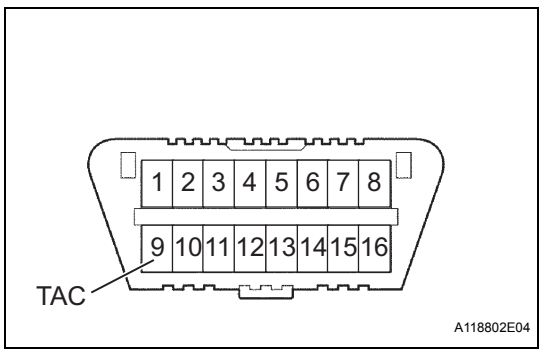
N04C-TY ENGINE MECHANICAL

EM

ENGINE

ON-VEHICLE INSPECTION

1. **INSPECT ENGINE COOLANT QUALITY (See page CO-3)**
2. **CHECK ENGINE OIL LEVEL (See page LU-1)**
3. **CHECK BATTERY CONDITION (See page CH-4)**
4. **INSPECT AIR CLEANER ASSEMBLY**
   (a) Remove the air cleaner filter element sub-assembly.
   (b) Visually check that there is no dirt, blockage, or damage to the air cleaner filter element.
   HINT:
   - If there is any dirt or blockages in the air cleaner filter element, clean it with compressed air.
   - If any dirt or blockages remain even after cleaning the air cleaner filter element with compressed air, replace it.
5. **INSPECT ENGINE IDLING SPEED AND MAXIMUM SPEED**
   NOTICE:
   Turn all electrical systems and the A/C OFF.
   (a) Warm up and then stop the engine.
   (b) When using an intelligent tester:
      (1) Connect the intelligent tester to the DLC3.
      (2) Turn the ignition switch ON.
      (3) Select the following menu items:
      HINT:
      Refer to the intelligent tester operator manual for further information regarding the selection of Data List.
      (4) Inspect the engine idling speed.
      Idling speed:
      600 to 700 rpm
      (5) Fully depress the accelerator pedal.
      (6) Check the maximum speed.
      Maximum speed:
      3600 to 3700 rpm
      (7) Turn the ignition switch OFF.
      (8) Disconnect the intelligent tester from the DLC3.



   (c) When not using an intelligent tester II:
      (1) Install SST to terminal (TAC) of DLC3, then connect a tachometer.
      SST 09843-18040
      NOTICE:
      Examine the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.
      (2) Turn the ignition switch ON.
      (3) Inspect the engine idling speed.
      Idling speed:
      600 to 700 rpm

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(4) Fully depress the accelerator pedal.
(5) Check the maximum speed.
Maximum speed:
3600 to 3700 rpm
(6) Turn the ignition switch OFF.
(7) Disconnect the tachometer.
(8) Remove SST from terminal.

6. INSPECT COMPRESSION

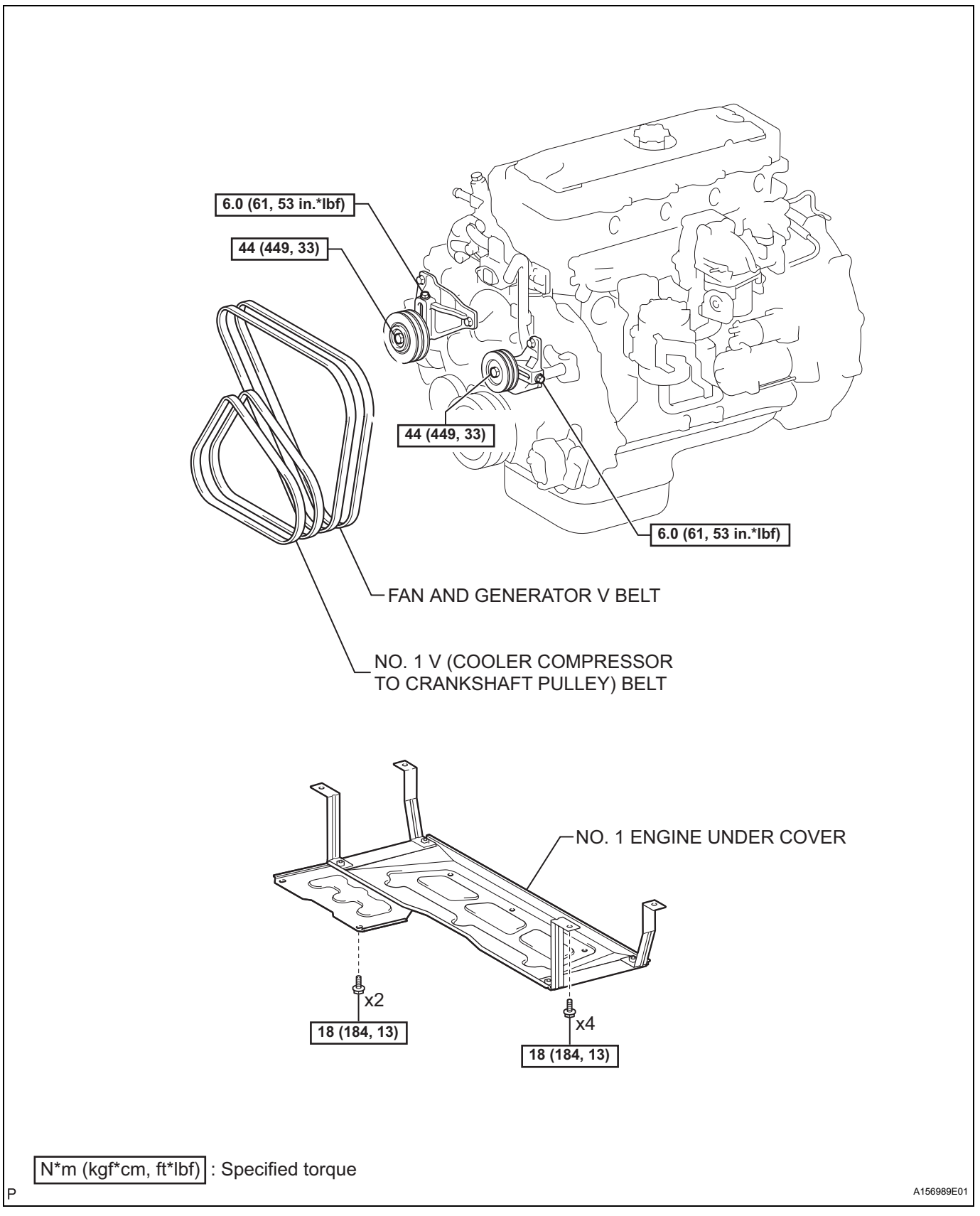
(a) Warm up and stop the engine.
(b) Remove the 4 bolts from the glow plug hole.
(c) Remove the oil filler cap.
(d) Remove the 2 bolts, then remove the No.2 cylinder head cover sub-assembly.
(e) Disconnect all connectors from the 4 injectors.
(f) Crank the engine to remove foreign matter before measuring the compression.
(g) Install SST into the glow plug hole.
SST 09992-00025
(h) Connect a compression gauge to SST.
SST 09992-00025
(i) While cranking the engine, measure the compression pressure.
Compression pressure:
3,200 kPa (33 kgf/cm 464 psi)
Minimum pressure:
2,700 kPa (27 kgf/cm 392 psi)
Difference between each cylinder:
290 kPa (3 kgf/cm 42 psi)
NOTICE:
- **Use a fully-charged battery so that the engine speed can be increased to 250 rpm or more.**
- **Inspect the other cylinders in the same way.**
- **Measure the compression pressure in as short a time as possible.**

If the cylinder compression is low, pour a light coat of engine oil into the cylinder through the glow plug hole, then inspect it again.
HINT:
- If adding oil increases the compression, the piston rings and/or cylinder bore may be worn or damaged.
- If the pressure stays low, a valve may be stuck or seated improperly, or there may be leakage from the gasket.

(j) Remove the compression gauge and SST.
(k) Disconnect the cable from the negative battery terminal.
(l) Connect all connectors to the 4 injectors.
(m) Install the No. 2 cylinder head cover sub-assembly with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)
(n) Install the 4 bolts into the glow plug hole.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

DRIVE BELT

COMPONENTS



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

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REMOVAL

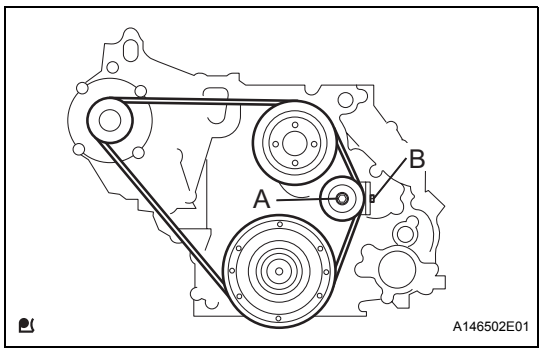
1. REMOVE NO. 1 ENGINE UNDER COVER

(a) Remove the 6 bolts and remove the No. 1 engine under cover.

2. REMOVE FAN AND GENERATOR V BELT

(a) Loosen the A bolt.

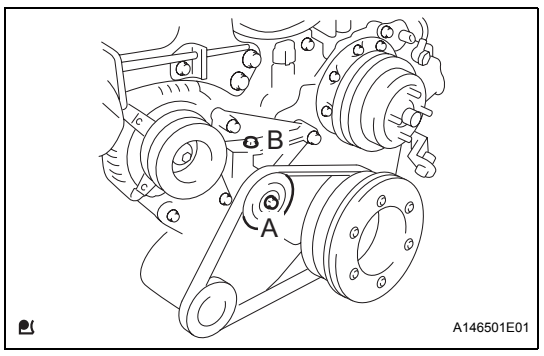
(b) Loosen the B bolt, then remove the fan and generator V belt.



3. REMOVE NO. 1 V (COOLER COMPRESSOR TO CRANKSHAFT PULLEY) BELT

(a) Loosen the A bolt.

(b) Loosen the B bolt, then remove the No.1 V belt.



INSPECTION

1. INSPECT V BELT

(a) Check the belt for wear, cracks and other signs of damage.

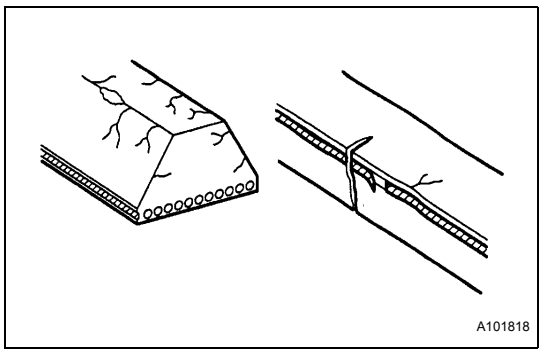
If any defects are found, replace the V belt.

HINT:

Replace the drive belt if any of the following defects are found:

- The belt is worn out and the wire is exposed.
- The cracks reach the wire in more than one place.

(b) Check that the belt fits properly into the grooves.



INSTALLATION

1. INSTALL NO. 1 V (COOLER COMPRESSOR TO CRANKSHAFT PULLEY) BELT

(a) Install the belt.

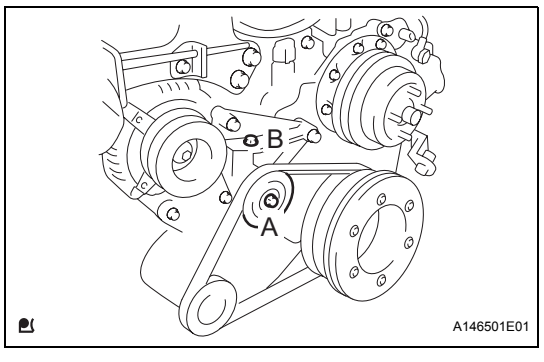
(b) Turn the adjusting B bolt and adjust the tension of the V belt.

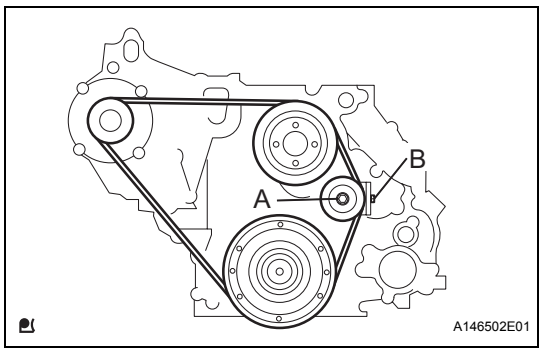
(c) Tighten the fixing A bolt.

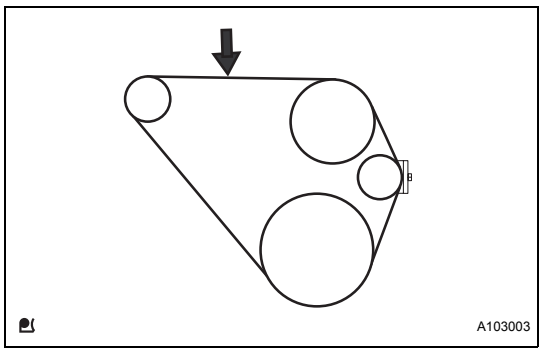
Torque: 44 N*m (449 kgf*cm, 33 ft.*lbf)

(d) Tighten the adjusting B bolt.

Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)







2. INSTALL FAN AND GENERATOR V BELT

(a) Install the belt.

(b) Turn the adjusting B bolt and adjust the tension of the V belt.

(c) Tighten the fixing A bolt.
Torque: 44 N*m (449 kgf*cm, 33 ft.*lbf)

(d) Tighten the adjusting B bolt.
Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)

3. INSPECT FAN AND GENERATOR V BELT

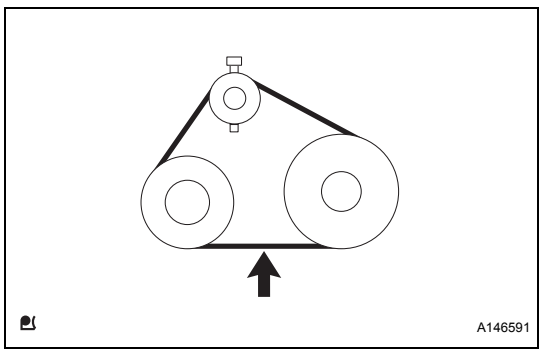
(a) Check the V belt deflection and tension.
HINT:
The specified deflection and tension values per belt are shown in the following table.
Deflection

Item	Specified Condition
New belt	9.5 to 11.5 mm (0.37 to 0.45 in)
Used belt	11.4 mm (0.45 in)

Tension

Item	Specified Condition
New belt	392 to 588 N (40 to 60 kg, 88 to 132 lb)
Used belt	343 N (35 kg, 77 lb)

NOTICE:
- **Check the V belt deflection at the specified point.**
- **When installing a new belt, set its tension to the specified value.**
- **When inspecting a belt which has been used for over 5 minutes, apply the Used Belt specifications.**



4. INSPECT NO. 1 V (COOLER COMPRESSOR TO CRANKSHAFT PULLEY) BELT

(a) Check the V belt deflection and tension.
HINT:
The specified deflection and tension valves per belt are shown in the above table.
Deflection

Item	Specified Condition
New belt	8.6 to 10.6 mm (0.34 to 0.42 in)
Used belt	11.4 mm (0.45 in)

Tension

Item	Specified Condition
New belt	404 to 576 N (41 to 59 kg, 91to 129 lb)
Used belt	343 N (35 kg, 77lb)

NOTICE:
- **Check the V belt deflection at the specified point.**

EM

- **When installing a new belt, set its tension to the specified value.**
- **When inspecting a belt which has been used for over 5 minutes, apply the Used Belt specifications.**

5. INSTALL NO. 1 ENGINE UNDER COVER

(a) Install the No. 1 engine under cover with the 6 bolts.
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)

VALVE CLEARANCE

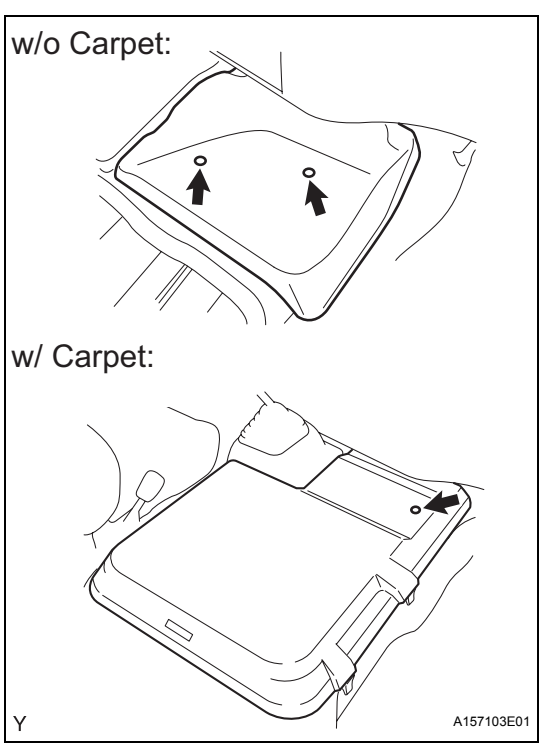
ADJUSTMENT

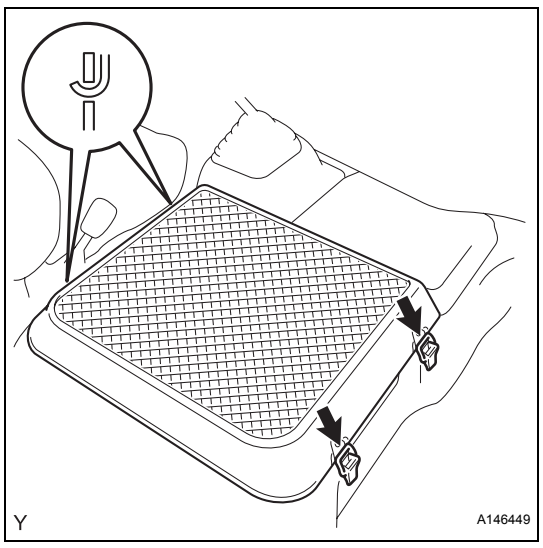
1. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL

2. REMOVE NO. 1 ENGINE UNDER COVER (See page EM-4)

3. REMOVE ENGINE SERVICE HOLE COVER MAT

(a) Remove the engine service hole cover mat.





4. REMOVE ENGINE SERVICE HOLE MAIN COVER

(a) Remove the engine service hole main cover.

5. REMOVE REAR ENGINE SERVICE COVER WEATHERSTRIP

(a) Remove the rear engine service hole cover weatherstrip.

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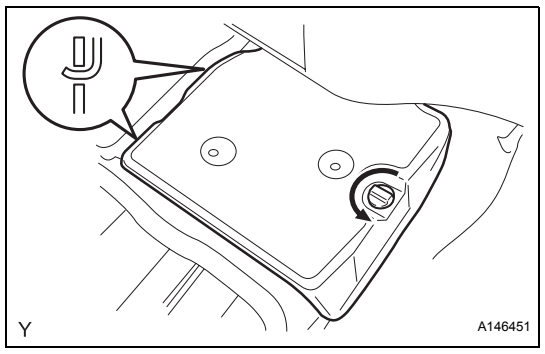
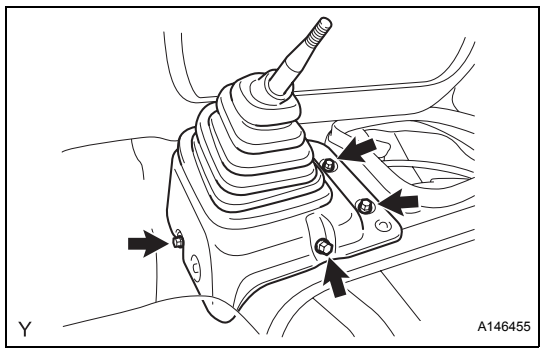


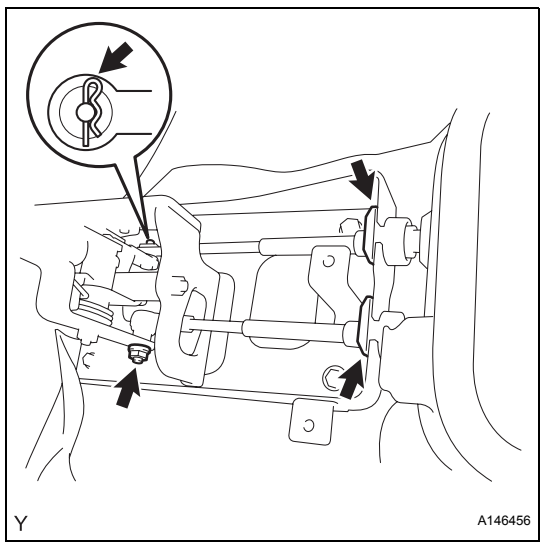
6. REMOVE NO. 2 ENGINE SERVICE HOLE COVER ASSEMBLY

(a) Remove the No. 2 engine service hole cover assembly.



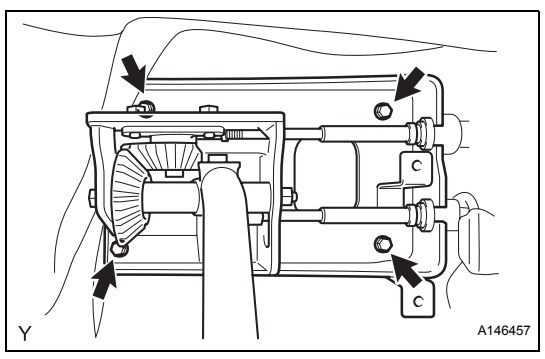
7. REMOVE SHIFT AND SELECT LEVER SUPPORT WITH BOOTS

(a) Remove the shift lever knob sub-assembly.
(b) Remove the transmission cover mat.
(c) Remove the 4 bolts and remove the shift and select lever support with boots.

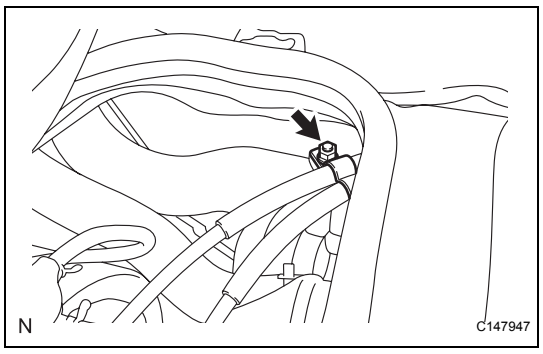


8. REMOVE FLOOR SHIFT SHIFT LEVER ASSEMBLY

(a) Remove the nut and 3 clips and disconnect the select cable and the shift cable.

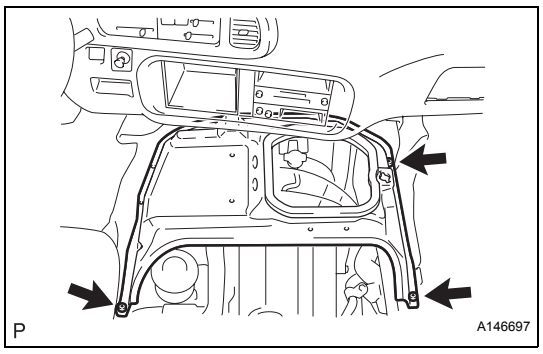


(b) Remove the 4 bolts and remove the floor shift shift lever assembly.



9. REMOVE FRONT ENGINE SERVICE COVER PANEL SUB-ASSEMBLY

(a) Remove the nut and separate the shift wire clamp from the front engine service cover panel sub-assembly.



(b) Remove the 3 bolts and remove the front engine service cover panel sub-assembly.

10. DRAIN COOLANT (See page CO-4)

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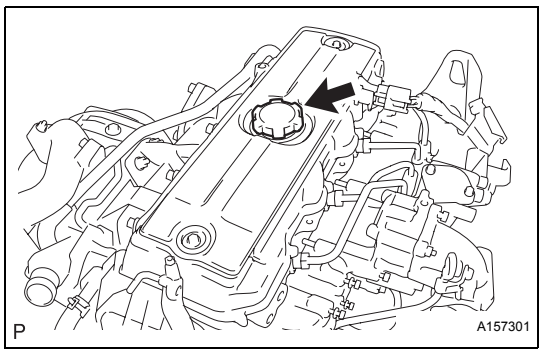
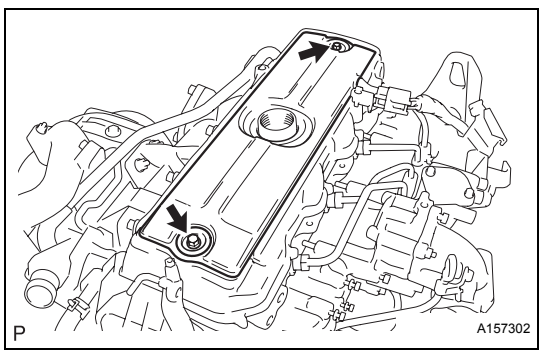


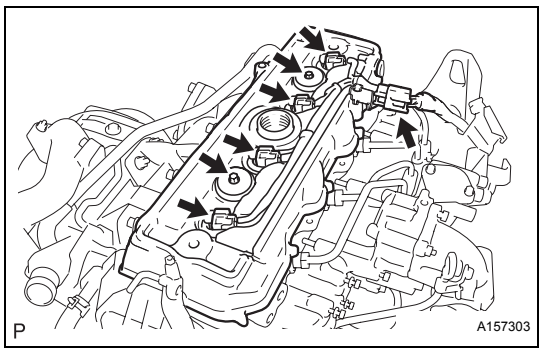
11. REMOVE OIL FILLER CAP SUB-ASSEMBLY

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



12. REMOVE NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove the 2 bolts and remove the No. 2 cylinder head cover sub-assembly.

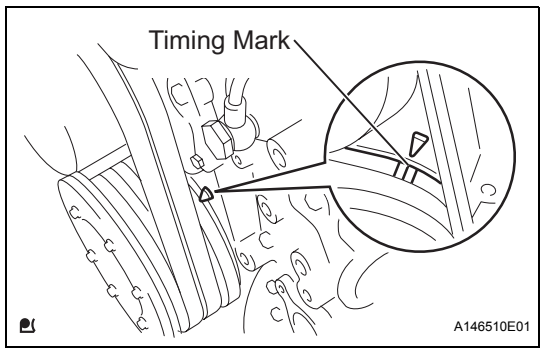


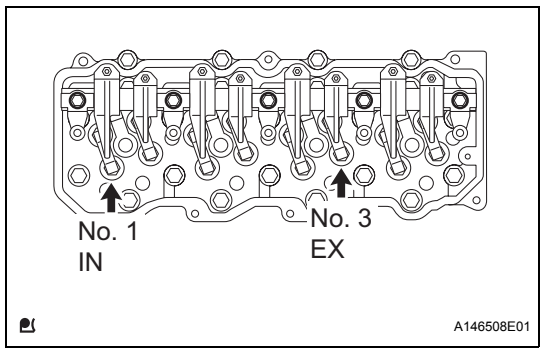
13. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

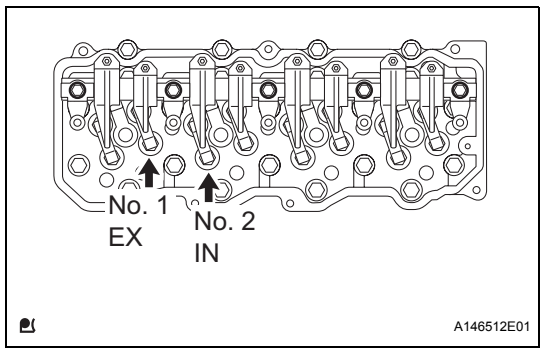
(a) Remove the wire harness.
(b) Remove the cylinder head cover cushion rubber.
(c) Remove the 2 bolts and remove the cylinder head cover sub-assembly.

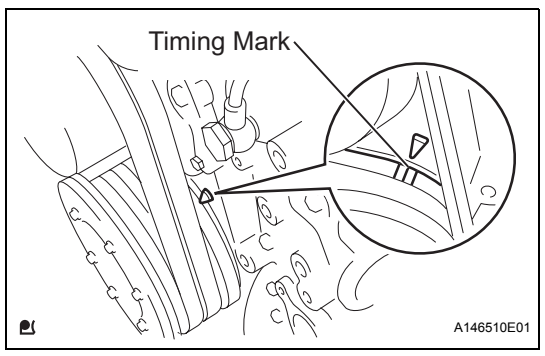
14. REMOVE INJECTION PIPE CLAMP (See page FU-9)

15. REMOVE INJECTOR ASSEMBLY (See page FU-9)









16. INSPECT VALVE CLEARANCE

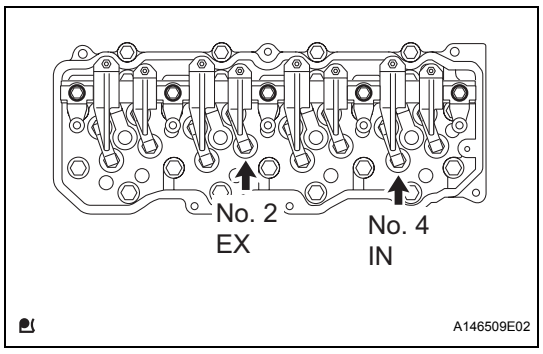
(a) Set the No. 1 cylinder to the TDC/Compression.

(b) Check the valve clearance of the No. 1 cylinder intake valve and the No. 3 cylinder exhaust valve.
Valve clearance (Cold):
Intake:
0.30 mm (0.0118 in.)
Exhaust:
0.45 mm (0.0177 in.)
NOTICE:
Do not apply excessive force to the valve adjusting screw.
HINT:
If the clearance is not as specified, record the out-of-specification measurement, then adjust the valve clearance.

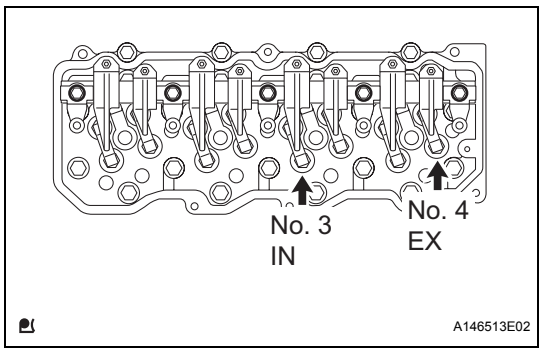
(c) Check the valve clearance of the No. 1 cylinder exhaust valve and the No. 2 cylinder intake valve.
Valve clearance (Cold):
Intake:
0.30 mm (0.0118 in.)
Exhaust:
0.45 mm (0.0177 in.)
NOTICE:
Do not apply excessive force to the valve adjusting screw.
HINT:
If the clearance is not as specified, record the out-of-specification measurement, then adjust the valve clearance.

(d) Turn the crankshaft by a further 360° clockwise.

(e) Set the No. 4 cylinder to the TDC/Compression.



(f) Check the valve clearance of the No. 2 cylinder exhaust valve and the No. 4 cylinder intake valve.
Valve clearance (Cold):
Intake:
0.30 mm (0.0118 in.)
Exhaust:
0.45 mm (0.0177 in.)
NOTICE:
Do not apply excessive force to the valve adjusting screw.
HINT:
If the clearance is not as specified, record the out-of-specification measurement, then adjust the valve clearance.



(g) Check the valve clearance of the No. 3 cylinder intake valve and the No. 4 cylinder exhaust valve.
Valve clearance (Cold):
Intake:
0.30 mm (0.0118 in.)
Exhaust:
0.45 mm (0.0177 in.)
NOTICE:
Do not apply excessive force to the valve adjusting screw.
HINT:
If the clearance is not as specified, record the out-of-specification measurement, then adjust the valve clearance.

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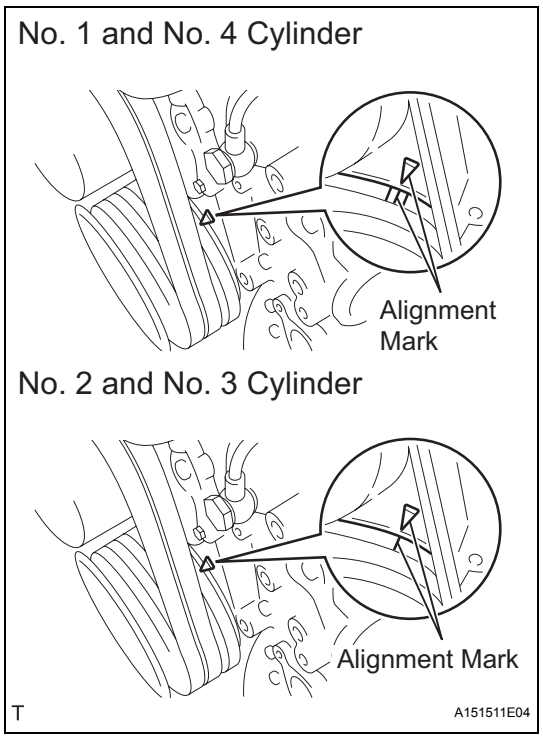
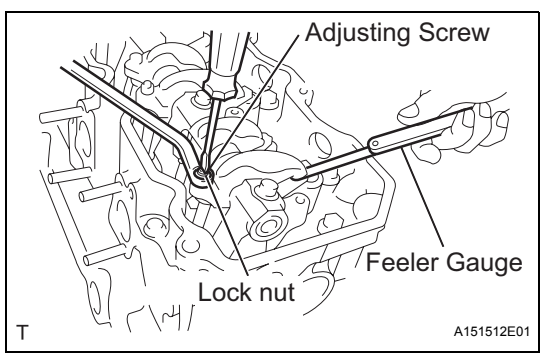


17. ADJUST VALVE CLEARANCE

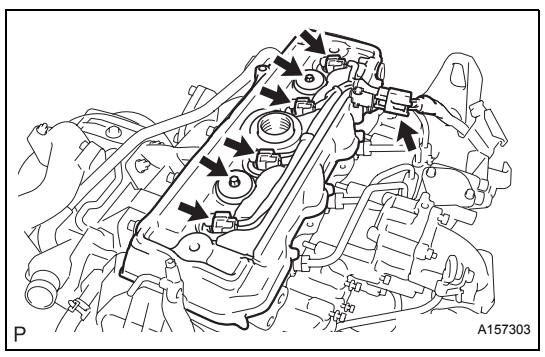
(a) Turn the crankshaft clockwise to align the alignment mark on the crankshaft pulley with the pointer on the timing gear case.
HINT:
If not, turn the crankshaft 1 revolution (360°) to align the alignment mark.



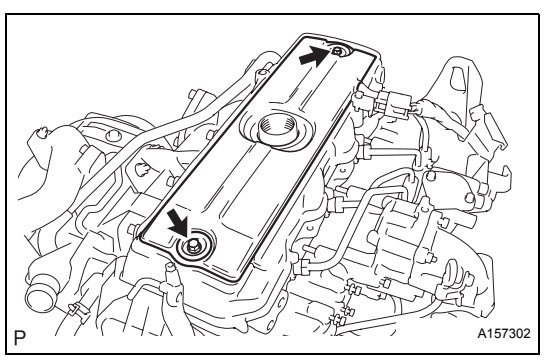
(b) With the No. 1 piston positioned at TDC on the compression stroke, using a feeler gauge, adjust each valve clearance.
Valve clearance (Cold):
Intake:
0.30 mm (0.0118 in.)
Exhaust:
0.45 mm (0.0177 in.)
HINT:
The feeler gauge should move with a very slight pull.
(c) Loosen the lock nut on the valve rocker arm and loosen the adjusting screw.
(d) Insert a 0.30 mm(0.012 in.) feeler gauge for the intake or a 0.45 mm (0.018 in.) feeler gauge for the exhaust between the adjusting screw on the valve rocker arm and the valve bridge.
(e) Turn the adjusting screw on the valve rocker arm until the feeler gauge slides with a very slight drag, and lock the adjusting screw with the lock nut.
Torque: 29 N*m (296 kgf*cm, 22 ft.*lbf)

18. INSTALL INJECTOR ASSEMBLY (See page FU-10)

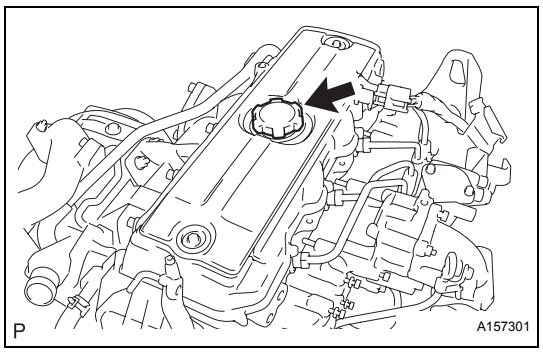
19. INSTALL INJECTION PIPE CLAMP (See page FU-12)



20. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY
(a) Install a new cylinder head cover gasket onto the cylinder head cover sub-assembly.
(b) Install the cylinder head cover sub-assembly with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)
(c) Install the cylinder head cover cushion rubber.
(d) Install the engine wire.

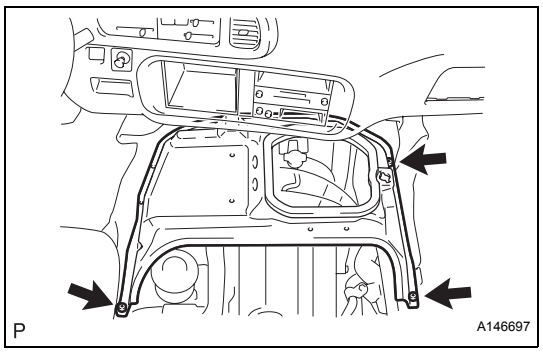


21. INSTALL NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY
(a) Install the No. 2 cylinder head cover sub-assembly with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



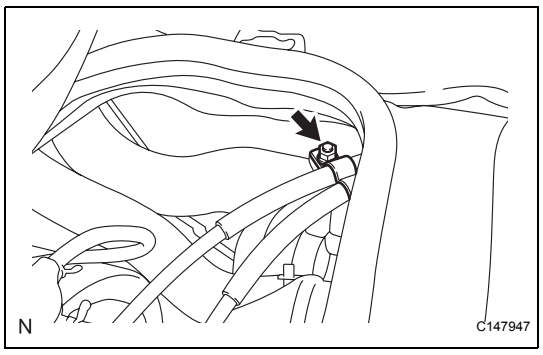
22. INSTALL OIL FILLER CAP SUB-ASSEMBLY

(a) Install the oil filler cap sub-assembly.

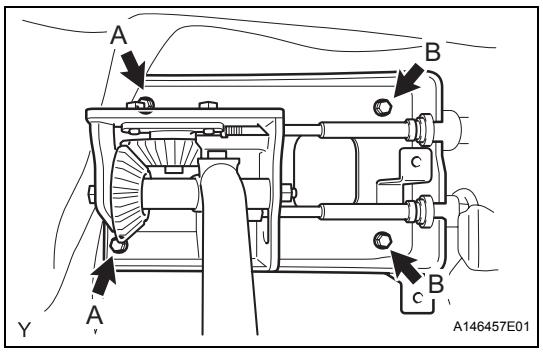


23. INSTALL FRONT ENGINE SERVICE COVER PANEL SUB-ASSEMBLY

(a) Install the front engine service cover panel sub-assembly with the 3 bolts.
Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)



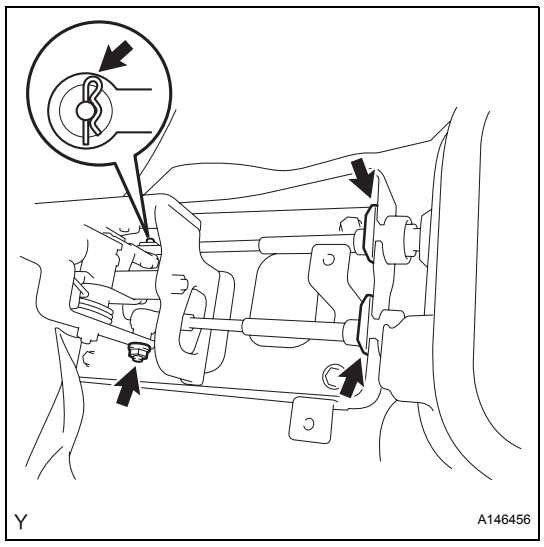
(b) Install the shift wire clamp with the nut.
Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)



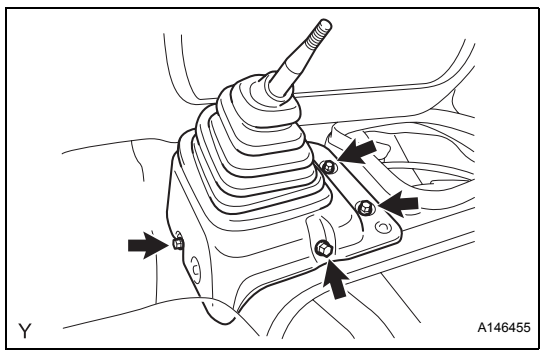
24. INSTALL FLOOR SHIFT SHIFT LEVER ASSEMBLY

(a) Install the floor shift shift lever assembly with the 4 bolts.
Torque: for Bolt A
12 N*m (122 kgf*cm, 9 ft.*lbf)
for Bolt B
7.5 N*m (76 kgf*cm, 66 in.*lbf)

EM



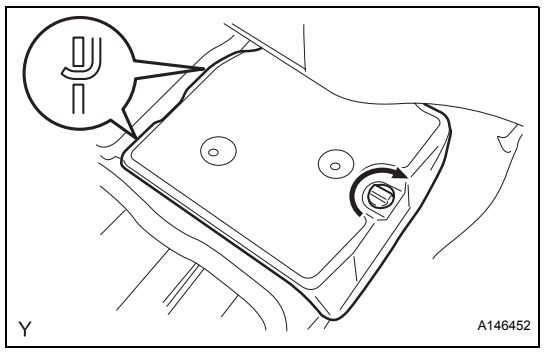
(b) Connect the select cable and shaft cable and install the nut and 3 clips.
Torque: 15 N*m (153 kgf*cm, 11 ft.*lbf)



25. INSTALL SHIFT AND SELECT LEVER SUPPORT WITH BOOTS
(a) Install the shift and select lever support with boots with the 4 bolts.
Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)
(b) Install the transmission cover mat.
(c) Install the shift lever knob sub-assembly.

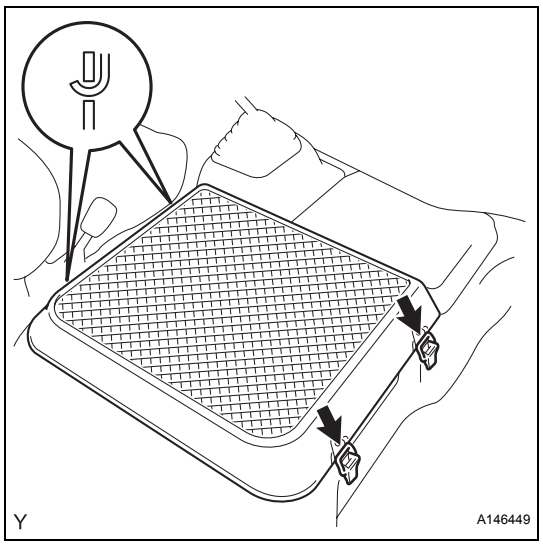
26. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

27. INSPECT FOR OIL LEAK (See page LU-4)



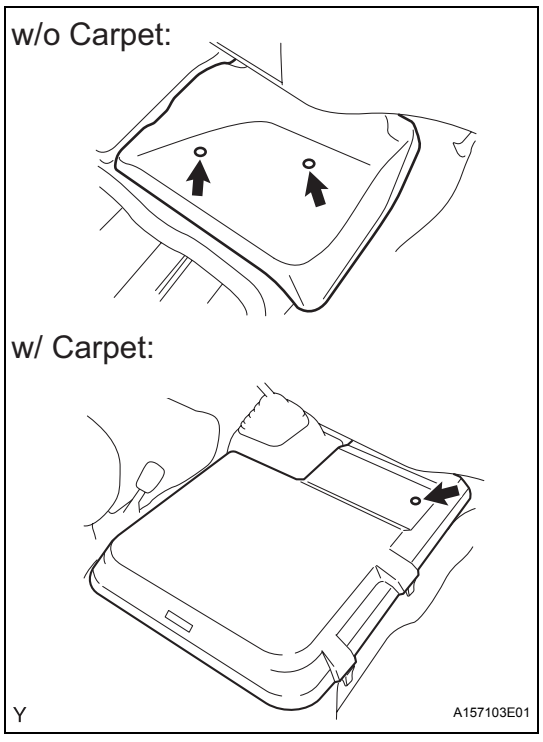
28. INSTALL NO. 2 ENGINE SERVICE HOLE COVER ASSEMBLY
(a) Install the No. 2 engine service hole cover assembly.

29. INSTALL REAR ENGINE SERVICE COVER WEATHERSTRIP
(a) Install the rear engine service cover weatherstrip.



30. INSTALL ENGINE SERVICE HOLE MAIN COVER

(a) Install the engine service hole main cover.



31. INSTALL ENGINE SERVICE HOLE COVER MAT

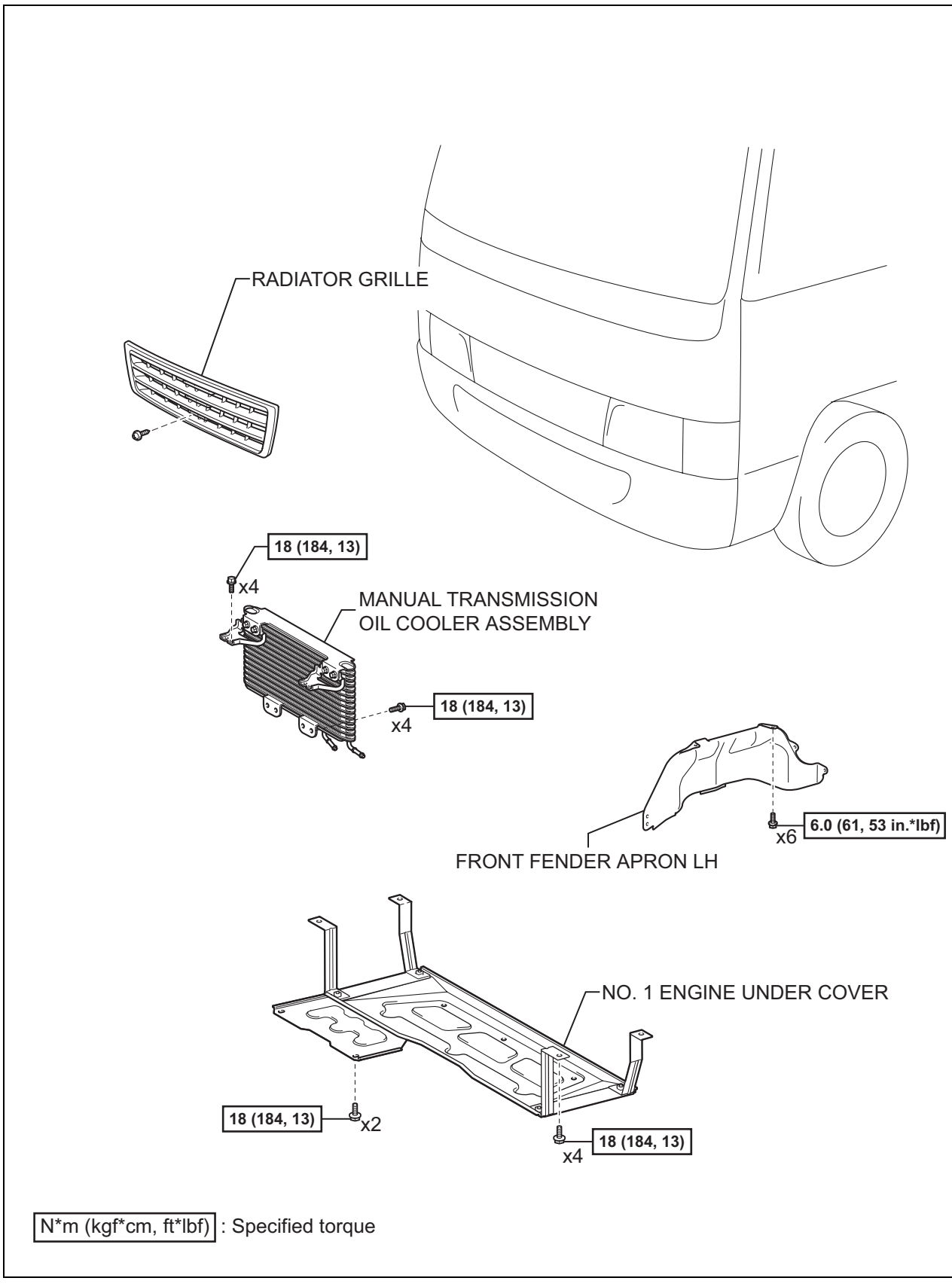
(a) Install the engine service hole cover mat.

32. INSTALL NO. 1 ENGINE UNDER COVER (See page EM-6)

EM

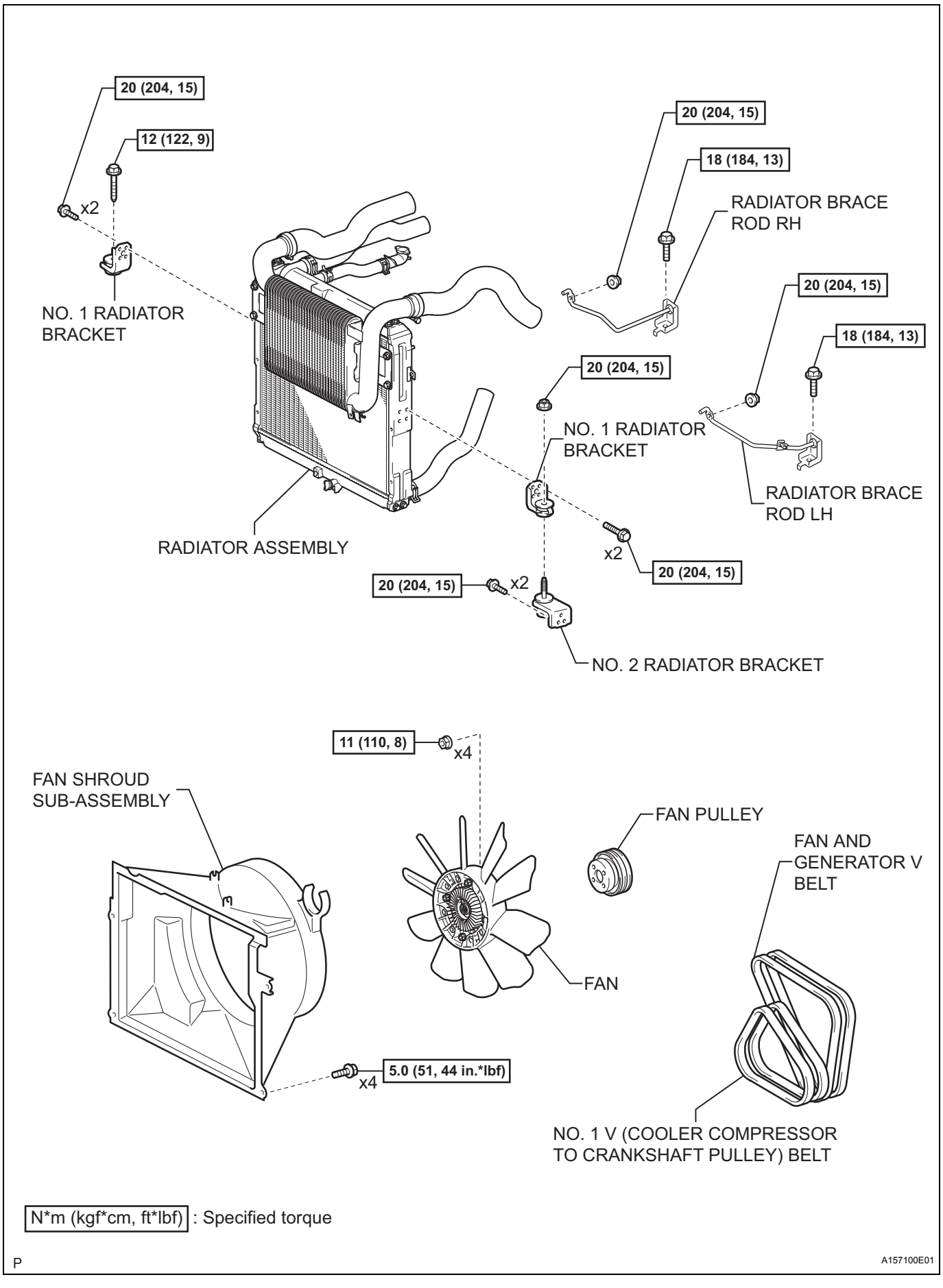
CAMSHAFT

COMPONENTS



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

A157046E01

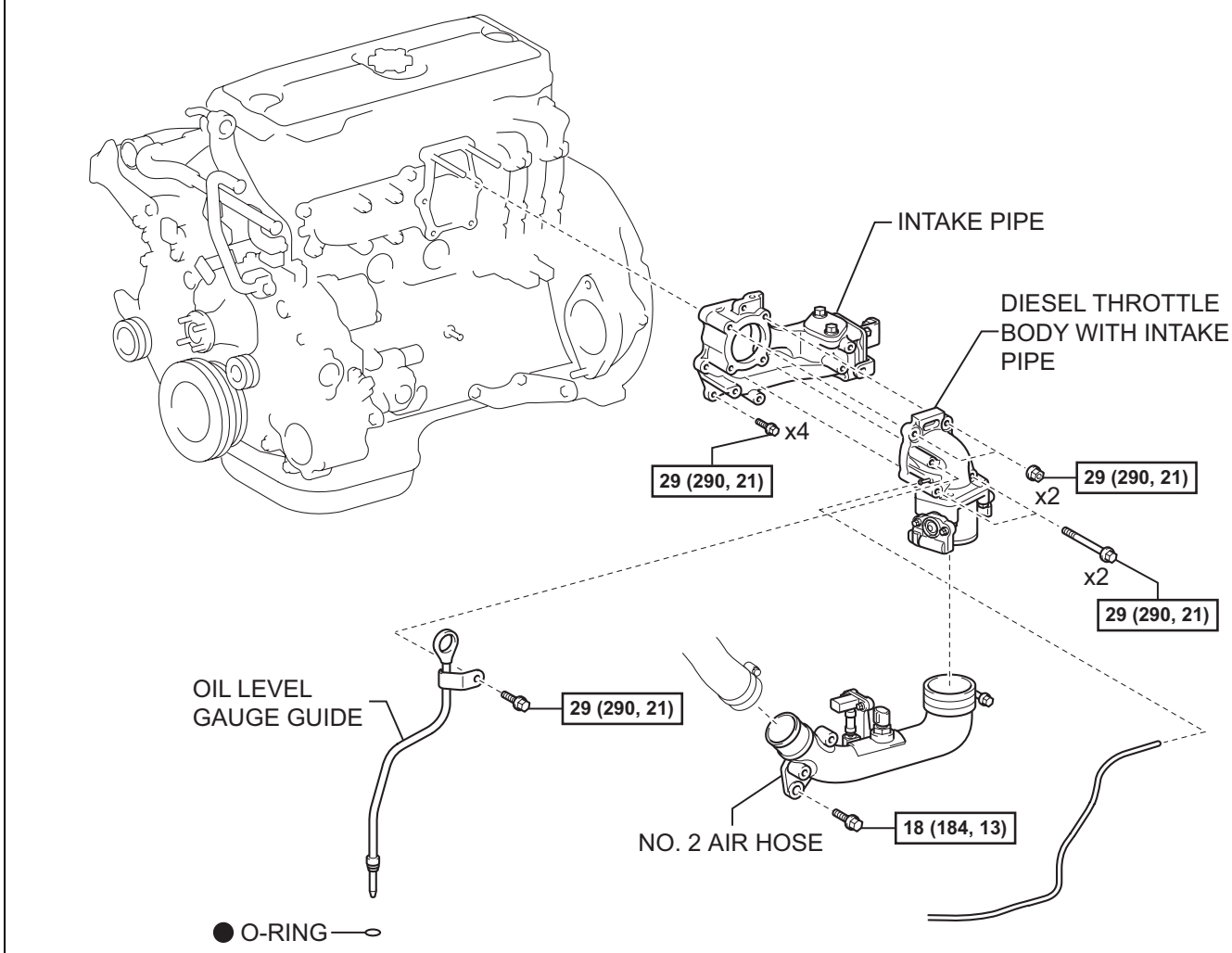


N*m (kgf*cm, ft*lbf) : Specified torque

P

A157100E01

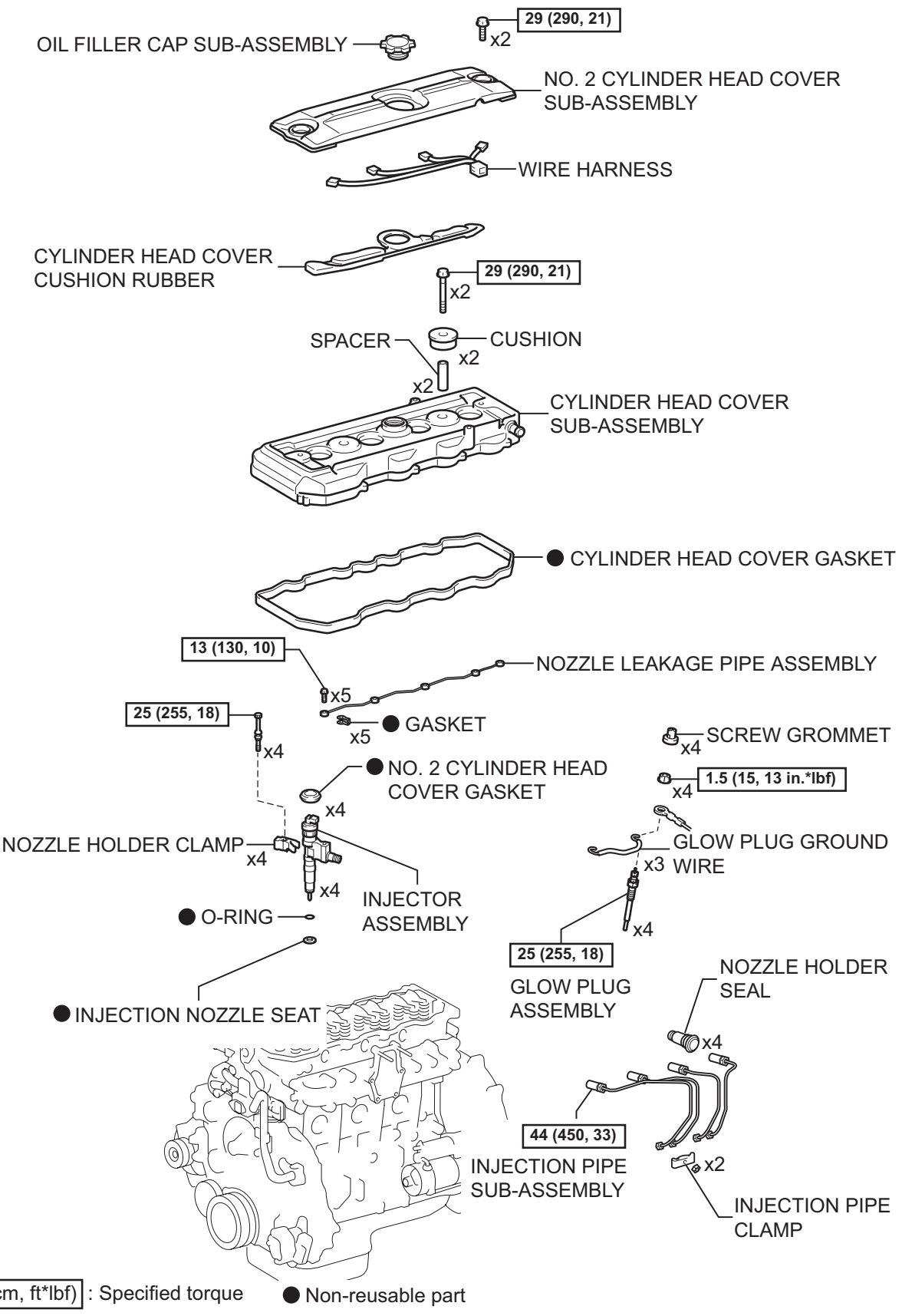
EM



N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

Y

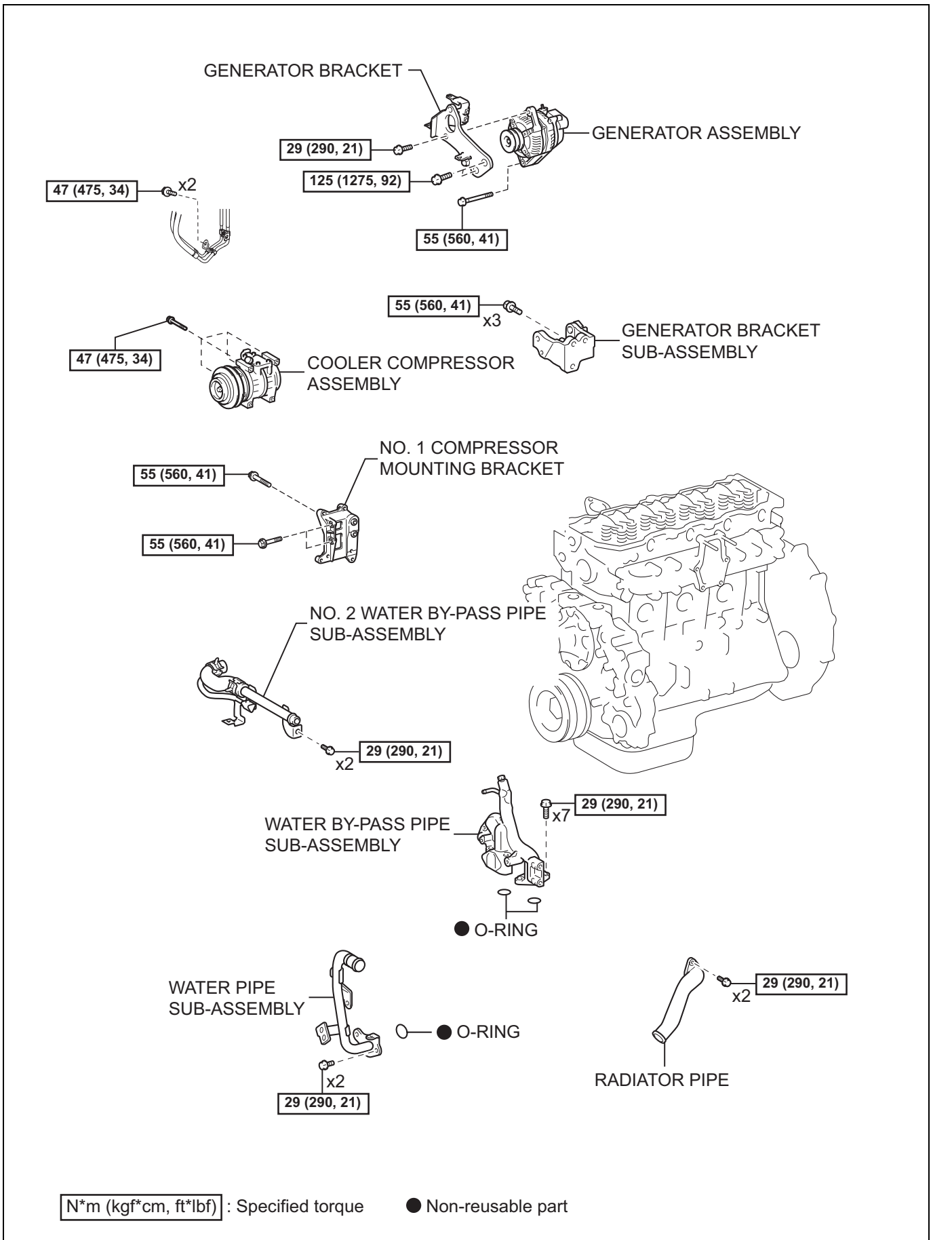
A156991E01



T

A157044E01

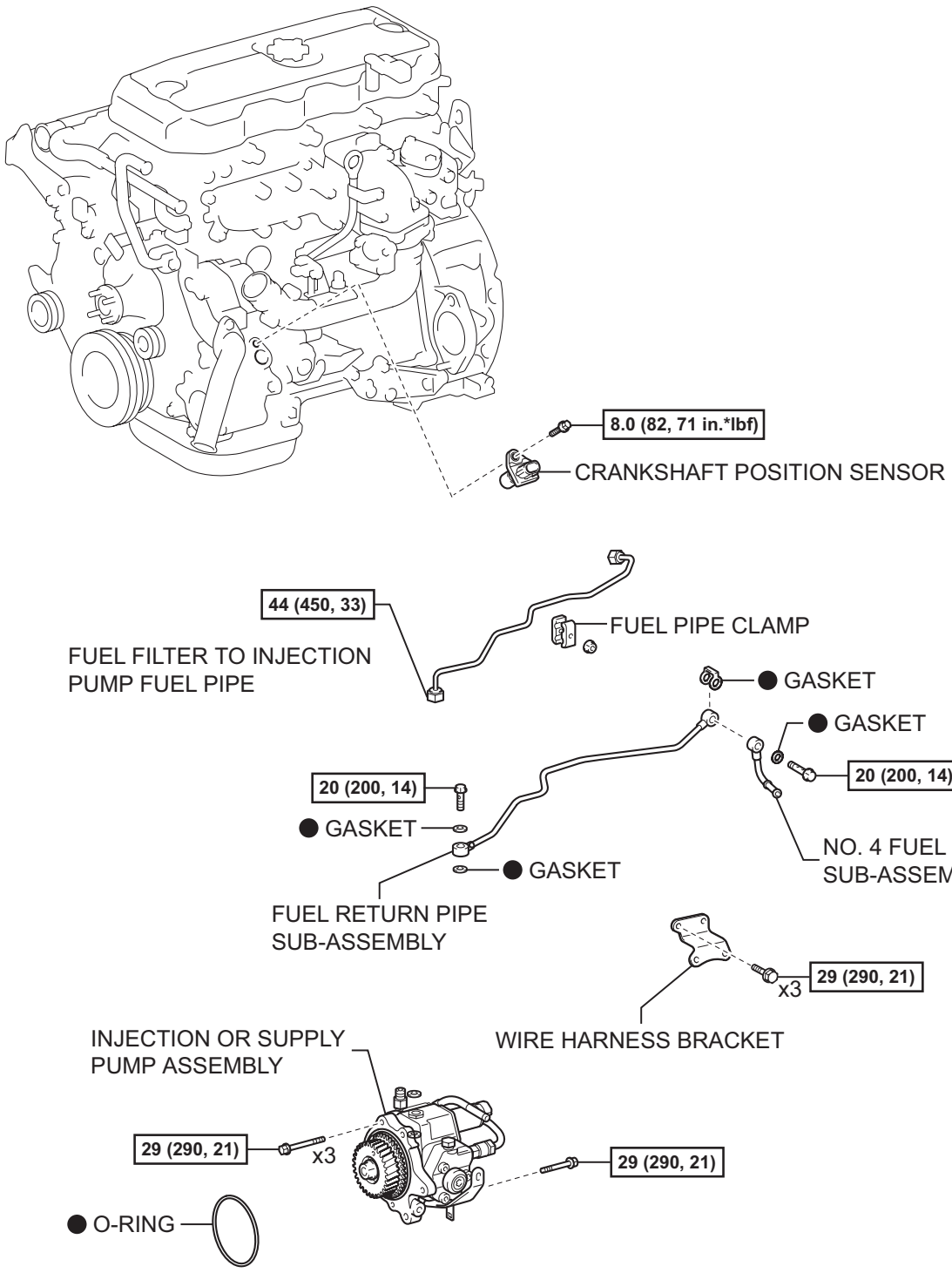
EM



N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

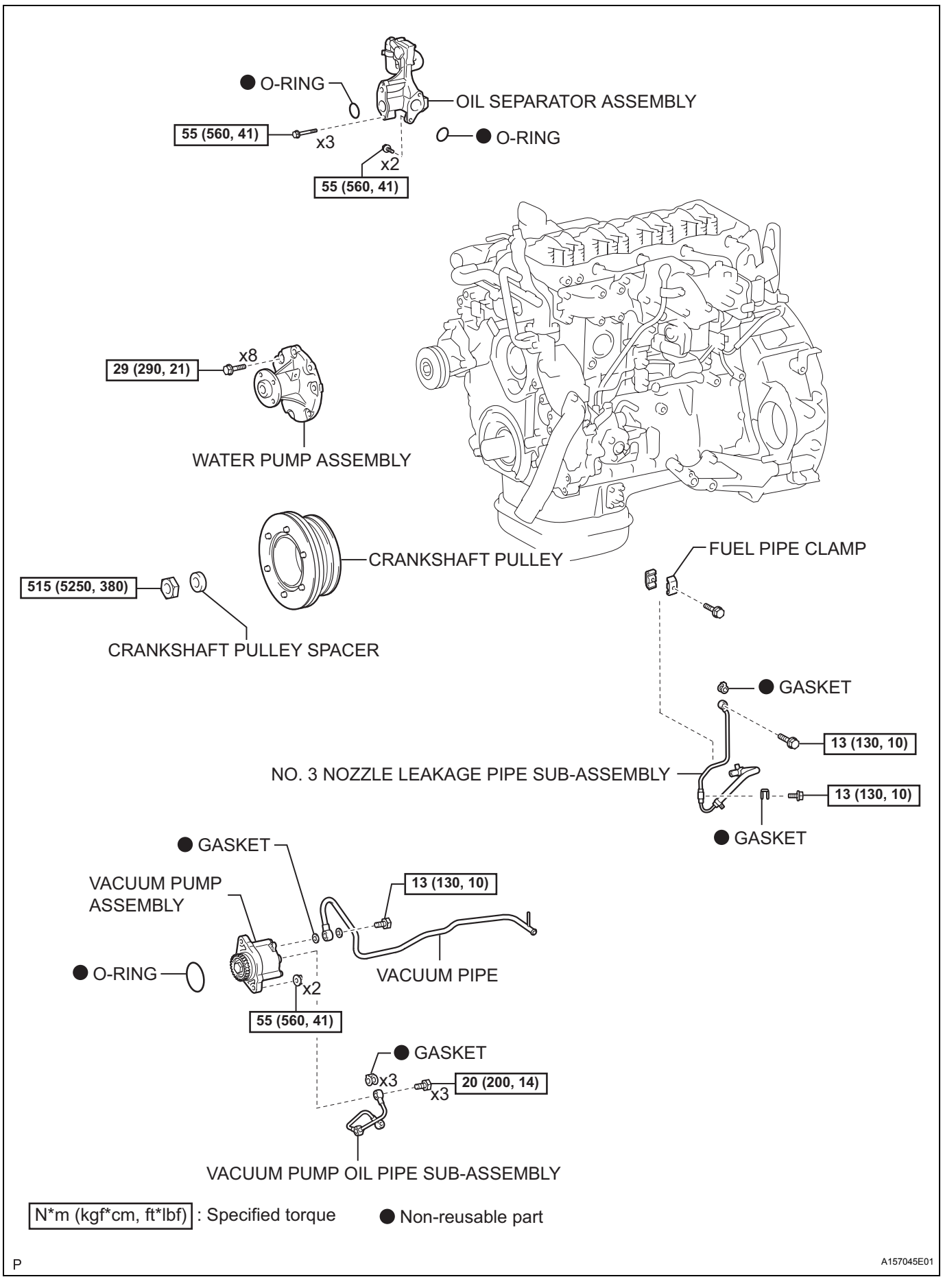
T

A146592E01



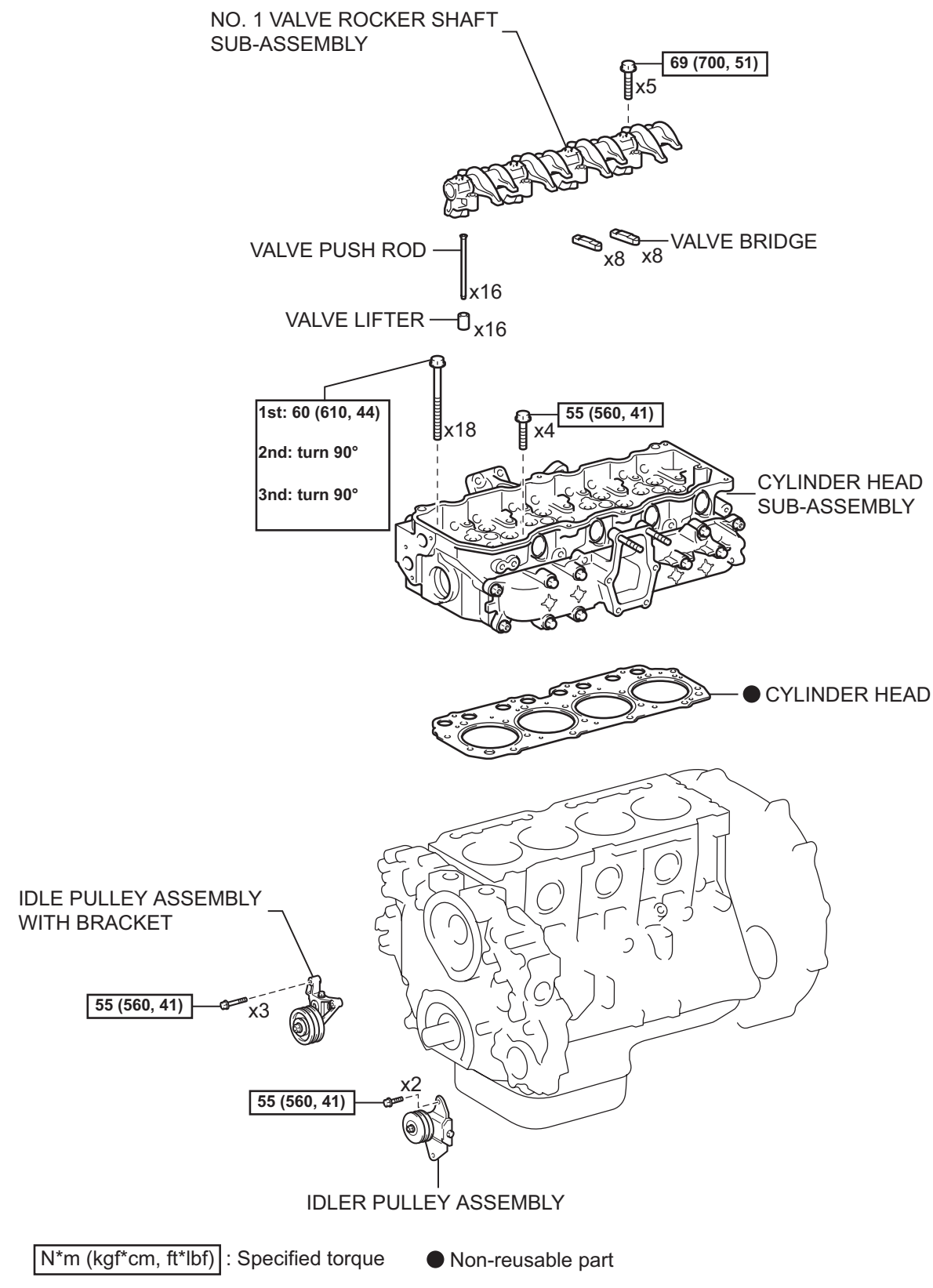
N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

A156992E01



P

A157045E01

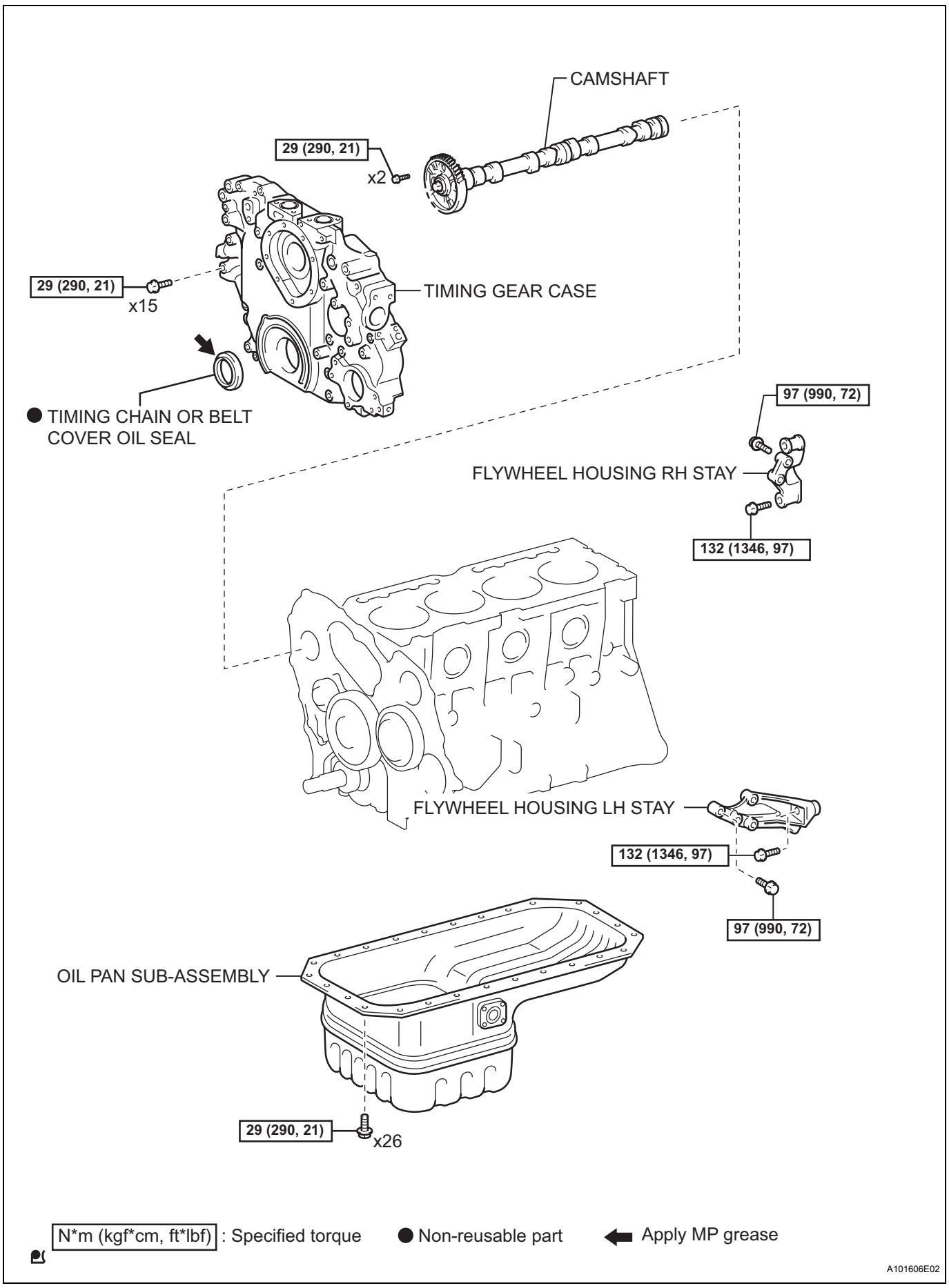


N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

T

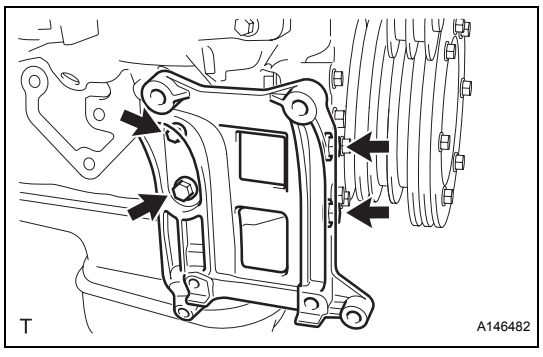
A157106E01

EM

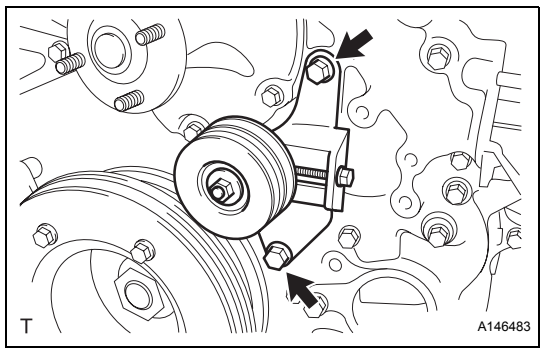


REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE NO. 1 ENGINE UNDER COVER (See page EM-4)**
3. **DRAIN ENGINE OIL (See page LU-3)**
4. **DRAIN COOLANT (See page CO-4)**
5. **REMOVE TURBOCHARGER SUB-ASSEMBLY**
   Refer to the procedures under " REMOVE TURBOCHARGER SUB-ASSEMBLY " (IT-10).
6. **REMOVE NO. 1 AIR HOSE (See page EM-85)**
7. **REMOVE RADIATOR GRILLE (See page ET-3)**
8. **REMOVE MANUAL TRANSMISSION OIL COOLER ASSEMBLY (See page CO-36)**
9. **REMOVE FAN (See page CO-25)**
10. **REMOVE RADIATOR ASSEMBLY (See page EM-85)**
11. **DISCONNECT OUTLET HEATER WATER HOSE (See page EM-87)**
12. **REMOVE RADIATOR PIPE (See page EM-88)**
13. **REMOVE WATER PIPE SUB-ASSEMBLY (See page EM-48)**
14. **REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY (See page EM-49)**
15. **REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY (See page EM-49)**
16. **SEPARATE COOLER COMPRESSOR ASSEMBLY (See page EM-88)**
17. **REMOVE NO. 1 COMPRESSOR MOUNTING BRACKET**
    (a) Remove the 4 bolts, then remove the No. 1 compressor mounting bracket.

