

<b>2005 Toyota RAV4</b>
2005 ENGINE Engine Mechanical - RAV4

## **2005 ENGINE**

### **Engine Mechanical - RAV4**

## **CO/HC**

### **INSPECTION**

#### **HINT:**

This check is used only to determine whether or not the idle CO/HC complies with specifications.

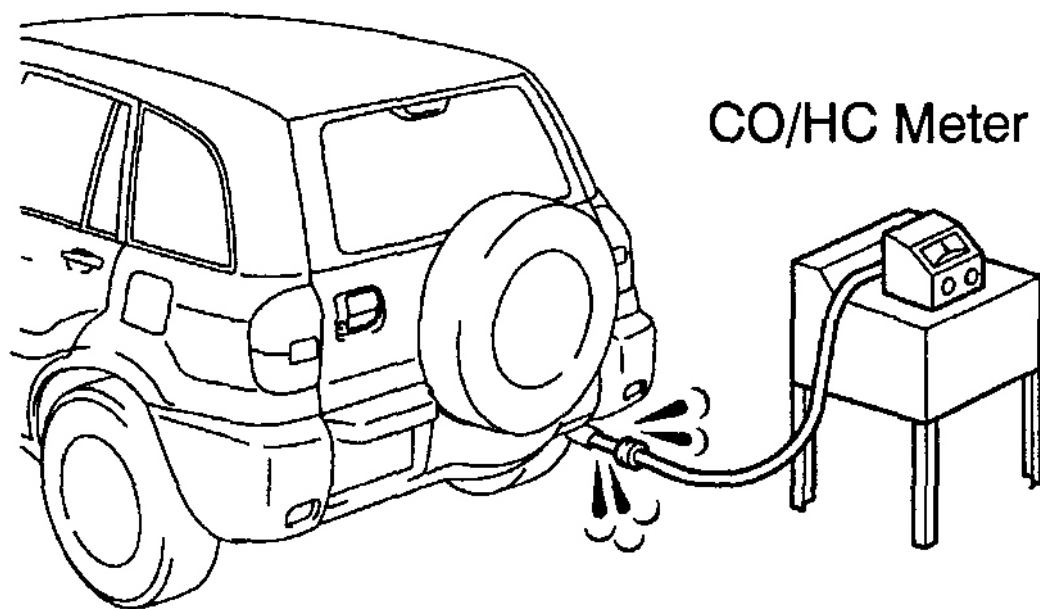
#### **1. INITIAL CONDITIONS**

- a. Engine at normal operating temperature
- b. Air cleaner installed
- c. Air pipes and hoses of air induction system connected
- d. All accessories switched OFF
- e. All vacuum lines properly connected
- f. SFI system wiring connectors fully plugged
- g. Ignition timing check correctly
- h. Transmission in neutral position
- i. Tachometer and CO/HC meter calibrated by hand

#### **2. START ENGINE**

#### **3. RACE ENGINE AT 2,500 RPM FOR APPROX. 180 SECONDS**

#### **4. INSERT CO/HC METER TESTING PROBE AT LEAST 40 cm (1.3 ft) INTO TAILPIPE DURING IDLING**



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**Fig. 1: Inserting CO/HC Meter Testing Probe Into Tailpipe**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**5. IMMEDIATELY CHECK CO/HC CONCENTRATION AT IDLE AND/OR 2,500 RPM**

Complete the measuring within 3 minutes.

HINT:

When performing the 2 mode (2,500 RPM and idle) test, follow the measurement order prescribed by the applicable local regulations.

If the CO/HC concentration does not conform to specifications, perform troubleshooting in the order given below.

1. Check the A/F sensor operation (see **DTC P2195: OXYGEN (A/F) SENSOR SIGNAL STUCK LEAN (BANK 1 SENSOR 1)** ).
2. See table for possible causes, and then inspect and correct the applicable causes if necessary.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4

CO	HC	Problems	Causes
Normal	High	Rough idle	1. Faulty ignitions: <ul style="list-style-type: none"><li>• Incorrect timing</li><li>• Fouled, shorted or improperly gapped plugs</li></ul> 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinders
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: <ul style="list-style-type: none"><li>• PCV hoses</li><li>• Intake manifold</li><li>• Throttle body</li><li>• IAC valve</li><li>• Brake booster line</li></ul> 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty SFI system: <ul style="list-style-type: none"><li>• Faulty fuel pressure regulator</li><li>• Defective ECT sensor</li><li>• Faulty ECM</li><li>• Faulty injectors</li><li>• Faulty throttle position sensor</li><li>• Faulty MAF meter</li></ul>

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**Fig. 2: CO/HC Problem & Cause Table**

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

## COMPRESSION

### INSPECTION

#### HINT:

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 IGNITION COIL )

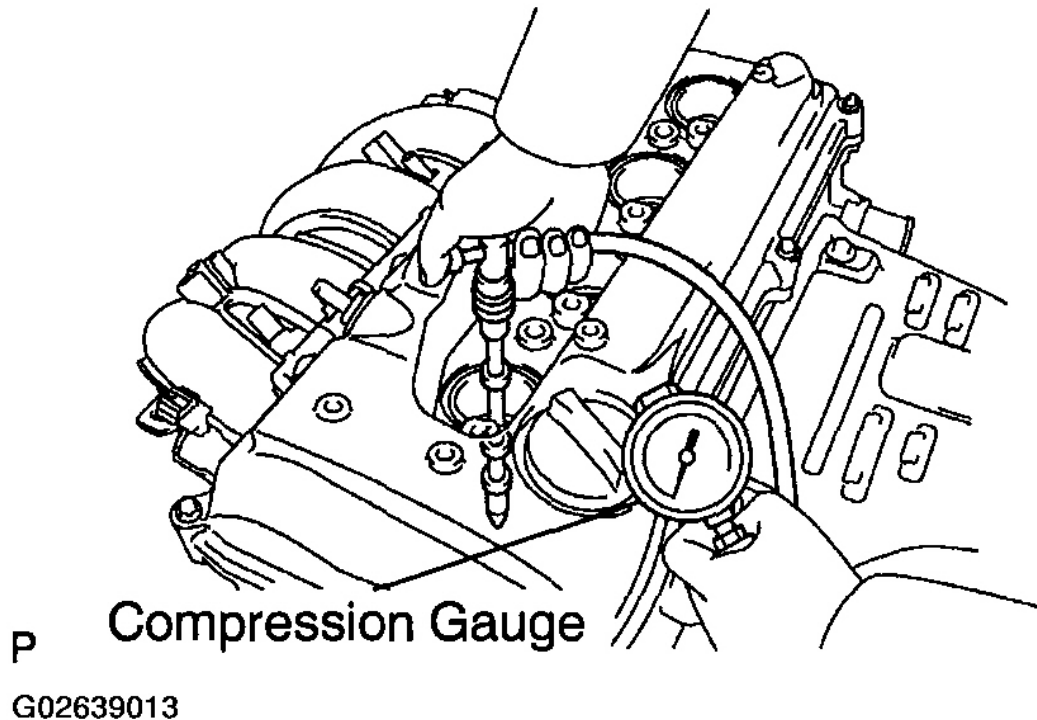
#### 3. REMOVE SPARK PLUGS , see (IGNITION SYSTEM )

#### 4. INSPECT CYLINDER COMPRESSION PRESSURE

- Insert a compression gauge into the spark plug hole.
- Fully open the throttle.
- While cranking the engine, measure the compression pressure.

#### HINT:

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



**Fig. 3: Measuring Compression Pressure**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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

**Compression pressure**  
**1.300 kPa (13.8 kgf/cm<sup>2</sup> , 196 psi)**

**Minimum pressure: 1.00 MPa (10 kgf/cm<sup>2</sup> , 142 psi)**

**Difference between each cylinder:**  
**100 kPa (1.0 kgf/cm<sup>2</sup> , 14 psi)**

- e. If the cylinder compression pressure in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps () through (c) for cylinders with low compression pressure.
- 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.

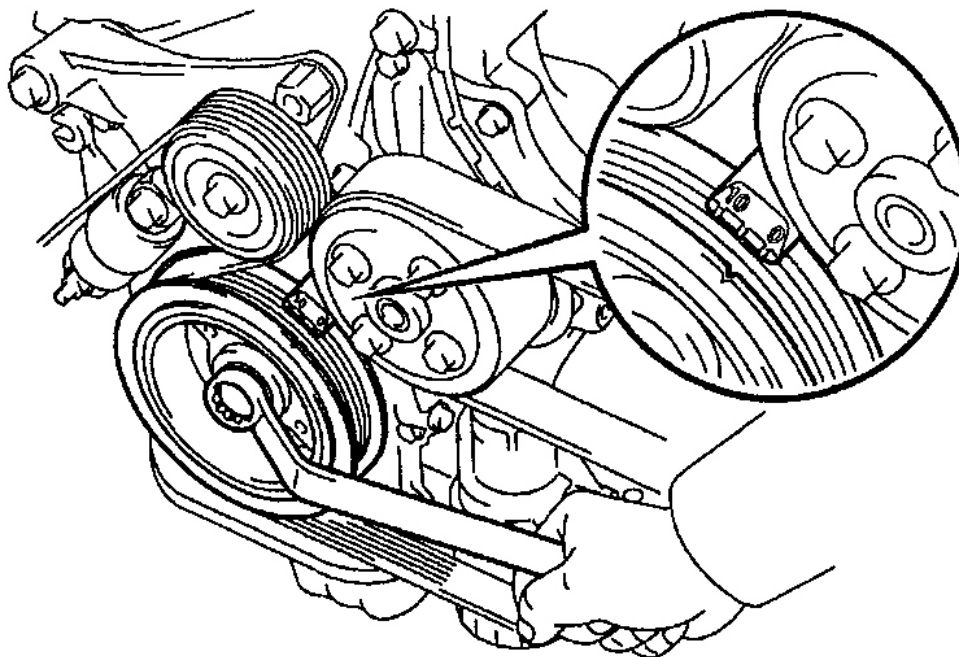
5. **REINSTALL SPARK PLUGS** , see (**IGNITION SYSTEM** )



**6. REINSTALL IGNITION COILS (See IGNITION COIL )****VALVE CLEARANCE****ADJUSTMENT****HINT:**

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.

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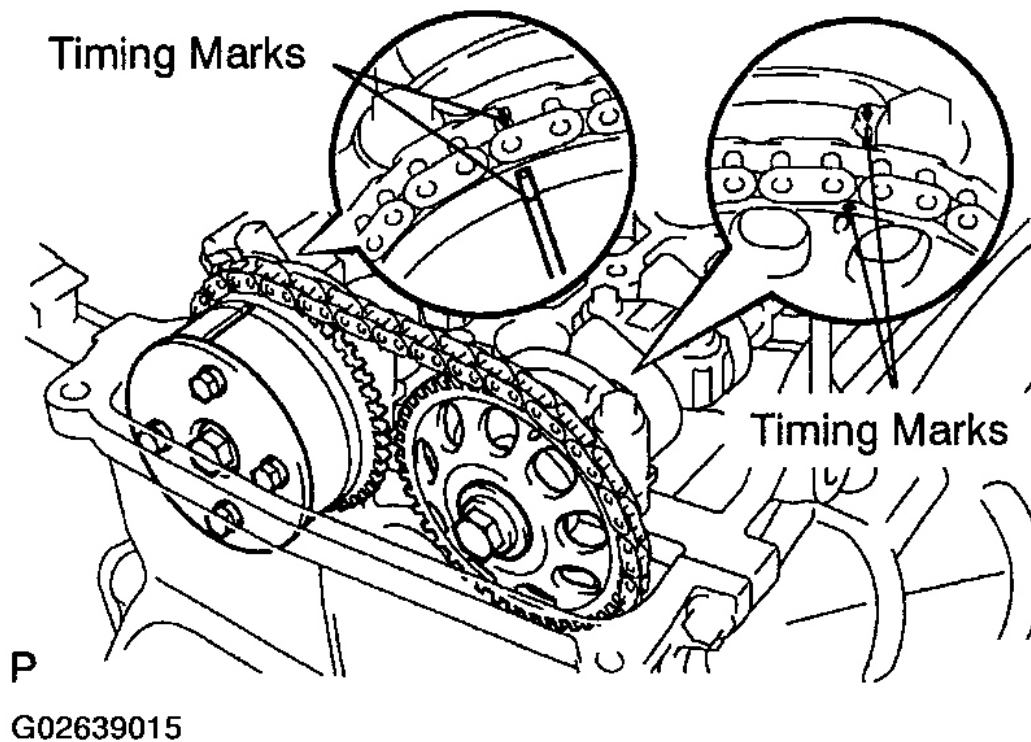
**Fig. 4: Turning Crankshaft Pulley**

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.



**Fig. 5: Checking Timing Marks Of Camshaft Timing Sprocket And VVT Timing Sprocket**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

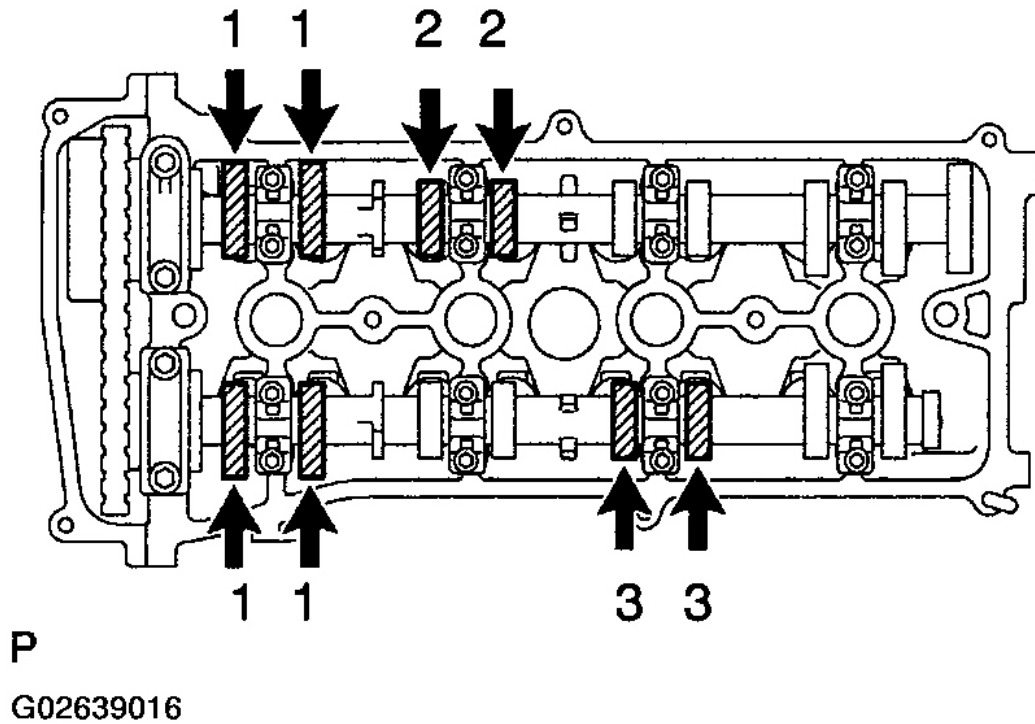
## 5. INSPECT VALVE CLEARANCE

- a. Check only the valve 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):**

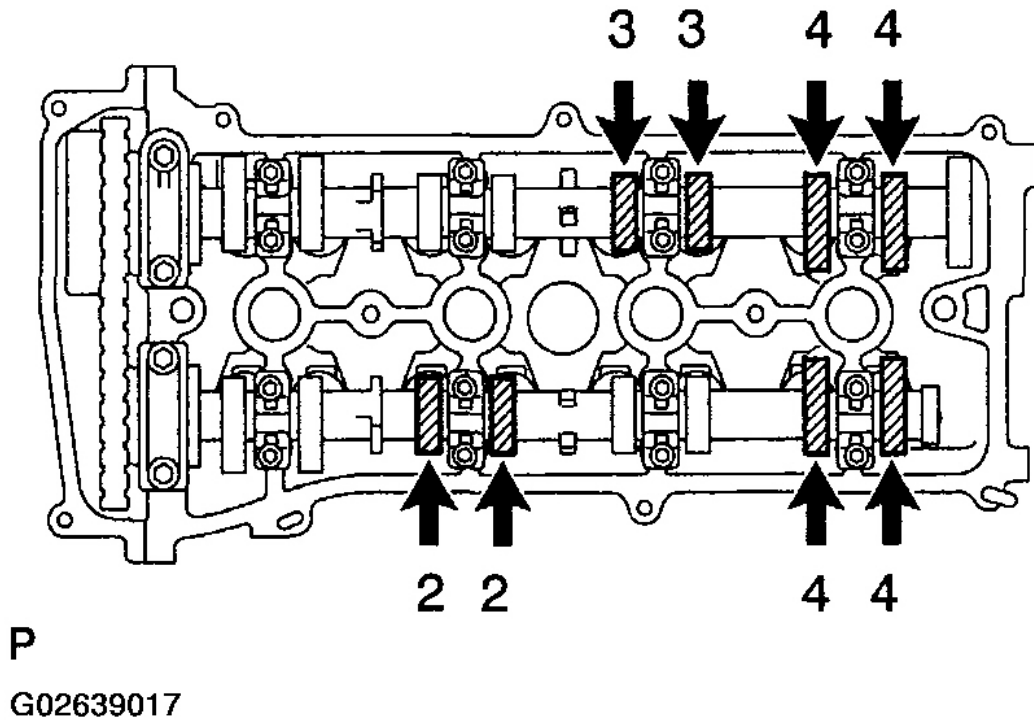
### **VALVE CLEARANCE (COLD)**

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



**Fig. 6: Inspecting Valve Clearance (Check Only The Valves Indicated)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

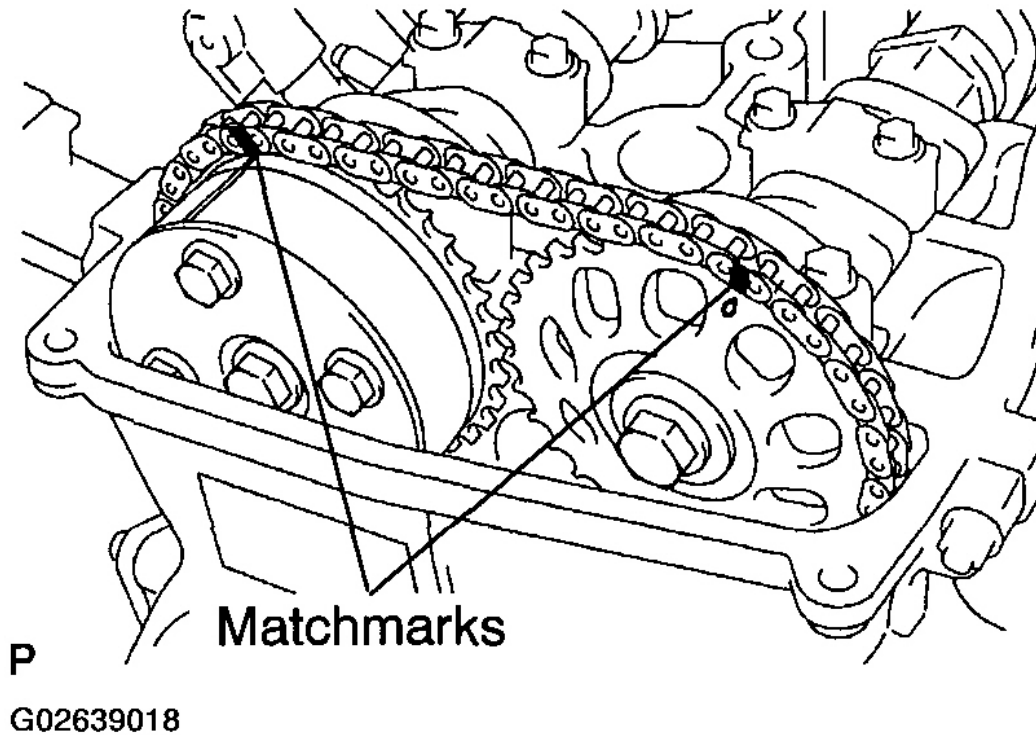
- b. Turn the crankshaft 1 revolution (360°) and align the mark as above (see step 4).
- c. Check only the valves indicated as shown. Measure the valve clearance (see step (a)).



**Fig. 7: Inspecting Valve Clearance (Check Only The Valves Indicated)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**6. ADJUST VALVE CLEARANCE**

- a. Set the No. 1 cylinder to the TDC/compression (See step 4).
- b. Place matchmarks on the timing chain and camshaft timing sprockets.

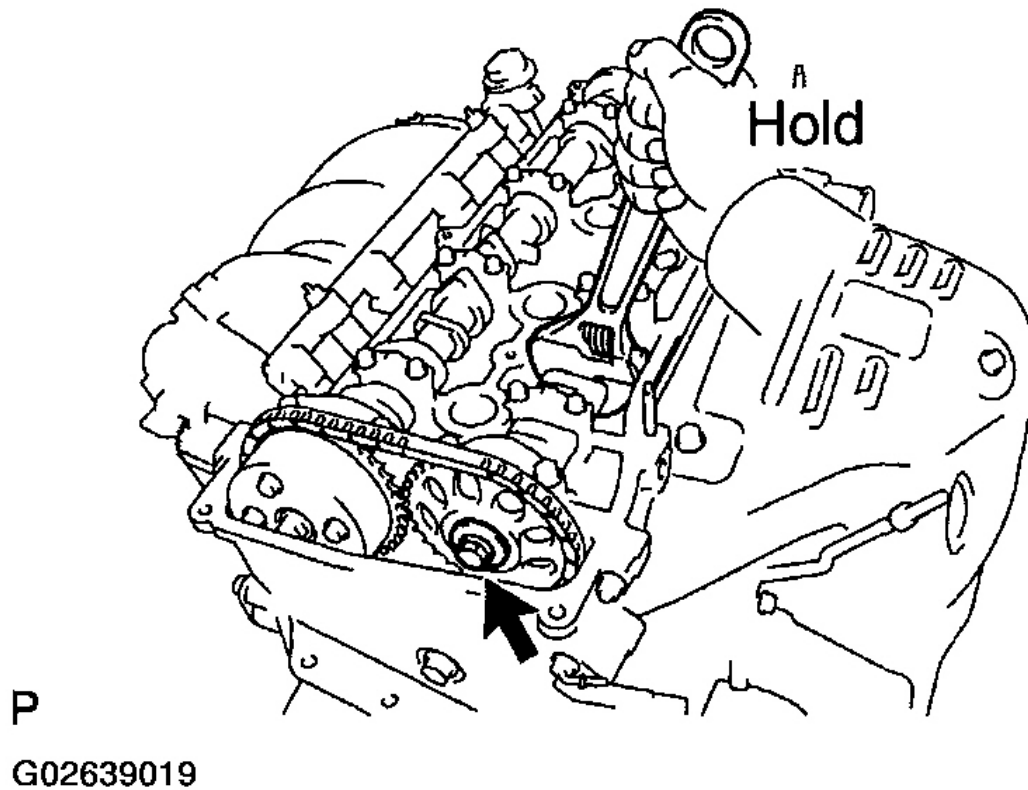


**Fig. 8: Identifying Matchmarks**

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

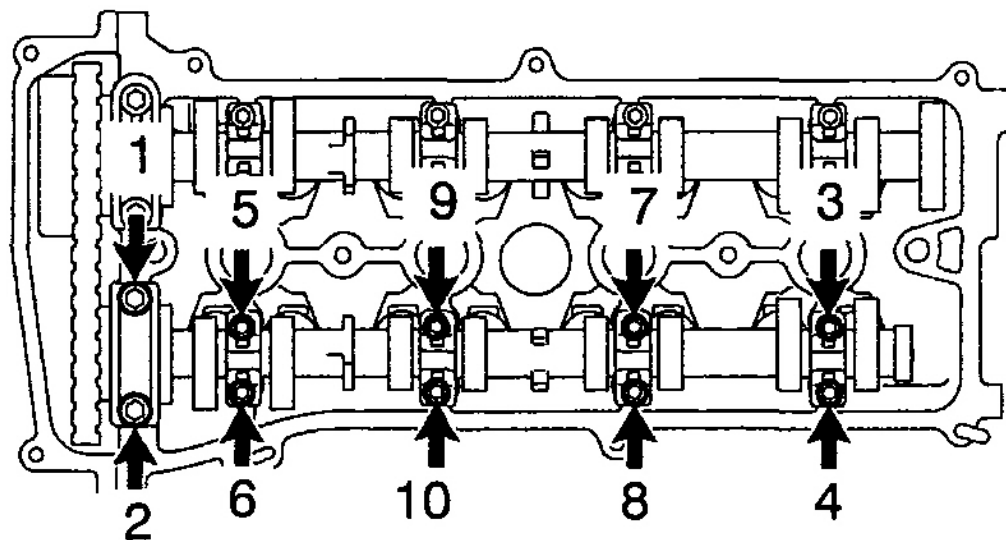
- c. Remove the 2 nuts, gasket and chain tensioner.
- d. Hold the hexagonal head portion of the camshaft with a wrench, and loosen the camshaft timing sprocket bolt.

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



**Fig. 9: Holding Hexagonal Head Portion Of Camshaft**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Uniformly loosen and remove the 10 camshaft bearing cap bolts in several passes, in the sequence shown.
- f. Remove the 5 camshaft bearing caps.

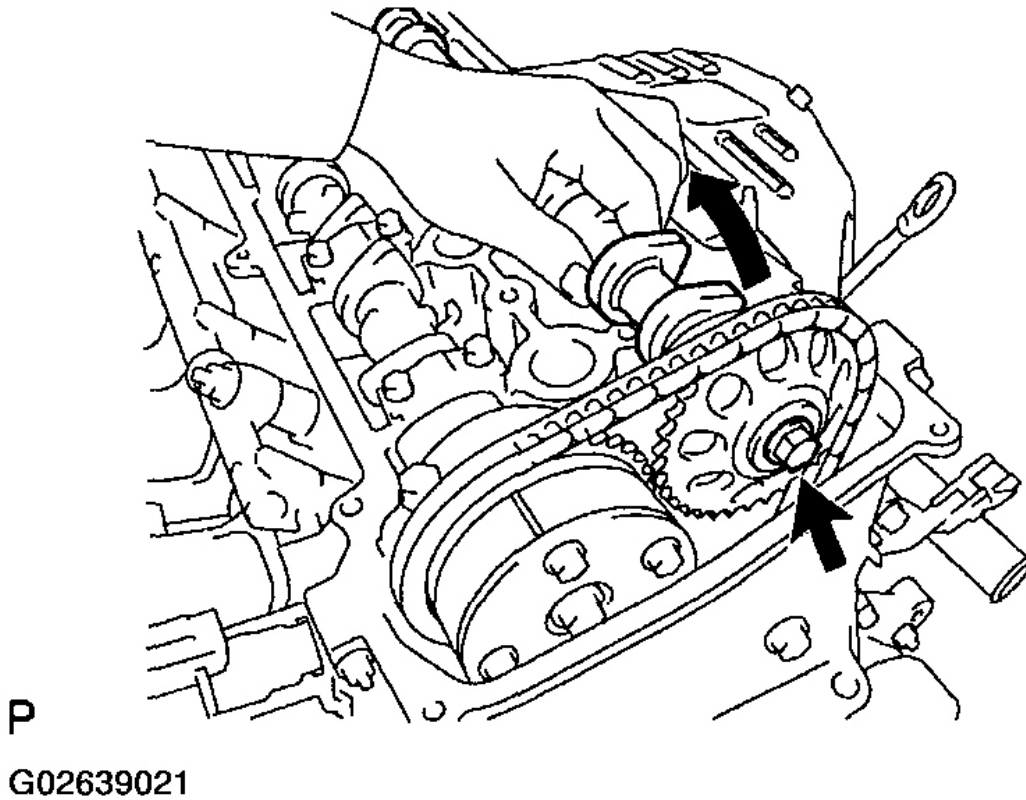


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**Fig. 10: Identifying Camshaft Bearing Cap Removing Sequence**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

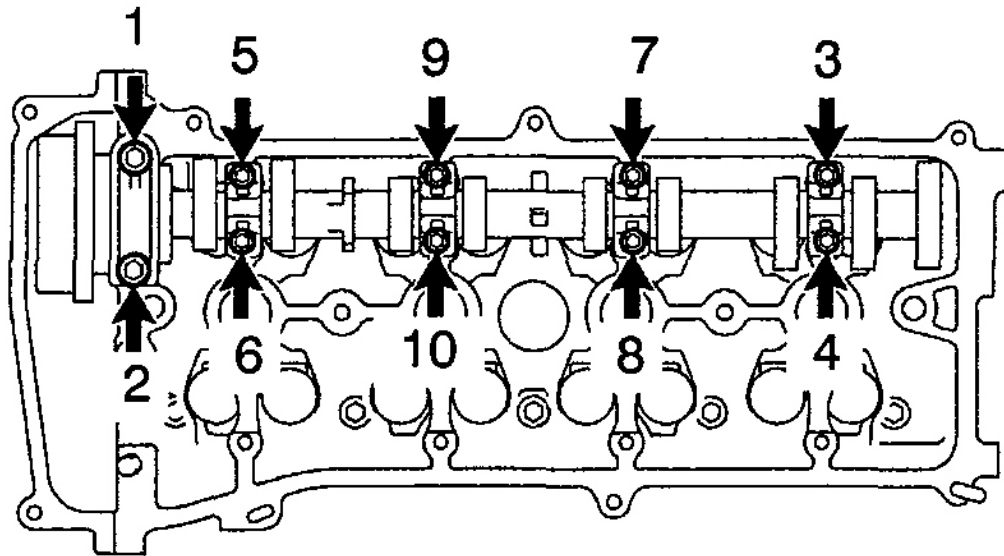
- g. Raising the camshaft, remove the camshaft timing sprocket bolt.



**Fig. 11: 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.
- 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.





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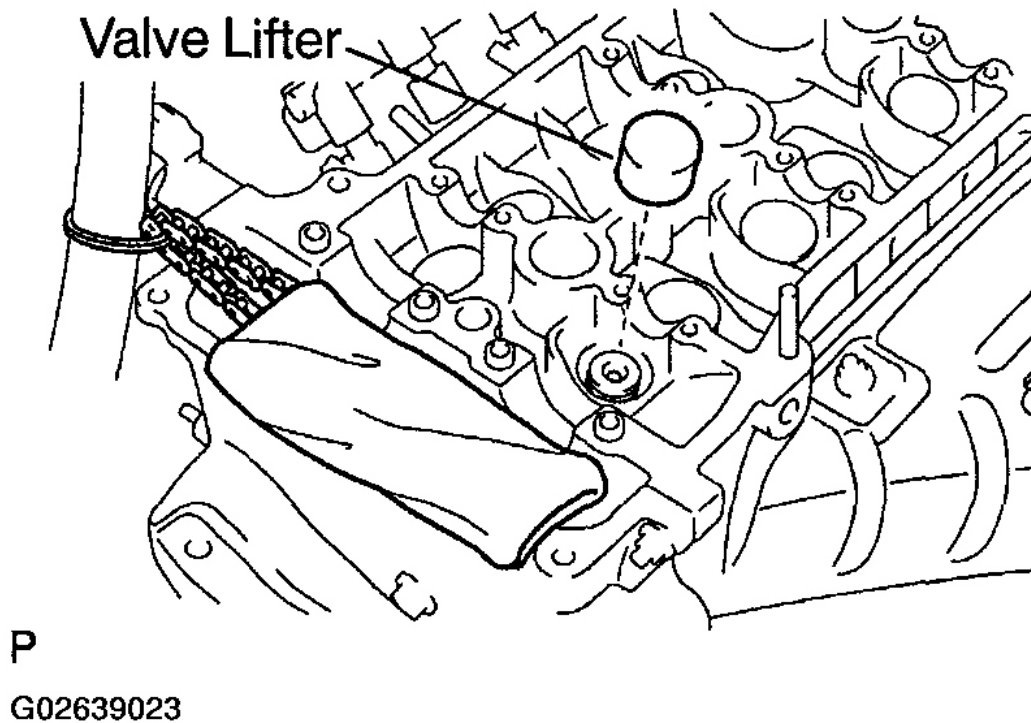
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**Fig. 12: Identifying Camshaft Bearing Cap Removing Sequence**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- m. Tie the timing chain as shown, see **Fig. 13**.

**NOTE:**

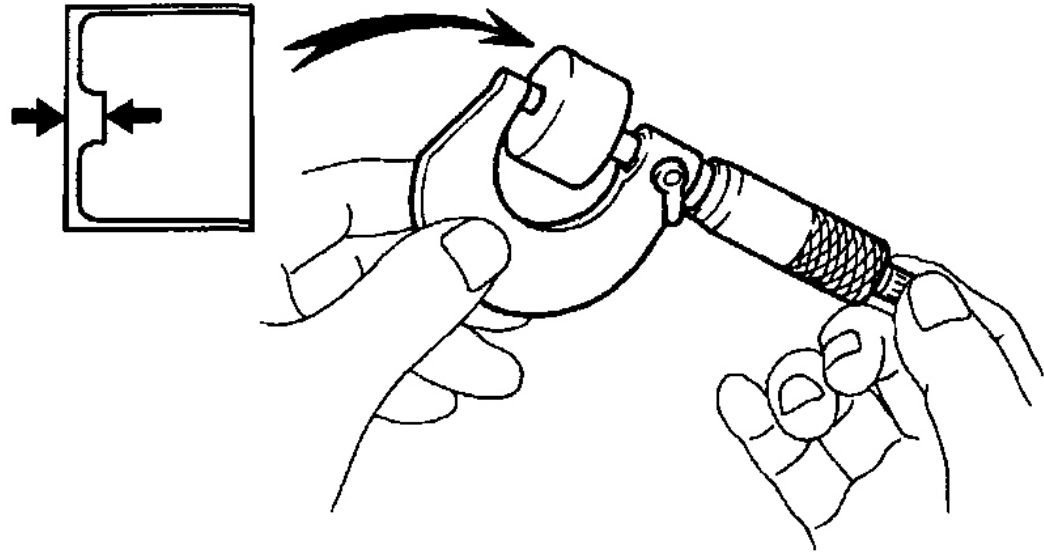
- Be careful not to drop anything inside the timing chain cover.
- Do not allow the chain to come into contact with water or dust.



**Fig. 13: Tie-Up Timing Chain**

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

- n. Remove the valve lifter.
- o. Determine the replacement valve lifter size according to these Formula, see **VALVE LIFTER SIZE FORMULA** or Charts: **Fig. 16** and **Fig. 17**.
  - Using a micrometer, measure the thickness of the removed lifter.



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**Fig. 14: Measuring Thickness Of Removed Lifter Using Micrometer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Calculate the thickness of a new lifter so the valve clearance comes within the specified value.

T.....Thickness of used lifter

A.....Measured valve clearance

N.....Thickness of new lifter

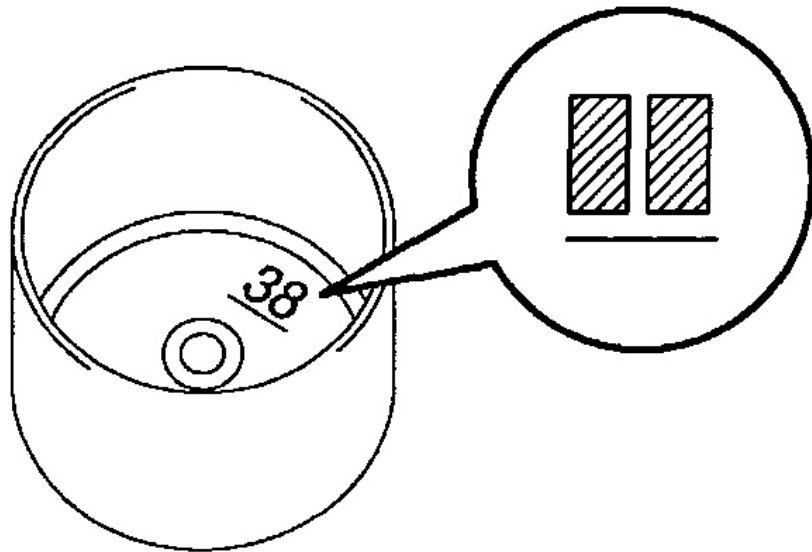
- Select a new lifter with a thickness as close as possible to the calculated values.

#### VALVE LIFTER SIZE FORMULA

Intake	$N = T + (A - 0.24 \text{ mm (0.009 in.)})$
Exhaust	$N = T + (A - 0.35 \text{ mm (0.014 in.)})$

#### HINT:

- 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.).



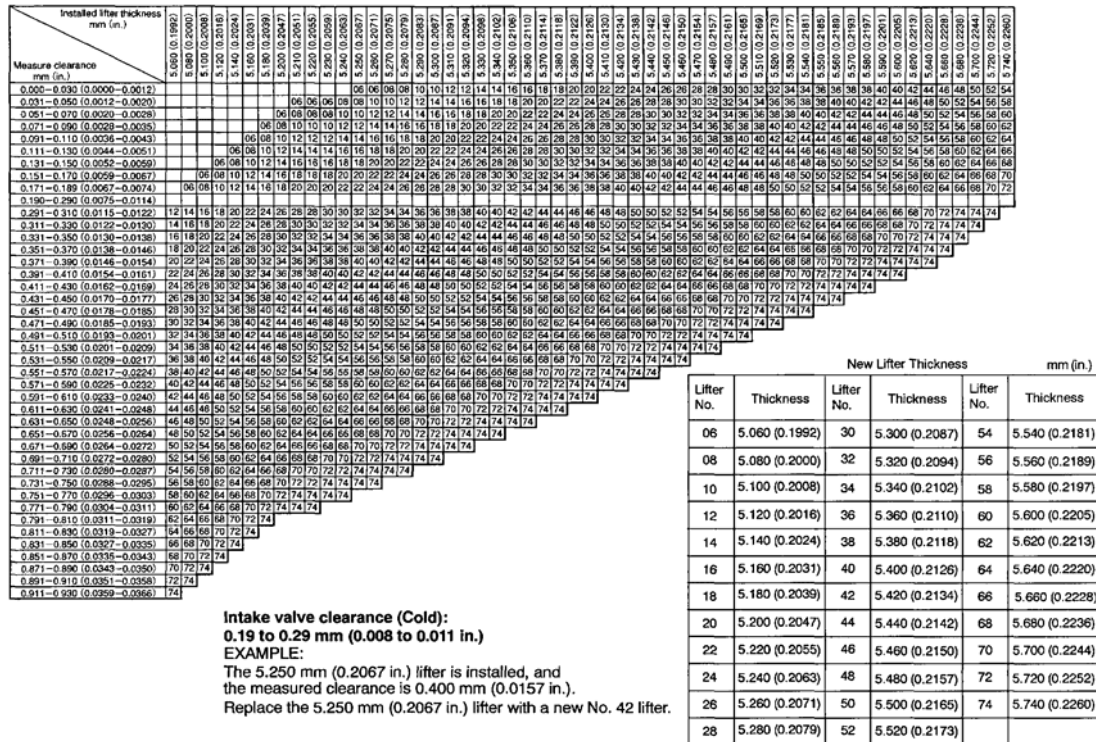
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**Fig. 15: Locating Valve Lifter Identification Number**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**Valve lifter Selection Chart (Intake)**

## 2005 ENGINE Engine Mechanical - RAV4



# 2005 Toyota RAV4

## 2005 ENGINE Engine Mechanical - RAV4

Measure clearance mm (in.)	Installed lifter thickness mm (in.)																											
	5.060 (0.1992)	5.090 (0.2000)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)	5.100 (0.2008)
0.000-0.030 (0.0000-0.0012)																												
0.031-0.050 (0.0012-0.0020)																												
0.051-0.070 (0.0020-0.0028)																												
0.071-0.090 (0.0028-0.0035)																												
0.091-0.110 (0.0035-0.0043)																												
0.111-0.130 (0.0043-0.0051)																												
0.131-0.150 (0.0051-0.0059)																												
0.151-0.170 (0.0059-0.0067)																												
0.171-0.190 (0.0067-0.0075)																												
0.191-0.210 (0.0075-0.0083)																												
0.211-0.230 (0.0083-0.0091)																												
0.231-0.250 (0.0091-0.0099)																												
0.251-0.270 (0.0099-0.0106)																												
0.271-0.290 (0.0106-0.0114)																												
0.291-0.310 (0.0114-0.0122)																												
0.311-0.330 (0.0122-0.0130)																												
0.331-0.350 (0.0130-0.0138)																												
0.351-0.370 (0.0138-0.0146)																												
0.371-0.390 (0.0146-0.0154)																												
0.391-0.410 (0.0154-0.0162)																												
0.411-0.430 (0.0162-0.0170)																												
0.431-0.450 (0.0170-0.0178)																												
0.451-0.470 (0.0178-0.0186)																												
0.471-0.490 (0.0186-0.0194)																												
0.491-0.510 (0.0194-0.0202)																												
0.511-0.530 (0.0202-0.0210)																												
0.531-0.550 (0.0210-0.0218)																												
0.551-0.570 (0.0218-0.0226)																												
0.571-0.590 (0.0226-0.0234)																												
0.591-0.610 (0.0234-0.0242)																												
0.611-0.630 (0.0242-0.0250)																												
0.631-0.650 (0.0250-0.0258)																												
0.651-0.670 (0.0258-0.0266)																												
0.671-0.690 (0.0266-0.0274)																												
0.691-0.710 (0.0274-0.0282)																												
0.711-0.730 (0.0282-0.0290)																												
0.731-0.750 (0.0290-0.0298)																												
0.751-0.770 (0.0298-0.0306)																												
0.771-0.790 (0.0306-0.0314)																												
0.791-0.810 (0.0314-0.0322)																												
0.811-0.830 (0.0322-0.0330)																												
0.831-0.850 (0.0330-0.0338)																												
0.851-0.870 (0.0338-0.0346)																												
0.871-0.890 (0.0346-0.0354)																												
0.891-0.910 (0.0354-0.0362)																												
0.911-0.930 (0.0362-0.0370)																												
0.931-0.950 (0.0370-0.0378)																												
0.951-0.970 (0.0378-0.0386)																												
0.971-0.990 (0.0386-0.0394)																												
0.991-1.010 (0.0394-0.0402)																												
1.011-1.030 (0.0402-0.0410)																												
1.031-1.050 (0.0410-0.0418)																												
1.051-1.070 (0.0418-0.0426)																												

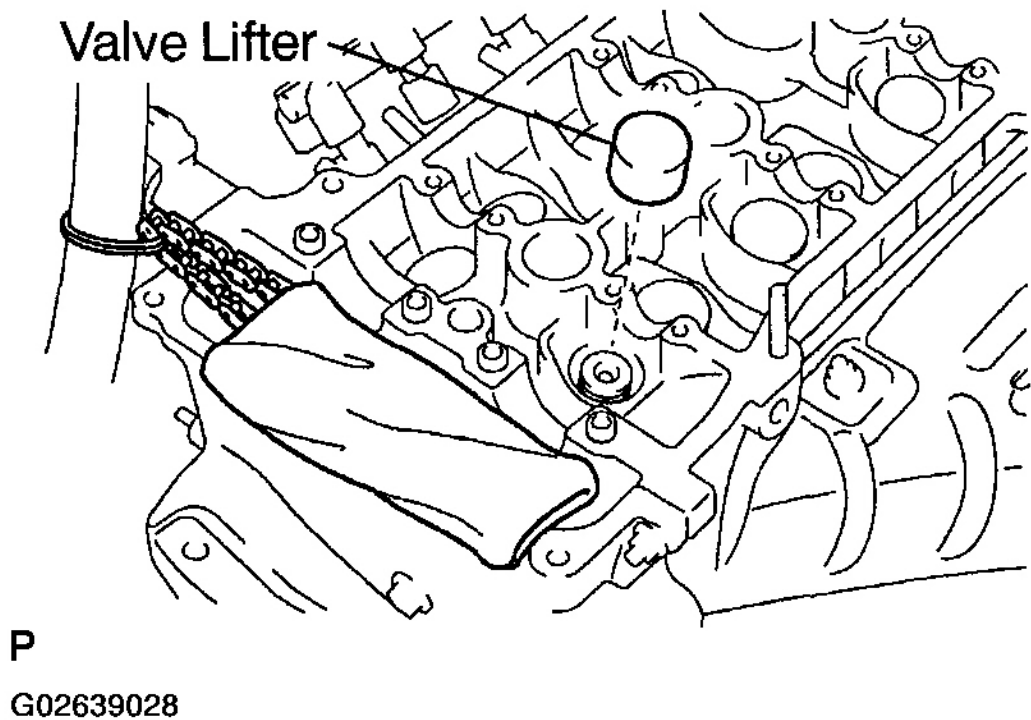
New Lifter Thickness mm (in.)			
Lifter No.	Thickness	Lifter No.	Thickness
06	5.060 (0.1992)	30	5.300 (0.2087)
08	5.060 (0.2000)	32	5.320 (0.2094)
10	5.100 (0.2008)	34	5.340 (0.2102)
12	5.120 (0.2016)	36	5.360 (0.2110)
14	5.140 (0.2024)	38	5.380 (0.2118)
16	5.160 (0.2031)	40	5.400 (0.2126)
18	5.180 (0.2039)	42	5.420 (0.2134)
20	5.200 (0.2047)	44	5.440 (0.2142)
22	5.220 (0.2055)	46	5.460 (0.2150)
24	5.240 (0.2063)	48	5.480 (0.2157)
26	5.260 (0.2071)	50	5.500 (0.2165)
28	5.280 (0.2079)	52	5.520 (0.2173)

**Exhaust valve clearance (Cold):**  
**0.30 to 0.40 mm (0.012 to 0.016 in.)**  
**EXAMPLE:**  
 The 5.340 mm (0.2102 in.) lifter is installed, and the measured clearance is 0.430 mm (0.0169 in.).  
 Replace the 5.340 mm (0.2102 in.) lifter with a new No. 42 lifter.

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

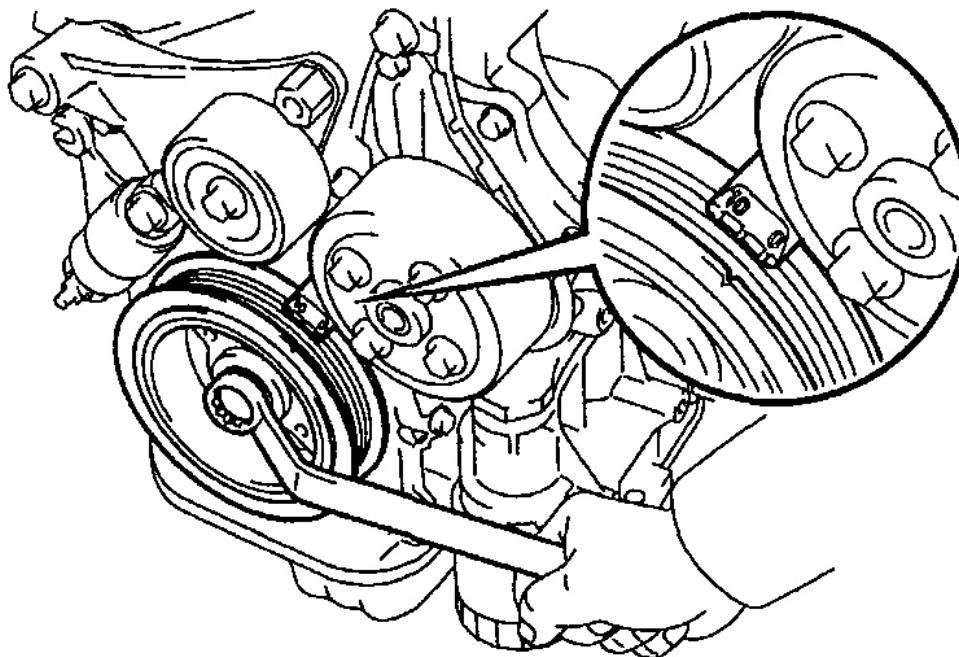
- Apply a light coat engine oil to new valve lifter.
- Reinstall the valve lifter.



**Fig. 18: Reinstalling Valve Lifter**

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

- r. Align the crankshaft pulley groove with timing mark 0 of the timing chain cover.



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**Fig. 19: Aligning Crankshaft Pulley Groove With 0 Timing Mark On Timing Chain Cover**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- s. Hold the timing chain.

#### **7. REINSTALL INTAKE CAMSHAFT**

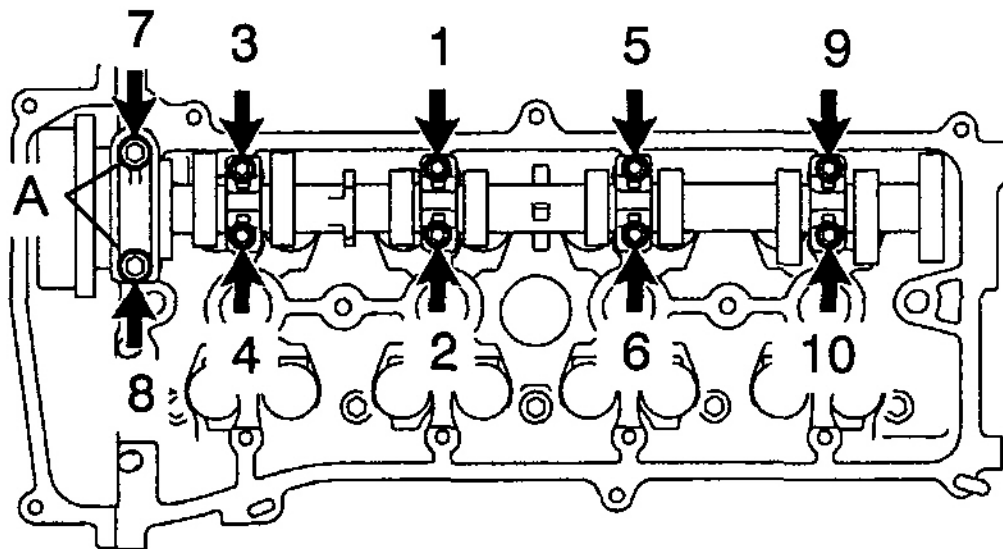
- a. Align the matchmarks on the timing chain and VVT timing sprocket (See step a), and place the intake camshaft on the cylinder head.
- b. Apply a light coat engine oil on the threads and under the camshaft bearing cap bolts.
- c. Install the 5 intake camshaft bearing caps in their proper locations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

**Torque:**

**30 N.m (301 kgf.cm, 22 ft.lbf) for bolt A**

**9.0 N.m (92 kgf.cm, 80 in.lbf) for others**





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**Fig. 20: Identifying Bearing Cap Bolt Tightening Sequence**

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

- e. Align the matchmarks on the timing chain and camshaft timing sprocket (See step a), and install them.

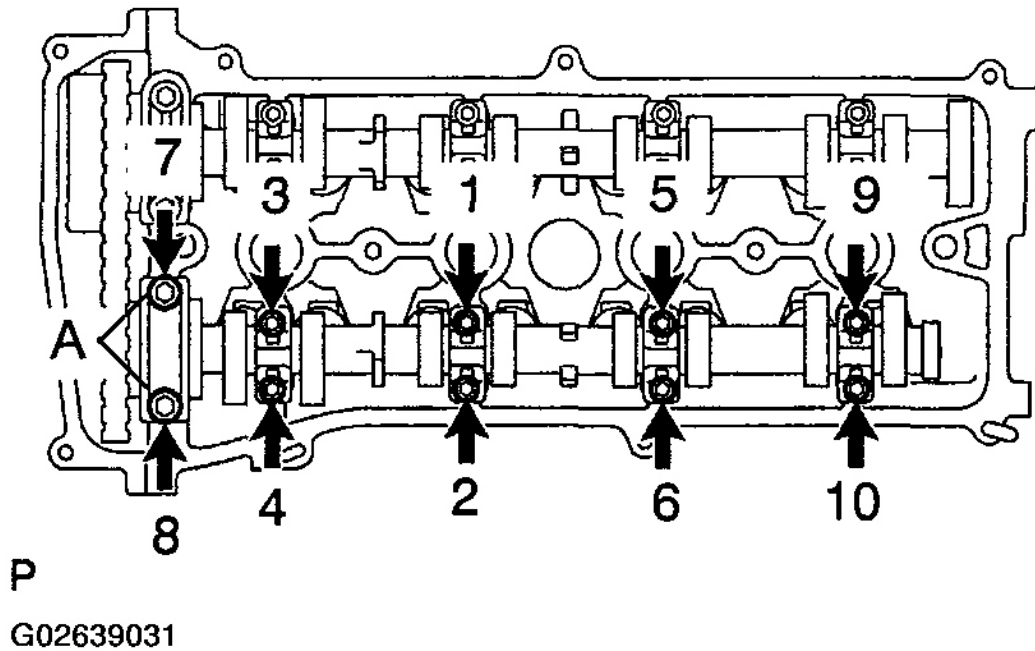
## 8. REINSTALL EXHAUST CAMSHAFT

- 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:**

**30 N.m (301 kgf.cm, 22 ft.lbf) for bolt A**

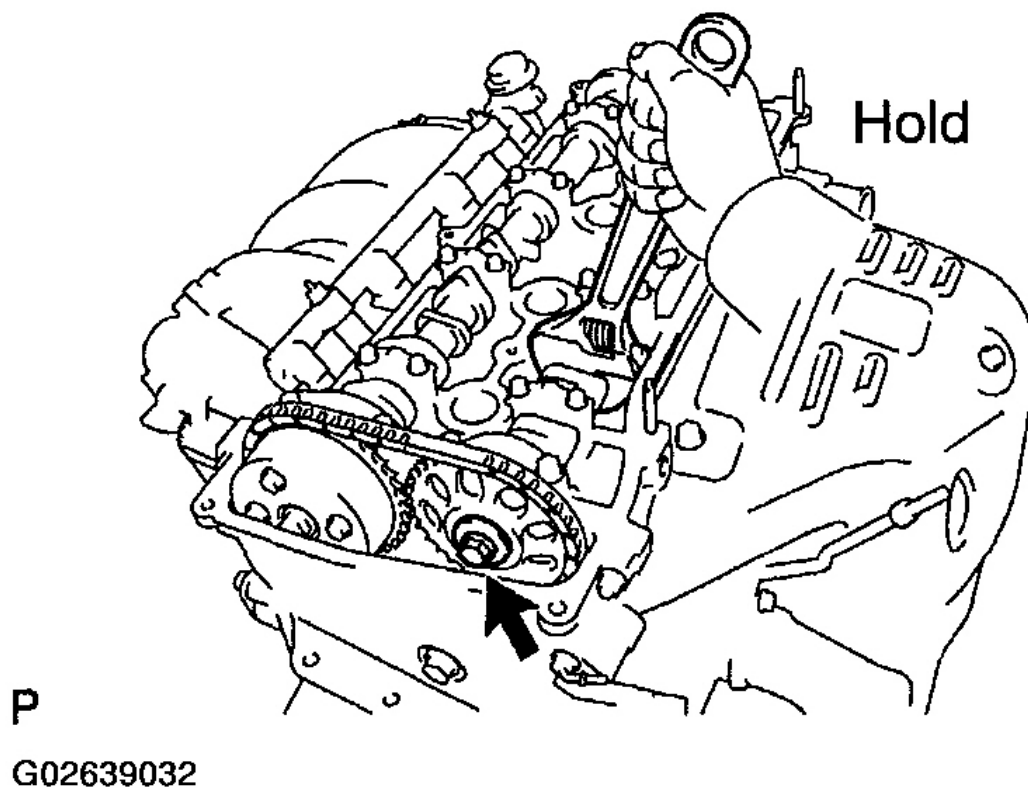
**9.0 N.m (92 kgf.cm, 80 in.lbf) for others**



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

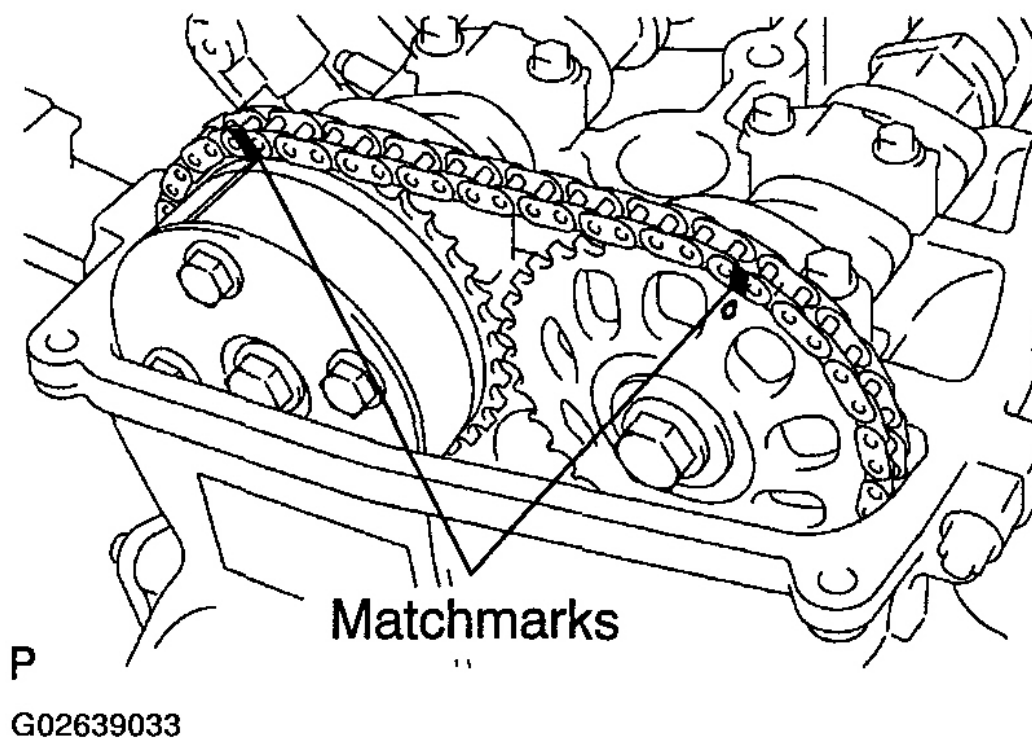
- f. Hold the hexagon head portion of the exhaust camshaft with a wrench, and tighten the bolt.

**Torque: 54 N.m (551 kgf.cm, 40 ft.lbf)**



**Fig. 22: Holding Hexagon Head Portion Of Exhaust Camshaft**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- g. Check that the each sprocket aligned with the matchmarks as shown.



**Fig. 23: Identifying Sprocket Matchmarks**

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**

## IGNITION TIMING

### INSPECTION

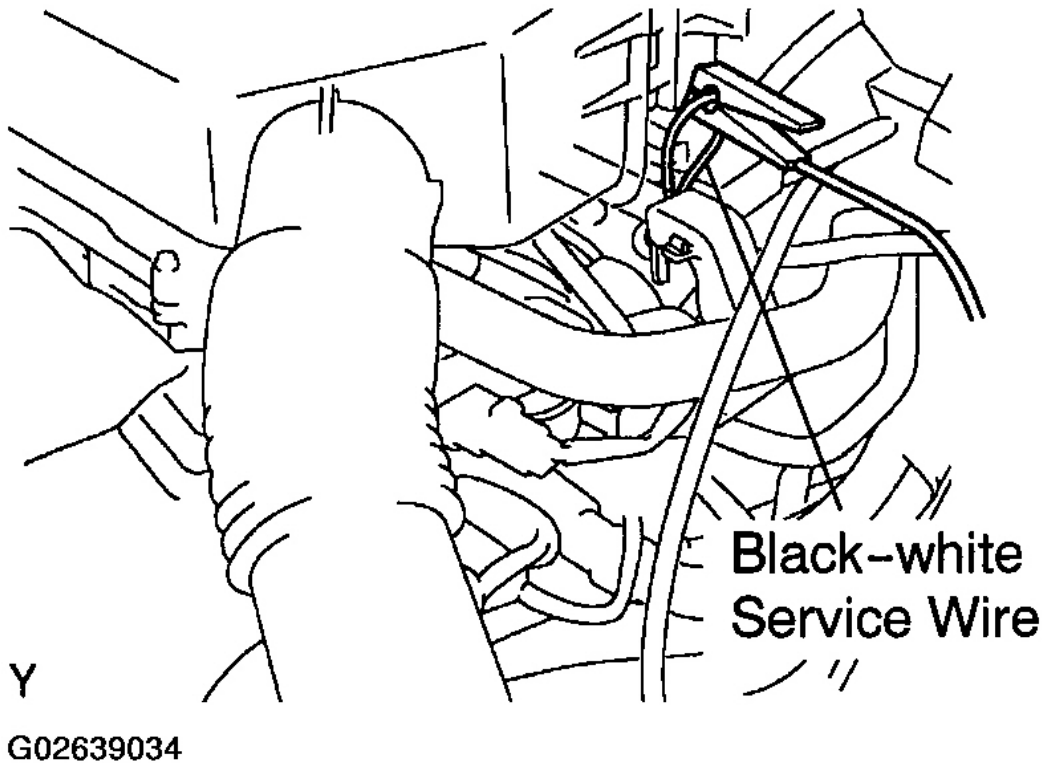
#### 1. WARM UP ENGINE

Allow the engine to warm up to normal operating temperature.

#### 2. CHECK IDLE SPEED (See **IDLE SPEED**)

### 3. CONNECT TIMING LIGHT

Connect the tester probe of a timing light to the black-white service wire of the engine wire as shown.



**Fig. 24: Connecting Tester Probe Of Timing Light To Service Wire**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

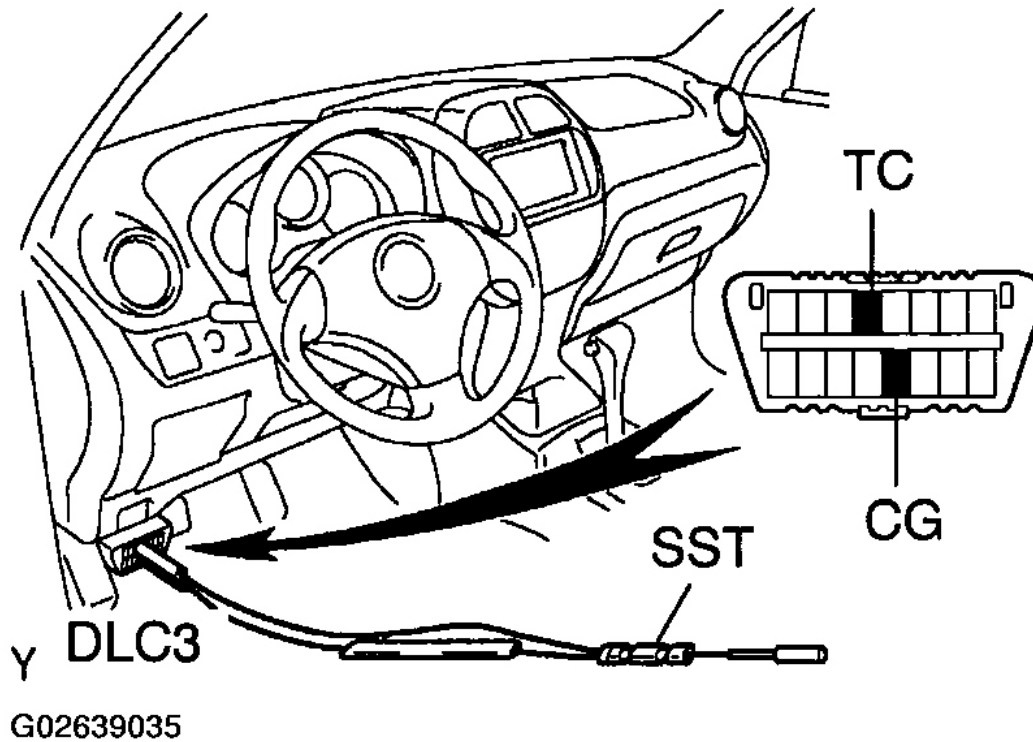
### 4. INSPECT IGNITION TIMING

- a. Using SST, connect terminals to TC and CG of the DLC3.

SST 09843-18040

HINT:

After engine RPM is kept at 900 - 1,500 RPM for 5 seconds, check that it returns to idle speed.



**Fig. 25: Connecting Terminals To TC And CG Of DLC3 Using SST**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using a timing light, check the ignition timing.

**Ignition timing: 8 to 12° BTDC @ idle**

- c. Remove the SST from the DLC3.

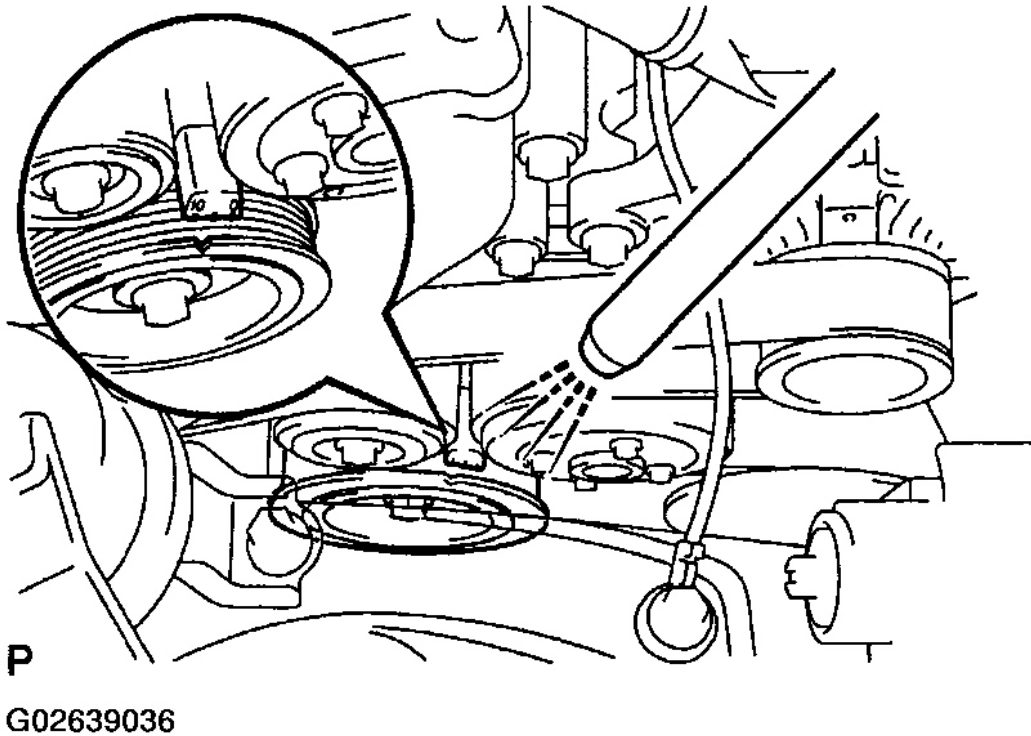
#### 5. FURTHER CHECK IGNITION TIMING

**Ignition timing: 5 to 15° BTDC @ idle**

HINT:

The timing mark moves in a range between 5 and 15°.

#### 6. DISCONNECT TIMING LIGHT



**Fig. 26: Checking Ignition Timing Using Timing Light**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## IDLE SPEED

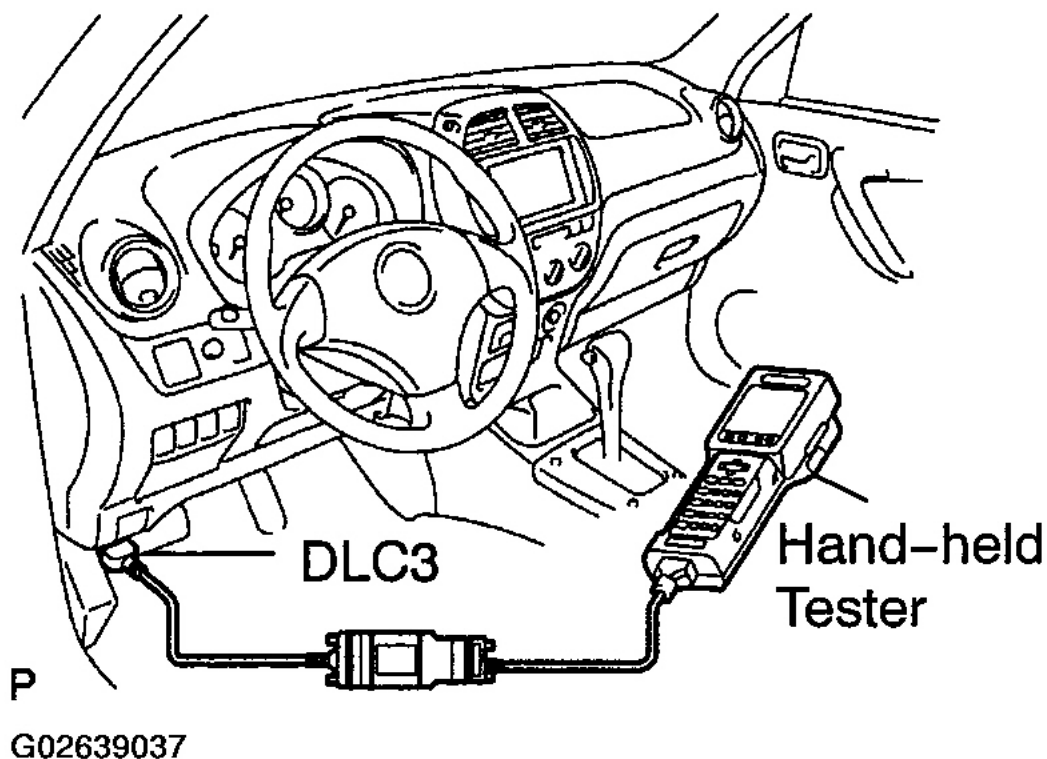
### INSPECTION

#### 1. INITIAL CONDITIONS

- a. Engine at normal operating temperature.
- b. Air cleaner installed
- c. All pipes and hoses of air induction system connected
- d. All vacuum lines properly connected
- e. SFI system wiring connectors fully plugged
- f. All operating accessories switched OFF
- g. Ignition timing check correctly
- h. Transmission in neutral range
- i. A/C switched OFF

#### 2. CONNECT HAND-HELD TESTER OR OBD II SCAN TOOL

- a. Connect the hand-held tester or OBD II scan tool to the DLC3.
- b. Refer to the hand-held tester or OBD II scan tool operator's for further details.



**Fig. 27: Connecting Hand-Held Tester OBD II Scan Tool To DLC3**

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

### 3. INSPECT IDLE SPEED

- a. Race the engine at 2,500 RPM for approx. 90 seconds.
- b. Check the idle speed.

**Idle speed (w/ Cooling fan OFF):**

#### **IDLE SPEED (W/ COOLING FAN OFF)**

AT	610 to 710 RPM
MT	610 +/- 710 RPM

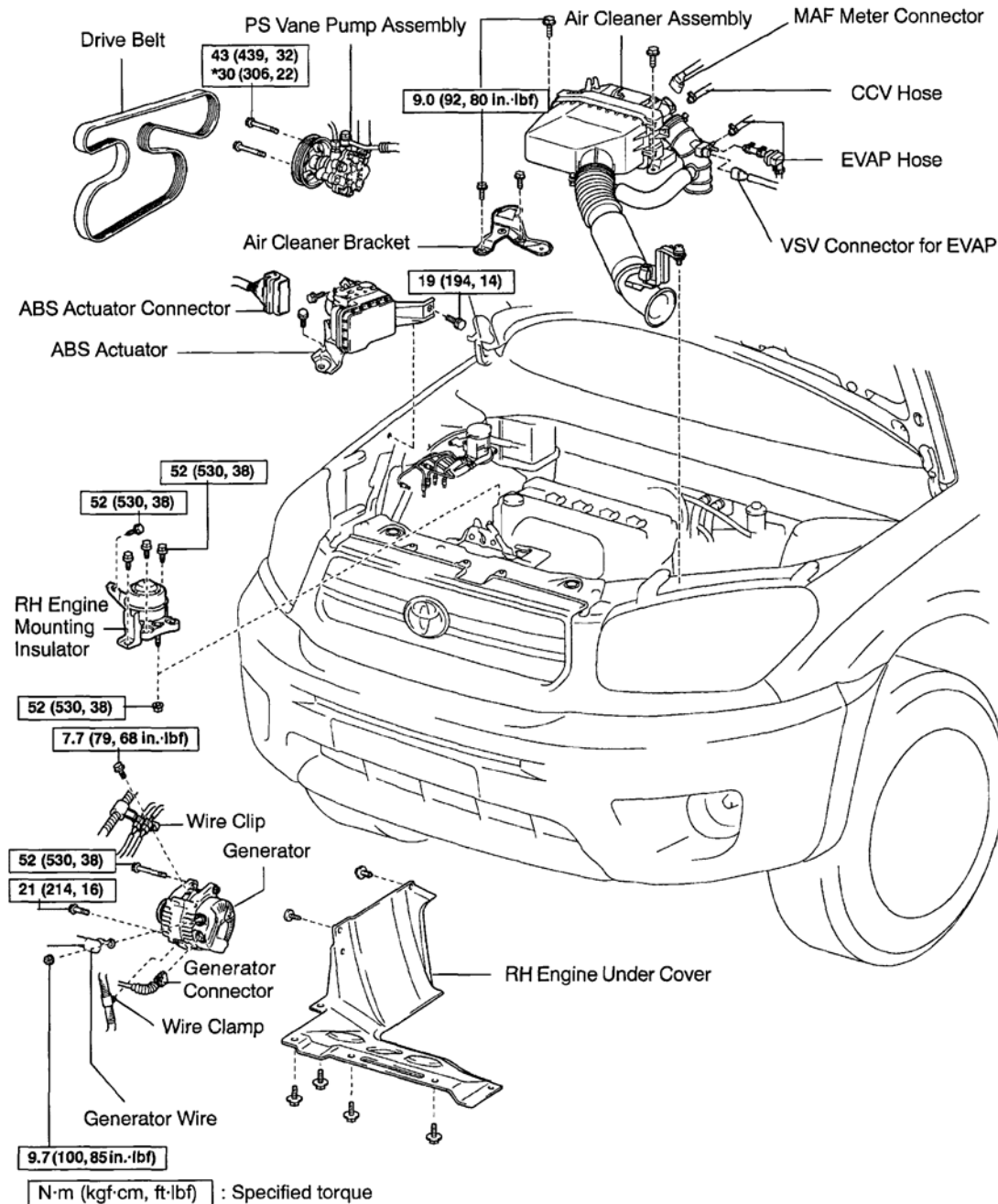
If the idle speed is not as specified, check the air intake system.

### 4. DISCONNECT HAND-HELD TESTER OR OBD II SCAN TOOL



## TIMING CHAIN

### COMPONENTS

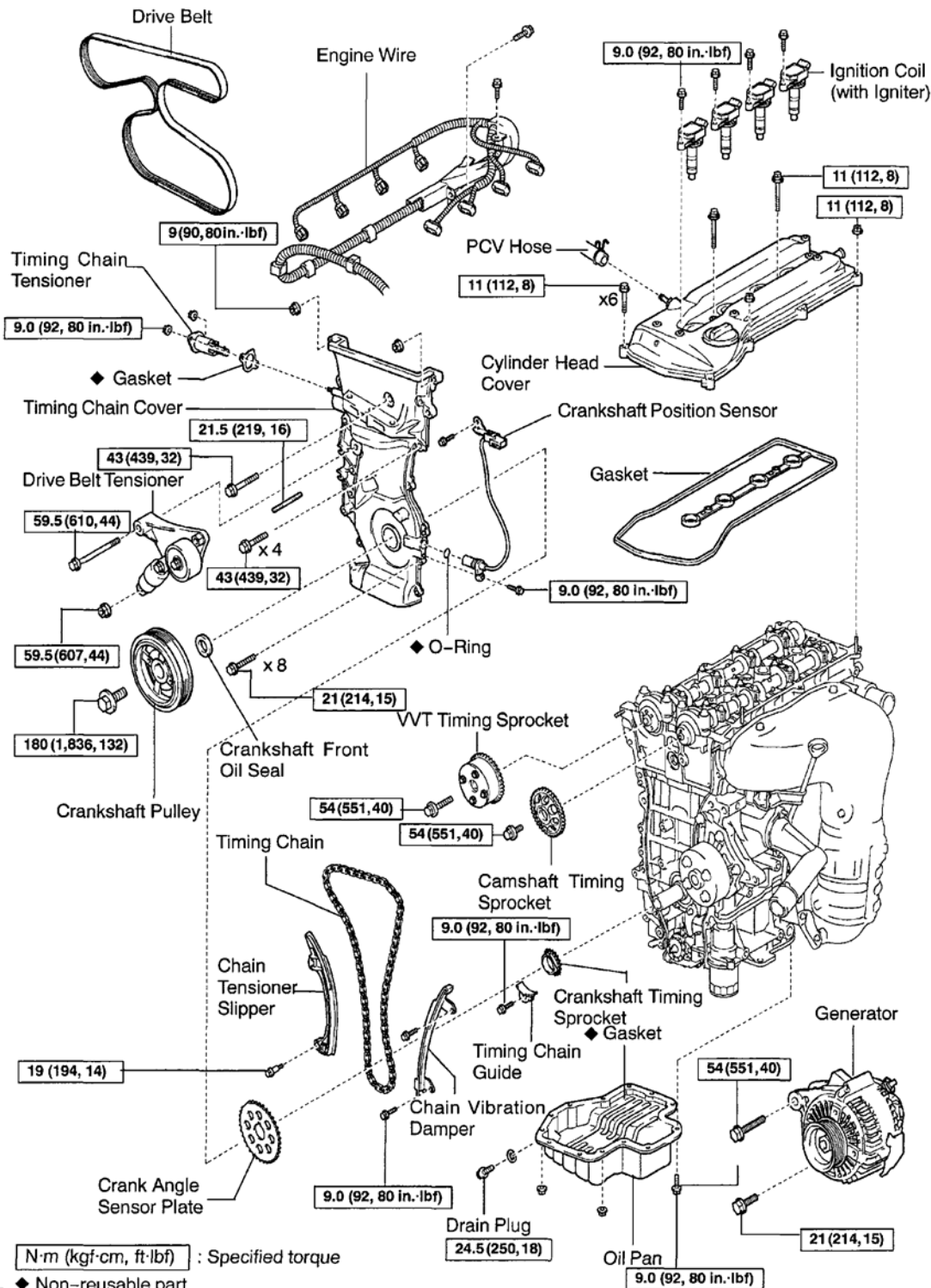


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**Fig. 28: Identifying Timing Chain Components & Torque Specifications (1 of 2)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2005 Toyota RAV4

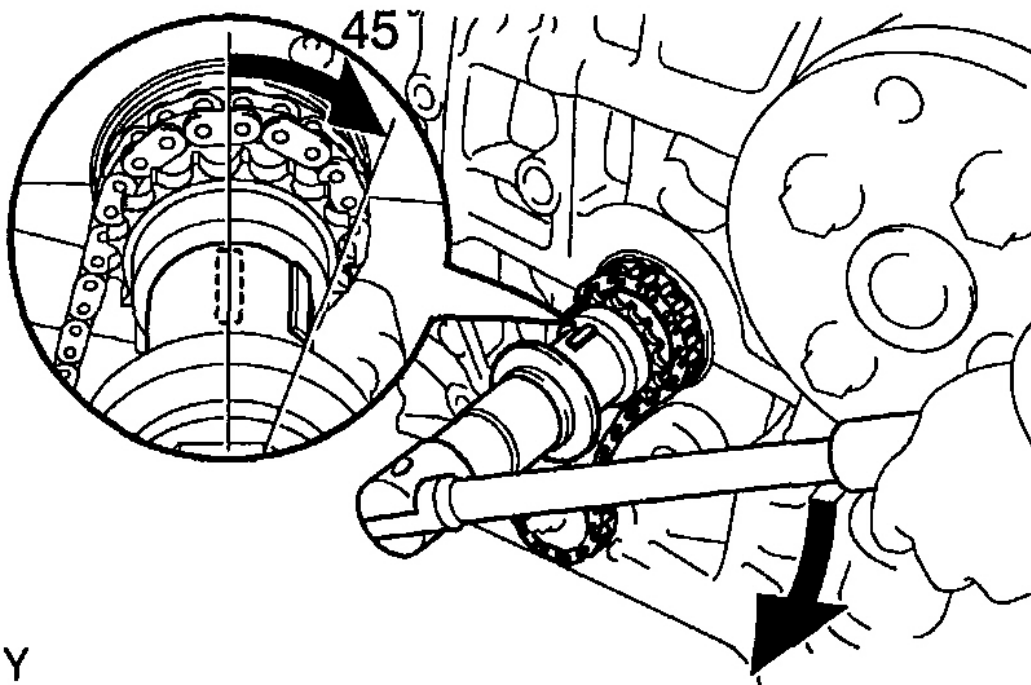
### 2005 ENGINE Engine Mechanical - RAV4



**Fig. 29: Identifying Timing Chain Components & Torque Specifications (2 of 2)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**REMOVAL**

**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.



Y

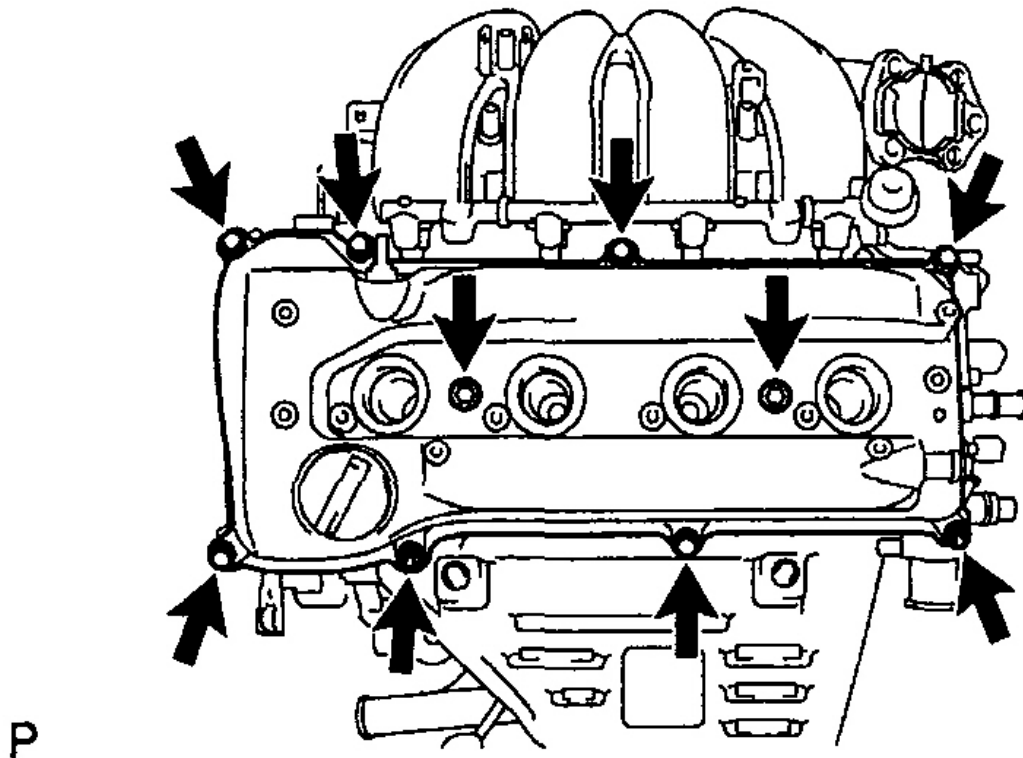
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**Fig. 30: Rotating Camshafts Clockwise By About 45°**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. **DRAIN ENGINE OIL**
2. **REMOVE RH ENGINE UNDER COVER**
3. **REMOVE PS VANE PUMP (See REMOVAL )**
4. **REMOVE ABS ACTUATOR (See REMOVAL )**
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 IGNITION COIL )**

# 10. REMOVE CYLINDER HEAD COVER

- a. Disconnect the 2 PCV hoses from the cylinder head cover.
- b. Remove the 8 bolts, 2 nuts, cylinder head cover and gasket.

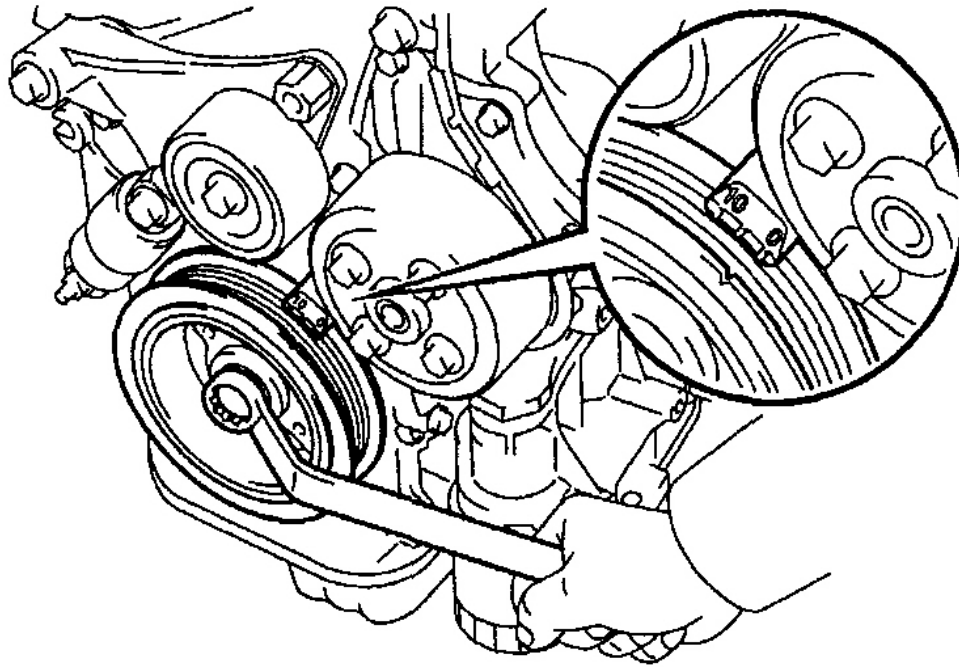


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**Fig. 31: Removing Cylinder Head Cover And Gasket**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

# 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.



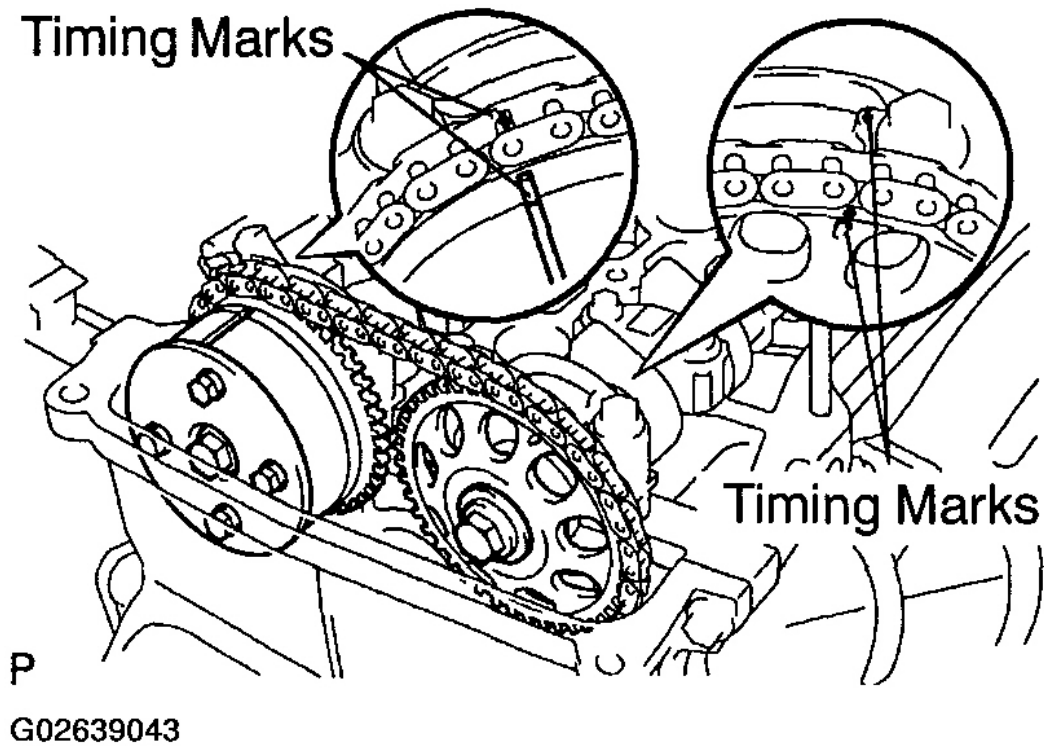
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**Fig. 32: Aligning Crankshaft Pulley Groove With 0 Timing Mark Of Timing Chain Cover**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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



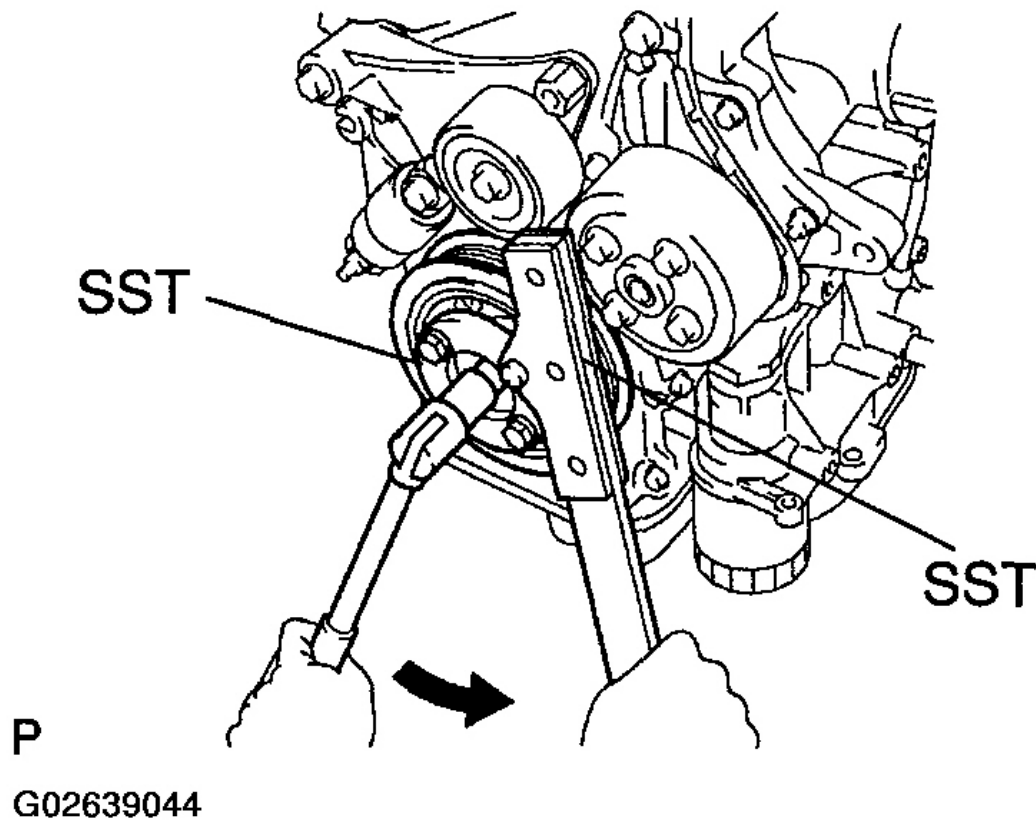
**Fig. 33: Checking Timing Marks Of Camshaft Timing Sprocket**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**12. REMOVE CRANKSHAFT PULLEY**

- a. Using SST, loosen the pulley bolt.

SST 09213-54015, 09330-00021

- b. Remove the pulley bolt and crankshaft pulley.



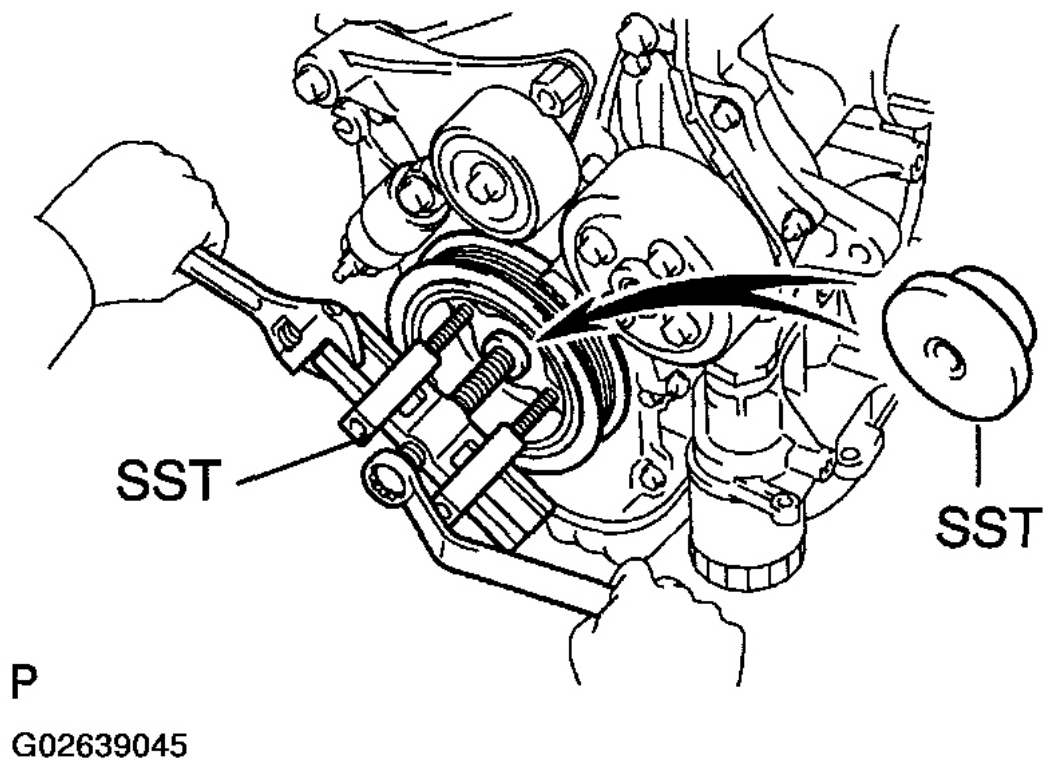
**Fig. 34: Loosening Crankshaft Pulley**

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

HINT:

If necessary, remove the pulley with SST.

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



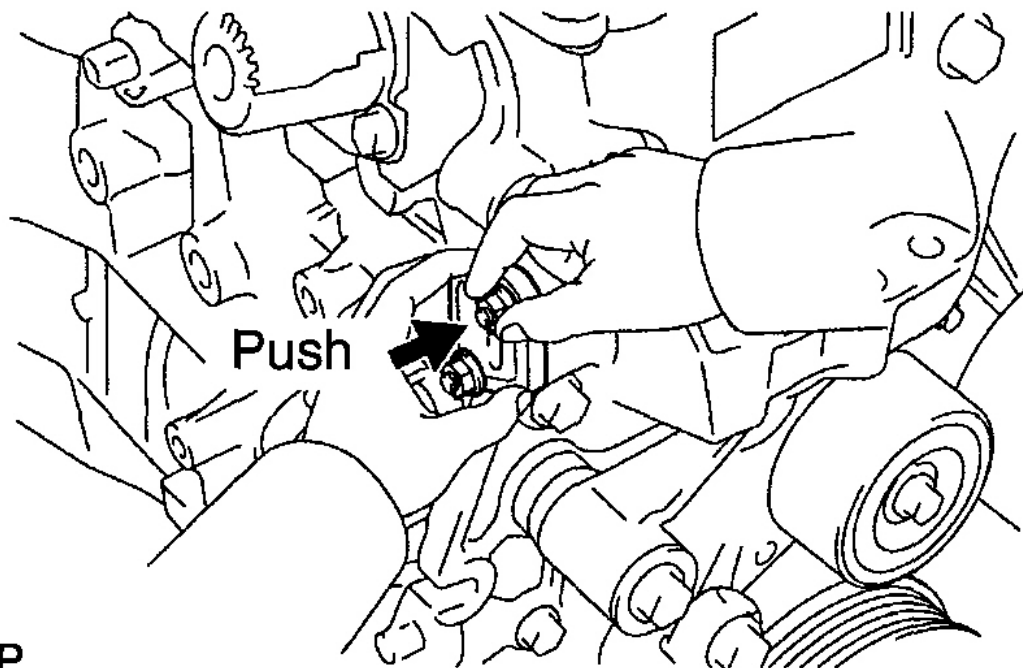
**Fig. 35: Removing Crankshaft Pulley**

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

### 13. REMOVE CHAIN TENSIONER

Remove the 2 nuts, chain tensioner and gasket.





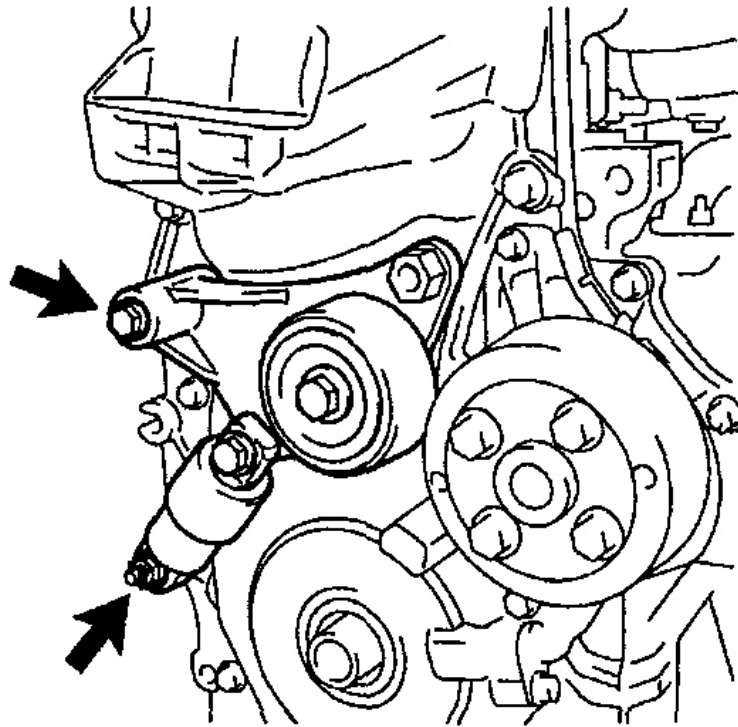
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**Fig. 36: Removing Nuts, Chain Tensioner And Gasket**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**14. REMOVE DRIVE BELT TENSIONER**

Remove the bolt, nut and drive belt tensioner.



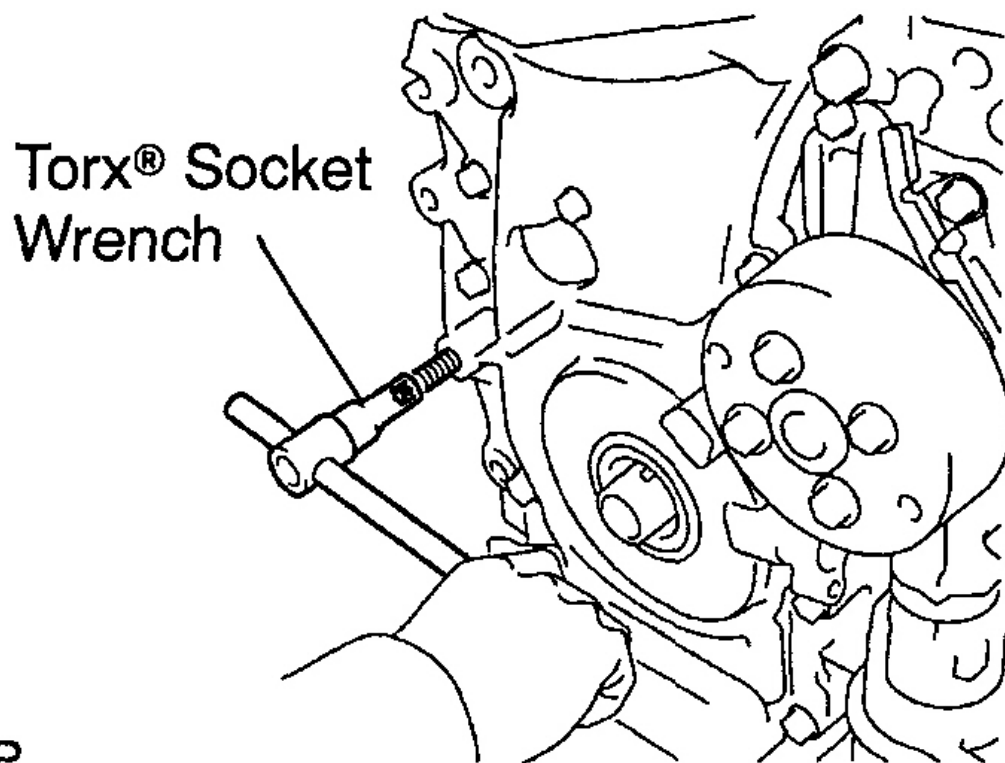
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**Fig. 37: Removing Drive Belt Tensioner**

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

15. **REMOVE CRANKSHAFT POSITION SENSOR** (See CRANKSHAFT POSITION SENSOR )
16. **REMOVE OIL PAN** (See REMOVAL )
17. **REMOVE TIMING CHAIN COVER**
  - a. Using a Torx(R) socket wrench (T10), remove the stud bolt for the drive belt tensioner.



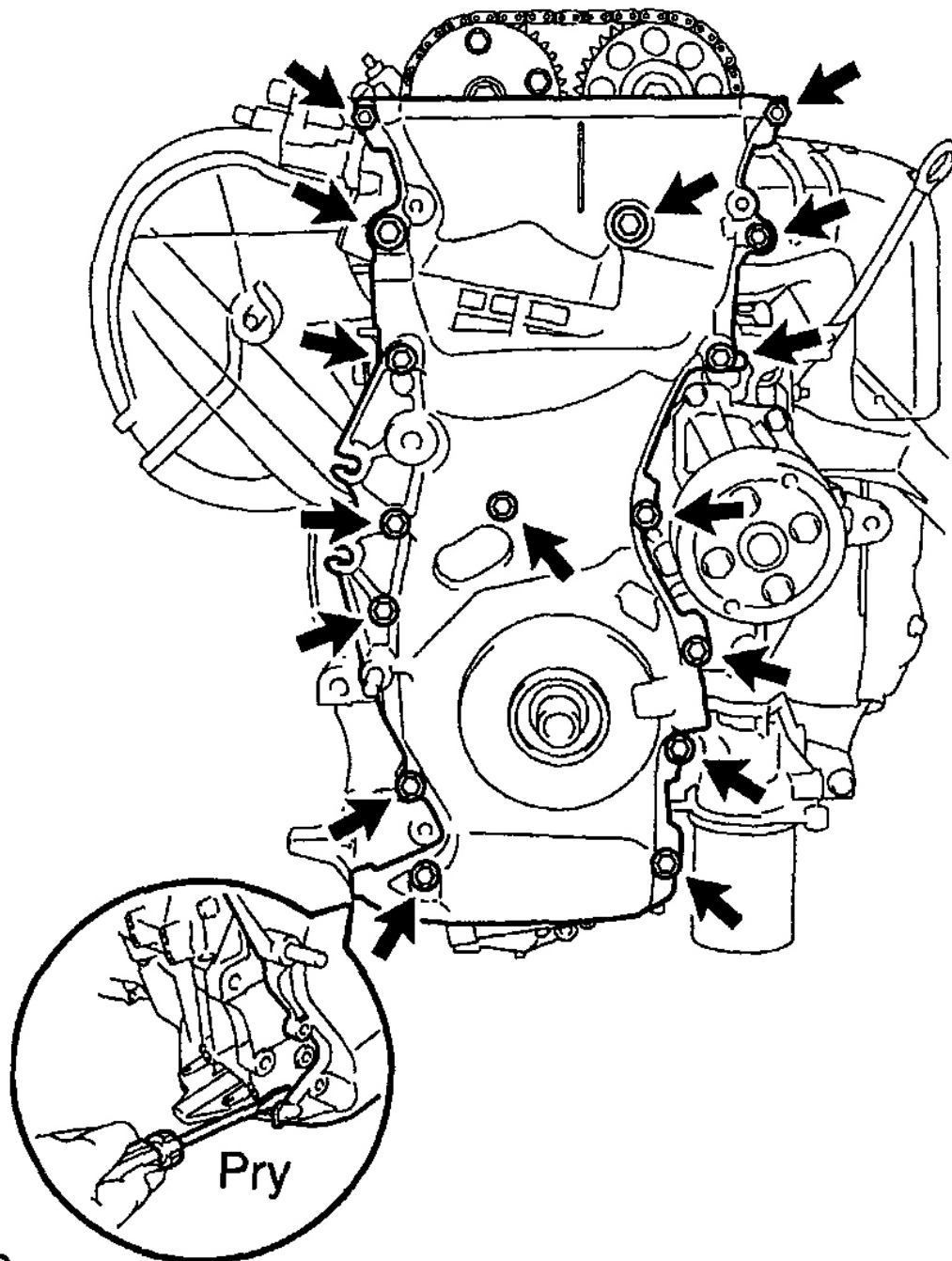
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**Fig. 38: Removing Timing Chain Cover**

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

- b. Remove the 14 bolts and 2 nuts.



