

2012 ENGINE**Engine Mechanical [1GR-FE] (Service Information) - Tundra****ENGINE****ON-VEHICLE INSPECTION****ON-VEHICLE INSPECTION****1. INSPECT IGNITION TIMING****NOTE:**

- Turn all electrical systems off.
- Perform the inspection when the cooling fan motor is turned off.

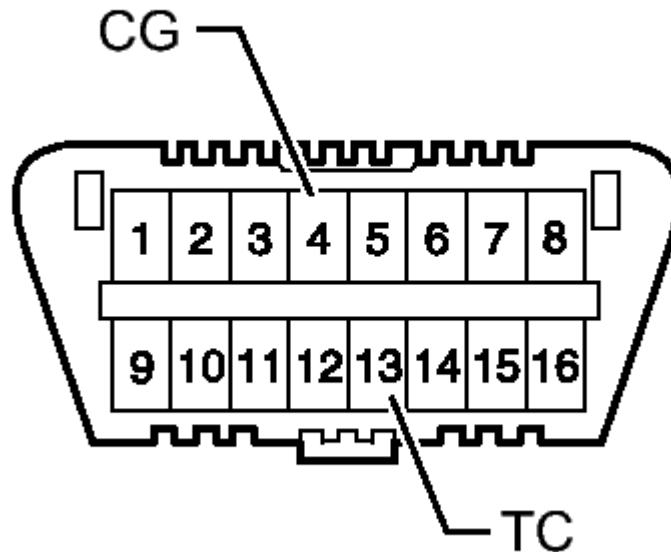
- a. Warm up the engine.
- b. When using the Techstream:
 1. Connect the Techstream to the DLC3.
 2. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / IGN Advance.
 3. Inspect the ignition timing during idling.

Standard ignition timing

8 to 12° BTDC @ idle (transmission in neutral and A/C switch off)

4. Check that the ignition timing advances immediately when the engine speed is increased.
- c. When not using the Techstream:

*a

**Fig. 1: DLC3 Connector End View**

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

1. Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.
 - SST: 09843-18040

TEXT IN ILLUSTRATION

*a	Front view of DLC3
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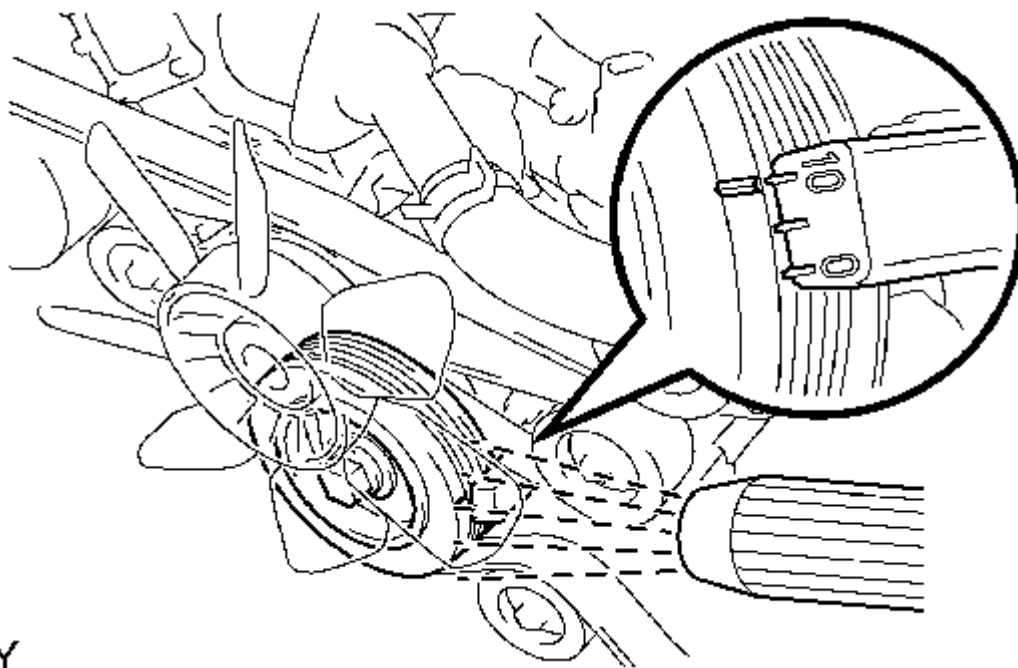
NOTE: Be sure not to improperly connect the terminals. This may damage the engine.

2. Connect the tester probe of a timing light to the wire of the ignition coil connector for the No. 1 cylinder.

NOTE:

- Use a timing light that detects primary signals.
- After the inspection, be sure to wrap the wire harness with tape.

3. Inspect the ignition timing during idling.



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Fig. 2: Inspecting Ignition Timing During Idling
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard ignition timing

8 to 12° BTDC @ idle (transmission in neutral and A/C switch off)

4. Remove SST from the DLC3.
5. Inspect the ignition timing during idling.

Standard ignition timing

7 to 24° BTDC @ idle (transmission in neutral and A/C switch off)

6. Disconnect the timing light from the engine.

2. INSPECT ENGINE IDLE SPEED

NOTE:

- Turn all the electrical systems off.
- Perform the inspection when the cooling fan motor is turned off.

- a. Warm up the engine.
- b. When using the Techstream:
 1. Connect the Techstream to the DLC3.
 2. Enter the following menus: Powertrain / Engine and ECT / Data List / All Data / Engine Speed.

3. Inspect the engine idle speed.

Standard idle speed

650 to 750 RPM (transmission in neutral and A/C switch off)

- c. When not using the Techstream:

*a

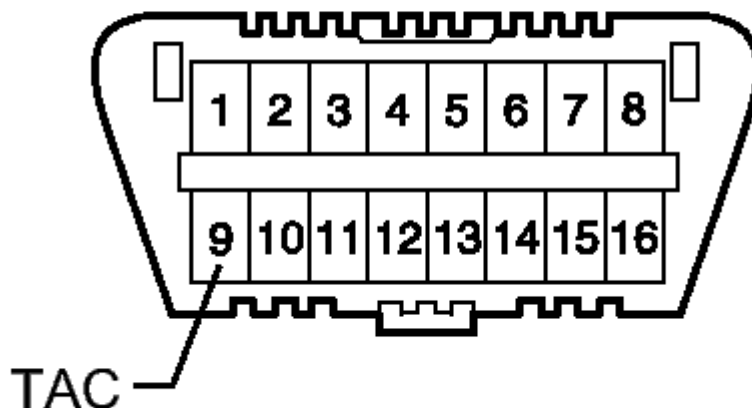


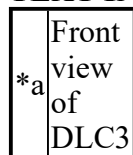
Fig. 3: DLC3 Connector End View

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

1. Connect SST to terminal 9 (TAC) of the DLC3.

- SST: 09843-18030

TEXT IN ILLUSTRATION



2. Race the engine at 2500 RPM for approximately 90 seconds.
3. Inspect the engine idle speed.

Standard idle speed

650 to 750 RPM (transmission in neutral and A/C switch off)

3. INSPECT COMPRESSION

- a. Warm up and stop the engine.
- b. Remove the intake air surge tank. Refer to **REMOVAL** .
- c. Remove the 6 spark plugs. Refer to **REMOVAL** .
- d. Disconnect the 6 fuel injector connectors.
- e. Inspect the cylinder compression pressure.
 1. Insert a compression gauge into the spark plug hole. (Procedure A)
 2. While cranking the engine, measure the compression pressure. (Procedure B)

Compression pressure

1400 kPa (14.3 kgf/cm² , 203 psi) or higher

Minimum pressure

1100 kPa (11.2 kgf/cm² , 160 psi)

Difference between each cylinder

100 kPa (1.0 kgf/cm² , 15 psi) or less

HINT:

- Use a fully-charged battery so that the engine speed can be increased to 250 RPM or more.
 - Measure the compression in as short a time as possible.
3. Repeat procedures A and B for each cylinder.
 4. If the cylinder compression is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat procedures A and B for cylinders with low compression.
 - If adding oil increases the compression, the piston rings and/or cylinder bore may be worn or damaged.
 - If pressure stays low, a valve may be stuck or seated improperly, or there may be leakage from the gasket.
- f. Connect the 6 injector connectors.
 - g. Install the 6 spark plugs. Refer to **INSTALLATION** .
 - h. Install the intake air surge tank. Refer to **INSTALLATION** .

4. INSPECT CO/HC**HINT:**

This check is to determine whether or not the idle CO/HC concentration complies with regulations.

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- a. Start the engine.
- b. Run the engine at 2500 RPM for approximately 180 seconds.
- c. Insert the CO/HC meter testing probe at least 40 cm (1.31 ft) into the tailpipe during idling.
- d. Immediately check the CO/HC concentration during idling and/or at 2500 RPM.

HINT:

When carrying out the 2 tests (idling and 2500 RPM), the measurement orders are prescribed by the applicable local regulations.

- e. If the CO/HC concentration does not comply with regulations, perform troubleshooting in the order given below.
 1. Check the air fuel ratio sensor operation. Refer to **INSPECTION** and heated oxygen sensor operation. Refer to **INSPECTION**.
 2. See the table below for possible causes, and then inspect and correct the corresponding causes if necessary.

CO	HC	Symptom	Causes
Normal	High	Rough idling	a. Faulty ignition: • Incorrect timing • Plugs are contaminated or shorted, or plug gaps are incorrect b. Incorrect valve clearance c. Leaky intake and exhaust valves d. Leaky cylinders
Low	High	Rough idling (Fluctuating HC reading)	a. Vacuum leaks: • Ventilation hoses • Intake manifold • Throttle body • Brake booster line b. Lean mixture causing misfire

2012 Toyota Tundra

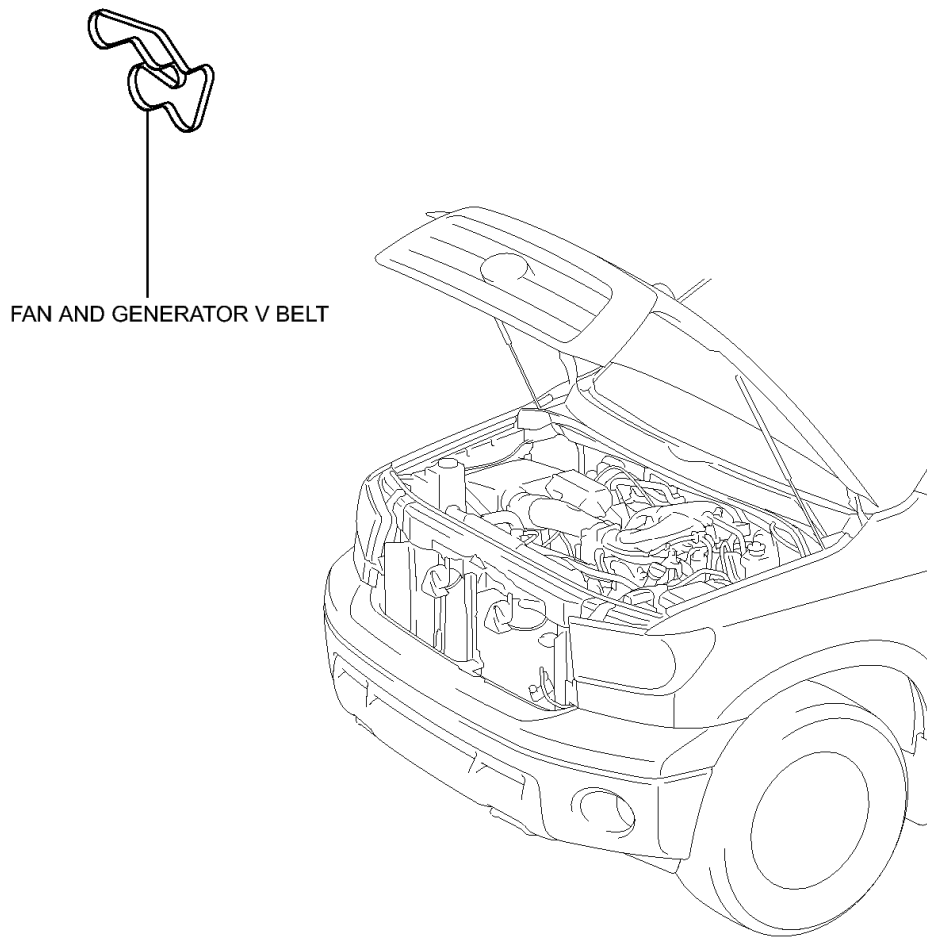
2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

High	High	Rough idle (Black smoke from exhaust)	a. Restricted air filter b. Plugged PCV valve c. Faulty SFI system: • Faulty pressure regulator • Defective engine coolant temperature sensor • Faulty mass air flow meter • Faulty ECM • Faulty injectors • Faulty throttle position sensor
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DRIVE BELT

COMPONENTS

ILLUSTRATION



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Fig. 4: Drive Belt Replacement Components

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

ON-VEHICLE INSPECTION

ON-VEHICLE INSPECTION

1. INSPECT FAN AND GENERATOR V BELT

- a. Check the belt for wear, cracks or other signs of damage.

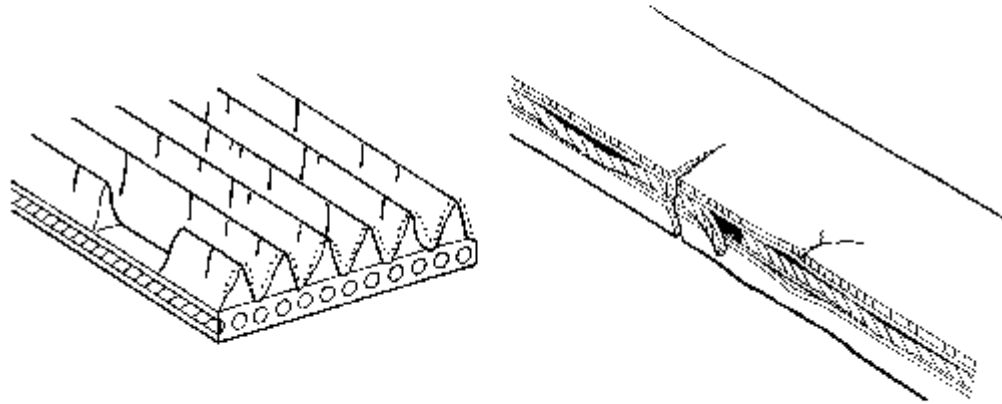
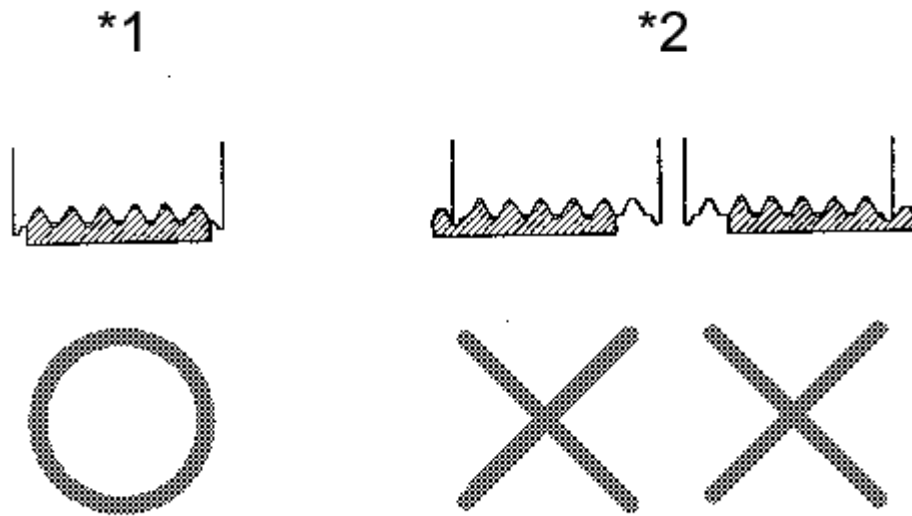
**B00543**

Fig. 5: Inspecting Fan And Generator V Belt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

If any of the following defects is found, replace the fan and generator V belt.

- The belt is cracked.
 - The belt is worn out to the extent that the cords are exposed.
 - The belt has chunks missing from the ribs.
- b. Check that the belt fits properly in the ribbed grooves.



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Fig. 6: Identifying Belt Fits Properly

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

TEXT IN ILLUSTRATION

*1	CORRECT
*2	INCORRECT

HINT:

Check with your hand to confirm that the belt has not slipped out of the grooves on the bottom of the pulley. If it has slipped out, replace the fan and generator V belt. Install a new fan and generator V belt correctly.

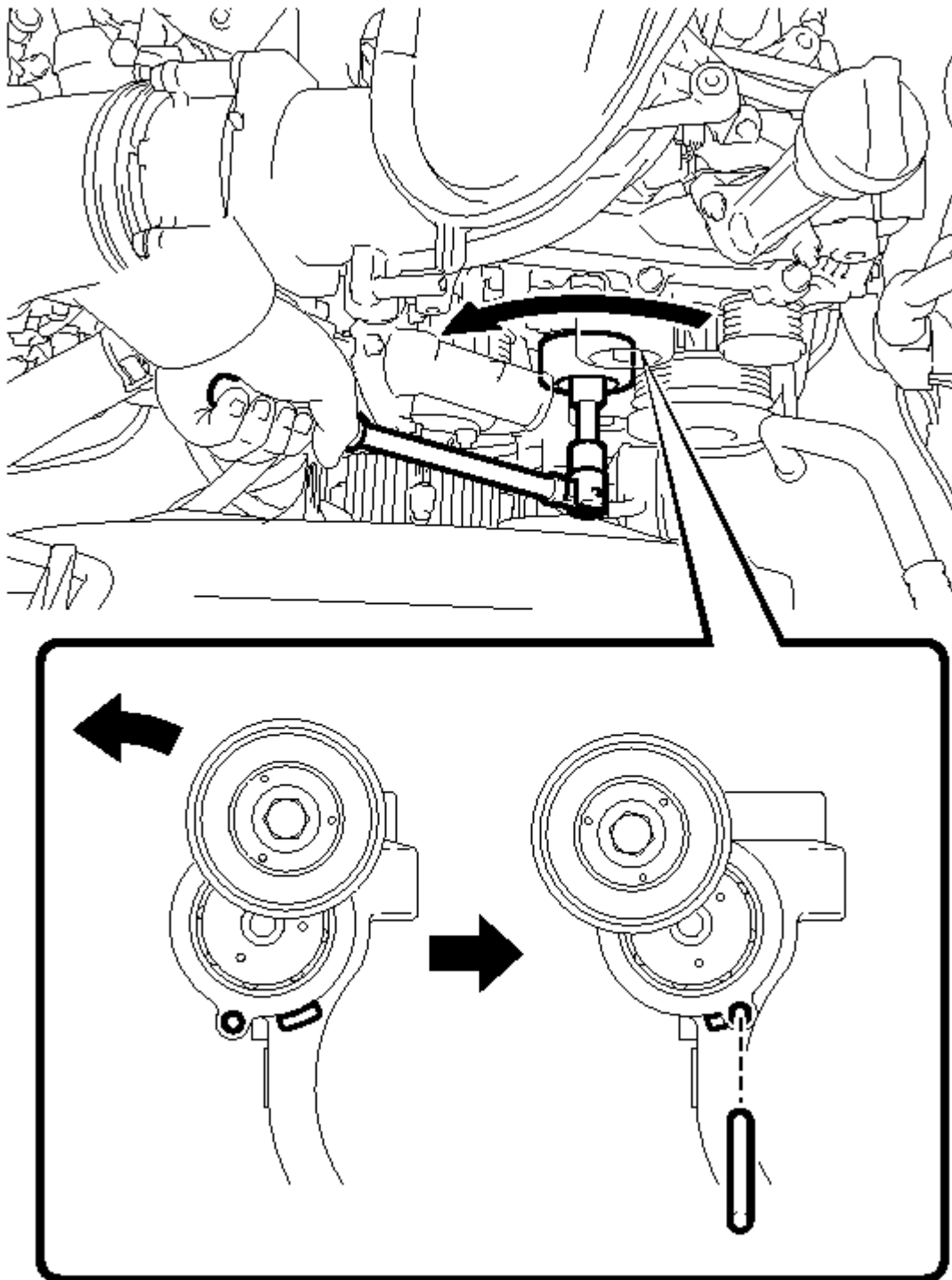
2. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

- a. Check that nothing gets caught in the tensioner by turning it clockwise and counterclockwise.

If the result is not as specified, replace the tensioner.

REMOVAL**REMOVAL****1. REMOVE FAN AND GENERATOR V BELT**

- a. While turning the belt tensioner counterclockwise, align the service hole for the belt tensioner and the belt tensioner fixing position, and then insert a bar of 6 mm (0.236 in.) into the service hole to fix the belt tensioner in place.



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Fig. 7: Identifying Belt Tensioner And Bar

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

HINT:

The pulley bolt for the belt tensioner has a left-hand thread.

- b. Remove the V belt.

INSTALLATION

INSTALLATION

1. INSTALL FAN AND GENERATOR V BELT

- a. Set the V belt onto every part.

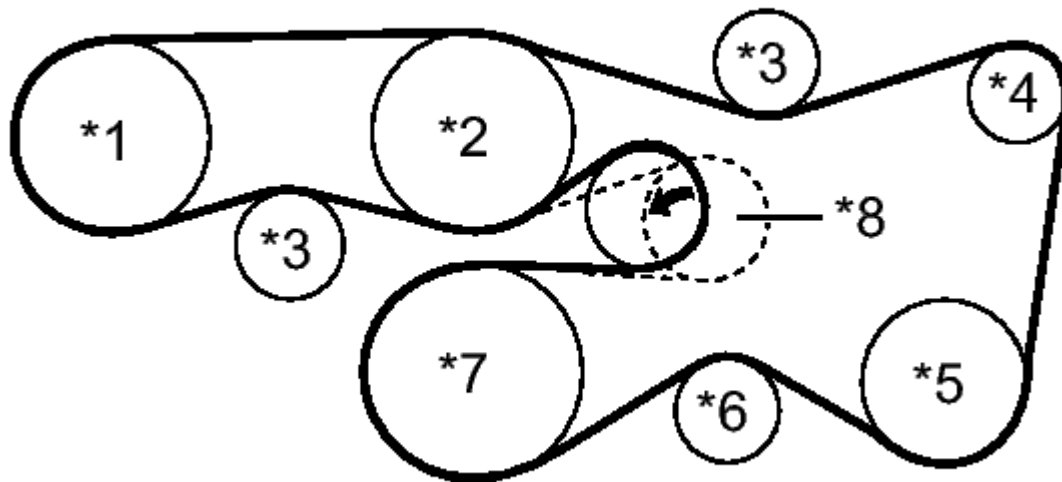


Fig. 8: Identifying Fan And Generator V Belt Routing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

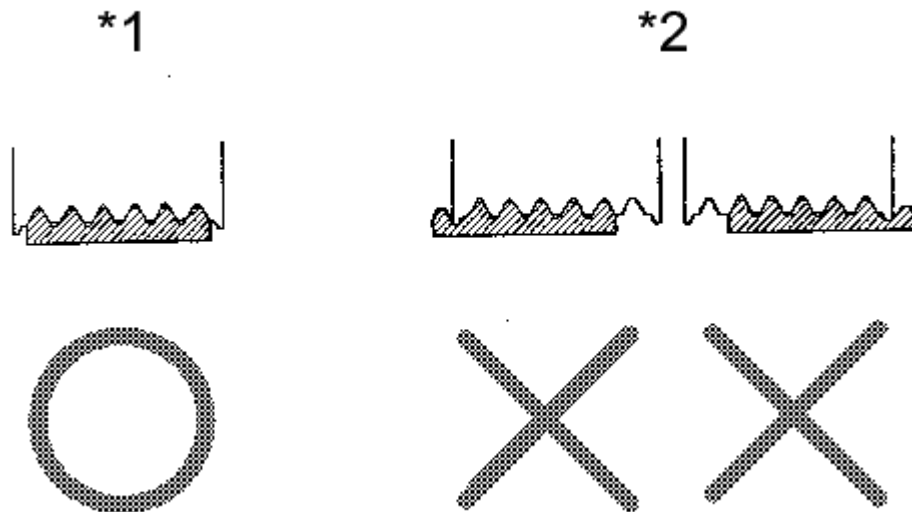
TEXT IN ILLUSTRATION

*1	Vane Pump
*2	Water Pump
*3	No. 2 Idler
*4	Generator
*5	Cooler Compressor
*6	No. 1 Idler
*7	Crankshaft
*8	V-ribbed Belt

Tensioner

- b. While turning the belt tensioner counterclockwise, remove the pin.

NOTE: Make sure that the V belt is properly installed to each pulley.



B00540

Fig. 9: Identifying Belt Fits Properly

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

- c. Check that the belt fits properly in the ribbed grooves.

TEXT IN ILLUSTRATION

*1	CORRECT
*2	INCORRECT

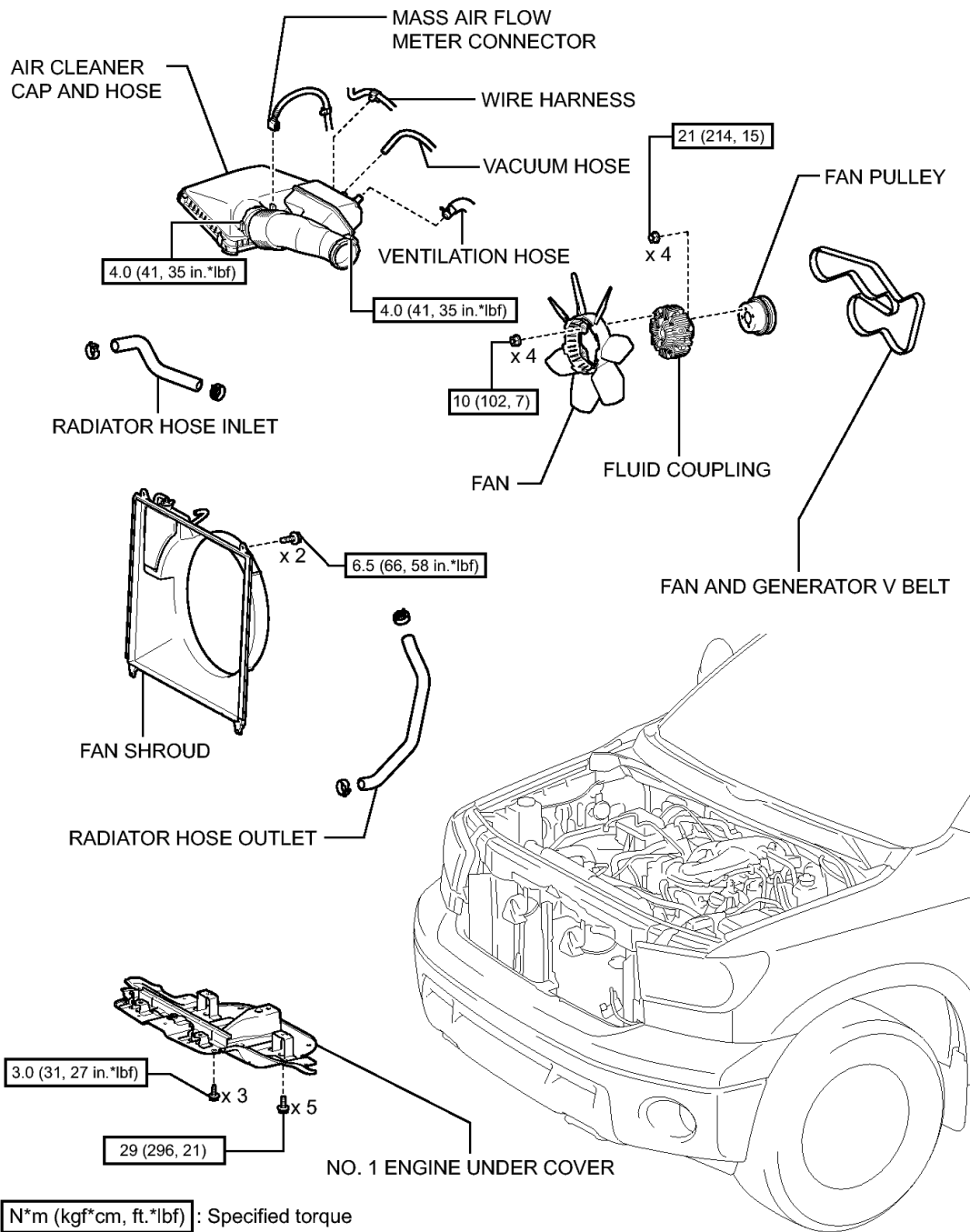
HINT:

Make sure to check by hand that the belt has not slipped out of the grooves on the bottom of the pulley.

CAMSHAFT

COMPONENTS

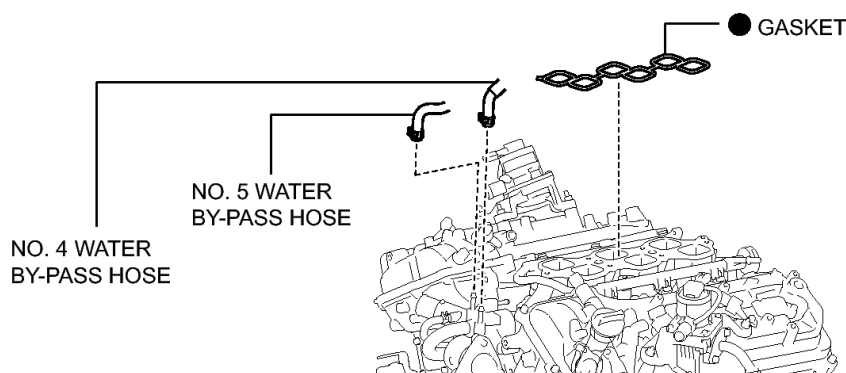
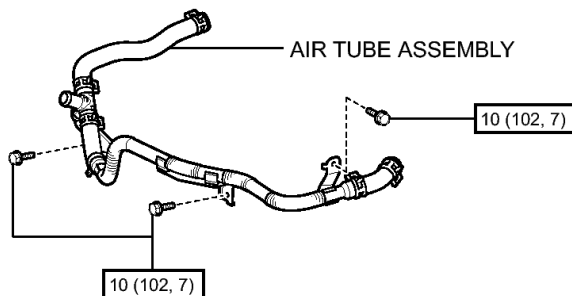
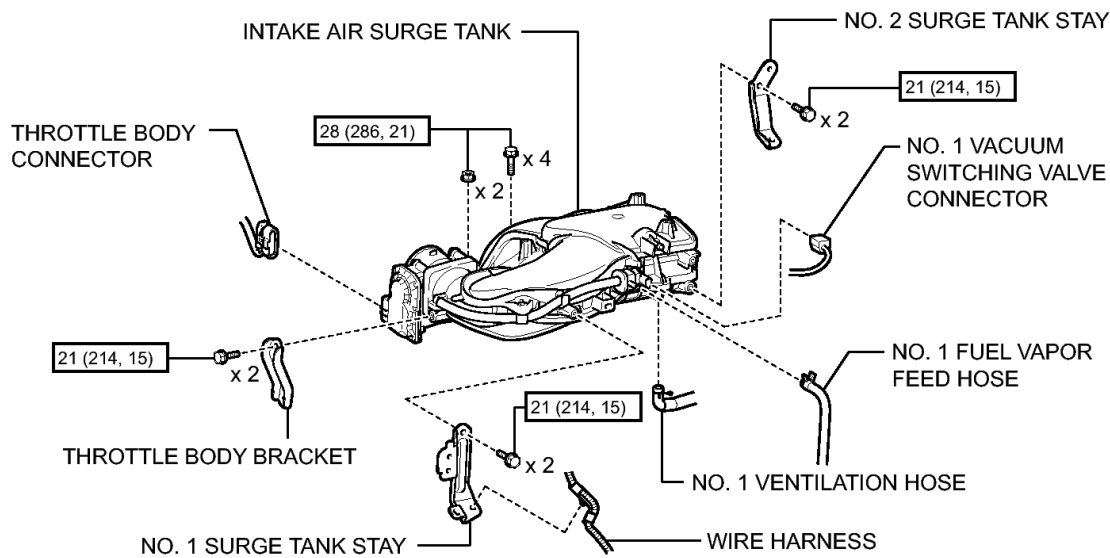
ILLUSTRATION



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Fig. 10: Camshaft Replacement Components With Torque Specifications (1 Of 6)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



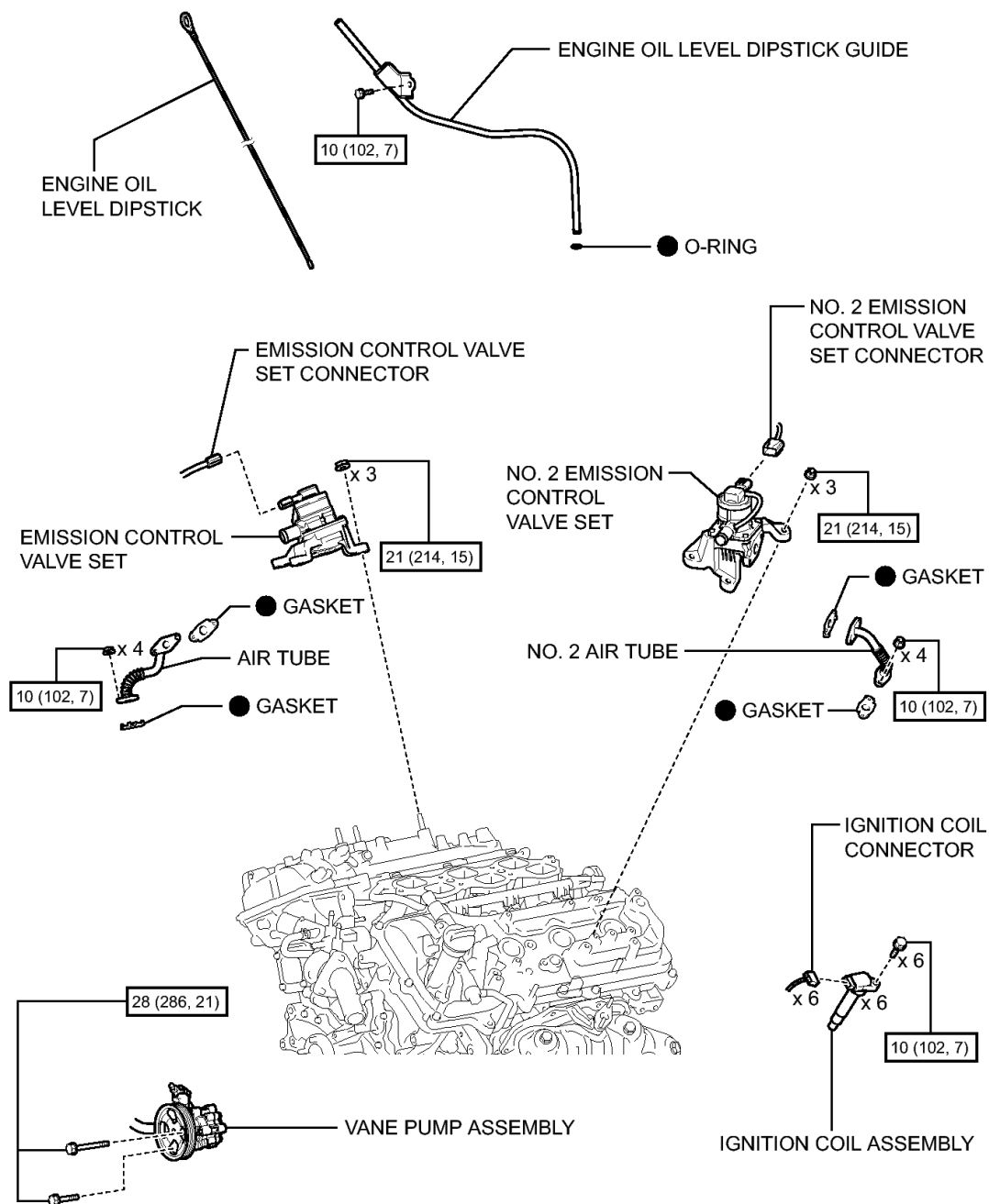
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

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Fig. 11: Camshaft Replacement Components With Torque Specifications (2 Of 6)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

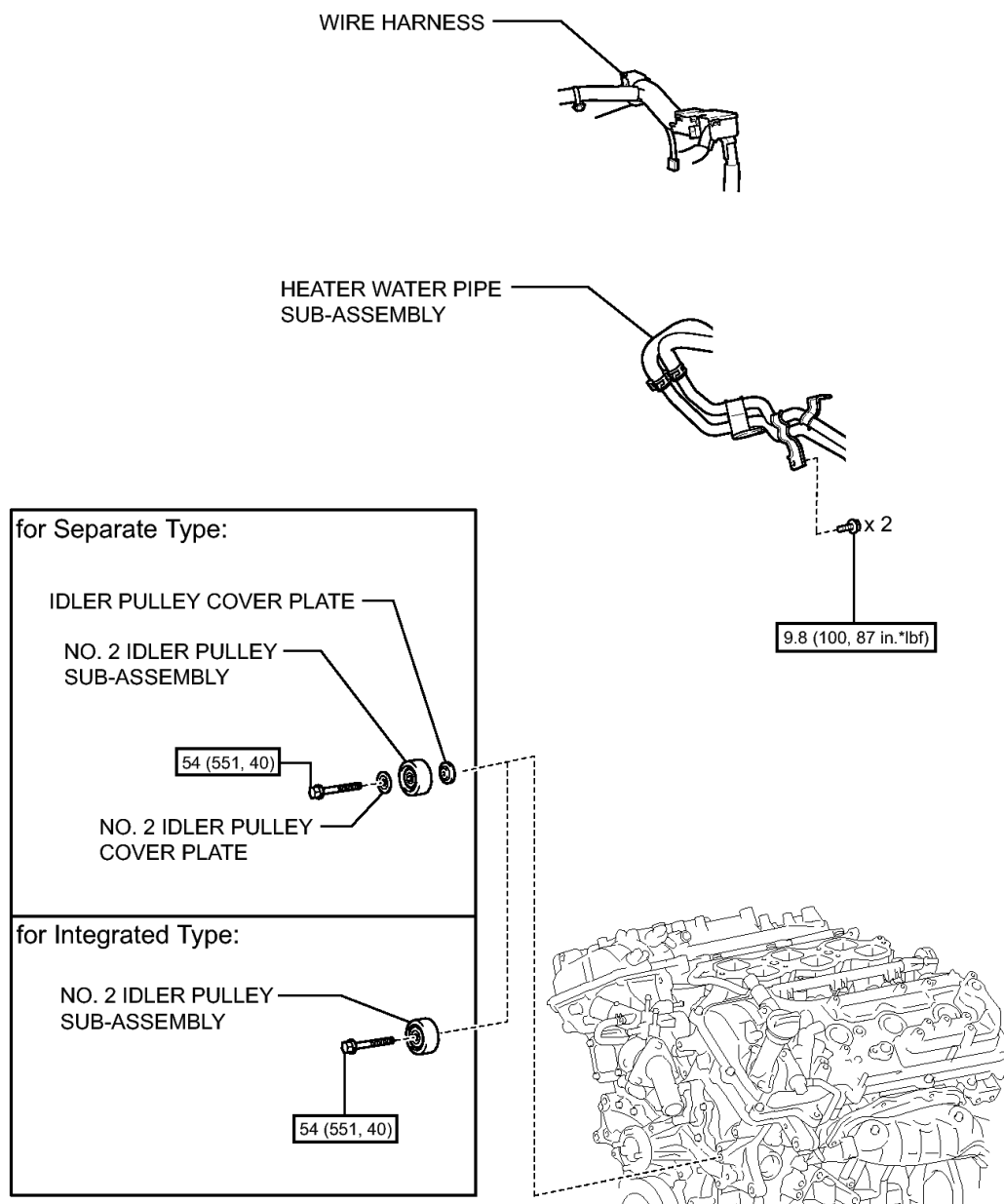
ILLUSTRATION



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Fig. 12: Camshaft Replacement Components With Torque Specifications (3 Of 6)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



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

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Fig. 13: Camshaft Replacement Components With Torque Specifications (4 Of 6)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

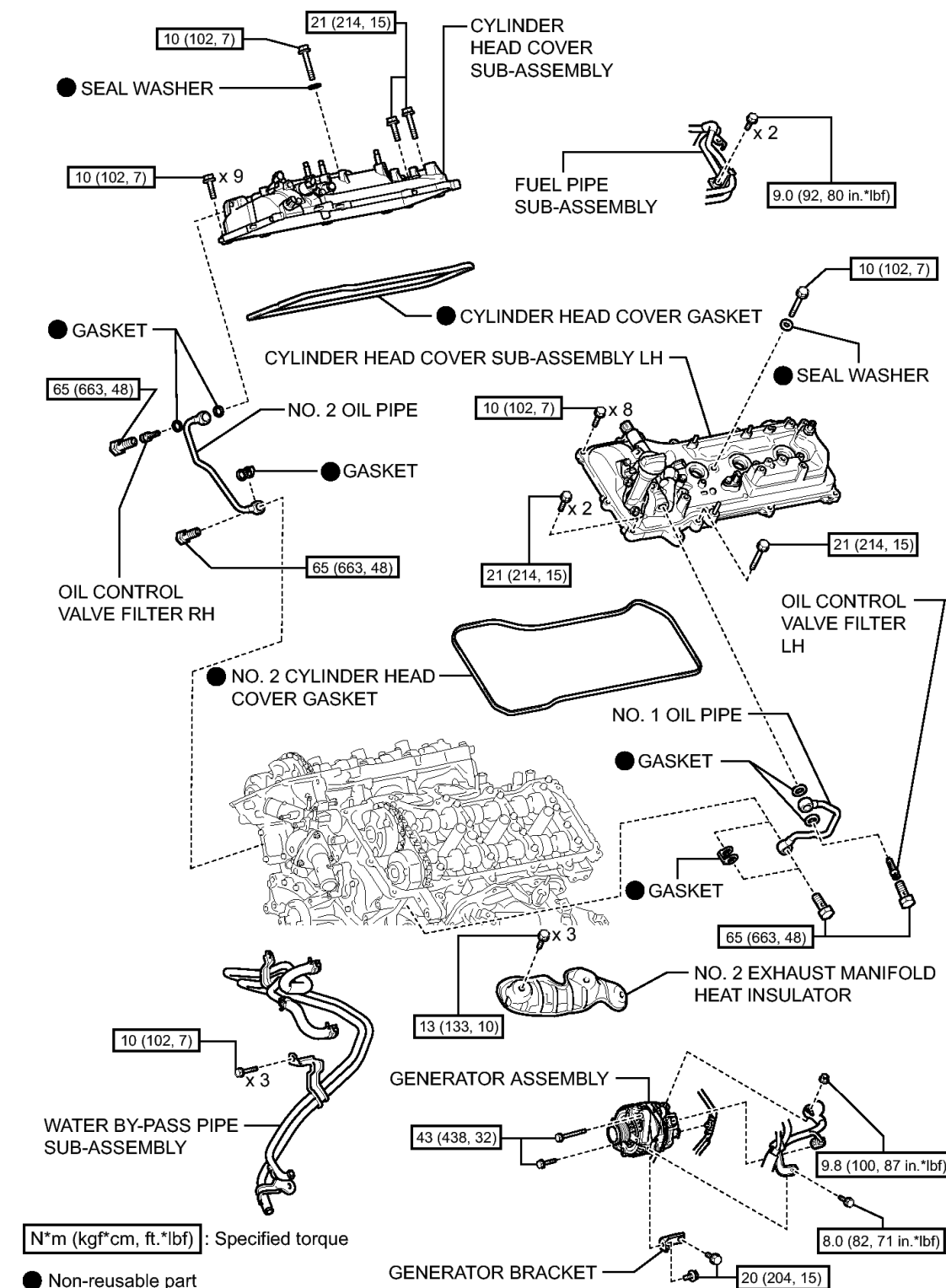


Fig. 14: Camshaft Replacement Components With Torque Specifications (5 Of 6)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

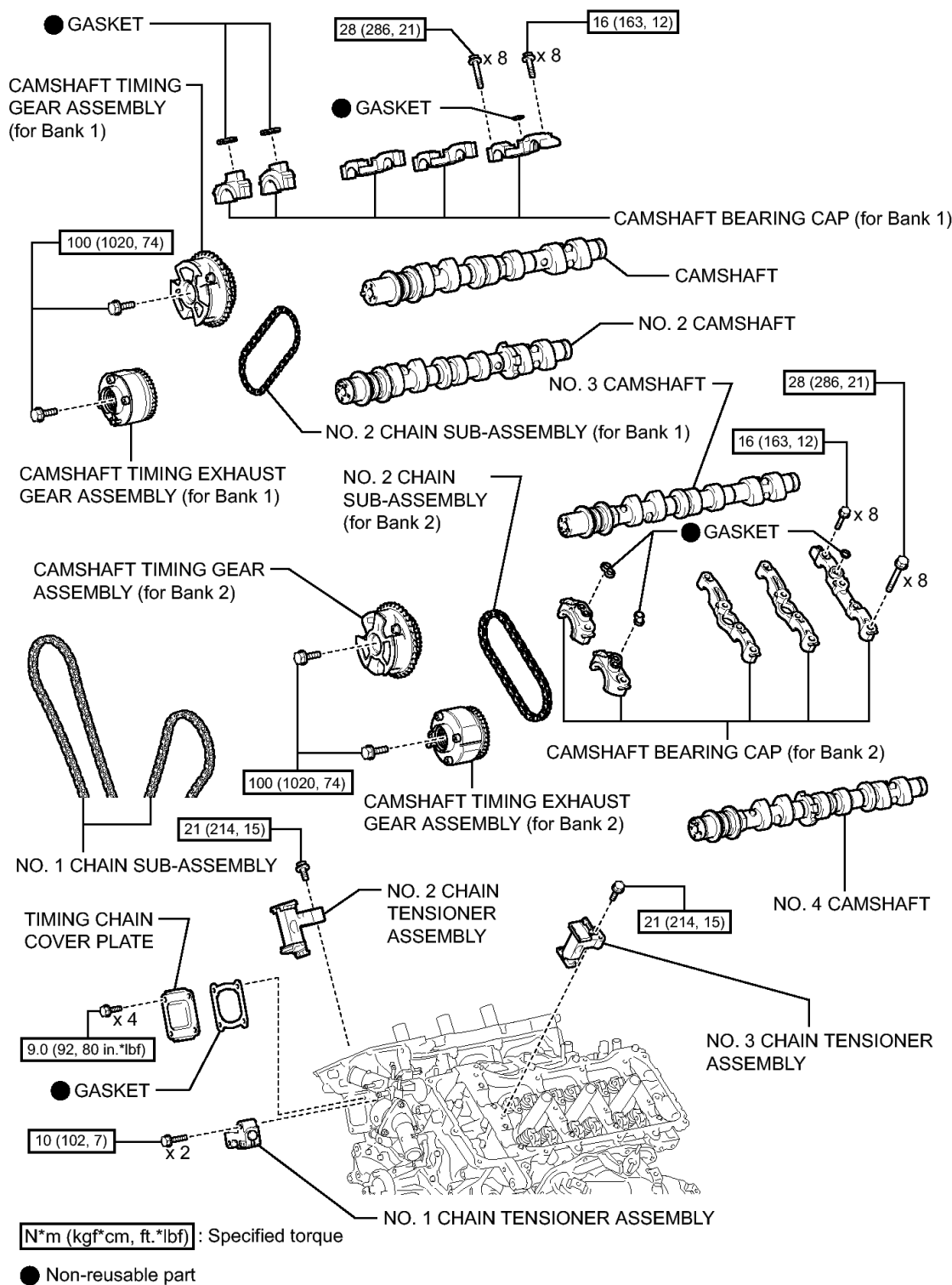


Fig. 15: Camshaft Replacement Components With Torque Specifications (6 Of 6)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL**1. PRECAUTION**

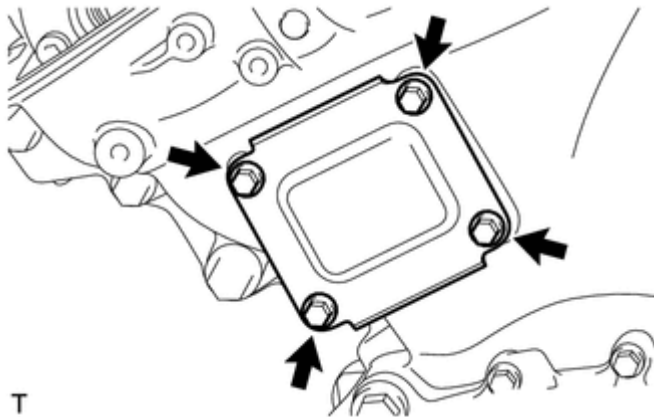
NOTE: After turning the ignition switch off, waiting time may be required before disconnecting the cable from the battery terminal. Therefore, make sure to read the disconnecting the cable from the battery terminal notice before proceeding with work. Refer to PRECAUTION .

2. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected. Refer to INITIALIZATION .

3. **REMOVE NO. 1 ENGINE UNDER COVER** . Refer to REPLACEMENT - Step 1
4. **DRAIN ENGINE OIL** . Refer to REPLACEMENT - Step 2
5. **DRAIN ENGINE COOLANT** . Refer to REPLACEMENT - Step 2
6. **DISCONNECT CABLE FROM POSITIVE BATTERY TERMINAL**
7. **REMOVE AIR CLEANER CAP AND HOSE** . Refer to REMOVAL - Step 1
8. **REMOVE RADIATOR HOSE INLET** . Refer to REMOVAL - Step 3
9. **REMOVE RADIATOR HOSE OUTLET** . Refer to REMOVAL - Step 4
10. **REMOVE FAN SHROUD** . Refer to REMOVAL - Step 5
11. **REMOVE AIR TUBE ASSEMBLY** . Refer to REMOVAL - Step 9
12. **REMOVE INTAKE AIR SURGE TANK** . Refer to REMOVAL - Step 10
13. **REMOVE AIR TUBE** . Refer to REMOVAL - Step 3
14. **REMOVE NO. 2 AIR TUBE** . Refer to REMOVAL - Step 2
15. **REMOVE EMISSION CONTROL VALVE SET** . Refer to REMOVAL - Step 4
16. **REMOVE NO. 2 EMISSION CONTROL VALVE SET** . Refer to REMOVAL - Step 4
17. **REMOVE IGNITION COIL ASSEMBLY** . Refer to REMOVAL - Step 3
18. **DISCONNECT VANE PUMP ASSEMBLY** . Refer to REMOVAL - Step 9
19. **DISCONNECT WIRE HARNESS** . Refer to REMOVAL - Step 5
20. **DISCONNECT HEATER WATER PIPE SUB-ASSEMBLY** . Refer to REMOVAL - Step 6
21. **REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY** . Refer to REMOVAL - Step 8
22. **REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR** . Refer to REMOVAL - Step 13
23. **REMOVE GENERATOR ASSEMBLY** . Refer to REMOVAL - Step 7
24. **REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE** . Refer to REMOVAL - Step 5
25. **REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY** . Refer to REMOVAL - Step 6
26. **REMOVE NO. 1 OIL PIPE** . Refer to REMOVAL - Step 14
27. **REMOVE NO. 2 OIL PIPE** . Refer to REMOVAL - Step 15
28. **DISCONNECT FUEL PIPE SUB-ASSEMBLY** . Refer to REMOVAL - Step 16

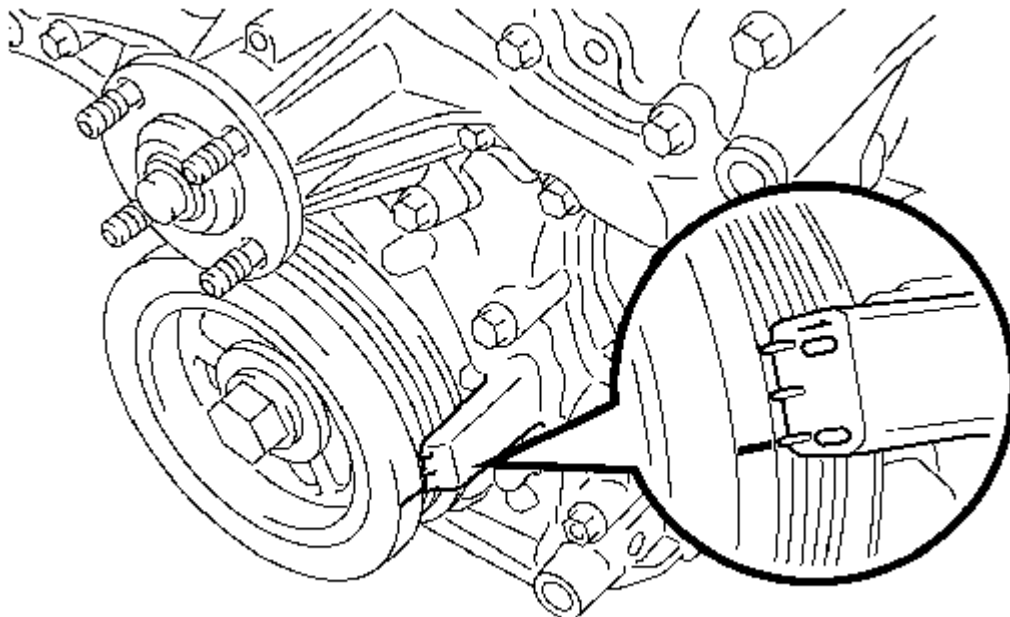
29. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH** . Refer to **REMOVAL - Step 17**
30. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY** . Refer to **REMOVAL - Step 18**
31. **REMOVE TIMING CHAIN COVER PLATE**
 - a. Remove the 4 bolts, timing chain cover plate and gasket.



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Fig. 16: Identifying Timing Chain Cover Plate & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

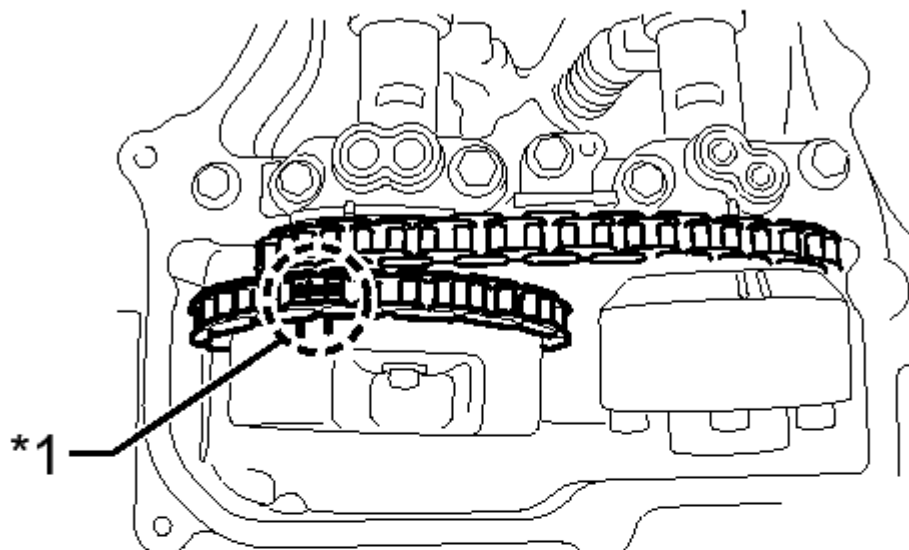
32. **SET NO. 1 CYLINDER TO TDC/COMPRESSION**
 - a. Turn the crankshaft pulley and align the notch with the "0" timing mark of the timing chain cover.



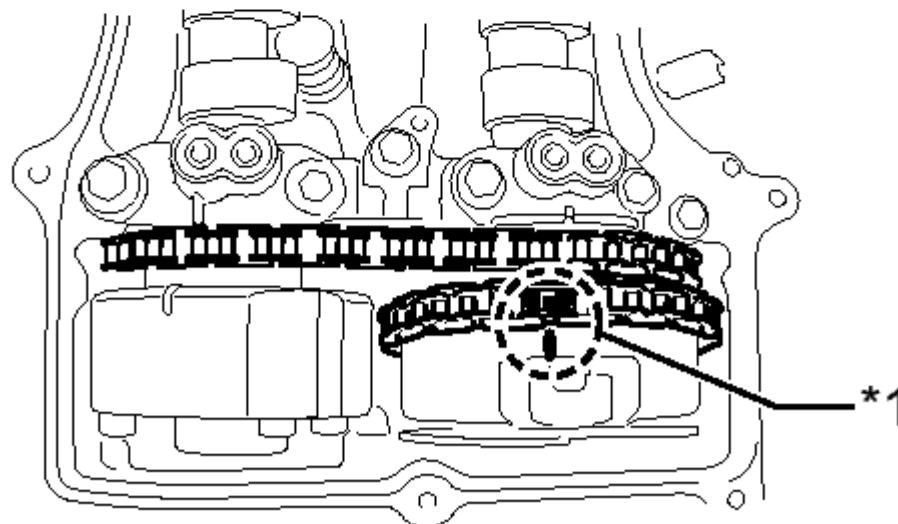
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Fig. 17: Aligning Crankshaft Pulley Groove & Timing Mark "0" Of Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

*A



*B



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Fig. 18: Identifying Timing Marks Of Camshaft Timing Gears & Timing Marks Of Bearing Caps

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

- b. Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the

bearing caps as shown in the illustration.

TEXT IN ILLUSTRATION

*A	for Bank 2
*B	for Bank 1
*1	Paint Mark

HINT:

If the marks are not aligned, turn the crankshaft again to align the marks.

- c. Place paint marks on the timing marks and sprockets of each camshaft timing gear and on the links of the No. 1 chain.

HINT:

Be sure to place the paint marks on 2 links of the chain and on the sprockets of the camshaft timing gears at the locations of the timing marks of the camshaft timing gears.

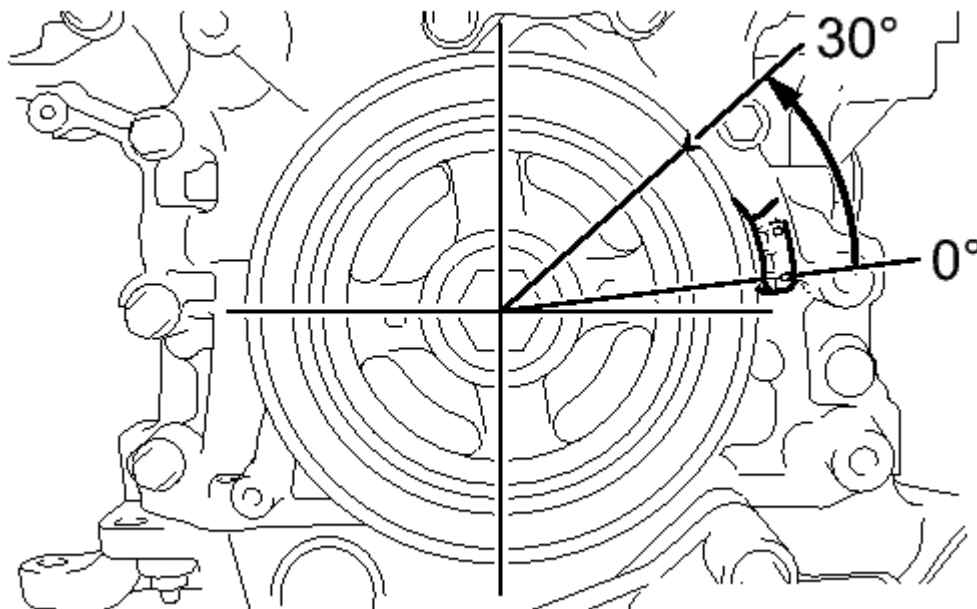
33. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY**T**

Fig. 19: Identifying Turning Angle

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

- a. Turn the crankshaft approximately 30° counterclockwise so that there is some slack in the chain.

HINT:

This prevents the valves and pistons from interfering with each other.

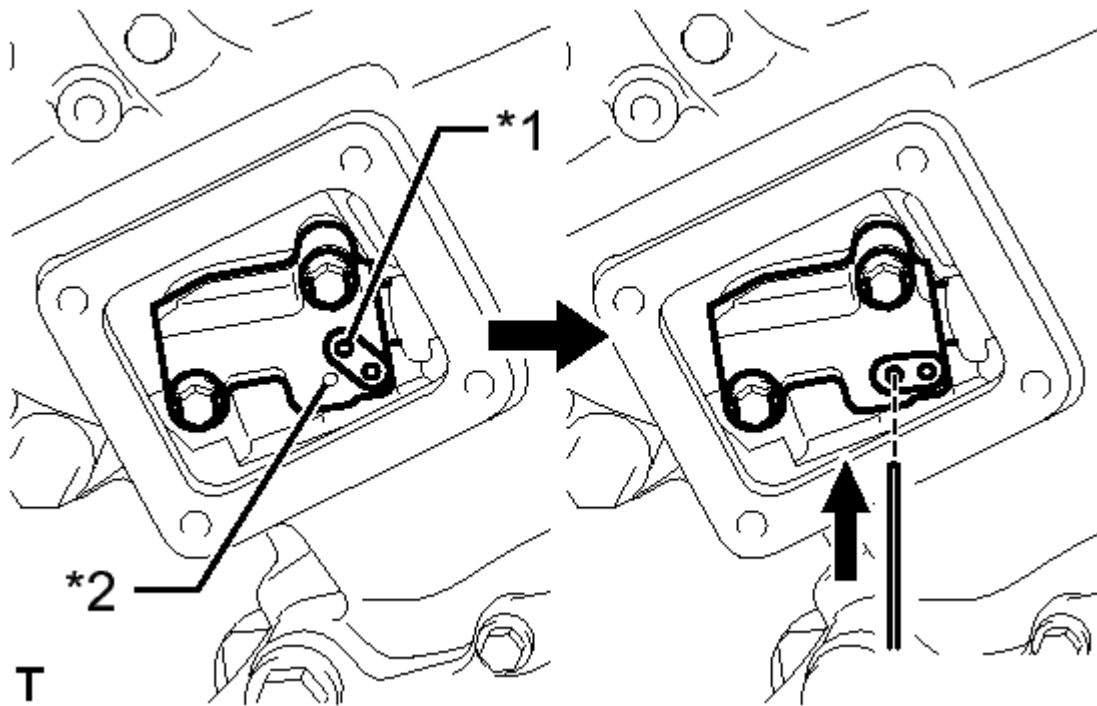
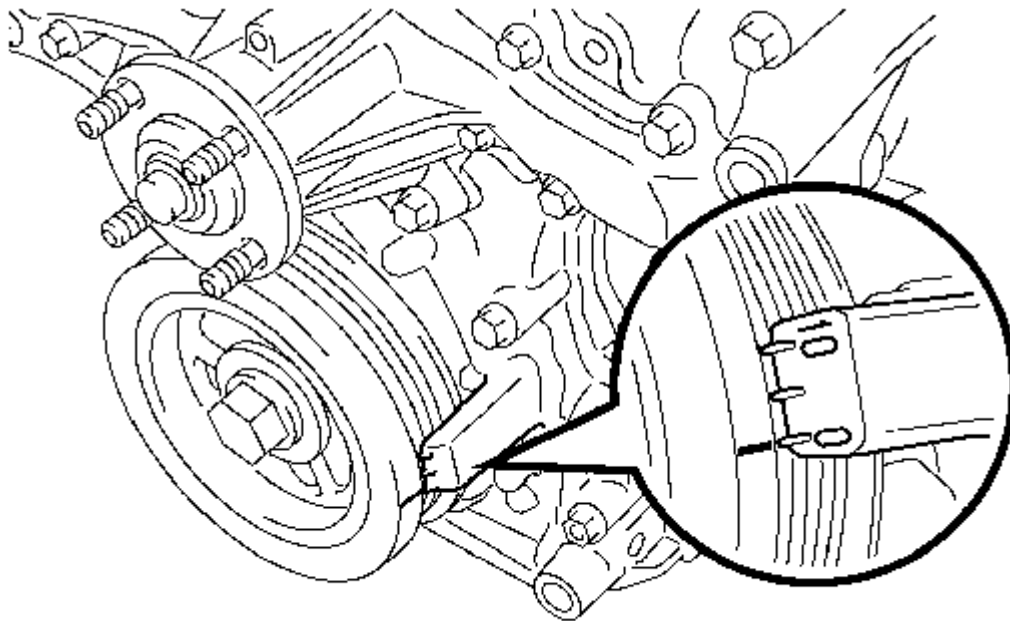


Fig. 20: Identifying Hole In Lever & Hole In Tensioner Body
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Align the hole in the lever of the tensioner with the hole in the tensioner body as shown in the illustration, and then insert a pin with a diameter of 1.27 mm (0.0500 in.) into the hole.

TEXT IN ILLUSTRATION

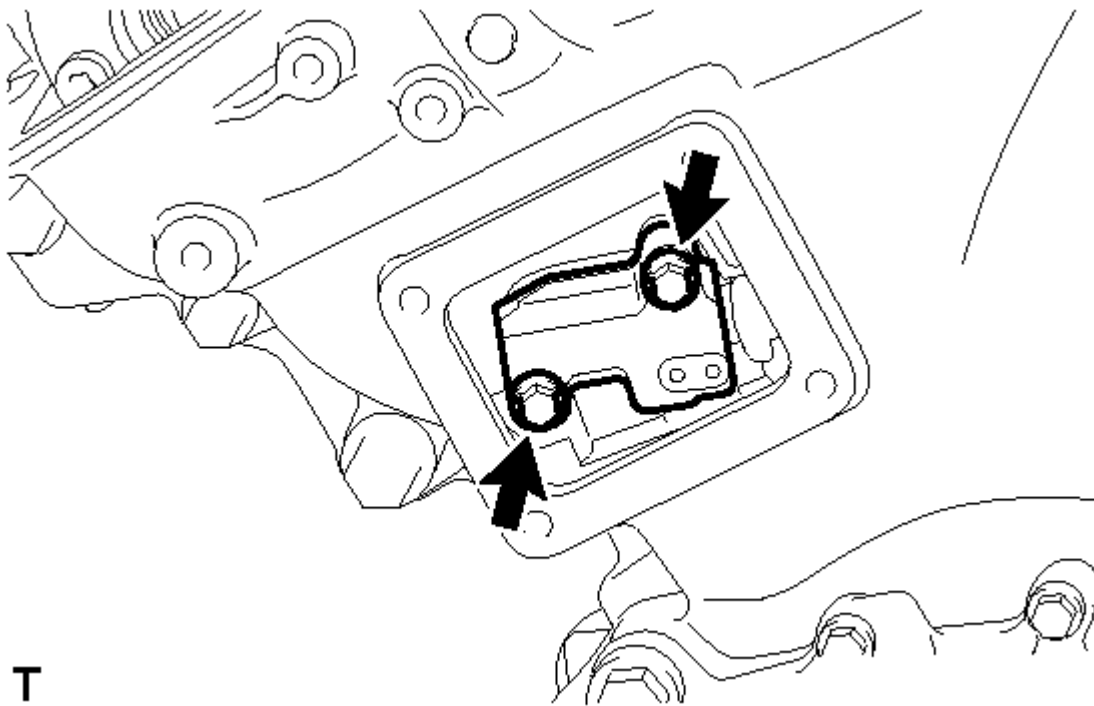
*1	Lever Hole
*2	Tensioner Hole



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Fig. 21: Aligning Crankshaft Pulley Groove & Timing Mark "0" Of Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Turn the crankshaft clockwise and align the notch with the "0" timing mark of the timing chain cover.



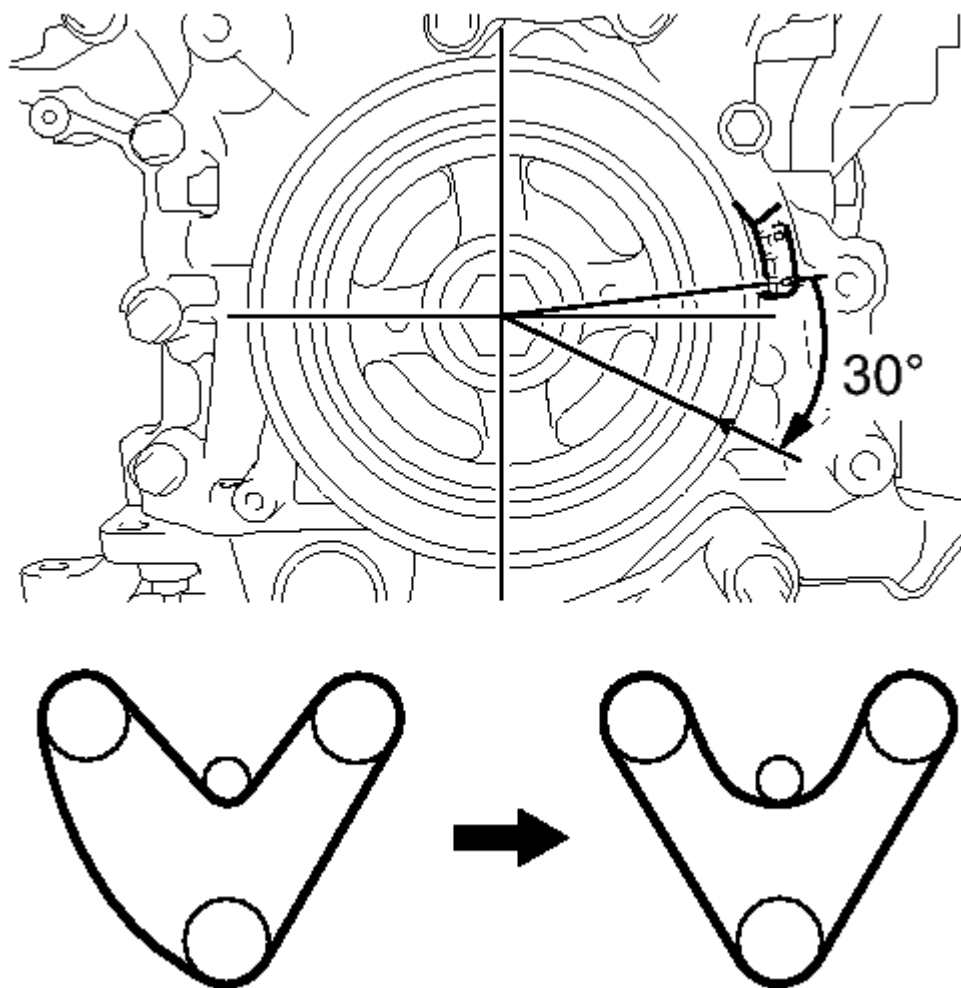
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Fig. 22: Identifying No. 1 Chain Tensioner Assembly & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not drop the No. 1 chain tensioner assembly or bolts into the timing chain cover.

d. Remove the 2 bolts and chain tensioner.

34. **DISCONNECT CHAIN SUB-ASSEMBLY (for Bank 1)**



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Fig. 23: Identifying Crankshaft Angle

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

WARNING: As the camshafts turn suddenly, do not touch the camshafts or camshaft timing gears.

a. Turn the crankshaft clockwise until it is in the position shown in the illustration so that there is some slack in the chain between the banks.

HINT:

When turning the crankshaft, engine oil may spray out of the oil holes.

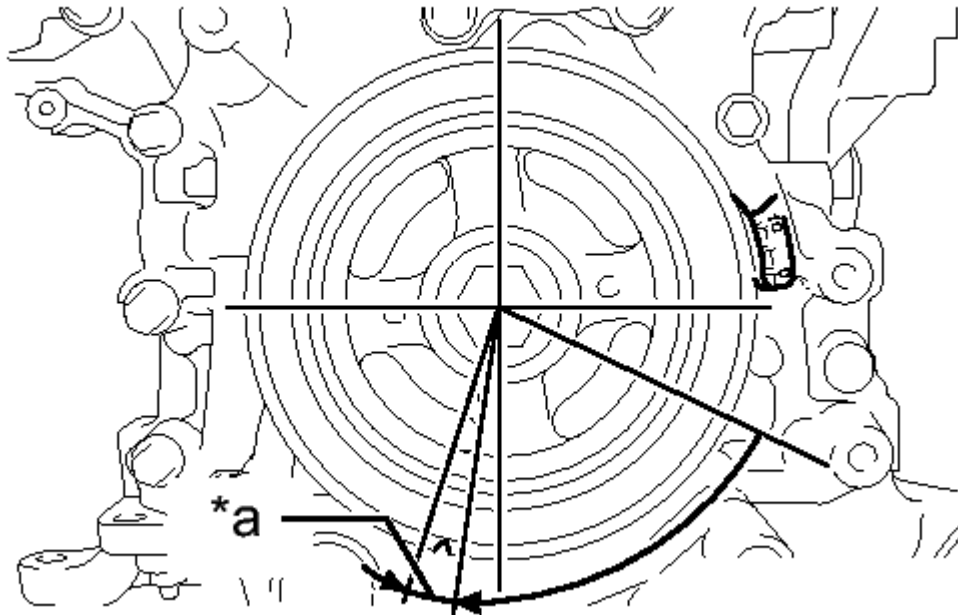
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Fig. 24: Rotating Crankshaft To Easily Remove Chain

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

- b. Turn the crankshaft clockwise until it is in the position shown in the illustration so that the chain can be removed easily.

TEXT IN ILLUSTRATION

	5°
*a to	10°

HINT:

When turning the crankshaft, engine oil may spray out of the oil holes.

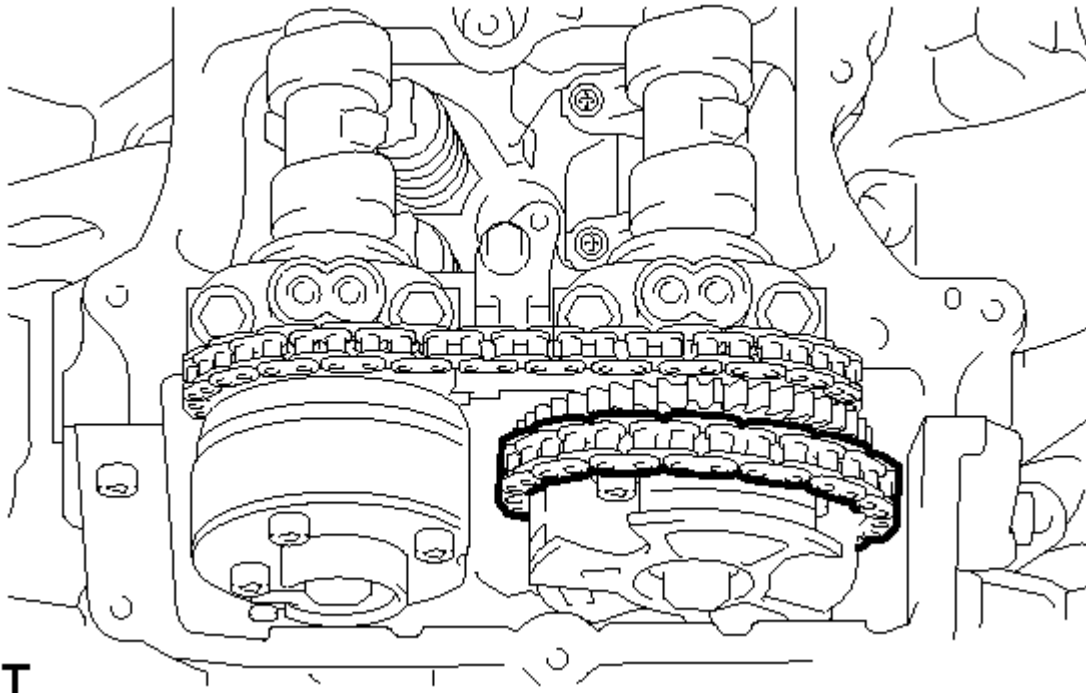


Fig. 25: Identifying Chain

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

WARNING: As the camshaft may turn suddenly and pinch your fingers when the chain is removed, pinch the chain and lift it upward to remove it from the sprocket.

- c. Remove the chain from the sprocket of the camshaft timing gear and set it on the gear.

35. REMOVE CAMSHAFT BEARING CAP (for Bank 1)

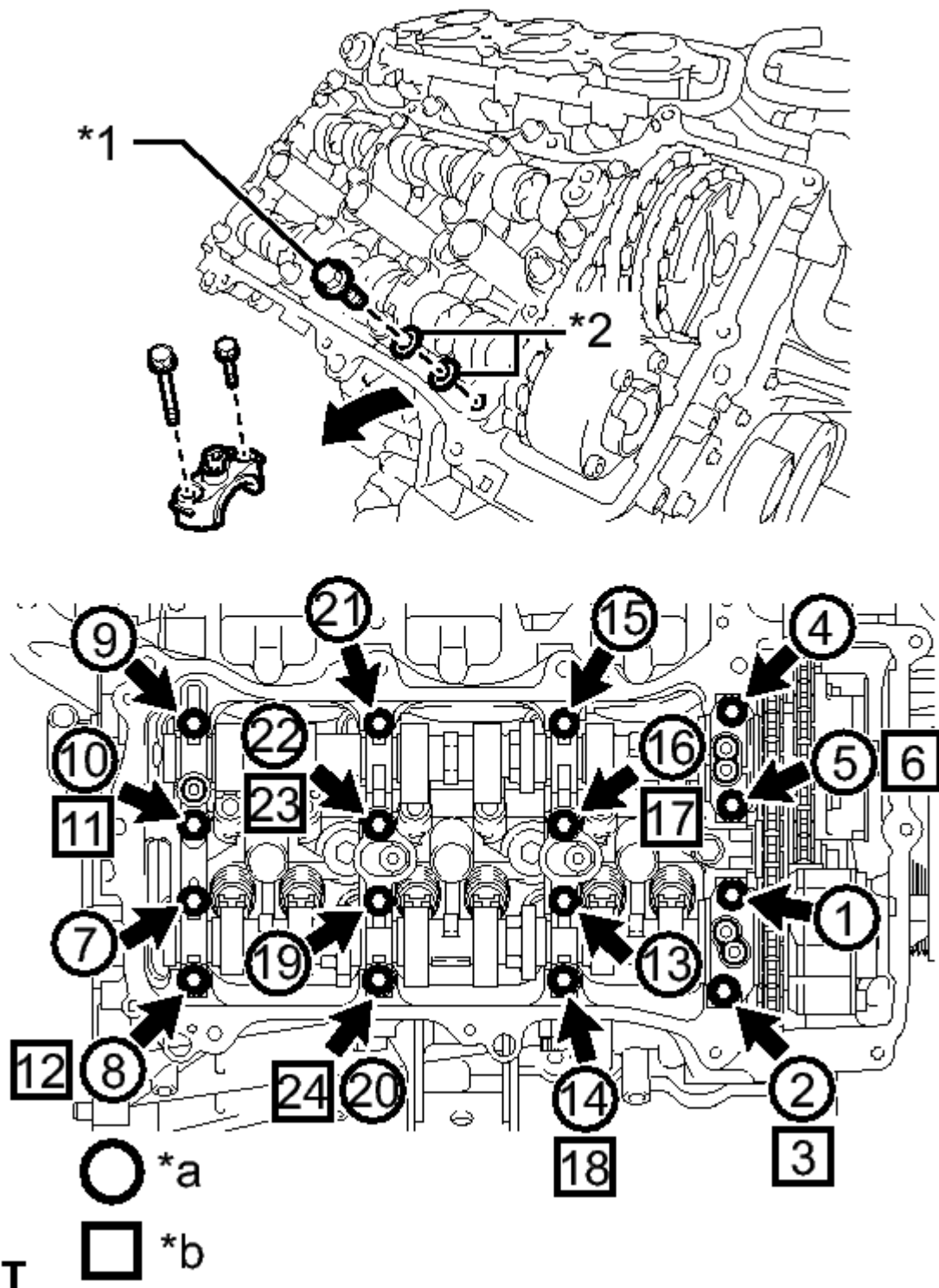


Fig. 26: Identifying Camshaft Bearing Caps And Bolts With Loosening Sequence (Bank 1)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- Do not install the bearing caps when installing bolts and washers for temporary installation of the camshaft housing.

- Be sure to follow the numerical order when performing this procedure.
 - Do not allow bolts and washers for temporary installation of the camshaft housing to contact the camshaft.
 - Do not drop bolts and washers for temporary installation of the camshaft housing into the cylinder head.
- a. Remove the bolts and bearing caps in the order shown in the illustration. Immediately after removing a bearing cap, install bolts and washers for temporary installation of the camshaft housing in the order shown in the illustration.

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

TEXT IN ILLUSTRATION

*1	Bolt
*2	Washer
*a	Part Removal
*b	Installation of Bolts and Washers for Temporary Installation of camshaft housing

HINT:

- Arrange the removed parts so that they can be reinstalled in their original locations.
- Part number of bolt for temporary installation of camshaft housing: 91551-G0845 (quantity: 8)
- Part number of washer for temporary installation of camshaft housing: 90201-12028 (quantity: 16)

36. REMOVE NO. 2 CAMSHAFT

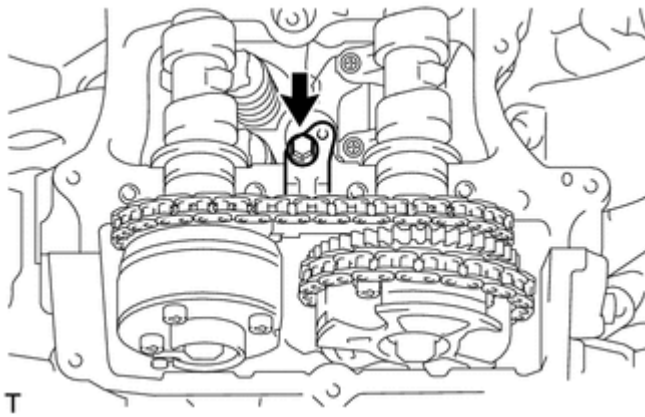


Fig. 27: Identifying No. 2 Chain Tensioner Assembly & Fastener
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the bolt of the No. 2 chain tensioner assembly.

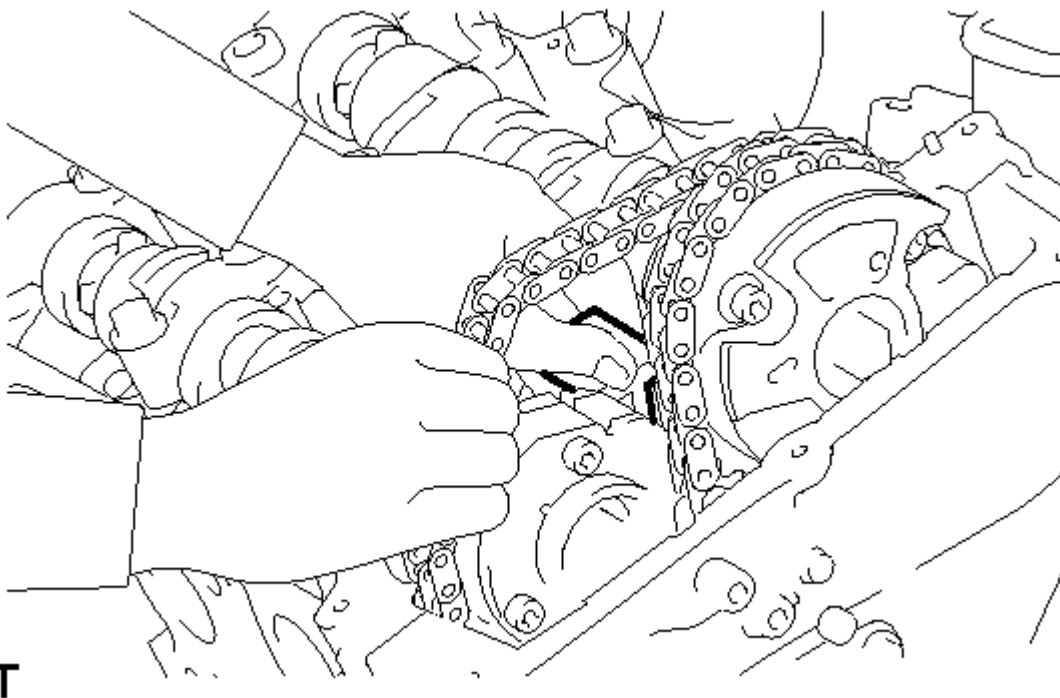


Fig. 28: Remove/Install No. 2 Chain Tensioner Assembly While Lifting Up The No. 2 Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the No. 2 chain tensioner assembly while lifting up the No. 2 camshaft.

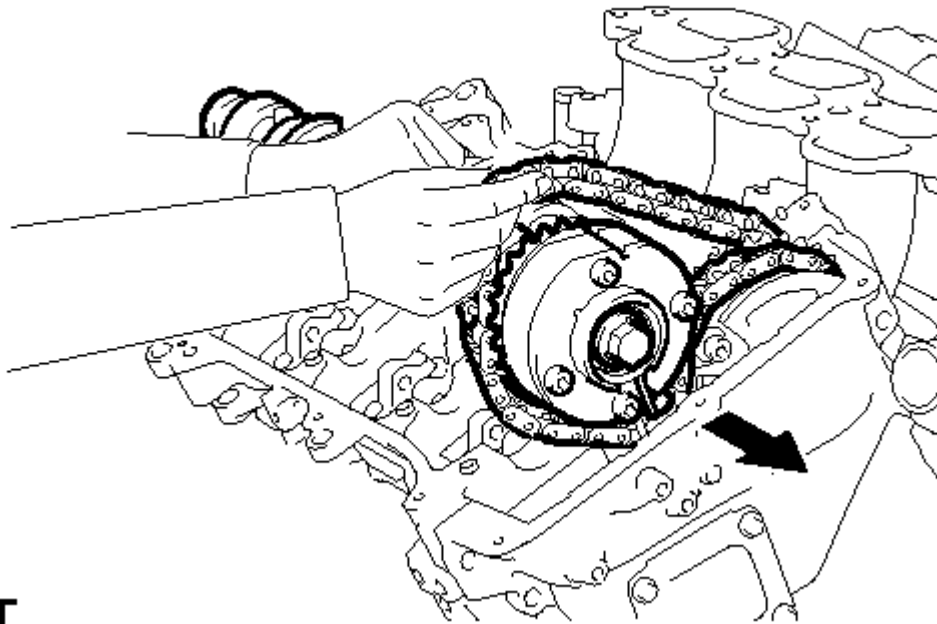
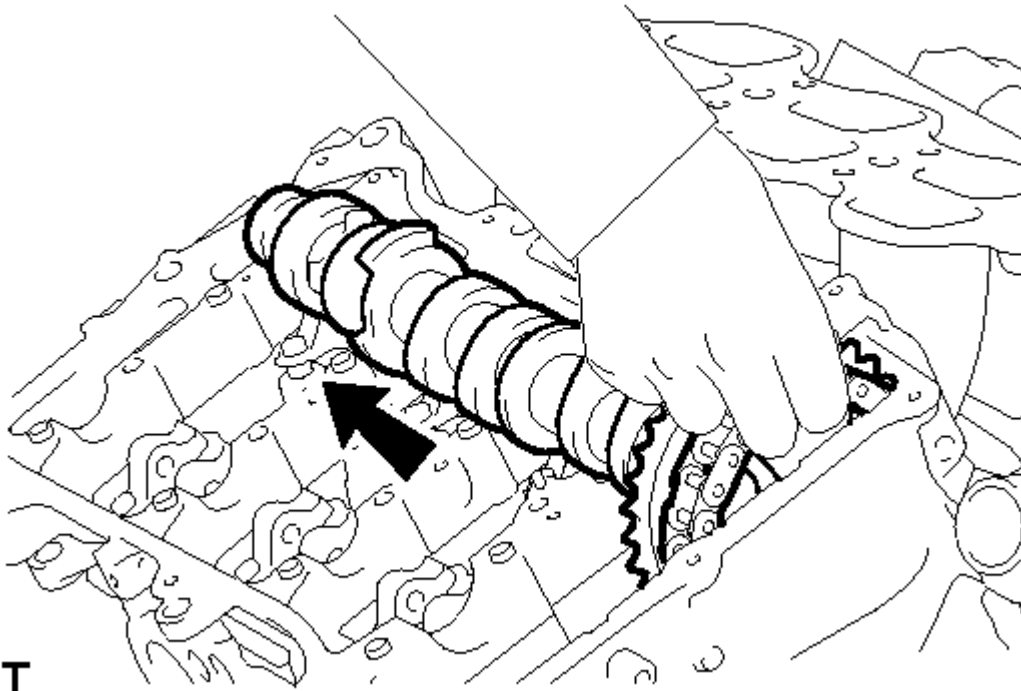
**T**

Fig. 29: Identifying No. 2 Camshaft And No. 2 Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. While lifting up the No. 2 camshaft, pass it through the No. 2 chain and pull it out towards the front of the vehicle to remove it.

37. REMOVE CAMSHAFT

- a. Lift up the rear of the camshaft so that it is at an angle.



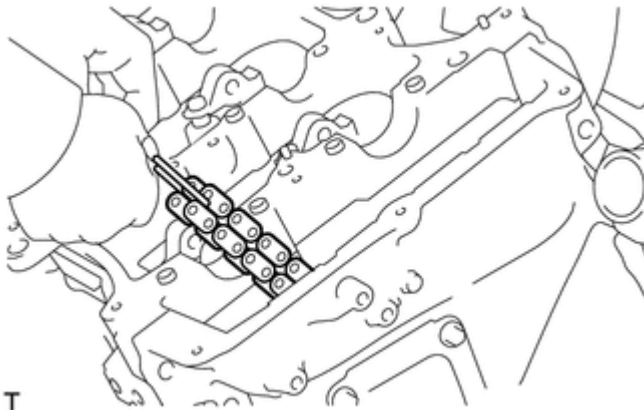
T

Fig. 30: Identifying Camshaft Timing Gear, Chain And Camshaft

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

NOTE: Do not drop the chain into the gap between the engine and cover.

- b. Remove the chain from the camshaft timing gear and pull out the camshaft and No. 2 chain towards the rear of the vehicle to remove them.



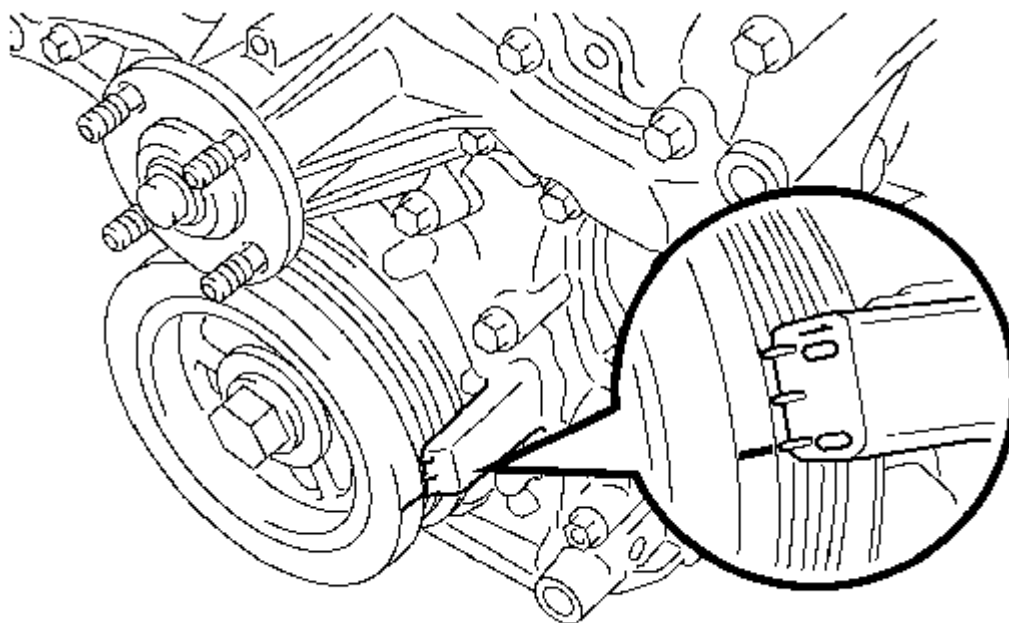
T

Fig. 31: Identifying Chain

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

- c. Suspend the chain with a string or equivalent.

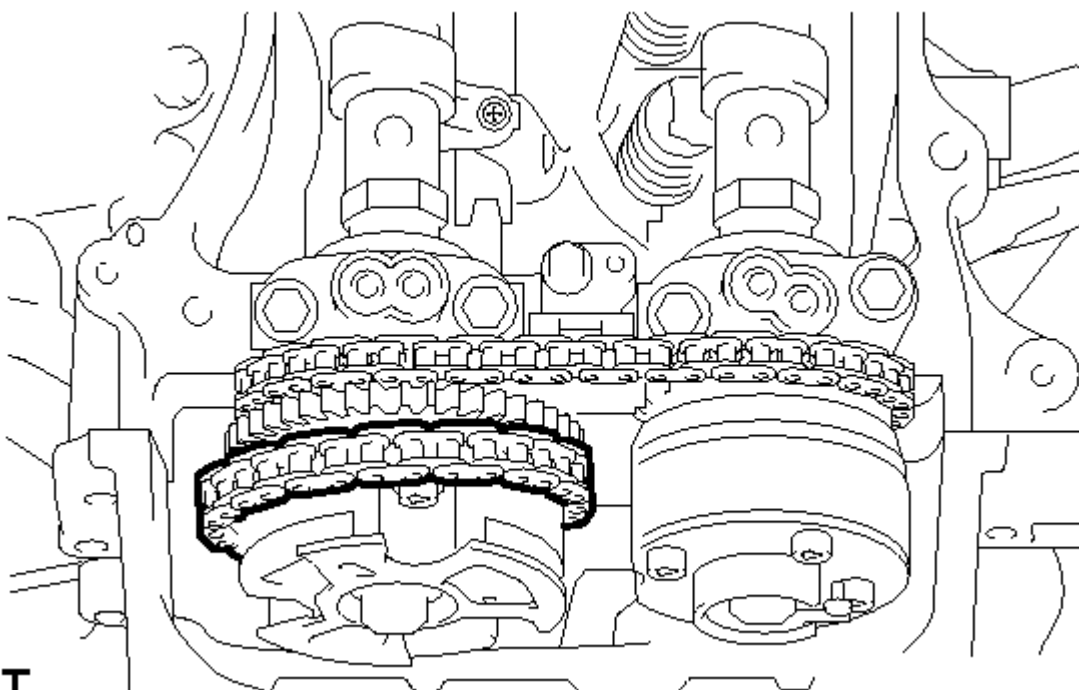
38. DISCONNECT CHAIN SUB-ASSEMBLY (for Bank 2)



Y

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

- a. Turn the crankshaft counterclockwise and align the notch with the "0" timing mark of the timing chain cover.



T

Fig. 33: Identifying Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

WARNING: As the camshaft may turn suddenly and pinch your fingers when the chain is removed, pinch the chain and lift it upward to remove it from the sprocket.

- b. Remove the chain from the sprocket of the camshaft timing gear and set it on the gear.

39. REMOVE CAMSHAFT BEARING CAP (for Bank 2)

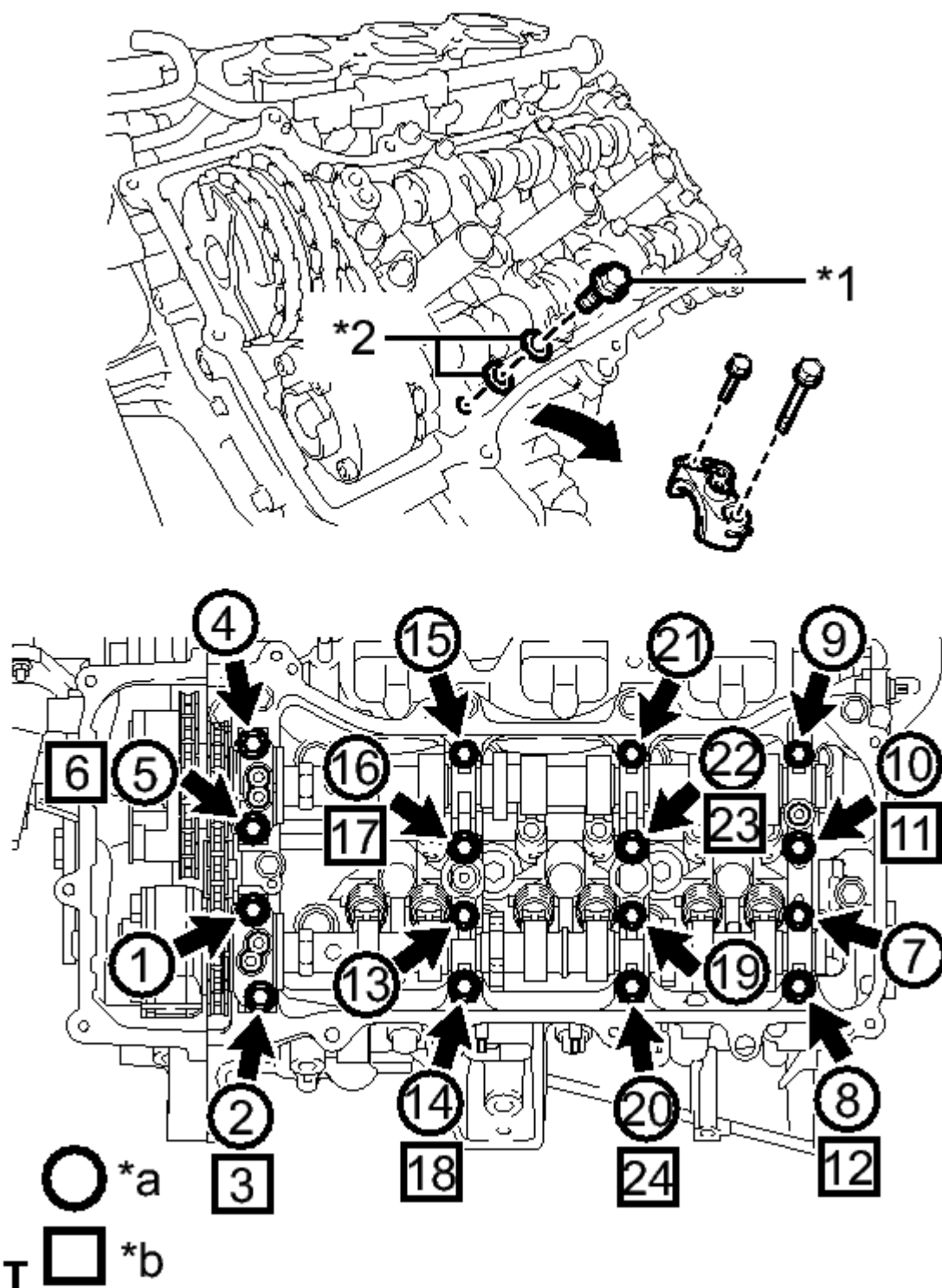


Fig. 34: Identifying Camshaft Bearing Caps And Bolts With Loosening Sequence (Bank 2)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- Do not install the bearing caps when installing bolts and washers for temporary installation of the camshaft housing.

- **Be sure to follow the numerical order when performing this procedure.**
 - **Do not allow bolts and washers for temporary installation of the camshaft housing to contact the camshaft.**
 - **Do not drop bolts and washers for temporary installation of the camshaft housing into the cylinder head.**
- a. Remove the bolts and bearing caps in the order shown in the illustration. Immediately after removing a bearing cap, install bolts and washers for temporary installation of the camshaft housing in the order shown in the illustration.

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

TEXT IN ILLUSTRATION

*1	Bolt
*2	Washer
*a	Part Removal
*b	Installation of Bolts and Washers for Temporary Installation of camshaft housing

HINT:

- Arrange the removed parts so that they can be reinstalled in their original locations.
- Part number of bolt for temporary installation of camshaft housing: 91551-G0845 (quantity: 8)
- Part number of washer for temporary installation of camshaft housing: 90201-12028 (quantity: 16)

40. REMOVE NO. 4 CAMSHAFT

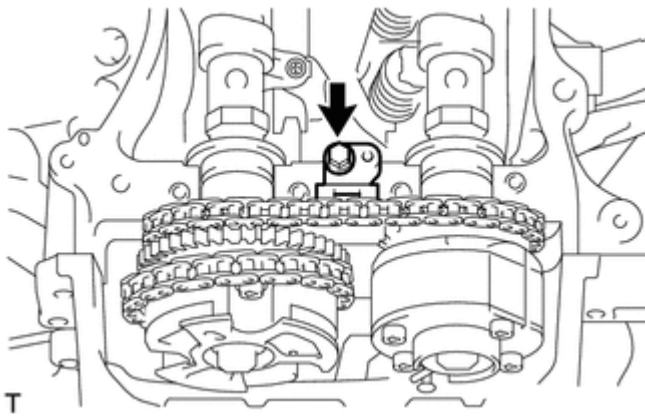


Fig. 35: Identifying No. 3 Chain Tensioner Assembly & Fastener
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the bolt of the No. 3 chain tensioner assembly.

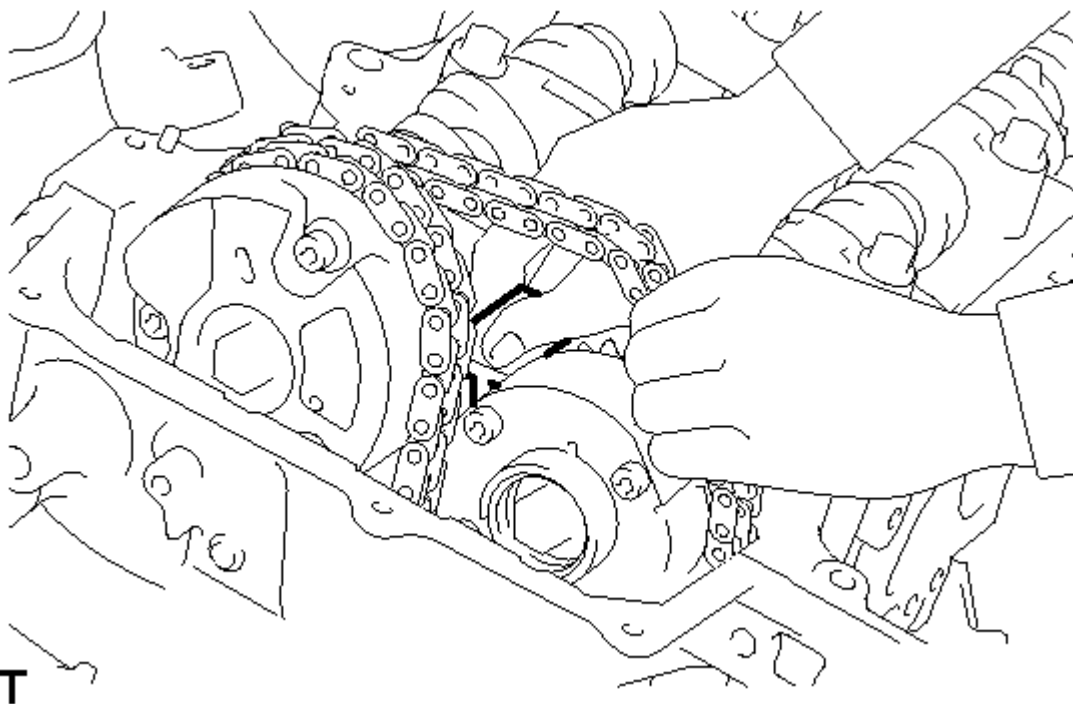


Fig. 36: Remove/Install No. 3 Chain Tensioner Assembly While Lifting Up The No. 4 Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the No. 3 chain tensioner assembly while lifting up the No. 4 camshaft.

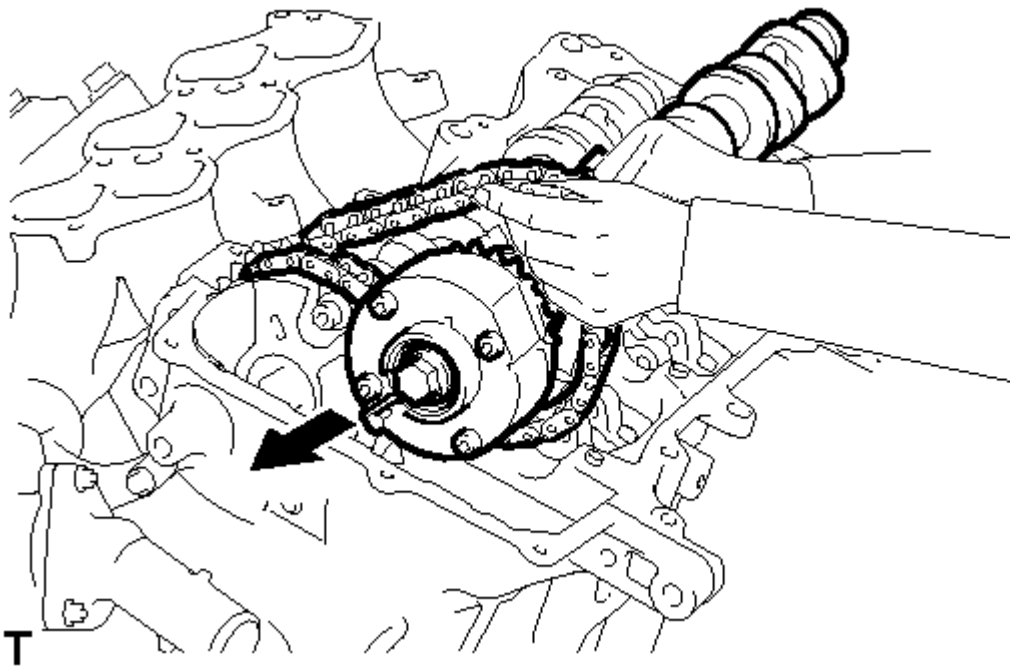


Fig. 37: Identifying No. 4 Camshaft And No. 2 Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. While lifting up the No. 4 camshaft, pass it through the No. 2 chain and pull it out towards the front of the vehicle to remove it.

41. REMOVE NO. 3 CAMSHAFT

- a. Lift up the rear of the camshaft so that it is at an angle.

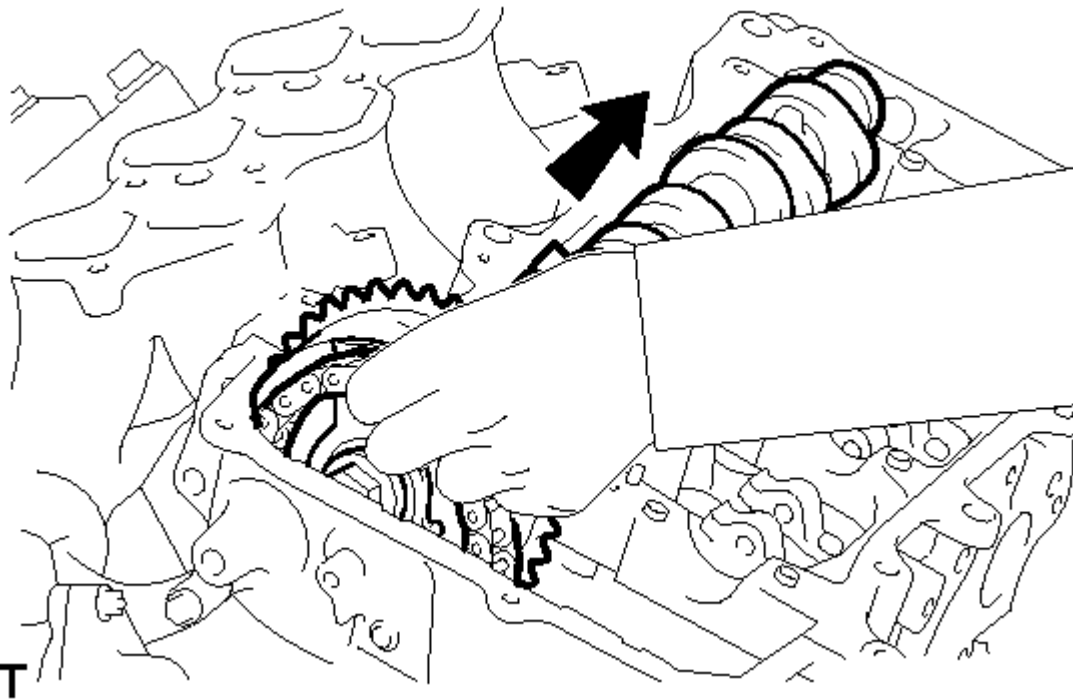


Fig. 38: Identifying Chain, Camshaft Timing Gear And No. 3 Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not drop the chain into the gap between the engine and cover.

- b. Remove the chain from the camshaft timing gear and pull out the No. 3 camshaft and No. 2 chain towards the rear of the vehicle to remove them.

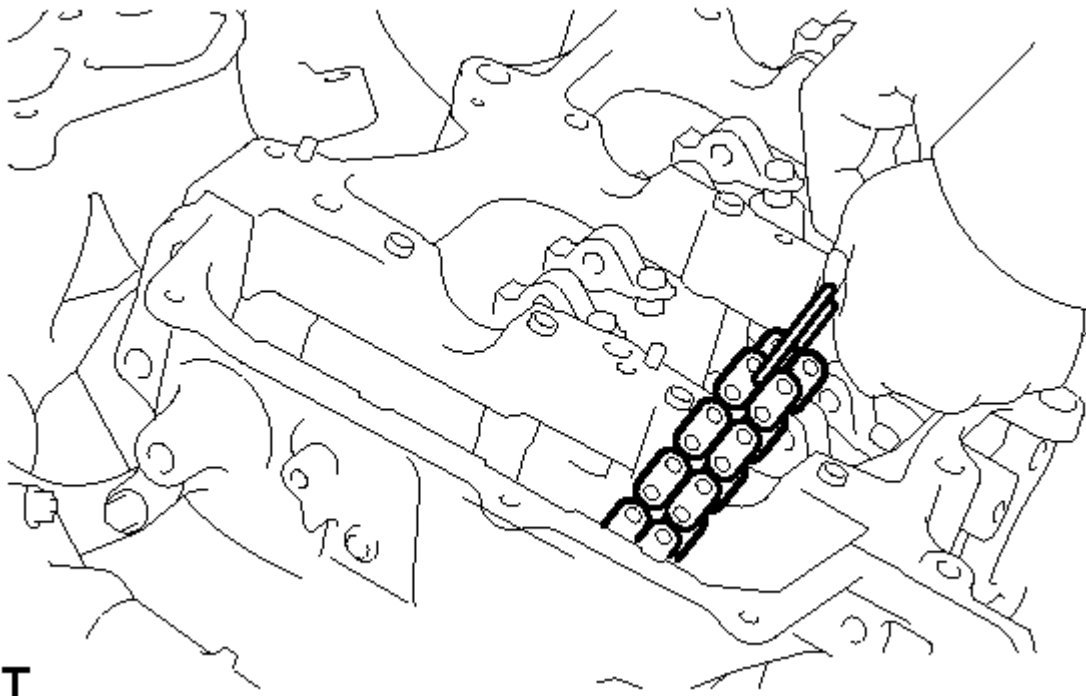


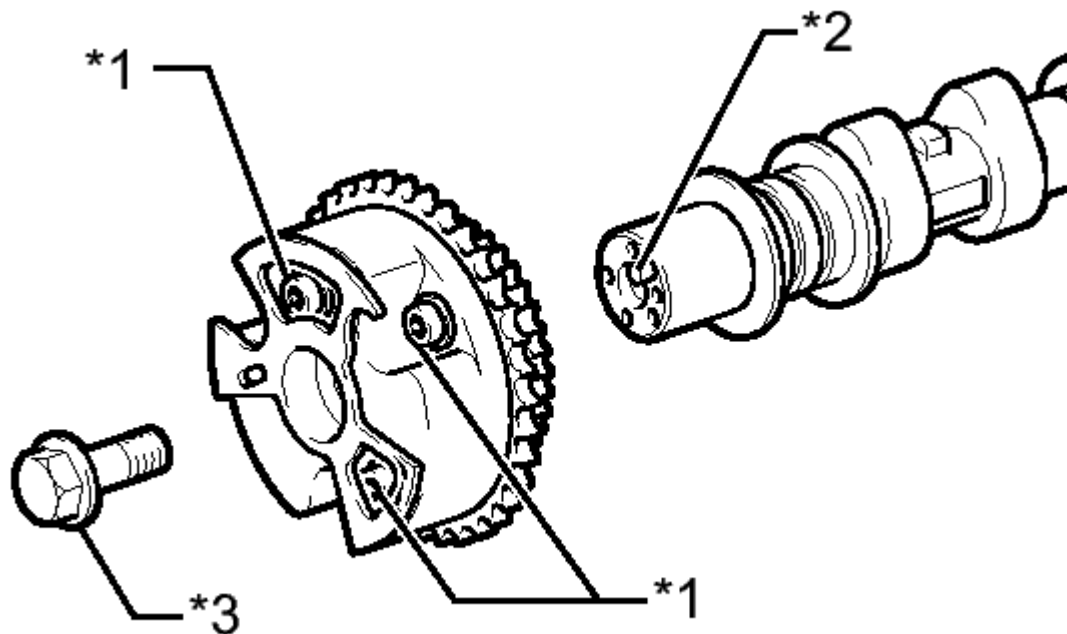
Fig. 39: Identifying Chain

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

- c. Suspend the chain with a string or equivalent.
- 42. **REMOVE CAMSHAFT TIMING GEAR ASSEMBLY**
 - a. Fix the camshaft in place.

NOTE: **Be careful not to damage the camshaft.**

- b. Remove the flange bolt and camshaft timing gear assembly.

**P****Fig. 40: Exploded View Of Camshaft Timing Gear Assembly**

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

TEXT IN ILLUSTRATION

*1	Do not remove
*2	Straight Pin
*3	Flange Bolt

NOTE:

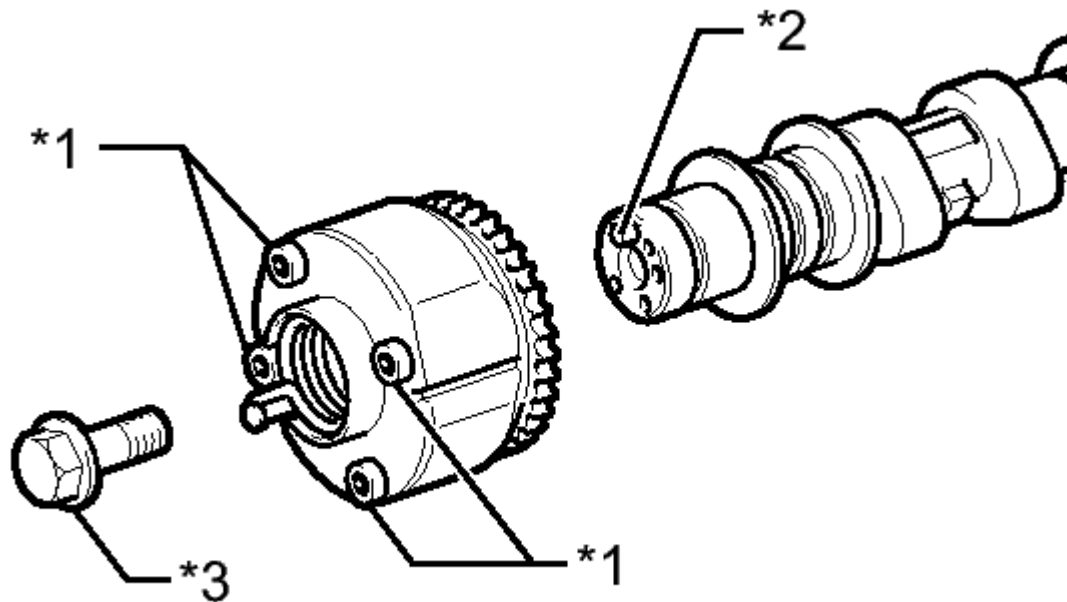
- Do not remove the other 3 bolts.
- If planning to reuse the camshaft timing gear, be sure to release the straight pin lock before installing the camshaft timing gear.

43. REMOVE CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY

- a. Fix the camshaft in place.

NOTE:**Be careful not to damage the camshaft.**

- b. Remove the flange bolt and camshaft timing exhaust gear assembly.

**P****Fig. 41: Exploded View Of Camshaft Timing Exhaust Gear Assembly**

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

TEXT IN ILLUSTRATION

*1	Do not remove
*2	Straight Pin
*3	Flange Bolt

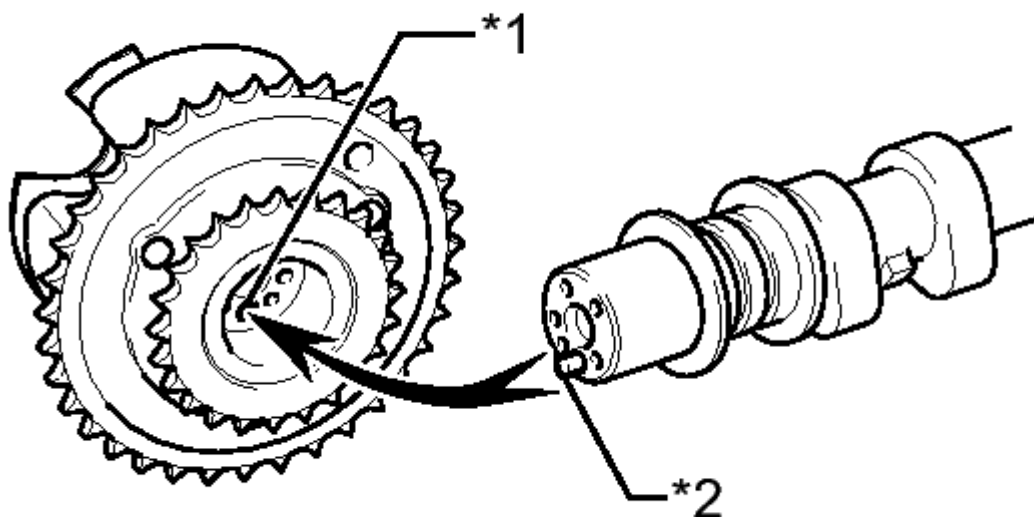
NOTE:

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

44. **INSPECT CAMSHAFT TIMING GEAR ASSEMBLY** See step 545. **INSPECT CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY** See step 6**INSTALLATION****INSTALLATION****1. INSTALL CAMSHAFT TIMING GEAR ASSEMBLY**

- a. Fix the camshaft in place.

NOTE: Be careful not to damage the camshaft.



P

Fig. 42: Identifying Pin Hole & Straight Pin

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

- b. Put the camshaft timing gear assembly and camshaft together by aligning the pin hole and straight pin.

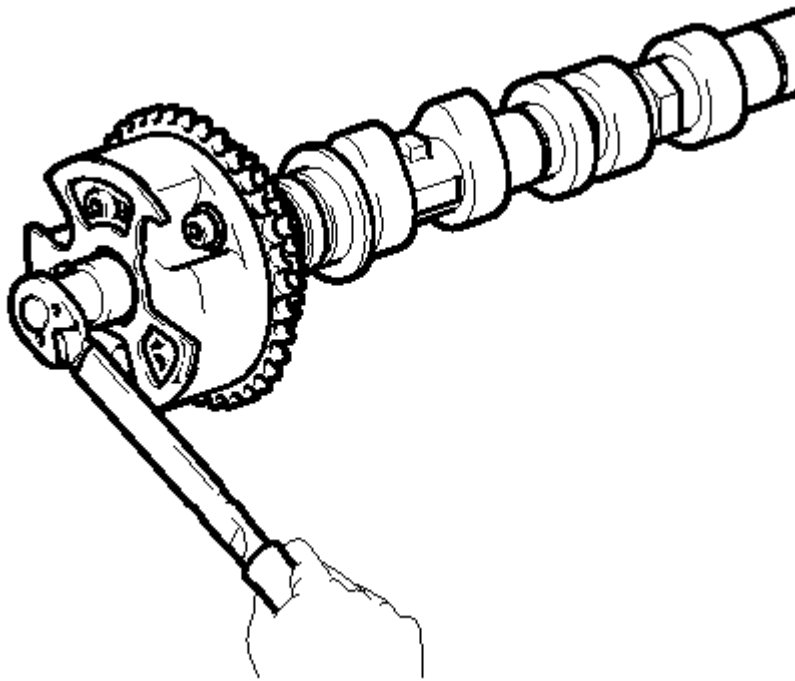
TEXT IN ILLUSTRATION

*1	Pin Hole
*2	Straight Pin

- c. Lightly press and turn the camshaft timing gear assembly against the camshaft, and press harder after the pin enters the hole.

NOTE: Be sure not to turn the camshaft timing gear assembly in the retard direction.

- d. Check that there is no clearance between the camshaft timing gear assembly flange and camshaft.
e. Install the flange bolt while holding the camshaft.



P

Fig. 43: Tightening Camshaft And Flange Bolt

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

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

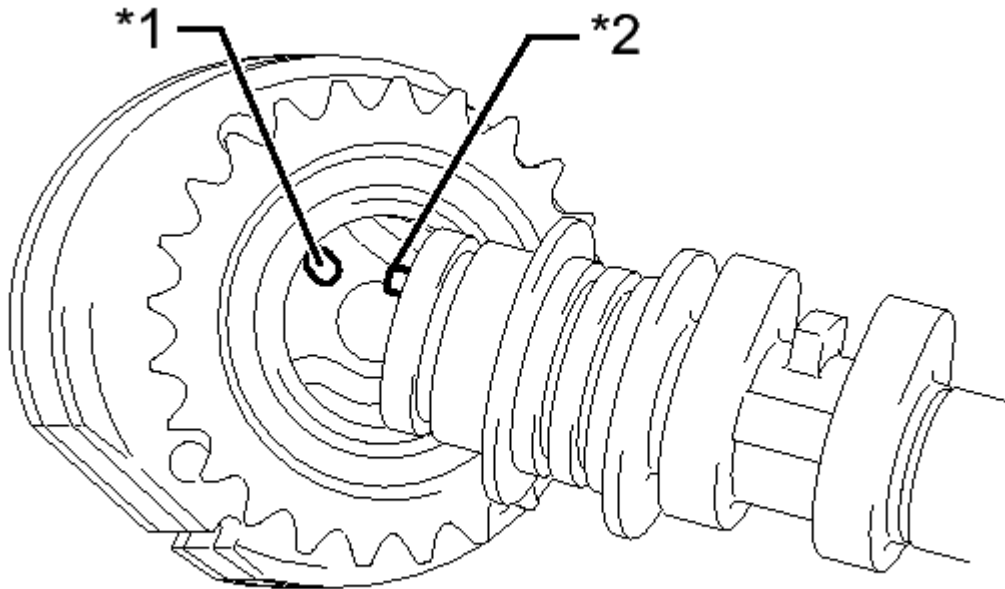
- f. Check the lock of the camshaft timing gear assembly.
 - 1. Fix the camshaft in place and confirm that the camshaft timing gear assembly is locked.

NOTE: Be careful not to damage the camshaft.

2. INSTALL CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY

- a. Fix the camshaft in place.

NOTE: Be careful not to damage the camshaft.

**P****Fig. 44: Identifying Pin Hole & Straight Pin**

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

- b. Put the camshaft timing exhaust gear assembly and camshaft together by aligning the pin hole and straight pin.

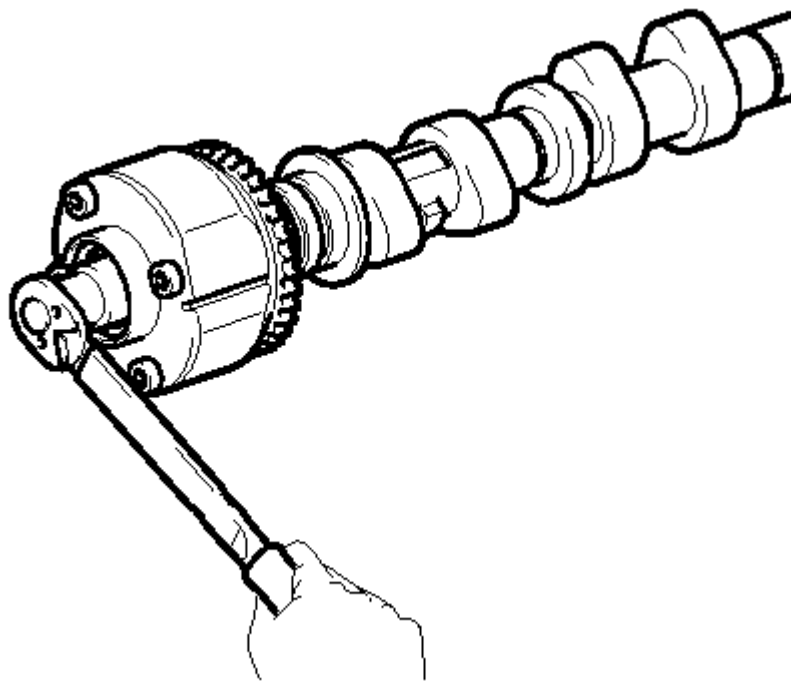
TEXT IN ILLUSTRATION

*1	Pin Hole
*2	Straight Pin

- c. Lightly press and turn the camshaft timing gear assembly against the camshaft, and press harder after the pin enters the hole.

NOTE: Be sure not to turn the camshaft timing exhaust gear in the advanced direction.

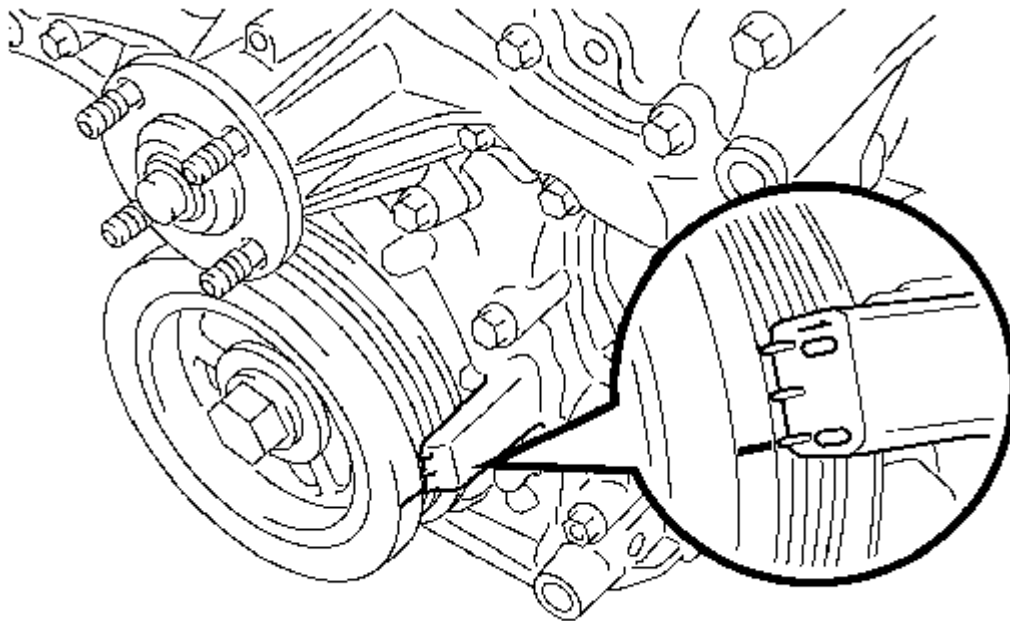
- d. Check that there is no clearance between the gear flange and camshaft.
e. Install the flange bolt while holding the camshaft.

**P****Fig. 45: Tightening Camshaft And Flange Bolt****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****Torque: 100 N*m (1020 kgf*cm, 74 ft.*lbf)**

f. Check the camshaft timing exhaust gear lock.

