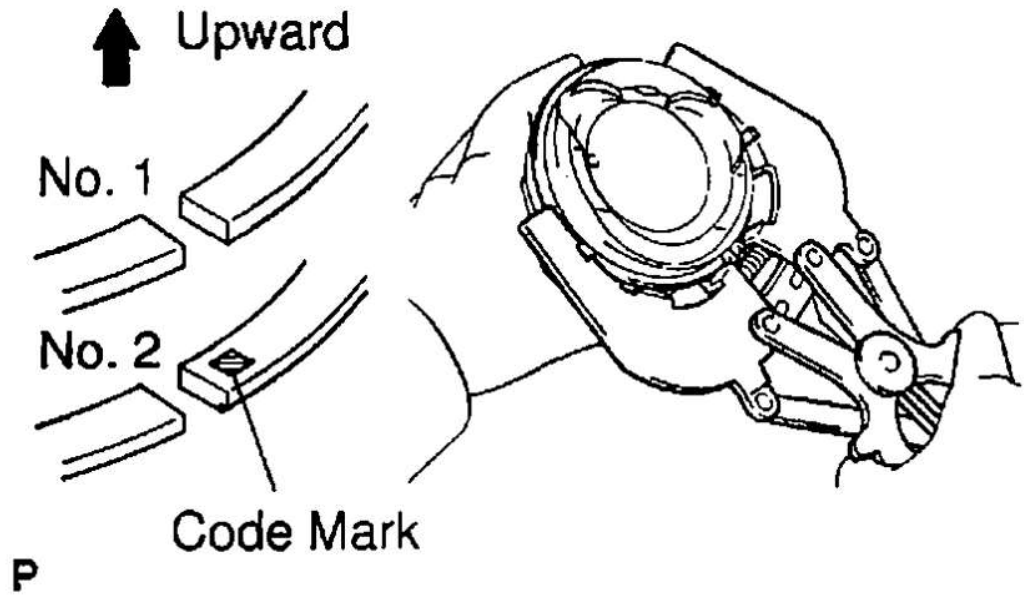


Fig. 299: Installing New Snap Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

2. **Install piston rings** .
   a. Install the oil ring expander and 2 side rails by hand.
   b. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

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Fig. 300: Displaying Compressor Rings Installation
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Code mark:

No. 1	None
No. 2	T

G01083899

Fig. 301: Displaying Code Mark Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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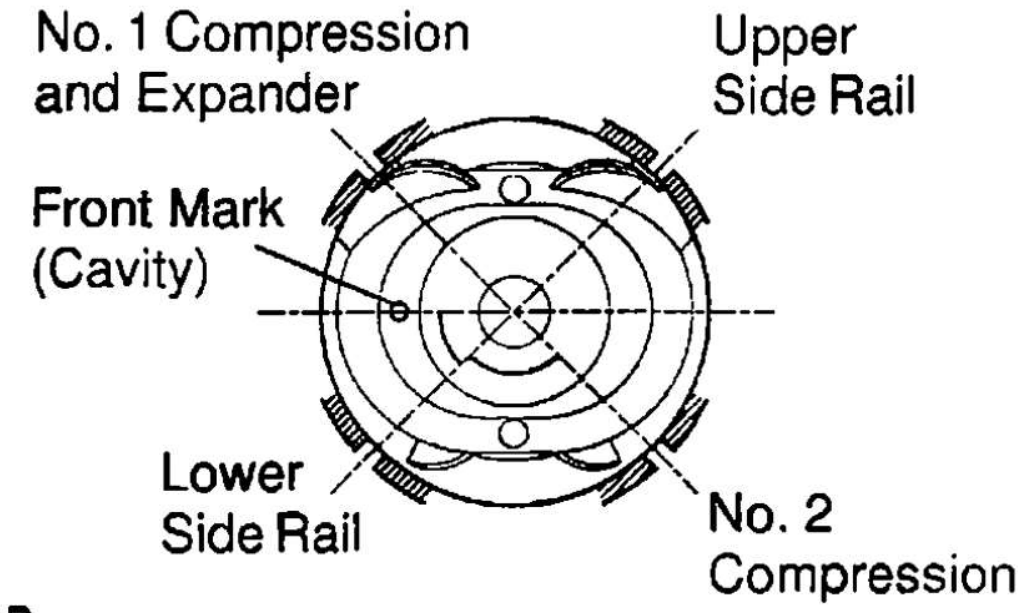
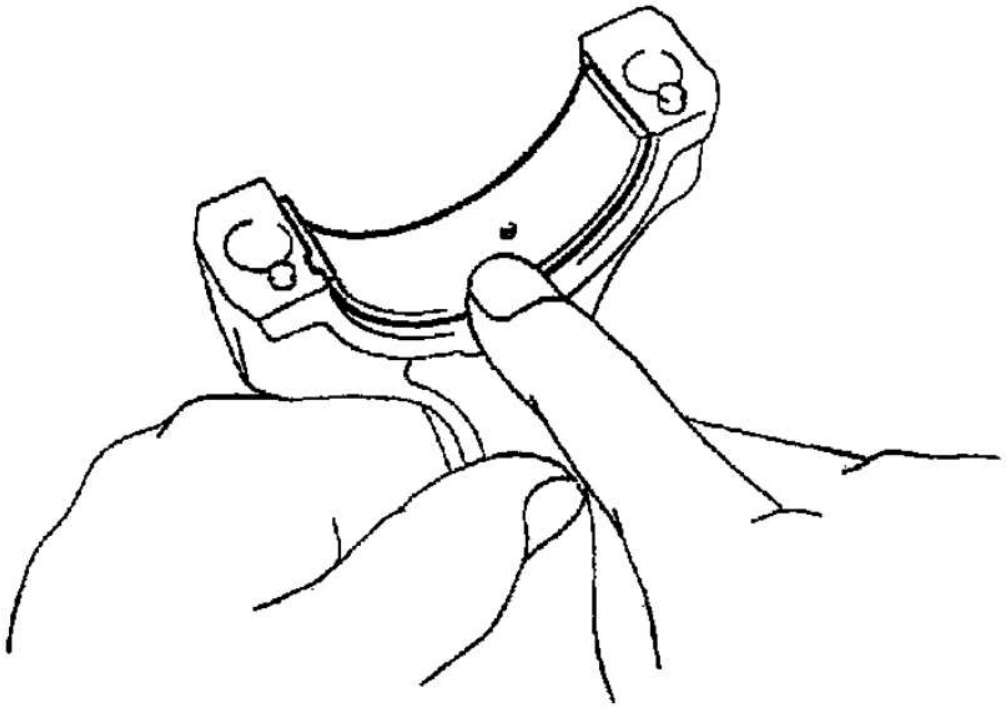


Fig. 302: Displaying Piston Rings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not align the ring ends.

3. **Install connecting rod bearings** .
   a. Align the bearing claw with the groove of the connecting rod or connecting cap.
   b. Install the bearings in the connecting rod and connecting rod cap.

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G01083902

Fig. 303: Installing Connecting Rod Bearings
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. **Install main bearings** .

NOTE: Upper bearings have an oil groove and oil holes; Lower bearings do not.

a. Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.

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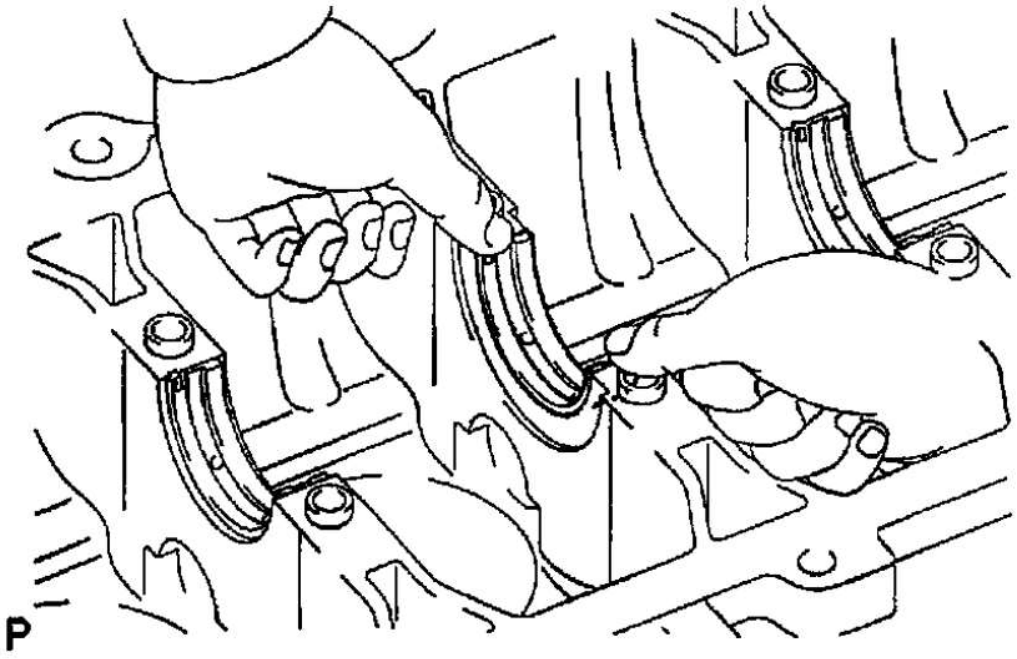


Fig. 304: Installing Main Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:
- **Install the bearing with the oil hole in the cylinder block.**
- **Clean the backside of the bearing and the bearing surface of the bearing cap and do not let the oils and fats stick.**

b. Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.

NOTE: Clean the backside of the bearing and the bearing surface of the bearing cap and do not let the oils and fats stick.

