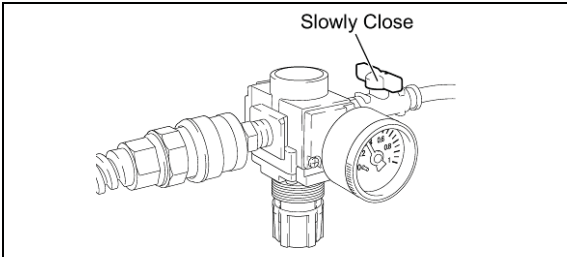


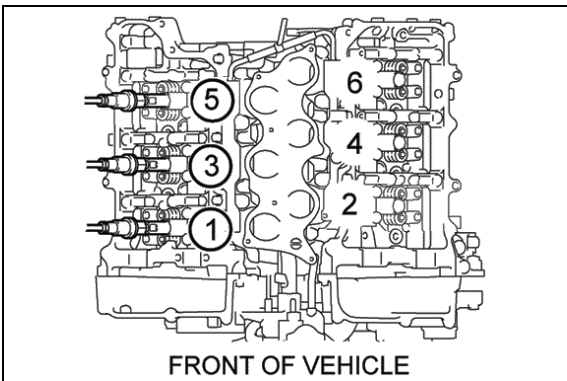
3. ATTACH THE ANTI-ROTATION TOOL TO THE CRANKSHAFT



4. PRESSURIZE CYLINDERS 1, 3, & 5

- a) **Close the regulator valve.**
- b) Hand tighten the air adapters to the spark plug holes. Do NOT use any tools to tighten the adapters.

NOTE: Remove the shop towel from the spark plug tube hole before trying to install the air adapter.

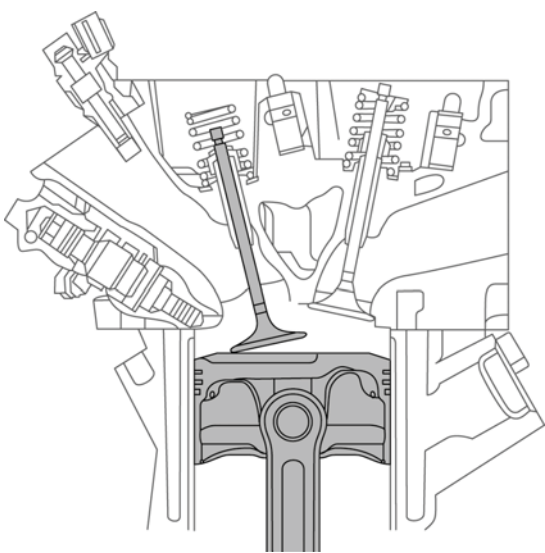


- c) Connect the air hoses to the air adapters then slowly open the regulator valve to pressurize cylinders 1, 3, & 5 at the same time.
- d) Check for large air leaks before removing the valve springs. Correct any connection issues as necessary. [Small air leaks (hissing) are normal]

NOTE: Pressurizing the cylinders at the same time will help balance the cylinders and prevent the crankshaft from spinning too much.

(RH BANK SHOWN)

TIGHTLY SECURE THE TIMING CHAIN DURING THIS STEP. IF THE CRANKSHAFT IS ROTATED WITHOUT HIGH TENSION ON THE TIMING CHAIN IT IS POSSIBLE FOR THE CHAIN TO BIND. SEE APPENDIX FOR SERVICE HINTS TO UNBIND THE CHAIN.



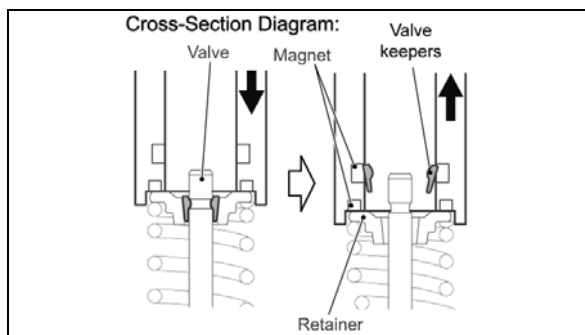
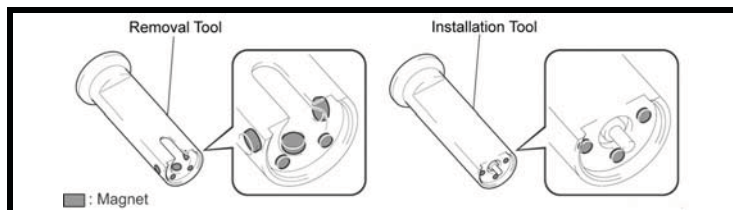
- e) Raise the piston on each cylinder before you remove the valve springs on each cylinder.
- f) Without un-securing the primary chain, use a second technician to help walk the primary chain while turning the crankshaft.
- g) Do NOT turn the crankshaft in only one direction during this step. Use back and forth motions when turning the crankshaft so that the timing marks do not deviate too far from the marked locations.

NOTE: This step will prevent the valve from completely dropping in the cylinder if the shop air is turned off or if a valve is pushed down while the spring is removed.

Temporary removal and reinstallation of the anti-rotation crankshaft tool is necessary before and after setting the pistons.

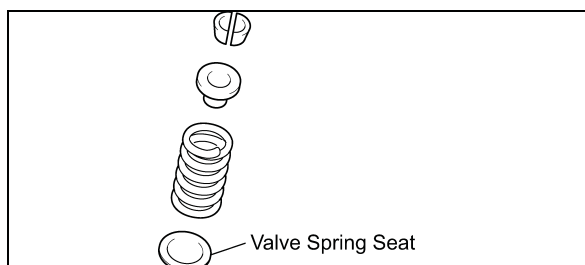


- Wear protective eyewear during valve spring removal and installation.
- Mark all the old replacement parts and relocate them to an area where they will not be confused with the new parts.



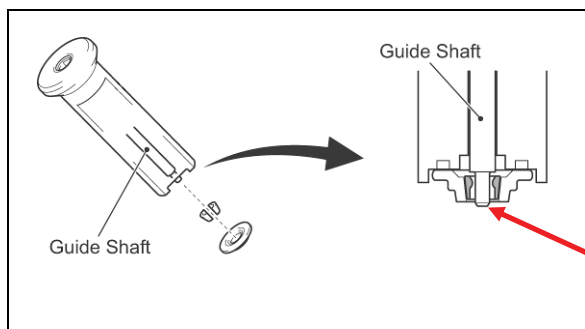
5. REMOVE THE VALVE SPRINGS

- Using the Valve Spring Removal Tool, remove the valve keepers, retainers.
- Mark the old valve springs so that they will not be re-installed into the engine.**
- Remove the valve spring.



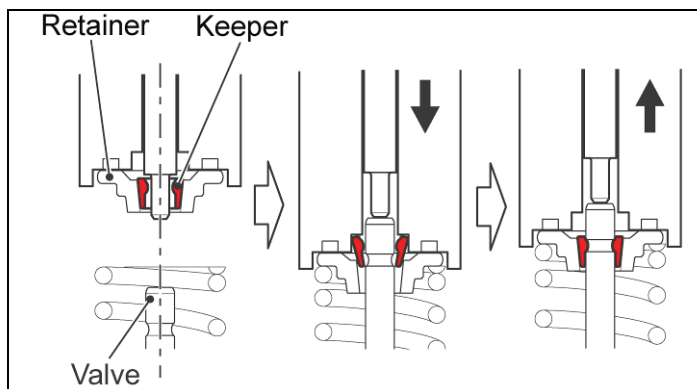
- Although it should stay in place, confirm the valve spring seat is still seated on the cylinder head after spring removal.

