DISASSEMBLY

1. REMOVE OIL FILLER CAP SUB-ASSEMBLY

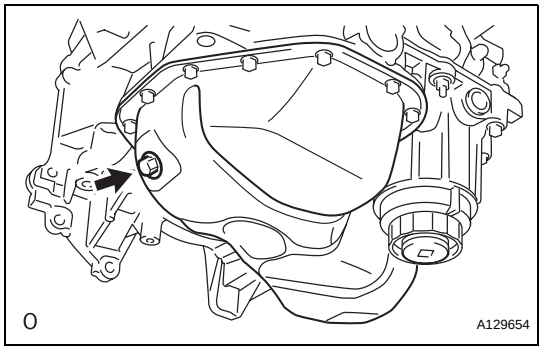
(a) Remove the oil filler cap sub-assembly and oil filler gasket.

2. REMOVE SPARK PLUG

(a) Remove the spark plugs.

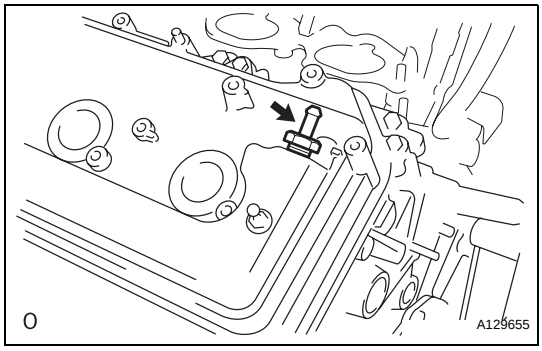
3. REMOVE OIL PAN DRAIN PLUG

(a) Remove the oil pan drain plug and oil pan drain plug gasket.



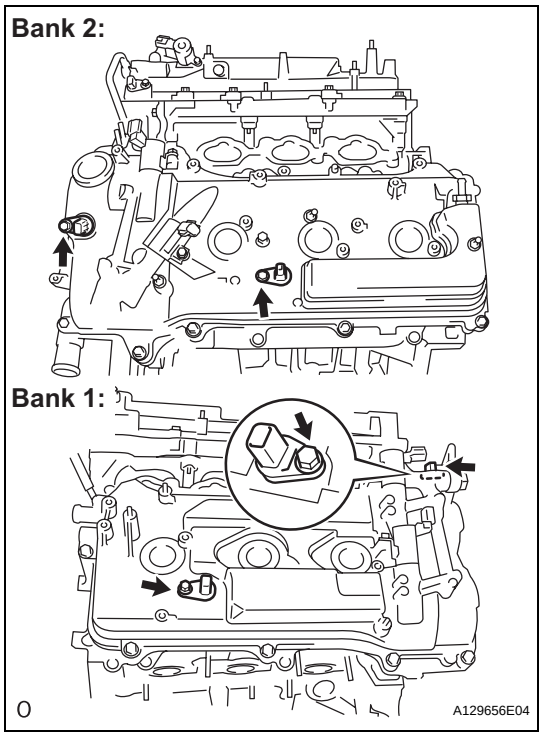
4. REMOVE VENTILATION VALVE SUB-ASSEMBLY

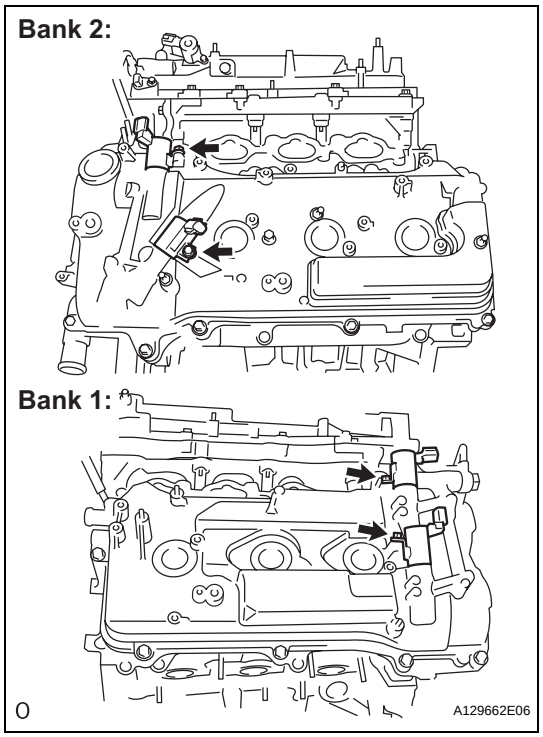
(a) Remove the ventilation valve sub-assembly.



5. REMOVE CAMSHAFT POSITION SENSOR

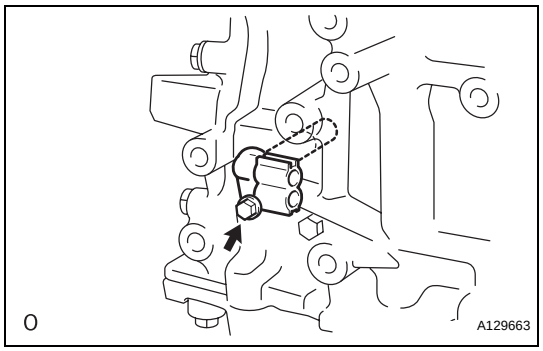
(a) Remove the 4 bolts and 4 camshaft position sensors.





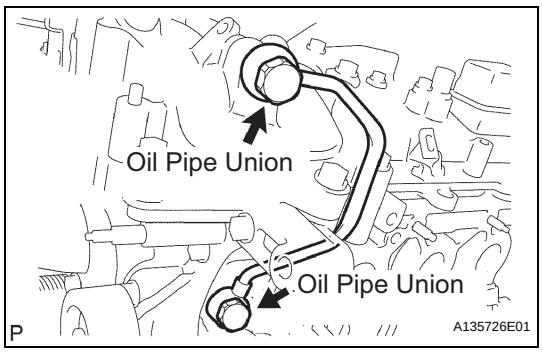
6. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

(a) Remove the 4 bolts and 4 camshaft oil control valves.



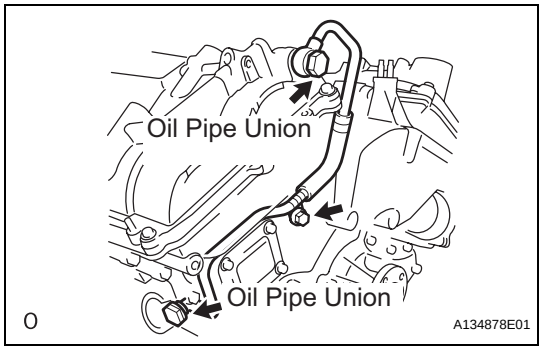
7. REMOVE CRANKSHAFT POSITION SENSOR

(a) Remove the bolt and crankshaft position sensor.



8. REMOVE NO. 1 OIL PIPE

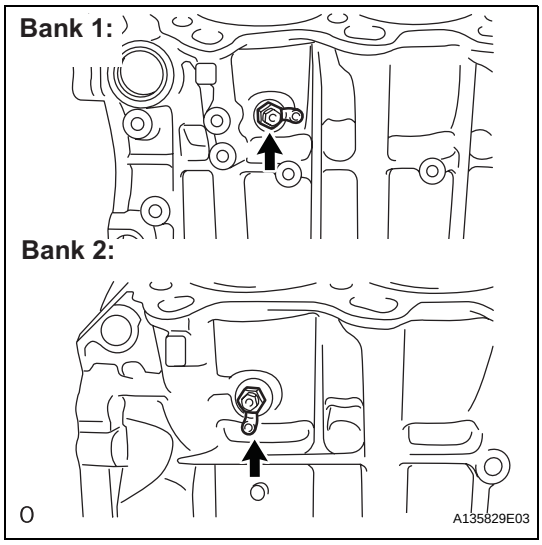
(a) Remove the 2 oil pipe unions, gaskets and oil pipe.
(b) Remove the oil control valve filter LH and gaskets.



9. REMOVE OIL PIPE

(a) Remove the bolt.
(b) Remove the 2 oil pipe unions and oil pipe.
(c) Remove the oil control valve filter RH and gaskets.

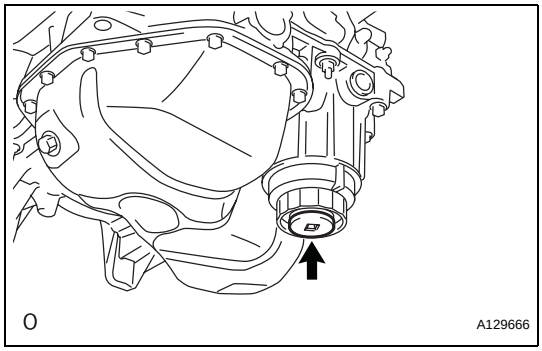
EM



10. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

(a) Remove the cylinder block water drain cocks from the cylinder block.

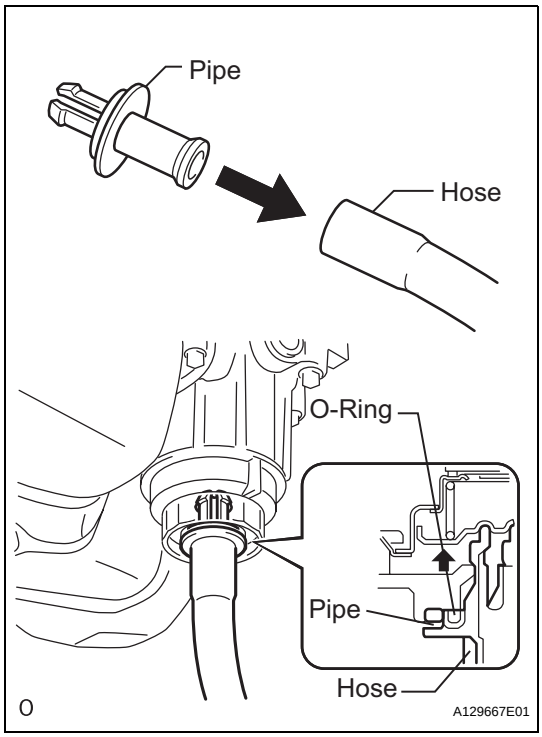
(b) Remove the cylinder block water drain cock plugs from the water drain cocks.



11. REMOVE OIL FILTER ELEMENT

(a) Remove the drain plug.

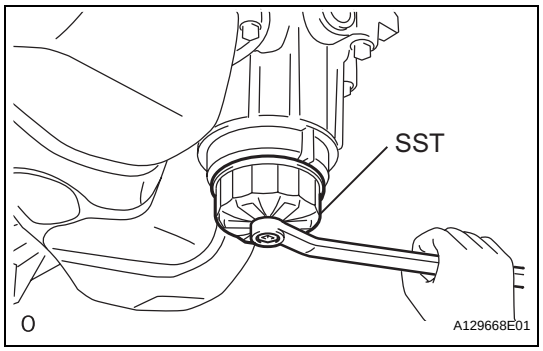
NOTICE:
Do not remove the O-ring from the oil filter cap.



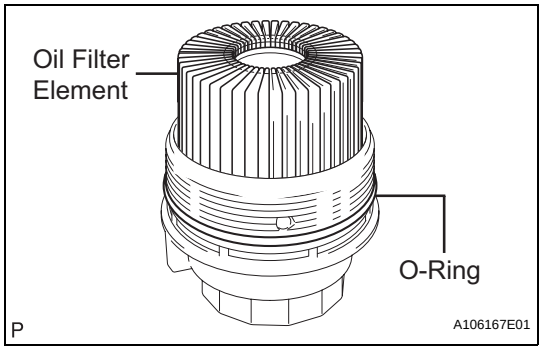
(b) Connect the hose to the pipe.

(c) Insert the pipe with the hose into the oil filter cap.

(d) Make sure that the oil is completely drained and remove the pipe and O-ring.

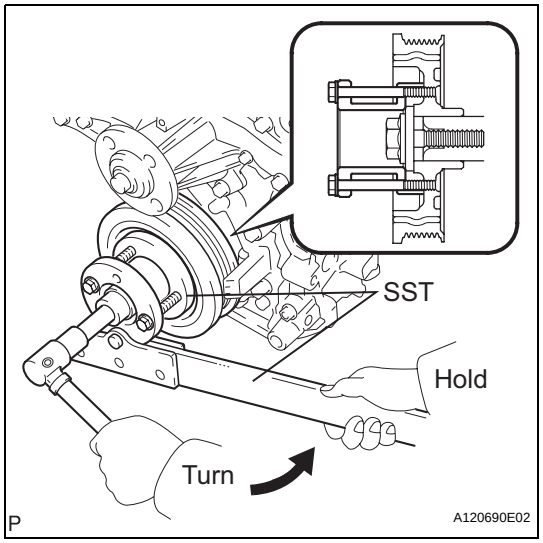


(e) Using SST, remove the oil filter cap sub-assembly.
SST 09228-06501



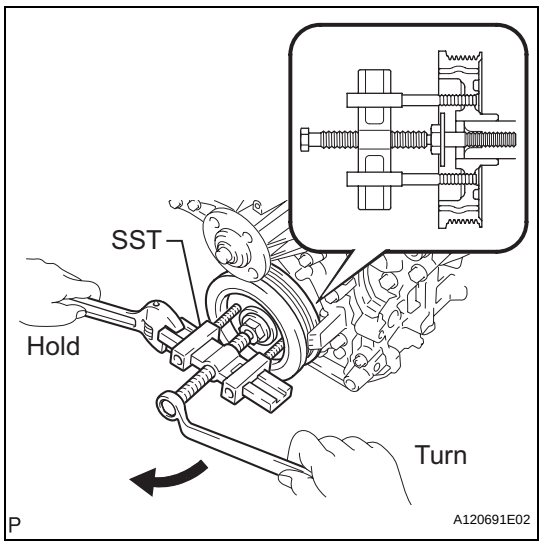
(f) Remove the oil filter element and O-ring from the oil filter cap sub-assembly.
NOTICE:
Do not use any tools when removing the O-ring to prevent the O-ring groove from being damaged.

EM

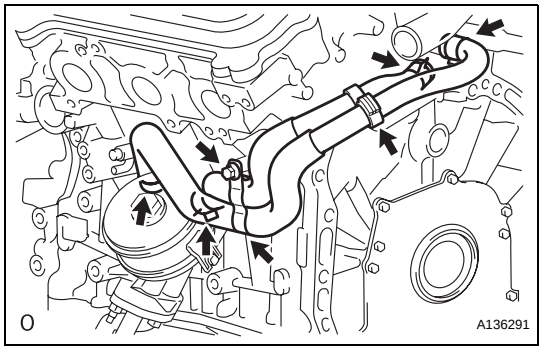


12. REMOVE CRANKSHAFT PULLEY

(a) Using SST, loosen the crankshaft pulley bolt.
SST 09213-70011 (09213-70020), 09330-00021

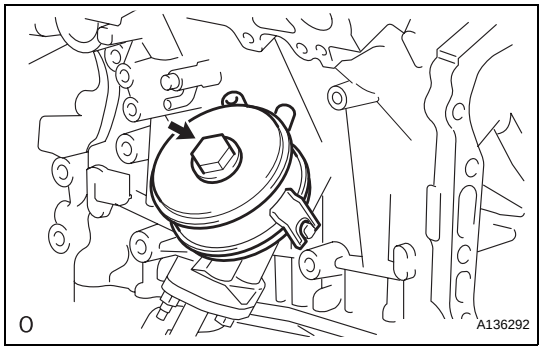


(b) Using SST, remove the crankshaft pulley bolt and crankshaft pulley.
SST 09950-50013 (09951-05010, 09952-05010, 09953-05020, 09954-05021)

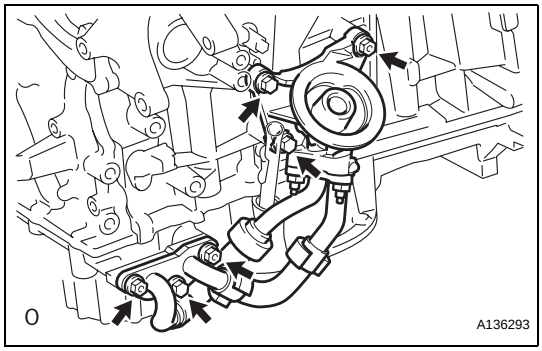


13. REMOVE OIL COOLER ASSEMBLY

(a) Remove the bolt, 2 clamps, and 4 clips and disconnect the 2 water by-pass hoses.

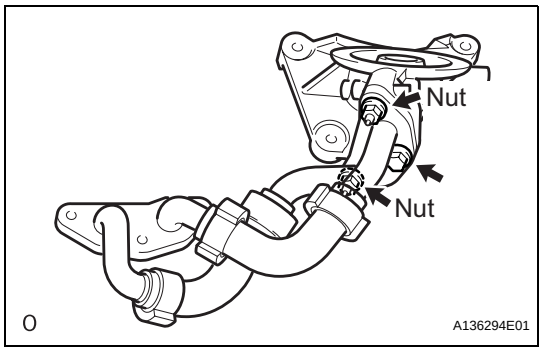


(b) Remove the union bolt, oil cooler assembly, and O-ring.



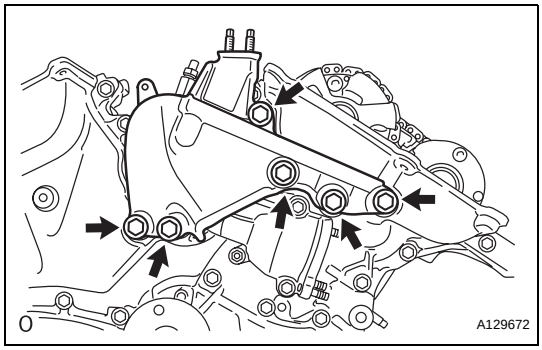
14. REMOVE NO. 1 OIL COOLER BRACKET

(a) Remove the 3 bolts, 3 nuts, and oil cooler pipe with No. 1 oil cooler bracket.



(b) Remove the bolt, 2 nuts, No. 1 oil cooler bracket, and gasket.

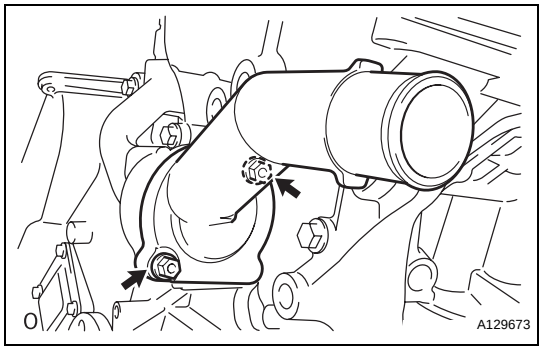
(c) Using a "TORX" socket wrench E8, remove the 2 stud bolts.



15. REMOVE NO. 1 FRONT ENGINE MOUNTING BRACKET LH

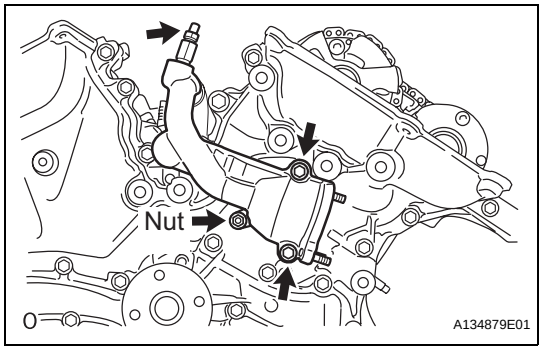
(a) Remove the 6 bolts and No. 1 front engine mounting bracket LH.

(b) Using a "TORX" socket wrench E8, remove the 2 stud bolts.

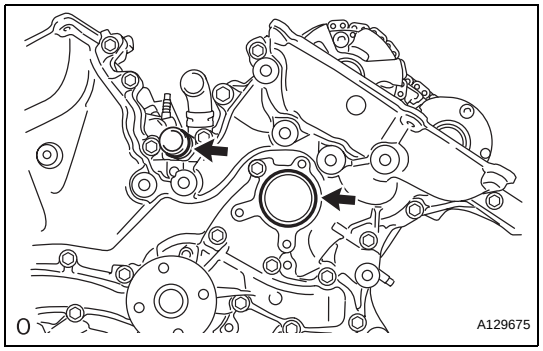


16. REMOVE WATER INLET HOUSING

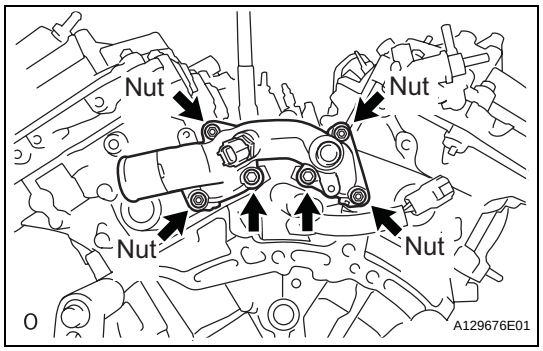
(a) Remove the 2 nuts, water inlet and thermostat.
(b) Remove the gasket.
(c) Remove the drain cock plug.
(d) Remove the drain cock assembly.
(e) Remove the 2 stud bolts.
(f) Separate the No. 1 water by-pass hose.



(g) Remove the 2 bolts, nut, and water inlet housing.

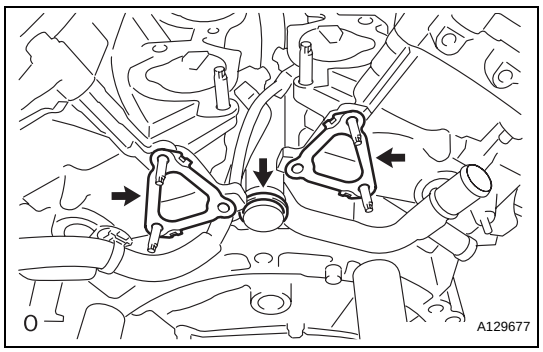


(h) Remove the 2 O-rings.

