

CO/HC INSPECTION

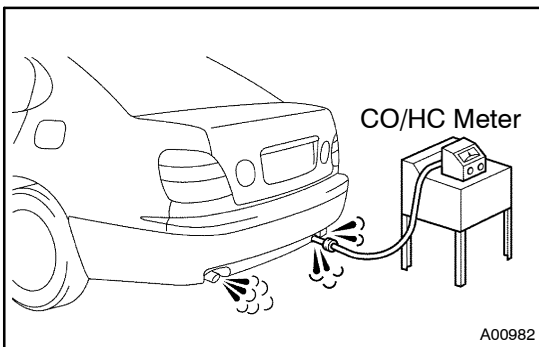
EM00Q-02

HINT:

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

1. INITIAL CONDITIONS

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



2. START ENGINE

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

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

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

Complete the measuring within 3 minutes.

HINT:

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

If the CO/HC concentration does not comply with regulations, troubleshoot in the order given below.

- (1) Check oxygen sensor operation.
(See [page DI-118](#))
- (2) See the table below for possible causes, then inspect and correct the applicable causes if necessary.

CO	HC	Symptom	Causes
Normal	High	Rough idle	1. Faulty ignitions: • Incorrect timing • Fouled, shorted or improperly gapped plugs 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinder
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks: • PCV hose • Intake manifolds • Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty EFI system: • Faulty pressure regulator • Defective water temperature sensor • Faulty engine ECU • Faulty injector • Faulty throttle position sensor • Air flow sensor

COMPRESSION INSPECTION

EMODR-02

HINT:

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

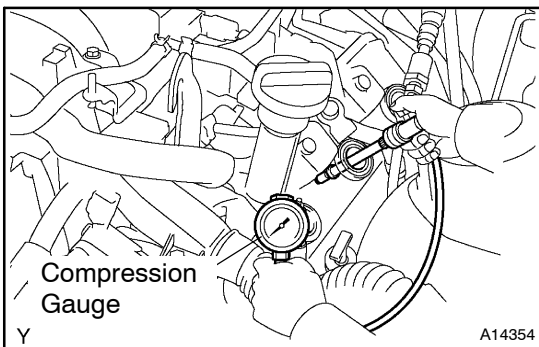
1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.

2. REMOVE IGNITION COILS

3. REMOVE SPARK PLUGS

4. DISCONNECT INJECTOR CONNECTORS



5. INSPECT CYLINDER COMPRESSION PRESSURE

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

HINT:

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

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

NOTICE:

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

Compression pressure:

1,226 kPa (12.5 kgf/cm², 178 psi) or more

Minimum pressure: 981 kPa (10.0 kgf/cm², 142 psi)

Difference between each cylinder:

98 kPa (1.0 kgf/cm², 14 psi) or less

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

6. RECONNECT INJECTOR CONNECTORS

7. REINSTALL SPARK PLUGS

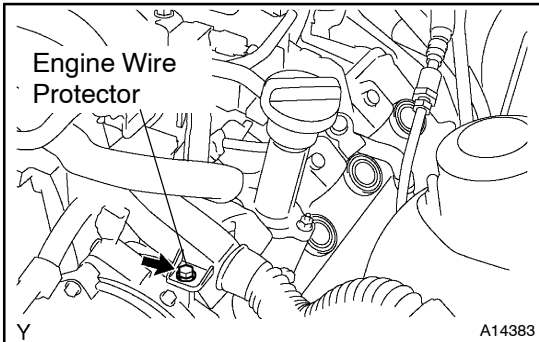
8. RECONNECT IGNITION COIL CONNECTORS

VALVE CLEARANCE INSPECTION

HINT:

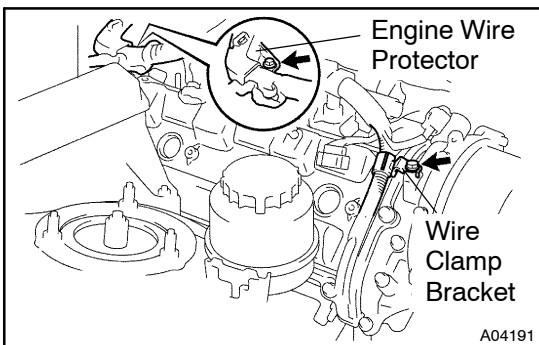
Inspect and adjust the valve clearance when the engine is cold.

1. **REMOVE V-BANK COVER**
2. **REMOVE INTAKE AIR CONNECTOR PIPE**
3. **REMOVE IGNITION COILS**



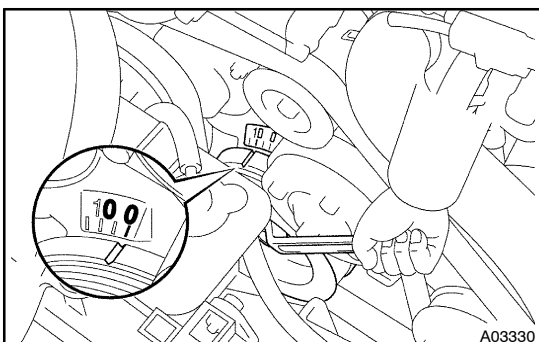
4. REMOVE LH CYLINDER HEAD COVER

- (a) Remove the bolt, and pull out the oil dipstick and guide for the engine.
- (b) Remove the bolt, and pull out the oil dipstick and guide for the transmission.
- (c) Disconnect the PCV valve on the PCV hose from the cylinder head cover.
- (d) Remove the bolt, and disconnect the engine wire protector from the camshaft bearing cap.
- (e) Remove the 9 bolts, 9 seal washers and cylinder head cover.



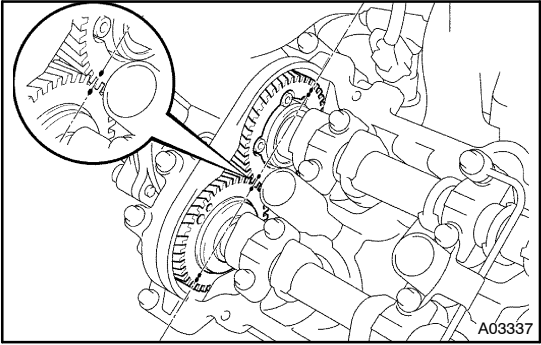
5. REMOVE RH CYLINDER HEAD COVER

- (a) Remove the bolt, and disconnect the wire clamp bracket from the camshaft bearing cap.
- (b) Remove the bolt, and disconnect the engine wire protector from the cylinder head.
- (c) Remove the 9 bolts, 9 seal washers and cylinder head cover.



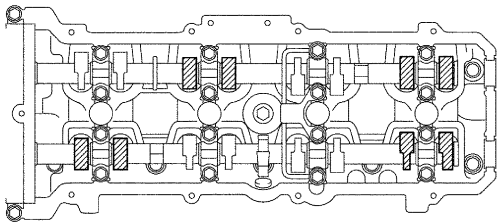
6. SET NO.1 CYLINDER TO TDC/COMPRESSION

- (a) Turn the crankshaft pulley, and align its groove with timing mark "0" of the No.1 timing belt cover.

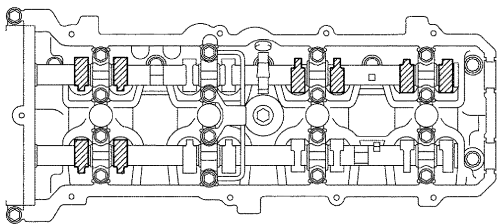


- (b) Check that the timing marks (1 dot mark) of the intake and exhaust camshaft gears on the LH bank are aligned. If not, turn the crankshaft 1 revolution (360°) and align the mark as above.

RH Bank



LH Bank



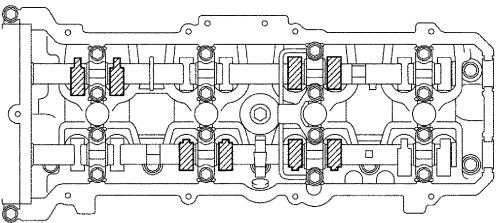
7. INSPECT VALVE CLEARANCE

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

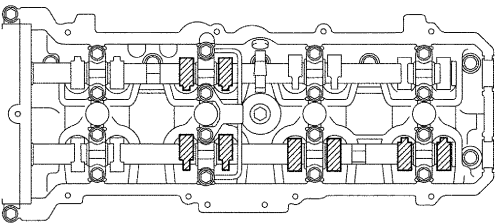
Valve clearance (Cold):

Intake	0.15 – 0.25 mm (0.006 – 0.010 in.)
Exhaust	0.25 – 0.35 mm (0.010 – 0.014 in.)

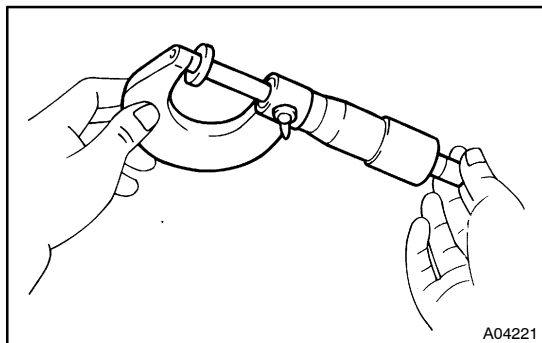
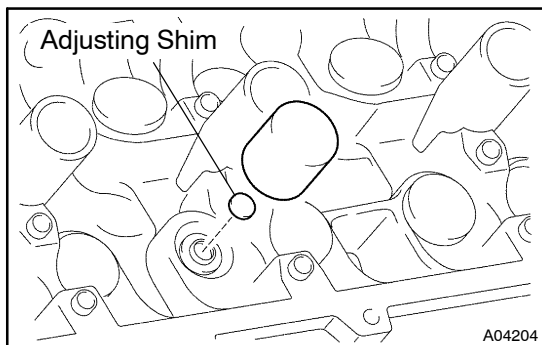
RH Bank



LH Bank



- (b) Turn the crankshaft 1 revolution (360°) and align the mark as above. (See procedure in step 9)
- (c) Check only the valves indicated as shown. Measure the valve clearance. (See procedure in step (a))



8. ADJUST VALVE CLEARANCE

- (a) Disconnect the timing belt from the camshaft timing pulleys. (See page EM-15)
- (b) Remove the camshafts. (See page EM-36)
- (c) Remove the valve lifter and adjusting shim.

NOTICE:

Be careful not to drop the adjusting shim into the lifter hole when removing the valve lifter.

- (d) Determine the replacement adjusting shim size according to these Formula or Charts:

- (1) Using a micrometer, measure the thickness of the removed shim.
 - (2) Calculate the thickness of a new shim so that the valve clearance comes within the specified value.
- T Thickness of removed shim
 A Measured valve clearance
 N Thickness of new shim

Intake	$N = T + (A - 0.20 \text{ mm (0.008 in.)})$
Exhaust	$N = T + (A - 0.30 \text{ mm (0.012 in.)})$

- (3) Select a new shim with a thickness as close as possible to the calculated value.

HINT:

Shims are available in 41 increments of 0.020 mm (0.0008 in.), from 2.00 mm (0.0787 in.) to 2.80 mm (0.1102 in.).

- (e) Reinstall a new adjusting shim to the spring retainer.
- (f) Reinstall the valve lifter.
- (g) Reinstall the camshafts. (See page EM-60)
- (h) Reconnect the timing belt to the camshaft timing pulleys. (See page EM-22)
- (i) Recheck the valve clearance.

9. REINSTALL CYLINDER HEAD COVERS

10. REINSTALL IGNITION COILS (See page IG-5)

11. REINSTALL INTAKE AIR CONNECTOR PIPE

12. REINSTALL V-BANK COVER

5

mm (in.)

New shim thickness

Exhaust valve clearance (Cold):

0.25 – 0.35 mm (0.010 – 0.014 in.)

EXAMPLE:

The 2.300 mm (0.0906 in.) shim is installed, and the measured clearance is 0.440 mm (0.0173 in.). Replace the 2.300 mm (0.0906 in.) shim with a No. 44 shim.

Shim No.	Thickness	Shim No.	Thickness	Shim No.	Thickness
00	2.000 (0.0787)	28	2.280 (0.0898)	56	2.560 (0.1008)
02	2.020 (0.0795)	30	2.300 (0.0906)	58	2.580 (0.1016)
04	2.040 (0.0803)	32	2.320 (0.0913)	60	2.600 (0.1024)
06	2.060 (0.0811)	34	2.340 (0.0921)	62	2.620 (0.1031)
08	2.080 (0.0819)	36	2.360 (0.0929)	64	2.640 (0.1039)
10	2.100 (0.0827)	38	2.380 (0.0937)	66	2.660 (0.1047)
12	2.120 (0.0835)	40	2.400 (0.0945)	68	2.680 (0.1055)
14	2.140 (0.0843)	42	2.420 (0.0953)	70	2.700 (0.1063)
16	2.160 (0.0850)	44	2.440 (0.0961)	72	2.720 (0.1071)
18	2.180 (0.0858)	46	2.460 (0.0969)	74	2.740 (0.1079)
20	2.200 (0.0866)	48	2.480 (0.0976)	76	2.760 (0.1087)
22	2.220 (0.0874)	50	2.500 (0.0984)	78	2.780 (0.1094)
24	2.240 (0.0882)	52	2.520 (0.0992)	80	2.800 (0.1102)
26	2.260 (0.0890)	54	2.540 (0.1000)		

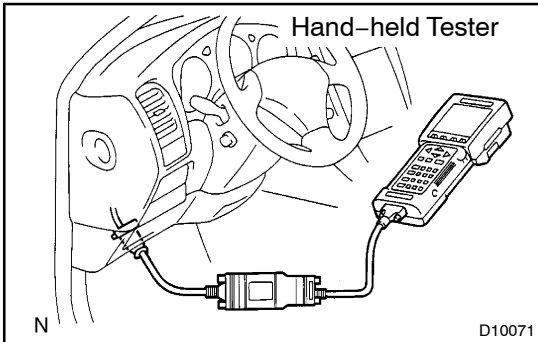
IGNITION TIMING INSPECTION

EM1KY-01

1. REMOVE V-BANK COVER

2. WARM UP ENGINE

Allow the engine to warm up to normal operating temperature.

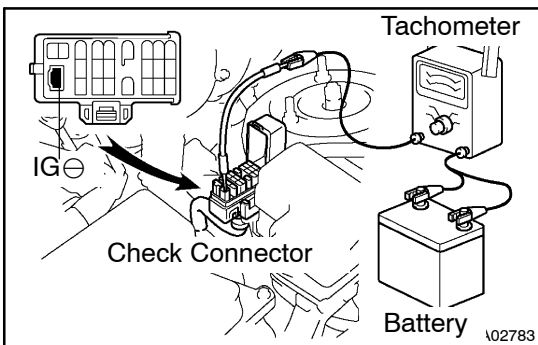


3. When using hand-held tester: INSPECT IGNITION TIMING

- Connect a hand-held tester to the DLC3.
- Please refer to the hand-held tester operator's manual for further details.
- Start the engine at idle.
- Check the ignition timing.

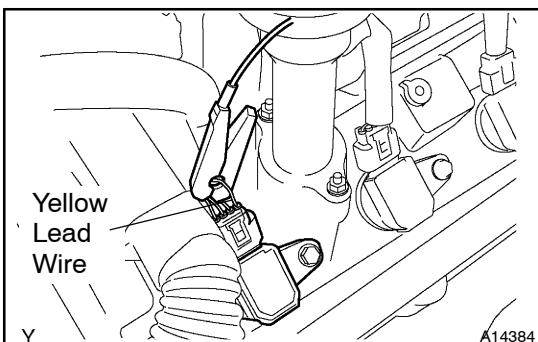
**Ignition timing: 8 – 12° BTDC @ idle
(Transmission in neutral position)**

- Disconnect a hand-held tester from the DLC3.

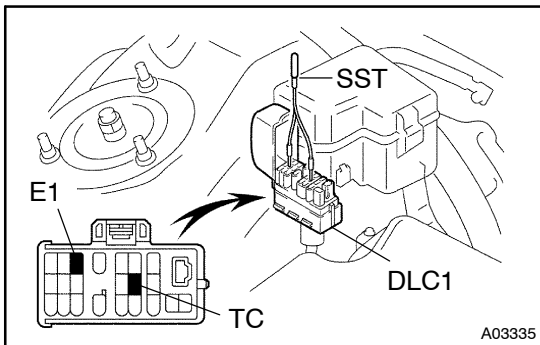


4. When not using hand-held tester: INSPECT IGNITION TIMING

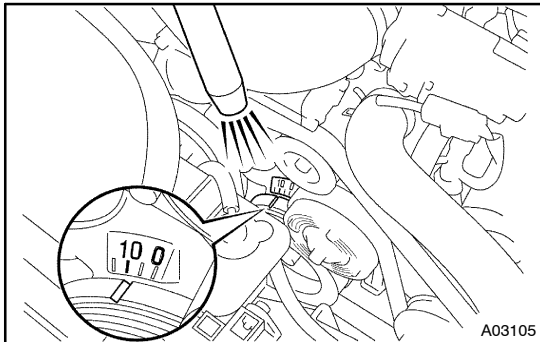
- Connect tachometer test probe to terminal IG $\ominus$ of the check connector.



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



- (c) Using SST, connect terminals TC and E1 of the DLC1.
SST 09843-18020



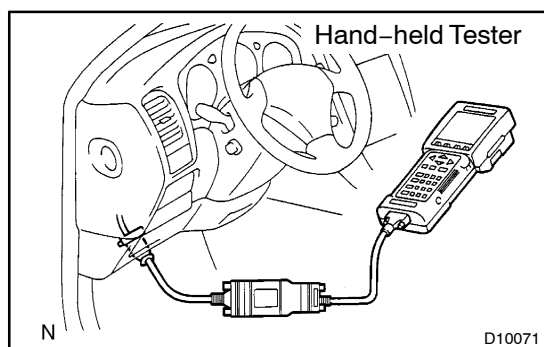
- (d) Start the engine at idle.
(e) Check the ignition timing.
**Ignition timing: 8 - 12° BTDC @ idle
(Transmission in neutral position)**
(f) Remove the SST from the DLC1.
SST 09843-18020
(g) Remove the timing light from the engine.
(h) Remove the tachometer.

5. REINSTALL V-BANK COVER

IDLE SPEED INSPECTION

1. INITIAL CONDITIONS

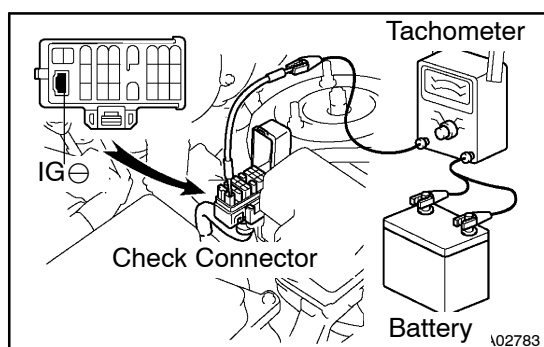
- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All pipes and hoses of air induction system connected
- (d) All vacuum lines properly connected
- (e) EFI system wiring connectors fully plugged
- (f) All operating accessories switched OFF
- (g) Ignition timing check correctly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



2. When using hand-held tester:

CONNECT HAND-HELD TESTER

- (a) Connect a hand-held tester to the DLC3.
- (b) Please refer to the hand-held tester operator's manual for further details.



3. When not using hand-held tester:

CONNECT TACHOMETER

Connect tachometer test probe to terminal IG $\ominus$ of the check connector.

4. INSPECT IDLE SPEED

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

Idle speed (w/ Cooling fan OFF): 750 $\pm$ 50 rpm

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

5. When using hand-held tester:

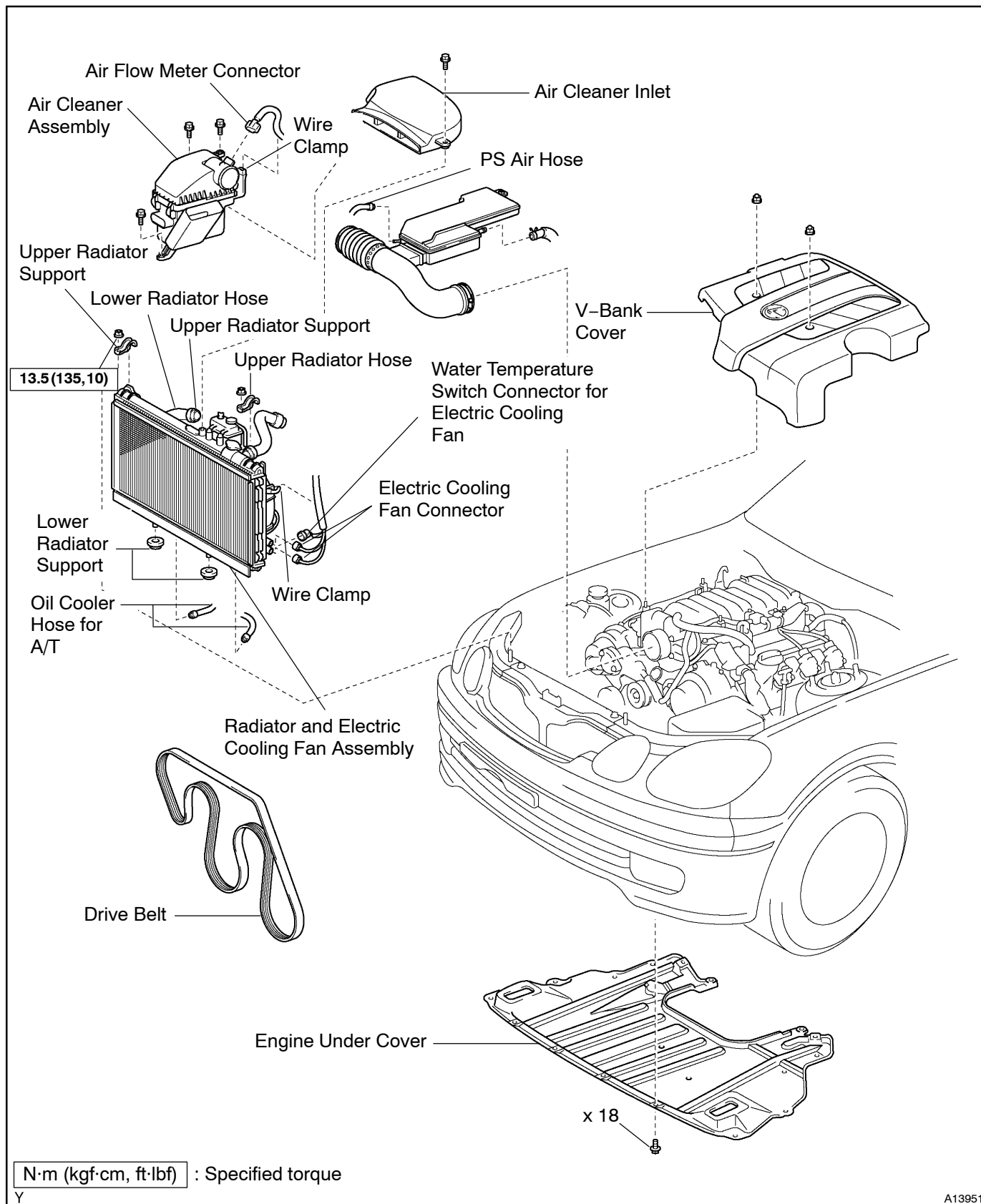
DISCONNECT HAND-HELD TESTER

6. When not using hand-held tester:

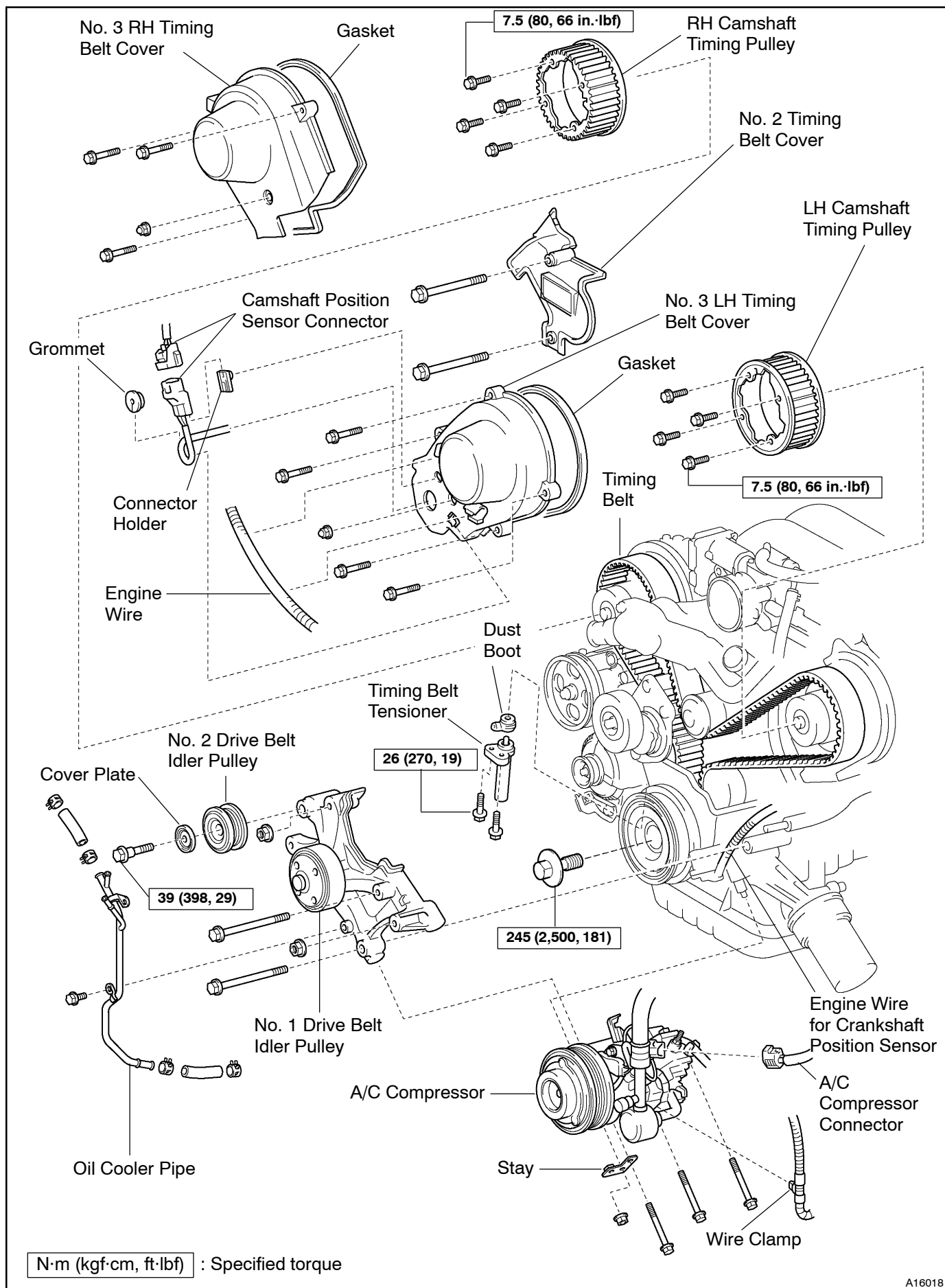
DISCONNECT TACHOMETER

TIMING BELT COMPONENTS

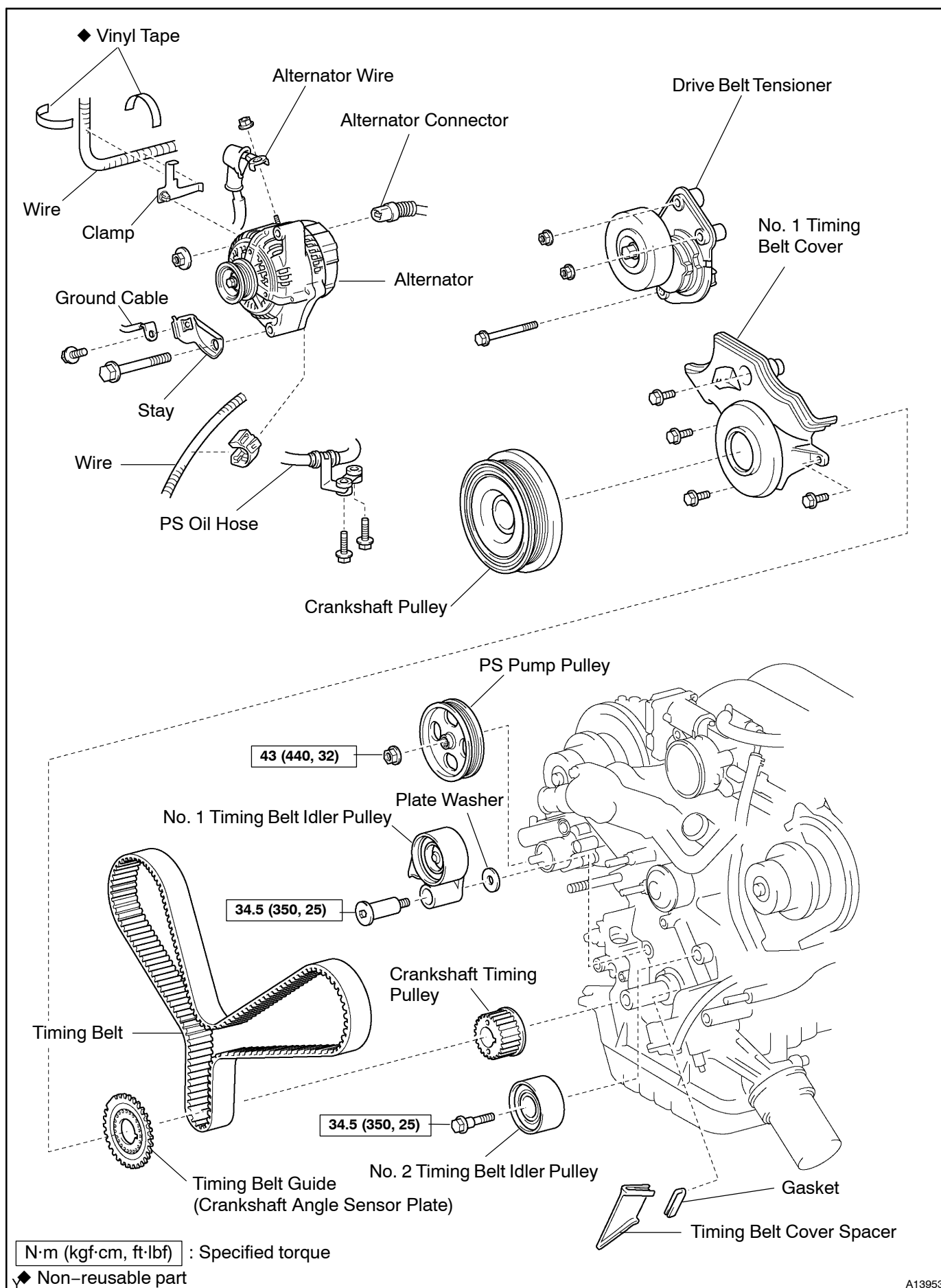
EM0DV-02



A13951



A16018



A13953

REMOVAL

1. REMOVE ENGINE UNDER COVER

2. DRAIN ENGINE COOLANT

3. REMOVE AIR CLEANER INLET

4. REMOVE V-BANK COVER

Remove the 2 bolts, 2 cap nuts and V-bank cover.

5. REMOVE AIR CLEANER ASSEMBLY

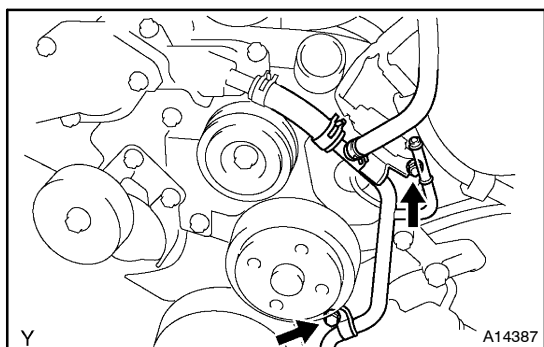
6. REMOVE INTAKE AIR CONNECTOR PIPE

7. REMOVE DRIVE BELT (See page CH-7)

8. REMOVE RADIATOR ASSEMBLY (See page CO-19)

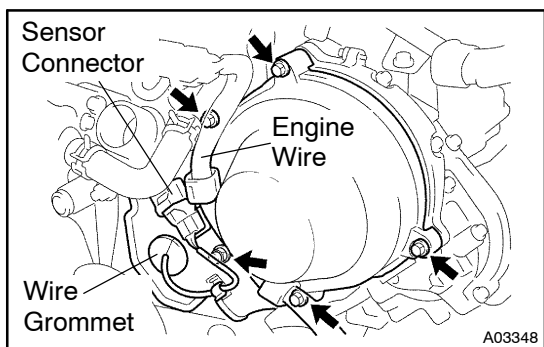
9. REMOVE NO.2 DRIVE BELT IDLER PULLEY

Remove the pulley bolt, cover plate and idler pulley.

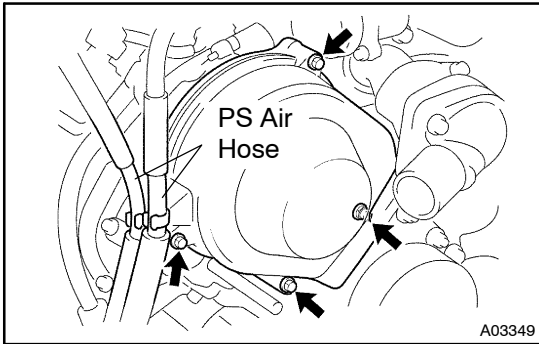


10. REMOVE LH NO.3 TIMING BELT COVER

- (a) Remove the bolt and nut, disconnect the oil cooler pipe from the timing belt cover and fan bracket.
- (b) Disconnect the 2 water bypass hoses from the oil cooler pipe.



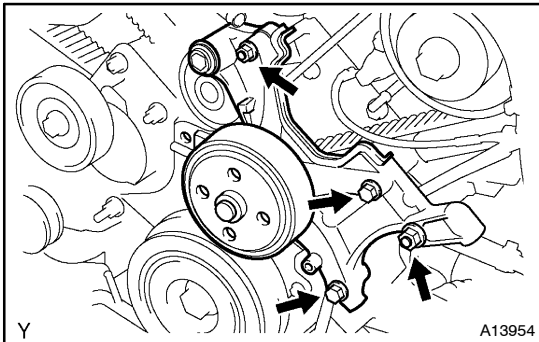
- (c) Disconnect the engine wire from the 2 wire clamps.
- (d) Disconnect the camshaft position sensor connector.
- (e) Disconnect the camshaft position sensor wire from the wire clamp on the timing belt cover.
- (f) Remove the wire grommet from the timing belt cover.
- (g) Remove the cap nut and 4 bolts, disconnect the timing belt cover from the timing plate and camshaft bearing cap.
- (h) Disconnect the wire clamp for the sensor from the timing belt cover.
- (i) Remove the connector holder from the sensor connector.
- (j) Remove the timing belt cover and gasket.

**11. REMOVE RH NO.3 TIMING BELT COVER**

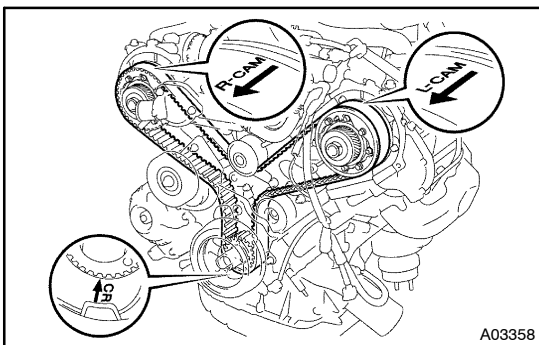
- (a) Disconnect the 2 PS air hoses from the hose clamp on the timing belt cover.
- (b) Remove the cap nut, 3 bolts, timing belt cover and gasket.

12. REMOVE NO.2 TIMING BELT COVER

Remove the 2 bolts and timing belt cover.

13. DISCONNECT A/C COMPRESSOR FROM ENGINE
(See page EM-80)**14. REMOVE NO.1 DRIVE BELT IDLER PULLEY**

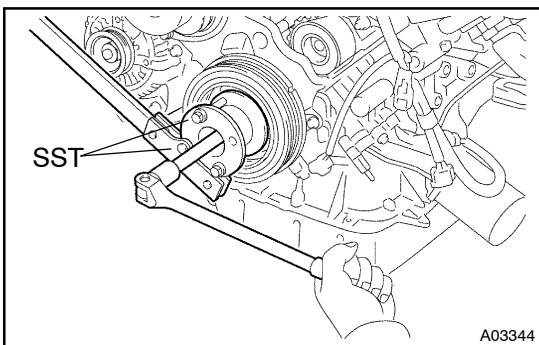
Remove the 2 bolts, 2 nuts and idler pulley.

**15. IF RE-USING TIMING BELT, CHECK INSTALLATION MARKS ON TIMING BELT**

Check that there are 3 installation marks on the timing belt by turning the crankshaft pulley as shown in the illustration.

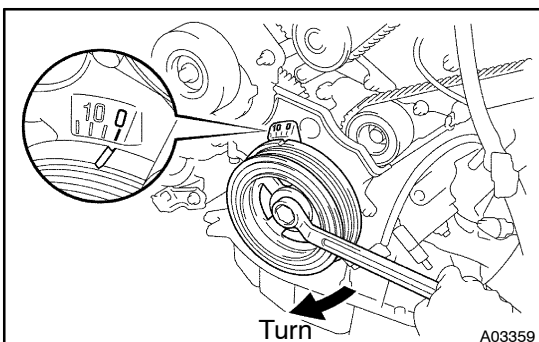
HINT:

If the installation marks have disappeared, place a new installation mark on the timing belt before removing each part.

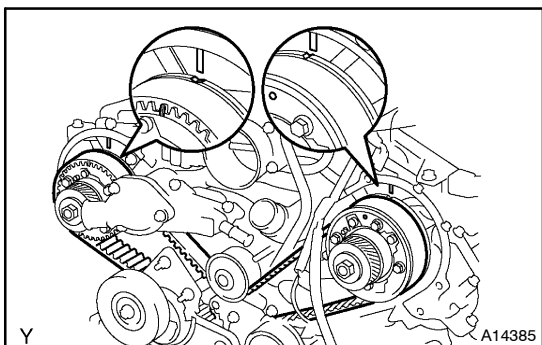
**16. LOOSEN CRANKSHAFT PULLEY BOLT**

Using SST, loosen the pulley bolt.

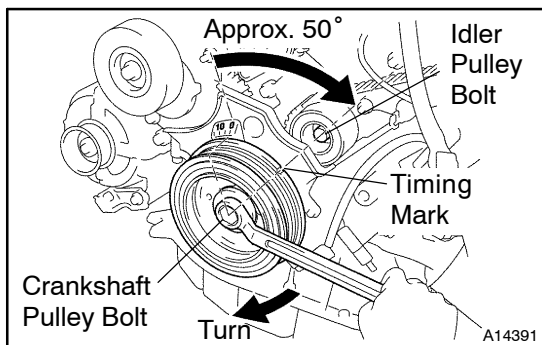
SST 09213-70010, 09330-00021

**17. SET NO.1 CYLINDER TO APPROX. 50° ATDC/COMPRESSION**

- (a) Turn the crankshaft pulley and align its groove with timing mark "0" of the No.1 timing belt cover.



- (b) Check that the timing marks of the camshaft timing pulleys and timing belt rear plates aligned.
If not, turn the crankshaft 1 revolution (360°).



- (c) Turn the crankshaft pulley approx. 50° clockwise, and put the timing mark of the crankshaft pulley in line with the centers of the crankshaft pulley bolt and the No.2 timing belt idler pulley bolt.

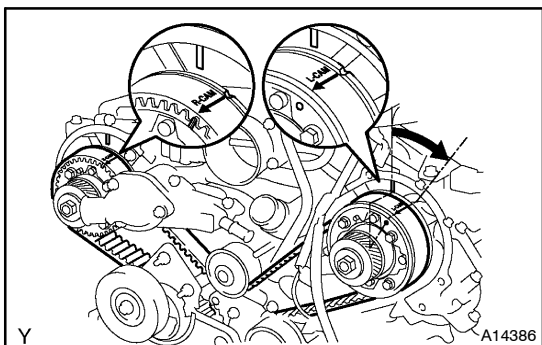
NOTICE:

If the timing belt is disengaged, having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you remove the camshaft timing pulley (step 15), causing damage. So always set the crankshaft pulley at the correct angle.

- (d) Remove the crankshaft pulley bolt.

NOTICE:

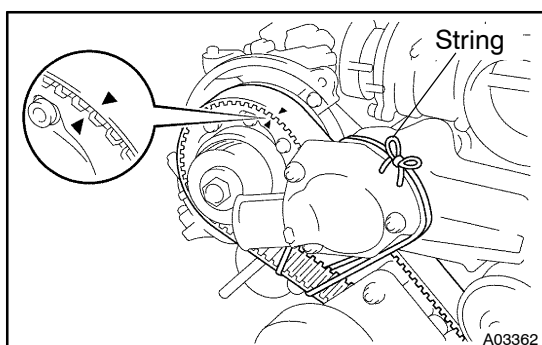
Do not turn the crankshaft pulley.

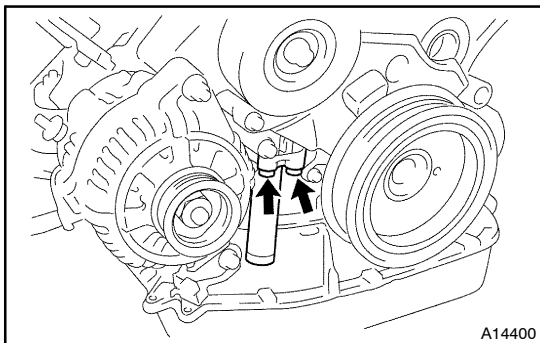


18. REMOVE TIMING BELT TENSIONER

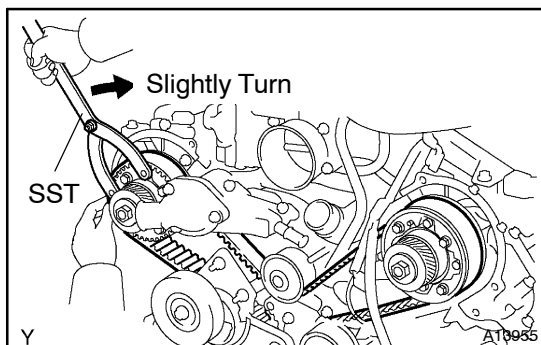
HINT:

- When re-using timing belt:
If the installation marks have disappeared, before remove the timing belt, place 2 new installation marks on the timing belt to match the timing marks of the camshaft timing pulleys.
- When replacing timing belt tensioner only:
To avoid meshing of the timing pulley and timing belt, secure one of them with string. And place matchmarks on the timing belt and RH camshaft timing pulley.



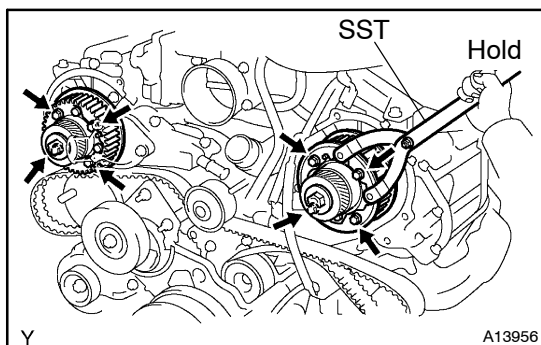


Alternately loosen the 2 bolts, and remove them, the belt tensioner and dust boot.



19. DISCONNECT TIMING BELT FROM CAMSHAFT TIMING PULLEYS

- (a) Using SST, loosen the tension between the LH and RH camshaft timing pulleys by slightly turning the RH camshaft timing pulley clockwise.
SST 09960-10010 (09962-01000, 09963-00350)
- (b) Disconnect the timing belt from the camshaft timing pulleys.



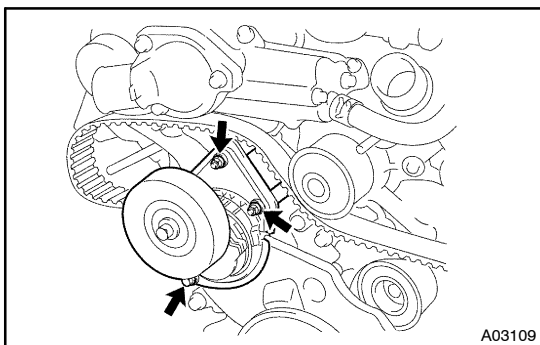
20. REMOVE CAMSHAFT TIMING PULLEYS

Using SST, remove the 4 bolts and timing pulley. Remove the 2 timing pulleys.

SST 09960-10010 (09962-01000, 09963-00350)

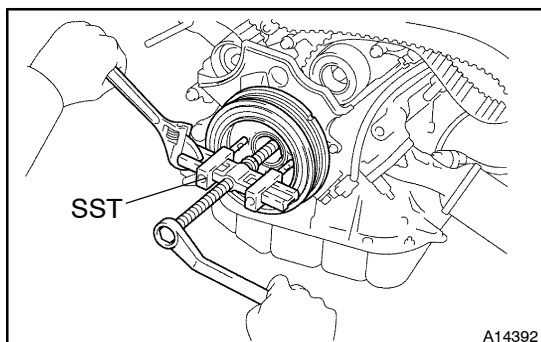
21. REMOVE PS PUMP PULLEY (See page CH-7)

22. REMOVE ALTERNATOR (See page CH-7)



23. REMOVE DRIVE BELT TENSIONER

Remove the bolt, 2 nuts and belt tensioner.



24. REMOVE CRANKSHAFT PULLEY

Using SST, remove the crankshaft pulley.

SST 09950-50012 (09951-05010, 09952-05010, 09953-05010, 09953-05020, 09954-05020)

NOTICE:

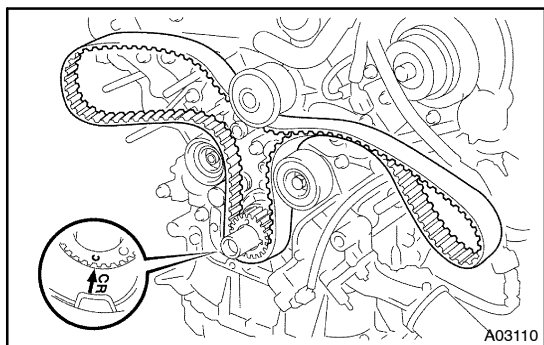
Do not turn the crankshaft pulley.

25. REMOVE NO.1 TIMING BELT COVER

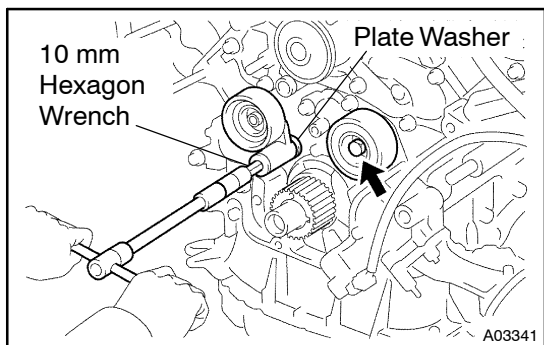
Remove the 4 bolts, timing belt cover.

26. REMOVE TIMING BELT GUIDE

27. REMOVE TIMING BELT COVER SPACER

**28. REMOVE TIMING BELT****HINT:**

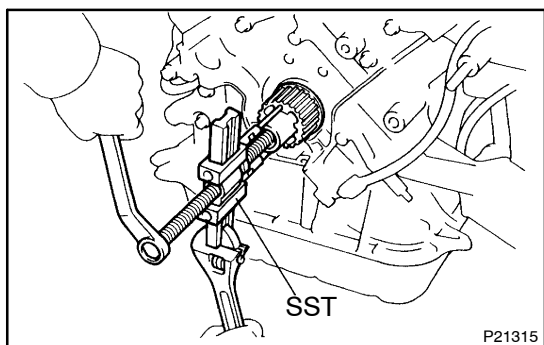
If re-using the belt and the installation mark has disappeared from it, place a new installation mark on the timing belt to match the dot mark of the crankshaft timing pulley.

**29. REMOVE NO.1 TIMING BELT IDLER PULLEY**

Using a 10 mm hexagon wrench, remove the bolt, idler pulley and plate washer.

30. REMOVE NO.2 TIMING BELT IDLER PULLEY

Remove the bolt and idler pulley.

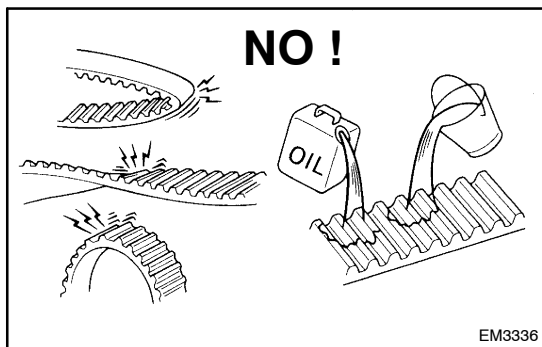
**31. REMOVE CRANKSHAFT TIMING PULLEY**

Using SST, remove the timing pulley.

SST 09950-50012 (09951-05010, 09952-05010, 09953-05010, 09953-05020, 09954-05010)

NOTICE:

Do not turn the timing pulley.



INSPECTION

1. INSPECT TIMING BELT

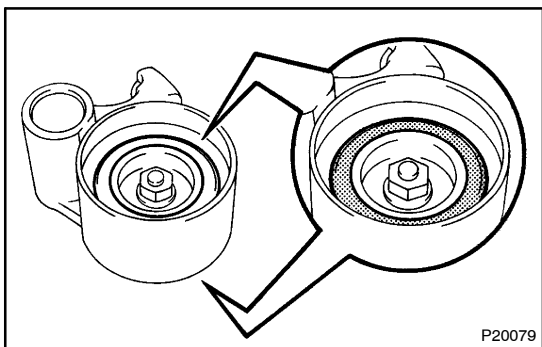
NOTICE:

- Do not bend, twist or turn the timing belt inside out.
- Do not allow the timing belt to come into contact with oil, water or steam.
- Do not utilize timing belt tension when installing or removing the mount bolt of the camshaft timing pulley.