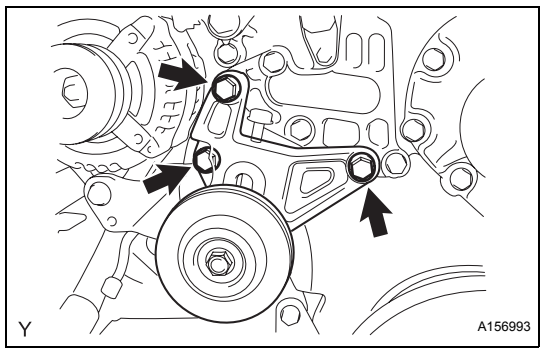


EM



18. REMOVE IDLER PULLEY ASSEMBLY

(a) Remove the 2 bolts and remove the idler pulley assembly.

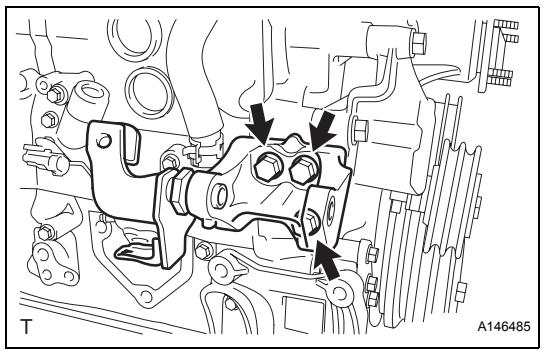


19. REMOVE IDLE PULLEY ASSEMBLY WITH BRACKET

(a) Remove the 3 bolts and remove the idle pulley assembly with bracket.

20. REMOVE WATER PUMP ASSEMBLY (See page CO-11)

21. REMOVE GENERATOR ASSEMBLY (See page CH-10)



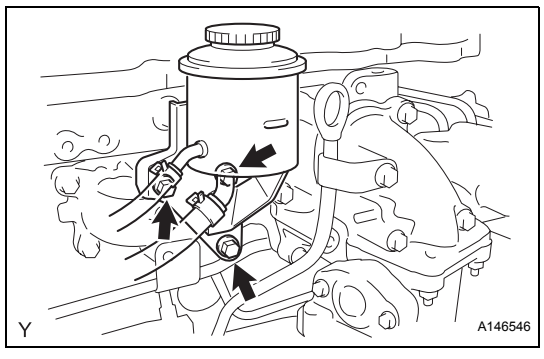
22. REMOVE GENERATOR BRACKET SUB-ASSEMBLY

(a) Remove the 3 bolts and remove the generator bracket.

23. REMOVE FRONT FENDER APRON LH (See page ES-255)

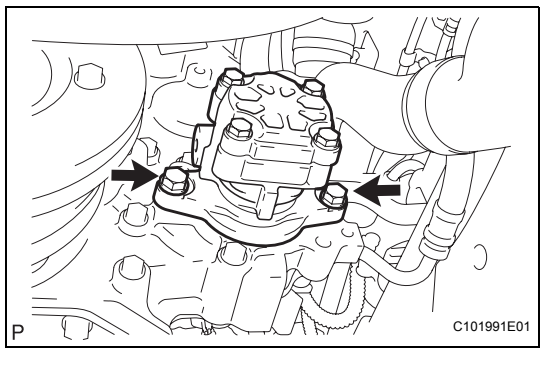
24. REMOVE NO. 2 AIR HOSE (See page EM-88)

25. REMOVE DIESEL THROTTLE BODY WITH INTAKE PIPE (See page EM-89)



26. SEPARATE VANE PUMP ASSEMBLY

(a) Remove the 3 bolts and separate the vane pump reservoir assembly.



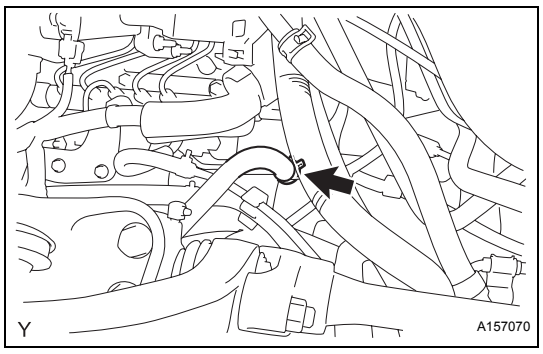
(b) Remove the 2 bolts and separate the vane pump assembly.

27. REMOVE GLOW PLUG ASSEMBLY (See page EM-91)

28. REMOVE OIL FILLER CAP SUB-ASSEMBLY (See page EM-9)

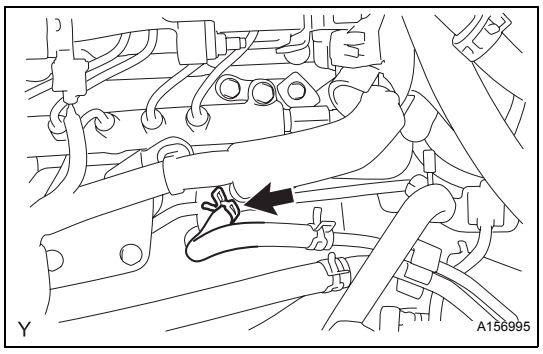
29. REMOVE NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-9)

30. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-9)



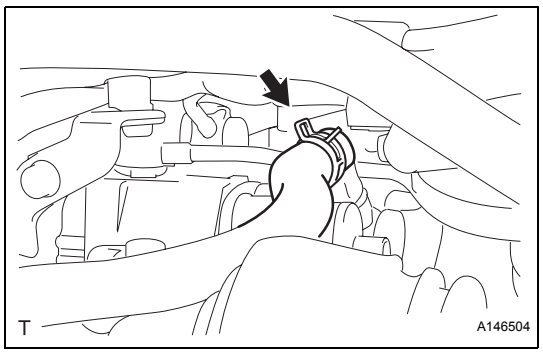
31. DISCONNECT UNION TO CONNECTOR TUBE HOSE

(a) Disconnect the union to connector tube hose.



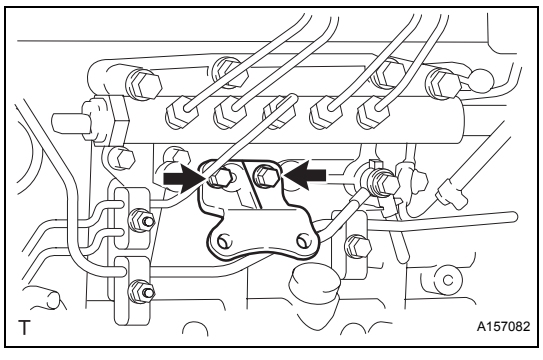
32. DISCONNECT NO. 1 FUEL HOSE

(a) Disconnect the No. 1 fuel hose return tube.



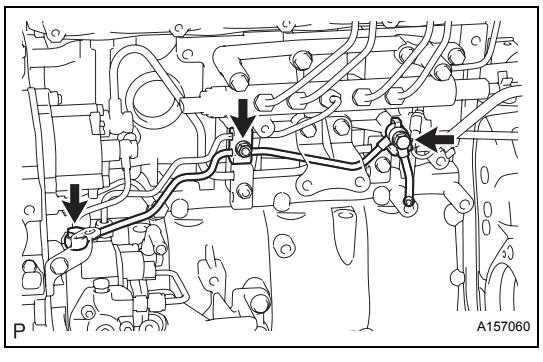
33. DISCONNECT INJECTION PUMP TO FUEL FILTER FUEL HOSE OR PIPE

(a) Disconnect the injection pump to fuel filter fuel hose or pipe.



34. REMOVE WIRE HARNESS BRACKET

(a) Remove the 2 bolts and remove the wire harness bracket.

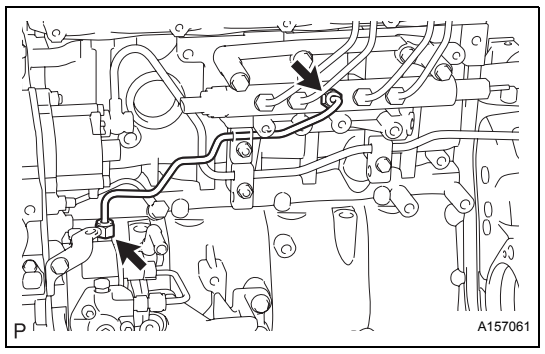


35. REMOVE FUEL RETURN PIPE SUB-ASSEMBLY

(a) Remove the nut and the fuel pipe clamp.

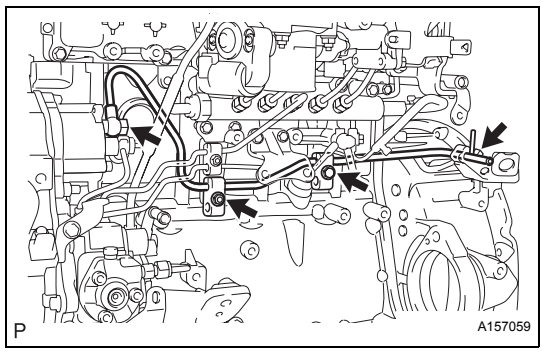
(b) Remove the 2 union bolts and remove the fuel return pipe sub-assembly and No. 4 fuel pipe sub-assembly.

EM



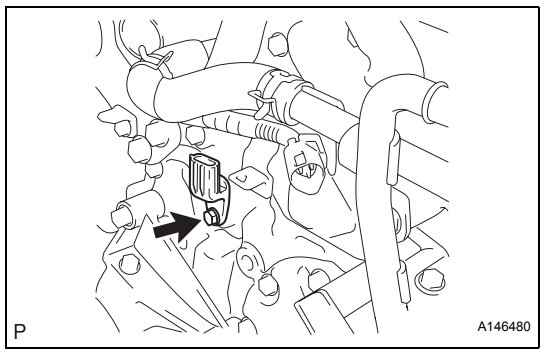
36. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE

(a) Using SST, loosen the 2 union nuts and remove the fuel filter to injection pump fuel pipe.
SST 09023-12901



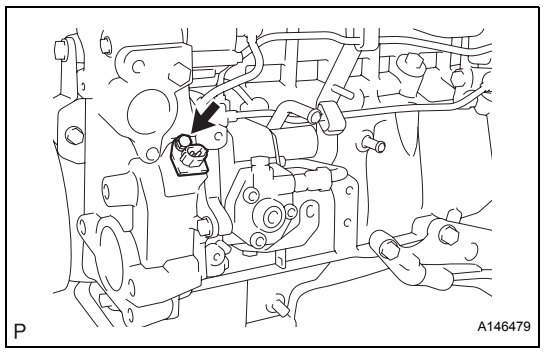
37. REMOVE VACUUM PIPE

(a) Remove the union bolt and 2 nuts and remove the 3 vacuum pipe clamps.
(b) Remove the vacuum pipe.



38. REMOVE CAMSHAFT POSITION SENSOR

(a) Disconnect the connector.
(b) Remove the bolt and remove the camshaft position sensor.



39. REMOVE CRANKSHAFT POSITION SENSOR

(a) Disconnect the connector.
(b) Remove the bolt and remove the crankshaft position sensor.

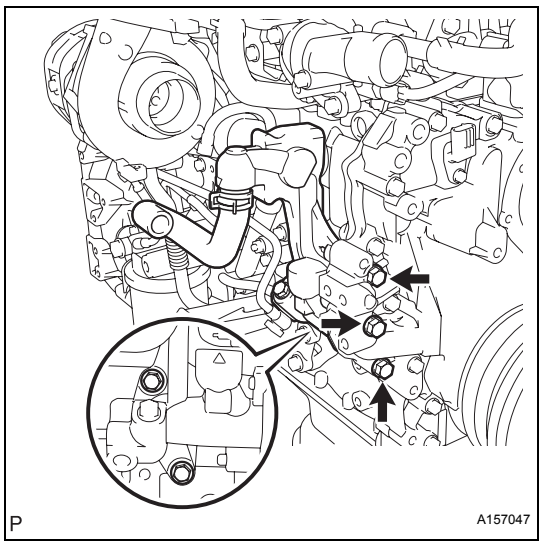
40. REMOVE INTAKE PIPE (See page EM-50)

41. REMOVE INJECTION PIPE CLAMP (See page EM-50)

42. REMOVE INJECTOR ASSEMBLY (See page EM-50)

43. REMOVE NO. 3 NOZZLE LEAKAGE PIPE SUB-ASSEMBLY (See page EM-51)

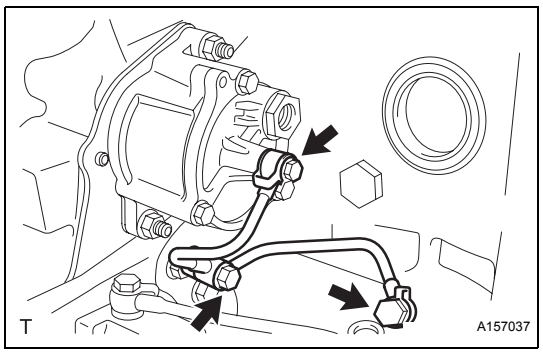
44. SET NO. 1 CYLINDER TO TDC / COMPRESSION (See page EM-52)



45. REMOVE OIL SEPARATOR ASSEMBLY

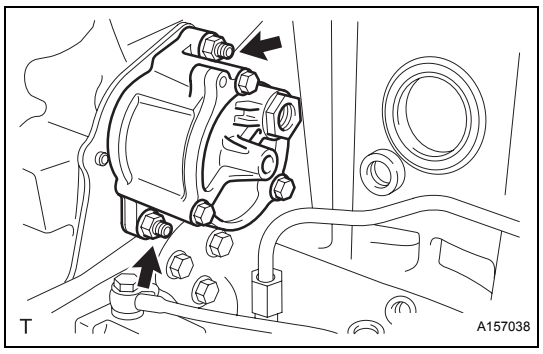
(a) Remove the 5 bolts and remove the oil separator assembly.

(b) Remove the 2 O-rings.



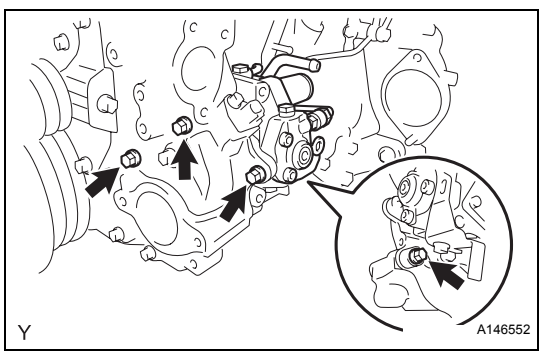
46. REMOVE VACUUM PUMP OIL PIPE SUB-ASSEMBLY

(a) Remove the 3 union bolts and remove the vacuum pump oil pipe sub-assembly.



47. REMOVE VACUUM PUMP ASSEMBLY

(a) Remove the 2 nuts and remove the vacuum pump assembly.



48. REMOVE INJECTION OR SUPPLY PUMP ASSEMBLY

(a) Remove the 4 bolts and remove the injection or supply pump assembly.

49. REMOVE NO. 1 VALVE ROCKER SHAFT SUB-ASSEMBLY (See page EM-53)

50. REMOVE VALVE PUSH ROD (See page EM-53)

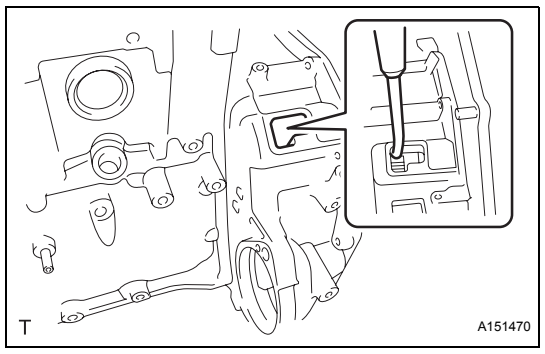
51. REMOVE VALVE BRIDGE (See page EM-53)

52. REMOVE CYLINDER HEAD SUB-ASSEMBLY (See page EM-53)

53. REMOVE CYLINDER HEAD GASKET

(a) Remove the cylinder head gasket.

54. REMOVE VALVE LIFTER (See page EM-53)



55. REMOVE CRANKSHAFT PULLEY

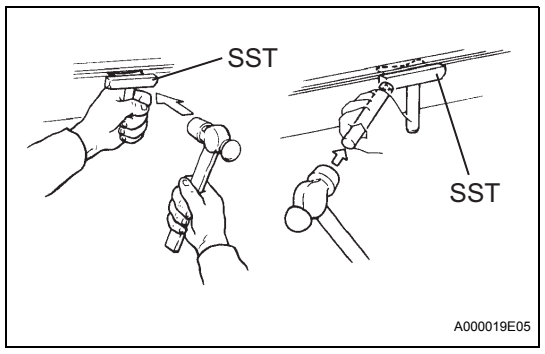
(a) Using a 46 mm socket wrench, remove the nut, spacer and pulley.
HINT:
Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.

56. REMOVE FLYWHEEL HOUSING RH STAY

(a) Remove the 4 bolts and the flywheel housing RH stay.

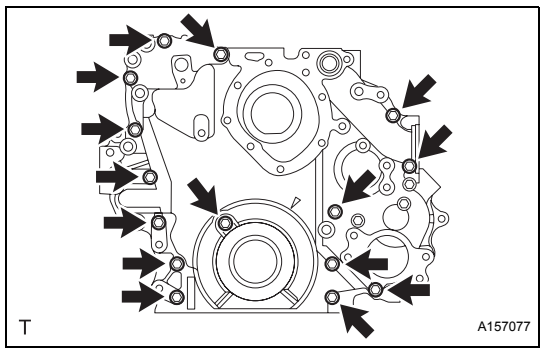
57. REMOVE FLYWHEEL HOUSING LH STAY

(a) Remove the 4 bolts and the flywheel housing LH stay.



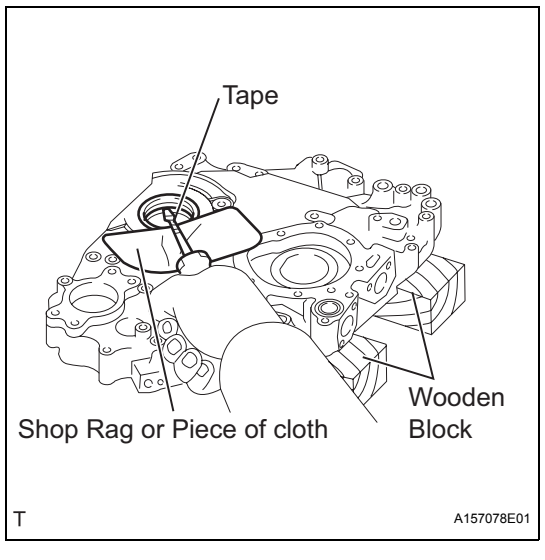
58. REMOVE OIL PAN SUB-ASSEMBLY

(a) Remove the 26 bolts from the oil pan.
(b) Insert the blade of SST between the crankcase and oil pan. Cut through the applied sealer and remove the oil pan.
SST 09032-00100
NOTICE:
Do not damage the contact surface of the cylinder block and oil pan.



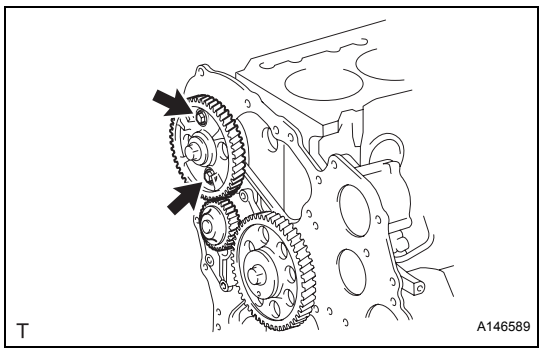
59. REMOVE TIMING GEAR CASE

(a) Remove the 15 bolts.
(b) Using a screwdriver with its tip wrapped in protective tape, pry out the timing gear case.
NOTICE:
Do not damage the contact surfaces of the timing gear case, cylinder block and cylinder head.



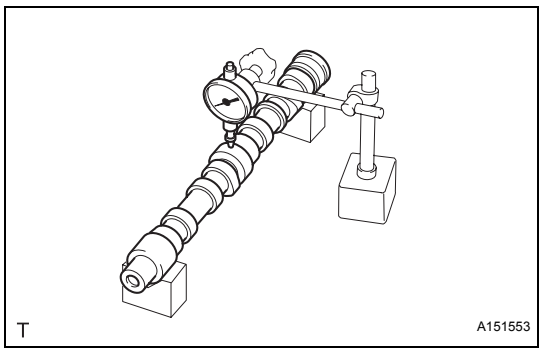
60. REMOVE TIMING CHAIN OR BELT COVER OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.
HINT:
Use wooden blocks and a shop rag or piece of cloth to prevent the contact surfaces and the timing gear case from being damaged.



61. REMOVE CAMSHAFT

(a) Remove the 2 bolts and remove the camshaft.

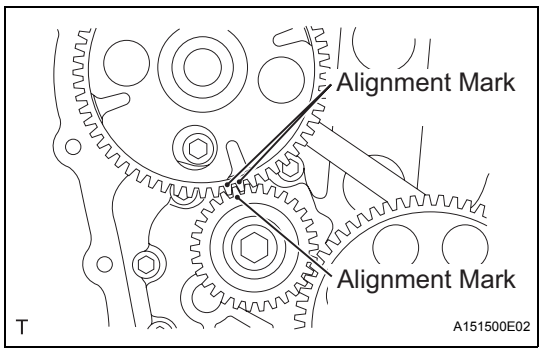


INSPECTION

1. INSPECT CAMSHAFT

(a) Inspect the camshaft for circle runout.
  (1) Place the camshaft on V-blocks.
  (2) Using a dial gauge, 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 camshaft.

(b) Using a micrometer, measure the cam lobe height.
Standard cam lobe height:
Intake:
50.66 to 50.86 mm (1.9944 to 2.0023 in.)
Exhaust:
49.36 to 49.56 mm (1.9432 to 1.9511 in.)
Minimum cam lobe height:
Intake:
50.20 mm (1.9764 in.)
Exhaust:
48.95 mm (1.9272 in.)
If the lobe height is less than the minimum, replace the camshaft.



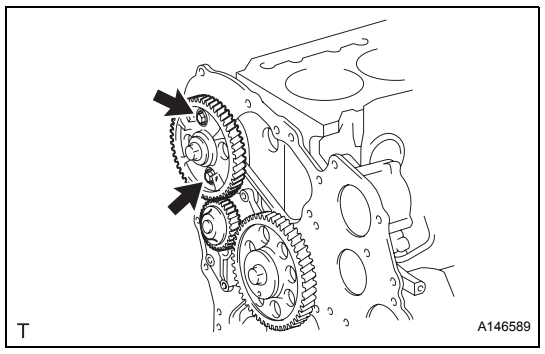
INSTALLATION

1. INSTALL CAMSHAFT

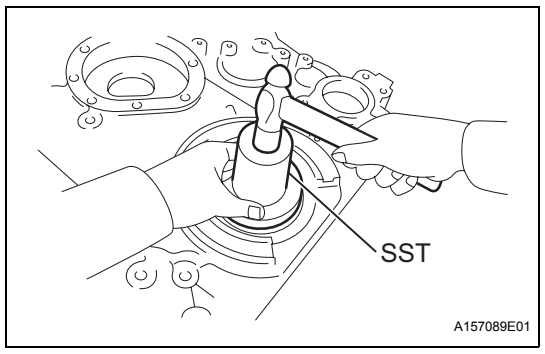
(a) Apply engine oil to the camshaft journal and bearing.

(b) Match the alignment marks on the camshaft timing gear and oil pump gear and install the camshaft.

EM



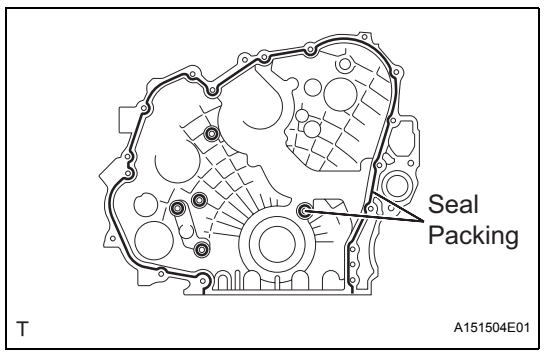
(c) Install the thrust plate with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



2. INSTALL TIMING CHAIN OR BELT COVER OIL SEAL

(a) Using SST and a hammer, tap the oil seal into the timing gear case until the oil seal is flush with the timing gear edge.
SST 09223-78010
NOTICE:
- **Be careful not to tap the oil seal at an angle.**
- **Keep the gap between the gear case edge and the oil seal free of foreign matter.**

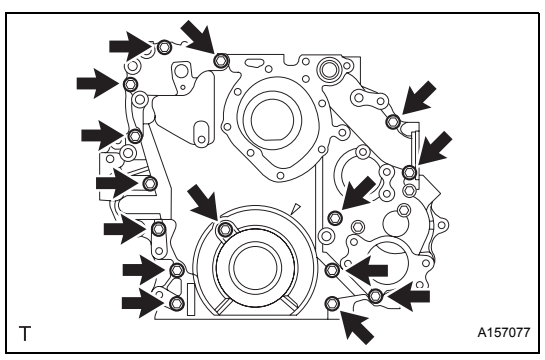
(b) Apply MP grease to the oil seal lip.



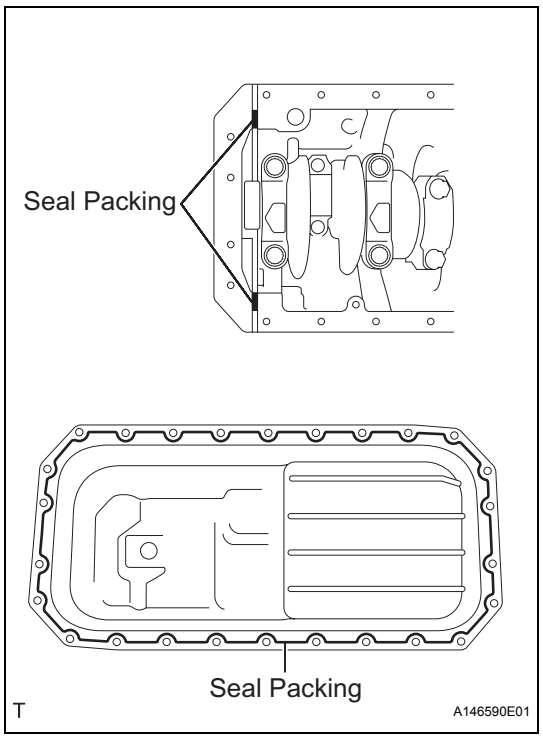
3. INSTALL TIMING GEAR CASE

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

(b) Apply a continuous bead of seal packing (diameter: 3 to 4 mm (0.11 to 0.15 in)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the belt cover within 3 minutes of applying the seal packing.**
- **Do not expose the seal packing to engine oil for at least 2 hours after installing.**



(c) Install the timing gear case with the 15 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



4. INSTALL OIL PAN SUB-ASSEMBLY

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

(b) Apply a continuous bead of seal packing (diameter: 3 to 4 mm (0.11 to 0.15 in.)) as shown in the illustration.

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

NOTICE:
- **Remove any oil from the contact surface.**
- **Install the belt cover within 3 minutes of applying the seal packing.**
- **Do not expose the seal packing to engine oil for at least 2 hours after installing.**

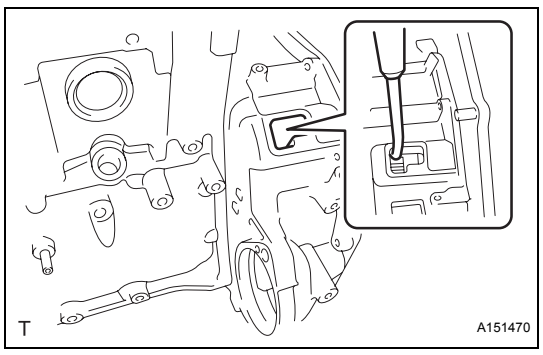
(c) Install the oil pan with the 26 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

5. INSTALL FLYWHEEL HOUSING RH STAY

(a) Install the flywheel housing RH stay with the 4 bolts.
Torque: for M14 bolt
132 N*m (1346 kgf*cm, 97 ft.*lbf)
for M12 bolt
97 N*m (990 kgf*cm, 72 ft.*lbf)

6. INSTALL FLYWHEEL HOUSING LH STAY

(a) Install the flywheel housing LH stay with the 4 bolts.
Torque: for M14 bolt
132 N*m (1346 kgf*cm, 97 ft.*lbf)
for M12 bolt
97 N*m (990 kgf*cm, 72 ft.*lbf)



7. INSTALL CRANKSHAFT PULLEY

(a) Install the pulley and spacer onto the crankshaft.
HINT:
Align the pulley set key with the key groove of the pulley.

(b) Using a 46 mm socket wrench, tighten the nut.
Torque: 515 N*m (5250 kgf*cm, 380 ft.*lbf)
HINT:
Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.

8. INSTALL VALVE LIFTER
NOTICE:
Be sure to install the push rod to its original position.

9. INSTALL CYLINDER HEAD GASKET

10. INSTALL CYLINDER HEAD SUB-ASSEMBLY (See page EM-66)

11. INSTALL VALVE BRIDGE (See page EM-66)

12. INSTALL VALVE PUSH ROD (See page EM-66)

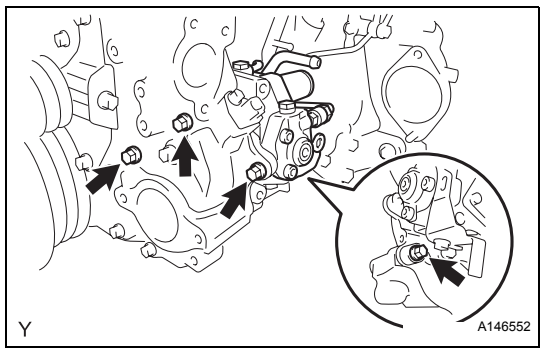
EM

13. INSTALL NO. 1 VALVE ROCKER SHAFT SUB-ASSEMBLY (See page EM-66)

14. ADJUST VALVE CLEARANCE (See page EM-11)

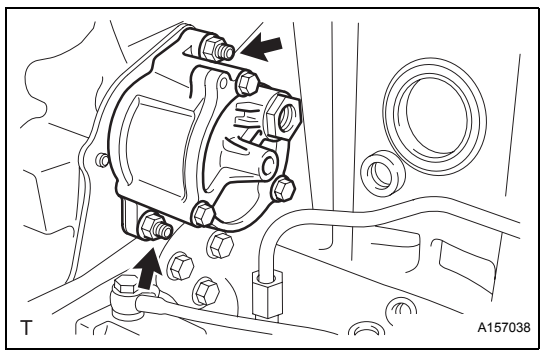
15. INSTALL INJECTION OR SUPPLY PUMP ASSEMBLY

(a) Install the injection or supply pump assembly with the 4 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



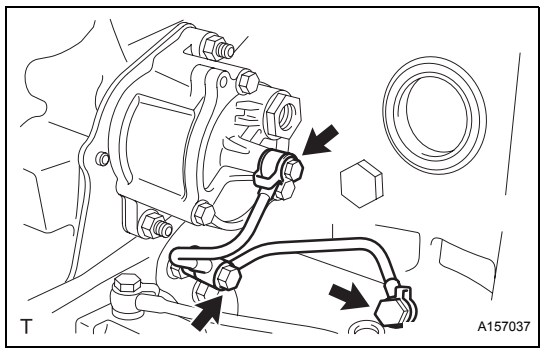
16. INSTALL VACUUM PUMP ASSEMBLY

(a) Install a new O-ring and vacuum pump assembly with the 2 nuts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



17. INSTALL VACUUM PUMP OIL PIPE SUB-ASSEMBLY

(a) Install the vacuum oil pipe sub-assembly with a new gasket and the 3 union bolts.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)



18. INSTALL OIL SEPARATOR ASSEMBLY

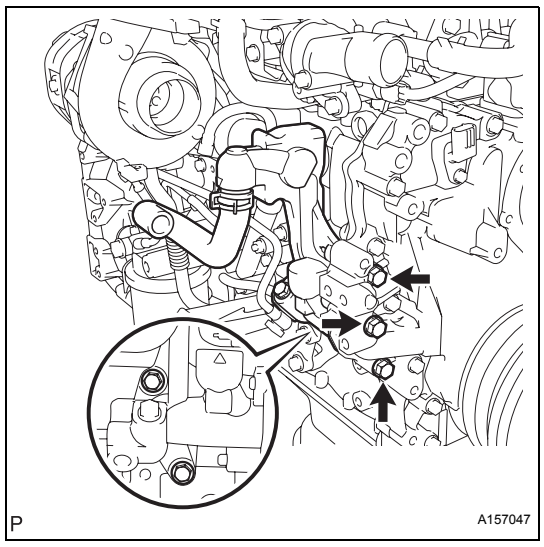
(a) Install 2 new O-rings onto the timing gear case.
(b) Install the oil separator with the 5 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

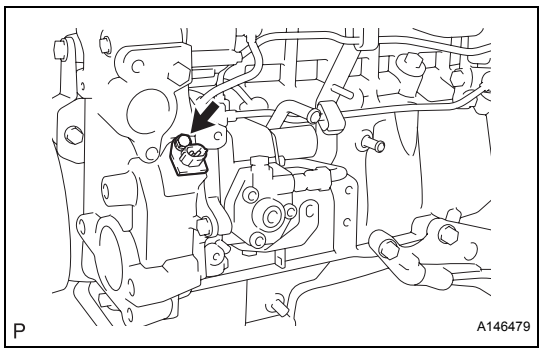
19. INSTALL NO. 3 NOZZLE LEAKAGE PIPE SUB-ASSEMBLY (See page EM-70)

20. INSTALL INJECTOR ASSEMBLY (See page FU-10)

21. INSTALL INJECTION PIPE CLAMP (See page FU-12)

22. INSTALL INTAKE PIPE (See page EM-72)

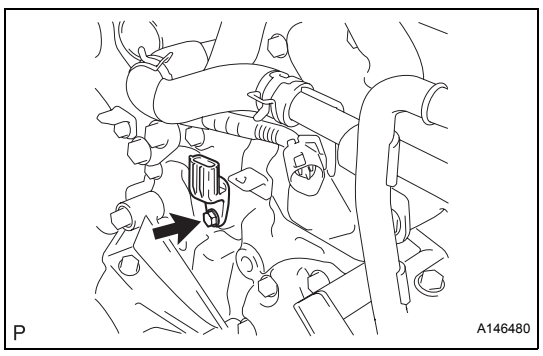




23. INSTALL CRANKSHAFT POSITION SENSOR

(a) Install the crankshaft position sensor with the bolt.
Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)

(b) Connect the connector.

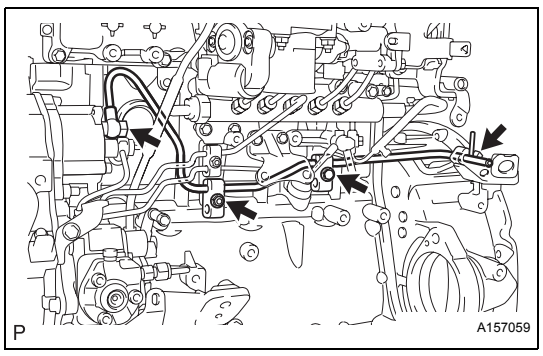


24. INSTALL CAMSHAFT POSITION SENSOR

(a) Install the camshaft position sensor with the bolt.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

(b) Connect the connector.

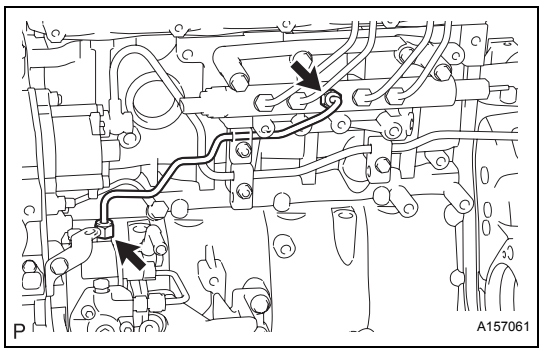
EM



25. INSTALL VACUUM PIPE

(a) Install the vacuum pipe with 2 new gaskets and the union bolt.
Torque: 13 N*m (130 kgf*cm, 10 ft.*lbf)

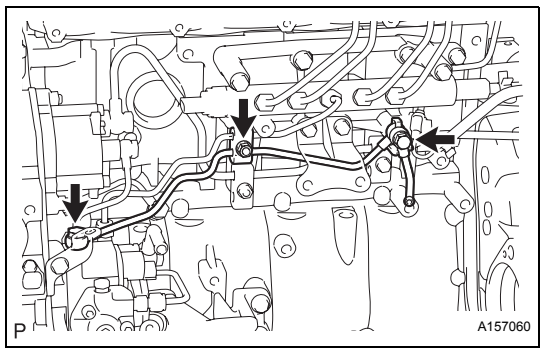
(b) Install the 3 pipe clamps with the 2 nuts.



26. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE

(a) Temporarily install the fuel filter to injection pump fuel pipe with the 2 union nuts.

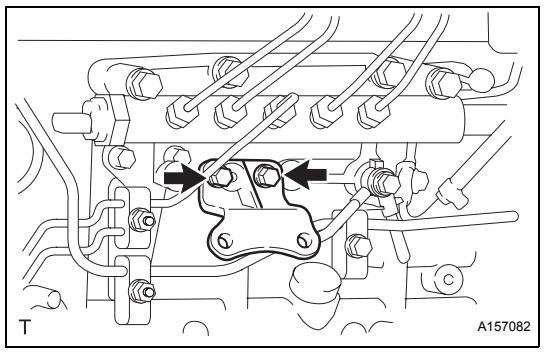
(b) Using SST, tighten the union nuts.
SST 09023-12901
Torque: 44 N*m (450 kgf*cm, 33 ft.*lbf)
NOTICE:
Refer to the torque above when not using SST. When using SST, calculate the torque in accordance with the lengths of SST and the torque wrench.



27. INSTALL FUEL RETURN PIPE SUB-ASSEMBLY

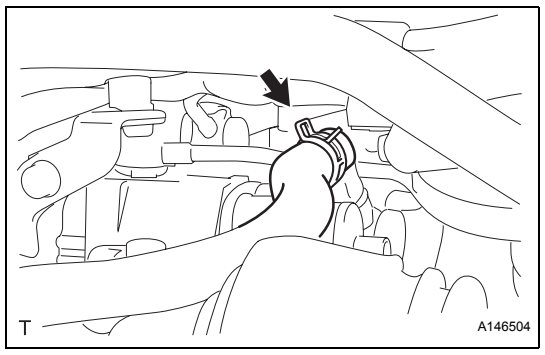
(a) Install the fuel return pipe sub-assembly and No. 4 fuel pipe with new gaskets and the 2 union bolts.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)

(b) Install the fuel pipe clamp with the nut. Tighten the nut until the clamp edges makes contact.



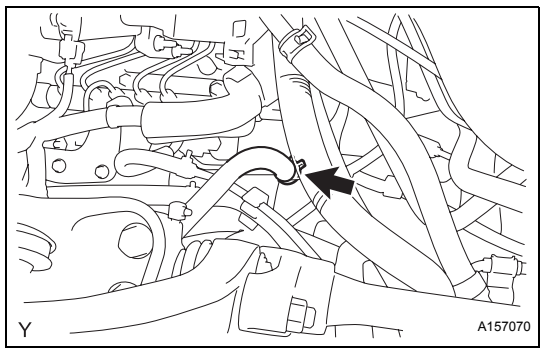
28. INSTALL WIRE HARNESS BRACKET

(a) Install the wire harness bracket with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



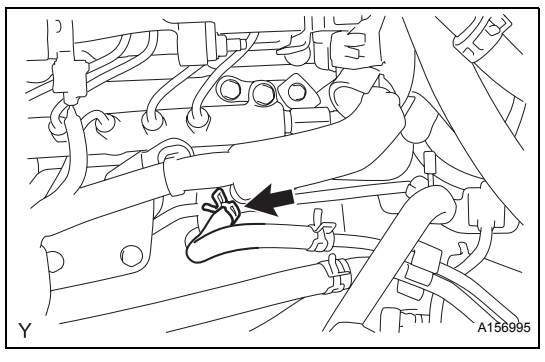
29. CONNECT INJECTION PUMP TO FUEL FILTER FUEL HOSE OR PIPE

(a) Connect the injection pump to fuel filter fuel hose or pipe.



30. CONNECT UNION TO CONNECTOR TUBE HOSE

(a) Connect the union to connector tube hose.



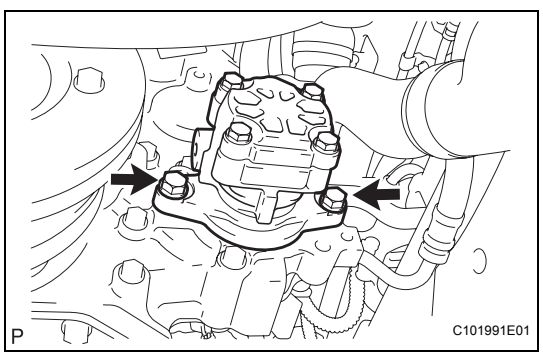
31. CONNECT NO. 1 FUEL HOSE RETURN TUBE

(a) Connect the No. 1 fuel hose return tube.

32. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-12)

33. INSTALL NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-12)

34. INSTALL OIL FILLER CAP SUB-ASSEMBLY (See page EM-13)

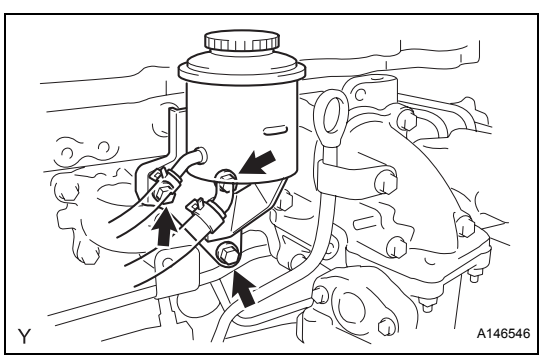


35. INSTALL GLOW PLUG ASSEMBLY (See page EM-112)

36. INSTALL VANE PUMP ASSEMBLY

(a) Coat a new O-ring with power steering fluid and install the vane pump.

(b) Install the vane pump assembly with the 2 bolts.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

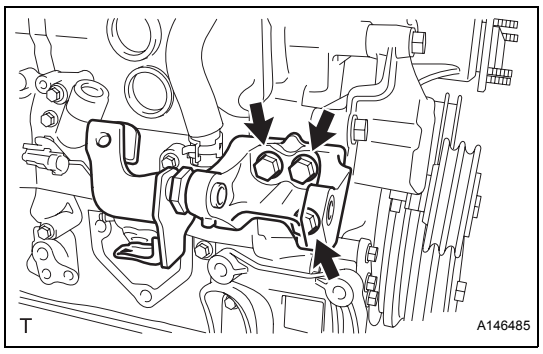


(c) Install the vane pump oil reservoir assembly with the 3 bolts.
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)

37. INSTALL DIESEL THROTTLE BODY WITH INTAKE PIPE (See page EM-115)

38. INSTALL NO. 2 AIR HOSE (See page EM-116)

39. INSTALL FRONT FENDER APRON LH (See page ES-256)

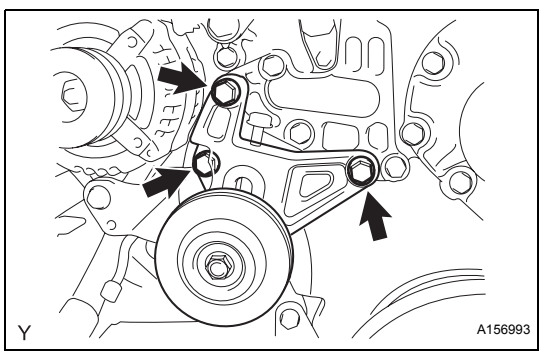


40. INSTALL GENERATOR BRACKET SUB-ASSEMBLY

(a) Install the generator bracket sub-assembly with the 3 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

41. INSTALL GENERATOR ASSEMBLY (See page CH-17)

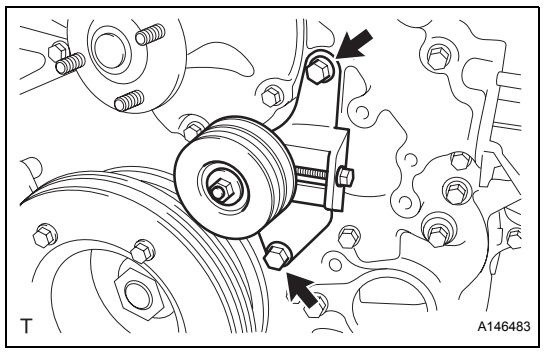
42. INSTALL WATER PUMP ASSEMBLY (See page CO-11)

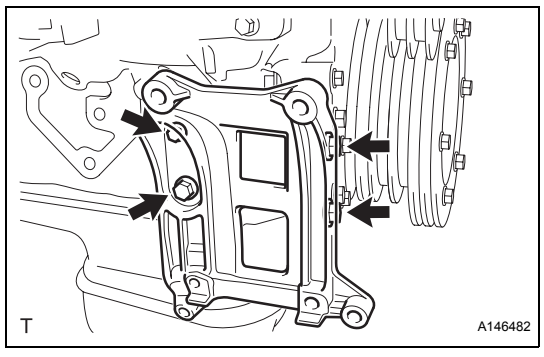


43. INSTALL IDLE PULLEY ASSEMBLY WITH BRACKET

(a) Install the idle pulley assembly with bracket with the 3 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

EM





44. INSTALL IDLER PULLEY ASSEMBLY

(a) Install the idler pulley assembly with the 2 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

45. INSTALL NO. 1 COMPRESSOR MOUNTING BRACKET

(a) Install the cooler compressor bracket with the 4 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

46. INSTALL COOLER COMPRESSOR ASSEMBLY (w/ Air Conditioning System) (See page EM-116)

47. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY (See page EM-73)

48. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY (See page EM-74)

49. INSTALL WATER PIPE SUB-ASSEMBLY (See page EM-74)

50. INSTALL RADIATOR PIPE (See page EM-117)

51. CONNECT OUTLET HEATER WATER HOSE (See page EM-117)

52. INSTALL RADIATOR ASSEMBLY (See page EM-117)

53. INSTALL FAN (See page CO-27)

54. INSTALL MANUAL TRANSMISSION OIL COOLER ASSEMBLY (See page CO-41)

55. INSTALL RADIATOR GRILLE (See page ET-6)

56. INSTALL NO. 1 AIR HOSE (See page EM-119)

57. INSTALL TURBOCHARGER SUB-ASSEMBLY
Refer to the procedures under " INSTALL TURBOCHARGER SUB-ASSEMBLY"(IT-14).

58. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 ft.*lbf)

59. ADD ENGINE OIL (See page LU-3)

60. ADD COOLANT (See page CO-4)

61. INSPECT FOR COOLANT LEAK (See page CO-3)

62. INSPECT FOR FUEL LEAK (See page FU-4)

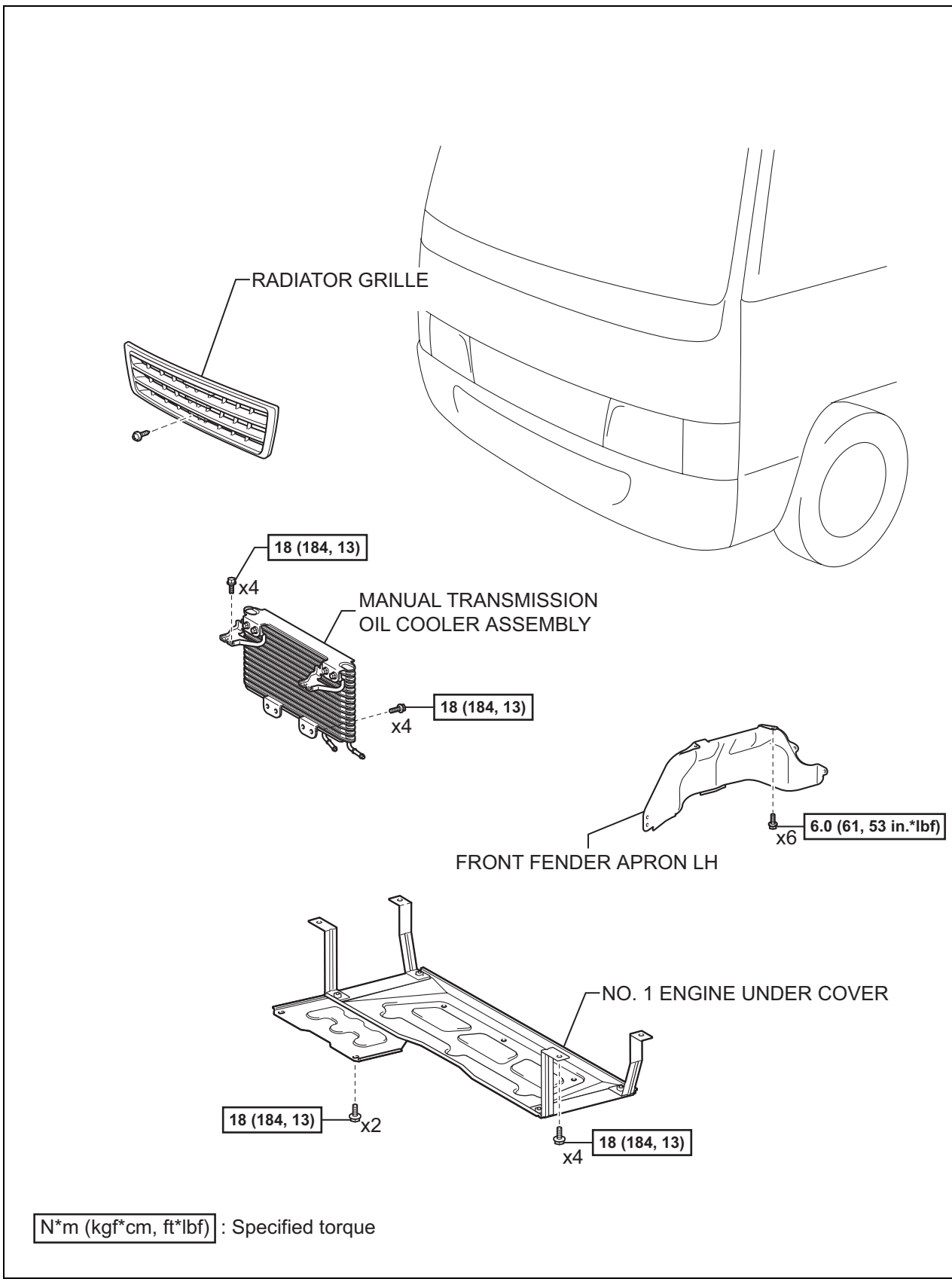
63. INSPECT FOR OIL LEAK

64. INSPECT FOR EXHAUST GAS LEAK

65. INSTALL NO. 1 ENGINE UNDER COVER (See page EM-6)

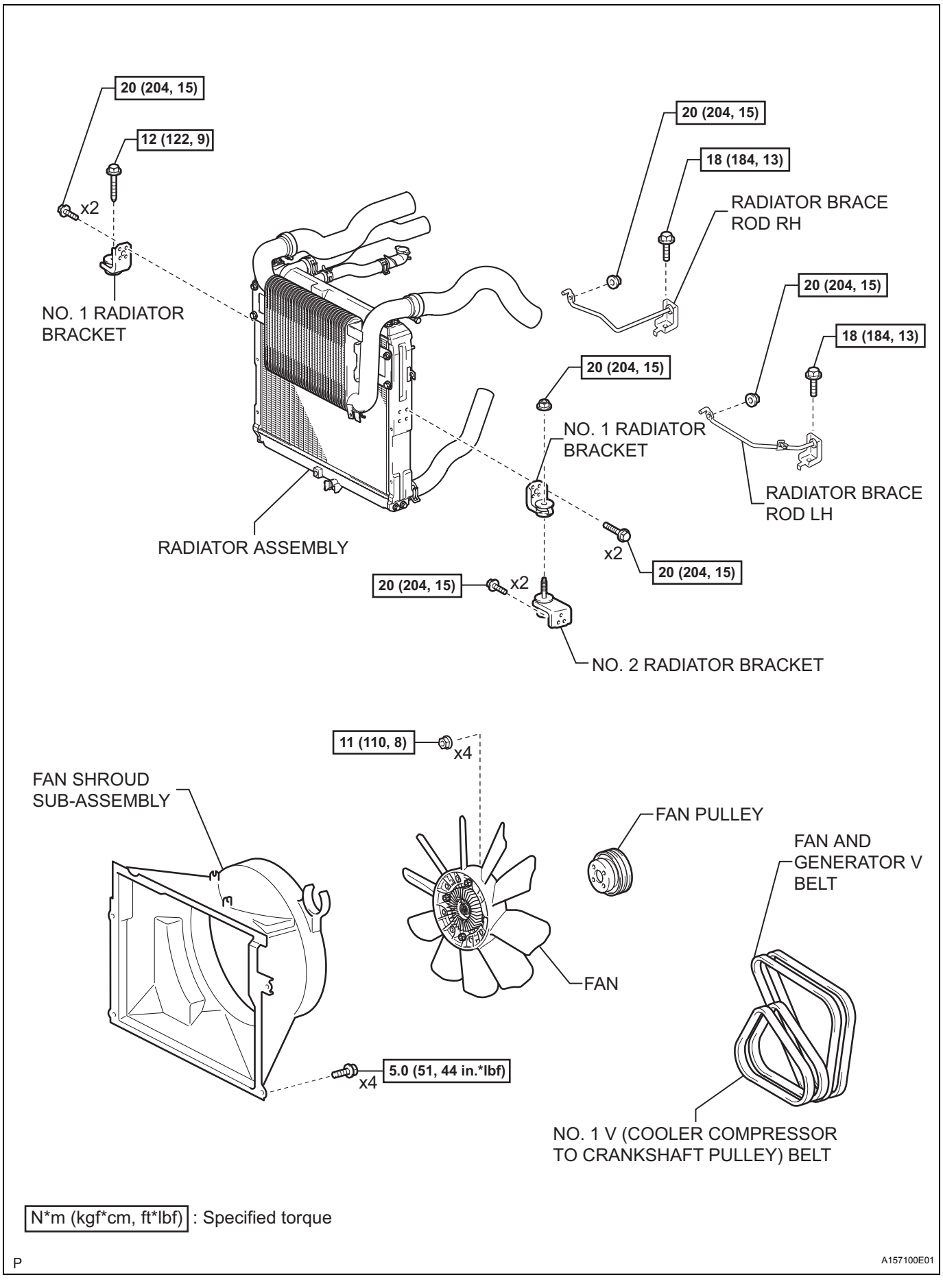
CYLINDER HEAD

COMPONENTS



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

A157046E01



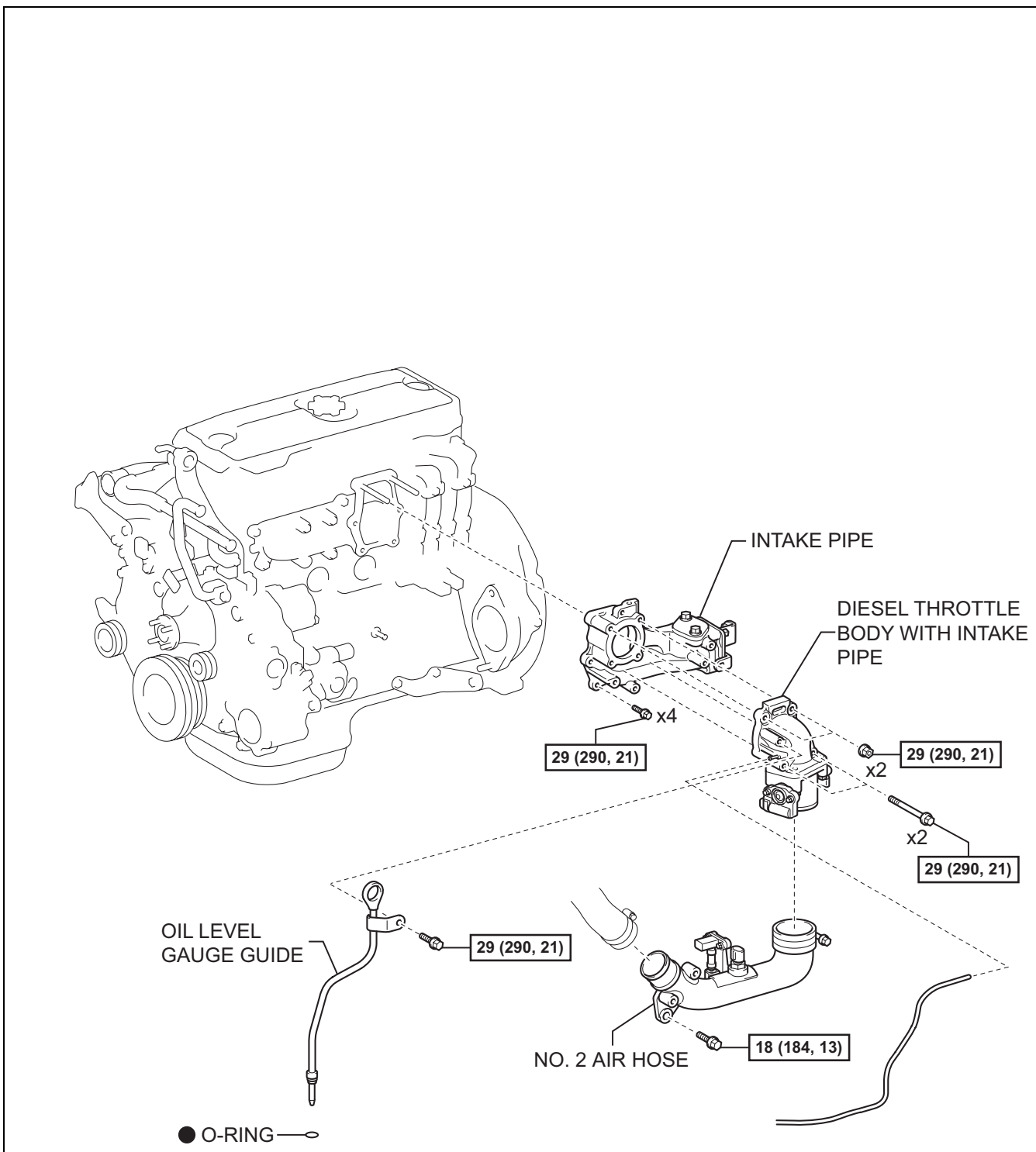
N*m (kgf*cm, ft*lbf) : Specified torque

P

A157100E01

EM

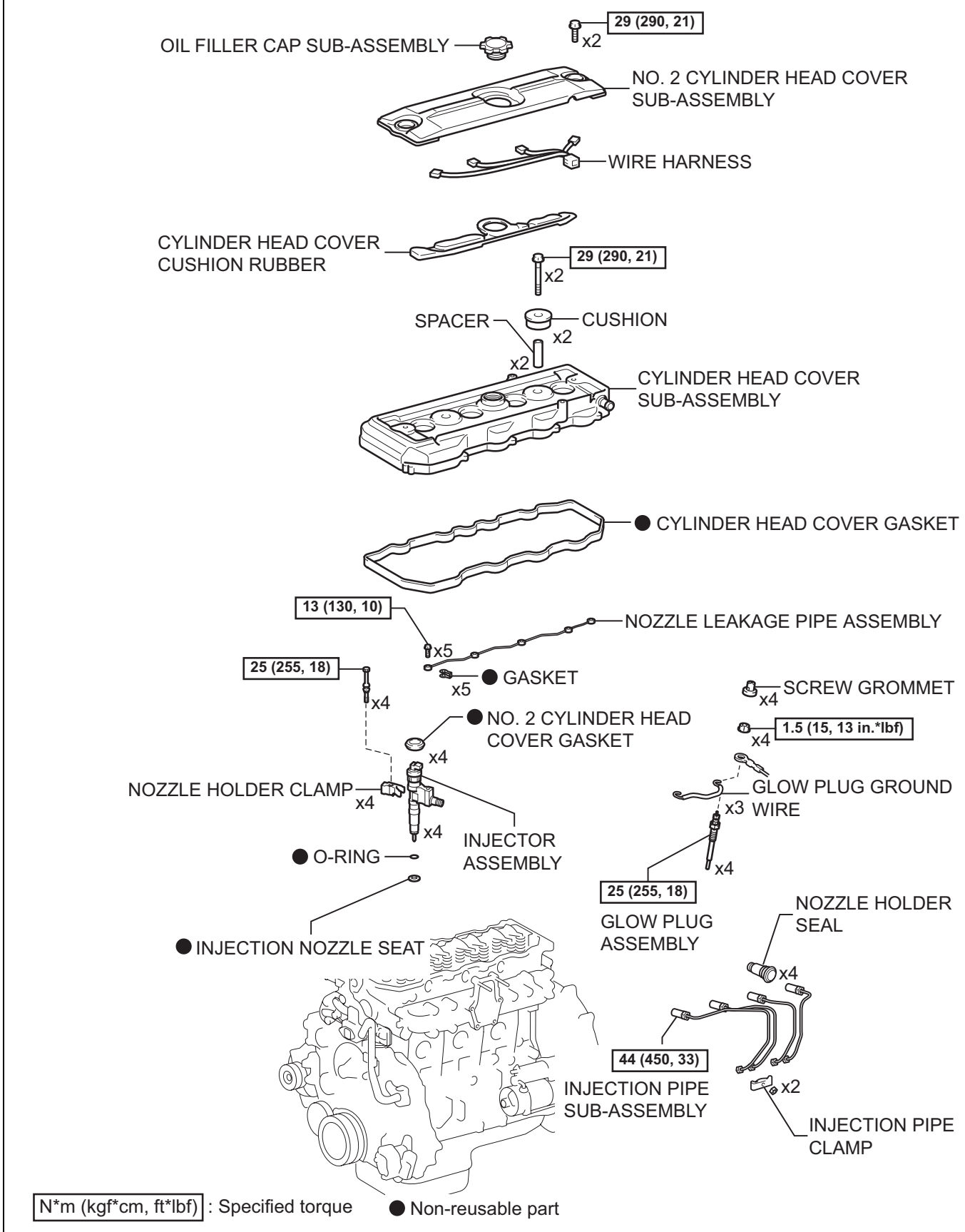
EM



N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

Y

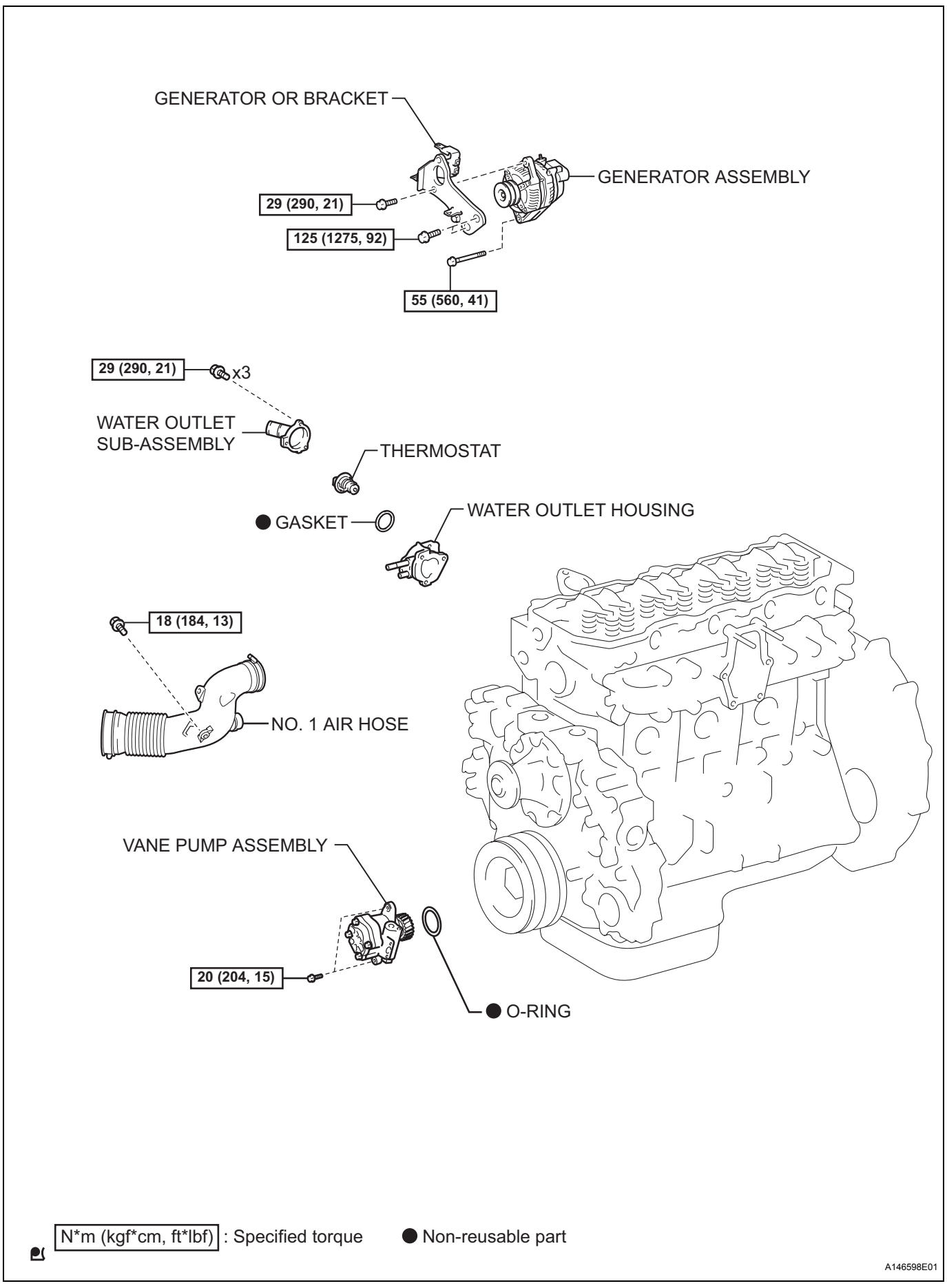
A156991E01

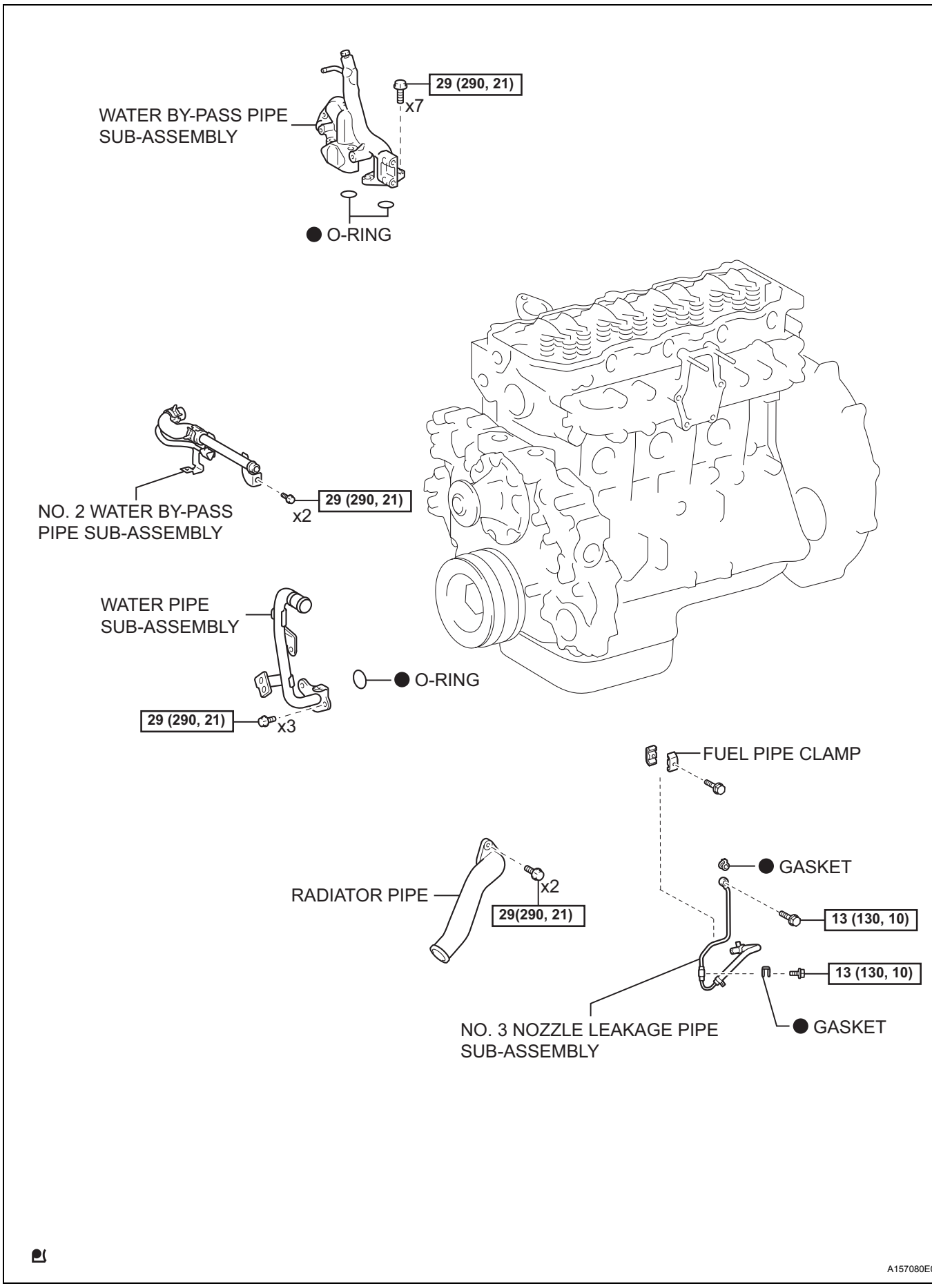


T

A157044E01

EM





A157080E01

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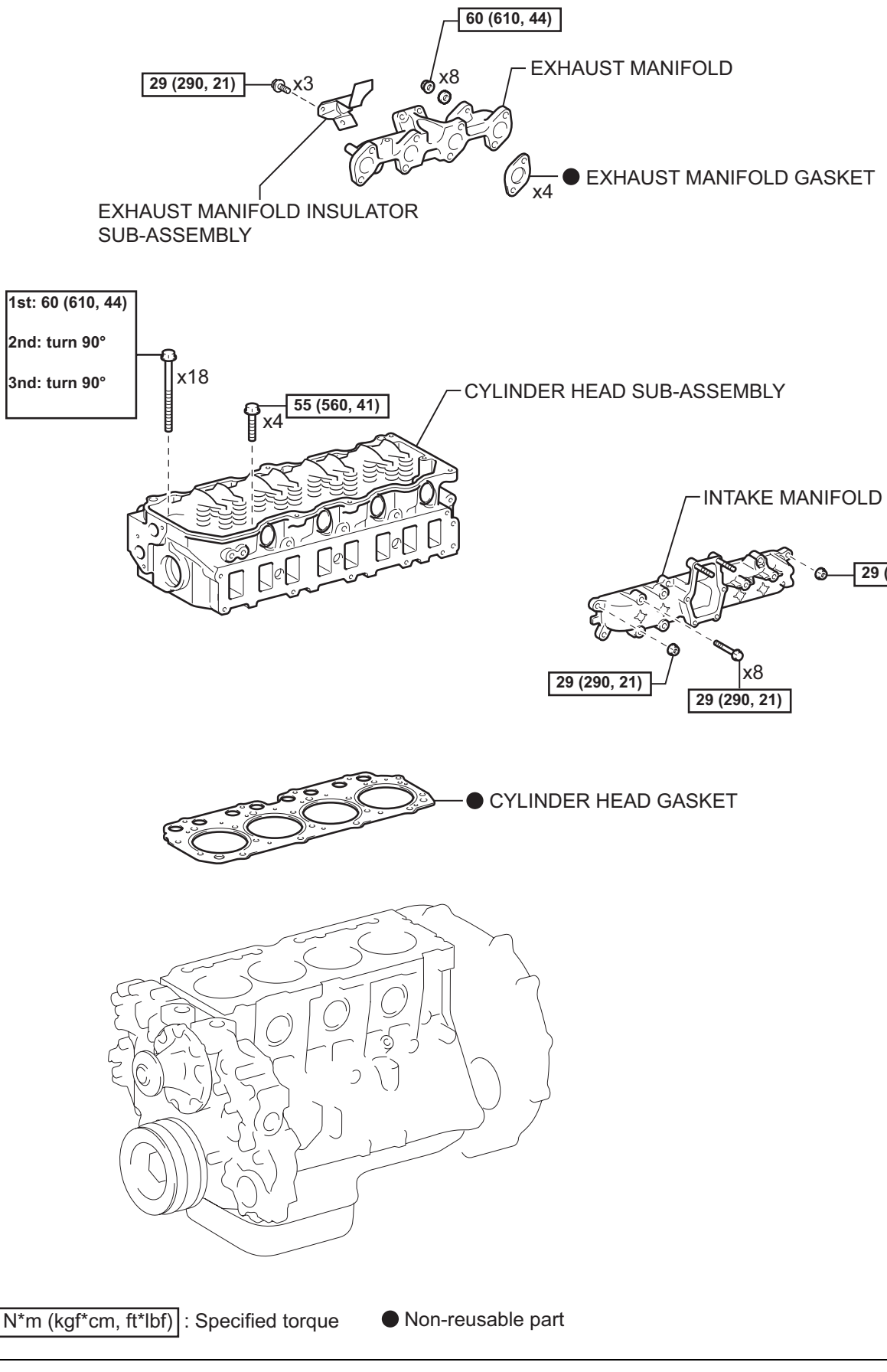
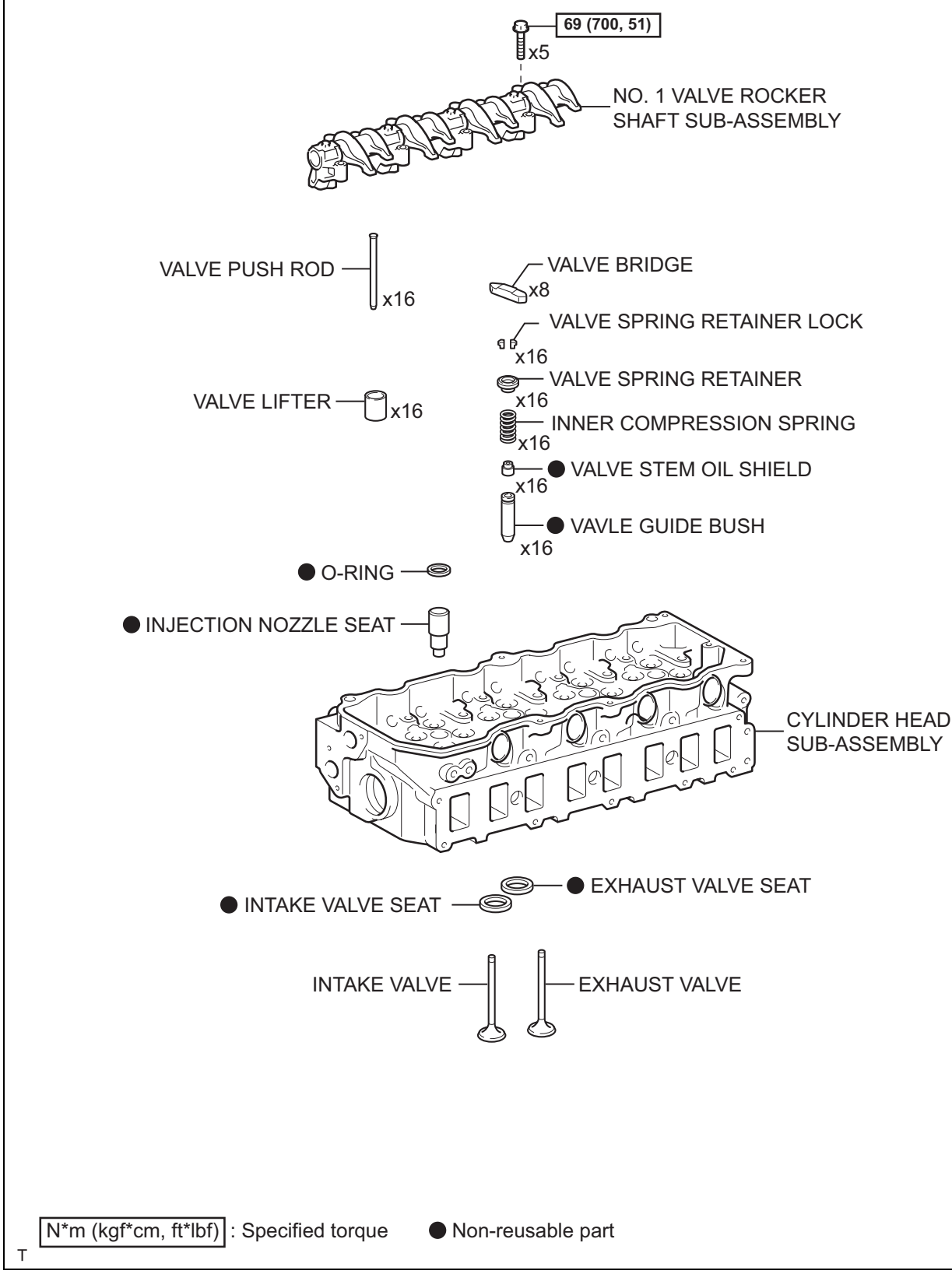


N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

T

A146530E01



N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

T

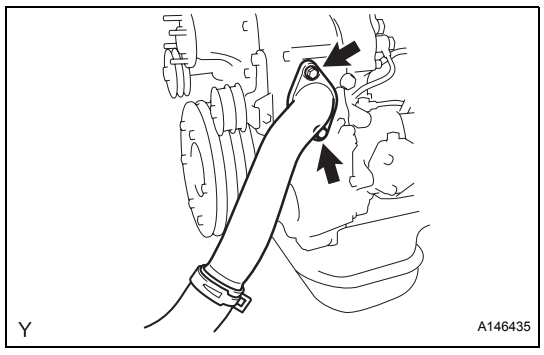
A146531E01

EM

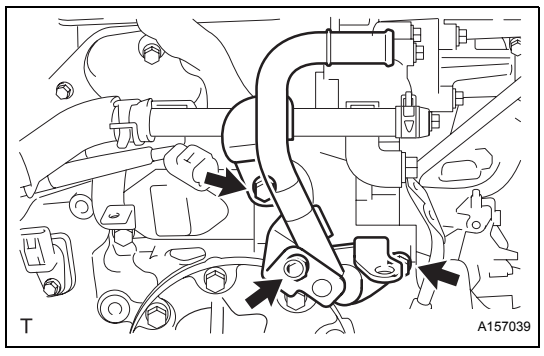
EM

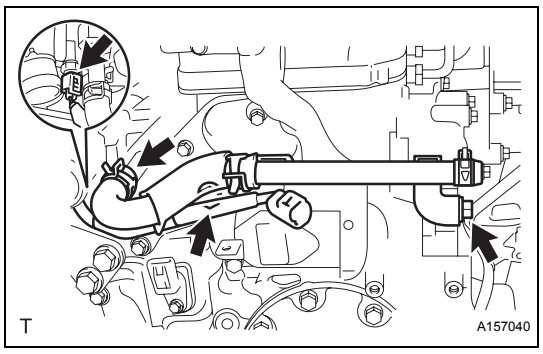
REMOVAL

1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE NO. 1 ENGINE UNDER COVER (See page EM-4)**
3. **DRAIN ENGINE OIL (See page LU-3)**
4. **DRAIN ENGINE COOLANT (See page CO-4)**
5. **REMOVE TURBOCHARGER SUB-ASSEMBLY**
   Refer to the procedures under " REMOVE TURBOCHARGER SUB-ASSEMBLY"(IT-10).
6. **REMOVE NO. 1 AIR HOSE (See page EM-85)**
7. **REMOVE RADIATOR GRILLE (See page ET-3)**
8. **REMOVE MANUAL TRANSMISSION OIL COOLER ASSEMBLY (See page CO-36)**
9. **REMOVE FAN (See page CO-25)**
10. **REMOVE RADIATOR ASSEMBLY (See page CO-37)**
11. **DISCONNECT INLET HEATER WATER HOSE B (See page EM-87)**
12. **REMOVE RADIATOR PIPE**
    (a) Remove the 2 bolts and remove the radiator pipe.