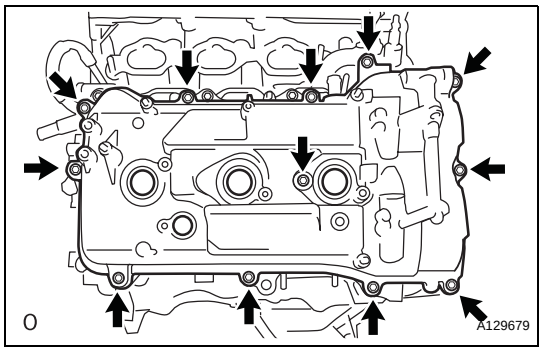


17. REMOVE WATER OUTLET

(a) Remove the 2 bolts, 4 nuts and water outlet.

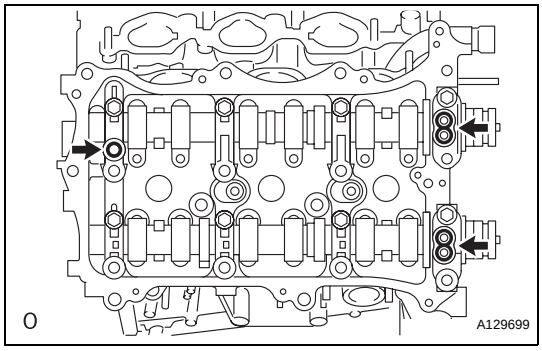


(b) Remove the 2 gaskets and O-ring.

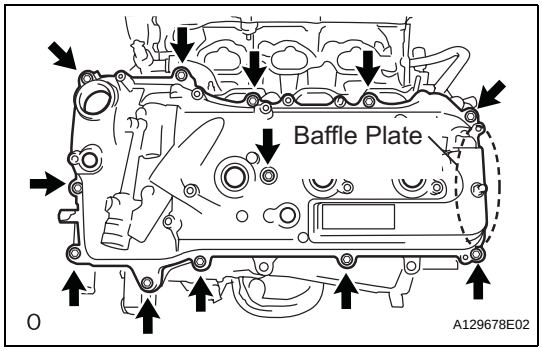


18. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)

(a) Remove the 12 bolts, seal washer, cylinder head cover sub-assembly and cylinder head cover gasket.



(b) Remove the 3 gaskets.

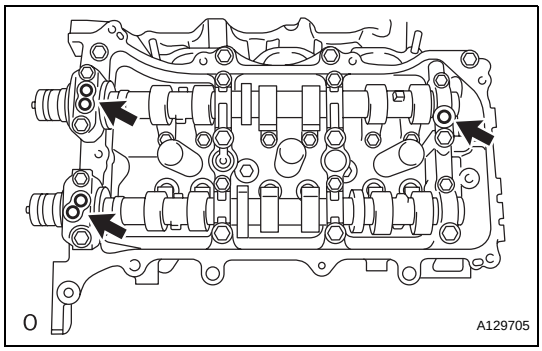


19. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 2)

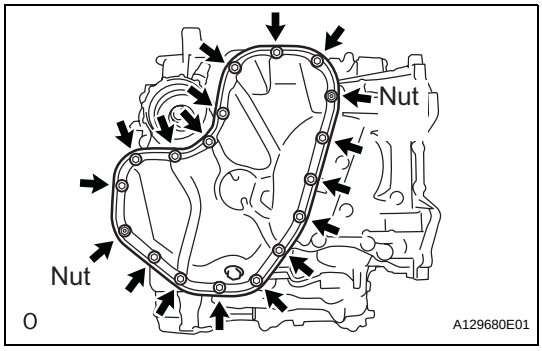
(a) Remove the 12 bolts, seal washer, cylinder head cover sub-assembly and cylinder head cover gasket.

NOTICE:

The baffle plate is located on the back of the portion shown in the illustration. Do not damage the baffle plate when removing the head cover.

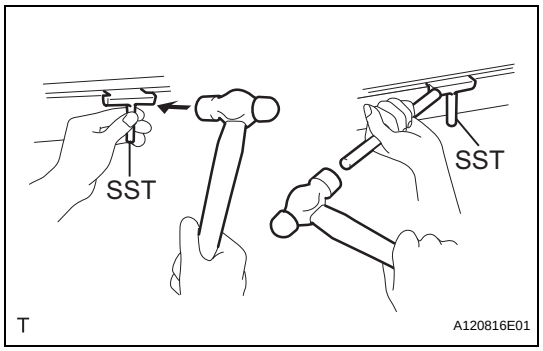


(b) Remove the 3 gaskets.



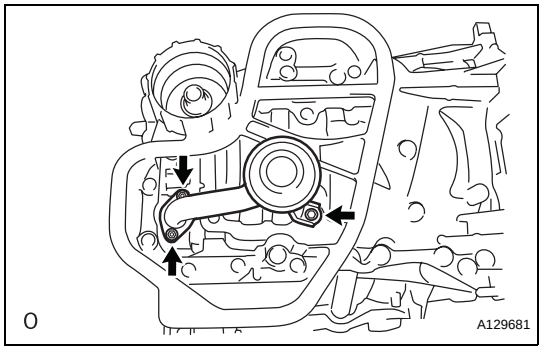
20. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

(a) Remove the 16 bolts and 2 nuts.



(b) Insert the blade of SST between the oil pans. Cut through the applied sealer and remove the No. 2 oil pan sub-assembly.
SST 09032-00100
NOTICE:
Be careful not to damage the contact surfaces of the oil pans.

(c) Using a "TORX" socket wrench E6, remove the 2 stud bolts.

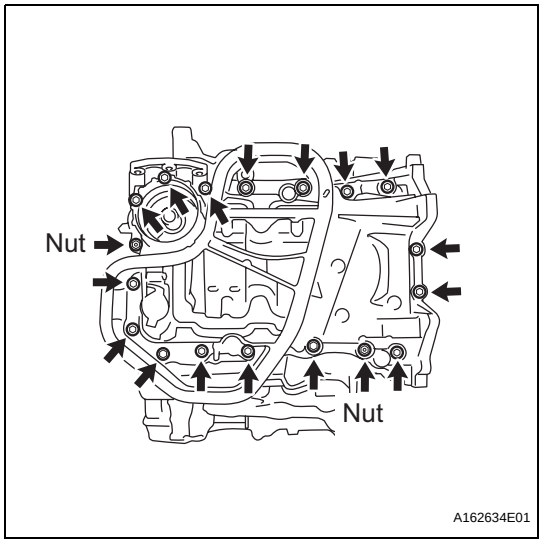


21. REMOVE OIL STRAINER SUB-ASSEMBLY

(a) Remove the bolt, 2 nuts, oil strainer sub-assembly and gasket.

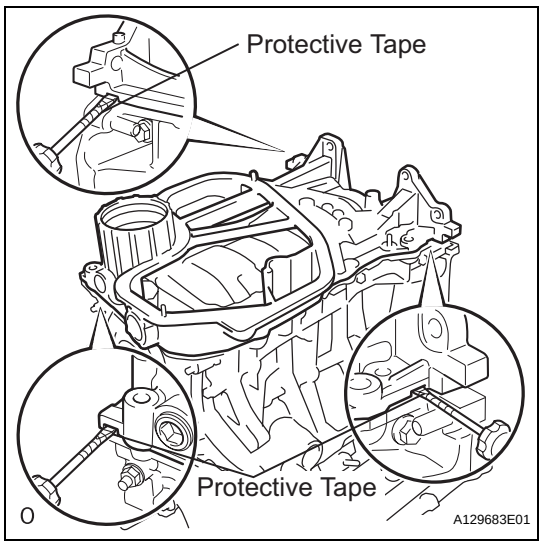
(b) Using a "TORX" socket wrench E6, remove the 2 stud bolts.

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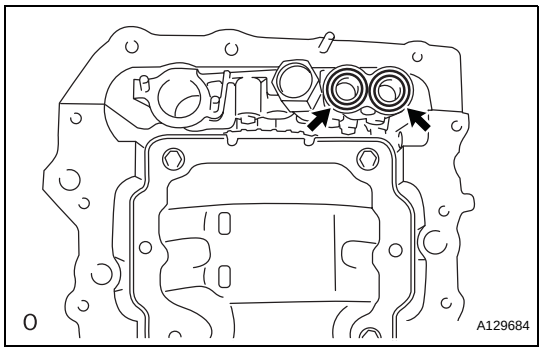


22. REMOVE OIL PAN SUB-ASSEMBLY

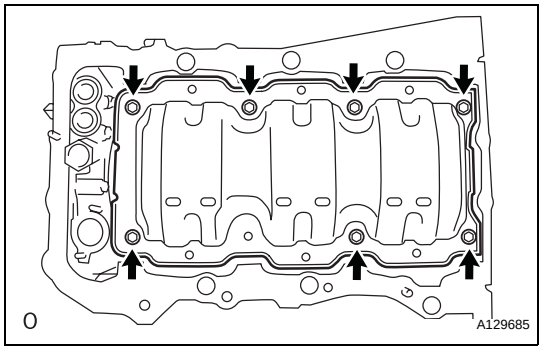
(a) Remove the 16 bolts and 2 nuts.
HINT:
Be sure to clean the bolts and stud bolts and check the threads for cracks or other damage.



(b) Remove the oil pan sub-assembly by prying between the oil pan sub-assembly and cylinder block sub-assembly with a screwdriver.
NOTICE:
Be careful not to damage the contact surfaces of the cylinder block and oil pan.
HINT:
Tape the screwdriver tip before use.

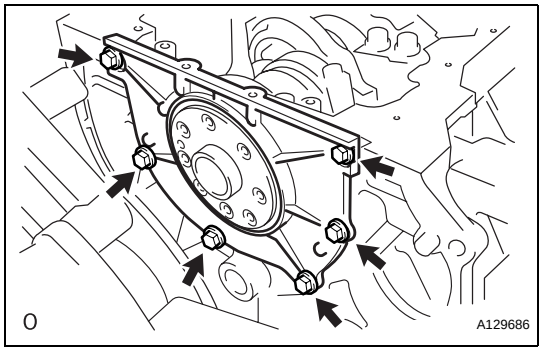


(c) Remove the 2 O-rings.
(d) Using a "TORX" socket wrench E8, remove the 2 stud bolts.



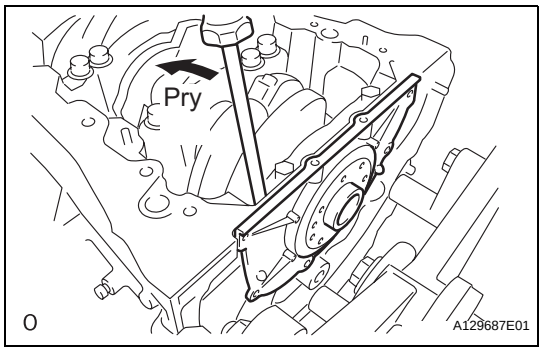
23. REMOVE OIL PAN BAFFLE PLATE

(a) Remove the 7 bolts and oil pan baffle plate.

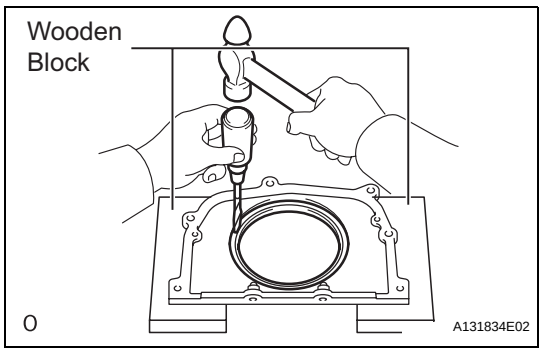


24. REMOVE ENGINE REAR OIL SEAL RETAINER

(a) Remove the 6 bolts.

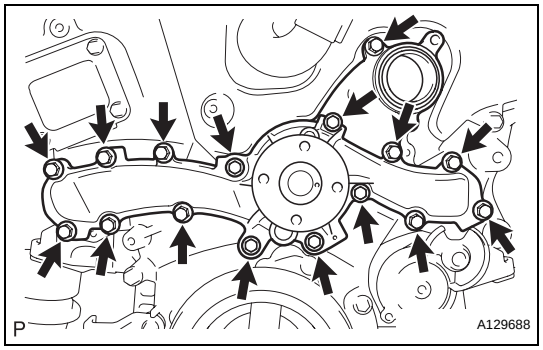


(b) Using a screwdriver, pry out the engine rear oil seal retainer.
NOTICE:
Be careful not to damage the engine rear oil seal retainer.
HINT:
Tape the screwdriver tip before use.



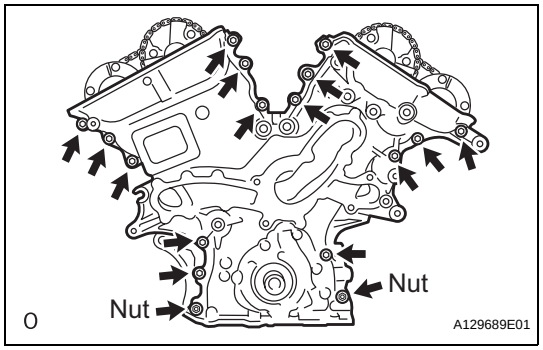
25. REMOVE ENGINE REAR OIL SEAL

(a) Place the oil seal retainer on wooden blocks.
NOTICE:
Be careful not to damage the engine rear oil seal retainer.
(b) Using a screwdriver and a hammer, tap out the oil seal.
HINT:
Tape the screwdriver tip before use.



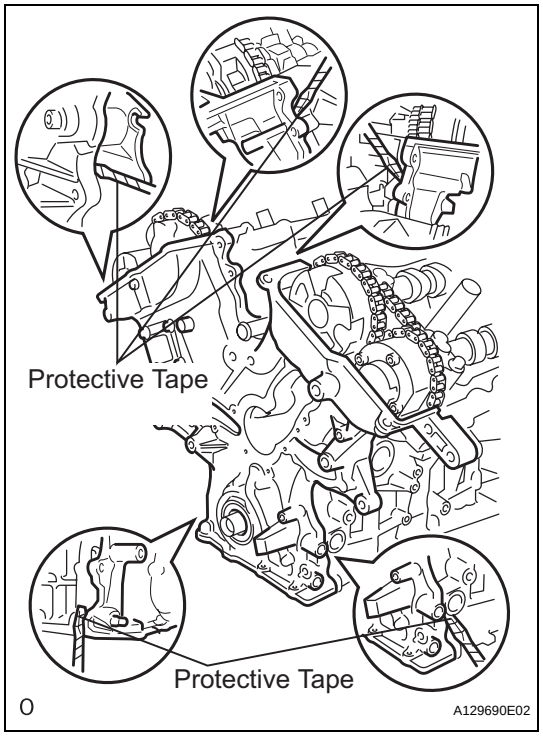
26. REMOVE WATER PUMP ASSEMBLY

(a) Remove the 16 bolts, water pump assembly and gasket.



27. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY

(a) Remove the 15 bolts and 2 nuts as shown in the illustration.



(b) Remove the timing chain cover sub-assembly by prying between the timing chain cover and cylinder head sub-assembly or cylinder block sub-assembly with a screwdriver.

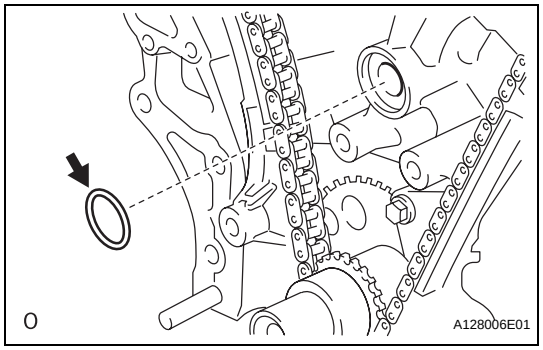
NOTICE:

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

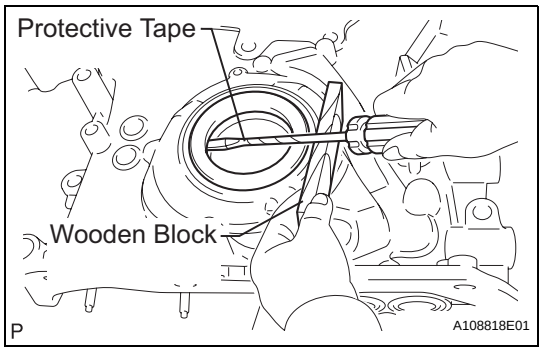
HINT:

Tape the screwdriver tip before use.

(c) Remove the 4 bolts, chain cover plate and chain cover plate gasket.



(d) Remove the gasket.

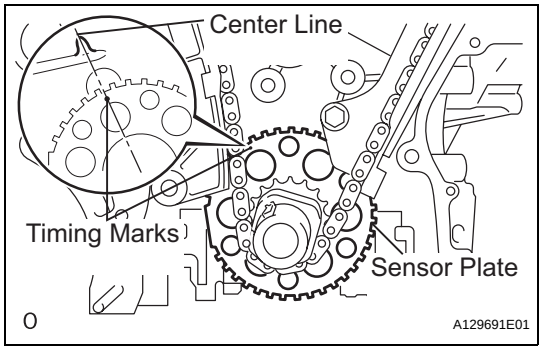


28. REMOVE TIMING CHAIN CASE OIL SEAL

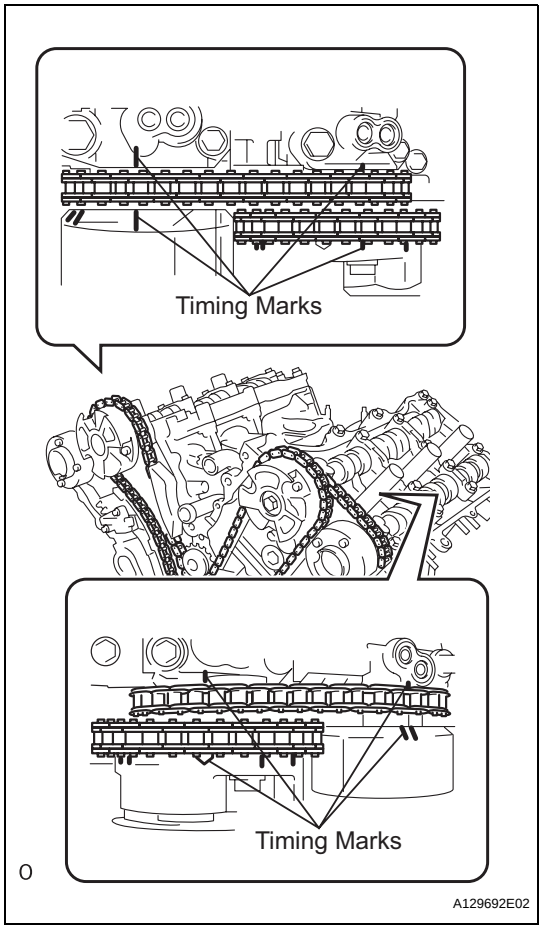
(a) Using a screwdriver, pry out the timing chain case oil seal.
HINT:
Tape the screwdriver tip before use.

29. SET NO. 1 CYLINDER TO TDC / COMPRESSION

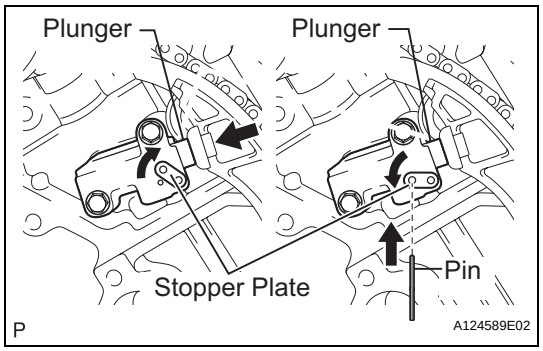
(a) Temporarily tighten the pulley set bolt.



(b) Set the timing mark on the crank angle sensor plate to the RH block bore center line (TDC / compression).



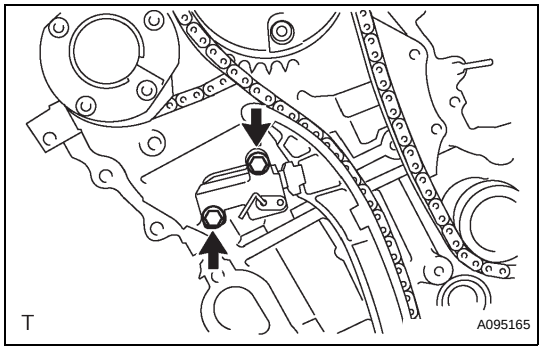
(c) Check that the timing marks of the camshaft timing gears are aligned with those of the bearing cap as shown in the illustration.
If not, turn the crankshaft 1 revolution (360°) and align the timing marks as above.



30. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

(a) Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.

(b) Move the stopper plate downward to set the lock, and insert a pin of ϕ1.27 mm (0.05 in.) into the stopper plate's hole.

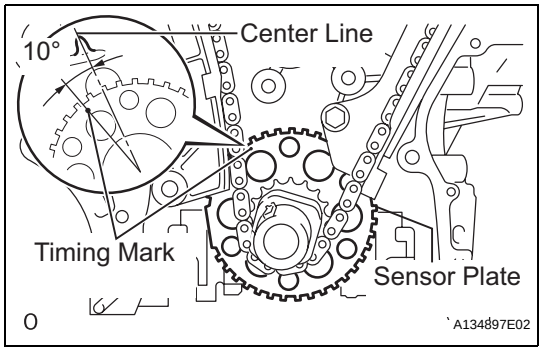


(c) Remove the 2 bolts and No. 1 chain tensioner assembly.

31. REMOVE CHAIN TENSIONER SLIPPER

(a) Remove the chain tensioner slipper.

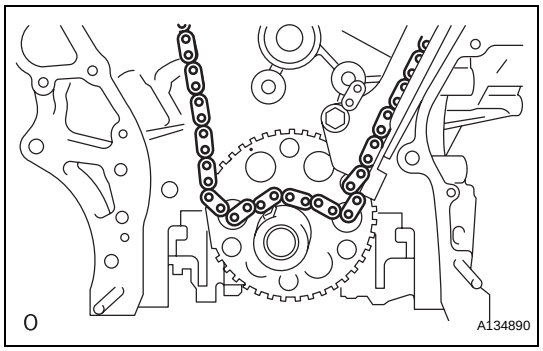
EM



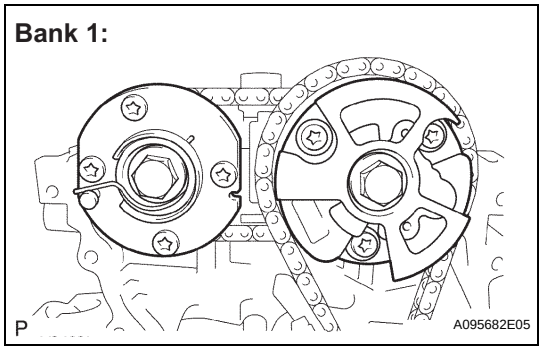
32. REMOVE CHAIN SUB-ASSEMBLY

(a) Turn the crankshaft counterclockwise 10° to loosen the chain sub-assembly of the crankshaft timing sprocket.

