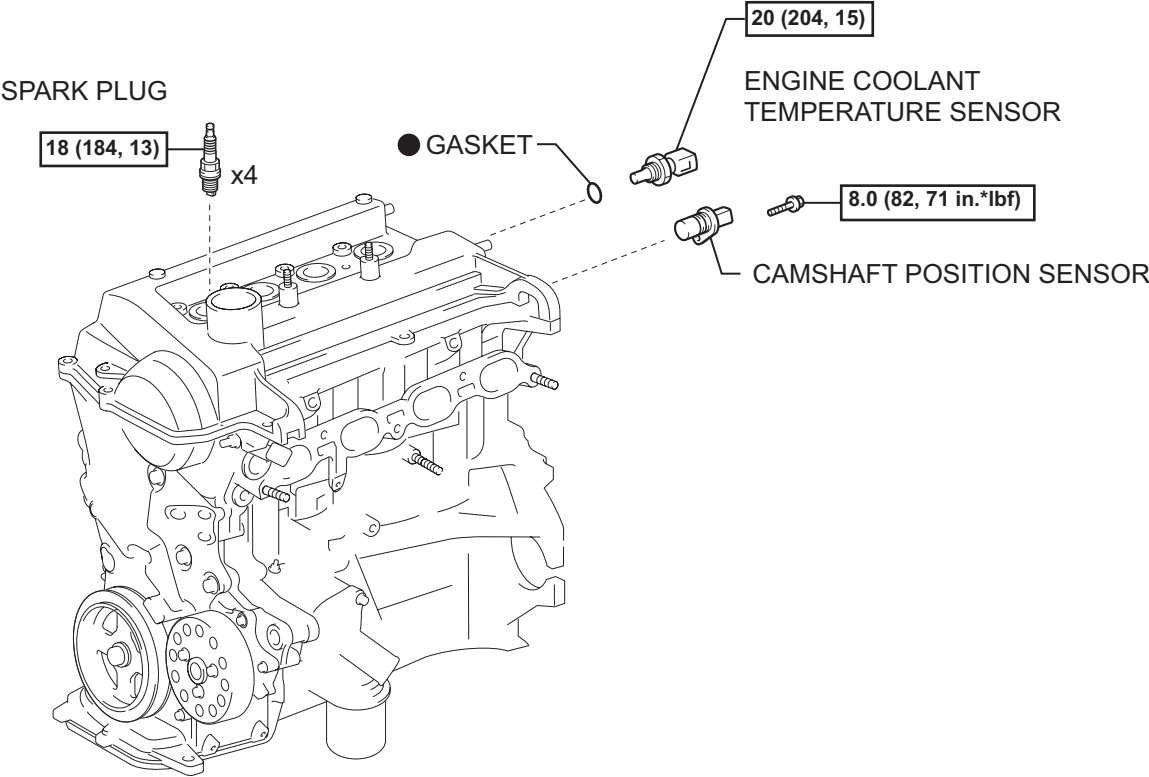
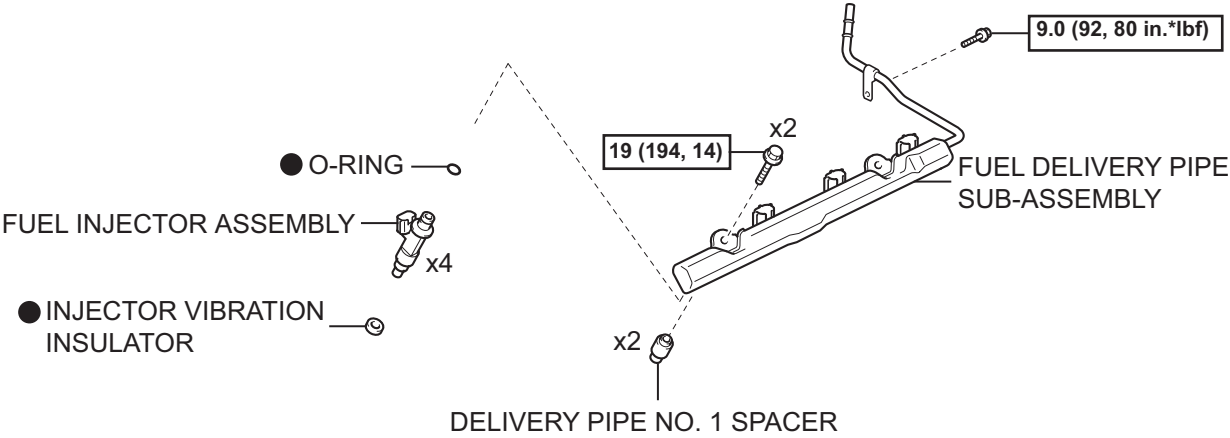


ENGINE UNIT

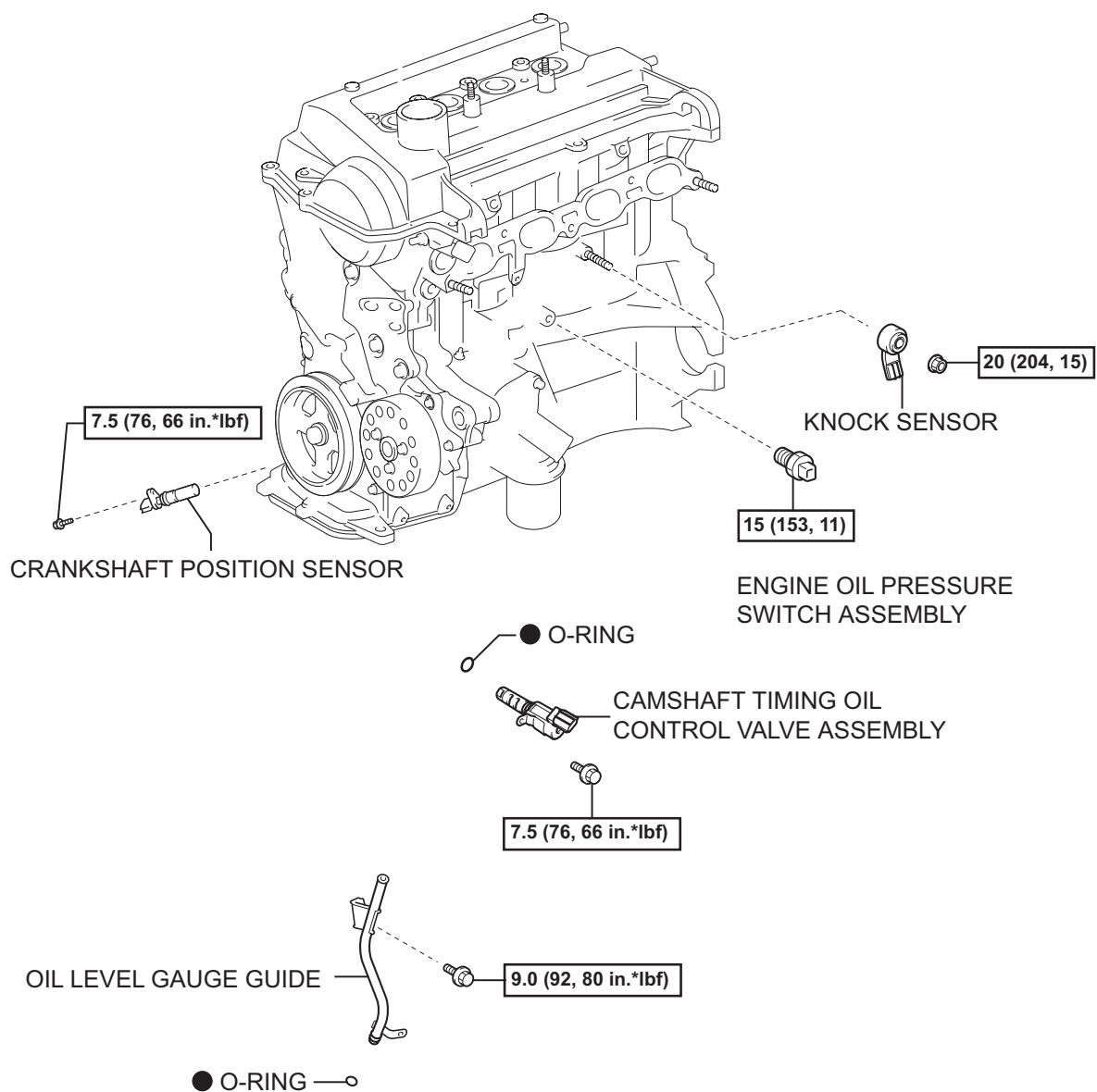
COMPONENTS

EM



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

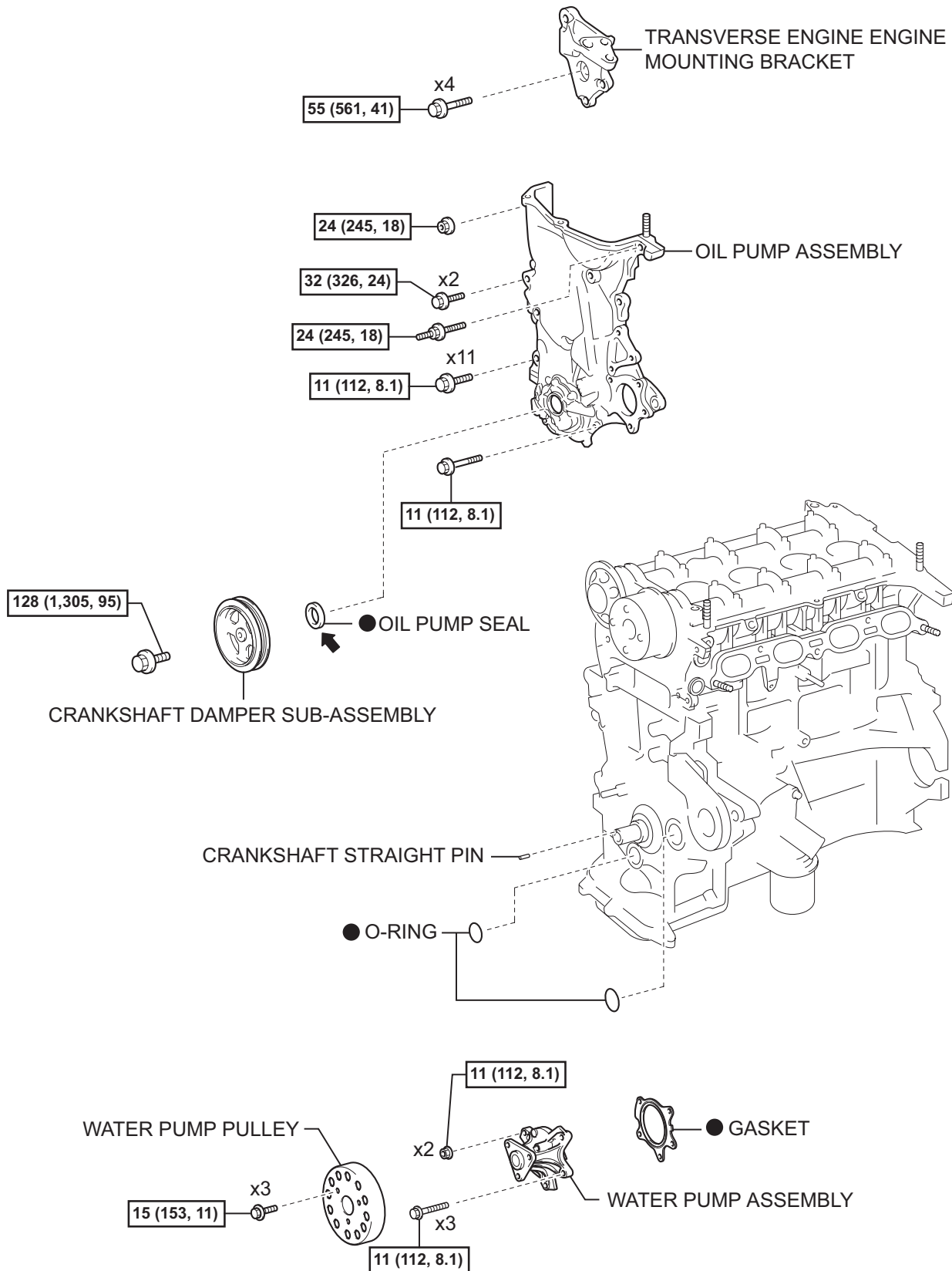
● Non-reusable part



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

● Non-reusable part

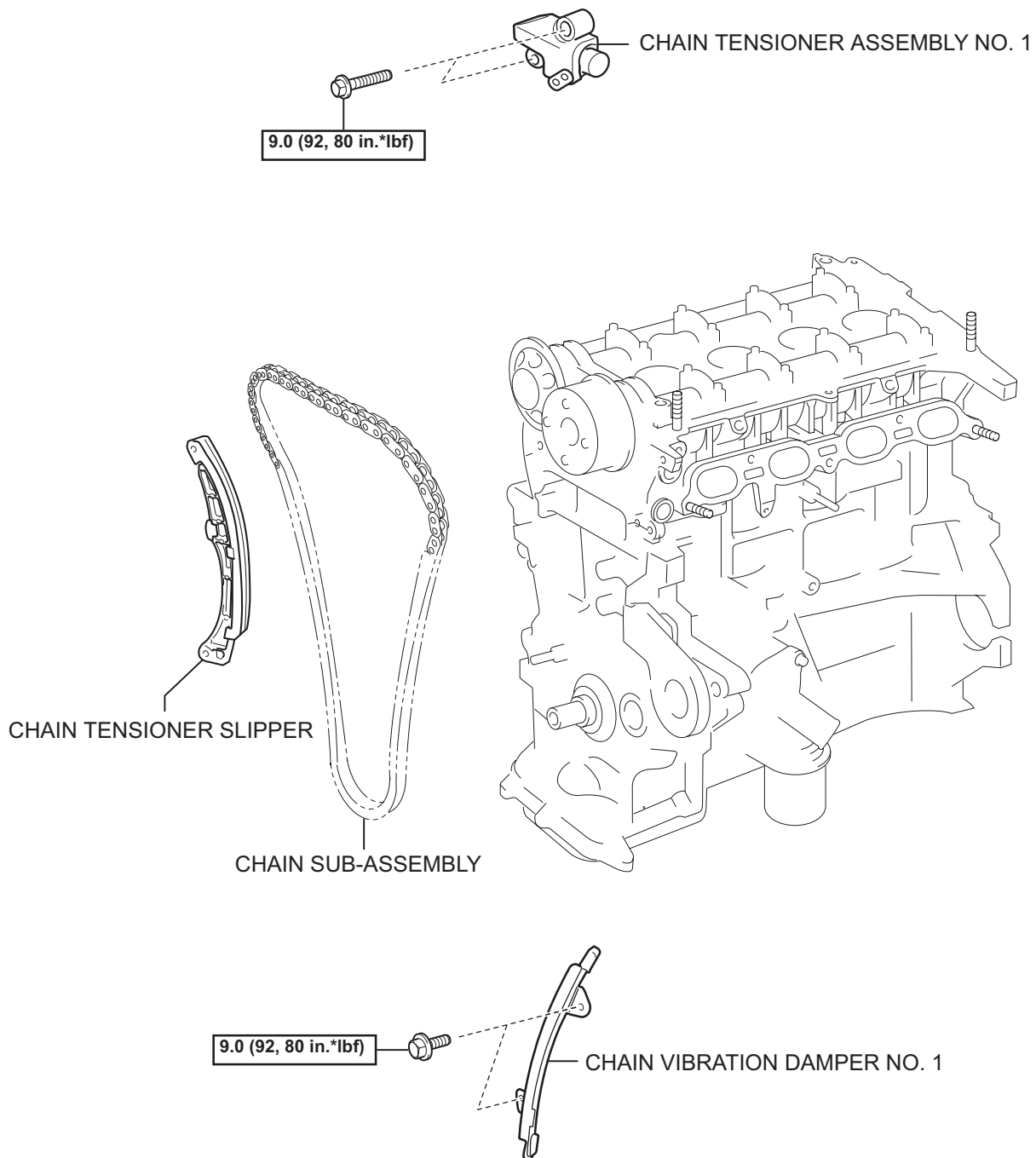
EM



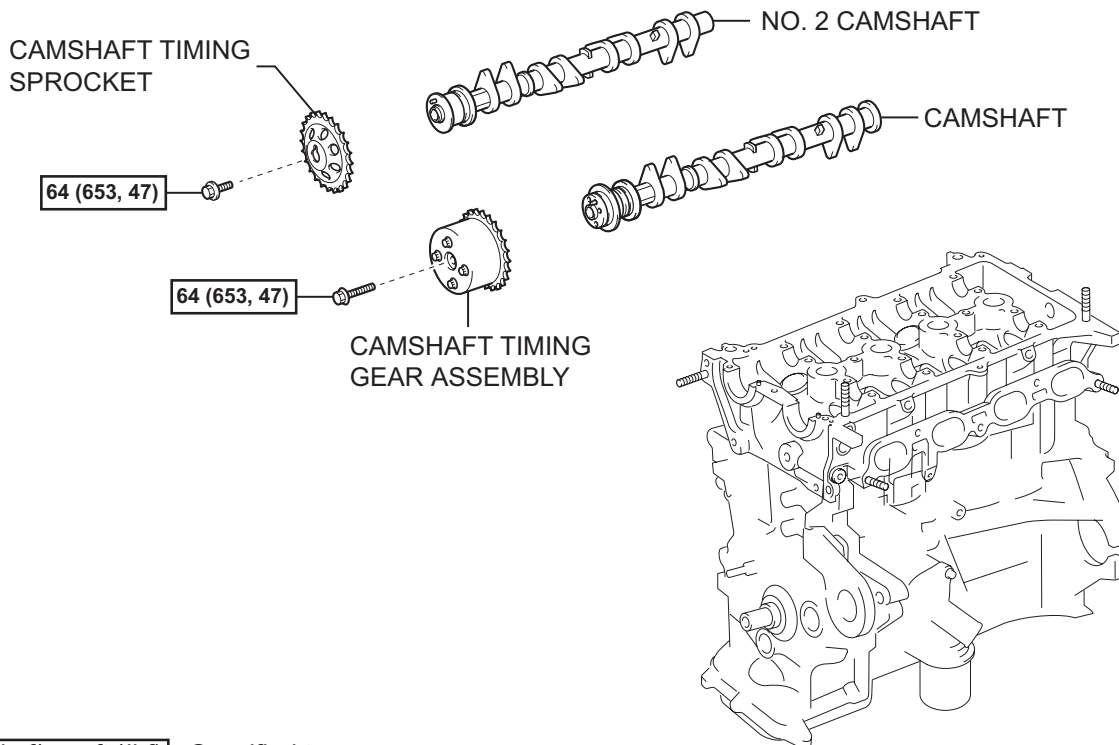
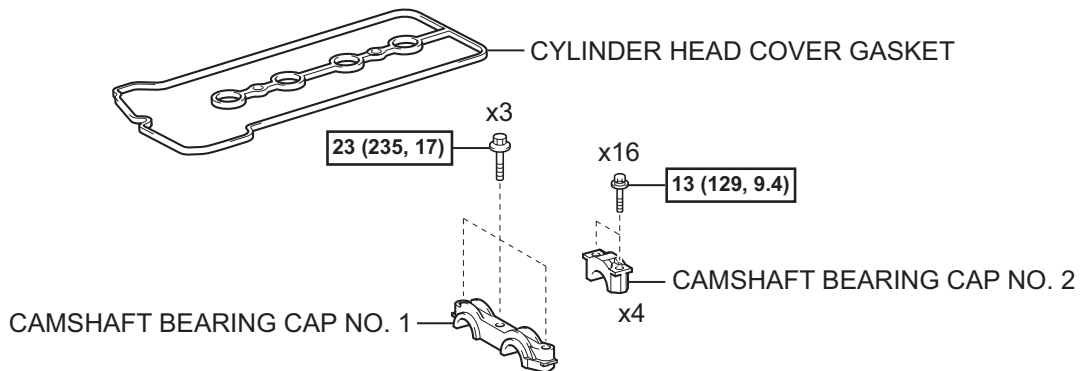
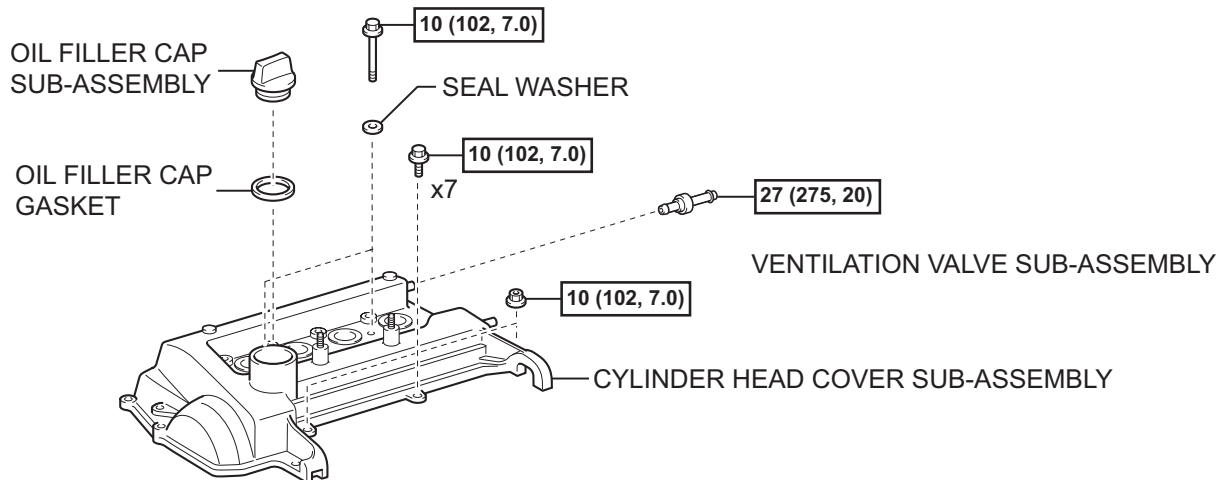
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part

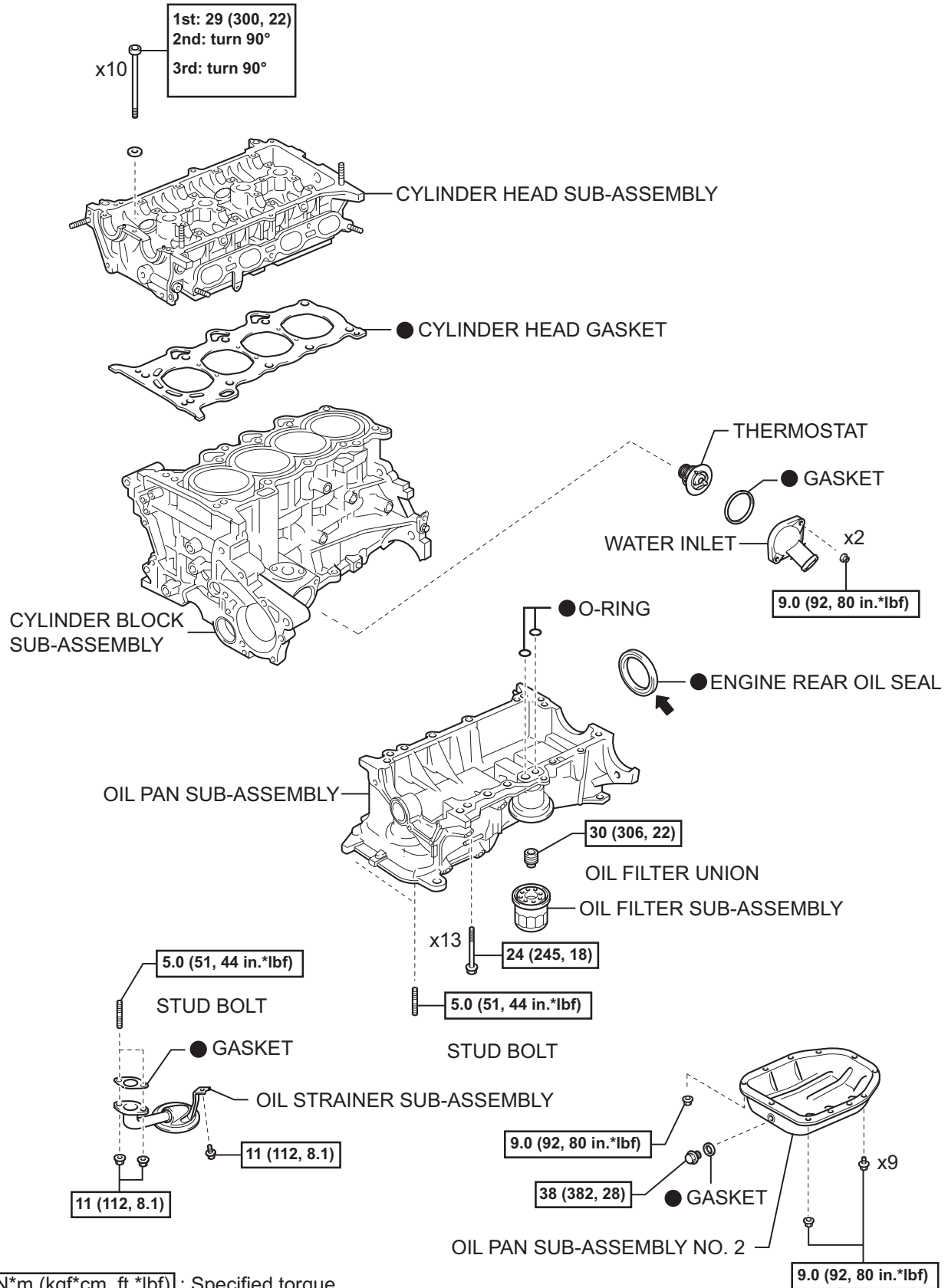
← Apply MP grease



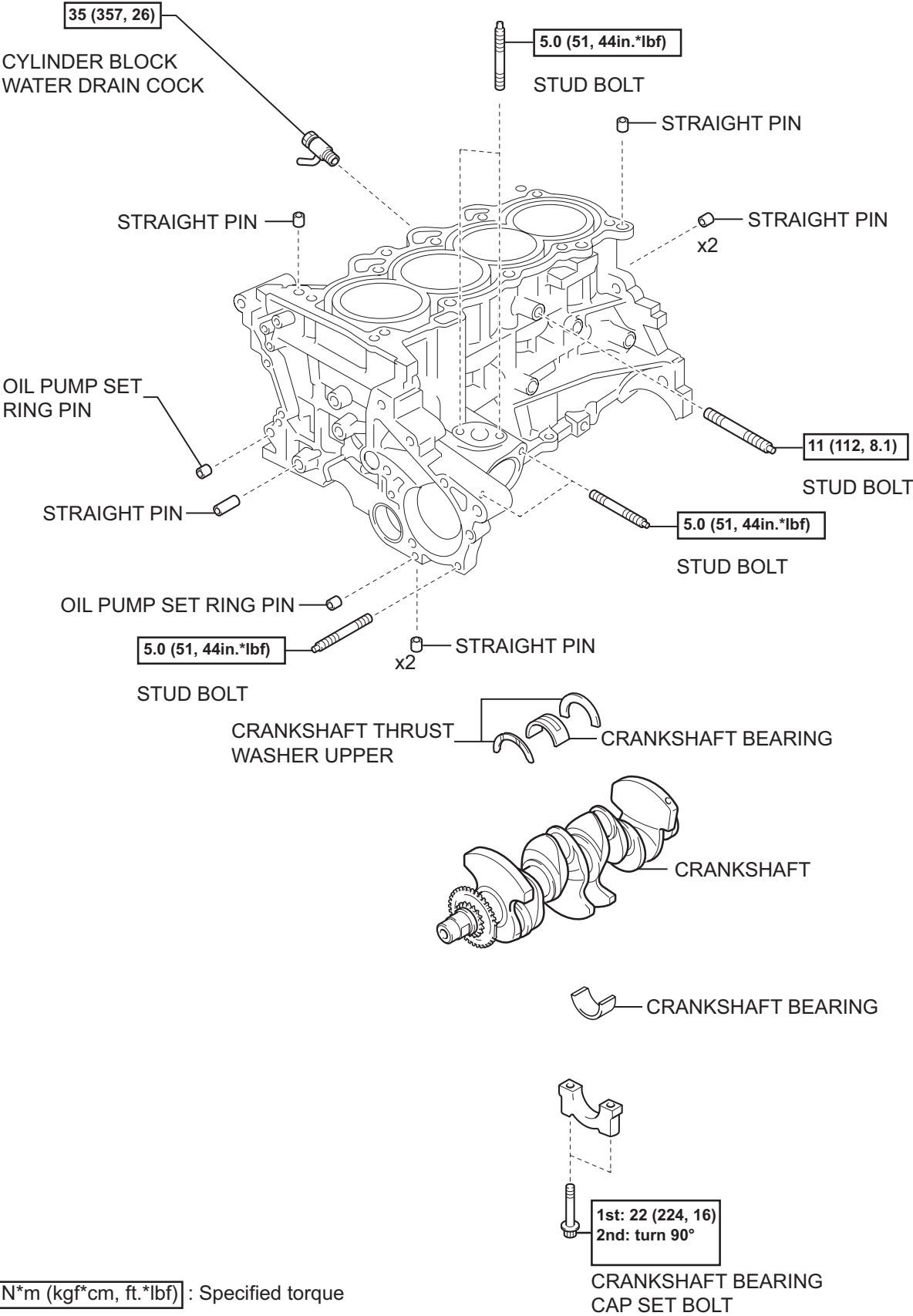
N*m (kgf*cm, ft.*lbf) : Specified torque