If there are any defects, as shown in the illustrations, check these points:

- Premature parting
 - Check for proper installation.
 - Check the timing cover gasket for damage and proper installation.
- If the belt teeth are cracked or damaged, check to see if either camshaft is locked.
- If there is noticeable wear or cracks on the belt face, check to see if there are nicks on the side of the idler pulley lock and water pump.
- If there is wear or damage on only one side of the belt, check the belt guide and the alignment of each pulley.
- If there is noticeable wear on the belt teeth, check timing cover for damage and check gasket has been installed correctly and for foreign material on the pulley teeth.

If necessary, replace the timing belt.



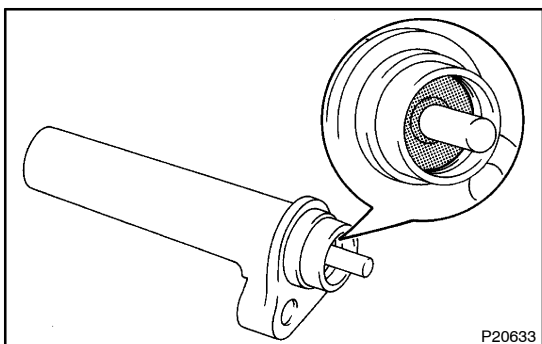
2. INSPECT IDLER PULLEYS

- Visually check the seal portion of the idler pulley for oil leakage.

If leakage is found, replace the idler pulley.

- Check that the idler pulley turns smoothly.

If necessary, replace the idler pulley.



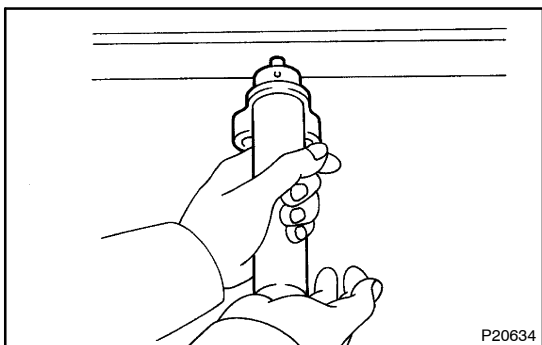
3. INSPECT TIMING BELT TENSIONER

- Visually check the seal portion of the tensioner for oil leakage.

HINT:

If there is only the faintest trace of oil on the seal on the push rod side, the tensioner is all right.

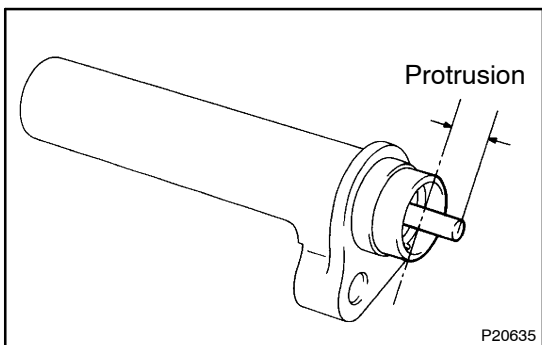
If leakage is found, replace the tensioner.



- (b) Hold the tensioner with both hands and push the push rod strongly as shown to check that it doesn't move. If the push rod moves, replace the tensioner.

NOTICE:

Never hold the tensioner push rod facing downward.

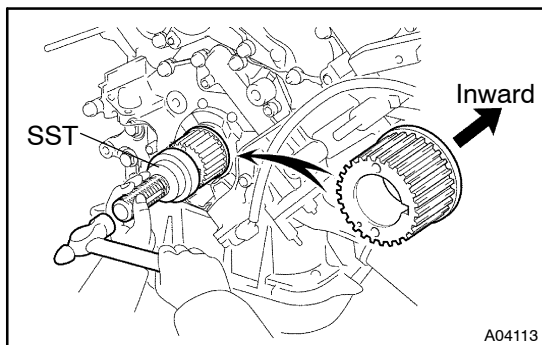


- (c) Measure the protrusion of the push rod from the housing end.

Protrusion: 9.5 – 10.5 mm (0.374 – 0.413 in.)

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

4. □ INSPECT WATER PUMP (See page CO-7)

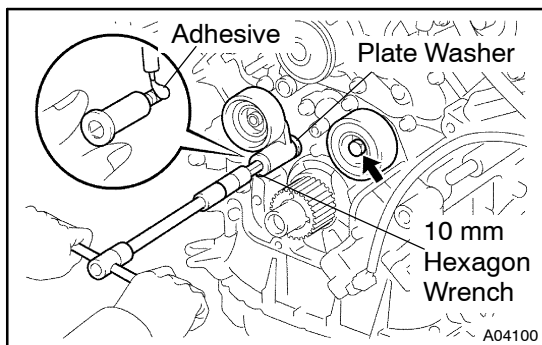


INSTALLATION

1. INSTALL CRANKSHAFT TIMING PULLEY

- (a) Align the timing pulley set key with the key groove of the pulley.
- (b) Using SST and a hammer, tap in the timing pulley, facing the flange side inward.

SST 09223-46011



2. INSTALL NO.1 TIMING BELT IDLER PULLEY

- (a) Apply adhesive 2 or 3 threads of the pivot bolt.

Adhesive:

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

- (b) Using a 10 mm hexagon wrench, install the plate washer and idler pulley with the pivot bolt.

Torque: 34.5 N·m (350 kgf·cm, 25 ft·lbf)

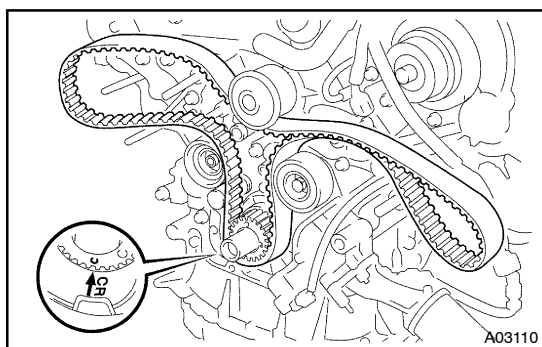
- (c) Check that the pulley bracket moves smoothly.

3. INSTALL NO.2 TIMING BELT IDLER PULLEY

- (a) Install the idler pulley with the bolt.

Torque: 34.5 N·m (350 kgf·cm, 25 ft·lbf)

- (b) Check that the idler pulley moves smoothly.



4. TEMPORARILY INSTALL TIMING BELT

NOTICE:

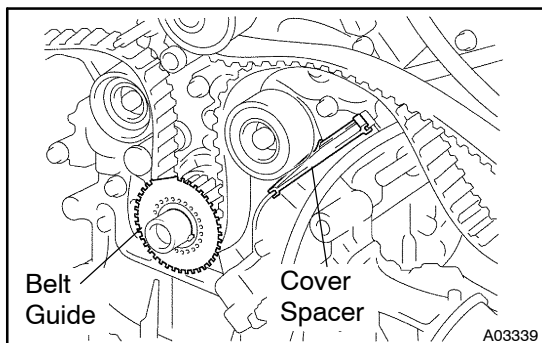
The engine should be cold.

- (a) Remove any oil or water on the crankshaft pulley, oil pump pulley, water pump pulley, No.1 idler pulley and No.2 idler pulley, and keep them clean.

NOTICE:

Only wipe the pulleys; do not use any cleansing agent.

- (b) Align the installation mark on the timing belt with the timing mark of the crankshaft timing pulley.
- (c) Install the timing belt on the crankshaft timing pulley, No.1 idler pulley and No.2 idler pulley.

**5. INSTALL TIMING BELT COVER SPACER**

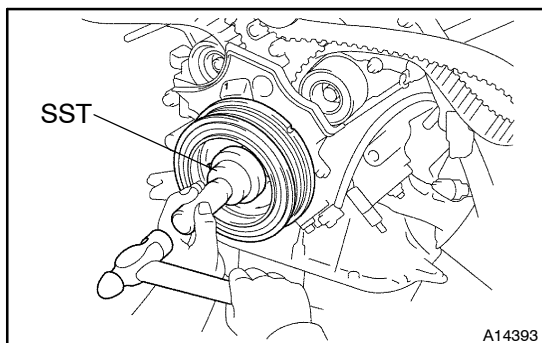
- (a) Install the gasket to the cover spacer.
- (b) Install the cover spacer.

6. INSTALL TIMING BELT GUIDE

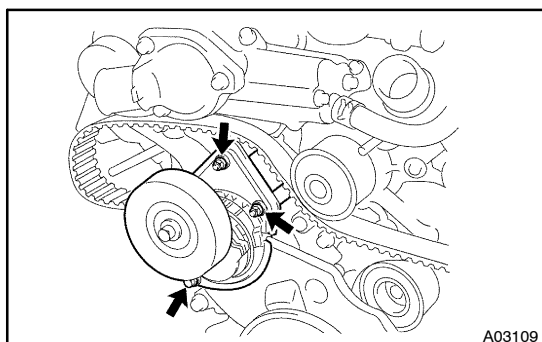
Install the belt guide, facing the cup side outward.

7. INSTALL NO.1 TIMING BELT COVER

Install the timing belt cover with the 4 bolts.

**8. INSTALL CRANKSHAFT PULLEY**

- (a) Align the pulley set key with the key groove of the crankshaft pulley.
- (b) Using SST and a hammer, tap in the crankshaft pulley.
SST 09223-46011

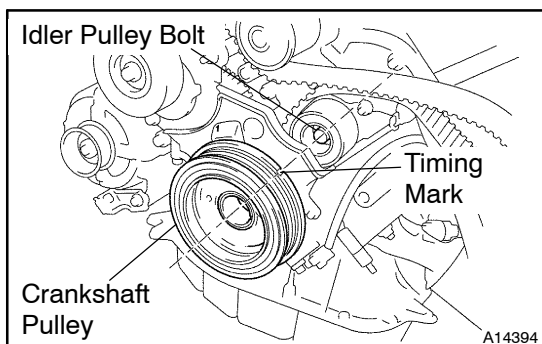
**9. INSTALL DRIVE BELT TENSIONER**

Install the belt tensioner with the bolt and 2 nuts.

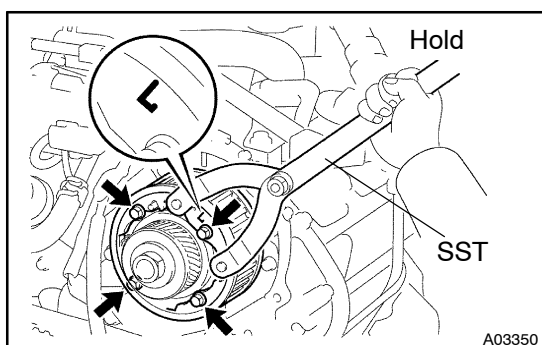
Torque: 15.5 N·m (160 kgf·cm, 11 ft·lbf)

HINT:

Use a bolt 106 mm (4.18 in.) in length.

10. INSTALL ALTERNATOR (See page CH-15)**11. INSTALL PS PUMP PULLEY (See page CH-15)****12. CHECK CRANKSHAFT PULLEY POSITION**

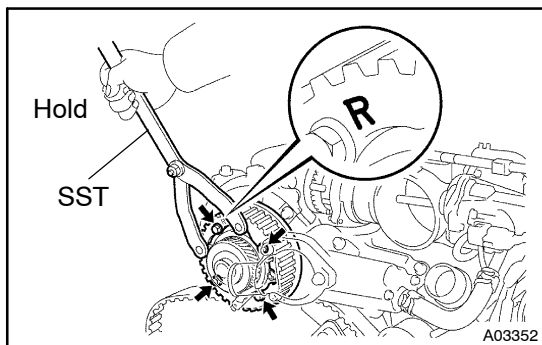
Check that the timing mark of the crankshaft pulley is aligned with the centers of the crankshaft pulley and the No.2 timing belt idler pulley bolt.

**13. INSTALL LH CAMSHAFT TIMING PULLEY**

- (a) Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.
- (b) Attach the timing pulley to the camshaft timing tube, facing the "L" mark forward.
- (c) Using SST, install the 4 pulley bolts.

SST 09960-10010 (09962-01000, 09963-00350)

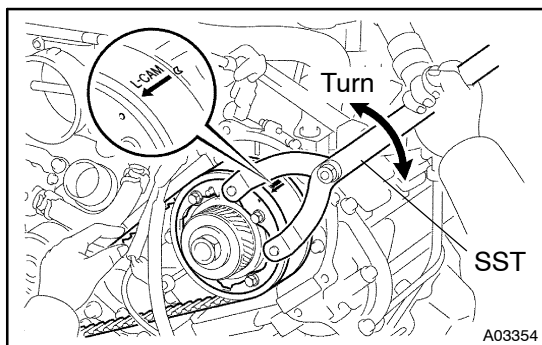
Torque: 7.5 N·m (80 kgf·cm, 66 in·lbf)

**14. INSTALL RH CAMSHAFT TIMING PULLEY**

- Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.
- Attach the timing pulley to the camshaft timing tube, facing the "R" mark forward.
- Using SST, install the 4 pulley bolts.

SST 09960-10010 (09962-01000, 09963-00350)

Torque: 7.5 N·m (80 kgf·cm, 66 in.·lbf)

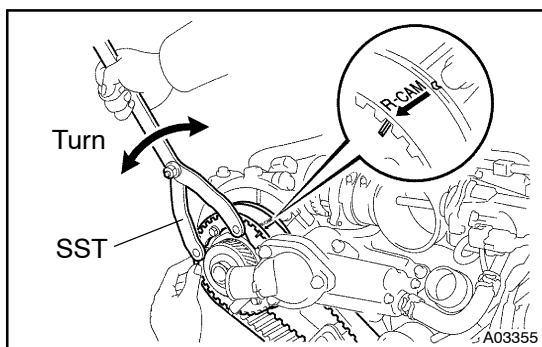
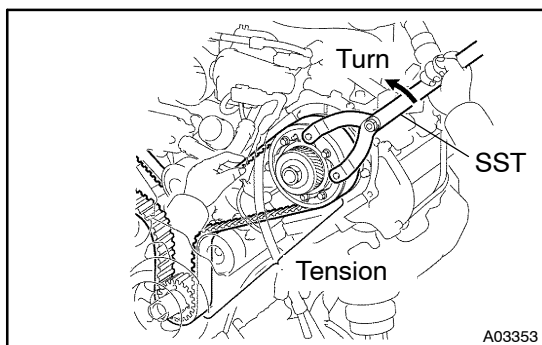
**15. CONNECT TIMING BELT TO LH CAMSHAFT TIMING PULLEY**

- Remove any oil or water on the timing pulley, and keep it clean.

NOTICE:

Only wipe the pulleys; do not use any cleansing agent.

- Using SST, turn the timing pulley. Align the installation mark on the timing belt with the timing mark of the timing pulley, and hang the timing belt on the timing pulley.
SST 09960-10010 (09962-01000, 09963-00350)
- Using SST, turn the LH camshaft timing pulley counter-clockwise until there is tension between the crankshaft timing pulley and LH camshaft timing pulley.
SST 09960-10010 (09962-01000, 09963-00350)

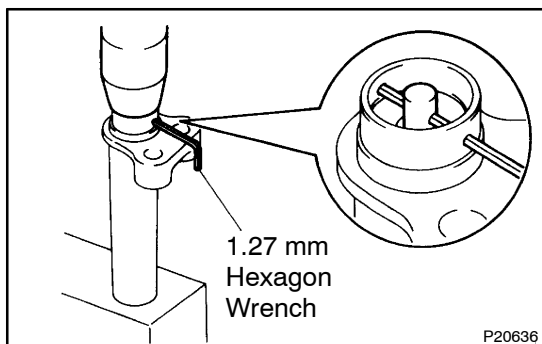
**16. CONNECT TIMING BELT TO RH CAMSHAFT TIMING PULLEY**

- Remove any oil or water on the camshaft timing pulley and water pump pulley, and keep them clean.

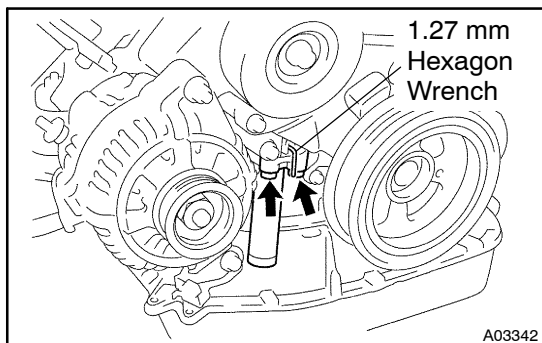
NOTICE:

Only wipe the pulleys; do not use any cleansing agent.

- Using SST, turn the timing pulley. Align the installation mark on the timing belt with the timing mark of the timing pulley, and hang the timing belt on the timing pulley.
SST 09960-10010 (09962-01000, 09963-00350)

**17. SET TIMING BELT TENSIONER**

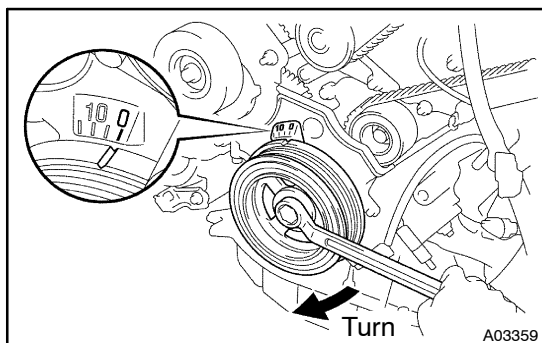
- Using a press, slowly press in the push rod using 981 – 9,807 N (100 – 1,000 kgf, 220 – 2,205 lbf) of pressure.
- Align the holes of the push rod and housing, pass a 1.27 mm hexagon wrench through the holes to keep the setting position of the push rod.
- Release the press.
- Install the dust boot to the belt tensioner.

**18. INSTALL TIMING BELT TENSIONER**

- Temporarily install the belt tensioner with the 2 bolts.
- Alternately tighten the 2 bolts.

Torque: 26 N·m (270 kgf·cm, 19 ft·lbf)

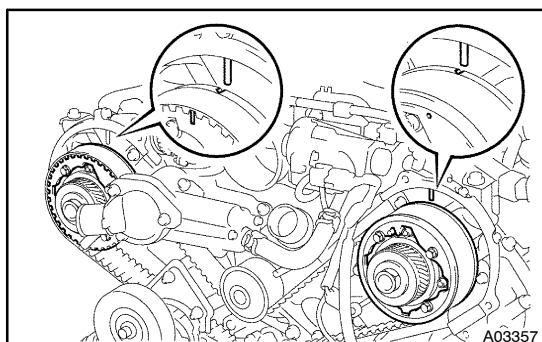
- Using pliers, remove the 1.27 mm hexagon wrench from the belt tensioner.

**19. CHECK VALVE TIMING**

- Temporarily install the crankshaft pulley bolt.
- Slowly turn the crankshaft pulley 2 revolutions from TDC to TDC.

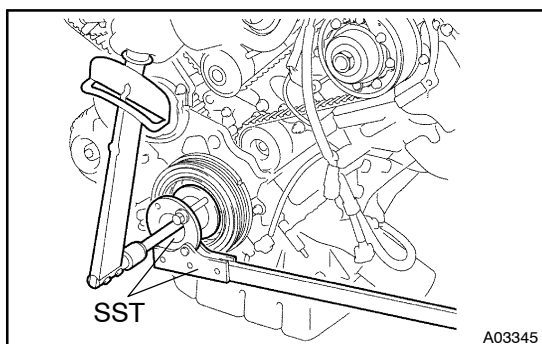
NOTICE:

Always turn the crankshaft pulley clockwise.



- Check that each pulley aligns with the timing marks as shown in the illustration.

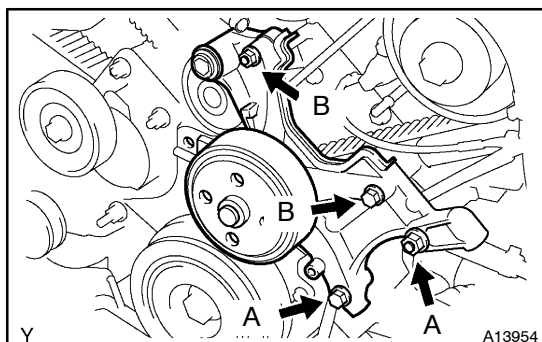
If the timing marks do not align, remove the timing belt and reinstall it.

**20. TIGHTEN CRANKSHAFT PULLEY BOLT**

Using SST, install the pulley bolt.

SST 09213-70010, 09330-00021

Torque: 245 N·m (2,500 kgf·cm, 181 ft·lbf)

**21. INSTALL NO.1 DRIVE BELT IDLER PULLEY**

Install the idler pulley with the 2 bolts and 2 nuts.

Torque:

16 N·m (160 kgf·cm, 12 ft·lbf) for 12 mm head

32 N·m (330 kgf·cm, 24 ft·lbf) for 14 mm head

HINT:

- Each bolt length is indicated in the illustration.

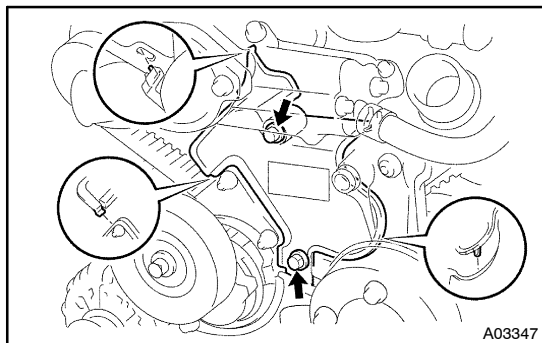
Bolt Length:

106 mm (4.17 in.) for 12 mm head (A)

114 mm (4.49 in.) for 14 mm head (B)

- Pass the engine wire for the crankshaft position sensor between the idler pulley and oil pump.

22. INSTALL A/C COMPRESSOR (See page EM-85)

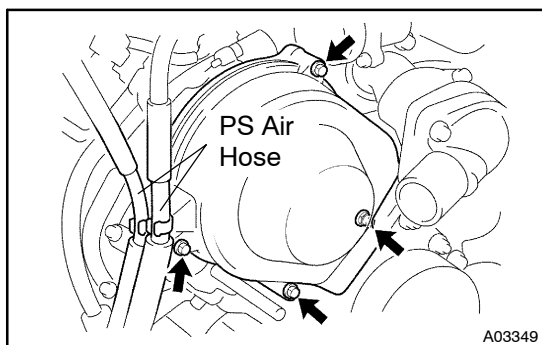


23. INSTALL NO.2 TIMING BELT COVER

- Fit the timing belt cover, matching the claws and pin with each part.
- Install the timing belt cover with the 2 bolts.
Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

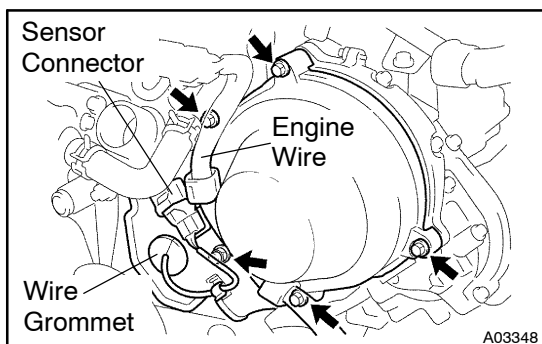
HINT:

Use bolts 106 mm (4.17 in.) in length.



24. INSTALL RH NO.3 TIMING BELT COVER

- Install the gasket to the timing belt cover.
- Install the timing belt cover with the cap nut and 3 bolts.
- Install the 2 PS air hoses to the clamp on the timing belt cover.



25. INSTALL LH NO.3 TIMING BELT COVER

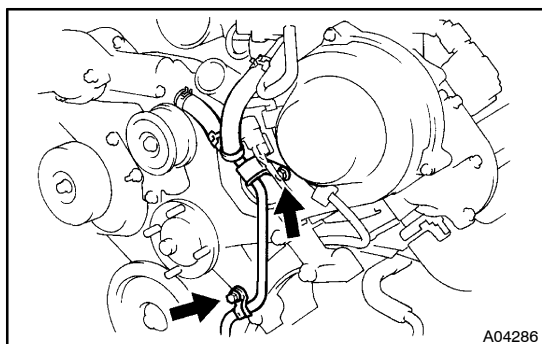
- Install the gasket to the timing belt cover.
- Run the camshaft position sensor wire through the timing belt cover hole.
- Install the timing belt cover with the cap nut and 4 bolts.
- Install the wire grommet to the timing belt cover.
- Install the sensor connector to the connector holder.
- Connect the sensor connector.
- Install the sensor wire to the wire clamp on the timing belt cover.
- Install the connector holder to the timing belt cover.
- Install the engine wire to the 2 wire clamps on the timing belt cover.
- Connect the 2 water bypass hoses to the oil cooler pipe.
- Install the oil cooler pipe to the belt cover and bracket with the bolt and nut.

26. INSTALL NO.2 DRIVE BELT IDLER PULLEY

Install the idler pulley and cover plate with the bolt.

Torque: 39 N·m (398 kgf·cm, 29 ft·lbf)

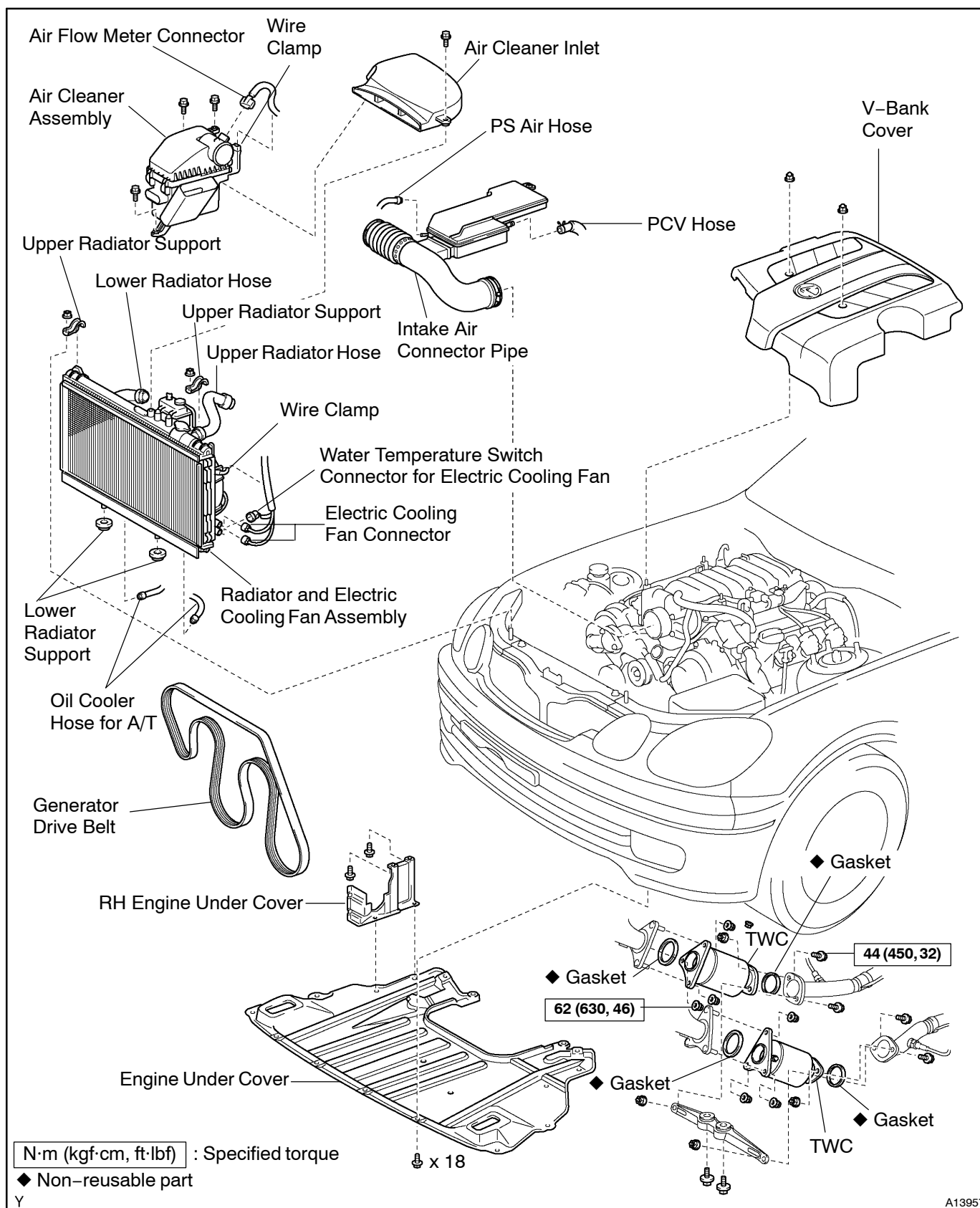
27. INSTALL RADIATOR ASSEMBLY (See page CO-24)



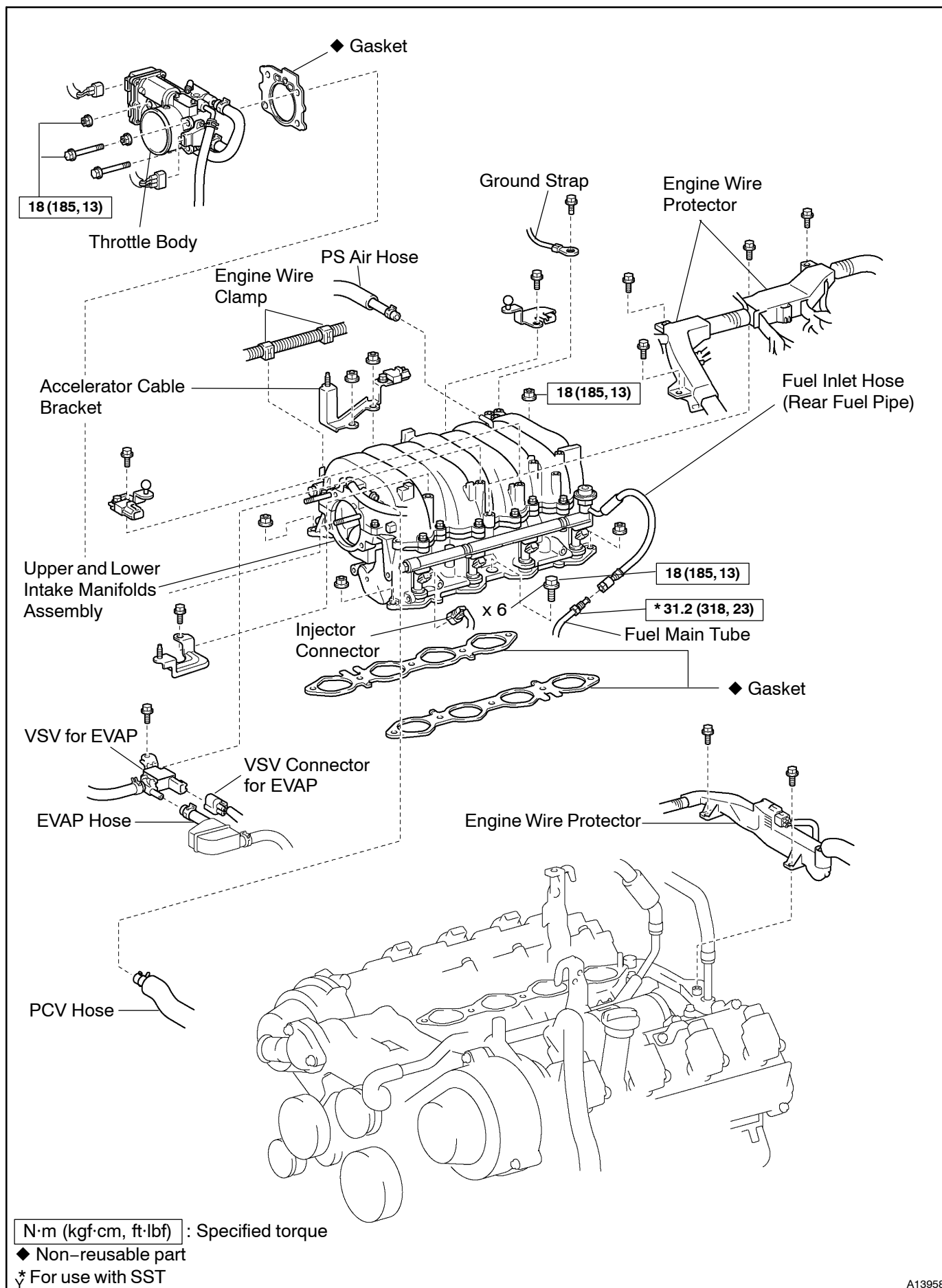
28. ☐ INSTALL DRIVE BELT (See page CH-16)
29. INSTALL INTAKE AIR CONNECTOR PIPE
30. INSTALL AIR CLEANER ASSEMBLY
31. ☐ FILL WITH ENGINE COOLANT (See page CO-2)
32. START ENGINE AND CHECK FOR ENGINE COOLANT LEAKS
33. INSTALL V-BANK COVER
34. INSTALL AIR CLEANER INLET
35. INSTALL ENGINE UNDER COVER