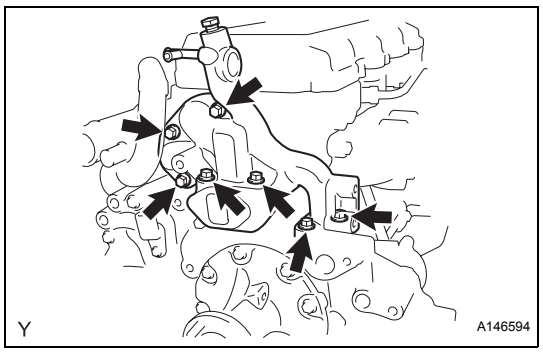
13. **REMOVE WATER PIPE SUB-ASSEMBLY**
    (a) Remove the 3 bolts and remove the water pipe sub-assembly.





14. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

(a) Disconnect the water temperature sensor connector.
(b) Disconnect the water hose.
(c) Remove the 2 bolts and remove the No. 2 water by-pass pipe sub-assembly.



15. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

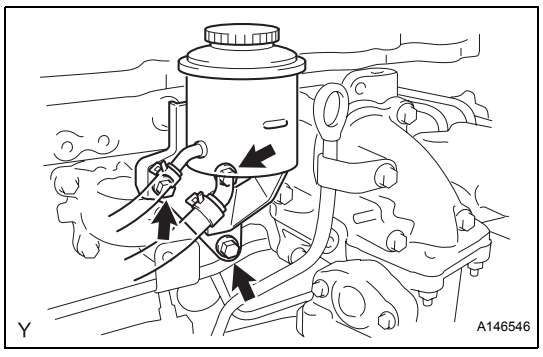
(a) Remove the 7 bolts and remove the water by-pass pipe sub-assembly.

16. REMOVE GENERATOR ASSEMBLY (See page CH-10)

17. REMOVE FRONT FENDER APRON LH (See page ES-255)

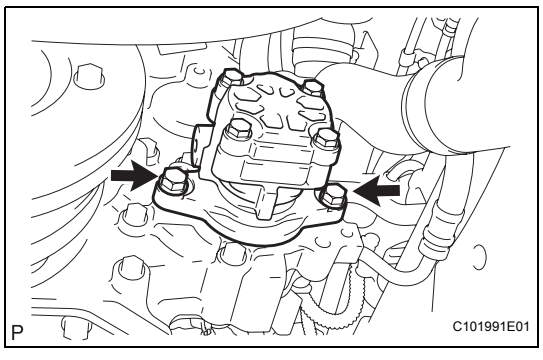
18. REMOVE NO. 2 AIR HOSE (See page EM-88)

19. REMOVE DIESEL THROTTLE BODY WITH INTAKE PIPE (See page EM-89)



20. SEPARATE VANE PUMP ASSEMBLY

(a) Remove the 3 bolts and separate the vane pump oil reservoir assembly.



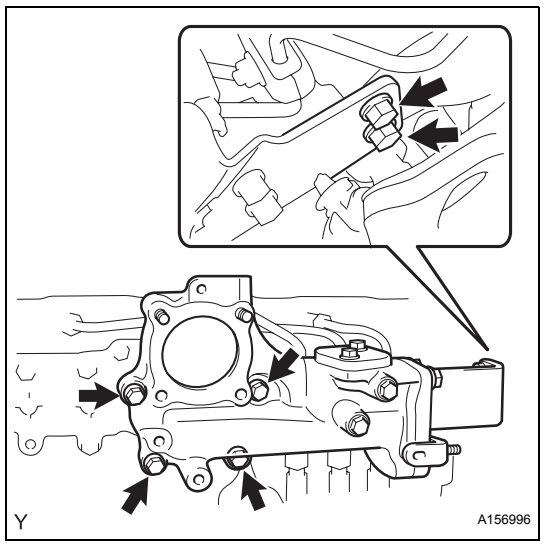
(b) Remove the 2 bolts and separate the vane pump assembly

21. REMOVE GLOW PLUG ASSEMBLY (See page EM-91)

22. REMOVE OIL FILLER CAP SUB-ASSEMBLY (See page EM-9)

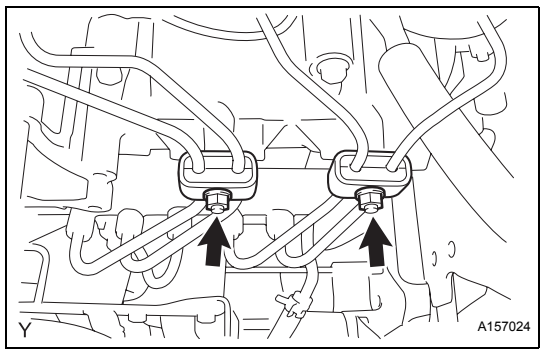
23. REMOVE NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-9)

24. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-9)



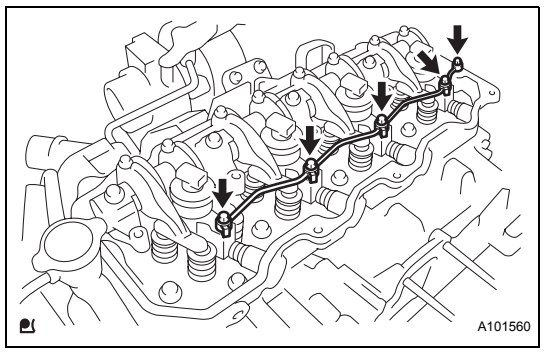
25. REMOVE INTAKE PIPE

(a) Remove the 6 bolts and remove the intake pipe.



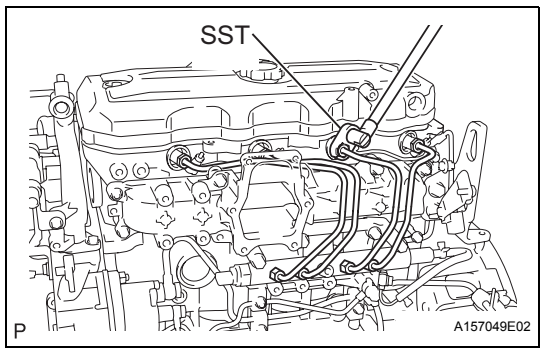
26. REMOVE INJECTION PIPE CLAMP

(a) Remove the 2 nuts and remove the 2 injection pipe clamps.

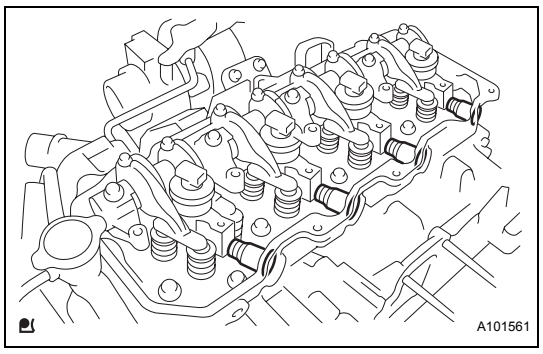


27. REMOVE INJECTOR ASSEMBLY

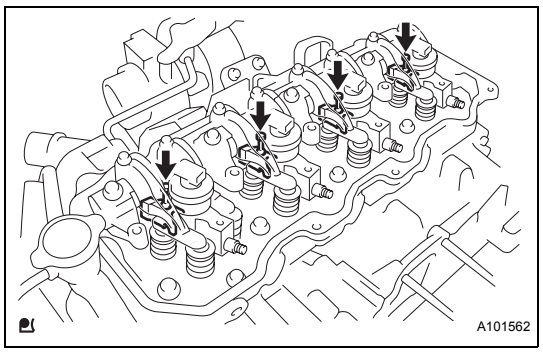
(a) Remove the 5 bolts and remove the nozzle leakage pipe.



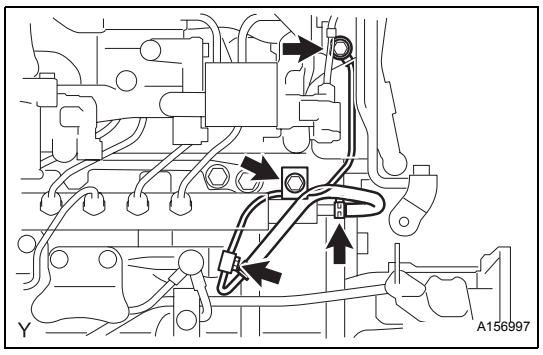
(b) Using SST, loosen the 4 union nuts and remove the injection pipe.
SST 09023-12900



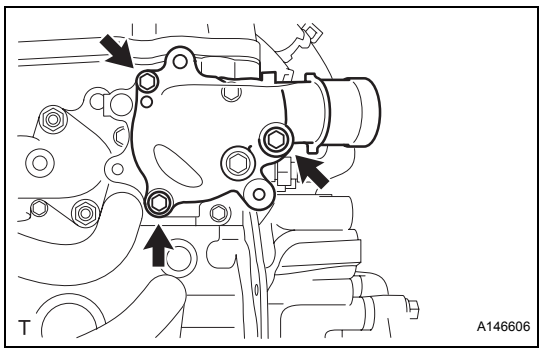
(c) Remove the 4 nozzle holder seals.



(d) Remove the 4 bolts and remove the 4 nozzle holder clamps.
(e) Remove the injector assembly.
(f) Remove the injection nozzle seat from the cylinder head.

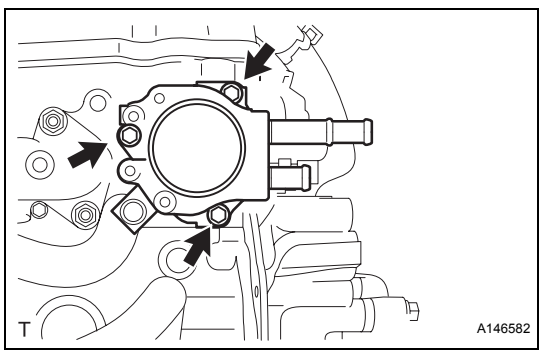


28. REMOVE NO. 3 NOZZLE LEAKAGE PIPE SUB-ASSEMBLY
(a) disconnect the fuel hose from the common rail assembly.
(b) Remove the bolt and remove the pipe clamp.
(c) Remove the 2 union bolts and remove the No. 3 nozzle leakage pipe sub-assembly.

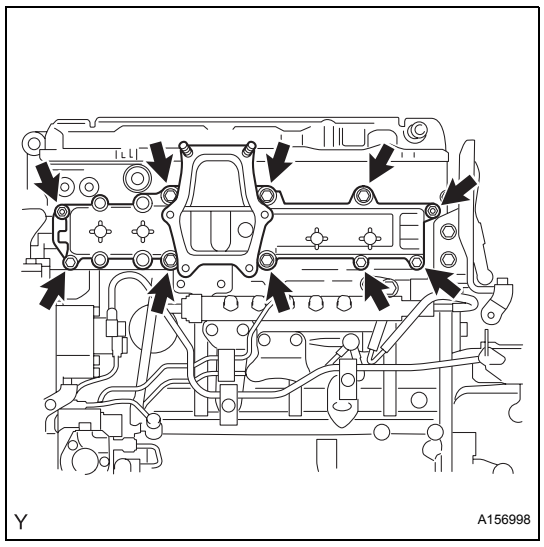


29. REMOVE WATER OUTLET SUB-ASSEMBLY
(a) Remove the 3 bolts and remove the water outlet sub-assembly.

30. REMOVE THERMOSTAT

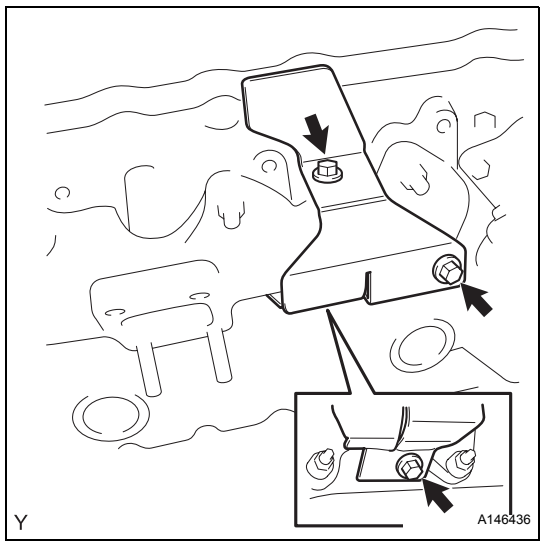


31. REMOVE WATER OUTLET HOUSING
(a) Remove the 3 bolts and water outlet housing.



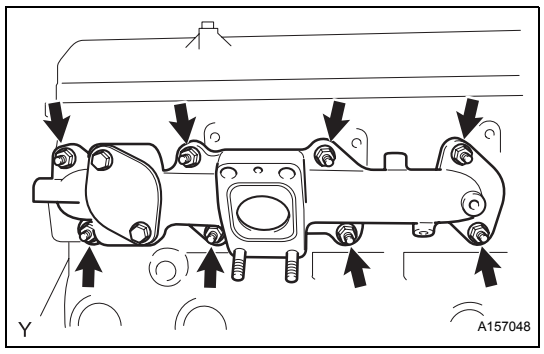
32. REMOVE INTAKE MANIFOLD

(a) Remove the 8 bolts and 2 nuts and remove the intake manifold.

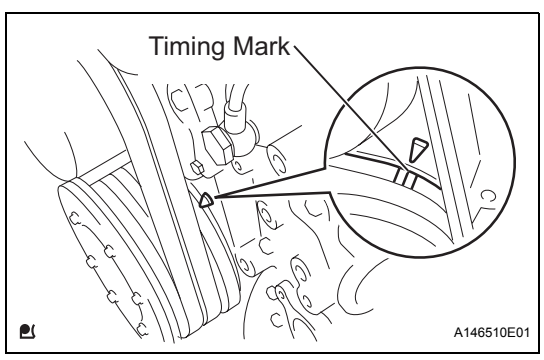


33. REMOVE EXHAUST MANIFOLD

(a) Remove the 3 bolts and remove the exhaust manifold insulator sub-assembly.

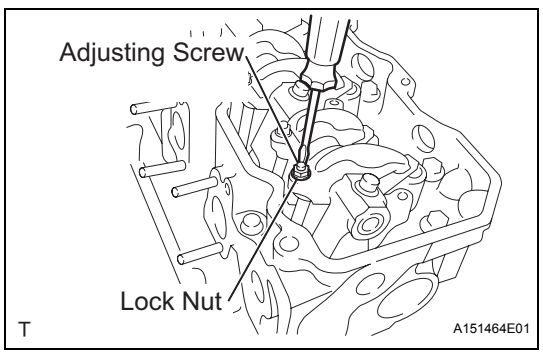


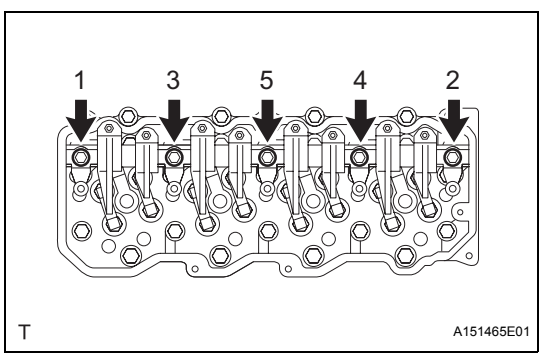
(b) Remove the 8 nuts and remove the exhaust manifold.

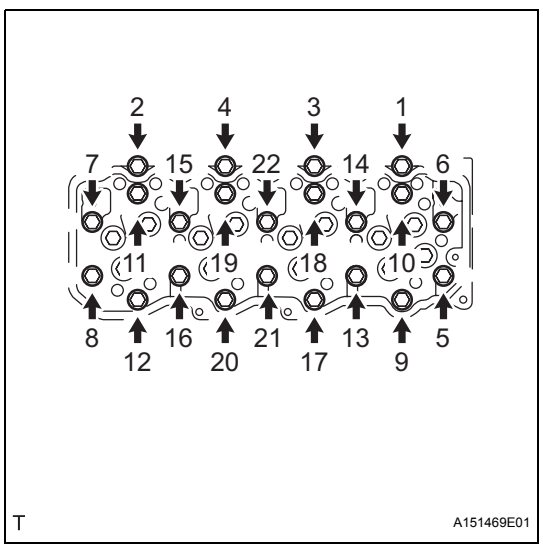


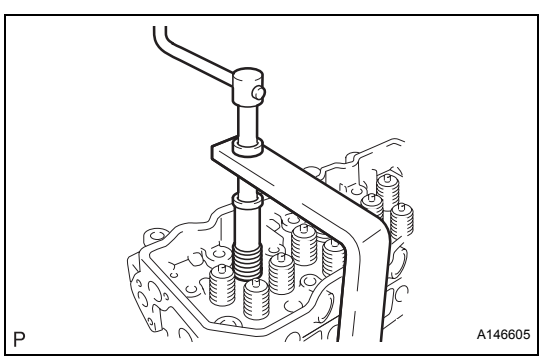
34. SET NO. 1 CYLINDER TO TDC / COMPRESSION

(a) Turn the crankshaft pulley until the groove of the crankshaft damper and the timing mark on the timing gear are aligned.









35. REMOVE NO. 1 VALVE ROCKER SHAFT SUB-ASSEMBLY

(a) Loosen the lock nuts at the top of the rocker arms and wind up the adjusting screws completely.
NOTICE:
If the adjusting screws are left unwound, the rocker shaft may bend when the rocker arm support bolts are loosened.

(b) Loosen the rocker arm support bolts in the order shown in the illustration.

36. REMOVE VALVE PUSH ROD

(a) Remove the valve push rod.
NOTICE:
Organize the parts so that each part location can be remembered for reassembly.

37. REMOVE VALVE BRIDGE

(a) Remove the valve bridge.
NOTICE:
Organize the parts so that each parts location can be remembered for reassembly.

38. REMOVE CYLINDER HEAD SUB-ASSEMBLY

(a) Remove the cylinder head bolts in the order shown in the illustration.

(b) Lift and remove the cylinder head from the cylinder block.

39. REMOVE CYLINDER HEAD GASKET

(a) Remove the cylinder head gasket.

40. REMOVE VALVE LIFTER

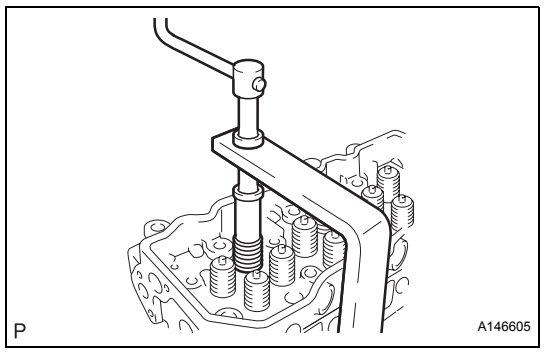
(a) Remove the valve lifter.
NOTICE:
Organize the parts so that each parts location can be remembered for reassembly.

DISASSEMBLY

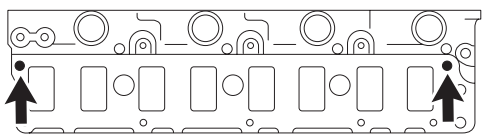
1. REMOVE INTAKE VALVE

(a) Using SST, remove the retainer lock and remove the retainer, compression spring and valve.
SST 09202-70020 (09202-01010, 09202-00020, 09202-01020, 90154-80004)
HINT:
Keep the removed parts in the correct order so that they can be returned to their original positions when reassembled.

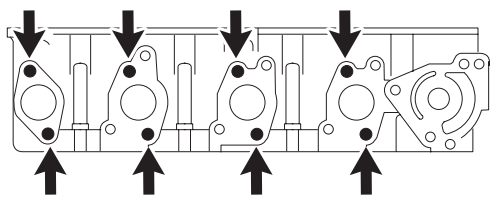
EM



Intake Manifold Side:



Exhaust Manifold Side:



2. REMOVE EXHAUST VALVE

(a) Using SST, remove the retainer lock and remove the retainer, compression spring and valve.

SST 09202-70020 (09202-01010, 09202-00020, 09202-01020, 90154-80004)

HINT:

Keep the removed parts in the correct order so that they can be returned to their original positions when reassembled.

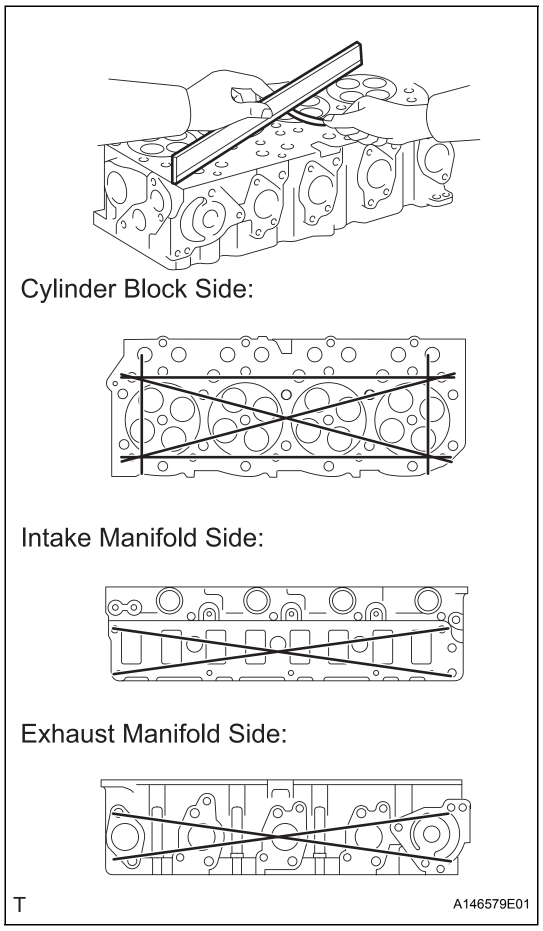
3. REMOVE VALVE STEM OIL SHIELD

(a) Using needle-nose pliers, remove the oil shield.

4. REMOVE STUD BOLT

(a) Remove the 10 stud bolts.

INSPECTION

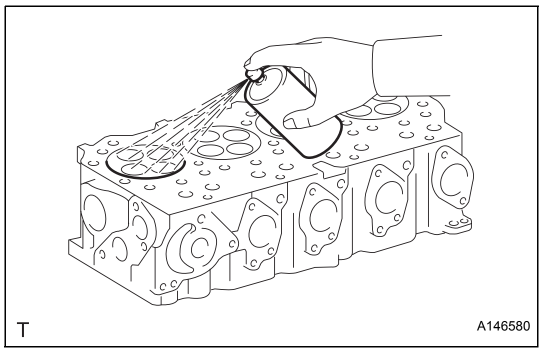


1. INSPECT CYLINDER HEAD FOR FLATNESS

(a) Using a precision straight edge and feeler gauge, measure the warpage on the cylinder block side and the intake and exhaust manifold sides.

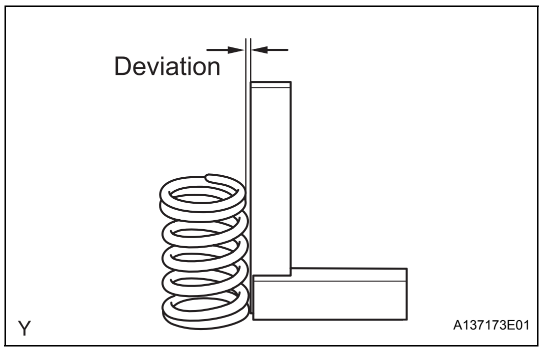
Maximum warpage:

0.10 mm (0.0039 in.)



2. INSPECT CYLINDER HEAD FOR CRACKS

(a) Using a dye penetrate, check the cylinder head for cracks.



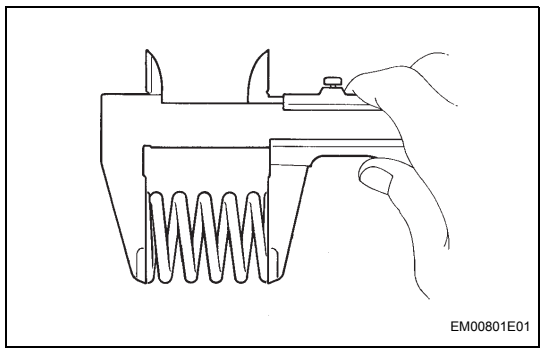
3. INSPECT INNER COMPRESSION SPRING

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

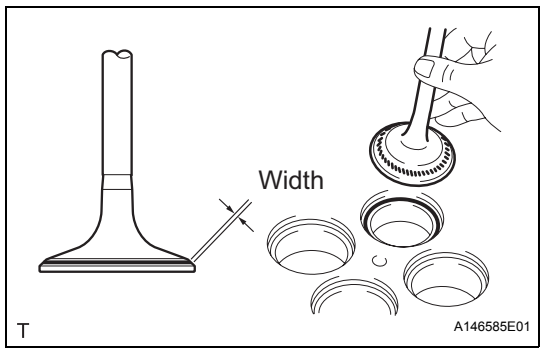
Maximum deviation:

2.0 mm (0.0787 in.)

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



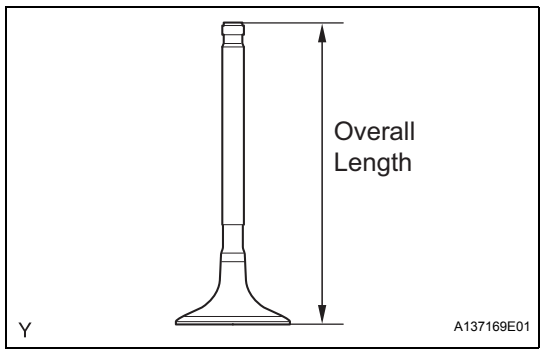
(b) Using vernier calipers, measure the free length of the compression spring.
Standard free length:
85.1 mm (3.350 in.)
maximum free length:
82.1 mm (3.232 in.)
If the free length is not as specified, replace the inner compression spring.



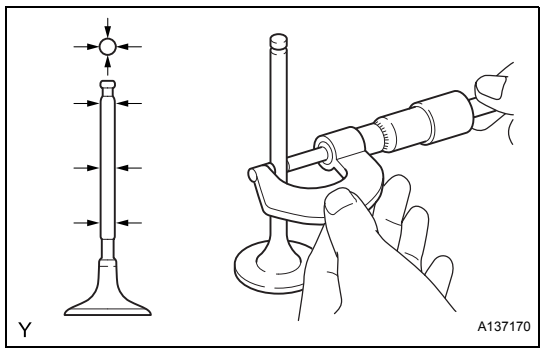
4. INSPECT INTAKE VALVE

(a) Visually check the valves for damage, burns, carbon or warpage, and check the valve heads, valve stems and valve stem grooves for cracks.
If there is excessive wear, burns, warpage or cranks, replace the valves.

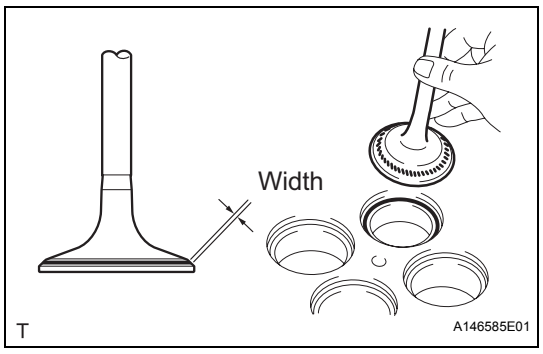
(b) Check the valve seating condition.
(1) Lightly apply red lead marking compound to the valve face.
(2) Tapping the valve against the seat, check the seating condition.
If the red lead mark is not concentric or the compound is scattered all around the valve face or seat, correct the valve face or the valve seat.



(c) Using vernier calipers, measure the overall length of the intake valve.
Standard overall length:
129.8 mm (5.1102 in.)
If the overall length is not as specified, replace the exhaust valve.



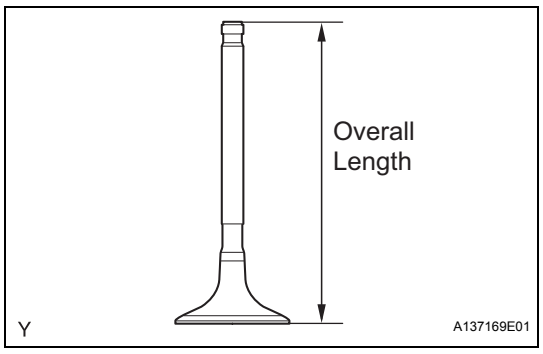
(d) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter:
6.96 to 6.97 mm (0.2739 to 0.2745 in.)



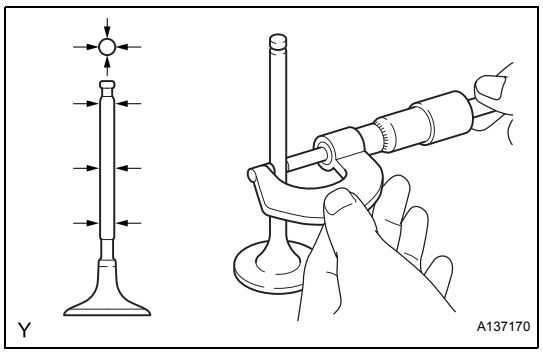
5. INSPECT EXHAUST VALVE

(a) Visually check the valves for damage, burns, carbon or warpage, and check the valve heads, valve stems and valve stem grooves for cracks.
If there is excessive wear, burns, warpage or cranks, replace the valves.

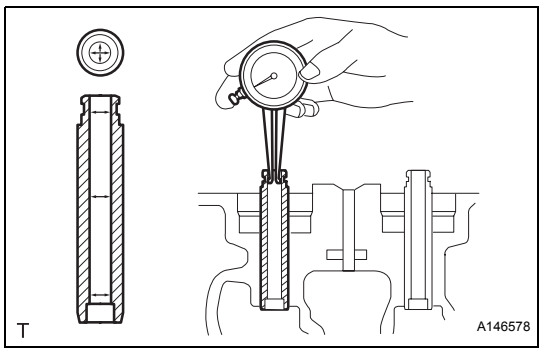
(b) Check the valve seating condition.
(1) Lightly apply red lead marking compound to the valve face.
(2) Tapping the valve against the seat, check the seating condition.
If the red lead mark is not concentric or the compound is scattered all around the valve face or seat, correct the valve face or the valve seat.



(c) Using vernier calipers, measure the overall length of the exhaust valve.
Standard overall length:
128.8 mm (5.0709 in.)
If the overall length is not as specified, replace the exhaust valve.



(d) Using a micrometer, measure the diameter of the valve stem.
Valve stem diameter:
6.93 to 6.94 mm (0.2729 to 0.2735 in.)
If the valve stem diameter is not as specified, replace the exhaust valve.

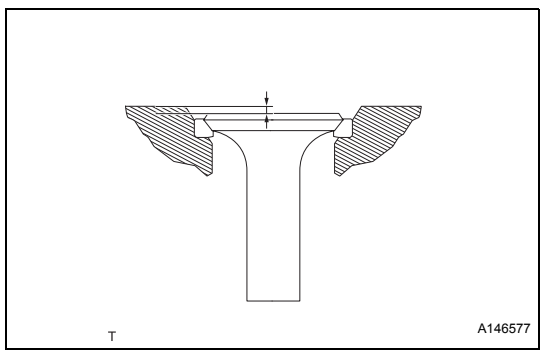


6. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

(a) Using a caliper gauge, measure the internal diameter of the valve guide bush.
Inside diameter:
7.00 to 7.01 mm (0.2756 to 0.2762 in.)
If the internal diameter is not as specified, replace the valve guide bush.

(b) Subtract the valve stem diameter measurement from the internal diameter measurement of the valve guide bush to calculate the oil clearance.
Standard oil clearance:
Intake:
0.02 to 0.05 mm (0.0009 to 0.0023 in.)
Exhaust:
0.05 to 0.08 mm (0.0020 to 0.0033 in.)

EM



7. INSPECT INTAKE VALVE SINK

(a) Using a vernier caliper, measure the valve depth.

Standard:

0.8 to 1.0 mm (0.0315 to 0.0394 in.)

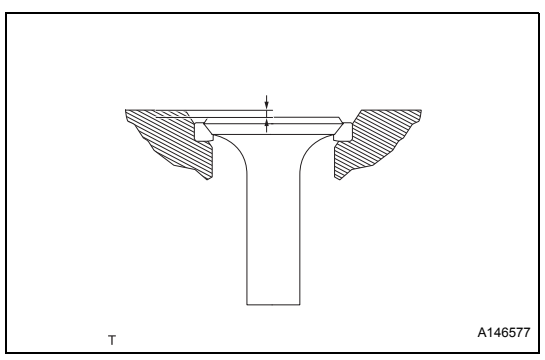
Maximum:

1.1 mm (0.0433 in.)

If the depth is greater than the maximum, replace the valve and valve seat.

NOTICE:

- **If the valve heads are protruding from the cylinder head surface, the valve heads may hit against the pistons while the engine is running.**
- **When replacing the valve and valve seat, always recheck the seating condition.**



8. INSPECT EXHAUST VALVE SINK

(a) Using a vernier caliper, measure the valve depth.

Standard:

1.8 to 2.0 mm (0.070 to 0.078 in.)

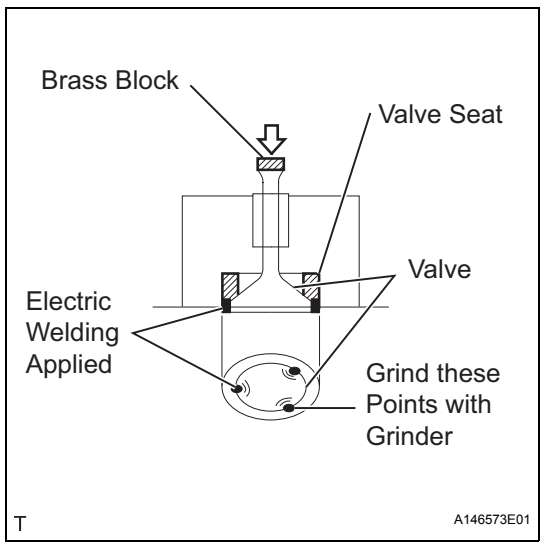
Maximum:

2.1 mm (0.082 in.)

If the depth is greater than the maximum, replace the valve and valve seat.

NOTICE:

- **If the valve heads are protruding from the cylinder head surface, the valve heads may hit against the pistons while the engine is running.**
- **When replacing the valve and valve seat, always recheck the seating condition.**



REPLACEMENT

1. REMOVE INTAKE VALVE SEAT

(a) Grind the 3 places on the circumference of a used valve and weld it to the valve seat as shown in the illustration.

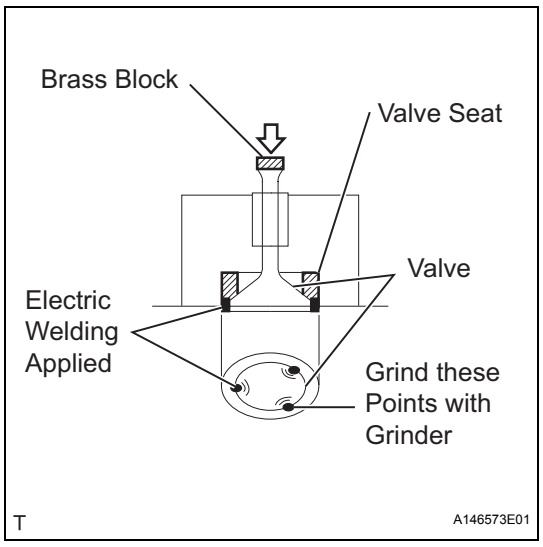
NOTICE:

To protect the lower surface of the cylinder head from welding spatters, be sure to apply grease before welding.

(b) Place a brass block on the top of the valve stem and strike it with a hammer to remove the valve seat.

CAUTION:

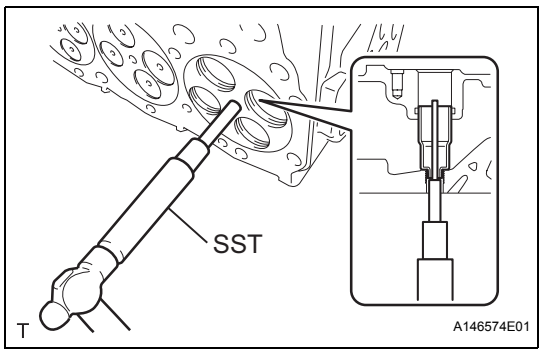
When striking, the valve tips may brake off on impact. Wear safety glasses to protect your eyes.



2. REMOVE EXHAUST VALVE SEAT

(a) Grind 3 places on the circumference of a used valve and weld it to the valve seat as shown in the illustration.
NOTICE:
To protect the lower surface of the cylinder head from welding spatters, be sure to apply grease before welding.

(b) Place a brass block on the top of the valve stem and strike it with a hammer to remove the valve seat.
CAUTION:
When striking, the valve tips may break off on impact. Wear safety glasses to protect your eyes.



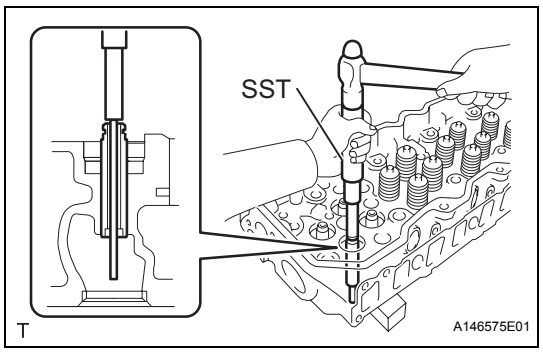
3. REMOVE INJECTION NOZZLE SEAT

(a) Using SST, remove the injection nozzle seat.
SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

(b) Remove the O-ring from the cylinder head sub-assembly.

4. REMOVE INTAKE VALVE GUIDE BUSH

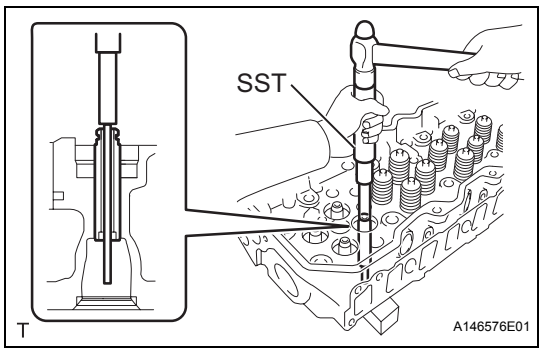
(a) Heat the cylinder head up to between 80 and 100°C (176 to 212 °F).



(b) Using SST and a hammer, tap out the valve guide bush.
SST 09201-10000 (09201-01070), 09950-70010 (09951-07100)

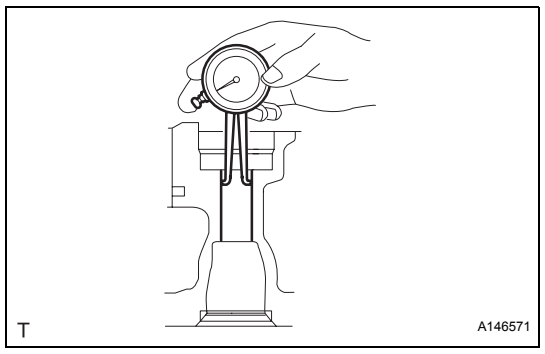
5. REMOVE EXHAUST VALVE GUIDE BUSH

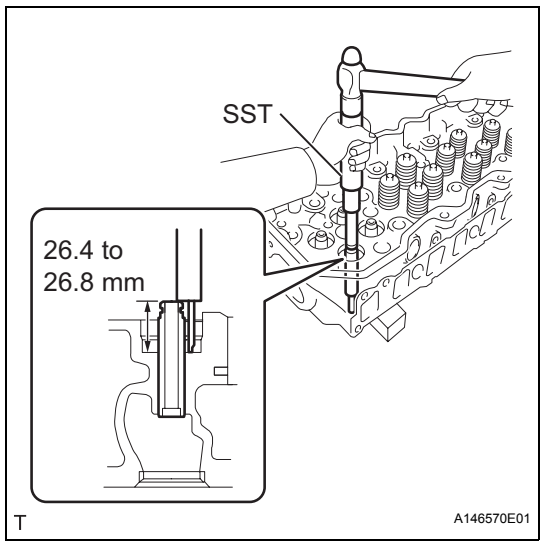
(a) Heat the cylinder head up to between 80 and 100°C (176 to 212 °F).



(b) Using SST and a hammer, tap out the valve guide bush.
SST 09201-10000 (09201-01070), 09950-70010 (09951-07100)

EM





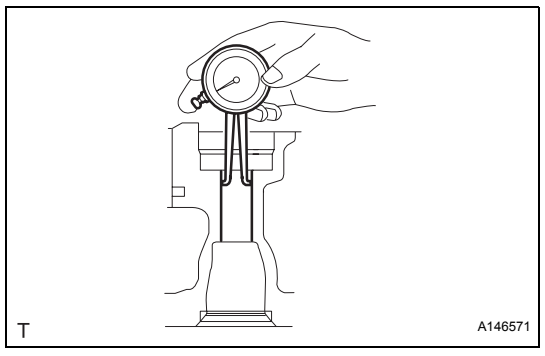
6. INSTALL INTAKE VALVE GUIDE BUSH

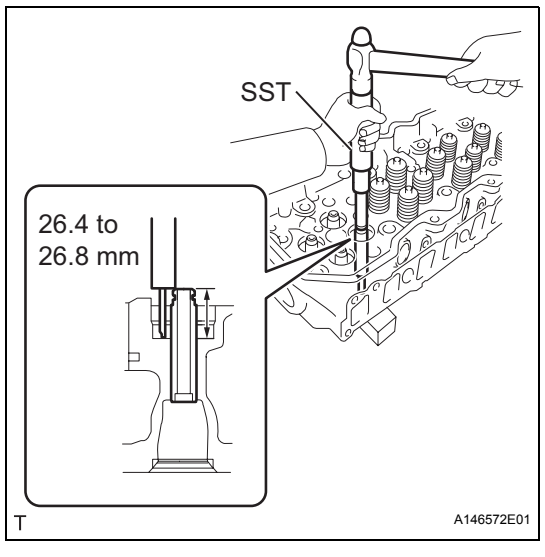
(a) Using a caliper gauge, measure the inside diameter of the guide bush.
Bush inside diameter:
13.00 to 13.01 mm (0.5118 to 0.5125 in.)
HINT:
If the inside diameter of the cylinder head is greater than the maximum, replace the cylinder head.

(b) Heat the cylinder head up to between 80 and 100°C (176 to 212 °F).

(c) Using SST, tap in a new valve guide bush to the specified protrusion height.
SST 09201-10000 (09201-01070), 09950-70010 (09951-07100)
Protrusion height:
26.4 to 26.8 mm (1.039 to 1.055 in.)
NOTICE:
Do not tap in the guide bush too much.

(d) Using a reamer, ream the inside of the valve guide bush to the specified oil clearance between the valve guide bush and valve stem.
Standard oil clearance:
0.01 to 0.02 mm (0.0006 to 0.0011 in.)





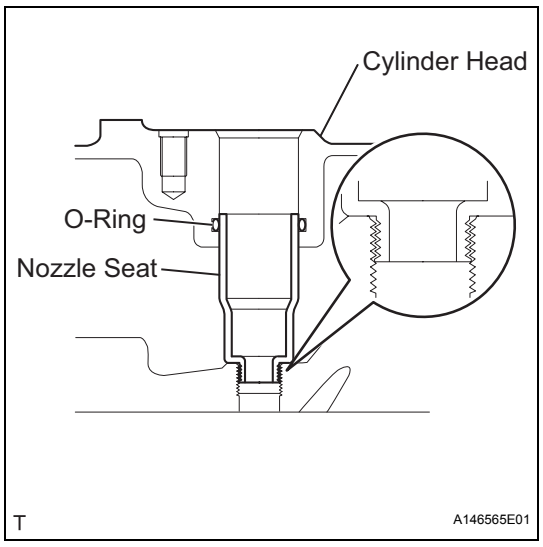
7. INSTALL EXHAUST VALVE GUIDE BUSH

(a) Using a caliper gauge, measure the inside diameter of the guide bush.
Bush inside diameter:
13.00 to 13.01 mm (0.5118 to 0.5125 in.)
HINT:
If the inside diameter of the cylinder head is greater than the maximum, replace the cylinder head.

(b) Heat the cylinder head up to between 80 and 100°C (176 to 212 °F).

(c) Using SST, tap in a new valve guide bush to the specified protrusion height.
SST 09201-10000 (09201-01070), 09950-70010 (09951-07100)
Protrusion height:
26.4 to 26.8 mm (1.039 to 1.055 in.)

(d) Using a reamer, ream the inside of the valve guide bush to the specified oil clearance between the valve guide bush and valve stem.
Standard oil clearance:
0.05 to 0.08 mm (0.0021 to 0.0033 in.)

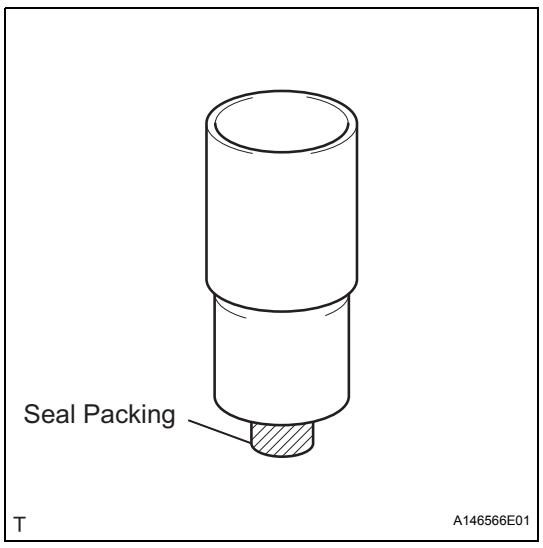


8. INSTALL INJECTION NOZZLE SEAT

(a) Apply a light coat of engine oil to a new O-ring, and install it into the cylinder head.

NOTICE:

Do not reuse the O-ring, as it may cause water or gas leakage inside the cylinder and the cylinder head may overheat or crack.



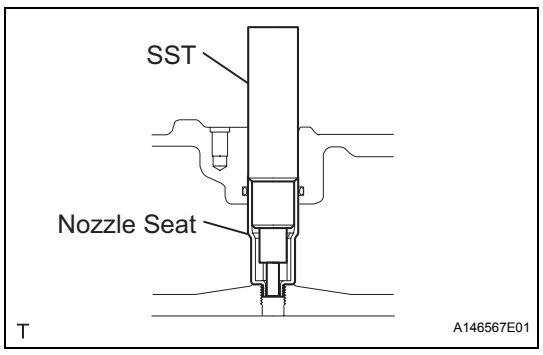
(b) Apply seal packing to a new nozzle seat.

Seal packing:

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

NOTICE:

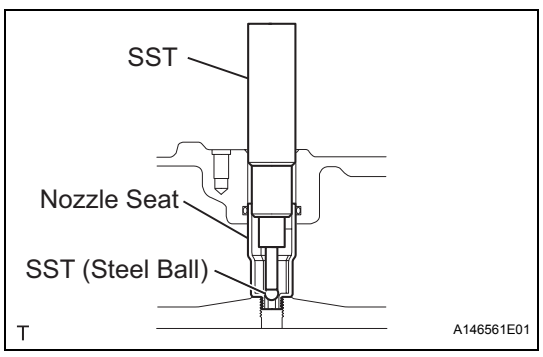
- **Remove any oil from the installation surface of the cylinder head and nozzle seat.**
- **Do not reuse the nozzle seat, as it may cause water or gas leakage inside the cylinder and the cylinder may overheat or crack.**



(c) Using SST, install the nozzle seat into the cylinder head.

SST 09260-69015

SST 09268-06020



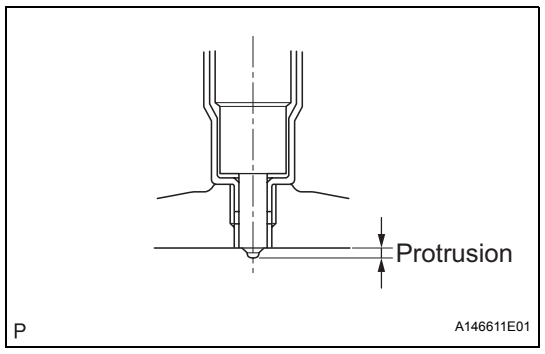
(d) Using SST, caulk the nozzle seat.

SST 09260-69015, 09268-06010, 09268-06020

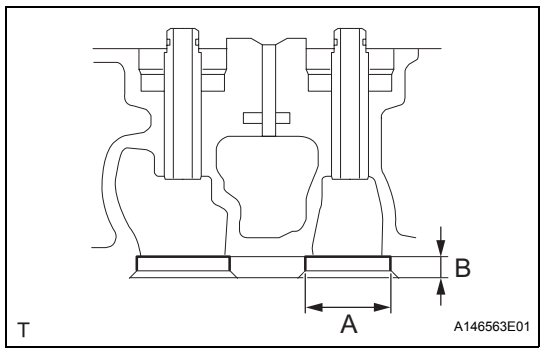
NOTICE:

Put a container under the cylinder head to prevent the steal ball from being lost.

EM



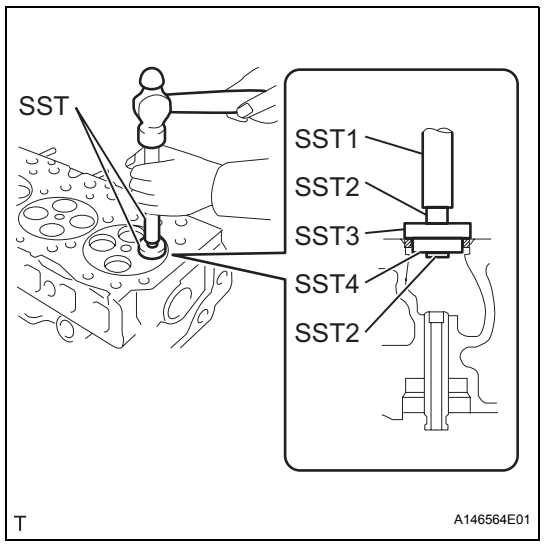
(e) Install the injector into the cylinder head. Using a vernier caliper, measure the protrusion of the injection from the lower surface of the cylinder head.
Standard:
2.45 to 2.95 mm (0.0964 to 0.1161 in.)



9. INSTALL INTAKE VALVE SEAT

(a) Using a caliper gauge and vernier caliper, measure the dimensions of the valve seat installation hole.
Cylinder head dimension:
A:
36.00 to 36.01 mm (1.4173 to 1.4179 in.)
B:
8.4 to 8.6 mm (0.3307 to 0.3386 in.)
If either result is not as specified, replace the cylinder head.

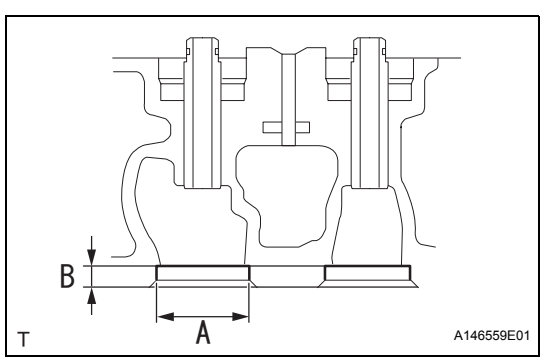
(b) Heat the cylinder head up to between 80 and 100°C (176 to 212 °F).



(c) Using SST and a hammer, lightly tap the valve seat into the cylinder head.
SST 09950-60010 (09951-00300, 09951-00360, 09952-06010), 09950-70010 (09951-07100)

SST 1	09951-07100
SST 2	09952-06010
SST 3	09951-00360
SST 4	09951-00300

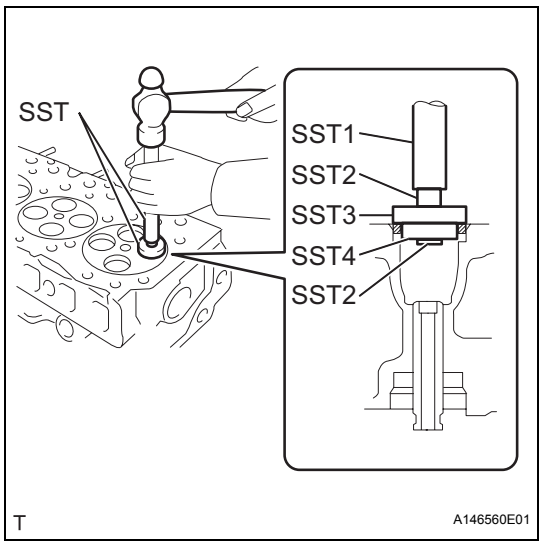
(d) Using SST and a hammer, completely tap in the valve seat.
SST 09950-60010 (09951-00300, 09951-00360, 09952-06010), 09950-70010 (09951-07100)



10. INSTALL EXHAUST VALVE SEAT

(a) Using a caliper gauge and vernier caliper, measure the dimensions of the valve seat installation hole.
Cylinder head dimension:
A:
32.00 to 32.01 mm (1.2598 to 1.26024 in.)
B:
7.6 to 7.8 mm (0.2992 to 0.3071 in.)
If either result is not as specified, replace the cylinder head.

(b) Heat the cylinder head up to between 80 and 100°C (176 to 212 °F).



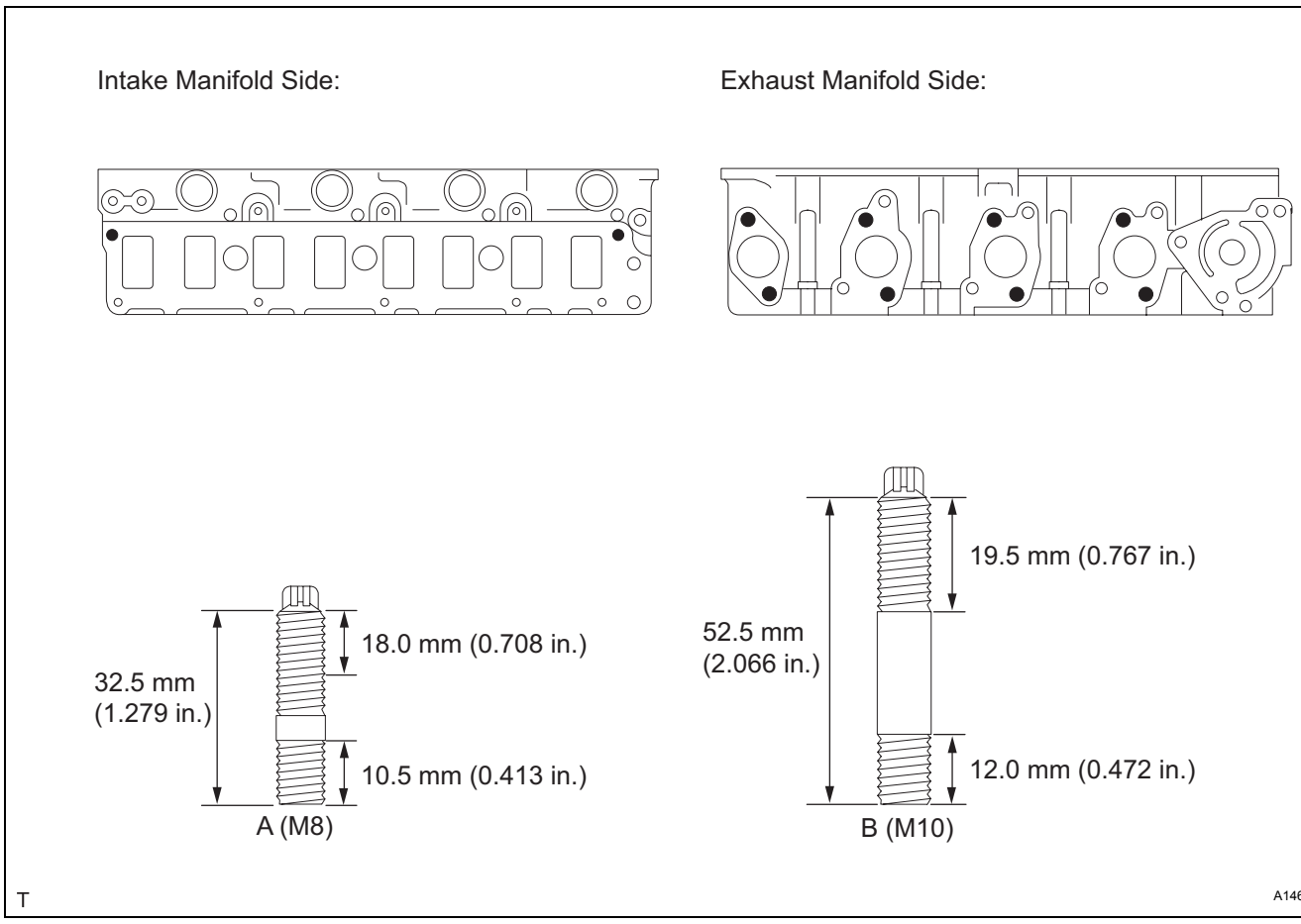
(c) Using SST and a hammer, lightly tap the valve seat into the cylinder head.
SST 09950-60010 (09951-00250, 09951-00320, 09952-06010), 09950-70010 (09951-07100)

SST 1	09951-07100
SST 2	09952-06010
SST 3	09951-00360
SST 4	09951-00300

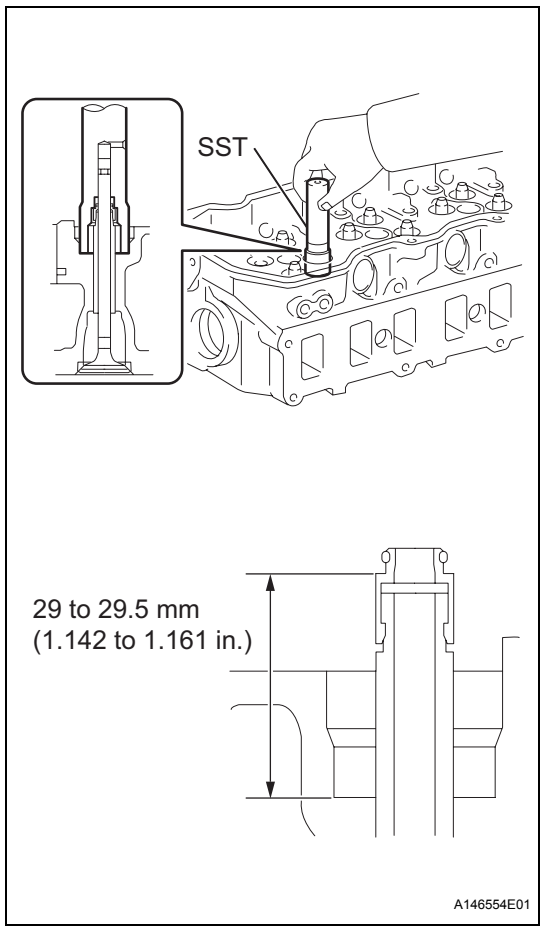
(d) Using SST and a hammer, completely tap in the valve seat.
SST 09950-60010 (09951-00250, 09951-00320, 09952-06010), 09950-70010 (09951-07100)

REASSEMBLY

1. INSTALL STUD BOLT



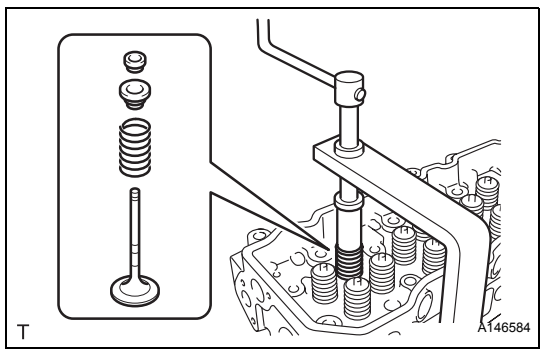
(a) Using "TORX" socket wrenches E10 and E8, install the stud bolts.
Torque: Bolt A
25 N*m (255 kgf*cm, 18 ft.*lbf)
Bolt B
51 N*m (520 kgf*cm, 38 ft.*lbf)



2. INSTALL VALVE STEM OIL SHIELD

(a) Apply a light coat of engine oil to the valve guide bush.

(b) Using SST, install the valve stem oil shield.
SST S0947-22210
HINT:
After pressing in the oil seal, check that the height of the valve stem oil seal is as illustrated.

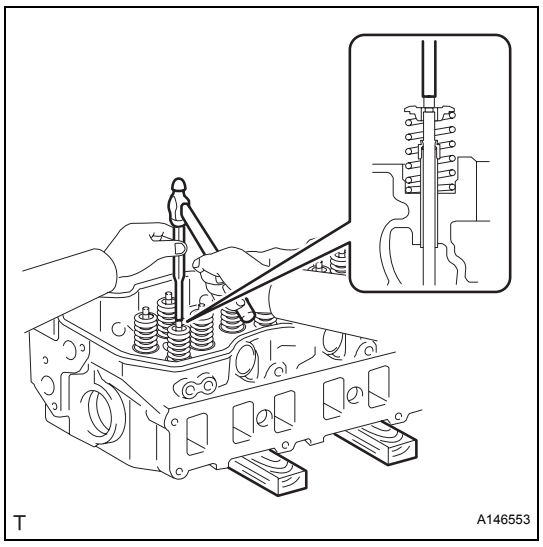


3. INSTALL INTAKE VALVE

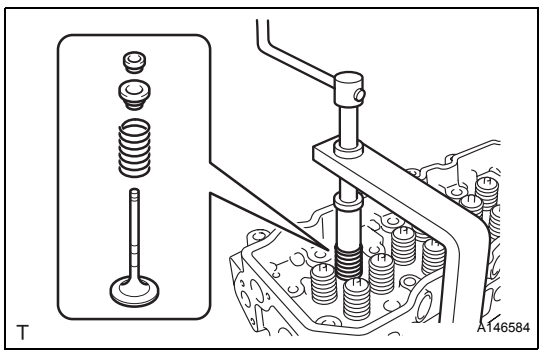
(a) Apply engine oil to the valve tip.

(b) Install the valve, inner compression spring and valve spring retainer.
NOTICE:
Install the parts in their original locations.

(c) Using SST, compress the inner compression spring and place the 2 valve spring retainer locks around the valve stem.
SST 09202-70020 (09202-01010, 09202-00020, 09202-01020, 90154-80004)

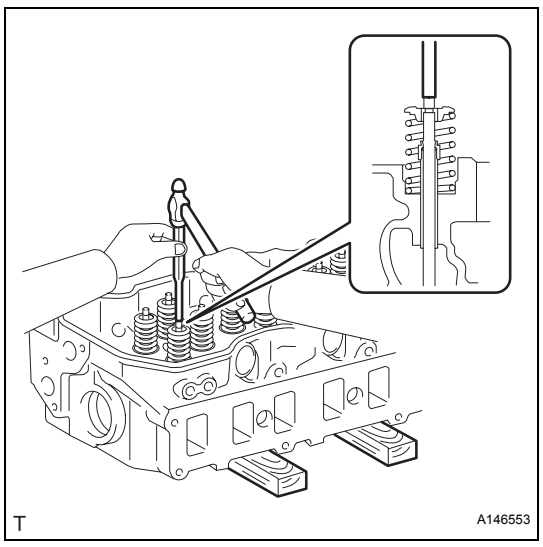


(d) Using a pin punch 5, lightly tap the valve stem tip to ensure a proper fit.
NOTICE:
Be careful not to damage the valve stem tip.



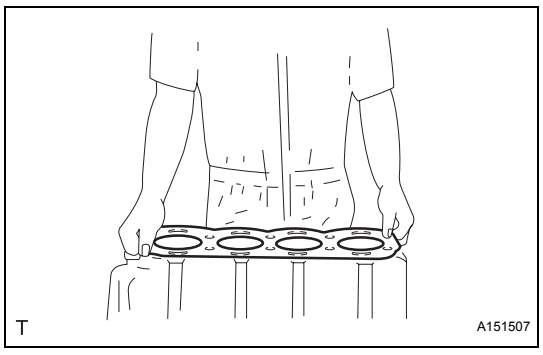
4. INSTALL EXHAUST VALVE

(a) Apply engine oil to the valve tip.
(b) Install the valve, inner compression spring and valve spring retainer.
NOTICE:
Install the parts in their original locations.
(c) Using SST, compress the inner compression spring and place the 2 valve spring retainer locks around the valve stem.
SST 09202-70020 (09202-01010, 09202-00020, 09202-01020, 90154-80004)
(d) Using a pin punch 5, lightly tap the valve stem tip to ensure a proper fit.
NOTICE:
Be careful not to damage the valve stem tip.



INSTALLATION

1. INSTALL VALVE LIFTER
NOTICE:
Be sure to return the removed bridge to its original location.



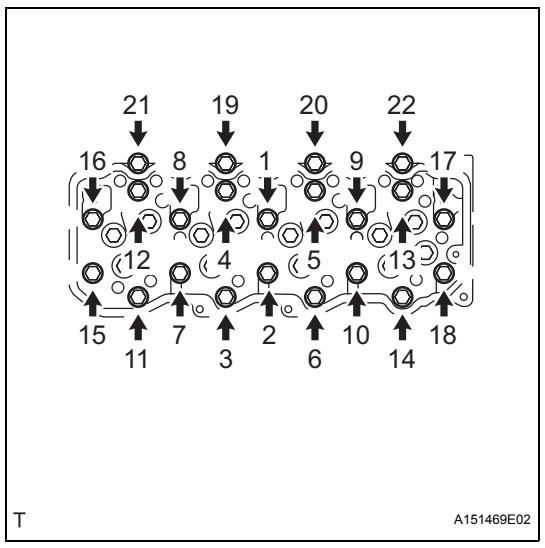
2. INSTALL CYLINDER HEAD GASKET

(a) Install a new cylinder head gasket.
NOTICE:
Always use a new cylinder head gasket after cleaning the surface of the cylinder head, cylinder block and keep them free of dirt, water and grease.

3. INSTALL CYLINDER HEAD SUB-ASSEMBLY

(a) Install the cylinder head over the dowels on the cylinder block.
HINT:
Since the cylinder head bolts are unique to this engine, do not substitute them with ordinary bolts.

(b) Uniformly install and tighten the cylinder head bolts (1 to 18) in the order shown in the illustration.
Torque: 60 N*m (610 kgf*cm, 44 ft.*lbf)

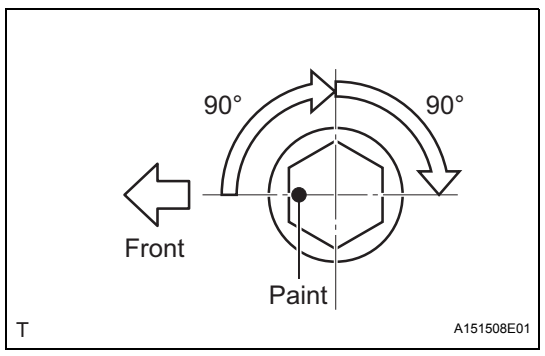


(c) Mark the front side of each cylinder head bolt head with paint as shown in the illustration.

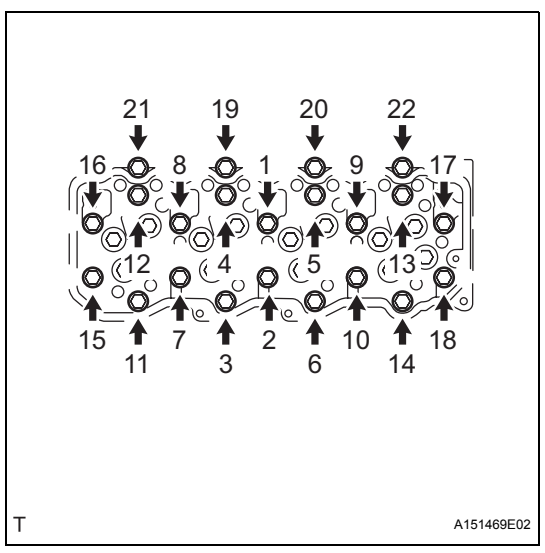
(d) Retighten the cylinder head bolts by 90° in the same order as step.