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**Fig. 39: Locating Timing Chain Cover Bolts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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**

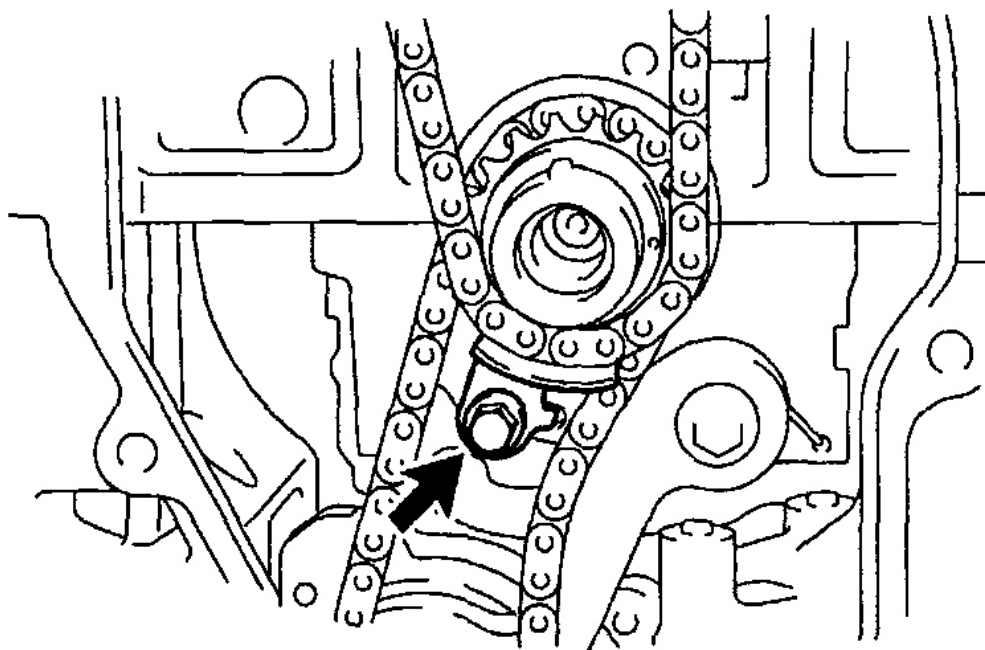
Remove the bolt and slipper.

**20. REMOVE CHAIN VIBRATION DAMPER**

Remove the 2 bolts and damper.

**21. REMOVE TIMING CHAIN GUIDE**

Remove the bolt and chain guide.



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**G02639050**

**Fig. 40: Removing Timing Chain Guide Bolt**

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

**22. REMOVE TIMING CHAIN**

**23. REMOVE CRANKSHAFT TIMING SPROCKET**

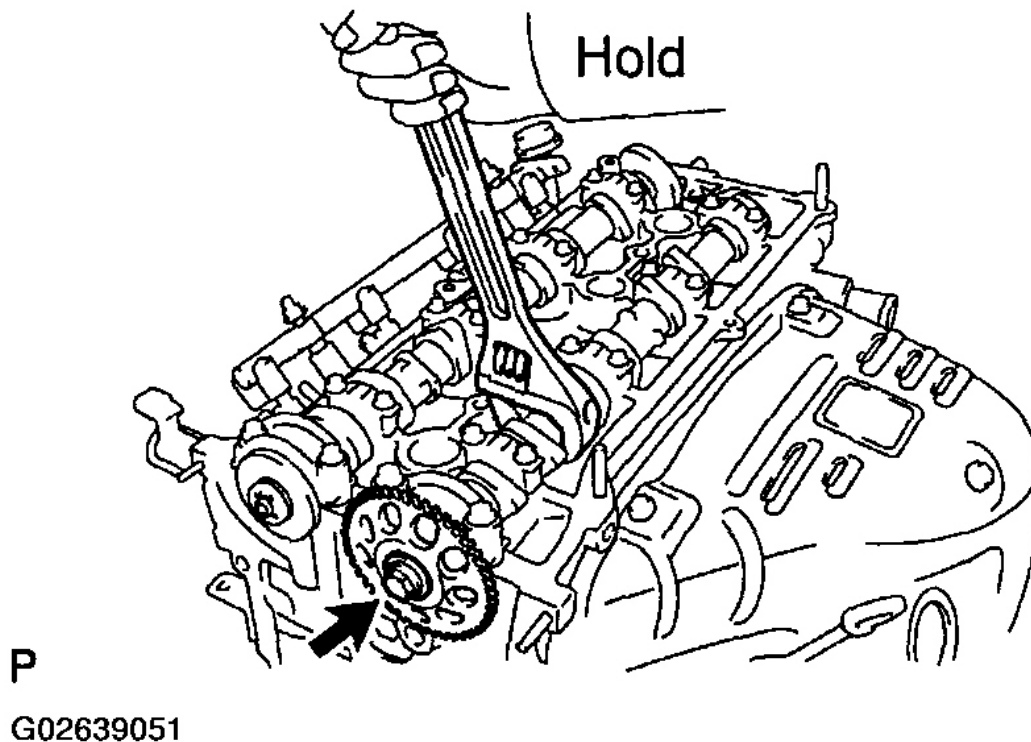
**24. REMOVE CAMSHAFT TIMING SPROCKET AND VVT TIMING SPROCKET**

- a. Hold the hexagonal head wrench portion of the camshaft with a wrench, and loosen the sprocket bolts.

**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.



**Fig. 41: Removing Camshaft Timing Sprocket And VVT Timing Sprocket**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**INSPECTION****1. INSPECT TIMING CHAIN AND TIMING SPROCKETS**

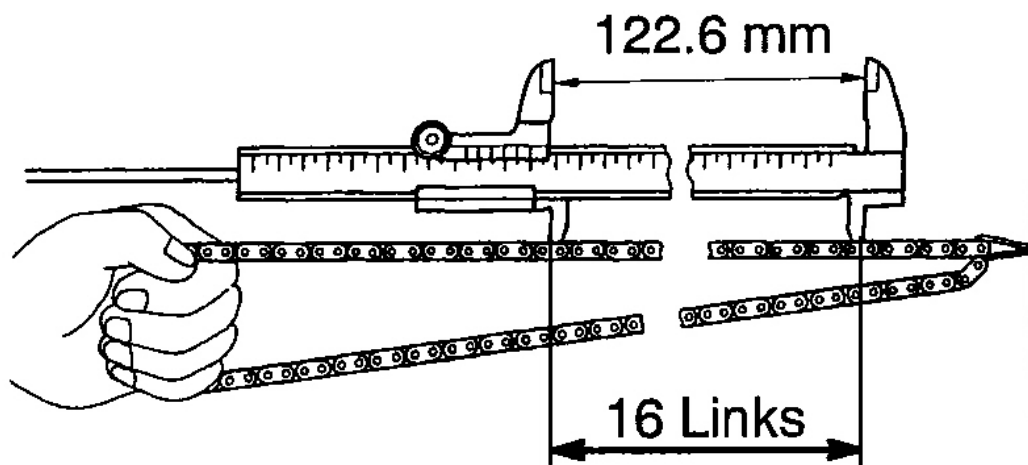
- a. Using vernier calipers, measure the length of the 16 links with the chain fully stretched.

**Maximum chain elongation: 122.6 mm (4.827 in.)**

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

**HINT:**

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

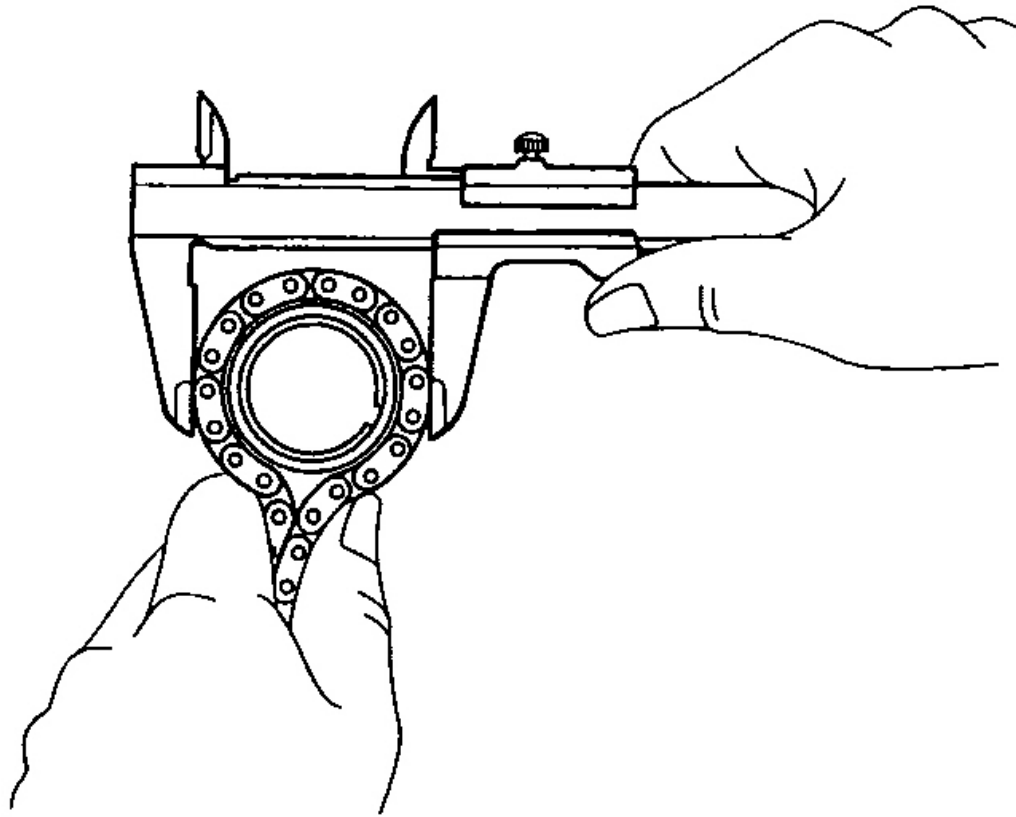


G02639052

**Fig. 42: Measuring Length Of Links With Chain Fully Stretched Using Vernier Calliper**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Wrap the chain around the timing sprocket.  
c. Using vernier calipers, measure the timing sprocket diameter with the chain.

**NOTE:** Vernier caliper must contact the chain rollers for measuring.



G02639053

**Fig. 43: Measuring Timing Sprocket Diameter With Chain Using Vernier Calliper**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**Minimum sprocket diameter (w/ Chain):**

**MINIMUM SPROCKET DIAMETER (W/ CHAIN)**

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

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

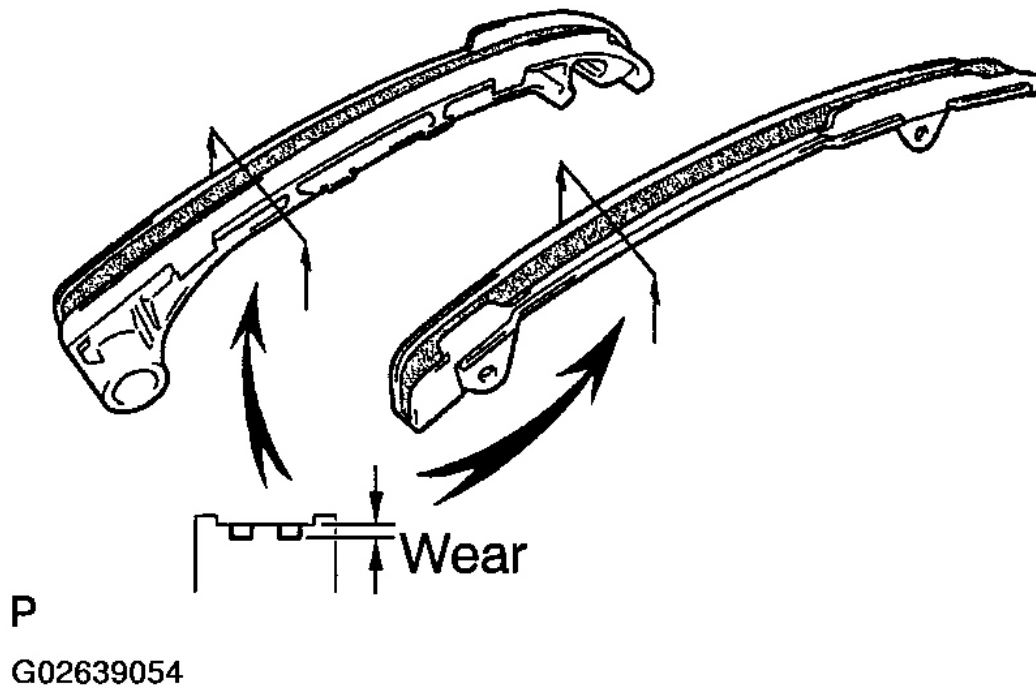
## 2. INSPECT CHAIN TENSIONER SLIPPER AND VIBRATION DAMPER

Measure the chain tensioner slipper and vibration damper wears.



**Maximum wear: 1.0 mm (0.039 in.)**

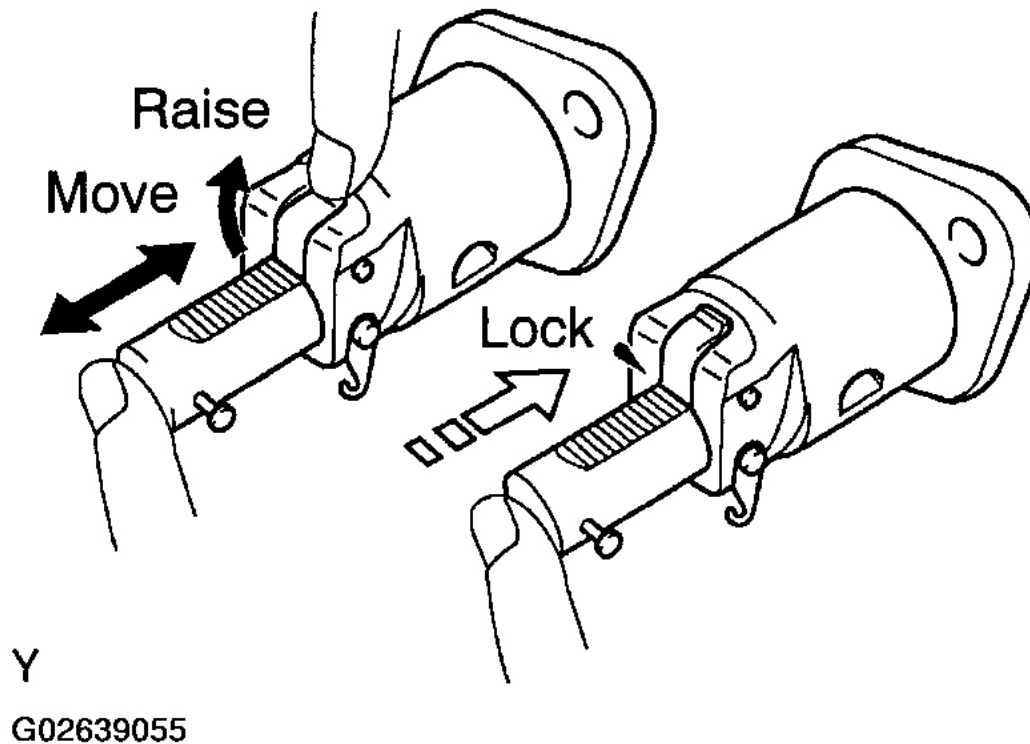
If the wear is greater than the maximum, replace the slipper and/or damper.



**Fig. 44: Measuring Chain Tensioner Slipper And Vibration Damper Wears**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

### 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. 45: Checking Plunger Function**

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

#### **4. INSPECT DRIVE BELT TENSIONER**

Check for oil leakage and or cracks.

If necessary, replace the drive belt tensioner.

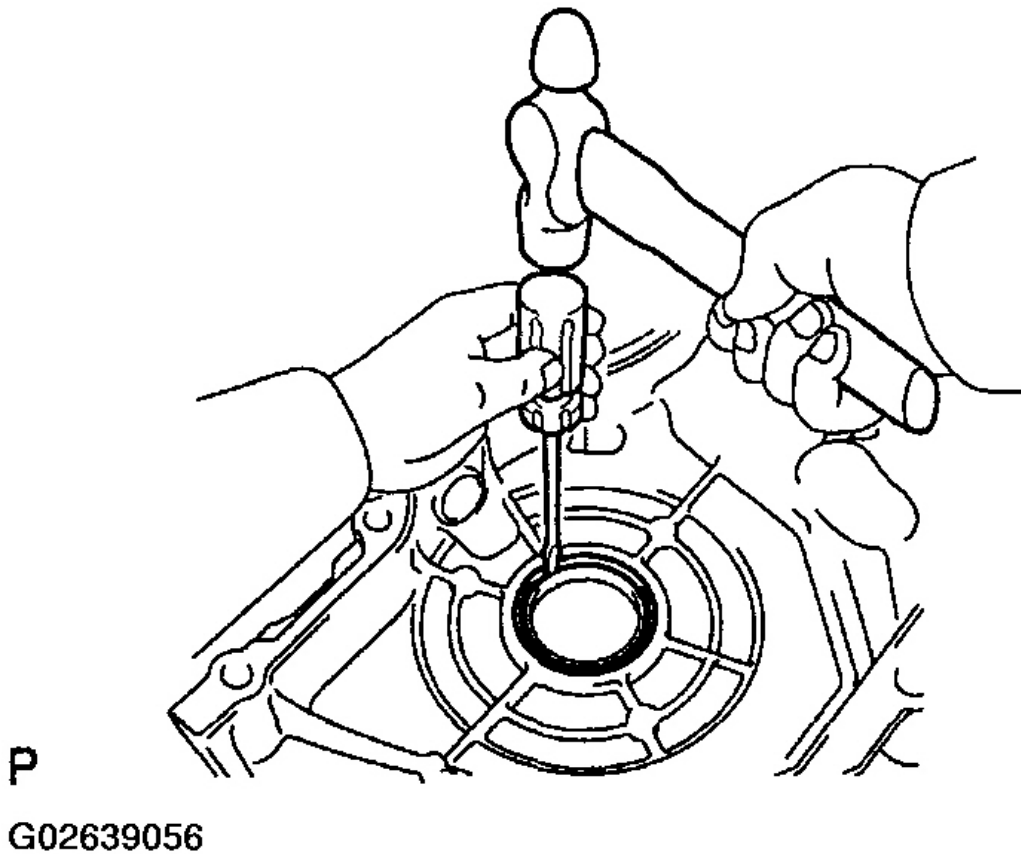
### **REPLACEMENT**

#### **REPLACE CRANKSHAFT FRONT OIL SEAL**

#### **HINT:**

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.

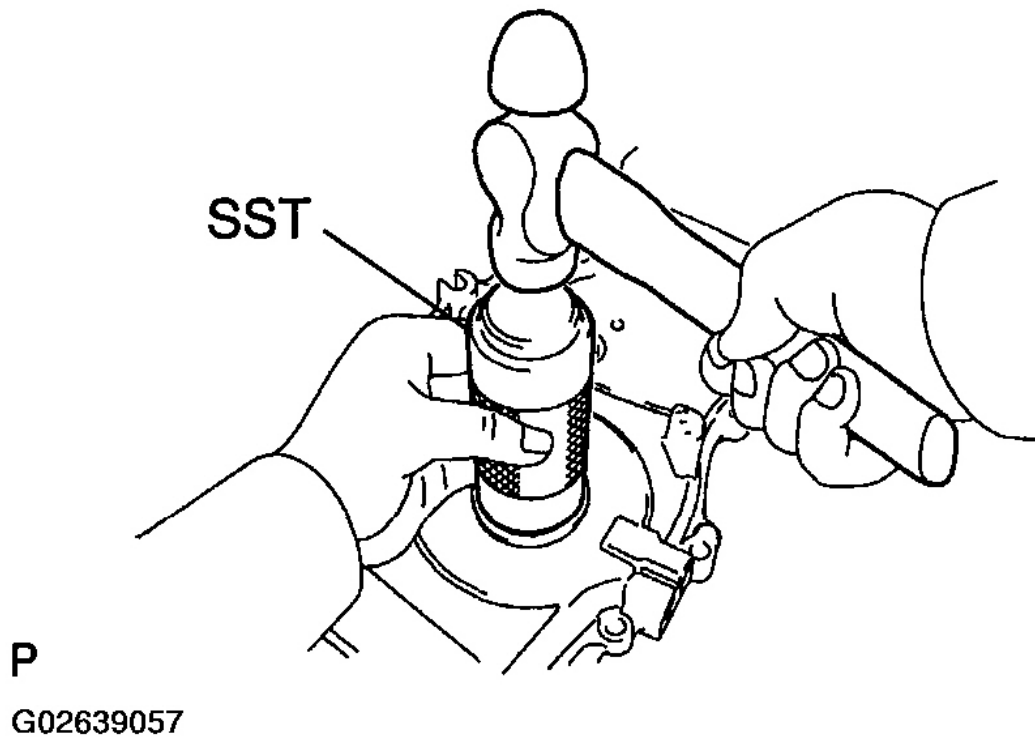


**Fig. 46: Taping Out Oil Seal Using Screwdriver And Hammer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

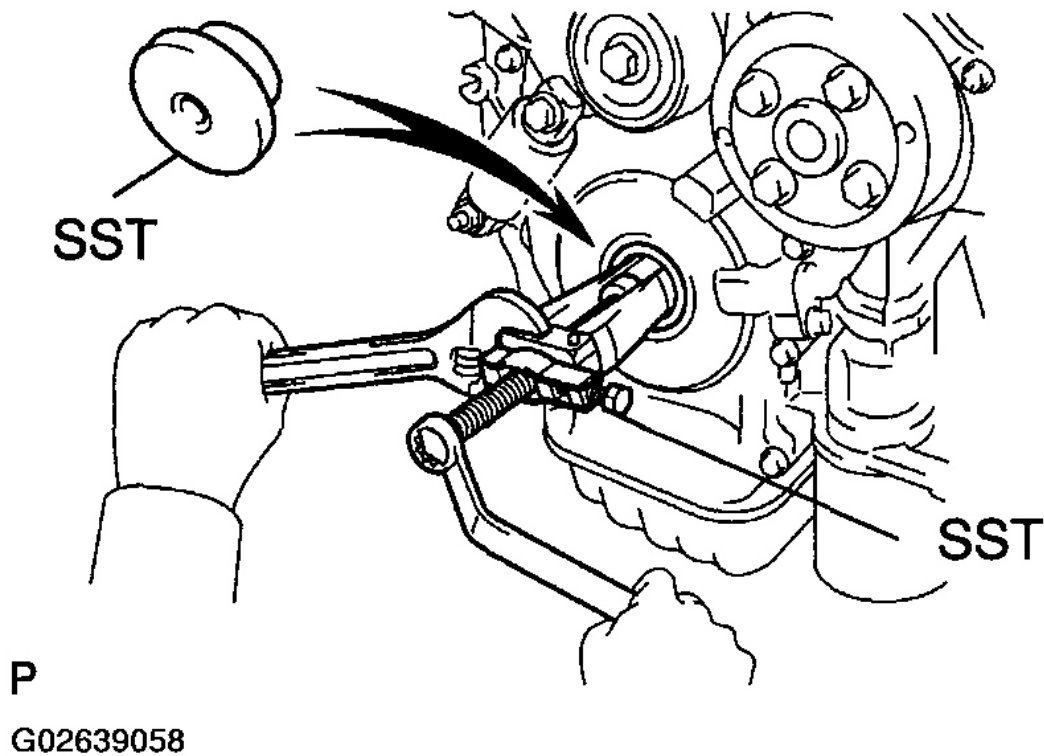
3. Apply MP grease to the oil seal lip.



**Fig. 47: Taping In Oil Seal Using SST And Hammer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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)

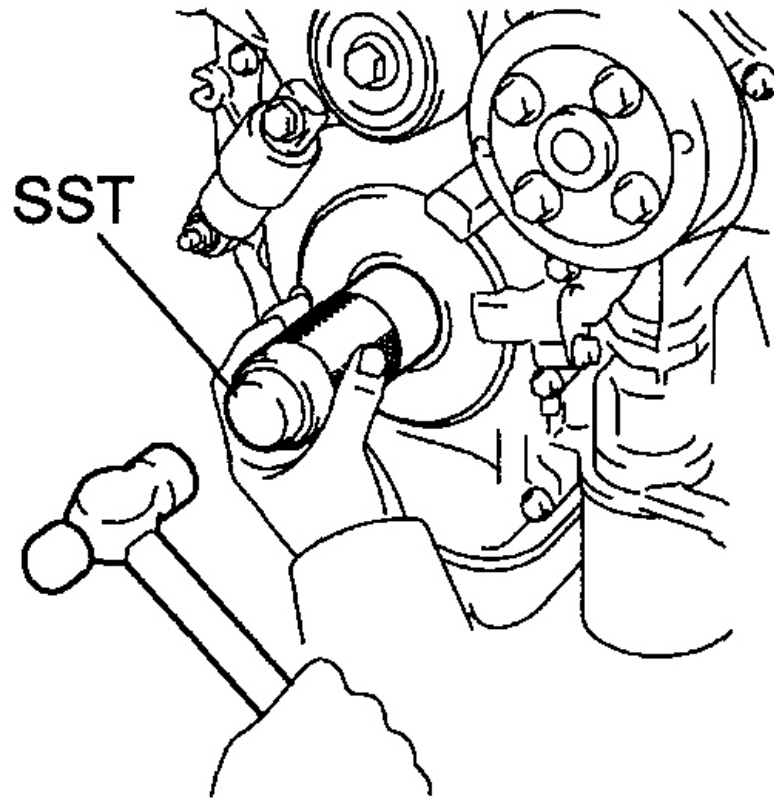


**Fig. 48: Removing Oil Seal Using SST**

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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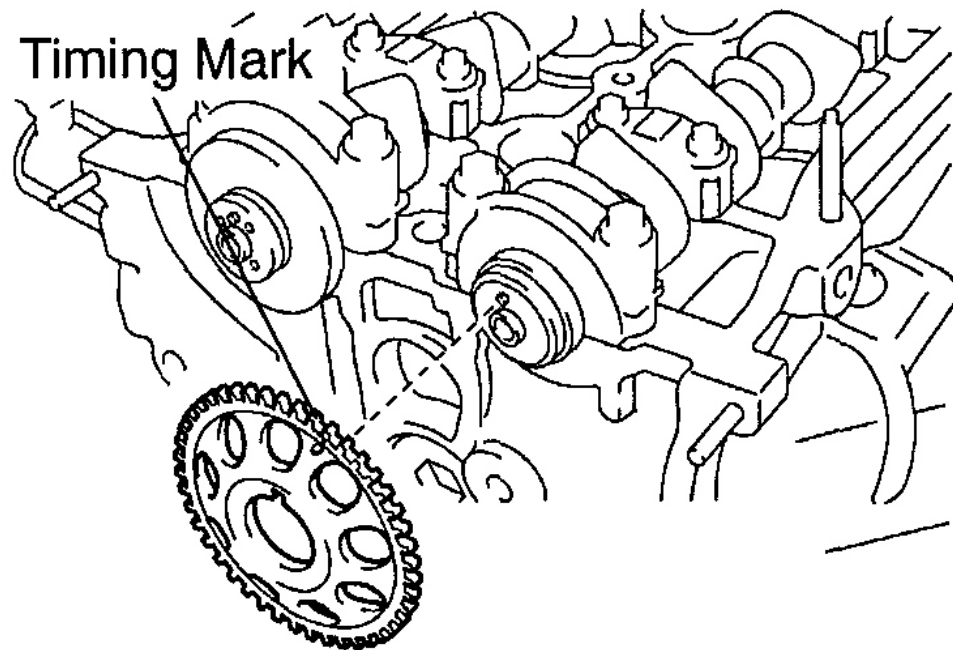
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**Fig. 49: Taping In Oil Seal Using SST And Hammer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## **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.
  2. Align the camshaft knock pin with the knock pin groove on the sprocket side with the timing mark, and slide on the timing sprocket.



P

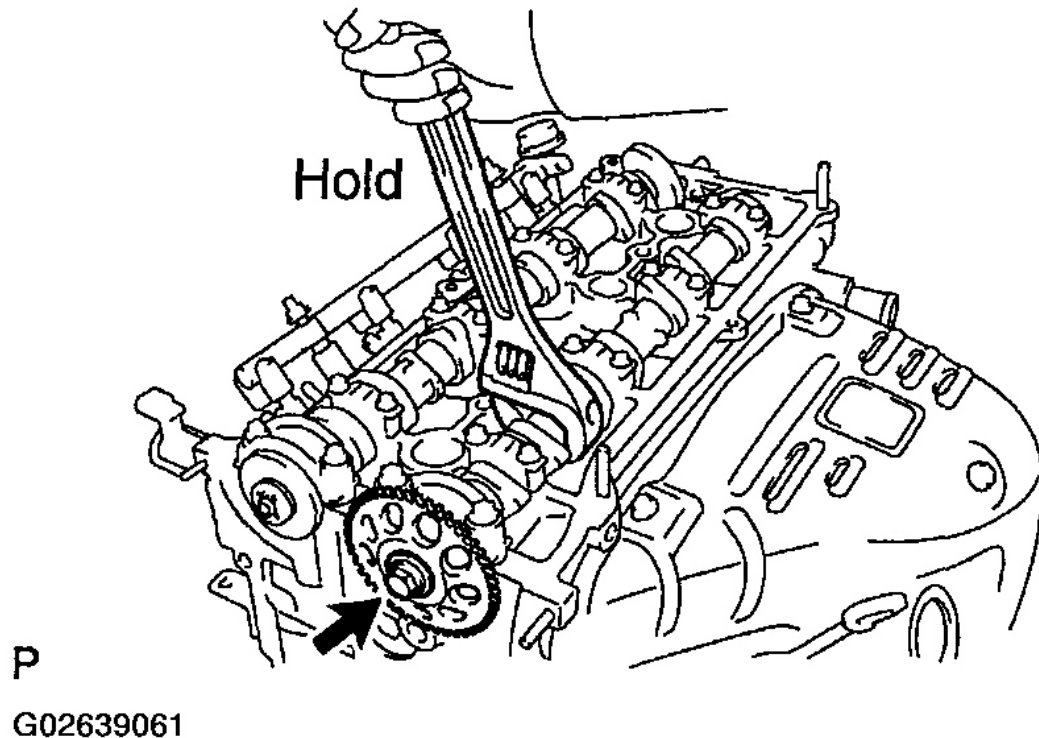
G02639060

**Fig. 50: Identifying Timing Mark**

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

3. Temporarily install the timing sprocket set bolt.
4. Hold the hexagon wrench head portion of the exhaust camshaft with a wrench, and tighten the bolt.

**Torque: 54 N.m (551 kgf.cm, 40 ft.lbf)**



**Fig. 51: Holding Exhaust Camshaft With A Wrench**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

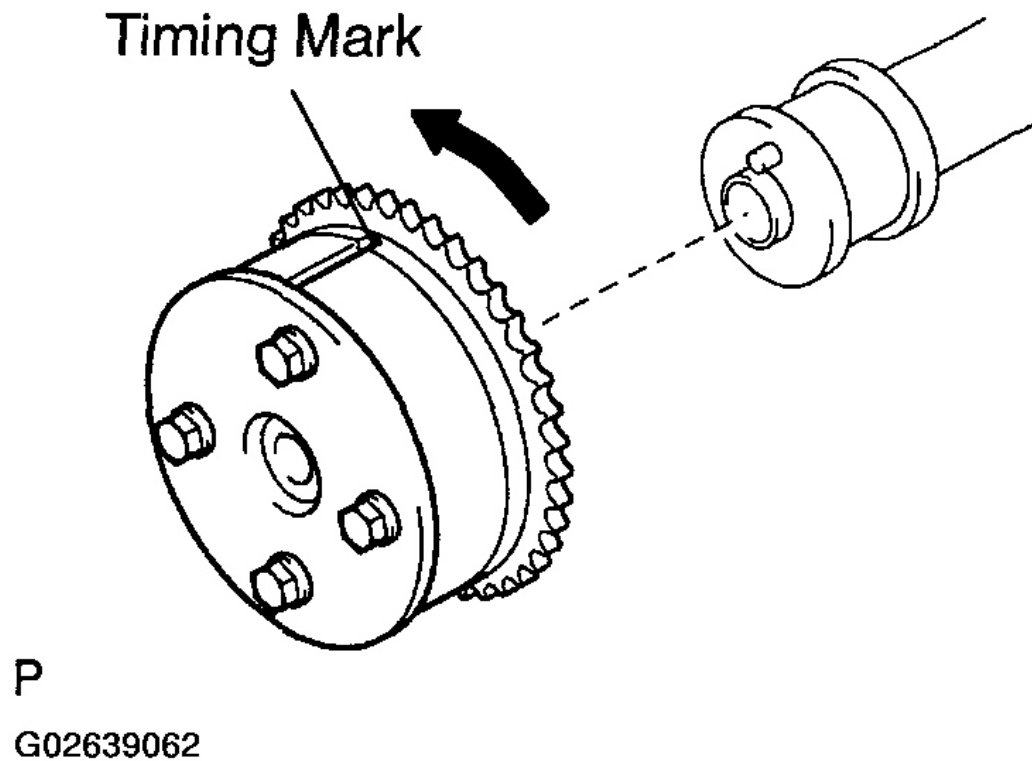
**NOTE:** Be careful not to turn the timing sprocket clockwise when installing it.

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

**Torque: 54 N.m (551 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.

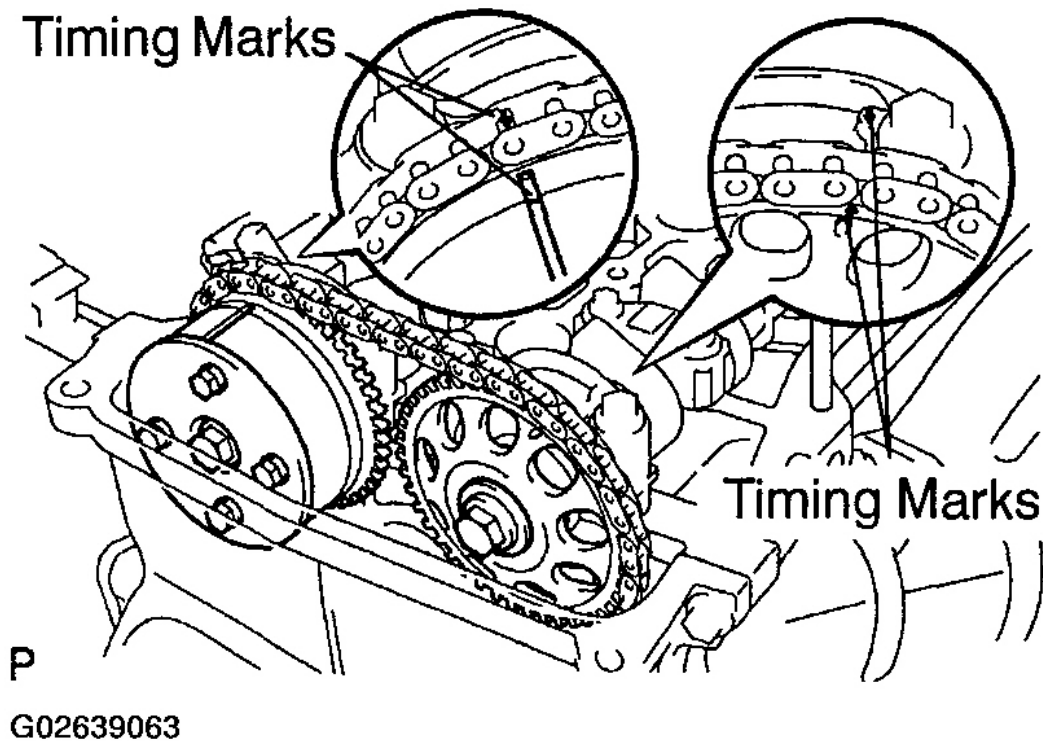




**Fig. 52: Identifying Timing Mark On Timing Sprocket**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

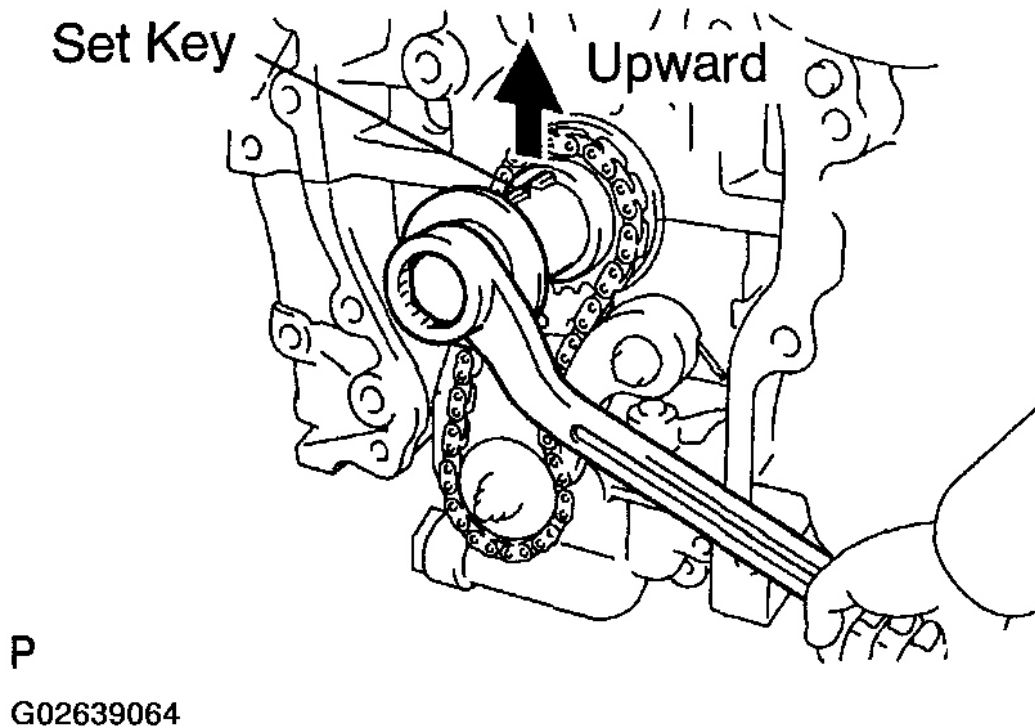
**2. SET NO. 1 CYLINDER TO TDC/COMPRESSION**

- 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.



**Fig. 53: Identifying Timing Marks On Camshaft Timing Sprockets**  
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.

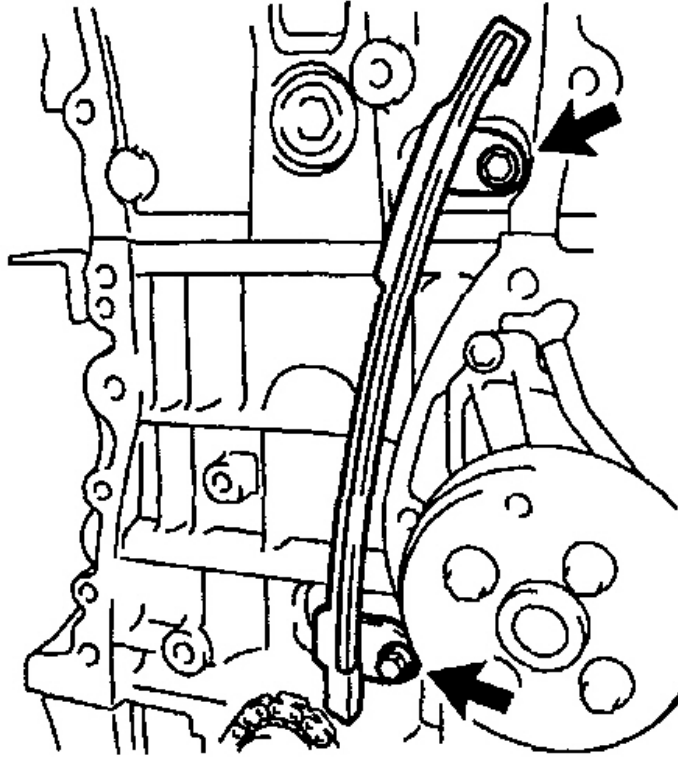


**Fig. 54: Turning Crankshaft Using Crankshaft Pulley Bolt**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

### 3. INSTALL CHAIN VIBRATION DAMPER

Install the damper with the 2 bolts.

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



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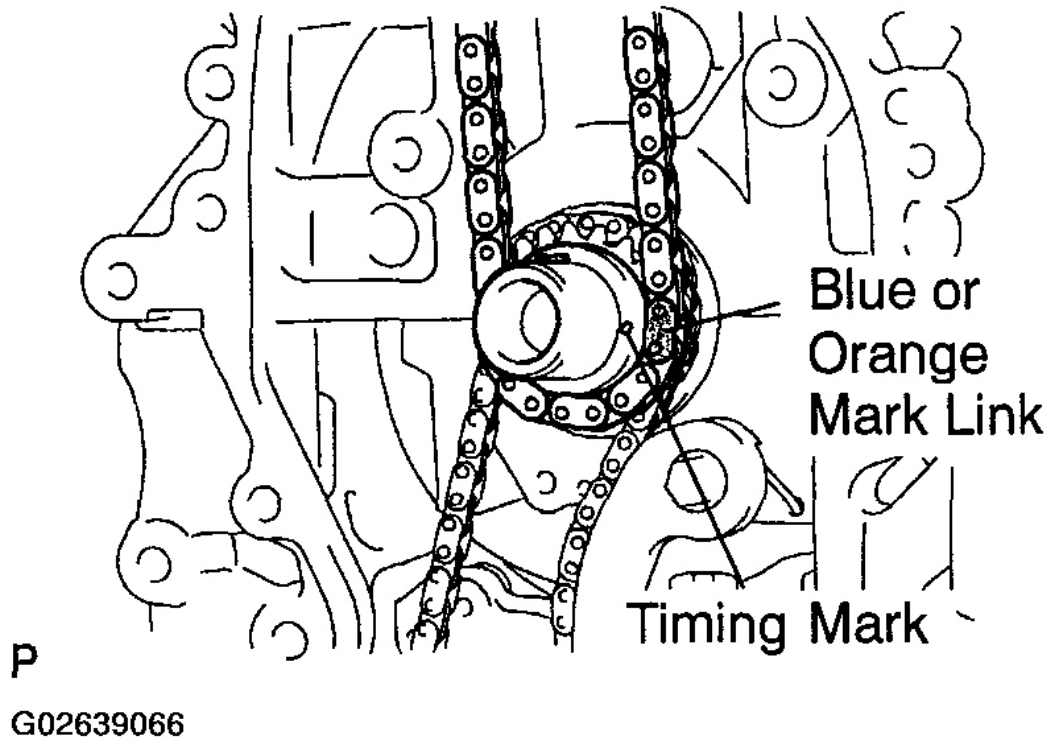
**Fig. 55: Installing Chain Vibration Damper**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**4. INSTALL CRANKSHAFT TIMING SPROCKET**

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

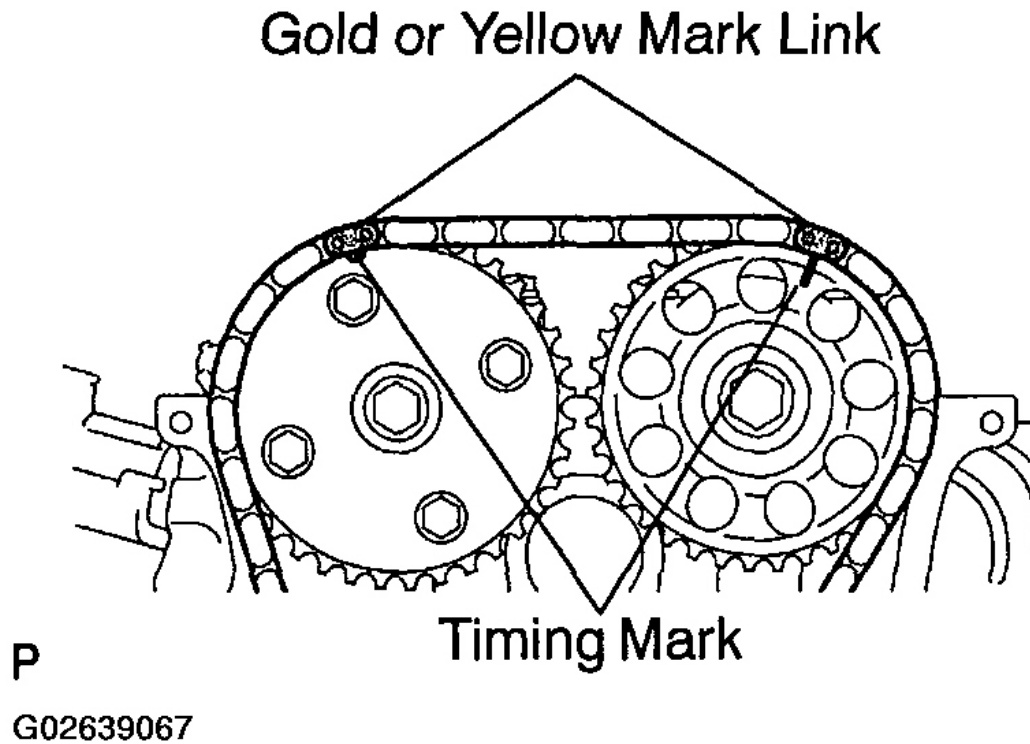
**5. INSTALL TIMING CHAIN**

- 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.



**Fig. 56: Installing Timing Chain On Crankshaft Timing Sprocket**  
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.

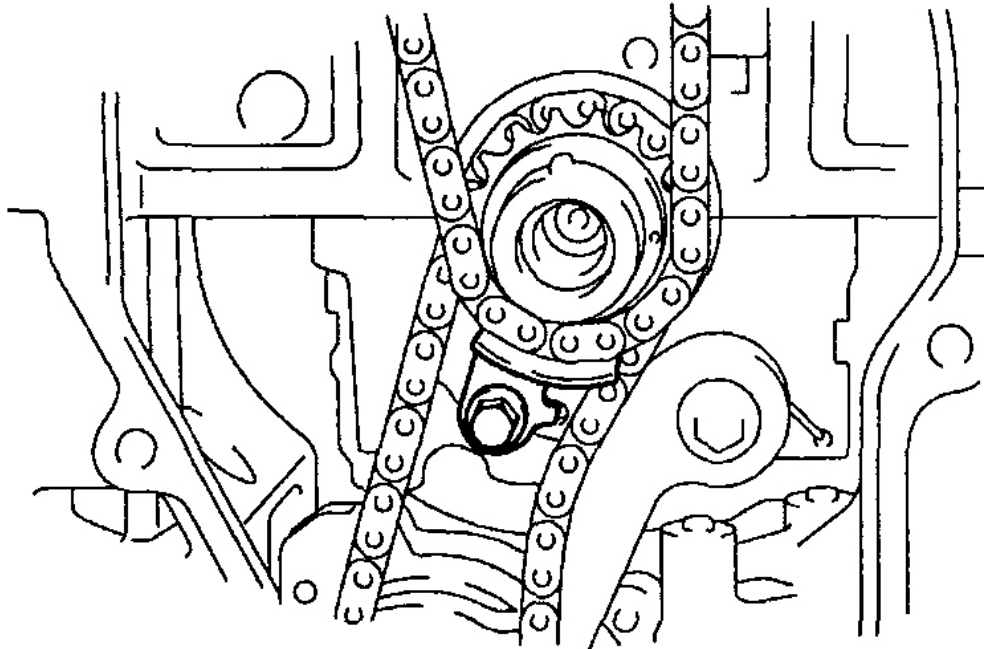


**Fig. 57: Installing Timing Chain On Camshaft Timing Sprockets**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 6. INSTALL TIMING CHAIN GUIDE

Install the timing chain guide with the bolt.

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



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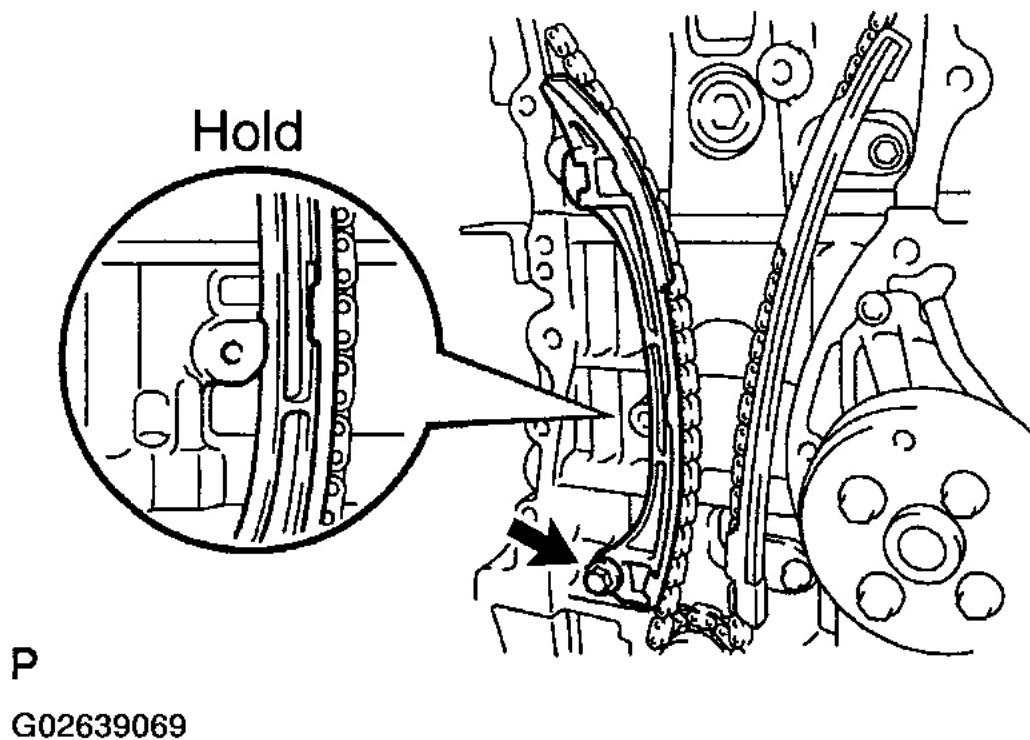
**Fig. 58: Installing Timing Chain Guide**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

**7. INSTALL CHAIN TENSIONER SLIPPER**

- a. Install the slipper with the bolt.

**Torque: 19 N.m (194 kgf.cm, 14 ft.lbf)**

- b. Check that the slipper is hold on the cylinder block stopper.

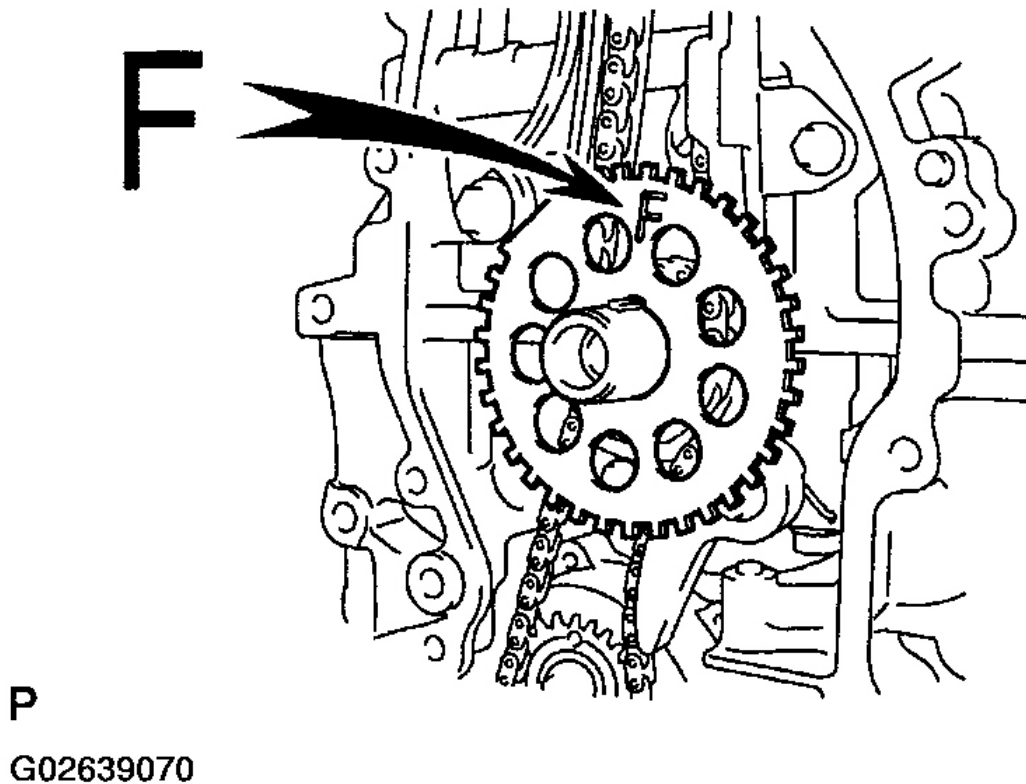


**Fig. 59: Installing Chain Tensioner Slipper**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 8. INSTALL CRANK ANGLE SENSOR PLATE

Install the plate with the F mark facing forward.





**Fig. 60: Installing Crank Angle Sensor Plate With F Mark Facing Forward**  
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. See **Fig. 61**.
  - 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.
- b. Apply seal packing to the timing chain cover as shown, see **Fig. 61**.

**Seal packing: Part No. 08826-00080 or equivalent**

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

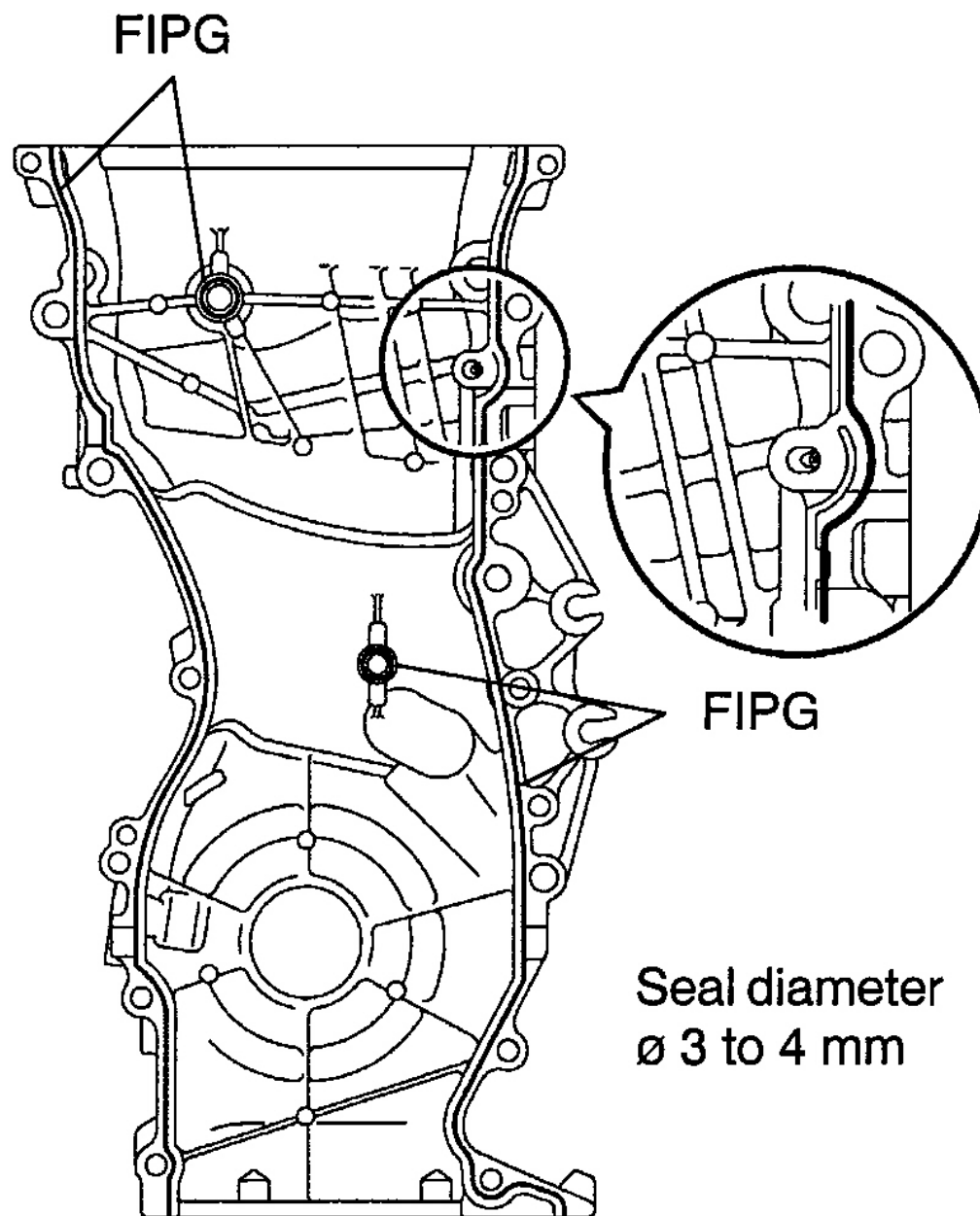
**HINT:**

## **2005 Toyota RAV4**

2005 ENGINE Engine Mechanical - RAV4

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.



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- c. Apply seal packing to 2 locations as shown, see **Fig. 62**.

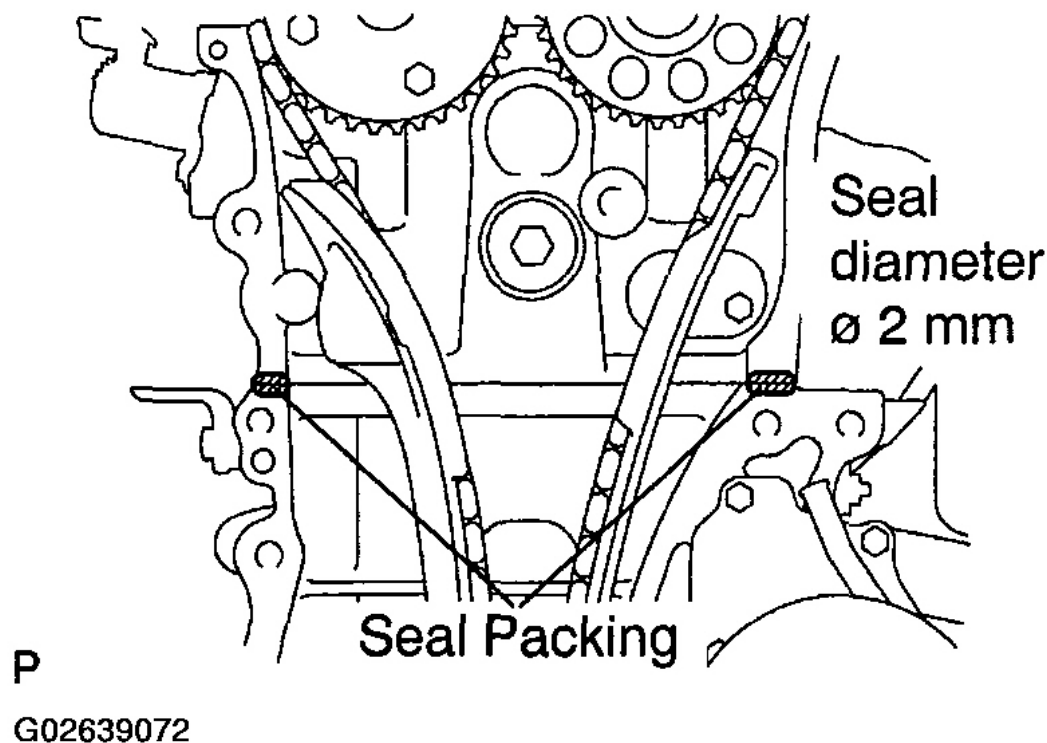
**Seal packing: Part No. 08826-00080 or equivalent**

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

**HINT:**

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.



**Fig. 62: Applying Seal Packing**

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

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

## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4

### Torque:

**9.0 N.m (92 kgf.cm, 80 in.lbf) for bolt A**

**21 N.m (214 kgf.cm, 15 ft.lbf) for bolt B**

**43 N.m (439 kgf.cm, 32 ft.lbf) for bolt C**

**43 N.m (439 kgf.cm, 32 ft.lbf) for bolt D**

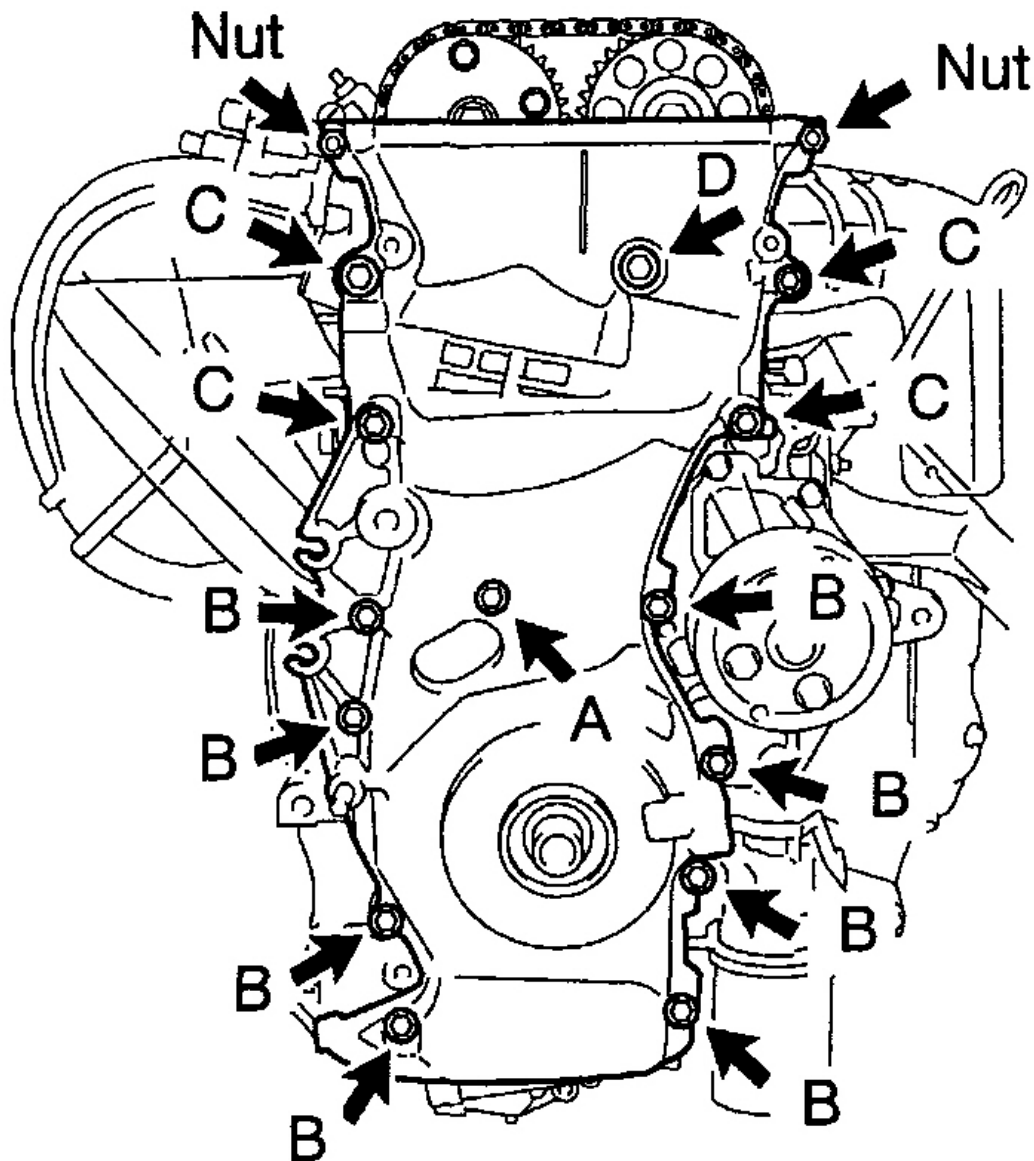
**9.0 N.m (92 kgf.cm, 80 ft.lbf) for nut**

### HINT:

Bolt length:

### BOLT LENGTH

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

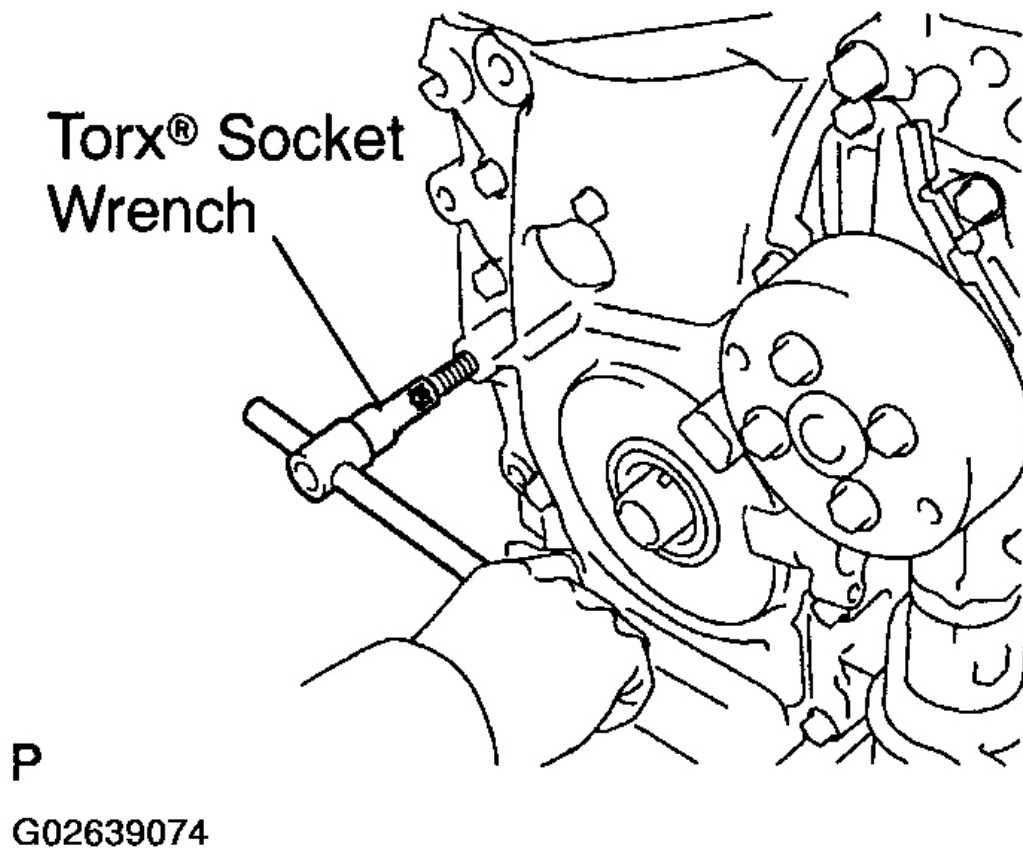


G02639073

**Fig. 63: Identifying Location Of Timing Chain Cover Fasteners**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Using a Torx(R) socket wrench (E10), install the stud bolt for the drive belt tensioner.

**Torque: 21.5 N.m (219 kgf.cm, 15.8 in.lbf)**



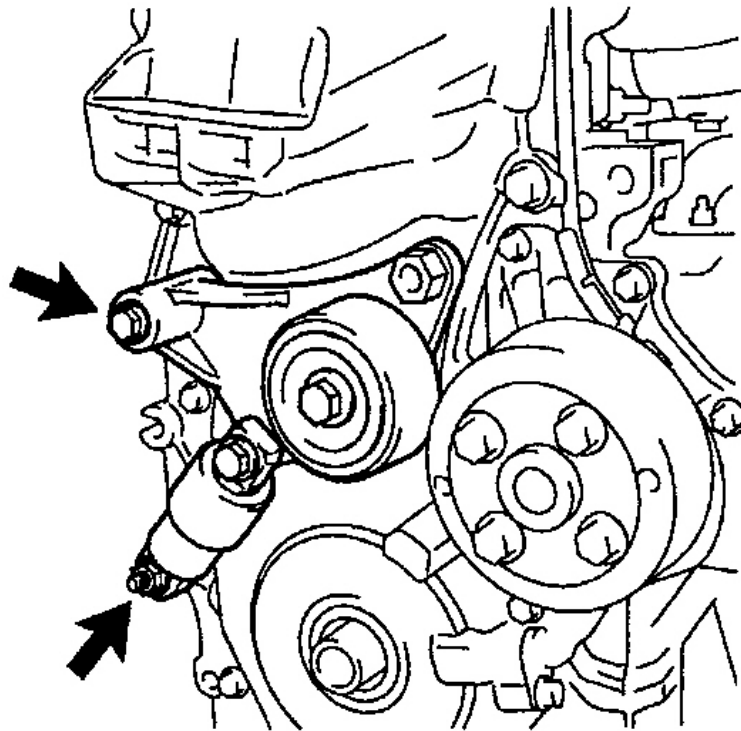
**Fig. 64: Installing Stud Bolt Using Torx Socket Wrench**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 10. INSTALL DRIVE BELT TENSIONER

Install the drive belt tensioner with the bolt and nut.

**Torque: 59.5 N.m (607 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 within 15 minutes after the timing chain cover is installed.



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**Fig. 65: Installing Drive Belt Tensioner**

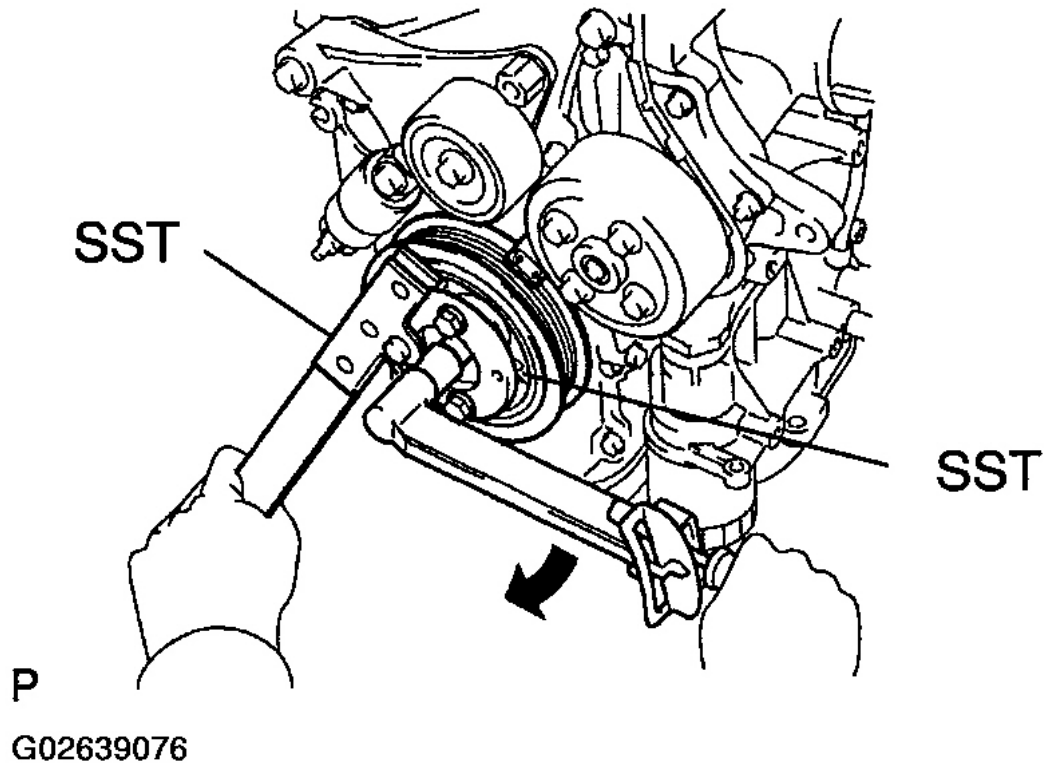
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

11. **INSTALL CRANKSHAFT POSITION SENSOR** (See CRANKSHAFT POSITION SENSOR )
12. **INSTALL OIL PAN** (See INSTALLATION )
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: 180 N.m (1,836 kgf.cm, 132 ft.lbf)**



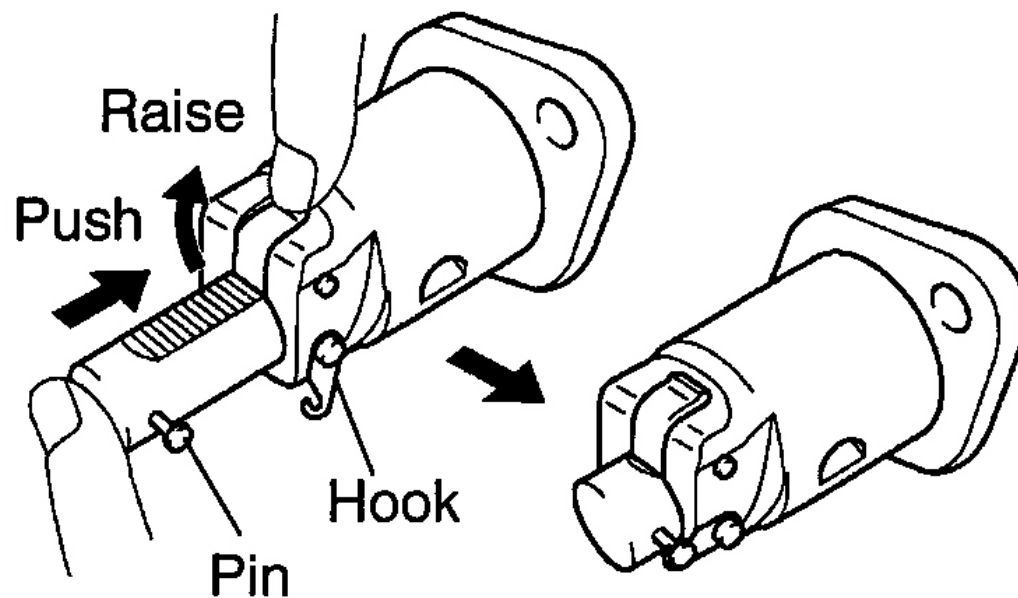


**Fig. 66: Installing Crankshaft Pulley**

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.



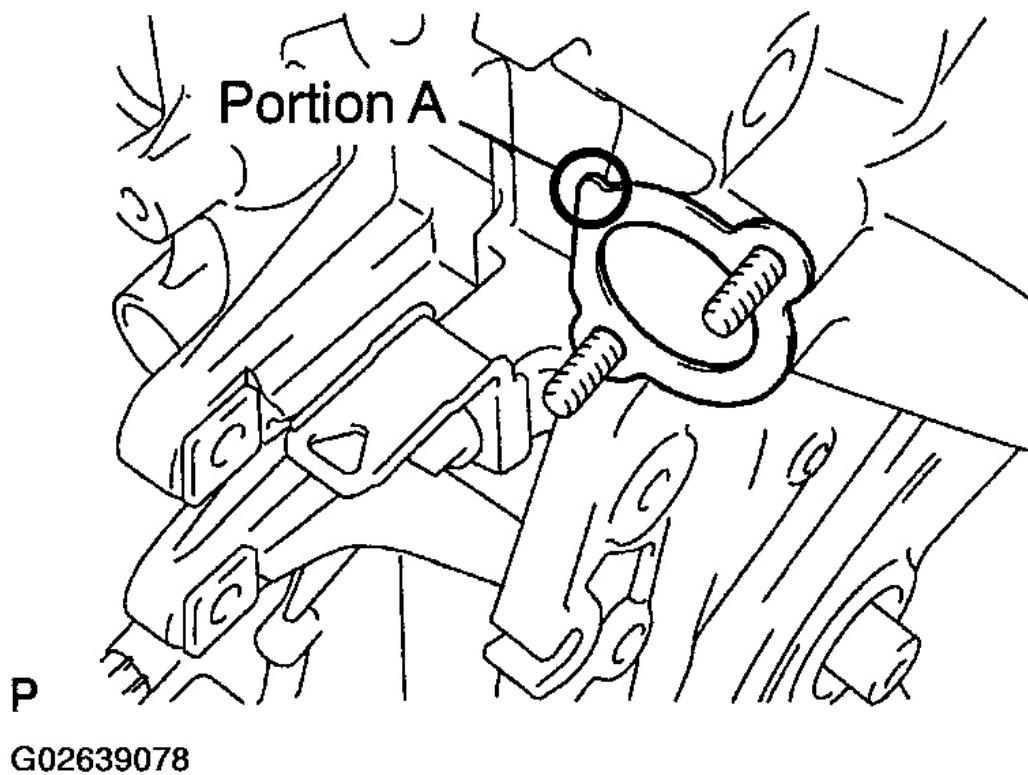
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**Fig. 67: Installing Chain Tensioner**

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

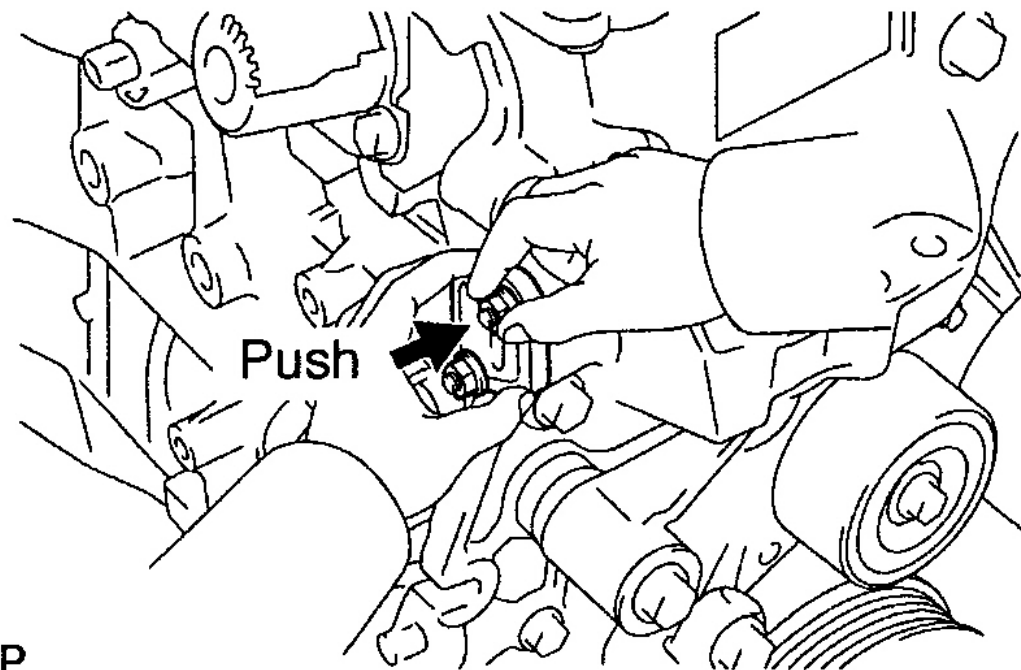
- b. Place a new gasket on the timing chain cover with portion A facing as shown.



**Fig. 68: Placing Gasket On Timing Chain Cover**  
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: 9.0 N.m (92 kgf.cm, 80 in.lbf)**



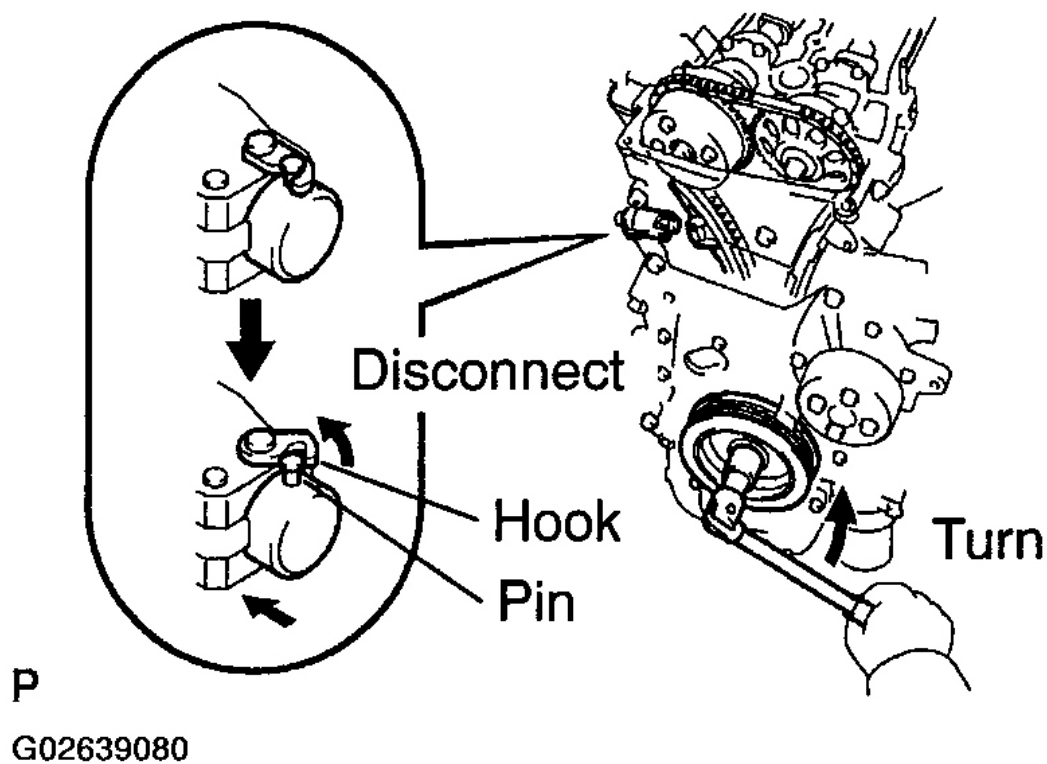
**P**

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**Fig. 69: Pushing Chain Tensioner Into Timing Chain Cover**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**15. SET CHAIN TENSION**

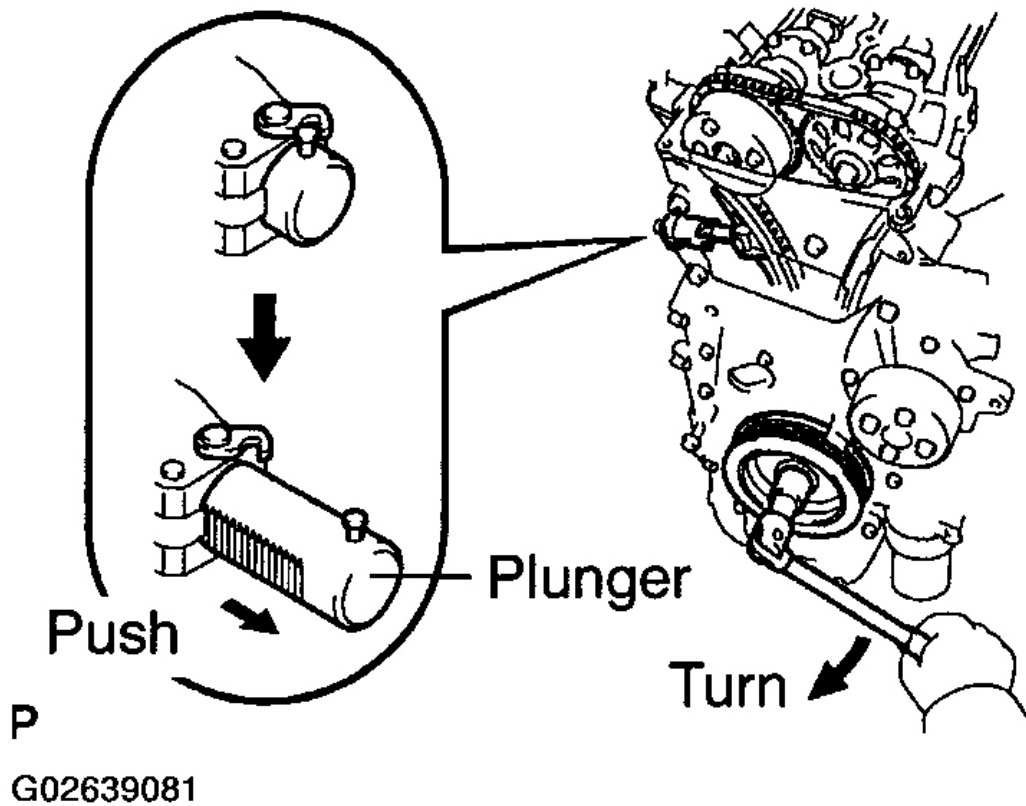
- a. Turn the crankshaft counterclockwise, and disconnect the plunger knock pin from the hook.



**Fig. 70: Setting Chain Tension (1 Of 2)**

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

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



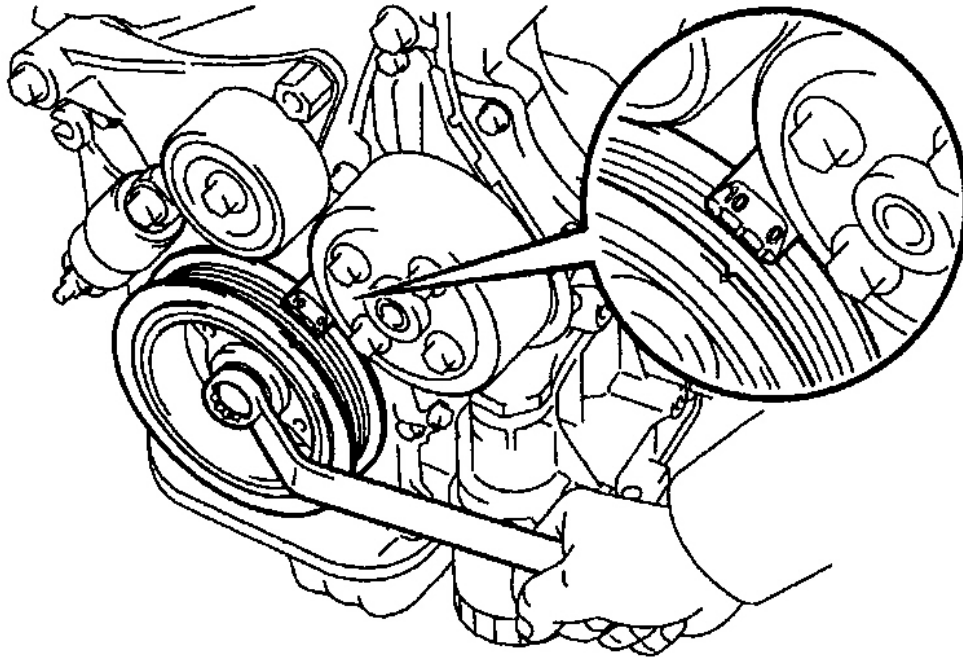
**Fig. 71: Setting Chain Tension (2 Of 2)**

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.



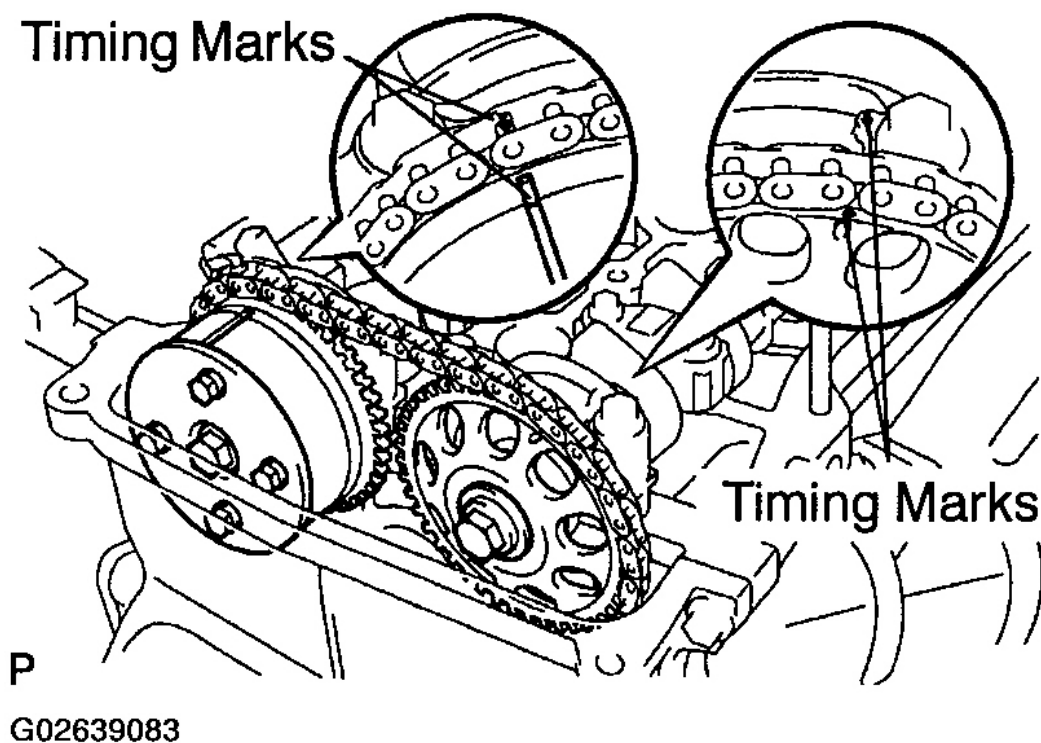
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**Fig. 72: Aligning Timing Marks Crankshaft Pulley & Timing Chain Cover**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.



**Fig. 73: Checking Timing Marks Of Camshaft Timing Sprockets**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 17. INSTALL CYLINDER HEAD COVER

- Remove any old packing (FIPG) material.
- Apply seal packing to 2 locations as shown, see **Fig. 74**.

**Seal packing: Part No. 08826-00080 or equivalent**

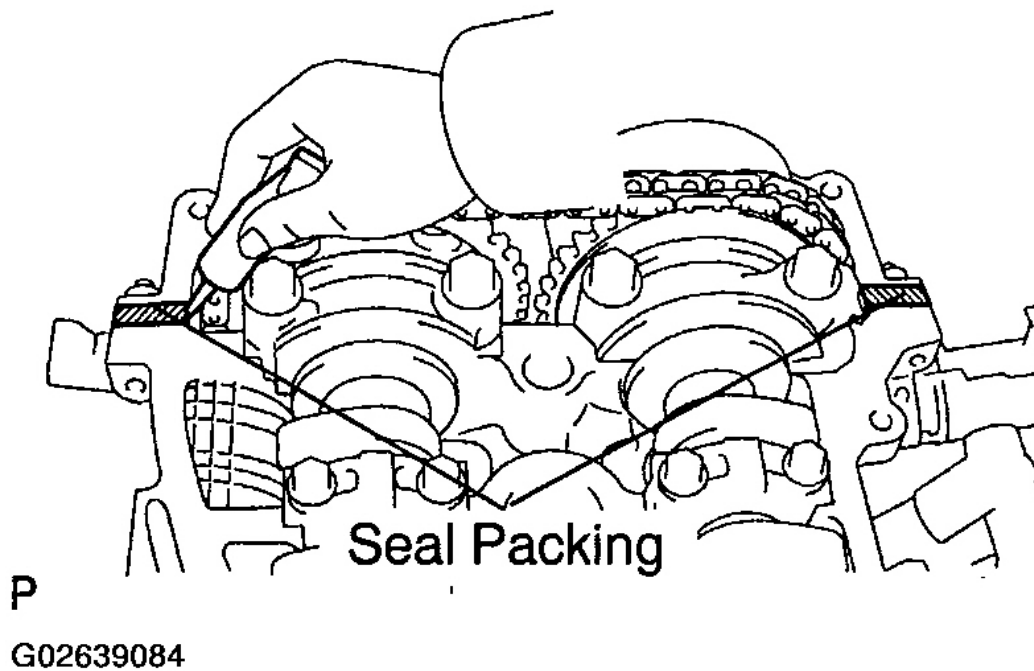
- Install the gasket to the cylinder head cover.

If the gasket has damage, replace a new one.

**HINT:**

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



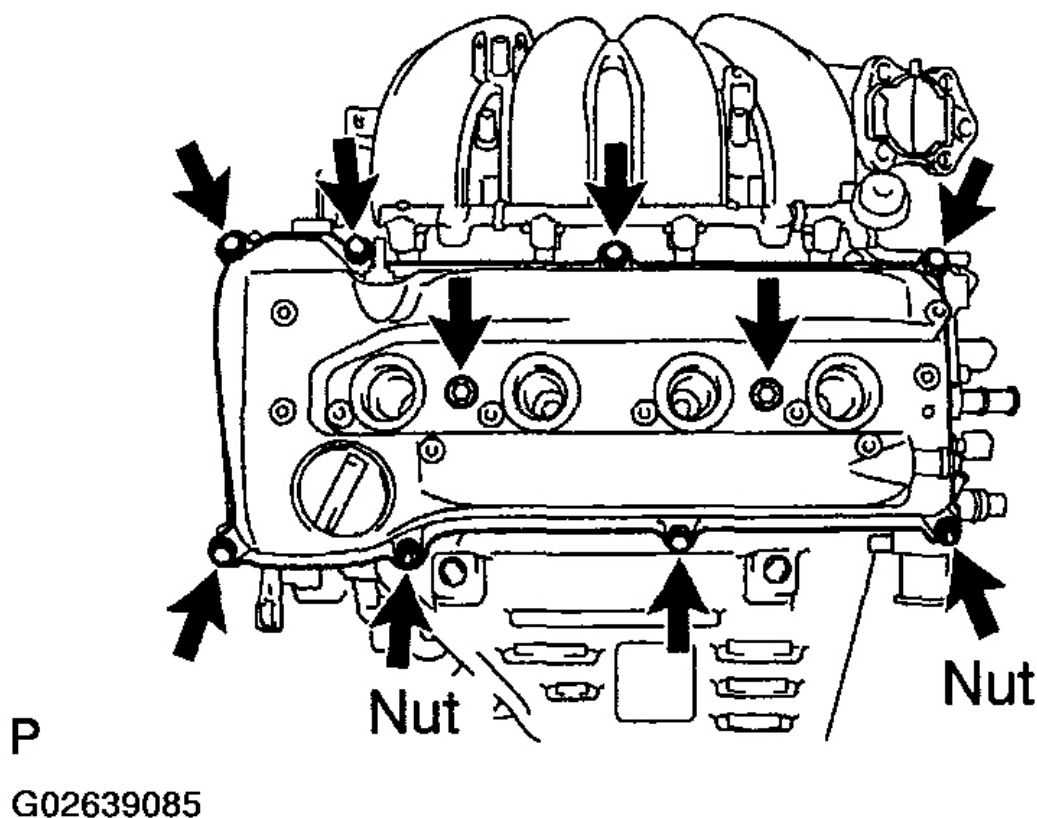


**Fig. 74: Applying Seal Packing To 2 Locations**

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

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

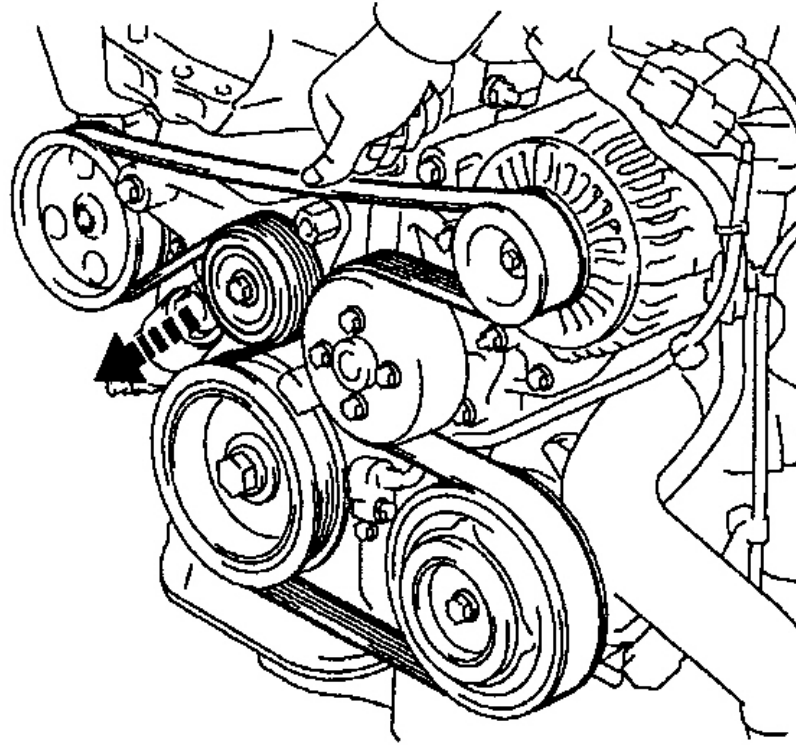
**Torque: 11 N.m (112 kgf.cm, 8 ft.lbf)**



**Fig. 75: Installing Cylinder Head Cover**

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

- e. Connect the 2 PCV hoses to the cylinder head cover.
- 18. **INSTALL IGNITION COILS** (See IGNITION COIL )
- 19. **INSTALL VANE PUMP** (See INSTALLATION )
- 20. **INSTALL GENERATOR** (See INSTALLATION )
- 21. **INSTALL RH ENGINE MOUNTING INSULATOR** (See REMOVAL)
- 22. **INSTALL DRIVE BELT** (See CHARGING SYSTEM )



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**Fig. 76: Identifying Drive Belt Routing**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

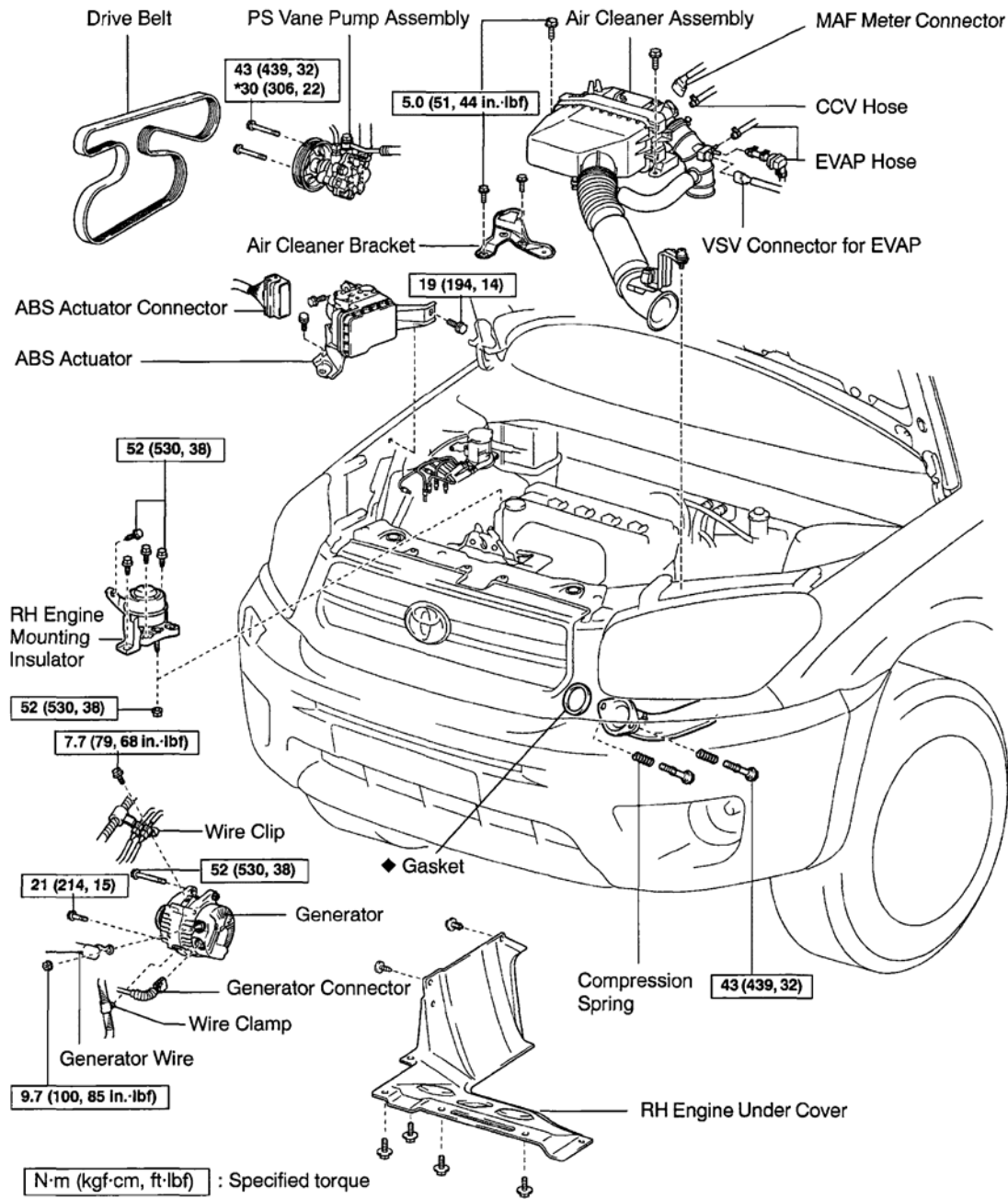
23. **INSTALL ABS ACTUATOR (See INSTALLATION )**
24. **INSTALL AIR CLEANER ASSEMBLY (See INSTALLATION)**
25. **INSTALL ENGINE UNDER COVER**
26. **FILL WITH ENGINE OIL (See REPLACEMENT )**
27. **START ENGINE AND CHECK FOR LEAK**
28. **RECHECK ENGINE OIL LEVEL**

## **CYLINDER HEAD**

### **COMPONENTS**

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4

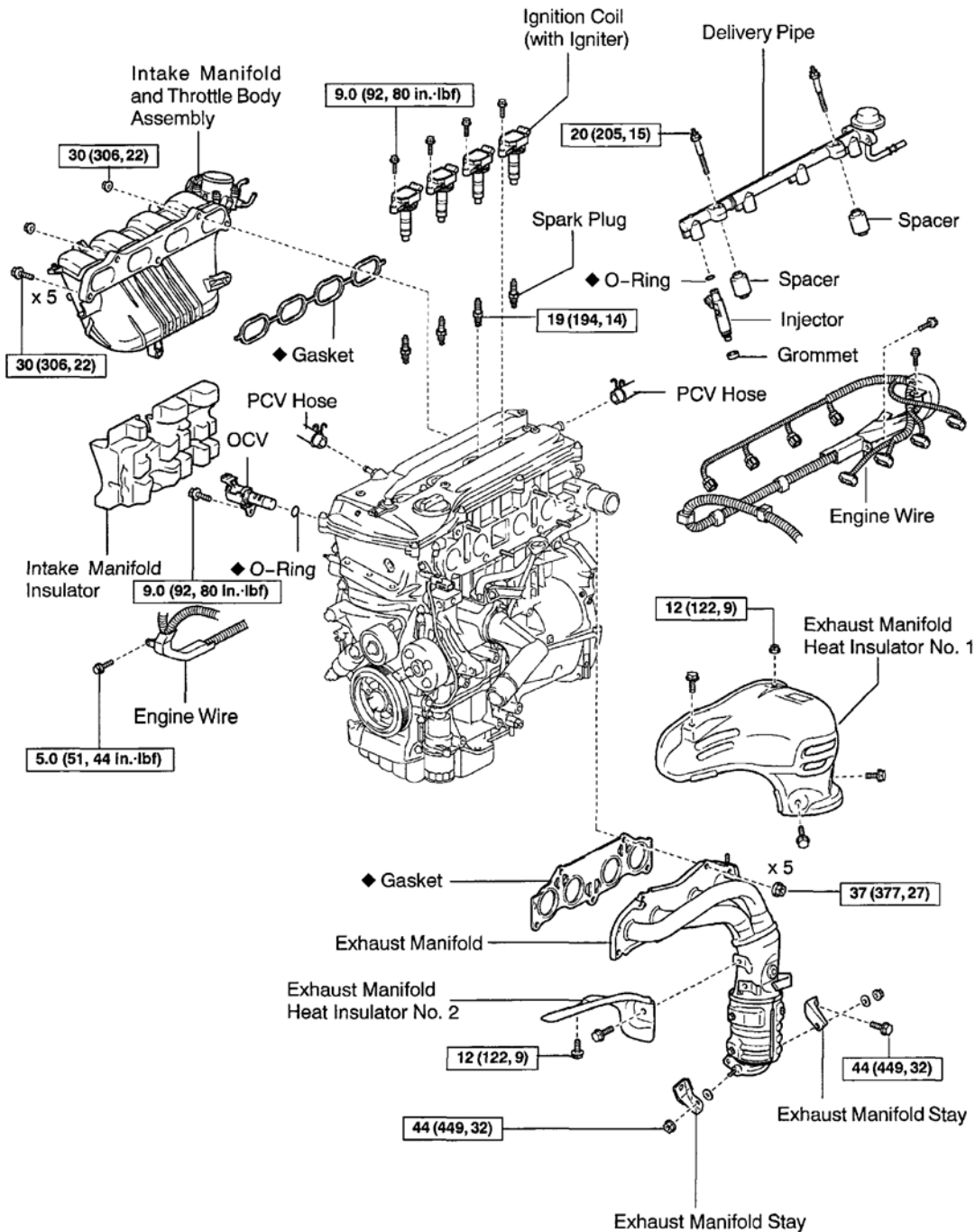


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**Fig. 77: Identifying Cylinder Head Components & Torque Specifications (1 Of 4)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4



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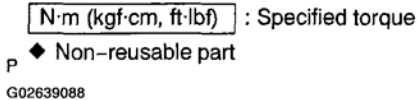
N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

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**Fig. 78: Identifying Cylinder Head Components & Torque Specifications (2 of 4)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

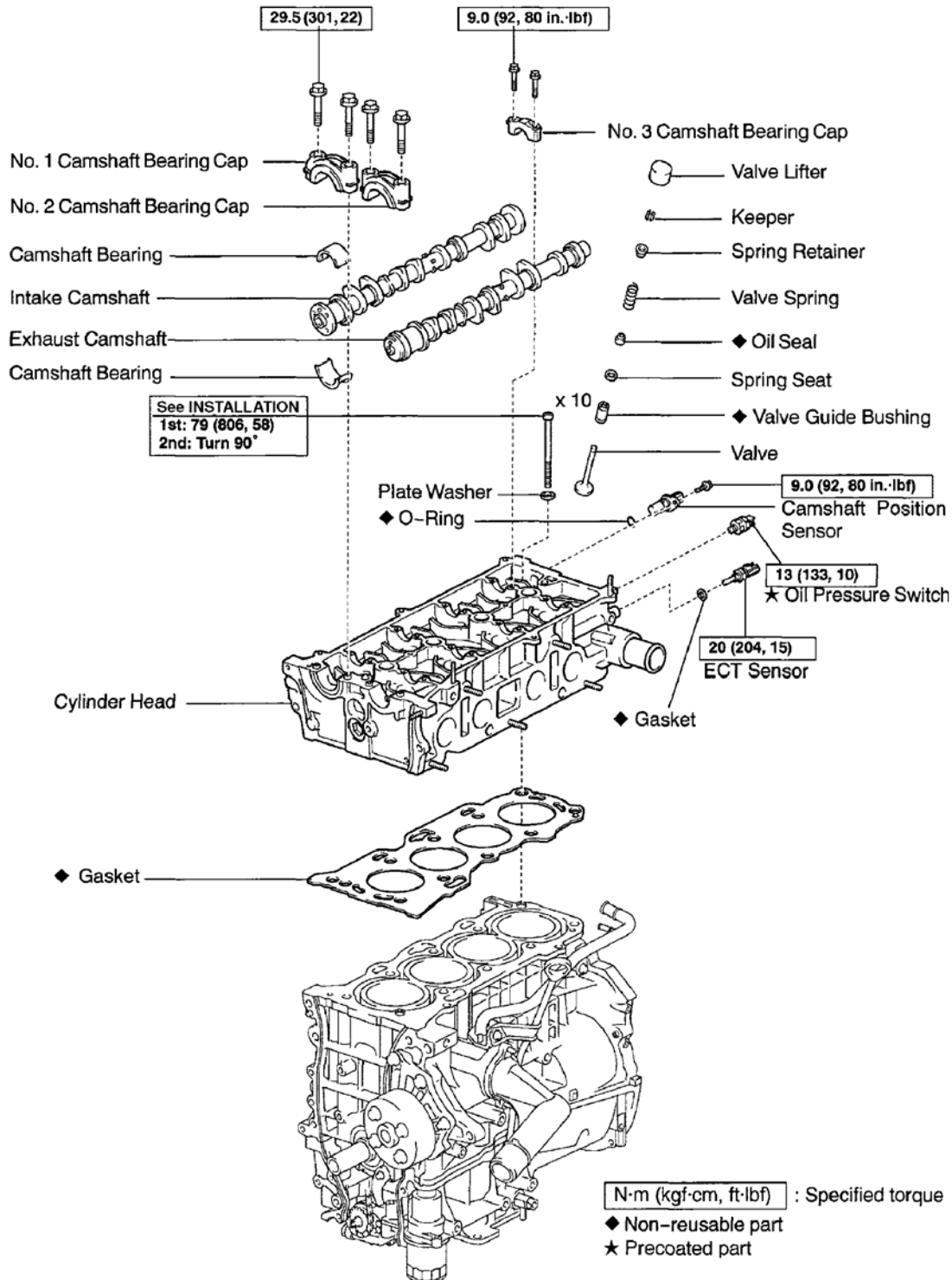
## 2005 ENGINE Engine Mechanical - RAV4



**Fig. 79: Identifying Cylinder Head Components & Torque Specifications (3 of 4)**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4

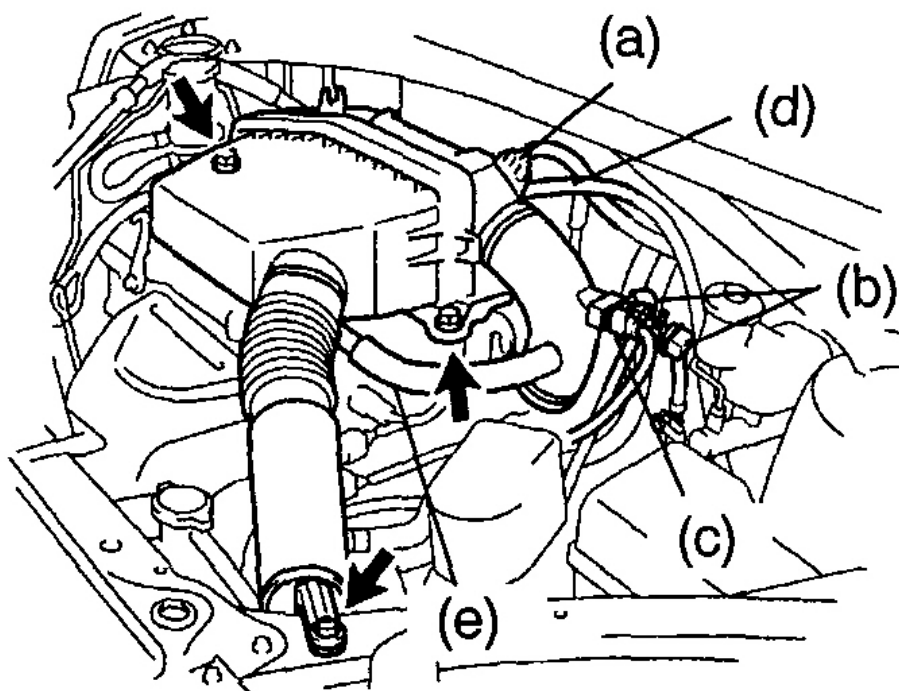


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**Fig. 80: Identifying Cylinder Head Components & Torque Specifications (4 of 4)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## REMOVAL

1. **REMOVE RH ENGINE UNDER COVER**
2. **DRAIN ENGINE COOLANT (See REPLACEMENT )**
3. **DRAIN ENGINE OIL (See REPLACEMENT )**
4. **REMOVE AIR CLEANER ASSEMBLY**
  - 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.