1. Make sure that the camshaft timing exhaust gear assembly locks.

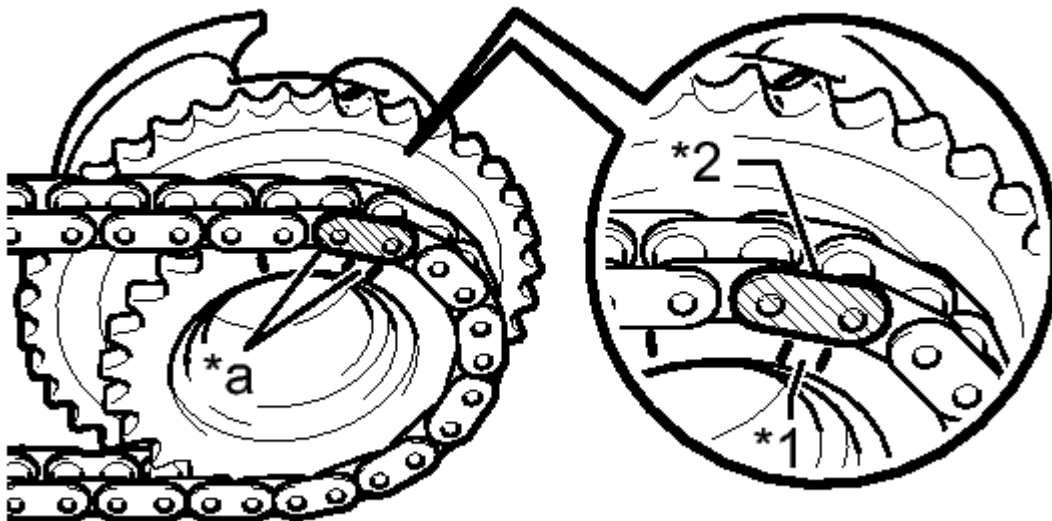
3. INSTALL NO. 3 CAMSHAFT



Y

Fig. 46: Aligning Crankshaft Pulley Groove & Timing Mark "0" Of Timing Chain Cover
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Check that the notch is aligned with the "0" timing mark of the timing chain cover.



P

Fig. 47: Identifying Timing Mark & Mark Plate (Yellow)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Align the mark plate (yellow) with the timing mark of the camshaft timing gear as shown in the illustration and install the No. 2 chain to the camshaft timing gear.

TEXT IN ILLUSTRATION

*1	Timing Mark
*2	Mark Plate (yellow)
*a	Align

- c. Clean the camshaft housing LH and camshaft journals and apply engine oil to them.
- d. Make sure that the No. 1 valve rocker arm sub-assembly is installed as shown in the illustration.

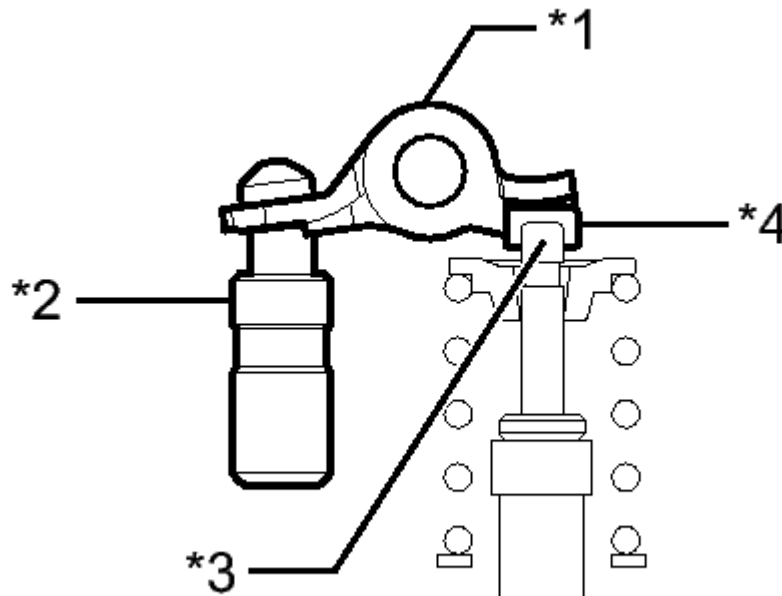
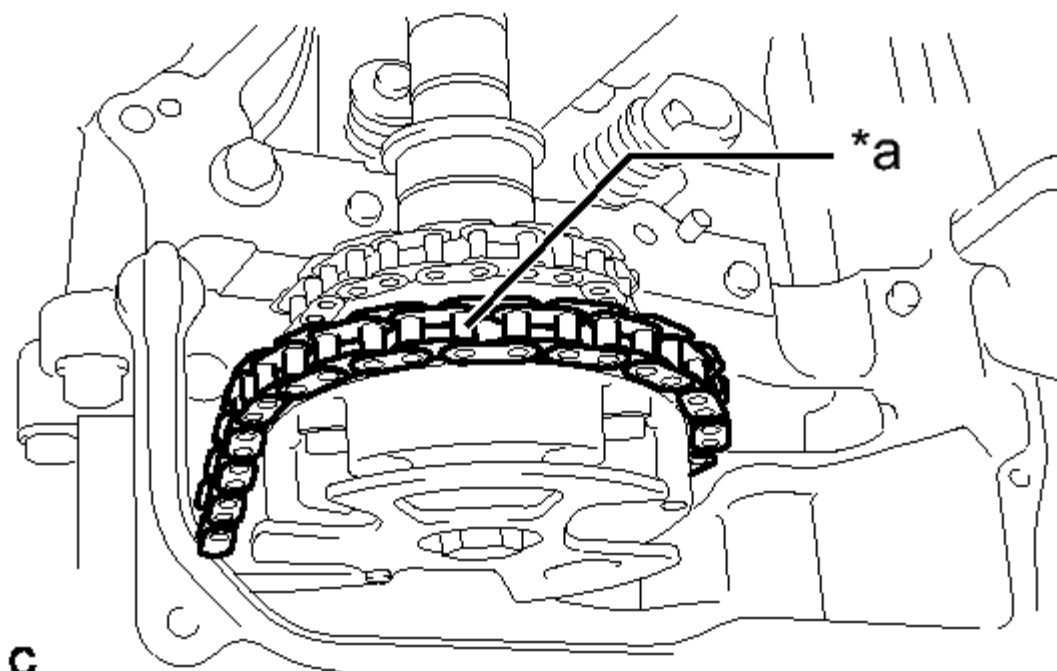
**P**

Fig. 48: Identifying No. 1 Valve Rocker Arm Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
	Valve

*4	Stem Cap
----	-------------

**Fig. 49: Identifying Chain**

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

- e. Install the chain to the No. 3 camshaft, and then install the camshaft to the camshaft housing LH.

TEXT IN ILLUSTRATION

*a	Place on camshaft timing gear
----	--

HINT:

- Place the chain on the camshaft timing gear but do not engage the teeth of the sprocket and the chain.
- Install the camshaft so that the timing mark is facing upward.

4. INSTALL NO. 4 CAMSHAFT

- a. Clean the camshaft housing LH and camshaft journals and apply engine oil to them.

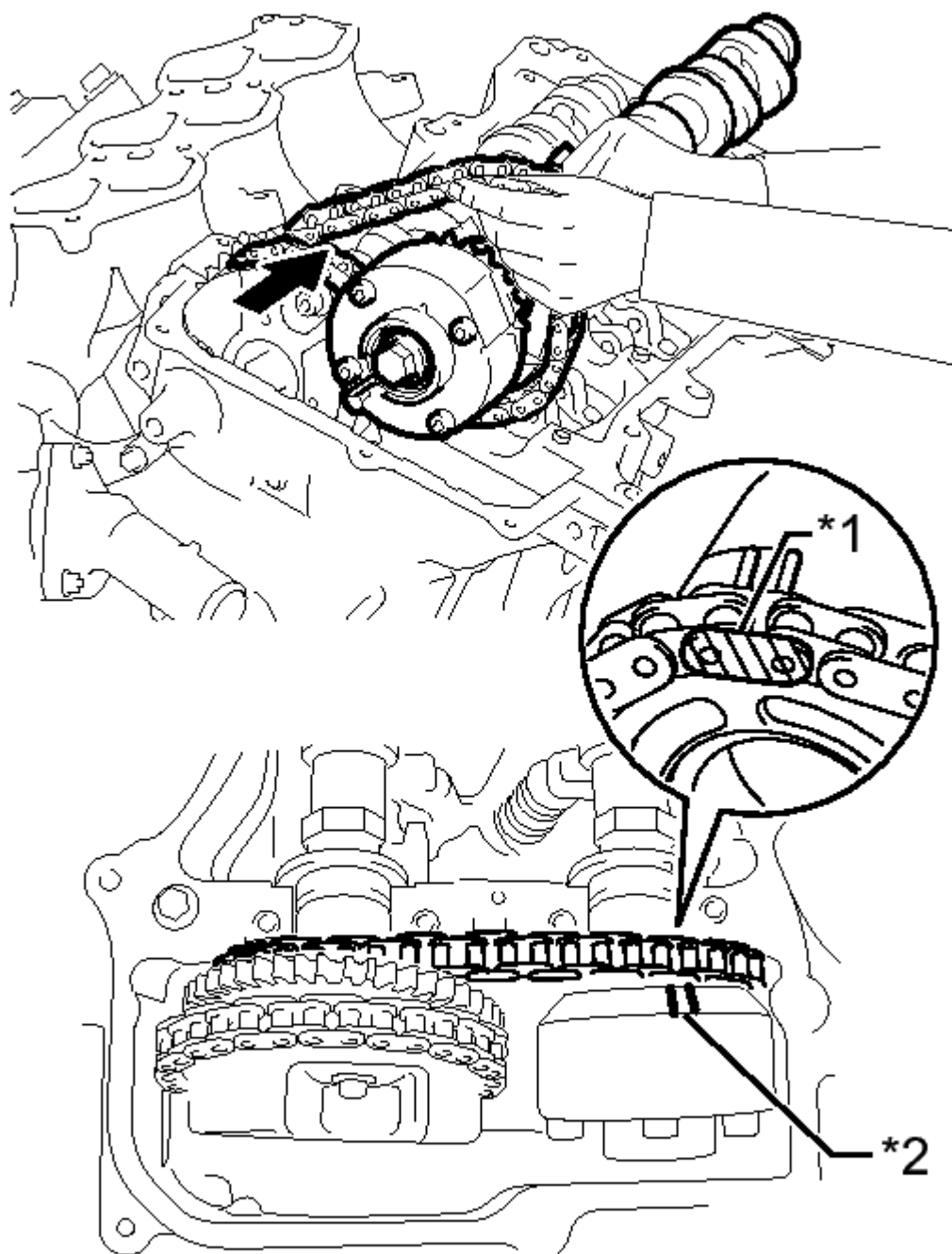
**C**

Fig. 50: Identifying No. 4 Camshaft Sub-Assembly And No. 2 Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Pass the No. 4 camshaft through the No. 2 chain from the front of the vehicle, align the mark plate (yellow) with the timing mark and install the No. 2 chain to the camshaft timing exhaust gear.

TEXT IN ILLUSTRATION

*1	Mark Plate (yellow)
*2	Timing Mark

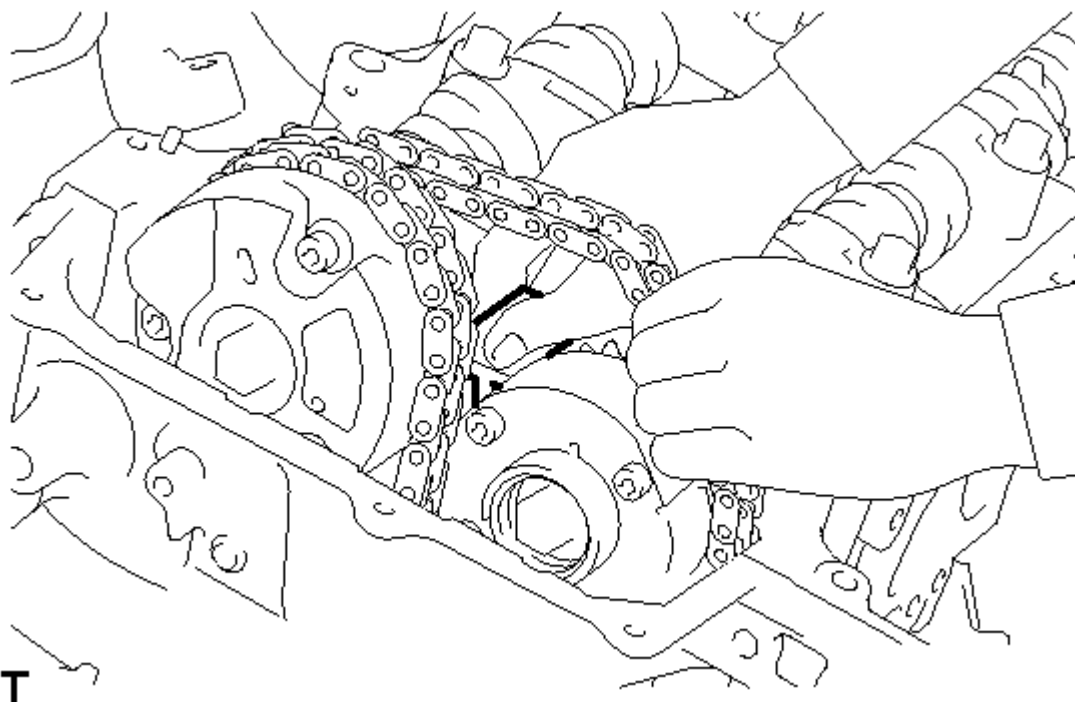


Fig. 51: Remove/Install No. 3 Chain Tensioner Assembly While Lifting Up The No. 4 Camshaft

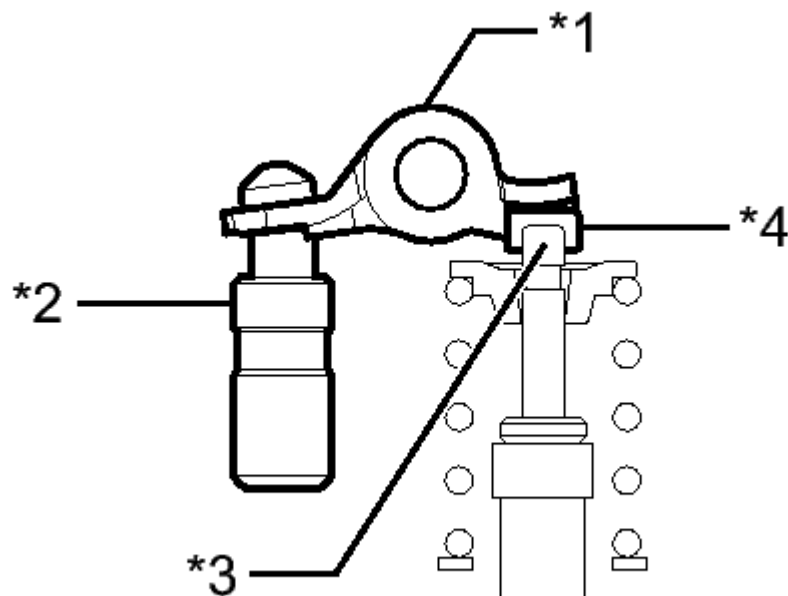
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. While lifting up the No. 4 camshaft, pass the No. 3 chain tensioner assembly through the No. 2 chain and set it in place.
- d. Install the No. 4 camshaft to the camshaft housing LH, and then install the No. 3 chain tensioner assembly with the bolt.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

5. INSTALL CAMSHAFT BEARING CAP (for Bank 2)

- a. Clean the camshaft bearing caps and apply engine oil to them.

**P****Fig. 52: Identifying No. 1 Valve Rocker Arm Sub-Assembly****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- b. Make sure that the No. 1 valve rocker arm sub-assembly is installed as shown in the illustration.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
*4	Valve Stem Cap

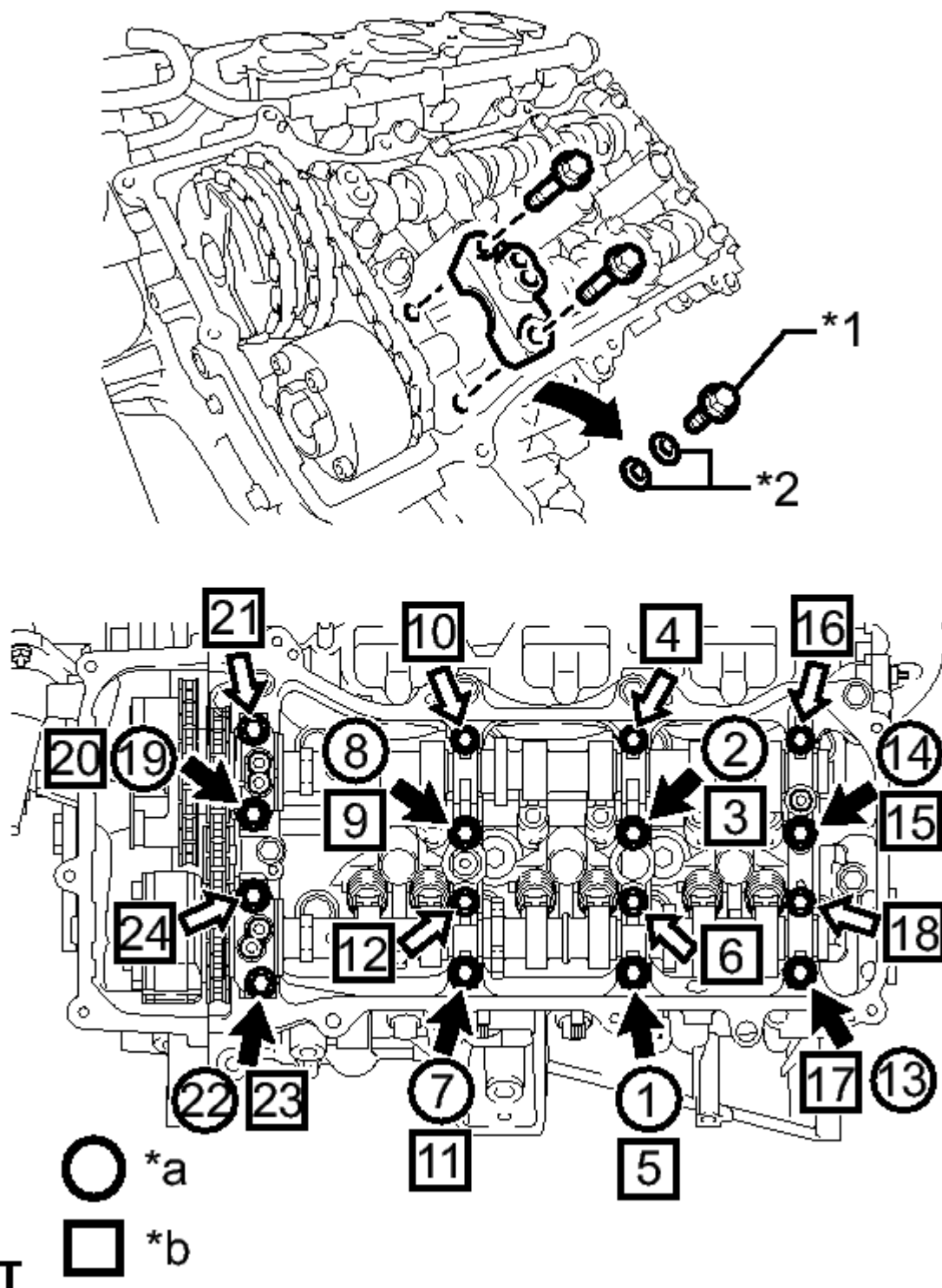


Fig. 53: Identifying Camshaft Bearing Caps And Bolts With Tightening Sequence (Bank 2)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- Be sure to follow the numerical order when performing this procedure.

- **Do not drop bolts and washers for temporary installation of the camshaft housing into the cylinder head.**

- c. Check the marks and numbers on the camshaft bearing caps, and then remove the replacement bolts and washers in the order shown in the illustration. Immediately after removing the bolts and washers for temporary installation of the camshaft housing in the location for a bearing cap, install the bearing cap with the bolts in the order shown in the illustration.

for bolt A

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

for bolt B

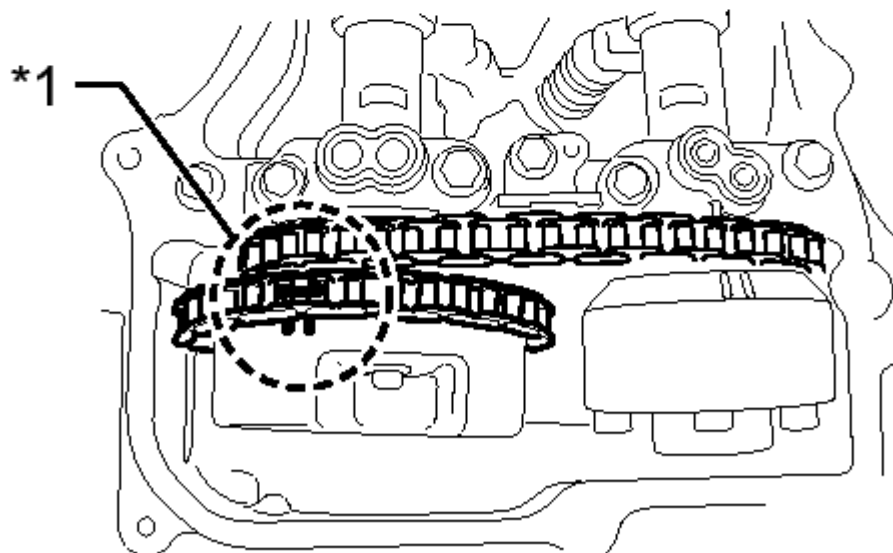
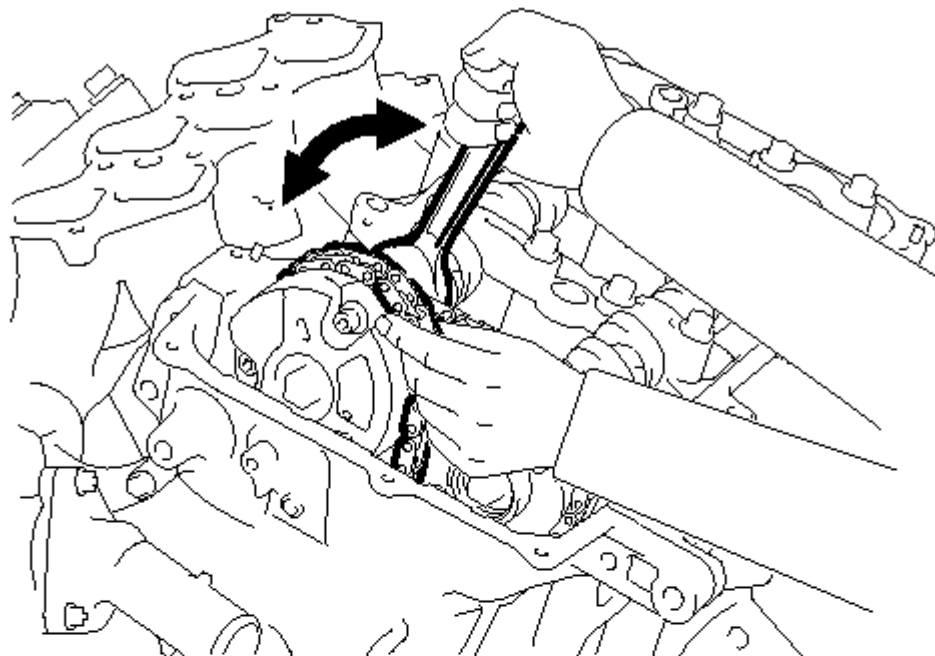
Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

TEXT IN ILLUSTRATION

*1	Bolt
*2	Washer
*a	Installation of Bolts and Washers for Temporary Installation of camshaft housing
*b	Part Installation
·	Bolt A
·	Bolt B

- d. Check the torque of each bolt again.

6. CONNECT CHAIN SUB-ASSEMBLY (for Bank 2)



P

Fig. 54: Aligning Paint Marks On Camshaft Timing Gear & No. 1 Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Align the paint marks on the camshaft timing gear and No. 1 chain and install the No. 1 chain to the camshaft timing gear.

TEXT IN ILLUSTRATION

*1	Paint Mark
----	---------------

HINT:

If the paint marks are not aligned, align them by turning the camshaft slightly.

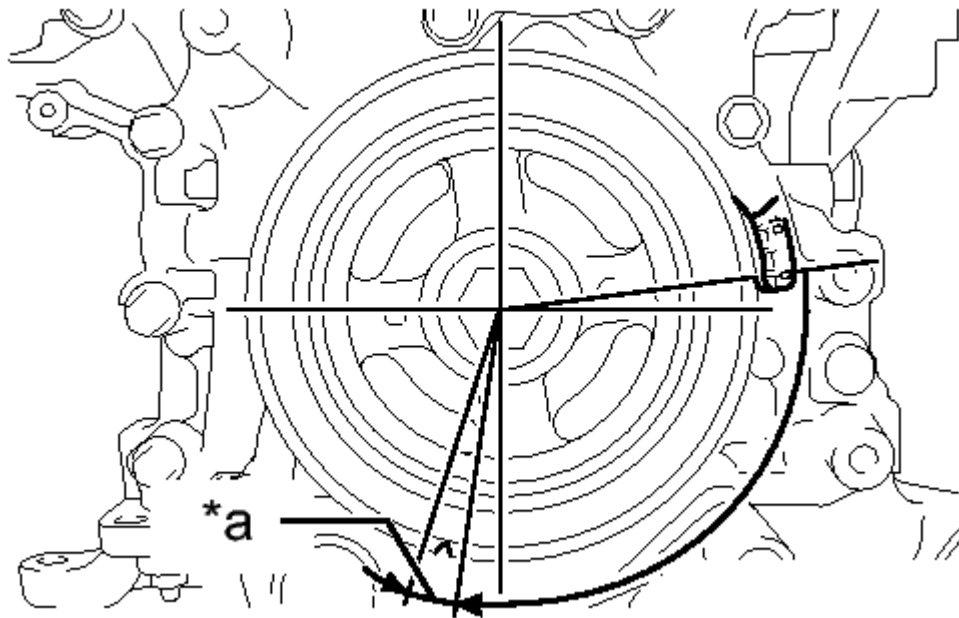
7. INSTALL CAMSHAFT**T**

Fig. 55: Turning Crankshaft So Chain Can Be Installed Easily
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

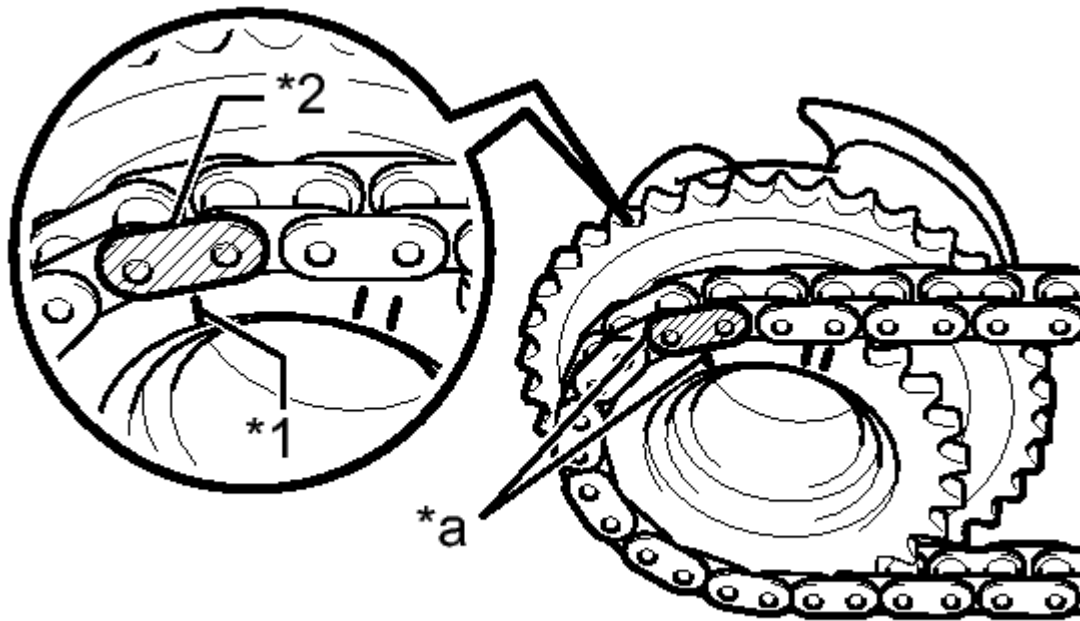
- a. Turn the crankshaft clockwise until it is in the position shown in the illustration so that the chain can be installed easily.

TEXT IN ILLUSTRATION

*a	5° to 10°
----	-----------------

HINT:

When turning the crankshaft, engine oil may spray out of the oil holes.



P

Fig. 56: Identifying Timing Mark & Mark Plate (Yellow)

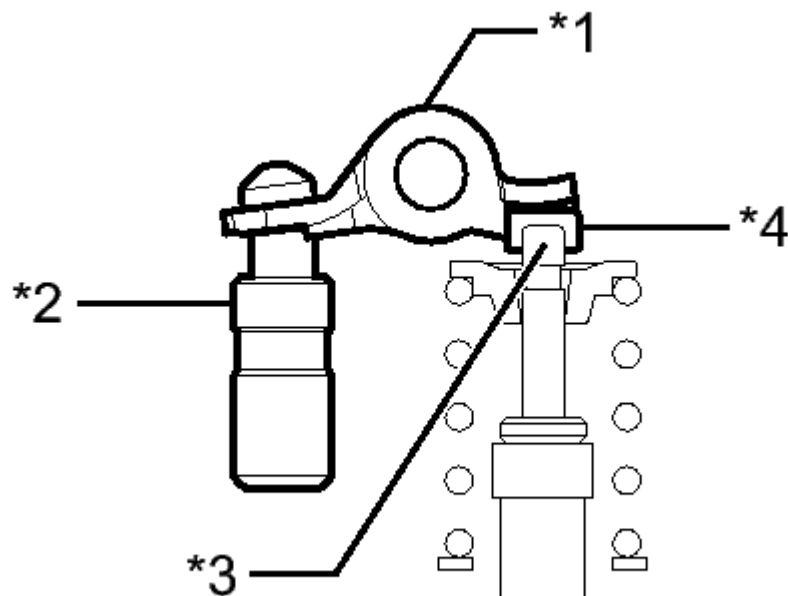
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Align the mark plate (yellow) with the timing mark of the camshaft timing gear as shown in the illustration and install the No. 2 chain to the camshaft timing gear.

TEXT IN ILLUSTRATION

*1	Timing Mark
*2	Mark Plate (yellow)
*a	Align

- c. Clean the camshaft housing RH and camshaft journals and apply engine oil to them.
- d. Make sure that the No. 1 valve rocker arm sub-assembly is installed as shown in the illustration.



P

Fig. 57: Identifying No. 1 Valve Rocker Arm Sub-Assembly
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
*4	Valve Stem Cap

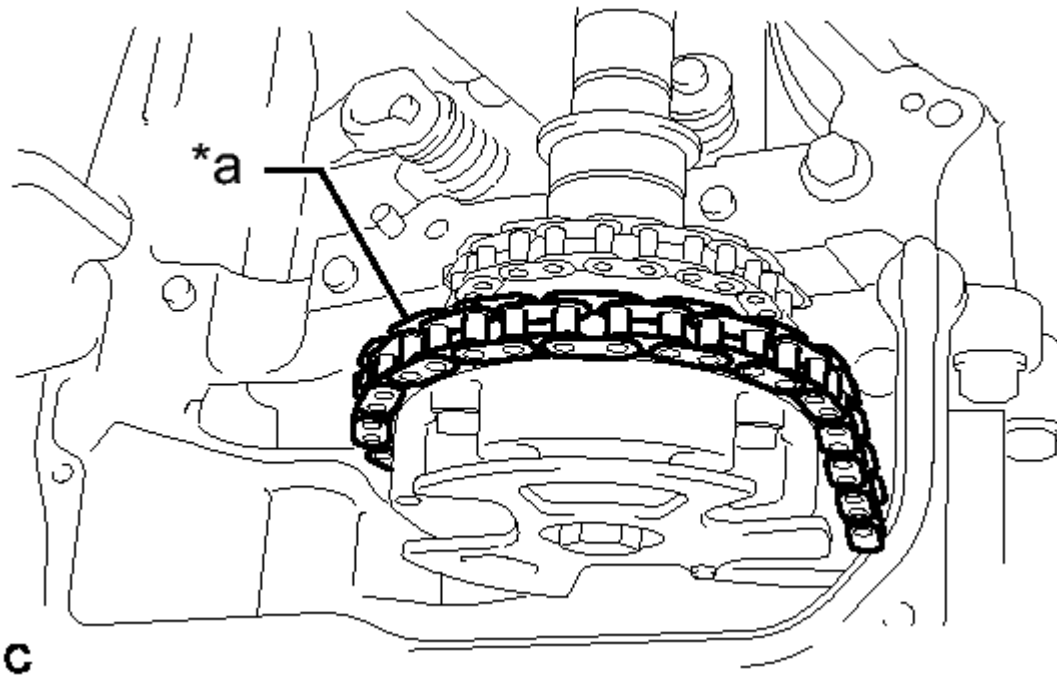


Fig. 58: Identifying Chain

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

- e. Install the chain to the camshaft, and then install the camshaft to the camshaft housing RH.

TEXT IN ILLUSTRATION

*a	Place on camshaft timing gear
----	--

HINT:

- Place the chain on the camshaft timing gear but do not engage the teeth of the sprocket and the chain.
- Install the camshaft so that the timing mark is facing upward.

8. INSTALL NO. 2 CAMSHAFT

- a. Clean the camshaft housing RH and camshaft journals and apply engine oil to them.

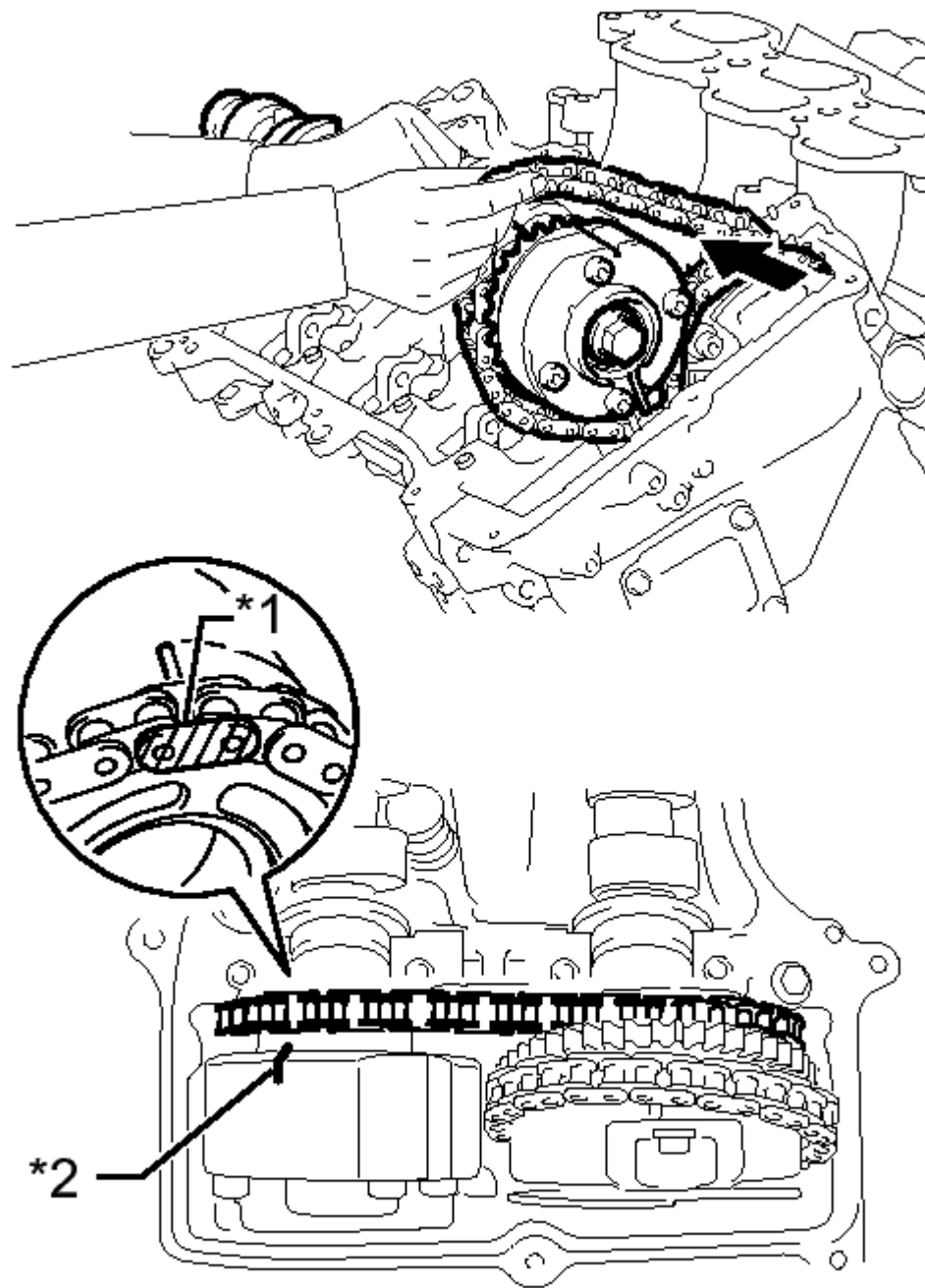
**C**

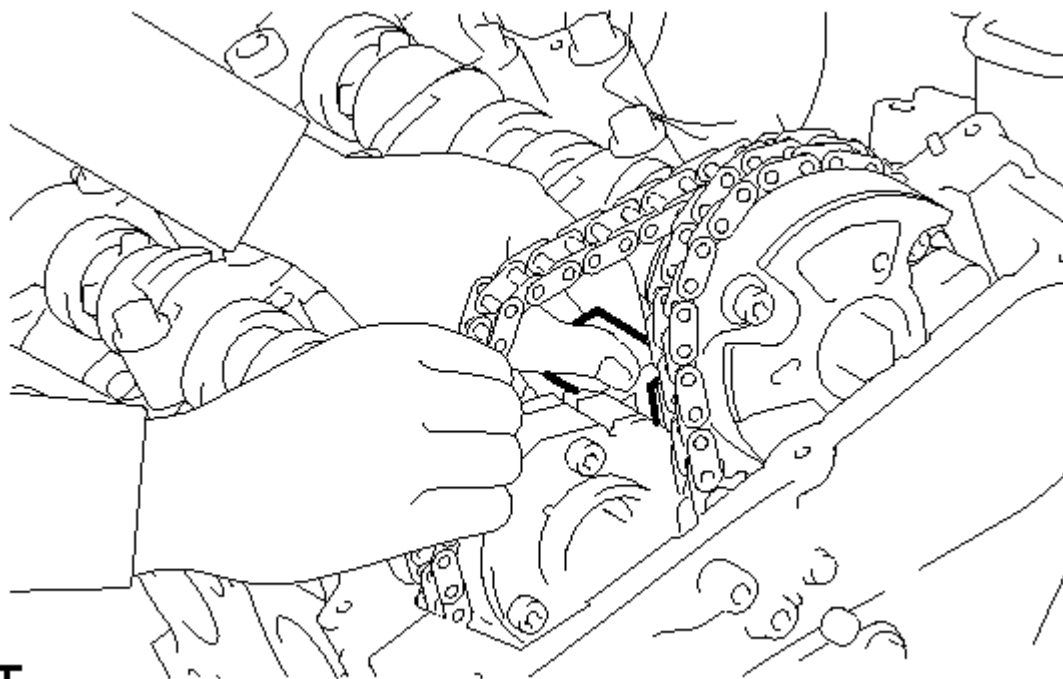
Fig. 59: Identifying No. 2 Camshaft, No. 2 Chain, Camshaft Timing Exhaust Gear, Mark Plate (Yellow) And Timing Mark
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Pass the No. 2 camshaft through the No. 2 chain from the front of the vehicle, align the mark plate

(yellow) with the timing mark and install the No. 2 chain to the camshaft timing exhaust gear.

TEXT IN ILLUSTRATION

	Mark
*1	Plate (yellow)
*2	Timing Mark



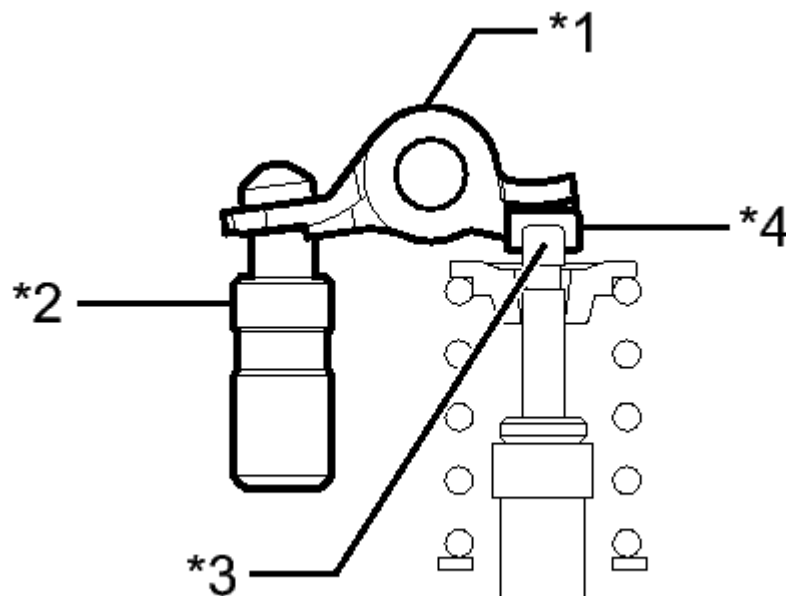
T
Fig. 60: Remove/Install No. 2 Chain Tensioner Assembly While Lifting Up The No. 2 Camshaft
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. While lifting up the No. 2 camshaft, pass the No. 2 chain tensioner assembly through the No. 2 chain and set it in place.
- d. Install the No. 2 camshaft to the camshaft housing RH, and then install the No. 2 chain tensioner assembly with the bolt.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

9. INSTALL CAMSHAFT BEARING CAP (for Bank 1)

- a. Clean the camshaft bearing caps and apply engine oil to them.

**P****Fig. 61: Identifying No. 1 Valve Rocker Arm Sub-Assembly****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- b. Make sure that the No. 1 valve rocker arm sub-assembly is installed as shown in the illustration.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
*4	Valve Stem Cap

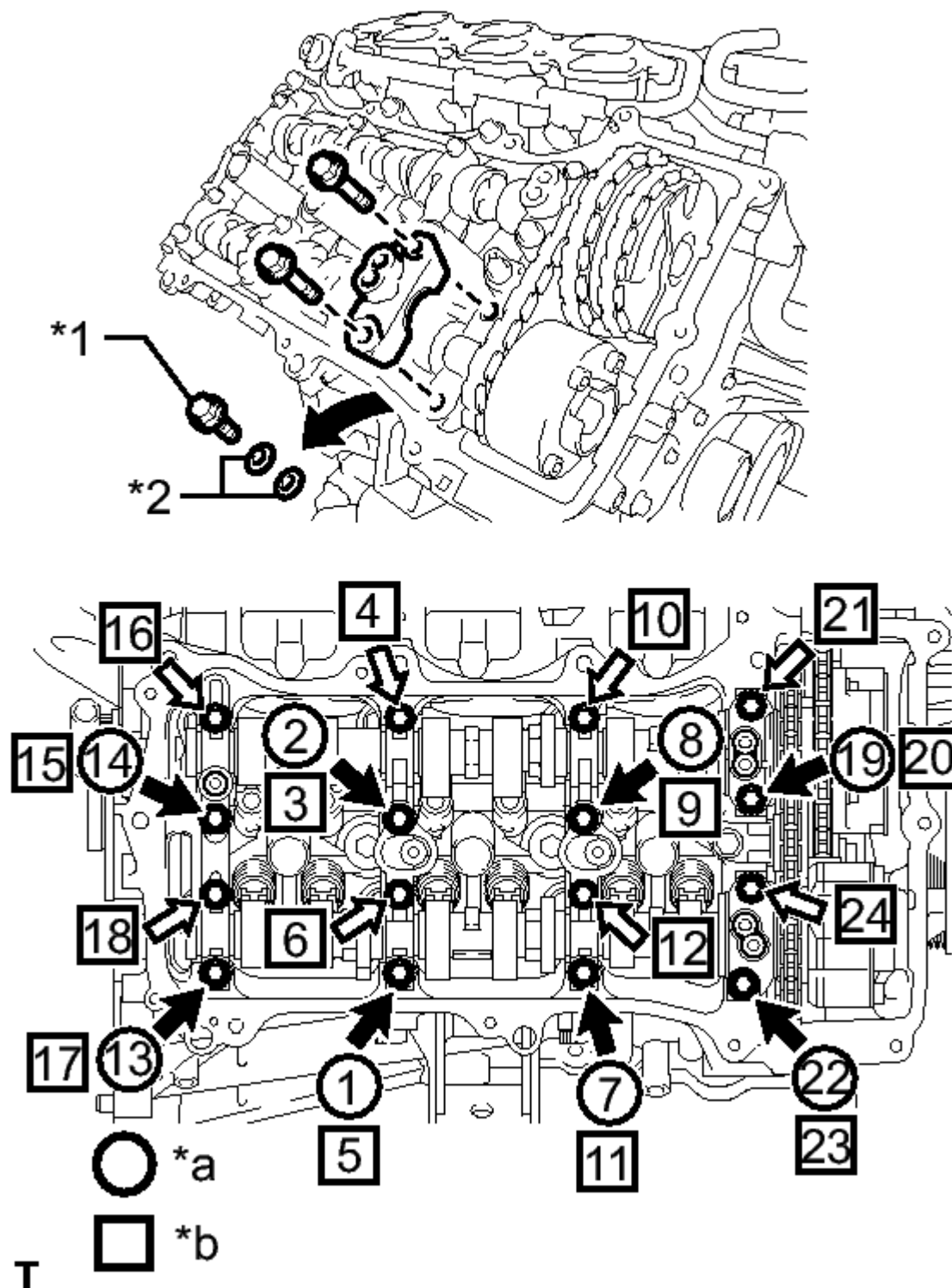


Fig. 62: Identifying Camshaft Bearing Caps And Bolts (Bank 1)

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

NOTE:

- Be sure to follow the numerical order when performing this procedure.

- **Do not drop bolts and washers for temporary installation of the camshaft housing into the cylinder head.**

- c. Check the marks and numbers on the camshaft bearing caps, and then remove the replacement bolts and washers in the order shown in the illustration. Immediately after removing the bolts and washers for temporary installation of the camshaft housing in the location for a bearing cap, install the bearing cap with the bolts in the order shown in the illustration.

for bolt A

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

for bolt B

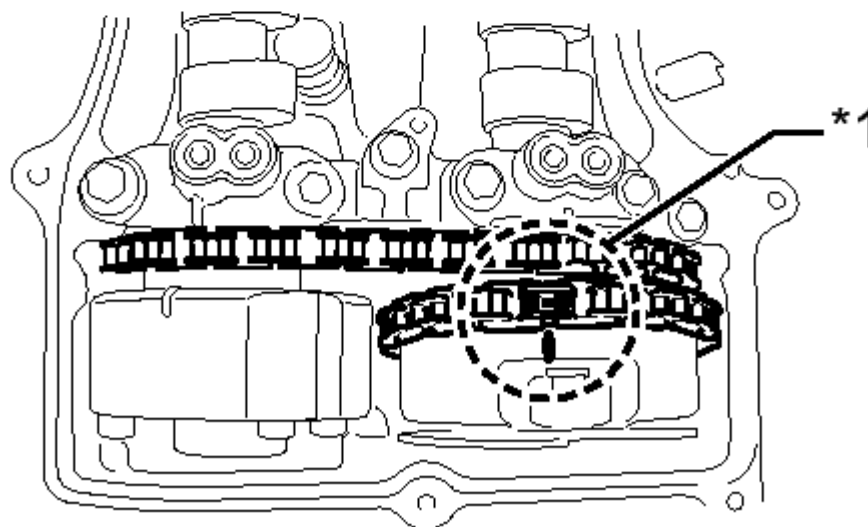
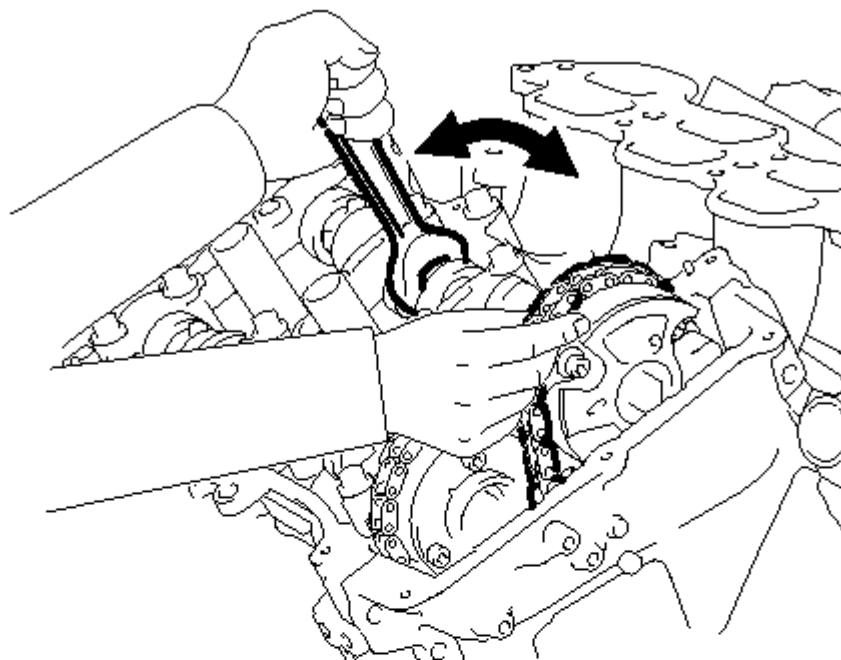
Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

TEXT IN ILLUSTRATION

*1	Bolt
*2	Washer
*a	Installation of Bolts and Washers for Temporary Installation of camshaft housing
*b	Part Installation
·	Bolt A
·	Bolt B

- d. Check the torque of each bolt again.

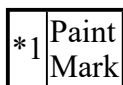
10. CONNECT CHAIN SUB-ASSEMBLY (for Bank 1)



C

Fig. 63: Aligning Paint Marks On Camshaft Timing Gear & No. 1 Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Align the paint marks on the camshaft timing gear and No. 1 chain and install the No. 1 chain to the camshaft timing gear.

TEXT IN ILLUSTRATION**HINT:**

If the paint marks are not aligned, align them by turning the camshaft slightly.

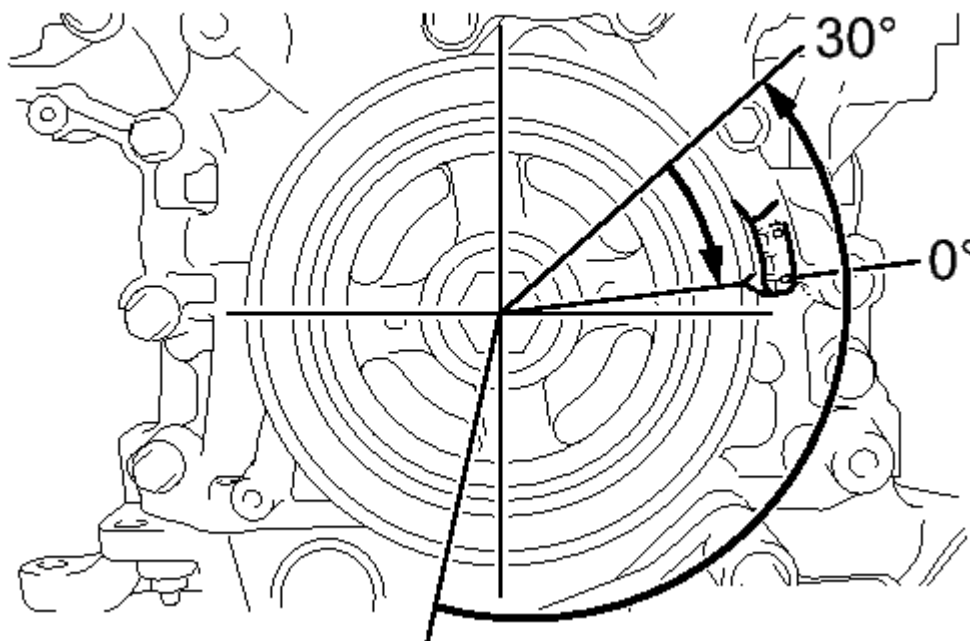
11. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY**T**

Fig. 64: Identifying Crankshaft Turning Angle

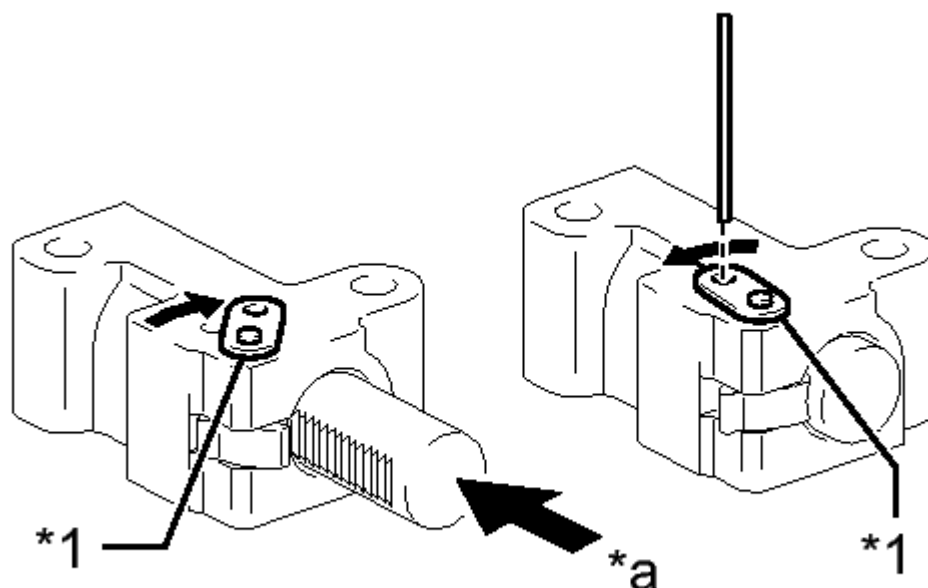
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Turn the crankshaft counterclockwise 30° past the "0" timing mark, and then turn it clockwise to align the notch with the "0" timing mark.
- Turn the crankshaft slightly to eliminate the slack in the chain.

HINT:

Make sure there is some slack in the chain around the area where the chain tensioner is installed.

- While turning the stopper plate of the tensioner clockwise, push in the plunger of the tensioner as shown in the illustration.

**Fig. 65: Identifying Stopper Plate**

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

TEXT IN ILLUSTRATION

*1	Stopper Plate
*a	Push

- d. While turning the stopper plate of the tensioner counterclockwise, insert a pin of 1.27 mm (0.0500 in.) into the holes in the stopper plate and tensioner to fix the stopper plate in place.
- e. Install the chain tensioner with the 2 bolts.

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

- f. Remove the pin from the No. 1 chain tensioner.

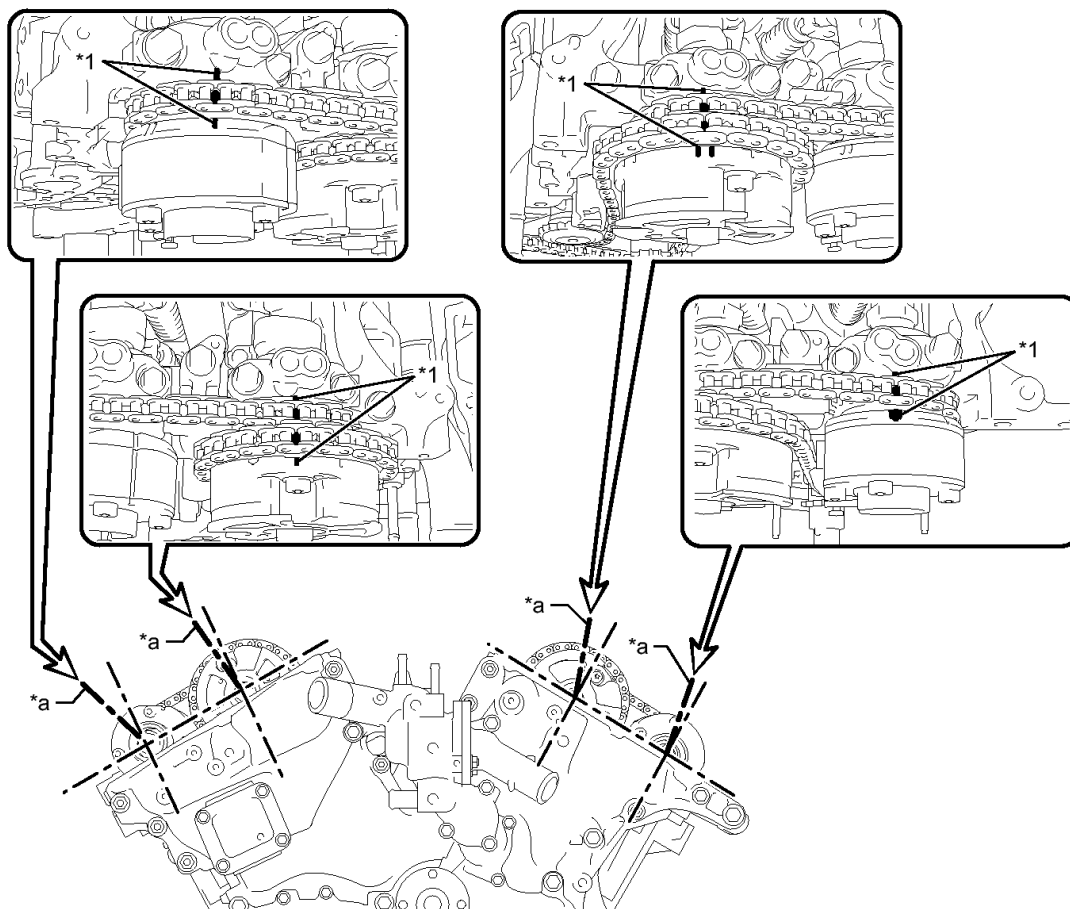
12. INSPECT VALVE TIMING

- a. Check the camshaft timing marks.

NOTE:

- Check each timing mark from a viewpoint directly in line with the center of the camshaft and the timing mark on each camshaft timing gear.
- If the timing marks are checked from any other viewpoint, the valve timing may appear misaligned.

- b. Check that each camshaft timing mark is positioned as shown in the illustration.



T

Fig. 66: Identifying Camshaft Timing Marks

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

TEXT IN ILLUSTRATION

*1	Timing Mark	--
*a	Viewpoint	--

HINT:

for Intake Camshaft:

Be sure to check mark A at the point when marks B, C and D are positioned in line. If the marks are checked from any other viewpoint, they cannot be checked correctly.

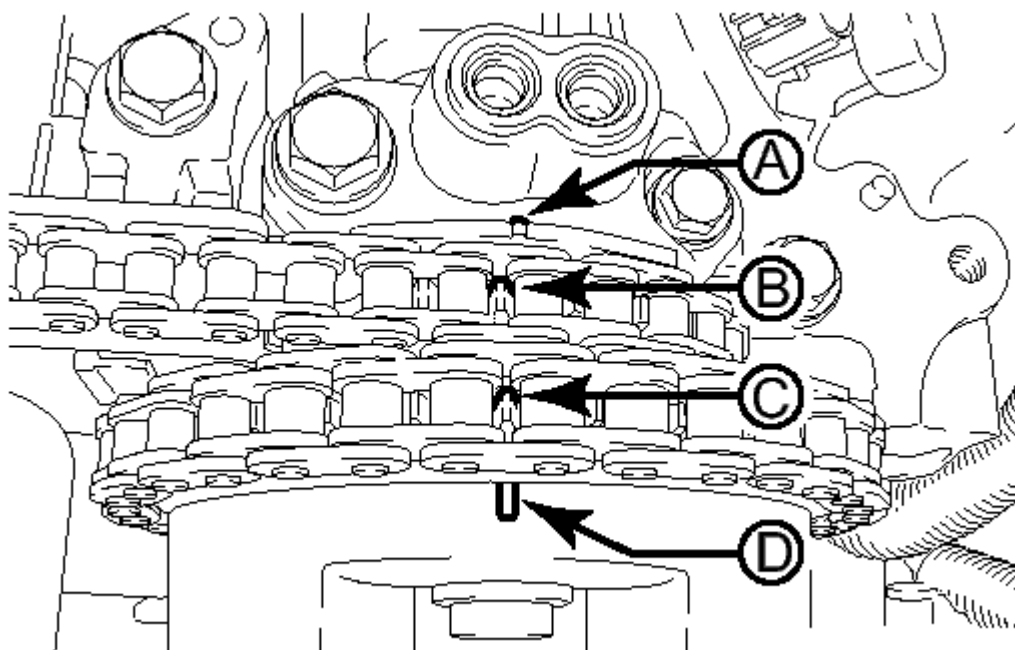
**P**

Fig. 67: Identifying Camshaft Timing Mark Position
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. If the valve timing is misaligned, reinstall the timing chain.
- d. Turn the crankshaft 2 revolutions, set the No. 1 cylinder to TDC/compression and check the timing marks again.

13. INSTALL TIMING CHAIN COVER PLATE

- a. Install a new gasket and the timing chain cover plate with the 4 bolts.

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

- 14. **POUR ENGINE OIL** See step 40
- 15. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY** . Refer to INSTALLATION - Step 6
- 16. **INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH** . Refer to INSTALLATION - Step 7
- 17. **CONNECT FUEL PIPE SUB-ASSEMBLY** . Refer to INSTALLATION - Step 8
- 18. **INSTALL NO. 2 OIL PIPE** . Refer to INSTALLATION - Step 9
- 19. **INSTALL NO. 1 OIL PIPE** . Refer to INSTALLATION - Step 10
- 20. **INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY** . Refer to INSTALLATION - Step 18
- 21. **INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE** . Refer to INSTALLATION - Step 19
- 22. **INSTALL GENERATOR ASSEMBLY** . Refer to INSTALLATION - Step 1
- 23. **INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR** . Refer to INSTALLATION - Step 2
- 24. **INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY** . Refer to INSTALLATION - Step 6
- 25. **CONNECT HEATER WATER PIPE SUB-ASSEMBLY** . Refer to INSTALLATION - Step 3

26. **CONNECT WIRE HARNESS** . Refer to **INSTALLATION - Step 4**
27. **CONNECT VANE PUMP ASSEMBLY** . Refer to **INSTALLATION - Step 5**
28. **INSTALL IGNITION COIL ASSEMBLY** . Refer to **INSTALLATION - Step 2**
29. **INSTALL NO. 2 EMISSION CONTROL VALVE SET** . Refer to **INSTALLATION - Step 1**
30. **INSTALL EMISSION CONTROL VALVE SET** . Refer to **INSTALLATION - Step 1**
31. **INSTALL NO. 2 AIR TUBE** . Refer to **INSTALLATION - Step 3**
32. **INSTALL AIR TUBE** . Refer to **INSTALLATION - Step 2**
33. **INSTALL INTAKE AIR SURGE TANK** . Refer to **INSTALLATION - Step 3**
34. **INSTALL AIR TUBE ASSEMBLY** . Refer to **INSTALLATION - Step 4**
35. **INSTALL FAN SHROUD** . Refer to **INSTALLATION - Step 2**
36. **INSTALL RADIATOR HOSE OUTLET** . Refer to **INSTALLATION - Step 3**
37. **INSTALL RADIATOR HOSE INLET** . Refer to **INSTALLATION - Step 4**
38. **INSTALL AIR CLEANER CAP AND HOSE** . Refer to **INSTALLATION - Step 4**
39. **CONNECT CABLE TO POSITIVE BATTERY TERMINAL**
40. **CONNECT CABLE TO NEGATIVE BATTERY TERMINAL**

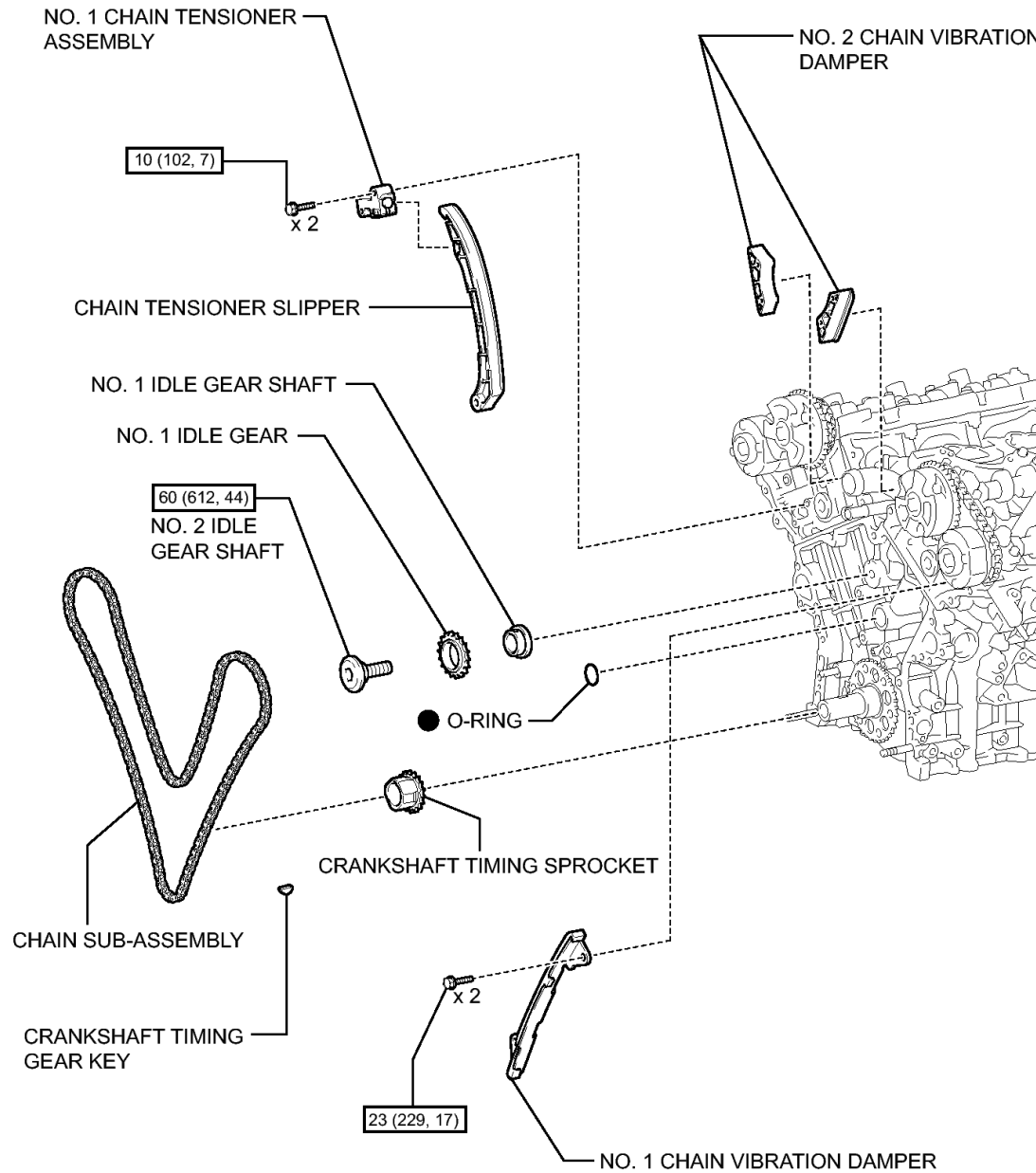
NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected. Refer to **INITIALIZATION** .

41. **ADD ENGINE COOLANT** . Refer to **REPLACEMENT - Step 3**
42. **ADD ENGINE OIL** . Refer to **REPLACEMENT - Step 5**
43. **INSPECT FOR COOLANT LEAK** . Refer to **ON-VEHICLE INSPECTION - Step 1**
44. **INSPECT FOR ENGINE OIL LEAK** . Refer to **REPLACEMENT - Step 7**
45. **INSTALL NO. 1 ENGINE UNDER COVER** . Refer to **REPLACEMENT - Step 8**
46. **INSPECT IGNITION TIMING** See step 1

CYLINDER HEAD GASKET

COMPONENTS

ILLUSTRATION



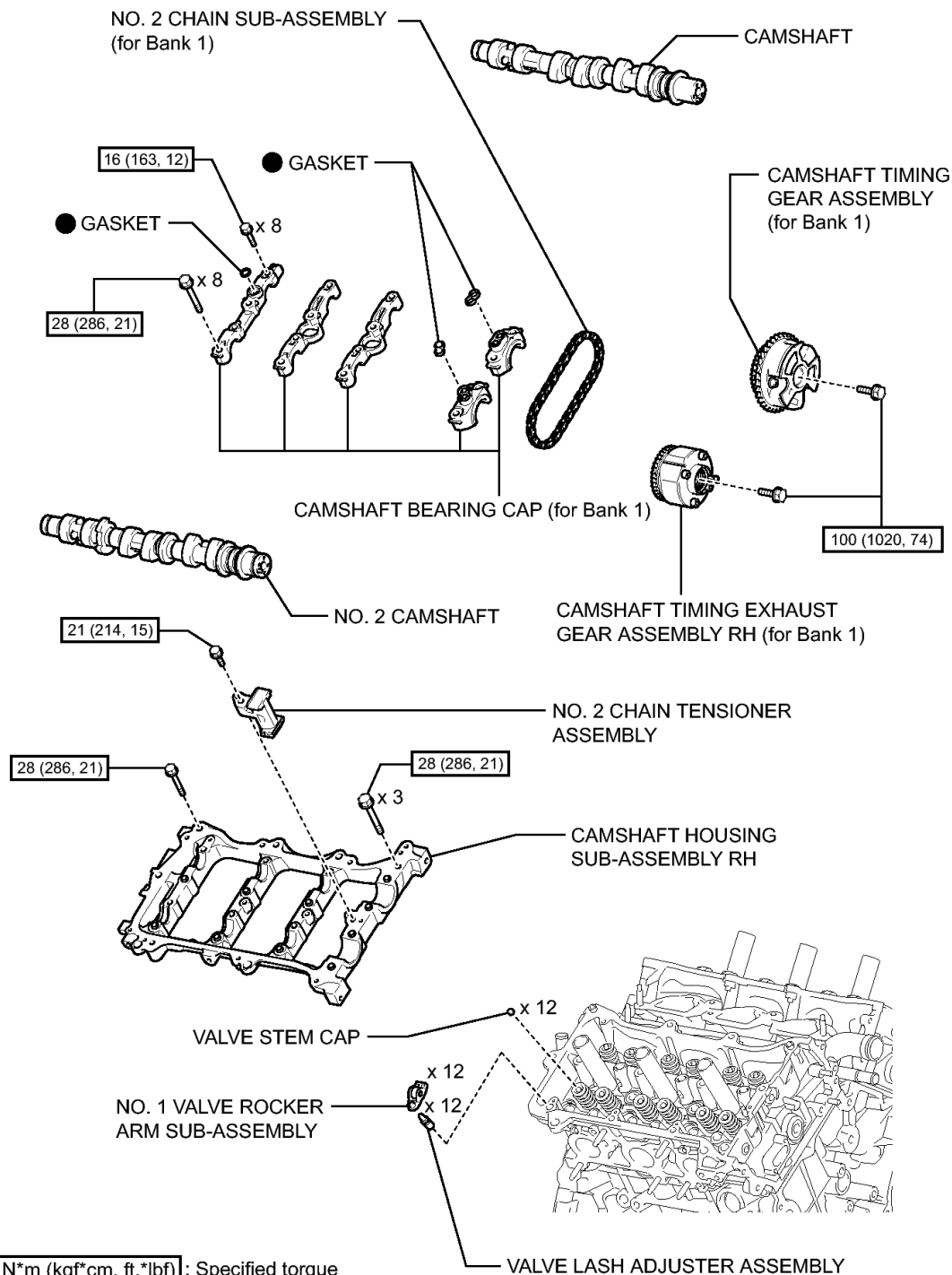
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

Fig. 68: Cylinder Head Gasket Replacement Components With Torque Specifications (1 Of 4)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

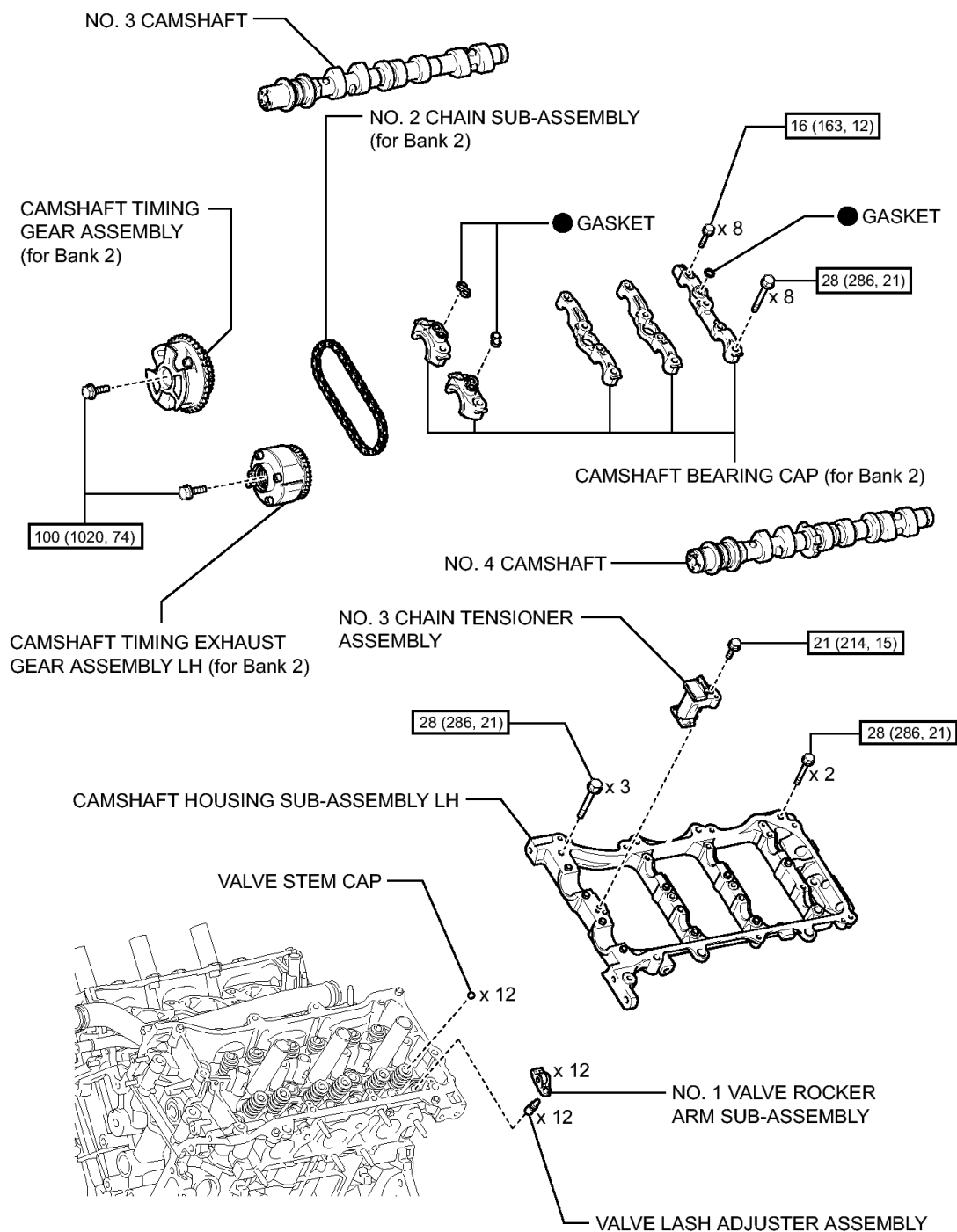
ILLUSTRATION



P

Fig. 69: Cylinder Head Gasket Replacement Components With Torque Specifications (2 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



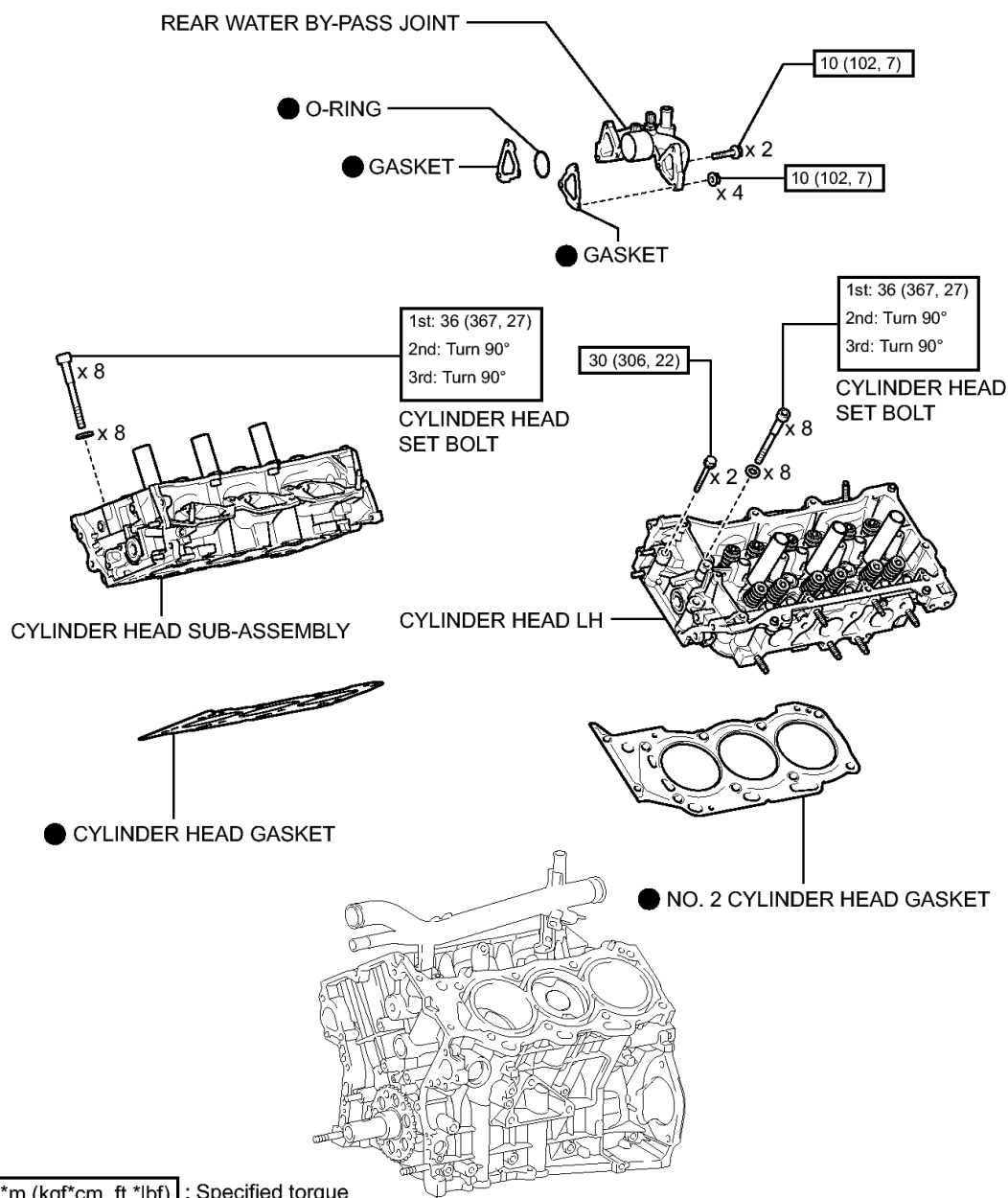
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

Fig. 70: Cylinder Head Gasket Replacement Components With Torque Specifications (3 Of 4)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



P

Fig. 71: Cylinder Head Gasket Replacement Components With Torque Specifications (4 Of 4)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL

1. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

Refer to **REMOVAL**

2. **SET NO. 1 CYLINDER TO TDC/COMPRESSION** See step 30
3. **REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY** See step 31
4. **REMOVE CHAIN TENSIONER SLIPPER** See step 32
5. **REMOVE CHAIN SUB-ASSEMBLY** See step 33
6. **REMOVE NO. 1 IDLE GEAR SHAFT** See step 34
7. **REMOVE NO. 1 CHAIN VIBRATION DAMPER** See step 35
8. **REMOVE NO. 2 CHAIN VIBRATION DAMPER** See step 36
9. **REMOVE CRANKSHAFT TIMING SPROCKET** See step 37
10. **REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)** See step 38
11. **REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY** See step 39
12. **REMOVE CAMSHAFT BEARING CAP (for Bank 1)** See step 40
13. **REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH** See step 41
14. **REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)** See step 42
15. **REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY** See step 43
16. **REMOVE CAMSHAFT BEARING CAP (for Bank 2)** See step 44
17. **REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH** See step 45
18. **REMOVE REAR WATER BY-PASS JOINT** See step 13
19. **REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY** See step 46
20. **REMOVE VALVE LASH ADJUSTER ASSEMBLY** See step 47
21. **REMOVE VALVE STEM CAP** See step 48
22. **REMOVE CYLINDER HEAD SUB-ASSEMBLY**
 - a. Using a 10 mm bi-hexagon wrench, uniformly loosen the 8 cylinder head bolts in the sequence shown in the illustration. Remove the 8 cylinder head bolts and plate washers.

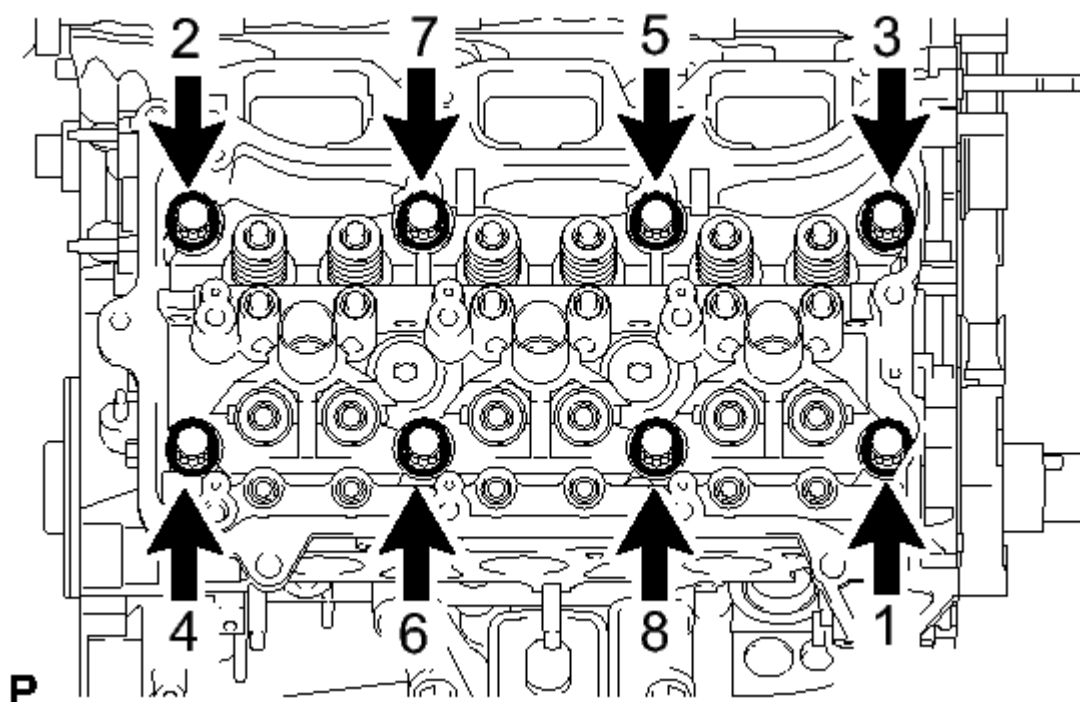


Fig. 72: Identifying Cylinder Head Sub-Assembly And Bolts With Loosening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

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

HINT:

Arrange the removed parts in the correct order.

- b. Remove the cylinder head sub-assembly.

23. REMOVE CYLINDER HEAD LH

- a. Uniformly loosen and remove the 2 cylinder head set bolts in several steps in the sequence shown in the illustration.

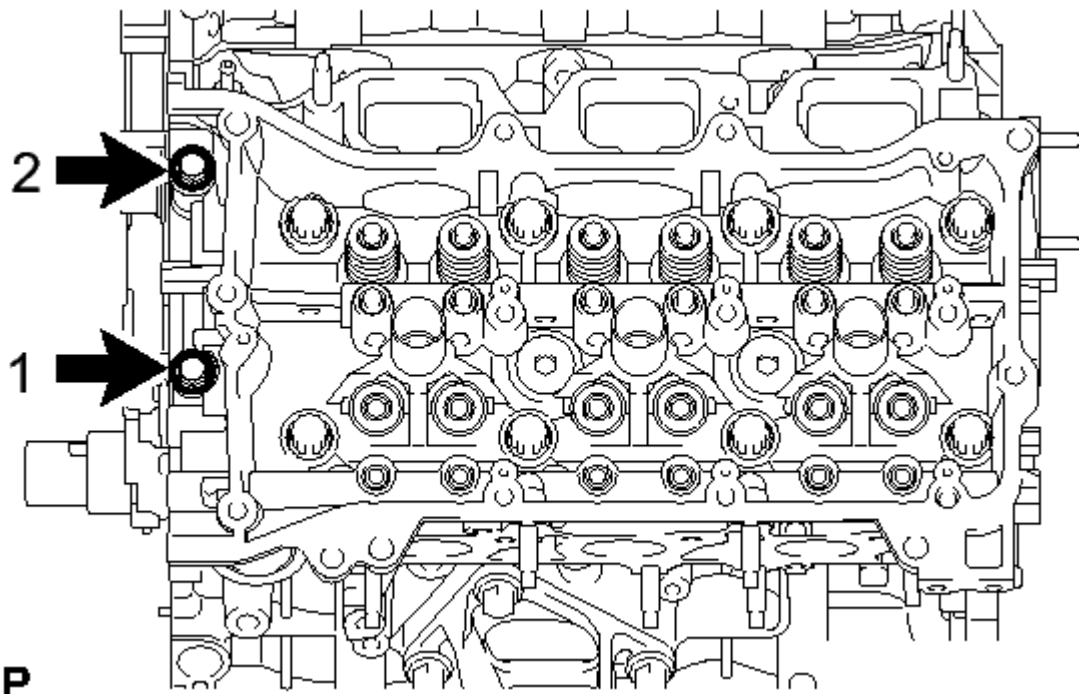
**P**

Fig. 73: Identifying Cylinder Head LH And Cylinder Head Set Bolts With Loosening Sequence

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

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

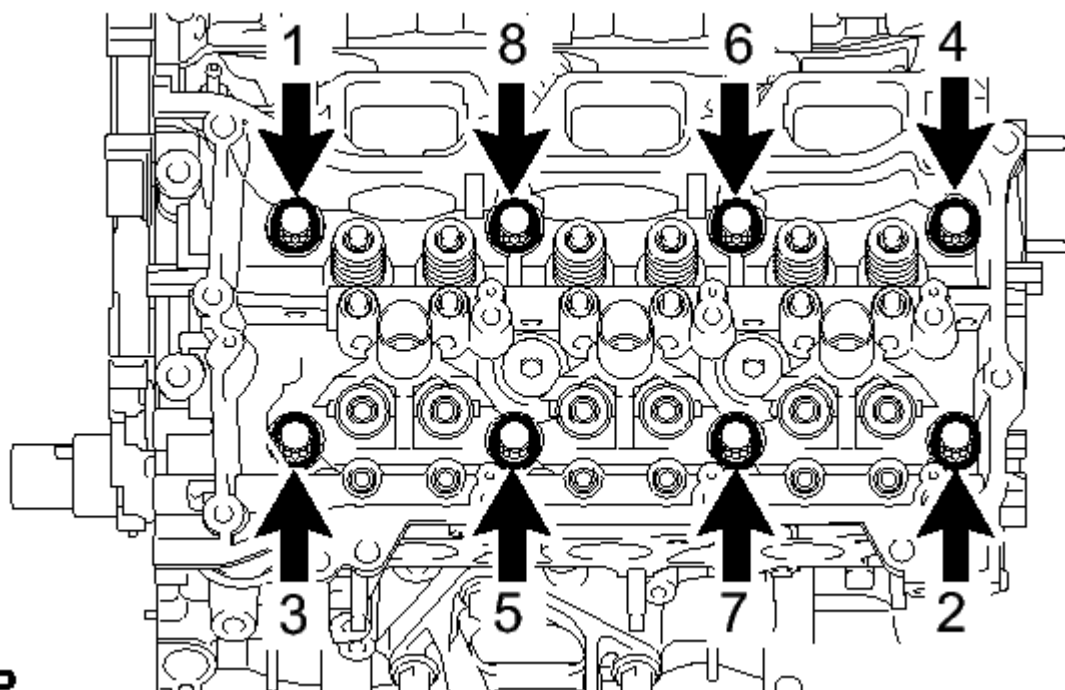
**P**

Fig. 74: Identifying Cylinder Head LH And Bolts With Loosening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

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

HINT:

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

c. Remove the cylinder head LH.

24. **REMOVE CYLINDER HEAD GASKET**

25. **REMOVE NO. 2 CYLINDER HEAD GASKET**

26. **INSPECT CYLINDER HEAD SET BOLT** See step 1

27. **INSPECT CYLINDER HEAD SUB-ASSEMBLY** See step 2

INSTALLATION**INSTALLATION****1. INSTALL CYLINDER HEAD GASKET**

- a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head or cylinder block.
- b. Apply seal packing to a new cylinder head gasket as shown in the illustration.

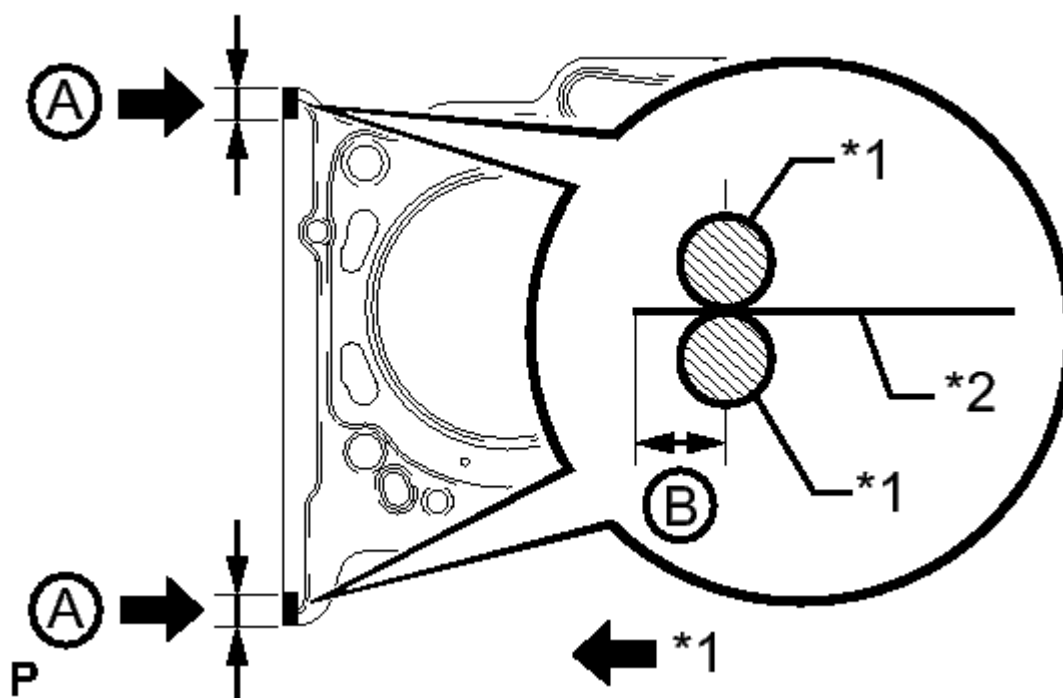


Fig. 75: Applying Seal Packing To Cylinder Head Gasket
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing

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

Standard seal diameter

2.5 to 3.0 mm (0.0984 to 0.118 in.)

SEAL PACKING APPLICATION RANGE

A	10 to 15 mm (0.394 to 0.591 in.)
B	1.25 to 1.5 mm (0.0492 to 0.0591 in.)

TEXT IN ILLUSTRATION

Seal

*1	Packing
*2	Gasket

NOTE:

- Remove any oil from the contact surface.
- Install the cylinder head gasket within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not add engine oil within 2 hours of installation.

- c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

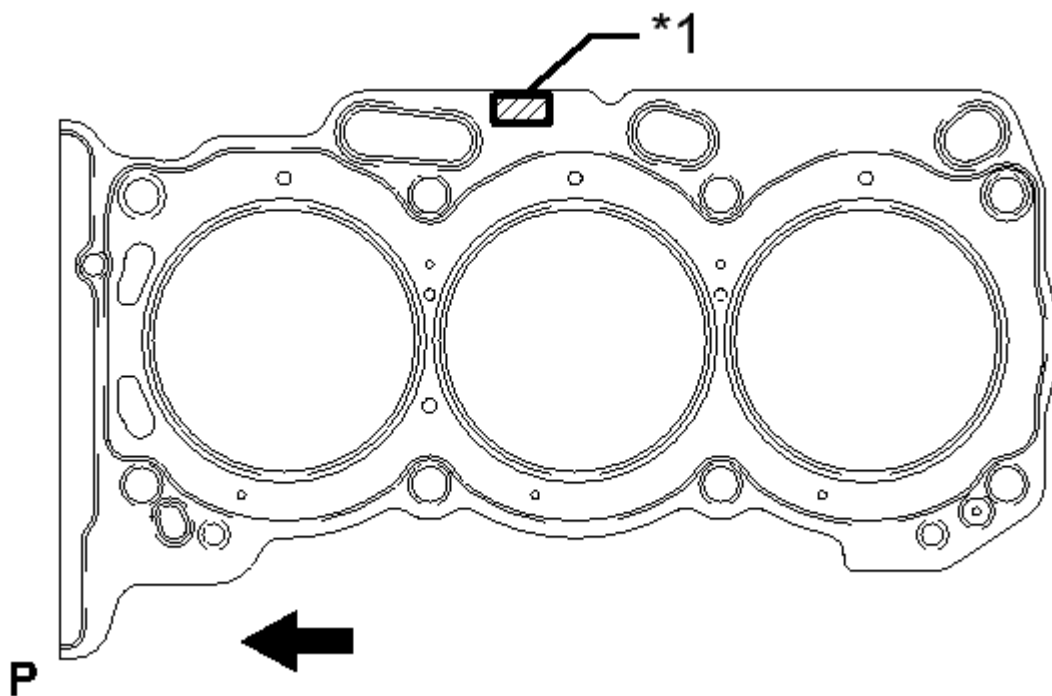


Fig. 76: Identifying Lot No. Stamp On Cylinder Head Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

Make sure that the gasket is installed facing the proper direction.

TEXT IN ILLUSTRATION

*1	Lot No.
.	Engine Front

2. INSTALL CYLINDER HEAD SUB-ASSEMBLY

- a. Place the cylinder head on the cylinder block.

NOTE:

- Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.
- Make sure that no oil is on the mounting surface of the cylinder head.

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

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

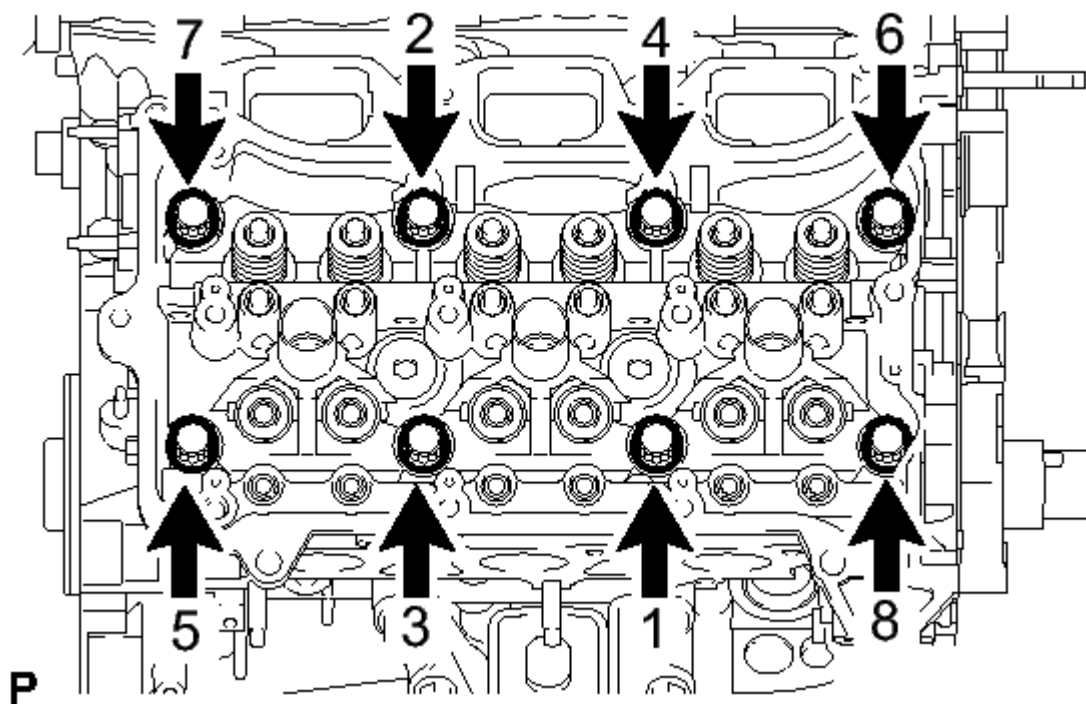


Fig. 77: Identifying Cylinder Head And Bolts With Tightening Sequence
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

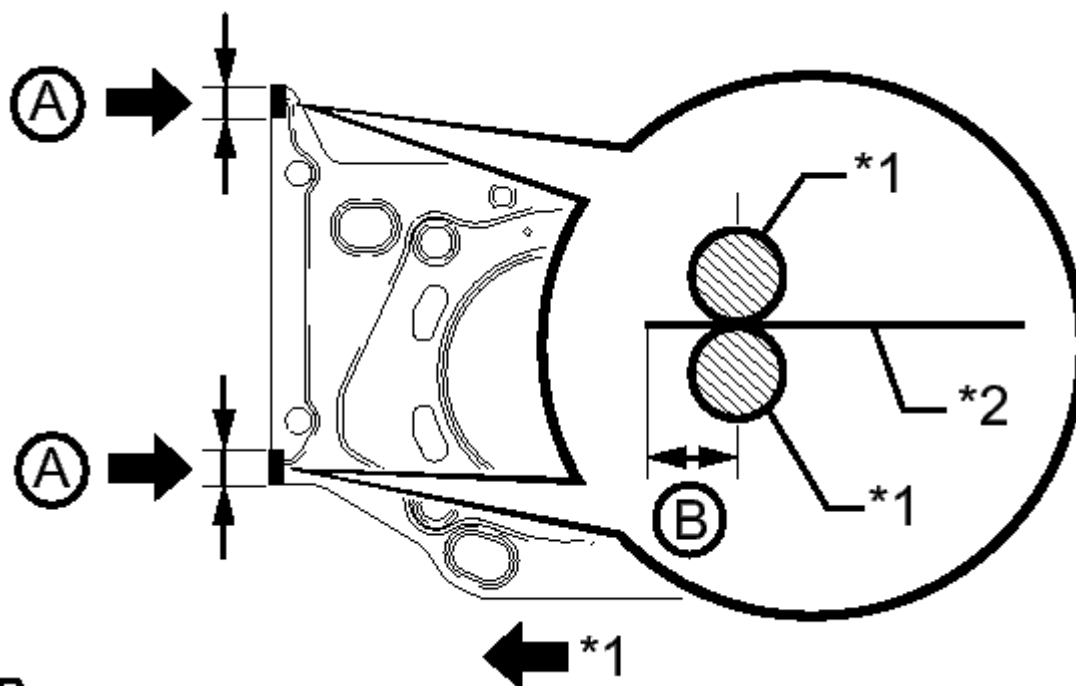
Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)

- d. Step 2:
 1. Mark the front side of each cylinder head bolt head with paint.
 2. Tighten the cylinder head bolts another 90°.
- e. Step 3:
 1. Tighten the cylinder head bolts an additional 90°.
 2. Check that the paint mark is now at a 180° angle to the front.

NOTE: Thoroughly wipe clean any seal packing.

3. INSTALL NO. 2 CYLINDER HEAD GASKET

- Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head or cylinder block.
- Apply seal packing to a new cylinder head gasket as shown in the illustration.



P

Fig. 78: Applying Seal Packing To Cylinder Head Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing

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

Standard seal diameter

2.5 to 3.0 mm (0.0984 to 0.118 in.)

SEAL PACKING APPLICATION RANGE

A	10 to 15 mm (0.394 to 0.591 in.)
	1.25 to

	1.5 mm (0.0492 in.)
B to	0.0591 in.)

TEXT IN ILLUSTRATION

*1	Seal Packing
*2	Gasket

NOTE:

- Remove any oil from the contact surface.
- Install the cylinder head gasket within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not add engine oil within 2 hours of installation.

- c. Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

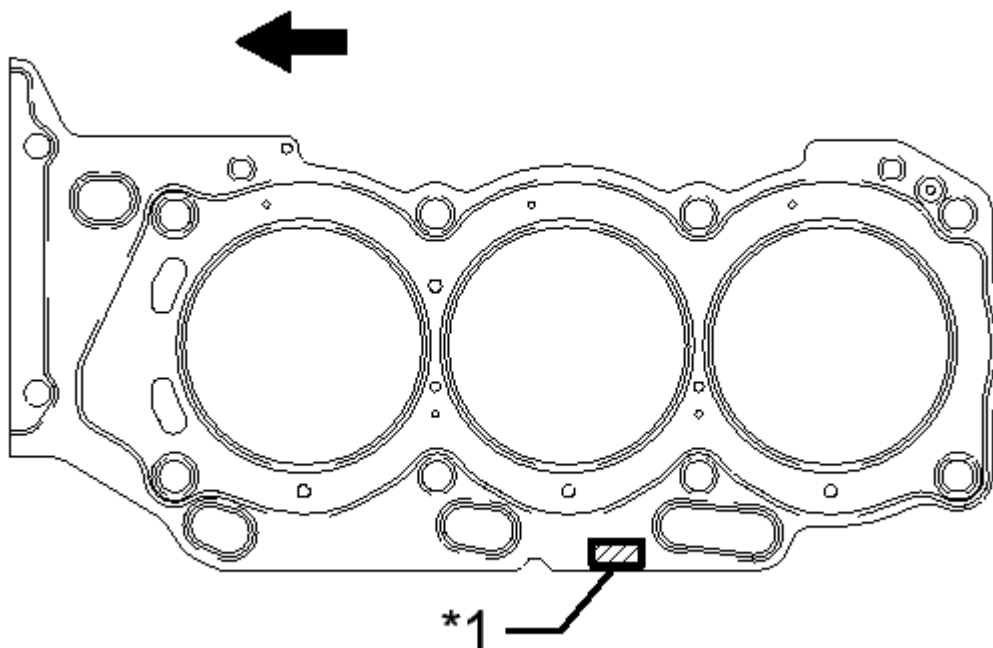
**P**

Fig. 79: Identifying Lot No. Stamp On Cylinder Head Gasket
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

Make sure that the gasket is installed facing the proper direction.

TEXT IN ILLUSTRATION

--	--

*1	Lot No.
.	Engine Front

4. INSTALL CYLINDER HEAD LH

- Place the cylinder head on the cylinder block.

NOTE:

- Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.
- Make sure that no oil is on the mounting surface of the cylinder head.

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

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

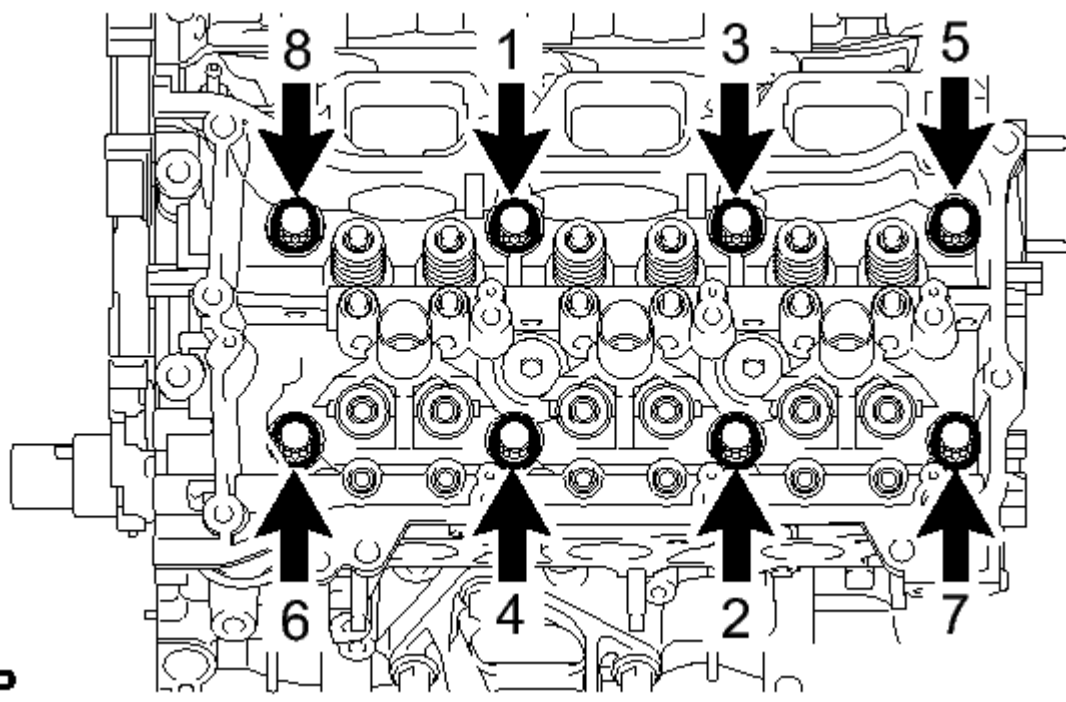


Fig. 80: Identifying Cylinder Head LH And Bolts With Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

- d. Step 2:
 - 1. Mark the front side of each cylinder head bolt head with paint.
 - 2. Tighten the cylinder head bolts another 90°.
- e. Step 3:
 - 1. Tighten the cylinder head bolts an additional 90°.
 - 2. Check that the paint mark is now at a 180° angle to the front.
- f. Tighten the 2 bolts in the order shown in the illustration.

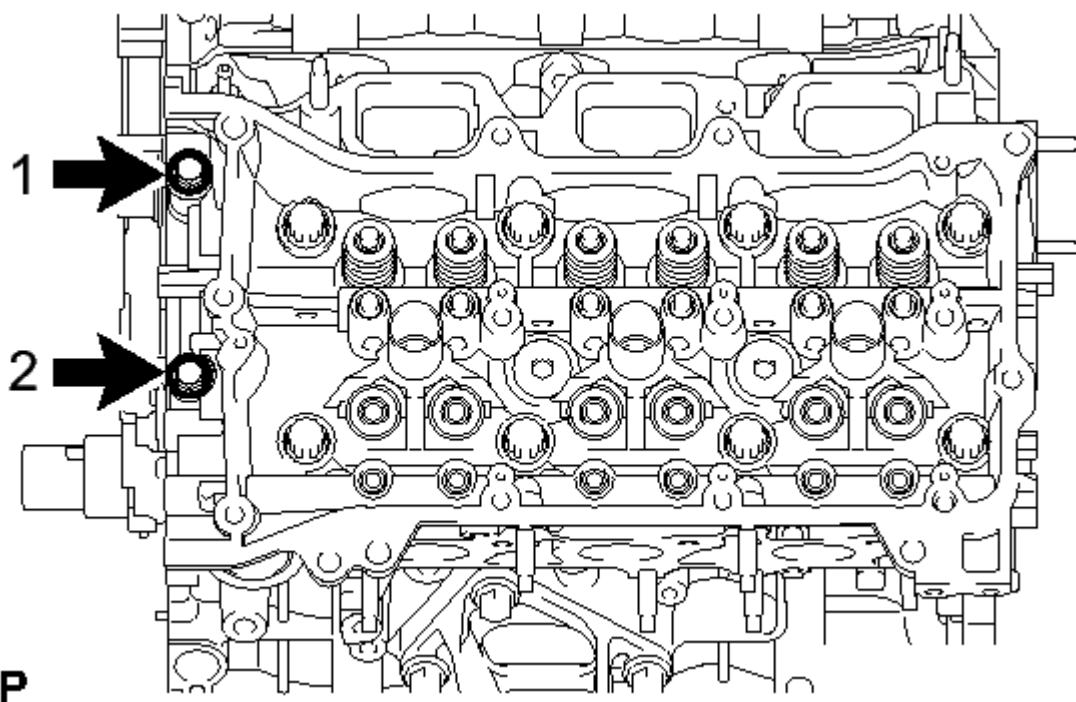


Fig. 81: Identifying Cylinder Head LH And Cylinder Head Set Bolts With Tightening Sequence

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

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

NOTE: Thoroughly wipe clean any seal packing.

- 5. **INSTALL VALVE STEM CAP** See step 13
- 6. **INSTALL VALVE LASH ADJUSTER ASSEMBLY** See step 14
- 7. **INSTALL NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY** See step 15
- 8. **INSTALL REAR WATER BY-PASS JOINT** See step 47
- 9. **INSTALL CAMSHAFT BEARING CAP (for Bank 2)** See step 16
- 10. **INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH** See step 17

11. **INSTALL CAMSHAFT BEARING CAP (for Bank 1)** See step 18
12. **INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH** See step 19
13. **INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY** See step 20
14. **INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)** See step 21
15. **INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY** See step 22
16. **INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)** See step 23
17. **INSTALL NO. 1 CHAIN VIBRATION DAMPER** See step 24
18. **INSTALL NO. 2 CHAIN VIBRATION DAMPER** See step 25
19. **INSTALL CRANKSHAFT TIMING SPROCKET** See step 26
20. **INSTALL NO. 1 IDLE GEAR SHAFT** See step 27
21. **INSTALL CHAIN SUB-ASSEMBLY** See step 28
22. **INSTALL CHAIN TENSIONER SLIPPER** See step 29
23. **INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY** See step 30
24. **INSPECT VALVE TIMING** See step 31
25. **INSTALL TIMING CHAIN COVER SUB-ASSEMBLY**

Refer to **INSTALLATION**

CYLINDER HEAD

COMPONENTS

ILLUSTRATION

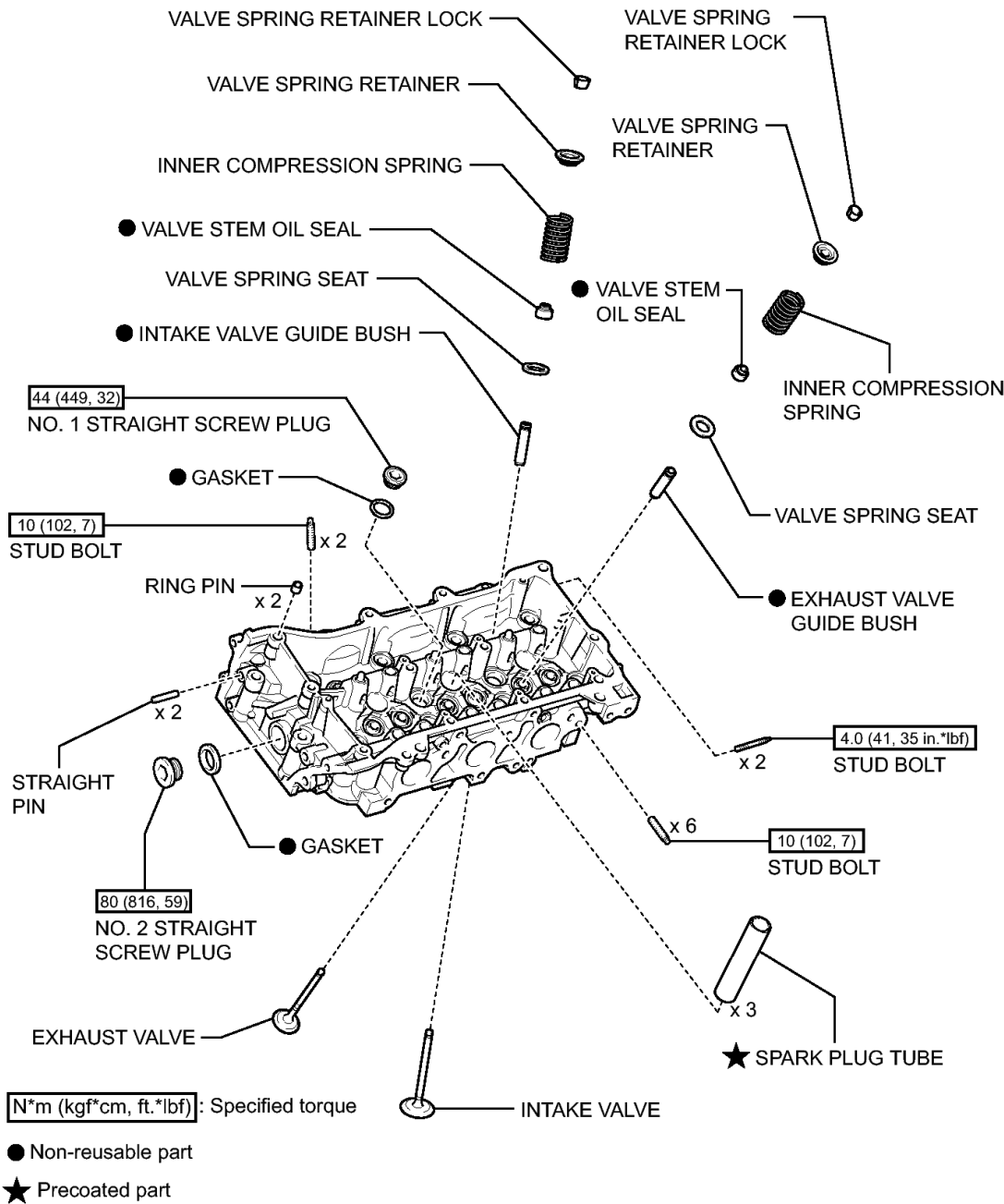


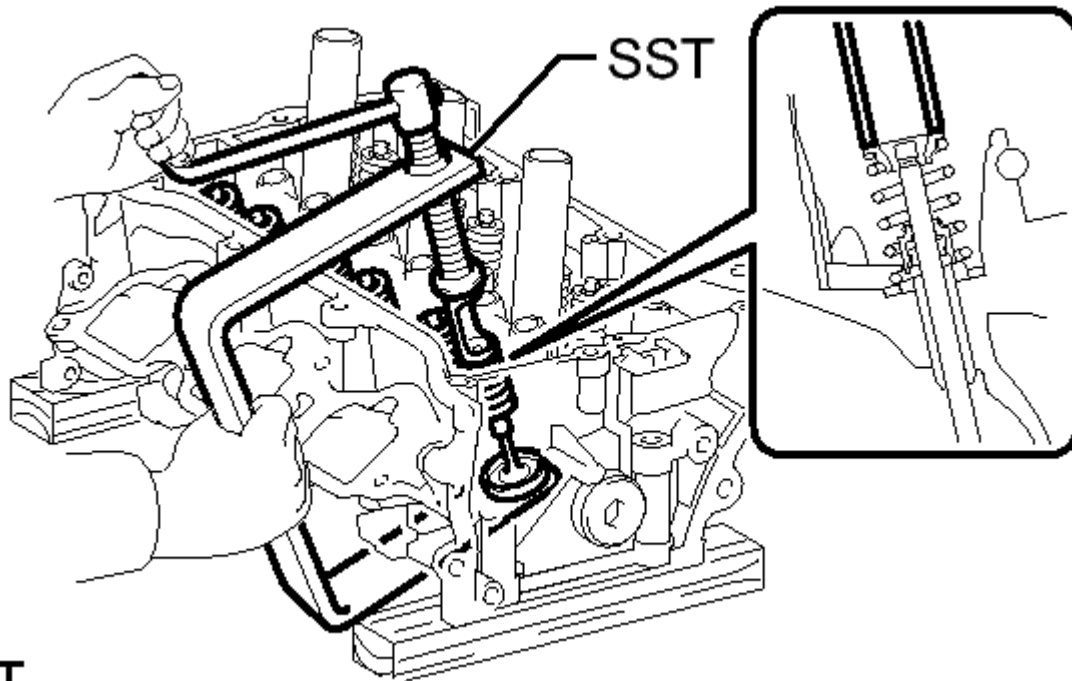
Fig. 82: Cylinder Head Replacement Components With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

DISASSEMBLY

1. REMOVE INTAKE VALVE

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



T

Fig. 83: Identifying Intake Valve And SST

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

- SST: 09202-70020
09202-00010

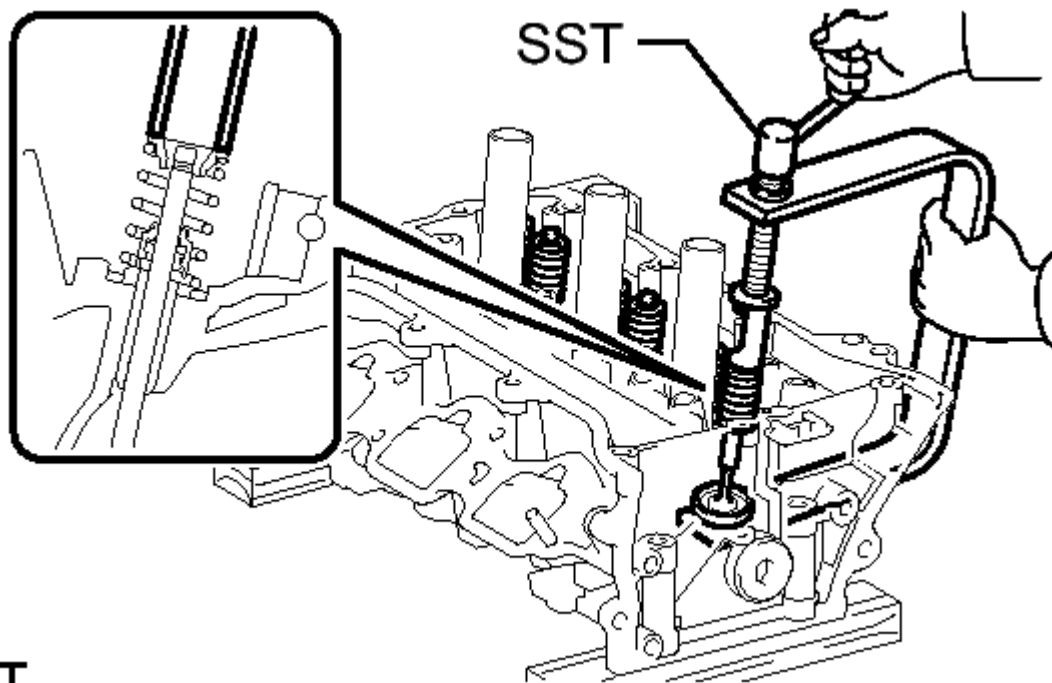
- b. Remove the valve spring retainer, inner compression spring and intake valve.

HINT:

Arrange the removed parts in the correct order.

2. REMOVE EXHAUST VALVE

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



T

Fig. 84: Identifying Exhaust Valve And SST

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

- SST: 09202-70020
09202-00010

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

HINT:

Arrange the removed parts in the correct order.

3. REMOVE VALVE STEM OIL SEAL

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

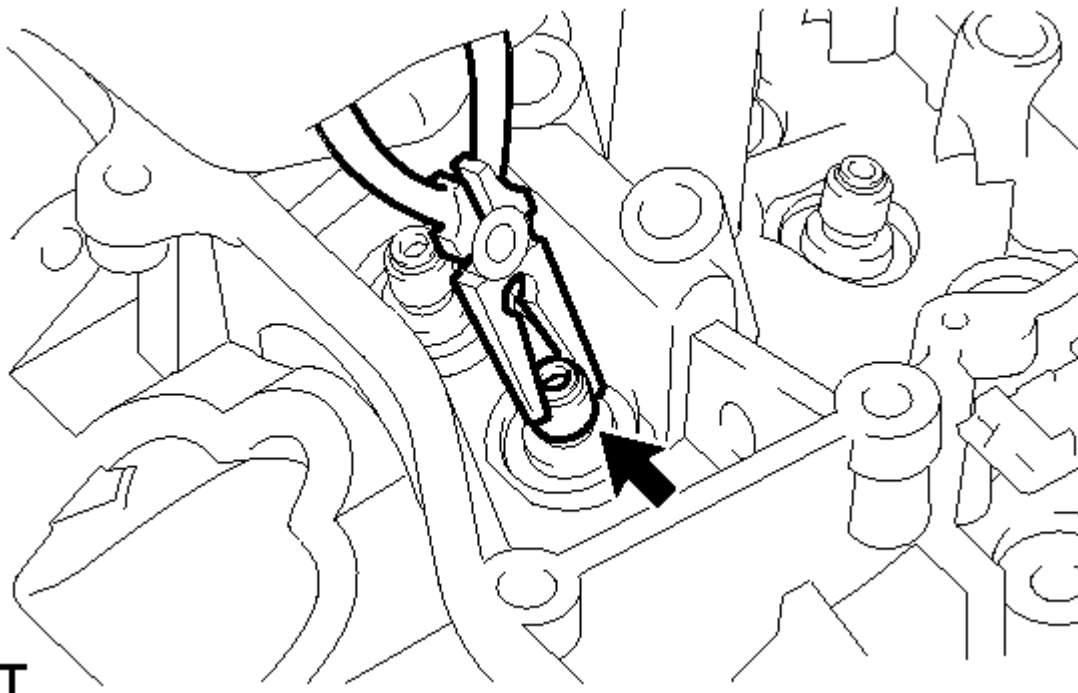
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Fig. 85: Identifying Valve Stem Oil Seal And Needle-Nose Pliers

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

4. REMOVE VALVE SPRING SEAT

- a. Using compressed air and a magnet hand, remove the valve spring seats by blowing air onto them.

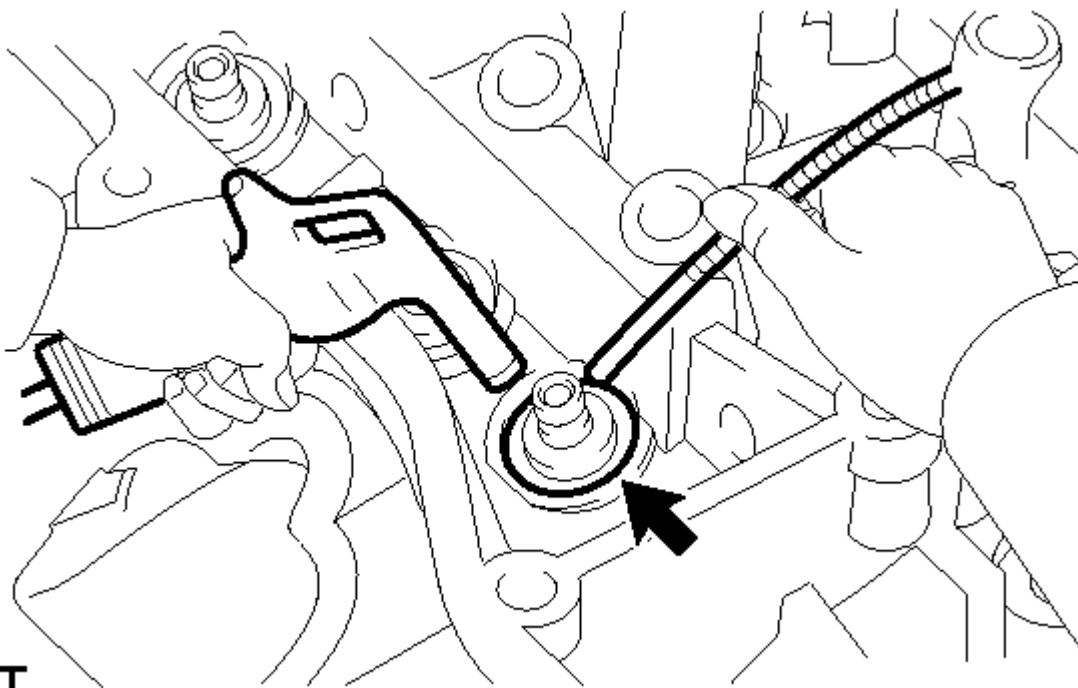
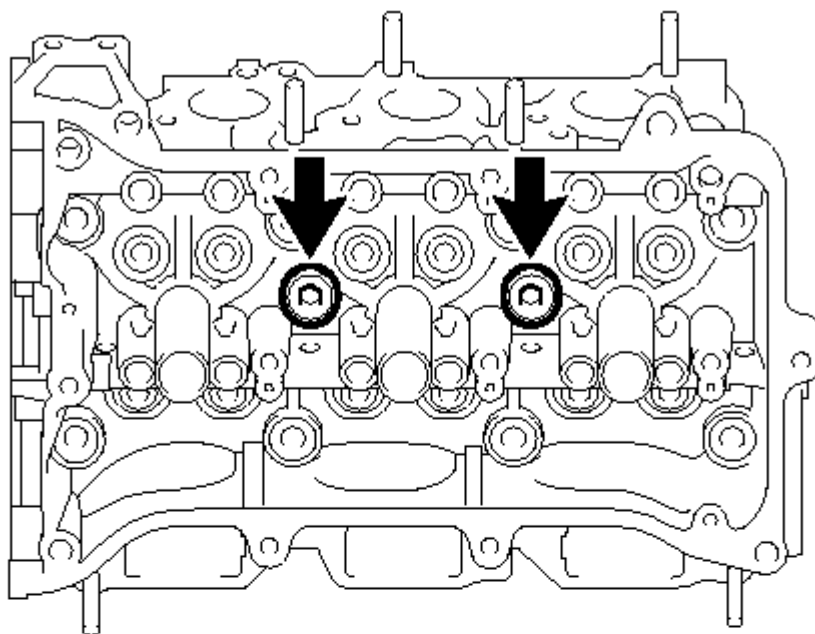
**T**

Fig. 86: Identifying Valve Spring Seat, Magnet And Compressed Air

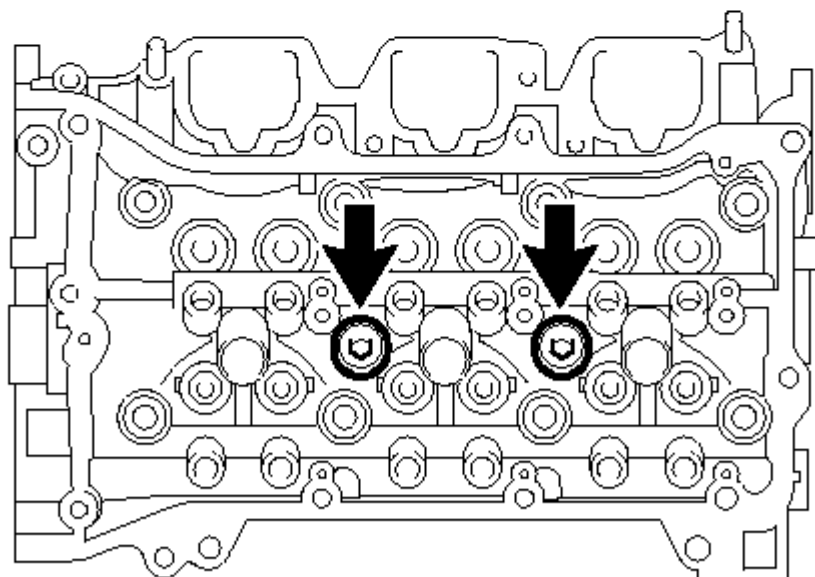
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

5. REMOVE NO. 1 STRAIGHT SCREW PLUG

*A



*B



T

Fig. 87: Identifying No. 1 Straight Screw Plugs

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

NOTE: If coolant leaks from a straight screw plug or a plug is corroded, replace it.