(b) Remove the pulley set bolt.

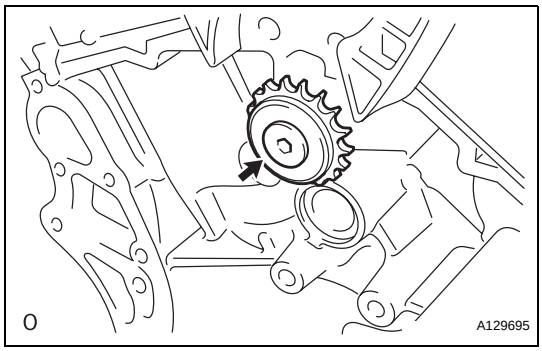


(c) Remove the chain sub-assembly from the crankshaft timing sprocket and place it on the crankshaft.



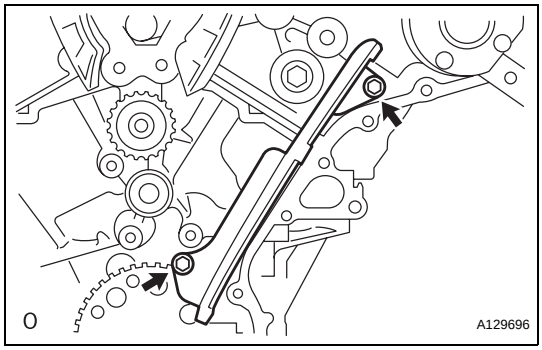
(d) Turn the camshaft timing gear assembly on the bank 1 clockwise (approximately 60°) and set it as shown in the illustration. Be sure to loosen the chain between the banks.

(e) Remove the chain.



33. REMOVE IDLE SPROCKET ASSEMBLY

(a) Using a 10 mm hexagon wrench, remove the No. 2 idle gear shaft, idle sprocket assembly and No. 1 idle gear shaft.

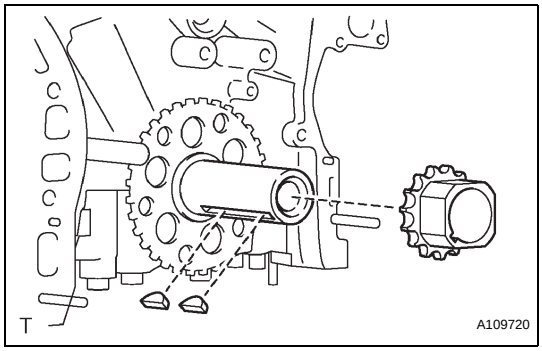


34. REMOVE NO. 1 CHAIN VIBRATION DAMPER

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

35. REMOVE NO. 2 CHAIN VIBRATION DAMPER

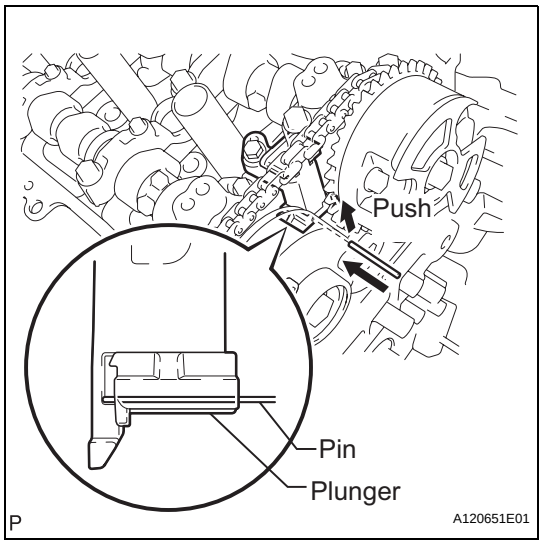
(a) Remove the 2 No. 2 chain vibration dampers.



36. REMOVE CRANKSHAFT TIMING SPROCKET

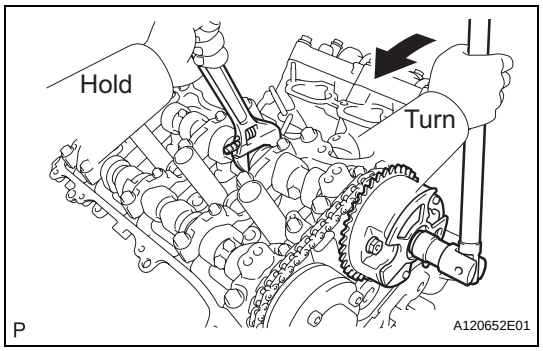
(a) Remove the crankshaft timing sprocket from the crankshaft.

(b) Remove the 2 keys from the crankshaft.



37. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

(a) While raising the No. 2 chain tensioner assembly, insert a pin of ϕ1.0 mm (0.039 in.) into the hole to fix the No. 2 chain tensioner.

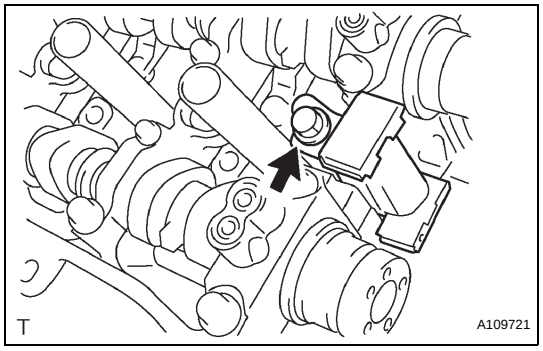


(b) Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts and 2 camshaft timing gear assemblies.

NOTICE:

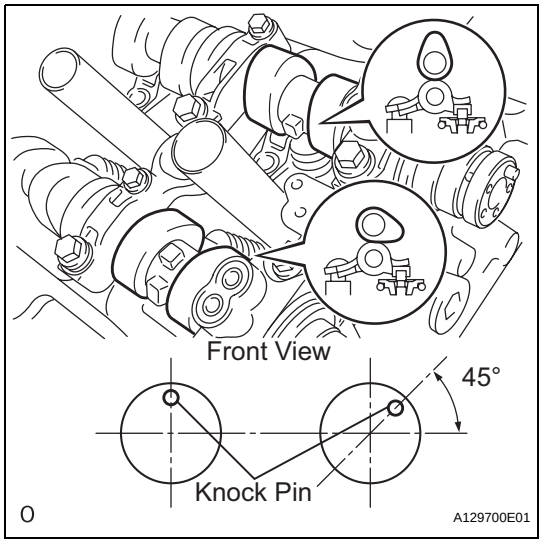
- **Be careful not to damage the cylinder head with the wrench.**
- **Do not disassemble the camshaft timing gear assemblies.**

(c) Remove the No. 2 chain assembly.



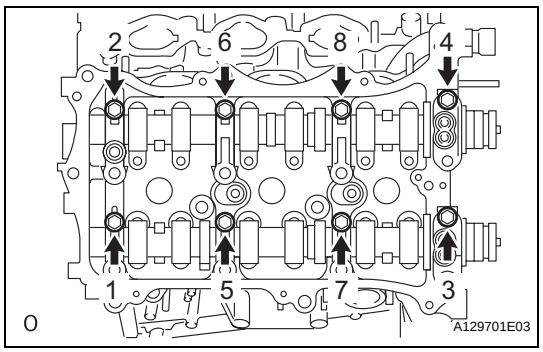
38. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

(a) Remove the bolt and No. 2 chain tensioner assembly.

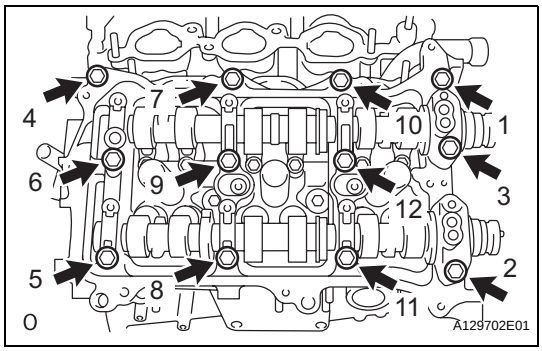


39. REMOVE CAMSHAFT BEARING CAP (for Bank 1)

(a) Check that the camshafts are positioned as shown in the illustration.



(b) Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

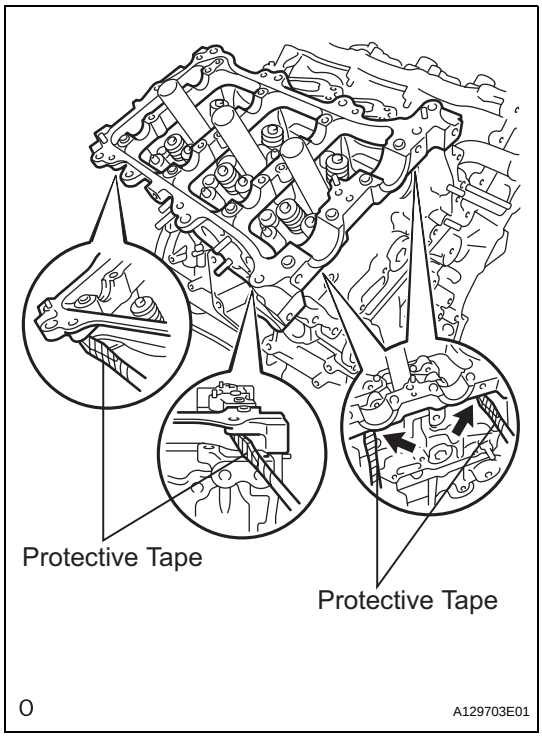


(c) Uniformly loosen and remove the 12 bearing cap bolts in the sequence shown in the illustration.
NOTICE:
Uniformly loosen the bolts while keeping the camshaft level.
(d) Remove the 5 bearing caps.

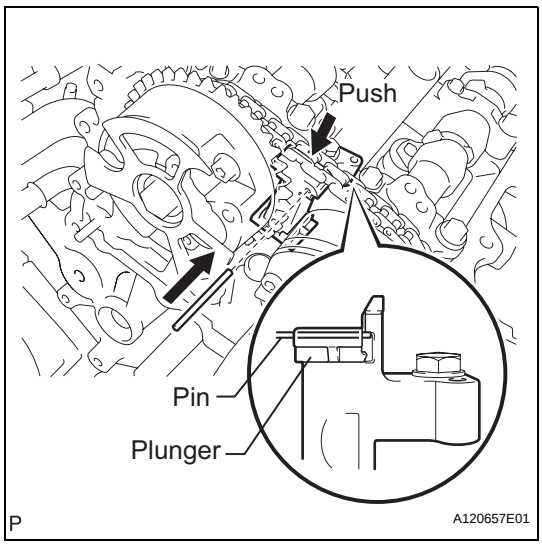
40. REMOVE CAMSHAFT
(a) Remove the camshaft.

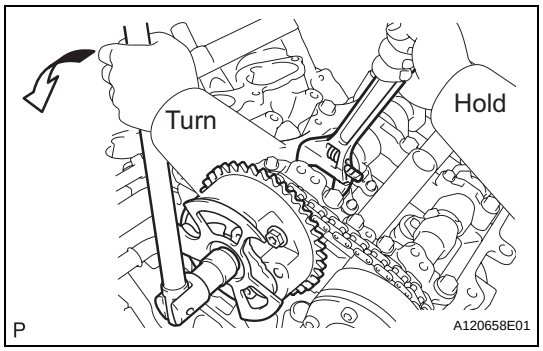
41. REMOVE NO. 2 CAMSHAFT
(a) Remove the No. 2 camshaft.

42. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH
(a) Remove the camshaft housing sub-assembly RH by prying between the cylinder head and camshaft housing sub-assembly RH with a screwdriver.
NOTICE:
Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.
HINT:
Tape the screwdriver tip before use.



43. REMOVE CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)
(a) While pushing down the No. 3 chain tensioner assembly, insert a pin of ϕ1.0 mm (0.039 in.) into the hole to fix the No. 3 chain tensioner assembly.



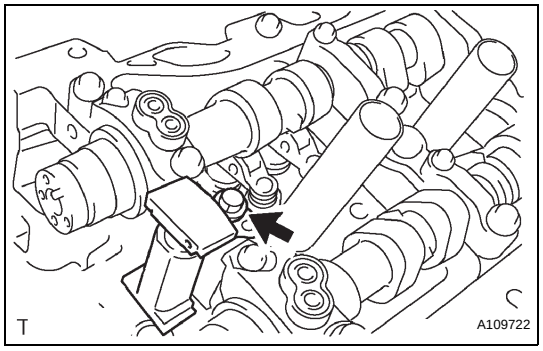


(b) Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts and 2 camshaft timing gear assemblies.

NOTICE:

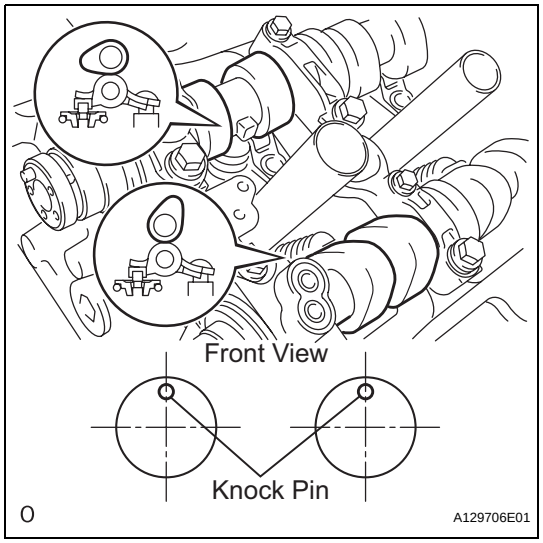
- **Be careful not to damage the cylinder head with the wrench.**
- **Do not disassemble the camshaft timing gear assemblies.**

(c) Remove the No. 2 chain sub-assembly.



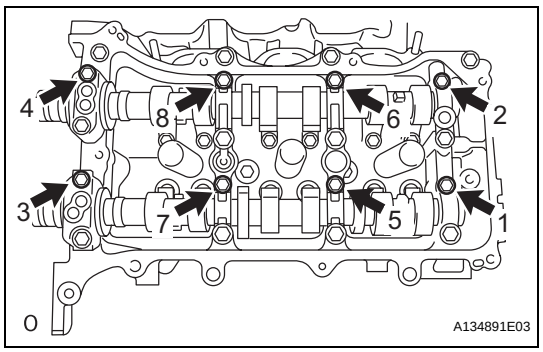
44. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

(a) Remove the bolt and No. 3 chain tensioner assembly.

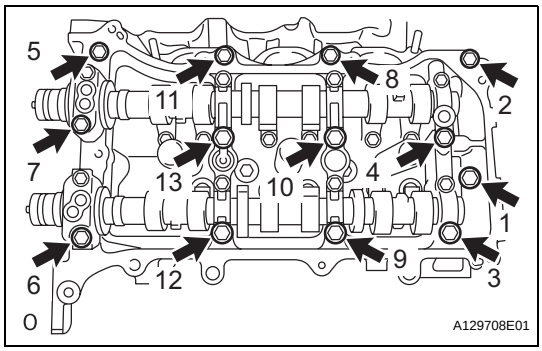


45. REMOVE CAMSHAFT BEARING CAP (for Bank 2)

(a) Check that the camshafts are positioned as shown in the illustration.



(b) Uniformly loosen and remove the 8 bearing cap bolts in the sequence shown in the illustration.

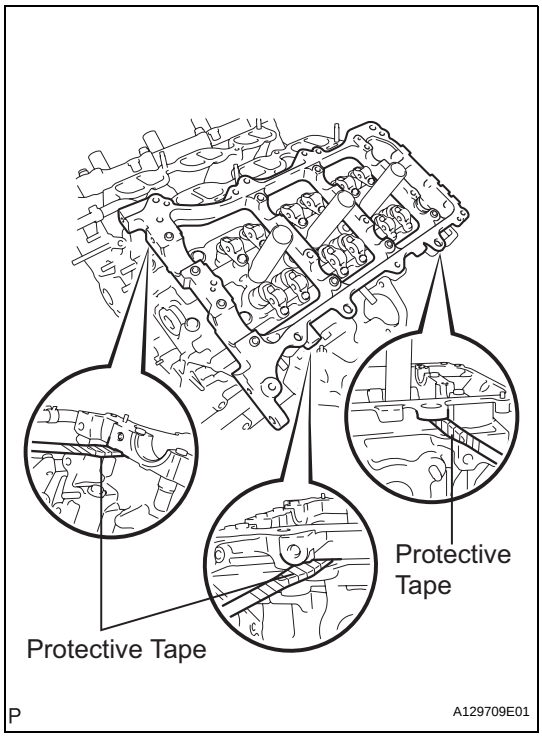


(c) Uniformly loosen and remove the 13 bearing cap bolts in the sequence shown in the illustration.
NOTICE:
Uniformly loosen the bolts while keeping the camshaft level.
(d) Remove the 5 bearing caps.

46. REMOVE NO. 3 CAMSHAFT
(a) Remove the No. 3 camshaft.

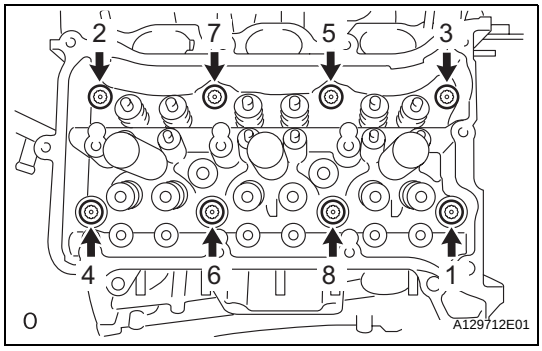
47. REMOVE NO. 4 CAMSHAFT
(a) Remove the No. 4 camshaft.

48. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH
(a) Remove the camshaft housing sub-assembly LH by prying between the cylinder head and camshaft housing sub-assembly LH with a screwdriver.
NOTICE:
Be careful not to damage the contact surfaces of the cylinder head and camshaft housing.
HINT:
Tape the screwdriver tip before use.



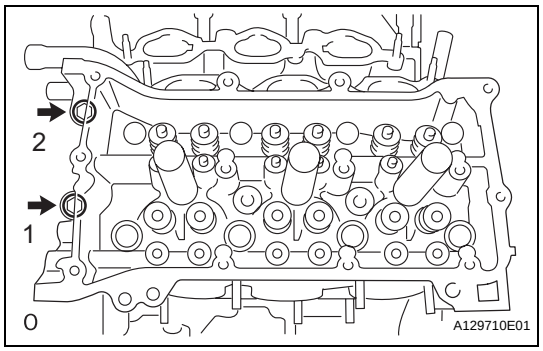
49. REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY
(a) Remove the 24 No. 1 valve rocker arm sub-assemblies.
HINT:
Arrange the removed parts in the correct order.

50. REMOVE VALVE LASH ADJUSTER ASSEMBLY
(a) Remove the 24 valve lash adjuster assemblies from the cylinder head.
HINT:
Arrange the removed parts in the correct order.



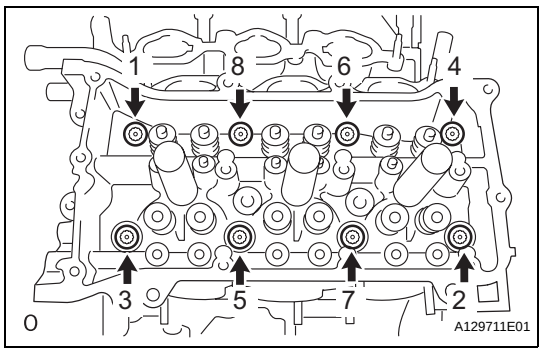
51. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH
(a) Using a 10 mm bi-hexagon wrench, uniformly loosen the 8 bolts in the sequence shown in the illustration. Remove the 8 cylinder head bolts and plate washers.
NOTICE:
- **Be careful not to drop washers into the cylinder head.**
- **Cylinder head warpage or cracking could result from removing bolts in an incorrect order.**

HINT:
Be sure to keep separate the removed parts for each installation position.
(b) Remove the cylinder head sub-assembly RH and cylinder head gasket.



52. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH

(a) Uniformly loosen and remove the cylinder head set bolts in the sequence shown in the illustration.



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

NOTICE:

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

HINT:

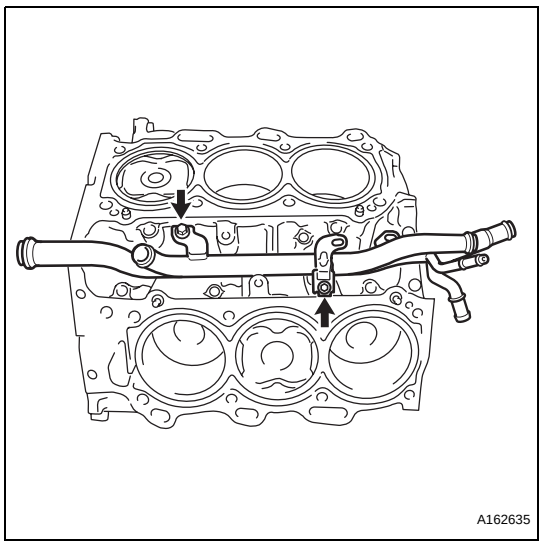
Be sure to keep separate the removed parts for each installation position.

(c) Remove the cylinder head sub-assembly LH and No. 2 cylinder head gasket.

53. REMOVE WATER INLET PIPE

(a) Remove 2 clamps and separate the No. 1 water by-pass hose.

(b) Remove the 2 bolts and water inlet pipe.