(e) Perform step (b) again.

(f) Check that each painted mark is now at a 180° angle to the front.



(g) Uniformly install and tighten the cylinder head bolts (19 to 22) in the order shown in the illustration.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



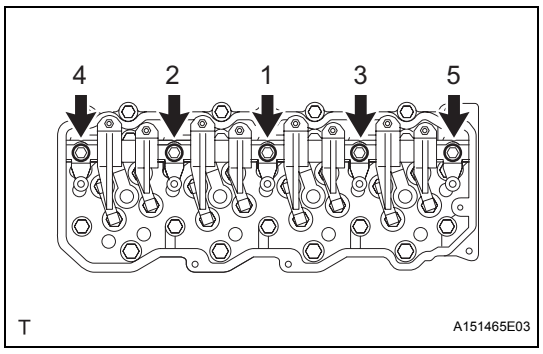
4. INSTALL VALVE BRIDGE
NOTICE:
Be sure to install the removed bridge to its original location.

5. INSTALL VALVE PUSH ROD
NOTICE:
Be sure to install the removed push rod to its original location.

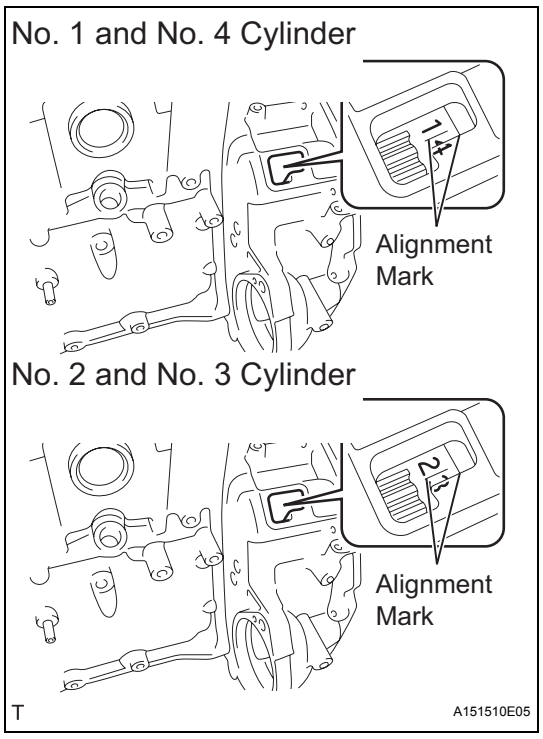
6. INSTALL NO. 1 VALVE ROCKER SHAFT SUB-ASSEMBLY

(a) Install the rocker shaft onto the cylinder head.

(b) Apply engine oil to the rocker arm and push rod.

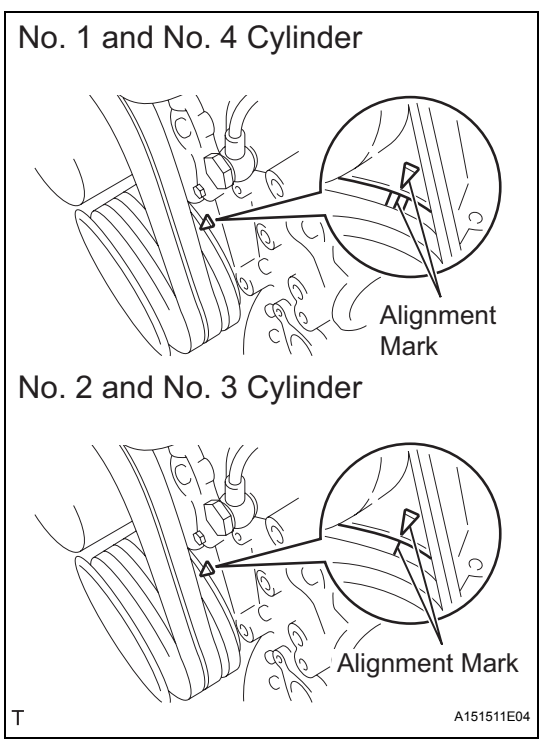


(c) Install the bolts in the order shown in the illustration.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)
NOTICE:
Do not allow the push rod to interfere with the adjusting screw.



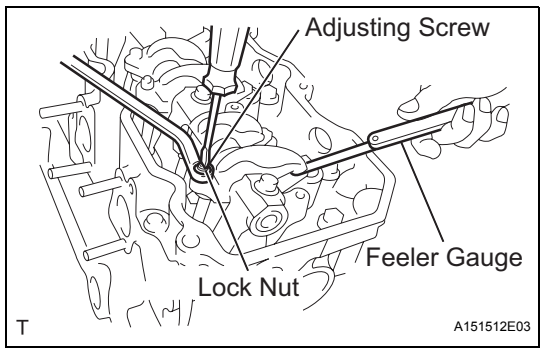
7. ADJUST VALVE CLEARANCE

(a) Flywheel housing side:
Turn the crankshaft clockwise to align the alignment marks on the flywheel with the line between the 2 numbers on the edge on the flywheel housing.



(b) Crankshaft pulley side:
Turn the crankshaft clockwise to align the alignment marks on the crankshaft pulley with the pointer on the timing gear case.
HINT:
If not, turn the crankshaft 1 revolution (360°) to align the alignment marks.

EM

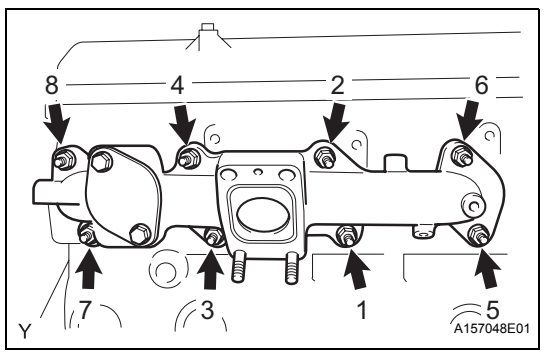


(c) With the No. 1 piston positioned at TDC on the compression stroke, using a feeler gauge, adjust the valve clearance.
Valve clearance (Cold)

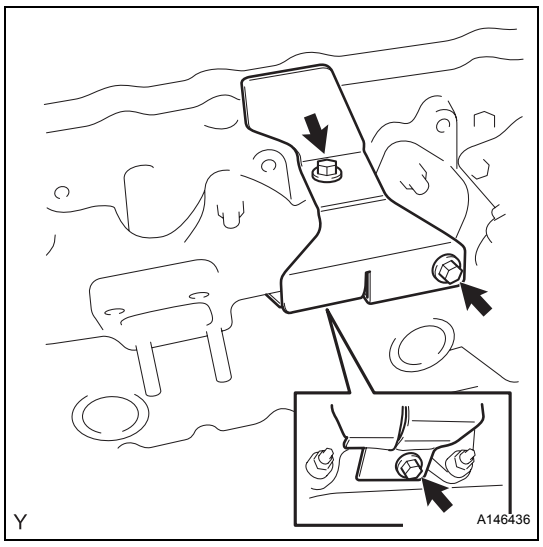
Intake	**0.30 mm (0.0118 in.)**
Exhaust	**0.45 mm (0.0177 in.)**

HINT:
The feeler gauge should move with a very slight pull.

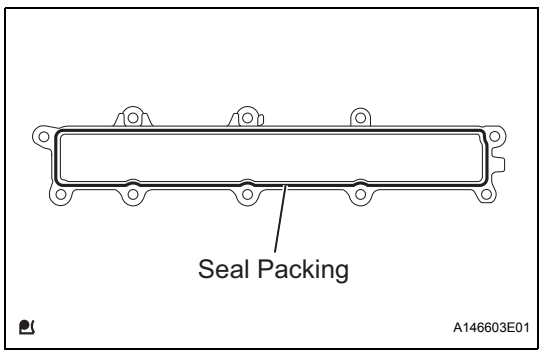
(d) Loosen the lock nut on the valve rocker arm and loosen the adjusting screw.
(e) Insert a 0.30 mm(0.012 in.) feeler gauge for the intake or a 0.45 mm (0.018 in.) feeler gauge for the exhaust between the adjusting screw on the valve rocker arm and the valve bridge.
(f) Turn the adjusting screw on the valve rocker arm until the feeler gauge slides with a very slight drag, and lock the adjusting screw with the lock nut.
Torque: 29 N*m (296 kgf*cm, 22 ft.*lbf)
(g) Recheck the clearance.
(h) Adjust the other valves.
(1) Turn the crankshaft 1 revolution (360°) clockwise.
(2) Adjust the valve clearance for each cylinder in the firing order.
Firing order:
1 - 3 - 4 - 2
(The cylinder number is counted from the timing gear side)



8. INSTALL EXHAUST MANIFOLD
(a) Install 4 new gaskets onto the exhaust manifold.
(b) Using several steps, tighten each nut in the sequence shown in the illustration.
Torque: 60 N*m (610 kgf*cm, 44 ft.*lbf)

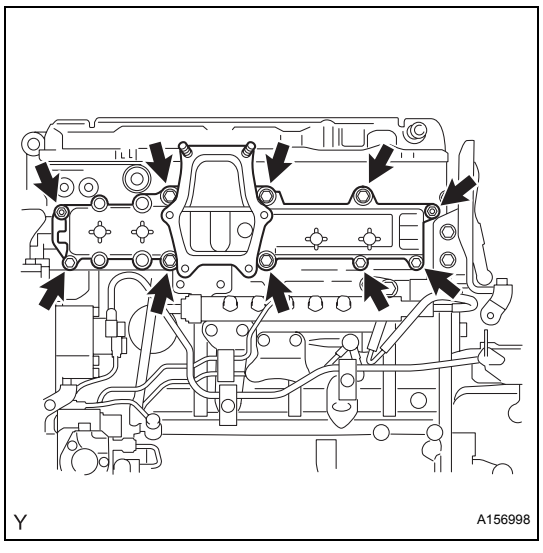


(c) Install the exhaust manifold insulator sub-assembly with the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



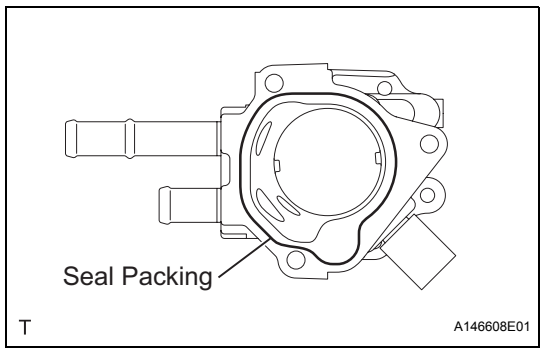
9. INSTALL INTAKE MANIFOLD

(a) Apply seal packing to the intake manifold.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the timing chain cover within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**
- **Do not start the engine for at least 2 hours after the installation.**



(b) Install the intake manifold with the 8 bolts and 2 nuts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

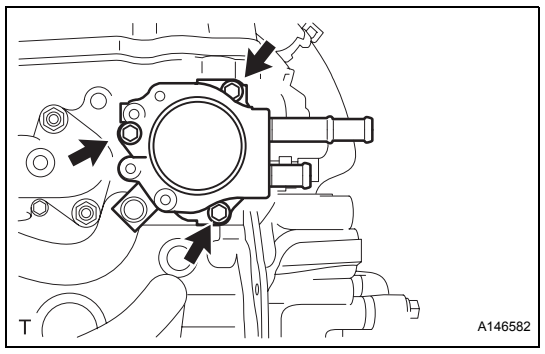
EM



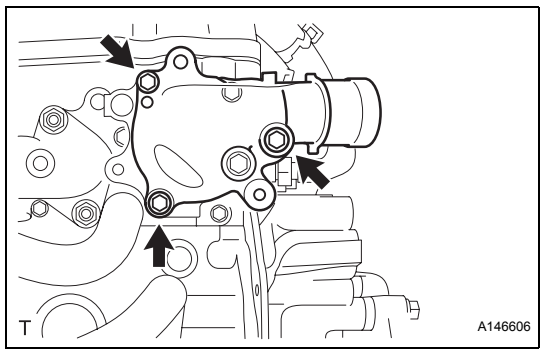
10. INSTALL WATER OUTLET HOUSING

(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm (0.06 to 0.10 in.)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the water outlet housing within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**

(b) Install the water outlet housing with the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

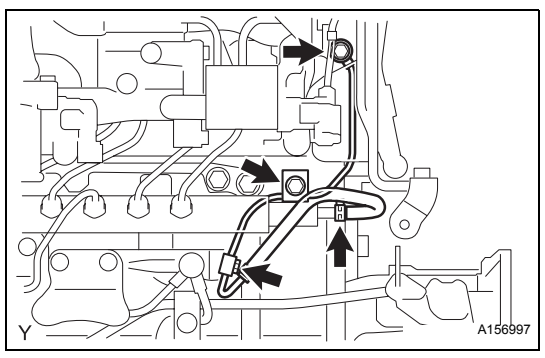


11. INSTALL THERMOSTAT



12. INSTALL WATER OUTLET SUB-ASSEMBLY

(a) Install the water outlet sub-assembly with the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

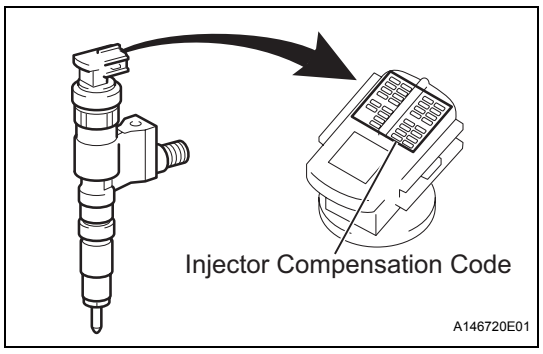


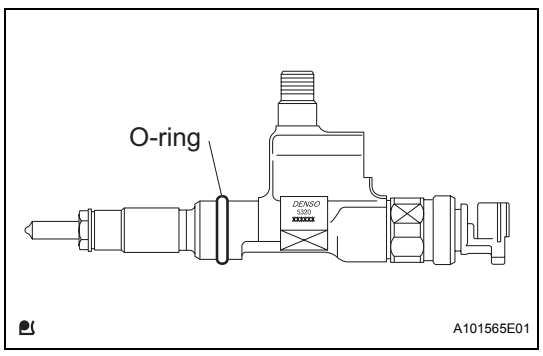
13. INSTALL NO. 3 NOZZLE LEAKAGE PIPE SUB-ASSEMBLY

(a) Install the No. 3 nozzle leakage pipe sub-assembly with 2 new gaskets and the 2 union bolts.
Torque: 13 N*m (130 kgf*cm, 10 ft.*lbf)

(b) Install the fuel pipe clamp with the bolt.

(c) Connect the fuel hose to the common rail.





14. INSTALL INJECTOR ASSEMBLY

NOTICE:

Register the injector compensation code of a new fuel injector in the ECM when replacing the fuel injector. Register the injector compensation code in advance so that it can be installed in the correct position.

(a) Install 4 new injection nozzle sheets onto the cylinder head.

(b) Apply a light amount of clean engine oil to 4 new O-rings.

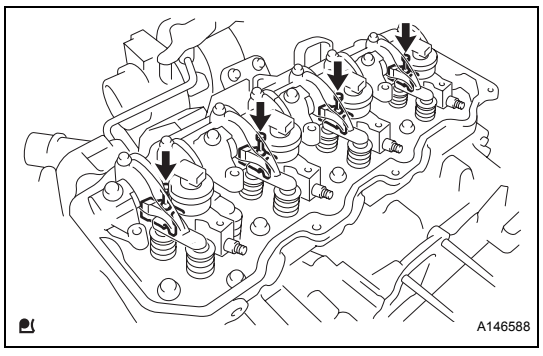
(c) Install the O-ring onto each injector as shown in the illustration.

(d) Install a new No. 2 cylinder head cover gasket onto each injector.

(e) Insert the 4 injectors into the cylinder head.

NOTICE:

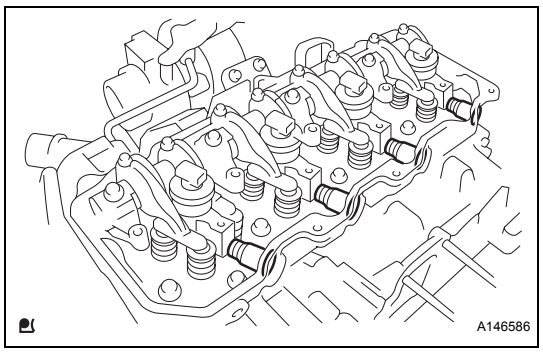
- **Check that the insertion part of the fuel injector has no foreign matter attached.**
- **When reusing a fuel injector, install the same fuel injector that was removed. Otherwise, it could cause the engine to malfunction.**
- **Carefully insert the fuel injector so that the O-ring is not caught between the cylinder head and the injector.**



(f) Temporarily install the 4 nozzle holder clamps with the 4 clamp bolts.

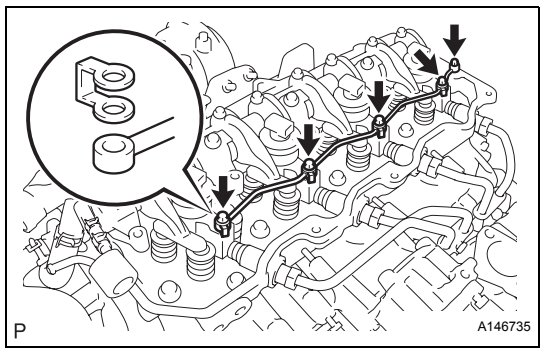
NOTICE:

Be sure to install the holder clamp and bolt in their original positions.



(g) Install the 4 nozzle holder seals.

EM

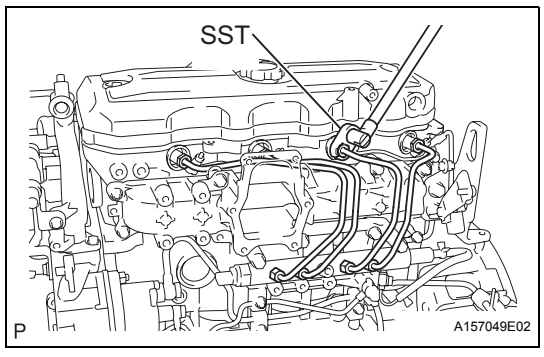


(h) Temporarily install the nozzle leakage pipe through 5 new gaskets by hand with the union bolt and 4 hollow screws.

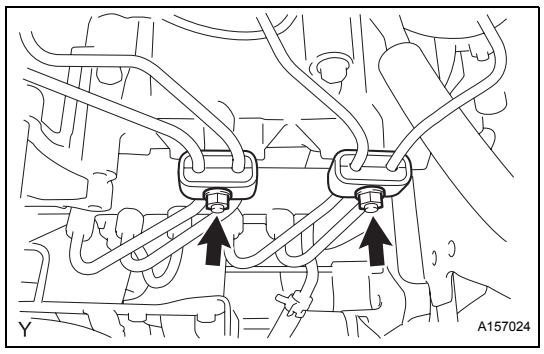
(i) Temporarily install the 4 injection pipes.
HINT:
Hand tighten the union nuts on the injection pipes.

(j) Tighten the 4 nozzle holder clamps and bolts.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)
NOTICE:
After tightening the nozzle holder clamp bolts, check that the fuel injector and the nozzle holder clamp do not interfere with the vale spring.

(k) Tighten the 4 nozzle hollow screws and union bolt.
Torque: 13 N*m (130 kgf*cm, 10 ft.*lbf)

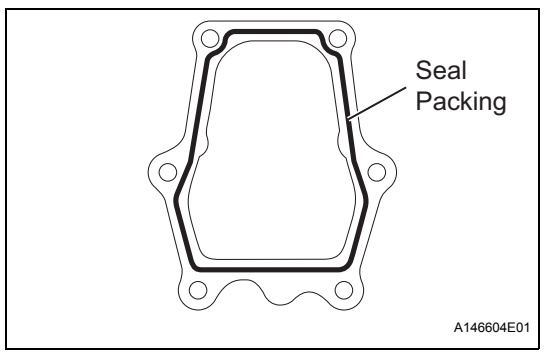


(l) Using SST, tighten the injection pipe union nuts.
SST 09023-12900
Torque: 44 N*m (450 kgf*cm, 33 ft.*lbf)
NOTICE:
Refer to the torque above when not using SST. When using SST, calculate the torque in accordance with the lengths of SST and the torque wrench.



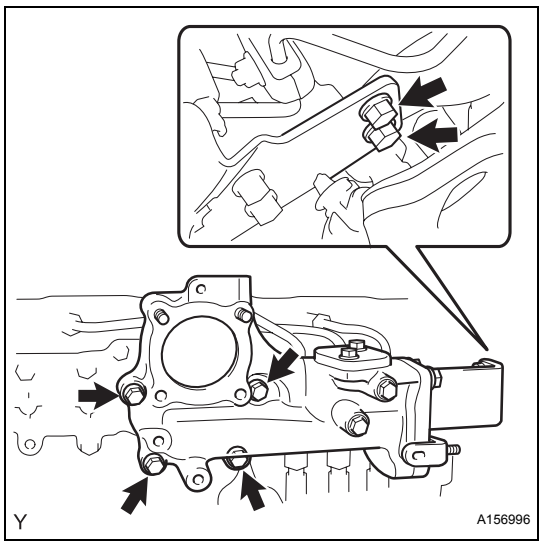
15. INSTALL INJECTION PIPE CLAMP

(a) Install the 2 injection pipe clamps with the 2 nuts. Tighten the 2 nuts until the clamp edges make contact.



16. INSTALL INTAKE PIPE

(a) Apply seal packing to the intake pipe.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the intake pipe with EGR valve within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**



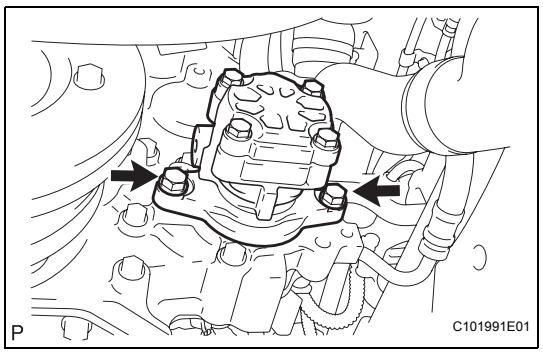
(b) Install the intake pipe with the 6 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

17. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-12)

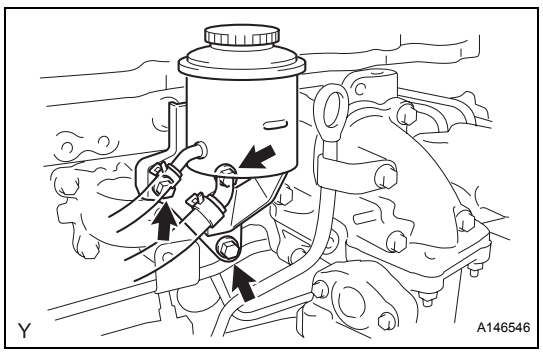
18. INSTALL NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY (See page EM-12)

19. INSTALL OIL FILLER CAP SUB-ASSEMBLY (See page EM-13)

20. INSTALL GLOW PLUG ASSEMBLY (See page EM-112)



21. INSTALL VANE PUMP ASSEMBLY
(a) Coat a new O-ring with power steering fluid and install it onto the vane pump.
(b) Install the vane pump assembly with the 2 bolts.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)



(c) Install the vane pump oil reservoir assembly with the 3 bolts.
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)

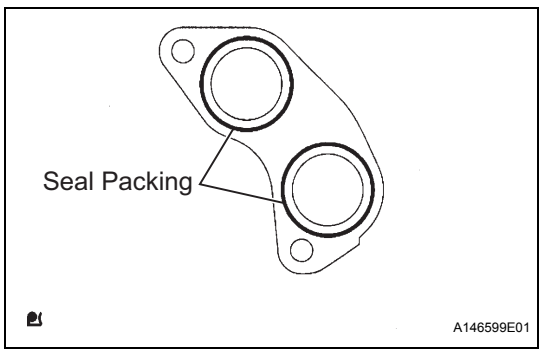
22. INSTALL DIESEL THROTTLE BODY WITH INTAKE PIPE (See page EM-115)

23. INSTALL NO. 2 AIR HOSE (See page EM-116)

24. INSTALL FRONT FENDER APRON LH (See page ES-256)

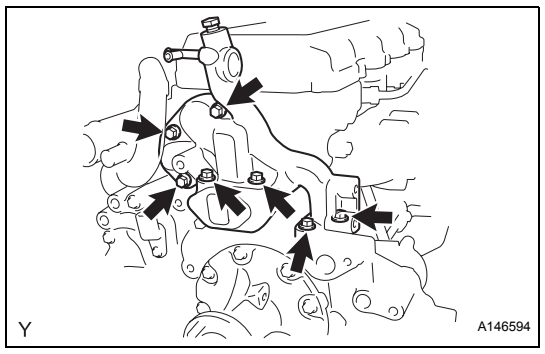
25. INSTALL GENERATOR ASSEMBLY (See page CH-17)

26. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY
(a) Remove any seal packing material from the contact surface.
(b) Apply a continuous bead of seal packing (diameter: 1.5 to 2.5 mm (0.06 to 0.10 in)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

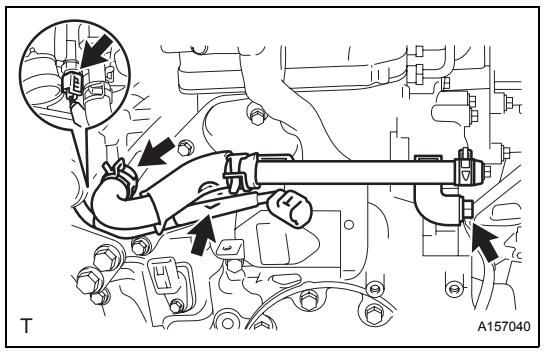


(c) Install 2 new O-rings onto the water by-pass pipe sub-assembly.

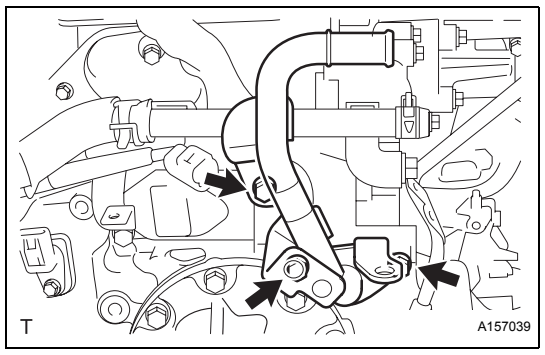
EM



(d) Install the water by-pass pipe sub-assembly with the 7 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

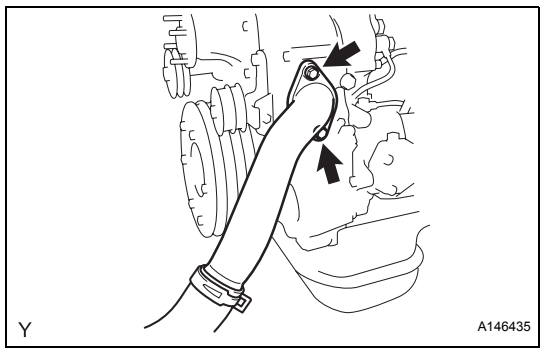


27. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY
(a) Connect the water hose.
(b) Connect the connector.
(c) Install the No. 2 water by-pass pipe sub-assembly with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



28. INSTALL WATER PIPE SUB-ASSEMBLY
(a) Install the water pipe sub-assembly with a new O-ring and 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

29. CONNECT INLET HEATER WATER HOSE B (See page EM-115)



30. INSTALL RADIATOR PIPE
(a) Install the radiator pipe with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

31. INSTALL RADIATOR ASSEMBLY (See page CO-40)

32. INSTALL FAN (See page CO-27)

33. INSTALL MANUAL TRANSMISSION OIL COOLER ASSEMBLY (See page CO-41)

34. INSTALL RADIATOR GRILLE (See page ET-6)

35. INSTALL NO. 1 AIR HOSE (See page EM-119)

36. INSTALL TURBOCHARGER SUB-ASSEMBLY
Refer to the procedures under " REMOVE TURBOCHARGER SUB-ASSEMBLY"(IT-14).

37. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 ft.*lbf)

38. ADD ENGINE OIL (See page LU-3)

39. ADD ENGINE COOLANT (See page CO-4)

40. INSPECT FOR OIL LEAK (See page LU-4)

41. INSPECT FOR COOLANT LEAK (See page CO-3)

42. INSPECT FOR EXHAUST GAS LEAK

43. INSTALL NO. 1 ENGINE UNDER COVER (See page EM-6)

REPAIR

1. REPAIR VALVE SEAT

NOTICE:

Gradually release the seat cutter pressure to make the valve seat surface smoother.

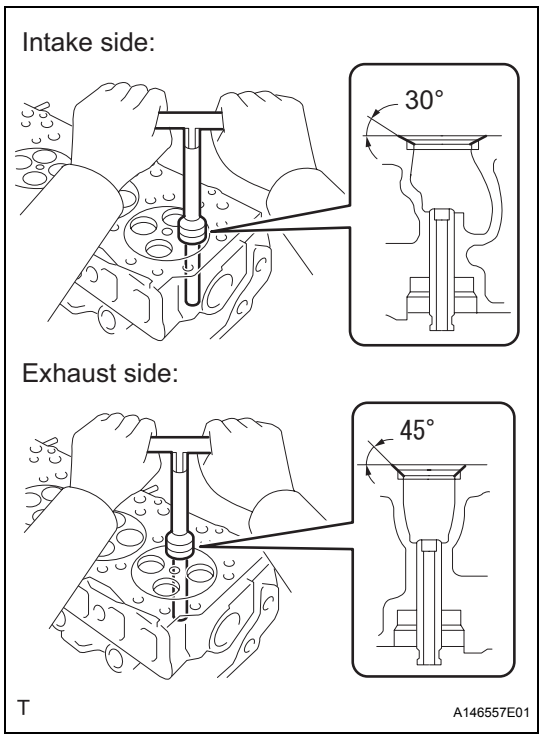
(a) If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

Standard

Intake	**0.8 to 1.0 mm (0.031 to 0.039 in.)**
Exhaust	**1.8 to 2.0 mm (0.070 to 0.078 in.)**

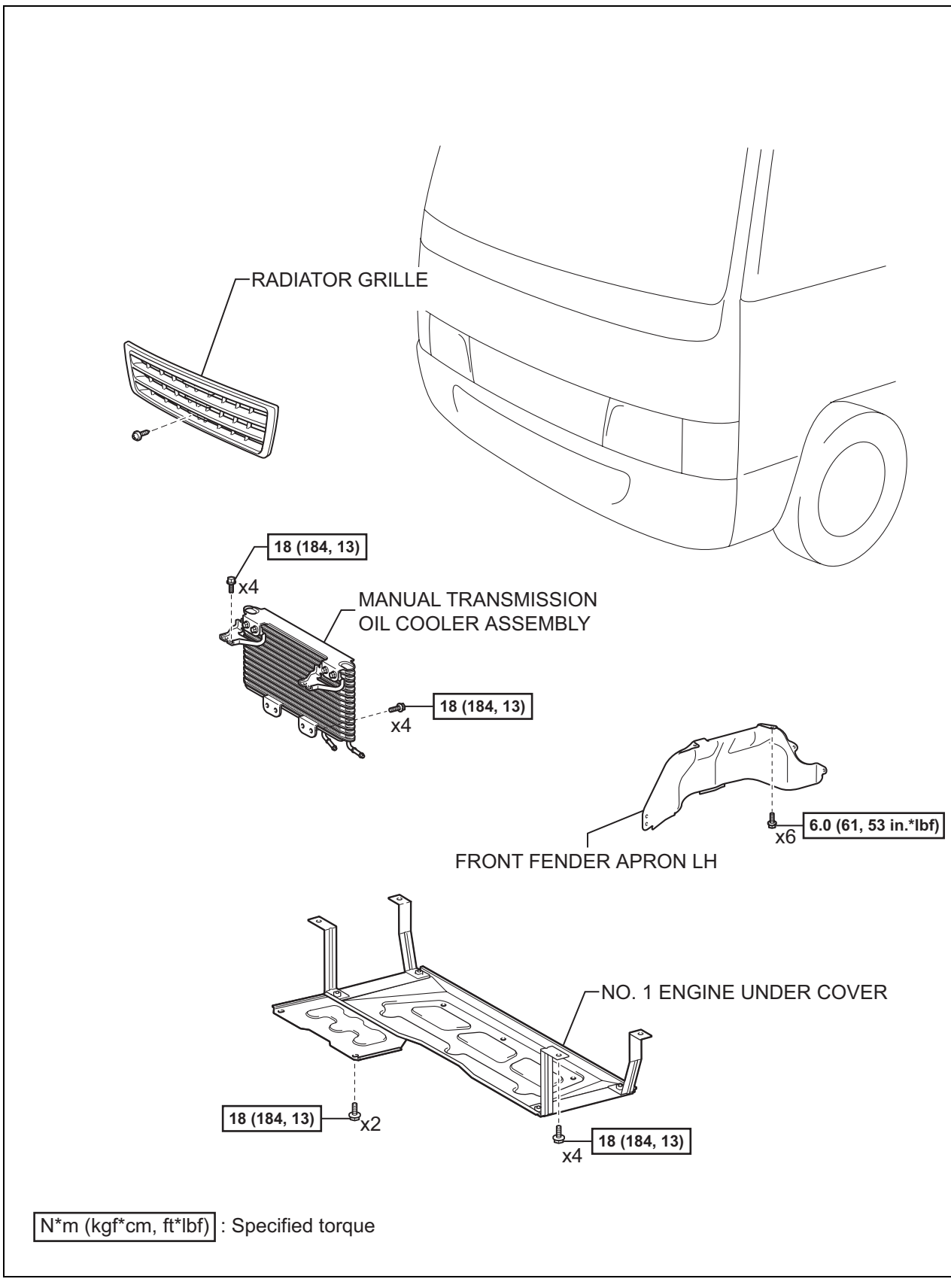
CAUTION:

When grinding, the valve tips may break off on impact. Wear safety glasses to protect your eyes.



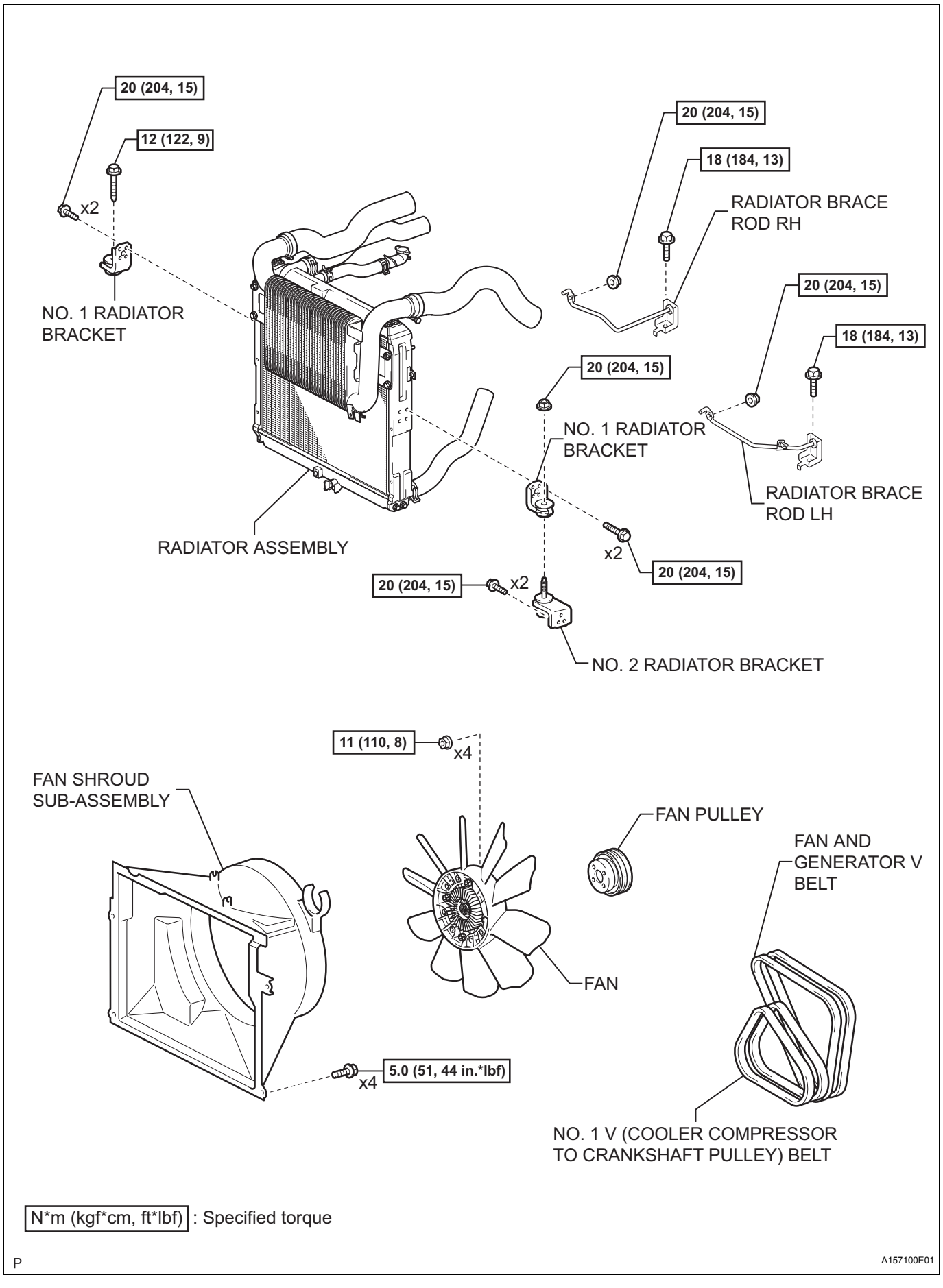
ENGINE ASSEMBLY

COMPONENTS



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

A157046E01

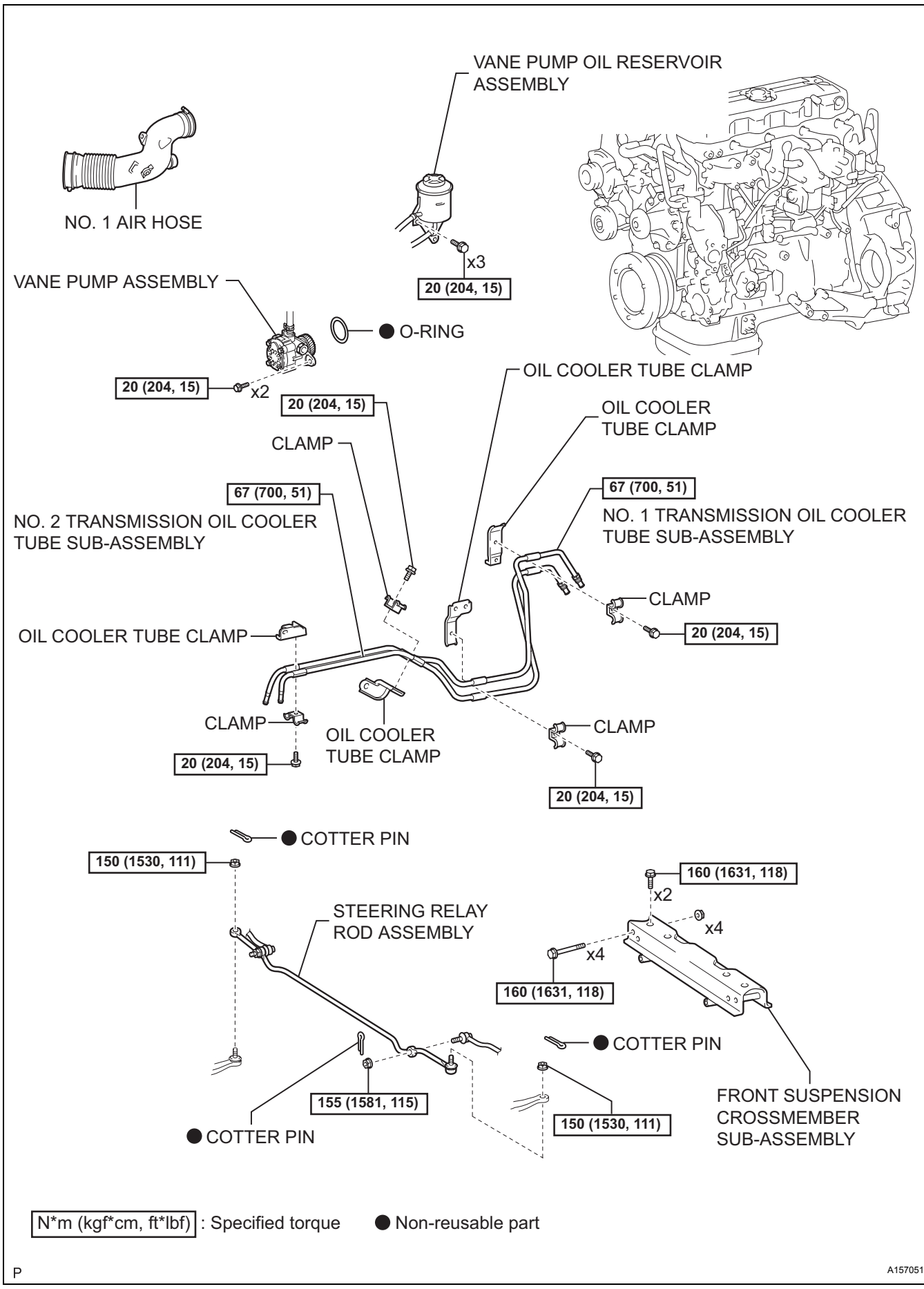


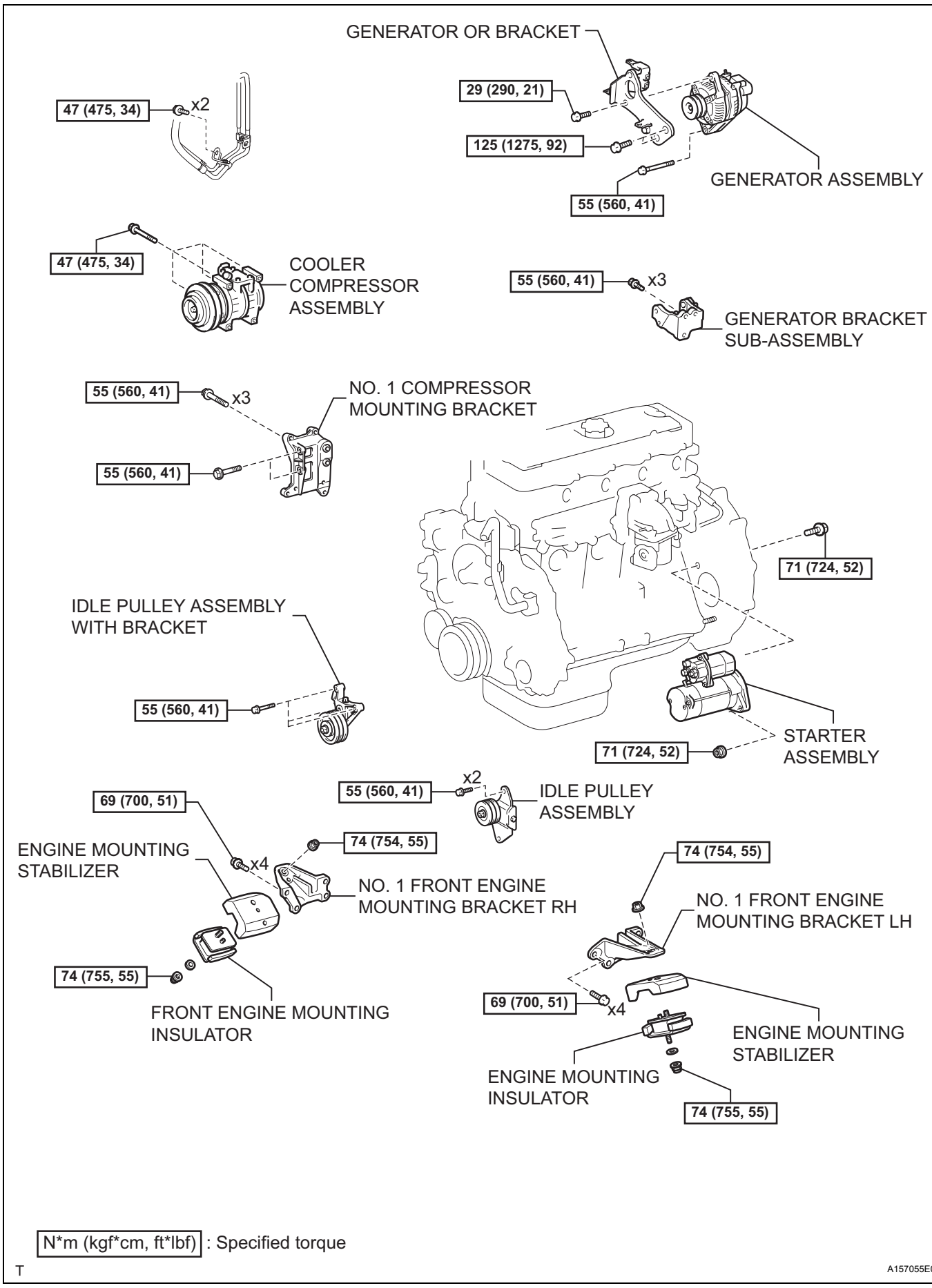
EM

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

P

A157100E01





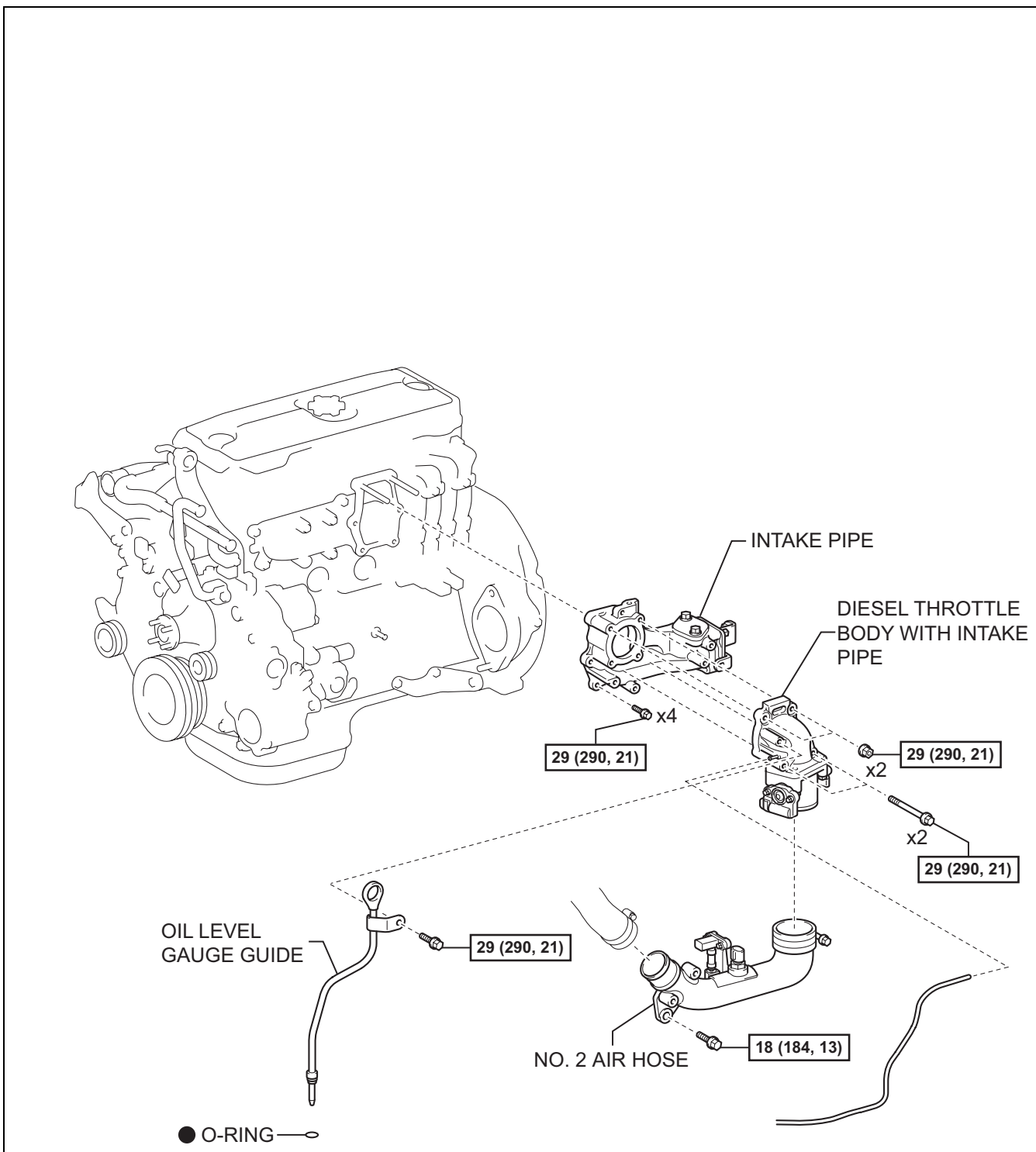
EM

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

T

A157055E01

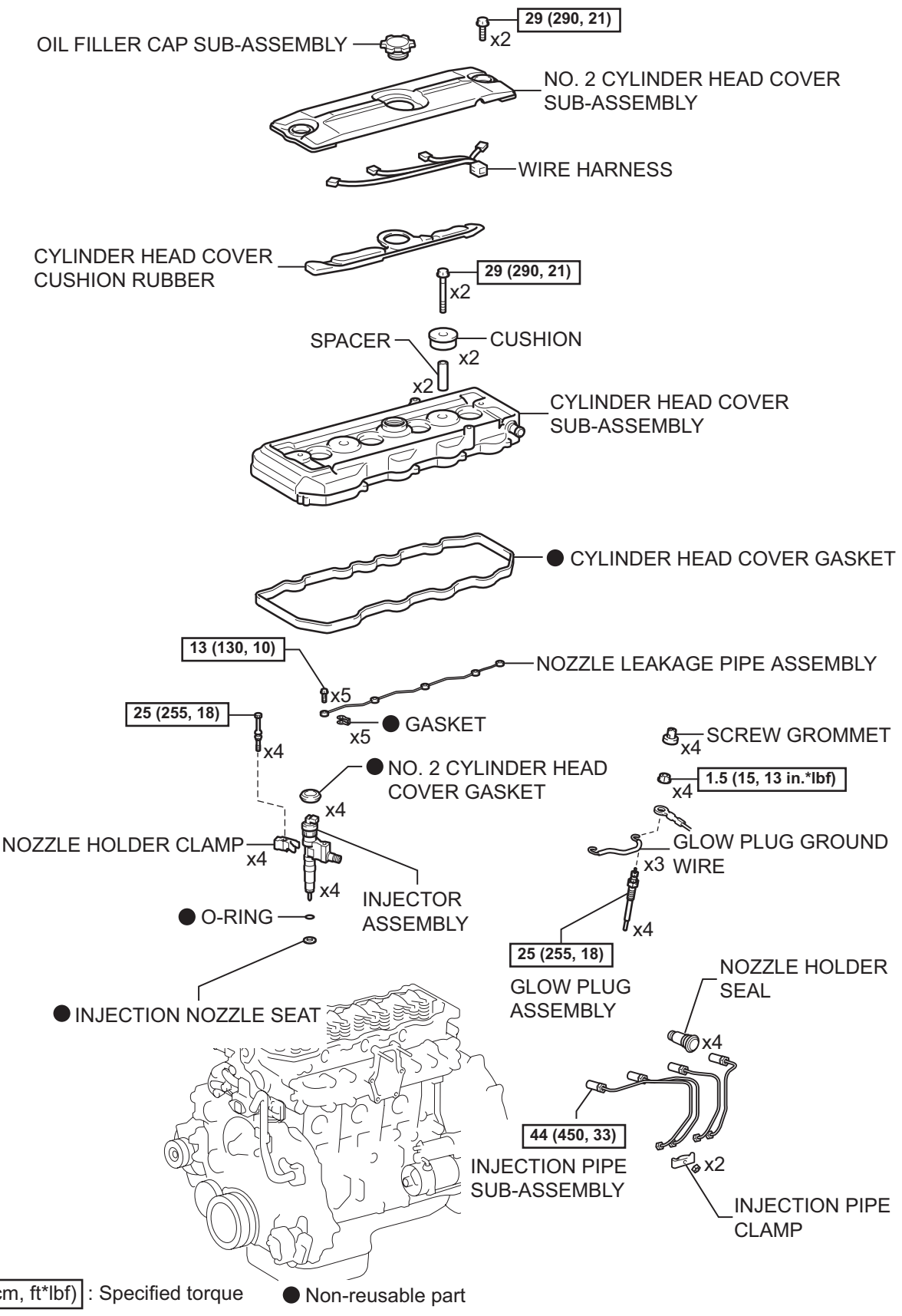
EM



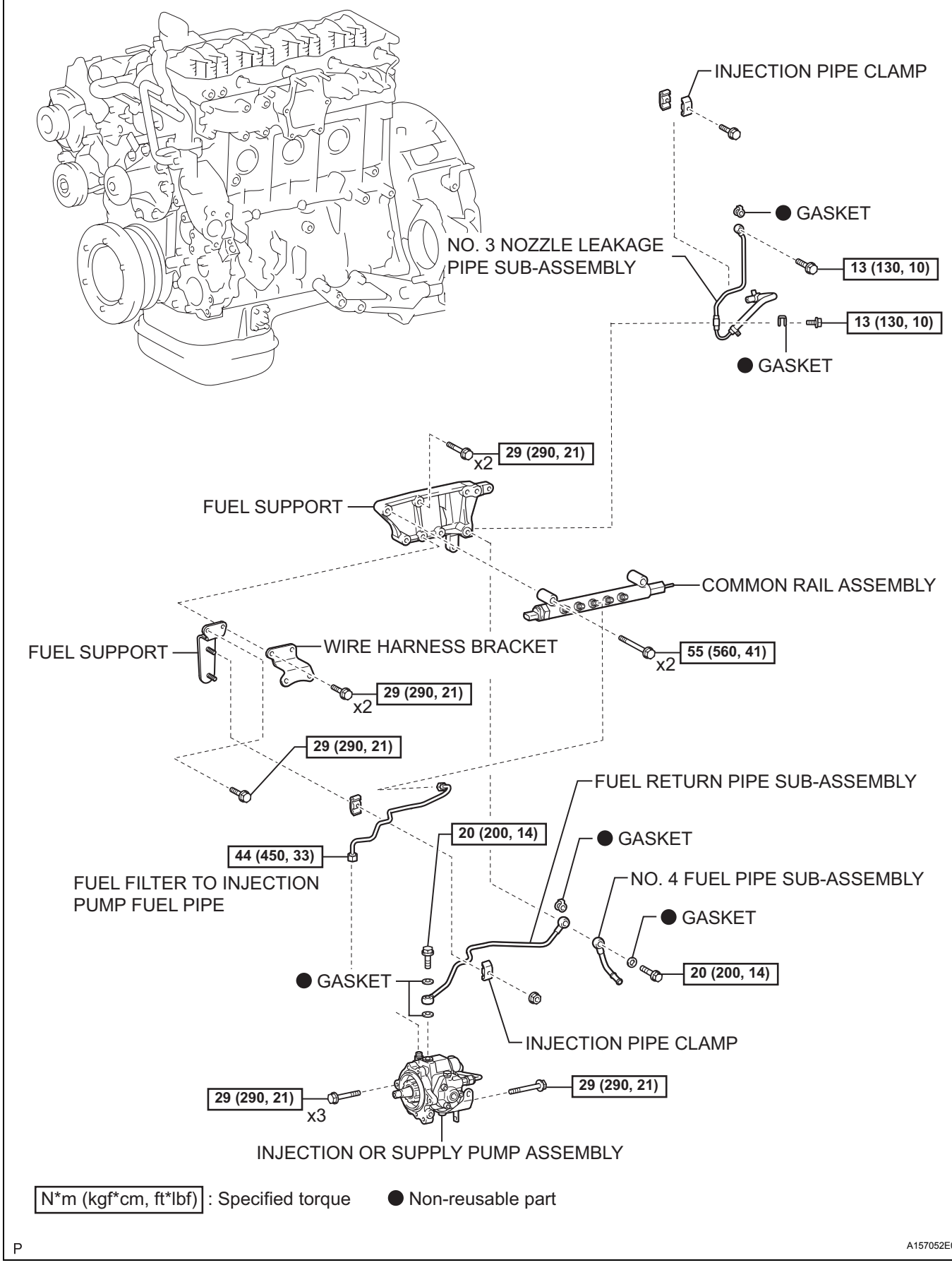
N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

Y

A156991E01

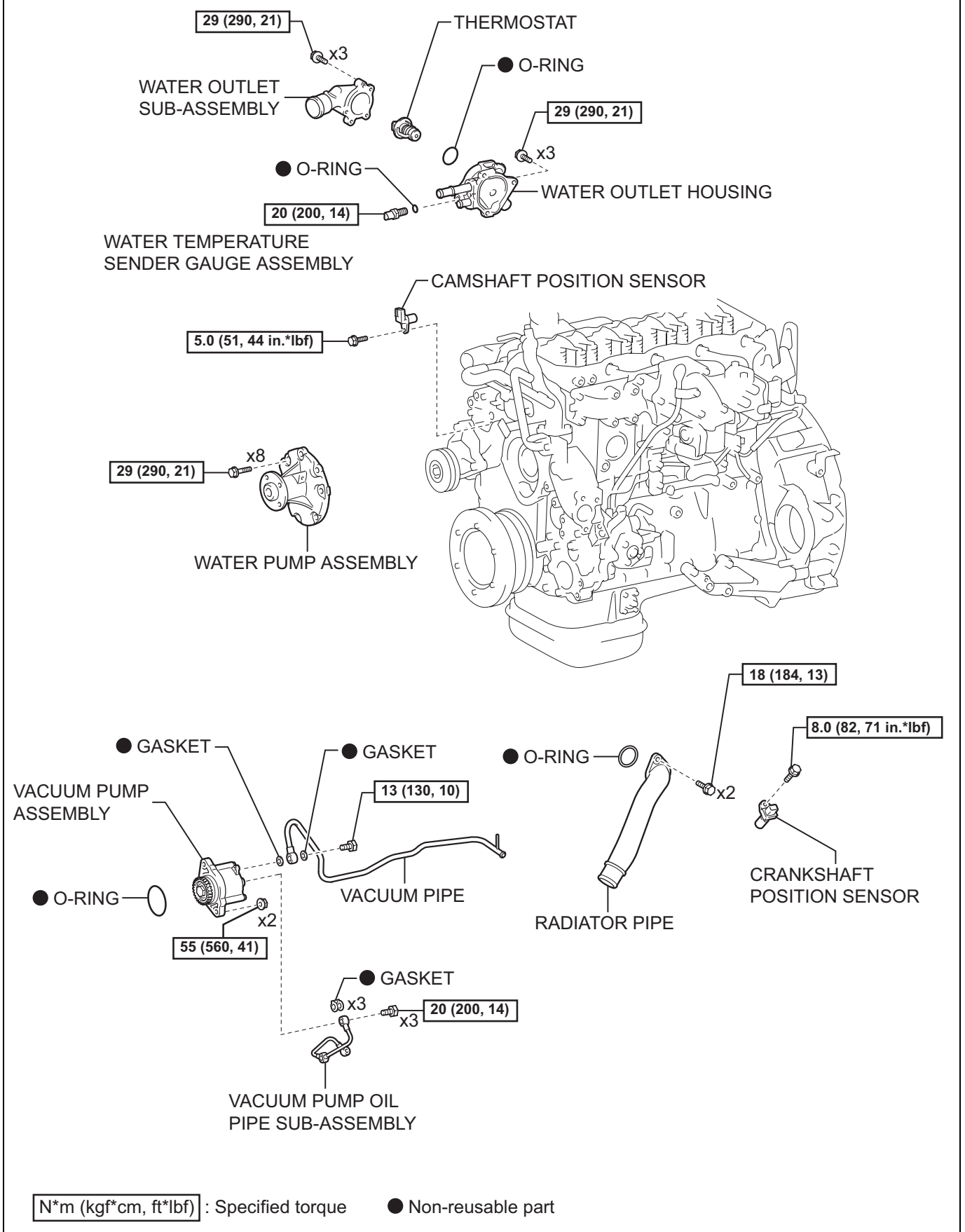


EM

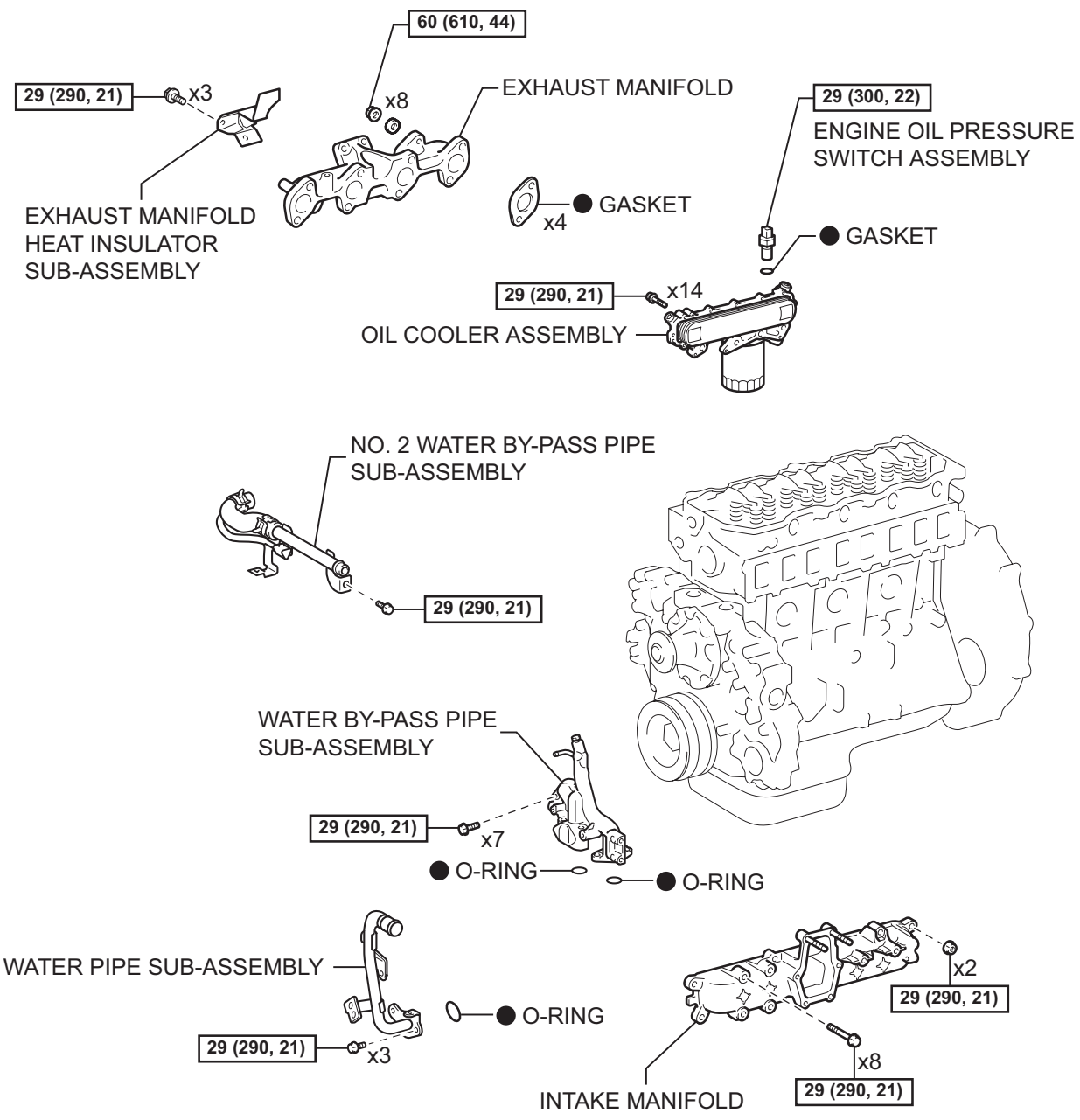


P

A157052E01



EM



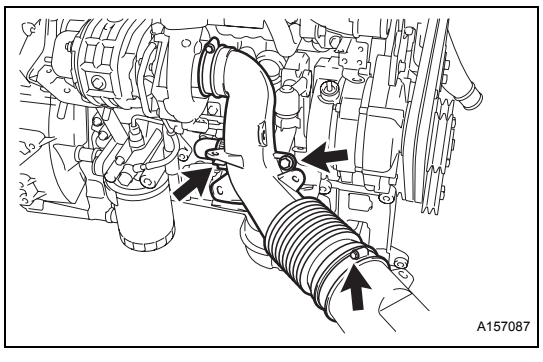
N*m (kgf*cm, ft*lbf) : Specified torque ● Non-reusable part

T

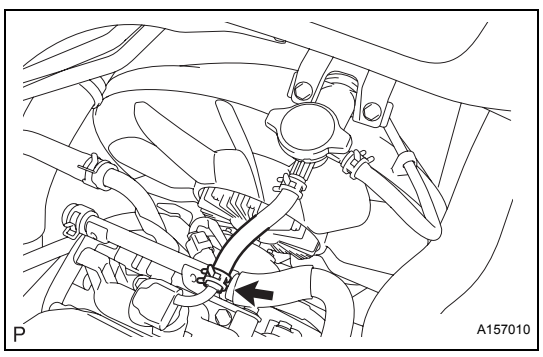
A157102E01

REMOVAL

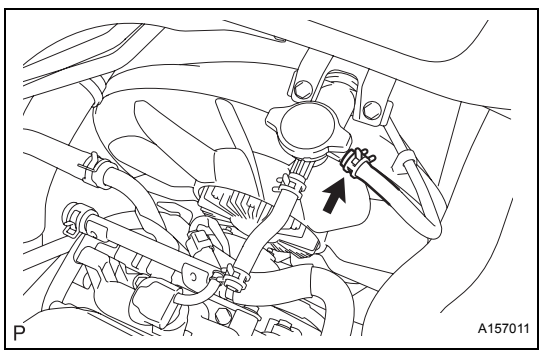
1. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
2. **REMOVE NO. 1 ENGINE UNDER COVER (See page EM-4)**
3. **DRAIN ENGINE OIL (See page LU-3)**
4. **DRAIN ENGINE COOLANT (See page CO-4)**
5. **REMOVE TURBOCHARGER SUB-ASSEMBLY**
   Refer to the procedures under " REMOVE TURBOCHARGER SUB-ASSEMBLY"(IT-10).
6. **REMOVE NO. 1 AIR HOSE**
   (a) Separate the engine wire.
   (b) Disconnect the ventilation hose.
   (c) Remove the bolt.
   (d) Loosen the No. 1 air cleaner hose clamp and remove the No. 1 air hose.



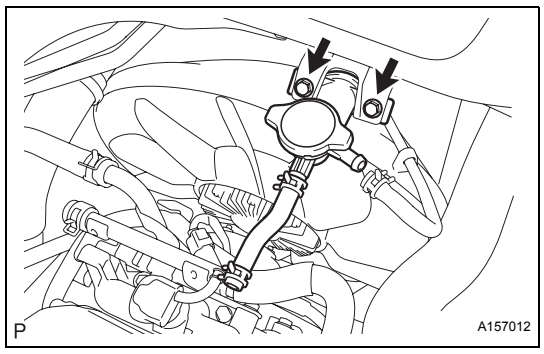
7. **REMOVE RADIATOR GRILLE (See page ET-3)**
8. **REMOVE MANUAL TRANSMISSION OIL COOLER ASSEMBLY (See page CO-36)**
9. **REMOVE FAN (See page CO-25)**
10. **REMOVE RADIATOR ASSEMBLY**
    (a) Disconnect the water by-pass hose.



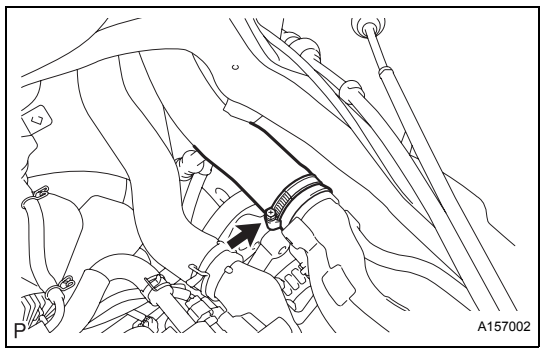
    (b) Disconnect the radiator reserve tank hose.



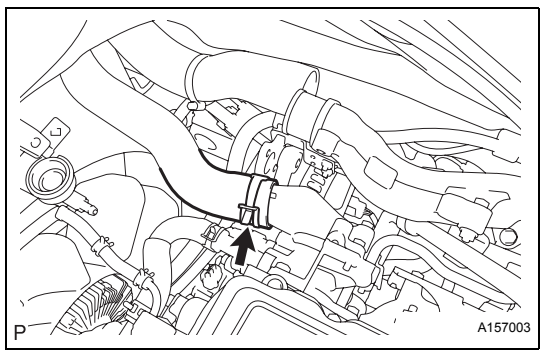
EM



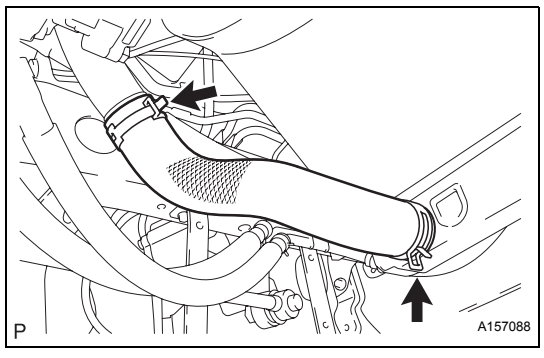
(c) Remove the 2 bolts and separate the water filler assembly.



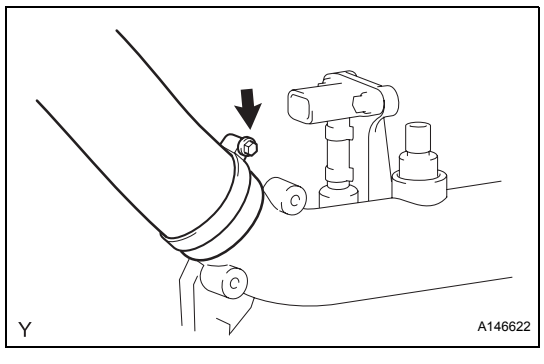
(d) Loosen the hose clamp and disconnect the No. 1 air hose.



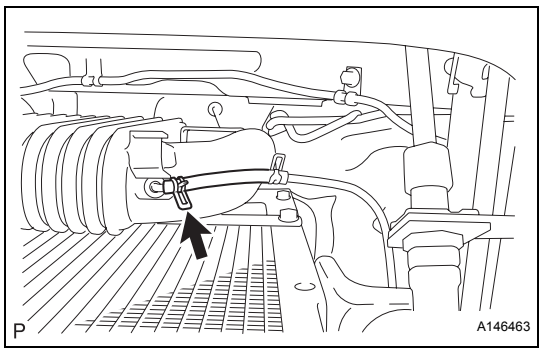
(e) Disconnect the inlet radiator hose.



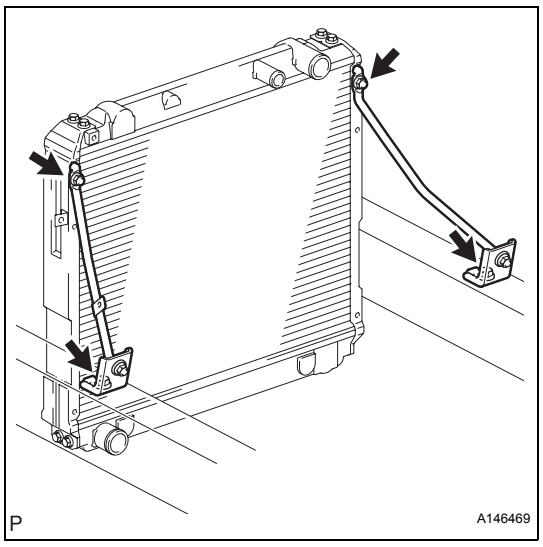
(f) Remove the No. 2 radiator hose.



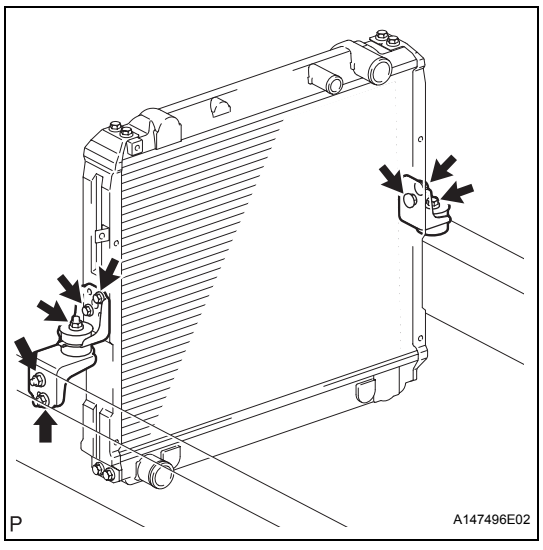
(g) Loosen the air hose clamp and disconnect the inter cooler air hose.



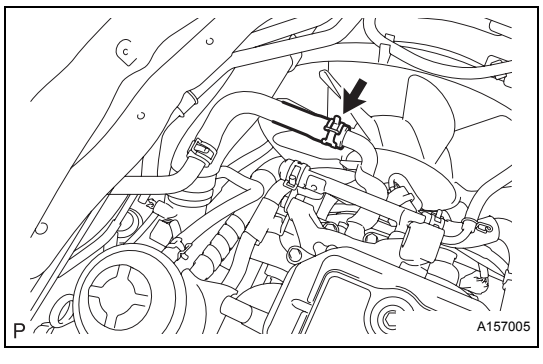
(h) Disconnect the vacuum transmitting hose.



(i) Remove the 2 nuts and 2 bolts and remove the radiator brace rod.



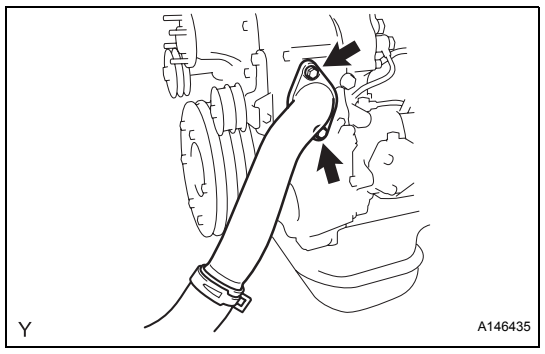
(j) Remove the 3 bolts and remove the No. 1 radiator bracket.
(k) Remove the nut and 2 bolts and remove the No. 2 radiator bracket.
(l) Remove the 2 bolts and remove the No. 1 radiator bracket.
(m) Remove the radiator with intercooler.



11. DISCONNECT HEATER WATER INLET HOSE B

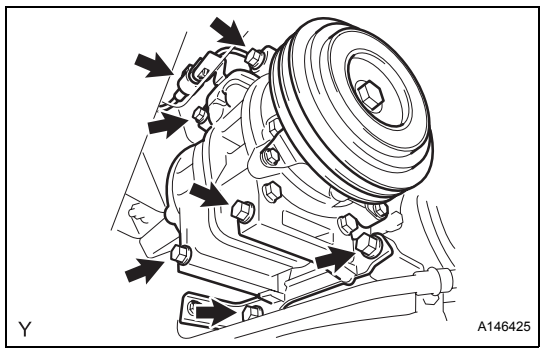
(a) Disconnect the outlet heater water hose E.

EM



12. REMOVE RADIATOR PIPE

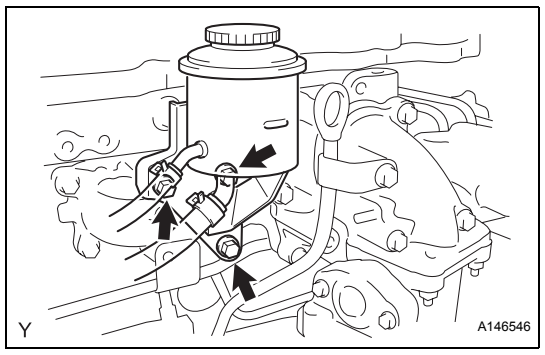
(a) Remove the 2 bolts and remove the radiator pipe.



13. SEPARATE COOLER COMPRESSOR ASSEMBLY

(a) Disconnect the connector.