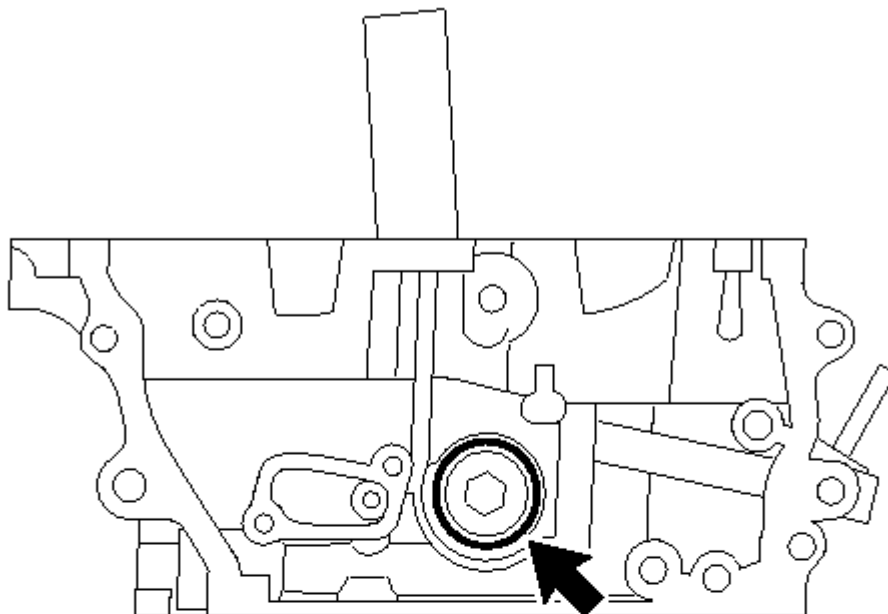
- a. Using a 10 mm hexagon wrench, remove the 4 No. 1 straight screw plugs and 4 gaskets.

TEXT IN ILLUSTRATION

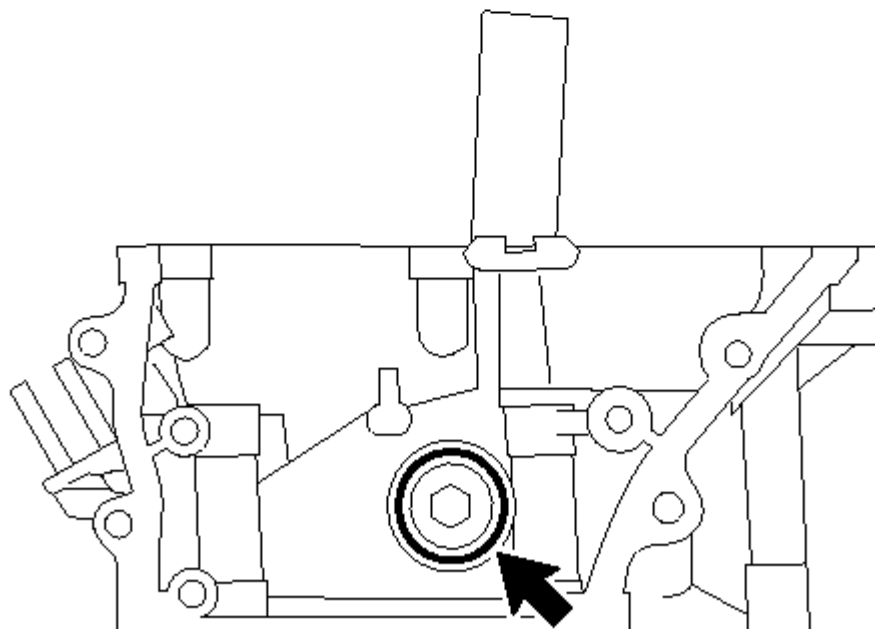
*A	RH
*B	LH

6. REMOVE NO. 2 STRAIGHT SCREW PLUG

*A



*B



T

Fig. 88: Identifying No. 2 Straight Screw Plugs
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: If coolant leaks from a straight screw plug or a plug is corroded, replace it.

- a. Using a 14 mm hexagon wrench, remove the 2 No. 2 straight screw plugs and 2 gaskets.

TEXT IN ILLUSTRATION

*A	RH
*B	LH

7. REMOVE STUD BOLT

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

8. REMOVE UNION

NOTE: It is not necessary to remove a union unless it is being replaced.

INSPECTION**INSPECTION****1. CLEAN CYLINDER HEAD SUB-ASSEMBLY**

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

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

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

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

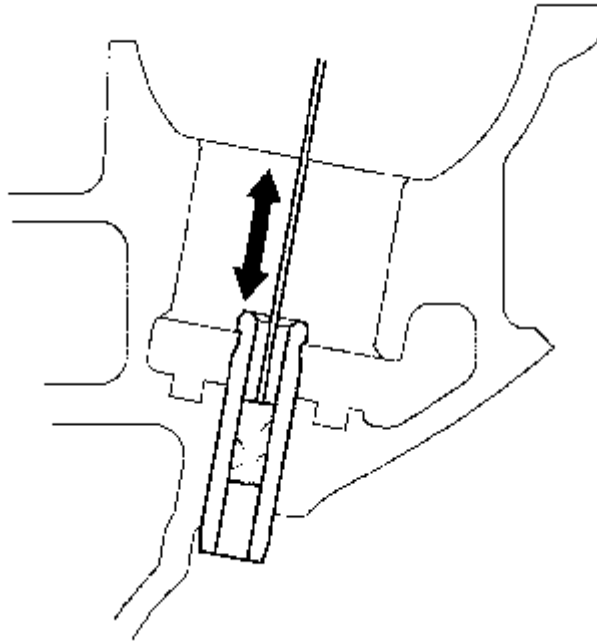


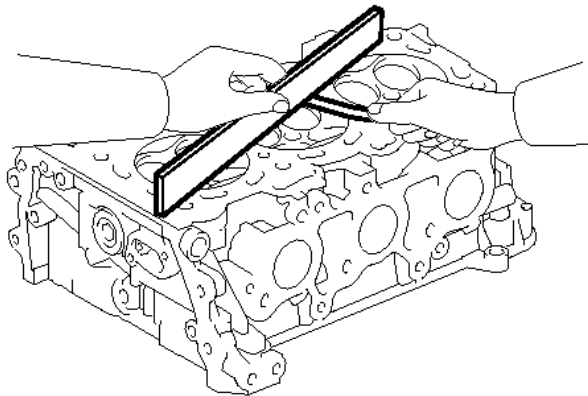
Fig. 89: Cleaning Guide Bushes

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

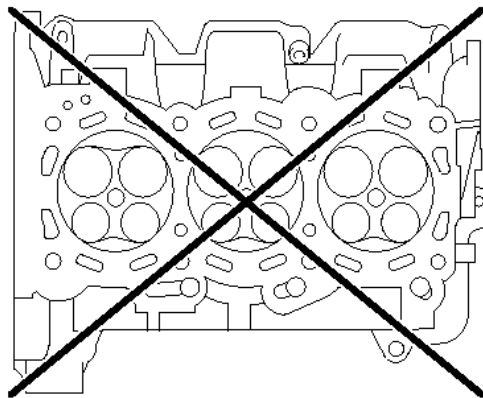
- c. Using a valve guide bushing brush and solvent, clean all the guide bushes.
- d. Using a soft brush and solvent, thoroughly clean the cylinder head.

2. INSPECT CYLINDER HEAD SUB-ASSEMBLY

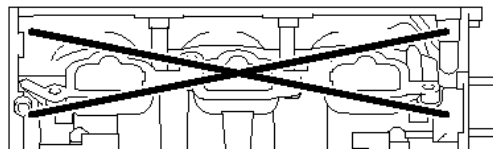
- a. Using a precision straightedge and feeler gauge, measure the warpage of the surfaces which contact the cylinder block sub-assembly and manifolds.



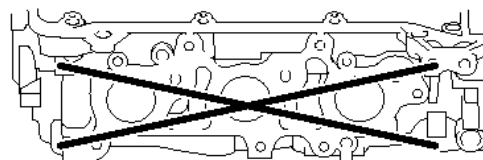
*A



*B



*C



T

Fig. 90: Identifying Cylinder Block Side, Intake Side & Exhaust Side
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Warpage



Item	Specified Condition
Cylinder block side	0.05 mm (0.00197 in.)
Intake side	0.08 mm (0.00315 in.)
Exhaust side	0.08 mm (0.00315 in.)

Maximum Warpage

Item	Specified Condition
Cylinder block side	0.10 mm (0.00394 in.)
Intake side	0.10 mm (0.00394 in.)
Exhaust side	0.10 mm (0.00394 in.)

TEXT IN ILLUSTRATION

*A	Cylinder Block Side
*B	Intake Side
*C	Exhaust Side

If the warpage is more than the maximum, replace the cylinder head sub-assembly.

- b. Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.

If cracked, replace the cylinder head sub-assembly.

3. CLEAN VALVE SEAT

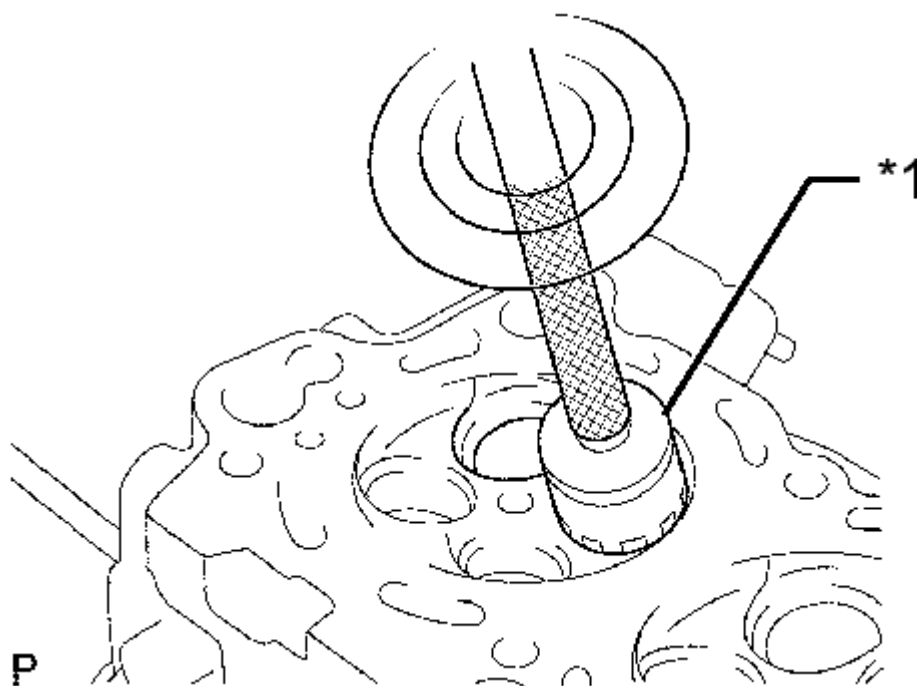


Fig. 91: Cleaning Valve Seat Using 45° Carbon Cutter
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Using a 45° carbon cutter, resurface the valve seats.

TEXT IN ILLUSTRATION

*1	45° Carbon Cutter
----	-------------------------

HINT:

Only remove the amount of metal necessary to clean the seats.

4. INSPECT INTAKE VALVE

- a. Clean the valves.
 1. Using a gasket scraper, chip off any carbon from the valve head.
 2. Using a wire brush, thoroughly clean the valve.
- b. Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter

5.470 to 5.485 mm (0.215 to 0.216 in.)

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

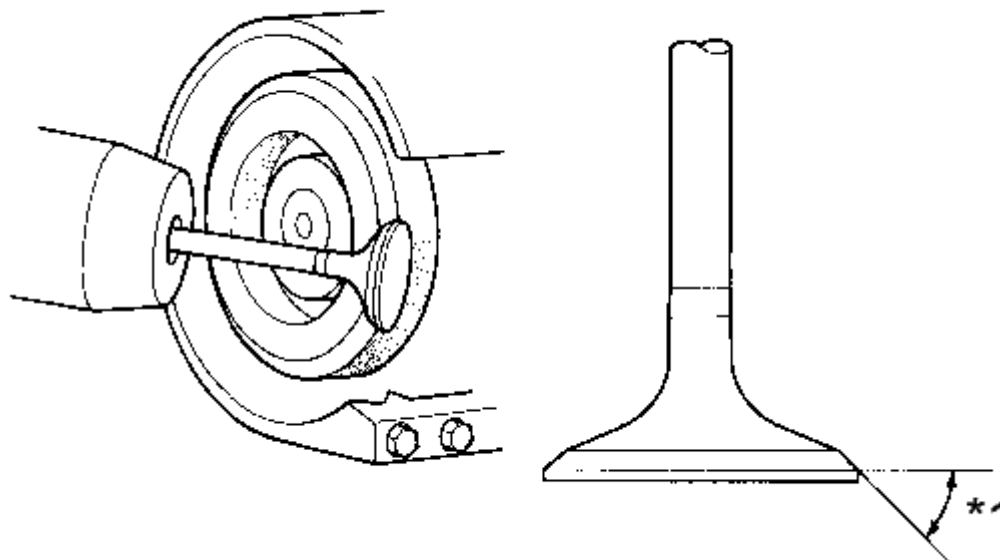


Fig. 92: Identifying Valve Component Face Angle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Check the valve face angle.

TEXT IN ILLUSTRATION

	Valve
*1	Face
	Angle

1. Grind the valve sufficiently to remove pits and carbon.
2. Check that the valve is ground to the correct valve face angle.

Standard valve face angle

45.5°

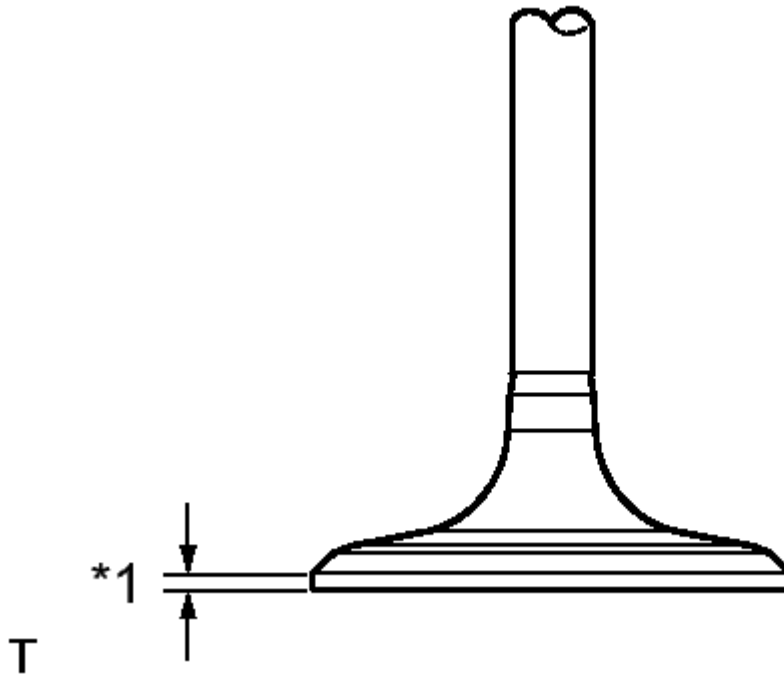


Fig. 93: Measuring Valve Head Margin Thickness
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Using a vernier caliper, measure the valve head margin thickness.

Standard margin thickness

1.25 mm (0.0492 in.)

Minimum margin thickness

1.10 mm (0.0433 in.)

TEXT IN ILLUSTRATION

*1	Margin Thickness
----	------------------

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

- e. Using a vernier caliper, measure the valve overall length.

Standard overall length

105.85 mm (4.17 in.)

Minimum overall length

105.35 mm (4.15 in.)

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

5. INSPECT EXHAUST VALVE

- a. Clean the valves.
 1. Using a gasket scraper, chip off any carbon from the valve head.
 2. Using a wire brush, thoroughly clean the valve.
- b. Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter

5.465 to 5.480 mm (0.215 to 0.216 in.)

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

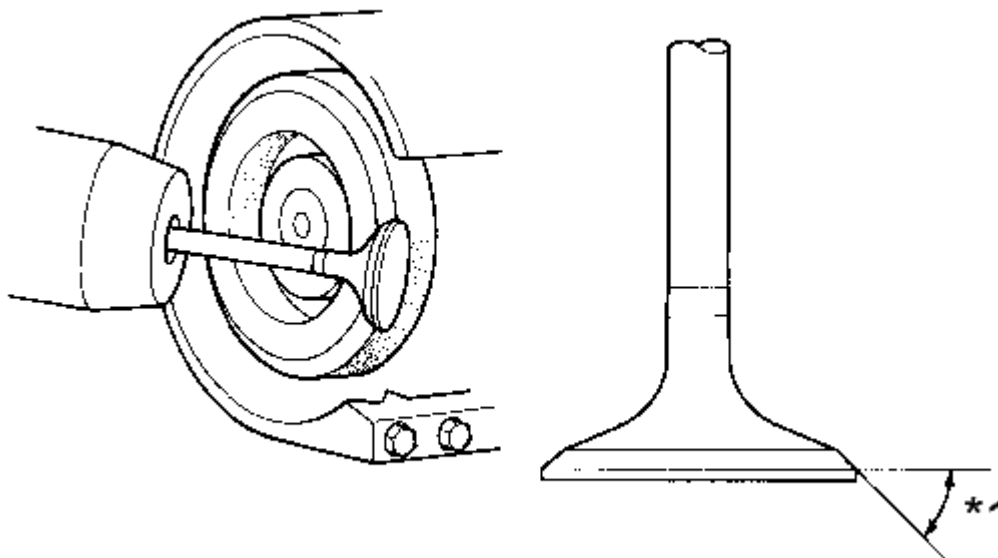


Fig. 94: Identifying Valve Component Face Angle
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Check the valve face angle.

TEXT IN ILLUSTRATION

	Valve
*1	Face
	Angle

1. Grind the valve sufficiently to remove pits and carbon.
2. Check that the valve is ground to the correct valve face angle.

Standard valve face angle

45.5°

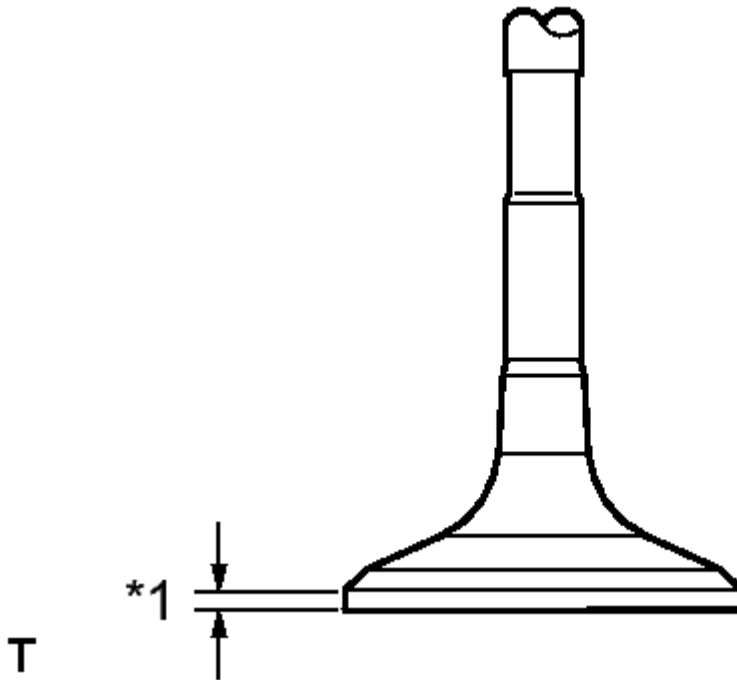


Fig. 95: Measuring Valve Head Margin Thickness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Using a vernier caliper, measure the valve head margin thickness.

Standard margin thickness

1.40 mm (0.0551 in.)

Minimum margin thickness

1.25 mm (0.0492 in.)

TEXT IN ILLUSTRATION

*1	Margin Thickness
----	------------------

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

- e. Using a vernier caliper, measure the valve overall length.

Standard overall length

110.40 mm (4.35 in.)

Minimum overall length

109.90 mm (4.33 in.)

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

6. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

- a. Using a caliper gauge, measure the inside diameter of the valve guide bush.

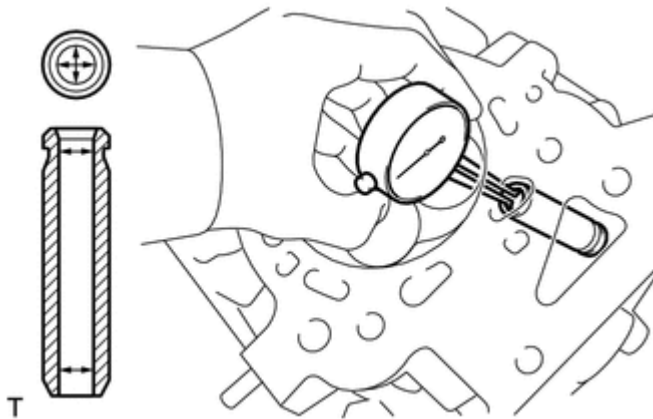


Fig. 96: Checking Inside Diameter Of Guide Bush
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Bush inside diameter

5.510 to 5.530 mm (0.217 to 0.218 in.)

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

Standard Clearance

Item	Specified Condition
Intake	0.025 to 0.060 mm (0.000984 to 0.00236 in.)

Exhaust	0.030 to 0.065 mm (0.00118 to 0.00256 in.)
---------	--

Maximum Oil Clearance

Item	Specified Condition
Intake	0.08 mm (0.00315 in.)
Exhaust	0.10 mm (0.00394 in.)

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

7. INSPECT INTAKE VALVE SEAT

- a. Apply a light coat of Prussian blue to the valve face.
- b. Lightly press the valve face against the valve seat.

NOTE: **Do not rotate the valve.**

- c. Check the valve face and valve seat by using the following procedure:

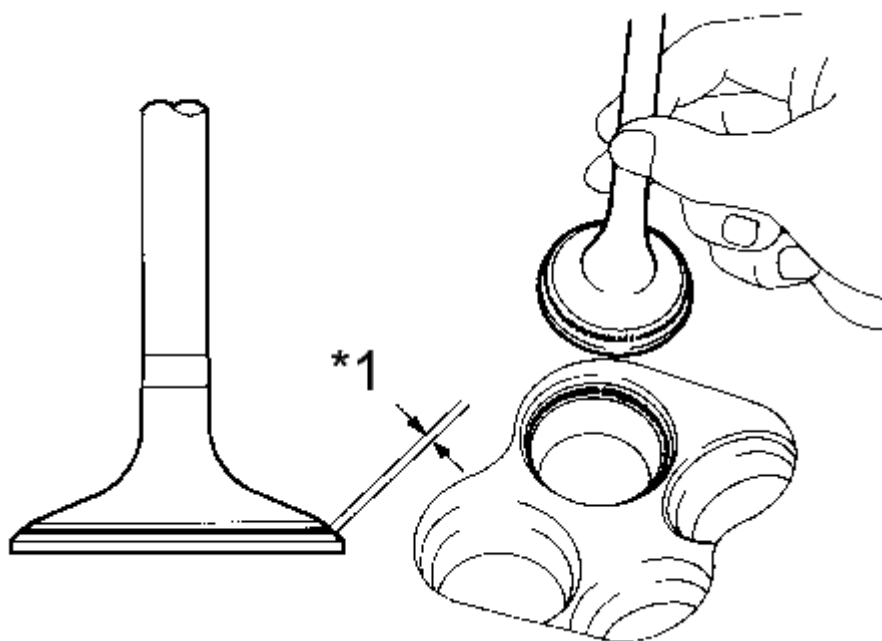


Fig. 97: Identifying Intake Valve Face & Valve Seat
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

***1** Width

1. Check that Prussian blue appears around the entire valve face. If not, replace the valve.
2. If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.
3. Check that the valve seat contacts the middle of the valve face with the width between 1.1 and 1.5 mm (0.0433 and 0.0591 in.).

8. INSPECT EXHAUST VALVE SEAT

- a. Apply a light coat of Prussian blue to the valve face.
- b. Lightly press the valve face against the valve seat.

NOTE: Do not rotate the valve.

- c. Check the valve face and valve seat by using the following procedure:

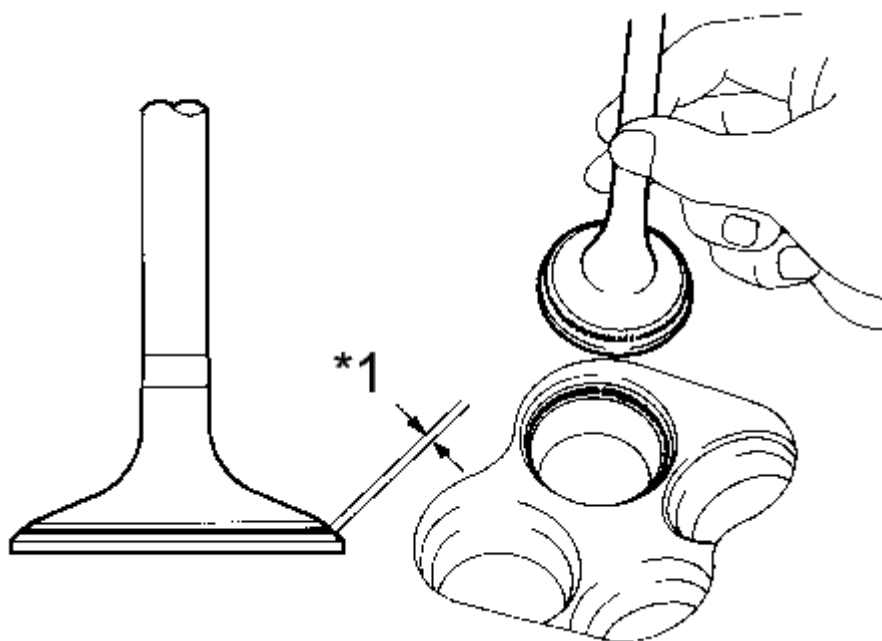


Fig. 98: Identifying Valve Face & Valve Seat

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

TEXT IN ILLUSTRATION

*1 Width

1. Check that Prussian blue appears around the entire valve face. If not, replace the valve.
2. If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.
3. Check that the valve seat contacts the middle of the valve face with the width between 1.1 and 1.5 mm (0.0433 and 0.0591 in.).

9. INSPECT INNER COMPRESSION SPRING

- a. Using a vernier caliper, measure the free length of the inner compression spring.

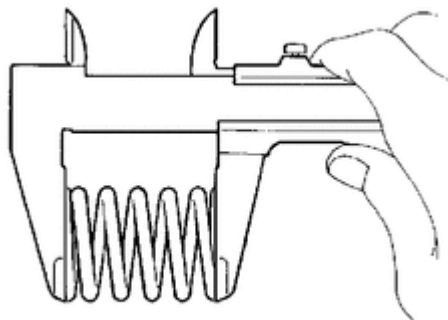


Fig. 99: Measuring Free Length Of Inner Compression Spring

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

Standard free length

48.63 mm (1.91 in.)

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

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

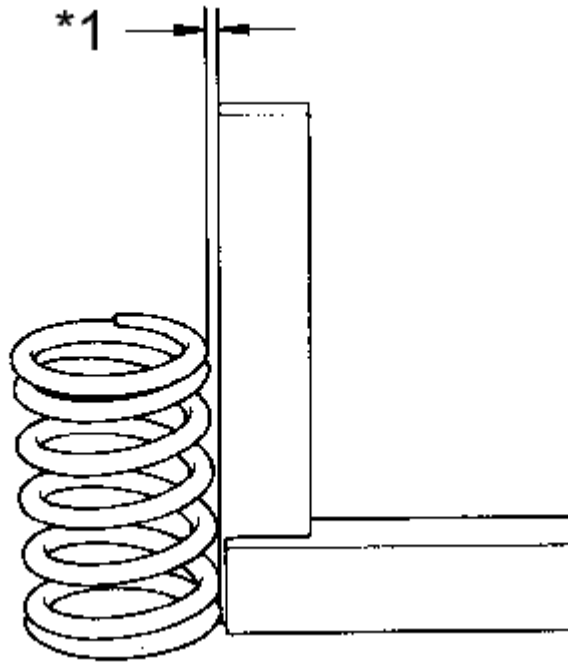


Fig. 100: Measuring Deviation Of Inner Compression Spring
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum deviation

1.0 mm (0.0394 in.)

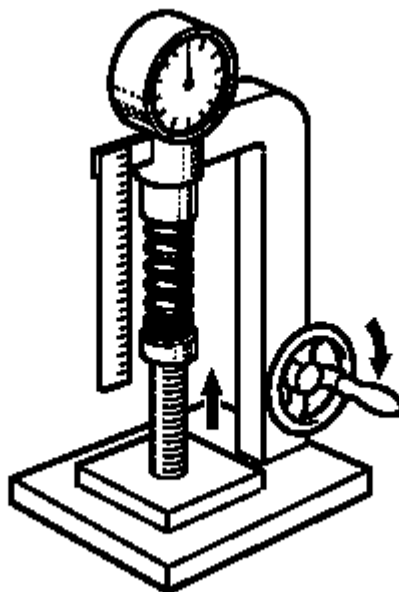
Maximum angle (reference)

2°

TEXT IN ILLUSTRATION

***1** Deviation

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



G

Fig. 101: Measuring Tension Of Valve Spring

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

- c. Using a spring tester, measure the tension of the valve spring when it is compressed to the specified installation length.

Standard installed tension

235.6 to 260.4 N (24 to 27 kgf, 53.0 to 58.5 lbf) at 36.9 mm (1.45 in.)

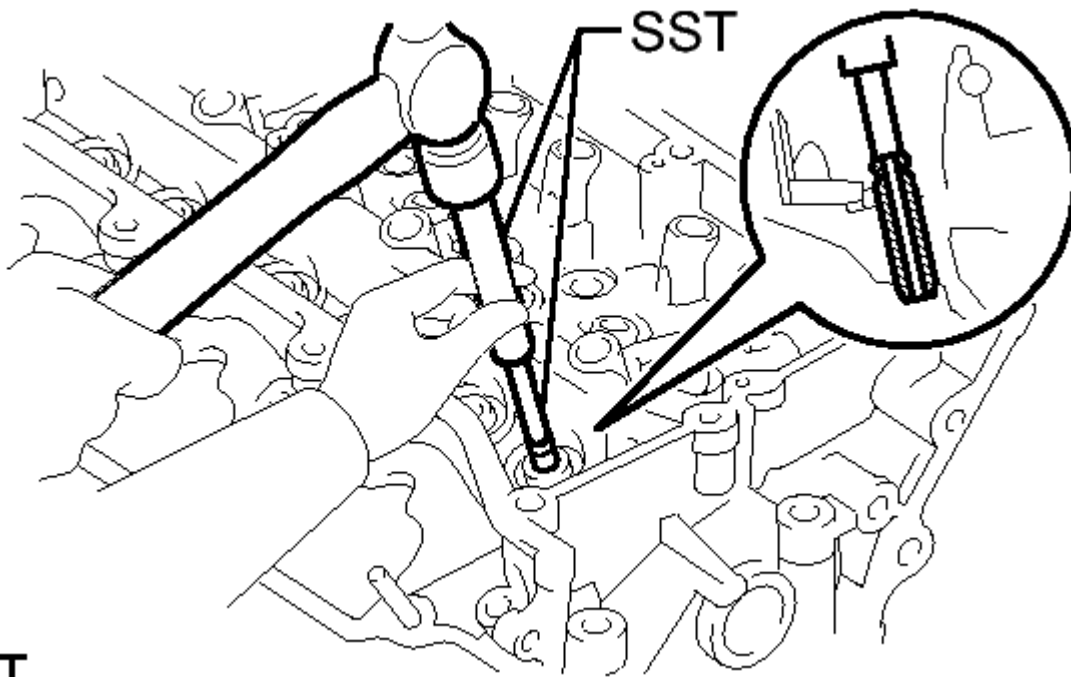
If the installed tension is not as specified, replace the valve spring.

REPLACEMENT

REPLACEMENT

1. REPLACE INTAKE VALVE GUIDE BUSH

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



T

Fig. 102: Identifying Intake Valve Guide Bush, SST And Hammer
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- SST: 09201-10000
09201-01050
 - SST: 09950-70010
09951-07100
- d. Using a caliper gauge, measure the intake valve guide bush bore diameter of the cylinder head.

Standard Bush Bore Diameter

Item	Specified Condition
STD	10.285 to 10.306 mm (0.4049 to 0.4057 in.)
O/S 0.05	10.335 to 10.356 mm (0.4069 to 0.4077 in.)

- e. Select a new valve guide bush.

New Guide Bush

Item	Specified Condition	
Bush Bore Diameter	10.285 to 10.306 mm (0.4049 to 0.4057 in.)	10.335 to 10.356 mm (0.4069 to 0.4077 in.)
Use Bush	STD	O/S 0.05

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

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

New Guide Bush Diameter

Item	Specified Condition
STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
O/S 0.05	10.383 to 10.394 mm (0.4088 to 0.4092 in.)

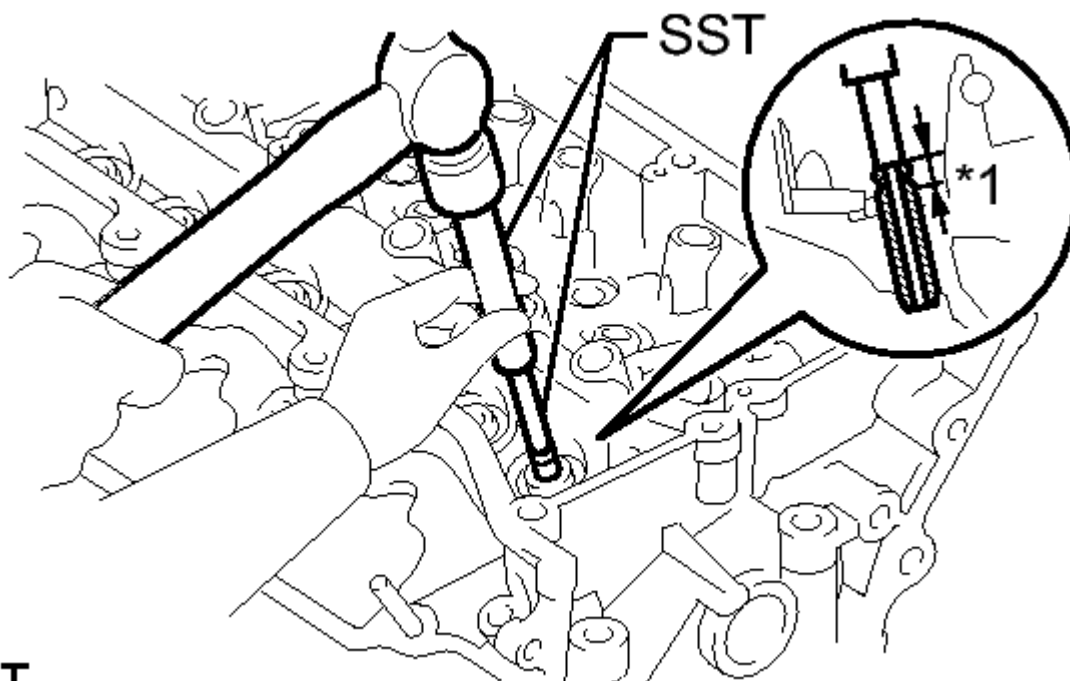
HINT:

Different bushes are used for the intake and exhaust.

Standard bush length

41.3 to 41.7 mm (1.63 to 1.64 in.)

- f. Heat the cylinder head to 80 to 100°C (176 to 212°F).
- g. Place the cylinder head on wooden blocks.
- h. Using SST, tap in the intake valve guide bushes to the specified protrusion height.



T

Fig. 103: Tapping In Intake Valve Guide Bushes

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

- SST: 09201-10000
09201-01050
- SST: 09950-70010
09951-07100

Protrusion height

9.10 to 9.90 mm (0.358 to 0.390 in.)

TEXT IN ILLUSTRATION

*1	Protrusion Height
----	----------------------

- i. Using a sharp 5.5 mm reamer, ream the valve guide bushes to obtain the specified clearance.

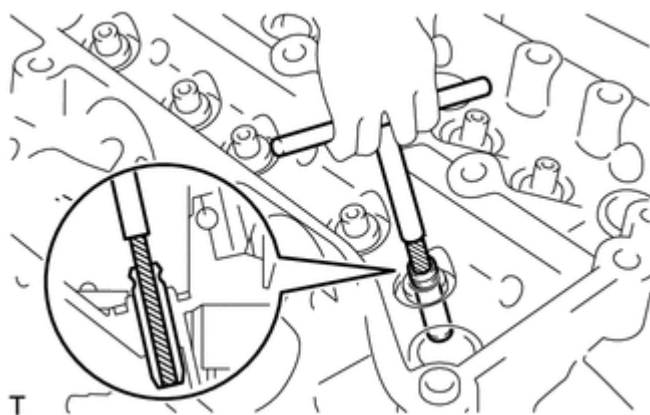


Fig. 104: Reaming Valve Guide Bush

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

Standard oil clearance

0.025 to 0.060 mm (0.000984 to 0.00236 in.)

2. REPLACE EXHAUST VALVE GUIDE BUSH

- a. Heat the cylinder head to 80 to 100°C (176 to 212°F).
- b. Place the cylinder head on wooden blocks.

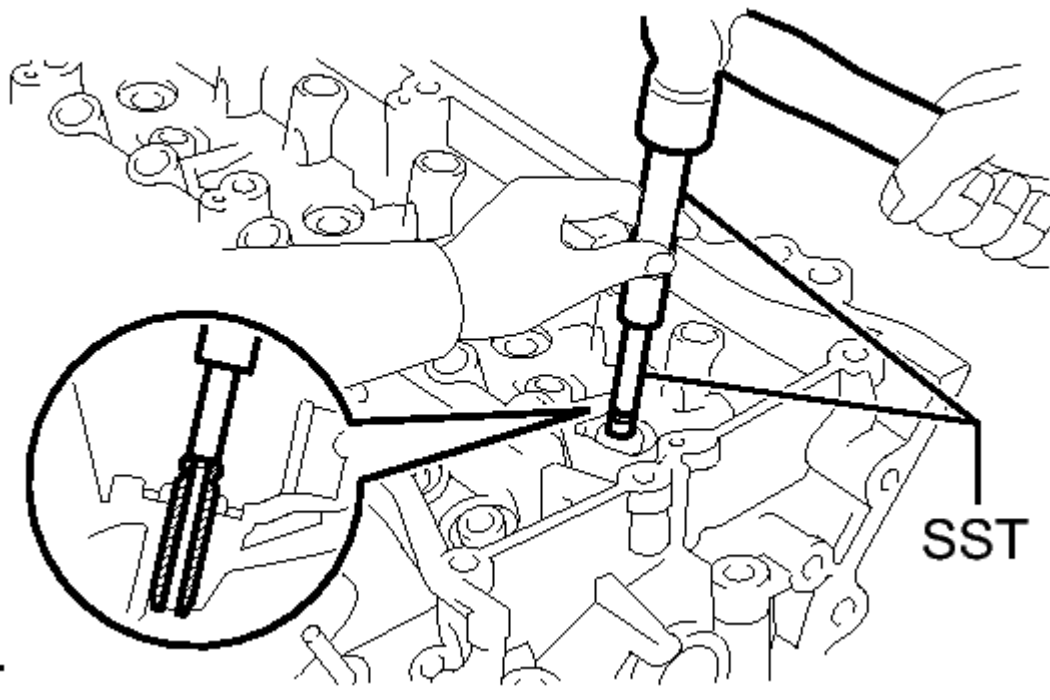


Fig. 105: Identifying Exhaust Valve Guide Bush, SST And Hammer

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

- c. Using SST and a hammer, tap out the exhaust valve guide bushes.

2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

- **SST: 09201-10000**

09201-01050

- **SST: 09950-70010**

09951-07100

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

Standard Bush Bore Diameter

Item	Specified Condition
STD	10.285 to 10.306 mm (0.4049 to 0.4057 in.)
O/S 0.05	10.335 to 10.356 mm (0.4069 to 0.4077 in.)

- e. Select a new valve guide bush.

New Guide Bush

Item	Specified Condition	
Bush Bore Diameter	10.285 to 10.306 mm (0.4049 to 0.4057 in.)	10.335 to 10.356 mm (0.4069 to 0.4077 in.)
Use Bush	STD	O/S 0.05

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

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

cylinder head.

New Guide Bush Diameter

Item	Specified Condition
STD	10.333 to 10.344 mm (0.4068 to 0.4072 in.)
O/S 0.05	10.383 to 10.394 mm (0.4088 to 0.4092 in.)

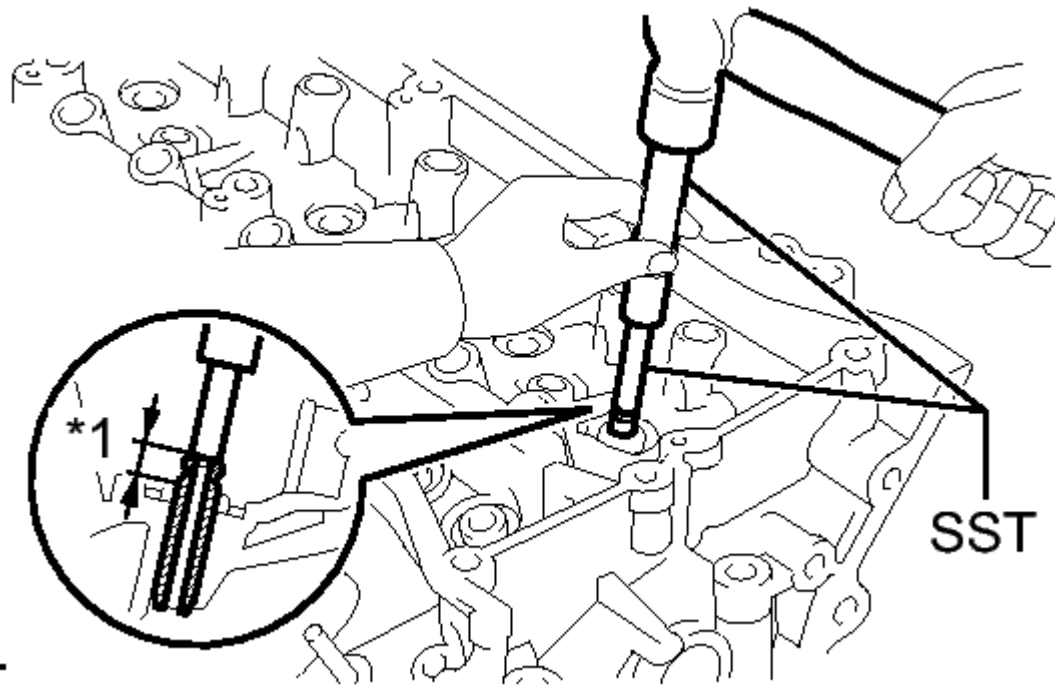
HINT:

Different bushes are used for the intake and exhaust.

Standard bush length

46.8 to 47.2 mm (1.84 to 1.86 in.)

- f. Heat the cylinder head to 80 to 100°C (176 to 212°F).
- g. Place the cylinder head on wooden blocks.
- h. Using SST, tap in the exhaust valve guide bushes to the specified protrusion height.

**T****Fig. 106: Tapping In Exhaust Valve Guide Bushes**

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

- SST: 09201-10000
09201-01050
- SST: 09950-70010
09951-07100

Protrusion height

9.10 to 9.90 mm (0.358 to 0.390 in.)

TEXT IN ILLUSTRATION

*1	Protrusion Height
----	----------------------

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

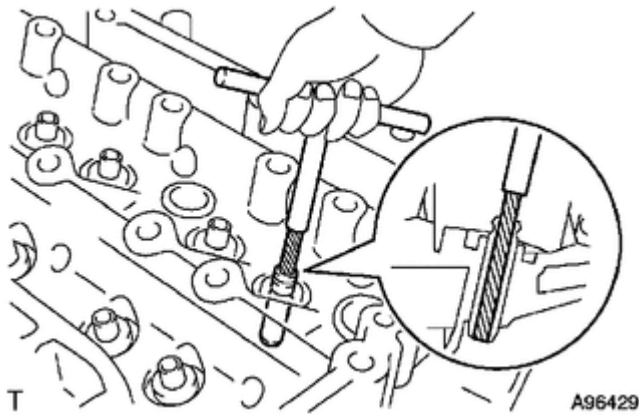


Fig. 107: Reaming Valve Guide Bushing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard oil clearance

0.030 to 0.065 mm (0.00118 to 0.00256 in.)

3. REPLACE STRAIGHT PIN

NOTE: If a straight pin is deformed, replace it.

- a. Using a plastic-faced hammer, tap in new straight pins as shown in the illustration.

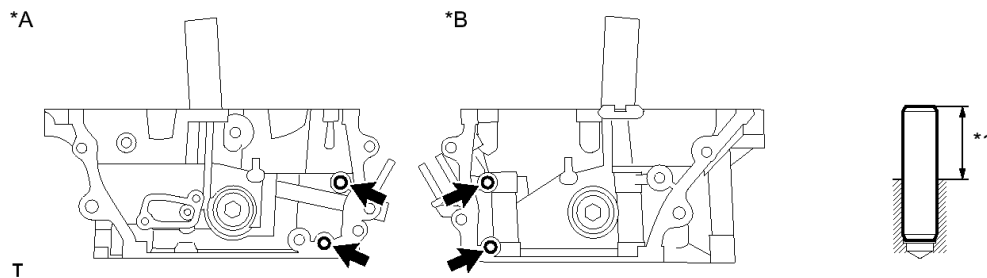


Fig. 108: Identifying Straight Pins
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*A	RH	*B	LH
*1	Protrusion Height	-	-

Protrusion height

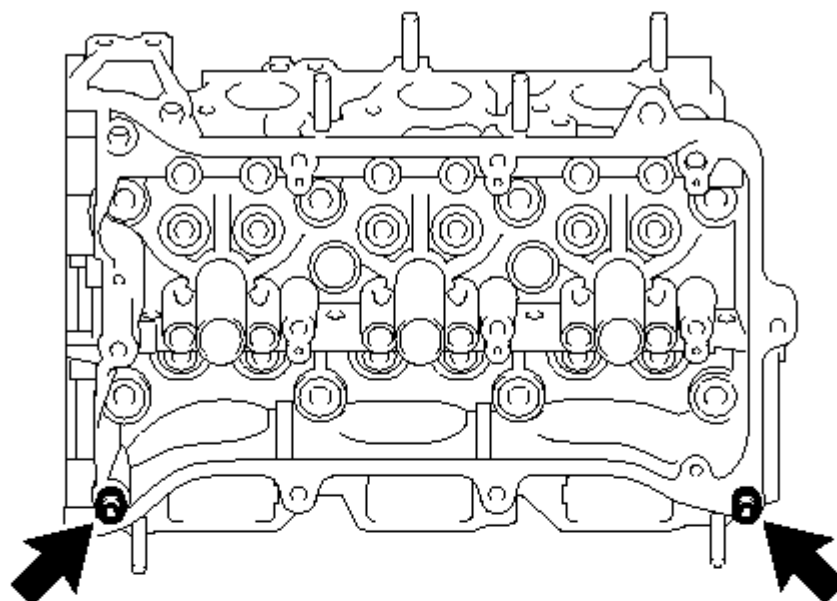
18.0 to 19.0 mm (0.708 to 0.748 in.)

4. REPLACE RING PIN

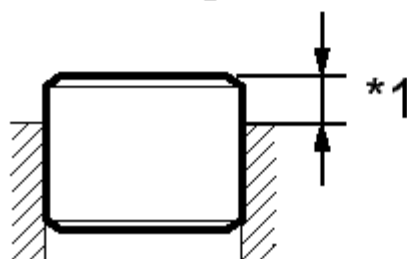
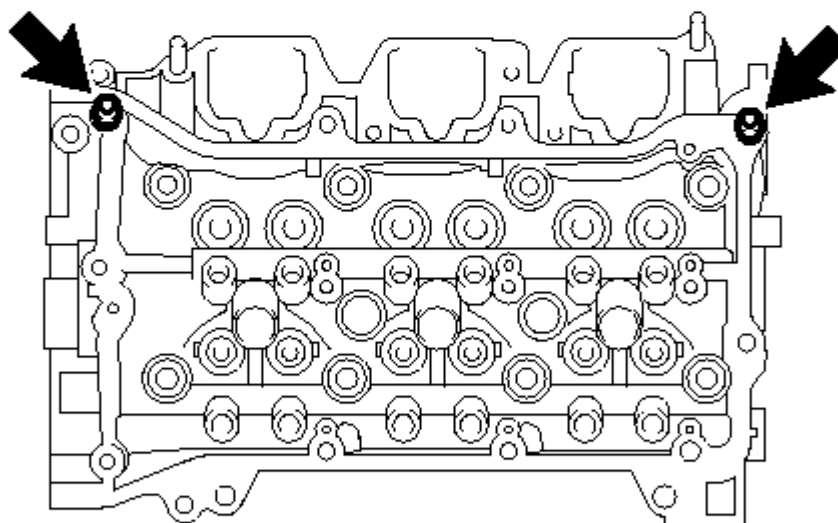
NOTE: It is not necessary to remove a ring pin unless it is being replaced.

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

***A**



***B**



T

Fig. 109: Identifying Ring Pins

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

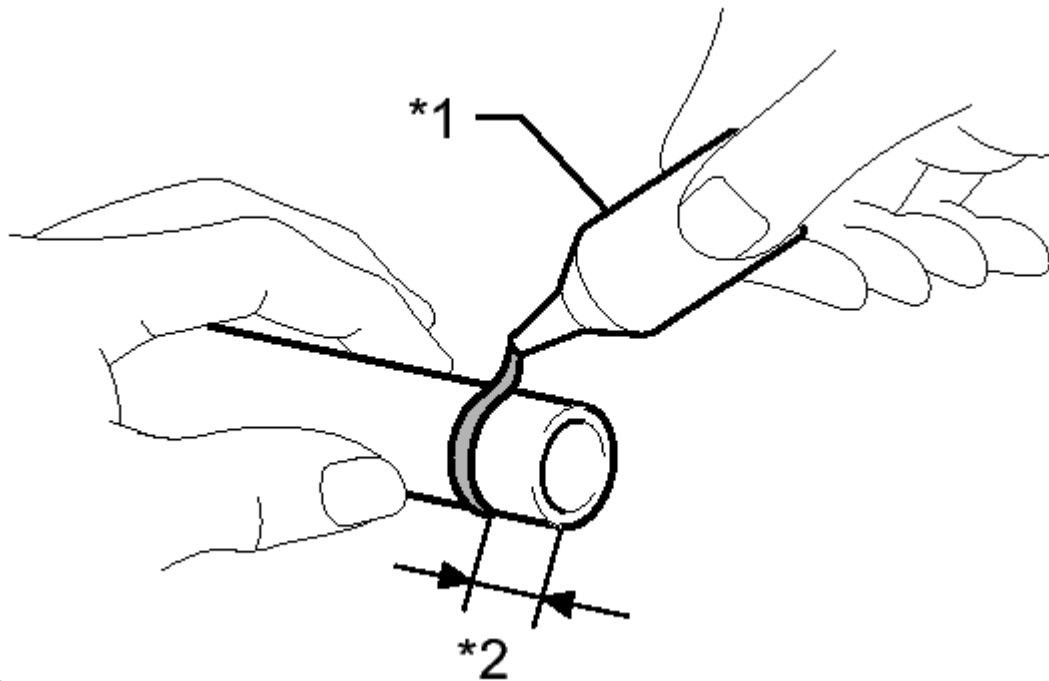
Protrusion height

2.5 to 3.5 mm (0.0984 to 0.138 in.)

TEXT IN ILLUSTRATION

*A	RH
*B	LH
*1	Protrusion Height

5. REPLACE SPARK PLUG TUBE



P

Fig. 110: Applying Adhesive To Spark Plug Tubes
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

When using a new cylinder head, the spark plug tubes must be replaced.

- Apply adhesive to the end of a new spark plug tube.

Adhesive

Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent.

Standard seal diameter

1.0 to 3.0 mm (0.394 to 0.118 in.)

Distance

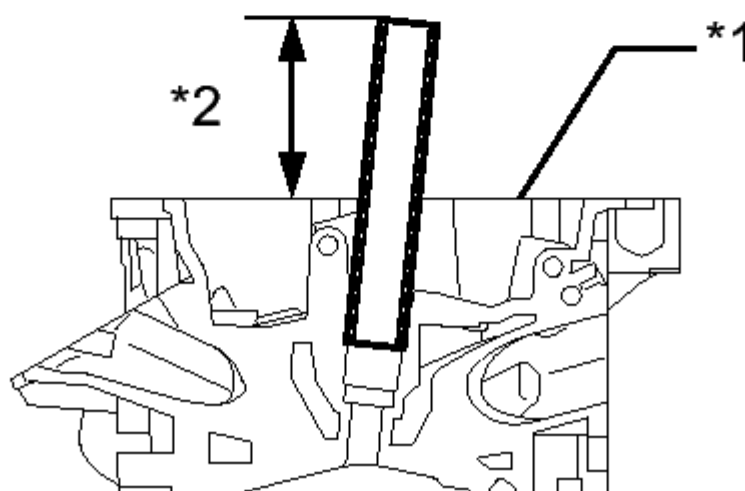
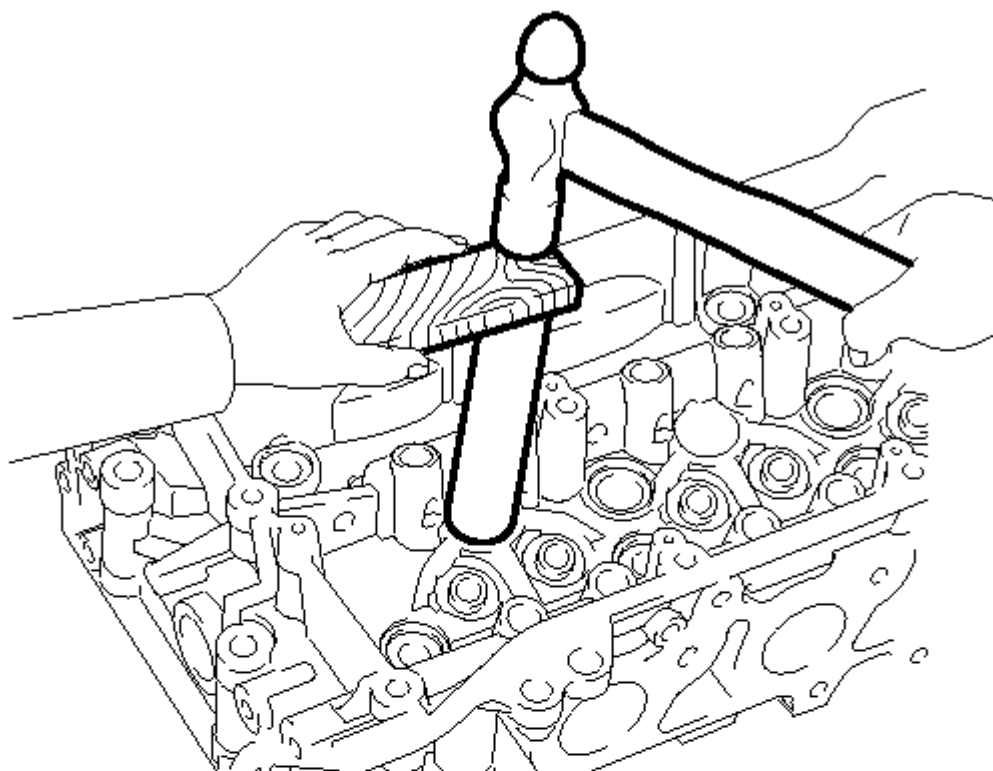
9.0 to 15.0 mm (0.354 to 0.590 in.)

TEXT IN ILLUSTRATION

*1	Adhesive
*2	Distance

NOTE:

- Be careful not to deform the spark plug tube.
- Be careful not to expose the seal to coolant for at least 1 hour after installing it.



P

Fig. 111: Tapping In Spark Plug Tube

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

NOTE: To avoid tapping in the spark plug tube too far, measure the protrusion height while tapping it.

- b. Using a wooden block and hammer, tap in the spark plug tube to the specified protrusion height.

Standard protrusion height

75.1 to 76.1 mm (2.96 to 3.00 in.)

TEXT IN ILLUSTRATION

*1	Cylinder Head Top Surface
*2	Protrusion Height

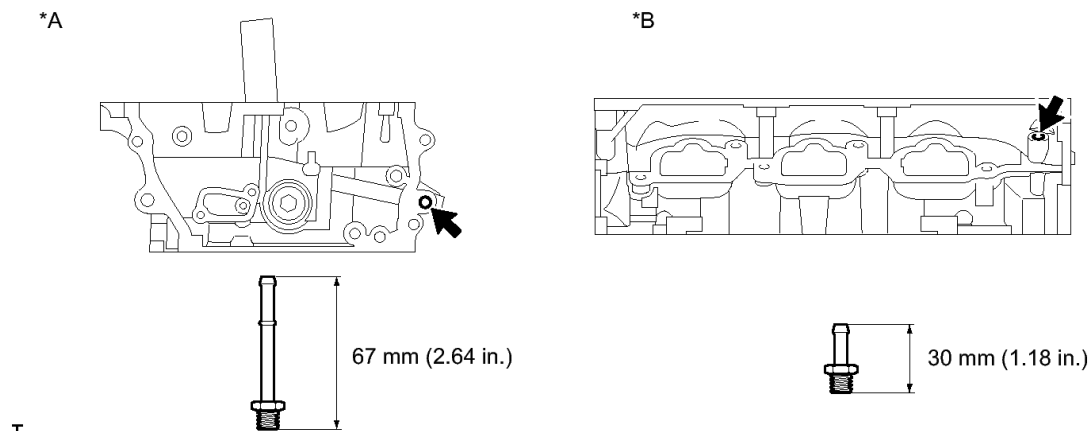
REASSEMBLY

REASSEMBLY

1. INSTALL UNION

NOTE: It is not necessary to remove a union unless it is being replaced.

- a. Remove the union from the bank 1 cylinder head (front side) and bank 2 cylinder head (intake port side).



T

Fig. 112: Identifying Bank 1 Cylinder Head (Front Side) & Bank 2 Cylinder Head (Intake Port Side)

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

TEXT IN ILLUSTRATION

*A	Front Side of RH	*B	Intake Side of LH
----	---------------------------	----	-------------------------

- b. Apply adhesive to 2 or 3 threads of the bolt ends of new unions.

Adhesive

Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

- c. Using a 12 mm deep socket wrench, install the 2 unions.

Torque: 15 N*m (150 kgf*cm, 11 ft.*lbf)

2. INSTALL STUD BOLT

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

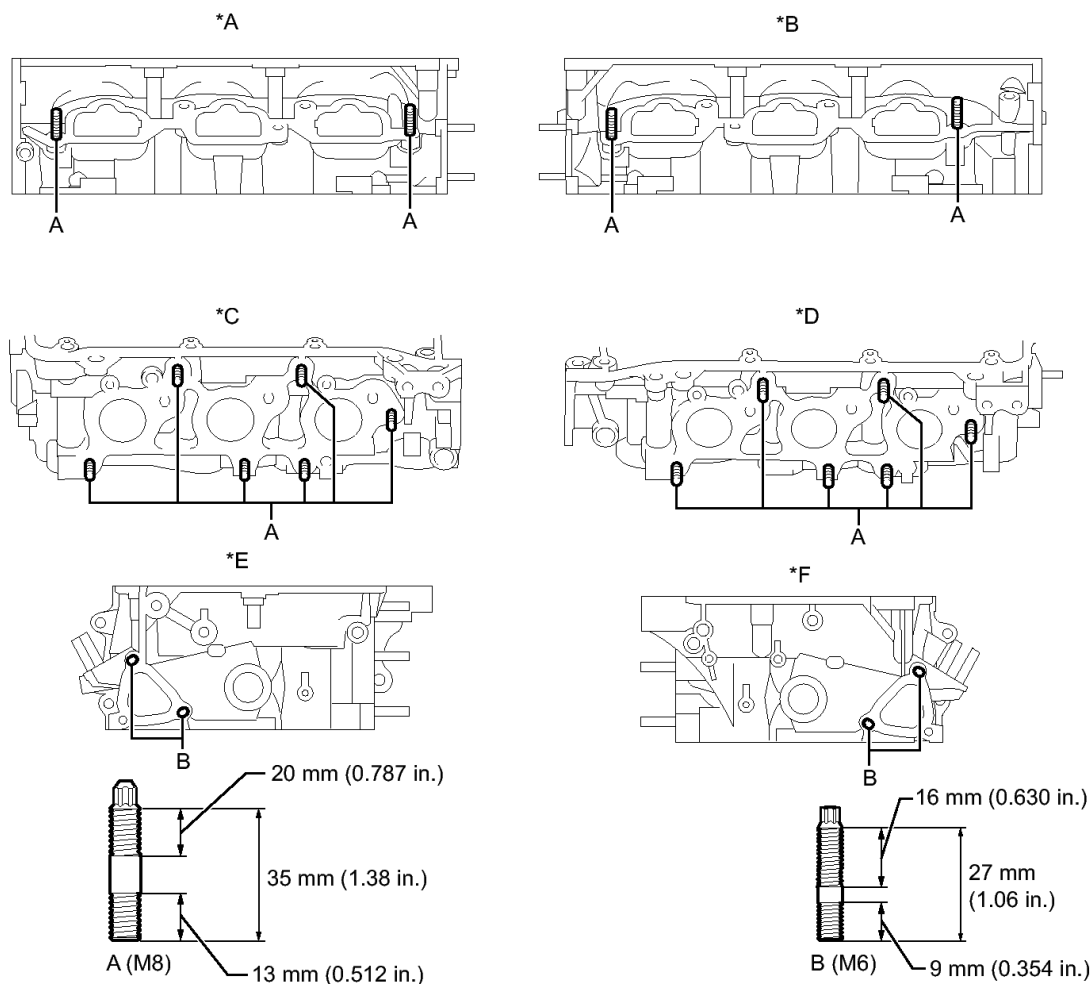
- a. Using E6 and E8 "TORX" sockets, install the stud bolts.

for bolt A

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

for bolt B

Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)



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Fig. 113: Locating Stud Bolts

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

TEXT IN ILLUSTRATION

*A	Intake Side of RH	*B	Intake Side of LH
*C	Exhaust Side of RH	*D	Exhaust Side of LH
*E	Rear Side of RH	*F	Rear Side of LH

3. INSTALL NO. 2 STRAIGHT SCREW PLUG

NOTE: If coolant leaks from a straight screw plug or a plug is corroded, replace it.

- a. Using a 14 mm hexagon wrench, install 2 new gaskets and the 2 No. 2 straight screw plugs.

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

4. INSTALL NO. 1 STRAIGHT SCREW PLUG

NOTE: If coolant leaks from a straight screw plug or a plug is corroded, replace it.

- a. Using a 10 mm hexagon wrench, install 4 new gaskets and the 4 No. 1 straight screw plugs.

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

5. INSTALL VALVE SPRING SEAT

- a. Install the valve spring seats to the cylinder head.

6. INSTALL VALVE STEM OIL SEAL

- a. Apply a light coat of engine oil to new valve stem oil seals.

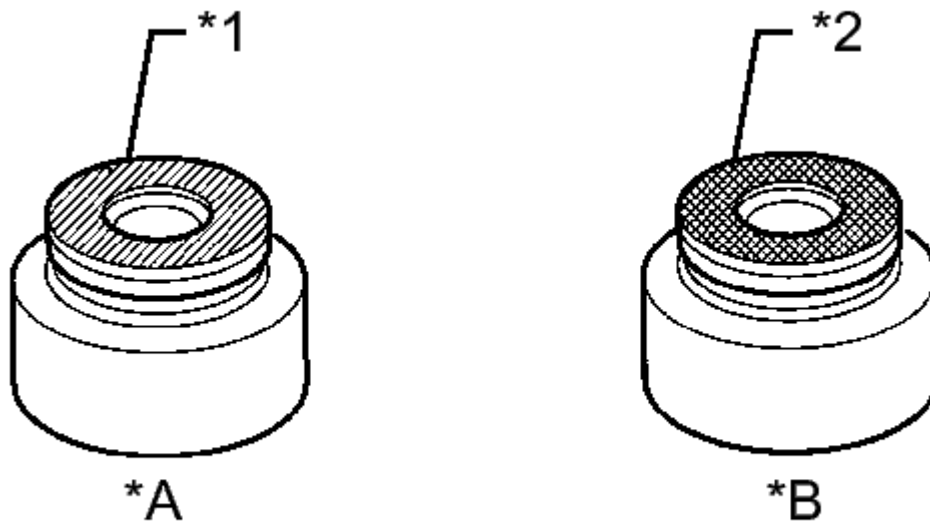


Fig. 114: Identifying Valve Stem Oil Seals
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*A	Intake Side
	Exhaust

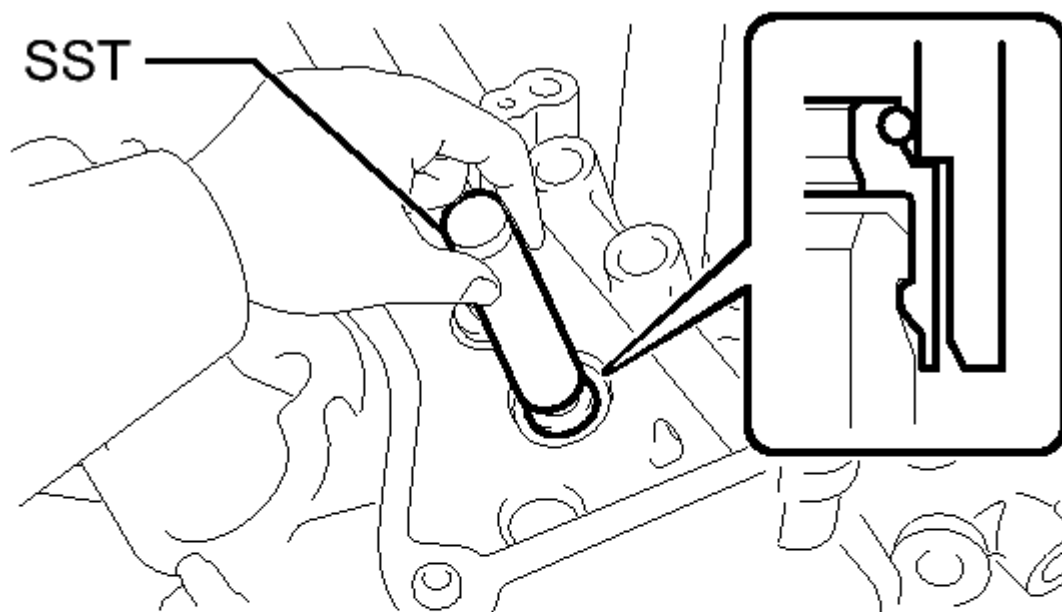
*B	Side
*1	Gray
*2	Black

HINT:

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

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

- b. Using SST, push in the oil seals.



*a



*b



T

Fig. 115: Identifying Valve Stem Oil Seal Installation Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- SST: 09201-41020

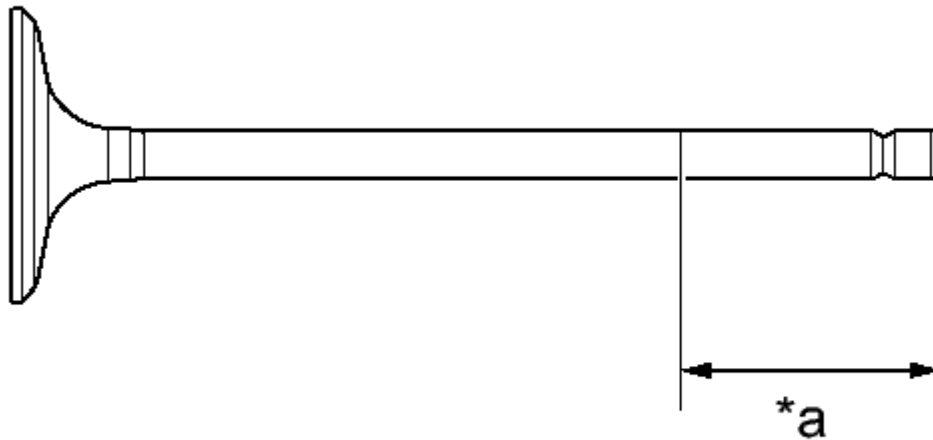
TEXT IN ILLUSTRATION

*a	CORRECT
*b	INCORRECT

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

7. INSTALL INTAKE VALVE

- Apply a sufficient coat of engine oil to the tip area of the intake valve shown in the illustration.



T

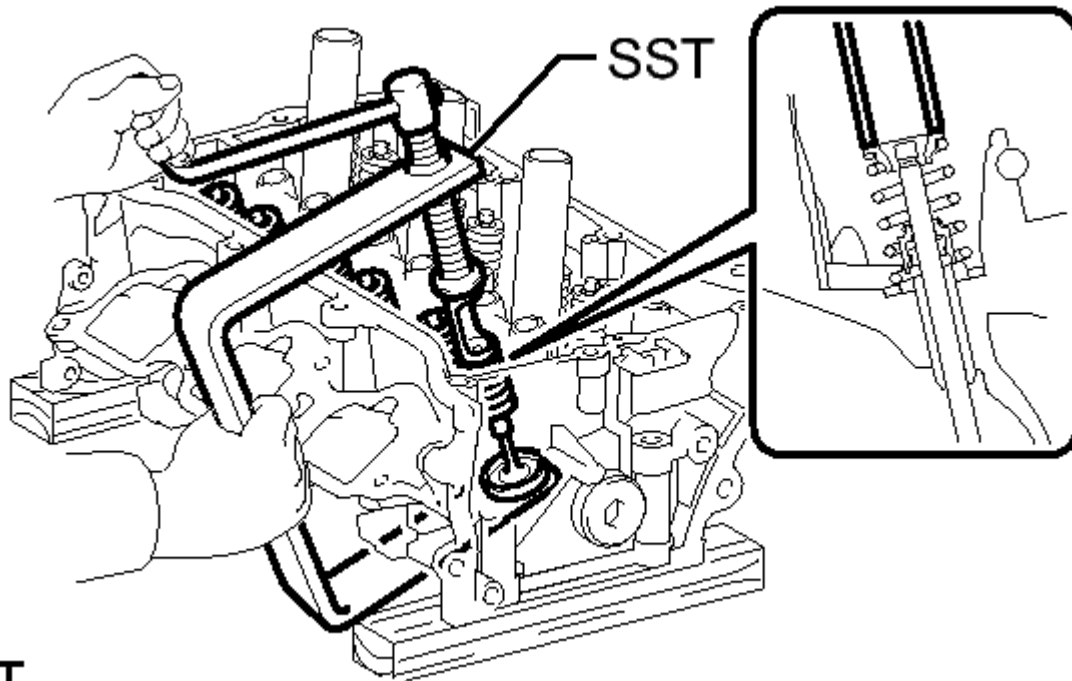
Fig. 116: Identifying Intake Valve
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	30 mm (1.18 in.) or more
----	---

- Install the intake valve, inner compression spring and valve spring retainer to the cylinder head.

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

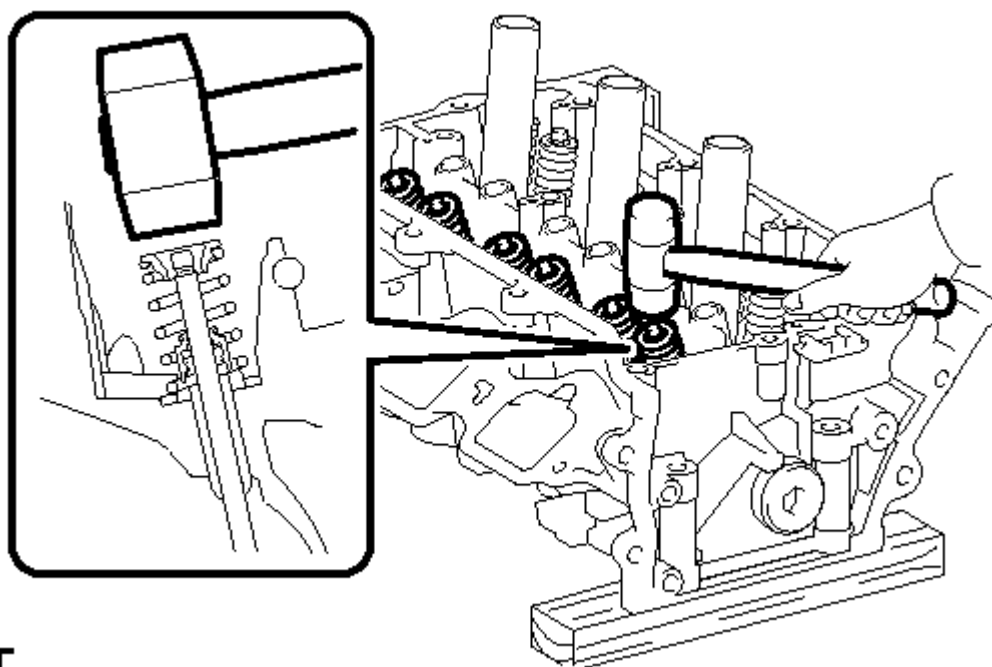


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Fig. 117: Identifying Intake Valve And SST

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

- c. Using SST, compress the inner compression spring and install the 2 valve spring retainer locks.
 - **SST: 09202-70020**
09202-00010
- d. Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.



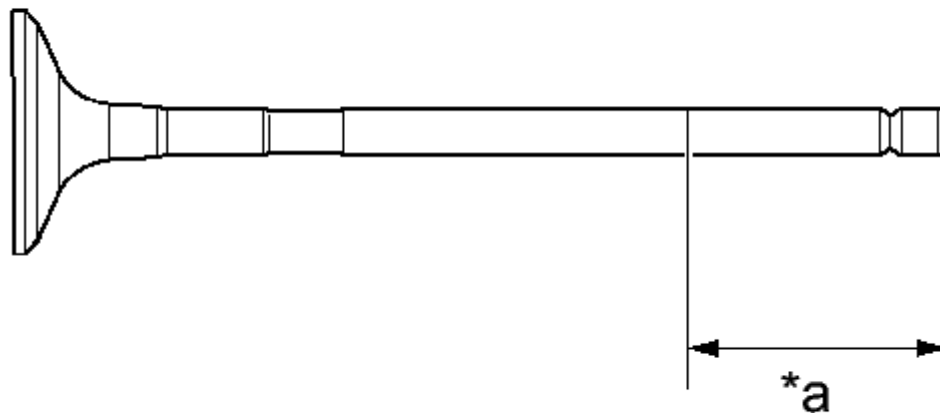
T

Fig. 118: Identifying Valve Stem Tip And Hammer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to damage the retainer.

8. INSTALL EXHAUST VALVE

- a. Apply a sufficient coat of engine oil to the tip area of the exhaust valve shown in the illustration.



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Fig. 119: Identifying Exhaust Valve

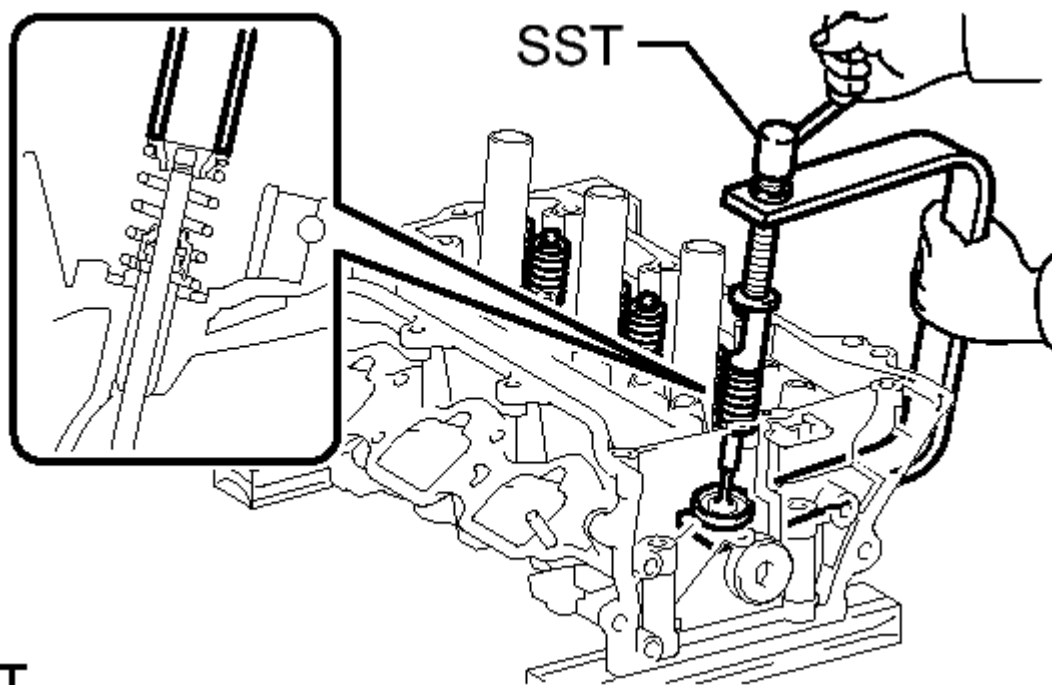
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

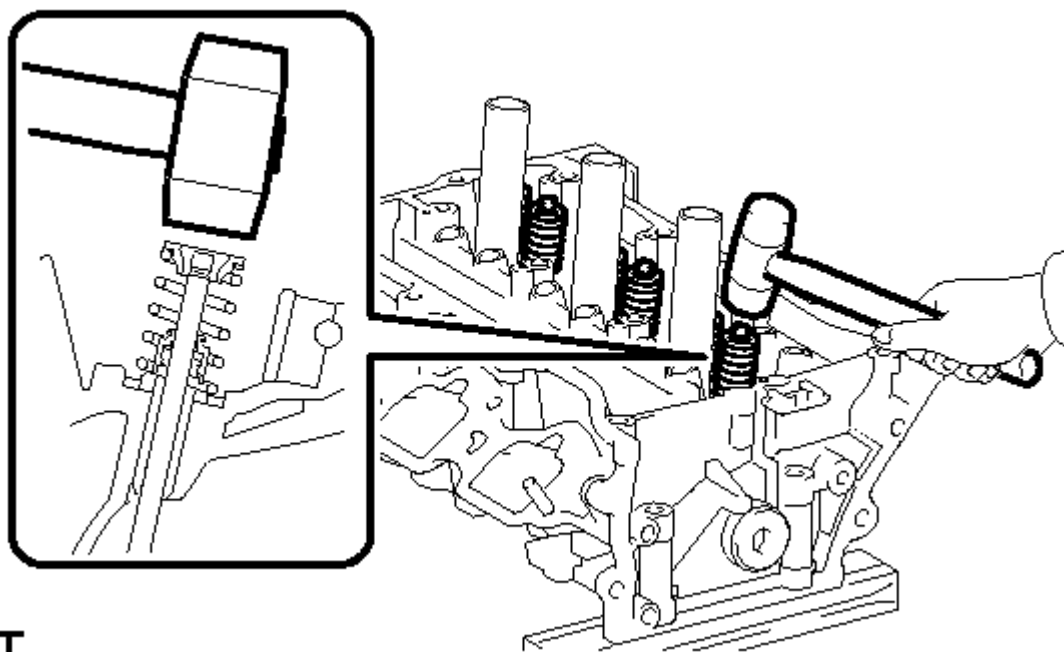
*a	30
	mm
	(1.18
	in.)
	or more

- b. Install the exhaust valve, inner compression spring and valve spring retainer to the cylinder head.

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

**T****Fig. 120: Identifying Exhaust Valve And SST****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- c. Using SST, compress the inner compression spring and install the 2 valve spring retainer locks.
 - **SST: 09202-70020**
09202-00010
- d. Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.



T
Fig. 121: Identifying Valve Stem Tip And Hammer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Be careful not to damage the retainer.

REPAIR

REPAIR

1. REPAIR INTAKE VALVE SEAT

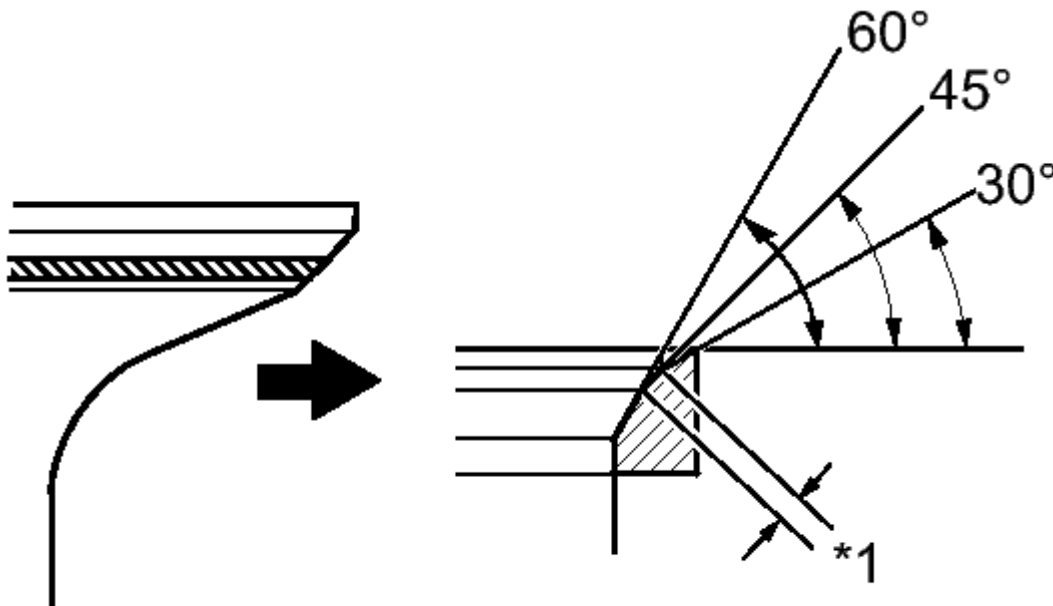
NOTE:

- Repair the intake valve seat while checking the seating position.
 - Keep the lip free of foreign matter.
 - Take off the cutter gradually to make the intake valve seat smooth.
- a. Using a 45° cutter, resurface the valve seat so that the valve seat width is more than the specification.

**Fig. 122: Resurfacing Valve Seat**

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

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



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Fig. 123: Identifying Intake Valve Seat

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

Standard width

1.1 to 1.5 mm (0.0433 to 0.0591 in.)

TEXT IN ILLUSTRATION

*1	Width
----	-------

- c. Hand-lap the intake valve and intake valve seat with an abrasive compound.
- d. Check the intake valve seating position.

2. REPAIR EXHAUST VALVE SEAT

NOTE:

- Repair the seat while checking the seating position.
- Keep the lip free of foreign matter.
- Take off the cutter gradually to make the exhaust valve seat smooth.

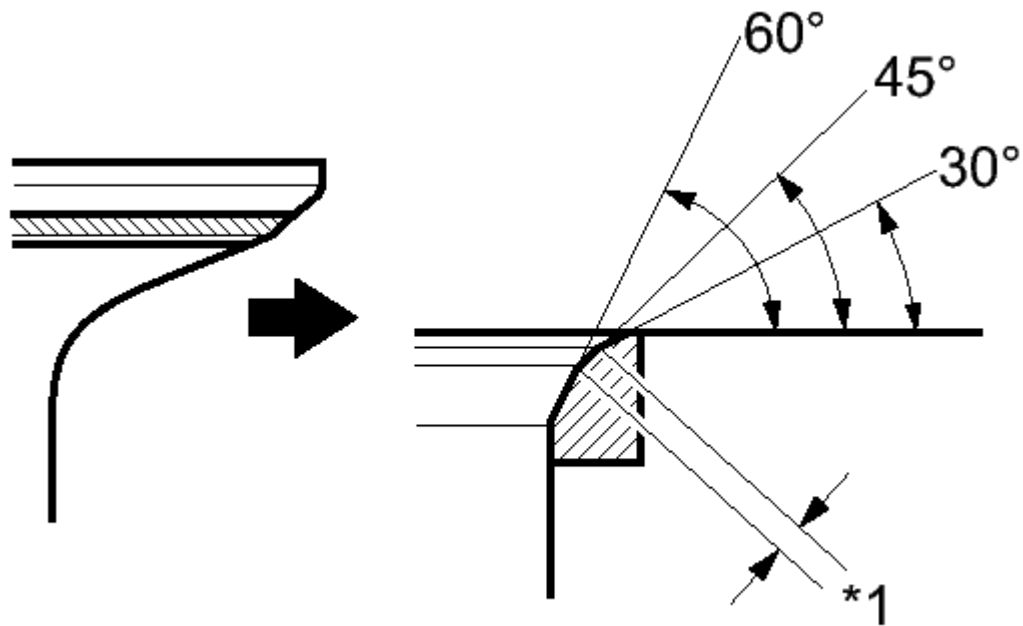
- a. Using a 45° cutter, resurface the valve seat so that the valve seat width is more than the specification.



Fig. 124: Resurfacing Valve Seat

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

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



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Fig. 125: Identifying Exhaust Valve Seat
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard width

1.1 to 1.5 mm (0.0433 to 0.0591 in.)

TEXT IN ILLUSTRATION

*1 Width

- c. Hand-lap the exhaust valve and exhaust valve seat with an abrasive compound.
- d. Check the exhaust valve seating position.

CYLINDER BLOCK

COMPONENTS

ILLUSTRATION

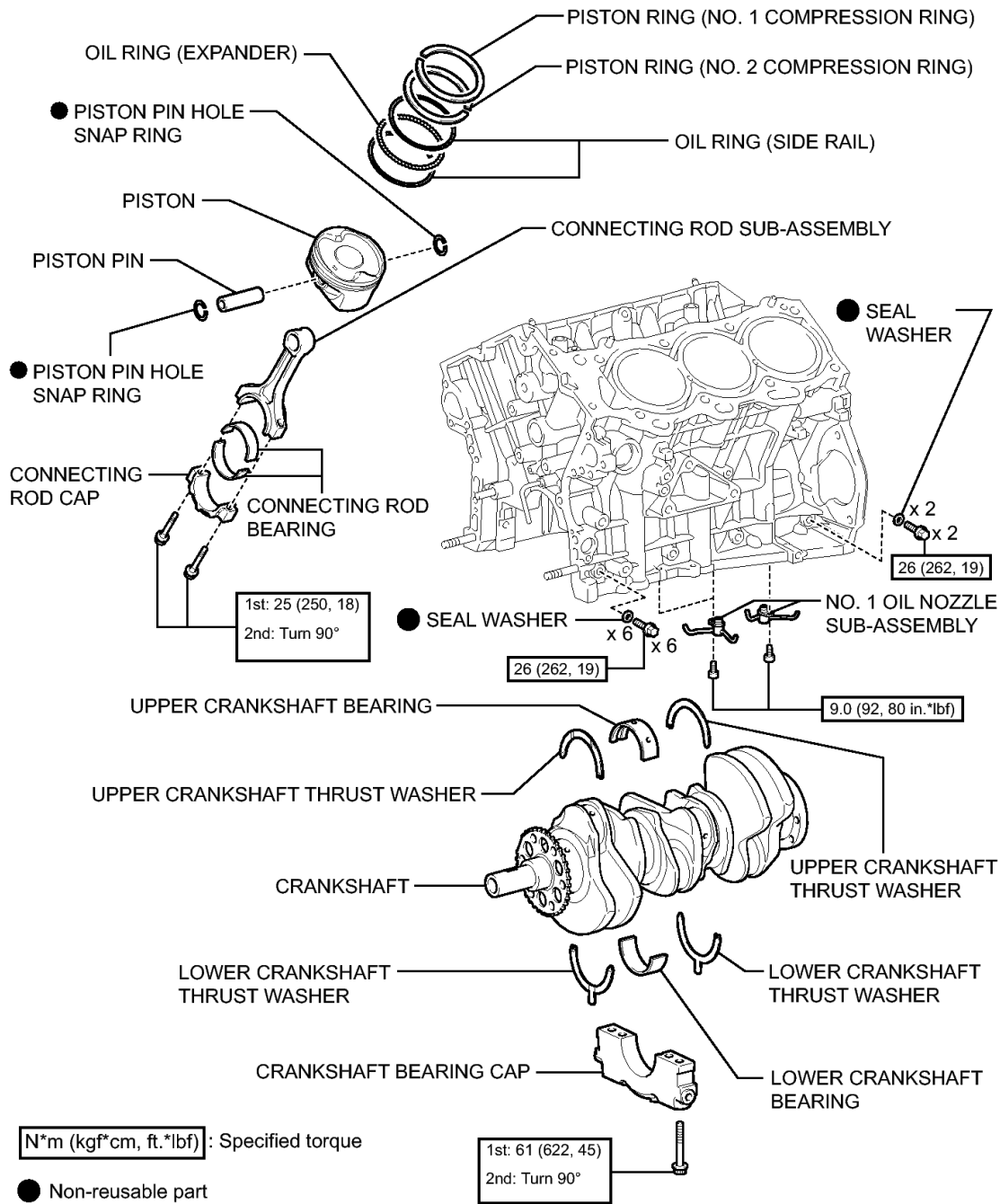


Fig. 126: Cylinder Block Replacement Components With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

DISASSEMBLY

1. INSPECT CONNECTING ROD THRUST CLEARANCE

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

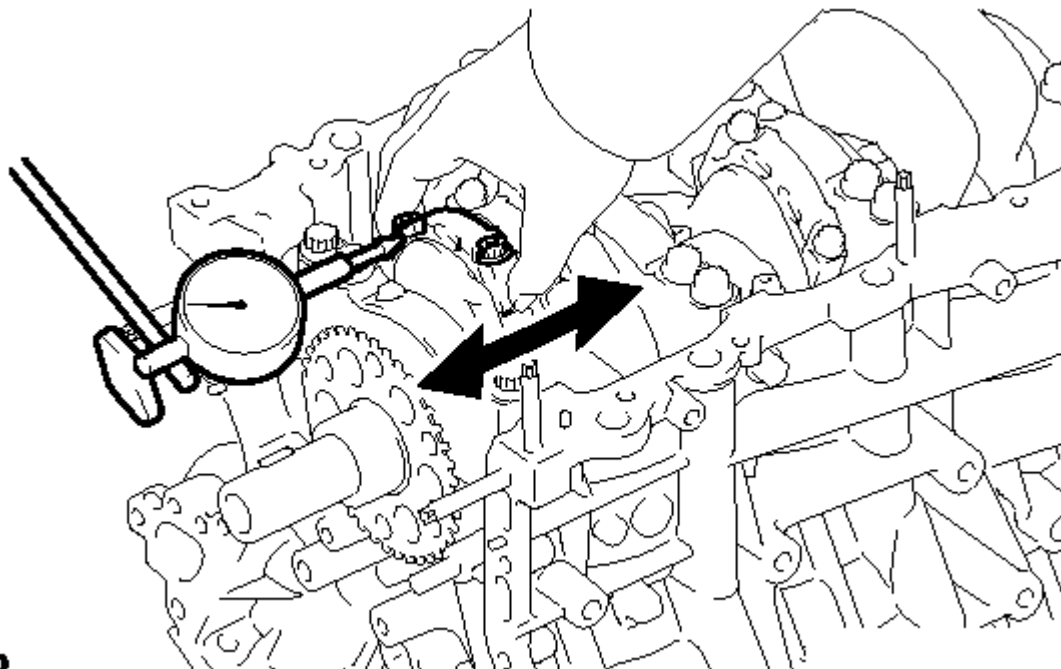
**P**

Fig. 127: Inspecting Connecting Rod Thrust Clearance
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard thrust clearance

0.15 to 0.30 mm (0.00591 to 0.0118 in.)

Maximum thrust clearance

0.35 mm (0.0138 in.)

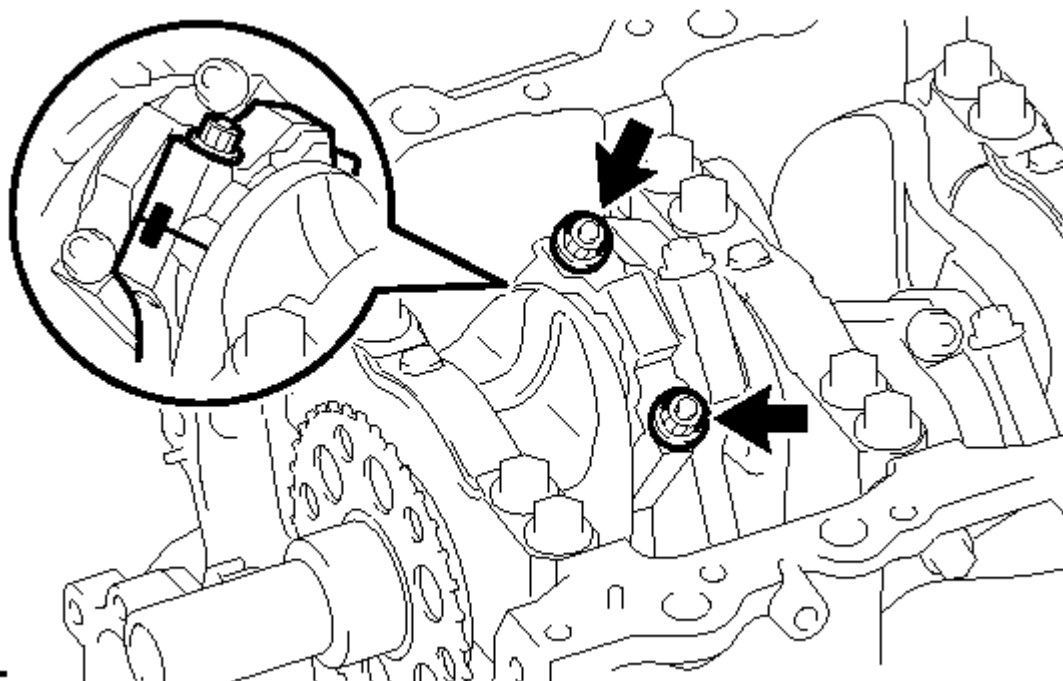
If the thrust clearance is more than the maximum, replace one or more connecting rods as necessary.

Standard connecting rod thickness

20.80 to 20.85 mm (0.819 to 0.821 in.)

If necessary, replace the crankshaft.

2. INSPECT CONNECTING ROD OIL CLEARANCE

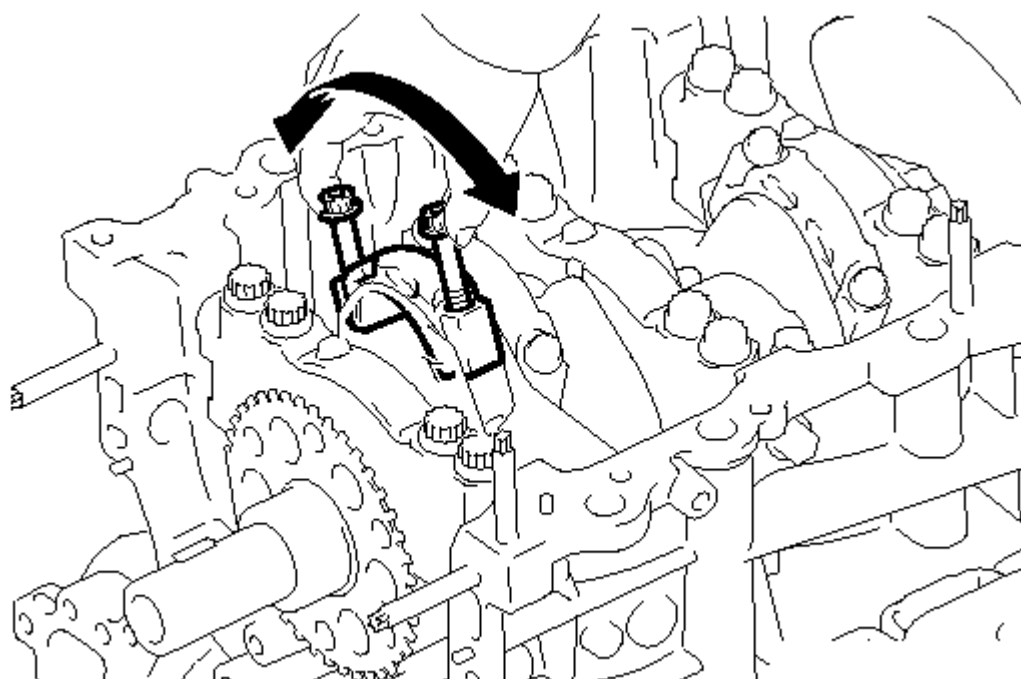


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Fig. 128: Identifying Connecting Rod Cap Bolts And Matchmarks On The Connecting Rod And Cap

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

- Check the matchmarks on the connecting rod and cap to ensure correct reassembly.
- Remove the 2 connecting rod cap bolts.



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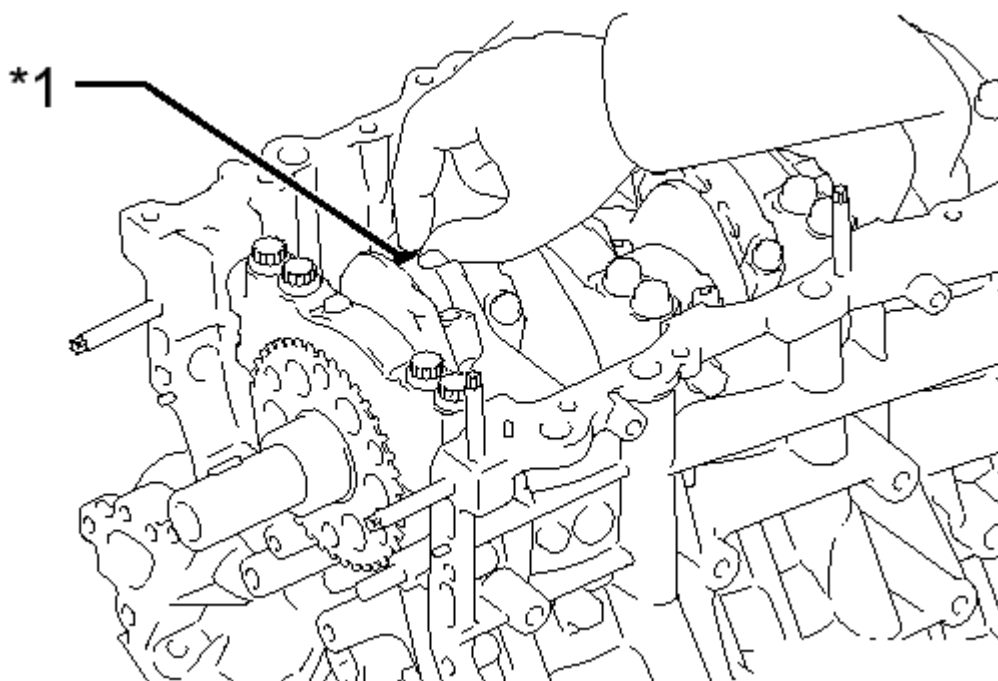
Fig. 129: Identifying Connecting Rod Cap And Lower Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

HINT:

Keep the lower bearing and connecting rod cap together.

- 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 across the crank pin.



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Fig. 130: Identifying Plastigage
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

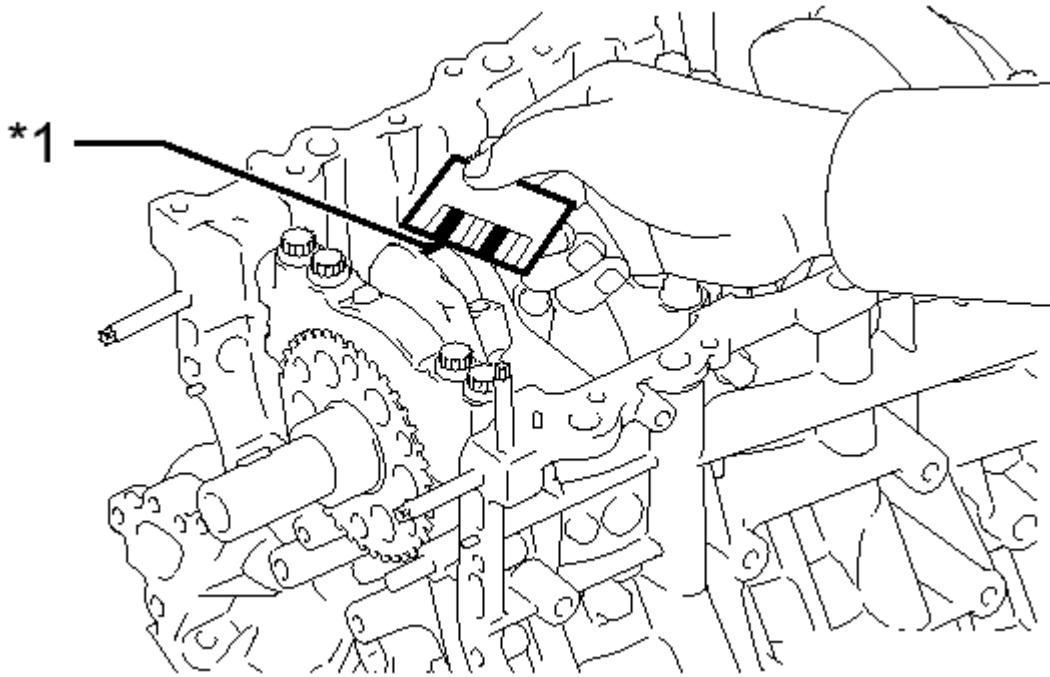
*1 Plastigage

- g. Install the connecting rod cap. See step 9.

NOTE: Do not turn the crankshaft.

- h. Remove the 2 bolts, connecting rod cap and lower bearing.

- i. Measure the Plastigage at its widest point.

**P****Fig. 131: Identifying Plastigage Width****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

Standard oil clearance

0.040 to 0.066 mm (0.00157 to 0.00260 in.)

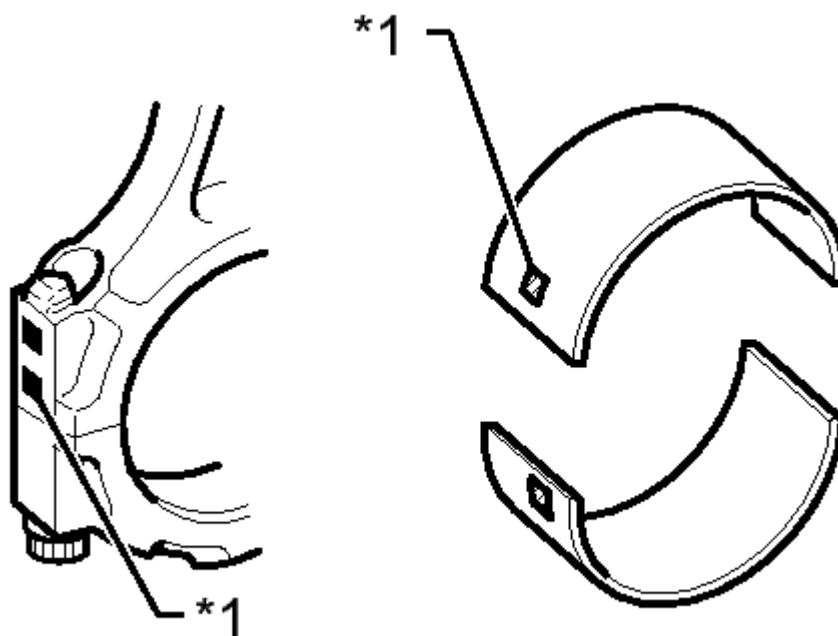
Maximum oil clearance

0.086 mm (0.00339 in.)

TEXT IN ILLUSTRATION***1** Plastigage

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

HINT:



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Fig. 132: Identifying Bearing & Connecting Rod

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

If replacing a bearing, replace it with one that has the same number as the number marked on the connecting rod. There are 4 sizes of standard bearings, marked "1", "2", "3" and "4" accordingly.

Connecting Rod Diameter

Item	Specified Condition
Mark 1	59.000 to 59.006 mm (2.32283 to 2.32307 in.)
Mark 2	59.007 to 59.012 mm (2.32311 to 2.32330 in.)
Mark 3	59.013 to 59.018 mm (2.32334 to 2.32354 in.)

	in.)
Mark 4	59.019 to 59.024 mm (2.32358 to 2.32377 in.)

Standard Bearing Center Wall Thickness

Item	Specified Condition
Mark 1	1.484 to 1.487 mm (0.05843 to 0.05854 in.)
Mark 2	1.487 to 1.490 mm (0.05854 to 0.05866 in.)
Mark 3	1.490 to 1.493 mm (0.05866 to 0.05878 in.)
Mark 4	1.493 to 1.496 mm (0.05878 to 0.05900 in.)

Standard crankshaft pin diameter

55.992 to 56.000 mm (2.2044 to 2.2047 in.)

TEXT IN ILLUSTRATION

*1	Number Mark
----	----------------

j. Completely remove the Plastigage.

3. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

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

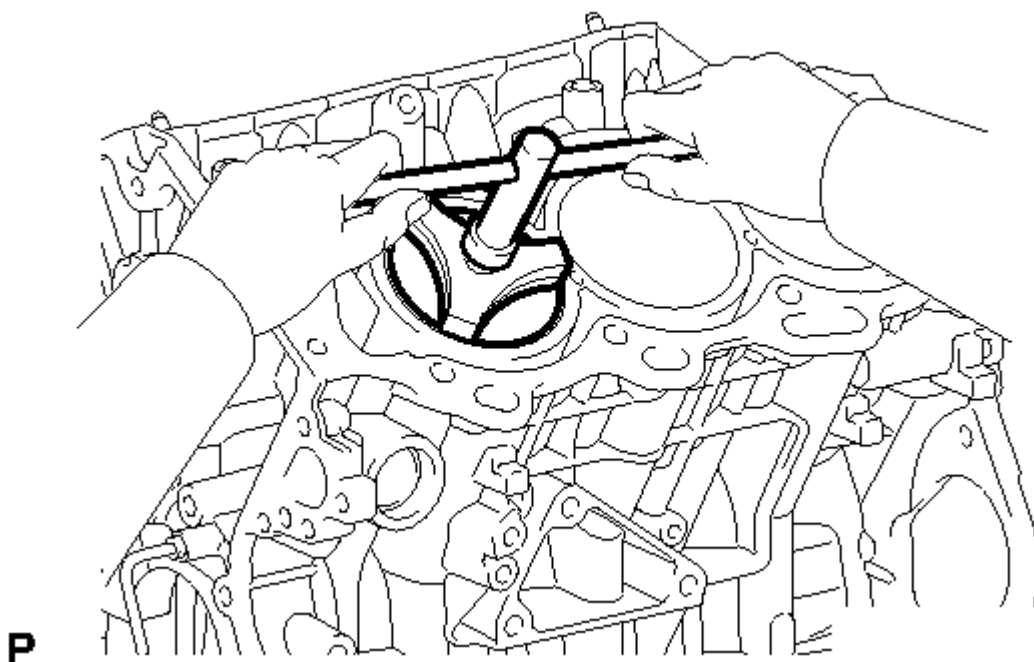


Fig. 133: Identifying Ridge Reamer

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

- b. Push out the piston with connecting rod and upper bearing through the top of the cylinder block.

HINT:

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

4. REMOVE CONNECTING ROD BEARING

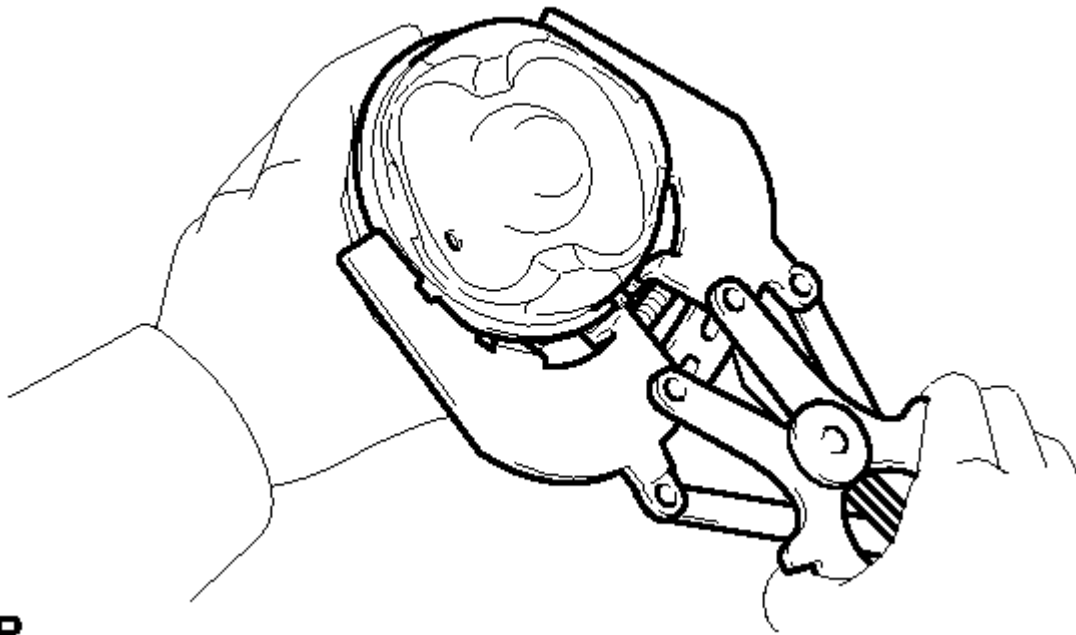
- a. Remove the connecting rod bearings from the connecting rods and connecting rod caps.

HINT:

Arrange the removed parts in the correct order.

5. REMOVE PISTON RING SET

- a. Using a piston ring expander, remove the 2 compression rings.



P

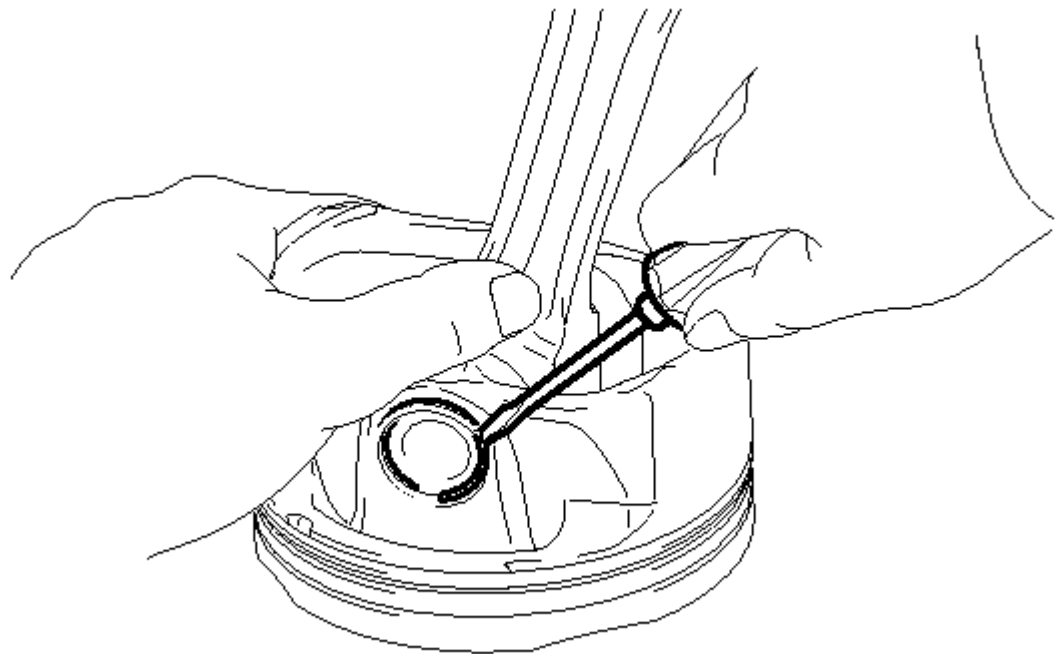
Fig. 134: Identifying Piston And Piston Ring Expander

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

- b. Remove the 2 side rails and oil ring (expander) by hand.

6. REMOVE PISTON WITH PIN SUB-ASSEMBLY

- a. Disconnect the connecting rod from the piston.

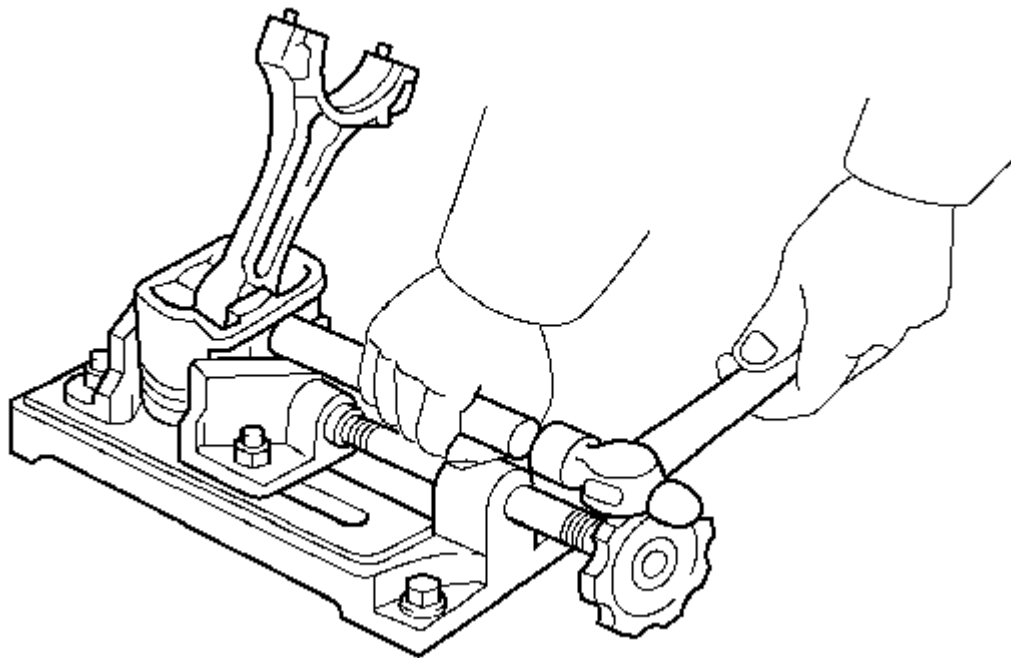


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Fig. 135: Identifying Snap Rings

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

1. Using a screwdriver, pry out the 2 snap rings.
2. Gradually heat the piston to approximately 80°C (176°F).

**Fig. 136: Tapping Out Piston Pin & Removing Connecting Rod Using Hammer & Brass Bar**

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

3. Using a plastic-faced hammer and 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.

7. INSPECT CRANKSHAFT THRUST CLEARANCE

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

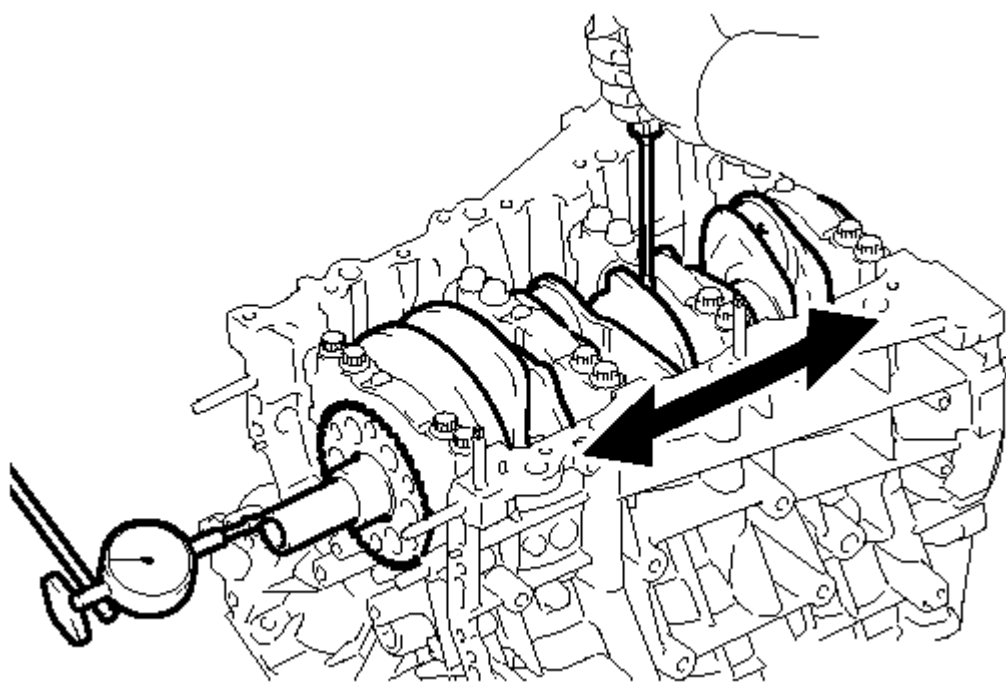


Fig. 137: Inspecting Crankshaft Thrust Clearance Using Dial Indicator And Screwdriver
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard thrust clearance

0.04 to 0.24 mm (0.00157 to 0.00945 in.)

Maximum thrust clearance

0.30 mm (0.0118 in.)

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

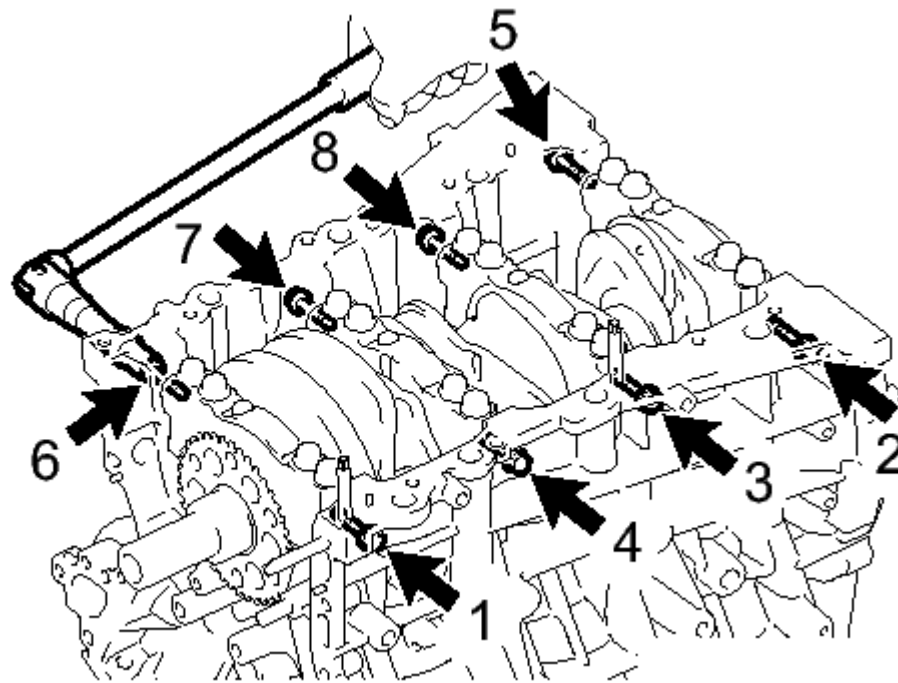
Standard thrust washer thickness

1.93 to 1.98 mm (0.0760 to 0.0780 in.)

If necessary, replace the crankshaft.

8. INSPECT CRANKSHAFT OIL CLEARANCE

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

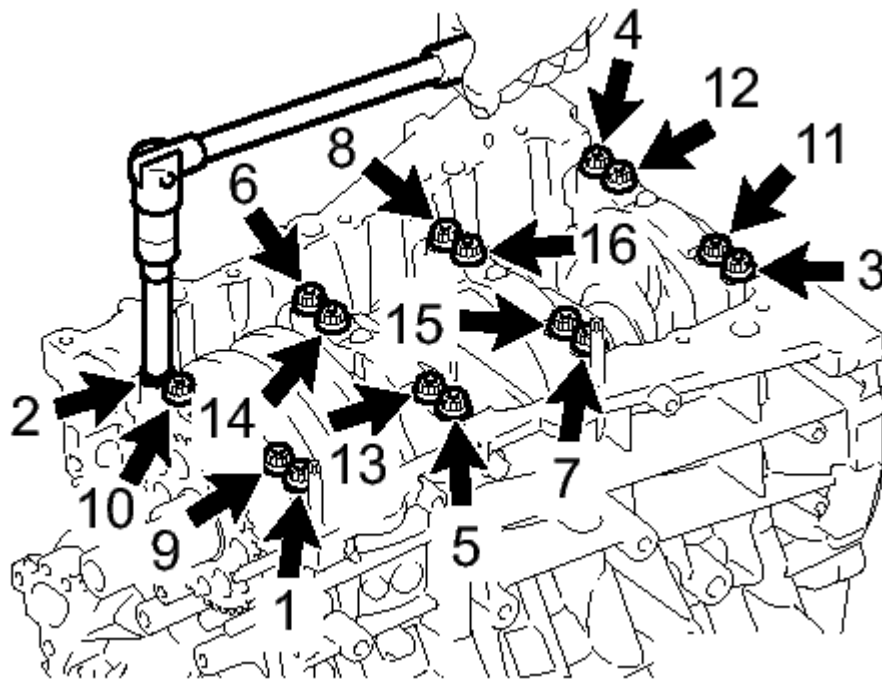


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Fig. 138: Identifying Side Bearing Cap Bolts With Loosening Sequence

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

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



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Fig. 139: Identifying Bearing Cap Bolts With Loosening Sequence

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

- c. Using a screwdriver, pry out the bearing caps. Remove the 4 bearing caps and lower bearings.

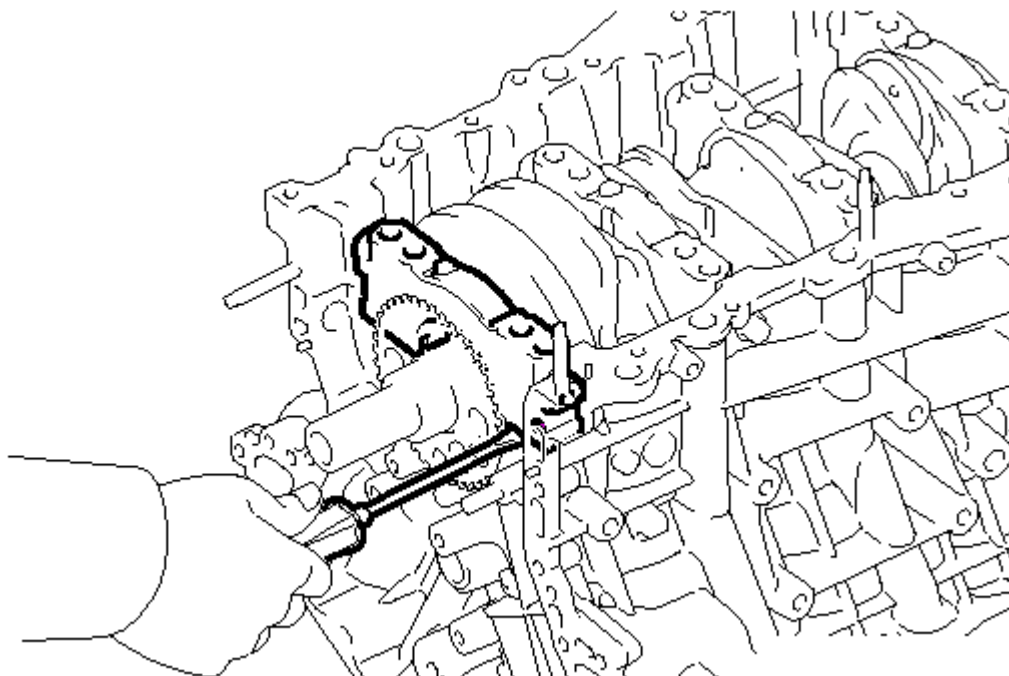


Fig. 140: Identifying Bearing Cap And Screwdriver
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- Push up on the cap little by little, alternating between the right and left side until the cap can be removed.
- Be careful not to damage the joint surfaces of the cylinder block or bearing cap.

- d. Remove the 2 lower crankshaft thrust washers.

HINT:

- Keep the lower bearing and crankshaft bearing cap together.
 - Arrange the removed parts in the correct order.
 - Be sure to arrange the bearing caps and lower thrust washers in such a way that they can be reinstalled exactly as before.
- e. Lift out the crankshaft.

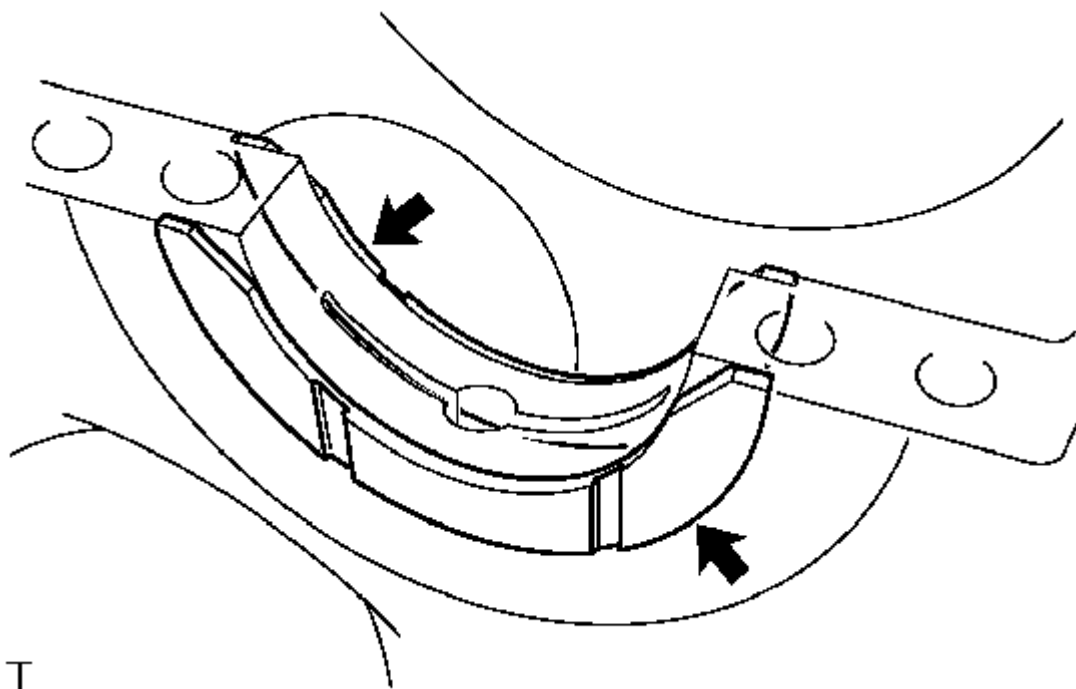


Fig. 141: Identifying Upper Thrust Washers

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

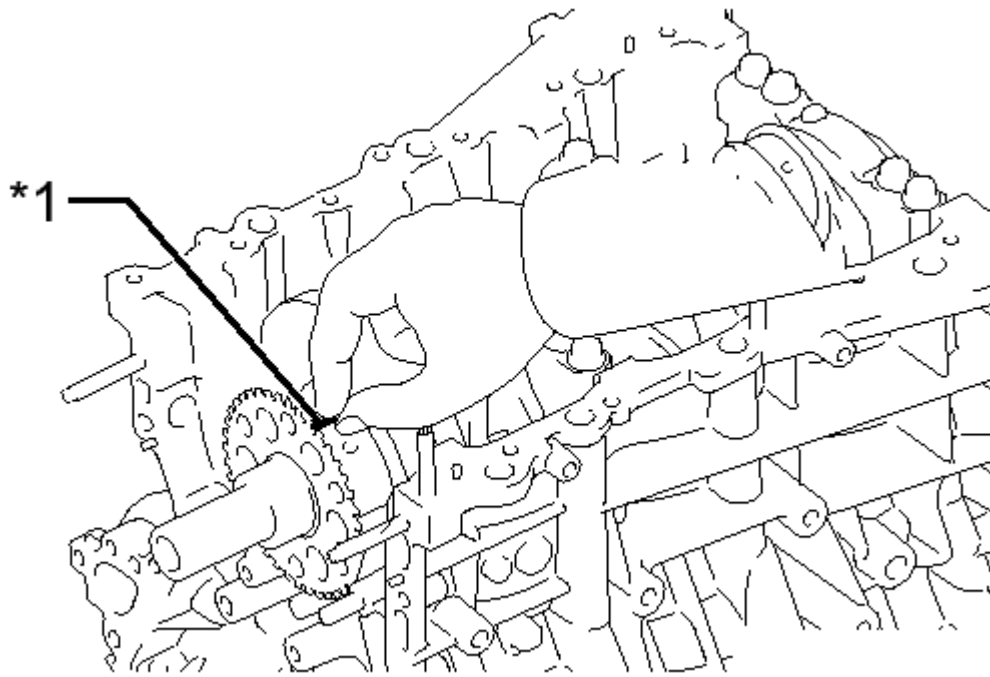
- f. Remove the 2 upper thrust washers.