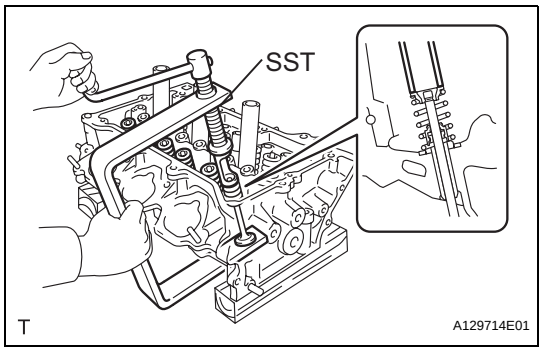
54. REMOVE VALVE STEM CAP

(a) Remove the valve stem caps from the cylinder heads.

HINT:

Arrange the removed parts in the correct order.

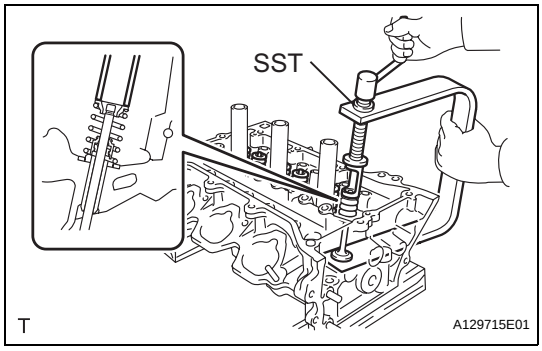
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55. REMOVE INTAKE VALVE

(a) Using SST, compress the inner compression spring and remove the valve spring retainer locks.
SST 09202-70020 (09202-00010)

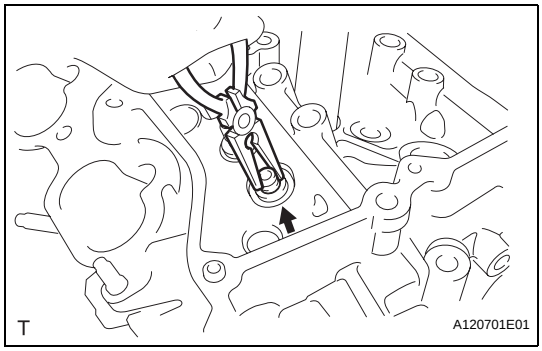
(b) Remove the valve spring retainer, inner compression spring and intake valve.
HINT:
Arrange the removed parts in the correct order.



56. REMOVE EXHAUST VALVE

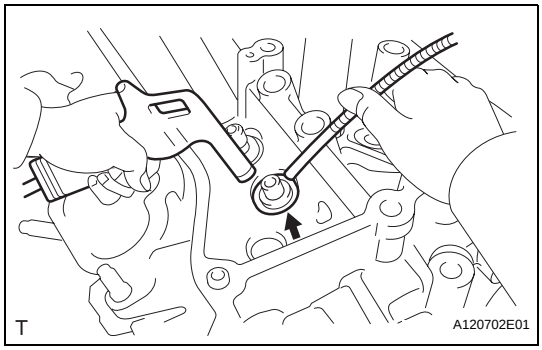
(a) Using SST, compress the inner compression spring and remove the valve spring retainer locks.
SST 09202-70020 (09202-00010)

(b) Remove the valve spring retainer, inner compression spring and exhaust valve.
HINT:
Arrange the removed parts in the correct order.



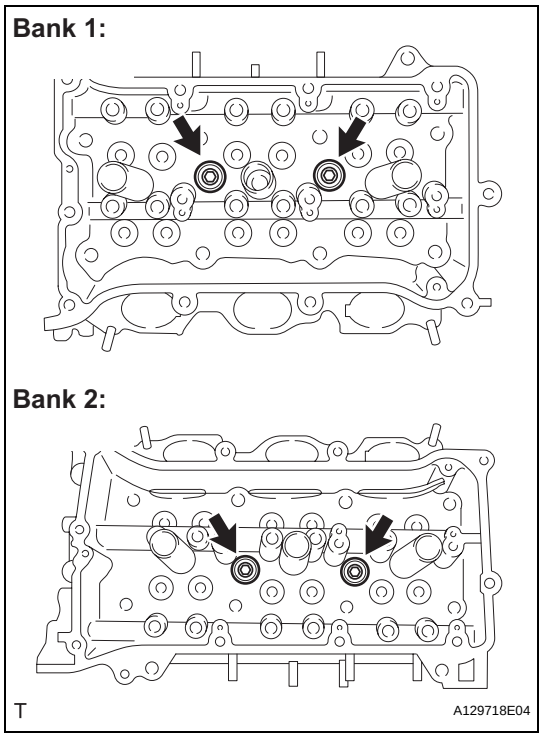
57. REMOVE VALVE STEM OIL SEAL

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



58. REMOVE VALVE SPRING SEAT

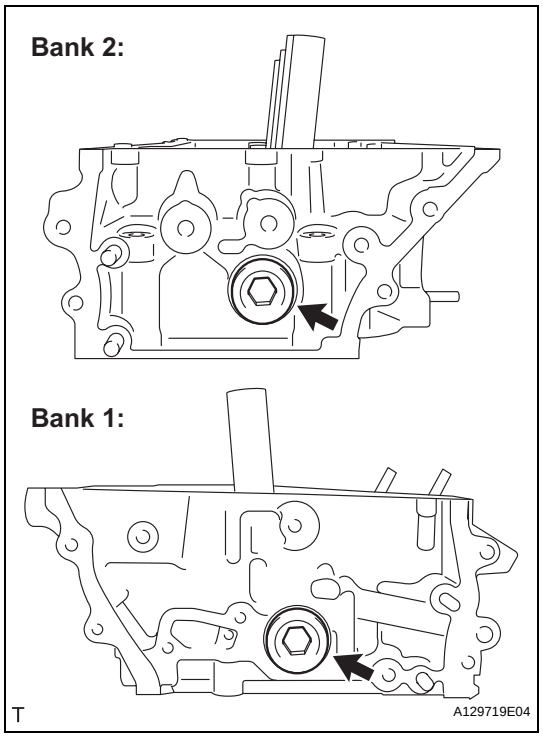
(a) Using compressed air and a magnetic finger, remove the valve spring seats by blowing air onto them.



59. REMOVE NO. 1 STRAIGHT SCREW PLUG

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

NOTICE:
If water leaks from the straight screw plug or the plug corrodes, replace it.



60. REMOVE NO. 2 STRAIGHT SCREW PLUG

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

NOTICE:
If water leaks from the straight screw plug or the plug corrodes, replace it.

61. REMOVE RING PIN

NOTICE:
It is not necessary to remove the ring pin unless it is being replaced.

62. REMOVE STUD BOLT

NOTICE:
If the stud bolt is deformed or the threads are damaged, replace it.

63. REMOVE STRAIGHT PIN

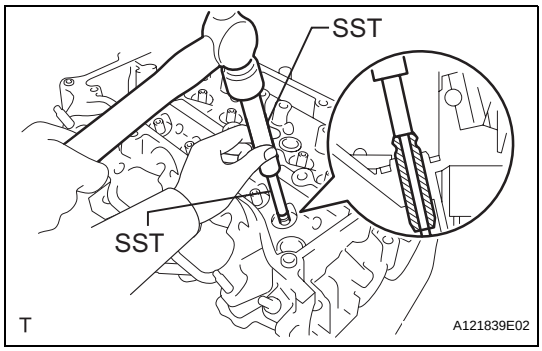
NOTICE:
If the straight pin is deformed or the threads are damaged, replace it.

64. REMOVE INTAKE VALVE GUIDE BUSH

(a) Heat the cylinder head to 80 to 100°C (176 to 212°F).

(b) Place the cylinder head on wooden blocks.

EM

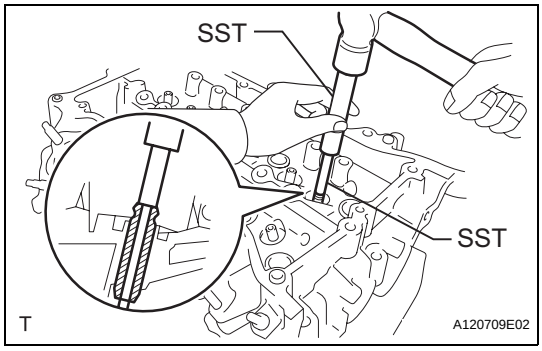


(c) Using SST and a hammer, tap out the intake valve guide bushes.
SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

65. REMOVE EXHAUST VALVE GUIDE BUSH

(a) Heat the cylinder head to 80 to 100°C (176 to 212°F).

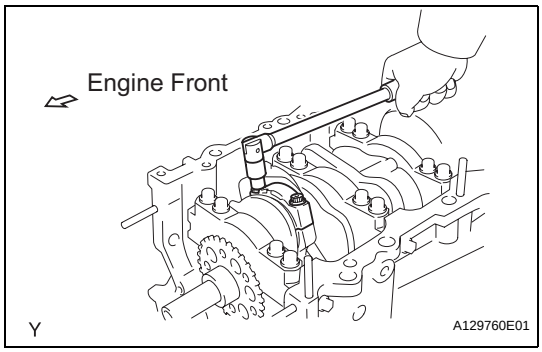
(b) Place the cylinder head on wooden blocks.



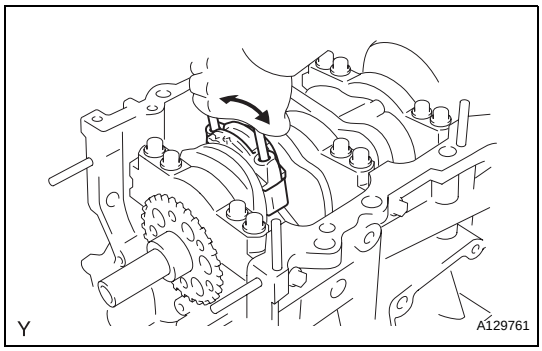
(c) Using SST and a hammer, tap out the exhaust valve guide bushes.
SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

66. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

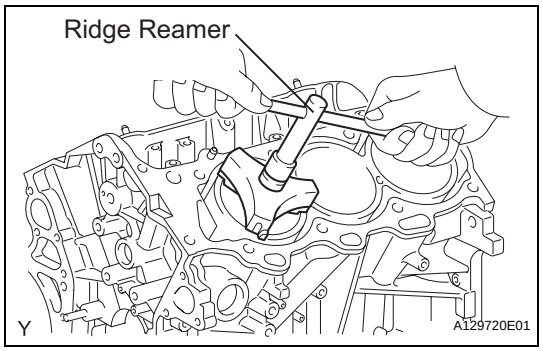
(a) Check that the matchmarks on the connecting rod sub-assembly and connecting rod cap are aligned.
HINT:
The matchmarks on the connecting rod sub-assembly and connecting rod cap are for ensuring the correct reassembly.



(b) Remove the 2 connecting rod cap bolts.



(c) Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.
HINT:
Keep the lower bearing inserted to the connecting rod cap.



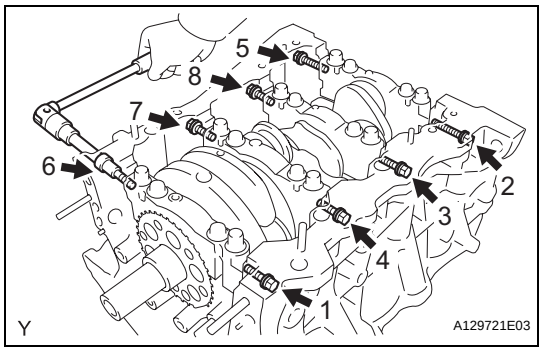
(d) Using a ridge reamer, remove all the carbon from the top of the cylinder.

(e) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.
HINT:
- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in the correct order.

67. REMOVE CONNECTING ROD BEARING

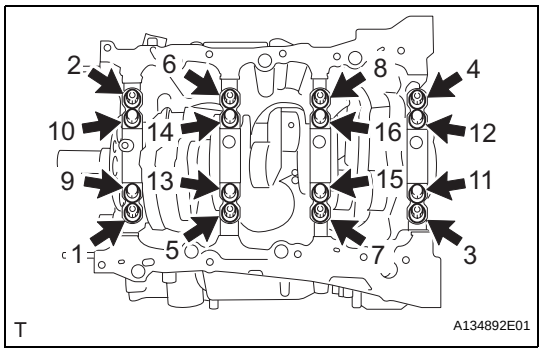
HINT:

Arrange the removed parts in the correct order.

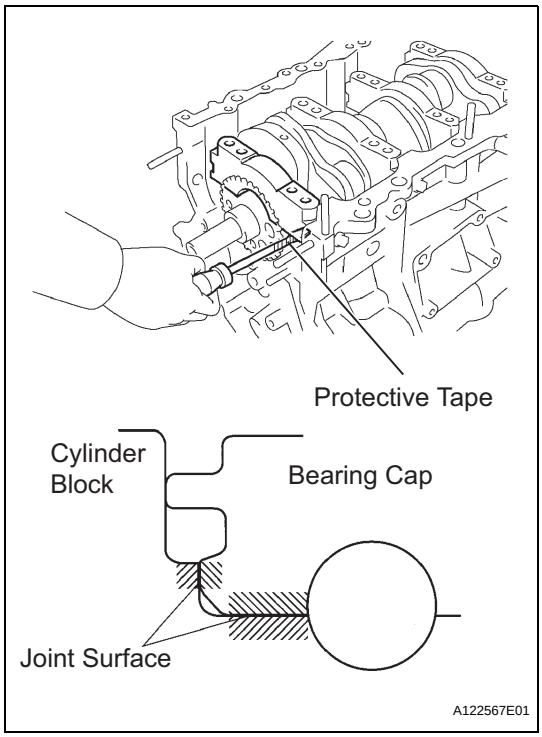


68. REMOVE CRANKSHAFT

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



(b) Uniformly loosen the 16 crankshaft bearing cap bolts, in several steps and in the sequence shown in the illustration.

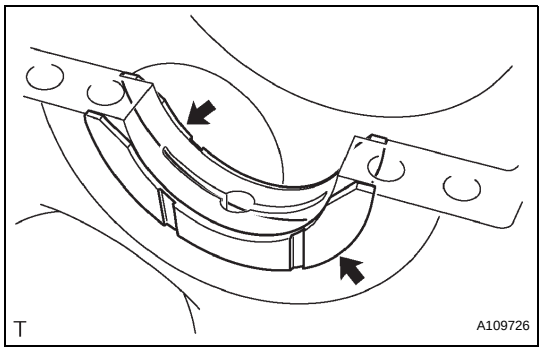


(c) Using a screwdriver, pry out the main bearing caps. Remove the 4 crankshaft bearing caps and lower crankshaft bearings.
NOTICE:
- **Push up on the cap little by little, from the right and left side alternately so that the cap can be removed.**
- **Be careful not to damage the joint surface of the cylinder block and the main bearing cap.**

(d) Remove the crankshaft.

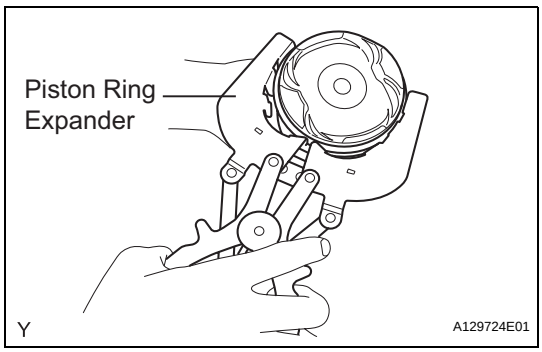
69. REMOVE CRANKSHAFT BEARING

(a) Remove the upper crankshaft bearing and lower crankshaft bearing.
HINT:
Arrange the removed parts in the correct order.



70. REMOVE CRANKSHAFT THRUST WASHER SET

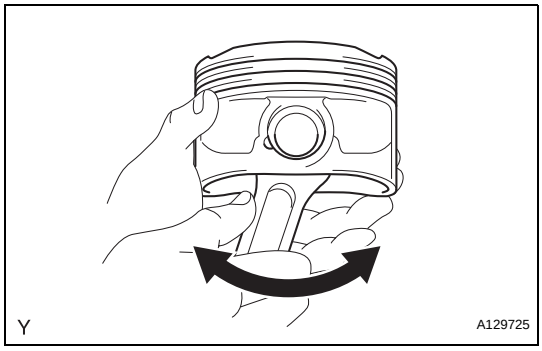
(a) Remove the upper crankshaft bearings and upper crankshaft thrust washers from the cylinder block sub-assembly.



71. REMOVE PISTON RING SET

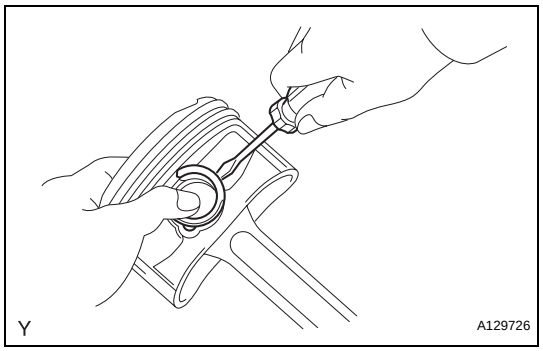
(a) Using a piston ring expander, remove the 2 compression rings.

(b) Remove the oil ring expander and 2 side rails by hand.
HINT:
Arrange the removed parts in the correct order.

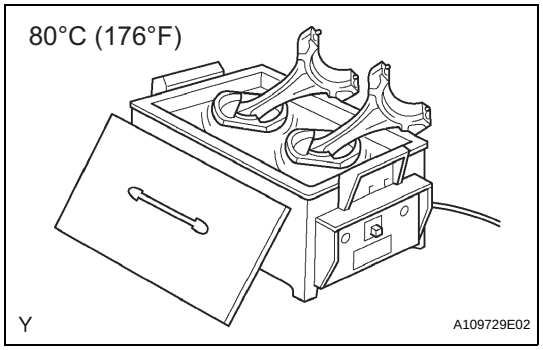


72. REMOVE PISTON SUB-ASSEMBLY WITH PIN

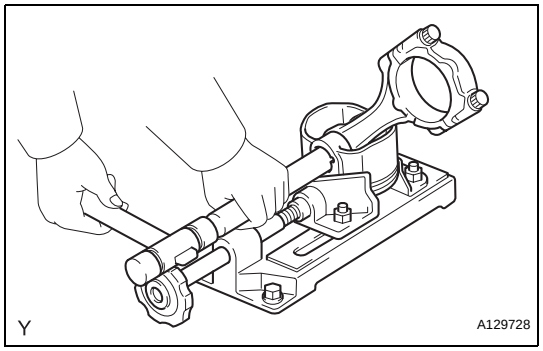
(a) Check the fitting condition between the piston and piston pin.
(1) Try to move the piston back and forth on the piston pin.
If any movement is felt, replace the piston and pin as a set.



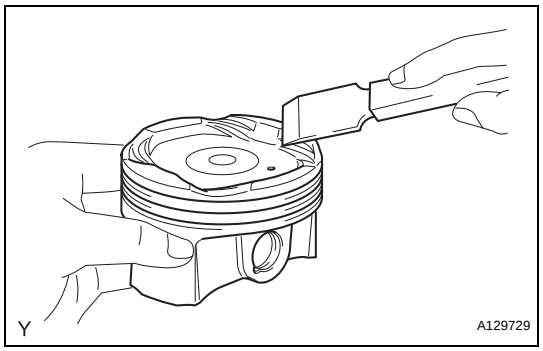
(b) Disconnect the connecting rod from the piston.
(1) Using a screwdriver, pry off the piston pin hole snap rings from the piston.



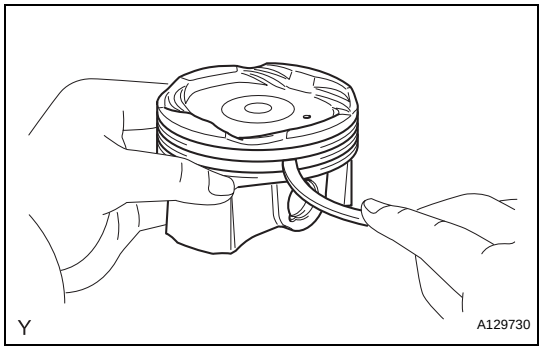
(2) Gradually heat the piston to approximately 80°C (176°F).



(3) Using a brass bar and plastic hammer, lightly tap out the piston pin and remove the connecting rod.
HINT:
- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.

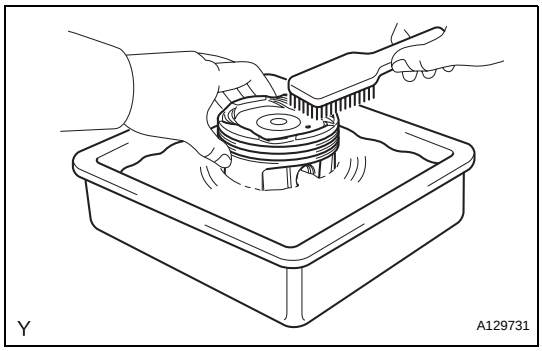


(c) Using a gasket scraper, remove the carbon from the piston top.

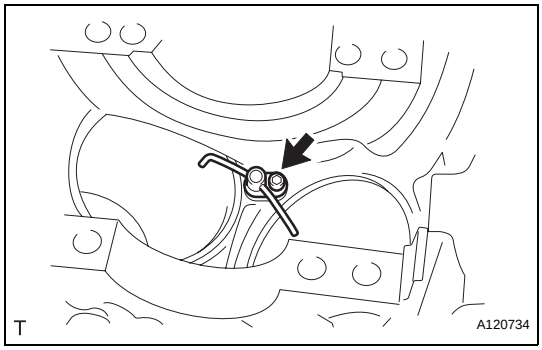


(d) Using a groove cleaning tool or broken ring, clean the piston ring grooves.

EM



(e) Using solvent and a brush, thoroughly clean the piston.
NOTICE:
Do not use a wire brush.

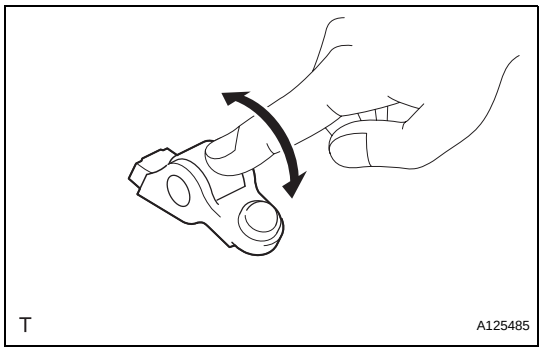


73. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

(a) Using a 5 mm hexagon wrench, remove the bolts and No. 1 oil nozzle sub-assembly.