NOTE: The valve spring seat is bi-directional and can be installed in either direction.



6. INSTALL THE VALVE SPRINGS

- Place the spring retainer facing up in your hand.
- Install the keepers into the retainer.
- Place the valve spring compression installation tool over the keepers and retainer.
- Confirm all parts are secured by the magnets and aligned for proper installation.
- Confirm the guide shaft is fully extended or the keepers and retainer will fall off.**

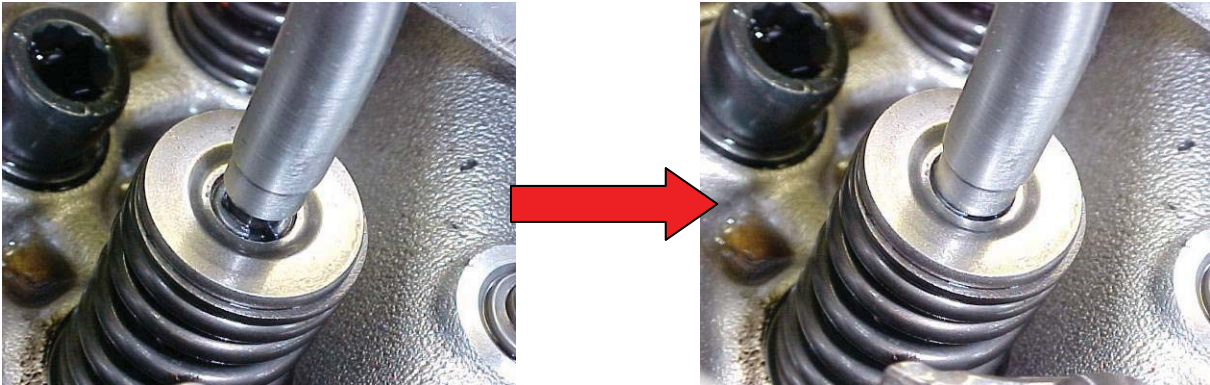


- Using the Valve Spring Installation Tool, compress and reinstall the keepers and retainer.
- Install the **NEW** valve spring.

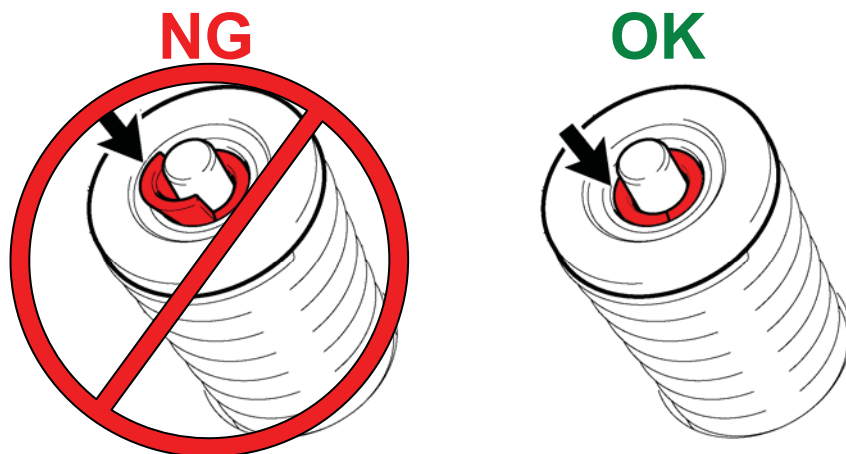
NOTE: The valve springs are bi-directional and can be installed in either direction.

7. CONFIRM THE VALVE KEEPERS ARE COMPLETELY SEATED

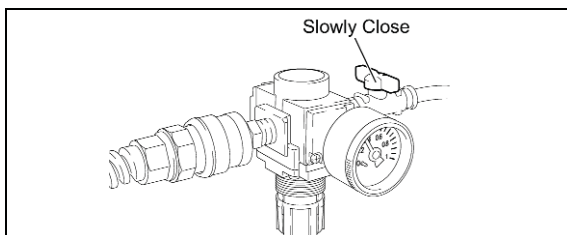
- a) After installing new valve springs: Place the Valve Keeper Set Tool (SST) on top of the keepers and lightly tap several times to fully seat the keepers.



- Visual inspection. The keepers need to be slightly recessed below the lip of the valve retainer.
- If one or both of the keepers was not installed onto the valve stem properly, do NOT use the Valve Keeper Set Tool to force it in. You must reinstall both keepers using the hand operated valve spring installation tool.

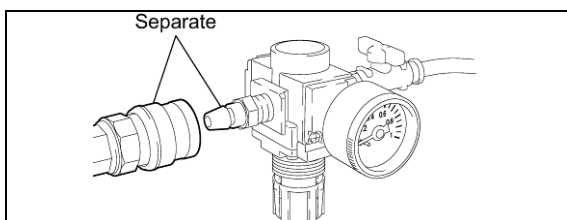


**If the keepers are not properly installed
The valves will drop in to the cylinder.**

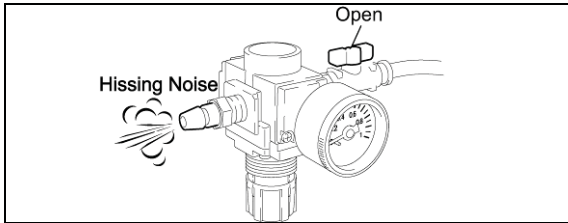


8. RELEASE THE AIR PRESSURE

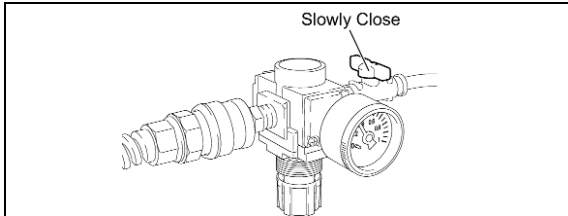
- a) Close the regulator valve.



- b) Disconnect the air supply from the regulator.



c) Open the valve to release the residual pressure.



9. REMOVE THE ADAPTERS

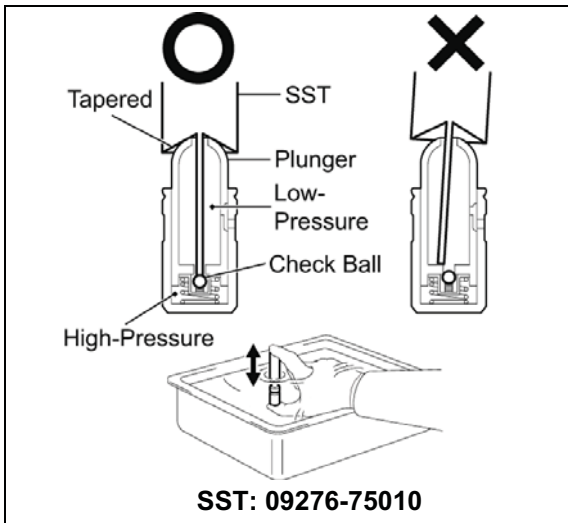
- a) Close the regulator valve.
- b) Remove the air adapters from the cylinders



These are not self-bleeding lash adjusters, if they are not bled properly, you will have excessive valve noise after reinstallation.

