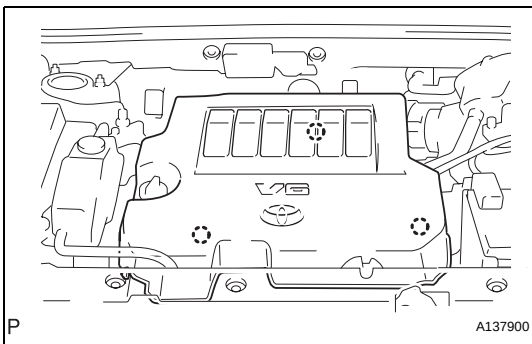
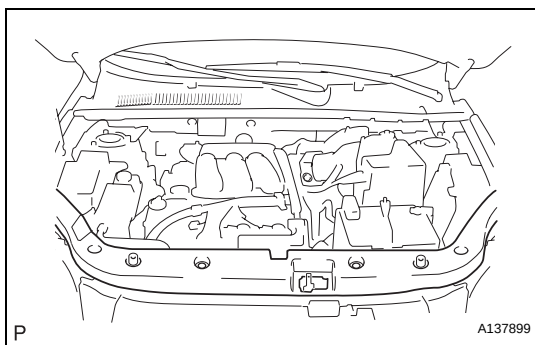


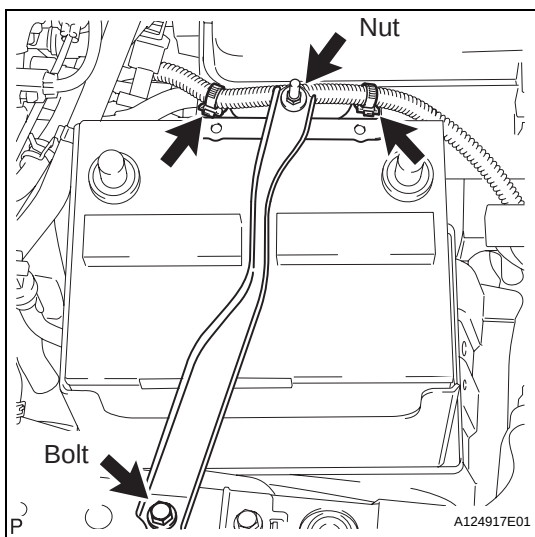
REMOVAL

1. **DISCHARGE REFRIGERANT FROM REFRIGERATION SYSTEM** (See page [AC-172](#))
2. **DISCHARGE FUEL SYSTEM PRESSURE** (See page [FU-13](#))
3. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
CAUTION:
Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
4. **REMOVE NO. 1 ENGINE UNDER COVER**
(a) Remove the 4 bolts, 12 clips and under cover.
5. **REMOVE REAR ENGINE UNDER COVER RH**
(a) Remove the 2 clips and under cover.
6. **REMOVE REAR ENGINE UNDER COVER LH**
(a) Remove the 2 clips and under cover.
7. **REMOVE NO. 2 ENGINE UNDER COVER**
(a) Remove the 2 clips and under cover.
8. **REMOVE FRONT FLOOR COVER** (See page [FU-34](#))
9. **DRAIN ENGINE COOLANT** (See page [CO-8](#))
10. **DRAIN ENGINE OIL** (See page [LU-4](#))
11. **DRAIN AUTOMATIC TRANSAXLE FLUID**
(a) 2WD:
Drain automatic transaxle fluid (see page [AX-172](#)).
(b) 4WD:
Drain automatic transaxle fluid (see page [AX-173](#))
12. **DRAIN TRANSFER OIL (for 4WD)**
13. **REMOVE HOOD SUB-ASSEMBLY** (See page [ED-4](#))
14. **REMOVE V-BANK COVER SUB-ASSEMBLY**
(a) Detach the 3 clips and remove the V-bank cover.

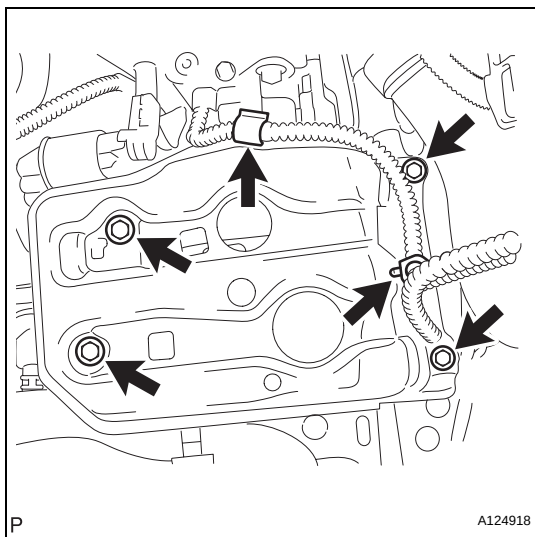
EM

**15. REMOVE RADIATOR SUPPORT OPENING COVER**

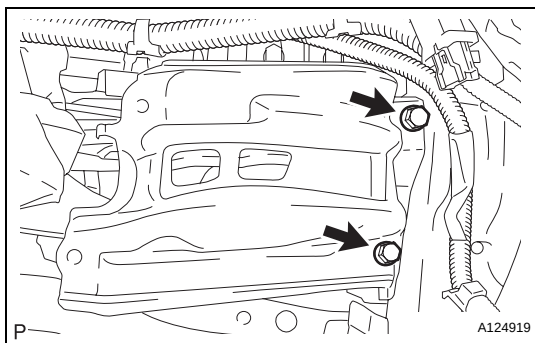
- (a) Remove the 9 clips and cover.

**16. REMOVE BATTERY CLAMP SUB-ASSEMBLY**

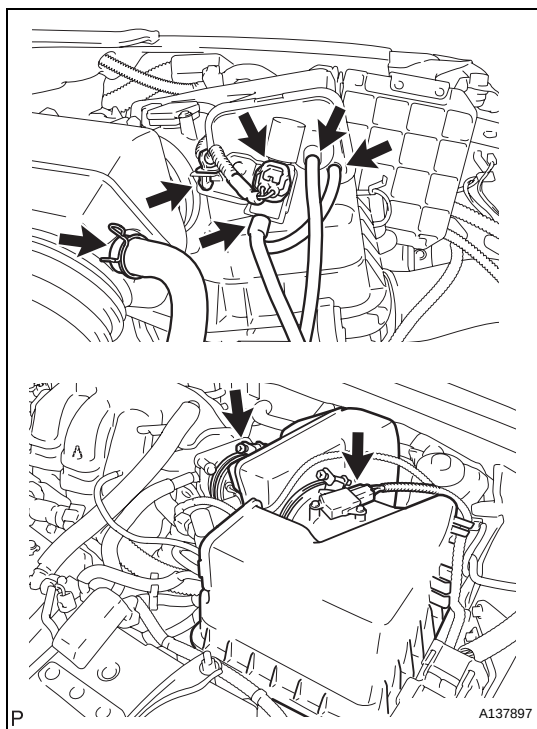
- (a) Remove the bolt and loosen the nut.
(b) Detach the 2 wire harness clamps.
(c) Detach the hook of the battery clamp from the battery bracket front, and then remove the battery clamp.

17. REMOVE BATTERY**18. REMOVE FRONT BATTERY BRACKET**

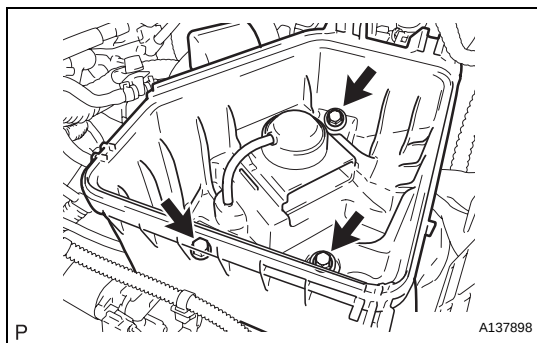
- (a) Detach the 2 wire harness clamps.
(b) Remove the 4 bolts and front bracket.

**19. REMOVE BATTERY BRACKET REINFORCEMENT**

- (a) Remove the 2 bolts and bracket reinforcement.

**20. REMOVE AIR CLEANER CAP SUB-ASSEMBLY**

- (a) Disconnect the mass air flow meter connector.
- (b) Disconnect the VSV (air intake control) connector.
- (c) Disconnect the wire harness clamp and 3 vacuum hoses.
- (d) Disconnect the No. 2 ventilation hose from the air cleaner hose.
- (e) Loosen the No. 1 air cleaner hose clamp.
- (f) Unfasten the 2 hook clamps, and then remove the air cleaner cap.
- (g) Remove the air cleaner filter element from the air cleaner case.

**21. REMOVE AIR CLEANER CASE**

- (a) Disconnect the harness clamp.
- (b) Remove the 3 bolts and air cleaner case.

22. DISCONNECT HOSES AND CONNECTORS

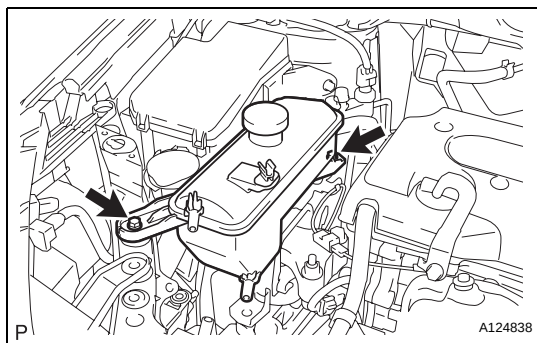
- (a) Remove the engine room junction block cover (upper).
- (b) Remove the nut and disconnect the engine room junction block cover (side) with 3 connectors and wire.
- (c) Remove the nut and disconnect the starter wire.
- (d) Disconnect the fuel hoses.
- (e) Disconnect the 2 heater hoses.
- (f) Disconnect the 2 ECM connectors.

23. REMOVE ECM (See page [ES-470](#))**24. REMOVE RADIATOR RESERVOIR TANK ASSEMBLY**

- (a) Remove the 2 bolts, 2 hoses and reservoir tank.

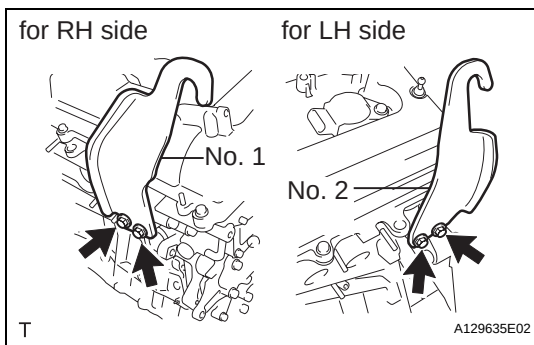
25. REMOVE DISCHARGE HOSE SUB-ASSEMBLY (See page [AC-220](#))**26. DISCONNECT SUCTION HOSE SUB-ASSEMBLY (See page [AC-220](#))****27. DISCONNECT RADIATOR HOSE INLET****28. DISCONNECT RADIATOR HOSE OUTLET****29. DISCONNECT OIL COOLER HOSE****30. DISCONNECT TRANSMISSION CONTROL CABLE ASSEMBLY**

- (a) 2WD:
Disconnect the control cable (see page [AX-154](#)).



- (b) 4WD:
Disconnect the control cable (see page [AX-154](#)).

31. REMOVE FRONT EXHAUST PIPE ASSEMBLY (See page [EX-3](#))
32. REMOVE CENTER EXHAUST PIPE ASSEMBLY (See page [EX-2](#))
33. REMOVE PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (See page [PR-3](#))
34. REMOVE FRONT WHEELS
35. REMOVE FRONT AXLE HUB NUT LH
 - (a) Remove the hub nut (see page [AH-8](#)).
36. REMOVE FRONT AXLE HUB NUT RH
 - (a) Remove the hub nut (see page [AH-8](#)).
37. DISCONNECT FRONT STABILIZER LINK ASSEMBLY LH (See page [SP-30](#))
38. DISCONNECT FRONT STABILIZER LINK ASSEMBLY RH (See page [SP-30](#))
39. DISCONNECT STEERING INTERMEDIATE SHAFT (See page [PS-44](#))
40. DISCONNECT TIE ROD END SUB-ASSEMBLY RH (See page [PS-42](#))
41. DISCONNECT TIE ROD END SUB-ASSEMBLY LH (See page [PS-42](#))
42. REMOVE FRONT DRIVE SHAFT LH
 - (a) 2WD:
Remove the drive shaft (see page [DS-10](#)).
 - (b) 4WD:
Remove the drive shaft (see page [DS-43](#)).
43. REMOVE FRONT DRIVE SHAFT RH
 - (a) 2WD:
Remove the drive shaft (see page [DS-10](#)).
 - (b) 4WD:
Remove the drive shaft (see page [DS-43](#)).
44. REMOVE ENGINE WITH TRANSAXLE
 - (a) Install the No. 1 and No. 2 engine hangers with the 4 bolts as shown in the illustration.
Torque: 33 N*m (337 kgf*cm, 24 ft.*lbf)



Part Name	Part No.
No. 1 engine hanger	12281-31120
No. 2 engine hanger	12282-31100
Bolt	91671-10825

HINT:

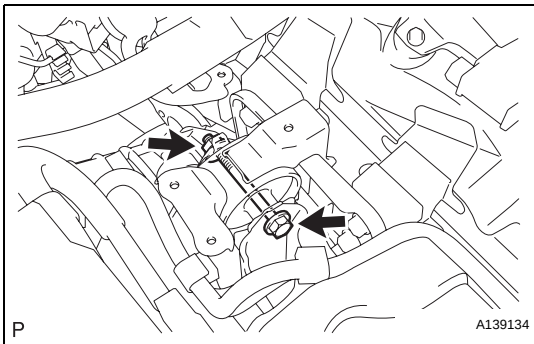
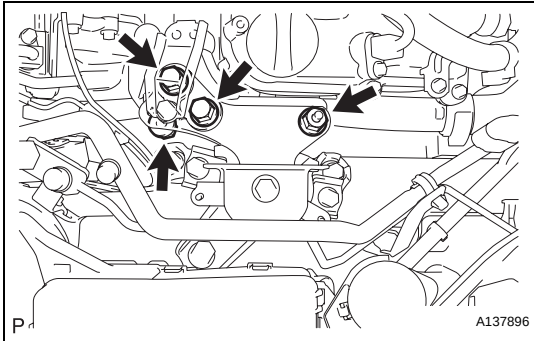
- Insert the claw of the hanger into hole of the cylinder head.
- Fit the fork part of the hanger onto the rib of the cylinder head.