CYLINDER HEAD COMPONENTS

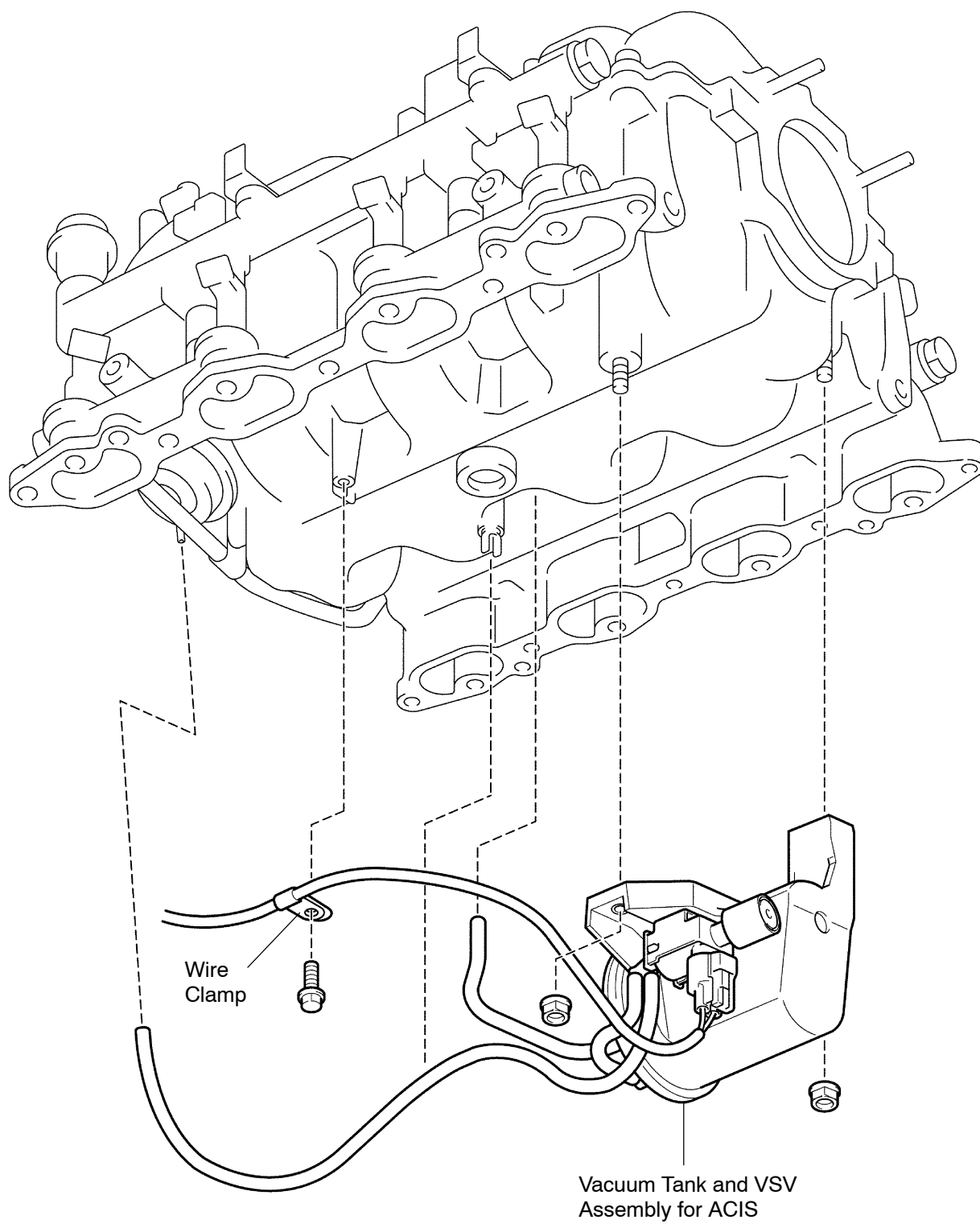
EM02-02

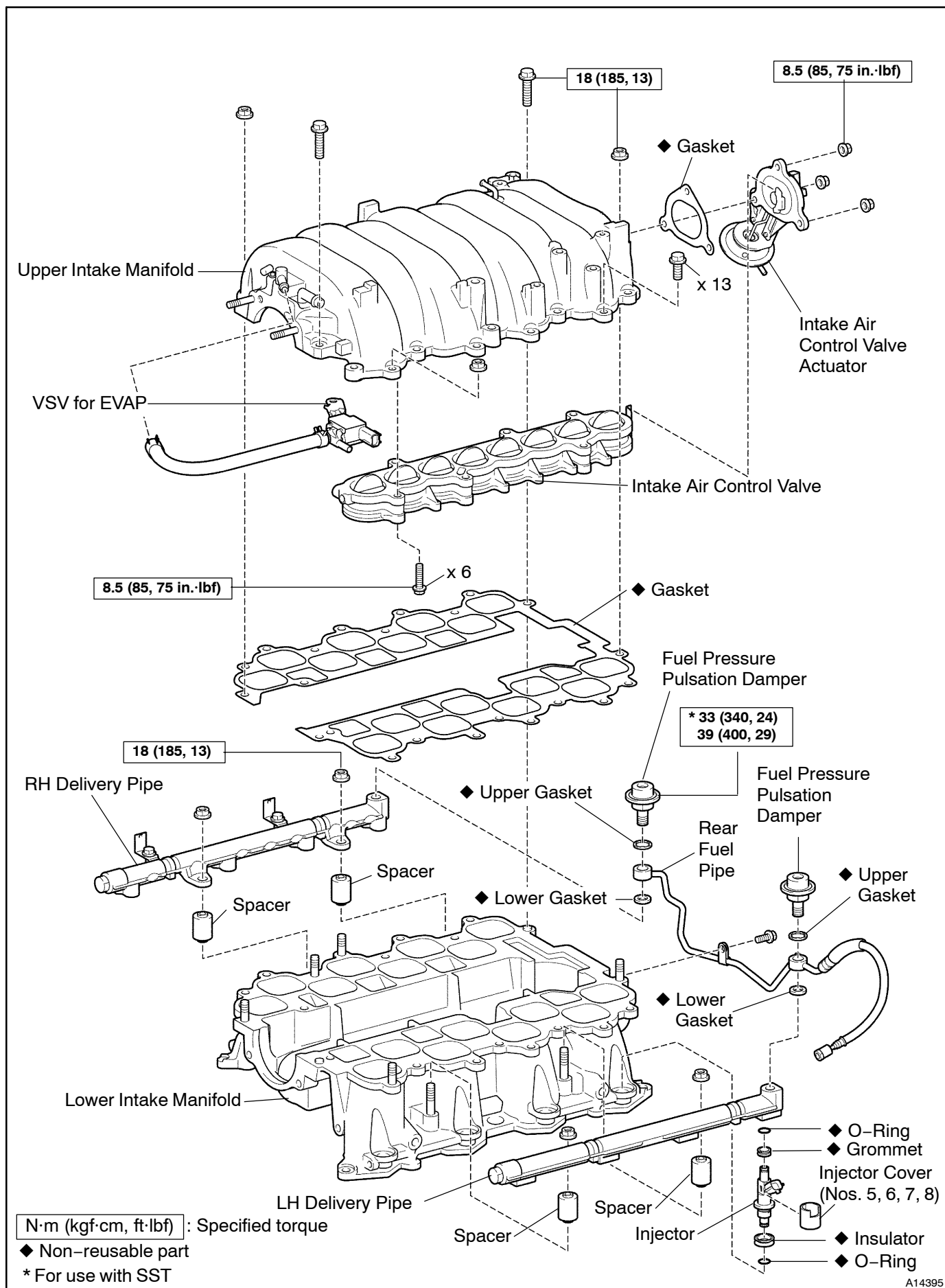


A13957

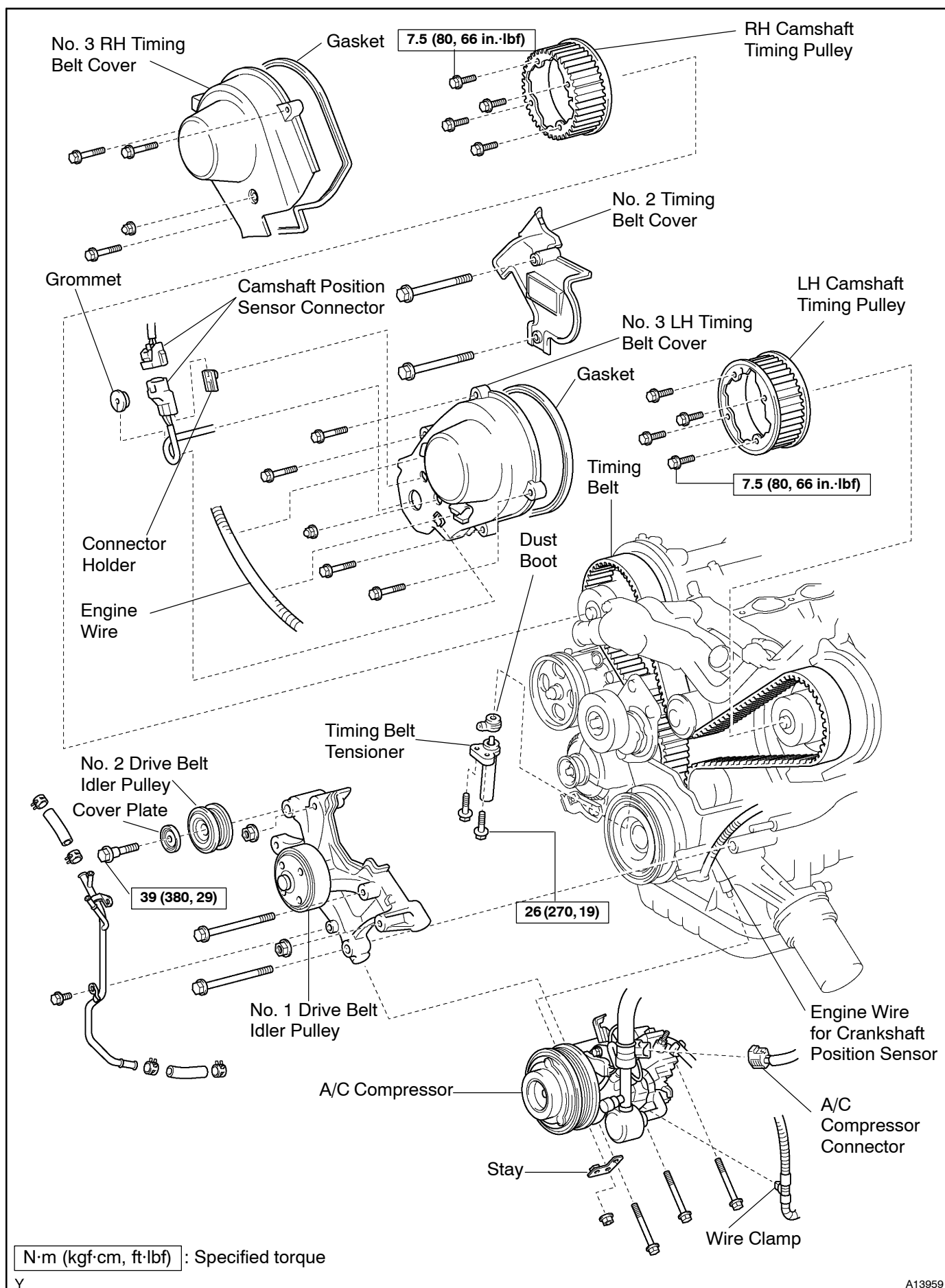


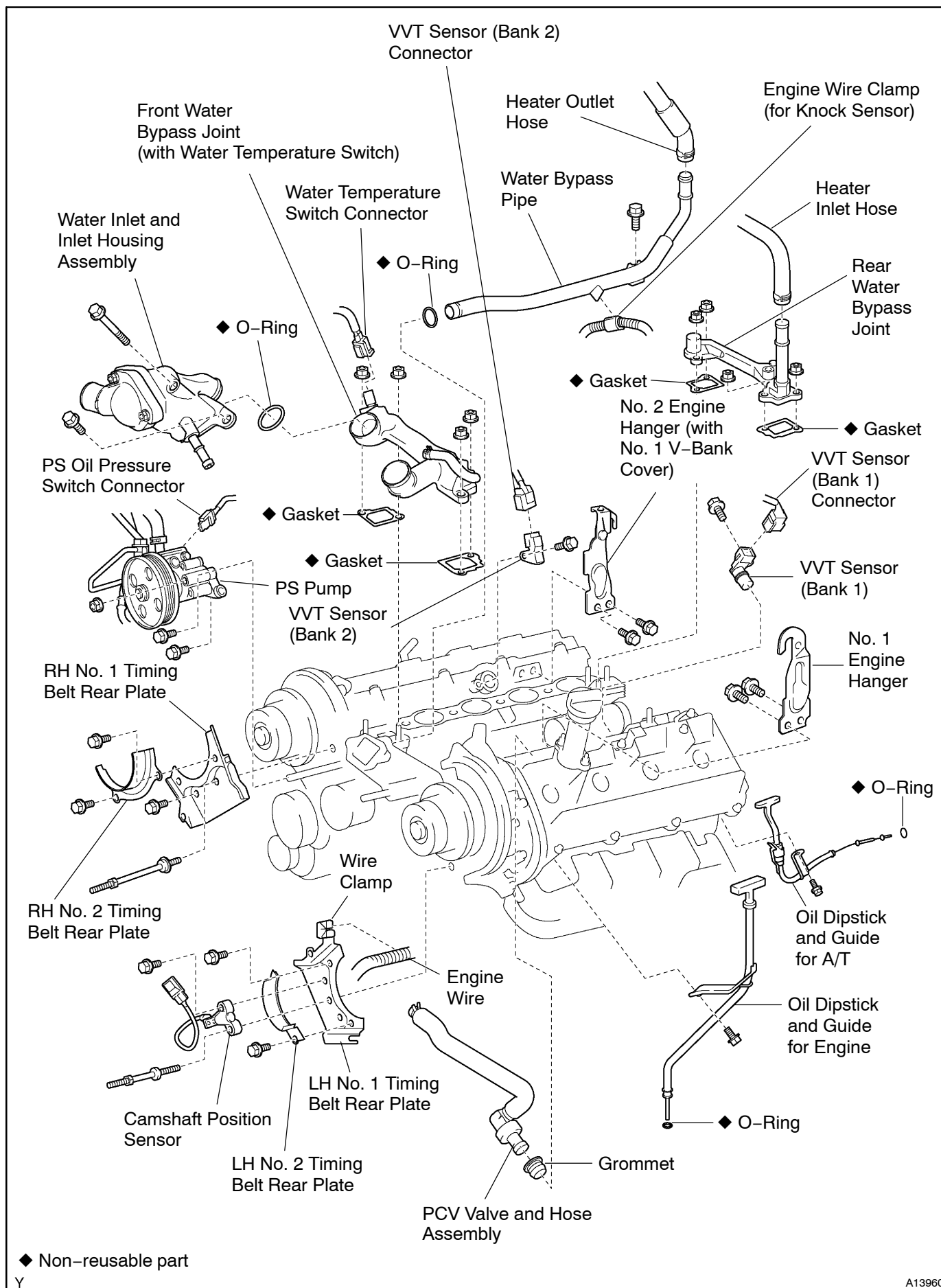
A13958

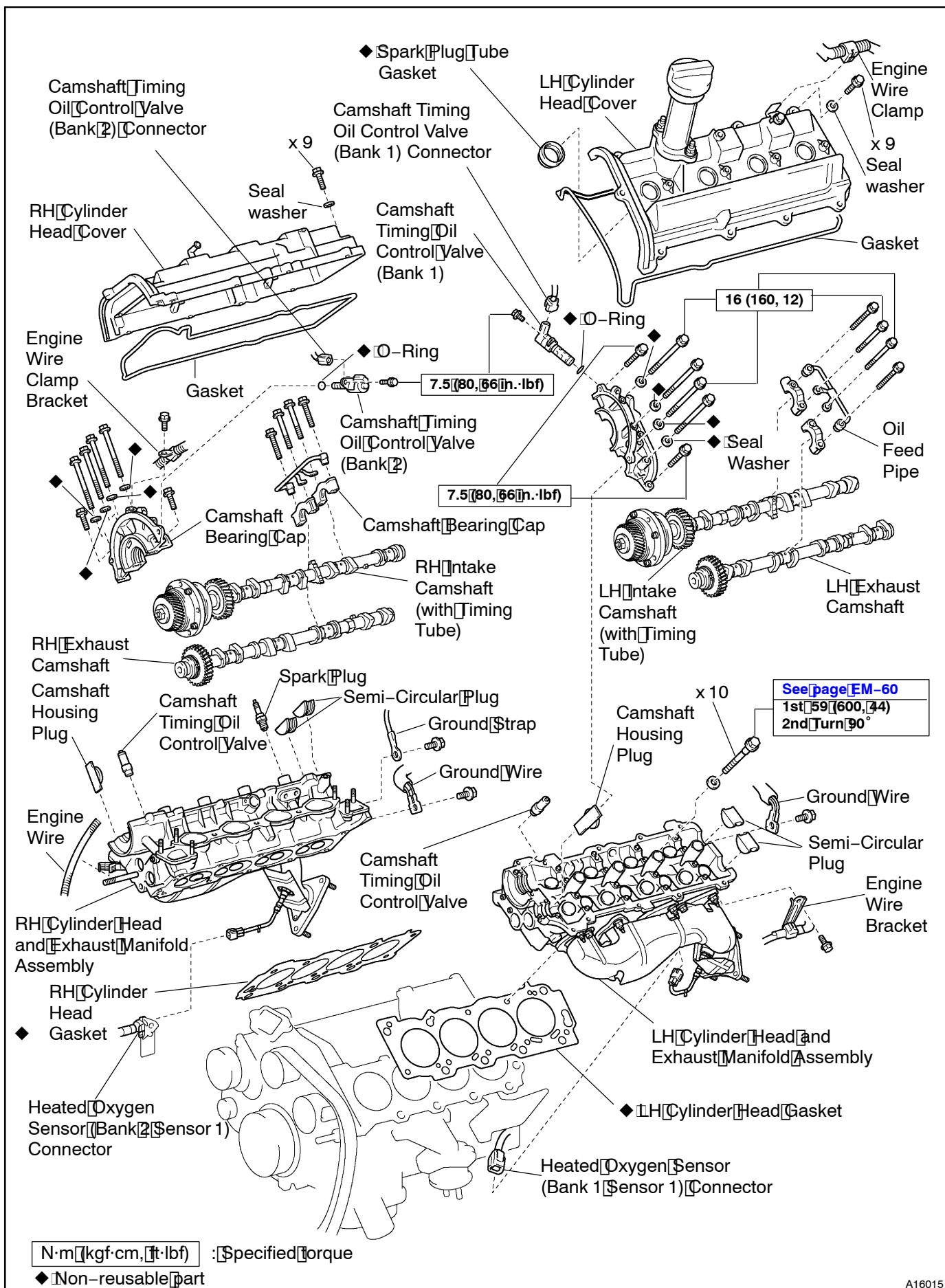




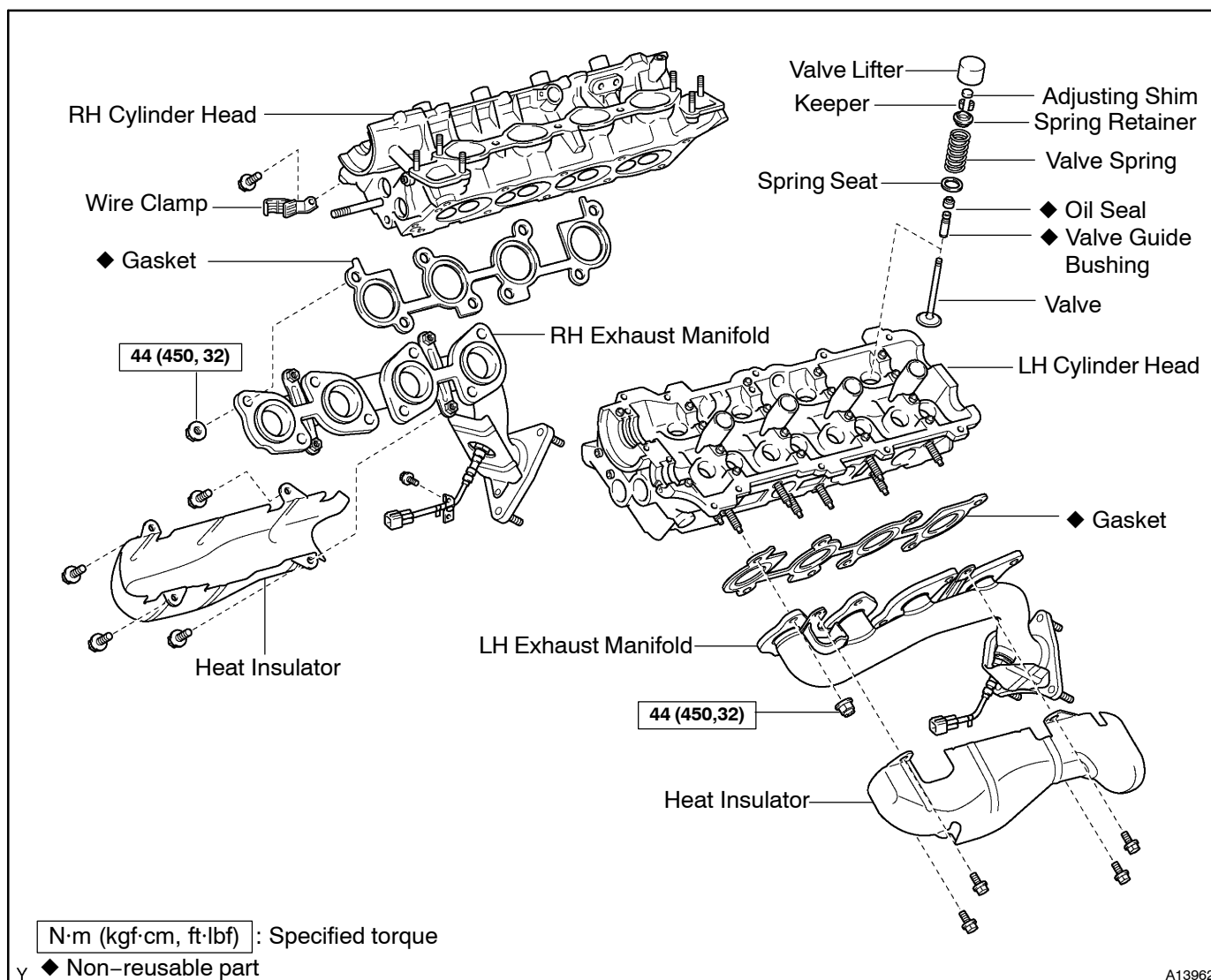
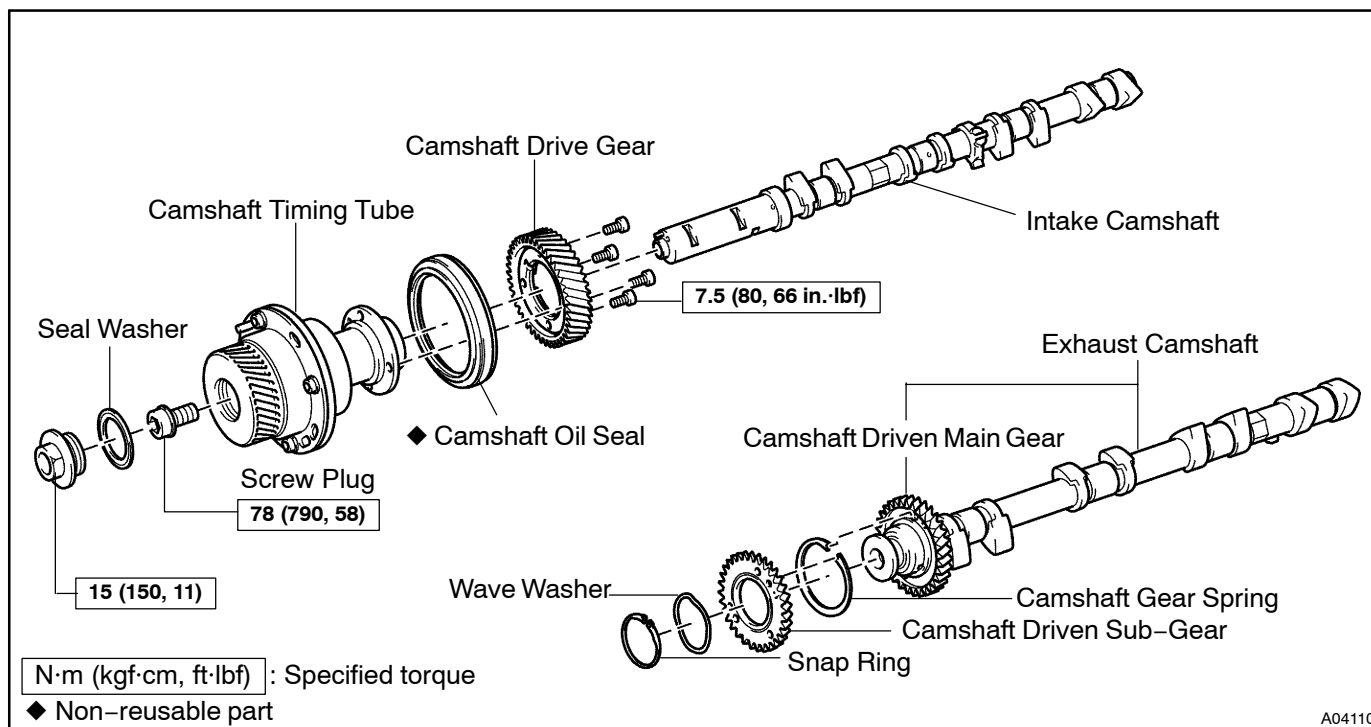
A14395





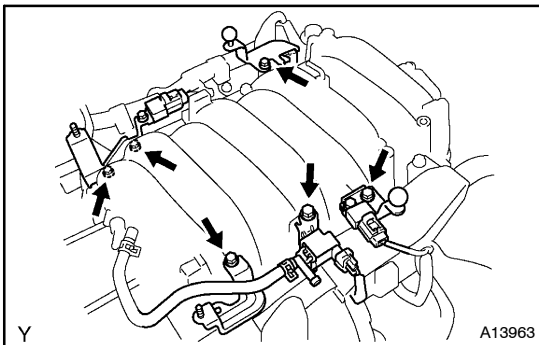


A16015

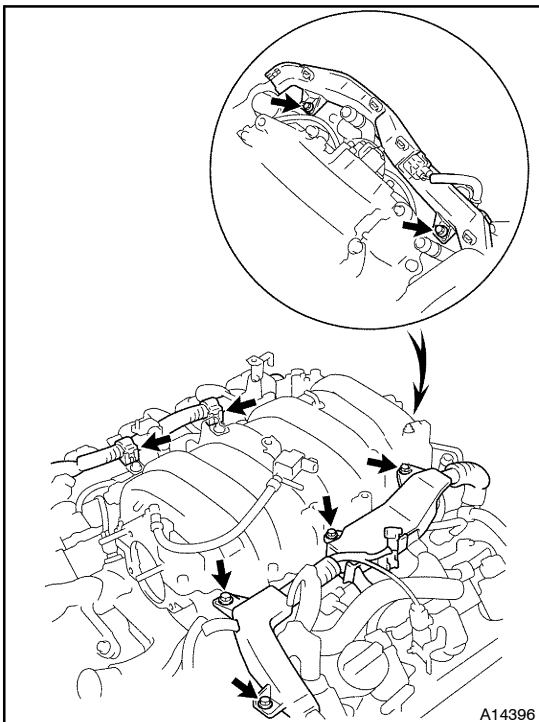


REMOVAL

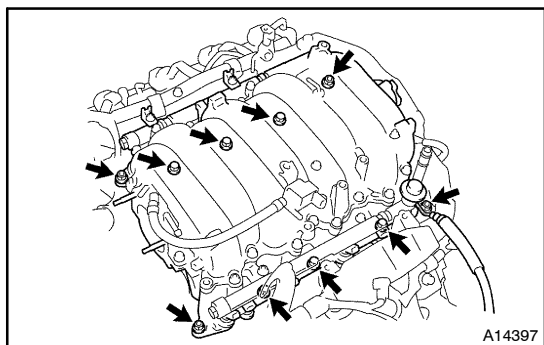
1. REMOVE ENGINE UNDER COVER
2. DRAIN ENGINE COOLANT
3. REMOVE V-BANK COVER
4. REMOVE AIR CLEANER ASSEMBLY
5. REMOVE INTAKE AIR CONNECTOR PIPE
6. REMOVE RADIATOR ASSEMBLY (See page CO-19)
7. REMOVE THROTTLE BODY (See page FI-38)
8. REMOVE UPPER AND LOWER INTAKE MANIFOLDS ASSEMBLY
 - (a) Disconnect the fuel inlet hose (rear fuel pipe) from the fuel main tube.



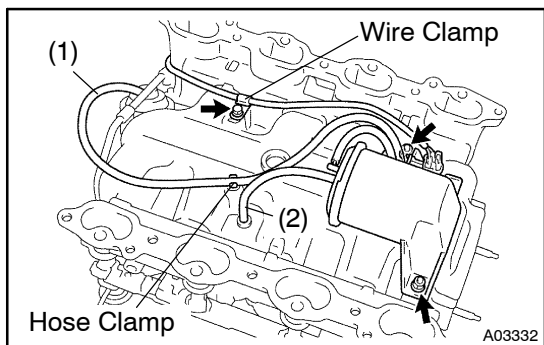
- (b) Remove and disconnect these parts:
 - (1) Disconnect the VSV connector for EVAP.
 - (2) Disconnect the EVAP hose from the VSV for EVAP.
 - (3) Disconnect the VSV for EVAP from the upper intake manifold.
 - (4) Remove the No. 1 V-bank cover bracket.
 - (5) Remove the No. 2 V-bank cover bracket.
 - (6) Remove the No. 3 V-bank cover bracket.
 - (7) Remove the No. 4 V-bank cover bracket.



- (c) Remove the 4 bolts, and disconnect the engine wire protector (LH side) from upper intake manifold and camshaft bearing cap.
- (d) Disconnect the 2 wire clamps on the engine wire (RH side) from the brackets on the RH delivery pipe.
- (e) Remove the 2 bolts, and disconnect the engine wire protector (rear side) from the rear water bypass joint and RH cylinder head.
- (f) Disconnect the VSV connector for ACIS.
- (g) Disconnect the 8 injector connectors.

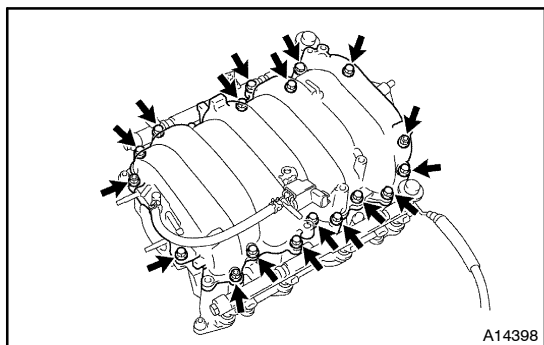


- (h) Remove the 6 bolts, 4 nuts, the upper, lower intake manifold assembly and 2 gaskets.

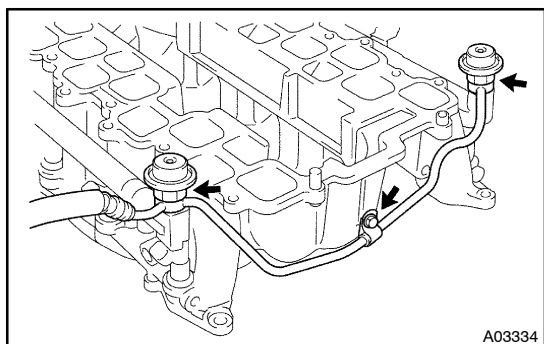


9. DISASSEMBLE UPPER AND LOWER INTAKE MANIFOLDS

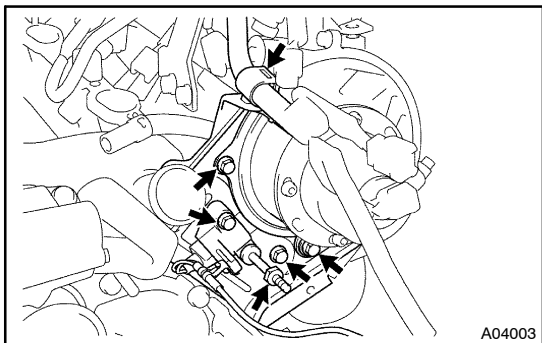
- (a) Disconnect these vacuum hoses:
- (1) Vacuum hose (from VSV for ACIS) from air control valve actuator
 - (2) Vacuum hose (from vacuum tank) from lower intake manifold
- (b) Disconnect the vacuum hose (VSV for ACIS to air control valve actuator) from the hose clamp.
- (c) Remove the bolt, and disconnect the wire clamp from the lower intake manifold.
- (d) Remove the 2 nuts, the vacuum tank and VSV assembly for the ACIS.
- (e) Remove the 3 nuts, air control valve actuator and gasket.



- (f) Remove the 15 bolts, 5 nuts, upper intake manifold and gasket.
- (g) Remove the 6 bolts and air control valve from the upper intake manifold.
- (h) Disconnect the EVAP hose from the upper intake manifold, and remove the VSV for EVAP.

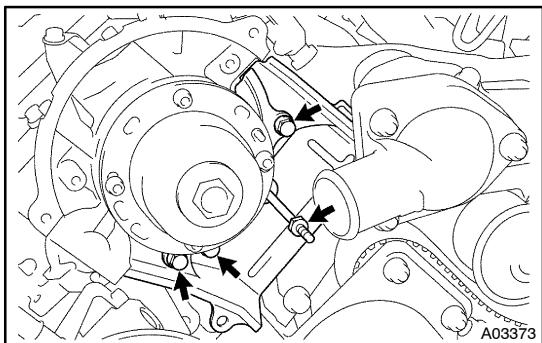


- (i) Remove the fuel pressure pulsation damper and 2 gaskets. Remove the 2 pulsation dampers.
- (j) Remove the bolt and rear fuel pipe.
- (k) Remove the 2 delivery pipes and 8 injectors.
(See [page FI-22](#))
- ## 10. DISCONNECT TIMING BELT FROM CAMSHAFT TIMING PULLEYS (See [page EM-15](#))
- ## 11. REMOVE CAMSHAFT TIMING PULLEYS (See [page EM-15](#))



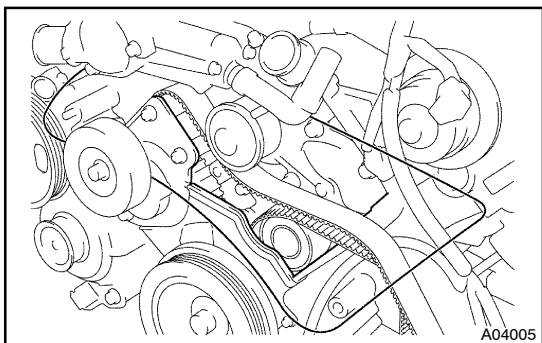
12. REMOVE CAMSHAFT POSITION SENSOR AND LH TIMING BELT REAR PLATES

- Remove the stud bolt, bolt and camshaft position sensor.
- Remove the 2 bolt, No.1 and No.2 rear plate.



13. REMOVE RH TIMING BELT REAR PLATES

Remove the stud bolt, 3 bolts, No.1 and No.2 rear plates.

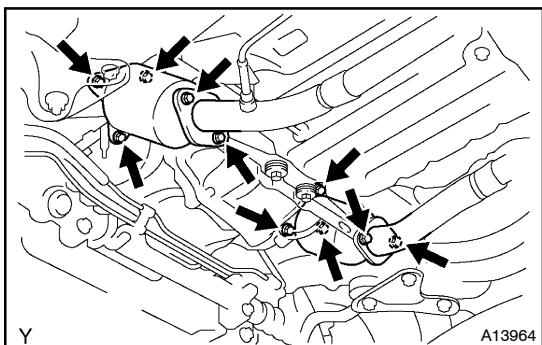


NOTICE:

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

14. DISCONNECT PS PUMP FROM ENGINE

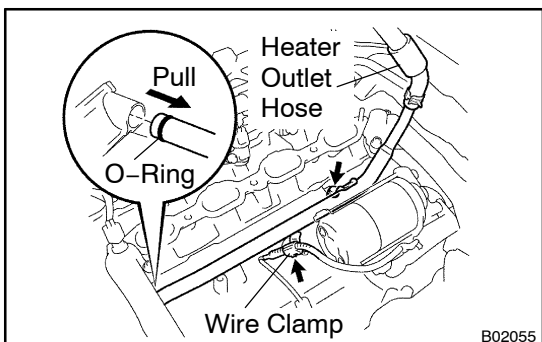
(See [page EM-80](#))



15. REMOVE TWC

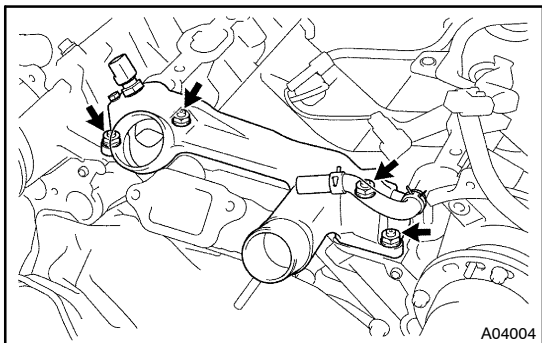
- Remove the 4 bolts and 4 nuts holding the front exhaust pipe to the TWC.
- Disconnect the front exhaust pipe from the 2 TWC, and remove the 2 gaskets.
- Remove the 3 nuts, TWC and gasket. Remove the 2 TWC.

16. DISCONNECT WATER INLET AND INLET HOUSING ASSEMBLY (See [page CO-6](#))

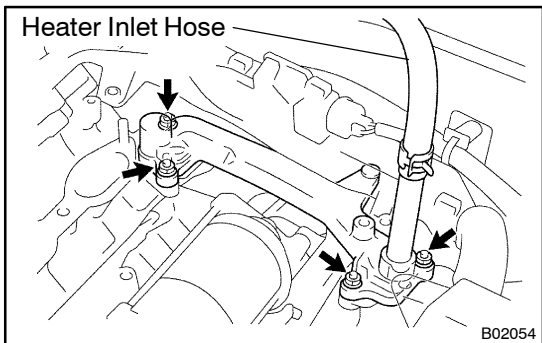


17. REMOVE WATER BYPASS PIPE

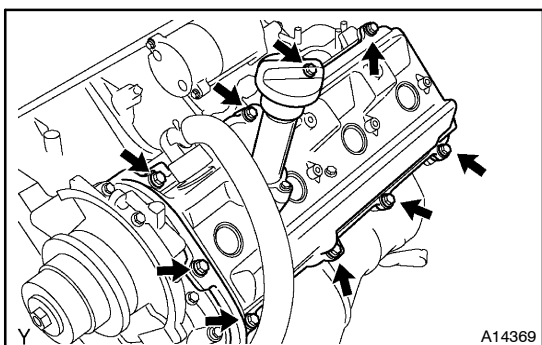
- Disconnect the heater outlet hose from the water bypass pipe.
- Disconnect the wire clamp (for knock sensor 1, 2) from bracket of the water bypass pipe.
- Remove the bolt.
- Pull out the water bypass pipe from the water pump.
- Remove the O-ring from the water bypass pipe.

**18. REMOVE FRONT WATER BYPASS JOINT**

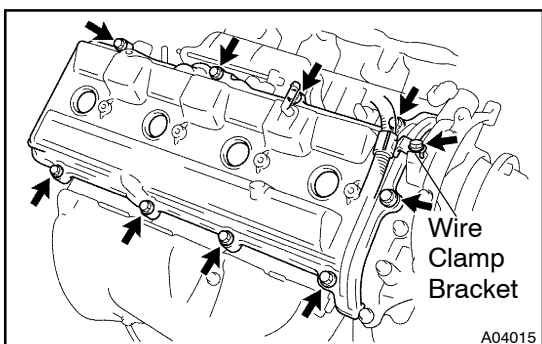
- (a) Disconnect the water temperature sensor connector.
- (b) Remove the 4 nuts, water bypass joint and 2 gaskets.

**19. REMOVE REAR WATER BYPASS JOINT**

- (a) Disconnect the heater inlet hose from the water bypass joint.
- (b) Remove the 4 nuts, water bypass joint and 2 gaskets.

20. REMOVE IGNITION COILS**21. REMOVE VVT SENSORS****22. REMOVE ENGINE HANGERS****23. REMOVE OIL DIPSTICK AND GUIDE FOR A/T****24. REMOVE OIL DIPSTICK AND GUIDE FOR ENGINE****25. REMOVE LH CYLINDER HEAD COVER**

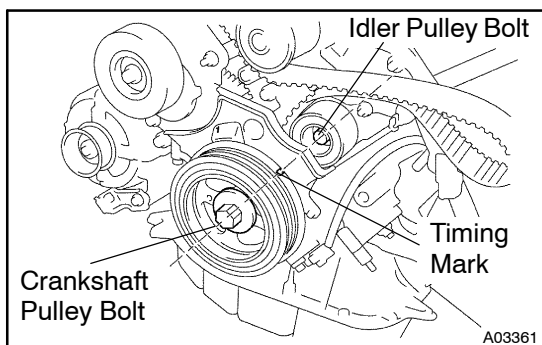
Remove the 9 bolts, 9 seal washers, cylinder head cover and gasket.

**26. REMOVE RH CYLINDER HEAD COVER**

- (a) Remove the bolt, and disconnect the wire clamp bracket on the engine wire from the camshaft bearing cap.
- (b) Remove the 9 bolts, 9 seal washers, cylinder head cover and gasket.

27. IF NECESSARY, REMOVE SEMI-CIRCULAR PLUGS AND CAMSHAFT HOUSING PLUGS**28. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE****29. REMOVE CAMSHAFTS****NOTICE:**

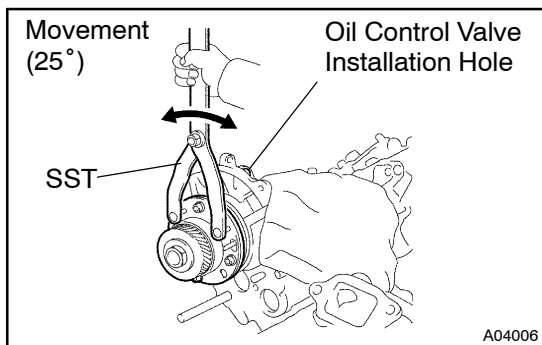
Since the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head receiving the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.



- (a) Check the crankshaft pulley position.
Check that the timing mark of the crankshaft pulley is in aligned with the centers of the crankshaft pulley bolt and No.2 timing belt idler pulley bolt.

NOTICE:

Having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you remove the camshaft, causing damage. So always set the crankshaft pulley at the correct angle.

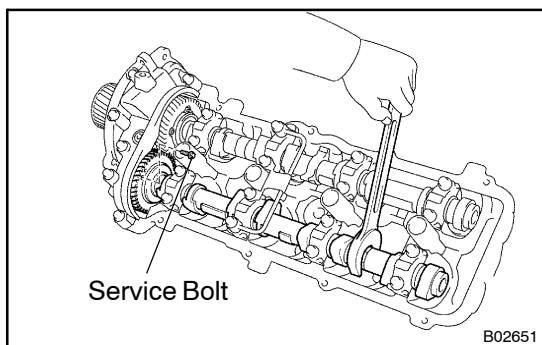


- (b) Release the oil from the front bearing caps.
Using SST, rotate the camshaft timing tube from left to right 2 to 3 times within its VVT-i range of movement (25°) and use a waste cloth to collect the oil from the camshaft timing oil control valve installation hole.

SST 09960-10010 (09962-01000, 09963-00400)

NOTICE:

Approximately 20 cc (1.2 cu in.) of oil will be ejected, so take care not to spill it.



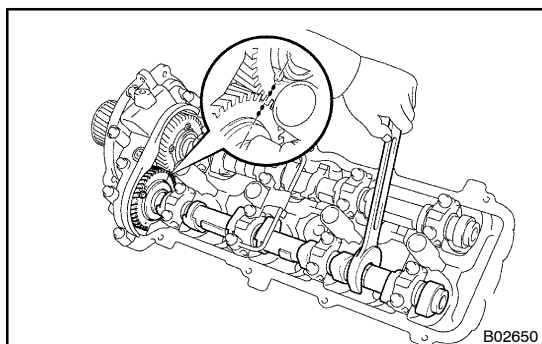
- (c) Remove the LH camshafts.
(1) Boring the service bolt hole of the sub-gear upward by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.
(2) Secure the sub-gear to the main gear with a service bolt.

Recommended service bolt:

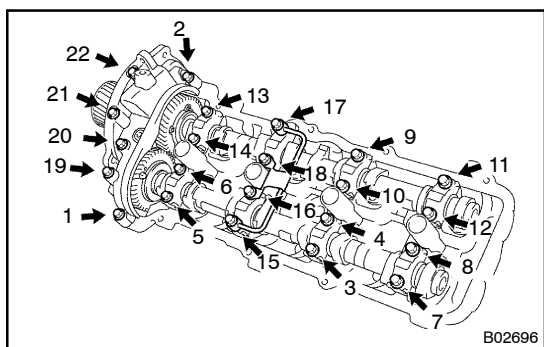
Thread diameter	6 mm
Thread pitch	1.0 mm
Bolt length	16 - 20 mm (0.63 - 0.79 in.)

HINT:

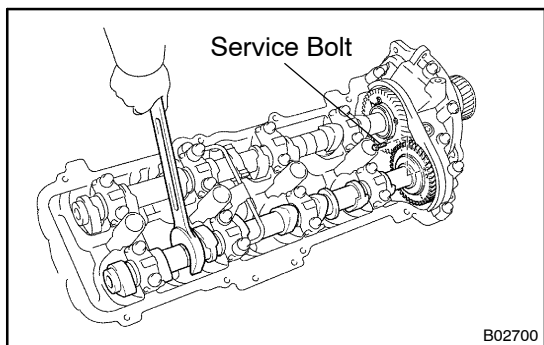
When removing the camshaft, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.



- (3) Align the timing mark (2 dot marks) of the camshaft drive gear by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.



- (4) Uniformly loosen the 22 bearing cap bolts in several passes, in the sequence shown.
- (5) Remove the 22 bearing cap bolts, 4 seal washers, oil feed pipe, 9 bearing caps, camshaft housing plug, oil control valve filter and 2 camshafts.



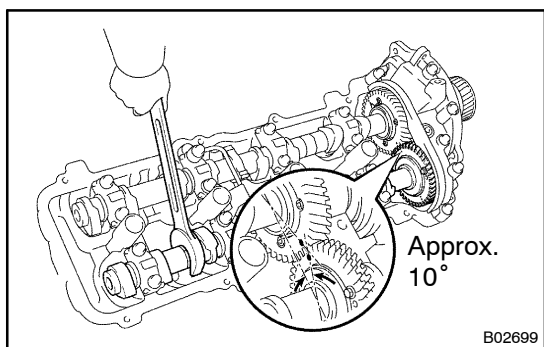
- (d) Remove the RH camshafts.
 - (1) Boring the service bolt hole of the sub-gear upward by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.
 - (2) Secure the sub-gear to the main gear with a service bolt.

Recommended service bolt:

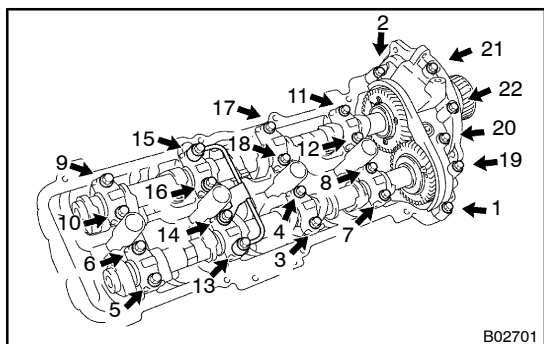
Thread diameter	6 mm
Thread pitch	1.0 mm
Bolt length	16 – 20 mm (0.63 – 0.79 in.)

HINT:

When removing the camshafts, make sure that the torsional spring force of the sub-gear has been eliminated by the above operation.



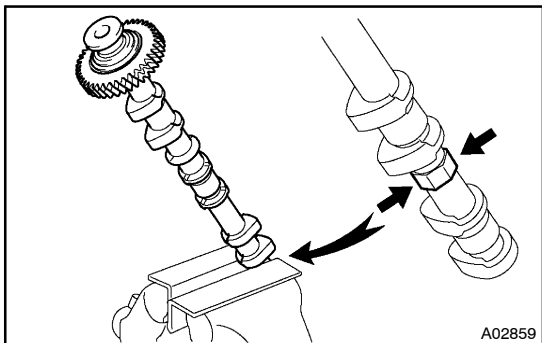
- (3) Set the timing mark (1 dot mark) of the camshaft main gear at approx. 10° angle by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.



- (4) Uniformly loosen the 22 bearing cap bolts in several passes, in the sequence shown.
- (5) Remove the 22 bearing cap bolts, 4 seal washers, oil feed pipe, 9 bearing caps, camshaft housing plug, oil control valve filter and 2 camshafts.

HINT:

Arrange the bearing caps (RH and LH sides).

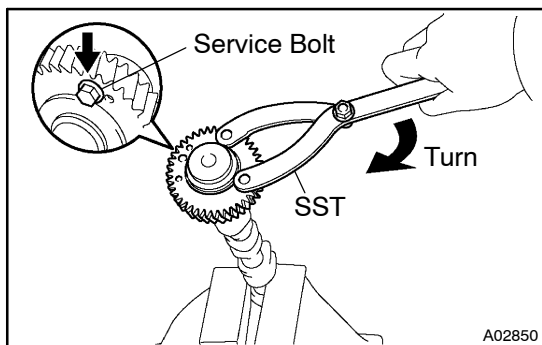


30. DISASSEMBLE EXHAUST CAMSHAFT

- (a) Mount the hexagon wrench head portion of the camshaft in a vise.

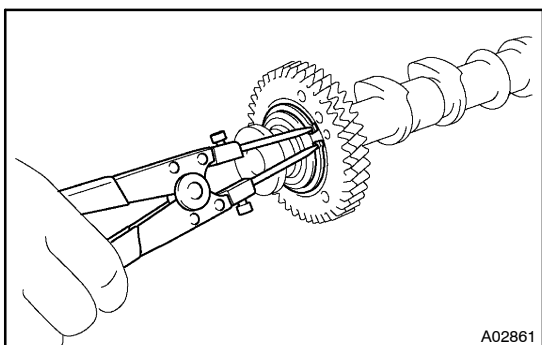
NOTICE:

Be careful not to damage the camshaft.



- (b) Using SST, turn the sub-gear clockwise, and remove the service bolt.

SST 09960-10010 (09962-01000, 09963-00500)



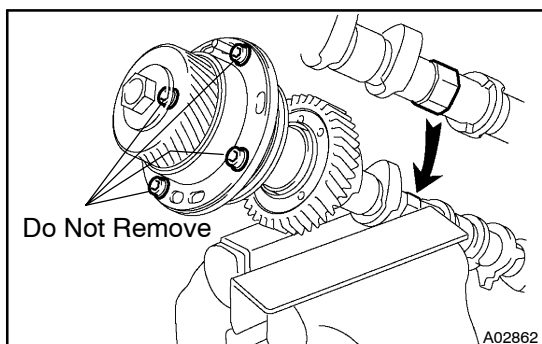
- (c) Using snap ring pliers, remove the snap ring.

- (d) Remove these parts:

- (1) Remove the wave washer.
- (2) Remove the camshaft driven sub-gear.
- (3) Remove the camshaft gear spring.

HINT:

Arrange the driven sub-gears and gear spring (RH and LH sides).

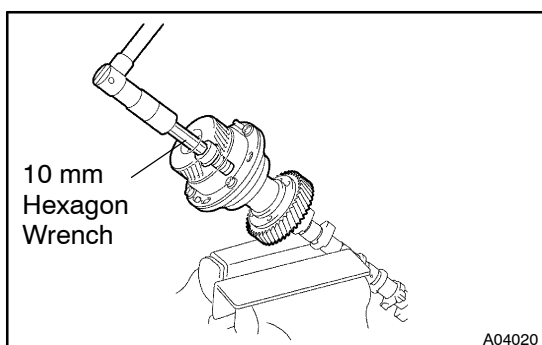


31. REMOVE CAMSHAFT TIMING TUBE FROM INTAKE CAMSHAFT

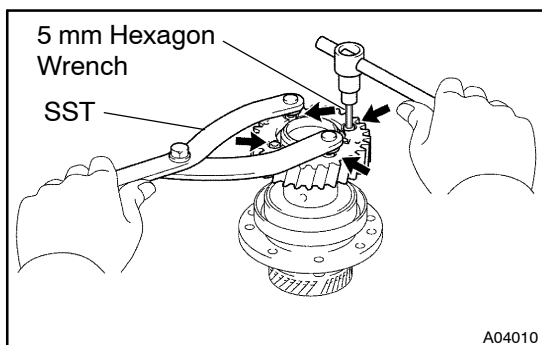
- (a) Mount the hexagon wrench head portion of the intake camshaft in a vise.

NOTICE:

- **Be careful not to damage the camshaft.**
- **The 4 bolts shown in the illustration determine the backlash of the gear in the timing tube, so do not remove them. If any of the 4 bolts are removed, install a new timing tube assembly.**



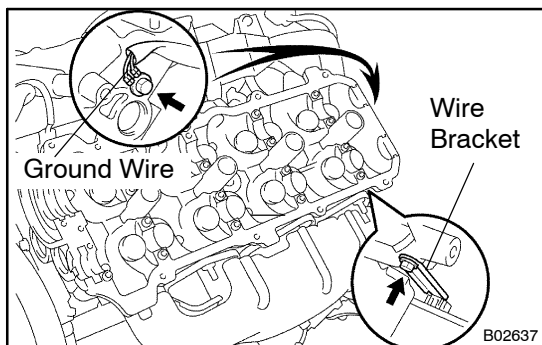
- (b) Remove the screw plug and seal washer.
- (c) Using a 10 mm hexagon wrench, and remove the bolt.
- (d) Pull out the timing tube and drive gear assembly from the camshaft.



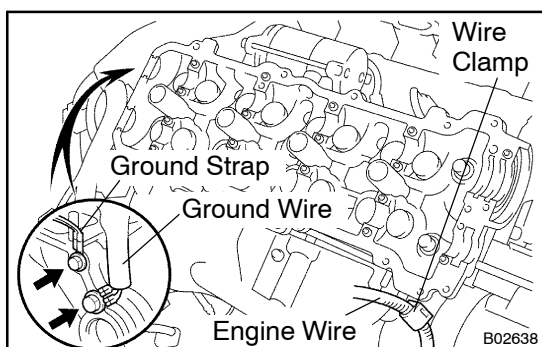
- (e) Using SST and a 5 mm hexagon wrench, and remove the 4 bolts, drive gear and oil seal.
SST 09960-10010 (09962-01000, 09963-00500)

NOTICE:

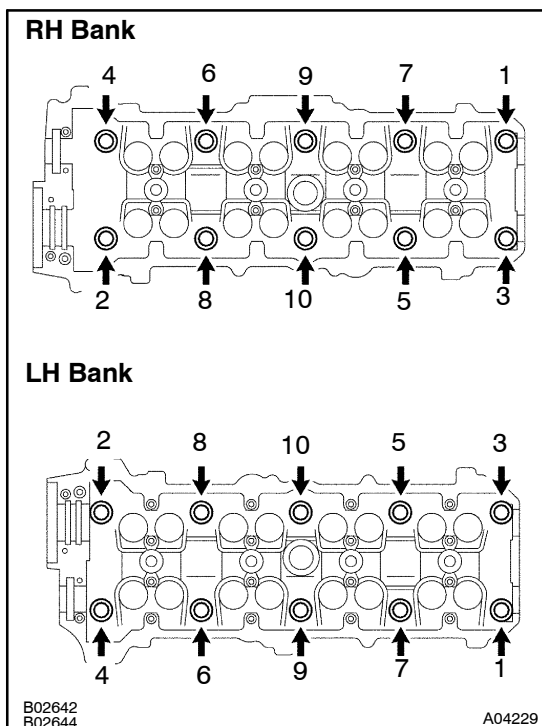
Be careful not to damage the timing tube.

32. REMOVE SPARK PLUGS**33. REMOVE CYLINDER HEAD AND EXHAUST MANIFOLD ASSEMBLIES**

- (a) Disconnect the 2 heated oxygen sensor connectors.
(b) Remove the bolt, and disconnect the ground wire from the LH cylinder head.
(c) Remove the bolt, and disconnect the engine wire bracket for the heated oxygen sensor from the LH cylinder head.



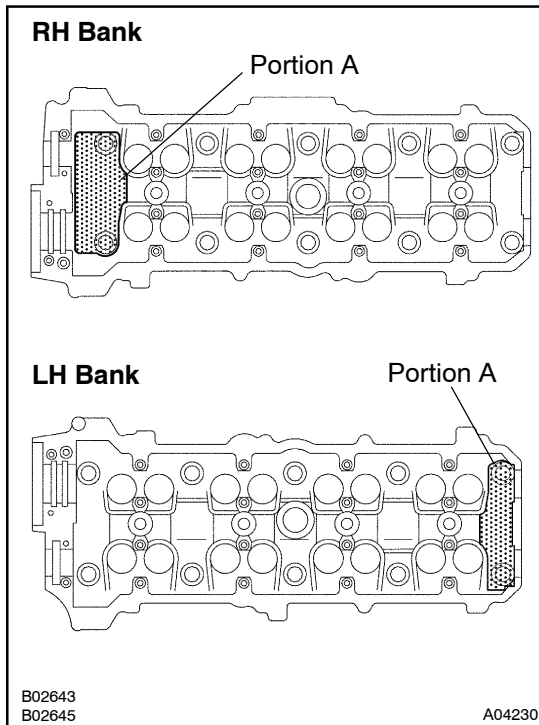
- (d) Remove the bolt, and disconnect the ground wire from the RH cylinder head.
(e) Remove the bolt, and disconnect the ground strap from the RH cylinder head.
(f) Disconnect the engine wire from the wire clamp on the RH cylinder head.



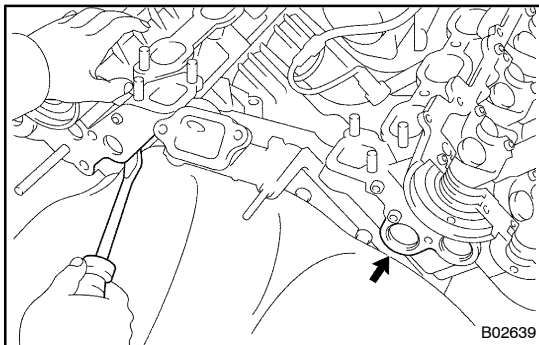
- (g) Uniformly loosen the 10 cylinder head bolts on one side of each cylinder head in several passes, in the sequence shown, then do the other side as shown. Remove the 20 cylinder head bolts and plate washers.

NOTICE:

- Cylinder head warpage or cracking could result from removing bolts in incorrect order.**



- Do not drop the plate washer for cylinder head bolt into portion A of the cylinder head. If dropped into portion A, the plate washer will pass through the cylinder head and cylinder block into the oil pan.



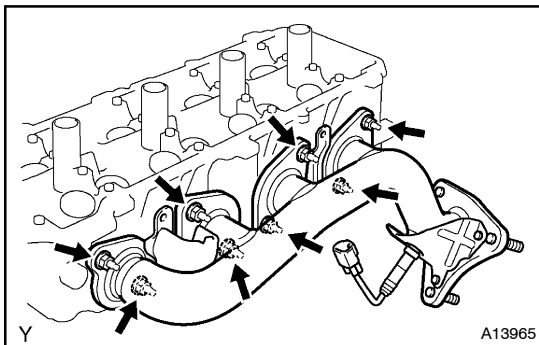
- (h) Lift the cylinder head from the dowels on the cylinder block, and place the 2 cylinder heads on wooden blocks on a bench.

HINT:

If the cylinder head is lift off, pry between the cylinder head and cylinder block with a screwdriver.

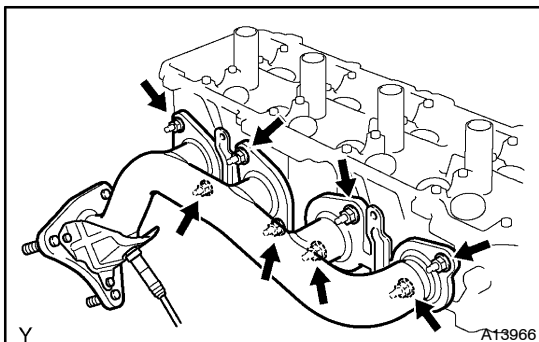
NOTICE:

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



34. REMOVE LH EXHAUST MANIFOLD FROM CYLINDER HEAD

- Remove the 4 bolts and heat insulator.
- Remove the 8 nuts, exhaust manifold and gasket.



35. REMOVE RH EXHAUST MANIFOLD FROM CYLINDER HEAD

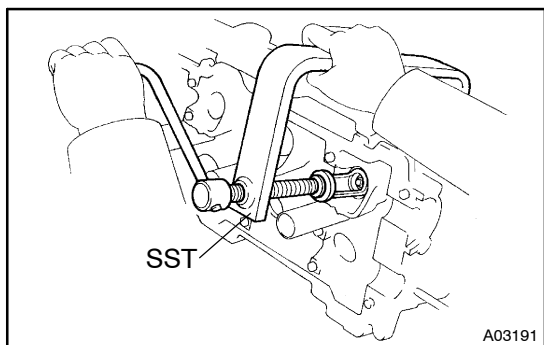
- Remove the 4 bolts and heat insulator.
- Remove the 8 nuts, exhaust manifold and gasket.

DISASSEMBLY

1. REMOVE VALVE LIFTERS AND SHIMS

HINT:

Arrange the valve lifters and shims in correct order.



2. REMOVE VALVES

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

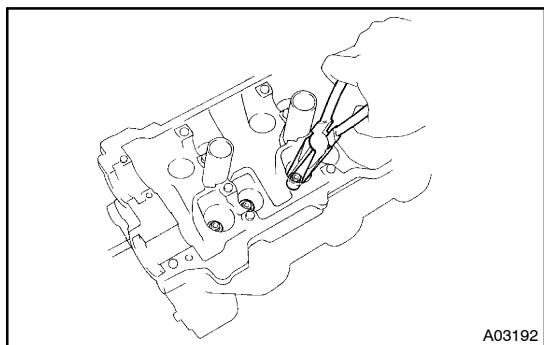
SST 09202-70020 (09202-00010)

- (b) Remove these parts:

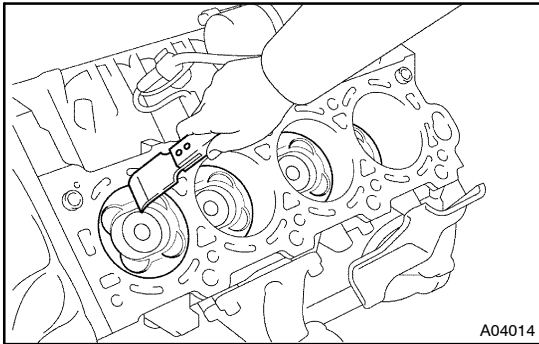
- Remove the spring retainer.
- Remove the valve spring.
- Remove the valve.
- Remove the spring seat.

HINT:

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



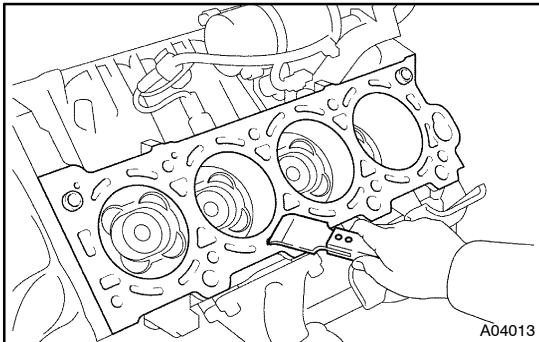
- (c) Using needle-nose pliers, remove the oil seal.



INSPECTION

1. CLEAN TOP SURFACES OF PISTONS AND CYLINDER BLOCK

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

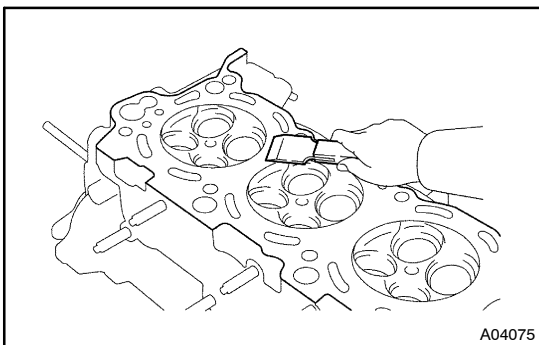


- (b) Using a gasket scraper, remove all the gasket material from the cylinder block surface.
- (c) Using compressed air, blow carbon and oil from the bolt holes.

CAUTION:

Protect your eyes when using high pressure compressed air.

2. INSPECT TOP SURFACE OF CYLINDER BLOCK FOR FLATNESS [\[See page EM-101\]](#)

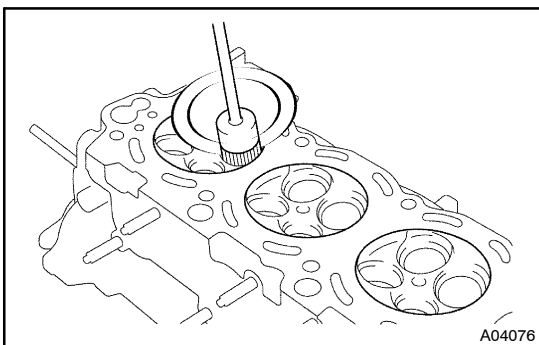


3. CLEAN CYLINDER HEAD

- (a) Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

NOTICE:

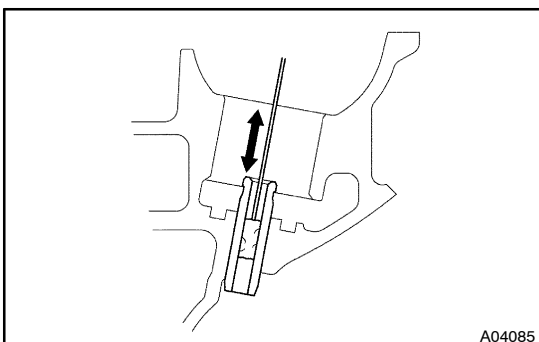
Be careful not to scratch the cylinder block contact surface.