F. REINSTALL THE CAMSHAFTS

[Click here for video supplement 4 \(step F\)](#)

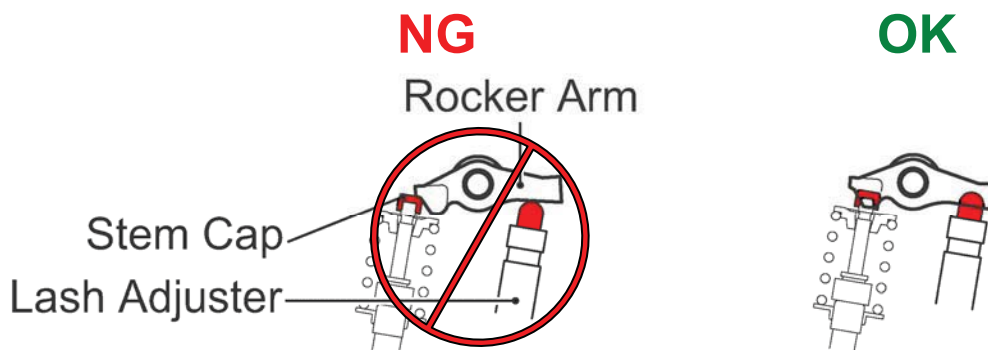


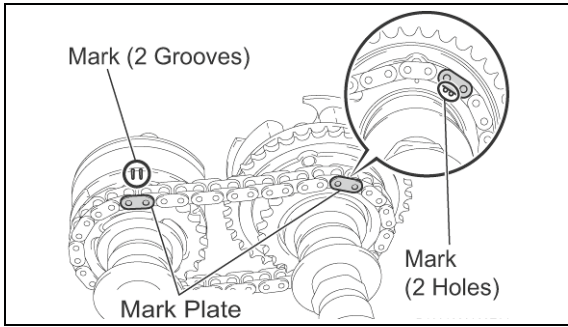
1. INSTALL THE NEW VALVE LASH ADJUSTERS

- a) Remove air from 24 **NEW** lash adjusters.
 - Submerge the lash adjuster into clean engine oil.
 - Keep the SST and the plunger aligned and seated together **while keeping the lash adjuster vertical**.
 - Pump the SST at least 6 times to remove air from the high pressure chamber.
 - **Remove the SST from the lash adjuster and then strongly and quickly push the plunger end with your fingers and check that the plunger barely moves.**
 - Put the lash adjuster back into the oil to fill the low pressure chamber.
- b) Insert and twist to properly install the lash adjusters.

2. REINSTALL THE STEM CAPS AND ROCKER ARMS

- a) After reinstallation, verify the rocker arms are seated correctly on both the valve lash adjusters and the stem caps.
- b) Before you tighten the camshaft bearing caps check for the correct position of the rocker arm again. It is possible for rocker arms to be knocked out of position when installing the cams.
- c) **It is helpful to install engine assembly lube to the rocker arms to help keep them in place.**

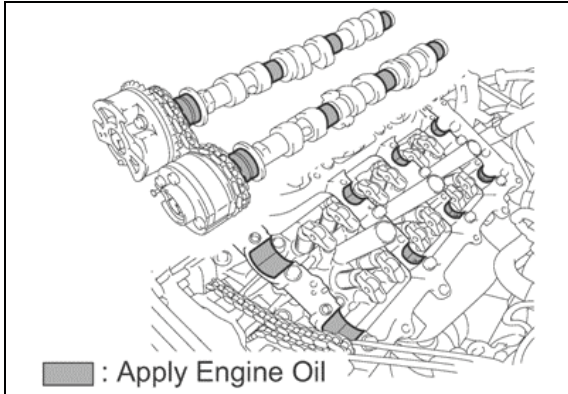




3. REINSTALL THE CAMSHAFTS

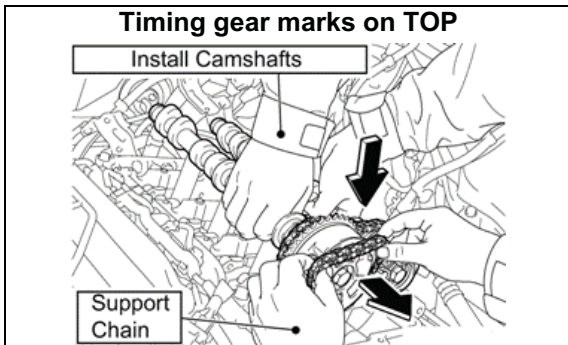
- a) Align the yellow chain link with the 2 holes on the intake VVT gear.
- b) Align the other yellow chain link with the 2 grooves on the exhaust VVT gear.

(LH BANK SHOWN)



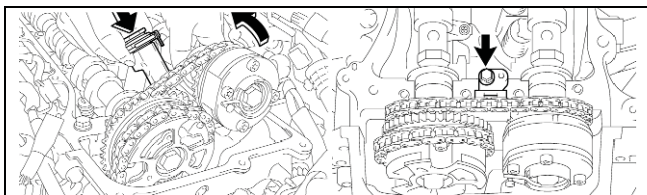
- c) Apply engine oil to the bearings and journals.

(LH BANK SHOWN)



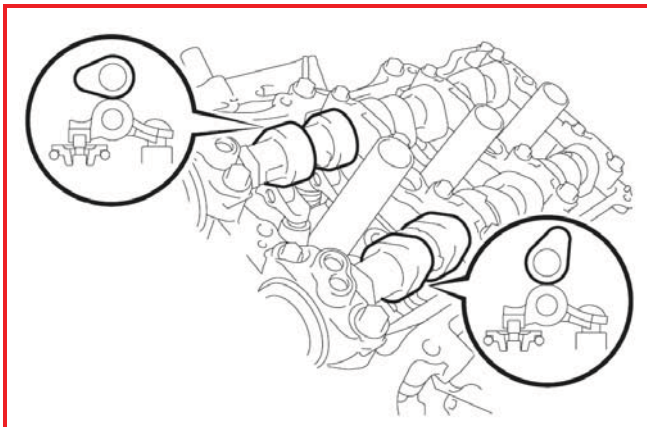
- d) Have two people perform the following steps.
 - Tightly hold the primary chain.
 - Set both camshafts in place with the timing marks facing up.
 - Place the chain on the VVT actuator in a position where it will not fall off.

(LH BANK SHOWN)



- e) Install the tensioner.
 - Lift up on the exhaust camshaft
 - Install the chain tensioner.

Torque Spec: 15 ft.*lbs (21 N*m)



- f) Confirm your timing marks are still aligned.
- g) **Confirm the camshafts are in a neutral position before tightening the bearing cap bolts, if the valve spring pressure is not reduced the bearing caps can break.**

(LH BANK SHOWN)



Degrease and dry the bearing cap bolts and holes before reinstallation. If you install oily bolts you will overtighten and stretch them due to the decreased friction.

h) Reinstall the bearing caps.