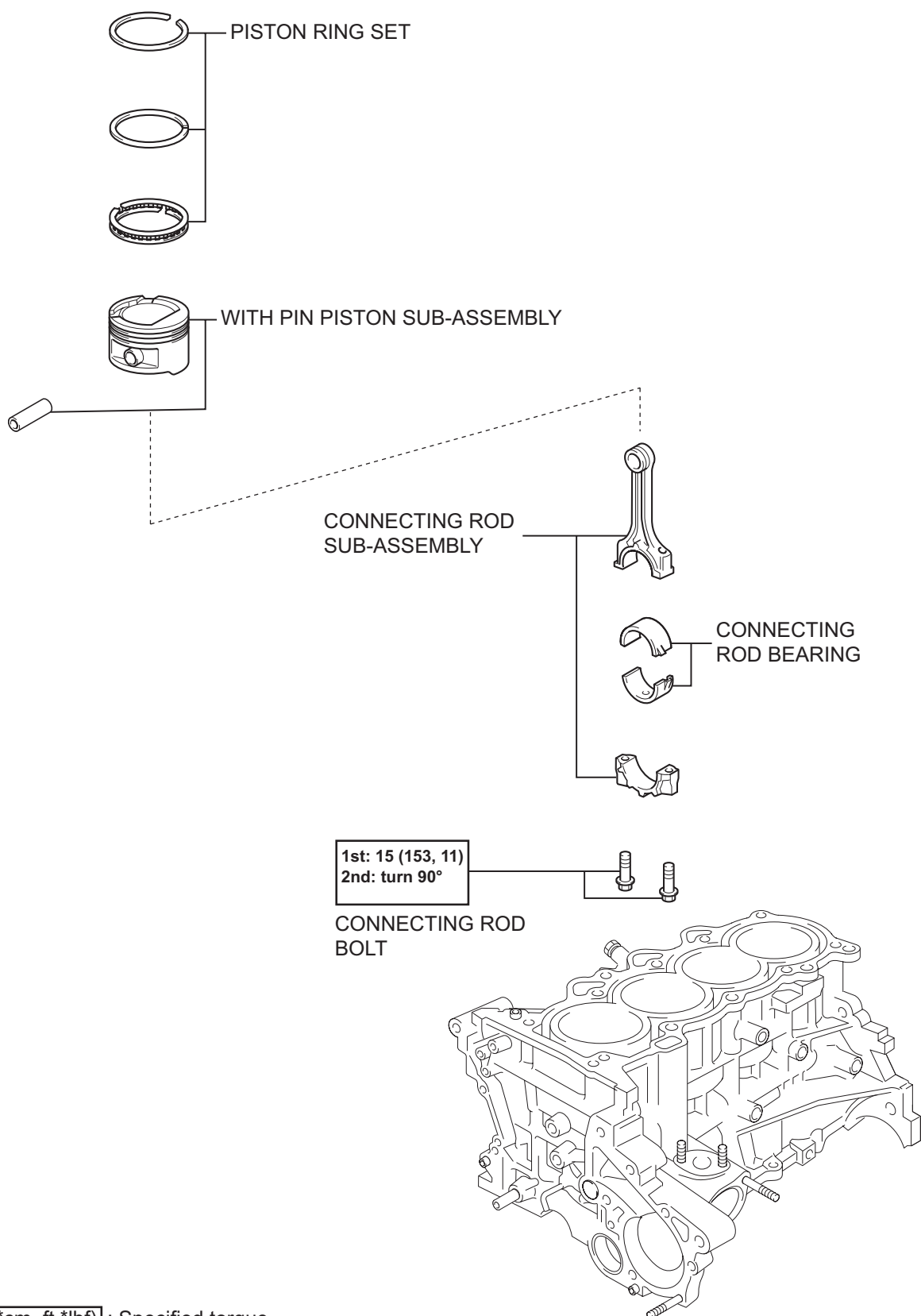
N*m (kgf*cm, ft.*lbf) : Specified torque



EM



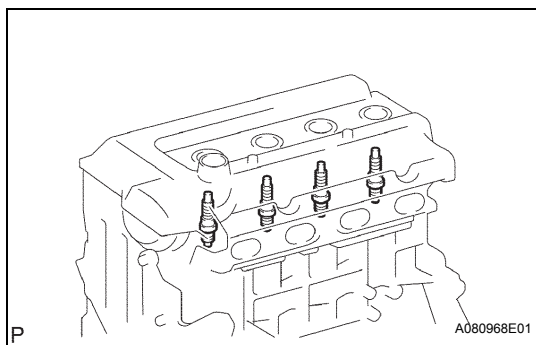
EM



DISASSEMBLY

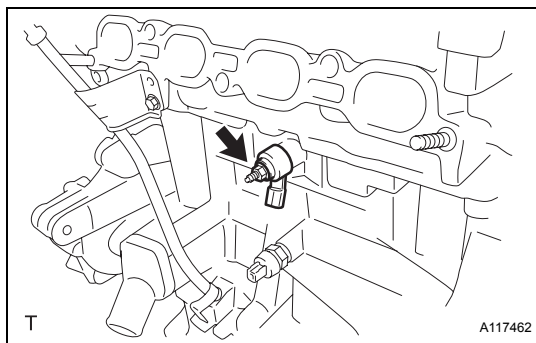
1. REMOVE SPARK PLUG

- (a) Using a spark plug wrench, remove the 4 spark plugs.



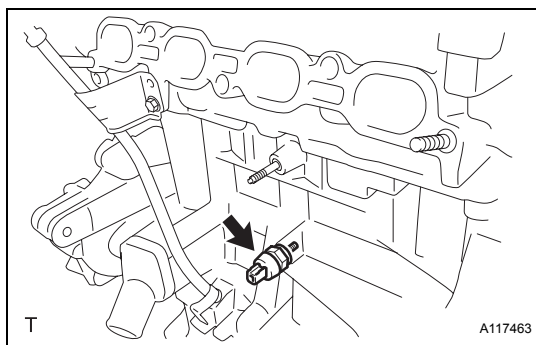
2. REMOVE KNOCK SENSOR

- (a) Remove the nut and remove the knock sensor.



3. REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY

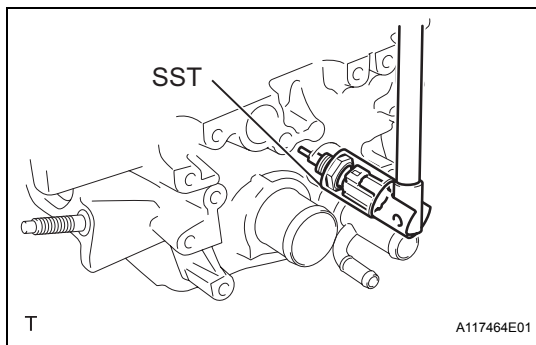
- (a) Using a 24 mm deep socket wrench, remove the oil pressure switch.



4. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

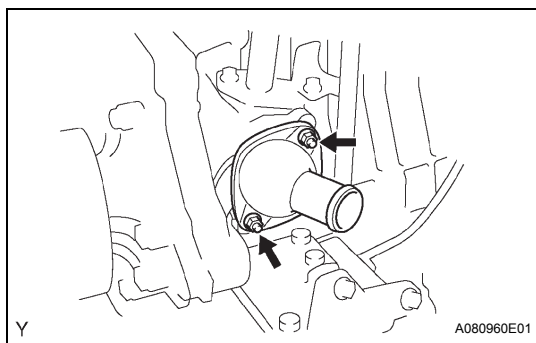
- (a) Using SST, remove the engine coolant temperature sensor.

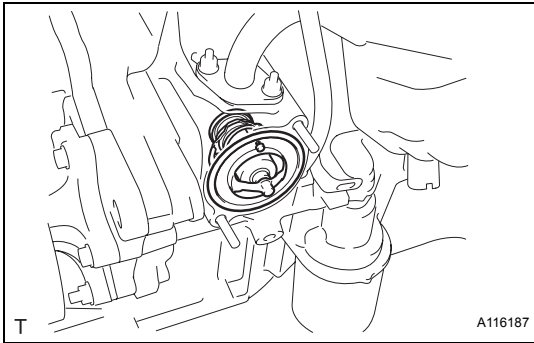
SST 09817-33190



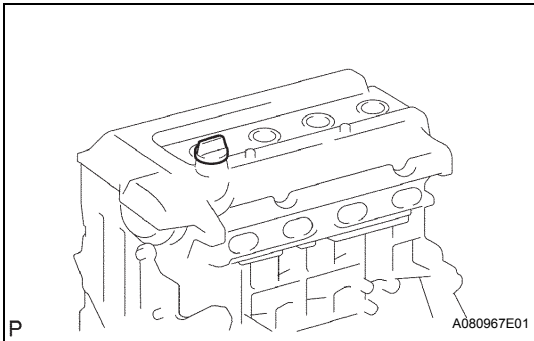
5. REMOVE WATER INLET

- (a) Remove the 2 nuts and remove the water inlet.

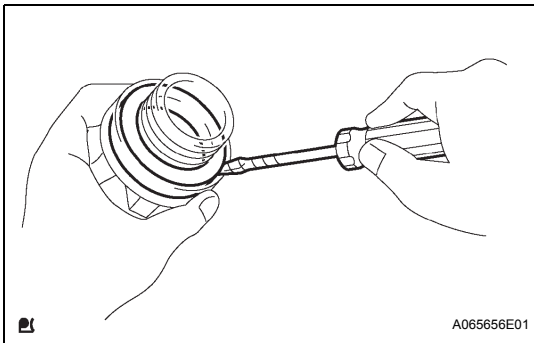


**6. REMOVE THERMOSTAT**

- (a) Remove the thermostat.
- (b) Remove the gasket from the thermostat.

**7. REMOVE OIL FILLER CAP SUB-ASSEMBLY**

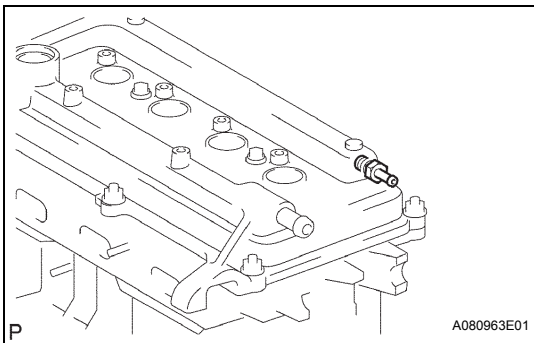
- (a) Remove the oil filler cap from the cylinder head cover.

**8. REMOVE OIL FILLER CAP GASKET**

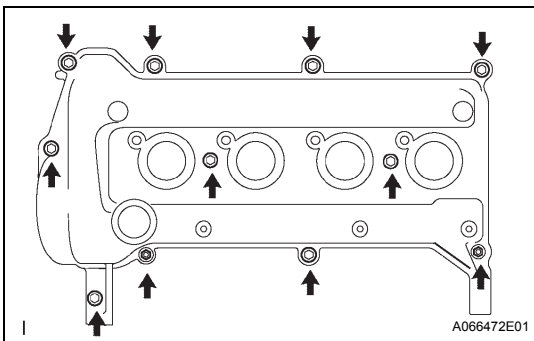
- (a) Using a screwdriver, remove the gasket from the oil filler cap.

9. REMOVE CRANKSHAFT POSITION SENSOR

- (a) Remove the bolt and the crankshaft position sensor.

**10. REMOVE VENTILATION VALVE SUB-ASSEMBLY**

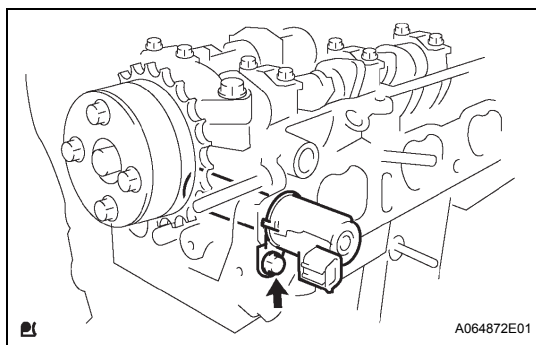
- (a) Remove the ventilation valve from the cylinder head cover.

**11. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY**

- (a) Remove the 9 bolts, 2 nuts and 2 seal washers and then remove the cylinder head cover sub-assembly.

12. REMOVE CYLINDER HEAD COVER GASKET

- (a) Remove the gasket from the cylinder head cover.

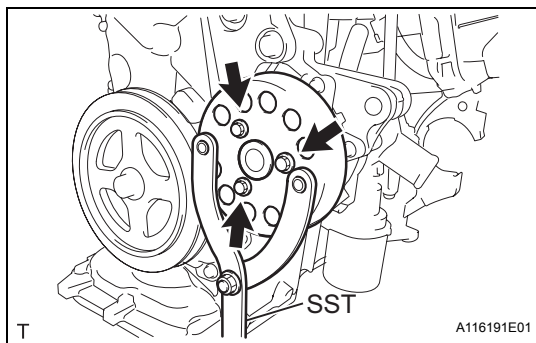


13. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

- (a) Remove the bolt and the camshaft timing oil control valve.

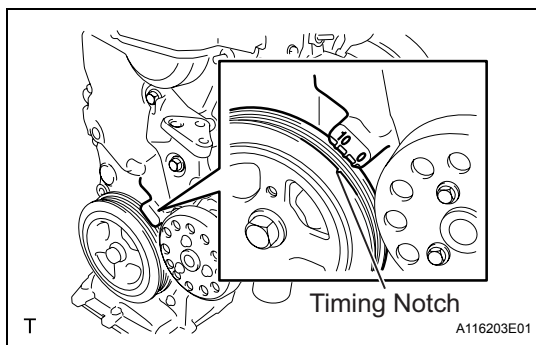
14. REMOVE OIL LEVEL GAUGE GUIDE

- (a) Remove the bolt and the oil level gauge guide.



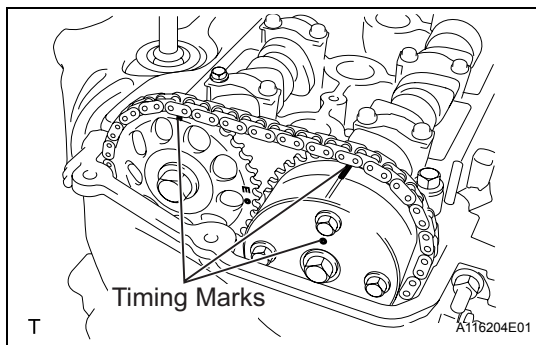
15. REMOVE WATER PUMP PULLEY

- (a) Using SST, hold the pump pulley.
SST 09960-10010 (09962-01000, 09963-00700)
 (b) Remove the 3 bolts and the pump pulley.

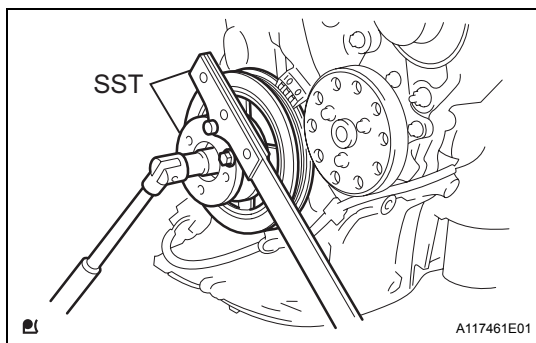


16. REMOVE CRANKSHAFT DAMPER SUB-ASSEMBLY

- (a) Set cylinder No. 1 to TDC/compression.
 (1) Turn the crankshaft damper sub-assembly, and align its timing notch with timing mark "0" of the oil pump.



- (2) Check that the timing marks on the camshaft timing sprocket and the camshaft timing gear are all facing upward, as shown in the illustration.
 If not, turn the crankshaft 1 complete revolution (360°) and align the marks as above.

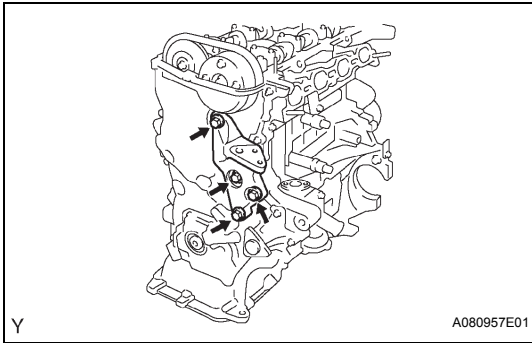


- (b) Using 2 SSTs, loosen the bolt while holding the crankshaft damper sub-assembly.
SST 09213-14010 (91651-60865), 09330-00021

NOTICE:

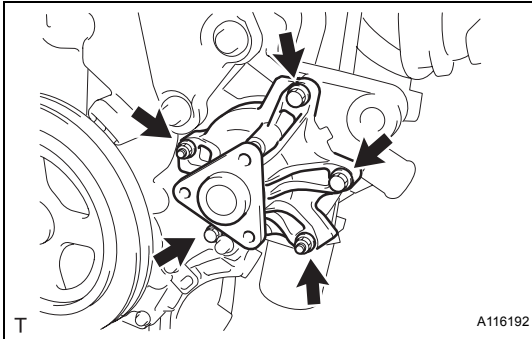
Check the SST installation positions when installing them, to avoid the SST fixing bolts from coming into contact with the oil pump assembly.

- (c) Remove the SSTs and the bolt.
 (d) Remove the crankshaft damper sub-assembly.



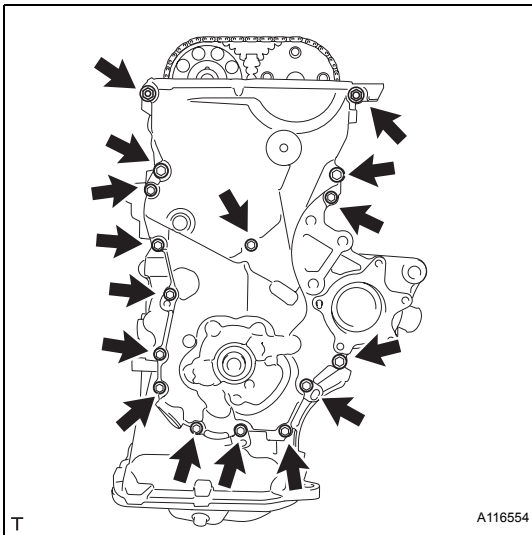
17. REMOVE TRANSVERSE ENGINE ENGINE MOUNTING BRACKET

- (a) Remove the 4 bolts and remove the transverse engine mounting bracket.



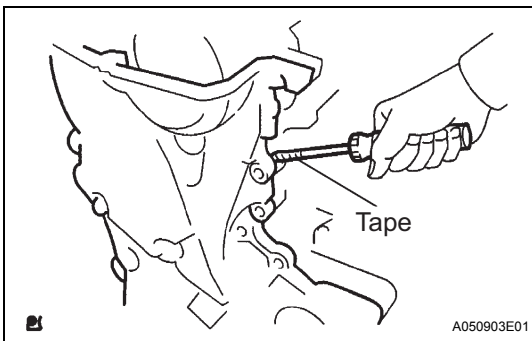
18. REMOVE WATER PUMP ASSEMBLY

- (a) Remove the 3 bolts and the 2 nuts and remove the water pump and the gasket.



19. REMOVE OIL PUMP ASSEMBLY

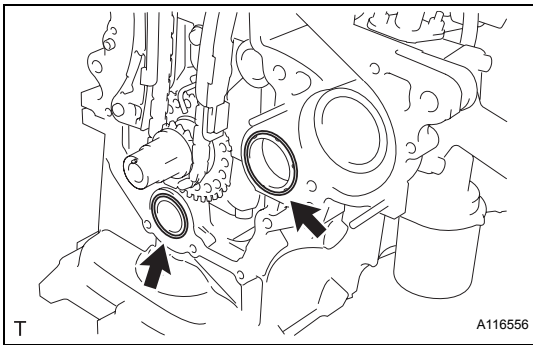
- (a) Remove the 15 bolts and the nut.



- (b) Using a screwdriver with its tip wrapped in protective tape, prize the oil pump assembly to remove it.

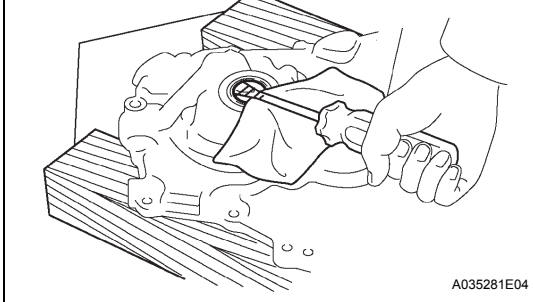
NOTICE:

Do not damage the contact surface of the oil pump assembly and oil pan sub-assembly.



- (c) Remove the 2 O-rings from the cylinder block and oil pan sub-assembly.

Wooden Blocks



20. REMOVE OIL PUMP SEAL

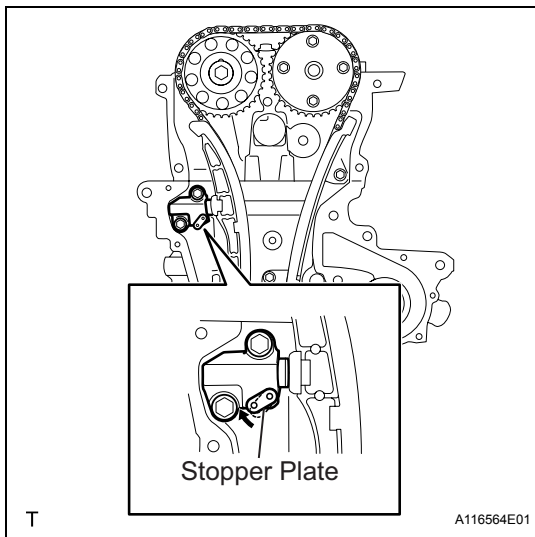
- (a) Using a screwdriver with its tip wrapped in tape, remove the oil seal.

21. REMOVE CHAIN TENSIONER ASSEMBLY NO. 1

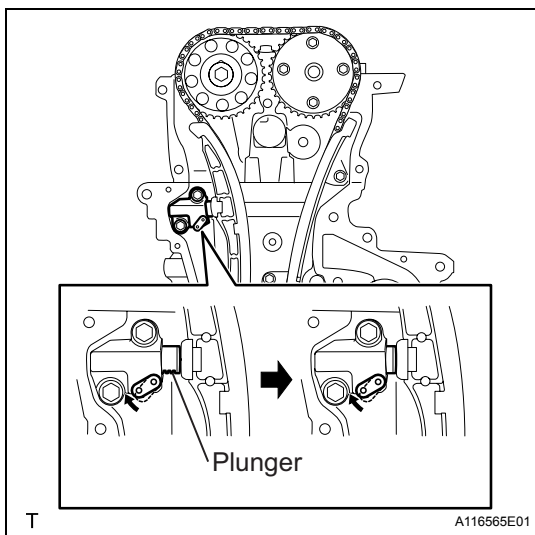
NOTICE:

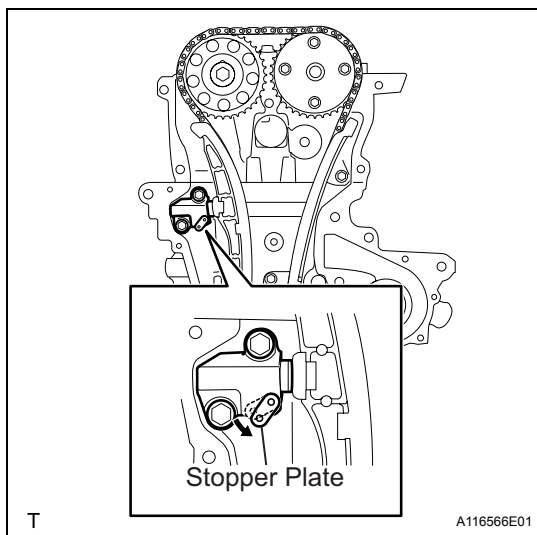
- Do not rotate the crankshaft with the chain tensioner removed.
- When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40° from the TDC first.

- (a) Pull up the stopper plate and hold it with its lock released.

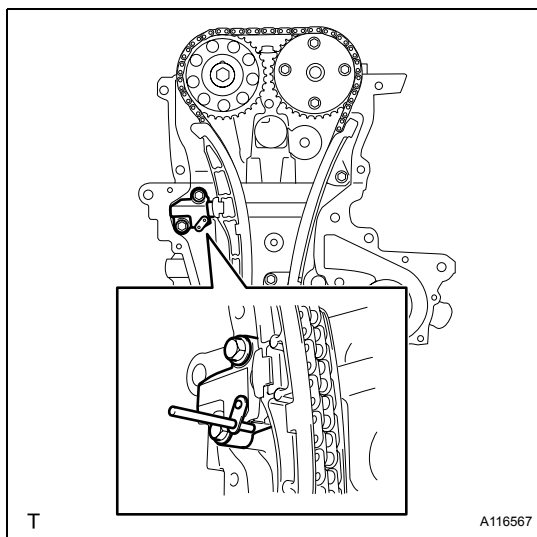


- (b) Unlock the plunger of the tensioner and push it in to the end.

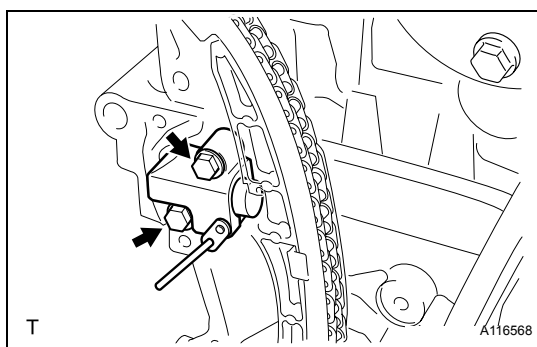




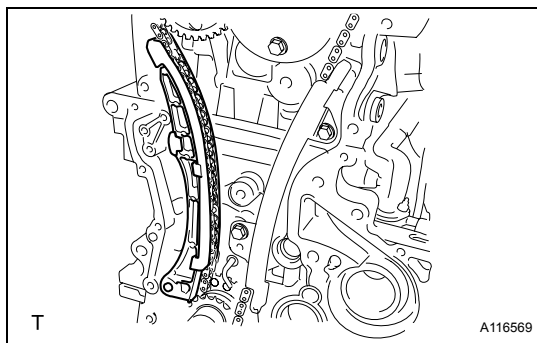
- (c) Pull down the stopper plate with the plunger pushed to the end and lock the plunger.



- (d) Insert a 3 mm (0.12 in.) diameter bar into the hole in the stopper plate and lock the plunger.

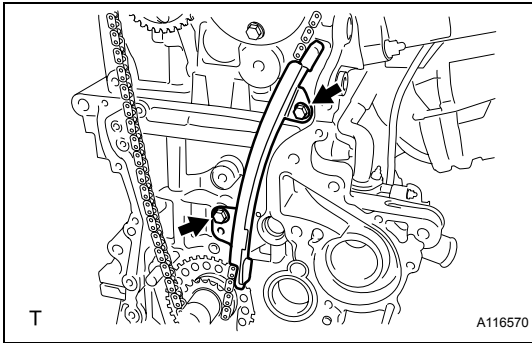


- (e) Remove the 2 bolts and remove chain tensioner assembly No. 1.

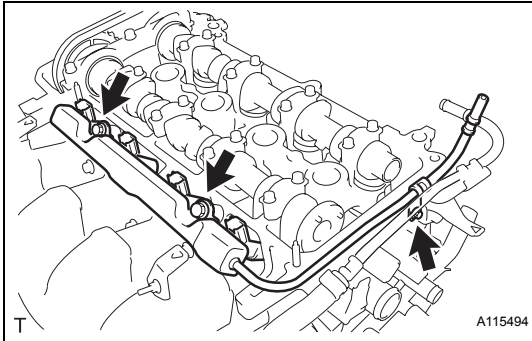


22. REMOVE CHAIN TENSIONER SLIPPER

- (a) Remove the chain tensioner slipper.

**23. REMOVE CHAIN VIBRATION DAMPER NO. 1**

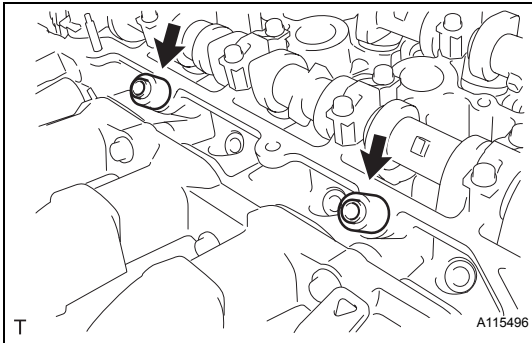
- (a) Remove the 2 bolts and remove chain vibration damper No. 1.

24. REMOVE CHAIN SUB-ASSEMBLY**25. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY**

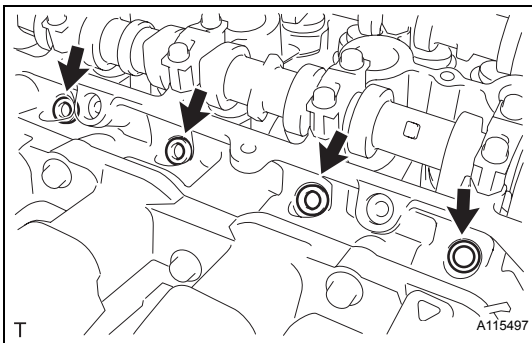
- (a) Remove the 3 bolts and remove the fuel delivery pipe sub-assembly with 4 fuel injectors.