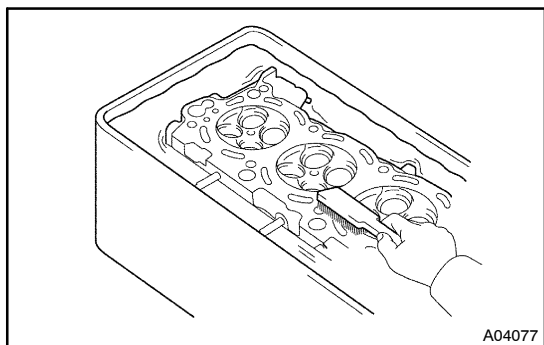
- (b) Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE:

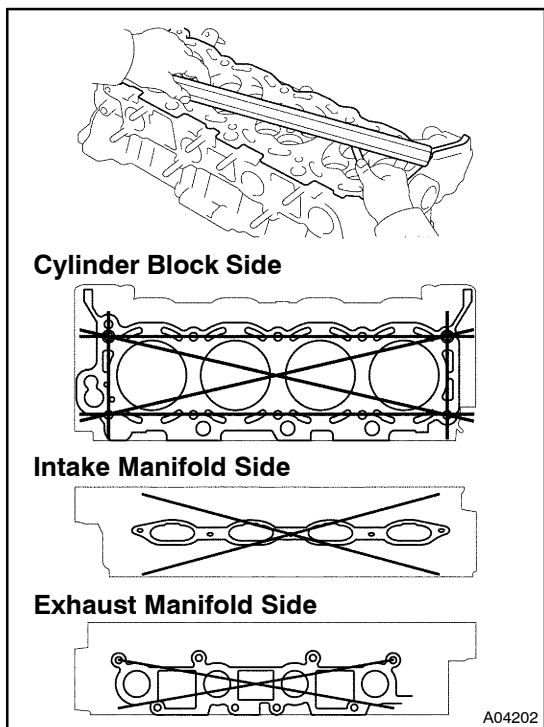
Be careful not to scratch the cylinder block contact surface.



- (c) Using a valve guide bushing brush and solvent, clean all the guide bushings.



- (d) Using a soft brush and solvent, thoroughly clean the cylinder head.

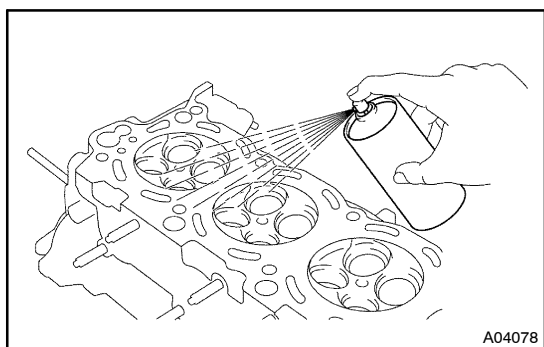


4. INSPECT CYLINDER HEAD

- (a) Inspect for flatness.
Using a precision straight edge and feeler gauge, measure the surfaces contacting the cylinder block and the manifolds for warpage.

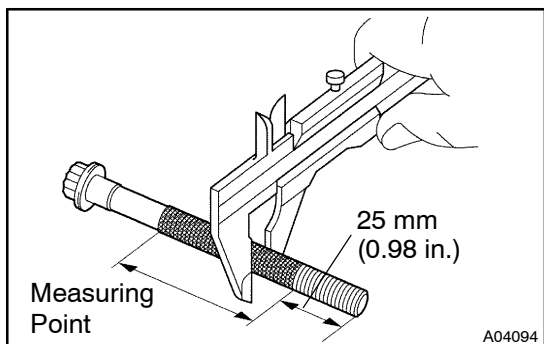
Maximum warpage: 0.10 mm (0.0039 in.)

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



- (b) Inspect for cracks.
Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks.

If cracked, replace the cylinder head.



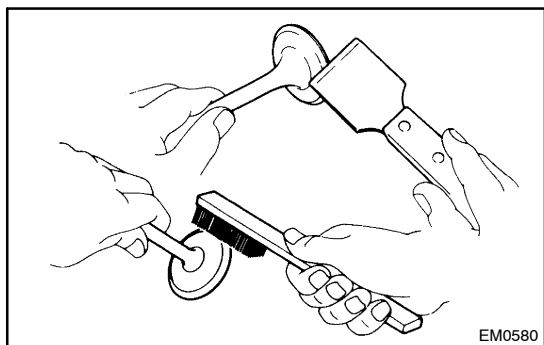
- (c) Using vernier calipers, measure the thread outside diameter of the cylinder head bolt.

Standard outside diameter:

9.770 – 9.960 mm (0.3846 – 0.3921 in.)

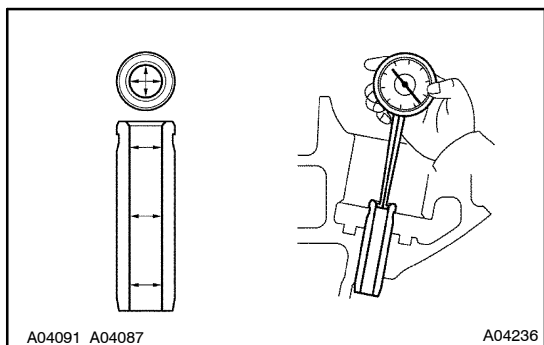
Minimum outside diameter: 9.70 mm (0.3819 in.)

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



5. CLEAN VALVES

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

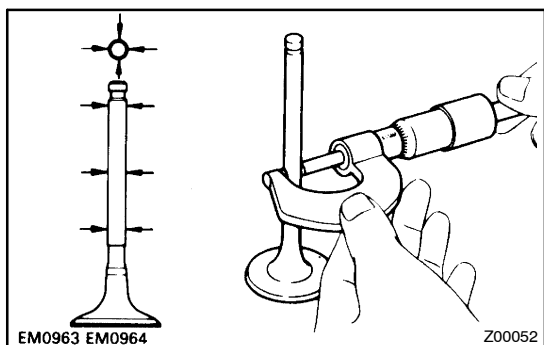


6. INSPECT VALVE STEMS AND GUIDE BUSHINGS

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

Bushing inside diameter:

5.510 – 5.530 mm (0.2169 – 0.2177 in.)



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

Valve stem diameter:

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

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

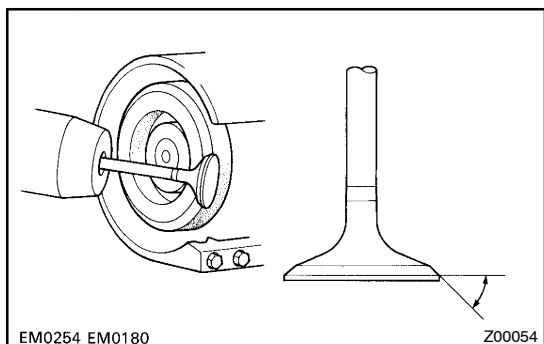
Standard oil clearance:

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

Maximum oil clearance:

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

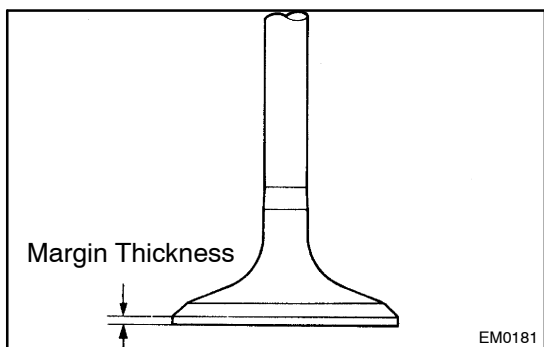
If the clearance is greater than maximum, replace the valve and guide bushing. (See page EM-56)



7. INSPECT AND GRIND VALVES

- Grind the valve enough to remove pits and carbon.
- Check that the valve is ground to the correct valve face angle.

Valve face angle: 44.5°

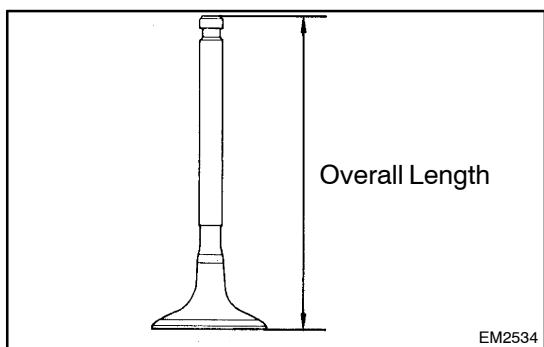


- (c) Check the valve head margin thickness.

Standard margin thickness: 1.0 mm (0.039 in.)

Minimum margin thickness: 0.5 mm (0.020 in.)

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



- (d) Check the valve overall length.

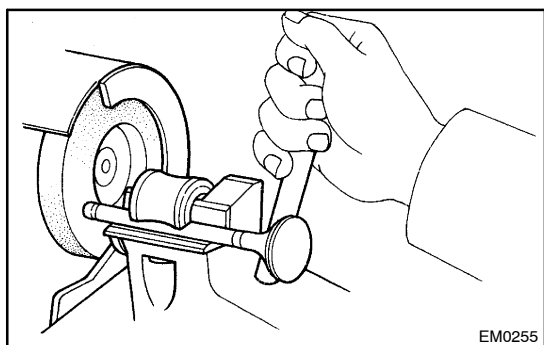
Standard overall length:

Intake	94.80 – 95.30 mm (3.7323 – 3.7520 in.)
Exhaust	94.85 – 95.35 mm (3.7342 – 3.7539 in.)

Minimum overall length:

Intake	94.55 mm (3.7224 in.)
Exhaust	94.60 mm (3.7244 in.)

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

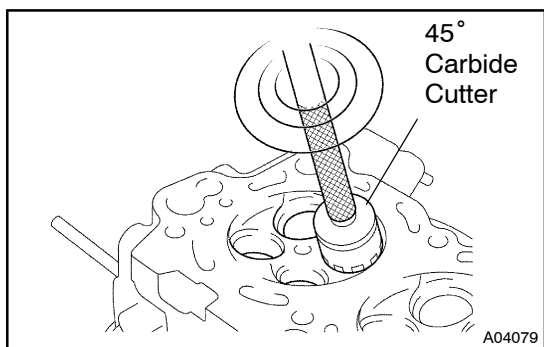


- (e) Check the surface of the valve stem tip for wear.

If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

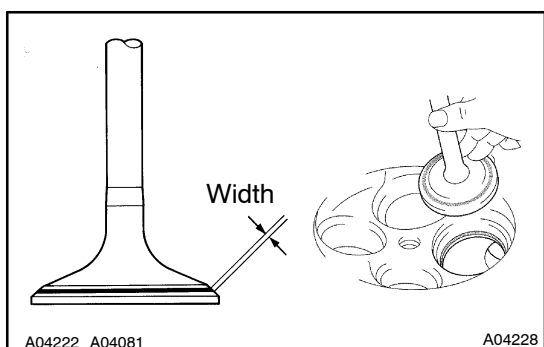
NOTICE:

Do not grind off more than minimum.



8. INSPECT AND CLEAN VALVE SEATS

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



- (b) Check the valve seating position.

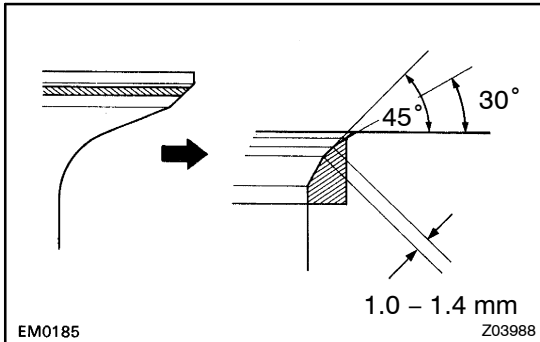
Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.

- (c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.

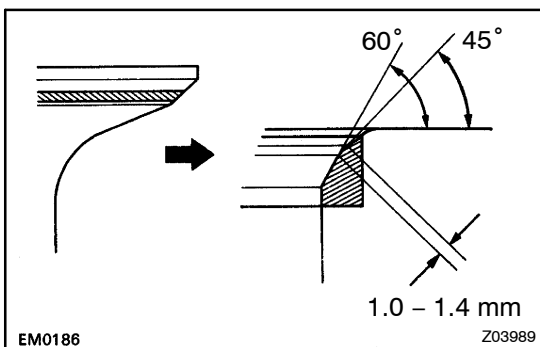
- Check that the seat contact is in the middle of the valve face with these width:

1.0 – 1.4 mm (0.039 – 0.055 in.)

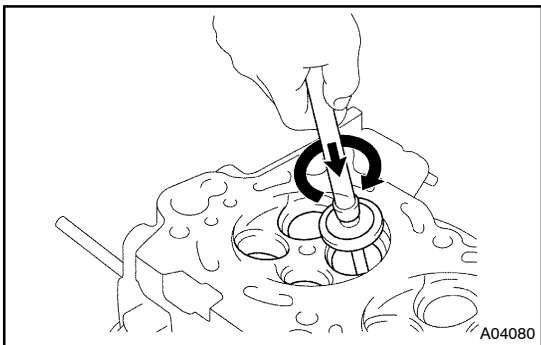


If not, correct the valve seats as follows:

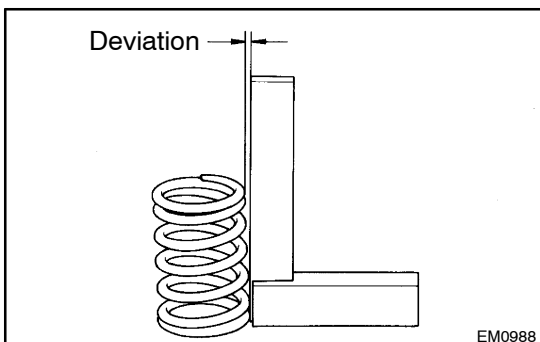
- If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.



- If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.



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

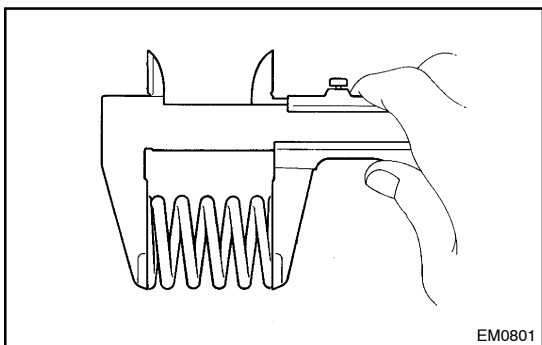


9. INSPECT VALVE SPRINGS

- (a) Using a steel square, measure the deviation of the valve spring.

Maximum deviation: 2.0 mm (0.079 in.)

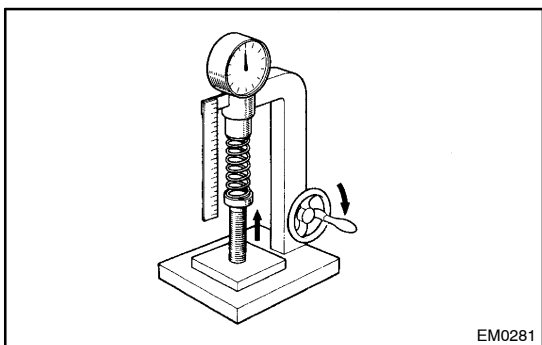
If the deviation is greater than maximum, replace the valve spring.



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

Free length: 54.05 – 54.15 mm (2.1279 – 2.1319 in.)

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



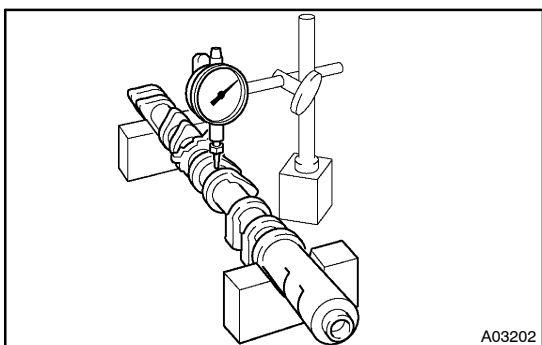
- (c) Using a spring tester, measure the tension of the valve spring at the specified installed length.

Installed tension:

210 – 226 N (21.4 – 23.0 kgf, 47.2 – 50.7 lbf)

at 35.04 mm (1.3795 in.)

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



10. INSPECT CAMSHAFTS

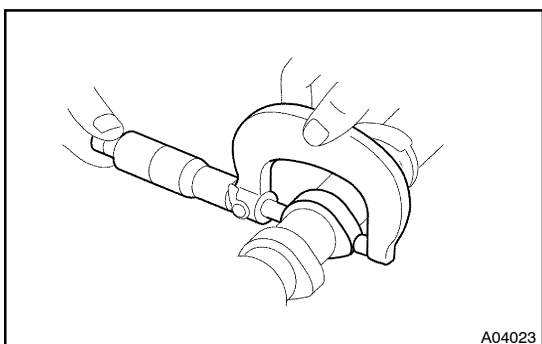
- (a) Inspect the circle runout.

(1) Place the camshaft on V-blocks.

(2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.08 mm (0.0031 in.)

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



- (b) Using a micrometer, measure the cam lobe height.

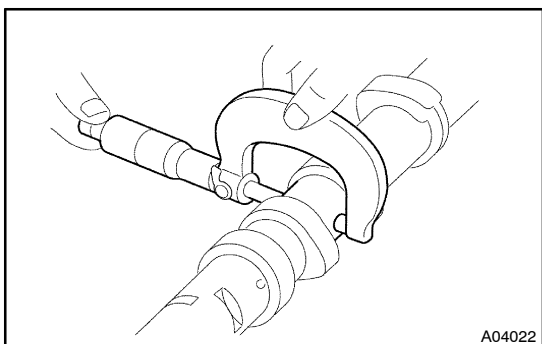
Standard cam lobe height:

Intake	42.610 – 42.710 mm (1.6776 – 1.6815 in.)
Exhaust	42.630 – 42.730 mm (1.6783 – 1.6823 in.)

Minimum cam lobe height:

Intake	42.46 mm (1.6717 in.)
Exhaust	42.48 mm (1.6724 in.)

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



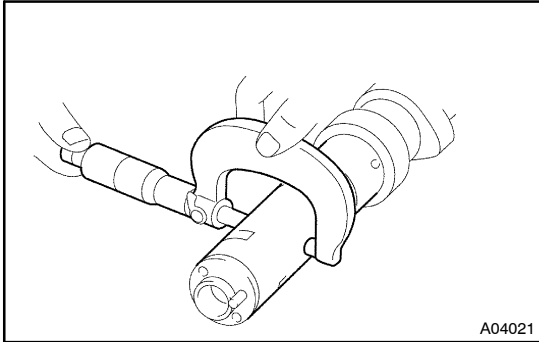
- (c) Inspect the journal.

(1) Using a micrometer, measure the journal diameter for the camshaft bearing.

Journal diameter:

26.954 – 26.970 mm (1.0612 – 1.0618 in.)

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

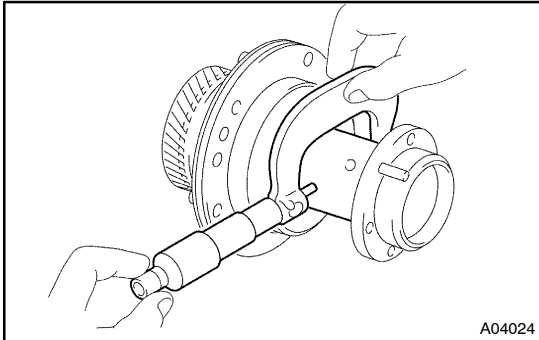


- (2) Using a micrometer, measure the journal diameter for the camshaft timing tube.

Journal diameter:

30.984 – 31.000 mm (1.2198 – 1.2205 in.)

11. INSPECT CAMSHAFT TIMING TUBE

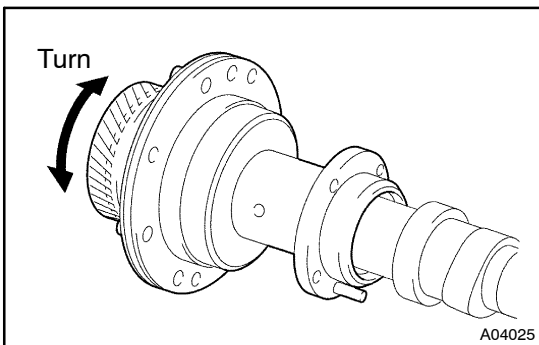


- (a) Using a micrometer, measure the journal diameter.

Journal diameter:

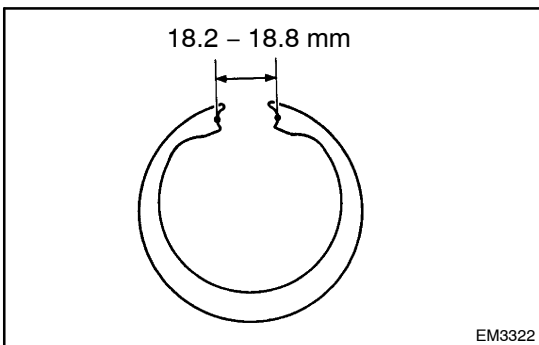
39.955 – 39.964 mm (1.5730 – 1.5734 in.)

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



- (b) Install the timing tube to the intake camshaft, and check the timing tube turn smoothly.

If necessary, replace the timing tube and intake camshaft.



12. INSPECT CAMSHAFT GEAR SPRING

Using vernier calipers, measure the free distance between the spring ends.

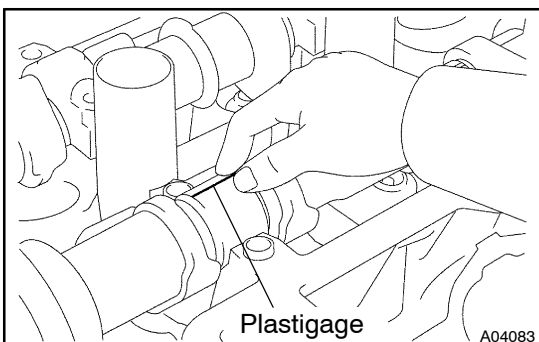
Free distance: 18.2 – 18.8 mm (0.712 – 0.740 in.)

If the free distance is not as specified, replace the gear spring.

13. INSPECT CAMSHAFT BEARINGS

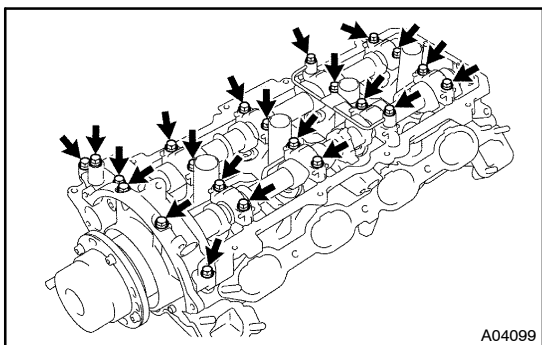
Check that bearings for flaking and scoring.

If the bearings are damaged, replace the bearing caps and cylinder head as a set.



14. INSPECT CAMSHAFT AND CAMSHAFT TIMING TUBE JOURNAL OIL CLEARANCE

- Install the camshaft timing tube to the intake camshaft. (See [page EM-60](#))
- Clean the bearing caps and journals.
- Place the camshafts on the cylinder head.
- Lay a strip of Plastigage across each of the journals.

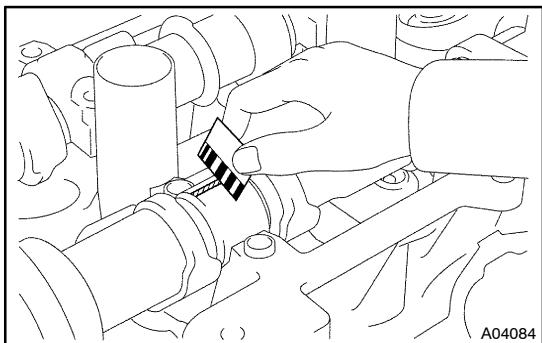


(e) Install the bearing caps. (See page EM-60)

NOTICE:

Do not turn the camshaft.

(f) Remove the bearing caps.



(g) Measure the Plastigage at its widest point.

Standard oil clearance:

Camshaft journal	0.030 – 0.067 mm (0.0012 – 0.0026 in.)
Camshaft timing tube journal	0.036 – 0.057 mm (0.0014 – 0.0022 in.)

Maximum oil clearance:

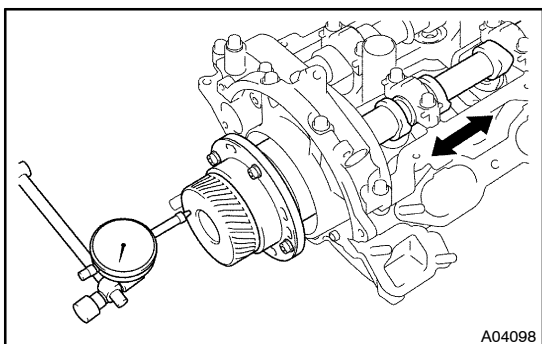
Camshaft journal	0.100 mm (0.0039 in.)
Camshaft timing tube journal	0.075 mm (0.0030 in.)

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

(h) Completely remove the Plastigage.

(i) Remove the camshafts.

(j) Remove the camshaft timing tube from the intake camshaft.



15. INSPECT CAMSHAFT THRUST CLEARANCE

(a) Install the camshaft timing tube to the intake camshaft. (See page EM-60)

(b) Install the camshaft. (See page EM-60)

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

Standard thrust clearance:

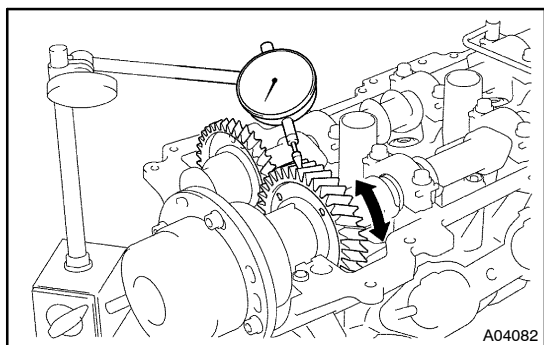
Intake	0.060 – 0.100 mm (0.0024 – 0.0039 in.)
Exhaust	0.030 – 0.075 mm (0.0012 – 0.0030 in.)

Maximum thrust clearance:

Intake	0.13 mm (0.0051 in.)
Exhaust	0.12 mm (0.0047 in.)

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

- (d) Remove the camshafts.
- (e) Remove the camshaft timing tube from the intake camshaft.

**16. INSPECT CAMSHAFT GEAR BACKLASH**

- (a) Install the drive gear to the camshaft timing tube.
(See page EM-60)
- (b) Install the camshaft timing tube to the intake camshaft.
(See page EM-60)
- (c) Install the camshafts without installing the exhaust camshaft sub-gear and front bearing cap.
(See page EM-60)

- (d) Using a dial indicator, measure the backlash.

Standard backlash:

0.020 – 0.200 mm (0.0008 – 0.0079 in.)

Maximum backlash: 0.30 mm (0.0188 in.)

If the backlash is greater than maximum, replace the Intake camshaft drive gear and exhaust camshaft.

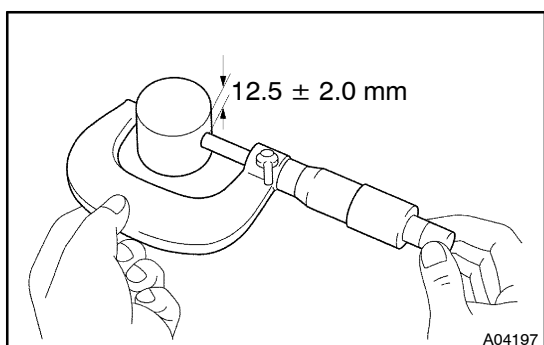
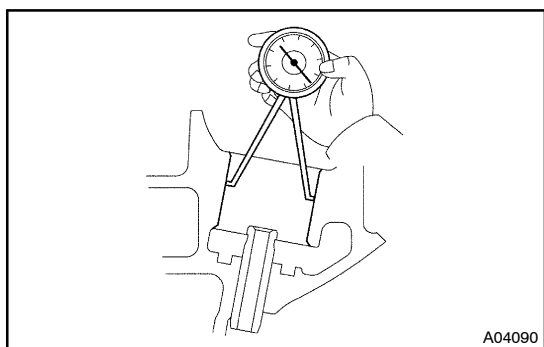
- (e) Remove the camshafts.
- (f) Remove the camshaft timing tube from the intake camshaft.
- (g) Remove the drive gear from the camshaft timing tube.

17. INSPECT VALVE LIFTERS AND LIFTER BORES

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

Lifter bore diameter:

31.000 – 31.016 mm (1.2205 – 1.2211 in.)



- (b) Using a micrometer, measure the lifter diameter at the 12.5 ± 2.0 mm (0.492 ± 0.079 in.) from the top surface.

Lifter diameter:

30.968 – 30.976 mm (1.2192 – 1.2195 in.)

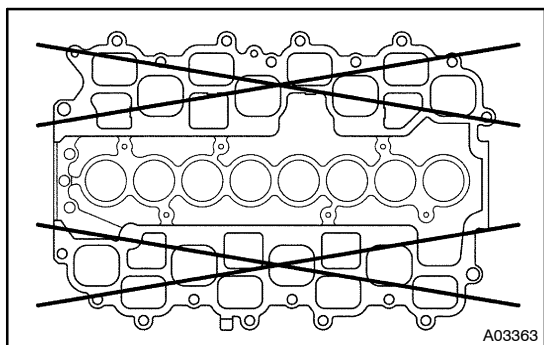
- (c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance:

0.024 – 0.048 mm (0.0009 – 0.0018 in.)

Maximum oil clearance: 0.07 mm (0.0028 in.)

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

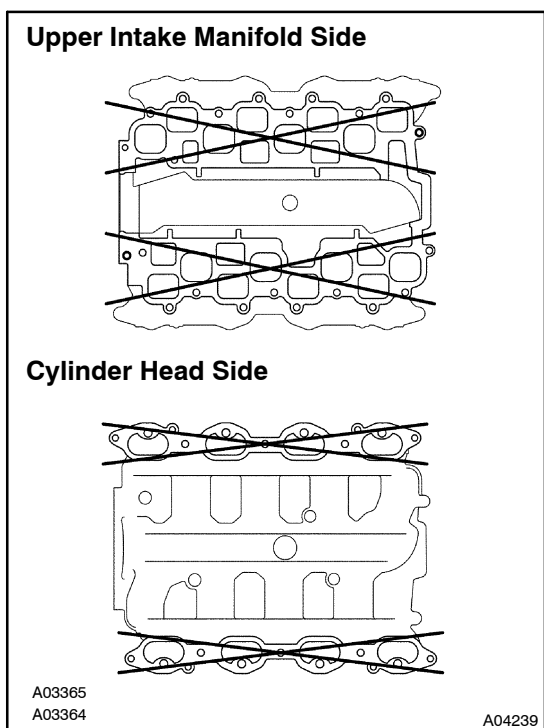


18. INSPECT UPPER INTAKE MANIFOLD

Using a precision straight edge and feeler gauge, measure the surface contacting the lower intake manifold for warpage.

Maximum warpage: 0.15 mm (0.0059 in.)

If warpage is greater than maximum, replace the upper intake manifold.

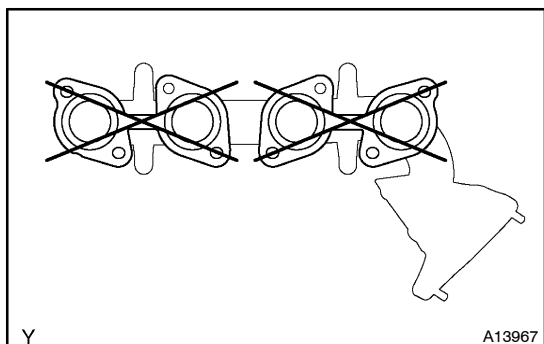


19. INSPECT LOWER INTAKE MANIFOLD

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

Maximum warpage: 0.15 mm (0.0059 in.)

If warpage is greater than maximum, replace the lower intake manifold.

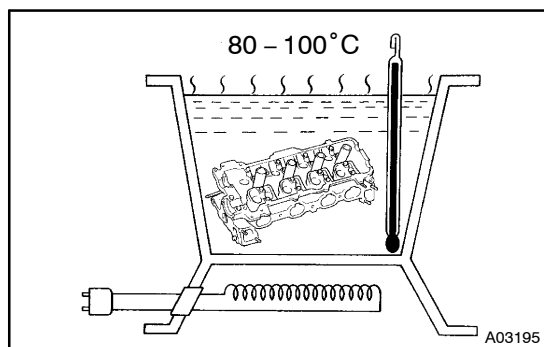


20. INSPECT EXHAUST MANIFOLD

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

Maximum warpage: 0.50 mm (0.0197 in.)

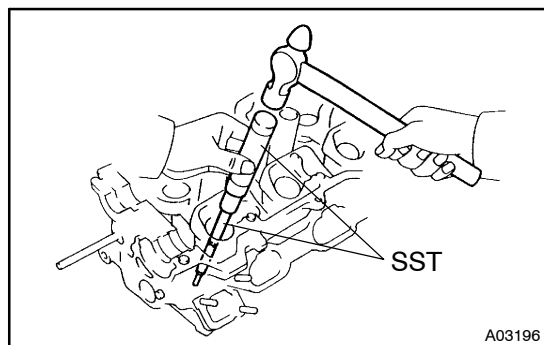
If warpage is greater than maximum, replace the manifold.



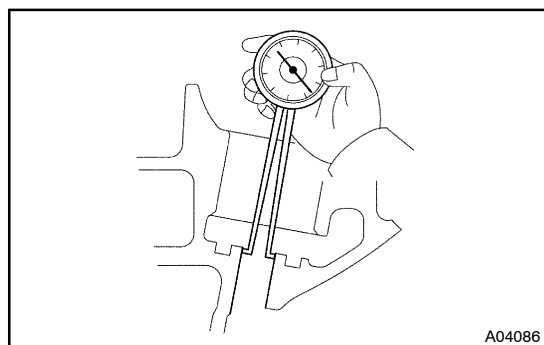
REPLACEMENT

1. REPLACE VALVE GUIDE BUSHINGS

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



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



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

Both intake and exhaust

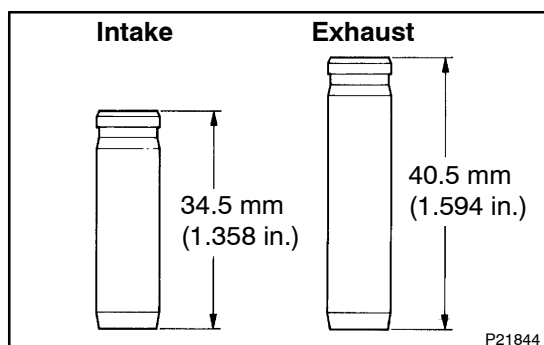
Bushing bore diameter mm (in.)	Bushing size
10.285 - 10.306 (0.4049 - 0.4057)	Use STD
10.335 - 10.356 (0.4069 - 0.4077)	Use O/S STD

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

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

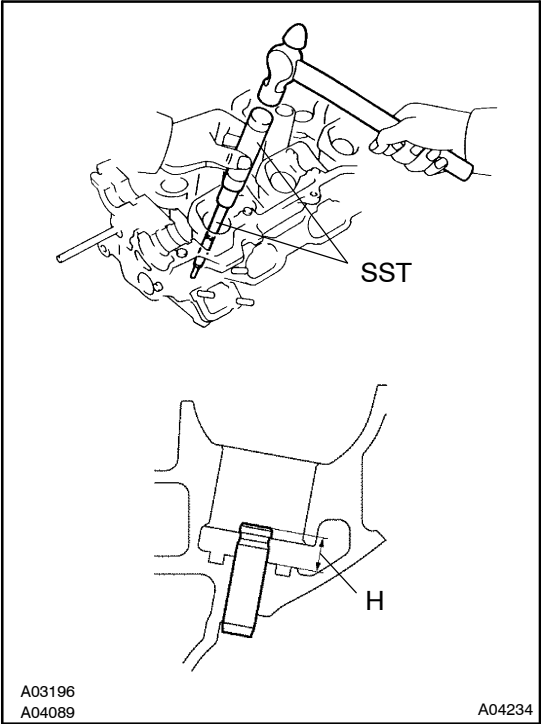
10.335 - 10.356 mm (0.4069 - 0.4077 in.)

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



HINT:

Different the bushings are used for the intake and exhaust.

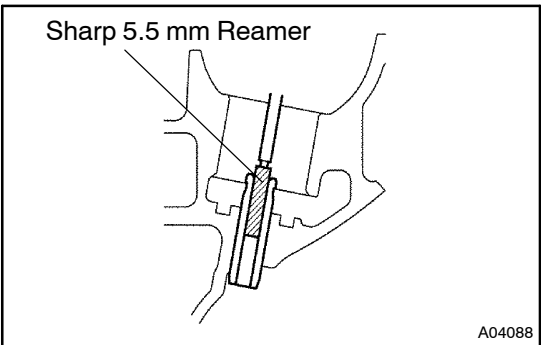


- (e) Gradually heat the cylinder head to 80 – 100°C (176 – 212°F).
- (f) Using SST and a hammer, tap in a new guide bushing to the specified protrusion height.

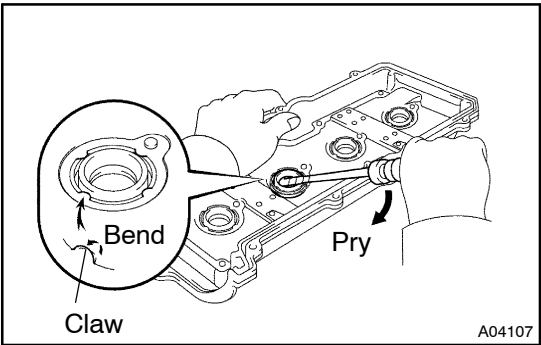
SST 09201-01055, 09950-70010 (09951-07100)

Protrusion height (H):

Intake	9.2 – 9.8 mm (0.362 – 0.386 in.)
Exhaust	8.2 – 8.8 mm (0.323 – 0.346 in.)



- (g) Using a sharp 5.5 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page EM-46) between the guide bushing and valve stem.

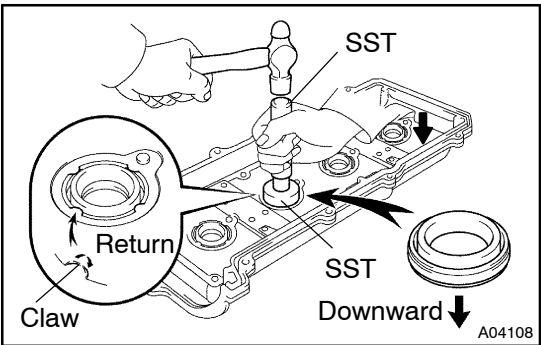


2. REPLACE SPARK PLUG TUBE GASKETS

- (a) Bend the 4 ventilation case claws installed on the cylinder head cover to an angle of 90° or more.
- (b) Using a screwdriver, pry out the gasket.

NOTICE:

Be careful not to damage the cylinder head cover. Tape the screwdriver tip.



- (c) Using SST and a hammer, tap in a new gasket until its surface is flush with the upper edge of the cylinder head cover.

SST 09950-60010 (09551-00240, 09951-00440, 09952-06010), 09950-70010 (09951-07100)

NOTICE:

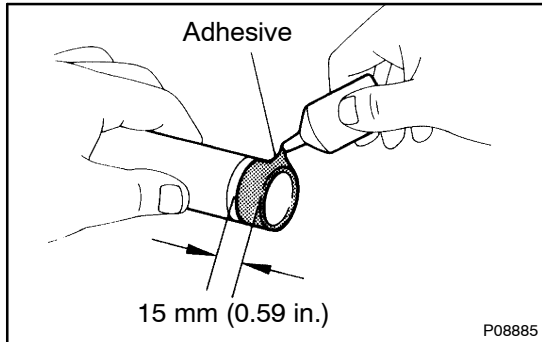
Be careful of the installation direction.

- (d) Apply a light coat of MP grease to the gasket lip.
- (e) Return the 4 ventilation case claws to its original position.

REASSEMBLY

HINT:

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



1. INSTALL SPARK PLUG TUBES

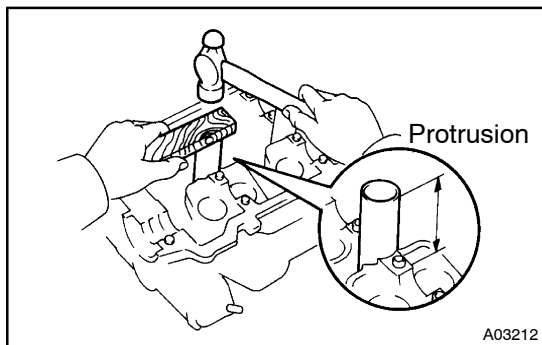
HINT:

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

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

Adhesive:

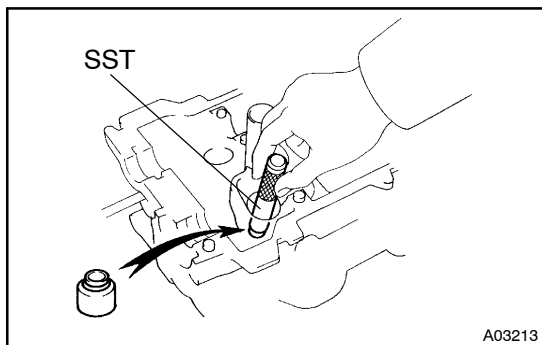
Part No. 08833-00070, THREE BOND 1324 or equivalent



- (b) Using a wooden block and hammer, tap in a new spark tube until there is 48.4 – 49.6 mm (1.906 – 1.953 in.) protruding from the camshaft bearing cap installation surface of the cylinder head.

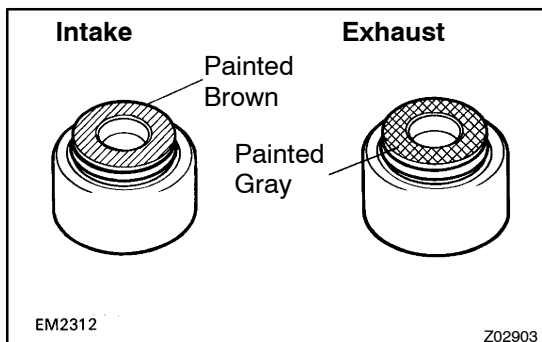
NOTICE:

Avoid tapping a new spark plug tube in too far by measuring the amount of the protrusion while tapping.



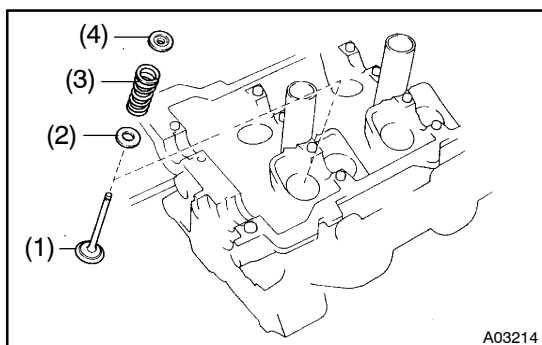
2. INSTALL VALVES

- (a) Using SST, push in a new oil seal.
SST 09201-41020

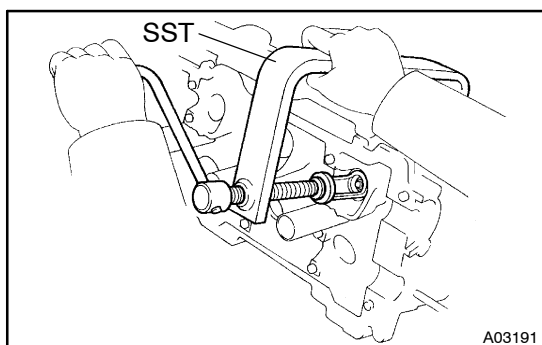


HINT:

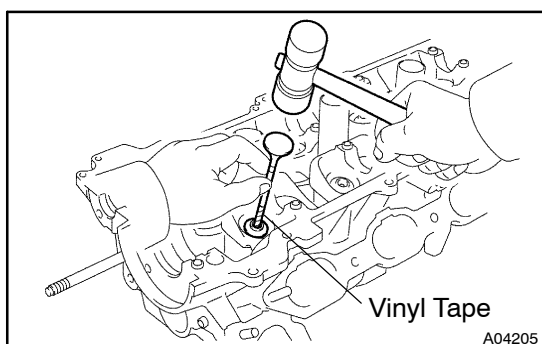
The intake valve oil seal is brown and the exhaust valve oil seal is gray.



- (b) Install these parts:
- (1) Install the valve.
 - (2) Install the spring seat.
 - (3) Install the valve spring.
 - (4) Install the spring retainer.



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



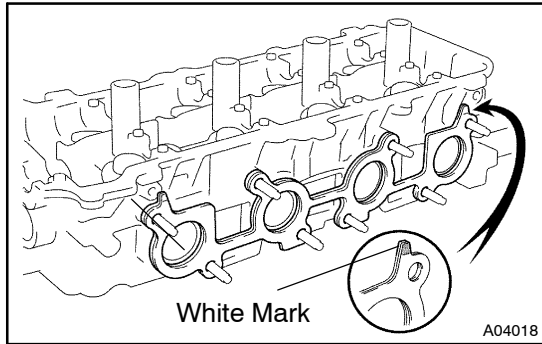
- (d) Using a plastic-faced hammer and the valve stem (not in use) tip wound with vinyl tape, lightly tap the valve stem tip to assure proper fit.

NOTICE:

Be careful not to damage the valve stem tip.

3. INSTALL VALVE LIFTERS AND SHIMS

- (a) Install the valve lifter and shim.
- (b) Check that the valve lifter rotates smoothly by hand.



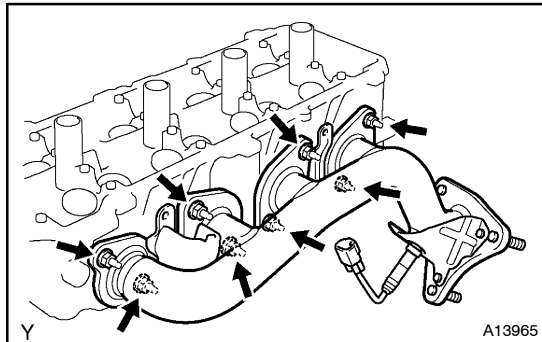
INSTALLATION

1. INSTALL LH EXHAUST MANIFOLD TO CYLINDER HEAD

- (a) Place a new gasket on the cylinder head with the white mark facing the manifold side.

NOTICE:

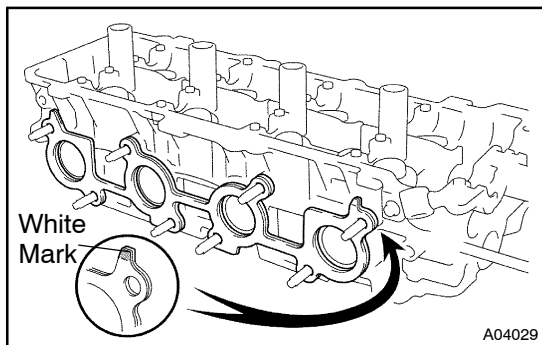
Be careful of the installation direction.



- (b) Install the exhaust manifold with 8 new nuts. Uniformly tighten the nuts in several passes.

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

- (c) Install the heat insulator with the 3 bolts.

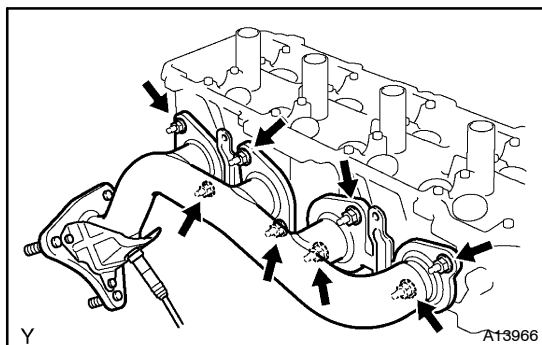


2. INSTALL RH EXHAUST MANIFOLD TO CYLINDER HEAD

- (a) Place a new gasket on the cylinder head with the white mark facing the manifold side.

NOTICE:

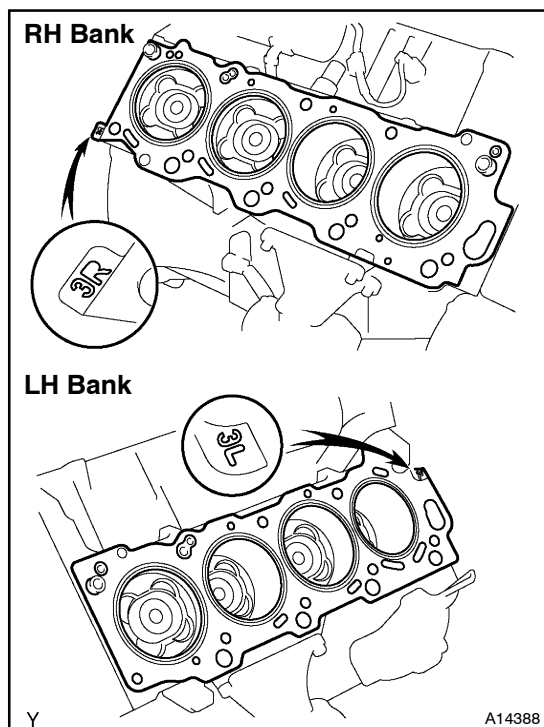
Be careful of the installation direction.



- (b) Install the exhaust manifold with 8 new nuts. Uniformly tighten the nuts in several passes.

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

- (c) Install the heat insulator with the 3 bolts.



3. PLACE CYLINDER HEAD ON CYLINDER BLOCK

- (a) Place 2 new cylinder head gaskets in position on the cylinder block.