1. Loosen the hold-down bolts for one cap location at a time.



2. Remove the hold-down bolt and two washers, one cap location at a time.



3. Reinstall the bearing caps, one at a time, tighten the bolts by hand and then torque to spec.

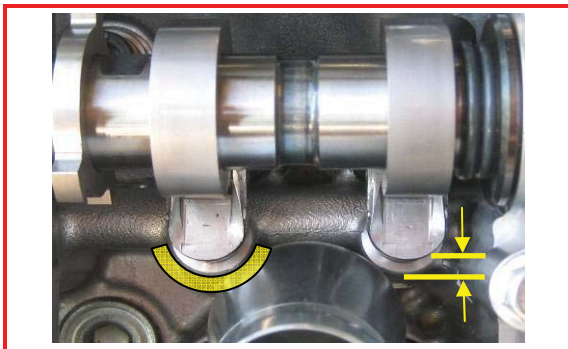
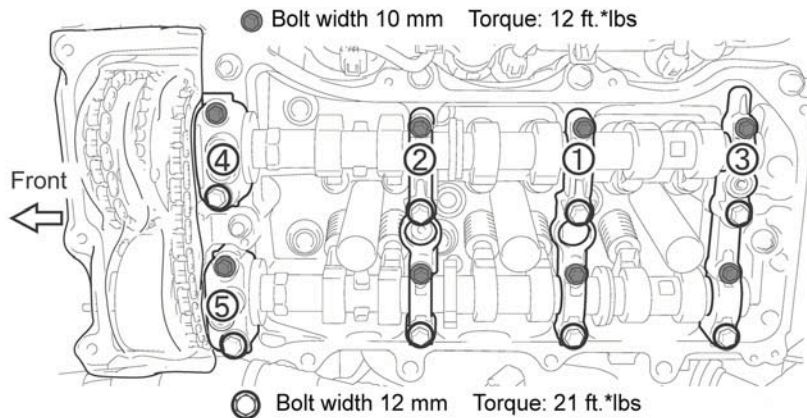


If any binding is felt while tightening the bolts by hand, replace the bearing cap bolt. If the bolt seems to stretch during the torque procedure, replace the bearing cap bolt.

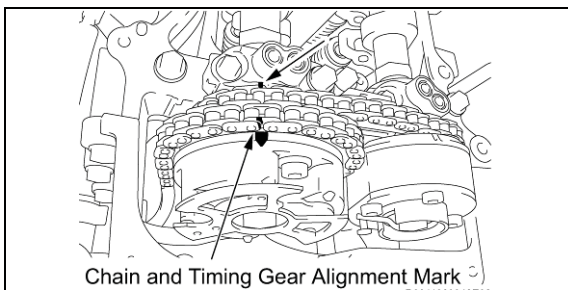


Replace the bolt if it has stretched before allowing it to break in the cylinder head.

Reinstall the bearing caps in the sequence shown here (LH bank)



i) After installing the camshafts, confirm all rocker arms are correctly installed - Check for a consistent "U" shape distance.



j) Align the chain so that it matches up with the timing marks and paint marks made before disassembly.

(LH BANK SHOWN)

NOTE: Please reference L-SB-0156-08 to easily identify the timing marks.

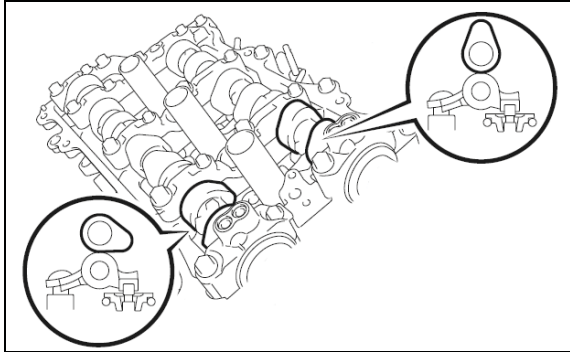
Repeat “Steps E, F” for the RH bank.



This includes removal and replacement of the valve springs and reinstallation of the camshafts.

NOTE: The following are different for the left and right hand banks.

- Timing marks
- Torque sequence

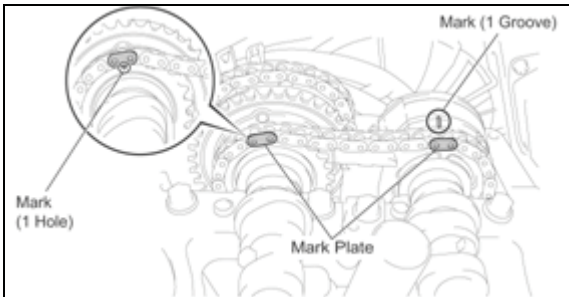


RH BANK CAMSHAFT INSTALLATION

- a) Confirm the camshafts are in a neutral position; this will prevent the lobes from compressing a valve spring.

NOTE: The cams should sit flush in the journals. If the cams are not flush in the journals it is probable that the cam caps will break during reinstallation.

(RH BANK)

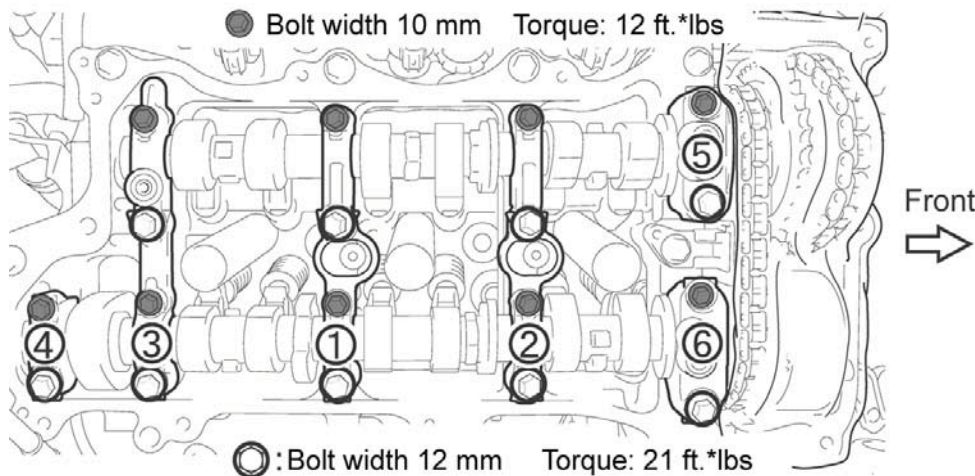


RH BANK TIMING MARKS

- b) Align the yellow chain link with the hole on the intake VVT gear.
- c) Align the other yellow chain link with the groove on the exhaust VVT gear.

(RH BANK)

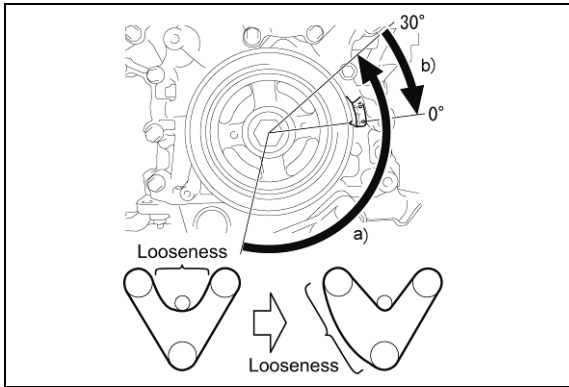
Reinstall the bearing caps in the sequence shown here (RH bank)



G. REINSTALL THE TIMING CHAIN TENSIONER AND VALVE COVER

[Click here for video supplement 5 \(step G\)](#)

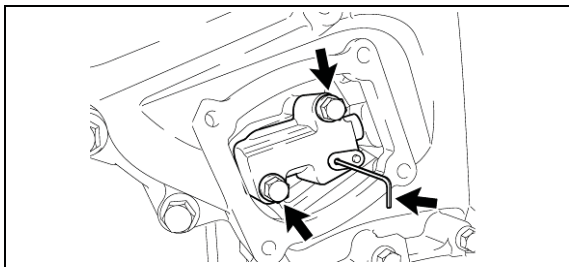
If the chain becomes trapped or skips, see the appendix for service hints.