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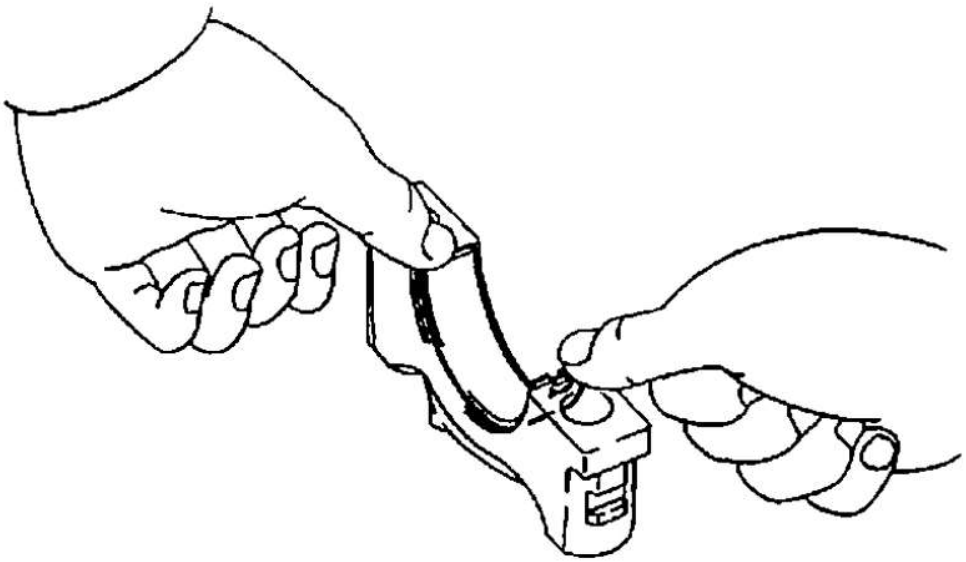


Fig. 305: Aligning Bearing Claw
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. **Install thrust washers** .

   Install the 2 thrust washers under the No. 3 journal position of the cylinder block with the oil grooves facing outward.

6. **Place crankshaft on cylinder block** .

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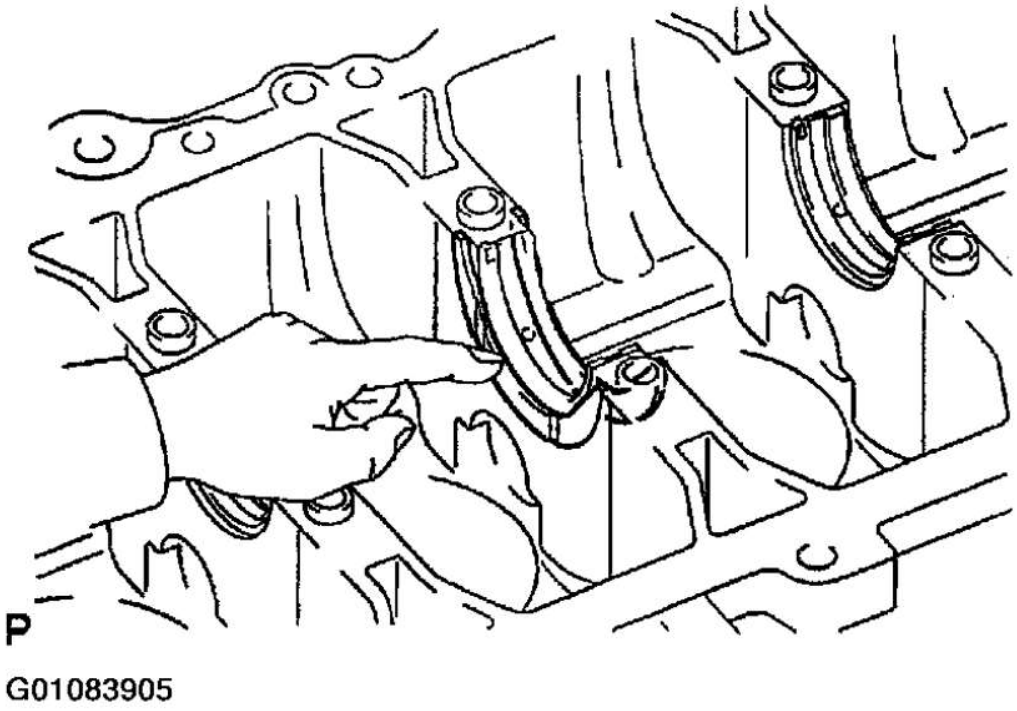


Fig. 306: Installing Thrust Washer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

7. **Install main bearing caps** .
   a. Install the 5 main bearing caps in their proper locations.

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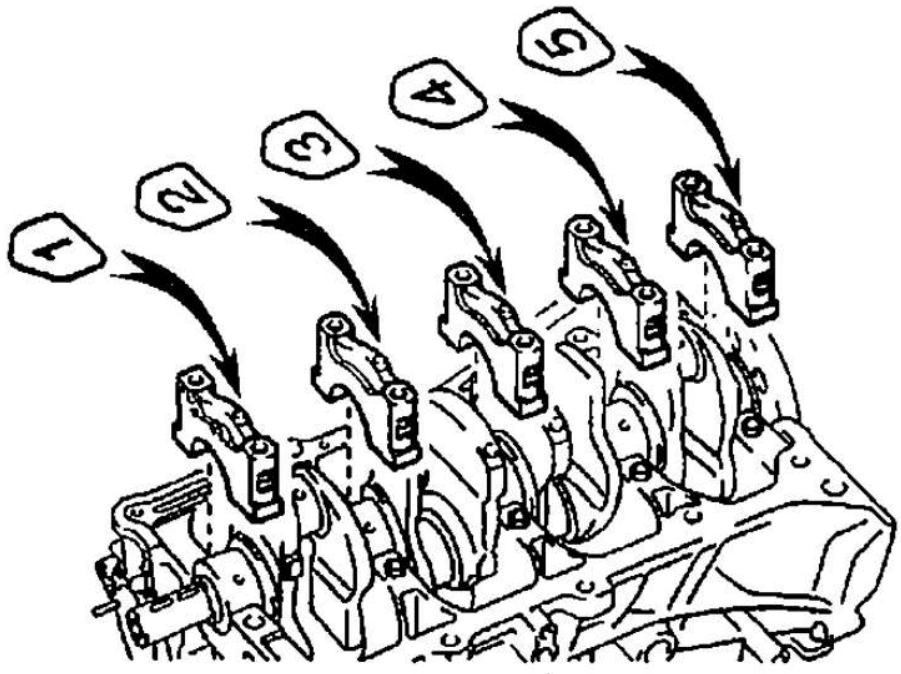


Fig. 307: Installing Main Bearing Caps
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

b. Install the main bearing cap bolts.

NOTE:

- **The main bearing cap bolts are tightened in 2 progressive steps (steps (2), (3) and (5)).**
- **If any one of the main bearing cap bolts is broken or deformed, replace it.**

1. Apply a light coat of engine oil on the threads and under the main bearing cap bolts.
2. Install and uniformly tighten the 10 main bearing cap bolts in several passes, in the sequence shown.

   Torque: 20 N.m (205 kgf. cm, 15 ft. lbf)
3. Retighten the 10 main bearing cap bolts in several passes, in the sequence shown.

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Torque: 40 N.m (410 kgf. cm, 30 ft. lbf)

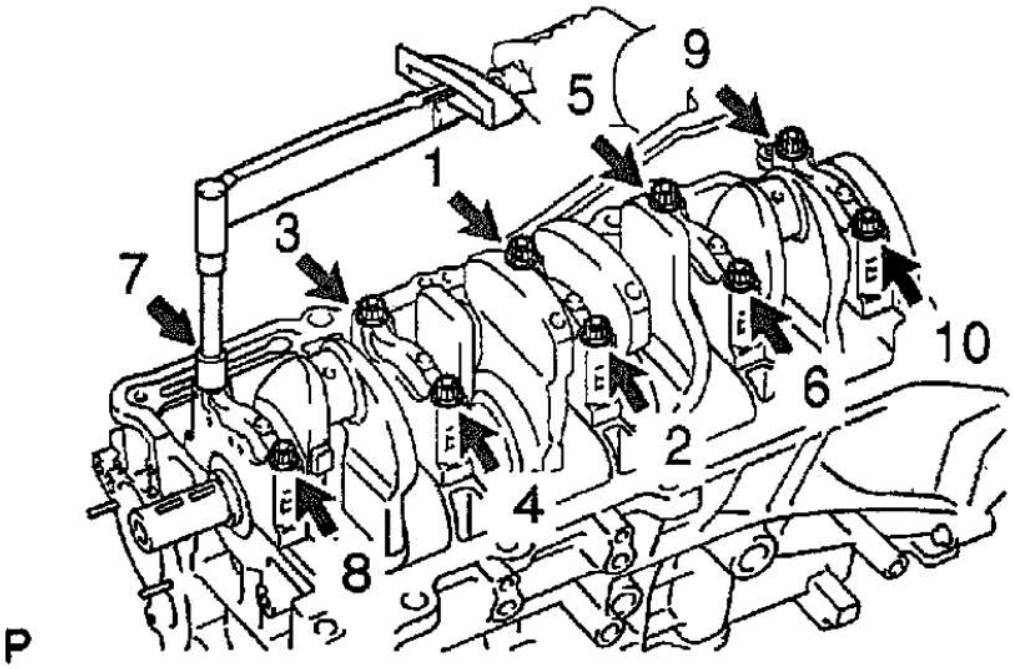


Fig. 308: Tightening Main Bearing Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If any one of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.

4. Mark the front of the main bearing cap bolt with paint.
5. Retighten the main bearing cap bolts by 90° in the numerical order shown.
6. Check that the painted mark is now at a 90° angle to the front.

c. Check that the crankshaft turns smoothly.

8. **Check crankshaft thrust clearance (See DISASSEMBLY) .**

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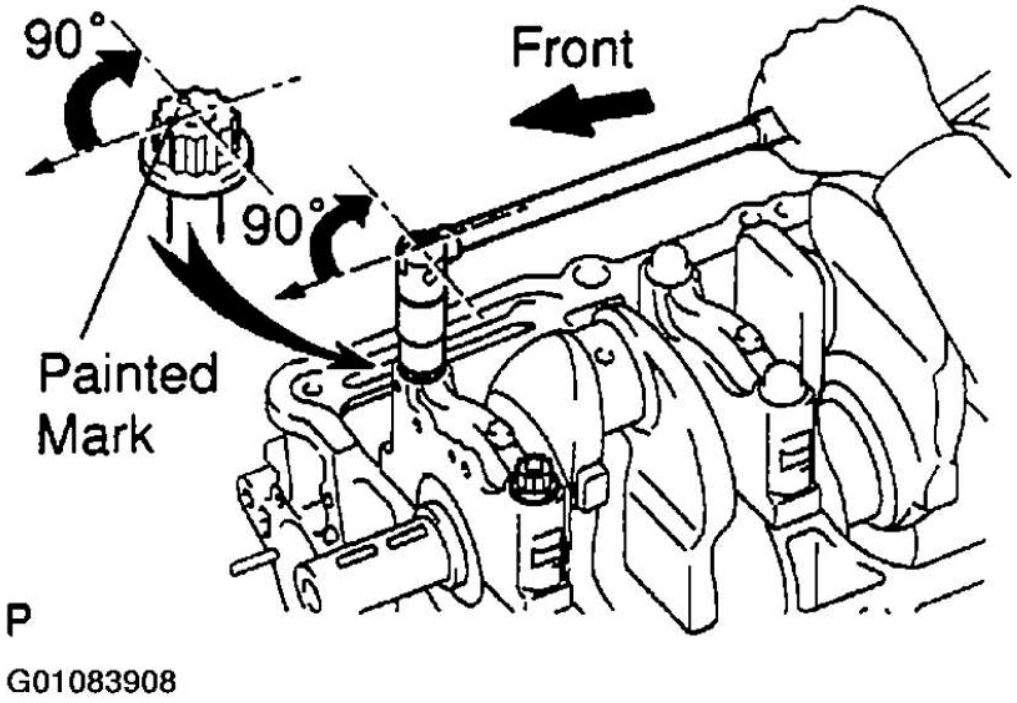


Fig. 309: Marking Front Part Of Main Bearing Cap Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **Install piston and connecting rod assembles** .