HINT:

- Be sure to arrange the removed upper thrust washers in such a way that they can be reinstalled exactly as before.
 - Keep the upper bearings together with the cylinder block.
- g. Clean each crankshaft journal and bearing.
- h. Check each crankshaft journal and bearing for pitting and scratches.

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

- i. Place the crankshaft on the cylinder block.



P

Fig. 142: Identifying Plastigage

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

- j. Lay a strip of Plastigage across each journal.

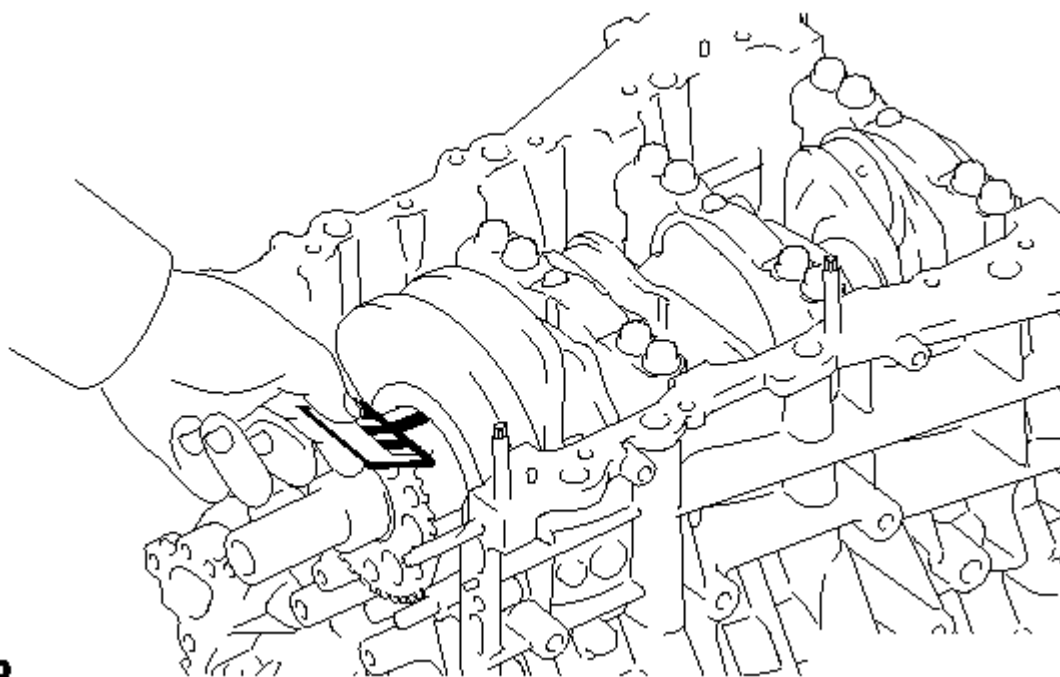
TEXT IN ILLUSTRATION

*1 Plastigage

- k. Install the crankshaft bearing cap. See step 6.

NOTE: Do not turn the crankshaft.

- l. Remove the crankshaft bearing cap.
- m. Measure the Plastigage at its widest point.

**P****Fig. 143: Identifying Plastigage Width****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

Standard oil clearance

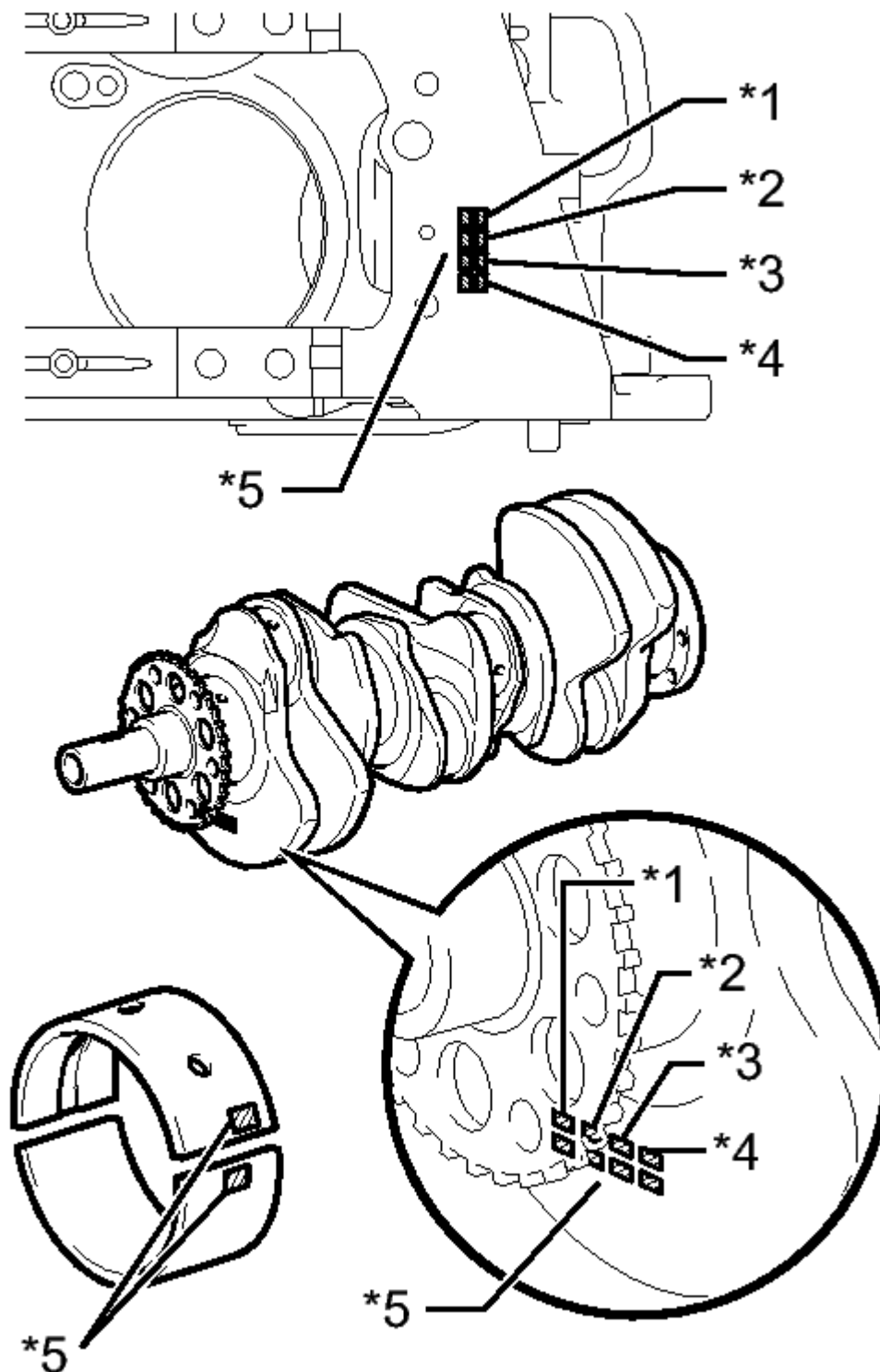
0.026 to 0.046 mm (0.00102 to 0.00181 in.)

Maximum clearance

0.080 mm (0.00315 in.)

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

- n. If replacing a bearing, replace it with one that has 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, and then refer to the table below for the appropriate bearing number. There are 5 sizes of standard bearings, marked "1", "2", "3", "4" and "5" accordingly.



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Fig. 144: Identifying Bearing Replacement Sizes
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

New Bearing

2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

Item	Specified Condition				
Cylinder block main journal bore diameter (A) + Crankshaft main journal diameter (B)	0 to 5	6 to 11	12 to 17	18 to 23	24 to 28
Use bearing	1	2	3	4	5

TEXT IN ILLUSTRATION

*1	No. 1
*2	No. 2
*3	No. 3
*4	No. 4
*5	Number Mark

EXAMPLE:

Cylinder block "11" (A) + Crankshaft "06" (B) = Total number 17 (Use bearing "3")

Cylinder Block Main Journal Bore Diameter (A)

Mark	Specified Condition
Mark 00	77.000 mm (3.03149 in.)
Mark 01	77.001 mm (3.03152 in.)
Mark 02	77.002 mm (3.03156 in.)

2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

Mark 03	77.003 mm (3.03160 in.)
Mark 04	77.004 mm (3.03164 in.)
Mark 05	77.005 mm (3.03168 in.)
Mark 06	77.006 mm (3.03172 in.)
Mark 07	77.007 mm (3.03176 in.)
Mark 08	77.008 mm (3.03180 in.)
Mark 09	77.009 mm (3.03184 in.)
Mark 10	77.010 mm (3.03188 in.)
Mark 11	77.011 mm (3.03192 in.)
Mark 12	77.012 mm (3.03196 in.)
Mark 13	77.013 mm (3.03200 in.)
Mark	77.014 mm

2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

14	(3.03204 in.)
Mark 15	77.015 mm (3.03208 in.)
Mark 16	77.016 mm (3.03211 in.)

Crankshaft Main Journal Diameter (B)

Item	Specified Condition
Mark 00	71.999 to 72.000 mm (2.83460 to 2.83464 in.)
Mark 01	71.998 to 71.999 mm (2.83456 to 2.83460 in.)
Mark 02	71.997 to 71.998 mm (2.83452 to 2.83456 in.)
Mark 03	71.996 to 71.997 mm (2.83448 to 2.83452 in.)
Mark 04	71.995 to 71.996 mm (2.83440 to 2.83448 in.)
	71.994 to

2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

Mark 05	71.995 mm (2.83440 to 2.83444 in.)
Mark 06	71.993 to 71.994 mm (2.83436 to 2.83440 in.)
Mark 07	71.992 to 71.993 mm (2.83432 to 2.83436 in.)
Mark 08	71.991 to 71.992 mm (2.83428 to 2.83432 in.)
Mark 09	71.990 to 71.991 mm (2.83424 to 2.83428 in.)
Mark 10	71.989 to 71.990 mm (2.83420 to 2.83424 in.)
Mark 11	71.988 to 71.989 mm (2.83416 to 2.83420 in.)

Standard Bearing Center Wall Thickness

Item	Specified Condition

Mark 1	2.488 to 2.491 mm (0.0980 to 0.0981 in.)
Mark 2	2.491 to 2.494 mm (0.0981 to 0.0982 in.)
Mark 3	2.494 to 2.497 mm (0.0982 to 0.0983 in.)
Mark 4	2.497 to 2.500 mm (0.0983 to 0.0984 in.)
Mark 5	2.500 to 2.503 mm (0.0984 to 0.0985 in.)

- o. Completely remove the Plastigage.

9. REMOVE CRANKSHAFT

- a. Lift out the crankshaft.
- b. Remove the 2 upper thrust washers.

10. REMOVE CRANKSHAFT BEARING

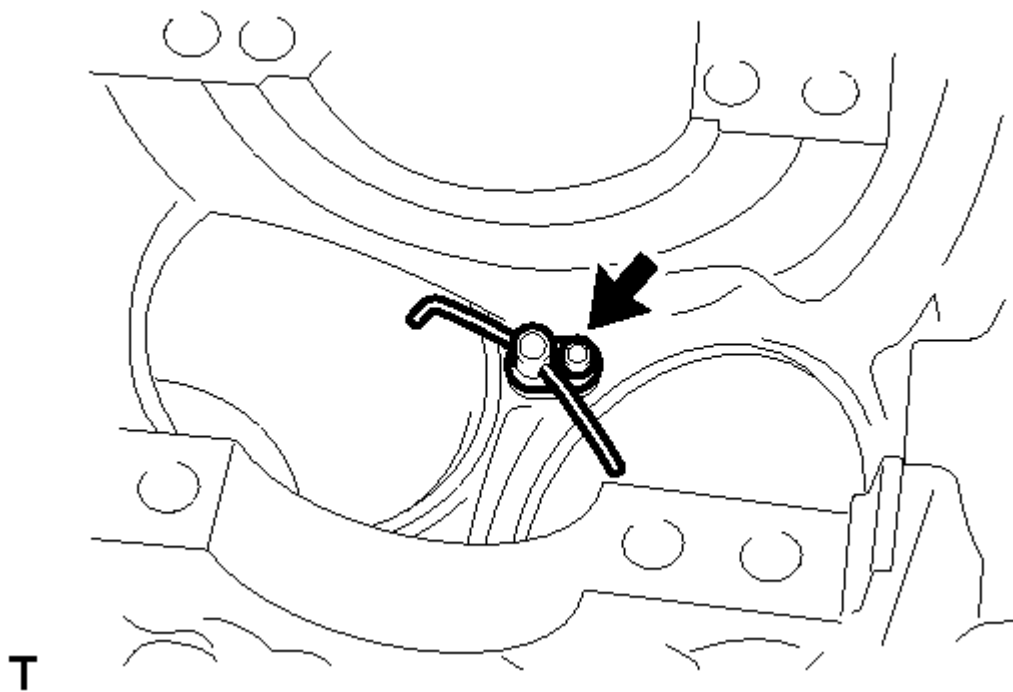
- a. Remove the crankshaft bearings from the bearing caps and cylinder block.

HINT:

Arrange the removed parts in the correct order.

11. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

- a. Using a 5 mm hexagon socket wrench, remove the 3 bolts and 3 oil nozzles.



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Fig. 145: Identifying Bolt And Oil Nozzle
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

12. REMOVE STUD BOLT

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

INSPECTION

INSPECTION

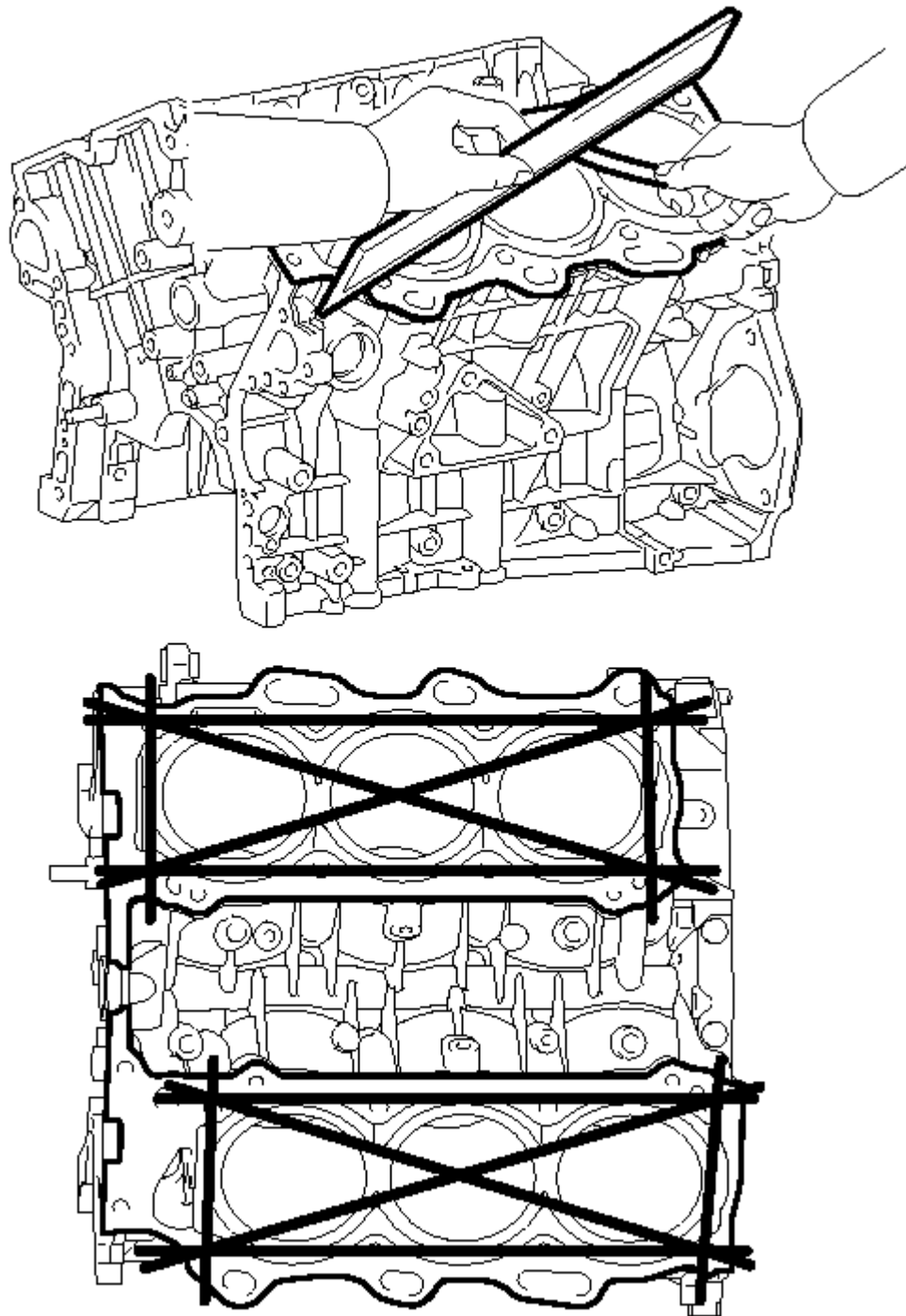
1. CLEAN CYLINDER BLOCK SUB-ASSEMBLY

- Using a gasket scraper, remove all the gasket material from the top surface of 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. Always wash the cylinder block at a temperature of 45°C (113°F) or less.

2. INSPECT CYLINDER BLOCK FOR WARPAGE

- Using a precision straightedge and feeler gauge, measure the warpage of the surfaces which contact the cylinder head gaskets.



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Fig. 146: Inspecting Cylinder Block

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

Maximum warpage

0.05 mm (0.00197 in.)

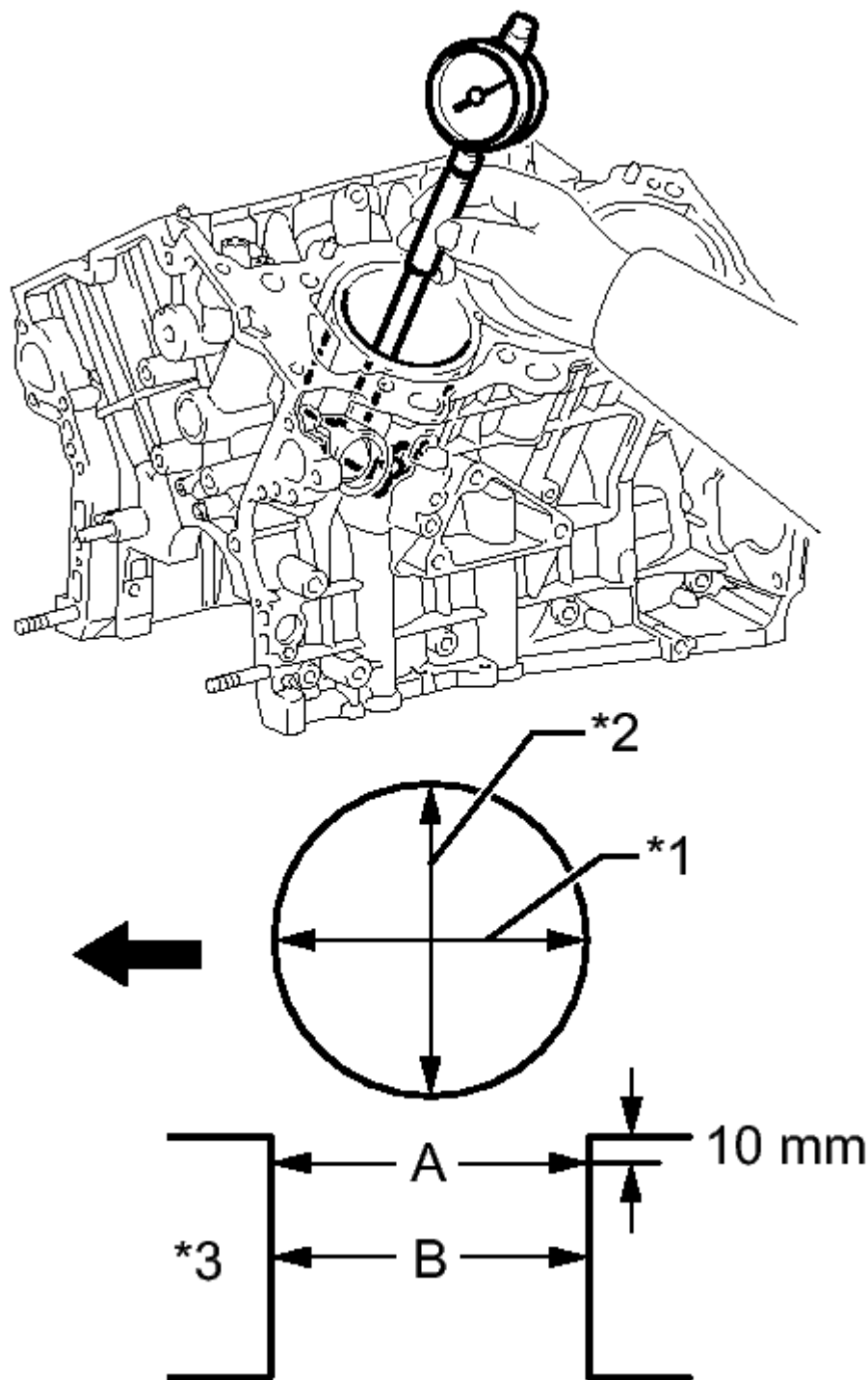
If the warpage is more than the maximum, replace the cylinder block.

- b. Visually check the cylinder for vertical scratches. If deep scratches are present, rebore all 6 cylinders.

If necessary, replace the cylinder block.

3. INSPECT CYLINDER BORE

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



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Fig. 147: Measuring Cylinder Bore Diameter

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

Standard diameter

94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter

94.132 mm (3.7060 in.)

Measurement position (A)

10 mm (0.394 in.)

TEXT IN ILLUSTRATION

*1	Axial Direction
*2	Thrust Direction
*3	Center
.	Engine Front

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

4. INSPECT RING GROOVE CLEARANCE

- a. Using a feeler gauge, measure the clearance between a new piston ring and the wall of the ring groove.

Standard Ring Groove Clearance

Item	Specified Condition
No. 1 compression ring	0.02 to 0.07 mm (0.000787 to 0.00276 in.)
No. 2 compression ring	0.02 to 0.06 mm (0.000787 to 0.00236 in.)
Oil Ring	0.07 to 0.15 mm (0.00276 to 0.00590 in.)

If the clearance is not as specified, replace the piston with pin sub-assembly.

5. INSPECT PISTON RING END GAP

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

Standard End Gap

Item	Specified Condition
No. 1 compression ring	0.22 to 0.32 mm (0.00866 to 0.0126 in.)
No. 2 compression ring	0.35 to 0.45 mm (0.0138 to 0.0177 in.)
Oil Ring (Side Rail)	0.10 to 0.40 mm (0.00394 to 0.0157 in.)

Maximum End Gap

Item	Specified Condition
No. 1 compression ring	1.0 mm (0.0394 in.)
No. 2 compression ring	1.1 mm (0.0433 in.)
Oil Ring (Side Rail)	1.0 mm (0.0394 in.)

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

6. CLEAN PISTON WITH PIN SUB-ASSEMBLY

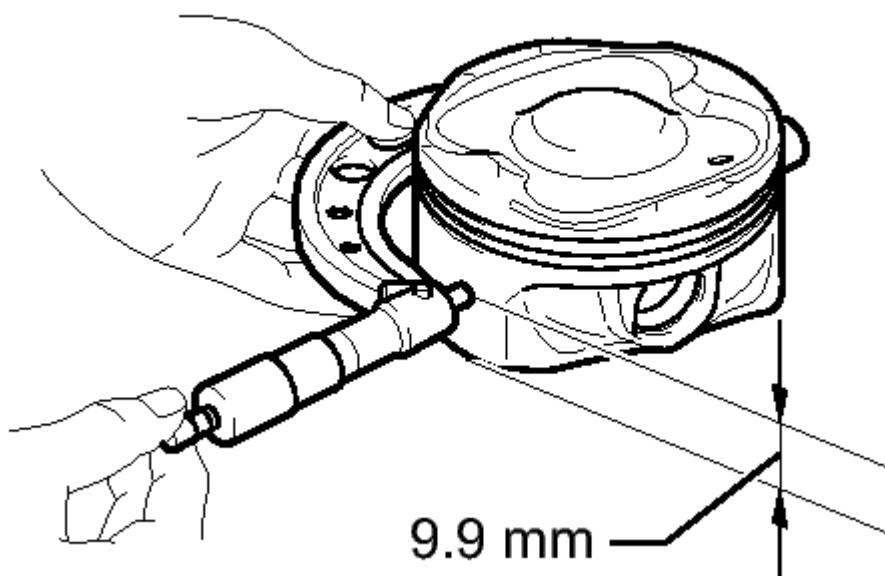
a. Clean the piston.

1. Using a gasket scraper, remove the carbon from the piston top.
2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
3. Using solvent and a brush, thoroughly clean the piston.

NOTE: Do not use a wire brush.

7. INSPECT PISTON OIL CLEARANCE

- a. Using a micrometer, measure the piston diameter at a position that is 9.9 mm (0.390 in.) from the bottom of the piston (refer to the illustration below).



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Fig. 148: Measuring Piston Diameter

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

Piston diameter

93.961 to 93.991 mm (3.6992 to 3.7004 in.)

- b. Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance

0.009 to 0.051 mm (0.000354 to 0.00201 in.)

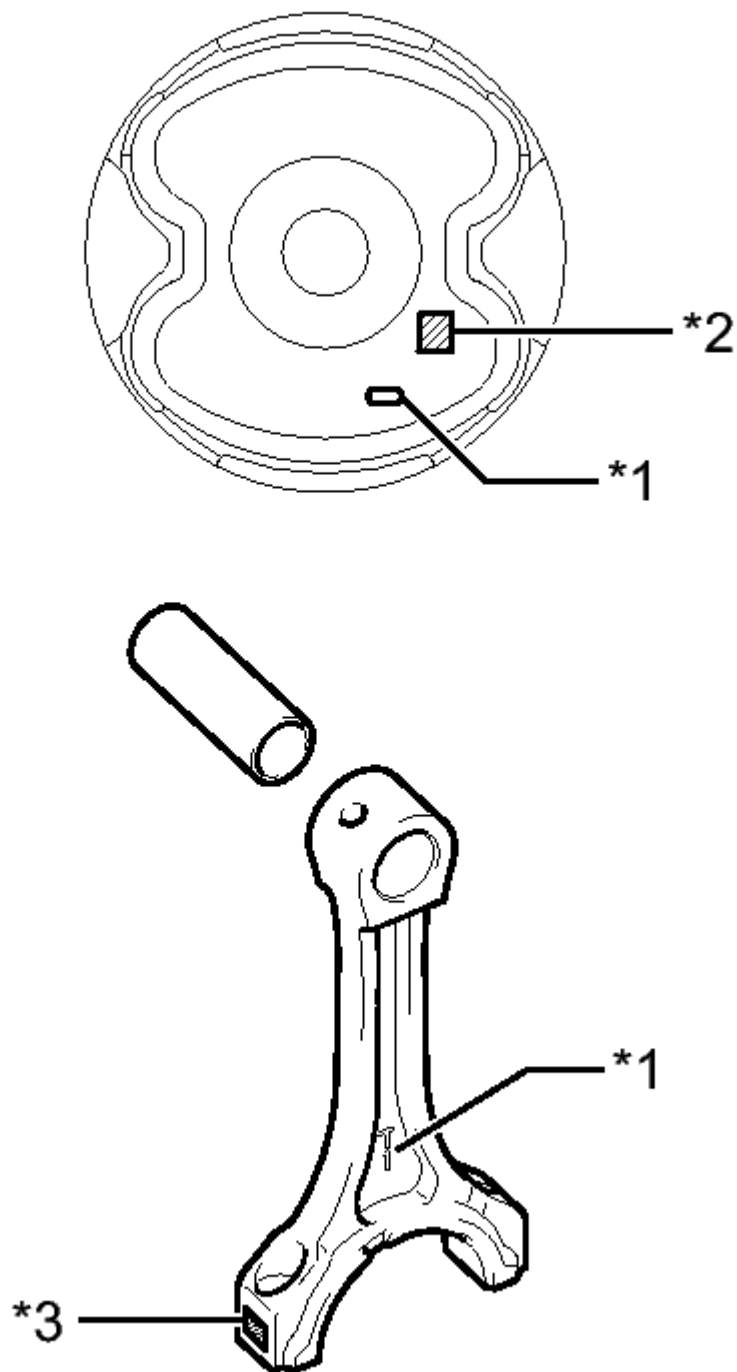
Maximum oil clearance

0.110 mm (0.00433 in.)

If the oil clearance is more than the maximum, replace all 6 pistons. If necessary, replace the cylinder block.

8. INSPECT PISTON PIN OIL CLEARANCE

- a. Check each mark on the piston and connecting rod.



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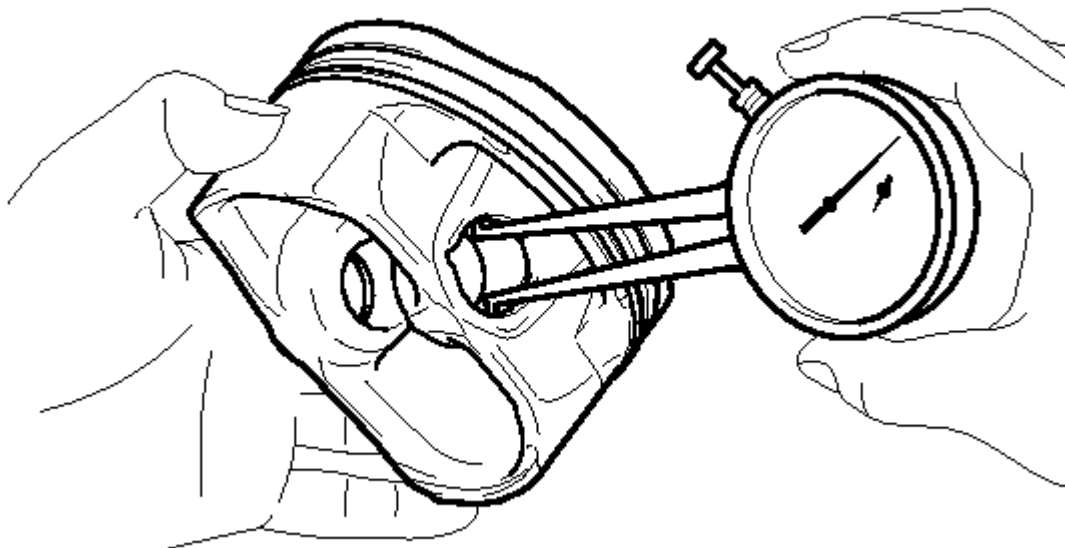
Fig. 149: Identifying Piston & Connecting Rod
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1 Front Mark

	Position Pin Hole
*2	Inside Diameter Mark
	Connecting Rod Bush
*3	Inside Diameter Mark

- b. Using a caliper gauge, measure the inside diameter of the piston pin hole.



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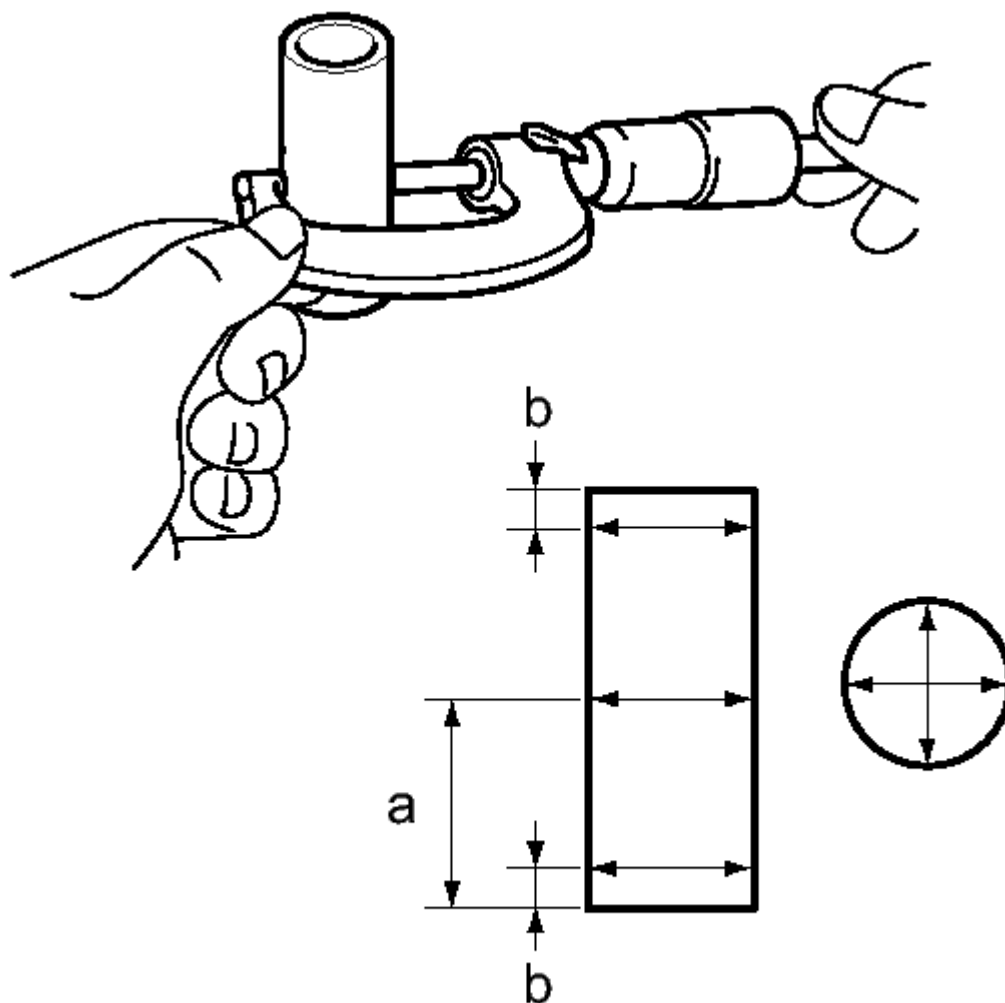
Fig. 150: Identifying Piston Pin Hole Inside Diameter
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Piston Pin Hole Inside Diameter

Item	Specified Condition
Mark A	22.001 to 22.004 mm (0.86618 to 0.86630 in.)
	22.005 to

Mark B	22.007 mm (0.86634 to 0.86642 in.)
Mark C	22.008 to 22.010 mm (0.86645 to 0.86653 in.)

- c. Using a micrometer, measure the piston pin diameter.



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Fig. 151: Identifying Piston Pin Diameter

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

Measurement Position

Measurement Position	Piston Pin Position
a	28 mm (1.102 in.) from edge
b	5 mm (0.197 in.) from edge

Standard Piston Pin Diameter

Item	Specified Condition
Mark A	21.997 to 22.000 mm (0.86602 to 0.86614 in.)
Mark B	22.001 to 22.003 mm (0.86618 to 0.86626 in.)
Mark C	22.004 to 22.006 mm (0.86630 to 0.86642 in.)

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

Standard Bush Inside Diameter

Item	Specified Condition
	22.005 to

Mark A	22.008 mm (0.86634 to 0.86645 in.)
Mark B	22.009 to 22.011 mm (0.86649 to 0.86657 in.)
Mark C	22.012 to 22.014 mm (0.86661 to 0.86669 in.)

- e. Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance

0.001 to 0.007 mm (0.0000394 to 0.000276 in.)

Maximum oil clearance

0.040 mm (0.00157 in.)

If the oil clearance is more than the maximum, replace the piston with pin sub-assembly.

- f. Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance

0.005 to 0.011 mm (0.000197 to 0.000433 in.)

Maximum oil clearance

0.050 mm (0.00197 in.)

If the oil clearance is more than the maximum, replace the connecting rod sub-assembly. If necessary, replace the piston with pin sub-assembly.

9. INSPECT CONNECTING ROD SUB-ASSEMBLY

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

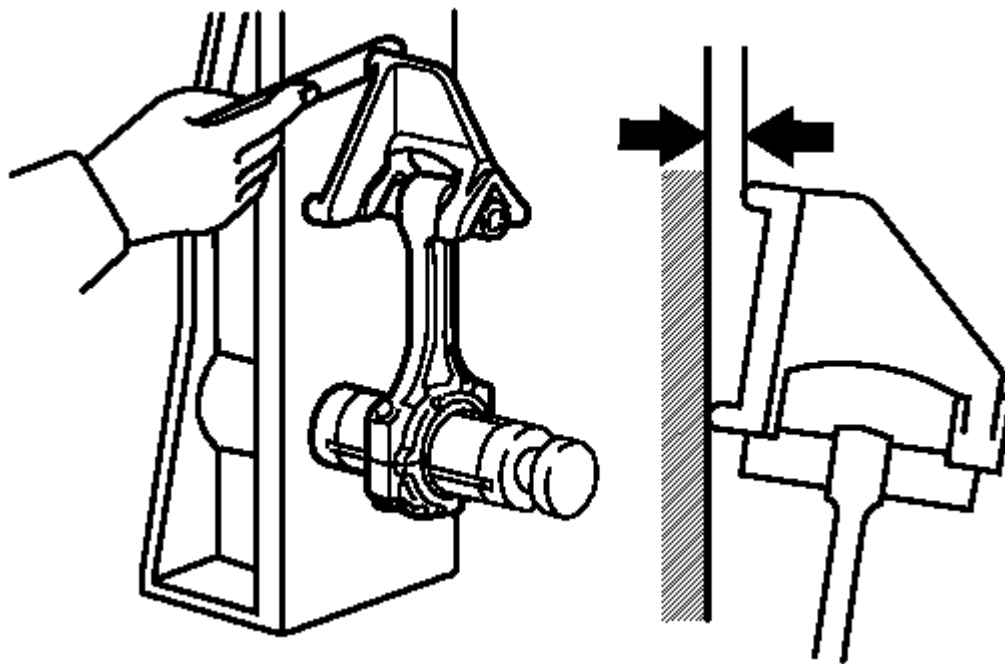


Fig. 152: Checking Connecting Rod For Bend
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

1. Check for bend.

Maximum bend

0.05 mm (0.00197 in.) per 100 mm (3.94 in.)

If the bend is more than the maximum, replace the connecting rod sub-assembly.

2. Check for twist.

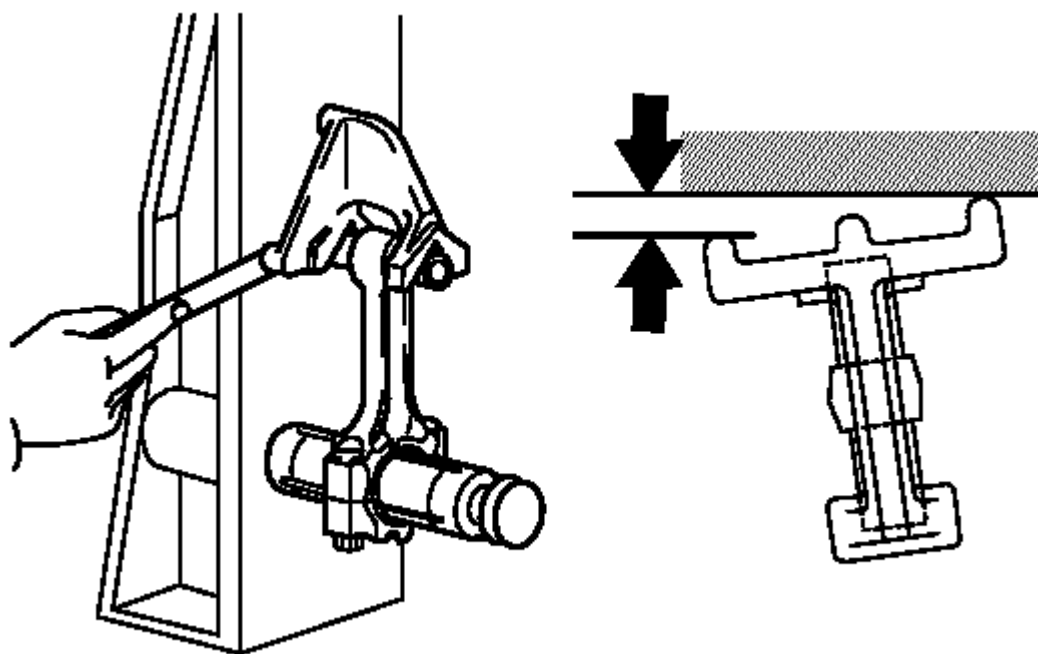


Fig. 153: Checking Connecting Rod For Twist
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum twist

0.15 mm (0.00591 in.) per 100 mm (3.94 in.)

If the twist is more than the maximum, replace the connecting rod sub-assembly.

10. INSPECT CRANKSHAFT

- a. Using a dial indicator, measure the runout at the center journal.

Maximum circle runout

0.06 mm (0.00236 in.)

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

- b. Using a micrometer, measure the diameter of each main journal.

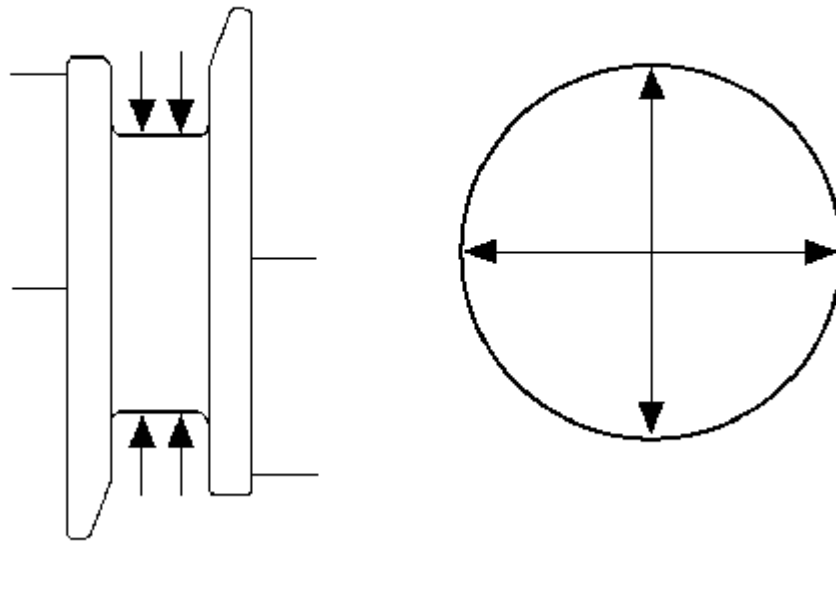


Fig. 154: Checking Main Journal For Taper & Out-Of-Roundness
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard diameter

71.988 to 72.000 mm (2.8342 to 2.8346 in.)

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

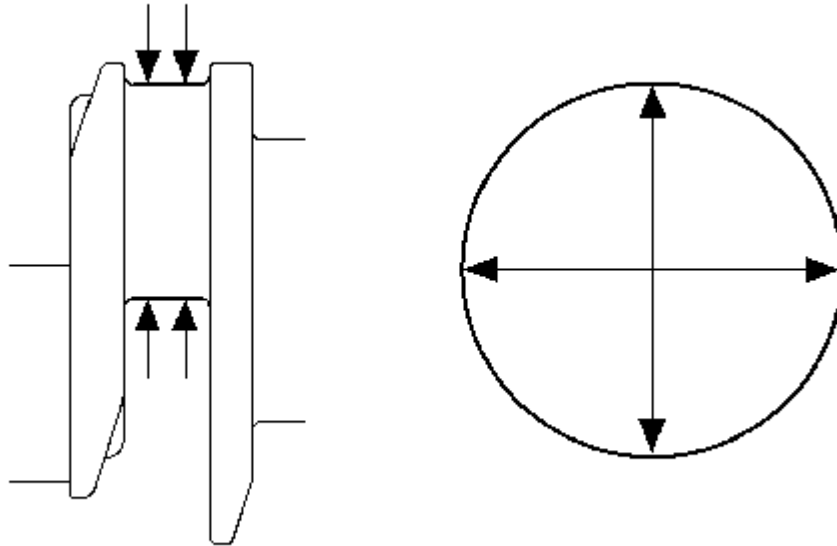
- c. Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round

0.02 mm (0.000787 in.)

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

- d. Using a micrometer, measure the diameter of each crank pin.



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Fig. 155: Checking Crank Pin For Taper & Out-Of-Roundness
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard diameter

55.992 to 56.000 mm (2.2044 to 2.2047 in.)

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

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

Maximum taper and out-of-round

0.02 mm (0.000787 in.)

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

11. INSPECT CONNECTING ROD BOLT

- a. Using a vernier caliper, measure the tension portion diameter of the bolt.

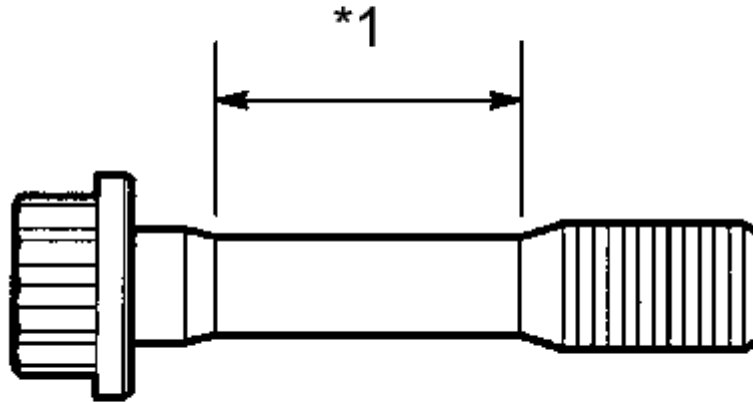


Fig. 156: Identifying Tension Portion Diameter Of Connecting Rod Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard diameter

7.2 to 7.3 mm (0.283 to 0.287 in.)

Minimum diameter

7.0 mm (0.276 in.)

TEXT IN ILLUSTRATION

*1	Measurement Area
----	---------------------

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

12. INSPECT CRANKSHAFT BEARING CAP SET BOLT

- a. Using a vernier caliper, measure the thread outside diameter of the crankshaft bearing cap set bolt.

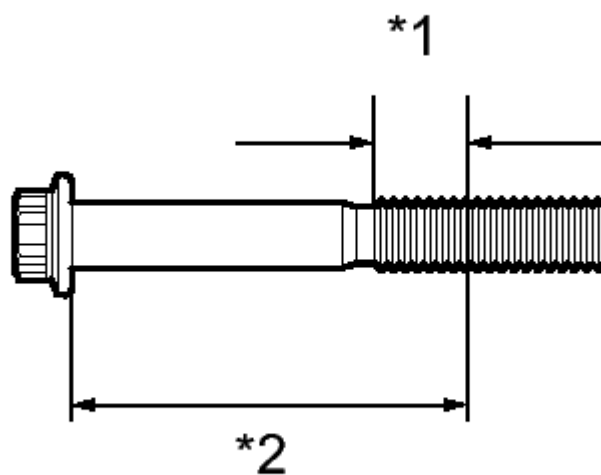


Fig. 157: Measuring Thread Outside Diameter Of the Crankshaft Bearing Cap Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Distance

60 mm (2.36 in.)

Standard diameter

10.0 to 10.2 mm (0.394 to 0.402 in.)

TEXT IN ILLUSTRATION

*1	Measurement Area
*2	Distance

If the result is not as specified, replace the crankshaft bearing cap set bolt.

13. INSPECT NO. 1 OIL NOZZLE SUB-ASSEMBLY

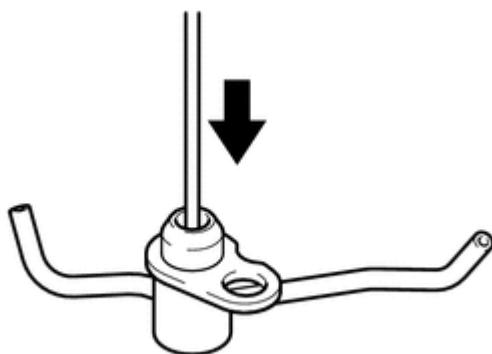
**P**

Fig. 158: Inspecting No. 1 Oil Nozzle Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- Push the check valve with a pin to check if it is stuck. If stuck, replace the oil nozzle.
- Push the check valve with a pin to check if it moves smoothly.

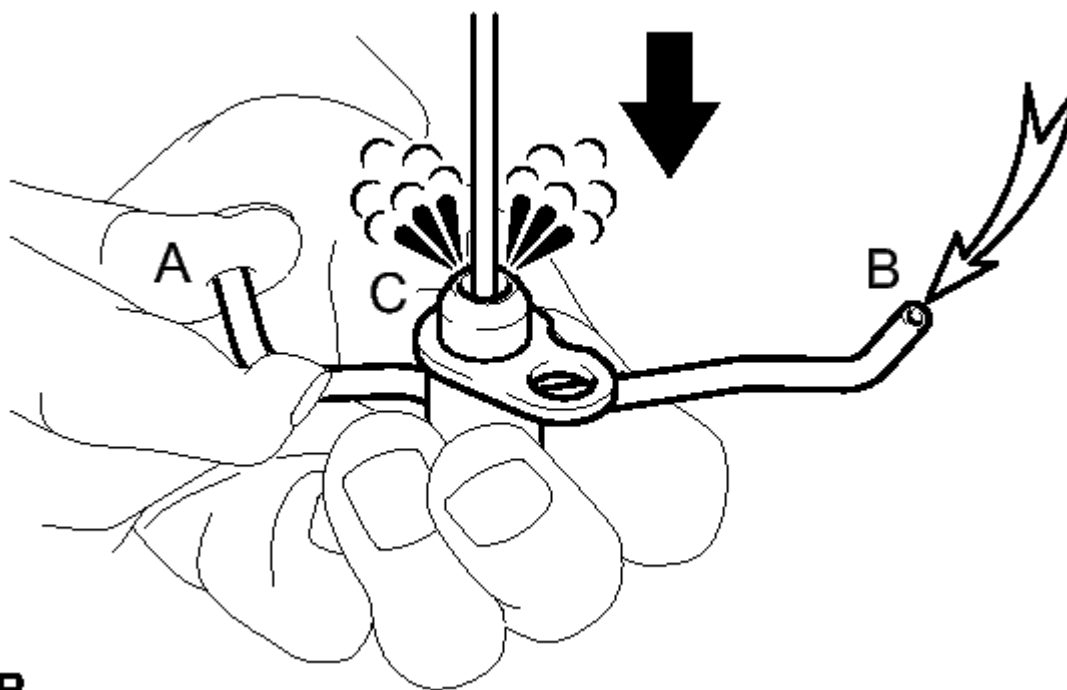
If it does not move smoothly, clean or replace the oil nozzle.

**P**

Fig. 159: Checking Oil nozzle For Leaks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- While covering A, blow air into B. Check that air does not leak through C. Perform the check again while covering B and blowing air into A.

If air leaks, clean or replace the oil nozzle.

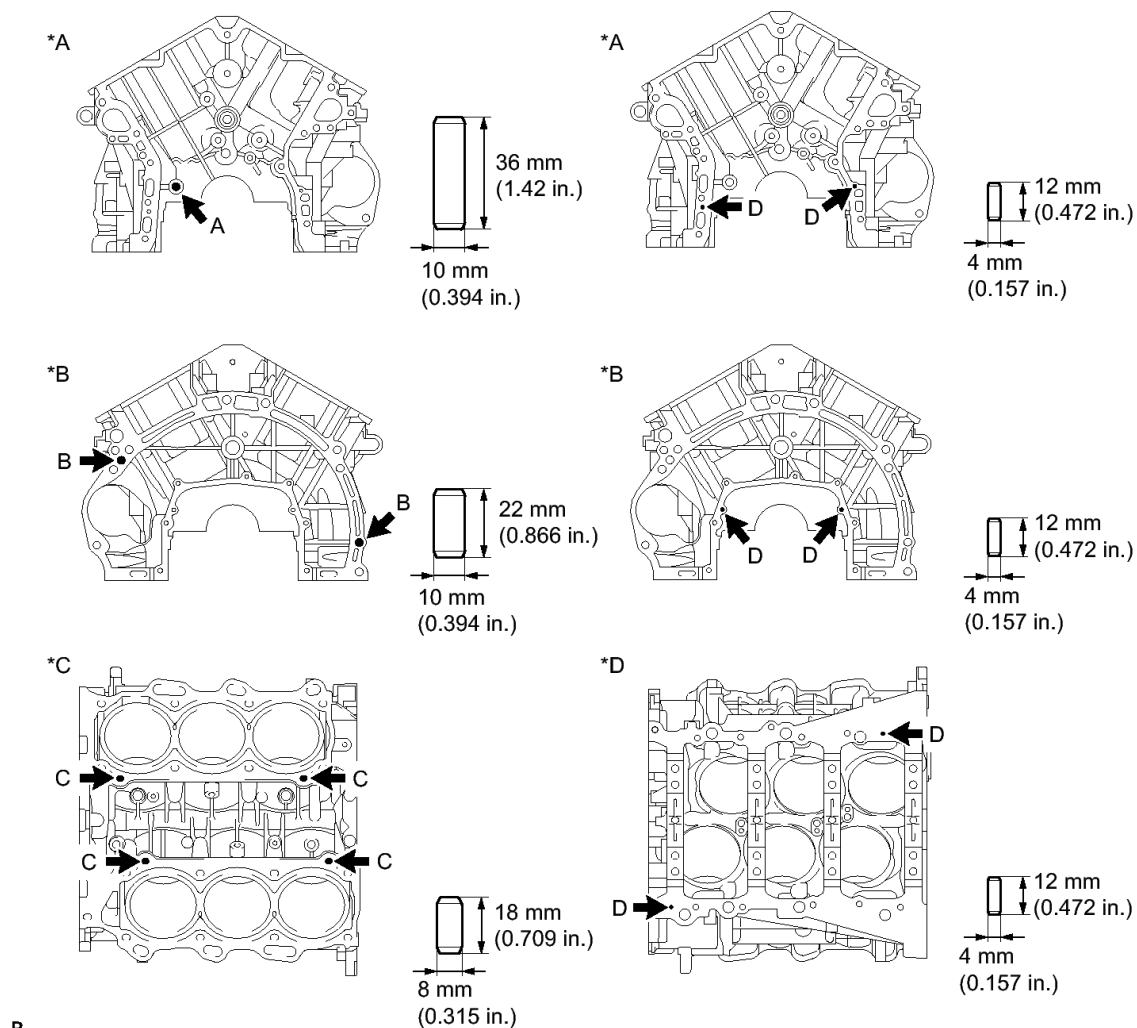
**P****Fig. 160: Inspecting Check Valve Operation****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- d. Push the check valve while covering A, and blow air into B. Check that air passes through C. Perform the check again while covering B, pushing the check valve and blowing air into A.

If air does not pass through C, clean or replace the oil nozzle.

REPLACEMENT**REPLACEMENT****1. REPLACE STRAIGHT PIN**

NOTE: It is not necessary to remove a straight pin unless it is being replaced.



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Fig. 161: Identifying Straight Pins Locations

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

TEXT IN ILLUSTRATION

*A	Front Side	*B	Rear Side
*C	Upper Side	*D	Lower Side

- Remove the straight pins.
- Using a plastic-faced hammer, tap in new straight pins to the cylinder block.

Standard Protrusion Height

Item	Specified Condition

2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

Pin A	22.5 to 23.5 mm (0.886 to 0.925 in.)
Pin B	10.5 to 11.5 mm (0.413 to 0.453 in.)
Pin C	8.5 to 9.5 mm (0.335 to 0.374 in.)
Pin D	5.5 to 6.5 mm (0.217 to 0.256 in.)

REASSEMBLY

REASSEMBLY

1. INSTALL STUD BOLT

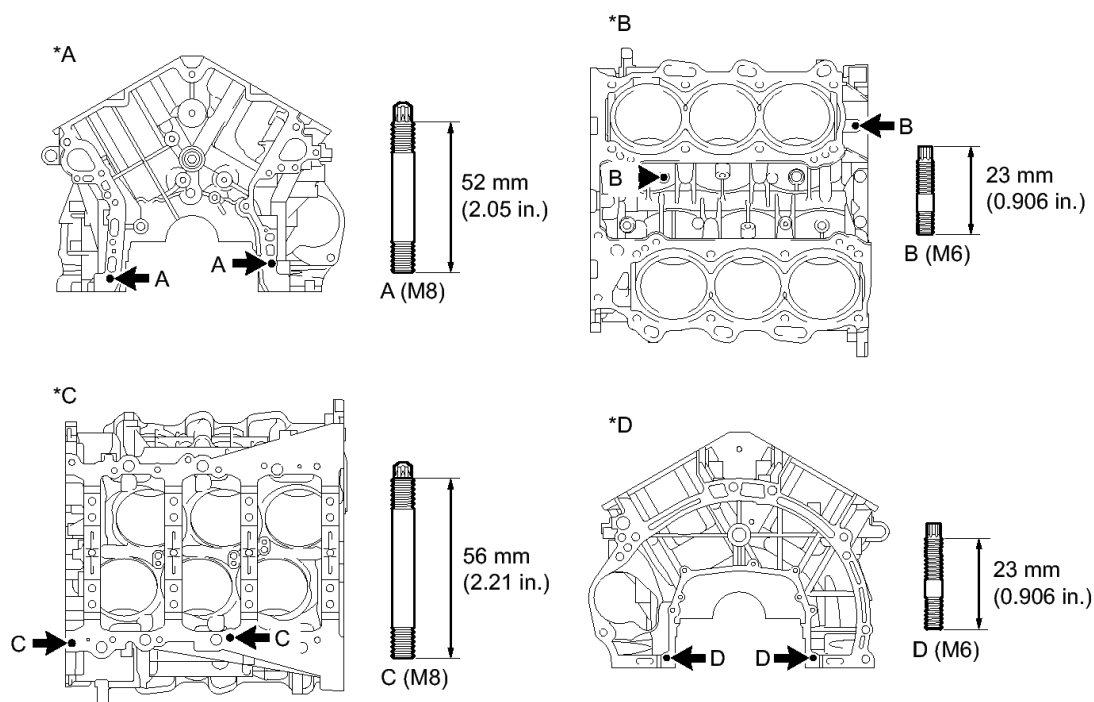
- Install new stud bolts.

for stud bolt A and C

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

for stud bolt B and D

Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)



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Fig. 162: Identifying Stud Bolts Locations

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

TEXT IN ILLUSTRATION

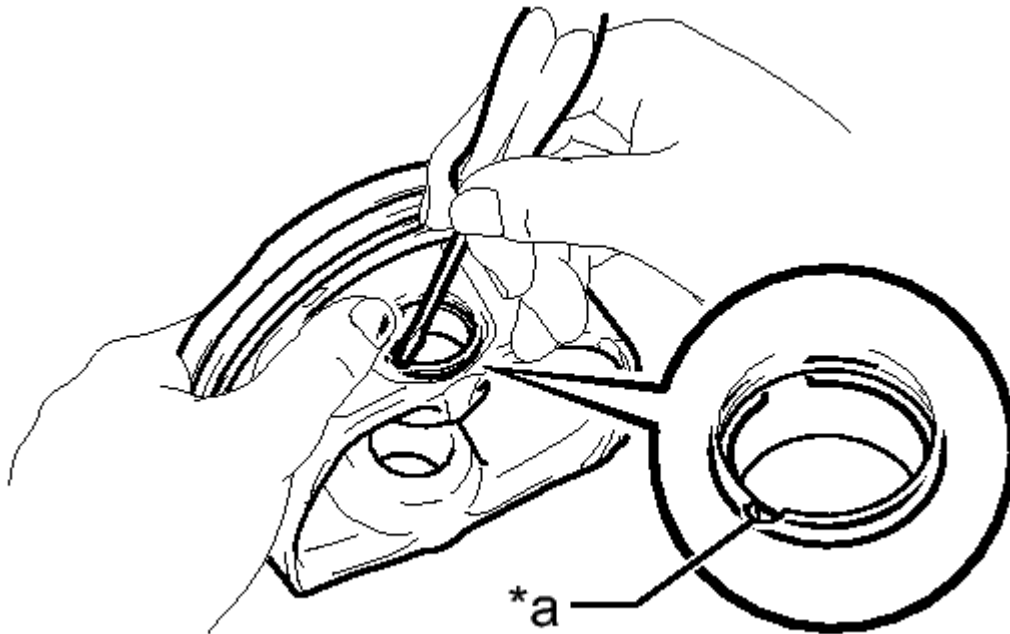
*A	Front Side	*B	Upper Side
*C	Lower Side	*D	Rear Side

2. INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY

- Using a 5 mm hexagon socket wrench, install the 3 oil nozzles with the 3 bolts.

Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)
3. INSTALL PISTON WITH PIN SUB-ASSEMBLY

- Using a screwdriver, install a new snap ring on one side of the piston pin hole.

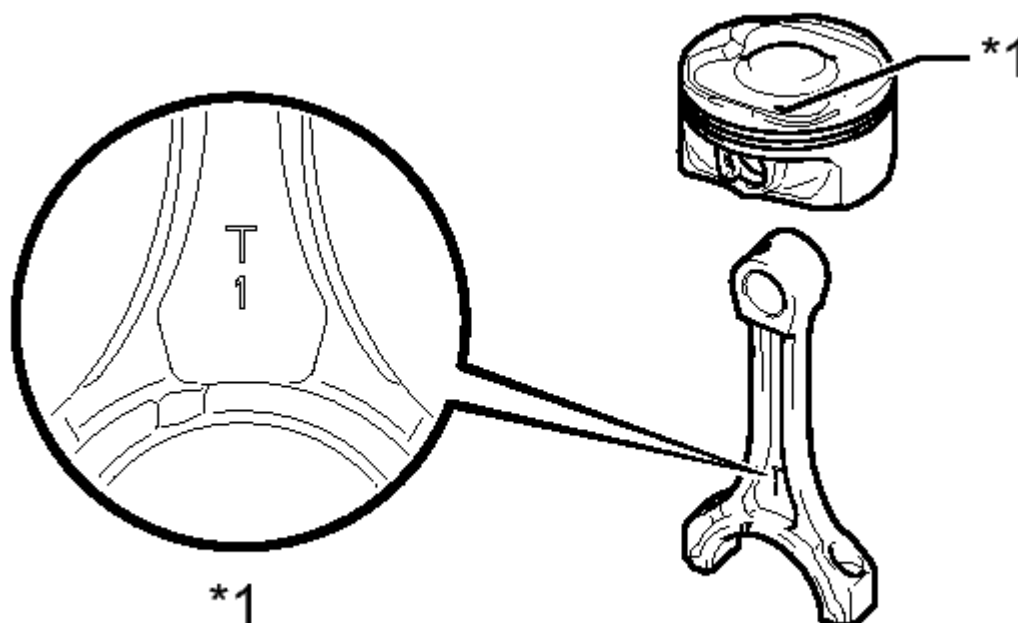
**P****Fig. 163: Installing New Snap Ring Using A Screwdriver****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****TEXT IN ILLUSTRATION**

*a	Pin Hole Cutout Portion
----	----------------------------------

HINT:

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

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

**P****Fig. 164: Identifying Piston & Connecting Rod**

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

- d. Align the front marks of the piston and connecting rod, insert the connecting rod into the piston, and then push in the piston pin with your thumb until the pin comes into contact with the snap ring.

TEXT IN ILLUSTRATION

*1	Front Mark
----	---------------

HINT:

The piston and pin are a matched set.

- e. Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.
- f. Using a screwdriver, install a new snap ring at the other end of the piston pin hole.

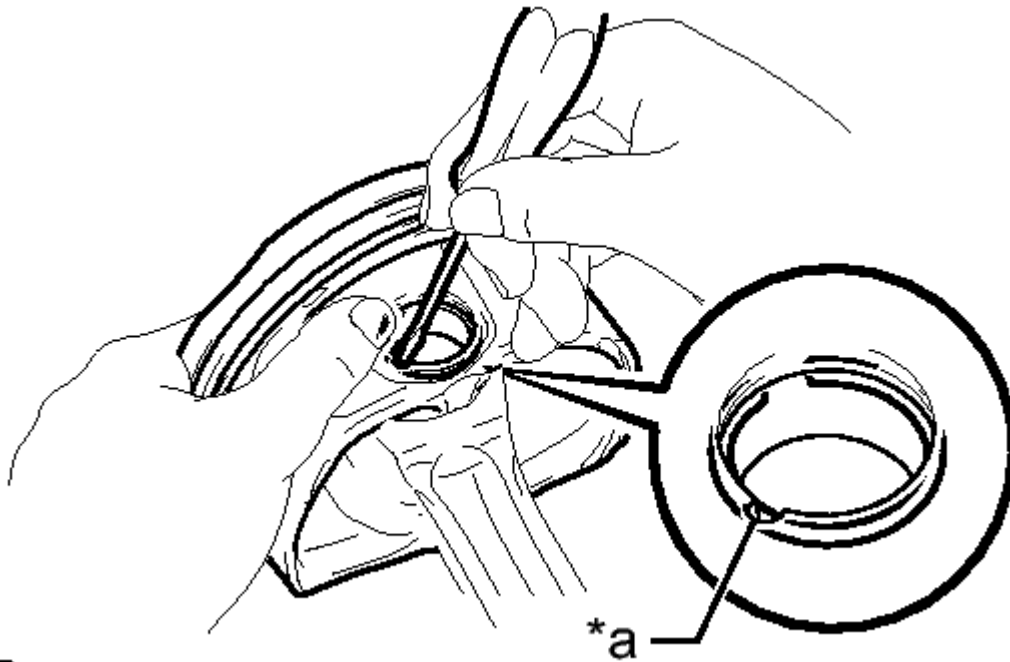
**P**

Fig. 165: Installing New Snap Ring Using Screwdriver
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

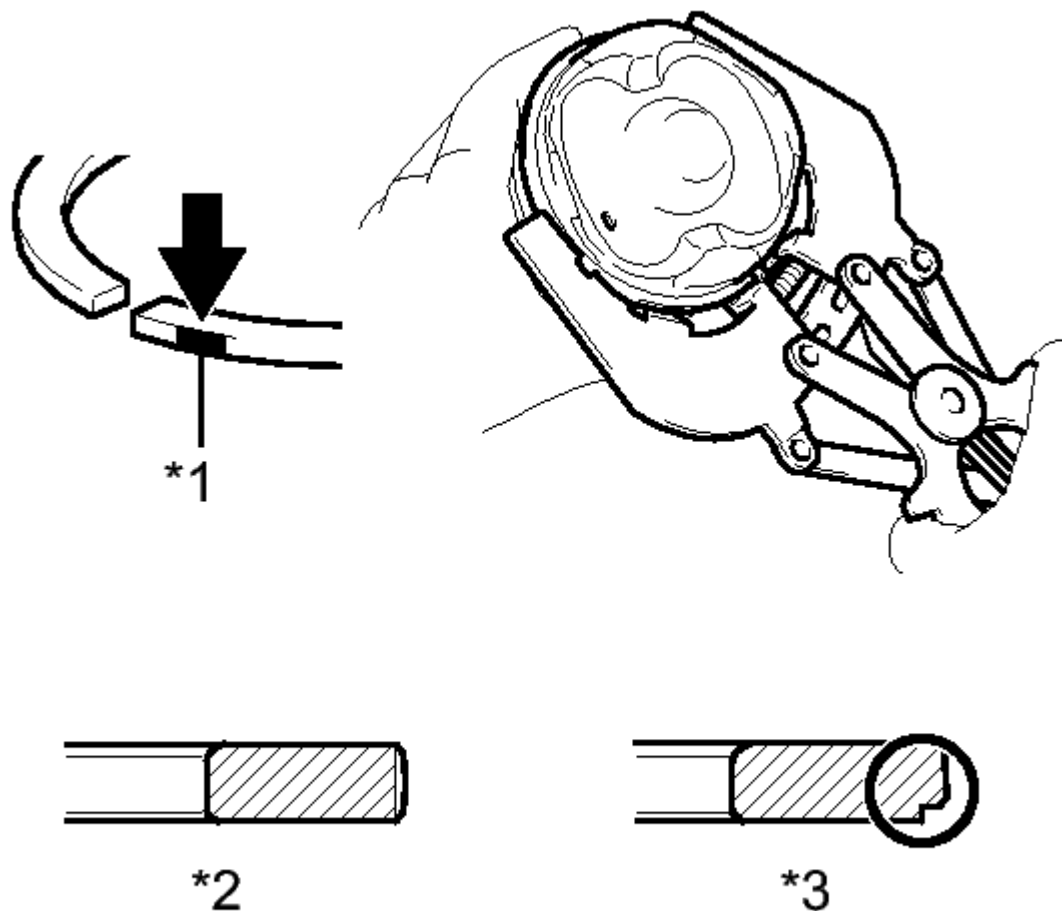
*a	Pin Hole Cutout Portion
----	----------------------------------

HINT:

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

4. INSTALL PISTON RING SET

- Install the oil ring (expander) and 2 side rails by hand.
- Using a piston ring expander, install the 2 compression rings with the painted mark on the right side.



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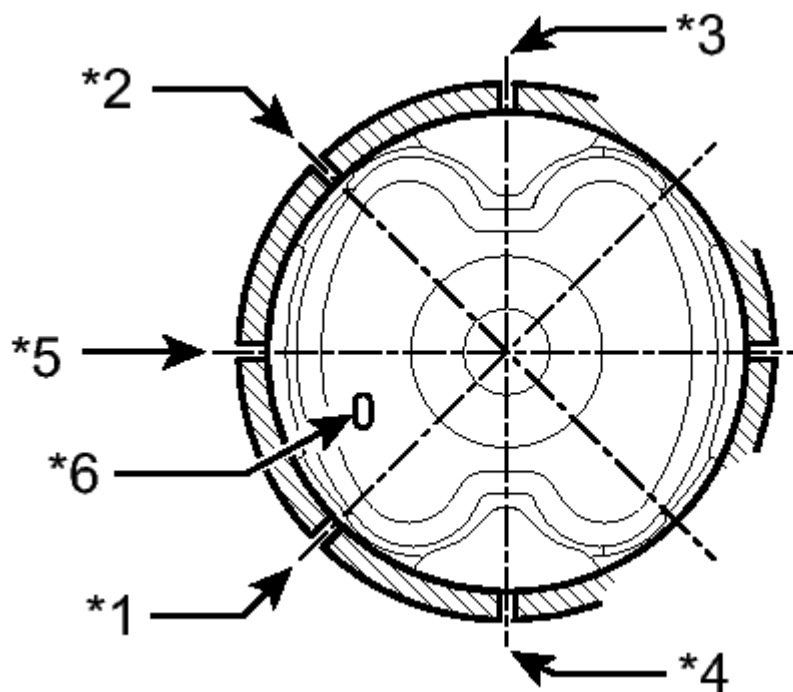
Fig. 166: Identifying Compression Rings

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

TEXT IN ILLUSTRATION

*1	Painted Mark
*2	No. 1 Compression Ring
*3	No. 2 Compression Ring
·	Right Side

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

**P****Fig. 167: View of Piston Component Rings**

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

TEXT IN ILLUSTRATION

*1	No. 1 Compression Ring
*2	No. 2 Compression Ring
*3	Lower Side Rail
*4	Upper Side Rail
*5	Expander
*6	Front Mark

5. INSTALL CRANKSHAFT BEARING**HINT:**

Main bearings come in widths of 17.3 mm (0.681 in.) and 19.9 mm (0.783 in.). Install the 19.9 mm (0.783 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the bearing caps. Install the 17.3 mm (0.681 in.) bearings in the No. 2 and No. 3 positions.

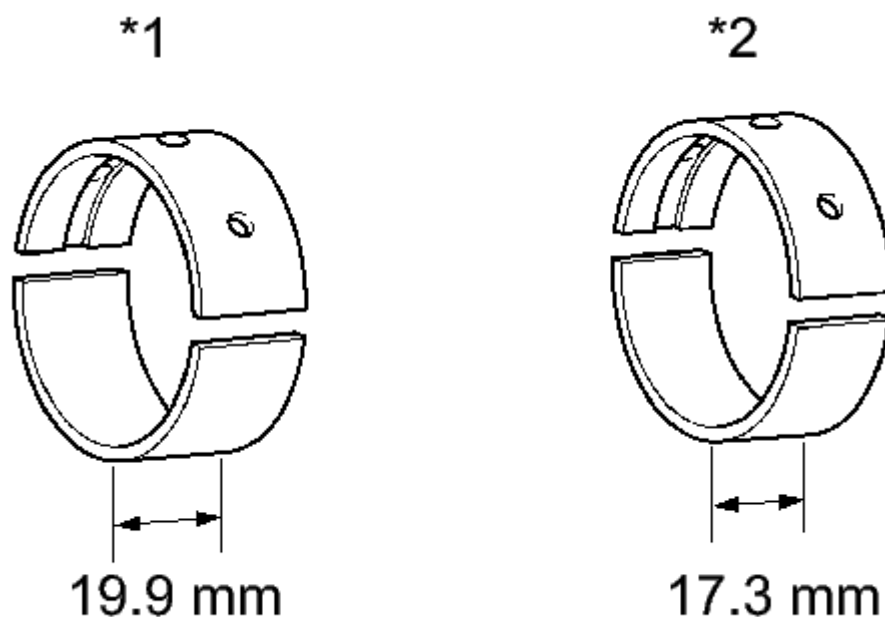


Fig. 168: Identifying Crankshaft Bearings

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

TEXT IN ILLUSTRATION

*1	No. 1 and No. 4 Journal Bearings
*2	No. 2 and No. 3 Journal Bearings

- a. Clean each main journal and bearing.
- b. Install the upper bearing.
 1. Install the upper bearing to the cylinder block as shown in the illustration.

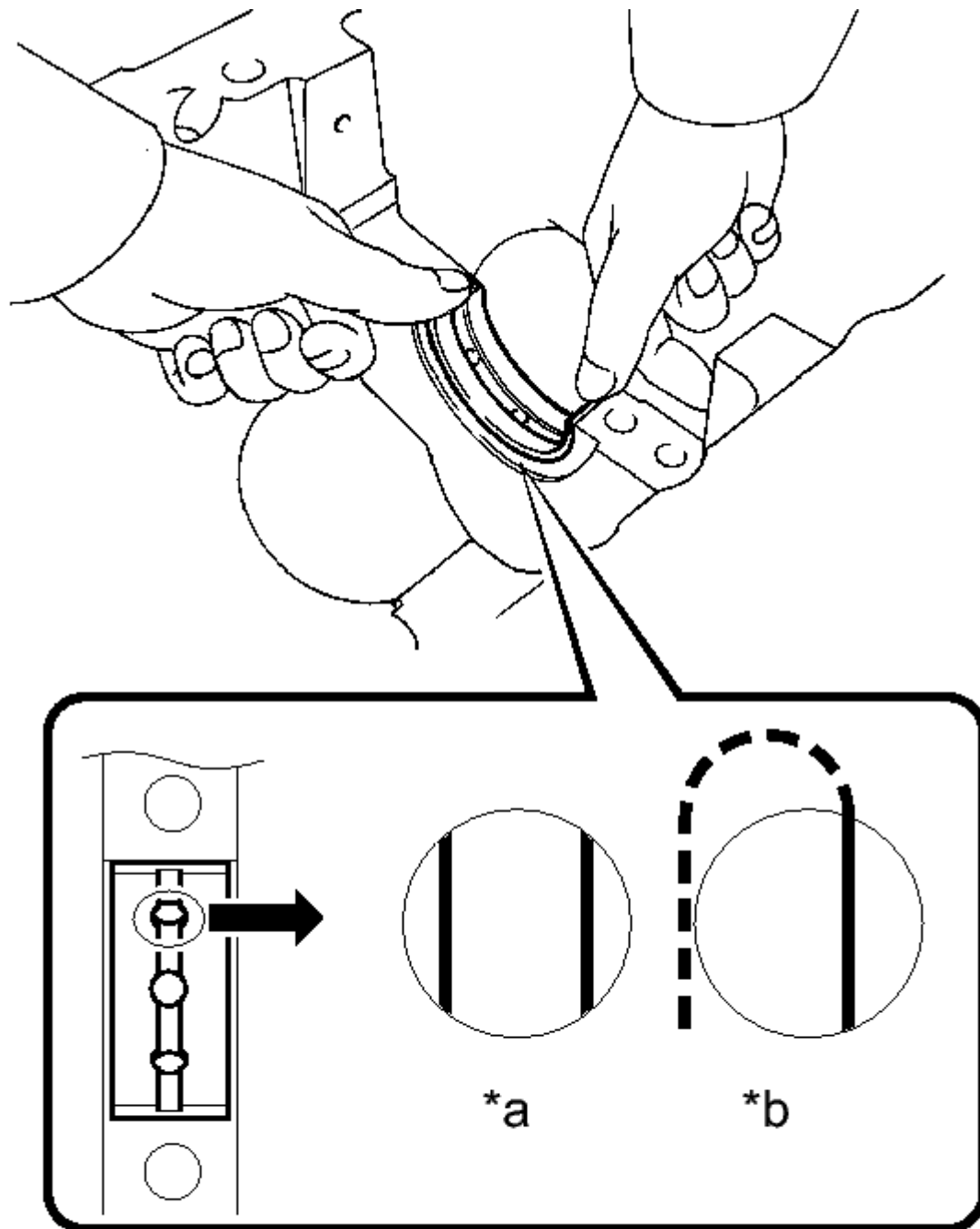


Fig. 169: Identifying Upper Bearing On Cylinder Block
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

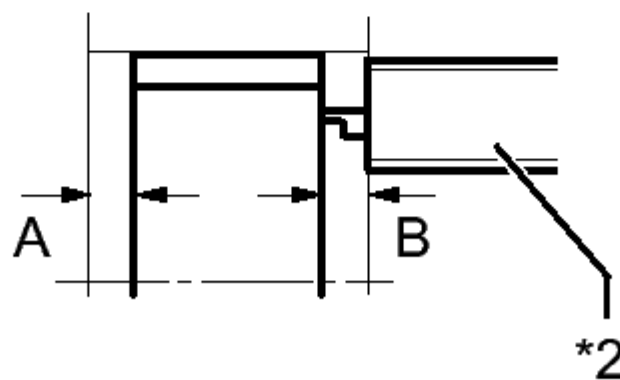
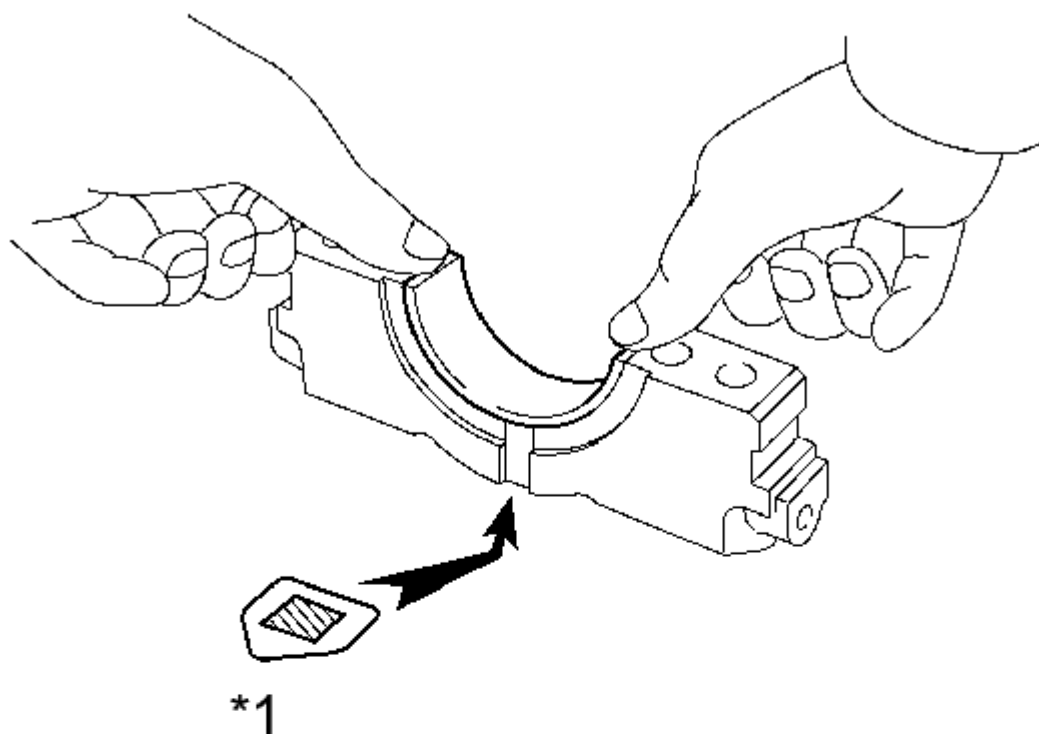
TEXT IN ILLUSTRATION

*a	CORRECT
----	---------

b|INCORRECT|*NOTE:**

- Do not apply engine oil to the bearings or contact surfaces.
- Both sides of the oil groove in the cylinder block should be visible through the oil feed holes in the bearing. The amount visible on each side of the holes should be equal.
- Do not allow coolant to come into contact with the inner surface of the bearing.
- If any coolant comes into contact with the inner surface of the bearing, replace the bearing with a new one.

c. Install the lower bearing.

**T****Fig. 170: Installing Lower Bearing****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

1. Install the lower bearings to the crankshaft bearing caps.

TEXT IN ILLUSTRATION

*1	Mark 1, 2, 3 or 4
*2	Vernier Caliper

2. Using a vernier caliper, measure the distance between the edge of the crankshaft bearing cap and the edge of the lower bearing.

Dimension A - B or B - A

0 to 0.7 mm (0 to 0.0276 in.)

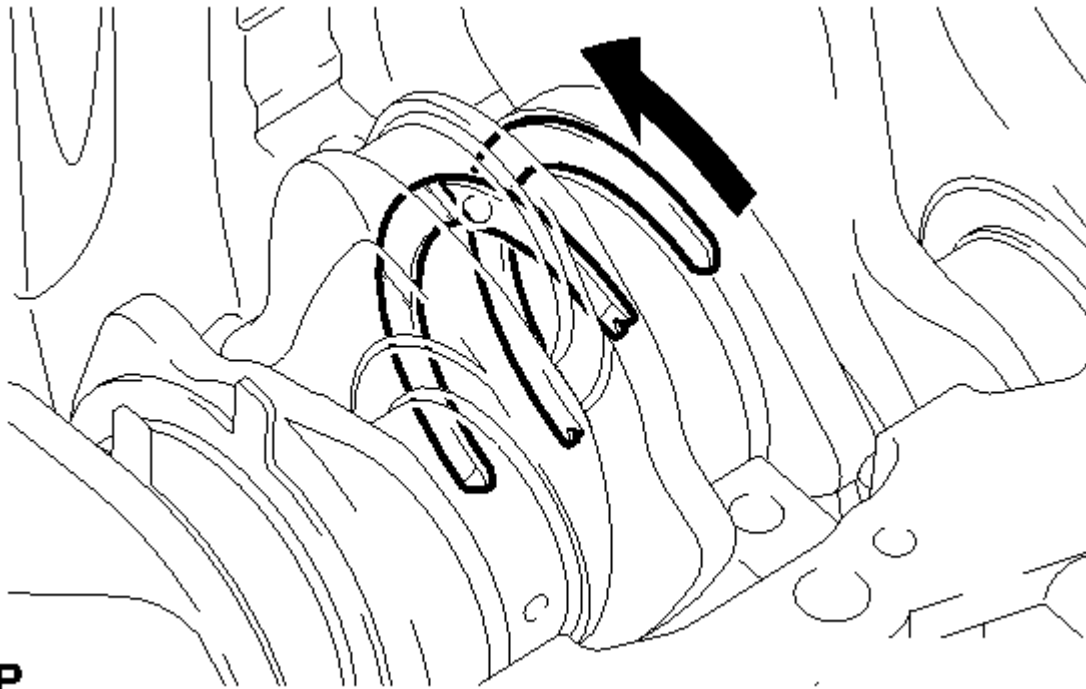
NOTE:

- Do not apply engine oil to the bearings or contact surfaces.
- Do not allow coolant to come into contact with the inner surface of the bearing.
- If any coolant comes into contact with the inner surface of the bearing, replace the bearing with a new one.

6. INSTALL CRANKSHAFT

NOTE: Clean the contact surface of each main journal and crank pin.

- a. Apply new engine oil to the upper bearing and install the crankshaft to the cylinder block.
- b. Push the crankshaft in the rear thrust direction to create clearance and install a thrust washer to the No. 2 journal position with the oil groove facing the front of the engine.

**P****Fig. 171: Installing Thrust Washer Into No. 2 Journal Position****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- c. Push the crankshaft in the forward thrust direction to create clearance and install a thrust washer to the No. 2 journal position with the oil groove facing the rear of the engine.
- d. Install the 2 lower thrust washers to the No. 2 bearing cap with the grooves facing outward.

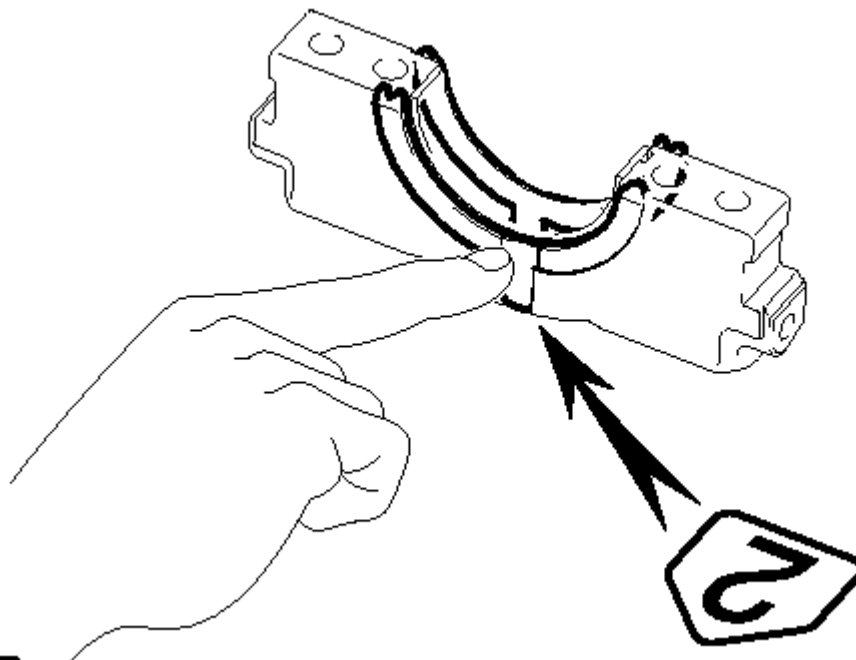
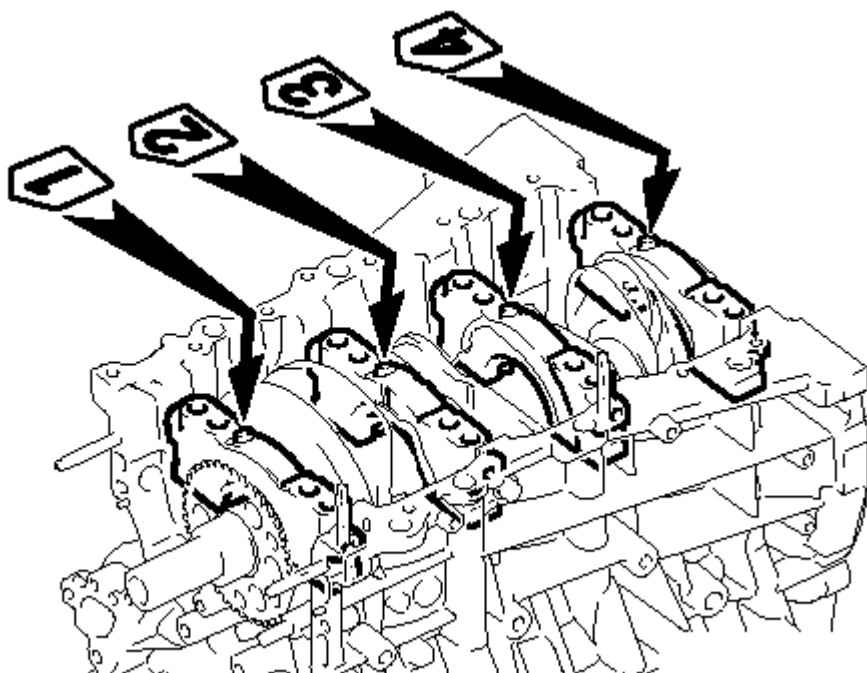
**P**

Fig. 172: Examining Front Marks & Numbers

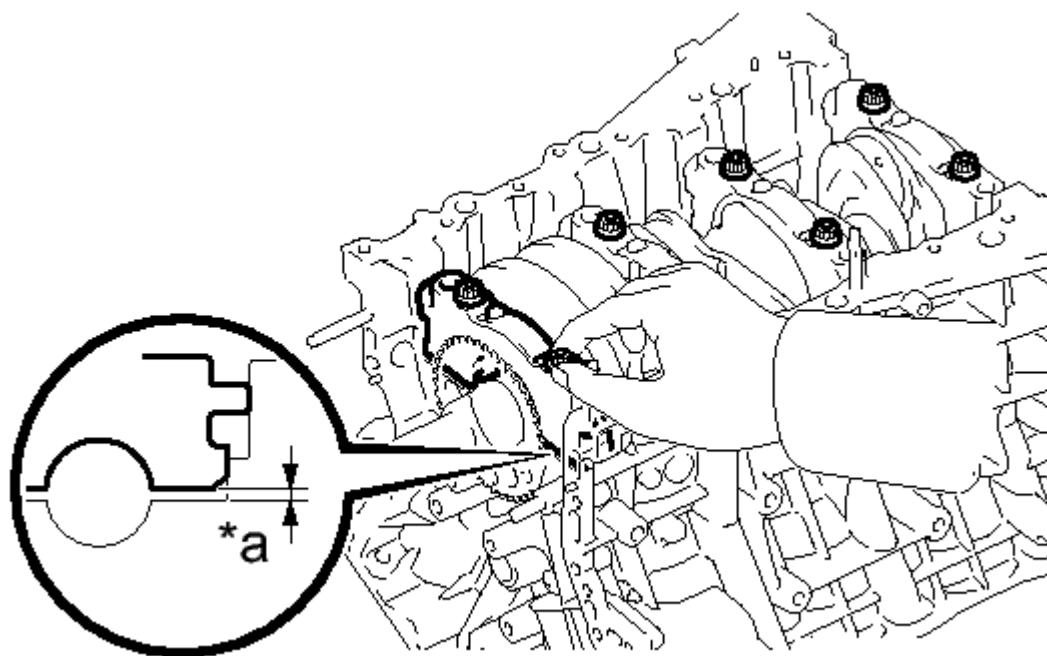
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- e. Examine the front marks and numbers and set the crankshaft bearing caps on the cylinder block.

**P****Fig. 173: Identifying Crankshaft Bearing Cap Front Marks And Numbers**

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

- f. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts.
- g. Temporarily install the 8 crankshaft bearing cap bolts to the inside positions.
- h. Tighten the 2 bolts for each bearing cap until the clearance between the crankshaft bearing cap and the cylinder block becomes less than 6 mm (0.236 in.).

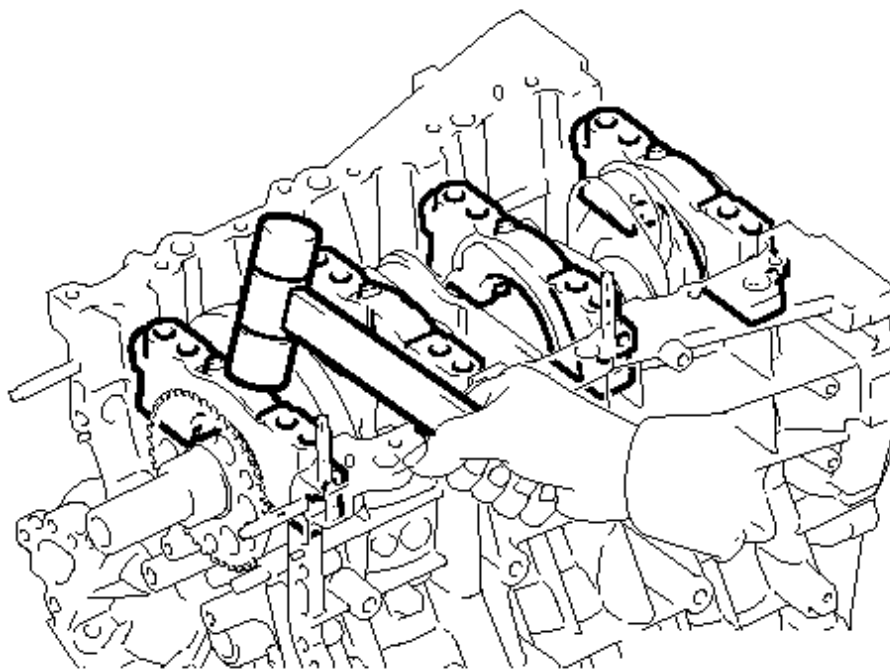
**P****Fig. 174: Identifying Bearing Cap Clearance**

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

TEXT IN ILLUSTRATION

*a	Less than 6 mm
----	-------------------------

- i. Using a plastic-faced hammer, lightly tap the crankshaft bearing cap to ensure a proper fit.

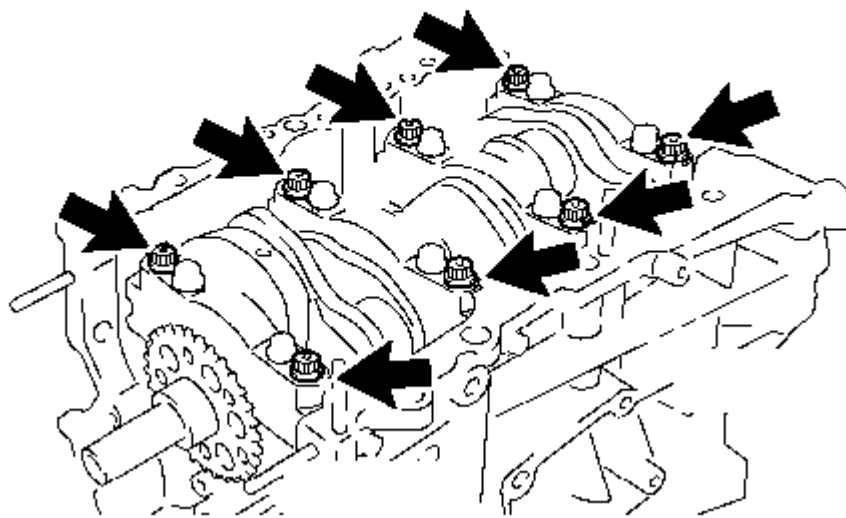


P

Fig. 175: Identifying Bearing Cap And Hammer

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

- j. Apply a light coat of engine oil to the threads of the crankshaft bearing cap bolts and temporarily install the 8 crankshaft bearing bolts to the outside positions.



Y

Fig. 176: Identifying Outside Position Crankshaft Bearing Bolts

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

- k. Tighten the crankshaft bearing cap bolts.

HINT:

The cap bolts are tightened in 2 progressive steps.

1. Step 1:

Uniformly tighten the 16 bolts in several steps in the order shown in the illustration.

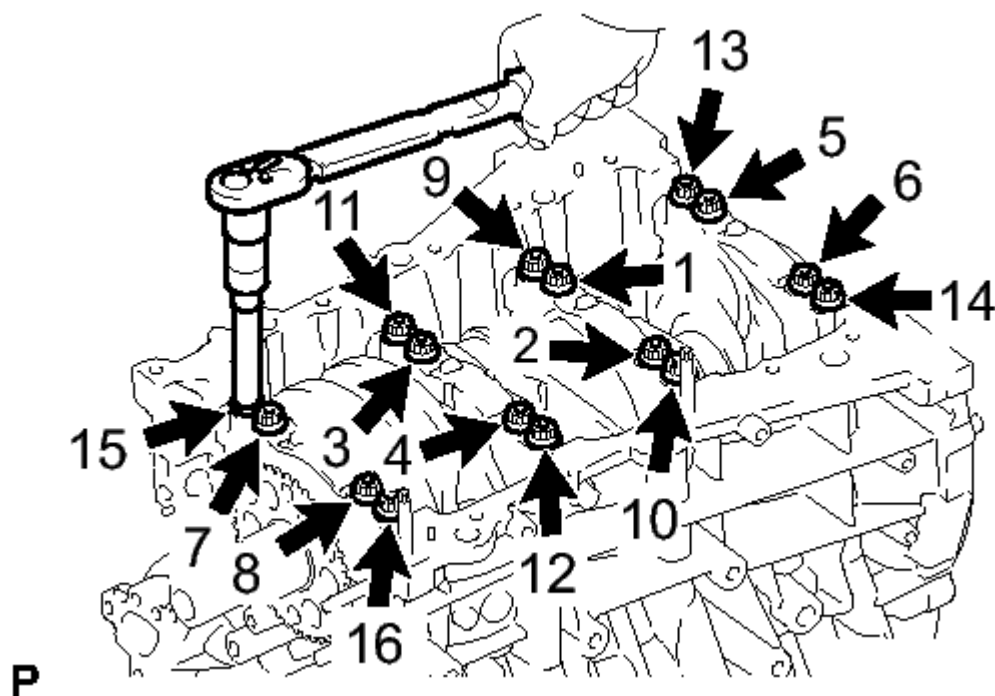


Fig. 177: Identifying Crankshaft Bearing Bolts With Tightening Sequence
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

2. Mark the front side of the crankshaft bearing cap bolts with paint.
3. Step 2:

Tighten the bearing cap bolts 90° in the order shown in step 1.

4. Check that the paint mark is now at a 90° angle to the front.
1. Check that the crankshaft turns smoothly.

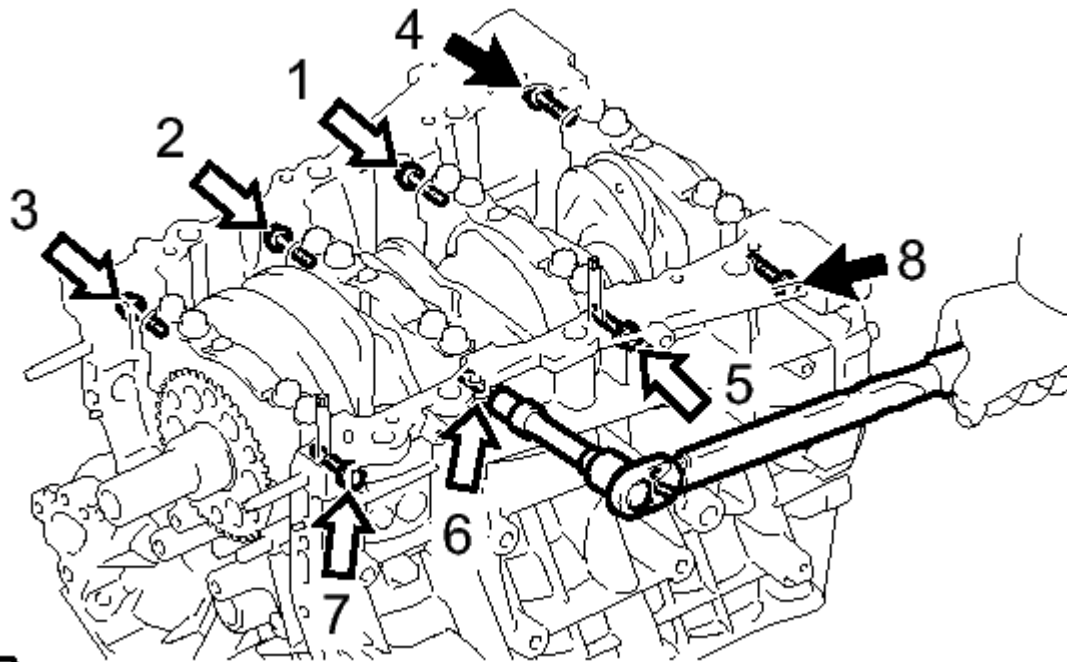
**P**

Fig. 178: Identifying 8 Main Bearing Cap Bolts With New Seal Washers With Tightening Sequence

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

- m. Install and uniformly tighten the 8 main bearing cap bolts together with 8 new seal washers in several steps in the sequence shown in the illustration.

Torque: 26 N*m (262 kgf*cm, 19 ft.*lbf)

Standard Bolt

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

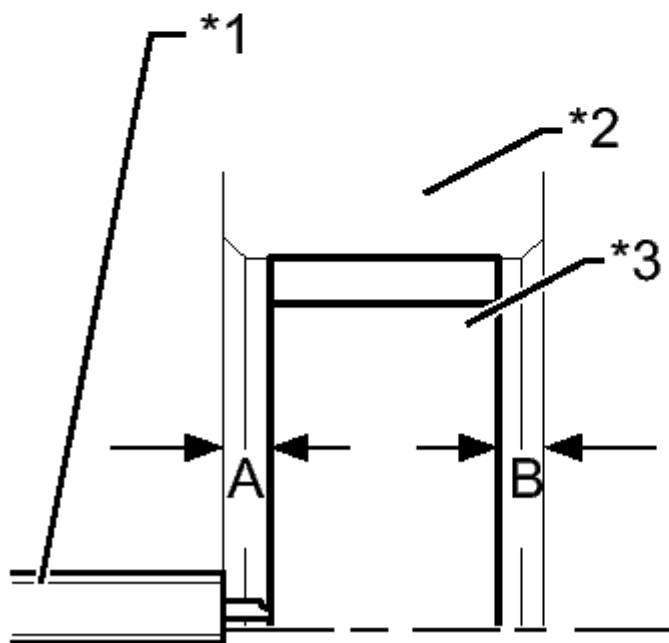
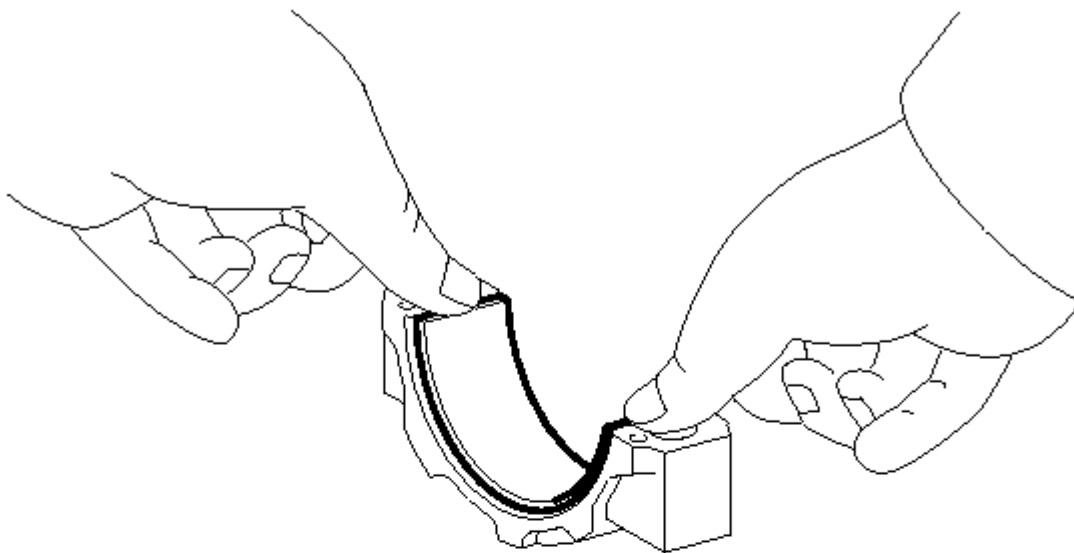
TEXT IN ILLUSTRATION

Bolt A
Bolt B

- n. Check that the crankshaft turns smoothly.

7. INSTALL CONNECTING ROD BEARING

- a. Install the bearing to the connecting rod cap.



T

Fig. 179: Identifying Connecting Rod Cap And Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- **Clean the contact surfaces of the bearing and connecting rod cap.**
- **Do not apply engine oil to the bearing or the surface it contacts.**

TEXT IN ILLUSTRATION

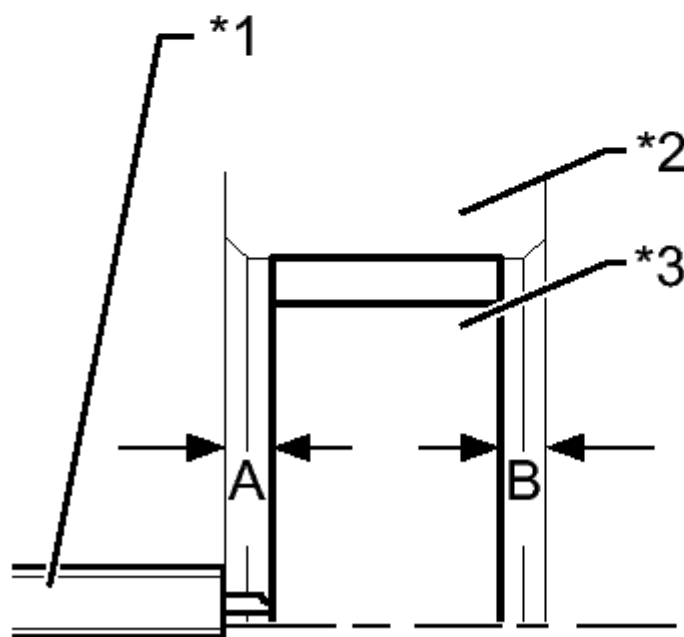
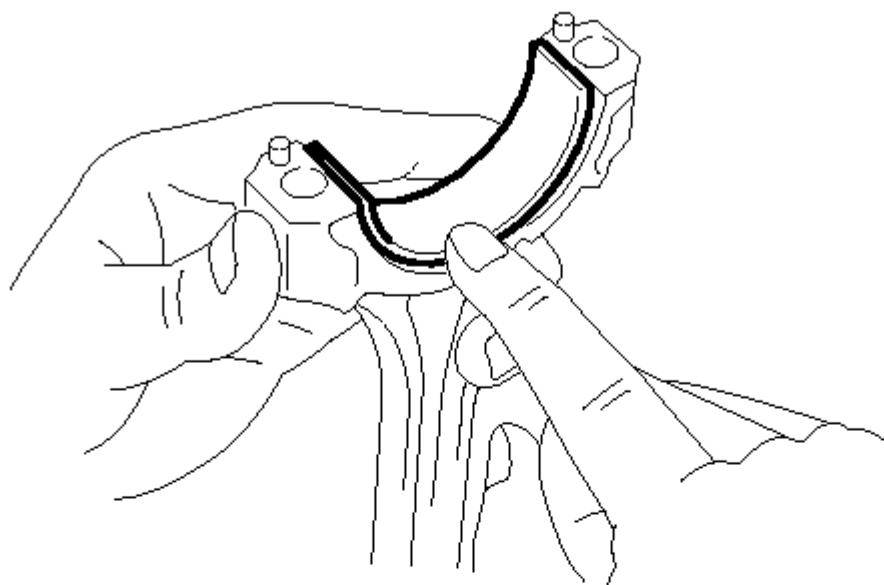
*1	Vernier Caliper
*2	Connecting Rod Cap
*3	Connecting Rod Bearing

- b. Using a vernier caliper, measure the distance between the connecting rod cap edge and connecting rod bearing edge.

Dimension A - B or B - A

0 to 0.7 mm (0 to 0.0276 in.)

- c. Install the bearing to the connecting rod.



T

Fig. 180: Identifying Connecting Rod And Bearing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE:

- Clean the contact surface of the bearing and connecting rod.

- Do not apply engine oil to the bearing or the surface it contacts.

TEXT IN ILLUSTRATION

*1	Vernier Caliper
*2	Connecting Rod
*3	Connecting Rod Bearing

- d. Using a vernier caliper, measure the distance between the connecting rod edge and connecting rod bearing edge.

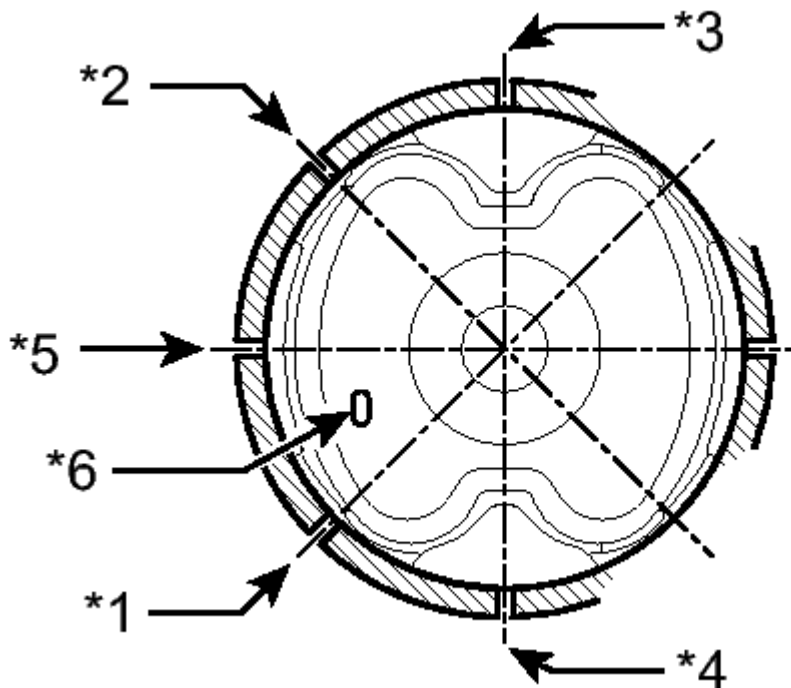
Dimension A - B or B - A

0 to 0.7 mm (0 to 0.0276 in.)

8. **INSPECT CRANKSHAFT THRUST CLEARANCE** See step 7

9. **INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD**

- a. Apply engine oil to the cylinder walls, pistons and surfaces of the connecting rod bearings.
- b. Check the positions of the piston ring ends.



P

Fig. 181: View of Piston Component Rings

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

TEXT IN ILLUSTRATION

No. 1
*1 Compression Ring
No. 2
*2 Compression Ring
*3 Lower Side Rail
*4 Upper Side Rail
*5 Expander
*6 Front Mark

- c. Using a hammer handle and piston ring compressor, press a piston and connecting rod assembly into each cylinder with the front mark of the piston facing forward.

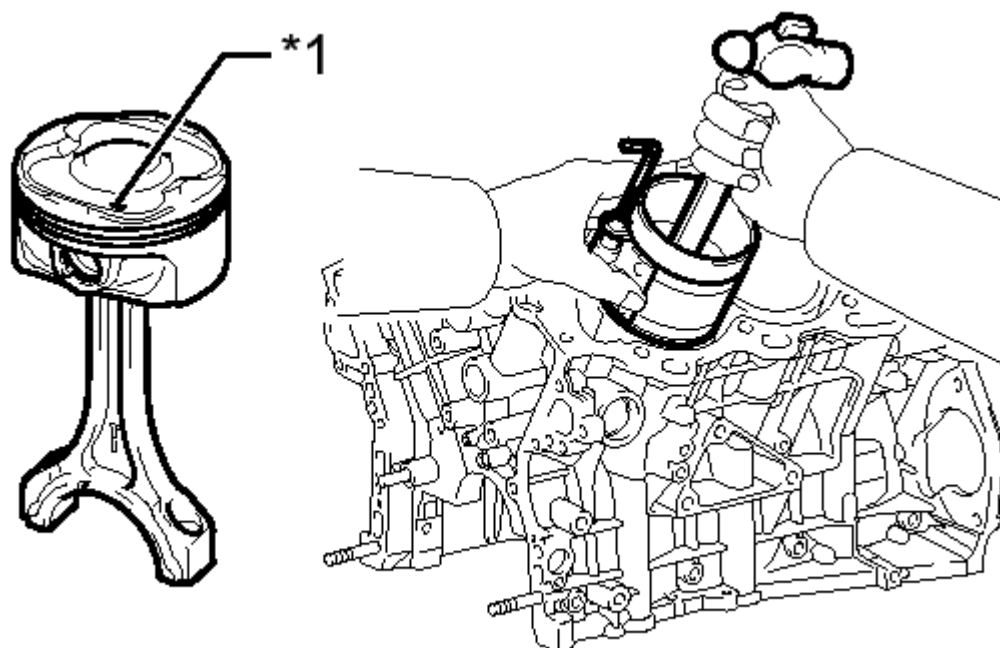
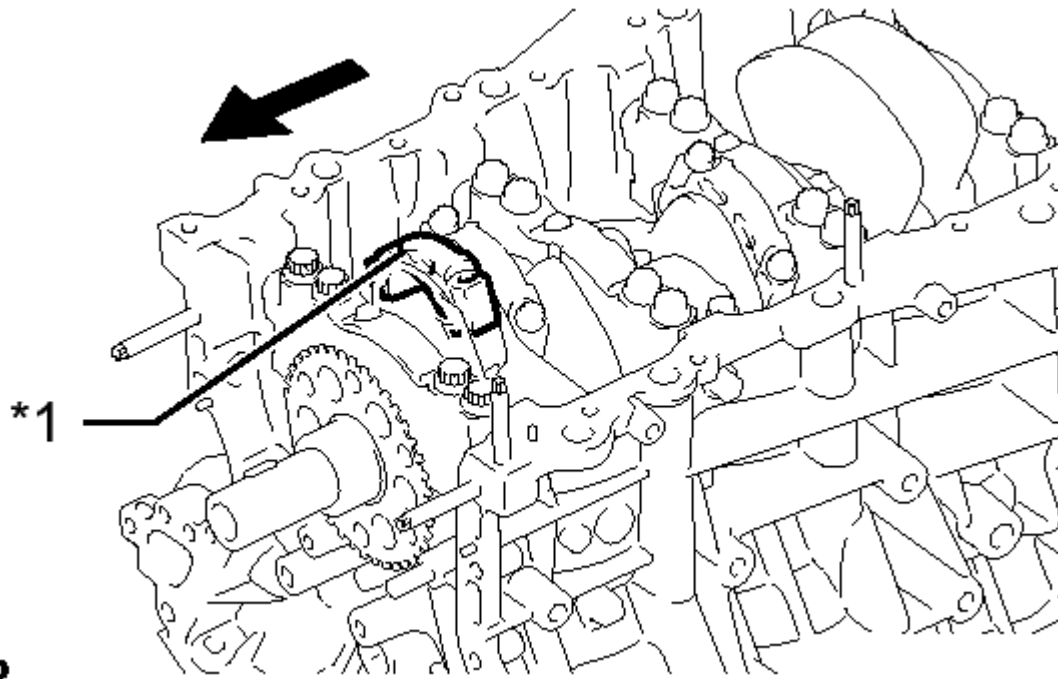
**P**

Fig. 182: Pressing Piston & Connecting Rod Assembly Into Cylinder
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1
Front Mark

- d. Install each connecting rod cap so that the protrusion is facing the correct direction.

**P****Fig. 183: Identifying Connecting Rod Cap**

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

TEXT IN ILLUSTRATION

*1	Protrusion
-	Front

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

- e. Apply a light coat of engine oil to the threads of the connecting rod cap bolts.
- f. Install the connecting rod cap bolts.

HINT:

The cap bolts are tightened in 2 progressive steps.

1. Step 1:

Install and alternately tighten the bolts of each connecting rod cap in several steps.

Torque: 25 N*m (250 kgf*cm, 18 ft.*lbf)

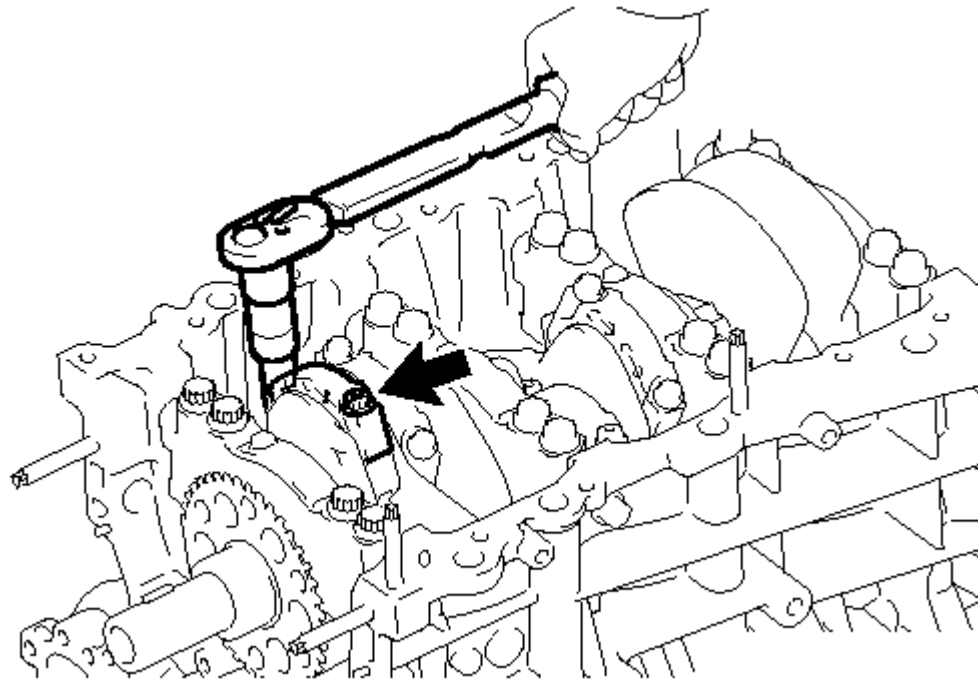


Fig. 184: Identifying Connecting Rod Cap Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

2. Mark the front side of each connecting rod cap bolt with paint.
3. Step 2:

Tighten the cap bolts 90°.

4. Check that the paint mark is now at a 90° angle to the front.
 - g. Check that the crankshaft turns smoothly.

10. INSPECT CONNECTING ROD THRUST CLEARANCE See step 1

FRONT CRANKSHAFT OIL SEAL

COMPONENTS

ILLUSTRATION

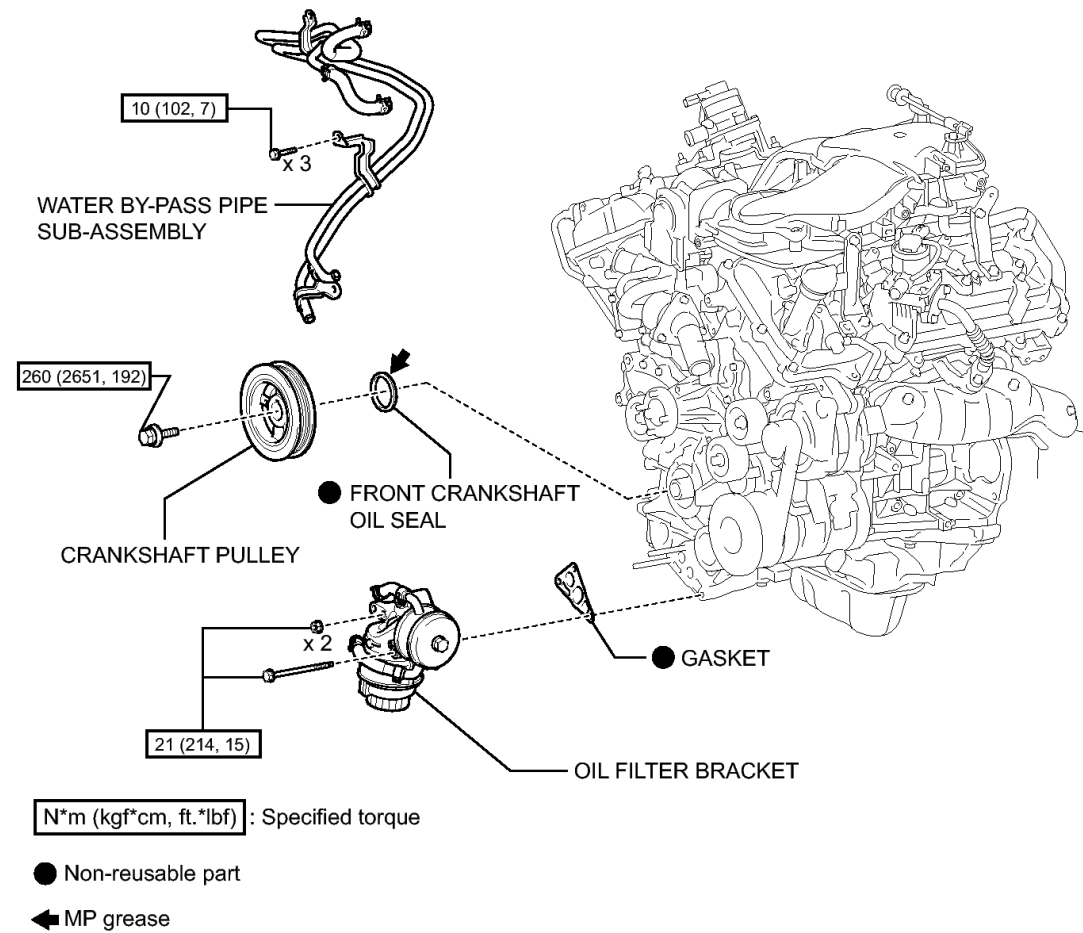


Fig. 185: Front Crankshaft Oil Seal Replacement Components With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL

1. REMOVE RADIATOR ASSEMBLY

Refer to **REMOVAL**

2. DISCONNECT WATER BY-PASS PIPE SUB-ASSEMBLY . Refer to **REMOVAL - Step 5**

3. REMOVE OIL FILTER BRACKET . Refer to **REMOVAL - Step 12**

4. REMOVE CRANKSHAFT PULLEY . Refer to **REMOVAL - Step 13**

5. REMOVE FRONT CRANKSHAFT OIL SEAL

- Using a screwdriver, pry out the oil seal.

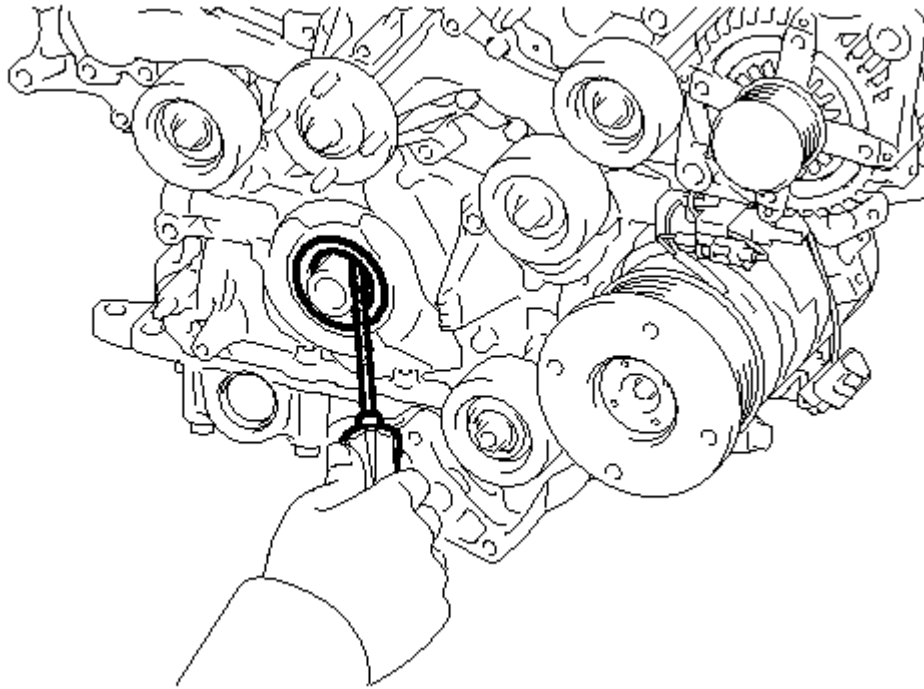
**P**

Fig. 186: Identifying Front Crankshaft Oil Seal And Screwdriver
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Tape the screwdriver tip before use.

NOTE: **Do not damage the surface of the oil seal press fit hole or crankshaft.**

INSTALLATION**INSTALLATION****1. INSTALL FRONT CRANKSHAFT OIL SEAL**

- a. Apply MP grease to the lip of a new oil seal.

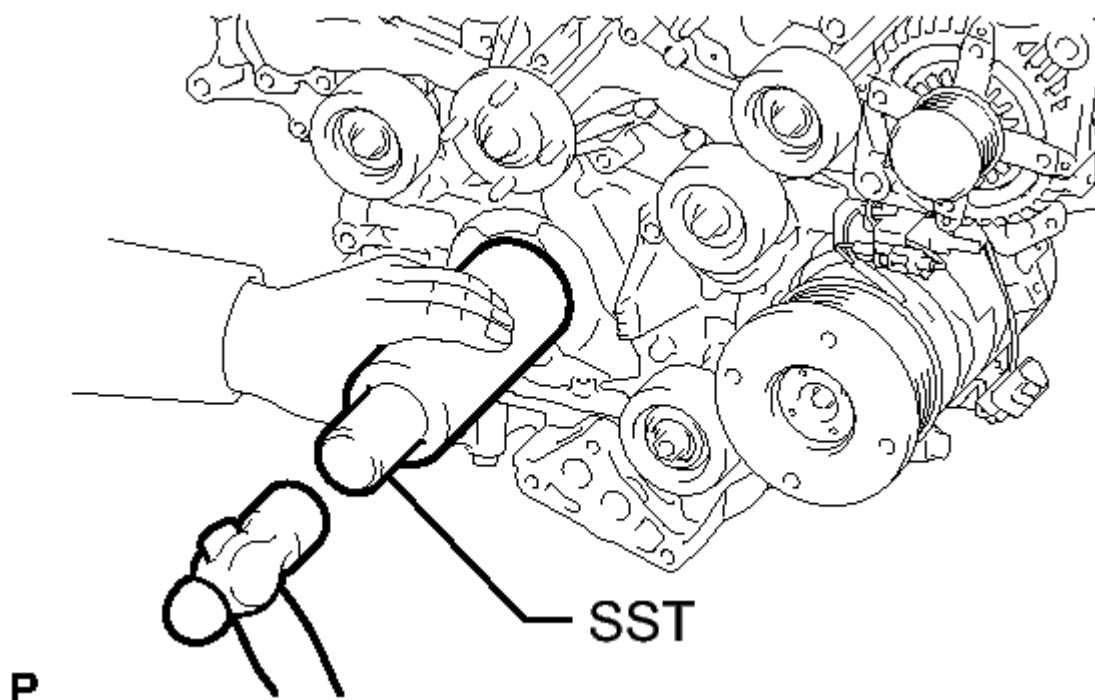


Fig. 187: Identifying Front Crankshaft Oil Seal, SST And Hammer

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

- b. Using SST and a hammer, tap in the oil seal until its surface is flush with the timing chain cover edge.
 - SST: 09226-10010

NOTE:

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

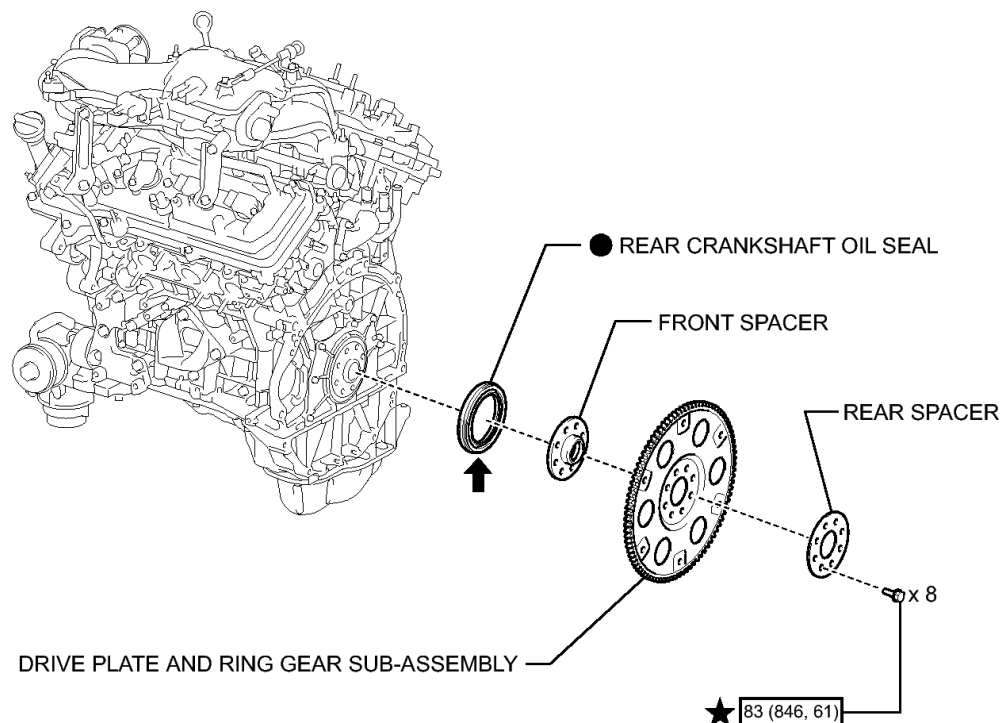
2. **INSTALL CRANKSHAFT PULLEY** . Refer to INSTALLATION - Step 11
3. **INSTALL OIL FILTER BRACKET** . Refer to INSTALLATION - Step 12
4. **CONNECT WATER BY-PASS PIPE SUB-ASSEMBLY** . Refer to INSTALLATION - Step 3
5. **INSTALL RADIATOR ASSEMBLY**

Refer to INSTALLATION

REAR CRANKSHAFT OIL SEAL

COMPONENTS

ILLUSTRATION



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

● Non-reusable part

← MP grease

★ Precoated part

P

Fig. 188: Rear Crankshaft Oil Seal Replacement Components With Torque Specifications
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL

1. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY

Refer to **REMOVAL**

2. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY See step 48

3. REMOVE REAR CRANKSHAFT OIL SEAL

- Using a knife, cut off the lip of the oil seal.