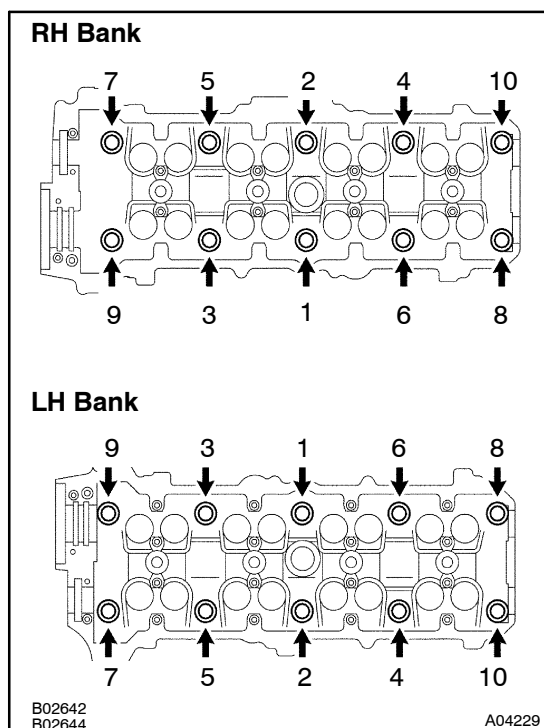
HINT:

On the rear side of the cylinder head gasket are marks to distinguish the RH and LH banks, a "3R" mark for the RH bank and a "3L" mark for the LH bank.

NOTICE:

Be careful of the installation direction.

- (b) Place the 2 cylinder heads in position on the cylinder head gaskets.



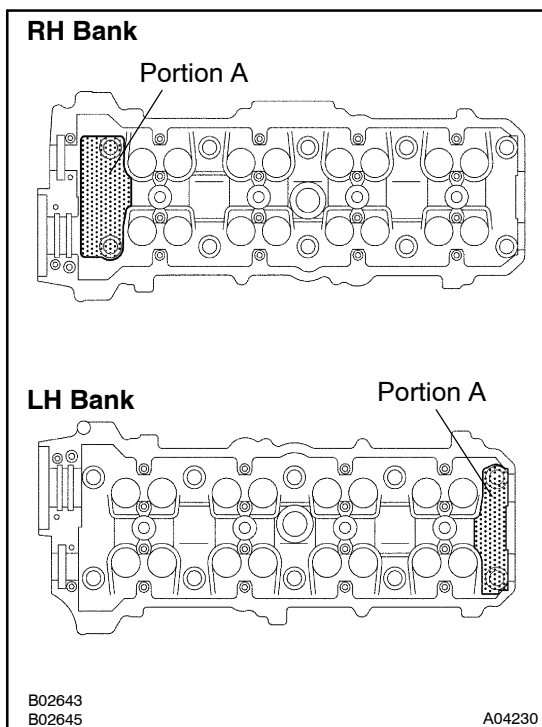
4. INSTALL CYLINDER HEAD BOLTS

HINT:

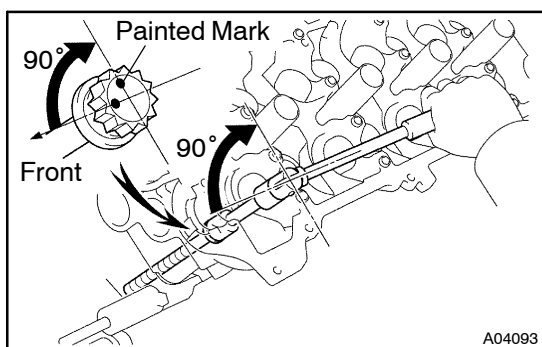
- The cylinder head bolts are tightened in 2 progressive steps (steps (c) and (e)).
 - If any cylinder head bolt is broken or deformed, replace it.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- (b) Install the plate washer to the cylinder head bolt.
- (c) Install and uniformly tighten the 10 cylinder head bolts on one side of the cylinder head in several passes in the sequence shown, then do the other side as shown.

Torque: 59 N·m (600 kgf·cm, 44 ft·lbf)

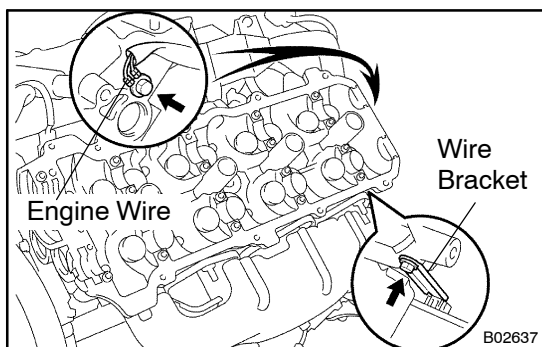
If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.

**NOTICE:**

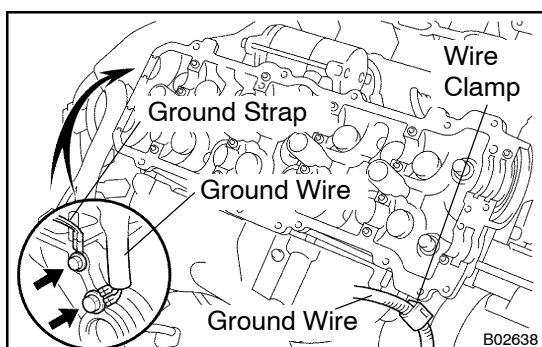
Do not drop the plate washer for cylinder head bolt into portion A of the cylinder head. If dropped into portion A, the plate washer will pass through the cylinder head and cylinder block into the oil pan.



- (d) Mark the front of the cylinder head bolt head with paint.
- (e) Retighten the cylinder head bolts by 90° in the numerical order shown.
- (f) Check that the painted mark is now at a 90° angle to front.

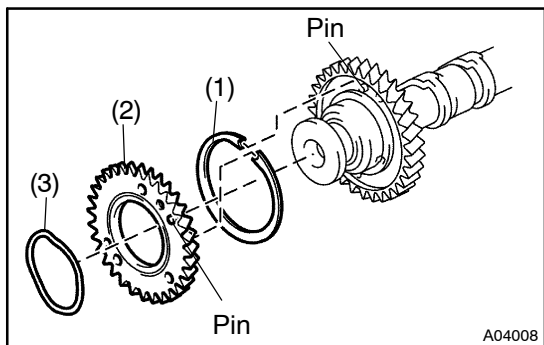
**5. INSTALL ENGINE WIRE**

- (a) Install the engine wire bracket for the heated oxygen sensor to the LH cylinder head with the bolt.
- (b) Install the ground wire to LH cylinder head with the bolt.



- (c) Install the ground wire to RH cylinder head with the bolt.
- (d) Install the ground strap to RH cylinder head with the bolt.
- (e) Install the engine wire to the wire clamp on the RH cylinder head.
- (f) Connect the 2 heated oxygen sensor connectors.

6. INSTALL SPARK PLUGS



7. ASSEMBLE EXHAUST CAMSHAFT

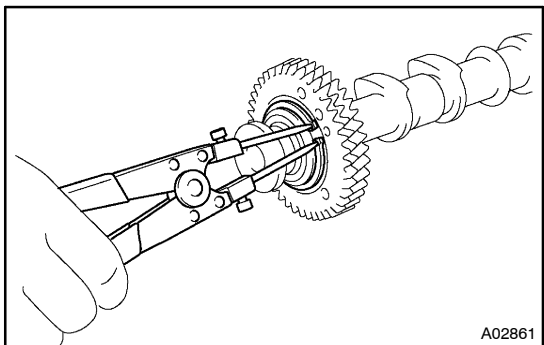
(a) Install these parts:

- (1) Install the camshaft gear spring.
- (2) Install the camshaft driven sub-gear.

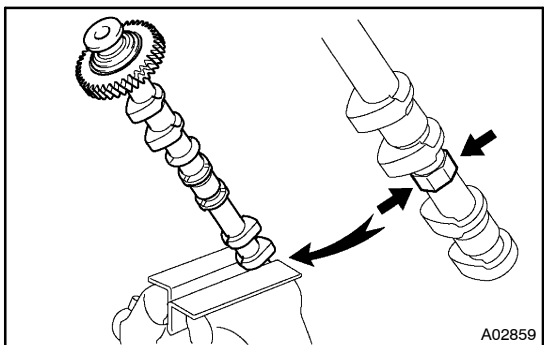
HINT:

Attach the pins on the gears to the gear spring ends.

- (3) Install the wave washer.



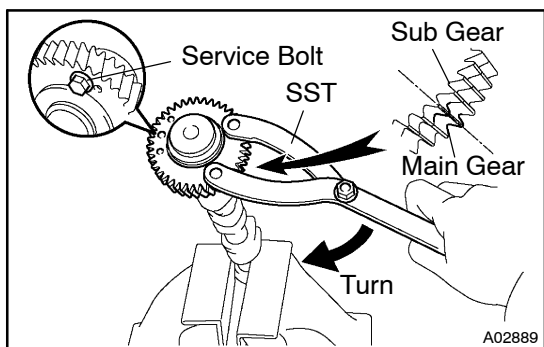
(b) Using snap ring pliers, install the snap ring.



(c) Mount the hexagon wrench head portion of the camshaft in a vise.

NOTICE:

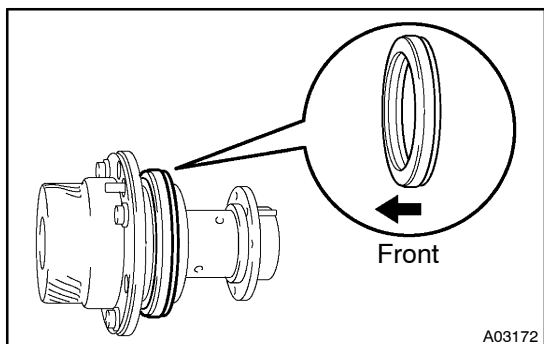
Be careful not to damage the camshaft.



(d) Using SST, align the holes of the driven main gear and sub-gear by turning the sub-gear clockwise, and temporarily install a service bolt.

SST 09960-10010 (09962-01000, 09963-00500)

(e) Align the gear teeth of the driven main gear and sub-gear, and tighten the service bolt.

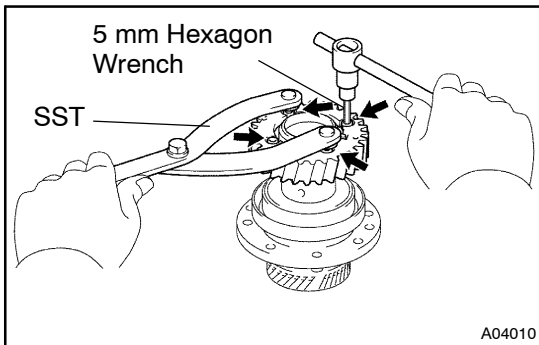


8. INSTALL CAMSHAFT TIMING TUBE TO INTAKE CAM-SHAFT

(a) Place a new oil seal to the timing tube.

NOTICE:

Be careful of the installation direction.



(b) Align the timing tube knock pin with the knock pin groove of the drive gear, and temporarily install the drive gear with the 4 bolts.

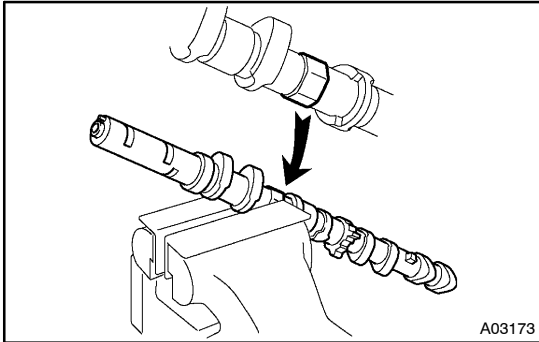
(c) Using SST and a 5 mm hexagon wrench, uniformly tighten the 4 bolts in several passes.

SST 09960-10010 (09962-01000, 09963-00500)

Torque: 7.5 N·m (80 kgf·cm, 66 in·lbf)

NOTICE:

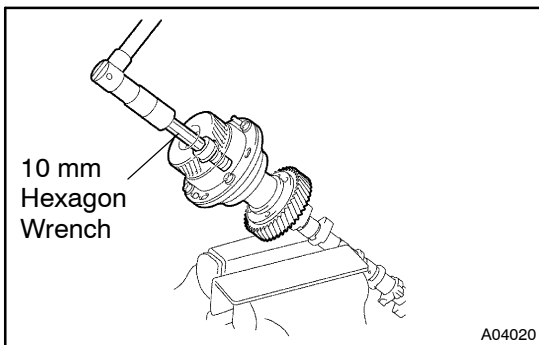
Be careful not to damage the timing tube.



(d) Mount the hexagon wrench head portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.



(e) Align the camshaft knock pin with the knock pin groove of the timing tube, and push the timing tube by hand until you feel it touch the bottom.

(f) Using a 10 mm hexagon wrench, install the bolt.

Torque: 78 N·m (790 kgf·cm, 58 ft·lbf)

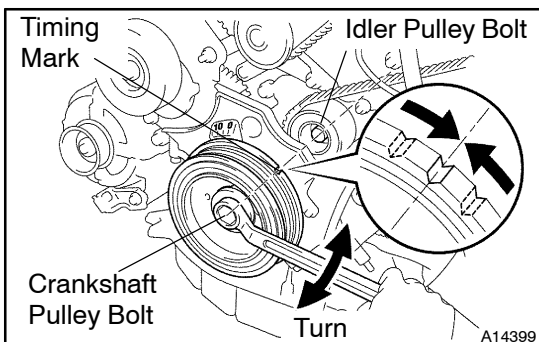
(g) Install the seal washer and screw plug.

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

9. INSTALL CAMSHAFTS

NOTICE:

Since the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head receiving the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.

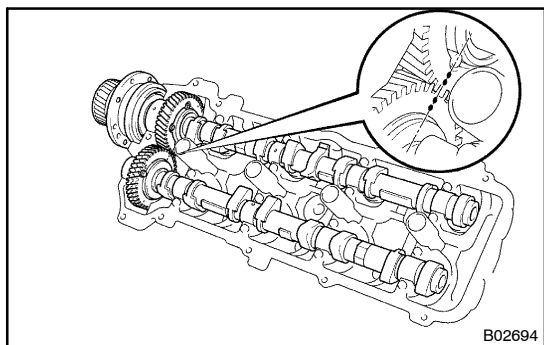


(a) Set the crankshaft pulley position.

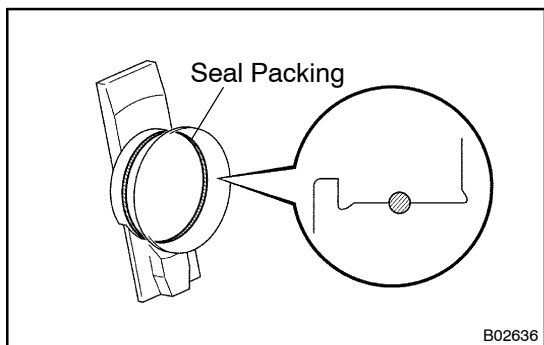
Turn the pulley clockwise or counterclockwise, and put the timing mark of the crankshaft pulley in line with the centers of the crankshaft pulley bolt and idler pulley bolt.

NOTICE:

Having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you install the camshaft, causing damage. So always set the crankshaft pulley at the correct angle.

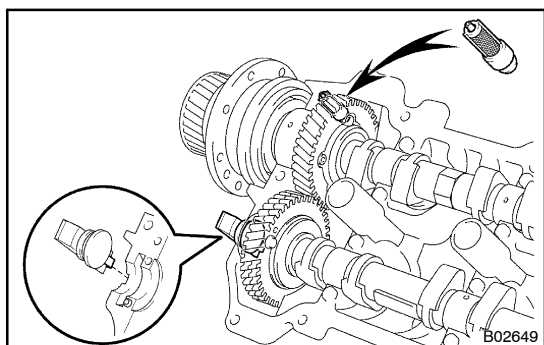


- (b) Install the LH camshafts.
- (1) Apply MP grease to the thrust portion of the intake and exhaust camshafts.
 - (2) Align the timing marks (2 dot marks) of the camshaft drive and driven main gears, and place the intake and exhaust camshafts.



- (3) Apply seal packing to the camshaft housing plug.
 - Remove the old packing (FIPG) material.
 - Apply seal packing to the housing plug.

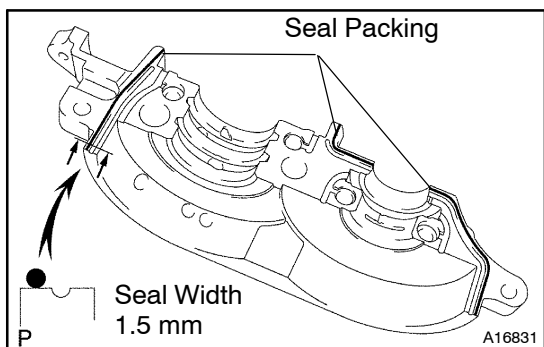
Seal packing: Part No. 08826-00080 or equivalent



- (4) Install the camshaft housing plug to the cylinder head as shown in the illustration.
- (5) Install the oil control valve filter to the cylinder head.

NOTICE:

Be careful of the installation direction.

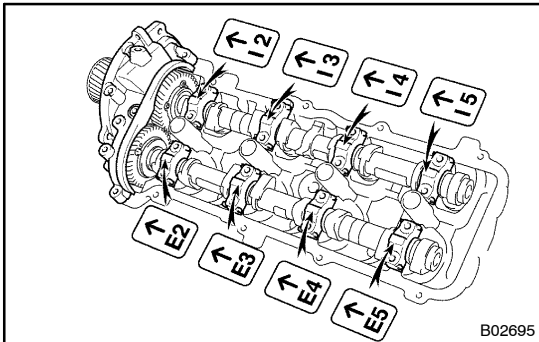


- (6) Apply seal packing to the front bearing cap.
 - Remove any old packing (FIPG) material and be care not to drop any oil on the contact surfaces of the bearing cap and cylinder head. Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and groove. Thoroughly clean all components to remove all the loose material. Using a non-residue solvent, clean both sealing surfaces.
 - Apply seal packing to the bearing cap as shown in the illustration. Install a nozzle that has been cut to a 1.5 mm (0.059 in.) opening. Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied. Immediately remove nozzle from the tube and reinstall cap.

Seal packing: Part No. 08826-00080 or equivalent

NOTICE:

Do not apply seal packing to the front bearing cap grooves.

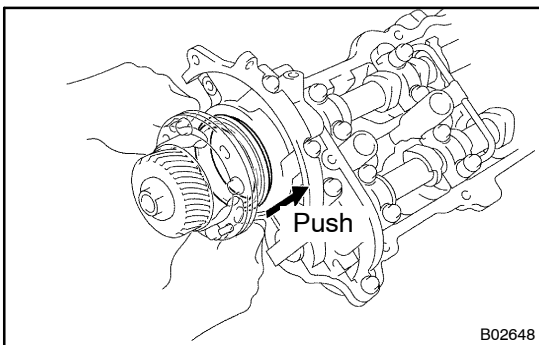


- (7) Install the front bearing cap.

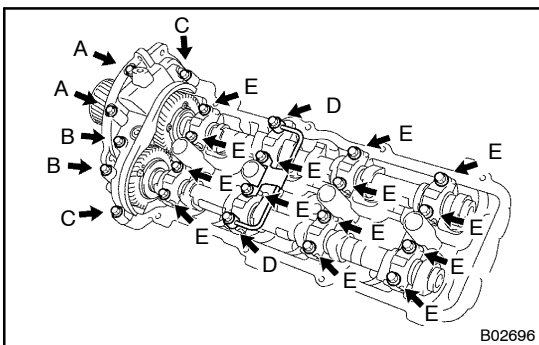
HINT:

Installing the front bearing cap will determine the thrust portion of the camshaft.

- (8) Install the other bearing cap in the sequence shown with the arrow mark facing forward.



- (9) Push in the camshaft oil seal.



- (10) Install a new seal washer to the bearing cap bolt (A and B).

- (11) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts (D and E).

NOTICE:

Do not apply engine oil under the heads of the bearing cap bolt (A), (B) and (C).

HINT:

Each bolt length is indicated in the illustration.

Bolt length:

94 mm (3.70 in.) for A with seal washer

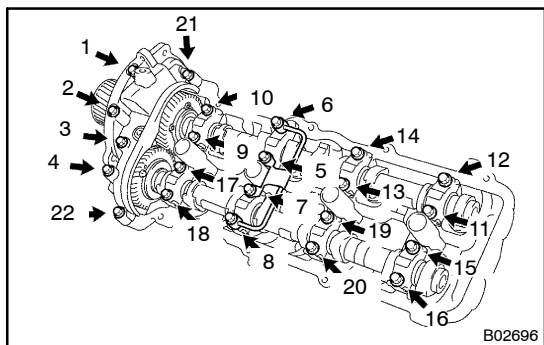
72 mm (2.83 in.) for B with seal washer

25 mm (0.98 in.) for C

52 mm (2.05 in.) for D

38 mm (1.50 in.) for E

- (12) Install the oil feed pipe and the 22 bearing cap bolts as shown in the illustration.

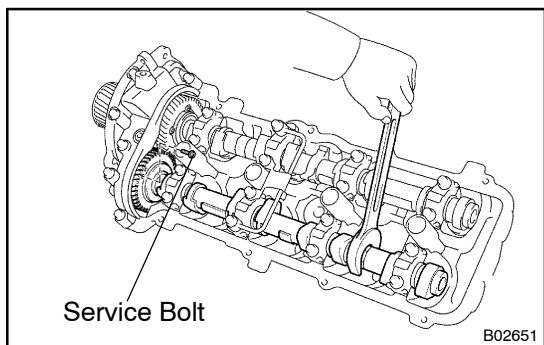


- (13) Uniformly tighten the 22 bearing cap bolts in several passes, in the sequence shown.

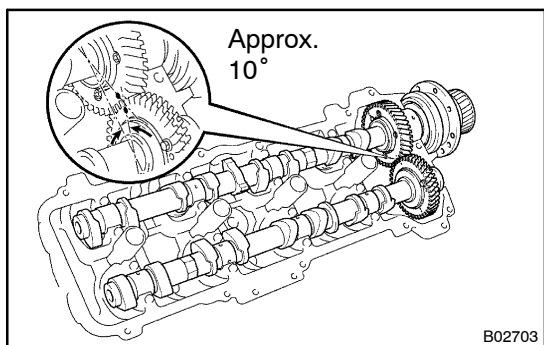
Torque:

7.5 N·m (80 kgf·cm, 66 in.·lbf) for bolt C

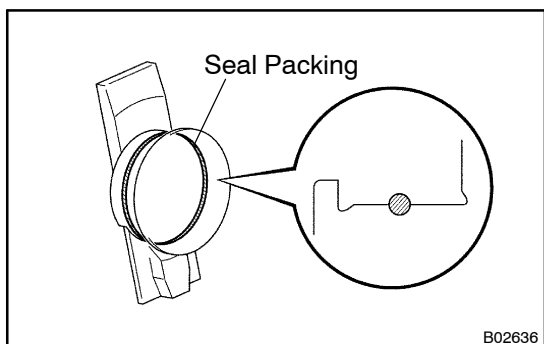
16 N·m (160 kgf·cm, 12 ft·lbf) for others



- (14) Remove the service bolt.

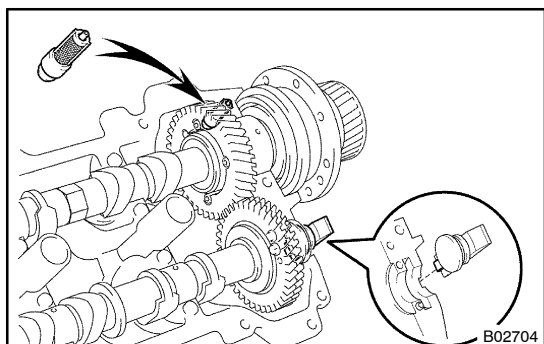


- (c) Install the RH camshafts.
- (1) Apply MP grease to the thrust portion of the intake and exhaust camshafts.
 - (2) Align the timing marks (1 dot mark) of the camshaft drive and driven main gears, and place the intake and exhaust camshafts.
 - (3) Set the timing mark (1 dot mark) of the camshaft drive and driven main gears at approx. 10° angle.



- (4) Apply seal packing to the camshaft housing plug.
 - Remove the old packing (FIPG) material.
 - Apply seal packing to the housing plug.

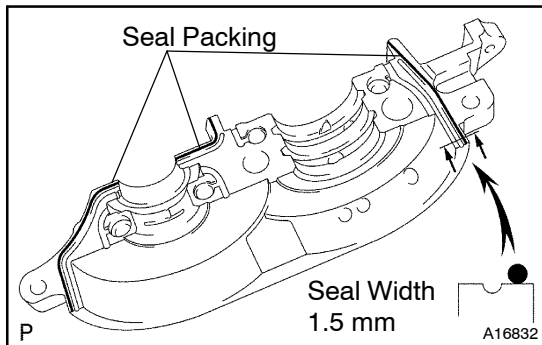
Seal packing: Part No. 08826-00080 or equivalent



- (5) Install the camshaft housing plug to the cylinder head as shown in the illustration.
- (6) Install the oil control valve filter to the cylinder head.

NOTICE:

Be careful of the installation direction.

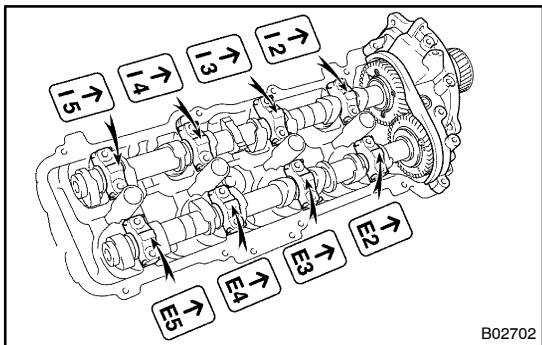


- (7) Apply seal packing to the front bearing cap.
- Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the bearing cap and cylinder head. Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and groove. Thoroughly clean all components to remove all the loose material. Using a non-residue solvent, clean both sealing surfaces.
 - Apply seal packing to the bearing cap as shown in the illustration. Install a nozzle that has been cut to a 1.5 mm (0.059 in.) opening. Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied. Immediately remove nozzle from the tube and reinstall cap.

Seal packing: Part No. 08826-00080 or equivalent

NOTICE:

Do not apply seal packing to the front bearing cap grooves.

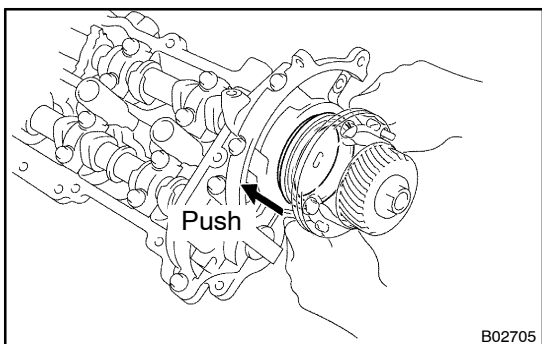


- (8) Install the front bearing cap.

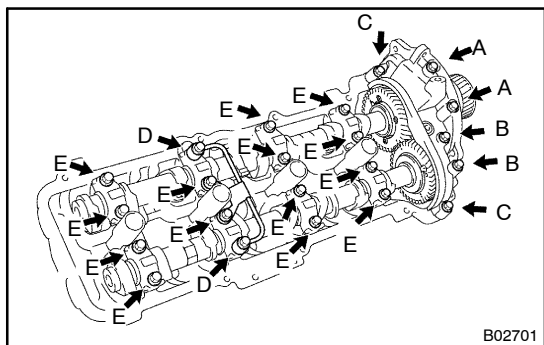
HINT:

Installing the front bearing cap will determine the thrust portion of the camshaft.

- (9) Install the other bearing caps in the sequence shown with the arrow mark facing forward.



- (10) Push in the camshaft oil seal.



- (11) Install a new seal washer to the bearing cap bolt (A and B).
- (12) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts (D and E).

NOTICE:

Do not apply engine oil under the heads of the bearing cap bolt (A), (B) and (C).

HINT:

Each bolt length is indicated in the illustration.

Bolt length:

94 mm (3.70 in.) for A with seal washer

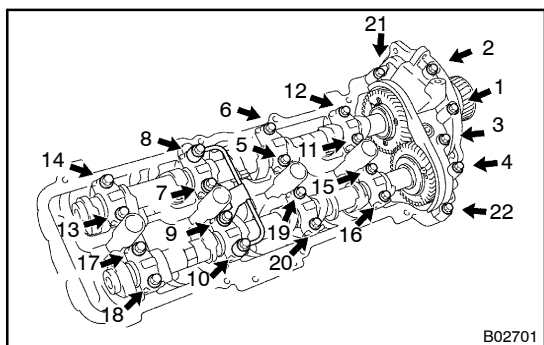
72 mm (2.83 in.) for B with seal washer

25 mm (0.98 in.) for C

52 mm (2.05 in.) for D

38 mm (1.50 in.) for E

- (13) Install the oil feed pipe and the 22 bearing cap bolts as shown in the illustration.

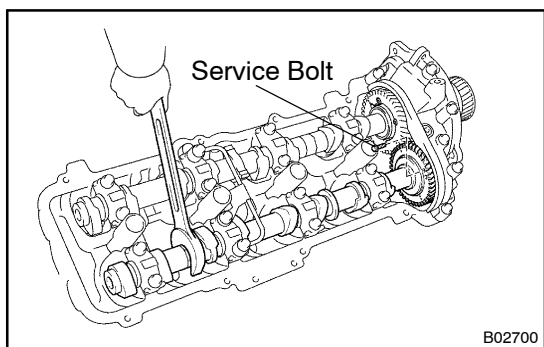


- (14) Uniformly tighten the 22 bearing cap bolts in several passes, in the sequence shown.

Torque:

7.5 N·m (80 kgf·cm, 66 in·lbf) for bolt C

16 N·m (160 kgf·cm, 12 ft·lbf) for others



- (15) Remove the service bolt.

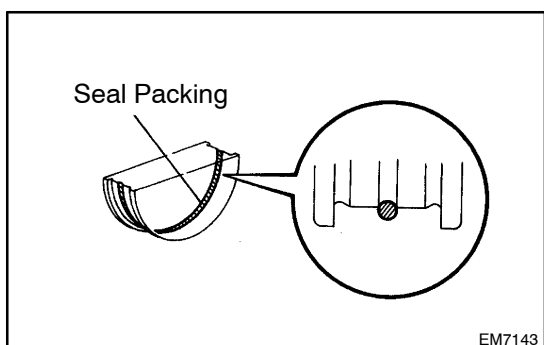
10. CHECK AND ADJUST VALVE CLEARANCE

(See [page EM-4](#))

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

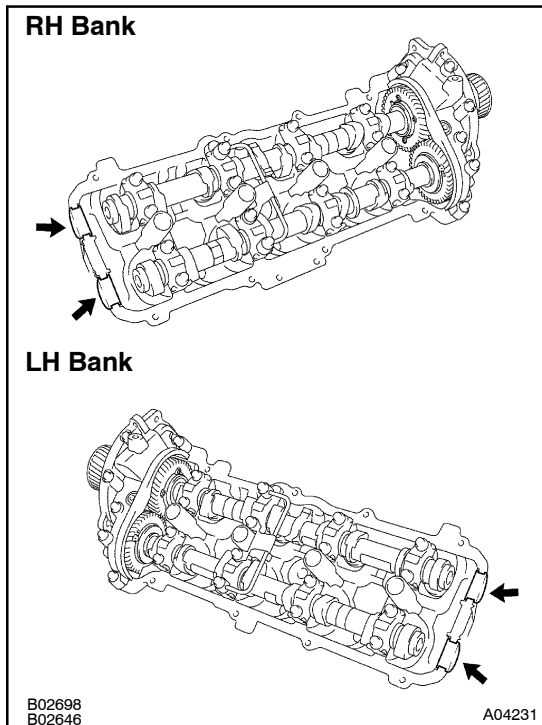
11. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE

(See [page FI-44](#))

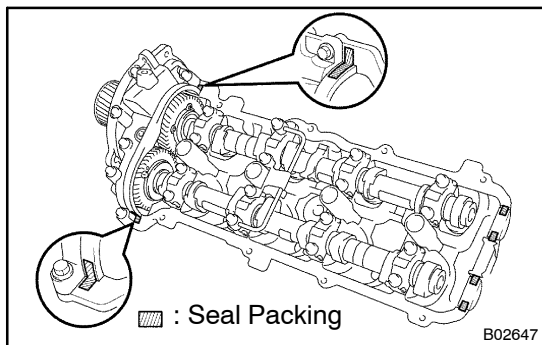


12. INSTALL SEMI-CIRCULAR PLUGS

- (a) Remove any old packing (FIPG) material.
 - (b) Apply seal packing to the semi-circular plug grooves.
- Seal packing: Part No. 08826-00080 or equivalent**



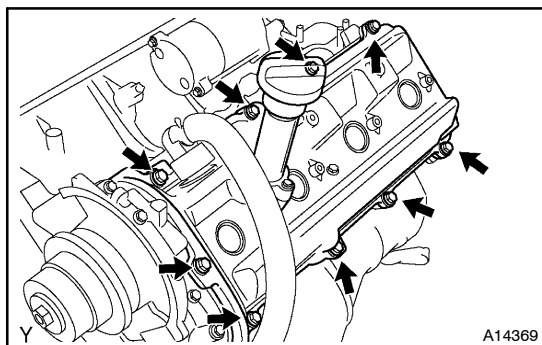
- (c) Install the 4 semi-circular plugs to the cylinder heads as shown in the illustration.



13. INSTALL LH CYLINDER HEAD COVER

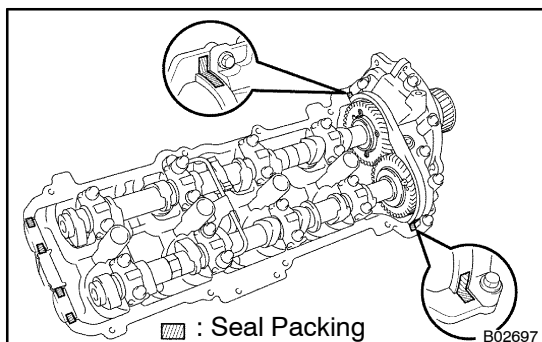
- (a) Remove any old packing (FIPG) material.
(b) Apply seal packing to the cylinder heads as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent



- (c) Install the gasket to the cylinder head cover.
(d) Install the seal washer to the bolt.
(e) Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several passes.

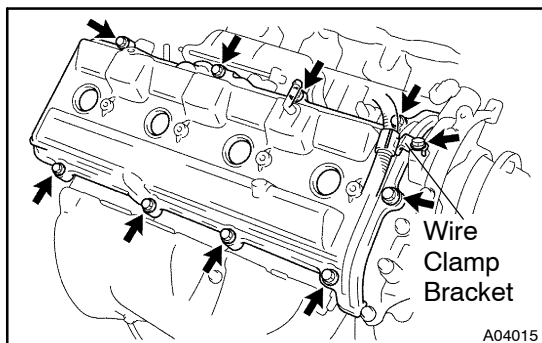
Torque: 6.0 N·m (60 kgf·cm, 53 in.-lbf)



14. INSTALL RH CYLINDER HEAD COVER

- (a) Remove any old packing (FIPG) material.
(b) Apply seal packing to the cylinder heads as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent



- (c) Install the gasket to the cylinder head cover.
- (d) Install the seal washer to the bolt.
- (e) Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several passes. Install the 2 cylinder head covers.

Torque: 6.0 N·m (60 kgf·cm, 53 in·lbf)

- (f) Install the wire clamp bracket on the engine wire to the camshaft bearing cap.

15. INSTALL ENGINE HANGERS

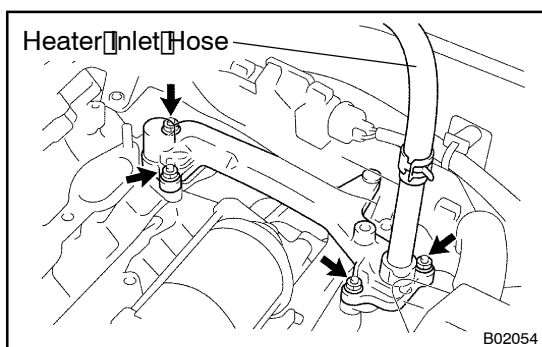
Torque: 37 N·m (380 kgf·cm, 27 ft·lbf)

16. INSTALL VVT SENSORS (See page FI-71)

17. INSTALL OIL DIPSTICK AND GUIDE FOR ENGINE (See page LU-15)

18. INSTALL OIL DIPSTICK AND GUIDE FOR A/T (See page EM-85)

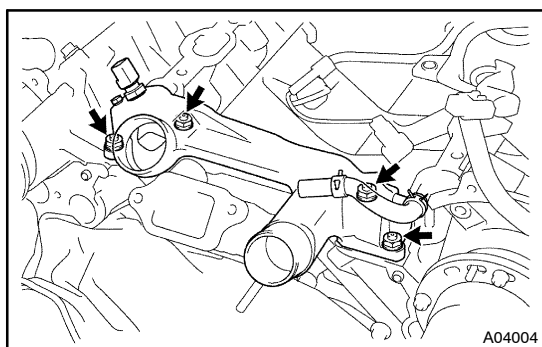
19. INSTALL IGNITION COILS (See page G-5)



20. INSTALL REAR WATER BYPASS JOINT

- (a) Install 2 new gaskets and the water bypass joint with the 4 nuts. Alternately tighten the nuts.
- (b) Connect the heater inlet hose to the water bypass joint.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

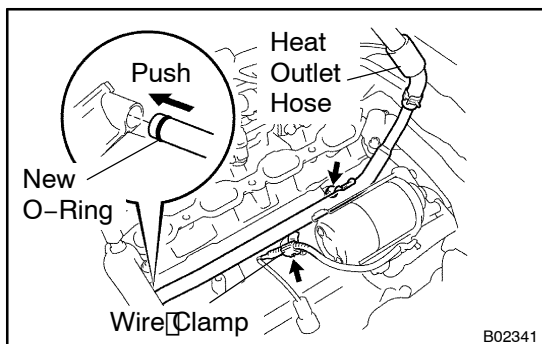


21. INSTALL FRONT WATER BYPASS JOINT

- (a) Install 2 new gaskets and the water bypass joint with the 4 nuts. Alternately tighten the nuts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

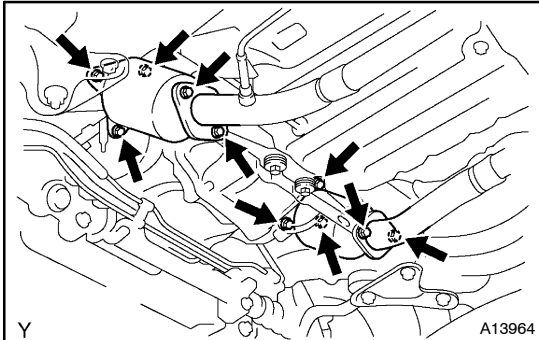
- (b) Connect the water temperature sensor connector.



22. INSTALL WATER BYPASS PIPE

- (a) Install a new O-ring to the water bypass pipe.
 - (b) Apply soapy water to the O-ring.
 - (c) Push in the water bypass pipe end into the pipe hole of the water pump.
 - (d) Install the water bypass pipe with the bolt.
- Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)**
- (e) Install the wire clamp to the bracket of the water bypass pipe.
 - (f) Connect the heater outlet hose to the water bypass pipe.

23. INSTALL WATER INLET AND INLET HOUSING ASSEMBLY (See page CO-8)



24. INSTALL TWC

- (a) Install a new gasket and the TWC with 3 new nuts. Install the 2 TWC.

Torque: 62 N·m (630 kgf·cm, 46 ft·lbf)

- (b) Install a new gasket to each front end of the front exhaust pipe.
- (c) Connect the front exhaust pipe to the 2 front TWC with the 4 bolts and 4 new nuts.

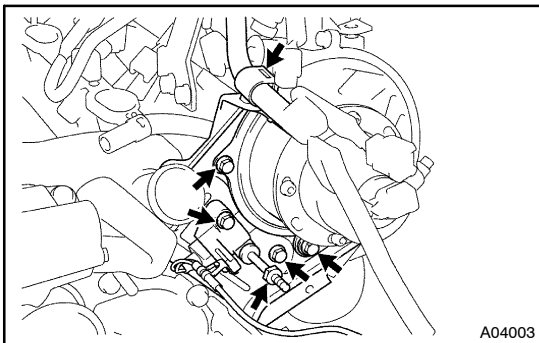
Torque: 44 N·m (450 kgf·cm, 32 ft·lbf)

25. INSTALL PS PUMP (See page EM-85)

26. INSTALL LH TIMING BELT REAR PLATES AND CAMSHAFT POSITION SENSOR

Install the No.1, No.2 rear plates and camshaft position sensor with the stud bolt and 3 bolts.

Torque: 7.5 N·m (80 kgf·cm, 66 in·lbf)



27. INSTALL RH TIMING BELT REAR PLATES

Install the No.1 and No.2 rear plates with the stud bolt and 3 bolts.

Torque: 7.5 N·m (80 kgf·cm, 66 in·lbf)

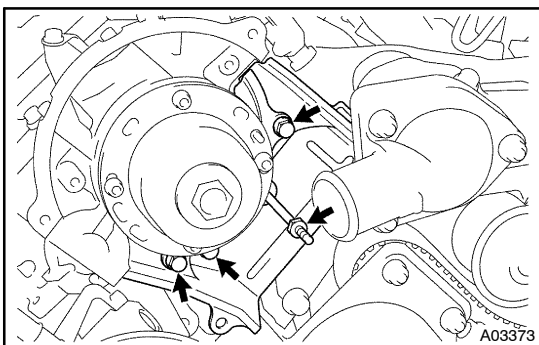
28. INSTALL CAMSHAFT TIMING PULLEYS

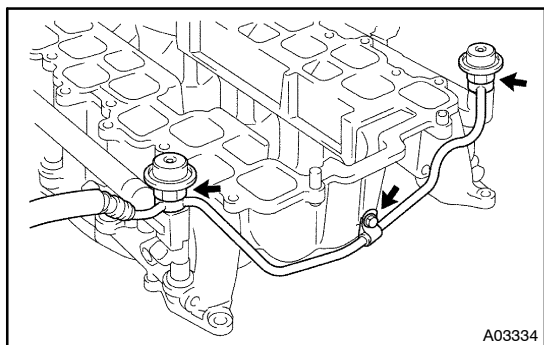
(See page EM-22)

29. CONNECT TIMING BELT TO CAMSHAFT TIMING PULLEYS (See page EM-22)

30. ASSEMBLE UPPER AND LOWER INTAKE MANIFOLDS

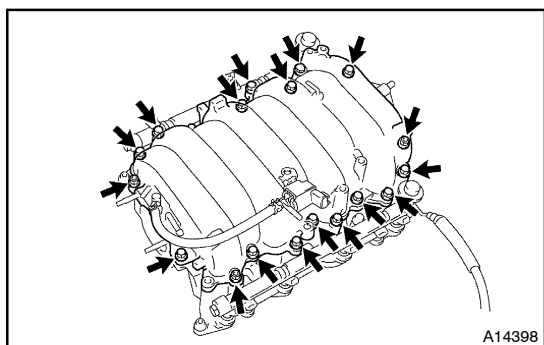
- (a) Install the 2 delivery pipes and 8 injectors.
(See page FI-26)





- (b) Temporarily install the rear fuel pipe to delivery pipes with new lower, upper gaskets and 2 fuel pressure pulsation dampers.
- (c) Install the rear fuel pipe to the lower intake manifold with the bolt.
- (d) Tighten the fuel pressure pulsation dampers.
(See [page FI-30](#))
- (e) Install the EVAP hose with the VSV for the EVAP to the upper intake manifold.
- (f) Install the air tube to the upper intake manifold with the 2 bolts.
- (g) Install the air control valve to the upper intake manifold with the 6 bolts. Uniformly tighten the bolts in several passes.

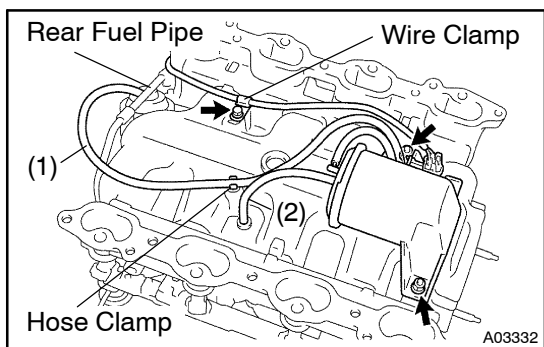
Torque: 8.5 N·m (85 kgf·cm, 75 in·lbf)



- (h) Install a new gasket and the upper intake manifold with the 15 bolts and 3 nuts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

- (i) Install the air control valve. (See [page FI-52](#))

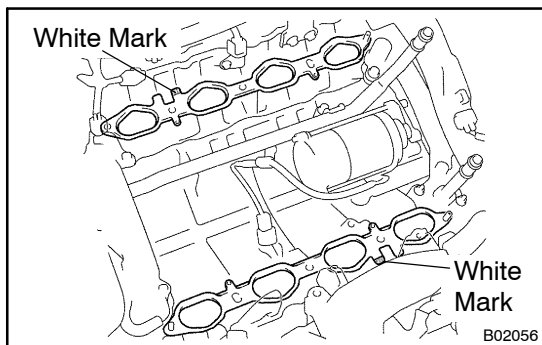


- (j) Install the vacuum tank and VSV assembly for the ACIS with the 2 nuts.
Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)
- (k) Install the wire clamp to the lower intake manifold with the bolt.
- (l) Connect these vacuum hoses:
 - (1) Vacuum hose (from VSV for ACIS) to air control valve actuator.

HINT:

Pass the vacuum hose over the rear fuel pipe.

- (2) Vacuum hose (from vacuum tank) to lower intake manifold.
- (m) Install the vacuum hose (the VSV for the ACIS to the air control valve actuator) to the hose clamp.

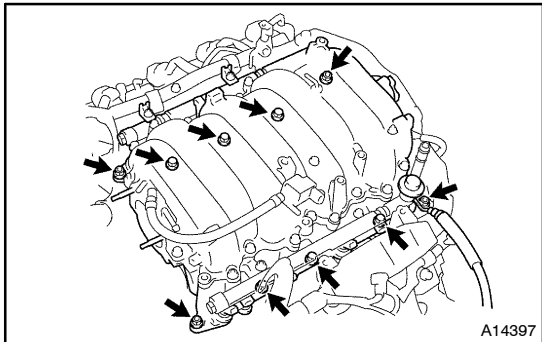


31. INSTALL UPPER AND LOWER INTAKE MANIFOLDS ASSEMBLY

- (a) Place 2 new gaskets on the cylinder heads with the white mark facing outward.

NOTICE:

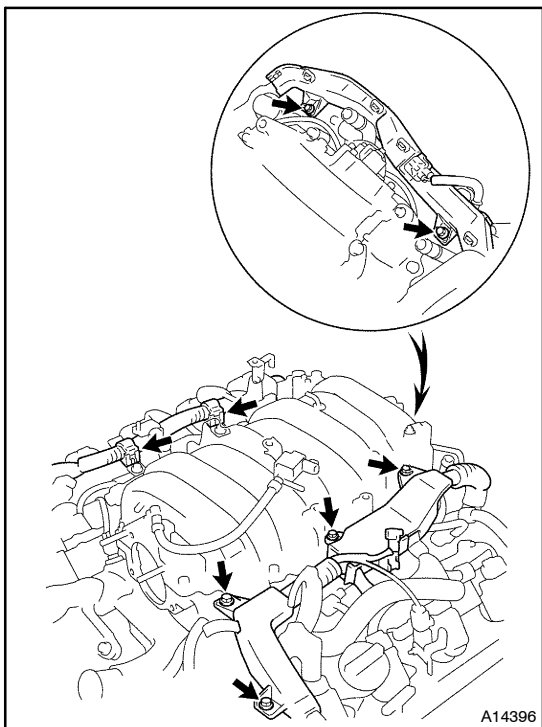
Be careful of the installation direction.



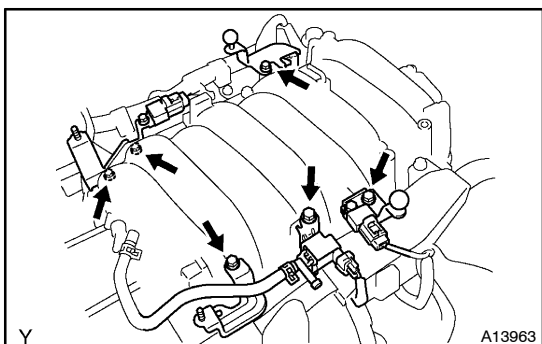
- (b) Install the upper and lower intake manifolds assembly with the 6 bolts and 4 nuts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

- (c) Connect the 8 injector connectors.
(d) Connect the VSV connector for ACIS.



- (e) Install the engine wire protector (rear side) with the 2 bolts.
(f) Install the engine wire protector (LH side) with the 4 bolts.
(g) Install the 2 wire clamps on the engine wire (Rh side) to the brackets on the RH delivery pipe.