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

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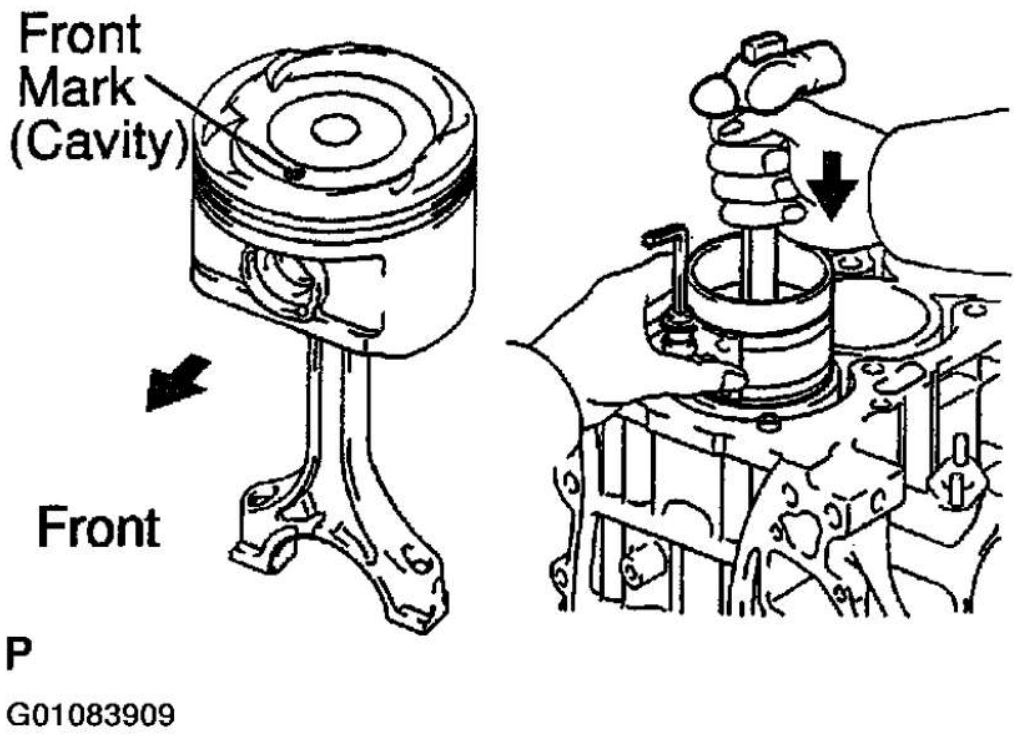


Fig. 310: Installing Piston & Connecting Rod Assembles
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

10. **Install connecting rod cap** .
    a. Place the connecting rod cap on the connecting rod.

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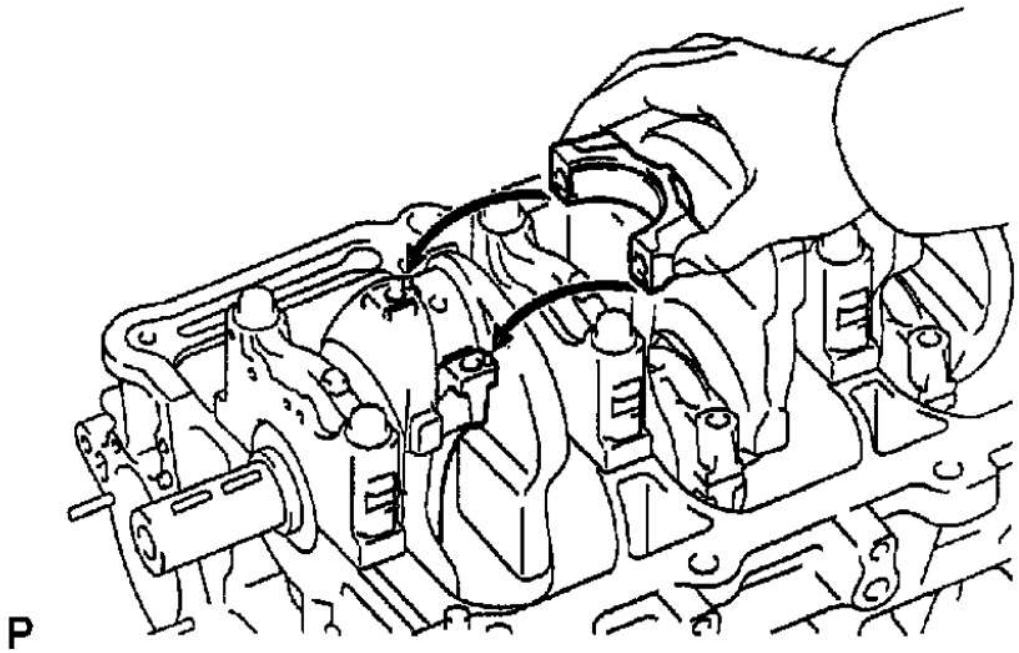


Fig. 311: Install Connecting Rod Cap
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Match the numbered connecting rod cap with the connecting rod.
2. Align the pin dowels of the connecting rod cap with the pins of the connecting rod, and install the connecting rod.

NOTE: Clean the backside of the bearing and the bearing surface of the bearing cap and do not let the oils and fats stick.

3. Check that the protrusion of the connecting rod cap is facing in the correct direction.

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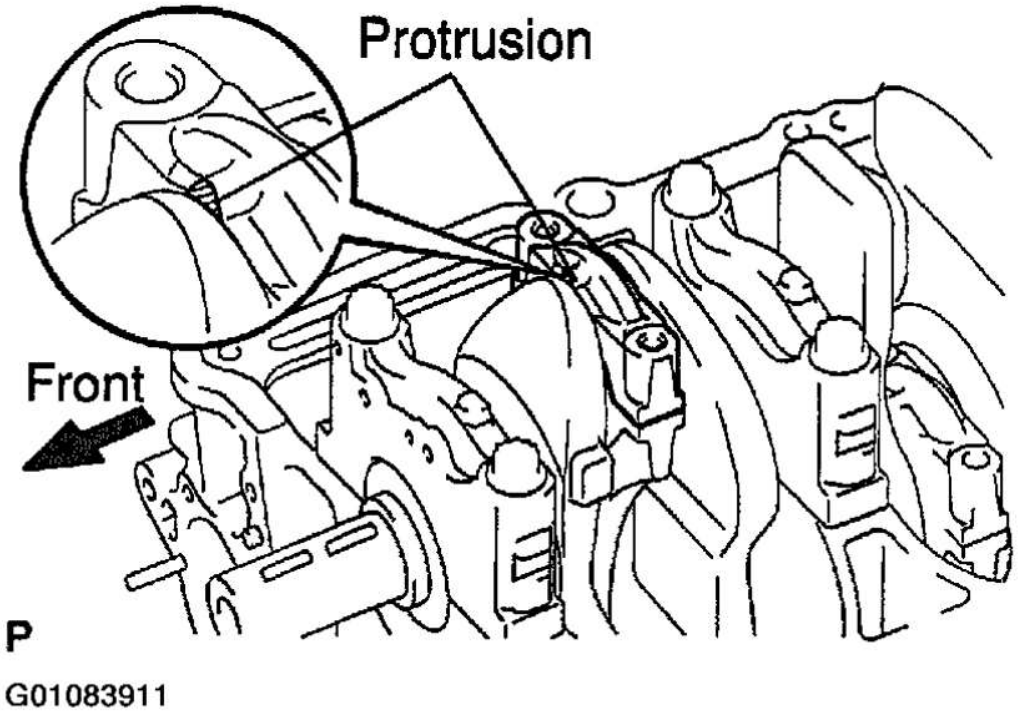


Fig. 312: Identifying Front Direction
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. Install the connecting rod cap bolts.

NOTE: The connecting rod cap bolts are tightened in 2 steps (steps (3) and (4)).

If any of the connecting rod cap bolts is broken or deformed, replace it.

5. Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.

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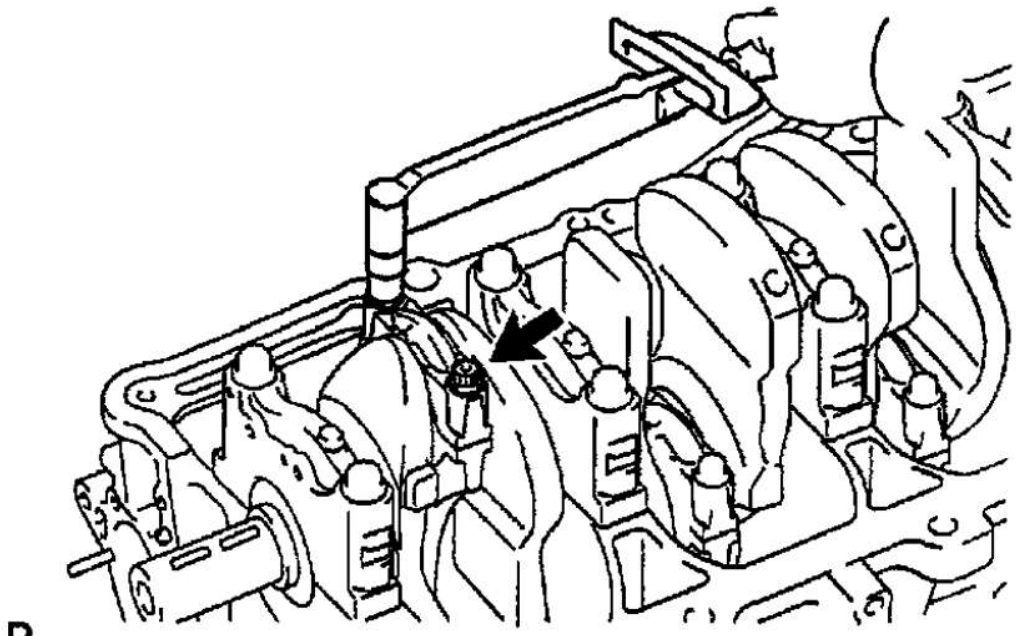


Fig. 313: Tightening Connecting Rod Cap Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

6. Install and alternately tighten the 2 connecting rod cap bolts in several passes.

   Torque: 24.5 N.m (250 kgf. cm, 18 ft. lbf)

   If any of the connecting rod cap bolts does not meet the torque specification, replace the connecting rod cap bolts.