- (b) Install an engine sling device to the engine and hold the engine with a chain block.

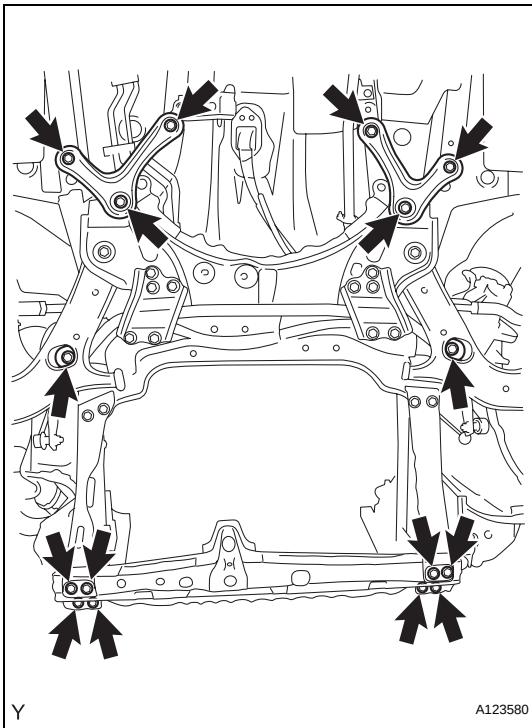
CAUTION:

Do not raise the engine more than necessary. If the engine is raised excessively, the vehicle may also be lifted up.

- (c) Set an engine lifter underneath the engine.
- (d) Remove the column hole cover. Loosen the bolt holding the intermediate shaft, and slide the intermediate shaft.
- (e) Put matchmarks on the intermediate shaft and pinion.
- (f) Remove the 2 bolts and 2 nuts, and disconnect the engine mounting insulator RH.



- (g) Remove the bolt and nut, and disconnect the engine mounting insulator LH.



- (h) Remove the 6 bolts and front suspension member brace rear RH and LH.
- (i) Remove the 6 bolts, crossmember and suspension member.
- (j) Using the chain block, slowly remove the engine from the vehicle and the intermediate shaft from the pinion. Then set the engine on the engine lifter.

NOTICE:

- Make sure that the engine is clear of all wiring and hoses.
- While lowering the engine from the vehicle, do not allow it to contact the vehicle.

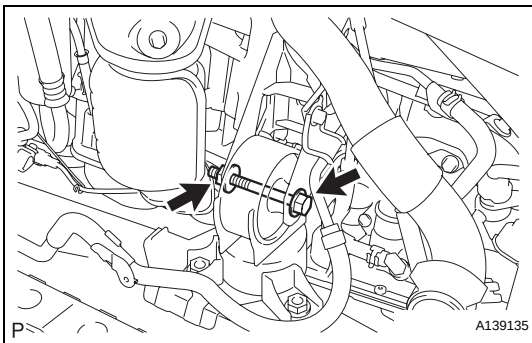
HINT:

Place the engine on wooden blocks or an equivalent so that the engine is level.

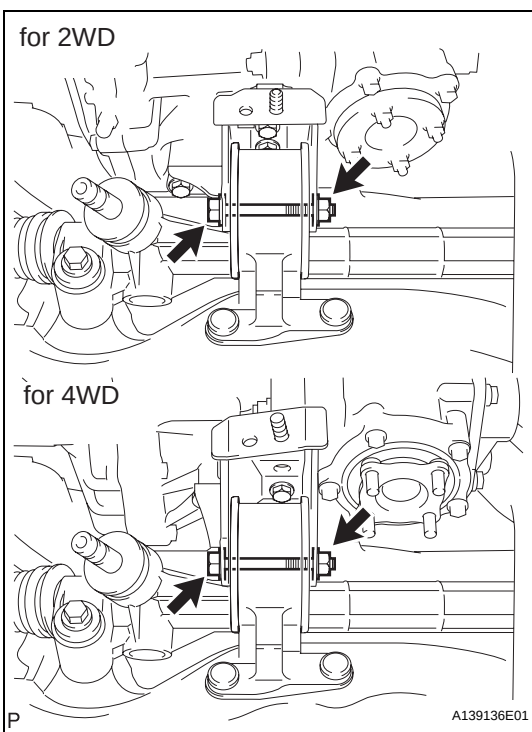
- (k) Remove the sling device from the engine.

45. REMOVE FRONT CROSSMEMBER SUB-ASSEMBLY

- (a) Install a chain block.



- (b) Remove the bolt, nut and crossmember.

**46. REMOVE FRONT SUSPENSION CROSSMEMBER SUB-ASSEMBLY**

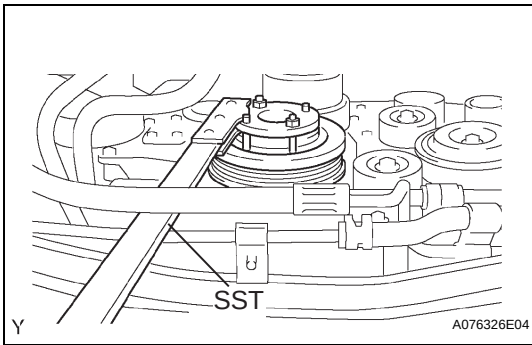
- (a) Remove the bolt and suspension crossmember.

47. REMOVE ENGINE WIRE

- (a) Remove the engine wire from the engine.

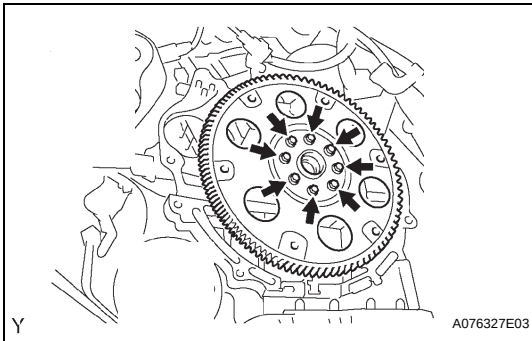
48. REMOVE STARTER ASSEMBLY (See page [ST-6](#))**49. REMOVE TRANSFER ASSEMBLY (for 4WD) (See page [TF-60](#))****50. REMOVE AUTOMATIC TRANSAXLE ASSEMBLY**

- (a) 2WD:
Remove the automatic transaxle (see page [AX-172](#)).
- (b) 4WD:
Remove the automatic transaxle (see page [AX-173](#)).



51. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

- (a) Using SST, hold the crankshaft.
SST 09213-70011, 09330-00021



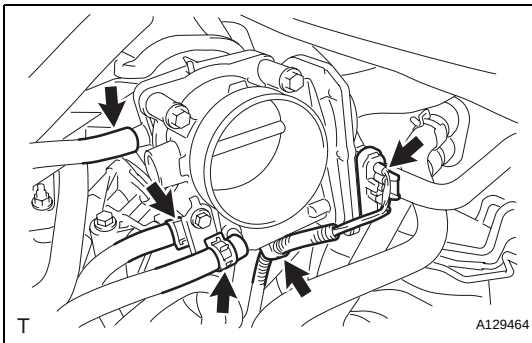
- (b) Remove the 8 bolts, front spacer, drive plate and rear spacer.

NOTICE:

Do not reuse the bolts.

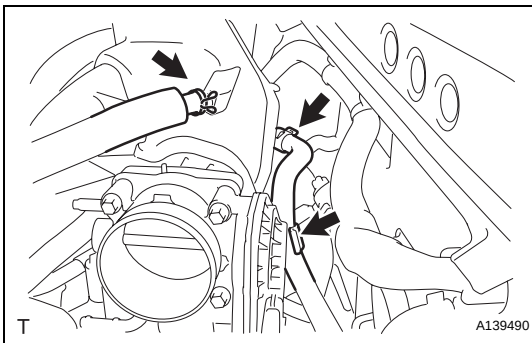
52. INSTALL ENGINE TO ENGINE STAND

- (a) Install the engine to an engine stand. Remove the sling device and chain block from the engine.

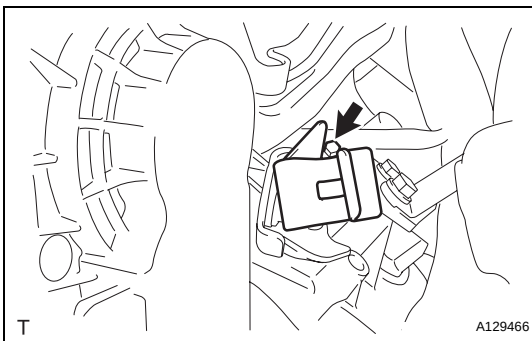


53. REMOVE INTAKE AIR SURGE TANK ASSEMBLY

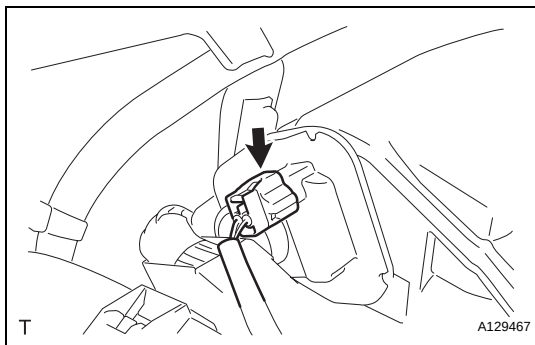
- (a) Disconnect the 2 water by-pass hoses from the throttle body.
 (b) Disconnect the vapor feed hose.
 (c) Disconnect the throttle body connector and clamp.



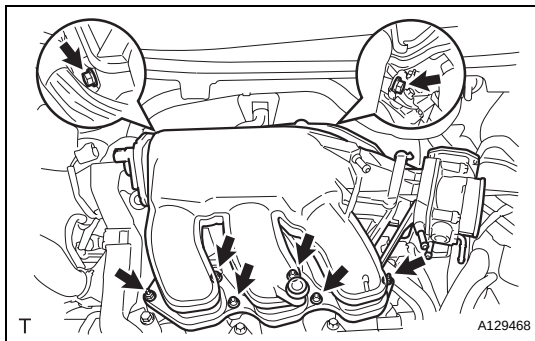
- (d) Disconnect the No. 2 ventilation hose.
 (e) Disconnect the union to check valve hose.



- (f) Remove the bolt and vacuum hose clamp.



(g) Disconnect the connector.



(h) Using a 5 mm socket hexagon wrench, remove the 4 bolts.

(i) Remove the 2 nuts, 2 bolts and surge tank.

(j) Remove the gasket from the surge tank.

54. REMOVE IGNITION COIL ASSEMBLY

(a) Remove the 6 bolts and 6 coils from the cylinder head.

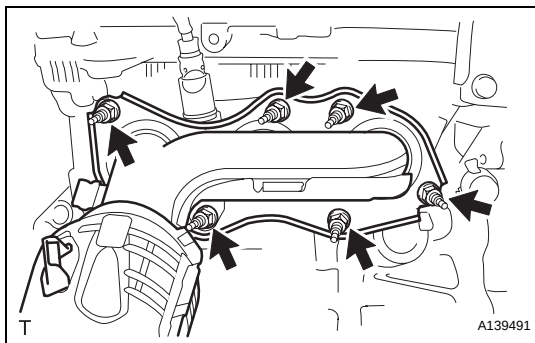
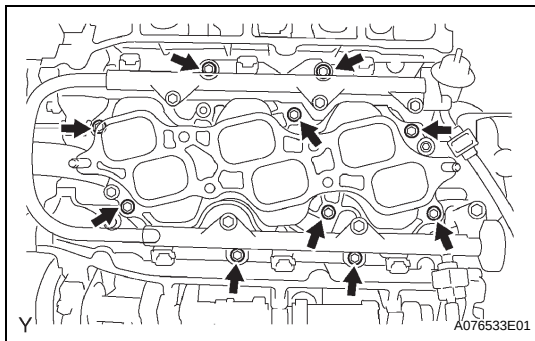
55. REMOVE NO. 2 ENGINE MOUNTING STAY RH

(a) Remove the bolt and mounting stay.

56. REMOVE FUEL INJECTOR ASSEMBLY (See page [FU-14](#))

57. REMOVE INTAKE MANIFOLD

(a) Remove the 6 bolts, 4 nuts, intake manifold and 2 gaskets.



58. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

(a) Disconnect the air fuel ratio sensor connector clamp.

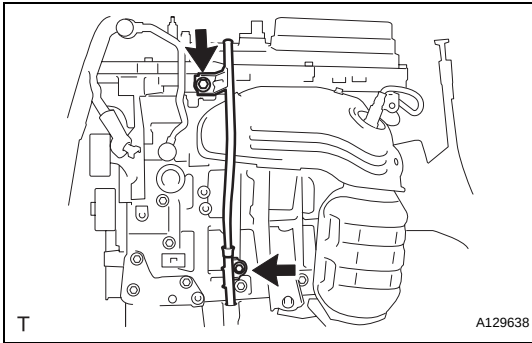
(b) Uniformly loosen and remove the 6 nuts.

(c) Remove the manifold and gasket.

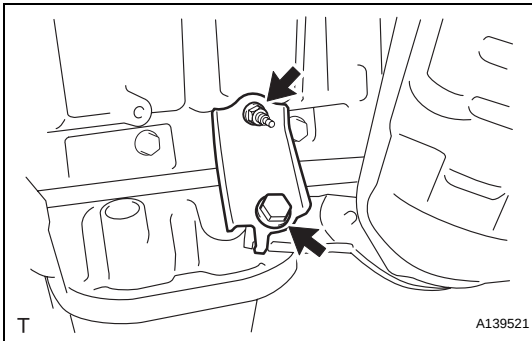
59. REMOVE FAN AND GENERATOR V BELT (See page [EM-8](#))

60. REMOVE COMPRESSOR WITH PULLEY ASSEMBLY (See page [AC-220](#))

61. REMOVE GENERATOR ASSEMBLY (See page [CH-12](#))

**62. REMOVE OIL DIPSTICK GUIDE**

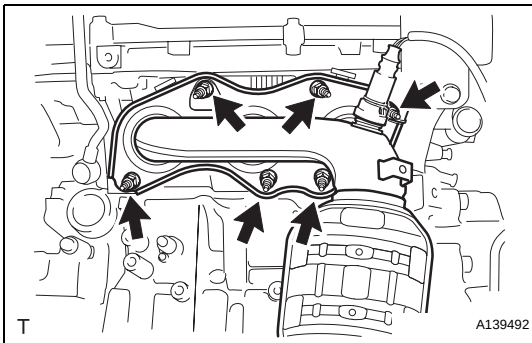
- (a) Remove the dipstick.
- (b) Remove the 2 bolts, and the No. 1 and No. 2 guides.
- (c) Remove the O-rings from the guide.