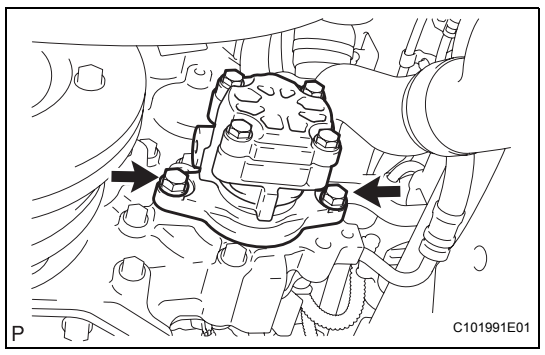
(b) Remove the 6 bolts and separate the cooler compressor assembly.



14. SEPARATE VANE PUMP OIL RESERVOIR ASSEMBLY

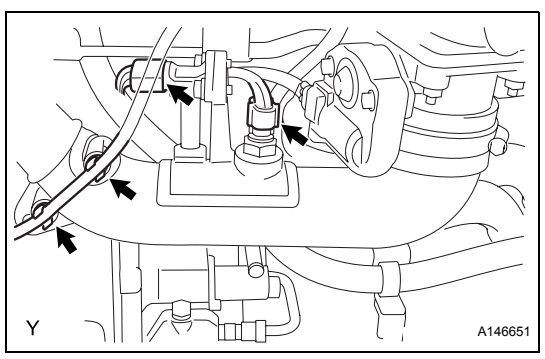
(a) Remove the 3 bolts and remove the vane pump oil reservoir assembly.

15. REMOVE FRONT FENDER APRON LH (See page ES-255)



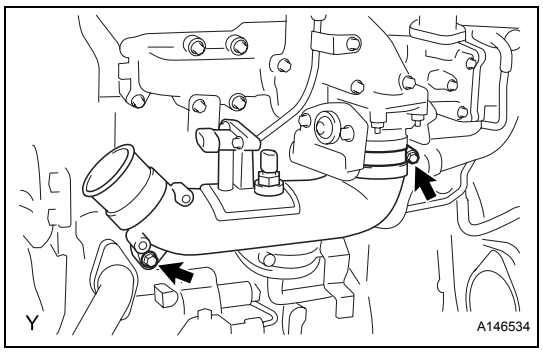
16. SEPARATE VANE PUMP ASSEMBLY

(a) Remove the 2 bolts and separate the vane pump assembly.

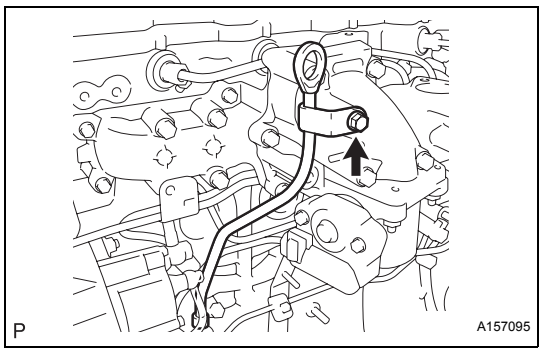


17. REMOVE NO. 2 AIR HOSE

(a) Disconnect the 2 connectors and separate the vacuum transmitting hose.

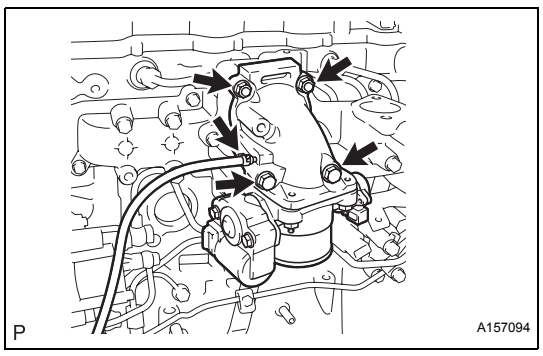


(b) Loosen the air hose clamp, remove the bolt and remove the No. 2 air hose.

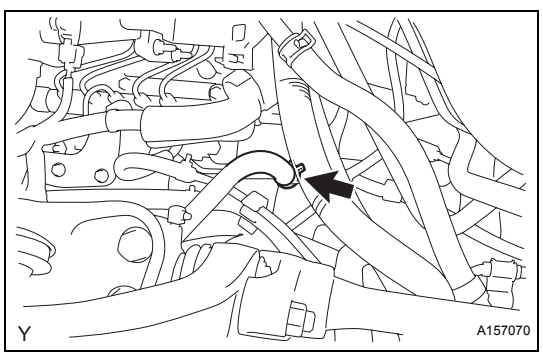


18. REMOVE DIESEL THROTTLE BODY WITH INTAKE PIPE

(a) Remove the bolt and remove the oil level gauge.

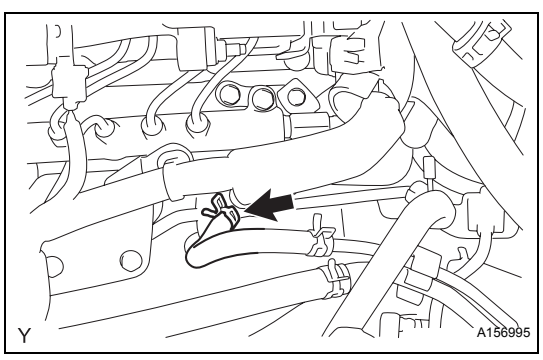


(b) Disconnect the vacuum hose.
(c) Remove the 2 nuts and 2 bolts and remove the diesel throttle body with intake pipe.



19. DISCONNECT UNION TO CONNECTOR TUBE HOSE

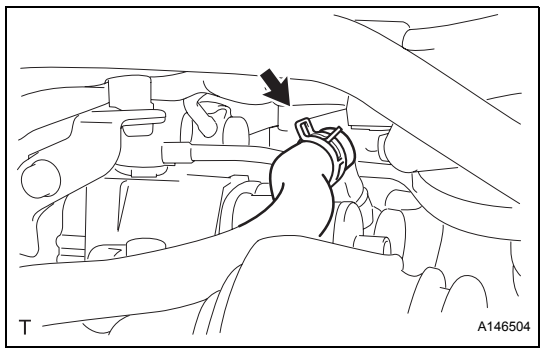
(a) Disconnect the union to connector tube hose.



20. DISCONNECT NO. 2 FUEL HOSE

(a) Disconnect the No. 2 fuel hose.

EM



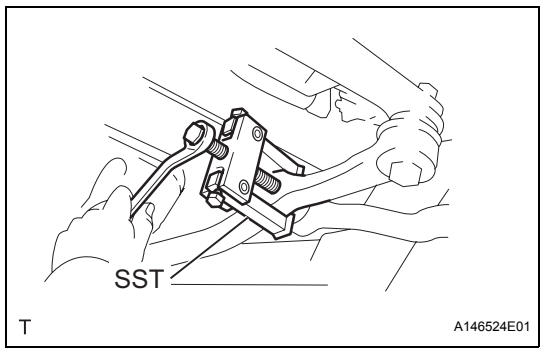
21. DISCONNECT INJECTION PUMP TO FUEL FILTER FUEL HOSE OR PIPE

(a) Disconnect the injection pump to fuel filter fuel hose or pipe.

22. REMOVE GENERATOR ASSEMBLY (See page CH-10)

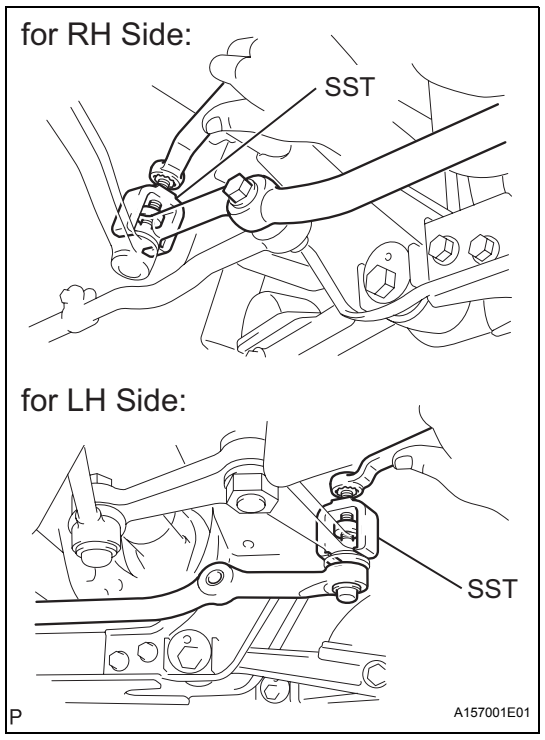
23. REMOVE STARTER ASSEMBLY (See page ST-17)

24. REMOVE MANUAL TRANSMISSION ASSEMBLY



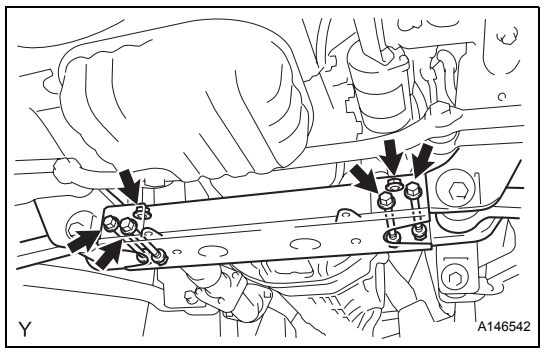
25. SEPARATE TIE ROD ASSEMBLY LH

(a) Remove the cotter pin.
(b) Remove the nut.
(c) Using SST, separate the tie rod end assembly LH from the relay rod.
SST 09628-62011



26. SEPARATE STEERING RELAY ROD ASSEMBLY

(a) Remove the cotter pin.
(b) Remove the nut.
(c) Using SST, separate the steering relay rod assembly from the center arm.
SST 09611-20015



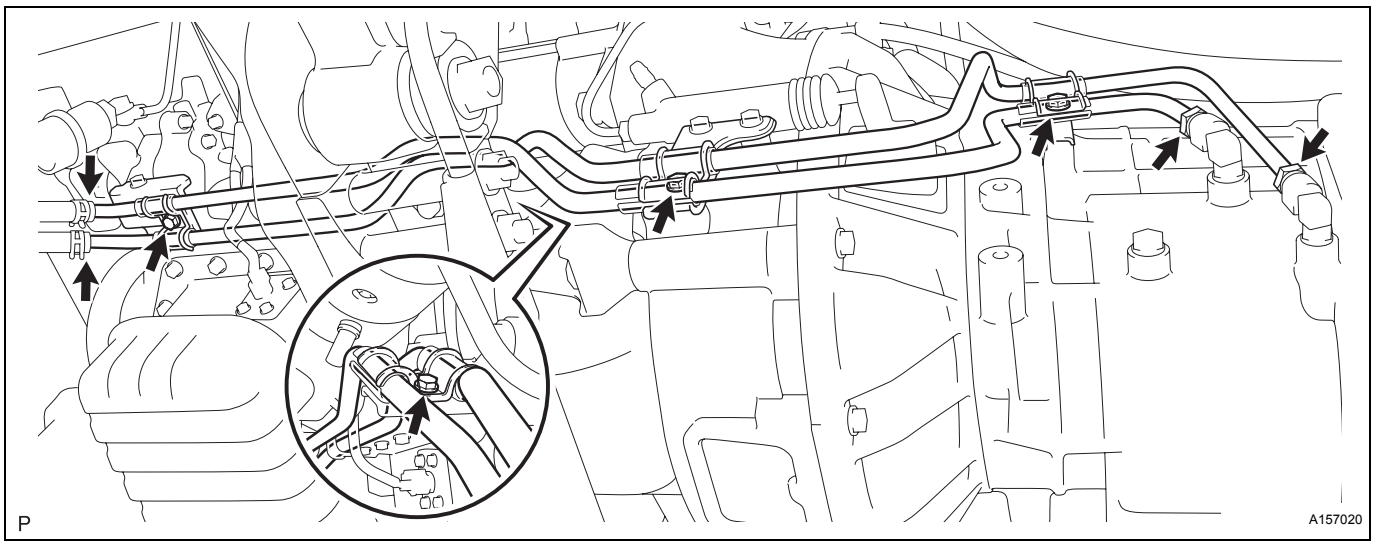
27. REMOVE FRONT SUSPENSION CROSSMEMBER SUB-ASSEMBLY

(a) Remove the 6 bolts and 4 nuts and remove the suspension crossmember.

28. REMOVE TRANSMISSION OIL COOLER TUBE

(a) Disconnect the 2 oil cooler hoses.
(b) Remove the 4 bolts and remove the 4 oil cooler tube clamps.

(c) Remove the 2 union nuts and remove the 2 oil cooler tubes.

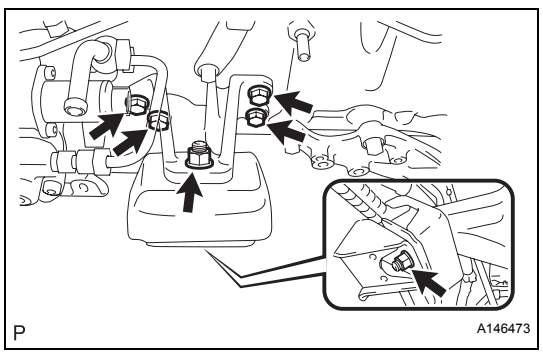


29. SEPARATE ENGINE WIRE

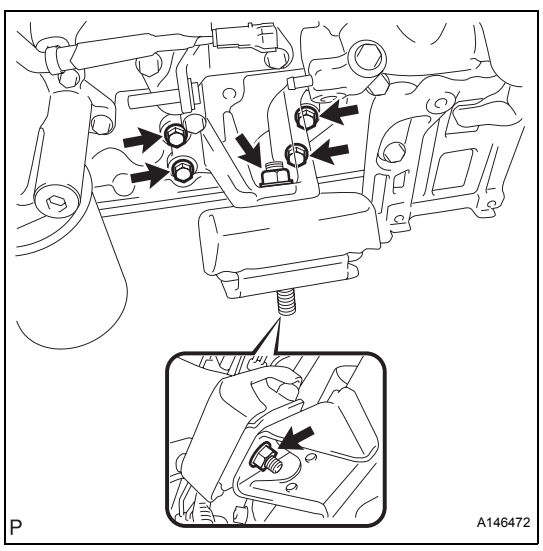
(a) Separate all engine wires from the engine.

30. REMOVE ENGINE ASSEMBLY

(a) Support the engine using an engine lifter.
(b) Remove the 2 nuts.
(c) Remove the 4 bolts and remove the front No. 1 engine mounting bracket LH.
(d) Remove the engine mounting stabilizer and front engine mounting insulator.

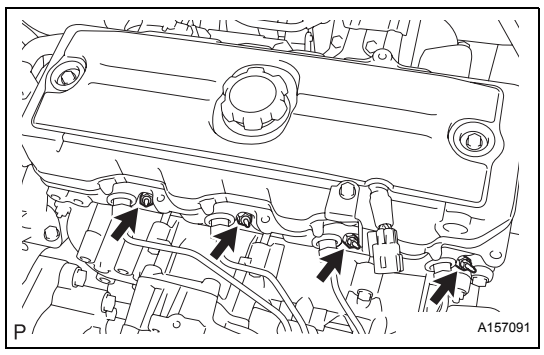


(e) Remove the 2 nuts.
(f) Remove the 4 bolts and remove the front No. 1 engine mounting bracket RH.
(g) Remove the engine mounting stabilizer and front engine mounting insulator.
(h) Remove the engine assembly.

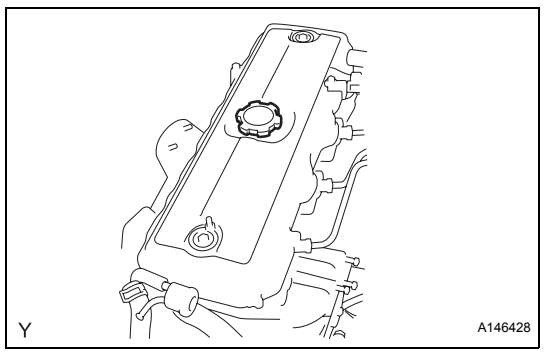


31. REMOVE GLOW PLUG ASSEMBLY

(a) Remove the 4 nuts and remove the 3 glow plug ground wires and wire harness.

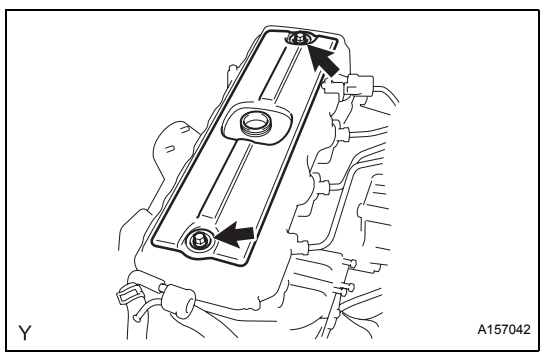


(b) Remove the 4 glow plugs.



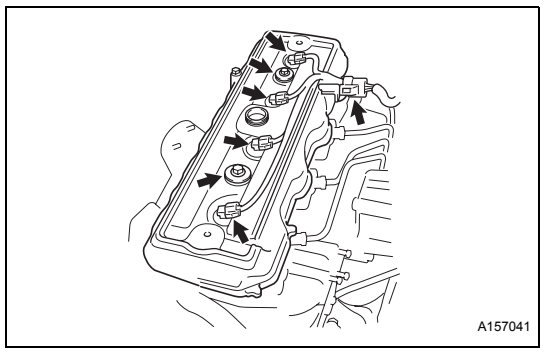
32. REMOVE OIL FILLER CAP SUB-ASSEMBLY

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



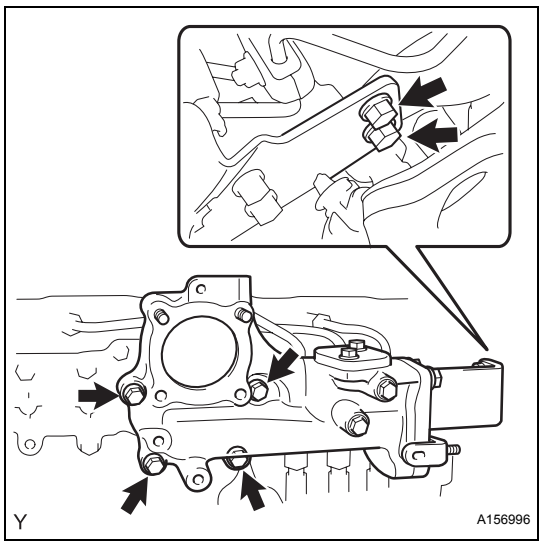
33. REMOVE NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove the 2 bolts and remove the No. 2 cylinder head cover sub-assembly.



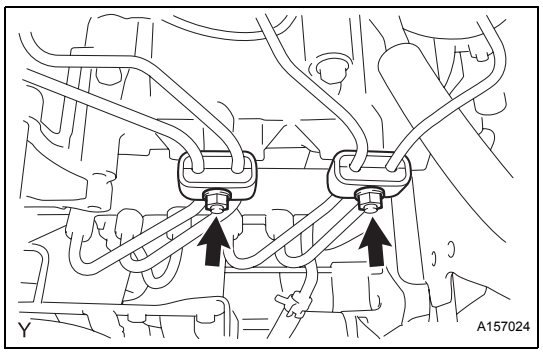
34. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove the wire harness.
(b) Remove the cylinder head cover cushion rubber.
(c) Remove the 2 bolts and remove the cylinder head cover sub-assembly.



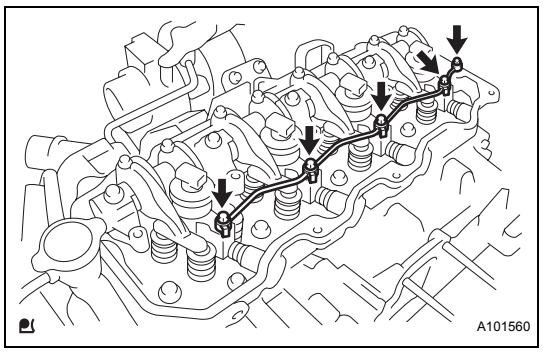
35. REMOVE INTAKE PIPE

(a) Remove the 6 bolts and remove the intake pipe.



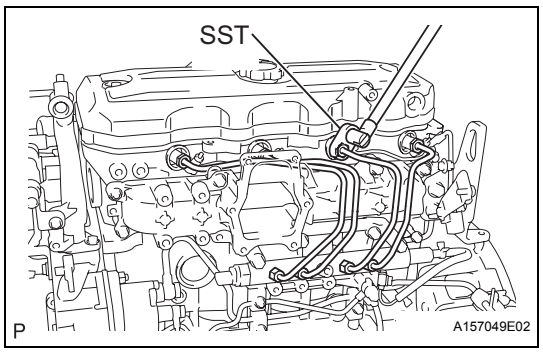
36. REMOVE INJECTION PIPE CLAMP

(a) Remove the 2 nuts and remove the 2 injection pipe clamps.

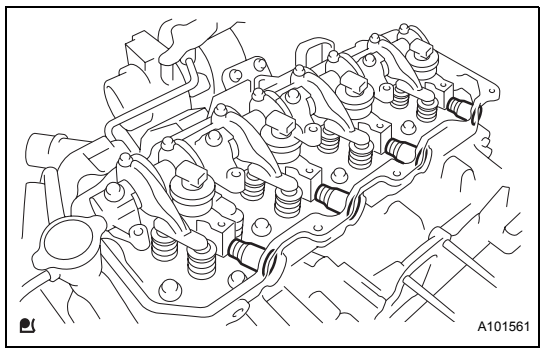


37. REMOVE INJECTOR ASSEMBLY

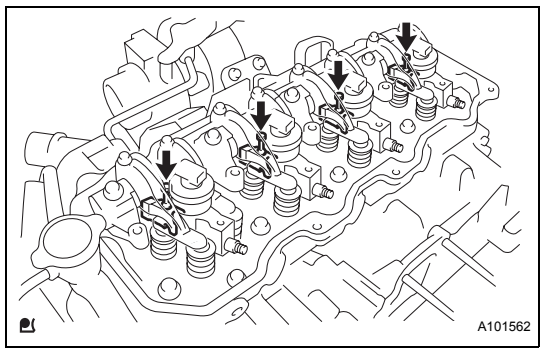
(a) Remove the 4 hollow screws and union bolt and remove the nozzle leakage pipe assembly.



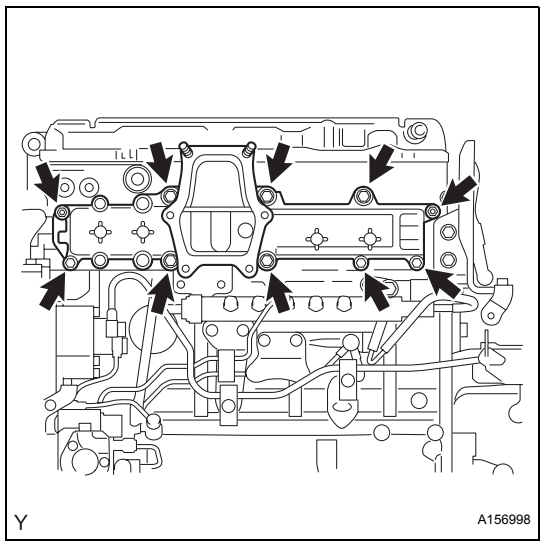
(b) Using SST, remove the 4 injection pipes.
SST 09023-12900



(c) Remove the 4 nozzle holder seals.

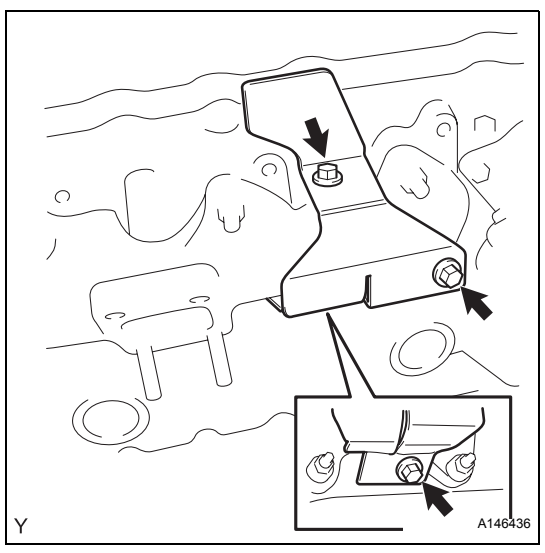


(d) Remove the 4 nozzle holder clamps.
(e) Remove the 4 injector assemblies.
(f) Remove the injection nozzle seat gasket from the cylinder head sub-assembly.



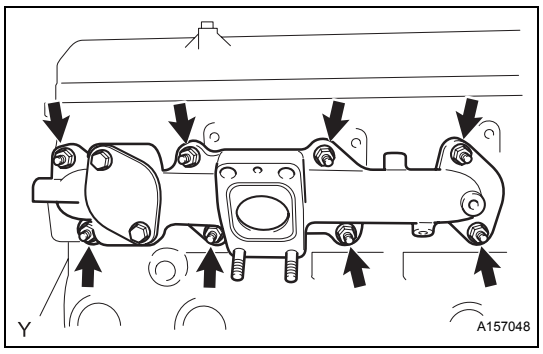
38. REMOVE INTAKE MANIFOLD

(a) Remove the 8 bolts and 2 nuts and remove the intake manifold.

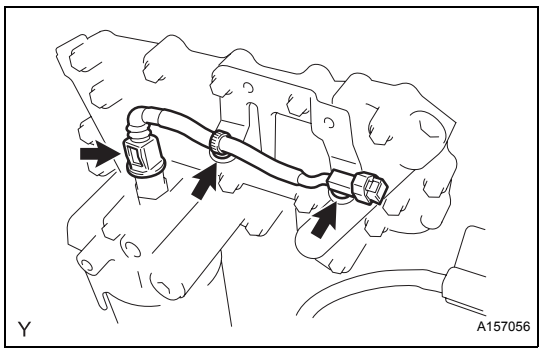


39. REMOVE EXHAUST MANIFOLD

(a) Remove the 3 bolts and remove the exhaust manifold heat insulator sub-assembly.



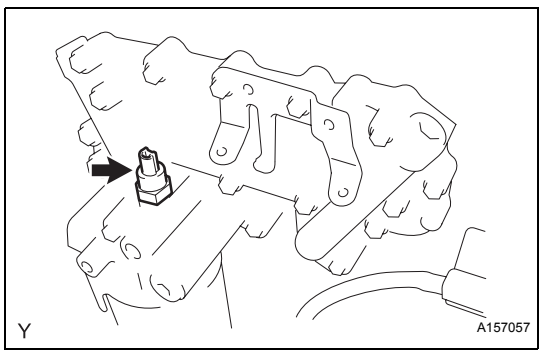
(b) Remove the 8 nuts and remove the exhaust manifold.



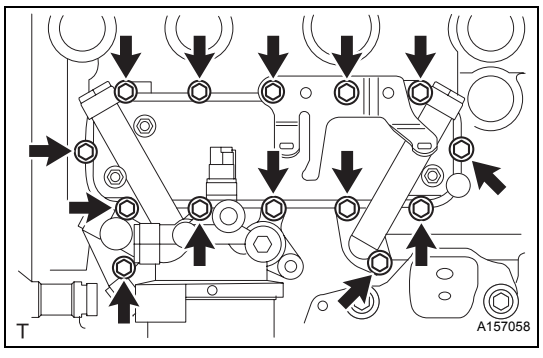
40. REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY

(a) Remove the wire harness.

EM

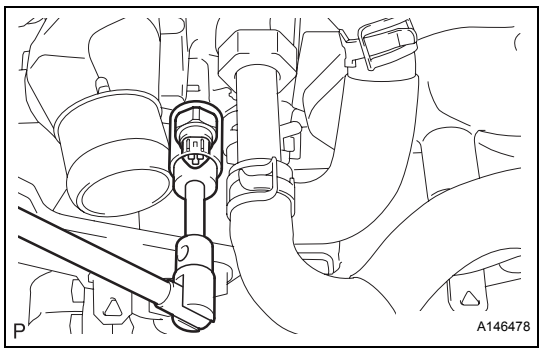


(b) Remove the engine oil pressure switch assembly.



41. REMOVE OIL COOLER ASSEMBLY

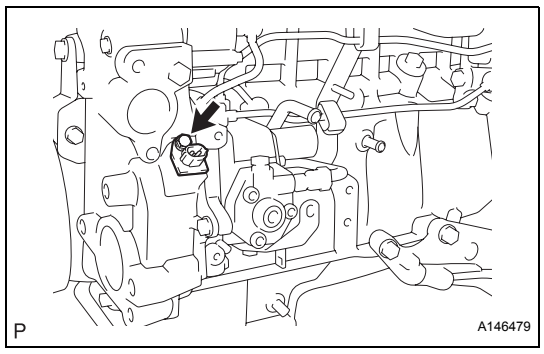
(a) Remove the 14 bolts and remove the oil cooler assembly with bracket.



42. REMOVE WATER TEMPERATURE SENDER GAUGE ASSEMBLY

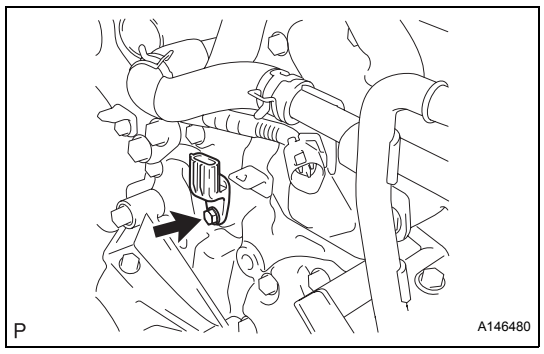
(a) Disconnect the connector.

(b) Remove the water temperature sender gauge assembly.



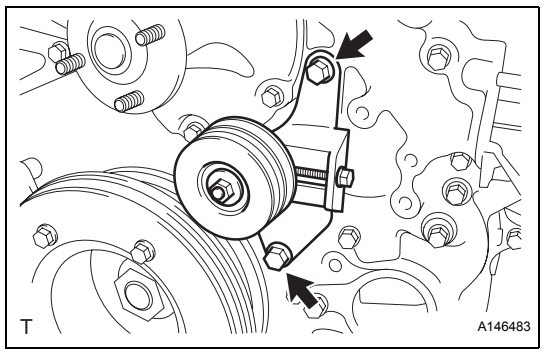
43. REMOVE CRANKSHAFT POSITION SENSOR

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



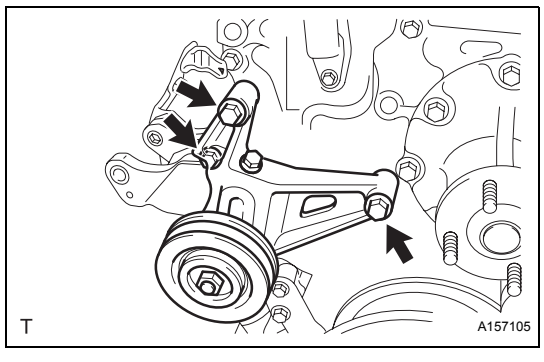
44. REMOVE CAMSHAFT POSITION SENSOR

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



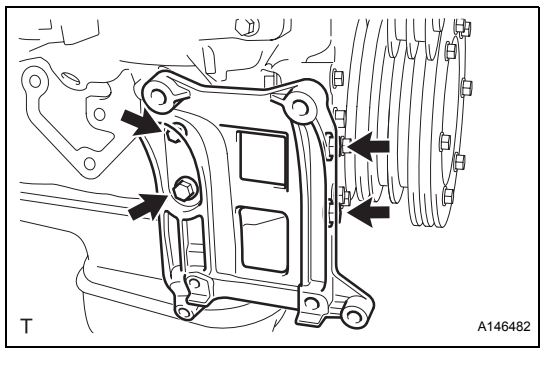
45. REMOVE IDLER PULLEY ASSEMBLY

(a) Remove the 2 bolts and remove the idler pulley assembly.



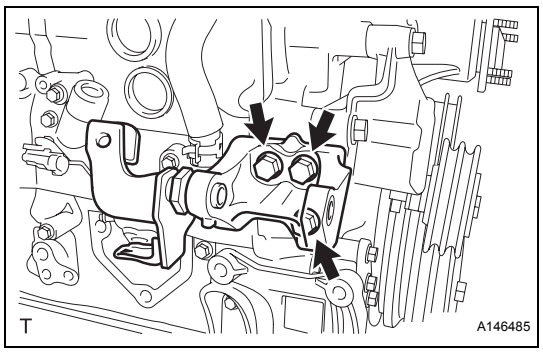
46. REMOVE IDLE PULLEY ASSEMBLY WITH BRACKET

(a) Remove the 3 bolts and remove the idler pulley assembly with bracket.



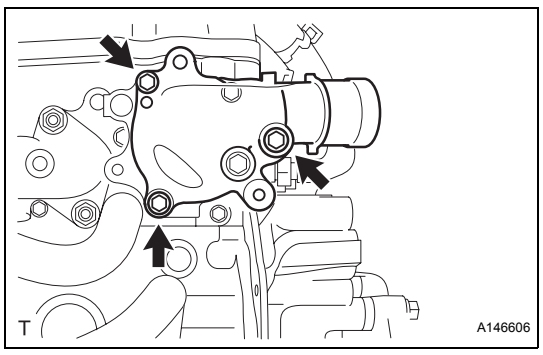
47. REMOVE NO. 1 COMPRESSOR MOUNTING BRACKET

(a) Remove the 4 bolts and remove the No. 1 compressor mounting bracket.



48. REMOVE GENERATOR BRACKET SUB-ASSEMBLY

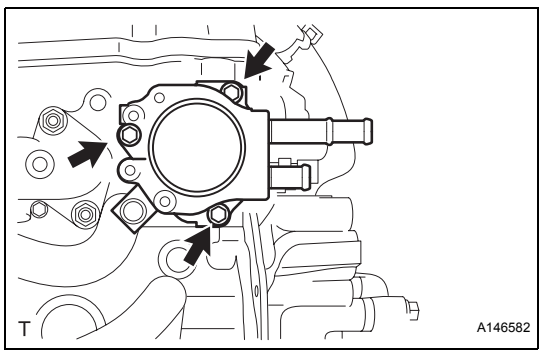
(a) Remove the 3 bolts and remove the generator bracket sub-assembly.



49. REMOVE WATER OUTLET SUB-ASSEMBLY

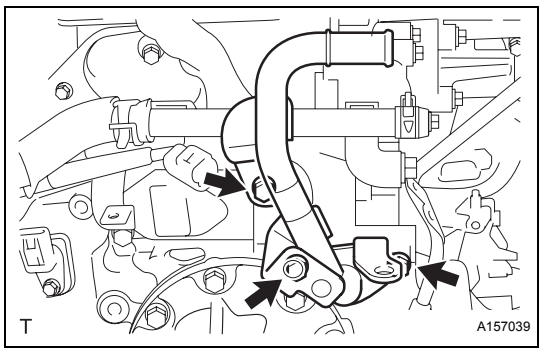
(a) Remove the 3 bolts and remove the water outlet sub-assembly.

50. REMOVE THERMOSTAT



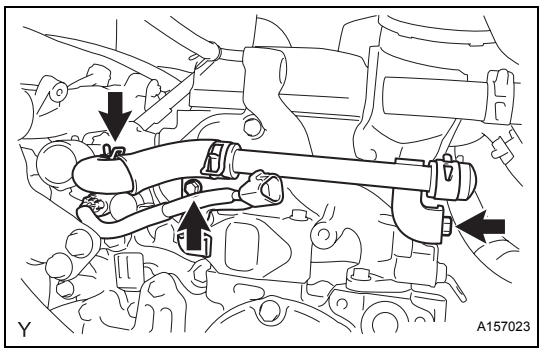
51. REMOVE WATER OUTLET HOUSING

(a) Remove the 3 bolts and remove the water outlet housing.



52. REMOVE WATER PIPE SUB-ASSEMBLY

(a) Remove the 3 bolts and remove the water pipe sub-assembly.

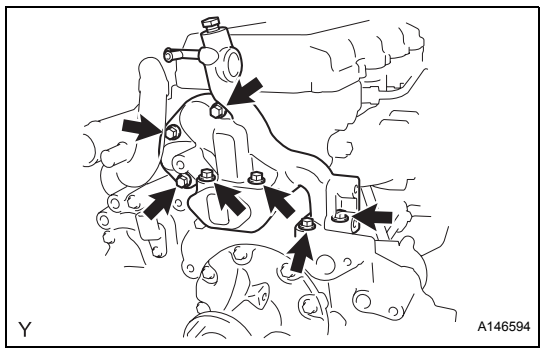


53. REMOVE NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

(a) Disconnect the water hose.

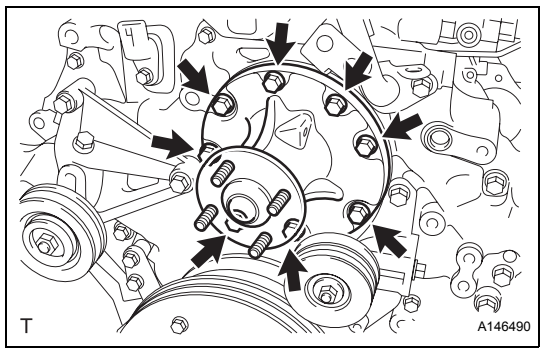
(b) Remove the 2 bolts and remove the No. 2 water by-pass pipe sub-assembly.

EM



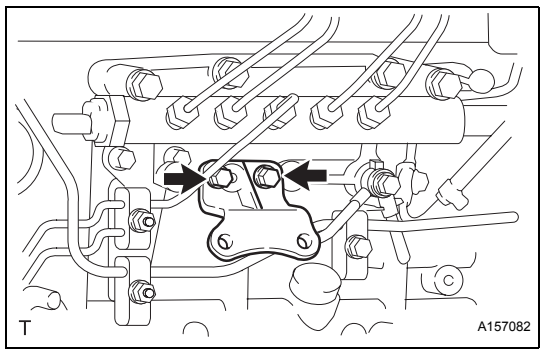
54. REMOVE WATER BY-PASS PIPE SUB-ASSEMBLY

(a) Remove the 7 bolts and remove the water by-pass pipe sub-assembly.



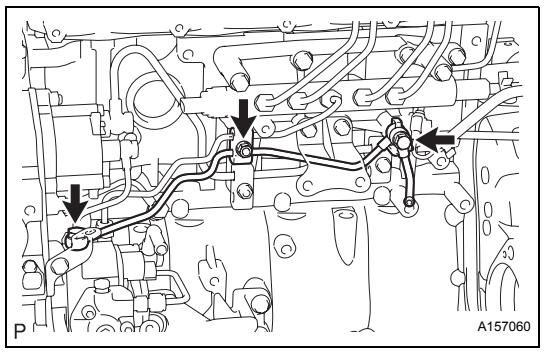
55. REMOVE WATER PUMP ASSEMBLY

(a) Remove the 8 bolts and remove the water pump assembly.



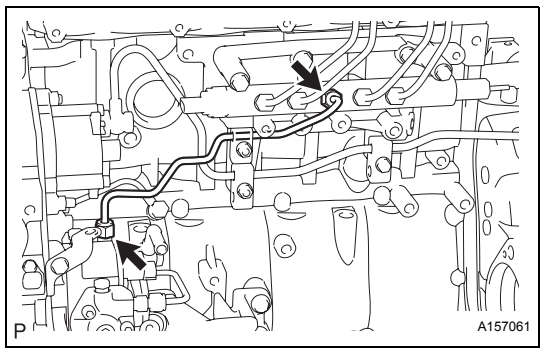
56. REMOVE WIRE HARNESS BRACKET

(a) Remove the 2 bolts and remove the wire harness bracket.



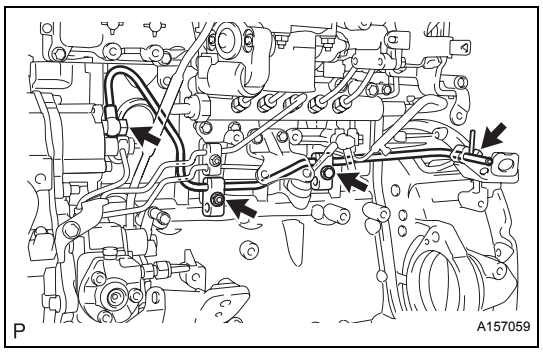
57. REMOVE FUEL RETURN PIPE SUB-ASSEMBLY

(a) Remove the nut and remove the fuel pipe clamp.
(b) Remove the 2 union bolts and remove the fuel return pipe sub-assembly.



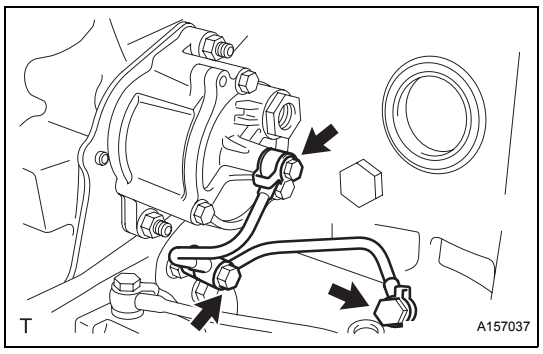
58. REMOVE FUEL FILTER TO INJECTION PUMP FUEL PIPE

(a) Using SST, loosen the union nuts and remove the fuel filter to injection pump fuel pipe.
SST 09023-12901



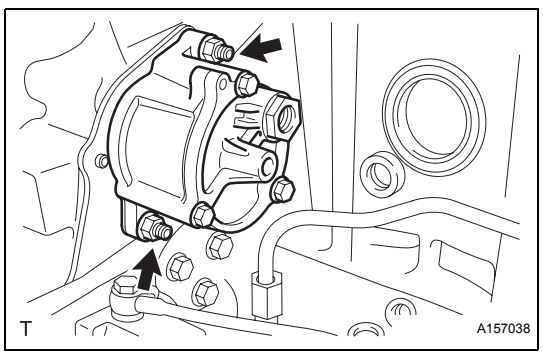
59. REMOVE VACUUM PIPE

(a) Remove the 2 nuts and remove the 3 pipe clamps.
(b) Remove the union bolt and remove the vacuum pipe.



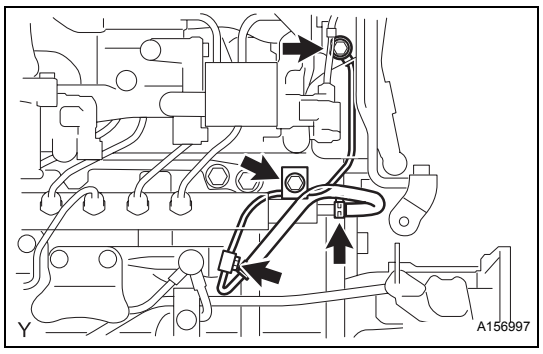
60. REMOVE VACUUM PUMP OIL PIPE SUB-ASSEMBLY

(a) Remove the 3 union bolts and remove the vacuum pump oil pipe sub-assembly.



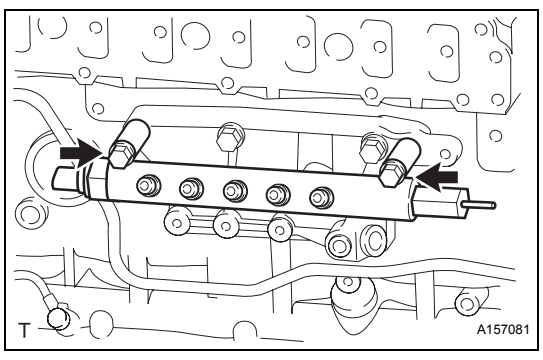
61. REMOVE VACUUM PUMP ASSEMBLY

(a) Remove the 2 nuts and remove the vacuum pump assembly.



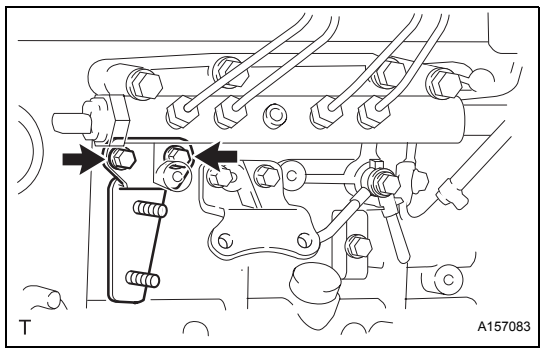
62. REMOVE NO. 3 NOZZLE LEAKAGE PIPE SUB-ASSEMBLY

(a) Remove the bolt and remove the pipe clamp.
(b) Remove the 2 union bolts and remove the No. 3 nozzle leakage pipe sub-assembly.



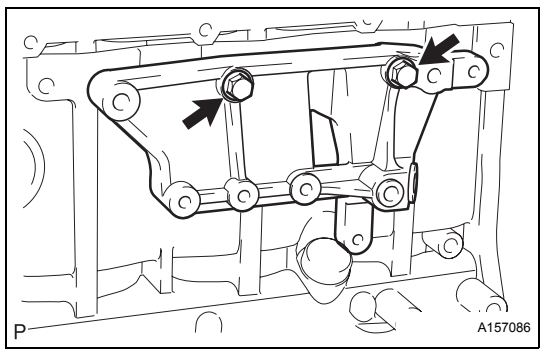
63. REMOVE COMMON RAIL ASSEMBLY

(a) Remove the 2 bolts and remove the common rail assembly.

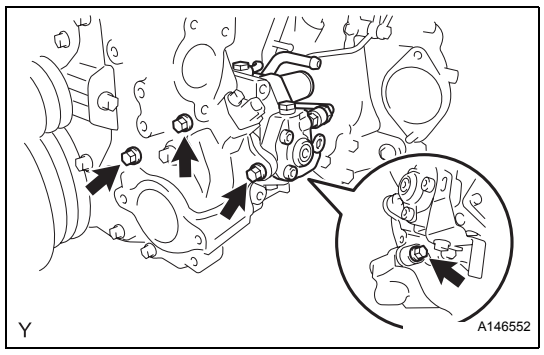


64. REMOVE FUEL SUPPORT

(a) Remove the 2 bolts and remove the fuel support.



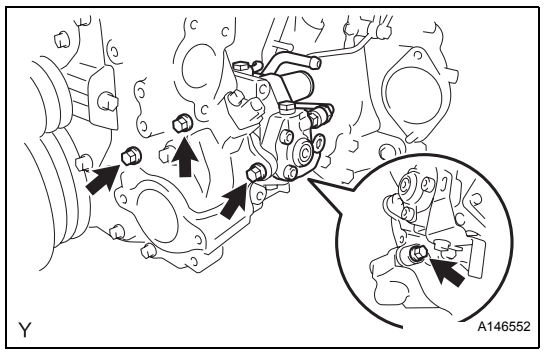
(b) Remove the 2 bolts and remove the fuel support.



65. REMOVE INJECTION OR SUPPLY PUMP ASSEMBLY

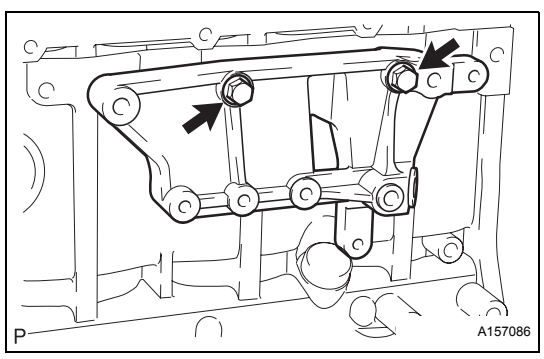
(a) Remove the 4 bolts and remove the injection or supply pump assembly.

INSTALLATION



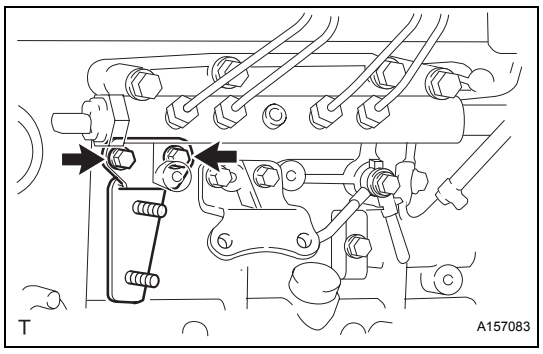
1. INSTALL INJECTION OR SUPPLY PUMP ASSEMBLY

(a) Install the injection or supply pump assembly with the 4 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

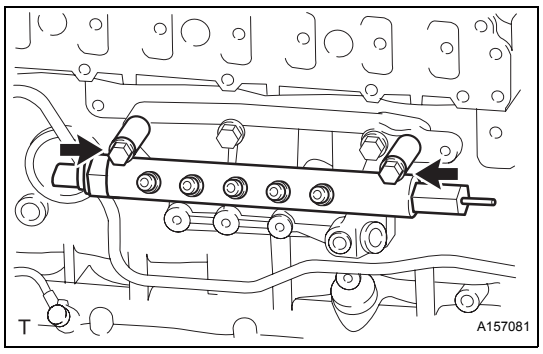


2. INSTALL FUEL SUPPORT

(a) Install the fuel support with the 2 bolts.
Torque: 55 N*m (290 kgf*cm, 21 ft.*lbf)

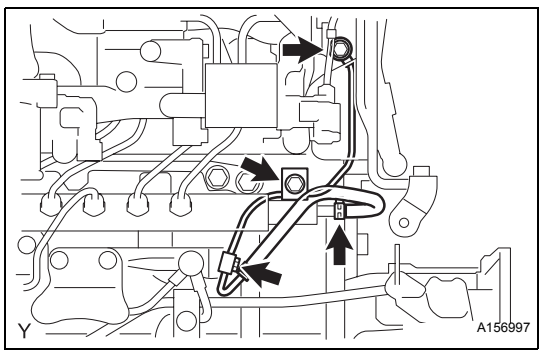


(b) Install the fuel support with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



3. INSTALL COMMON RAIL ASSEMBLY

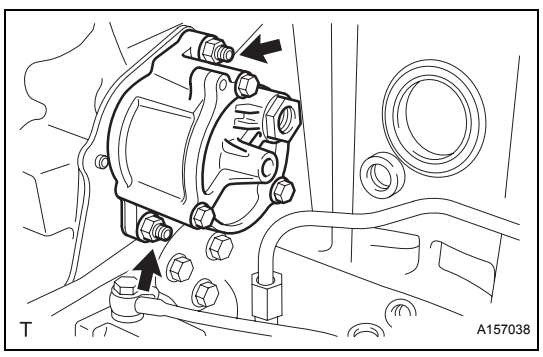
(a) Install the common rail assembly with the 2 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



4. INSTALL NO. 3 NOZZLE LEAKAGE PIPE SUB-ASSEMBLY

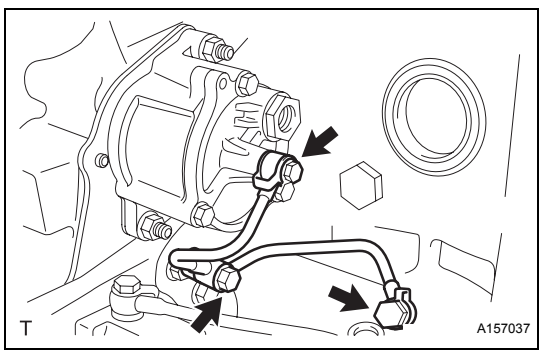
(a) Install the No. 3 nozzle leakage pipe sub-assembly with 2 new gaskets and the 2 union bolts.
Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

(b) Install the fuel pipe clamp with the bolt. Tighten the nut until the clamp edges make contact.



5. INSTALL VACUUM PUMP ASSEMBLY

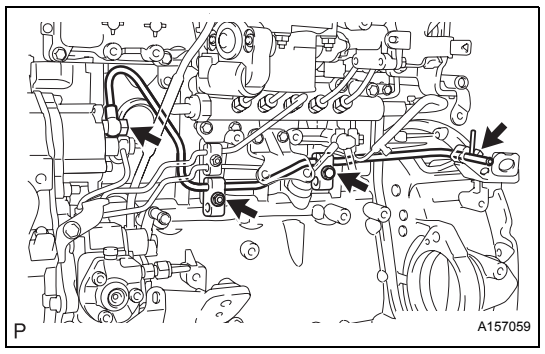
(a) Install the vacuum pump assembly with new O-ring and the 2 nuts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



6. INSTALL VACUUM PUMP OIL PIPE SUB-ASSEMBLY

(a) Install the vacuum oil pipe sub-assembly with 3 new gaskets and the 3 union bolts.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)

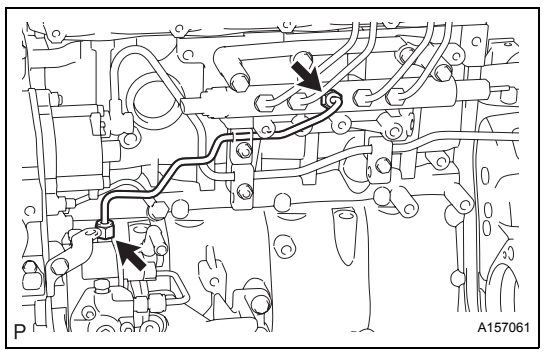
EM



7. INSTALL VACUUM PIPE

(a) Install the vacuum pipe with 2 new gaskets and the union bolt.
Torque: 13 N*m (130 kgf*cm, 10 ft.*lbf)

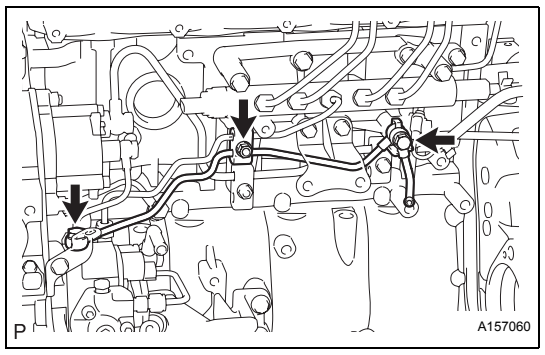
(b) Install the 3 pipe clamps with the bolt and 2 nuts. Tighten the bolt and 2 nuts until the clamp edges make contact.



8. INSTALL FUEL FILTER TO INJECTION PUMP FUEL PIPE

(a) Temporarily install the fuel filter to injection pump fuel pipe with the union nuts.

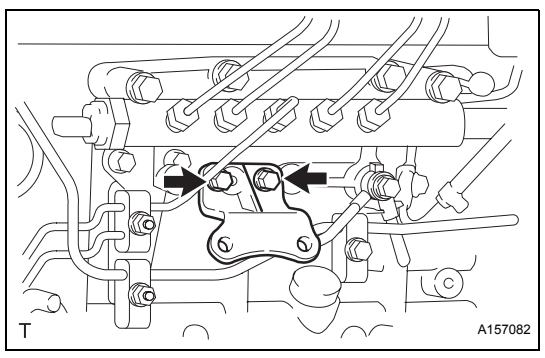
(b) Using SST, tighten the union nuts.
SST 09023-12901
Torque: 44 N*m (450 kgf*cm, 33 ft.*lbf)
NOTICE:
Refer to the torque above when not using SST. When using SST, calculate the torque in accordance with the lengths of SST and the torque wrench.



9. INSTALL FUEL RETURN PIPE SUB-ASSEMBLY

(a) Install the fuel return pipe sub-assembly and No. 4 fuel pipe with 4 new gaskets and the 2 union bolts.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)

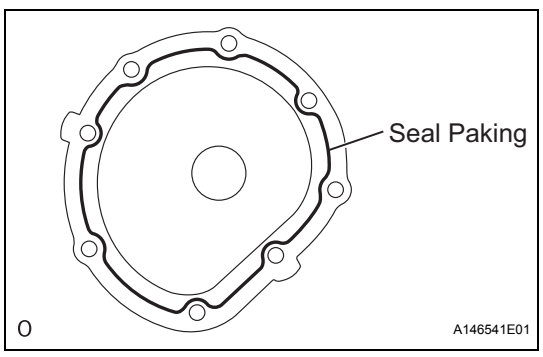
(b) Install the fuel pipe clamp with the nut. Tighten the nut until the clamp edges make contact.



10. INSTALL WIRE HARNESS BRACKET

(a) Install the wire harness bracket with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

EM



11. INSTALL WATER PUMP ASSEMBLY

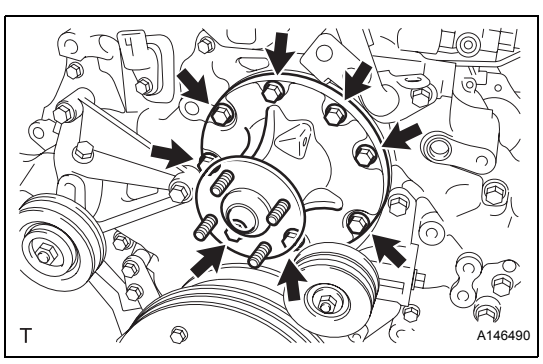
(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm(0.06 to 0.10 in.)) as shown in the illustration.

NOTICE:

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

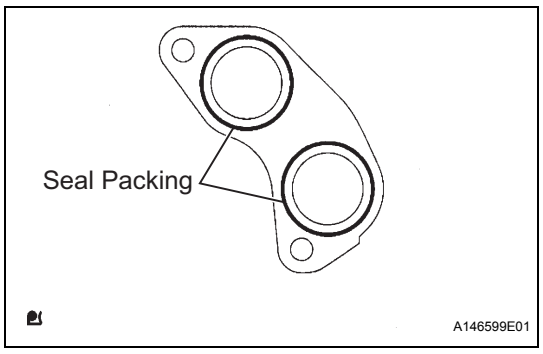
Seal packing:

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



(b) Install the water pump assembly with the 8 bolts.

Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



12. INSTALL WATER BY-PASS PIPE SUB-ASSEMBLY

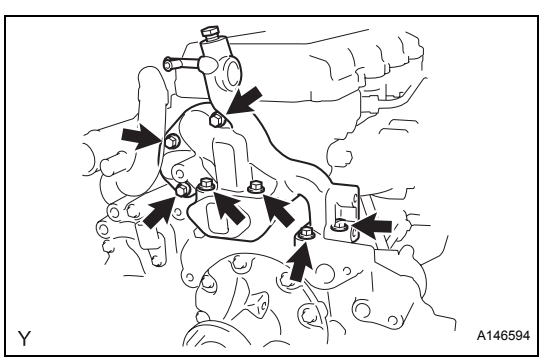
(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm(0.06 to 0.10 in.)) as shown in the illustration.

Seal packing:

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

NOTICE:

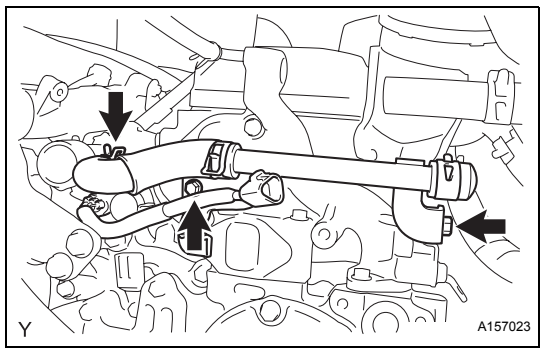
- **Remove any oil from the contact surface.**
- **Install the water by-pass pipe sub-assembly within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**



(b) Install the water by-pass pipe sub-assembly with 2 new O-rings and the 7 bolts.

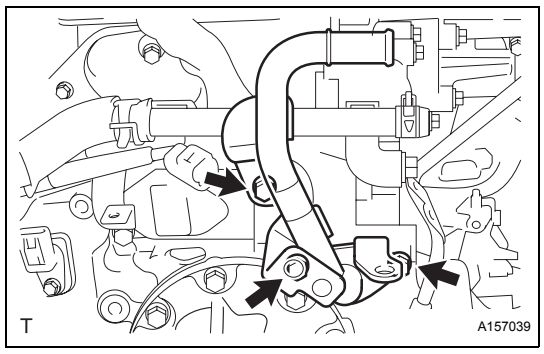
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

EM



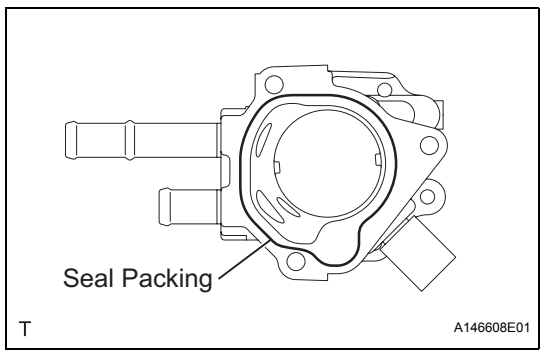
13. INSTALL NO. 2 WATER BY-PASS PIPE SUB-ASSEMBLY

(a) Connect the water hose.
(b) Connect the connector.
(c) Install the No. 2 water by-pass pipe sub-assembly with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



14. INSTALL WATER PIPE SUB-ASSEMBLY

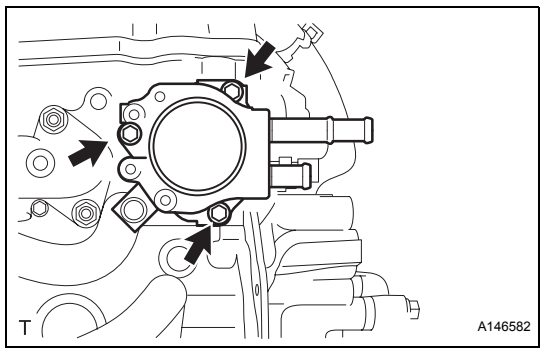
(a) Install the water pipe sub-assembly with a new O-ring and the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



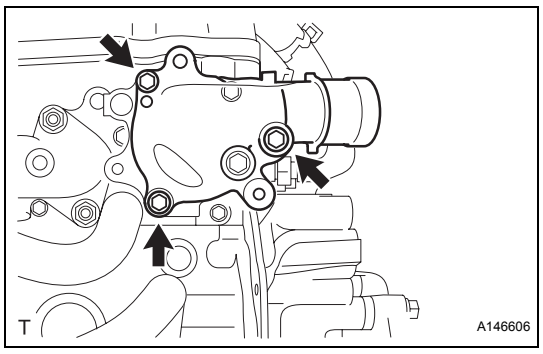
15. INSTALL WATER OUTLET HOUSING

(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm(0.06 to 0.10 in.)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the water outlet housing within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**

(b) Install the water outlet housing with the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

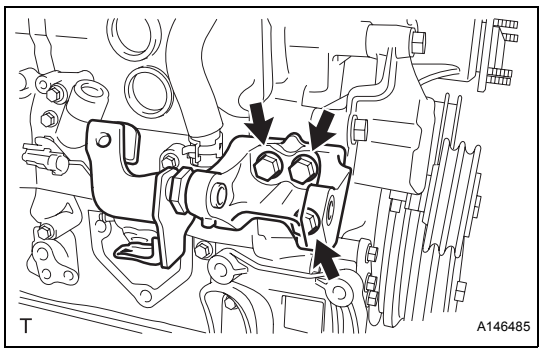


16. INSTALL THERMOSTAT



17. INSTALL WATER OUTLET SUB-ASSEMBLY

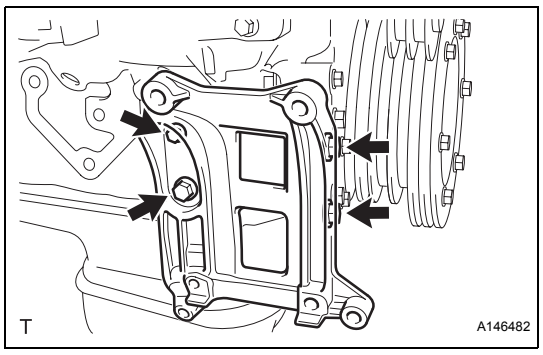
(a) Install the water outlet sub-assembly with the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



18. INSTALL GENERATOR BRACKET SUB-ASSEMBLY

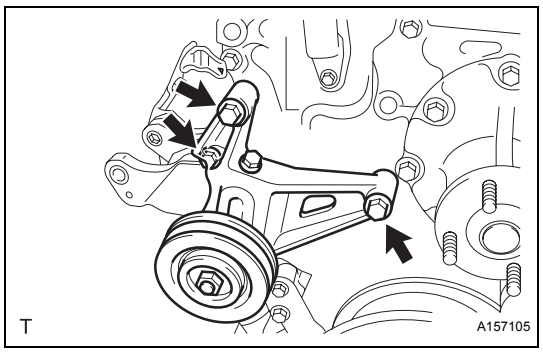
(a) Install the generator bracket sub-assembly with the 3 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

EM



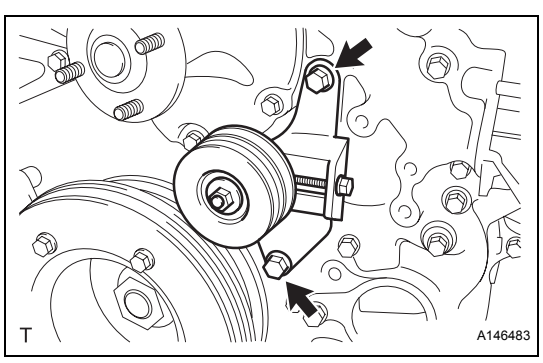
19. INSTALL NO. 1 COMPRESSOR MOUNTING BRACKET

(a) Install the No. 1 compressor mounting bracket with the 4 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



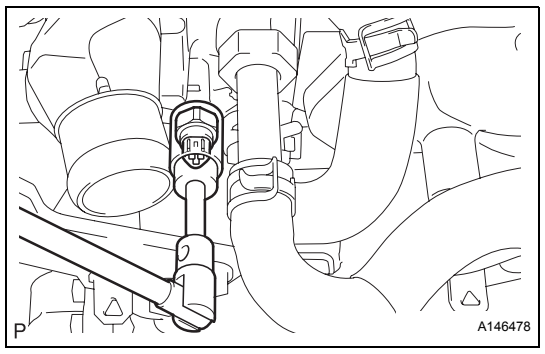
20. INSTALL IDLE PULLEY ASSEMBLY WITH BRACKET

(a) Install the idle pulley assembly with bracket with the 3 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



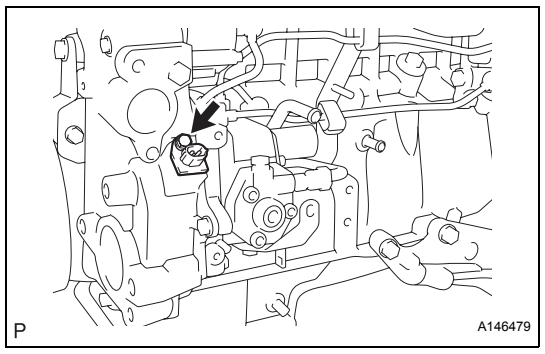
21. INSTALL IDLER PULLEY ASSEMBLY

(a) Install the idler pulley assembly with the 2 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



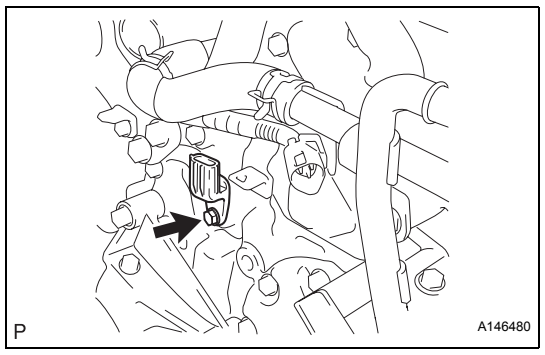
22. INSTALL WATER TEMPERATURE SENDER GAUGE ASSEMBLY

(a) Install the water temperature sender gauge assembly with a new gasket.
Torque: 20 N*m (200 kgf*cm, 14 ft.*lbf)



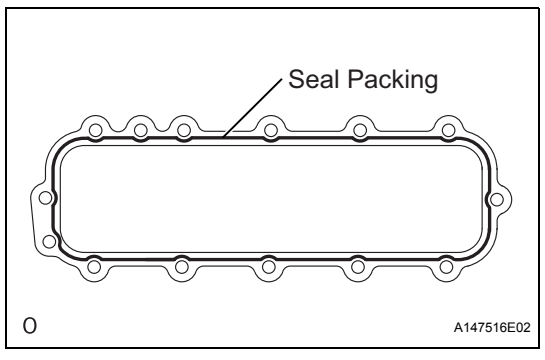
23. INSTALL CRANKSHAFT POSITION SENSOR

(a) Install the crankshaft position sensor with the bolt.
Torque: 8.0 N*m (82 kgf*cm, 71 in.*lbf)



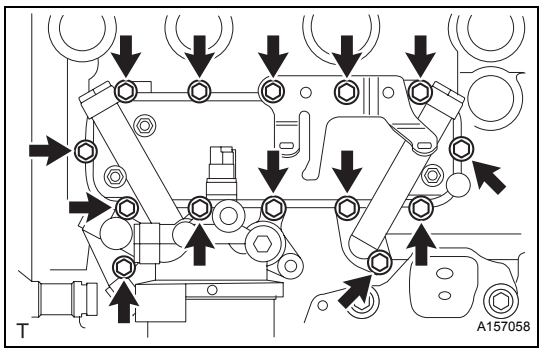
24. INSTALL CAMSHAFT POSITION SENSOR

(a) Install the crankshaft position sensor with the bolt.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

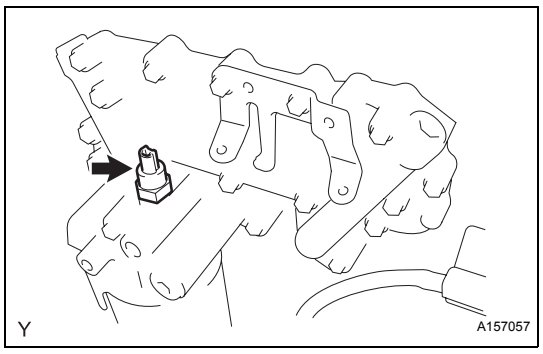


25. INSTALL OIL COOLER ASSEMBLY

(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm(0.06 to 0.10 in.)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the oil cooler assembly within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**

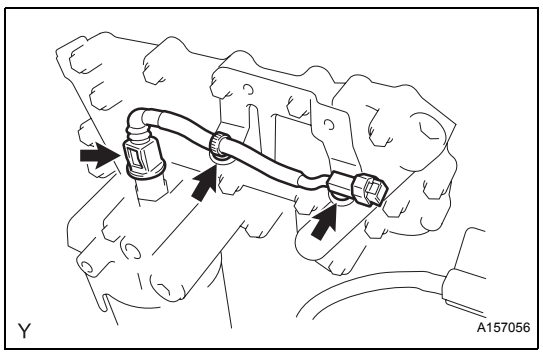


(b) Install the oil cooler assembly with bracket with the 14 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

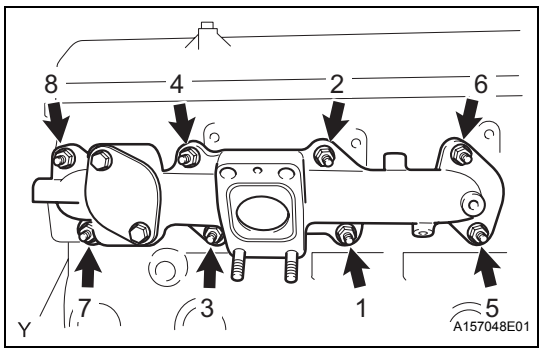


26. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY

(a) Install the engine oil pressure switch assembly with a new gasket.
Torque: 29 N*m (300 kgf*cm, 22 ft.*lbf)



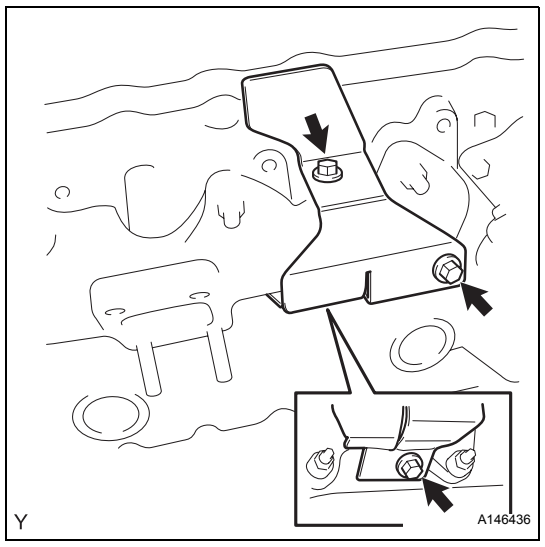
(b) Install the wire harness.



27. INSTALL EXHAUST MANIFOLD

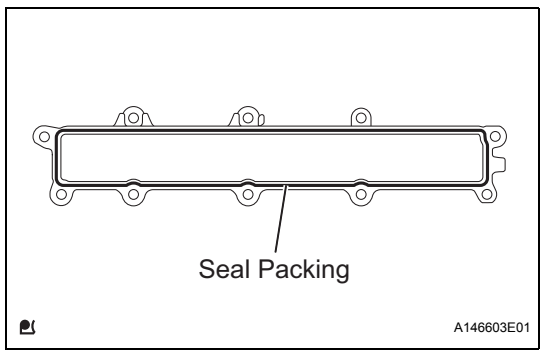
(a) Install 4 new gaskets onto the exhaust manifold.
(b) Using several steps, tighten each nut in the sequence shown in the illustration.
Torque: 60 N*m (610 kgf*cm, 44 ft.*lbf)

EM



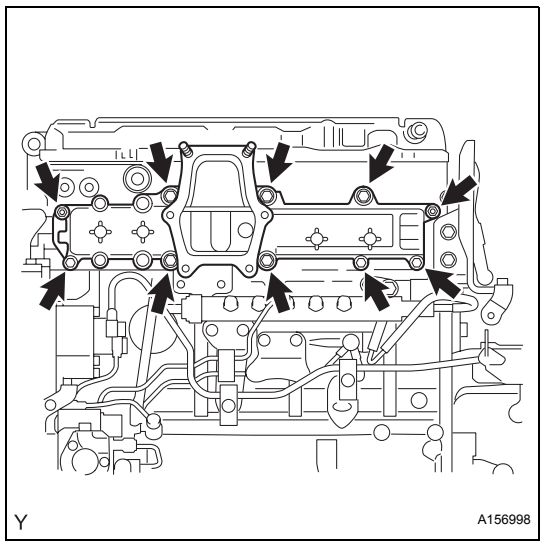
(c) Install the exhaust manifold heat insulator sub-assembly with the 3 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

EM

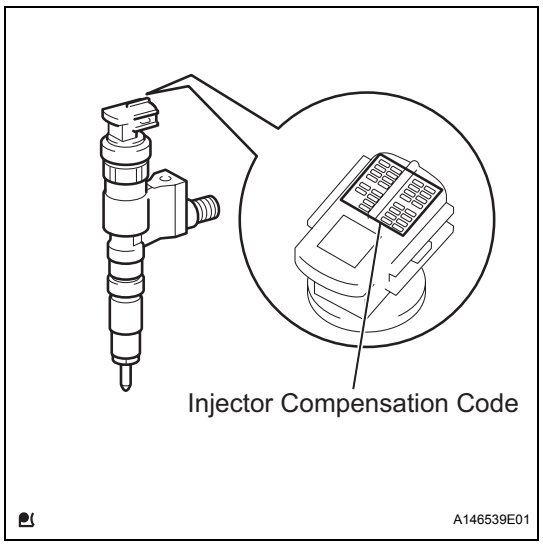


28. INSTALL INTAKE MANIFOLD

(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm (0.06 to 0.10 in.)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the timing chain cover within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**



(b) Install the intake manifold with the 8 bolts and 2 nuts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

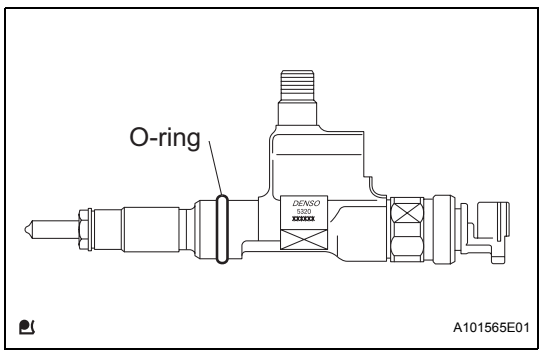


29. INSTALL INJECTOR ASSEMBLY

NOTICE:

Register the injector compensation code of a new fuel injector in the ECM when replacing the fuel injector. Register the injector compensation code in advance so that it can be installed in the correct position.

(a) Install 4 new injection nozzle sheets into the cylinder head.



(b) Apply a light amount of clean engine oil to 4 new O-rings.