NOTICE:

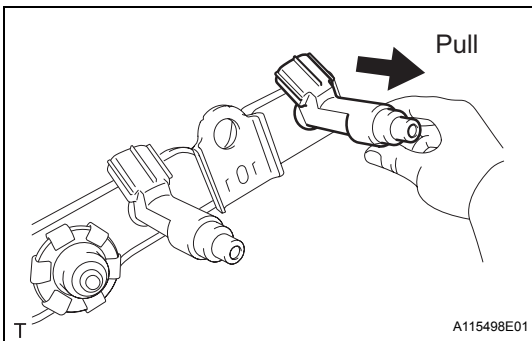
Do not drop the fuel injectors when removing the fuel delivery pipe sub-assembly.

**26. REMOVE DELIVERY PIPE NO. 1 SPACER**

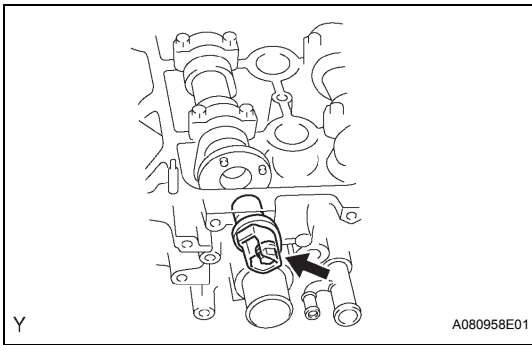
- (a) Remove the 2 delivery pipe No. 1 spacers.

**27. REMOVE INJECTOR VIBRATION INSULATOR**

- (a) Remove the 4 injector vibration insulators.

**28. REMOVE FUEL INJECTOR ASSEMBLY**

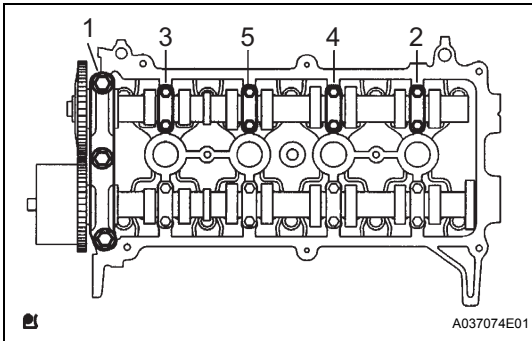
- (a) Pull the 4 fuel injector assemblies out of the fuel delivery pipe sub-assembly.

**29. REMOVE CAMSHAFT POSITION SENSOR**

- (a) Remove the bolt and the camshaft position sensor.

30. REMOVE NO. 2 CAMSHAFT**NOTICE:**

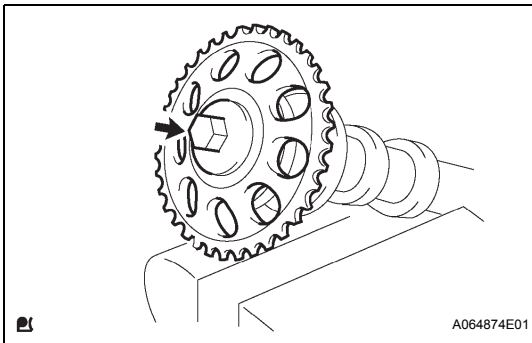
When rotating the camshaft with the timing chain removed, rotate the crankshaft counterclockwise 40° from the TDC first.



- (a) Using several steps, uniformly loosen and remove the 11 bearing cap bolts in the sequence shown in the illustration, then remove camshaft bearing cap No. 1, camshaft bearing cap No. 2 and camshaft No. 2.

NOTICE:

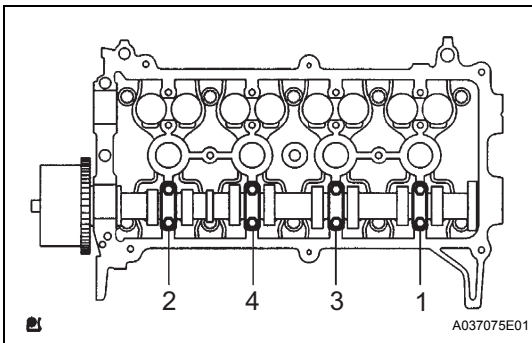
Loosen each bolt uniformly while keeping the camshaft level.

**31. REMOVE CAMSHAFT TIMING SPROCKET**

- (a) Clamp the camshaft in a vice.
(b) Remove the flange bolt and the camshaft timing sprocket.

NOTICE:

Do not damage the camshaft.

**32. REMOVE CAMSHAFT**

- (a) Using several steps, uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration, then remove camshaft bearing cap No. 2 and the camshaft.

NOTICE:

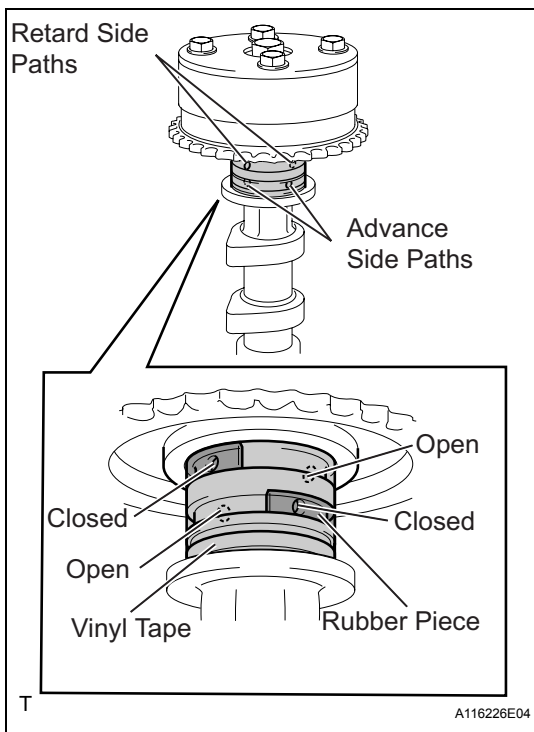
Loosen each bolt uniformly while keeping the camshaft level.

33. REMOVE CAMSHAFT TIMING GEAR ASSEMBLY

- (a) Clamp the camshaft in a vise, and confirm that it is locked.

NOTICE:

Do not damage the camshaft.

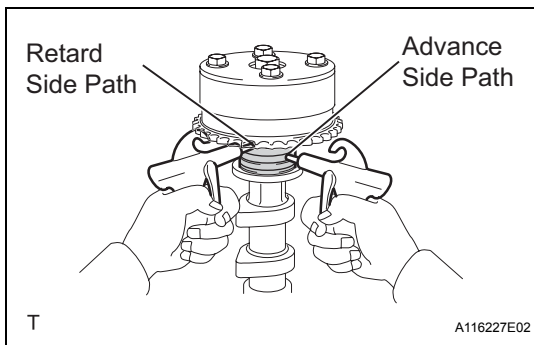


- (b) Cover the 4 oil paths of the cam journal with tape as shown in the illustration.

HINT:

One of the 2 grooves located on the cam journal is for retarding cam timing (upper) and the other is for advancing cam timing (lower). Each groove has 2 oil paths. Plug one of the oil paths for each groove with a piece of rubber before wrapping the cam journal with the tape.

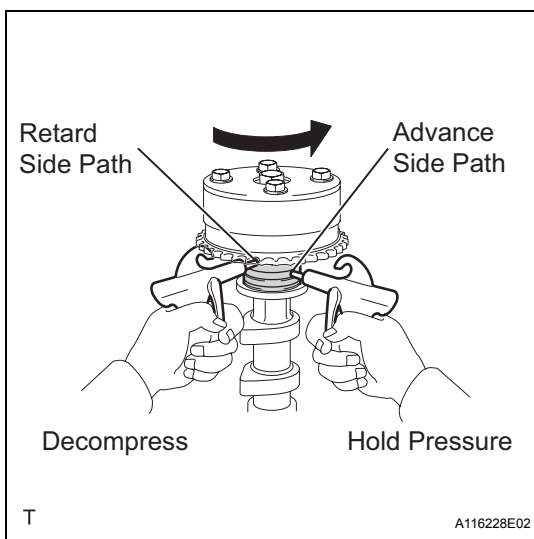
- (c) Puncture the tape covering the advance oil path and the retard oil path on the opposite side from the advance oil path.



- (d) Apply about 150 kPa (1.5 kgf*cm²) air pressure into the 2 broken paths (the advance side path and the retard side path).

NOTICE:

Cover the paths with a shop rag or piece of cloth to prevent oil splashes.



- (e) Confirm that the camshaft timing gear assembly revolves in the timing advance direction when the air pressure on the timing retard path is reduced.

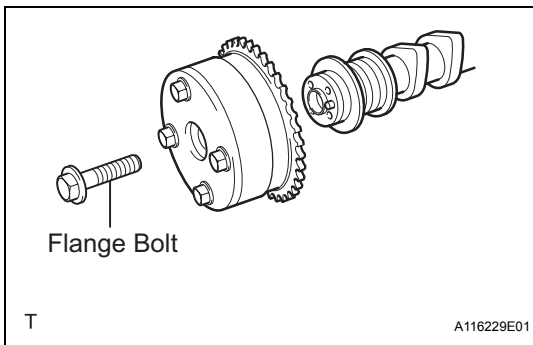
HINT:

The lock pin is released and the camshaft timing gear revolves in the advance direction.

- (f) When the camshaft timing gear reaches the most advanced position, release the air pressure on the timing retard side path, and then release the air pressure on the timing advance side path.

NOTICE:

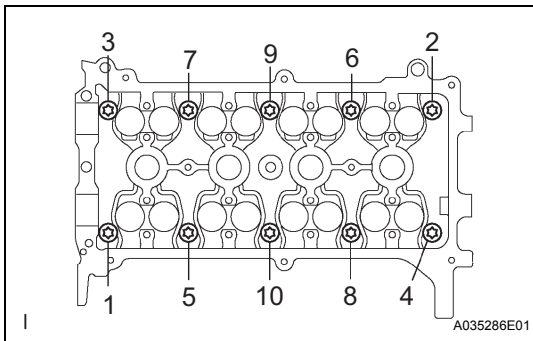
Camshaft timing gear assembly occasionally shifts to the retard side abruptly if the air pressure on the advance side path is released first. This often results in breakage of the lock pin.



- (g) Remove the flange bolt and remove the camshaft timing gear assembly.

NOTICE:

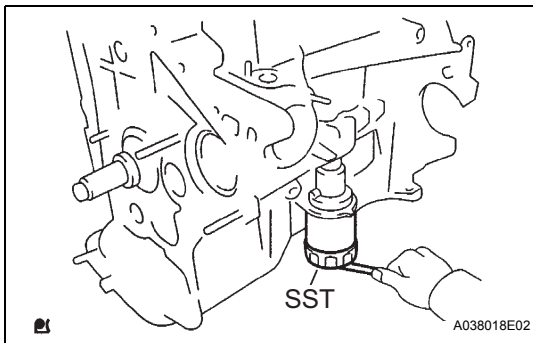
- Do not remove the other 4 bolts.
- When reusing the camshaft timing gear, unlock the lock pin inside the camshaft timing gear first.

**34. REMOVE CYLINDER HEAD SUB-ASSEMBLY**

- (a) Using several steps, uniformly loosen and remove the 10 cylinder head bolts with an 8 mm bi-hexagon wrench in the sequence shown in the illustration. Remove the 10 cylinder head bolts and the plate washers.

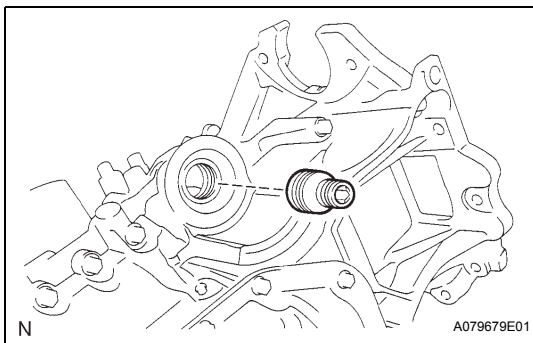
NOTICE:

- Do not drop the washers into the cylinder head.
- Head warpage or cracking could result from removing bolts in the wrong order.

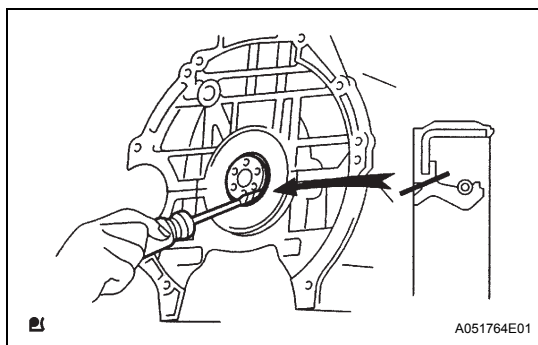
**35. REMOVE CYLINDER HEAD GASKET****36. REMOVE OIL FILTER SUB-ASSEMBLY**

- (a) Using SST, remove the oil filter.

SST 09228-06501

**37. REMOVE OIL FILTER UNION**

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

**38. REMOVE ENGINE REAR OIL SEAL**

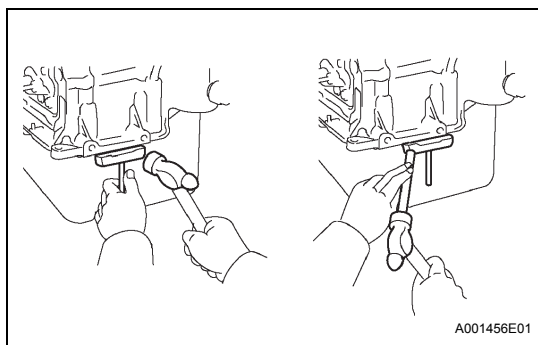
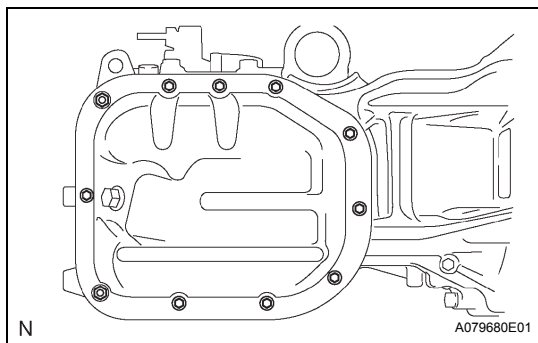
- (a) Using a knife, cut off the oil seal lip.
- (b) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.

NOTICE:

After removal, check the crankshaft for any damage. If damaged, smooth the surface with 400-grit sandpaper.

39. REMOVE OIL PAN SUB-ASSEMBLY NO. 2

- (a) Remove the oil pan drain plug and gasket.
- (b) Remove the 9 bolts and 2 nuts.



- (c) Insert the blade of SST between oil pan No. 1 and oil pan No. 2, and cut off the applied sealer and remove oil pan No. 2.

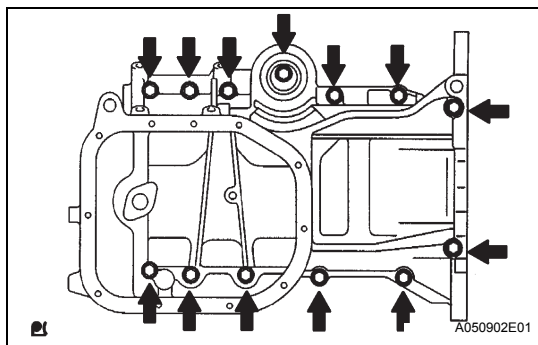
SST 09032-00100

NOTICE:

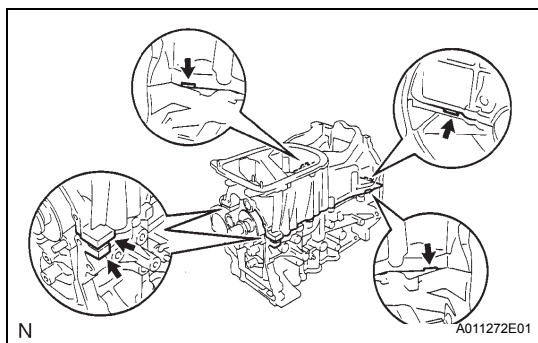
Do not damage oil pan No. 1 or oil pan No. 2.

40. REMOVE OIL STRAINER SUB-ASSEMBLY

- (a) Remove the bolt and 2 nuts.
- (b) Remove the oil strainer and the gasket.

**41. REMOVE OIL PAN SUB-ASSEMBLY**

- (a) Loosen and remove the 13 bolts uniformly in several steps.

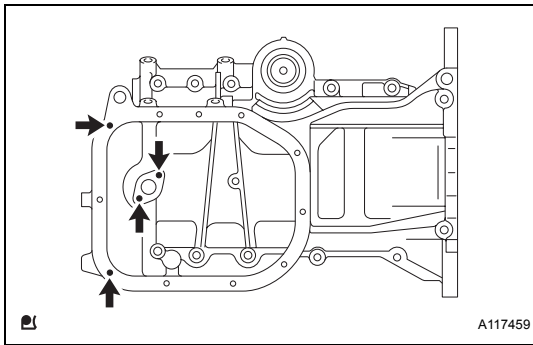


- (b) Using a screwdriver, remove oil pan No. 1 by prying between the cylinder block and oil pan No. 1.

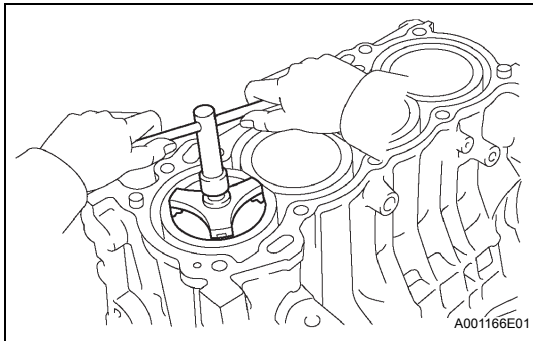
NOTICE:

Do not damage the contact surfaces of oil pan No. 1 or the cylinder block.

- (c) Remove the 2 O-rings from the cylinder block.

**42. REMOVE STUD BOLT**

- (a) Remove the 4 stud bolts.

**43. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD**

- (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 down through the top of the cylinder block to remove them.

HINT:

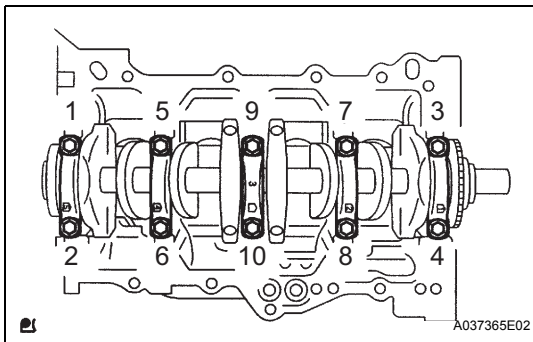
- Keep the bearing, connecting rod and cap together.
- Keep the piston and the connecting rod assemblies in the correct order so that they can be returned to their original locations when reassembled.

44. REMOVE CONNECTING ROD BEARING**45. REMOVE CRANKSHAFT**

- (a) Using several steps, loosen and remove the 10 bearing cap sub-assembly bolts uniformly with SST in the sequence shown in the illustration.

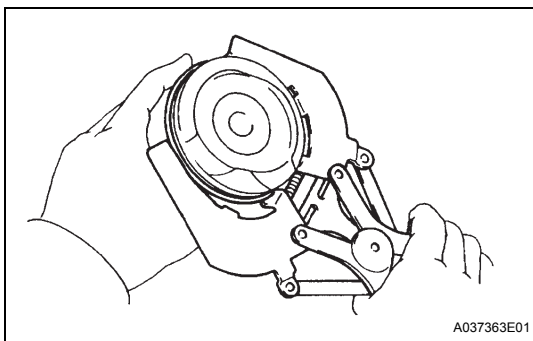
SST 09011-38121

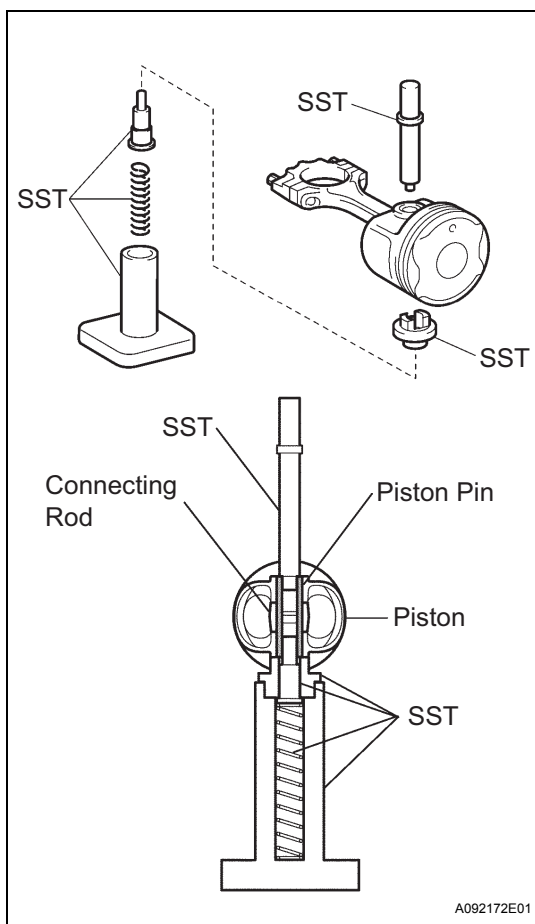
- (b) Remove the bearing cap and the crankshaft.

**46. REMOVE CRANKSHAFT BEARING****47. REMOVE CRANKSHAFT THRUST WASHER UPPER****48. REMOVE PISTON RING SET****NOTICE:**

Keep the piston rings in the correct combination and correct order so that they can be returned to their original locations when reassembled.

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



**49. REMOVE WITH PIN PISTON SUB-ASSEMBLY**

- (a) Using SST, press the piston pin out of the piston.
SST 09221-25026 (09221-00021, 09221-00030, 09221-00090, 09221-00150, 09221-00100)

NOTICE:

Keep the pistons, pins, rings, connecting rods and bearings in the correct order so that they can be returned to their original locations when reassembled.

50. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY**51. REMOVE STUD BOLT**

- (a) Using "Torx" socket wrench E5, remove the 7 stud bolts.

52. REMOVE RING PIN**53. REMOVE STRAIGHT PIN**

INSPECTION

1. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

(a) Check the lock of camshaft timing gear.

- (1) Clamp the camshaft in a vice, and check that the camshaft timing gear is locked.

NOTICE:

Do not damage the camshaft.

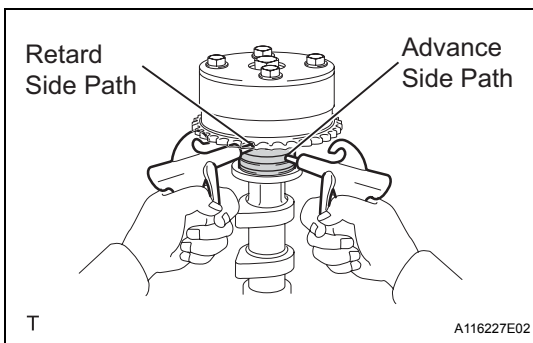
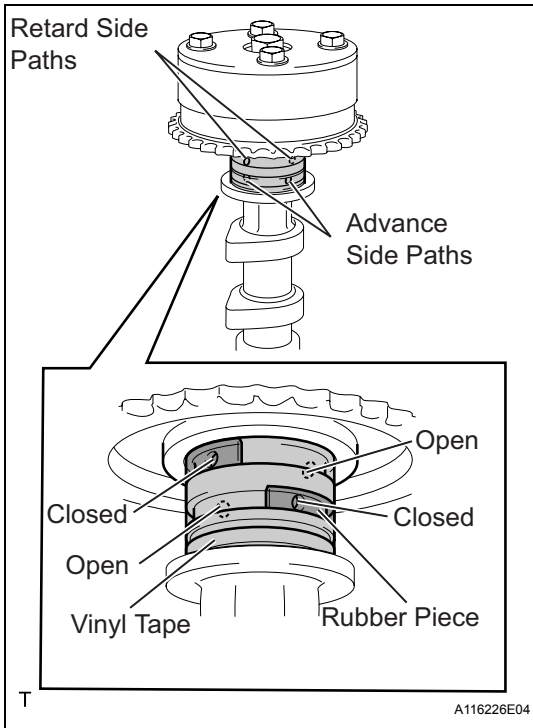
(b) Release the lock pin.

- (1) Cover the 4 oil paths of the cam journal with tape as shown in the illustration.

HINT:

One of the 2 grooves located on the cam journal is for retarding cam timing (upper) and the other is for advancing cam timing (lower). Each groove has 2 oil paths. Plug one of the oil paths for each groove with a piece of rubber before wrapping the cam journal with the tape.

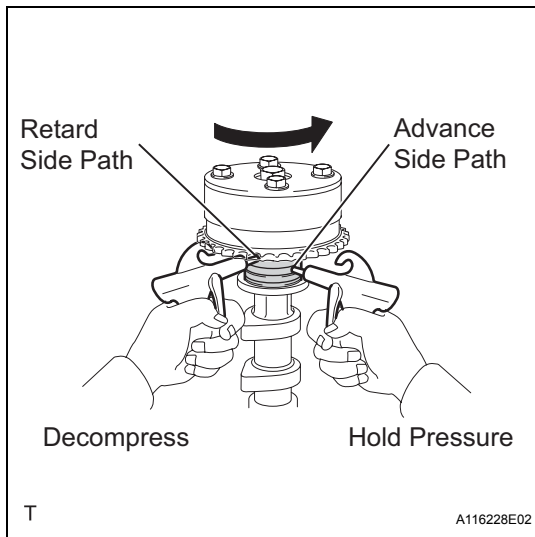
- (2) Puncture the tape covering the advance oil path and the retard oil path on the opposite side from the advance oil path.



- (3) Apply air at about 150 kPa (1.5 kgf*cm²) pressure into the 2 broken paths (the advance side path and the retard side path).

NOTICE:

Cover the paths with a shop rag or piece of cloth to prevent oil splashes.



- (4) Confirm that the camshaft timing gear assembly revolves in the timing advance direction when the air pressure on the timing retard path is reduced.

HINT:

The lock pin is released and the camshaft timing gear revolves in the advance direction.

- (5) When the camshaft timing gear reaches the most advanced position, release the air pressure on the timing retard side path, and then release the air pressure on the timing advance side path.

NOTICE:

Camshaft timing gear assembly occasionally shifts to the retard side abruptly if the air pressure on the advance side path is released first. This often results in breakage of the lock pin.

- (c) Check that the revolution is smooth.
 - (1) Rotate the valve timing assembly back and forth several times, except where the lock pin meets it at the most retarded angle. Check the movable range and that it rotates smoothly.

Standard:

Smooth movable range is about 22.5°

NOTICE:

Perform this check by hand, instead of using air pressure.

- (d) Check that the gear locks in the most retarded position.
 - (1) Confirm that the camshaft timing gear assembly is locked in the most retarded position.

2. INSPECT CHAIN SUB-ASSEMBLY

- (a) Using a spring scale, apply 140 N (14.3 kgf, 31.5 lb) to the timing chain and measure its length.

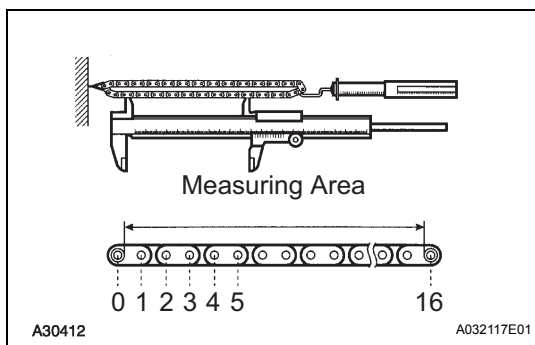
Maximum chain elongation:

123.2 mm (4.850 in.)

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

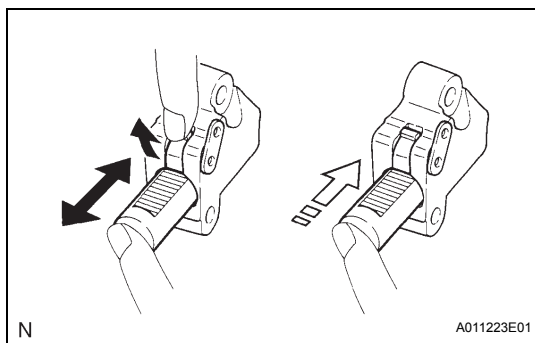
HINT:

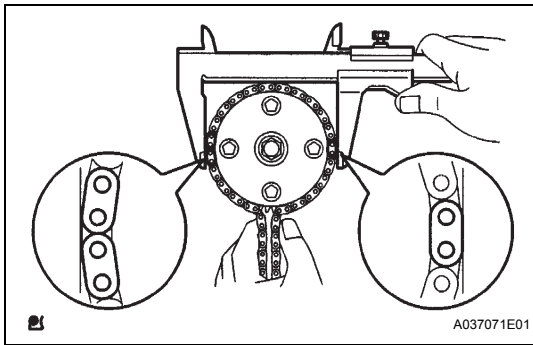
Perform the same measurement at 3 or more random places and calculate the average length.



3. INSPECT CHAIN TENSIONER ASSEMBLY NO. 1

- (a) Check that the plunger moves smoothly when the ratchet pawl is raised with your finger.
- (b) Release the ratchet pawl and check that the plunger is locked in place by the ratchet pawl and does not move when pushed with your finger.





4. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

- Wrap the chain around the timing sprocket.
- Using vernier calipers, measure the diameter of the timing gear with the chain.