**63. REMOVE NO. 2 MANIFOLD STAY**

- (a) Remove the bolt, nut and manifold stay.

64. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

- (a) Remove the 3 bolts and insulator.

**65. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH**

- (a) Uniformly loosen and remove the 6 nuts.
- (b) Remove the manifold and gasket.

66. REMOVE ENGINE MOUNTING BRACKET RH

- (a) Remove the 3 bolts and bracket.

67. REMOVE DRIVE SHAFT BEARING BRACKET

- (a) Remove the 3 bolts and drive shaft bearing bracket.

68. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

- (a) Remove the 5 bolts and V-ribbed belt tensioner assembly.

69. REMOVE NO. 2 TIMING GEAR COVER

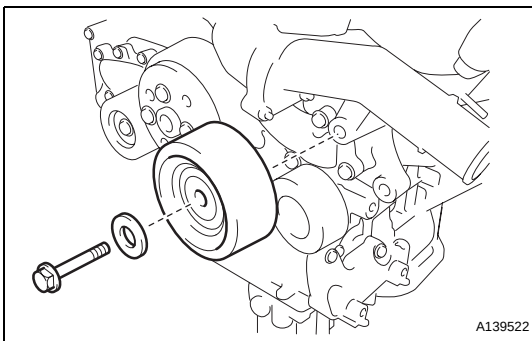
- (a) Remove the 2 bolts and gear cover.

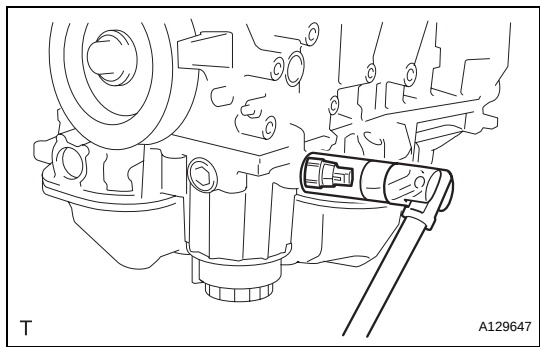
70. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

- (a) Remove the bolt, plate and idler pulley.

71. REMOVE WATER PUMP PULLEY (See page [CO-12](#))**72. REMOVE NO. 1 FRONT ENGINE MOUNTING BRACKET LH**

- (a) Remove the 6 bolts and bracket.

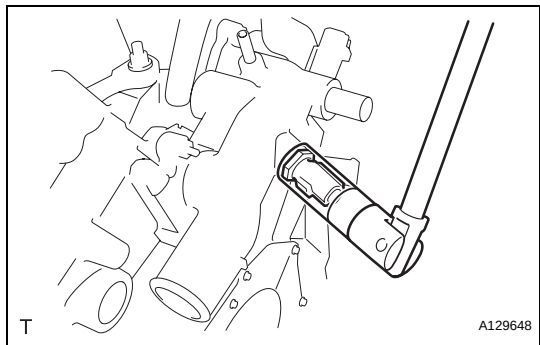




73. REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY

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

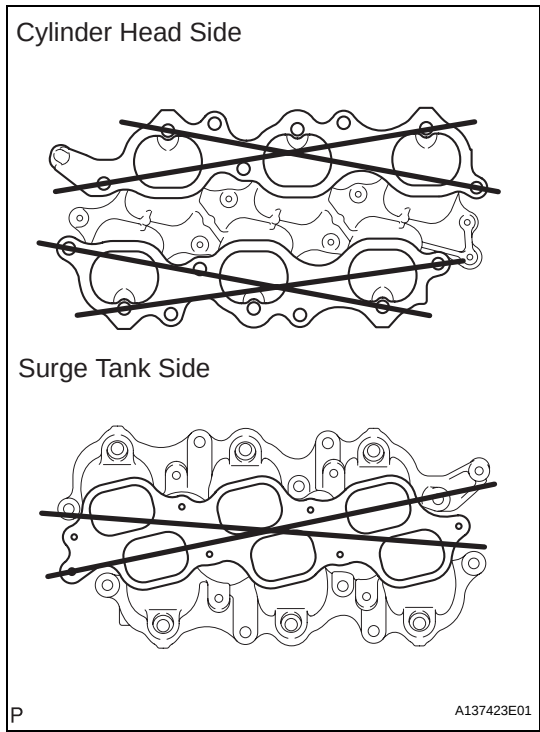
74. REMOVE KNOCK SENSOR (See page ES-459)



75. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

- (a) Using a 19 mm deep socket wrench, remove the sensor and gasket.

EM



INSPECTION

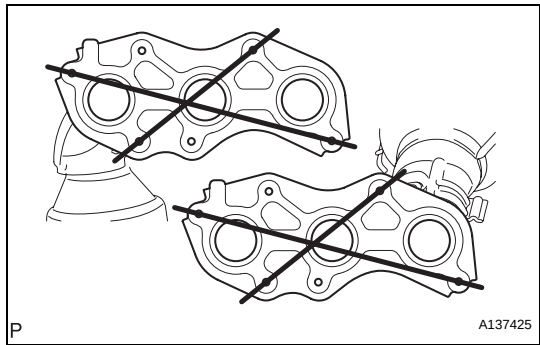
1. INSPECT INTAKE MANIFOLD

- (a) Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head and intake air surge tank.

Maximum warpage

Item	Specified Condition
Intake manifold side	0.8 mm (0.031 in.)
Cylinder head side	0.2 mm (0.008 in.)

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



2. INSPECT EXHAUST MANIFOLD

- (a) Using a precision straightedge and feeler gauge, measure the surface contacting the cylinder head for warpage.

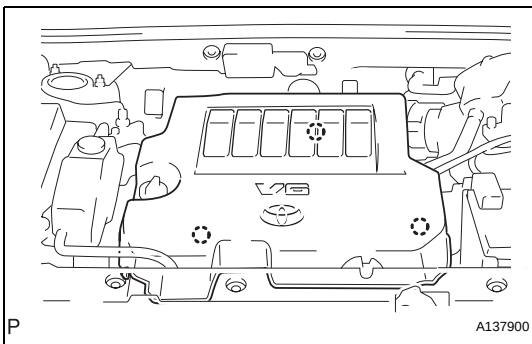
Maximum warpage:

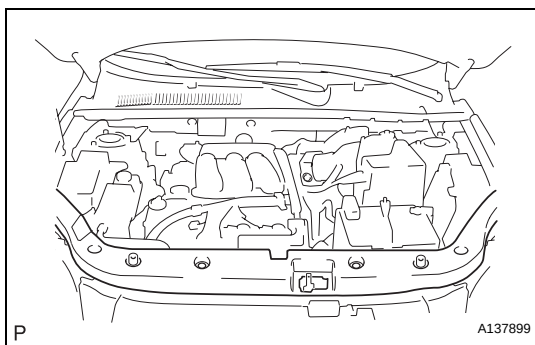
0.70 mm (0.0028 in.)

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

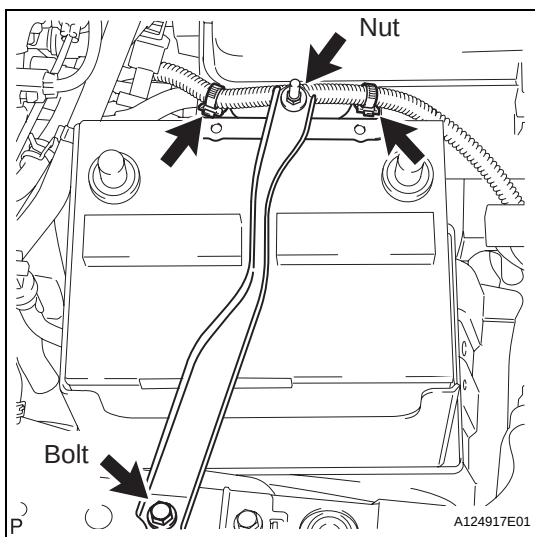
REMOVAL

1. **DISCHARGE REFRIGERANT FROM REFRIGERATION SYSTEM** (See page [AC-172](#))
2. **DISCHARGE FUEL SYSTEM PRESSURE** (See page [FU-13](#))
3. **DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL**
CAUTION:
Wait at least 90 seconds after disconnecting the cable from the negative (-) battery terminal to prevent airbag and seat belt pretensioner activation.
4. **REMOVE NO. 1 ENGINE UNDER COVER**
(a) Remove the 4 bolts, 12 clips and under cover.
5. **REMOVE REAR ENGINE UNDER COVER RH**
(a) Remove the 2 clips and under cover.
6. **REMOVE REAR ENGINE UNDER COVER LH**
(a) Remove the 2 clips and under cover.
7. **REMOVE NO. 2 ENGINE UNDER COVER**
(a) Remove the 2 clips and under cover.
8. **REMOVE FRONT FLOOR COVER** (See page [FU-34](#))
9. **DRAIN ENGINE COOLANT** (See page [CO-8](#))
10. **DRAIN ENGINE OIL** (See page [LU-4](#))
11. **DRAIN AUTOMATIC TRANSAXLE FLUID**
(a) 2WD:
Drain automatic transaxle fluid (see page [AX-172](#)).
(b) 4WD:
Drain automatic transaxle fluid (see page [AX-173](#))
12. **DRAIN TRANSFER OIL (for 4WD)**
13. **REMOVE HOOD SUB-ASSEMBLY** (See page [ED-4](#))
14. **REMOVE V-BANK COVER SUB-ASSEMBLY**
(a) Detach the 3 clips and remove the V-bank cover.

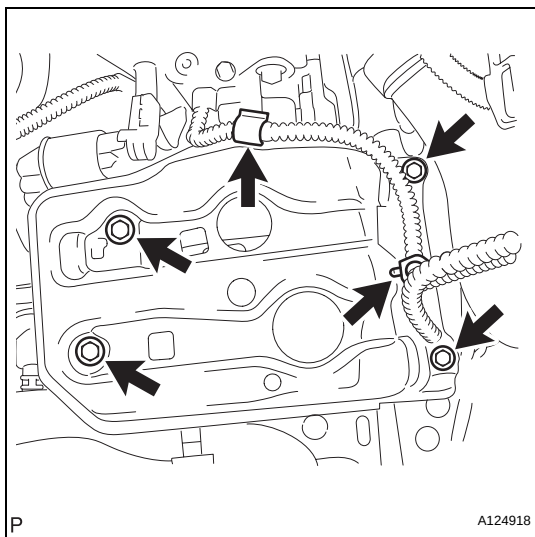
EM

**15. REMOVE RADIATOR SUPPORT OPENING COVER**

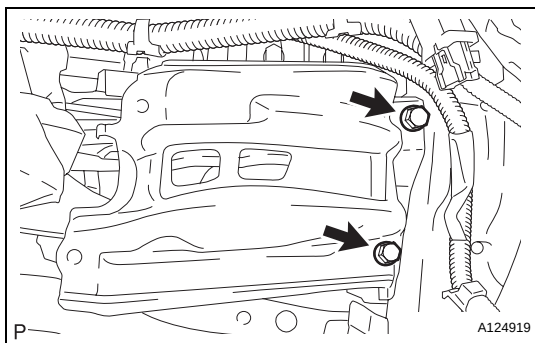
- (a) Remove the 9 clips and cover.

**16. REMOVE BATTERY CLAMP SUB-ASSEMBLY**

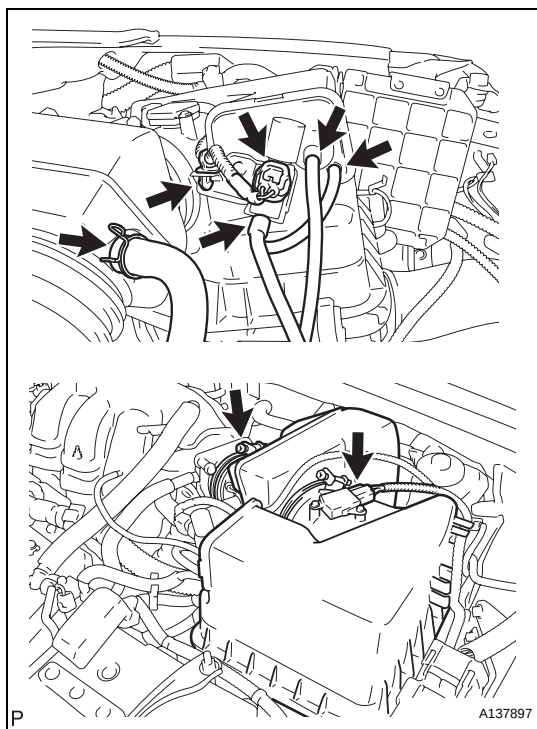
- (a) Remove the bolt and loosen the nut.
(b) Detach the 2 wire harness clamps.
(c) Detach the hook of the battery clamp from the battery bracket front, and then remove the battery clamp.

17. REMOVE BATTERY**18. REMOVE FRONT BATTERY BRACKET**

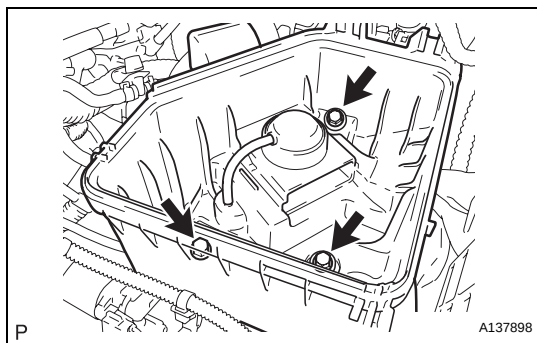
- (a) Detach the 2 wire harness clamps.
(b) Remove the 4 bolts and front bracket.

**19. REMOVE BATTERY BRACKET REINFORCEMENT**

- (a) Remove the 2 bolts and bracket reinforcement.

**20. REMOVE AIR CLEANER CAP SUB-ASSEMBLY**

- (a) Disconnect the mass air flow meter connector.
- (b) Disconnect the VSV (air intake control) connector.
- (c) Disconnect the wire harness clamp and 3 vacuum hoses.
- (d) Disconnect the No. 2 ventilation hose from the air cleaner hose.
- (e) Loosen the No. 1 air cleaner hose clamp.
- (f) Unfasten the 2 hook clamps, and then remove the air cleaner cap.
- (g) Remove the air cleaner filter element from the air cleaner case.

**21. REMOVE AIR CLEANER CASE**

- (a) Disconnect the harness clamp.
- (b) Remove the 3 bolts and air cleaner case.