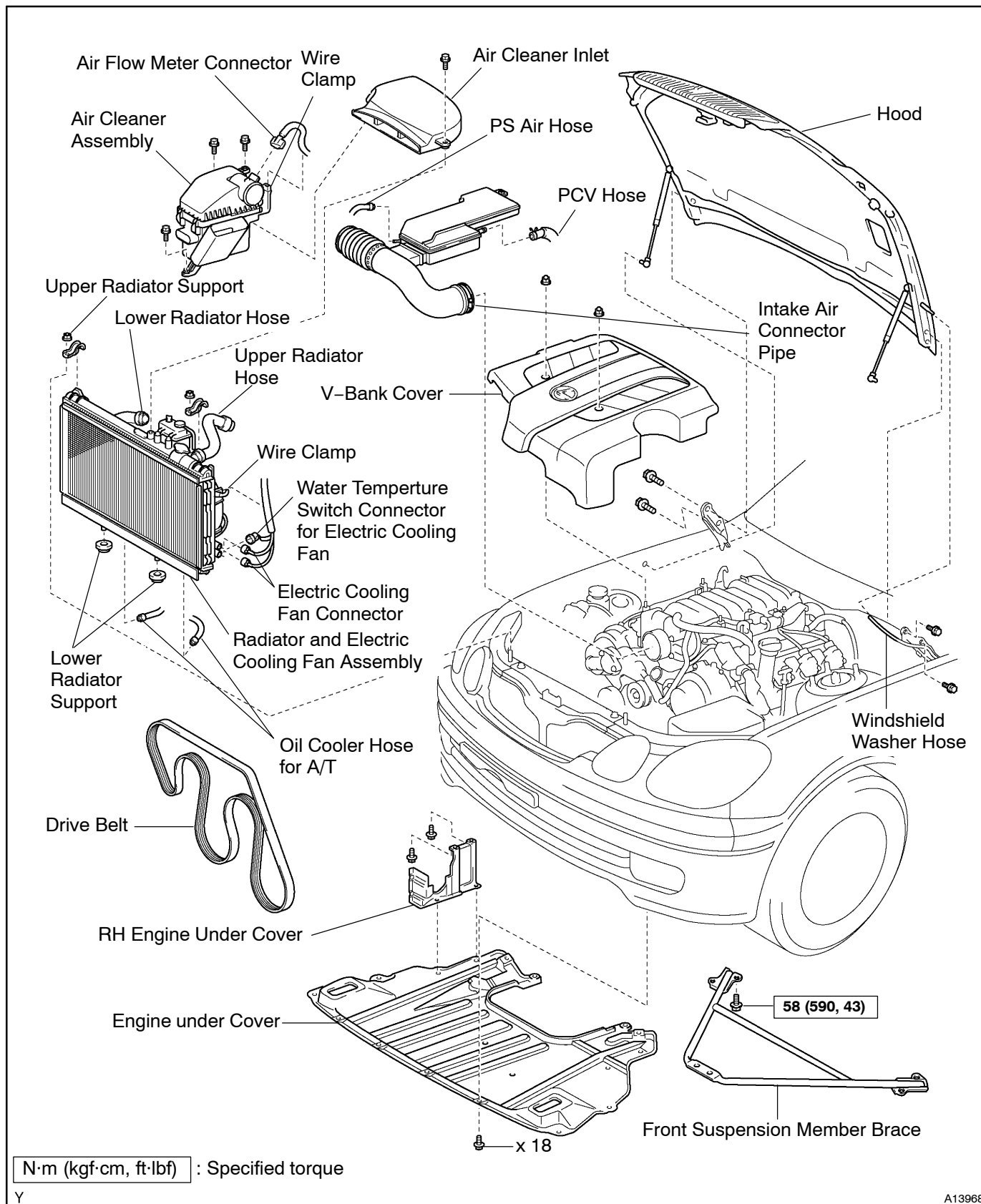


- (h) Install and connect these parts:
(1) Install the NO. 1 V-bank cover bracket.
(2) Install the NO. 2 V-bank cover bracket.
(3) Install the NO. 3 V-bank cover bracket.
(4) Install the NO. 4 V-bank cover bracket.
(5) Connect the VSV for EVAP.
(6) Connect the EVAP hose to the VSV for EVAP.
(7) Connect the VSV connector for EVAP.
(i) Connect the fuel inlet hose (rear fuel pipe) to the fuel main tube. [\[See page FI-1\]](#)

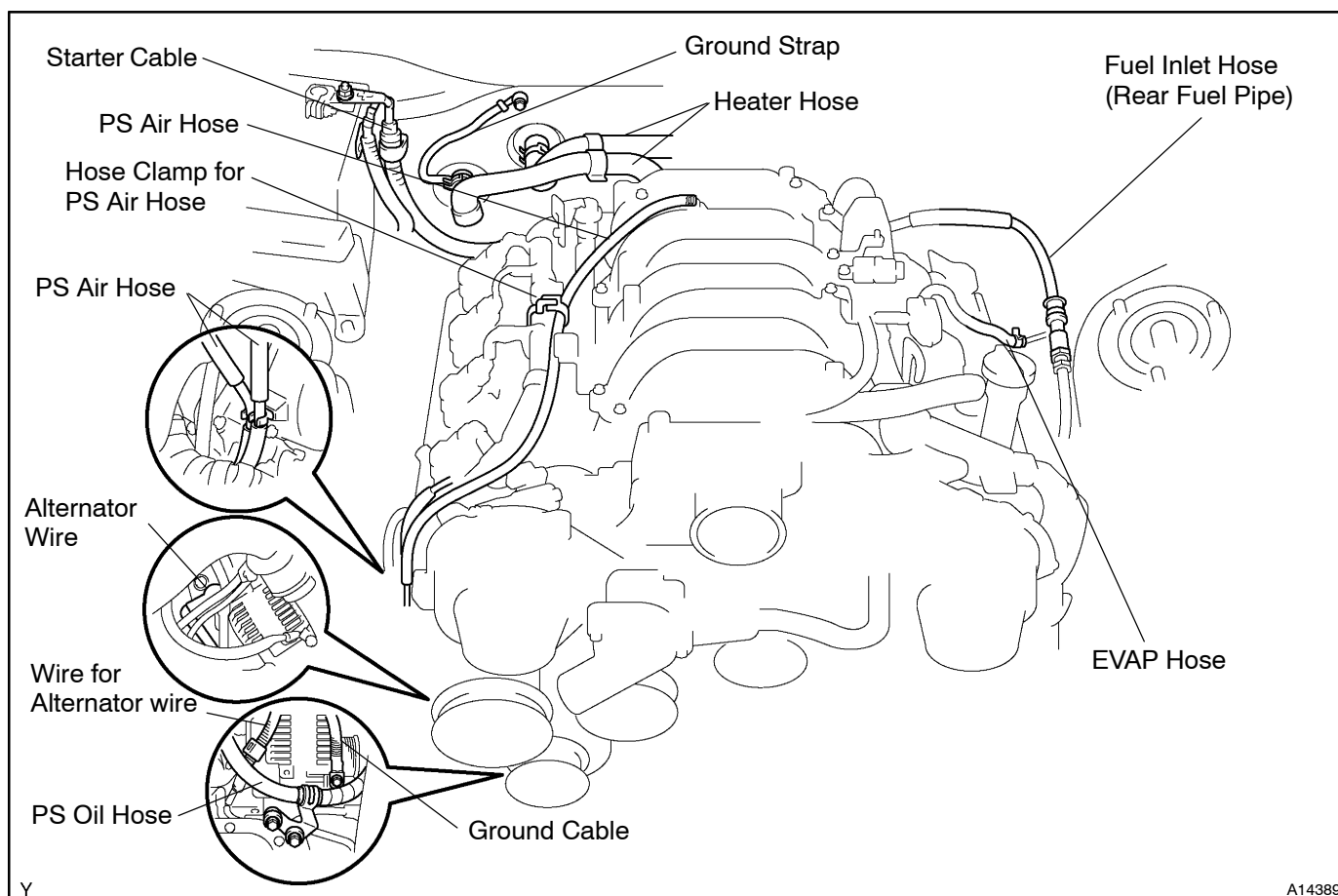
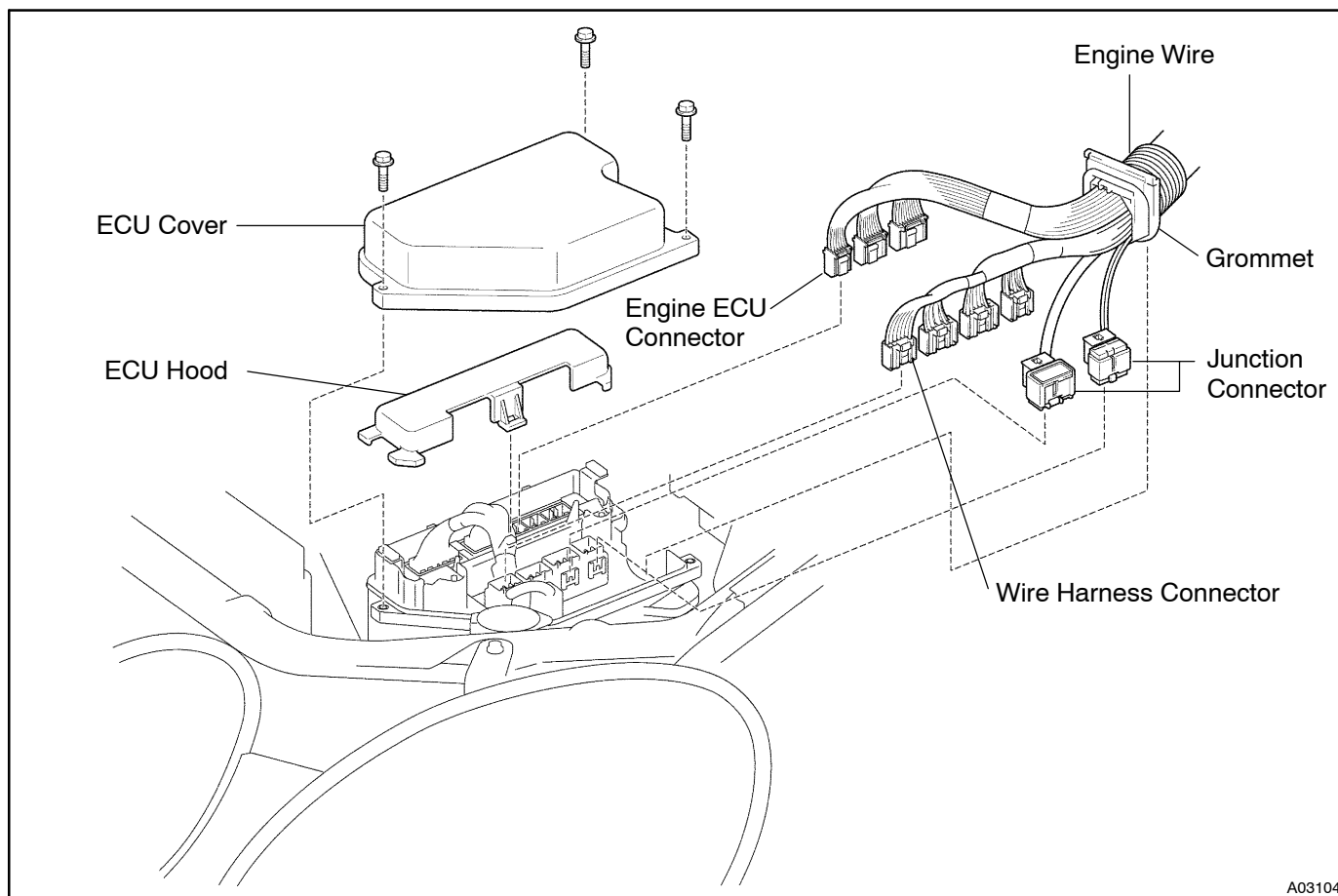
32. INSTALL THROTTLE BODY
33. □ INSTALL RADIATOR ASSEMBLY (See page CO-24)
34. INSTALL INTAKE AIR CONNECTOR PIPE
35. INSTALL AIR CLEANER ASSEMBLY
36. □ FILL WITH ENGINE COOLANT (see page CO-2)
37. START ENGINE AND CHECK FOR ENGINE COOLANT AND FUEL
38. CHECK ENGINE OIL LEVEL
39. INSTALL V-BANK COVER
40. INSTALL ENGINE UNDER COVER

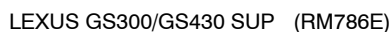
ENGINE UNIT COMPONENTS

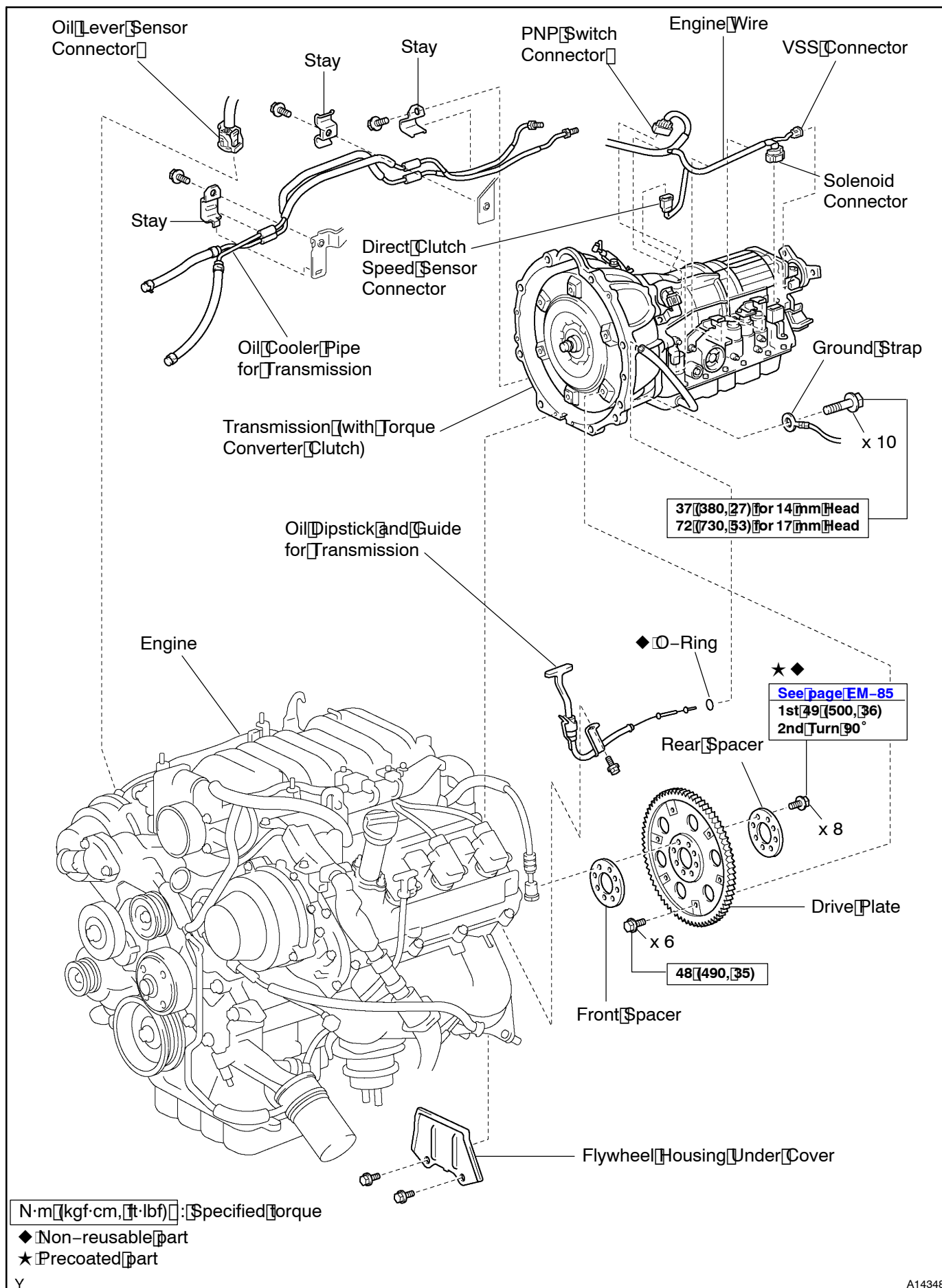
EM0E6-02



A13968

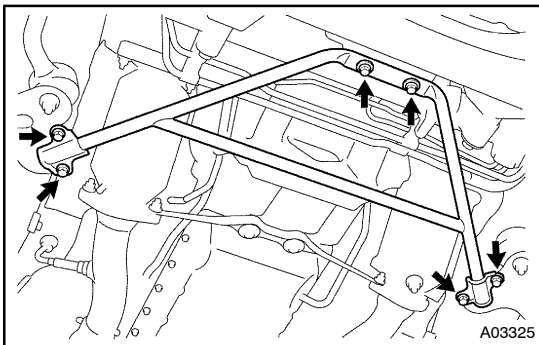






REMOVAL

1. REMOVE HOOD
2. REMOVE ENGINE UNDER COVER
3. DRAIN ENGINE COOLANT
4. DRAIN ENGINE OIL
5. REMOVE V-BANK COVER
6. REMOVE AIR CLEANER INLET
7. REMOVE AIR CLEANER ASSEMBLY
8. REMOVE INTAKE AIR CONNECTOR PIPE
9. REMOVE RADIATOR ASSEMBLY (See page CO-19)
10. REMOVE DRIVE BELT (See page CH-7)



11. REMOVE FRONT SUSPENSION MEMBER BRACE

Remove the 6 bolts and brace.

12. DISCONNECT WIRE, CABLES, HOSES AND CLAMP

- Disconnect the alternator wire from alternator.
- Disconnect the wire for alternator wire from wire clamp on alternator.
- Disconnect the ground cable from stay on alternator.
- Disconnect the PS oil hose from No. 1 oil pan.
- Disconnect the 2 PS air hoses from hose clamp on No. 3 RH timing belt cover.
- Disconnect the hose clamp for PS air hose.
- Disconnect the PS air hose from upper intake manifold.
- Disconnect the starter cable from battery.
- Disconnect the ground strap from body.
- Disconnect the 2 heater hoses.
- Disconnect the fuel inlet hose (rear fuel pipe) from fuel main tube.

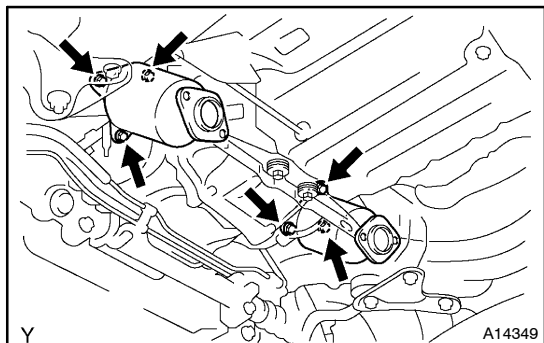
13. DISCONNECT ENGINE WIRE FROM ECU BOX

- (a) Remove these parts:
 - Remove the ECU cover
 - Remove the ECU hood
- (b) Disconnect these connectors:
 - Disconnect the 3 engine ECU connectors
 - Disconnect the 4 wire harness connectors
 - Disconnect the 2 junction connectors
- (c) Disconnect the grommet and engine wire from the ECU box.

14. DISCONNECT HEATED OXYGEN SENSORS FROM FRONT EXHAUST PIPE

- (a) Disconnect the 2 wire grommets from the floor panel.
- (b) Disconnect the 2 oxygen sensors from the exhaust pipe.

15. REMOVE FRONT AND CENTER EXHAUST PIPES



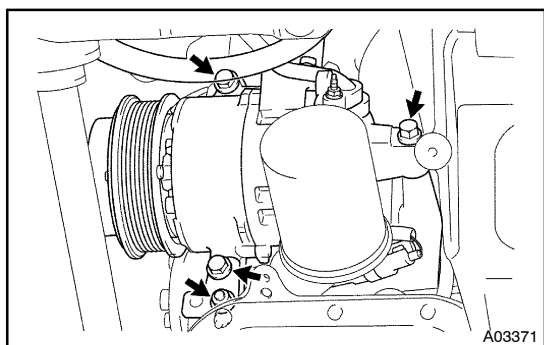
16. REMOVE TWC

Remove the 3 nuts, TWC and gasket. Remove the 2 TWC.

17. REMOVE CENTER FRONT FLOOR BRACE

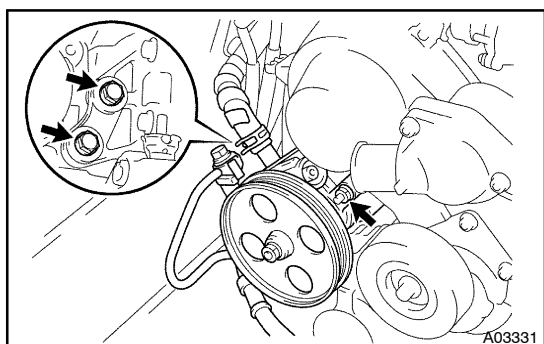
18. REMOVE HEAT INSULATORS

19. REMOVE PROPELLER SHAFT (See Pub. No. RM588E on page PR-4)



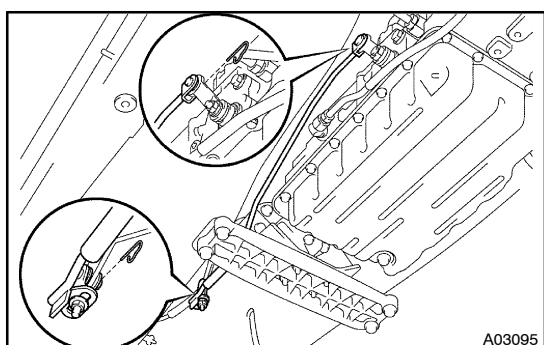
20. DISCONNECT A/C COMPRESSOR FROM ENGINE

- (a) Disconnect the A/C compressor connector.
- (b) Disconnect the wire clamp from the wire bracket on the A/C compressor.
- (c) Remove the bolt, nut and A/C compressor stay.
- (d) Remove the bolt, and disconnect the wire bracket from the A/C compressor.
- (e) Remove the bolt, and disconnect the A/C compressor from the engine.



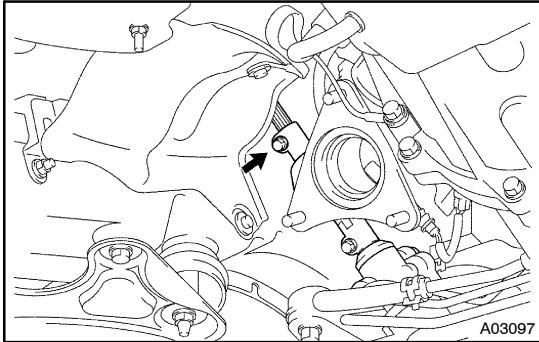
21. REMOVE PS PUMP

- (a) Remove the 2 screws and RH engine under cover.
- (b) Disconnect the PS oil pressure switch connector.
- (c) Remove the 2 bolts and nut, and disconnect the PS pump from the engine.

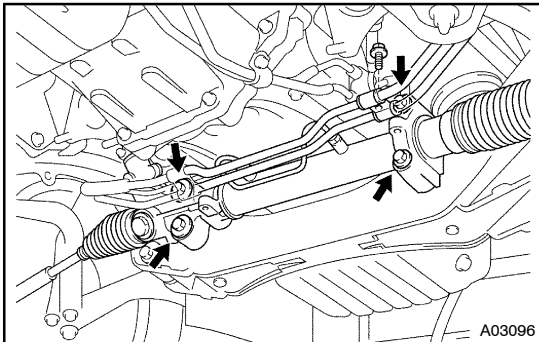


22. REMOVE TRANSMISSION CONTROL ROD

Remove the 2 clips and control rod.

**23. DISCONNECT PS GEAR HOUSING**

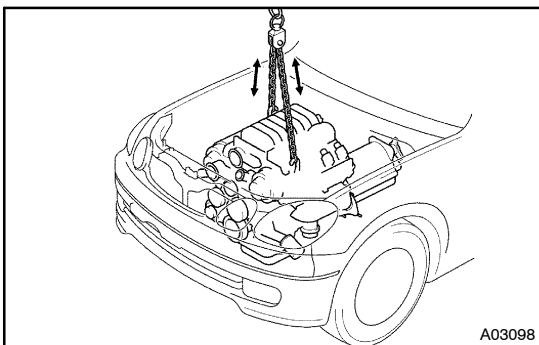
- (a) Check the steering wheel at the straight-ahead position.
- (b) Remove the bolt holding the sliding yoke to the steering intermediate shaft.



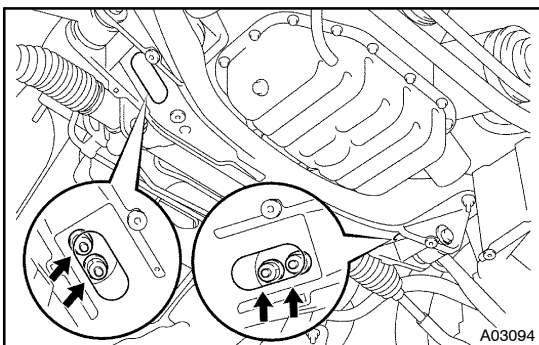
- (c) Remove the bolt, and disconnect the 2 PS oil tubes from the front frame.
- (d) Remove the 4 bolts, and disconnect the PS gear housing from the front frame.
- (e) Disconnect the sliding yoke from the intermediate shaft.

HINT:

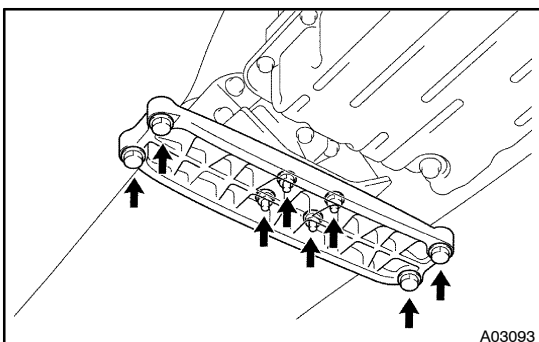
Suspend the PS gear housing securely.

**24. REMOVE ENGINE AND TRANSMISSION ASSEMBLY FROM VEHICLE**

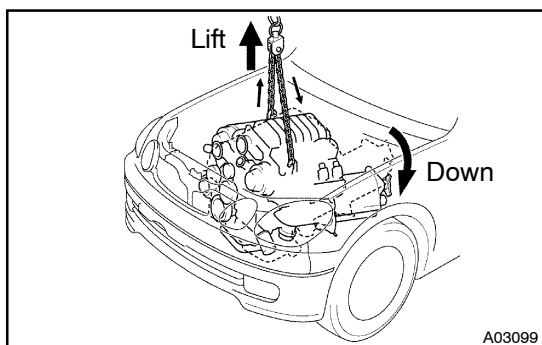
- (a) Remove the nut and No.1 V-bank cover bracket from the No.2 engine hanger.
- (b) Attach the engine chain hoist to the engine hangers.



- (c) Remove the 2 hole plugs.
- (d) Remove the 4 nuts holding the engine mounting insulators to the front suspension crossmember.



- (e) Remove the 4 bolts, 4 nuts and rear engine mounting member.



- (f) Lift the engine out of the vehicle slowly and carefully.

HINT:

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

- (g) Place the engine and transmission assembly onto the stand.

25. DISCONNECT ENGINE WIRE FROM TRANSMISSION

Disconnect the connectors and wire:

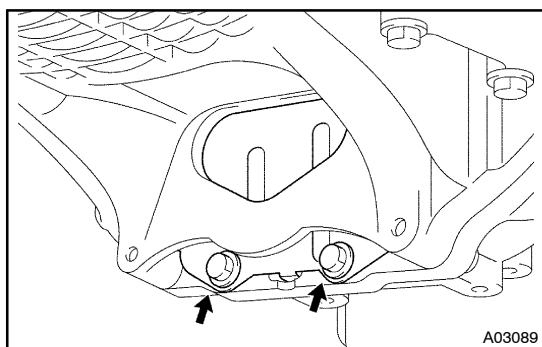
- Disconnect the VSV connector.
- Disconnect the PNP switch connector.
- Disconnect the solenoid connector.
- Disconnect the direct clutch speed sensor connector.
- Disconnect the engine wire from 3 wire clamps.

26. REMOVE OIL DIPSTICK GUIDE AND DIPSTICK FOR TRANSMISSION

- (a) Remove the bolt.
- (b) Pull out the dipstick guide and dipstick from the dipstick tube of transmission.
- (c) Remove the O-ring from the dipstick guide.

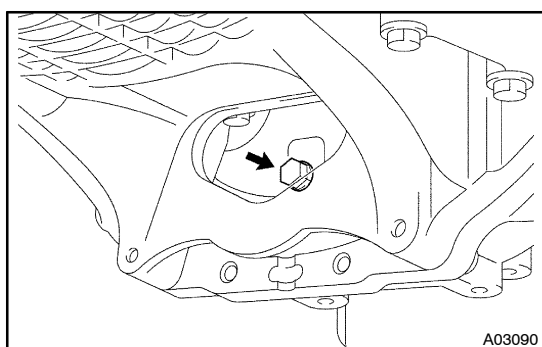
27. REMOVE OIL COOLER PIPES FOR TRANSMISSION

- (a) Disconnect the oil level sensor connector.
- (b) Remove the 3 bolts and 3 stays.
- (c) Loosen the 2 union nuts, and remove the 2 oil cooler pipes.

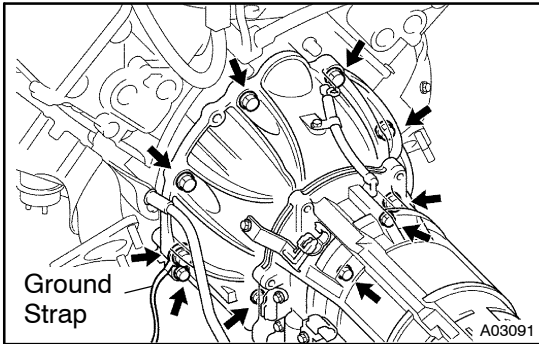


28. REMOVE TORQUE CONVERTER CLUTCH BOLTS

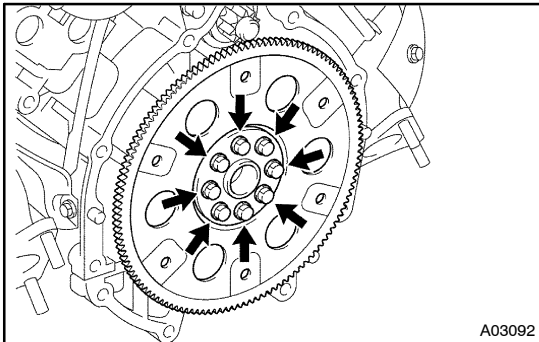
- (a) Remove the 2 bolts and flywheel housing under cover.



- (b) Turn the crankshaft pulley bolt to gain access to each bolt.
- (c) Hold the crankshaft pulley bolt with a wrench, and remove the 6 bolts.

**29. REMOVE TRANSMISSION**

- (a) Remove the 10 bolts and ground strap.
- (b) Remove the transmission together with the torque converter clutch from the engine.

**30. REMOVE DRIVE PLATE**

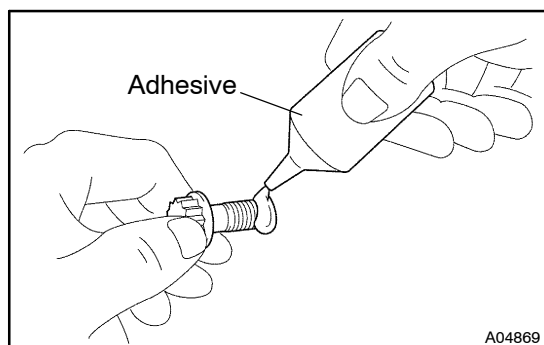
Remove the 8 bolts, front spacer, drive plate and rear spacer.

INSTALLATION

1. INSTALL DRIVE PLATE

HINT:

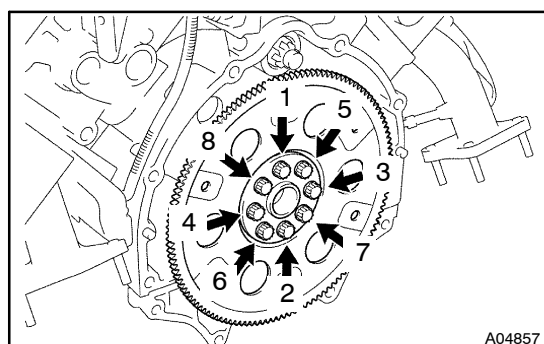
- The mounting bolts are tightened in 2 progressive steps (steps (c) and (e)).
- If any one of the mounting bolts is broken or deformed, replace it.



- (a) Apply adhesive to 2 or 3 threads of the mounting bolt end.

Adhesive:

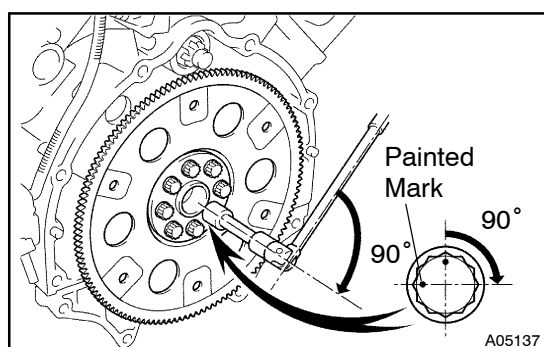
Part No. 08833-00070, THREE BOND 1324 or equivalent



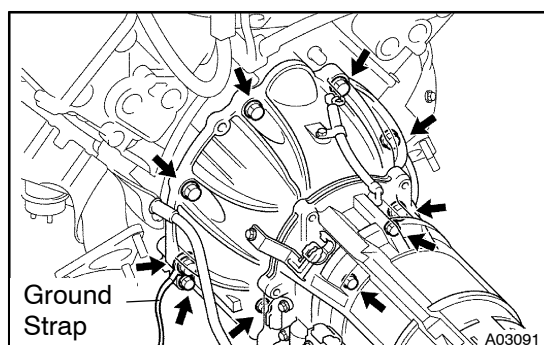
- (b) Install the front spacer, drive plate and rear spacer on the crankshaft.
- (c) Install and uniformly tighten the 8 mounting bolts in several passes, in the sequence shown.

Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

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



- (d) Mark the mounting bolt with paint.
- (e) Retighten the mounting bolts by 90° in the numerical order shown.
- (f) Check that the painted mark is now at a 90° angle to (e).



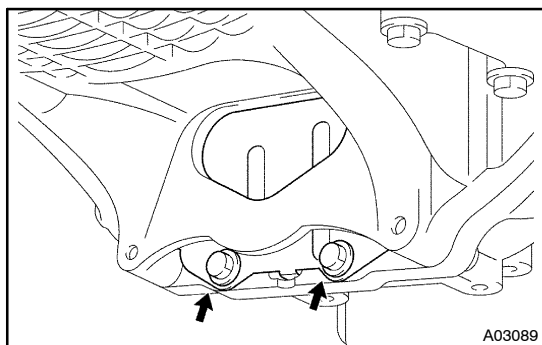
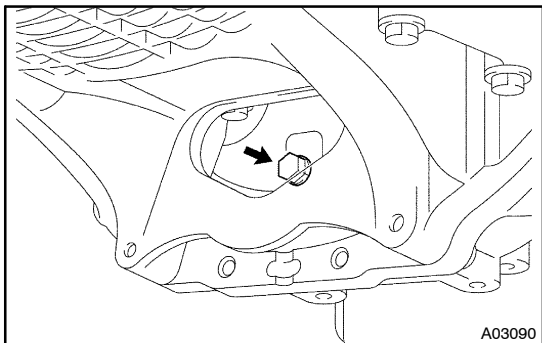
2. INSTALL TRANSMISSION TO ENGINE

- (a) Check the torque converter clutch installation.
(See [page AT-26](#))
- (b) Attach the transmission to the engine.
- (c) Install the ground strap and 10 bolts.

Torque:

37 N·m (380 kgf·cm, 27 ft·lbf) for 14 mm head

72 N·m (730 kgf·cm, 53 ft·lbf) for 17 mm head



3. INSTALL TORQUE CONVERTER CLUTCH BOLTS

- (a) Apply adhesive to 2 or 3 threads of the bolt end.

Adhesive:

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

- (b) Hold the crankshaft pulley bolt with a wrench, and install the 6 bolts evenly.

Torque: 48 N·m (490 kgf·cm, 35 ft·lbf)

HINT:

First install the black colored bolt, install the other bolts.

- (c) Install the flywheel housing under cover with the 2 bolts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

4. INSTALL OIL COOLER PIPE FOR TRANSMISSION

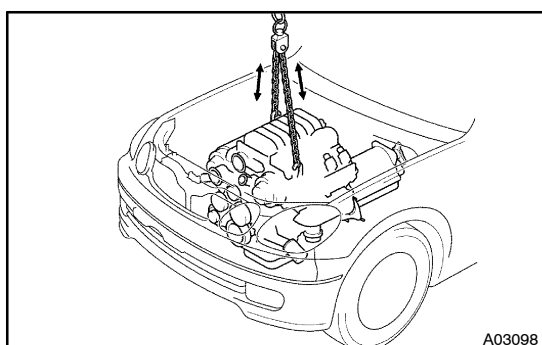
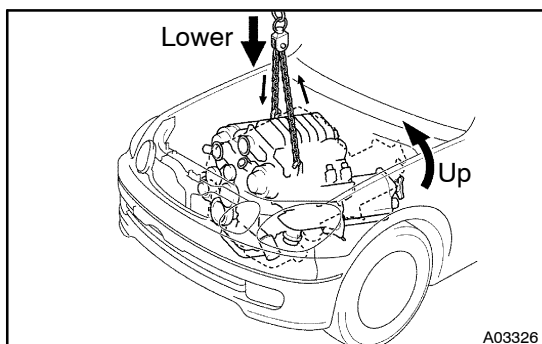
5. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK FOR TRANSMISSION

- (a) Install a new O-ring to the dipstick guide.
 (b) Apply soapy water to the O-ring.
 (c) Connect the dipstick guide end to the dipstick tube of the oil pan.
 (d) Install the dipstick guide with the bolt.
 (e) Install the dipstick.

6. CONNECT ENGINE WIRE TO TRANSMISSION

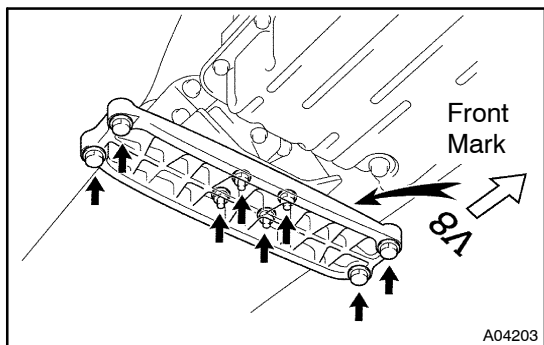
Connect the connectors and wire:

- Connect the VSV connector.
- Connect the PNP switch connector.
- Connect the solenoid connector.
- Connect the direct clutch speed sensor connector.
- Connect the engine wire to 3 wire clamps.



7. INSTALL ENGINE AND TRANSMISSION ASSEMBLY IN VEHICLE

- (a) Attach the engine chain hoist to the engine hangers.
 (b) Slowly lower the engine and transmission assembly into the engine compartment.
 (c) Insert the stud bolts of the front engine mounting brackets into the stud bolt holes of the front suspension crossmember.
 (d) Keep the engine level.



- (e) Install the rear engine mounting member with the 4 bolts and 4 nuts.

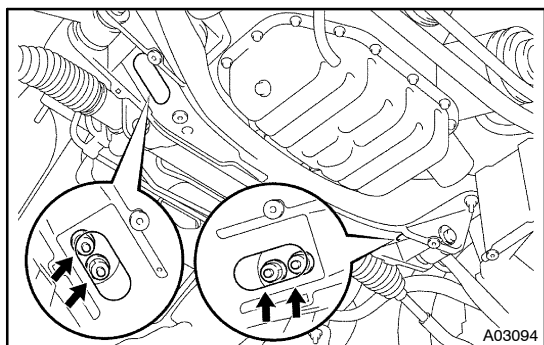
Torque:

25.5 N·m (260 kgf·cm, 19 ft·lbf) for bolts

13.5 N·m (135 kgf·cm, 10 ft·lbf) for nuts

NOTICE:

Be careful of installation direction.



- (f) Install the 4 nuts holding the engine mounting brackets to the front suspension crossmember.

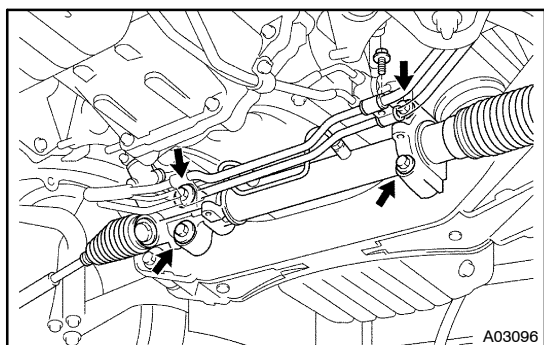
Torque: 68 N·m (700 kgf·cm, 50 ft·lbf)

- (g) Install the 2 hole plugs.

- (h) Remove the engine chain hoist.

- (i) Install the No.1 V-bank cover bracket to the No.2 engine hanger with the nut.

8. INSTALL HEAT INSULATORS FOR FRONT SIDE OF FRONT EXHAUST PIPE



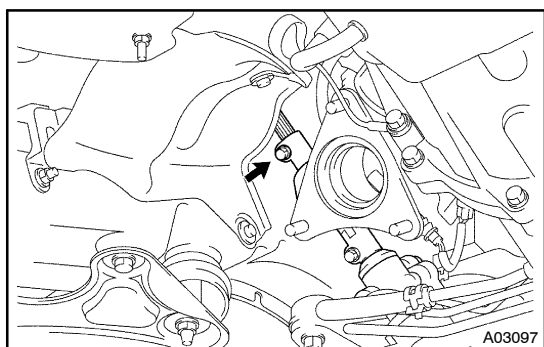
9. INSTALL PS GEAR HOUSING

- (a) Connect the sliding yoke to the steering intermediate shaft.

- (b) Install the PS gear housing with the 4 bolts.

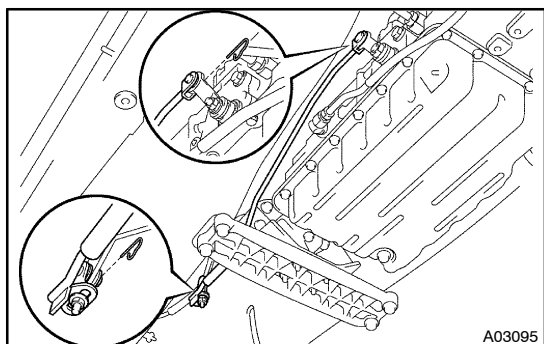
Torque: 65 N·m (660 kgf·cm, 48 ft·lbf)

- (c) Install the 2 PS oil tube with the bolt.



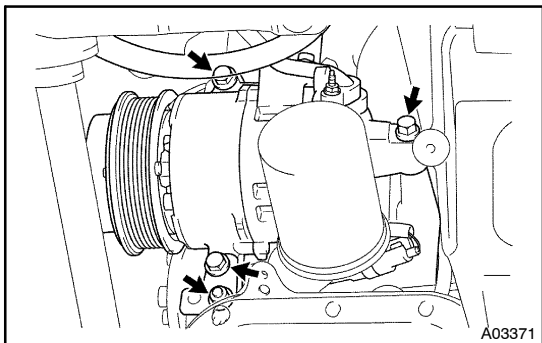
- (d) Install the bolt holding the sliding yoke to the steering intermediate shaft.

Torque: 35 N·m (360 kgf·cm, 26 ft·lbf)



10. INSTALL TRANSMISSION CONTROL ROD

Install the control rod with the 2 clips.

**11. INSTALL A/C COMPRESSOR**

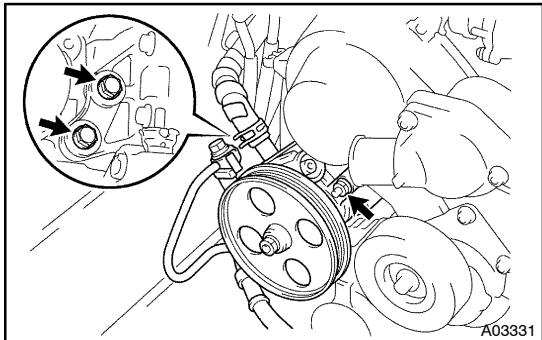
- (a) Install the A/C compressor, compressor stay and wire bracket with the 3 bolts and nut.

Torque:

49 N·m (500 kgf·cm, 36 ft·lbf) for bolt

29 N·m (300 kgf·cm, 21 ft·lbf) for nut

- (b) Connect the A/C compressor connector.
(c) Install the wire clamp.

**12. INSTALL PS PUMP**

- (a) Install the PS pump with the 2 bolts and nut. Alternately tighten the bolts and nut.

Torque:

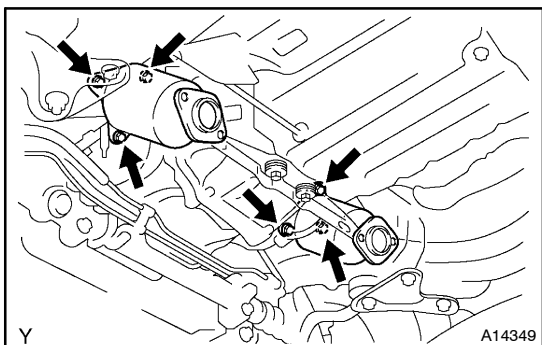
39.2 N·m (400 kgf·cm, 29 ft·lbf) for bolts

43.1 N·m (440 kgf·cm, 32 ft·lbf) for nut

- (b) Connect the PS oil pressure switch connector.
(c) Install the RH engine under cover with the 2 screws.

13. INSTALL PROPELLER SHAFT (See Pub. No. RM588E on page PR-10)**14. INSTALL CENTER FRONT FLOOR BRACE**

Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)

15. INSTALL HEAT INSULATORS**16. INSTALL TWC**

Install a new gasket and the TWC with 3 new nuts. Install the 2 TWC.

Torque: 62 N·m (630 kgf·cm, 46 ft·lbf)

17. INSTALL CENTER AND FRONT EXHAUST PIPE**18. INSTALL HEATED OXYGEN SENSORS**

Install the 2 oxygen sensors to the front exhaust pipe.

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

HINT:

- Before installing the oxygen sensor, twist the sensor wire counterclockwise 3 and 1/2 turns.
- After installing the oxygen sensor, check that the sensor wire is not twisted. If it is twisted, remove the oxygen sensor and reinstall it.

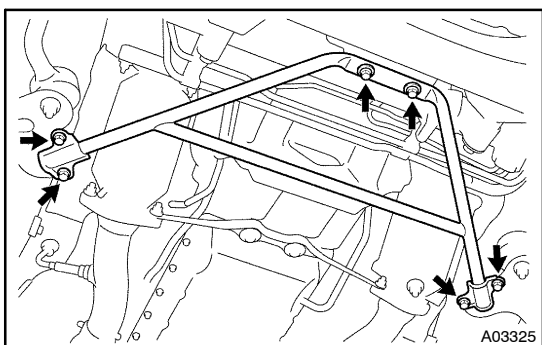
19. CONNECT ENGINE WIRE TO ECU BOX

- (a) Install the engine wire grommet to the ECU box.
(b) Connect these connectors:
- Connect the 3 engine ECU connectors.
 - Connect the 4 wire harness connectors.
 - Connect the 2 junction connectors.

- (c) Install these parts:
- Install the ECU hood.
 - Install the ECU cover.

20. CONNECT CONNECTORS, WIRE, STRAPS, CLAMPS AND HOSES

- Connect the alternator wire to alternator.
- Connect the wire for alternator wire to wire clamp on alternator.
- Connect the ground cable to stay on alternator.
- Connect the PS oil hose to No. 1 oil pan.
- Connect the 2 PS air hoses to hose clamp on No. 3 RH timing belt cover.
- Connect the hose clamp for PS air hose.
- Connect the PS air hose to upper intake manifold.
- Connect the starter cable to battery.
- Connect the ground strap to body.
- Connect the 2 heater hoses.
- Connect the fuel inlet hose (rear fuel pipe) to fuel main tube.



21. INSTALL FRONT SUSPENSION MEMBER BRACE

Install the brace with the 6 bolts.