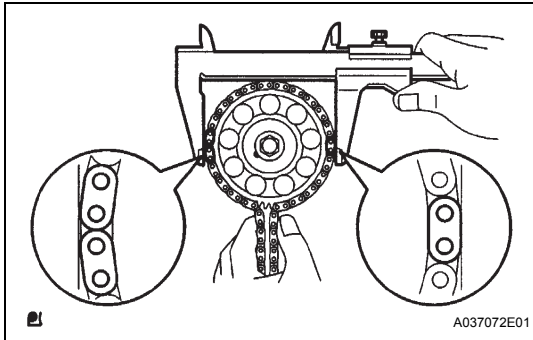
Minimum gear diameter (with chain):

96.2 mm (3.787 in.)

If the diameter is less than the minimum, replace the camshaft timing gear.

NOTICE:

Make sure that the vernier calipers are in contact with the chain link when measuring.



5. INSPECT CAMSHAFT TIMING SPROCKET

- Wrap the chain around the timing sprocket.
- Using vernier calipers, measure the diameter of the timing gear with the chain.

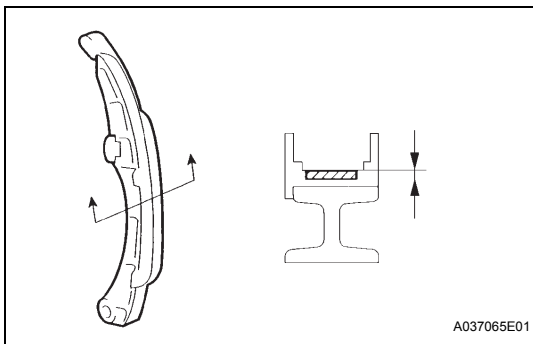
Minimum gear diameter (with chain):

96.2 mm (3.787 in.)

If the diameter is less than the minimum, replace the camshaft timing sprocket.

NOTICE:

Make sure that the vernier calipers are in contact with the chain link when measuring.



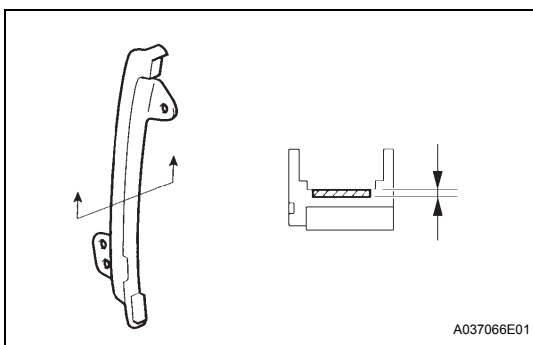
6. INSPECT CHAIN TENSIONER SLIPPER

- Check the chain tensioner slipper.

Minimum thickness:

1.0 mm (0.039 in.)

If the thickness is less than the minimum, replace the chain tensioner slipper.



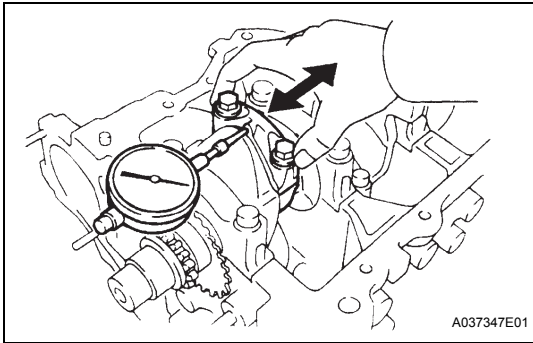
7. INSPECT CHAIN VIBRATION DAMPER NO. 1

- Check the vibration damper.

Minimum thickness:

1.0 mm (0.039 in.)

If the thickness is less than the minimum, replace the chain vibration damper.



8. INSPECT CONNECTING ROD THRUST CLEARANCE

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

Standard thrust clearance:

0.16 to 0.36 mm (0.0063 to 0.0142 in.)

Maximum thrust clearance:

0.36 mm (0.0142 in.)

9. INSPECT CONNECTING ROD OIL CLEARANCE

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

- (b) Using SST, remove the 2 connecting rod cap bolts.

SST 09205-16010

- (c) Clean the crank pin and bearing.

- (d) Check the crank pin and bearing for pitting and scratches.

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

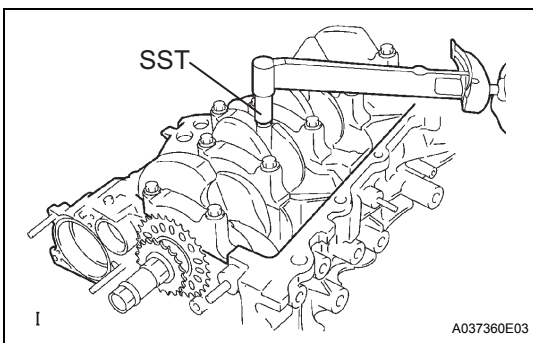
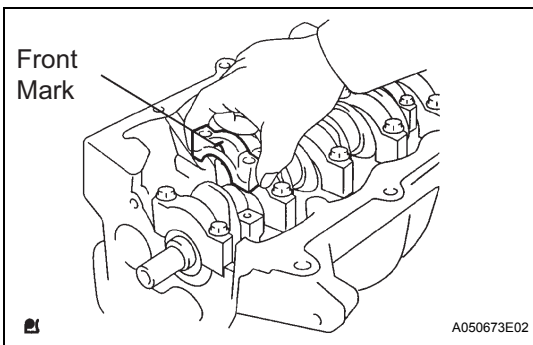
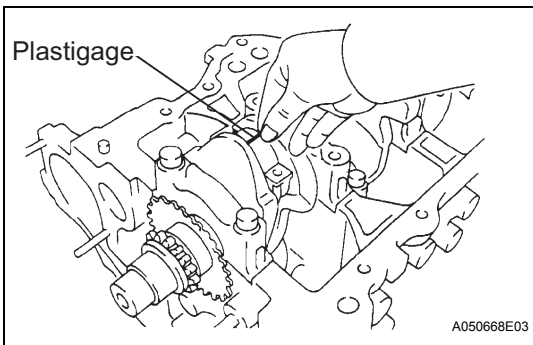
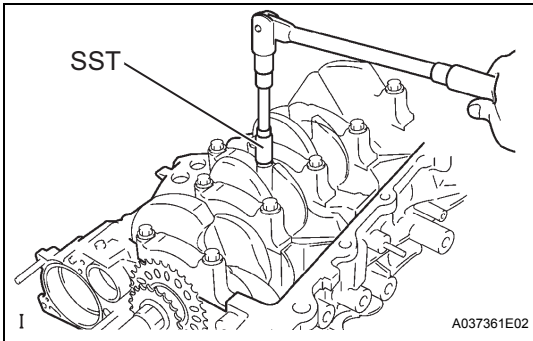
- (f) Make sure that the connecting rod and its cap are in the correct combination and that the front mark of the cap is facing in the correct mounting orientation, then install the cap onto the connecting rod.

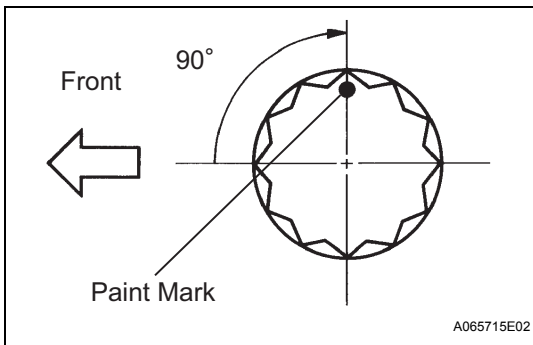
- (g) Apply a light coat of engine oil to the threads of the connecting rod cap bolts.

- (h) Using SST, tighten the bolts in several steps to the specified torque.

SST 09205-16010

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

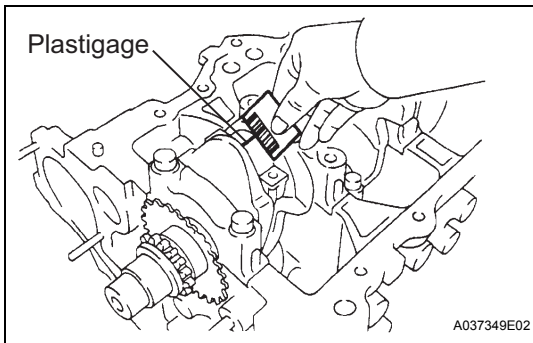




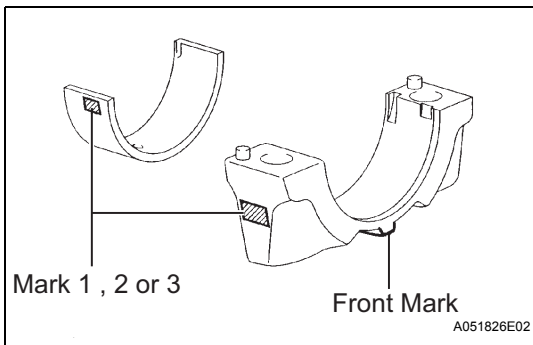
- (i) Mark the front of the connecting cap bolts with paint.
- (j) Retighten the cap bolts by 90° as shown in the illustration.

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

- (k) Remove the 2 bolts, connecting rod cap and lower bearing.



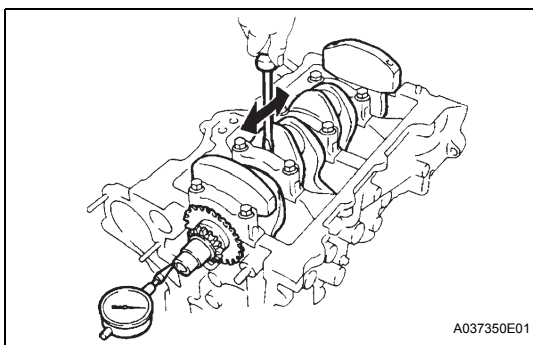
- (l) Measure the Plastigage at its widest point.

Standard oil clearance:**0.012 to 0.038 mm (0.00047 to 0.00015 in.)****Maximum oil clearance:****0.058 mm (0.0028in.)****NOTICE:****Completely remove the Plastigage after the measurement.**

- (m) When replacing a bearing, replace it with one with the same number as marked on the connecting rod. There are 3 sizes of standard bearings, marked 1, 2 and 3 accordingly.

Standard bearing center wall thickness

Mark	mm (in.)
1	1.491 to 1.494 (0.0587 to 0.0588)
2	1.494 to 1.497 (0.0588 to 0.0589)
3	1.497 to 1.500 (0.0589 to 0.0591)

**10. INSPECT CRANKSHAFT THRUST CLEARANCE**

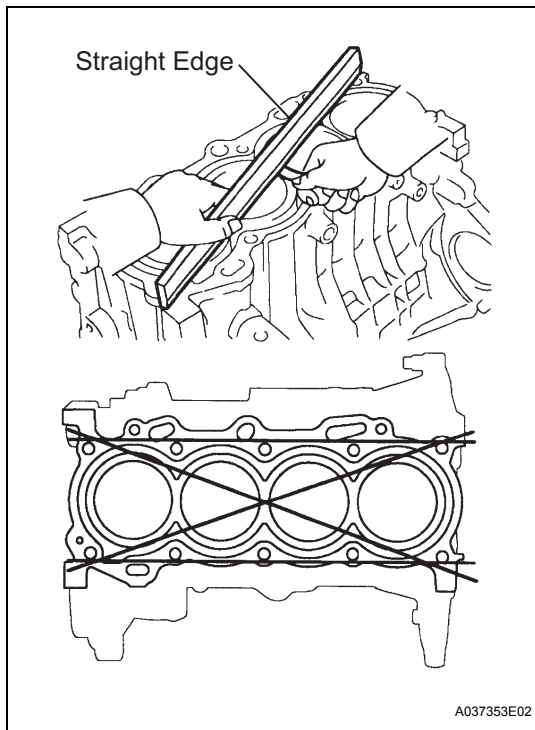
- (a) Using a dial indicator, measure the thrust clearance while moving the crankshaft back and forth with a screwdriver.

Standard thrust clearance:**0.09 to 0.19 mm (0.0035 to 0.0075 in.)****Maximum thrust clearance:****0.30 mm (0.0118 in.)**

If the thrust clearance is greater than the maximum, replace the thrust washers as a set. Check the crankshaft and block for wear. Repair or replace the parts if necessary.

HINT:

Thrust washer thickness: 2.43 to 2.48 mm (0.0957 to 0.0976 in.)

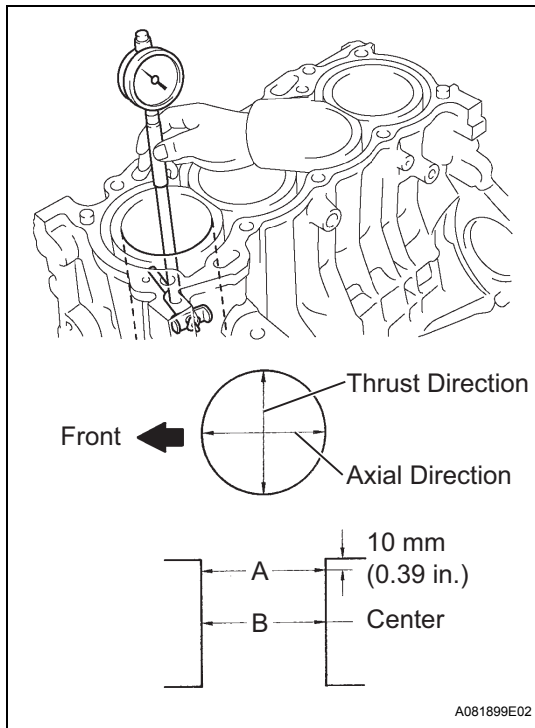


11. INSPECT CYLINDER BLOCK FOR WARPAGE

- (a) Using a precision straight edge and feeler gauge, measure the warpage of the surface which is in contact with the cylinder head gasket.

Maximum warpage:

0.05 mm (0.0020 in.)



12. INSPECT CYLINDER BORE

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

Standard Inside diameter:

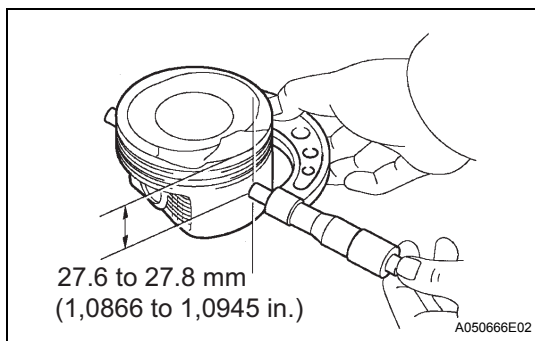
75.000 to 75.013 mm (2.9528 to 2.9533 in.)

- (b) Calculate the difference between the maximum diameter and the minimum diameter of the 4 measured values.

Difference limit:

0.10 mm (0.0039 in.)

If the difference is greater than the limit, replace the cylinder block.

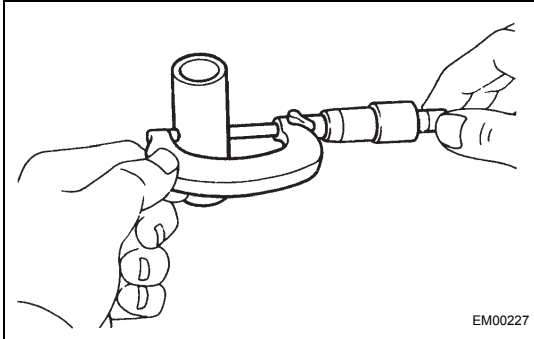


13. INSPECT WITH PIN PISTON SUB-ASSEMBLY

- (a) Using a micrometer, measure the piston diameter at a right angle to the piston pin center line, and at the position 27.6 to 27.8 mm (1.0866 to 1.0945 in.) from the top of the piston head.

Piston diameter:

74.935 to 74.945 mm (2.9502 to 2.9506 in.)



- (b) Using a caliper gauge, measure the piston pin hole diameter.

Piston pin hole diameter:

18.013 to 18.016 mm (0.7092 to 0.7093 in.) at 20°C (68°F)

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

Piston pin diameter:

18.001 to 18.004 mm (0.7087 to 0.7088 in.)

- (d) Subtract the piston pin diameter measurement from the piston pin hole diameter measurement to calculate the oil clearance.

Standard oil clearance:

0.009 to 0.015 mm (0.0004 to 0.0006 in.)

Maximum oil clearance:

0.050 mm (0.0020 in.)

If necessary, replace the piston and piston pin together.

EM

14. INSPECT PISTON CLEARANCE

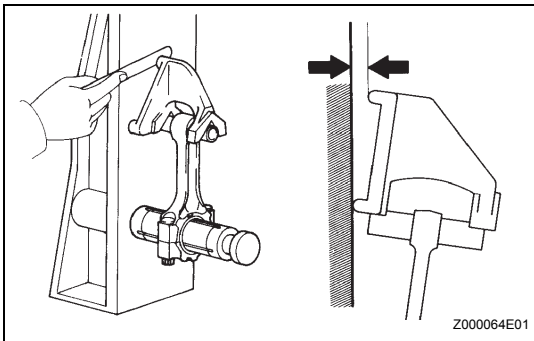
- (a) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:

0.045 to 0.068 mm (0.0018 to 0.0027 in.)

Maximum oil clearance:

0.08 mm (0.0032 in.)



15. INSPECT CONNECTING ROD SUB-ASSEMBLY

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

- (1) Check for misalignment.

Maximum misalignment:

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

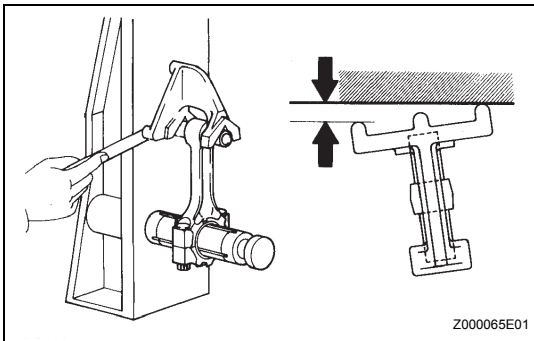
If the misalignment is greater than the maximum, replace the connecting rod assembly.

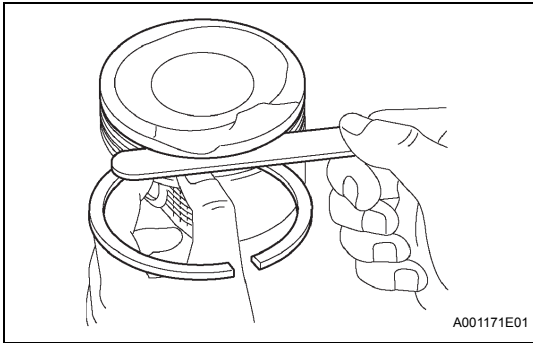
- (2) Check for twist.

Maximum twist:

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

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





16. INSPECT RING GROOVE CLEARANCE

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

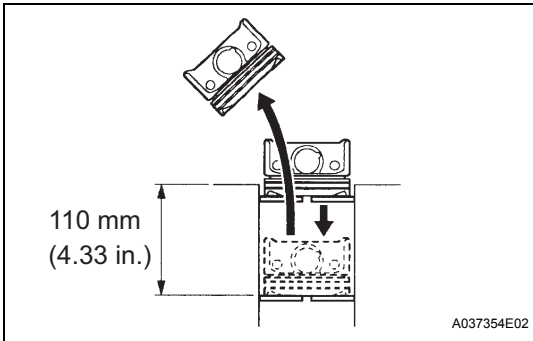
Ring groove clearance:

No. 1:

0.03 to 0.07 mm (0.0012 to 0.0028 in.)

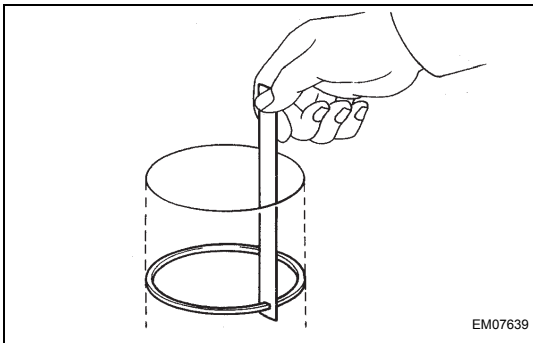
No. 2:

0.02 to 0.06 mm (0.0008 to 0.0024 in.)



17. INSPECT PISTON RING END GAP

- (a) Using a piston, push the piston ring, a little beyond the bottom of the ring travel, 110 mm (4.33 in.) from the top of the cylinder block.



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

Standard end gap:

No. 1:

0.25 to 0.35 mm (0.0098 to 0.0138 in.)

No. 2:

0.35 to 0.50 mm (0.0138 to 0.0197 in.)

Oil (Side Rail):

0.10 to 0.35 mm (0.0039 to 0.0138 in.)

Maximum end gap:

No. 1:

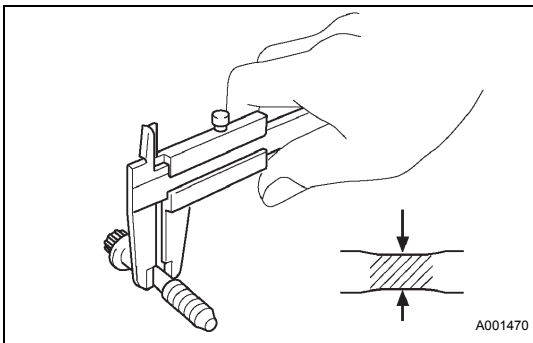
0.91 mm (0.0358 in.)

No. 2:

1.06 mm (0.0417 in.)

Oil (Side Rail):

0.82 mm (0.323 in.)



18. INSPECT CONNECTING ROD BOLT

- (a) Using vernier calipers, measure the diameter of the bolt at the elongated portion.

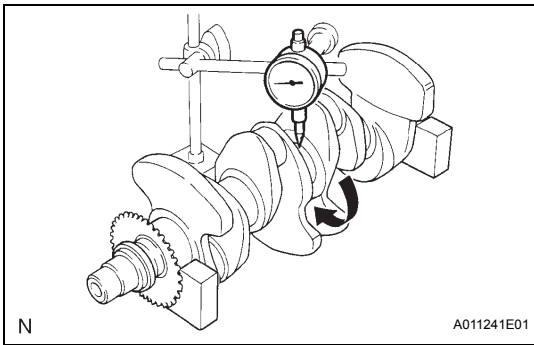
Standard diameter:

6.6 to 6.7 mm (0.260 to 0.264 in.)

Minimum diameter:

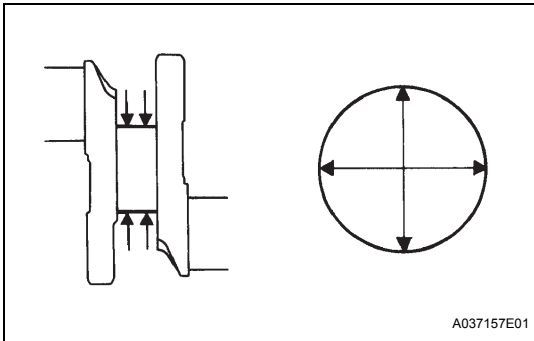
6.4 mm (0.252 in.)

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

**19. INSPECT CRANKSHAFT**

- (a) Using a dial indicator and V-blocks, measure the circle runout as shown in the illustration.

Maximum circle runout:
0.03 mm (0.0012 in.)

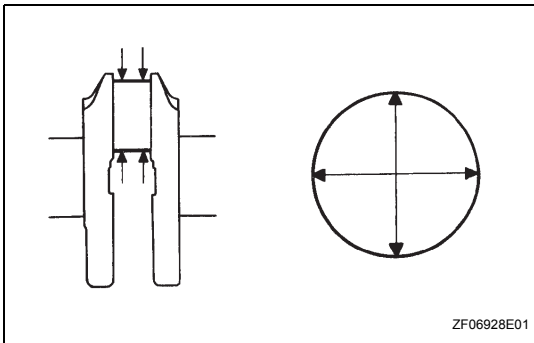


- (b) Using a micrometer, measure the diameter of each main journal.

Outside diameter:
45.988 to 46.000 mm (1.8106 to 1.8110 in.)

- (c) Check each main journal for taper and out-of-roundness as shown.

Maximum taper and out-of-roundness:
0.02 mm (0.0008 in.)

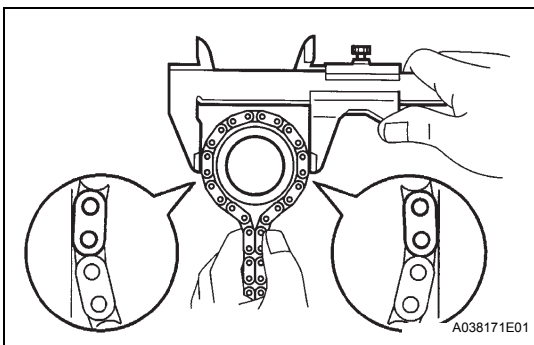


- (d) Using a micrometer, measure the diameter of each crank pin.

Outside diameter:
39.992 to 40.000 mm (1.5745 to 1.5748 in.)

- (e) Check each crank pin for taper and out-of-roundness as shown.

Maximum taper and out-of-roundness:
0.02 mm (0.0008 in.)



- (f) Wrap the chain around the timing sprocket.

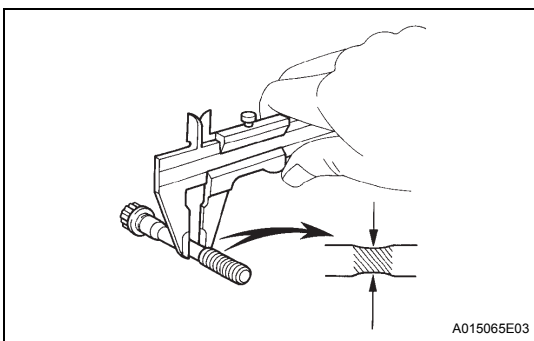
- (g) Using vernier calipers, measure the timing sprocket diameter with the chain.

Standard sprocket diameter (with chain):
51.72 mm (2.0362 in.)

Minimum sprocket diameter (with chain):
50.5 mm (1.988 in.)

NOTICE:

Make sure that the vernier calipers are in contact with the chain rollers when measuring.

**20. INSPECT CRANKSHAFT BEARING CAP SET BOLT**

- (a) Using vernier calipers, measure the tension portion diameter of the elongated portion.

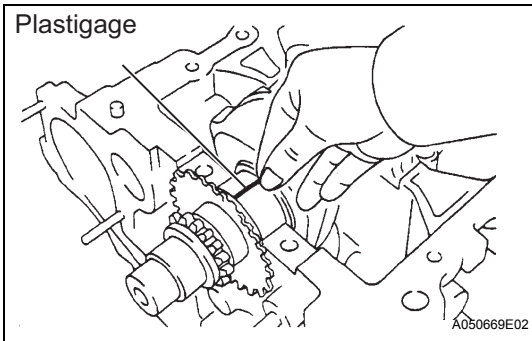
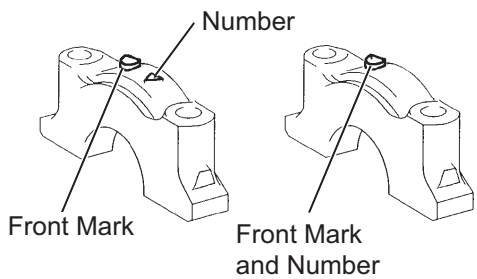
Standard diameter:
7.3 to 7.5 mm (0.287 to 0.295 in.)

Minimum diameter:
7.2 mm (0.283 in.)

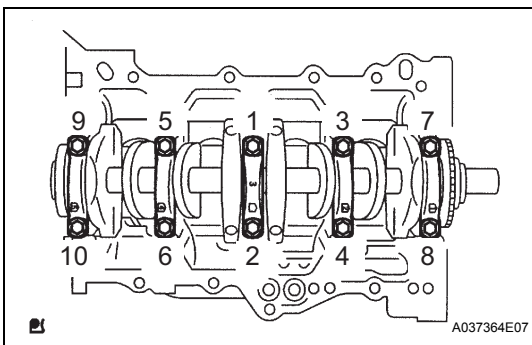
If the diameter is less than the minimum, replace the bolt.

21. INSPECT CRANKSHAFT OIL CLEARANCE

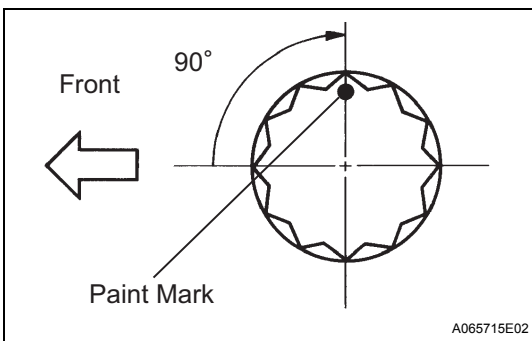
- (a) Clean each main journal and bearing.
- (b) Install the bearing onto the cylinder block and bearing cap. (See page [EM-183](#))
- (c) Place the crankshaft onto the cylinder block.
- (d) Lay a strip of Plastigage across each journal.

**Bearing Cap No. 3:****Bearing Cap No. 1, 2, 4, 5:**

- (e) Examine the front marks and numbers and install the bearing cap onto the cylinder block.
- (f) Apply a light coat of engine oil to the threads of the bearing cap bolts.