22. DISCONNECT HOSES AND CONNECTORS

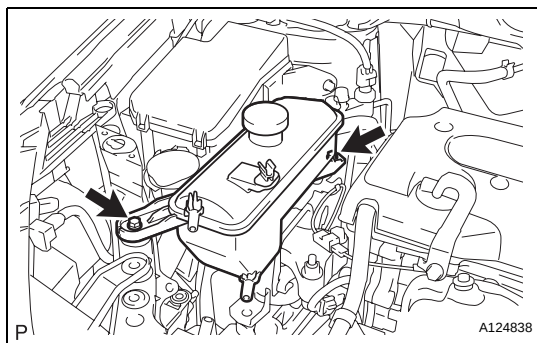
- (a) Remove the engine room junction block cover (upper).
- (b) Remove the nut and disconnect the engine room junction block cover (side) with 3 connectors and wire.
- (c) Remove the nut and disconnect the starter wire.
- (d) Disconnect the fuel hoses.
- (e) Disconnect the 2 heater hoses.
- (f) Disconnect the 2 ECM connectors.

23. REMOVE ECM (See page [ES-470](#))**24. REMOVE RADIATOR RESERVOIR TANK ASSEMBLY**

- (a) Remove the 2 bolts, 2 hoses and reservoir tank.

25. REMOVE DISCHARGE HOSE SUB-ASSEMBLY (See page [AC-220](#))**26. DISCONNECT SUCTION HOSE SUB-ASSEMBLY (See page [AC-220](#))****27. DISCONNECT RADIATOR HOSE INLET****28. DISCONNECT RADIATOR HOSE OUTLET****29. DISCONNECT OIL COOLER HOSE****30. DISCONNECT TRANSMISSION CONTROL CABLE ASSEMBLY**

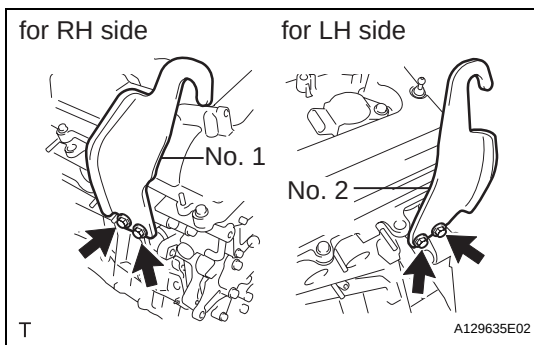
- (a) 2WD:
Disconnect the control cable (see page [AX-154](#)).



EM

- (b) 4WD:
Disconnect the control cable (see page [AX-154](#)).

31. REMOVE FRONT EXHAUST PIPE ASSEMBLY (See page [EX-3](#))
32. REMOVE CENTER EXHAUST PIPE ASSEMBLY (See page [EX-2](#))
33. REMOVE PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (See page [PR-3](#))
34. REMOVE FRONT WHEELS
35. REMOVE FRONT AXLE HUB NUT LH
 - (a) Remove the hub nut (see page [AH-8](#)).
36. REMOVE FRONT AXLE HUB NUT RH
 - (a) Remove the hub nut (see page [AH-8](#)).
37. DISCONNECT FRONT STABILIZER LINK ASSEMBLY LH (See page [SP-30](#))
38. DISCONNECT FRONT STABILIZER LINK ASSEMBLY RH (See page [SP-30](#))
39. DISCONNECT STEERING INTERMEDIATE SHAFT (See page [PS-44](#))
40. DISCONNECT TIE ROD END SUB-ASSEMBLY RH (See page [PS-42](#))
41. DISCONNECT TIE ROD END SUB-ASSEMBLY LH (See page [PS-42](#))
42. REMOVE FRONT DRIVE SHAFT LH
 - (a) 2WD:
Remove the drive shaft (see page [DS-10](#)).
 - (b) 4WD:
Remove the drive shaft (see page [DS-43](#)).
43. REMOVE FRONT DRIVE SHAFT RH
 - (a) 2WD:
Remove the drive shaft (see page [DS-10](#)).
 - (b) 4WD:
Remove the drive shaft (see page [DS-43](#)).
44. REMOVE ENGINE WITH TRANSAXLE
 - (a) Install the No. 1 and No. 2 engine hangers with the 4 bolts as shown in the illustration.
Torque: 33 N*m (337 kgf*cm, 24 ft.*lbf)



Part Name	Part No.
No. 1 engine hanger	12281-31120
No. 2 engine hanger	12282-31100
Bolt	91671-10825

HINT:

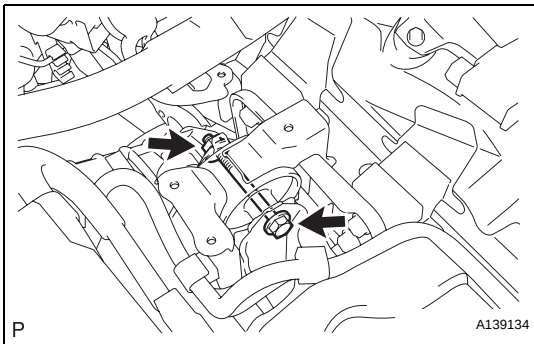
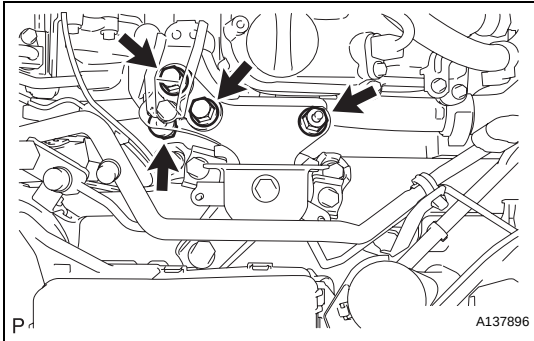
- Insert the claw of the hanger into hole of the cylinder head.
- Fit the fork part of the hanger onto the rib of the cylinder head.

- (b) Install an engine sling device to the engine and hold the engine with a chain block.

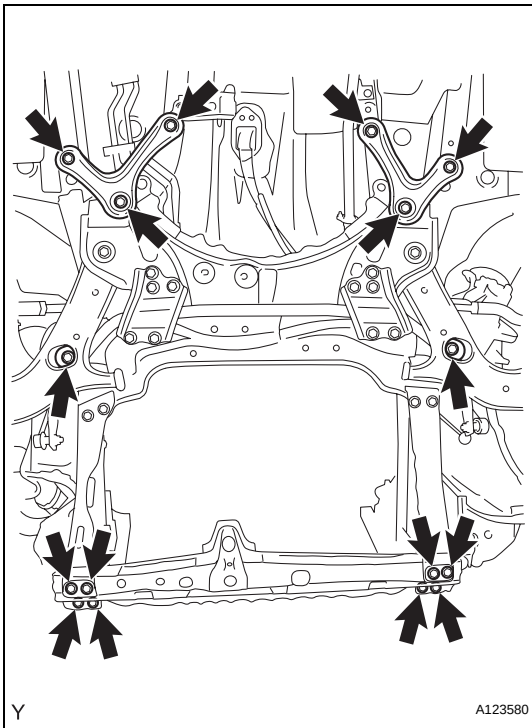
CAUTION:

Do not raise the engine more than necessary. If the engine is raised excessively, the vehicle may also be lifted up.

- (c) Set an engine lifter underneath the engine.
- (d) Remove the column hole cover. Loosen the bolt holding the intermediate shaft, and slide the intermediate shaft.
- (e) Put matchmarks on the intermediate shaft and pinion.
- (f) Remove the 2 bolts and 2 nuts, and disconnect the engine mounting insulator RH.



- (g) Remove the bolt and nut, and disconnect the engine mounting insulator LH.



- (h) Remove the 6 bolts and front suspension member brace rear RH and LH.
- (i) Remove the 6 bolts, crossmember and suspension member.
- (j) Using the chain block, slowly remove the engine from the vehicle and the intermediate shaft from the pinion. Then set the engine on the engine lifter.

NOTICE:

- Make sure that the engine is clear of all wiring and hoses.
- While lowering the engine from the vehicle, do not allow it to contact the vehicle.

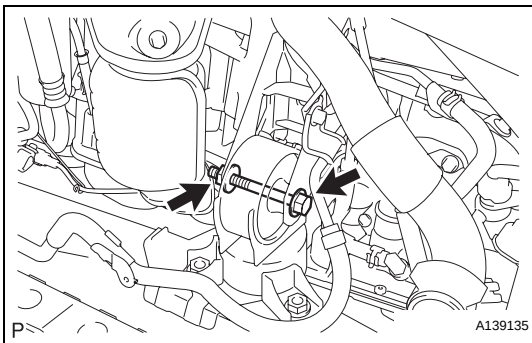
HINT:

Place the engine on wooden blocks or an equivalent so that the engine is level.

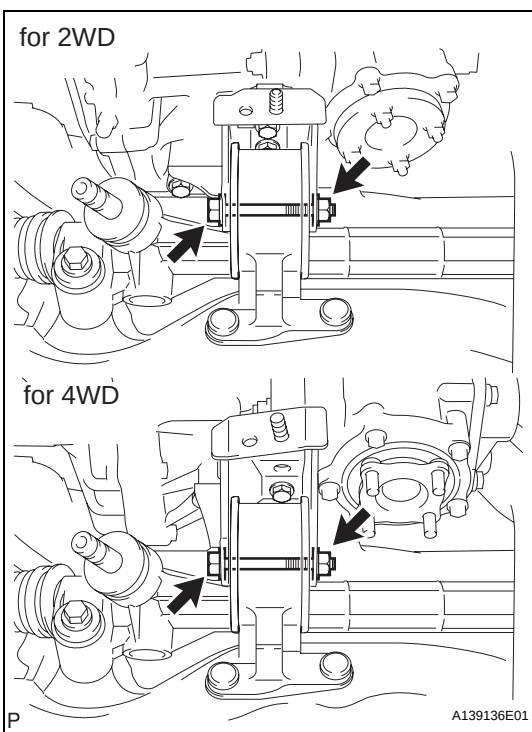
- (k) Remove the sling device from the engine.

45. REMOVE FRONT CROSSMEMBER SUB-ASSEMBLY

- (a) Install a chain block.



- (b) Remove the bolt, nut and crossmember.

**46. REMOVE FRONT SUSPENSION CROSSMEMBER SUB-ASSEMBLY**

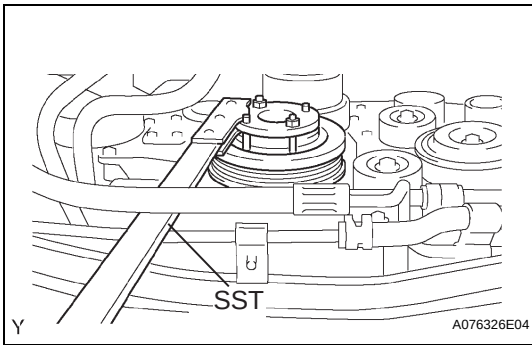
- (a) Remove the bolt and suspension crossmember.

47. REMOVE ENGINE WIRE

- (a) Remove the engine wire from the engine.

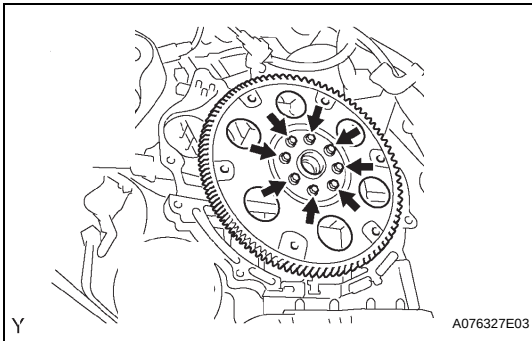
48. REMOVE STARTER ASSEMBLY (See page [ST-6](#))**49. REMOVE TRANSFER ASSEMBLY (for 4WD) (See page [TF-60](#))****50. REMOVE AUTOMATIC TRANSAXLE ASSEMBLY**

- (a) 2WD:
Remove the automatic transaxle (see page [AX-172](#)).
- (b) 4WD:
Remove the automatic transaxle (see page [AX-173](#)).



51. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

- (a) Using SST, hold the crankshaft.
SST 09213-70011, 09330-00021



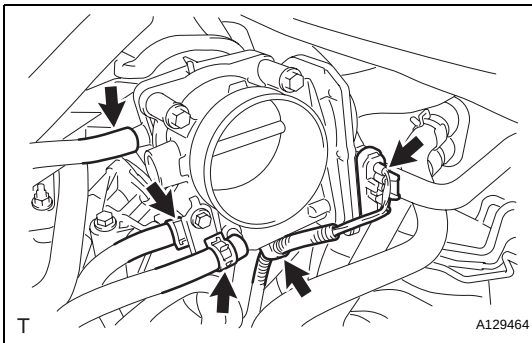
- (b) Remove the 8 bolts, front spacer, drive plate and rear spacer.

NOTICE:

Do not reuse the bolts.

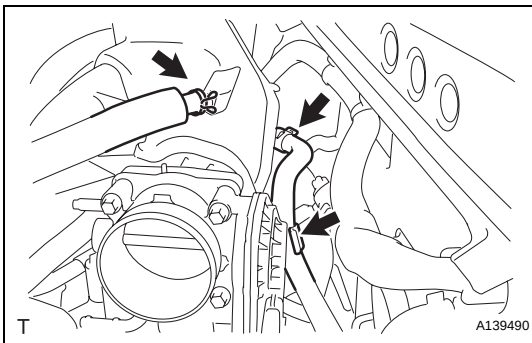
52. INSTALL ENGINE TO ENGINE STAND

- (a) Install the engine to an engine stand. Remove the sling device and chain block from the engine.

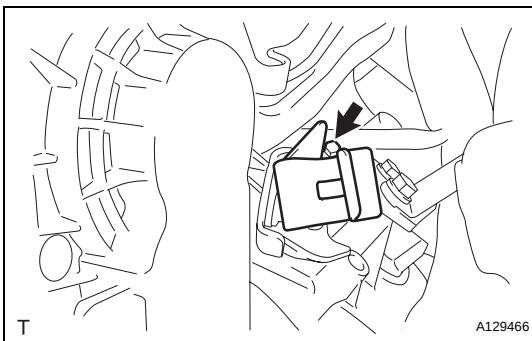


53. REMOVE INTAKE AIR SURGE TANK ASSEMBLY

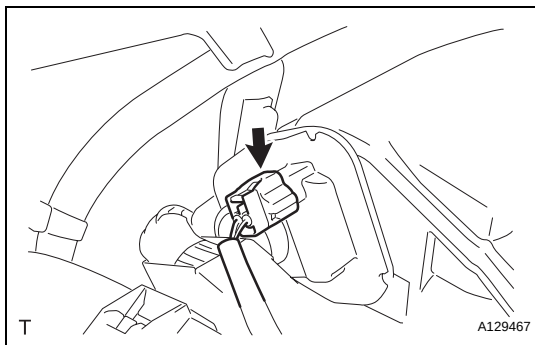
- (a) Disconnect the 2 water by-pass hoses from the throttle body.
(b) Disconnect the vapor feed hose.
(c) Disconnect the throttle body connector and clamp.