7. Mark the front of the connecting cap bolts with paint.

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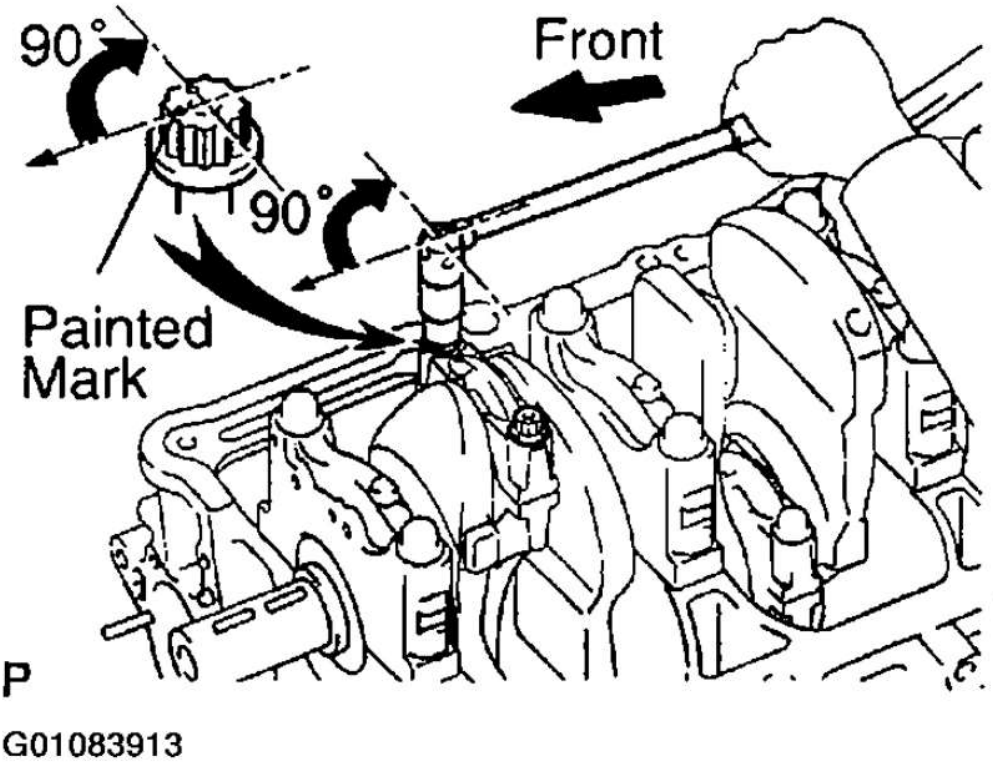


Fig. 314: Locating Front Part & Retightening Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. Retighten the cap bolts by 90° as shown.
9. Check that the painted mark is now at a 90° angle to the front.

b. Check that the crankshaft turns smoothly.

11. **Check connecting rod thrust clearance (See INSPECTION) .**
12. **Install rear crankshaft oil seal (See REPLACEMENT) .**

NOTE: Wipe seal packing away from the contact surface of the cylinder block assembly and oil seal.

13. **Install crank case .**

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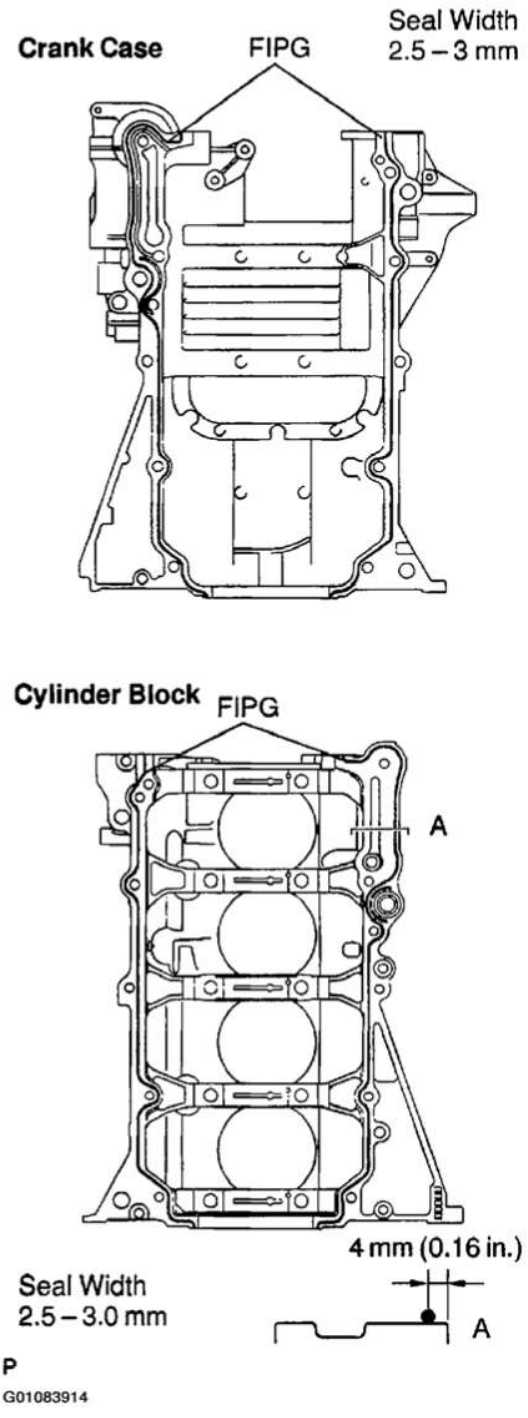


Fig. 315: Identifying Crank Case & Cylinder Block
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces

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of the crank case and cylinder block.

- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
- Thoroughly clean all components to remove all the loose material.
- Using a non-residue solvent, clean both sealing surfaces.

b. Apply seal packing to the crank case or cylinder block as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 2.5 - 3.0 mm (0.10 - 0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

c. Install a new O-ring to the cylinder block.

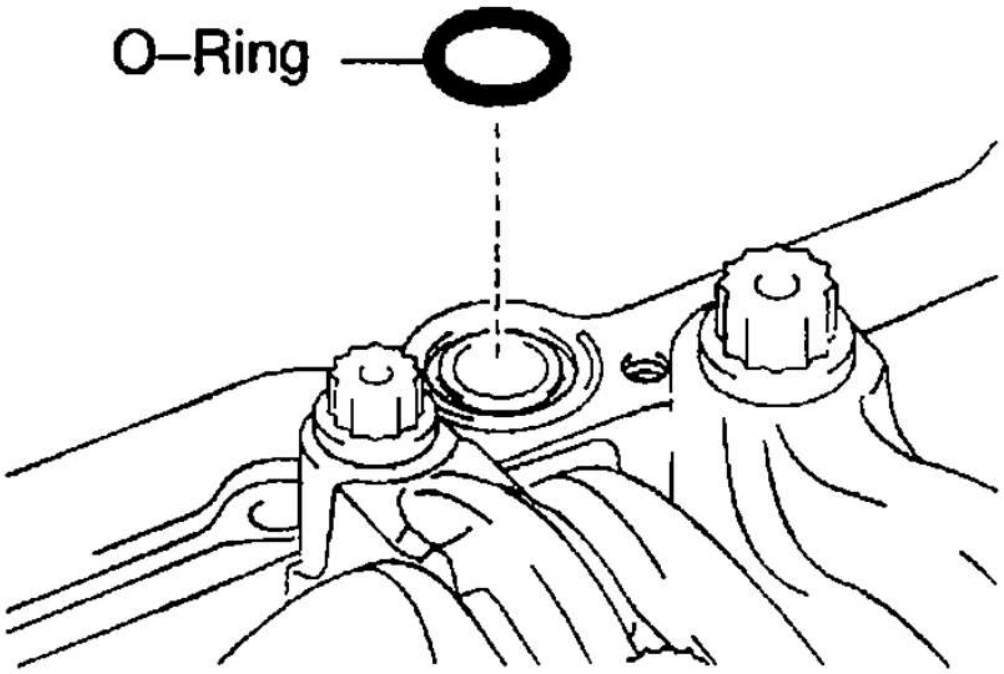


Fig. 316: Installing O-Ring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Temporarily install the crank case with the 11 bolts.

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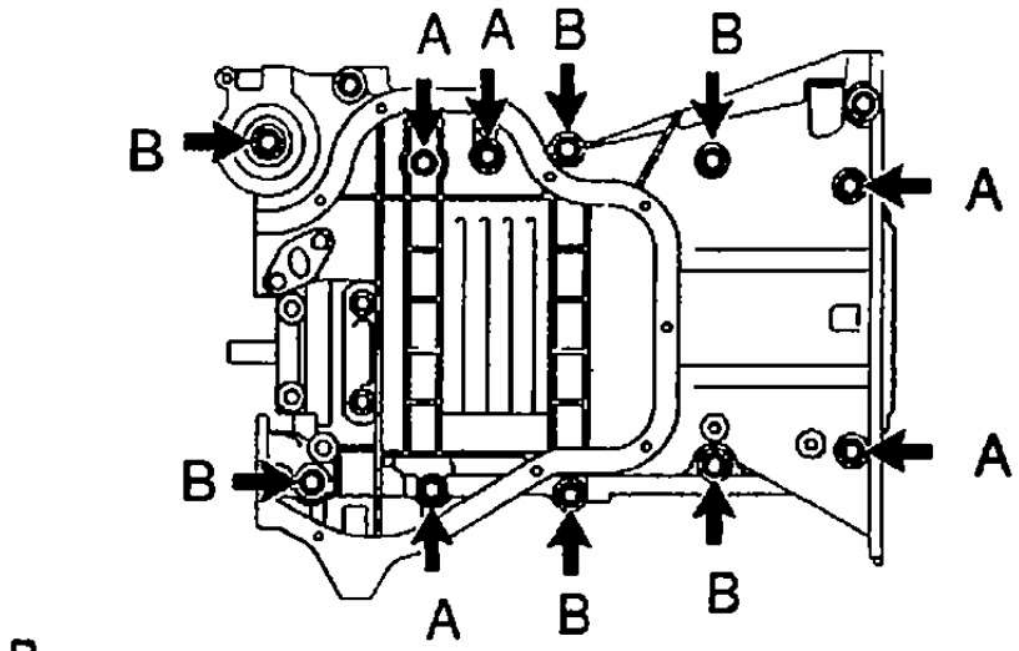


Fig. 317: Installing Crank Case With Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Each bolt length is indicated in the illustration.