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**Fig. 81: Removing Air Cleaner Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

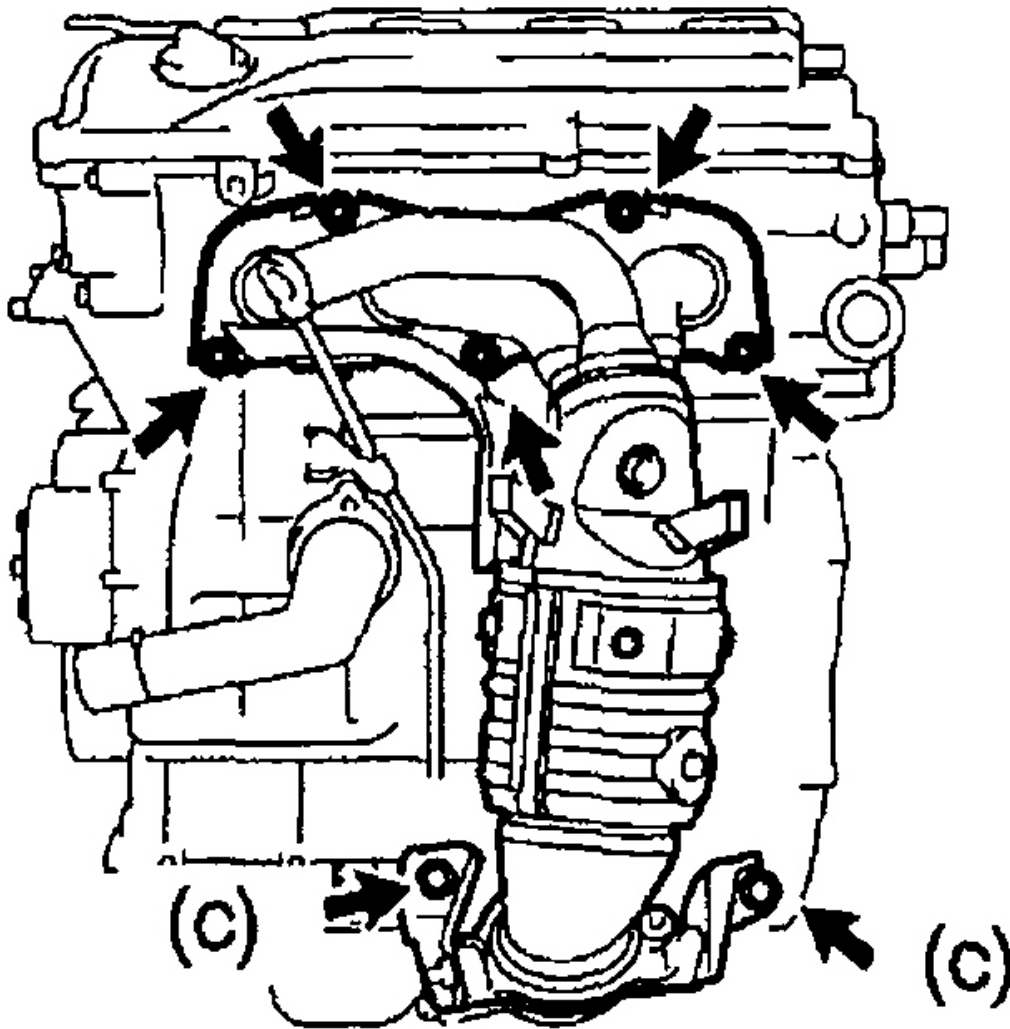
5. **REMOVE DRIVE BELT (See CHARGING SYSTEM )**
6. **REMOVE GENERATOR (See REMOVAL )**



## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4

7. **REMOVE PS VANE PUMP (See REMOVAL )**
8. **REMOVE IGNITION COILS (See IGNITION COIL )**
9. **REMOVE SPARK PLUGS (See IGNITION SYSTEM )**
10. **REMOVE INJECTORS (See REMOVAL )**
11. **REMOVE EXHAUST MANIFOLD ASSEMBLY**
  - a. Disconnect the A/F sensor connector.
  - b. Remove the 3 bolts, nut and exhaust manifold heat insulator No. 1.
  - c. Remove the 2 bolts holding the exhaust manifold stays and crank case.
  - d. Remove the 5 nuts, 2 bolts, 2 compression springs, the exhaust manifold assembly and 2 gaskets.
  - e. Remove the 2 nuts, No. 1 and No. 2 exhaust manifold stays.

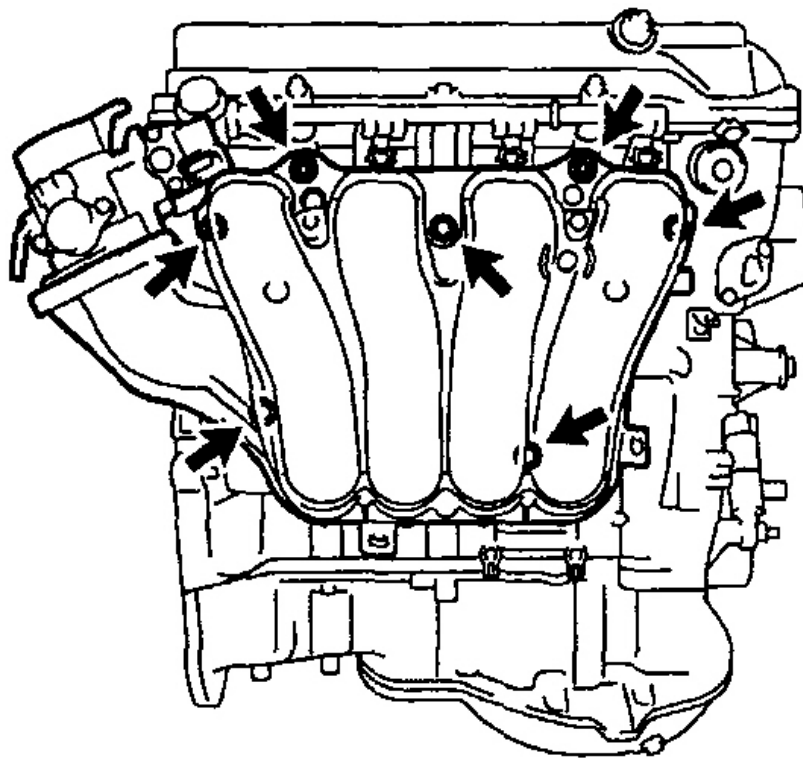


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**Fig. 82: Removing Exhaust Manifold Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. **REMOVE OIL FILLER CAP**
13. **REMOVE PCV HOSES AND VALVE**
  - a. Remove the 2 PCV hoses.
  - b. Remove the PCV valve and grommet.
14. **REMOVE INTAKE MANIFOLD AND THROTTLE BODY ASSEMBLY**

- a. Disconnect the throttle position sensor connector.
- b. Disconnect the 2 water hoses from the throttle body.
- c. Disconnect the 2 vacuum hoses from the intake manifold.
- d. Disconnect the engine wire harness from the clamp.
- e. Remove the 5 bolts, 2 nuts, the intake manifold and throttle body assembly, and gasket.
- f. Remove the intake manifold insulator.



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**Fig. 83: Removing Intake Manifold And Throttle Body Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**15. 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.

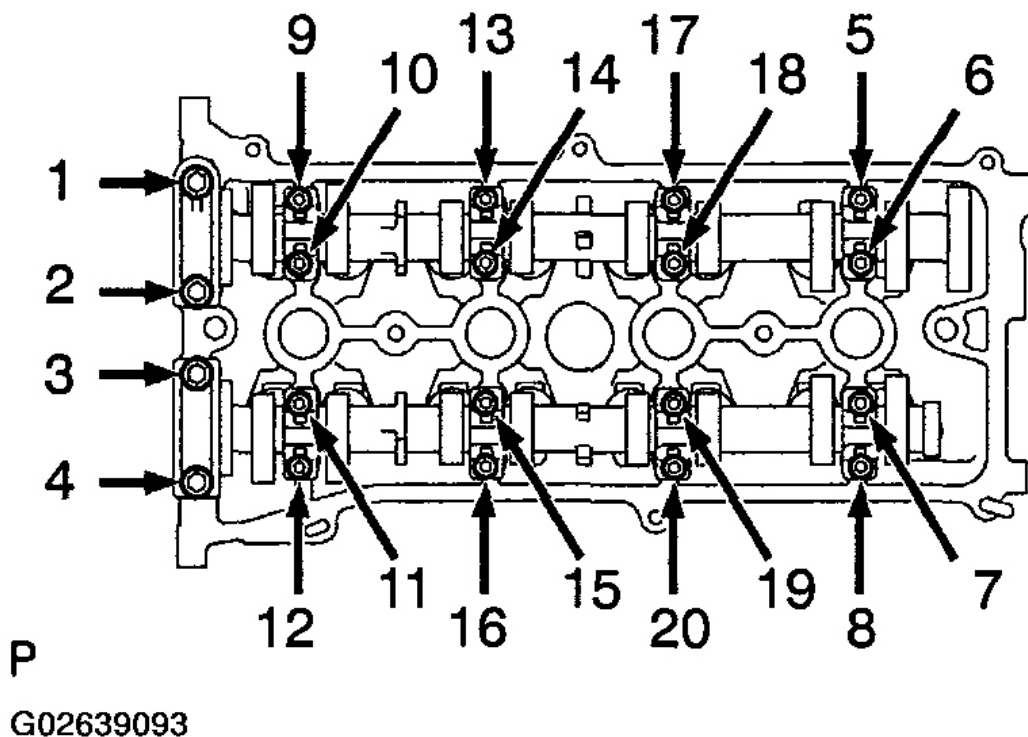
16. **REMOVE CAMSHAFT TIMING CHAIN** (See REMOVAL)

17. **REMOVE TIMING SPROCKET AND VVT SPROCKET** (See REMOVAL)

18. **REMOVE CAMSHAFT TIMING OIL CONTROL VALVE (OCV)** (See COMPONENTS )

19. **REMOVE CAMSHAFTS**

- 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.



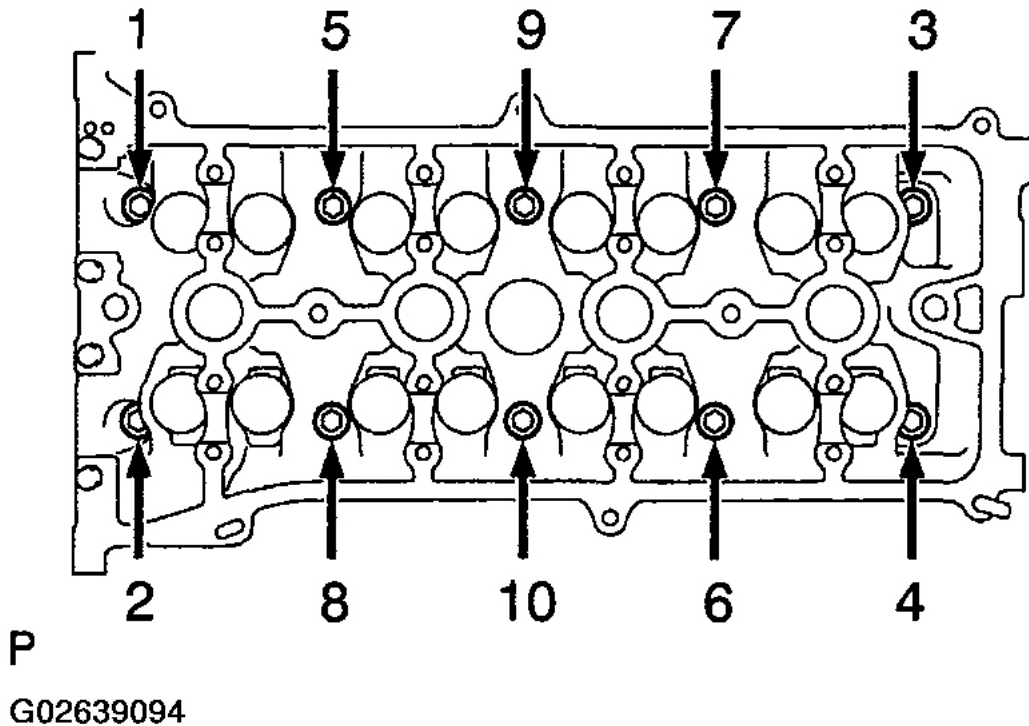
**Fig. 84: Identifying Bearing Cap Bolt Loosening Sequence**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

20. **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.

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

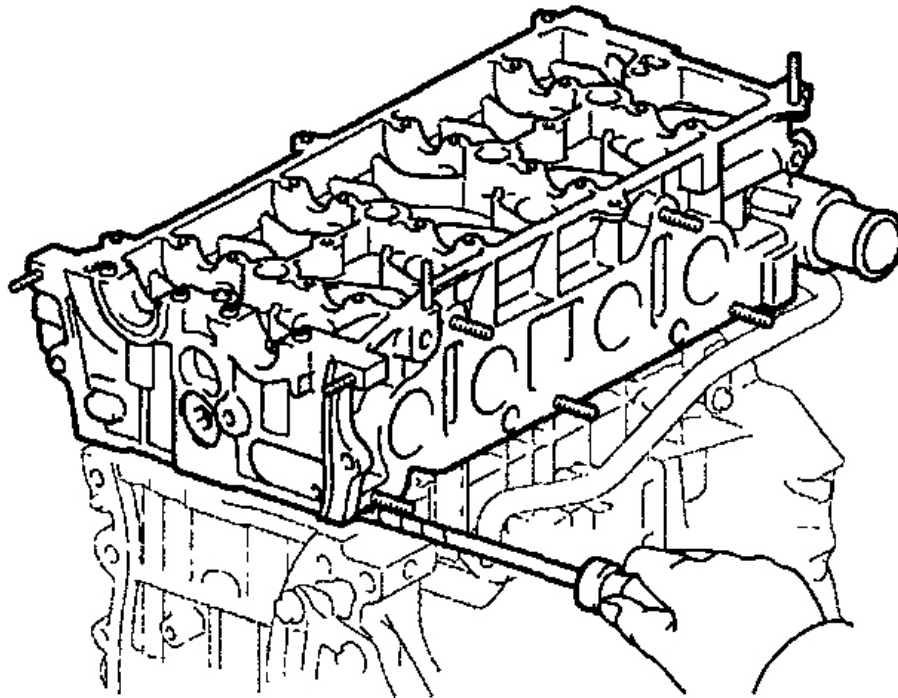
- b. Remove the 10 plate washers.



**Fig. 85: Identifying Cylinder Head Bolt Loosening Sequence**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Using a screwdriver, pry between the cylinder head and cylinder block, and remove the cylinder head.

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



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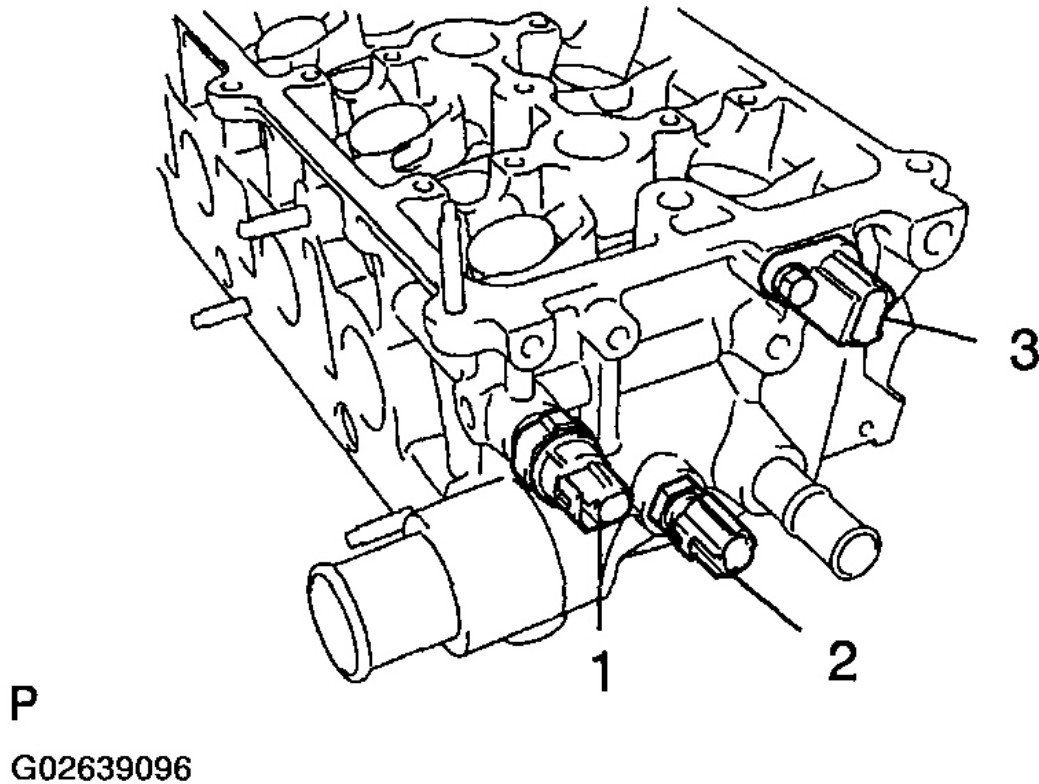
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**Fig. 86: Carefully Prying Between Cylinder Head And Cylinder Block Using Screwdriver**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## **DISASSEMBLY**

- 1. REMOVE OIL PRESSURE SWITCH**
- 2. REMOVE ECT SENSOR**
- 3. REMOVE CAMSHAFT POSITION SENSOR**

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



**Fig. 87: Identifying Cylinder Head Mounted Sensors**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**4. REMOVE VALVE LIFTERS**

HINT:

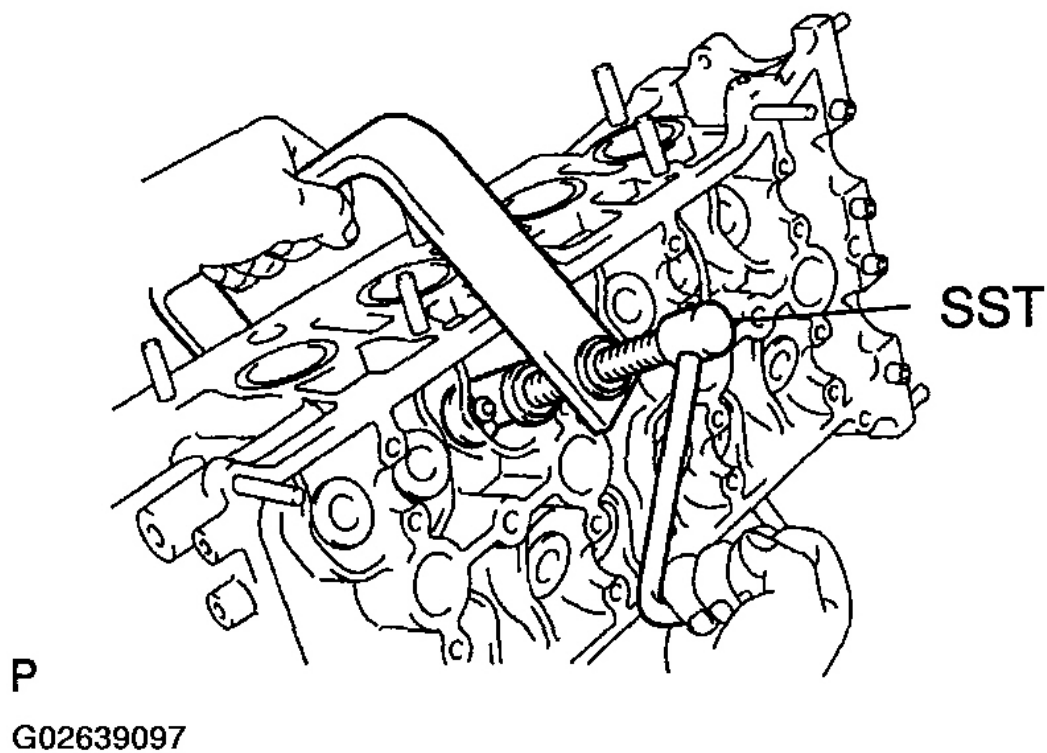
Arrange the valve lifters in the correct order.

**5. REMOVE VALVES**

- a. Using SST, compress the valve spring and remove the 2 keepers.

SST 09202-00020, 09202-70020

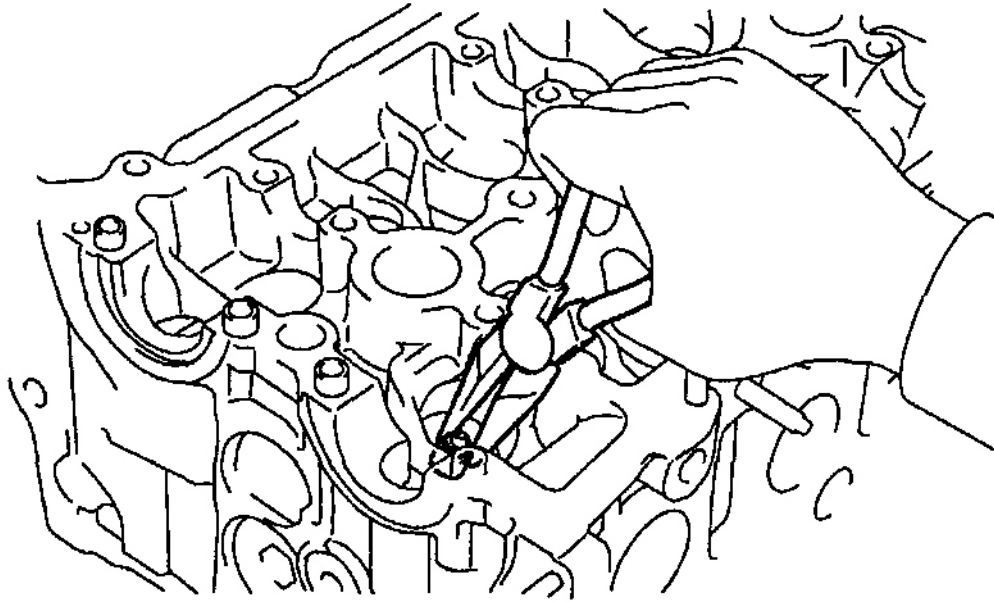
- b. Remove the spring retainer, valve spring and valve.



**Fig. 88: Compressing Valve Spring Using SST**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Using needle-nose pliers, remove the oil seal.





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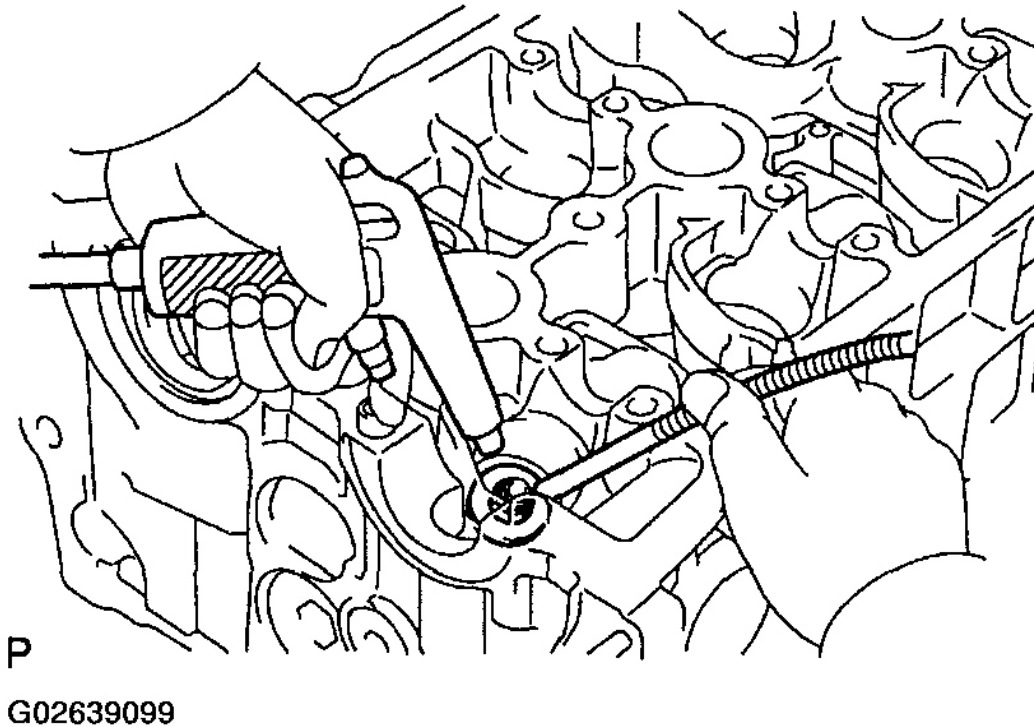
**G02639098**

**Fig. 89: Removing Oil Seal Using Needle-Nose Pliers**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

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

**HINT:**

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

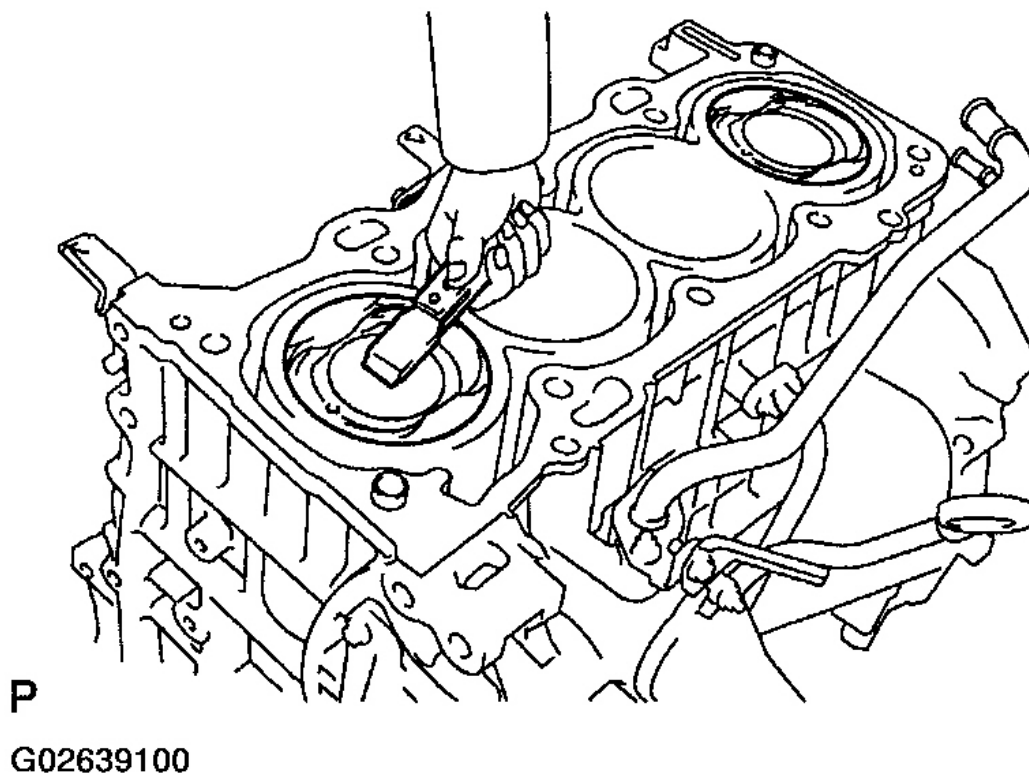


**Fig. 90: Removing Spring Seat By Blowing Air Using Compressed Air And Magnet**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## INSPECTION

### 1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

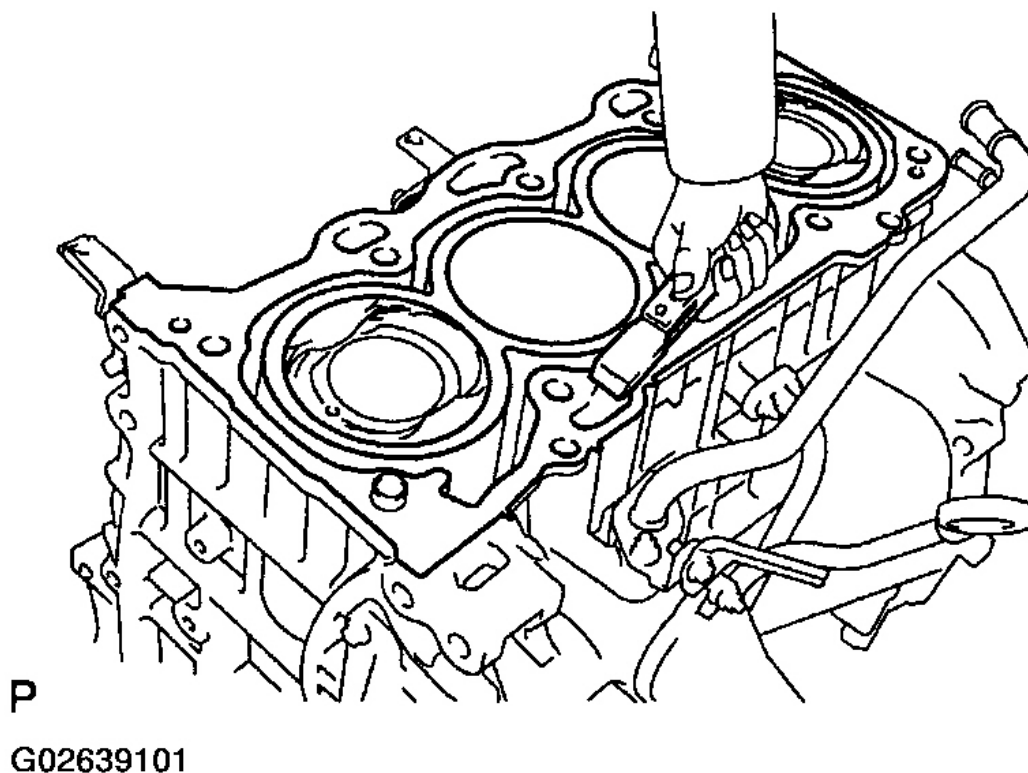
- a. Turn the crankshaft, and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston surface.



**Fig. 91: Cleaning Top Surfaces Of Pistons**

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

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



**Fig. 92: Removing Gasket Material From Cylinder Block Surface**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

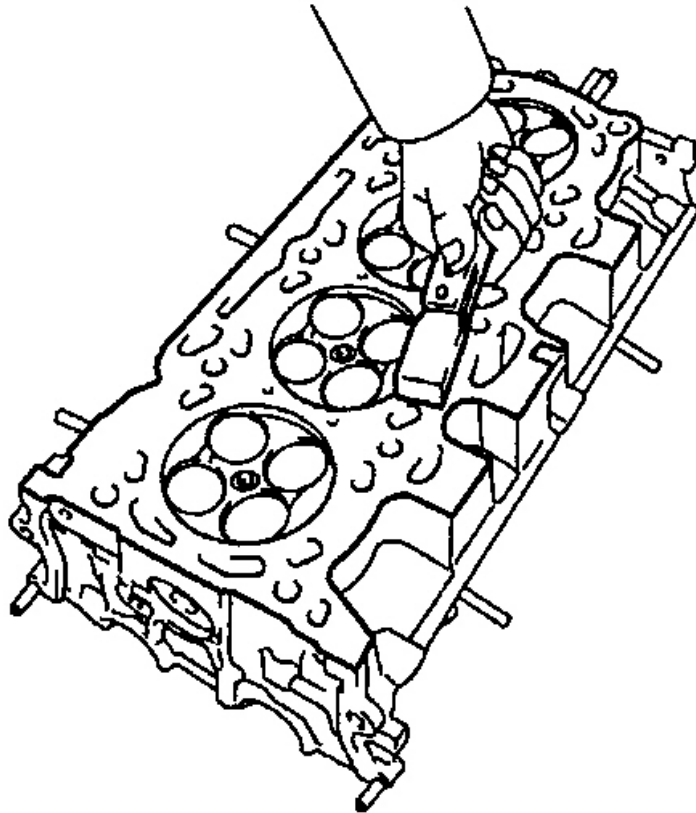
**CAUTION:** Protect your eyes when using high pressure compressed air.

**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.

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



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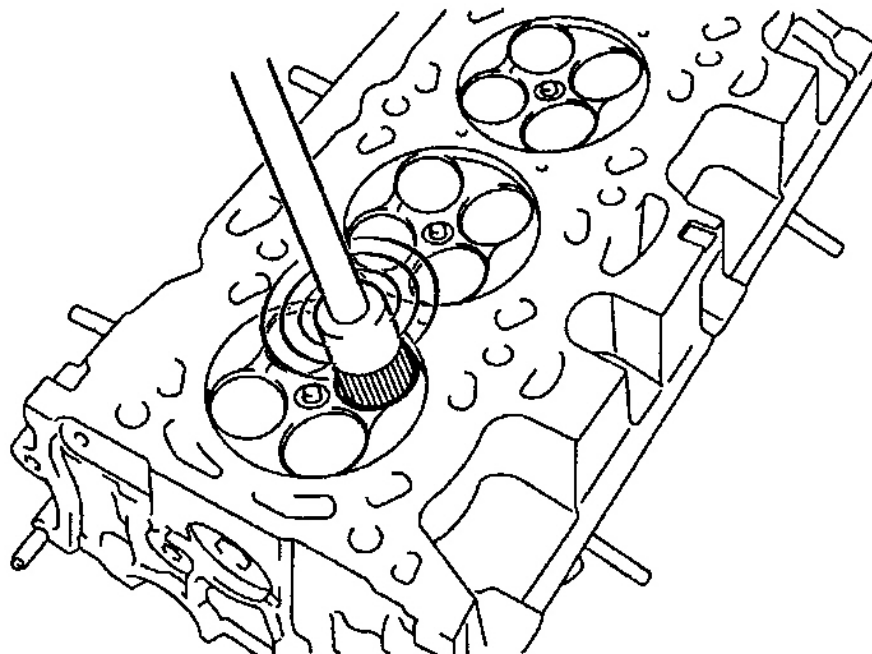
G02639102

**Fig. 93: Cleaning Cylinder Head Mating Surface**

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

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

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

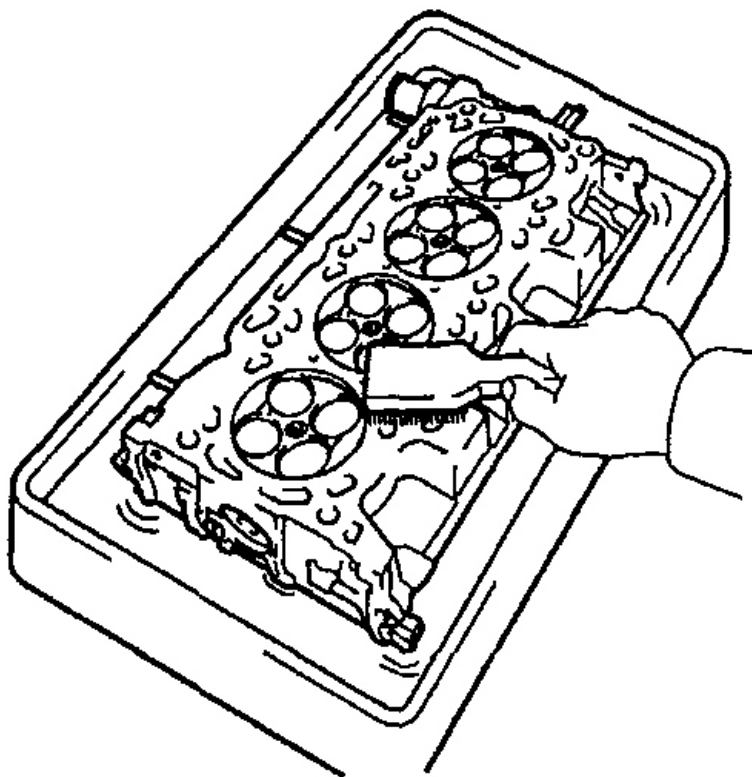


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**Fig. 94: Removing Carbon From Combustion Chambers**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

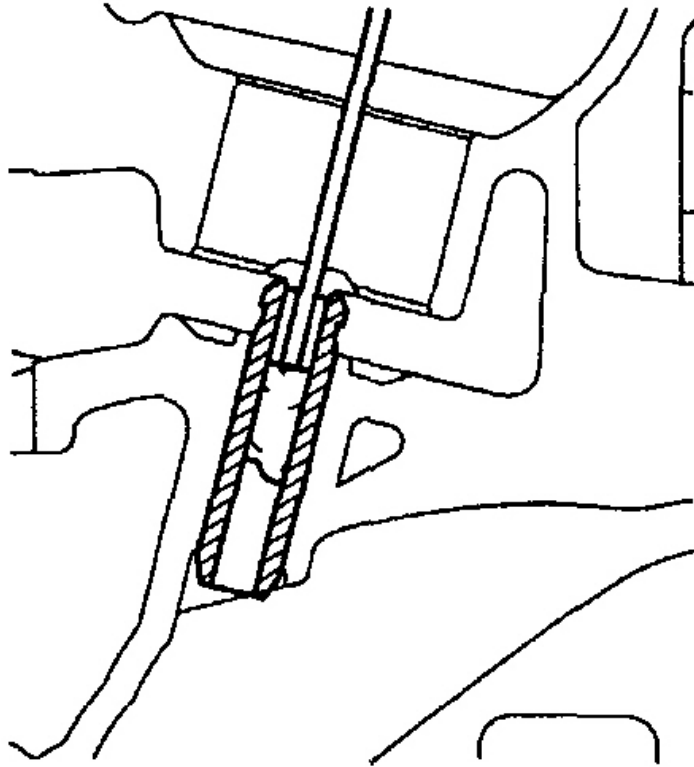


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**Fig. 95: Cleaning Cylinder Head Using Soft Brush And Solvent**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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



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**Fig. 96: Cleaning Guide Bushings Using Valve Guide Bushing Brush And Solvent**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### **4. INSPECT CYLINDER HEAD**

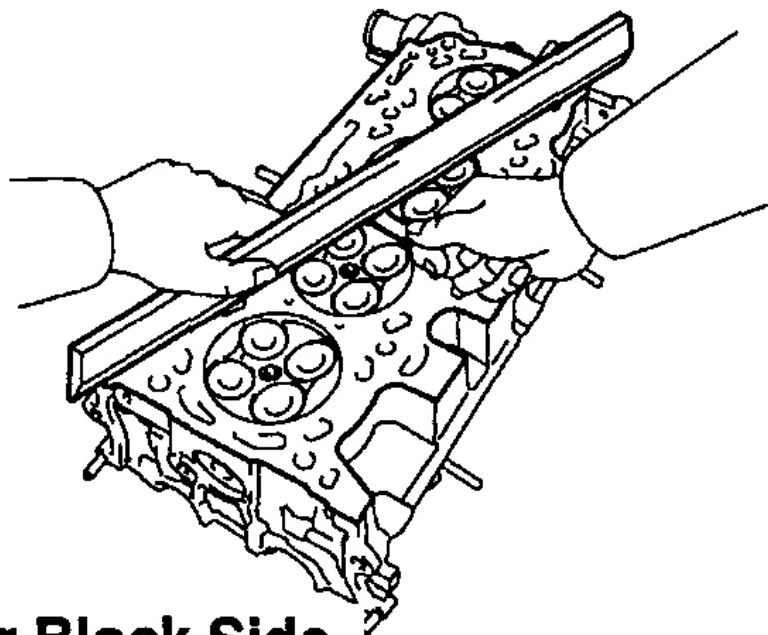
- a. Inspect for flatness.

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

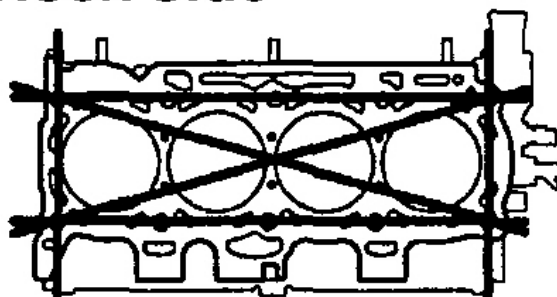
**Maximum warpage: 0.08 mm (0.0031 in.)**

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

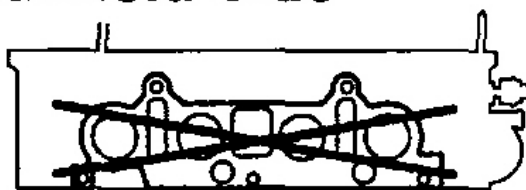




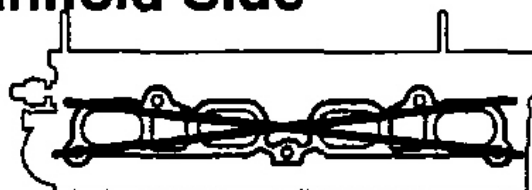
**Cylinder Block Side**



**Exhaust Manifold Side**



**Intake Manifold Side**

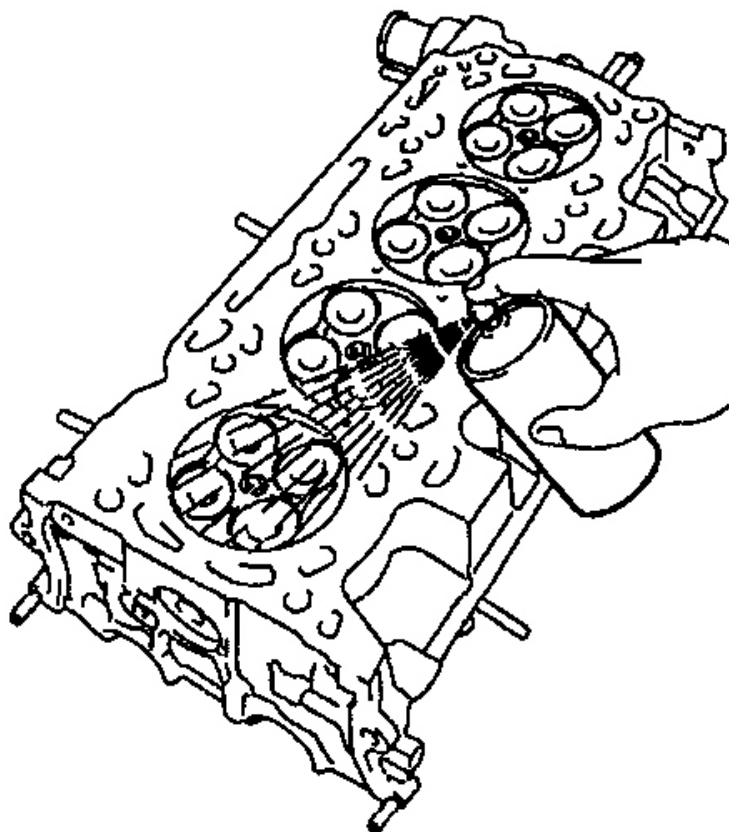


**Fig. 97: Checking Cylinder Head For Warpage At Mating Surfaces**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.

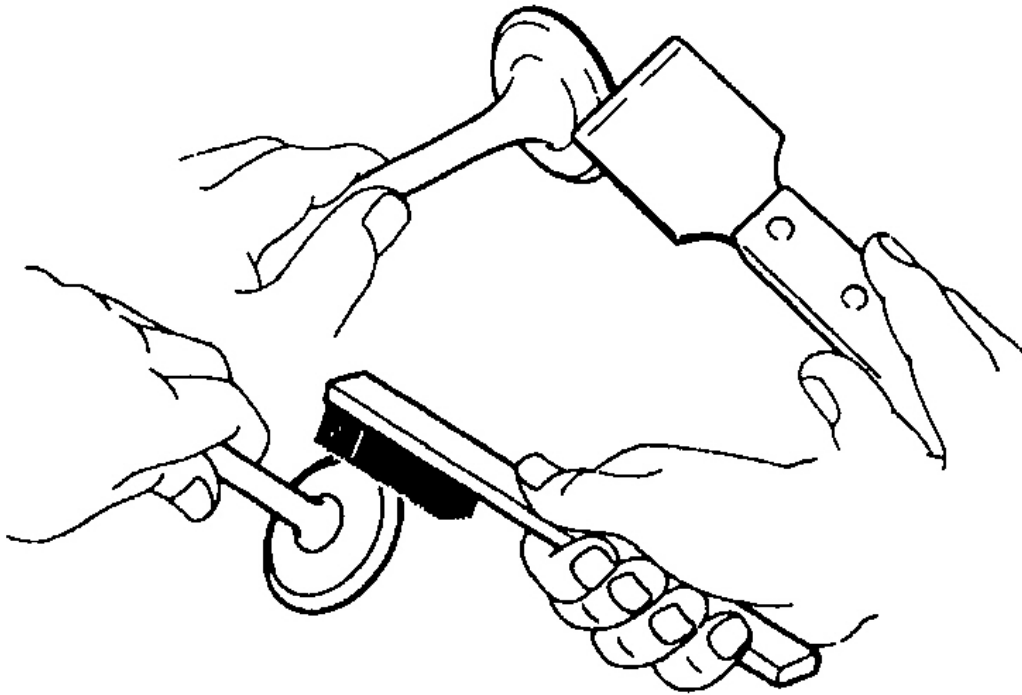


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**Fig. 98: Checking Combustion Chamber For Cracks**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Using a gasket scraper, chip off any carbon from the valve head.
- b. Using a wire brush, thoroughly clean the valve.



**G02639108**

**Fig. 99: Cleaning Valves**

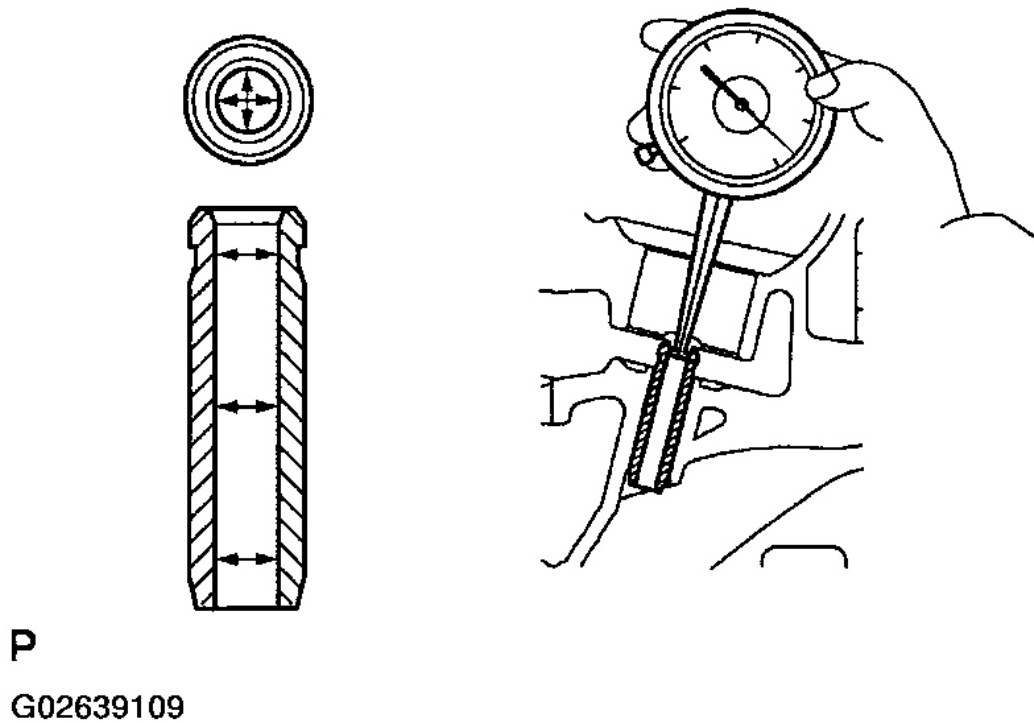
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## **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 to 5.530 mm (0.2169 to 0.2177 in.)**



**Fig. 100: Measuring Inside Diameter Of Guide Bushing**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

**Valve stem diameter:**

**VALVE STEM DIAMETER**

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

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

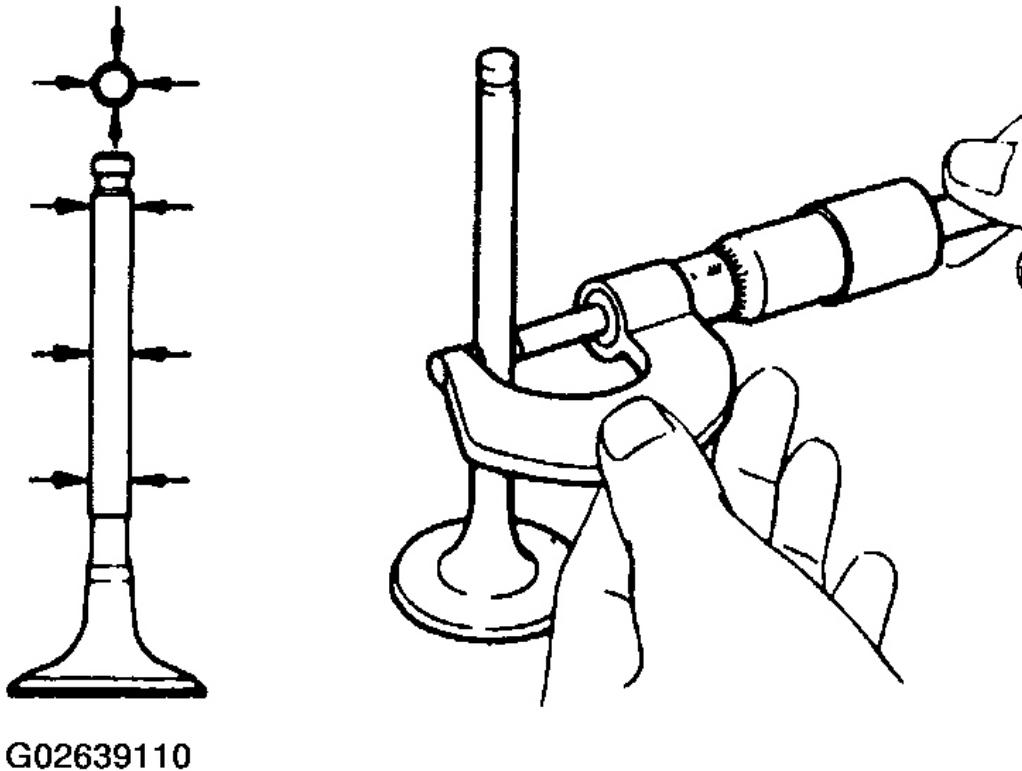
**Standard oil clearance:**

**STANDARD OIL CLEARANCE**

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

**Maximum oil clearance:****MAXIMUM OIL CLEARANCE**

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



**Fig. 101: Measuring Diameter Of Valve Stem Using Micrometer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

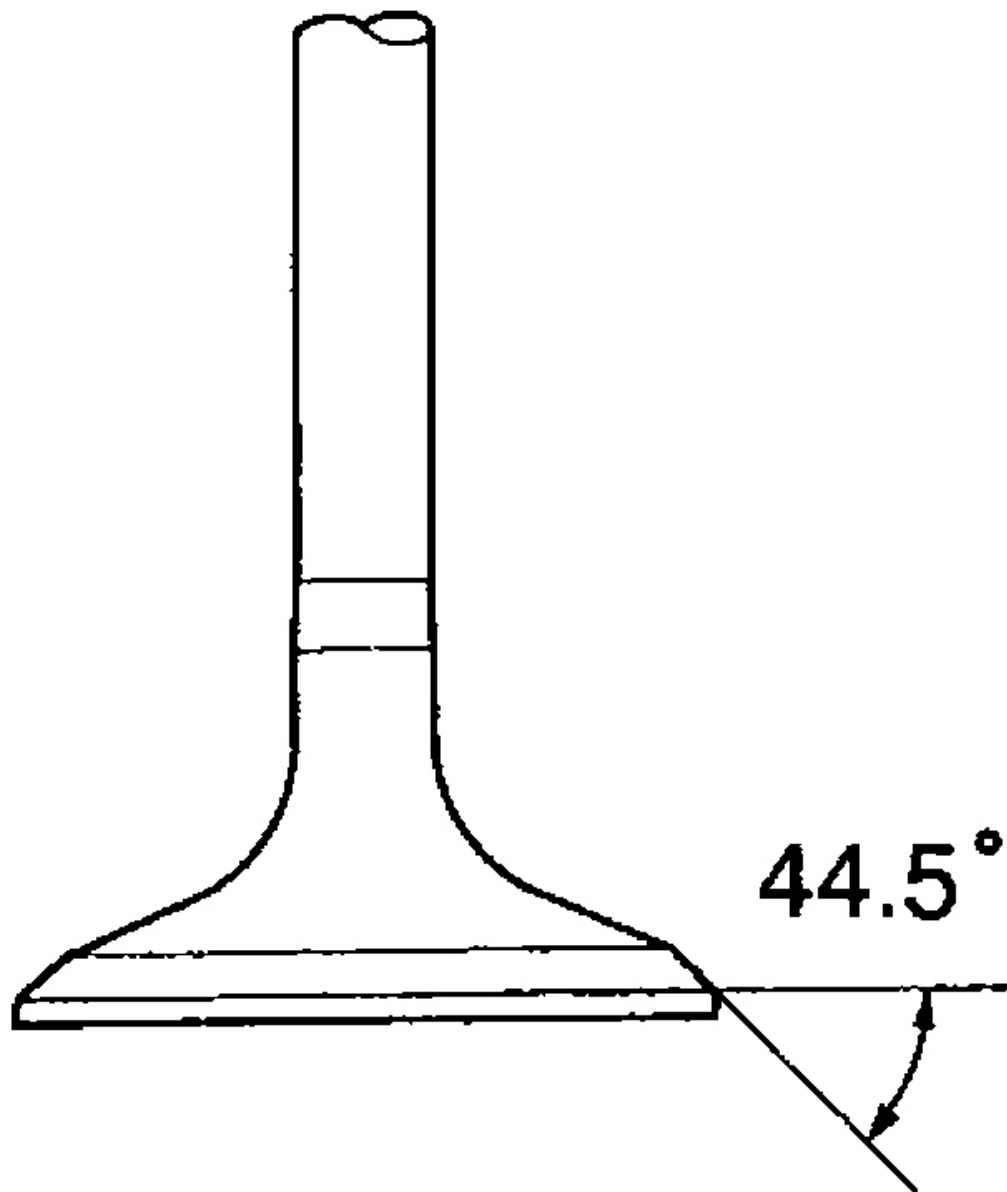
**7. INSPECT VALVES**

- Check the valve is ground to the correct valve face angle.

**Valve face angle: 44.5°**

- Check that the surface of the valve for wear.

If the valve face is worn, replace the valve.



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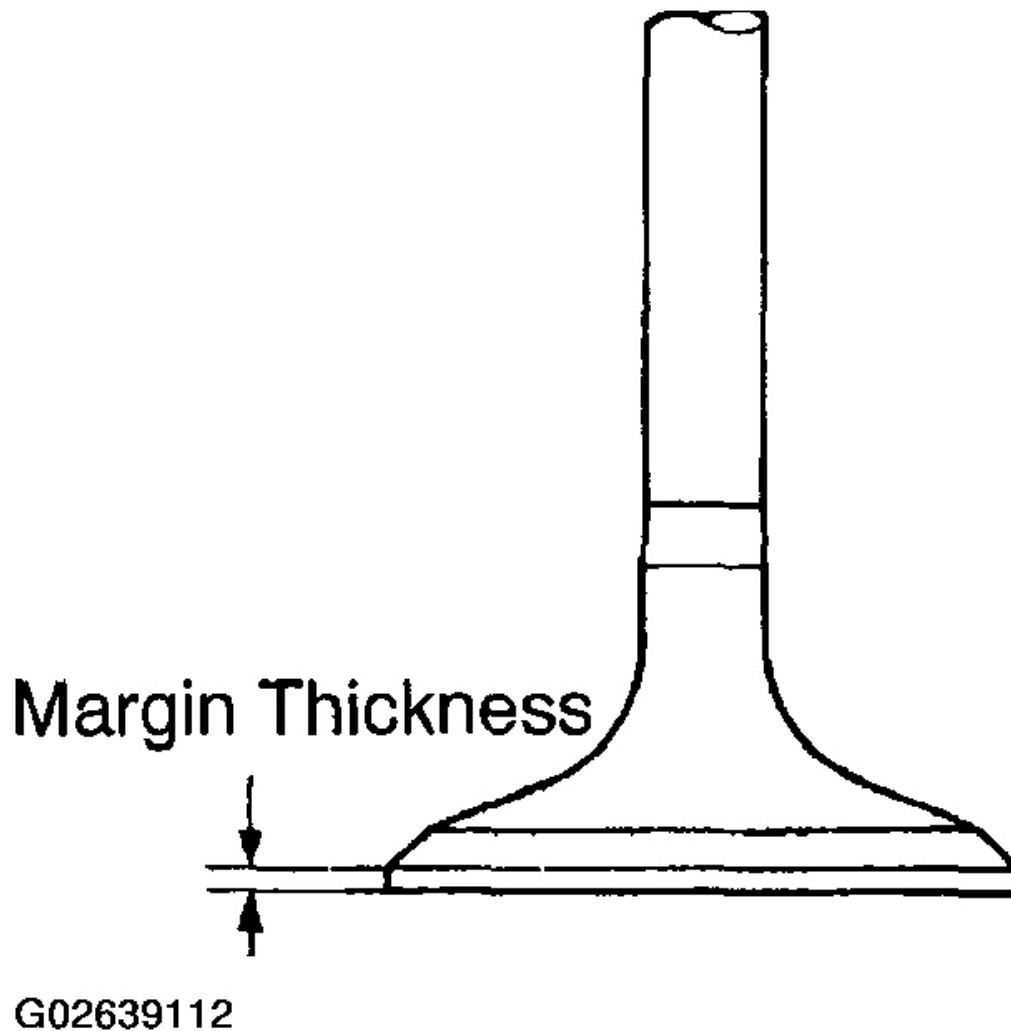
**Fig. 102: Checking Valve Is Ground To Correct Valve Face Angle**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.)**

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



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

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- d. Check the valve overall length.

#### Standard overall length:

##### STANDARD OVERALL LENGTH

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

#### Minimum overall length:

##### MINIMUM OVERALL LENGTH

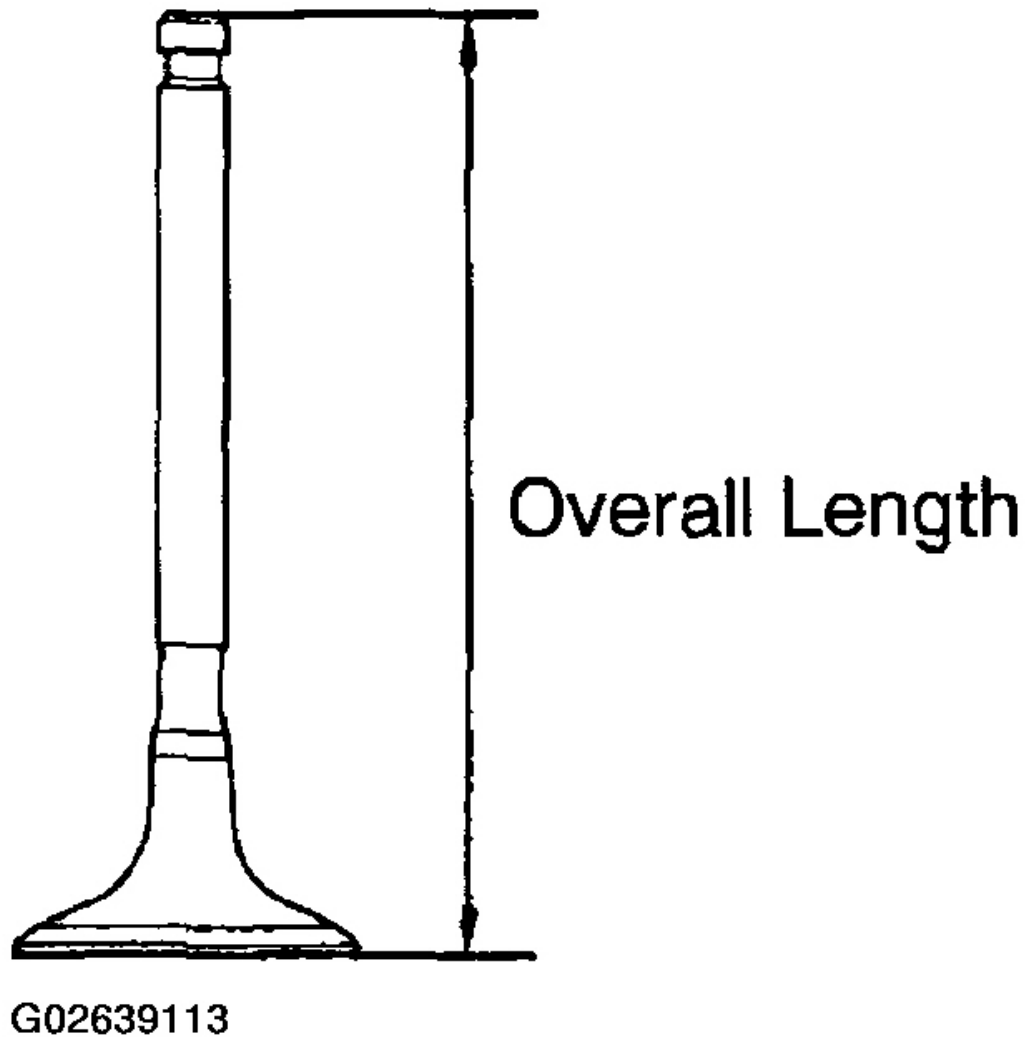
Intake	101.21 mm (3.9846 in.)
Exhaust	100.70 mm (3.9646 in.)

If the overall length is less than the 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.

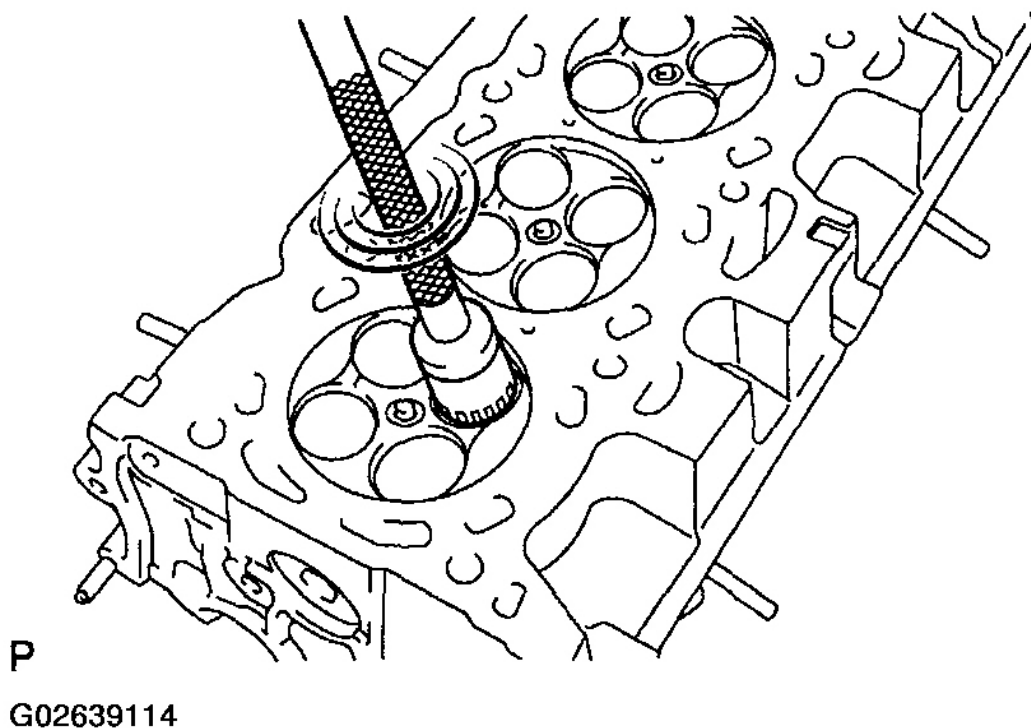




**Fig. 104: Checking Valve Overall Length**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**8. INSPECT AND CLEAN VALVE SEATS**

- a. Using a 45° carbide cutter, resurface the valve seats.
- b. Remove only enough metal to clean the seats.



**Fig. 105: Resurfacing Valve Seats**

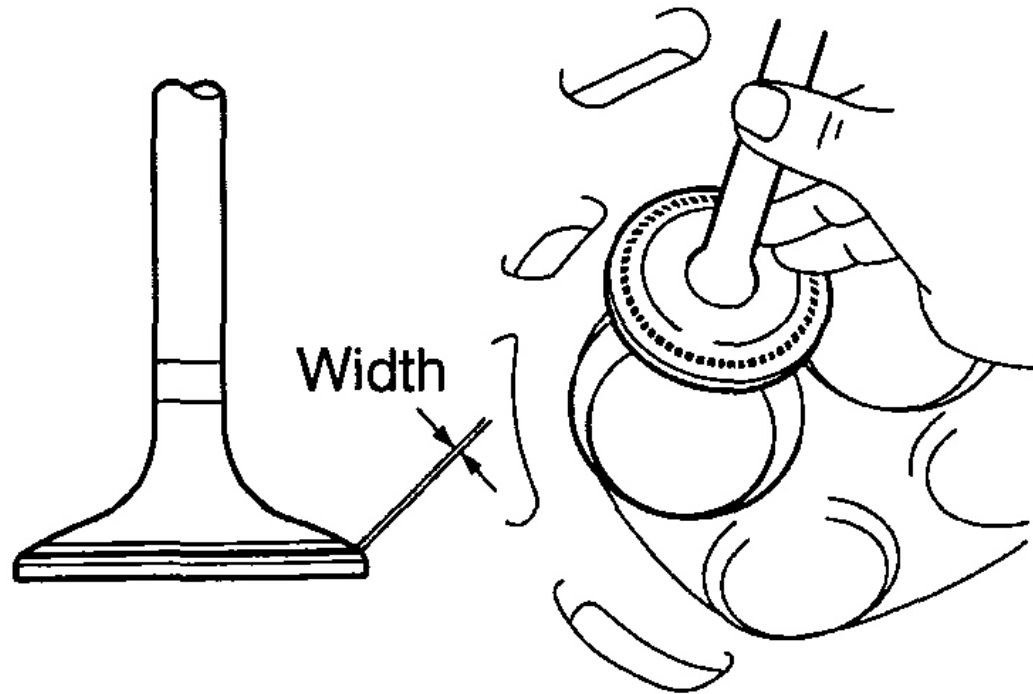
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.

- 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.



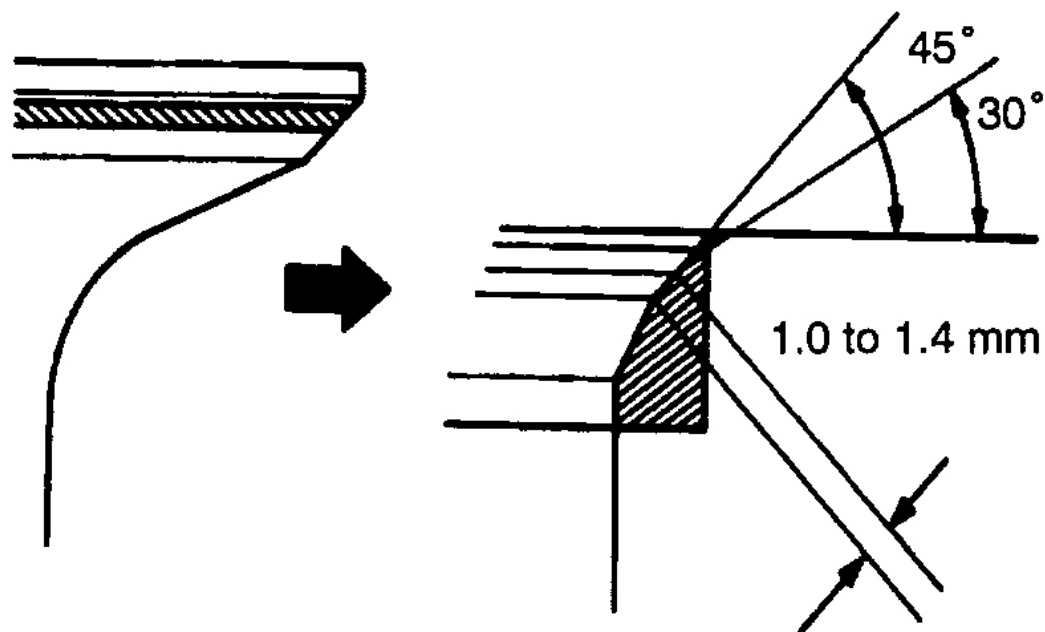
G02639115

**Fig. 106: Checking Valve Face & Valve Seating Position**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Check that the valve seat contact is in the middle of the valve face with the width between 1.0 to 1.4 mm (0.039 to 0.055 in.).

If not, correct the valve seats as follows:

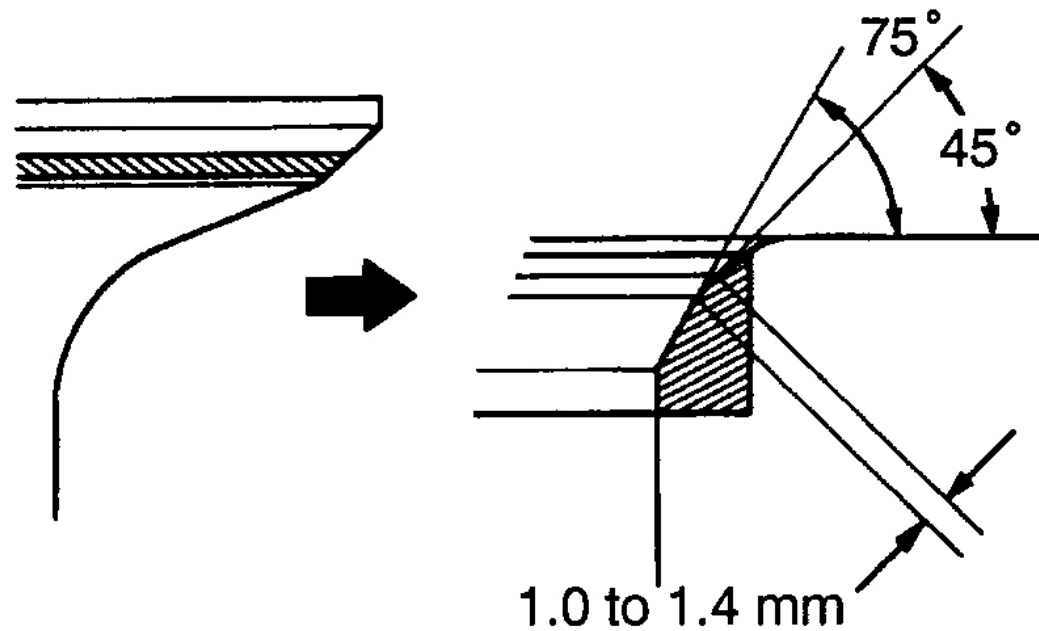
1. If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.



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**Fig. 107: Identifying Seat Cutter Angle (Seating Is Too High)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

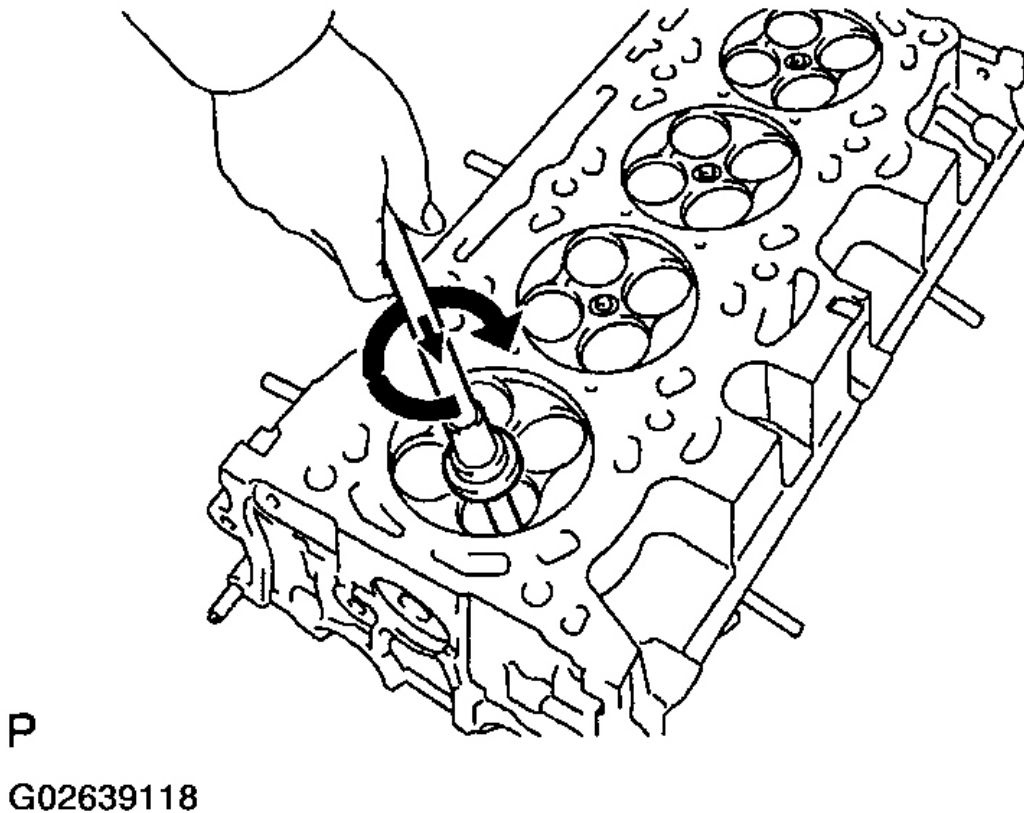
2. If the seating is too low on the valve face, use 75° and 45° cutters to correct the seat.



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**Fig. 108: Identifying Seat Cutter Angle (Seating Is Too Low)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Hand-lap the valve and valve seat with an abrasive compound.
- f. After hand-lapping, clean the valve and valve seat.



**Fig. 109: Hand-Lap Valve And Valve Seat**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

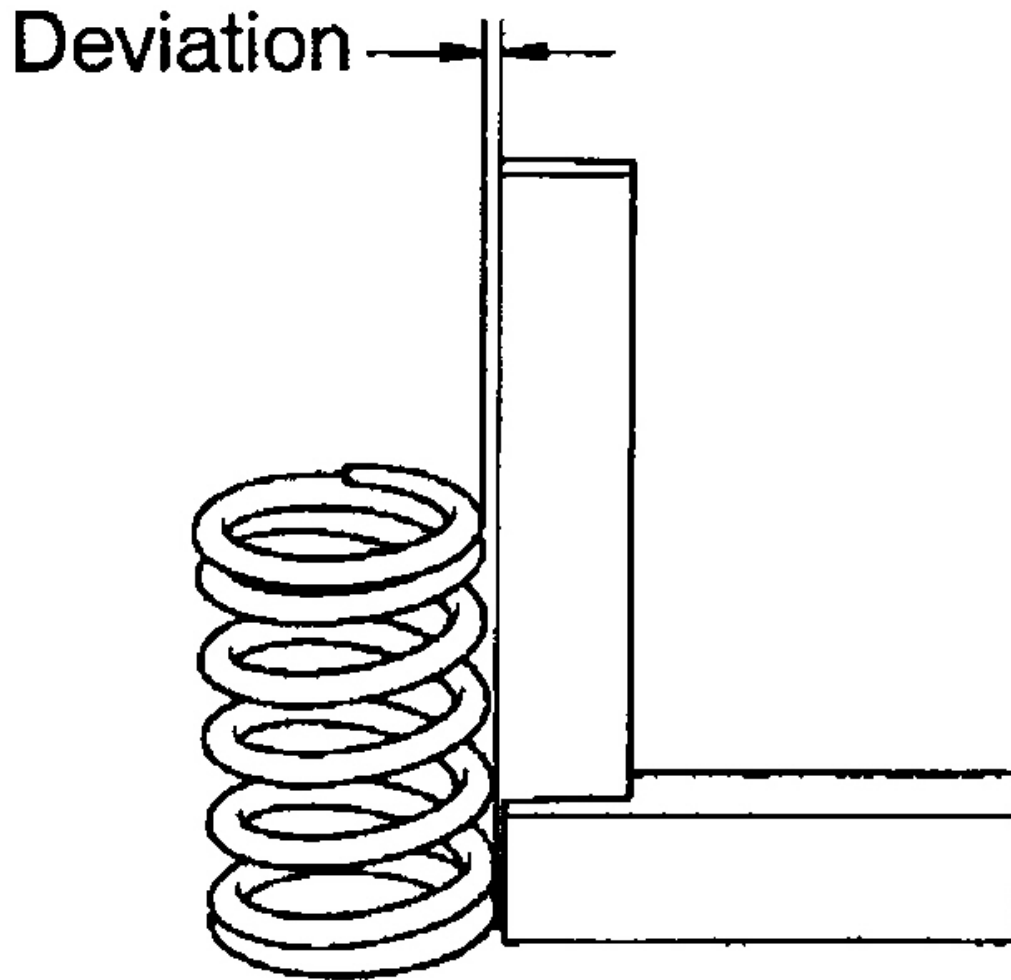
## 9. INSPECT VALVE SPRINGS

- 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 the maximum, replace the valve spring.



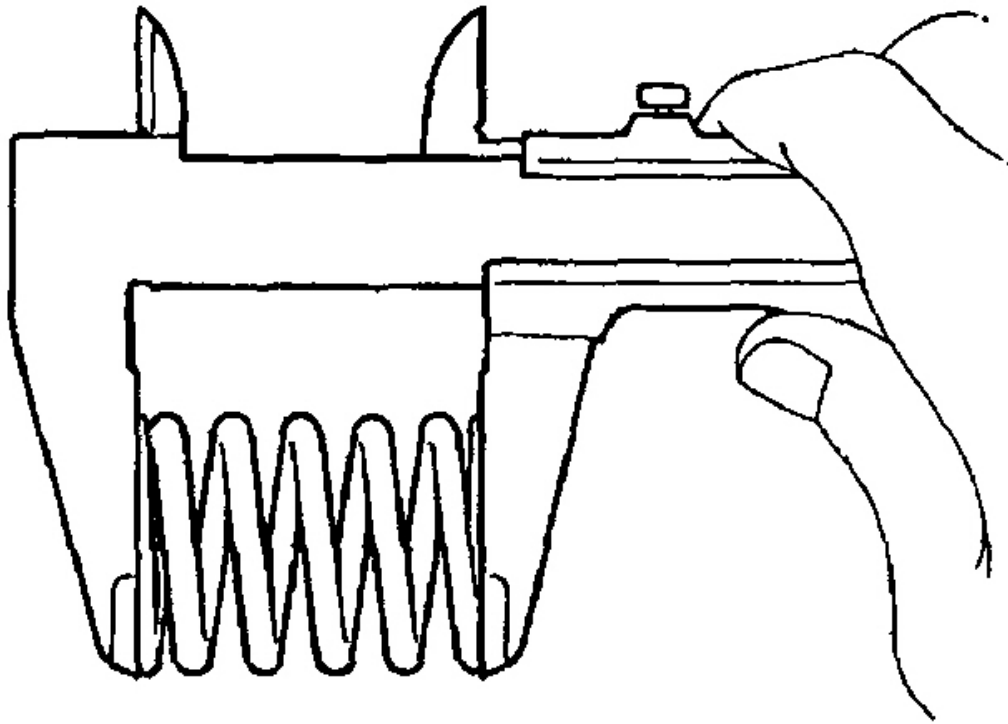
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**Fig. 110: Measuring Deviation Of Valve Spring Using Steel Square**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using vernier calipers, measure the free length of the valve spring.

**Free length: 45.7 mm (1.799 in.)**

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



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**Fig. 111: Measuring Free Length Of Valve Spring Using Vernier Calipers**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

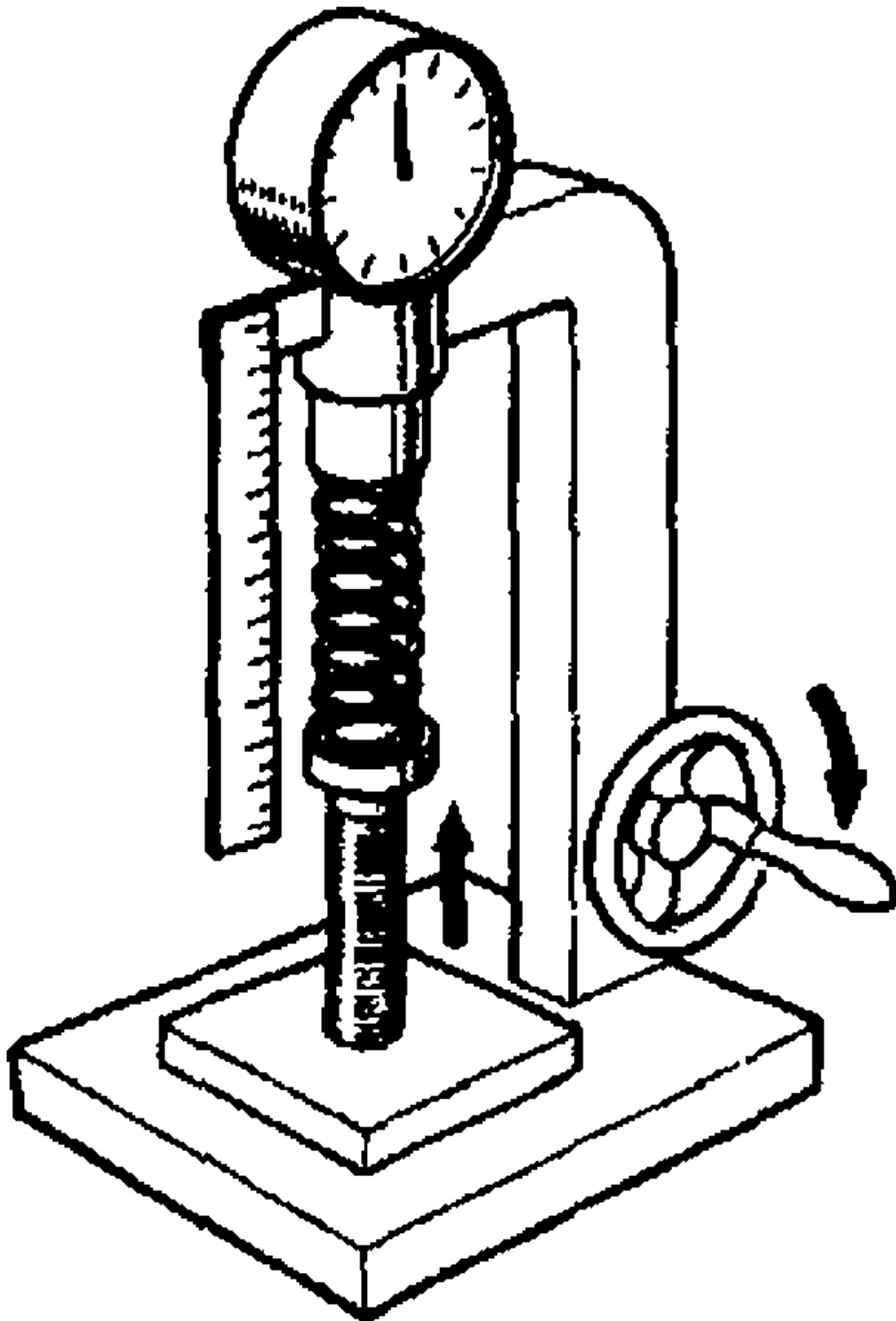
- c. Using a spring tester, measure the tension of the valve spring at the specified installed length.

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

**Maximum working tension: 344.8 to 381.2 N (35.2 to 38.9 kgf, 77.4 to 85.8 lbf) at 24.6 mm (0.968 in.)**

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





**Fig. 112: Measuring Tension Of Valve Spring At Specified Installed Length Using Spring Tester**

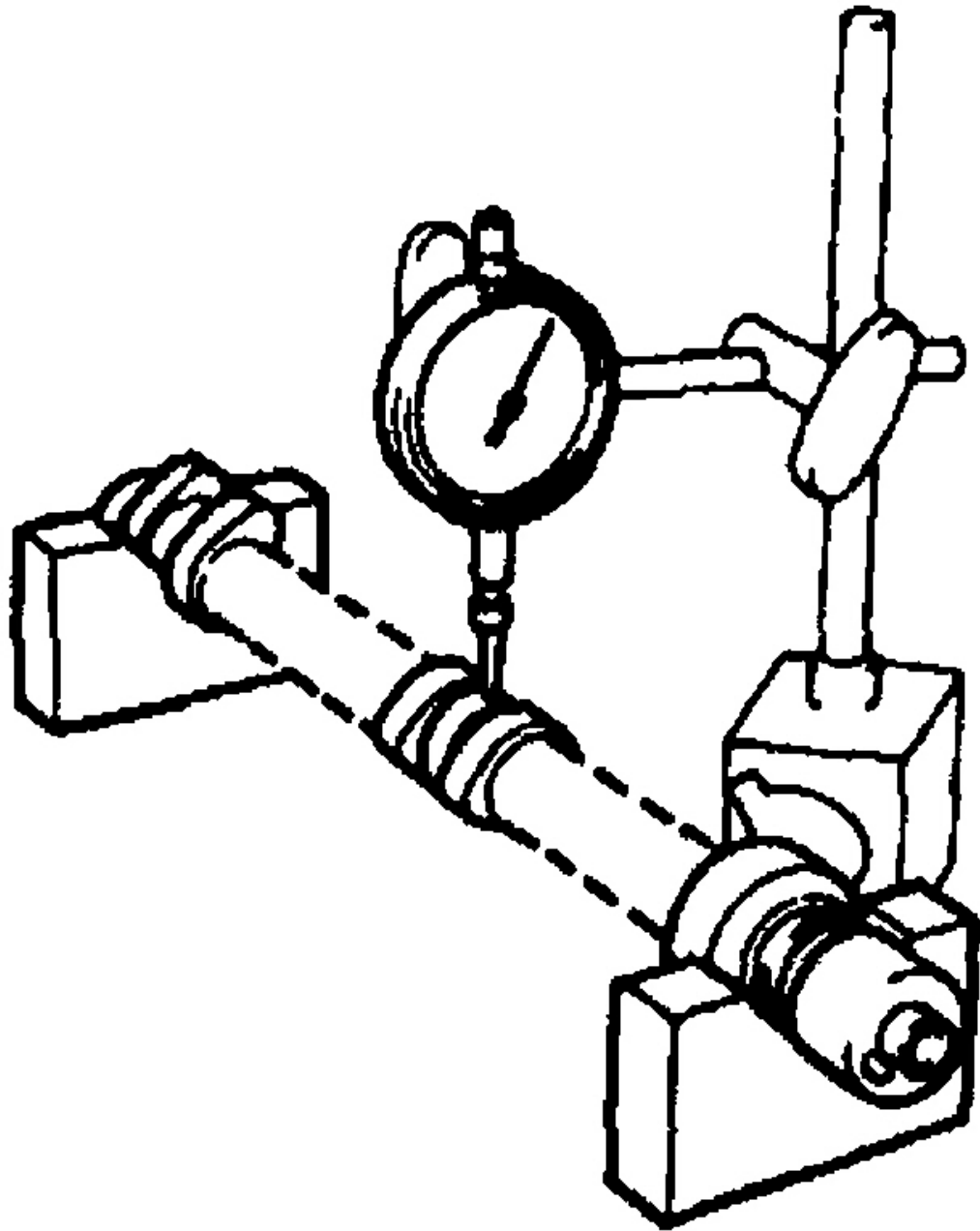
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

**10. INSPECT CAMSHAFTS**

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

**Maximum circle runout: 0.03 mm (0.0012 in.)**

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



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**Fig. 113: Measuring Circle Runout At Center Journal**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4

- b. Inspect the cam lobes.

Using a micrometer, measure the cam lobe height.

#### Standard cam lobe height:

##### STANDARD CAM LOBE HEIGHT

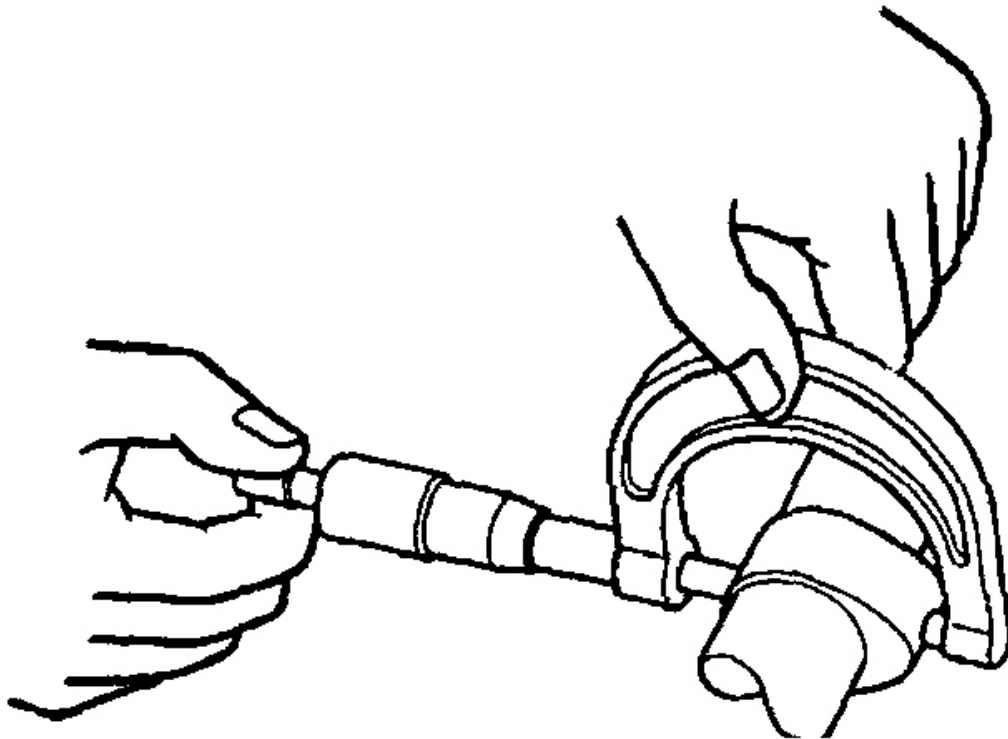
Intake	46.495 to 46.595 mm (1.8305 to 1.8345 in.)
Exhaust	45.983 to 46.083 mm (1.8106 to 1.8143 in.)

#### Minimum cam lobe height:

##### MINIMUM CAM LOBE HEIGHT

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

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



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**Fig. 114: Measuring Cam Lobe Height Using Micrometer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Inspect the camshaft journals.

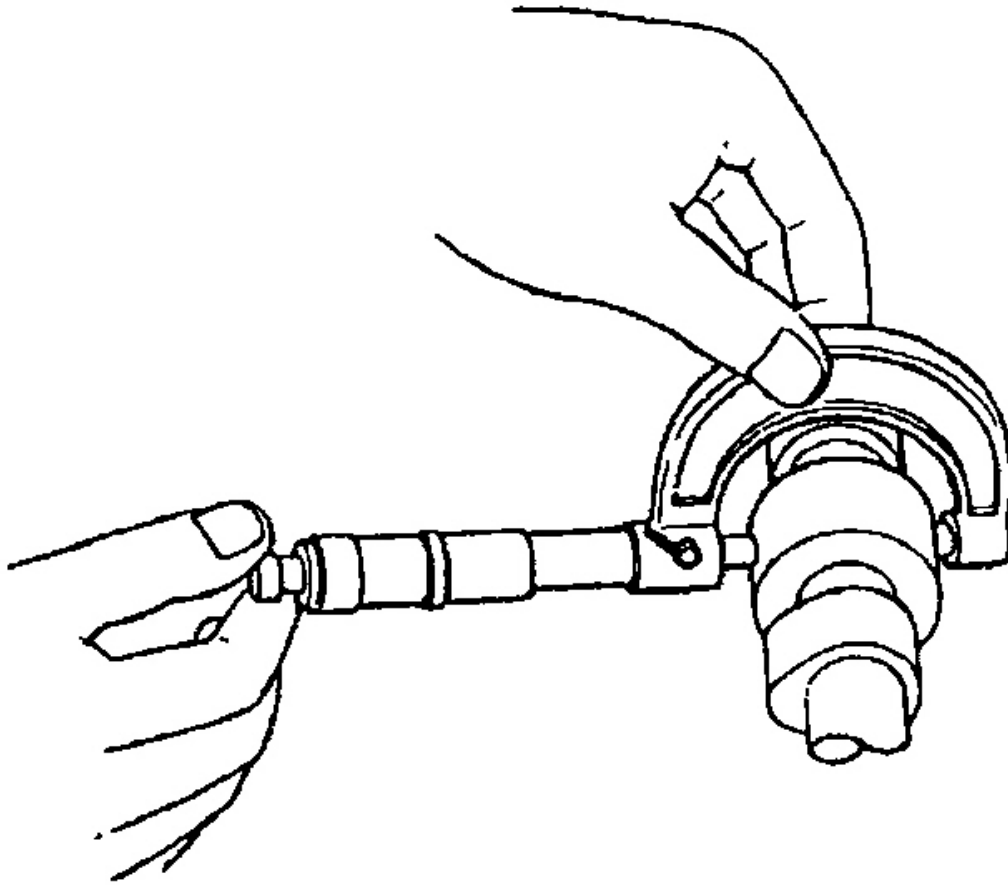
Using a micrometer, measure the journal diameter.

**Journal diameter:**

**JOURNAL DIAMETER**

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

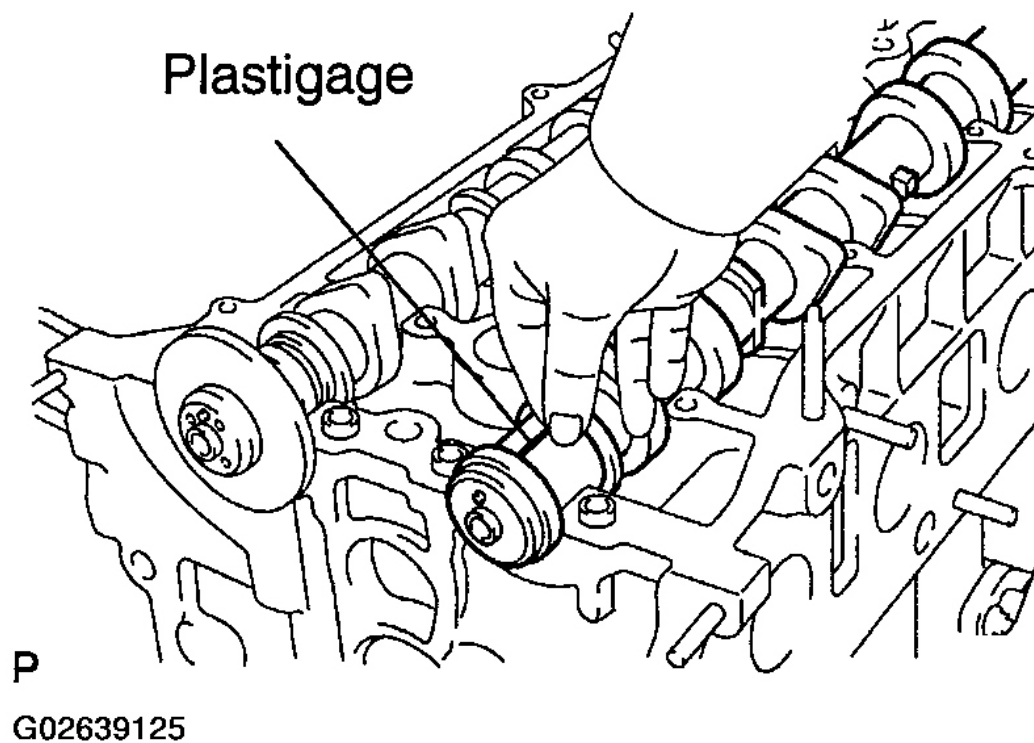
If the journal diameter is not as specified, check the oil clearance.