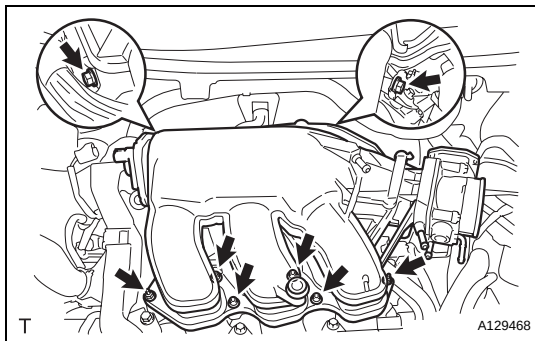
- (d) Disconnect the No. 2 ventilation hose.
(e) Disconnect the union to check valve hose.



- (f) Remove the bolt and vacuum hose clamp.



(g) Disconnect the connector.



(h) Using a 5 mm socket hexagon wrench, remove the 4 bolts.

(i) Remove the 2 nuts, 2 bolts and surge tank.

(j) Remove the gasket from the surge tank.

54. REMOVE IGNITION COIL ASSEMBLY

(a) Remove the 6 bolts and 6 coils from the cylinder head.

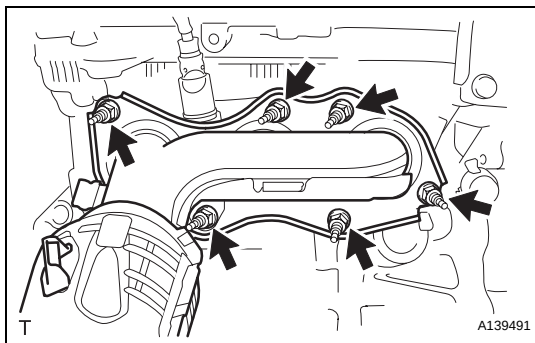
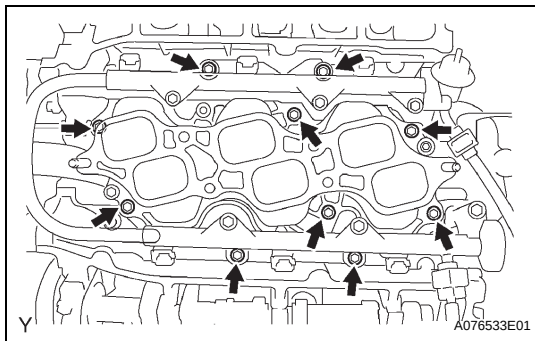
55. REMOVE NO. 2 ENGINE MOUNTING STAY RH

(a) Remove the bolt and mounting stay.

56. REMOVE FUEL INJECTOR ASSEMBLY (See page [FU-14](#))

57. REMOVE INTAKE MANIFOLD

(a) Remove the 6 bolts, 4 nuts, intake manifold and 2 gaskets.



58. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY RH

(a) Disconnect the air fuel ratio sensor connector clamp.

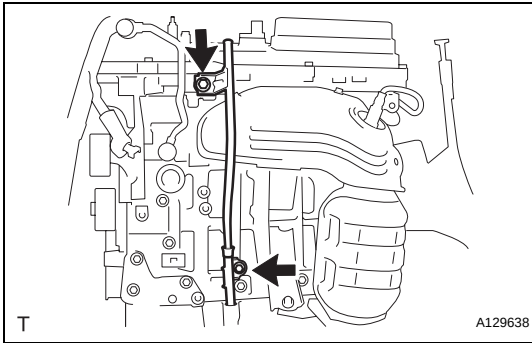
(b) Uniformly loosen and remove the 6 nuts.

(c) Remove the manifold and gasket.

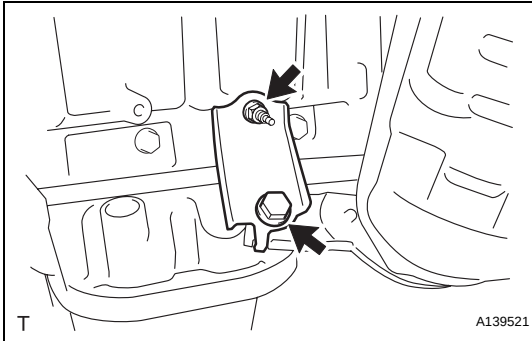
59. REMOVE FAN AND GENERATOR V BELT (See page [EM-8](#))

60. REMOVE COMPRESSOR WITH PULLEY ASSEMBLY (See page [AC-220](#))

61. REMOVE GENERATOR ASSEMBLY (See page [CH-12](#))

**62. REMOVE OIL DIPSTICK GUIDE**

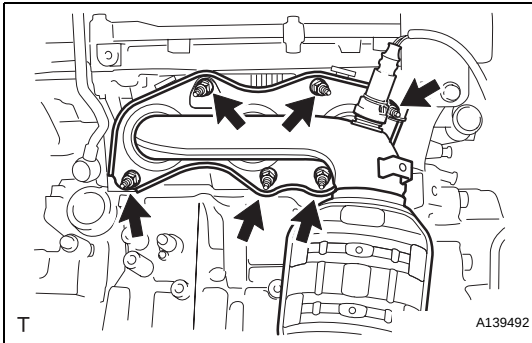
- (a) Remove the dipstick.
- (b) Remove the 2 bolts, and the No. 1 and No. 2 guides.
- (c) Remove the O-rings from the guide.

**63. REMOVE NO. 2 MANIFOLD STAY**

- (a) Remove the bolt, nut and manifold stay.

64. REMOVE NO. 2 EXHAUST MANIFOLD HEAT INSULATOR

- (a) Remove the 3 bolts and insulator.

**65. REMOVE EXHAUST MANIFOLD SUB-ASSEMBLY LH**

- (a) Uniformly loosen and remove the 6 nuts.
- (b) Remove the manifold and gasket.

66. REMOVE ENGINE MOUNTING BRACKET RH

- (a) Remove the 3 bolts and bracket.

67. REMOVE DRIVE SHAFT BEARING BRACKET

- (a) Remove the 3 bolts and drive shaft bearing bracket.

68. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY

- (a) Remove the 5 bolts and V-ribbed belt tensioner assembly.

69. REMOVE NO. 2 TIMING GEAR COVER

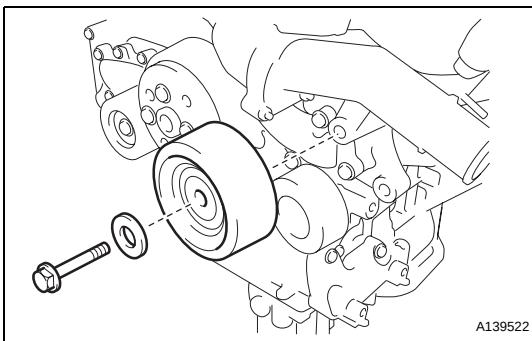
- (a) Remove the 2 bolts and gear cover.

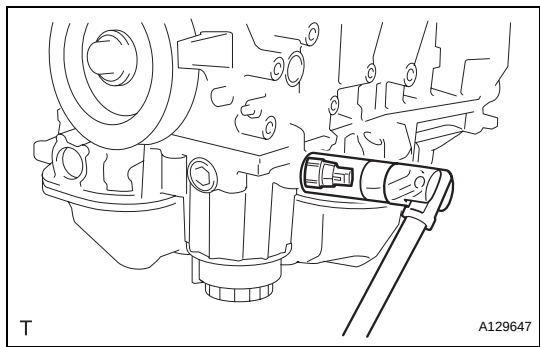
70. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY

- (a) Remove the bolt, plate and idler pulley.

71. REMOVE WATER PUMP PULLEY (See page [CO-12](#))**72. REMOVE NO. 1 FRONT ENGINE MOUNTING BRACKET LH**

- (a) Remove the 6 bolts and bracket.

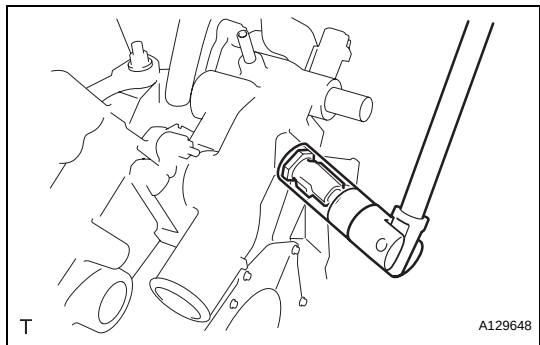




73. REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY

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

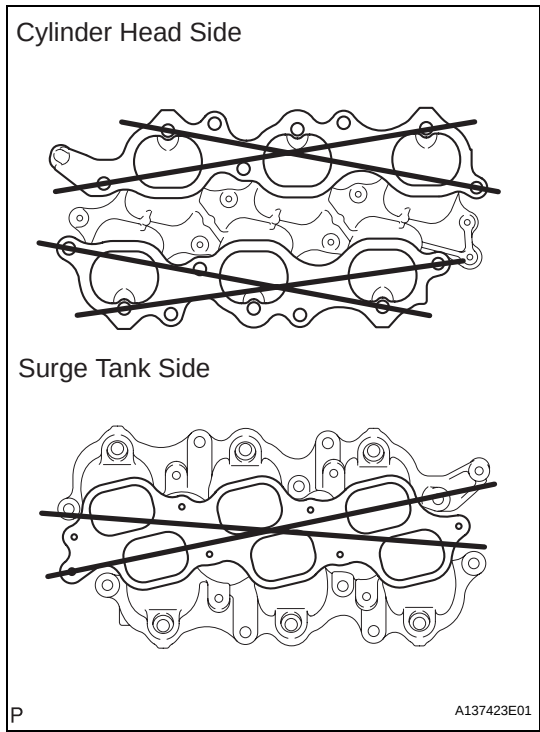
74. REMOVE KNOCK SENSOR (See page ES-459)



75. REMOVE ENGINE COOLANT TEMPERATURE SENSOR

- (a) Using a 19 mm deep socket wrench, remove the sensor and gasket.

EM



INSPECTION

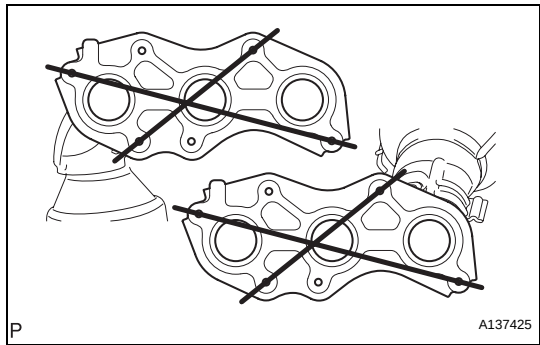
1. INSPECT INTAKE MANIFOLD

- (a) Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head and intake air surge tank.

Maximum warpage

Item	Specified Condition
Intake manifold side	0.8 mm (0.031 in.)
Cylinder head side	0.2 mm (0.008 in.)

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



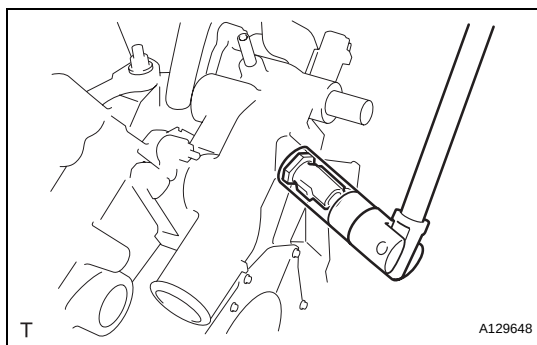
2. INSPECT EXHAUST MANIFOLD

- (a) Using a precision straightedge and feeler gauge, measure the surface contacting the cylinder head for warpage.

Maximum warpage:

0.70 mm (0.0028 in.)

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



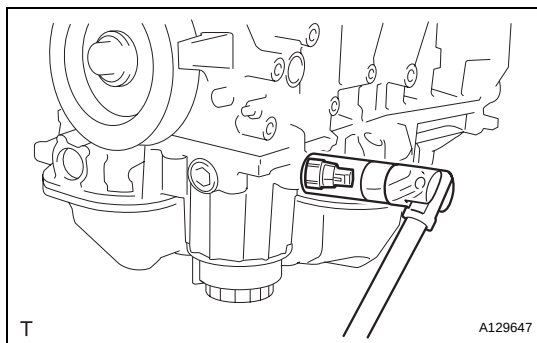
INSTALLATION

1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

- (a) Using a 19 mm deep socket wrench, install the sensor and a new gasket.

Torque: 20 N*m (204 kgf*cm, 14 ft.*lbf)

2. INSTALL KNOCK SENSOR (See page [ES-459](#))



3. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY

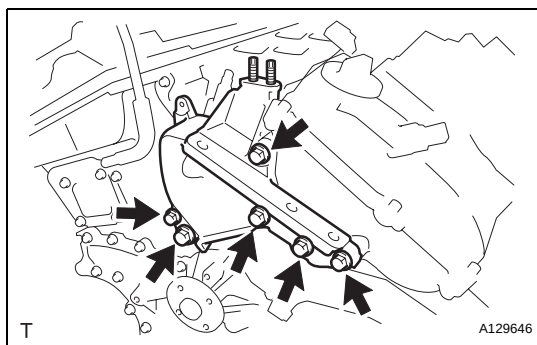
- (a) Clean the threads of the oil pressure switch. Apply adhesive to 2 or 3 threads of the oil pressure switch.

Adhesive:

Toyota Genuine Adhesive 1344, Three Bond 1344 or Equivalent

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

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

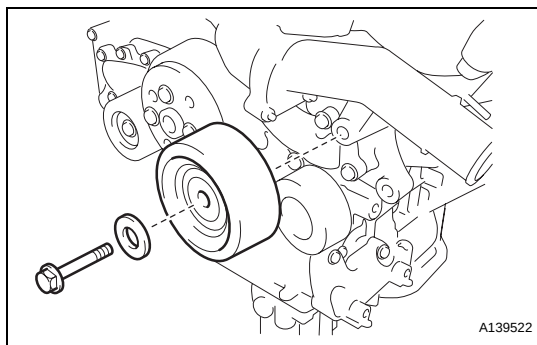


4. INSTALL NO. 1 FRONT ENGINE MOUNTING BRACKET LH

- (a) Install the mounting bracket with the 6 bolts.