Bolt length: 112 mm (4.41 in.) for A of 12 mm head, 35 mm (1.38 in.) for B of 12 mm head

e. Uniformly tighten the bolts, stud bolts and nuts in several passes.
Torque: 32.5 N.m (330 kgf. cm, 24 ft. lbf)

14. **Install oil filter union** .

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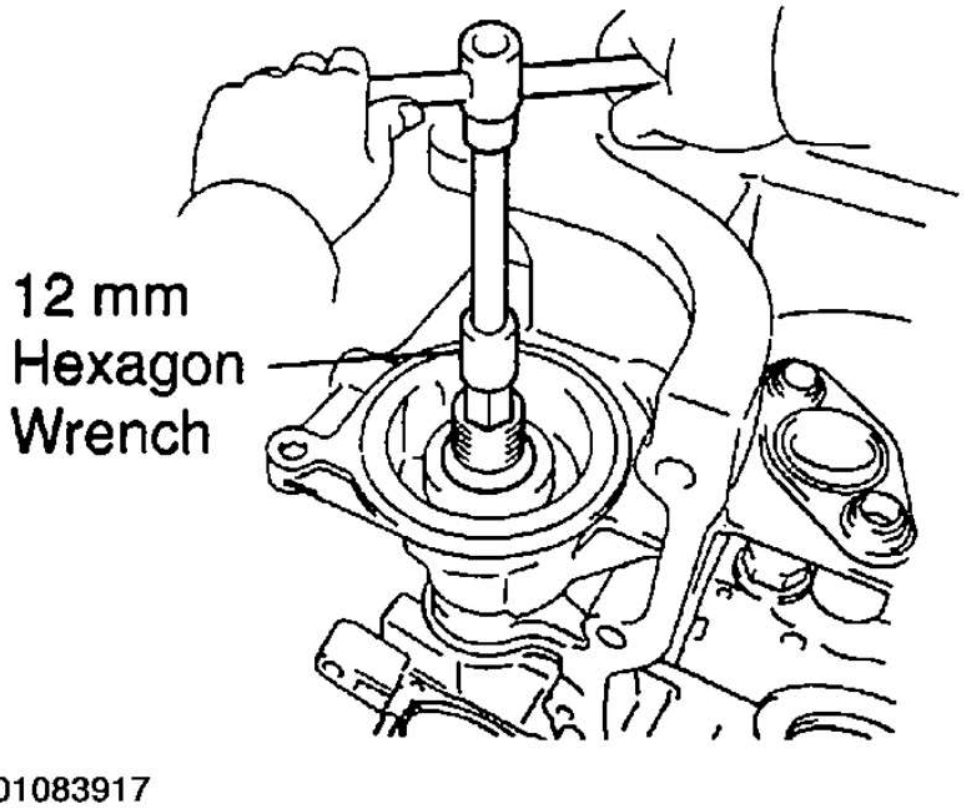


Fig. 318: Installing Oil Filter Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a 12 mm hexagon wrench, install the oil filter union.

Torque: 29.5 N.m (300 kgf. cm, 22 ft. lbf)

15. **Install oil filter (See REPLACEMENT) .**
16. **Install oil pump (See INSTALLATION) .**
17. **Install water by-pass pipe .**

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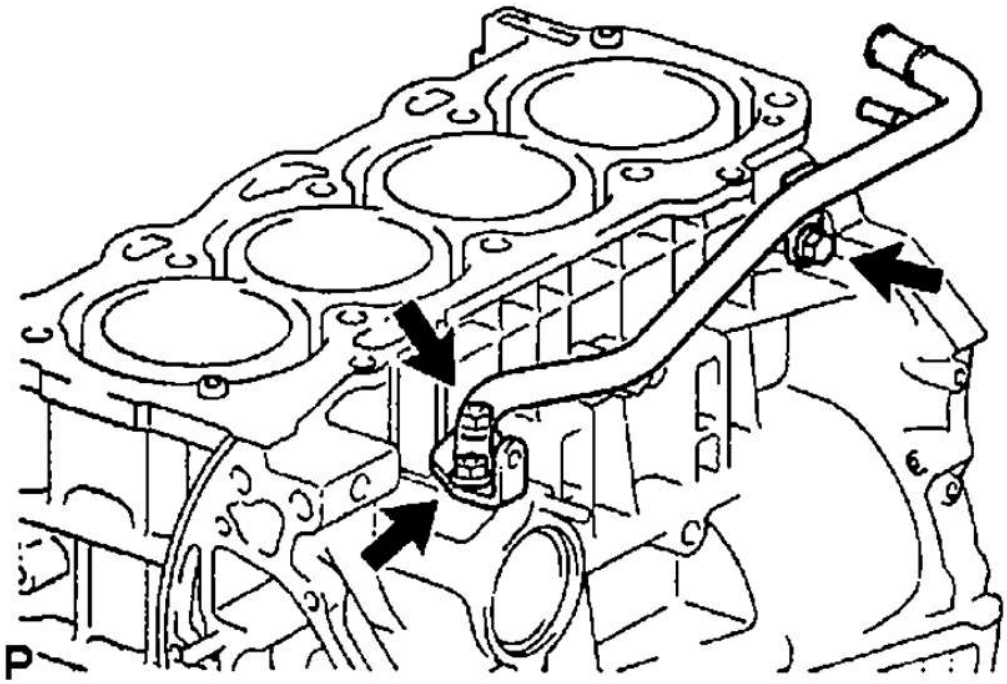


Fig. 319: Installing Water By-Pass Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Install a new gasket, the water bypass pipe with the 2 nuts.

Torque: 9 N.m (90 kgf. cm, 80 in. lbf)

18. **Install oil dipstick and guide** .
    a. Install a new O-ring to the dipstick guide.
    b. Apply soapy water to the O-ring.
    c. Push in the dipstick guide end into the guide hole of the No. 1 oil pan.
    d. Install the dipstick guide with the bolt.

Torque: 9 N.m (90 kgf. cm, 80 in. lbf)

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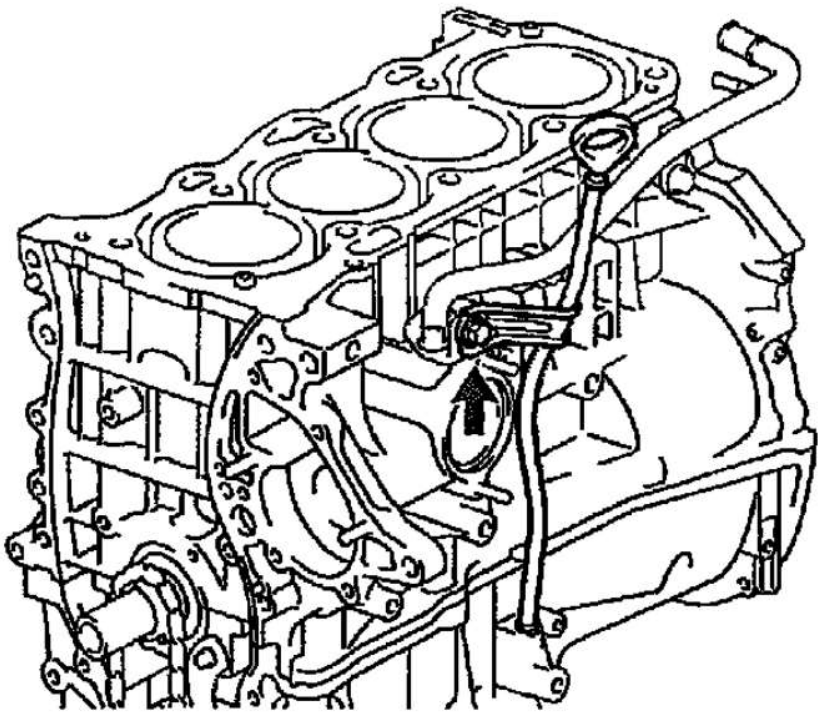


Fig. 320: Installing Oil Dipstick & Guide
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

e. Install the dipstick.

19. **Install engine coolant drain union** .
    a. Apply adhesive to 2 or 3 threads.
       Seal packing: Part No. 08826-00100 or equivalent

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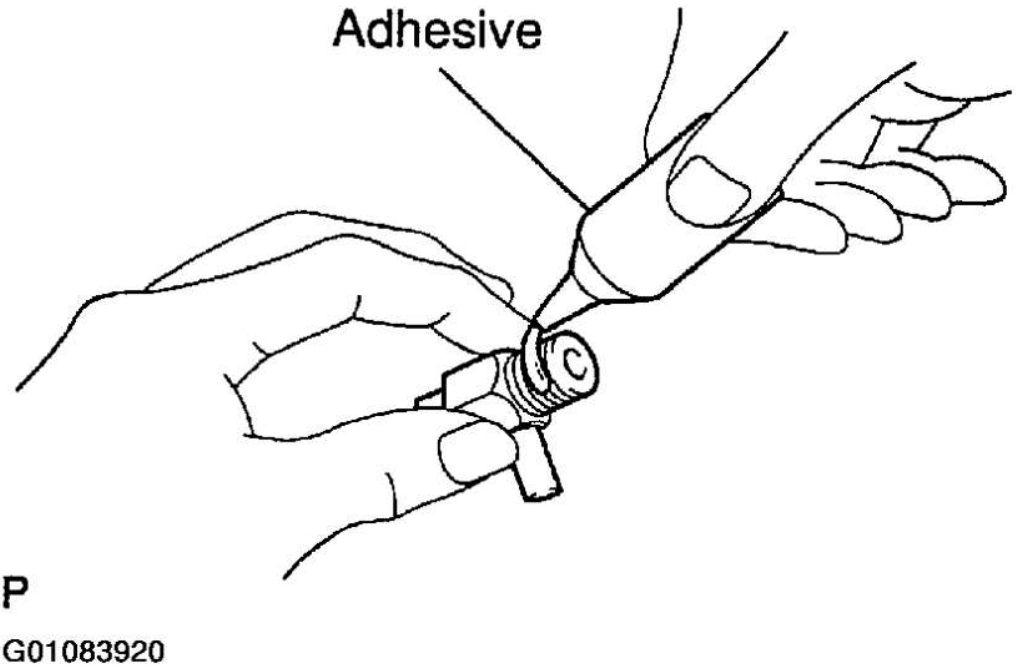


Fig. 321: Installing Engine Coolant Drain Union
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Install the drain union.