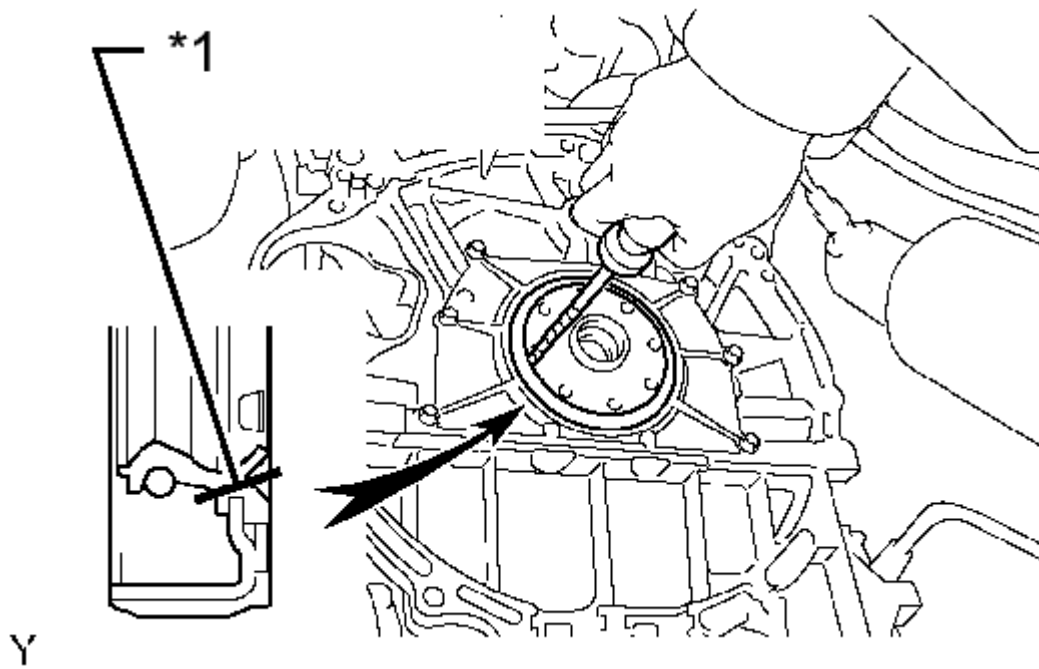


Fig. 189: Identifying Rear Crankshaft Oil Seal
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Cut Position
----	-----------------

- b. Using a screwdriver, pry out the oil seal.

HINT:

Tape the screwdriver tip before use.

NOTE: Do not damage the surface of the oil seal press fit hole or crankshaft.

INSTALLATION

INSTALLATION

1. INSTALL REAR CRANKSHAFT OIL SEAL

- a. Apply MP grease to the lip of a new oil seal.

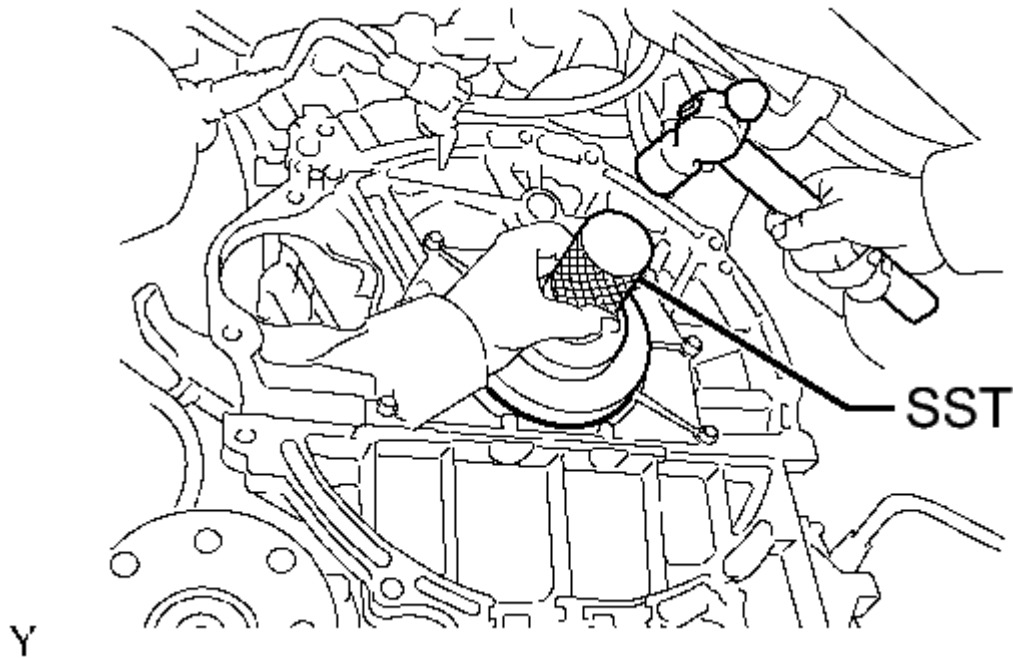


Fig. 190: Identifying Rear Crankshaft Oil Seal, SST And Hammer
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
 - SST: 09223-78010

NOTE:

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

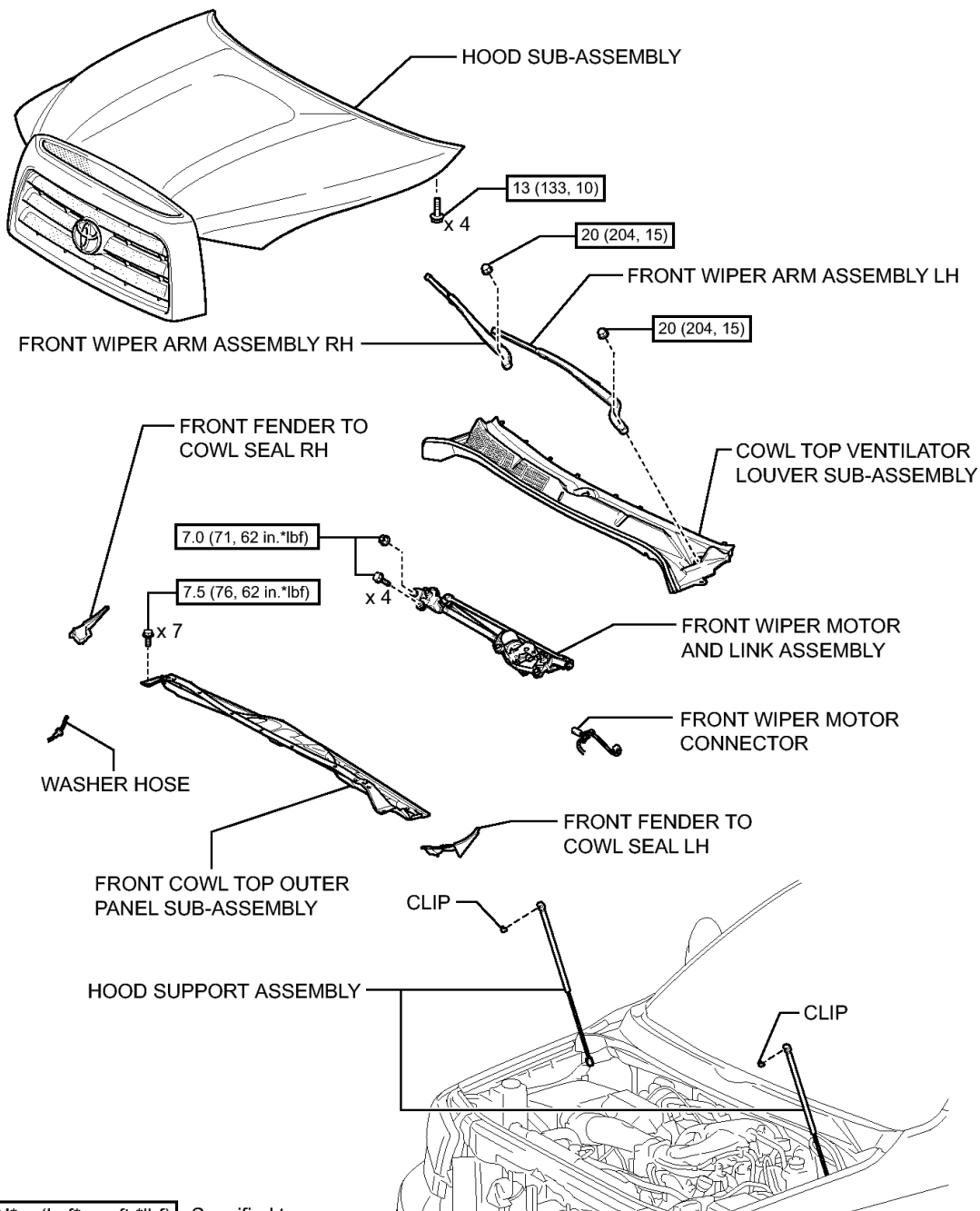
2. **INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY** See step 5
3. **INSTALL AUTOMATIC TRANSMISSION ASSEMBLY**

Refer to **INSTALLATION**

ENGINE ASSEMBLY

COMPONENTS

ILLUSTRATION

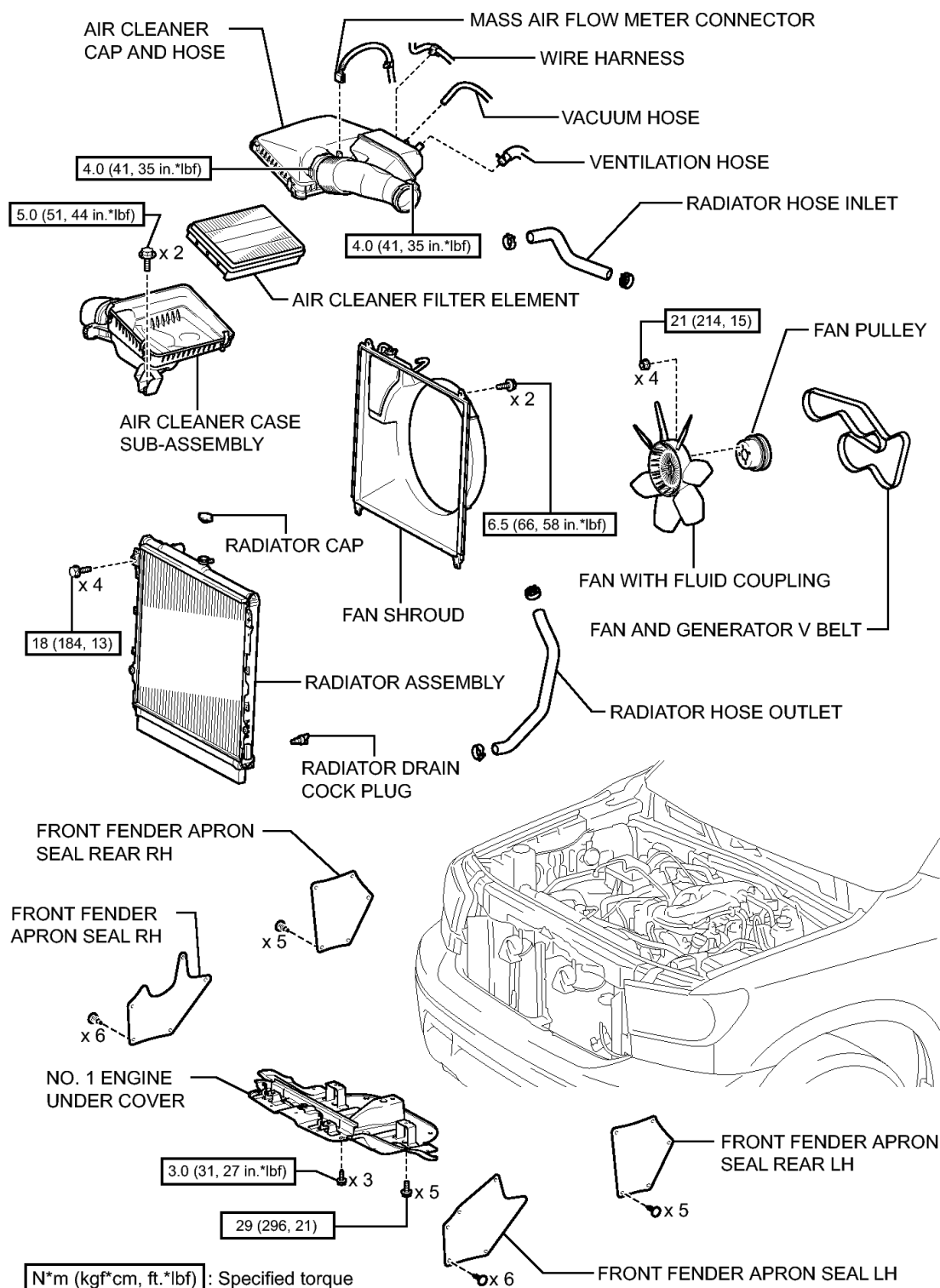


N*m (kgf*cm, ft.*lbf): Specified torque

P

Fig. 191: Engine Assembly Replacement Components With Torque Specifications (1 Of 8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

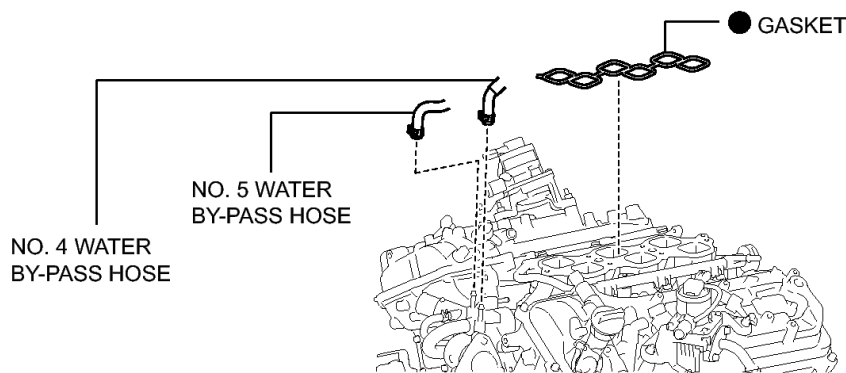
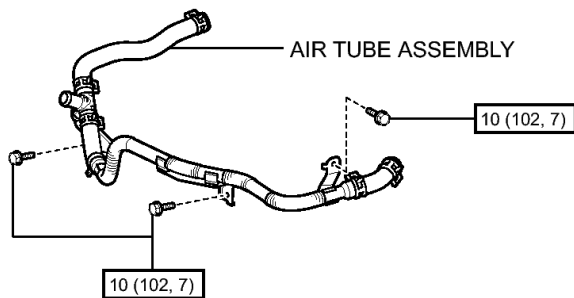
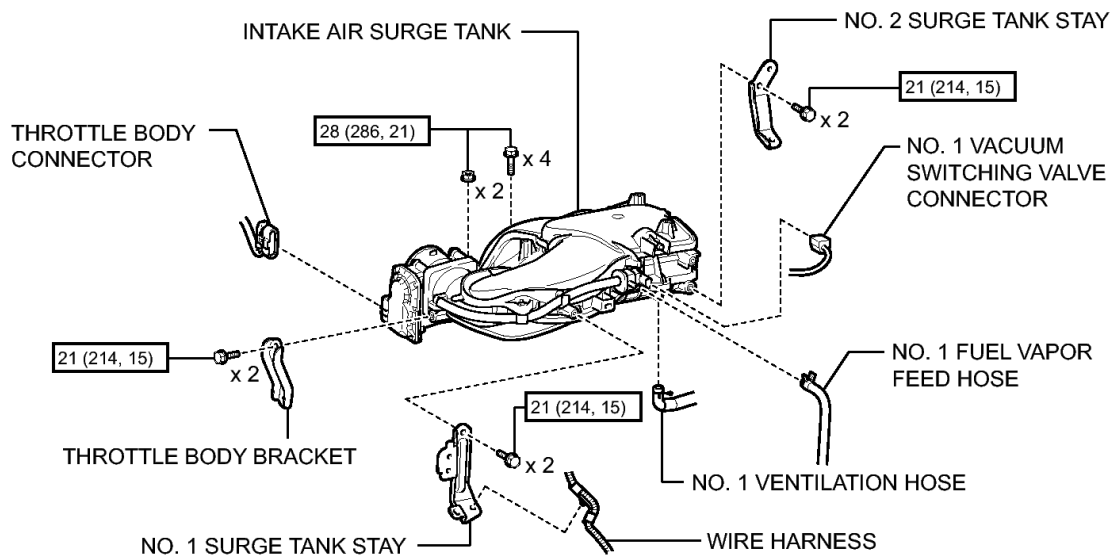
ILLUSTRATION



P

Fig. 192: Engine Assembly Replacement Components With Torque Specifications (2 Of 8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



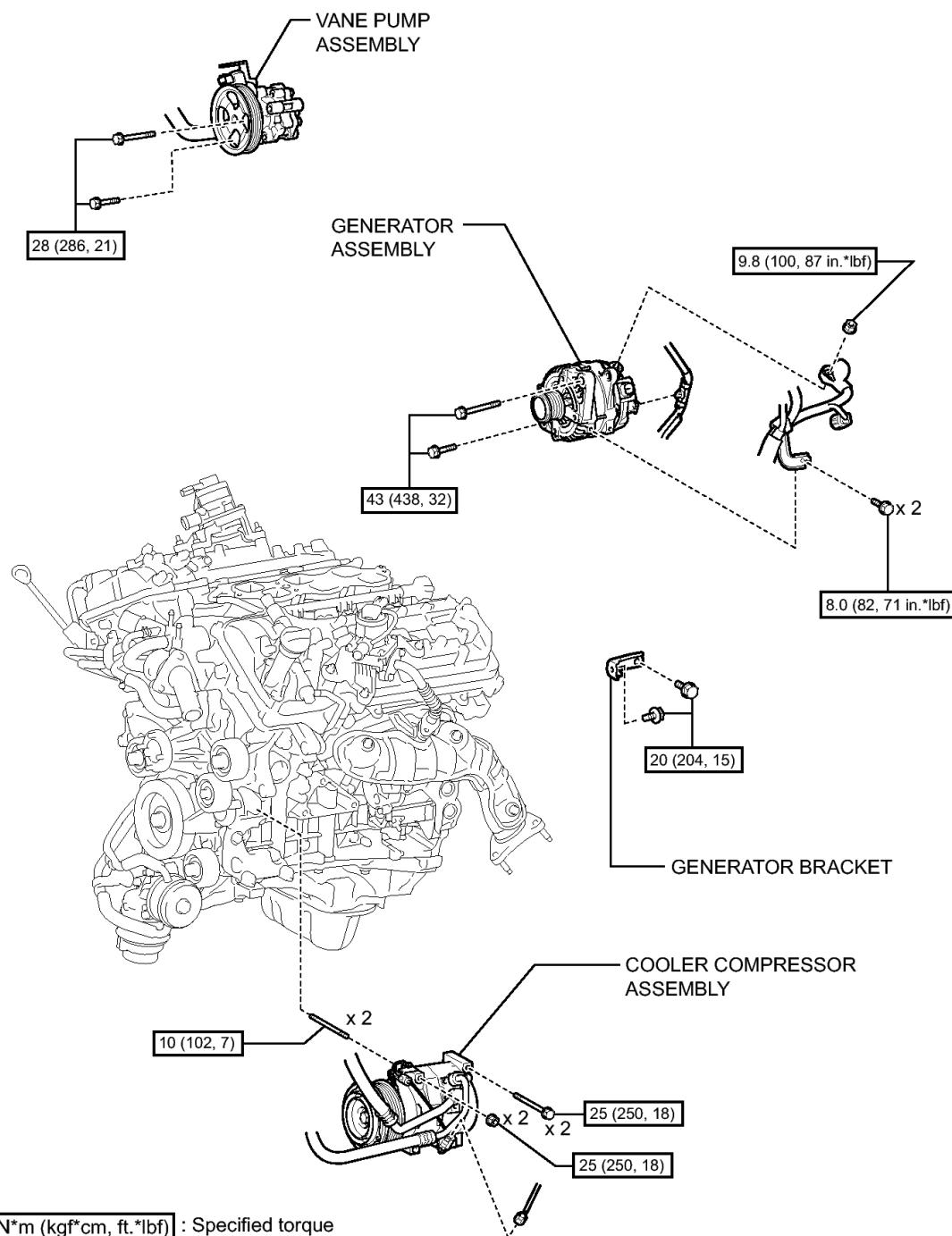
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

Fig. 193: Engine Assembly Replacement Components With Torque Specifications (3 Of 8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

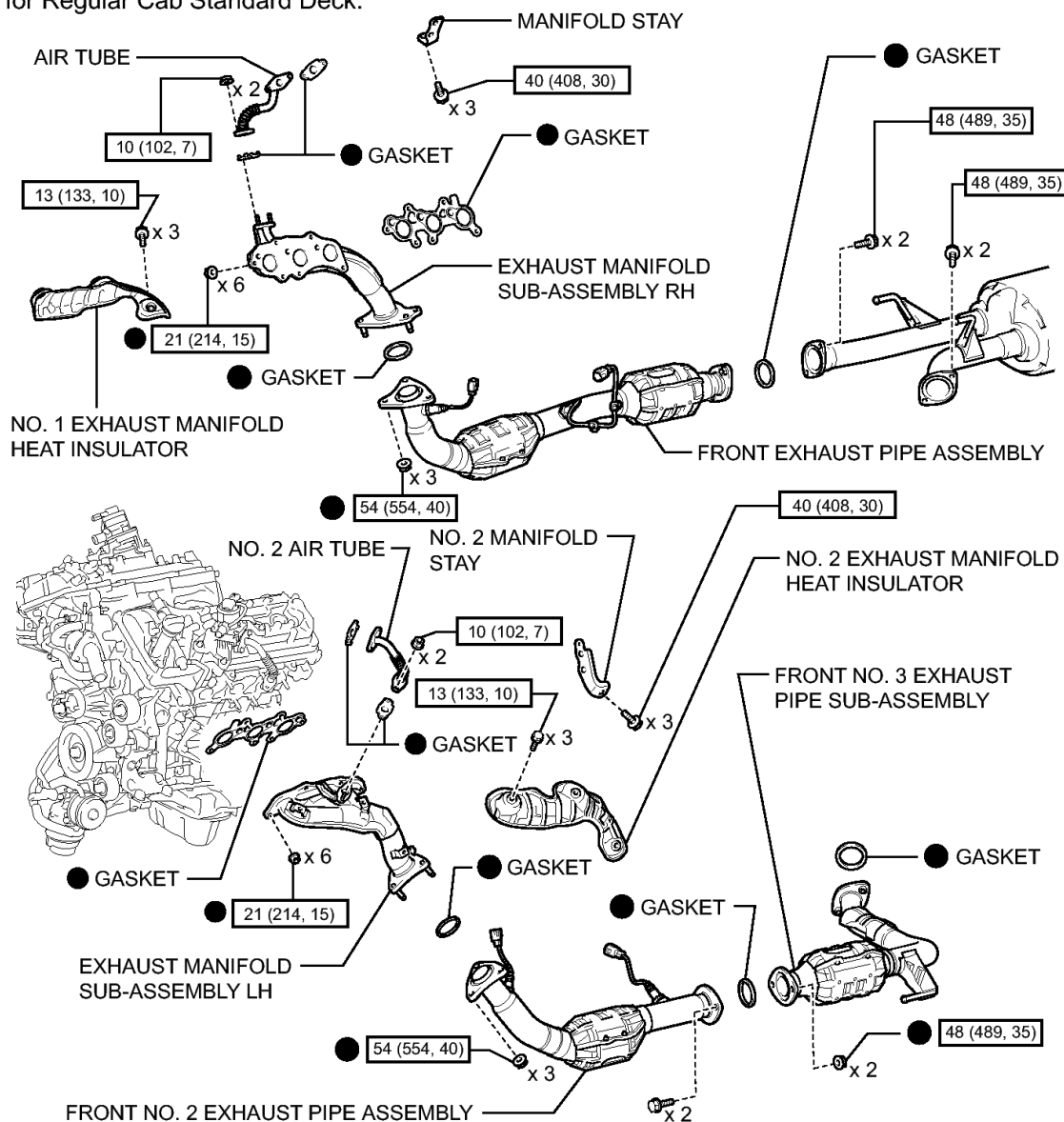


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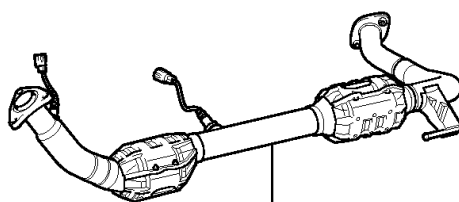
Fig. 194: Engine Assembly Replacement Components With Torque Specifications (4 Of 8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

for Regular Cab Standard Deck:



except Regular Cab Standard Deck:



FRONT NO. 2 EXHAUST PIPE ASSEMBLY

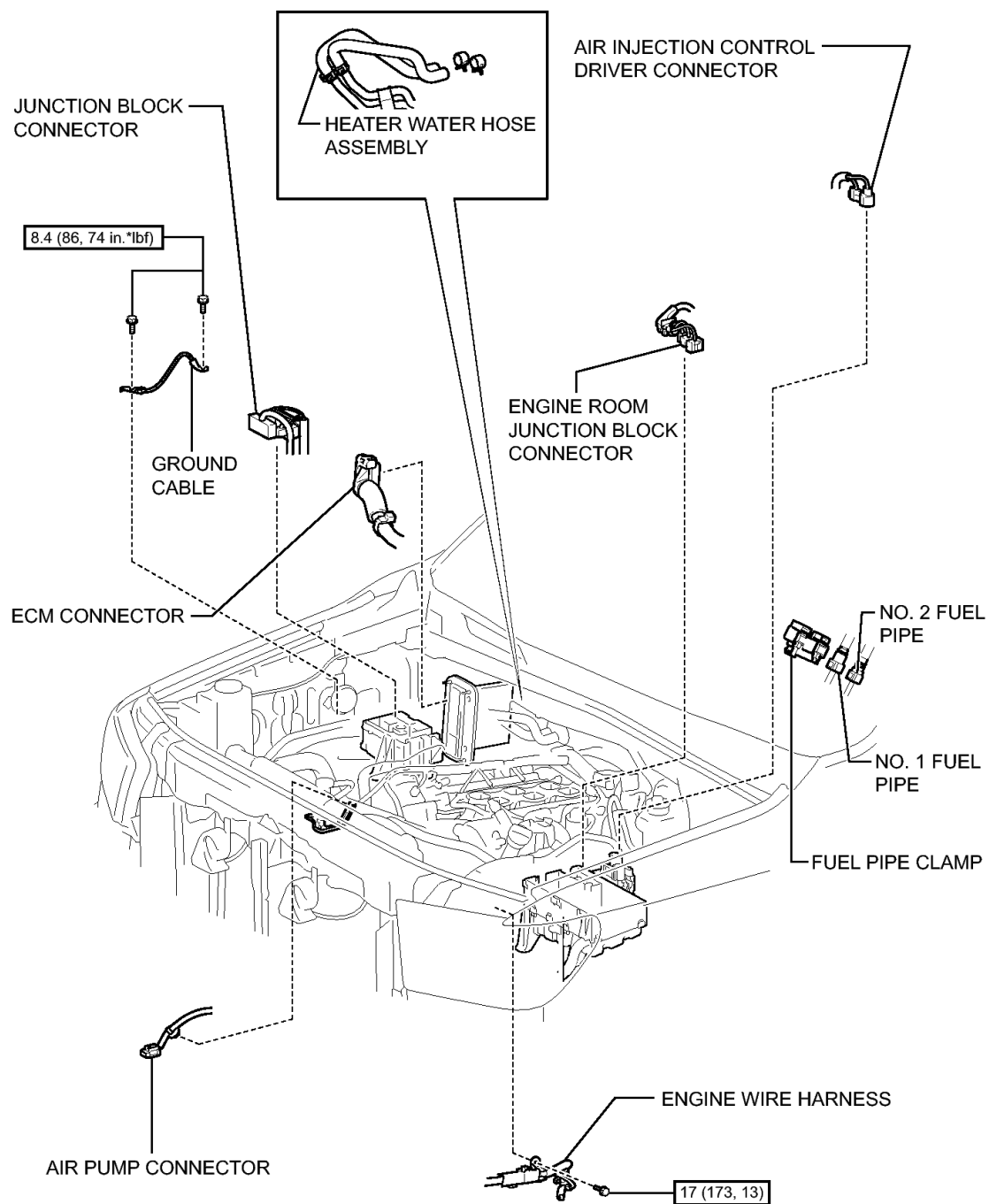
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

Fig. 195: Engine Assembly Replacement Components With Torque Specifications (5 Of 8)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

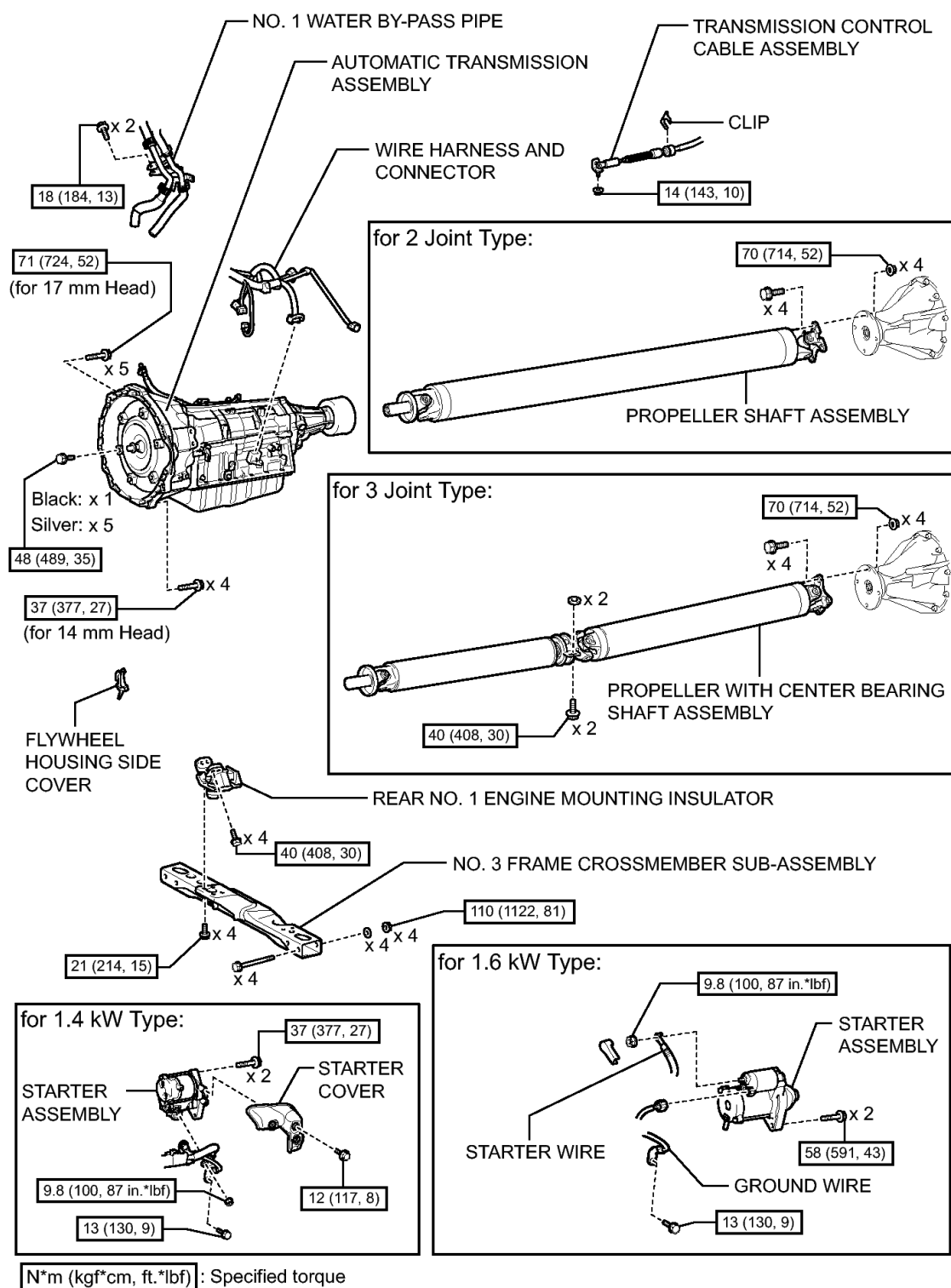


N*m (kgf*cm, ft.*lbf) : Specified torque

P

Fig. 196: Engine Assembly Replacement Components With Torque Specifications (6 Of 8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



P

Fig. 197: Engine Assembly Replacement Components With Torque Specifications (7 Of 8)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

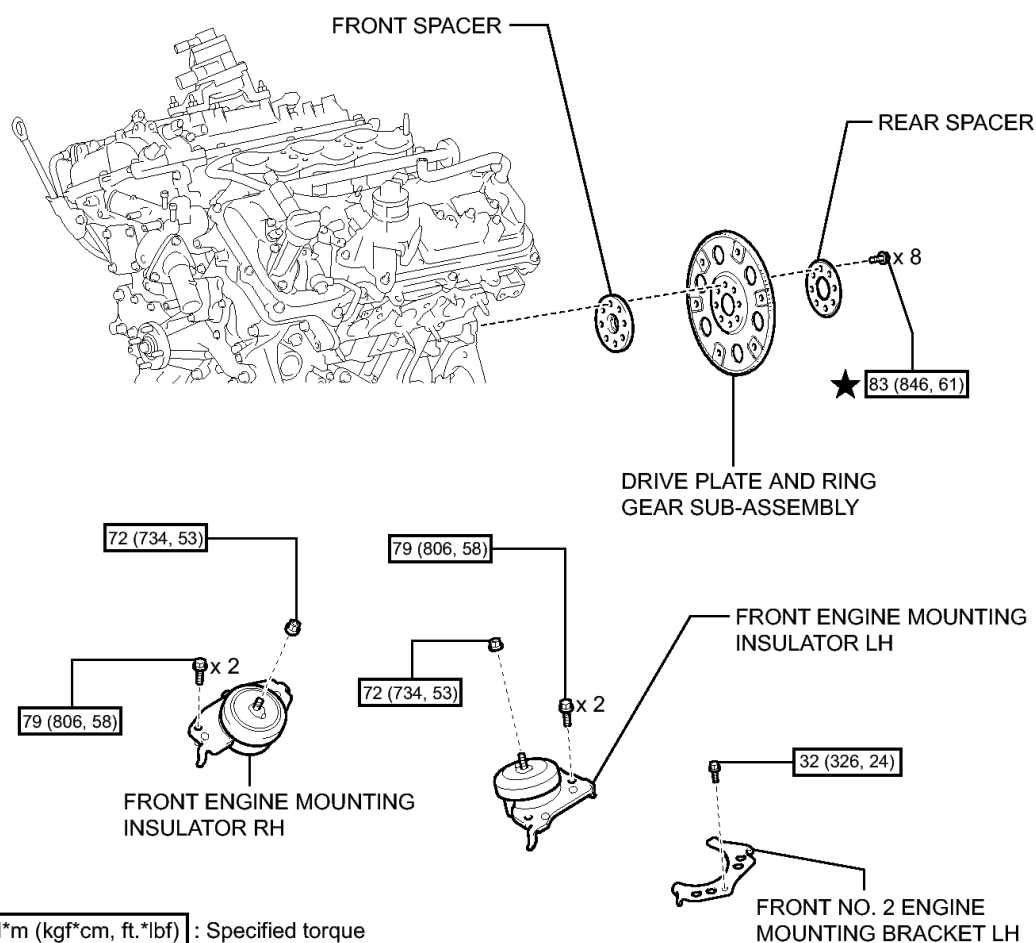


Fig. 198: Engine Assembly Replacement Components With Torque Specifications (8 Of 8)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL

1. **DISCHARGE FUEL SYSTEM PRESSURE** . Refer to **REMOVAL - Step 1**
2. **PRECAUTION**

NOTE: After turning the ignition switch off, waiting time may be required before disconnecting the cable from the battery terminal. Therefore, make sure to read the disconnecting the cable from the battery terminal notice before proceeding with work. Refer to **PRECAUTION** .

3. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected. Refer to INITIALIZATION .

4. REMOVE HOOD SUB-ASSEMBLY

- a. Remove the 4 bolts, 2 clips and hood.

5. REMOVE FRONT WIPER MOTOR AND LINK ASSEMBLY

Refer to REMOVAL

6. REMOVE FRONT COWL TOP OUTER PANEL SUB-ASSEMBLY . Refer to REMOVAL - Step 7

7. REMOVE NO. 1 ENGINE UNDER COVER . Refer to REPLACEMENT - Step 1

8. REMOVE FRONT FENDER APRON SEAL LH

- a. Remove the 6 clips and front fender apron seal.

9. REMOVE FRONT FENDER APRON SEAL RH

- a. Remove the 6 clips and front fender apron seal.

10. REMOVE FRONT FENDER APRON SEAL REAR LH

- a. Remove the 5 clips and fender apron seal.

11. REMOVE FRONT FENDER APRON SEAL REAR RH

- a. Remove the 5 clips and fender apron seal.

12. DRAIN ENGINE OIL . Refer to REPLACEMENT - Step 2

13. DRAIN ENGINE COOLANT . Refer to REPLACEMENT - Step 2

14. REMOVE AIR CLEANER CAP AND HOSE . Refer to REMOVAL - Step 1

15. REMOVE AIR CLEANER CASE SUB-ASSEMBLY . Refer to REMOVAL - Step 2

16. REMOVE RADIATOR HOSE INLET . Refer to REMOVAL - Step 3

17. REMOVE RADIATOR HOSE OUTLET . Refer to REMOVAL - Step 4

18. REMOVE FAN SHROUD . Refer to REMOVAL - Step 5

19. REMOVE RADIATOR ASSEMBLY . Refer to REMOVAL - Step 6

20. REMOVE AIR TUBE ASSEMBLY . Refer to REMOVAL - Step 9

21. REMOVE INTAKE AIR SURGE TANK . Refer to REMOVAL - Step 10

22. REMOVE FAN AND GENERATOR V BELT See step 1

23. DISCONNECT VANE PUMP ASSEMBLY . Refer to REMOVAL - Step 9

24. REMOVE FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY (for Regular Cab Standard Deck)

- a. Remove the 2 bolts and 2 nuts.
- b. Disconnect the exhaust pipe from the exhaust pipe support and remove the 2 gaskets.

25. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY (for Regular Cab Standard Deck)

- a. Disconnect the air fuel ratio sensor connector.
- b. Disconnect the heated oxygen sensor connector.
- c. Remove the 3 nuts, exhaust pipe and gasket.

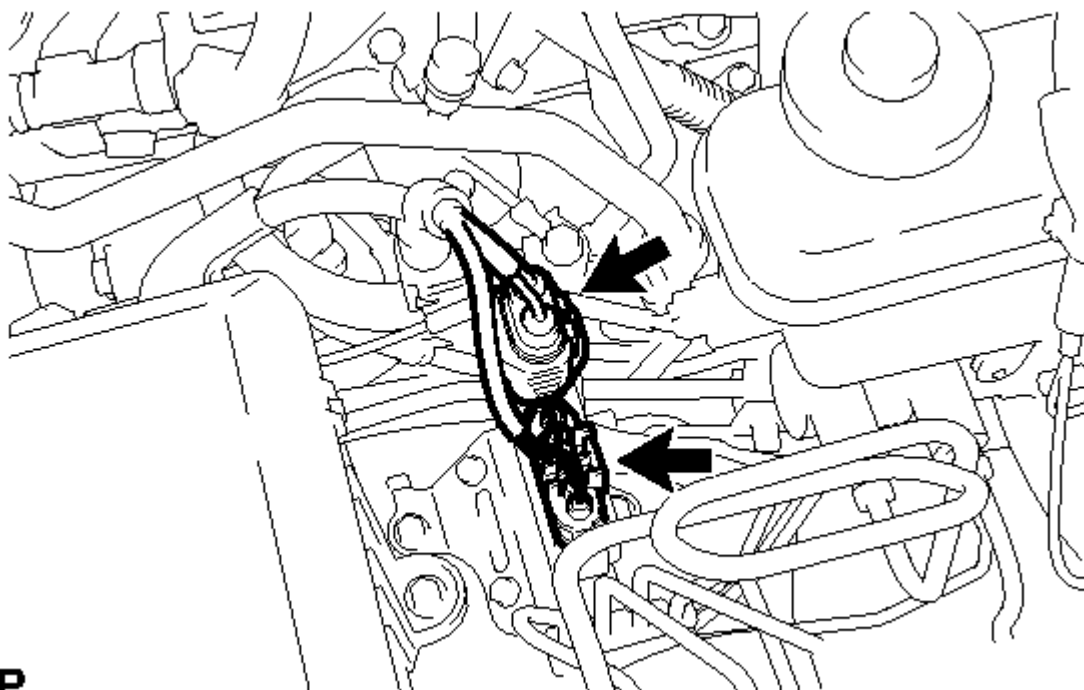
26. REMOVE FRONT NO. 2 EXHAUST PIPE ASSEMBLY (except Regular Cab Standard Deck)

- a. Disconnect the air fuel ratio sensor connector.
- b. Disconnect the heated oxygen sensor connector.
- c. Remove the 3 nuts, 2 bolts, exhaust pipe and gasket.

27. REMOVE FRONT EXHAUST PIPE ASSEMBLY

- a. Disconnect the air fuel ratio sensor connector.
- b. Disconnect the heated oxygen sensor connector and detach the 2 clamps.
- c. Remove the 2 bolts.
- d. Remove the 3 nuts, exhaust pipe and 2 gaskets.

28. REMOVE MANIFOLD STAY . Refer to REMOVAL - Step 7**29. REMOVE AIR TUBE . Refer to REMOVAL - Step 3****30. REMOVE NO. 1 EXHAUST MANIFOLD HEAT INSULATOR . Refer to REMOVAL - Step 9****31. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH . Refer to REMOVAL - Step 10****32. REMOVE NO. 2 MANIFOLD STAY . Refer to REMOVAL - Step 11****33. REMOVE NO. 2 AIR TUBE . Refer to REMOVAL - Step 2****34. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR . Refer to REMOVAL - Step 13****35. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH . Refer to REMOVAL - Step 14****36. REMOVE GENERATOR ASSEMBLY . Refer to REMOVAL - Step 7****37. REMOVE STARTER COVER (for 1.4 kW Type) . Refer to REMOVAL - Step 4****38. REMOVE STARTER ASSEMBLY (for 1.4 kW Type) . Refer to REMOVAL - Step 5****39. REMOVE STARTER ASSEMBLY (for 1.6 kW Type) . Refer to REMOVAL - Step 4****40. REMOVE DRIVE PLATE AND TORQUE CONVERTER SETTING BOLT . Refer to REMOVAL - Step 17****41. DISCONNECT ENGINE WIRE**

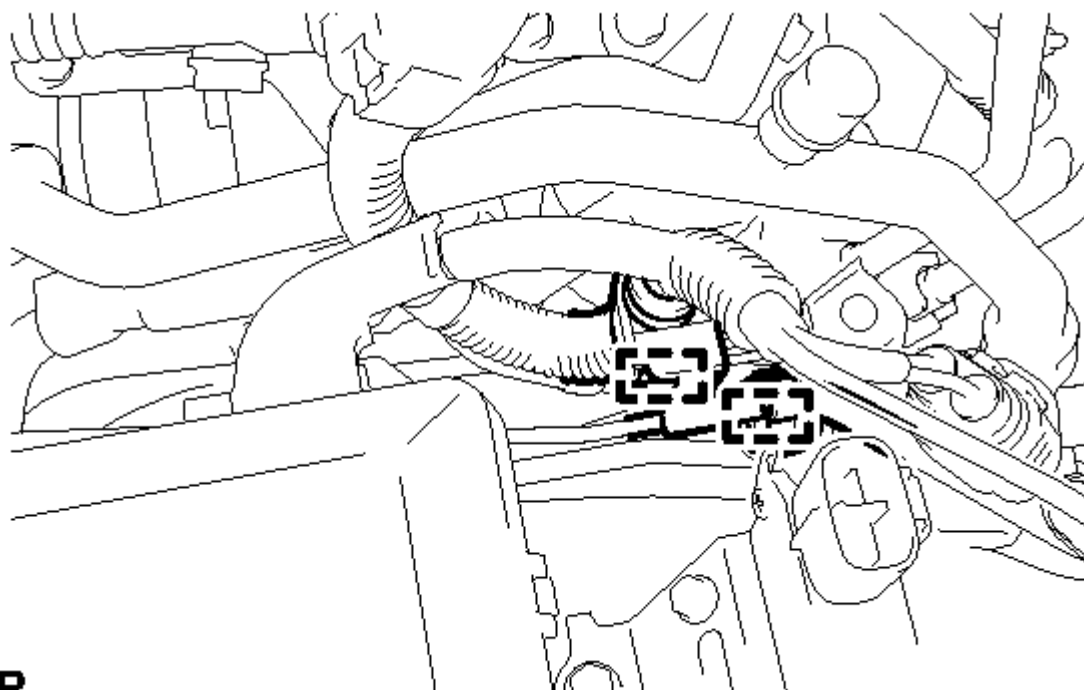


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Fig. 199: Identifying 2 Air Injection Control Driver Connectors

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

- a. Disconnect the 2 air injection control driver connectors.

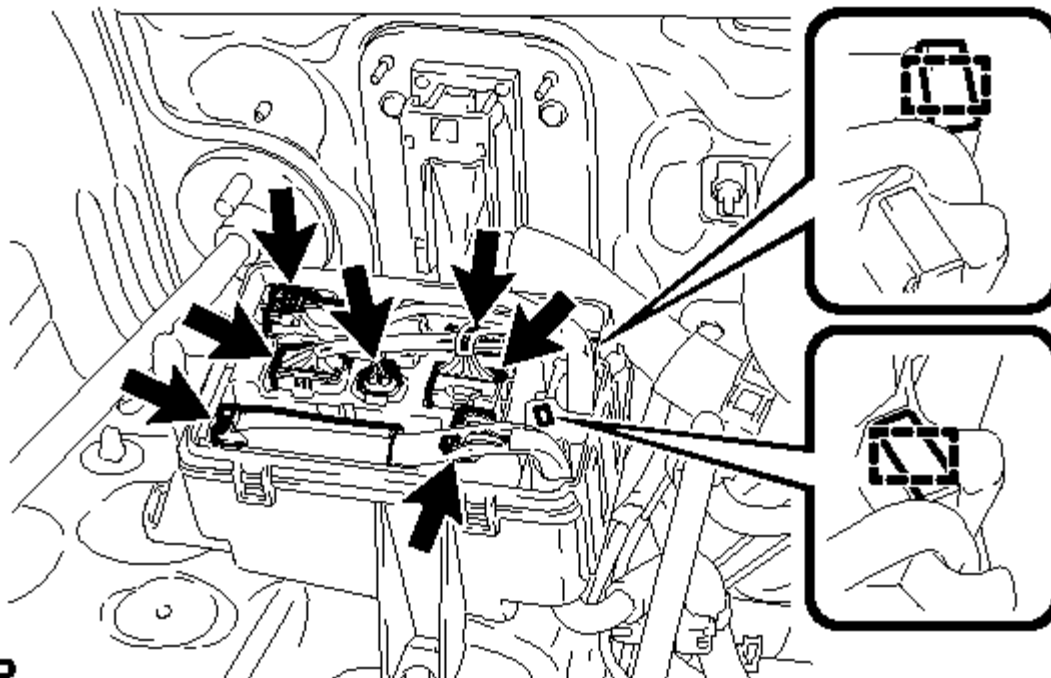


P

Fig. 200: Identifying Wire Harness Clamps

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

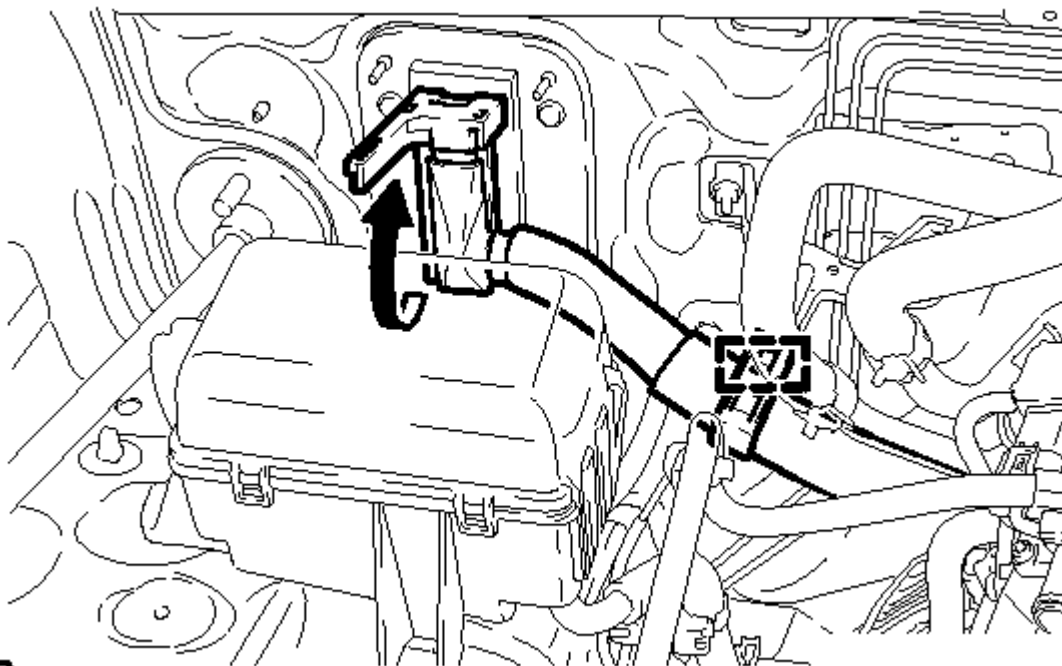
- b. Detach the 2 wire harness clamps.
- c. Remove the junction block cover.



P

Fig. 201: Identifying Connectors, Junction Block Connector & Junction Block
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Disconnect the 7 connectors, detach the 2 clamps and disconnect the junction block connector from the junction block.

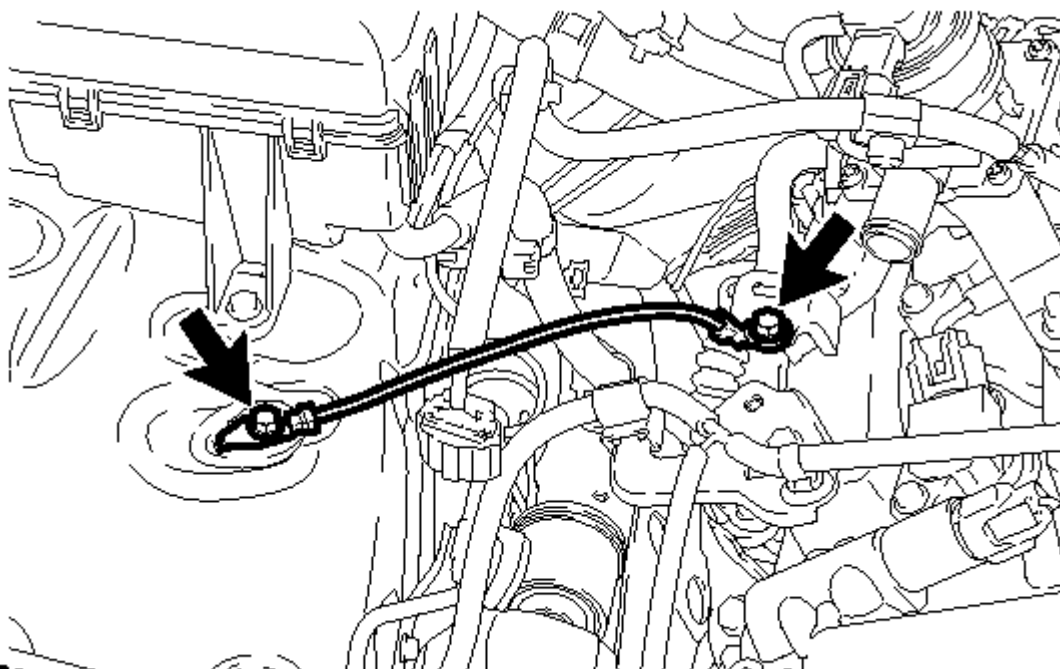


P

Fig. 202: Identifying Clamp & Disconnecting ECM Connector

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

- e. Detach the clamp and disconnect the ECM connector. Refer to **REMOVAL**.

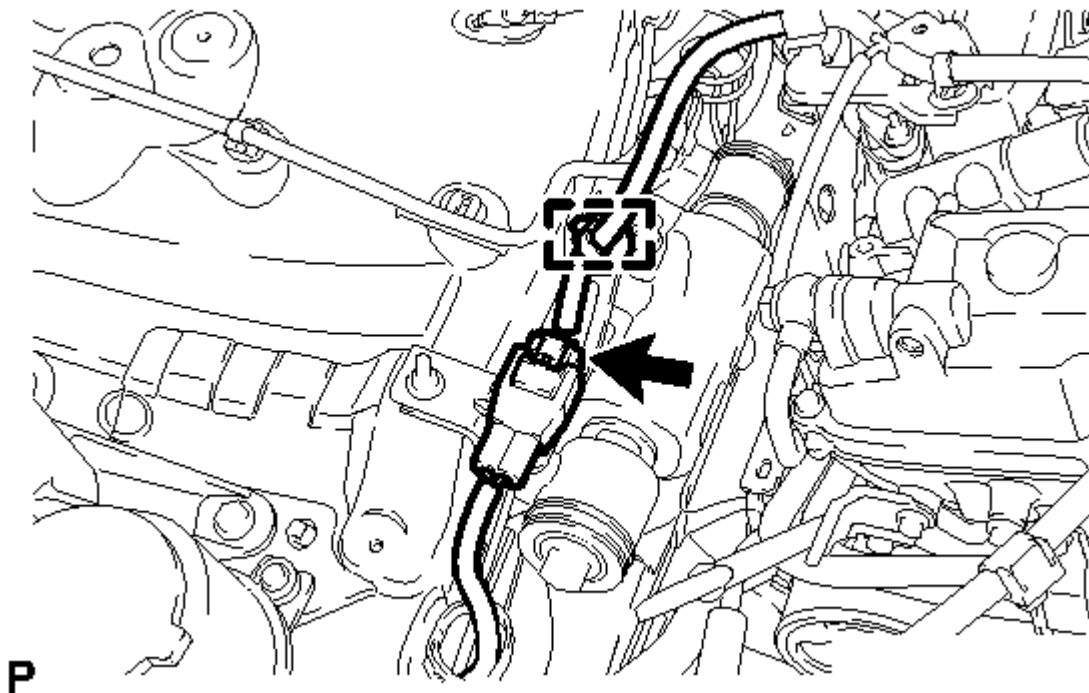


P

Fig. 203: Identifying Bolts & Ground Cable

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

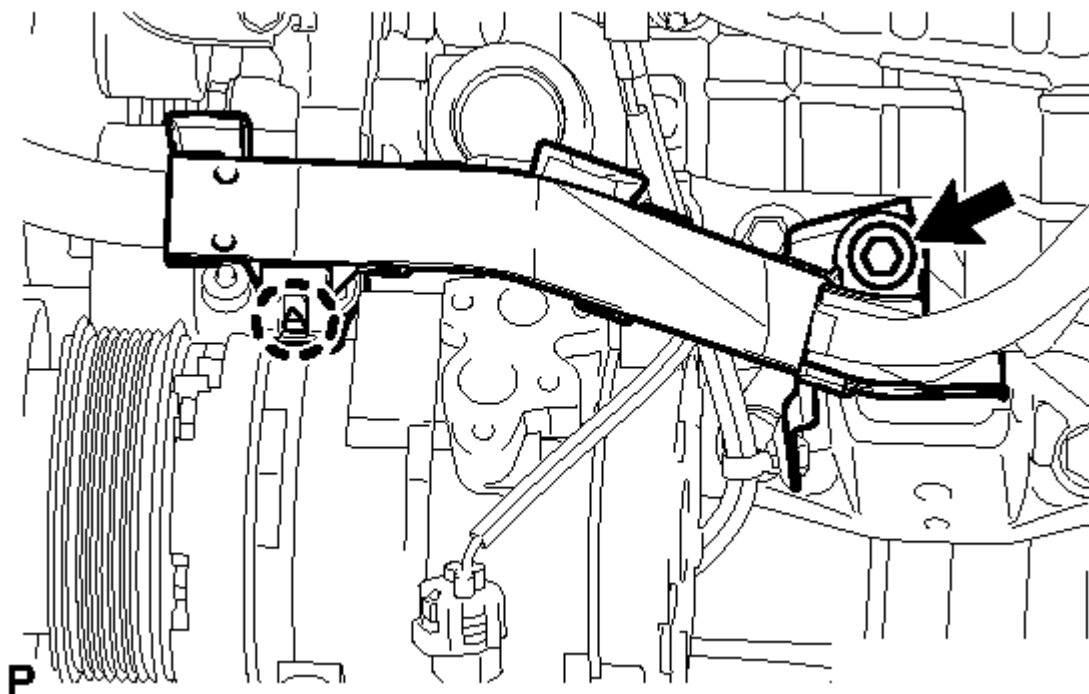
- f. Remove the 2 bolts and ground cable.



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Fig. 204: Identifying Air Pump Connector & Detach Clamp
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- g. Disconnect the air pump connector and detach the clamp.



P

Fig. 205: Identifying Engine Wire Harness & Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- h. Remove the bolt, detach the claw and disconnect the engine wire harness.

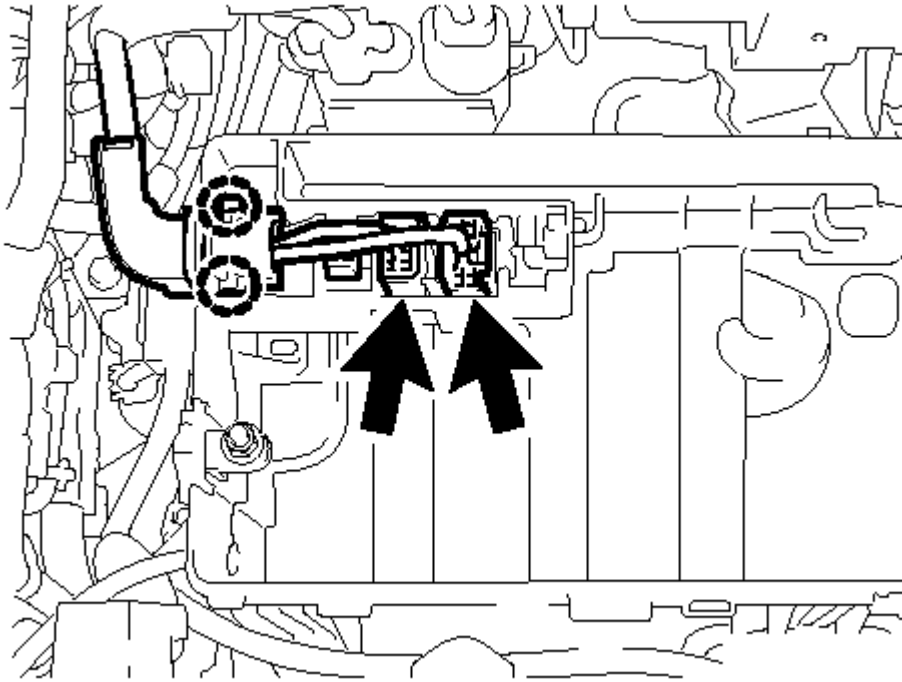


Fig. 206: Identifying Engine Room Block Connector, Engine Room Junction Block & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- i. Disconnect the 2 connectors, detach the 2 claws and disconnect the engine room junction block connector from the engine room junction block.
42. **DISCONNECT COOLER COMPRESSOR ASSEMBLY**
- a. Disconnect the cooler compressor connector.
 - b. Remove the 2 bolts, 2 nuts and 2 stud bolts and disconnect the cooler compressor.

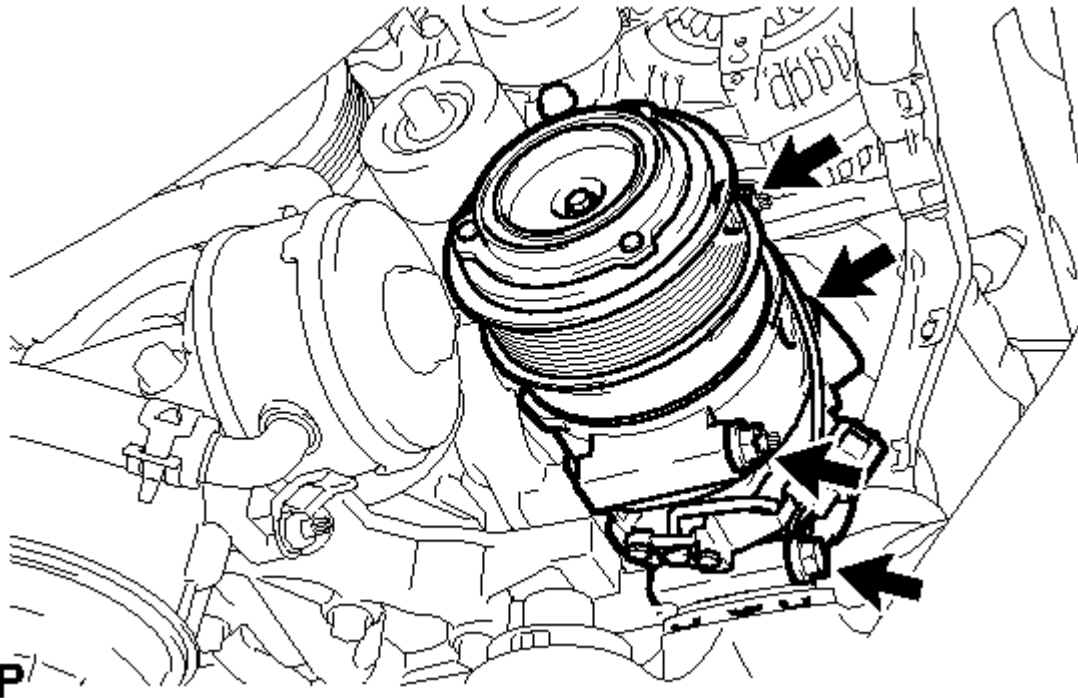


Fig. 207: Identifying Cooler Compressor & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

It is not necessary to completely remove the compressor. With the hoses connected to the compressor, hang the compressor on the vehicle body with a rope.

43. DISCONNECT HEATER WATER HOSE ASSEMBLY

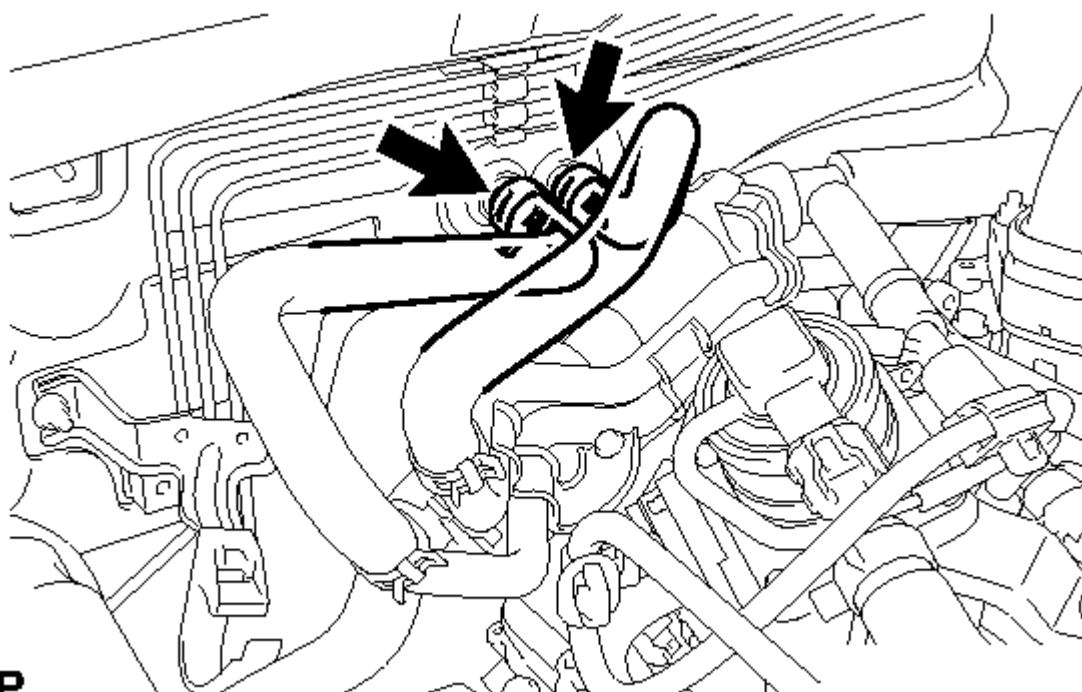
**P**

Fig. 208: Identifying Heater Water Inlet & Outlet Hoses

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

- a. Disconnect the heater water inlet and outlet hoses.

44. DISCONNECT NO. 1 AND NO. 2 FUEL PIPES

- a. Remove the No. 2 fuel pipe clamp from the fuel tube connector.

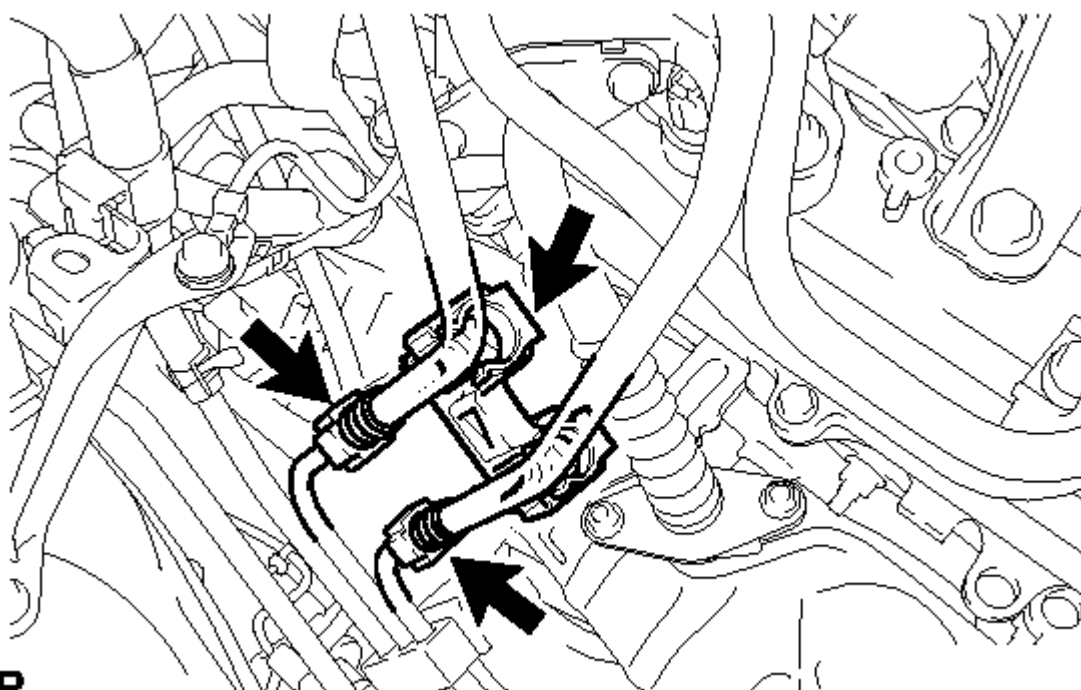
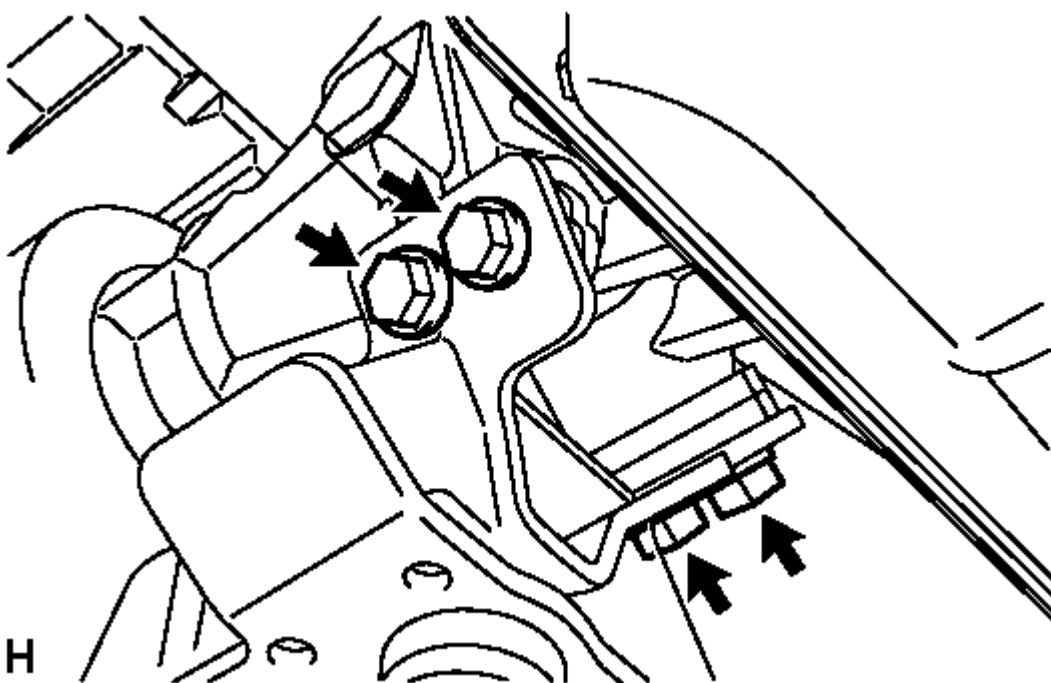
**P**

Fig. 209: Identifying No. 1 And No. 2 Fuel Pipes

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

- b. Disconnect the No. 1 and No. 2 fuel pipes. Refer to **PRECAUTION**.

45. REMOVE PROPELLER SHAFT ASSEMBLYRefer to **REMOVAL****46. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY**Refer to **REMOVAL****47. REMOVE REAR NO. 1 ENGINE MOUNTING INSULATOR****Fig. 210: Identifying Rear Engine Mounting Insulator Bolts**

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

HINT:

Only perform this procedure when replacement of the engine mounting insulator is necessary.

- a. Remove the 4 bolts and rear engine mounting insulator from the transmission.

48. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

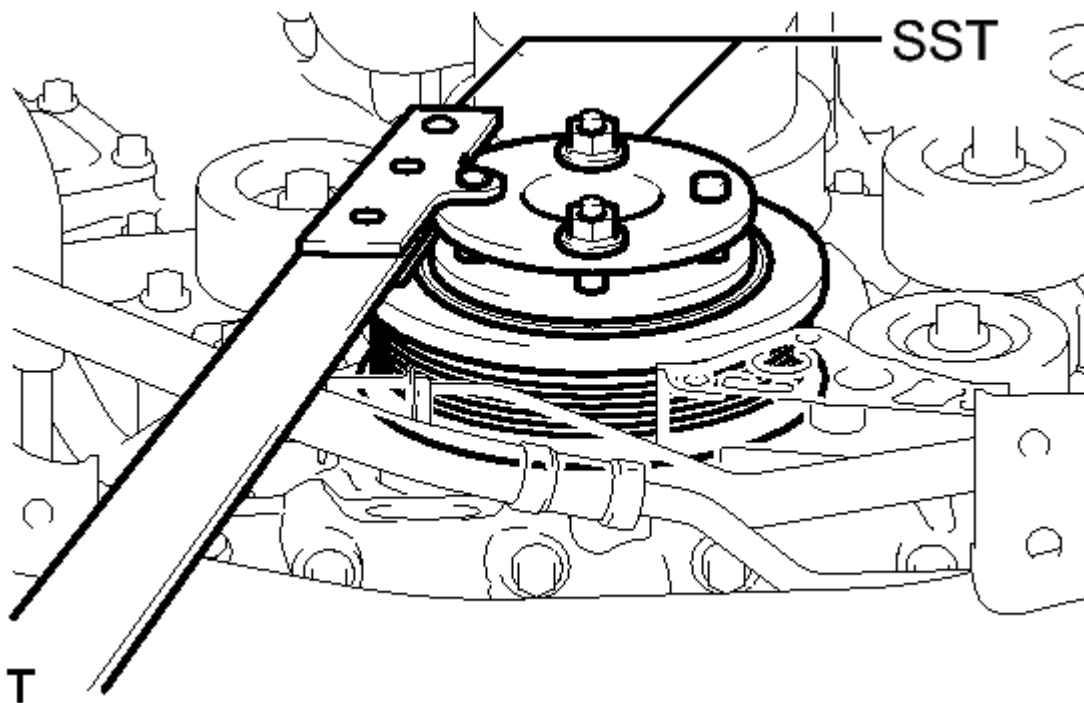
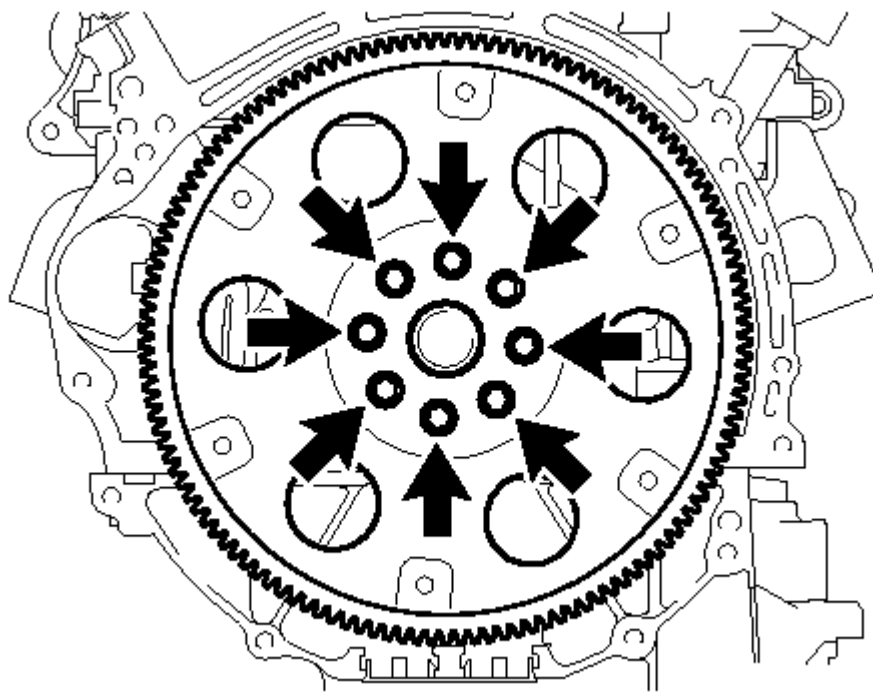


Fig. 211: Remove/Install Crankshaft Component Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Using SST, hold the crankshaft.
 - SST: 09213-54015
91651-60855
 - SST: 09330-00021
- b. Remove the 8 bolts, rear spacer, drive plate and front spacer.



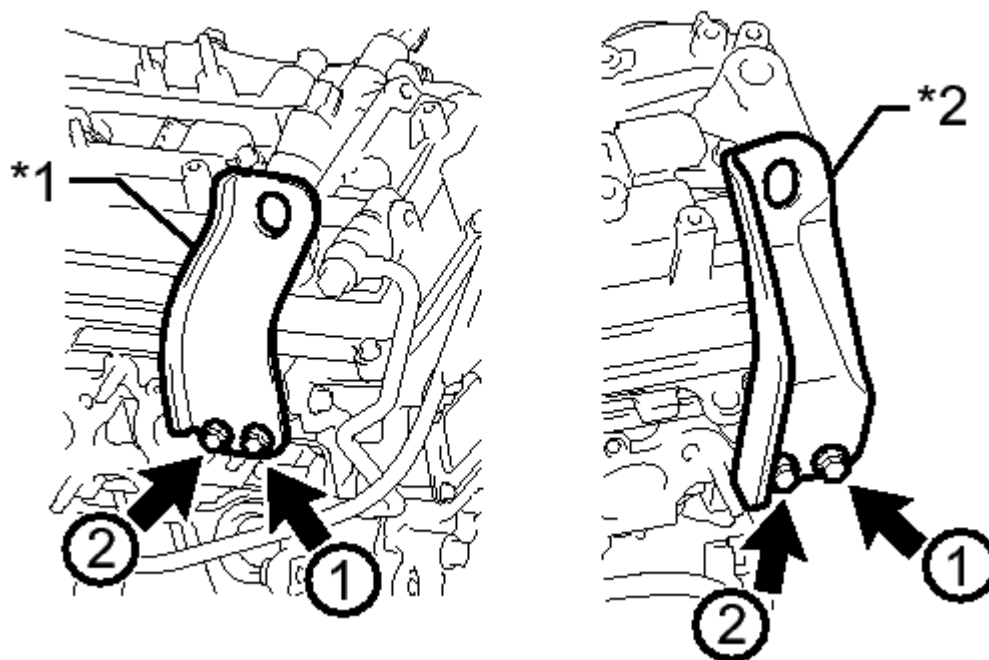
T

Fig. 212: Identifying Drive Plate And Bolts

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

49. REMOVE ENGINE ASSEMBLY

- a. Install 2 engine hangers with 4 bolts as shown in the illustration.



T

Fig. 213: Identifying Engine Hangers And Bolts

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

Torque: 33 N*m (337 kgf*cm, 24 ft.*lbf)

TEXT IN ILLUSTRATION

*1	No. 1 Engine Hanger
*2	No. 2 Engine Hanger

HINT:

No. 1 Engine Hanger	12281- 31110
No. 2 Engine Hanger	12282- 31140
Bolt	91671- C0830

- b. Attach an engine sling device and hang the engine with a chain block.
- c. Remove the 2 nuts, 4 bolts and front engine mounting insulator LH and RH.

**P**

Fig. 214: Identifying Engine Mounting Insulator LH & RH & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Lift the engine out of the vehicle carefully.

TEXT IN ILLUSTRATION

Nut
Bolt

NOTE:

- Make sure the engine is clear of all wiring and hoses.
- With the exception of installing the engine assembly to an engine stand or removing the engine assembly from an engine stand, do not perform any work on the engine while it is suspended, as doing so is dangerous.
- Pay attention to the angle of the sling device as the engine

assembly or engine hangers may be damaged or deformed if the angle is incorrect.

50. INSTALL ENGINE TO ENGINE STAND

- a. Install the engine to an engine stand with bolts.
- b. Remove the 2 engine hangers and 4 bolts.

51. REMOVE FRONT NO. 2 ENGINE MOUNTING BRACKET LH

- a. Remove the bolt and front No. 2 engine mounting bracket LH.

INSTALLATION

INSTALLATION

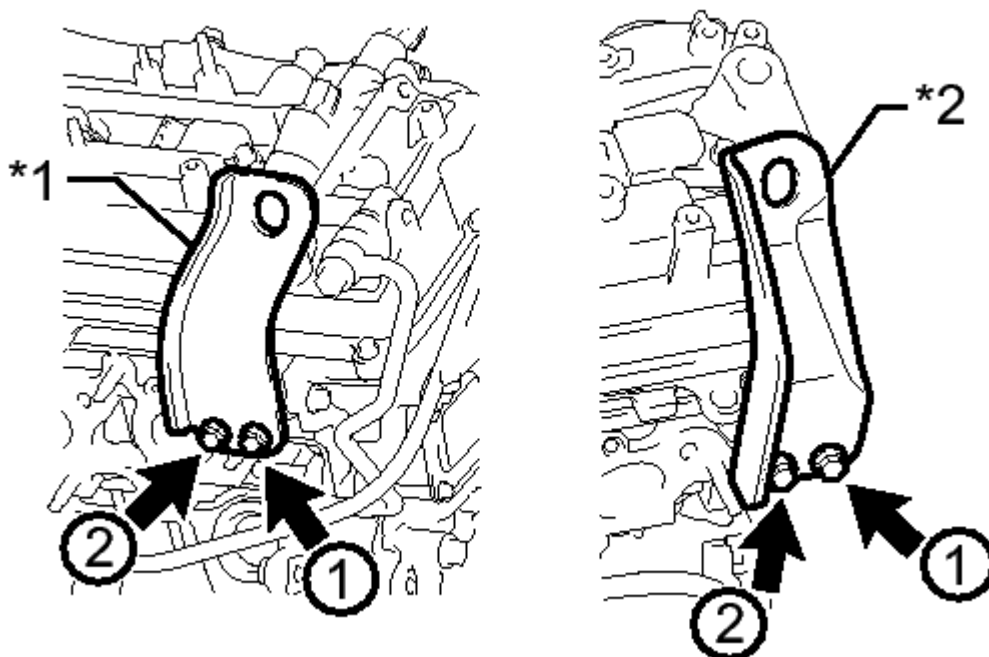
1. INSTALL FRONT NO. 2 ENGINE MOUNTING BRACKET LH

- a. Install the front No. 2 engine mounting bracket LH with the bolt.

Torque: 32 N*m (326 kgf*cm, 24 ft.*lbf)

2. INSTALL ENGINE HANGER

- a. Install 2 engine hangers with 4 bolts as shown in the illustration.



T

Fig. 215: Identifying Engine Hangers And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 33 N*m (337 kgf*cm, 24 ft.*lbf)

TEXT IN ILLUSTRATION

*1	No. 1 Engine Hanger
*2	No. 2 Engine Hanger

HINT:

No. 1 Engine Hanger	12281- 31110
No. 2 Engine Hanger	12282- 31140
Bolt	91671- C0830

3. REMOVE ENGINE FROM ENGINE STAND

- Attach an engine sling device and hang the engine with a chain block.
- Lift the engine and remove it from the engine stand.

NOTE:

- With the exception of installing the engine assembly to an engine stand or removing the engine assembly from an engine stand, do not perform any work on the engine while it is suspended, as doing so is dangerous.
- Pay attention to the angle of the sling device as the engine assembly or engine hangers may be damaged or deformed if the angle is incorrect.

4. INSTALL ENGINE ASSEMBLY

- Slowly lower the engine into the engine compartment.

**P**

Fig. 216: Identifying Engine Mounting Insulator LH & RH & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the front engine mounting insulator LH with the nut and 2 bolts.

for nut

Torque: 72 N*m (734 kgf*cm, 53 ft.*lbf)

for bolt

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

TEXT IN ILLUSTRATION



- c. Install the front engine mounting insulator RH with the nut and 2 bolts.

for nut

Torque: 72 N*m (734 kgf*cm, 53 ft.*lbf)

for bolt

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

- d. Remove the 2 engine hangers and 4 bolts.

5. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

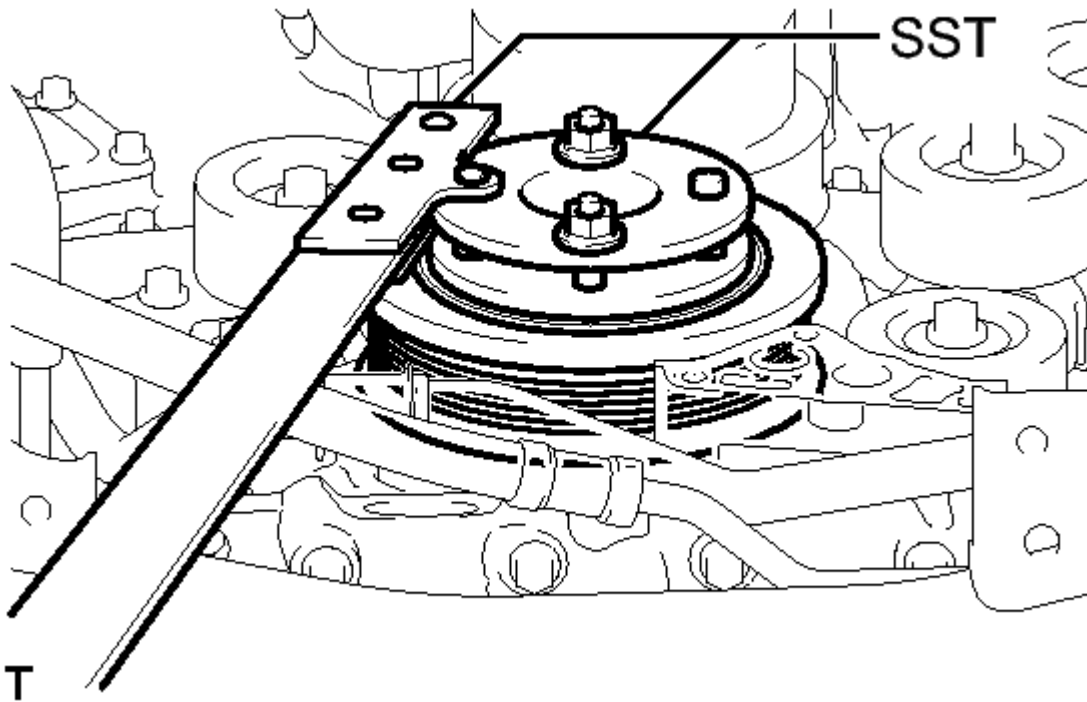


Fig. 217: Remove/Install Crankshaft Component Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Using SST, hold the crankshaft.
- **SST: 09213-54015**
91651-60855
 - **SST: 09330-00021**

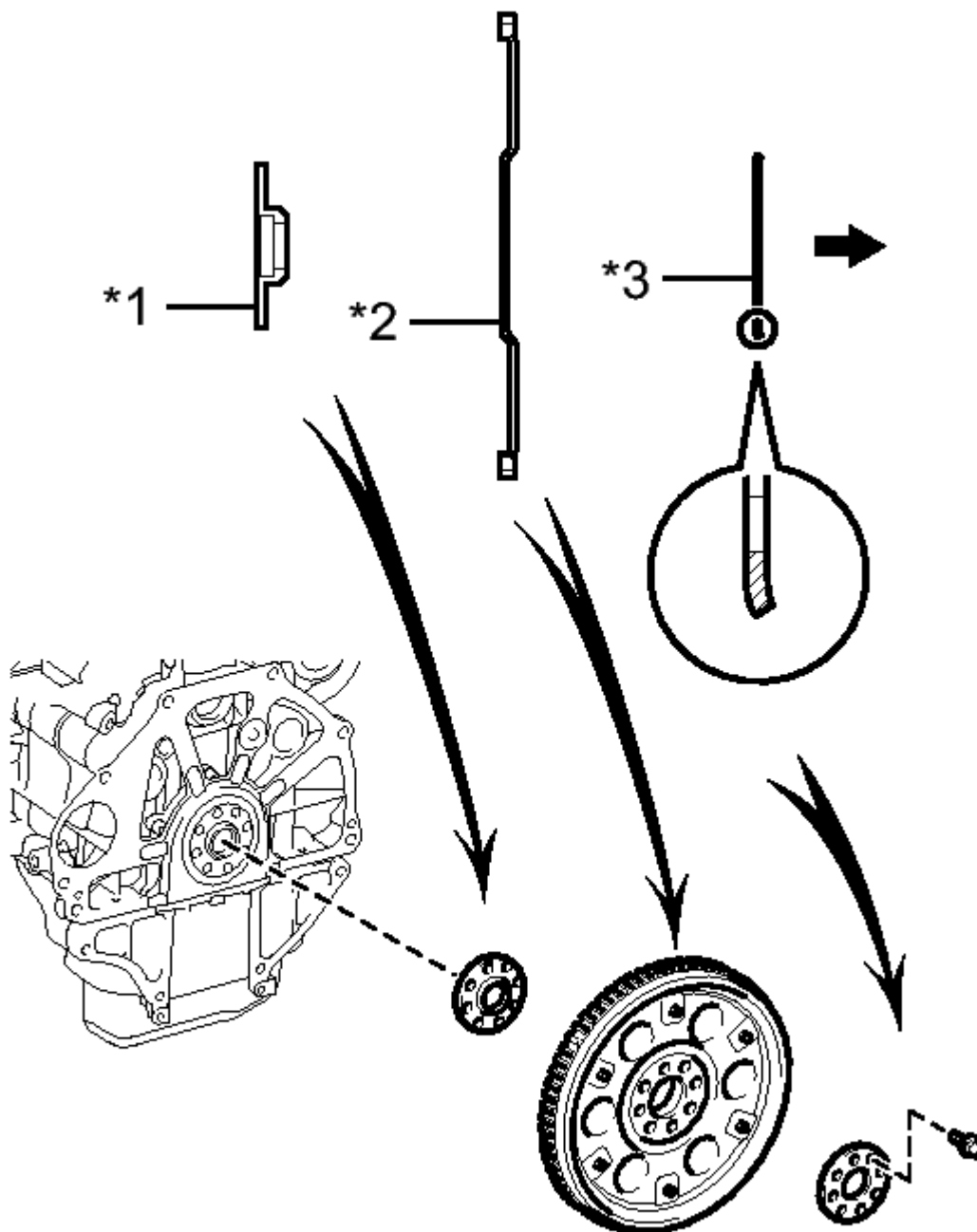
**T**

Fig. 218: Identifying Front Spacer, Drive Plate, Rear Spacer And Bolts (Automatic Transmission)

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

- b. Install the front spacer, drive plate and rear spacer to the crankshaft.

TEXT IN ILLUSTRATION

*1	Front Spacer
	Drive Plate
*2	and Ring
	Gear
*3	Rear Spacer
	Automatic
	Transmission
	Side

HINT:

As the front spacer, the drive plate and ring gear and the rear spacer are not reversible, be sure to install them so that they are facing in the direction shown in the illustration.

- c. Clean the bolts and bolt holes.

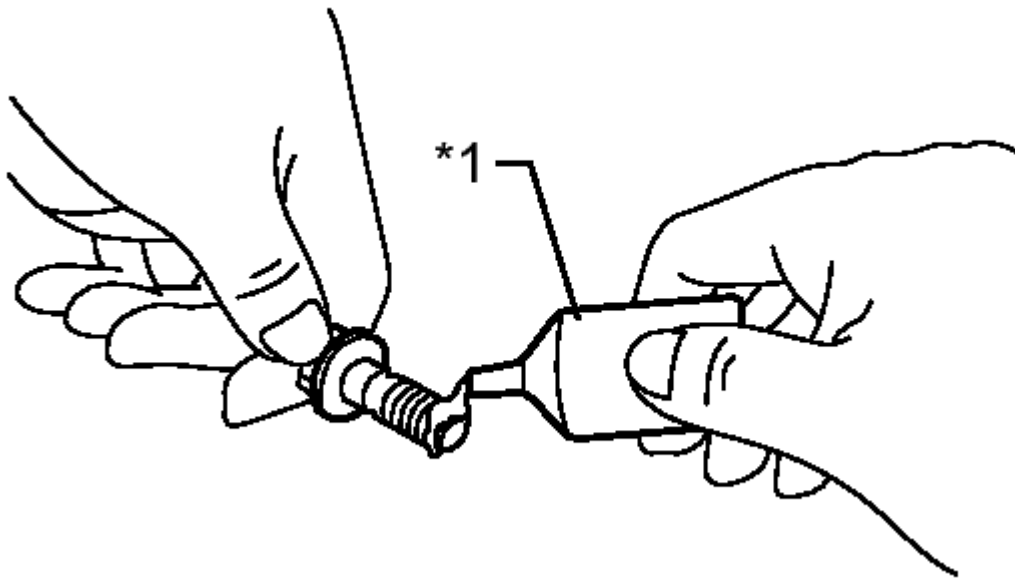


Fig. 219: Apply Adhesive To End Threads Of Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

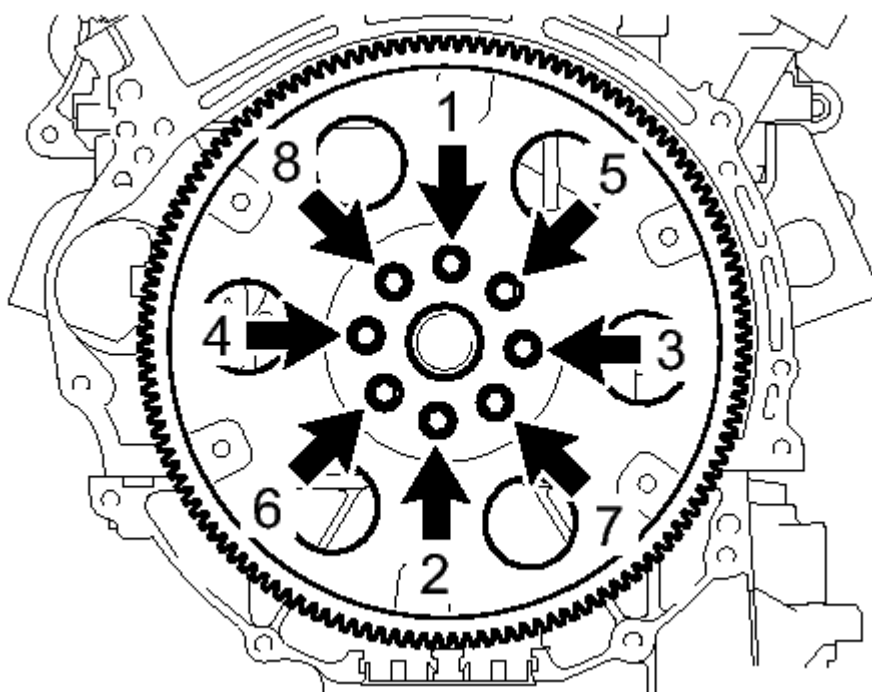
- d. Apply adhesive to 2 or 3 threads at the end of each of the 8 bolts.

Adhesive

Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

TEXT IN ILLUSTRATION

*1|Adhesive



T
Fig. 220: Identifying Drive Plate Bolt Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not start the engine for at least 1 hour after installation.

- e. Install and uniformly tighten the 8 bolts in several steps in the sequence shown in the illustration.

Torque: 83 N*m (846 kgf*cm, 61 ft.*lbf)

6. INSTALL REAR NO. 1 ENGINE MOUNTING INSULATOR

HINT:

Only perform this procedure when replacement of the engine mounting insulator is necessary.

- a. Install the rear engine mounting insulator to the transmission with the 4 bolts.

Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)

7. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY

Refer to **INSTALLATION**

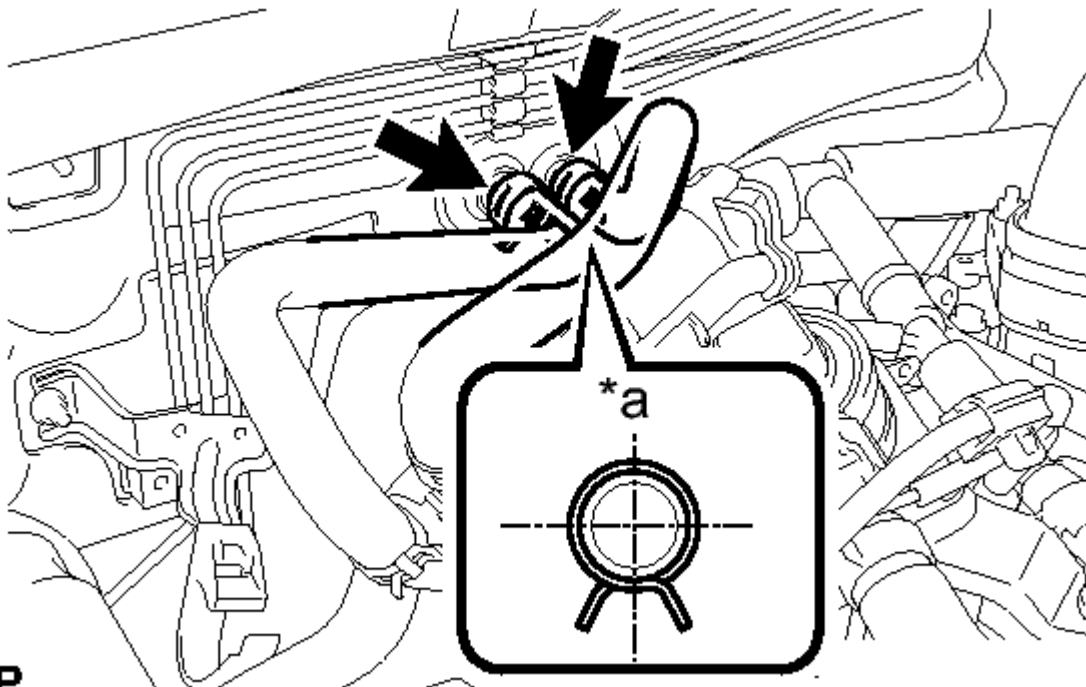
8. INSTALL PROPELLER SHAFT ASSEMBLY

Refer to **INSTALLATION**

9. CONNECT NO. 1 AND NO. 2 FUEL PIPES

- a. Connect the No. 1 and No. 2 fuel pipes. Refer to **PRECAUTION**.
- b. Install the No. 2 fuel pipe clamp to the fuel tube connector.

10. CONNECT HEATER WATER HOSE ASSEMBLY



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Fig. 221: Identifying Heater Water Inlet & Outlet Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Connect the heater water inlet and outlet hoses.

TEXT IN ILLUSTRATION

*aTop

HINT:

The direction of the hose clamp is indicated in the illustration.

- b. Attach the wire harness clamp.

11. CONNECT COOLER COMPRESSOR ASSEMBLY

- a. Install the cooler compressor with the 2 stud bolts.

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

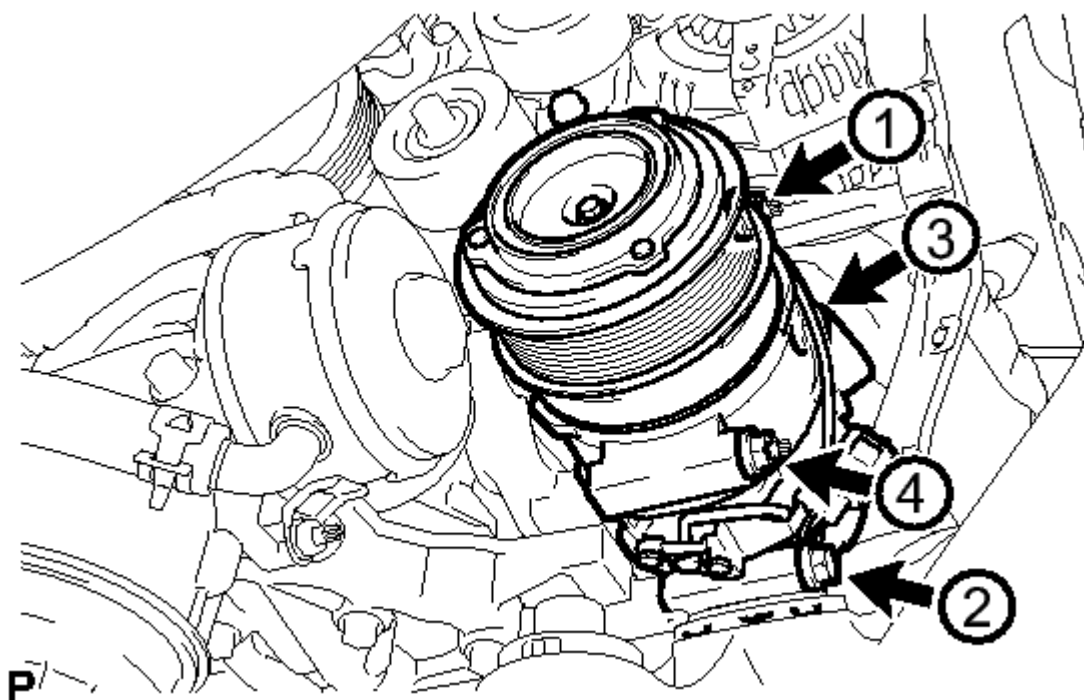


Fig. 222: Identifying Cooler Compressor & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Install the 2 bolts and 2 nuts.

Torque: 25 N*m (250 kgf*cm, 18 ft.*lbf)

HINT:

Tighten the bolts and nuts in the order shown in the illustration to install the cooler compressor.

- c. Connect the cooler compressor connector.

12. CONNECT ENGINE WIRE

- a. Attach the 2 claws and connect the 2 connectors to connect the engine room junction block connector to the engine room junction block.
- b. Attach the claw and install the bolt to connect the engine wire harness.

Torque: 17 N*m (173 kgf*cm, 13 ft.*lbf)

- c. Attach the clamp and connect the air pump connector.
- d. Install the ground cable with the 2 bolts.

Torque: 8.4 N*m (86 kgf*cm, 74 in.*lbf)

- e. Attach the clamp and connect the ECM connector. Refer to **INSTALLATION**.
- f. Attach the 2 clamps and connect the 7 connectors to connect the junction block connector to the

junction block.

- g. Install the junction block cover.
- h. Attach the 2 wire harness clamps.
- i. Connect the 2 air injection control driver connectors.

- 13. **INSTALL DRIVE PLATE AND TORQUE CONVERTER SETTING BOLT** . Refer to **INSTALLATION - Step 10**
- 14. **INSTALL STARTER ASSEMBLY (for 1.6 kW Type)** . Refer to **INSTALLATION - Step 2**
- 15. **INSTALL STARTER ASSEMBLY (for 1.4 kW Type)** . Refer to **INSTALLATION - Step 2**
- 16. **INSTALL STARTER COVER (for 1.4 kW Type)** . Refer to **INSTALLATION - Step 3**
- 17. **INSTALL GENERATOR ASSEMBLY** . Refer to **INSTALLATION - Step 1**
- 18. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH** . Refer to **INSTALLATION - Step 1**
- 19. **INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR** . Refer to **INSTALLATION - Step 2**
- 20. **INSTALL NO. 2 AIR TUBE** . Refer to **INSTALLATION - Step 3**
- 21. **INSTALL MANIFOLD STAY** . Refer to **INSTALLATION - Step 4**
- 22. **INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH** . Refer to **INSTALLATION - Step 5**
- 23. **INSTALL NO. 1 EXHAUST MANIFOLD HEAT INSULATOR** . Refer to **INSTALLATION - Step 6**
- 24. **INSTALL AIR TUBE** . Refer to **INSTALLATION - Step 2**
- 25. **INSTALL NO. 2 MANIFOLD STAY** . Refer to **INSTALLATION - Step 8**
- 26. **INSTALL FRONT EXHAUST PIPE ASSEMBLY**

- a. Install a new gasket and the exhaust pipe to the exhaust manifold RH with 3 new nuts.

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

- b. Install a new gasket and the exhaust pipe to the center exhaust pipe with the 2 bolts.

Torque: 48 N*m (489 kgf*cm, 35 ft.*lbf)

- c. Connect the air fuel ratio sensor connector.
- d. Connect the heated oxygen sensor connector and attach the 2 clamps.

- 27. **INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY (except Regular Cab Standard Deck)**

- a. Connect the front No. 2 exhaust pipe to the exhaust pipe support.
- b. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 3 new nuts.

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

- c. Install a new gasket and the front No. 2 exhaust pipe to the center exhaust pipe with the 2 bolts.

Torque: 48 N*m (489 kgf*cm, 35 ft.*lbf)

- d. Connect the air fuel ratio sensor connector.

e. Connect the heated oxygen sensor connector.

28. INSTALL FRONT NO. 2 EXHAUST PIPE ASSEMBLY (for Regular Cab Standard Deck)

a. Install a new gasket and the front No. 2 exhaust pipe to the exhaust manifold LH with 3 new nuts.

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

b. Connect the air fuel ratio sensor connector.

c. Connect the heated oxygen sensor connector and attach the 2 clamps.

29. INSTALL FRONT NO. 3 EXHAUST PIPE SUB-ASSEMBLY (for Regular Cab Standard Deck)

a. Install a new gasket to the front No. 2 exhaust pipe.

b. Install a new gasket to the front No. 3 exhaust pipe.

c. Connect the front No. 3 exhaust pipe to the exhaust pipe support.

d. Install the front No. 3 exhaust pipe with the 4 bolts and 2 new nuts.

Torque: 48 N*m (489 kgf*cm, 35 ft.*lbf)

30. CONNECT VANE PUMP ASSEMBLY . Refer to **INSTALLATION - Step 5**

31. INSTALL FAN AND GENERATOR V BELT See step 1

32. INSTALL INTAKE AIR SURGE TANK . Refer to **INSTALLATION - Step 3**

33. INSTALL AIR TUBE ASSEMBLY . Refer to **INSTALLATION - Step 4**

34. INSTALL RADIATOR ASSEMBLY . Refer to **INSTALLATION - Step 1**

35. INSTALL FAN SHROUD . Refer to **INSTALLATION - Step 2**

36. INSTALL RADIATOR HOSE OUTLET . Refer to **INSTALLATION - Step 3**

37. INSTALL RADIATOR HOSE INLET . Refer to **INSTALLATION - Step 4**

38. INSTALL AIR CLEANER CASE SUB-ASSEMBLY . Refer to **INSTALLATION - Step 3**

39. INSTALL AIR CLEANER CAP AND HOSE . Refer to **INSTALLATION - Step 4**

40. ADD ENGINE COOLANT . Refer to **REPLACEMENT - Step 3**

41. ADD ENGINE OIL . Refer to **REPLACEMENT - Step 5**

42. INSTALL FRONT COWL TOP OUTER PANEL SUB-ASSEMBLY . Refer to **INSTALLATION - Step 11**

43. INSTALL FRONT WIPER MOTOR AND LINK ASSEMBLY

Refer to **INSTALLATION**

44. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

NOTE: When disconnecting the cable, some systems need to be initialized after the cable is reconnected. Refer to **INITIALIZATION** .

45. INSPECT FOR FUEL LEAK . Refer to **INSTALLATION - Step 7**

46. INSPECT FOR ENGINE OIL LEAK . Refer to **REPLACEMENT - Step 7**

- 47. **INSPECT FOR EXHAUST GAS LEAK** . Refer to **INSTALLATION - Step 10**
- 48. **CHECK ENGINE OIL LEVEL** . Refer to **ON-VEHICLE INSPECTION - Step 2**
- 49. **INSTALL FRONT FENDER APRON SEAL REAR RH**
 - a. Install the fender apron seal with the 5 clips.
- 50. **INSTALL FRONT FENDER APRON SEAL REAR LH**
 - a. Install the fender apron seal with the 5 clips.
- 51. **INSTALL FRONT FENDER APRON SEAL RH**
 - a. Install the front fender apron seal with the 6 clips.
- 52. **INSTALL FRONT FENDER APRON SEAL LH**
 - a. Install the front fender apron seal with the 6 clips.
- 53. **INSTALL NO. 1 ENGINE UNDER COVER** . Refer to **REPLACEMENT - Step 8**
- 54. **PERFORM RESET MEMORY**

Refer to **INITIALIZATION**

- 55. **INSPECT IGNITION TIMING** See step 1
- 56. **INSPECT ENGINE IDLE SPEED** See step 2
- 57. **INSPECT CO/HC** See step 4
- 58. **INSTALL HOOD SUB-ASSEMBLY**
 - a. Install the hood with the 4 bolts and 2 clips.

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

- 59. **ADJUST HOOD SUB-ASSEMBLY** . Refer to **ADJUSTMENT - Step 1**

ENGINE UNIT

COMPONENTS

ILLUSTRATION

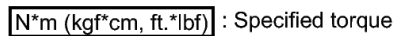
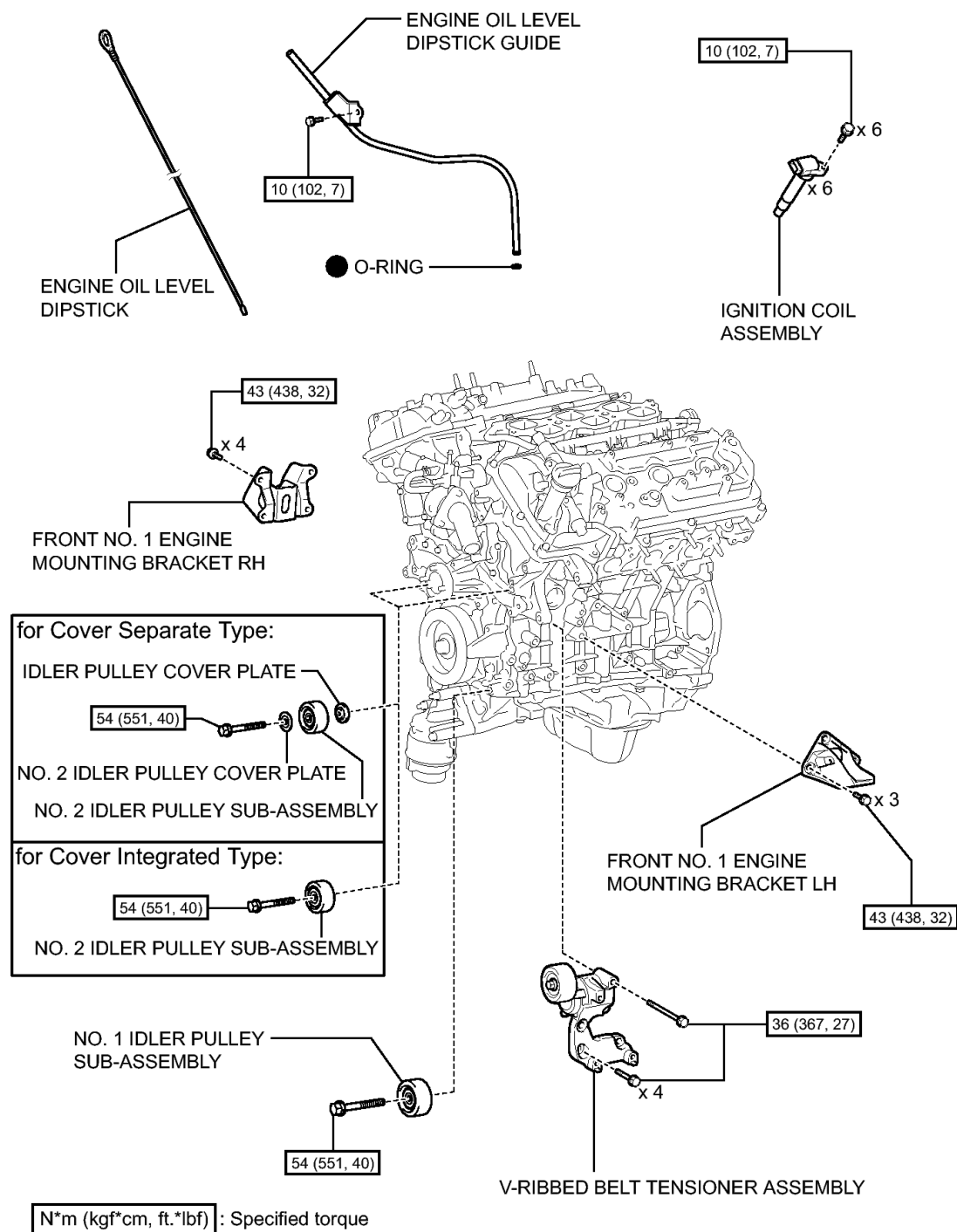


Fig. 223: Engine Unit Replacement Components With Torque Specifications (1 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

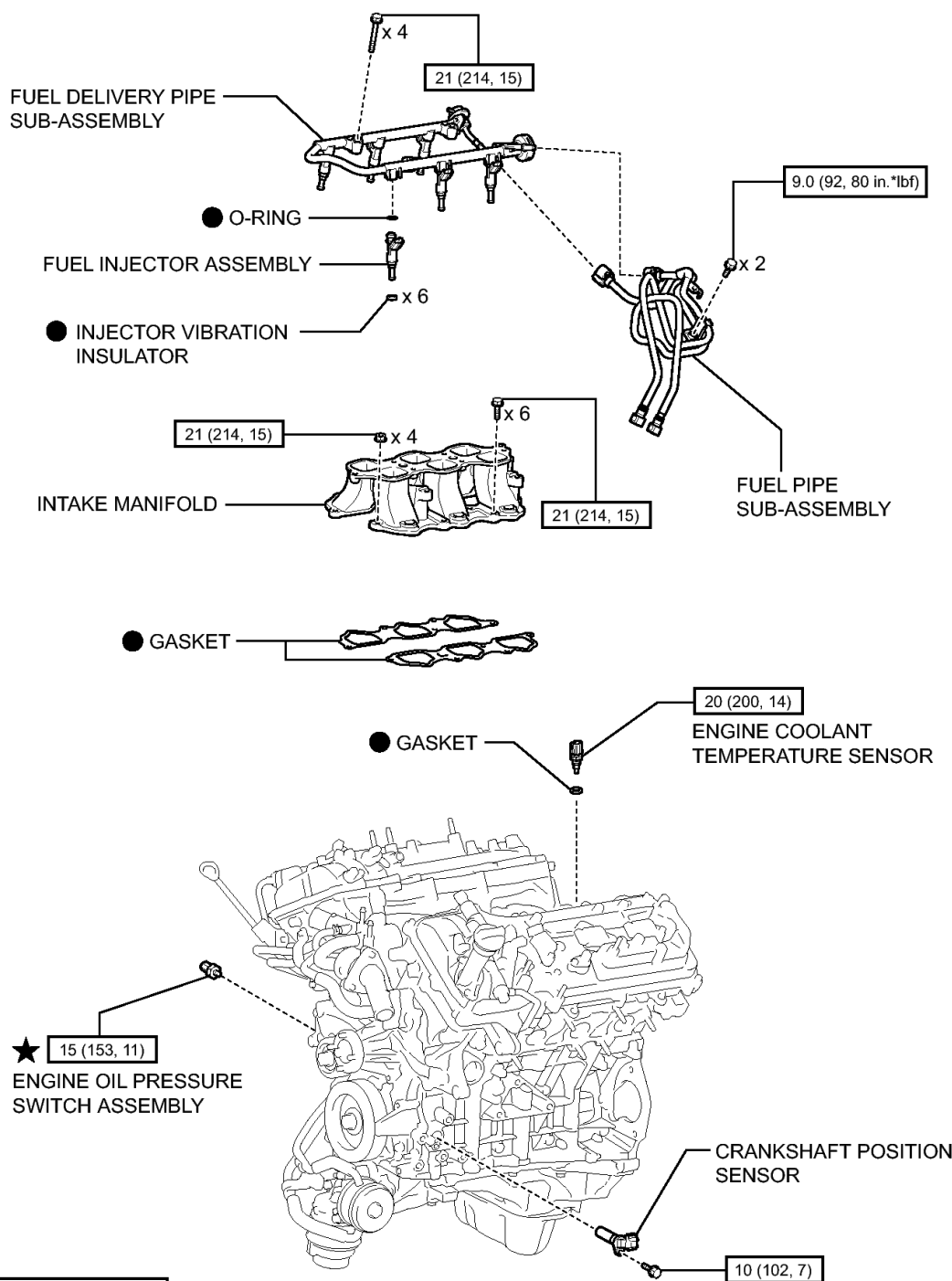
domingo, 3 de enero de 2021 07:39:25 p. m.