1. VALVE TIMING CHECK

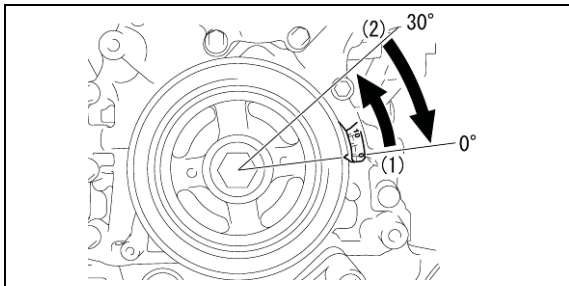
- Rotate the crankshaft back to approximately 30° before TDC.
- Rotate the crankshaft back to TDC.

NOTE: This step provides the space necessary to reinstall the tensioner.



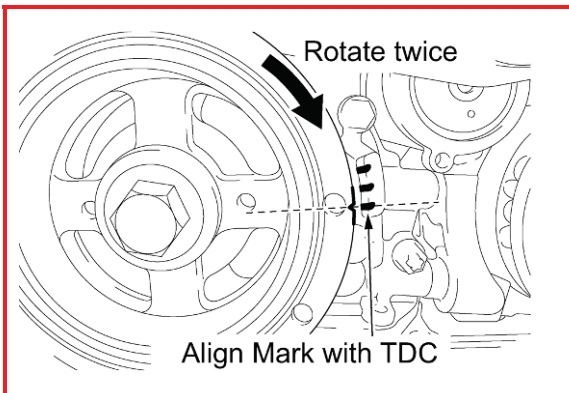
- Install the tensioner and torque to spec.
- Remove the pin.

Torque: 7 ft.*lbs (10 N*m)



- Rotate the crankshaft 30° counterclockwise.
- Rotate the crankshaft back to TDC.

NOTE: This step provides the proper tension to the chain.

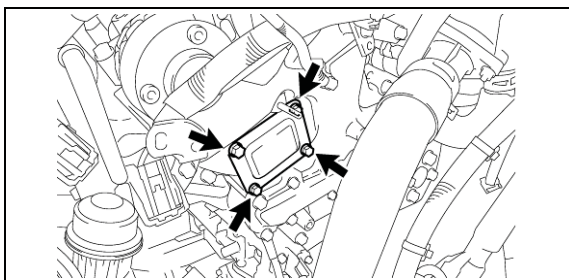


- Rotate the engine 720° and stop at the TDC mark.

NOTE: Pay close attention for any binding or abnormalities. If the engine does not rotate smoothly, diagnose and repair before completing reassembly steps.

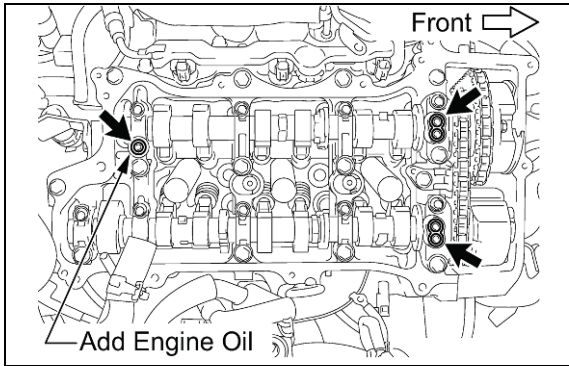
- Reconfirm the timing marks are still perfectly aligned, realign as necessary.

NOTE: the painted markings on the chain will not realign after the engine has been rotated.



- Install a **NEW** gasket.
- Reinstall the tensioner cover and bolts and torque to spec.

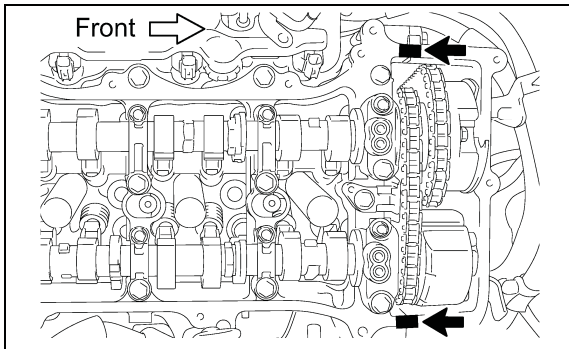
Torque: 80 in.*lbs (9.0 N*m)
gasket p/n 11328-31030



2. REINSTALL THE VALVE COVER RH

- a) Install the 3 **NEW** gaskets into the bearing caps.
- b) Pour oil into the hole illustrated.

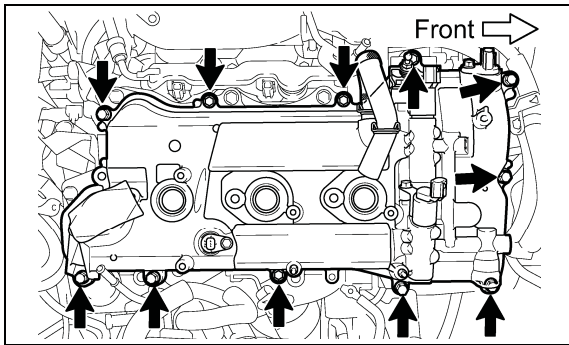
Bearing cap o-ring: (1 hole) p/n 90430-10024
Camshaft oil hole gaskets: (2 holes) p/n 11159-31010



- c) Degrease and dry the valve cover bolts and mounting surface.
- d) Install the **NEW** gasket into the valve cover.
- e) Apply FIGP to the points illustrated and within 3 minutes attach and bolt down the valve cover.

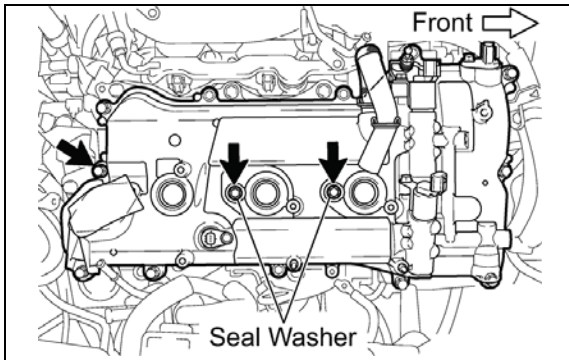
Valve cover gasket RH: p/n 11213-31040
Valve cover gasket LH: p/n 11214-31020

NOTE: WAIT 2 HRS BEFORE STARTING THE ENGINE AFTER APPLYING FIGP.



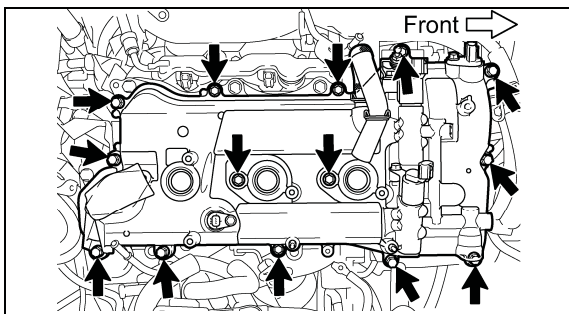
- f) Apply adhesive 1324 to the threads and install the valve cover bolts. Do not torque yet.

Adhesive 1324 p/n: 08833-00070
 (thread-locker)



- g) Install the **NEW** seal washers
- h) Install the 3 bolts.