**G02639124**

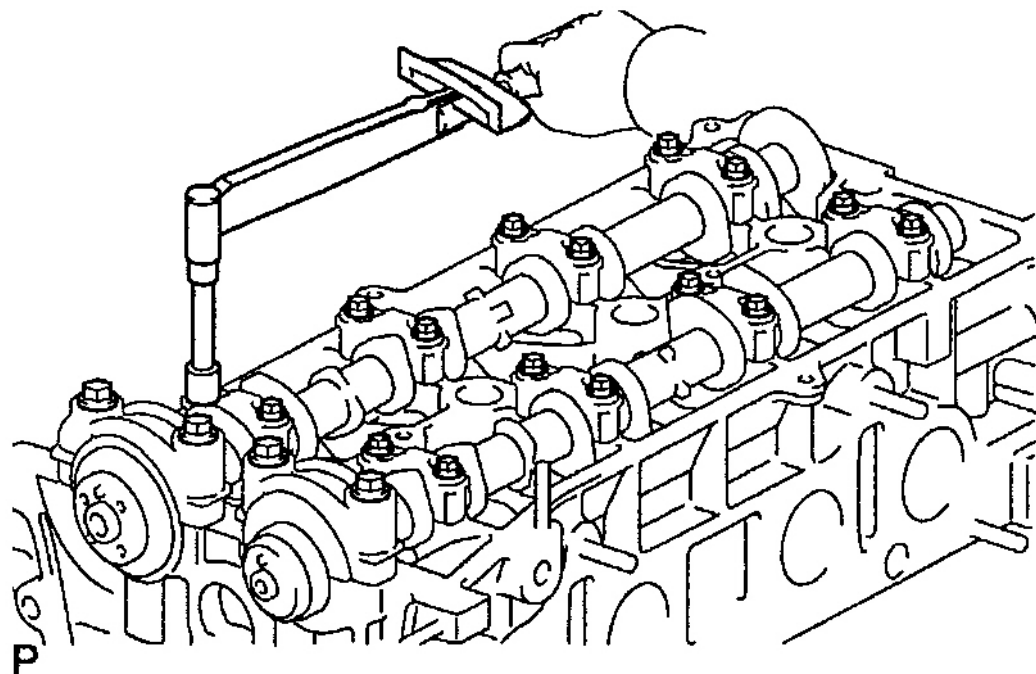
**Fig. 115: Measuring Camshaft Journal Diameter Using Micrometer**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- 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 camshaft journal.



**Fig. 116: Inspecting Camshaft Journal Clearance**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Install the bearing caps (see INSTALLATION).



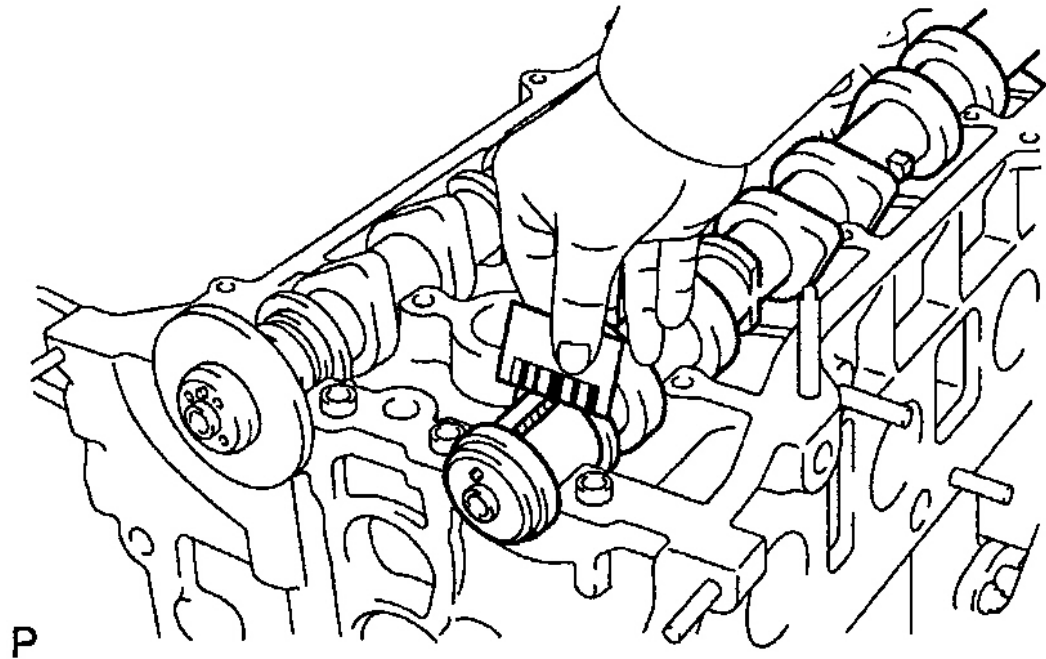
G02639126

**Fig. 117: Installing Bearing Caps**

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

6. Remove the bearing caps.
7. Measure the Plastigage at its widest point.

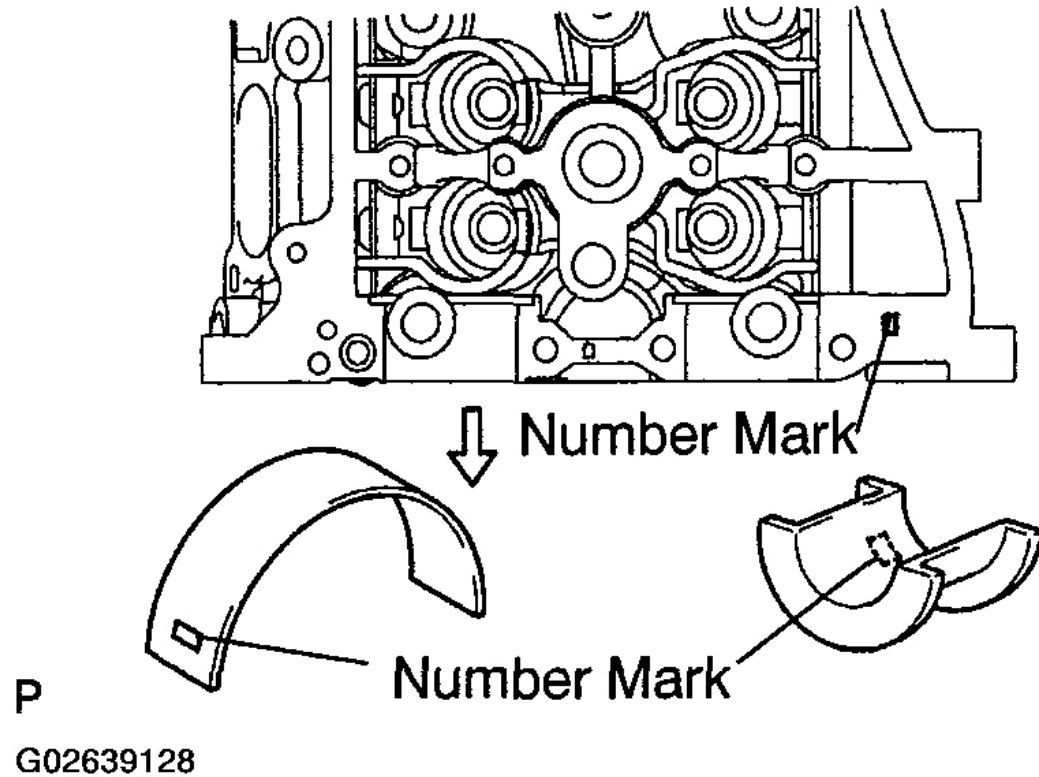




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**Fig. 118: Measuring Plastigage At Its Widest Point**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**Standard oil clearance:**



**Fig. 119: Identifying Bearing Oil Clearance Specification**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**Maximum oil clearance:**

**MAXIMUM OIL CLEARANCE**

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

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

**HINT:**

If using a standard bearing, replace with the one which has the same number.

**Reference**

**Cylinder head journal bore diameter:**

## 2005 Toyota RAV4

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#### CYLINDER HEAD JOURNAL BORE DIAMETER

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

#### Standard bearing center wall thickness:

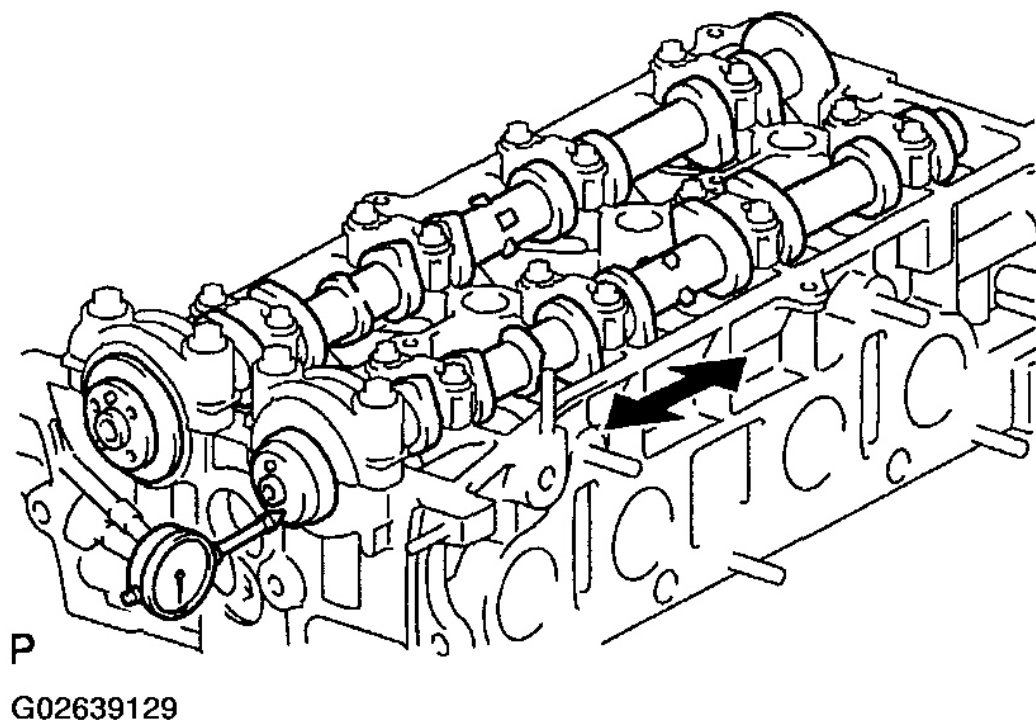
#### STANDARD BEARING CENTER WALL THICKNESS

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

#### Camshaft journal diameter:

**35.971 to 35.985 mm (1.4165 to 1.4167 in.)**

8. Remove the Plastigage completely.
  9. Remove the camshafts.
  10. Remove the bearings.
- e. Inspect the thrust clearance.
1. Install the bearings.
  2. Install the camshafts (see **INSTALLATION**).



**Fig. 120: Inspecting Camshaft Thrust Clearance**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

**Standard thrust clearance:**

**STANDARD THRUST CLEARANCE**

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

**Maximum thrust clearance:**

**MAXIMUM THRUST CLEARANCE**

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

If the thrust clearance is greater than the 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)**

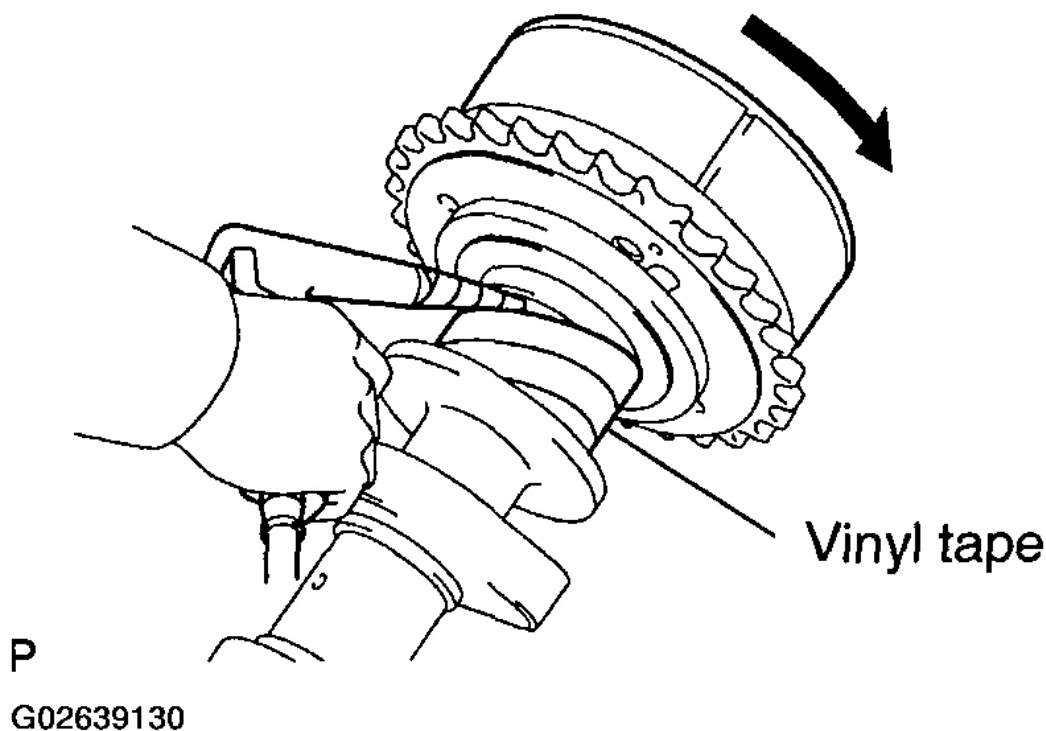
- a. Apply vinyl tape to all the ports except the one.
- b. Install the VVT timing sprocket.

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

**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. 100kPa (1 kgf/cm<sup>2</sup>, 14 psi) to the port of the camshaft.

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



**Fig. 121: Inspecting Thrust Clearance**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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### 2005 ENGINE Engine Mechanical - RAV4

#### HINT:

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 angle side (the arrow marked direction in the illustration) with your hand.

#### **Standard: Must turn**

#### HINT:

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.

#### **Standard: Moves smoothly in the range about 30°**

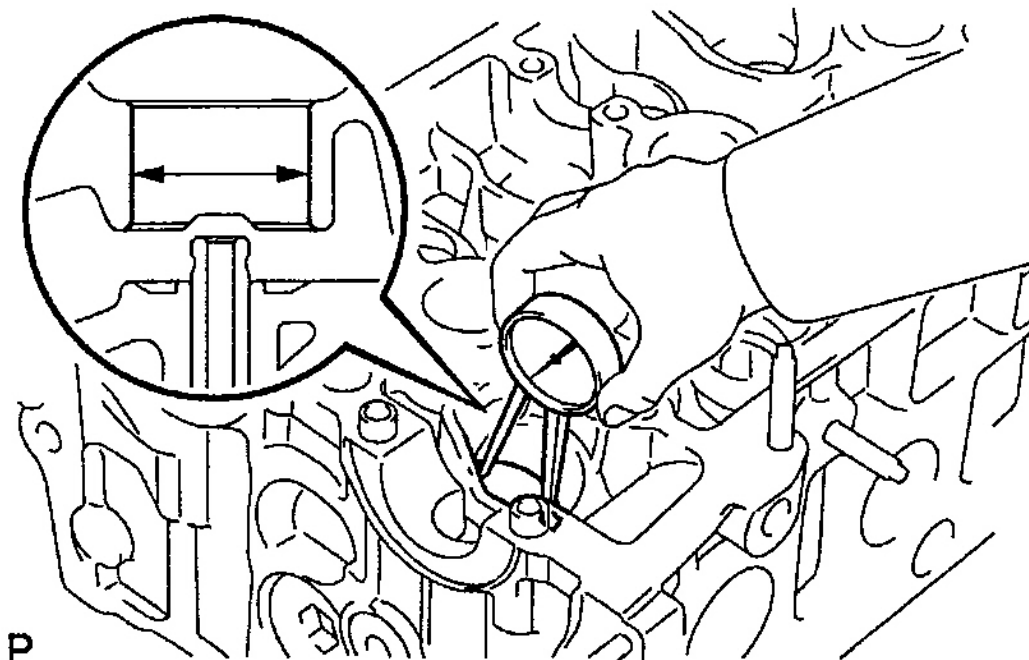
- g. Turn the VVT timing sprocket with your hand and lock it at the maximum delay angel position.

## 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 to 31.025 mm (1.2208 to 1.2215 in.)**



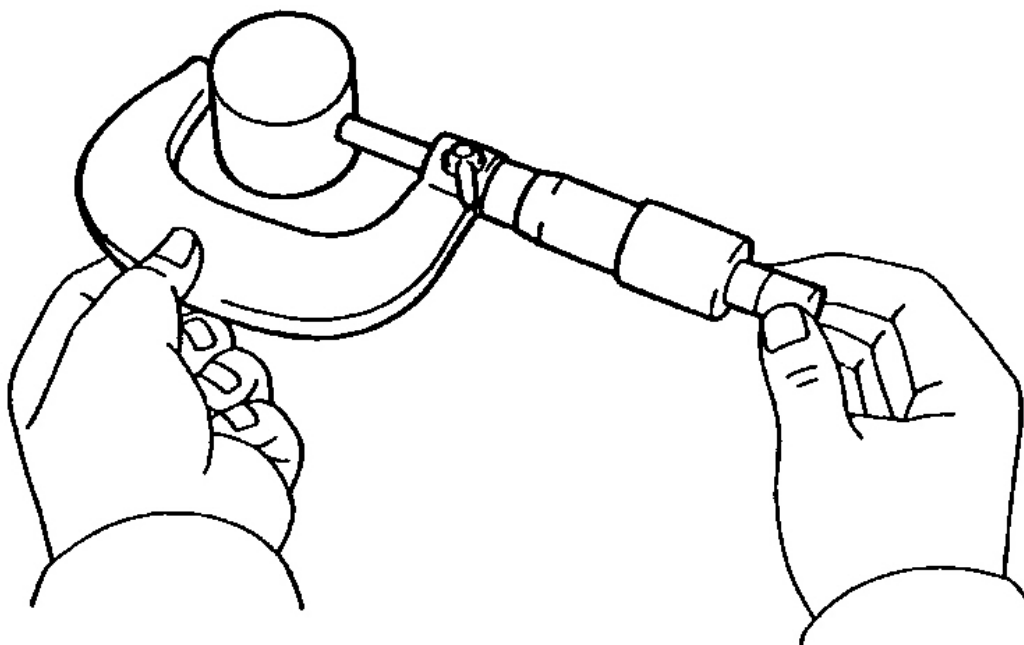
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**Fig. 122: Inspecting Lifter Bore Diameter Of The Cylinder Head**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using a micrometer, measure the lifter diameter.

**Lifter diameter:**

**30.966 to 30.976 mm (1.2191 to 1.2195 in.)**



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**Fig. 123: Inspecting 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 to 0.059 mm (0.0013 to 0.0023 in.)**

**Maximum oil clearance: 0.079 mm (0.0031 in.)**

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

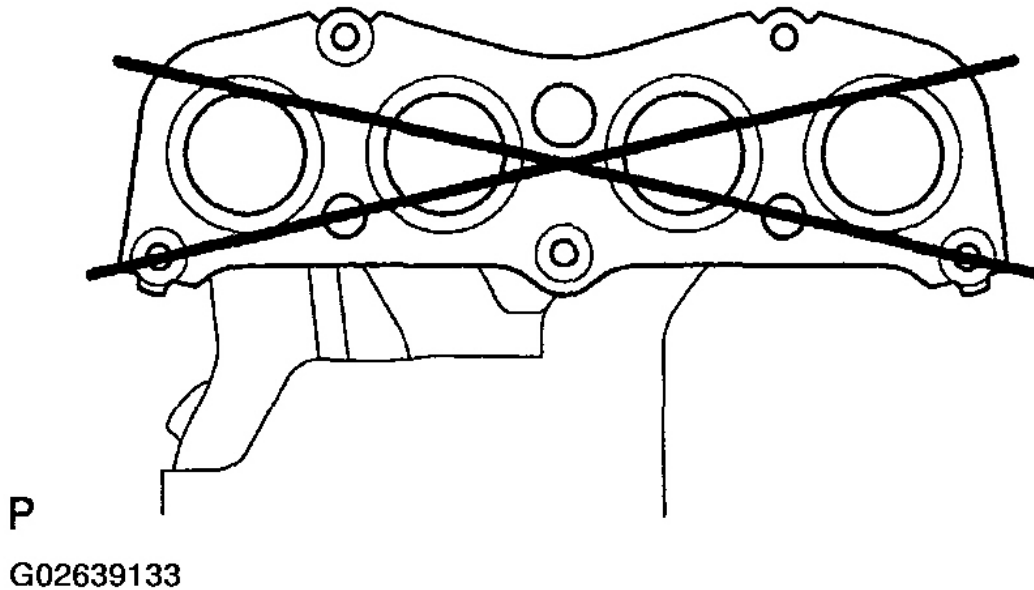
### 13. INSPECT EXHAUST MANIFOLD

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

**Maximum warpage: 0.7 mm (0.0275 in.)**



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



**Fig. 124: Inspect Exhaust Manifold Flange For Warpage**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

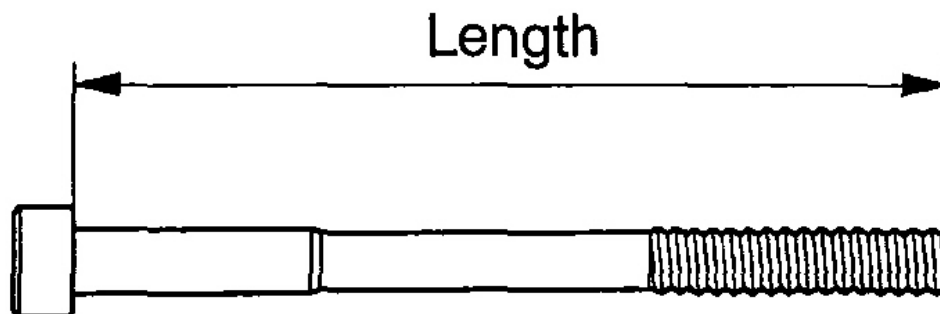
#### 14. INSPECT CYLINDER HEAD BOLTS

**Standard length:**

**161.3 the 162.7 mm (6.350 the 6.405 in.)**

**Maximum length: 164.2 mm (6.4646 in.)**

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



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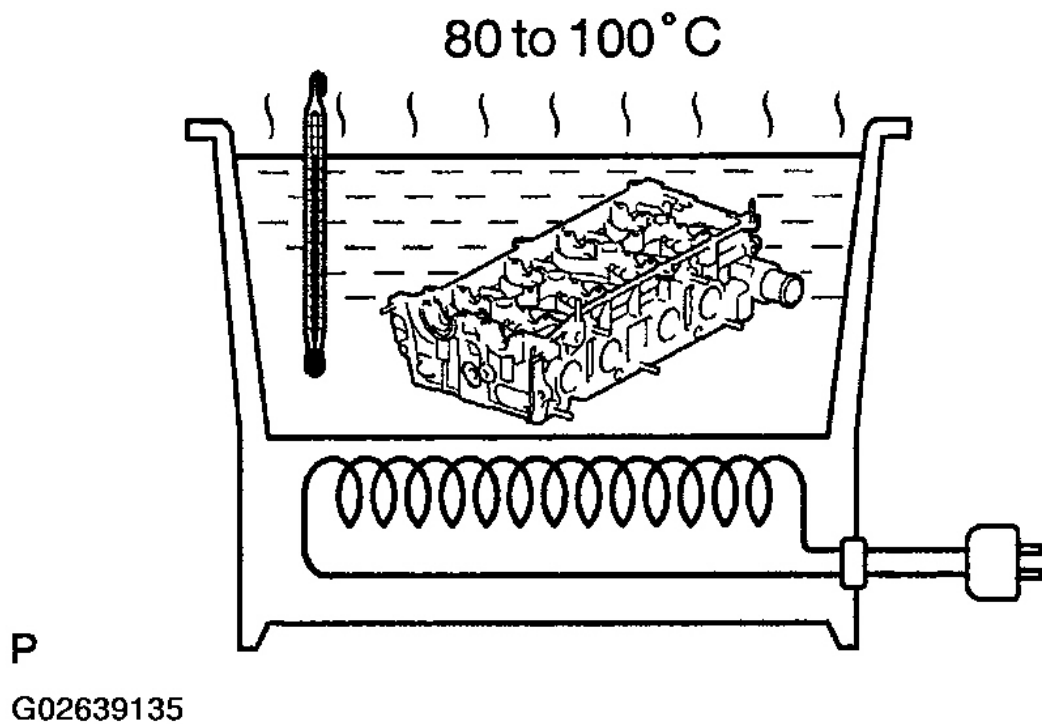
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**Fig. 125: Inspecting Cylinder Head Bolts Length**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## **REPLACEMENT**

### **REPLACE VALVE GUIDE BUSHINGS**

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

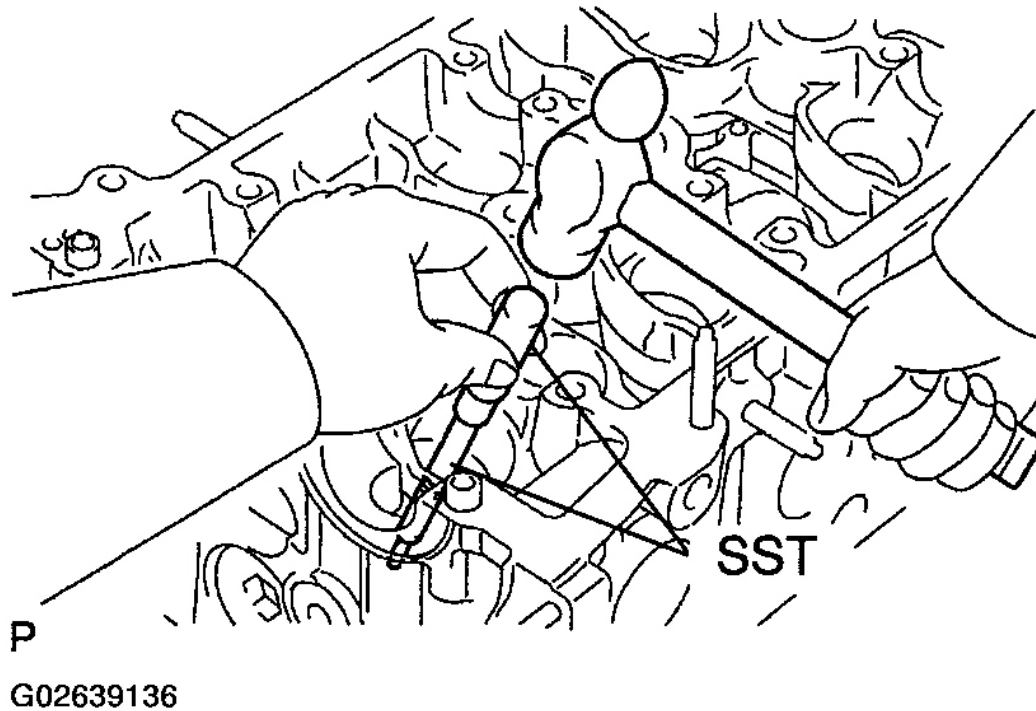


**Fig. 126: Heating Cylinder Head**

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

- b. Using SST and a hammer, tap out the guide bushing.

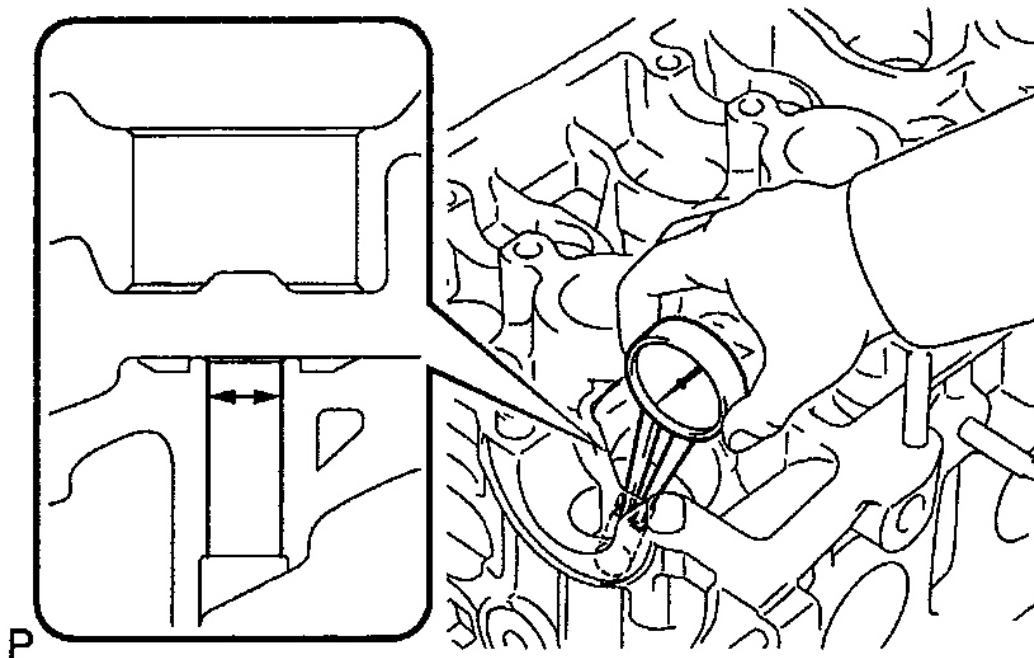
SST 09201-01055, 09950-70010 (09951-07100)



**Fig. 127: Taping Out Guide Bushing Using SST And Hammer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

**Diameter: 10.285 to 10.306 mm (0.4049 to 0.4057 in.)**



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**Fig. 128: Measuring Bushing Bore Diameter Of Cylinder Head Using Caliper Gauge**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Install the standard bushing if the diameter is within specified diameter.

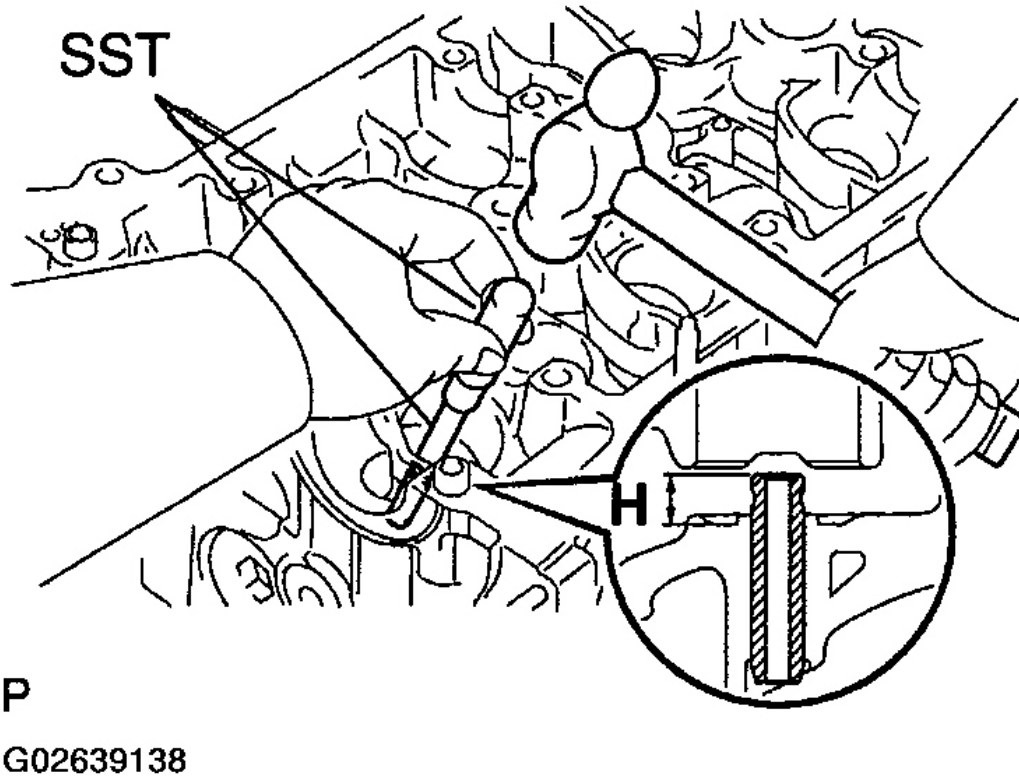
**Standard: 10.333 to 10.344 mm (0.4068 to 0.4072 in.)**

- e. Gradually heat the cylinder head to 80 to 100°C (176 to 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)

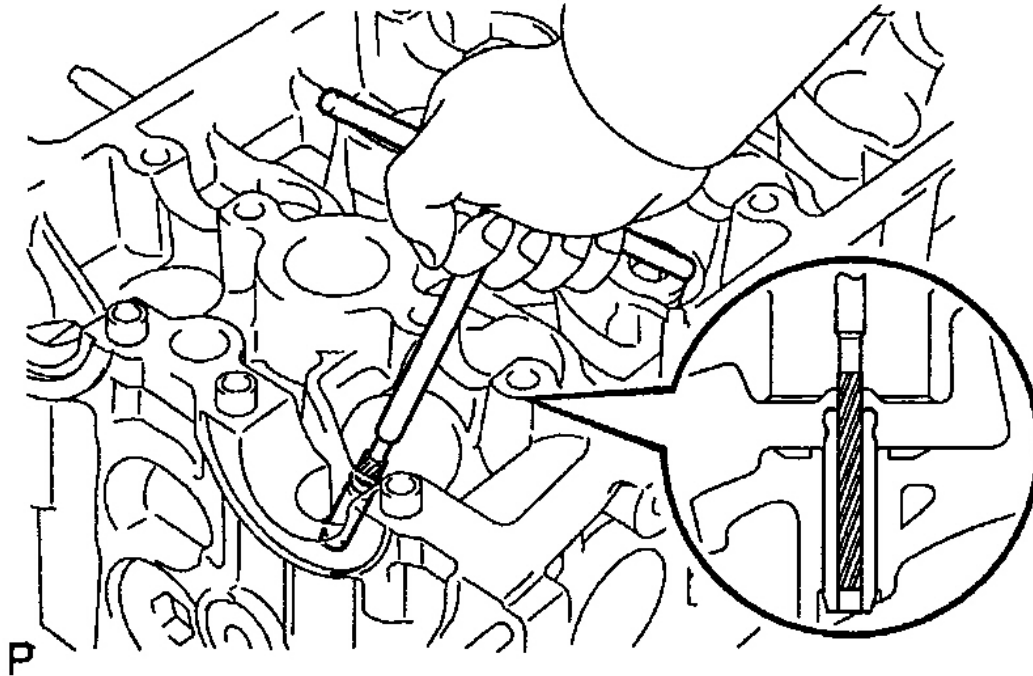
**Protrusion height (H):**

**9.6 to 10.0 mm (0.380 to 0.394 in.)**



**Fig. 129: Taping In Guide Bushing Using SST And Hammer**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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. 130: Reaming Guide Bushing**

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

## **REASSEMBLY**

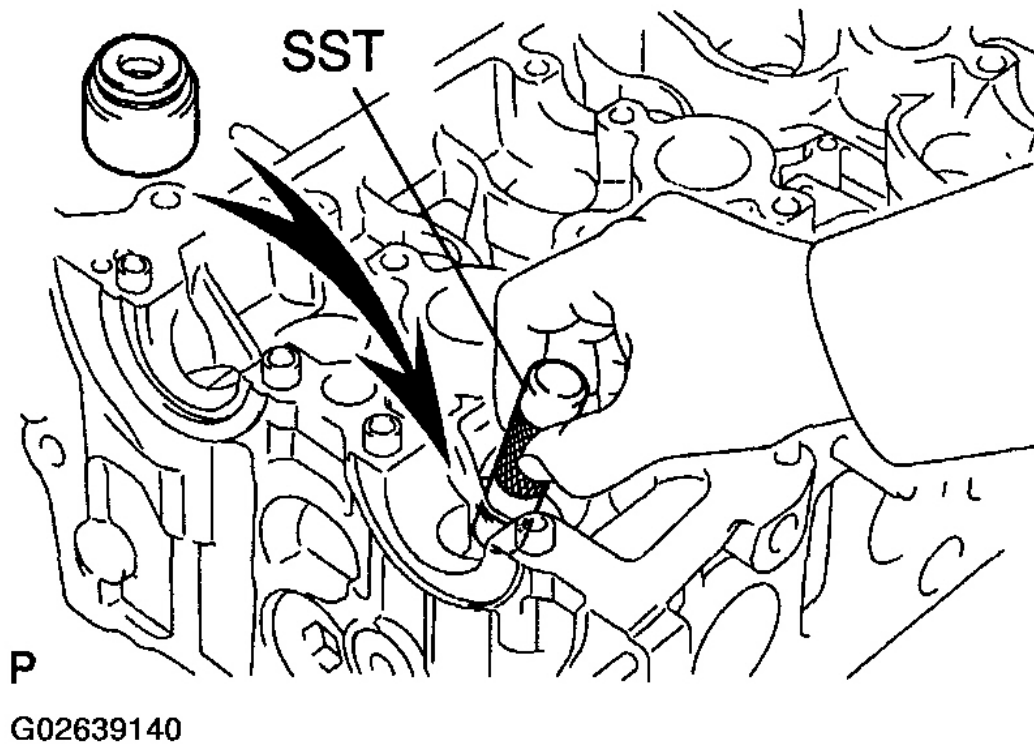
### **HINT:**

- 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



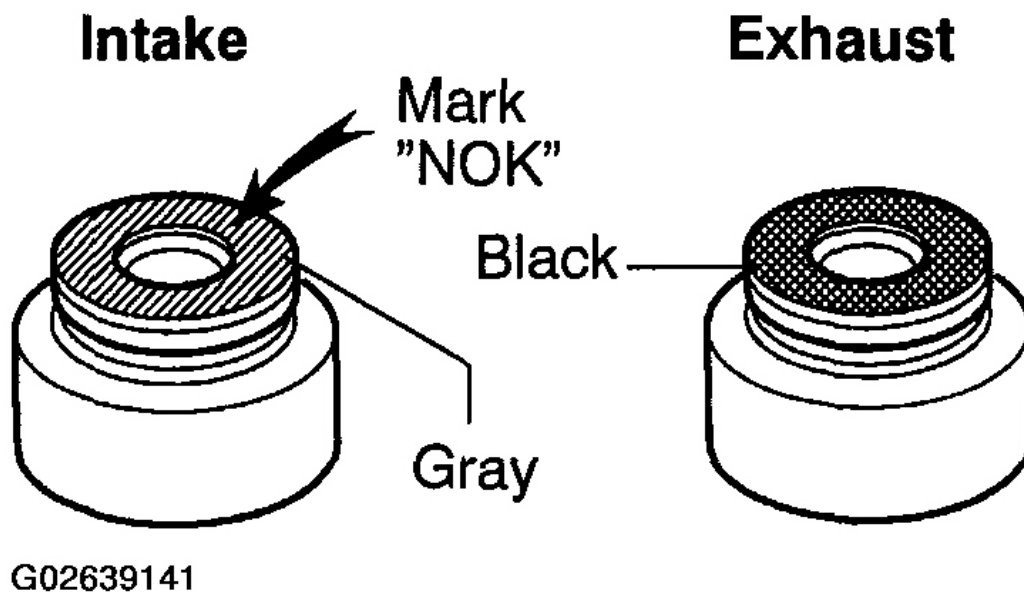
**Fig. 131: Installing Guide Bushing Oil Seal**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**HINT:**

The intake valve oil seal is gray and the exhaust valve oil seal is black.

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

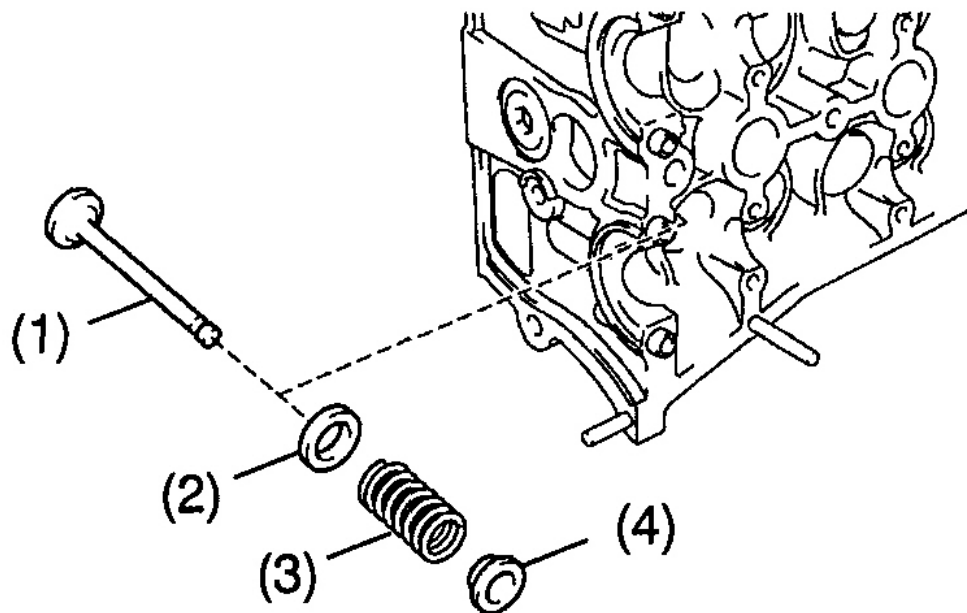




**Fig. 132: Identifying Guide Bushing Oil Seals**

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

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



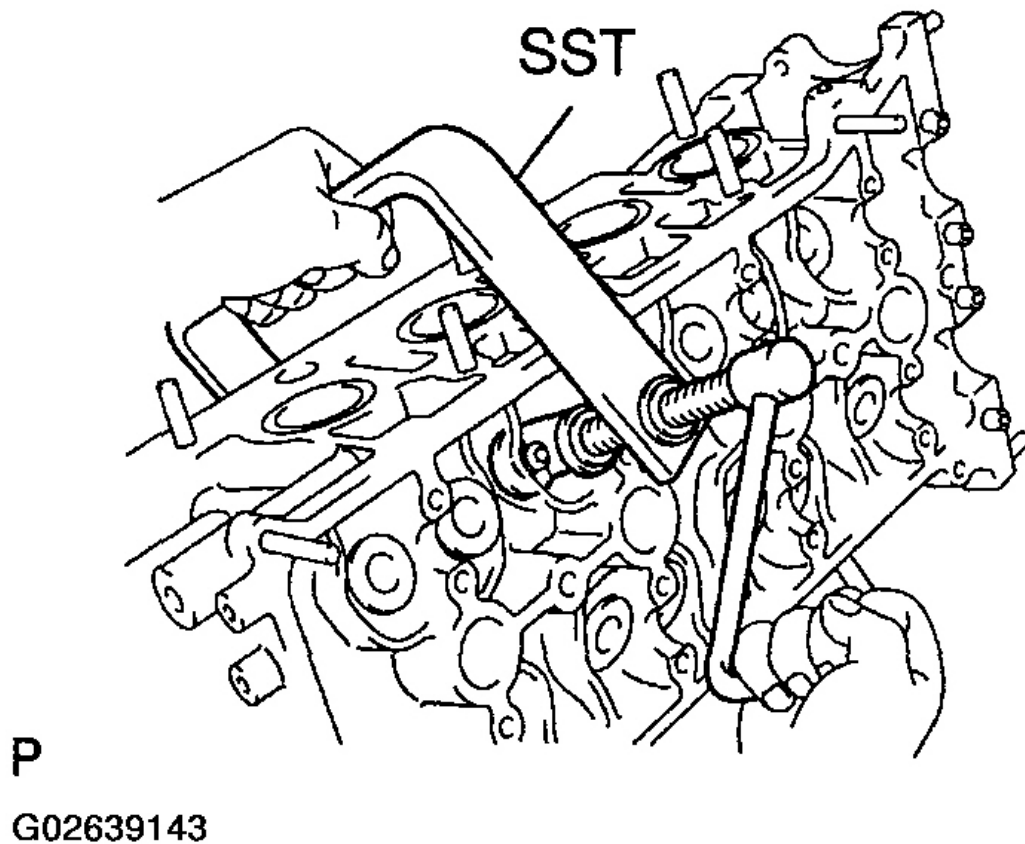
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**Fig. 133: Identifying Valve & Related Components**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Using SST, compress the valve spring and place the 2 keepers around the valve stem.

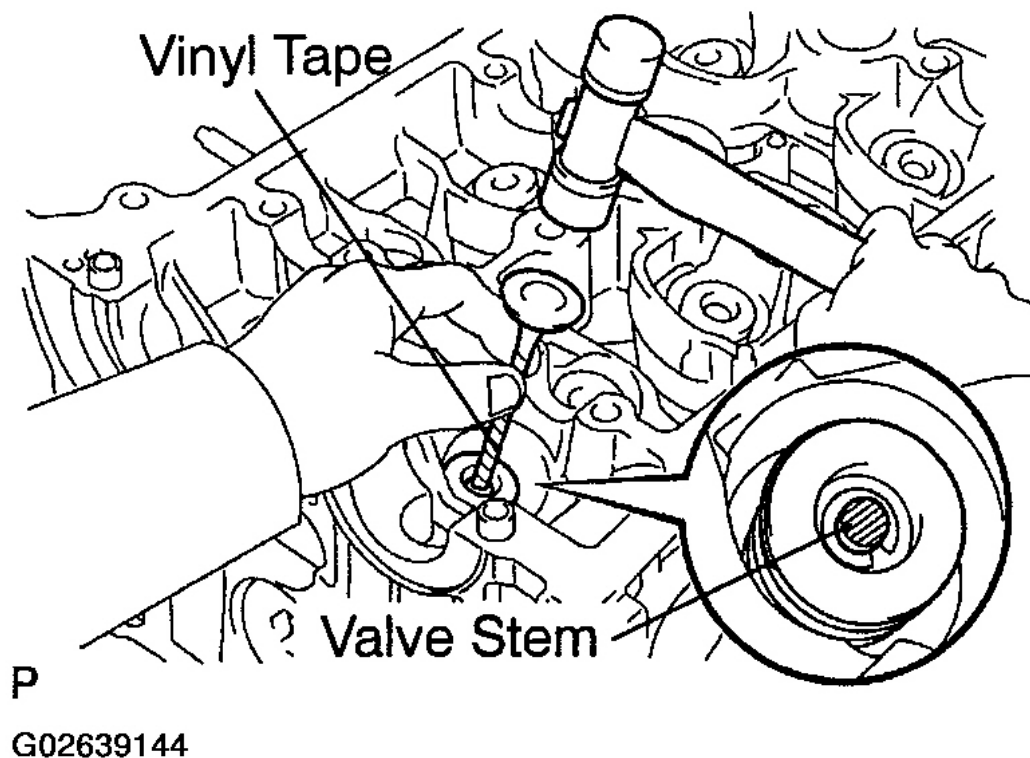
SST 09202-00020, 09202-70020



**Fig. 134: Installing Spring Seat, Spring, Spring Retainer And Keepers**  
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.

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



**Fig. 135: Seat Keeper By Lightly Tapping Valve Stem Tip**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**2. INSTALL VALVE LIFTERS**

- a. Install the valve lifter.
- b. Check that the valve lifter rotates smoothly by hand.

**3. INSTALL CAMSHAFT POSITION SENSOR**

Install the camshaft position sensor with the bolt. See **Fig. 136**.

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

**4. INSTALL ECT SENSOR**

Install a new gasket and the ECT sensor. See **Fig. 136**.

**Torque: 20 N.m (204 kgf.cm, 15 ft.lbf)**

**5. INSTALL OIL PRESSURE SWITCH**

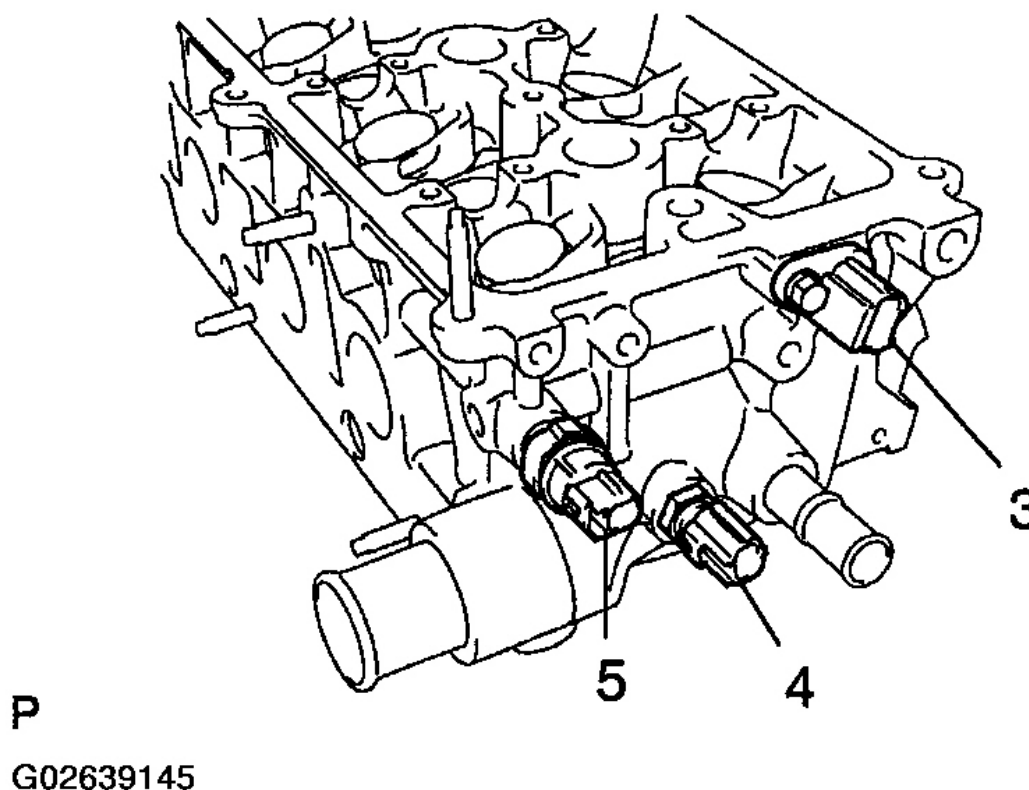
- a. Apply adhesive to 2 or 3 threads of the oil pressure switch. See **Fig. 136**.

**Adhesive:**

**Part No.08833-00080, THREE BOND 1344, LOCTITE 242 or equivalent.**

- b. Install the oil pressure switch.

**Torque: 13 N.m (133 kgf.cm, 10 ft.lbf)**



**Fig. 136: Installing Camshaft Position Sensor, ECT Sensor & Oil Pressure Switch**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**INSTALLATION**

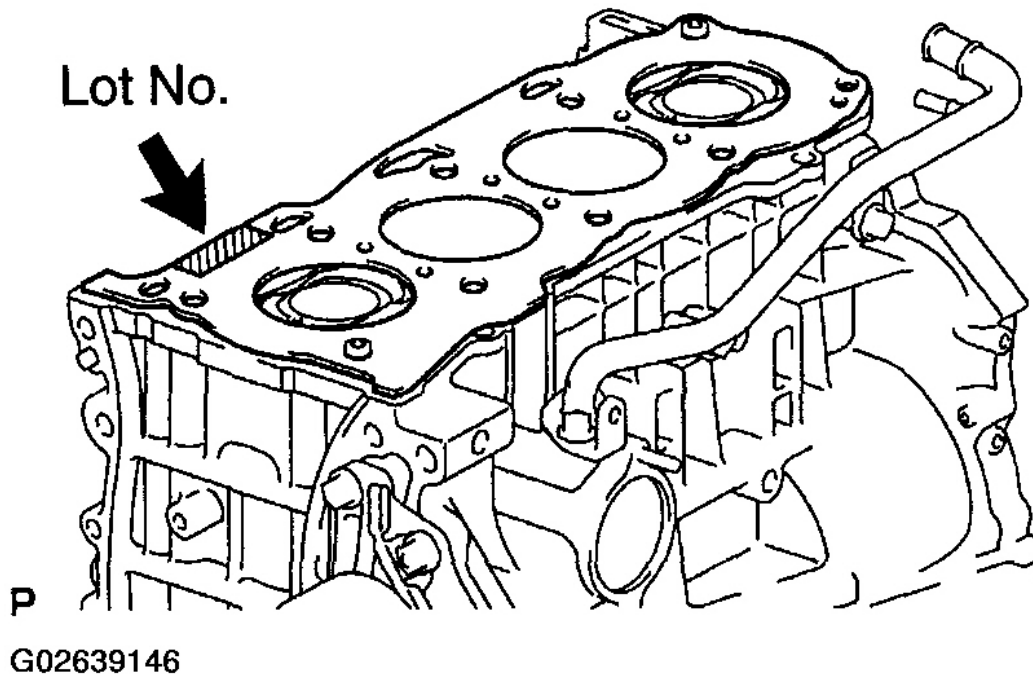
**HINT:**

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



**Fig. 137: Installing Cylinder Head Gasket On Block**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**NOTE:** Be careful of the installation direction.

- b. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the head.
- c. Install the cylinder head bolts.

**HINT:**

- 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 heads of the cylinder head bolts.
  2. Using a 10 mm bi-hexagon wrench, install and uniformly tighten the 10 cylinder head bolts and plate washers in several passes, in the sequence shown.

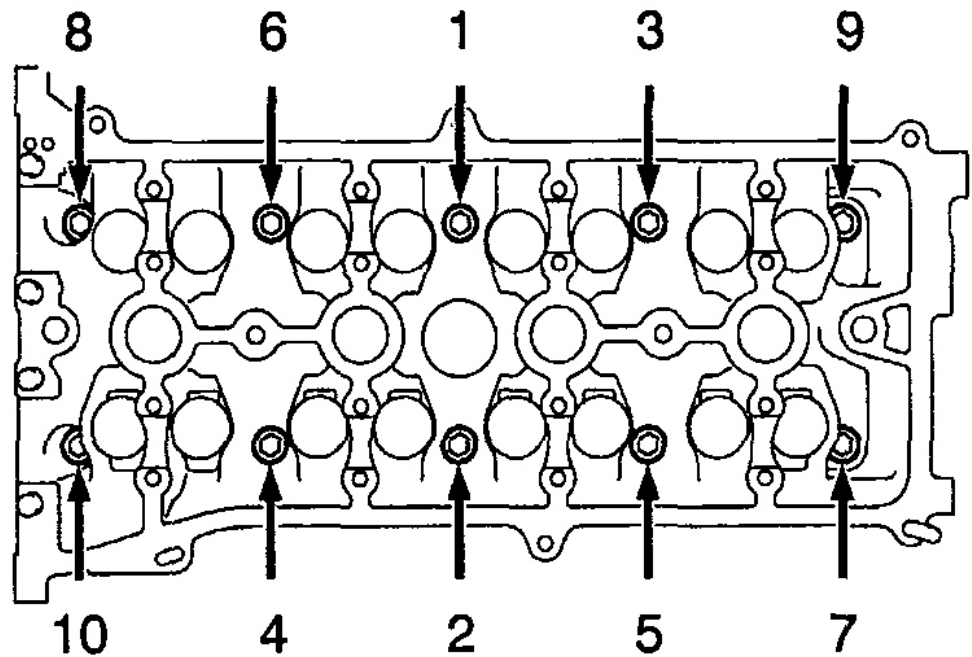
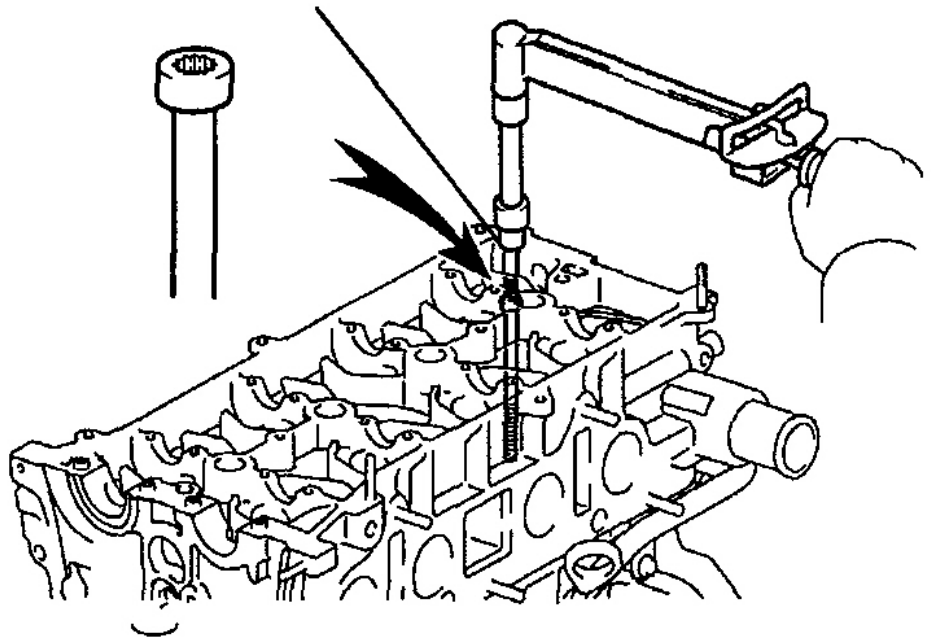
## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4

**Torque: 79 N.m (806 kgf.cm, 58 ft.lbf)**

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

## 10 mm Bi-hexagon Wrench



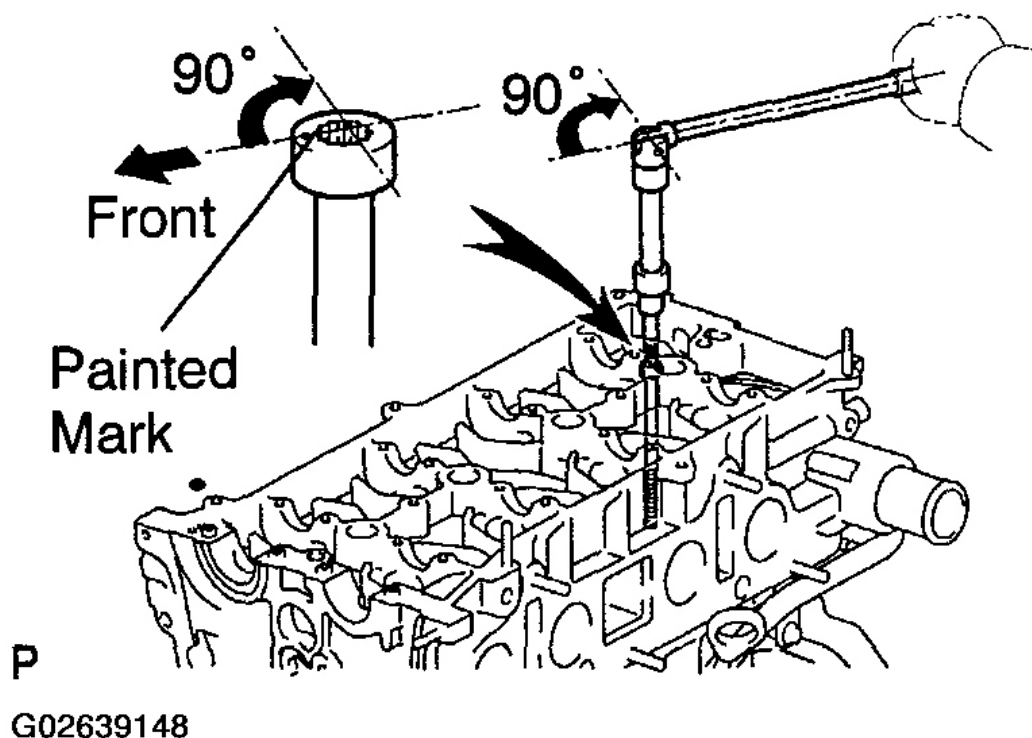
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**Fig. 138: Tightening Cylinder Head Bolts In Sequence Shown**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

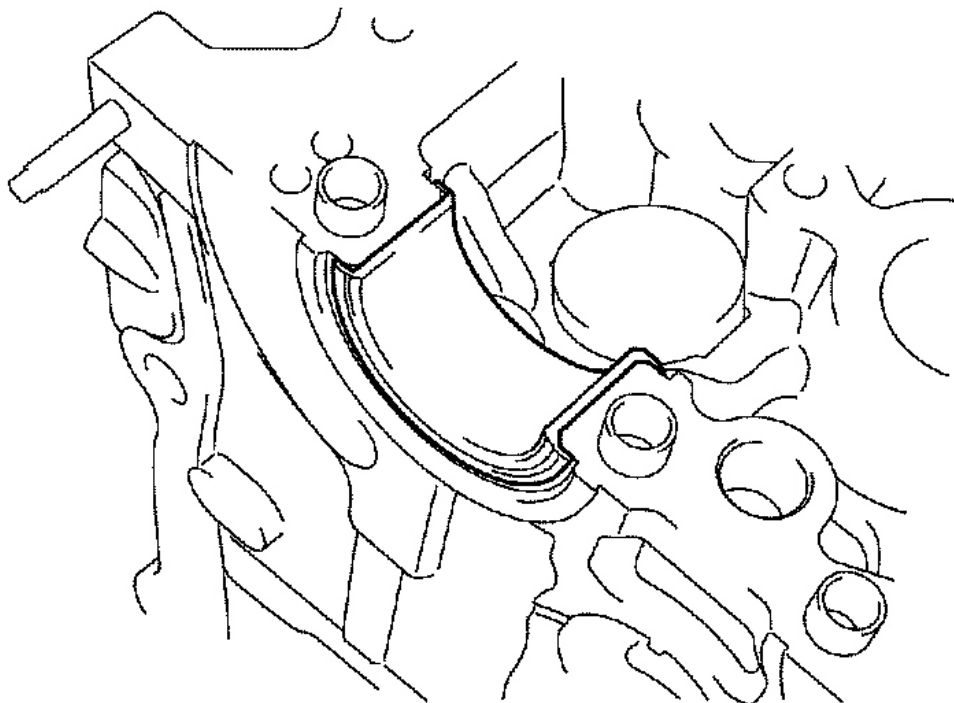
3. Mark the front of the cylinder head bolt with paint.
4. Retighten the cylinder head bolts 90° in the numerical order shown.
5. Check that the painted mark is now at a 90° angle to the front.



**Fig. 139: Retightening Cylinder Head Bolts An Additional 90°**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2. INSTALL CAMSHAFTS

- a. Install the lower camshaft bearing to the cylinder head.

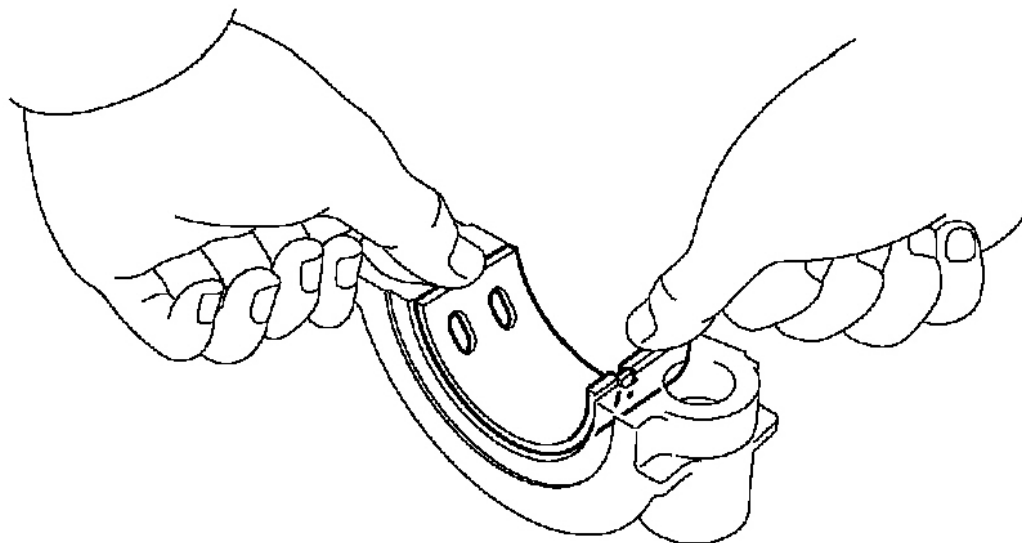


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**Fig. 140: Installing Lower Camshaft Bearing To Cylinder Head**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

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

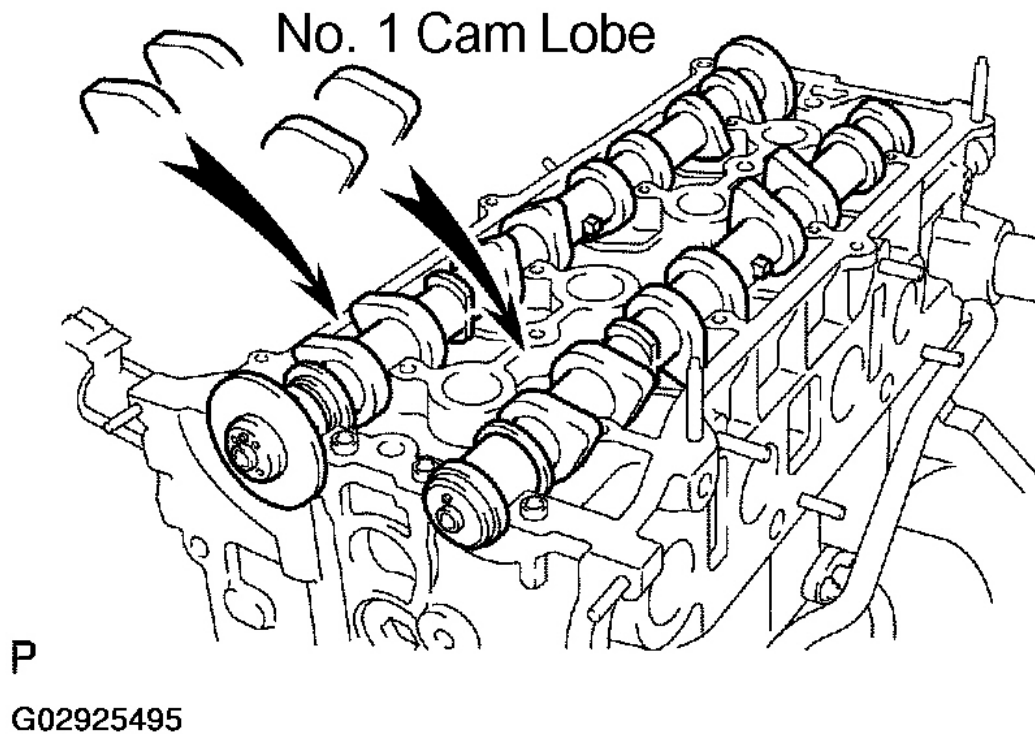


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**Fig. 141: Aligning Bearing Claw With The Claw Groove Of No. 1 Bearing Cap**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Place the 2 camshafts on the cylinder head with the No. 1 cam lobes facing as shown, see **Fig. 142** .

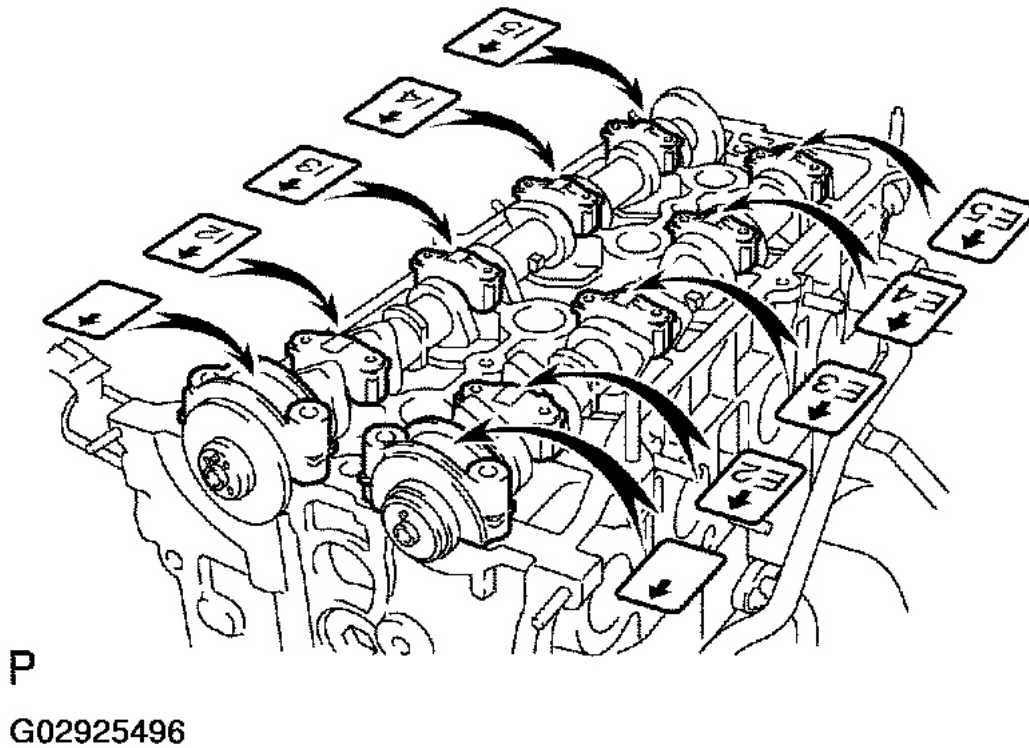


**Fig. 142: Placing Camshafts On Cylinder Head With No. 1 Cam Lobes**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Install the bearing caps in their proper locations.

HINT:

- 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.

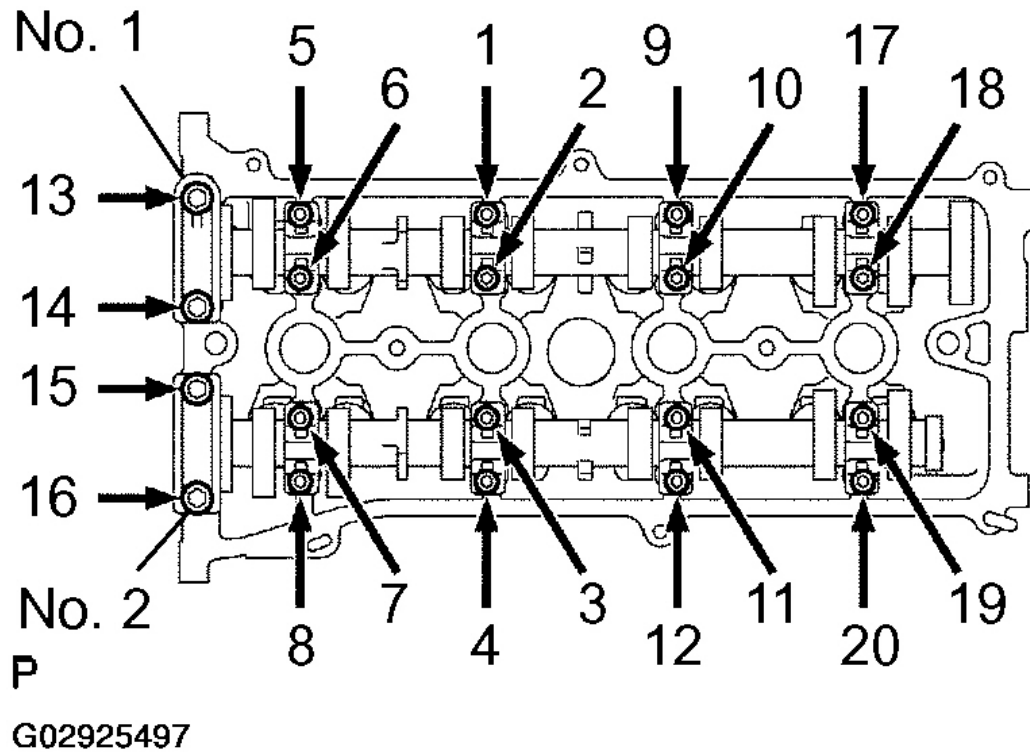


**Fig. 143: Installing Bearing Caps In Their Proper Locations**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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, see **Fig. 144**.

**Torque:**

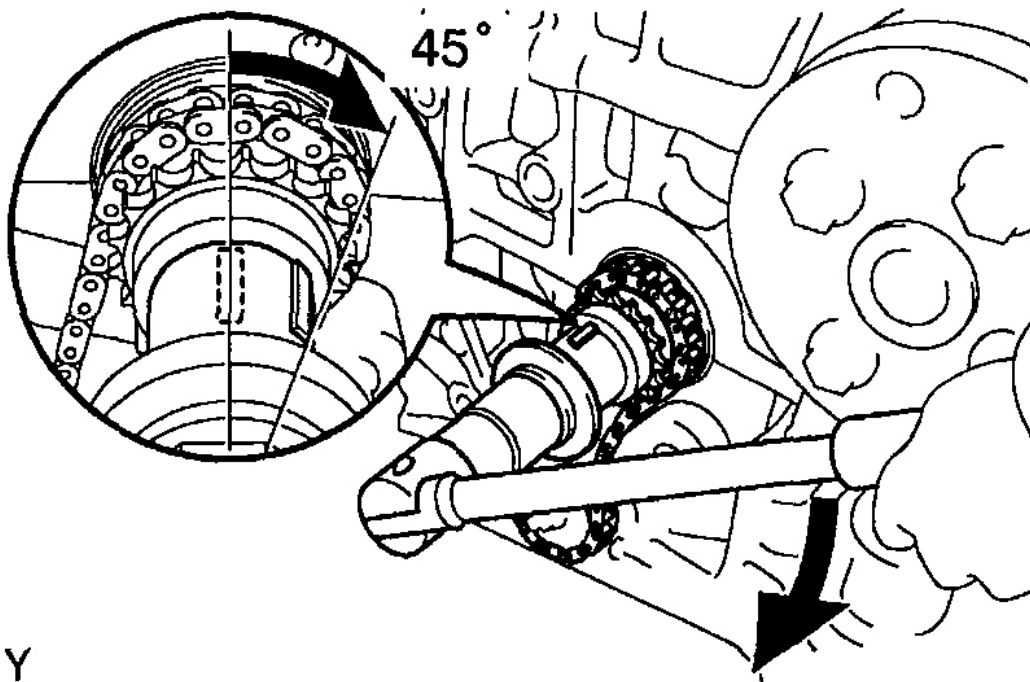
**29.5 N.m (301 kgf.cm, 22 ft.lbf) for No. 1 and No. 2**  
**9.0 N.m (92 kgf.cm, 80 in.lbf) for others**



**Fig. 144: Tightening Bearing Cap Bolts In Sequence**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. **CHECK AND ADJUST VALVE CLEARANCE** (See VALVE CLEARANCE)

**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. See Fig. 145



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**Fig. 145: Positioning Crankshaft**

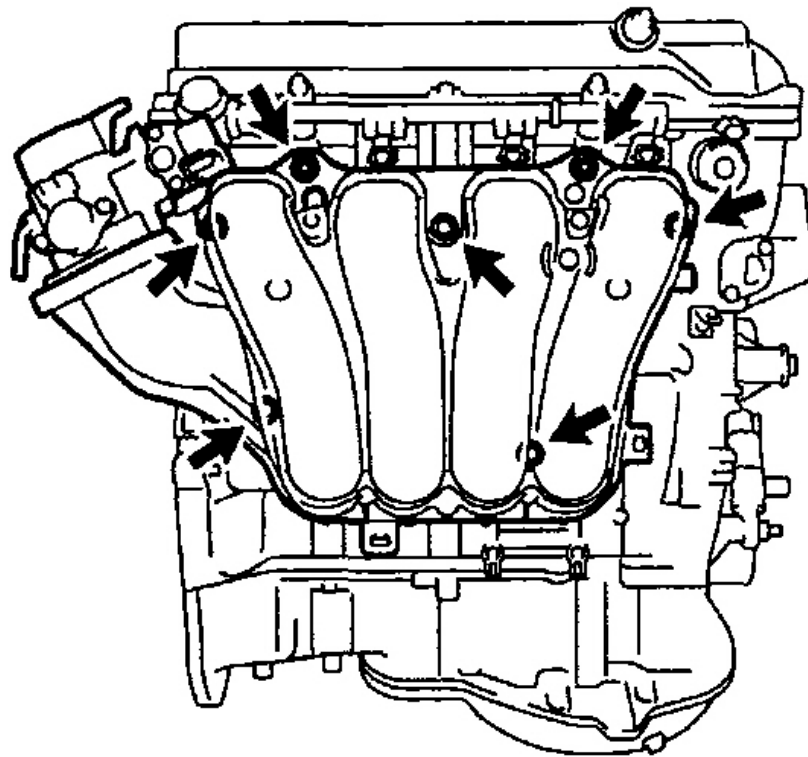
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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 COMPONENTS )**
8. **INSTALL OIL FILLER CAP**
9. **INSTALL INTAKE MANIFOLD AND THROTTLE BODY ASSEMBLY**
  - 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 (306 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 throttle position sensor connector.



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**Fig. 146: Installing Intake Manifold & Throttle Body Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**10. INSTALL PCV VALVE AND HOSES**

- a. Install the PCV valve with the grommet.
- 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 EXHAUST MANIFOLD ASSEMBLY**

- a. Temporary install the No. 1 and No. 2 exhaust manifold stays to the exhaust manifold with the 2 nuts.
- b. Install a new gasket and the exhaust manifold with the 5 nuts.

**Torque: 37 N.m (377 kgf.cm, 27 ft.lbf)**

- c. Install the 2 exhaust manifold stays with the 2 bolts.

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

- d. Tighten the 2 nuts holding the exhaust manifold stays to crank case.

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

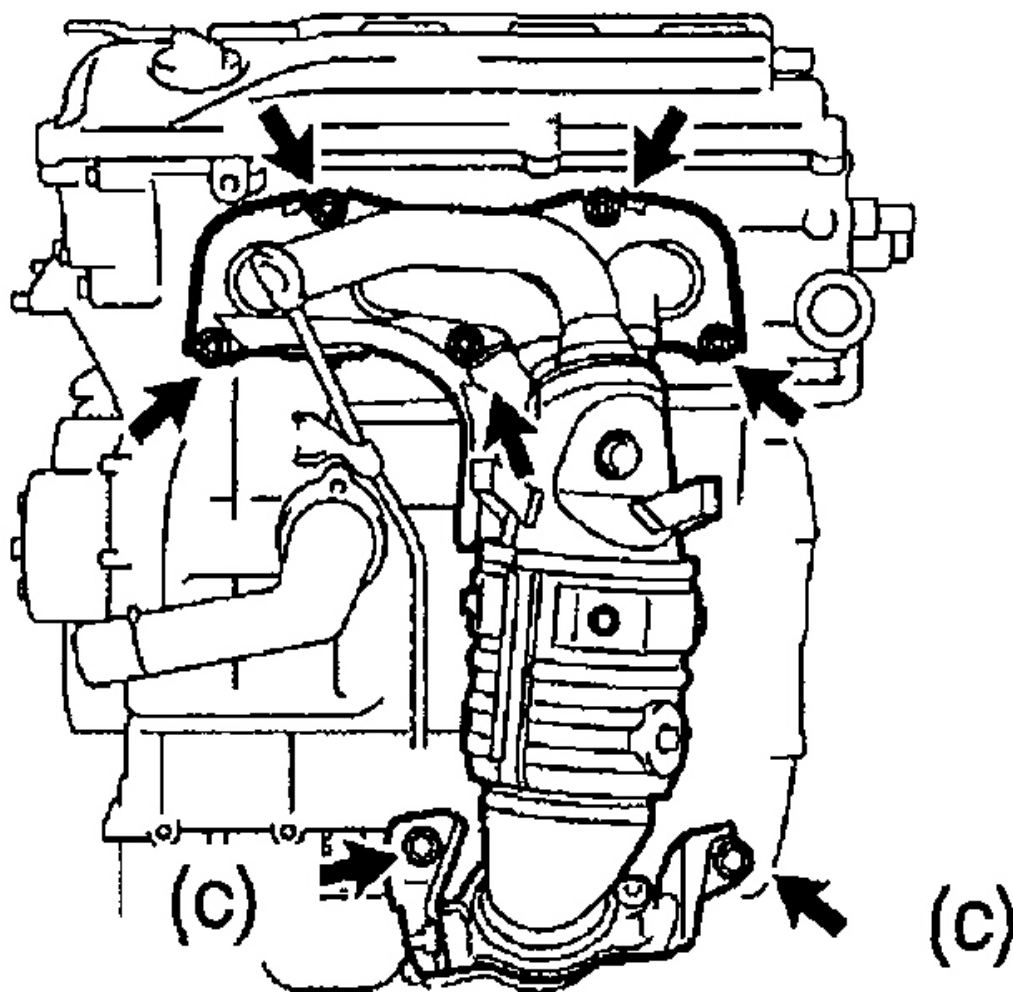
- e. Install the 2 compression springs and 2 bolts holding the exhaust manifold and front exhaust pipe.

**Torque: 43 N.m (439 kgf.cm, 32 ft.lbf)**

- f. Install the exhaust manifold heat insulator No. 1 with the 4 bolts.

**Torque: 12 N.m (122 kgf.cm, 9 ft.lbf)**

- g. Connect the A/F sensor connector.



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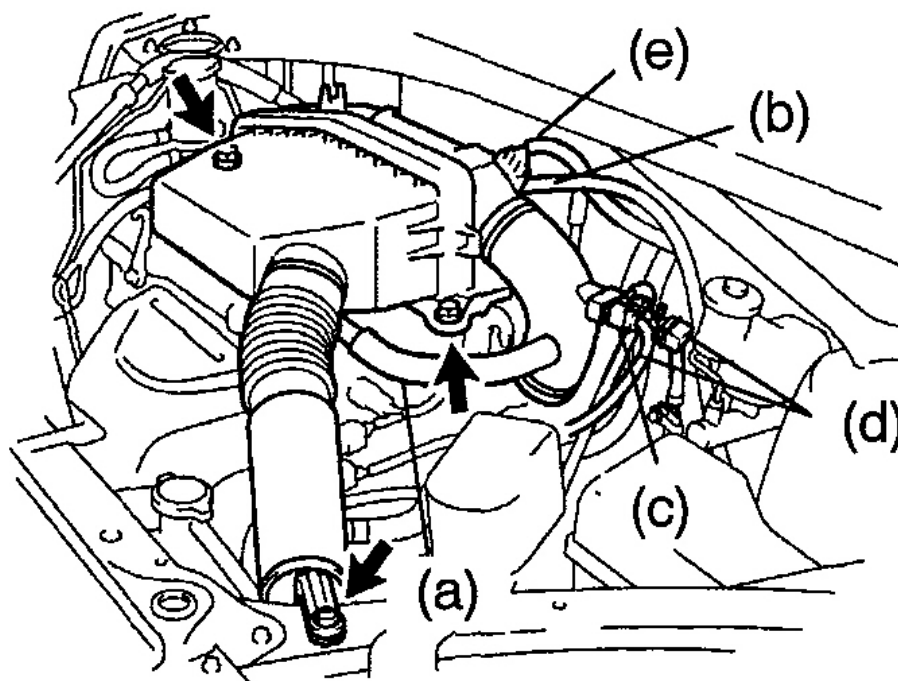
**Fig. 147: Installing Exhaust Manifold**

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

13. INSTALL INJECTORS (See INSTALLATION )
14. INSTALL SPARK PLUGS (See IGNITION SYSTEM )
15. INSTALL IGNITION COILS (See IGNITION COIL )
16. INSTALL PS VANE PUMP (See INSTALLATION )
17. INSTALL GENERATOR (See INSTALLATION )
18. INSTALL DRIVE BELT (See INSTALLATION )

**19. INSTALL AIR CLEANER ASSEMBLY**

- 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.

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**Fig. 148: Installing Air Cleaner Assembly**

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

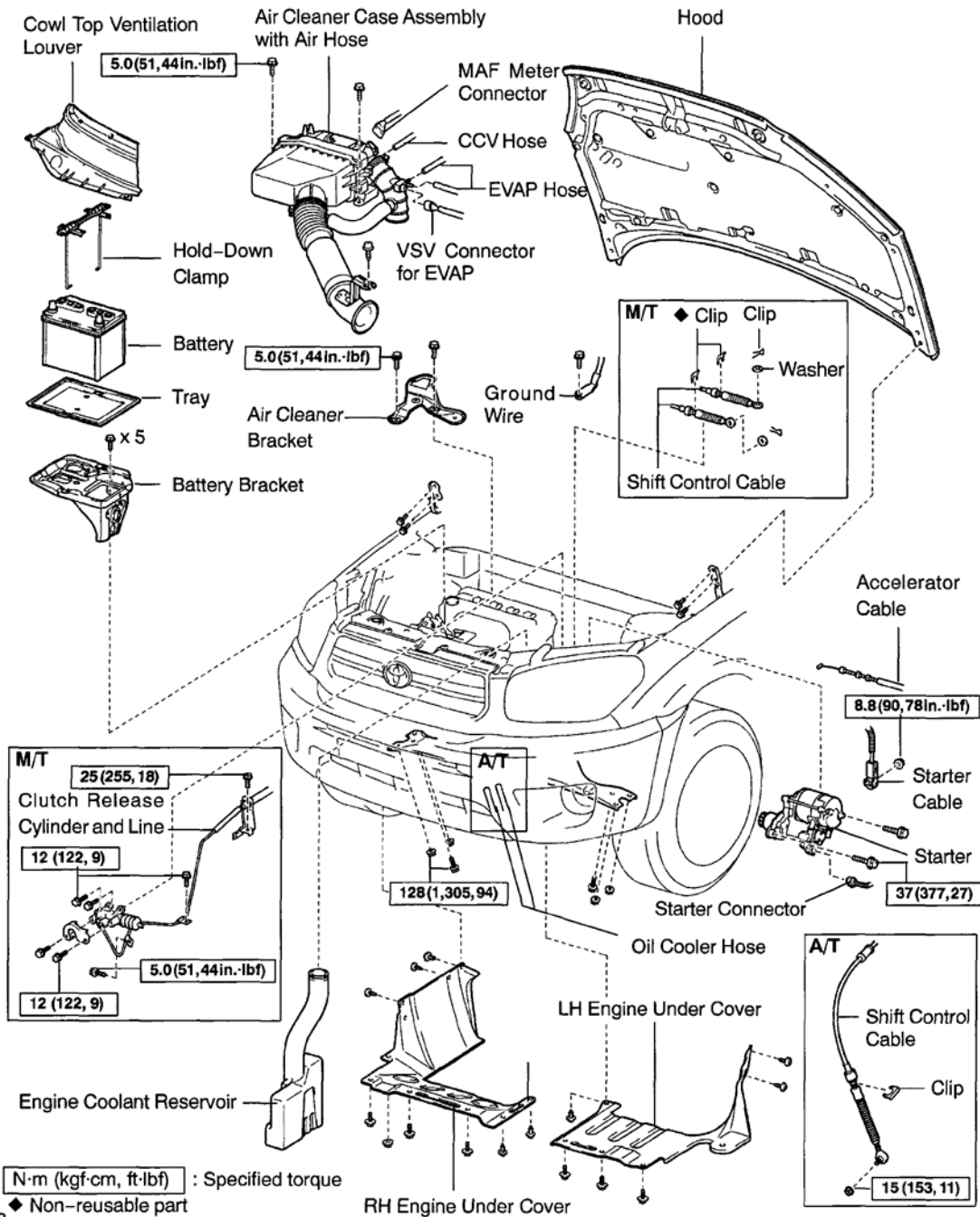
20. **FILL WITH ENGINE OIL** (See **REPLACEMENT** )
21. **FILL WITH ENGINE COOLANT**
22. **START ENGINE AND CHECK FOR LEAK**
23. **RECHECK ENGINE OIL AND COOLANT LEVEL**
24. **INSTALL RH ENGINE UNDER COVER**

**ENGINE UNIT**

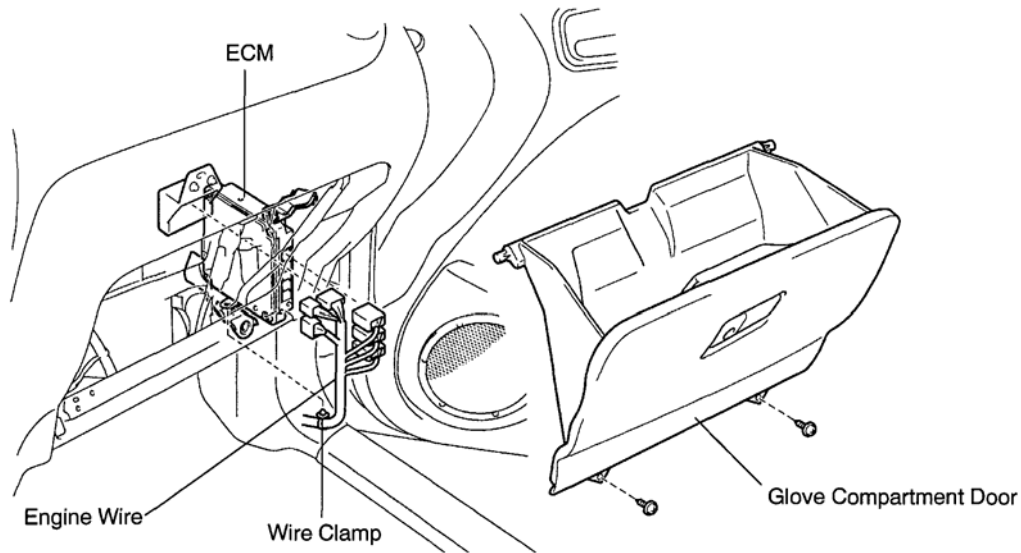
# 2005 Toyota RAV4

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## COMPONENTS



**Fig. 149: Identifying Engine Unit Components & Torque Specifications (1 of 6)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

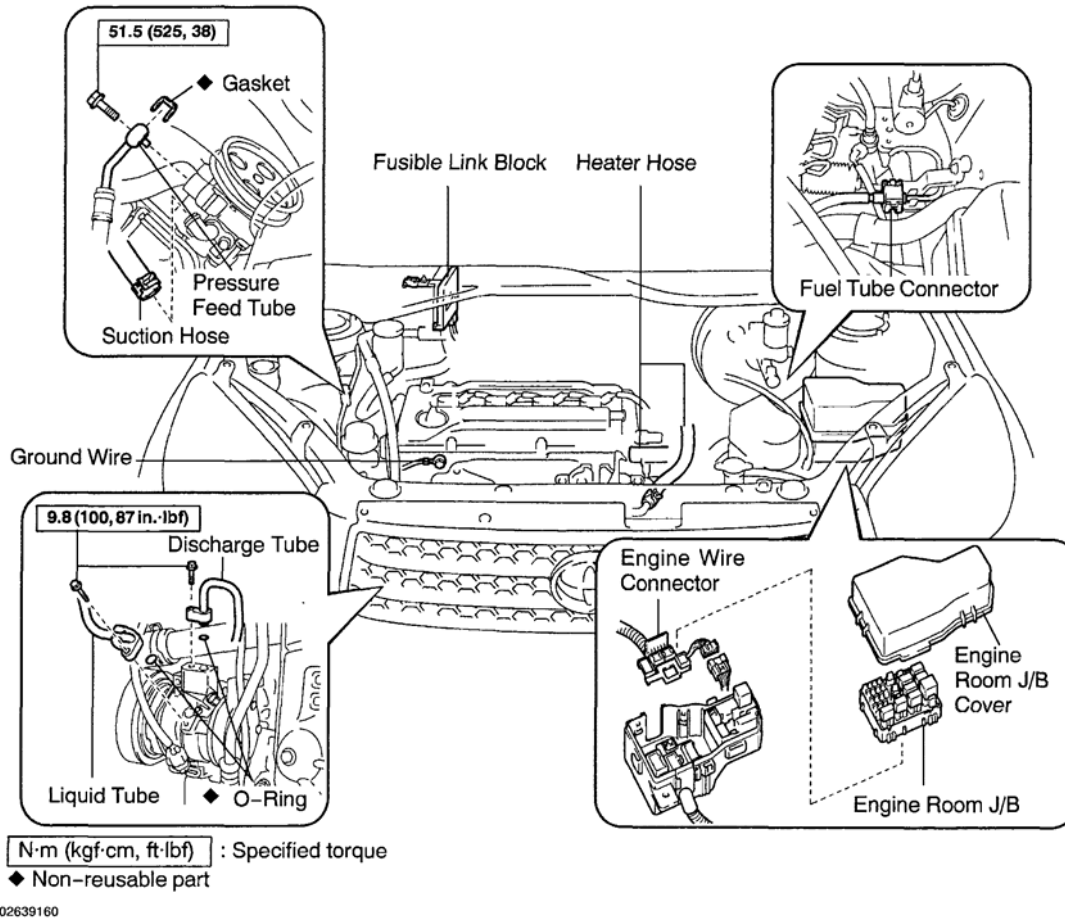


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**Fig. 150: Identifying Engine Unit Components (2 of 6)**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

## 2005 Toyota RAV4

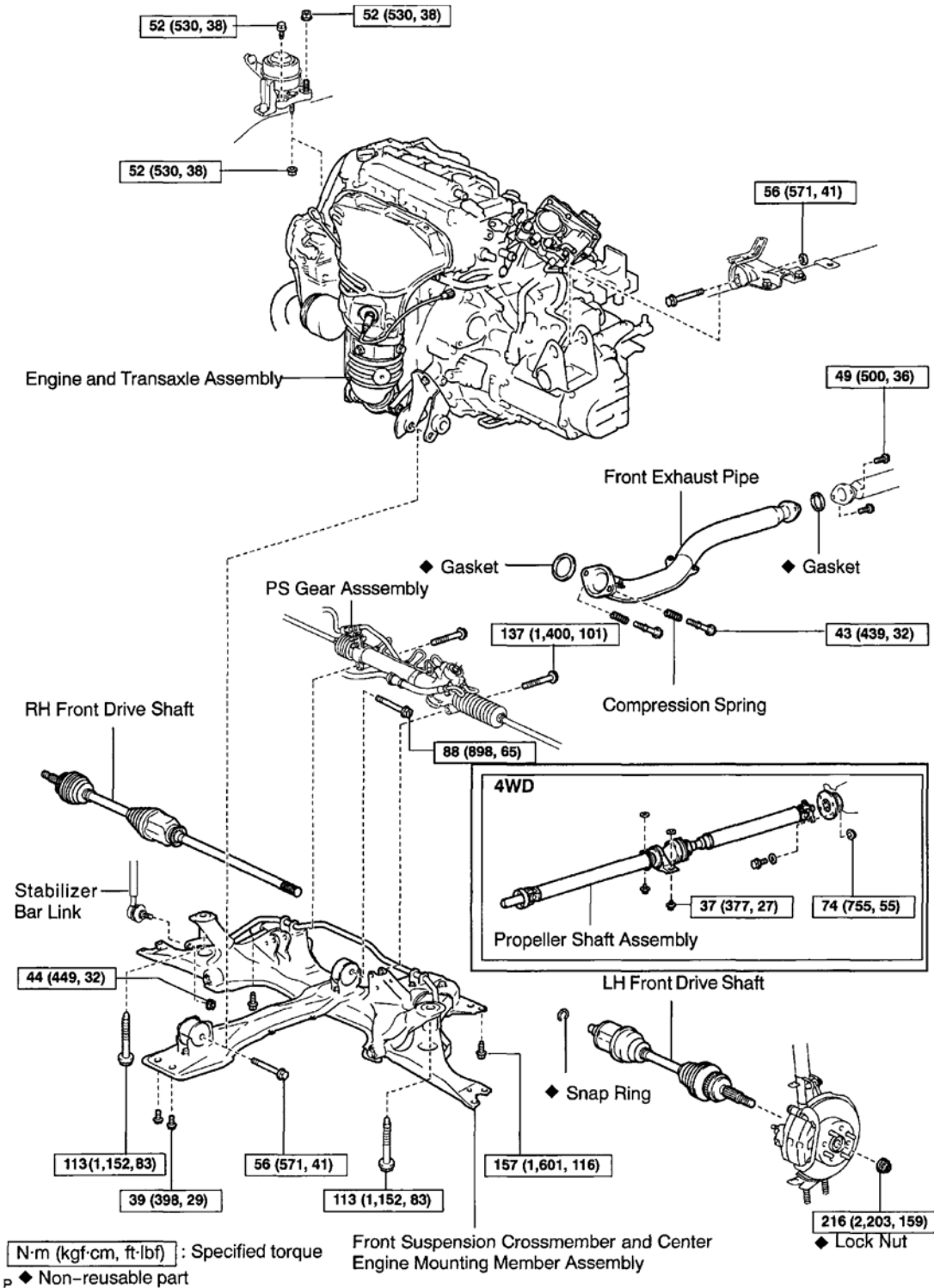
### 2005 ENGINE Engine Mechanical - RAV4



**Fig. 151: Identifying Engine Unit Components & Torque Specifications (3 of 6)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4



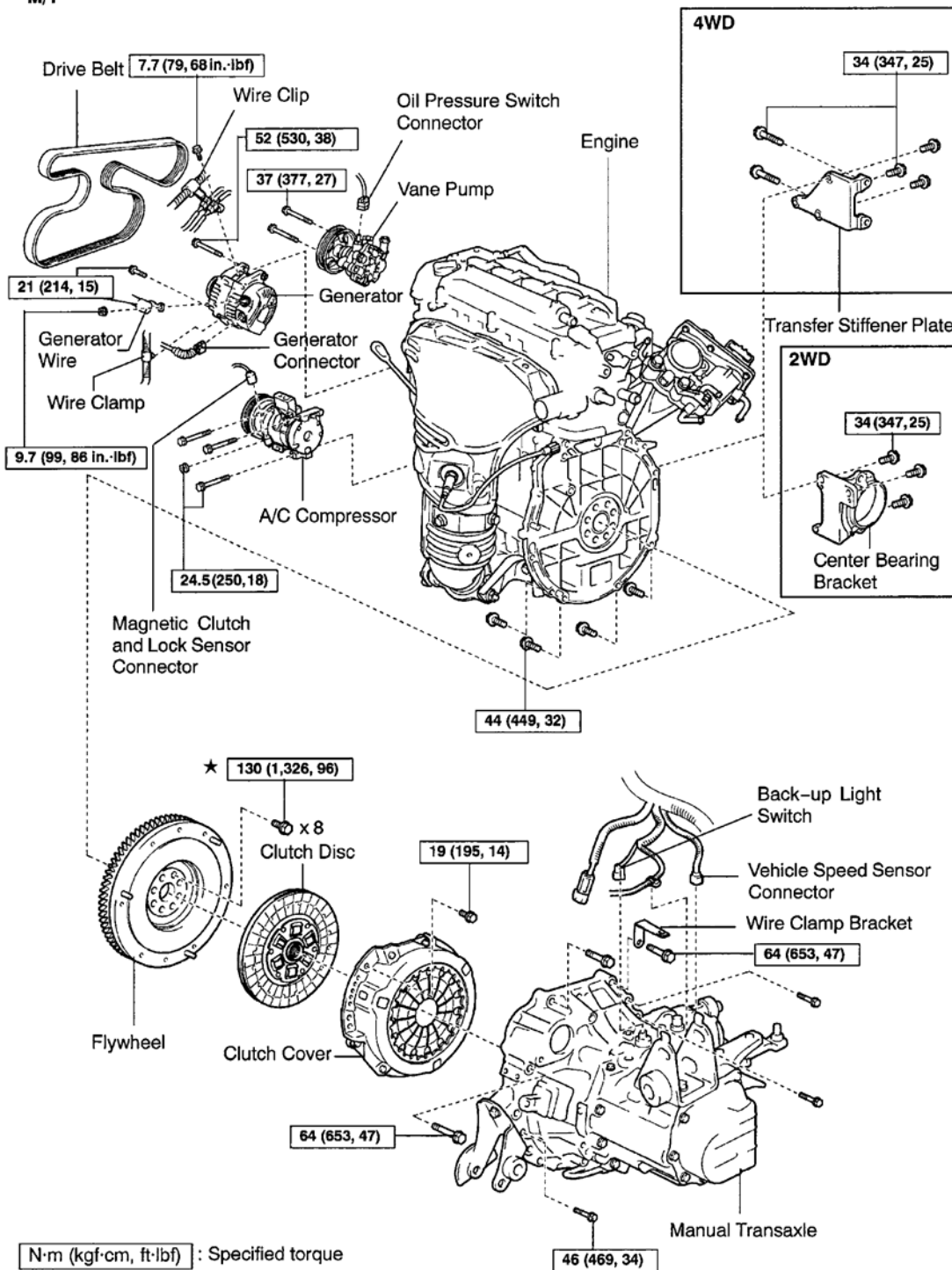
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**Fig. 152: Identifying Engine Unit Components & Torque Specifications (4 of 6)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

# 2005 Toyota RAV4

## 2005 ENGINE Engine Mechanical - RAV4

M/T



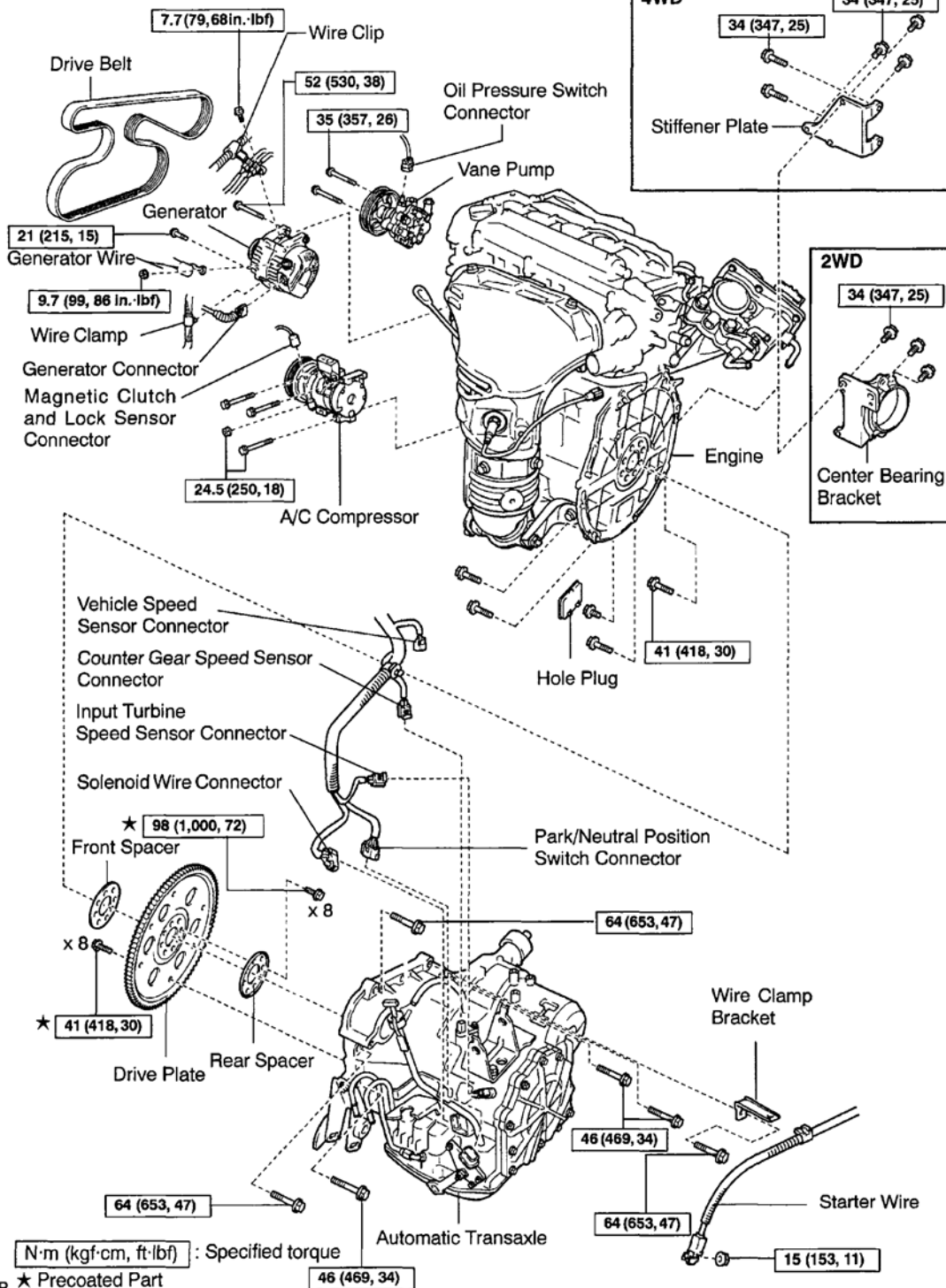
**Fig. 153: Identifying Engine Unit Components & Torque Specifications (5 of 6)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.