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Fig. 224: Engine Unit Replacement Components With Torque Specifications (2 Of 12)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



[N*m (kgf*cm, ft.*lbf)] : Specified torque

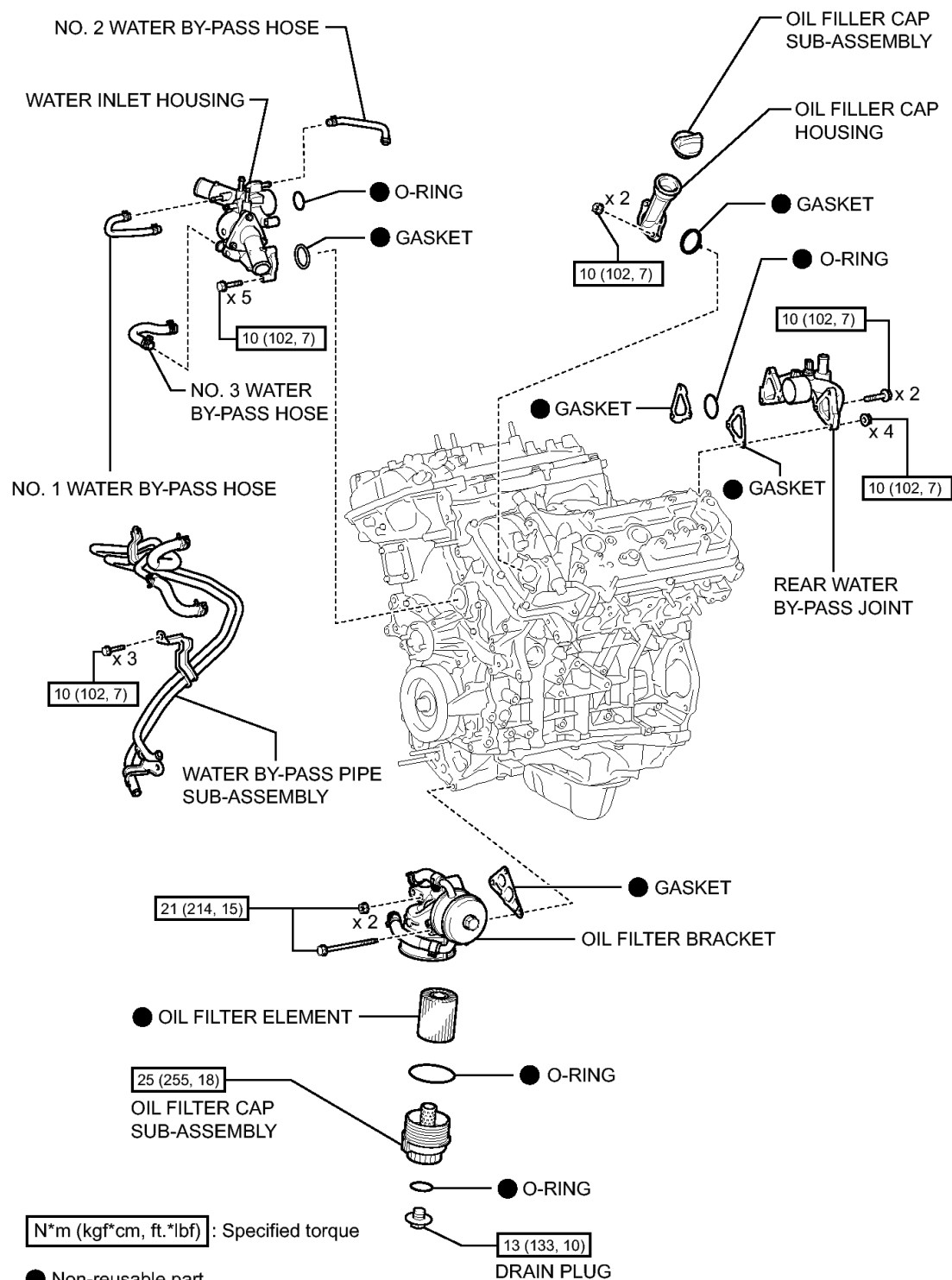
● Non-reusable part

★ Precoated part

P

Fig. 225: Engine Unit Replacement Components With Torque Specifications (3 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

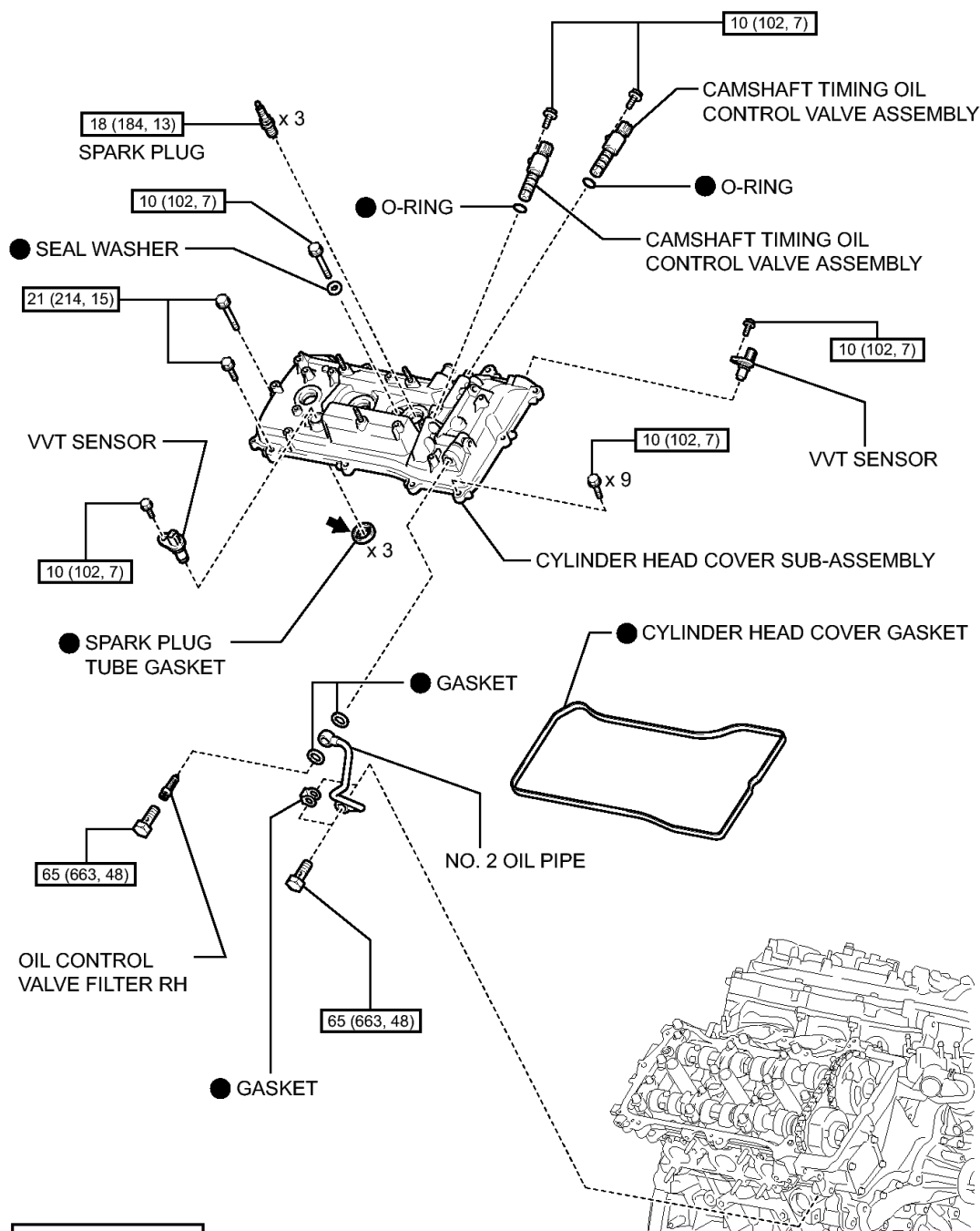
ILLUSTRATION



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Fig. 226: Engine Unit Replacement Components With Torque Specifications (4 Of 12)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



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

● Non-reusable part

← MP grease

P

Fig. 227: Engine Unit Replacement Components With Torque Specifications (5 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION

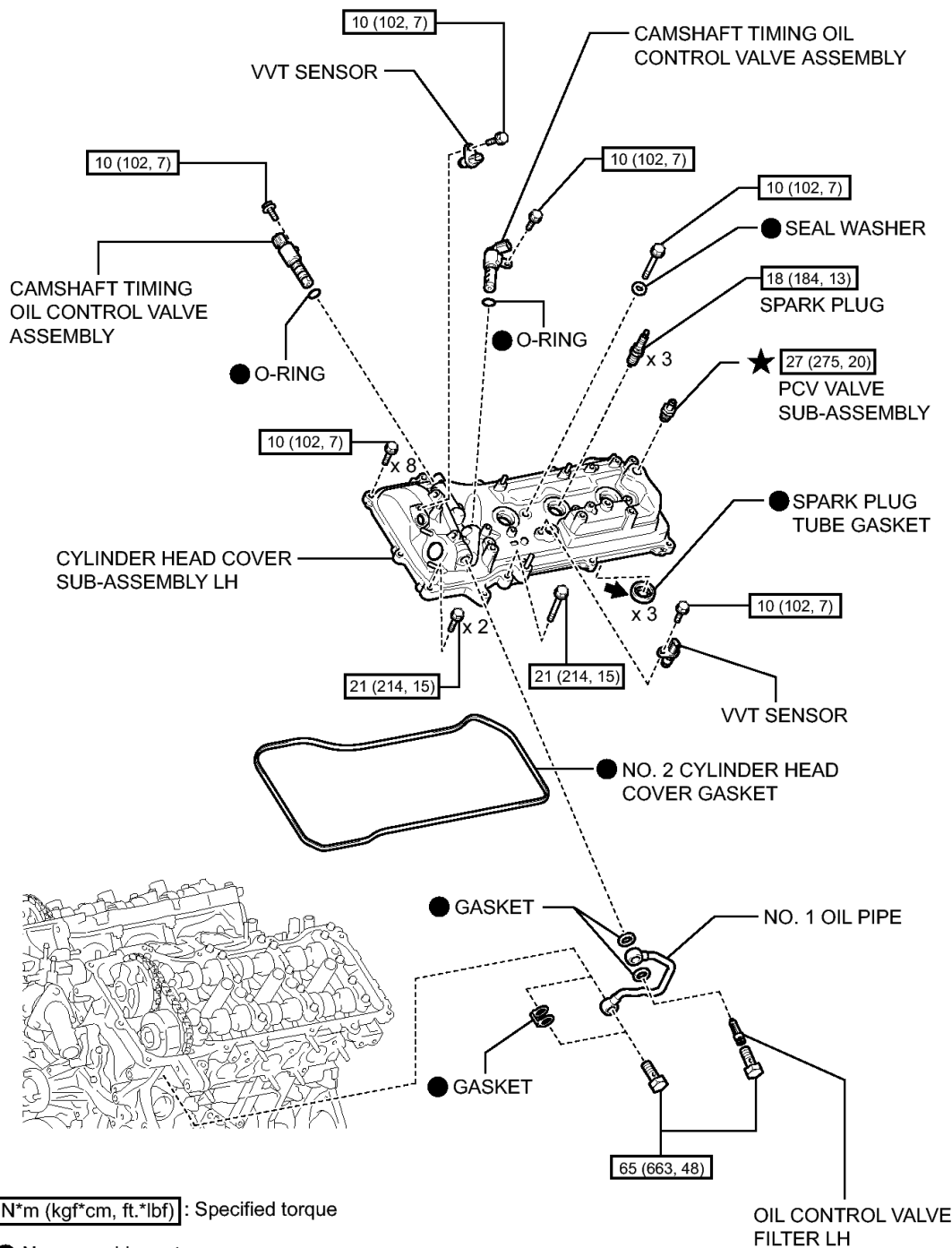
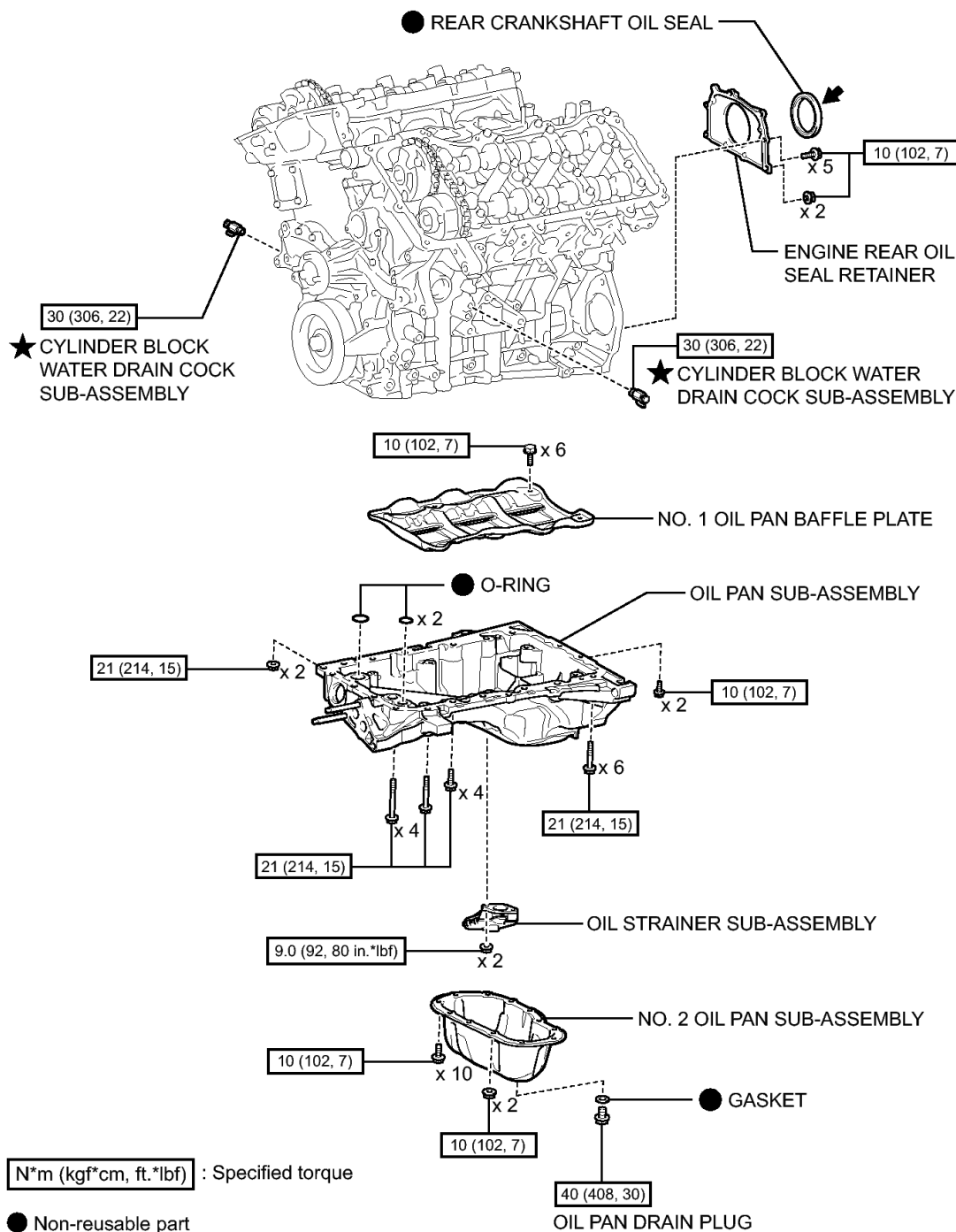


Fig. 228: Engine Unit Replacement Components With Torque Specifications (6 Of 12)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

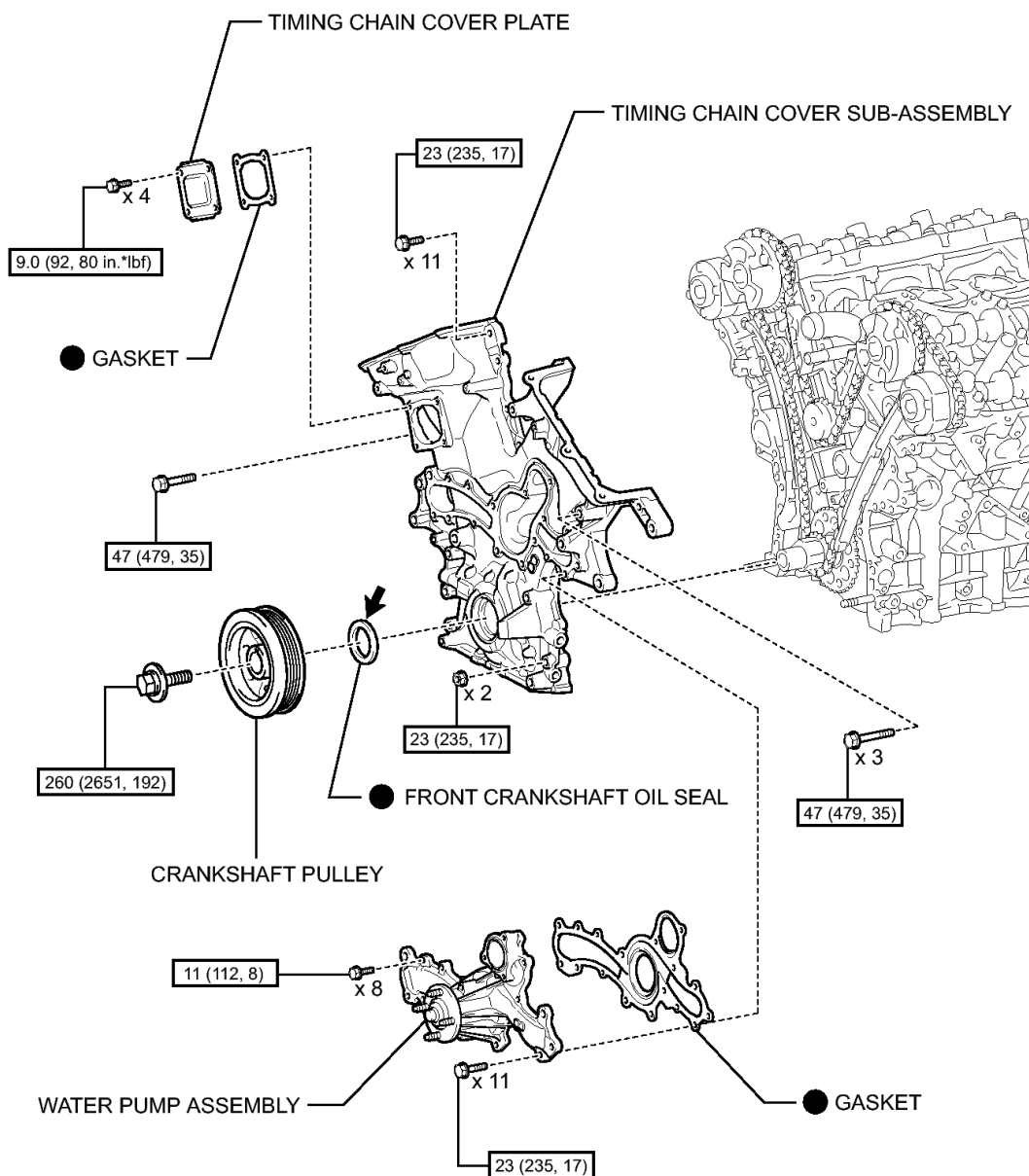
ILLUSTRATION



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Fig. 229: Engine Unit Replacement Components With Torque Specifications (7 Of 12)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



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

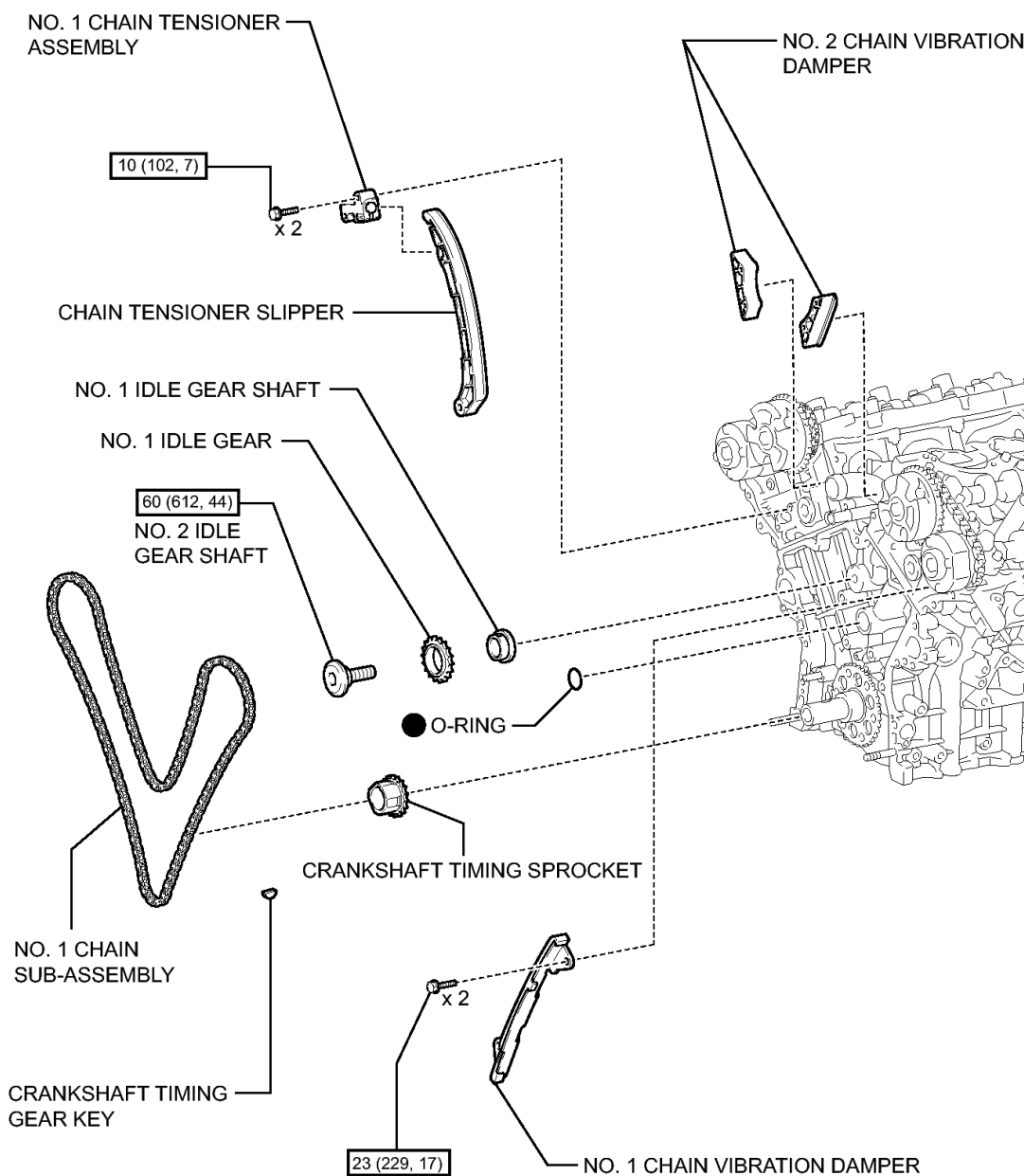
● Non-reusable part

← MP grease

P

Fig. 230: Engine Unit Replacement Components With Torque Specifications (8 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



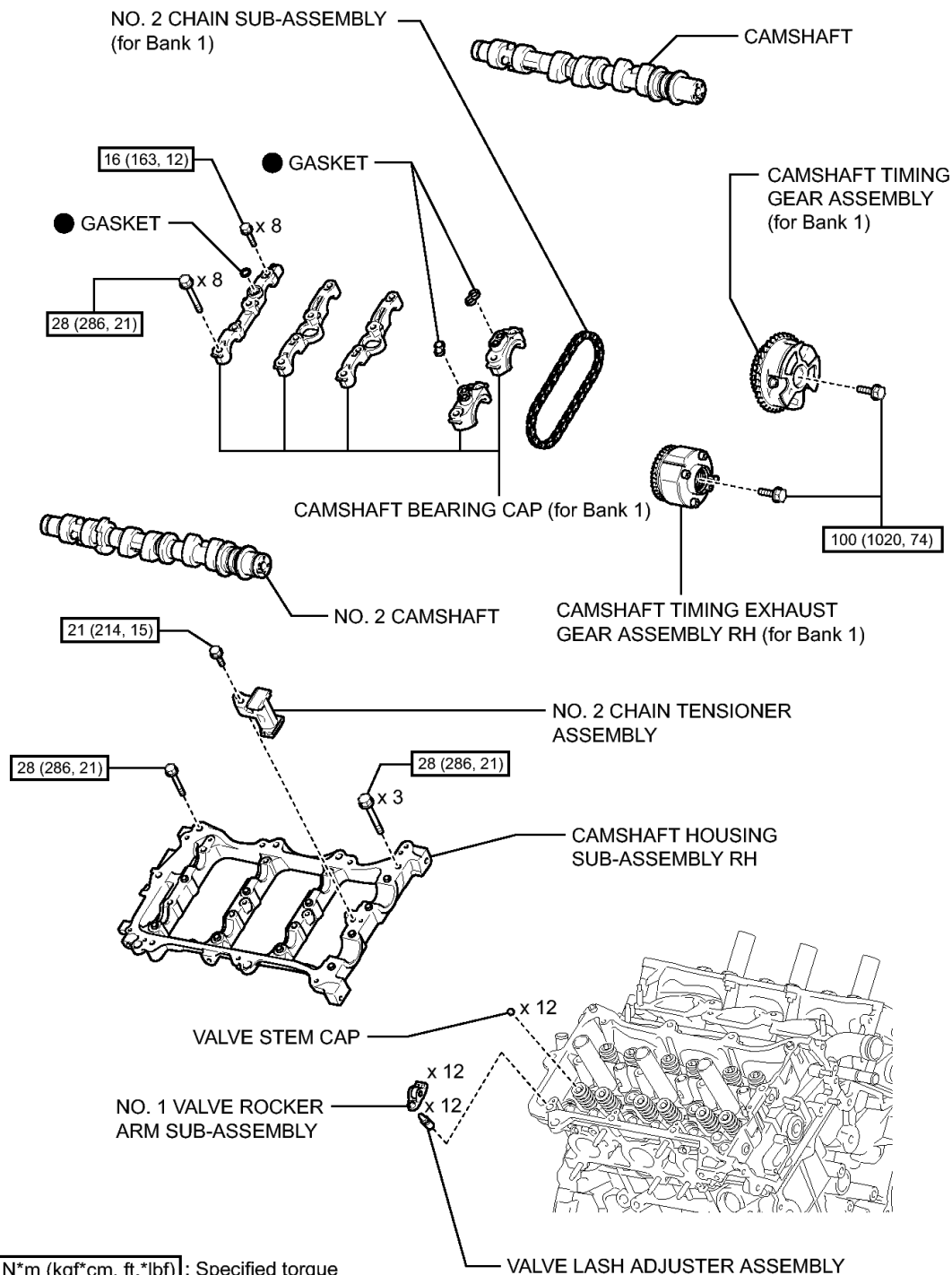
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

P

Fig. 231: Engine Unit Replacement Components With Torque Specifications (9 Of 12)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



P

Fig. 232: Engine Unit Replacement Components With Torque Specifications (10 Of 12)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

ILLUSTRATION



ILLUSTRATION

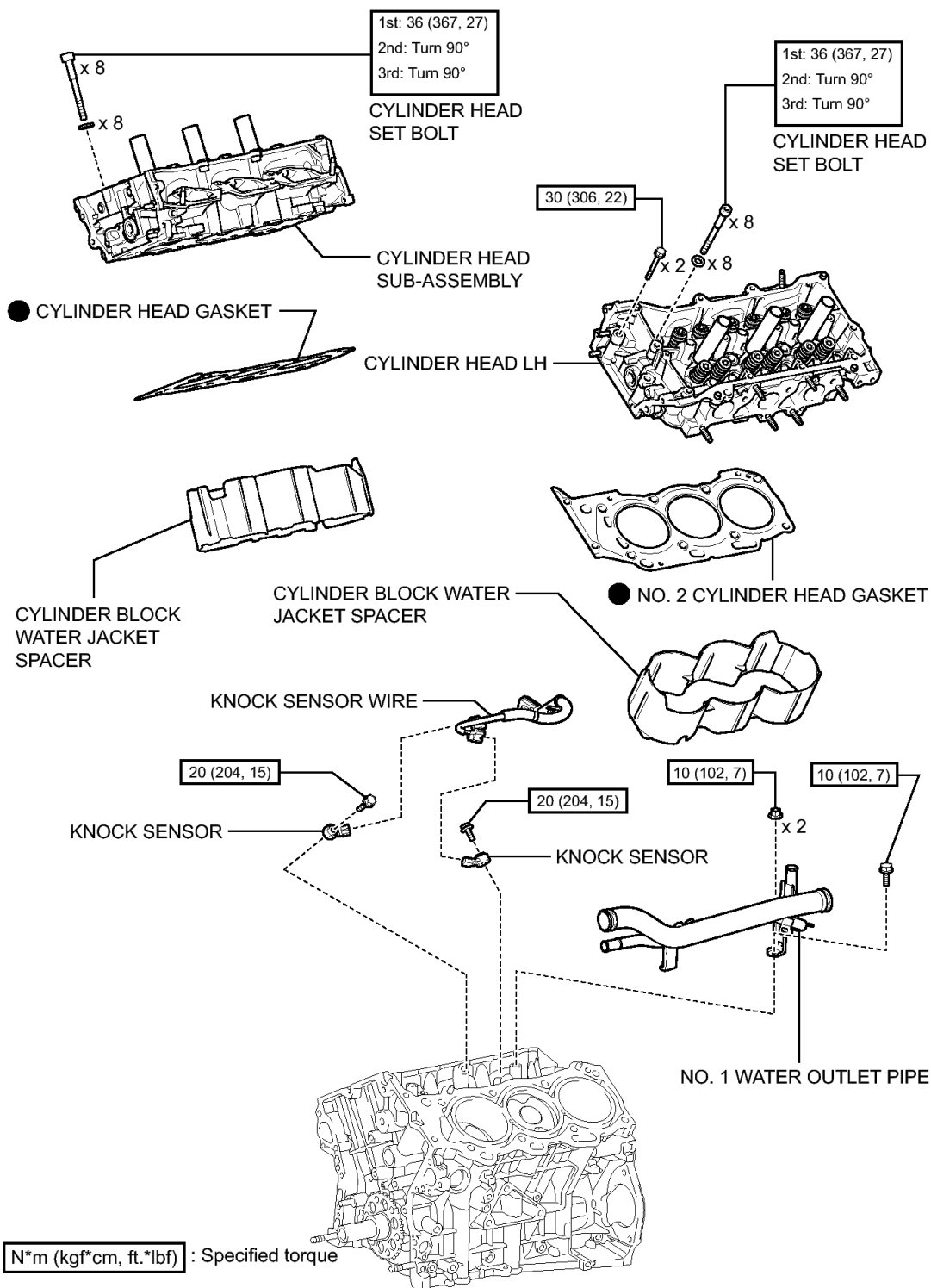


Fig. 234: Engine Unit Replacement Components With Torque Specifications (12 Of 12)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

REMOVAL

REMOVAL

1. **REMOVE ENGINE WIRE**
2. **REMOVE NO. 1 WATER BY-PASS PIPE**
 - a. Disconnect the 2 water by-pass pipe hoses and remove the pipe.

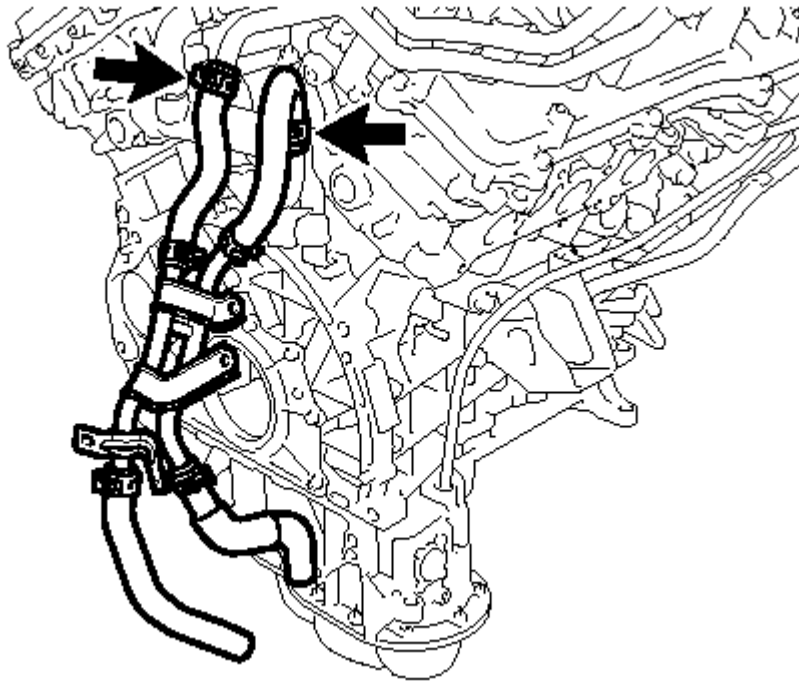
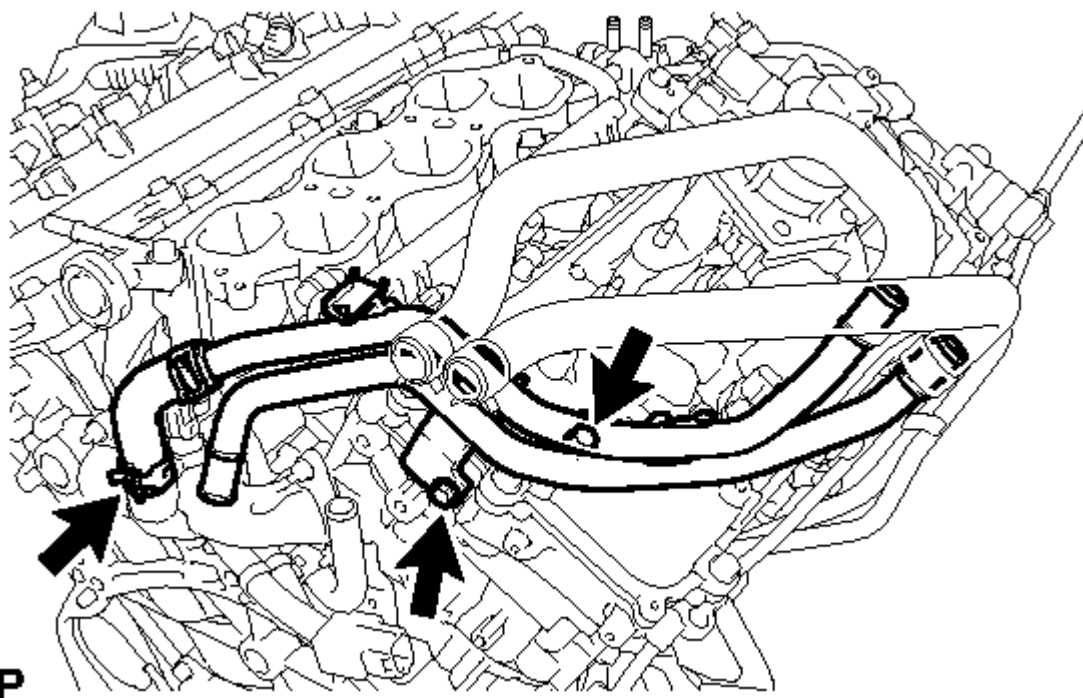
**P**

Fig. 235: Identifying 2 Water By-Pass Pipe Hoses
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

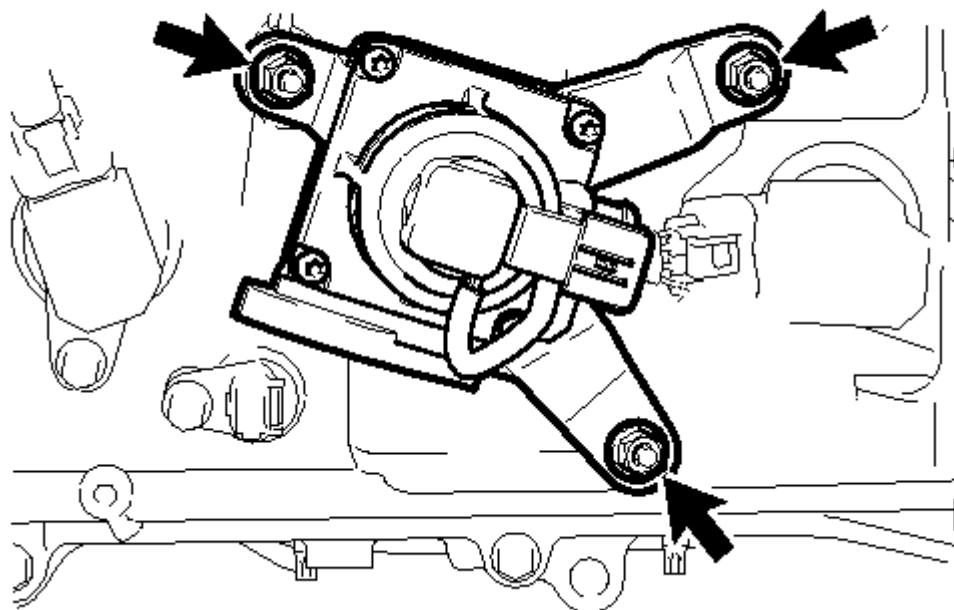
3. **REMOVE HEATER WATER PIPE SUB-ASSEMBLY**
 - a. Disconnect the hose and remove the 2 bolts and heater water pipe.



P

Fig. 236: Identifying Hose, Bolts & Heater Water Pipe
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

4. REMOVE EMISSION CONTROL VALVE SET

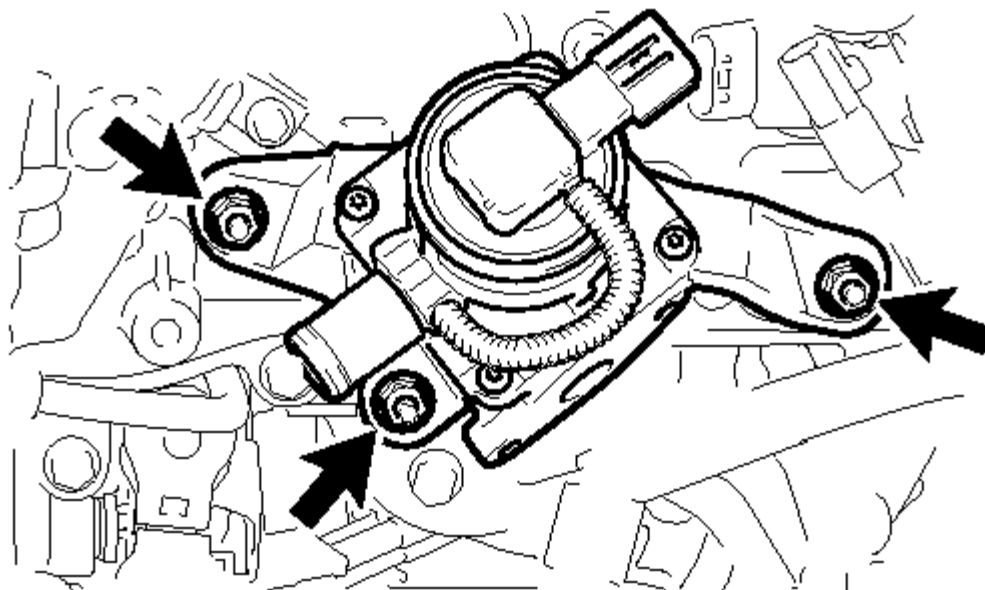


P

Fig. 237: Identifying Emission Control Valve Set & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the 3 nuts and emission control valve set.

5. REMOVE NO. 2 EMISSION CONTROL VALVE SET



P

Fig. 238: Identifying No. 2 Emission Control Valve Set & Fasteners

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

- a. Remove the 3 nuts and No. 2 emission control valve set.

6. REMOVE WIRING HARNESS CLAMP BRACKET

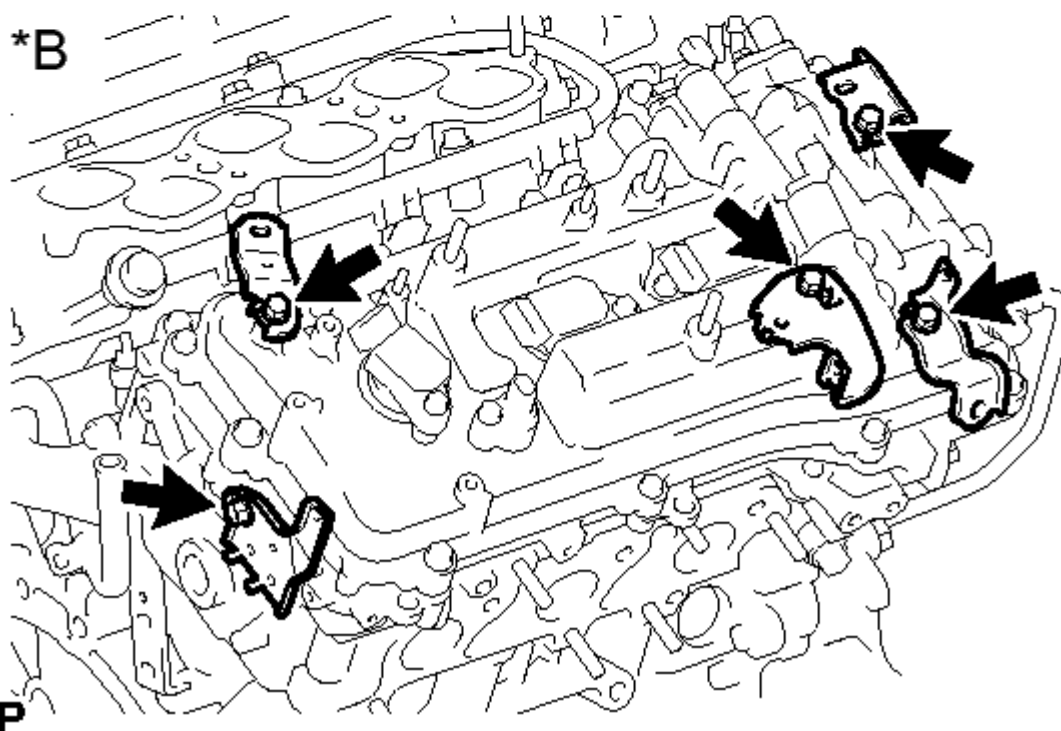
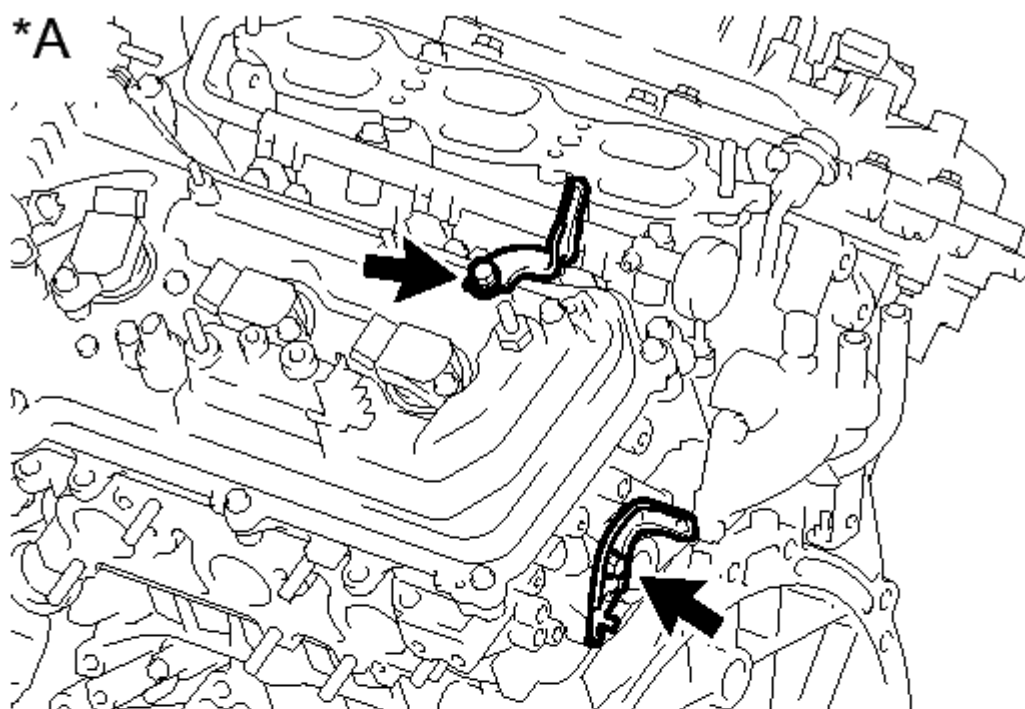


Fig. 239: Identifying Harness Clamp Brackets & Fasteners
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the 7 bolts and 7 wiring harness clamp brackets.

TEXT IN ILLUSTRATION

*A	for Bank 2
*B	for Bank 1

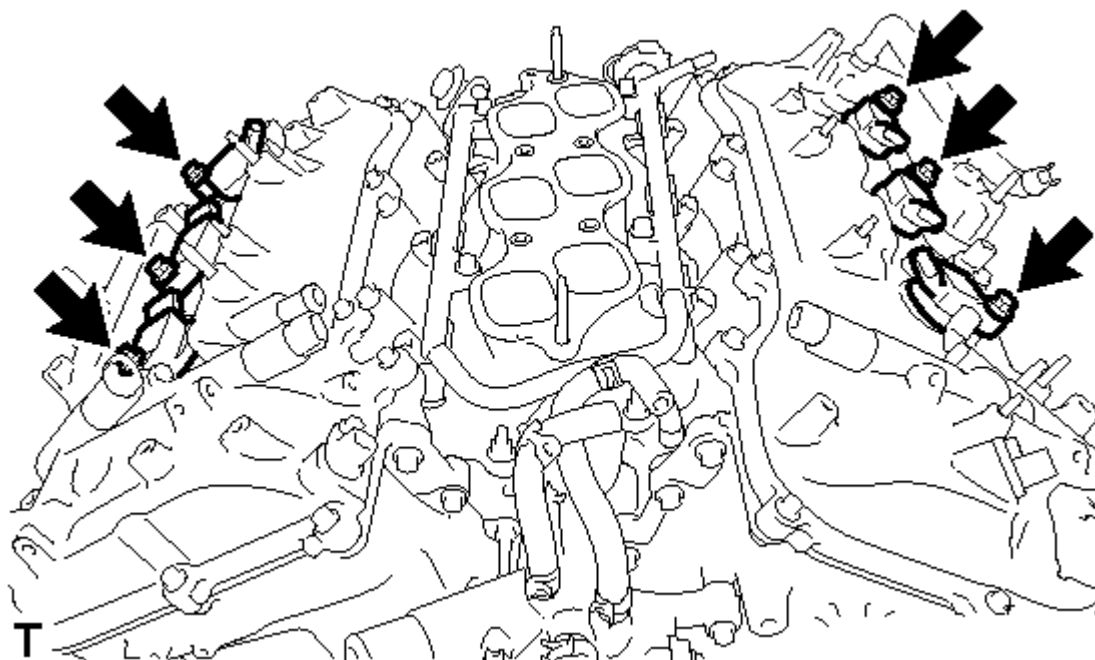
7. REMOVE IGNITION COIL ASSEMBLY

Fig. 240: Identifying Ignition Coil Assembly And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the 6 bolts and 6 ignition coils.

8. REMOVE FUEL PIPE SUB-ASSEMBLY

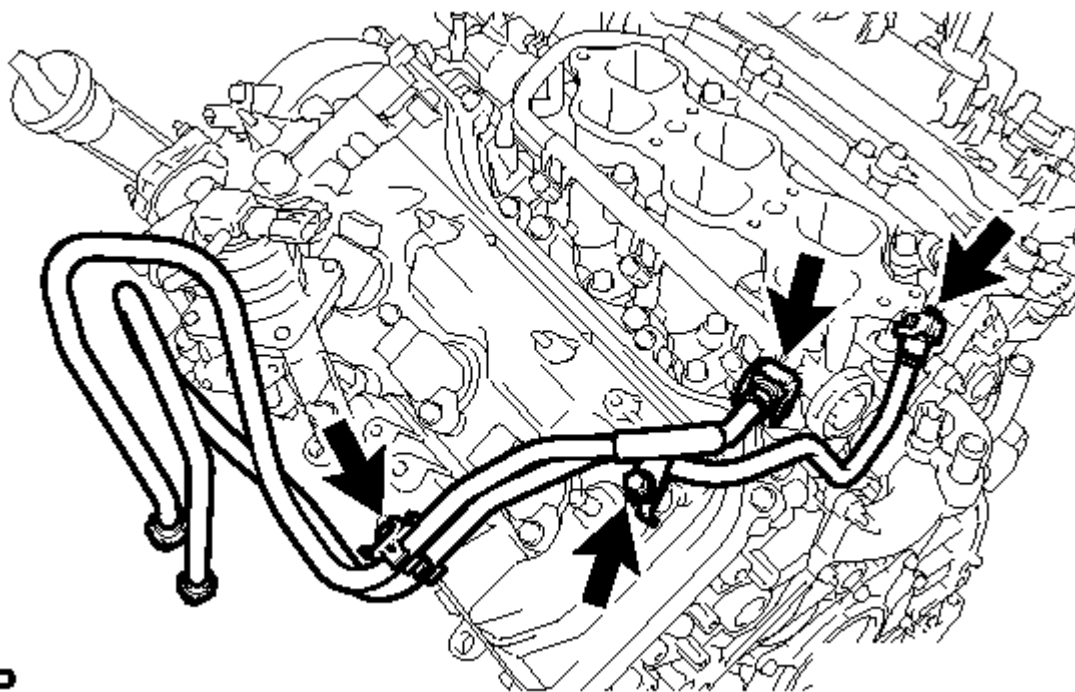
**P**

Fig. 241: Identifying No. 1 Fuel Pipe, No. 2 Fuel Pipe & Fasteners

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

- a. Disconnect the 2 fuel pipes. Refer to **PRECAUTION**.
- b. Remove the 2 bolts and No. 1 fuel pipe and No. 2 fuel pipe.
9. **REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY**. Refer to **REMOVAL - Step 5**
10. **REMOVE FUEL INJECTOR ASSEMBLY**. Refer to **REMOVAL - Step 6**
11. **REMOVE INTAKE MANIFOLD**. Refer to **REMOVAL - Step 12**
12. **REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY**. Refer to **REMOVAL - Step 6**
13. **REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY**. Refer to **REMOVAL - Step 8**
14. **REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY**. Refer to **REMOVAL - Step 8**
15. **REMOVE V-RIBBED BELT TENSIONER ASSEMBLY**. Refer to **REMOVAL - Step 10**
16. **REMOVE ENGINE OIL LEVEL DIPSTICK GUIDE**. Refer to **REMOVAL - Step 5**
17. **REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET LH**
 - a. Remove the 3 bolts and front No. 1 engine mounting bracket LH.

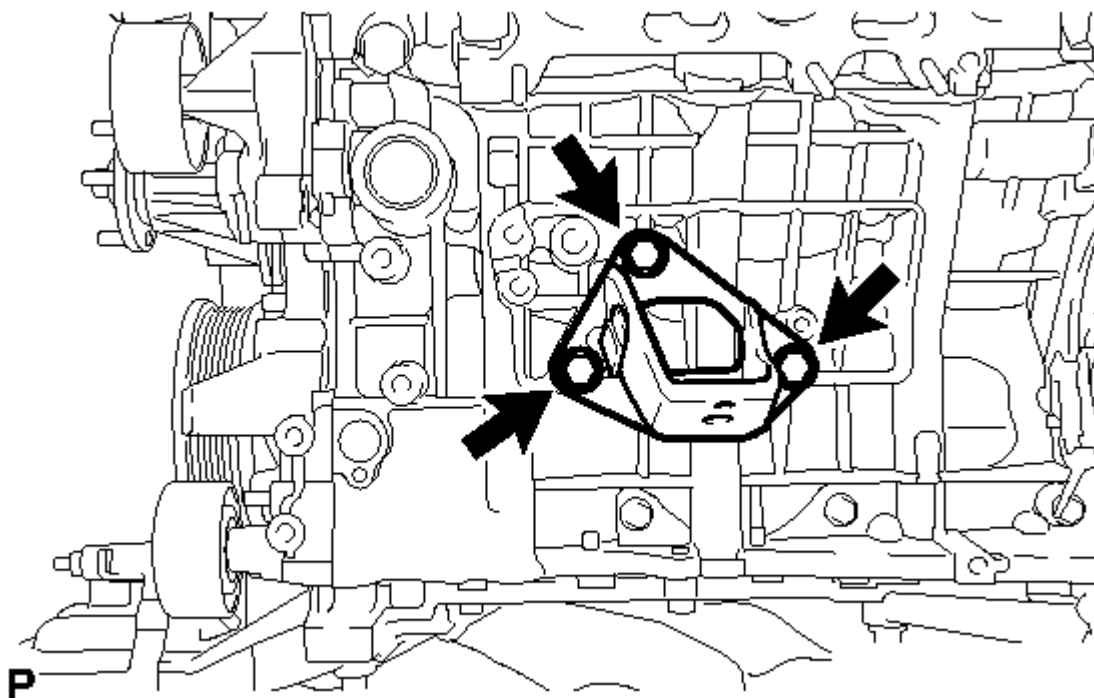


Fig. 242: Identifying Front No. 1 Engine Mounting Bracket LH And Bolts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

18. **REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET RH**
- Remove the 4 bolts and front No. 1 engine mounting bracket RH.

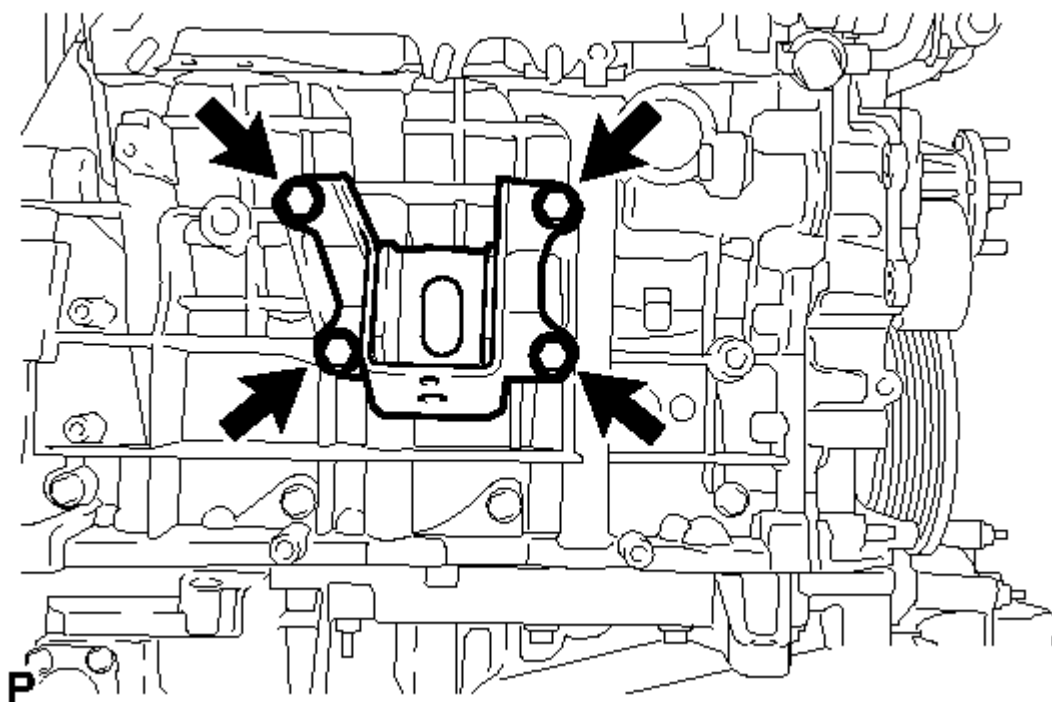


Fig. 243: Identifying Front No. 1 Engine Mounting Bracket RH And Bolts

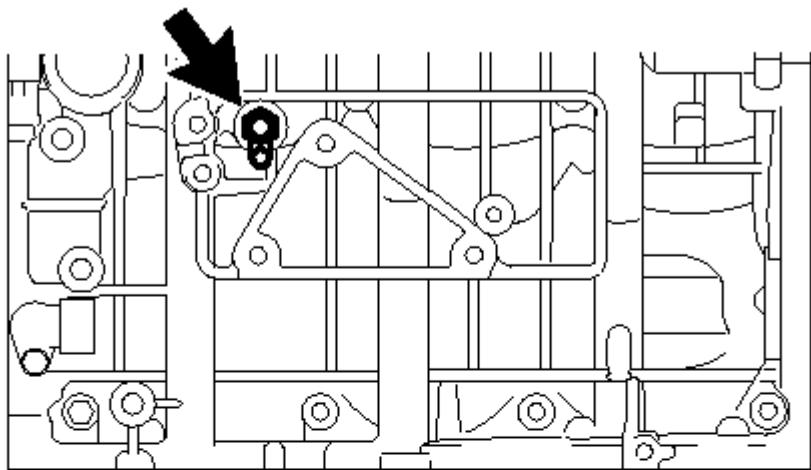
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

DISASSEMBLY

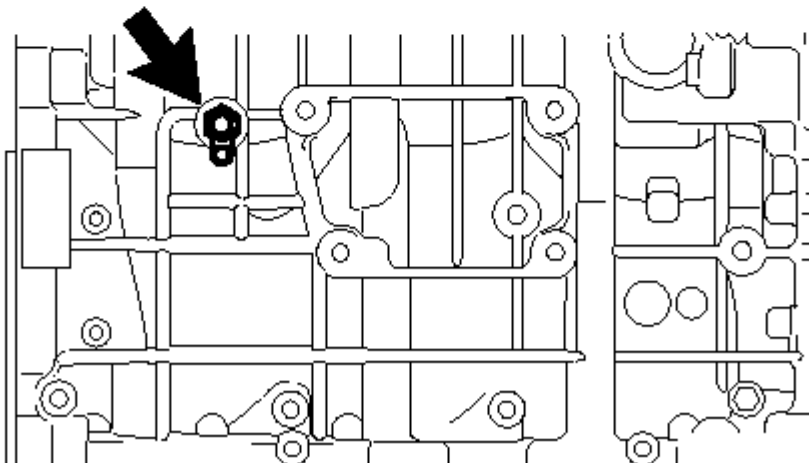
DISASSEMBLY

1. **REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY** . Refer to **REMOVAL - Step 2**
2. **REMOVE ENGINE COOLANT TEMPERATURE SENSOR** . Refer to **REMOVAL - Step 2**
3. **REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY**
 - a. Remove the 2 water drain cock plugs from the water drain cocks.

*A



*B



P

Fig. 244: Identifying Drain Cock Plugs

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

TEXT IN ILLUSTRATION



*A	LH Side
*B	RH Side

- b. Remove the 2 water drain cocks from the cylinder block.

4. REMOVE VVT SENSOR

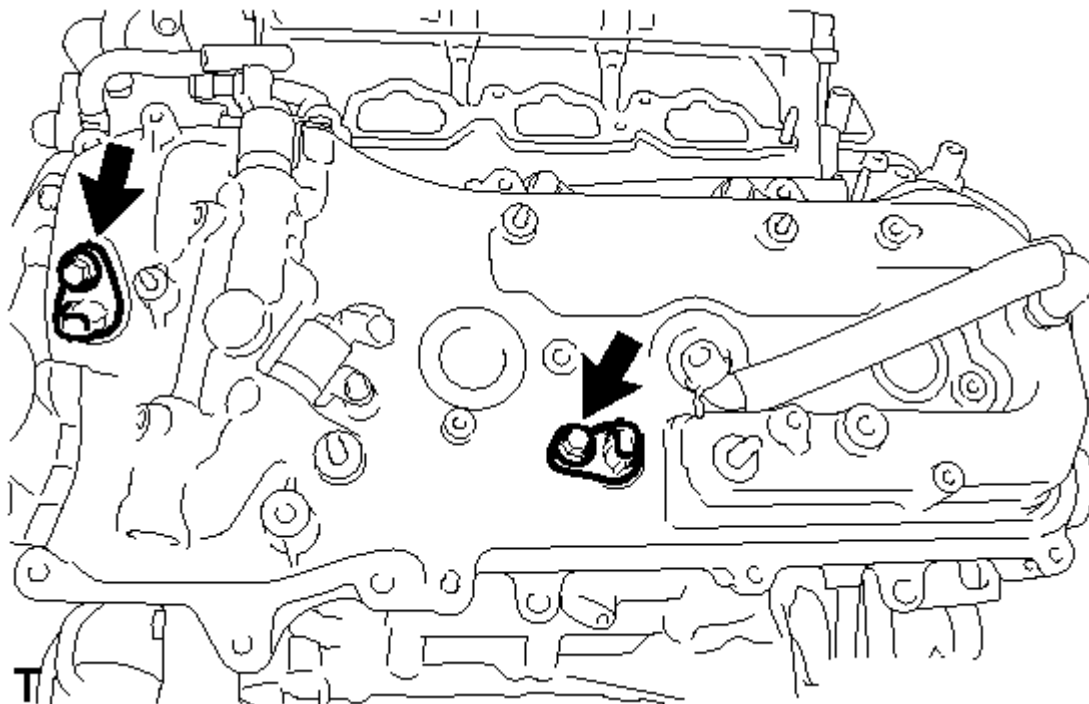


Fig. 245: Identifying VVT Sensors & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. LH:

Remove the 2 bolts and 2 VVT sensors.

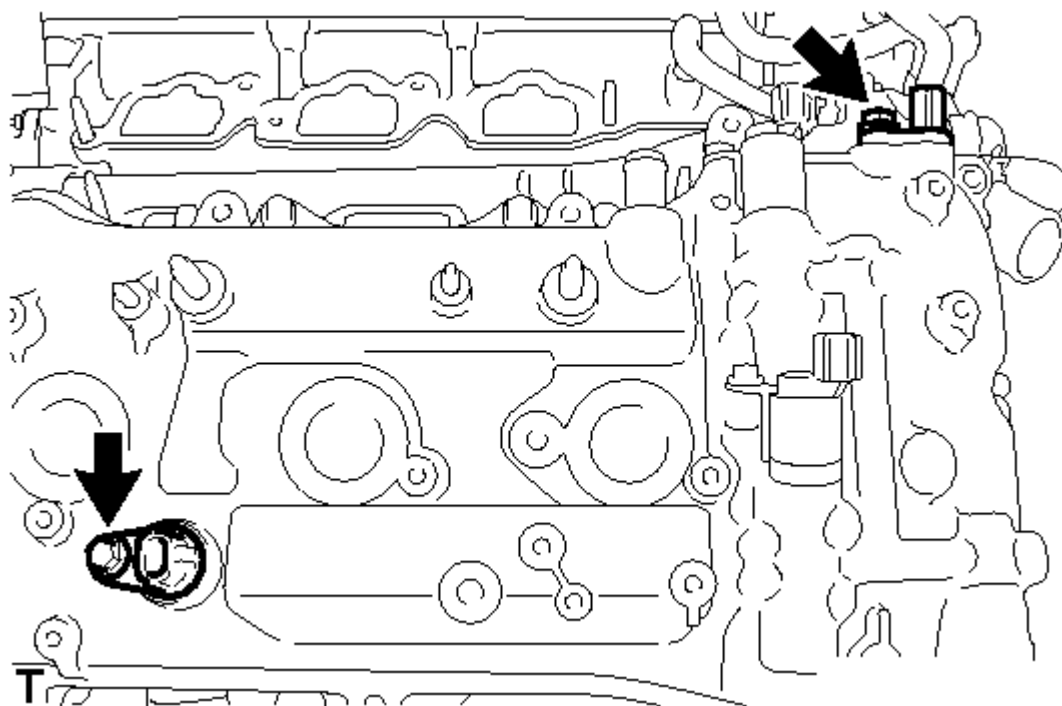


Fig. 246: Identifying VVT Sensors & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. RH:

Remove the 2 bolts and 2 VVT sensors.

5. REMOVE CRANKSHAFT POSITION SENSOR

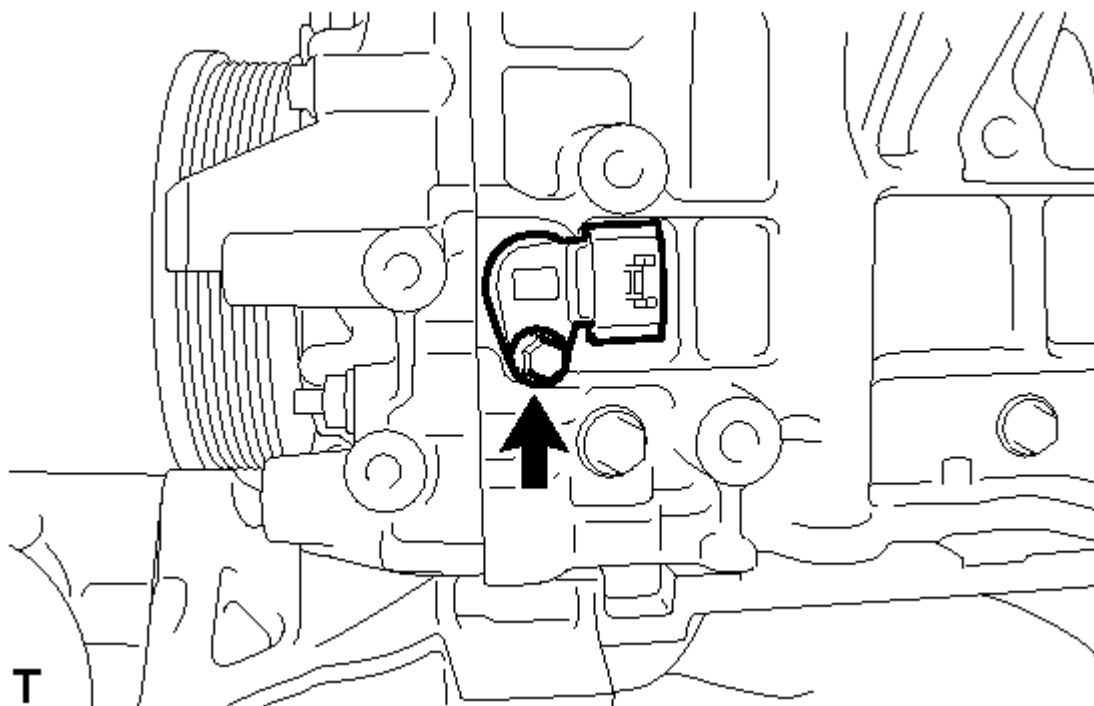


Fig. 247: Identifying Crankshaft Position Sensor & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the bolt and crankshaft position sensor.

6. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY RH

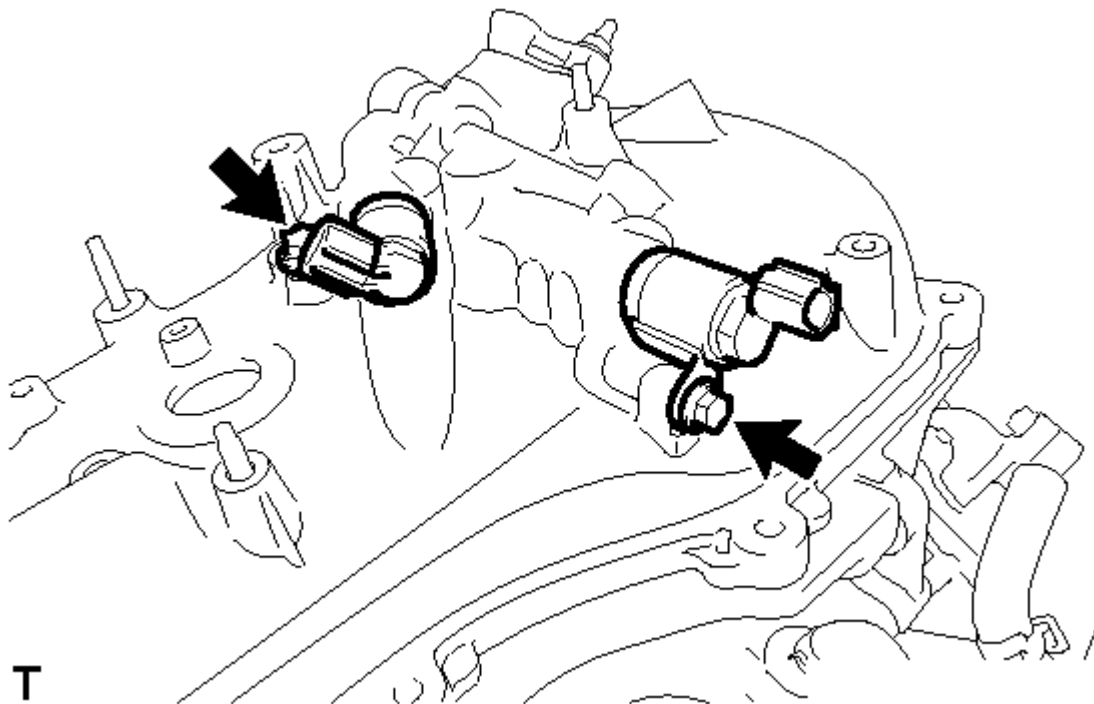


Fig. 248: Identifying Oil Control Valves & Fasteners

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

a. LH:

Remove the 2 bolts and 2 oil control valves.

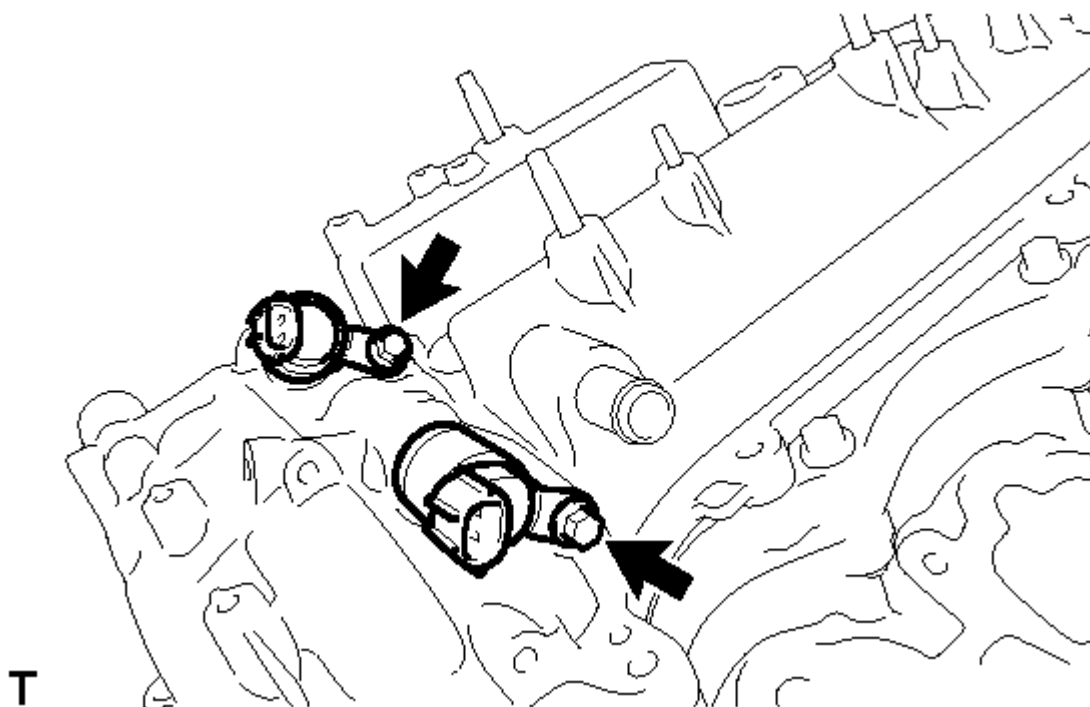


Fig. 249: Identifying Oil Control Valves & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. RH:

Remove the 2 bolts and 2 oil control valves.

7. REMOVE OIL FILLER CAP HOUSING

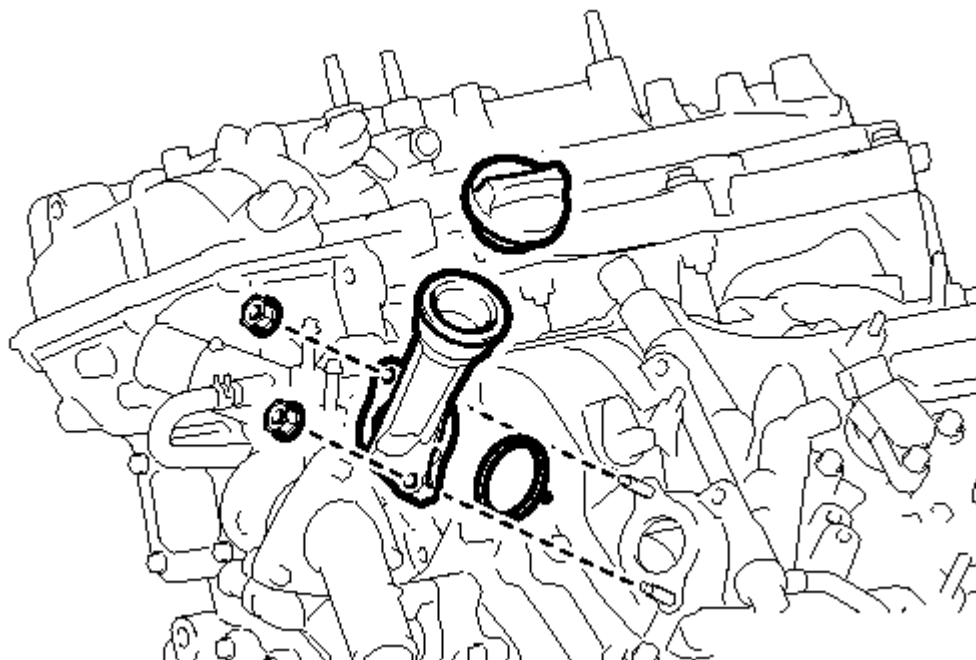
**P**

Fig. 250: Identifying Oil Filler Cap Housing, Gasket And Nuts

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

- a. Remove the oil filler cap.
- b. Remove the 2 nuts, oil filler cap housing and gasket.
8. **REMOVE NO. 1 OIL PIPE** . Refer to **REMOVAL - Step 14**
9. **REMOVE NO. 2 OIL PIPE** . Refer to **REMOVAL - Step 15**
10. **REMOVE OIL FILTER ELEMENT** . Refer to **REPLACEMENT - Step 3**
11. **REMOVE OIL FILTER BRACKET** . Refer to **REMOVAL - Step 12**
12. **REMOVE WATER INLET HOUSING** . Refer to **REMOVAL - Step 7**
13. **REMOVE REAR WATER BY-PASS JOINT**
 - a. Remove the 2 bolts, 4 nuts, rear water by-pass joint and 2 gaskets.

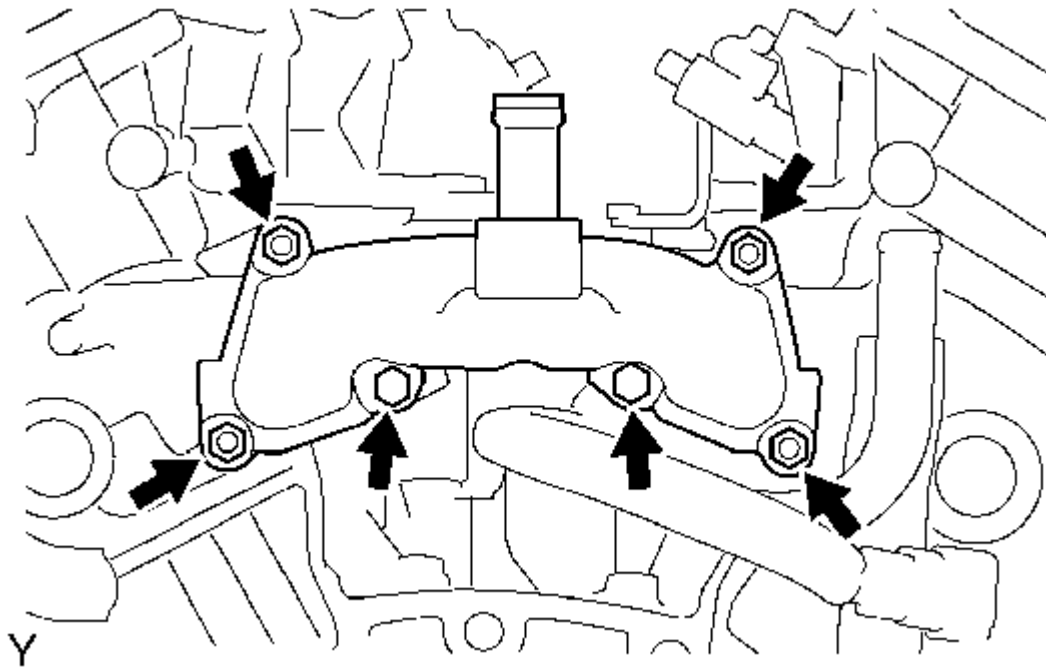
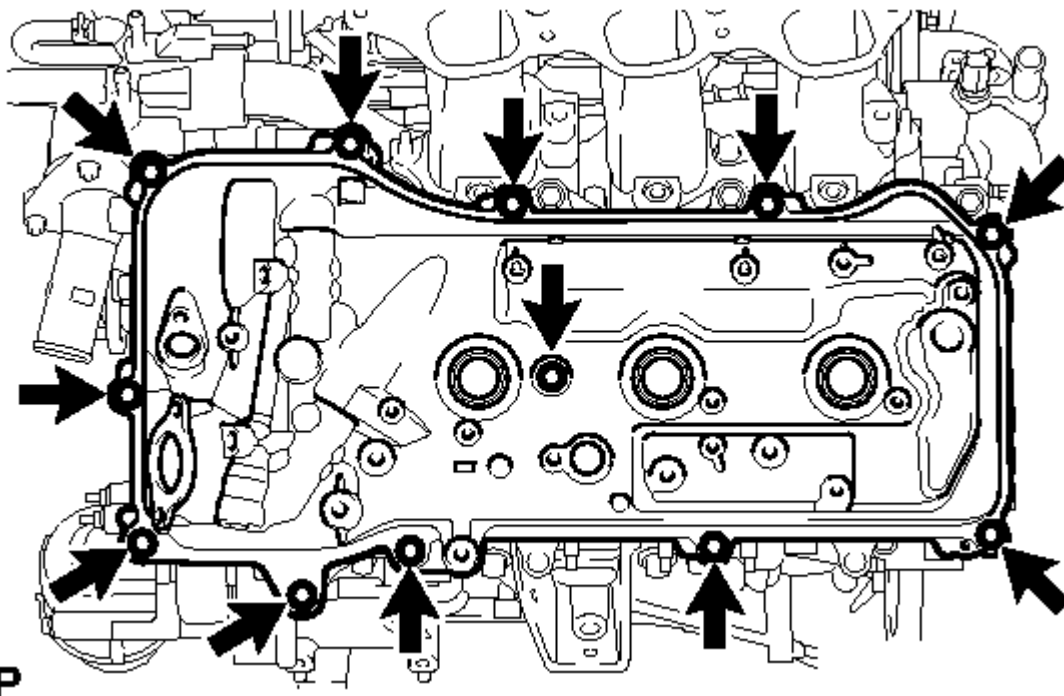


Fig. 251: Removing Water By-Pass Joint RR Bolts & Nuts
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Remove the O-ring from the No. 1 water outlet pipe.
- 14. **REMOVE SPARK PLUG** . Refer to **REMOVAL - Step 4**
- 15. **REMOVE PCV VALVE SUB-ASSEMBLY** . Refer to **REMOVAL - Step 1**
- 16. **REMOVE CRANKSHAFT PULLEY** . Refer to **REMOVAL - Step 13**
- 17. **REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH**

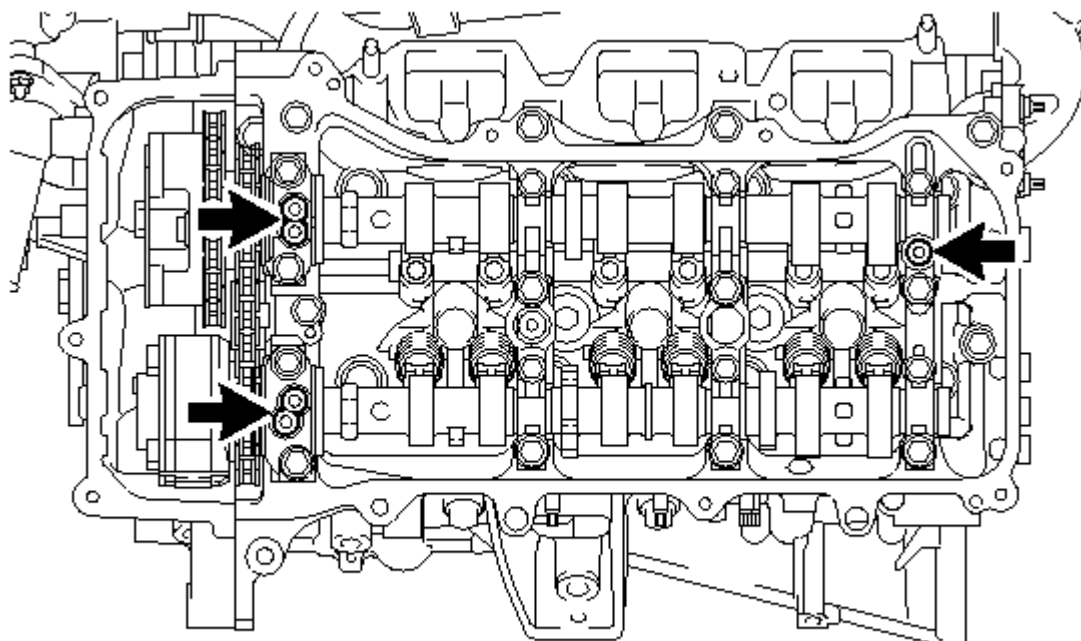


P
Fig. 252: Identifying Cylinder Head Cover Sub-Assembly And Bolts (LH)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the 12 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.



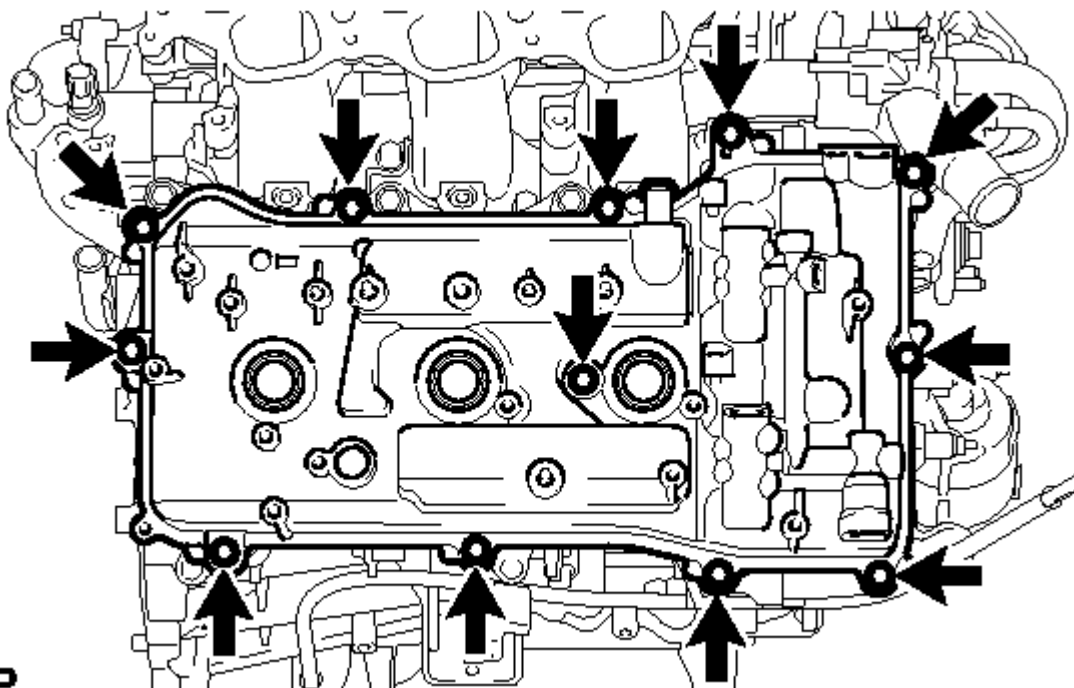
P

Fig. 253: Remove/Install Gaskets (LH)

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

- b. Remove the 3 gaskets.

18. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY



P

Fig. 254: Identifying Cylinder Head Cover Sub-Assembly And Bolts (RH)

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

- a. Remove the 12 bolts, seal washer, cylinder head cover and gasket.

HINT:

Make sure the removed parts are returned to the same places they were removed from.

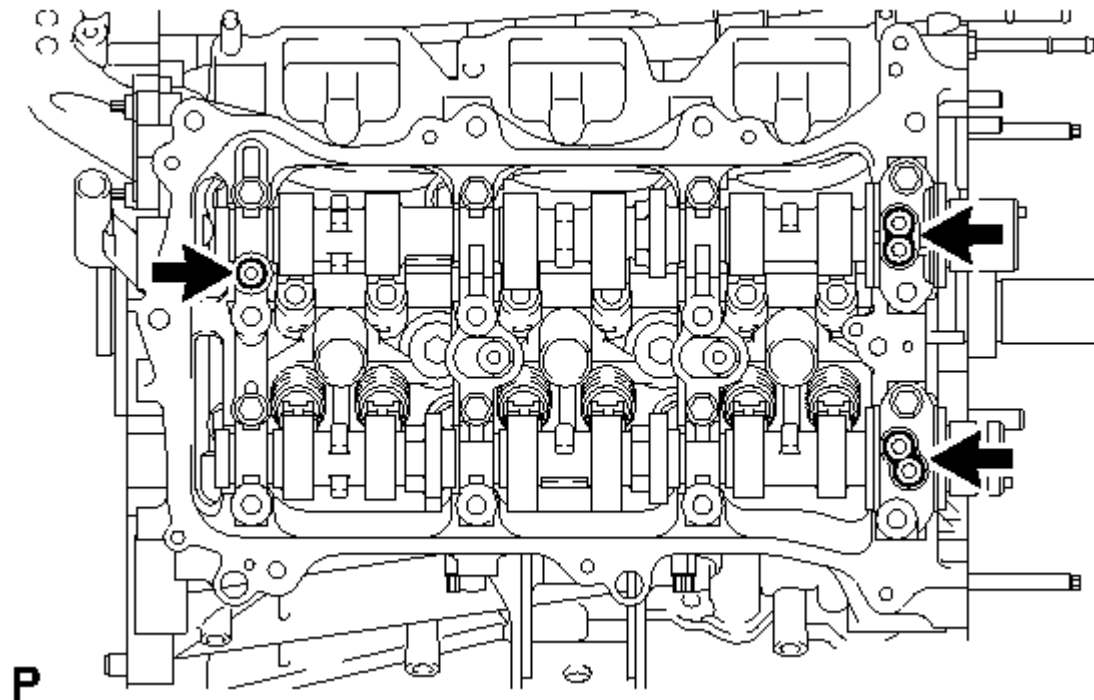


Fig. 255: Remove/Install Gaskets (RH)

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

- b. Remove the 3 gaskets.

19. REMOVE SPARK PLUG TUBE GASKET

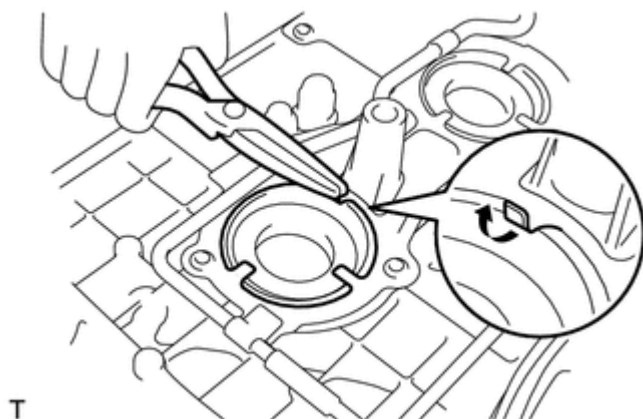


Fig. 256: Bending Ventilation Baffle Plate Claws On Cylinder Head Cover

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

- a. Bend the ventilation baffle plate claws on the cylinder head cover to an angle of 90° or more.

TEXT IN ILLUSTRATION

Pry

- b. Remove the 6 spark plug tube gaskets.

HINT:

Be careful not to damage the gasket when removing it as the removed gasket needs to be used when installing a new one.

20. REMOVE OIL PAN DRAIN PLUG

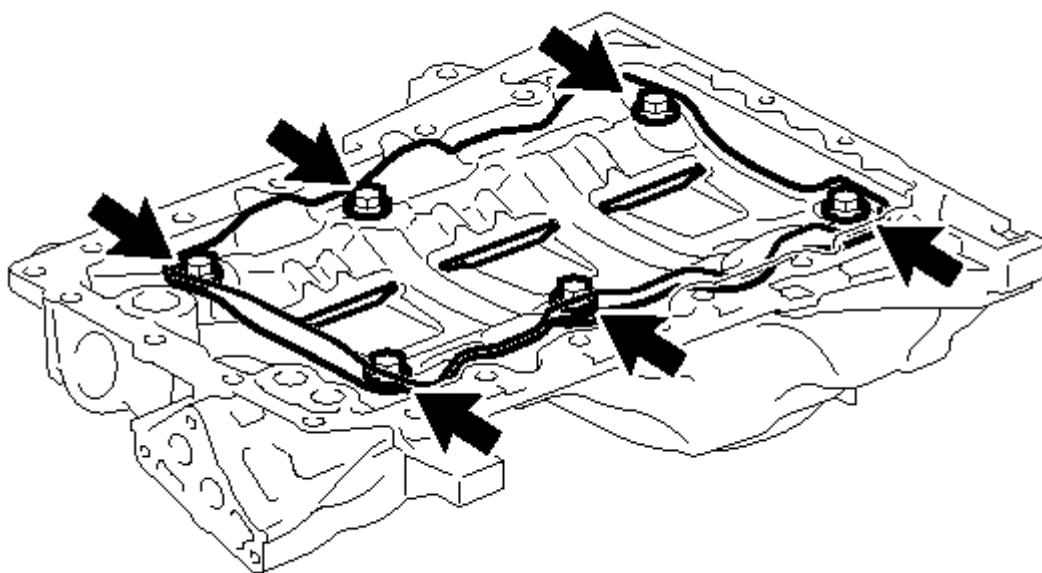
- a. Remove the drain plug and gasket.

21. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY . Refer to REMOVAL - Step 19

22. REMOVE OIL STRAINER SUB-ASSEMBLY . Refer to REMOVAL - Step 20

23. REMOVE OIL PAN SUB-ASSEMBLY . Refer to REMOVAL - Step 21

24. REMOVE NO. 1 OIL PAN BAFFLE PLATE



T

Fig. 257: Identifying No. 1 Oil Pan Baffle Plate & Fasteners
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the 6 bolts and No. 1 oil pan baffle plate.

25. REMOVE ENGINE REAR OIL SEAL RETAINER

- a. Remove the 5 bolts and 2 nuts.

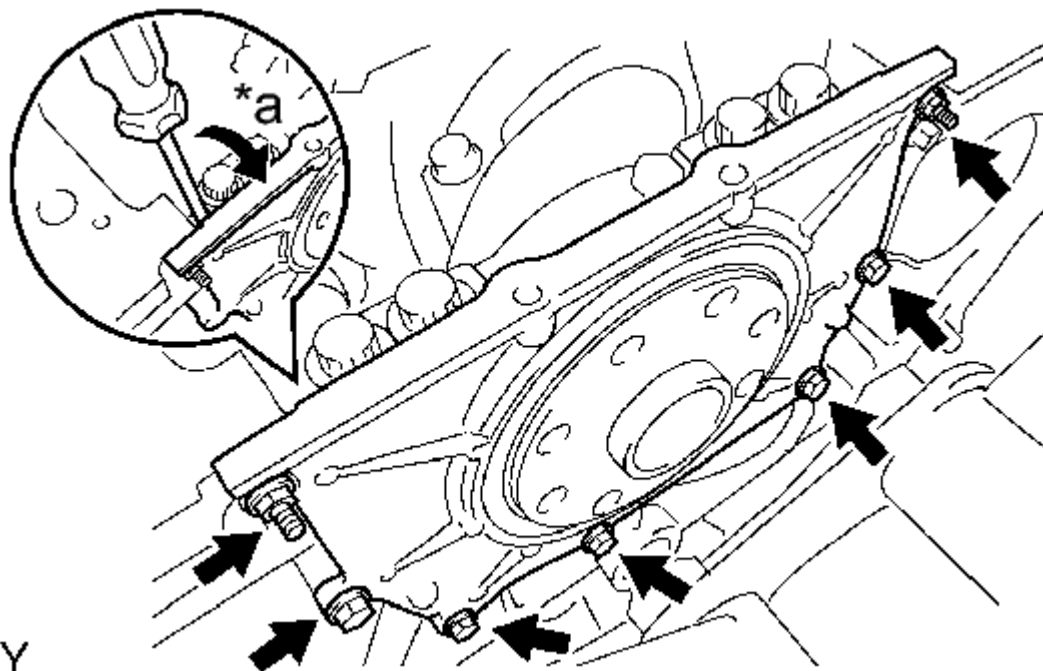


Fig. 258: Identifying Engine Rear Oil Seal Retainer, Bolts And Nuts
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using a screwdriver, remove the oil seal retainer by prying between the oil seal retainer and crankshaft bearing cap.

TEXT IN ILLUSTRATION

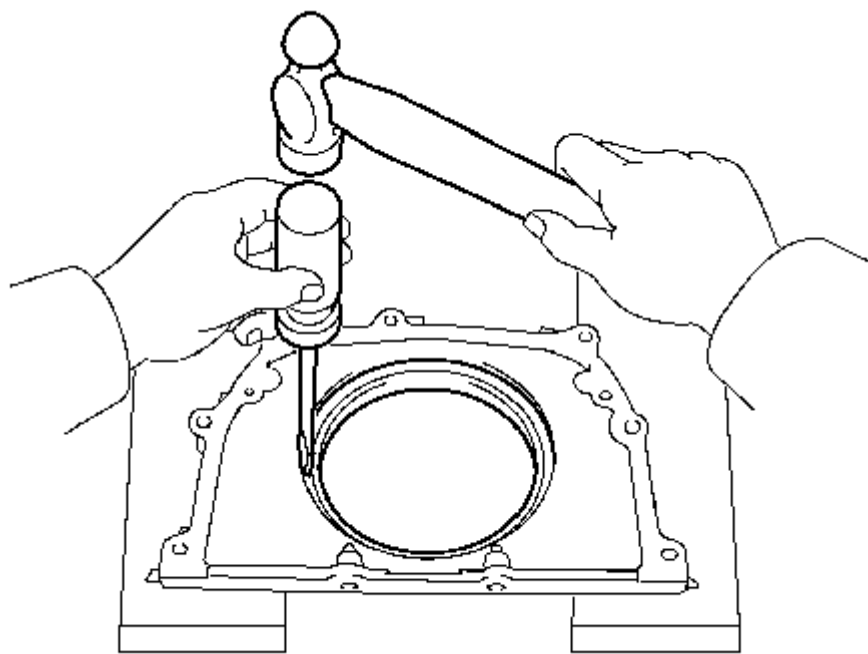
*a	Pry
----	-----

HINT:

Tape the screwdriver tip before use.

26. REMOVE REAR CRANKSHAFT OIL SEAL

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



Y
Fig. 259: Tapping Out Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

27. **REMOVE TIMING CHAIN COVER SUB-ASSEMBLY** . Refer to **REMOVAL - Step 22**
28. **REMOVE WATER PUMP ASSEMBLY**
 - a. Remove the 8 bolts, water pump and gasket.

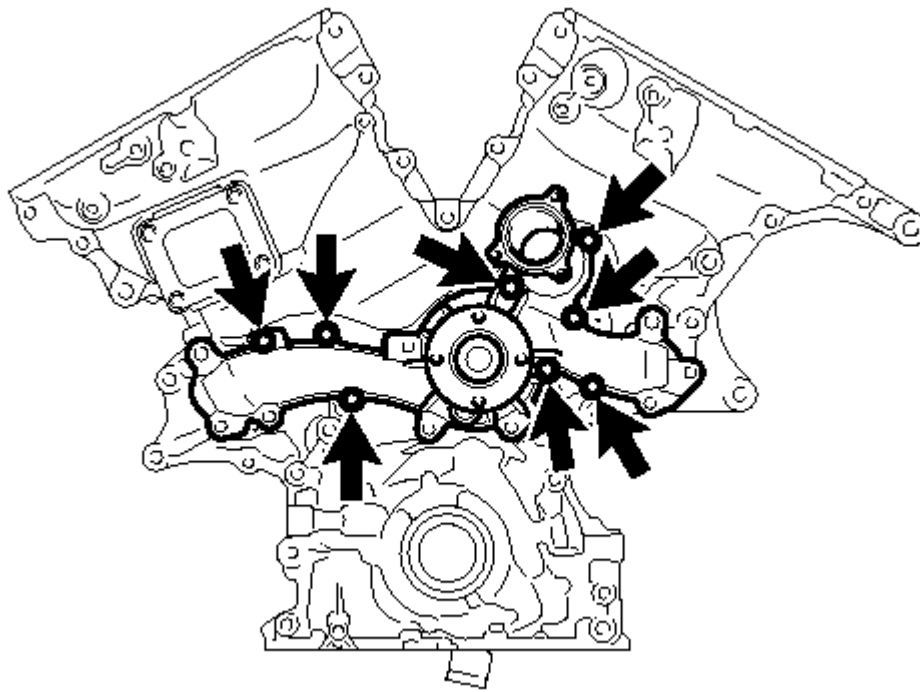
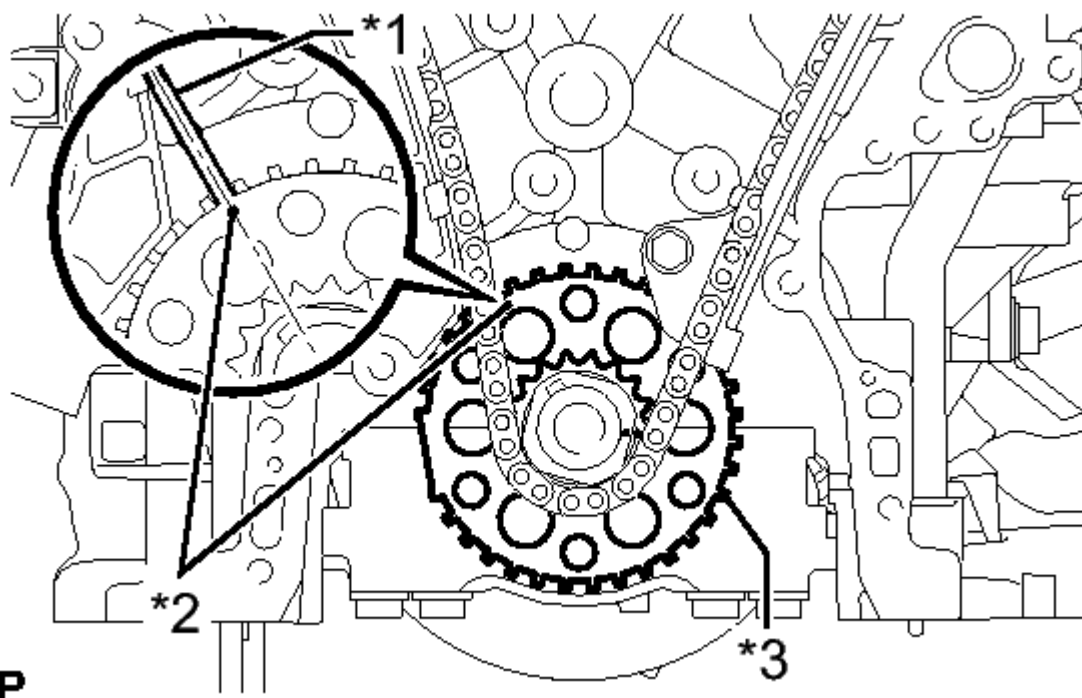
**P**

Fig. 260: Identifying Water Pump & Gasket & Fasteners

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

29. **REMOVE FRONT CRANKSHAFT OIL SEAL** . Refer to **REMOVAL - Step 23**
30. **SET NO. 1 CYLINDER TO TDC/COMPRESSION**
 - a. Temporarily install the pulley set bolt.
 - b. Turn the crankshaft clockwise to align the timing mark on the crank angle sensor plate with the RH block bore center line (TDC/compression).

**P****Fig. 261: Identifying Timing Mark On The Crank Angle Sensor Plate****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****TEXT IN ILLUSTRATION**

*1	Center Line
*2	Timing Mark
*3	Sensor Plate

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

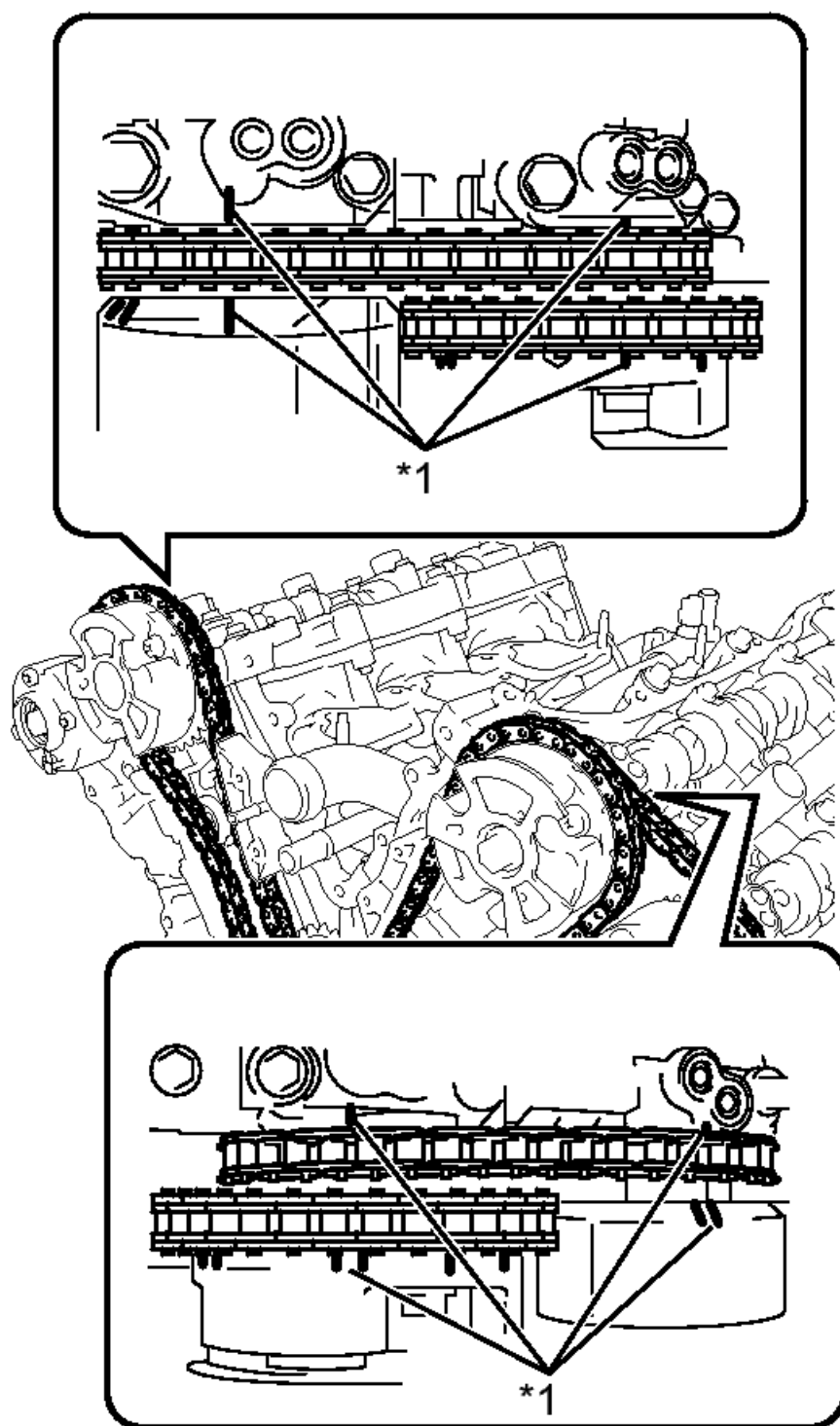
**P**

Fig. 262: Checking Alignment Of Camshaft Timing Gears And Bearing Caps Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*1	Timing Mark
----	----------------

31. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

- a. Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.

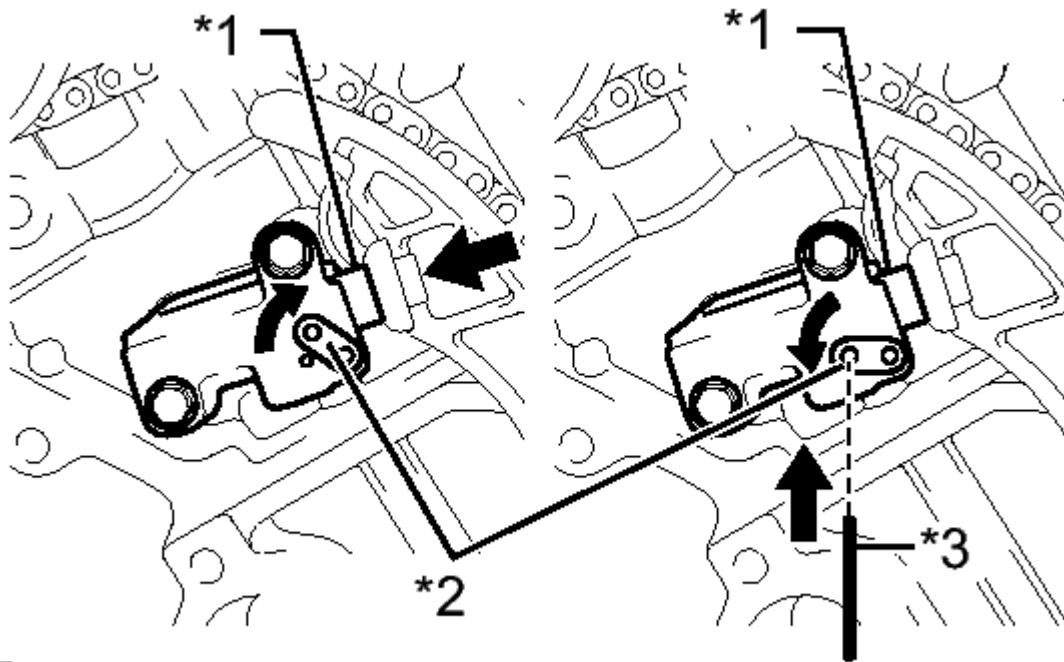
**P**

Fig. 263: Identifying No. 1 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Plunger
*2	Stopper Plate
*3	Pin

- b. Move the stopper plate downward to set the lock, and insert a pin of 1.27 mm (0.0500 in.) into the stopper plate hole.
- c. Remove the 2 bolts and No. 1 chain tensioner assembly.

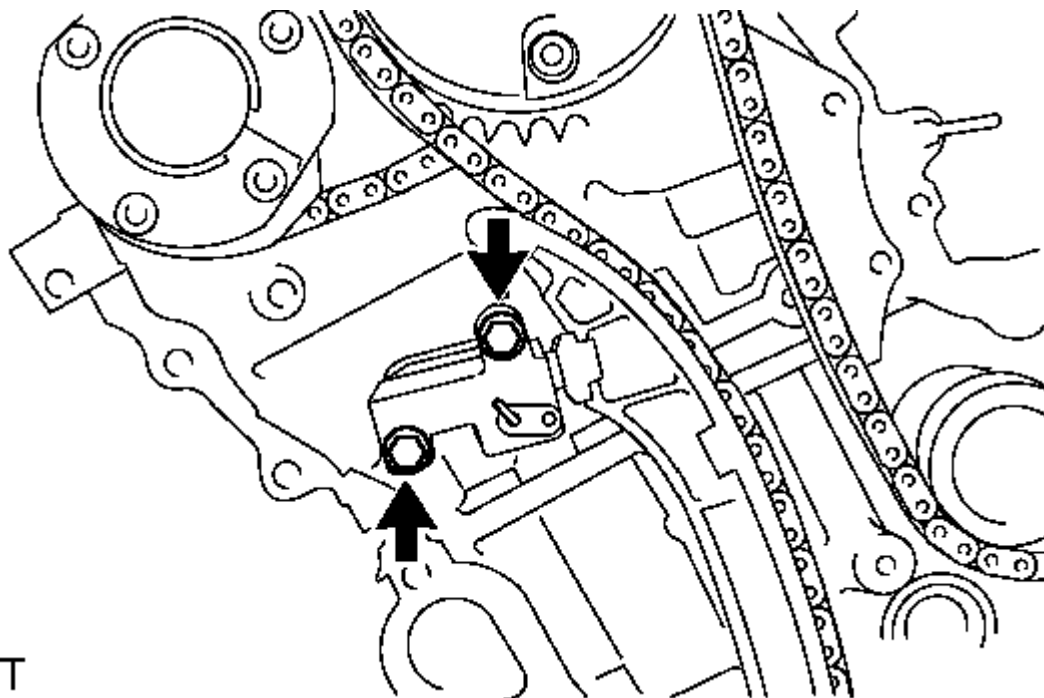


Fig. 264: Identifying No. 1 Chain Tensioner Assembly & Fasteners
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

32. REMOVE CHAIN TENSIONER SLIPPER

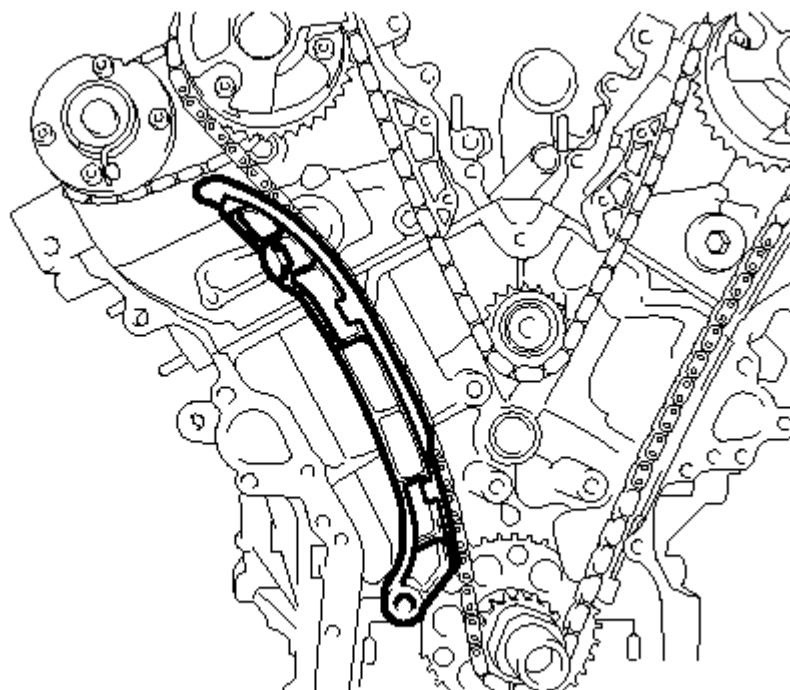
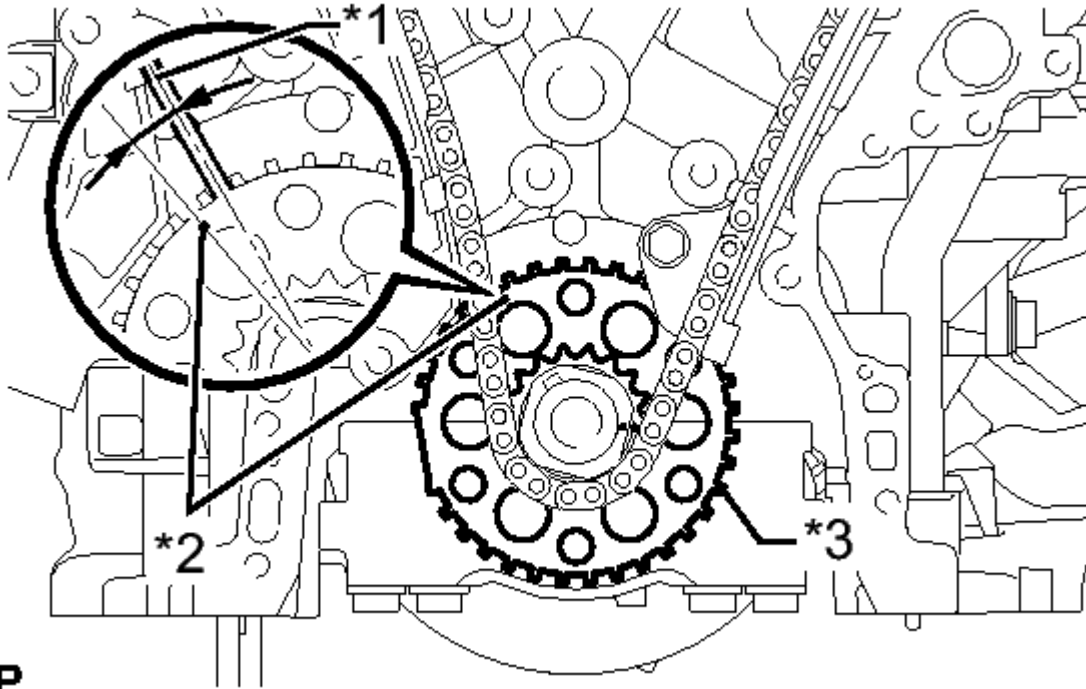


Fig. 265: Identifying Chain Tensioner Slipper
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- a. Remove the chain tensioner slipper.

33. REMOVE NO. 1 CHAIN SUB-ASSEMBLY

- a. Turn the crankshaft counterclockwise 10° to loosen the chain of the crankshaft timing sprocket.



P

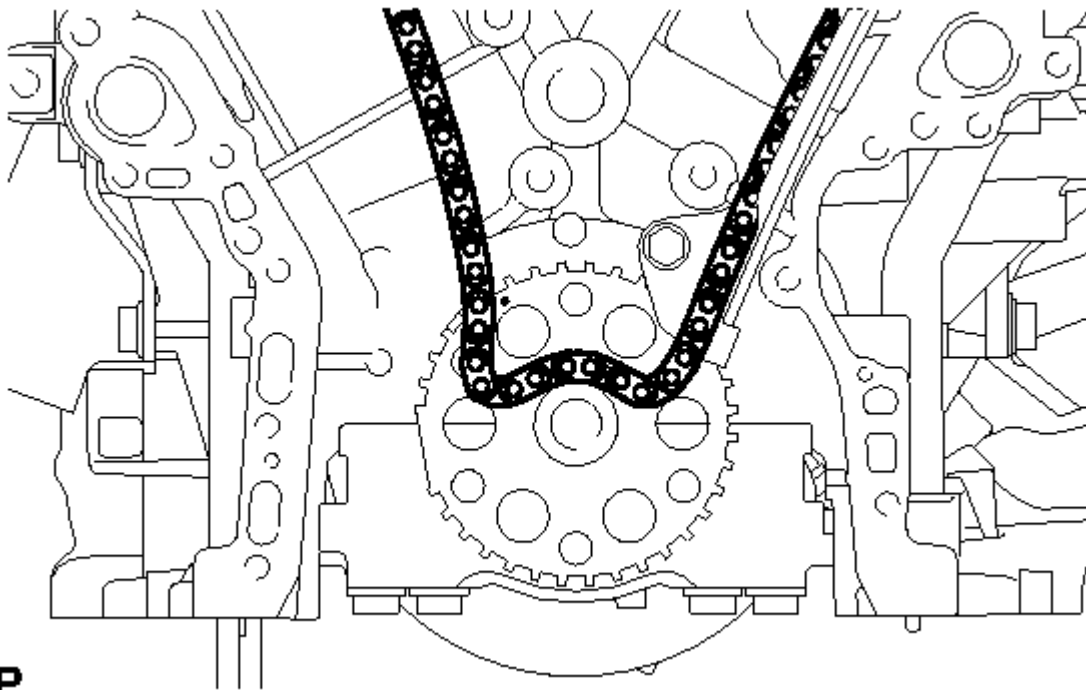
Fig. 266: Turning Crankshaft Counterclockwise 10° To Loosen Chain Of Crankshaft Timing Sprocket

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

TEXT IN ILLUSTRATION

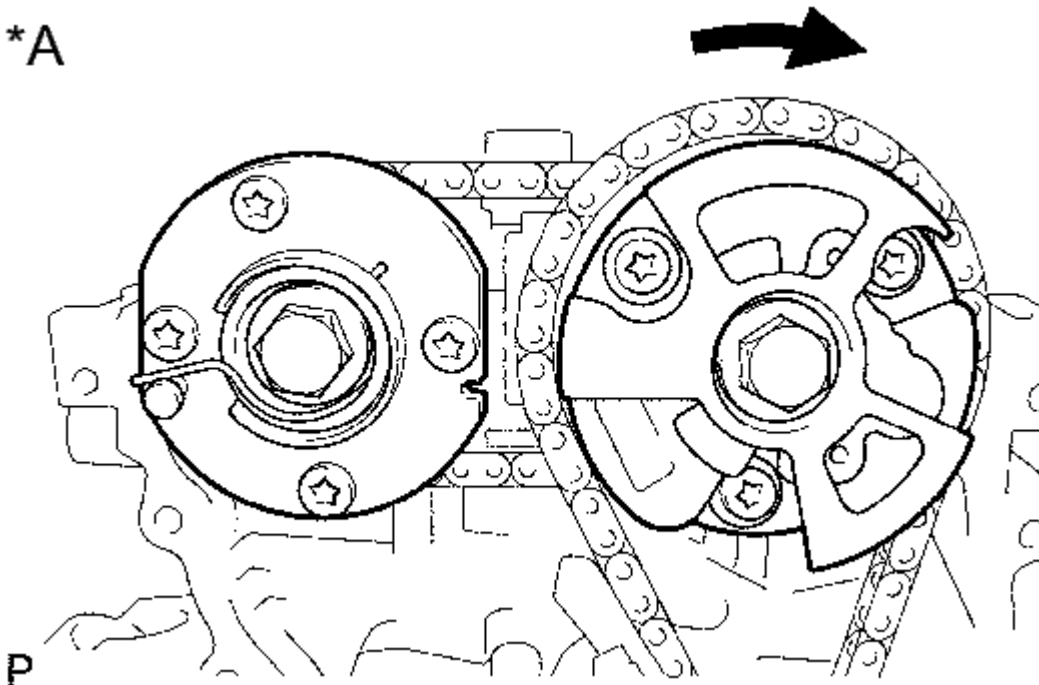
*1	Center Line
*2	Timing Mark
*3	Sensor Plate

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

**P****Fig. 267: Remove/Install Crankshaft Timing Sprocket And Chain**

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

- d. Turn the camshaft timing gear assembly on bank 1 clockwise approximately 60° so that it is as shown in the illustration. Be sure to loosen the chain sub-assembly between the banks.

A****P*Fig. 268: Turning Camshaft Timing Gear Assembly On Bank 1**

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

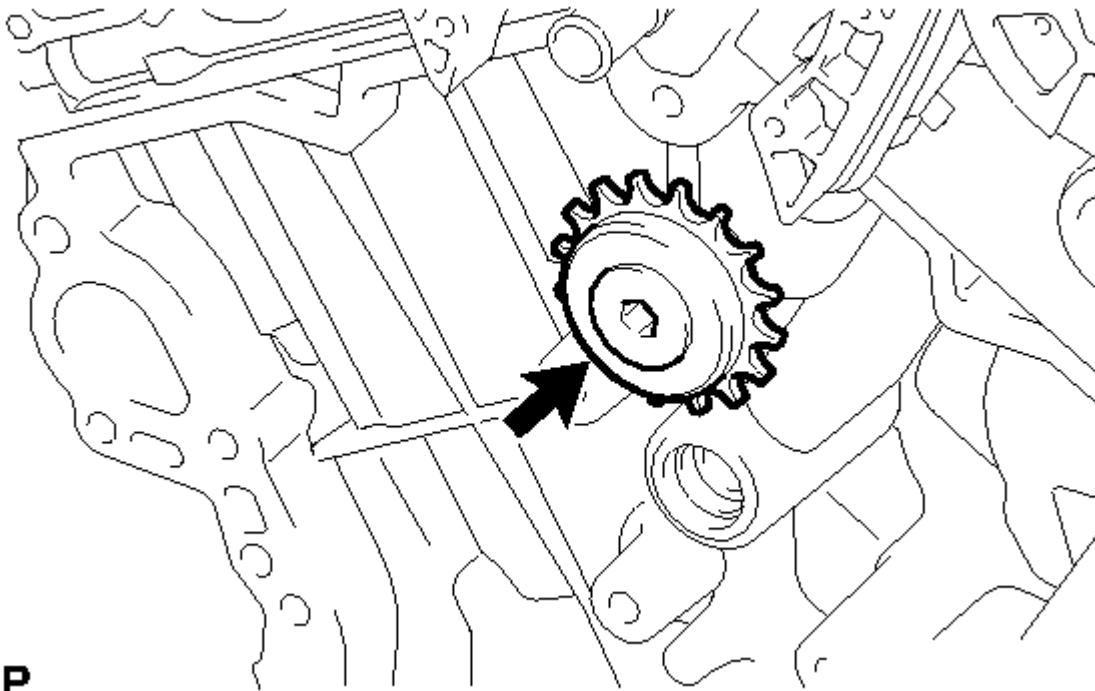
- e. Remove the chain sub-assembly.

TEXT IN ILLUSTRATION

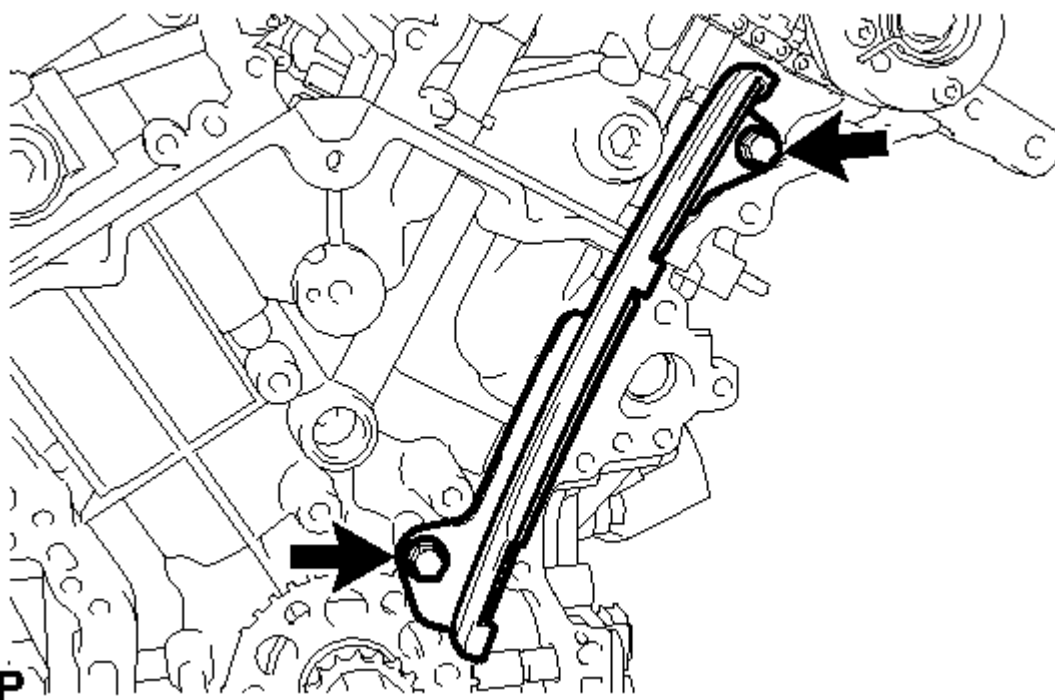
	for
*A	Bank
1	1

34. REMOVE NO. 1 IDLE GEAR SHAFT

- a. Using a 10 mm hexagon wrench, remove the No. 2 idle gear shaft, No. 1 idle gear and No. 1 idle gear shaft.

**P****Fig. 269: Identifying No. 1 Idle Gear Shaft****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****35. REMOVE NO. 1 CHAIN VIBRATION DAMPER**

- a. Remove the 2 bolts and No. 1 chain vibration damper.



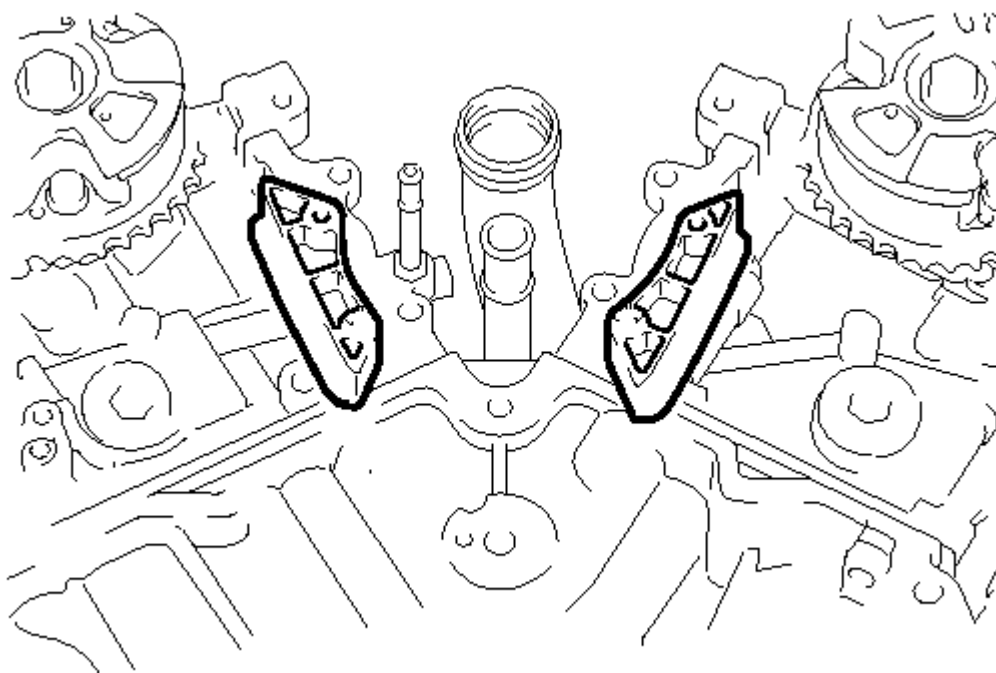
P

Fig. 270: Identifying No. 1 Chain Vibration Damper & Fasteners

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

36. REMOVE NO. 2 CHAIN VIBRATION DAMPER

- a. Remove the 2 No. 2 chain vibration dampers.



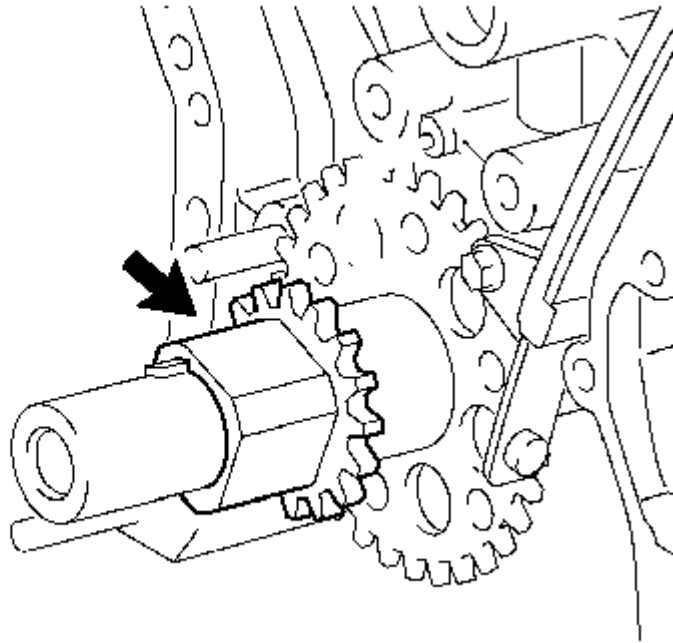
P

Fig. 271: Identifying No. 2 Chain Vibration Dampers

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

37. REMOVE CRANKSHAFT TIMING SPROCKET

- a. Remove the crankshaft timing sprocket.



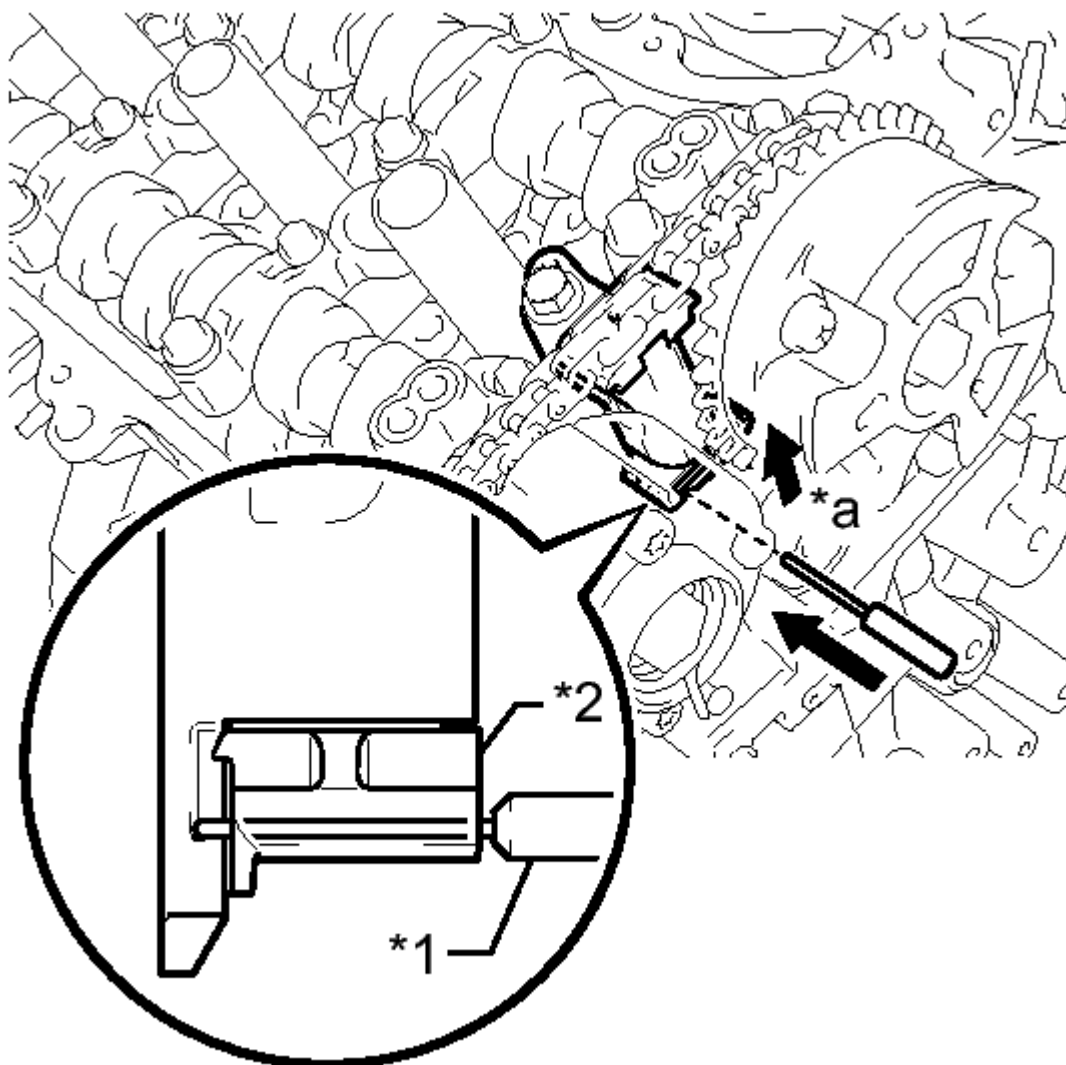
Y

Fig. 272: Identifying Crankshaft Timing Sprocket

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

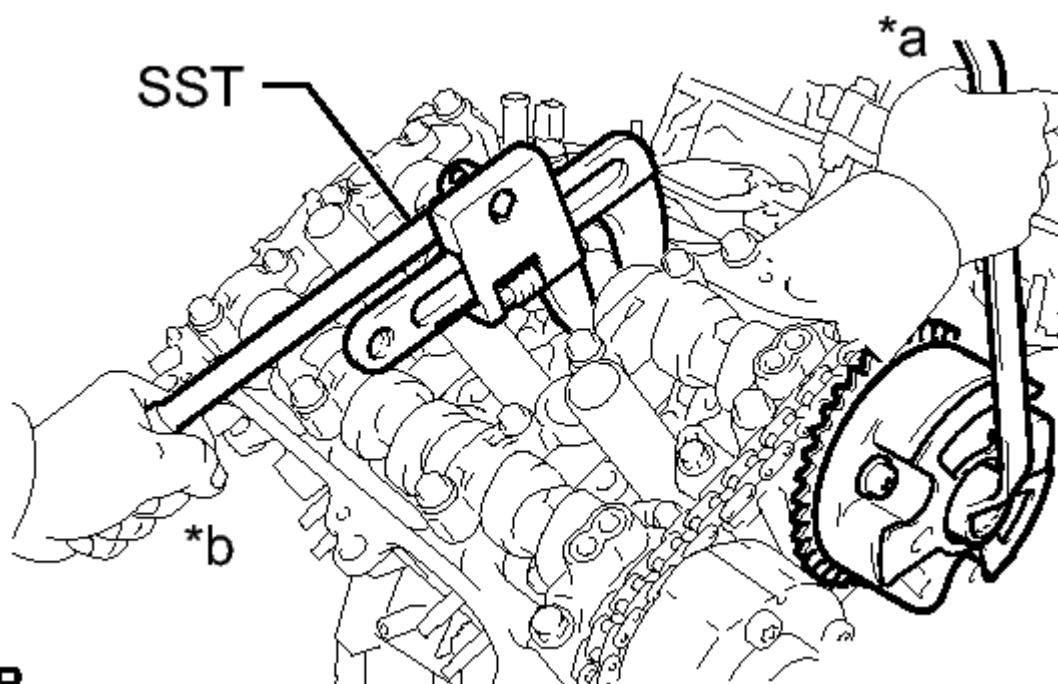
38. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

- a. While raising the No. 2 chain tensioner assembly, insert a pin with a diameter of 1.0 mm (0.0394 in.) into the hole to hold the No. 2 chain tensioner assembly.

**P****Fig. 273: Identifying Camshaft Timing Gears And No. 2 Chain (Bank 1)****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****TEXT IN ILLUSTRATION**

*1	Pin
*2	Plunger
*a	Push

- b. Using SST to hold the hexagonal portion of each camshaft, loosen the bolts of the camshaft timing gear assembly and camshaft timing exhaust gear assembly.
 - SST: 09922-10010

**P****Fig. 274: Remove/Install Camshaft Timing Gear Assembly Using SST****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.****TEXT IN ILLUSTRATION**

*a	Turn
*b	Hold

NOTE: Do not loosen the other 4 bolts. If any of the 4 bolts is loosened, replace the camshaft timing gear assembly and/or camshaft timing exhaust gear assembly with a new one.

c. Remove the 2 bolts and camshaft timing gear assembly together with the No. 2 chain.

39. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

a. Remove the bolt and No. 2 chain tensioner assembly.