Seal washer p/n 90210-06013



- i) In several increments torque the bolts.

Torque:
Bolt width 10 mm: 7 ft.*lbs (10 N*m)
Bolt width 12 mm: 15ft.*lbs (21 N*m)



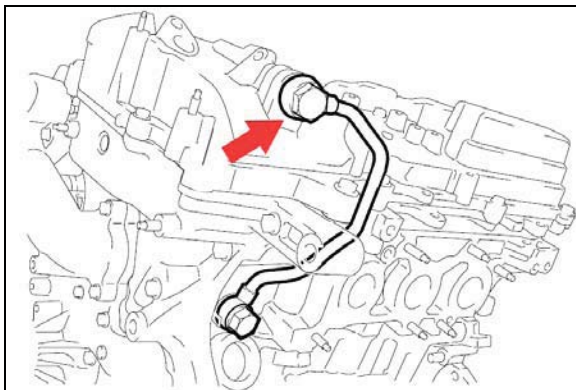
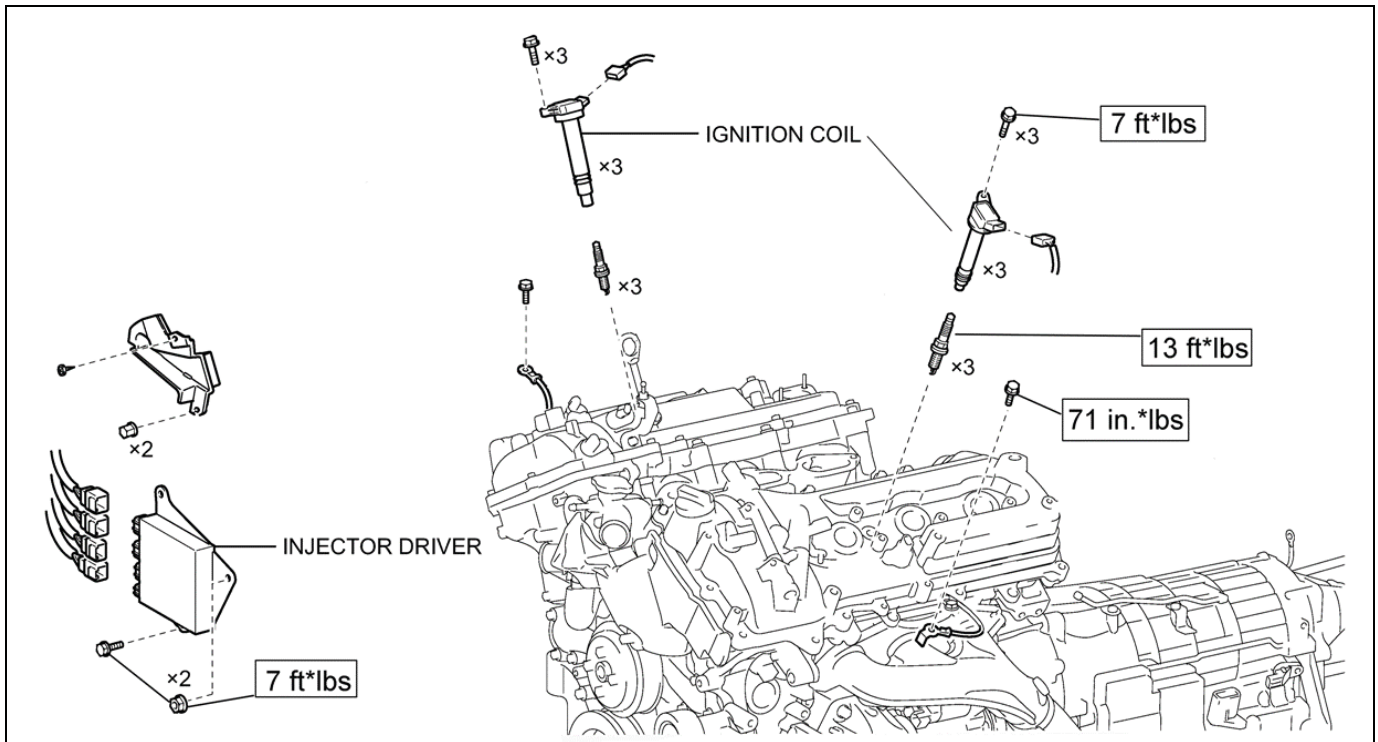
Repeat "Step 6 REINSTALL THE VALVE COVER" for the LH bank

NOTE: The following is different between the LH and RH banks.

- The LH bank only has 1 seal washer

H. REINSTALL THE AUXILLARY ENGINE COMPONENTS

1. REINSTALL THE IGNITION AND OIL COMPONENTS



2. RECONNECT THE TOP SIDE OF THE OIL PIPES (Both LH & RH sides)

NOTE:

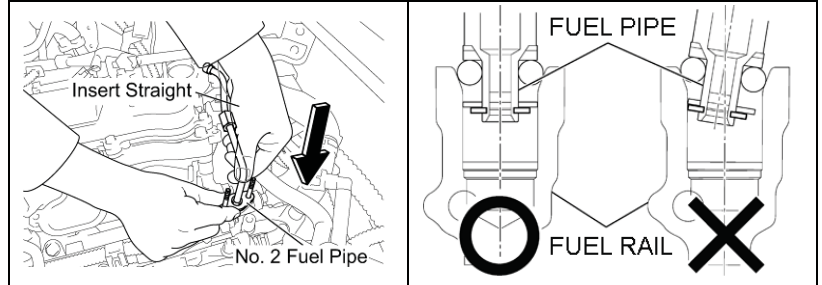
- Torque: 48 ft.*lbs
- No.1 Gasket : p/n 90430-16012
- Do not forget to install *NEW* washer gaskets.