# 2005 Toyota RAV4

## 2005 ENGINE Engine Mechanical - RAV4

A/T

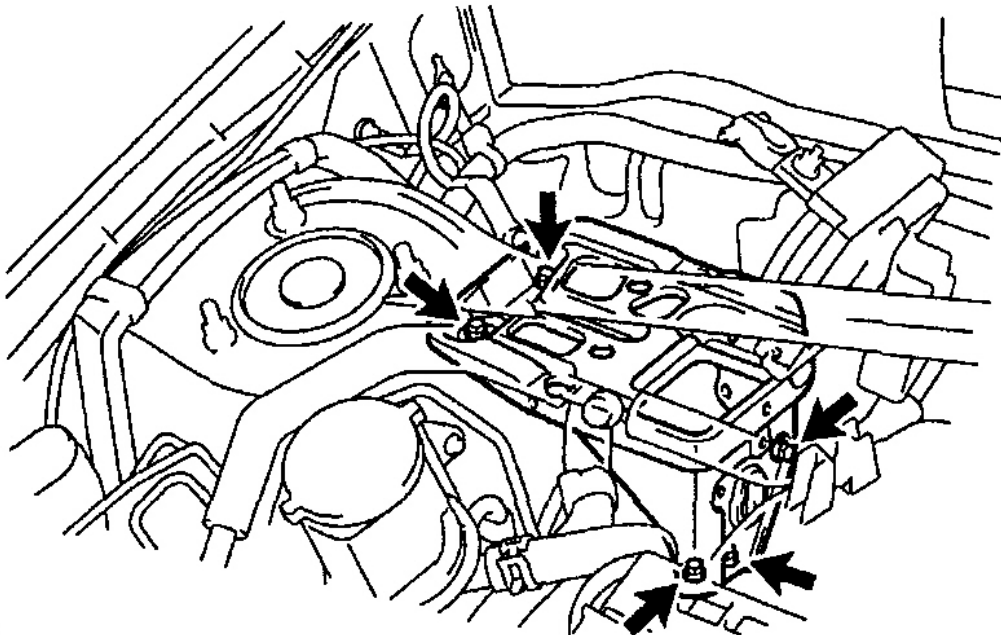


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**Fig. 154: Identifying Engine Unit Components & Torque Specifications (6 of 6)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 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.



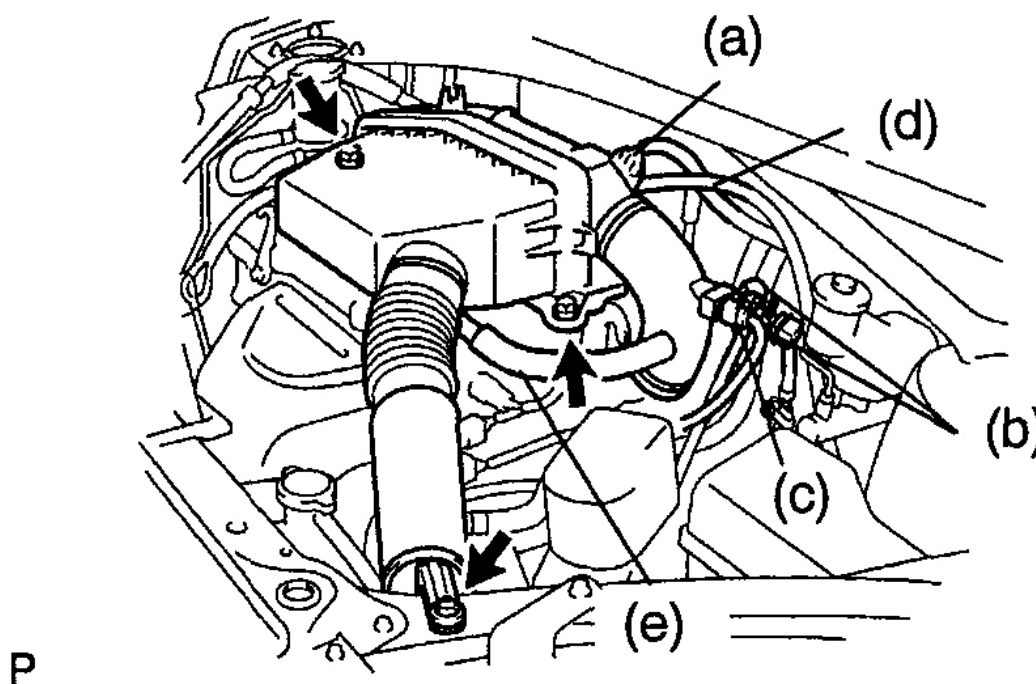
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**Fig. 155: Removing Battery Tray**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

9. **REMOVE AIR CLEANER ASSEMBLY**
  - 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.

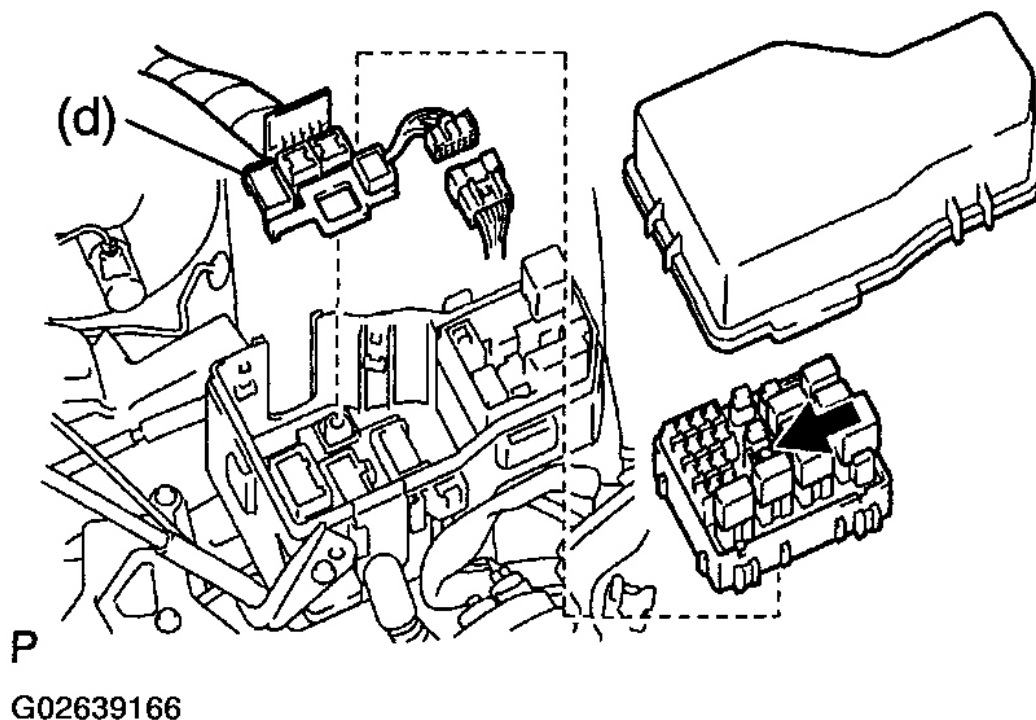


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**Fig. 156: Removing Air Cleaner Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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



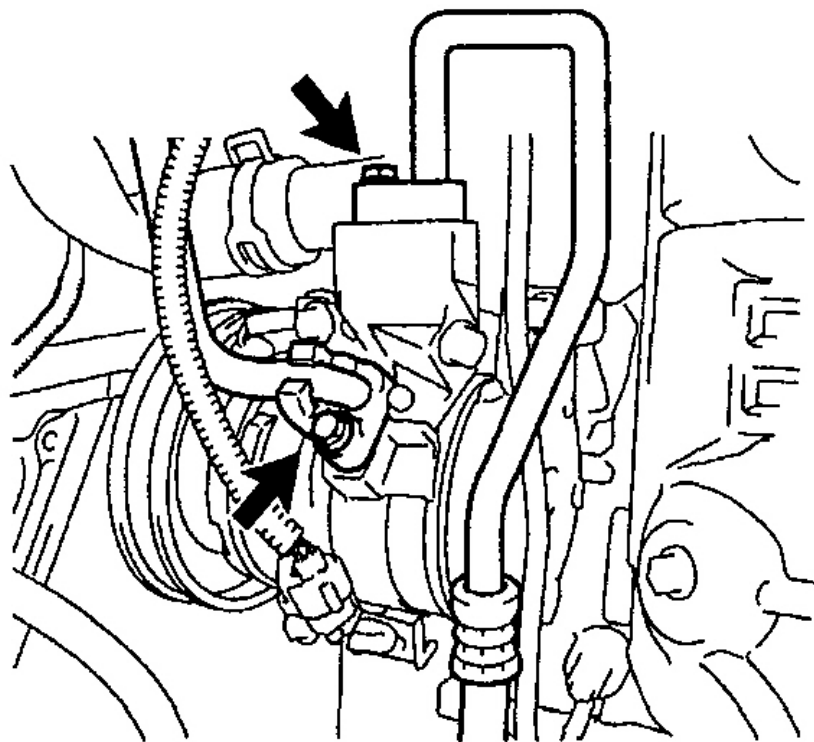
**Fig. 157: Removing Engine Room Junction/Box**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**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** ).

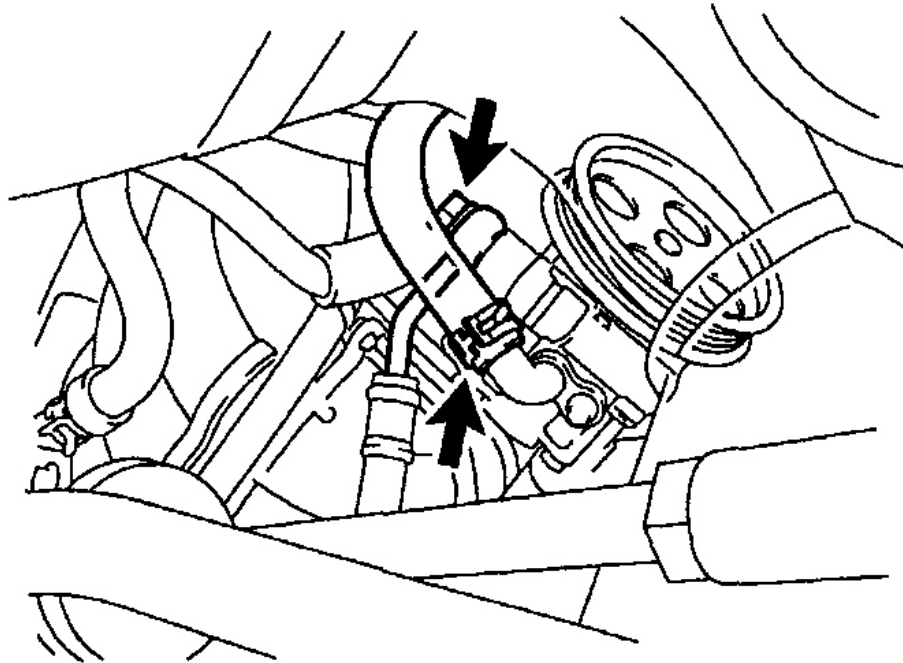


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**Fig. 158: Disconnecting Discharge And Liquid Tubes From Compressor**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Disconnect the suction hose, pressure feed tube and gasket from the PS vane pump.

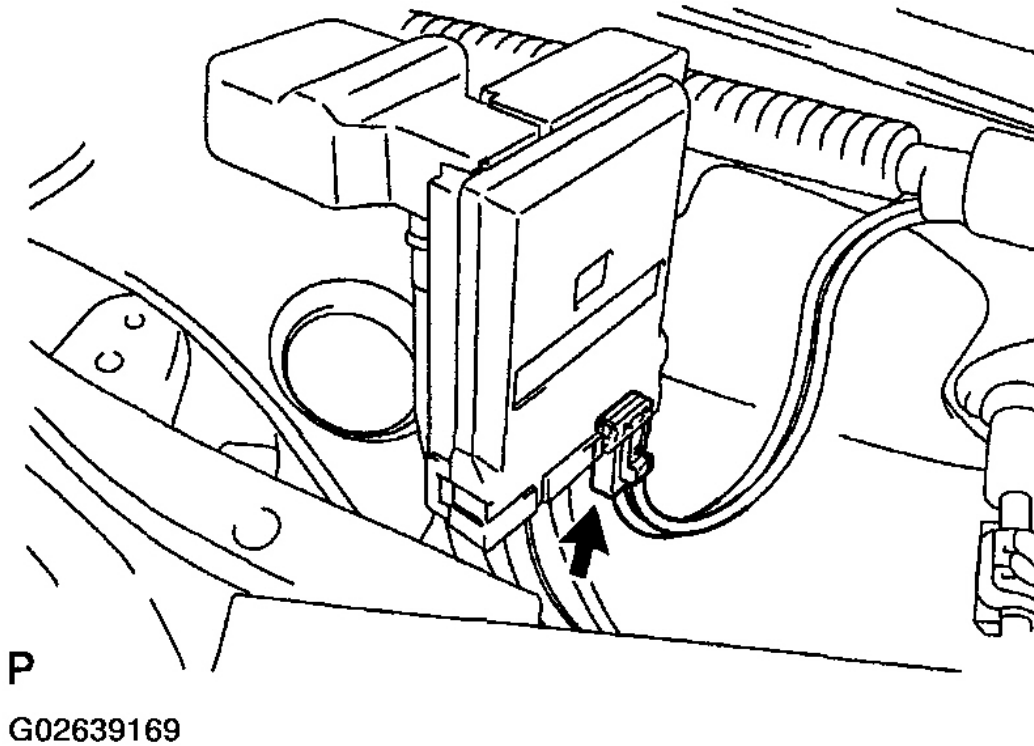


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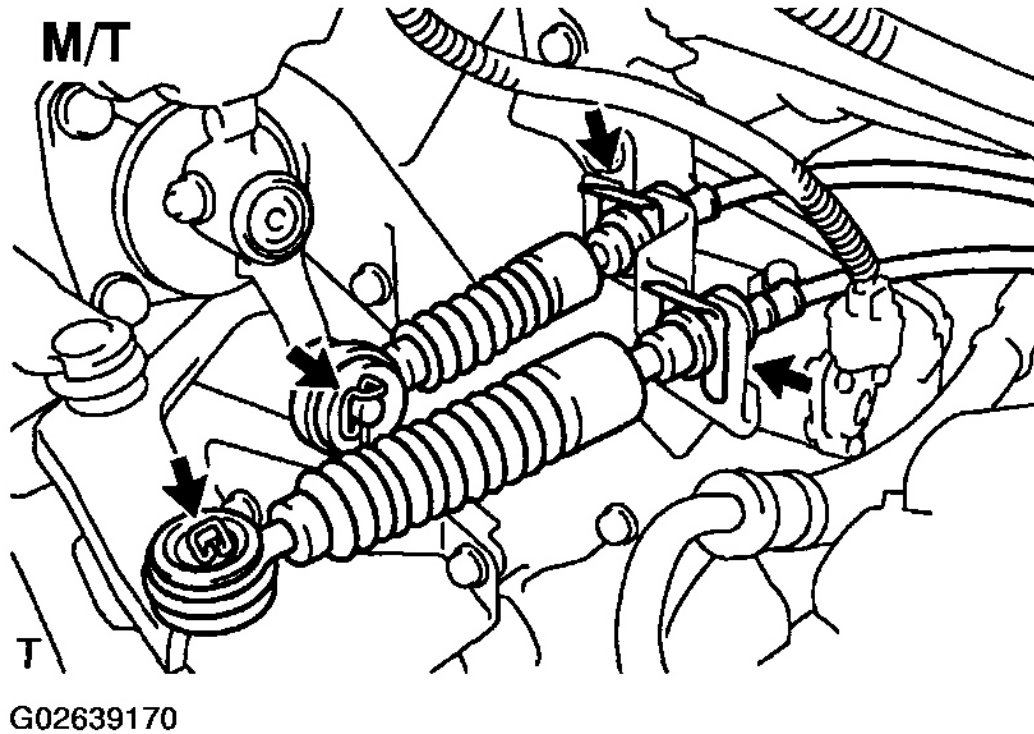
**Fig. 159: Disconnecting Suction Hose & Pressure Feed Tube From PS Vane Pump**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Disconnect the upper radiator hose.
- f. Disconnect the lower radiator hose.
- g. Disconnect the fuel tube connector (see **SFI** ).
- h. Disconnect the 2 heater hoses.
- i. Disconnect the connector from the fusible link block.



**Fig. 160: Disconnecting Connector From Fusible Link Block**  
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.

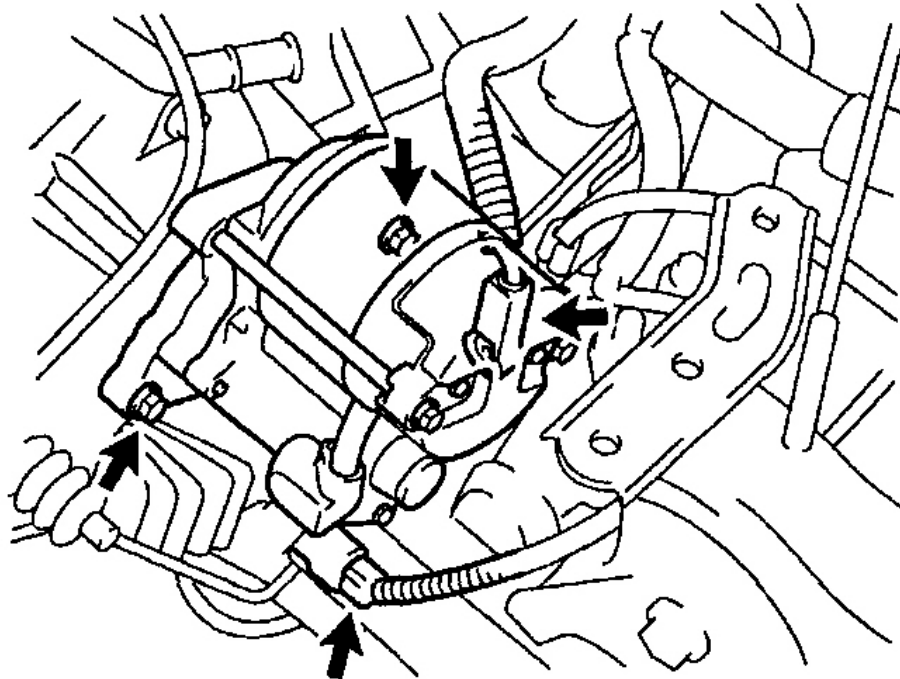


**Fig. 161: Disconnecting Shift Control Cables From Transaxle**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**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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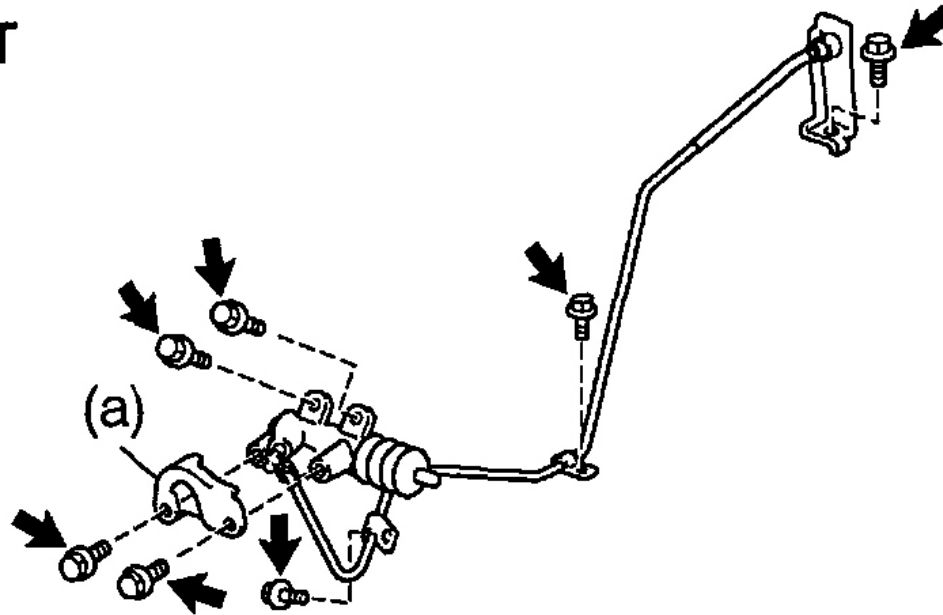
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**Fig. 162: Removing Starter**

**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.

M/T

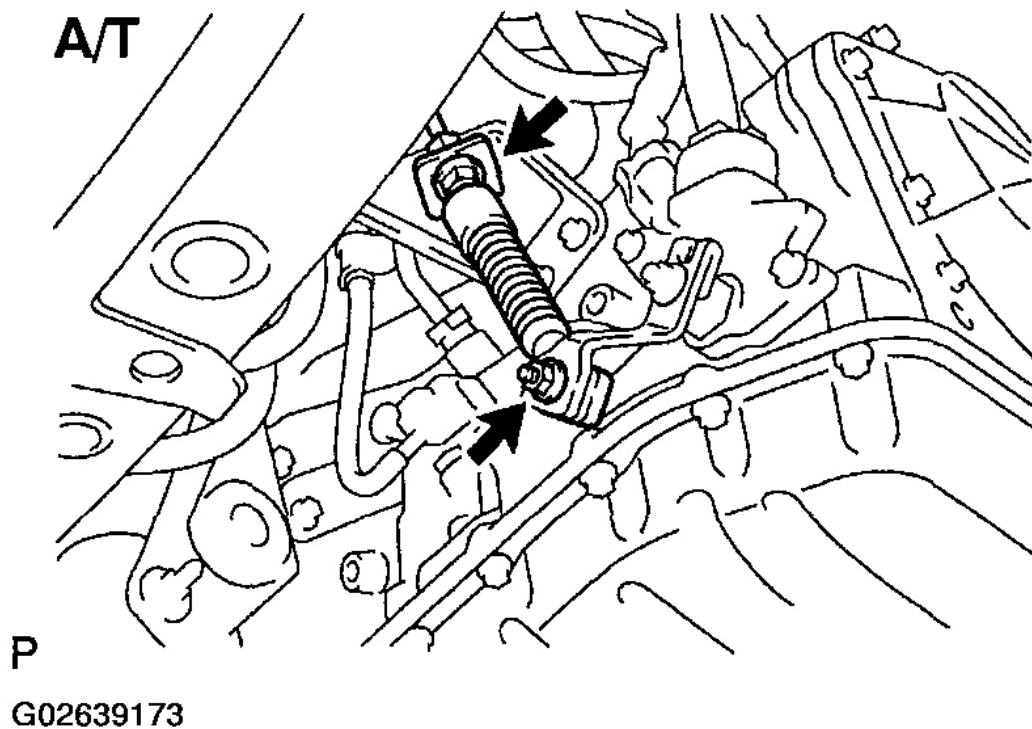


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**Fig. 163: Disconnecting Clutch Release Cylinder & Line From Transaxle (M/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

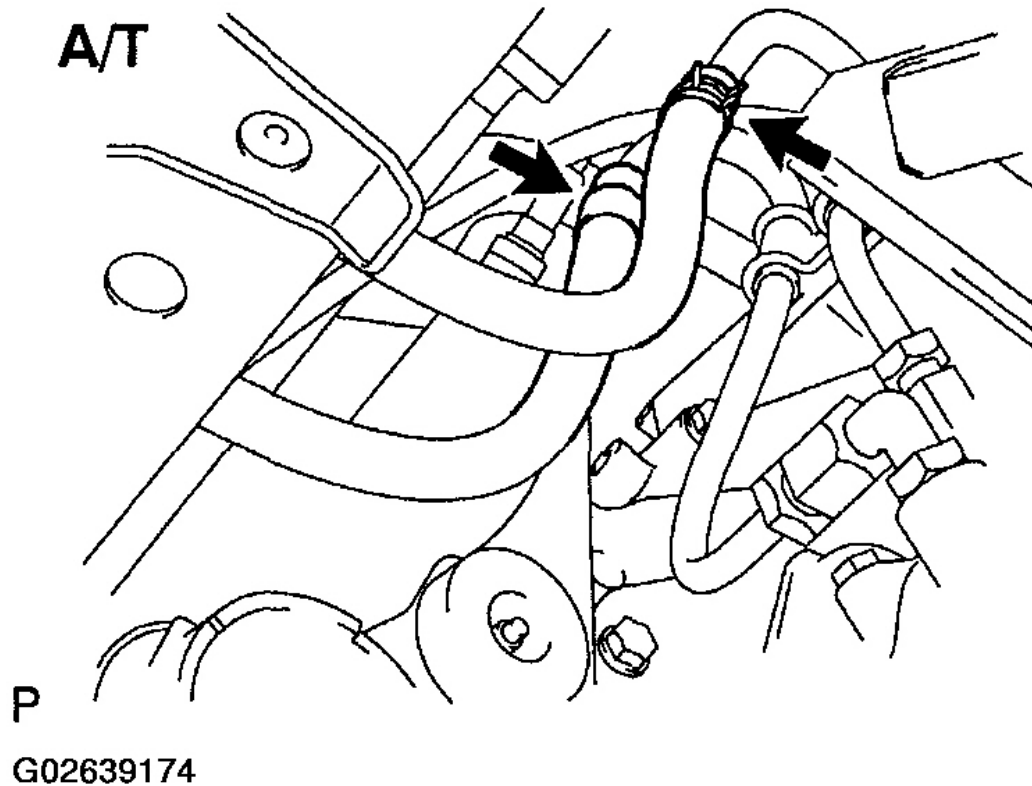
**16. A/T: DISCONNECT SHIFT CONTROL CABLE FROM TRANSAXLE**

- 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.



**Fig. 164: Disconnecting Shift Control Cable From Transaxle (A/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**17. A/T: DISCONNECT OIL COOLER HOSES**

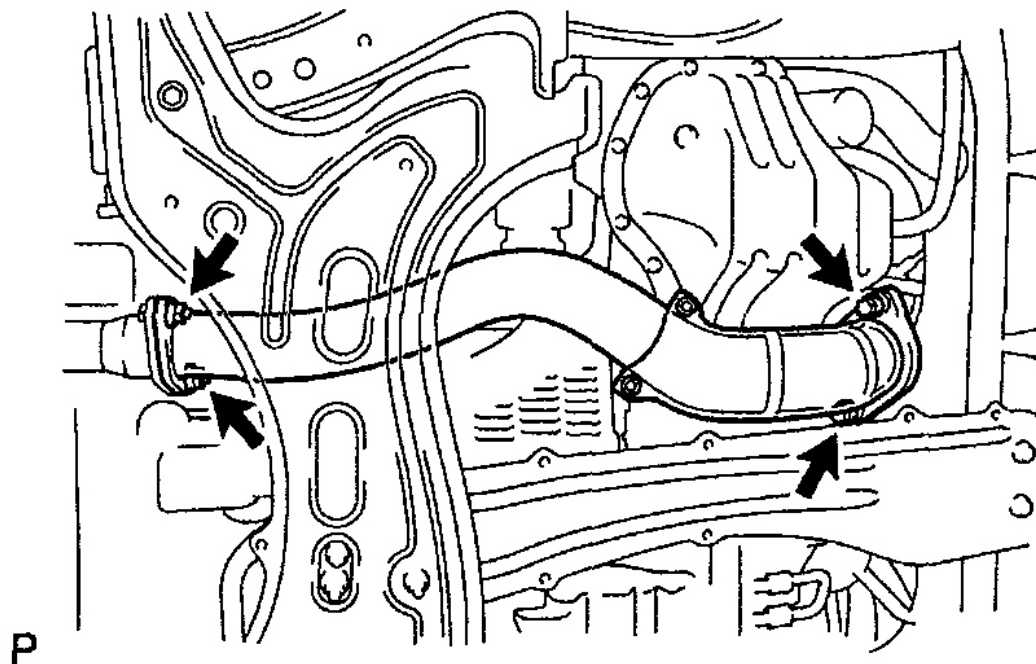


**Fig. 165: Disconnecting Oil Cooler Hoses**

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

18. **DISCONNECT GROUND CABLE FROM TRANSAXLE**
19. **4WD: REMOVE PROPELLER SHAFT (See PROPELLER SHAFT ASSEMBLY )**
20. **REMOVE FRONT DRIVE SHAFTS (See REMOVAL )**
21. **REMOVE FRONT EXHAUST PIPE**

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

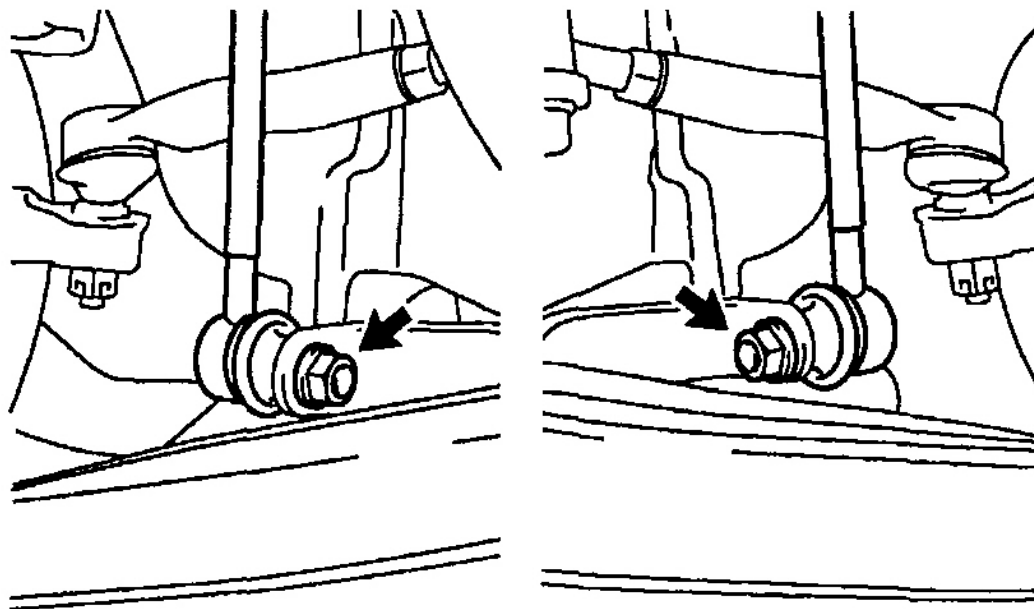


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**Fig. 166: Removing Front Exhaust Pipe**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 22. DISCONNECT STABILIZER BAR LINKS

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



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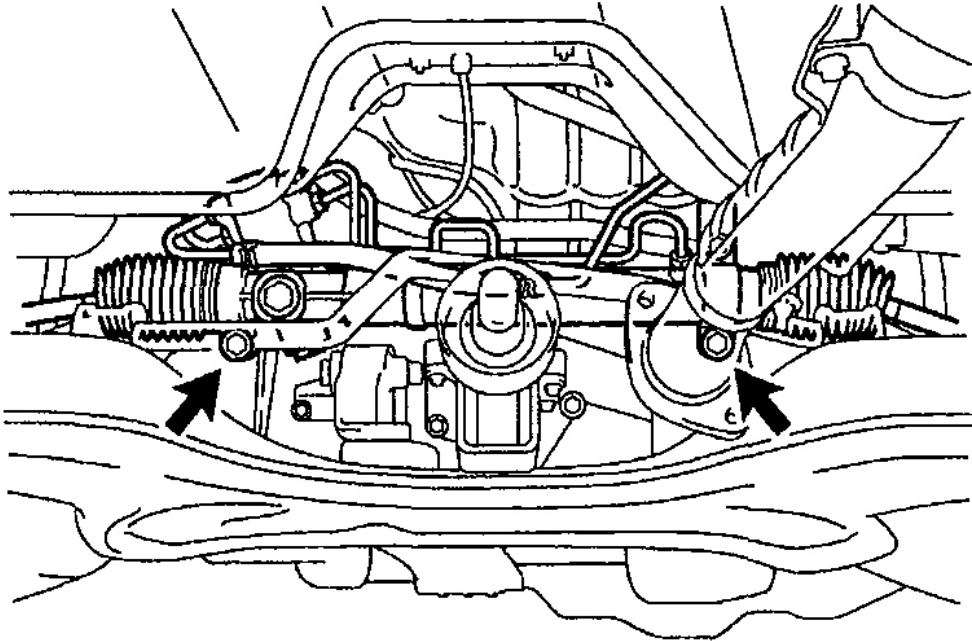
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**Fig. 167: Disconnecting Stabilizer Bar Links**

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. 168: Removing 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.

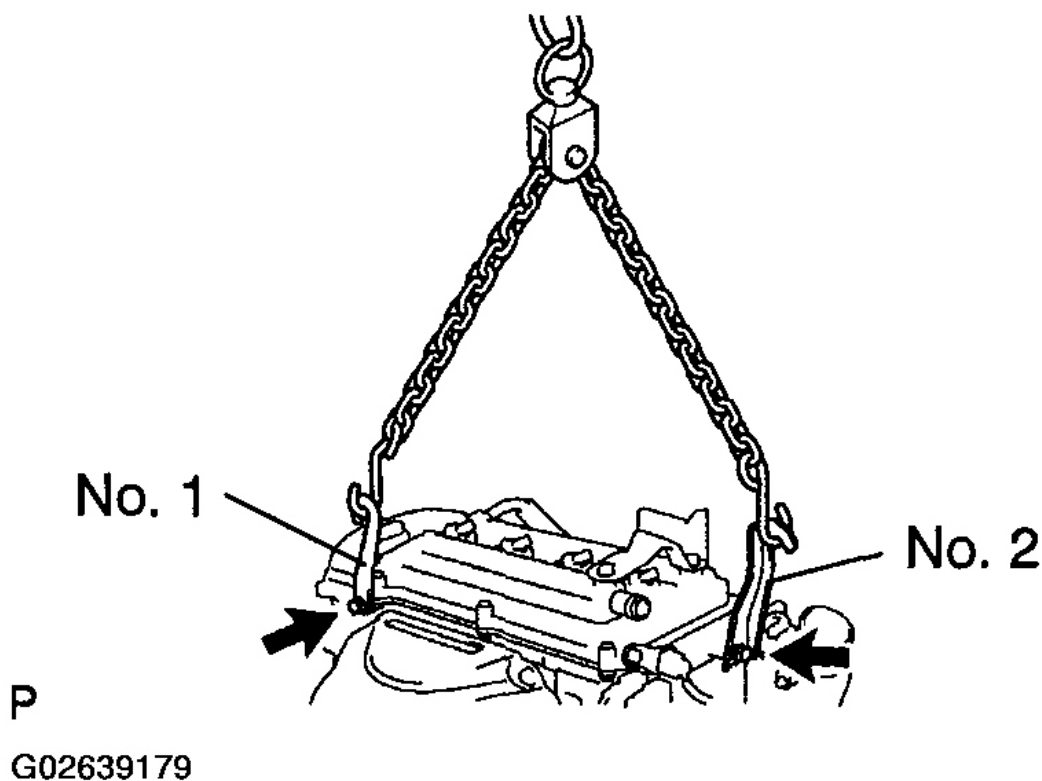
Item	Part No.
No. 1 and No. 2 engine hangars	12281-28010, 12281-28020 or 12281-28030
bolt	91512-61020 x 2

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**Fig. 169: Removing PS Gear Assembly**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**Torque: 38 N.m (387 kgf.cm, 28 ft.lbf)**

- b. Attach the sling device to the engine hangers.

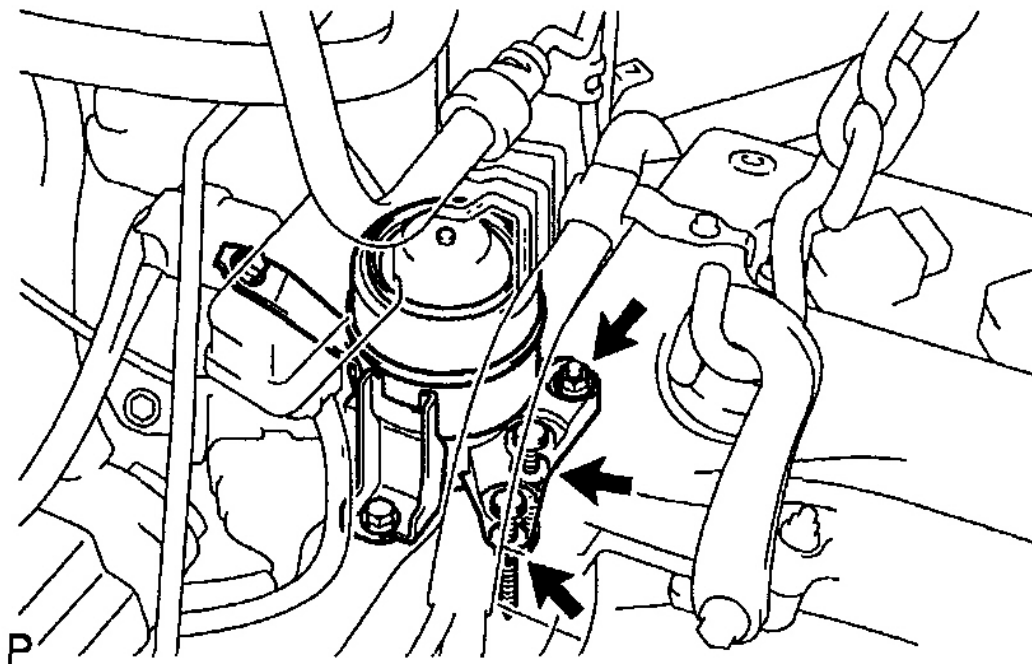


**Fig. 170: Attaching Sling Device To Engine Hangers**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**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 timing chain cover.

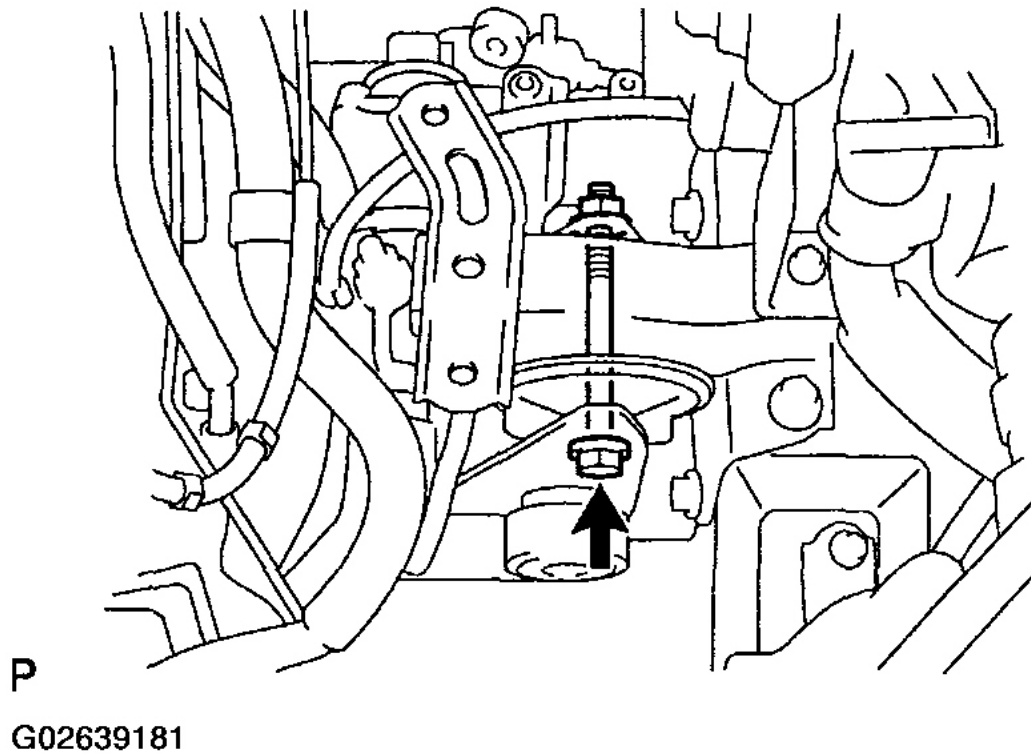




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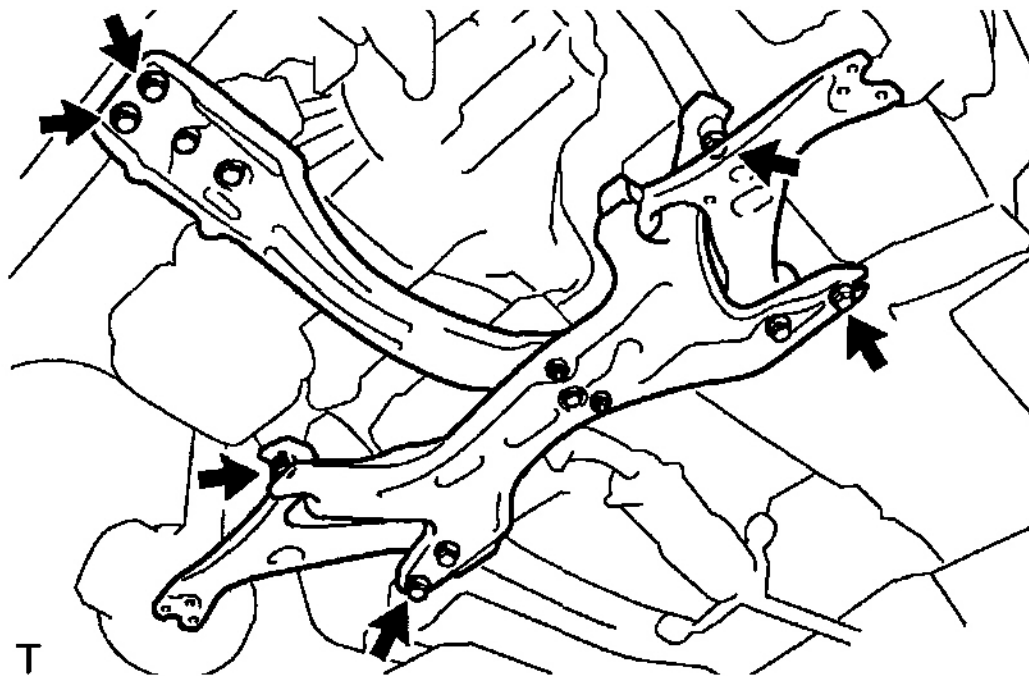
**Fig. 171: Removing RH Engine Mounting Insulator**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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



**Fig. 172: Removing LH Engine Mounting Insulator To Mounting Bracket**  
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.

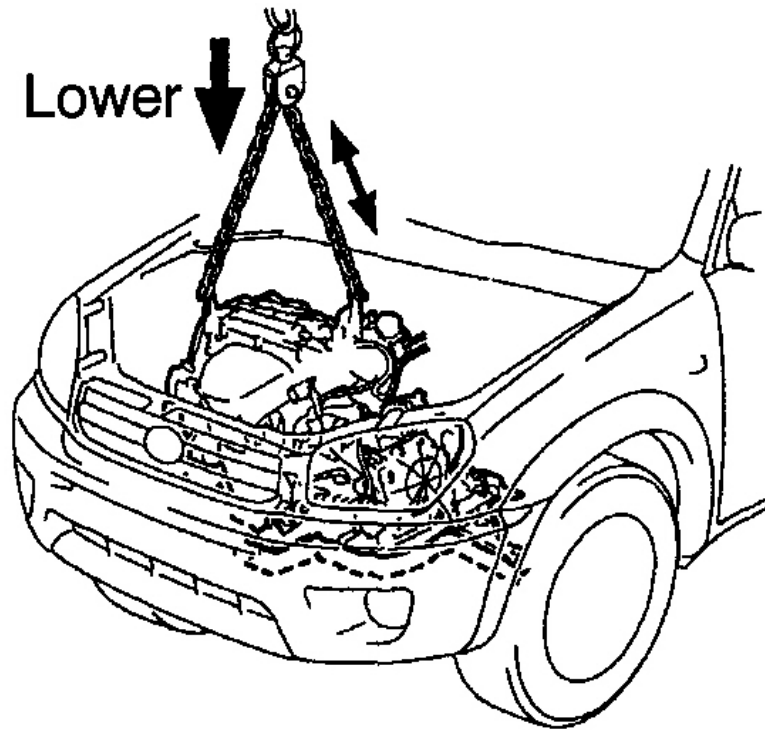


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**Fig. 173: Removing Front Suspension Crossmember**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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



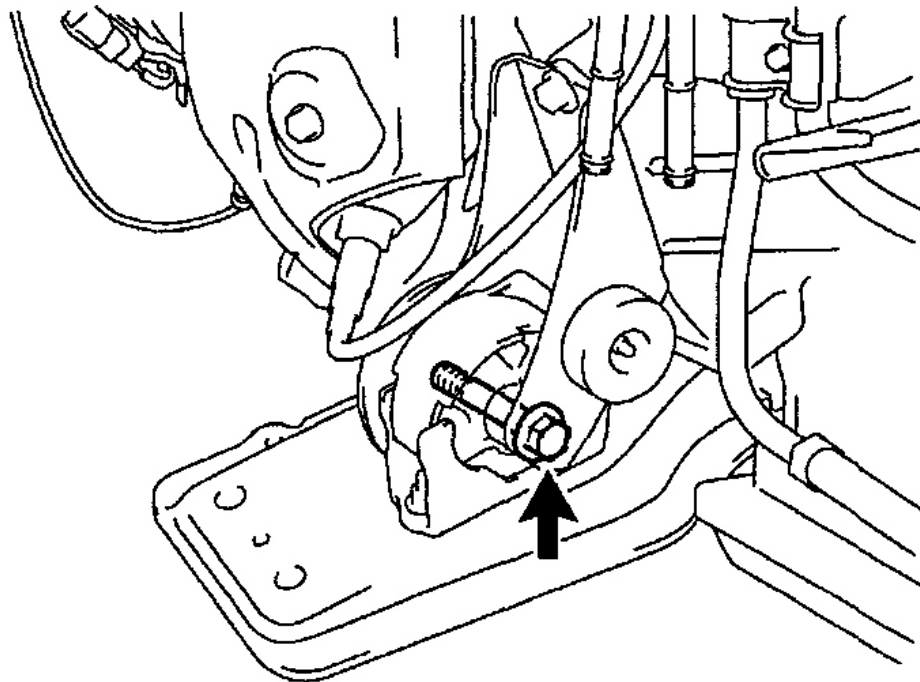
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**Fig. 174: Lowering Engine Out Of Vehicle**

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

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.

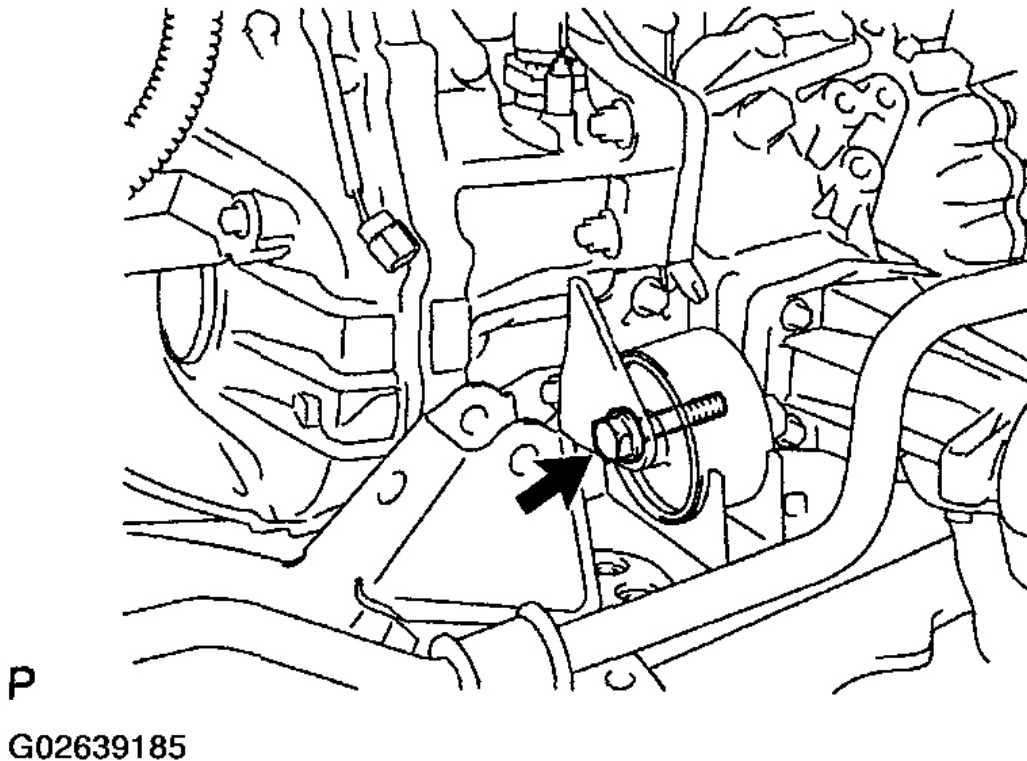


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**Fig. 175: Removing Bolt Holding Front Engine Mounting Bracket To Mounting Insulator**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

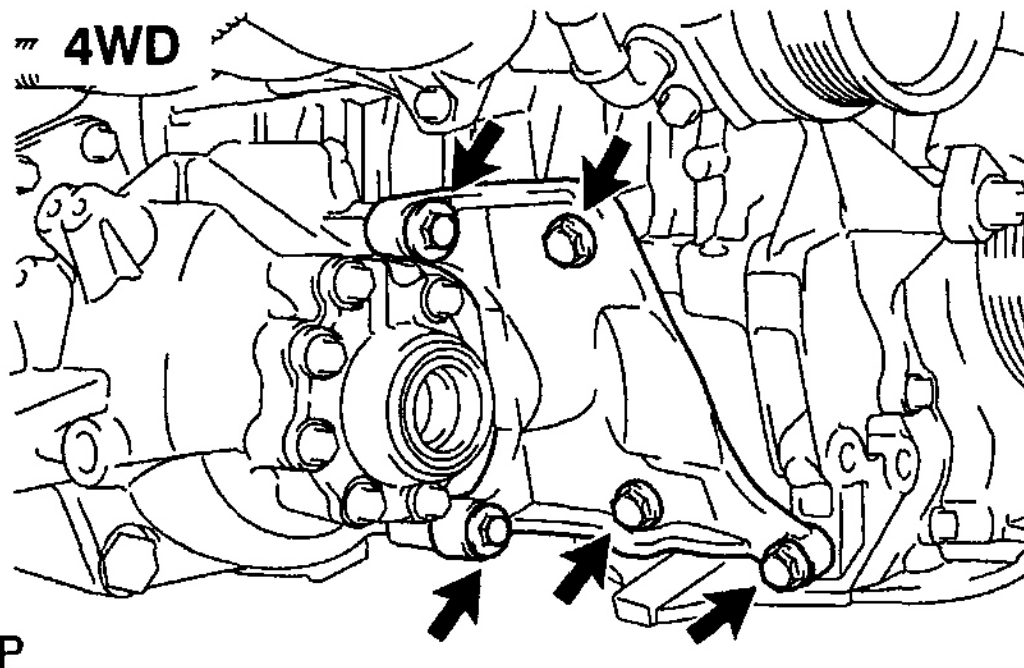


**Fig. 176: Removing Bolt Holding Rear Engine Mounting Bracket To Mounting Insulator**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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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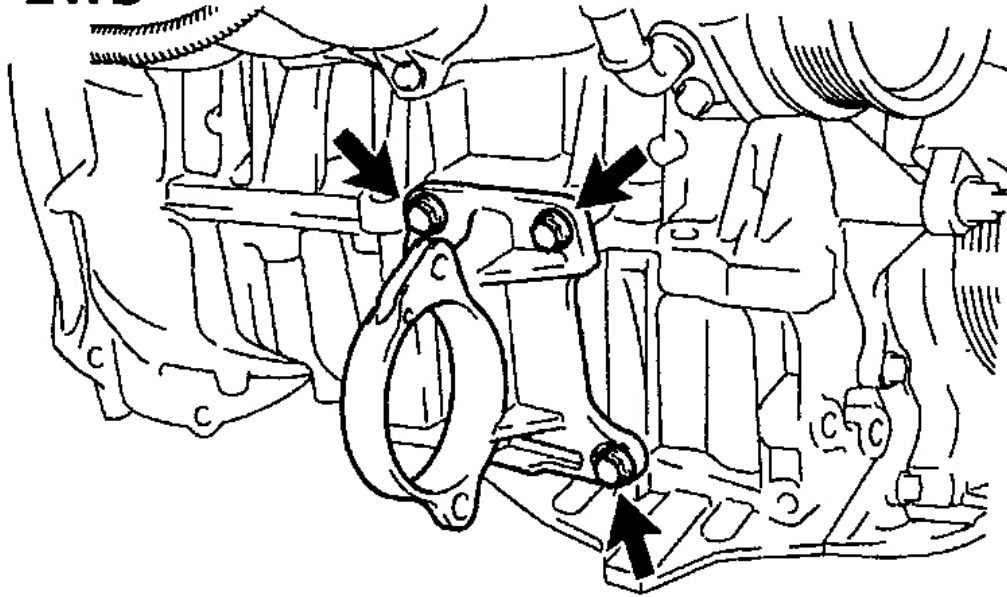
**Fig. 177: Removing Stiffener Plate (4WD)**

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

**28. 2WD: REMOVE CENTER BEARING BRACKET**

Remove the 3 bolts and bearing bracket.

**2WD**



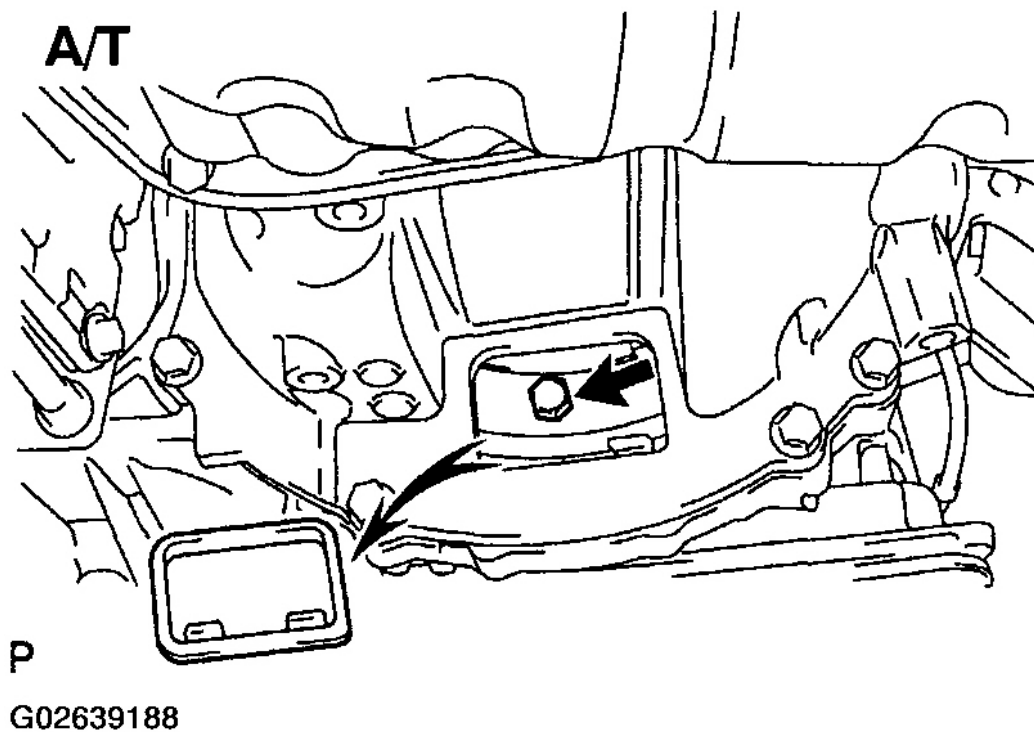
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**Fig. 178: Removing Center Bearing Bracket (2WD)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

29. **A/T: REMOVE TORQUE CONVERTER CLUTCH BOLTS**
- Remove the hole plug.
  - Turn the crankshaft to gain access to each bolt.
  - Hold the crankshaft pulley bolt with a wrench, and remove the 6 bolts.

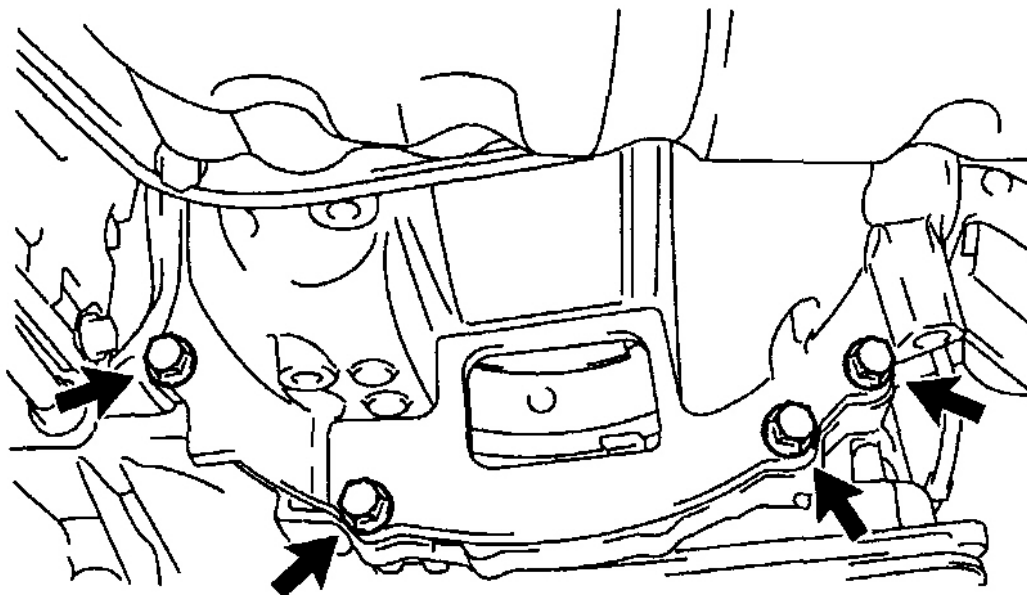




**Fig. 179: Removing Torque Converter Clutch Bolts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**30. REMOVE TRANSAXLE FROM ENGINE**

- a. Remove the 4 lower bolts holding the engine to the transaxle.

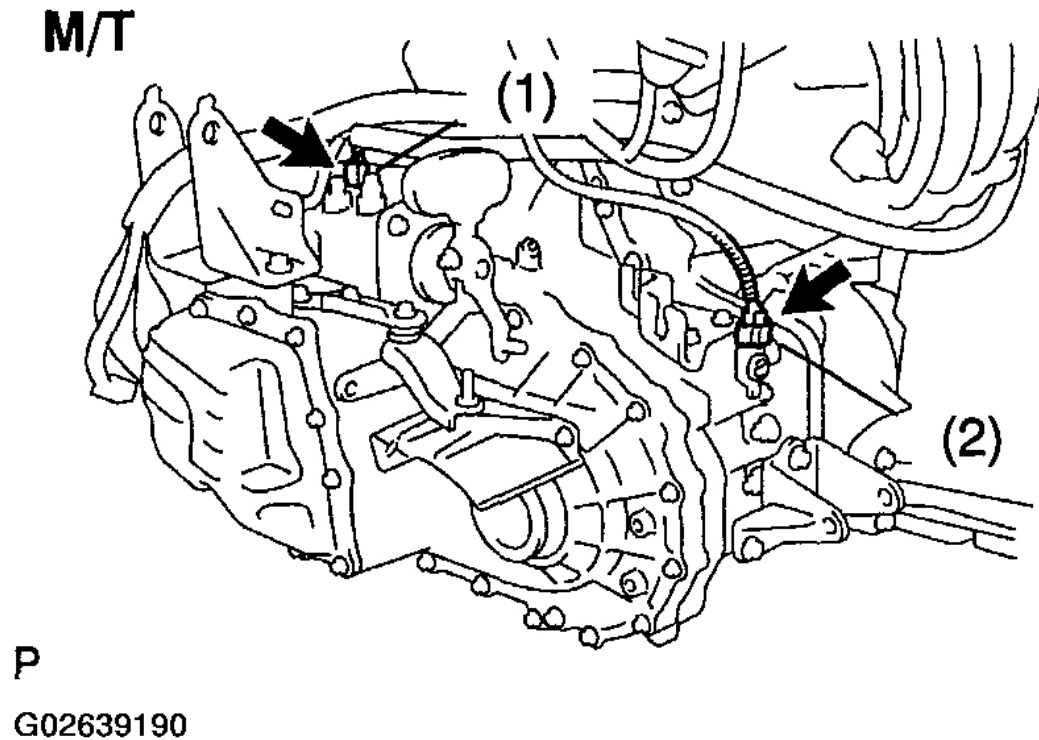


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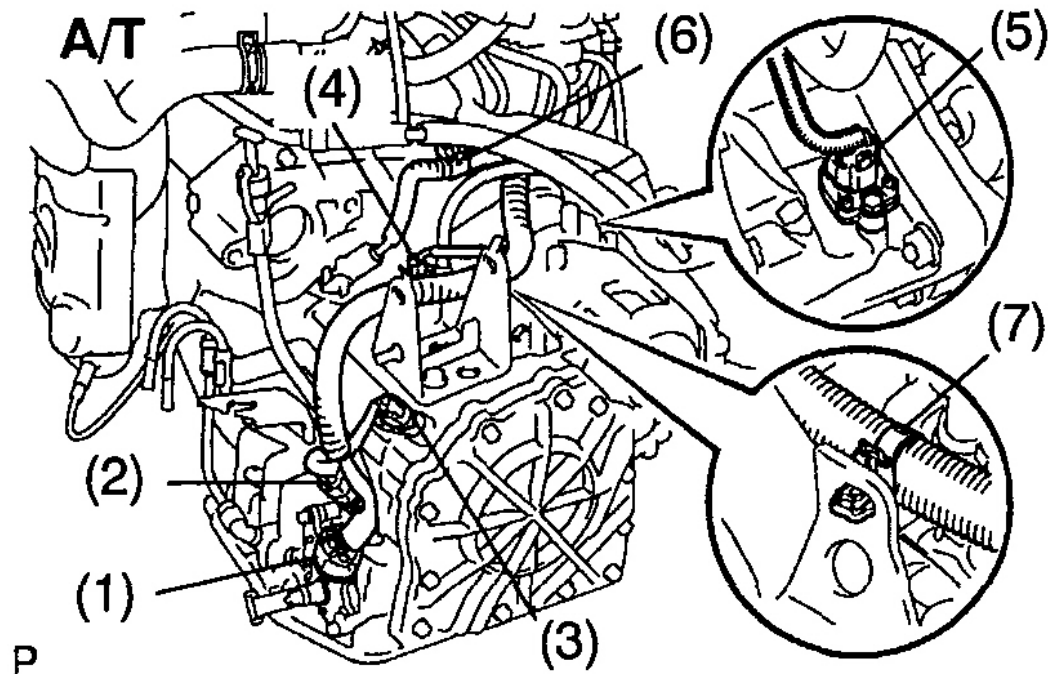
**Fig. 180: Removing Bolts Holding Transaxle To Engine**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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



**Fig. 181: Disconnecting Wiring Harness Connectors From Transaxle (M/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

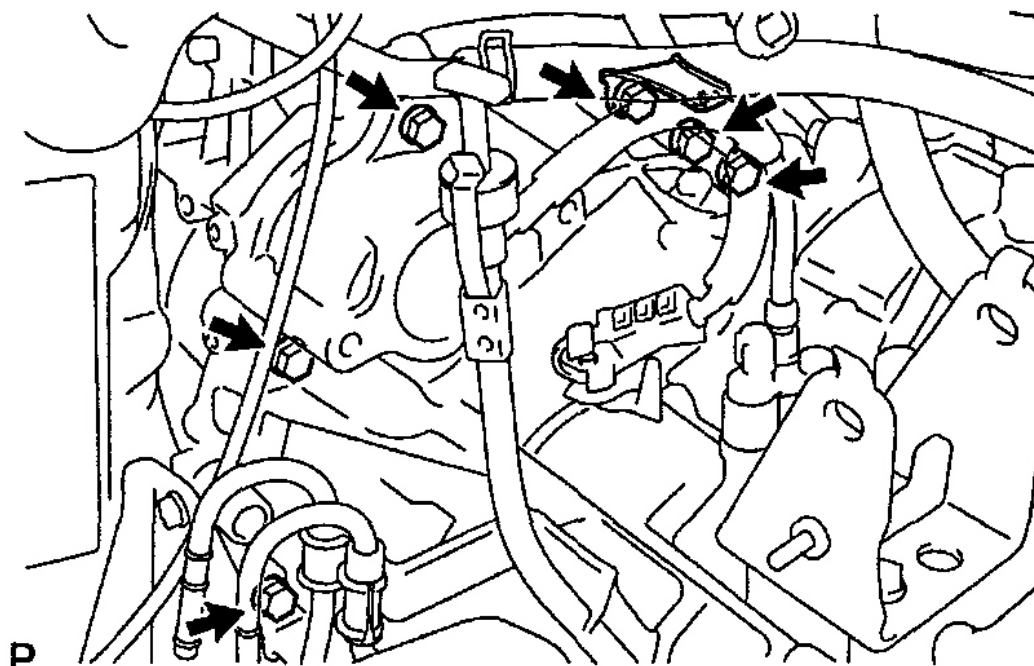
- c. A/T: Disconnect the connectors and clamps.
  - 1. Disconnect the park/neutral position switch connector.
  - 2. Disconnect the solenoid wire connector.
  - 3. Disconnect the input turbine speed sensor connector.
  - 4. Disconnect the counter gear speed sensor connector.
  - 5. Disconnect the vehicle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



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**Fig. 182: Disconnecting Wiring Harness Connectors From Transaxle (A/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

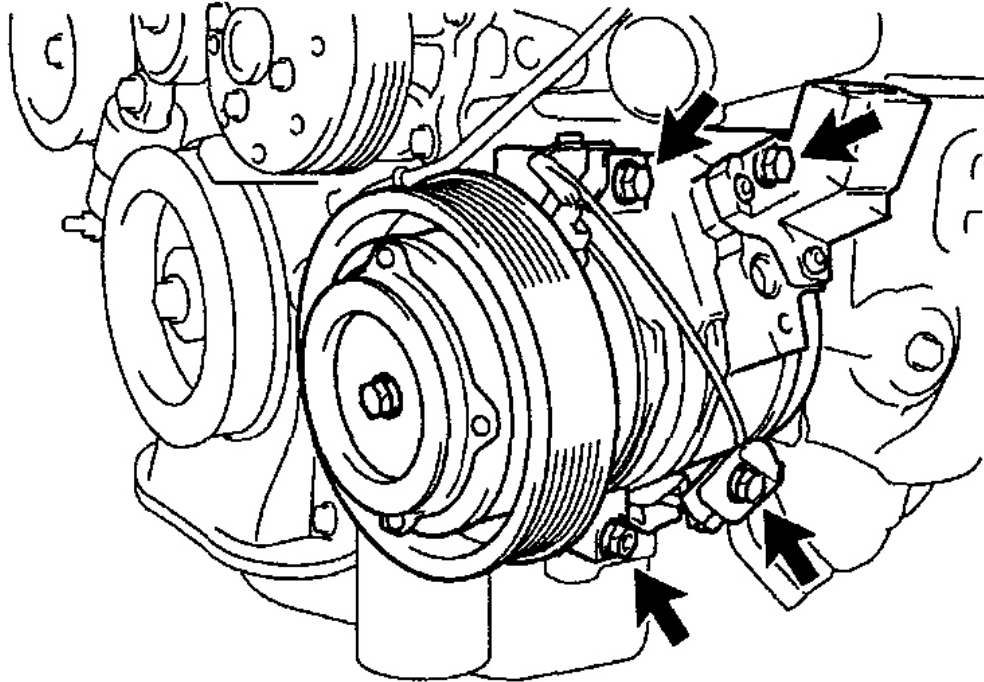
6. Disconnect the wire clamp from the bracket.
  7. Disconnect the wire clamp from the engine mounting bracket.
- d. Remove the 6 upper bolts holding the transaxle to the engine.



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**Fig. 183: Removing Upper Bolts Holding Transaxle To Engine**  
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, DISC AND FLYWHEEL**
- 33. **A/T: REMOVE DRIVE PLATE**
- 34. **REMOVE A/C COMPRESSOR**
  - a. Disconnect the magnetic clutch and lock sensor connector from the compressor.
  - b. Remove the 3 bolts, nut and compressor.



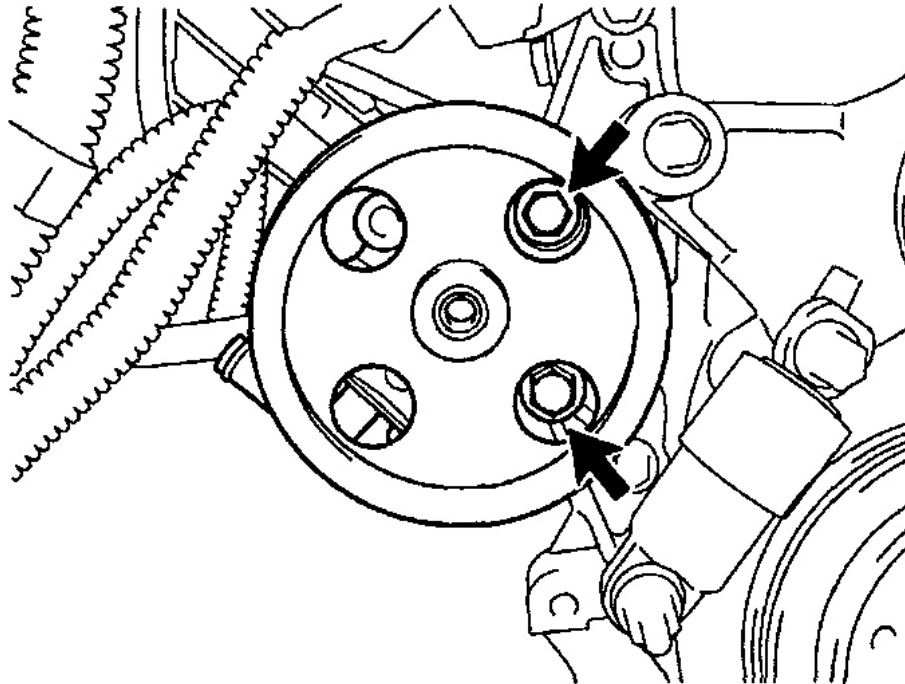
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**Fig. 184: Removing A/C Compressor Bolts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**35. REMOVE PS VANE PUMP**

- a. Disconnect the oil pressure switch connector.
- b. Remove the 2 bolts and vane pump.



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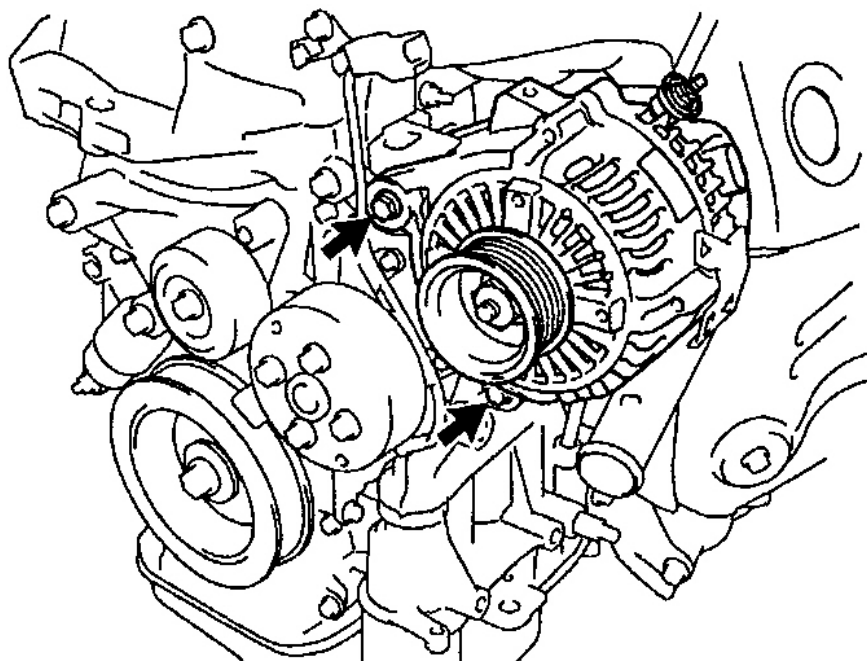
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**Fig. 185: Removing PS Vane Pump**

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

### 36. REMOVE GENERATOR

- 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.



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**Fig. 186: Removing Generator**

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

## **INSTALLATION**

### **1. INSTALL GENERATOR**

- a. Install the generator with the 2 bolts.

**Torque:**

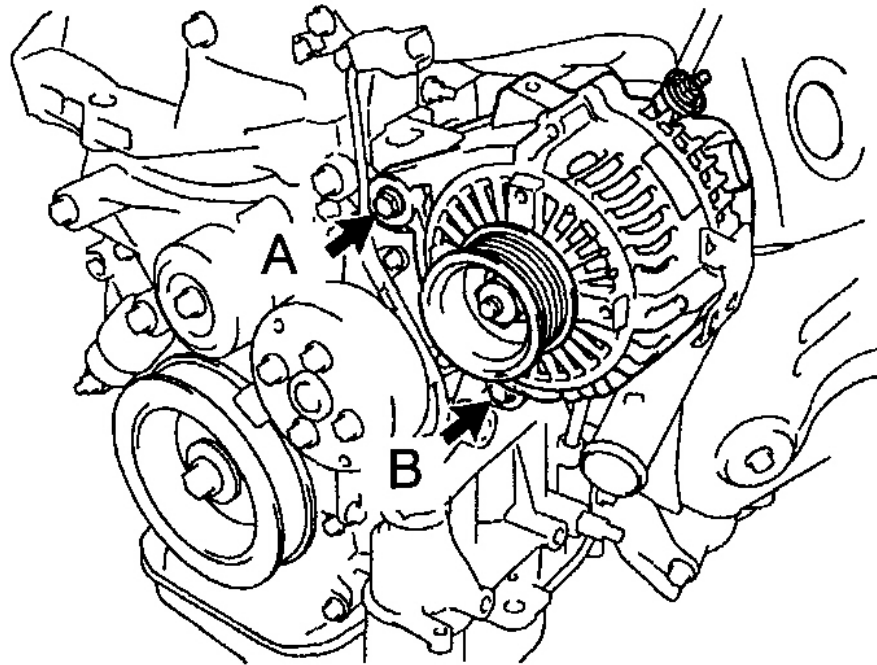
**52 N.m (530 kgf.cm, 38 ft.lbf) for bolt A**

**21 N.m (214 kgf.cm, 15 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 (99 kgf.cm, 86 in.lbf)**





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**Fig. 187: Installing Generator**

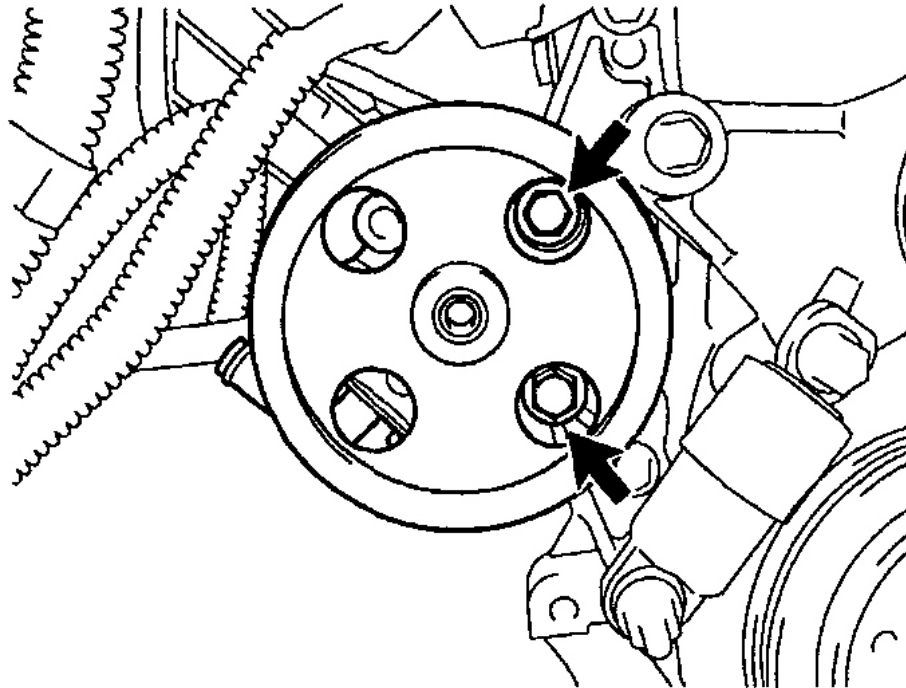
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**2. INSTALL PS VANE PUMP**

- a. Install the vane pump with the 2 bolts.

**Torque: 43 N.m (439 kgf.cm, 32 ft.lbf)**

- b. Connect the oil pressure switch connector.



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**Fig. 188: Installing PS Vane Pump**

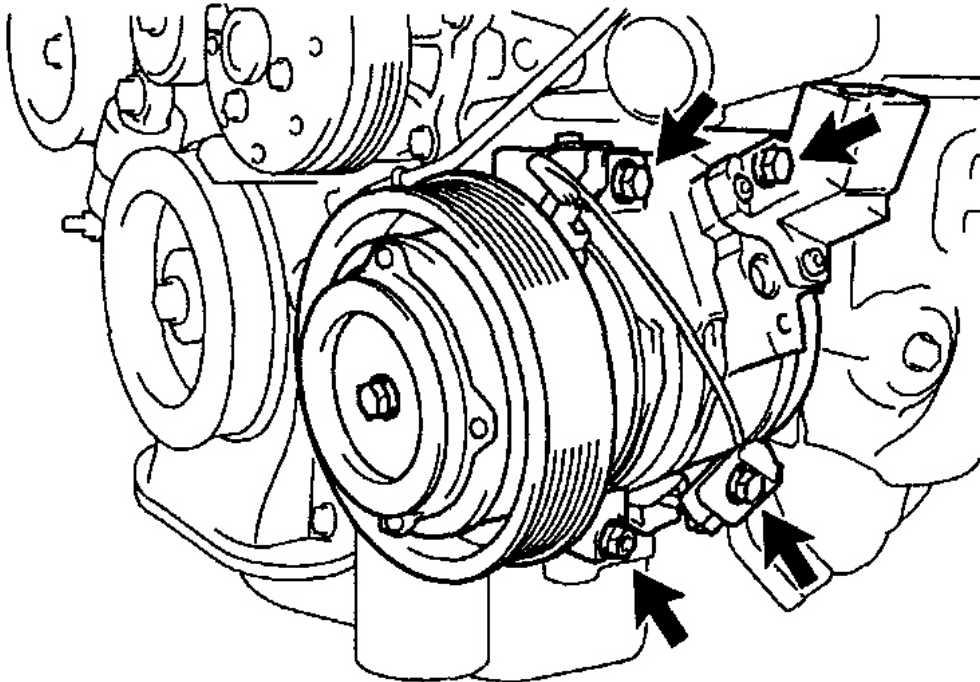
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

### 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)**

- b. Connect the magnetic clutch and lock sensor connector.



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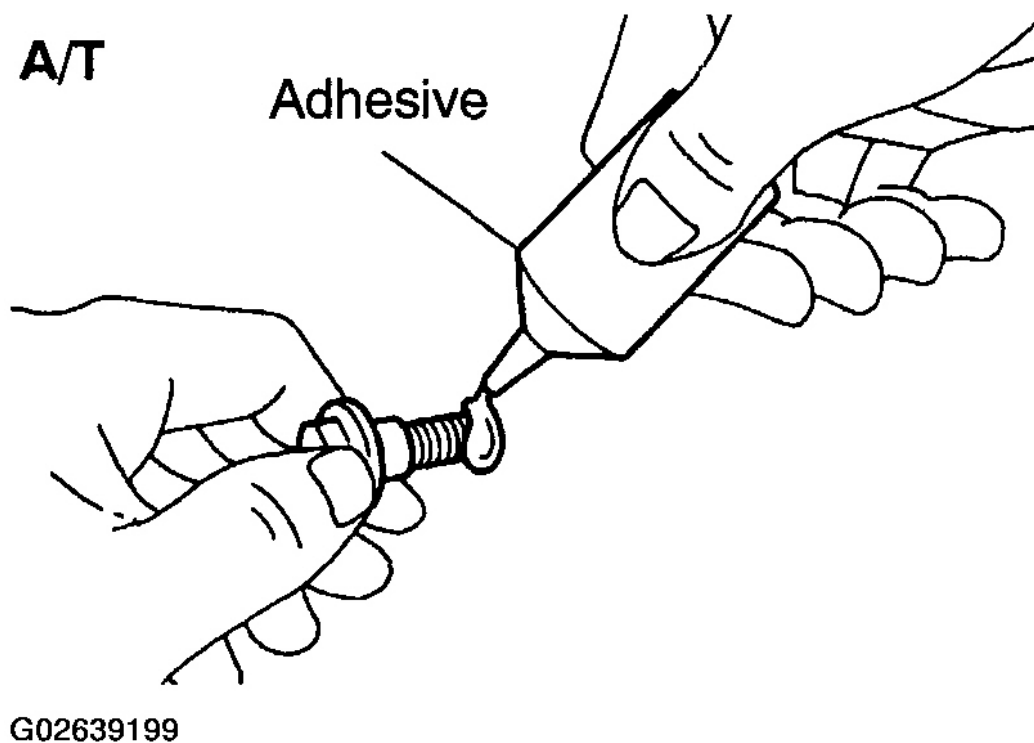
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**Fig. 189: Installing A/C Compressor**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- 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.

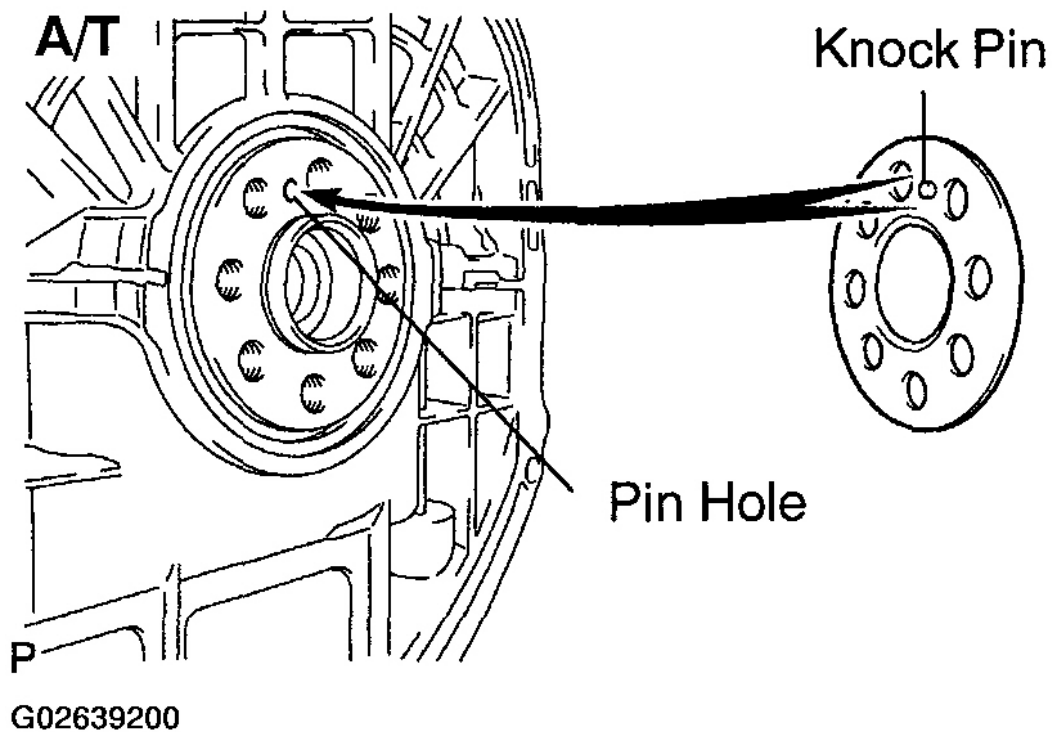
**Adhesive:**

**Part No. 08833-00070, THREE BOND 1324 or equivalent**



**Fig. 190: Applying Adhesive To Threads Of Bolt End**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

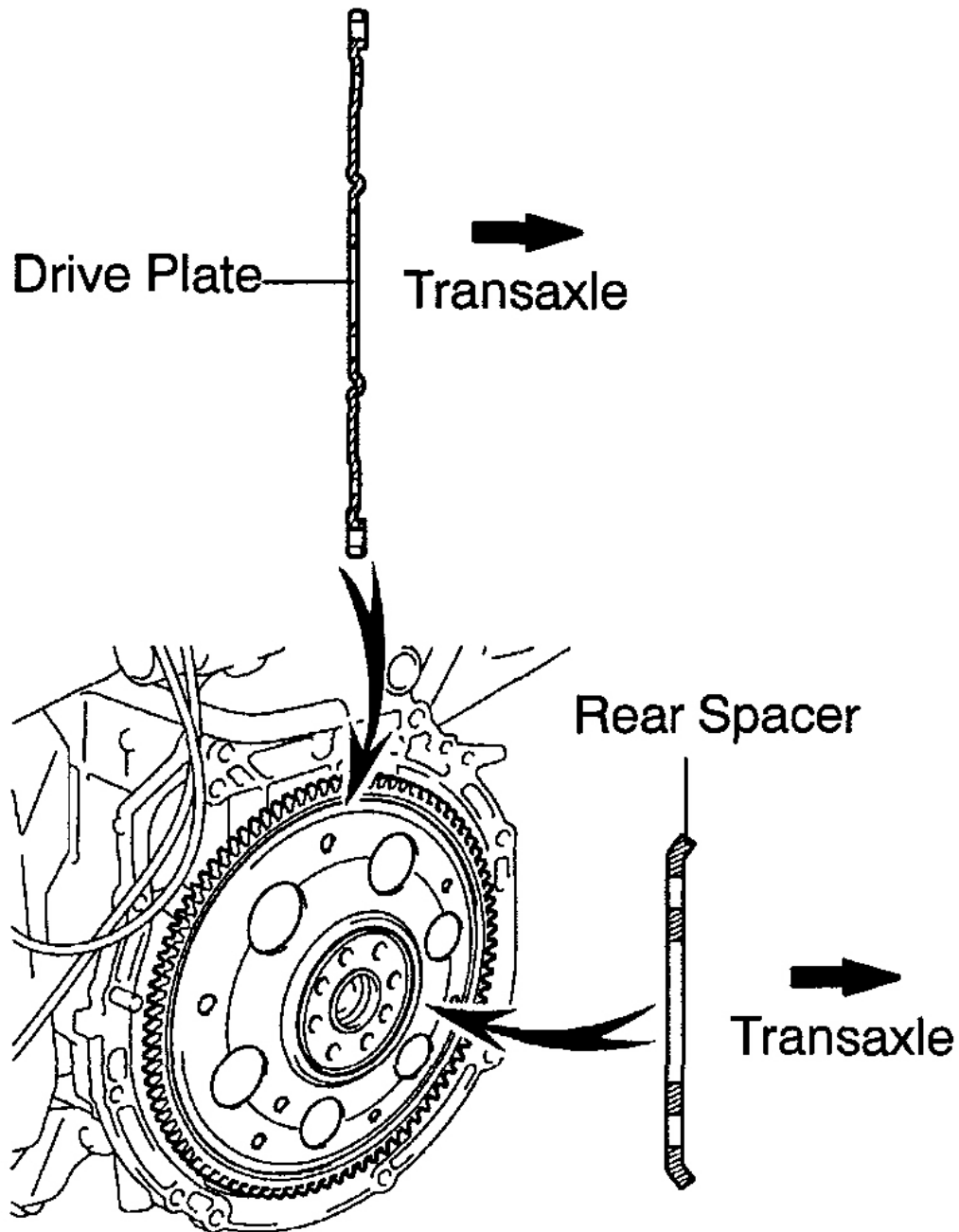
- b. Align the pin of the front spacer with the pin hole of the crankshaft, and install the front spacer.



**Fig. 191: Aligning Pin Of Front Spacer With Pin Hole In Crack**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Install the drive plate and rear spacer as shown.

A/T



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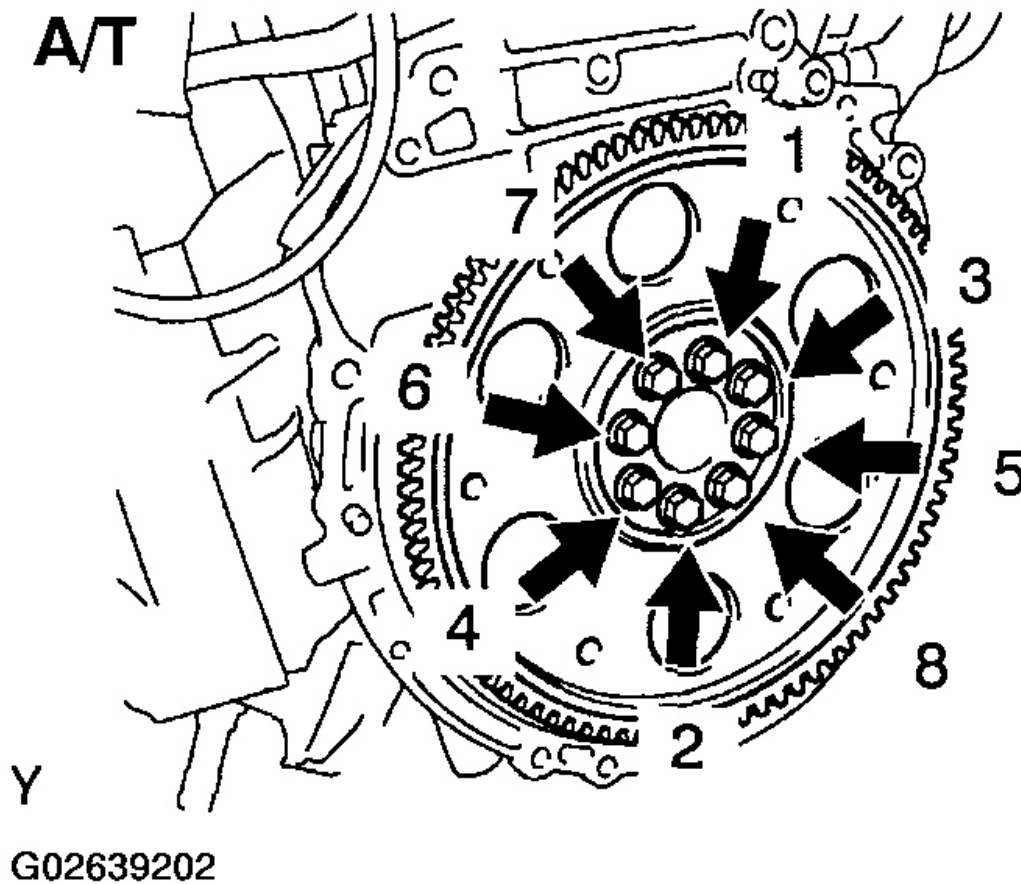
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**Fig. 192: Installing Drive Plate And Rear Spacer**

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 (1,000 kgf.cm, 72 ft.lbf)**



**Fig. 193: Tightening Drive Plate Bolts In Several Passes In Sequence Shown**

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

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 INSTALLATION )

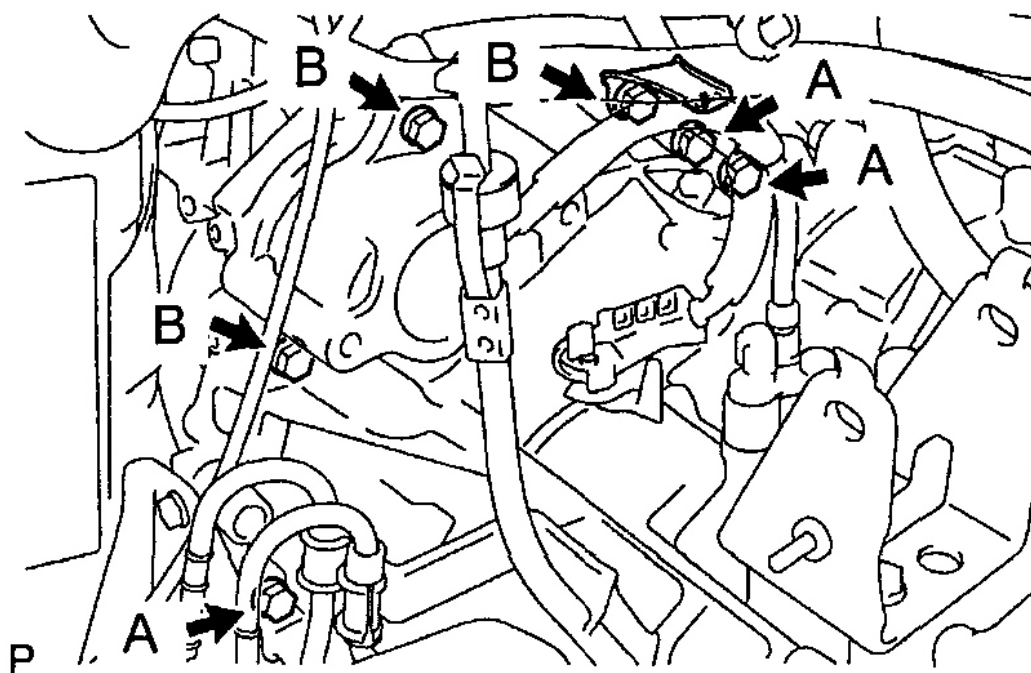
8. **INSTALL ENGINE TO TRANSAXLE**

- a. Install the 6 upper bolts holding the transaxle to the engine.

**Torque:**

**46 N.m (469 kgf.cm, 34 ft.lbf) for bolt A**

**64 N.m (653 kgf.cm, 47 ft.lbf) for bolt B**

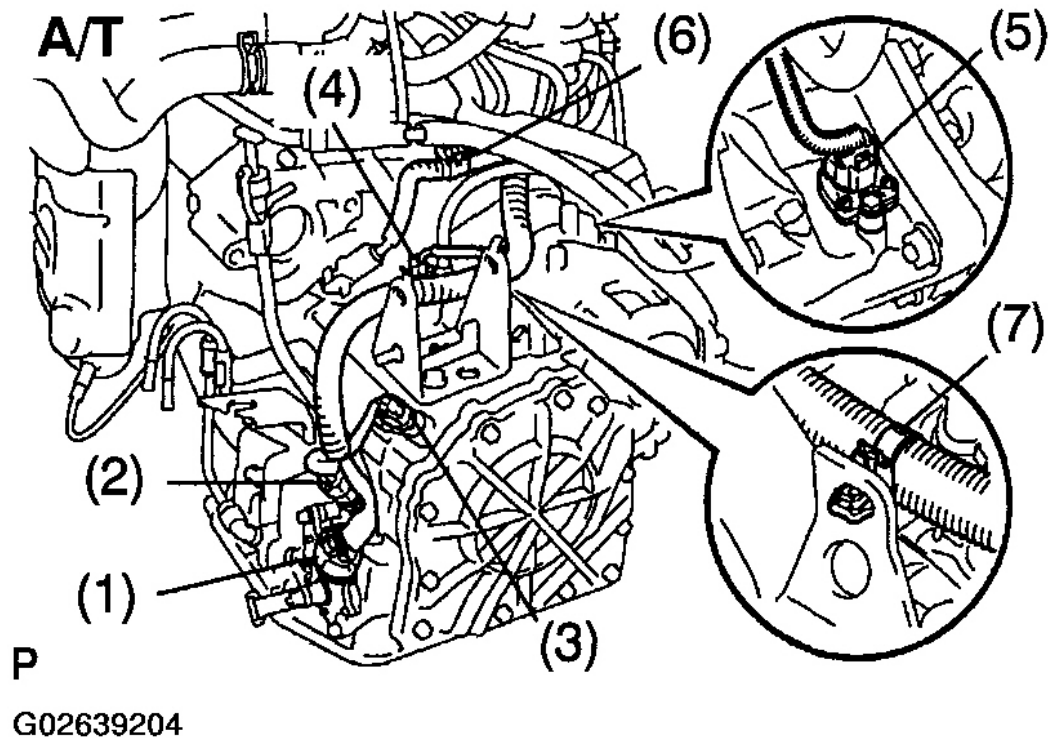


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**Fig. 194: Installing Upper Bolts Holding Transaxle To Engine**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

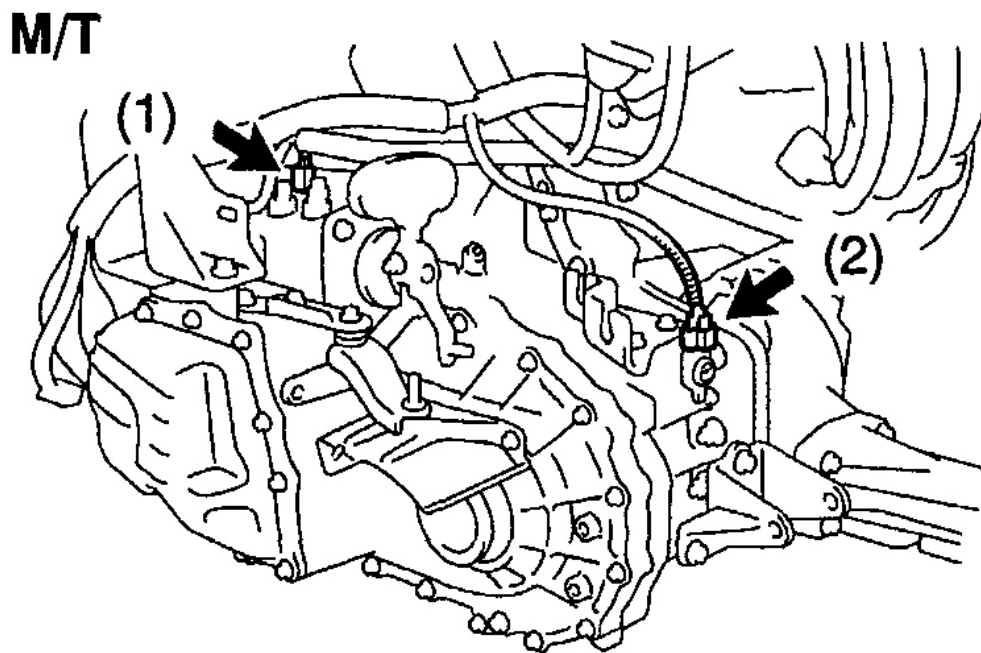
- b. A/T: Connect the connectors and clamps.
1. Connect the park/neutral position switch connector.
  2. Connect the solenoid wire connector.
  3. Connect the input turbine speed sensor connector.
  4. Connect the counter gear speed sensor connector.
  5. Connect the vehicle speed sensor.
  6. Connect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





**Fig. 195: Connecting Wiring Harness Connectors & Clamps (A/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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



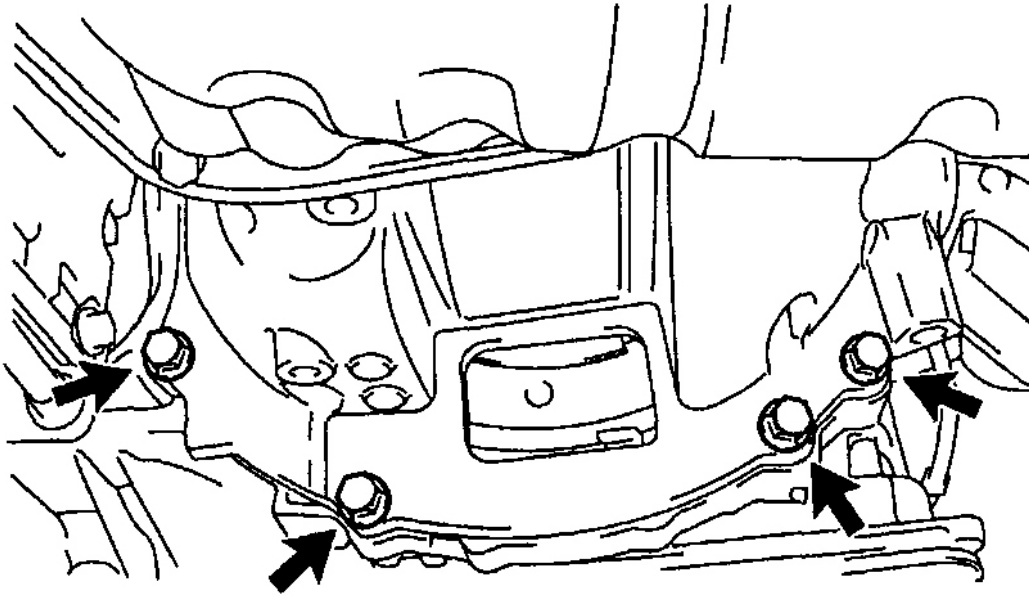
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**Fig. 196: Connecting Wiring Harness Connectors (M/T)**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- d. Install the 4 lower bolts holding the engine to the transaxle.

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



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**Fig. 197: Installing Lower Bolts Holding Transaxle To Engine**  
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:**

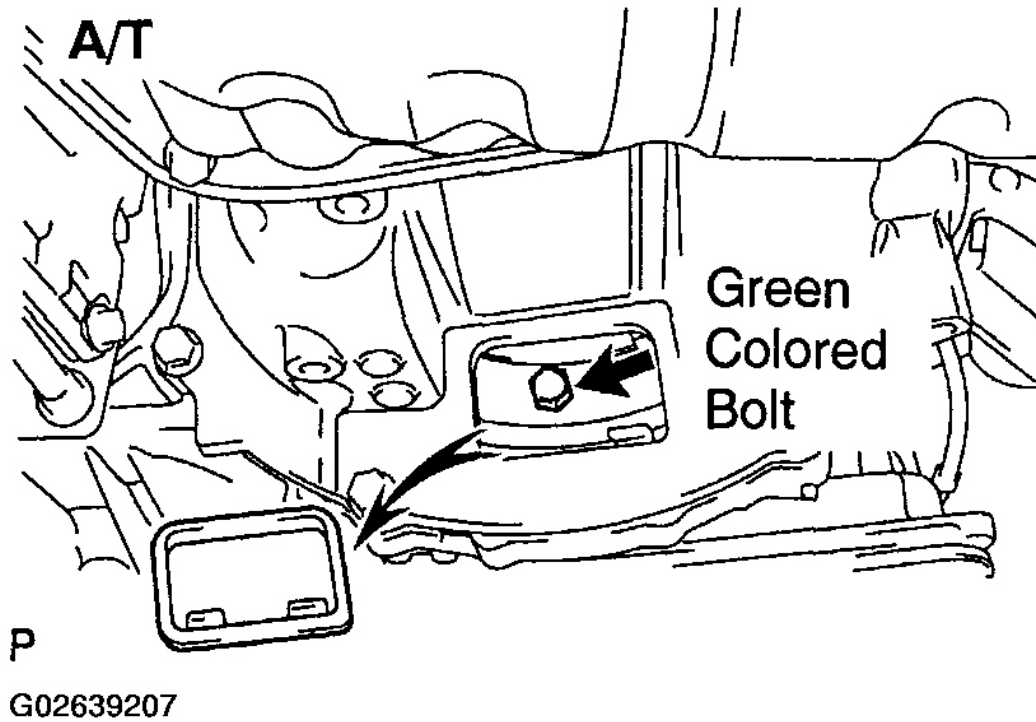
**Part No. 08833-00070, THREE BOND 1324 or equivalent**

- 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)**

**HINT:**

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

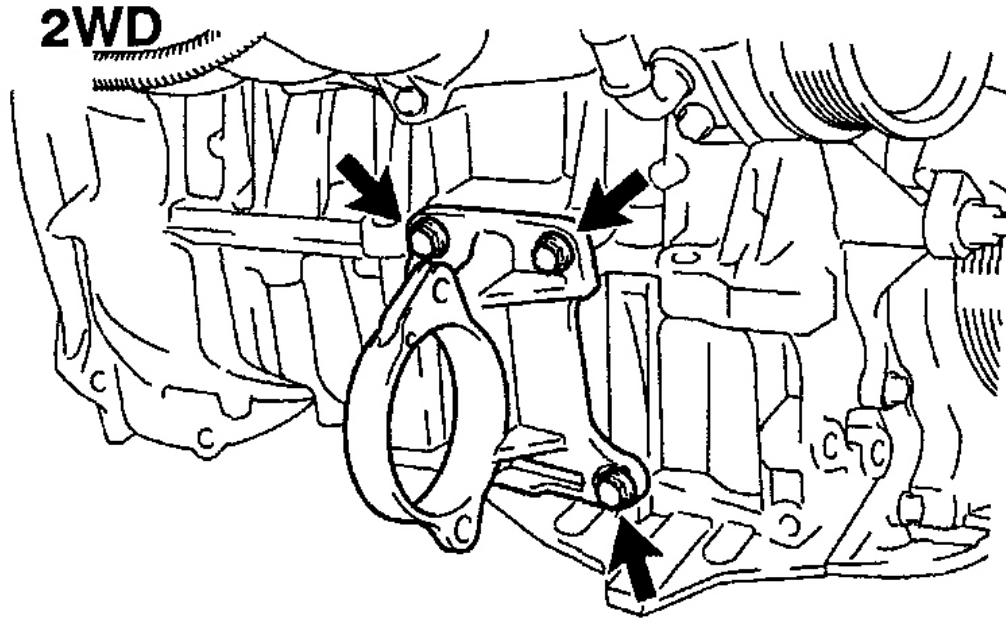


**Fig. 198: Installing Torque Converter Clutch Bolts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**10. 2WD: INSTALL CENTER BEARING BRACKET**

Install the bearing bracket with the 3 bolts.