(b) Check the 3 oil nozzles for damage or clogging. If necessary, replace the No. 1 oil nozzle sub-assembly.

74. CLEAN CYLINDER BLOCK



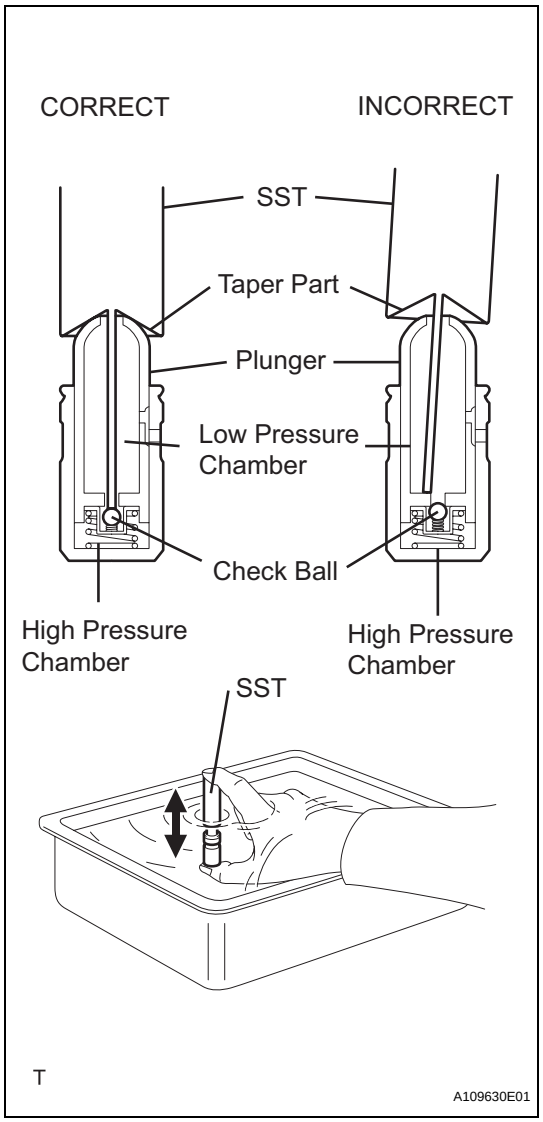
INSPECTION

1. INSPECT NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

(a) Turn the roller by hand to check that it turns smoothly.
HINT:
If the roller does not turn smoothly, replace the valve rocker arm sub-assembly.

2. INSPECT VALVE LASH ADJUSTER ASSEMBLY
NOTICE:
- **Keep the lash adjuster free of dirt and foreign objects.**
- **Only use clean engine oil.**

(a) Place the valve lash adjuster assembly into a container filled with engine oil.



(b) Insert SST's tip into the valve lash adjuster assembly's plunger and use the tip to press down on the check ball inside the plunger.
SST 09276-75010

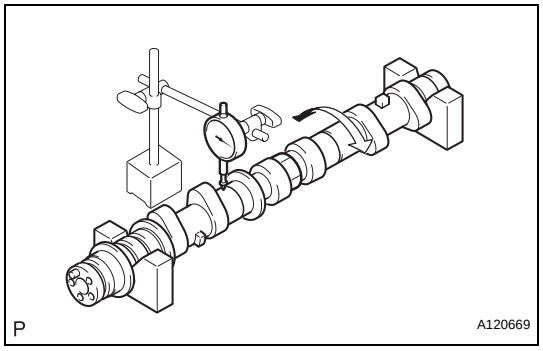
(c) Squeeze SST and valve lash adjuster assembly together to move the plunger up and down 5 to 6 times.

(d) Check the movement of the plunger and bleed the air.
OK:
Plunger moves up and down.
NOTICE:
When bleeding air from the high-pressure chamber, make sure that the tip of SST is actually pressing the check ball as shown in the illustration. If the check ball is not pressed, air will not bleed.

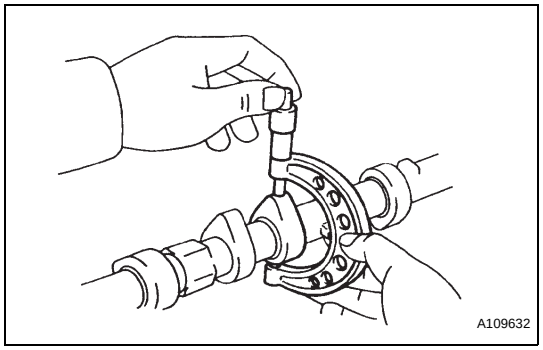
(e) After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with a finger.
OK:
Plunger is very difficult to move.
If the result is not as specified, replace the lash adjuster.

3. INSPECT CAMSHAFT

(a) Inspect the camshaft for runout.
(1) Place the camshaft on V-blocks.



(2) Using a dial indicator, measure the circle runout at the center journal.
Maximum circle runout:
0.04 mm (0.0016 in.)
If the circle runout is greater than the maximum, replace the camshaft.
HINT:
Check the oil clearance after replacing the camshaft.

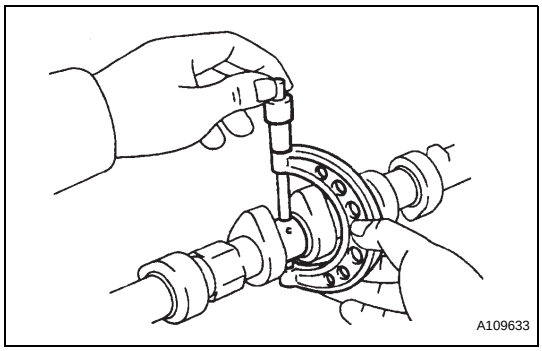


(b) Using a micrometer, measure the cam lobe height.
Standard cam lobe height

Item	Specification
Intake camshaft	44.316 to 44.416 mm (1.7447 to 1.7487 in.)
Exhaust camshaft	44.262 to 44.362 mm (1.7426 to 1.7465 in.)

Maximum cam lobe height

Item	Specification
Intake camshaft	44.166 mm (1.7388 in.)
Exhaust camshaft	44.112 mm (1.7367 in.)



(c) Using a micrometer, measure the journal diameter.
Standard journal diameter

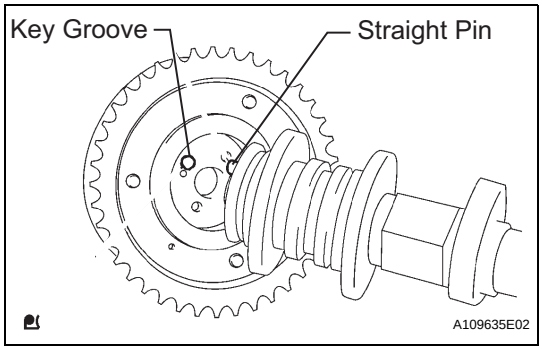
Item	Specification
No. 1 journal	35.946 to 35.960 mm (1.4152 to 1.4157 in.)
Other journals	25.959 to 25.975 mm (1.0220 to 1.0226 in.)

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

4. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

(a) Clamp the camshaft in a vise.
NOTICE:
Be careful not to damage the camshaft in the vise.

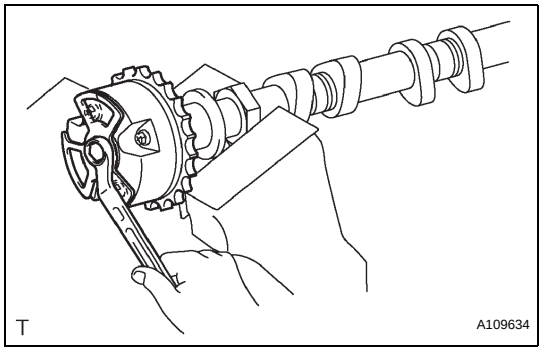
EM



(b) Put the camshaft timing gear assembly and camshaft together by aligning the key groove and straight pin.

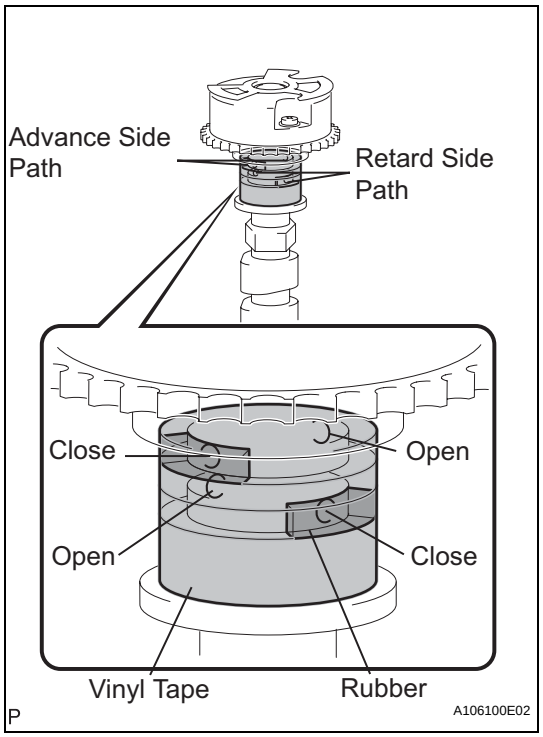
(c) Lightly press the camshaft timing gear assembly against the camshaft, and turn the camshaft timing gear assembly. Push further at the position where the pin enters the groove.
NOTICE:
Be sure not to turn the camshaft timing gear in the retard direction (the right angle).

(d) Check that there is no clearance between the camshaft timing gear assembly's flange and the camshaft.

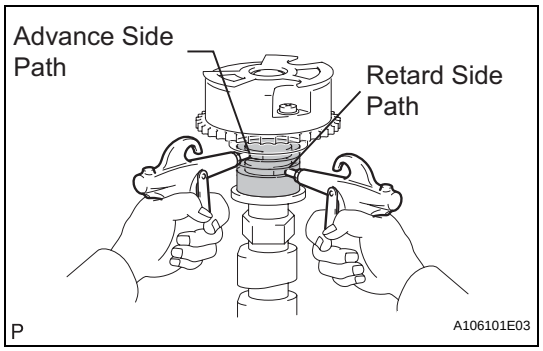


(e) Tighten the flange bolt with the camshaft timing gear fixed.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

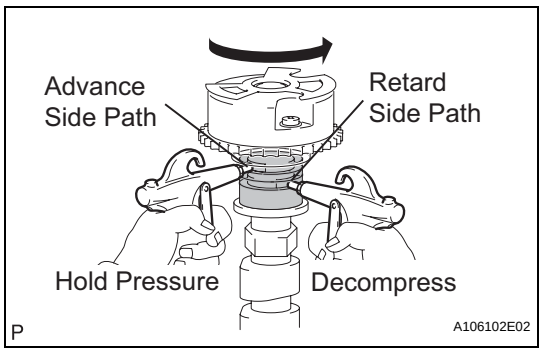
(f) Check the lock of the camshaft timing gear assembly.
(1) Clamp the camshaft in a vise, and confirm that the camshaft timing gear assembly is locked.
NOTICE:
Be careful not to damage the camshaft.



(g) Release the lock pin.
(1) Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.
HINT:
2 advance side paths are provided in the groove of the camshaft. Plug one of the paths with a rubber piece.
(2) Break through the tape of the advance side path and the retard side path on the opposite side to the hole of the advance side path, as shown in the illustration.



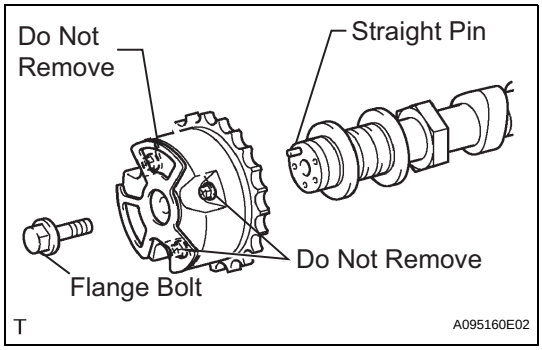
(3) Apply approximately 200 kPa (2.0 kgf/cm^2, 28 psi) of air pressure to the 2 broken paths.
CAUTION:
Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.



(4) Check that the camshaft timing gear assembly revolves in the advance direction when reducing the air pressure applied to the retard side path.
HINT:
This operation releases the lock pin for the most retarded position.
(5) When the camshaft timing gear assembly reaches the most advanced position, release the air pressure from the retard side path and advance side path, in that order.
NOTICE:
Do not release the air pressure from the advance side path first. The gear may abruptly shift in the retard direction and break the lock pin.

(h) Check for smooth rotation.
(1) Turn the camshaft timing gear assembly within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.
NOTICE:
Do not use air pressure to perform the smooth operation check.

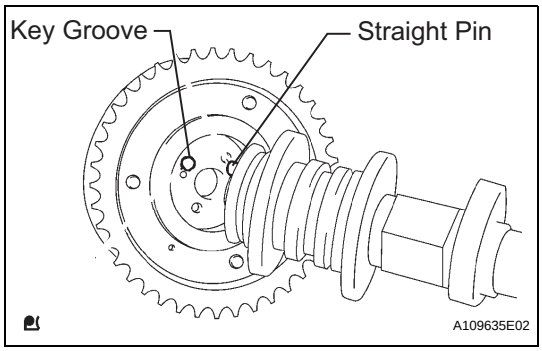
(i) Check the lock in the most retarded position.
(1) Confirm that the camshaft timing gear assembly is locked at the most retarded position.



(j) Remove the flange bolt and camshaft timing gear assembly.
NOTICE:
- **Do not remove the other 3 bolts.**
- **If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.**

5. INSPECT CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY

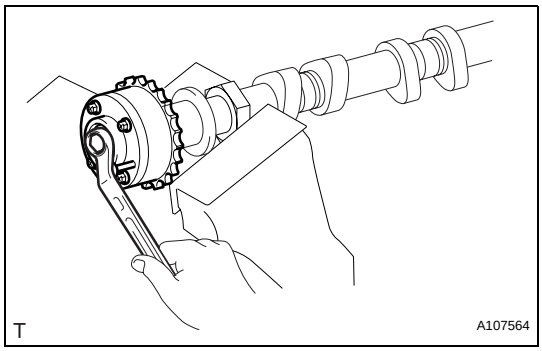
(a) Clamp the camshaft in a vise.
NOTICE:
Be careful not to damage the camshaft in the vise.



(b) Put the camshaft timing exhaust gear assembly and camshaft together by aligning the key groove and straight pin.

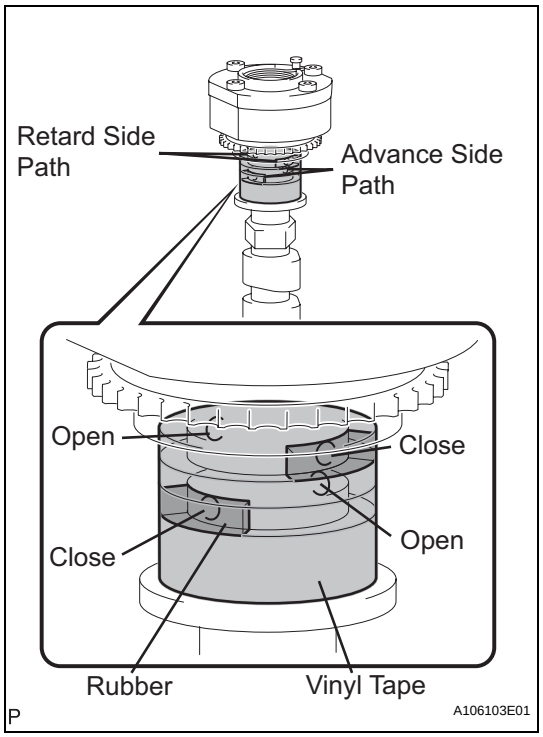
(c) Lightly press the camshaft timing gear against the camshaft, and turn the camshaft timing gear assembly. Push further at the position where the pin enters the groove.
NOTICE:
Be sure not to turn the camshaft timing exhaust gear in the retard direction (the right angle).

(d) Check that there is no clearance between the gear's flange and the camshaft.

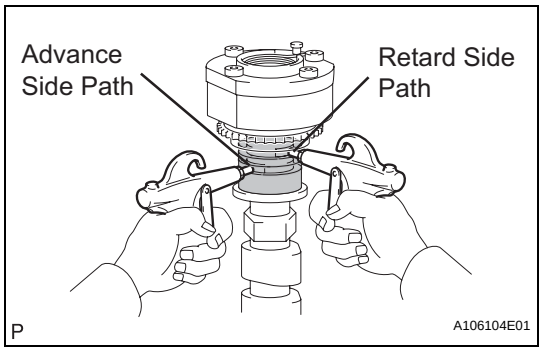


(e) Tighten the flange bolt with the camshaft timing exhaust gear assembly fixed.
Torque: 100 N*m (1020 kgf*cm, 74 ft.*lbf)

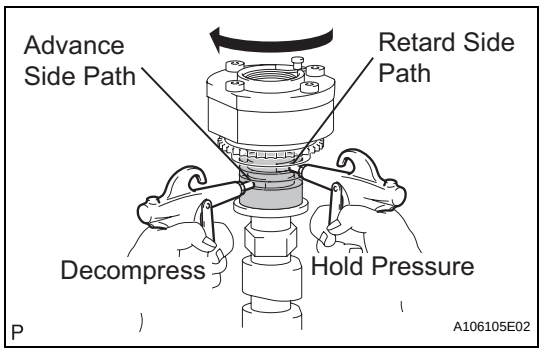
(f) Check the camshaft timing exhaust gear lock.
(1) Make sure that the camshaft timing exhaust gear assembly is locked.



(g) Release the lock pin.
(1) Cover the 4 oil paths of the cam journal with vinyl tape as shown in the illustration.
HINT:
4 oil paths are provided in the groove. Plug 2 paths with rubber pieces.
(2) Prick a hole in the tape placed on the advance side path. Prick a hole in the tape placed on the retard side path, on the opposite side to that of the advance side path, as shown in the illustration.



(3) Apply approximately 200 kPa (2.0 kgf/cm^2, 28 psi) of air pressure to the 2 broken paths (the advance side path and the retard side path).
CAUTION:
Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.

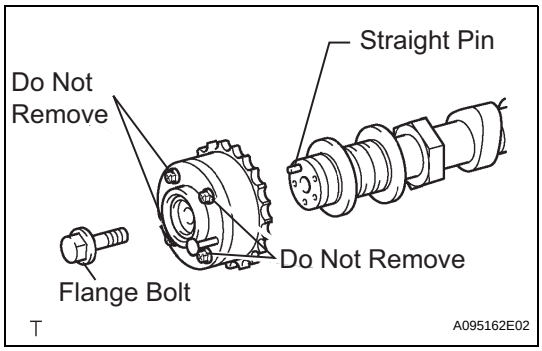


(4) Make sure that the camshaft timing exhaust gear turns in the retard direction when reducing the air pressure applied to the advance side path.
HINT:
The lock pin is released and the camshaft timing exhaust gear turns in the retard direction.
(5) When the camshaft timing exhaust gear moves to the most retarded position, release the air pressure from the advance side path, and then release the air pressure from the retard side path.
NOTICE:
Be sure to release the air pressure from the advance side path first. If the air pressure of the retard side path is released first, the camshaft timing exhaust gear may abruptly shift in the advance direction and break the lock pin or other parts.

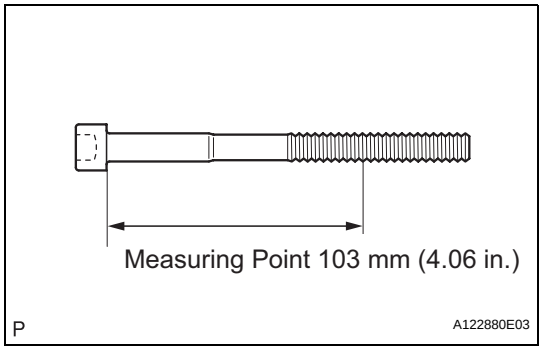
(h) Check for smooth rotation.
(1) Turn the camshaft timing exhaust gear within its movable range (18.5°) 2 or 3 times, but do not turn it to the most advanced position. Make sure that the gear turns smoothly.
NOTICE:
When the air pressure is released from the advance side path and then from the retard side path, the gear automatically returns to the most advanced position due to the advance assist spring operation and locks. Gradually release the air pressure from the retard side path before performing the smooth rotation check.

(i) Check the lock at the most advanced position.
(1) Make sure that the camshaft timing exhaust gear is locked at the most advanced position.

EM

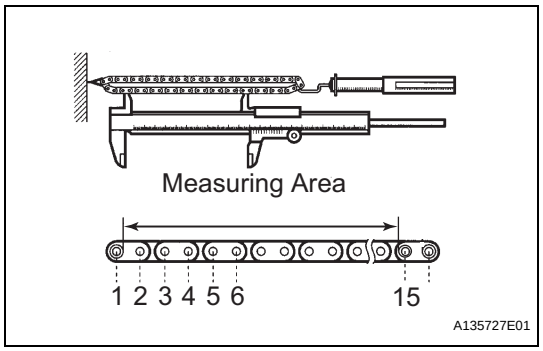


(j) Remove the flange bolt and camshaft timing exhaust gear.
NOTICE:
- **Be sure not to remove the other 4 bolts.**
- **If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.**



6. INSPECT CYLINDER HEAD SET BOLT

(a) Using vernier calipers, measure the minimum diameter of the elongated thread at the measuring point.
Standard outside diameter:
10.85 to 11.00 mm (0.4272 to 0.4331 in.)
Minimum outside diameter:
10.70 mm (0.4213 in.)
Measuring Point:
103 mm (4.06 in.)
HINT:
If a visual check reveals no excessively thin areas, check the center of the bolt and find the area that has the lowest diameter.
If the diameter is less than the minimum, replace the cylinder head bolt.

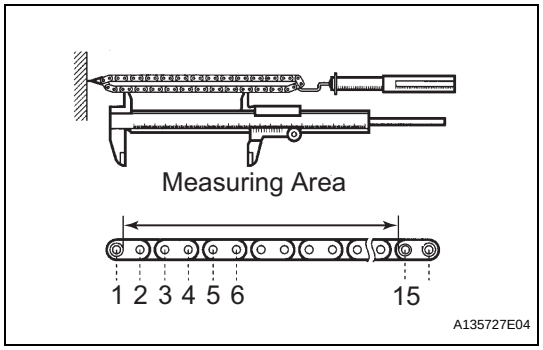


7. INSPECT CHAIN SUB-ASSEMBLY

(a) Pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.