3. REINSTALL THE FUEL COMPONENTS

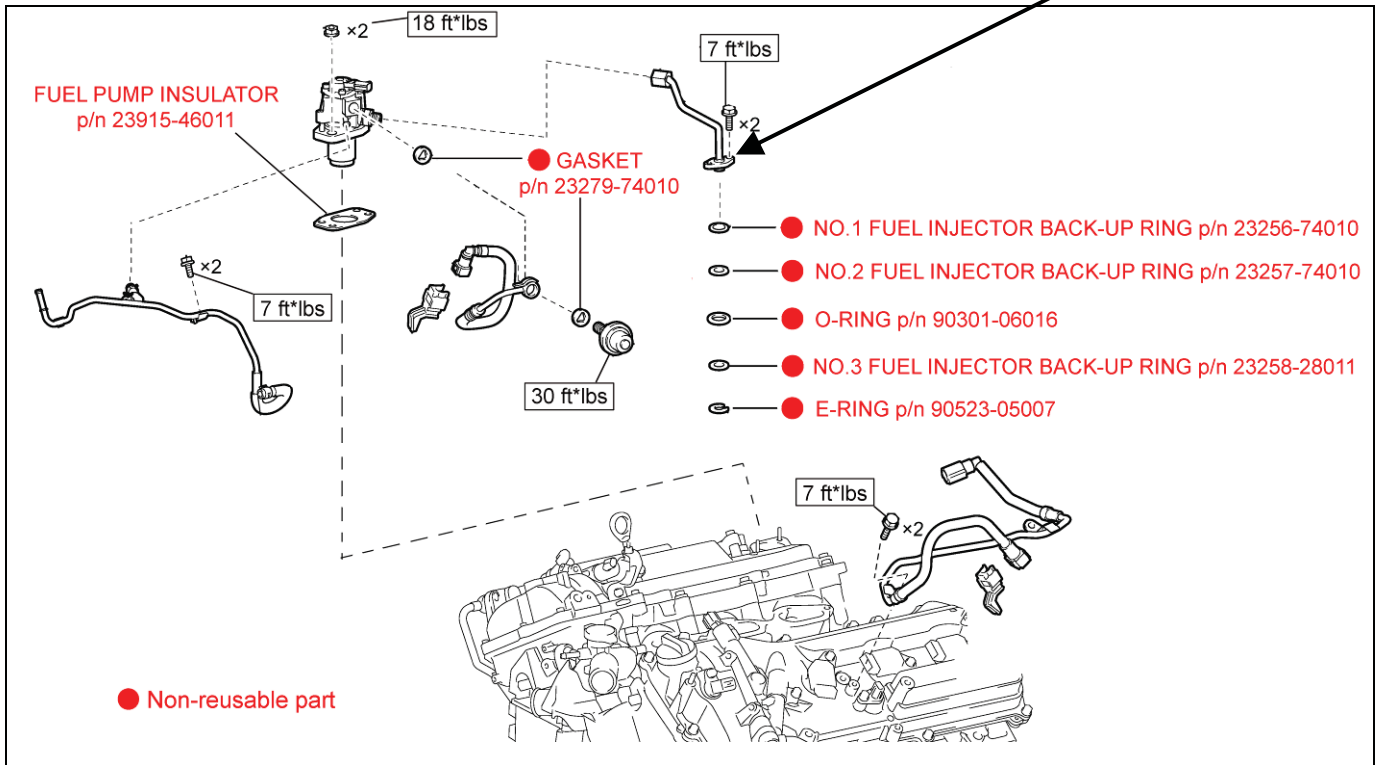


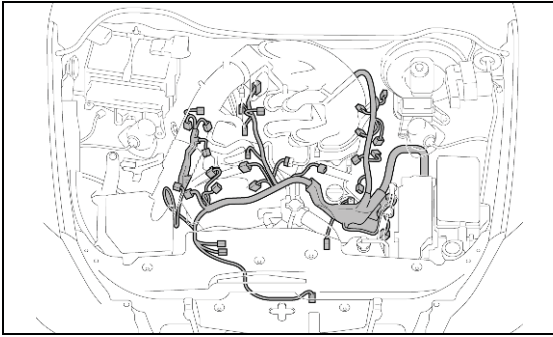
- Never have an ignition source near by when working on the fuel system.
- Always wear protective eye wear when working on the fuel system.
- Lubricate the camshaft contact point on the high pressure fuel pump.

Install the fuel pipe directly down to prevent fuel rail damage. Use SST 04007-32331 stud bolts for assistance.

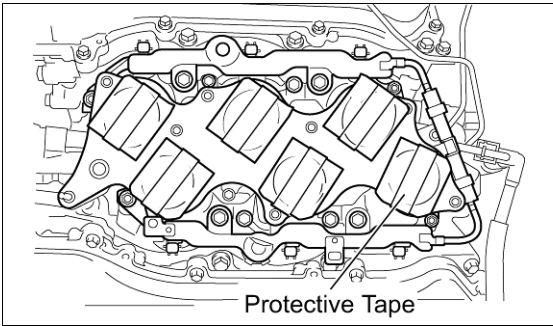


NOTE: Pushing at an angle can cause scratches and nicks which will potentially cause fuel leaks.