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

NOTE: After applying the specified torque, rotate the drain union clockwise until its drain port is facing downward.

20. **Install thermostat (See INSTALLATION) .**
21. **Install plug .**
22. **Install wire clamps .**
23. **Install knock sensor (See KNOCK SENSOR) .**
24. **Install water pump (See INSTALLATION) .**
25. **Install OCV filter**

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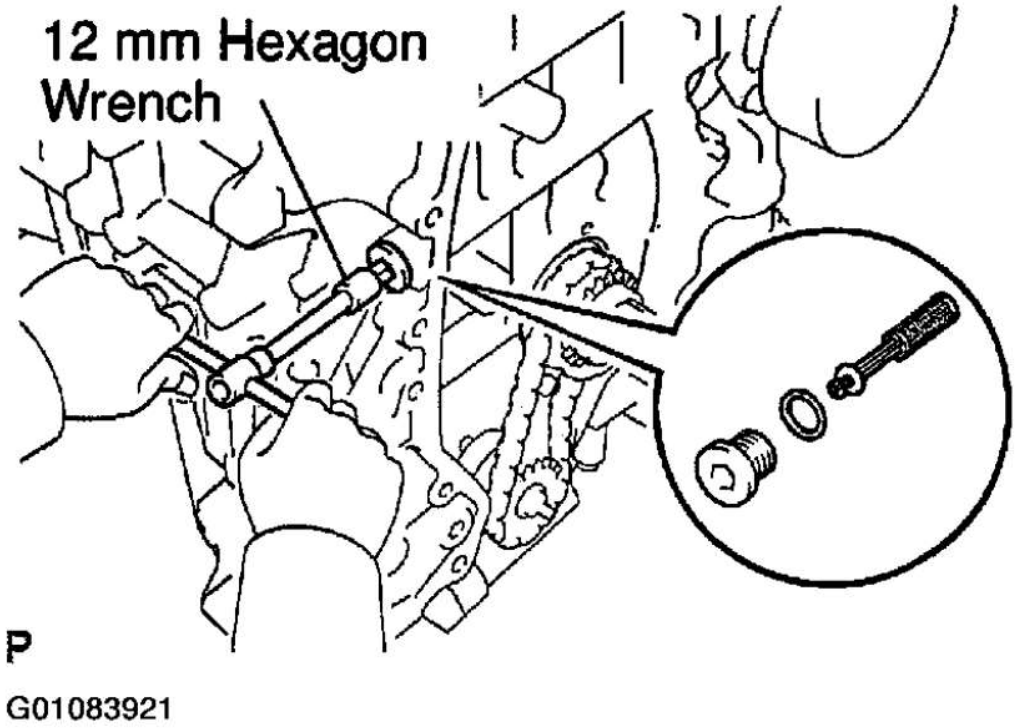


Fig. 322: Installing OCV Filter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Using a 12 mm hexagon wrench, install the OCV filter with a new gasket and the plug.

Torque: 30 N.m (305 kgf. cm, 22 ft. lbf)

26. **Install cylinder head (See INSTALLATION) .**
27. **Install timing chain (See INSTALLATION) .**
28. **Remove engine stand .**

ENGINE SPECIFICATIONS

GENERAL SPECIFICATIONS

Application	Specification
Displacement	121.9 Cu. In. (2.0L)
Bore	3.39 In. (86.0 mm)
Stroke	3.39 In. (86.0 mm)
Fuel System	SFI

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WARPAGE SPECIFICATIONS

Application	In. (mm)
Cylinder Block	.0031 (.08)
Cylinder Head	
Cylinder Block Side	.0031 (.08)
Manifold Side	.0031 (.08)
Exhaust Manifold	.027 (.70)
Intake Manifold	
Air Intake Chamber Side	.0079 (.20)
Cylinder Head Side	.0031 (.08)

VALVE CLEARANCE SPECIFICATIONS (1)

Application	In. (mm)
Intake Valve	.008-.011 (.19-.29)
Exhaust Valve	.012-.016 (.30-.40)
(1) Adjust valve clearance with engine cold.	

CRANKSHAFT, MAIN & CONNECTING ROD BEARINGS

Application	In. (mm)
Crankshaft	
Crankshaft Bearing Cap Set Bolt	
Standard	.295-.299 (7.5-7.6)
Wear Limit	.283 (7.2)
End Play	
Standard	.0016-.0094 (.040-.24)
Wear Limit	.0118 (.30)
Maximum Runout	.0012 (.03)
Main Bearings	
Journal Diameter	(1)
Journal Out-Of-Round	.0001 (.003)
Journal Taper	.0001 (.003)
Oil Clearance	
Standard Crankshaft Journal	
Standard	.0007-.0016 (.017-.040)
Maximum	.0028 (.07)
Connecting Rod Bearings	
Journal Diameter	1.8894-1.8898 (47.99-48.00)
Journal Out-Of-Round (Maximum)	.0001 (.003)
Journal Taper	.0001 (.003)
Oil Clearance	

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Standard Crankshaft Journal	
Standard	.0007-.0016 (.017-.040)
Wear Limit	.0028 (.07)
(1) Main bearing journal diameter is determined by main bearing journal size mark stamped on crankshaft.	

CONNECTING RODS

Application	In. (mm)
Connecting Rod Bolt Diameter	
Standard	.283-.287 (7.2-7.3)
Wear Limit	.276 (7.0)
Bore Diameter	
Pin Bushing Bore	.8662-.8665 (22.001-22.010)
Maximum Bend	.002 Per 3.94 (.05 Per 100.0)
Maximum Twist	.0059 Per 3.94 (.150 Per 100.0)
Side Play	
Standard	.0063-.0143 (.160-.362)
Wear Limit	.0143 (.362)

PISTONS, PINS & RINGS

Application	In. (mm)
Pistons	
Clearance	
Standard	.0025-.0034 (.063-.086)
Wear Limit	.0039 (.10)
Diameter	3.3829-3.3833 (85.927-85.937)
Pins	
Pin Diameter	.8660-.8664 (21.997-22.006)
Piston Fit	(1)
Rod Fit	
Standard	.0002-.0004 (.005-.011)
Wear Limit	.0020 (.051)
Rings	
No. 1	
End Gap	
Standard	.0118-.0157 (.30-.40)
Wear Limit	.0350 (.89)
Side Clearance	.0012-.0028 (.030-.070)
No. 2	
End Gap	

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Standard	.0185-.0244 (.47-.62)
Wear Limit	.0531 (1.35)
Side Clearance	.0012-.0028 (.030-.070)
No. 3 (Oil)	
End Gap	
Standard	.0039-.0138 (.10-.35)
Wear Limit	.0287 (.73)
(1) With piston temperature at 176-194°F (80-90°C), piston pin should slide through piston with thumb pressure.	

CYLINDER BLOCK

Application	In. (mm)
Cylinder Bore	
Standard Diameter	3.3858-3.3863 (86.00-86.013)
Maximum Deck Warpage	.0031 (.08)
Main Bearing Bore I.D.	(1)
(1) Main bearing bore I.D. is determined by main bearing bore size mark on cylinder block.	

OIL PUMP SPECIFICATIONS

Application	In. (mm)
Rotor Side Clearance	
Standard	.0012-.0033 (.030-.085)
Wear Limit	.0063 (.16)
Rotor Tip Clearance	
Standard	.0031-.0063 (.080-.160)
Wear Limit	.0138 (.350)
Body Clearance	
Standard	.0039-.067 (.10-.170)
Wear Limit	.0128-(.325)

VALVES & VALVE SPRINGS

Application	Specification
Intake Valves	
Face Angle	44.5 degrees
Standard Margin	.041-.057 in. (1.05-1.45 mm)
Minimum Margin	.020 in. (.51 mm)
Standard Overall Length	4.043 in. (101.71)
Minimum Overall Length	3.985 in. (101.21 mm)
Stem Diameter	.2154-.2159 in. (5.470-5.485 mm)
Exhaust Valves	

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Face Angle	44.5 degrees
Standard Margin	.047-.063 in. (1.2-1.6 mm)
Minimum Margin	.020 in. (.51 mm)
Standard Overall Length	3.9823 in. (101.15)
Minimum Overall Length	3.9649 in. (100.7 mm)
Stem Diameter	.2152-.2157 in. (5.465-5.480 mm)
Valve Springs	
Free Length	1.799 in. (45.7 mm)
Maximum Deviation	.063 in. (1.6 mm)
Maximum Angle (Reference)	2 degrees

CYLINDER HEAD

Application	Specification
Maximum Warpage	
Cylinder Block Surface	.0020 in. (.051 mm)
Intake & Exhaust Manifold Surface	.0031 in. (.078 mm)
Valve Seats	
Intake Valve	
Seat Angle	45 degrees
Seat Width	.039-.055 in. (.99-1.40 mm)
Exhaust Valve	
Seat Angle	45 degrees
Seat Width	.039-.055 in. (.99-1.40 mm)
Valve Guides	
Intake Valve	
Valve Guide I.D.	.2169-.2177 in. (5.51-5.53 mm)
Valve Guide Installed Protrusion Height	.3779-.3937 in. (9.6-10 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.001-.0024 in. (.025-.060 mm)
Wear Limit	.0031 in. (.08 mm)
Exhaust Valve	
Valve Guide I.D.	.2169-.2177 in. (5.51-5.53 mm)
Valve Guide Installed Protrusion Height	.3779-.3937 in. (9.6-10 mm)
Valve Stem-To-Guide Oil Clearance	
Standard	.0012-.0026 in. (.030-.066 mm)
Wear Limit	.0039 in. (.099 mm)