(b) Using vernier calipers, measure the length of 15 links.

Maximum chain elongation:
136.9 mm (5.390 in.)
NOTICE:
Perform the measurement at 3 random places.
Use the average of the measurements.
If the elongation is greater than the maximum, replace the chain.

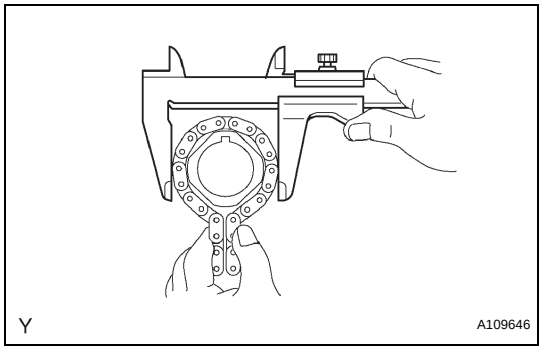


8. INSPECT NO. 2 CHAIN SUB-ASSEMBLY

(a) Pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.

(b) Using vernier calipers, measure the length of 15 links.

Maximum chain elongation:
137.6 mm (5.417 in.)
NOTICE:
Perform the measurement at 3 random places.
Use the average of the measurements.
If the elongation is greater than the maximum, replace the chain.

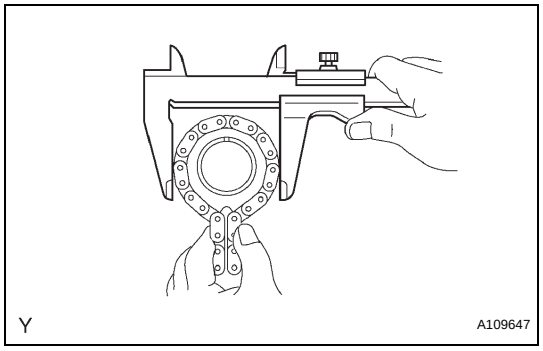


9. INSPECT CRANKSHAFT TIMING SPROCKET

(a) Wrap the chain around the sprocket.

(b) Using vernier calipers, measure the sprocket diameter with the chain.

Minimum sprocket diameter (with chain):
61.4 mm (2.417 in.)
HINT:
The vernier calipers must contact the chain rollers for the measurement.
If the diameter is less than the minimum, replace the chain and sprocket.



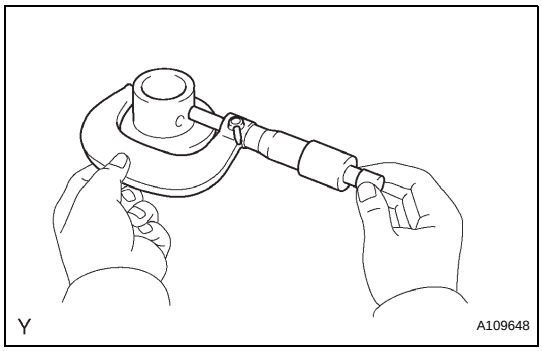
10. INSPECT IDLE SPROCKET ASSEMBLY

(a) Wrap the chain around the sprocket.

(b) Using vernier calipers, measure the sprocket diameter with the chain.

Minimum sprocket diameter (with chain):
61.4 mm (2.417 in.)
HINT:
The vernier calipers must contact the chain rollers for the measurement.
If the diameter is less than the minimum, replace the chain and sprocket.

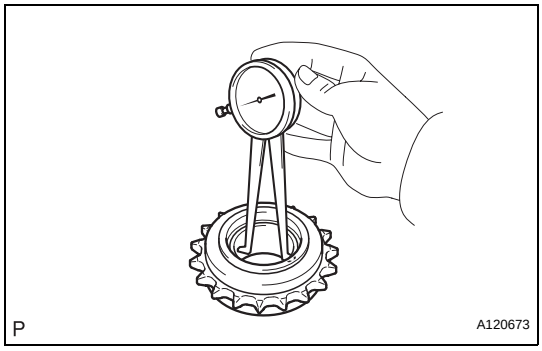
EM



11. INSPECT IDLE GEAR SHAFT OIL CLEARANCE

(a) Using a micrometer, measure the idle gear shaft diameter.

Idle gear shaft diameter:
22.987 to 23.000 mm (0.9050 to 0.9055 in.)



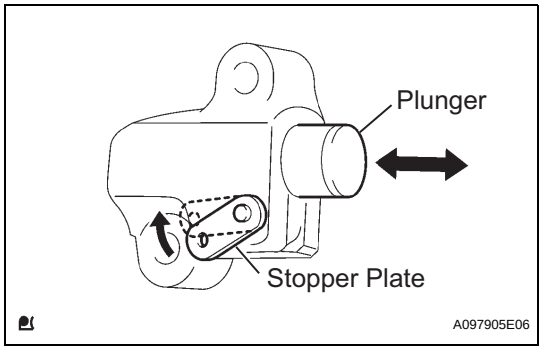
(b) Using a caliper gauge, measure the inside diameter of the idle sprocket.

Idle gear inside diameter:
23.020 to 23.030 mm (0.9063 to 0.9067 in.)

(c) Subtract the idle gear shaft diameter measurement from the idle sprocket inside diameter measurement.

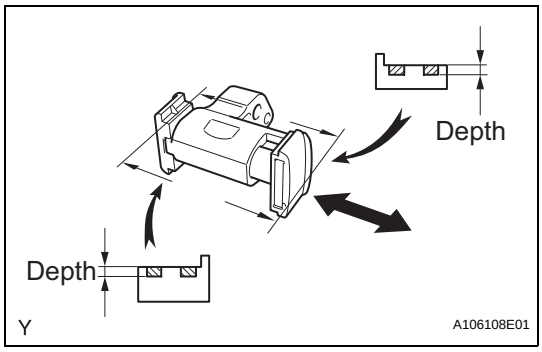
Standard oil clearance:
0.020 to 0.043 mm (0.0008 to 0.0017 in.)
Maximum oil clearance:
0.093 mm (0.0037 in.)

If the thrust oil clearance is greater than the maximum, replace the idle gear shaft and idle sprocket.



12. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

(a) Move the stopper plate upward to release the lock. Push the plunger and check that it moves smoothly. If necessary, replace the No. 1 chain tensioner assembly.



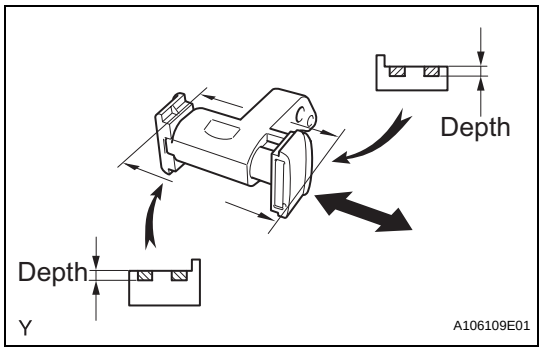
13. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

(a) Check that the plunger moves smoothly.

(b) Measure the worn depth of the No. 2 chain tensioner.

Maximum depth:
0.9 mm (0.035 in.)

If the depth is greater than the maximum, replace the No. 2 chain tensioner assembly.



14. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

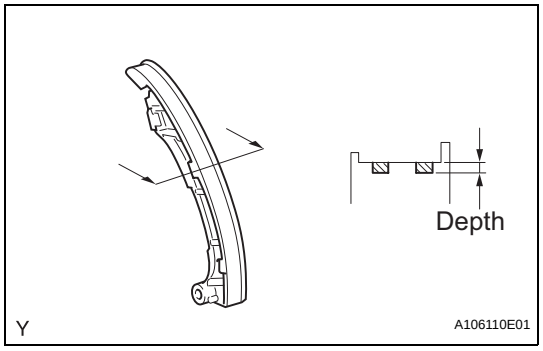
(a) Check that the plunger moves smoothly.

(b) Measure the worn depth of the No. 3 chain tensioner.

Maximum depth:

0.9 mm (0.035 in.)

If the depth is greater than the maximum, replace the No. 3 chain tensioner assembly.



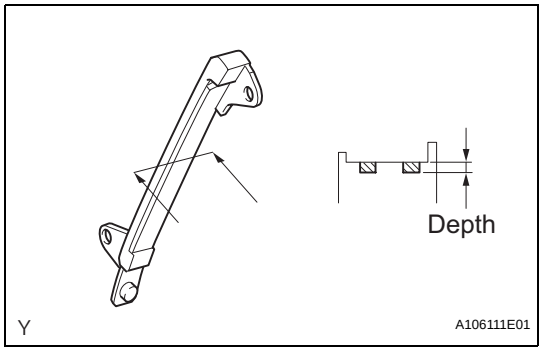
15. INSPECT CHAIN TENSIONER SLIPPER

(a) Measure the worn depth of the chain tensioner slipper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the chain tensioner slipper.



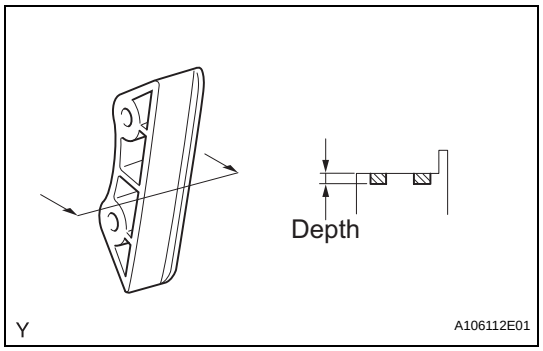
16. INSPECT NO. 1 CHAIN VIBRATION DAMPER

(a) Measure the worn depth of the No. 1 chain vibration damper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the No. 1 chain vibration damper.



17. INSPECT NO. 2 CHAIN VIBRATION DAMPER

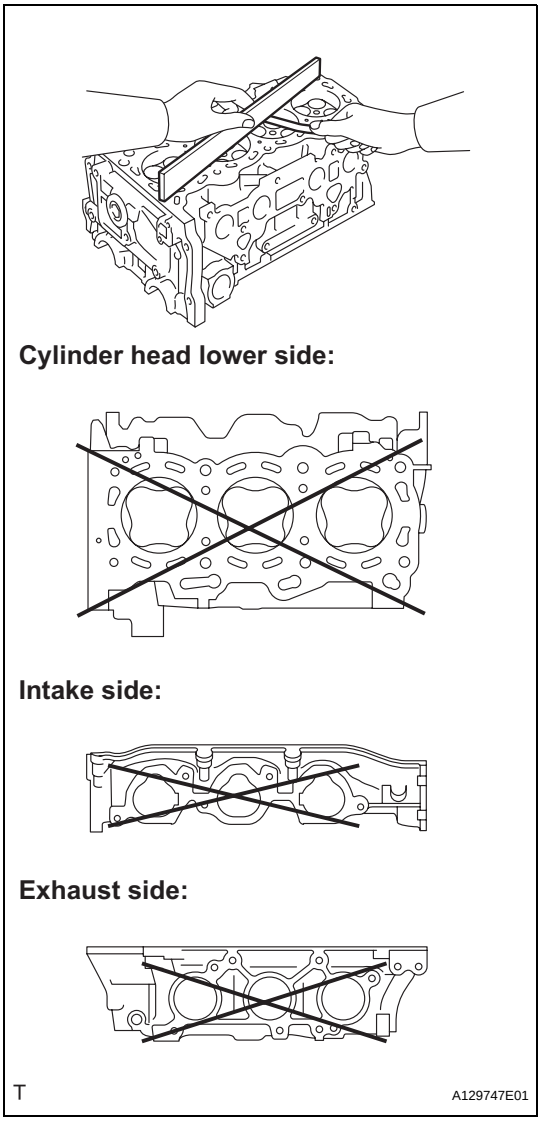
(a) Measure the worn depth of the No. 2 chain vibration damper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the No. 2 chain vibration damper.

EM



18. INSPECT CYLINDER HEAD SUB-ASSEMBLY

(a) Using a precision straight edge and feeler gauge, measure the warpage of the contact surface of the cylinder block and manifolds.

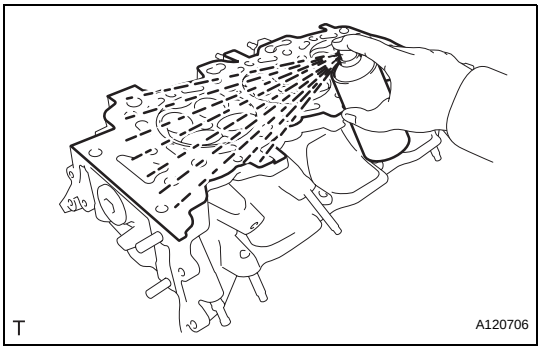
Standard warpage

Item	Warpage
Cylinder head lower	0.05 mm (0.0020 in.)
Intake	0.08 mm (0.0031 in.)
Exhaust	0.08 mm (0.0031 in.)

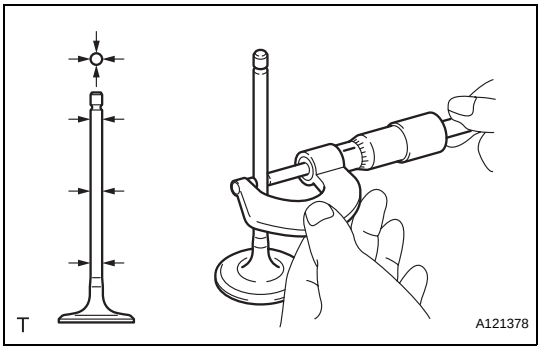
Maximum warpage

Item	Warpage
Cylinder head lower	0.10 mm (0.0039 in.)
Intake	0.10 mm (0.0039 in.)
Exhaust	0.10 mm (0.0039 in.)

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



(b) Using a dye penetrant, check the intake ports, exhaust ports and cylinder surface for cracks.
If cracked, replace the cylinder head assembly.

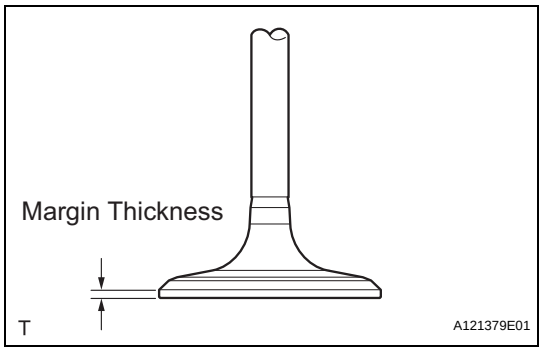


19. INSPECT INTAKE VALVE

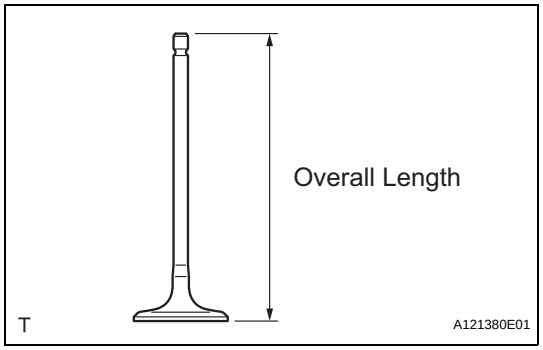
(a) Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter:
5.470 to 5.485 mm (0.2154 to 0.2159 in.)

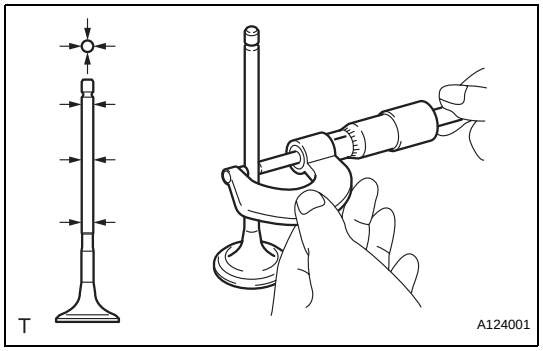
If the valve stem is not as specified, check the oil clearance.



(b) Using vernier calipers, measure the valve head margin thickness.
Standard margin thickness:
1.0 mm (0.039 in.)
Minimum margin thickness:
0.5 mm (0.0197 in.)
If the margin thickness is less than the minimum, replace the intake valve.

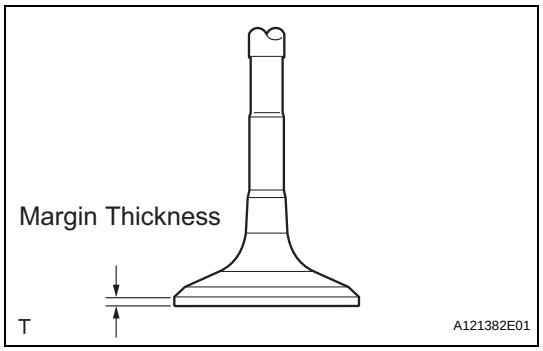


(c) Using vernier calipers, measure the valve's overall length.
Standard overall length:
105.85 mm (4.1673 in.)
Minimum overall length:
105.35 mm (4.1476 in.)
If the overall length is less than the minimum, replace the intake valve.

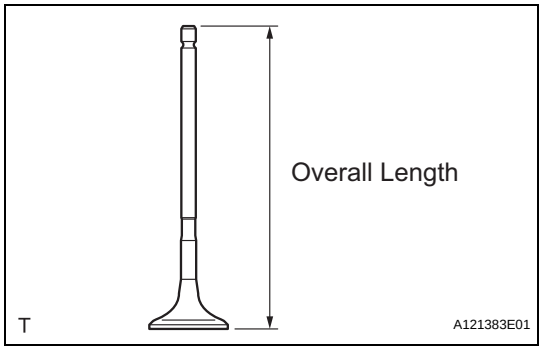


20. INSPECT EXHAUST VALVE

(a) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter:
5.465 to 5.480 mm (0.2151 to 0.2157 in.)
If the valve stem is not as specified, check the oil clearance.



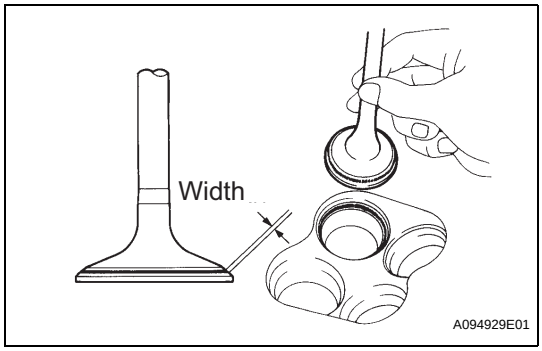
(b) Using vernier calipers, measure the valve head margin thickness.
Standard margin thickness:
1.0 mm (0.039 in.)
Minimum margin thickness:
0.5 mm (0.0197 in.)
If the margin thickness is less than the minimum, replace the exhaust valve.



(c) Using vernier calipers, measure the valve's overall length.
Standard overall length:
110.40 mm (4.3464 in.)
Minimum overall length:
109.90 mm (4.3268 in.)
If the overall length is less than the minimum, replace the exhaust valve.

21. INSPECT INTAKE VALVE SEAT

(a) Apply a light coat of Prussian blue to the valve face.



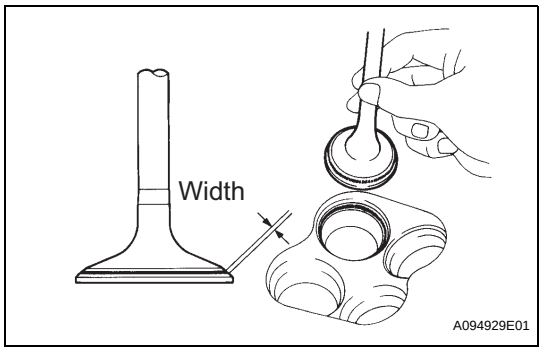
(b) Lightly press the valve face against the valve seat.

(c) Check the valve face and valve spring seat by using the following procedure:
   (1) If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
   (2) If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve spring seat.
   (3) Check that the valve spring seat contacts in the middle of the valve face with the width between 1.1 and 1.5 mm (0.043 and 0.059 in.).

22. INSPECT EXHAUST VALVE SEAT

(a) Apply a light coat of Prussian blue to the valve face.

(b) Lightly press the valve face against the valve spring seat.

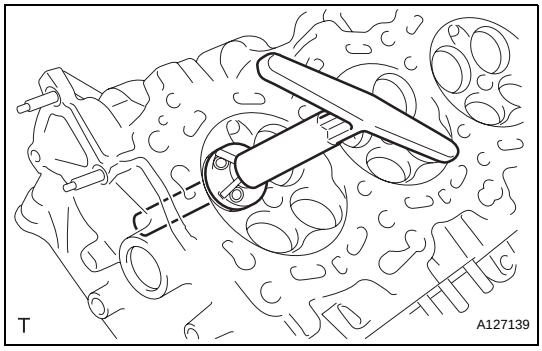


(c) Check the valve face and valve spring seat by using the following procedure:
   (1) If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
   (2) If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve spring seat.
   (3) Check that the valve spring seat contacts in the middle of the valve face with the width between 1.1 and 1.5 mm (0.043 and 0.059 in.).

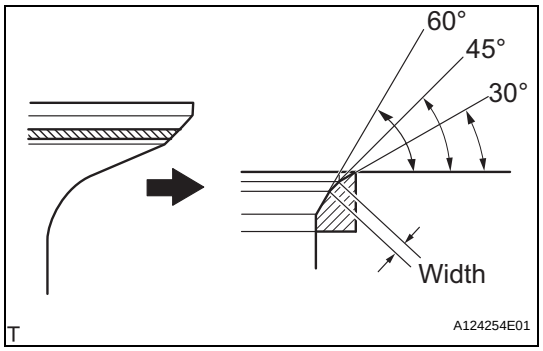
23. REPAIR INTAKE VALVE SEAT

NOTICE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**



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



(b) Using 30° and 60° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve spring seat, and the valve spring seat width should be maintained within the specified range around the entire circumference of the seat.
Width:
1.1 to 1.5 mm (0.043 to 0.059 in.)