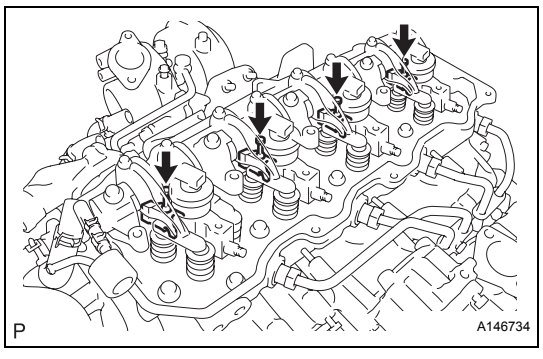
(c) Install the O-ring onto each injector as shown in the illustration.

(d) Install a new No. 2 cylinder head cover gasket onto each injector.

(e) Insert the 4 injectors into the cylinder head.

NOTICE:

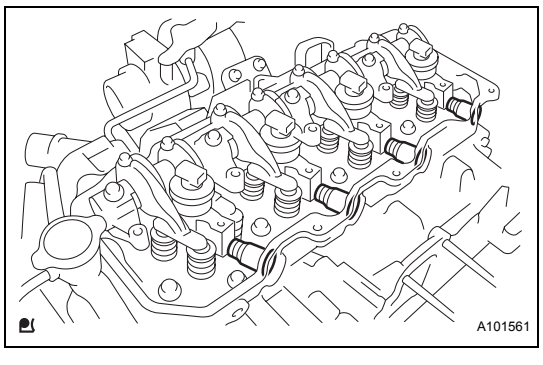
- **Check that the insertion part of the fuel injector has no foreign matter attached.**
- **When reusing a fuel injector, install the same fuel injector that was removed. Otherwise, it could cause the engine to malfunction.**
- **Carefully insert the fuel injector so that the O-ring is not caught between the cylinder head and the injector.**



(f) Temporarily install the 4 nozzle holder clamps with the 4 clamp bolts.

NOTICE:

Be sure to install the holder clamp and bolt in their original positions.

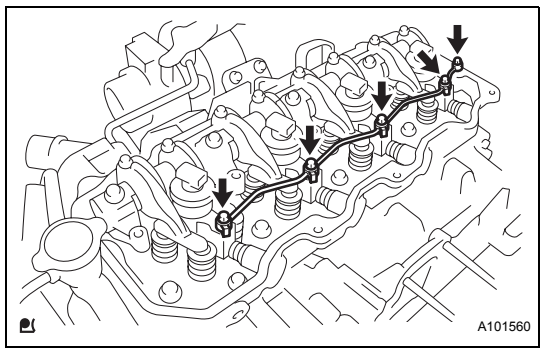


(g) Install the 4 nozzle holder seals.

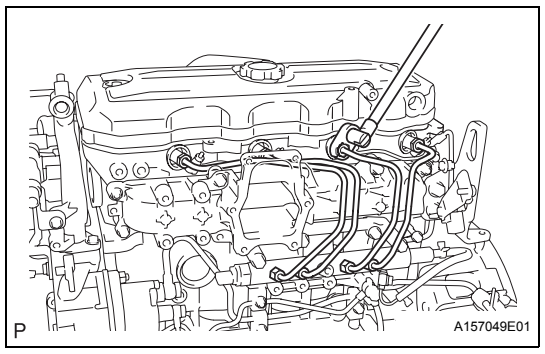
NOTICE:

Securely insert the tip of the holder seal into the fuel injector.

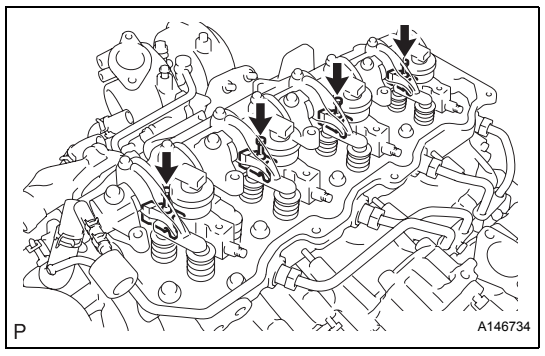
EM



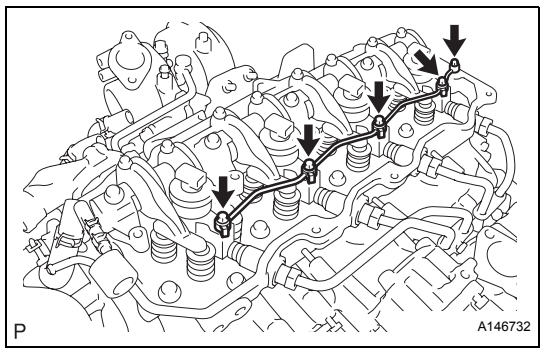
(h) Temporarily install the nozzle leakage pipe assembly through 5 new gaskets by hand with the union bolt and 4 hollow screws.



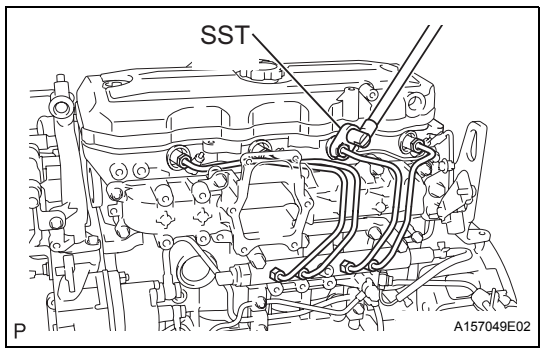
(i) Temporarily install the 4 injection pipes.
HINT:
Hand tighten the union nuts on the injection pipes.



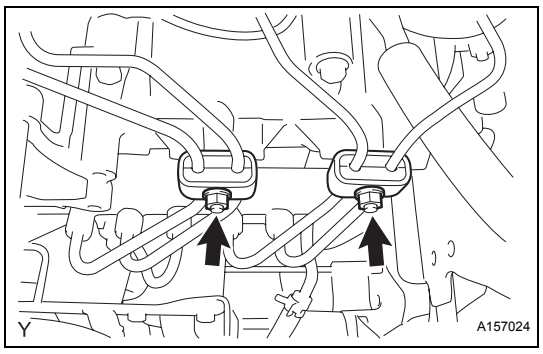
(j) Tighten the 4 nozzle holder clamps bolts.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)
NOTICE:
After tightening the nozzle holder clamp bolts, check that the fuel injector and the nozzle holder clamp do not interfere with the vale spring.



(k) Tighten the 4 nozzle hollow screws and union bolt.
Torque: 13 N*m (130 kgf*cm, 10 ft.*lbf)

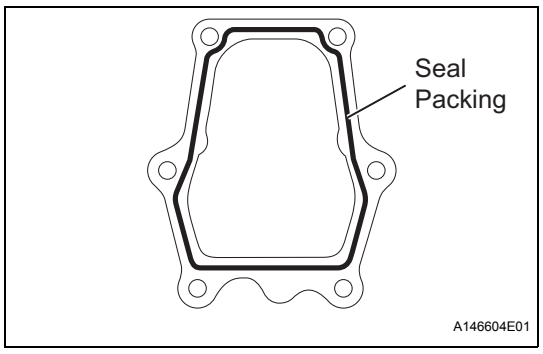


(l) Using SST, tighten the injection pipe union nuts.
SST 09023-12900
Torque: 44 N*m (450 kgf*cm, 33 ft.*lbf)
NOTICE:
Refer to the torque above when not using SST. When using SST, calculate the torque in accordance with the lengths of SST and the torque wrench.



30. INSTALL INJECTION PIPE CLAMP

(a) Install the 2 injection pipe clamps with the 2 nuts. Tighten the 2 nuts until the clamp edges make contact.



31. INSTALL INTAKE PIPE

(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm(0.06 to 0.10 in.)) as shown in the illustration.

Seal packing:

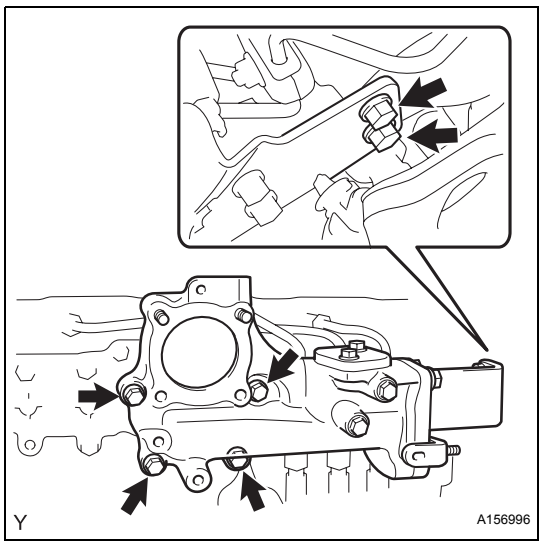
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent

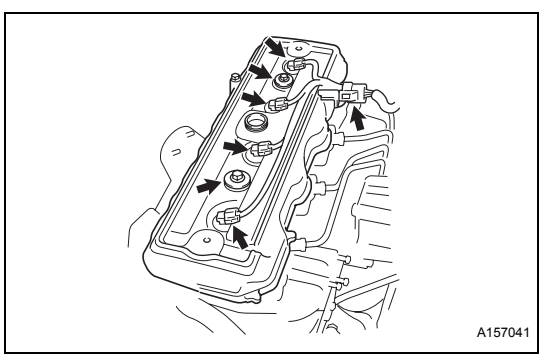
NOTICE:

- **Remove any oil from the contact surface.**
- **Install the intake pipe with EGR valve within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**

(b) Install the intake pipe with EGR valve with the 6 bolts.

Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)





32. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Install a new cylinder head cover gasket onto the cylinder head cover.

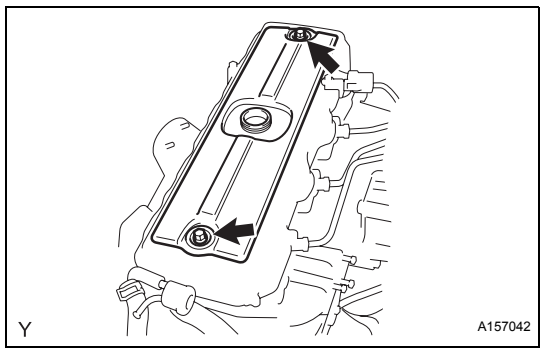
(b) Install the cylinder head cover sub-assembly with the 2 bolts.

Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

(c) Install the cylinder head cover cushion rubber.

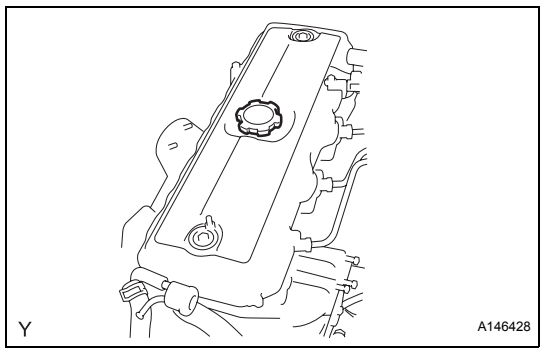
(d) Connect the ventilation hose.

EM



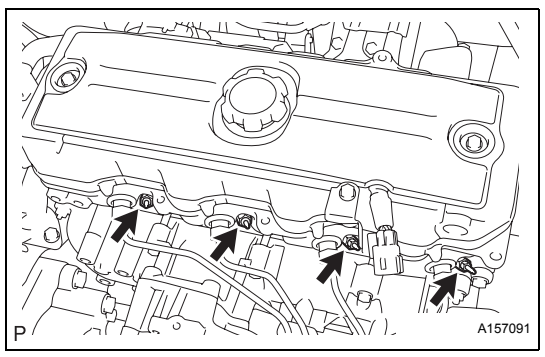
33. INSTALL NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Install the No. 2 cylinder head cover sub-assembly with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)



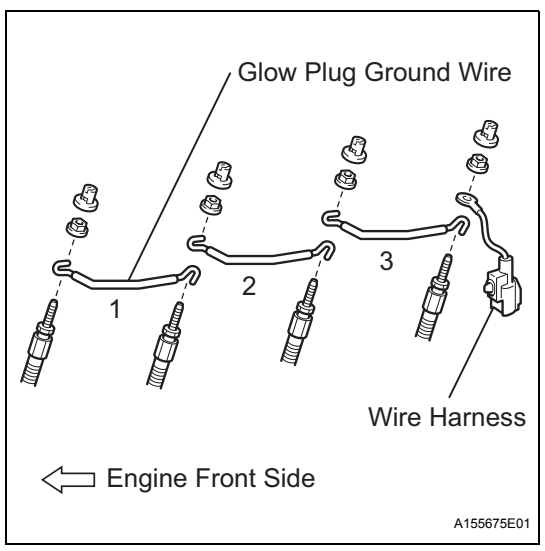
34. INSTALL OIL FILLER CAP SUB-ASSEMBLY

(a) Install the oil filler cap sub-assembly.



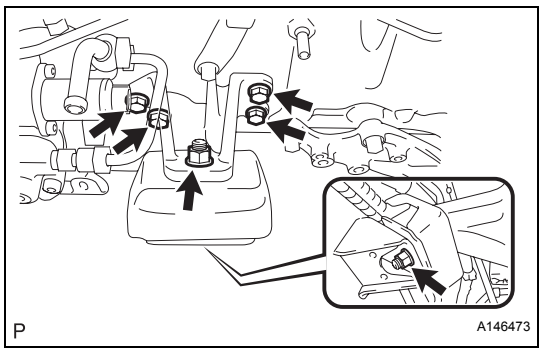
35. INSTALL GLOW PLUG ASSEMBLY

(a) Install the 4 glow plugs.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)



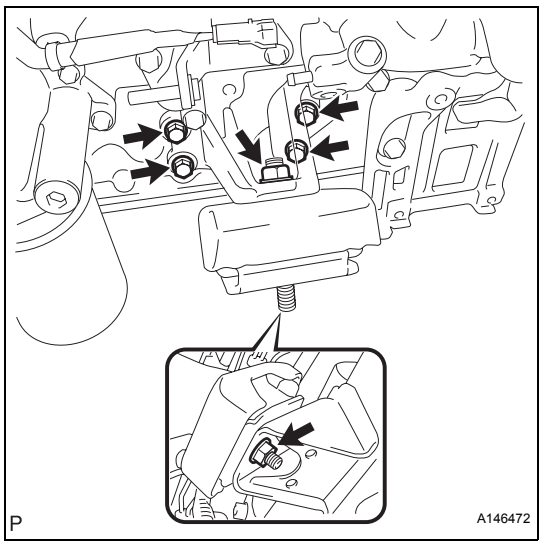
(b) Install the 3 glow plug ground wires and wire harness with the 4 nuts.
Torque: 1.5 N*m (15 kgf*cm, 13 in.*lbf)
NOTICE:
- **Install the 3 glow plug ground wires from the engine front side, as shown in the illustration. Installing the wires in the wrong order may deform them.**
- **Make sure that the glow plug ground wires are not caught in the cylinder head or intake manifold.**

(c) Install the 4 screw grommets.



36. INSTALL ENGINE ASSEMBLY

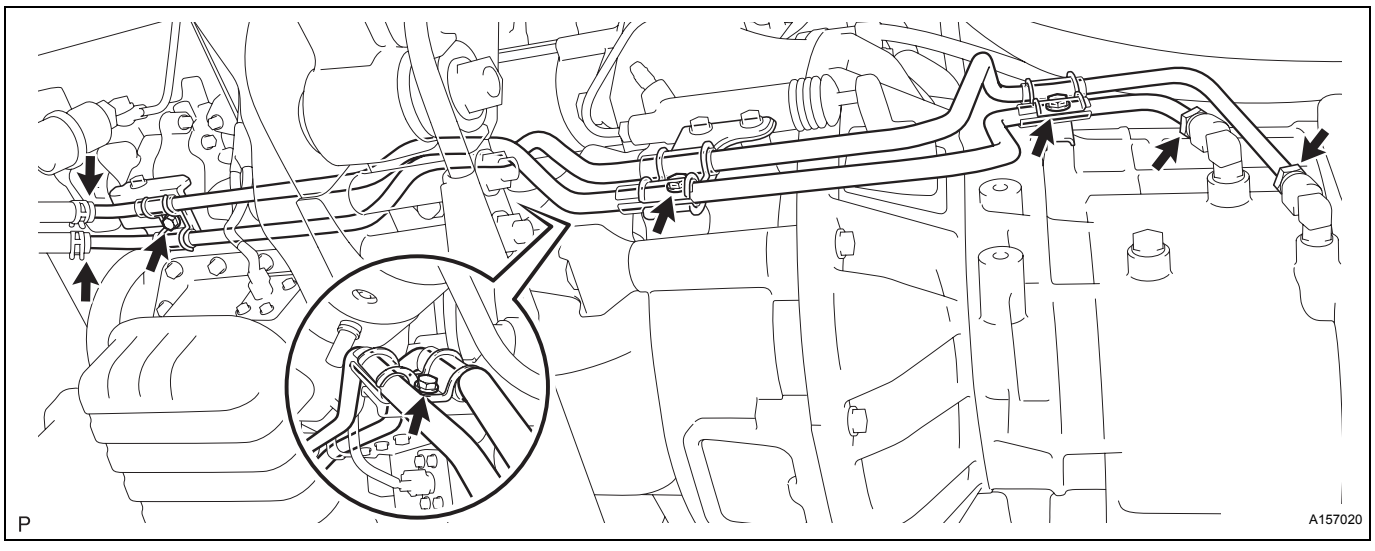
(a) Support the engine with an engine lifter.
(b) Install the engine assembly.
(c) Install the No. 1 front engine mounting bracket LH with the 4 bolts.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)
(d) Install the engine mounting stabilizer and front engine mounting insulator with the 2 nuts.
Torque: 74 N*m (755 kgf*cm, 55 ft.*lbf)



(e) Install the No. 1 front engine mounting bracket RH with the 4 bolts.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)
(f) Install the engine mounting stabilizer and front engine mounting insulator with the 2 nuts.
Torque: 74 N*m (755 kgf*cm, 55 ft.*lbf)

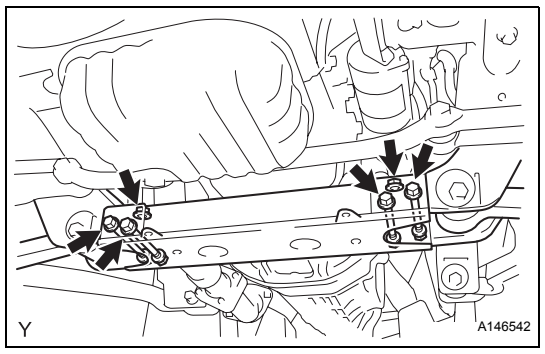
37. INSTALL TRANSMISSION OIL COOLER TUBE

(a) Install the 2 oil cooler tubes with the 2 union nuts.
Torque: 67 N*m (700 kgf*cm, 51 ft.*lbf)
(b) Install the 4 oil cooler tube clamps with the 4 bolts through the 4 clamps.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)



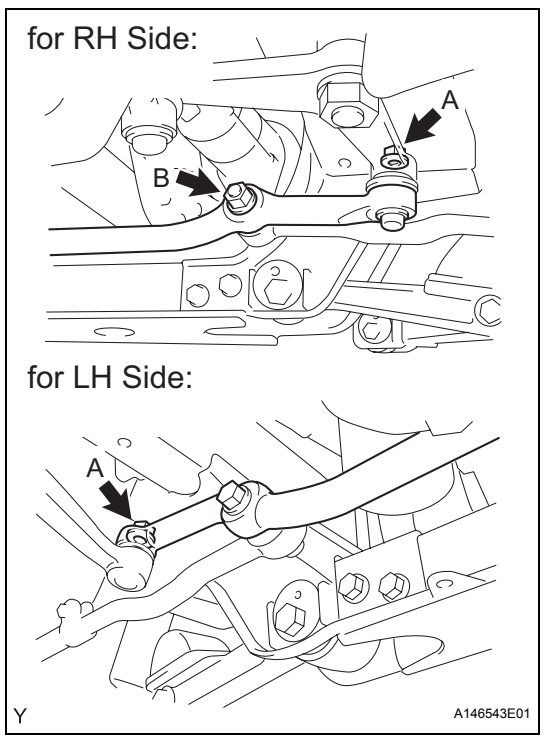
38. INSTALL ENGINE WIRE

(a) Install the engine wire.



39. INSTALL FRONT SUSPENSION CROSSMEMBER SUB-ASSEMBLY

(a) Install the front suspension crossmember sub-assembly with the 6 bolts and 4 nuts.
Torque: 160 N*m (1631 kgf*cm, 118 ft.*lbf)



40. INSTALL STEERING RELAY ROD ASSEMBLY

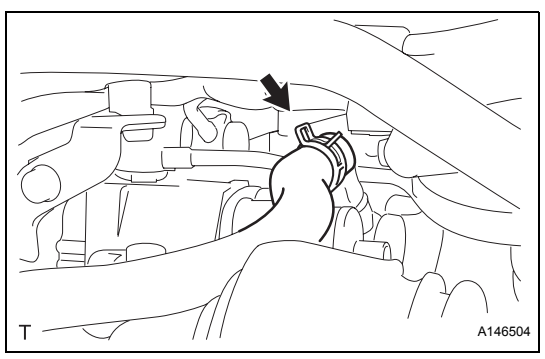
(a) Install the steering relay rod assembly with the 3 nuts.
Torque: for Bolt A
150 N*m (1530 kgf*cm, 111 ft.*lbf)
for Bolt A
155 N*m (1581 kgf*cm, 115 ft.*lbf)

(b) Install a new cotter pin.

41. INSTALL MANUAL TRANSMISSION ASSEMBLY

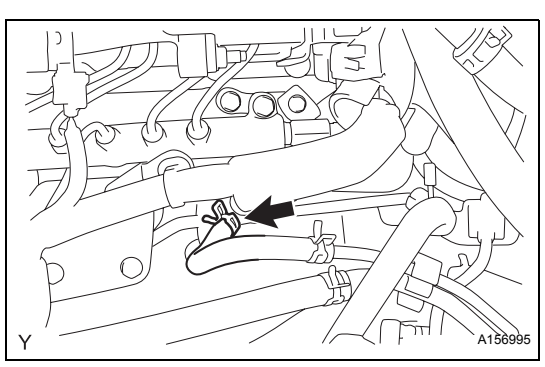
42. INSTALL STARTER ASSEMBLY (See page ST-27)

43. INSTALL GENERATOR ASSEMBLY (See page CH-17)



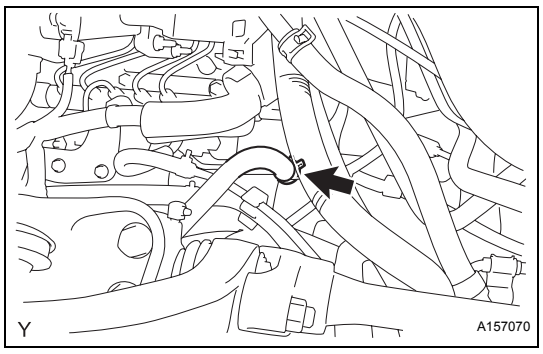
44. CONNECT INJECTION PUMP TO FUEL FILTER FUEL HOSE OR PIPE

(a) Connect the injection pump to fuel filter fuel hose or pipe.



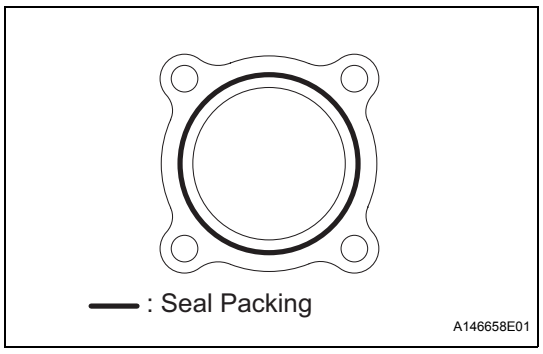
45. CONNECT NO. 2 FUEL HOSE

(a) Connect the No. 2 fuel hose.



46. CONNECT UNION TO CONNECTOR TUBE HOSE

(a) Connect the union to connector tube hose.



47. INSTALL DIESEL THROTTLE BODY WITH INTAKE PIPE

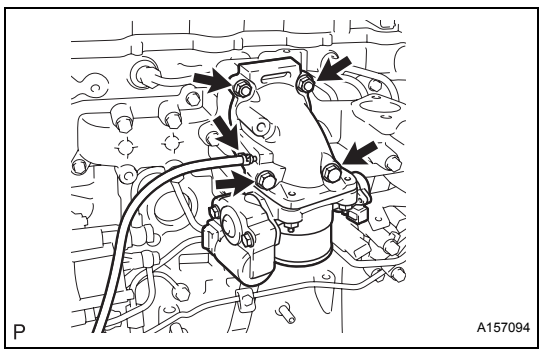
(a) Apply a continuous bead of seal packing (width: 1.5 to 2.5 mm(0.06 to 0.10 in.)) as shown in the illustration.

Seal packing:

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

NOTICE:

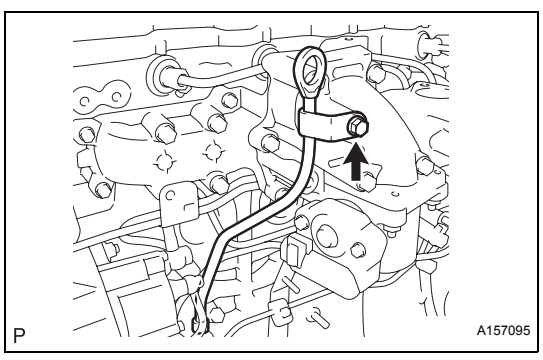
- **Remove any oil from the contact surface.**
- **Install the diesel throttle body with intake pipe within 3 minutes, and tighten the bolts within 15 minutes of applying the seal packing.**



(b) Install the diesel throttle body with intake pipe with intake air pipe with the 2 nuts and 2 bolts.

Torque: 29 N*m (290 kgf*cm, 21 in.*lbf)

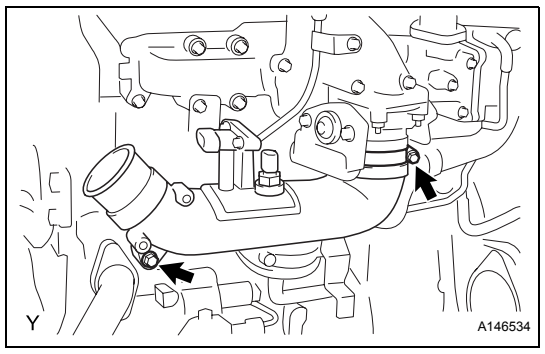
(c) Connect the vacuum hose.



(d) Install the oil level gauge guide with the bolt.

Torque: 29 N*m (290 kgf*cm, 21 in.*lbf)

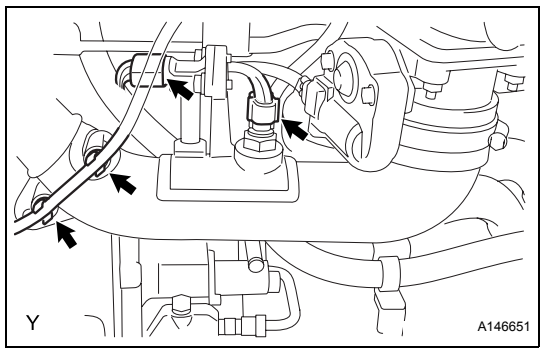
EM



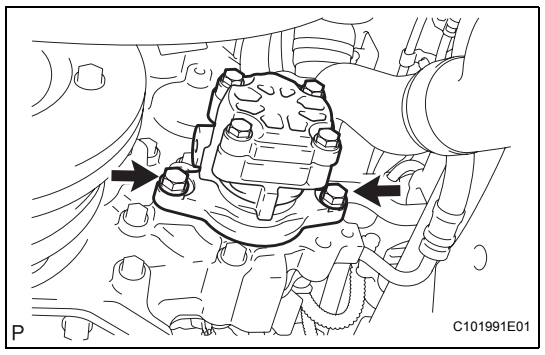
48. INSTALL NO. 2 AIR HOSE

(a) Install the No. 2 air hose with the bolt and tighten the air hose clamp.
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)

(b) Connect the 2 connectors.



(c) Install the vacuum transmitting hose onto the No. 2 air hose.

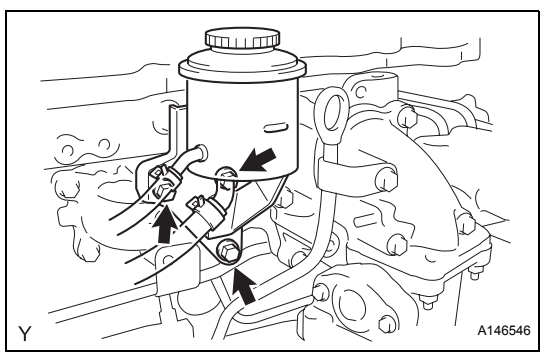


49. INSTALL VANE PUMP ASSEMBLY

(a) Coat a new O-ring with power steering fluid and install it onto the vane pump assembly.

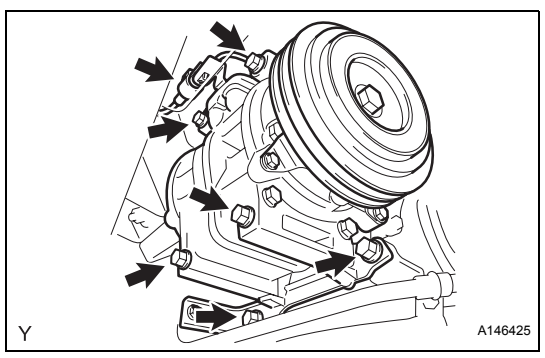
(b) Install the vane pump assembly with the 2 bolts.
Torque: 20 N*m (204 kgf*cm, 15 ft.*lbf)

50. INSTALL FRONT FENDER APRON LH (See page ES-256)



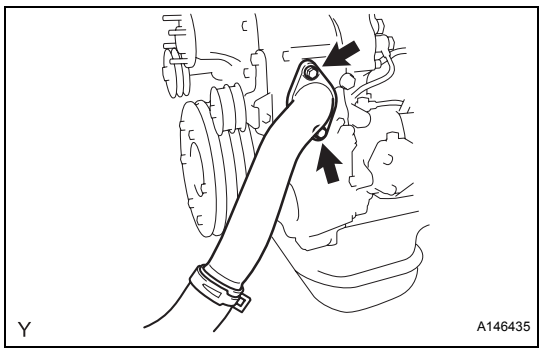
51. INSTALL VANE PUMP OIL RESERVOIR ASSEMBLY

(a) Install the vane pump oil reservoir assembly with the 3 bolts.
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)



52. INSTALL COOLER COMPRESSOR ASSEMBLY (w/ Air Conditioning System)

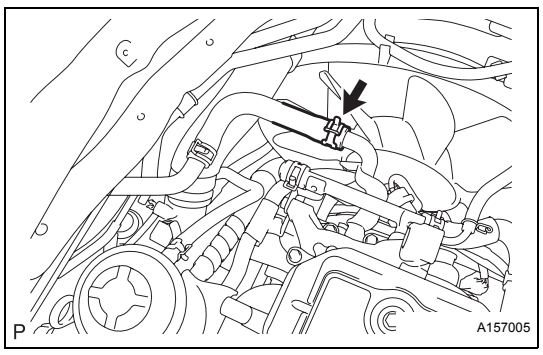
(a) Install the cooler compressor assembly with the 6 bolts.
Torque: 47 N*m (475 kgf*cm, 34 ft.*lbf)



53. INSTALL RADIATOR PIPE

(a) Install a new O-ring onto the radiator pipe.

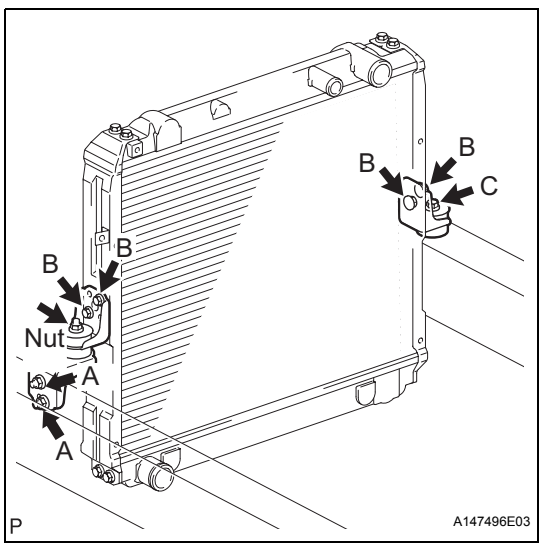
(b) Install the radiator pipe with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 in.*lbf)



54. CONNECT OUTLET HEATER WATER HOSE B

(a) Connect the outlet heater water hose.

EM

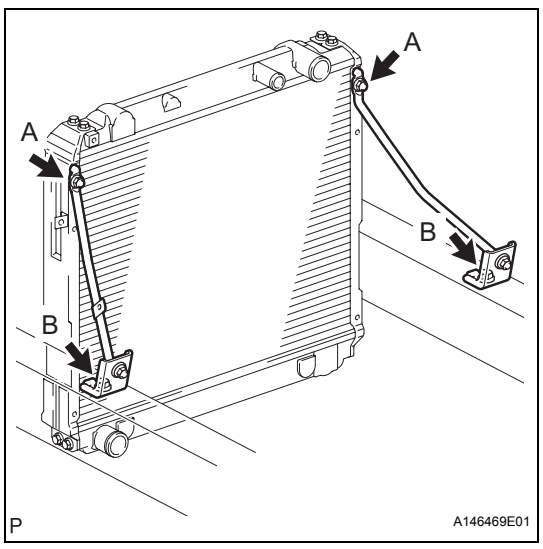


55. INSTALL RADIATOR ASSEMBLY

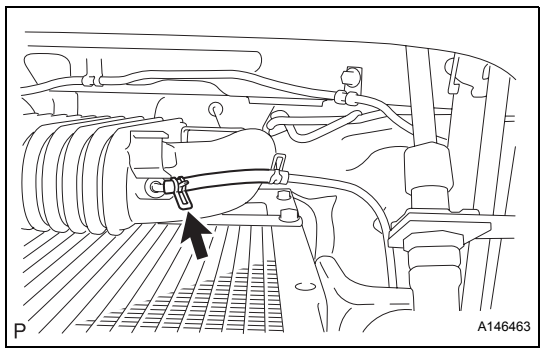
(a) Install the radiator assembly together with the intercooler assembly.

(b) Install the No. 2 radiator bracket with the 2 bolts.
Torque: for Bolt A
20 N*m (204 kgf*cm, 15 ft.*lbf)

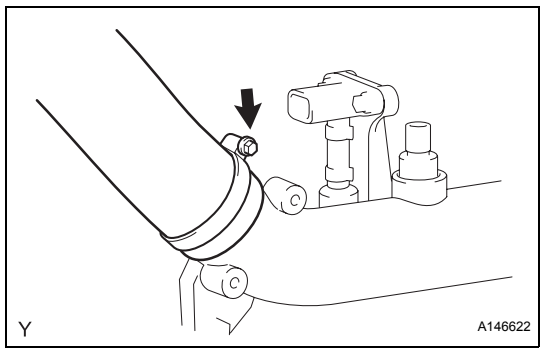
(c) Install the 2 No. 1 radiator brackets with the 5 bolts and nut.
Torque: for Bolt B
20 N*m (204 kgf*cm, 15 ft.*lbf)
for Bolt C
12 N*m (122 kgf*cm, 9 ft.*lbf)
for Bolt Nut
20 N*m (204 kgf*cm, 15 ft.*lbf)



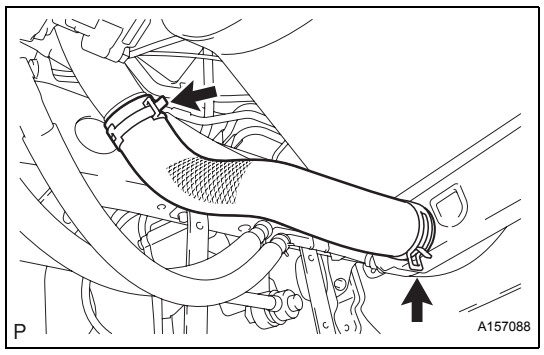
(d) Install the radiator brace rod RH with the bolt and nut.
Torque: For nut A
20 N*m (204 kgf*cm, 15 ft.*lbf)
Torque: For bolt B
18 N*m (184 kgf*cm, 13 ft.*lbf)
HINT:
Use the same procedure as for the LH side.



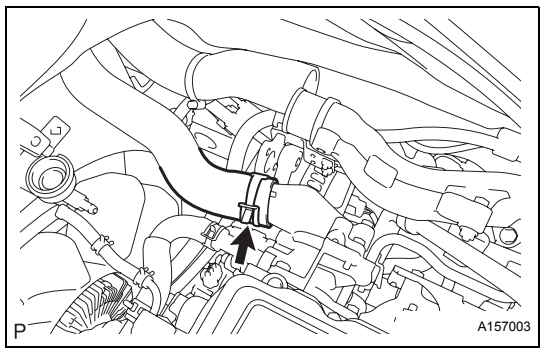
(e) Connect the vacuum transmitting hose.



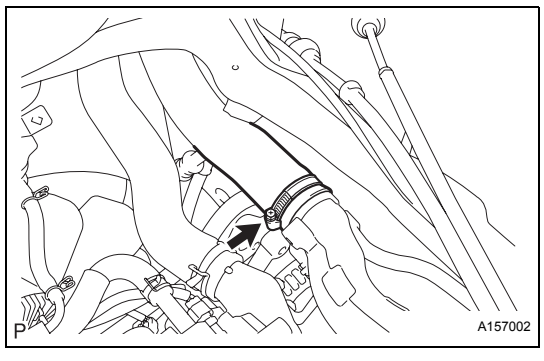
(f) Connect the inter cooler hose to the No. 2 air hose.
(g) Tighten the hose clamp.



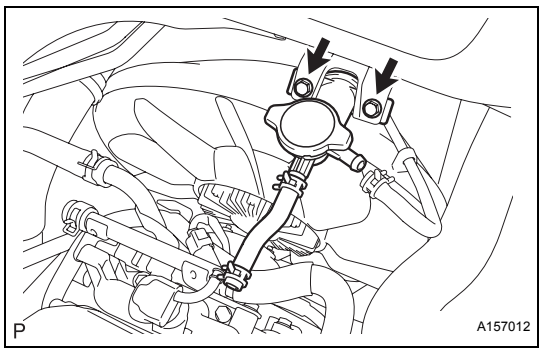
(h) Install the outlet radiator hose.



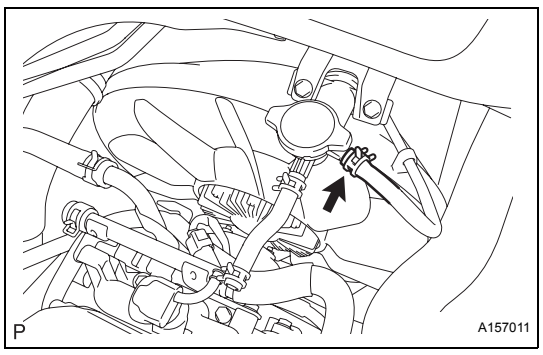
(i) Connect the inlet radiator hose.



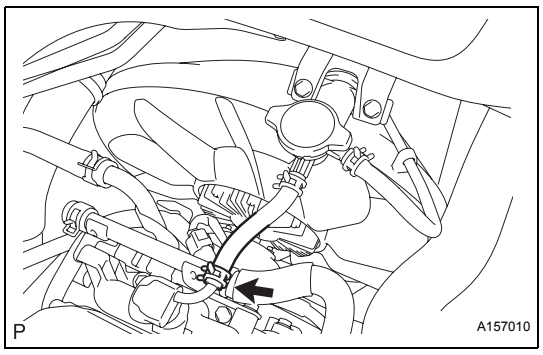
(j) Connect the No. 1 air hose.
(k) Tighten the hose clamp.



(l) Install the water filler assembly with the 2 bolts.
Torque: 7.5 N*m (76 kgf*cm, 66 in.*lbf)



(m) Connect the radiator reserve tank hose.

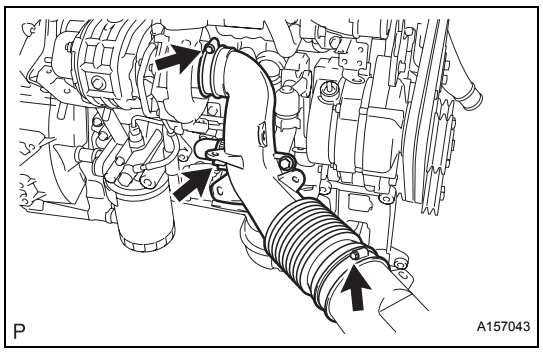


(n) Connect the water by-pass hose.

56. INSTALL FAN (See page CO-27)

57. INSTALL MANUAL TRANSMISSION OIL COOLER ASSEMBLY (See page CO-41)

58. INSTALL RADIATOR GRILLE (See page ET-6)



59. INSTALL NO. 1 AIR HOSE
(a) Install the No. 1 air hose with the bolt.
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)
(b) Tighten the air hose clamp.
(c) Connect the ventilation hose.
(d) Install the wire harness.

60. INSTALL TURBOCHARGER SUB-ASSEMBLY
Refer to the procedures under " INSTALL TURBOCHARGER SUB-ASSEMBLY" (IT-14).

61. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL
Torque: 3.9 N*m (40 kgf*cm, 35 in.*lbf)

62. ADD ENGINE OIL (See page LU-3)

63. ADD ENGINE COOLANT (See page CO-4)

64. ADD MANUAL TRANSMISSION OIL

65. INSPECT FOR FUEL LEAK (See page FU-4)

66. INSPECT FOR ENGINE COOLANT LEAK (See page CO-3)

EM

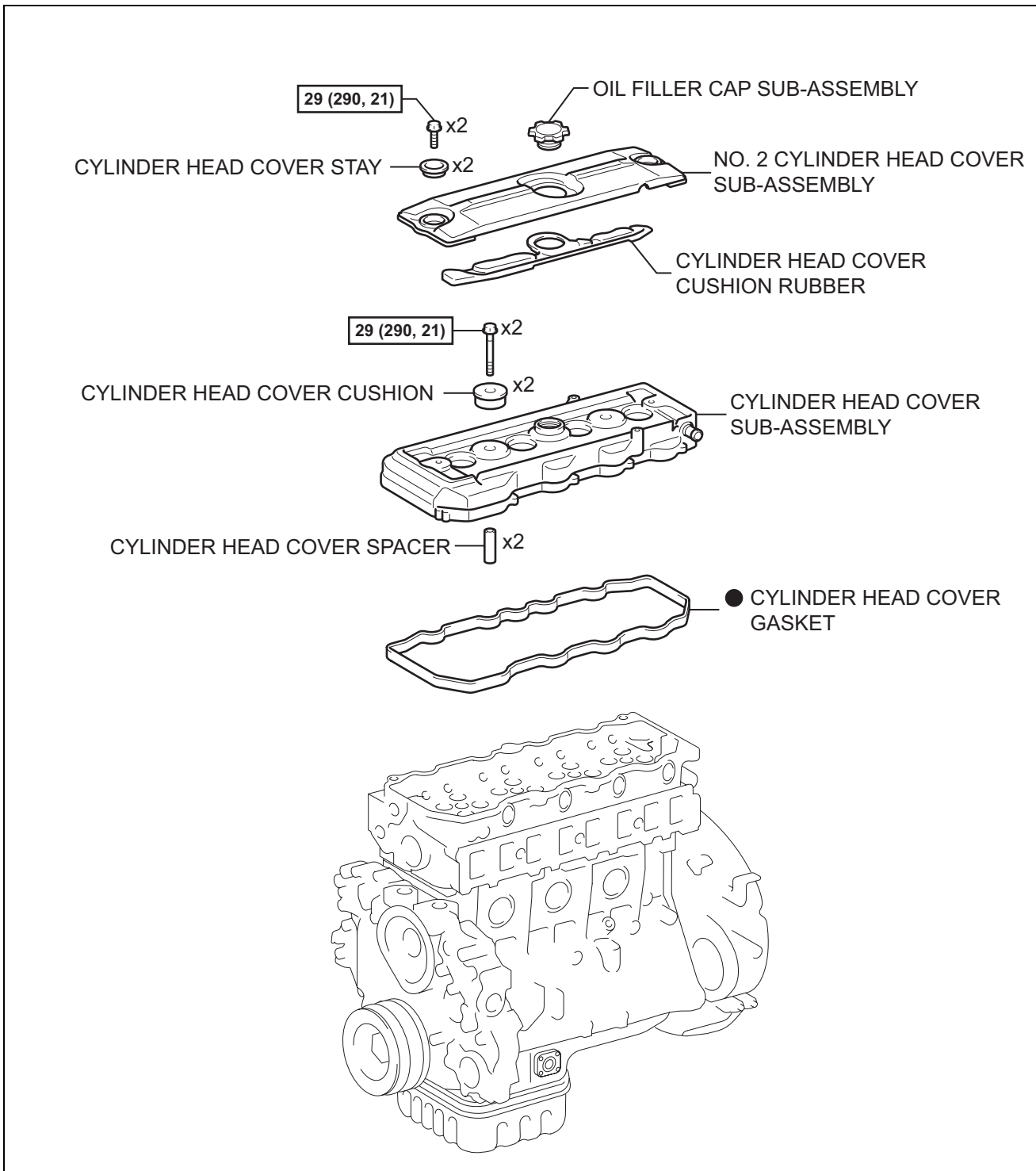
67. INSPECT FOR OIL LEAK (See page LU-4)

68. INSPECT FOR EXHAUST GAS LEAK

69. INSTALL NO. 1 ENGINE UNDER COVER (See page EM-6)

ENGINE UNIT

COMPONENTS



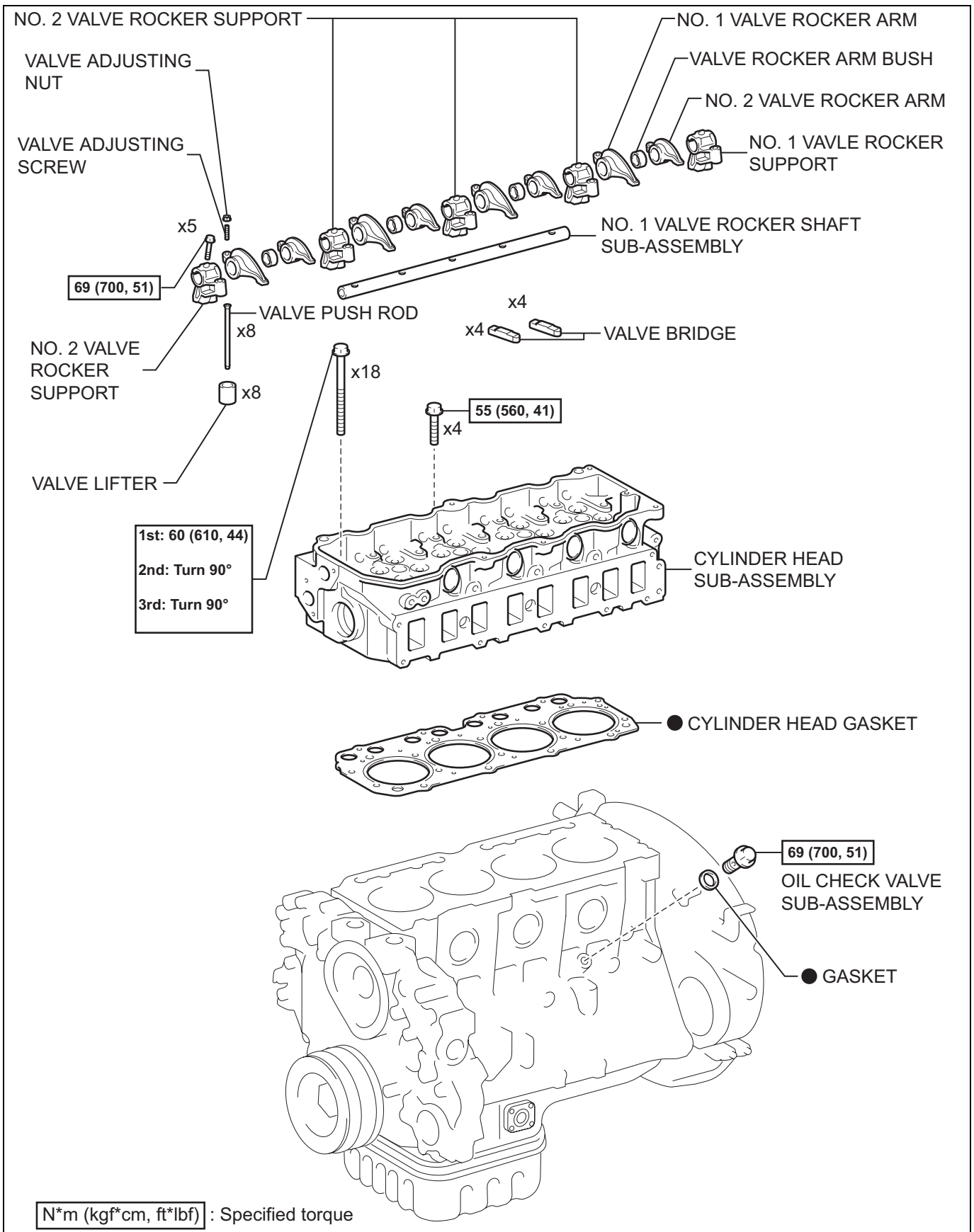
N*m (kgf*cm, ft*lbf) : Specified torque

● Non-reusable part

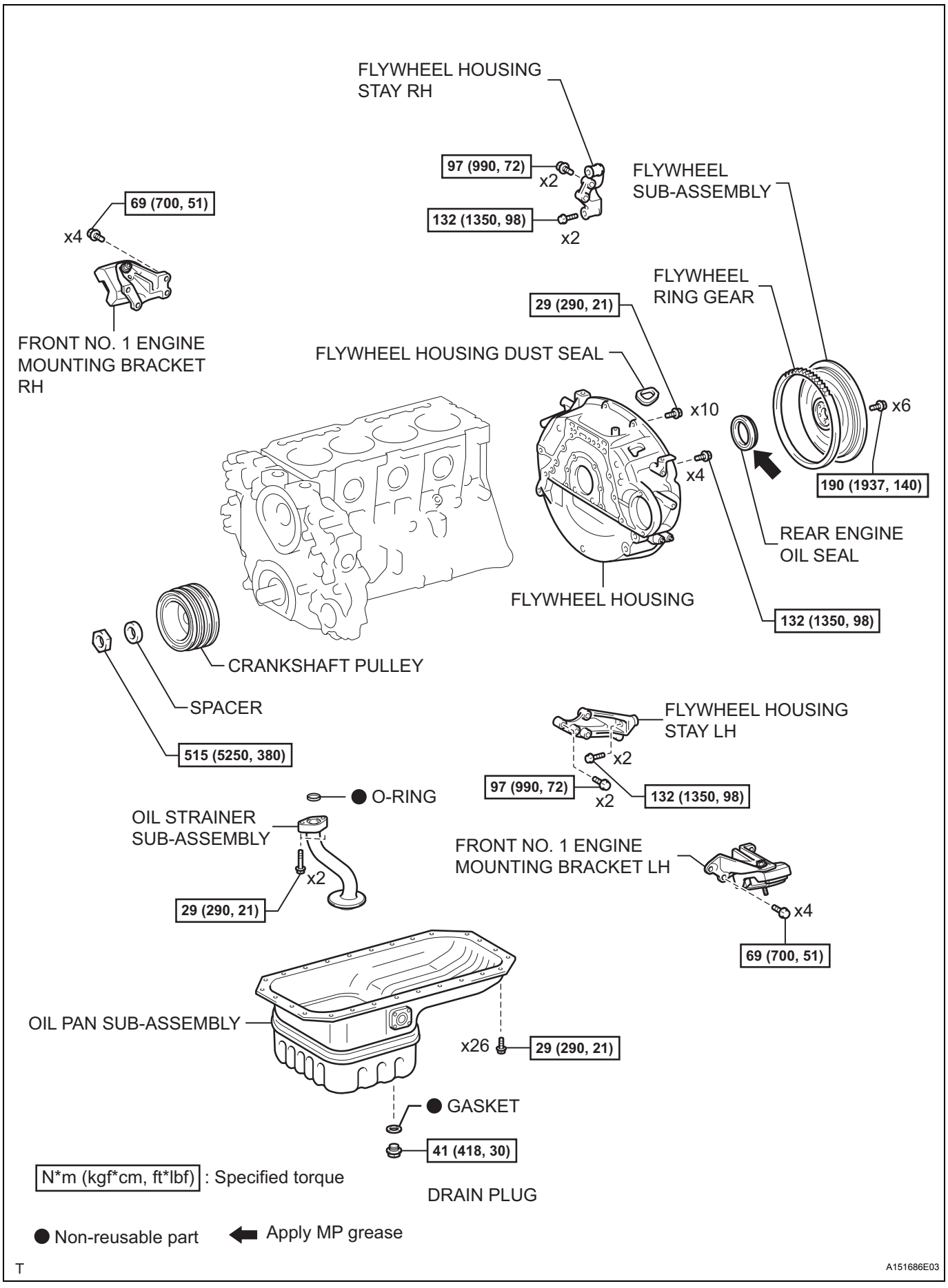
T

A151684E03

EM



A151685E04

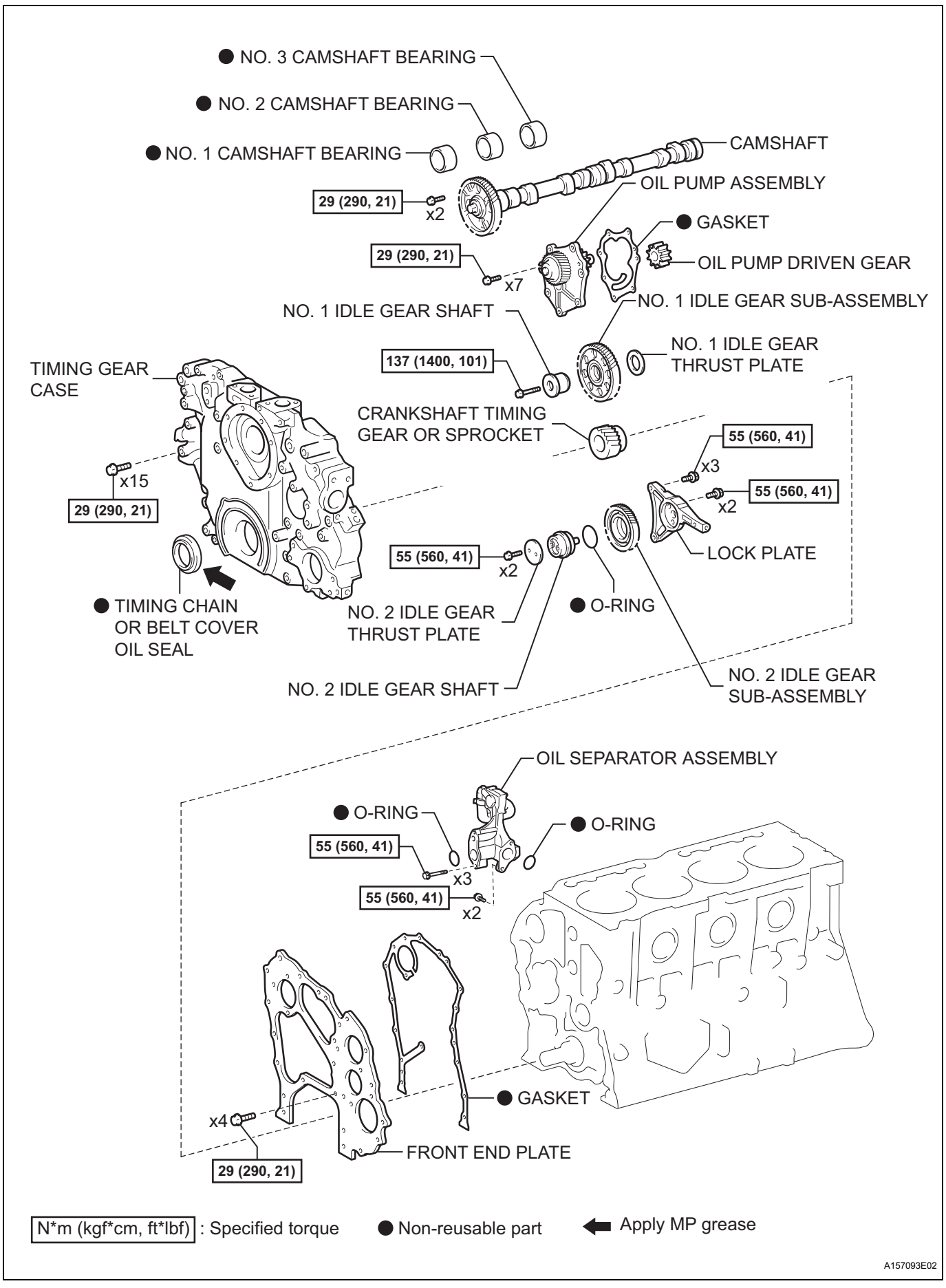


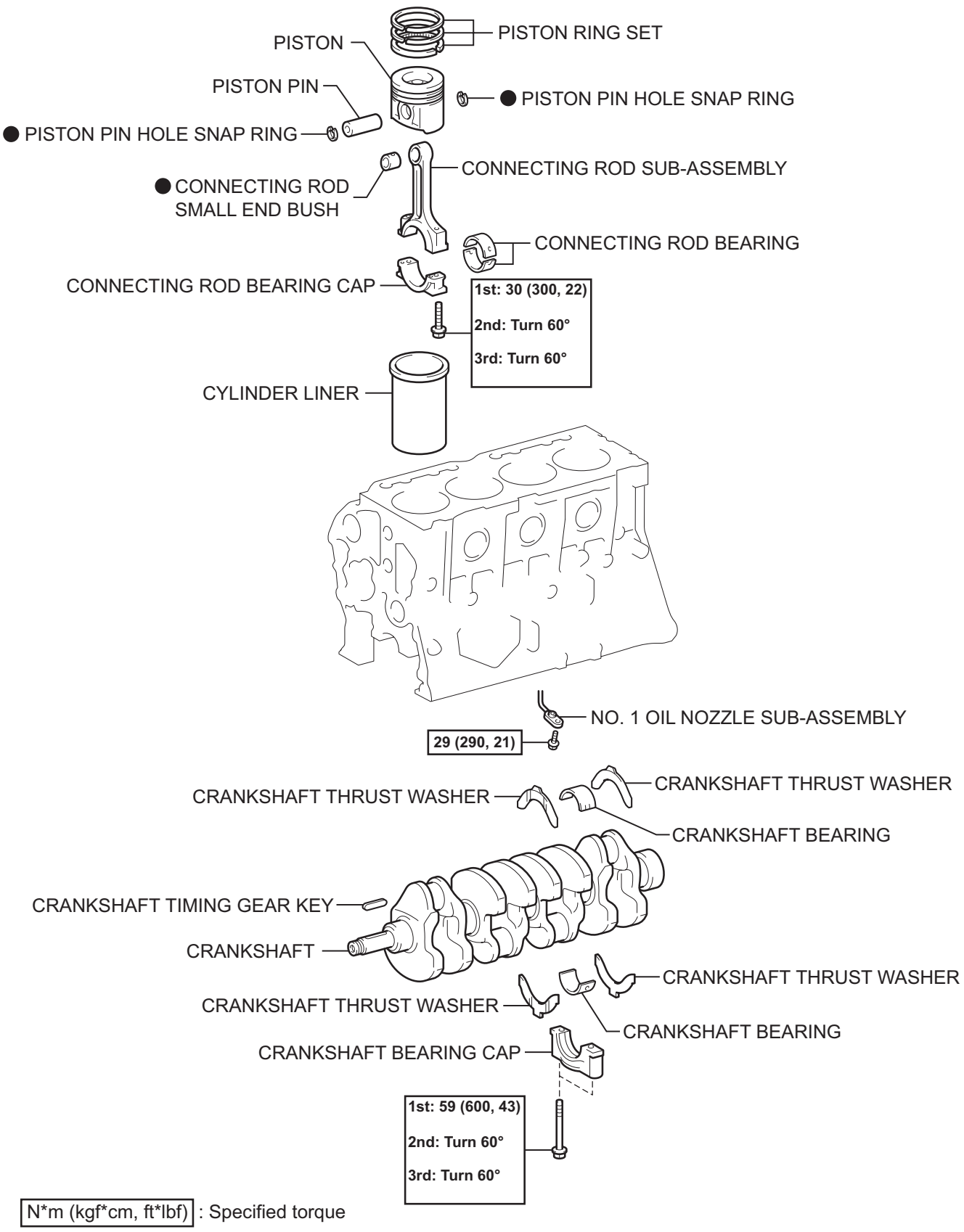
T

A151686E03

EM

EM





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

● Non-reusable part

T

A152898E03

EM

DISASSEMBLY

1. REMOVE OIL FILLER CAP SUB-ASSEMBLY

2. REMOVE NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove the 2 bolts and the No. 2 cylinder head cover.

3. REMOVE CYLINDER HEAD COVER CUSHION RUBBER

(a) Remove the cylinder head cover cushion rubber from the No. 2 cylinder head cover.

4. REMOVE CYLINDER HEAD COVER STAY

(a) Remove the 2 cylinder head cover stays from the No. 2 cylinder head cover.

5. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY

(a) Remove the 2 bolts and cylinder head cover.

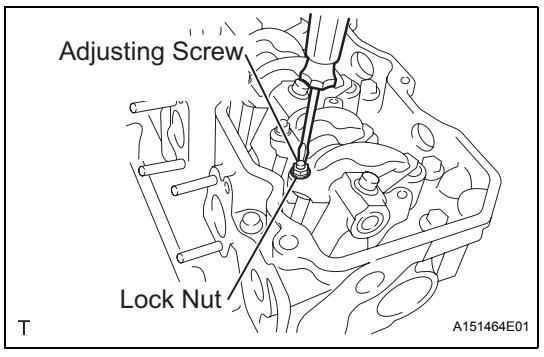
(b) Remove the 2 cylinder head cover spacers from the cylinder head cover.

6. REMOVE CYLINDER HEAD COVER CUSHION

(a) Remove the 2 cylinder head cover cushions from the cylinder head cover.

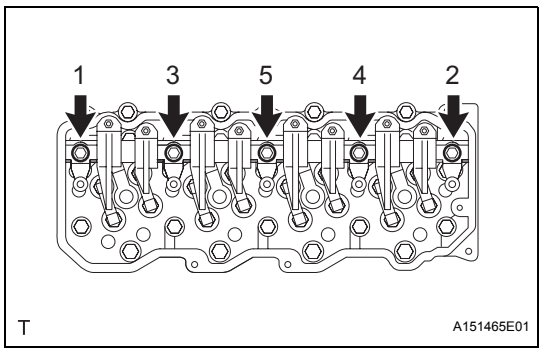
7. REMOVE CYLINDER HEAD COVER GASKET

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



8. REMOVE NO. 1 VALVE ROCKER SHAFT SUB-ASSEMBLY

(a) Loosen the lock nut at the top of the rocker arms, then turn out the adjusting screws completely.
NOTICE:
If the adjusting screws are not turned out, the rocker shaft may bend when the rocker arm support bolts are loosened.

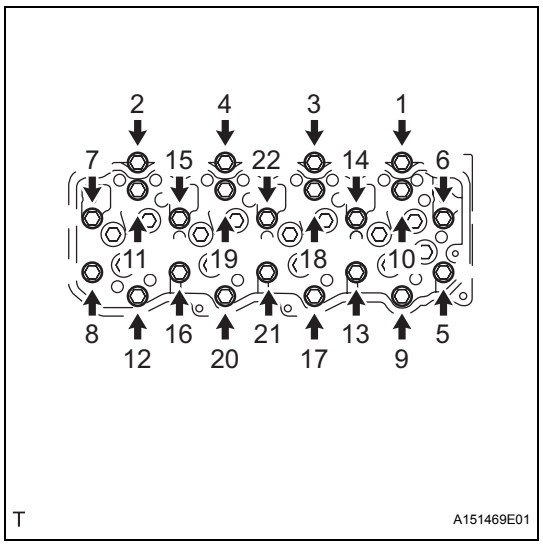


(b) Loosen the 5 rocker arm support bolts in the order shown in the illustration.

(c) Remove the bolts and the No. 1 valve rocker shaft.

9. REMOVE VALVE PUSH ROD
NOTICE:
Organize the parts so that each parts location can be remembered for reassembly.

10. REMOVE VALVE BRIDGE
NOTICE:
Keep the removed parts in the correct order so that they can be returned to their original positions when reassembled.



11. REMOVE CYLINDER HEAD SUB-ASSEMBLY

(a) Remove the cylinder head bolts in the order shown in the illustration.

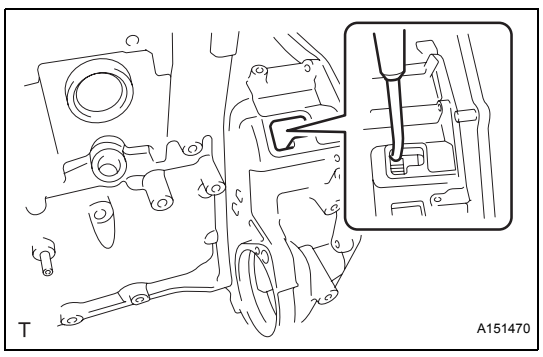
(b) Lift and remove the cylinder head from the cylinder block.

(c) Remove the cylinder head gasket.

12. REMOVE VALVE LIFTER

NOTICE:

Keep the removed parts in the correct order so that they can be returned to their original positions when reassembled.



13. REMOVE CRANKSHAFT PULLEY

(a) Using a 46 mm socket wrench, remove the nut, spacer and pulley.

HINT:

Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.

14. REMOVE FLYWHEEL HOUSING STAY RH

(a) Remove the 4 bolts and the flywheel housing stay.

15. REMOVE FLYWHEEL HOUSING STAY LH

(a) Remove the 4 bolts and the flywheel housing stay.

16. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET RH

(a) Remove the 4 bolts and the front No. 1 engine mounting bracket.

17. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET LH

(a) Remove the 4 bolts and the front No. 1 engine mounting bracket.

18. REMOVE OIL PAN SUB-ASSEMBLY

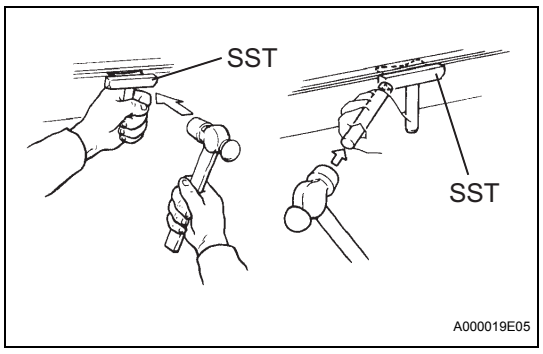
(a) Remove the 26 bolts from the oil pan.

(b) Insert the blade of SST between the crankcase and oil pan. Cut through the applied sealer and remove the oil pan.

SST 09032-00100

NOTICE:

Do not damage the contact surface of the cylinder block and oil pan.



19. REMOVE OIL STRAINER SUB-ASSEMBLY

(a) Remove the 2 bolts and strainer.

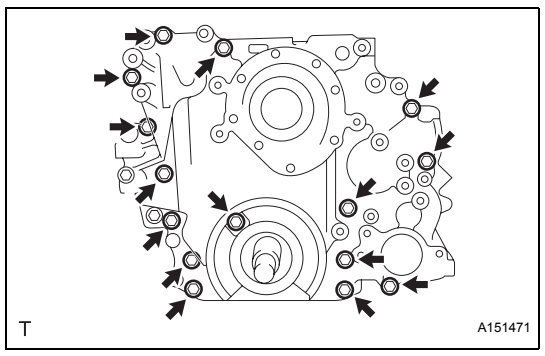
(b) Remove the O-ring.

EM

20. REMOVE OIL SEPARATOR ASSEMBLY

(a) Remove the 5 bolts and remove the oil separator assembly.

(b) Remove the 2 O-rings.

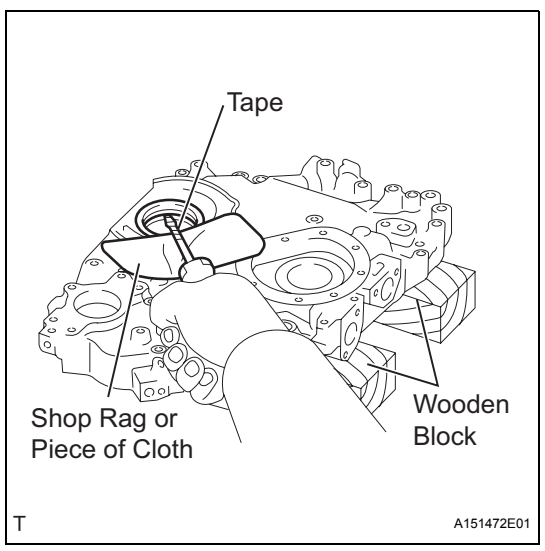


21. REMOVE TIMING GEAR CASE

(a) Remove the 15 bolts.

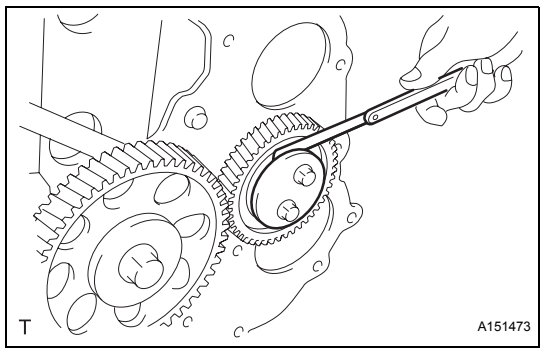
(b) Using a screwdriver with its tip wrapped in protective tape, pry off the timing gear case.
NOTICE:
Do not damage the contact surfaces of the timing gear case, cylinder block and cylinder head.

EM



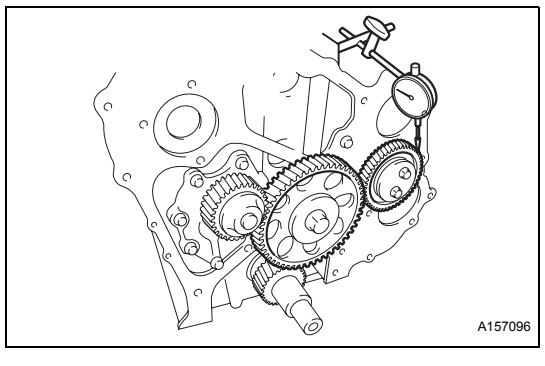
22. REMOVE TIMING CHAIN OR BELT COVER OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.
HINT:
Use wooden blocks and a shop rag or piece of cloth to prevent damage to the timing gear case.



23. INSPECT NO. 2 IDLE GEAR THRUST CLEARANCE

(a) Using a feeler gauge, measure the thrust clearance between the No. 2 idle gear thrust plate and No. 2 idle gear.
Standard thrust clearance:
0.103 to 0.164 mm (0.0040 to 0.0064 in.)
Maximum thrust clearance:
0.30 mm (0.0118 in.)
If the thrust clearance is greater than the maximum, replace the No. 2 idle gear thrust plate and No. 2 idle gear.



24. INSPECT NO. 2 IDLE GEAR BACKLASH

(a) Using a dial indicator, measure the backlash between the No. 1 idle gear and No. 2 idle gear.
Standard backlash:
0.036 to 0.227 mm (0.0014 to 0.0089 in.)
Maximum backlash:
0.30 mm (0.0118 in.)
If the backlash is greater than the maximum, replace the No. 1 idle gear and No. 2 idle gear.

25. REMOVE NO. 2 IDLE GEAR THRUST PLATE

(a) Remove the 2 bolts and No. 2 idle gear thrust plate.

26. REMOVE NO. 2 IDLE GEAR SUB-ASSEMBLY

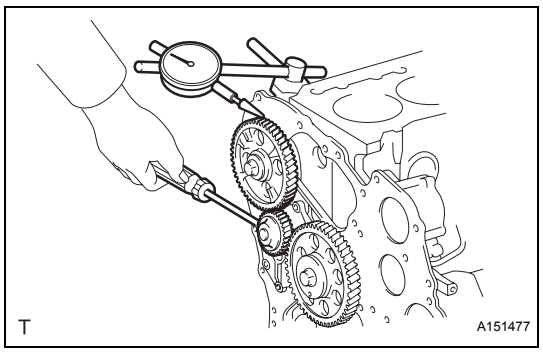
27. REMOVE NO. 2 IDLE GEAR SHAFT

(a) Remove the 2 bolts and No. 2 idle gear shaft.

(b) Remove the O-ring.

28. REMOVE LOCK PLATE

(a) Remove the 3 bolts and plate from the end plate.



29. INSPECT CAMSHAFT TIMING GEAR BACKLASH

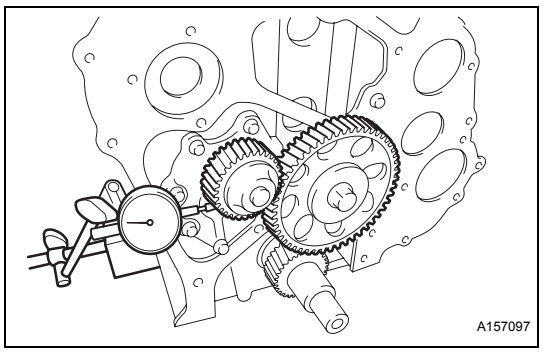
(a) Using a dial indicator, measure the backlash between the camshaft timing gear and No. 1 idle gear.

Standard backlash:
0.069 to 0.203 mm (0.0027 to 0.0079 in.)
Maximum backlash:
0.30 mm (0.0118 in.)

If the backlash is greater than the maximum, replace the camshaft timing gear and No. 1 idle gear.

30. REMOVE CAMSHAFT

(a) Remove the 2 bolts, thrust plate and camshaft.

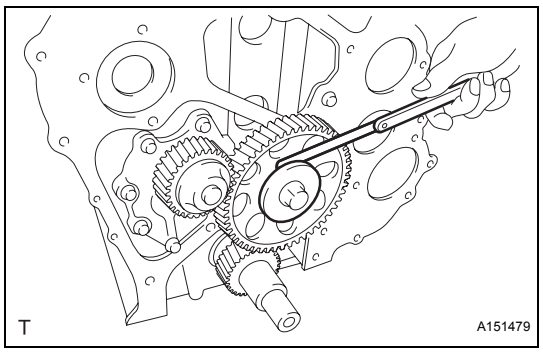


31. INSPECT OIL PUMP GEAR BACKLASH

(a) Using a dial indicator, measure the backlash between the oil pump gear and No. 1 idle gear.

Standard backlash:
0.065 to 0.215 mm (0.0025 to 0.0084 in.)
Maximum backlash:
0.30 mm (0.0118 in.)

If the backlash is greater than the maximum, replace the pump and No. 1 idle gear.

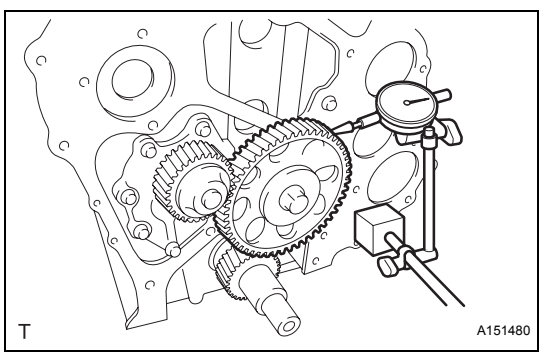


32. INSPECT NO. 1 IDLE GEAR THRUST CLEARANCE

(a) Using a feeler gauge, measure the thrust clearance between the No. 1 idle gear thrust plate and No. 1 idle gear.

Standard thrust clearance:
0.103 to 0.164 mm (0.0040 to 0.0064 in.)
Maximum thrust clearance:
0.30 mm (0.0118 in.)

If the thrust clearance is greater than the maximum, replace the No. 1 idle gear thrust plate and No. 1 idle gear.



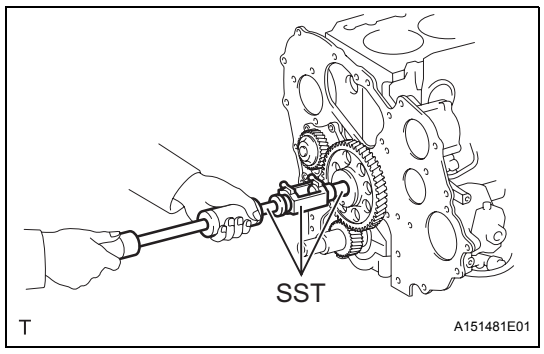
33. INSPECT NO. 1 IDLE GEAR BACKLASH

(a) Using a dial indicator, measure the backlash between the crankshaft timing gear and No. 1 idle gear.