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



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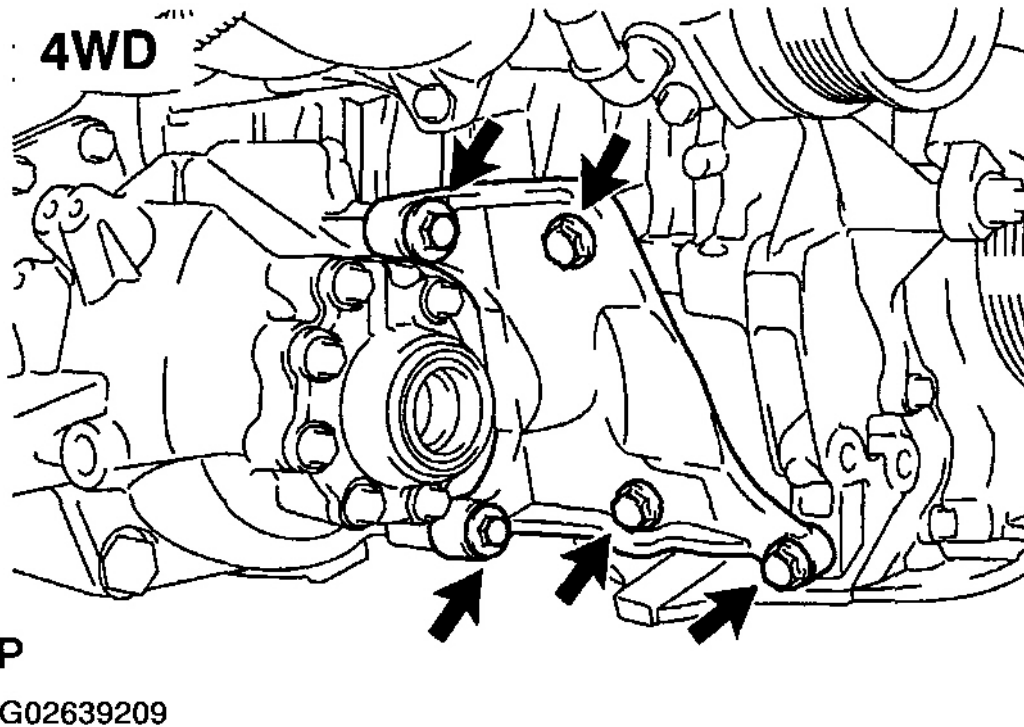
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**Fig. 199: Installing Center Bearing Bracket (2WD)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**11. 4WD: INSTALL STIFFENER PLATE**

Install the stiffener plate with the 5 bolts.

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

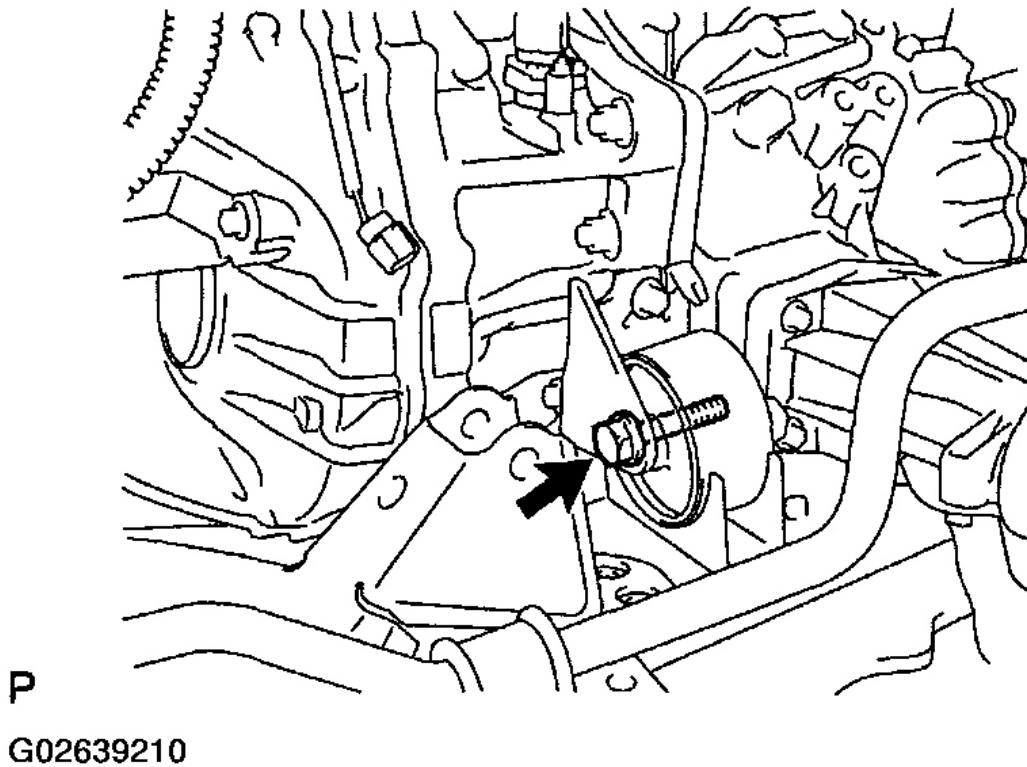


**Fig. 200: Installing Stiffener Plate (4WD)**

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.

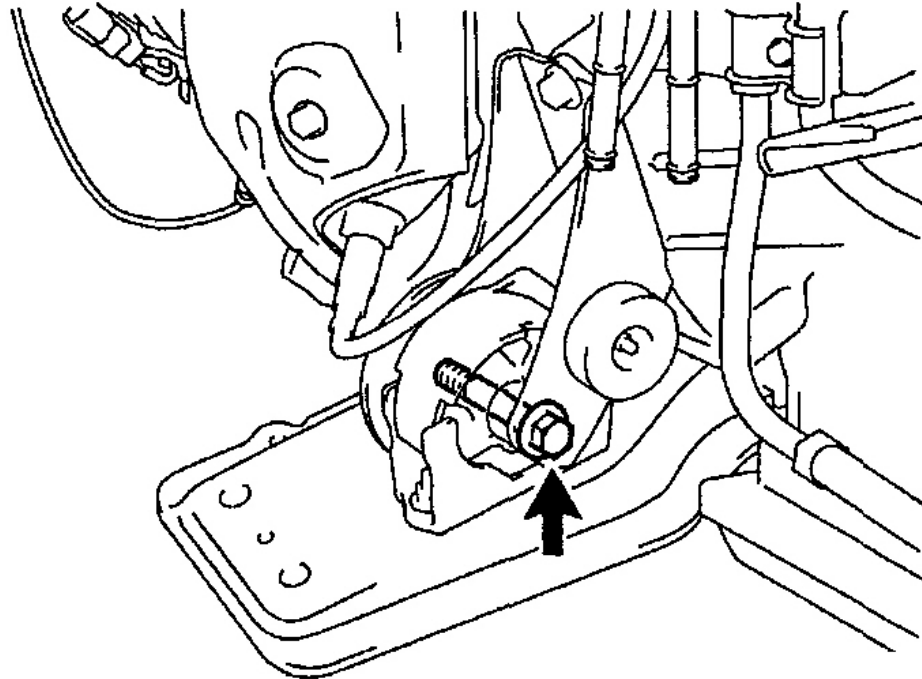
**Torque: 88 N.m (898 kgf.cm, 65 ft.lbf)**



**Fig. 201: Installing Bolt Holding Rear Engine Mounting Bracket To Mounting Insulator**  
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)**



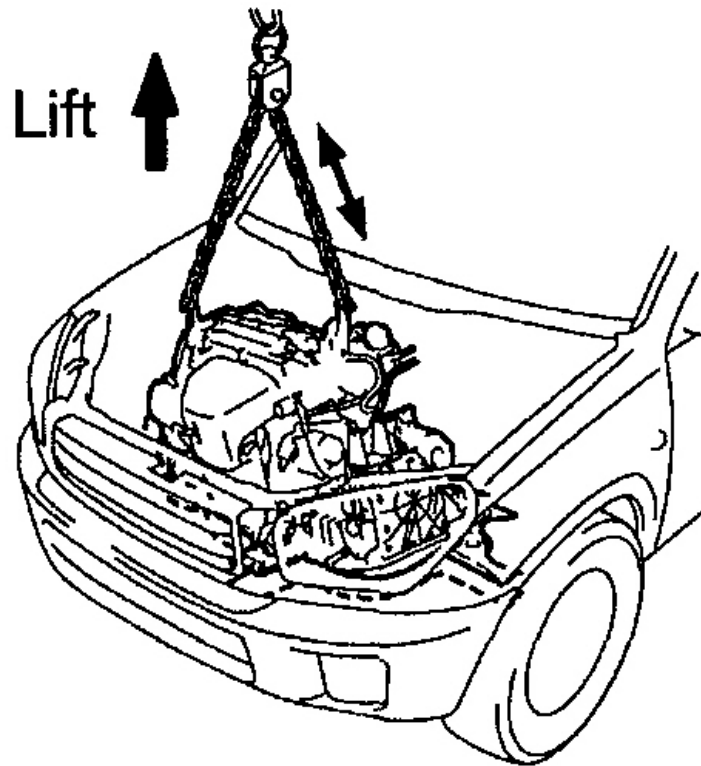
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**Fig. 202: Installing Bolt Holding Front Engine Mounting Bracket To Mounting Insulator**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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.





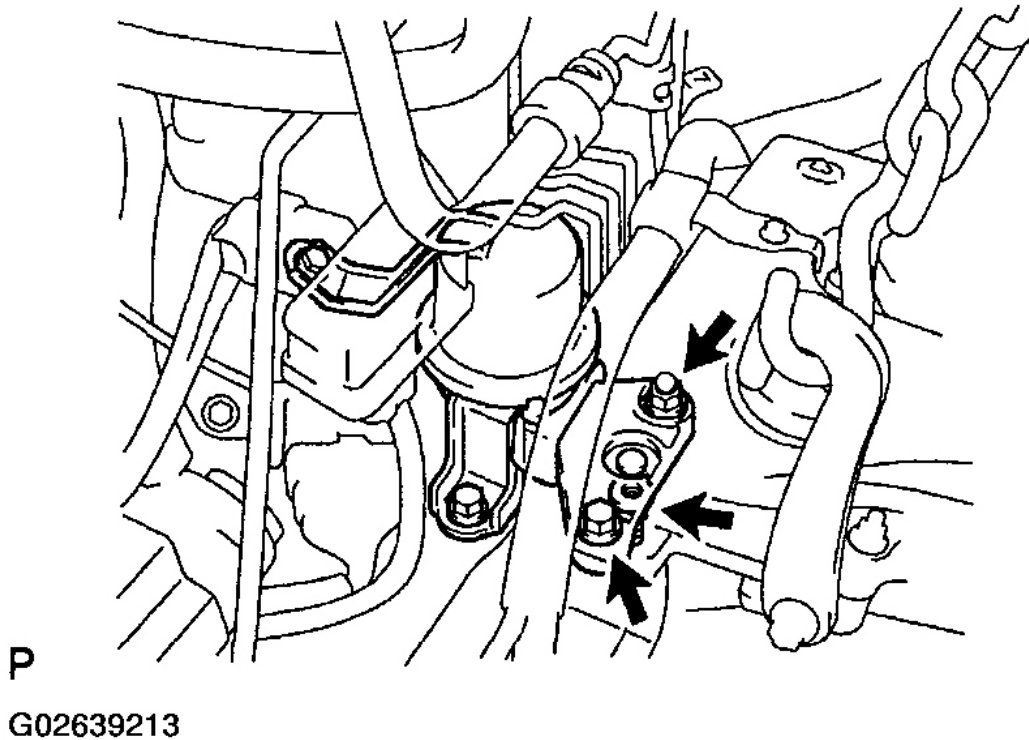
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**Fig. 203: Lifting Engine Into Engine Compartment**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- c. Install the bolt and 2 nuts holding the RH engine mounting insulator to the timing chain cover.

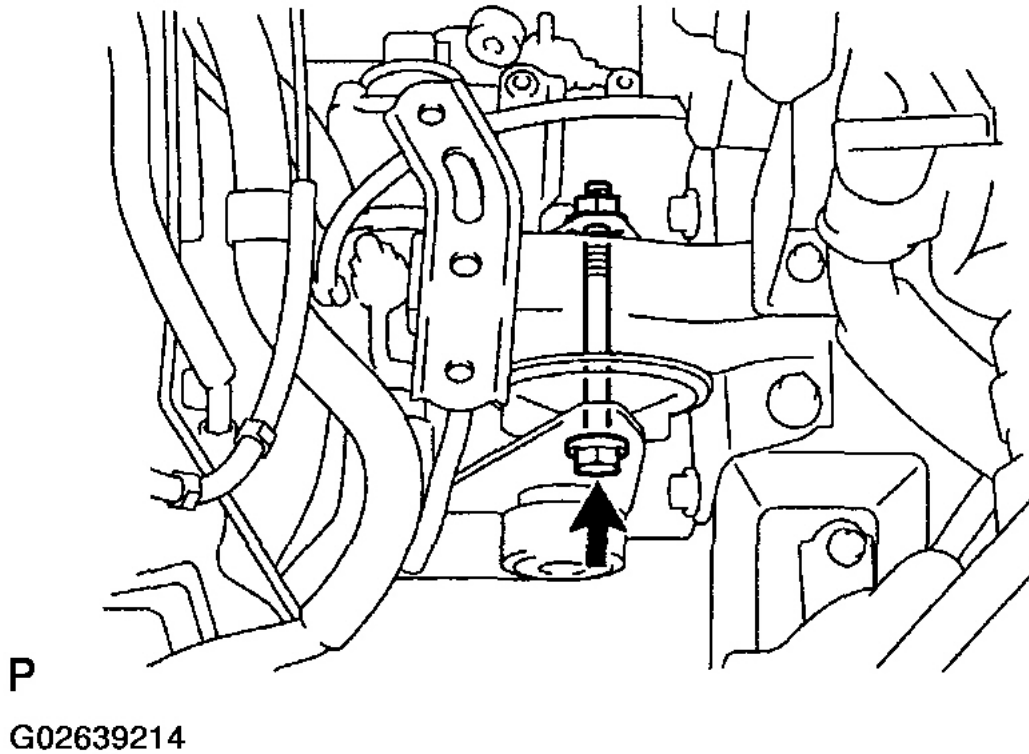
**Torque: 52 N.m (530 kgf.cm, 38 ft.lbf)**



**Fig. 204: Installing RH Engine Mounting Insulator To Timing Chain Cover**  
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)**



**Fig. 205: Installing LH Engine Mounting Bracket To Mounting Insulator**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

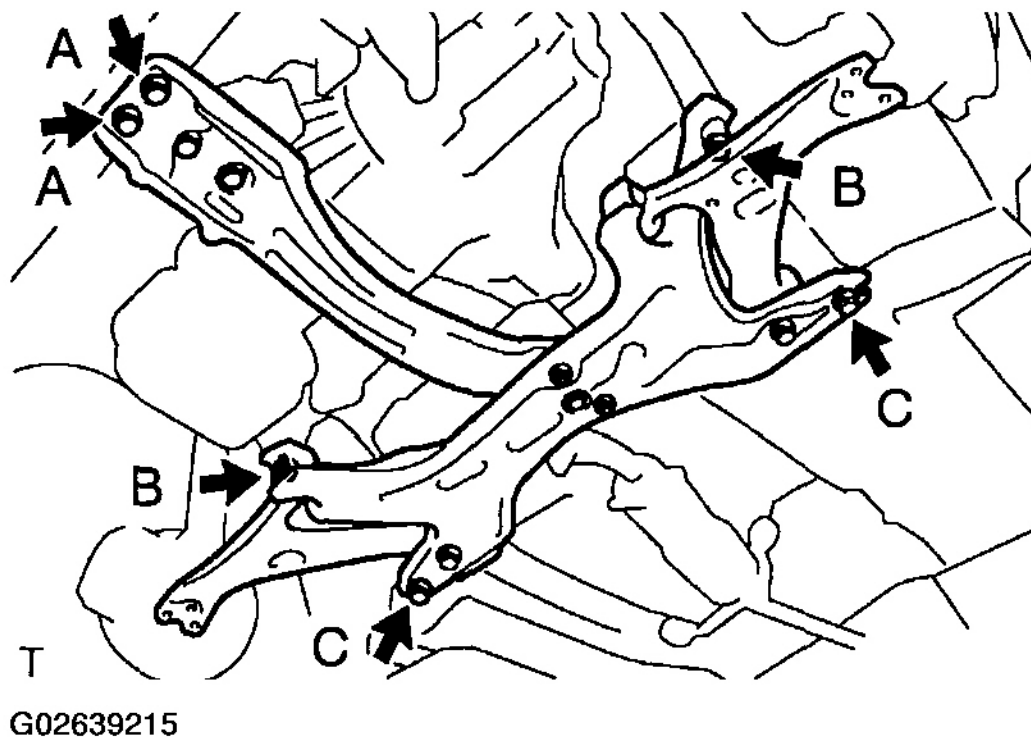
- e. Support the suspension crossmember with a jack.
- f. Install the 6 bolts holding the suspension crossmember engine mounting member to the body.

**Torque:**

**39 N.m (398 kgf.cm, 29 ft.lbf) for bolt A**

**113 N.m (1,153 kgf.cm, 83 ft.lbf) for bolt B**

**157 N.m (1,601 kgf.cm, 116 ft.lbf) for bolt C**

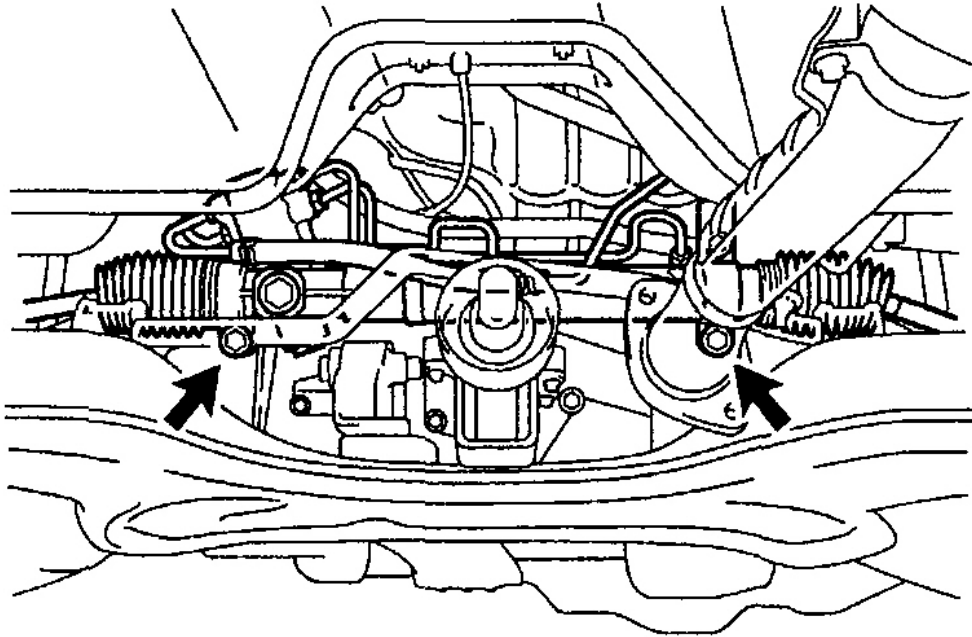


**Fig. 206: Installing Front Suspension Crossmember**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 14. INSTALL PS GEAR ASSEMBLY

Install the PS gear assembly with the 2 bolts.

**Torque: 137 N.m (1,397 kgf.cm, 101 ft.lbf)**



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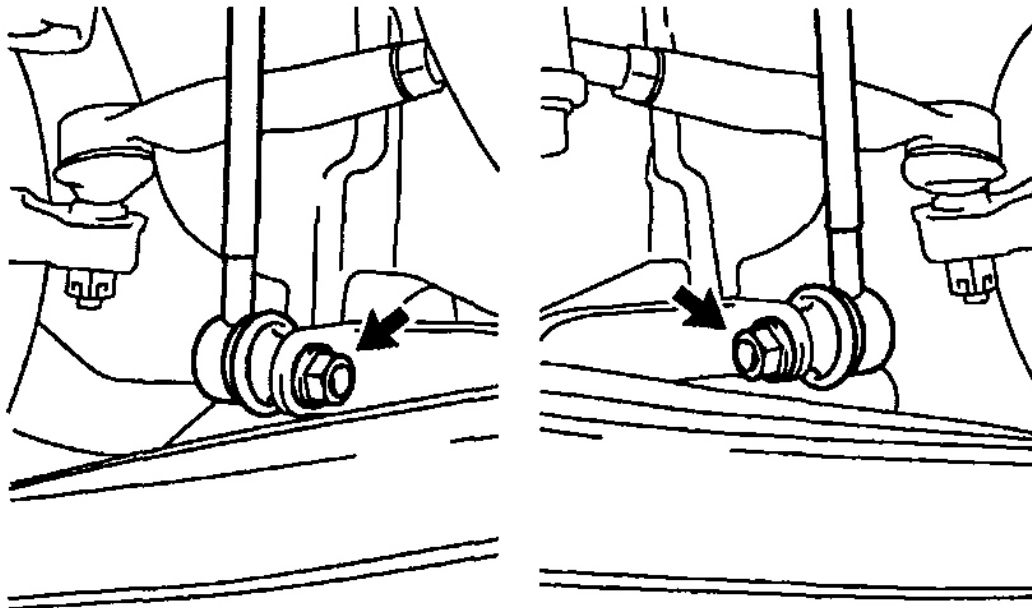
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**Fig. 207: Installing PS Gear Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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 (449 kgf.cm, 32 ft.lbf)**



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**Fig. 208: Connecting LH & RH Stabilizer Links**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

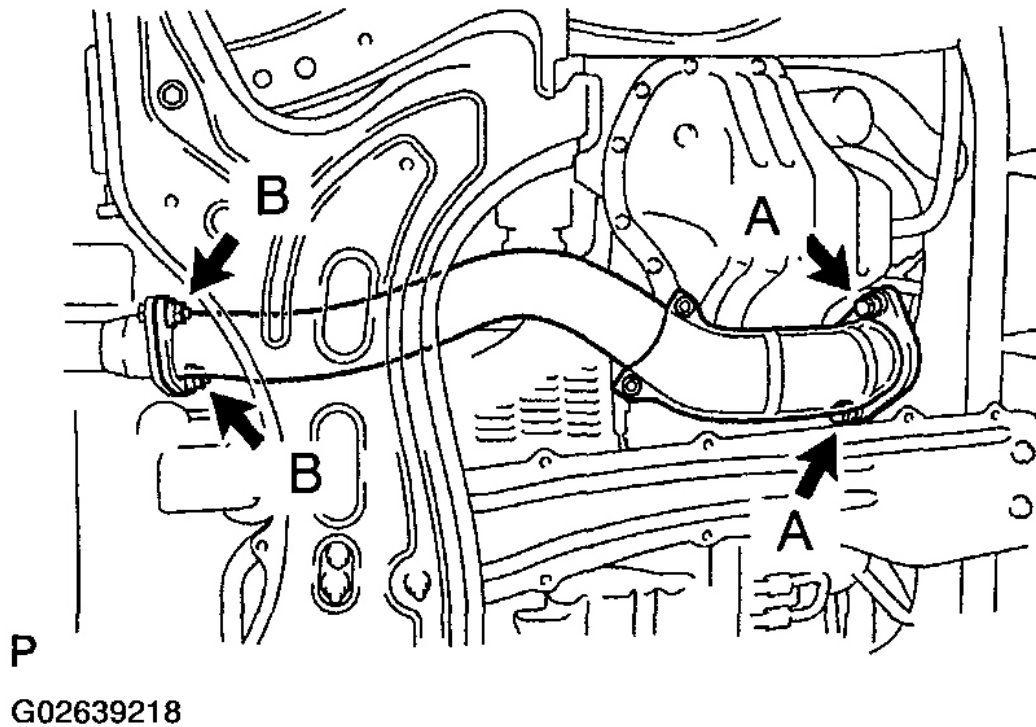
#### 17. INSTALL FRONT EXHAUST PIPE

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**

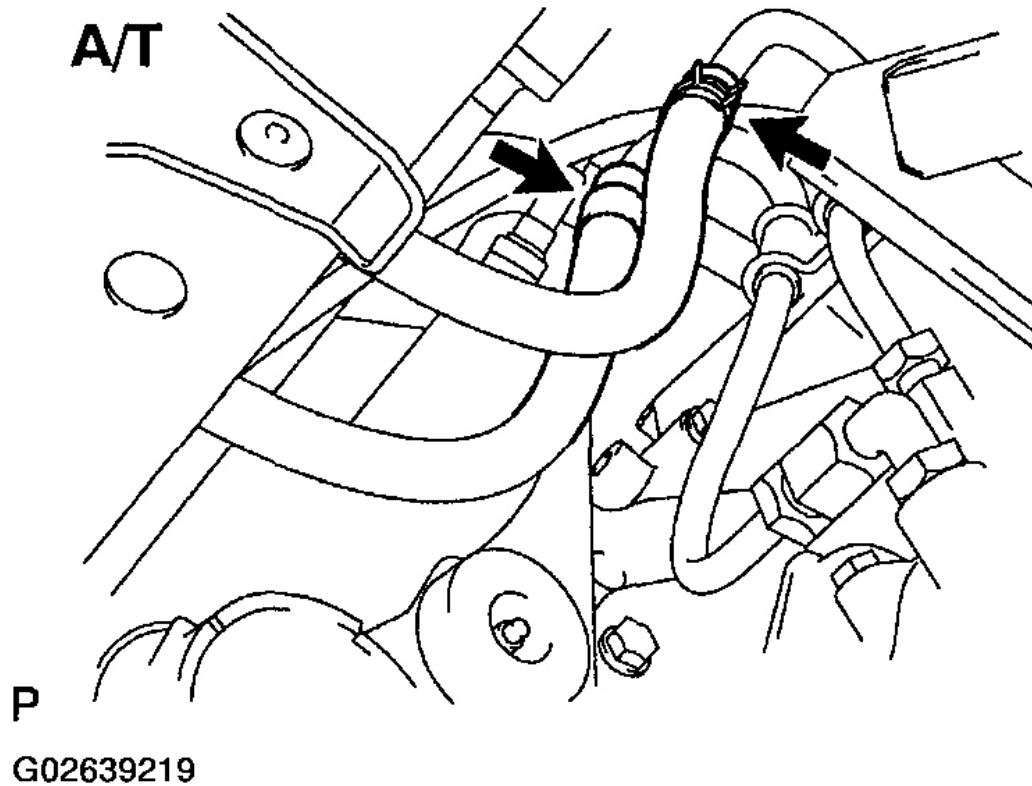


**Fig. 209: Installing Front Exhaust Pipe**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **INSTALL LH AND RH FRONT DRIVE SHAFTS (See INSTALLATION )**
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**



**Fig. 210: Connecting Oil Cooler Hoses (A/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

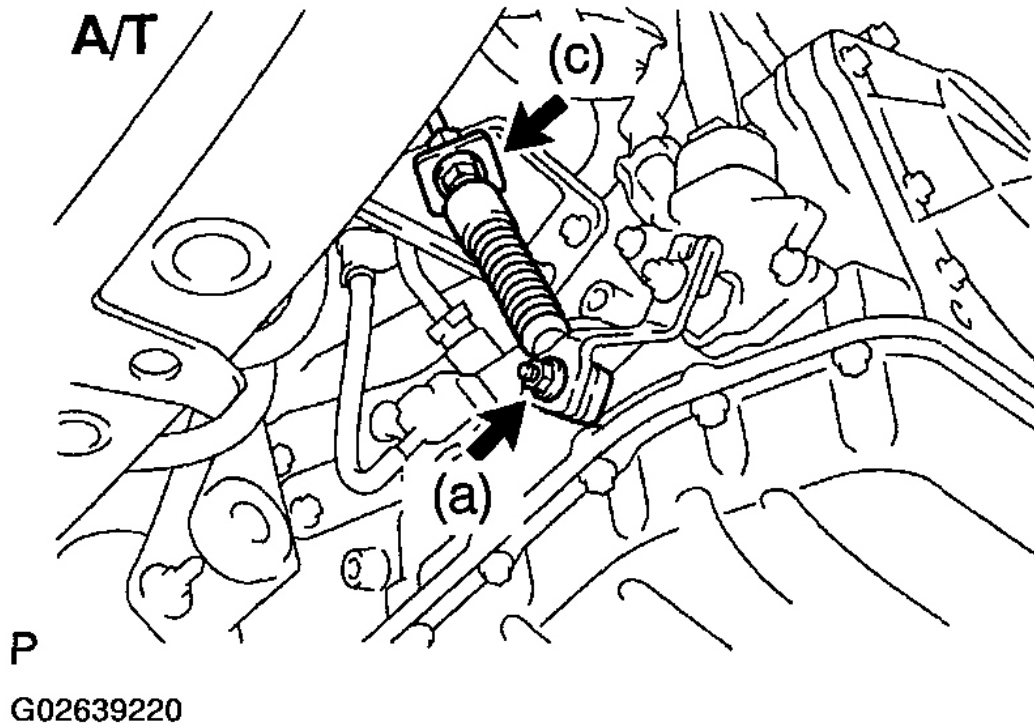
**22. A/T: CONNECT SHIFT CONTROL CABLE TO TRANSAXLE**

- a. Connect the control cable with the nut.

**Torque: 15 N.m (153 kgf.cm, 11 ft.lbf)**

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





**Fig. 211: Connecting Control Cable (A/T)**

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

**23. M/T: INSTALL CLUTCH RELEASE CYLINDER AND TUBE**

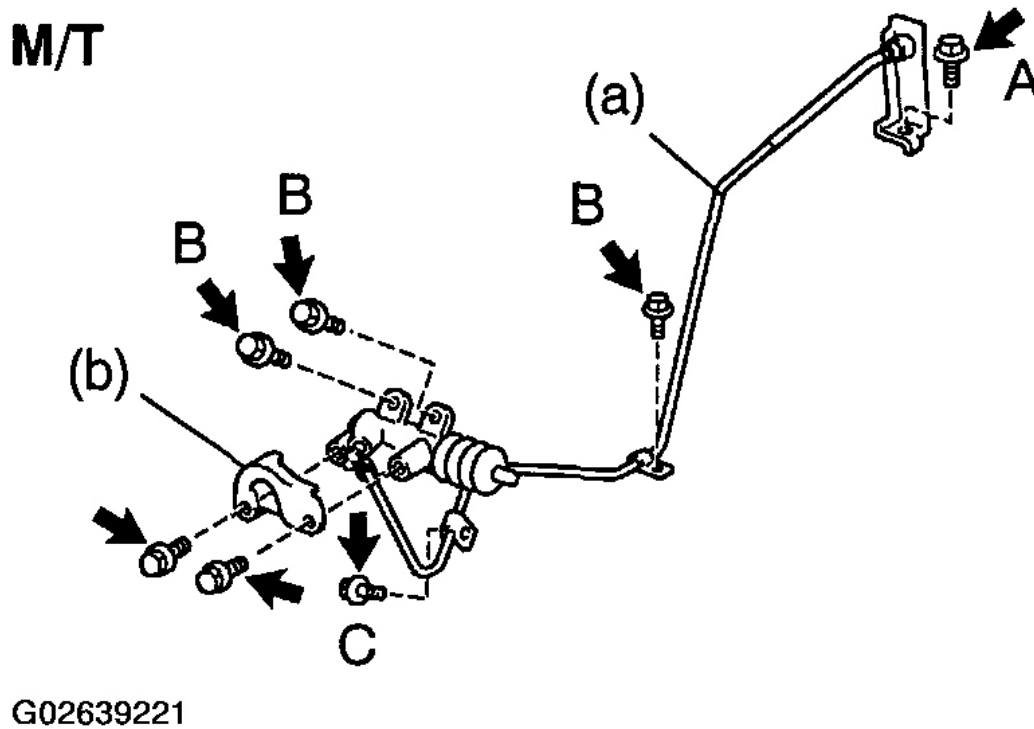
- a. Install the release cylinder with the 5 bolts.

**Torque:**

**25 N.m (255 kgf.cm, 18 ft.lbf) for bolt A**

**12 N.m (122 kgf.cm, 9 ft.lbf) for bolt B**

**5.0 N.m (51 kgf.cm, 44 in.lbf) for bolt C**



**Fig. 212: Installing Clutch Release Cylinder & Tube (M/T)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the heat insulator with the 2 bolts.

**Torque: 12 N.m (122 kgf.cm, 9 ft.lbf)**

## 24. INSTALL STARTER

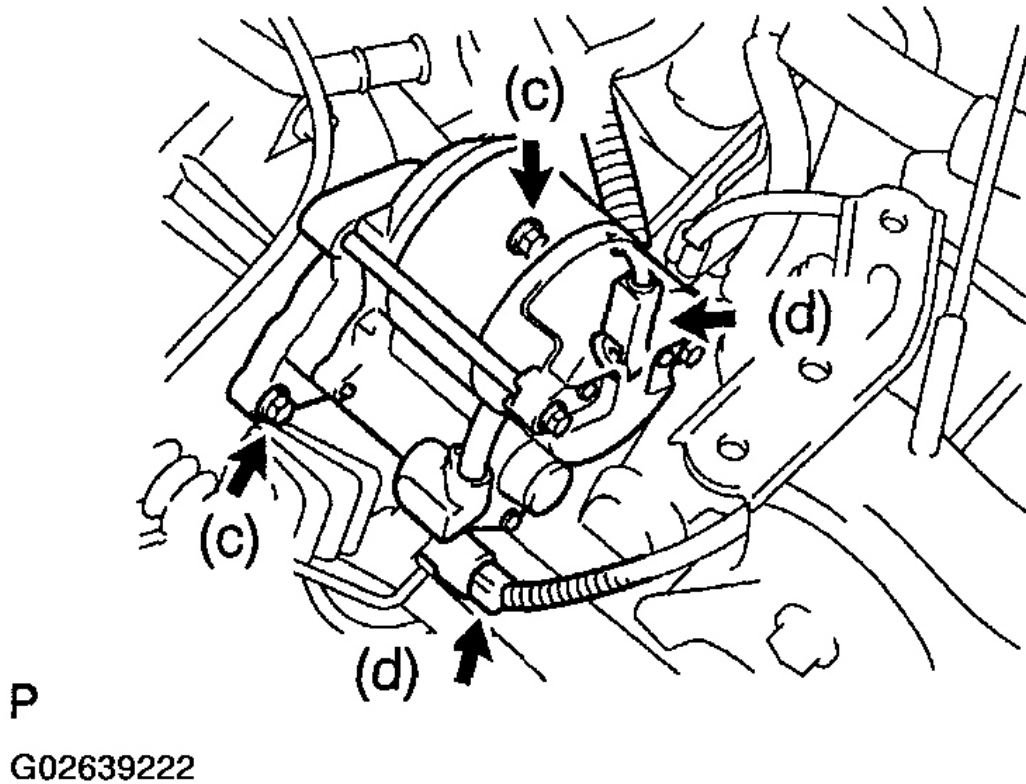
- a. Install the starter.
- b. Connect the starter cable with the nut.

**Torque: 8.8 N.m (90 kgf.cm, 78 in.lbf)**

- c. Install the starter with the 2 bolts.

**Torque: 37 N.m (377 kgf.cm, 27 ft.lbf)**

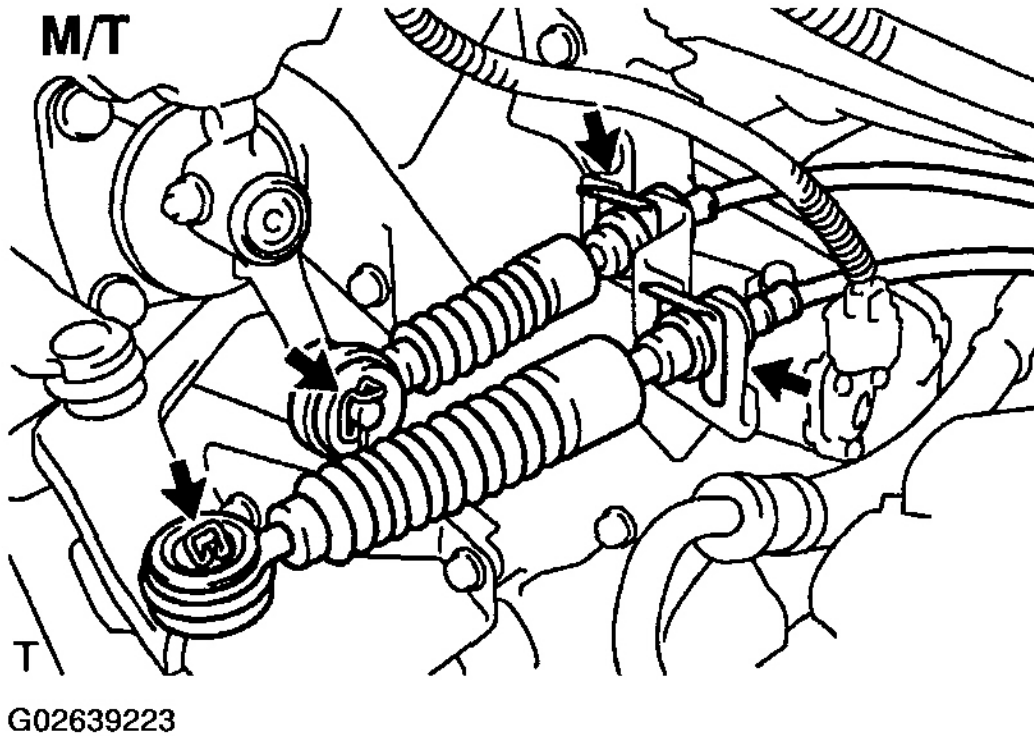
- d. Connect the connector.



**Fig. 213: Installing Starter**

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

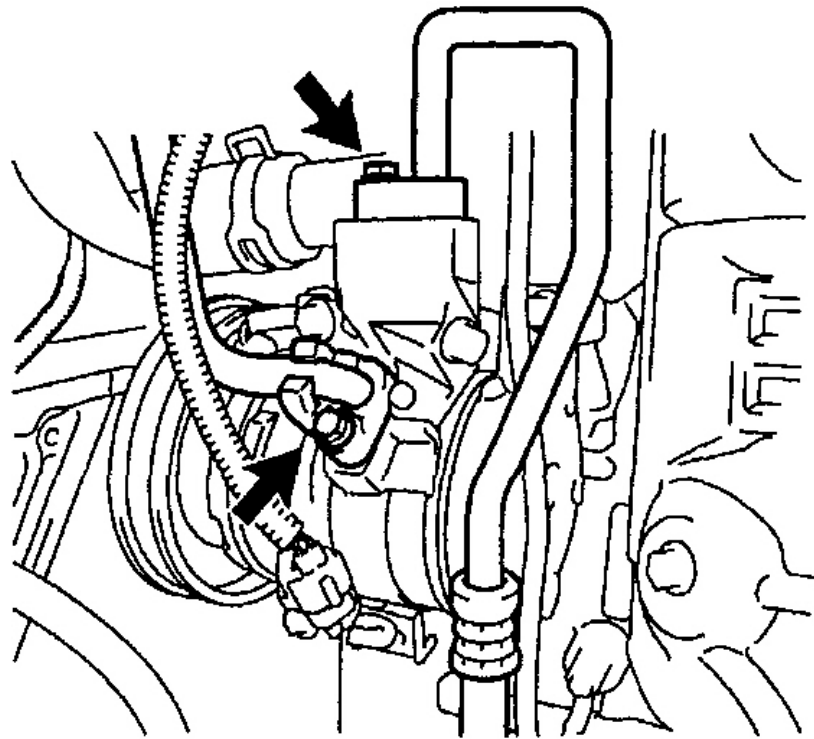
- e. Connect the hose to the dipstick guide.
- 25. **M/T: CONNECT SHIFT CONTROL CABLES TO TRANSAXLE**
  - a. Connect the 2 control cables with the 2 clips.
  - b. Install the 2 washers and 2 clips.



**Fig. 214: Connecting Shift Control Cables To Transaxle (M/T)**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**26. CONNECT TUBES, HOSES, CONNECTOR, CABLE AND WIRE**

- a. Install 2 new O-rings, and connect the discharge and liquid tubes to the compressor (see **REMOVAL** ).

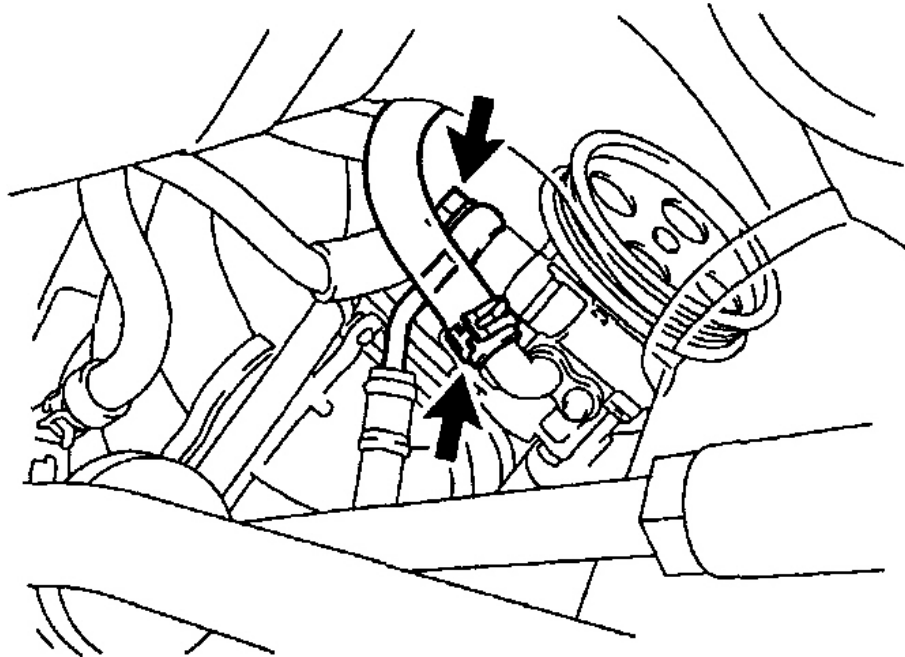


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**Fig. 215: Connecting Discharge & Liquid Tubes To A/C Compressor**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Connect the accelerator cable.
- c. Connect the ground wire to the cylinder head.
- d. Install a new gasket, and connect the suction hose and pressure feed tube to the PS vane pump.

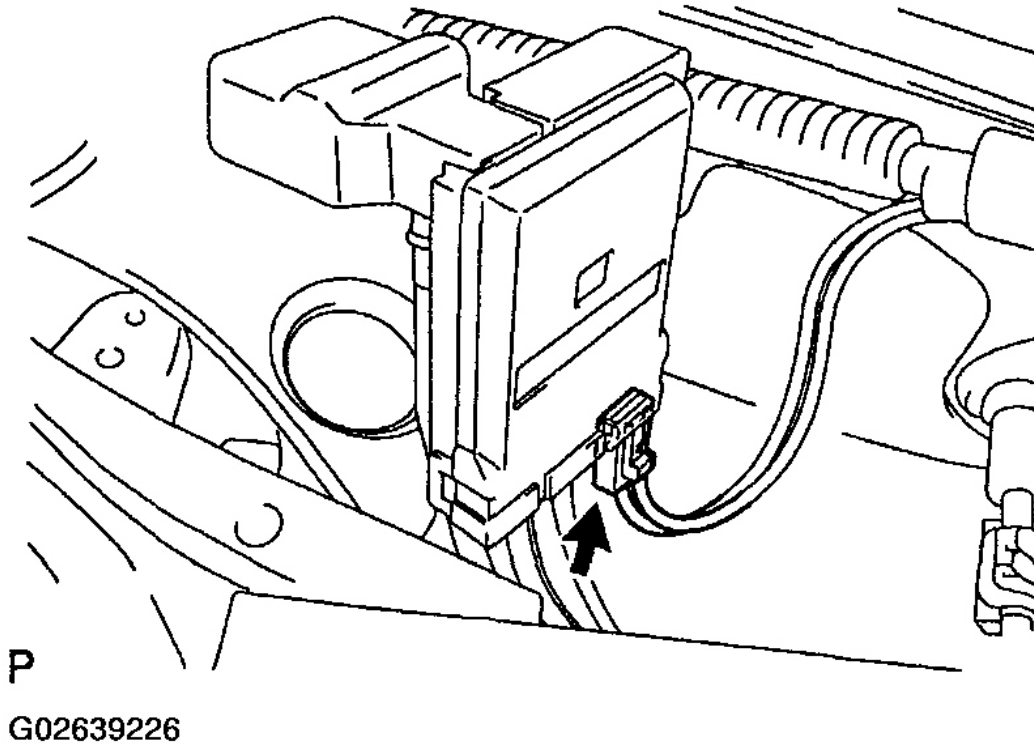


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**Fig. 216: Installing Suction Hose And Pressure Feed Tube To PS Vane Pump**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Connect the upper radiator hose.
- f. Connect the lower radiator hose.
- g. Connect the fuel tube connector (see **SFI** ).
- h. Connect the 2 heater hoses.
- i. Connect the connector to the fusible link block.



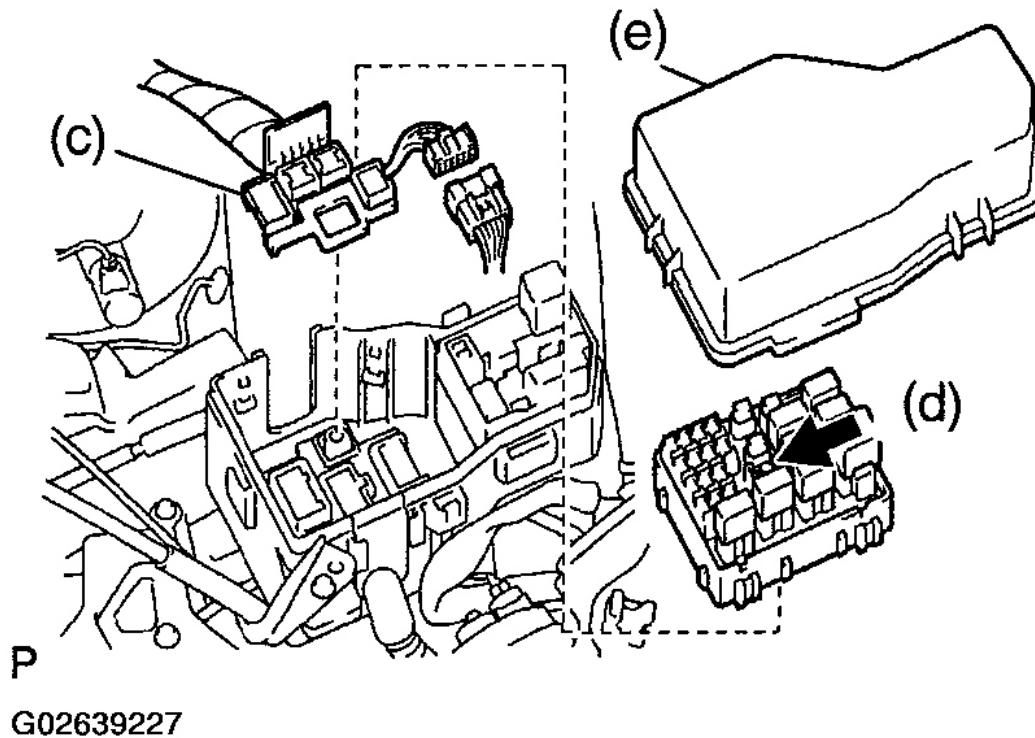
**Fig. 217: Connecting Harness Connector To Fusible Link Block**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**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**

- 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.

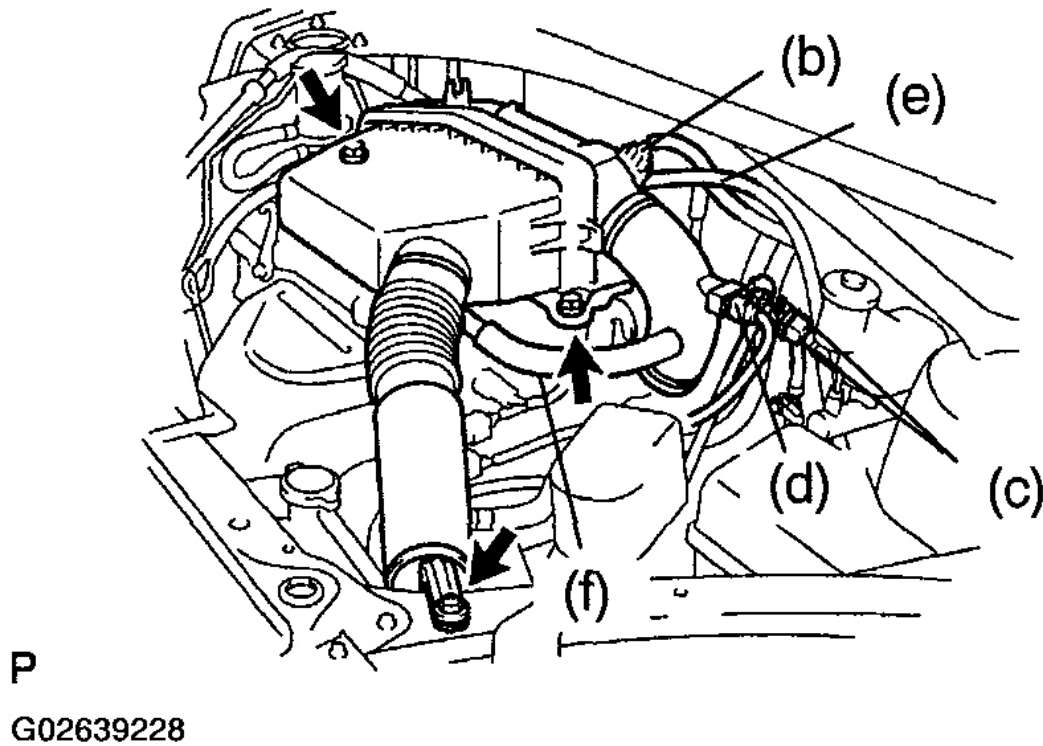


**Fig. 218: Installing Engine Room Junction/Box**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 29. INSTALL AIR CLEANER ASSEMBLY

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

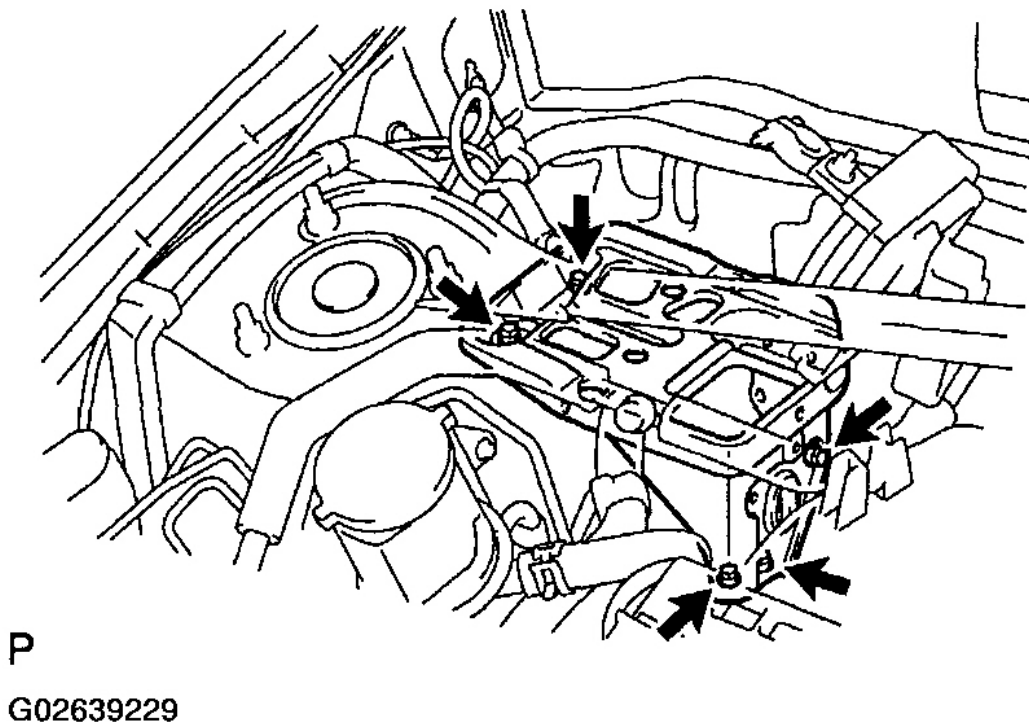




**Fig. 219: Installing Air Cleaner Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**30. INSTALL BATTERY AND TRAY**

- a. Install the battery bracket with the 5 bolts.
- b. Install the battery tray and battery with the hold-down clamp.



**Fig. 220: Installing Battery Bracket**

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

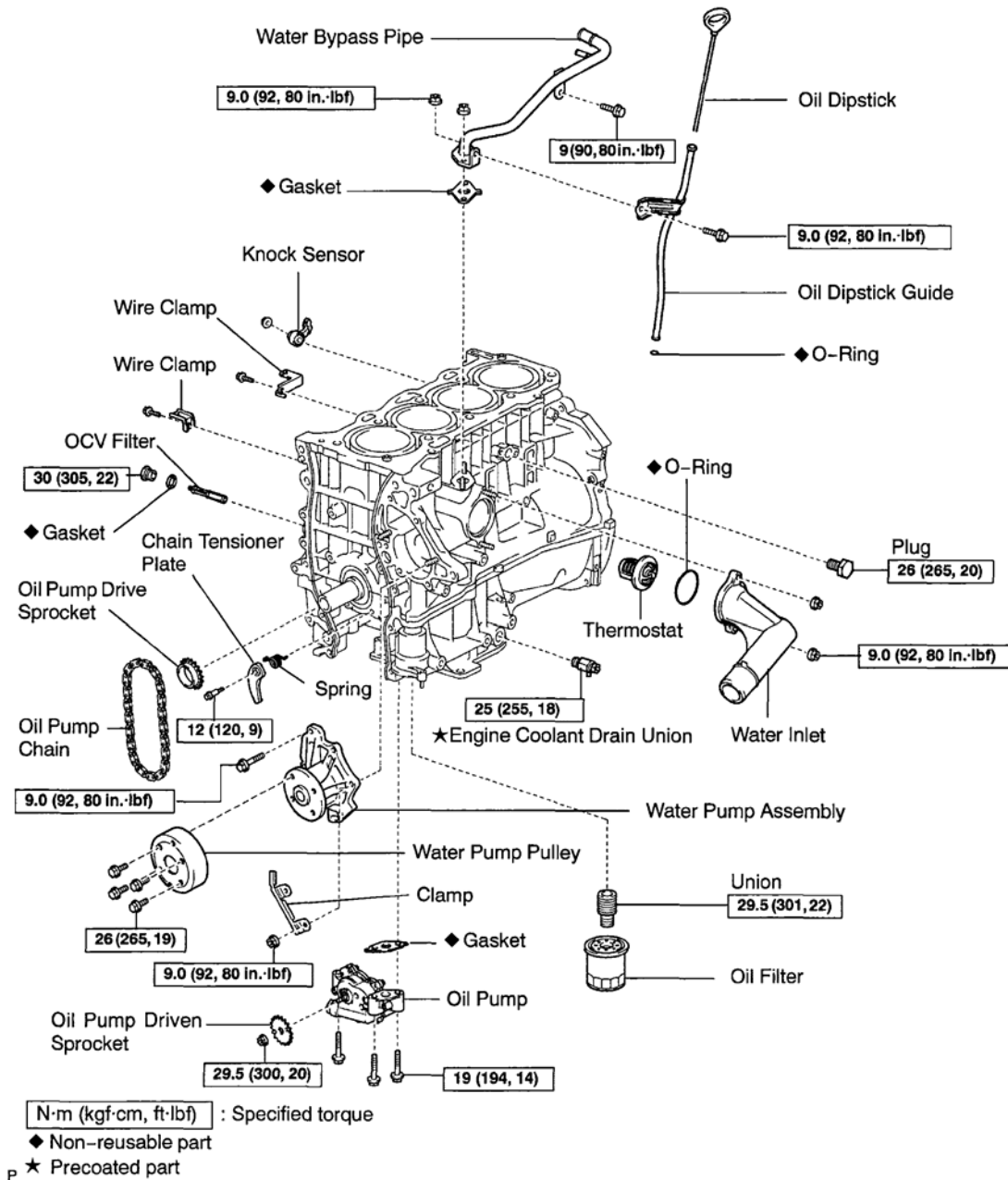
- c. Install the cowl top ventilation louver (see INSTALLATION ).
- 31. **INSTALL RADIATOR RESERVOIR TANK**
- 32. **INSTALL HOOD (See HOOD )**
- 33. **FILL WITH ENGINE COOLANT**
- 34. **FILL WITH ENGINE OIL**
- 35. **FILL WITH TRANSFER OIL**
- 36. **FILL WITH TRANSAXLE OIL**
- 37. **START ENGINE AND CHECK FOR LEAKS**
- 38. **BLEED POWER STEERING SYSTEM (See BLEEDING )**
- 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**

### CYLINDER BLOCK

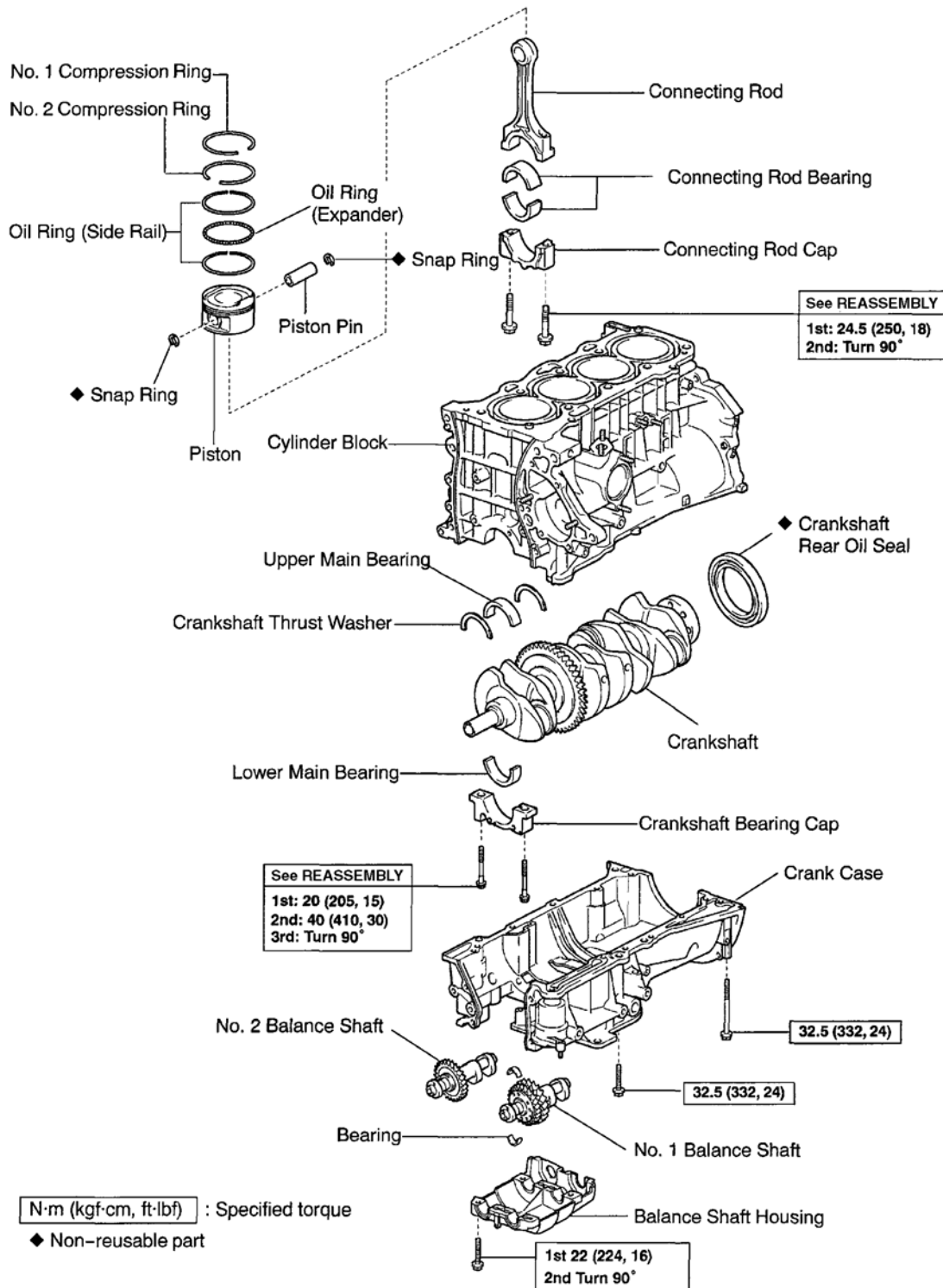
#### COMPONENTS



**Fig. 221: Identifying Cylinder Block Components & Torque Specifications (1 Of 2)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4



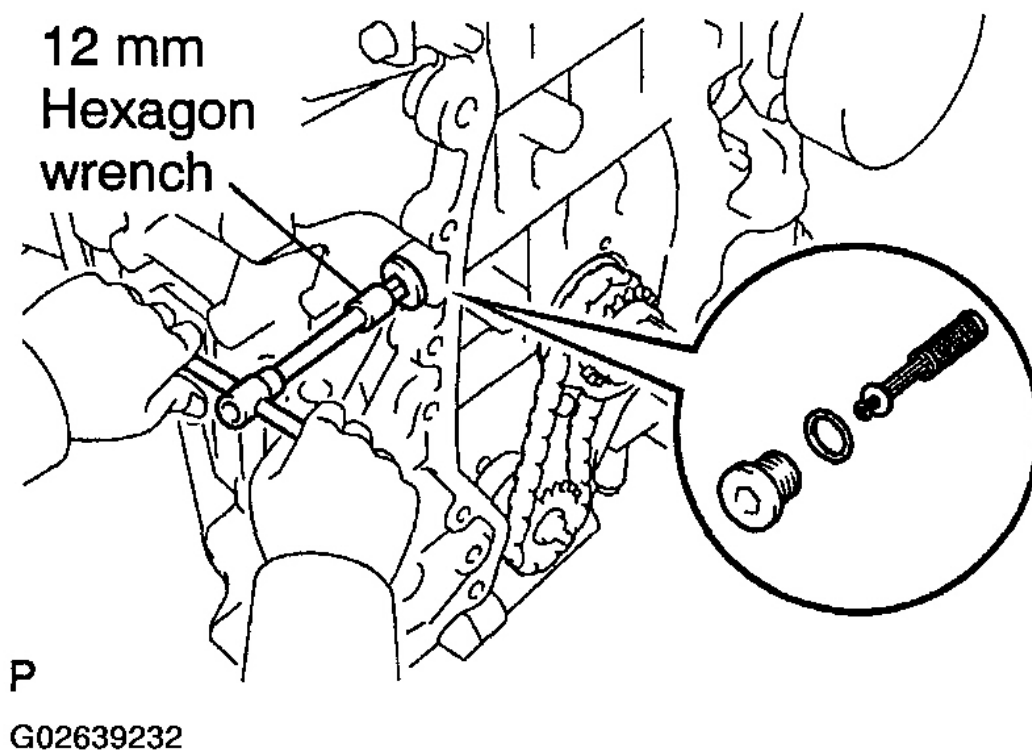
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**Fig. 222: Identifying Cylinder Block Components & Torque Specifications (2 Of 2)**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**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 KNOCK SENSOR )**
5. **REMOVE ENGINE WIRE CLAMPS**
6. **REMOVE PLUG**
7. **REMOVE OCV FILTER**

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

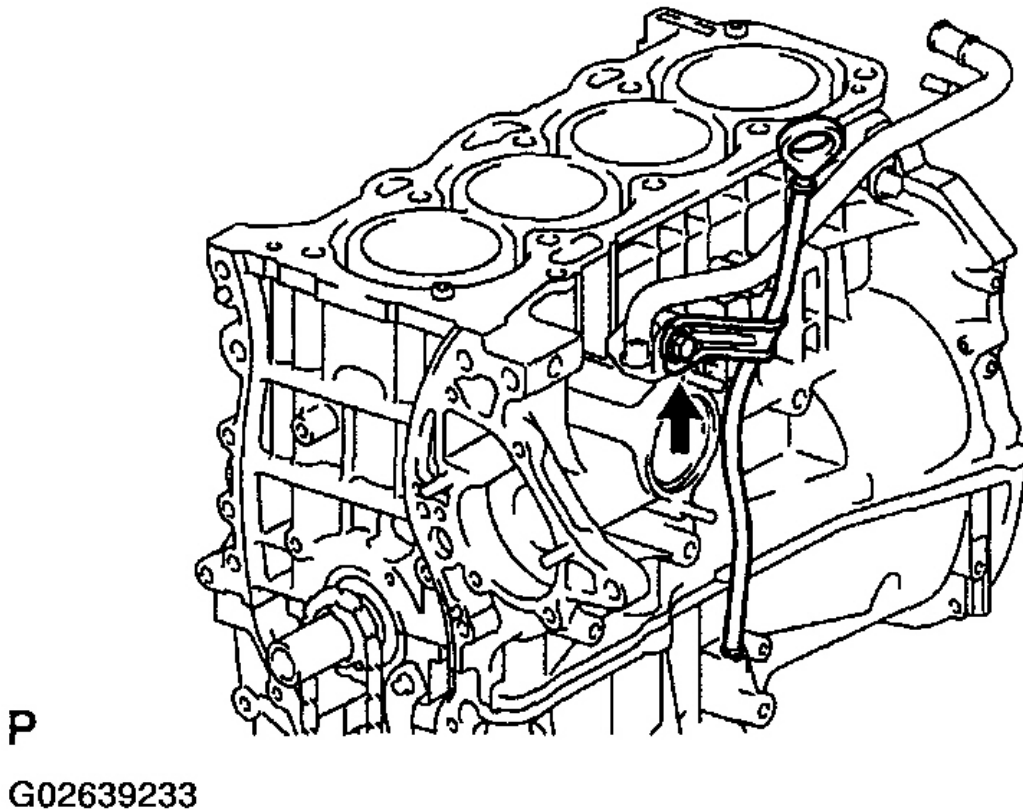


**Fig. 223: Removing Plug, Gasket & OCV Filter**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

8. **REMOVE WATER PUMP (See REMOVAL )**
9. **REMOVE THERMOSTAT (See REMOVAL )**
10. **REMOVE ENGINE COOLANT DRAIN UNION**

**11. REMOVE OIL DIPSTICK AND GUIDE**

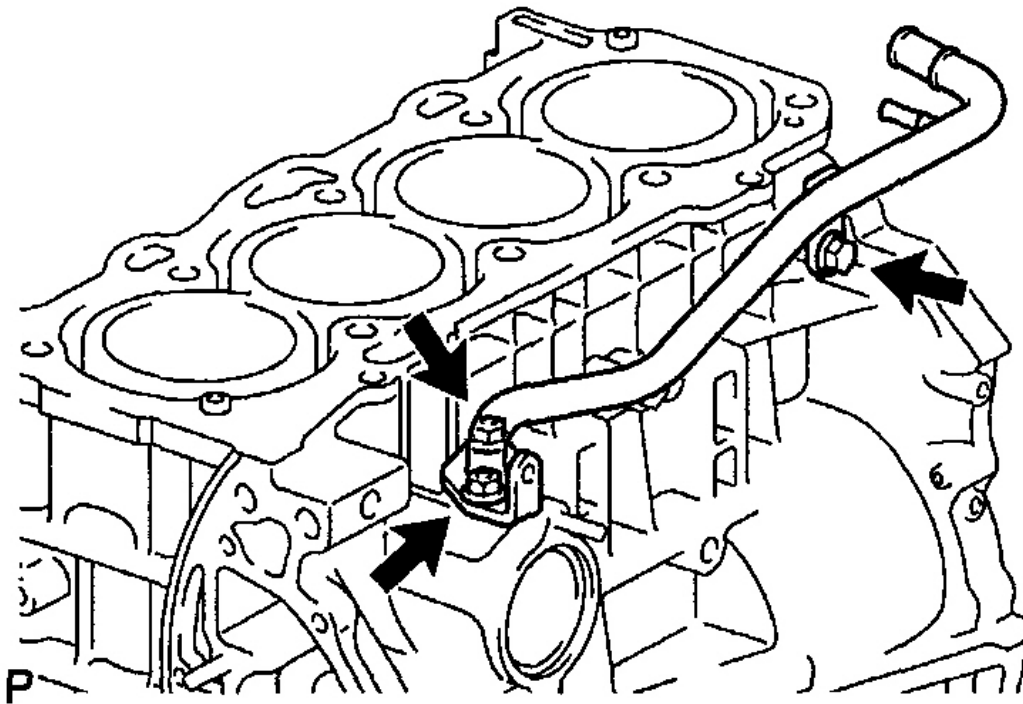
- a. Remove the bolt, oil dipstick and guide.
- b. Remove the O-ring from the oil dipstick.



**Fig. 224: Removing Oil Dipstick & Guide**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**12. REMOVE WATER BYPASS PIPE**

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

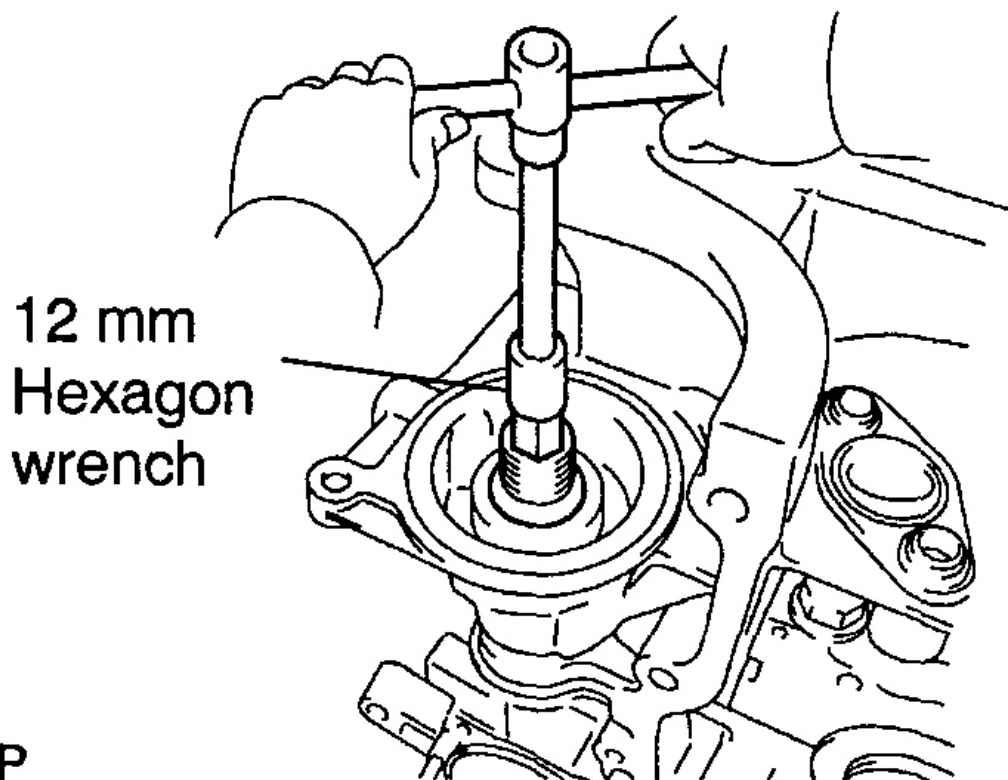


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**Fig. 225: Removing Water Bypass Pipe**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

13. **REMOVE OIL PUMP** (See REMOVAL )
14. **REMOVE OIL FILTER** (See REPLACEMENT )
15. **REMOVE OIL FILTER UNION**

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



12 mm  
Hexagon  
wrench

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**Fig. 226: Removing Oil Filter Union**

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

#### 16. CHECK BALANCE SHAFT THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while moving the balance shaft back and forth.

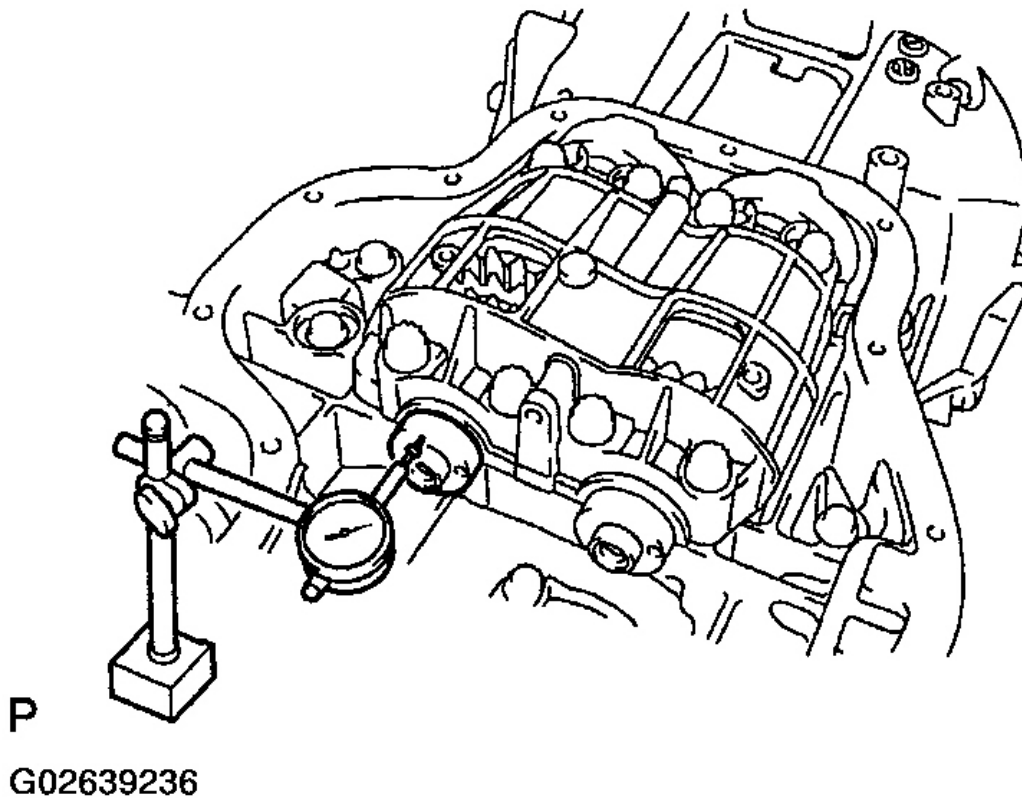
**Standard thrust clearance:**

**0.050 to 0.090 mm (0.00197 to 0.00354 in.)**

**Maximum thrust clearance: 0.090 mm (0.00354 in.)**

If the thrust clearance is greater than maximum, replace the balance shaft housing and bearings. If necessary, replace the balance shaft.



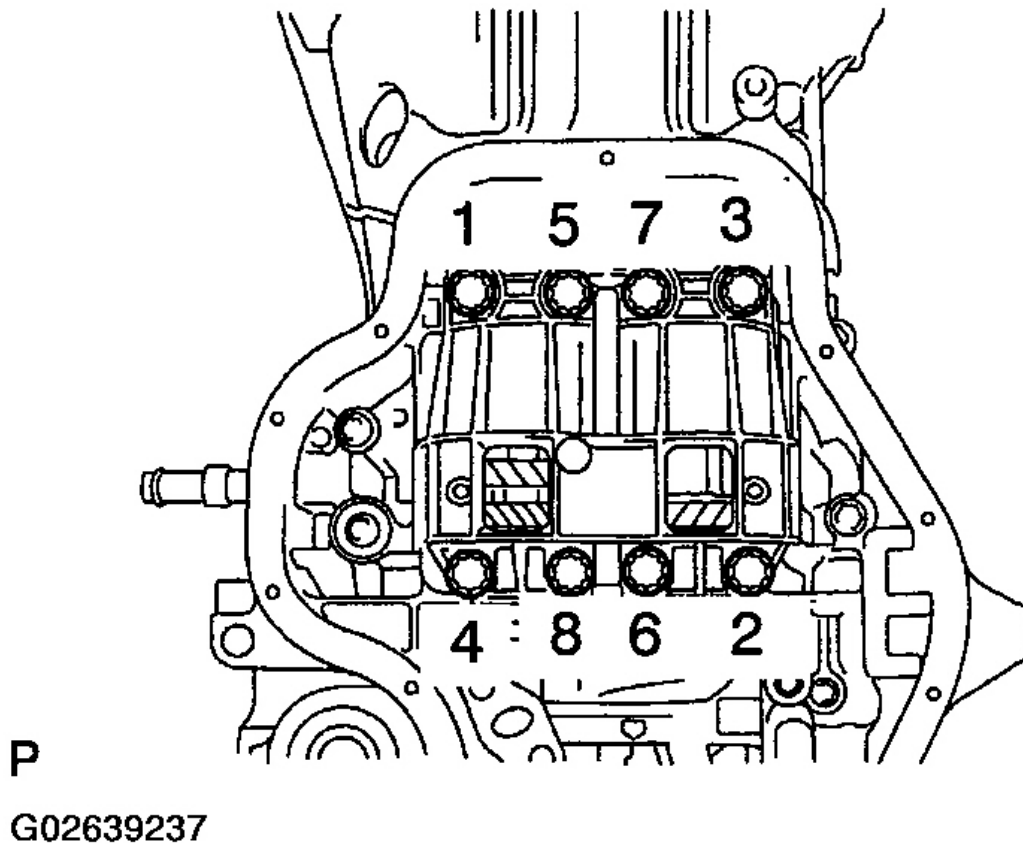


**Fig. 227: Measuring Balance Shaft Thrust Clearance**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**17. REMOVE BALANCE SHAFT HOUSING AND CHECK OIL CLEARANCE**

- a. Uniformly loosen and remove the 8 bolts in several passes, in the sequence shown.

If the balance shaft housing is difficult to lift up, pry between the balance shaft housing and crank case with a screwdriver.



**Fig. 228: Removing Balance Shaft Housing**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**NOTE:** Be careful not to damage the contact surfaces of the balance shaft housing and crank case.

**HINT:**

Keep the lower bearing and balance shaft housing together.

- b. Lift out the No. 1 and No. 2 balance shafts.

**HINT:**

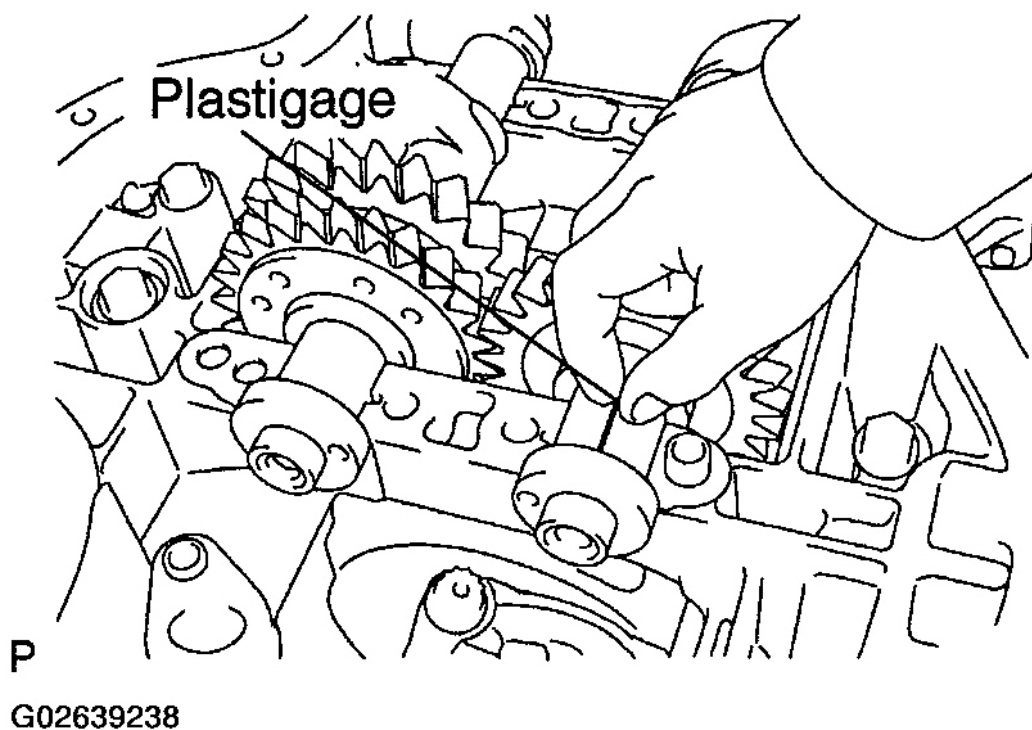
Keep the upper bearing with the crank case.

- c. Clean each bearings and journals.

- d. Check each bearings and journals for pitting and scratches.

If the bearing or journal is damaged, replace the bearings. If necessary, replace the balance shaft.

- e. Place the No. 1 and No. 2 balance shafts on the crank case.
- f. Lay a strip of Plastigage across each journal.



**Fig. 229: Placing Plastigage Across Each Journal**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- g. Install the balance shaft housing (see **REASSEMBLY**).

**NOTE:**        **Do not turn the balance shaft.**

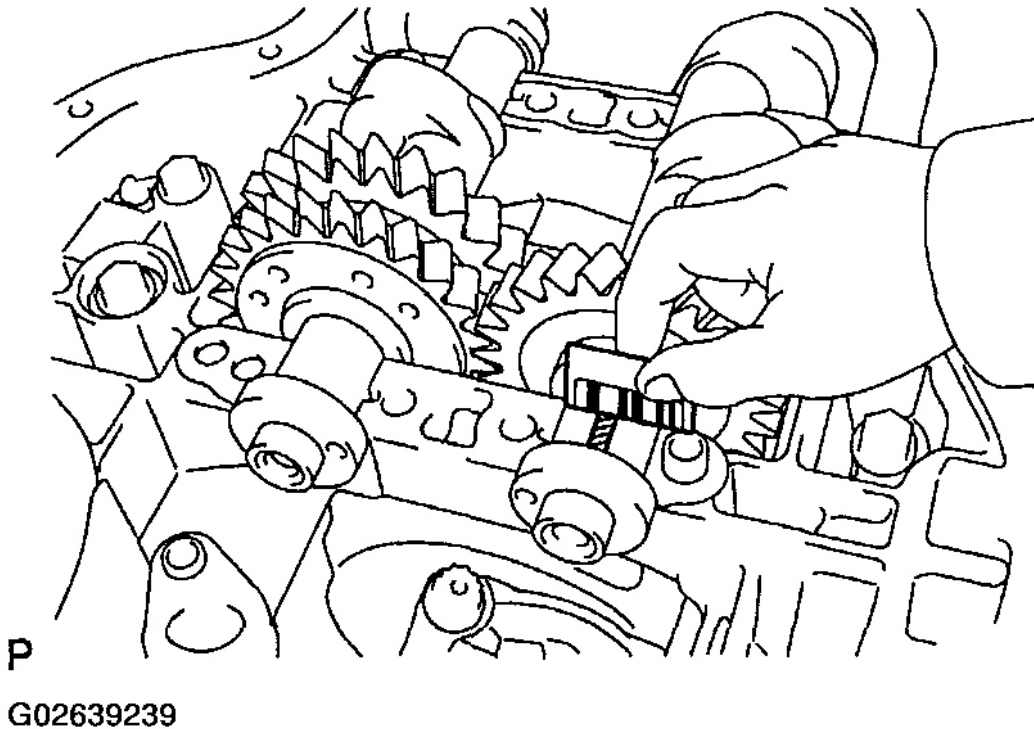
- h. Remove the balance shaft housing (See procedure () above).
- i. Measure the Plastigage at its widest point.

**Standard clearance:**

**0.004 to 0.049 mm (0.00016 to 0.00192 in.)**

If the oil clearance is greater than standard, replace the bearings.

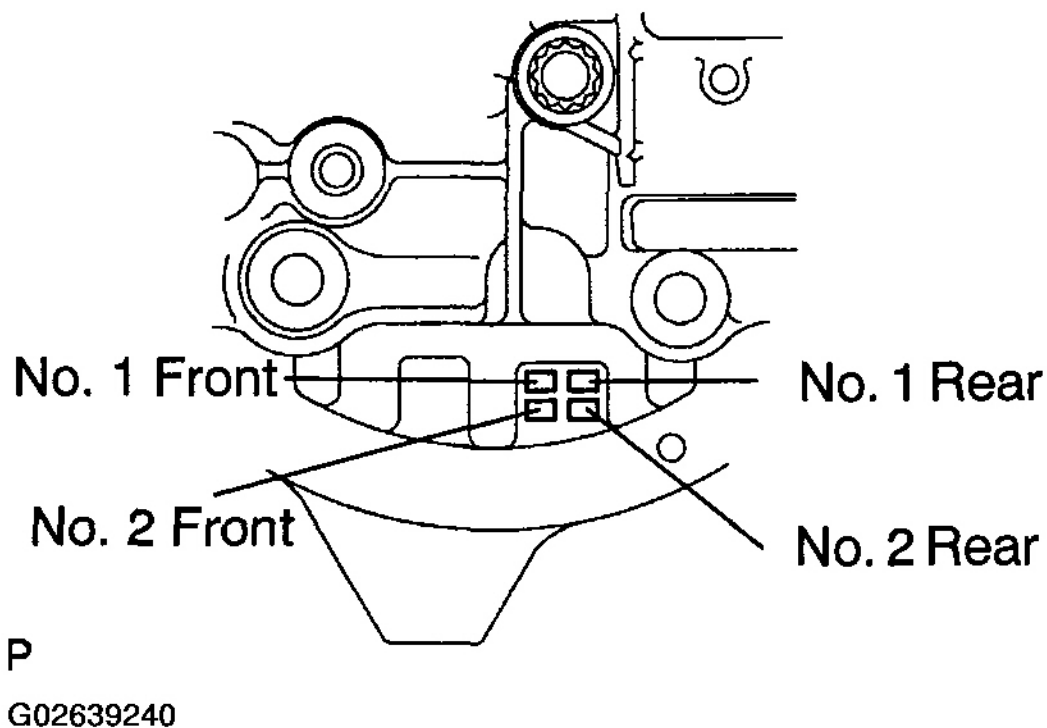
If necessary, replace the balance shaft.



**Fig. 230: Measuring Plastigage At Its Widest Point**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

If using a standard bearing, replace it with one having the same number.



**Fig. 231: Locating Standard Bearing Identification**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

(Reference)

**Balance Shaft Housing Journal Bore Diameter:**

**BALANCE SHAFT HOUSING JOURNAL BORE DIAMETER**

Mark 1	26.000 to 26.006 mm (1.02362 to 1.02386 in.)
Mark 2	26.007 to 26.012 mm (1.02390 to 1.02409 in.)
Mark 3	26.013 to 26.018 mm (1.02413 to 1.02433 in.)

**Balance shaft journal diameter:**

**22.985 to 23.000 mm (0.90492 to 0.90551 in.)**

**Standard bearing center wall thickness:**

**STANDARD BEARING CENTER WALL THICKNESS**

Mark 1	1.486 to 1.489 mm (0.05850 to 0.05862 in.)

Mark 2	1.490 to 1.492 mm (0.05866 to 0.05874 in.)
Mark 3	1.493 to 1.495 mm (0.05877 to 0.05885 in.)

**18. REMOVE BALANCE SHAFT**

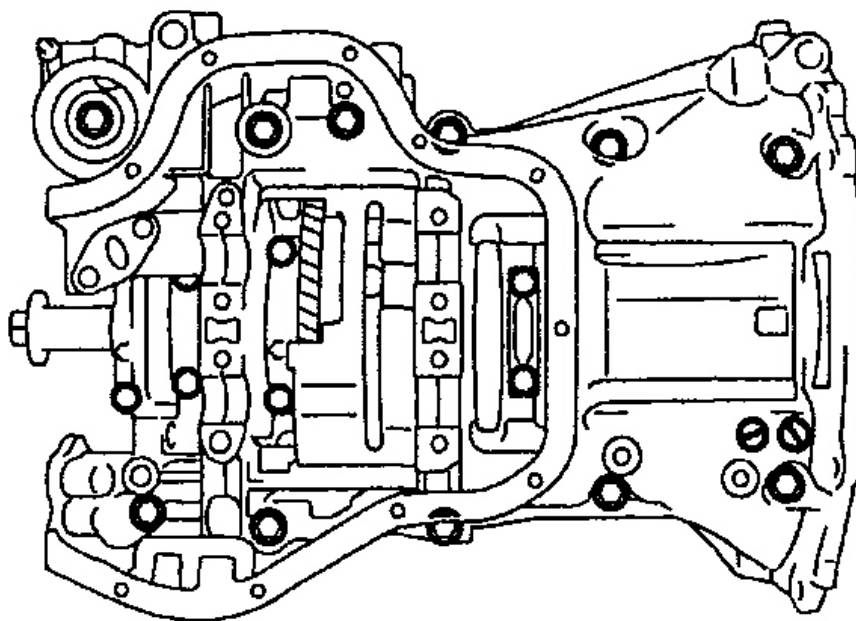
- a. Lift out the balance shaft.
- b. Remove the 4 upper bearings from the crank case.

HINT:

Arrange the bearings in the correct order.

**19. REMOVE CRANK CASE**

- a. Uniformly loosen and remove the 11 bolts in several passes, in the sequence shown.



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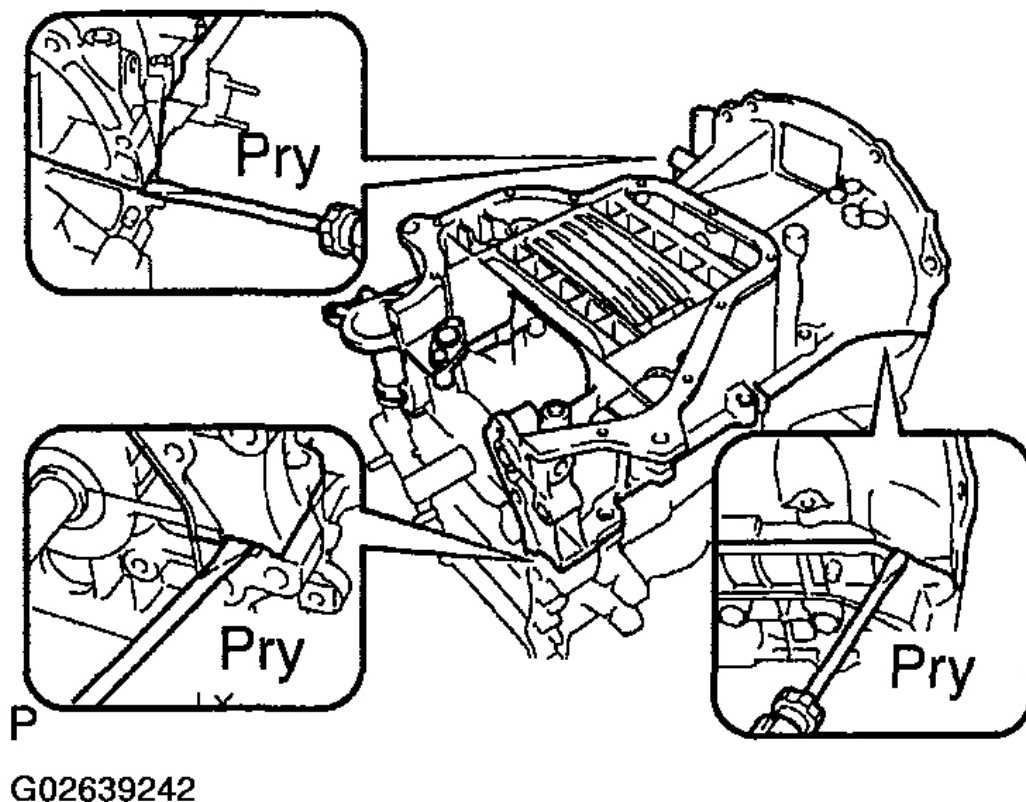
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**Fig. 232: Removing Crank Case Bolts In Sequence Shown**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.



**Fig. 233: Prying Apart Crank Case & Cylinder Block.**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

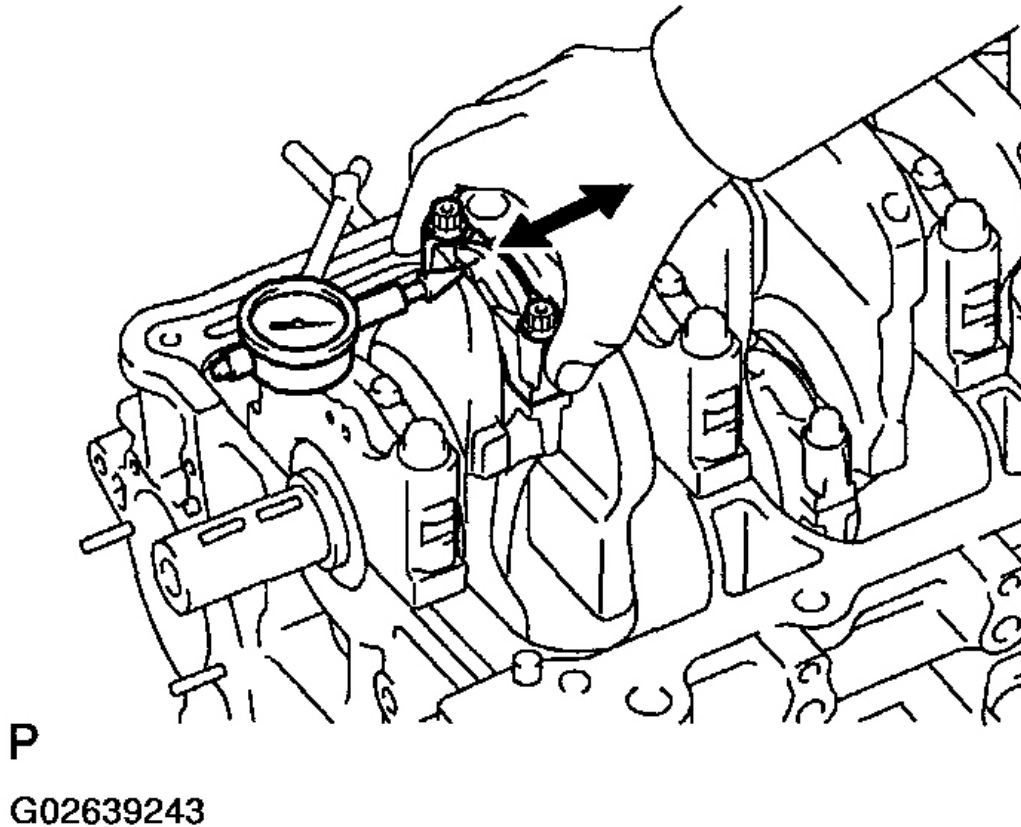
- c. Remove the O-ring.
- 20. **REMOVE CRANKSHAFT REAR OIL SEAL**
- 21. **CHECK CONNECTING ROD THRUST CLEARANCE**

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

**Standard thrust clearance:**

**0.160 to 0.362 mm (0.0063 to 0.0143 in.)**

**Maximum thrust clearance: 0.362 mm (0.0143 in.)**



**Fig. 234: Checking Connecting Rod Thrust Clearance**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

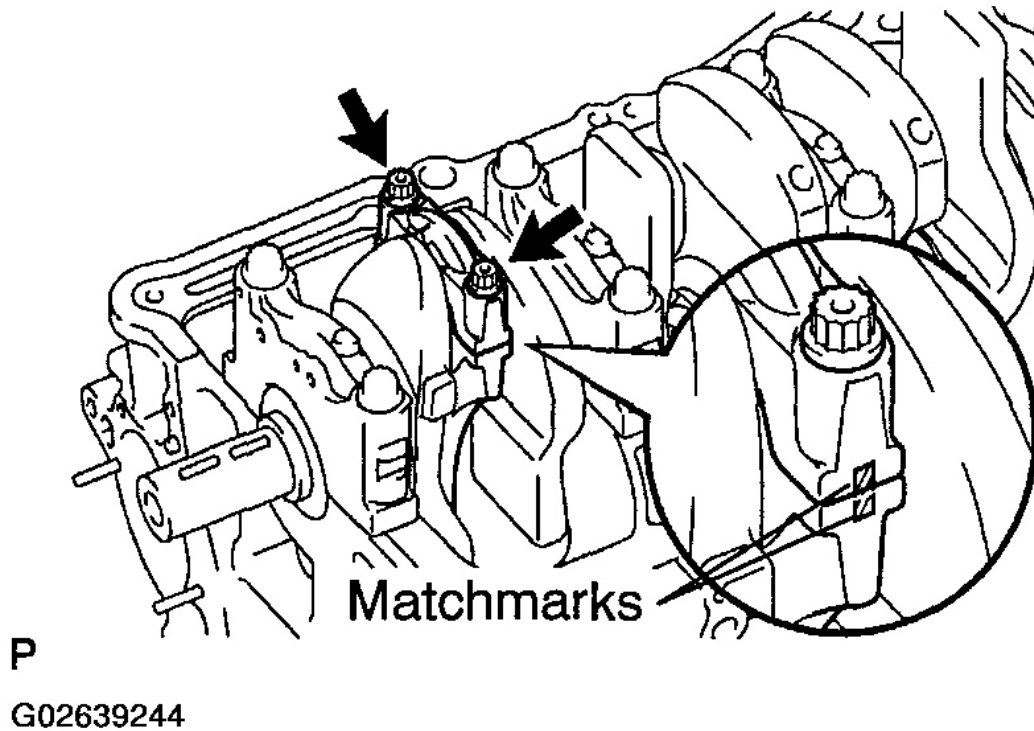
**Connecting rod thickness:**

**19.788 to 19.840 mm (0.7791 to 0.7811 in.)**

**22. REMOVE CONNECTING ROD CAPS AND CHECK OIL CLEARANCE**

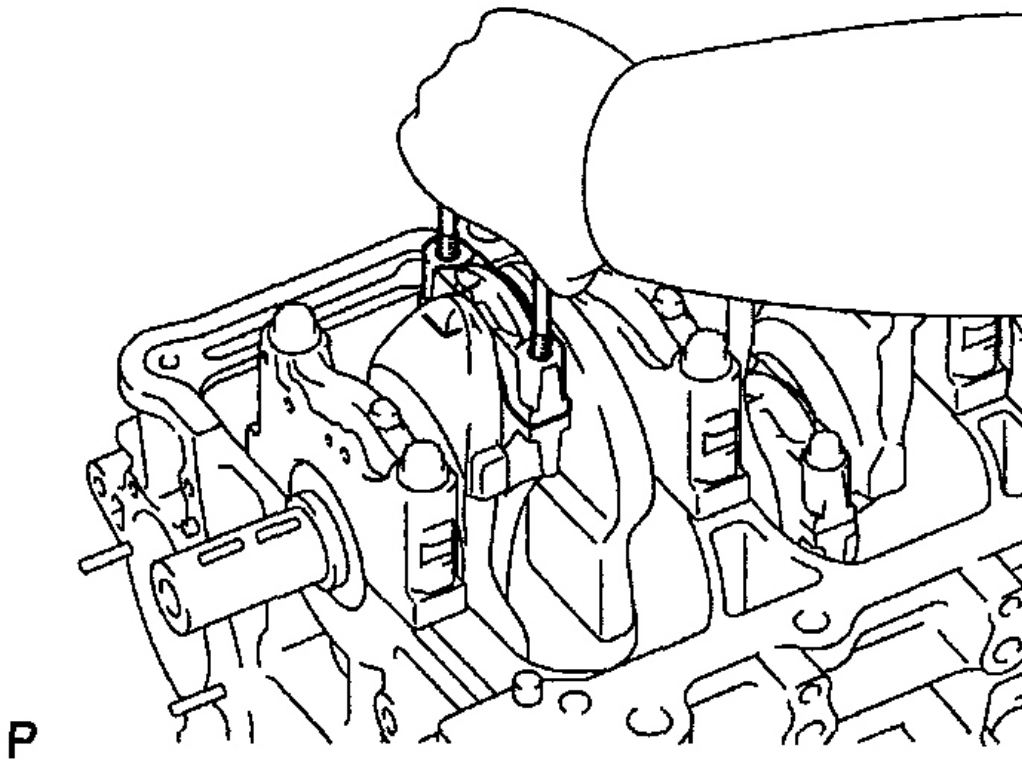
- a. Check the matchmarks on the connecting rod and cap are aligned to ensure correct reassembly.