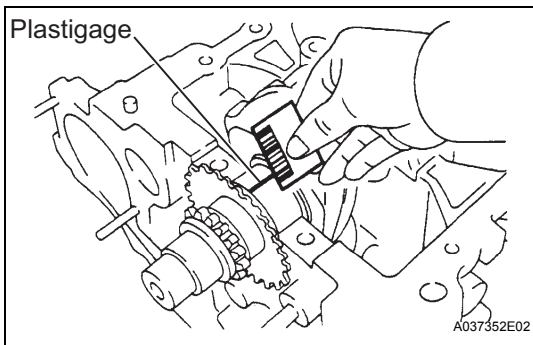
- (g) Using SST, tighten the bolts in several steps to the specified torque in the sequence shown in the illustration. (*1)

SST 09011-38121**Torque: 22 N*m (224 kgf*cm, 16 ft.*lbf)**

- (h) Mark the front of the bearing cap bolts with paint.
- (i) Retighten the bearing cap bolts by 90° in the same sequence as step (*1).
- (j) Check that the painted mark is now at a 90° angle from the front.

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

- (k) Remove the bearing cap sub-assembly.



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

Standard oil clearance:

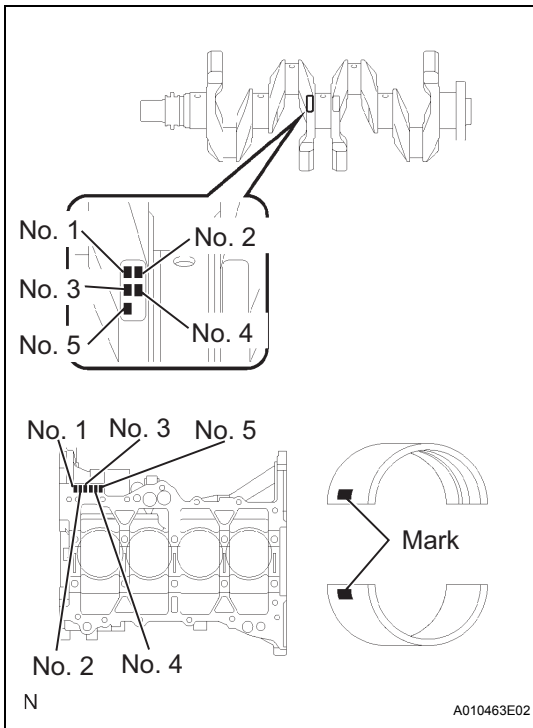
0.01 to 0.023 mm (0.0004 to 0.0009 in.)

Maximum oil clearance:

0.07 mm (0.0028 in.)

NOTICE:

Completely remove the Plastigage after the measurement.



- (m) When replacing a standard bearing, replace it with one with the same number. If the number of the bearing cannot be found, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then select the bearing with the same number as the total. There are 4 sizes of standard bearings, marked 1, 2, 3 and 4 accordingly.

EXAMPLE: Cylinder Block 4 (A) + Crankshaft 3 (B) = Total 7 (Use Bearing 3)

Cylinder Block (A) + Crankshaft (B)	0 to 2	3 to 5	6 to 8	9 to 11
Use Bearing	1	2	3	4

Item	Mark	mm (in.)
Cylinder block main journal bore diameter (A)	0	50.000 to 50.003 (1.96850 to 1.96862)
	1	50.003 to 50.005 (1.96862 to 1.96870)
	2	50.005 to 50.007 (1.96870 to 1.96878)
	3	50.007 to 50.010 (1.96878 to 1.96890)
	4	50.010 to 50.012 (1.96890 to 1.96898)
	5	50.012 to 50.014 (1.96898 to 1.96906)
	6	50.014 to 50.016 (1.96906 to 1.96913)
Crankshaft main journal diameter (B)	0	45.998 to 46.000 (1.81094 to 1.81102)
	1	45.996 to 45.998 (1.81087 to 1.81094)
	2	45.994 to 45.996 (1.81079 to 1.81087)
	3	45.992 to 45.994 (1.81071 to 1.81079)
	4	45.990 to 45.992 (1.81063 to 1.81071)
	5	45.988 to 45.990 (1.81055 to 1.81063)
Standard bearing center wall thickness	1	1.992 to 1.995 (0.07843 to 0.07854)
	2	1.995 to 1.998 (0.07854 to 0.07866)
	3	1.998 to 2.001 (0.07866 to 0.07878)
	4	2.001 to 2.004 (0.07878 to 0.07890)

REASSEMBLY

1. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

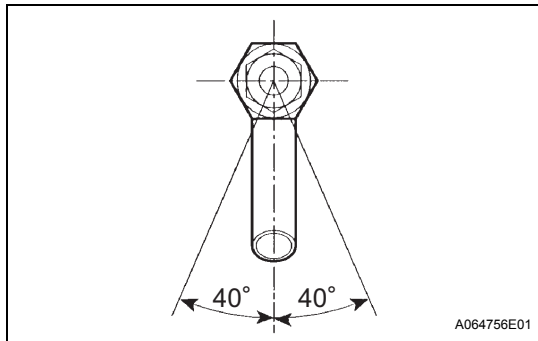
- (a) Apply adhesive to the end 2 or 3 threads of the drain union and install the water drain cock within 3 minutes of applying the adhesive.

- (b) After applying the specified torque, rotate the drain union clockwise until its drain port faces downward.

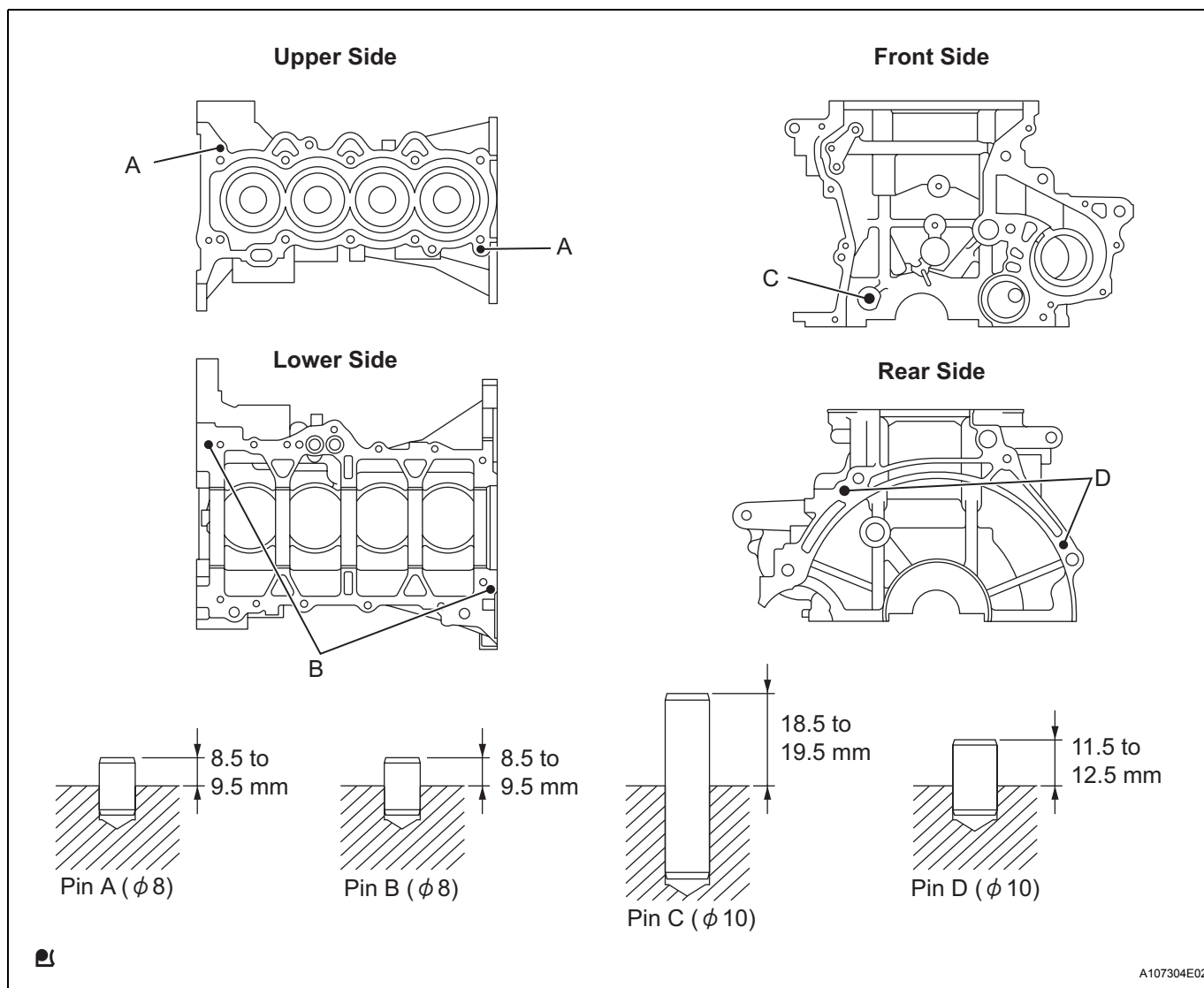
Torque: 35 N*m (357 kgf*cm, 26 ft.*lbf)

NOTICE:

- Do not add coolant within 1 hour of installation.
- Do not rotate the drain union more than 360° in step (b), and never loosen it after setting the union correctly.



2. INSTALL STRAIGHT PIN



- (a) Using a plastic-faced hammer, tap in the straight pin.

Standard protrusion:

Pin A:

8.5 to 9.5 mm (0.335 to 0.374 in.)

Pin B:

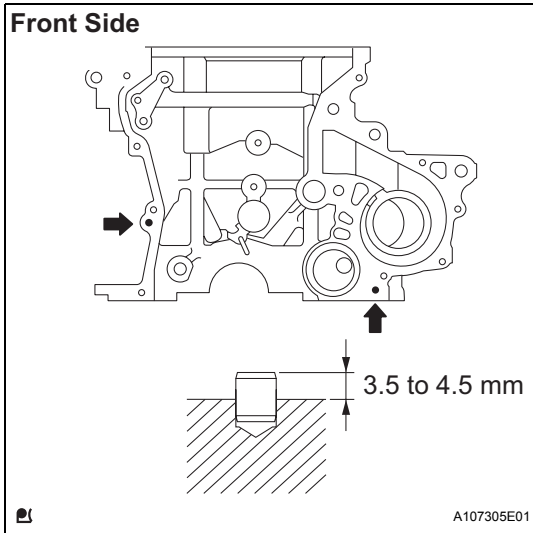
8.5 to 9.5 mm (0.335 to 0.374 in.)

Pin C:

18.5 to 19.5 mm (0.728 to 0.768 in.)

Pin D:

11.5 to 12.5 mm (0.453 to 0.492 in.)



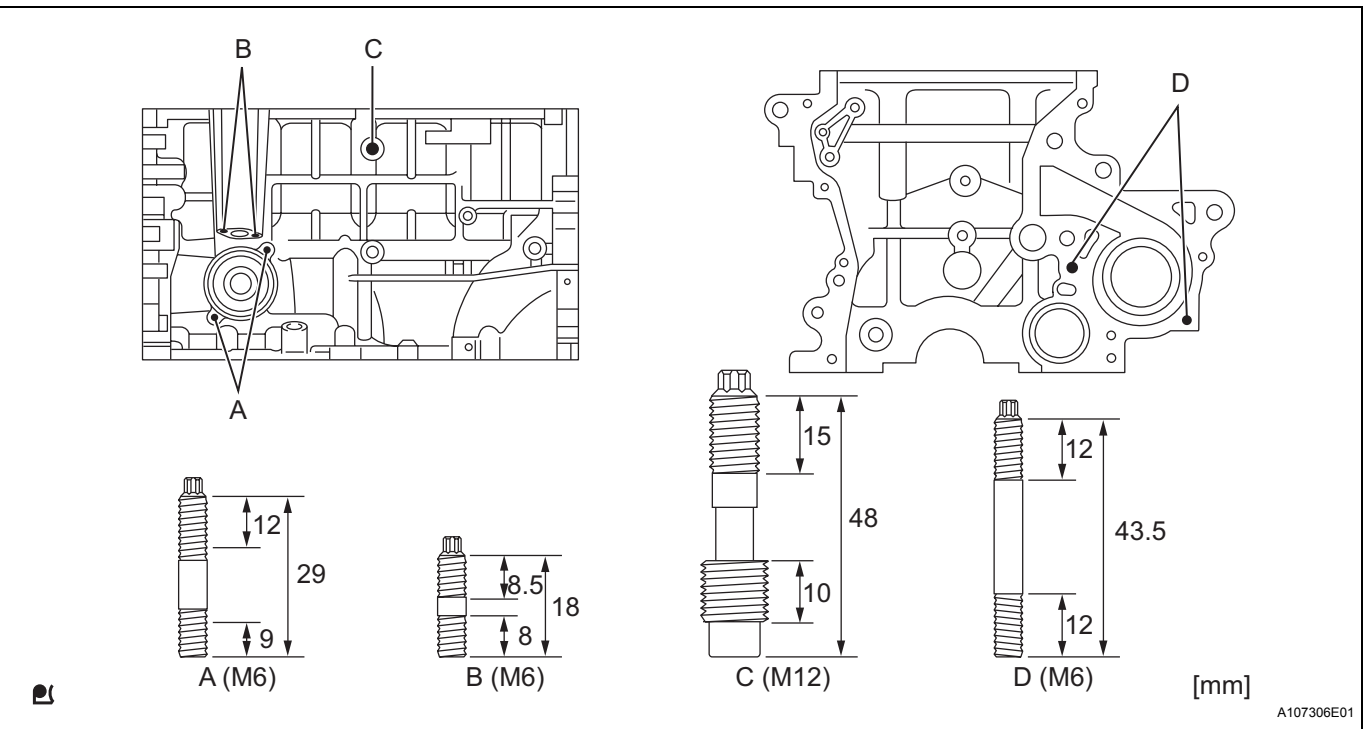
3. INSTALL OIL PUMP SET RING PIN

- (a) Using a plastic-faced hammer, tap in a new ring pin.

Standard protrusion:

3.5 to 4.5 mm (0.138 to 0.177 in.)

4. INSTALL STUD BOLT



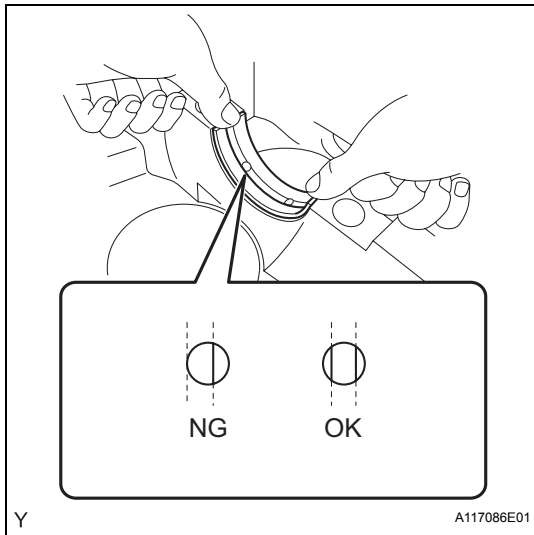
- (a) Using "Torx" socket wrench E5, install the 7 stud bolts.

Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf) (for Stud bolt A, B and D)

11 N*m (112 kgf*cm, 8.1 ft.*lbf) (for Stud bolt C)

NOTICE:

The lower threads of the bolt are installed into the cylinder block.

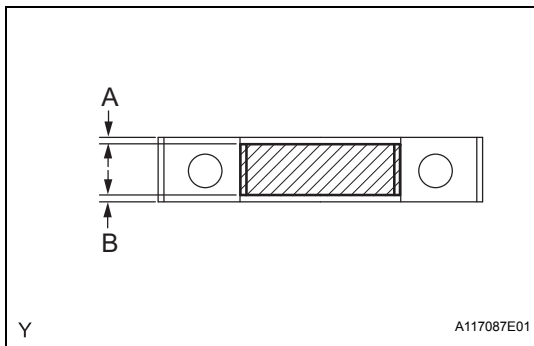


5. INSTALL CRANKSHAFT BEARING

- (a) Align the crankshaft bearing (upper) with the oil hole of the cylinder block and install the bearing.

NOTICE:

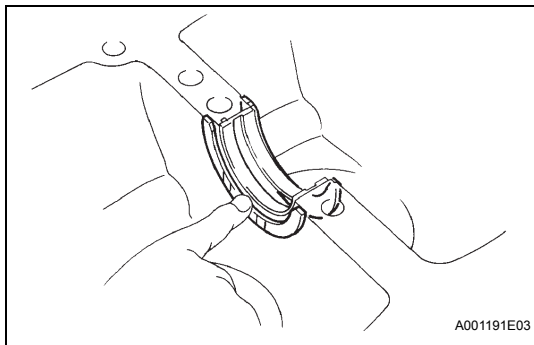
Do not apply engine oil to the bearing or its contact surface.



- (b) Align the crankshaft bearing (lower) with the bearing cap and install the crankshaft bearing cap.

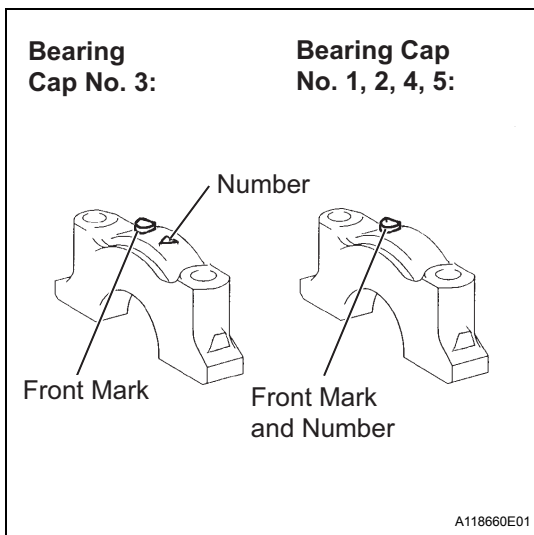
NOTICE:

- Install the bearing cap so that the gap between A and B is less than 0.7 mm (0.028 in.).
- Do not apply engine oil to the bearing or its contact surface.



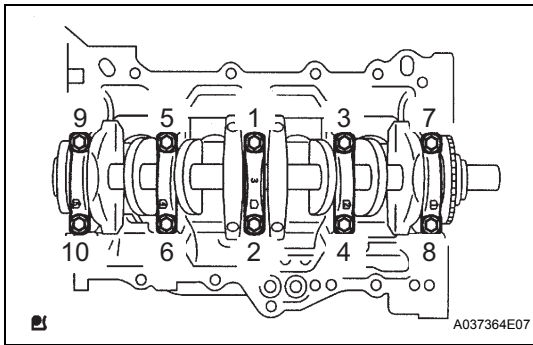
6. INSTALL CRANKSHAFT THRUST WASHER UPPER

- (a) Install the 2 thrust washers onto the No. 3 journal position of the cylinder block with the oil grooves facing outward.
- (b) Apply engine oil to the upper bearing and install the crankshaft onto the cylinder block.



7. INSTALL CRANKSHAFT

- (a) Examine the front marks and numbers and install the bearing caps onto the cylinder block.
- (b) Apply a light coat of engine oil to the threads of the bearing cap bolts.



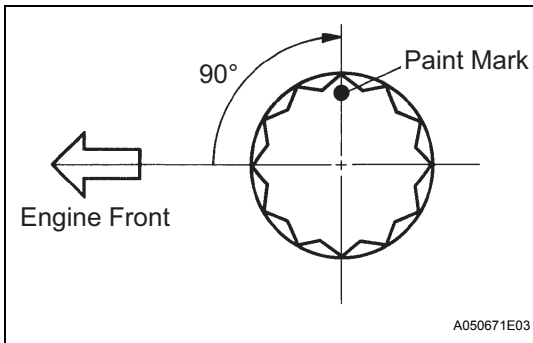
- (c) Using SST, tighten the bolts in several steps to the specified torque in the sequence shown in the illustration (*1).

SST 09011-38121

Torque: 22 N*m (224 kgf*cm, 16 ft.*lbf)

NOTICE:

Check that the crankshaft turns smoothly.



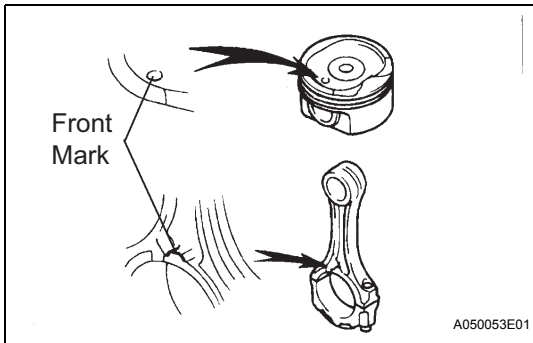
- (d) Mark the front of the bearing cap bolts with paint.
 (e) Retighten the bearing cap bolts by 90° in the same sequence as step (*1).
 (f) Check that the painted mark is now at a 90° angle from the front.

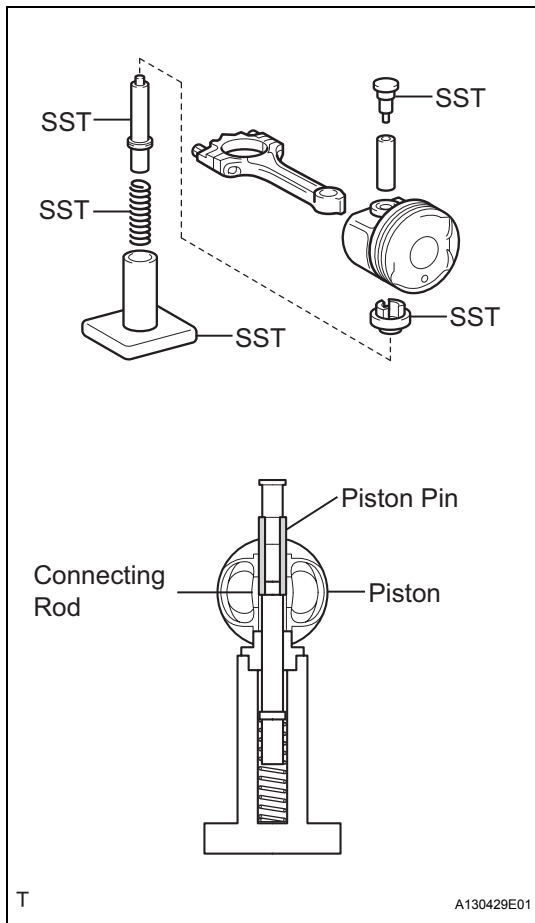
8. INSPECT CRANKSHAFT THRUST CLEARANCE (See page [EM-174](#))

9. INSPECT CRANKSHAFT OIL CLEARANCE (See page [EM-179](#))

10. INSTALL WITH PIN PISTON SUB-ASSEMBLY

- (a) Coat the piston pin and pin holes in the piston with engine oil.
 (b) Align the cavity of the piston with the protruding portion on the connecting rod.



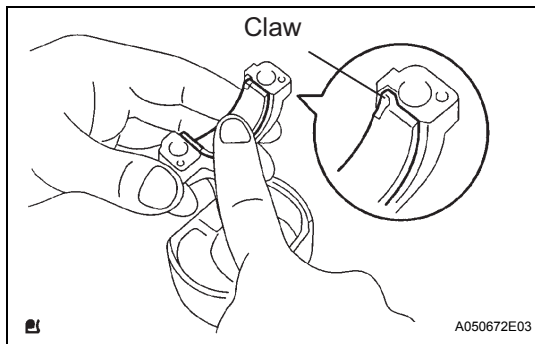


- (c) Using SST, press in the piston pin.

SST 09221-25026 (09221-00021, 09221-00030, 09221-00090, 09221-00150, 09221-00100)

NOTICE:

Keep the pistons, pins, rings, connecting rods and bearings in the correct order so that they can be returned to the original locations when reassembled.

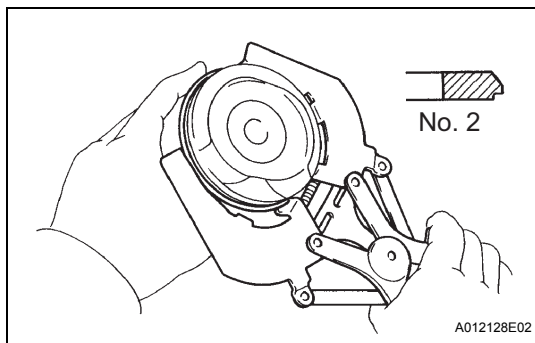


11. INSTALL CONNECTING ROD BEARING

- (a) Align the bearing claw with the groove of the connecting rod or connecting cap.

NOTICE:

Clean the back side of the bearing and the bearing surface of the connecting rod and keep them free of oil.

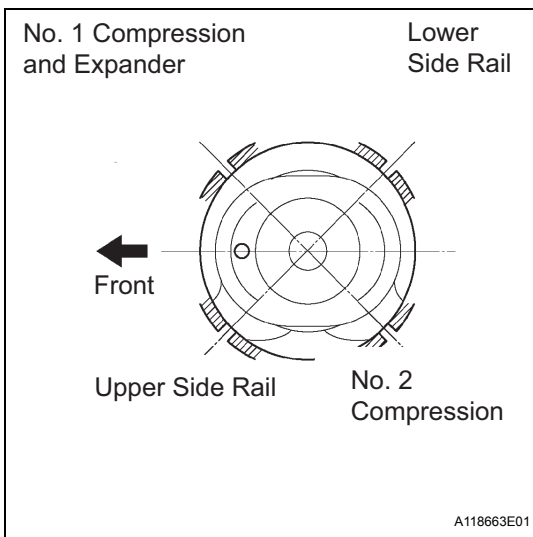


12. INSTALL PISTON RING SET

HINT:

When reusing the piston rings, install them onto the matched pistons with the surfaces facing correctly.

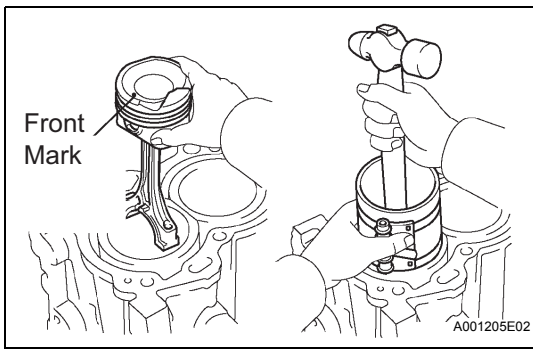
- (a) Install the oil ring expander and 2 side rails by hand.
(b) Using a piston ring expander, install the 2 compression rings.



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

13. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD

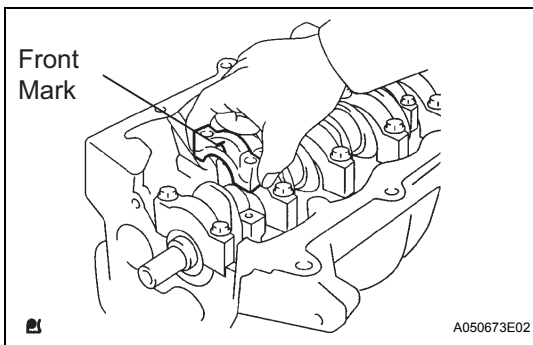
- (a) Apply engine oil to the cylinder walls, the pistons, and the surfaces of the connecting rod bearings.
- (b) Check the position of the piston ring ends.



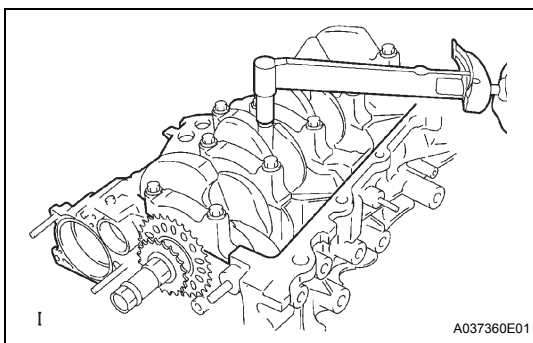
- (c) Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark on the piston facing forward.

NOTICE:

- Clean the back side of the bearing and the bearing surface of the connecting rod cap and keep them free of oil.
- Match the numbered connecting rod cap with the connecting rod.



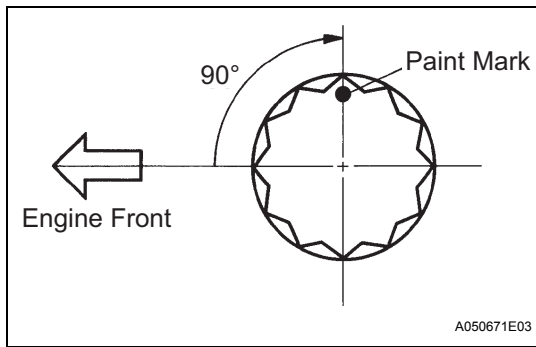
- (d) Make sure that the connecting rod and its cap are in the correct combination and that the front mark of the cap is facing in the correct mounting orientation, then install the cap onto the connecting rod.
- (e) Apply a light coat of engine oil to the threads of the connecting rod cap bolts.



- (f) Using SST, tighten the bolts in several steps to the specified torque.

SST 09205-16010

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



- (g) Mark the front of the connecting cap bolts with paint.
- (h) Retighten the cap bolts by 90° as shown.
- (i) Check that the crankshaft turns smoothly.