Standard backlash:
0.035 to 0.193 mm (0.0014 to 0.0075 in.)
Maximum backlash:
0.30 mm (0.0118 in.)

If the backlash is greater than the maximum, replace the crankshaft timing gear and No. 1 idle gear.

EM



34. REMOVE NO. 1 IDLE GEAR SHAFT

(a) Remove the bolt.

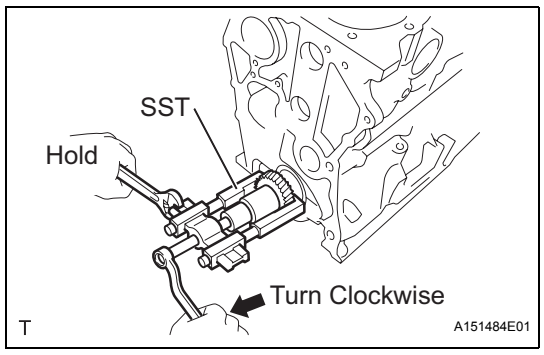
(b) Using SST, remove the No. 1 idle gear shaft.
SST 09910-00015 (09911-00011, 09912-00010)
NOTICE:
When removing the gear shaft, hold the No. 1 idle gear to prevent the No. 1 gear and No. 1 idle gear thrust plate from falling.

35. REMOVE NO. 1 IDLE GEAR SUB-ASSEMBLY

36. REMOVE NO. 1 IDLE GEAR THRUST PLATE

37. REMOVE CRANKSHAFT TIMING GEAR OR SPROCKET

(a) Using SST, remove the crankshaft timing gear or sprocket.
SST 09950-40011 (09951-04010, 09952-04010, 09953-04020, 09954-04010, 09955-04051)



38. REMOVE OIL PUMP ASSEMBLY

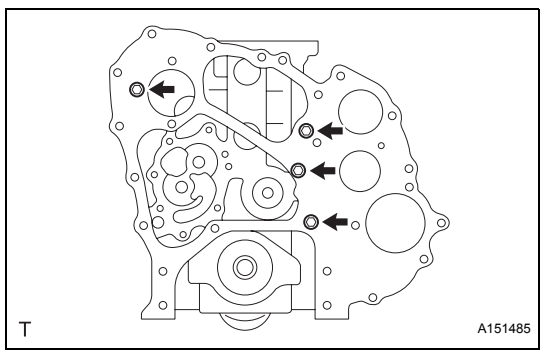
(a) Remove the 7 bolts and oil pump.

39. REMOVE OIL PUMP COVER GASKET

(a) Remove the gasket from the oil pump.

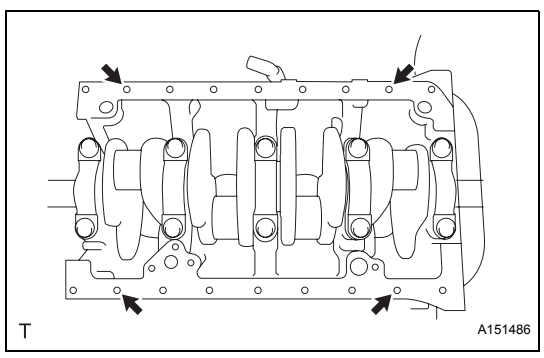
40. REMOVE FRONT END PLATE

(a) Remove the 4 bolts and front end plate.



41. REMOVE FRONT END PLATE GASKET

(a) Remove the front end plate gasket from the front end plate.

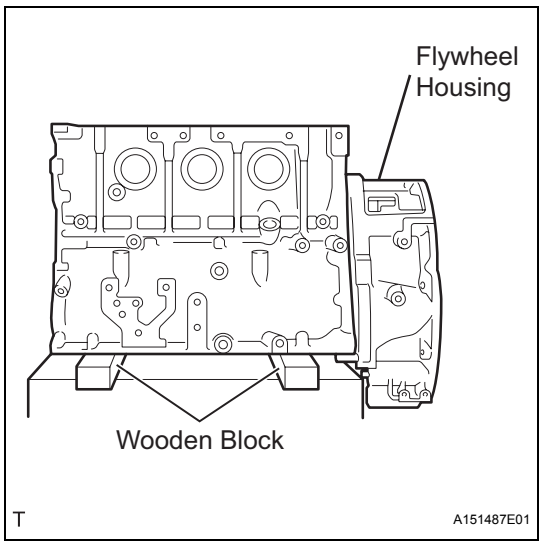


42. REMOVE FLYWHEEL SUB-ASSEMBLY

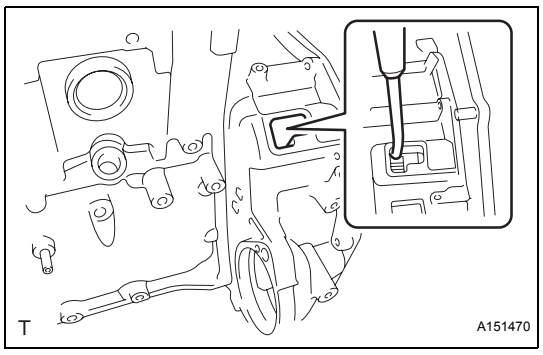
(a) Temporarily install 4 bolts in the positions of the cylinder block shown in the illustration to prevent the wires from sliding toward the center of the block.

(b) Attach 2 wires to the cylinder block.
HINT:
The wires must be attached to the outside of the installed bolts.

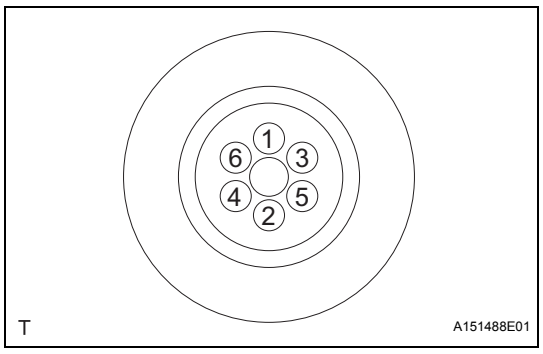
(c) Using a chain block and an engine sling device, remove the cylinder block from the engine stand.



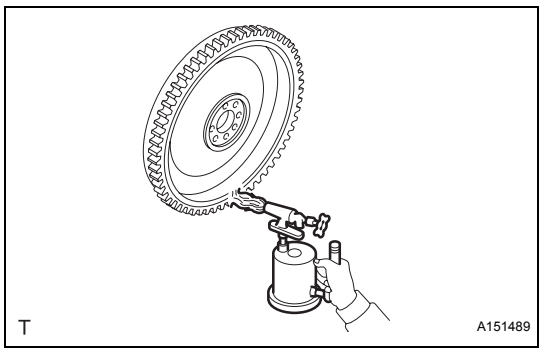
(d) Place the cylinder block on wooden blocks on a workbench.
(e) Remove the 4 bolts from the cylinder block.



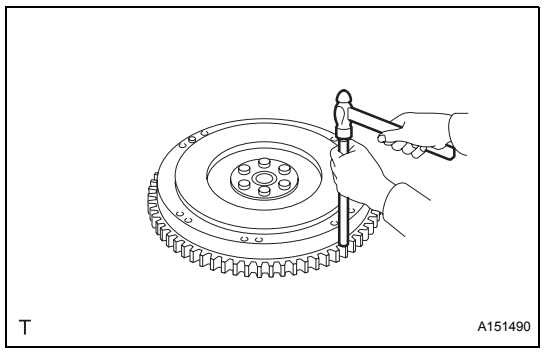
(f) Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.



(g) Uniformly loosen and remove the 6 bolts in the order shown in the illustration.
(h) Remove the flywheel.
NOTICE:
The flywheel is heavy. When removing, be careful not to drop it.



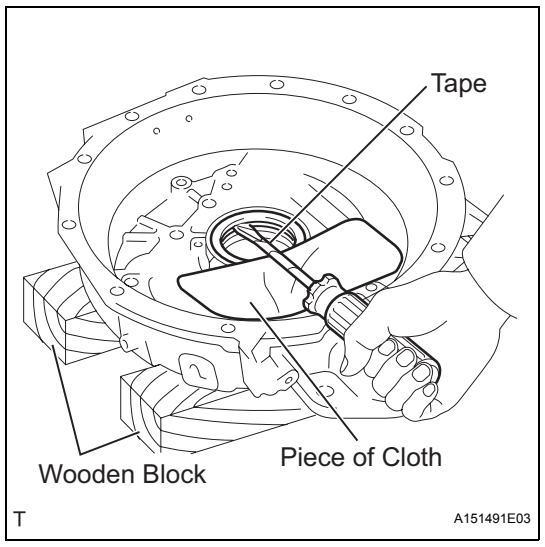
43. REMOVE FLYWHEEL RING GEAR
(a) Using a torch, heat the ring gear evenly to approximately 200°C (392°F).
NOTICE:
Be careful not to overheat the ring gear.
CAUTION:
Do not touch the ring gear and flywheel while they are hot.



(b) Using a brass bar and hammer, uniformly strike all around the ring gear and remove the gear.
CAUTION:
After removing, allow the ring gear to cool before handling.

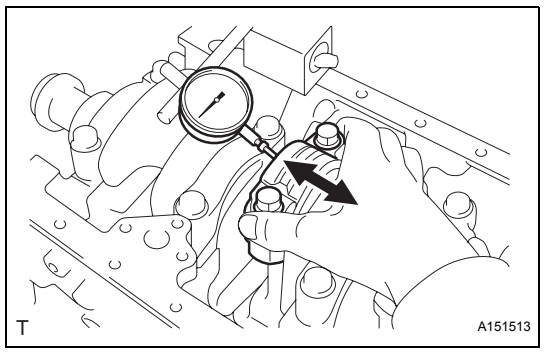
44. REMOVE FLYWHEEL HOUSING

(a) Remove the 14 bolts from the cylinder block.
(b) Using a screwdriver with its tip wrapped in protective tape, pry off the flywheel housing.



45. REMOVE REAR ENGINE OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the rear engine oil seal.
HINT:
Use wooden blocks and a piece of cloth to prevent damage to the flywheel housing.



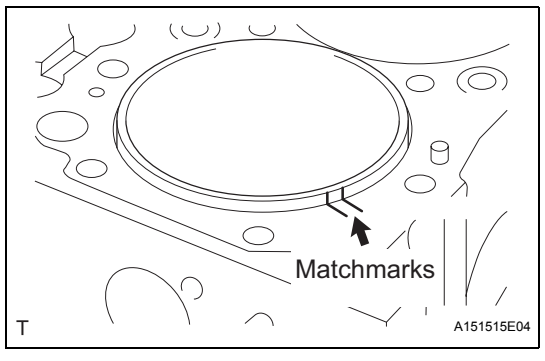
46. INSPECT CONNECTING ROD THRUST CLEARANCE

(a) Using a dial indicator, measure the thrust clearance while moving the connecting rod back and forth.
Standard thrust clearance:
0.200 to 0.520 mm (0.0079 to 0.0205 in.)
Maximum thrust clearance:
0.60 mm (0.0236 in.)
If the thrust clearance is greater than the maximum, replace the connecting rod. If necessary, replace the crankshaft.

47. REMOVE PISTON WITH CONNECTING ROD

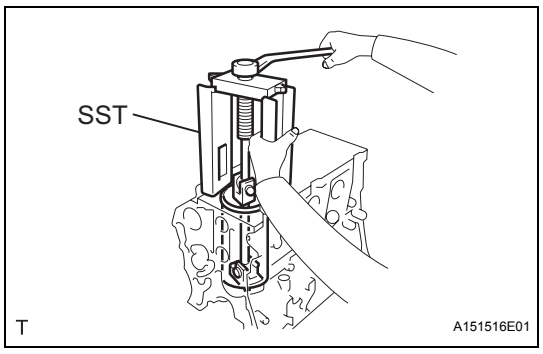
(a) Remove the piston with connecting rod from the cylinder block.

48. REMOVE CONNECTING ROD SUB-ASSEMBLY

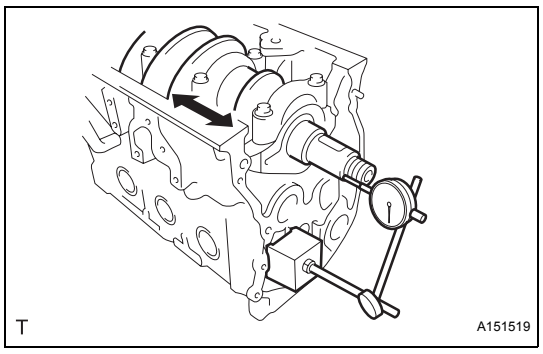


49. REMOVE CYLINDER LINER

HINT:
Before removing the cylinder liner, put matchmarks on the cylinder liner and cylinder block.
NOTICE:
When reusing the cylinder liner, misalignment with the cylinder block may concentrate stress on the thin part of the cylinder liner and it may break.

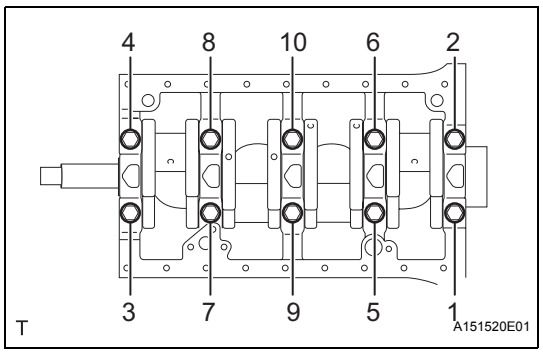


(a) Using SST, remove the cylinder liner.
SST S0942-01460
NOTICE:
Keep the removed parts in the correct order so that they can be returned to their original positions when reassembled.



50. INSPECT CRANKSHAFT THRUST CLEARANCE

(a) Using a dial indicator, measure the thrust clearance while prying the crankshaft back and forth with a screwdriver.
Standard thrust clearance:
0.050 to 0.220 mm (0.0019 to 0.0086 in.)
Maximum thrust clearance:
0.40 mm (0.0157 in.)
If the thrust clearance is greater than the maximum, replace the crankshaft or thrust washers as a set.



51. REMOVE CRANKSHAFT

(a) Remove the 10 bearing cap bolts in the order shown in the illustration.
(b) Using a plastic-faced hammer, tap the bearing caps to remove them.
NOTICE:
Be careful not to damage the thrust washers and bearings.
(c) Remove the crankshaft.

52. REMOVE CRANKSHAFT THRUST WASHER SET
NOTICE:
Organize the parts so that each parts location can be remembered for reassembly.

53. REMOVE CRANKSHAFT BEARING SET
NOTICE:
Organize the parts so that each parts location can be remembered for reassembly.

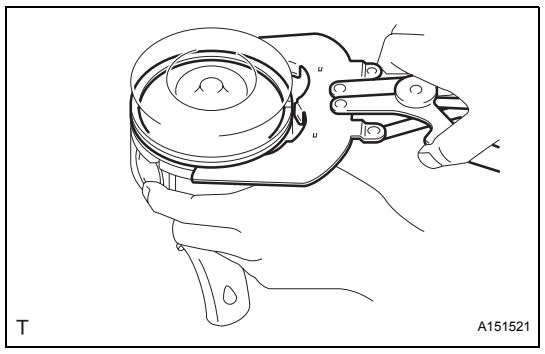
54. REMOVE OIL CHECK VALVE SUB-ASSEMBLY

(a) Remove the bolt, the oil check valve and gasket.

55. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

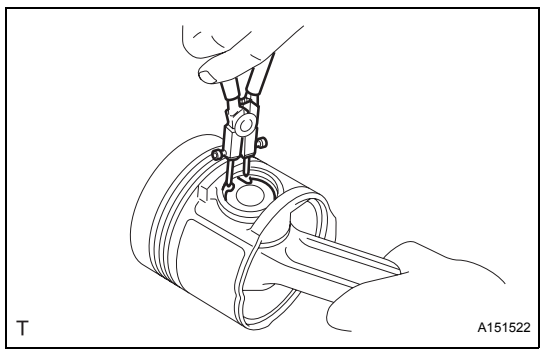
(a) Remove the bolt and the No. 1 oil nozzle.

EM



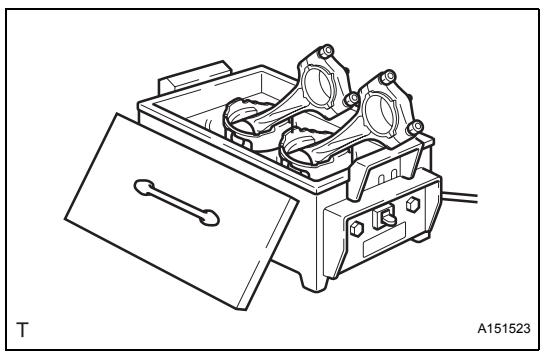
56. REMOVE PISTON RING SET

(a) Using a piston ring expander, remove the piston rings.
HINT:
Arrange the piston rings in the correct order.



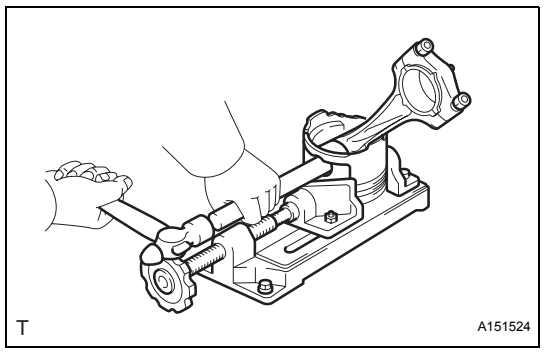
57. REMOVE PISTON PIN HOLE SNAP RING

(a) Using snap ring pliers, remove the snap rings.



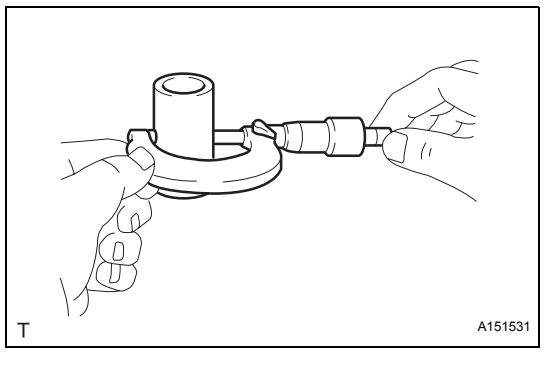
58. REMOVE PISTON

(a) Gradually heat the piston to approximately 50°C (122°F).



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

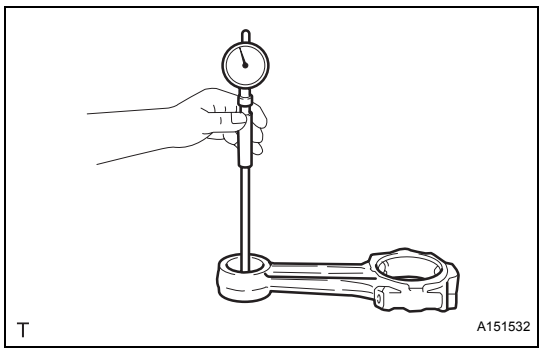
59. REMOVE STUD BOLT



60. INSPECT PISTON PIN OIL CLEARANCE

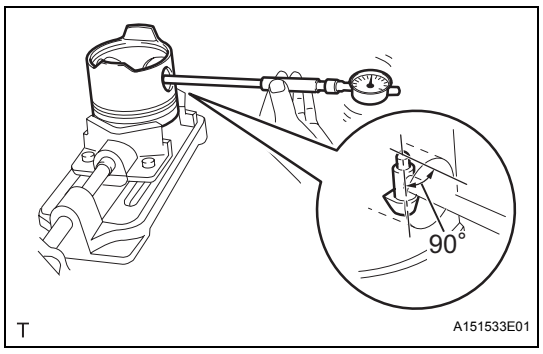
(a) Using a micrometer, measure the piston pin diameter.
Standard piston pin diameter:
36.989 to 37.000 mm (1.4563 to 1.4567 in.)
Minimum piston pin diameter:
36.96 mm (1.4551 in.)
If the diameter is less than the minimum, replace the piston pin with a new one.

HINT:
Never grind the piston pin, because the surface is coated with a special material.



(b) Using a cylinder gauge, measure the connecting rod bush inside diameter.
Standard bush inside diameter:
37.035 to 37.045 mm (1.4581 to 1.4585 in.)
Maximum bush inside diameter:
37.10 mm (1.4606 in.)
If the inside diameter is greater than the maximum, replace the connecting rod bush with a new one.

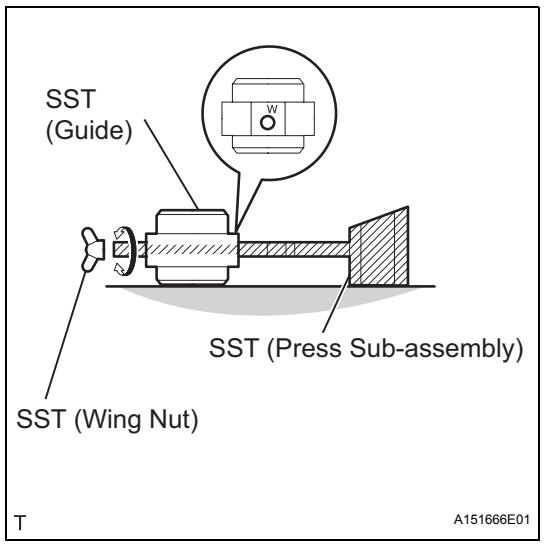
(c) Subtract the diameter measurement of the piston pin from the inside diameter measurement of the connecting rod bush.
Standard oil clearance:
0.035 to 0.056 mm (0.0014 to 0.0022 in.)
Maximum oil clearance:
0.08 mm (0.0031 in.)
If the oil clearance is greater than the maximum, replace the piston with a new one.



(d) Using a cylinder gauge, measure the piston pin hole inside diameter while turning the gauge 90°.
Standard piston pin hole inside diameter:
36.987 to 37.003 mm (1.4562 to 1.4568 in.)
Maximum piston pin hole inside diameter:
37.05 mm (1.4587 in.)
If the piston pin hole inside diameter is greater than the maximum, replace the piston with a new one.

(e) Subtract the diameter measurement of the piston pin from the inside diameter measurement of the piston pin hole.
Standard oil clearance:
-0.013 to 0.014 mm (-0.0005 to 0.0005 in.)
Maximum oil clearance:
0.05 mm (0.0020 in.)
HINT:
If the clearance is greater than the maximum, replace the piston or piston pin.

EM

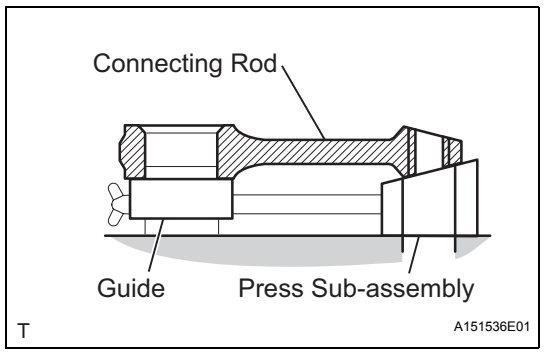


61. REMOVE CONNECTING ROD SMALL END BUSH

(a) Prepare SST.

SST S0940-21450, S0948-11130, S9233-10360

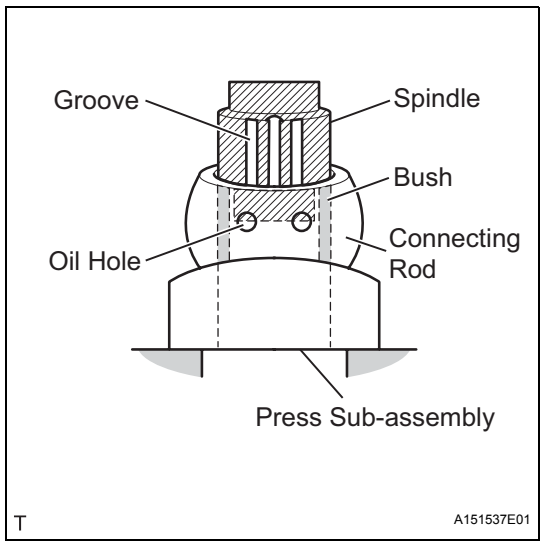
(1) Assemble the guide and press sub-assembly by inserting its pin into the guide, then secure them with the wing nut.
HINT:
Orient the letter W, stamped on the guide, above the pin.



(2) Align both supporting surfaces of the guide and press sub-assembly flatly on an even plane.

(b) Using the SST, remove the bush.

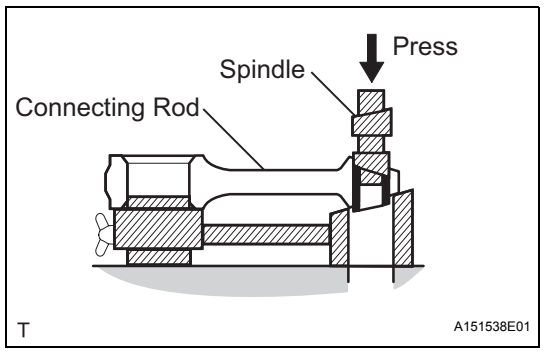
(1) Set the connecting rod assembled without connecting rod bearing on the guide and press sub-assembly.



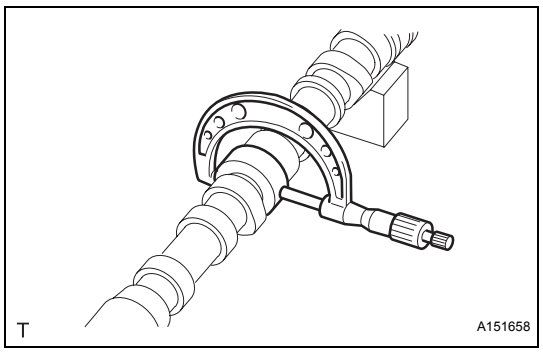
(2) Using SST, install the spindle into the bush.

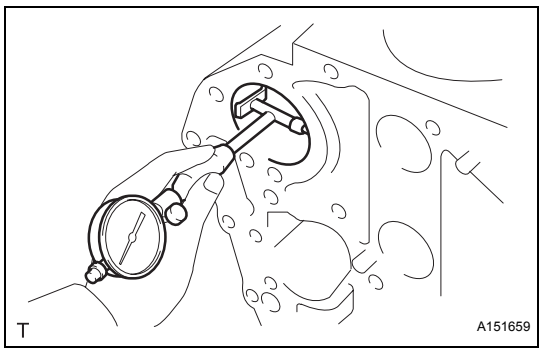
SST S0940-21470

HINT:
Align the groove of the spindle with the oil hole of the bush.



(3) Using a press, remove the bush.
HINT:
Always operate the press slowly and smoothly.





62. INSPECT CAMSHAFT OIL CLEARANCE

(a) Measure the oil clearance of the camshaft journal.

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

Journal outside diameter:

Journal No.	Specified Condition
No. 1	56.95 to 56.97 mm (2.2421 to 2.2429 in.)
No. 2	56.75 to 56.77 mm (2.2343 to 2.2350 in.)
No. 3	56.55 to 56.57 mm (2.2264 to 2.2272 in.)

If the outside diameter is outside the specified range, replace the camshaft.

(2) Using a cylinder gauge, measure the camshaft bearing inside diameter.

Inside diameter

Journal No.	Specified Condition
No. 1	57.035 to 57.135 mm (2.2455 to 2.2494 in.)
No. 2	56.835 to 56.935 mm (2.2376 to 2.2415 in.)
No. 3	56.635 to 56.735 mm (2.2297 to 2.2337 in.)

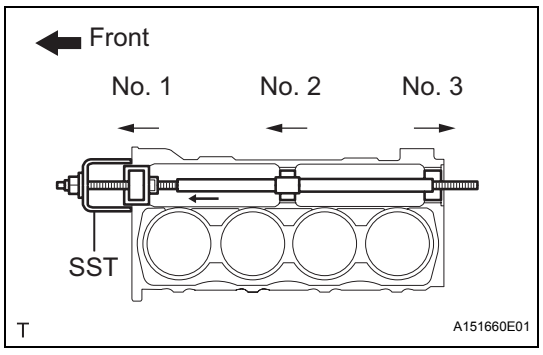
If the inside diameter is outside the specified range, replace the camshaft bearing.

(3) Subtract the outside diameter measurement of the camshaft journal from the inside diameter measurement of the camshaft bearing.

Oil clearance

Item	Specified Condition
Standard	0.030 to 0.120 mm (0.0012 to 0.0047 in.)
Maximum	0.15 mm (0.0059 in.)

If the oil clearance is greater than the maximum, replace the camshaft or camshaft bearing.



63. REMOVE CAMSHAFT BEARING

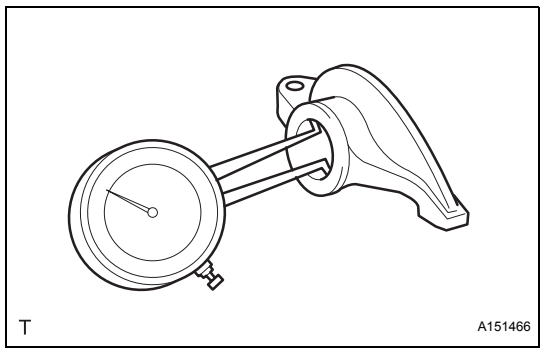
(a) Using SST, remove the camshaft bearings in the directions indicated by the arrow marks in the illustration.

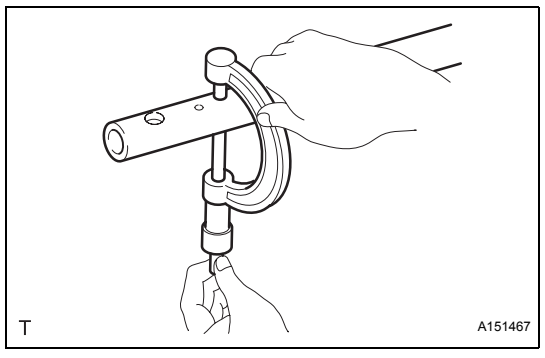
SST 09215-00101 (09215-00130, 09215-00141, 09215-00150, 09215-00161), 09215-00013 (09215-00021, 09215-00461)

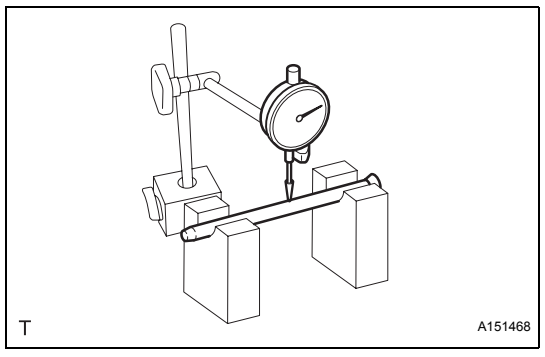
NOTICE:

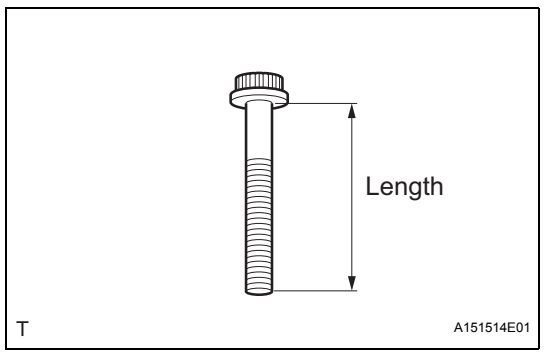
Remove the bearings No. 1, No. 2 and No. 3 in order.

EM









INSPECTION

1. INSPECT VALVE ROCKER ARM OIL CLEARANCE

(a) Using a caliper gauge, measure the inside diameter of the rocker arm bush.
Standard bush inside diameter:
22.023 to 22.052 mm (0.8670 to 0.8681 in.)
Maximum bush inside diameter:
22.08 mm (0.8693 in.)
If the inside diameter is greater than the maximum, replace the bush.
NOTICE:
When installing a bush into the rocker arm, align the bush correctly with the 2 oil holes on the rocker arm.

(b) Using a micrometer, measure the outside diameter of the rocker arm shaft.
Standard shaft diameter:
21.959 to 21.980 mm (0.8645 to 0.8653 in.)
Minimum shaft diameter:
21.92 mm (0.8630 in.)
If the outside diameter is less than the minimum, replace the rocker arm shaft and rocker arm.

(c) Subtract the valve rocker arm inside diameter measurement from the valve rocker shaft outside diameter measurement.
Standard oil clearance:
0.043 to 0.093 mm (0.0017 to 0.0036 in.)
Maximum oil clearance:
0.15 mm (0.0059 in.)
If the oil clearance is greater than the maximum, replace the rocker arm shaft and rocker arm bush.

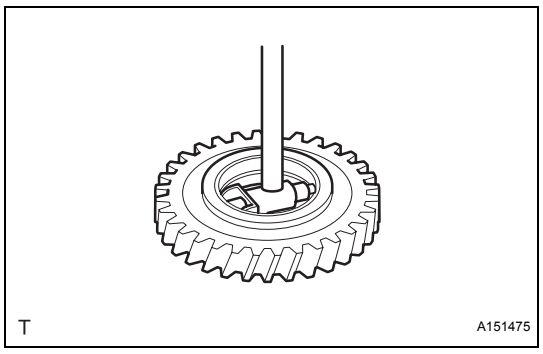
2. INSPECT VALVE PUSH ROD

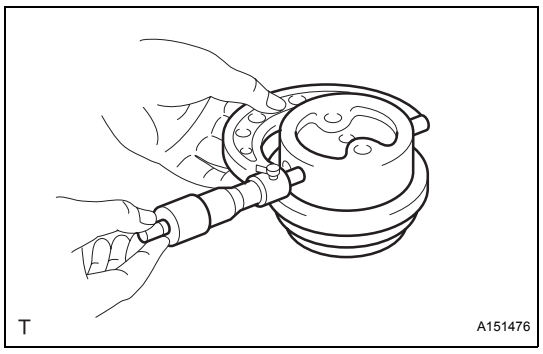
(a) Place the push rod on V-blocks.

(b) Using a dial indicator, measure the circle runout at the center of the push rod.
Maximum circle runout:
0.30 mm (0.0118 in.)
If the circle runout is greater than the maximum, replace the push rod.

3. INSPECT CYLINDER HEAD SET BOLT

(a) Measure the length of the M12 head bolts (No. 1 to No. 18).
Maximum length:
129 mm (5.07 in.)
If the length is greater than the maximum, replace the applicable bolts.



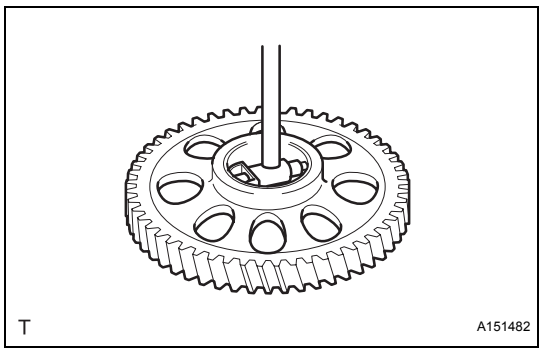


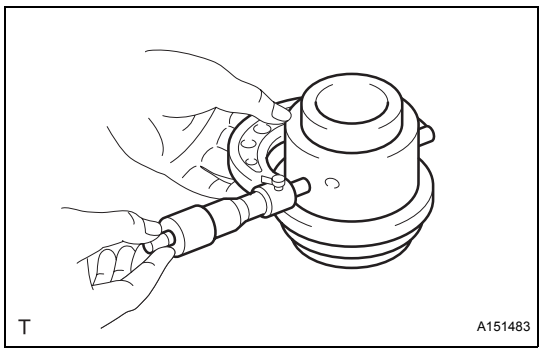
4. INSPECT NO. 2 IDLE GEAR OIL CLEARANCE

(a) Using a cylinder gauge, measure the inside diameter of the No. 2 idle gear.
Standard idle gear inside diameter:
50.000 to 50.025 mm (1.9685 to 1.9695 in.)
Maximum idle gear inside diameter:
50.05 mm (1.9704 in.)
If the diameter is greater than the maximum, replace the No. 2 idle gear.

(b) Using a micrometer, measure the diameter of the No. 2 idle gear shaft.
Standard shaft diameter:
49.950 to 49.975 mm (1.9665 to 1.9675 in.)
Minimum idle gear shaft diameter:
49.95 mm (1.9665 in.)
If the diameter is less than the minimum, replace the No. 2 idle gear shaft.

(c) Subtract the No. 2 idle gear inside diameter measurement from the No. 2 idle gear shaft diameter measurement.
Standard oil clearance:
0.0125 to 0.0375 mm (0.0005 to 0.0014 in.)
Maximum oil clearance:
0.10 mm (0.0039 in.)
If the clearance is greater than the maximum, replace the No. 2 idle gear and No. 2 idle gear shaft.





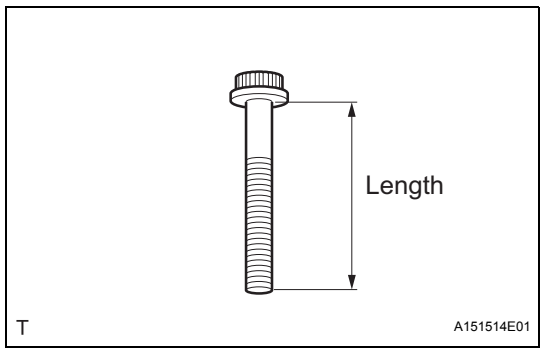
5. INSPECT NO. 1 IDLE GEAR OIL CLEARANCE

(a) Using a cylinder gauge, measure the inside diameter of the No. 1 idle gear.
Standard idle gear inside diameter:
50.000 to 50.025 mm (1.9685 to 1.9695 in.)
Maximum idle gear inside diameter:
50.05 mm (1.9704 in.)
If the diameter is greater than the maximum, replace the No. 1 idle gear.

(b) Using a micrometer, measure the diameter of the No. 1 idle gear shaft.
Standard idle gear shaft diameter:
49.950 to 49.975 mm (1.9665 to 1.9675 in.)
Minimum idle gear shaft diameter:
49.95 mm (1.9665 in.)
If the diameter is less than the minimum, replace the No. 1 idle gear shaft.

(c) Subtract the No. 1 idle gear inside diameter measurement from the No. 1 idle gear shaft outside diameter measurement.
Standard oil clearance:
0.0125 to 0.0370 mm (0.0005 to 0.0014 in.)
Maximum oil clearance:
0.10 mm (0.0039 in.)

If the clearance is greater than the maximum, replace the No. 1 idle gear and No. 1 idle gear shaft.

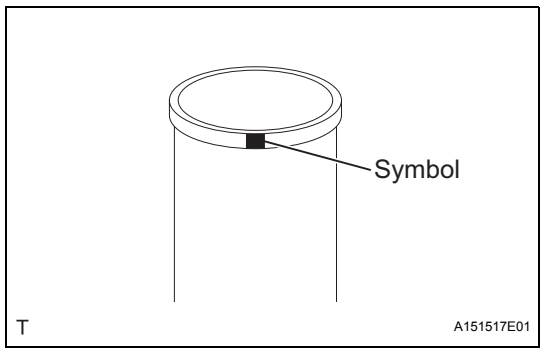


6. INSPECT CONNECTING ROD BOLT

(a) Using a vernier caliper, measure the length of the connecting rod bolt.

Standard bolt length:
59.00 mm (2.3228 in.)
Maximum bolt length:
61.5 mm (2.421 in.)

If the diameter is greater than the maximum, replace the connecting rod bolt.



7. INSPECT CYLINDER LINER

(a) Using a micrometer, measure the outside diameter of the cylinder liner.

Standard

Symbols	Outside Diameter
A	106.982 to 106.989 mm (4.2119 to 4.2122 in.)
B	106.990 to 106.995 mm (4.2122 to 4.2124 in.)
C	106.996 to 107.004 mm (4.2124 to 4.2128 in.)

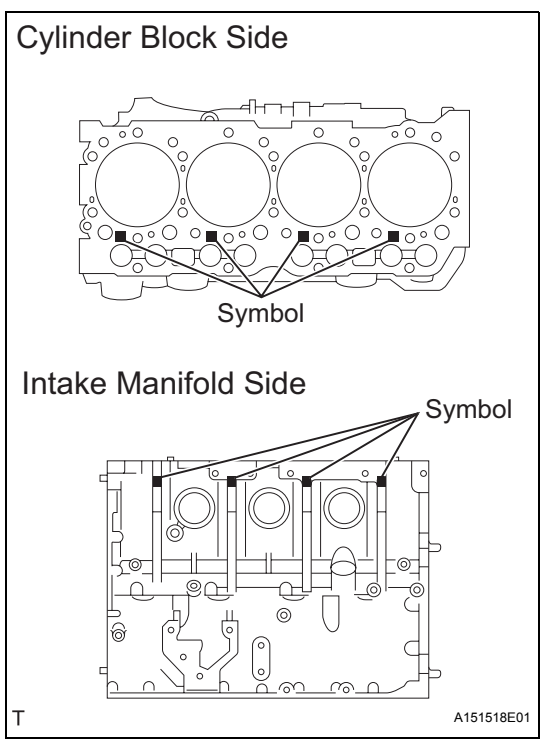
If the diameter is less than the standard, replace the cylinder liner.

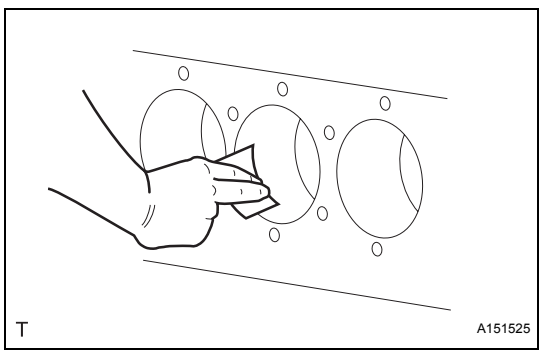
(b) Using a cylinder gauge, measure the inside diameter of the cylinder block.

Standard

Symbols	Inside Diameter
A	107.000 to 107.008 mm (4.2126 to 4.2129 in.)
B	107.008 to 107.014 mm (4.2129 to 4.2131 in.)
C	107.014 to 107.022 mm (4.2131 to 4.2135 in.)

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

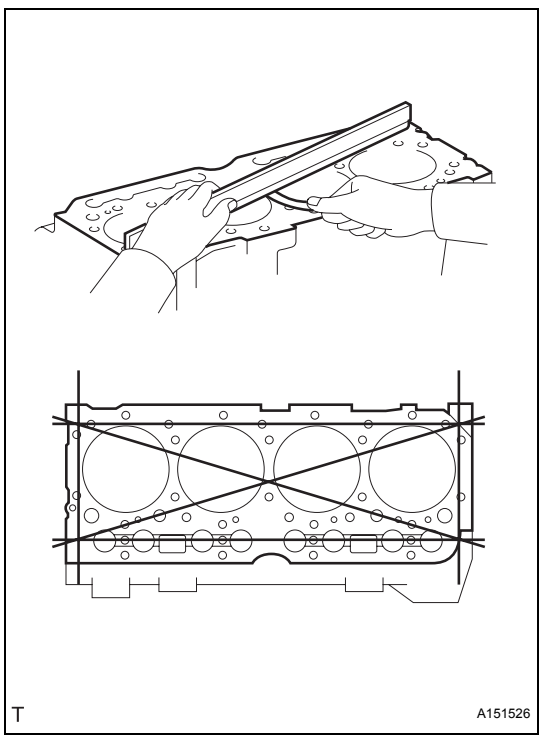




8. INSPECT CYLINDER BLOCK FOR WARPAGE

HINT:

Before the measurement, remove carbon deposits from the upper end inside the cylinder liner with a scraper or emery paper (recommended: No. 150), working in a circular direction. Make sure that there are no scratches inside the cylinder liner.



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

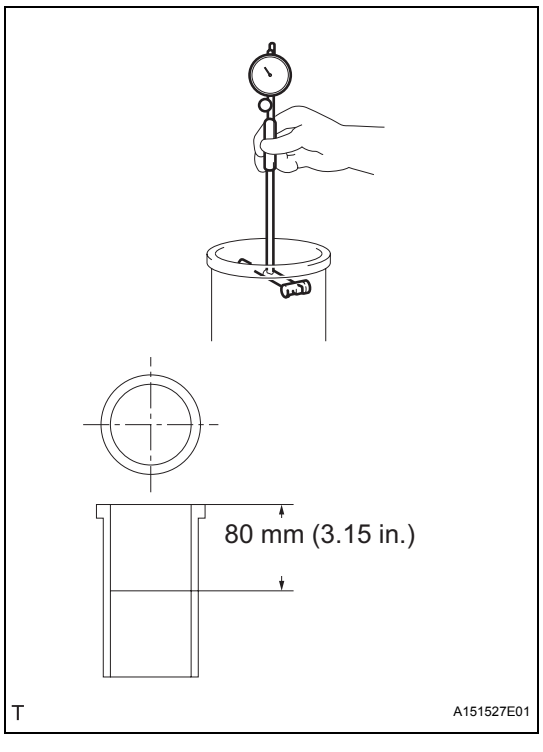
Maximum warpage:

0.10 mm (0.0039 in.)

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

(b) Visually check the cylinders for vertical scratches.

If deep scratches are found, rebore all 4 cylinders. If necessary, replace the cylinder block.



9. INSPECT CYLINDER BORE

(a) Using a cylinder gauge, measure the cylinder liner inside diameter at the 4 points shown in the illustration.

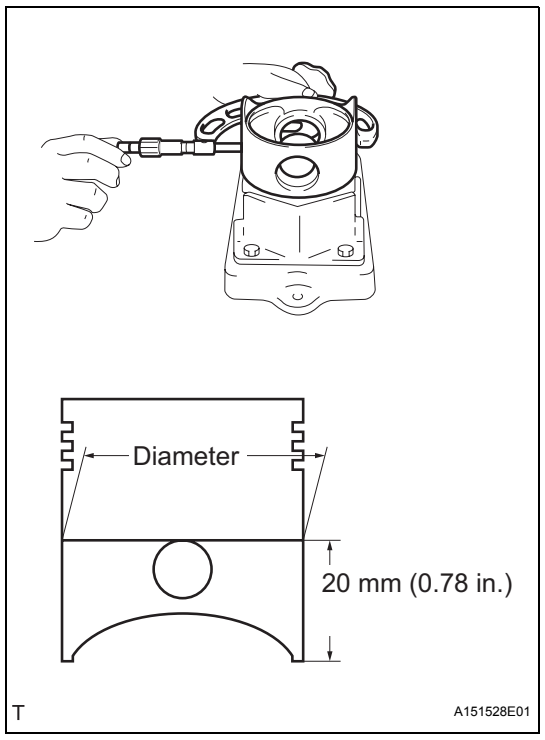
Standard inside diameter:

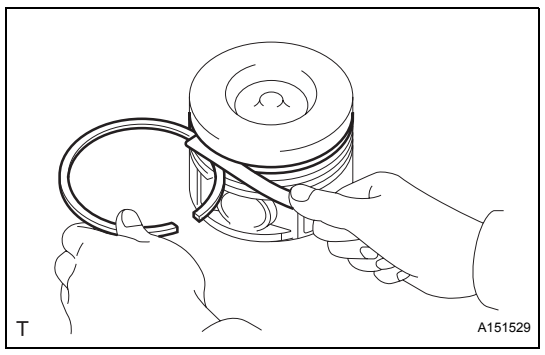
104.012 to 104.036 mm (4.0950 to 4.0959 in.)

Maximum inside diameter:

104.15 mm (4.1004 in.)

If the diameter is greater than the maximum, replace the cylinder liner with a new one.





10. INSPECT PISTON

(a) Using a micrometer, measure the piston diameter at the point in the illustration.
Standard piston diameter:
103.912 to 103.928 mm (4.0910 to 4.0917 in.)
If the diameter is less than the standard, replace the piston with a new one.

11. INSPECT PISTON OIL CLEARANCE

(a) Subtract the piston diameter measurement from the cylinder liner inside diameter measurement.
Standard oil clearance:
0.084 to 0.124 mm (0.0033 to 0.0049 in.)
If the clearance is outside the specified range, replace the cylinder liner and/or piston with a new one.
HINT:
Apply the value measured at the most worn point to the cylinder liner inside diameter.

12. INSPECT RING GROOVE CLEARANCE

(a) Insert the piston ring into the piston ring groove.
(b) Using a feeler gauge, measure the clearance between the piston ring and piston ring groove.
Standard groove clearance

Item	Specified Condition
1st	0.11 to 0.15 mm (0.0043 to 0.0059 in.)
2nd	0.07 to 0.11 mm (0.0028 to 0.0043 in.)
Oil	0.02 to 0.06 mm (0.0008 to 0.0024 in.)

Maximum groove clearance:
0.30 mm (0.0118 in.)
If the clearance is greater than the maximum, measure the width of the piston ring and piston ring groove individually and replace any parts that do not meet the specified range with new ones.

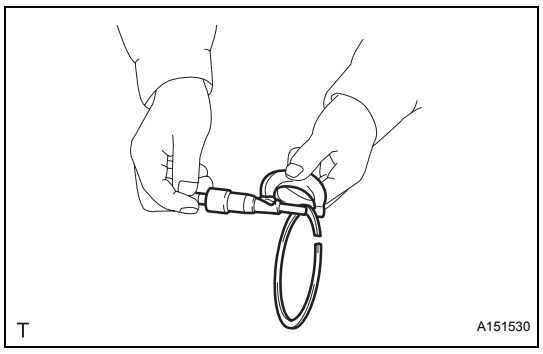
(c) Using a feeler gauge, measure the dimension of each groove.
Standard groove width

Item	Specified Condition
1st	2.58 to 2.60 mm (0.1016 to 0.1024 in.)
2nd	2.06 to 2.08 mm (0.0811 to 0.0819 in.)
Oil	4.01 to 4.03 mm (0.1579 to 0.1587 in.)

Maximum groove width

Item	Specified Condition
1st	3.10 mm (0.1220 in.)
2nd	2.20 mm (0.0866 in.)
Oil	4.08 mm (0.1606 in.)

If the dimension is greater than the maximum, replace the piston and piston rings as a set.



(d) Using a micrometer, measure the piston ring thickness.

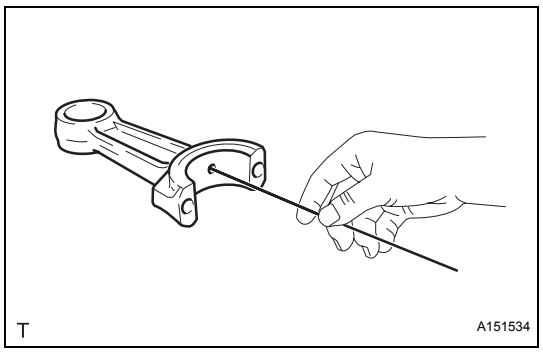
Standard ring thickness

Item	Specified Condition
1st	2.47 to 2.49 mm (0.0972 to 0.0980 in.)
2nd	1.97 to 1.99 mm (0.0776 to 0.0783 in.)
Oil	3.97 to 3.99 mm (0.1563 to 0.1570 in.)

Minimum ring thickness

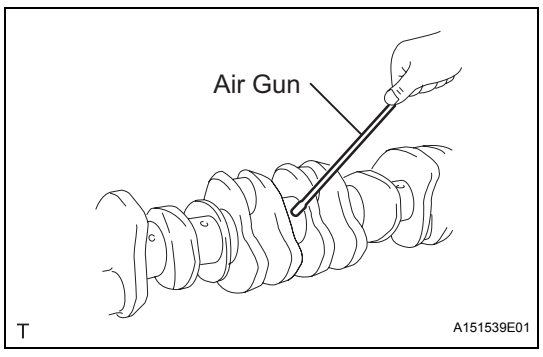
Item	Specified Condition
1st	2.32 mm (0.0913 in.)
2nd	1.82 mm (0.0717 in.)
Oil	3.95 mm (0.1555 in.)

If the thickness is less than the minimum, replace the piston ring.



13. INSPECT CONNECTING ROD SUB-ASSEMBLY

(a) Check that there is no clogging in the lubrication passage to the connecting rod small end.
If there is any clogging, blow air through the lubrication passage using an air gun, or clean by inserting a wire.

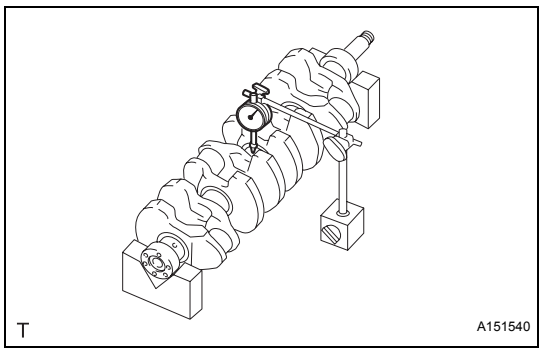


14. INSPECT CRANKSHAFT

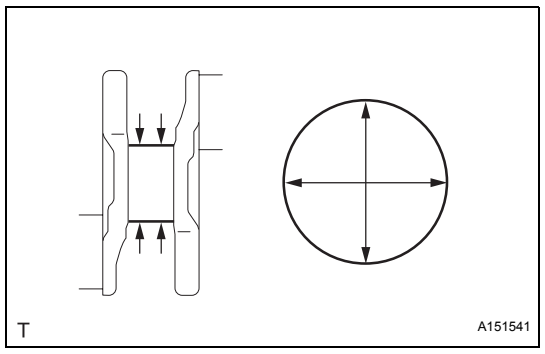
HINT:
Before the inspection, clean the crankshaft with a commercial cleaning agent and clean the lubrication passage using an air gun.

(a) Performing the dye penetrant test, check the crankshaft for cracks.
HINT:
Pay special attention to the finished R section and oil hole of the crankshaft journal and crankshaft pin.

(b) Visually check the crankshaft journal and pin for damage or wear.
If any damage is found, replace the crankshaft with a new one.



(c) Inspect for runout.
(1) Place the crankshaft on V-blocks.
(2) Using a dial gauge, measure the circle runout of the crankshaft at the center journal.
Maximum runout:
0.04 mm (0.0016 in.)
If the circle runout is greater than the maximum, replace the crankshaft with a new one.



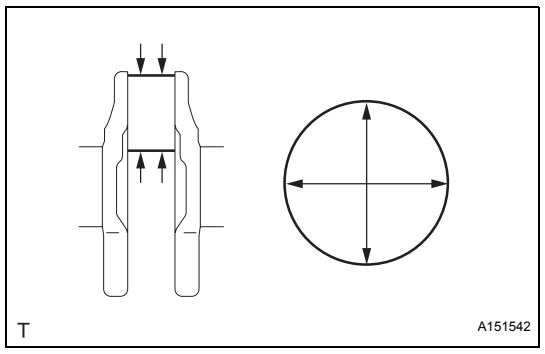
(d) Using a micrometer, measure the main journal outside diameter.
Standard journal diameter:
72.94 to 72.96 mm (2.8717 to 2.8724 in.)
Minimum journal diameter

Item	Specified Condition
New	72.74 mm (2.8638 in.)
Old	71.76 mm (2.8252 in.)

If the diameter is less than the minimum, replace the crankshaft with a new one.

(e) Check each main journal for taper and out-of-round.
Maximum taper and out-of-round:
0.1 mm (0.004 in.)
If the taper and out-of-round are greater than the maximum, replace the crankshaft.

EM

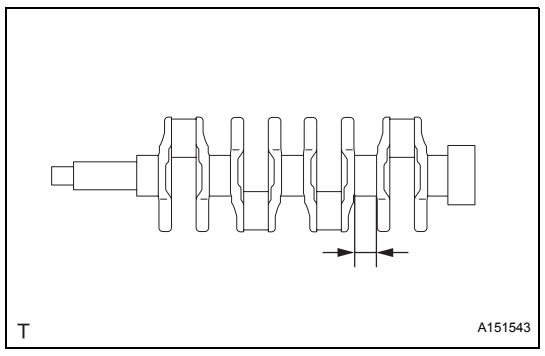


(f) Using a micrometer, measure the crankshaft pin outside diameter.
Standard journal diameter:
61.94 to 61.96 mm (2.4386 to 2.4394 in.)
Minimum journal diameter

Item	Specified Condition
New	61.74 mm (2.4307 in.)
Old	60.76 mm (2.3921 in.)

If the diameter is less than the minimum, replace the crankshaft with a new one.

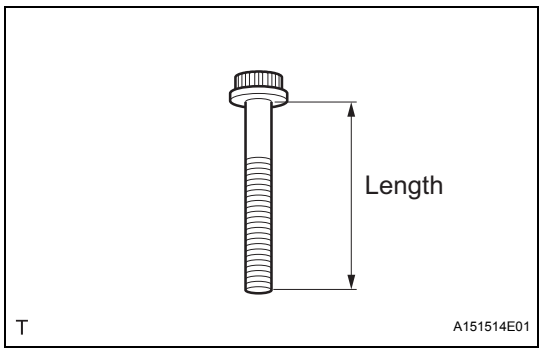
(g) Check each crankshaft pin for taper and out-of-round.
Maximum taper and out-of-round:
0.1 mm (0.004 in.)
If the taper and out-of-round are greater than the maximum, replace the crankshaft.



(h) Using a vernier caliper, measure the dimension of the crankshaft No. 4 journal.
Standard journal dimension:
34.00 to 34.08 mm (1.3386 to 1.3417 in.)
Maximum journal dimension:
34.48 mm (1.3574 in.)
If the dimension is greater than the maximum, replace the crankshaft.

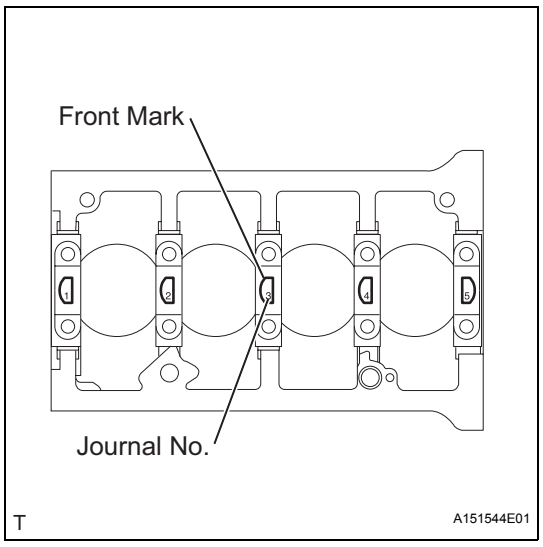
(i) Visually check if there are any cracks on the crankshaft.

(j) Check if the oil hole of the crankshaft is blocked.
If any blockage is found, replace the crankshaft.



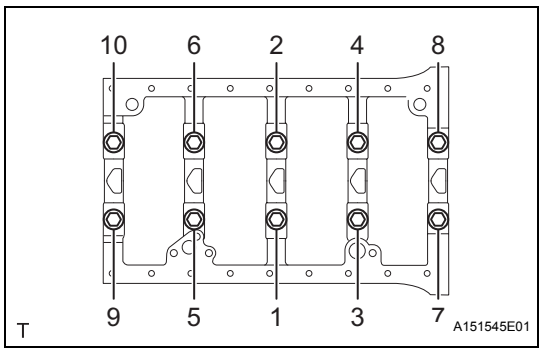
15. INSPECT CRANKSHAFT BEARING CAP SET BOLT

(a) Using a vernier caliper, measure the bearing cap bolt length.
Standard bolt length:
92.80 to 93.80 mm (3.6535 to 3.6929 in.)
Maximum bolt length:
95.00 mm (3.7401 in.)
If the length is longer than the maximum, replace the bolt.

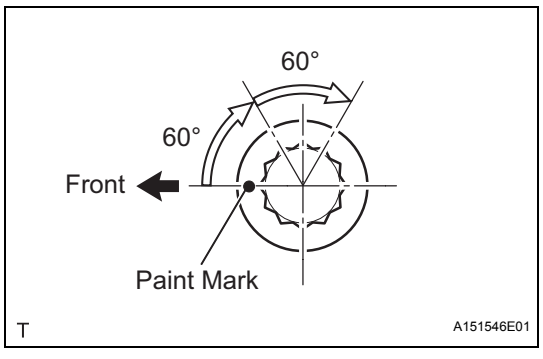


16. INSPECT CRANKSHAFT BEARING CAP

(a) Install the bearing caps onto the cylinder block.
(b) Apply a light coat of engine oil to the threads of the bearing cap bolts.

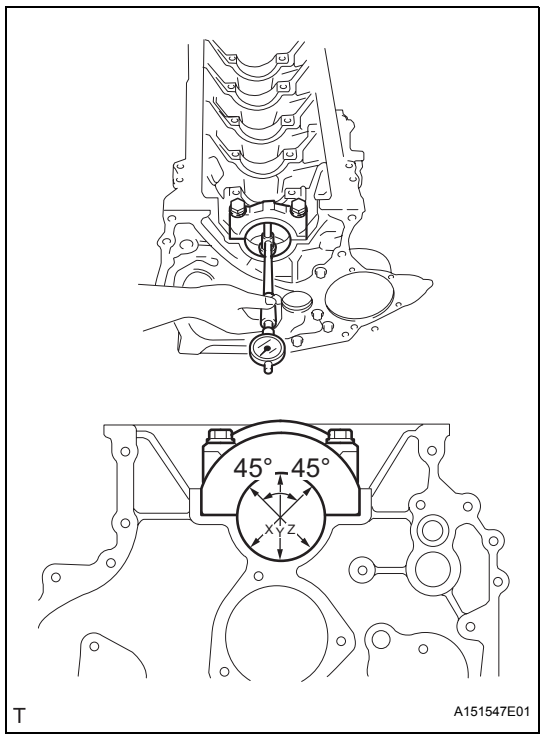


(c) Uniformly tighten the 10 bolts, in several steps, in the order shown in the illustration.
Torque: 59 N*m (600 kgf*cm, 43 ft.*lbf)

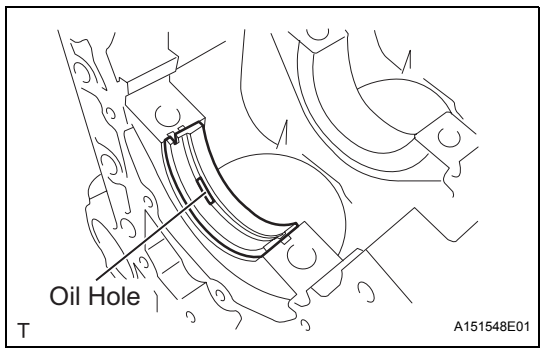


(d) Mark the front side of the bolts with paint.
(e) Retighten the bolts by 60° in the same order as step (c).
(f) Perform step (e) again.
(g) Check that each painted mark is now at a 120° angle to the front.

EM

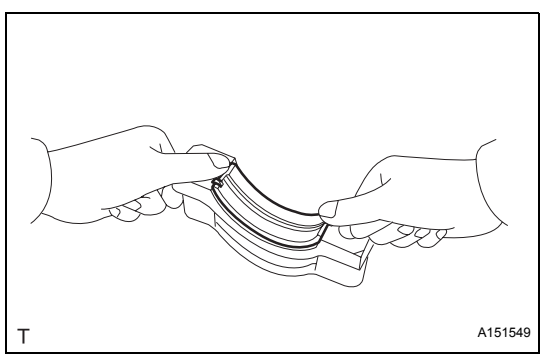


(h) Using a cylinder gauge, measure the crankshaft bearing cap inside diameter at 3 points (X, Y, Z in the illustration).
Standard crankshaft bearing cap inside diameter:
77.985 to 78.00 mm (3.0703 to 3.0709 in.)
Maximum crankshaft bearing cap inside diameter:
78.20 mm (3.0787 in.)
If the inside diameter is greater than the maximum, carry out boring after overlay welding or replace the cylinder block with a new one.
HINT:
When installing the main bearing caps, return them to their original locations according to the number stamped on the caps.

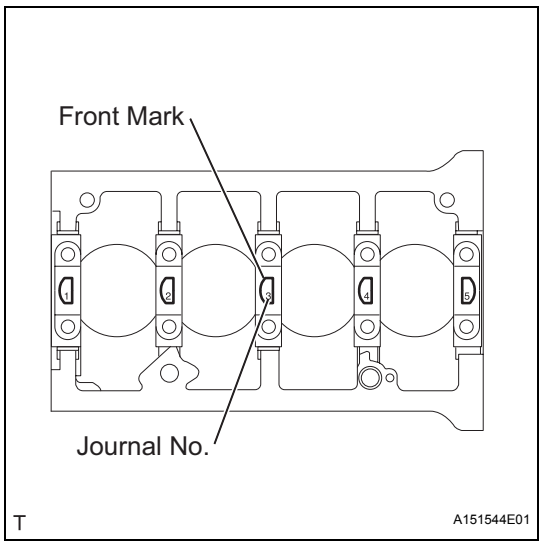


17. INSPECT CRANKSHAFT OIL CLEARANCE
HINT:
The upper bearings have an oil groove and oil hole, however, the lower bearings do not.

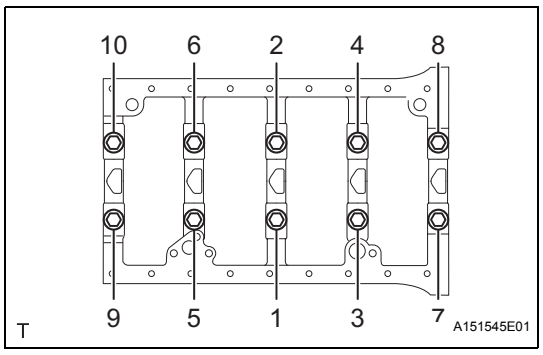
(a) Align the claw of the bearing with the claw groove of the cylinder block, and push in the upper bearing.
NOTICE:
Do not apply engine oil to the bearing and its contact surface.



(b) Align the claw of the bearing with the claw groove of the main bearing cap, and push in the lower bearing.
NOTICE:
Do not apply engine oil to the bearing and its contact surface.

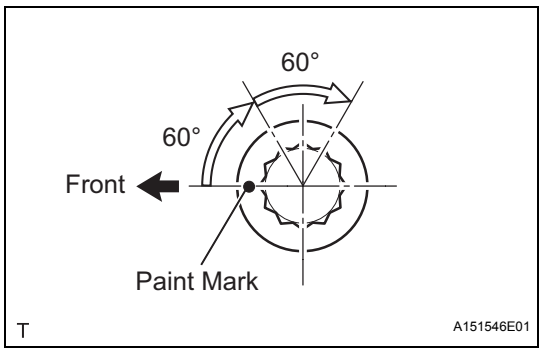


(c) Install the bearing cap onto the cylinder block.
(d) Apply a light coat of engine oil to the threads of the bearing cap bolt.

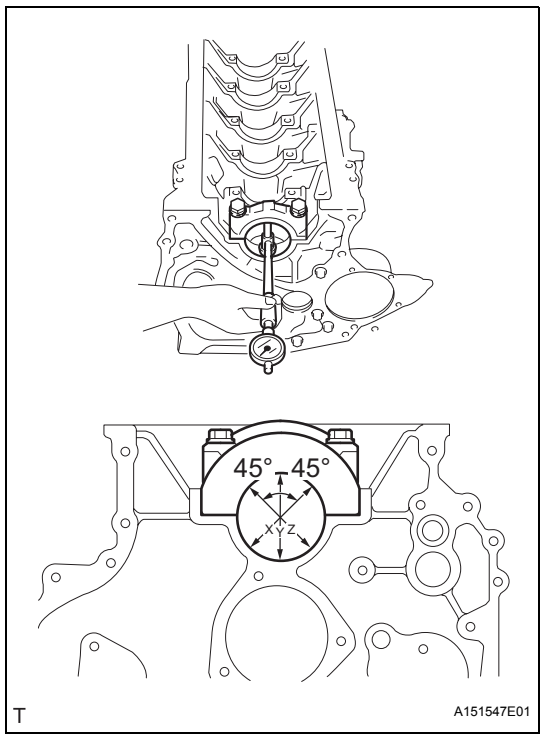


(e) Uniformly tighten the 10 bolts, in several steps, in the order shown in the illustration.
Torque: 59 N*m (600 kgf*cm, 43 ft.*lbf)

EM



(f) Mark the front side of the bolts with paint.
(g) Retighten the bolts by 60° in the same order as step (e).
(h) Perform step (g) again.
(i) Check that each painted mark is now at a 120° angle to the front.

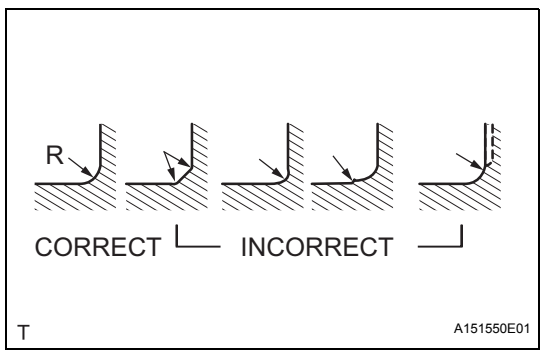


(j) Using a cylinder gauge, measure the crankshaft bearing inside diameter at 3 points (X, Y, Z in the illustration).
Standard crankshaft bearing inside diameter:
73.01 to 73.04 mm (2.8744 to 2.8756 in.)
Maximum crankshaft bearing inside diameter:
73.30 mm (2.8858 in.)
NOTICE:
Do not damage the crankshaft bearing.
If the inside diameter is greater than the maximum, replace the bearing with a new one.
HINT:
When installing the bearing caps, return them to their original locations according to the number stamped on the caps.

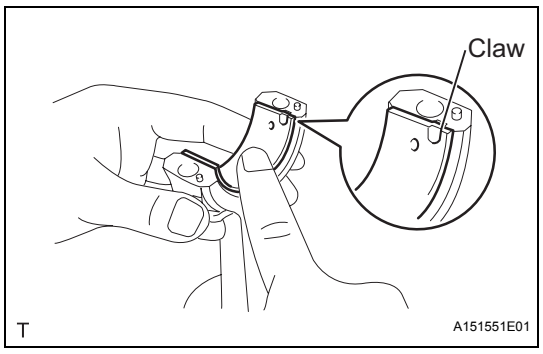
(k) Subtract the crankshaft journal diameter measurement from the bearing inside diameter measurement.
Standard oil clearance:
0.051 to 0.102 mm (0.0020 to 0.0004 in.)
Maximum oil clearance:
0.20 mm (0.0078 in.)
If the oil clearance is greater than the maximum, use an undersize bearing and correct or regrind the crankshaft so that the oil clearance becomes 0.20 mm (0.0078 in.) or less.
Under size bearing diameter

Item	Specified Condition
STD	72.94 to 72.96 mm (2.8717 to 2.8724 in.)
U/S 0.25	72.69 to 72.71 mm (2.8618 to 2.8626 in.)
U/S 0.50	72.44 to 72.46 mm (2.8520 to 2.8528 in.)
U/S 0.75	72.19 to 72.21 mm (2.8421 to 2.8429 in.)
U/S 1.00	71.94 to 71.96 mm (2.8323 to 2.8330 in.)

HINT:
Replace the upper and lower main bearings as one set.



(l) Machined dimension of file R
Main crankshaft journal:
3.00 to 3.50 mm (0.1181 to 0.1378 in.)



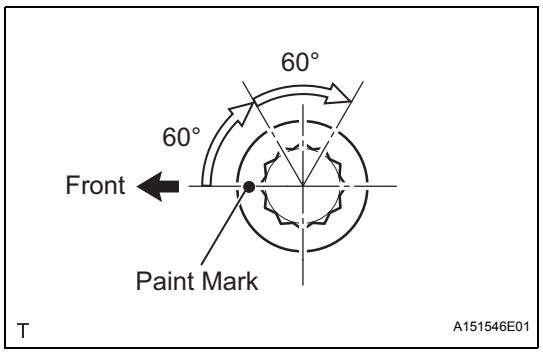
18. INSPECT CONNECTING ROD BEARING OIL CLEARANCE

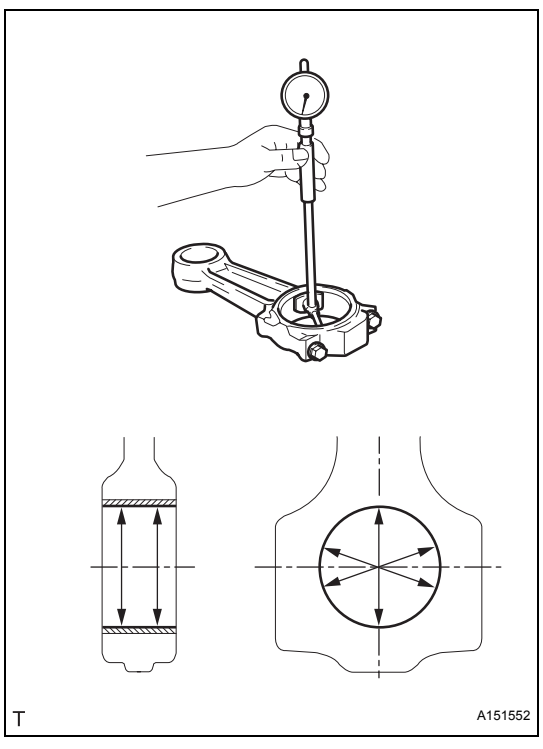
(a) Align the claw of the bearing with the claw grooves of the connecting rod and connecting cap.
NOTICE:
Clean the back side of the bearing and the bearing surface of the connecting rod. The surface should be free of dust and oil.

(b) Tighten the connecting rod bolts.
(1) Install the bearing caps.
NOTICE:
Be careful of the installation direction of the bearing caps.
(2) Uniformly tighten the bolts in several steps.
(3) Retighten the connecting rod bolts.
Torque: 30 N*m (300 kgf*cm, 22 ft.*lbf)
(4) Mark the front side of the bolts with paint.

(c) Retighten the bolts by 60° in the same order as step (b-2).

(d) Perform step (c) again.



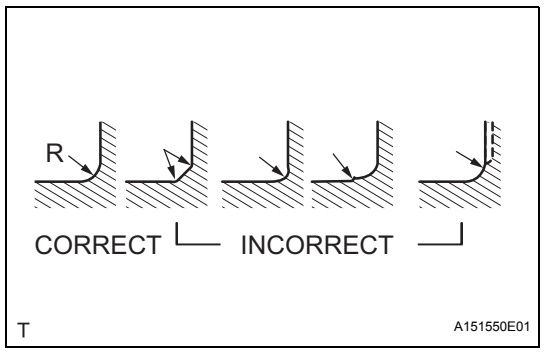


(e) Using a cylinder gauge, measure the connecting rod big end inside diameter.
Standard big end inside diameter (w/ bearing):
61.991 to 62.022 mm (2.4406 to 2.4418 in.)
Maximum big end inside diameter (w/ bearing):
62.06 mm (2.4433 in.)
If the result is greater than the maximum, replace the connecting rod bearing.

(f) Subtract the inside diameter measurement of the connecting rod from the diameter measurement of the crankshaft pin.
Standard clearance:
0.031 to 0.082 mm (0.0012 to 0.0032 in.)
Maximum oil clearance:
0.20 mm (0.0079 in.)
If the result is greater than the maximum, use an undersize bearing and correct or regrind the crankshaft so that the oil clearance becomes 0.2 mm (0.0079 in.) or less.
Under size bearing diameter

Item	Specified Condition
STD	61.94 to 61.96 mm (2.4386 to 2.4394 in.)
U/S 0.25	61.69 to 61.71 mm (2.4287 to 2.4295 in.)
U/S 0.50	61.44 to 61.46 mm (2.4189 to 2.4197 in.)
U/S 0.75	61.19 to 61.21 mm (2.4090 to 2.4098 in.)
U/S 1.00	60.94 to 60.96 mm (2.3992 to 2.4000 in.)

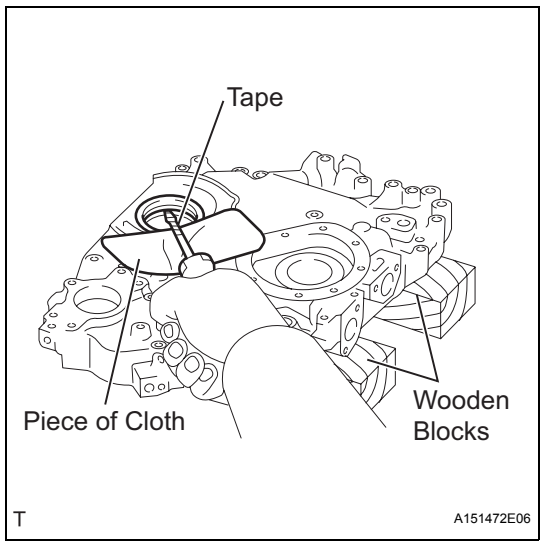
EM



(1) Machined dimension of file R
Crankshaft pin:
3.50 to 4.00 mm (0.1378 to 0.1575 in.)