Torque: 58 N·m (590 kgf·cm, 43 ft·lbf)

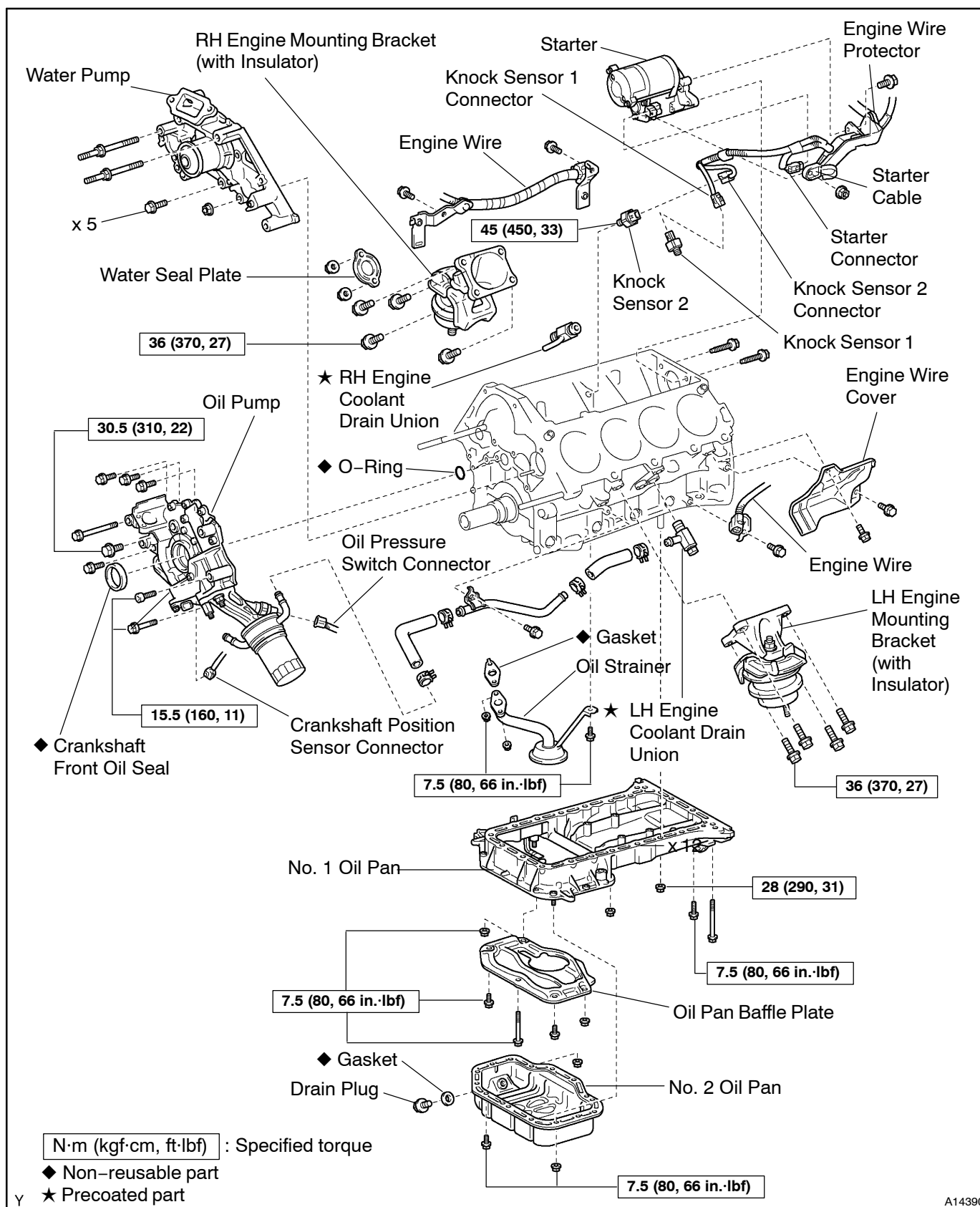
22. □ INSTALL DRIVE BELT (See page CH-16)
23. □ INSTALL RADIATOR ASSEMBLY (See page CO-24)
24. INSTALL INTAKE AIR CONNECTOR PIPE
25. INSTALL AIR CLEANER ASSEMBLY
26. INSTALL AIR CLEANER INLET
27. FILL WITH ENGINE COOLANT
28. FILL WITH ENGINE OIL
29. START ENGINE AND CHECK FOR LEAKS
30. INSTALL V-BANK COVER
31. INSTALL ENGINE UNDER COVER
32. INSTALL HOOD
33. PERFORM ROAD TEST

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

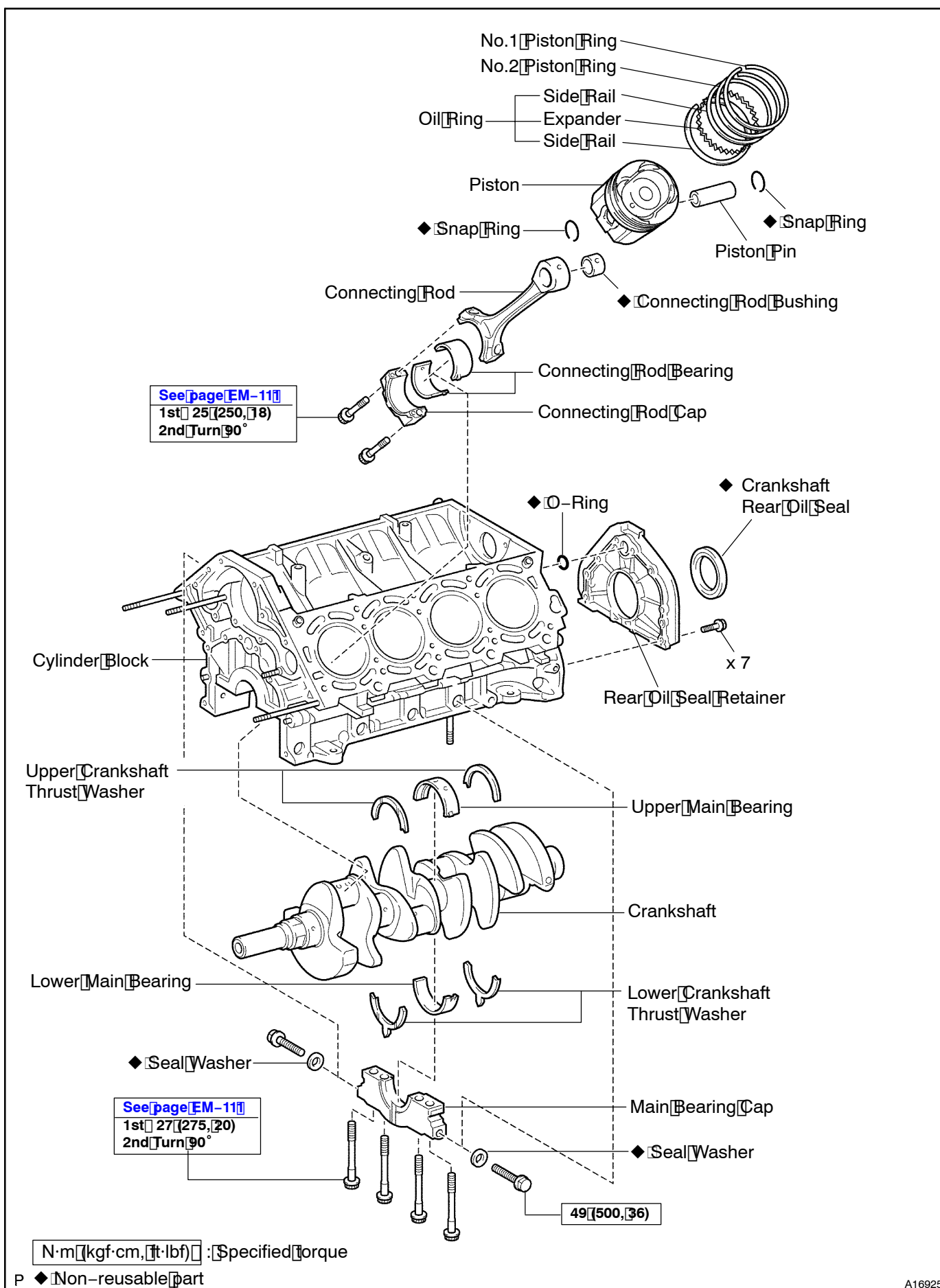
34. RECHECK ENGINE COOLANT AND OIL LEVELS

CYLINDER BLOCK COMPONENTS

EM0E9-07

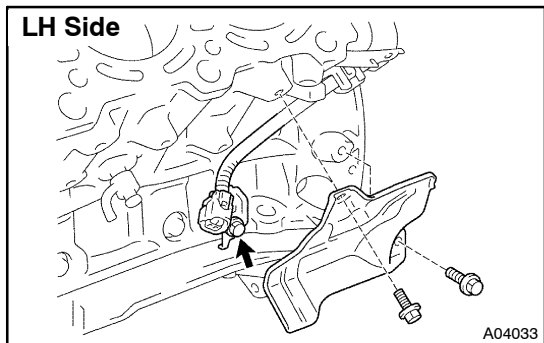


A14390

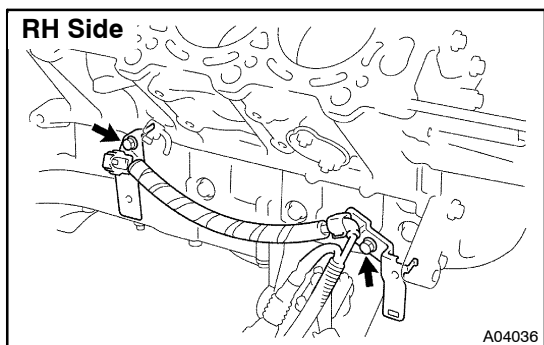


DISASSEMBLY

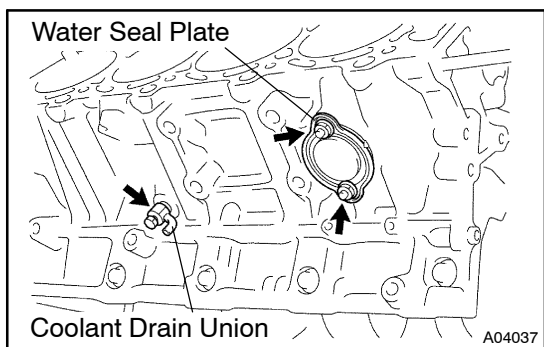
1. INSTALL ENGINE TO ENGINE STAND
2. REMOVE TIMING BELT AND PULLEYS
(See page EM-15)
3. REMOVE CYLINDER HEAD (See page EM-36)
4. REMOVE RH ENGINE MOUNTING BRACKET
5. REMOVE LH ENGINE MOUNTING BRACKET
6. REMOVE STARTER (See page ST-5)
7. REMOVE KNOCK SENSORS (See page FI-64)



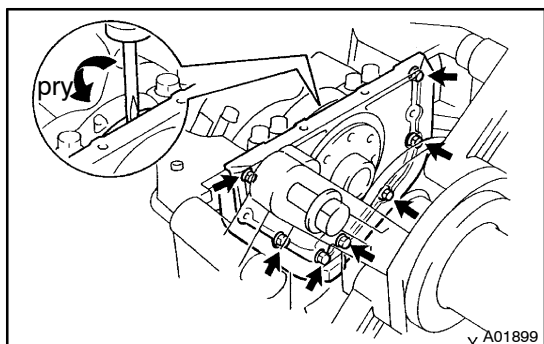
8. REMOVE ENGINE WIRE
 - (a) Disconnect the crankshaft position sensor connector.
 - (b) Remove the 2 bolts and engine wire cover from the LH side of the cylinder block.



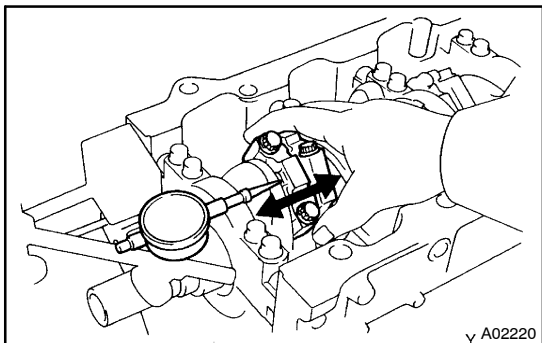
- (c) Remove the 2 bolts, and disconnect the engine wire from the RH side of the cylinder block.
 - (d) Remove the bolt and engine wire.
9. REMOVE WATER PUMP (See page CO-6)
10. REMOVE NO.2 OIL PAN (See page LU-9)
11. REMOVE OIL PAN BAFFLE PLATE
12. REMOVE NO.1 OIL PAN (See page LU-9)
13. REMOVE OIL STRAINER
14. REMOVE OIL PUMP (See page LU-9)



15. REMOVE WATER SEAL PLATE
Remove the 2 nuts and seal plate.
16. REMOVE ENGINE COOLANT DRAIN UNIONS
Remove the RH and LH drain unions.



17. REMOVE REAR OIL SEAL RETAINER
 - (a) Remove the 7 bolts.
 - (b) Using a screwdriver, remove the oil seal retainer by prying the portions between the oil seal retainer and main bearing cap.
 - (c) Remove the O-ring.

**18. CHECK CONNECTING ROD THRUST CLEARANCE**

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

Standard thrust clearance:

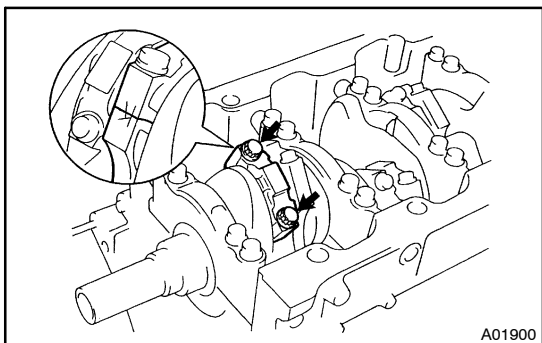
0.160 – 0.290 mm (0.0063 – 0.0138 in.)

Maximum thrust clearance: 0.35 mm (0.0138 in.)

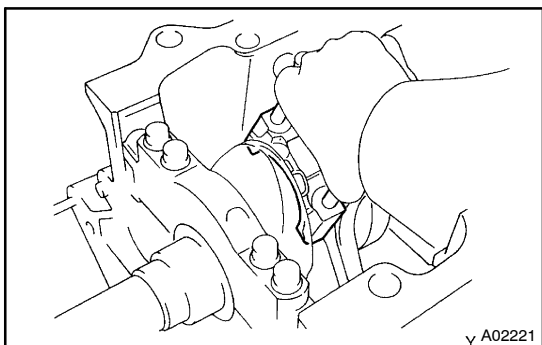
If the thrust clearance is greater than maximum, replace the connecting rod assembly(s). If necessary, replace the crankshaft.

Connecting rod thickness:

22.880 – 22.920 mm (0.9008 – 0.9024 in.)

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

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

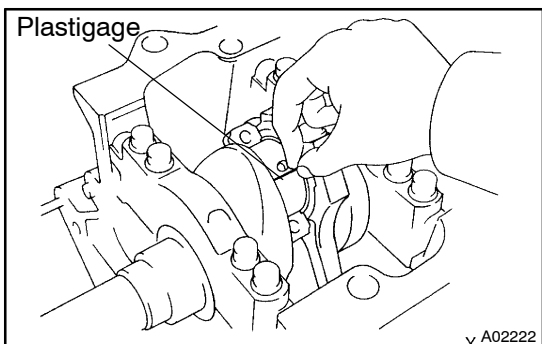


- (c) Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

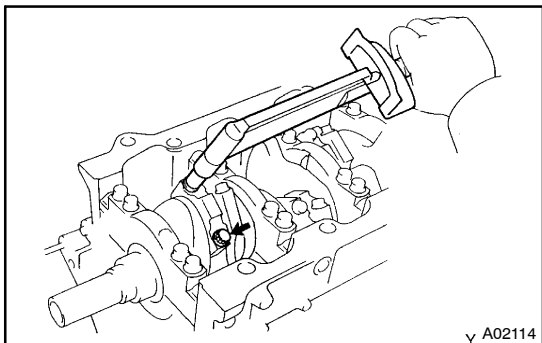
HINT:

Keep the lower bearing inserted with the connecting rod cap.

- (d) Clean the crank pin and bearing.
- (e) Check the crank pin and bearing for pitting and scratches. If the crank pin or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.



- (f) Lay a strip of Plastigage across the crank pin.

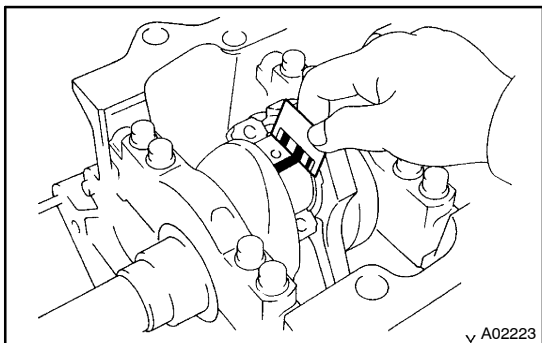


- (g) Install the connecting rod cap with the 2 bolts (See page EM-111).

NOTICE:

Do not turn the crankshaft.

- (h) Remove the 2 bolts, connecting rod cap and lower bearing (See procedure (b) and (c) above).



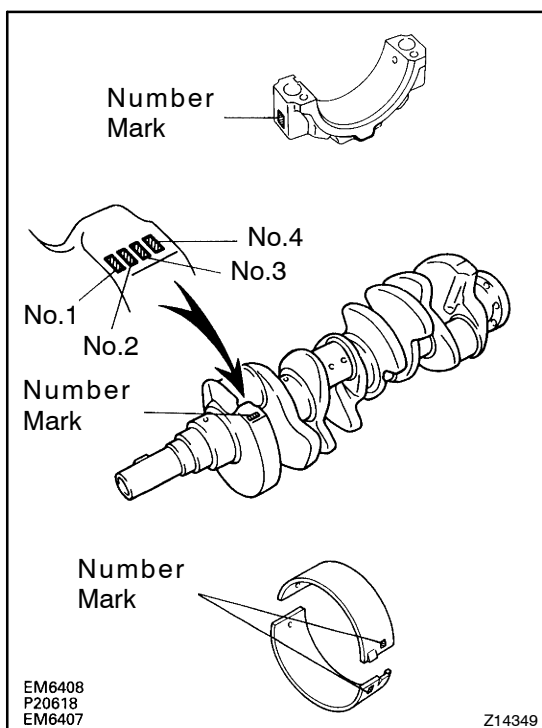
- (i) Measure the Plastigage at its widest point.

Standard oil clearance:

0.021 – 0.047 mm (0.0008 – 0.0019 in.)

Maximum oil clearance: 0.065 mm (0.0026 in.)

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



HINT:

If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the connecting rod cap and crankshaft, then selecting the bearing with the same number as the total. There are 6 sizes of standard bearings, marked "2", "3", "4", "5", "6" and "7".

	Number mark											
Connecting rod cap	1	1	2	1	2	3	2	3	4	3	4	4
Crankshaft	1	2	1	3	2	1	3	2	1	3	2	3
Use bearing	2	3		4			5		6	7		

EXAMPLE:

Connecting rod cap "3" + Crankshaft "1"
= Total number 4 (Use bearing "4")

Reference

Connecting rod big end inside diameter:

Mark "1"	55.000 – 55.006 mm (2.1654 – 2.1656 in.)
Mark "2"	55.006 – 55.012 mm (2.1656 – 2.1658 in.)
Mark "3"	55.012 – 55.018 mm (2.1658 – 2.1661 in.)
Mark "4"	55.018 – 55.024 mm (2.1661 – 2.1663 in.)

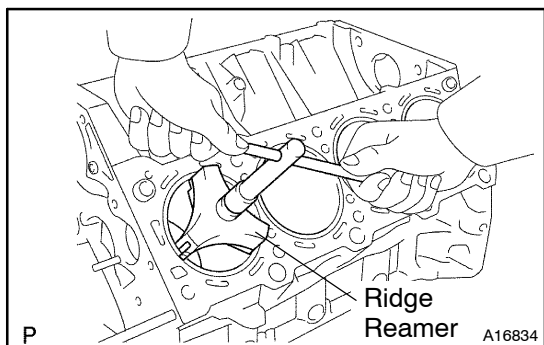
Crankshaft crank pin diameter:

Mark "1"	51.994 – 52.000 mm (2.0470 – 2.0472 in.)
Mark "2"	51.988 – 51.994 mm (2.0468 – 2.0470 in.)
Mark "3"	51.982 – 51.988 mm (2.0465 – 2.0468 in.)

Standard sized bearing center wall thickness:

Mark "2"	1.487 – 1.490 mm (0.0585 – 0.0587 in.)
Mark "3"	1.490 – 1.493 mm (0.0587 – 0.0588 in.)
Mark "4"	1.493 – 1.496 mm (0.0588 – 0.0589 in.)
Mark "5"	1.496 – 1.499 mm (0.0589 – 0.0590 in.)
Mark "6"	1.499 – 1.502 mm (0.0590 – 0.0591 in.)
Mark "7"	1.502 – 1.505 mm (0.0591 – 0.0593 in.)

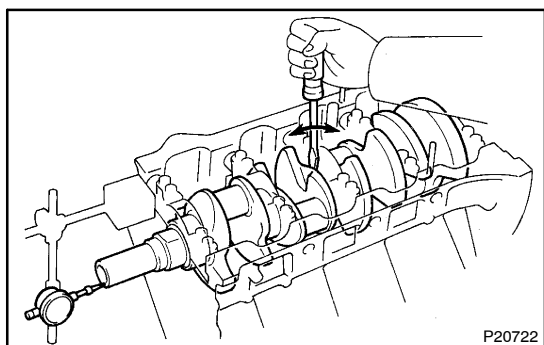
- (j) Completely remove the Plastigage.

**20. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES**

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

HINT:

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

**21. CHECK CRANKSHAFT THRUST CLEARANCE**

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

Standard thrust clearance:

0.020 – 0.220 mm (0.0008 – 0.0087 in.)

Maximum thrust clearance: 0.30 mm (0.0118 in.)

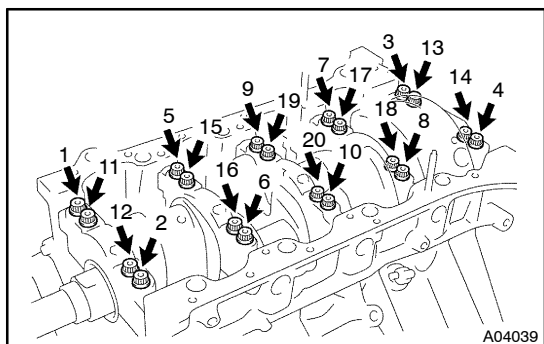
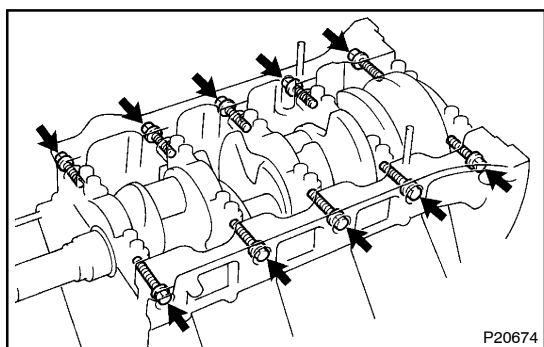
If the thrust clearance is greater than maximum, replace the thrust washers as a set.

Thrust washer thickness:

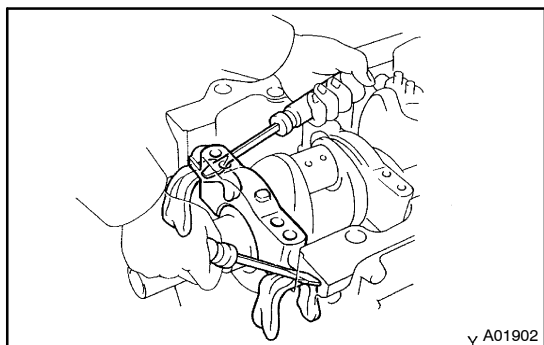
2.440 – 2.490 mm (0.0961 – 0.0980 in.)

22. REMOVE MAIN BEARING CAPS AND CHECK OIL CLEARANCE

- (a) Remove the 10 main bearing cap bolts.



- (b) Uniformly loosen and remove the 20 main bearing cap bolts in several passes, in the sequence shown.



- (c) Using 2 screwdrivers, pry out the main bearing cap, and remove the 5 main bearing caps, 5 lower bearings and 2 lower thrust washers (No.3 main bearing cap only).

NOTICE:

Be careful not to damage the cylinder block.

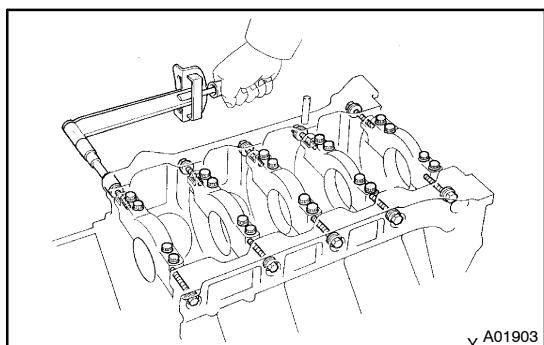
HINT:

- Keep the lower bearing and main bearing cap together.
 - Arrange the main bearing caps and lower thrust washers in correct order.
- (d) Lift out the crankshaft.
(e) Remove the 2 upper thrust washers.

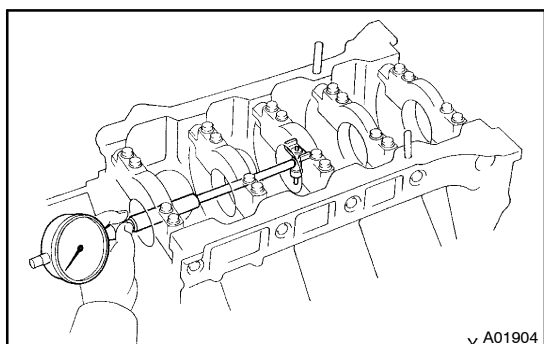
HINT:

- Arrange the upper thrust washers in correct order.
 - Keep the upper bearings together with the cylinder block.
- (f) Clean each main journal and bearing.
(g) Check each main journal and bearing for pitting and scratches.

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



- (h) Install the 10 main bearings and 5 main bearing caps with the 30 bolts. Do not install the crankshaft (See page EM-111).



- (i) Using a cylinder gauge, measure the inside diameter of the main bearing.

Bearing inside diameter:

66.986 – 67.000 mm (2.6372 – 2.6378 in.)

- (j) Measure the diameter of the main journal (See page EM-101)

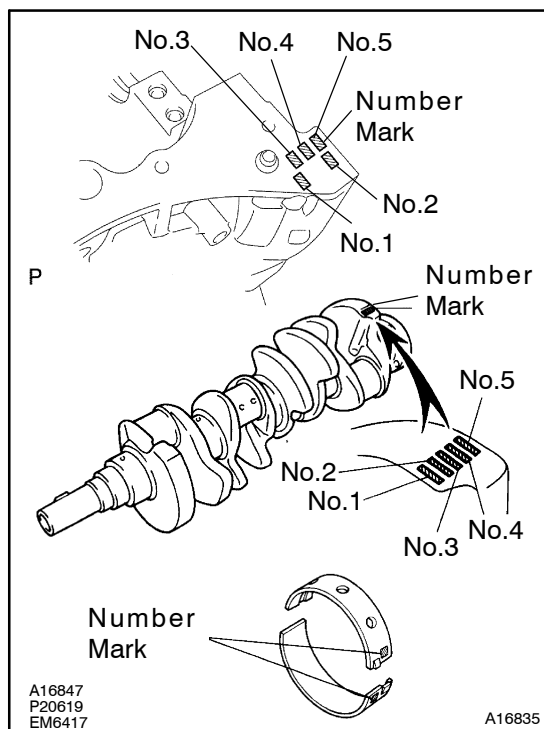
- (k) Subtract the main journal diameter measurement from the main bearing inside diameter measurement.

Standard clearance:

No.1 and No.5	0.017 – 0.033 mm (0.0007 – 0.0013 in.)
Others	0.029 – 0.045 mm (0.0011 – 0.0018 in.)

Maximum clearance:

No.1 and No.5	0.043 mm (0.0017 in.)
Others	0.055 mm (0.0022 in.)



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

HINT:

If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 sizes of the standard bearings. For No.1 and No.5 position bearings, use bearings marked "3", "4", "5", "6" and "7". For others position bearings, use bearings marked "1", "2", "3", "4" and "5".

No.1, No.5:

		Use bearing	
		Upper	Lower
Cylinder block (A) + Crankshaft (B)	0 - 5	3	3
	6 - 8	3	4
	9 - 11	4	4
	12 - 14	4	5
	15 - 17	5	5
	18 - 20	5	6
	21 - 23	6	6
	24 - 26	6	7
	27 - 28	7	7

EXAMPLE:

Cylinder block "08" + Crankshaft "06"
= Total number 14 (Use bearing "4" (Upper), "5" (Lower))

Others:

		Use bearing	
		Upper	Lower
Cylinder block (A) + Crankshaft (B)	0 - 5	1	1
	6 - 8	1	2
	9 - 11	2	2
	12 - 14	2	3
	15 - 17	3	3
	18 - 20	3	4
	21 - 23	4	4
	24 - 26	4	5
	27 - 28	5	5

EXAMPLE:

Cylinder block "08" + Crankshaft "06"
= Total number 14 (Use bearing "2" (Upper), "3" (Lower))

Reference

Cylinder block main journal bore diameter (A):

Mark "00"	72.000 mm (2.8346 in.)
Mark "01"	72.001 mm (2.8347 in.)
Mark "02"	72.002 mm (2.8347 in.)
Mark "03"	72.003 mm (2.8348 in.)
Mark "04"	72.004 mm (2.8348 in.)
Mark "05"	72.005 mm (2.8348 in.)

Mark "06"	72.006 mm (2.8349 in.)
Mark "07"	72.007 mm (2.8349 in.)
Mark "08"	72.008 mm (2.8350 in.)
Mark "09"	72.009 mm (2.8350 in.)
Mark "10"	72.010 mm (2.8350 in.)
Mark "11"	72.011 mm (2.8351 in.)
Mark "12"	72.012 mm (2.8351 in.)
Mark "13"	72.013 mm (2.8352 in.)
Mark "14"	72.014 mm (2.8352 in.)
Mark "15"	72.015 mm (2.8352 in.)
Mark "16"	72.016 mm (2.8353 in.)

Crankshaft main journal diameter (B):

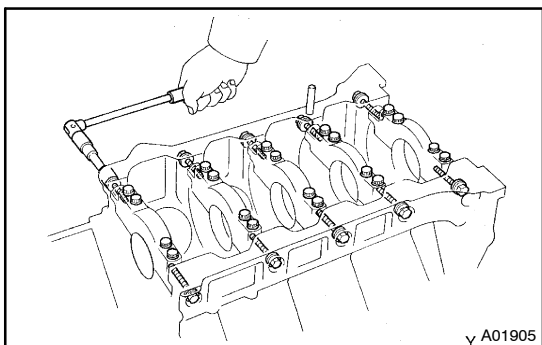
Mark "00"	67.000 mm (2.6378 in.)
Mark "01"	66.999 mm (2.6378 in.)
Mark "02"	66.998 mm (2.6377 in.)
Mark "03"	66.997 mm (2.6377 in.)
Mark "04"	66.996 mm (2.6376 in.)
Mark "05"	66.995 mm (2.6376 in.)
Mark "06"	66.994 mm (2.6376 in.)
Mark "07"	66.993 mm (2.6375 in.)
Mark "08"	66.992 mm (2.6375 in.)
Mark "09"	66.991 mm (2.6374 in.)
Mark "10"	66.990 mm (2.6374 in.)
Mark "11"	66.989 mm (2.6374 in.)
Mark "12"	66.988 mm (2.6373 in.)

**Standard bearing center wall thickness:
No.1 and No.5**

Mark "3"	2.492 – 2.495 mm (0.0981 – 0.0982 in.)
Mark "4"	2.495 – 2.498 mm (0.0982 – 0.0983 in.)
Mark "5"	2.498 – 2.501 mm (0.0983 – 0.0985 in.)
Mark "6"	2.501 – 2.504 mm (0.0985 – 0.0986 in.)
Mark "7"	2.504 – 2.507 mm (0.0986 – 0.0987 in.)

Others

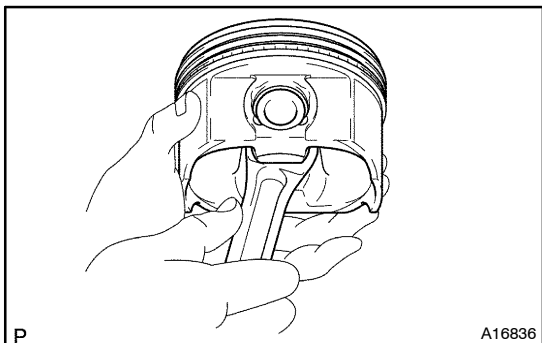
Mark "1"	2.486 – 2.489 mm (0.0979 – 0.0980 in.)
Mark "2"	2.489 – 2.492 mm (0.0980 – 0.0981 in.)
Mark "3"	2.492 – 2.495 mm (0.0981 – 0.0982 in.)
Mark "4"	2.495 – 2.498 mm (0.0982 – 0.0983 in.)
Mark "5"	2.498 – 2.501 mm (0.0983 – 0.0985 in.)



- (l) Remove the 10 bolts, 20 nuts, 5 main bearing caps and 5 lower main bearing. (See procedure (a) to (c) above)
- (m) Remove the 5 upper main bearings from the cylinder block.

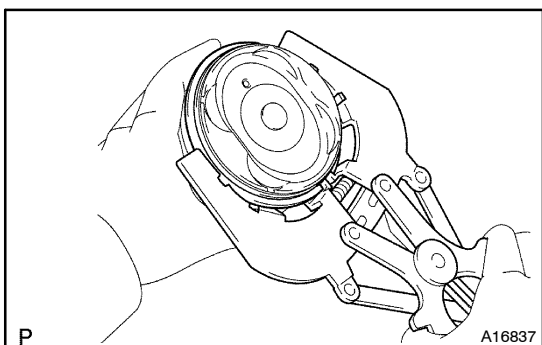
HINT:

Arrange the main bearing caps, bearings and thrust washers in correct order.

**23. CHECK FIT BETWEEN PISTON AND PISTON PIN**

Try to move the piston back and forth on the piston pin.

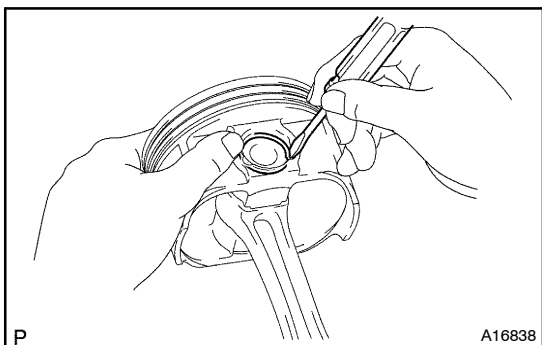
If any movement is felt, replace the piston and pin as a set.

**24. REMOVE PISTON RINGS**

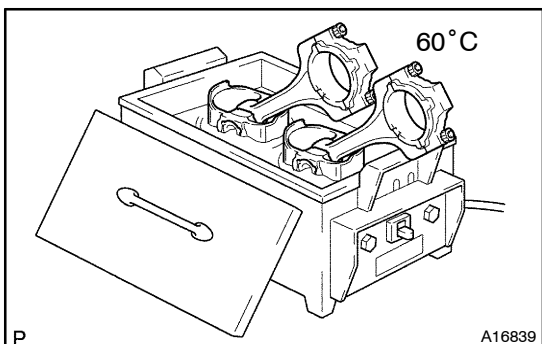
- (a) Using a piston ring expander, remove the 2 compression rings.
- (b) Remove the 2 side rails and oil ring by hand.

HINT:

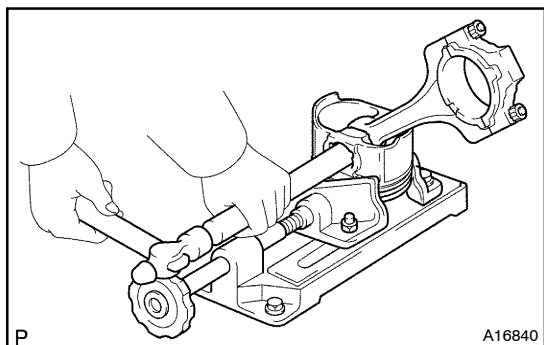
Arrange the piston rings in correct order only.

**25. DISCONNECT CONNECTING ROD FROM PISTON**

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



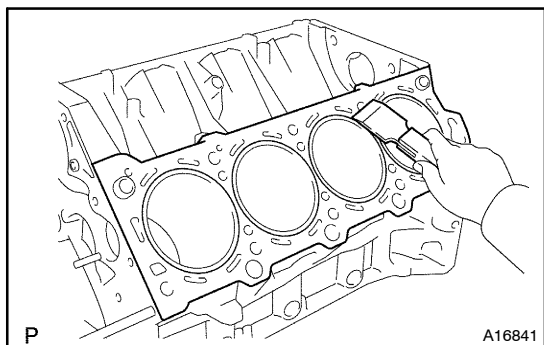
- (b) Gradually heat the piston to approx. 60°C (140°F).



- (c) Using a plastic-faced hammer and brass bar, lightly tap out the piston pin and 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 correct order.



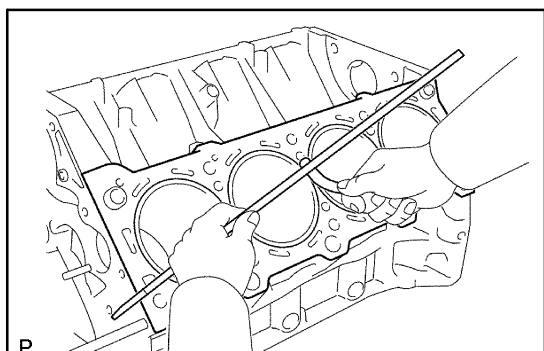
INSPECTION

1. CLEAN CYLINDER BLOCK

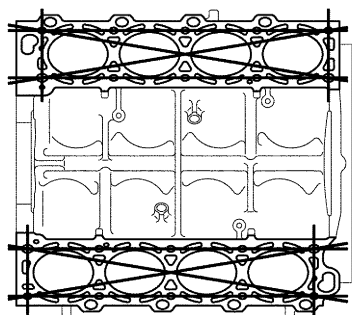
- (a) Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.
- (b) Using a soft brush and solvent, thoroughly clean the cylinder block.

NOTICE:

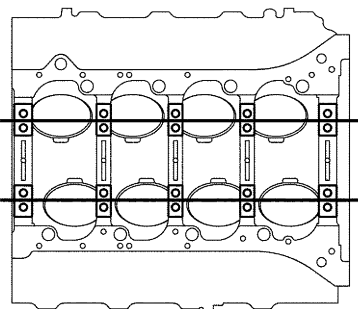
If the cylinder is washed at high temperatures, the cylinder liner sticks out beyond the cylinder block, so always wash the cylinder block at a temperature of 45° or less.



Cylinder Block Side



Main Bearing Cap Side



A16842
A16843
A04047

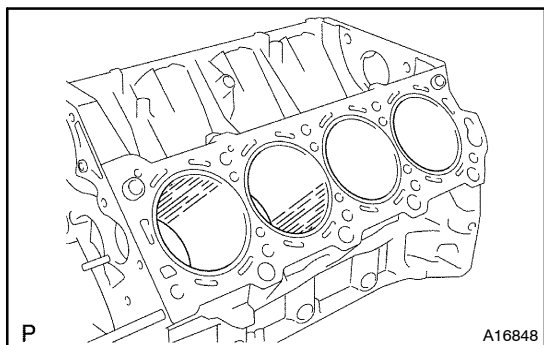
A16844

2. INSPECT CYLINDER BLOCK

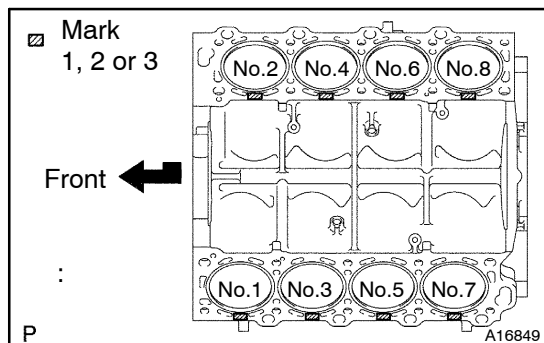
- (a) Inspect for flatness.
Using a precision straight edge and feeler gauge, measure the surfaces contacting the cylinder head and main bearing cap for warpage.

Maximum warpage: 0.07 mm (0.0028 in.)

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



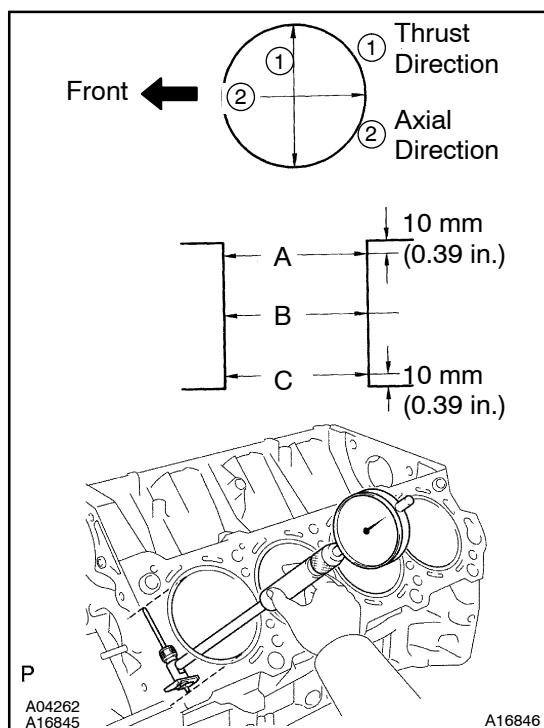
- (b) Visually check the cylinder for vertical scratches. If deep scratches are present, replace the cylinder block.



- (c) Inspect the cylinder bore diameter.

HINT:

There are 3 sizes of the standard cylinder bore diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the top of the cylinder block.



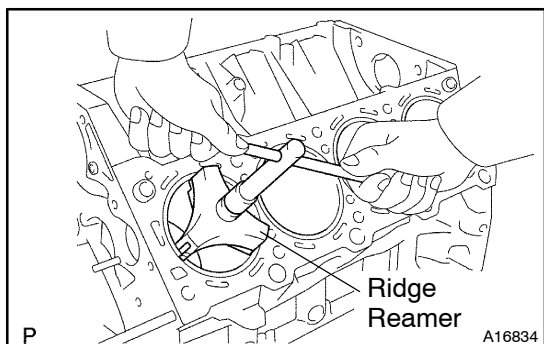
Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions.

Standard diameter:

Mark "1"	91.000 – 91.008 mm (3.5827 – 3.5830 in.)
Mark "2"	91.008 – 91.021 mm (3.5830 – 3.5835 in.)
Mark "3"	91.021 – 91.029 mm (3.5835 – 3.5838 in.)

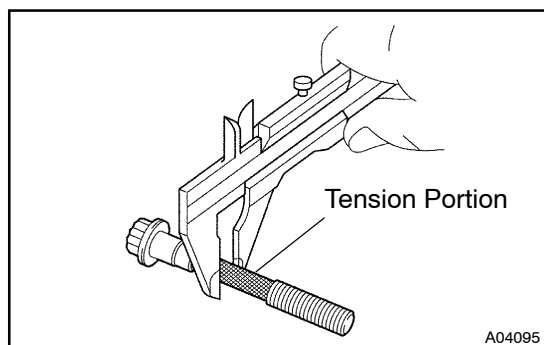
Maximum diameter: 87.73 mm (3.4539 in.)

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



- (d) Remove the cylinder ridge.

If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.



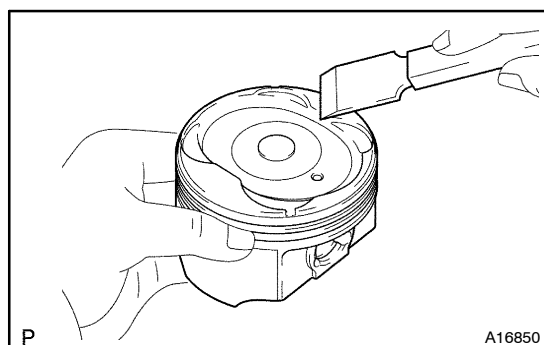
- (e) Using vernier calipers, measure the tension portion diameter of the main bearing cap bolt.

Standard diameter:

7.500 – 7.600 mm (0.2953 – 0.2992 in.)

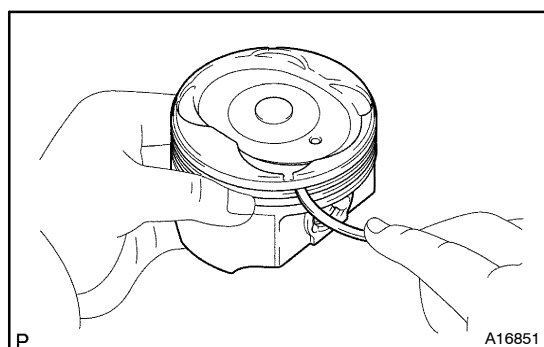
Minimum diameter: 7.20 mm (0.2835 in.)

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

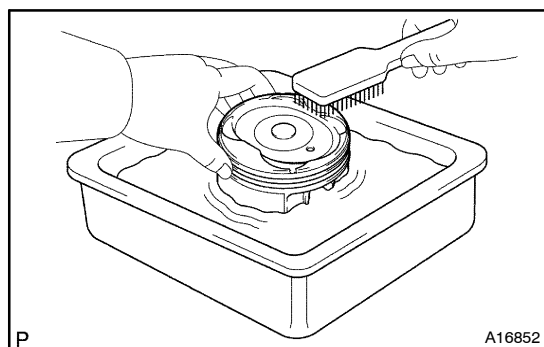


3. CLEAN PISTON

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



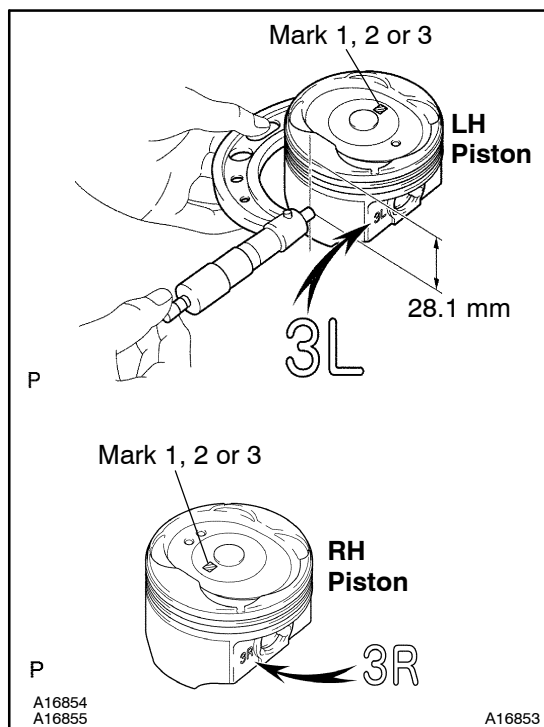
- (b) Using a groove cleaning tool or broken ring, clean the piston ring grooves.



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

NOTICE:

Do not use a wire brush.



4. INSPECT PISTON AND CONNECTING ROD

(a) Inspect the piston oil clearance.

HINT:

There are 3 sizes of the standard piston diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the piston top.

- (1) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, 28.1 mm (1.106 in.) from the piston head.

Piston diameter:

Mark "1"	90.910 – 90.920 mm (3.5791 – 3.5795 in.)
Mark "2"	90.920 – 90.928 mm (3.5795 – 3.5798 in.)
Mark "3"	90.928 – 90.938 mm (3.5798 – 3.5802 in.)

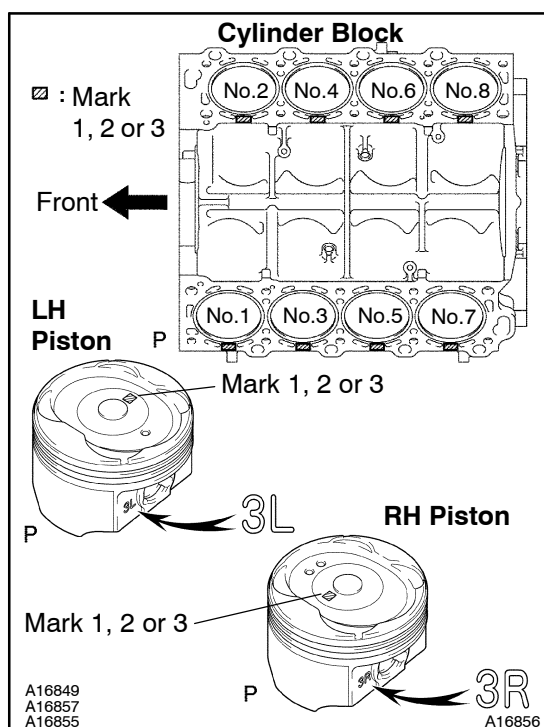
- (2) Measure the cylinder bore diameter in the thrust directions. (See step 2 above)
- (3) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:

0.080 – 0.101 mm (0.0031 – 0.0040 in.)

Maximum oil clearance: 0.121 mm (0.0048 in.)

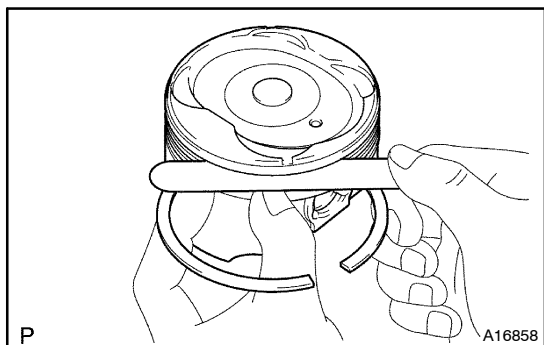
If the oil clearance is greater than maximum, replace all the 8 pistons. If necessary, replace the cylinder block.



HINT

Use new cylinder block:

- Use a piston with the same number mark as the cylinder diameter marked on the cylinder block.
- The shape of the piston varies for the LH and RH banks. The LH piston is marked with "3L", the RH piston with "3R".

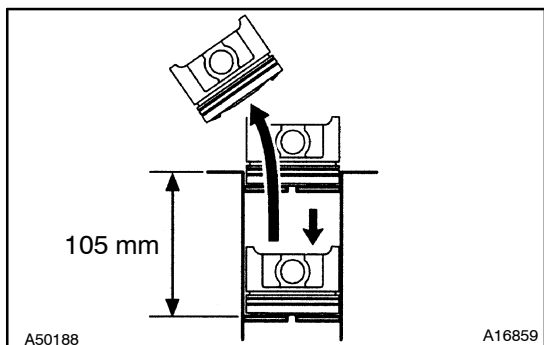


- (b) Inspect the piston ring groove clearance.
Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

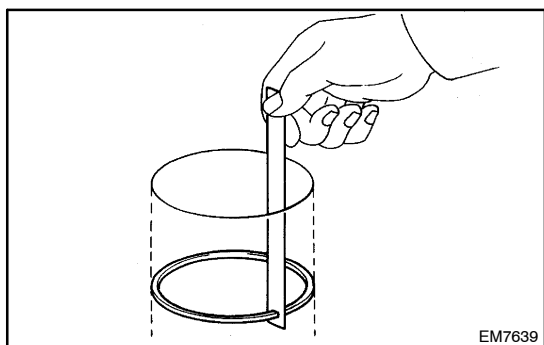
Ring groove clearance:

No.1	0.030 – 0.080 mm (0.0012 – 0.0031 in.)
No.2	0.020 – 0.060 mm (0.0008 – 0.0024 in.)

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



- (c) Inspect the piston ring end gap.
- (1) Insert the piston ring into the cylinder bore.
 - (2) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 105 mm (4.13 in.) from the top of the cylinder block.



- (3) Using a feeler gauge, measure the end gap.