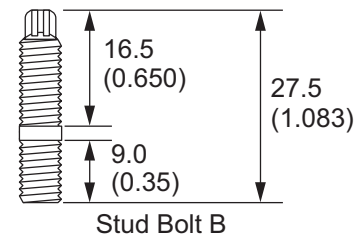
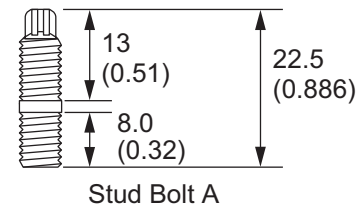
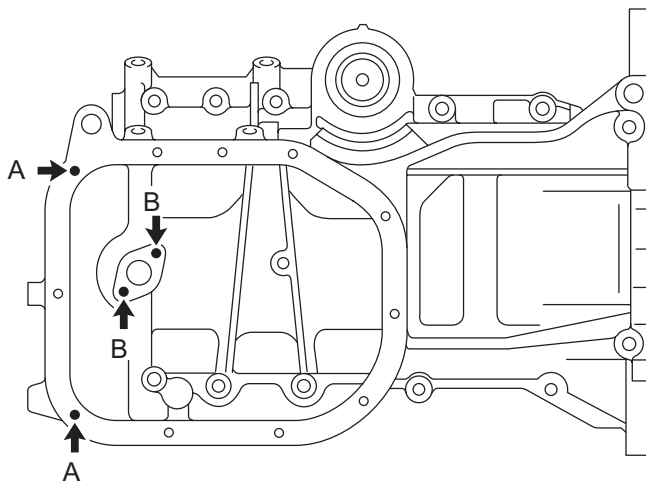
14. INSPECT CONNECTING ROD THRUST CLEARANCE (See page EM-173)

15. INSPECT CONNECTING ROD OIL CLEARANCE (See page EM-173)

16. INSTALL STUD BOLT

- (a) Using "Torx" socket wrench E5, install the 4 stud bolts.

Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)



mm (in.)

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17. INSTALL OIL PAN SUB-ASSEMBLY

- (a) Remove any old packing material from the contact surface.
- (b) Apply a continuous bead of seal packing (Diameter 2.0 mm to 3.0 mm (0.079 to 0.118 in.)) to the oil pan mating surface as shown in the illustration.

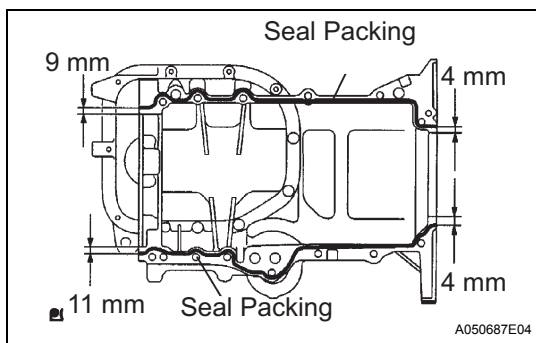
Seal packing:

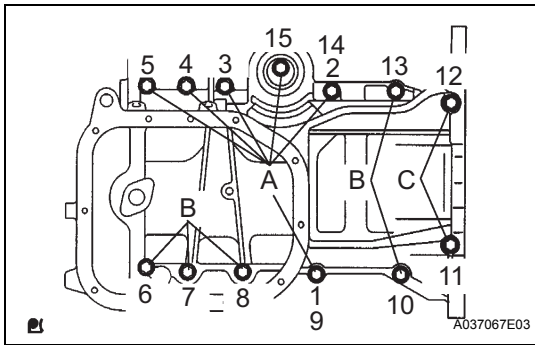
Toyota Genuine Seal Packing Black, Three Bond 1207B or Equivalent

NOTICE:

- Remove any oil from the contact surface.
- Install the oil pan within 3 minutes of applying the seal packing.
- Do not expose the seal to engine oil for at least within 2 hours after the installation.

- (c) Install 2 new O-rings onto the cylinder block.





- (d) Using several steps, install and tighten the 13 bolts uniformly in the sequence shown in the illustration.

Torque: 24 N*m (245 kgf*cm, 18 ft.*lbf)

HINT:

Each bolt length is as follows:

Bolt A 49 mm (1.93 in.)

Bolt B 88 mm (3.47 in.)

Bolt C 144 mm (5.67 in.)

18. INSTALL OIL STRAINER SUB-ASSEMBLY

- (a) Install a new gasket and the oil strainer with the 2 nuts and the bolt.

Torque: 11 N*m (112 kgf*cm, 8.1 ft.*lbf)

19. INSTALL OIL PAN SUB-ASSEMBLY NO. 2

- (a) Remove any old packing material from the contact surface.

- (b) Apply a continuous bead of seal packing (Diameter 2.5 to 3.5 mm (0.0984 to 0.1378 in.)) to the oil pan mating surface as shown in the illustration.

Seal packing:

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

NOTICE:

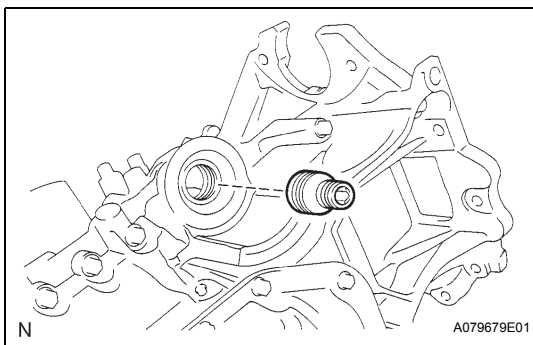
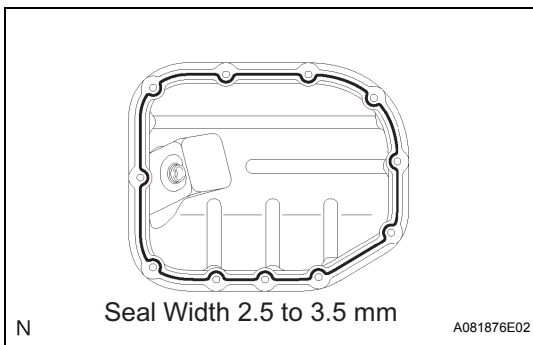
- Remove any oil from the contact surface.
- Install the oil pan within 3 minutes of applying the seal packing.
- Do not expose the seal to engine oil for at least 2 hours after the installation.
- Do not start the engine for at least 2 hours after the installation.

- (c) Install oil pan No. 2 with the 9 bolts and the 2 nuts.

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

- (d) Install the drain plug with a new gasket.

Torque: 38 N*m (382 kgf*cm, 28 ft.*lbf)



20. INSTALL OIL FILTER UNION

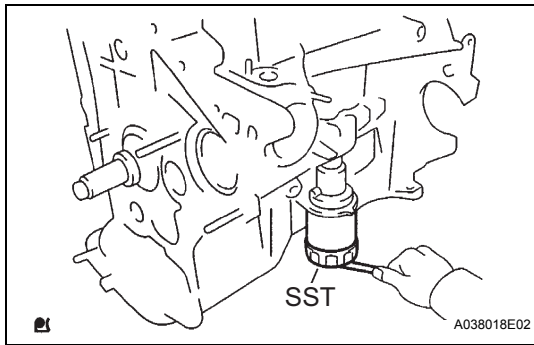
- (a) Using a 12 mm hexagon wrench, install the oil filter union.

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

21. INSTALL OIL FILTER SUB-ASSEMBLY

- (a) Check and clean the oil filter installation surface.
- (b) Apply clean engine oil to the gasket of a new oil filter.

- (c) Gently screw the oil filter into place, and tighten it until the gasket comes into contact with the seat.



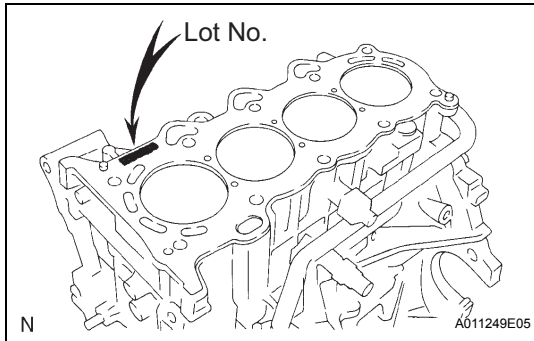
- (d) Using SST, tighten it an additional 3/4 turn.

SST 09228-06501

HINT:

When using a torque wrench, tighten it to the specified torque.

Torque: 13 N*m (133 kgf*cm, 9.5 ft.*lbf)



22. INSTALL CYLINDER HEAD GASKET

- (a) Place a new cylinder head gasket on the cylinder block with the Lot No. stamp facing upward.

NOTICE:

- Remove any oil from the contact surface.
- Pay attention to the mounting orientation of the cylinder head gasket.
- Place the cylinder head on the cylinder head gently in order not to damage the gasket.

23. INSTALL CYLINDER HEAD SUB-ASSEMBLY

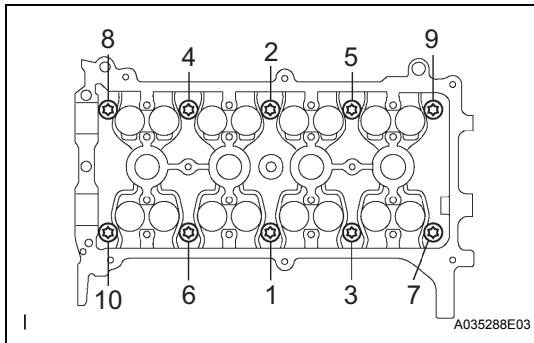
HINT:

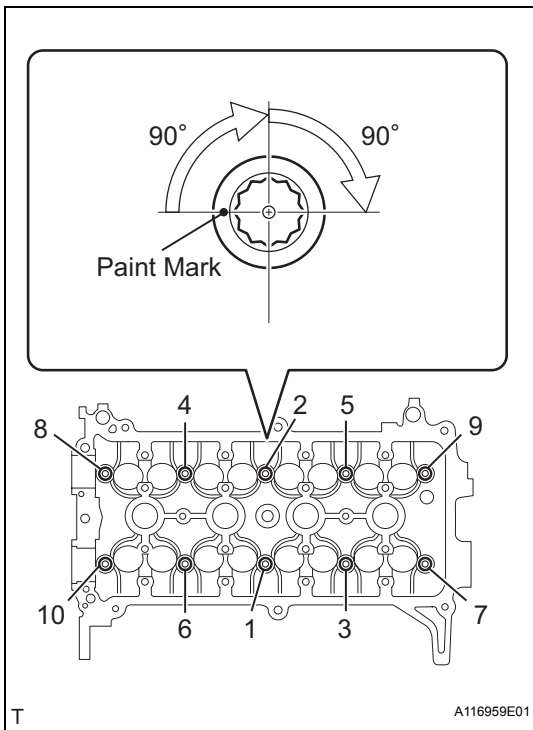
The cylinder head bolts are tightened in 2 successive steps.

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

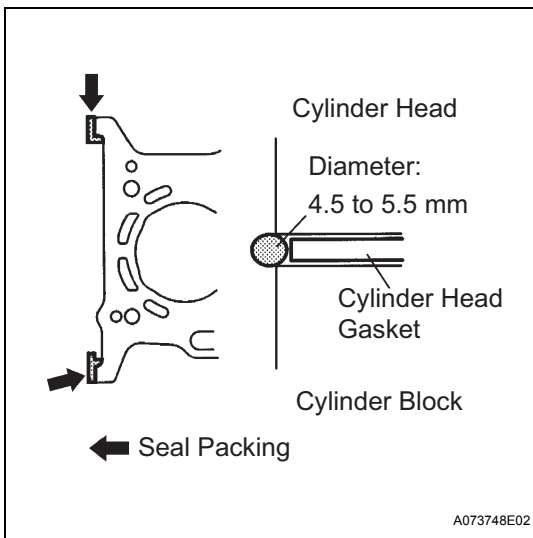
Torque: 29 N*m (300 kgf*cm, 22 ft.*lbf)

- (c) Mark the front of the cylinder head bolt with paint.





- (d) Retighten the cylinder head bolts by 90° and then an additional 90° as shown in the illustration.
- (e) Check that the paint mark is now at a 180° angle from the front.



- (f) Apply a continuous bead of seal packing (Diameter 4.5 to 5.5 mm (0.177 to 0.217 in.)) as shown in the illustration.

Seal Packing:

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

NOTICE:

- Remove any oil from the contact surface.
- Install the oil pump assembly within 3 minutes and tighten the bolts within 15 minutes of applying seal packing.

24. INSTALL ENGINE REAR OIL SEAL

- (a) Apply MP grease to a new oil seal lip.

NOTICE:

Keep the seal lip free of foreign matter.

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

SST 09223-56010

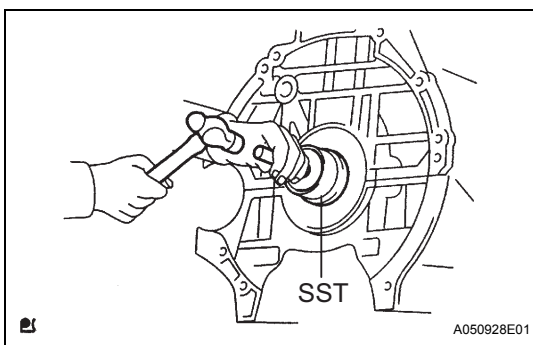
NOTICE:

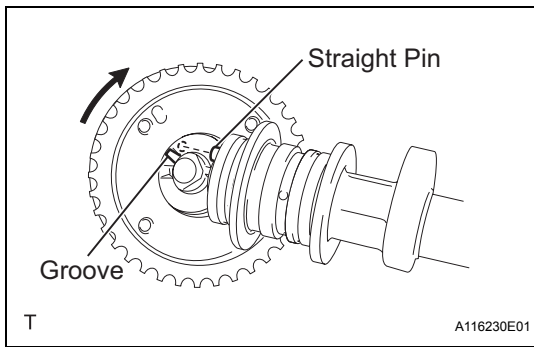
- Do not tap the oil seal at an angle.
- Wipe any extra grease off the crankshaft.

25. INSTALL CAMSHAFT TIMING GEAR ASSEMBLY

NOTICE:

Install the camshaft timing gear assembly onto the camshaft with the lock pin of the camshaft timing gear assembly released.





- (a) Put the camshaft timing gear assembly and camshaft together with the straight pin of the groove.
- (b) Turn the camshaft timing gear assembly clockwise while pushing it gently toward the camshaft. When the pin fits into the groove, push to ensure a good fit.

NOTICE:

Do not turn the camshaft timing gear in the retard direction (clockwise).

- (c) Check that there is no clearance between the gear fringe and the camshaft.
- (d) Tighten the flange bolt with the camshaft timing gear fixed.

Torque: 64 N*m (653 kgf*cm, 47 ft.*lbf)

NOTICE:

- Do not lock the camshaft timing gear assembly when tightening the bolt.
 - Release the lock pin of the camshaft timing gear assembly first, and tighten the bolt when the lock pin is locked in the most retarded position.
 - Tightening the bolts with the lock pin locked could cause breakage of the lock pin.
- (e) Check that the camshaft timing gear assembly moves smoothly in the retard direction (clockwise) and is locked in the most retarded position.

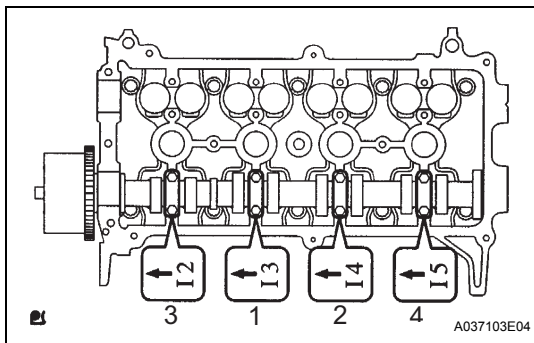
26. INSTALL CAMSHAFT

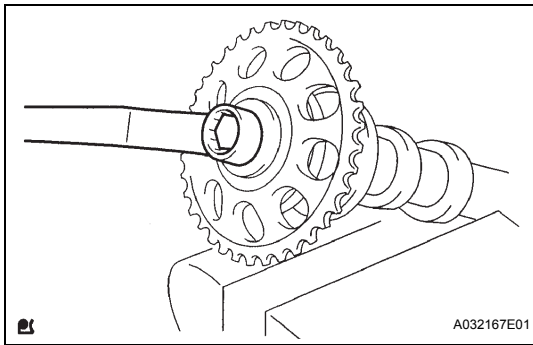
- (a) Apply a light coat of engine oil to the camshaft journals.
- (b) Place the camshaft on the cylinder head with the timing mark on the camshaft timing gear facing upward.
- (c) Examine the front marks and numbers and tighten the bolts in the sequence shown in the illustration.

Torque: 13 N*m (129 kgf*cm, 9.4 ft.*lbf)

NOTICE:

Tighten each bolt uniformly while keeping the camshaft level.



**27. INSTALL CAMSHAFT TIMING SPROCKET**

- Clamp the camshaft in a vice.
- Align the knock pin hole in the camshaft timing sprocket with the knock pin of the camshaft, and install the camshaft timing sprocket.

Torque: 64 N*m (653 kgf*cm, 47 ft.*lbf)

NOTICE:

Do not damage the camshaft.

28. INSTALL NO. 2 CAMSHAFT

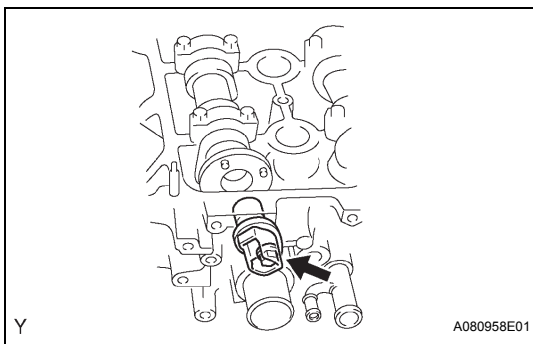
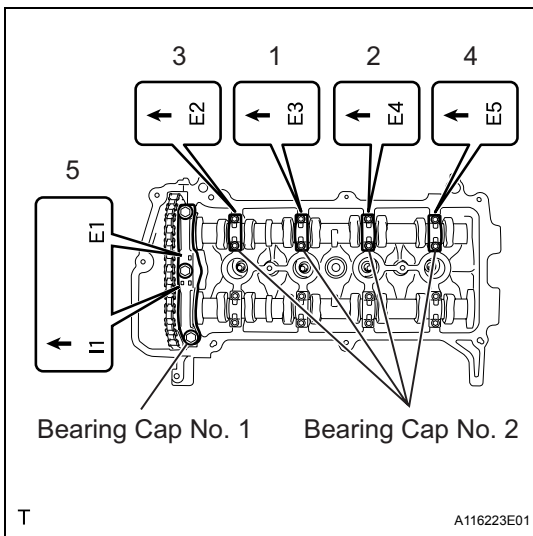
- Apply a light coat of engine oil to the camshaft journals.
- Place the camshaft on the cylinder head with the timing mark on the camshaft timing gear facing upward.
- Examine the front marks and numbers on camshaft bearing caps No. 1 and No. 2 and check that the sequence is as shown in the illustration. Then uniformly tighten the bolts, in several steps, in the sequence shown in the illustration.

Torque: 13 N*m (129 kgf*cm, 9.4 ft.*lbf) for bearing cap No. 2

23 N*m (235 kgf*cm, 17 ft.*lbf) for bearing cap No. 1

NOTICE:

Tighten each bolt uniformly while keeping the camshaft level.

**29. INSTALL CAMSHAFT POSITION SENSOR**

- Apply engine oil to the O-ring.

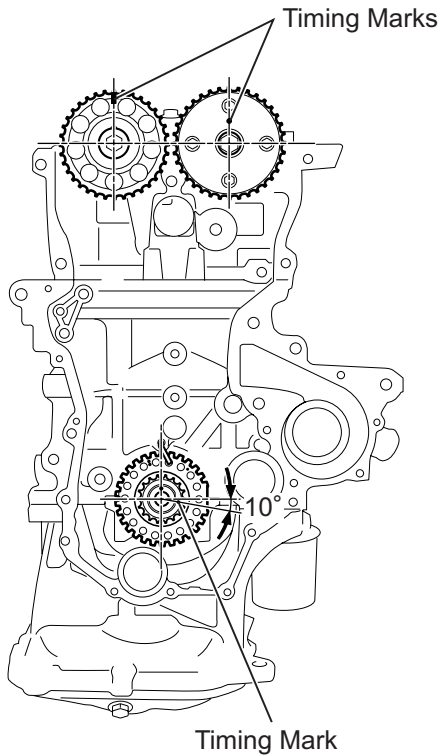
NOTICE:

If the O-ring is damaged, replace the camshaft position sensor.

- Install the camshaft position sensor with the bolt.

Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

TDC:



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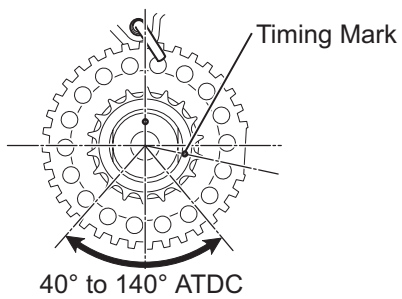
30. INSTALL CHAIN SUB-ASSEMBLY

- (a) Make sure that all the timing marks are in the positions (TDC) shown in the illustration.

HINT:

The positions of the timing marks may differ from the predetermined positions due to the force of the valve spring.

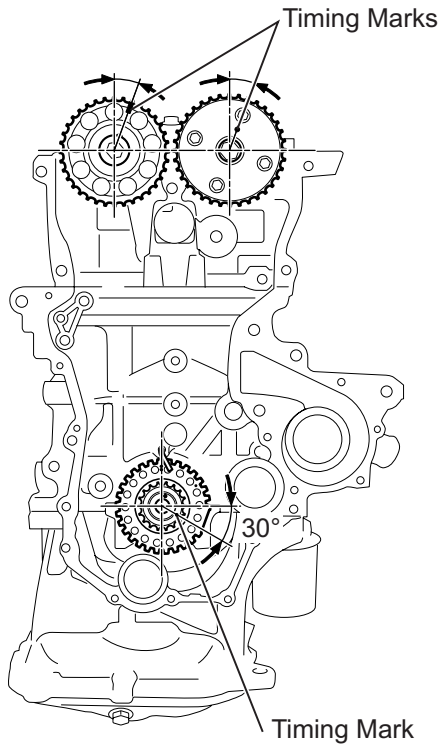
- (b) Set the timing mark of the crankshaft in a position between 40 and 140°ATDC, as illustrated.



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20° ATDC:

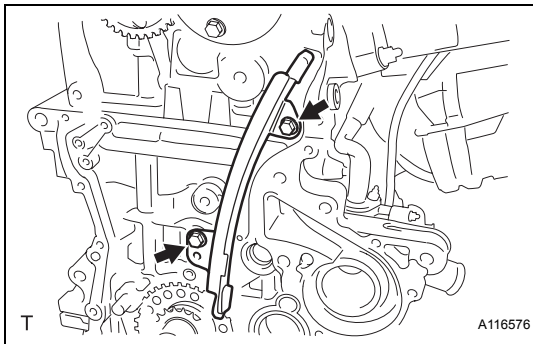


T

A116574E01

- (c) Set the camshaft timing gear and the camshaft timing sprocket in the positions (20°ATDC) shown in the illustration.
- (d) Set the crankshaft in the position (20°ATDC) shown in the illustration.

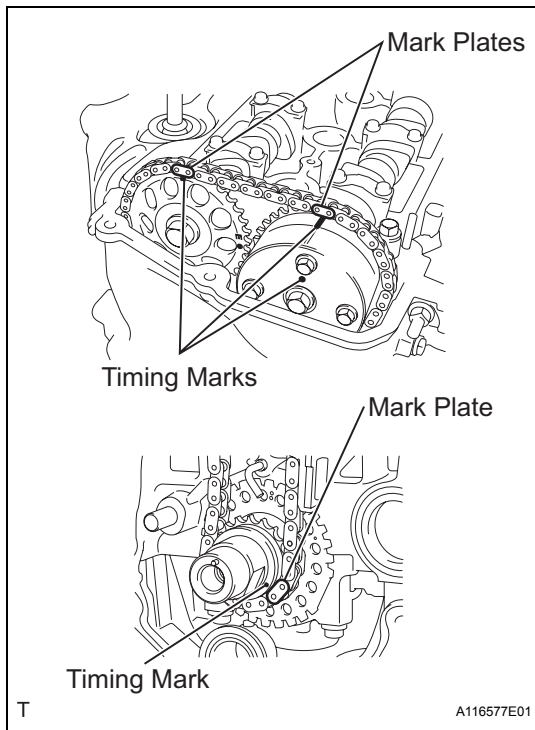
EM



T

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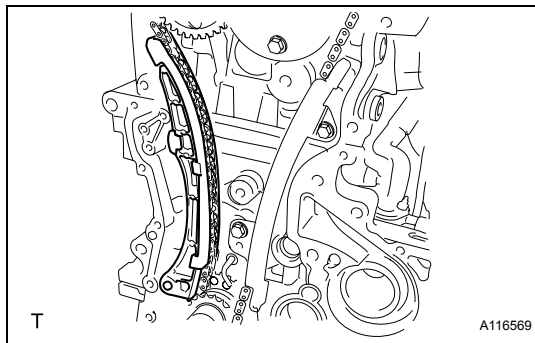
- (e) Install chain vibration damper No. 1 with the 2 bolts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)



- (f) Align the timing marks of the camshaft with the mark plates of the timing chain and install the timing chain.

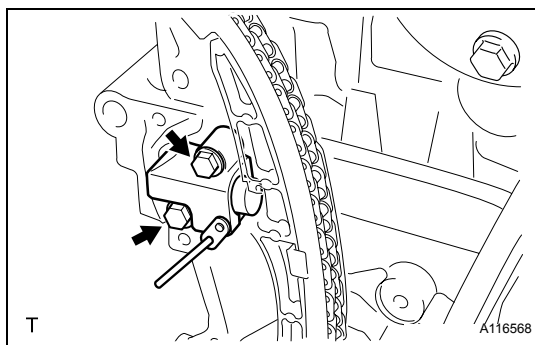
HINT:

Align the timing marks with the mark plates while turning the hexagonal service portion of the camshaft using a wrench.



31. INSTALL CHAIN TENSIONER SLIPPER

- (a) Install the chain tensioner slipper.

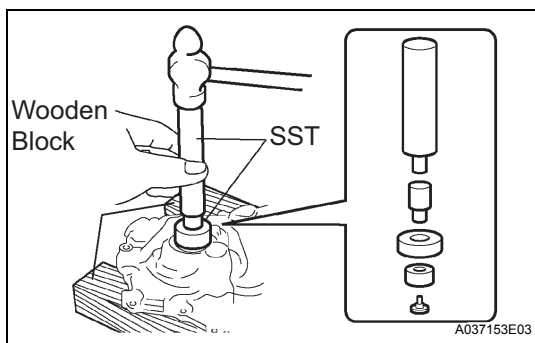


32. INSTALL CHAIN TENSIONER ASSEMBLY NO. 1

- (a) Install chain tensioner assembly No. 1 with the 2 bolts.

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

- (b) Remove the bar from chain tensioner assembly No. 1.



33. INSTALL OIL PUMP SEAL

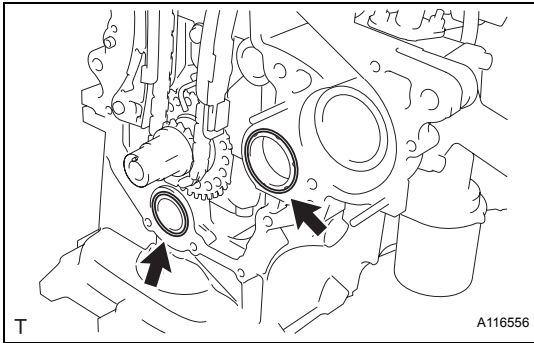
- (a) Using SST and a hammer, tap in a new oil seal until its surface is flush with the timing chain cover edge.