CAMSHAFT

Application	In. (mm)
End Play	
Intake Camshaft	

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Standard	.0016-.0037 (.040-.095)
Wear Limit	.0043 (.11)
Exhaust Camshaft	
Standard	.0032-.0053 (.080-.135)
Wear Limit	.0059 (.15)
Journal Diameter	
No. 1 Journal	1.4165-1.4167 (35.971-35.985)
Other Journal	.9039-.9045 (22.959-22.975)
Journal Runout	.0012 (.03)
Lobe Height	
Intake Camshaft	
Standard	1.8305-1.8345 (46.495-46.595)
Wear Limit	1.8262 (46.385)
Exhaust Camshaft	
Standard	1.8104-1.8143 (45.983-46.083)
Wear Limit	1.8060 (45.873)
Oil Clearance	
Intake No. 1 Journal	
Standard	.0028-.0015 (.007-.038)
Wear Limit	.0028 (.07)
Other Intake Journals	
Standard	.00098-.00244 (.025-.062)
Wear Limit	.0039 (.10)
Exhaust No. 1 Journal	
Standard	.0006-.0021 (.015-.054)
Wear Limit	.0039 (.10)
Other Exhaust Journals	
Standard	.0006-.0021 (.015-.054)
Wear Limit	.0039 (.10)

VALVE LIFTERS

Application	In. (mm)
Bore Diameter	1.2208-1.2215 (31.009-31.025)
Lifter Diameter	1.2191-1.2195 (30.966-30.976)
Oil Clearance	
Standard	.0013-.0023 (.033-.059)
Wear Limit	.0028 (.071)

TORQUE SPECIFICATIONS

TORQUE SPECIFICATIONS

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Application	Ft. Lbs. (N.m)
ABS Actuator-To-Body	14 (19)
A/C Compressor	18 (25)
Belt Tensioner-To-Engine Block	44 (60)
Camshaft Bearing Cap Bolts (1)	
No. 1	22 (30)
No. 2	22 (30)
No. 3	(2)
Camshaft Sprocket Bolt	40 (54)
Center Bearing Bracket (2WD)	25 (34)
Chain Tensioner Slipper Bolt	14 (19)
Connecting Rod Bearing Cap	
Step 1	18 (25)
Step 2	(3)
Coolant Drain Union	18 (25)
Coolant Temperature Sensor	15 (20)
Crankcase-To-Cylinder Block Bolt	24 (33)
Crankshaft Pulley Bolt	125 (170)
Crankshaft Main Bearing Cap (4)	
Step 1	15 (20)
Step 2	30 (40)
Step 3	(3)
Cylinder Head Bolts (5)	
Step 1	58 (79)
Step 2	(3)
Delivery Pipe-To-Cylinder Head	15 (20)
Drive Plate-To-Flywheel Bolts	72 (98)
Engine Mounting Components	
Front Engine Mount Bracket-To-Front Insulator Bolt	41 (56)
Hanger-To-Cylinder Head Bolt	28 (38)
Left Engine Mount-To-Left Insulator Bolt	41 (56)
Rear Engine Mount Bracket-To-Rear Insulator Bolt	65 (88)
Right Side Mounting Insulator-To-Body Bolts	38 (52)
Right Side Mounting Insulator-To-Timing Chain Cover Bolts	38 (52)
Exhaust Components	
Front Exhaust Pipe-To-Center Exhaust Pipe	36 (49)
Manifold-To-Cylinder Head Bolt	25 (37)
Exhaust Manifold Stays	30 (40)
Exhaust Pipe-To-Manifold Bolt	32 (43)

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Front Drive Shaft-To-Front Axle Hub	150 (216)
Flywheel-To-Crankshaft Bolts	96 (130)
Generator Bolts	
Outer Bolt	38 (52)
Lower Bolt	16 (21)
Ground Cable-To-Transaxle	14 (19)
Intake Manifold-To-Cylinder Head Bolt	22 (30)
Oil Filter Union	22 (30)
Oil Pan Drain Plug	18 (25)
Oil Pump Bolt	15 (20)
Oil Pump Sprocket	22 (30)
Plug-To-Cylinder Block	20 (27)
Power Steering Pressure Hose Fitting	38 (51)
Power Steering Pump Bolt	22 (30)
Propeller Shaft-To-Body	27 (37)
Propeller Shaft-To-Differential	54 (74)
Starter-To-Transaxle Bolt	28 (37)
Stiffener Plate Bolt	25 (34)
Timing Cover (6)	
Bolt "A"	(2)
Bolt "B"	15 (21)
Bolt "C"	32 (43)
Bolt "D"	32 (43)
Nut	(2)
Transaxle-To-Engine Bolts (7)	
Bolt "A"	34 (46)
Bolt "B"	47 (64)
Variable Valve Timing Sprocket Bolt	40 (54)
	INCH Lbs. (N.m)
Belt Tensioner Stud	84 (9.5)
Camshaft Position Sensor	80 (9)
Cam Timing Oil Control Valve Bolts	80 (9)
Chain Tensioner-To-Crankshaft Bearing Cap	106 (12)
Chain Tensioner-To-Timing Chain Cover	80 (9)
Chain Vibration Damper Bolt	80 (9)
Coolant Bypass Pipe-To-Cylinder Block	80 (9)
Coolant Inlet	80 (9)
Coolant Pump Bolt	80 (9)
Crankshaft Position Sensor	80 (9)
Cylinder Head Cover Bolts	97 (11)

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Discharge Tube-To-Compressor	97 (9.8)
Heat Shield Bolt	106 (12)
Ignition Coil Bolts	80 (9)
Liquid Tube-To-Compressor	97 (9.8)
Oil Dipstick Tube	80 (9)
Oil Pan Bolts	80 (9)
Oil Pressure Switch	115 (13)
Starter Cable-To-Starter	78 (8.8)
Timing Chain Guide Bolt	80 (9)
Wire Clip For Generator	68 (7.7)

(1) Tighten to specification in sequence. See **Fig. 323** .

(2) Tighten to 80 INCH Lbs. (9 N.m).

(3) Tighten an additional 90 degrees.

(4) Tighten to specification in sequence. See **Fig. 324** .

(5) Tighten to specification in sequence. See **Fig. 325** .

(6) Tighten to specification in sequence. See **Fig. 326** .

(7) Tighten to specification in sequence. See **Fig. 327** .

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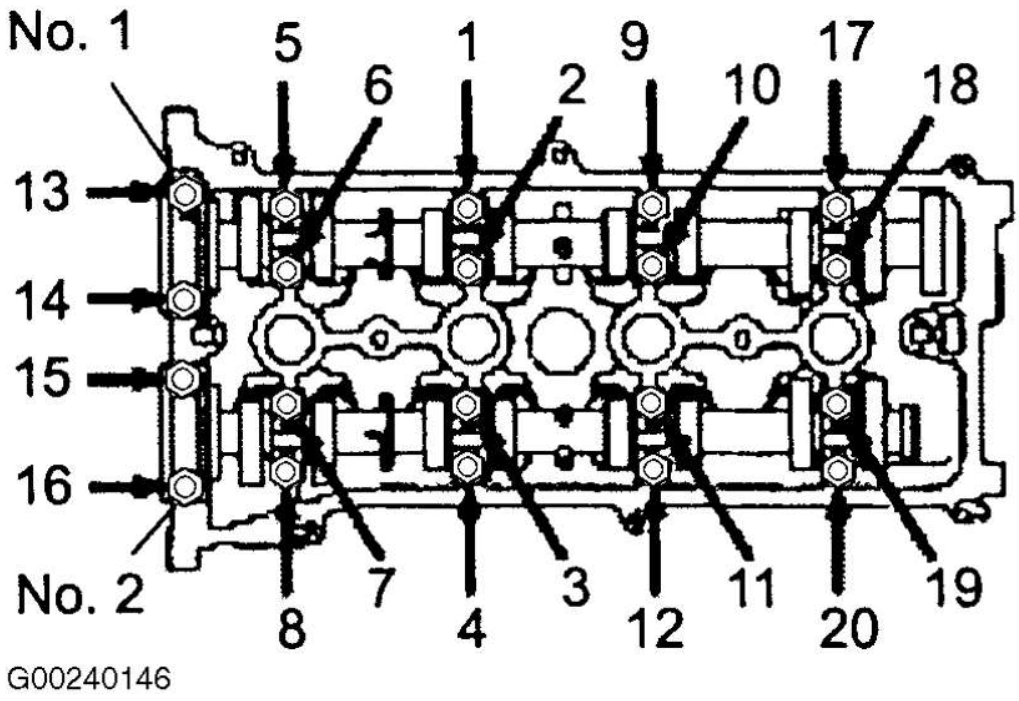
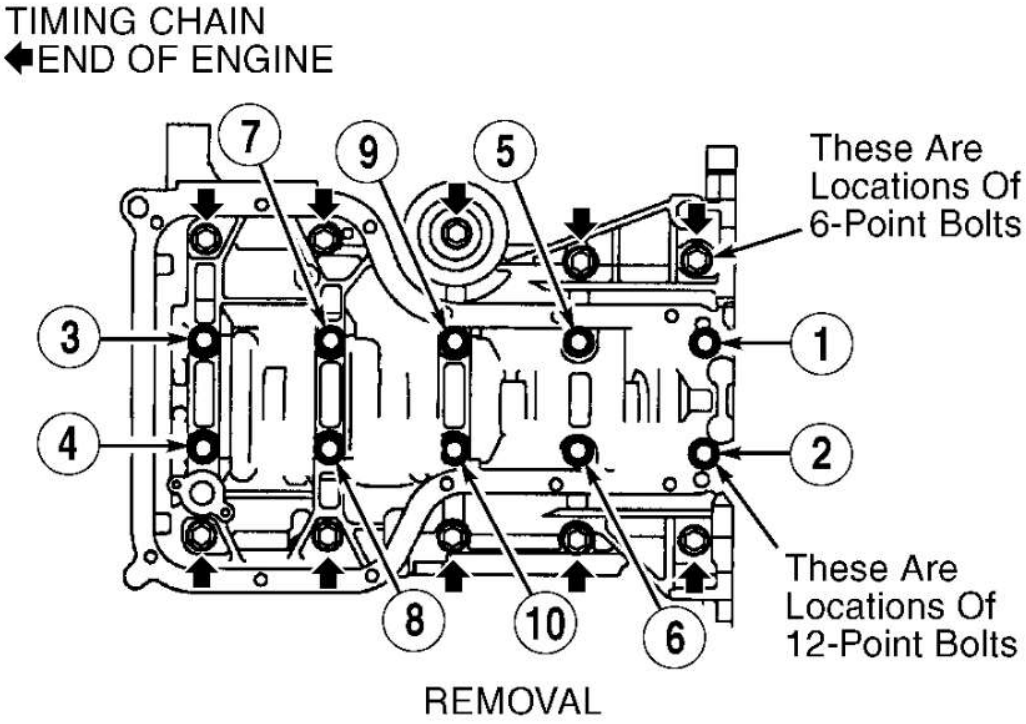
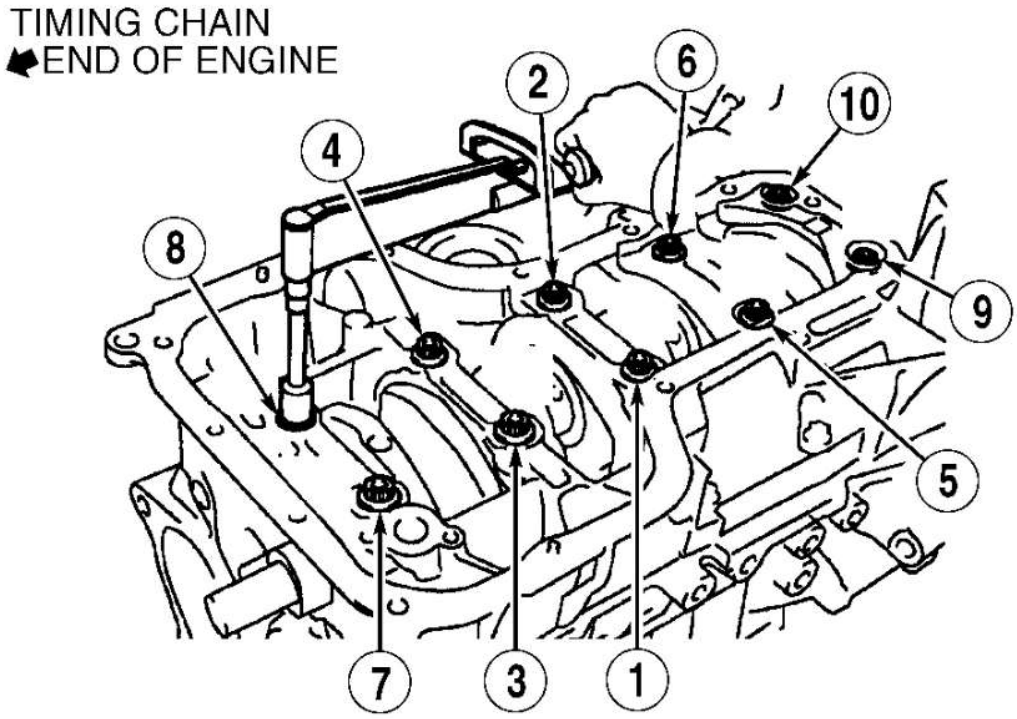