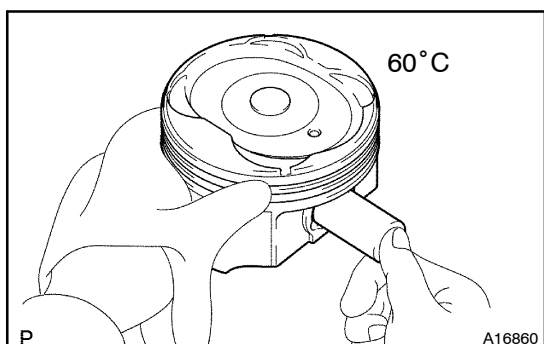
Standard end gap:

No.1	0.300 – 0.500 mm (0.0118 – 0.0197 in.)
No.2	0.400 – 0.600 mm (0.0157 – 0.0236 in.)
Oil (Side rail)	0.150 – 0.500 mm (0.0059 – 0.0197 in.)

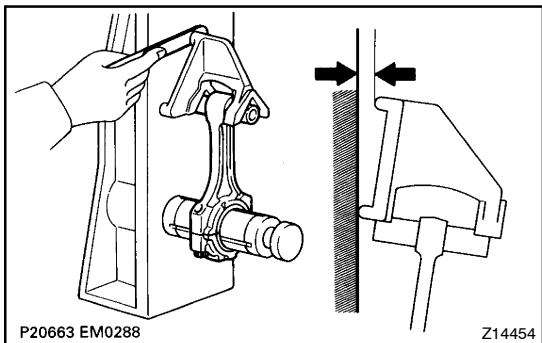
Maximum end gap:

No.1	1.10 mm (0.0433 in.)
No.2	1.20 mm (0.0472 in.)
Oil (Side rail)	1.10 mm (0.0433 in.)

If the end gap is greater than maximum, replace the piston ring.
If the end gap is greater than maximum, even with a new piston ring, replace the cylinder block.



- (d) Inspect the piston pin fit.
At 60°C (140°F), you should be able to push the piston pin into the piston pin hole with your thumb.



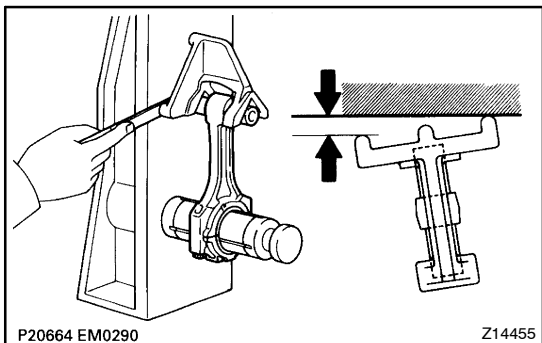
- (e) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for bend.

Maximum bend:

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

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

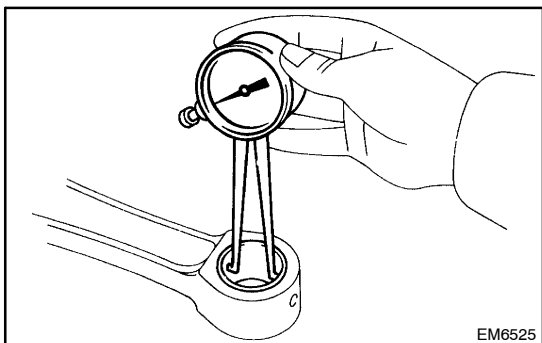


(2) Check for twist

Maximum twist:

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

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

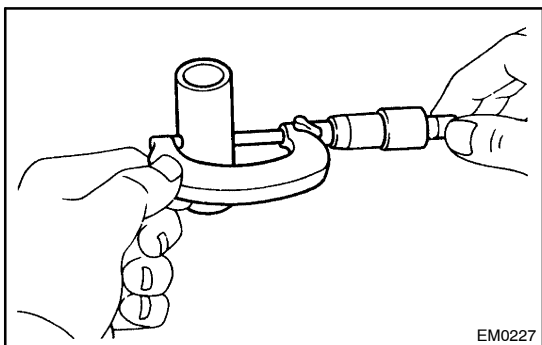


- (f) Inspect the piston pin oil clearance.

(1) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

Bushing inside diameter:

22.005 – 22.014 mm (0.8663 – 0.8667 in.)



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

Piston pin diameter:

21.997 – 22.006 mm (0.8660 – 0.8664 in.)

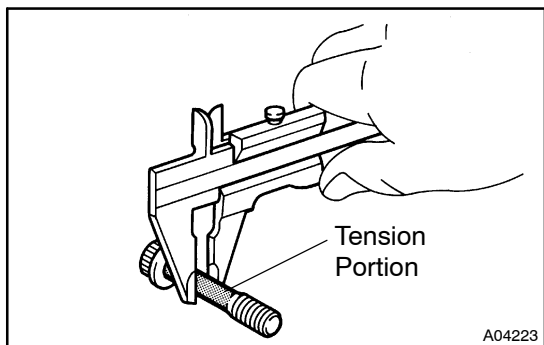
(3) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

Standard oil clearance:

0.005 – 0.011 mm (0.0002 – 0.0004 in.)

Maximum oil clearance: 0.05 mm (0.0020 in.)

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



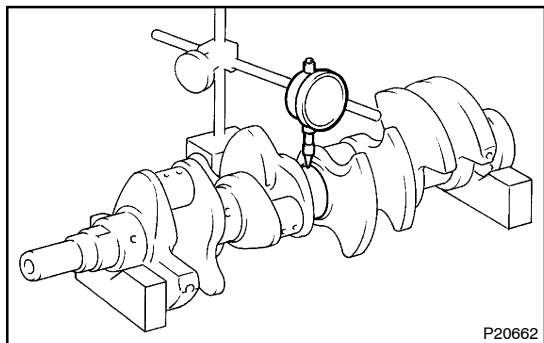
- (g) Using vernier calipers, measure the tension portion of the connecting rod bolt.

Standard diameter:

7.200 – 7.300 mm (0.2835 – 0.2874 in.)

Minimum diameter: 7.00 mm (0.2756 in.)

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



5. INSPECT CRANKSHAFT

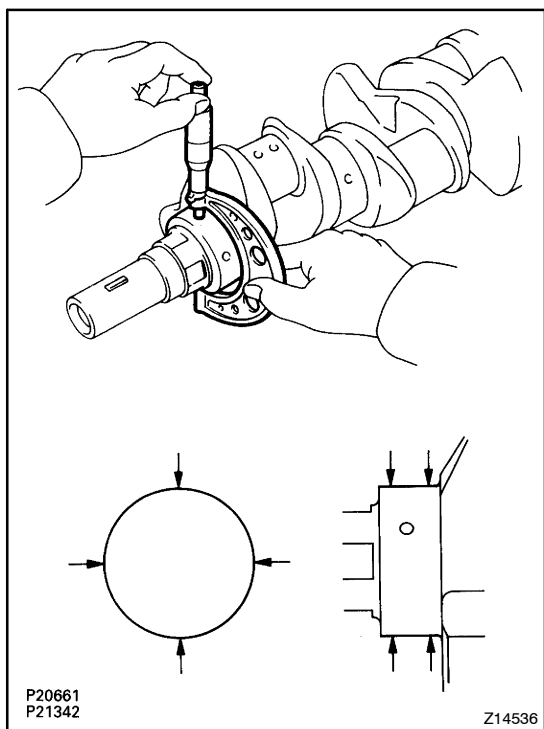
- (a) Inspect for circle runout.

(1) Place the crankshaft on V-blocks.

(2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.08 mm (0.0031 in.)

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



- (b) Inspect the main journals and crank pins.

(1) Using a micrometer, measure the diameter of each main journal and crank pin.

Main journal diameter:

66.988 – 67.000 mm (2.6373 – 2.6378 in.)

Crank pin diameter:

51.982 – 52.000 mm (2.0465 – 2.0472 in.)

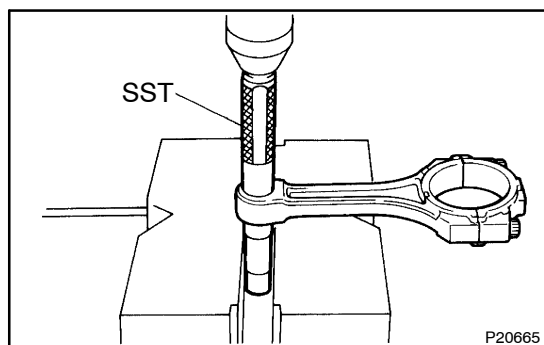
If the diameter is not as specified, check the oil clearance (See page EM-92). If necessary, replace the crankshaft.

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

Maximum taper and out-of-round:

0.02 mm (0.0008 in.)

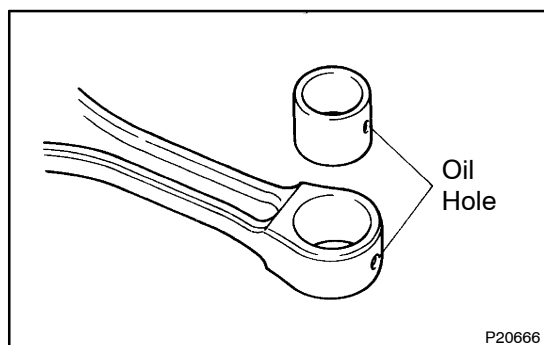
If the taper and out-of-round is greater than maximum, replace the crankshaft.



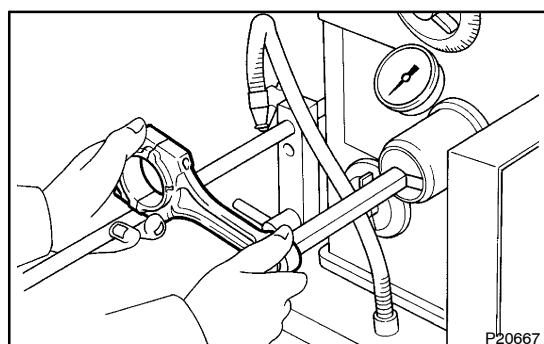
REPLACEMENT

1. REPLACE CONNECTING ROD BUSHINGS

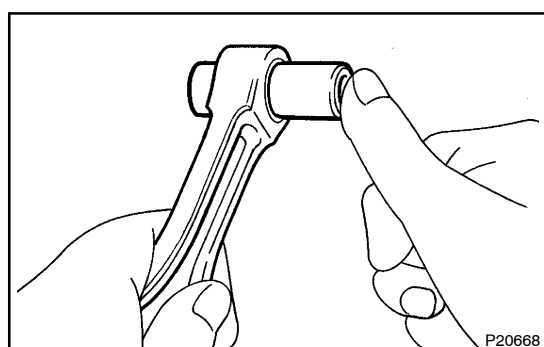
- (a) Using SST and a press, press out the bushing.
SST 09222-30010



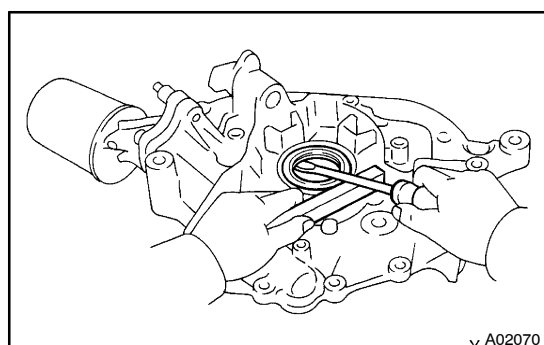
- (b) Align the oil holes of a new bushing and the connecting rod.
(c) Using SST and a press, press in the bushing.
SST 09222-30010



- (d) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (See page EM-101) between the bushing and piston pin.



- (e) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.

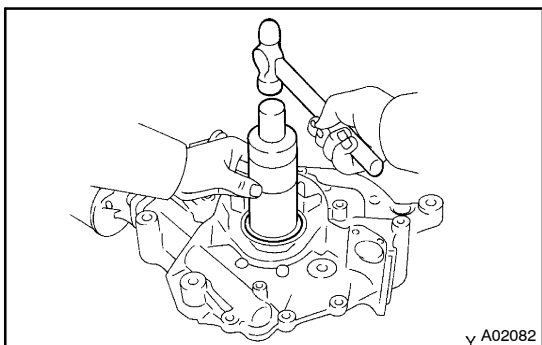


2. REPLACE CRANKSHAFT FRONT OIL SEAL

HINT:

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

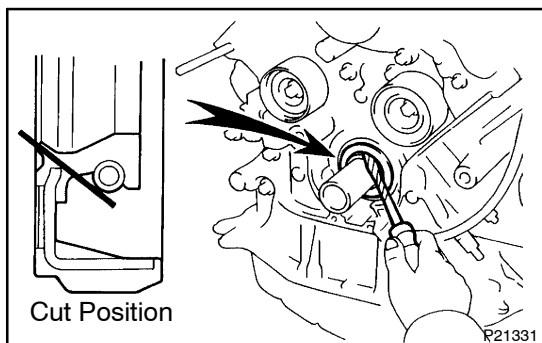
- (a) If the oil pump is removed from the cylinder block:
(1) Using a screwdriver, pry out the oil seal.



- (2) Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil pump body edge.

SST 09316-60011 (09316-00011)

- (3) Apply MP grease to the oil seal lip.

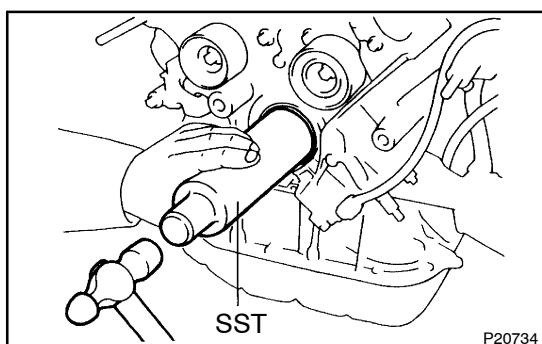


- (b) If the oil pump is installed to the cylinder block:

- (1) Using a knife, cut off the oil seal lip.
- (2) Using a screwdriver, pry out the oil seal.

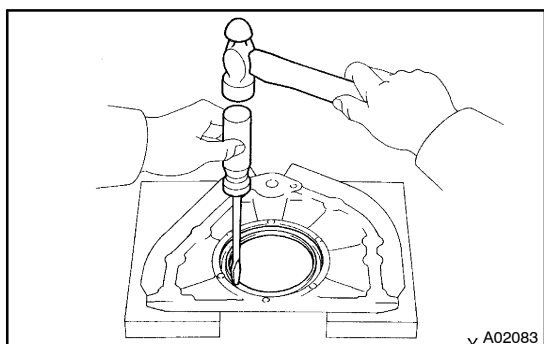
NOTICE:

Be careful not to damage the crankshaft. Tape the screwdriver tip.



- (3) Apply MP grease to a new oil seal lip.
- (4) Using SST and a hammer, tap in the oil seal until its surface is flush with the oil pump body edge.

SST 09316-60011 (09316-00011)



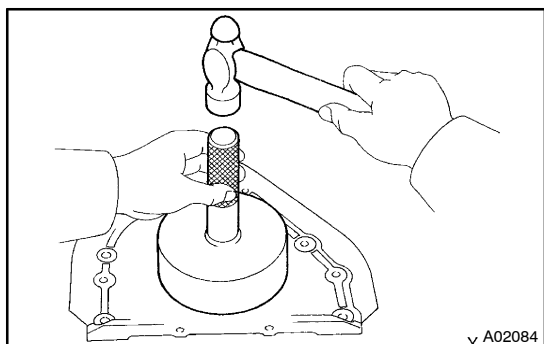
3. REPLACE CRANKSHAFT REAR OIL SEAL

HINT:

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

- (a) If the rear oil seal retainer is removed from the cylinder block:

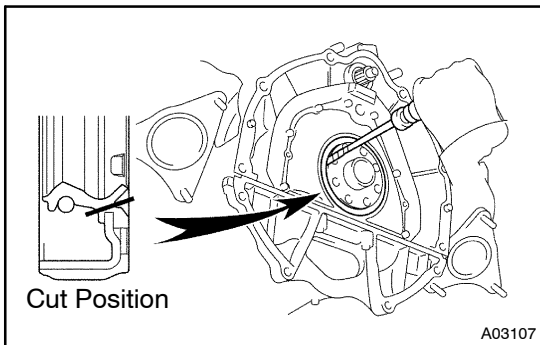
- (1) Using a screwdriver and hammer, tap out the oil seal.



- (2) Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.

SST 09223-56010

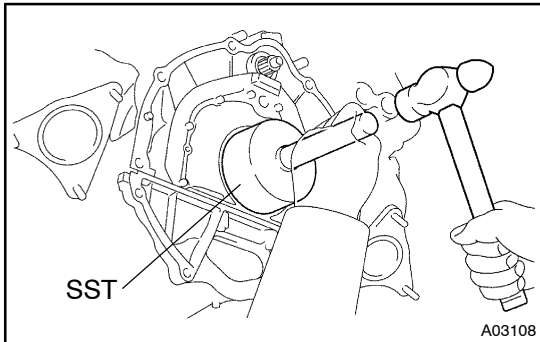
- (3) Apply MP grease to the oil seal lip.



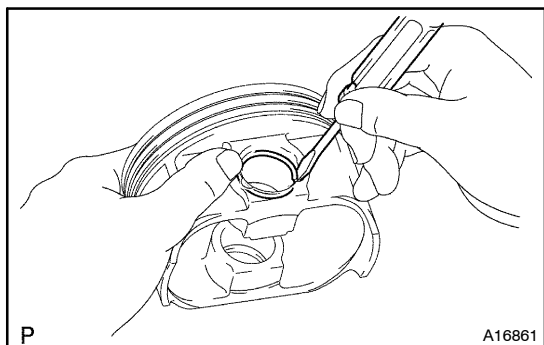
- (b) If the rear oil seal retainer is installed to the cylinder block:
- (1) Using a knife, cut off the oil seal lip.
 - (2) Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft. Tape the screwdriver tip.



- (3) Apply MP grease to a new oil seal lip.
 - (4) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
- SST 09223-56010



REASSEMBLY

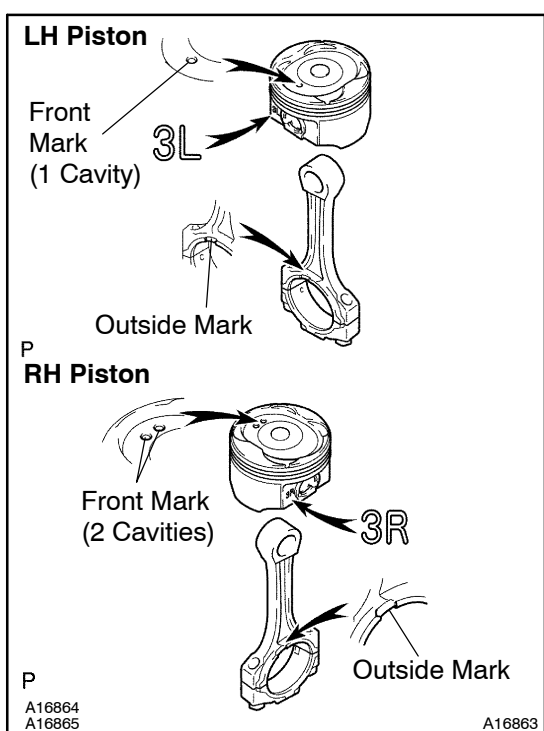
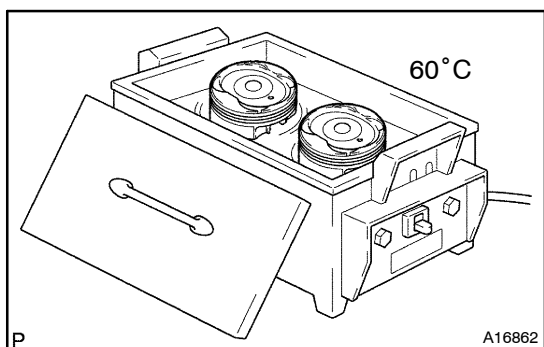
HINT:

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

1. ASSEMBLE PISTON AND CONNECTING ROD

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

- Gradually heat the piston to about 60°C (140°F).

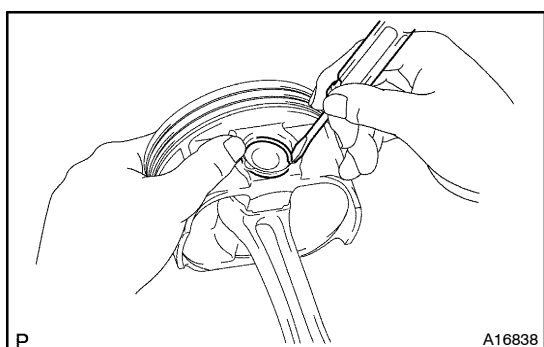


- Coat the piston pin with engine oil.
- Position the piston front mark with respect to the outside mark on the connecting rod as shown in the diagram.

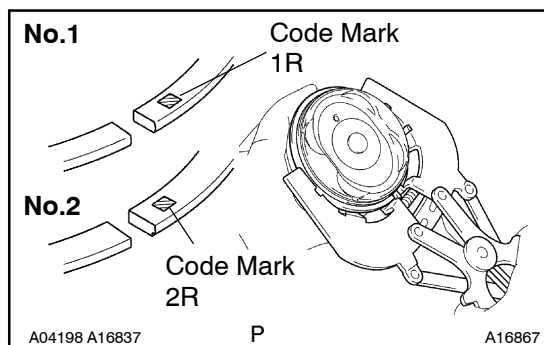
NOTICE:

The installation directions of the piston and connecting rod are different for the LH and RH banks. The LH piston is marked with "3L", the RH piston with "3R".

- Align the piston pin holes of the piston and connecting rod, and push in the piston pin with your thumb.



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

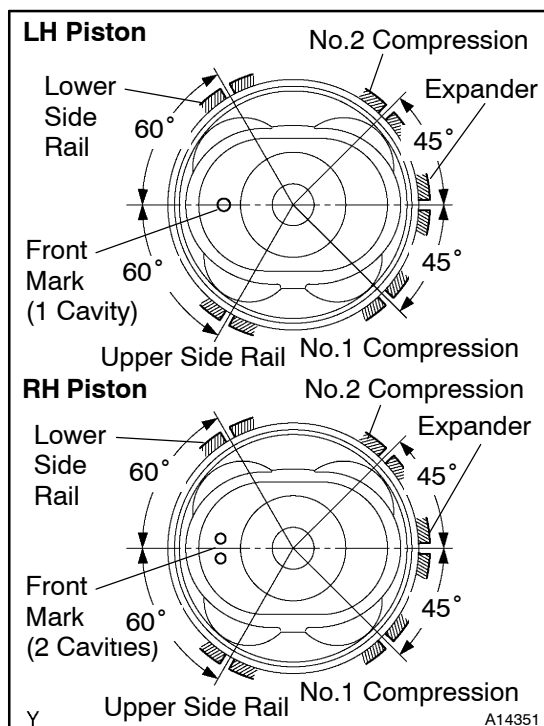


2. INSTALL PISTON RINGS

- Install the oil ring expander and 2 side rails by hand.
- Using a piston ring expander, install the 2 compression rings with the code mark facing upward.

Code mark:

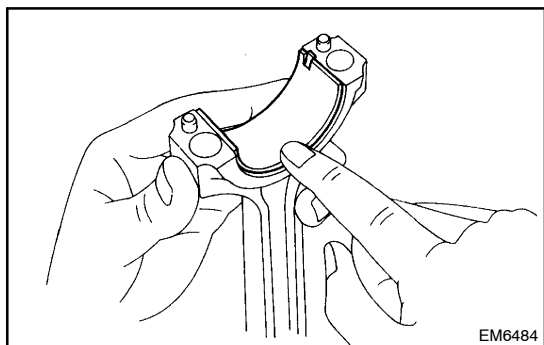
No.1	1R
No.2	2R



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

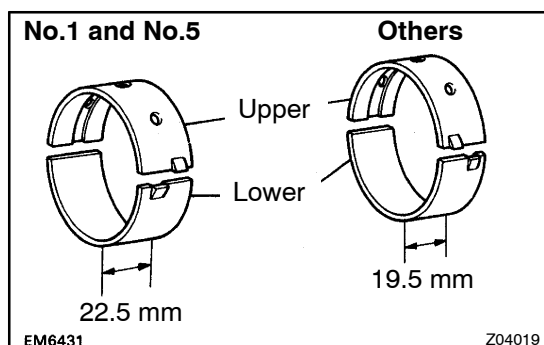
NOTICE:

Do not align the ring ends.



3. INSTALL BEARINGS

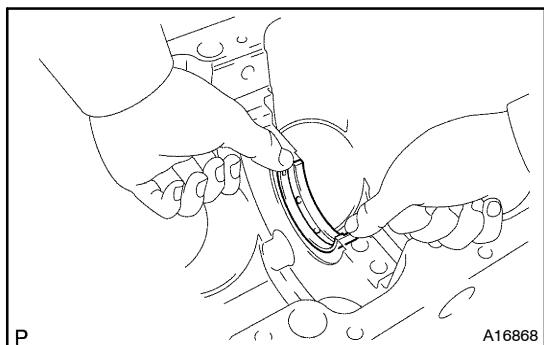
- Align the bearing claw with the groove of the connecting rod or connecting cap.
- Install the bearings in the connecting rod and connecting rod cap.



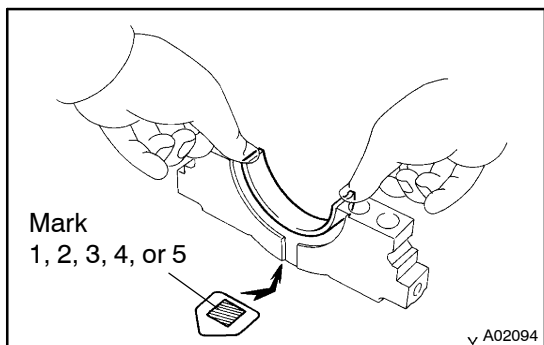
4. INSTALL MAIN BEARINGS

HINT:

- Main bearings come in widths of 19.5 mm (0.768 in.) and 22.5 mm (0.886 in.). Install the 22.5 mm (0.886 in.) bearings in the No.1 and No.5 cylinder block journal positions with the main bearing cap. Install the 19.5 mm (0.768 in.) bearings in the other positions.
- Upper bearings have an oil groove and oil holes; lower bearings do not.



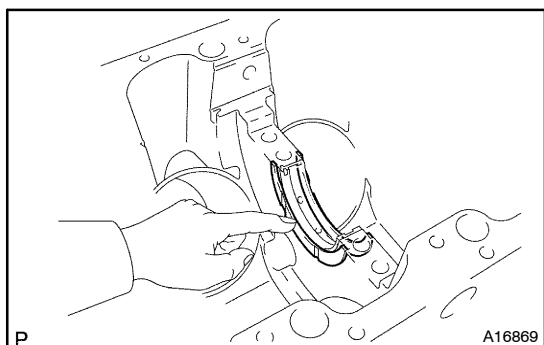
- (a) Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.



- (b) Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.

HINT:

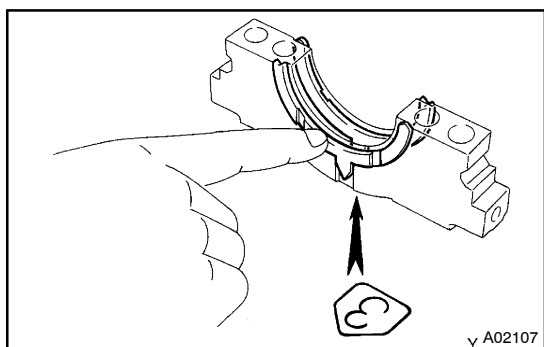
A number is marked on each main bearing cap to indicate the installation position.



5. INSTALL UPPER THRUST WASHERS

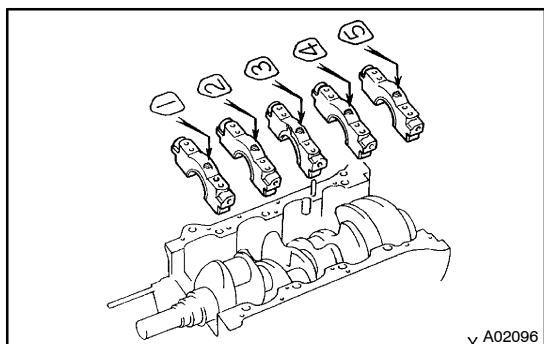
Install the 2 thrust washers under the No.3 journal position of the cylinder block with the oil grooves facing outward.

6. PLACE CRANKSHAFT ON CYLINDER BLOCK

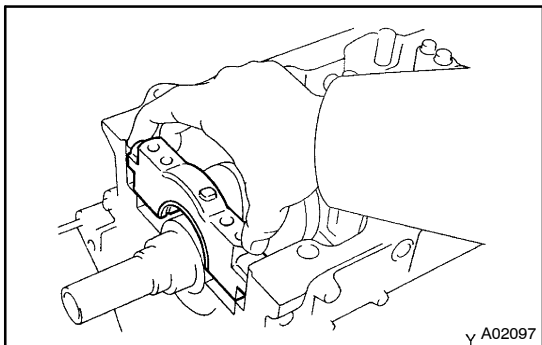


7. PLACE MAIN BEARING CAPS AND LOWER THRUST WASHERS ON CYLINDER BLOCK

- (a) Install the 2 thrust washers on the No.3 bearing cap with the grooves facing outward.



- (b) Install the 5 main bearing caps in their proper locations.

**HINT:**

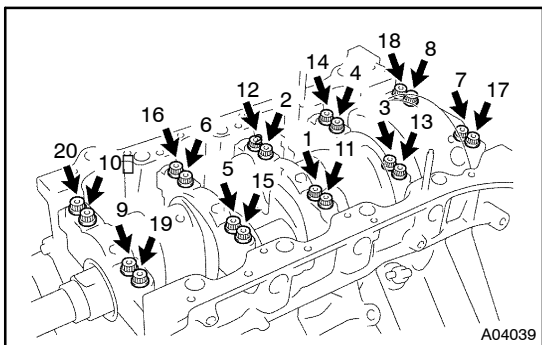
Place the bearing caps level and let them return to their original position by their own weight.

NOTICE:

Do not install the main bearing cap by tapping it.

8. INSTALL MAIN BEARING CAP BOLTS**HINT:**

- The main bearing cap bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any one of the main bearing cap bolts is broken or deformed, replace it.

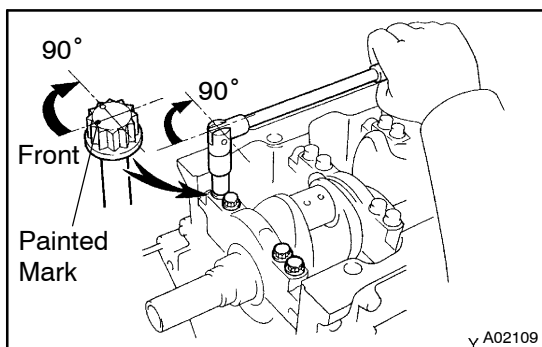


(a) Apply a light coat of engine oil on the threads and under the main bearing cap bolts.

(b) Install and uniformly tighten the 20 main bearing cap bolts in several passes, in the sequence shown.

Torque: 27 N·m (275 kgf·cm, 20 ft·lbf)

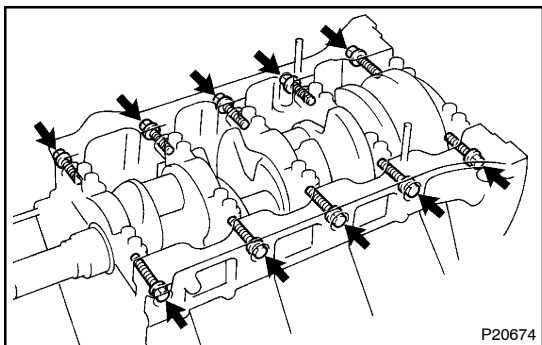
If any one of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.



(c) Mark the front of the main bearing cap bolt with paint.

(d) Retighten the main bearing cap bolts by 90° in the numerical order shown.

(e) Check that the painted mark is now at a 90° angle to the front.



(f) Install a new seal washer to the main bearing cap bolt.

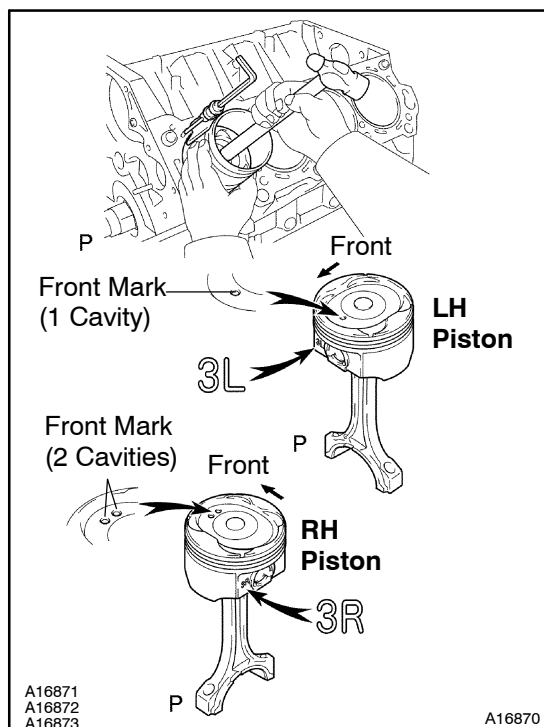
(g) Install and uniformly tighten the 10 main bearing cap bolts.

Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

(h) Check that the crankshaft turns smoothly.

9. CHECK CRANKSHAFT THRUST CLEARANCE

(See page EM-92)

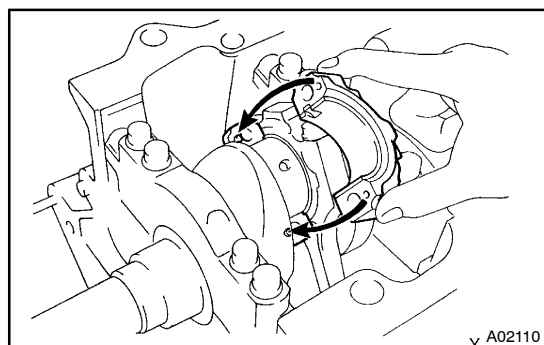


10. INSTALL PISTON AND CONNECTING ROD ASSEMBLES

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

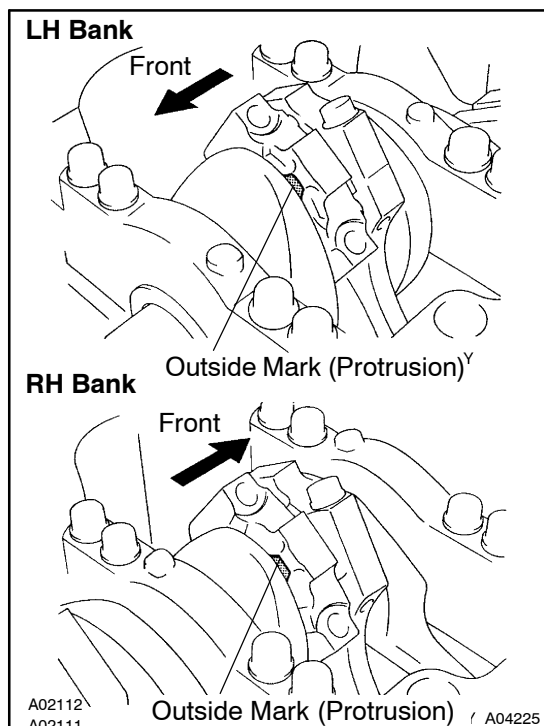
NOTICE:

The shape of the piston varies for the LH and RH banks. The LH piston is marked with "3L", the RH piston with "3R".



11. PLACE CONNECTING ROD CAP ON CONNECTING ROD

- Match the numbered connecting rod cap with the connecting rod.
- Align the pin groove of the connecting rod cap with the pins of the connecting rod, and install the connecting rod cap.

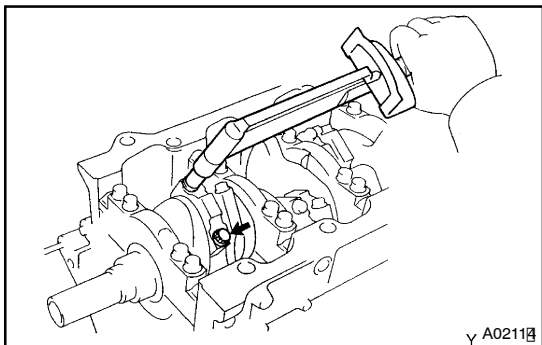


- Check that the outside mark of the connecting rod cap is facing in correct direction.

12. INSTALL CONNECTING ROD CAP BOLTS

HINT:

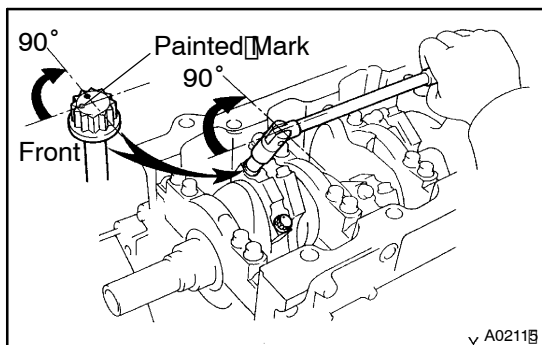
- The connecting rod cap bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any one of the connecting rod cap bolts is broken or deformed, replace it.



- (a) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.
- (b) Install and alternately tighten the 2 connecting rod cap bolts in several passes.

Torque: 24.5 N·m (250 kgf·cm, 18 ft·lbf)

If any one of the connecting rod cap bolts does not meet the torque specification, replace the connecting rod cap bolts.

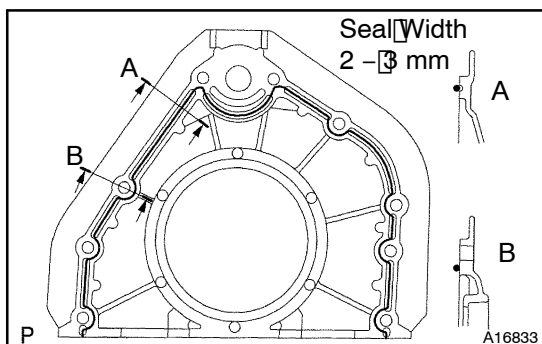


- (c) Mark the front of the connecting cap bolt with paint.
- (d) Retighten the cap bolts 90° as shown.
- (e) Check that the painted mark is now at a 90° angle to the front.
- (f) Check that the crankshaft turns smoothly.

13. CHECK CONNECTING ROD THRUST CLEARANCE (See page EM-92)

14. INSTALL REAR OIL SEAL RETAINER

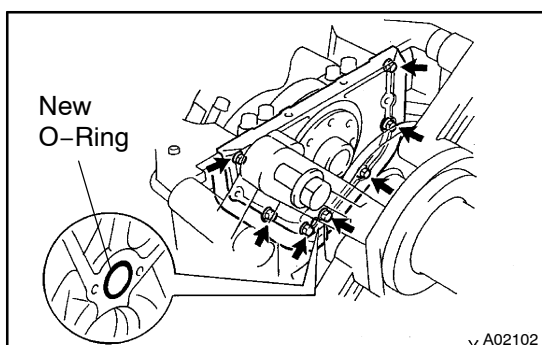
- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the oil seal retainer and cylinder block.
 - Using a razor blade and gasket scraper, remove all the oil packing (FIPG) material from the gasket surfaces and sealing grooves.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non-residue solvent, clean both sealing surfaces.



- (b) Apply seal packing to the oil seal retainer as shown in the illustration.

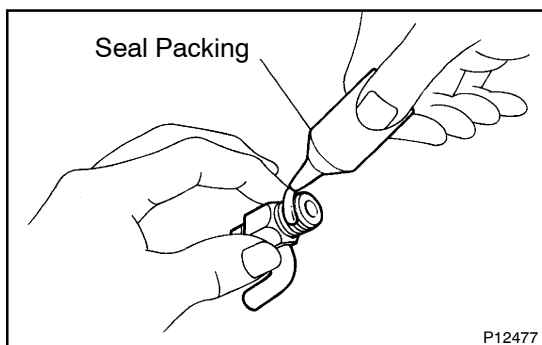
Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 2 - 3 mm (0.08 - 0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.



- (c) Install a new O-ring to the cylinder block.
- (d) Install the oil seal retainer with the 7 bolts.

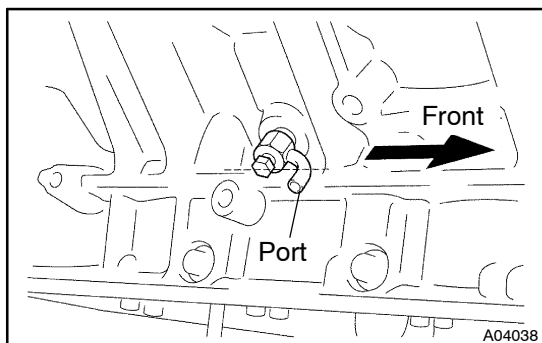
Torque: 8.0 N·m (80 kgf·cm, 71 in·lbf)



15. INSTALL ENGINE COOLANT DRAIN UNIONS

- (a) Apply seal packing to 2 or 3 threads.

Seal packing: Part No. 08826-00100 or equivalent



- (b) Install the RH and LH drain unions.

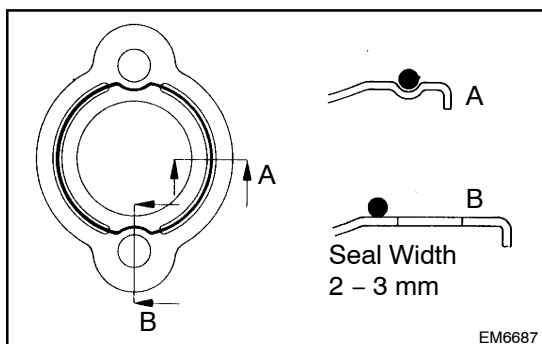
Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

HINT:

After applying the specified torque, rotate the drain union clockwise until its drain port is facing forward.

16. INSTALL WATER SEAL PLATE

- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the seal plate and cylinder block.
- Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non-residue solvent, clean both sealing surfaces.



- (b) Apply seal packing to the seal plate as shown in the illustration.

Seal packing: Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 2 - 3 mm (0.08 - 0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

- (c) Install the seal plate with the 2 nuts. Alternately tighten the nuts in several passes.

Torque: 14 N·m (145 kgf·cm, 10 ft·lbf)

17. ☐ INSTALL OIL PUMP (See page LU-15)

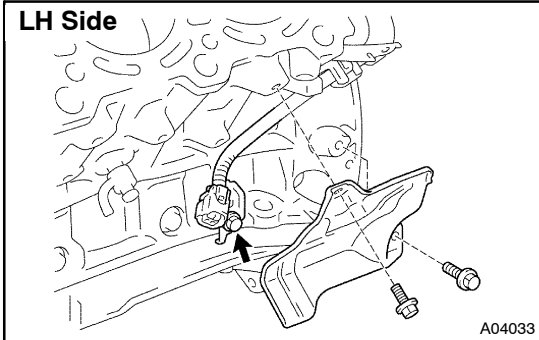
18. ☐ INSTALL OIL STRAINER (See page LU-15)

19. ☐ INSTALL NO.1 OIL PAN (See page LU-15)

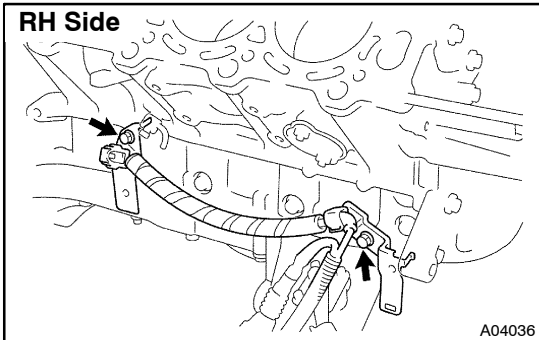
20. INSTALL OIL PAN BAFFLE PLATE
(See page LU-15)

21. ☐ INSTALL NO.2 OIL PAN (See page LU-15)

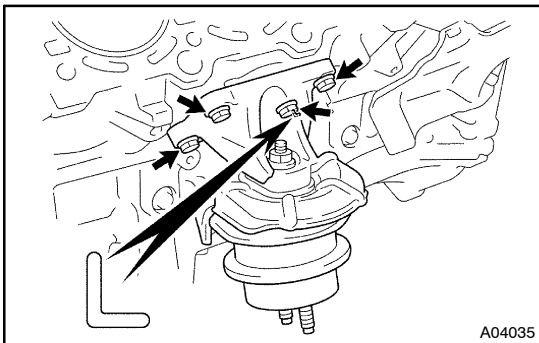
22. ☐ INSTALL WATER PUMP (See page CO-8)

LH Side**23. INSTALL ENGINE WIRE**

- (a) Install the engine wire to the LH side of the cylinder block with the 4 bolts.
- (b) Install the engine wire cover with the 2 bolts.

RH Side

- (c) Install the 2 brackets on the engine wire to the RH side of the cylinder block with the 2 bolts.
- (d) Connect the crankshaft position sensor connector.

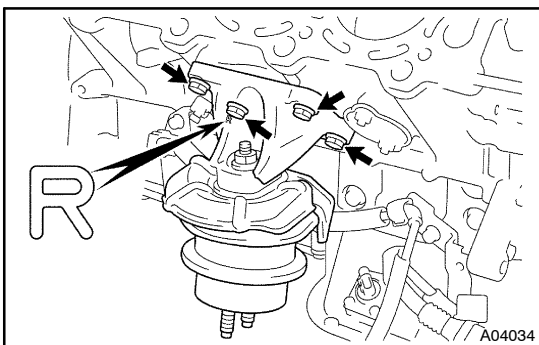
24. INSTALL KNOCK SENSORS (See page FI-64)**25. INSTALL STARTER (See page ST-17)****26. INSTALL LH ENGINE MOUNTING BRACKET**

Install the mounting bracket with the 4 bolts.

Torque: 36 N·m (370 kgf·cm, 27 ft·lbf)

HINT:

The LH mounting bracket is marked with "L".

**27. INSTALL RH ENGINE MOUNTING BRACKET**

Install the mounting bracket with the 4 bolts.

Torque: 36 N·m (370 kgf·cm, 27 ft·lbf)

HINT:

The RH mounting bracket is marked with "R".

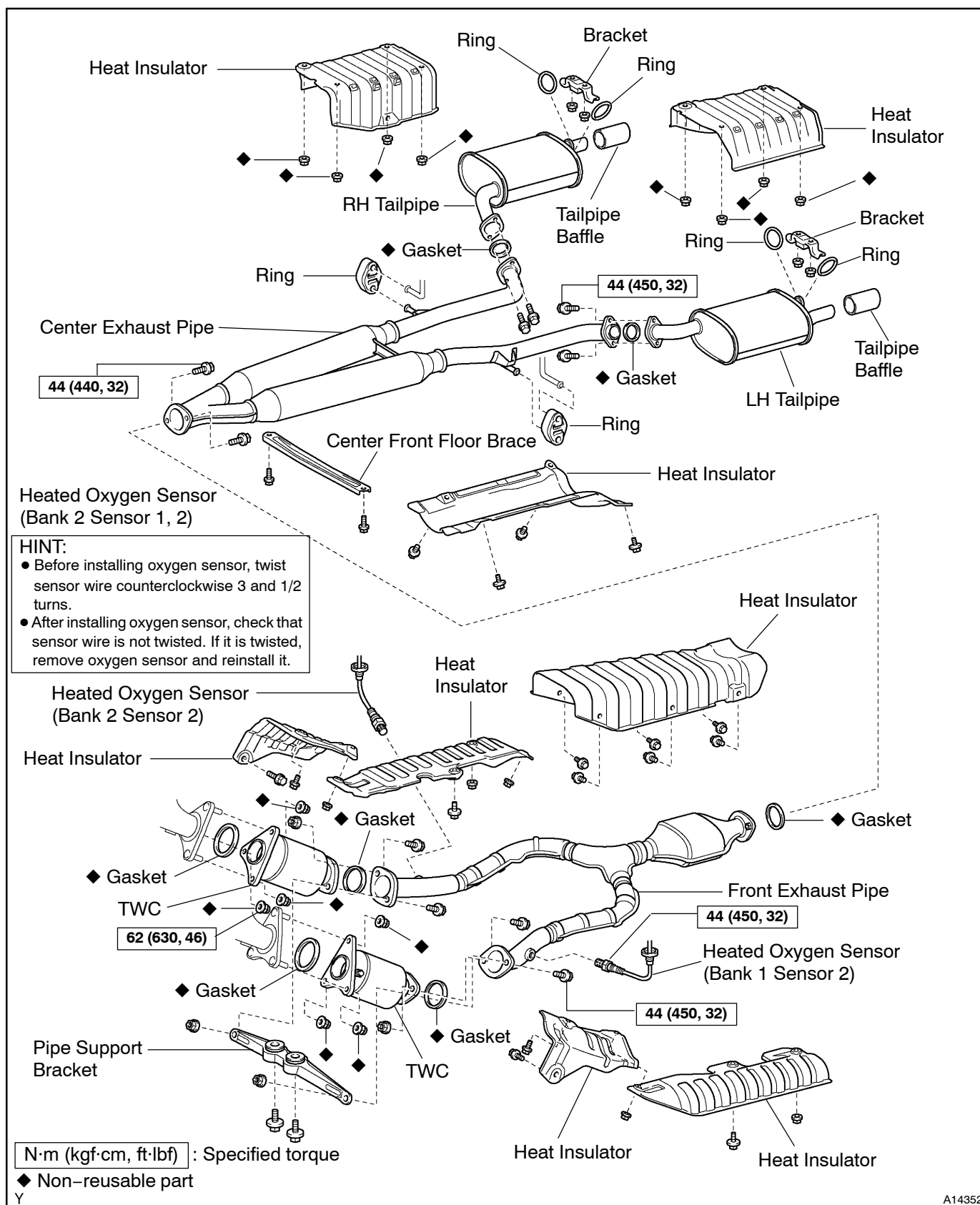
28. INSTALL CYLINDER HEADS (See page EM-60)**29. INSTALL TIMING BELT AND PULLEYS**

(See page EM-22)

30. DISCONNECT ENGINE FROM ENGINE STAND

EXHAUST SYSTEM COMPONENTS

EMOEE-12



A14352