SST 09950-60010 (09951-00250, 09951-00380, 09952-06010), 09950-70010 (09951-07100)

NOTICE:

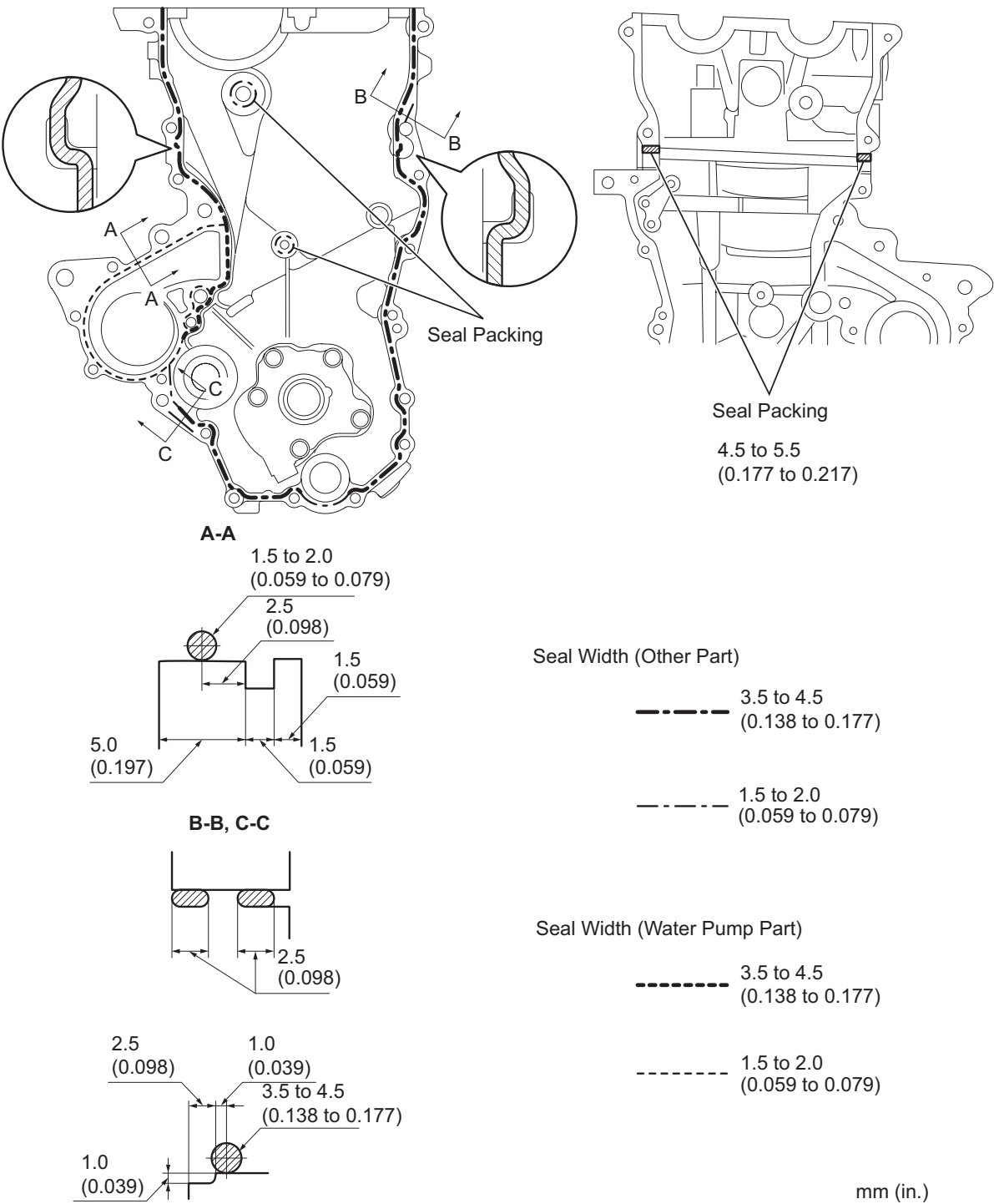
- Do not tap the oil seal at an angle.
- Keep the seal lip free of foreign matter.

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

**34. INSTALL OIL PUMP ASSEMBLY**

- (a) Install 2 new O-rings in the 2 locations shown in the illustration.

(b) Apply seal packing to the oil pump assembly, cylinder head and cylinder block as shown in the illustration.



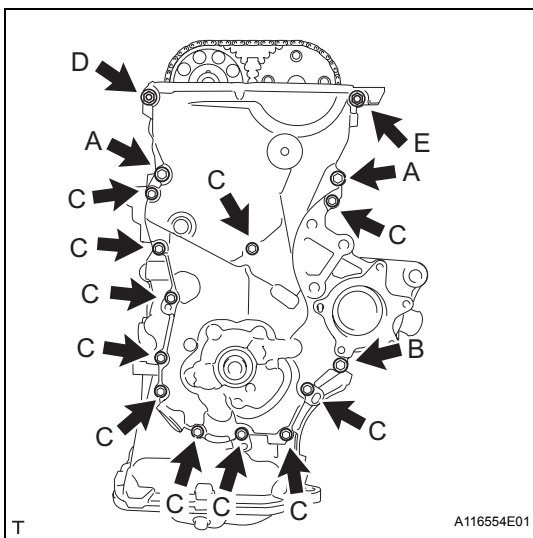
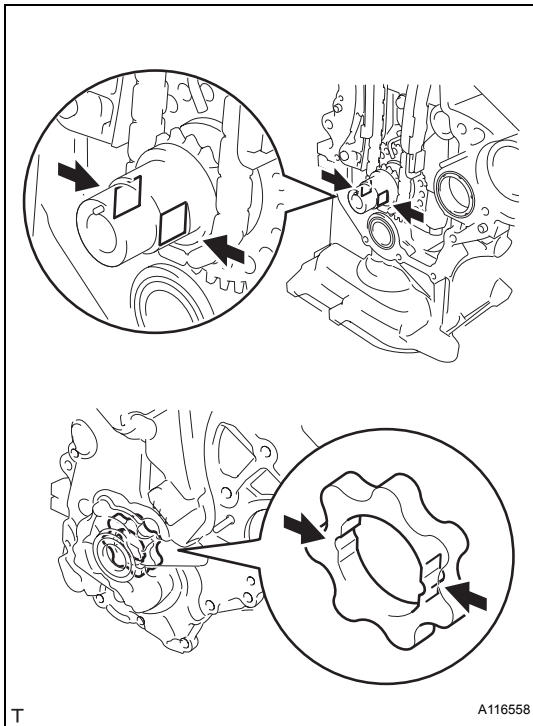
Seal packing:

Water pump part Toyota Genuine Seal Packing 1282B, Three Bond 1282B or Equivalent
Other part Toyota Genuine Seal Packing Black, Three Bond 1207B or Equivalent

NOTICE:

- Remove any oil from the contact surface.
- Install the oil pump assembly within 3 minutes and tighten the bolts and nut within 15 minutes of applying the seal packing.
- Do not expose the seal to engine oil for at least 2 hours after the installation.

- (c) Align the keyway of the oil pump rotor with the rectangular portion of the crankshaft, and slide the oil pump into place.



- (d) Install the oil pump assembly with the 15 bolts and nut. Tighten the bolts and nut uniformly in several steps.

Torque: 32 N*m (326 kgf*cm, 24 ft.*lbf) for bolt A
11 N*m (112 kgf*cm, 8.1 ft.*lbf) for bolt B
11 N*m (112 kgf*cm, 8.1 ft.*lbf) for bolt C
24 N*m (245 kgf*cm, 18 ft.*lbf) for nut D
24 N*m (245 kgf*cm, 18 ft.*lbf) for bolt E

NOTICE:

Install the mounting bracket and water pump within 15 minutes of installing the oil pump assembly.

HINT:

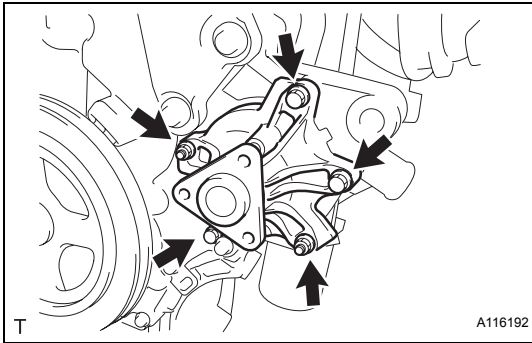
Each bolt length is as follows.

A: 30 mm (1.181 in.)

B: 35 mm (1.378 in.)

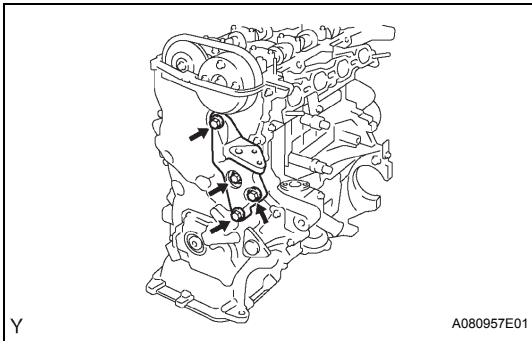
C: 20 mm (0.787 in.)

E: 20 to 14 mm (0.787 to 0.551 in.) Double ended bolt

**35. INSTALL WATER PUMP ASSEMBLY**

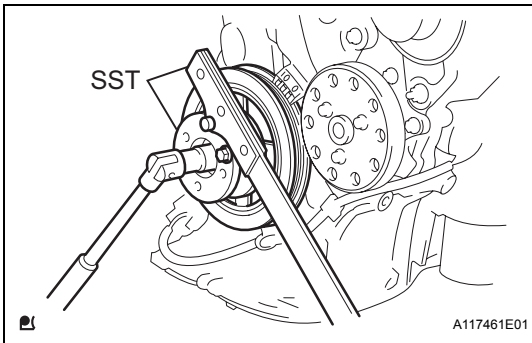
- (a) Install the water pump and a new gasket with the 3 bolts and 2 nuts.

Torque: 11 N*m (112 kgf*cm, 8.1 ft.*lbf)

**36. INSTALL TRANSVERSE ENGINE ENGINE MOUNTING BRACKET**

- (a) Install the transverse engine mounting bracket with the 4 bolts.

Torque: 55 N*m (561 kgf*cm, 41 ft.*lbf)

**37. INSTALL CRANKSHAFT DAMPER SUB-ASSEMBLY**

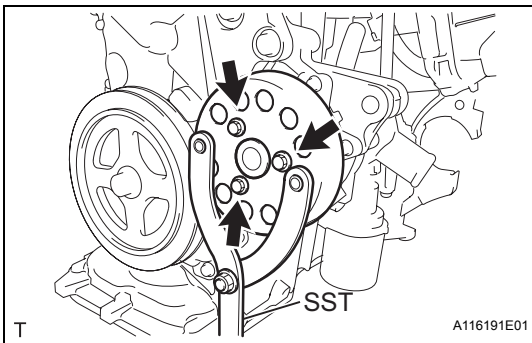
- (a) Align the pin hole in the crankshaft damper with the pin position and install the crankshaft damper sub-assembly.
- (b) Provisionally install the bolt.
- (c) Using 2 SSTs, tighten the bolt while holding the crankshaft damper sub-assembly.

SST 09213-14010 (91651-60865), 09330-00021

Torque: 128 N*m (1305 kgf*cm, 95 ft.*lbf)

NOTICE:

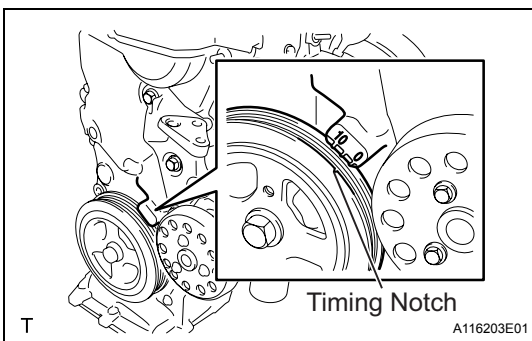
Check the SST installation positions when installing them, to avoid the SST fixing bolts from coming into contact with the oil pump assembly.

**38. INSTALL WATER PUMP PULLEY**

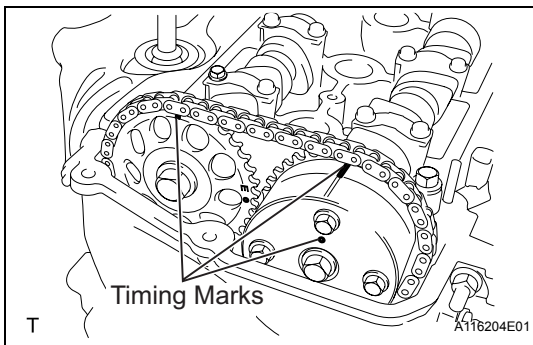
- (a) Using SST, install the pump pulley with the 3 bolts.

SST 09960-10010 (09962-01000, 09963-00700)

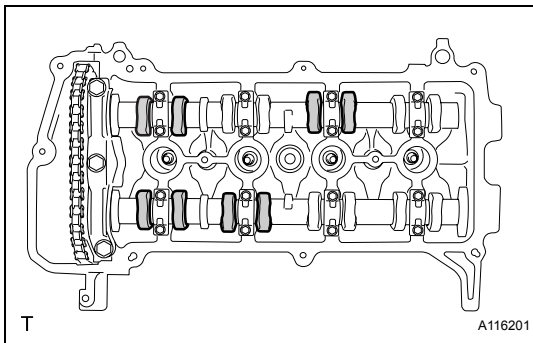
Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)

**39. INSPECT VALVE CLEARANCE**

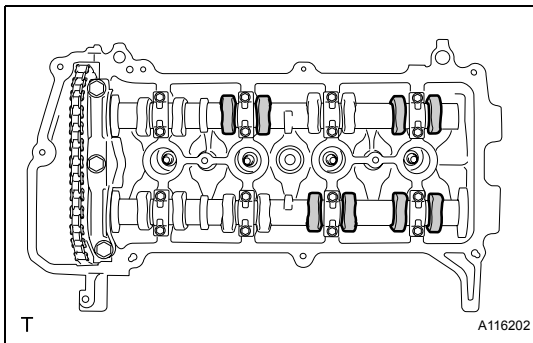
- (a) Set the No. 1 cylinder to TDC/compression.
- (1) Turn the crankshaft damper, and align its timing notch with the timing mark "0" of the oil pump.



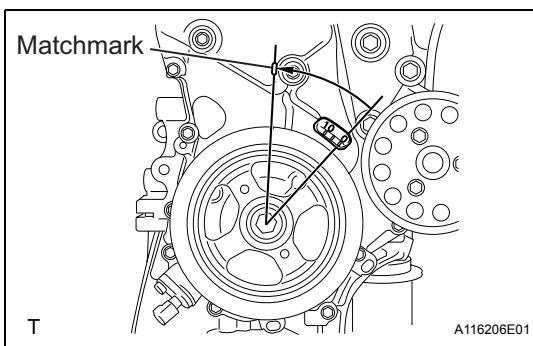
- (2) Check that the timing marks on the camshaft timing sprocket and camshaft timing gear are all facing upward, as shown in the illustration.
HINT:
If not, turn the crankshaft 1 complete revolution (360°) and align the marks as above.



- (b) Check the valves indicated in the illustration.
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
Valve clearance (cold):
for intake:
0.15 to 0.25 mm (0.006 to 0.010 in.)
for exhaust:
0.25 to 0.35 mm (0.010 to 0.014 in.)
(2) Record any out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.



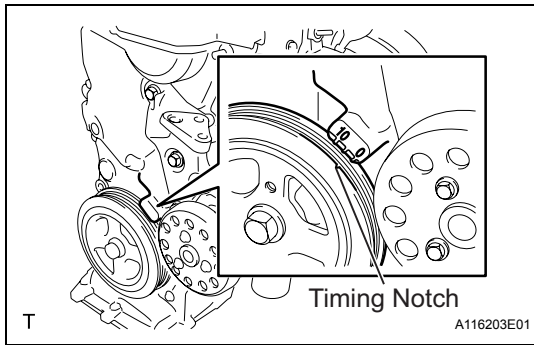
- (c) Turn the crankshaft 1 complete revolution (360°) and align its timing notch with timing mark "0" of the oil pump.
(d) Check the valves indicated in the illustration.
(1) Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
Valve clearance (cold):
for Intake:
0.15 to 0.25 mm (0.006 to 0.010 in.)
for Exhaust:
0.25 to 0.35 mm (0.010 to 0.014 in.)
(2) Record any out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.



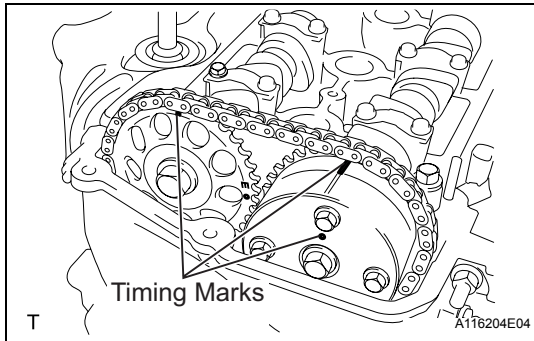
40. ADJUST VALVE CLEARANCE

NOTICE:

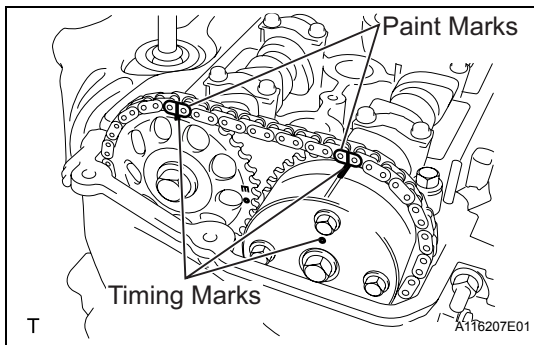
When rotating the camshaft with the timing chain removed, rotate the crankshaft damper counterclockwise 40° from the TDC and align its timing notch with the matchmark of the timing chain cover to prevent the pistons from coming into contact with the valves.



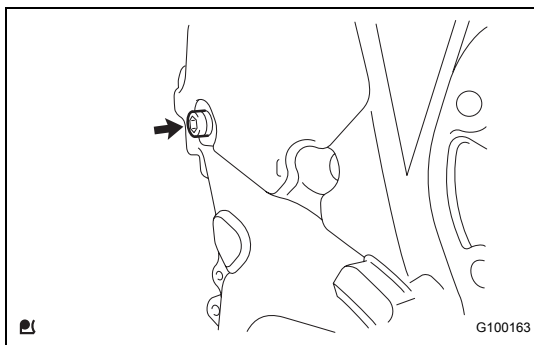
- (a) Set the No. 1 cylinder to TDC/compression.
 (1) Turn the crankshaft damper, and align its timing notch with timing mark "0" of the oil pump.



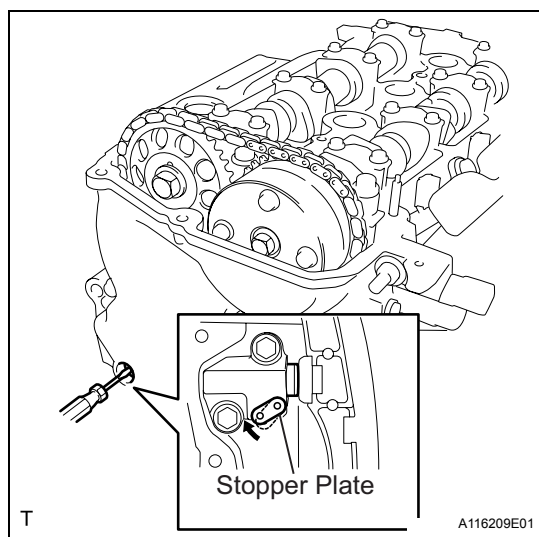
- (2) Check that the timing marks on the camshaft timing sprocket and camshaft timing gear are all facing upward as shown in the illustration.
 HINT:
 If not, turn the crankshaft 1 complete revolution (360°) and align the marks as above.



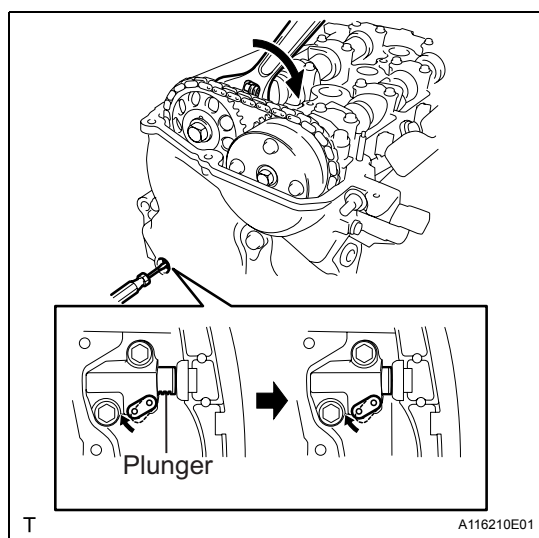
- (b) Put paint marks on the chain in the places where the timing marks of the camshaft timing sprocket and the camshaft timing gear are located.



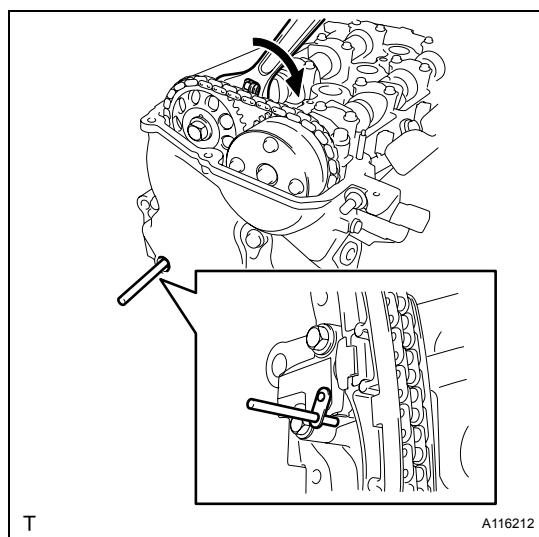
- (c) Using an 8 mm hexagon wrench, remove the screw plug.



- (d) Insert a screwdriver into the service hole in the chain tensioner to pull the stopper plate of the chain tensioner upward.



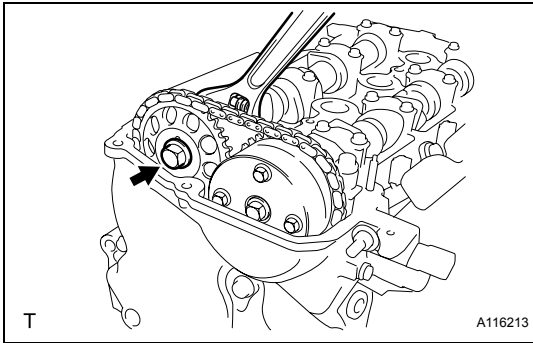
- (e) Using a wrench, rotate the No. 2 camshaft clockwise to push in the plunger of the chain tensioner.



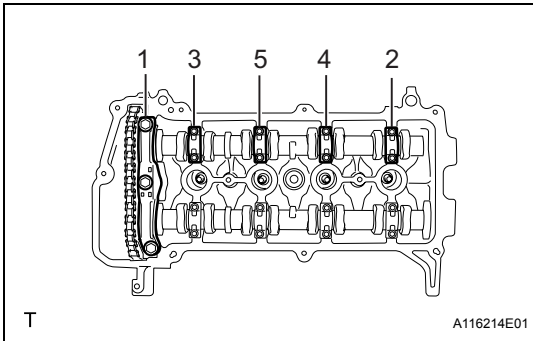
- (f) Remove the screwdriver from the service hole, then align the hole in the stopper plate with the service hole and insert a 3 mm (0.12 in.) diameter bar into the holes to hold the stopper plate.

HINT:

- Fix the stopper plate using the bar while rotating the camshaft right and left slightly.
- Hold the bar with tape so that it does not come out.



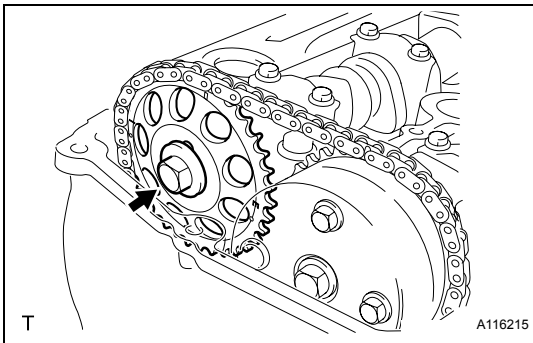
- (g) Using a wrench, hold the hexagonal lobe of No. 2 camshaft and remove the flange bolt.



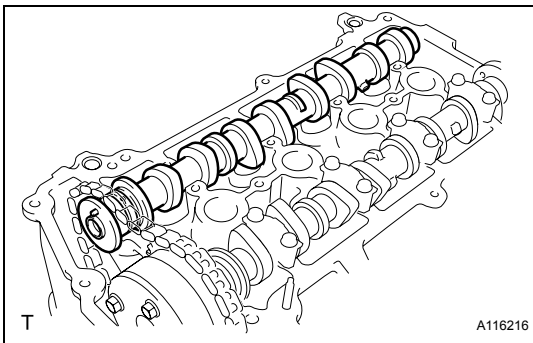
- (h) Using several steps, loosen and remove the 11 bearing cap bolts uniformly in the sequence shown in the illustration, then remove camshaft bearing cap No. 1 and camshaft bearing cap No. 2.

NOTICE:

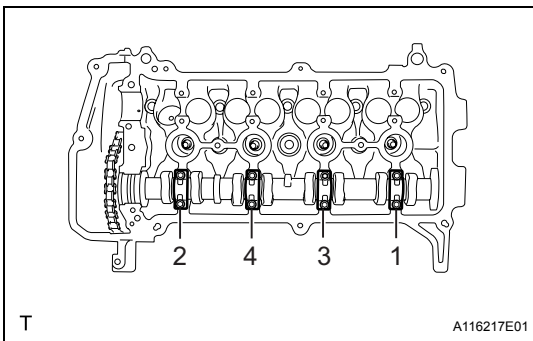
Loosen each bolt uniformly while keeping the camshaft level.



- (i) Remove the flange bolt and remove the camshaft timing sprocket.



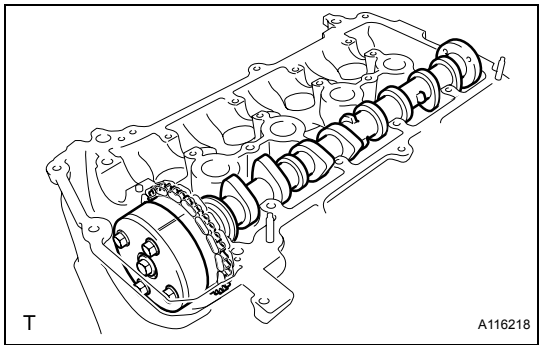
- (j) Remove the No. 2 camshaft.



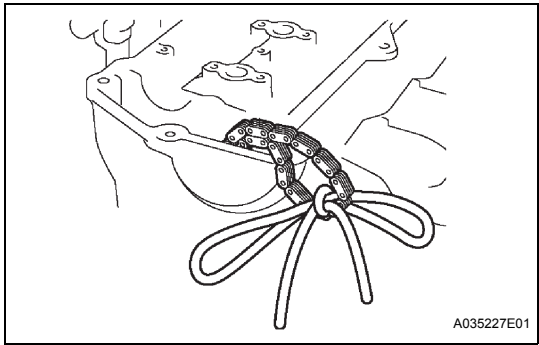
- (k) Using several steps, loosen and remove the 8 bearing cap bolts uniformly in the sequence shown in the illustration, then remove camshaft bearing cap No. 2.

NOTICE:

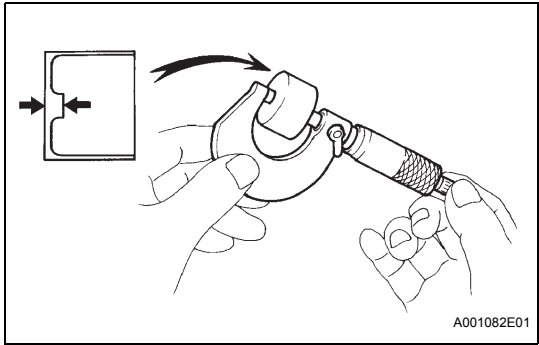
Loosen the bolts uniformly while keeping the camshaft level.



- (l) Hold the chain by hand, and remove the camshaft and the camshaft timing gear assembly.



- (m) Tie the chain with a piece of string as shown in the illustration.
(n) Remove the valve lifters.



- (o) Using a micrometer, measure the thickness of the removed lifter.
(p) Calculate the thickness of the new lifter so that the valve clearance comes to within the specified values.

A	Thickness of new lifter
B	Thickness of used lifter
C	Measured valve clearance

Valve clearance:

Intake $A = B + (C - 0.20 \text{ mm (0.008 in.)})$

Exhaust $A = B + (C - 0.30 \text{ mm (0.012 in.)})$

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

HINT:

Lifters are available in 35 sizes in increments of 0.020 mm (0.0008 in.), from 5.060 mm (0.1992 in.) to 5.740 mm (0.2260 in.).

T

Intake valve clearance (cold):
0.15 to 0.25 mm (0.006 to 0.010 in.)

EXAMPLE:

A 5.250 mm (0.2067 in.) lifter is installed, and the measured clearance is 0.400 mm (0.0158 in.). Replace the 5.250 mm (0.2067 in.) lifter with a new No. 46 lifter.