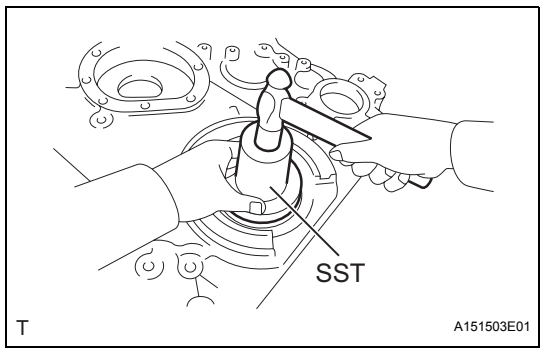
REPLACEMENT

HINT:
There are 2 methods to replace the timing chain or belt cover oil seal.



1. REPLACE TIMING CHAIN OR BELT COVER OIL SEAL

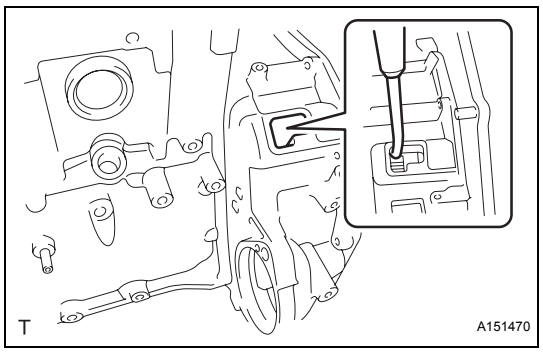
(a) If the timing gear case is removed from the cylinder block:
(1) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.
HINT:
Use wooden blocks and a piece of cloth to prevent damage to the timing gear case.



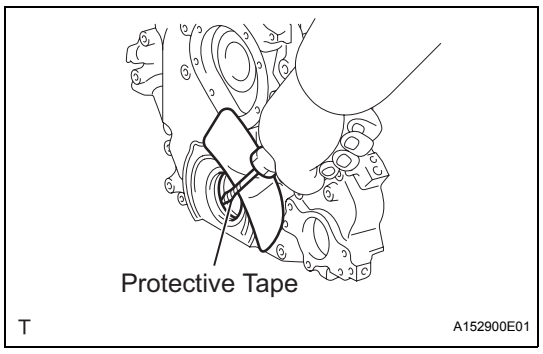
(2) Using SST and a hammer, tap in the oil seal to the timing gear case so that oil seal is flush with the timing gear edge.
SST 09223-78010
NOTICE:
- **Be careful not to tap the oil seal at an angle.**
- **Keep the gap between the gear case edge and the oil seal free of foreign matter.**

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

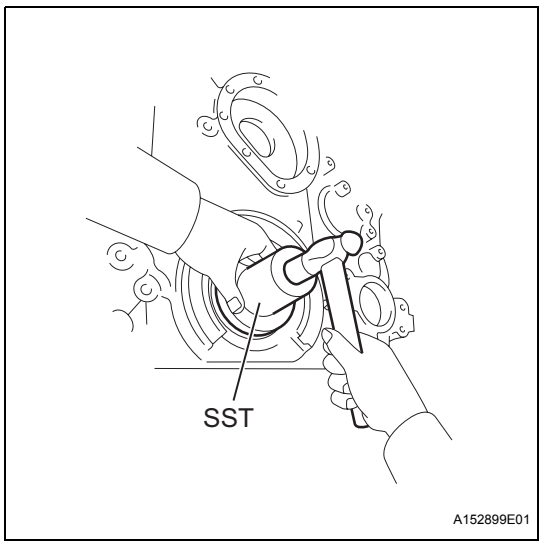
(b) If the timing gear case is installed onto the cylinder block:
(1) Drain engine oil (LU-3).
(2) Drain engine coolant (CO-4).
(3) Remove the intercooler assembly (IT-21).
(4) Remove the radiator assembly (CO-34).



(5) Using a 46 mm socket wrench, remove the nut, spacer and crankshaft pulley.
HINT:
Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.

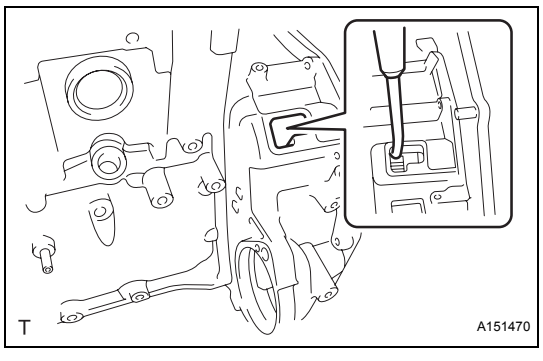


(6) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.



(7) Using SST and a hammer, tap in the oil seal into the timing gear case so that oil seal is flush with the timing gear edge.
SST 09223-78010
NOTICE:
- **Be careful not to tap the oil seal at an angle.**
- **Keep the gap between the gear case edge and the oil seal free of foreign matter.**

(8) Apply MP grease to the oil seal lip.



(9) Install the pulley and spacer onto the crankshaft.
HINT:
Align the pulley set key with the key groove of the pulley.

(10) Using a 46 mm socket wrench, tighten the nut.
Torque: 515 N*m (5250 kgf*cm, 380 ft.*lbf)
HINT:
Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.

(11) Install the radiator assembly (CO-39).

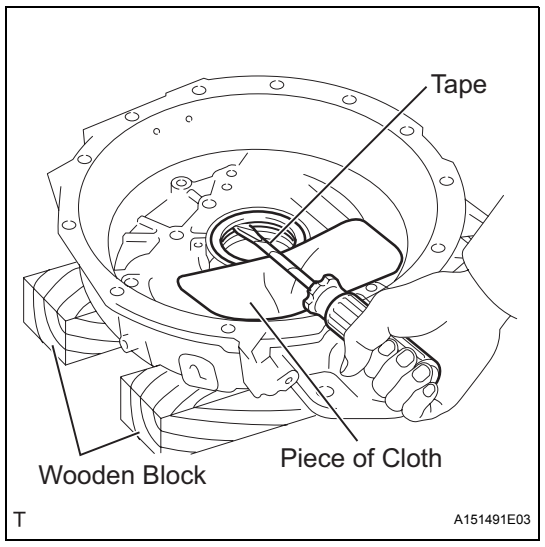
(12) Install the intercooler assembly (IT-23).

(13) Add engine coolant (CO-4).

(14) Add engine oil (LU-3).

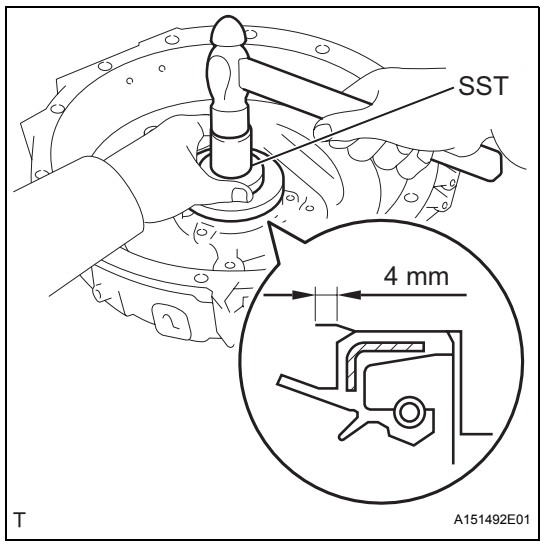
EM

(15) Inspect for coolant leak (CO-3).
(16) Inspect for oil leak (LU-4).



2. REPLACE ENGINE REAR OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the oil seal.



(b) Using SST and a hammer, tap in a new oil seal until it is 4 mm (0.16 in.) below the upper edge of the flywheel housing.
SST 09223-78010
NOTICE:
- **Be careful not to tap the oil seal at an angle.**
- **Keep the gap between the rear oil seal retainer edge and the oil seal free of foreign matter.**

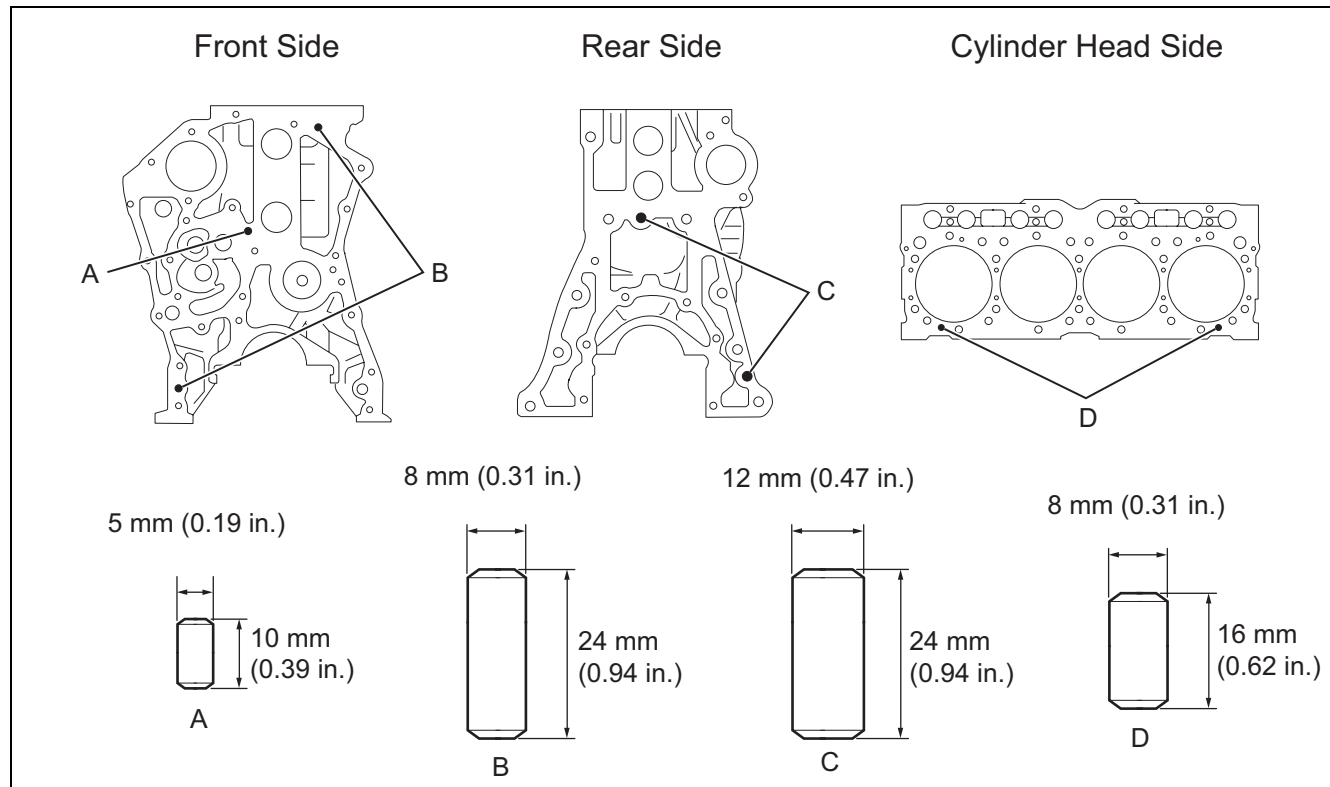
(c) Apply MP grease to the oil seal lip.

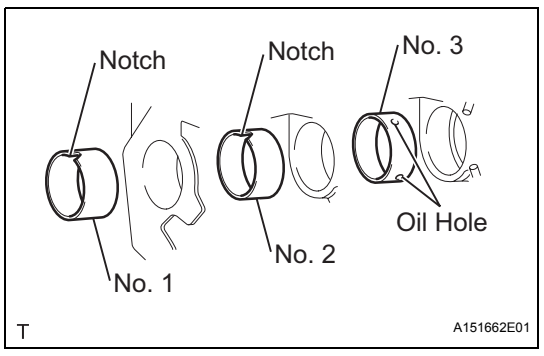
3. REPLACE STRAIGHT PIN

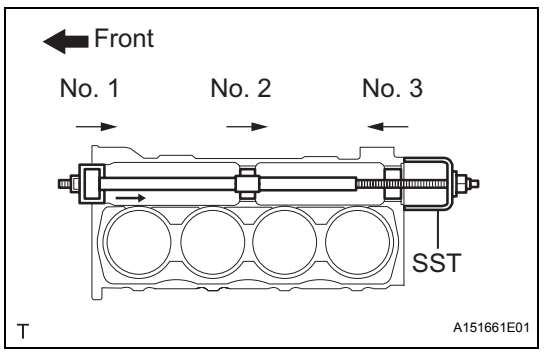
NOTICE:
It is not necessary to remove the straight pins unless they are being replaced.

(a) Remove the 7 straight pins.
(b) Using a plastic-faced hammer, install 7 new straight pins.
Standard protrusion height

Item	Specified Condition
A	6.0 mm (0.236 in.)
B	13.0 mm (0.512 in.)
C	16.0 mm (0.630 in.)
D	6.0 mm (0.236 in.)







REASSEMBLY

1. INSTALL CAMSHAFT BEARING SET

(a) Be sure to face the notches of the bearing No. 1 and No. 2 and oil holes of the No. 3 in the correct direction.

(b) Using SST, install new camshaft bearings in the direction indicated by the arrow marks in the illustration.

SST 09215-00101 (09215-00130, 09215-00141, 09215-00150, 09215-00161), 09215-00013 (09215-00021, 09215-00461)

Journal bearing diameter

Journal No.	Inside diameter	Outside diameter
No. 1	57.0 mm (2.2441 in.)	60.0 mm (2.3622 in.)
No. 2	56.8 mm (2.2362 in.)	59.8 mm (2.3543 in.)

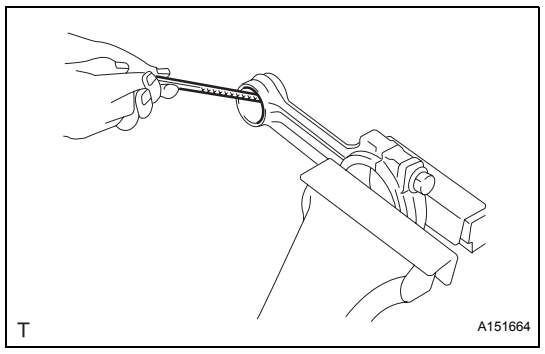
EM

Journal No.	Inside diameter	Outside diameter
No. 3	56.6 mm (2.2283 in.)	59.6 mm (2.3465 in.)

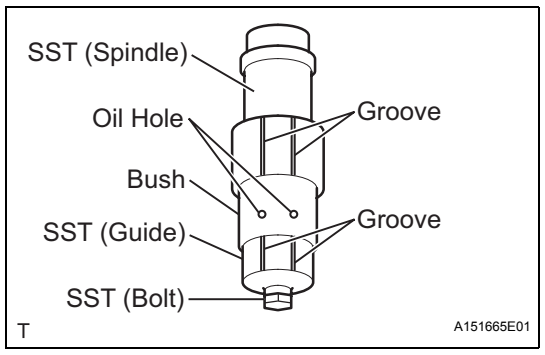
NOTICE:
Install the bearings No. 2, No. 1 and No. 3 in order.

2. INSTALL CONNECTING ROD SMALL END BUSH

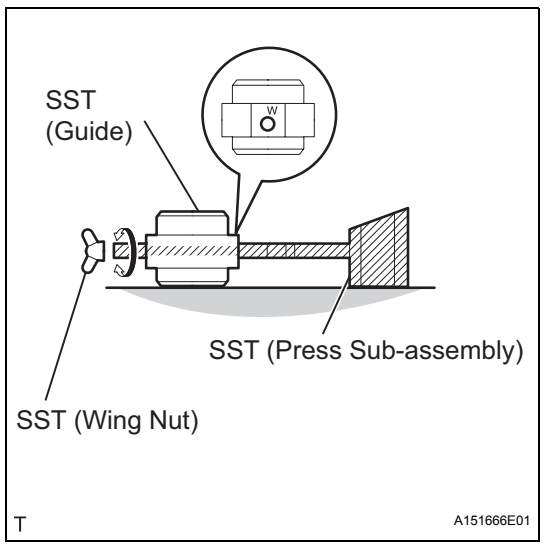
(a) Uniformly chamfer one edge of the bush hole at the small end of the connecting rod.
HINT:
- Irregular chamfering can cause out-of-round of the bush, which may result in jamming during the insertion.
- Remove dust from the inner surface of the connecting rod hole.

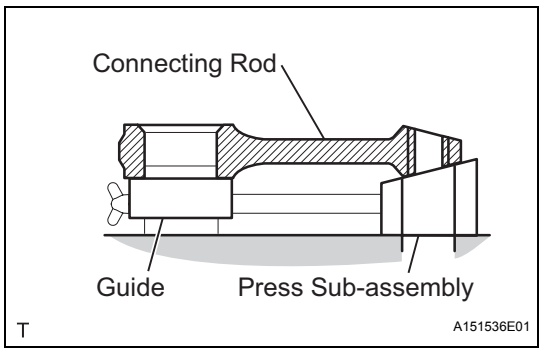


(b) Mount the bush on the spindle.
SST S0940-21470, S0948-11140, S9191-08252
Torque: 6.0 N*m (61 kgf*cm, 53 in.*lbf)
HINT:
Align the oil holes in the bush with both grooves of the spindle and guide, and make sure that oil holes will meet with the oil path in the connecting rod led from the big end bore in the rod.
(1) Apply fresh engine oil around the bush and guide.

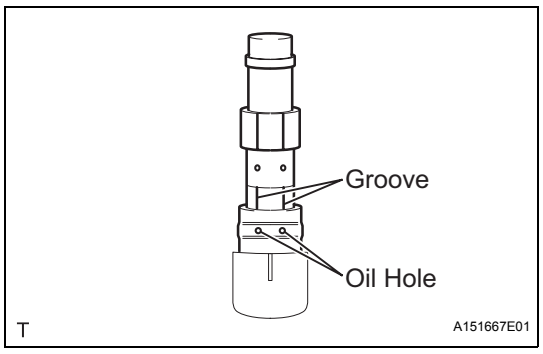


(c) Prepare SST.
SST S0940-21450, S0948-11130, S9233-10360
(1) Assemble the guide and press sub-assembly by inserting its pin into the guide, then secure them with the wing nut.
HINT:
Orient the letter W, stamped on the guide, above the pin.

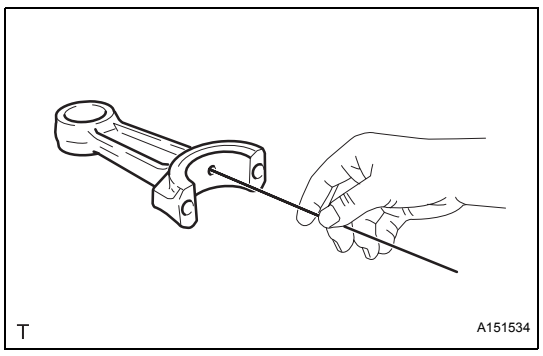




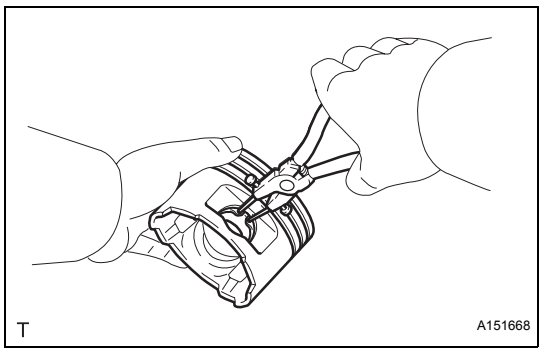
(2) Align both supporting surfaces of the guide and press sub-assembly on an even plane.



(d) Install the bush into the connecting rod. Position the spindle and bush so that the oil holes align with the oil path through the connecting rod.
HINT:
Before installing, fully coat the connecting rod bore with fresh engine oil.



(e) Inspect the bush position after the installation.
(1) Make sure that the oil hole of the bush and the oil path of the connecting rod are suitably aligned allowing a 6 mm (0.23 in.) diameter rod to penetrate.
HINT:
Misalignment can lead to insufficient lubrication, which may result in seizure.
(2) With a new piston pin inserted in the piston, make sure that the pin can be rotated by hand without looseness.



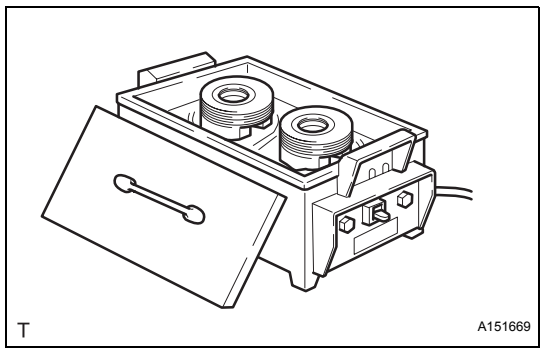
3. INSTALL PISTON PIN HOLE SNAP RING

(a) Using snap ring pliers, install a new snap ring into one side of the piston hole.

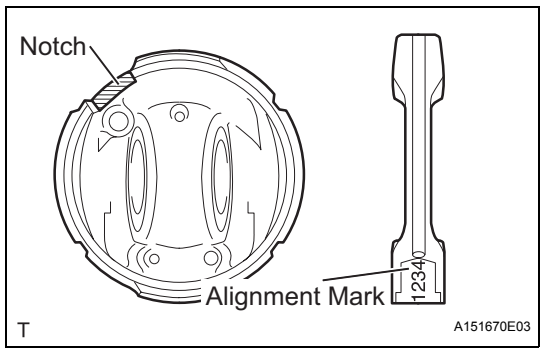
4. INSTALL PISTON

HINT:
Before assembling the piston with the connecting rod, check whether the piston is specified for this engine. The check should be performed using the engine compatible identification code on the top of the piston.
Engine compatible identification:
95

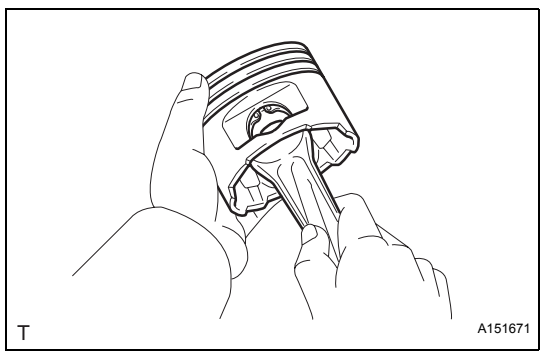
EM



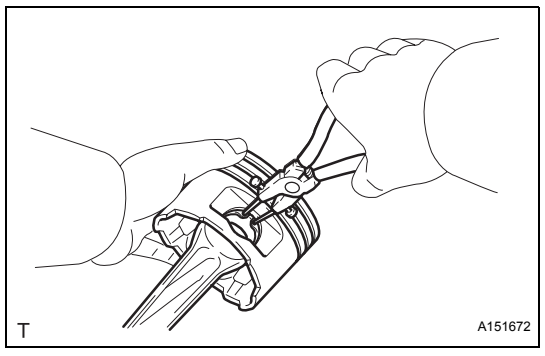
(a) Assemble the piston and connecting rod.
(1) Gradually heat the piston to approximately 50°C (122°F).
CAUTION:
Don't touch the piston while it is hot.



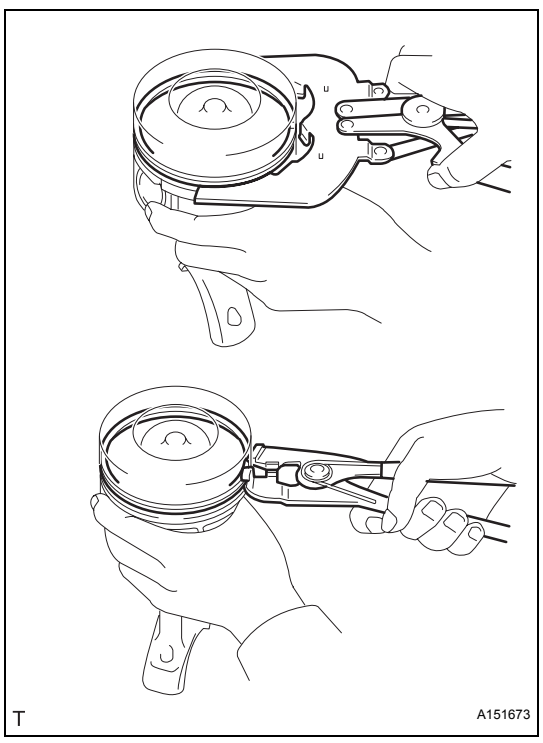
(2) Coat the piston pin with engine oil.
(3) Install the piston onto the connecting rod with the notch on the piston facing in the same direction as the alignment mark on the rod. Then, secure them with the piston pin.



(4) Check that the piston and piston pin fit securely.
HINT:
Try to move the piston back and forth.



(5) Using snap ring pliers, install a new snap ring into the other side of the piston pin hole.



5. INSTALL PISTON RING SET

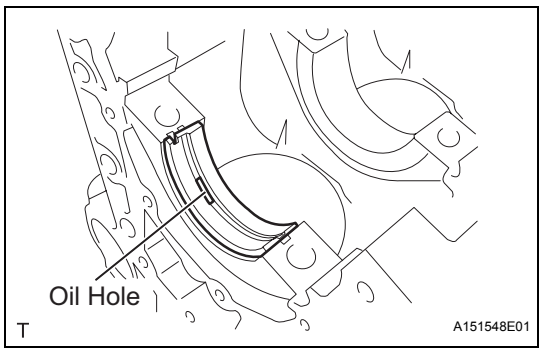
(a) Face the identification marks on the piston ring up, then using a piston ring expander, install them in the following order of the oil ring, 2nd ring and 1st ring.
HINT:
- Never change the combination of the coil and oil ring.
- Connect the joint of the coil expander for the oil ring and install it inside the oil ring. Align the expander joint 180° opposite to the gap of the ring.

6. INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY

(a) Install the No. 1 oil nozzle with the bolt.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)
NOTICE:
- **If the oil nozzle has been dropped or any impact has occurred to the nozzle, replace the nozzle with a new one.**
- **Replace a deformed nozzle with a new one.**

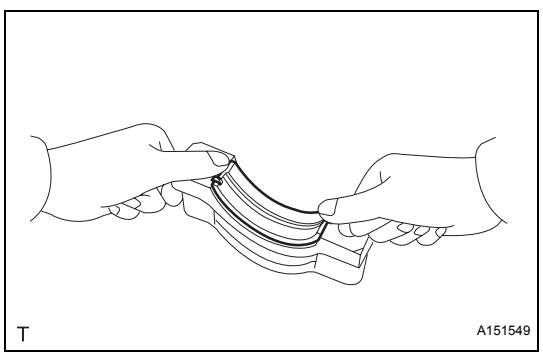
7. INSTALL OIL CHECK VALVE SUB-ASSEMBLY

(a) Install a new gasket and the oil check valve with the bolt.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)



8. INSTALL CRANKSHAFT BEARING SET

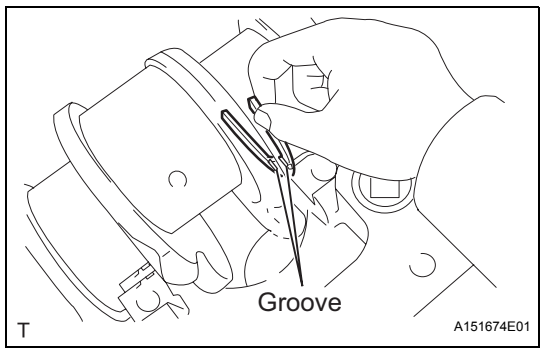
(a) Align the oil groove of the bearing with the oil hole of the cylinder block, and push in the 5 upper bearings.
NOTICE:
Keep the back side of the bearing and the bearing surface free of foreign matter.



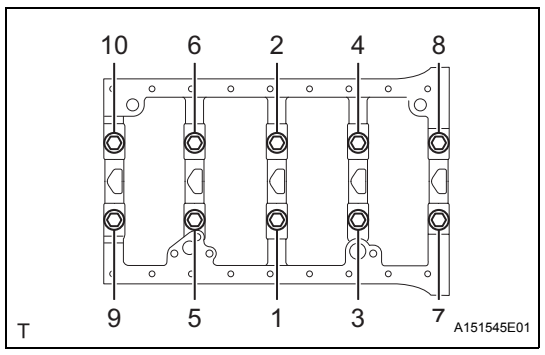
(b) Align the bearing with the crankshaft bearing cap, and push in the 5 lower bearings.
NOTICE:
Keep the back side of the bearing and the bearing surface free of foreign matter.

(c) Install the crankshaft.

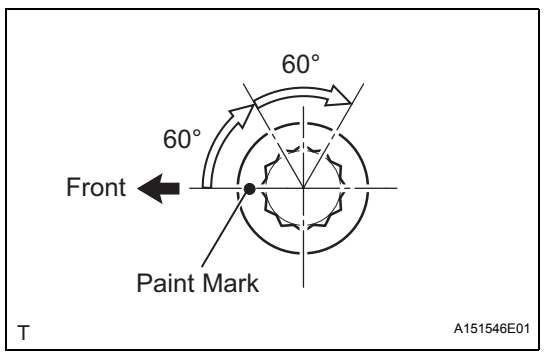
EM



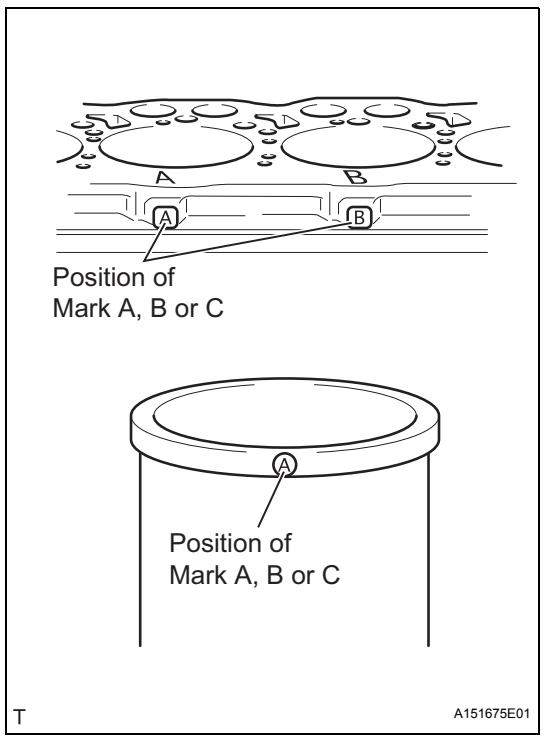
(d) Insert the thrust washer into the clearance between the cylinder block and crankshaft with the oil groove facing outward.
(e) Install the main bearing cap onto the cylinder block.
(f) Apply a light coat of engine oil to the threads and under the cap bolt.
NOTICE:
Be sure to install the removed thrust washer to its original position.



(g) Temporarily tighten the bolts in several steps, in the sequence shown in the illustration.
(h) Tighten the bolts to the specified torque.
Torque: 59 N*m (600 kgf*cm, 43 ft.*lbf)



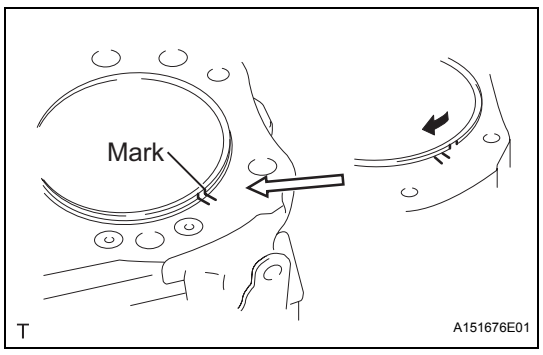
(i) Mark the front of the bearing cap bolts with paint.
(j) Retighten the bolts by 60° and then an additional 60° as shown in the illustration.



9. INSTALL CYLINDER LINER

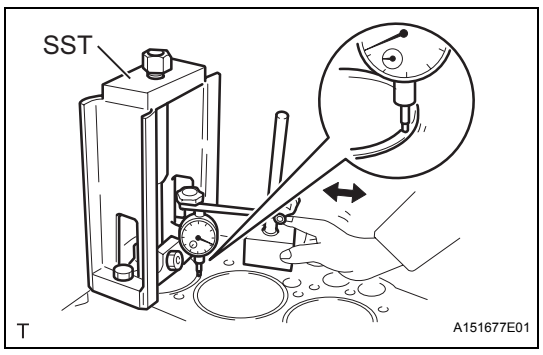
HINT:
- When assembling the cylinder liner into the cylinder block, the clearance can be set to 3 levels.
- The upper surface and side surface of the cylinder block are stamped A, B or C. When using a new cylinder liner, insert a matching cylinder liner with the same symbol.

(a) Apply engine oil to the cylinder block inside bore.



(b) Align the marks of the cylinder liner and cylinder block.
HINT:
When reusing the cylinder liner, install it according to the marks made during the removal. When reusing the cylinder liner, misalignment with the cylinder block may concentrate stress on the thin part of the cylinder liner and it may break.

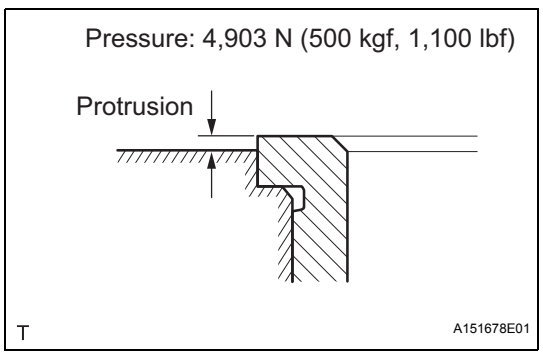
(c) Install the cylinder liner.
NOTICE:
Make sure to install the cylinder liner to its original location.



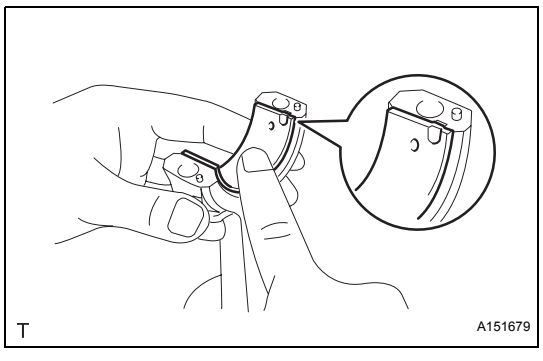
10. INSPECT PROTRUSION OF CYLINDER LINER

(a) Mount SST onto the cylinder block.
SST S0942-01460

(b) Tighten the center bolt to the specified torque below to set the SST in the proper installation position.
Torque: 9.8 N*m (100 kgf*cm, 7.2 ft.*lbf)

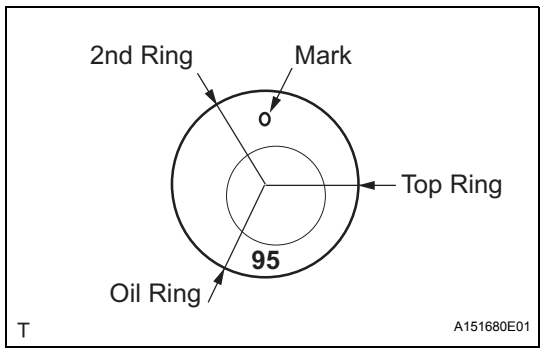


(c) Using a dial gauge, measure the protrusion of the cylinder liner.
Standard protrusion:
0.01 to 0.08 mm (0.0004 to 0.0031 in.)
Maximum protrusion:
0.08 mm (0.0031 in.)
If the protrusion is greater than the maximum, replace the cylinder liner.



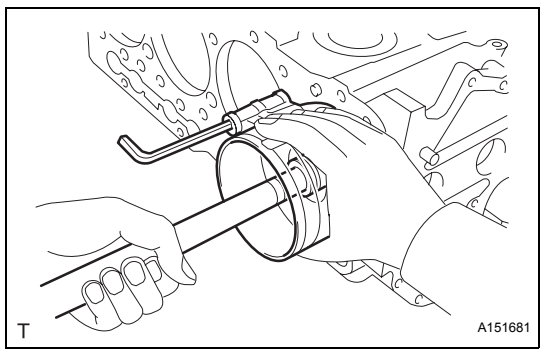
11. INSTALL CONNECTING ROD BEARING
NOTICE:
- **When reusing the bearing, reassemble the removed bearing as it was originally installed.**
- **Install the bearing with the oil hole onto the connecting rod side and install the bearing without the oil hole onto the cap side.**
- **Match the bearing protrusion with the notch of the connecting rod or cap.**
- **Keep the back side of the bearing and bearing surface of the bearing cap free of foreign matter.**

EM

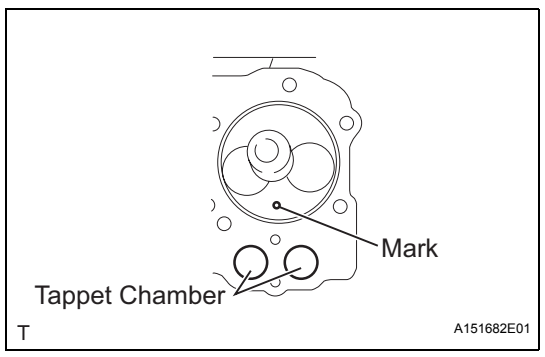


12. INSTALL PISTON WITH CONNECTING ROD

HINT:
Position the gaps of the piston rings at an even distance. Be careful not to position the gaps at the same position as the piston mark.



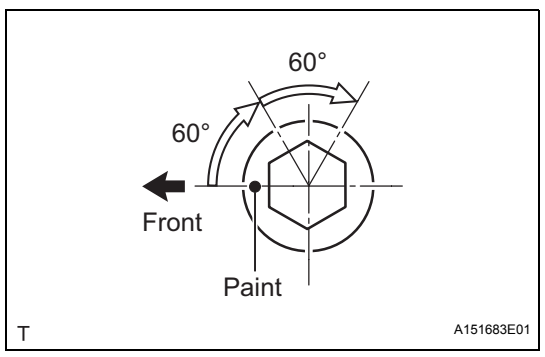
(a) Using a piston ring compressor and a hammer handle, insert the piston with connecting rod assembly into the cylinder block.
HINT:
- Before the installation, apply engine oil to the piston pin, piston ring, cylinder liner and connecting rod bearing.
- Recheck the gap of each piston ring.
- Do not damage the inside of the liner.



(1) Make sure that the mark on the piston is on the tappet chamber side.

(b) Install the bearing cap onto the connecting rod with the front mark facing in the correct direction.

(c) Uniformly install and tighten the bolts to the specified torque in several steps.
Torque: 30 N*m (300 kgf*cm, 22 ft.*lbf)

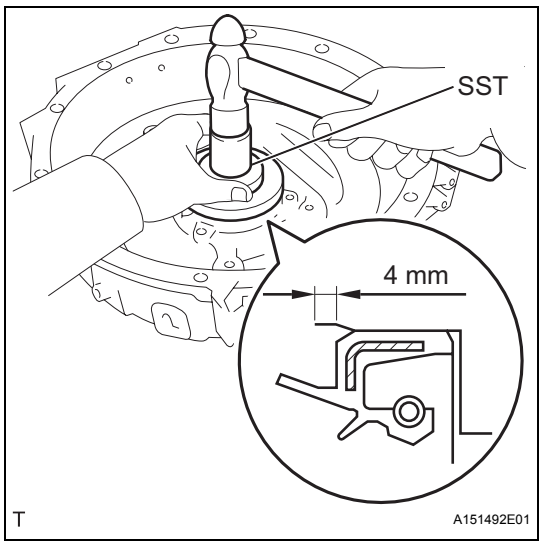


(d) Mark the front side of the bolt head with paint as shown in the illustration.

(e) Retighten the bolts by 60°.

(f) Perform step (e) again.

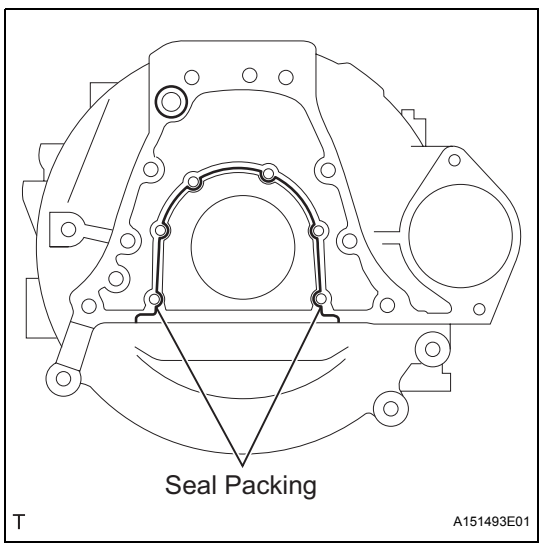
(g) Check that each painted mark is now at a 120° angle to the front.



13. INSTALL REAR ENGINE OIL SEAL

(a) Using SST and a hammer, tap in a new engine rear oil seal until it is 4 mm (0.16 in.) below the upper edge of the flywheel housing.
SST 09223-78010
NOTICE:
- **Be careful not to tap the oil seal at an angle.**
- **Keep the gap between the rear oil seal retainer edge and the oil seal free of foreign matter.**

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

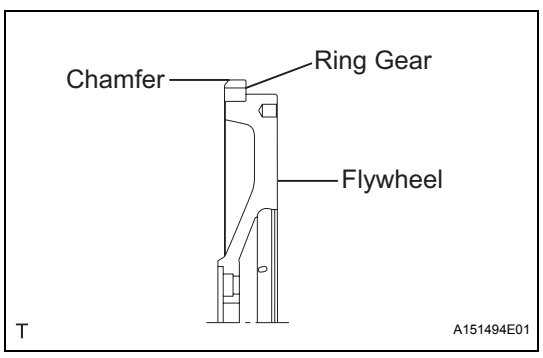


14. INSTALL FLYWHEEL HOUSING

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

(b) Apply a continuous bead of seal packing (diameter: 1.5 to 2.5 mm (0.06 to 0.10 in)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the flywheel housing within 3 minutes of applying the seal packing.**
- **Do not expose the seal packing to engine oil for at least 2 hours after installing.**

(c) Install the flywheel housing with the 14 bolts.
Torque: 132 N*m (1350 kgf*cm, 98 ft.*lbf) for bolt (M14)
29 N*m (290 kgf*cm, 21 ft.*lbf) for bolt (M8)



15. INSTALL FLYWHEEL RING GEAR

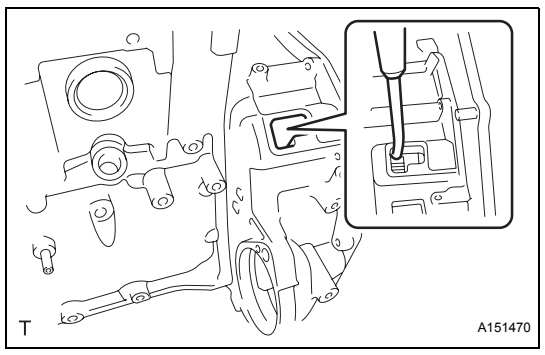
(a) Using a torch, heat the ring gear evenly to approximately 200°C (392°F).
NOTICE:
Be careful not to overheat the ring gear.

(b) Using a brass bar, strike the ring gear onto the flywheel with its chamfered gear teeth facing the block.
NOTICE:
After installing, allow the ring gear to cool before handling.

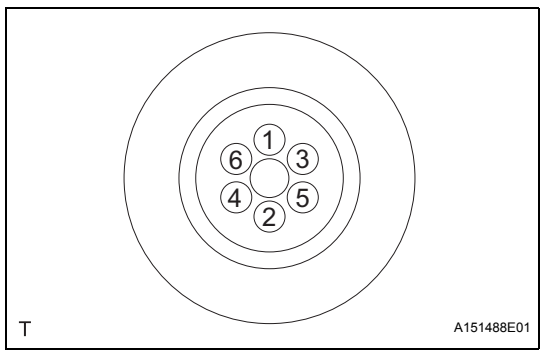
16. INSTALL FLYWHEEL SUB-ASSEMBLY

(a) Insert the flywheel slowly until it contacts the collar knock in order to prevent impact with the guide bar. Adjust the position, then insert it completely.
NOTICE:
The flywheel is heavy. When installing, be careful not to drop it.

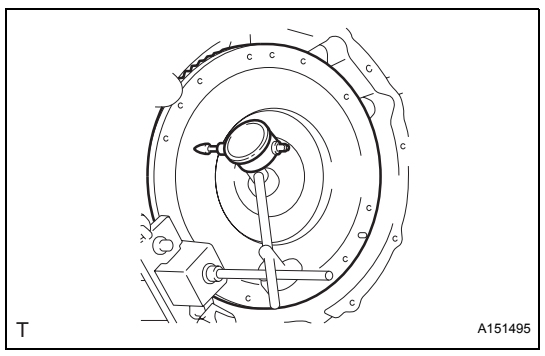
(b) Apply clean engine oil to the threads of the flywheel bolts and the flywheel bolt seats.



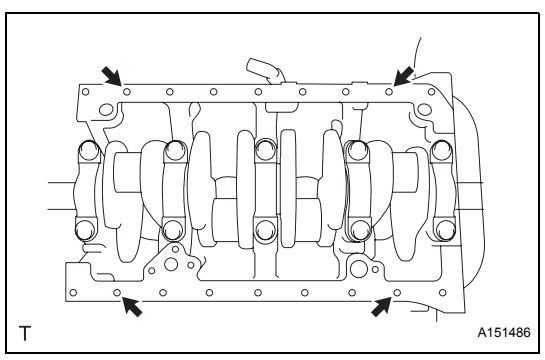
(c) Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.



(d) Tighten the flywheel bolts in several steps in the order shown in the illustration.
Torque: 190 N*m (1937 kgf*cm, 140 ft.*lbf)



(e) Using a dial indicator, measure the runout of the flywheel.
Maximum runout:
0.15 mm (0.0059 in.)
If the runout is greater than the maximum, resurface the sliding surface.

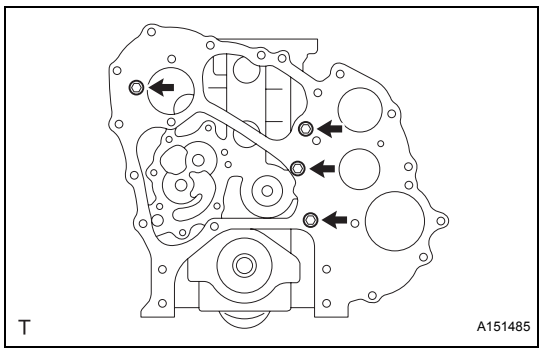


(f) Temporarily install 4 bolts in the positions of the cylinder block shown in the illustration to prevent the wires from sliding toward the center of the block.

(g) Attach 2 wires to the cylinder block.
HINT:
The wires must be attached outside the installed bolts.

(h) Using a chain block and an engine sling device, install the cylinder block onto the engine stand.

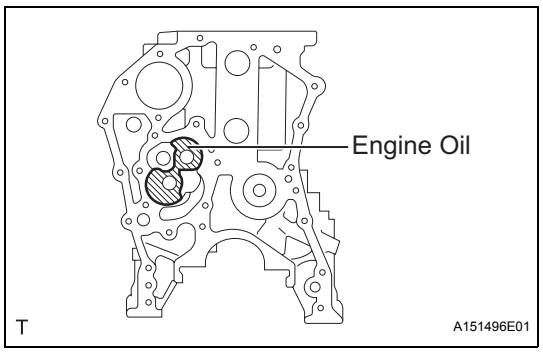
(i) Remove the 4 bolts from the cylinder block.



17. INSTALL FRONT END PLATE

(a) Install the front end plate with a new gasket and 4 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

(b) Using a cutter, cut the gasket so that it is flush with the lower surface of the cylinder block.

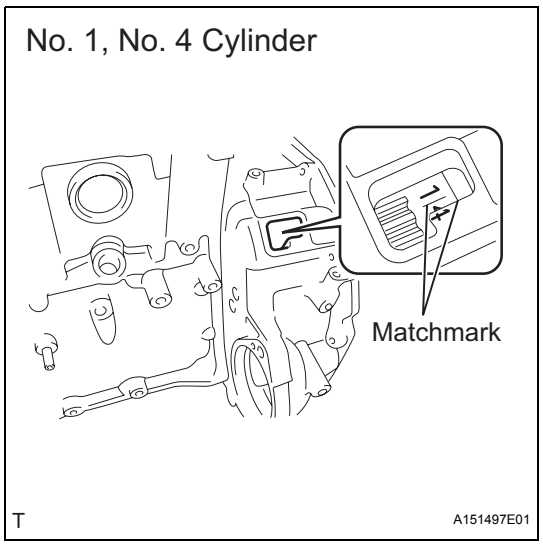


18. INSTALL OIL PUMP ASSEMBLY

(a) Apply engine oil to the oil pump case of the cylinder block and bearing.
NOTICE:
If engine oil is not applied, an oil suction malfunction will occur when starting the engine. The malfunction causes seizure or abnormal wear to the engine.

(b) Install a new gasket and oil pump with the 7 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

(c) Check that the oil pump rotates smoothly by hand after the installation.

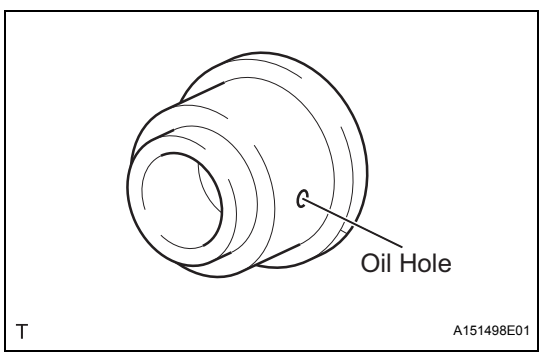


19. INSTALL CRANKSHAFT TIMING GEAR OR SPROCKET

(a) Turn the crankshaft clockwise, and align the matchmarks of the flywheel and flywheel housing to set the No. 1 cylinder to TDC.

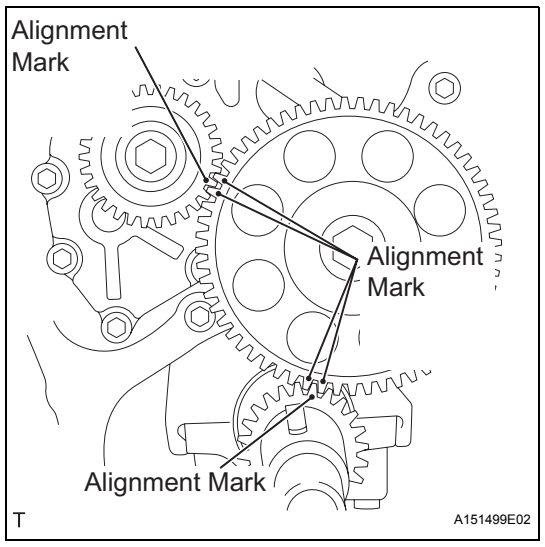
(b) Align the set key on the crankshaft with the key groove of the crankshaft timing gear.

(c) Using a hammer, tap in the crankshaft timing gear.



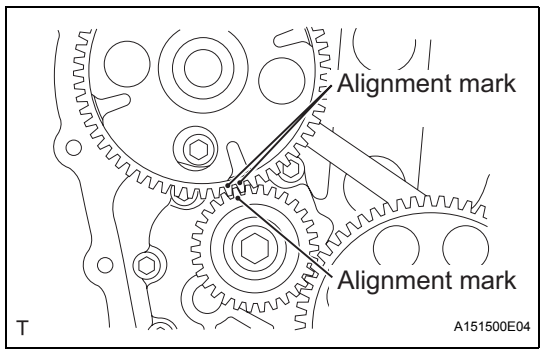
20. INSTALL NO. 1 IDLE GEAR SUB-ASSEMBLY

(a) Install the idle gear and idle gear thrust plate onto the idle gear shaft.

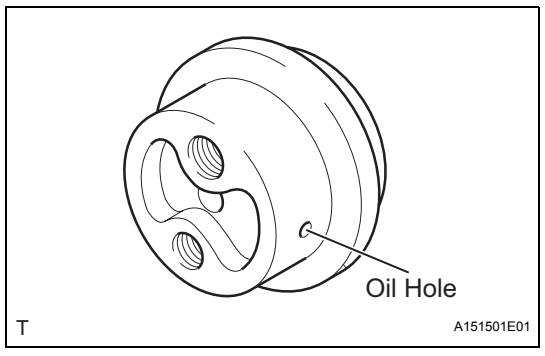


(b) With the idle gear shaft oil hole facing down, match the alignment marks for each gear, and insert the shaft into the cylinder block.
NOTICE:
If the oil hole is not facing down, it causes burning or abnormal wear.
(c) Tighten the bolt.
Torque: 137 N*m (1400 kgf*cm, 101 ft.*lbf)

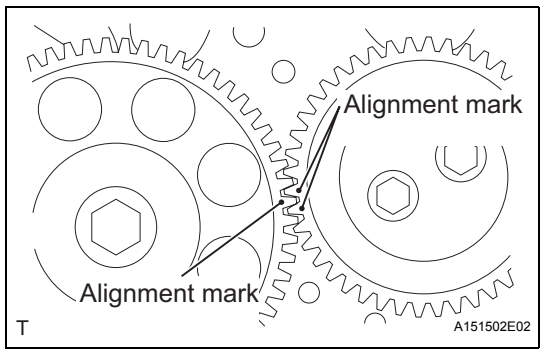
EM



21. INSTALL CAMSHAFT
(a) Apply engine oil to the camshaft journal and bearing.
(b) Match the alignment marks of the camshaft timing gear and oil pump gear and install the camshaft.
(c) Install the thrust plate with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

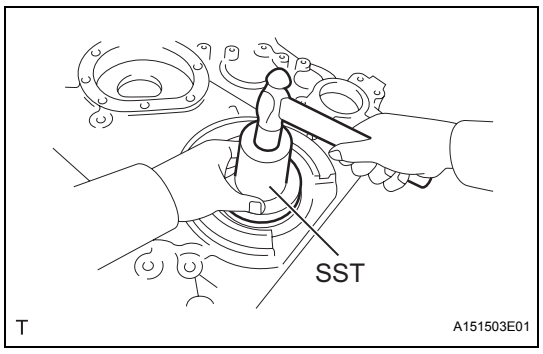


22. INSTALL NO. 2 IDLE GEAR SHAFT
(a) Install the lock plate onto the end plate with the 3 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)
(b) Install a new O-ring onto the idle gear shaft.
(c) With the idle gear shaft oil hole facing down, install the gear shaft onto the lock plate with the 2 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)
NOTICE:
If the oil hole is not facing down, it causes burning or abnormal wear.



23. INSTALL NO. 2 IDLE GEAR SUB-ASSEMBLY
(a) Match the alignment marks of the No. 1 and No. 2 idle gears and install the No. 2 idle gear.

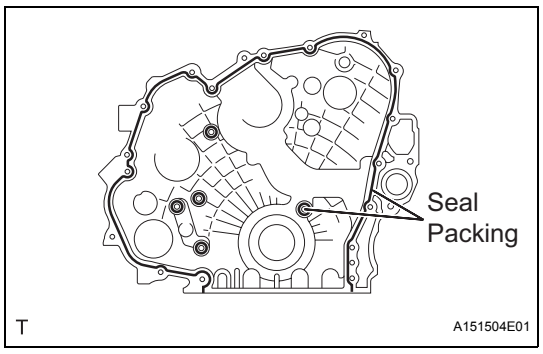
24. INSTALL NO. 2 IDLE GEAR THRUST PLATE
(a) Install the thrust plate with the 2 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)



25. INSTALL TIMING CHAIN OR BELT COVER OIL SEAL

(a) Using SST and a hammer, tap in the oil seal to the timing gear case so that the oil seal is flush with the timing gear edge.
SST 09223-78010
NOTICE:
- **Be careful not to tap the oil seal at an angle.**
- **Keep the gap between the gear case edge and the oil seal free of foreign matter.**

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

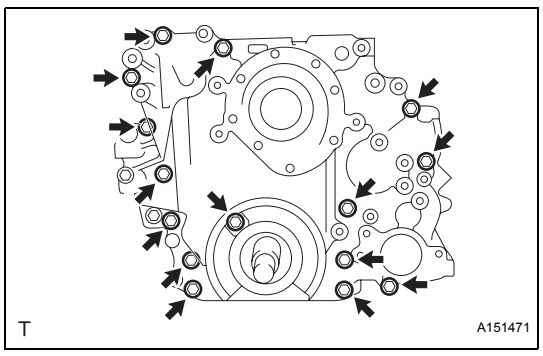


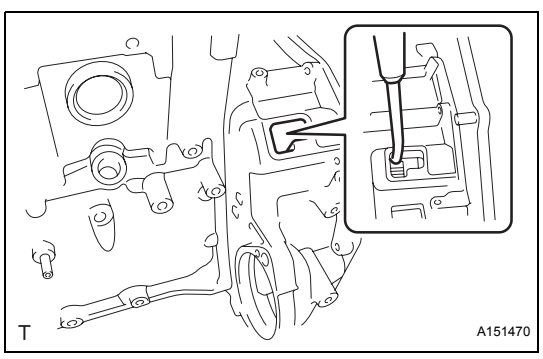
26. INSTALL TIMING GEAR CASE

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

(b) Apply a continuous bead of seal packing (diameter: 3 to 4 mm (0.11 to 0.15 in)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the timing gear case within 3 minutes of applying the seal packing.**
- **Do not expose the seal packing to engine oil for at least 2 hours after installing.**

(c) Install the timing gear case with the 15 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)





27. INSTALL CRANKSHAFT PULLEY

(a) Install the pulley and spacer onto the crankshaft.
HINT:
Align the pulley set key with the key groove of the pulley.

(b) Using a 46 mm socket wrench, tighten the nut.
Torque: 515 N*m (5250 kgf*cm, 380 ft.*lbf)
HINT:
Insert a screwdriver through the inspection hole of the flywheel housing into the ring gear of the flywheel to keep it from turning together with the crankshaft.

28. INSTALL OIL SEPARATOR ASSEMBLY

(a) Install 2 new O-rings onto the timing gear case.

(b) Install the oil separator assembly with the 5 bolts.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

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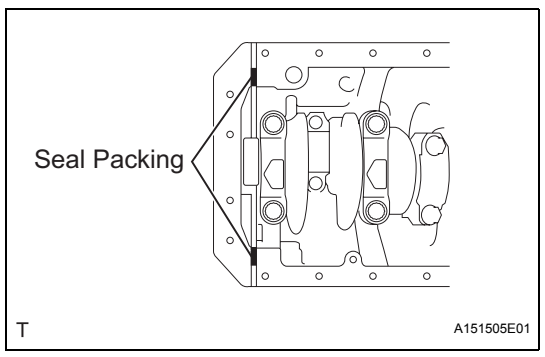
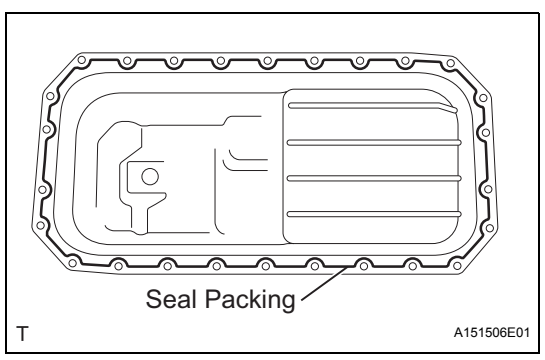




29. INSTALL OIL STRAINER SUB-ASSEMBLY

(a) Install a new O-ring onto the cylinder block.

(b) Install the strainer with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

30. INSTALL OIL PAN SUB-ASSEMBLY

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

(b) Apply a continuous bead of seal packing (diameter: 3 to 4 mm (0.11 to 0.15 in.)) as shown in the illustration.
Seal packing:
Toyota Genuine Seal Packing Black, Three Bond 1207B or equivalent
NOTICE:
- **Remove any oil from the contact surface.**
- **Install the oil pan within 3 minutes of applying the seal packing.**
- **Do not expose the seal packing to engine oil for at least 2 hours after installing.**

(c) Install the oil pan with the 26 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

31. INSTALL FLYWHEEL HOUSING STAY RH

(a) Install the stay with the 4 bolts.
Torque: 132 N*m (1350 kgf*cm, 98 ft.*lbf) for bolt (M14)
97 N*m (990 kgf*cm, 72 ft.*lbf) for bolt (M12)

32. INSTALL FLYWHEEL HOUSING STAY LH

(a) Install the stay with the 4 bolts.
Torque: 132 N*m (1350 kgf*cm, 98 ft.*lbf) for bolt (M14)
97 N*m (990 kgf*cm, 72 ft.*lbf) for bolt (M12)

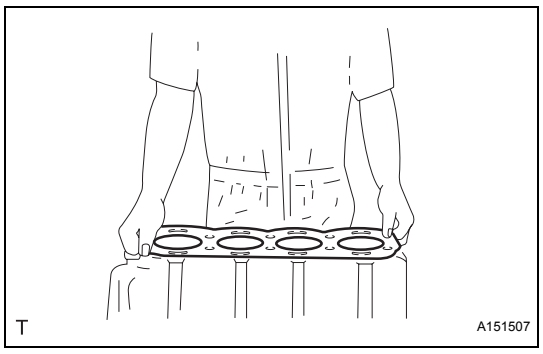
33. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET RH

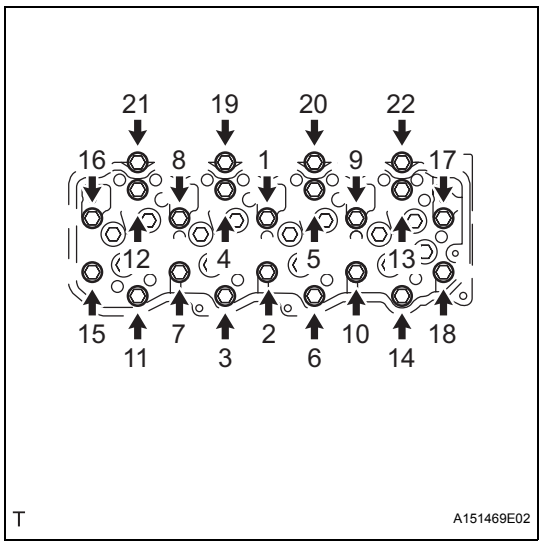
(a) Install the bracket with the 4 bolts.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)

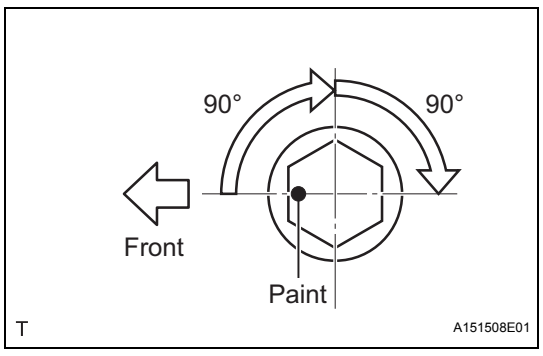
34. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET LH

(a) Install the bracket with the 4 bolts.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)

35. INSTALL VALVE LIFTER
NOTICE:
Be sure to install the removed push rod to its original position.







36. INSTALL CYLINDER HEAD SUB-ASSEMBLY

(a) Install a new cylinder head gasket.
NOTICE:
Always use a new cylinder head gasket after cleaning the surface of the cylinder head and cylinder block and keep them free of dirt, water and grease.

(b) Install the cylinder head over the dowels on the cylinder block.
HINT:
Since the cylinder head bolts are unique to this engine, do not substitute them with ordinary bolts.

(c) Uniformly install and tighten the cylinder head bolts (1 to 18) in several steps in the order shown in the illustration.
Torque: 60 N*m (610 kgf*cm, 44 ft.*lbf)

(d) Mark the front side of each cylinder head bolt head with paint as shown in the illustration.

(e) Retighten the cylinder head bolts by 90° in the same order as step (c).

(f) Perform step (e) again.

(g) Check that each painted mark is now at a 180° angle to the front.

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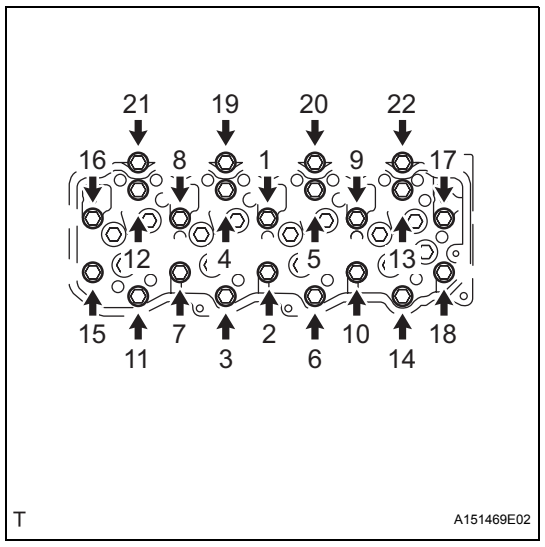


(h) Uniformly install and tighten the cylinder head bolts (19 to 22) in several steps in the order shown in the illustration.
Torque: 55 N*m (560 kgf*cm, 41 ft.*lbf)

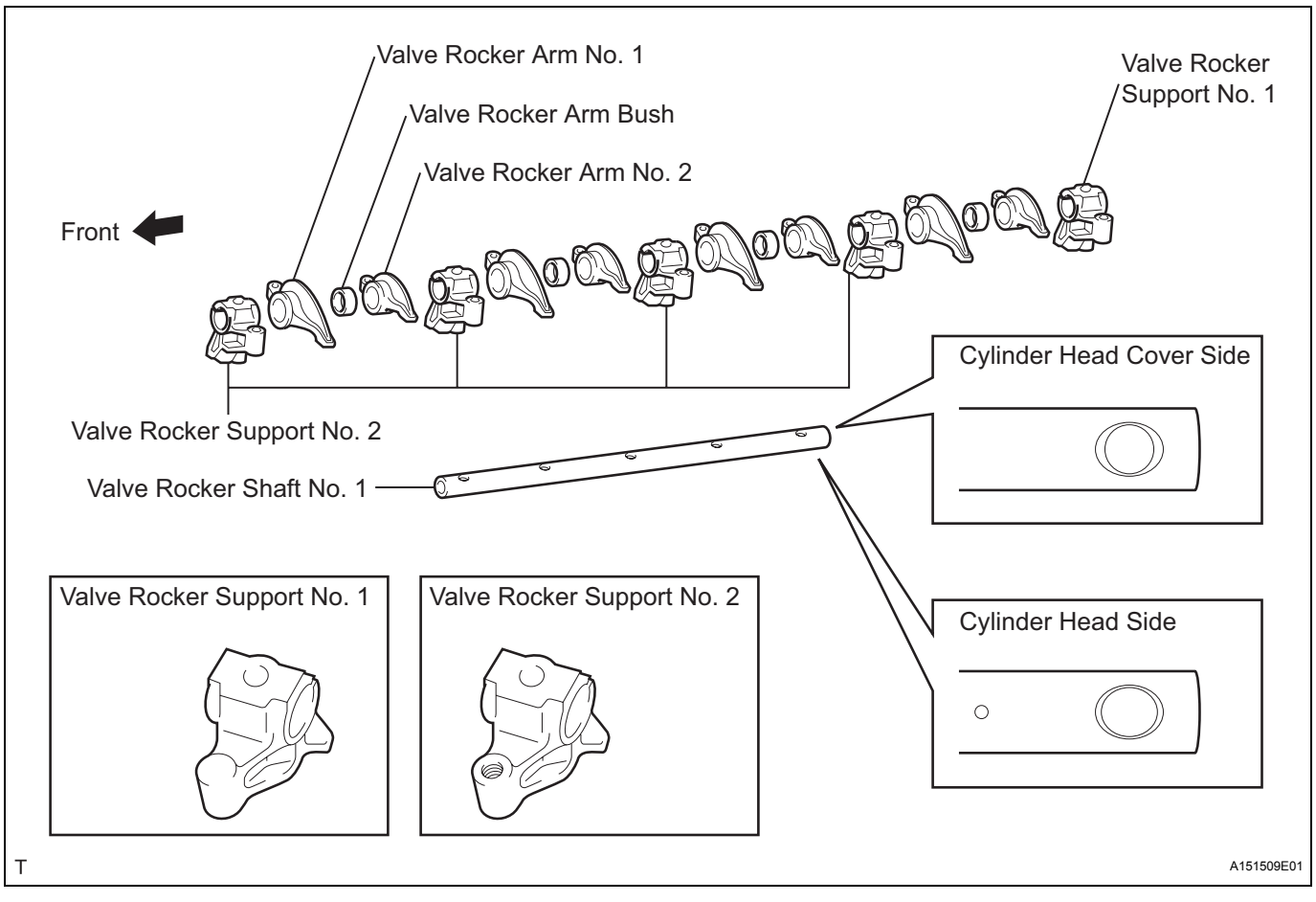
37. INSTALL VALVE BRIDGE
NOTICE:
Be sure to install the removed bridge to its original location.

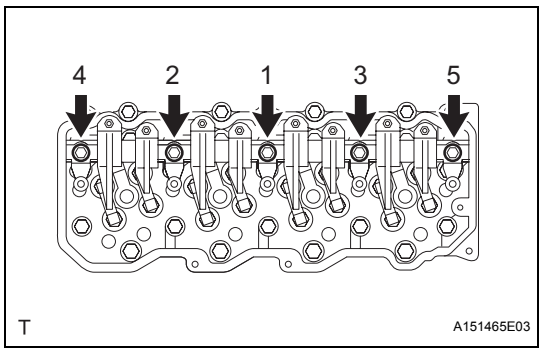
38. INSTALL VALVE PUSH ROD
NOTICE:
Be sure to install the removed push rod to its original location.

39. INSTALL NO. 1 VALVE ROCKER SHAFT SUB-ASSEMBLY

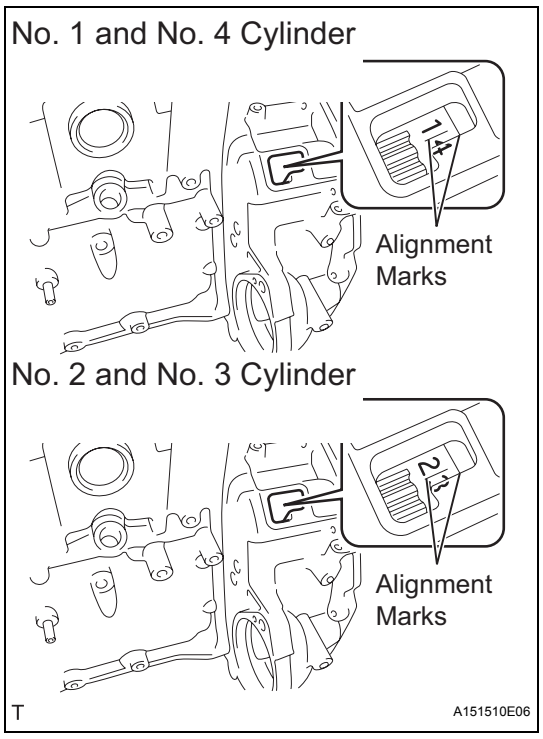
(a) Lubricate the rocker arm shaft and bush.
NOTICE:
Confirm that the oil hole on the No. 1 valve rocker support aligns with the shaft oil hole. Improper installation will result in the entire valve being burned.

(b) Install valve rocker arms No. 1 and No. 2 valve, rocker supports No. 1 and No. 2 and the valve rocker arm bushes onto rocker shaft No. 1.
NOTICE:
When installing, place the valve rocker shaft No. 1 with the smaller hole facing down.



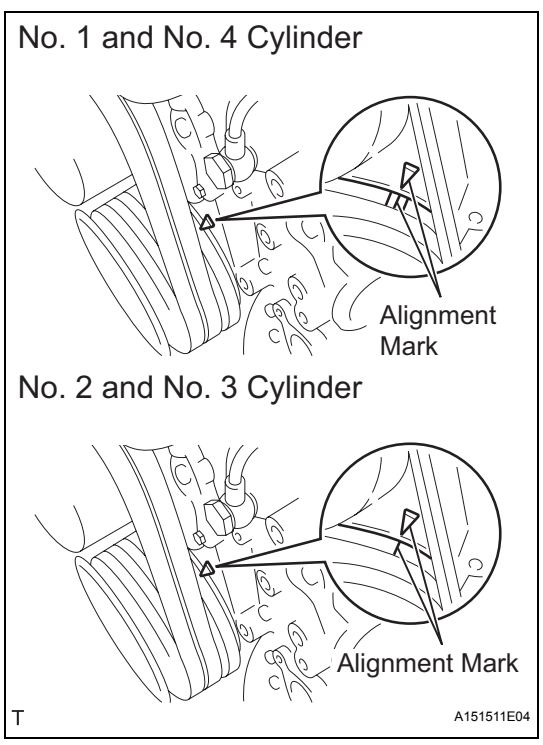


(c) Install the rocker shaft onto the cylinder head.
(d) Apply engine oil to the rocker arm and push rod.
(e) Install the bolts in the order shown in the illustration.
Torque: 69 N*m (700 kgf*cm, 51 ft.*lbf)
NOTICE:
Make sure that the push rod does not interfere with the adjusting screw.



40. ADJUST VALVE CLEARANCE

(a) Flywheel housing side:
Turn the crankshaft clockwise to align the alignment marks on the flywheel with the line between the 2 numbers on the edge on the flywheel housing.



(b) Crankshaft pulley side:
Turn the crankshaft clockwise to align the alignment marks on the crankshaft pulley with the pointer on the timing gear case.
HINT:
If not, turn the crankshaft 1 revolution (360°) to align the alignment marks.

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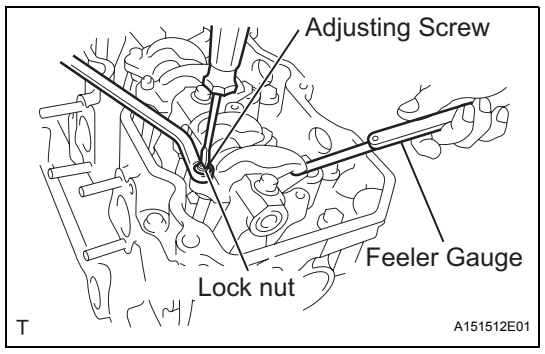

(c) With the No. 1 piston positioned at TDC on the compression stroke, using a feeler gauge, adjust the each valve clearance.
Valve clearance (Cold)

Item	Specified Condition
Intake	0.30 mm (0.0118 in.)
Exhaust	0.45 mm (0.0177 in.)

HINT:
The feeler gauge should move with a very slight pull.

(d) Loosen the lock nut on the valve rocker arm and loosen the adjusting screw.
(e) Insert a 0.30 mm(0.012 in.) feeler gauge for the intake or a 0.45 mm (0.018 in.) feeler gauge for the exhaust between the adjusting screw on the valve rocker arm and the valve bridge.
(f) Turn the adjusting screw on the valve rocker arm until the feeler gauge slides with a very slight drag, and lock the adjusting screw with the lock nut.
Torque: 29 N*m (296 kgf*cm, 22 ft.*lbf)
(g) Recheck the clearance.
(h) Adjust the other valves.
(1) Turn the crankshaft 1 revolution (360°) clockwise.
(2) Adjust the valve clearance for each cylinder in the firing order.
Firing order:
1 - 3 - 4 - 2
(The number of a cylinder is counted from the timing gear side)

41. INSTALL CYLINDER HEAD COVER GASKET
(a) Install a new cylinder head cover gasket onto the cylinder head cover.

42. INSTALL CYLINDER HEAD COVER CUSHION
(a) Install the 2 cylinder head cover spacers and 2 cylinder head cover cushions onto the cylinder head cover.

43. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY
(a) Install the cylinder head cover with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

44. INSTALL CYLINDER HEAD COVER STAY
(a) Install the 2 cylinder head cover stays onto the No. 2 cylinder head cover.

45. INSTALL CYLINDER HEAD COVER CUSHION RUBBER
(a) Install the cylinder head cover cushion rubber onto the No. 2 cylinder head cover.

46. INSTALL NO. 2 CYLINDER HEAD COVER SUB-ASSEMBLY
(a) Install the No. 2 cylinder head cover with the 2 bolts.
Torque: 29 N*m (290 kgf*cm, 21 ft.*lbf)

47. INSTALL OIL FILLER CAP SUB-ASSEMBLY

(a) Install the oil filler cap onto the No. 2 cylinder head cover.