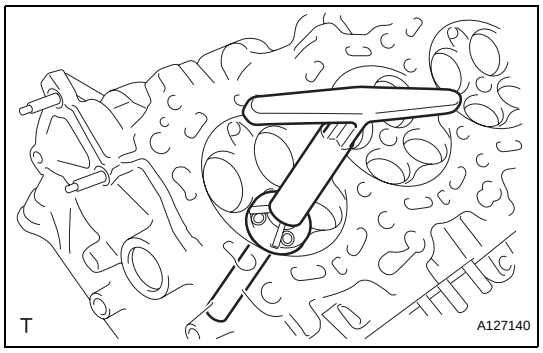
(c) Handrub the valve and valve seat with an abrasive compound.

(d) Check the valve seating position.

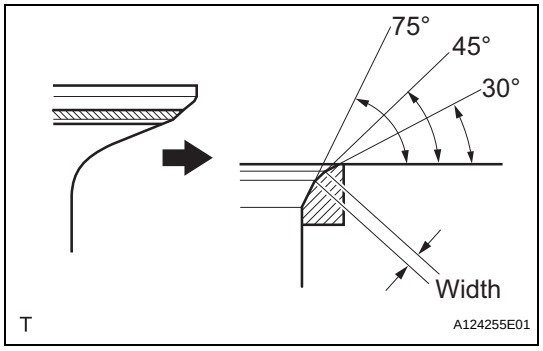
24. REPAIR EXHAUST VALVE SEAT

NOTICE:

- **Repair the seat while checking the seating position.**
- **Keep the lip free of foreign matter.**



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

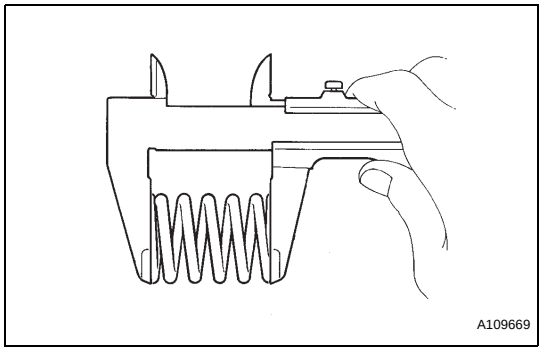


(b) Using 30° and 75° cutters, correct the valve seat so that the valve contacts the entire circumference of the seat. The contact should be in the center of the valve seat, and the valve seat width should be maintained within the specified range around the entire circumference of the seat.
Width:
1.1 to 1.5 mm (0.043 to 0.059 in.)

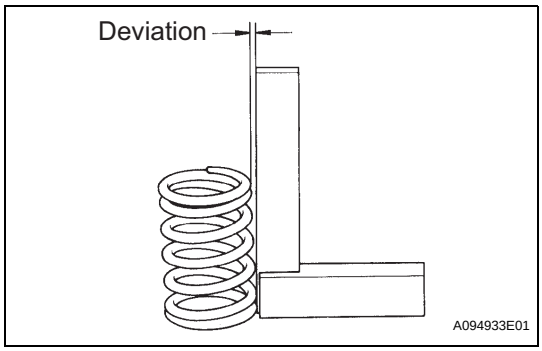
(c) Handrub the valve and valve seat with an abrasive compound.

(d) Check the valve seating position.

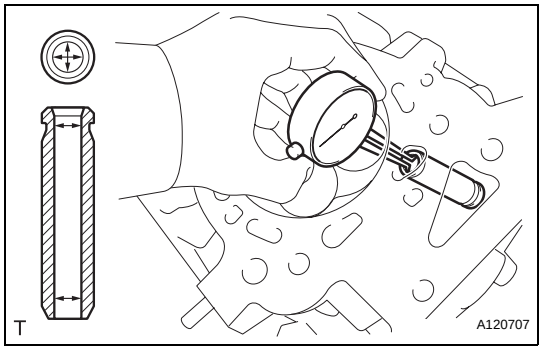
25. INSPECT INNER COMPRESSION SPRING



(a) Using vernier calipers, measure the free length of the inner compression spring.
Free length:
45.46 mm (1.7898 in.)
If the free length is not as specified, replace the inner compression spring.



(b) Using a steel square, measure the deviation of the inner compression spring.
Maximum deviation:
1.0 mm (0.039 in.)
Maximum angle (reference):
2°
If the deviation is greater than the maximum, replace the inner compression spring.



26. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

(a) Using a caliper gauge, measure the inside diameter of the valve guide bush.
Bush inside diameter:
5.510 to 5.530 mm (0.2169 to 0.2177 in.)

(b) Subtract the valve stem diameter measurement from the valve guide bush inside diameter measurement.
Standard clearance

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

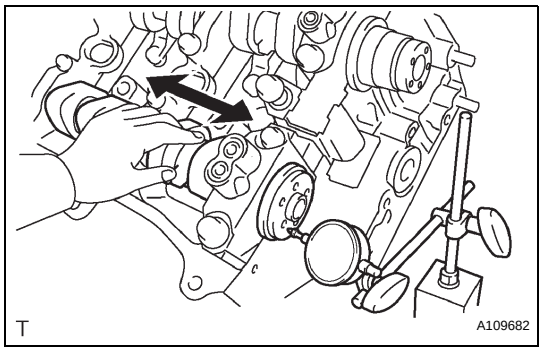
Maximum oil clearance

Item	Clearance
Intake	0.08 mm (0.0032 in.)
Exhaust	0.10 mm (0.0039 in.)

For intake side:
If the clearance is greater than the maximum, replace the intake valve and intake valve guide bush.
For exhaust side:
If the clearance is greater than the maximum, replace the exhaust valve and exhaust valve guide bush.

27. INSPECT CAMSHAFT THRUST CLEARANCE

(a) Inspect the bank 1 camshaft thrust clearance.
(1) Install the bank 1 camshaft (See page EM-126).

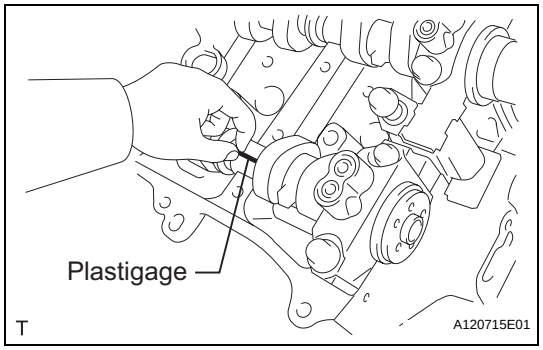


(2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.
Standard thrust clearance:
0.08 to 0.13 mm (0.0031 to 0.0051 in.)
Maximum thrust clearance:
0.15 mm (0.006 in.)
If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.

(b) Inspect the bank 2 camshaft thrust clearance.
(1) Install the bank 2 camshaft (See page EM-126).
(2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.
Standard thrust clearance:
0.08 to 0.13 mm (0.0031 to 0.0051 in.)
Maximum thrust clearance:
0.15 mm (0.006 in.)
If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.

28. INSPECT CAMSHAFT OIL CLEARANCE

(a) Clean the camshaft bearing caps, camshaft housing and camshaft journals.
(b) Place the camshafts on the camshaft housing.
(c) Lay a strip of Plastigage across each of the camshaft journals.
(d) Install the camshaft bearing caps (See page EM-126).
NOTICE:
Do not turn the camshaft.
(e) Remove the camshaft bearing caps (See page EM-76).



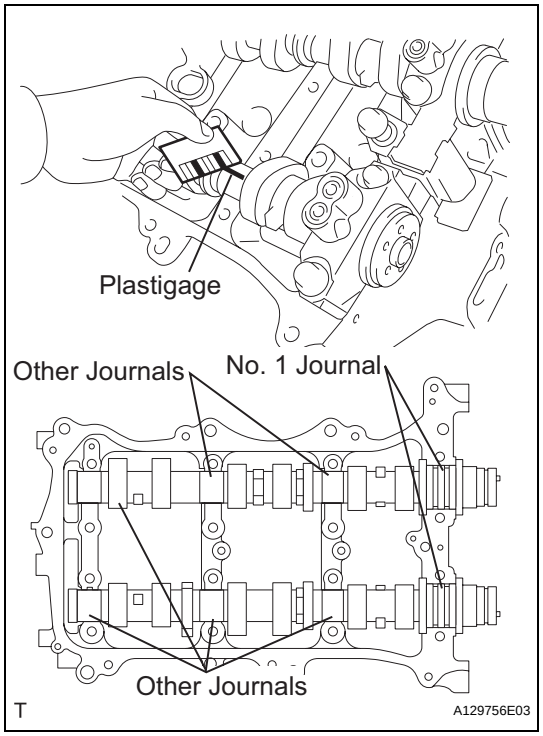
(f) Measure the Plastigage at its widest point.
Standard oil clearance

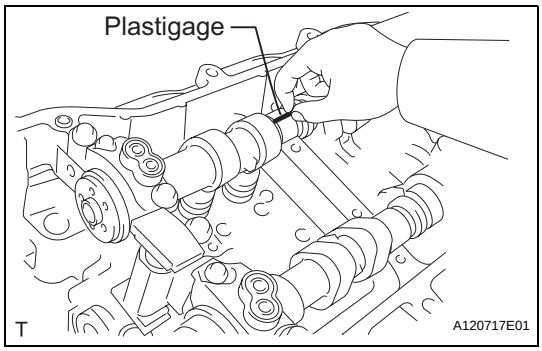
Item	Oil Clearance
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journals	0.025 to 0.062 mm (0.00098 to 0.0024 in.)

Maximum oil clearance

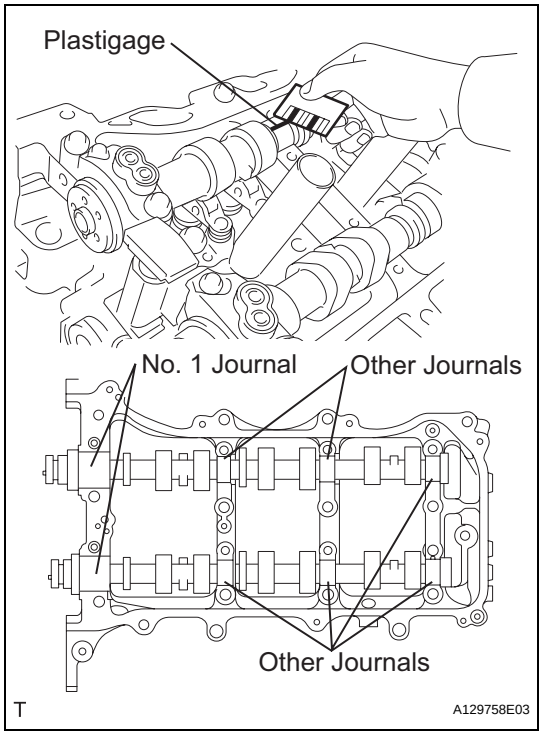
Item	Oil Clearance
No. 1 journal	0.10 mm (0.0039 in.)
Other journals	0.09 mm (0.0035 in.)

If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the camshaft housing.
(g) Clean the camshaft bearing caps, camshaft housing and camshaft journals.
(h) Place the camshafts on the camshaft housing.





(i) Lay a strip of Plastigage across each of the camshaft journals.
(j) Install the bearing caps (See page EM-126).
NOTICE:
Do not turn the camshaft.
(k) Remove the bearing caps (See page EM-76).



(l) Measure the Plastigage at its widest point.
Standard oil clearance

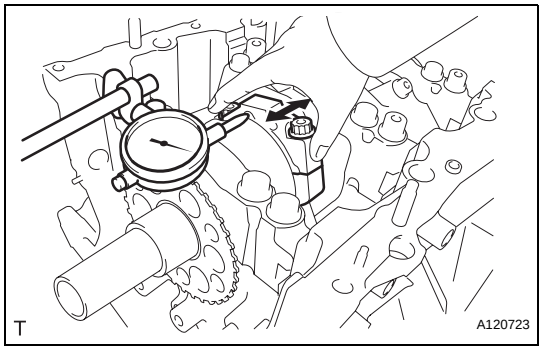
Item	Oil Clearance
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journals	0.025 to 0.062 mm (0.00098 to 0.0024 in.)

Maximum oil clearance

Item	Oil Clearance
No. 1 journal	0.10 mm (0.0039 in.)
Other journals	0.09 mm (0.0035 in.)

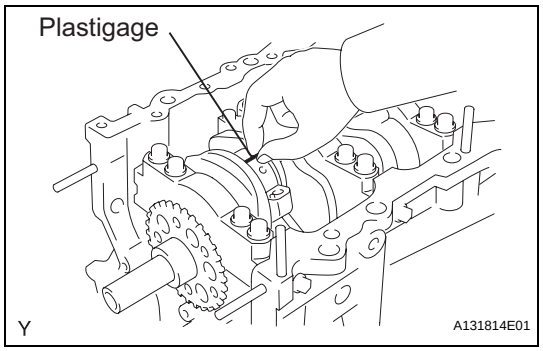
If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the camshaft housing.

29. INSPECT CONNECTING ROD THRUST CLEARANCE
(a) Install the connecting rod cap (See page EM-126).

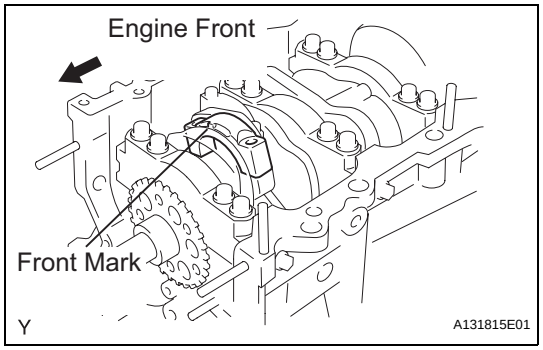


(b) Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.
Standard thrust clearance:
0.15 to 0.40 mm (0.0059 to 0.0157 in.)
Maximum thrust clearance:
0.50 mm (0.020 in.)
If the thrust clearance is greater than the maximum, replace the connecting rod assemblies as necessary. If necessary, replace the crankshaft.

30. INSPECT CONNECTING ROD OIL CLEARANCE
(a) Clean the crank pin and bearing.
(b) Check the crank pin and bearing for pitting and scratches.



(c) Lay a strip of Plastigage on the crank pin.



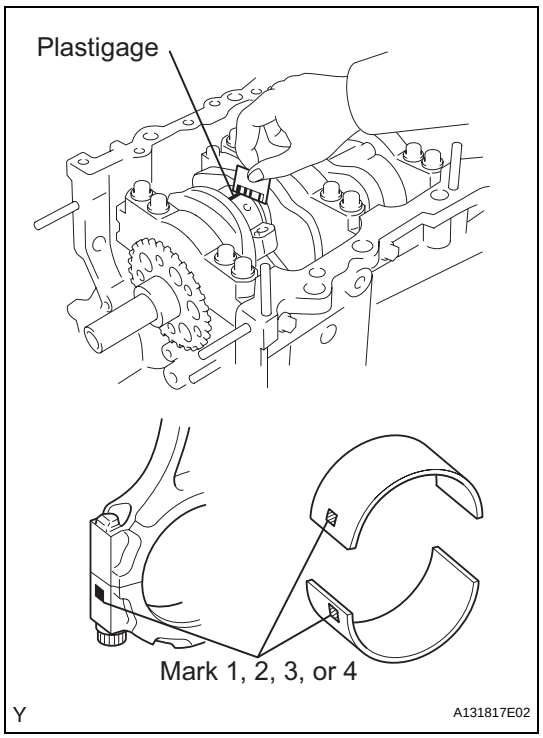
(d) Check that the front mark of the connecting rod cap is facing forward.

(e) Install the connecting rod cap (See page EM-126).

NOTICE:

Do not turn the crankshaft.

(f) Remove the 2 bolts and connecting rod cap (See page EM-76).



(g) Measure the Plastigage at its widest point.

Standard oil clearance:

0.045 to 0.067 mm (0.0018 to 0.0026 in.)

Maximum oil clearance:

0.070 mm (0.0028 in.)

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

HINT:

If replacing a bearing, replace it with one that has the same number as its respective connecting rod cap. Each bearing's standard thickness is indicated by a 1, 2, 3 or 4 mark on its surface.

Connecting rod diameter

Mark	Diameter
1	56.000 to 56.006 mm (2.2047 to 2.2050 in.)
2	56.007 to 56.012 mm (2.2050 to 2.2052 in.)
3	56.013 to 56.018 mm (2.2052 to 2.2054 in.)
4	56.019 to 56.024 mm (2.2055 to 2.2057 in.)

Connecting rod bearing center wall thickness

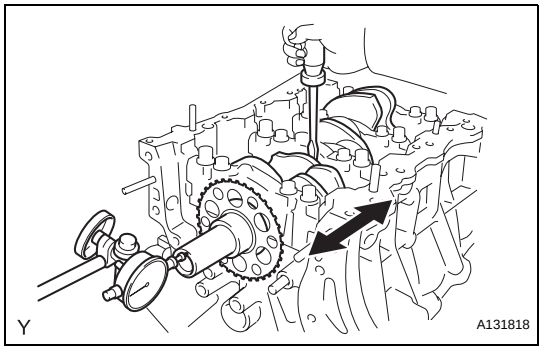
Mark	Thickness
1	1.481 to 1.484 mm (0.0583 to 0.0584 in.)
2	1.484 to 1.487 mm (0.0584 to 0.0585 in.)
3	1.487 to 1.490 mm (0.0585 to 0.0587 in.)
4	1.490 to 1.493 mm (0.0587 to 0.0588 in.)

Crankshaft pin diameter:

52.992 to 53.000 mm (2.0863 to 2.0866 in.)

NOTICE:

Completely remove the Plastigage after the measurement.



31. INSPECT CRANKSHAFT THRUST CLEARANCE

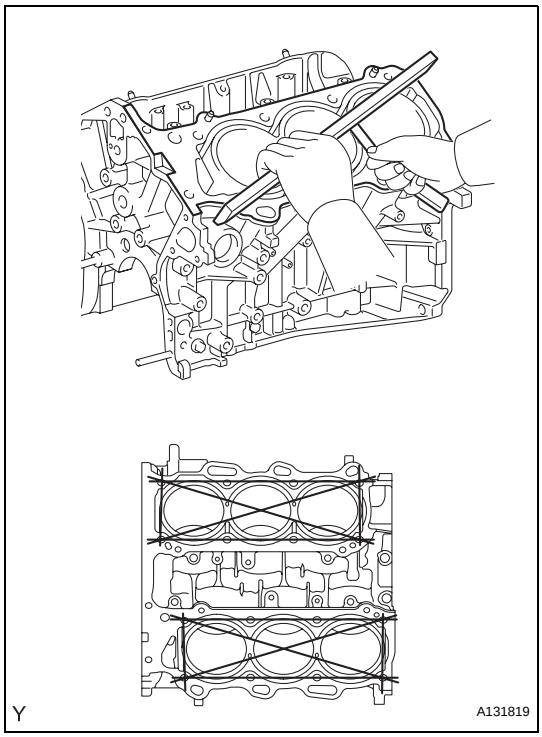
(a) Install the crankshaft bearing cap (See page EM-126).

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

Standard thrust clearance:
0.04 to 0.24 mm (0.0016 to 0.0094 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. If necessary, replace the crankshaft.

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

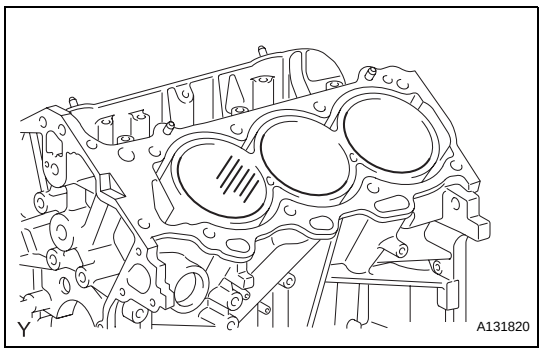


32. INSPECT CYLINDER BLOCK FOR WARPAGE

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

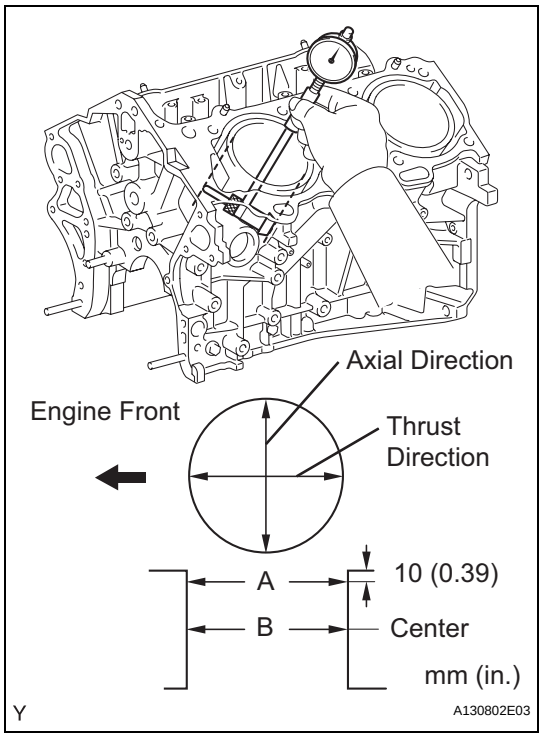
Maximum warpage:
0.07 mm (0.0028 in.)

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



33. INSPECT CYLINDER BORE

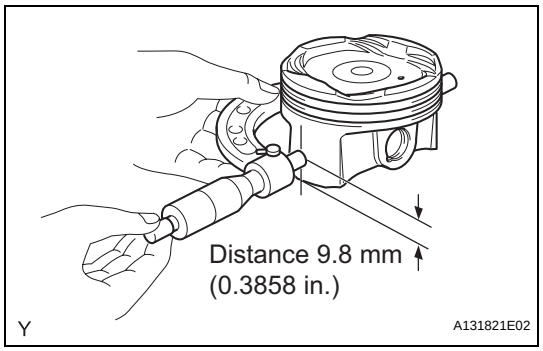
(a) Visually check the cylinder for vertical scratches. If deep scratches are present, rebore all the 6 cylinders. If necessary, replace the cylinder block.



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

Standard diameter:
94.000 to 94.012 mm (3.7008 to 3.7013 in.)
Maximum diameter:
94.200 mm (3.7087 in.)