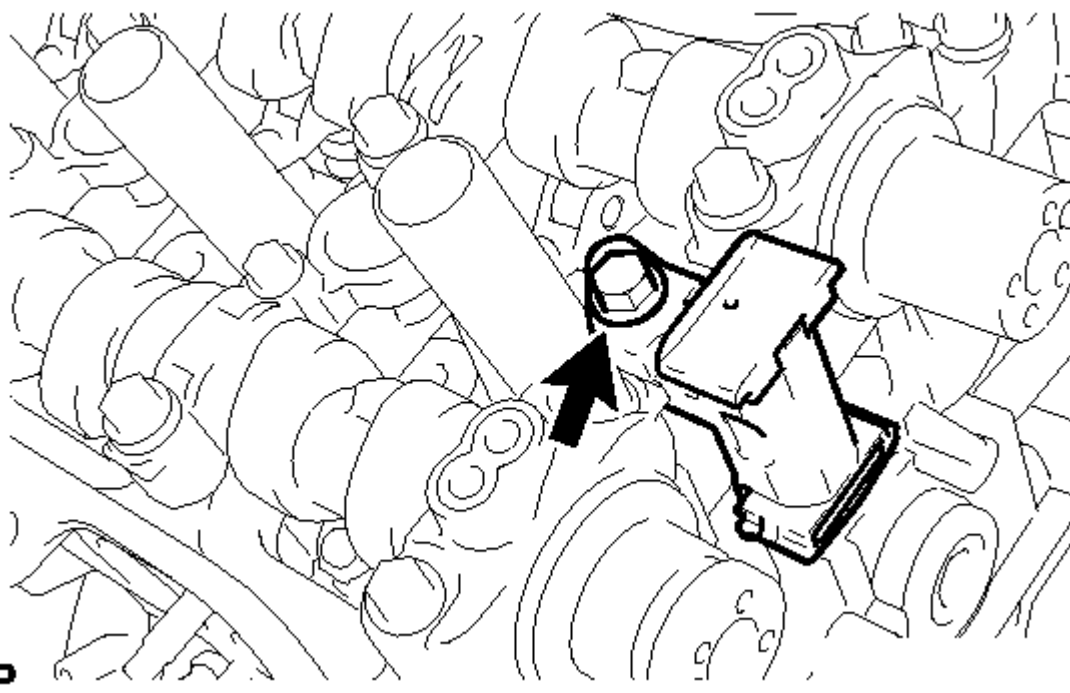
**P**

Fig. 275: Identifying No. 2 Chain Tensioner Assembly And Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

40. REMOVE CAMSHAFT BEARING CAP (for Bank 1)

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

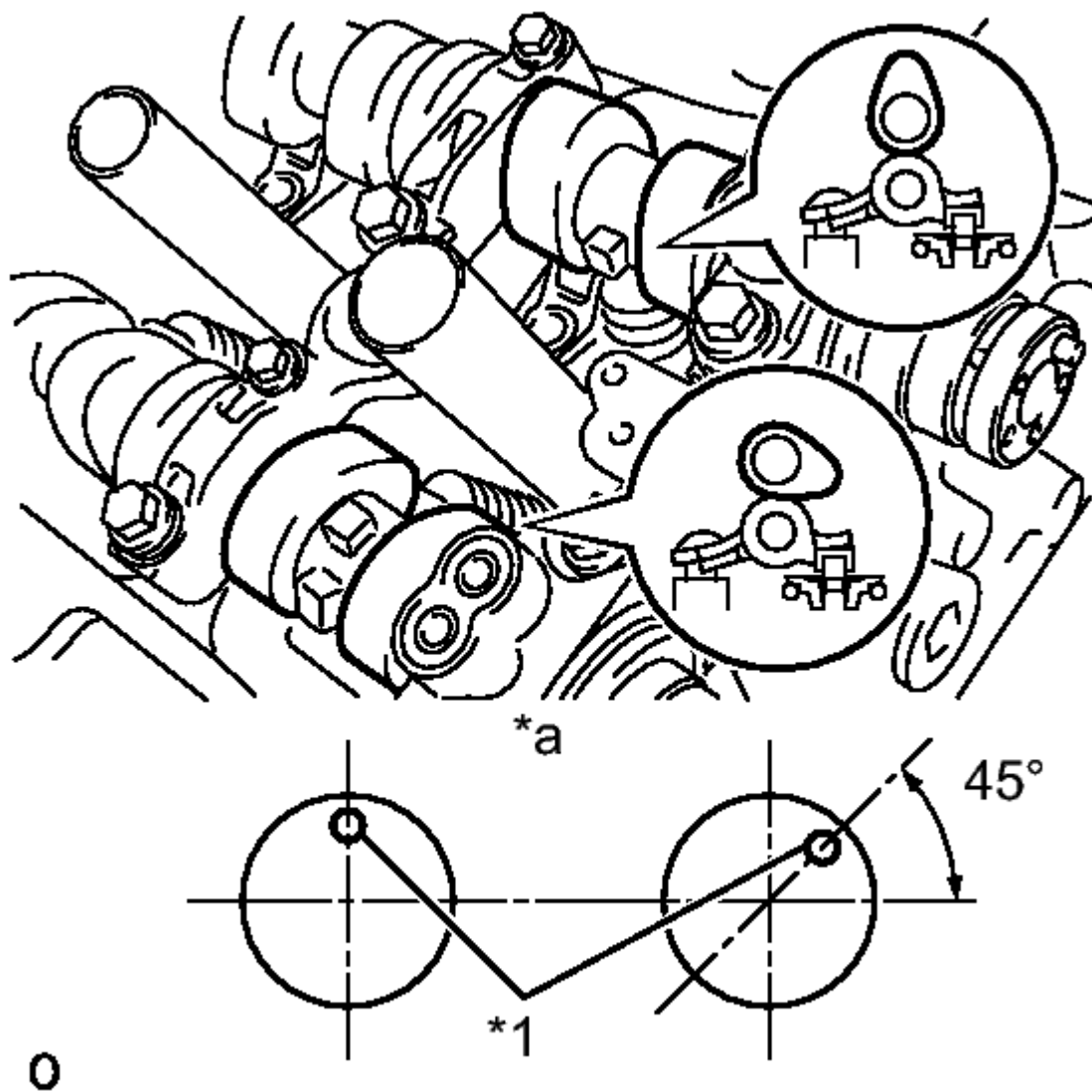
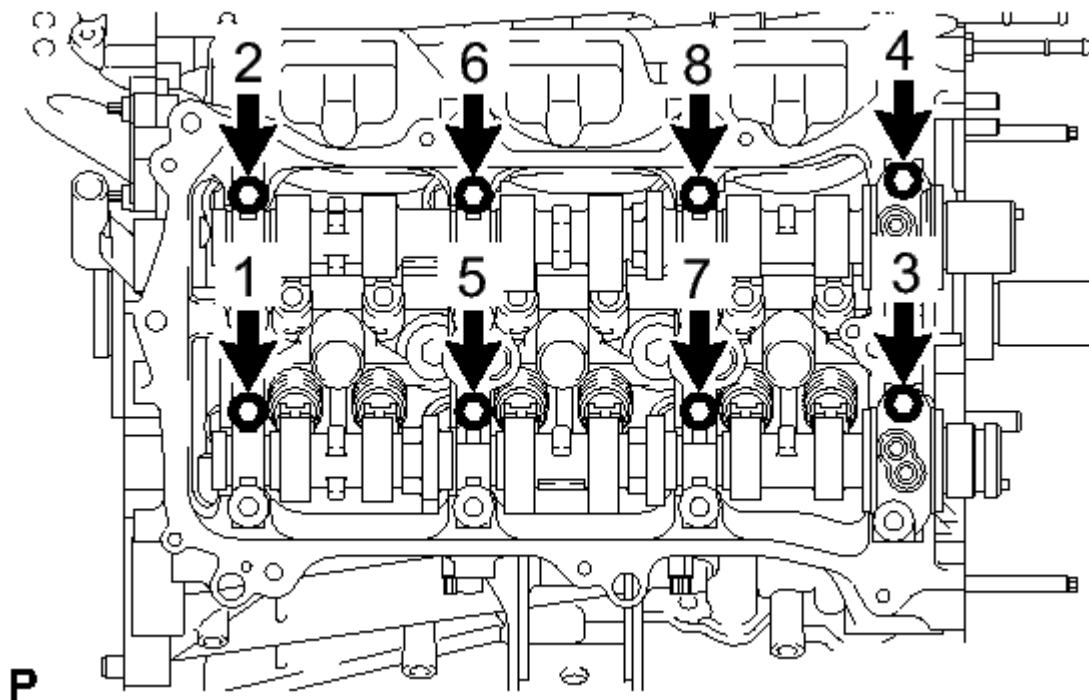


Fig. 276: Identifying Camshaft Bearing Cap (Bank 1)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Knock Pin
*a	Front View

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

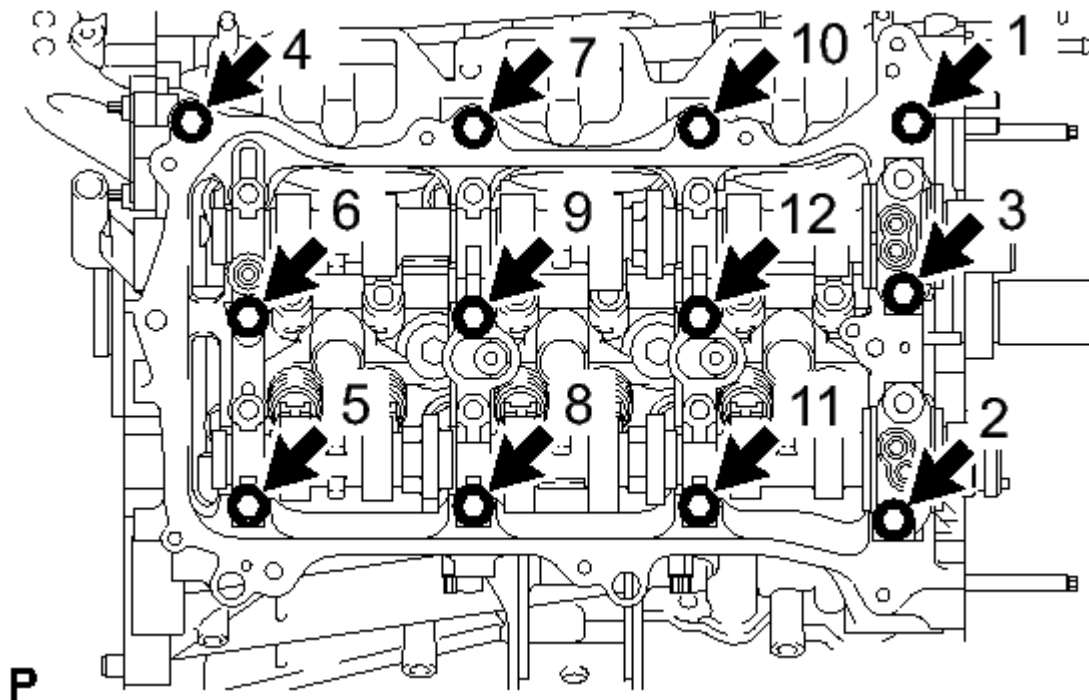


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Fig. 277: Identifying Bearing Cap Bolt With Loosening Sequence

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

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



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Fig. 278: Identifying Bearing Cap Bolt With Loosening Sequence

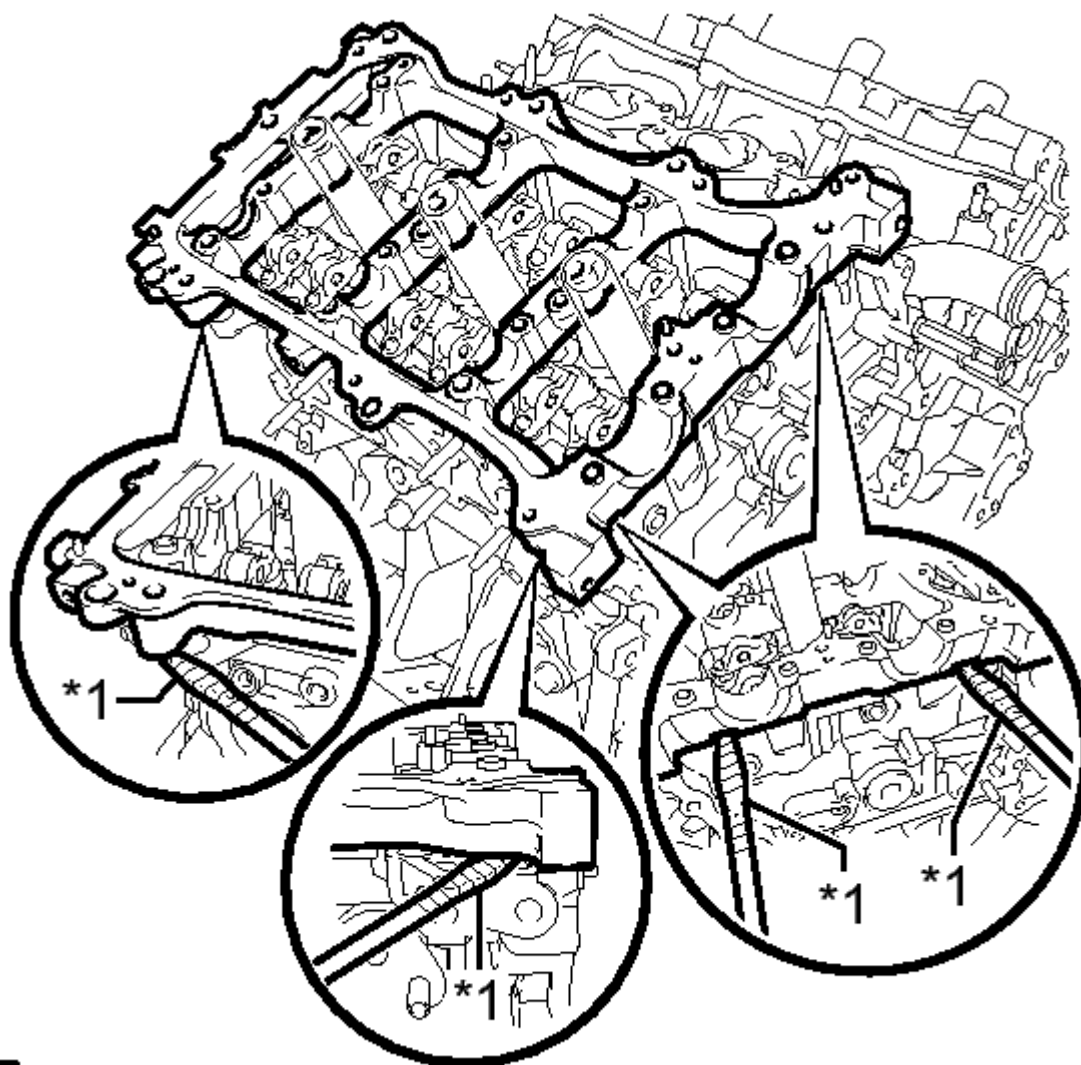
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

- d. Remove the 5 camshaft bearing caps.
- e. Remove the camshaft and No. 2 camshaft.

41. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH

- a. Remove the camshaft housing sub-assembly RH by prying between the cylinder head and camshaft housing sub-assembly RH with a screwdriver.



P

Fig. 279: Identifying Camshaft Housing Sub-Assembly RH

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

TEXT IN ILLUSTRATION

Protective

*1	Tape
----	------

HINT:

Tape the screwdriver tip before use.

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

42. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)

- a. While pushing down the No. 3 chain tensioner assembly, insert a pin with a diameter of 1.0 mm (0.0394 in.) into the hole to hold the No. 3 chain tensioner assembly.

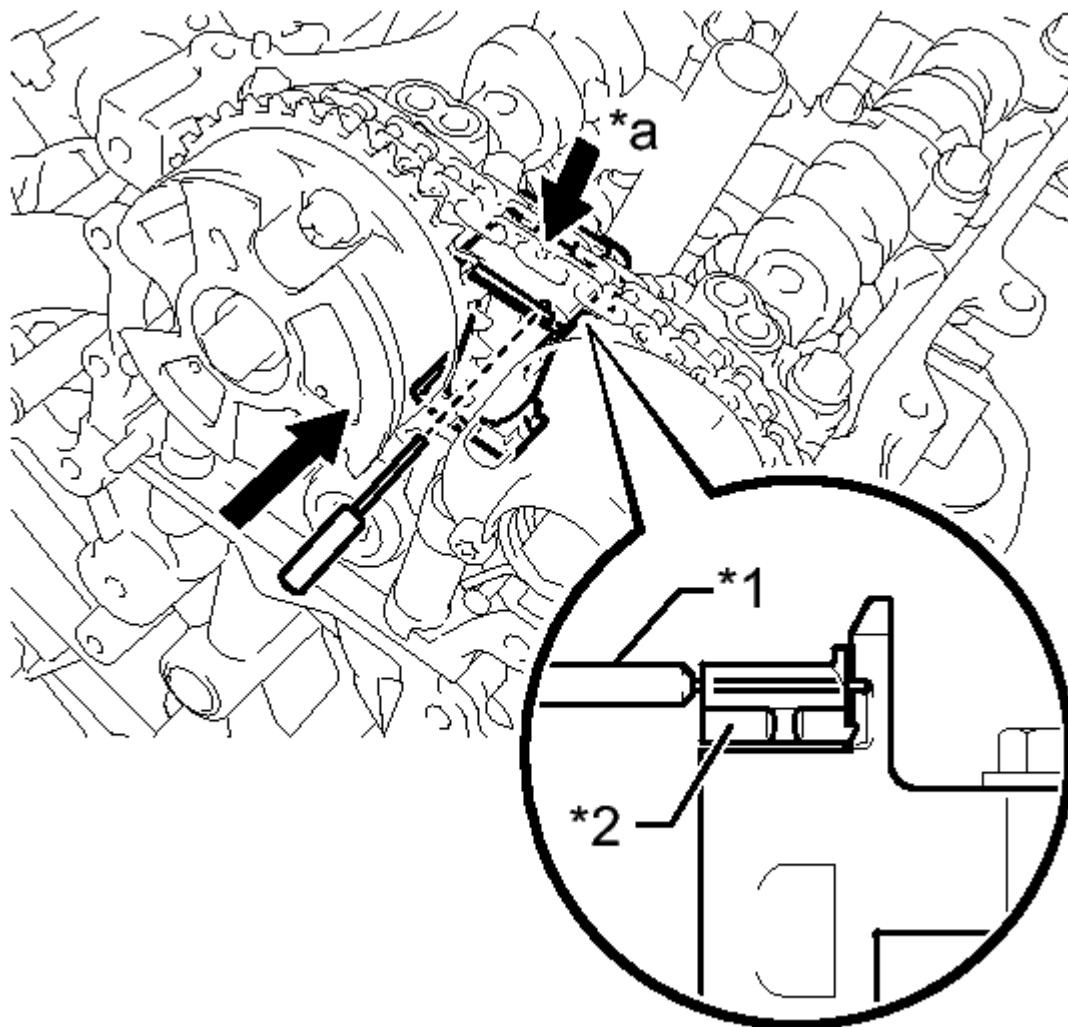
**P**

Fig. 280: Identifying No. 3 Chain Tensioner Assembly And Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Pin
*2	Plunger
*a	Push

- b. Using SST to hold the hexagonal portion of each camshaft, loosen the bolts of the camshaft timing gear assembly and camshaft timing exhaust gear assembly.
- SST: 09922-10010

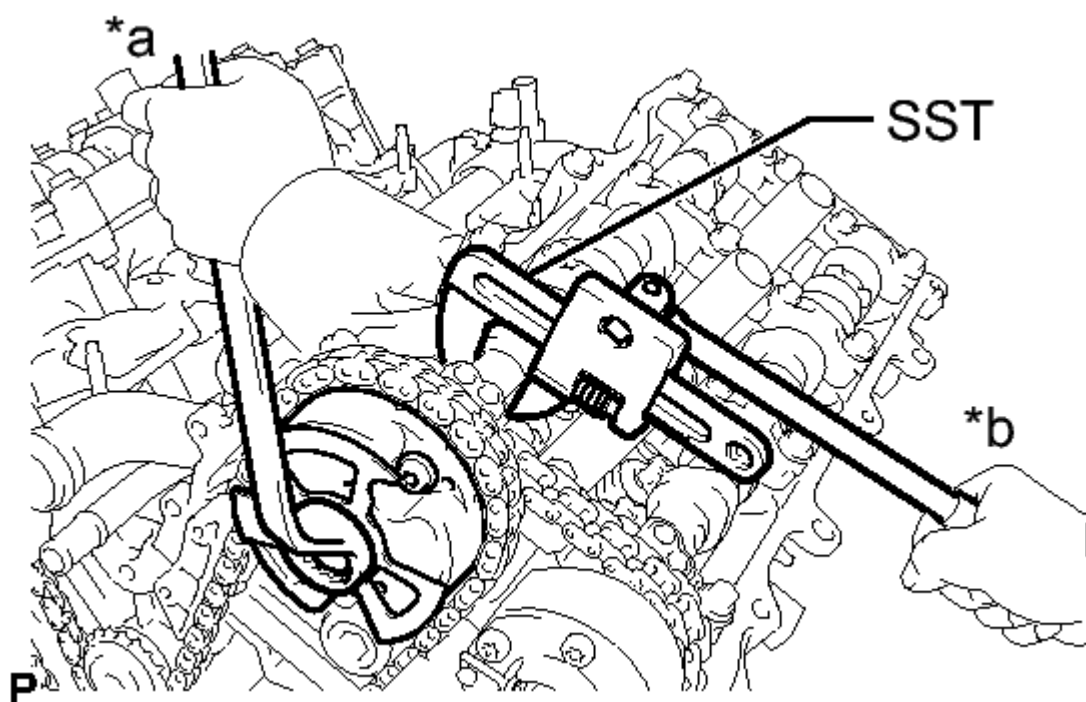


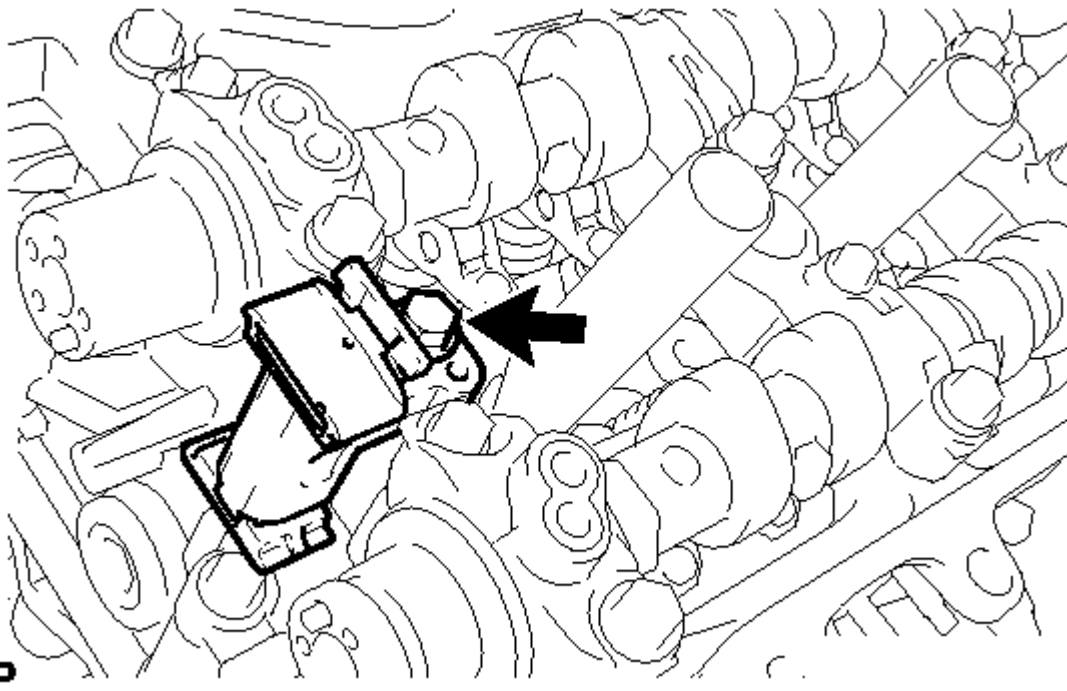
Fig. 281: Remove/Install Camshaft Timing Gear Assembly Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	Turn
*b	Hold

NOTE: Do not loosen the other 4 bolts. If any of the 4 bolts is loosened, replace the camshaft timing gear assembly and/or camshaft timing exhaust gear assembly with a new one.

- c. Remove the 2 bolts and camshaft timing gear together with the No. 2 chain.
43. **REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY**
- a. Remove the bolt and No. 3 chain tensioner assembly.



P

Fig. 282: Identifying No. 3 Chain Tensioner Assembly And Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

44. REMOVE CAMSHAFT BEARING CAP (for Bank 2)

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

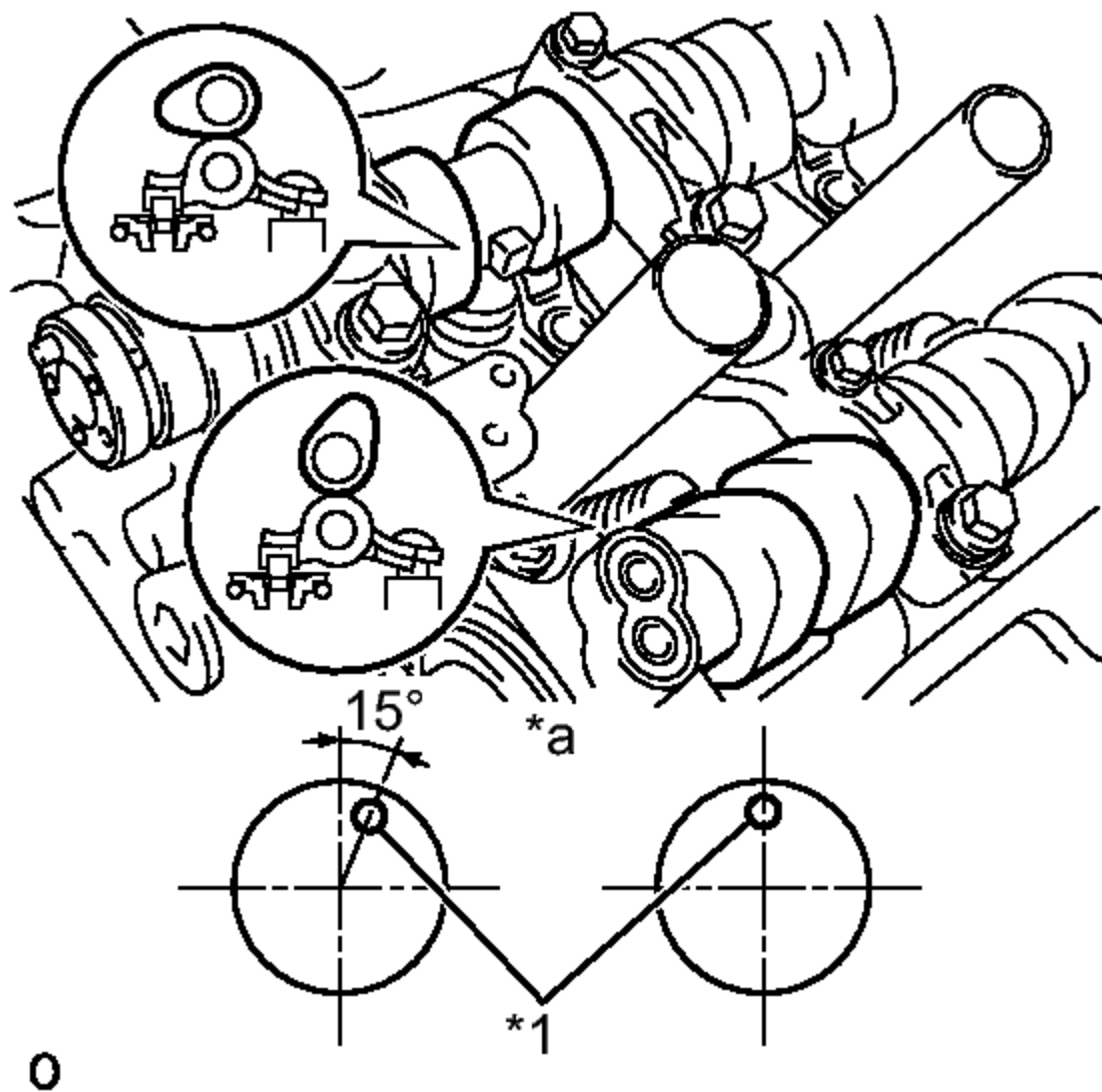


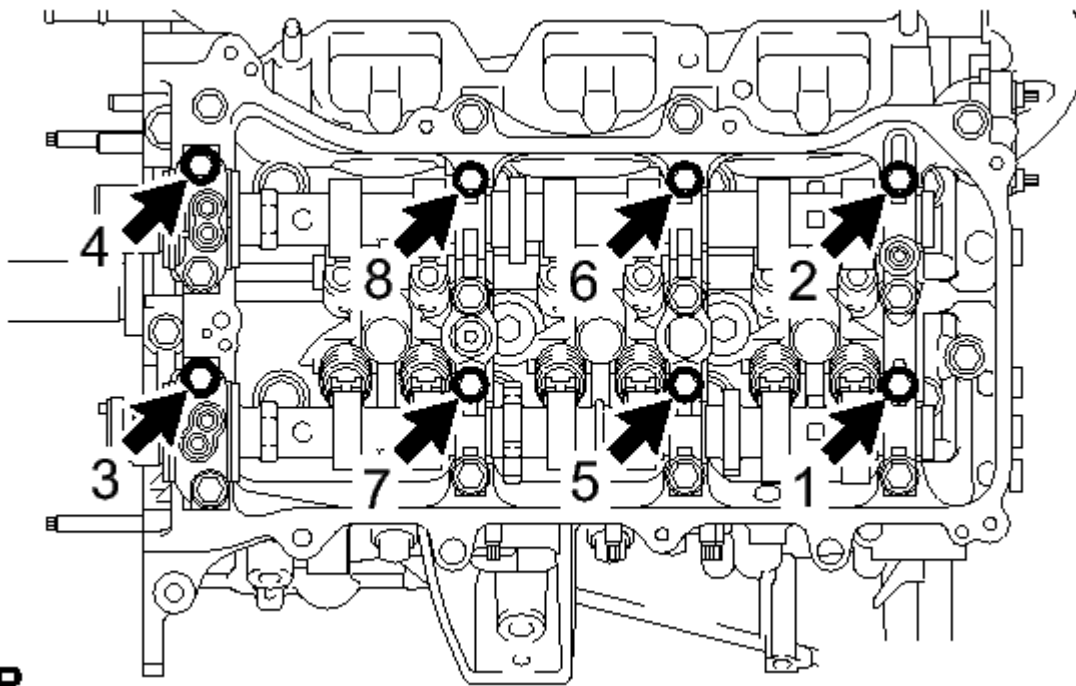
Fig. 283: Identifying Camshaft Bearing Cap (Bank 2)

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

TEXT IN ILLUSTRATION

*1	Knock Pin
*a	Front View

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

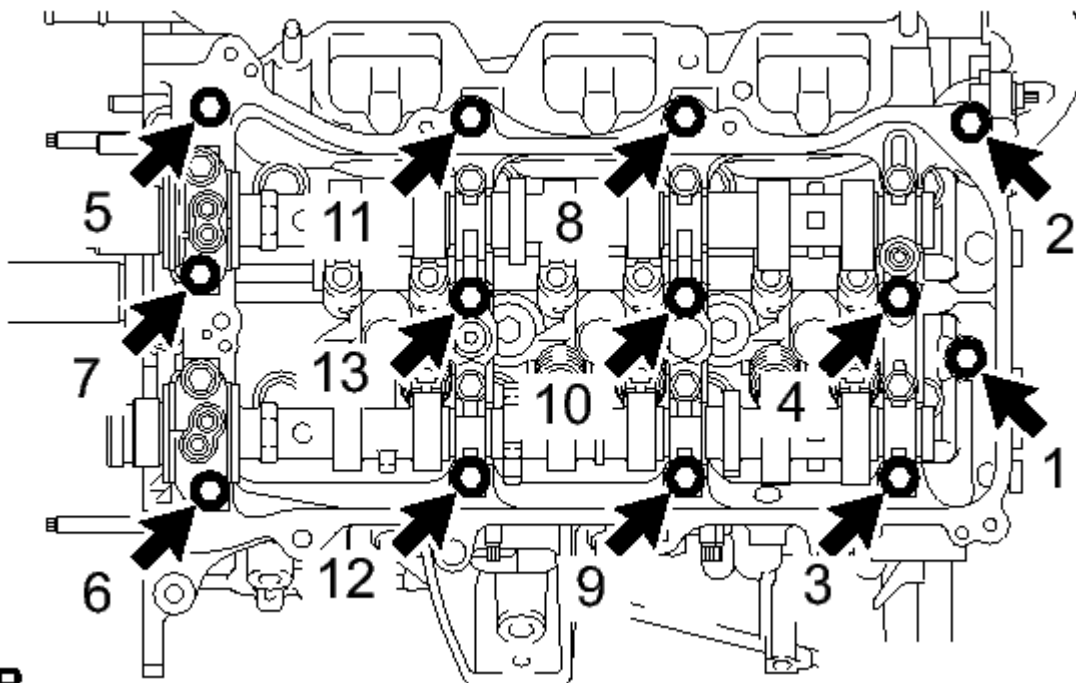


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Fig. 284: Identifying Bearing Cap Bolts With Loosening Sequence

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

- c. Uniformly loosen and remove the 13 bearing cap bolts in several steps in the sequence shown in the illustration.



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Fig. 285: Identifying Bearing Cap Bolts With Loosening Sequence

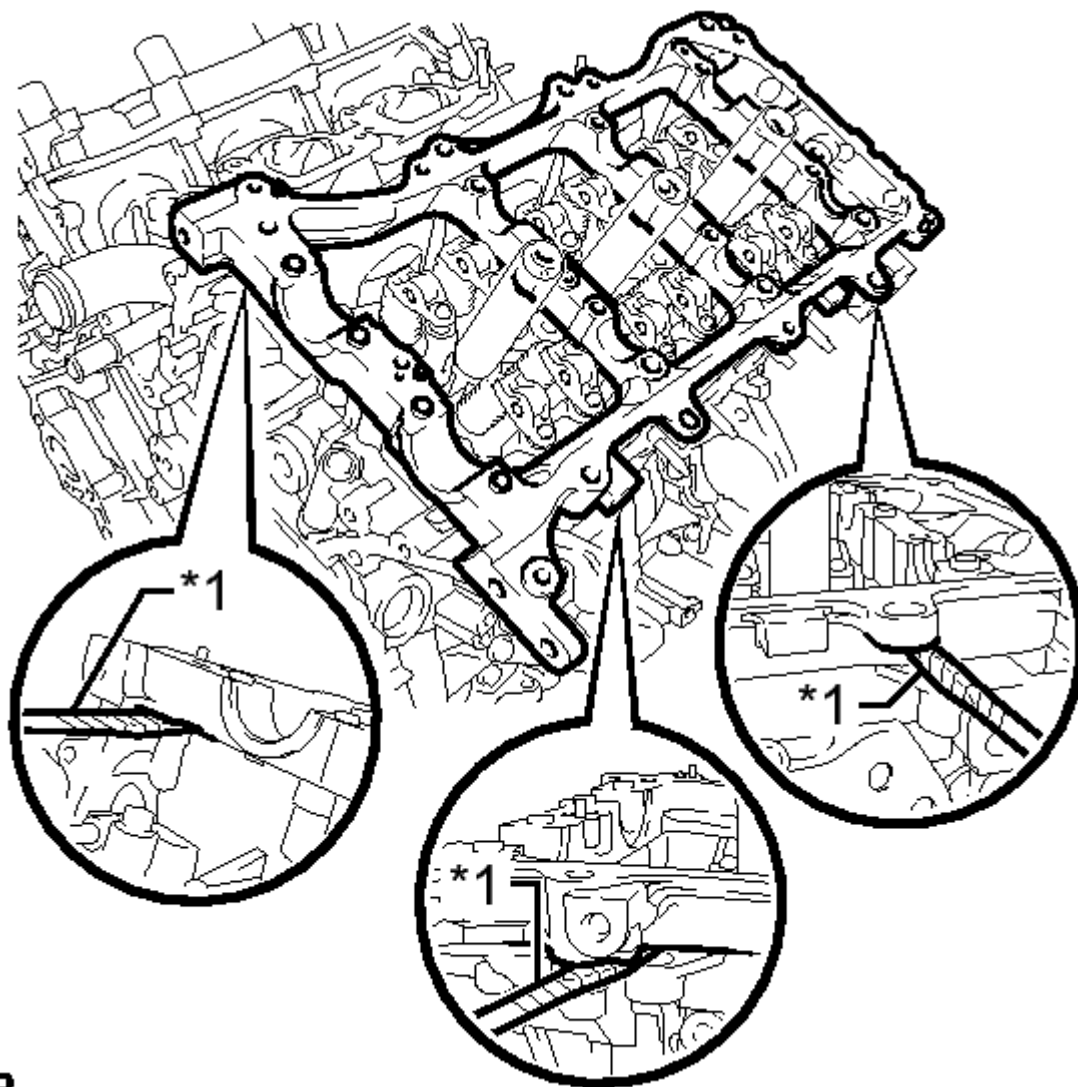
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

- d. Remove the 5 camshaft bearing caps.
- e. Remove the No. 3 camshaft and No. 4 camshaft.

45. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH

- a. Remove the camshaft housing sub-assembly LH by prying between the cylinder head and camshaft housing sub-assembly LH with a screwdriver.



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Fig. 286: Identifying Camshaft Housing Sub-Assembly LH

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

TEXT IN ILLUSTRATION

Protective

*1	Tape
----	------

HINT:

Tape the screwdriver tip before use.

NOTE: **Be careful not to damage the contact surfaces of the cylinder head and camshaft housing sub-assembly LH.**

46. REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

- a. Remove the 24 valve rocker arms from the cylinder head.

HINT:

Arrange the removed parts in the correct order.

47. REMOVE VALVE LASH ADJUSTER ASSEMBLY

- a. Remove the 24 valve lash adjusters from the cylinder head.

HINT:

Arrange the removed parts in the correct order.

48. REMOVE VALVE STEM CAP

- a. Remove the 24 valve stem caps from the cylinder head.

HINT:

Arrange the removed parts in the correct order.

49. REMOVE CYLINDER HEAD SUB-ASSEMBLY See step 22**50. REMOVE CYLINDER HEAD LH** See step 23**51. REMOVE CYLINDER HEAD GASKET****52. REMOVE NO. 2 CYLINDER HEAD GASKET****53. REMOVE NO. 1 WATER OUTLET PIPE** . Refer to **REMOVAL - Step 2****54. REMOVE KNOCK SENSOR** . Refer to **REMOVAL - Step 3****55. REMOVE CYLINDER BLOCK WATER JACKET SPACER**

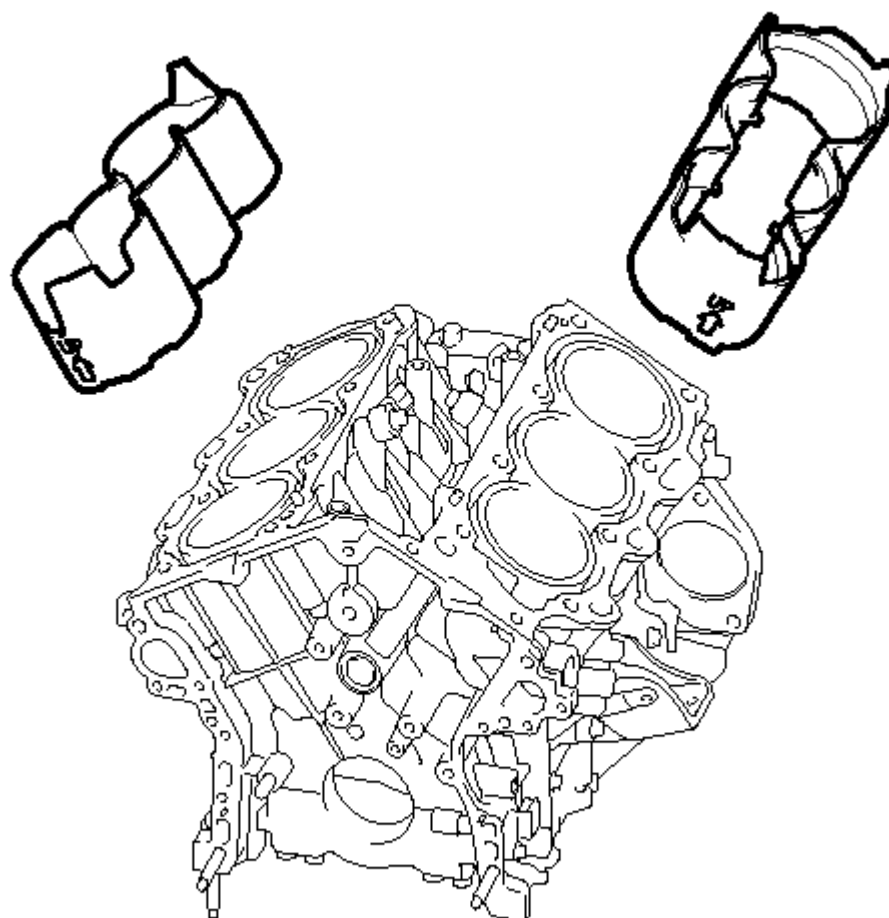
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Fig. 287: Identifying Cylinder Block Water Jacket Spacer

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

- a. Remove the 2 water jacket spacers from the cylinder head.

NOTE: Be sure to remove the water jacket spacers. If not, they may fall and become damaged when the cylinder block is inverted.

56. REMOVE STRAIGHT PIN

NOTE: It is not necessary to remove a straight pin unless it is being replaced.

57. REMOVE RING PIN

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

58. REMOVE STUD BOLT

NOTE: It is not necessary to remove a stud bolt unless it is being replaced.

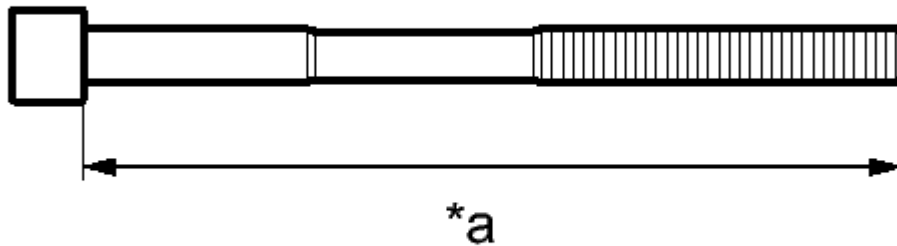
INSPECTION**INSPECTION****1. INSPECT CYLINDER HEAD SET BOLT**

Fig. 288: Identifying Cylinder Head Set Bolt

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

- a. Using a vernier caliper, measure the length of the cylinder head set bolt from the seat to the end.

TEXT IN ILLUSTRATION

*a	Measurement
	Length

Standard length

141.3 to 142.7 mm (5.56 to 5.62 in.)

Maximum length

143.7 mm (5.66 in.)

If the length is more than the maximum, replace the cylinder head set bolt.

- b. Using a vernier caliper, measure the diameter of the elongated thread at the narrowest visible area.

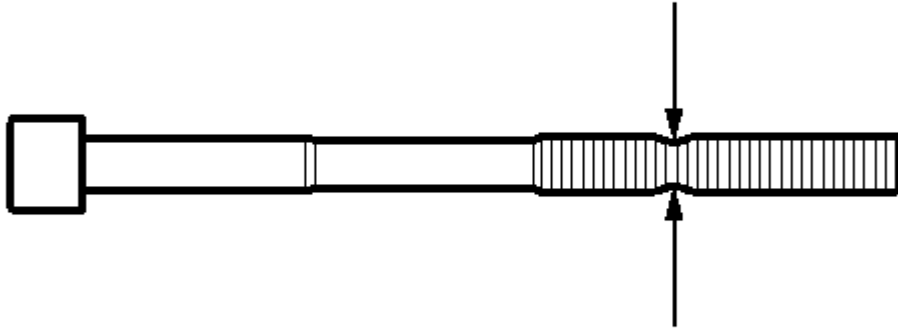


Fig. 289: Measuring Diameter Of Elongated Thread At Narrowest Visible Area
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard diameter

10.73 to 10.97 mm (0.422 to 0.432 in.)

Minimum diameter

10.70 mm (0.421 in.)

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

HINT:

If a visual check reveals no excessively thin areas, check the center of the bolt (refer to illustration above) and find the area that has the smallest diameter.

2. INSPECT NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

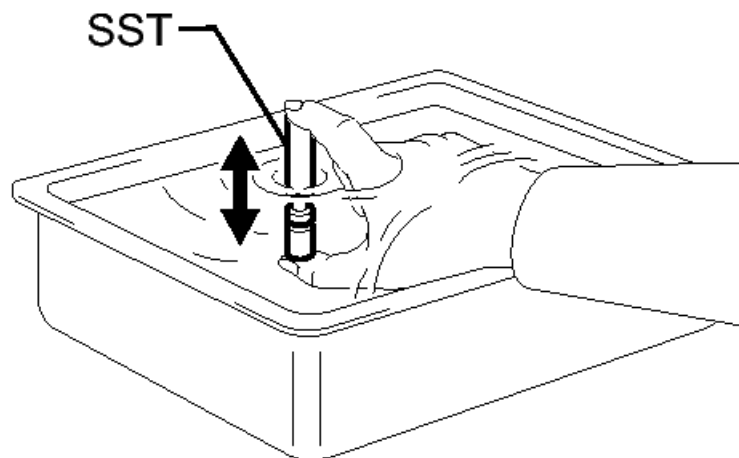
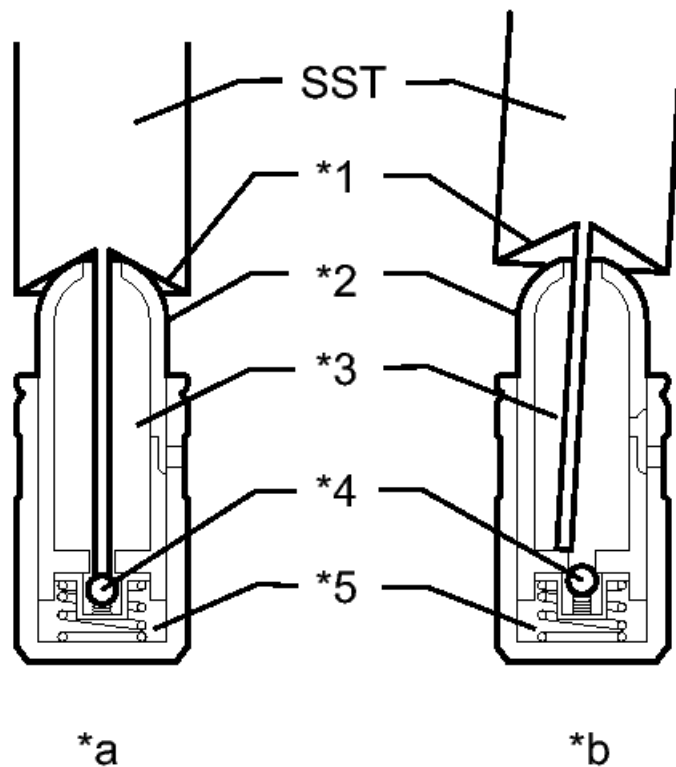
- a. Turn the roller by hand to check that it turns smoothly.

If the roller does not turn smoothly, replace the No. 1 valve rocker arm sub-assembly.

3. INSPECT VALVE LASH ADJUSTER ASSEMBLY

NOTE:

- **Keep the lash adjuster free from dirt and foreign objects.**
 - **Only use clean engine oil.**
- a. Place the lash adjuster into a container full of new engine oil.



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Fig. 290: Inspecting Valve Lash Adjuster Assembly
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Taper Part
*2	Plunger
*3	Low Pressure Chamber
*4	Check Ball
*5	High Pressure Chamber
*a	CORRECT
*b	INCORRECT

- b. Insert the tip of SST into the lash adjuster plunger and use the tip to press down on the check ball inside the plunger.

• **SST: 09276-75010**

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

OK

Plunger moves up and down.

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

- e. After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with your fingers.

OK

Plunger can be pressed 3 times.

If the plunger can still be compressed after pressing it 3 times, replace the valve lash adjuster with a new one.

4. INSPECT CAMSHAFT

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

Maximum runout

0.04 mm (0.00157 in.)

If the runout is more than the maximum, replace the camshaft.

HINT:

Check the oil clearance after replacing the camshaft.

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

Standard Cam Lobe Height

Item	Specified Condition
Intake camshaft	43.890 to 43.990 mm (1.728 to 1.732 in.)
Exhaust camshaft	44.262 to 44.362 mm (1.743 to 1.747 in.)

Minimum Cam Lobe Height

Item	Specified Condition
Intake camshaft	43.840 mm (1.726 in.)
Exhaust camshaft	44.212 mm (1.741 in.)

- c. Using a micrometer, measure the journal diameter.

Standard Journal Diameter

Item	Specified Condition
No. 1 journal	35.946 to 35.960 mm (1.4152 to 1.4157 in.)

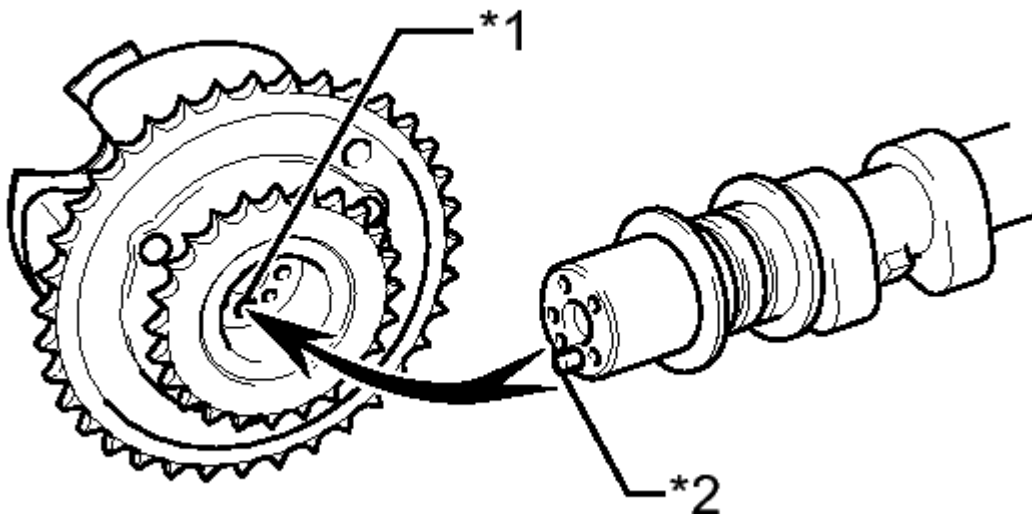
Other journals	25.959 to
	25.975
	mm
	(1.0221 to
	1.0226
	in.)

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

5. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

- Fix the camshaft in place.

NOTE: Be careful not to damage the camshaft.



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Fig. 291: Identifying Pin Hole & Straight Pin

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

- Put the camshaft timing gear assembly and camshaft together by aligning the pin hole and straight pin.

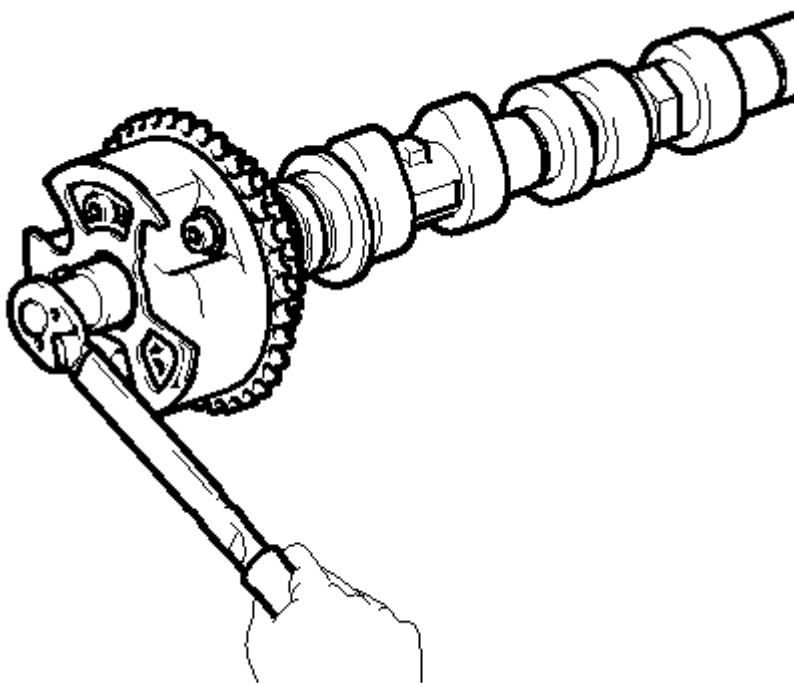
TEXT IN ILLUSTRATION

*1	Pin Hole
*2	Straight Pin

- c. Lightly press and turn the camshaft timing gear assembly against the camshaft, and press harder after the pin enters the hole.

NOTE: Be sure not to turn the camshaft timing gear assembly in the retard direction.

- d. Check that there is no clearance between the camshaft timing gear assembly flange and camshaft.
- e. Tighten the flange bolt while holding the camshaft.



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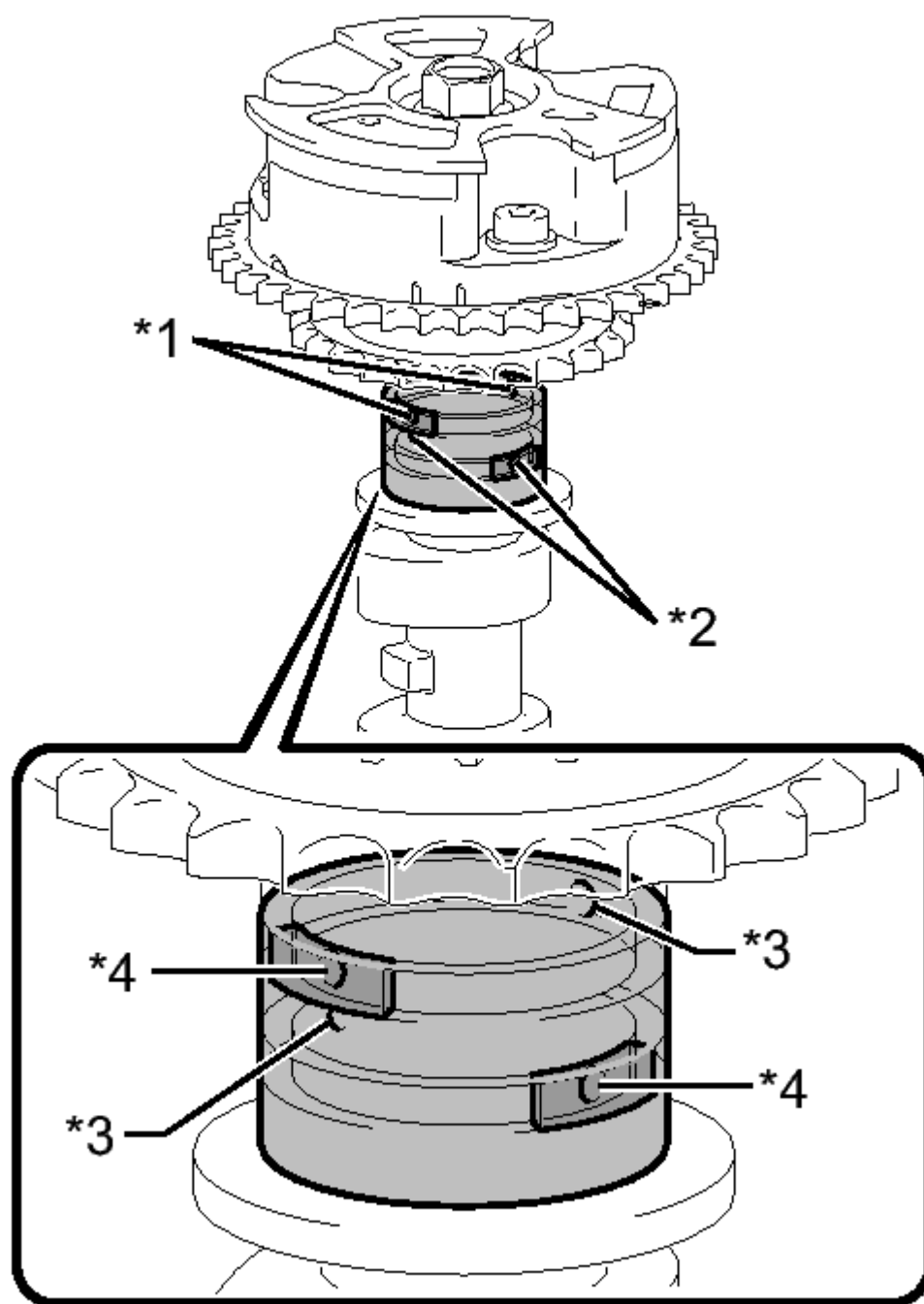
Fig. 292: Tightening Camshaft And Flange Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

- f. Check the lock of the camshaft timing gear assembly.
 - 1. Fix the camshaft in place and confirm that the camshaft timing gear assembly is locked.

NOTE: Be careful not to damage the camshaft.

- g. Release the lock pin.

**P****Fig. 293: Identifying Oil Paths Of Cam Journal**

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

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

TEXT IN ILLUSTRATION

*1	Advance Side Path
*2	Retard Side Path
*3	Open
*4	Close
-	Rubber
-	Vinyl Tape

HINT:

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

2. Break through the tape on the advance side path and the retard side path on the opposite side of the hole of the advance side path, as shown in the illustration.
3. Apply air at approximately 200 kPa (2.0 kgf/cm², 28 psi) to the 2 open paths.

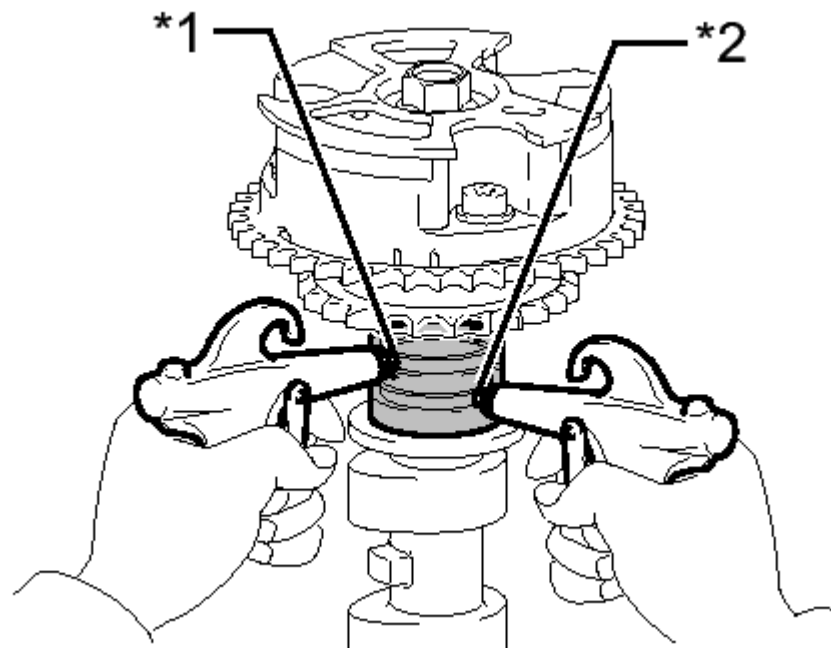
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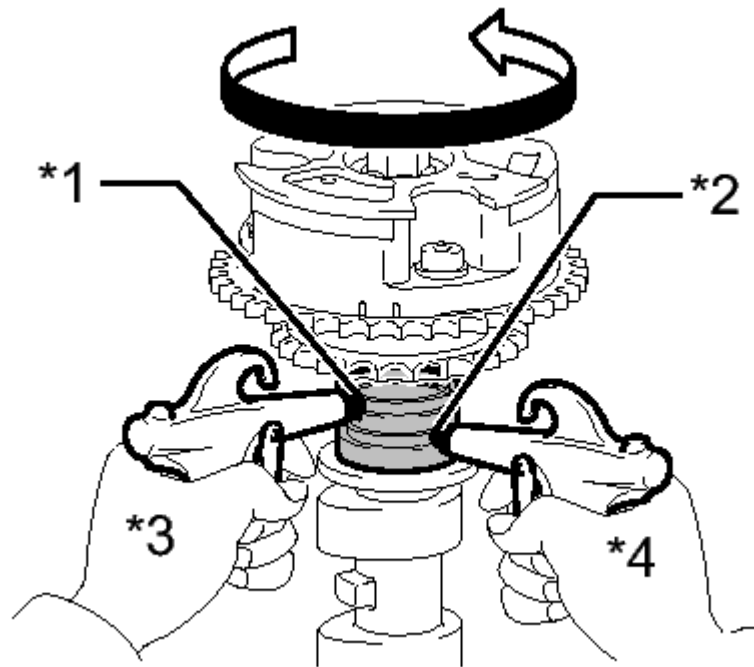
Fig. 294: Identifying Advance Side Path & Retard Side Path For Oil Of Cam Journal
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Advance Side Path
*2	Retard Side Path

WARNING: Cover the paths with a piece of cloth when applying pressure to prevent oil from spraying.

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



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Fig. 295: Checking Rotation Of Camshaft Timing Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Advance Side Path
*2	Retard Side Path
*3	Hold Pressure
*4	Decompress

HINT:

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

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

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

- h. Check for smooth rotation.

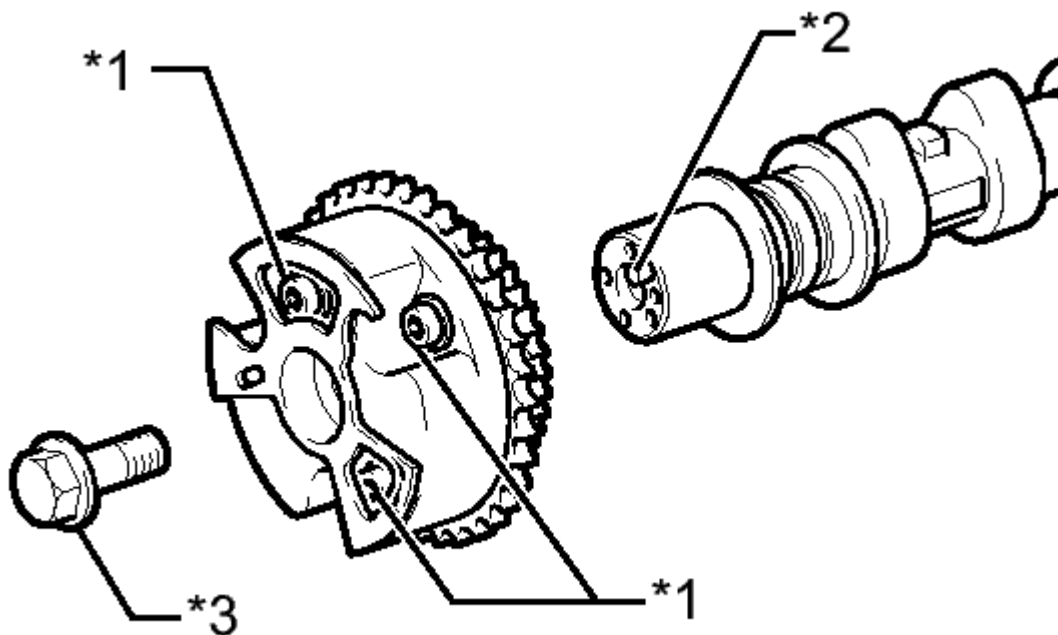
1. Turn the camshaft timing gear assembly within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.

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

- i. Check the lock in the most retarded position.

1. Confirm that the camshaft timing gear assembly locks at the most retarded position.

- j. Remove the flange bolt and camshaft timing gear assembly.



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Fig. 296: Exploded View Of Camshaft Timing Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Do not remove

*2	Straight Pin
*3	Flange Bolt

NOTE:

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

6. INSPECT CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY

- a. Fix the camshaft in place.

NOTE:

Be careful not to damage the camshaft.

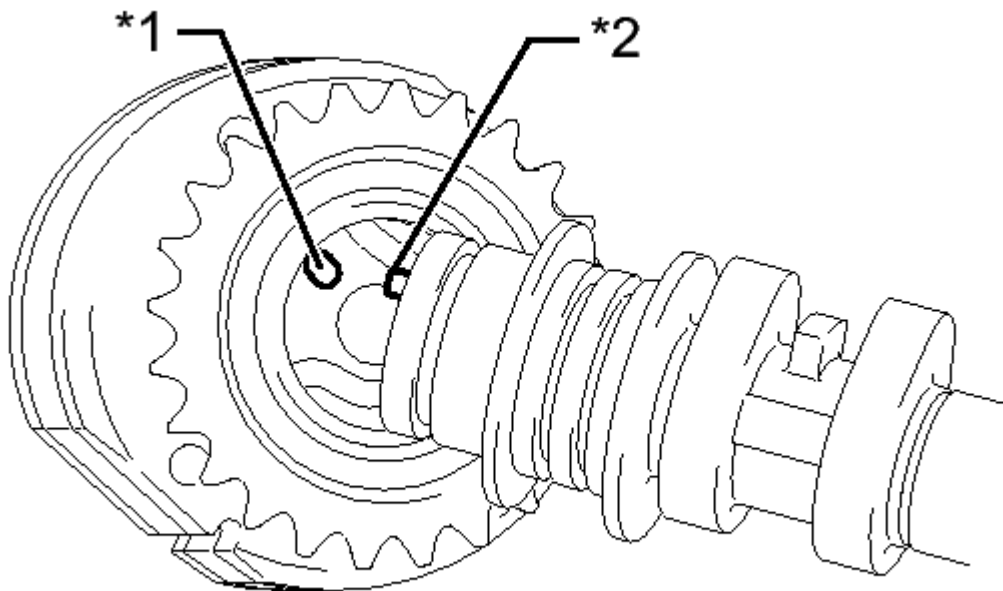
**P**

Fig. 297: Identifying Pin Hole & Straight Pin

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

- b. Put the camshaft timing exhaust gear assembly and camshaft together by aligning the pin hole and straight pin.

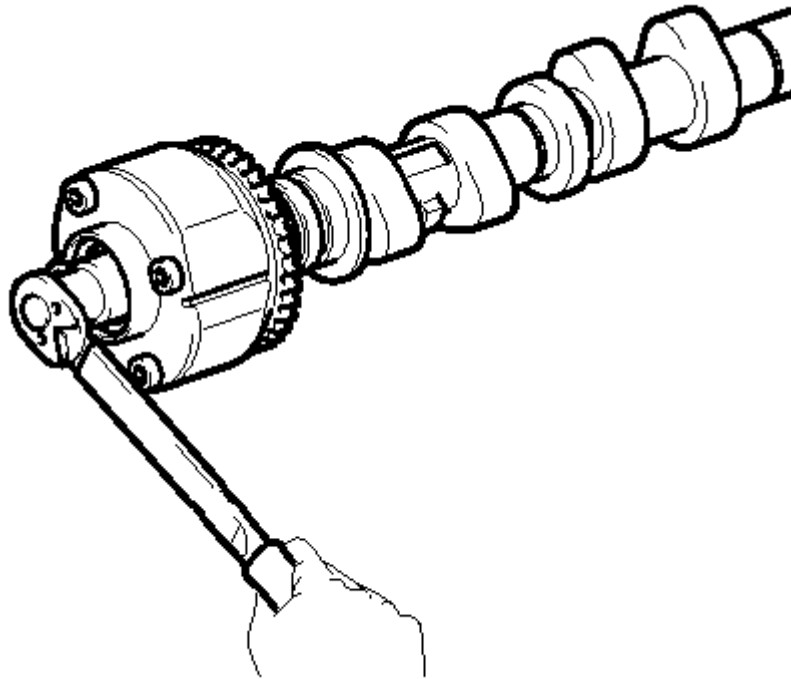
TEXT IN ILLUSTRATION

*1	Pin Hole
*2	Straight Pin

- c. Lightly press and turn the camshaft timing gear assembly against the camshaft, and press harder after the pin enters the hole.

NOTE: Be sure not to turn the camshaft timing exhaust gear in the advanced direction.

- d. Check that there is no clearance between the gear flange and camshaft.
- e. Tighten the flange bolt while holding the camshaft.

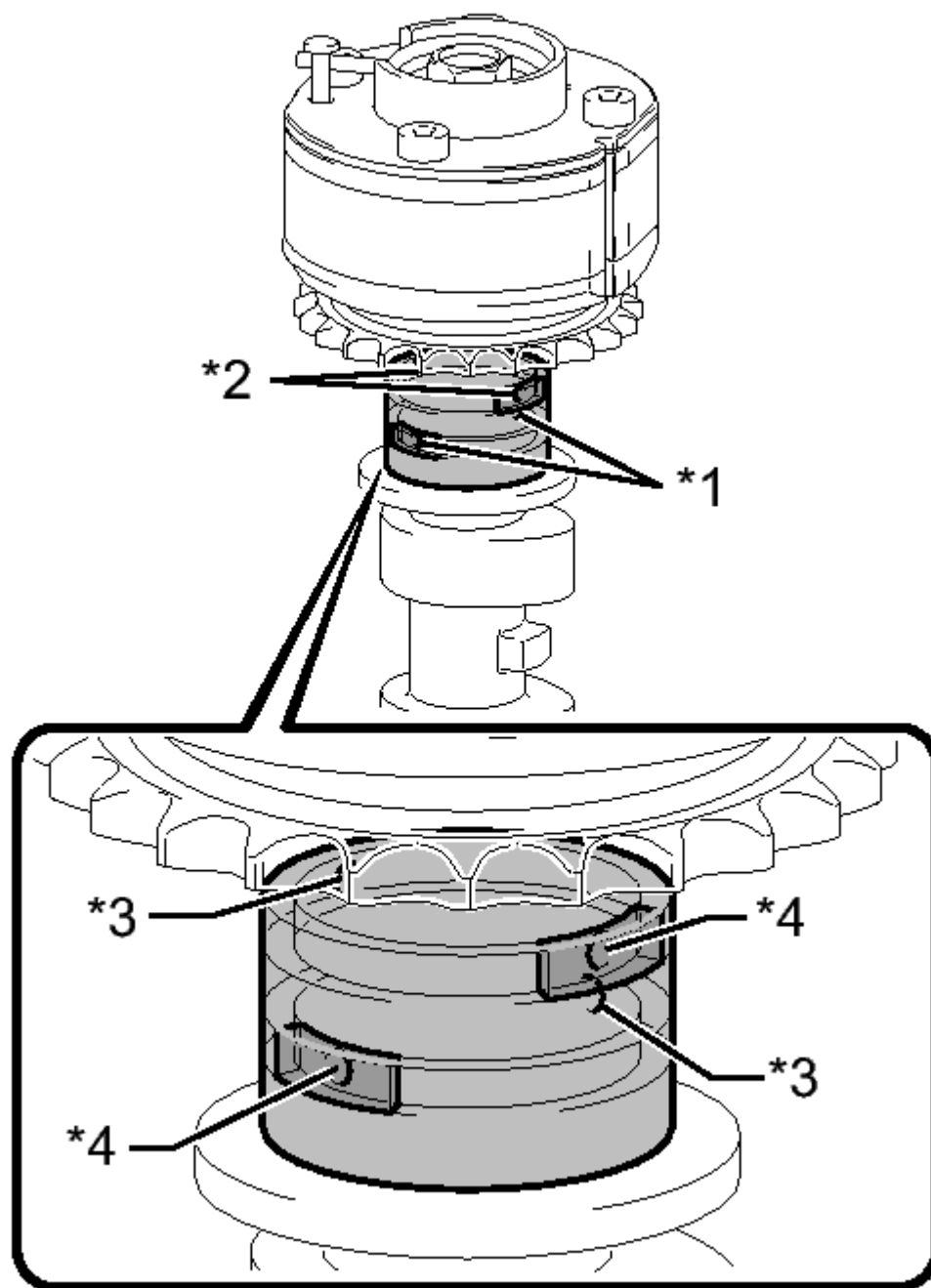


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Fig. 298: Tightening Camshaft And Flange Bolt
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

- f. Check the camshaft timing exhaust gear lock.
 - 1. Make sure that the camshaft timing exhaust gear assembly locks.
- g. Release the lock pin.

**P****Fig. 299: Identifying Oil Paths Of Cam Journal**

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

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

TEXT IN ILLUSTRATION

*1	Advance Side Path
*2	Retard Side Path
*3	Open
*4	Close
-	Rubber
-	Vinyl Tape

HINT:

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

2. Break through the tape on the advance side path and the retard side path on the opposite side of the hole of the advance side path, as shown in the illustration.
3. Apply air at approximately 200 kPa (2.0 kgf/cm², 28 psi) to the 2 open paths (the advance side path and retard side path).

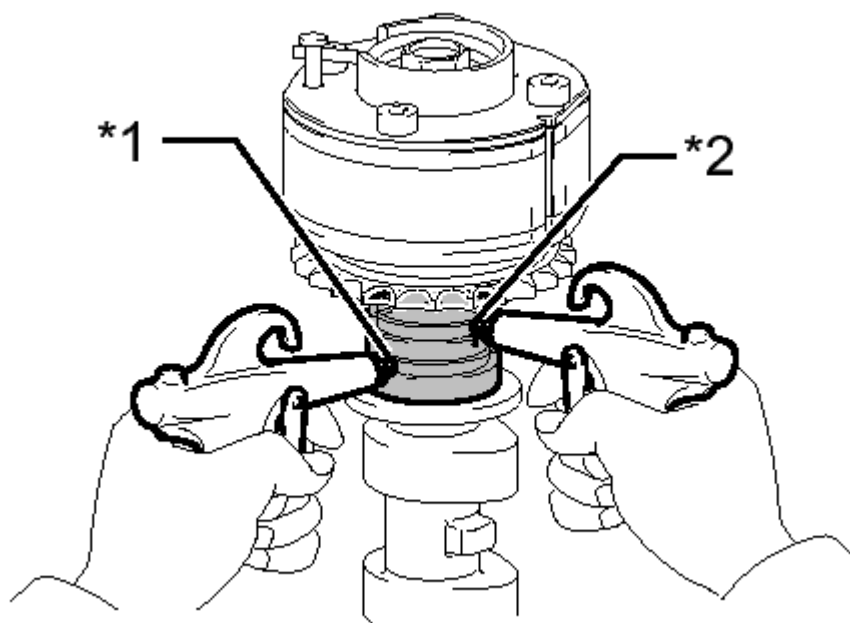
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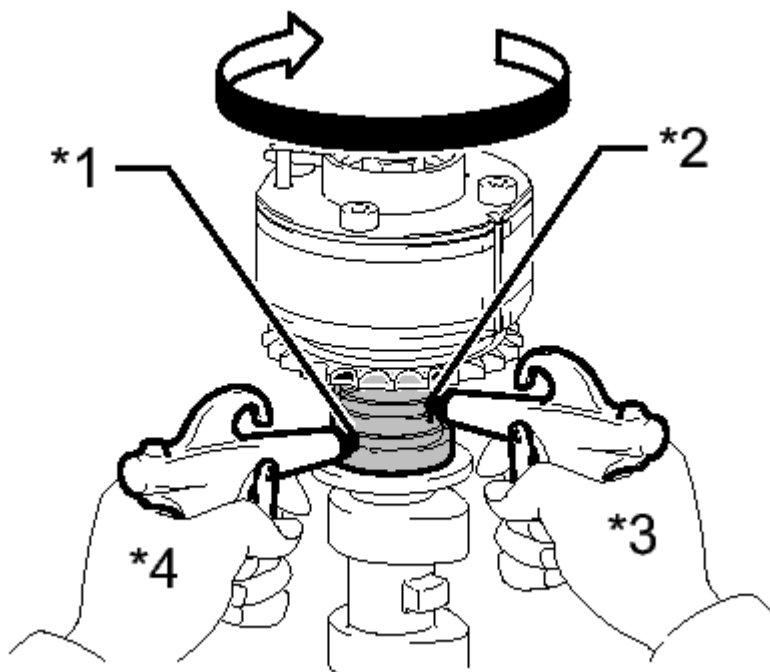
Fig. 300: Applying Air To Advance Side Path & Retard Side Path
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Advance Side Path
*2	Retard Side Path

WARNING: Cover the paths with a piece of cloth when applying pressure to prevent oil from spraying.

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



P

Fig. 301: Checking Rotation Of Camshaft Timing Exhaust Gear Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Advance Side Path
*2	Retard Side Path
*3	Hold Pressure
*4	Decompress

HINT:

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

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

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

- h. Check for smooth rotation.

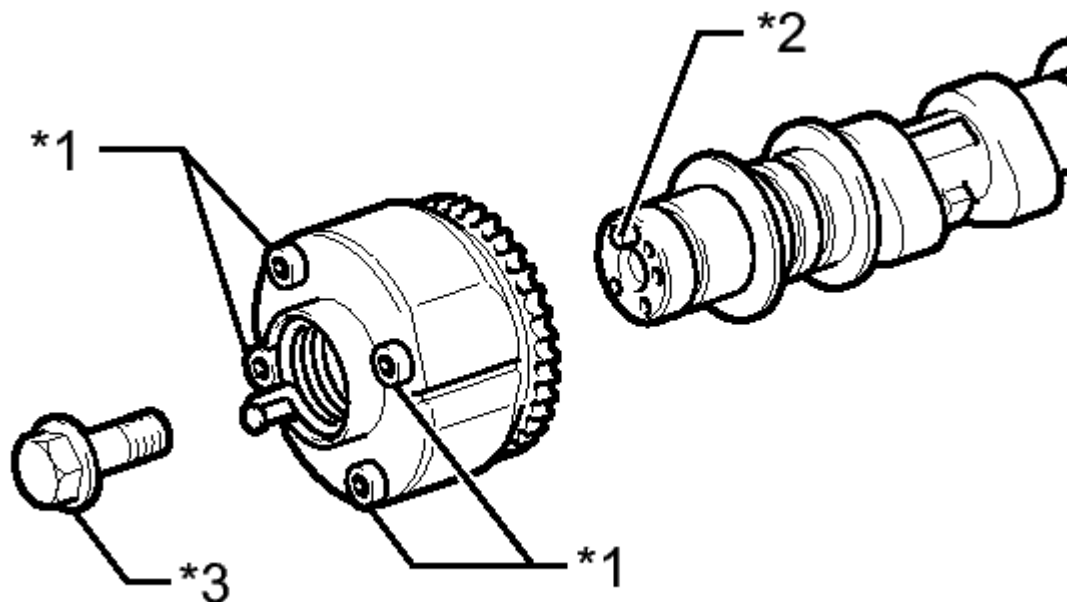
1. Turn the camshaft timing exhaust gear assembly within its movable range (18.5°) 2 or 3 times, but do not turn it to the most advanced position. Make sure that the gear assembly turns smoothly.

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

- i. Check the lock at the most advanced position.

1. Make sure that the camshaft timing exhaust gear assembly locks at the most advanced position.

- j. Remove the flange bolt and camshaft timing exhaust gear assembly.

**P****Fig. 302: Exploded View Of Camshaft Timing Exhaust Gear Assembly**

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

TEXT IN ILLUSTRATION

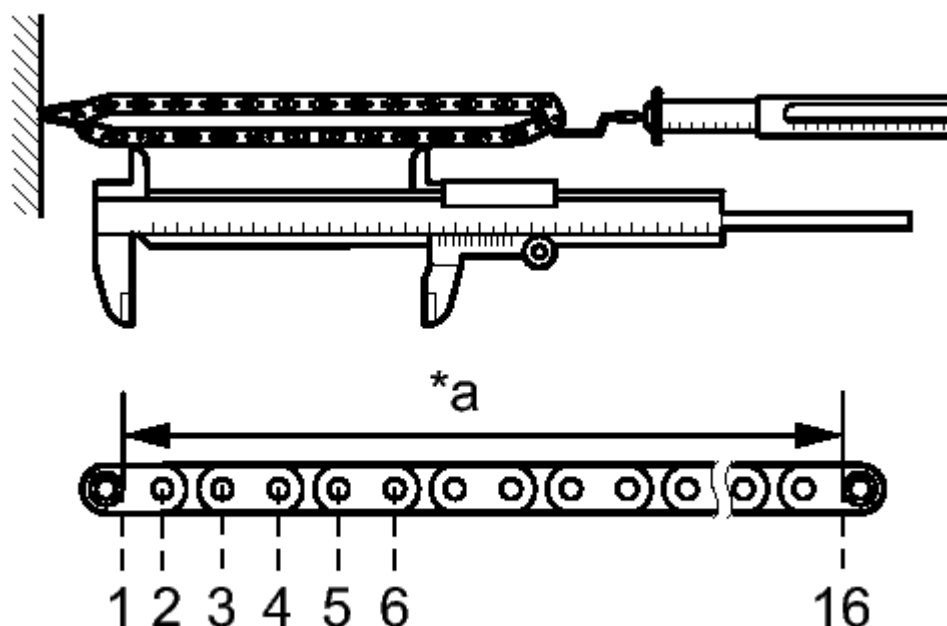
*1	Do not remove
*2	Straight Pin
*3	Flange Bolt

NOTE:

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

7. INSPECT NO. 1 CHAIN SUB-ASSEMBLY

- a. Using a spring scale, pull the No. 1 chain with a force of 147 N (15 kgf, 33 lbf) and measure the length of the No. 1 chain using a vernier caliper.

**P****Fig. 303: Measuring Length Of No. 1 Chain Using Vernier Caliper**

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

Maximum chain elongation

136.9 mm (5.39 in.)

TEXT IN ILLUSTRATION

*a	Measurement Area
----	------------------

HINT:

Perform the measurement at 3 random places.

If a measurement is more than the maximum, replace the No. 1 chain.

8. INSPECT NO. 2 CHAIN SUB-ASSEMBLY

- a. Using a spring scale, pull the No. 2 chain with a force of 147 N (15 kgf, 33 lbf) and measure the length of the No. 2 chain using a vernier caliper.

Maximum chain elongation

137.6 mm (5.42 in.)

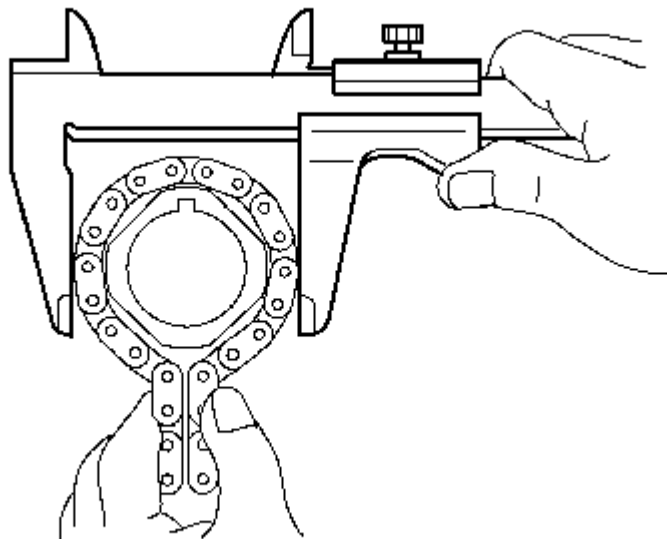
HINT:

Perform the measurement at 3 random places.

If a measurement is more than the maximum, replace the No. 2 chain.

9. INSPECT CRANKSHAFT TIMING SPROCKET

- a. Wrap the No. 1 chain around the sprocket.



Y

Fig. 304: Inspecting Crankshaft Timing Gear
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- b. Using a vernier caliper, measure the crankshaft timing sprocket diameter with the No. 1 chain.

Minimum gear diameter (with chain)

61.0 mm (2.40 in.)

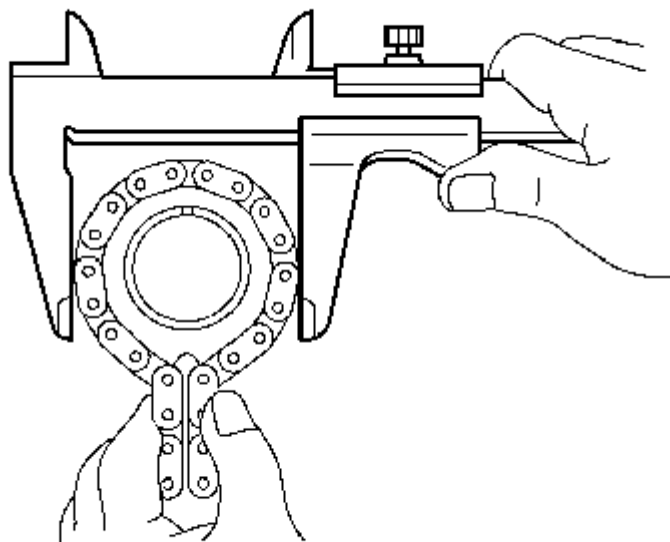
HINT:

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

If the diameter is less than the minimum, replace the No. 1 chain and crankshaft timing sprocket.

10. INSPECT NO. 1 IDLE GEAR

- a. Wrap the No. 1 chain around the gear.



Y

Fig. 305: Inspecting Idle Sprocket Assembly

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

- b. Using a vernier caliper, measure the No. 1 idle gear diameter with the No. 1 chain.

Minimum gear diameter (with chain)

61.0 mm (2.40 in.)

HINT:

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

If the diameter is less than the minimum, replace the No. 1 chain and No. 1 idle gear.

11. INSPECT NO. 1 IDLE GEAR SHAFT OIL CLEARANCE

- a. Using a micrometer, measure the No. 1 idle gear shaft diameter.

Standard idle gear shaft diameter

22.987 to 23.000 mm (0.905 to 0.906 in.)

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

Standard idle gear inside diameter

23.02 to 23.03 mm (0.906 to 0.907 in.)

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

Standard oil clearance

0.020 to 0.043 mm (0.000787 to 0.00169 in.)

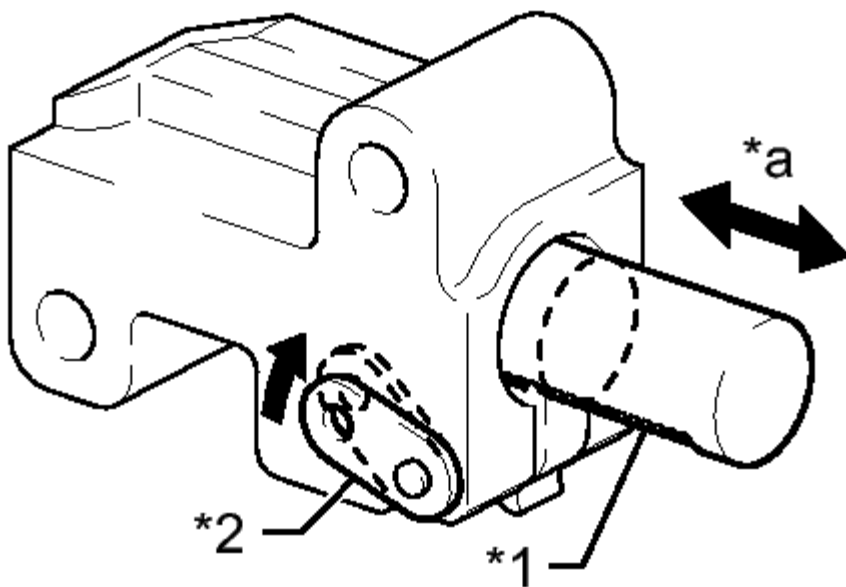
Maximum oil clearance

0.093 mm (0.00366 in.)

If the shaft oil clearance is more than the maximum, replace the idle gear shaft and idle gear.

12. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

- a. Move the stopper plate upward to release the lock. Push the plunger and check that it moves smoothly.



P

Fig. 306: Identifying No. 1 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Plunger
*2	Stopper Plate
*a	Moves Smoothly

If necessary, replace the No. 1 chain tensioner.

13. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

- a. Check that the plunger moves smoothly.

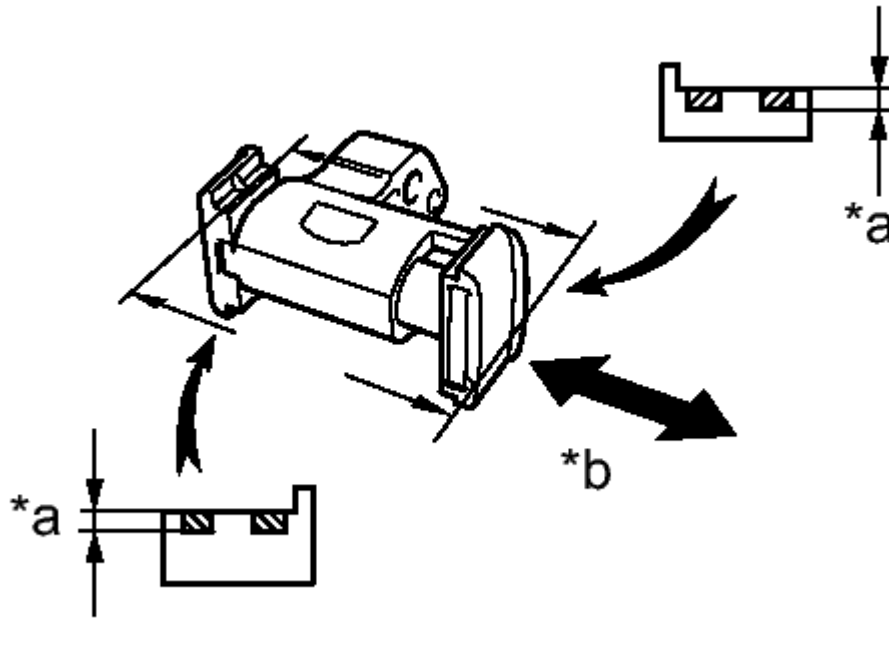


Fig. 307: Identifying No. 2 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	Depth
*b	Moves Smoothly

- b. Measure the depth of wear of the chain tensioner.

Maximum depth

1.0 mm (0.0394 in.)

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

14. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

- a. Check that the plunger moves smoothly.

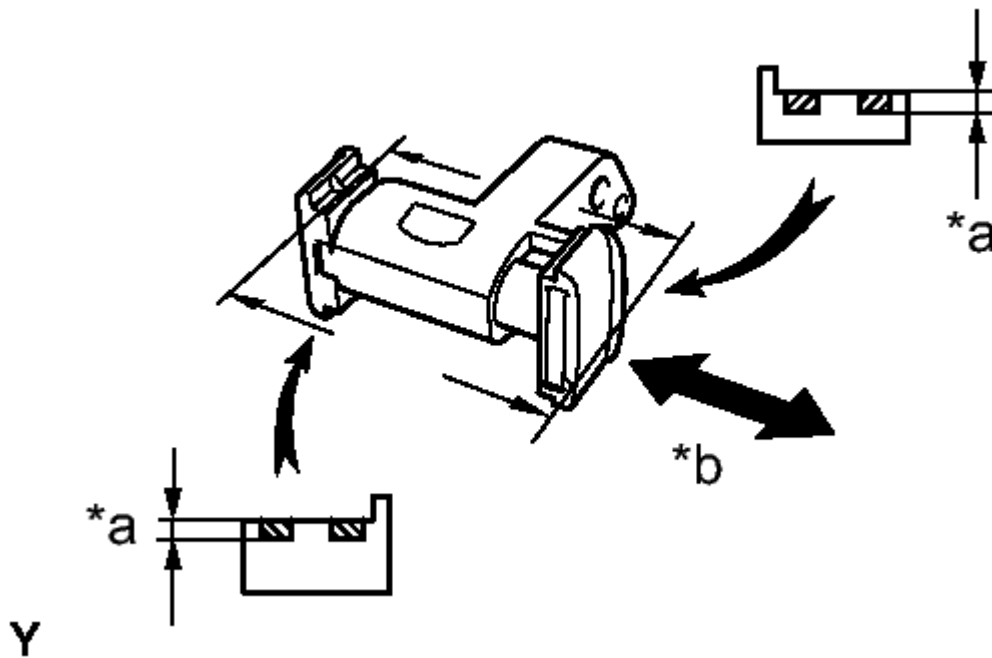


Fig. 308: Identifying No. 3 Chain Tensioner Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*a	Depth
*b	Moves Smoothly

- b. Measure the depth of wear of the chain tensioner.

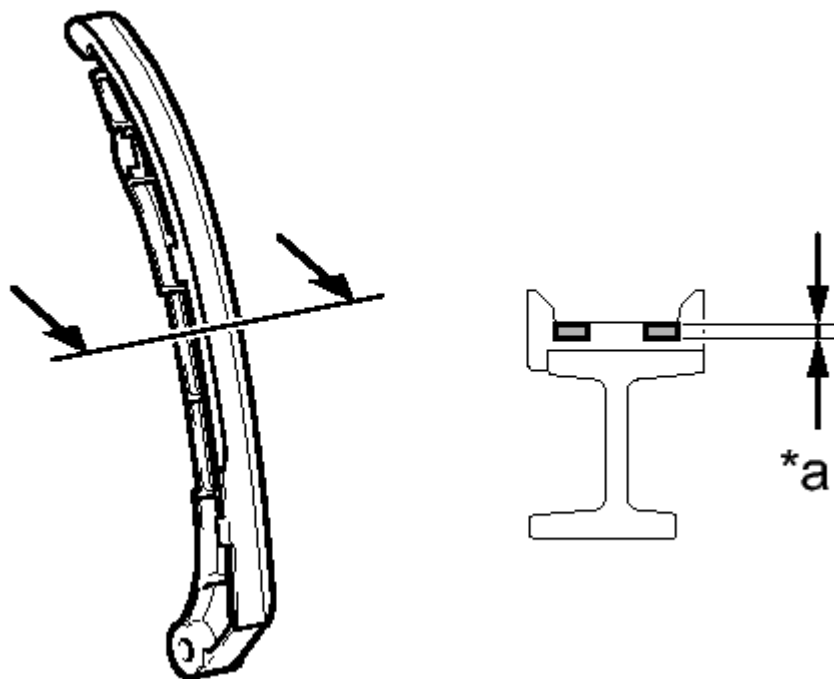
Maximum depth

1.0 mm (0.0394 in.)

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

15. INSPECT CHAIN TENSIONER SLIPPER

- a. Measure the depth of wear of the chain tensioner slipper.

**P****Fig. 309: Identifying Chain Tensioner Slipper**

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

Maximum depth

1.0 mm (0.0394 in.)

TEXT IN ILLUSTRATION

*a	Depth
----	-------

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

16. INSPECT NO. 1 CHAIN VIBRATION DAMPER

- a. Measure the depth of wear of the No. 1 chain vibration damper.

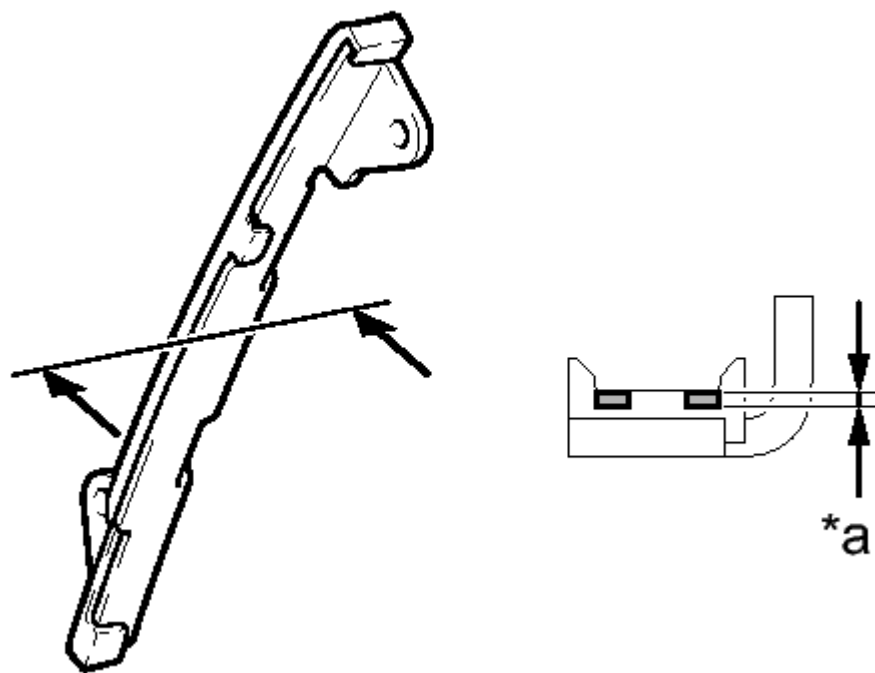
**P**

Fig. 310: Identifying No. 1 Chain Vibration Damper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum depth

1.0 mm (0.0394 in.)

TEXT IN ILLUSTRATION

*a Depth

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

17. INSPECT NO. 2 CHAIN VIBRATION DAMPER

- a. Measure the depth of wear of the No. 2 chain vibration damper.

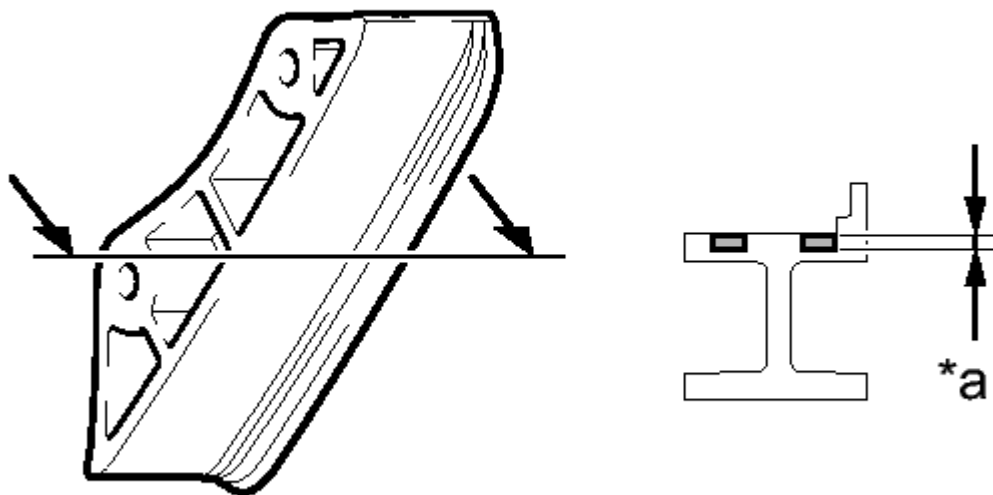
**P**

Fig. 311: Identifying No. 2 Chain Vibration Damper
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum depth

1.0 mm (0.0394 in.)

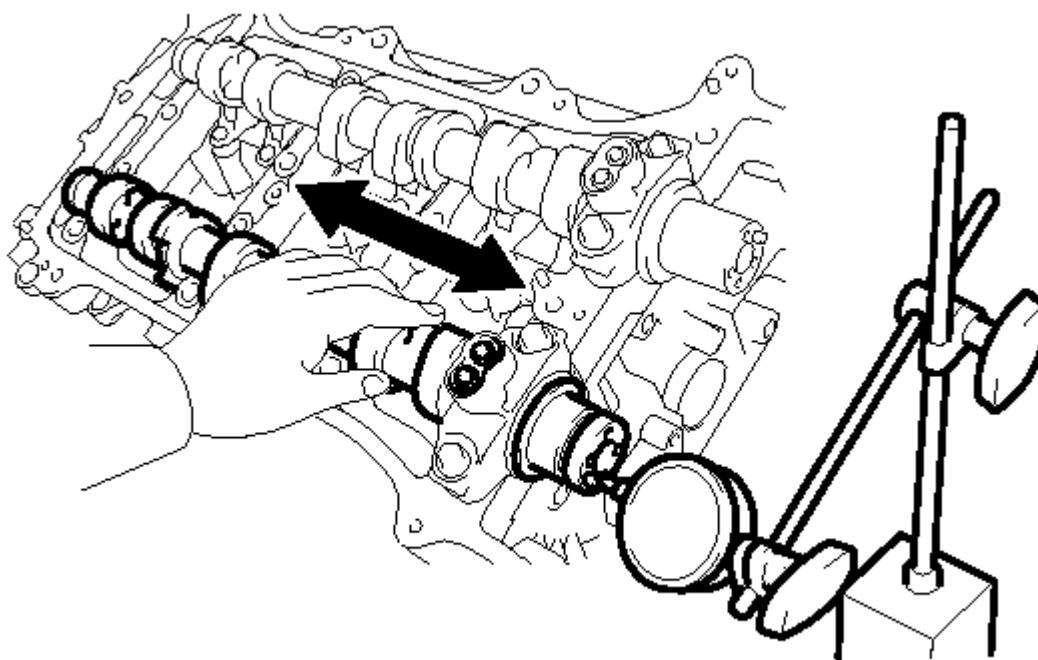
TEXT IN ILLUSTRATION

*a Depth

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

18. INSPECT CAMSHAFT THRUST CLEARANCE

- a. Install the camshafts. See step 18.

**T****Fig. 312: Identifying Camshaft Thrust Clearance****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

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

Standard thrust clearance

0.08 to 0.13 mm (0.00315 to 0.00512 in.)

Maximum thrust clearance

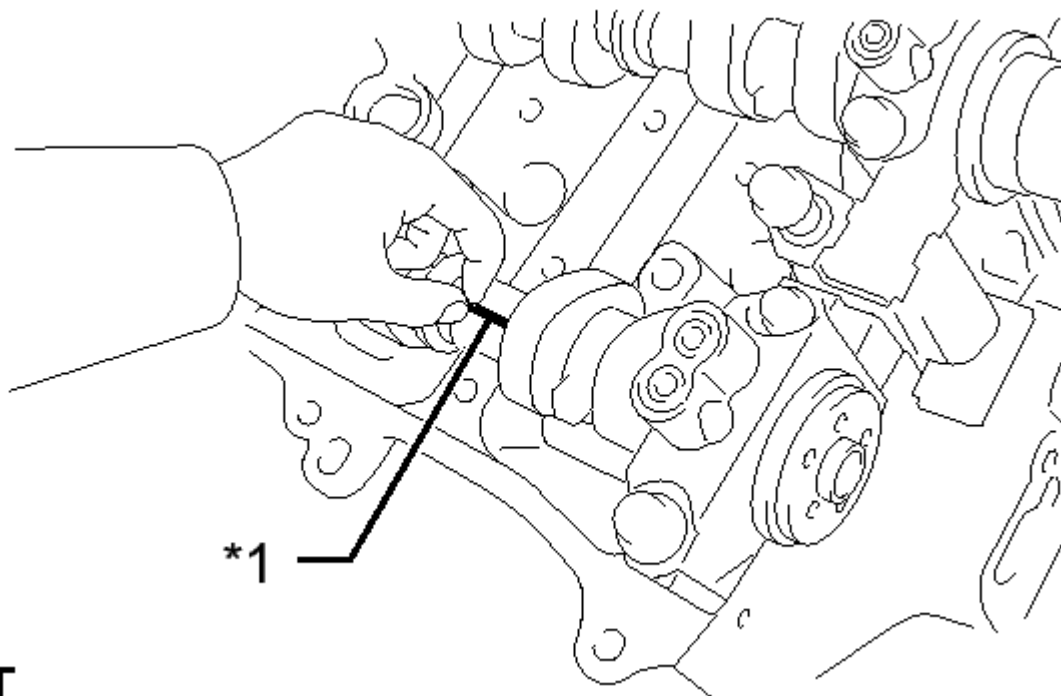
0.15 mm (0.00591 in.)

If the thrust clearance is more than the maximum, replace the camshafts.

If necessary, replace the camshaft bearing caps and cylinder head as a set.

19. INSPECT CAMSHAFT OIL CLEARANCE

- a. Clean the camshaft bearing caps, camshaft housing and camshaft journals.
- b. Place the camshafts on the camshaft housing.
- c. Lay a strip of Plastigage across each camshaft journal.

**T****Fig. 313: Identifying Plastigage Across Camshaft Journal**

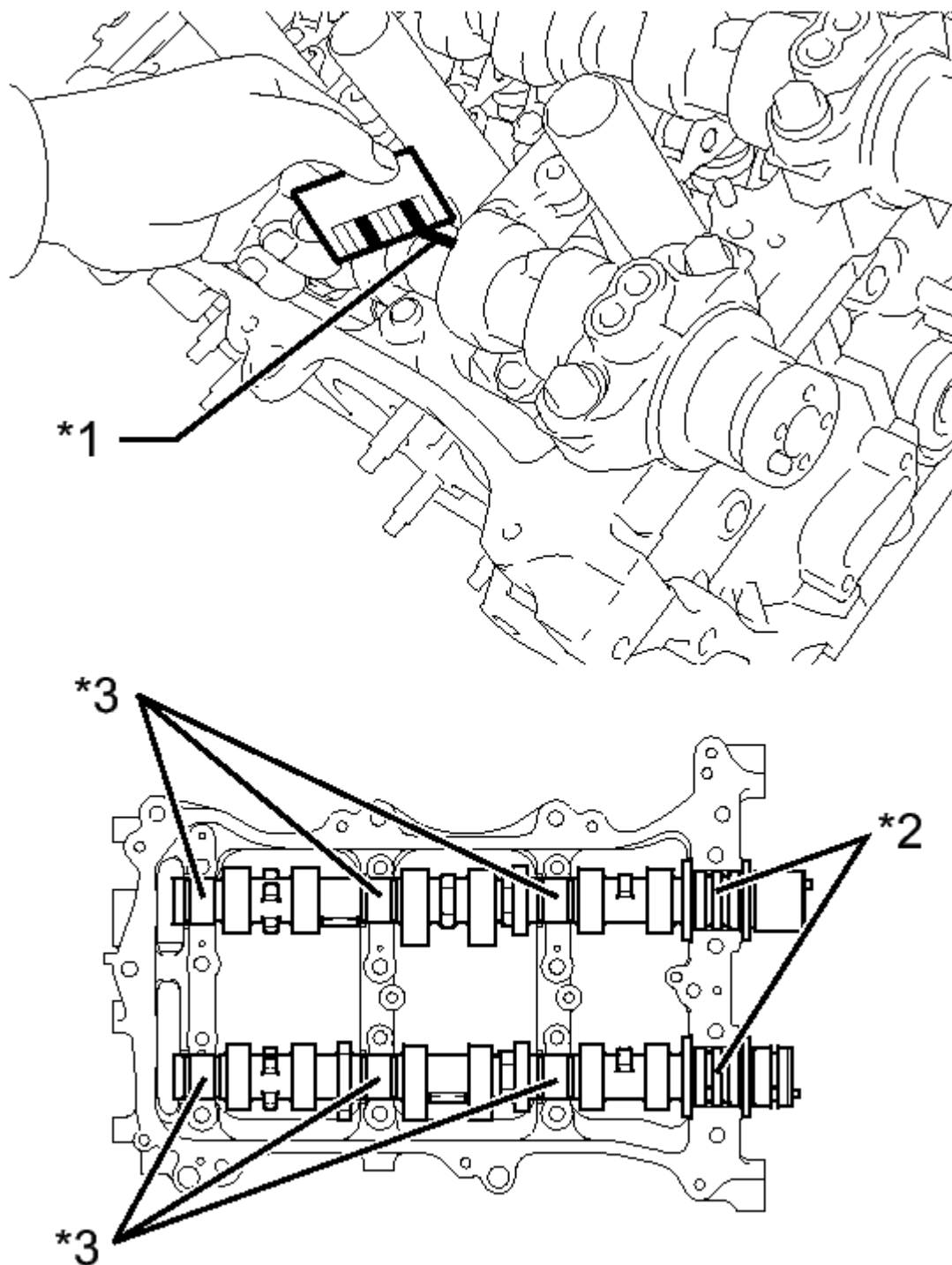
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION***1** Plastigage

- d. Install the camshaft bearing caps. See step 18.

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

- e. Remove the camshaft bearing caps. See step 40.
f. Measure the Plastigage at its widest point.



P

Fig. 314: Measuring Plastigage At Widest Point
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Standard Oil Clearance



Item	Specified Condition
No. 1 journal	0.032 to 0.063 mm (0.00126 to 0.00248 in.)
Other journals	0.025 to 0.062 mm (0.000984 to 0.00244 in.)

Maximum Oil Clearance

Item	Specified Condition
No. 1 journal	0.10 mm (0.00394 in.)
Other journals	0.09 mm (0.00354 in.)

TEXT IN ILLUSTRATION

*1	Plastigage
*2	No. 1 Journal
*3	Other Journals

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

20. INSPECT EXHAUST MANIFOLD SUB-ASSEMBLY

- Using a precision straightedge and feeler gauge, measure the warpage of the surface which contacts the cylinder head.

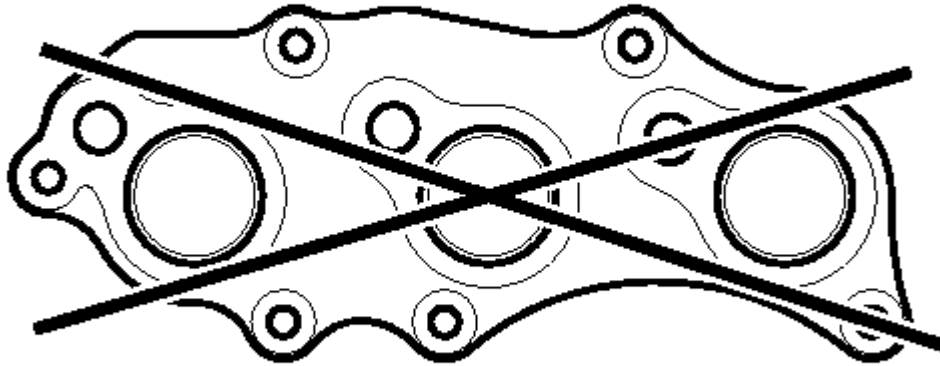
**P**

Fig. 315: Inspecting Exhaust Manifold Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum warpage

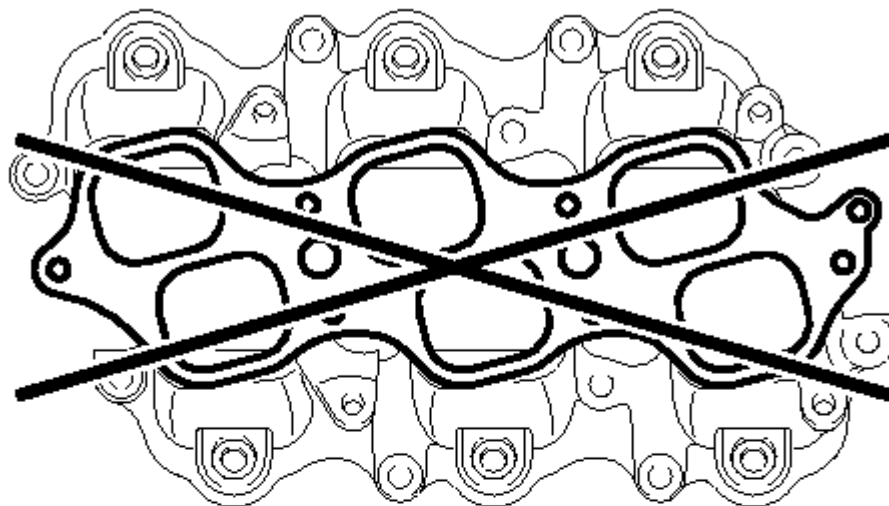
0.70 mm (0.0276 in.)

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

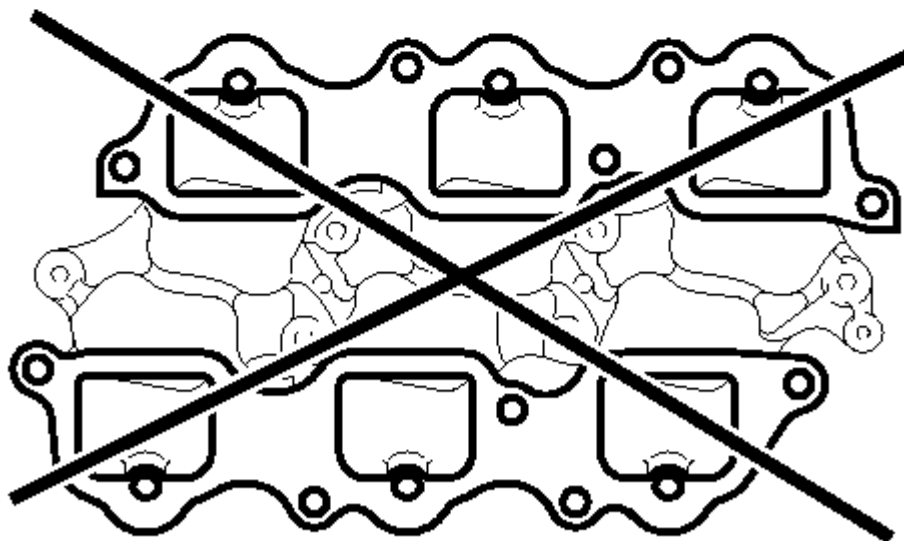
21. INSPECT INTAKE MANIFOLD FOR FLATNESS

- a. Using a precision straightedge and feeler gauge, measure the warpage of the surfaces which contact the cylinder head and intake air surge tank.

*A



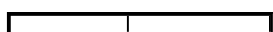
*B



P

Fig. 316: Identifying Intake Manifold Intake Air Surge Side & Cylinder Head Side
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Maximum Warpage



2012 Toyota Tundra

2012 ENGINE Engine Mechanical [1GR-FE] (Service Information) - Tundra

Item	Specified Condition
Intake air surge tank side	0.80 mm (0.0315 in.)
Cylinder head side	0.20 mm (0.00787 in.)

TEXT IN ILLUSTRATION

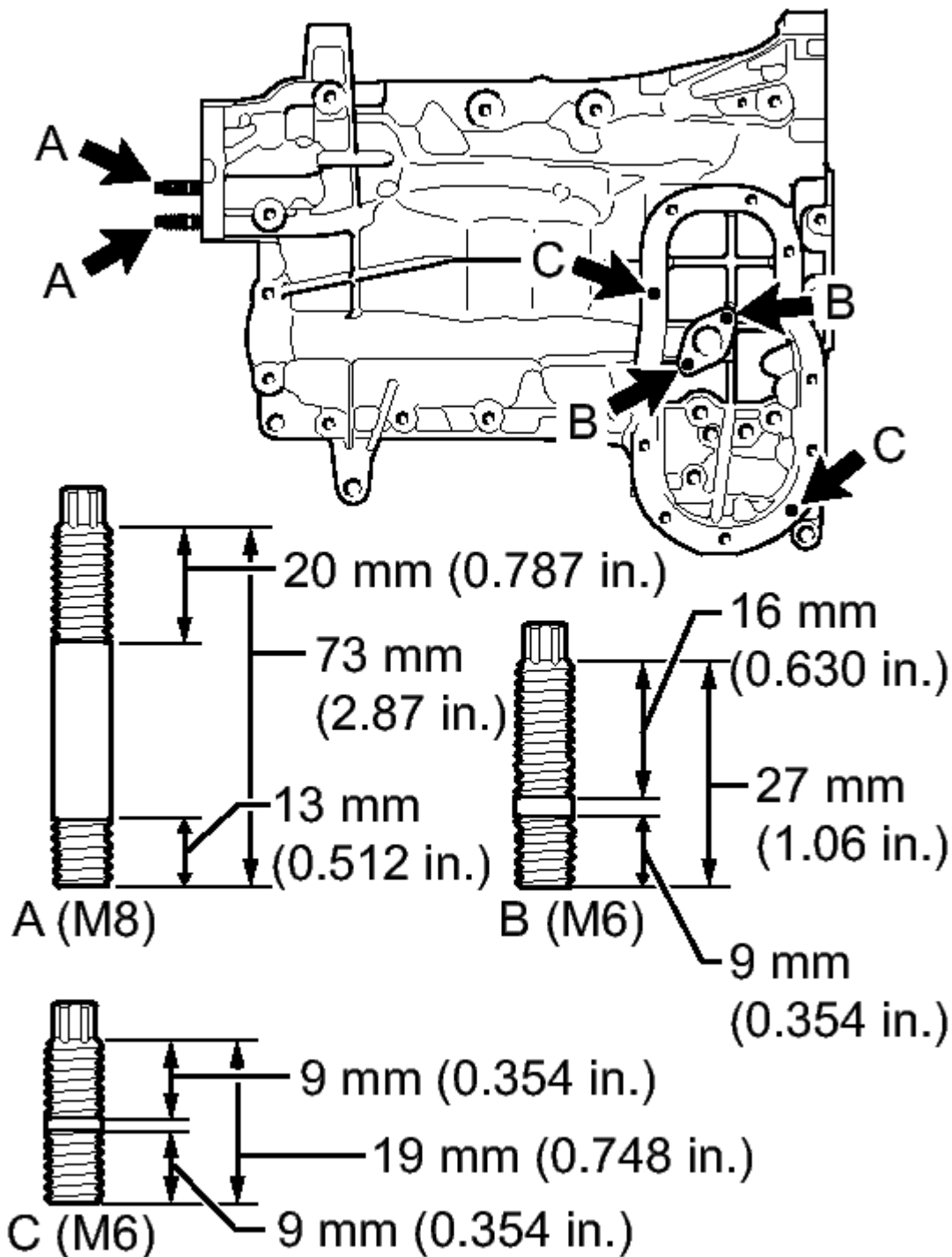
*A	Intake Air Surge Tank Side
*B	Cylinder Head Side

If the warpage is more than the maximum, replace the intake manifold.

REASSEMBLY

REASSEMBLY

1. INSTALL STUD BOLT



P

Fig. 317: Identifying Stud Bolts

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

NOTE: It is not necessary to remove a stud bolt unless it is being replaced.

a. Install the oil pan stud bolt.

1. Using E6 and E8 "TORX" socket wrenches, install the 6 stud bolts as shown in the illustration.

for stud bolt A

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

for stud bolt B and C

Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)

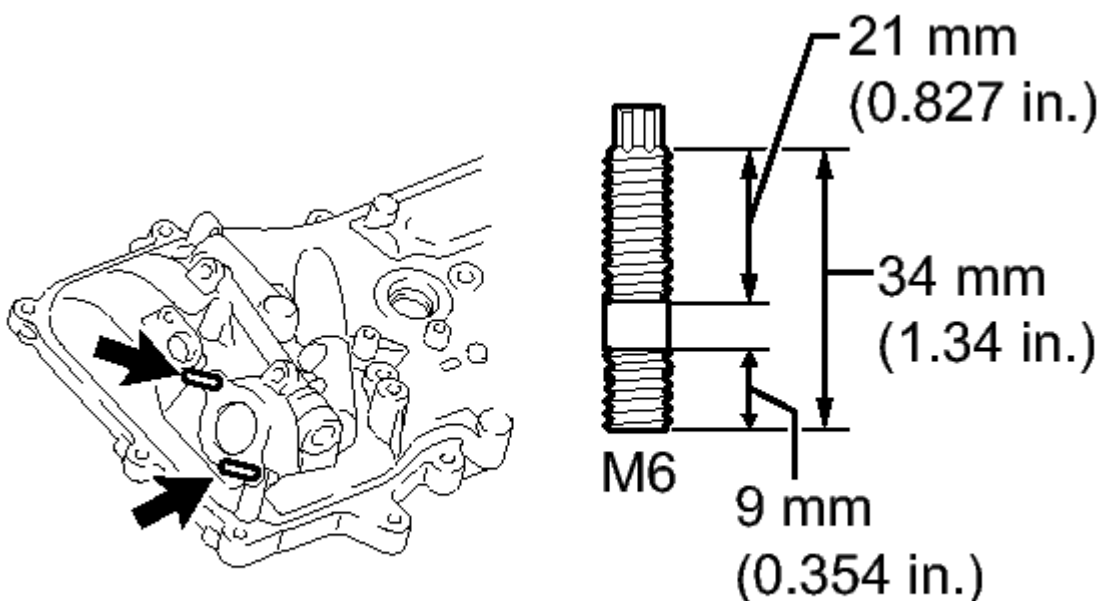


Fig. 318: Identifying Stud Bolts

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

b. Install the cylinder head cover LH stud bolt.

1. Using an E6 "TORX" socket wrench, install the stud bolt as shown in the illustration.

Torque: 4.0 N*m (41 kgf*cm, 35 in.*lbf)

2. INSTALL RING PIN

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

- a. Using a plastic-faced hammer, tap in new ring pins to the camshaft housing.

Standard protrusion height

2.7 to 3.3 mm (0.106 to 0.130 in.)

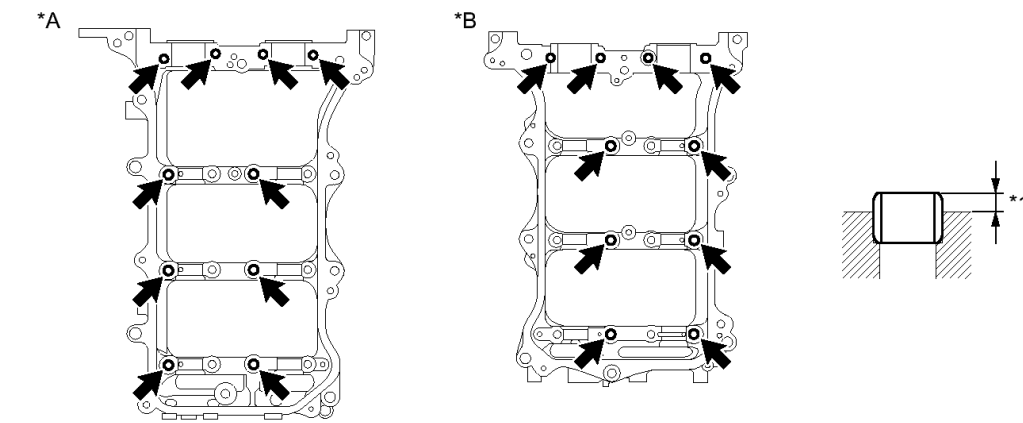


Fig. 319: Identifying Camshaft Housing Ring Pins
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*A	LH	*B	RH
*1	Protrusion Height	-	-

3. INSTALL STRAIGHT PIN

NOTE: It is not necessary to remove a straight pin unless it is being replaced.

- Using a plastic-faced hammer, tap in new straight pins to the camshaft housing.

Standard Protrusion Height

Item	Specified Condition
Ring pin A	7.7 to 8.3 mm (0.303 to 0.327 in.)
Ring pin B	5.7 to 6.3 mm (0.224 to 0.248 in.)

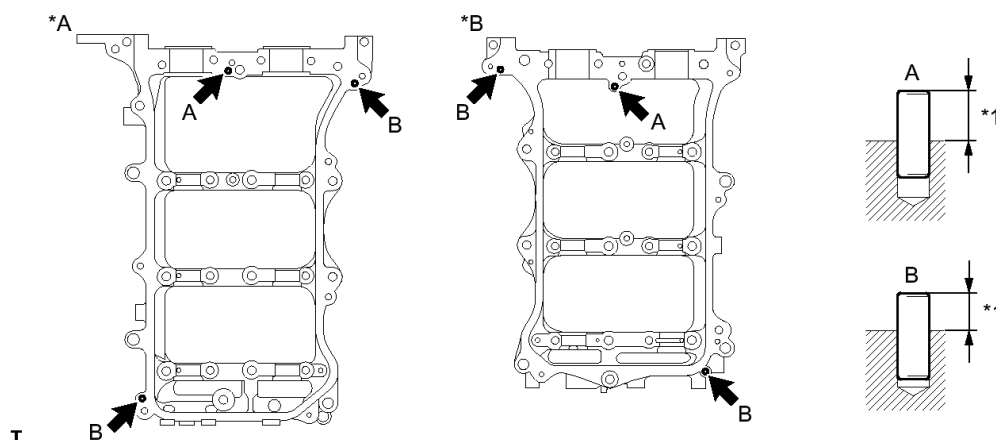


Fig. 320: Identifying Straight Pins Of Camshaft Housing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*A	LH	*B	RH
*1	Protrusion Height	-	-

4. INSTALL REAR CRANKSHAFT OIL SEAL

- a. Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.

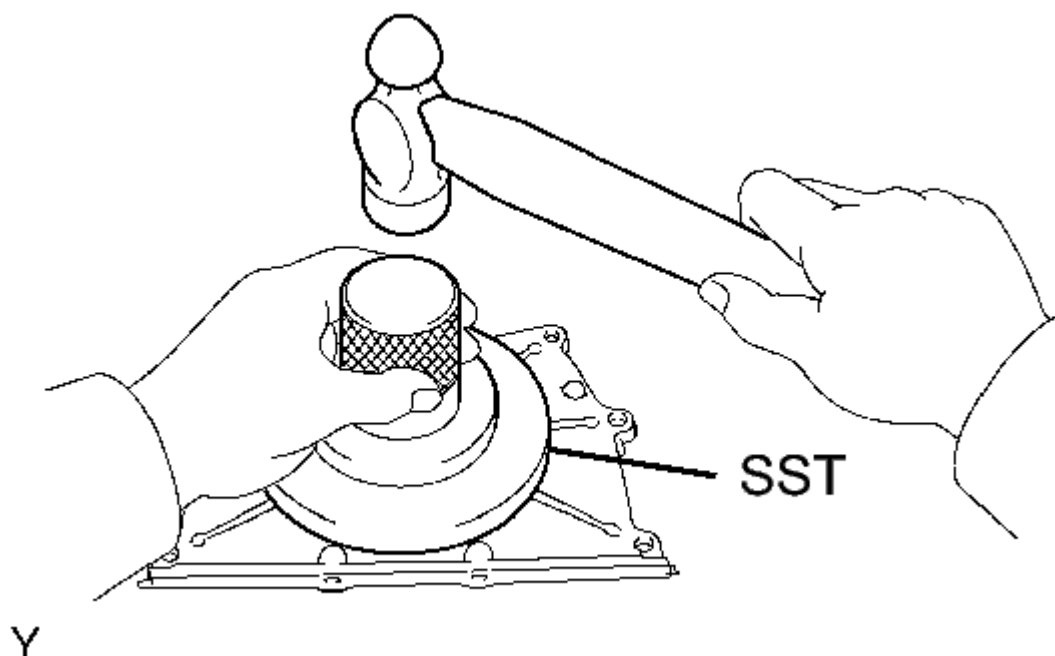


Fig. 321: Identifying Engine Rear Oil Seal
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- SST: 09223-78010

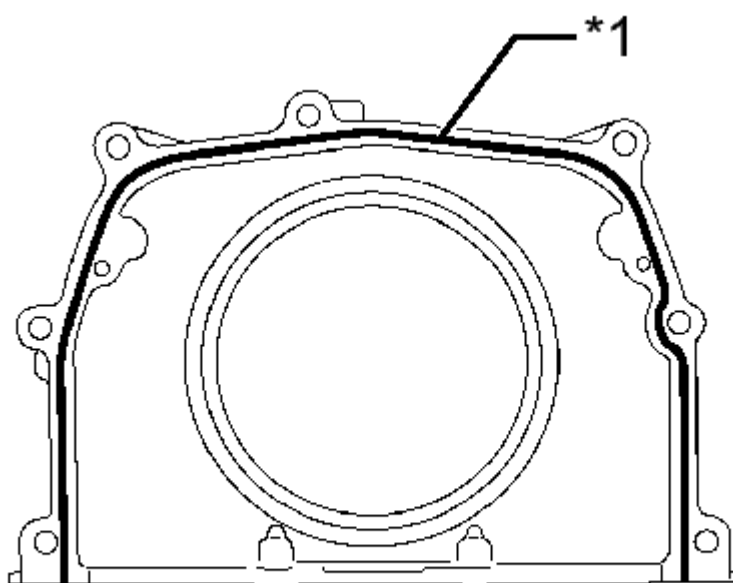
NOTE:

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

- b. Apply MP grease to the lip of the oil seal.

5. INSTALL ENGINE REAR OIL SEAL RETAINER

- a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the oil seal retainer or cylinder block.
- b. Apply seal packing in a continuous line as shown in the illustration.



Y

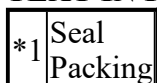
Fig. 322: Identifying Engine Rear Oil Seal Retainer
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing

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

Standard seal diameter

2 to 3 mm (0.0787 to 0.118 in.)

TEXT IN ILLUSTRATION

NOTE:

- Remove any oil from the contact surfaces.
- Install the oil seal retainer within 3 minutes after applying seal packing.

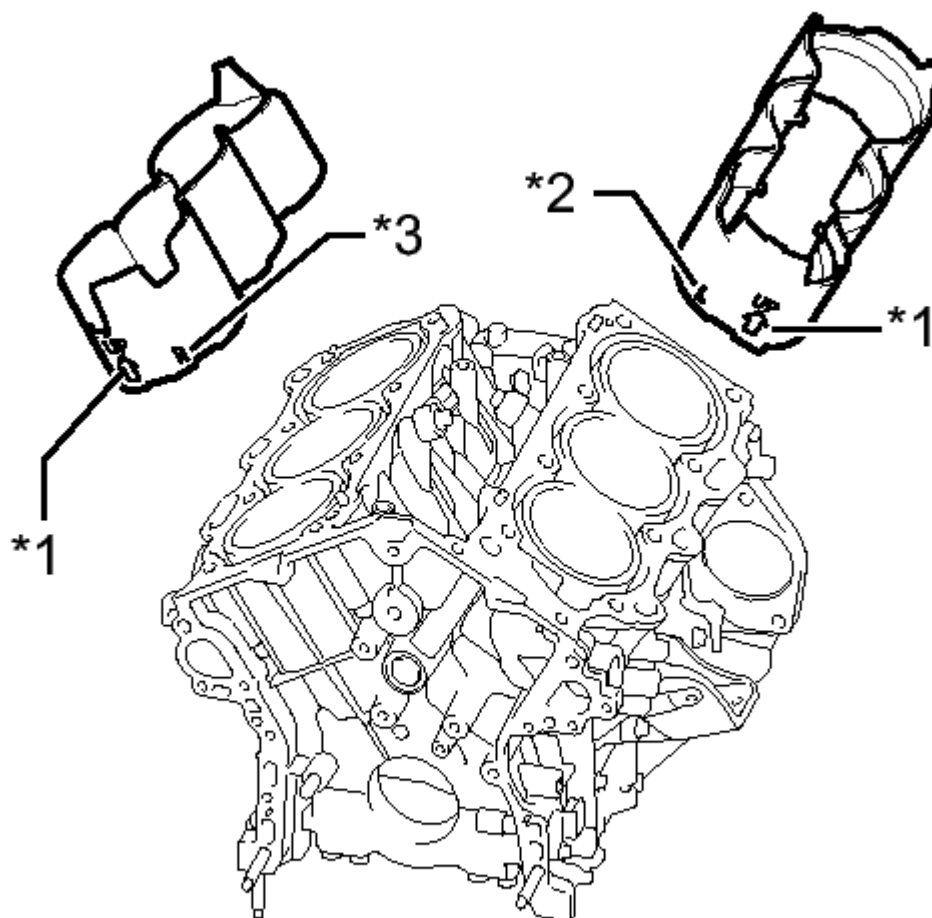
- c. Install the oil seal retainer with the 5 bolts and 2 nuts.