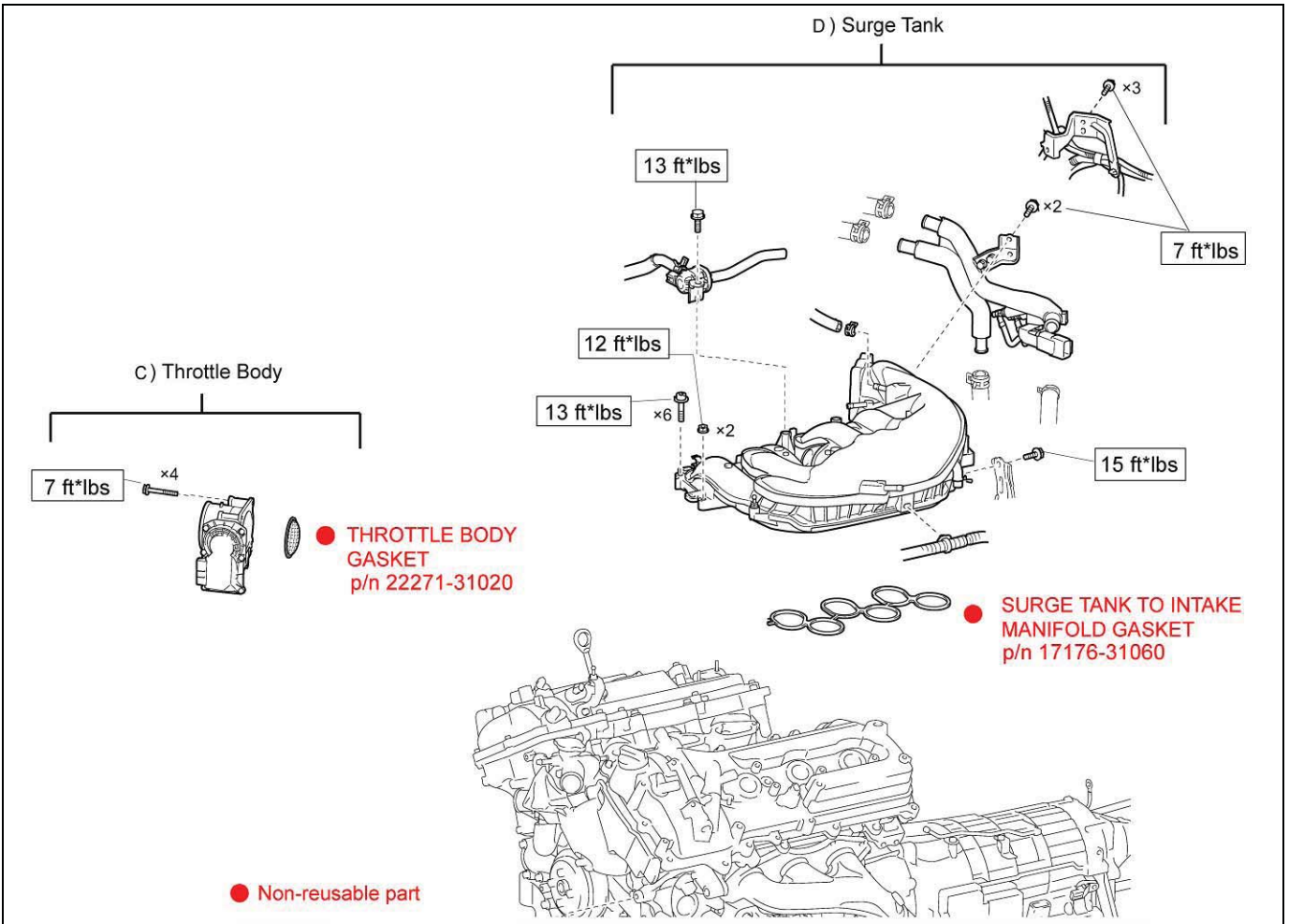


4. REINSTALL THE WIRE HARNESS

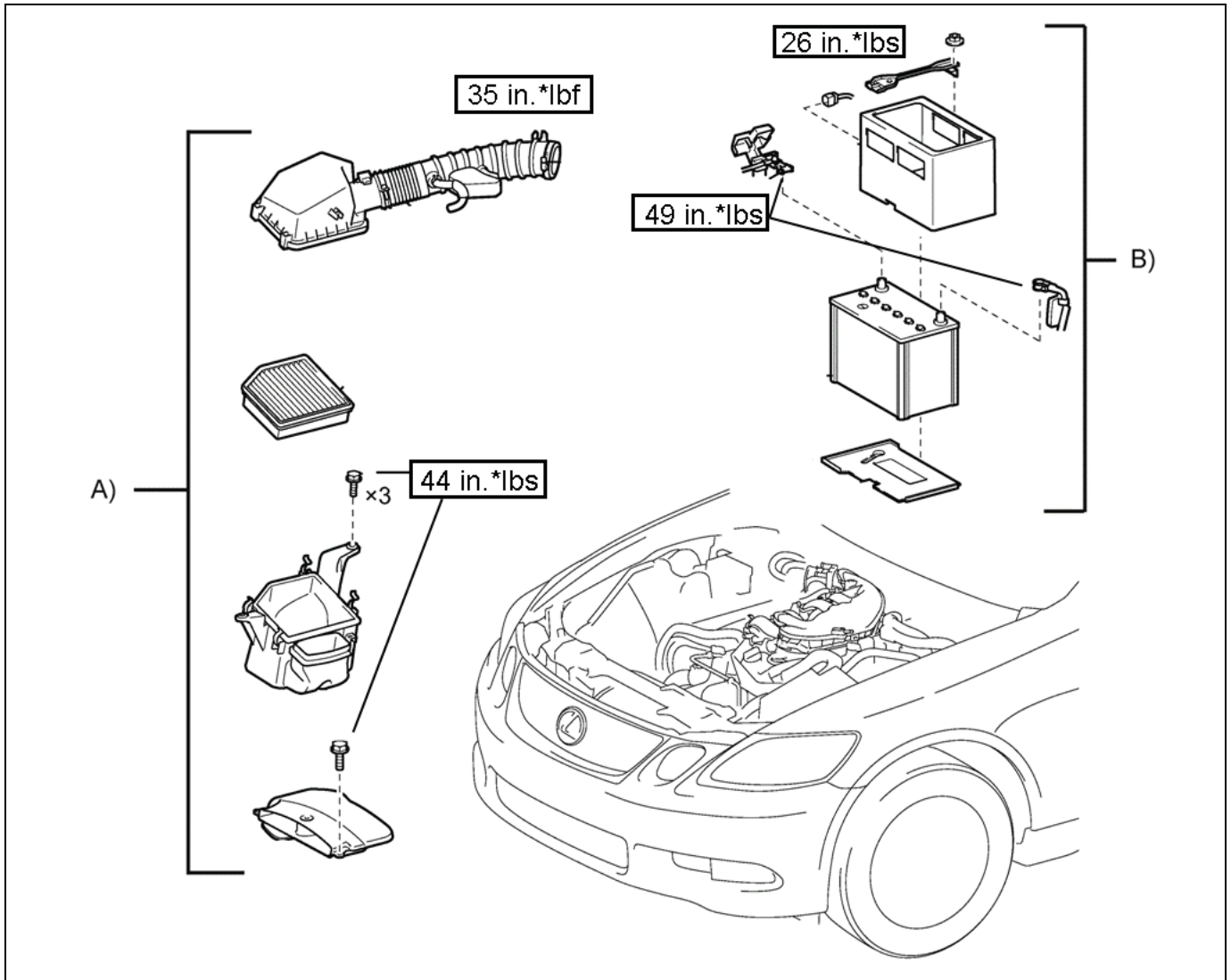


5. REMOVE THE TAPE FROM THE INTAKE MANIFOLD

6. REINSTALL COMPONENT GROUPS C-D



7. REINSTALL COMPONENT GROUPS A-C



8. REINSTALL THE GAS CAP
9. INSPECT FOR OIL LEAKS

10. INSPECT FOR FUEL LEAKS

Check that there are **NO** fuel leaks anywhere in the system. If there is a fuel leak, repair or replace parts as necessary.

11. PERFORM INITIALIZATIONS
12. CHECK FOR DTC'S AND REPAIR AS NEEDED

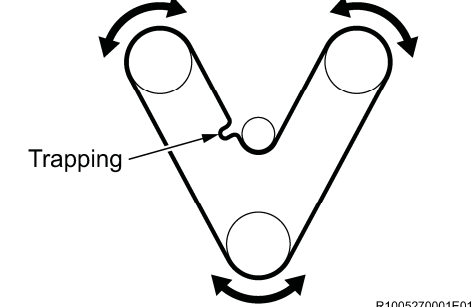
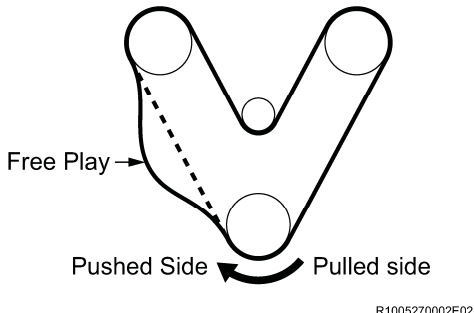
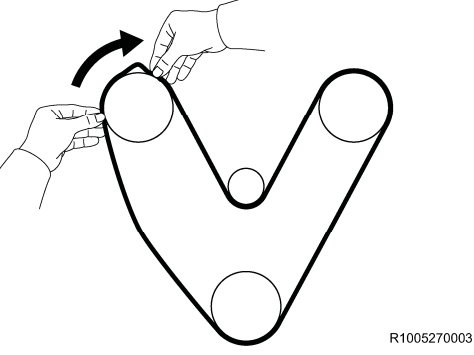
13. PERFORM A THOROUGH TEST DRIVE THAT WILL CONFIRM THE VALVETRAIN COMPONENTS WERE CORRECTLY INSTALLED.

14. REINSTALL THE ENGINE ROOM COVERS

APPENDIX

As required by Federal Regulations, please make sure all recalled parts (original parts) removed from the vehicle are disposed of in a manner in which they will not be reused.

■ COUNTERMEASURES IN THE EVENT OF CHAIN TRAPPING OR TOOTH SKIPPING

 <p>R1005270001E01</p>	<p>1. MEASURES IN THE EVENT OF TRAPPING</p> <ul style="list-style-type: none">a) Chain trapping is due to a kink in the chain and even forcefully turning the crankshaft will not release it.b) Find a point where the chain can be released (rotated) by rotating the <u>crankshaft and the camshafts of the RH and LH banks respectively clockwise or counterclockwise.</u>c) It is very helpful to have one technician pull the chain very tightly while another technician rotates the camshafts and crankshaft to un-bind the chain.
 <p>R1005270002E02</p>	<p>2. MEASURES IN THE EVENT OF TOOTH SKIPPING</p> <ul style="list-style-type: none">a) In the event of tooth skipping, correct the tooth position one by one by using the free play of the chain.<ul style="list-style-type: none">• When the shaft is rotated, free play of the chain gathers in the pushed portion of the chain.
 <p>R1005270003</p>	<ul style="list-style-type: none">• Then the chain can be shifted by one tooth using the free play.