If the average diameter of 4 positions is greater than the maximum, replace the cylinder block.



34. INSPECT PISTON SUB-ASSEMBLY WITH PIN

(a) Using a micrometer, measure the piston diameter at right angles to the piston center line where the distance from the piston end is as specified.

Distance:
9.8 mm (0.3858 in.)
Standard diameter:
93.960 to 93.980 mm (3.6992 to 3.7000 in.)
Maximum diameter:
93.830 mm (3.6941 in.)

35. INSPECT PISTON OIL CLEARANCE

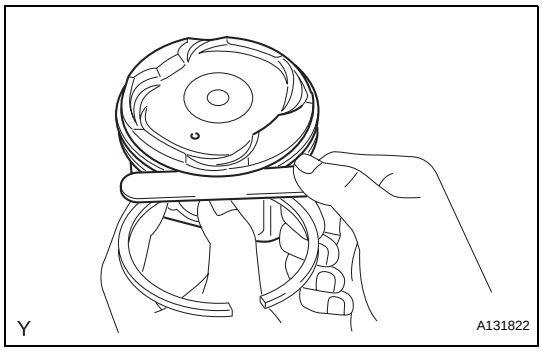
(a) Measure the cylinder bore diameter in the thrust directions.

(b) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:
0.020 to 0.052 mm (0.0008 to 0.0020 in.)
Maximum oil clearance:
0.060 mm (0.0024 in.)

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

EM



36. 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

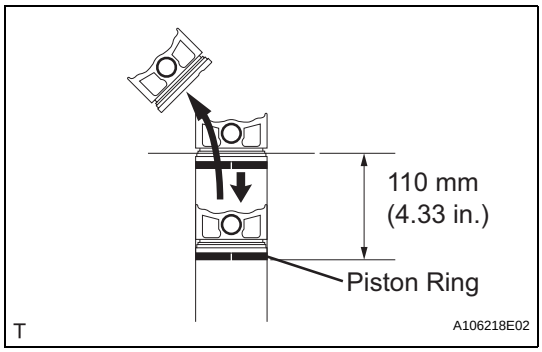
Item	Clearance
No. 1	0.020 to 0.070 mm (0.0008 to 0.0028 in.)
No. 2	0.020 to 0.060 mm (0.0008 to 0.0024 in.)
Oil	0.070 to 0.150 mm (0.0028 to 0.0059 in.)

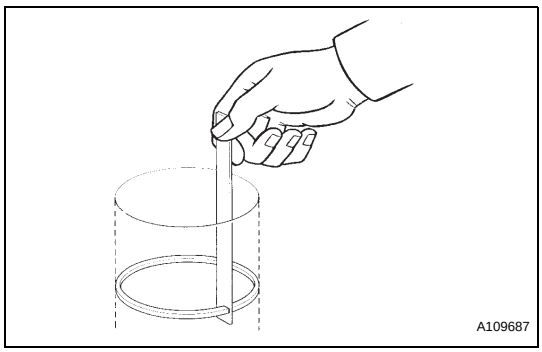
If the clearance is not as specified, replace the piston.

37. INSPECT PISTON RING END GAP

(a) Insert the piston ring into the cylinder bore.

(b) 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.





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

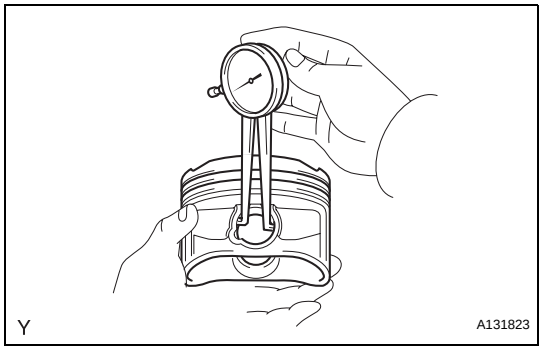
Standard end gap

Item	End Gap
No. 1	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
No. 2	0.50 to 0.60 mm (0.0197 to 0.0236 in.)
Oil	0.10 to 0.40 mm (0.0039 to 0.0157 in.)

Maximum end gap

Item	End Gap
No. 1	0.50 mm (0.0197 in.)
No. 2	0.85 mm (0.0335 in.)
Oil	0.60 mm (0.0236 in.)

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

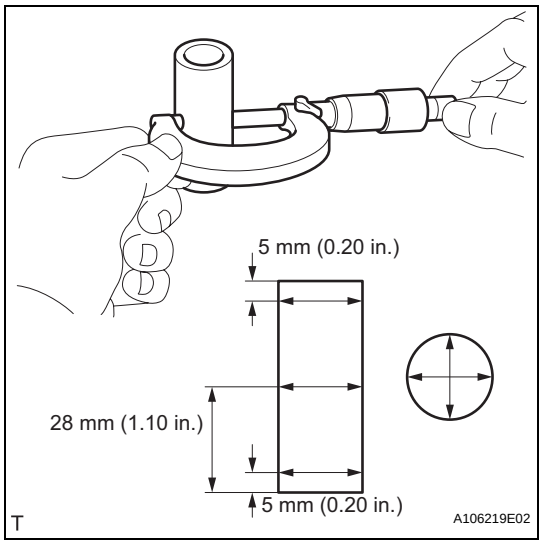


38. INSPECT PISTON PIN OIL CLEARANCE

(a) Using a caliper gauge, measure the inside diameter of the piston pin hole.

Piston pin hole inside diameter

Mark	Diameter
A	22.001 to 22.004 mm (0.8662 to 0.8663 in.)
B	22.004 to 22.007 mm (0.8663 to 0.8664 in.)
C	22.007 to 22.010 mm (0.8664 to 0.8665 in.)



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

Piston pin diameter

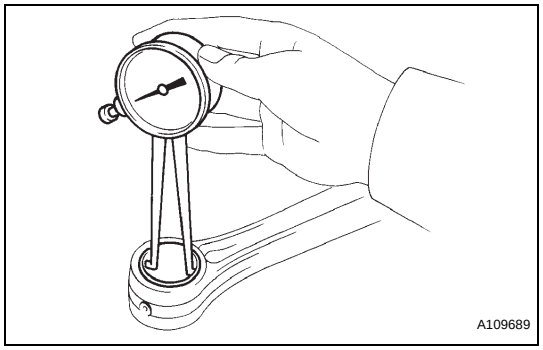
Mark	Diameter
A	21.997 to 22.000 mm (0.8660 to 0.8661 in.)
B	22.000 to 22.003 mm (0.8661 to 0.8663 in.)
C	22.003 to 22.006 mm (0.8663 to 0.8664 in.)

(c) Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:
0.001 to 0.007 mm (0.00004 to 0.00028 in.)
Maximum oil clearance:
0.015 mm (0.0006 in.)

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

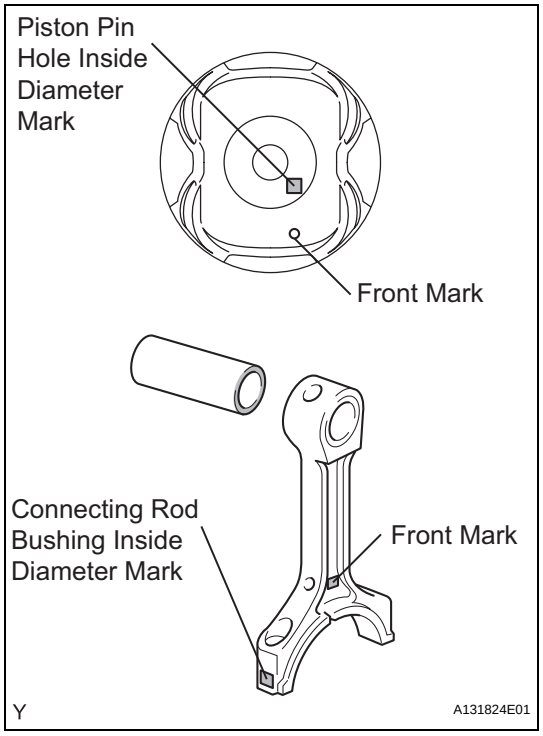
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(d) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

Bushing inside diameter

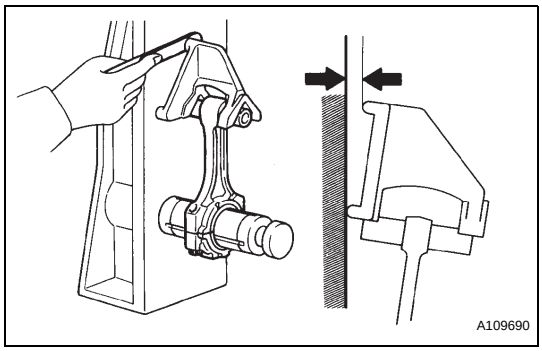
Mark	Diameter
A	22.005 to 22.008 mm (0.8663 to 0.8665 in.)
B	22.009 to 22.011 mm (0.8665 to 0.8666 in.)
C	22.012 to 22.014 mm (0.8666 to 0.8667 in.)



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

Standard oil clearance:
0.005 to 0.011 mm (0.0002 to 0.0004 in.)
Maximum oil clearance:
0.030 mm (0.0012 in.)

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



39. INSPECT CONNECTING ROD

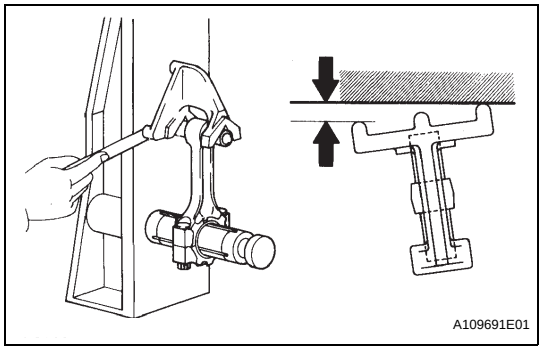
(a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

(1) Check for out-of-alignment.

Maximum out-of-alignment:

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

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

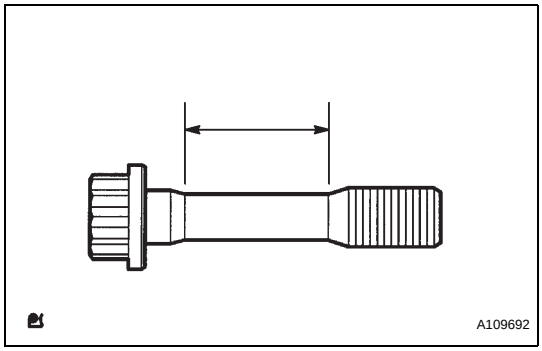


(2) Check for twist.

Maximum twist:

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

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



40. INSPECT CONNECTING ROD BOLT

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

Standard diameter:

7.2 to 7.3 mm (0.284 to 0.287 in.)

Minimum diameter:

7.0 mm (0.276 in.)

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

41. INSPECT CRANKSHAFT

(a) Inspect for circle runout.

(1) Clean the crank journal.

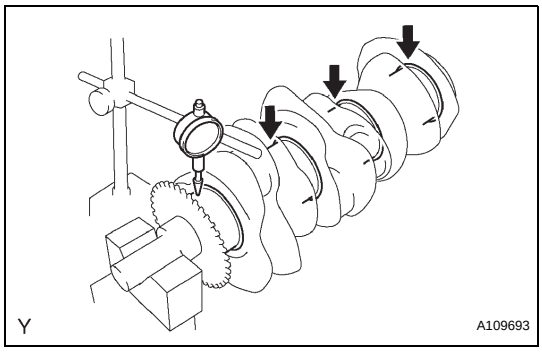
(2) Place the crankshaft on V-blocks.

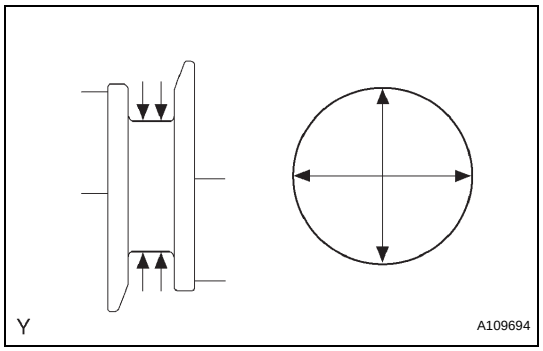
(3) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout:

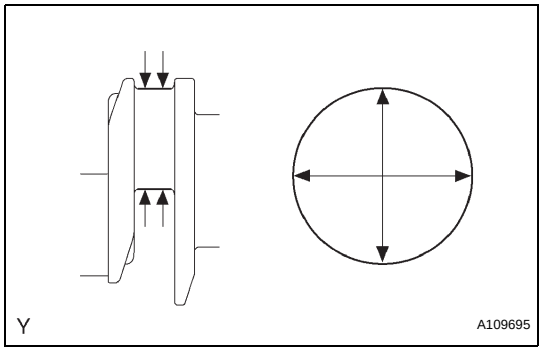
0.06 mm (0.0024 in.)

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





(b) Inspect the main journals.
(1) Using a micrometer, measure the diameter of each main journal.
Standard journal diameter:
60.988 to 61.000 mm (2.4011 to 2.4016 in.)
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.
(2) Check each main journal for taper and out-of-round as shown in the illustration.
Maximum taper and out-of-round:
0.02 mm (0.0008 in.)
If the taper and out-of-round is greater than the maximum, replace the crankshaft.

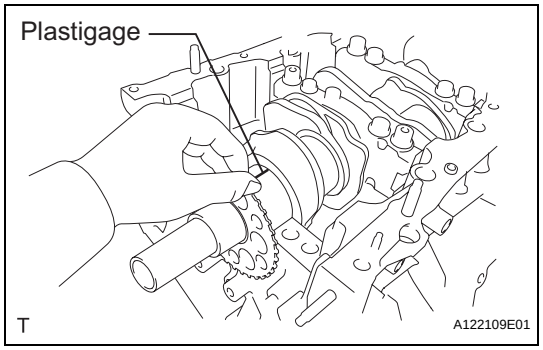


(c) Inspect the crank pin.
(1) Using a micrometer, measure the diameter of each crank pin.
Crankshaft pin diameter:
52.992 to 53.000 mm (2.0863 to 2.0866 in.)
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.
(2) Check each crank pin for taper and out-of-round as shown in the illustration.
Maximum taper and out-of-round:
0.02 mm (0.0008 in.)
If the taper and out-of-round is greater than the maximum, replace the crankshaft.

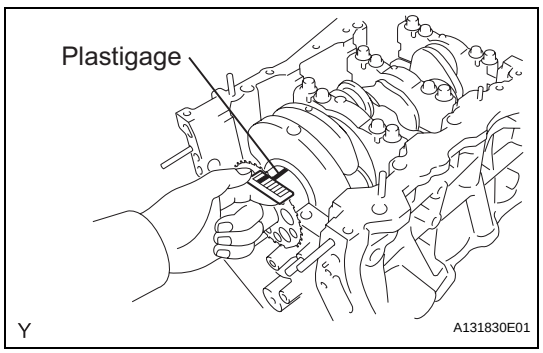
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42. INSPECT CRANKSHAFT OIL CLEARANCE

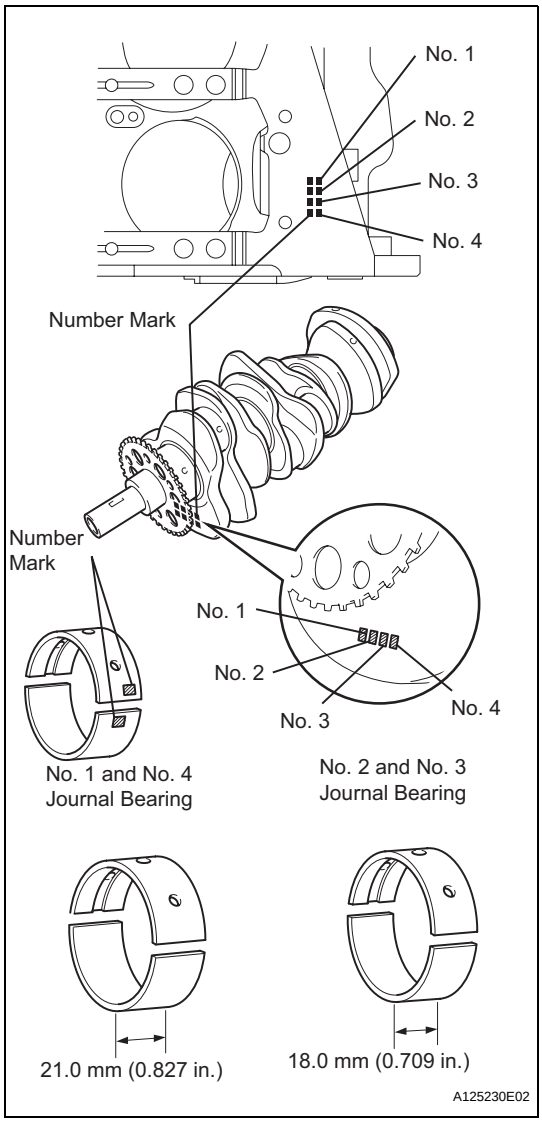
(a) Check the crank journal and bearing for pitting and scratches.
(b) Install the crankshaft bearing (See page EM-126).
(c) Place the crankshaft on the cylinder block.



(d) Lay a strip of Plastigage across each journal.
(e) Examine the front marks and numbers and install the bearing caps on the cylinder block.
HINT:
A number is marked on each main bearing cap to indicate the installation position.
(f) Install the main bearing cap (See page EM-126).
NOTICE:
Do not turn the crankshaft.
(g) Remove the main bearing caps (See page EM-76).



(h) Measure the Plastigage at its widest point.
Standard oil clearance:
0.026 to 0.047 mm (0.0010 to 0.0019 in.)
Maximum oil clearance:
0.050 mm (0.0020 in.)
If the oil clearance is greater than the maximum, replace the bearings. If necessary, replace the crankshaft.
NOTICE:
Completely remove the Plastigage after the measurement.



(i) If replacing a bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 sizes of standard bearings, marked "1", "2", "3", "4" and "5" accordingly.

Journal bearings:

Cylinder block + Crankshaft	0 - 5	6 - 11	12 - 17	18 - 23	24 - 28
Bearing to be used	"1"	"2"	"3"	"4"	"5"

HINT:
EXAMPLE: Cylinder block "11" + Crankshaft "06" = Total number 17 (Use bearing "3")

Crankshaft main journal diameter

Mark	Diameter
"00"	60.999 to 61.000 mm (2.4015 to 2.4016 in.)
"01"	60.998 to 60.999 mm (2.4015 to 2.4015 in.)
"02"	60.997 to 60.998 mm (2.4015 to 2.4015 in.)
"03"	60.996 to 60.997 mm (2.4014 to 2.4015 in.)
"04"	60.995 to 60.996 mm (2.4014 to 2.4014 in.)
"05"	60.994 to 60.995 mm (2.4013 to 2.4014 in.)
"06"	60.993 to 60.994 mm (2.4013 to 2.4013 in.)
"07"	60.992 to 60.993 mm (2.4013 to 2.4013 in.)
"08"	60.991 to 60.992 mm (2.4012 to 2.4013 in.)
"09"	60.990 to 60.991 mm (2.4012 to 2.4012 in.)
"10"	60.989 to 60.990 mm (2.4011 to 2.4012 in.)
"11"	60.988 to 60.989 mm (2.4011 to 2.4011 in.)

Standard upper bearing center wall thickness (No. 1 and No. 4 journal)

Mark	Thickness
"1"	2.500 to 2.503 mm (0.0984 to 0.0985 in.)
"2"	2.503 to 2.506 mm (0.0985 to 0.0987 in.)
"3"	2.506 to 2.509 mm (0.0987 to 0.0988 in.)
"4"	2.509 to 2.512 mm (0.0988 to 0.0989 in.)
"5"	2.512 to 2.515 mm (0.0989 to 0.0990 in.)

Standard lower bearing center wall thickness (No. 1 and No. 4 journal)

Mark	Thickness
"1"	2.478 to 2.481 mm (0.0976 to 0.0977 in.)
"2"	2.481 to 2.484 mm (0.0977 to 0.0978 in.)
"3"	2.484 to 2.487 mm (0.0978 to 0.0979 in.)
"4"	2.487 to 2.490 mm (0.0979 to 0.0980 in.)
"5"	2.490 to 2.493 mm (0.0980 to 0.0981 in.)

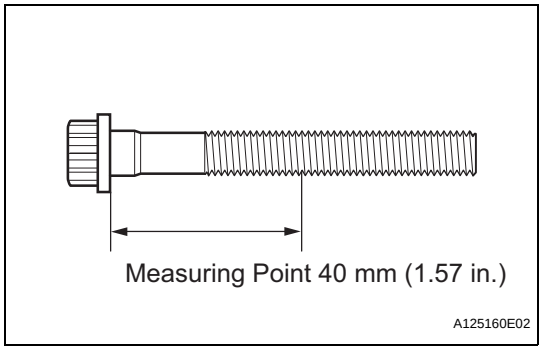
Standard upper bearing center wall thickness (No. 2 and No. 3 journal)

Mark	Thickness
"1"	2.478 to 2.481 mm (0.0976 to 0.0977 in.)
"2"	2.481 to 2.484 mm (0.0977 to 0.0978 in.)
"3"	2.484 to 2.487 mm (0.0978 to 0.0979 in.)
"4"	2.487 to 2.490 mm (0.0979 to 0.0980 in.)
"5"	2.490 to 2.493 mm (0.0980 to 0.0981 in.)

Standard lower bearing center wall thickness (No. 2 and No. 3 journal)

Mark	Thickness
"1"	2.500 to 2.503 mm (0.0984 to 0.0985 in.)
"2"	2.503 to 2.506 mm (0.0985 to 0.0987 in.)
"3"	2.506 to 2.509 mm (0.0987 to 0.0988 in.)
"4"	2.509 to 2.512 mm (0.0988 to 0.0989 in.)
"5"	2.512 to 2.515 mm (0.0989 to 0.0990 in.)

EM



43. INSPECT CRANKSHAFT BEARING CAP SET BOLT

(a) Using vernier calipers, measure the minimum diameter of the compressed thread at the measuring point.

Standard diameter:
10.8 to 11.0 mm (0.4252 to 0.4331 in.)
Minimum diameter:
10.7 mm (0.4213 in.)
Measuring Point:
40 mm (1.57 in.)

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