New Shim Thickness

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

Measured clearance mm(in.)	Installed lifter thickness mm(in.)	0.000 - 0.030 (0.0000 - 0.0012)	0.031 - 0.050 (0.0012 - 0.0020)	0.051 - 0.070 (0.0020 - 0.0028)	0.071 - 0.090 (0.0028 - 0.0035)	0.091 - 0.110 (0.0036 - 0.0043)	0.111 - 0.130 (0.0044 - 0.0051)	0.131 - 0.150 (0.0052 - 0.0059)	0.151 - 0.170 (0.0059 - 0.0067)	0.171 - 0.190 (0.0067 - 0.0075)	0.191 - 0.210 (0.0075 - 0.0083)	0.211 - 0.230 (0.0083 - 0.0091)	0.231 - 0.249 (0.0091 - 0.0098)	0.250 - 0.350 (0.0098 - 0.0138)	0.351 - 0.370 (0.0138 - 0.0146)	0.371 - 0.390 (0.0146 - 0.0154)	0.391 - 0.410 (0.0154 - 0.0161)	0.411 - 0.430 (0.0162 - 0.0169)	0.431 - 0.450 (0.0170 - 0.0177)	0.451 - 0.470 (0.0178 - 0.0185)	0.471 - 0.490 (0.0185 - 0.0193)	0.491 - 0.510 (0.0193 - 0.0201)	0.511 - 0.530 (0.0201 - 0.0209)	0.531 - 0.550 (0.0209 - 0.0217)	0.551 - 0.570 (0.0217 - 0.0224)	0.571 - 0.590 (0.0225 - 0.0232)	0.591 - 0.610 (0.0233 - 0.0240)	0.611 - 0.630 (0.0241 - 0.0248)	0.631 - 0.650 (0.0248 - 0.0256)	0.651 - 0.670 (0.0256 - 0.0264)	0.671 - 0.690 (0.0264 - 0.0272)	0.691 - 0.710 (0.0272 - 0.0280)	0.711 - 0.730 (0.0280 - 0.0287)	0.731 - 0.750 (0.0288 - 0.0295)	0.751 - 0.770 (0.0296 - 0.0303)	0.771 - 0.790 (0.0304 - 0.0311)	0.791 - 0.810 (0.0311 - 0.0319)	0.811 - 0.830 (0.0319 - 0.0327)	0.831 - 0.850 (0.0327 - 0.0335)	0.851 - 0.870 (0.0335 - 0.0343)	0.871 - 0.890 (0.0343 - 0.0350)	0.891 - 0.910 (0.0351 - 0.0358)	0.911 - 0.930 (0.0359 - 0.0366)	0.931 - 0.950 (0.0367 - 0.0374)	0.951 - 0.970 (0.0374 - 0.0382)	0.971 - 0.990 (0.0382 - 0.0390)	0.991 - 1.010 (0.0390 - 0.0398)	1.011 - 1.030 (0.0398 - 0.0406)
5.060 (0.1992)															12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74	
5.080 (0.2000)													06		14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74		
5.100 (0.2008)												06	06		16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74			
5.120 (0.2016)											06	06	06		18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74				
5.140 (0.2024)										06	06	06	06		20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74					
5.160 (0.2031)									06	06	06	08	10		22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74						
5.180 (0.2039)									06	06	08	10	12		24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74							
5.200 (0.2047)							06	06	08	10	12	14			26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74								
5.210 (0.2051)						06	06	08	10	12	14	16			28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74									
5.220 (0.2055)					06	06	08	10	12	14	16				28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74									
5.230 (0.2059)				06	06	08	10	12	14	16	18				30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74										
5.240 (0.2063)				06	06	08	10	12	14	16	18				30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74										
5.250 (0.2067)				06	06	06	10	12	14	16	18	20			32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74											
5.260 (0.2071)			06	06	06	08	10	12	14	16	18	20			32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74											
5.270 (0.2075)			06	06	08	10	12	14	16	18	20	22			34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74												
5.280 (0.2079)		06	06	08	10	12	14	16	18	20	22				34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74												
5.290 (0.2083)		06	06	08	10	12	14	16	18	20	22	24			36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74													
5.300 (0.2087)		06	06	08	10	12	14	16	18	20	22	24			36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74													
5.310 (0.2091)	06	06	08	10	12	14	16	18	20	22	24	26			38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74														
5.320 (0.2094)	06	06	08	10	12	14	16	18	20	22	24	26			38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74														
5.330 (0.2098)	06	08	10	12	14	16	18	20	22	24	26	28			40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74															
5.340 (0.2102)	06	08	10	12	14	16	18	20	22	24	26	28			40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74															
5.350 (0.2106)	08	10	12	14	16	18	20	22	24	26	28	30			42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																
5.360 (0.2110)	08	10	12	14	16	18	20	22	24	26	28	30			42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																
5.370 (0.2114)	10	12	14	16	18	20	22	24	26	28	30	32			44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																	
5.380 (0.2118)	10	12	14	16	18	20	22	24	26	28	30	32			44	46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																	
5.390 (0.2122)	12	14	16	18	20	22	24	26	28	30	32	34			46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																		
5.400 (0.2126)	12	14	16	18	20	22	24	26	28	30	32	34			46	48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																		
5.410 (0.2130)	14	16	18	20	22	24	26	28	30	32	34	36			48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																			
5.420 (0.2134)	14	16	18	20	22	24	26	28	30	32	34	36			48	50	52	54	56	58	60	62	64	66	68	70	72	74	74																			
5.430 (0.2138)	16	18	20	22	24	26	28	30	32	34	36	38			50	52	54	56	58	60	62	64	66	68	70	72	74	74																				
5.440 (0.2142)	16	18	20	22	24	26	28	30	32	34	36	38			50	52	54	56	58	60	62	64	66	68	70	72	74	74																				
5.450 (0.2146)	18	20	22	24	26	28	30	32	34	36	38	40			52	54	56	58	60	62	64	66	68	70	72	74	74																					
5.460 (0.2150)	18	20	22	24	26	28	30	32	34	36	38	40			52	54	56	58	60	62	64	66	68	70	72	74	74																					
5.470 (0.2154)	20	22	24	26	28	30	32	34	36	38	40	42			54	56	58	60	62	64	66	68	70	72	74	74																						
5.480 (0.2157)	20	22	24	26	28	30	32	34	36	38	40	42			54	56	58	60	62	64	66	68	70	72	74	74																						
5.490 (0.2161)	22	24	26	28	30	32	34	36	38	40	42	44			56	58	60	62	64	66	68	70	72	74	74																							
5.500 (0.2165)	22	24	26	28	30	32	34	36	38	40	42	44			56	58	60	62	64	66	68	70	72	74	74																							
5.510 (0.2169)	24	26	28	30	32	34	36	38	40	42	44	46			58	60	62	64	66	68	70	72	74	74																								
5.520 (0.2173)	24	26	28	30	32	34	36	38	40	42	44	46			58	60	62	64	66	68	70	72	74	74																								
5.530 (0.2177)	26	28	30	32	34	36	38	40	42	44	46	48			60	62	64	66	68	70	72	74	74																									
5.540 (0.2181)	26	28	30	32	34	36	38	40	42	44	46	48			60	62	64	66	68	70	72	74	74																									
5.550 (0.2185)	28	30	32	34	36	38	40	42	44	46	48	50			62	64	66	68	70	72	74	74																										
5.560 (0.2189)	28	30	32	34	36	38	40	42	44	46	48	50			62	64	66	68	70	72	74	74																										
5.570 (0.2193)	30	32	34	3																																												

Exhaust valve clearance (cold):
0.25 to 0.35 mm (0.010 to 0.014 in.)

EXAMPLE:

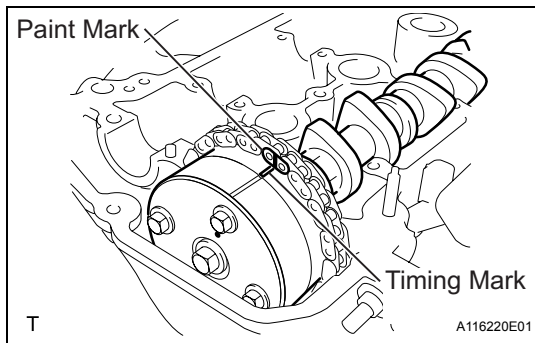
A 5.340 mm (0.2102 in.) lifter is installed, and the measured clearance is 0.440 mm (0.0173 in.). Replace the 5.340 mm (0.2102 in.) lifter with a new No. 48 lifter.

New Shim Thickness

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

EM

- (r) Install the selected valve lifter.
- (s) Apply a light coat of engine oil to the camshaft and camshaft journals.
- (t) Install the chain onto the camshaft timing gear with the paint mark and the timing mark aligned, as shown in the illustration.

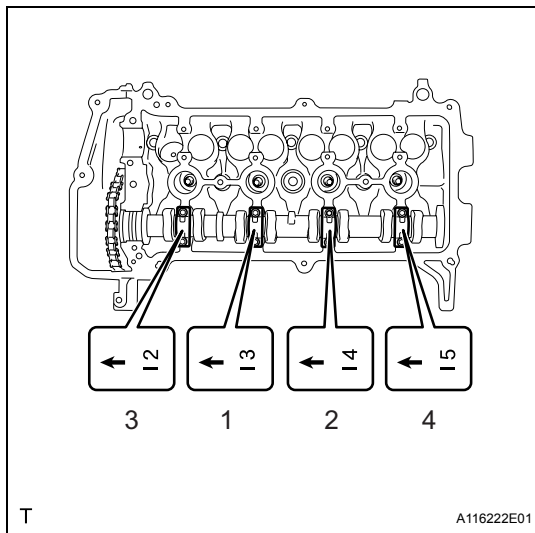


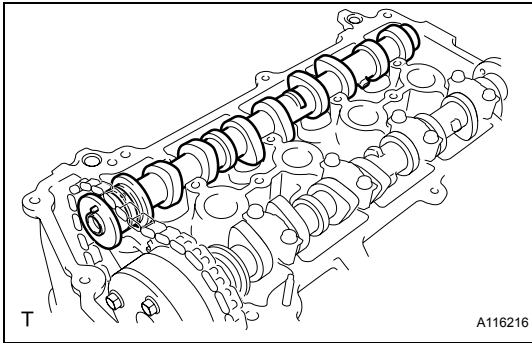
- (u) Examine the front marks and the numbers on camshaft bearing cap No. 2 and check that the sequence is as shown in the illustration. Then uniformly tighten the bolts in several steps in the sequence shown in the illustration.

Torque: 13 N*m (129 kgf*cm, 9.4 ft.*lbf)

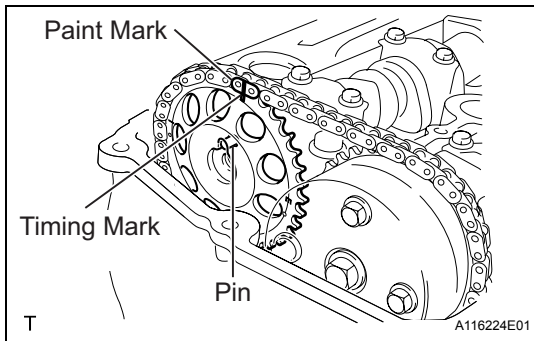
NOTICE:

Tighten the bolts uniformly while keeping the camshaft level.

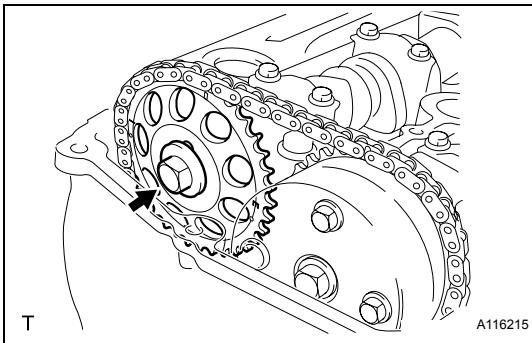




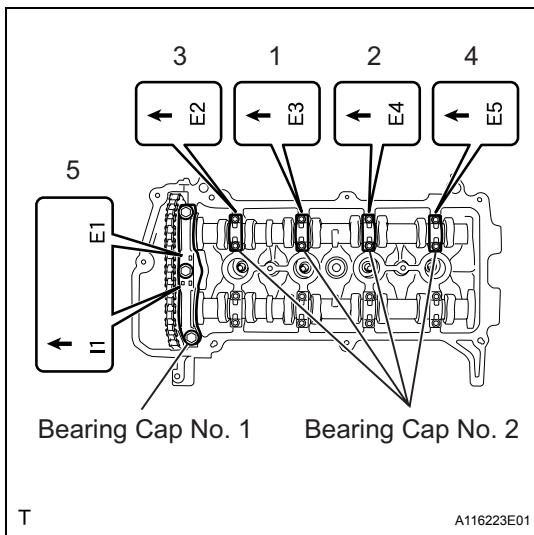
(v) Install camshaft No. 2.



- (w) Hold the chain, and align the timing mark on the camshaft timing sprocket with the paint mark of the chain.
- (x) Align the alignment pin hole in the camshaft timing sprocket with the alignment pin of the camshaft, and install the sprocket onto the camshaft.



(y) Provisionally install the flange bolt.

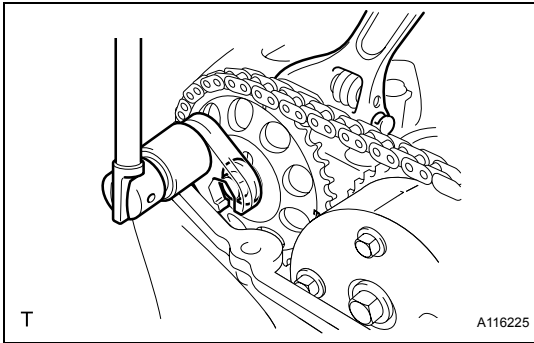


(z) Examine the front marks and the numbers of camshaft bearing cap No. 1 and camshaft bearing cap No. 2 and check that the sequence is as shown in the illustration. Then uniformly tighten the bolts, in several steps, in the sequence shown in the illustration.

Torque: 13 N*m (129 kgf*cm, 9.4 ft.*lbf) for bearing cap No. 2
23 N*m (235 kgf*cm, 17 ft.*lbf) for bearing cap No. 1

NOTICE:

Tighten the bolts uniformly while keeping the camshaft level.

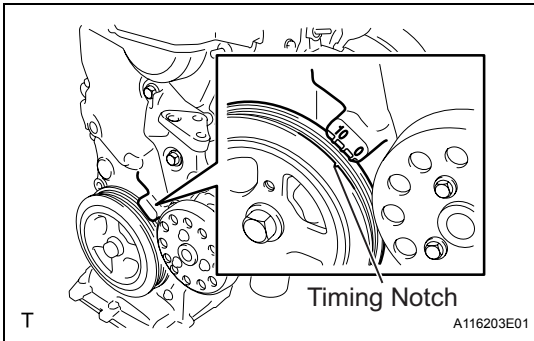


- (aa) Using a wrench, hold the hexagonal lobe of camshaft No. 2, and install the flange bolt.

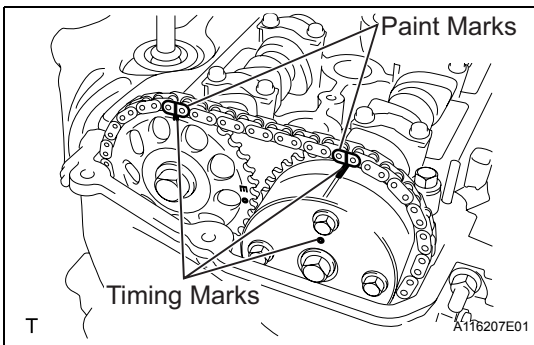
Torque: 64 N*m (653 kgf*cm, 47 ft.*lbf)

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- (ab) Remove the bar from the timing chain tensioner.



- (ac) Turn the crankshaft damper, and align its timing notch with the timing mark "0" of the oil pump.

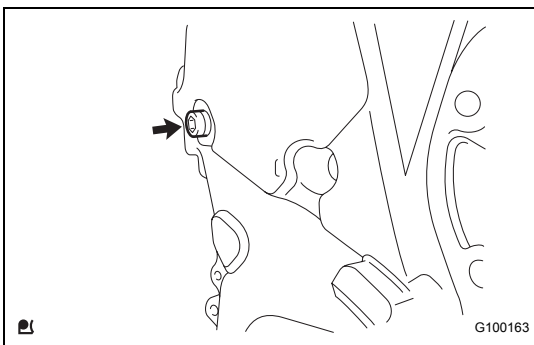


- (ad) Check that all the pairs of timing marks are aligned.

- (ae) Apply adhesive to the end 2 or 3 threads of the screw plug.

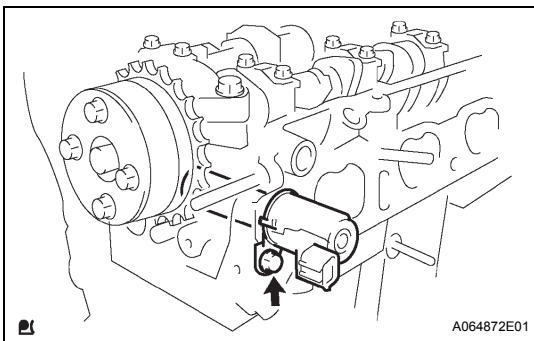
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent



- (af) Using an 8 mm hexagon wrench, install the screw plug.

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



41. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

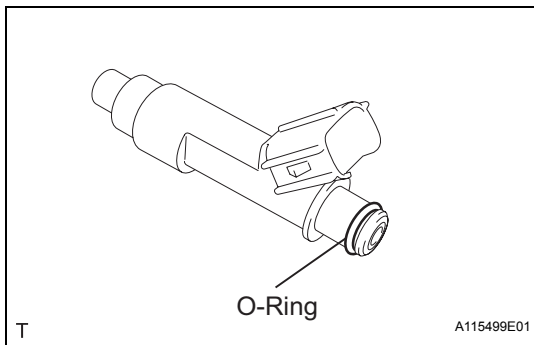
- (a) Apply a light coat of engine oil to a new O-ring, and install it onto the camshaft timing oil control valve.

- (b) Install the camshaft timing oil control valve with the bolt.

Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)

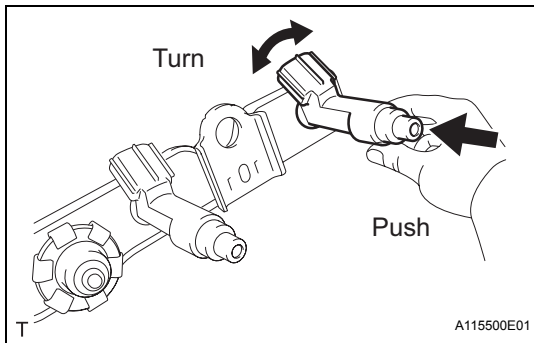
NOTICE:

Do not twist the O-ring.



42. INSTALL FUEL INJECTOR ASSEMBLY

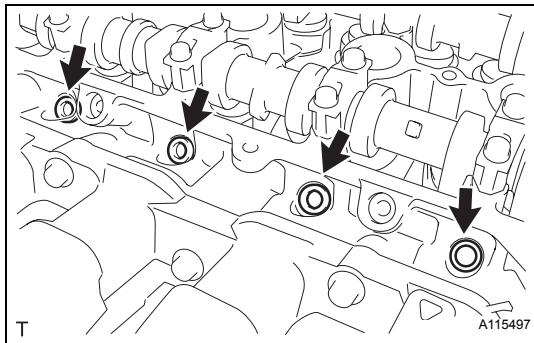
- (a) Apply a light coat of gasoline or spindle oil to new O-rings, then install one onto each fuel injector.
- (b) Apply a light coat of gasoline or spindle oil to the contact surfaces of the fuel delivery pipe and the O-ring of the fuel injector.



- (c) While turning the fuel injector left and right, install it onto the fuel delivery pipe.

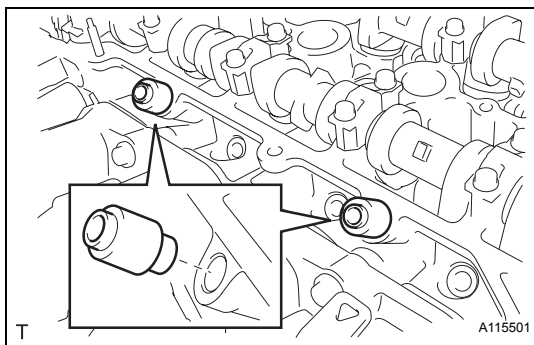
NOTICE:

- Do not twist the O-ring.
- After installing the fuel injectors, check that they turn smoothly. If not, replace the O-ring with a new one.



43. INSTALL INJECTOR VIBRATION INSULATOR

- (a) Install 4 new injector vibration insulators onto the cylinder head.

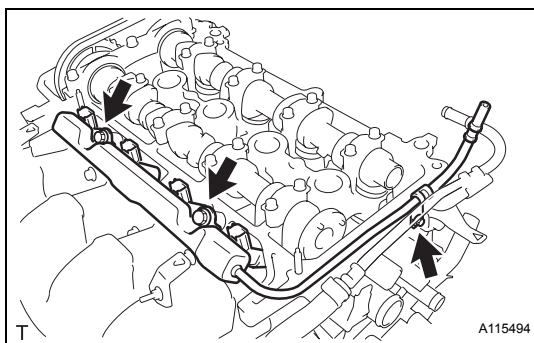


44. INSTALL DELIVERY PIPE NO. 1 SPACER

- (a) Install the 2 delivery pipe No. 1 spacers onto the cylinder head.

NOTICE:

Install delivery pipe No. 1 spacer in the correct direction.

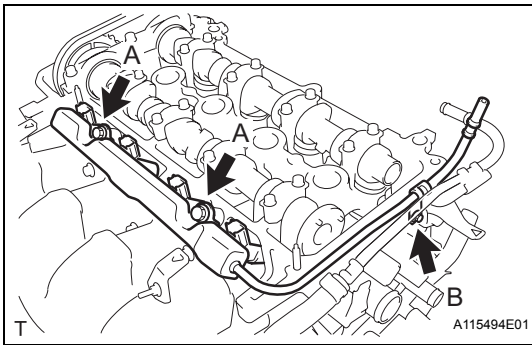


45. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

- (a) Provisionally install the fuel delivery pipe sub-assembly and 4 fuel injectors with the 3 bolts.

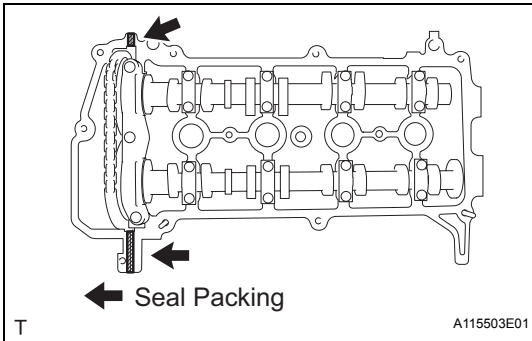
NOTICE:

- Do not drop the fuel injectors when installing the fuel delivery pipe sub-assembly.
- Check that the fuel injectors rotate smoothly after installing the fuel delivery pipe sub-assembly.



- (b) Tighten the 3 bolts to the specified torque.

Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf) for bolt A
9.0 N*m (92 kgf*cm, 80 in.*lbf) for bolt B



46. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

- (a) Install the gasket onto the cylinder head cover.
 (b) Apply seal packing to the cylinder head, as shown in the illustration.

Seal Packing:

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

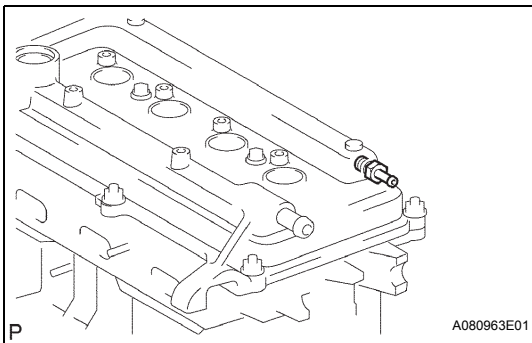
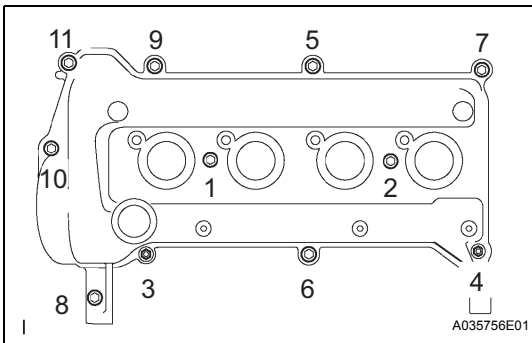
NOTICE:

- Remove any oil from the contact surface.
- Install the cylinder head cover sub-assembly within 3 minutes of applying the seal packing.
- Do not start engine for at least 2 hours after the installation.

- (c) Install the cylinder head cover sub-assembly with the 9 bolts, 2 nuts and 2 seal washers.

- (d) Tighten the 9 bolts and 2 nuts in the sequence shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7.0 ft.*lbf)



47. INSTALL VENTILATION VALVE SUB-ASSEMBLY

- (a) Install the ventilation valve onto the cylinder head cover.

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

48. INSTALL OIL LEVEL GAUGE GUIDE

- (a) Apply engine oil to a new O-ring.
 (b) Install the oil level gauge guide with the bolt.

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

49. INSTALL CRANKSHAFT POSITION SENSOR

- (a) Apply a light coat of engine oil to the O-ring on the crankshaft position sensor.

NOTICE:

If the O-ring is damaged, replace the crankshaft position sensor.

- (b) Install the crankshaft position sensor with the bolt.

Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)

50. INSTALL OIL FILLER CAP GASKET

- (a) Install the oil filler cap gasket onto the oil filler cap.

51. INSTALL OIL FILLER CAP SUB-ASSEMBLY

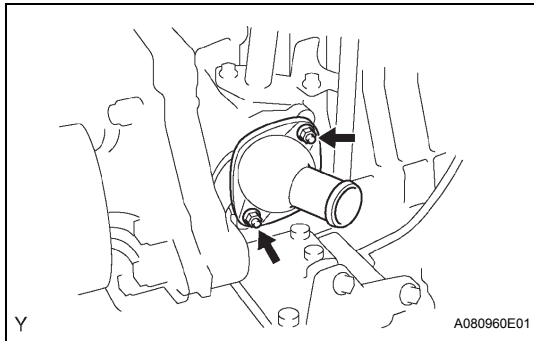
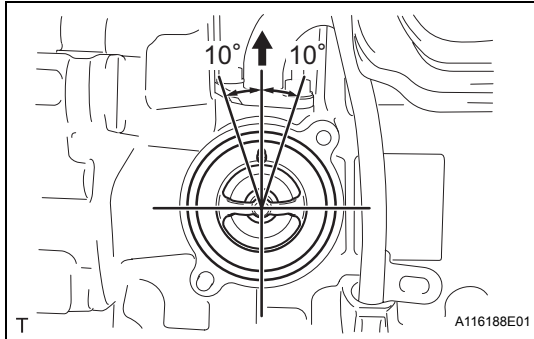
- (a) Install the oil filler cap onto the cylinder head cover.

52. INSTALL THERMOSTAT

- (a) Install a new gasket onto the thermostat.
 (b) Install the thermostat with the jiggle valve facing upward.

HINT:

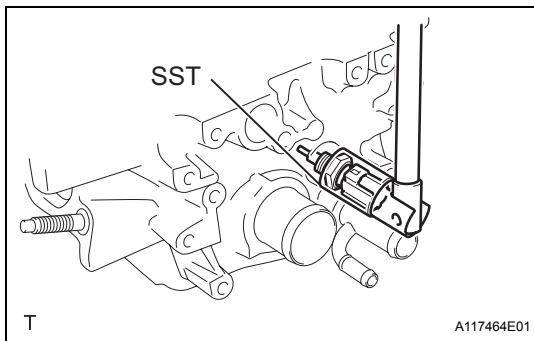
The jiggle valve may be set within 10° either side as shown in the illustration.

**53. INSTALL WATER INLET**

- (a) Install the water inlet with the 2 nuts.
Torque: 9.0 N*m (92 kgf*cm, 80 in.*lbf)

54. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

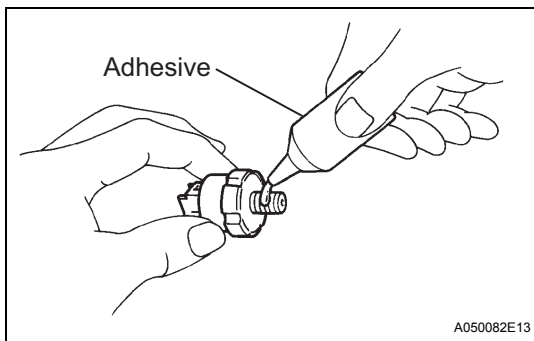
- (a) Provisionally install the engine coolant temperature sensor through a new gasket.



- (b) Using SST, tighten the engine coolant temperature sensor.

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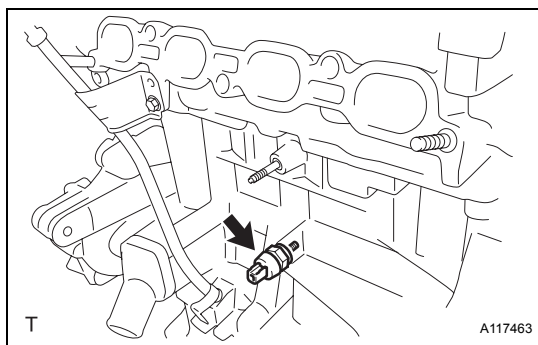
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

**55. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY**

- (a) Apply adhesive to the end 2 or 3 threads of the oil pressure switch.

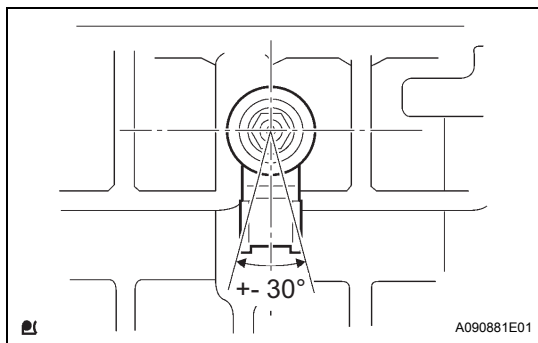
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent



- (b) Using a 24 mm deep socket wrench, install the oil pressure switch.

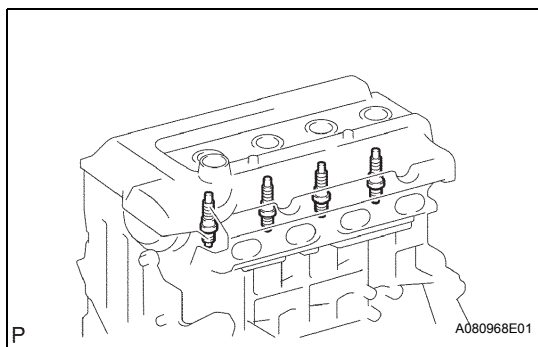
Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)



56. INSTALL KNOCK SENSOR

- (a) Install the knock sensor with the nut as shown in the illustration.

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

EM

57. INSTALL SPARK PLUG

- (a) Using a spark plug wrench, install the spark plugs.

Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)