**Fig. 235: Checking Matchmarks On Connecting Rod & Cap Are Aligned**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the 2 connecting rod cap bolts.
- 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. 236: Removing Connecting Rod Cap & Lower Bearing**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

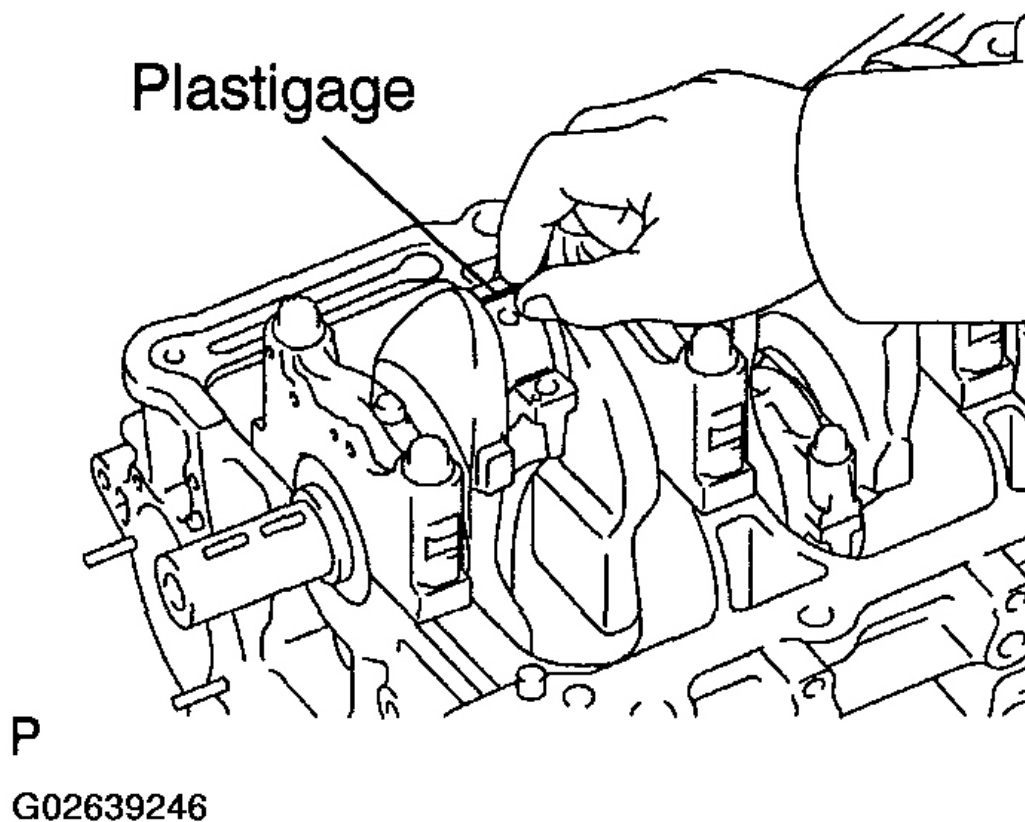
HINT:

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.

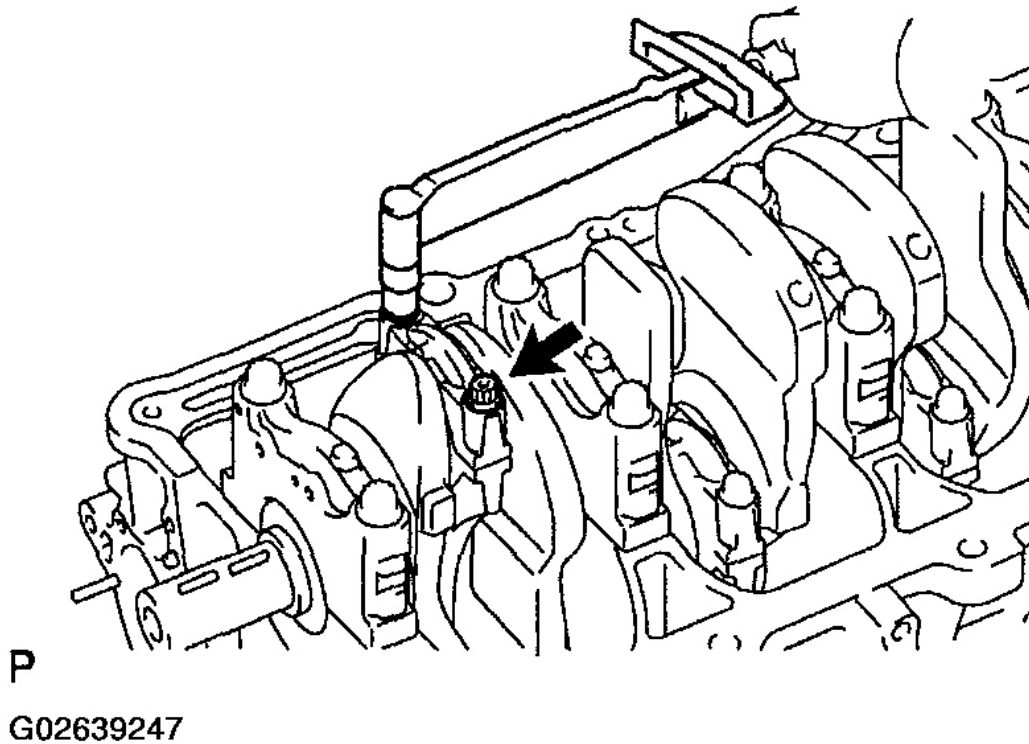
If the crank pin or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

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



**Fig. 237: Placing Strip Of Plastigage On Crank Pin**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- g. Install the connecting rod cap (see **REASSEMBLY**).



**Fig. 238: Installing Connecting Rod Cap**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**NOTE:**        **Do not turn the crankshaft.**

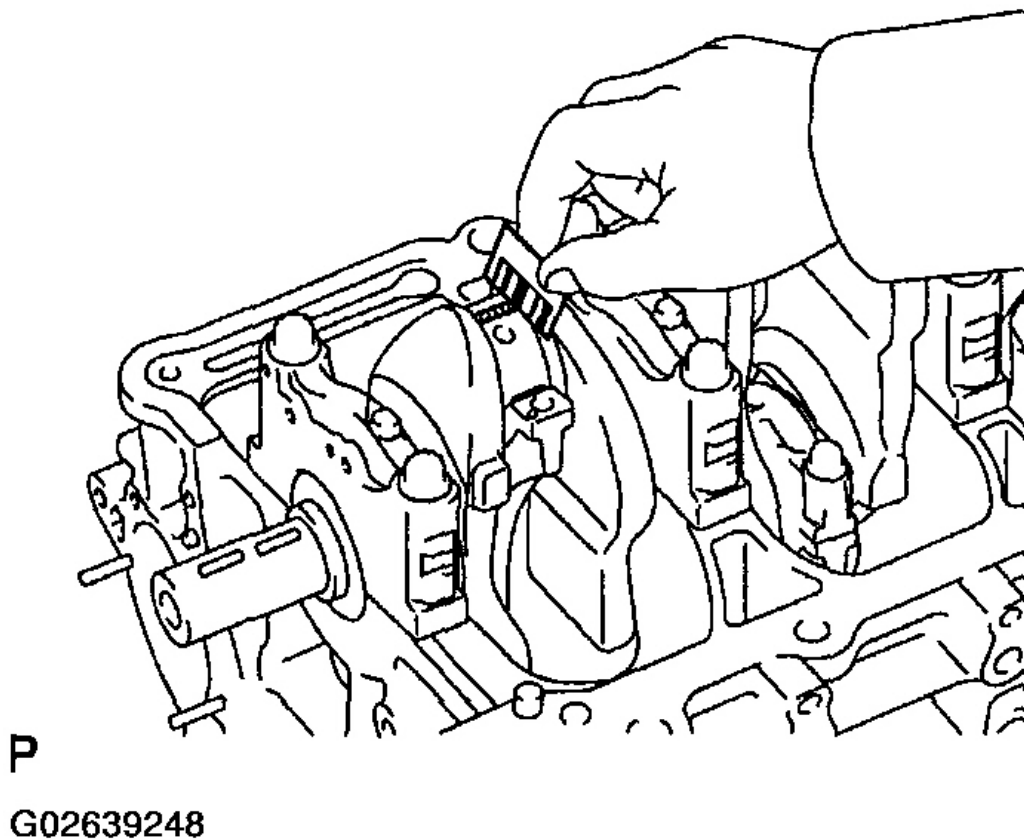
- h. Remove the connecting rod cap (See steps (a) and (c) above).
- i. Measure the Plastigage at its widest point.

**Standard oil clearance:**

**0.024 to 0.048 mm (0.0009 to 0.0019 in.)**

**Maximum oil clearance: 0.08 mm (0.0031 in.)**

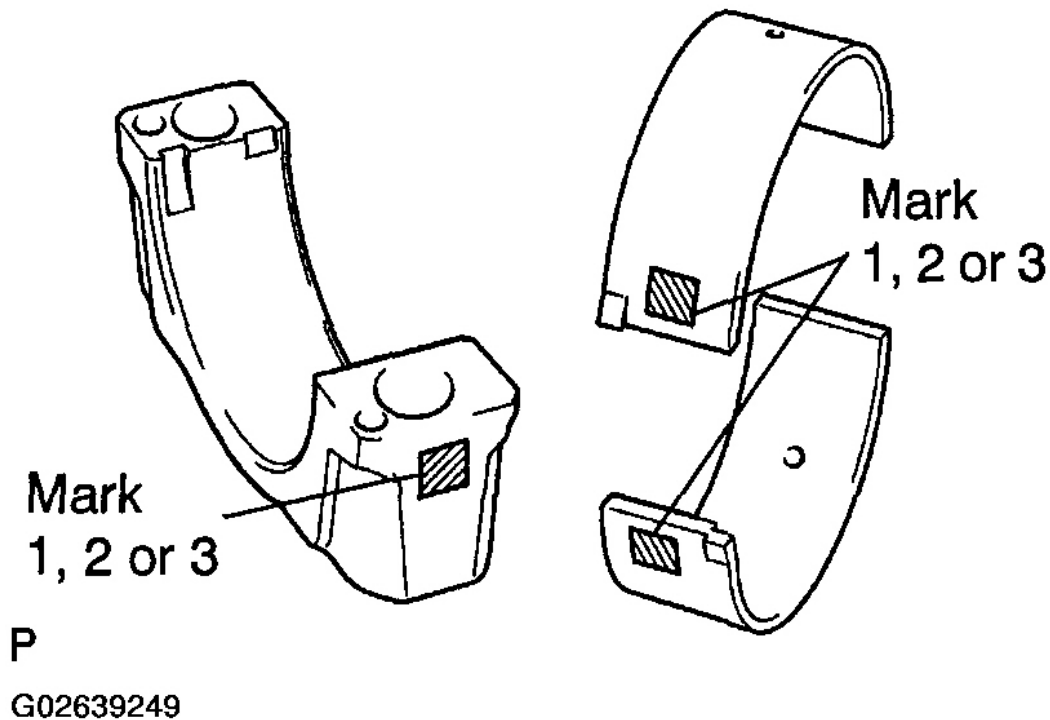
If the oil clearance is greater than the maximum, replace the bearings. If necessary, replace the crankshaft.



**Fig. 239: Measuring Plastigage At Its Widest Point**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**HINT:**

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.



**Fig. 240: Identifying Connecting Rod Bearing Size Markers**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### Reference

Standard bearing center wall thickness:

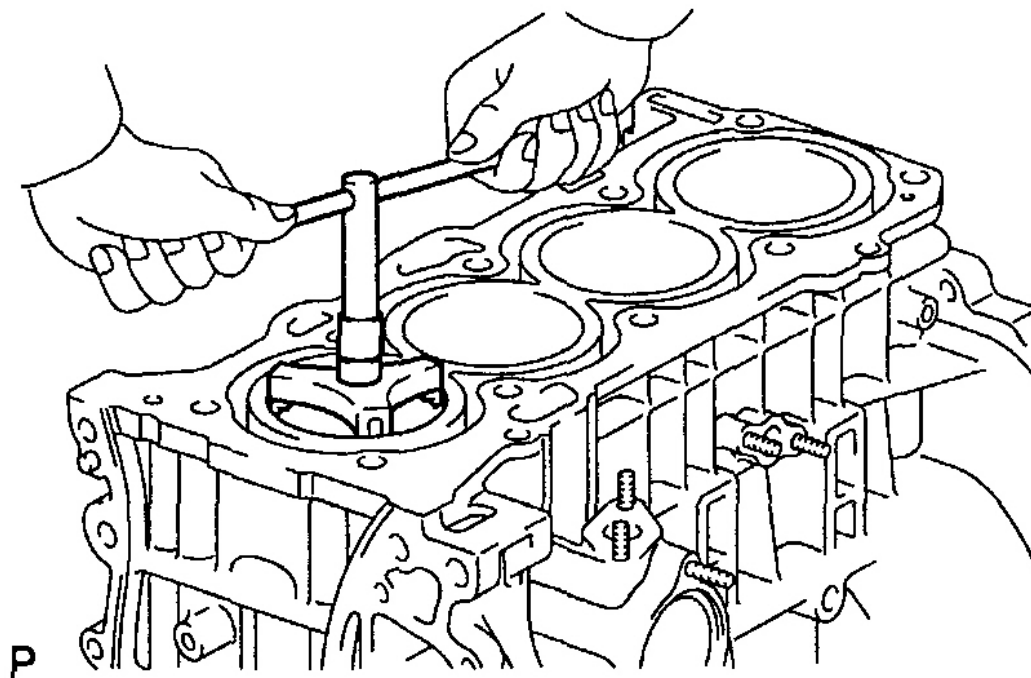
#### STANDARD BEARING CENTER WALL THICKNESS

Mark 1	1.485 to 1.488 mm (0.0585 to 0.0586 in.)
Mark 2	1.489 to 1.491 mm (0.0586 to 0.0587 in.)
Mark 3	1.492 to 1.494 mm (0.0586 to 0.0587 in.)

- j. Completely remove the Plastigage.

#### 23. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

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



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**Fig. 241: Removing Carbon From Top Of Cylinder Bore**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

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

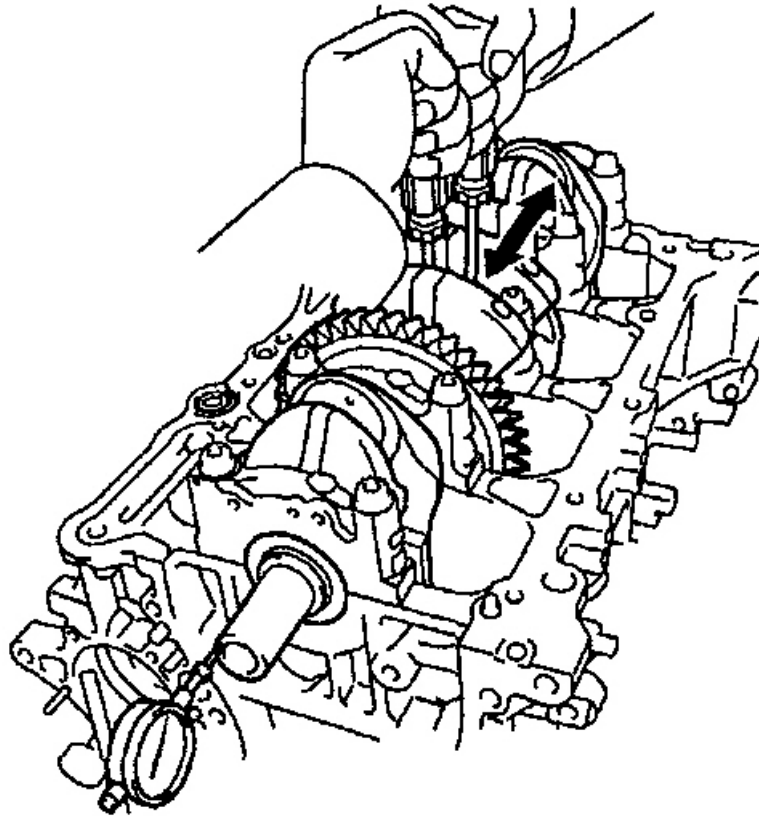
#### **24. CHECK CRANKSHAFT THRUST CLEARANCE**

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

**Standard thrust clearance:**

**0.040 to 0.240 mm (0.0016 to 0.0094 in.)**

**Maximum thrust clearance: 0.30 mm (0.0118 in.)**



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

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

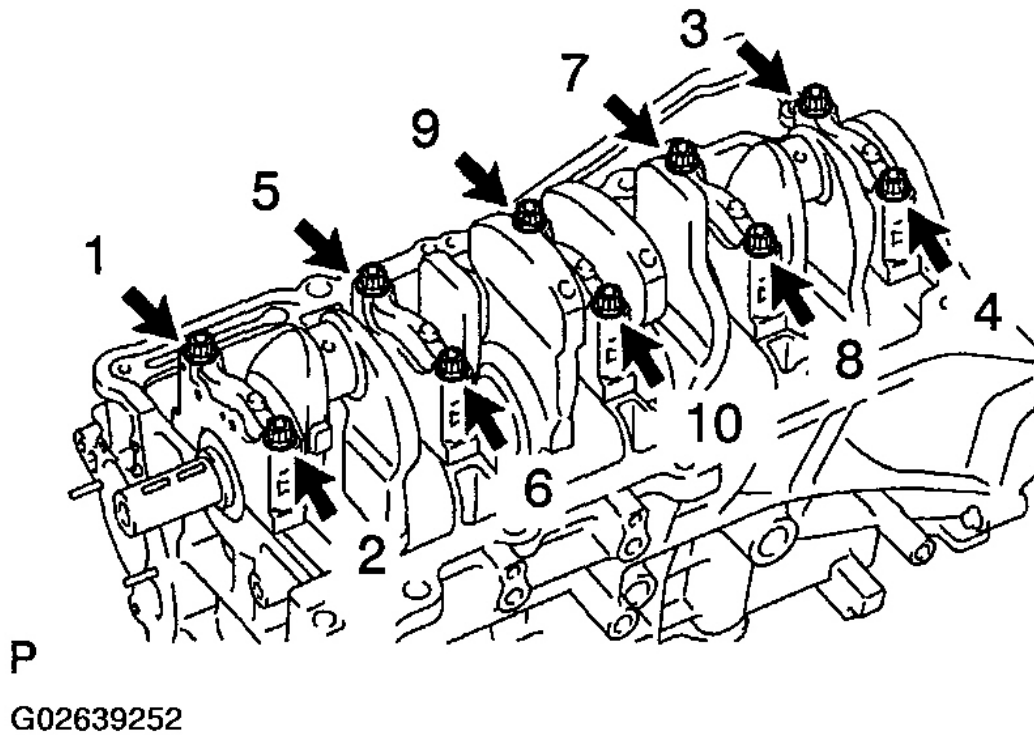
**Thrust washer thickness:**

**1.930 to 1.980 mm (0.0760 to 0.0780 in.)**

**25. 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.





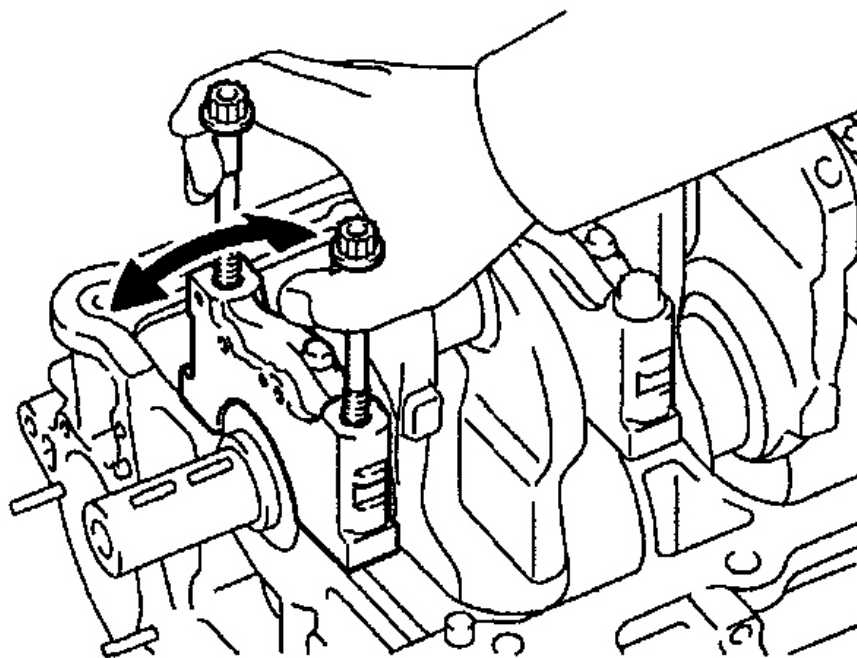
**Fig. 243: Removing Main Bearing Caps In Sequence**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

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

**HINT:**

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



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**Fig. 244: Removing Main Bearing Caps**

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

- c. Lift out the crankshaft.

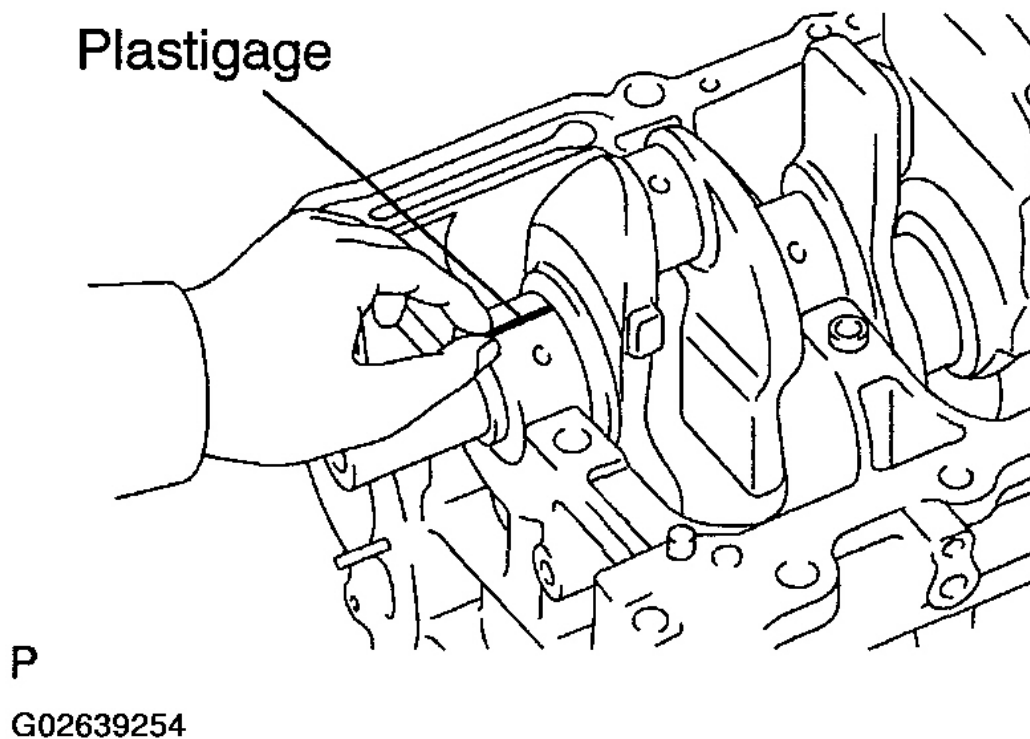
HINT:

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

- d. Clean each main journal and bearing.
- e. Check each main journal and bearing for pitting and scratches.

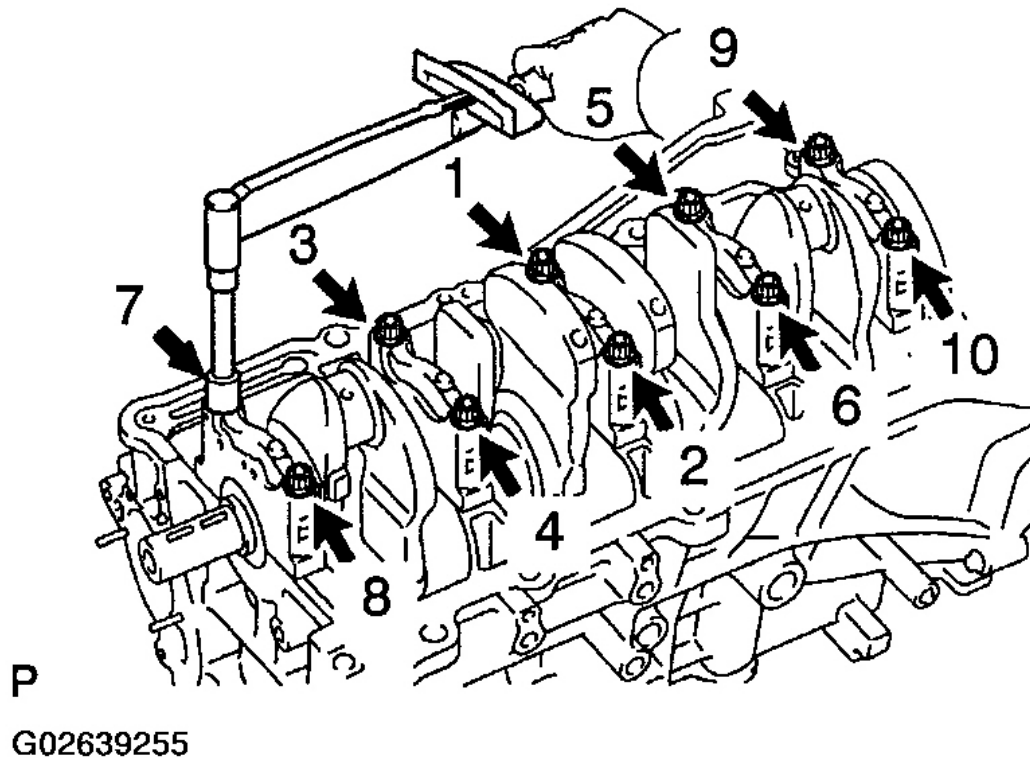
If the journal or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

- f. Place the crankshaft on the cylinder block.
- g. Lay a strip of Plastigage across each journal.



**Fig. 245: Placing A Strip Of Plastigage Across Each Crankshaft Journal**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- h. Install the main bearing caps (see **REASSEMBLY**).



**Fig. 246: Installing Main Bearing Caps**

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

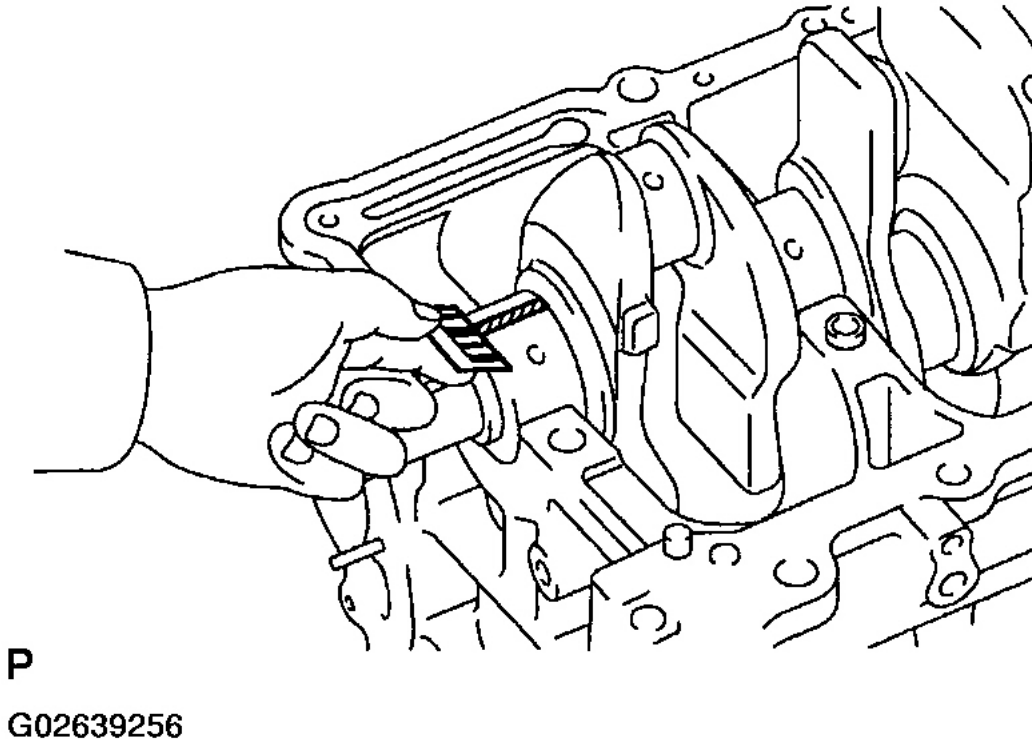
**NOTE:** Do not turn the crankshaft.

- i. Remove the main bearing cap (See steps ( ) and (b) above).
- j. Measure the Plastigage at its widest point.

**Standard oil clearance:**

**0.017 to 0.040 mm (0.0007 to 0.0016 in.)**

**Maximum oil clearance: 0.050 mm (0.0020 in.)**

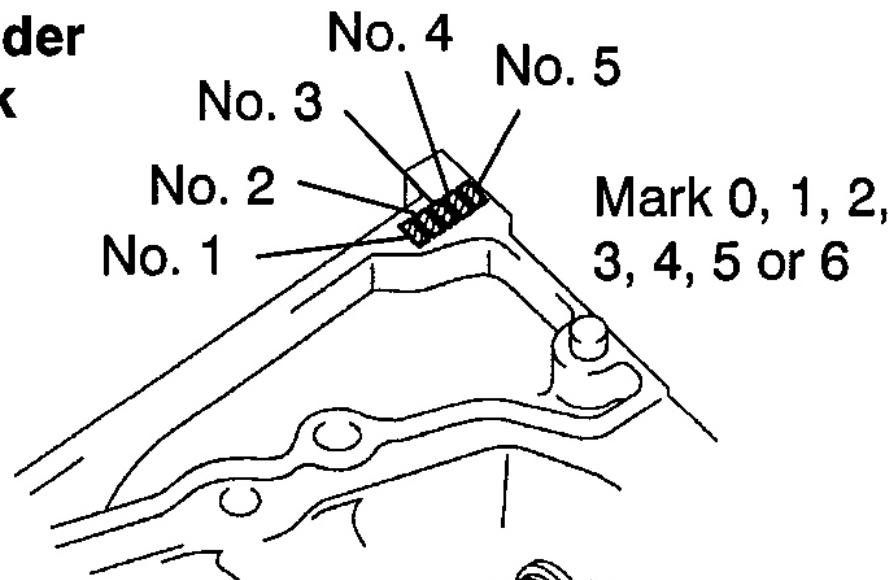


**Fig. 247: Measuring Plastigage At Its Widest Point**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

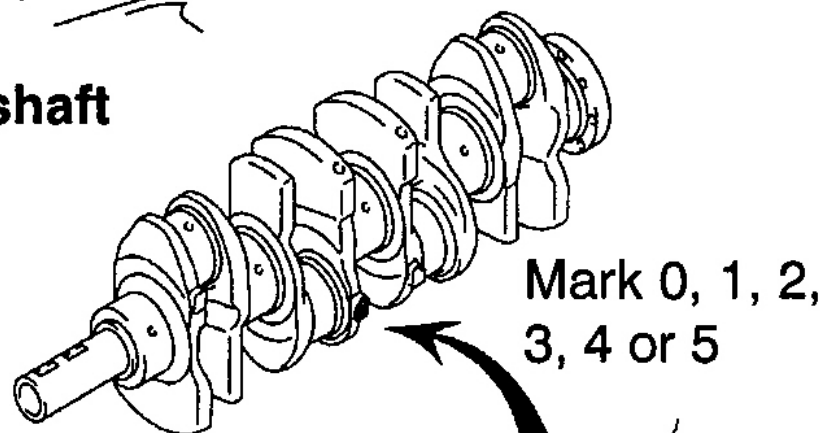
If the oil clearance is greater than the maximum, replace the bearings. If necessary, replace the crankshaft.

- k. If using a standard bearings, 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.

## Cylinder Block



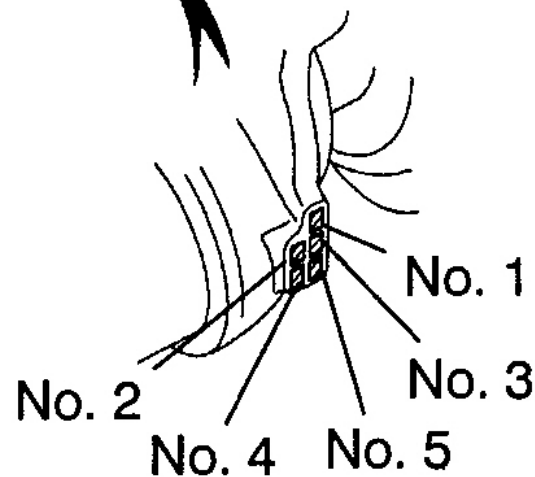
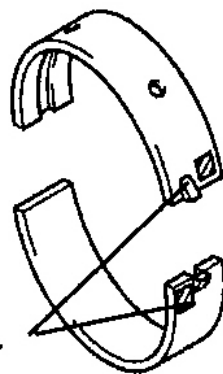
## Crankshaft



## Use Bearing

Mark  
1, 2, 3 or 4

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**Fig. 248: Identifying Crankshaft Journal Bearing Size Markers**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**EXAMPLE:**

Cylinder block "4"

+ Crankshaft "3"

= Total number 7 (Use bearing "3")

	Total number                    " ": Number mark			
Cylinder block + Crankshaft	0 to 2	3 to 5	6 to 8	9 to11
Use bearing	"1"	"2"	"3"	"4"

Cylinder block "4"

+ Crankshaft "3"

= Total number 7 (Use bearing "3")

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**Fig. 249: Determining Correct Bearing For Crankshaft Journal**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4

Item	Mark	Specified Condition
Cylinder block main journal bore diameter (A)	0	59.000 to 59.002 mm (2.3228 to 2.3229 in.)
	1	59.003 to 59.004 mm (2.3229 to 2.3230 in.)
	2	59.005 to 59.006 mm (2.3230 to 2.3231 in.)
	3	59.007 to 59.009 mm (2.3231 to 2.3232 in.)
	4	59.010 to 59.011 mm (2.3232 to 2.3233 in.)
	5	59.012 to 59.013 mm (2.3233 to 2.3234 in.)
	6	59.014 to 59.016 mm (2.3234 to 2.3235 in.)
Crankshaft main journal diameter (B)	0	54.999 to 55.000 mm (2.1653 to 2.1654 in.)
	1	54.997 to 54.998 mm (2.1652 to 2.1653 in.)
	2	54.995 to 54.996 mm (2.1651 to 2.1652 in.)
	3	54.993 to 54.994 mm (2.1650 to 2.1651 in.)
	4	54.991 to 54.992 mm (2.1650 to 2.1650 in.)
	5	54.988 to 54.990 mm (2.1649 to 2.1650 in.)
Standard bearing center wall thickness	1	1.993 to 1.996 mm (0.0785 to 0.0786 in.)
	2	1.996 to 1.999 mm (0.0786 to 0.0787 in.)
	3	1.999 to 2.002 mm (0.0787 to 0.0788 in.)
	4	2.002 to 2.005 mm (0.0788 to 0.0789 in.)

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**Fig. 250: Determining Correct Bearing For Crankshaft Journal Reference Chart**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### Reference

1. Completely remove the Plastigage.
26. **REMOVE CRANKSHAFT**
  - a. Lift out the crankshaft.
  - b. Remove the 5 upper main bearings and 2 thrust washers from the cylinder block.

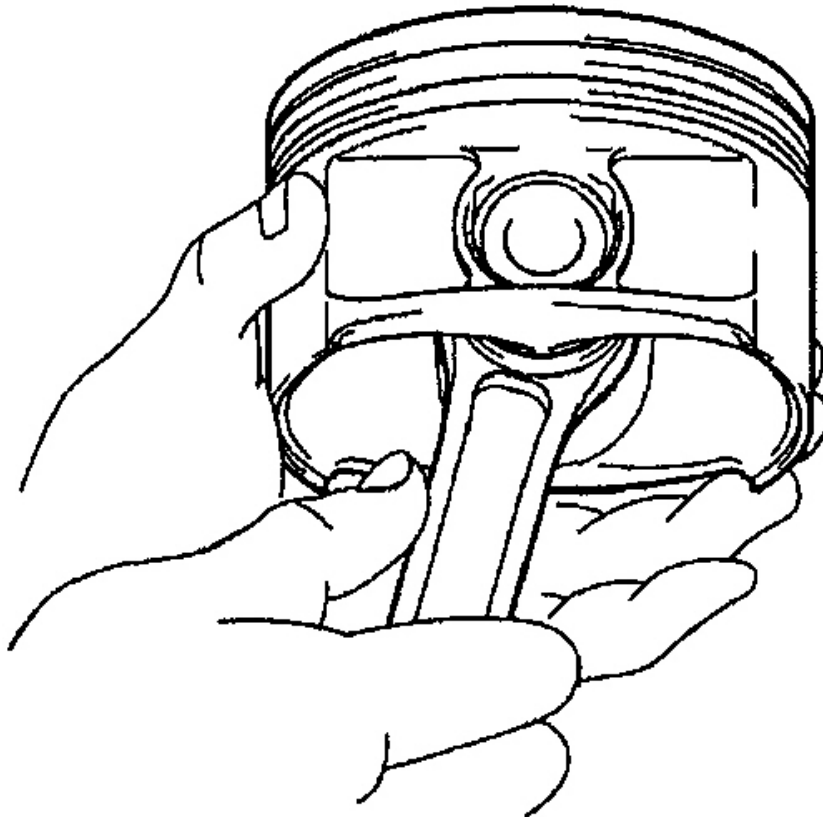
HINT:

Arrange the main bearings and thrust washers in the correct order.

#### 27. **CHECK FIT BETWEEN PISTON AND PISTON PIN**

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.





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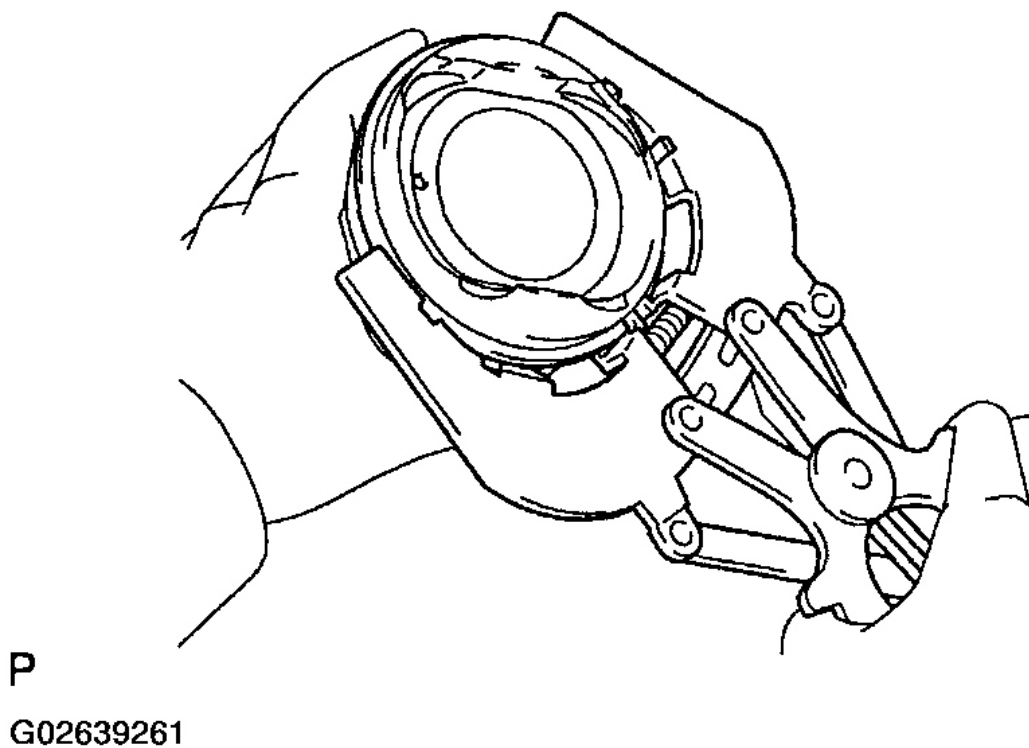
**Fig. 251: Checking Fit Between Piston & Piston Pin**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**28. 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.

HINT:

Arrange the piston rings in the correct order only.

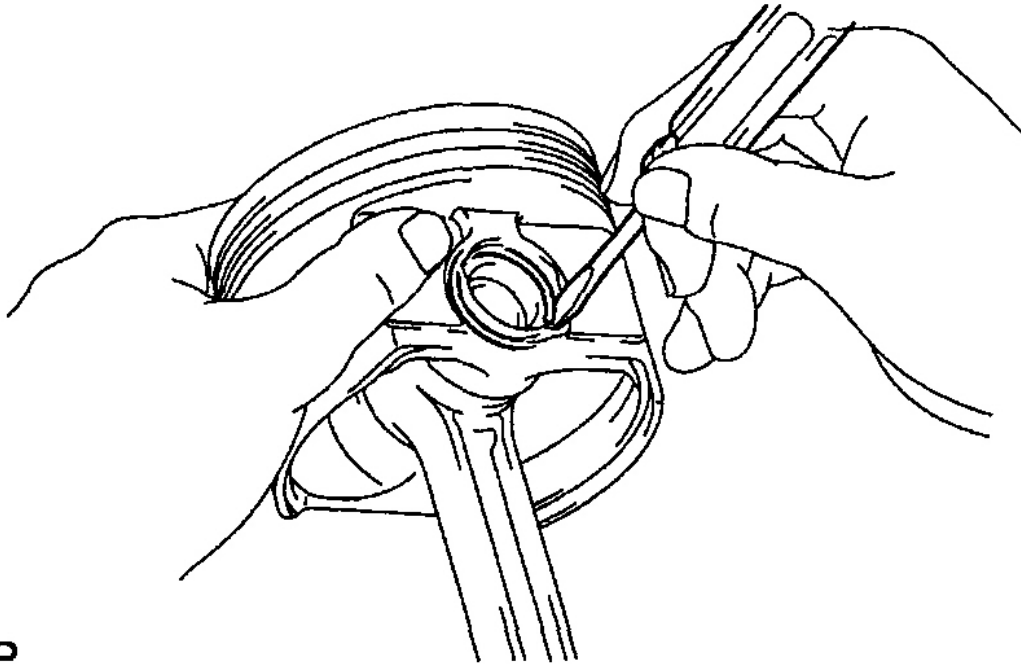


**Fig. 252: Removing Piston Rings**

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

**29. DISCONNECT CONNECTING ROD FROM PISTON**

- a. Using a small screwdriver, pry out the 2 snap rings.



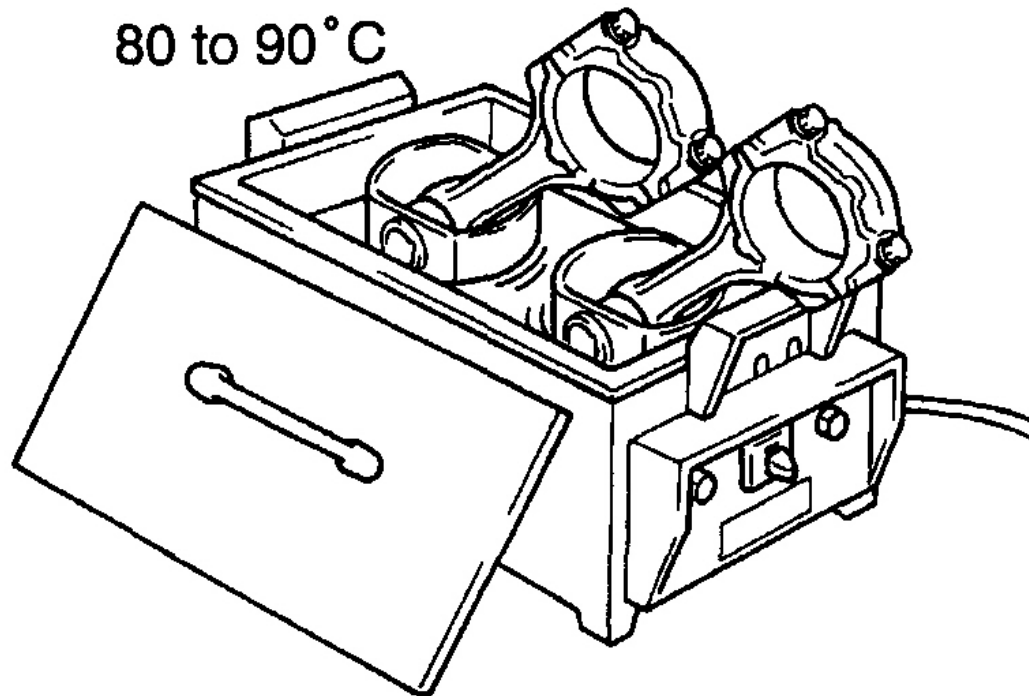
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**Fig. 253: Removing Piston Pin Snap Rings**

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

- b. Gradually heat the piston to 80 to 90°C (176 to 194°F).



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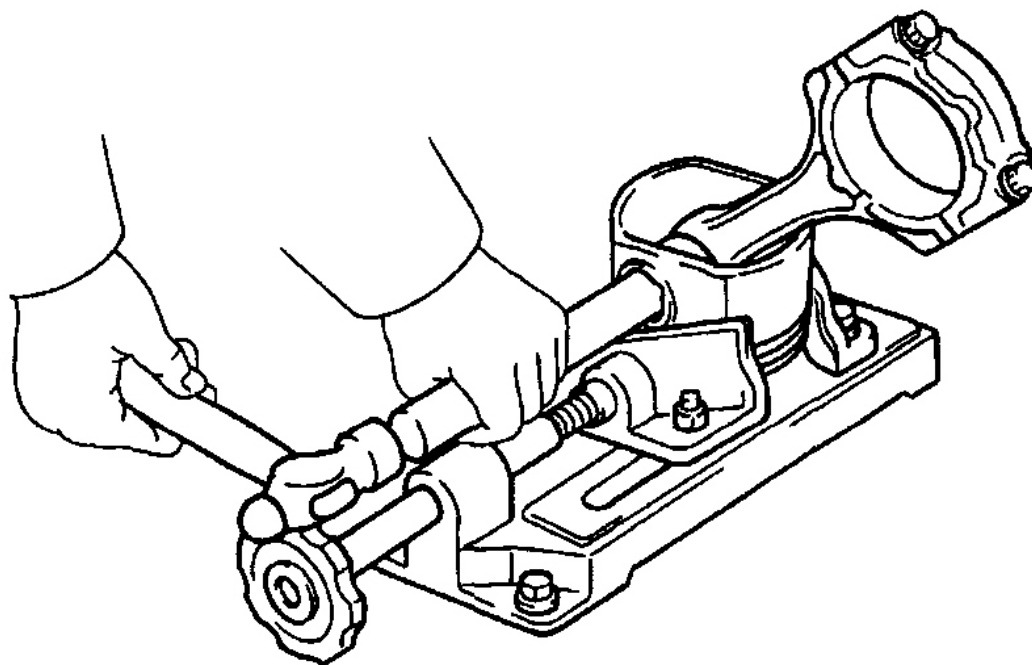
**Fig. 254: Gradually Heating Pistons**

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.

**HINT:**

- 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. 255: Lightly Tapping Out Piston Pin From Piston**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## INSPECTION

### 1. CLEAN CYLINDER BLOCK

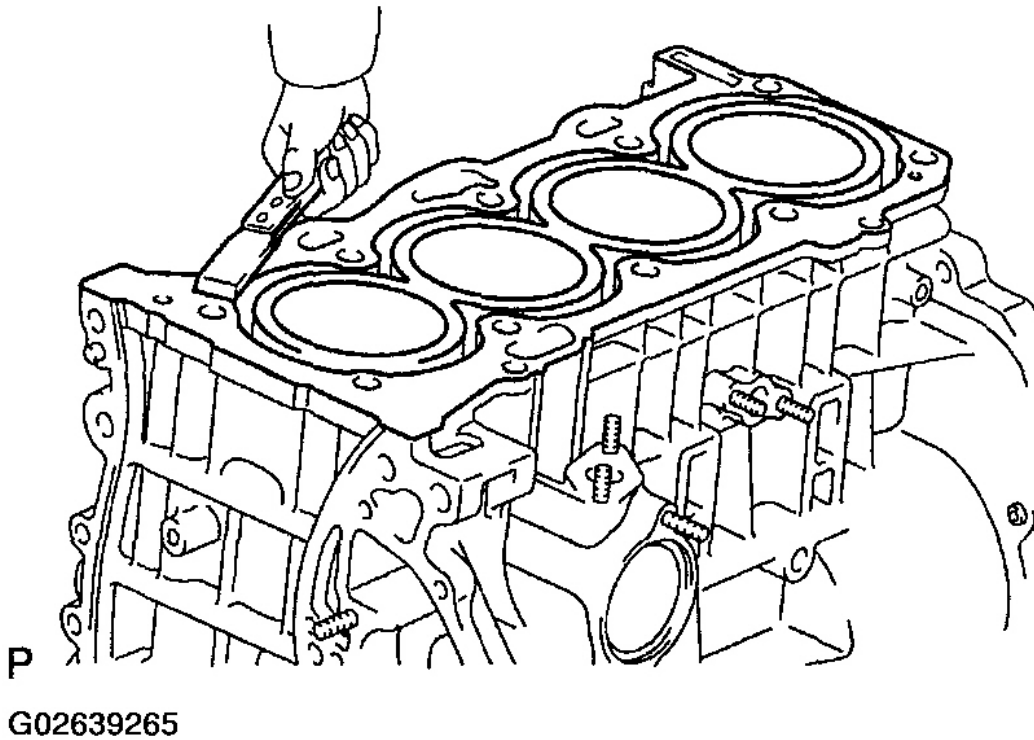
- a. Remove the gasket material.

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.

**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.



**Fig. 256: Removing Gasket Material From Top Surface Of Cylinder Block**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

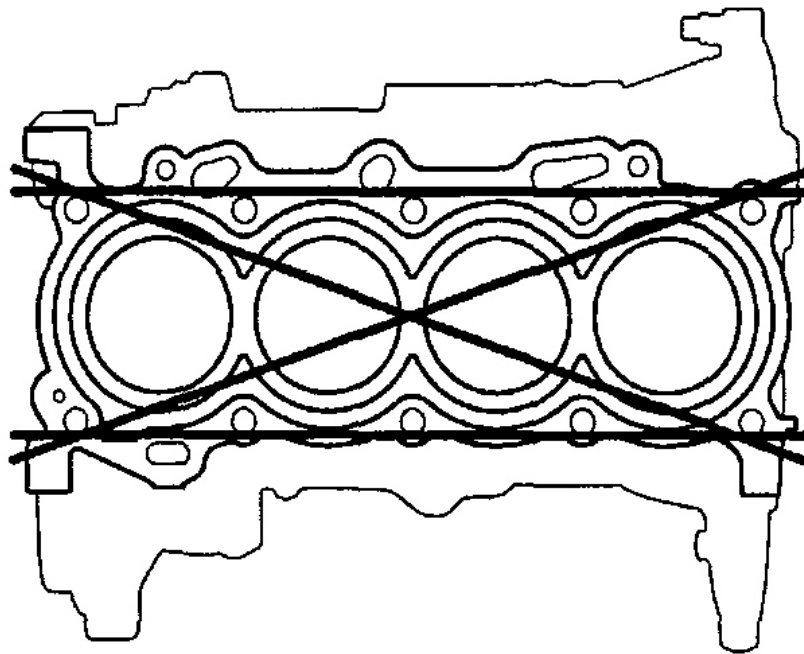
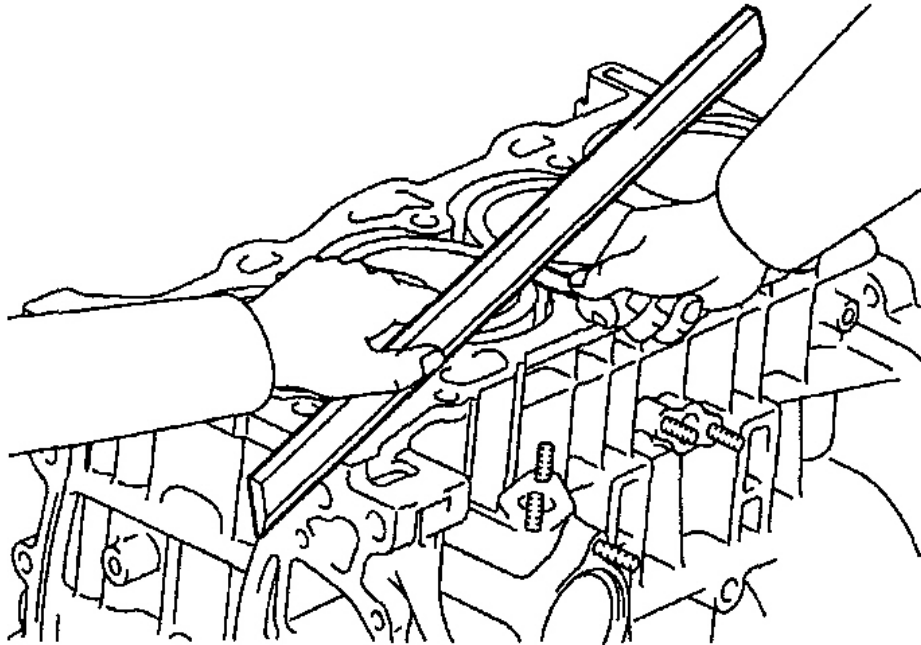
## **2. INSPECT CYLINDER BLOCK**

- a. Inspect for flatness.

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

## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4



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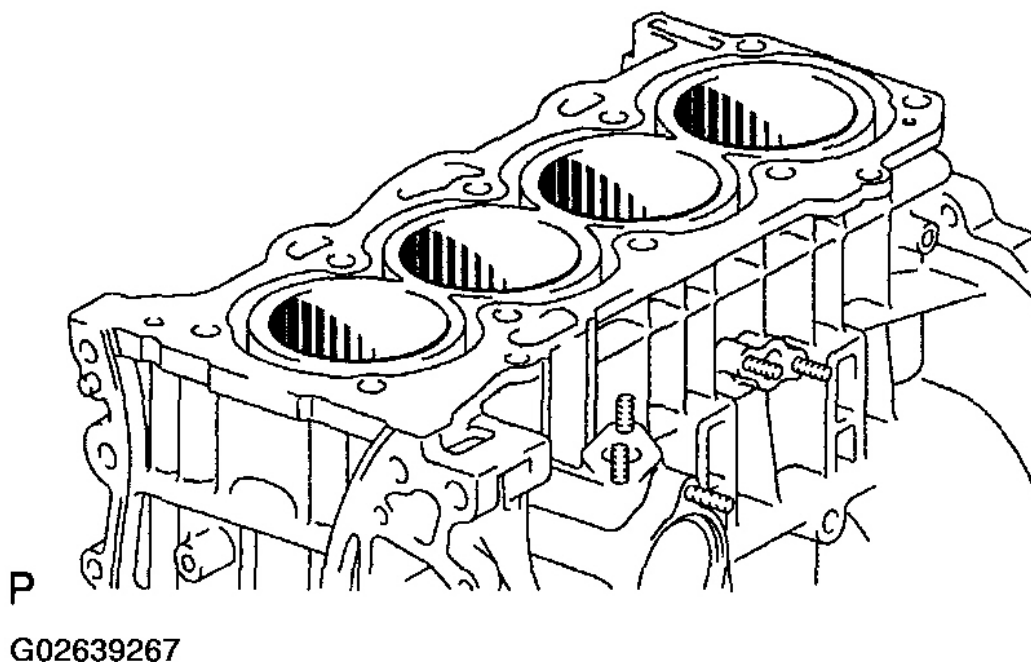
**Fig. 257: Measuring Block/Cylinder Head Surface For Warpage**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**Maximum warpage: 0.05 mm (0.0020 in.)**

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

- b. Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.



**Fig. 258: Visually Check Cylinder For Vertical Scratches**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.

**Specified diameter:**

**88.500 to 88.513 mm (3.4843 to 3.4847 in.)**

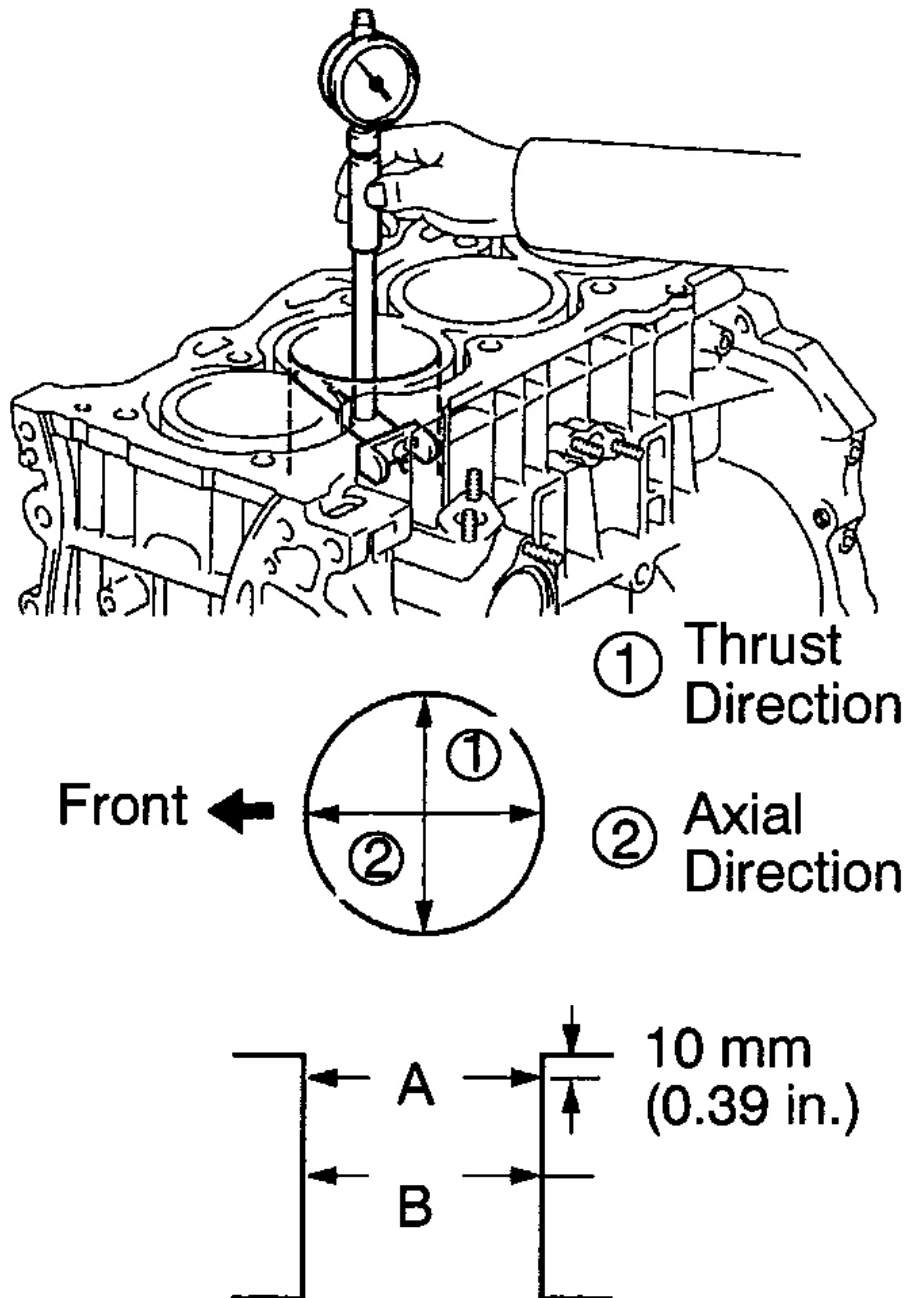


## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4

**Maximum diameter: 88.633 mm (6.4894 in.)**

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



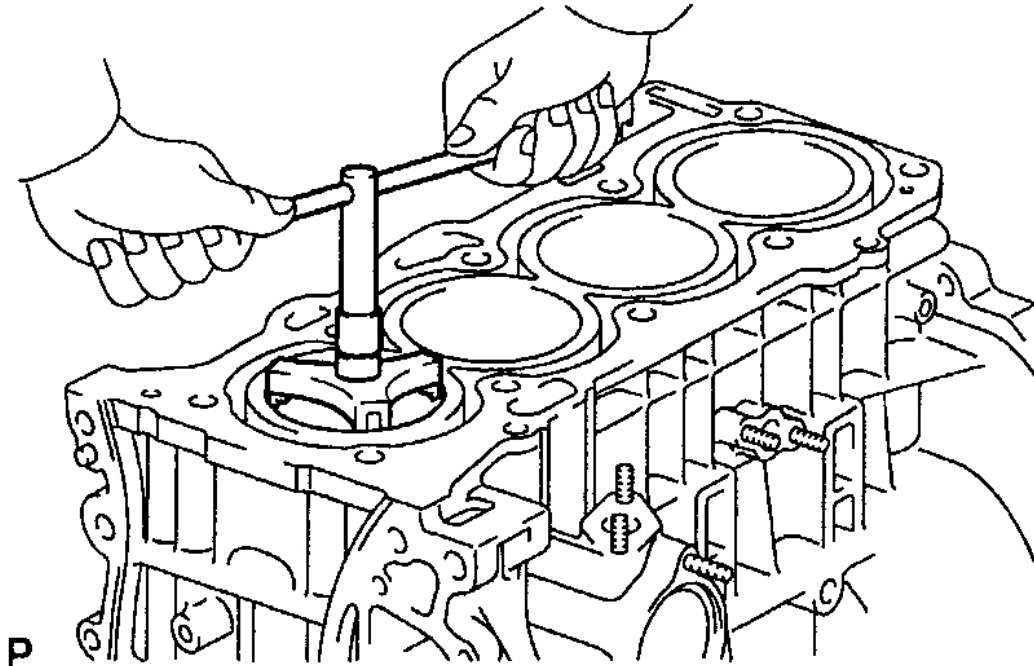
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**Fig. 259: Measuring Cylinder Bore Diameter**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

### 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.

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**Fig. 260: Removing Cylinder Bore Ridge**

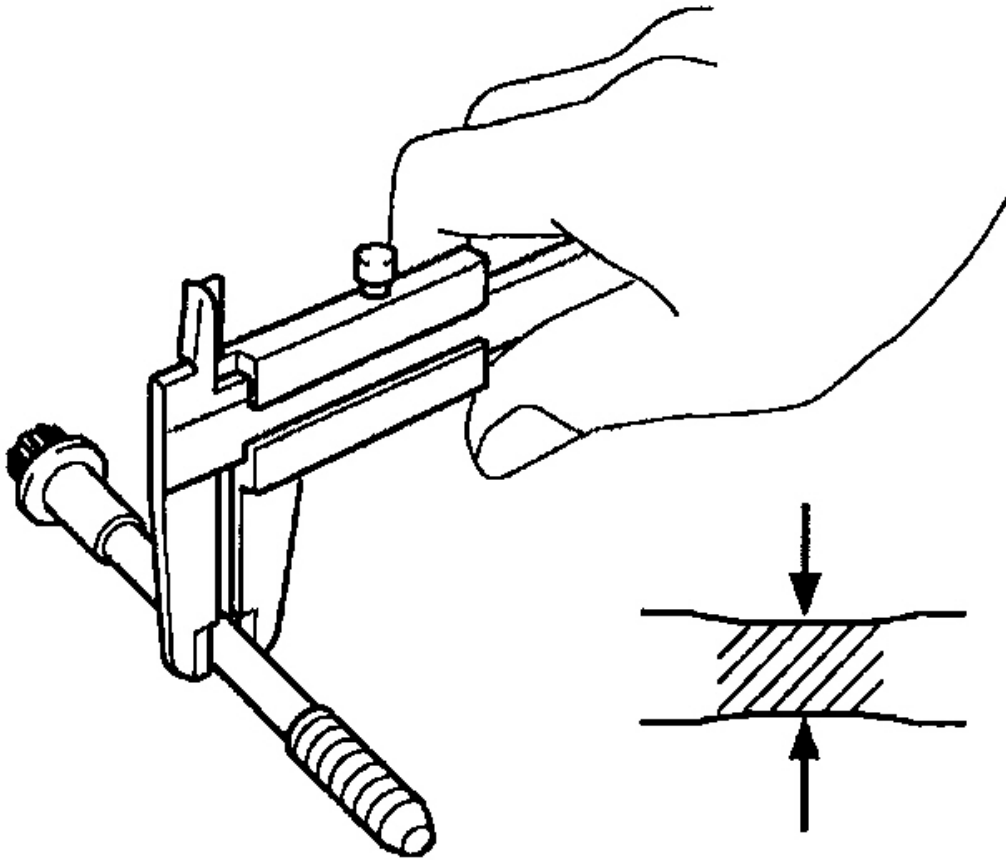
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

### 4. INSPECT CRANKSHAFT BEARING CAP BOLTS

Using vernier calipers, measure the tension portion diameter of the bolt.

**Standard diameter: 7.5 to 7.6 mm (0.2953 to 0.2992 in.)**

**Minimum diameter: 7.2 mm (0.284 in.)**



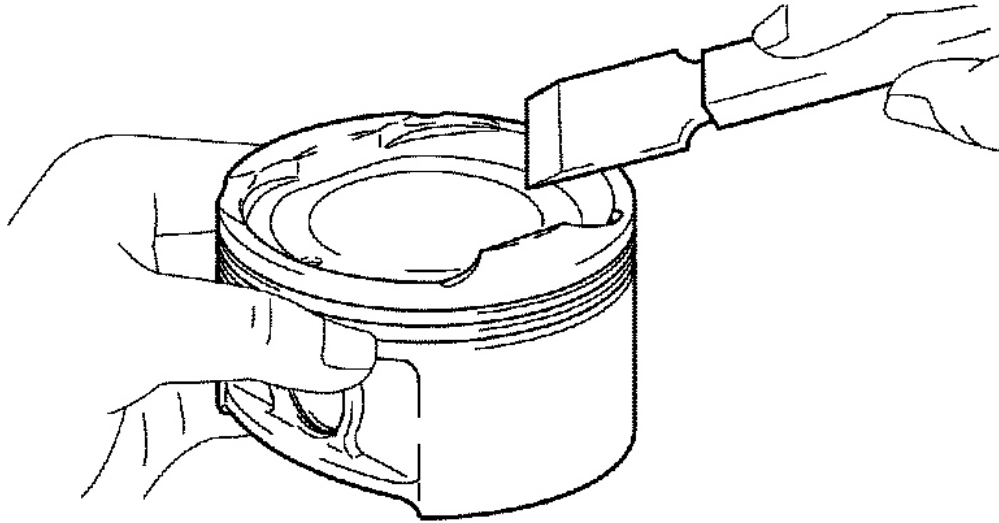
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**Fig. 261: Inspecting Crankshaft Bearing Cap Bolts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

**5. CLEAN PISTON**

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

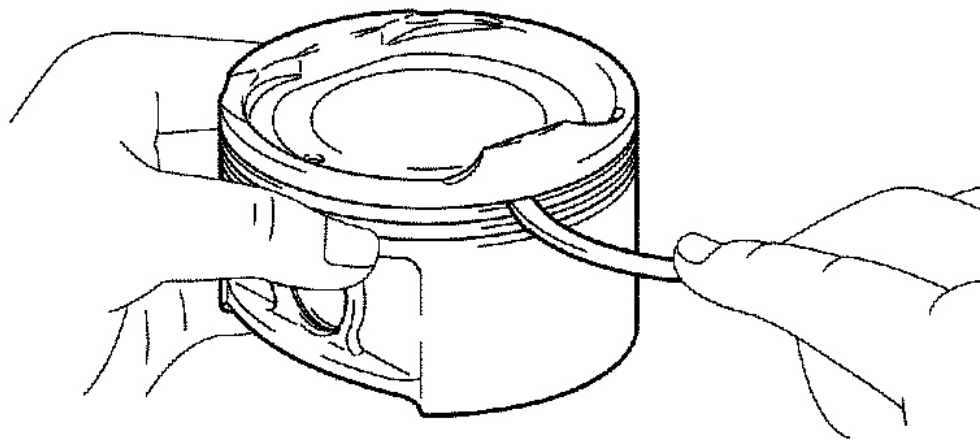


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**Fig. 262: Removing Carbon From Piston Top**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

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



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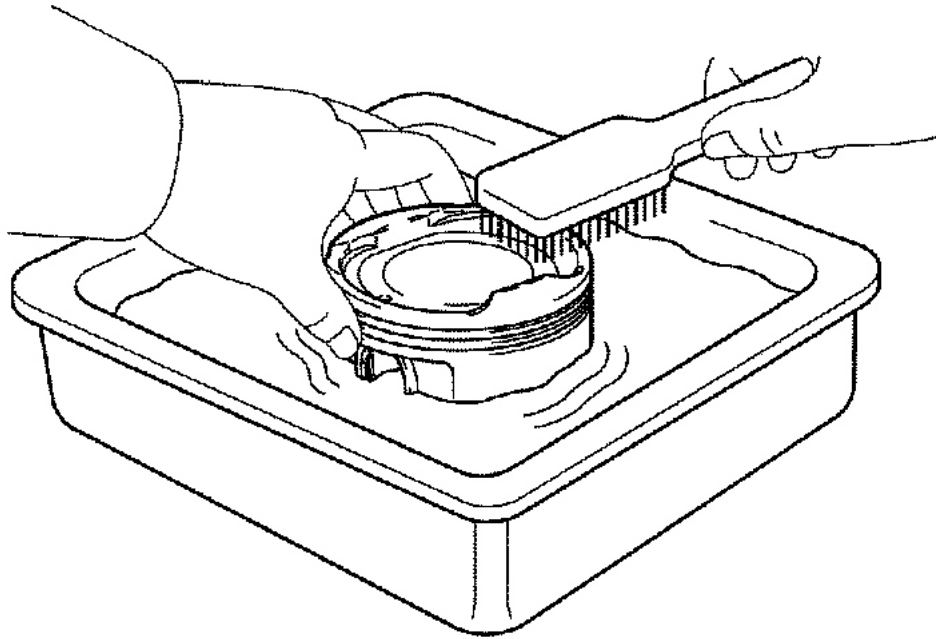
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**Fig. 263: Cleaning Piston Ring Grooves**

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

- c. Using a brush and solvent, thoroughly clean the piston.

**NOTE:**        **Do not use a wire brush.**



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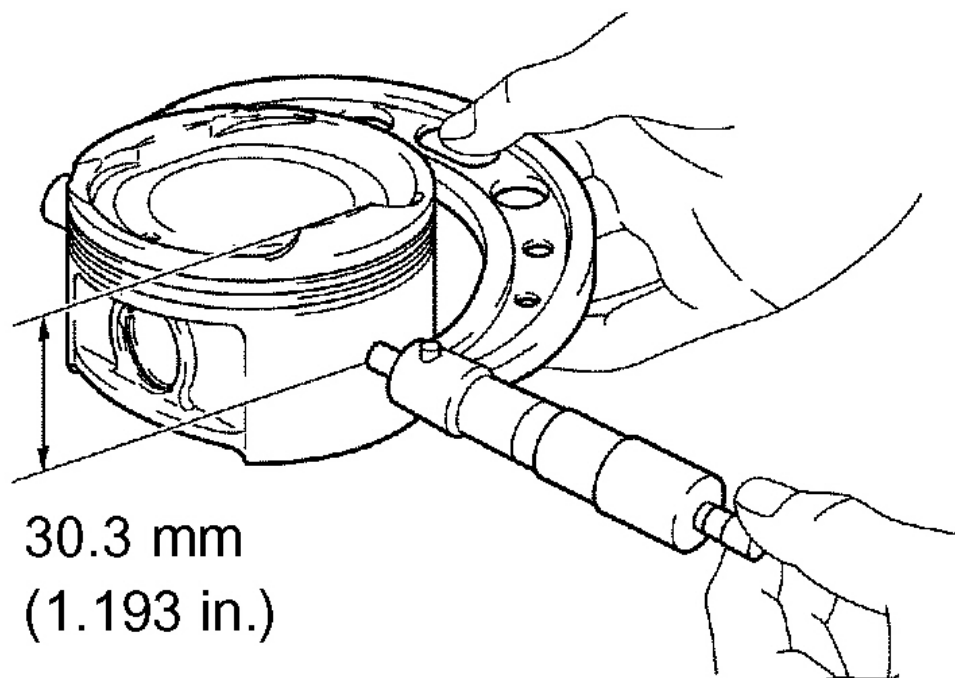
**Fig. 264: Cleaning Piston Using Brush & Solvent**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## **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 (1.1967 in.) from the piston head.

**Piston diameter:**

**88.439 to 88.449 mm (3.4818 to 3.4822 in.)**



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**Fig. 265: Measuring Piston Diameter At Right Angles**

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

2. Measure the cylinder bore diameter in the thrust directions (see step 2).
3. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

**Standard oil clearance:**

**0.051 to 0.074 mm (0.0020 to 0.0029 in.)**

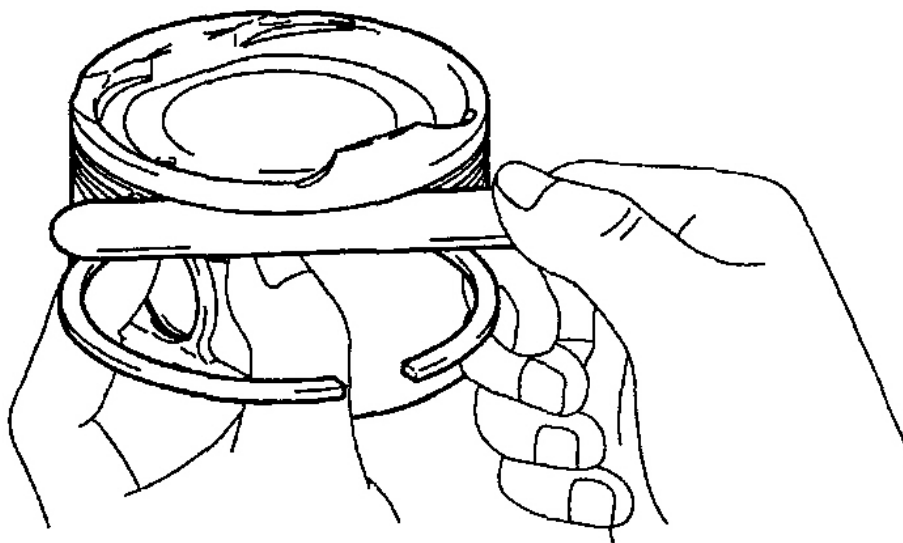
**Maximum oil clearance: 0.10 mm (0.0039 in.)**

If the oil clearance is greater than the 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.



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**Fig. 266: Measuring Clearance Between Piston Ring & Wall Of Ring Groove**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

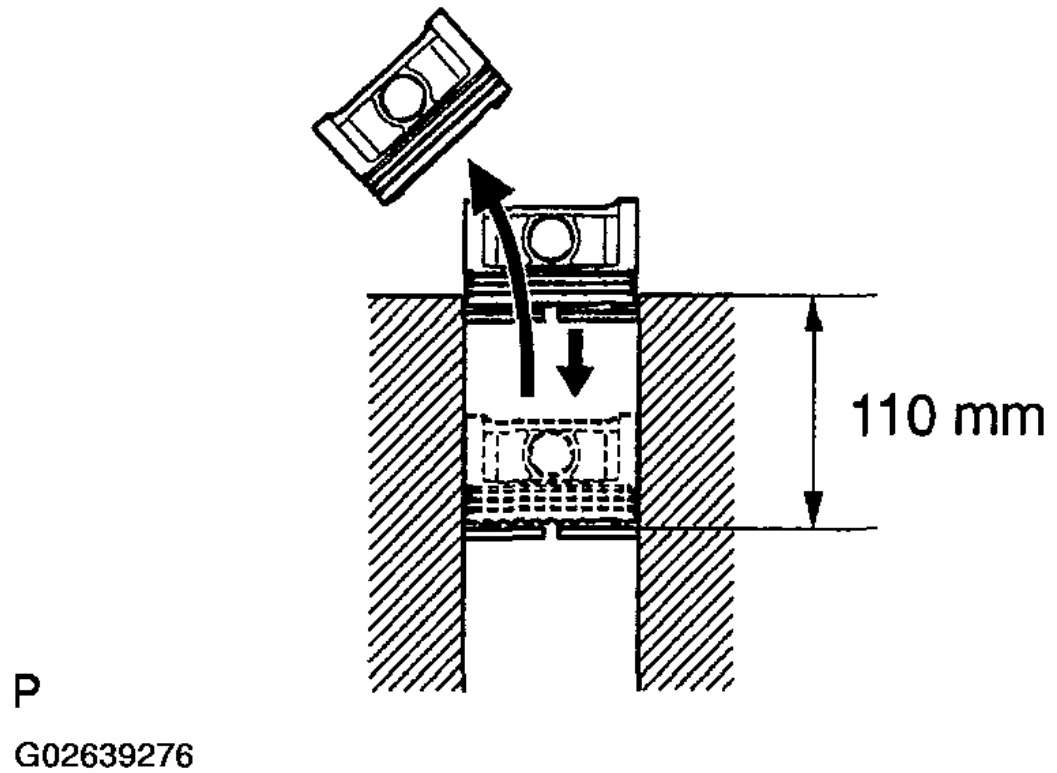
**Ring groove clearance:**

**RING GROOVE CLEARANCE**

No. 1	0.170 to 0.220 mm (0.0066 to 0.0086 in.)
No. 2	0.170 to 0.210 mm (0.0066 to 0.0082 in.)
Oil (Side rail)	0.210 to 0.290 mm (0.0082 to 0.0114 in.)

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

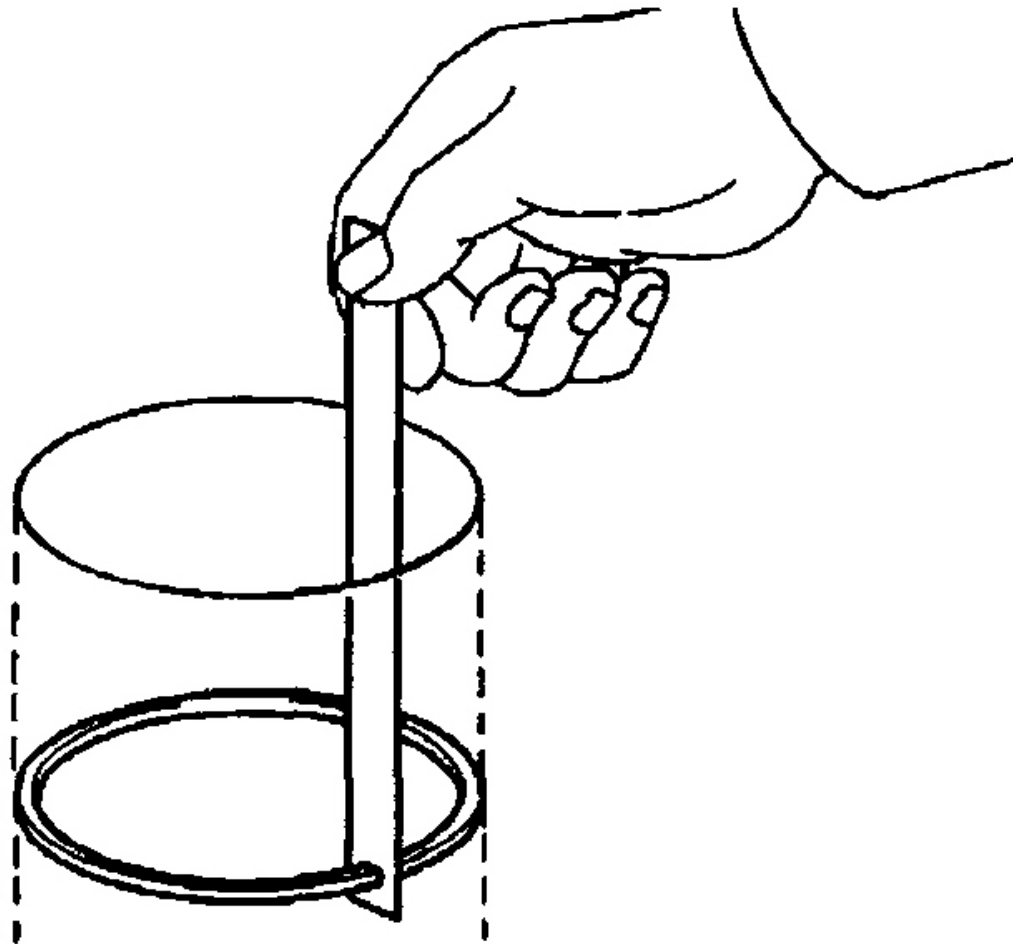
- c. Inspect the piston ring end gap.
  1. Insert the piston ring into the cylinder bore.
  2. Using the piston, push the piston ring a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.



**Fig. 267: Inserting Piston Ring Into Cylinder Bore**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Using a feeler gauge, measure the end gap. See **STANDARD END GAP** and **MAXIMUM END GAP**

**Standard end gap:**



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**Fig. 268: Inspecting Piston Ring End Gap**

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

**STANDARD END GAP**

No. 1	0.22 to 0.32 mm (0.0087 to 0.0126 in.)
No. 2	0.50 to 0.60 mm (0.0197 to 0.0236 in.)
Oil (side rail)	0.10 to 0.35 mm (0.0039 to 0.0138 in.)

**Maximum end gap:****MAXIMUM END GAP**

## 2005 Toyota RAV4

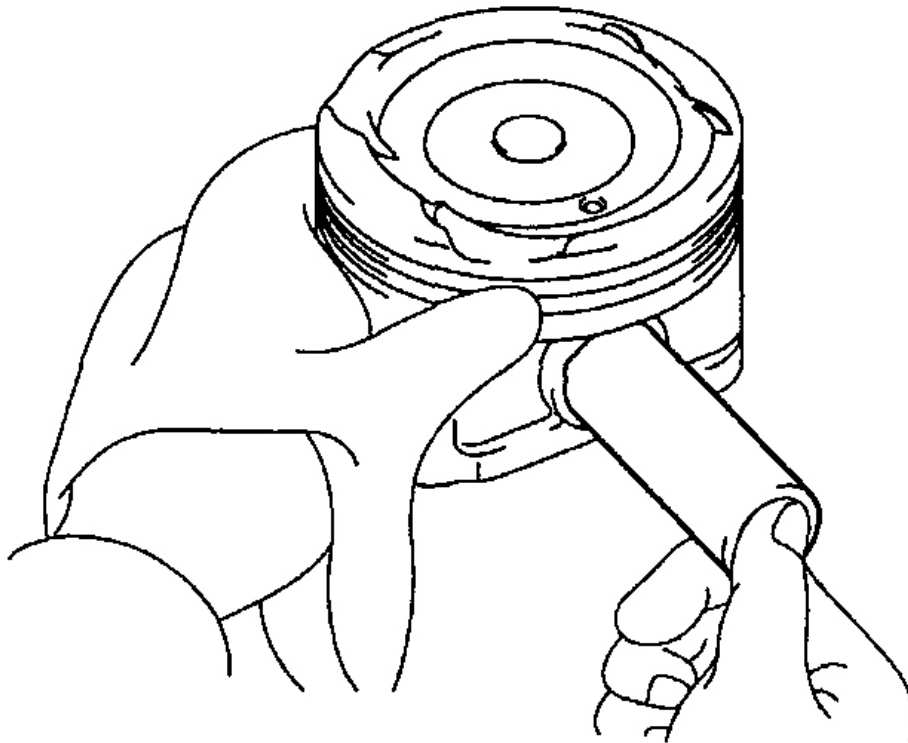
### 2005 ENGINE Engine Mechanical - RAV4

No. 1	0.89 mm (0.0350 in.)
No. 2	1.35 mm (0.0531 in.)
Oil (side rail)	0.73 mm (0.0287 in.)

If the end gap is greater than the 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.

At 80 to 90°C (176 to 194°F), you should be able to push the piston pin into the piston pin hole with your thumb.



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**Fig. 269: Inspecting Piston Pin Fit**

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

## 7. INSPECT CONNECTING ROD

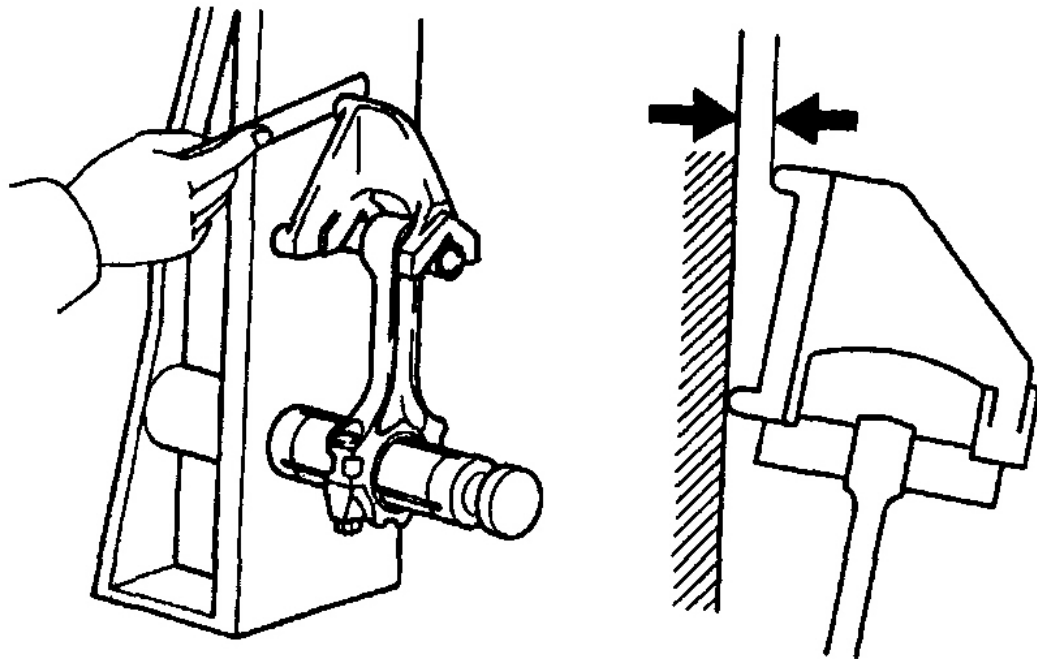
- Using a rod aligner and a feeler gauge, check the connecting rod alignment.

1. Check for out-of-alignment.

**Maximum out-of-alignment:**

**0.05 mm (0.0020 in.) per 100 mm (3.94 in.)**

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



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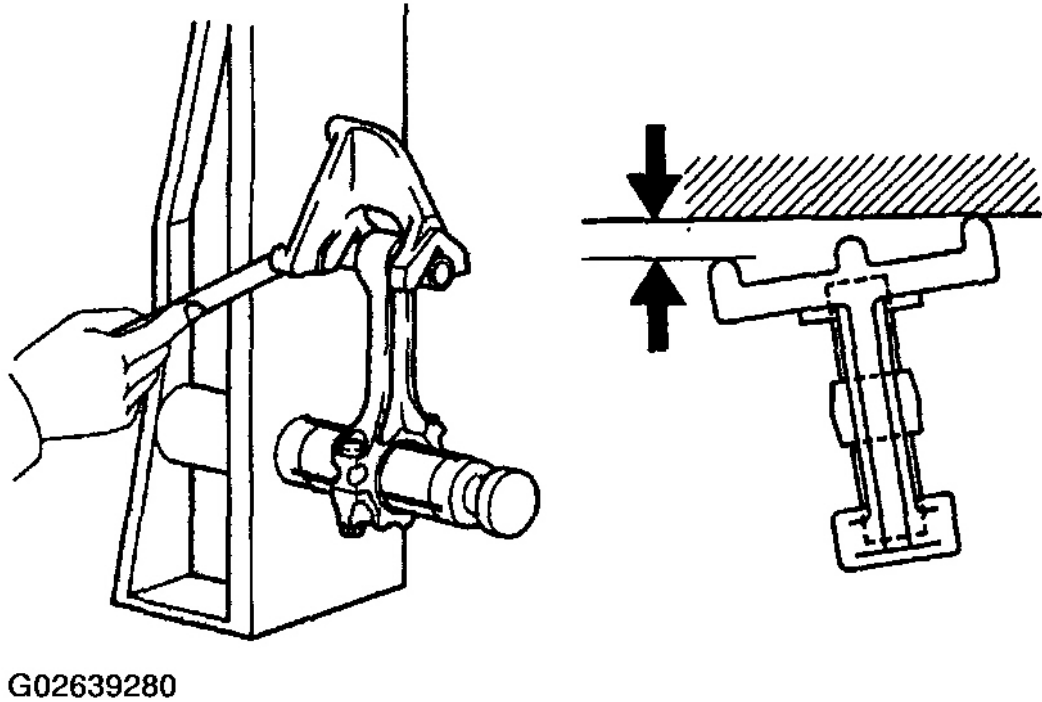
**Fig. 270: Checking Connecting Rod Alignment**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Check for twist.

**Maximum twist:**

**0.15 mm (0.0059 in.) per 100 mm (3.94 in.)**

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

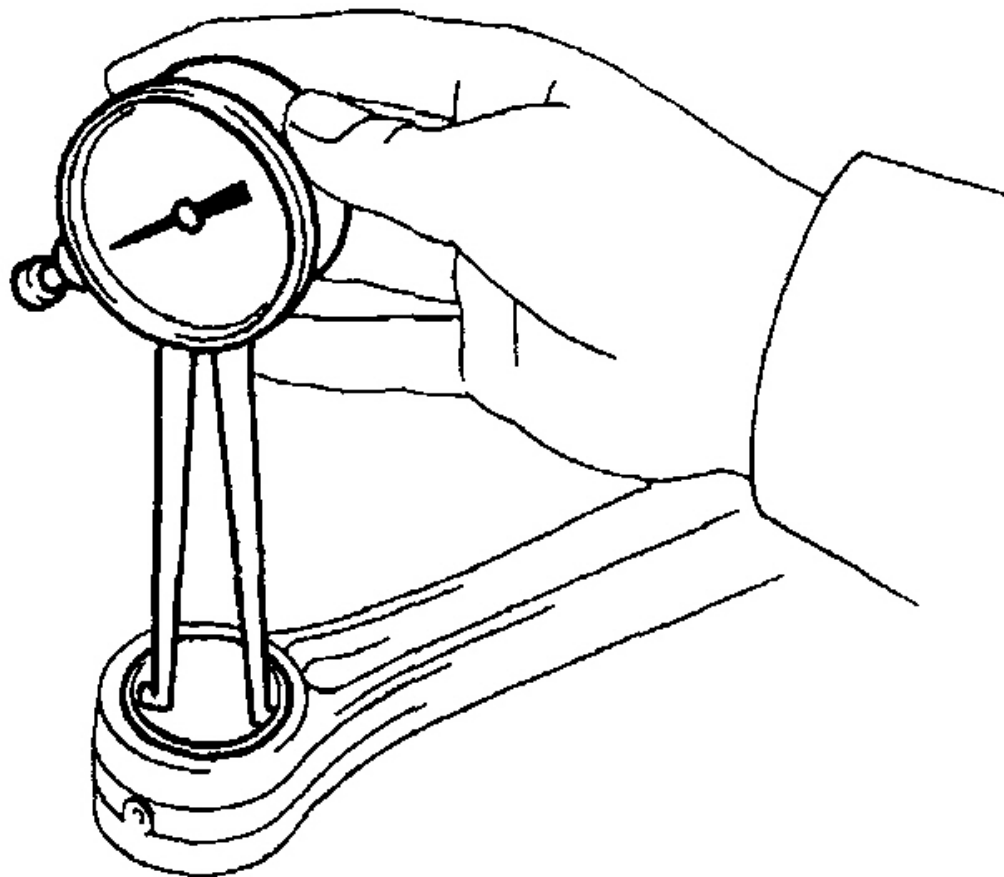


**Fig. 271: Checking Connecting Rod For Twist**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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 to 22.014 mm (0.8663 to 0.8667 in.)**



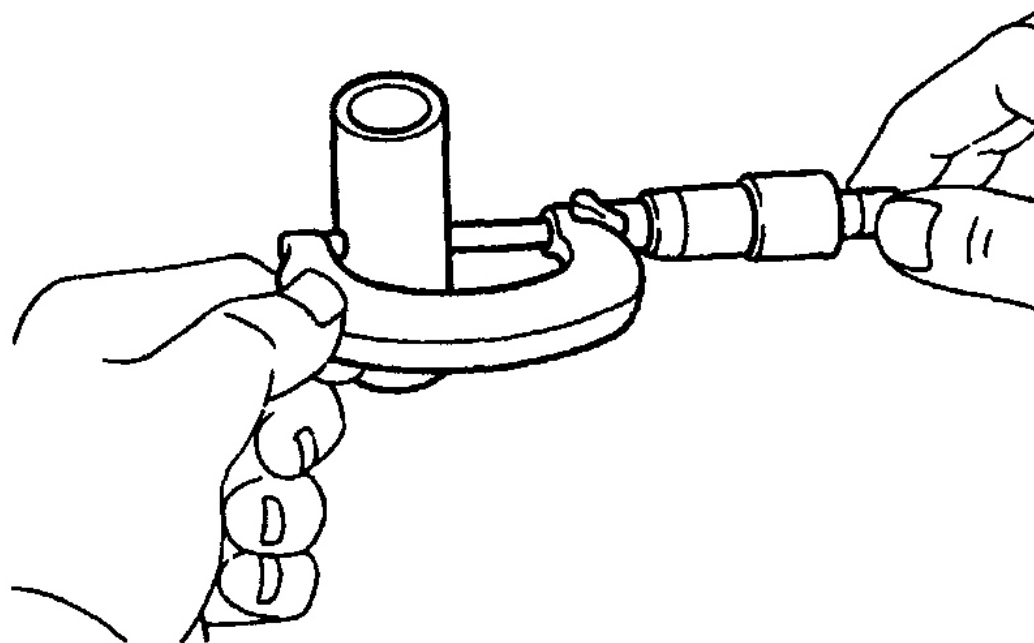
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**Fig. 272: Measuring Inside Diameter Of Connecting Rod Bushing**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

**Piston pin diameter:**

**21.997 to 22.006 mm (0.8660 to 0.8664 in.)**



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**Fig. 273: Measuring Piston Pin Diameter**

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

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

**Standard oil clearance:**

**0.005 to 0.011 mm (0.0002 to 0.0004 in.)**

**Maximum oil clearance: 0.05 mm (0.0020 in.)**

If the oil clearance is greater than the maximum, replace the bushing (see **REPLACEMENT**). If necessary, replace the piston and piston pin as a set.

## 8. INSPECT CONNECTING ROD BOLTS

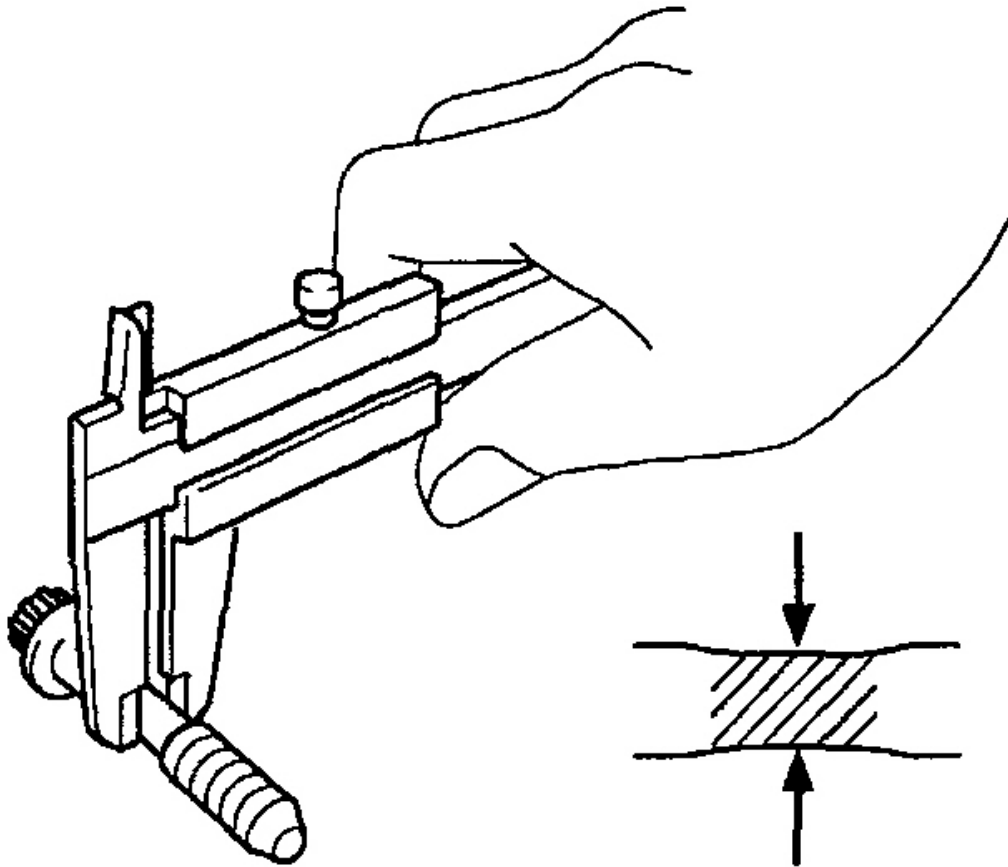
Using vernier calipers, measure the tension portion diameter of the bolt.

**Standard diameter: 7.2 to 7.3 mm (0.283 to 0.287 in.)**

**Minimum diameter: 7.0 mm (0.275 in.)**



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



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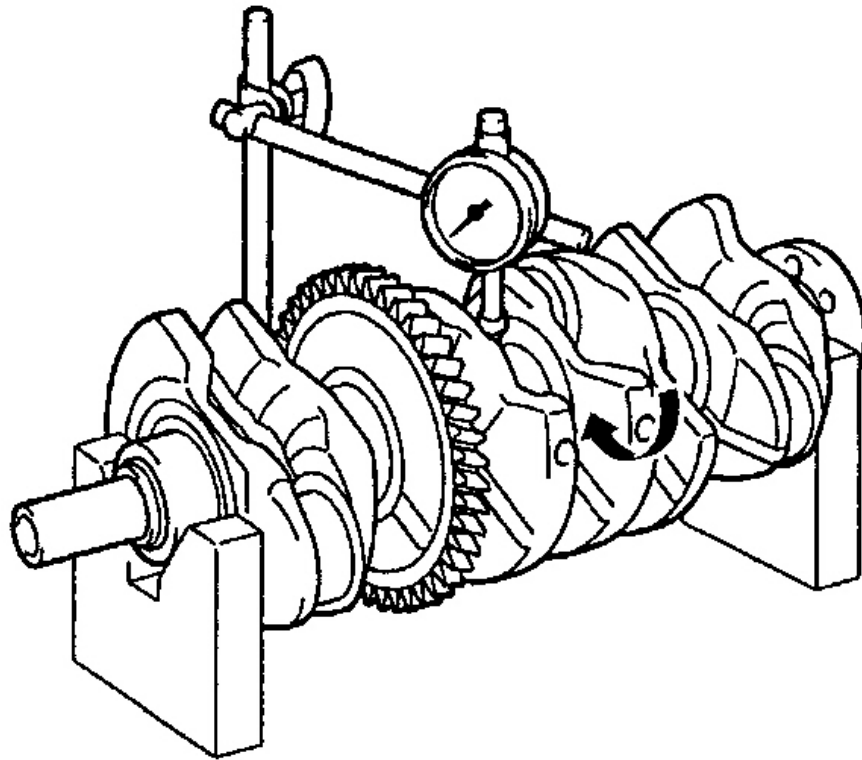
**Fig. 274: Measuring Tension Portion Diameter**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## 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.

**Maximum circle runout: 0.03 mm (0.0012 in.)**

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



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**Fig. 275: Measuring Circle Runout Crankshaft**

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

- b. Inspect the main journals and crank pins.
  1. Using a micrometer, measure the diameter of each main journal and crank pin.

**Diameter:**

**DIAMETER**

Main journal	54.988 to 55.000 mm (2.1649 to 2.1654 in.)
Crank pin	47.990 to 48.000 mm (1.8894 to 1.8898 in.)

If the diameter is not as specified, check the oil clearance (see **DISASSEMBLY**). If necessary, replace the crankshaft.

2. Check each main journal and crank pin for taper and out-of-round as shown.

## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4

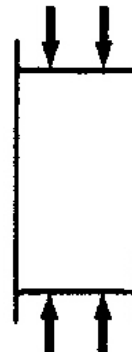
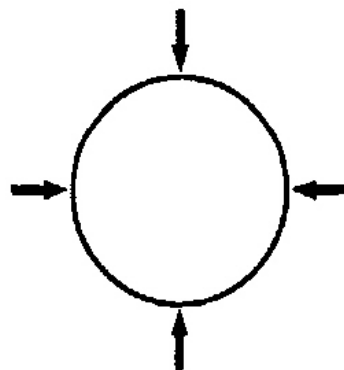
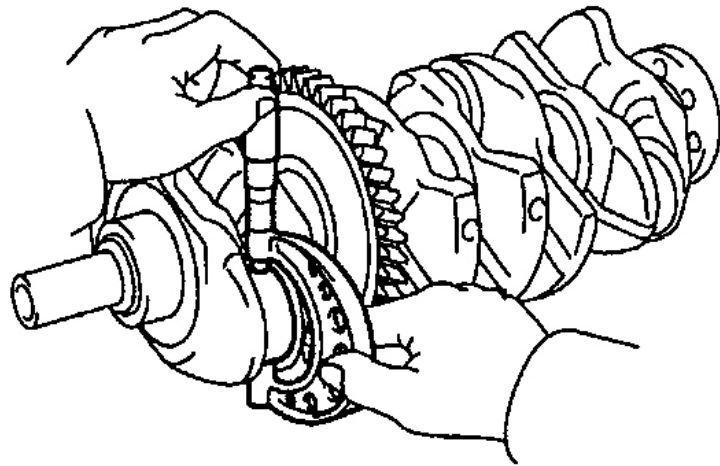
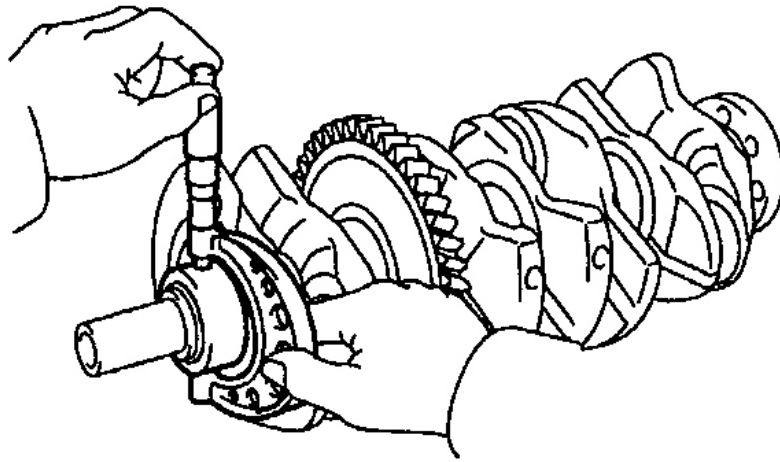
**Maximum taper and out-of-round:**

**0.003 mm (0.0001 in.)**

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

## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4



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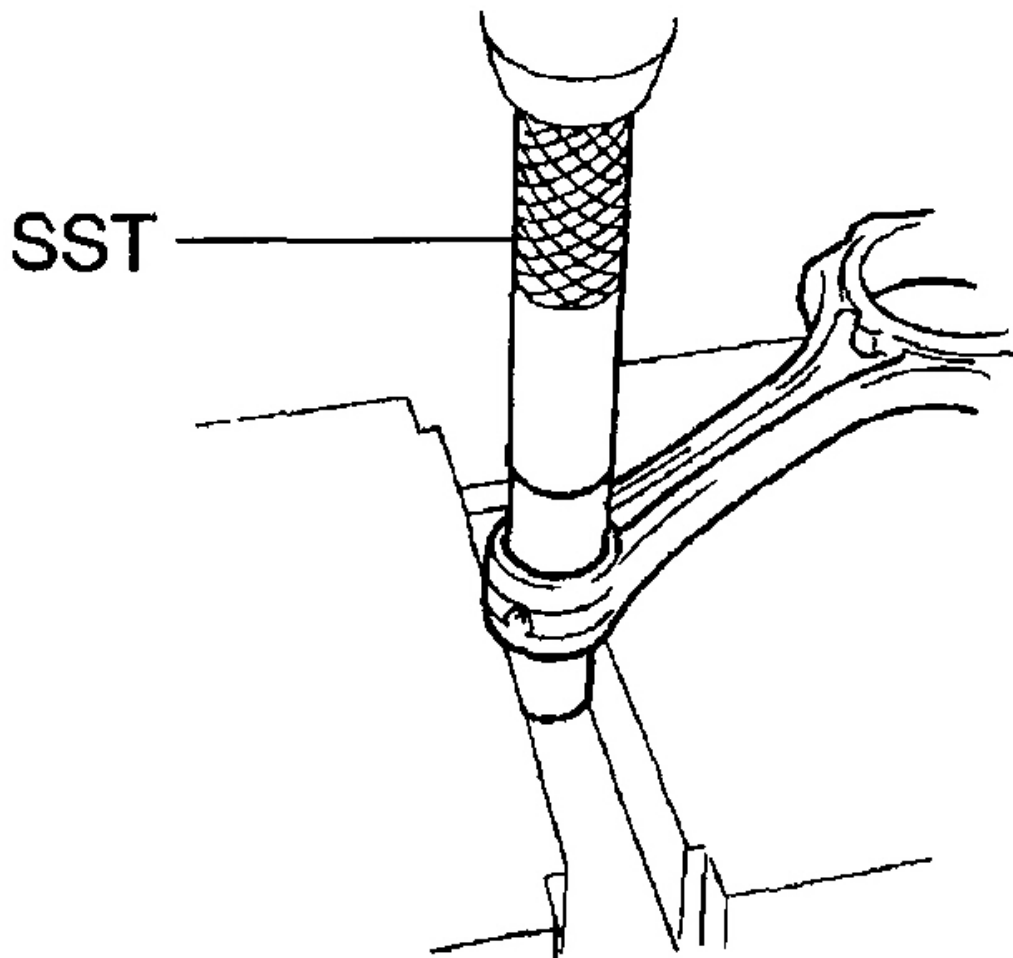
**Fig. 276: Checking Each Journal & Crank Pin For Taper And Out-Of-Round**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## REPLACEMENT

### 1. REPLACE CONNECTING ROD BUSHINGS

- a. Using SST and a press, press out the bushing.