Fig. 323: Identifying Camshaft Bearing Cap Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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REMOVAL



INSTALLATION

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Fig. 324: Identifying Main Bearing Cap Bolt Removal & Installation Sequence
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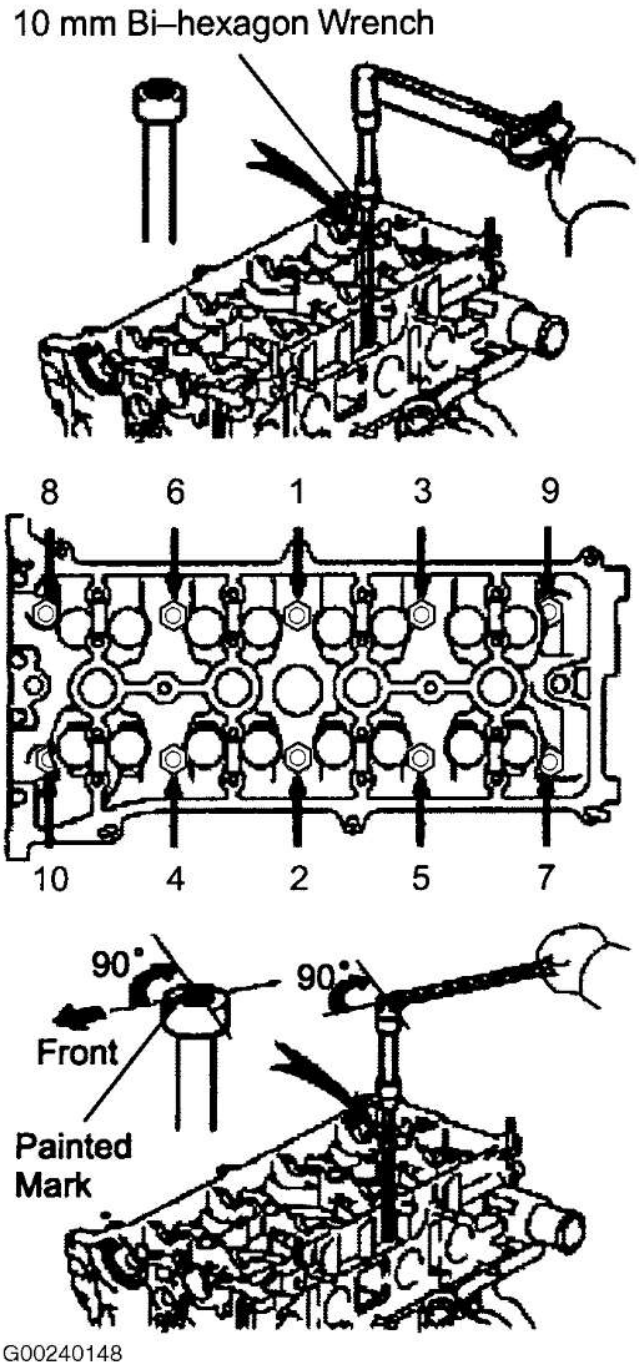
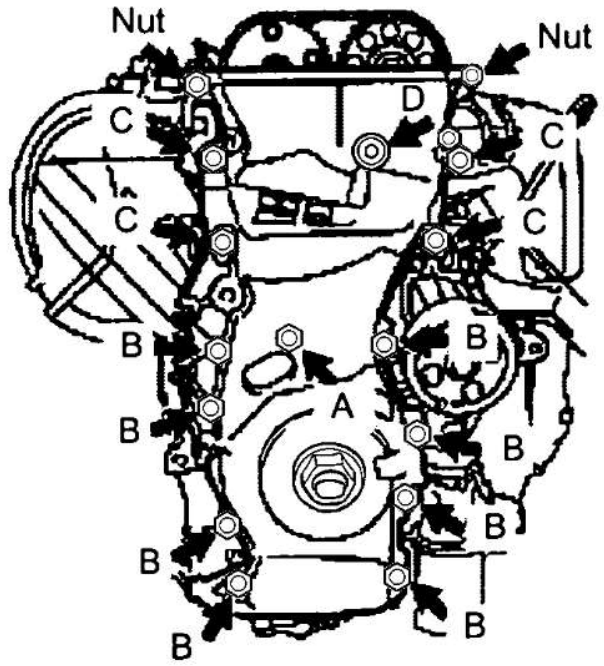


Fig. 325: Identifying Cylinder Head Bolt Tightening Sequence

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Torque:
9 N·m (90 kgf·cm, 80 in.·lbf) for bolt A
21 N·m (220 kgf·cm, 15 ft.·lbf) for bolt B
43 N·m (440 kgf·cm, 32 ft.·lbf) for bolt C
43 N·m (440 kgf·cm, 32 ft.·lbf) for bolt D
9 N·m (90 kgf·cm, 80 ft·lbf) for nuts

HINT:
Each bolt length in indicated in the illustration.

Bolt A	30 mm (1.18 in.) length for 10 mm head
Bolt B	30 mm (1.18 in.) length for 12 mm head
Bolt C	40 mm (1.57 in.) length for 14 mm head
Bolt D	65 mm (2.56 in.) length for 14 mm head

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Fig. 326: Identifying Timing Cover Bolt Tightening Sequence
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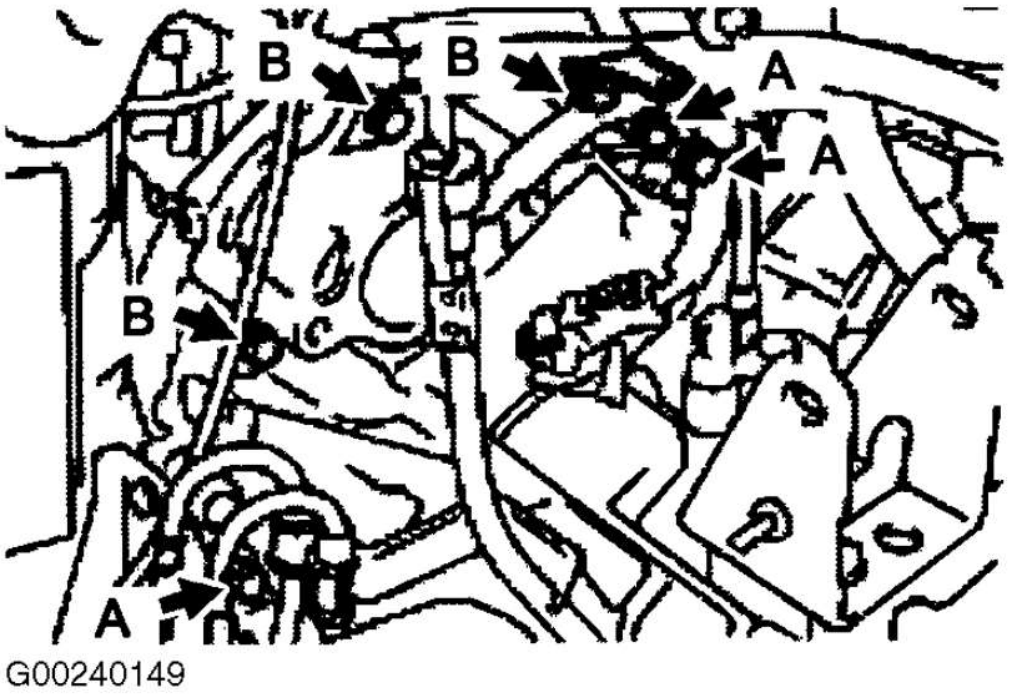


Fig. 327: Identifying Engine-To-Transaxle Bolt Tightening Sequence
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