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

NOTE:

- When installing the oil seal retainer, make sure the lip of the oil seal is not damaged.
- When installing the oil seal retainer, make sure the lip of the oil seal is not folded incorrectly.
- Do not start the engine for at least 2 hours after installation.

6. INSTALL CYLINDER BLOCK WATER JACKET SPACER

**T****Fig. 323: Identifying Water Jacket Spacers**

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

- a. Install the 2 water jacket spacers as shown in the illustration.

TEXT IN ILLUSTRATION

*1	UP Mark
*2	L Mark
*3	R Mark

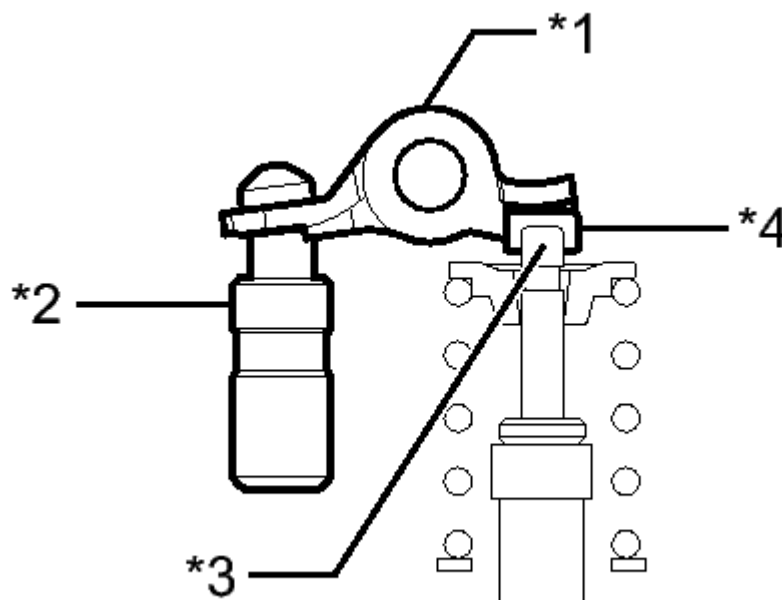
NOTE:

Make sure that face the "L mark", "R mark" and "UP mark" are oriented as shown in the illustration.

7. **INSTALL KNOCK SENSOR** . Refer to **INSTALLATION - Step 1**
8. **INSTALL NO. 1 WATER OUTLET PIPE** . Refer to **INSTALLATION - Step 2**
9. **INSTALL CYLINDER HEAD GASKET** See step 1
10. **INSTALL CYLINDER HEAD SUB-ASSEMBLY** See step 2
11. **INSTALL NO. 2 CYLINDER HEAD GASKET** See step 3
12. **INSTALL CYLINDER HEAD LH** See step 4
13. **INSTALL VALVE STEM CAP**
 - a. Apply a light coat of engine oil to the valve stem caps.
 - b. Install the 24 valve stem caps to the cylinder head.
14. **INSTALL VALVE LASH ADJUSTER ASSEMBLY**
 - a. Inspect the valve lash adjuster. See step 3.
 - b. Install the 24 valve lash adjusters to the cylinder head.

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

15. **INSTALL NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY**
 - a. Apply engine oil to the lash adjuster tips and valve stem cap ends.



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Fig. 324: Identifying No. 1 Valve Rocker Arm Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

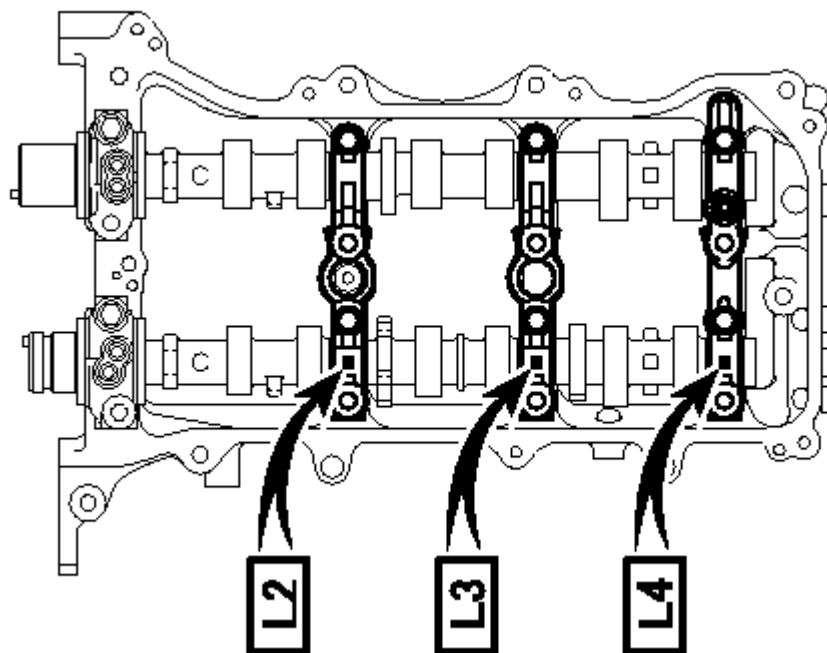
- b. Install the 24 valve rocker arms as shown in the illustration.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
*4	Valve Stem Cap

16. INSTALL CAMSHAFT BEARING CAP (for Bank 2)

- Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.
- Install the No. 3 camshaft and No. 4 camshaft to the camshaft housing.
- Check the marks and numbers on the camshaft bearing caps and place each of them in the proper position facing the proper direction.



P

Fig. 325: Identifying Camshaft Bearing Caps

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

- Temporarily install the 8 bolts in the order shown in the illustration.

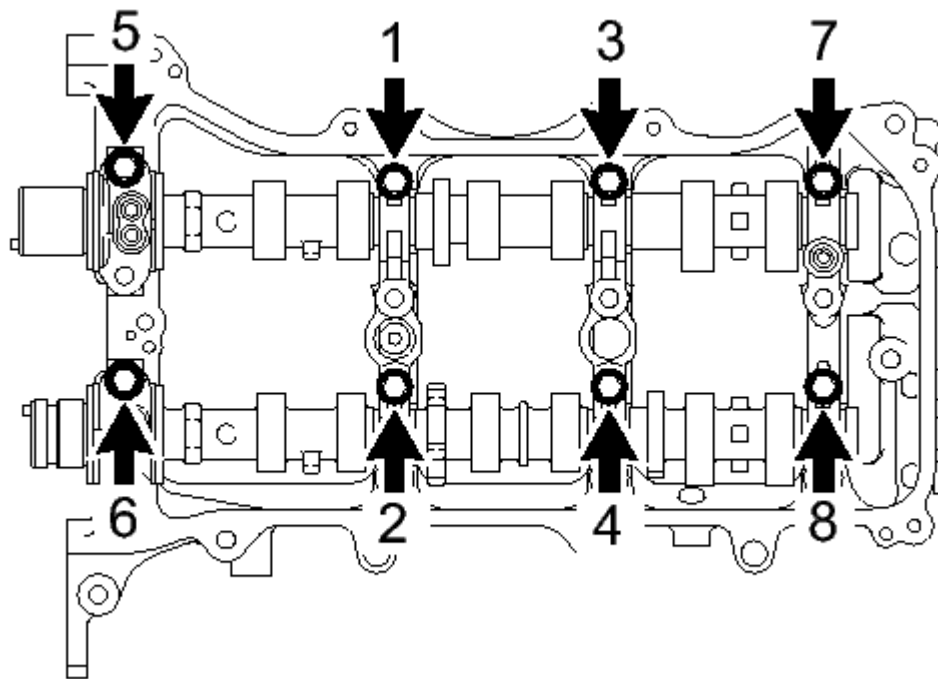
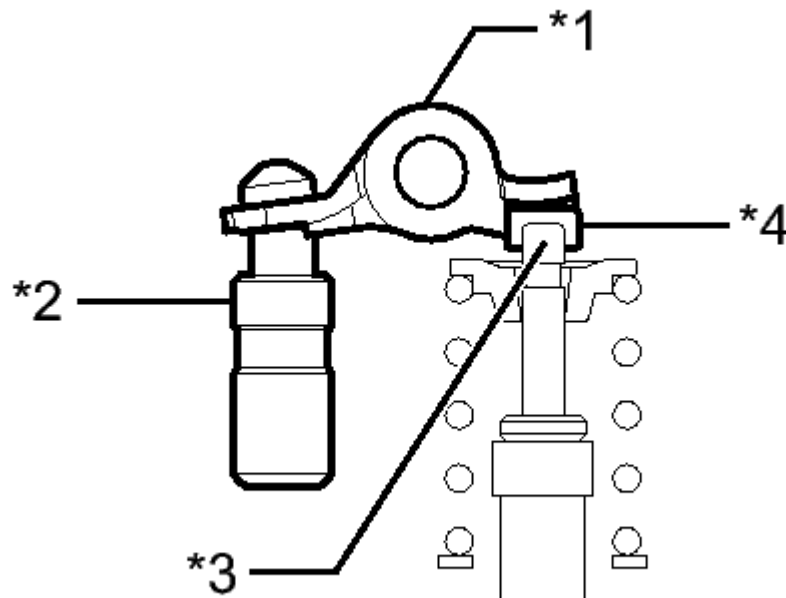
**P**

Fig. 326: Identifying Camshaft Bearing Cap Bolts With Tightening Sequence (Bank 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

17. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH

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



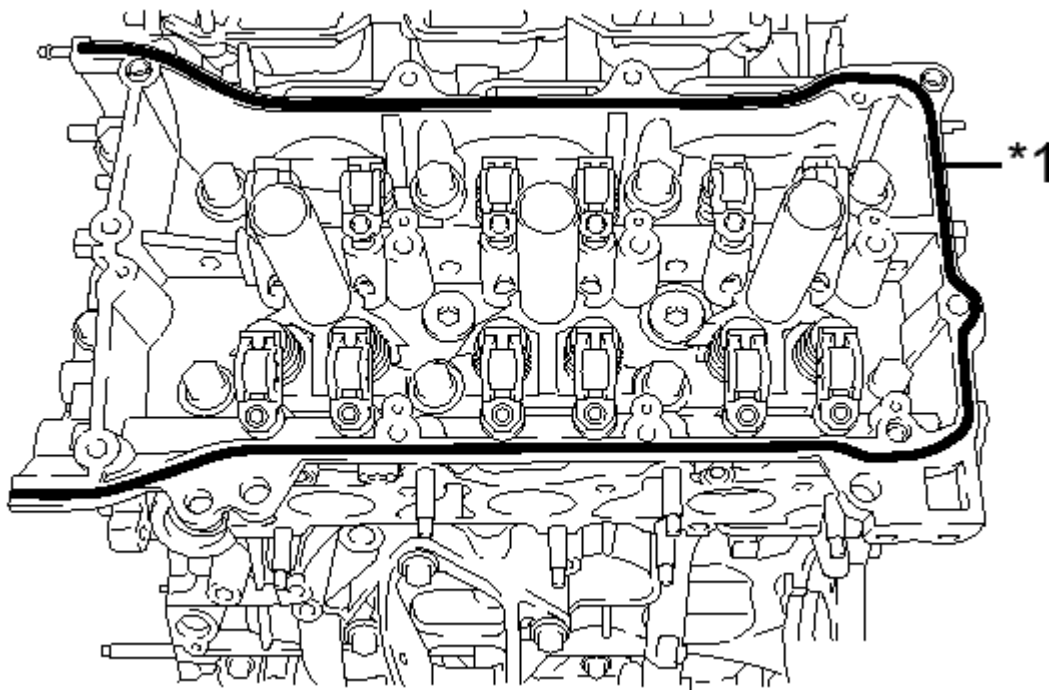
P

Fig. 327: Identifying No. 1 Valve Rocker Arm Sub-Assembly
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
*4	Valve Stem Cap

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



P

Fig. 328: Identifying Seal Packing Application

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

Seal packing

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

Seal diameter

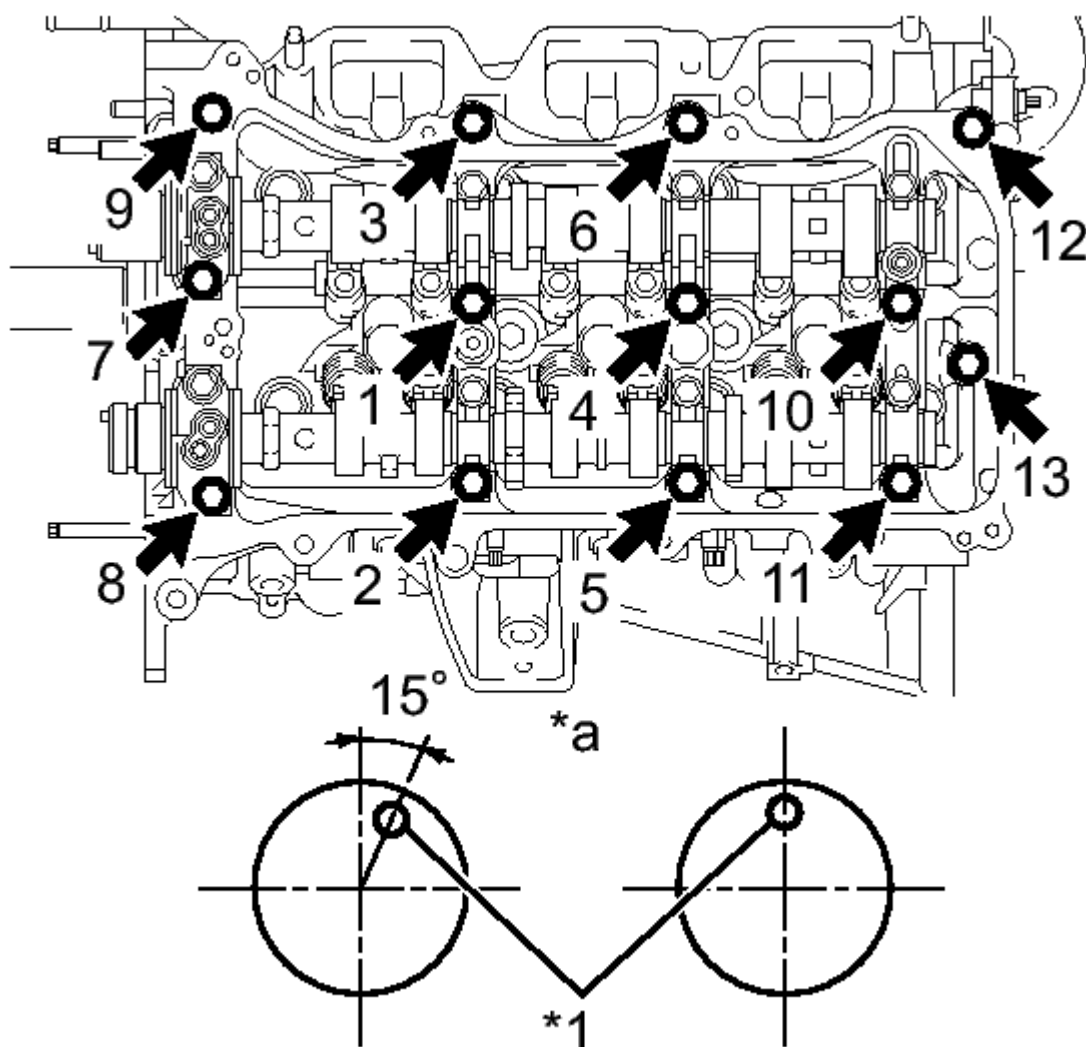
3.5 to 4.5 mm (0.138 to 0.177 in.)

TEXT IN ILLUSTRATION

*1	Seal Packing
----	-----------------

NOTE:

- Remove any oil from the contact surface.
 - Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- c. Install the camshaft housing sub-assembly LH and tighten the 13 bolts in the order shown in the illustration.



P

Fig. 329: Identifying Camshaft Housing Sub-Assembly Bolts With Tightening Sequence
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*1	Knock Pin
*a	Front View

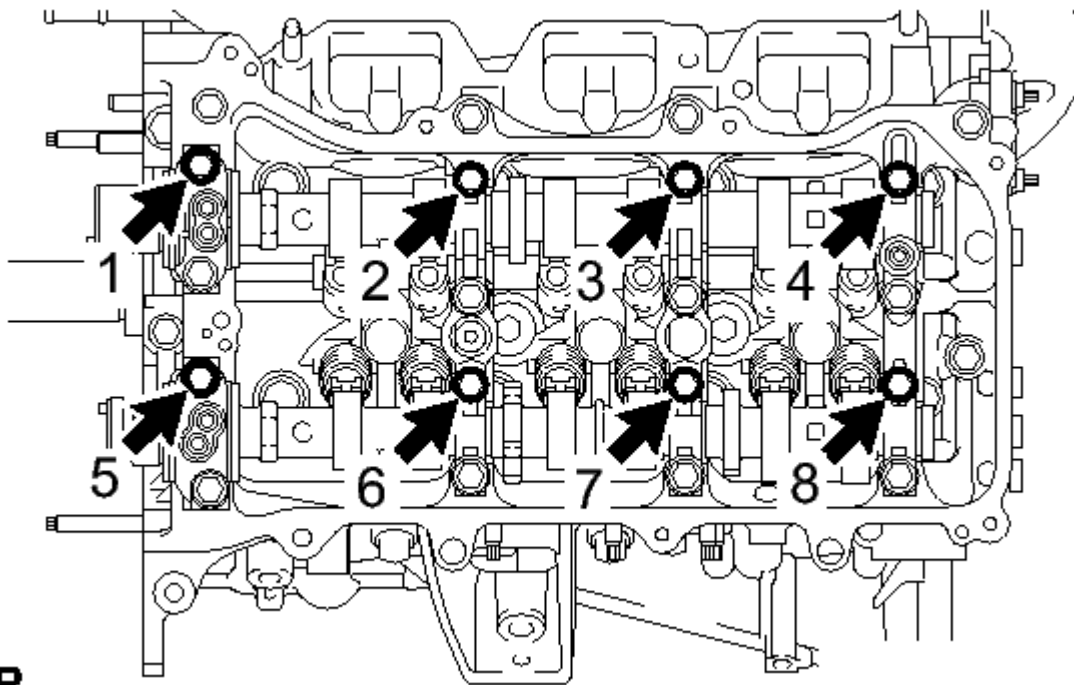
NOTE:

- When installing the camshaft housing sub-assembly LH, it is necessary to correctly position the camshafts as shown in the illustration. Failure to correctly position these parts may result in damage due to contact between the pistons and valves. If a

camshaft is rotated with a piston at TDC, valve contact will occur.

- If any of the bolts are loosened during installation, remove the camshaft housing sub-assembly LH, clean the installation surfaces and reapply seal packing.
- If the camshaft housing sub-assembly LH is removed because any of the bolts are loosened during installation, make sure that the previously applied seal packing does not enter any oil passages.
- Do not start the engine for at least 2 hours after installing.

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



P

Fig. 330: Identifying Bolts With Tightening Sequence

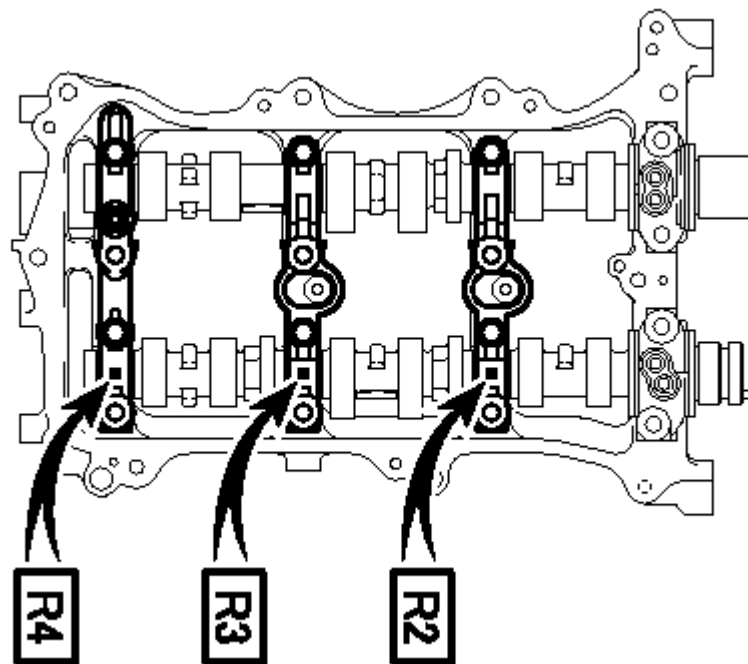
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

NOTE: Thoroughly wipe clean any seal packing.

18. INSTALL CAMSHAFT BEARING CAP (for Bank 1)

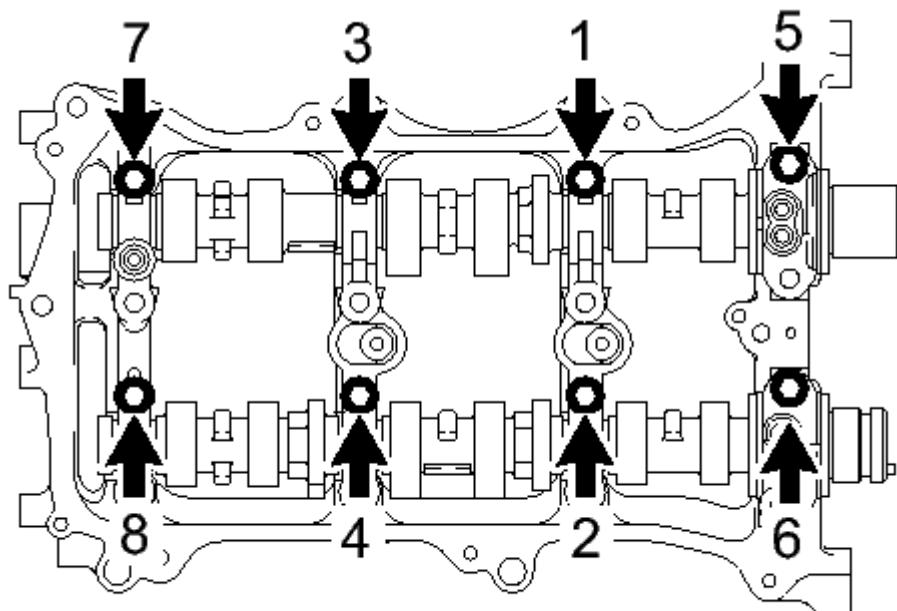
- Apply a light coat of engine oil to the camshaft journals, camshaft housings and bearing caps.
- Install the camshaft and No. 2 camshaft to the camshaft housing.
- Check the marks and numbers on the camshaft bearing caps and place each of them in the proper position facing the proper direction.



P

Fig. 331: Identifying Camshaft Bearing Cap Marks And Numbers (Bank 1)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- d. Temporarily install the 8 bearing cap bolts in the order shown in the illustration.



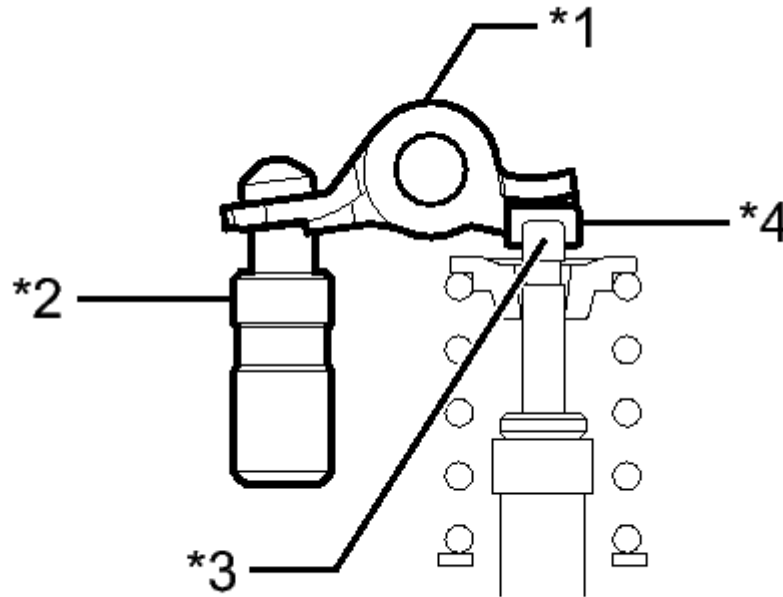
P

Fig. 332: Identifying Bearing Cap Bolts With Tightening Sequence
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

19. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH

- a. Make sure that the No. 1 valve rocker arm sub-assembly is installed as shown in the illustration.



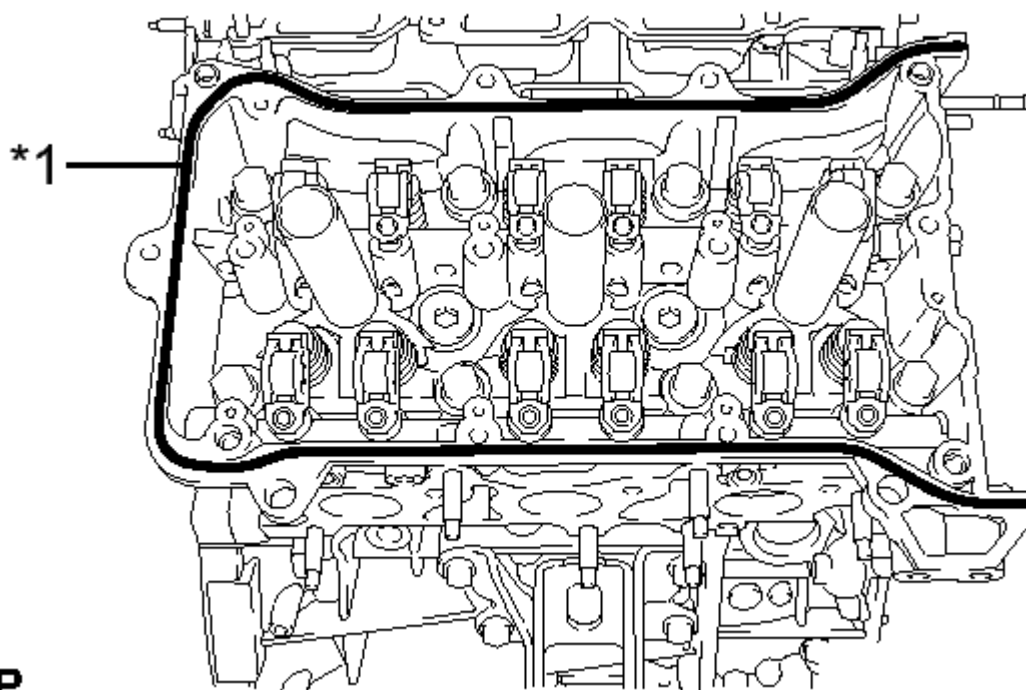
P

Fig. 333: Identifying No. 1 Valve Rocker Arm Sub-Assembly
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Valve Rocker Arm
*2	Lash Adjuster
*3	Valve Stem
*4	Valve Stem Cap

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

**P****Fig. 334: Identifying Seal Packing Application**

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

Seal packing

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

Seal diameter

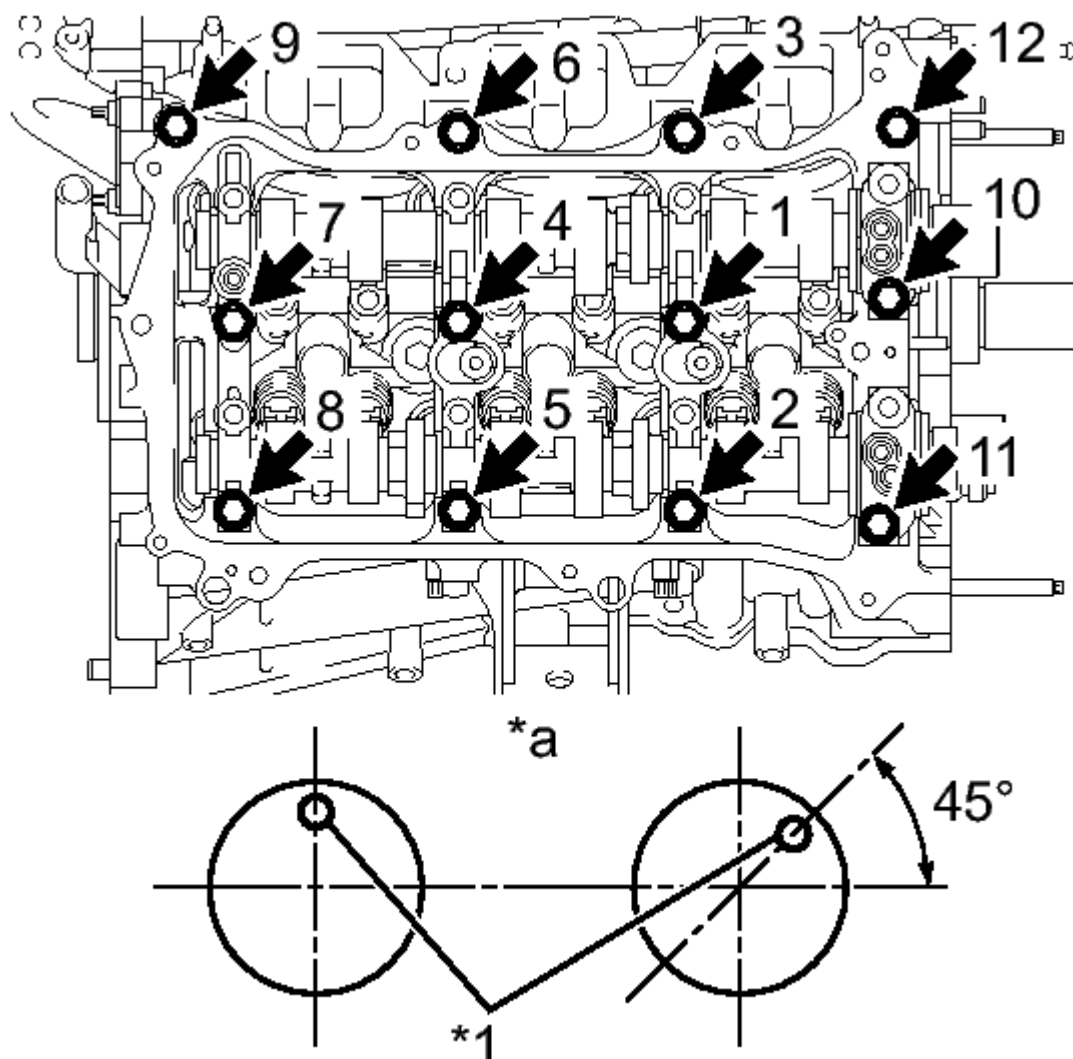
3.5 to 4.5 mm (0.138 to 0.177 in.)

TEXT IN ILLUSTRATION

*1	Seal Packing
----	-----------------

NOTE:

- Remove any oil from the contact surface.
 - Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- c. Install the camshaft housing sub-assembly RH and tighten the 12 bolts in the order shown in the illustration.



P

Fig. 335: Identifying Camshaft Housing Sub-Assembly Bolts With Tightening Sequence
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*1	Knock Pin
*a	Front View

NOTE:

- When installing the camshaft housing RH, it is necessary to correctly position the camshafts as shown in the illustration.

Failure to correctly position these parts may result in damage

due to contact between the pistons and valves. If a camshaft is rotated with a piston at TDC, valve contact will occur.

- If any of the bolts are loosened during installation, remove the camshaft housing sub-assembly RH, clean the installation surfaces and reapply seal packing.
- If the camshaft housing sub-assembly RH is removed because any of the bolts are loosened during installation, make sure that the previously applied seal packing does not enter any oil passages.
- Do not start the engine for at least 2 hours after installing.

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

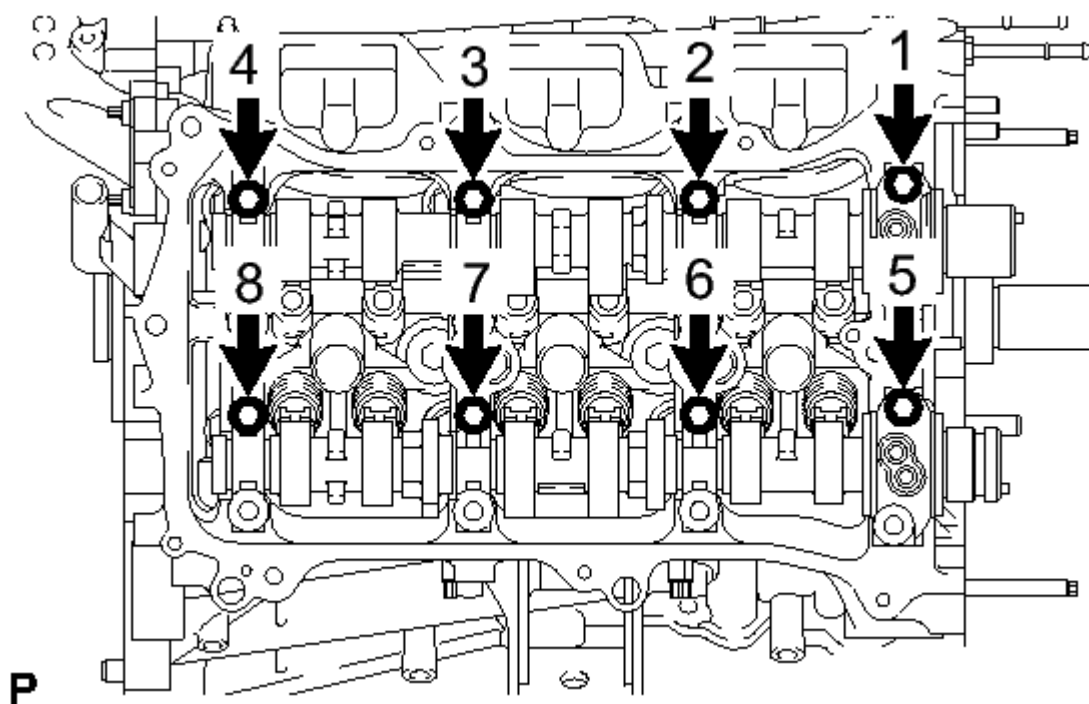


Fig. 336: Identifying Bolts With Tightening Sequence
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

NOTE: Thoroughly wipe clean any seal packing.

20. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY (for Bank 2)

- a. Install the No. 3 chain tensioner assembly with the bolt.

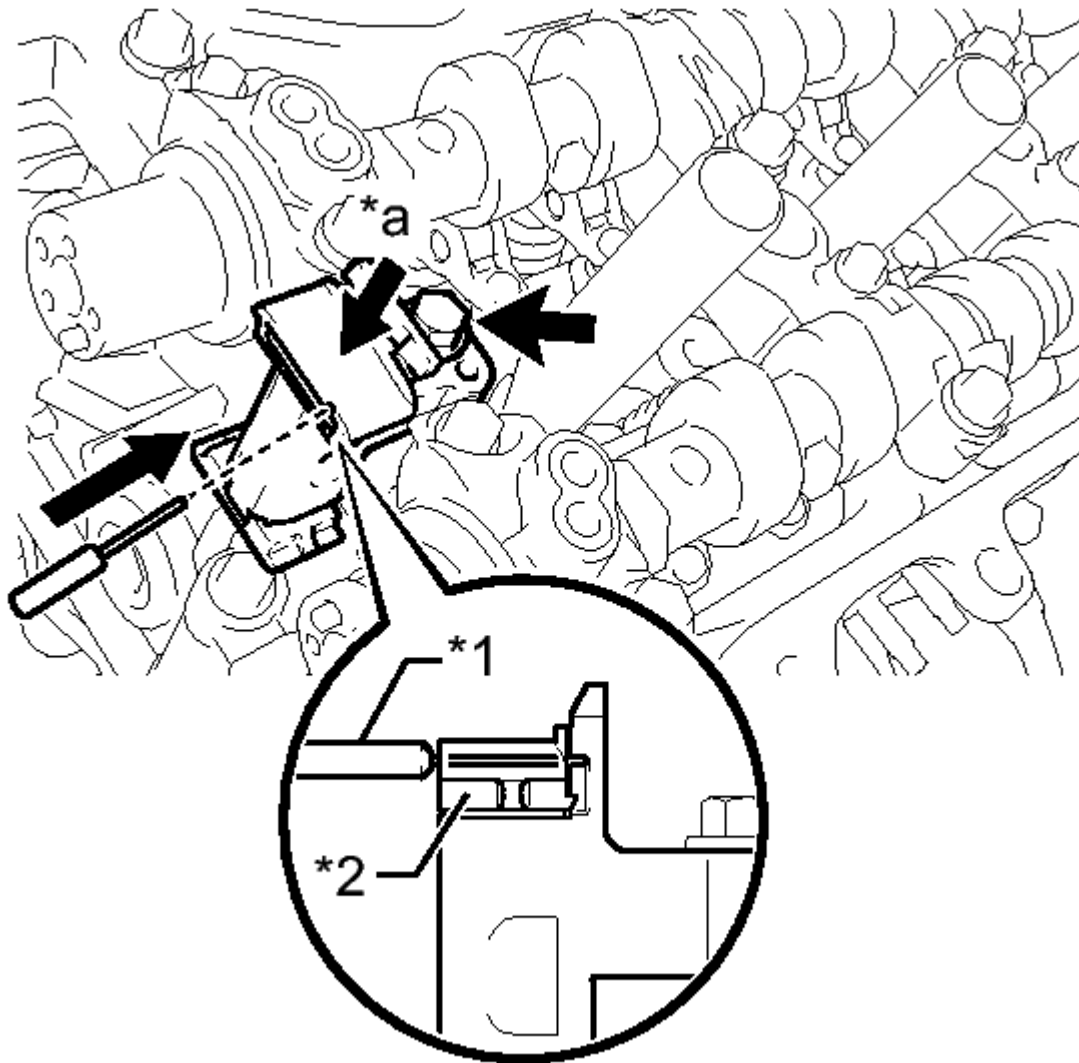


Fig. 337: Identifying No. 3 Chain Tensioner Assembly And Bolt (Bank 2)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

- b. Push in the tensioner and insert a pin with a diameter of 1.0 mm (0.0394 in.) into the hole to hold the tensioner.

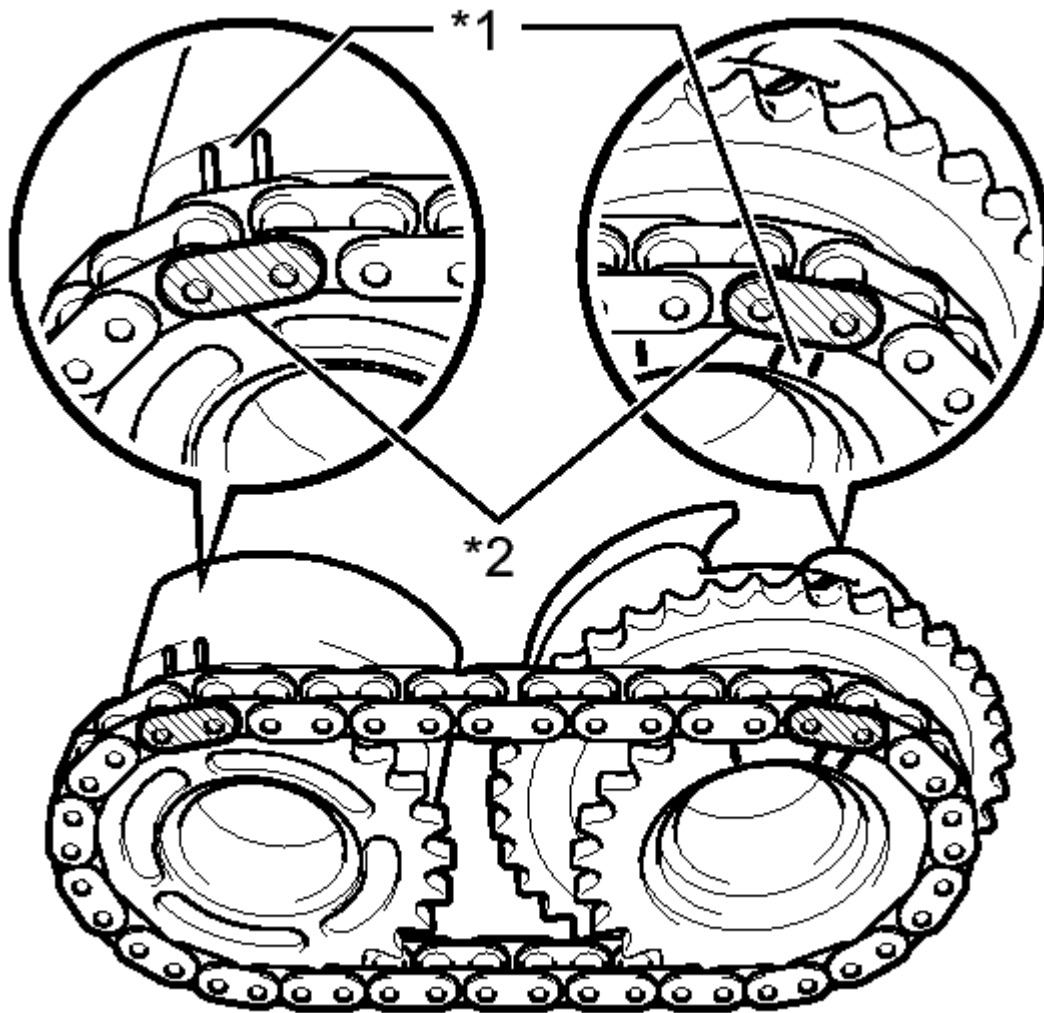
TEXT IN ILLUSTRATION

*1	Pin
*2	Plunger
*a	Push

21. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)

- a. Align the mark plates (yellow) with the timing marks of the camshaft timing gear assemblies as

shown in the illustration.



P

Fig. 338: Identifying Camshaft Timing Gears And No. 2 Chain (Bank 2)

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

TEXT IN ILLUSTRATION

*1	Timing Mark
*2	Mark Plate

- Apply a light coat of engine oil to the bolt threads and bolt-seating surface.
- Align the knock pin of the camshaft with the pin hole of the camshaft timing gear assembly. Install the camshaft timing gear assembly and camshaft timing exhaust gear LH with the No. 2 chain sub-assembly installed.

- d. Using SST to hold the hexagonal portion of each camshaft, tighten the bolts of the camshaft timing gear assembly and camshaft timing exhaust gear assembly.
- SST: 09922-10010

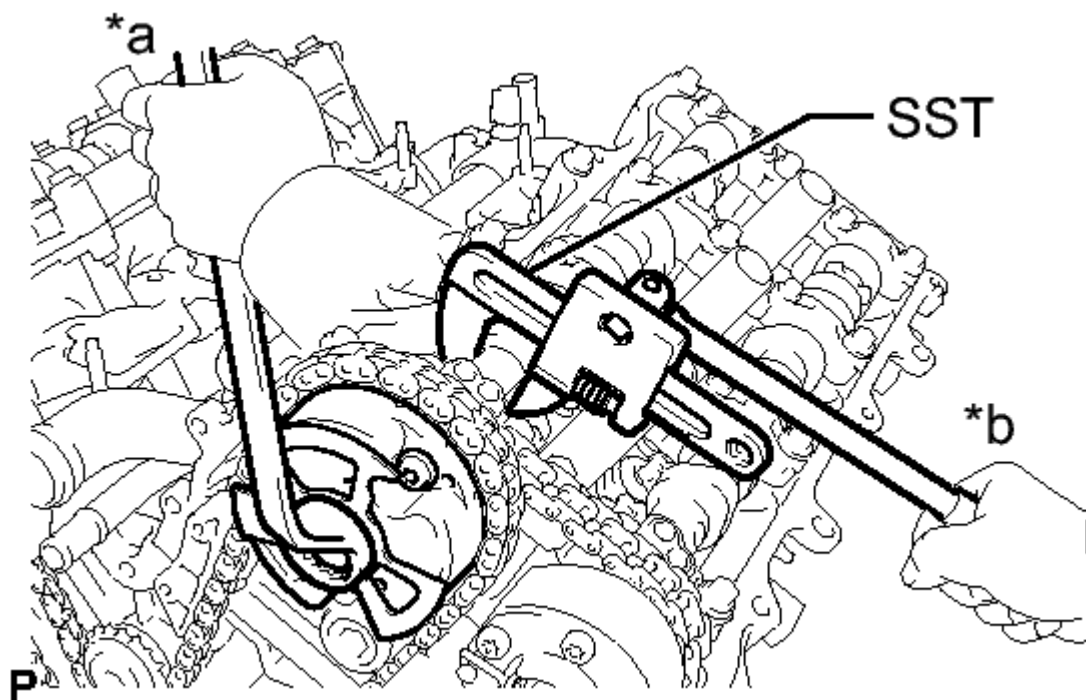


Fig. 339: Remove/Install Camshaft Timing Gear Assembly Using SST
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*a	Turn
*b	Hold

- e. Remove the pin from the No. 3 chain tensioner assembly.
- 22. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY (for Bank 1)**
- a. Install the No. 2 chain tensioner assembly with the bolt.

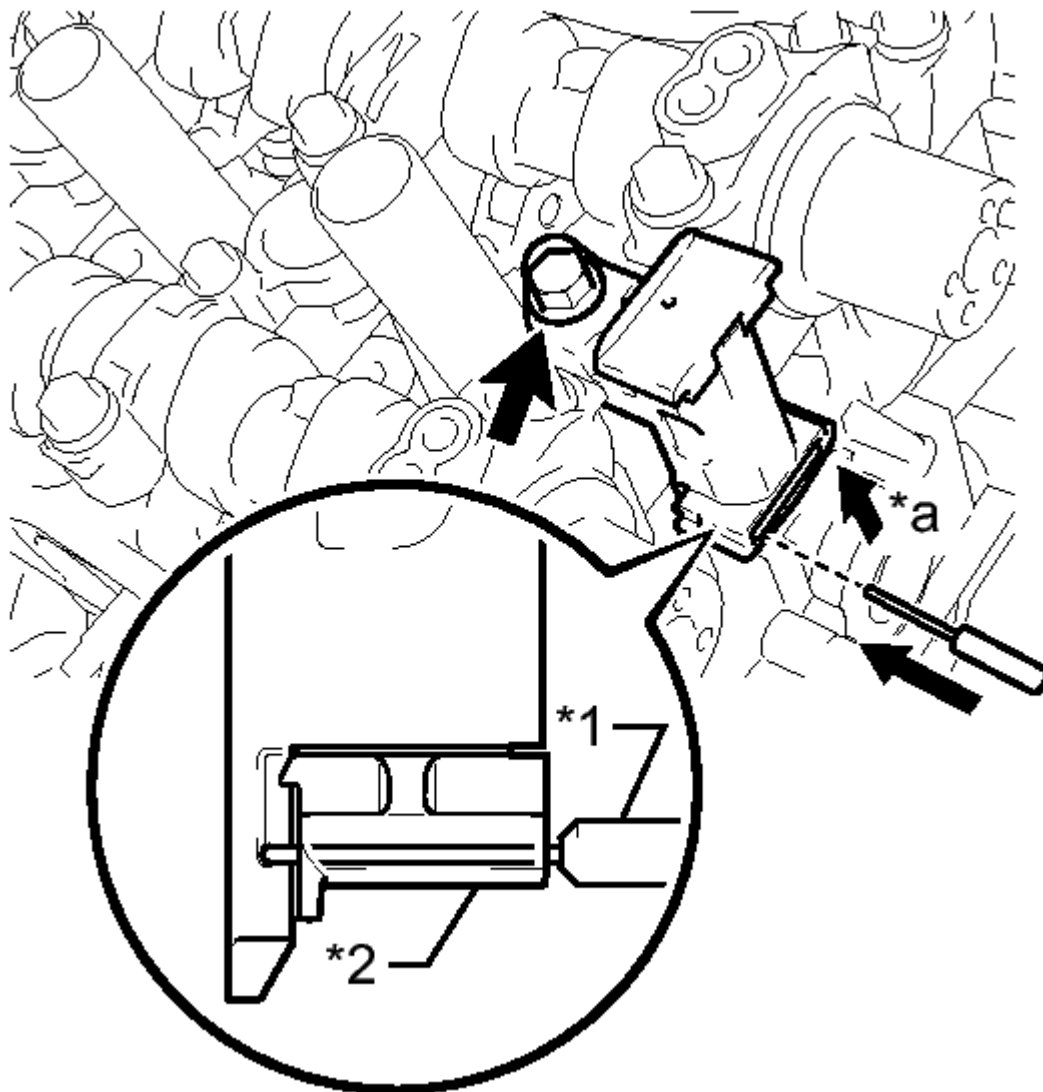
**P**

Fig. 340: Identifying No. 2 Chain Tensioner Assembly And Bolt (Bank 1)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

- b. Push in the No. 2 chain tensioner assembly and insert a pin with a diameter of 1.0 mm (0.0394 in.) into the hole to hold the tensioner.

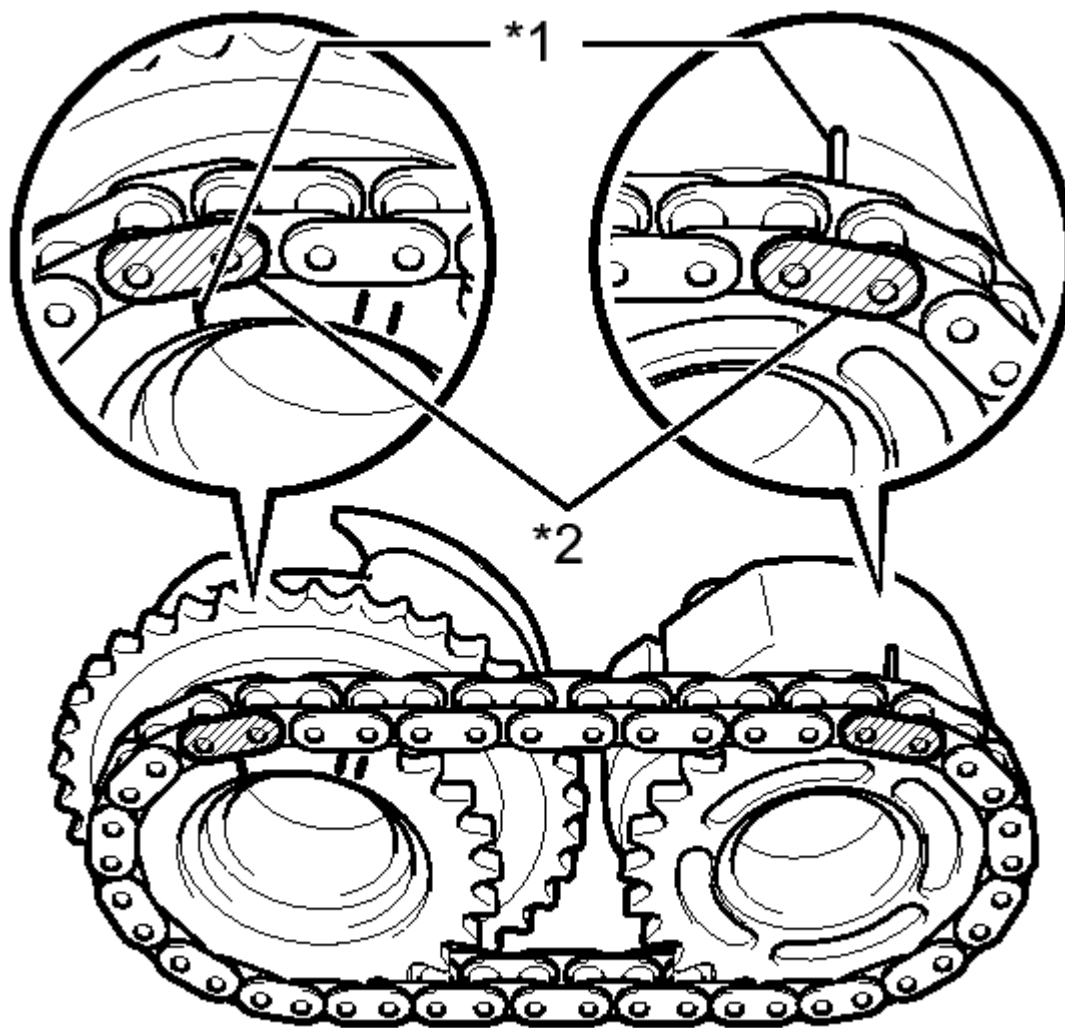
TEXT IN ILLUSTRATION

*1	Pin
*2	Plunger
*a	Push

23. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

- a. Align the mark plates (yellow) with the timing marks of the camshaft timing gear assemblies as

shown in the illustration.



P

Fig. 341: Identifying Camshaft Timing Gears And No. 2 Chain (Bank 1)

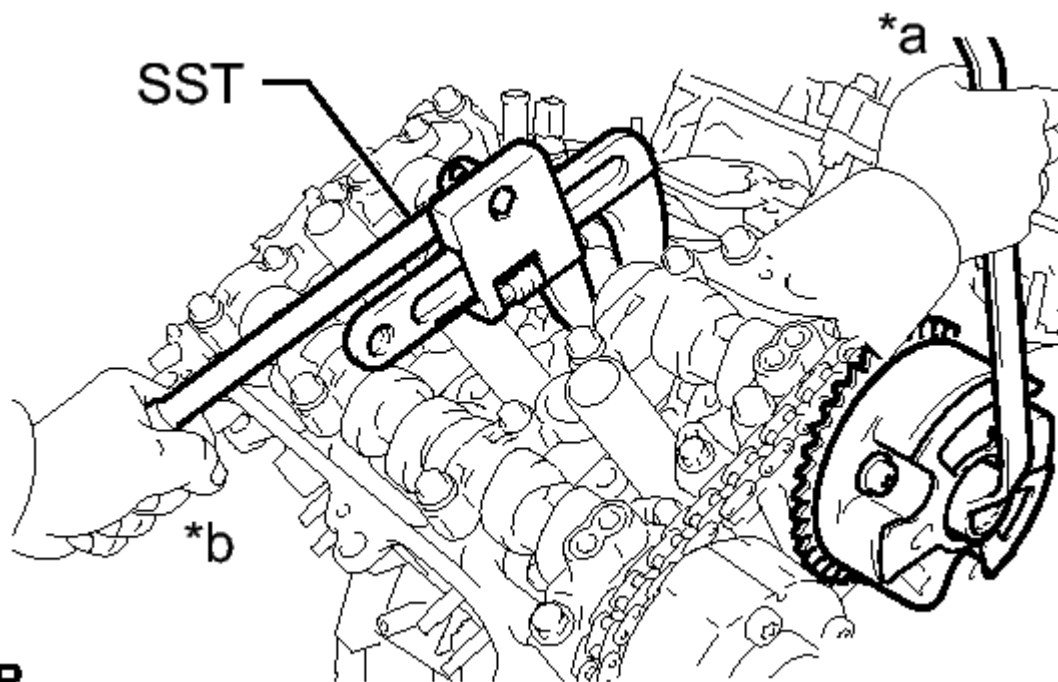
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Timing Mark
*2	Mark Plate

- Apply a light coat of engine oil to the bolt threads and bolt-seating surface.
- Align the knock pin of the camshaft with the pin hole of the camshaft timing gear assembly. Install the camshaft timing gear assembly and camshaft timing exhaust gear assembly with the No. 2 chain sub-assembly installed.

- d. Using SST to hold the hexagonal portion of each camshaft, tighten the bolts of the camshaft timing gear assembly and camshaft timing exhaust gear assembly.
 - SST: 09922-10010



P

Fig. 342: Remove/Install Camshaft Timing Gear Assembly Using SST
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*a	Turn
*b	Hold

- e. Remove the pin from the No. 2 chain tensioner assembly.
24. **INSTALL NO. 1 CHAIN VIBRATION DAMPER**
 - a. Install the No. 1 chain vibration damper with the 2 bolts.

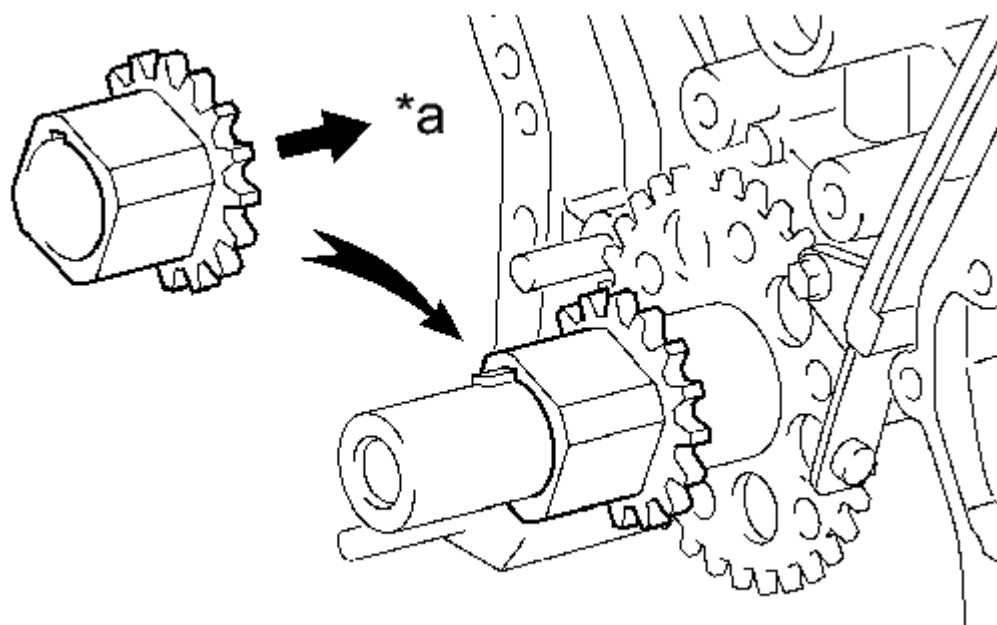
Torque: 23 N*m (229 kgf*cm, 17 ft.*lbf)

25. **INSTALL NO. 2 CHAIN VIBRATION DAMPER**

- a. Install the 2 No. 2 chain vibration dampers.

26. **INSTALL CRANKSHAFT TIMING SPROCKET**

- a. Align the key groove of the timing sprocket with the timing sprocket set key.



Y

Fig. 343: Identifying Crankshaft Timing Sprocket

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

- b. Install the timing sprocket to the crankshaft with the sprocket facing inward as shown in the illustration.

TEXT IN ILLUSTRATION

*a	Inward
----	--------

27. INSTALL NO. 1 IDLE GEAR SHAFT

- a. Apply a light coat of engine oil to the sliding surface of the No. 1 idle gear shaft.
- b. Temporarily install the No. 1 idle gear shaft and No. 1 idle gear with the No. 2 idle gear shaft while aligning the knock pin of the No. 1 idle gear shaft with the knock pin groove of the cylinder block.

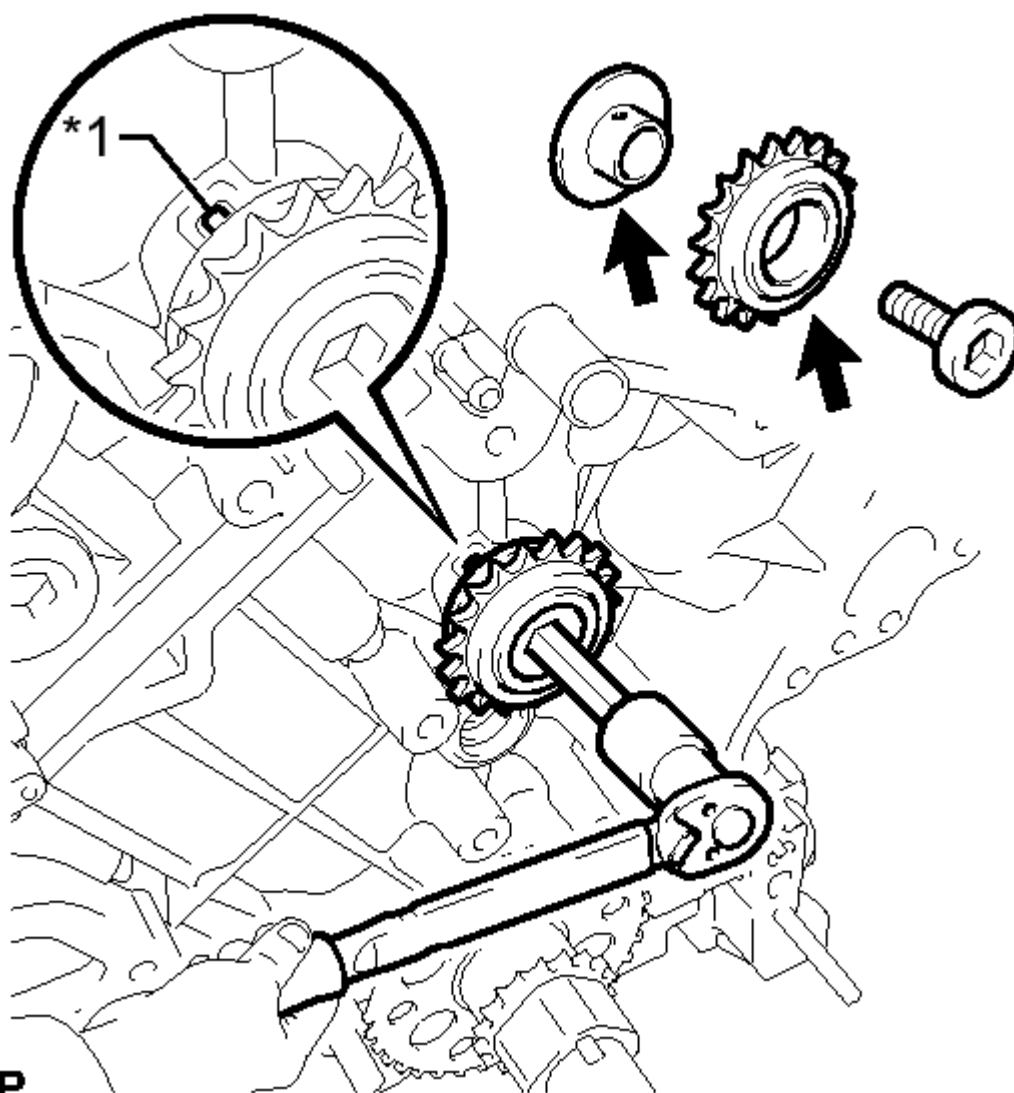
**P**

Fig. 344: Identifying No. 1 Idle Gear Shaft And Knock Pin
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Knock Pin
----	--------------

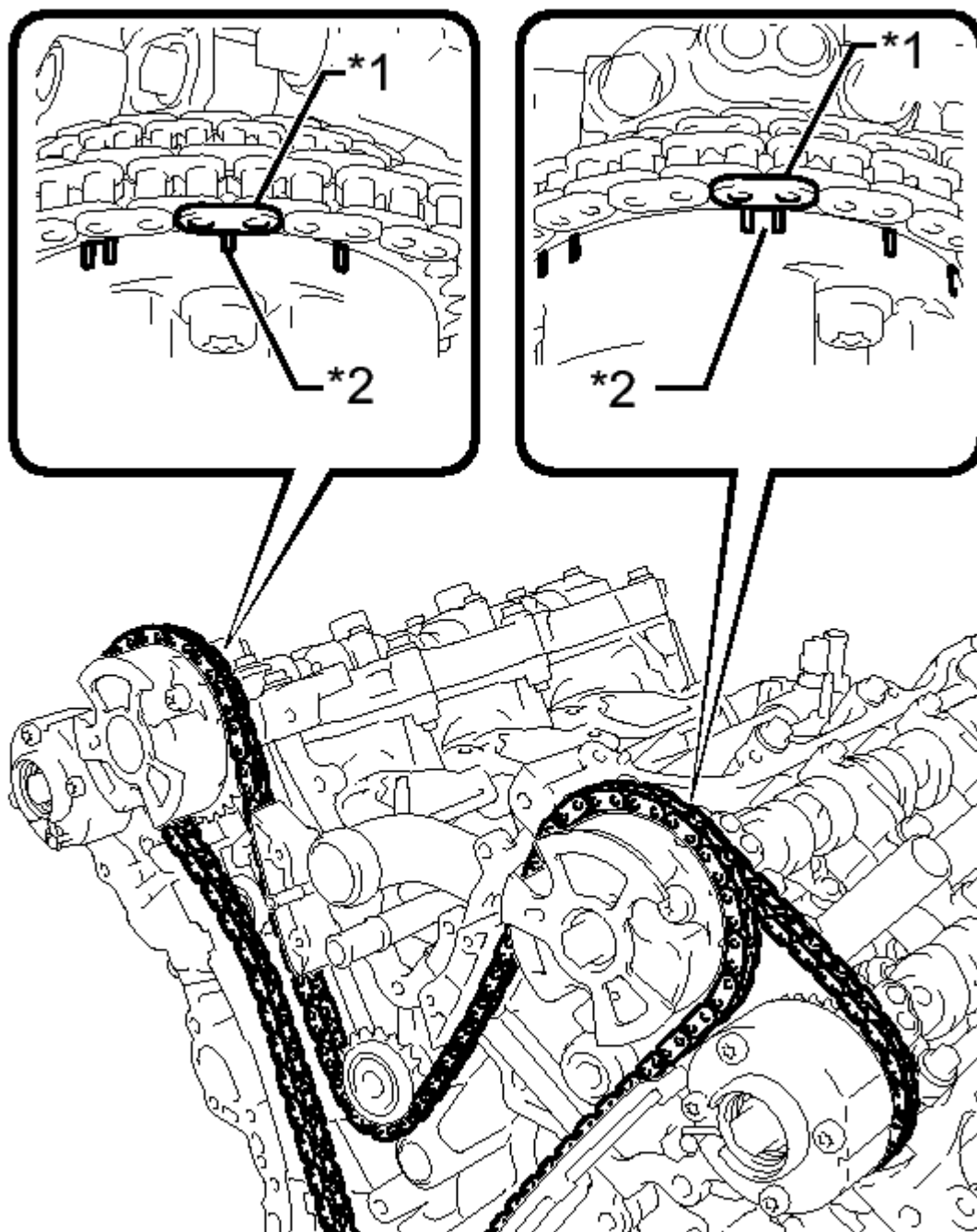
NOTE: Make sure that the idle gear is installed facing the proper direction.

- c. Using a 10 mm hexagon wrench, tighten the No. 2 idle gear shaft.

Torque: 60 N*m (612 kgf*cm, 44 ft.*lbf)

28. INSTALL NO. 1 CHAIN SUB-ASSEMBLY

- a. Align the mark plate and timing marks as shown in the illustration and install the chain.



P

Fig. 345: Identifying Alignment Of Mark Plate, Timing Marks And Chain
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

Mark

*1	Plate
*2	Timing Mark

HINT:

The camshaft mark plates are orange.

- b. Do not pass the chain around the crankshaft, just temporarily place it on the crankshaft.

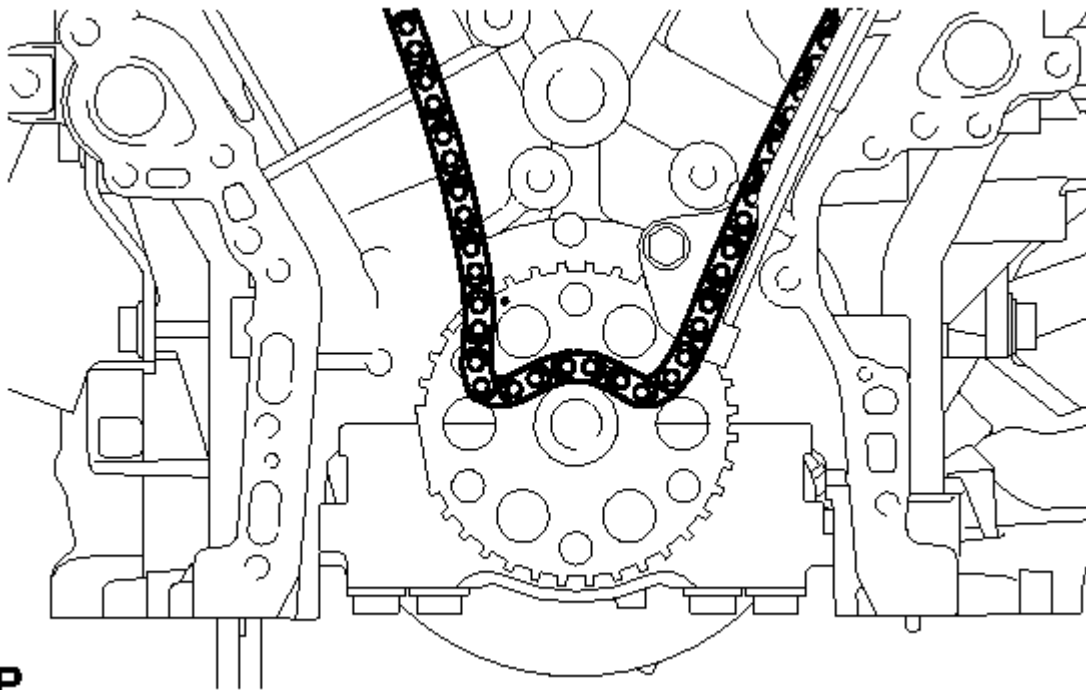
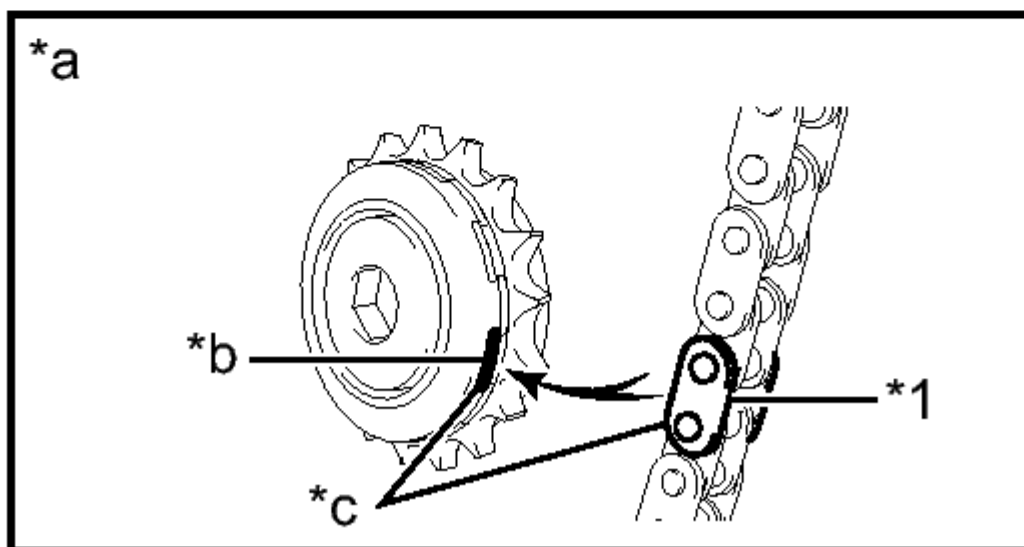
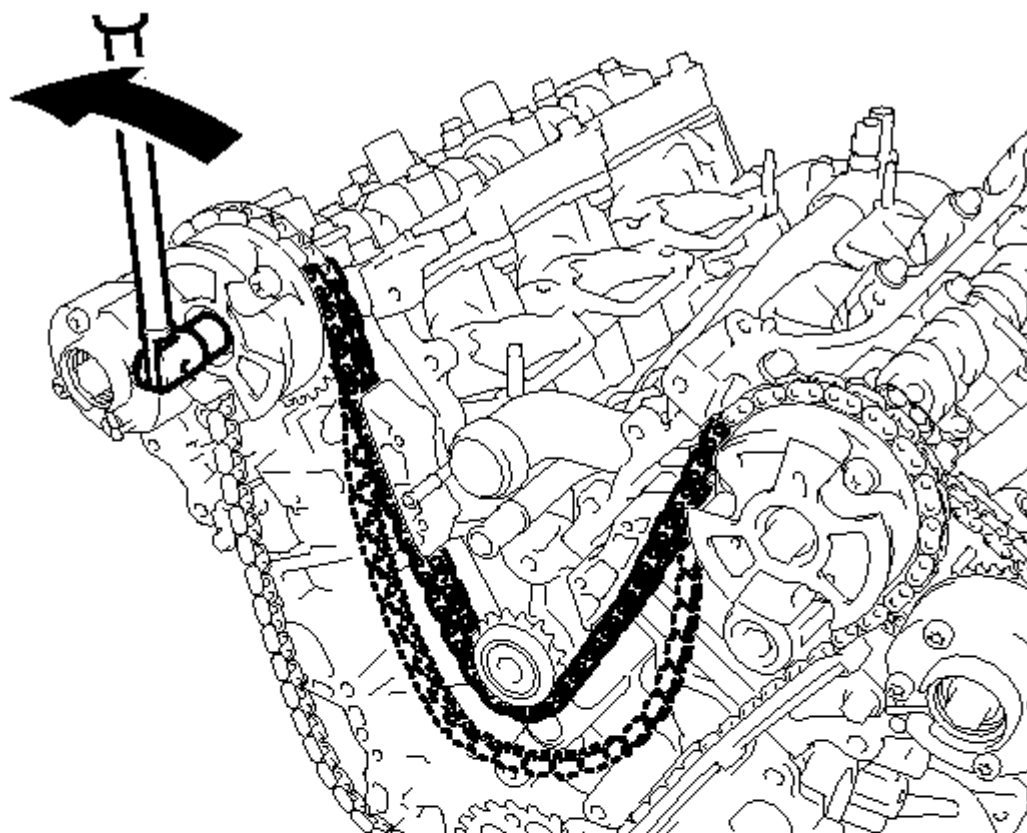
**P**

Fig. 346: Remove/Install Crankshaft Timing Sprocket And Chain
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

- c. Turn the camshaft timing gear assembly on bank 1 counterclockwise to tighten the chain between the banks.



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Fig. 347: Turning Bank 1 Camshaft Timing Gear Assembly Counterclockwise To Tighten Chain Between Banks

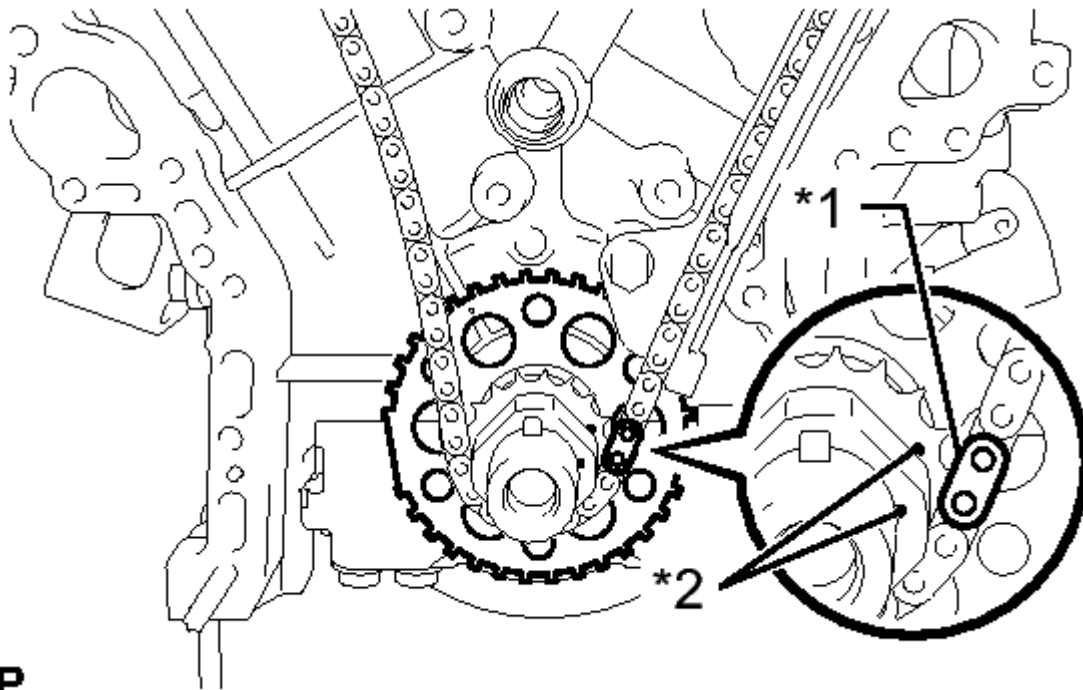
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Chain Plate
*a	When idle sprocket is reused
*b	Mark
*c	Align
·	Turn

NOTE: When the idle sprocket assembly is reused, align the chain plate with the mark where the plate had been when tightening the chain between the banks.

- d. Align the mark plate and timing marks as shown in the illustration and install the chain to the crankshaft timing sprocket.



P

Fig. 348: Aligning Mark Plate And Timing Marks
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

*1	Mark Plate
*2	Timing Mark

HINT:

The crankshaft mark plate is yellow.

- e. Temporarily install the pulley set bolt.
- f. Turn the crankshaft clockwise to set it to the RH block bore center line (TDC/compression).

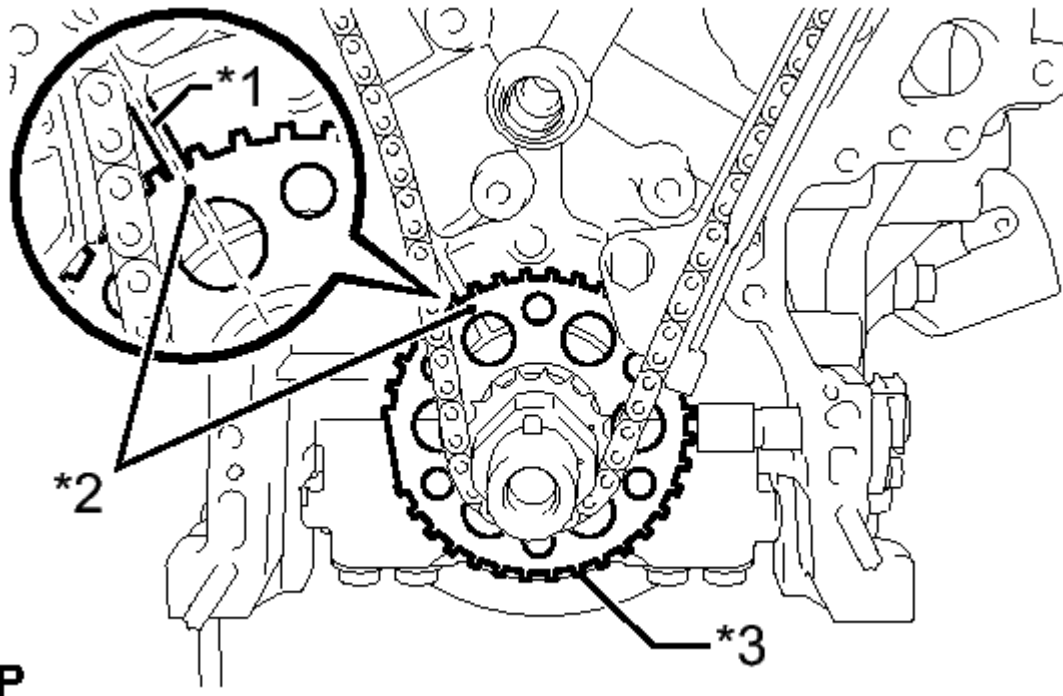
**P**

Fig. 349: Identifying RH Block Bore Center Line (TDC/Compression)
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

TEXT IN ILLUSTRATION

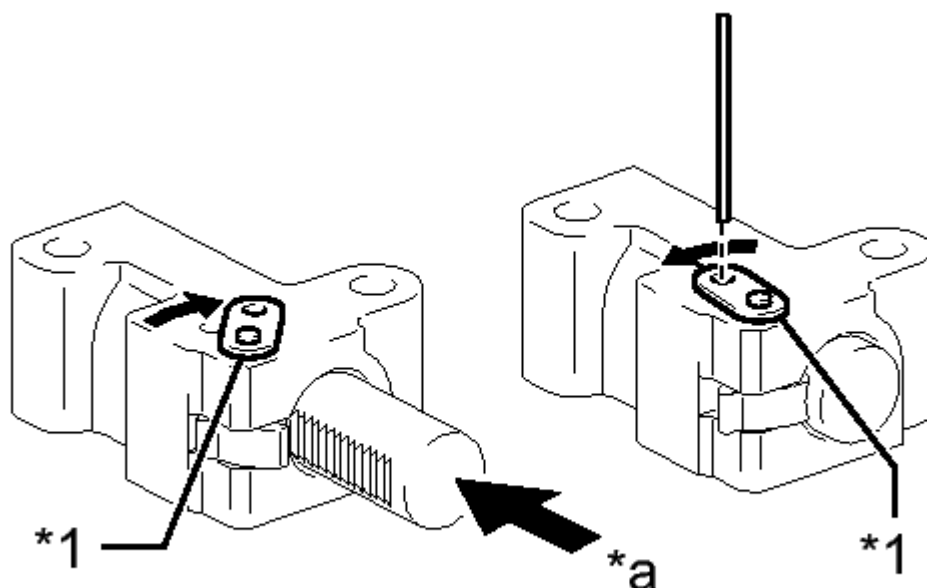
*1	Center Line
*2	Timing Mark
*3	Sensor Plate

29. INSTALL CHAIN TENSIONER SLIPPER

- a. Install the chain tensioner slipper.

30. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY

- a. Turn the stopper plate of the tensioner clockwise and push in the plunger of the tensioner as shown in the illustration.

**Fig. 350: Identifying Stopper Plate**

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

TEXT IN ILLUSTRATION

*1	Stopper Plate
*a	Push

- b. Turn the stopper plate of the tensioner counterclockwise and insert a pin of 1.27 mm (0.0500 in.) into the holes on the stopper plate and tensioner to fix the stopper plate in place.
- c. Install the chain tensioner with the 2 bolts.

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

- d. Remove the pin from the No. 1 chain tensioner.

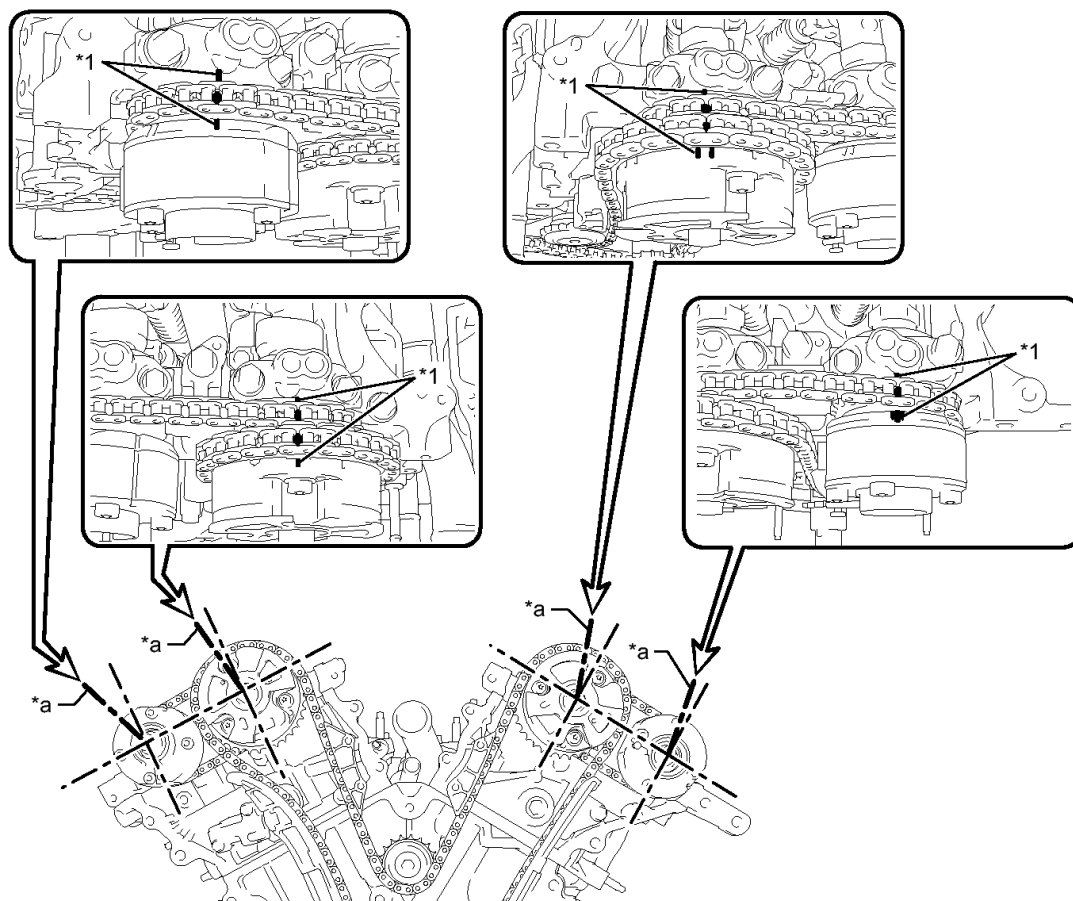
31. INSPECT VALVE TIMING

- a. Check the camshaft timing marks.

NOTE:

- Check each timing mark from a viewpoint directly in line with the center of the camshaft and the timing mark on each camshaft timing gear.
- If the timing marks are checked from any other viewpoint, the valve timing may appear misaligned.

- b. Check that each camshaft timing mark is positioned as shown in the illustration.



P

Fig. 351: Identifying Camshaft Timing Marks

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

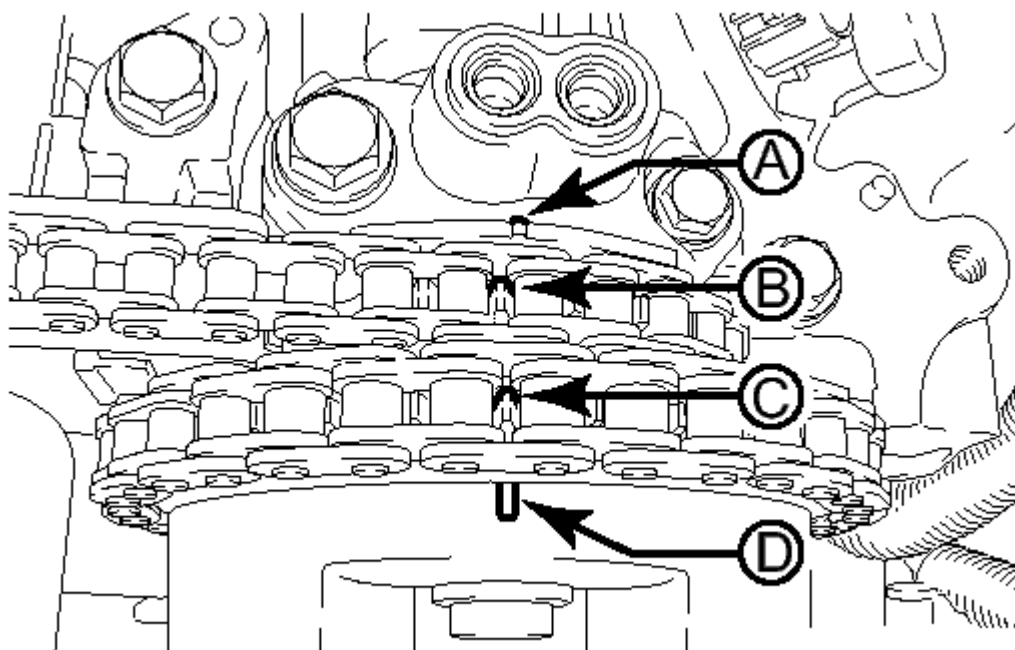
TEXT IN ILLUSTRATION

*1	Timing Mark	--
*a	Viewpoint	--

HINT:

for Intake Camshaft:

Be sure to check mark A at the point when marks B, C and D are positioned in line. If the marks are checked from any other viewpoint, they cannot be checked correctly.

**P****Fig. 352: Identifying Camshaft Timing Mark Position**

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

- c. If the valve timing is misaligned, reinstall the timing chain.
- d. Remove the pulley set bolt.

32. **INSTALL FRONT CRANKSHAFT OIL SEAL** . Refer to **INSTALLATION - Step 1**

33. **INSTALL WATER PUMP ASSEMBLY**

- a. Install a new gasket and the water pump with the 8 bolts.

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

34. **INSTALL TIMING CHAIN COVER SUB-ASSEMBLY** . Refer to **INSTALLATION - Step 2**

35. **INSTALL NO. 1 OIL PAN BAFFLE PLATE**

- a. Install the No. 1 oil pan baffle plate with the 6 bolts.

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

36. **INSTALL OIL PAN SUB-ASSEMBLY** . Refer to **INSTALLATION - Step 3**

37. **INSTALL OIL STRAINER SUB-ASSEMBLY** . Refer to **INSTALLATION - Step 4**

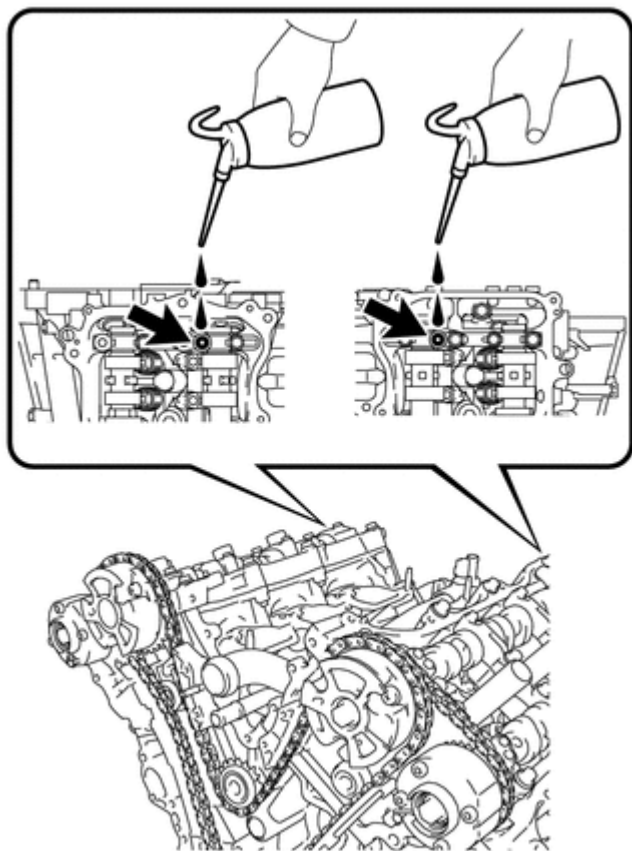
38. **INSTALL NO. 2 OIL PAN SUB-ASSEMBLY** . Refer to **INSTALLATION - Step 5**

39. **INSTALL OIL PAN DRAIN PLUG**

- a. Install a new gasket and the drain plug.

Torque: 40 N*m (408 kgf*cm, 30 ft.*lbf)

40. POUR ENGINE OIL



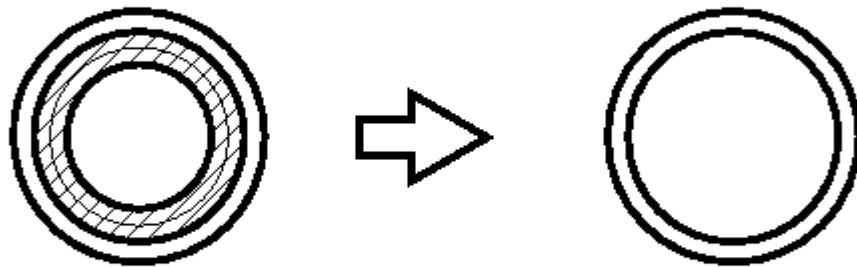
P

Fig. 353: Identifying Engine Oil Application Areas
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

HINT:

Before installing the cylinder head cover, pour engine oil into the locations shown in the illustration.

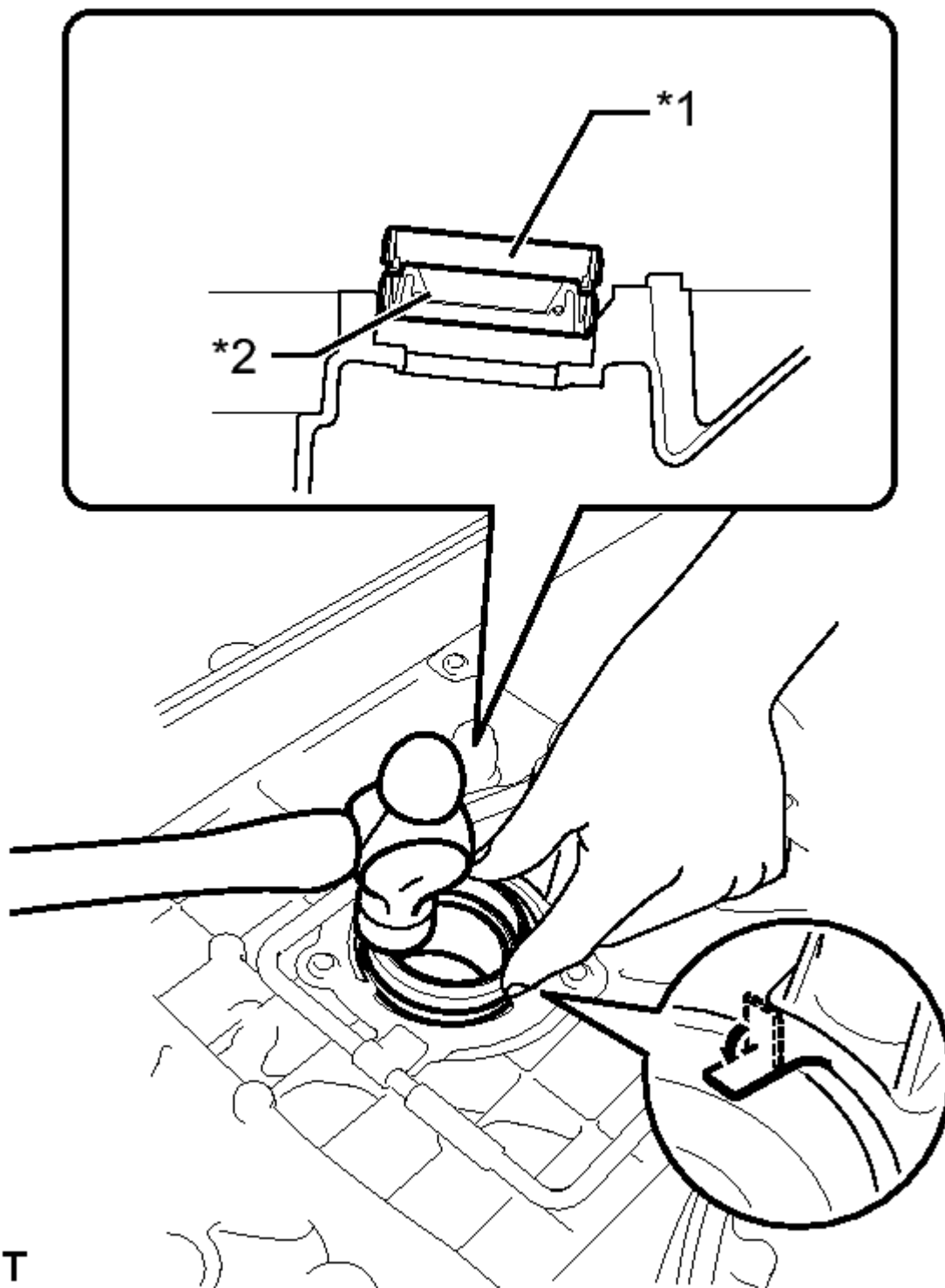
41. INSTALL SPARK PLUG TUBE GASKET

**T****Fig. 354: Identifying Spark Plug Tube Gasket****Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.**

- a. Using a cutter knife, cut off the seal part of the removed gasket.

TEXT IN ILLUSTRATION

Area to cut off

**T****Fig. 355: Identifying Gasket Installation**

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

- b. Using the removed gasket and a hammer, tap in a new gasket until it stops.

TEXT IN ILLUSTRATION

*1	Removed Gasket
*2	New Gasket

HINT:

If the removed gasket does not fit on the new one, correct the removed one with pliers.

- c. Apply a light coat of MP grease to the gasket lip.
- d. Return the ventilation baffle plate claws to their original positions.

42. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

- a. Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover or cylinder head cover.
- b. Apply seal packing as shown in the illustration.

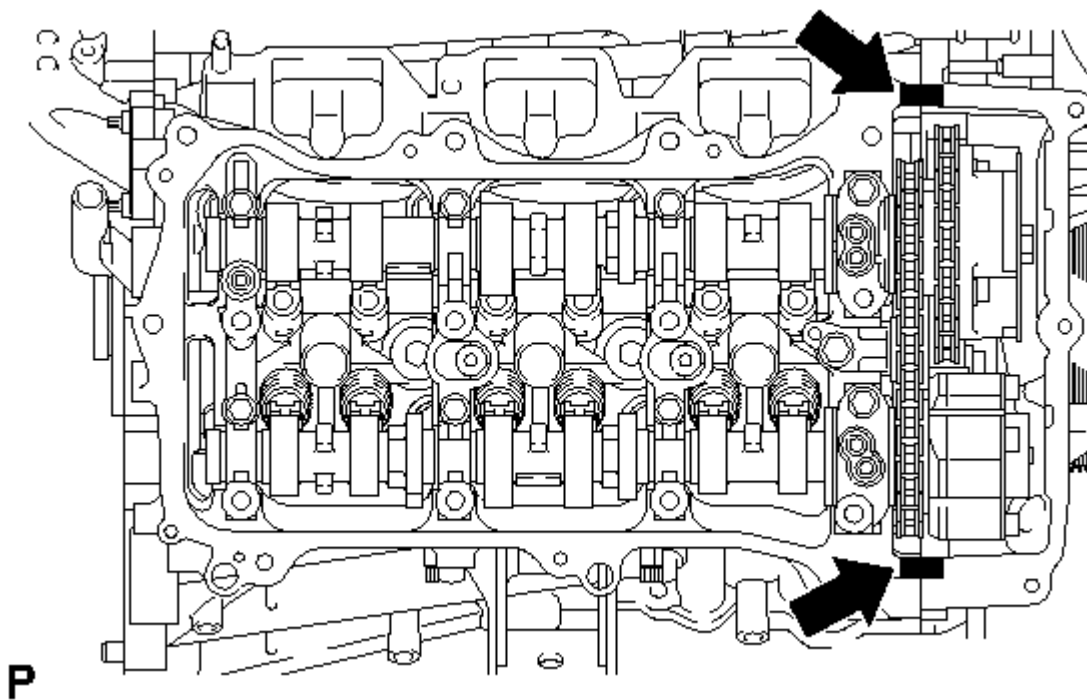


Fig. 356: View Of Cylinder Head Cover Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing

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

Standard seal diameter

2 to 3 mm (0.0787 to 0.118 in.)

TEXT IN ILLUSTRATION

Seal
Packing

NOTE:

- Remove any oil from the contact surface.
- Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.

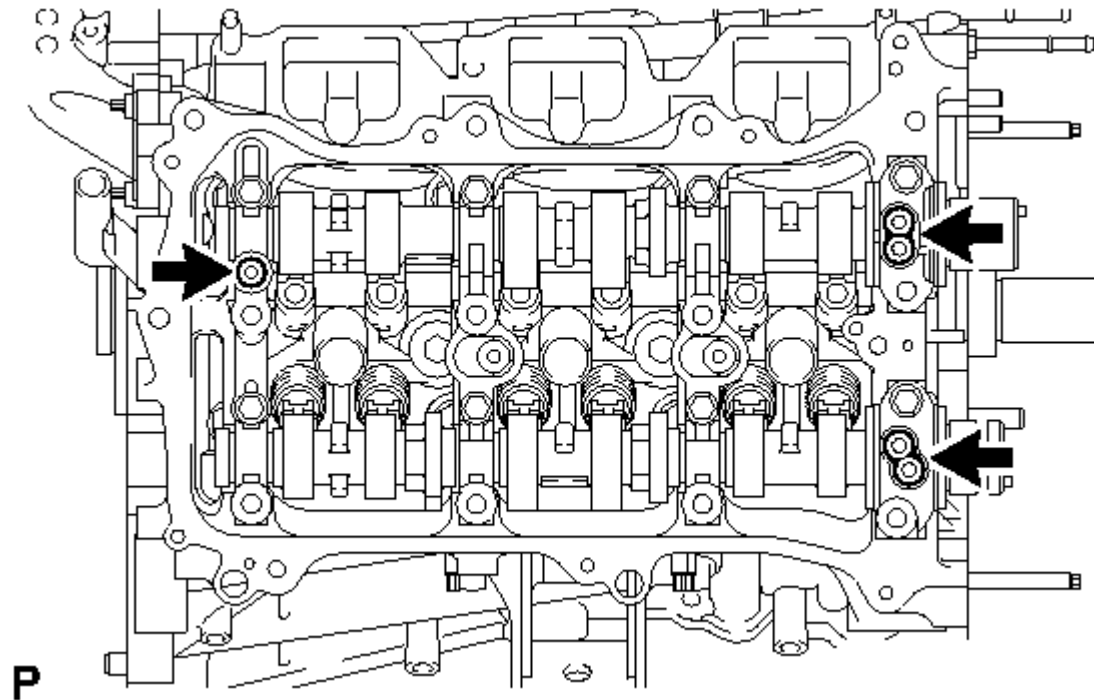


Fig. 357: Remove/Install Gaskets (RH)

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

- c. Install 3 new gaskets as shown in the illustration.
- d. Install a new gasket to the cylinder head cover.
- e. Install the seal washers to the bolts.

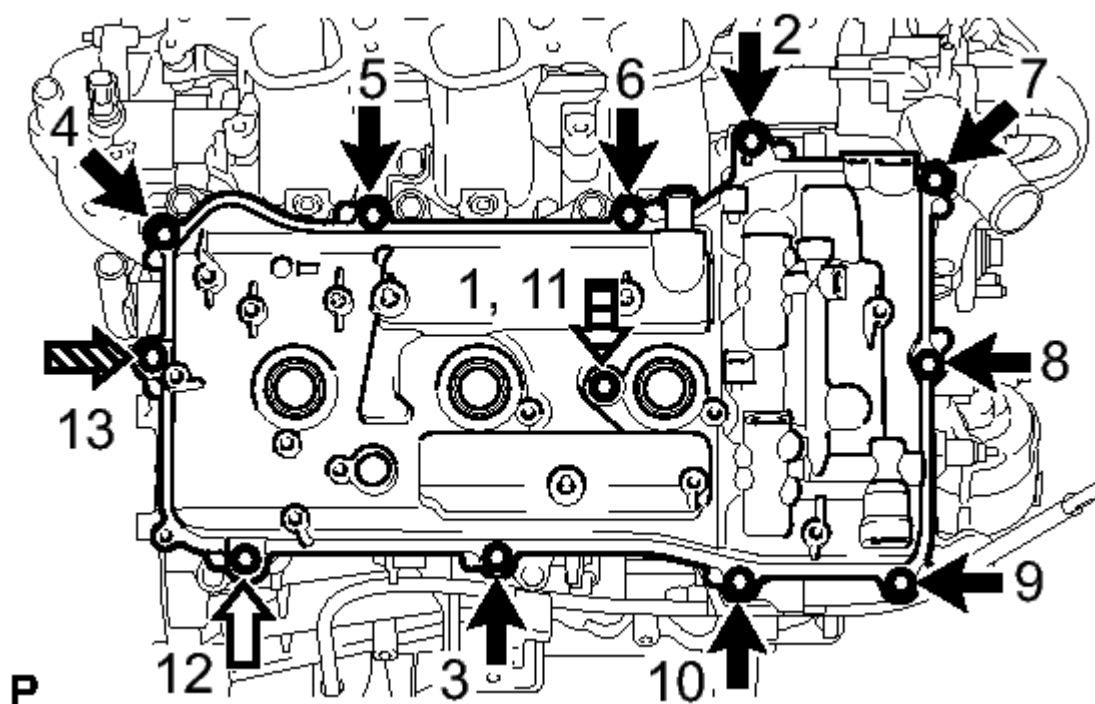


Fig. 358: Identifying Cylinder Head Cover Bolts With Tightening Sequence (RH)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not start the engine for at least 2 hours after the installation.

- f. Temporarily install the cylinder head cover with the 12 bolts. Tighten the bolts uniformly in several steps.

for bolt A and D

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

for bolt B and C

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

Standard Bolt

Item	Length
A	25 mm (0.984 in.)
B	35 mm (1.38 in.)
	65 mm

C	(2.56 in.)
D	60 mm (2.36 in.)

TEXT IN ILLUSTRATION

Bolt A
Bolt B
Bolt C
Bolt D

43. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

- Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the cylinder head, timing chain cover or cylinder head cover.
- Apply seal packing as shown in the illustration.

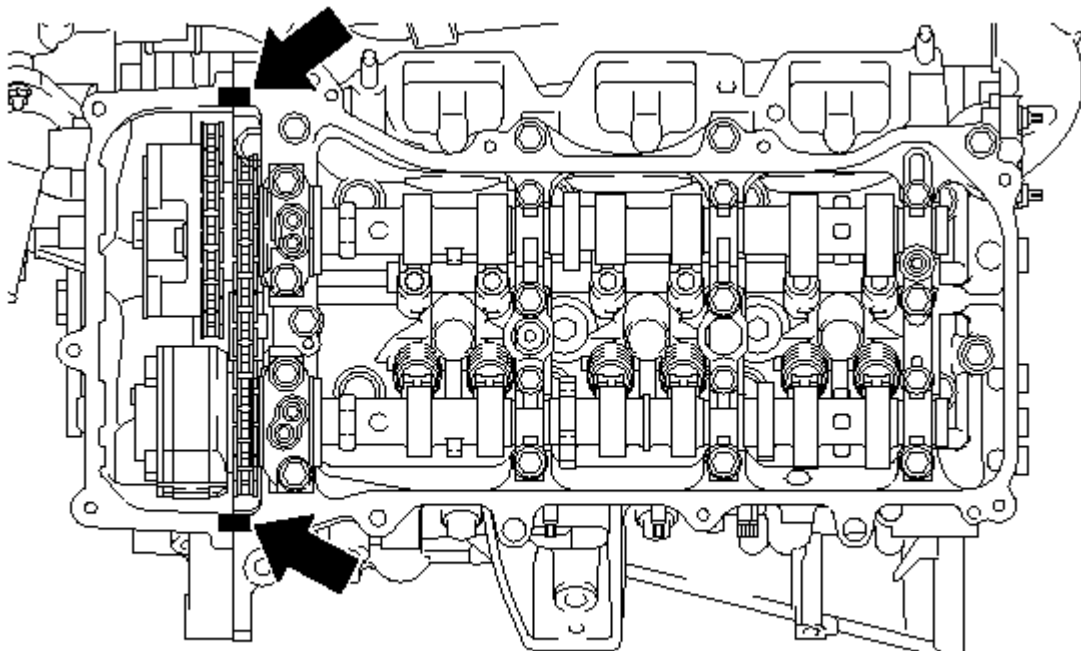
**P**

Fig. 359: View Of Cylinder Head Cover With Seal Packing
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

Seal packing

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

Standard seal diameter

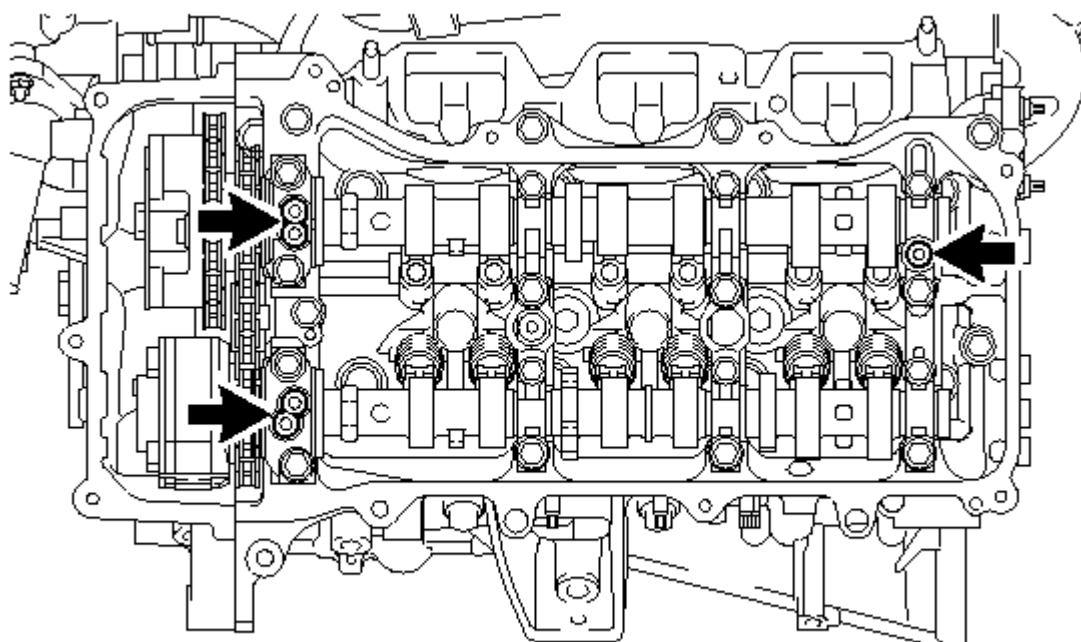
2 to 3 mm (0.0787 to 0.118 in.)

TEXT IN ILLUSTRATION

Seal
Packing

NOTE:

- Remove any oil from the contact surface.
- Install the cylinder head cover within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.



P

Fig. 360: Remove/Install Gaskets (LH)

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

- Install 3 new gaskets as shown in the illustration.
- Install a new gasket to the cylinder head cover.
- Install the seal washers to the bolts.

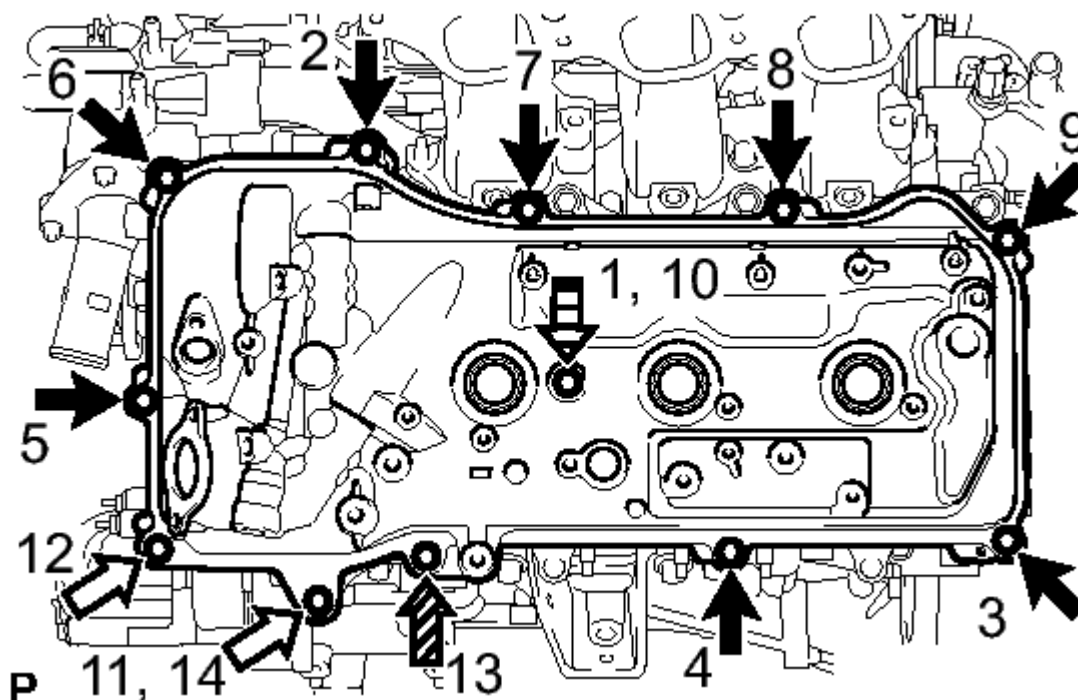


Fig. 361: Identifying Cylinder Head Cover Bolts With Tightening Sequence (LH)
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

NOTE: Do not start the engine for at least 2 hours after the installation.

- f. Temporarily install the cylinder head cover with the 12 bolts. Tighten the bolts uniformly in several steps.

for bolt A and D

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

for bolt B and C

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

Standard Bolt

Item	Length
A	25 mm (0.984 in.)
B	35 mm (1.38 in.)
	70 mm

C	(2.76 in.)
D	60 mm (2.36 in.)

TEXT IN ILLUSTRATION

Bolt A
Bolt B
Bolt C
Bolt D

44. **INSTALL CRANKSHAFT PULLEY** . Refer to **INSTALLATION - Step 11**
45. **INSTALL PCV VALVE SUB-ASSEMBLY** . Refer to **INSTALLATION - Step 1**
46. **INSTALL SPARK PLUG** . Refer to **INSTALLATION - Step 1**
47. **INSTALL REAR WATER BY-PASS JOINT**

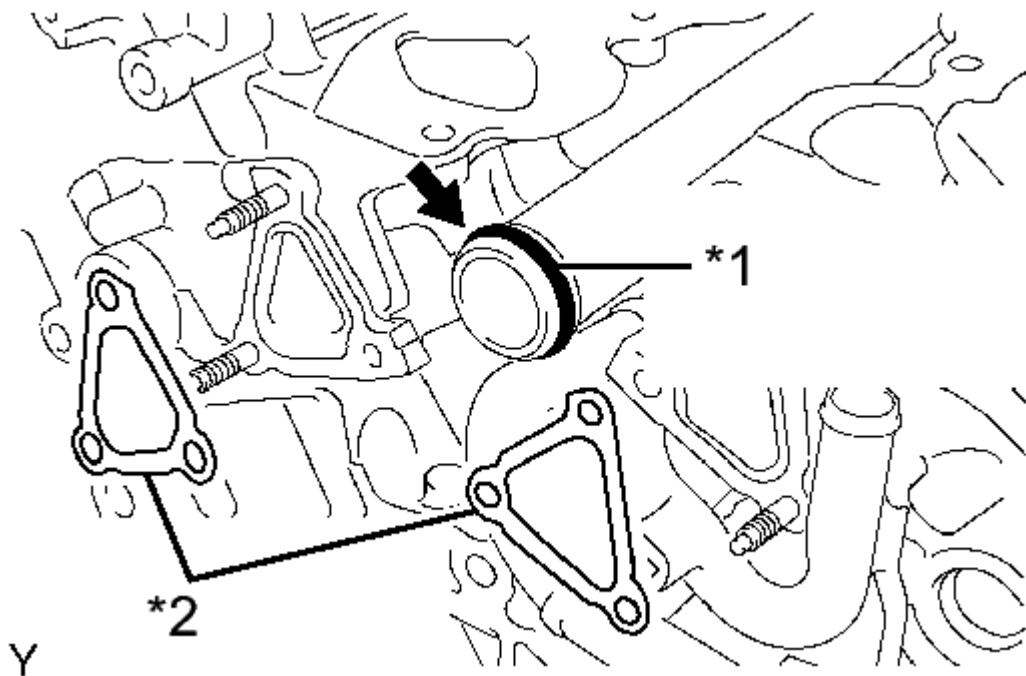


Fig. 362: Identifying O-Ring And Gaskets

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

- a. Apply soapy water to a new O-ring and install it to the water outlet pipe. Then install 2 new gaskets to the water ports LH and RH.

TEXT IN ILLUSTRATION

*1	New O- Ring
*2	New Gasket

- b. Install the rear water by-pass joint with the 2 bolts and 4 nuts.

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

48. **INSTALL WATER INLET HOUSING** . Refer to INSTALLATION - Step 17

49. **INSTALL OIL FILTER BRACKET** . Refer to INSTALLATION - Step 12

50. **INSTALL OIL FILTER ELEMENT** . Refer to REPLACEMENT - Step 4

51. **INSTALL NO. 2 OIL PIPE** . Refer to INSTALLATION - Step 9

52. **INSTALL NO. 1 OIL PIPE** . Refer to INSTALLATION - Step 10

53. **INSTALL OIL FILLER CAP HOUSING**

- a. Install a new gasket and the oil filler cap housing with the 2 nuts.

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

- b. Install the oil filler cap.

54. **INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY**

- a. RH:

1. Apply a light coat of engine oil to 2 new O-rings.
2. Install the 2 O-rings to the 2 oil control valves.
3. Install the 2 oil control valves with the 2 bolts.

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

NOTE: Be careful that the O-ring is not cracked when installing the camshaft timing oil control valve.

- b. LH:

1. Apply a light coat of engine oil to 2 new O-rings.
2. Install the 2 O-rings to the 2 oil control valves.
3. Install the 2 oil control valves with the 2 bolts.

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

NOTE: Be careful that the O-ring is not cracked when installing the camshaft timing oil control valve.

55. INSTALL CRANKSHAFT POSITION SENSOR

- a. Apply a light coat of engine oil to the O-ring of the sensor.

NOTE:

- When reusing the sensor, inspect the O-ring.
- If the O-ring has scratches or cuts, replace the sensor.

- b. Install the sensor with the bolt.

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

56. INSTALL VVT SENSOR

- a. RH:

1. Apply a light coat of engine oil to the 2 O-rings of the 2 sensors.

NOTE:

- When reusing the sensor, inspect the O-ring.
- If the O-ring has scratches or cuts, replace the sensor.

2. Install the 2 VVT sensors with the 2 bolts.

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

- b. LH:

1. Apply a light coat of engine oil to the 2 O-rings of the 2 sensors.

NOTE:

- When reusing the sensor, inspect the O-ring.
- If the O-ring has scratches or cuts, replace the sensor.

2. Install the 2 VVT sensors with the 2 bolts.

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

57. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

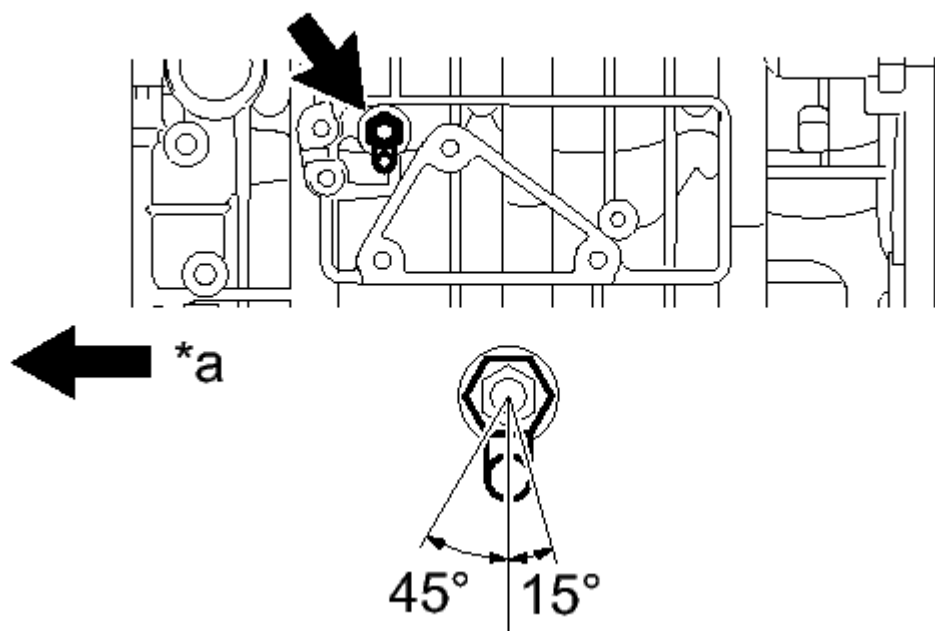
- a. Apply adhesive to 2 or 3 threads of the drain cock end.

Adhesive

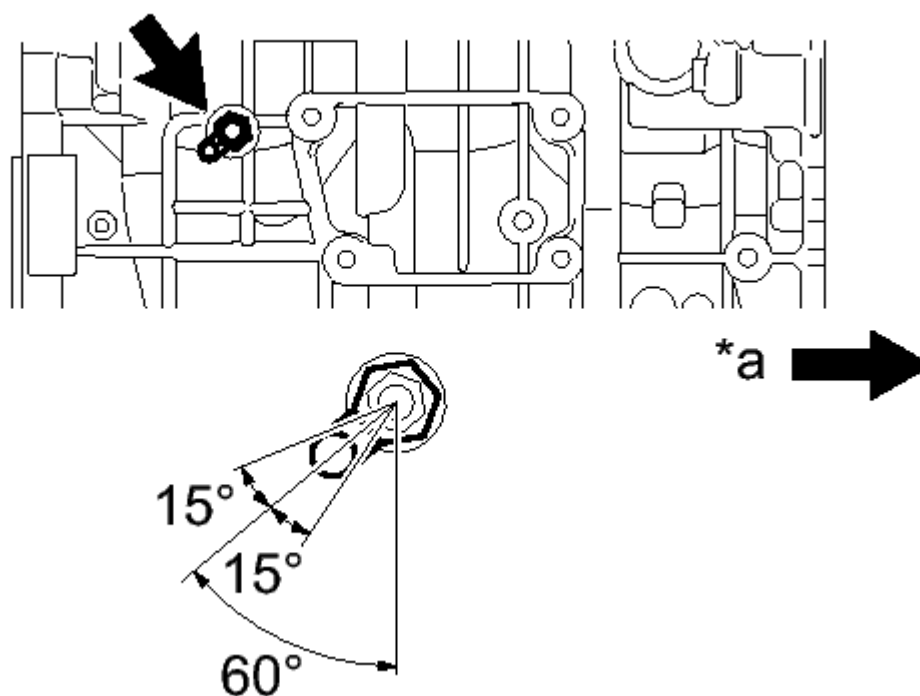
Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

- b. Install the drain cock.

*A



*B



P

Fig. 363: Identifying Drain Clockwise Rotation Dimensions
Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

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

TEXT IN ILLUSTRATION

*A	LH
*B	RH
*a	Front

NOTE:

- Install the drain cock within 3 minutes after applying adhesive.
- Do not expose the drain cock to coolant within 1 hour of the installation.

c. Rotate the drain cock clockwise to the position shown in the illustration.

NOTE:

- Do not rotate the drain cock by more than 1 revolution (360°) after tightening the drain cock to the specified torque.
- Do not loosen the drain cock after setting it correctly.

d. Install the water drain cock plugs to the water drain cocks.

Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

58. **INSTALL ENGINE COOLANT TEMPERATURE SENSOR** . Refer to INSTALLATION - Step 1

59. **INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY** . Refer to INSTALLATION - Step 1

INSTALLATION**INSTALLATION****1. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET RH**

a. Install the front No. 1 engine mounting bracket RH with the 4 bolts.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

2. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET LH

a. Install the front No. 1 engine mounting bracket LH with the 3 bolts.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

3. **INSTALL ENGINE OIL LEVEL DIPSTICK GUIDE** . Refer to INSTALLATION - Step 19

4. **INSTALL V-RIBBED BELT TENSIONER ASSEMBLY** . Refer to INSTALLATION - Step 14

5. **INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY** . Refer to INSTALLATION - Step 6

6. **INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY** . Refer to INSTALLATION - Step 16

7. **INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY** . Refer to INSTALLATION - Step 18

8. **INSTALL INTAKE MANIFOLD** . Refer to INSTALLATION - Step 1

9. **INSTALL FUEL INJECTOR ASSEMBLY** . Refer to INSTALLATION - Step 1

10. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY . Refer to INSTALLATION - Step 2**11. INSTALL FUEL PIPE SUB-ASSEMBLY**

- a. Install the No. 1 fuel pipe and No. 2 fuel pipe with the 2 bolts.

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

- b. Connect the 2 fuel pipes. Refer to PRECAUTION .

12. INSTALL IGNITION COIL ASSEMBLY

- a. Install the 6 ignition coils with the 6 bolts.

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

13. INSTALL WIRING HARNESS CLAMP BRACKET

- a. Install the 7 wiring harness clamp brackets with the 7 bolts.

Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

14. INSTALL NO. 2 EMISSION CONTROL VALVE SET

- a. Install the No. 2 emission control valve set with the 3 nuts.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

15. INSTALL EMISSION CONTROL VALVE SET

- a. Install the emission control valve set with the 3 nuts.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

16. INSTALL HEATER WATER PIPE SUB-ASSEMBLY

- a. Temporarily install the heater water pipe, and then tighten the 2 bolts in the order shown in the illustration.

Torque: 9.8 N*m (100 kgf*cm, 87 in.*lbf)

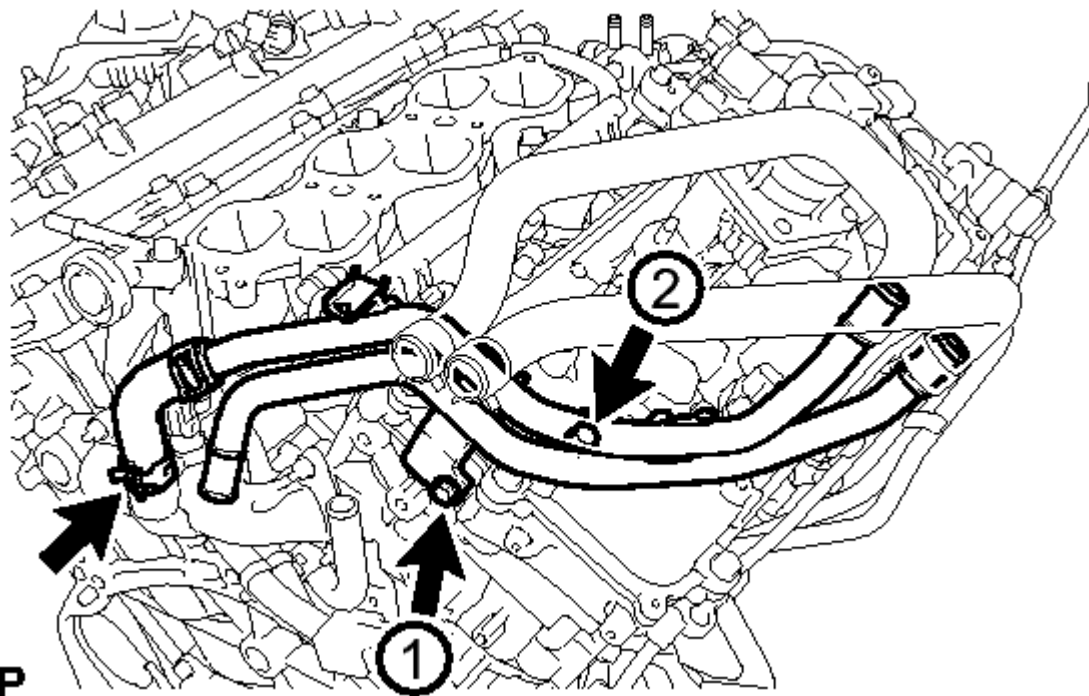


Fig. 364: Identifying Heater Water Pipe & Fasteners
 Courtesy of TOYOTA MOTOR SALES, U.S.A., INC.

b. Connect the hose.

17. INSTALL NO. 1 WATER BY-PASS PIPE

a. Connect the water by-pass pipe hoses to the water by-pass pipe and No. 1 water outlet pipe.

18. INSTALL ENGINE WIRE