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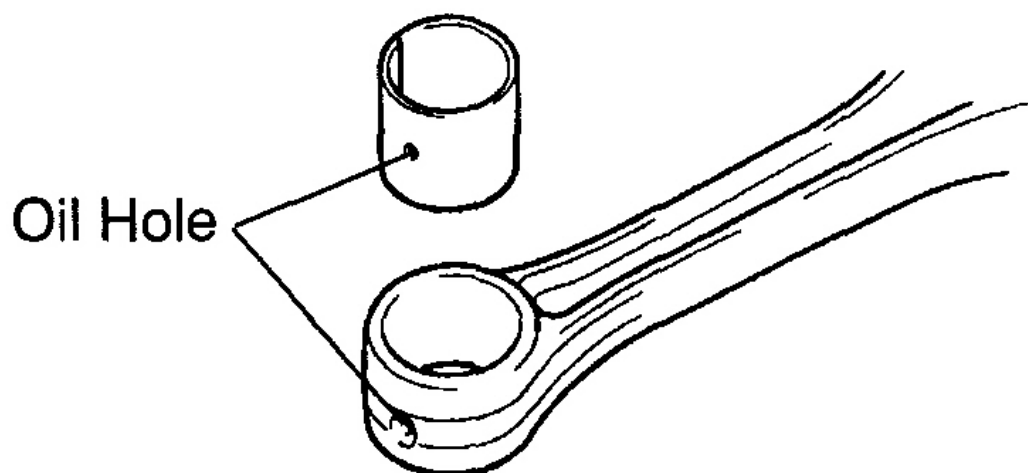


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**Fig. 277: Pressing Out Bushing**

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

- b. Align the oil hoses of a new bushing and the connecting rod.



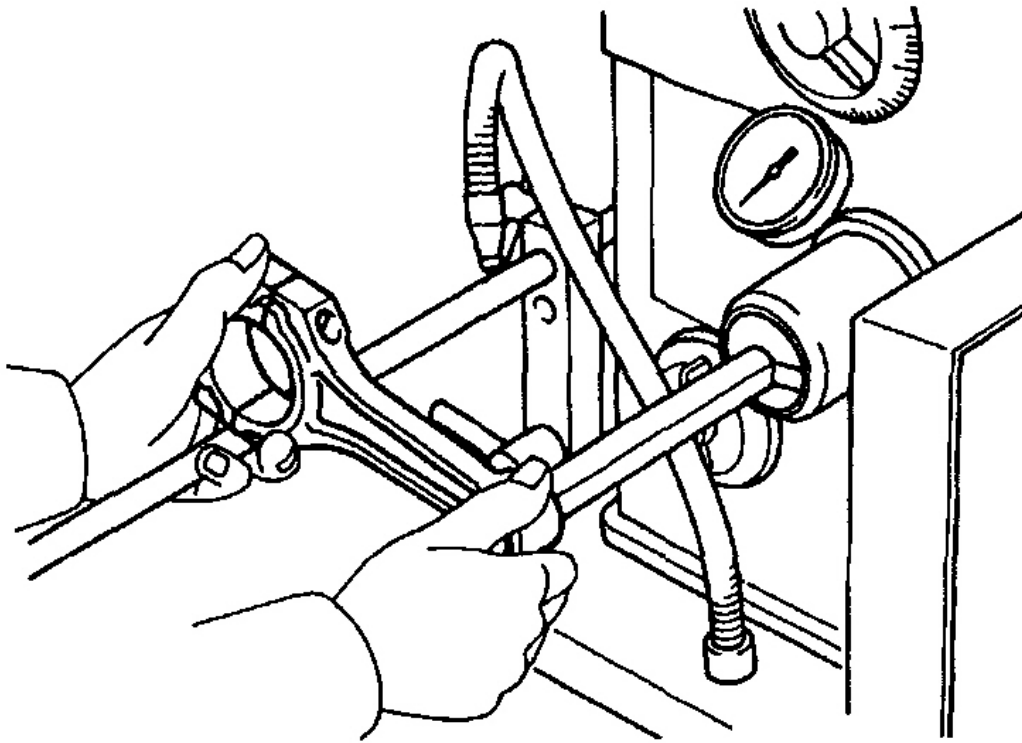
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**Fig. 278: Aligning Oil Holes Of Bushing & Connecting Rod**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- 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.

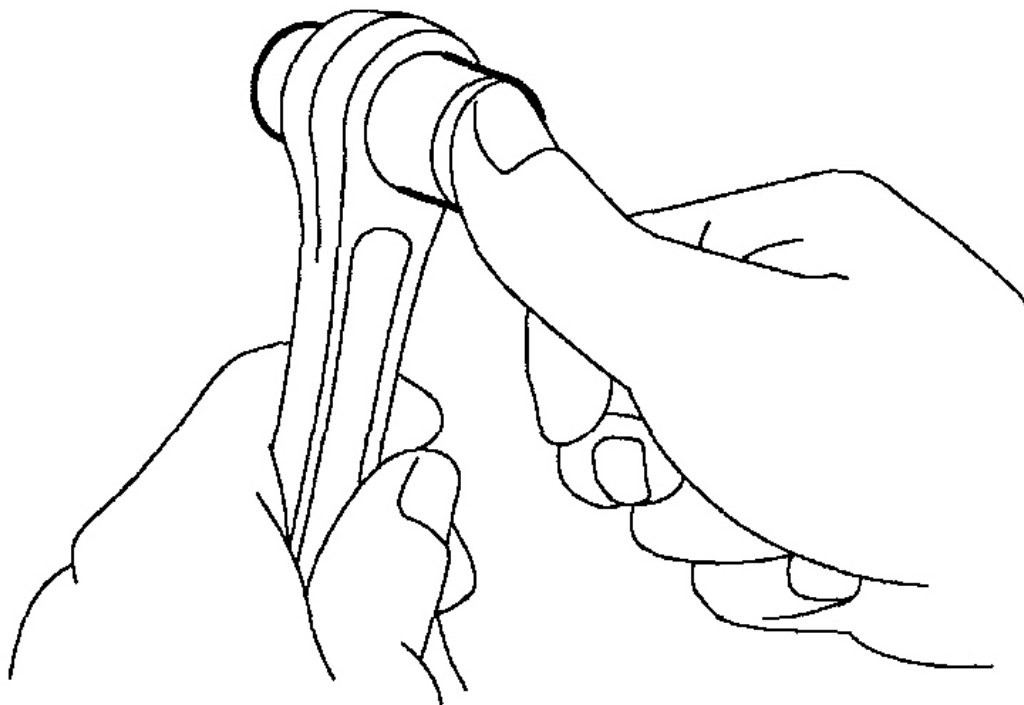


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**Fig. 279: Honing Connecting Rod Bushing**

**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. 280: Checking Piston Pin Fit**

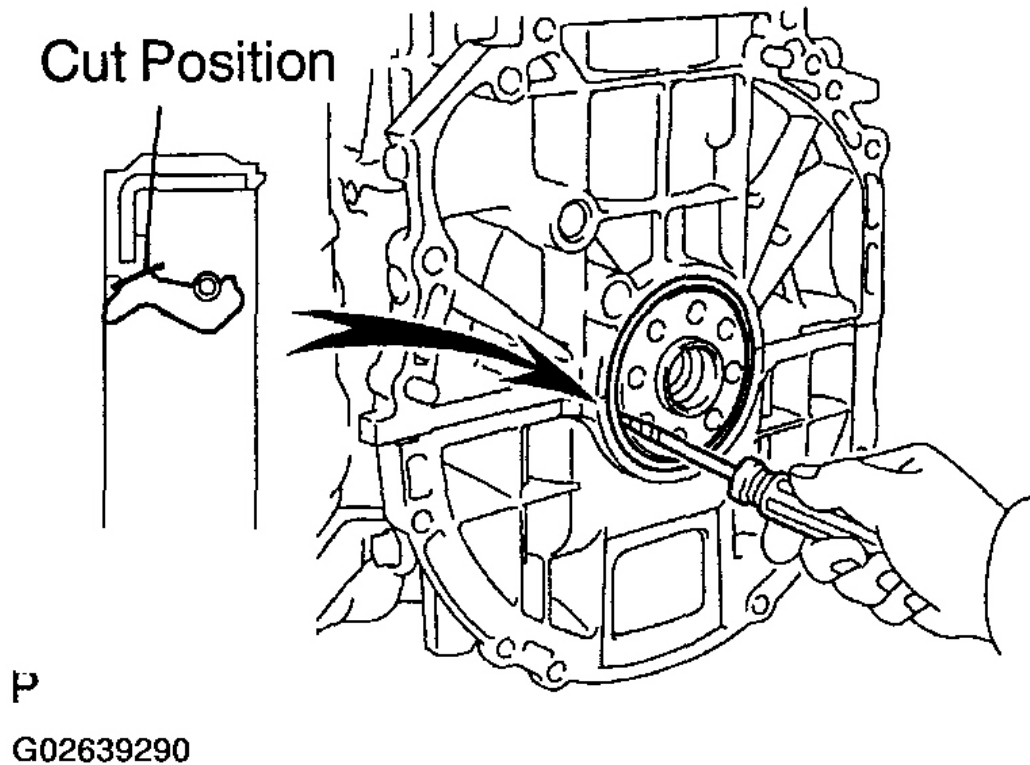
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

## **2. REPLACE CRANKSHAFT REAR OIL SEAL**

If the rear oil seal is installed to the cylinder block.

1. Using a knife, cut off the oil seal lip.





**Fig. 281: Cutting Off Oil Seal Lip**

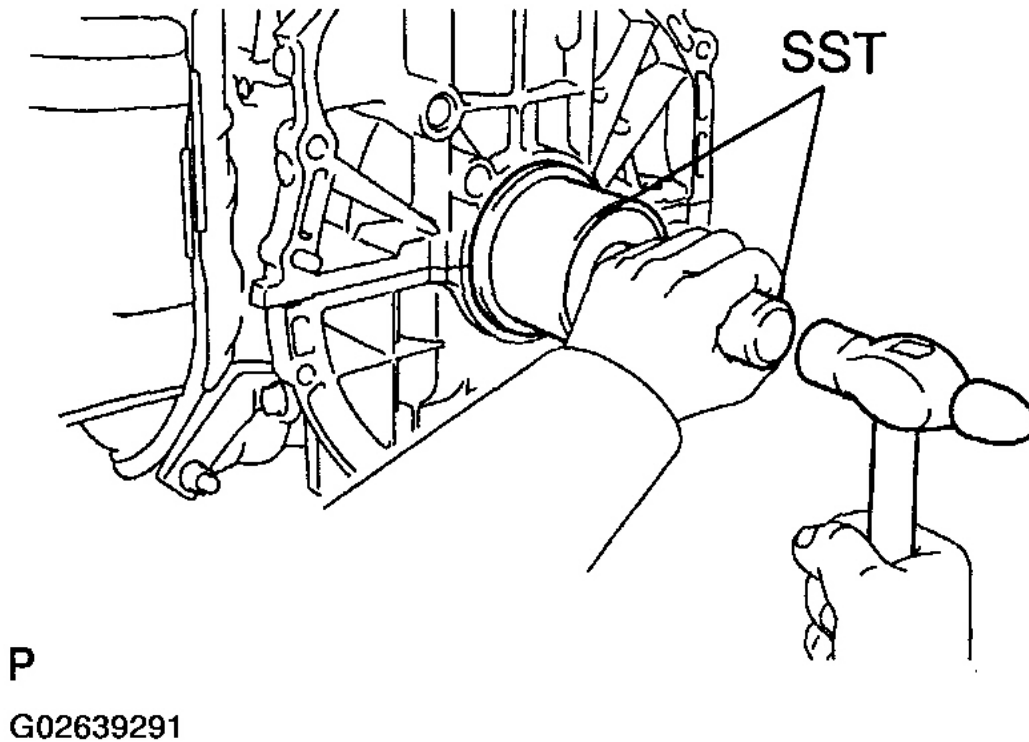
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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)



**Fig. 282: Cutting Off Oil Seal Lip**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

## REASSEMBLY

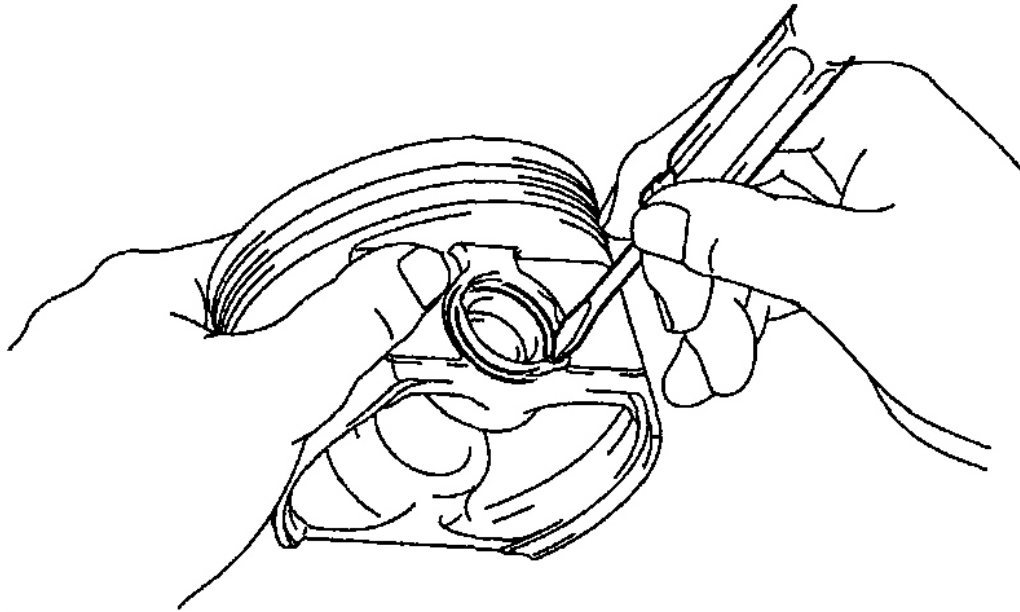
### HINT:

- 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.

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



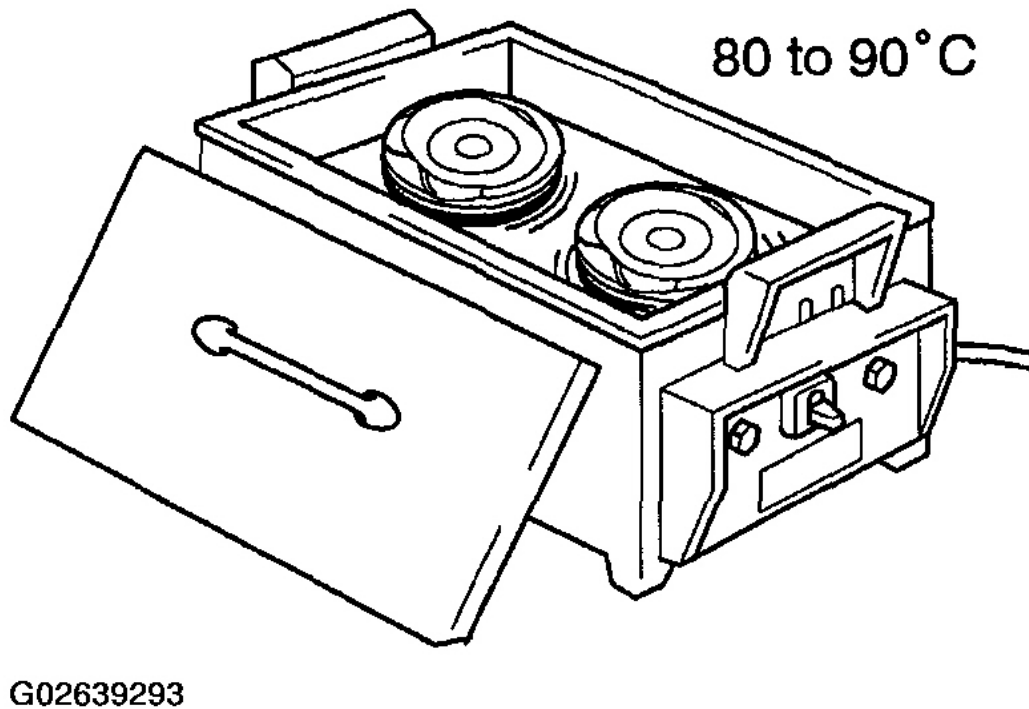
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**Fig. 283: Installing Snap Ring**

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

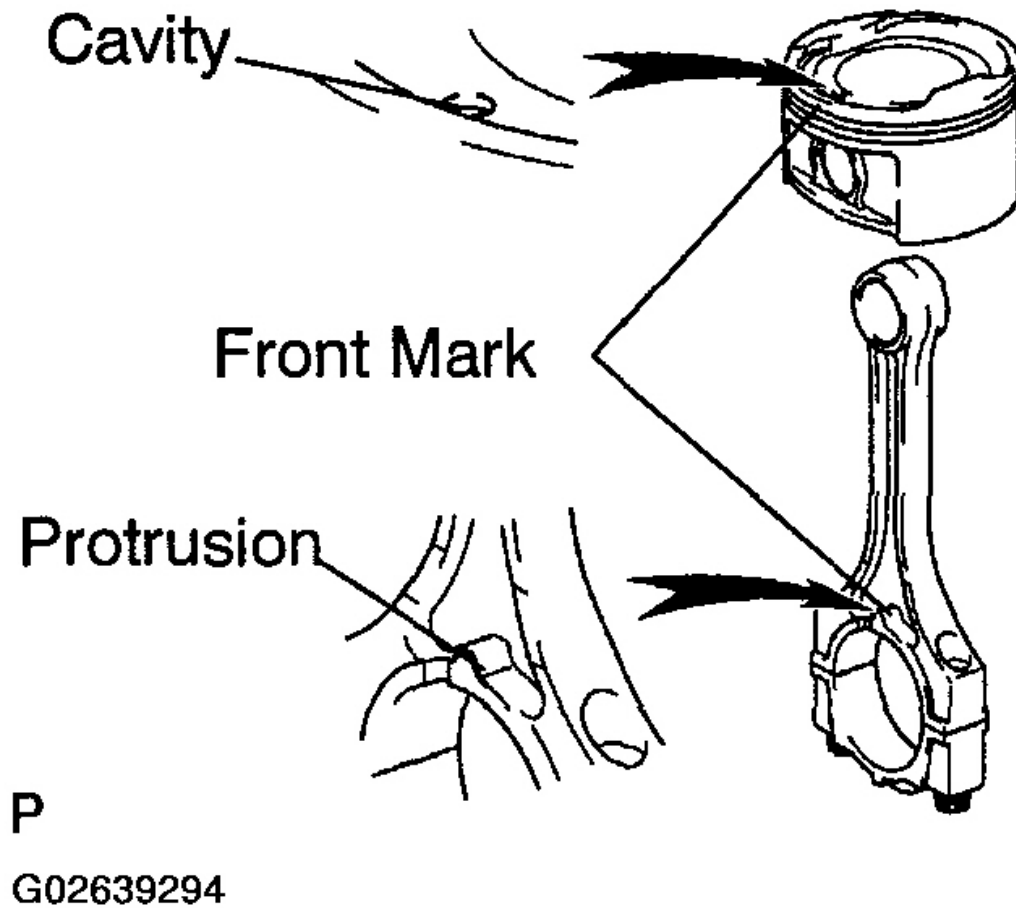
- b. Gradually heat the piston to 80 to 90°C (176 to 194°F).



**Fig. 284: Heating Pistons**

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

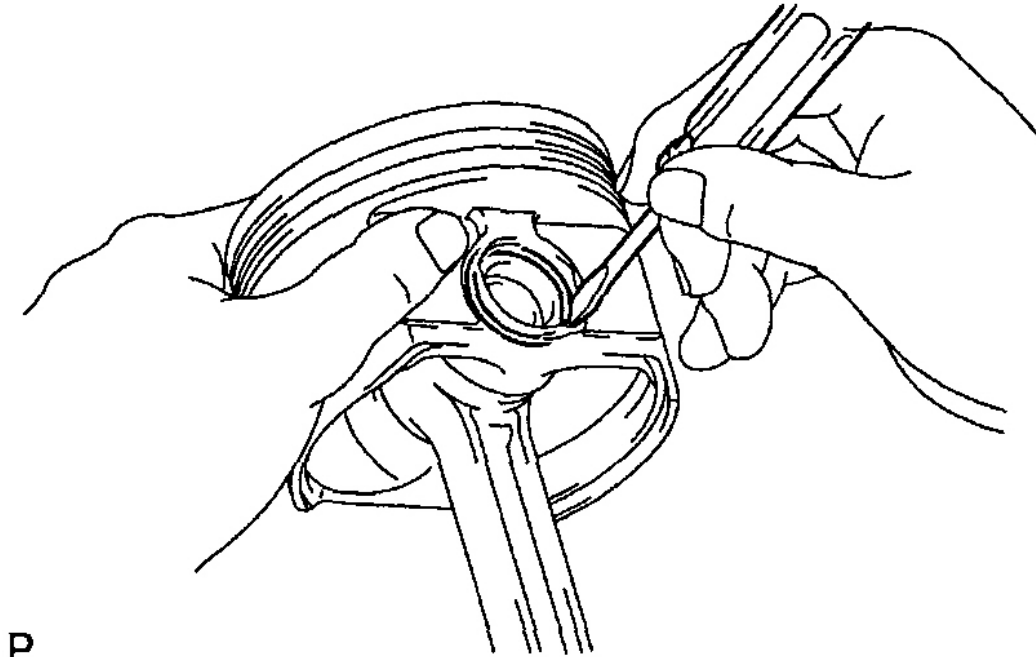
- c. Coat the piston pin with engine oil.
- d. Align the front marks on the piston and connecting rod, and push in the piston with your thumb.



**Fig. 285: Aligning Front Marks On 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.

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



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**Fig. 286: Installing Snap Ring**

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

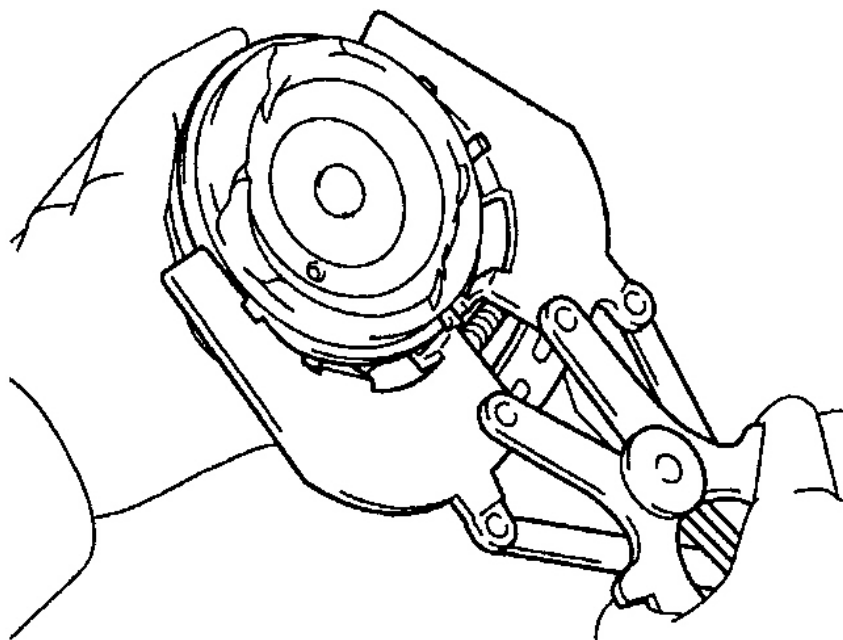
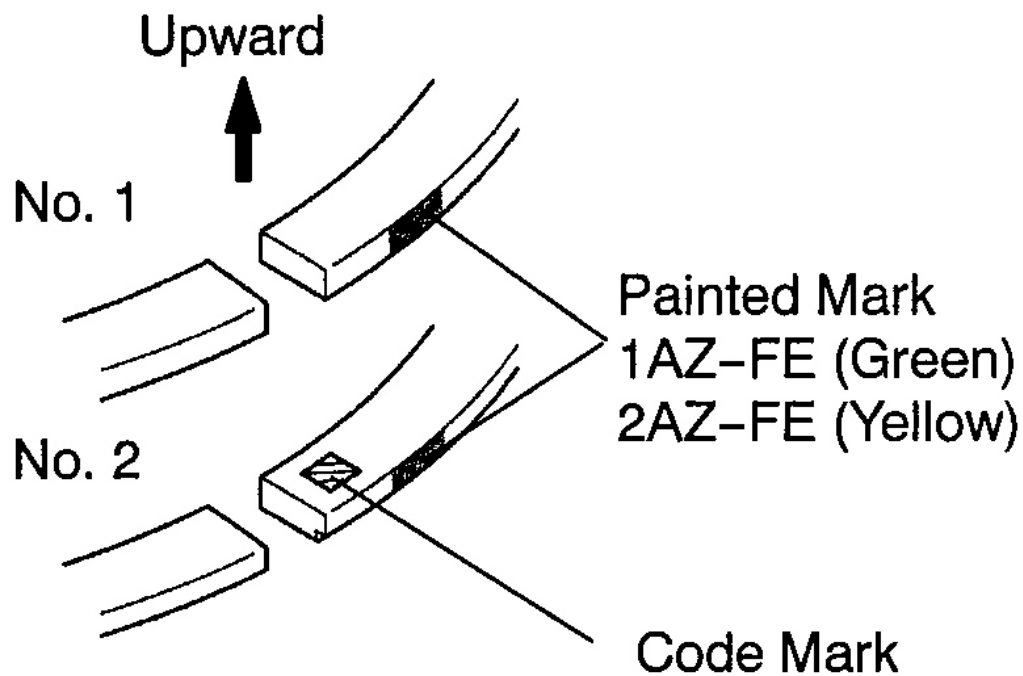
## 2. INSTALL PISTON RINGS

- Install the oil ring expander and 2 side rails by hand.
- Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

**Code mark:**

### CODE MARK

Piston Ring	Code
No. 1	None
No. 2	2N

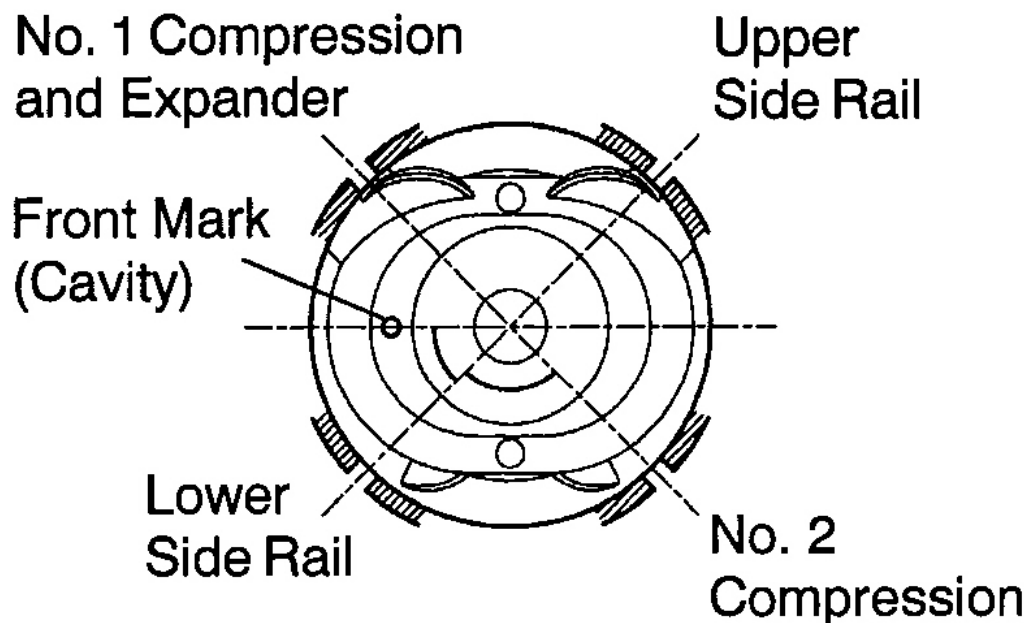


**Fig. 287: Installing Piston Rings**

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

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

**NOTE:** Do not align the ring ends.



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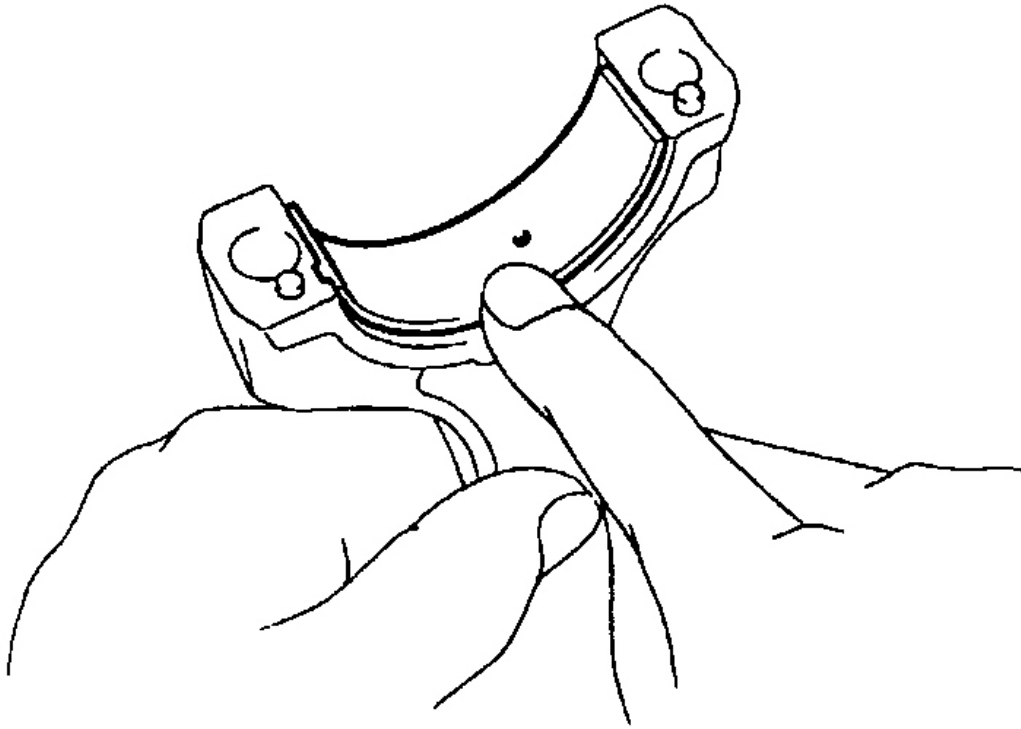
**Fig. 288: Positioning Piston Rings**

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

### 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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**Fig. 289: Installing Connecting Rod Bearings**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

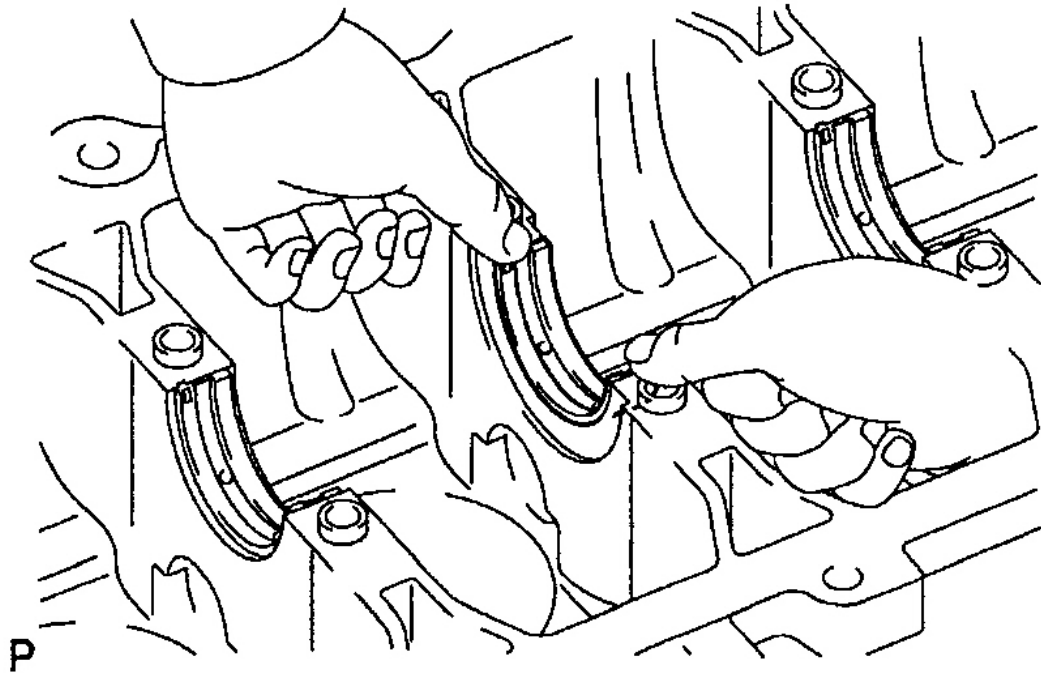
#### **4. INSTALL MAIN BEARINGS**

**HINT:**

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.

**NOTE:**     • Install the bearing with the oil hole in the cylinder block.

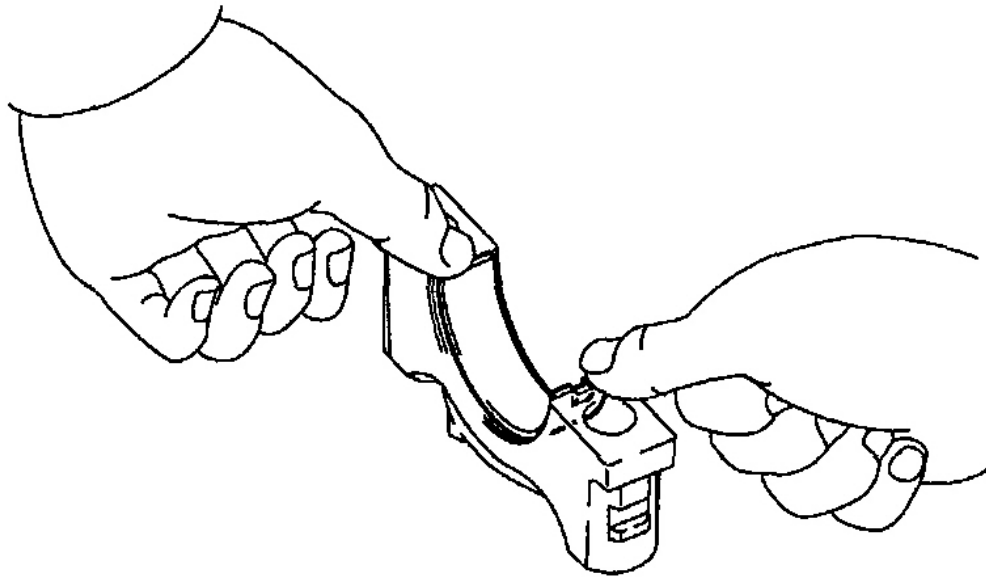


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**Fig. 290: Installing Bearing With Oil Hole In Cylinder Block**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- **Clean the backside of the bearing and the bearing surface of the bearing cap and do not let the oil and fat 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 oil and fat stick.**



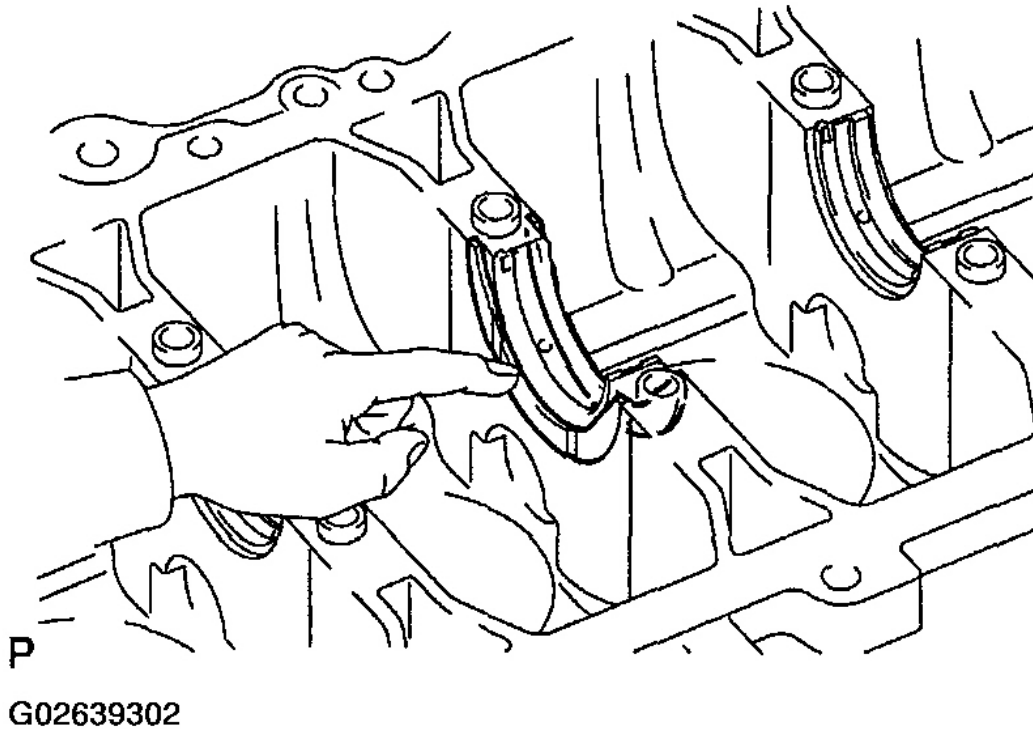
**P**

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**Fig. 291: Installing Bearing Main Bearing Caps**  
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.



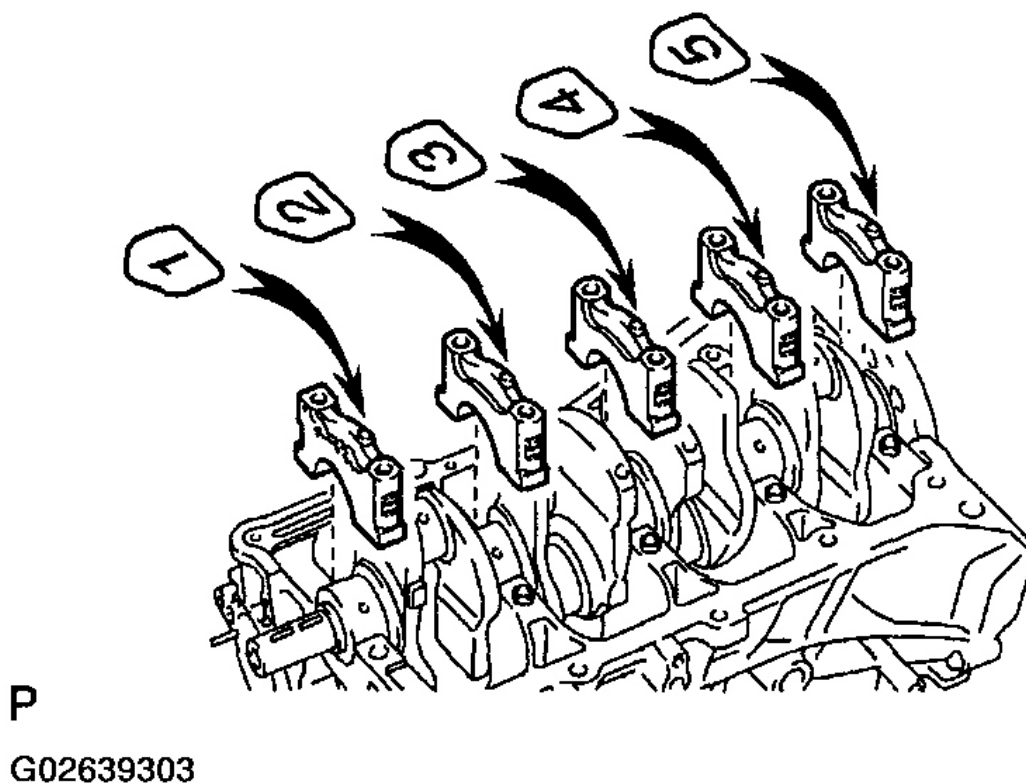
**Fig. 292: Installing Thrust Washers**

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

6. **PLACE CRANKSHAFT ON CYLINDER BLOCK**
7. **INSTALL MAIN BEARING CAPS**
  - a. Install the 5 main bearing caps in their proper locations.

HINT:

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



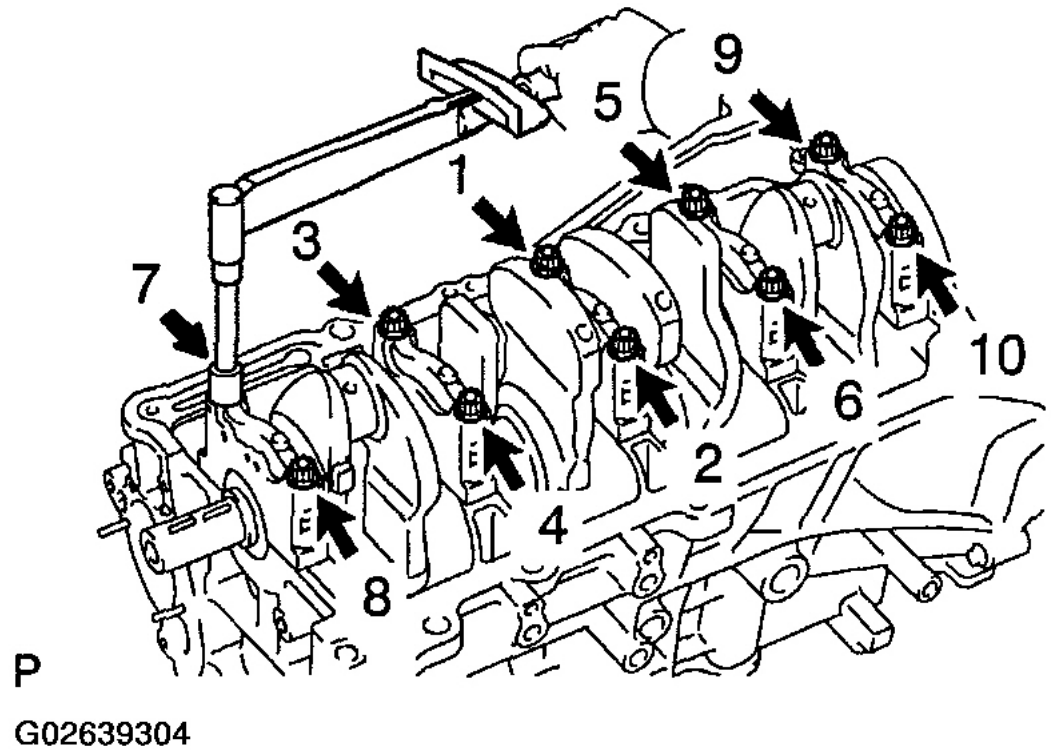
**Fig. 293: Installing Main Bearing Caps In Proper Locations**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the main bearing cap bolts.

**HINT:**

- 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 (204 kgf.cm, 15 ft.lbf)**



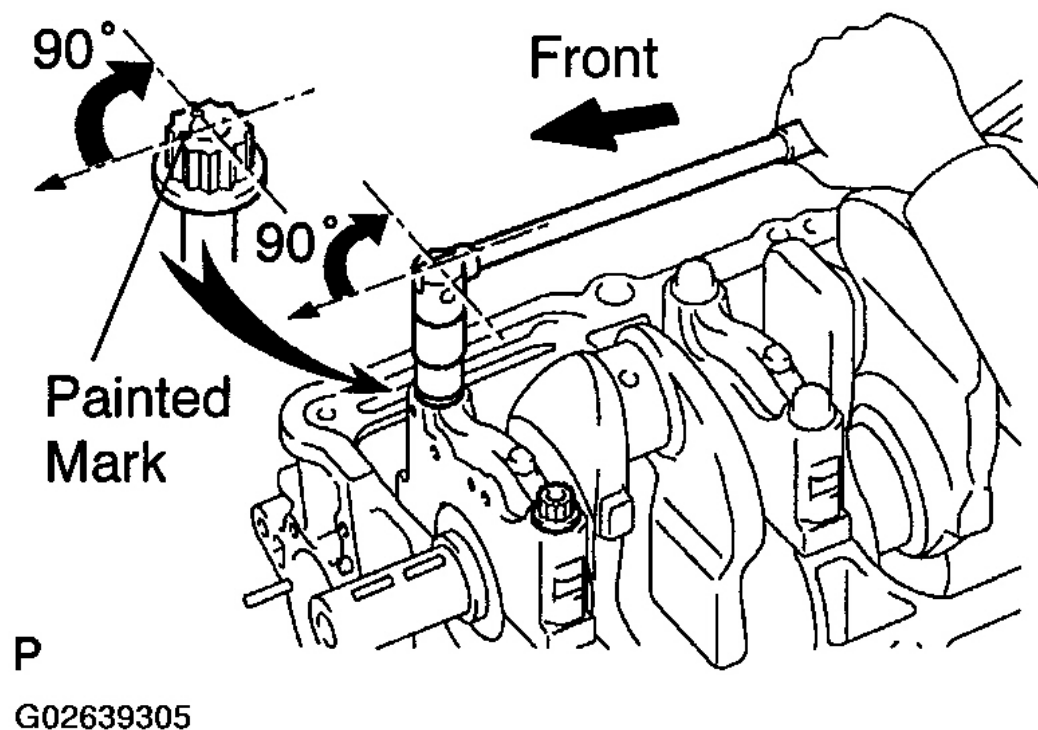
**Fig. 294: Identifying Bearing cap Bolt Tightening Sequence**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

3. Retighten the 10 main bearing cap bolts in several passes, in the sequence shown. See **Fig. 294**.

**Torque: 40 N.m (408 kgf.cm, 30 ft.lbf)**

If any one of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.

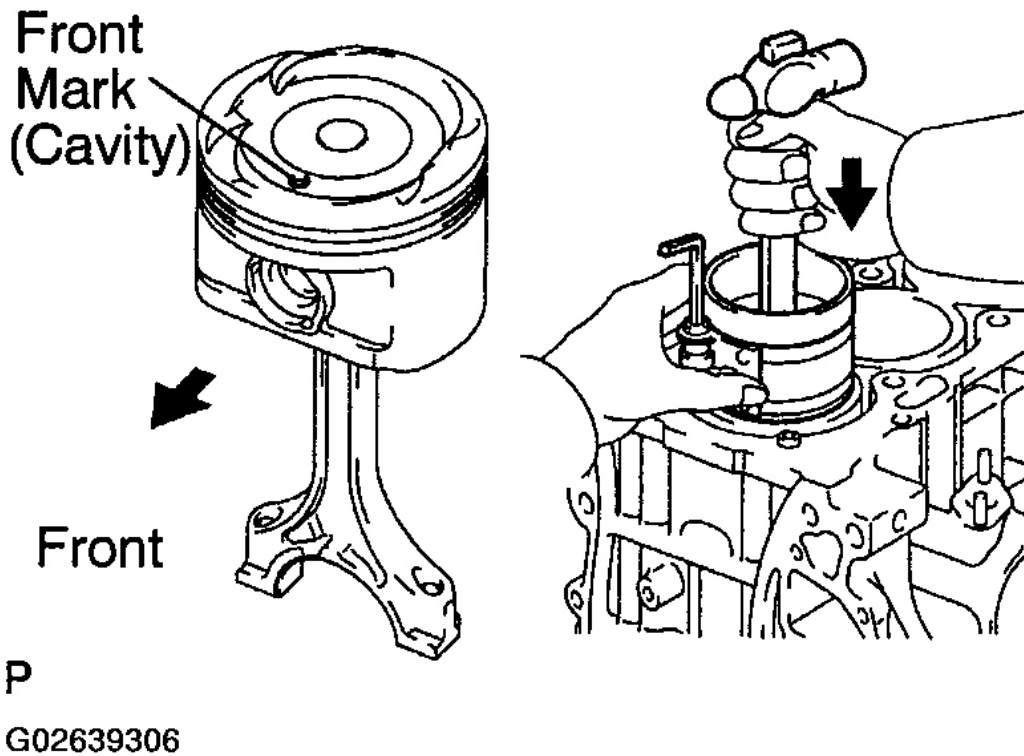
4. Mark the front of the main bearing cap bolt with paint.



**Fig. 295: Retightening Main Bearing Cap Bolts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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)**
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.

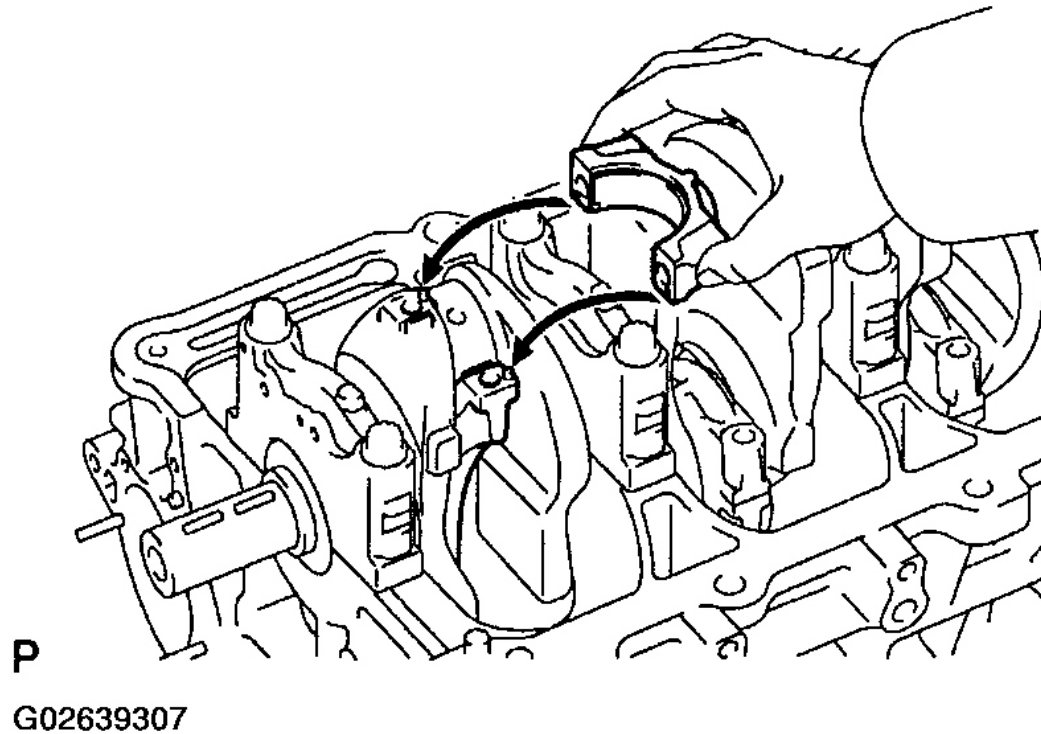


**Fig. 296: Installing Piston & Connecting Rod Assembly**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**10. INSTALL CONNECTING ROD CAP**

- a. Place the connecting rod cap on the connecting rod.
  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.

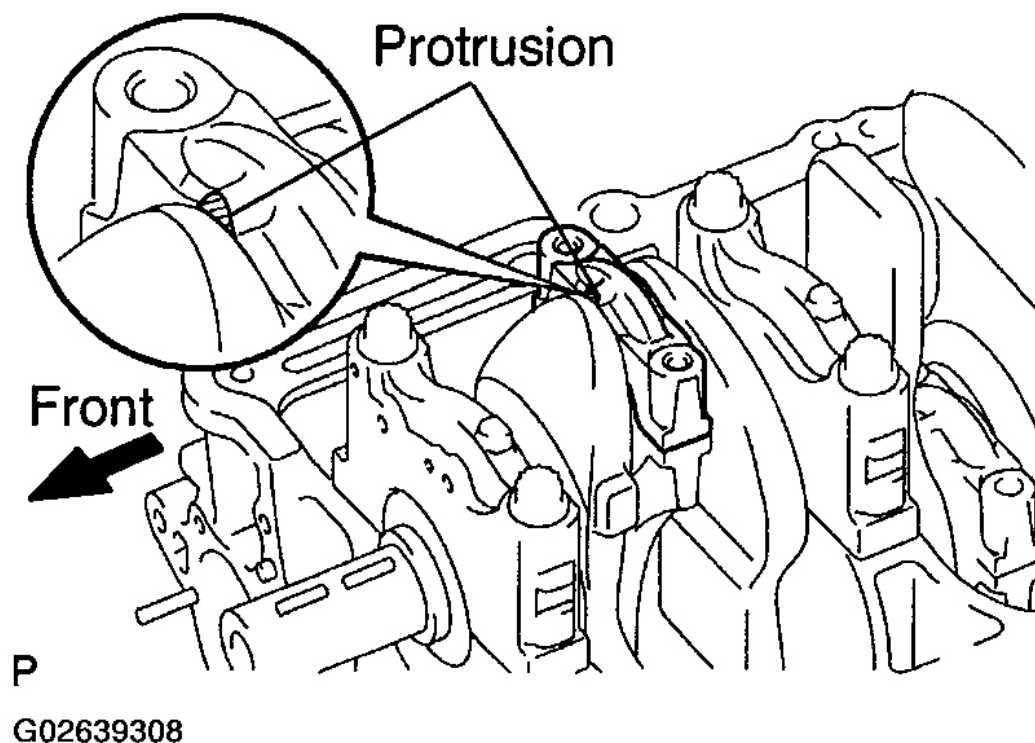




**Fig. 297: Placing Connecting Rod Cap On Connecting Rod**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**NOTE:** Clean the backside of the bearing and the bearing surface of the bearing cap and prevent oil from adhering to them.

3. Check that the protrusion of the connecting rod cap is facing in the correct direction.



**Fig. 298: Checking Protrusion Of Connecting Rod Cap**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

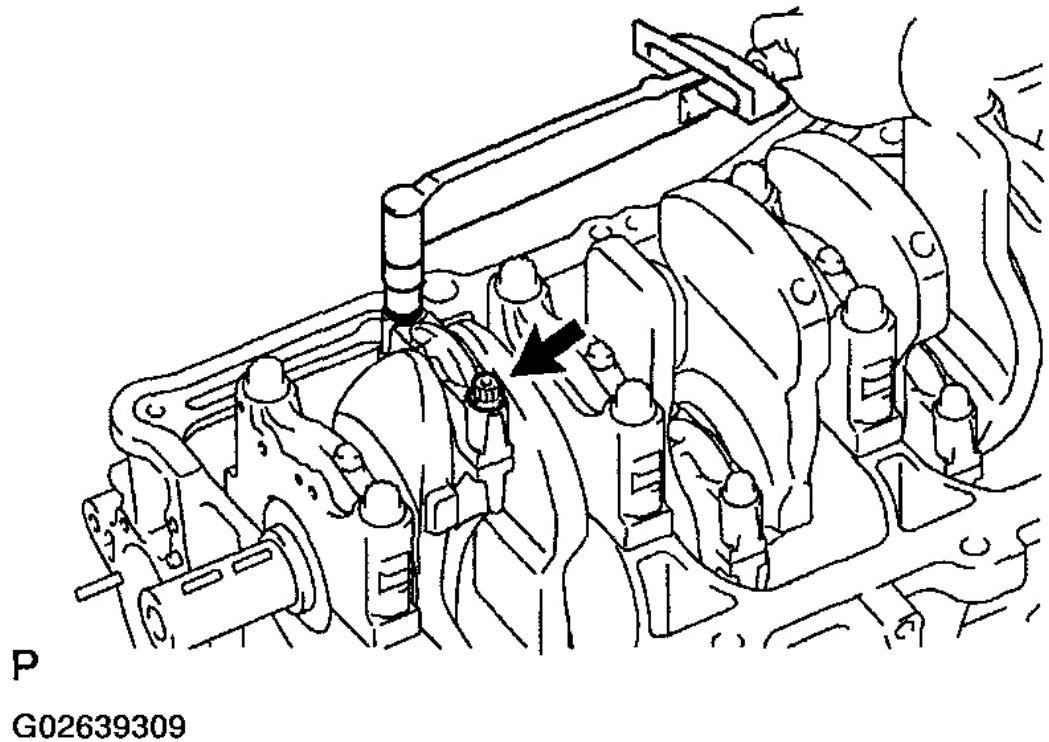
- b. Install the connecting rod cap bolts.

**HINT:**

- 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.
  1. Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.
  2. Install and alternately tighten the 2 connecting rod cap bolts in several passes.

**Torque: 24.5 N.m (250 kgf.cm, 18 ft.lbf)**

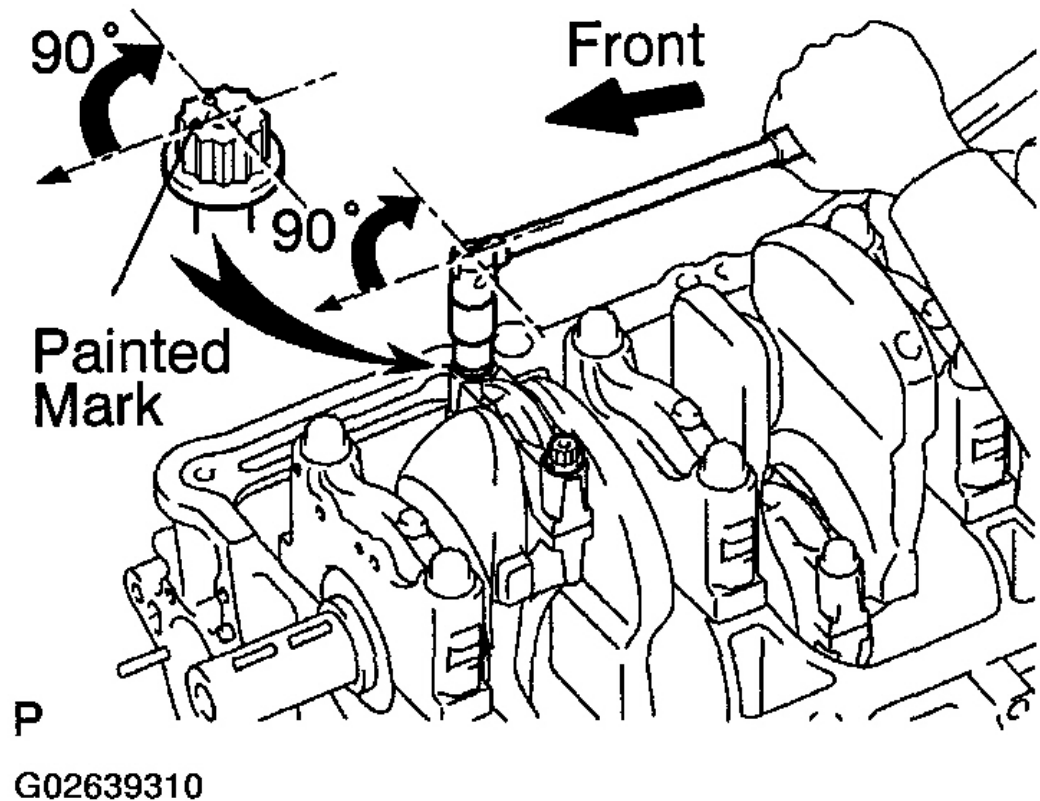
If any of the connecting rod cap bolts does not meet the torque specification, replace the connecting rod cap bolts.



**Fig. 299: Alternately Tightening The 2 Connecting Rod Cap Bolts In Several Passes**

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

3. Mark the front of the connecting cap bolts with paint.
4. Retighten the cap bolts by 90° as shown.



**Fig. 300: Marking Bolt Head & Retightening Cap Bolts By 90°**  
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. Check that the painted mark is now at a 90° angle to the front.
- c. Check that the crankshaft turns smoothly.
11. **CHECK CONNECTING ROD THRUST CLEARANCE** (See INSPECTION)
12. **INSTALL REAR CRANKSHAFT OIL SEAL** (See REPLACEMENT)

HINT:

Wipe seal packing away from the contact surface of the cylinder block assembly and oil seal.

### 13. **INSTALL CRANK CASE**

- a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces 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.

## 2005 Toyota RAV4

### 2005 ENGINE Engine Mechanical - RAV4

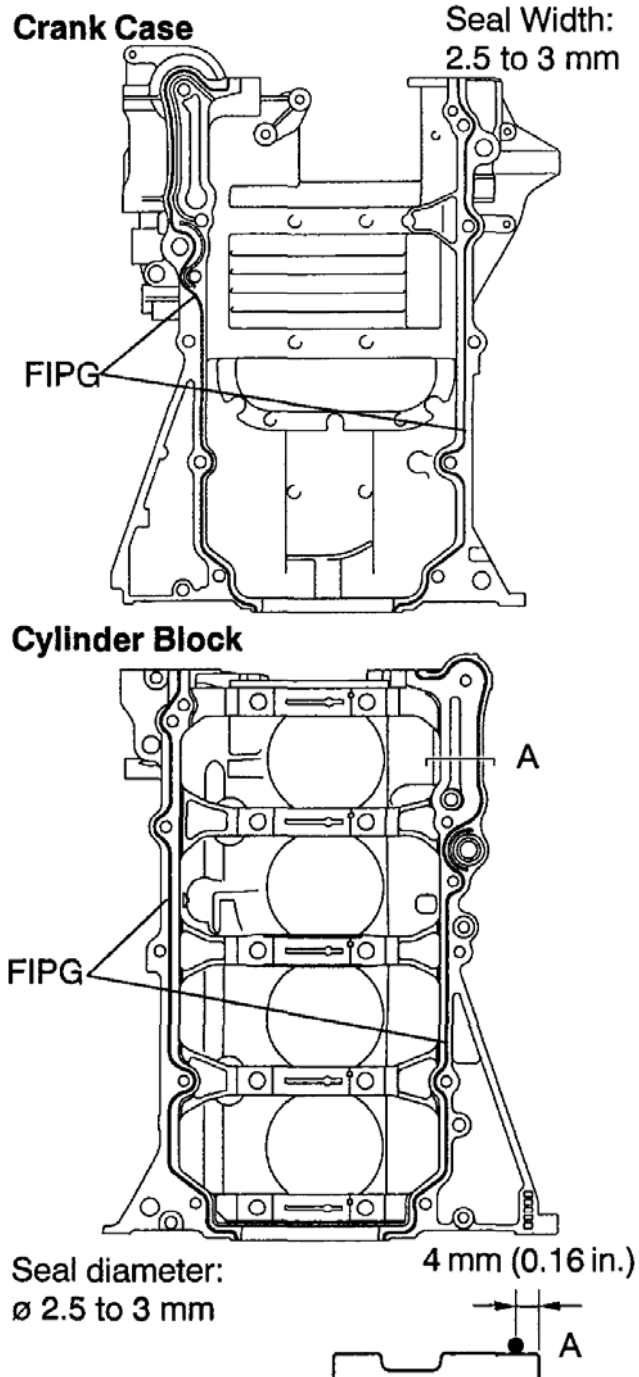
- Thoroughly clean all components to remove all the loose material.
  - Using a non-residue solvent, clean both sealing surfaces.
- b. Apply seal packing to the crank case or cylinder block as shown in the illustration.

#### **Seal packing: Part No. 08826-00080 or equivalent**

- Install a nozzle that has been cut to a 2.5 to 3.0 mm (0.10 to 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.

## 2005 Toyota RAV4

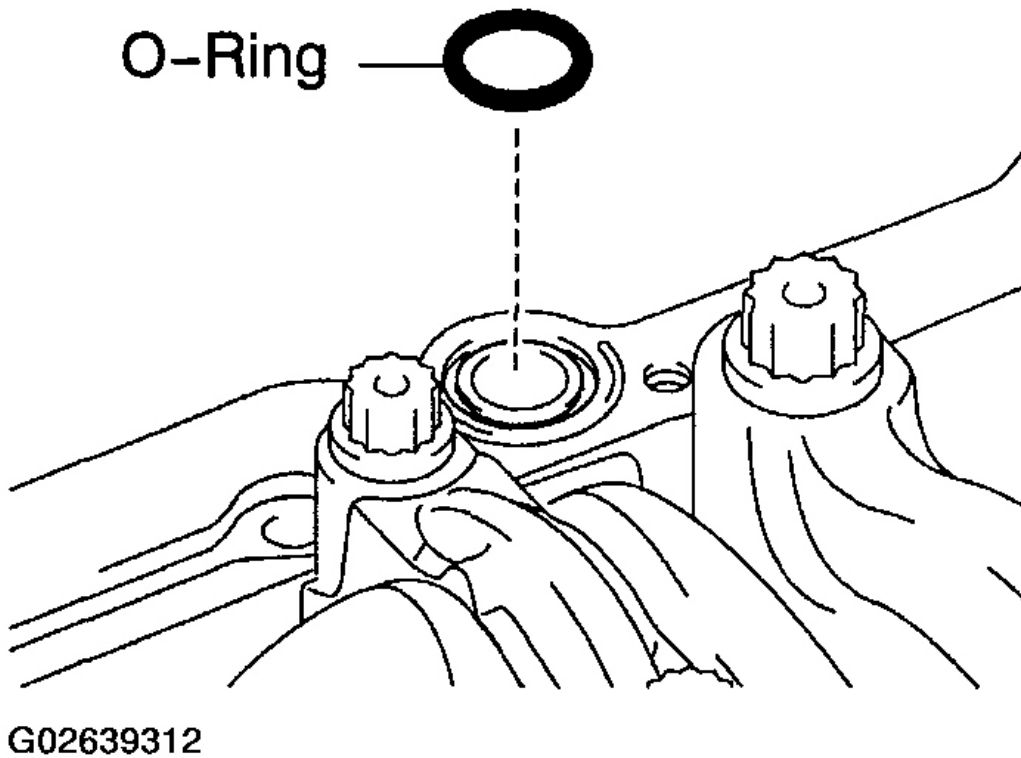
2005 ENGINE Engine Mechanical - RAV4



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**Fig. 301: Applying Seal Packing To Crank Case Or Cylinder Block**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Install a new O-ring to the cylinder block.



**Fig. 302: Installing O-Ring To Cylinder Block**

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

- d. Temporarily install the crank case with the 11 bolts.

HINT:

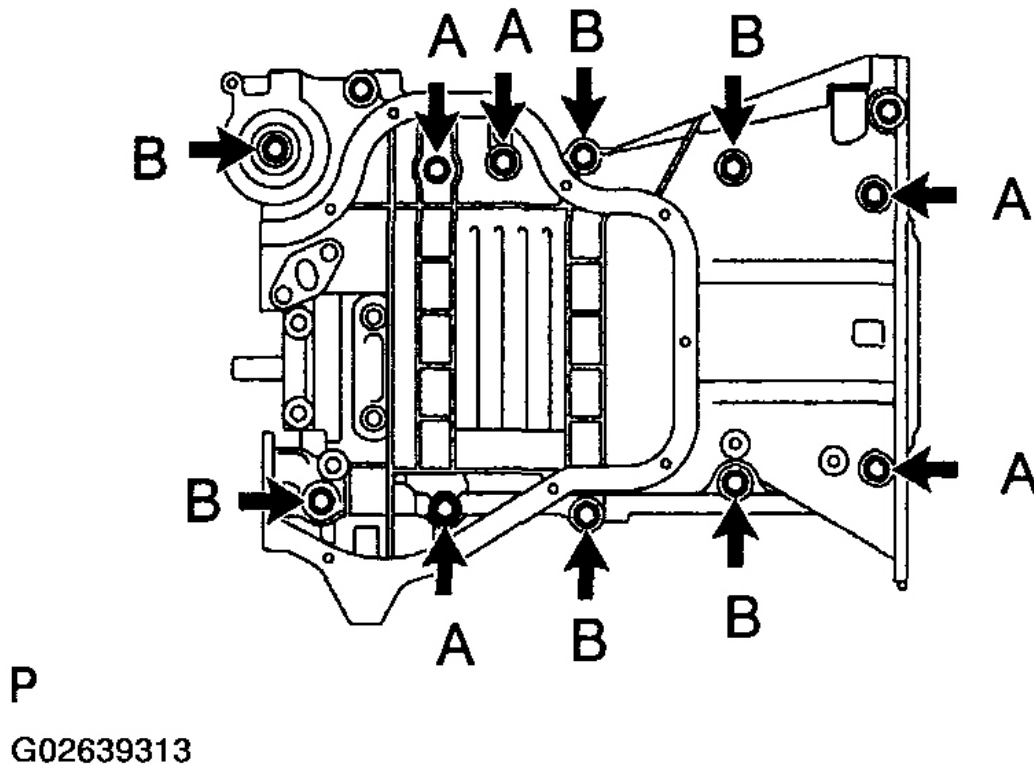
Bolt length:

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 (331 kgf.cm, 24 ft.lbf)**

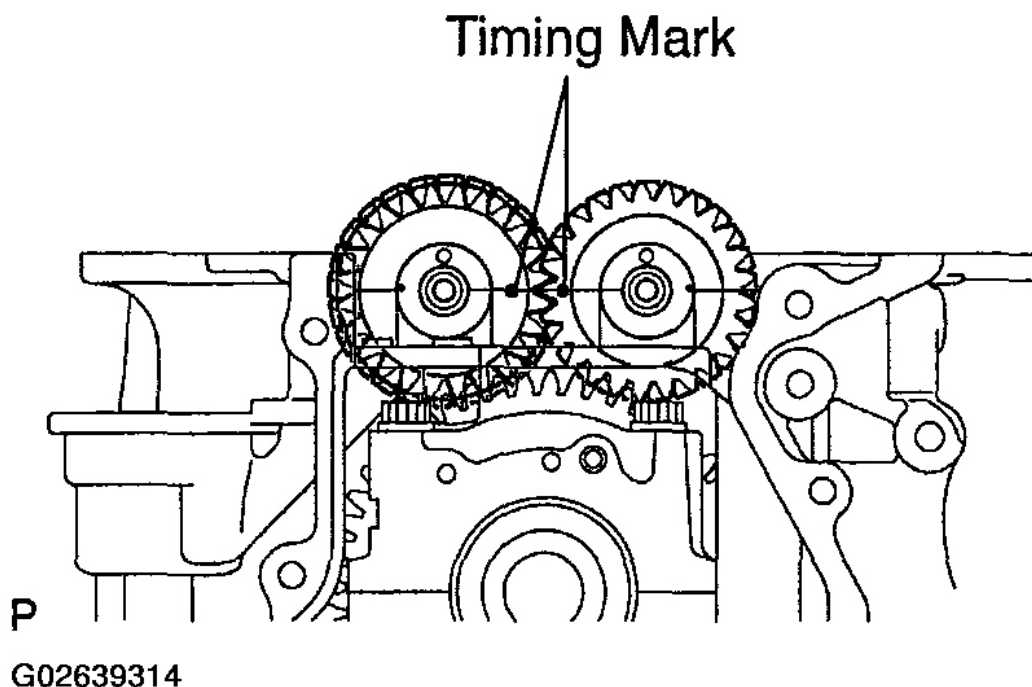


**Fig. 303: Identifying Locations Of Crank Case Bolts By Length**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 14. INSTALL BALANCE SHAFT

- Align the bearing claw with the claw groove, and push in the 8 bearings.
- Apply a light coat of engine oil on the bearings.
- Align the timing marks of the No. 1 and No. 2 balance shafts as shown.





**Fig. 304: Identifying Timing Mark Of Balance Shafts**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

d. Place the No. 1 and No. 2 balance shaft on the crank case.

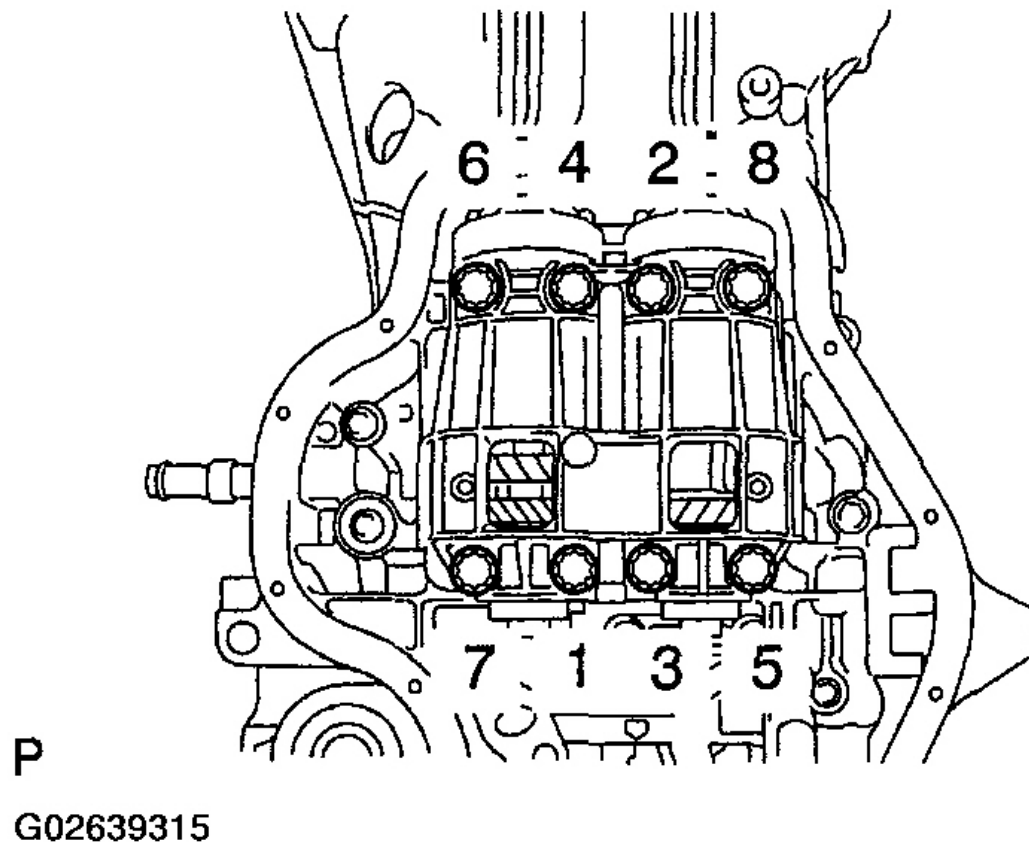
**15. INSTALL BALANCE SHAFT HOUSING**

**16. INSTALL BALANCE SHAFT HOUSING BOLTS**

**HINT:**

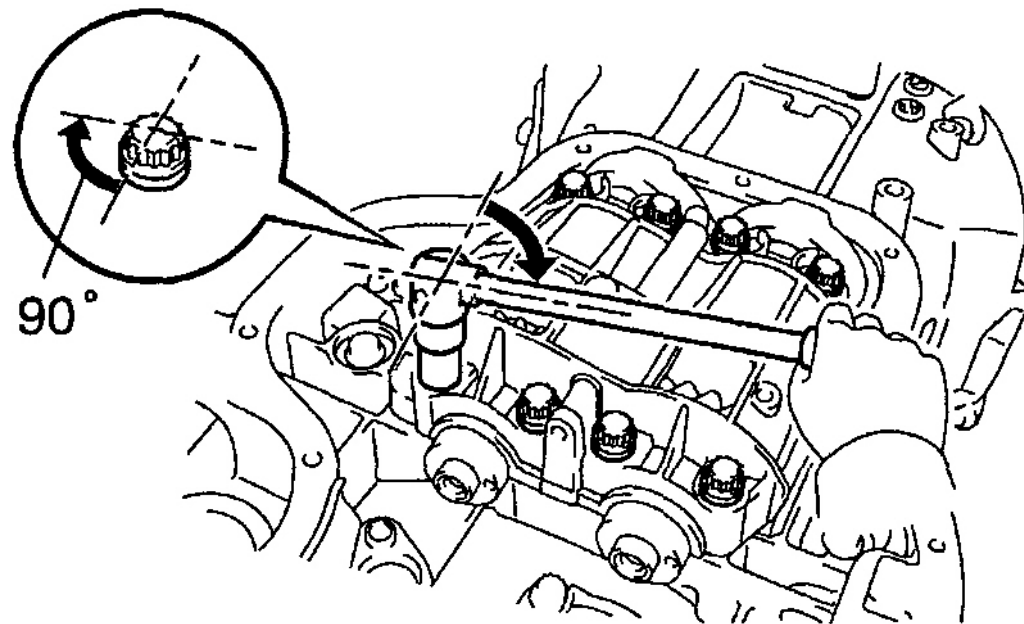
- The balance shaft housing bolts are tightened in 2 progressive steps (step (b) and (d)).
- If any of the balance shaft housing bolts is broken or deformed, replace it.
  - a. Apply a light coat of engine oil on the threads and under the heads of the balance shaft housing bolts.
  - b. Install and uniformly tighten the 8 bolts, several passes, in the sequence shown.

**Torque: 22 N.m (224 kgf.cm, 16 ft.lbf)**



**Fig. 305: Installing Balance Shaft Housing Bolts In Sequence**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Mark the front of the balance shaft housing bolts with paint.
- d. Retighten the bolts by 90° as shown.
- e. Check that the painted mark is now at a 90° angle to the front.
- f. Check that the balance shaft turns smoothly.
- g. Turn the balance shafts, and check that the timing marks of No. 1 and No. 2 balance shafts are in straight line on the crank case surface as shown.



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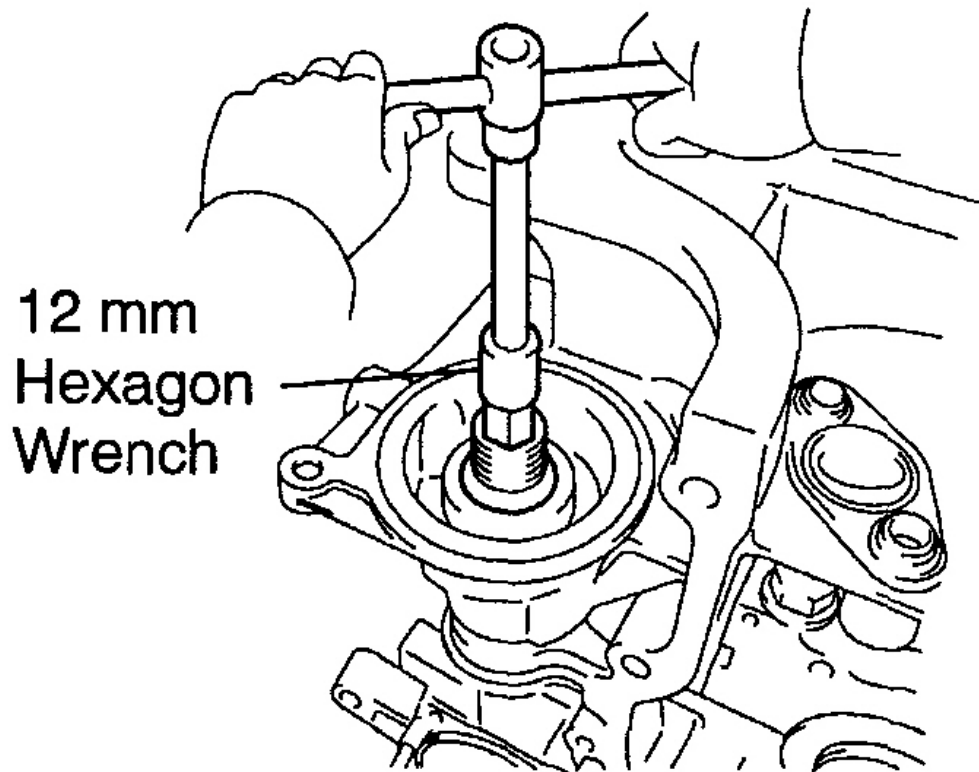
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**Fig. 306: Retightening Bolts Additional 90°**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

#### 17. INSTALL OIL FILTER UNION

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

**Torque: 29.5 N.m (301 kgf.cm, 22 ft.lbf)**



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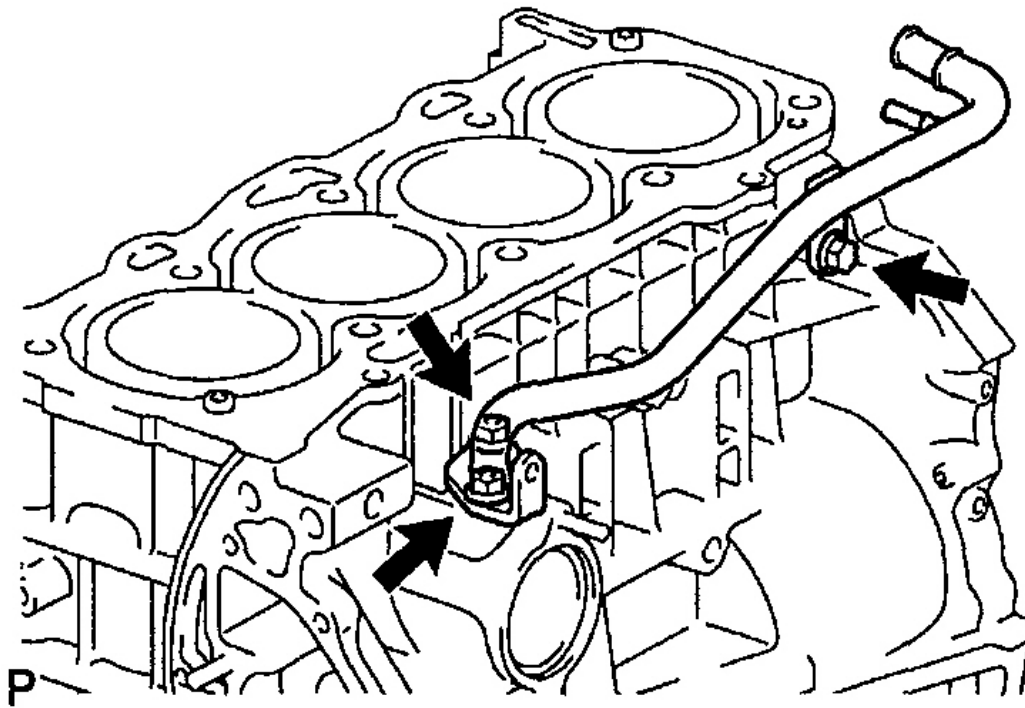
**Fig. 307: Installing Oil Filter Union Using Hexagon Wrench**

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

18. INSTALL OIL FILTER (See REPLACEMENT )
19. INSTALL OIL PUMP (See INSTALLATION )
20. INSTALL WATER BY-PASS PIPE

Install a new gasket, the water bypass pipe with the 2 nuts.

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



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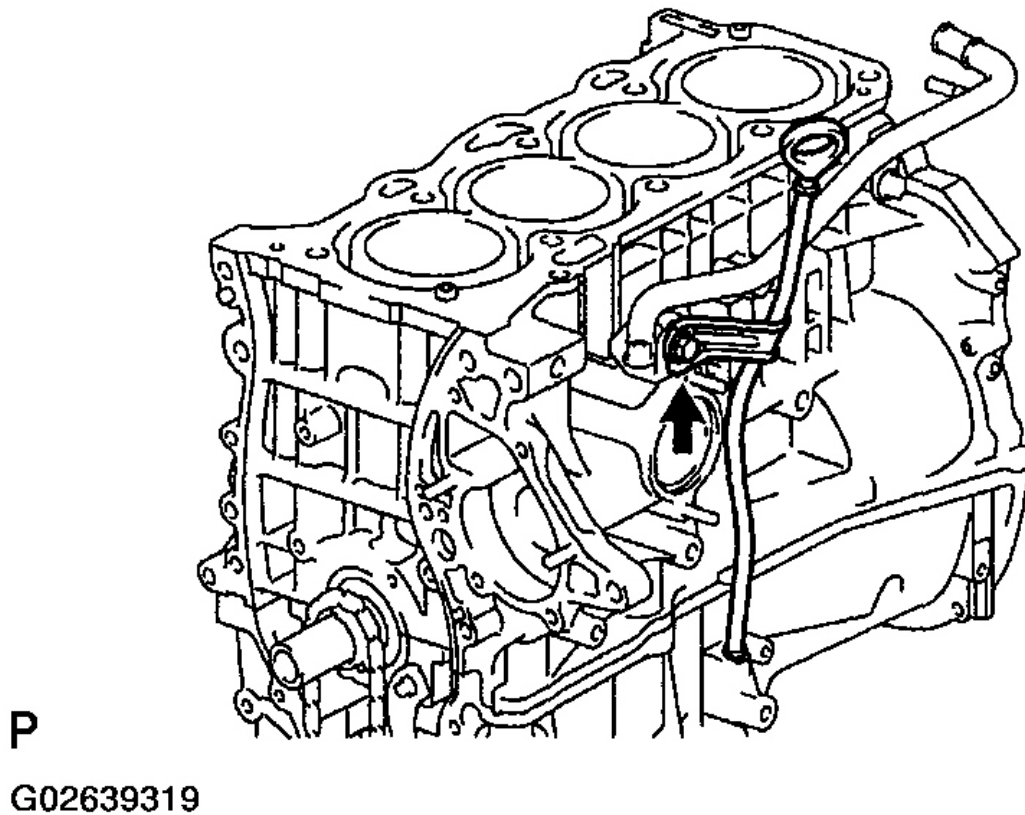
**Fig. 308: Installing Water By-Pass Pipe**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

**21. 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: 9.0 N.m (92 kgf.cm, 80 in.lbf)**

- e. Install the dipstick.



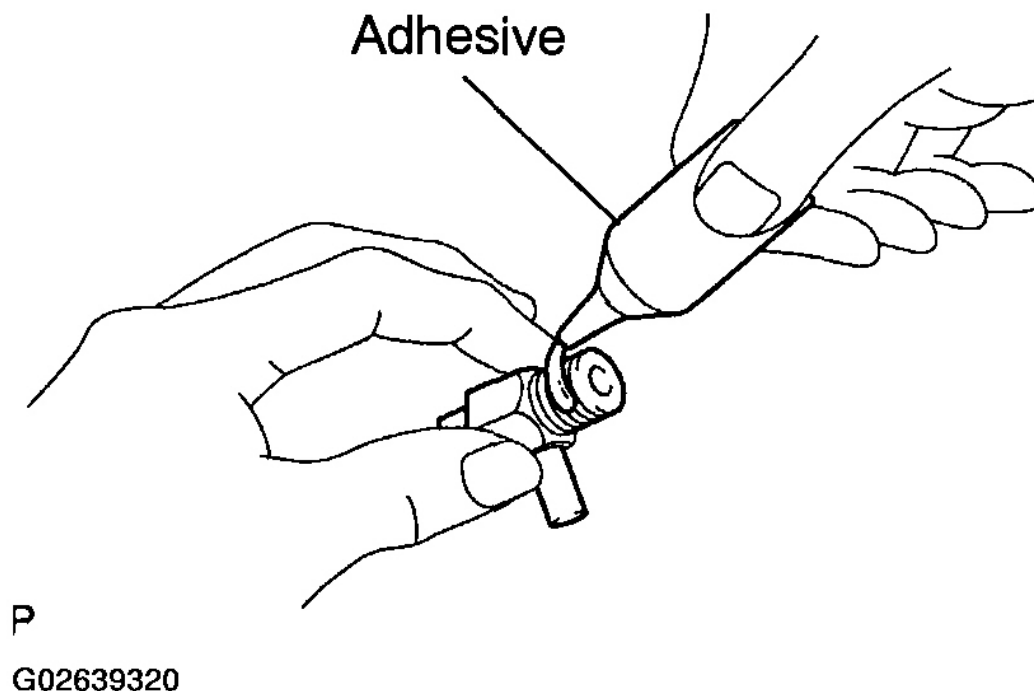
**Fig. 309: Installing Dipstick**

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

**22. INSTALL ENGINE COOLANT DRAIN UNION**

- a. Apply adhesive to 2 or 3 threads.

**Seal packing: Part No. 08826-00100 or equivalent**



**Fig. 310: Applying Adhesive To Threads**  
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**

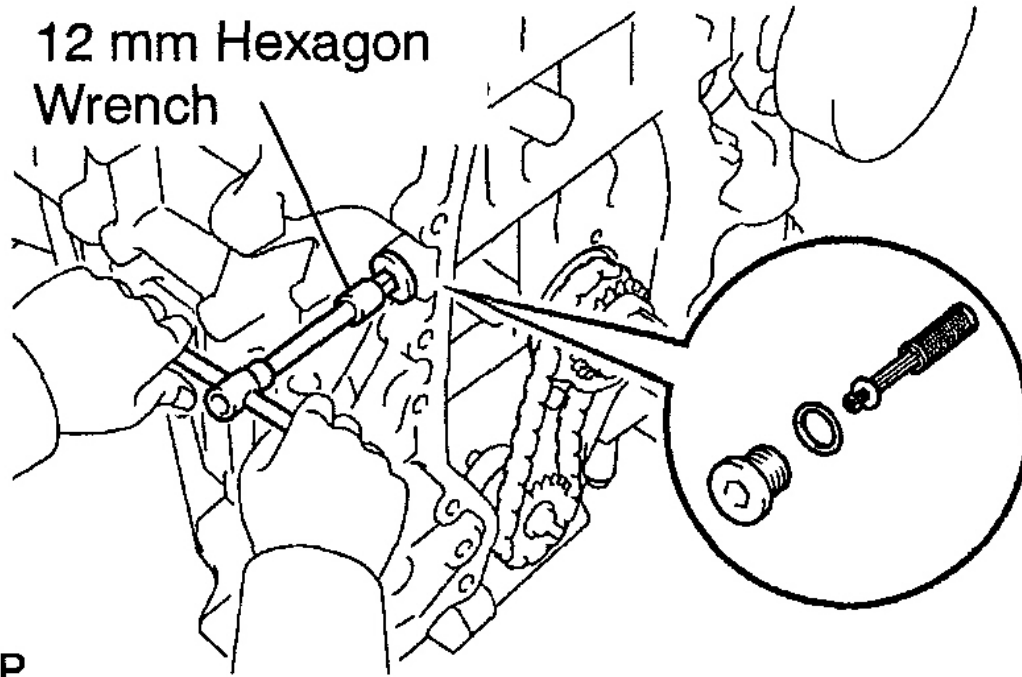
**HINT:**

After applying the specified torque, rotate the drain union clockwise until its drain port is facing downward.

- 23. **INSTALL THERMOSTAT (See INSTALLATION )**
- 24. **INSTALL PLUG**
- 25. **INSTALL WIRE CLAMPS**
- 26. **INSTALL KNOCK SENSOR (See KNOCK SENSOR )**
- 27. **INSTALL WATER PUMP (See INSTALLATION )**
- 28. **INSTALL OCV FILTER**

Using a 12 mm hexagon wrench, install the OCV filter with a new gasket and the plug.

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



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**Fig. 311: Installing OCV Filter With Gasket And Plug**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

29. **INSTALL CYLINDER HEAD** (See INSTALLATION)
30. **INSTALL TIMING CHAIN** (See INSTALLATION)
31. **REMOVE ENGINE STAND**

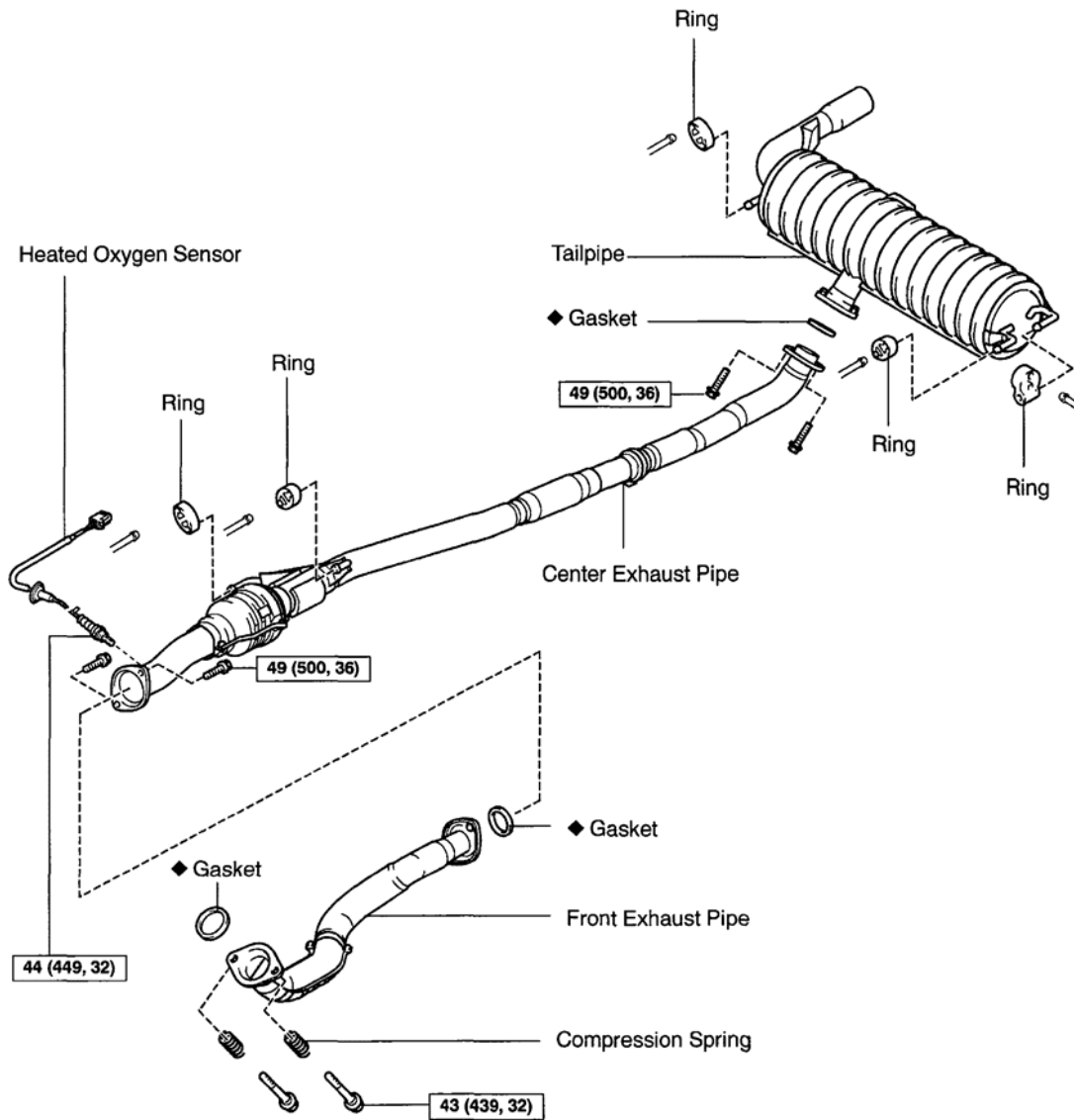
## **EXHAUST SYSTEM**

### **COMPONENTS**



## 2005 Toyota RAV4

2005 ENGINE Engine Mechanical - RAV4



N·m (kgf·cm, ft·lbf) : Specified torque

◆ Non-reusable part

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**Fig. 312: Identifying Exhaust System Components & Torque Specifications**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

### REPLACEMENT

**NOTE:** Check if an old gasket still remains on the pipe. If so, remove it. Also, check if any bolts or nuts are rusted. If so, replace them.

**1. REMOVE FRONT EXHAUST PIPE**

- a. Remove the 2 bolts and 2 compression springs.
- b. Remove the 2 bolts and exhaust pipe.
- c. Remove the exhaust pipe's gasket and exhaust manifold's gasket.

**2. REMOVE CENTER EXHAUST PIPE**

- a. Remove the heated oxygen sensor (bank 1 sensor 2).
- b. Remove the 2 bolts from the exhaust pipe.
- c. Remove the exhaust pipe from the 2 rings.
- d. Remove the gasket from the exhaust pipe.

**3. REMOVE TAILPIPE**

Remove the tailpipe from the 3 rings.

**4. INSTALL TAILPIPE**

Install the tailpipe to the 3 rings.

**5. INSTALL CENTER EXHAUST PIPE**

- a. Install a new gasket to the exhaust pipe.

**NOTE:**

- Do not reuse the gasket.
- The gasket must be installed to the exhaust pipe before the pipe is installed to the tailpipe. Do not indirectly use the tailpipe to force the gasket onto the exhaust pipe.

- b. Install the exhaust pipe to the 2 rings.
- c. Install the 2 bolts to the exhaust pipe.

**Torque: 49 N.m (500 kgf.cm, 36 ft.lbf)**

- d. Install the heated oxygen sensor (bank 1 sensor 2).

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

**HINT:**

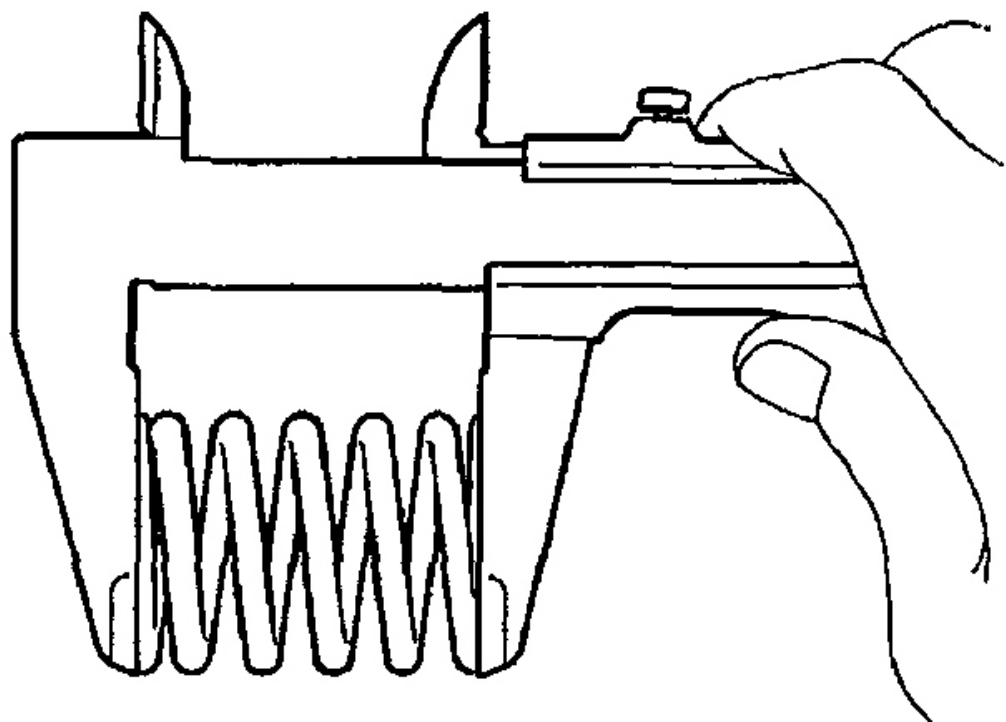
- Before installing the heated oxygen sensor, twist the sensor wire counterclockwise 3 and 1/2 turns.
- After installing the heated oxygen sensor, check that the sensor wire is not twisted. If it is twisted, remove the heated oxygen sensor and reinstall it.

**6. INSTALL FRONT EXHAUST PIPE**

- a. Using a vernier caliper, measure the free length of the compression spring.

**Minimum length: 40 mm (1.57 in.)**

If the free length is less than the minimum, replace the compression spring.



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**Fig. 313: Measuring Free Length Of Compression Spring**  
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install a new gasket to the front exhaust pipe.

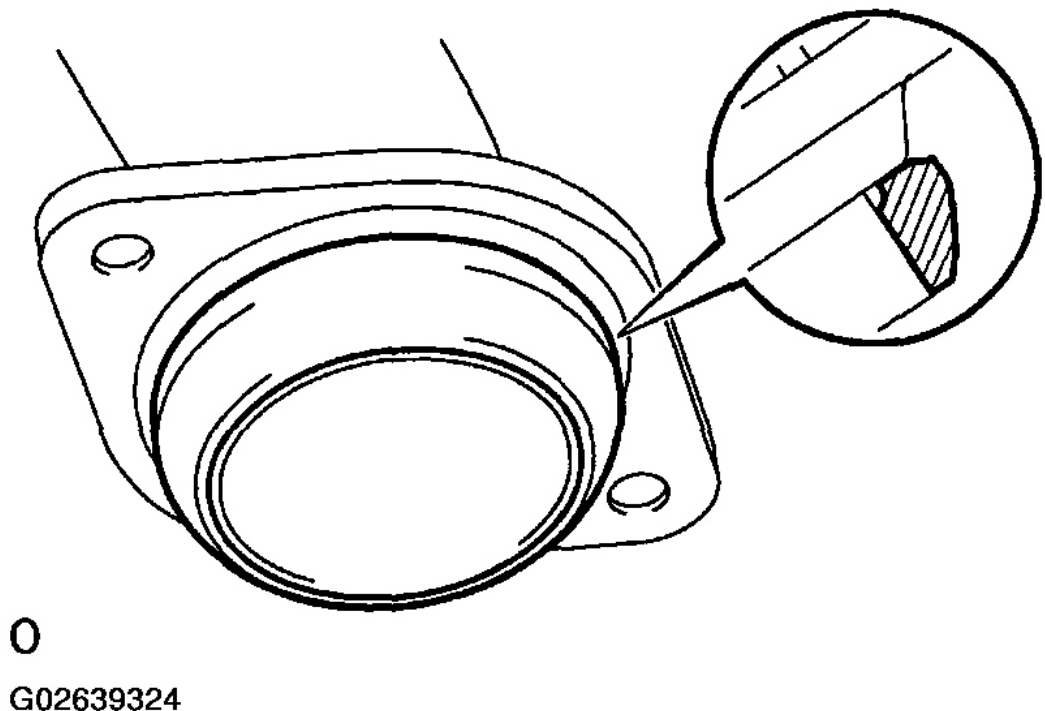
**NOTE:**

- Do not reuse the gasket.
- The gasket must be installed to the front exhaust pipe before the pipe is installed to the center exhaust pipe. Do not indirectly use the center exhaust pipe to force the gasket onto the front exhaust pipe.

- c. Install a new gasket to the exhaust manifold.

**NOTE:**

- Using a plastic faced hammer, uniformly strike the gasket so that the gasket and exhaust manifold are properly fit.
- Be careful with the installation direction of the gasket.
- Do not reuse the gasket.
- The gasket must be installed to the exhaust manifold before the manifold is installed to the exhaust pipe pipe. Do not indirectly use the exhaust pipe to force the gasket onto the exhaust manifold.



**Fig. 314: Installing Gasket To Exhaust Manifold**  
**Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- d. Temporarily install the 2 compression springs and 2 bolts holding the exhaust manifold to the front exhaust pipe.
- e. Install the front exhaust pipe to the center exhaust pipe with the 2 bolts.

**Torque: 49 N.m, (500 kgf.cm, 36 ft.lbf)**

- f. Tighten the 2 compression springs and 2 bolts.

**Torque: 43 N.m (439 kgf.cm, 32 ft.lbf)**

<b>2005 Toyota RAV4</b>
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## 7. CHECK FOR EXHAUST GAS LEAKS

If gas is leaking, tighten the areas necessary to stop the leak. Replace damaged parts as necessary.