Torque: 54 N*m (551 kgf*cm, 40 ft.*lbf)

5. INSTALL WATER PUMP PULLEY (See page [CO-14](#))



6. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY

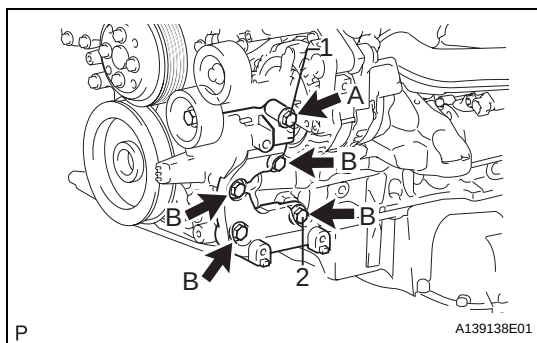
- (a) Install the idler pulley and cover plate with the bolt.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

7. INSTALL NO. 2 TIMING GEAR COVER

- (a) Install the gear cover with the 2 bolts.

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



8. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

- (a) Temporarily install the V-ribbed belt tensioner with the 5 bolts.

- (b) Install the V-ribbed belt tensioner by tightening the bolt 1 and bolt 2 in the order shown in the illustration.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

- (c) Tighten the other bolts.

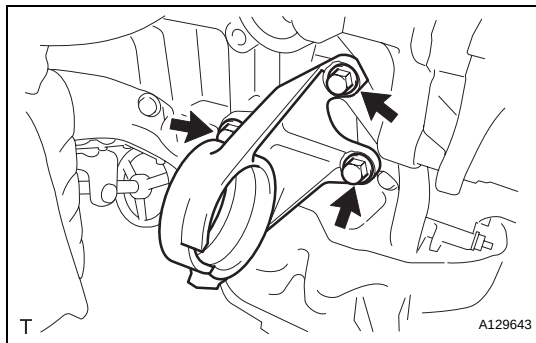
Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

Each bolt length is as follows:

A	70 mm (2.76 in.)
---	------------------

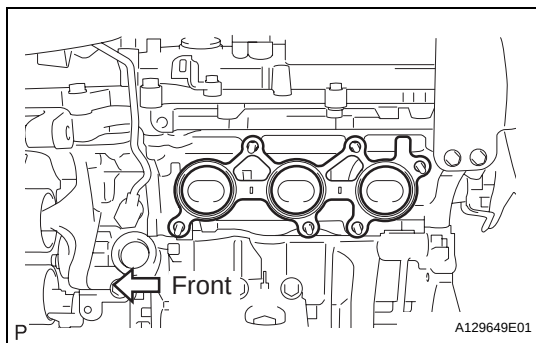
B

35 mm (1.37 in.)

**9. INSTALL DRIVE SHAFT BEARING BRACKET**

- (a) Install the drive shaft bearing bracket with the 3 bolts.

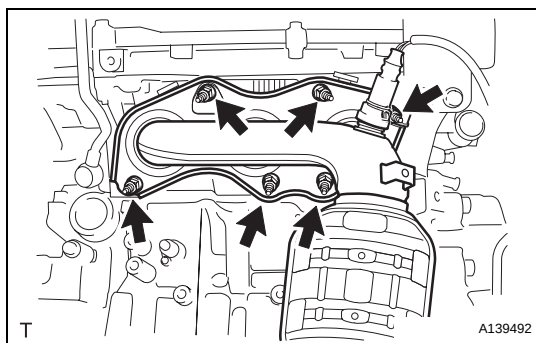
Torque: 64 N*m (653 kgf*cm, 47 ft.*lbf)

**10. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH**

- (a) Install a new gasket as shown in the illustration.

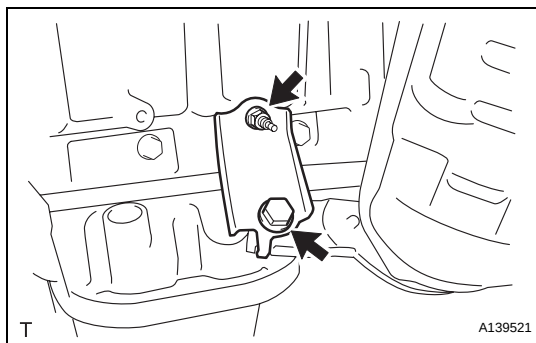
- (b) Install the manifold with the 6 nuts.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

**11. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR**

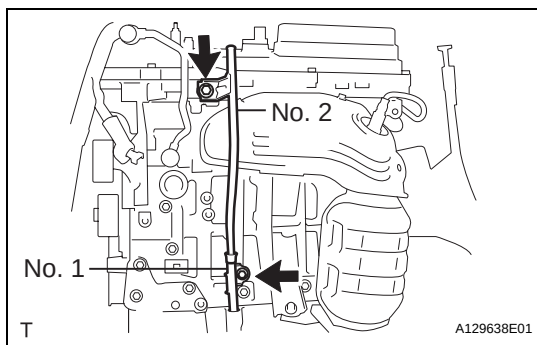
- (a) Install the No. 2 heat insulator with the 3 bolts.

Torque: 8.5 N*m (87 kgf*cm, 75 in.*lbf)

**12. INSTALL NO. 2 MANIFOLD STAY**

- (a) Install the No. 2 manifold stay with the bolt and nut.

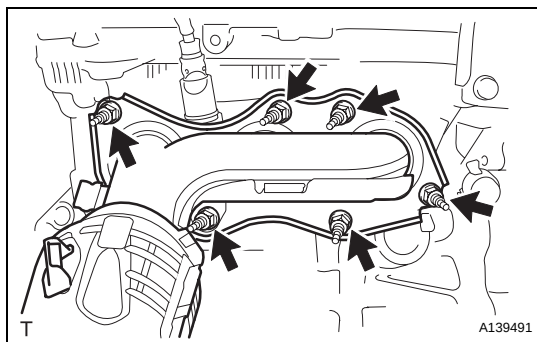
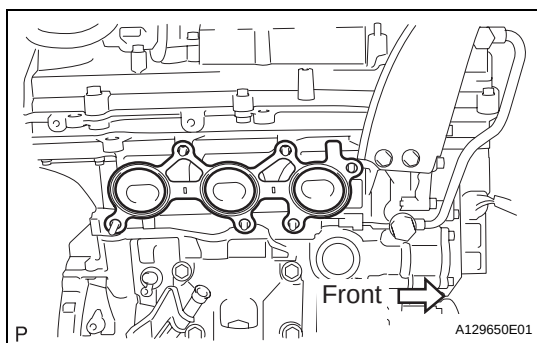
Torque: 34 N*m (347 kgf*cm, 25 ft.*lbf)

**13. INSTALL OIL DIPSTICK GUIDE**

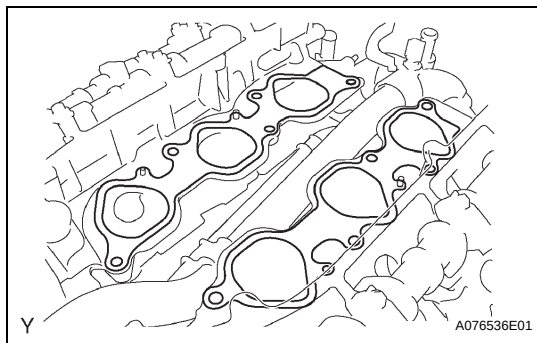
- (a) Install 2 new O-rings to the guide.
- (b) Apply a light coat of engine oil to the O-rings.
- (c) Push in the guide end into the guide hole.
- (d) Install the No. 1 guide with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- (e) Install the No. 2 guide with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- (f) Install the dipstick.

14. INSTALL GENERATOR ASSEMBLY (See page [CH-19](#))**15. INSTALL COMPRESSOR WITH PULLEY ASSEMBLY (See page [AC-221](#))****16. INSTALL FAN AND GENERATOR V BELT (See page [EM-8](#))****17. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH**

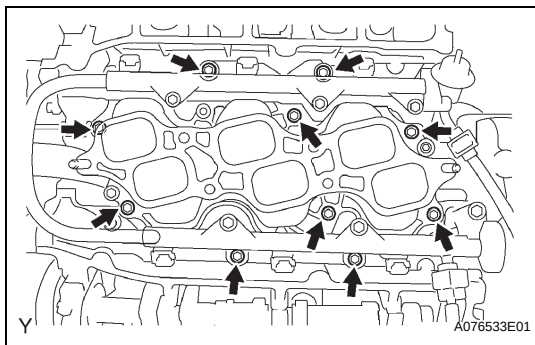
- (a) Install a new gasket as shown in the illustration.



- (b) Install the manifold with the 6 nuts.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

**18. INSTALL INTAKE MANIFOLD**

- (a) Set a new gasket on each cylinder head.
NOTICE:
 - **Align the port holes of the gasket and cylinder head.**
 - **Be careful of the installation direction.**
- (b) Set the intake manifold on the cylinder heads.



- (c) Install and uniformly tighten the 6 bolts and 4 nuts in several passes.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

- (d) Connect the 6 fuel injector connectors.

19. INSTALL FUEL INJECTOR ASSEMBLY (See page [FU-16](#))

20. INSTALL NO. 2 ENGINE MOUNTING STAY RH

- (a) Install the mounting stay with the bolt.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

21. INSTALL IGNITION COIL ASSEMBLY

- (a) Install the 6 ignition coils with the 6 bolts to the cylinder head.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

22. INSTALL INTAKE AIR SURGE TANK ASSEMBLY

NOTICE:

Make sure there is no oil on the bolts. If there is oil on the bolts, clean them before installing them.

- (a) Install a new gasket to the surge tank.
(b) Using a 5 mm hexagon socket wrench, install the 4 bolts.

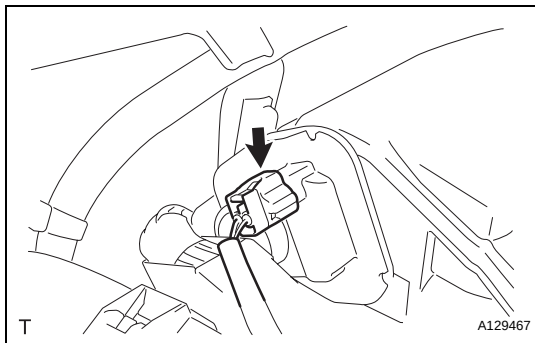
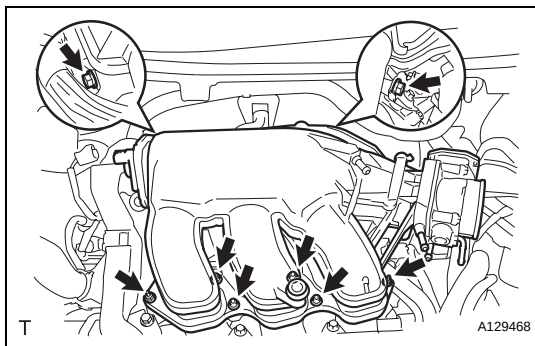
Torque: 18 N*m (184 kgf*cm, 13 ft.*lbf)

- (c) Install the surge tank with the 2 nuts and 2 bolts.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt

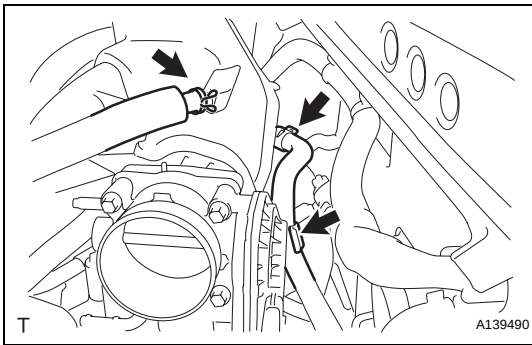
16 N*m (163 kgf*cm, 12 ft.*lbf) for nut

- (d) Connect the connector.

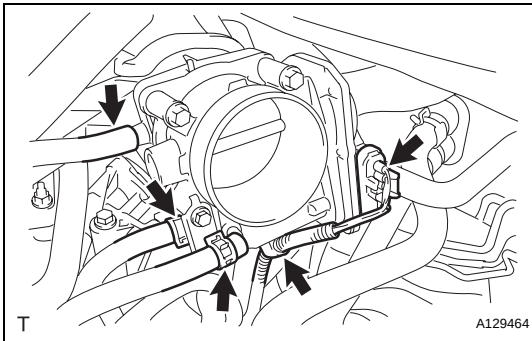


- (e) Install the vacuum hose clamp with the bolt.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)



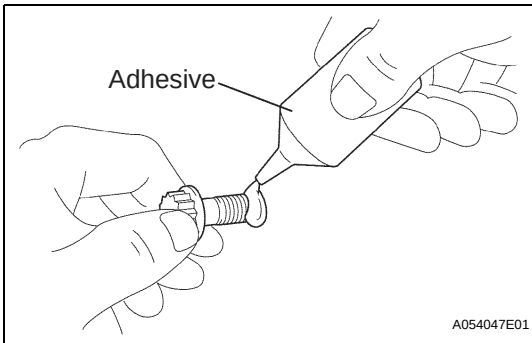
- (f) Connect the union to check valve hose.
- (g) Connect the No. 2 ventilation hose.



- (h) Install the clamp and connect the throttle body connector.
- (i) Connect the vapor feed hose.
- (j) Connect the 2 water by-pass hoses to the throttle body.

23. REMOVE ENGINE FROM ENGINE STAND

- (a) Install a sling device and chain block to the engine.
- (b) Remove the engine from the engine stand.

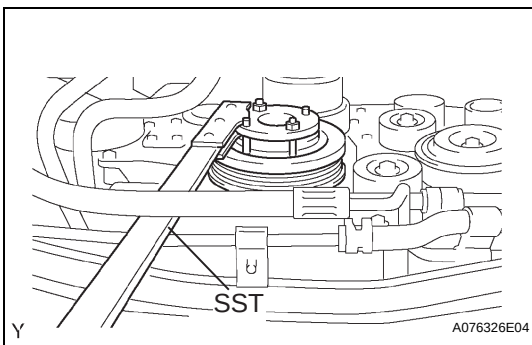


24. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

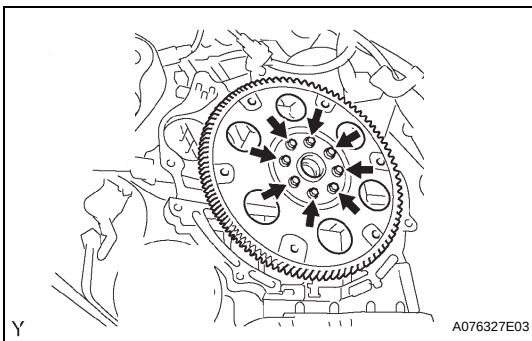
- (a) Clean the bolt and its hole.
- (b) Apply adhesive to 2 or 3 threads of the bolt end.

Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent



- (c) Using SST, hold the crankshaft.
SST 09213-70011, 09330-00021
- (d) Install the flywheel, drive plate and drive plate spacer on the crankshaft.



- (e) Uniformly install and tighten the 8 bolts in the sequence shown in the illustration.
Torque: 178 N*m (1,815 kgf*cm, 132 ft.*lbf)
NOTICE:
Do not start the engine for at least 1 hour after the installation.

25. INSTALL AUTOMATIC TRANSAXLE ASSEMBLY

- (a) 2WD:
Install the automatic transaxle (see page [AX-174](#)).

(b) 4WD:

Install the automatic transaxle (see page [AX-175](#)).

26. INSTALL TRANSFER ASSEMBLY (for 4WD) (See page [TF-75](#))

27. INSTALL STARTER ASSEMBLY (See page [ST-14](#))

28. INSTALL ENGINE WIRE

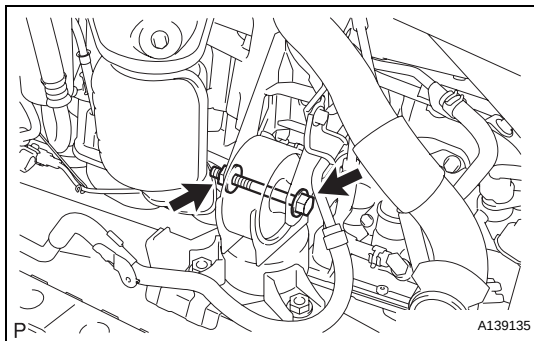
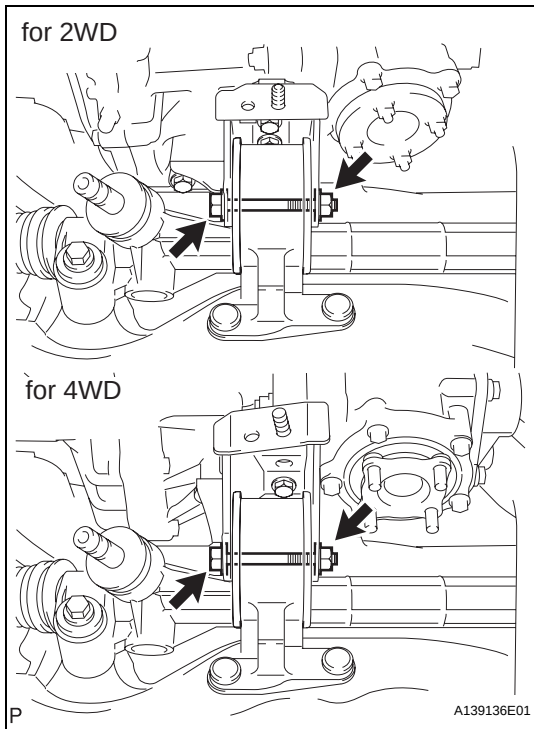
(a) Install the engine wire to the engine.

29. INSTALL FRONT SUSPENSION CROSSMEMBER SUB-ASSEMBLY

(a) Attach the engine together with the transaxle to the suspension crossmember and mounting.

(b) Install the bolt which secures the engine mounting bracket to the mounting insulator.

Torque: 95 N*m (969 kgf*cm, 70 ft.*lbf)



30. INSTALL FRONT CROSSMEMBER SUB-ASSEMBLY

(a) Install the bolt and nut which secures the engine mounting bracket to the mounting insulator.

Torque: 145 N*m (1,479 kgf*cm, 107 ft.*lbf)

31. INSTALL ENGINE WITH TRANSAXLE

(a) Place the engine on an engine lifter.

HINT:

Place the engine on wooden blocks or an equivalent so that the engine is level.

(b) Using the chain block, slowly install the engine to the vehicle and the intermediate shaft to the pinion.

CAUTION:

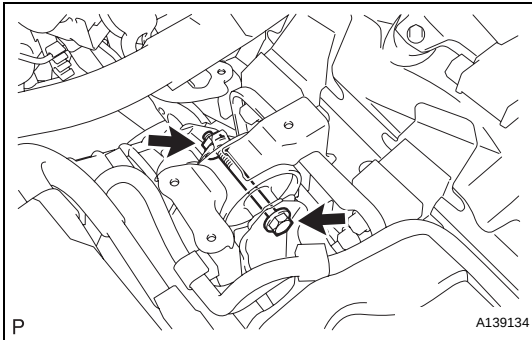
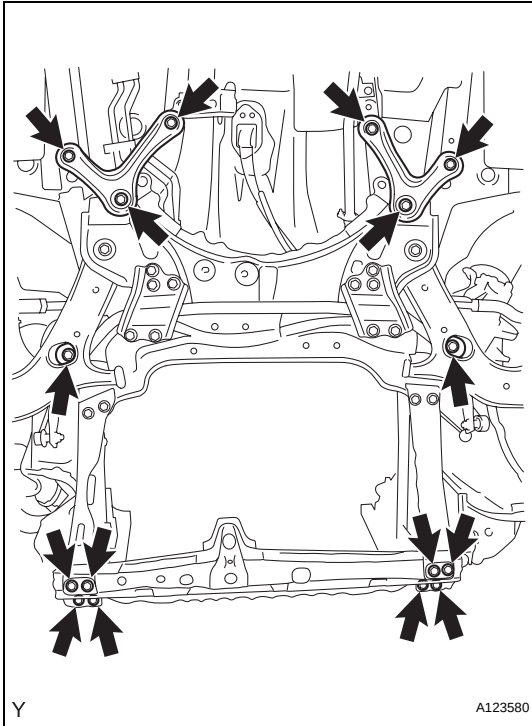
Do not raise the engine more than necessary. If the engine is raised excessively, the vehicle may also be lifted up.

NOTICE:

- Make sure that the engine is clear of all wiring and hoses.

- While raising the engine into the vehicle, do not allow it to contact the vehicle.
- Align the matchmarks on the intermediate shaft and pinion.

- (c) Temporarily install the suspension member and crossmember with the 10 bolts.
- (d) Temporarily install the member brace rear RH and LH with the 6 bolts.

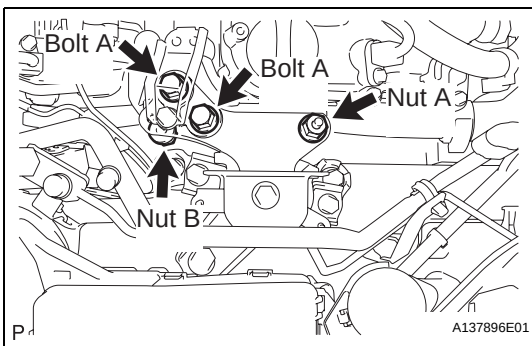


- (e) Install the engine mounting insulator LH with the bolt and nut.

Torque: 56 N*m (571 kgf*cm, 41 ft.*lbf)

NOTICE:

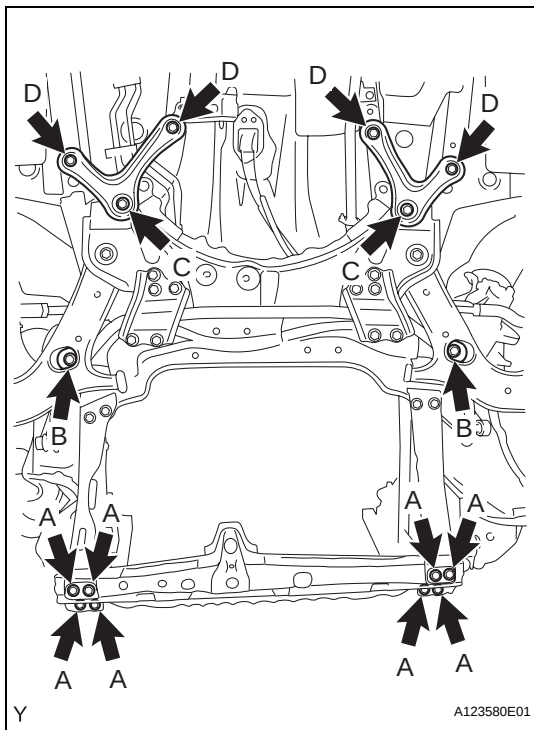
While holding the bolt in place, tighten the nut.



- (f) Install the engine mounting insulator RH with the 2 bolts and 2 nuts.

Torque: 95 N*m (969 kgf*cm, 70 ft.*lbf) for bolt and nut A

52 N*m (530 kgf*cm, 38 ft.*lbf) for nut B



- (g) Tighten the suspension member and crossmember's bolts.
Torque: 96 N*m (979 kgf*cm, 71 ft.*lbf) for bolt A
145 N*m (1,478 kgf*cm, 107 ft.*lbf) for bolt B
- (h) Tighten the member brace rear's bolts.
Torque: 145 N*m (1,478 kgf*cm, 107 ft.*lbf) for bolt C
93 N*m (948 kgf*cm, 69 ft.*lbf) for bolt D
- (i) Remove the sling device and chain block.
- (j) Remove the 2 bolts and No. 1 and No. 2 engine hangers.

32. INSTALL FRONT DRIVE SHAFT LH

- (a) 2WD:
Install the drive shaft (see page [DS-33](#)).
- (b) 4WD:
Install the drive shaft (see page [DS-66](#)).

33. INSTALL FRONT DRIVE SHAFT RH

- (a) 2WD:
Install the drive shaft (see page [DS-33](#)).
- (b) 4WD:
Install the drive shaft (see page [DS-66](#)).

34. CONNECT TIE ROD END SUB-ASSEMBLY LH (See page [PS-45](#))

35. CONNECT TIE ROD END SUB-ASSEMBLY RH (See page [PS-45](#))

36. CONNECT STEERING INTERMEDIATE SHAFT (See page [PS-44](#))

37. CONNECT FRONT STABILIZER LINK ASSEMBLY LH (See page [SP-31](#))

38. CONNECT FRONT STABILIZER LINK ASSEMBLY RH (See page [SP-31](#))

39. INSTALL FRONT AXLE HUB NUT LH

- (a) Install the hub nut (see page [AH-11](#)).

40. INSTALL FRONT AXLE HUB NUT RH

- (a) Install the hub nut (see page [AH-11](#)).

41. INSTALL FRONT WHEELS

42. INSTALL PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (See page [PR-5](#))

43. INSTALL CENTER EXHAUST PIPE ASSEMBLY (See page [EX-4](#))

44. INSTALL FRONT EXHAUST PIPE ASSEMBLY (See page [EX-4](#))

45. CONNECT TRANSMISSION CONTROL CABLE ASSEMBLY

- (a) 2WD:
Connect the control cable (see page [AX-154](#)).

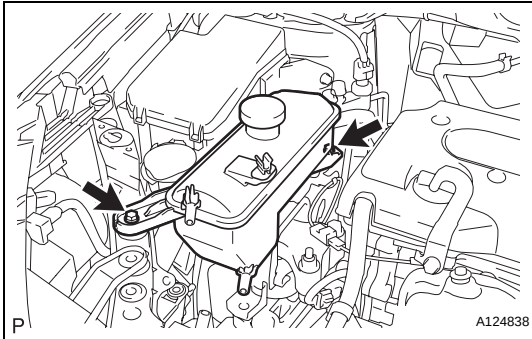
- (b) 4WD:
Connect the control cable (see page [AX-154](#)).

46. CONNECT RADIATOR HOSE INLET**47. CONNECT RADIATOR HOSE OUTLET****48. CONNECT OIL COOLER HOSE****49. CONNECT SUCTION HOSE SUB-ASSEMBLY** (See page [AC-221](#))**50. INSTALL DISCHARGE HOSE SUB-ASSEMBLY** (See page [AC-221](#))**51. INSTALL RADIATOR RESERVOIR TANK ASSEMBLY**

- (a) Install the reservoir tank with the 2 bolts.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)
- (b) Connect the 2 hoses

52. INSTALL ECM (See page [ES-471](#))**53. CONNECT HOSES AND CONNECTORS**

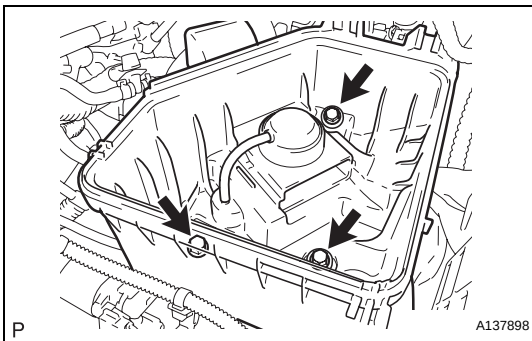
- (a) Connect the 2 ECM connectors.
- (b) Connect the 2 heater hoses.
- (c) Connect the fuel hoses.
- (d) Connect the starter wire with the nut.
Torque: 9.8 N*m (100 kgf*cm, 7 ft.*lbf)
- (e) Connect the 3 connectors and wire with the nut.
Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)
- (f) Install the engine room junction block cover (upper).

EM**54. INSTALL AIR CLEANER CASE**

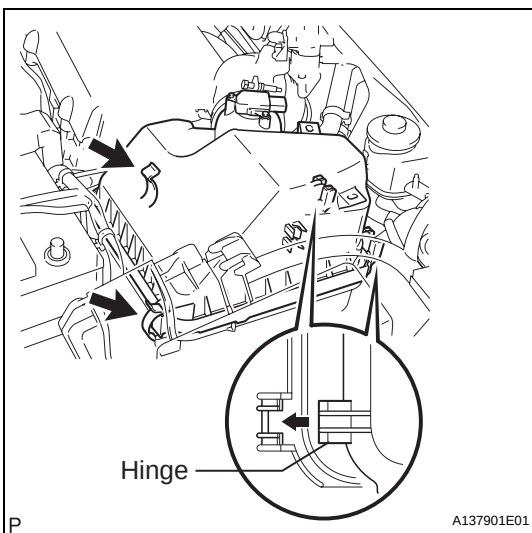
- (a) Install the air cleaner case with the 3 bolts.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)
- (b) Connect the harness clamp.

55. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

- (a) Install the air cleaner filter element onto the air cleaner case.

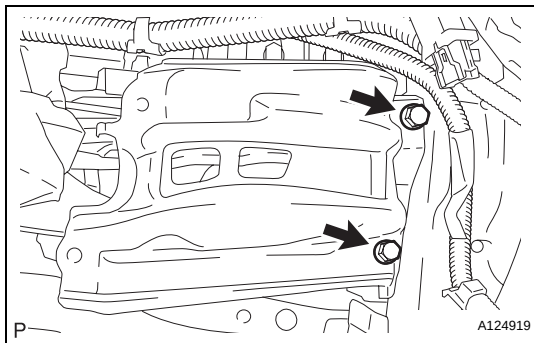


- (b) Insert the hinge part of the air cleaner cap into the air cleaner case, then hang the 2 hook clamps.



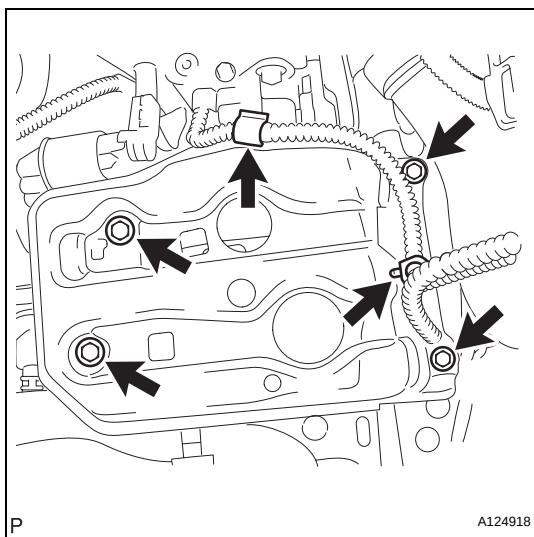


- (c) Tighten the No. 1 air cleaner hose clamp.
- (d) Connect the No. 2 ventilation hose to the air cleaner hose.
- (e) Connect the wire harness clamp and 3 vacuum hoses.
- (f) Connect the VSV (intake air control) connector.
- (g) Connect the mass air flow meter connector.



56. INSTALL BATTERY BRACKET REINFORCEMENT

- (a) Install the bracket reinforcement with the 2 bolts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)



57. INSTALL FRONT BATTERY BRACKET

- (a) Install the bracket front with the 4 bolts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)
- (b) Attach the 2 wire harness clamps.

58. INSTALL BATTERY

59. REMOVE BATTERY CLAMP SUB-ASSEMBLY

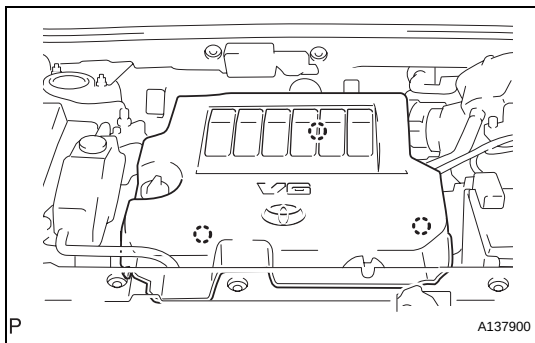
- (a) Attach the hook of the battery clamp to the battery bracket front.
- (b) Temporarily tighten the nut and install the bolt.
- (c) Adjust the battery clamp's position.
- (d) Fully tighten the nut and bolt.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)
- (e) Attach the 2 wire harness clamps.

60. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

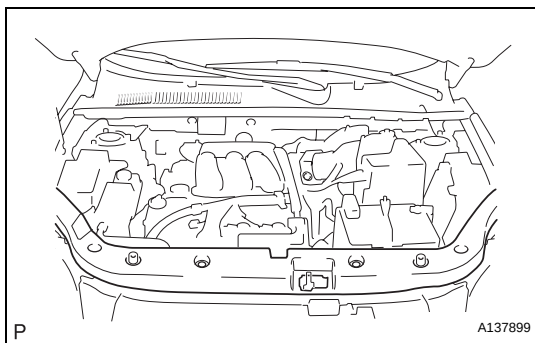
61. INSTALL HOOD SUB-ASSEMBLY

- (a) Install the hood (see page [ED-7](#)).
- (b) Adjust the hood (see page [ED-5](#)).

- 62. ADD AUTOMATIC TRANSAXLE FLUID**
 - (a) 2WD:
Add automatic transmission fluid (see page [AX-177](#)).
 - (b) 4WD:
Add automatic transmission fluid (see page [AX-178](#)).
- 63. ADD TRANSFER OIL (for 4WD) (See page [TF-45](#))**
- 64. ADD ENGINE OIL (See page [LU-6](#))**
- 65. ADD ENGINE COOLANT (See page [CO-8](#))**
- 66. CHARGE REFRIGERANT (See page [AC-172](#))**
- 67. CHECK FOR LEAKAGE OF REFRIGERANT (See page [AC-173](#))**
- 68. CHECK FOR ENGINE OIL LEAKS (See page [LU-6](#))**
- 69. CHECK FOR ENGINE COOLANT LEAKS (See page [CO-1](#))**
- 70. CHECK FOR FUEL LEAKS**
- 71. INSPECT EXHAUST GAS LEAKS**
- 72. INSPECT SHIFT LEVER POSITION**
 - (a) 2WD:
Inspect the shift lever position (see page [AX-159](#)).
 - (b) 4WD:
Inspect the shift lever position (see page [AX-158](#)).
- 73. ADJUST TRANSMISSION CONTROL CABLE**
 - (a) 2WD:
Adjust the shift lever position (see page [AX-159](#)).
 - (b) 4WD:
Adjust the shift lever position (see page [AX-159](#)).
- 74. INSTALL FRONT FLOOR COVER (See page [FU-39](#))**
- 75. INSTALL NO. 2 ENGINE UNDER COVER**
 - (a) Install the under cover with the 2 clips.
- 76. INSTALL REAR ENGINE UNDER COVER LH**
 - (a) Install the under cover with the 2 clips.
- 77. INSTALL REAR ENGINE UNDER COVER RH**
 - (a) Install the under cover with the 2 clips.
- 78. INSTALL NO. 1 ENGINE UNDER COVER**
 - (a) Install the under cover with the 4 bolts and 12 clips.

**79. INSTALL V-BANK COVER SUB-ASSEMBLY**

- (a) Attach the 3 clips to install the engine cover.

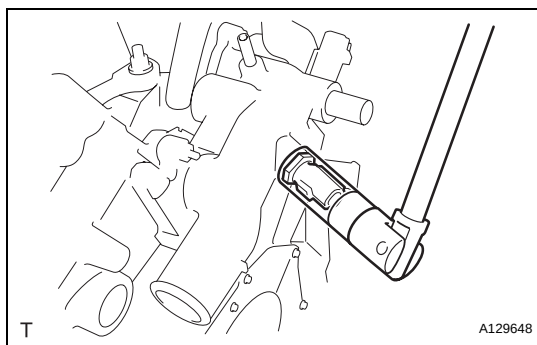
**80. INSTALL RADIATOR SUPPORT OPENING COVER**

- (a) Install the cover with the 9 clips.

81. ADJUST FRONT WHEEL ALIGNMENT

- (a) Adjust the front wheel alignment (see page [SP-3](#)).

82. INSPECT IDLE SPEED (See page [EM-2](#))



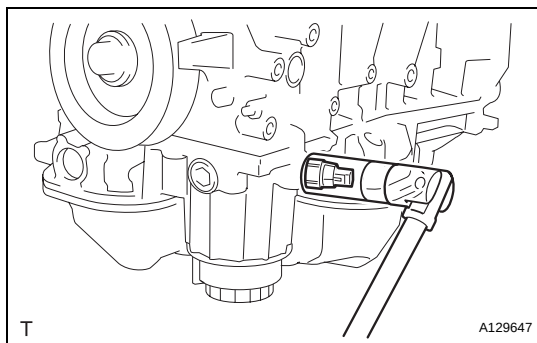
INSTALLATION

1. INSTALL ENGINE COOLANT TEMPERATURE SENSOR

- (a) Using a 19 mm deep socket wrench, install the sensor and a new gasket.

Torque: 20 N*m (204 kgf*cm, 14 ft.*lbf)

2. INSTALL KNOCK SENSOR (See page [ES-459](#))



3. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY

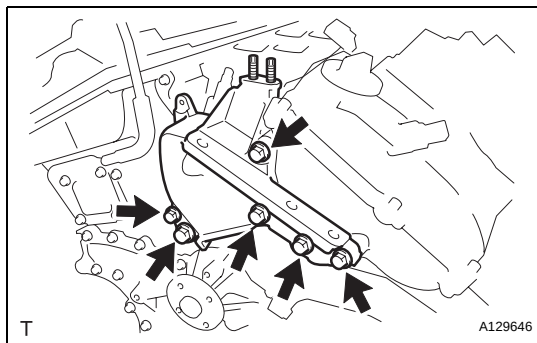
- (a) Clean the threads of the oil pressure switch. Apply adhesive to 2 or 3 threads of the oil pressure switch.

Adhesive:

Toyota Genuine Adhesive 1344, Three Bond 1344 or Equivalent

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

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

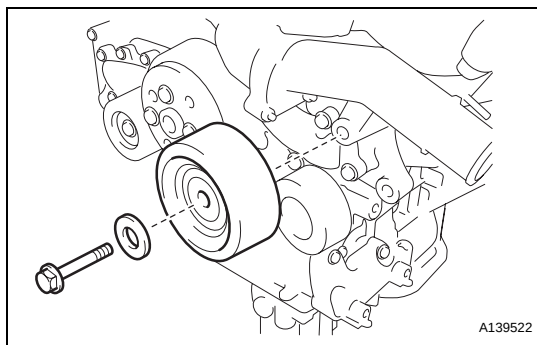


4. INSTALL NO. 1 FRONT ENGINE MOUNTING BRACKET LH

- (a) Install the mounting bracket with the 6 bolts.

Torque: 54 N*m (551 kgf*cm, 40 ft.*lbf)

5. INSTALL WATER PUMP PULLEY (See page [CO-14](#))



6. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY

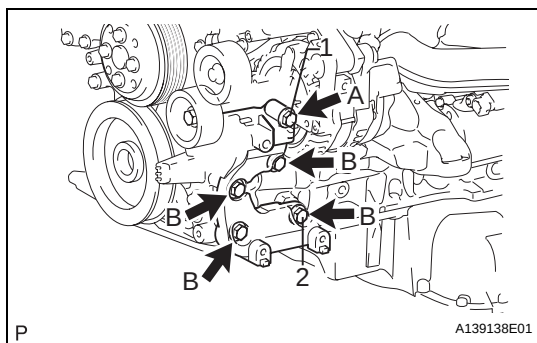
- (a) Install the idler pulley and cover plate with the bolt.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

7. INSTALL NO. 2 TIMING GEAR COVER

- (a) Install the gear cover with the 2 bolts.

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



8. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY

- (a) Temporarily install the V-ribbed belt tensioner with the 5 bolts.

- (b) Install the V-ribbed belt tensioner by tightening the bolt 1 and bolt 2 in the order shown in the illustration.

Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

- (c) Tighten the other bolts.

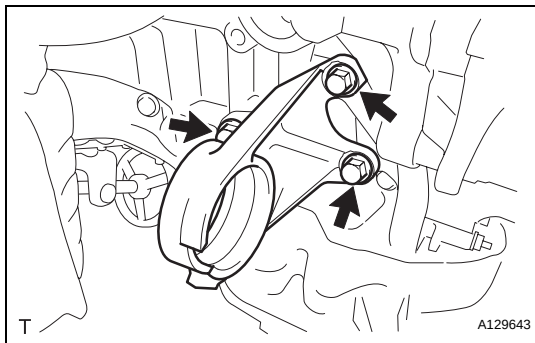
Torque: 43 N*m (438 kgf*cm, 32 ft.*lbf)

Each bolt length is as follows:

A	70 mm (2.76 in.)
---	------------------

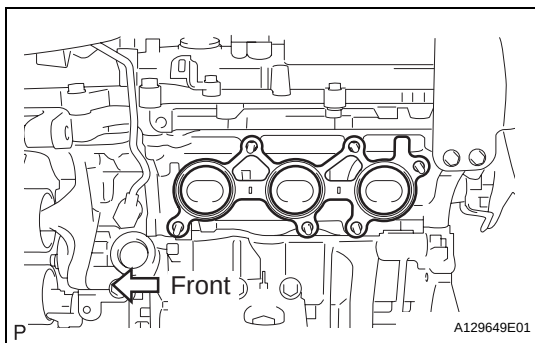
B

35 mm (1.37 in.)

**9. INSTALL DRIVE SHAFT BEARING BRACKET**

- (a) Install the drive shaft bearing bracket with the 3 bolts.

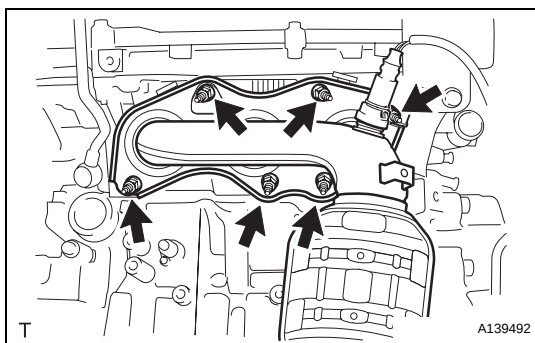
Torque: 64 N*m (653 kgf*cm, 47 ft.*lbf)

**10. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY LH**

- (a) Install a new gasket as shown in the illustration.

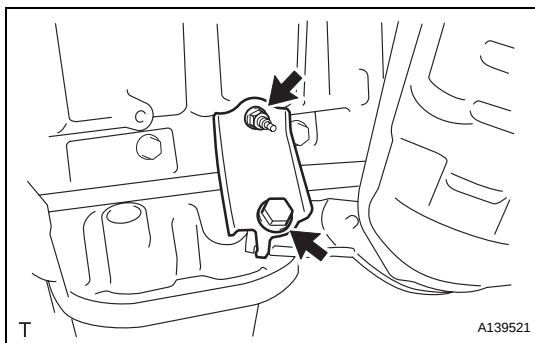
- (b) Install the manifold with the 6 nuts.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

**11. INSTALL NO. 2 EXHAUST MANIFOLD HEAT INSULATOR**

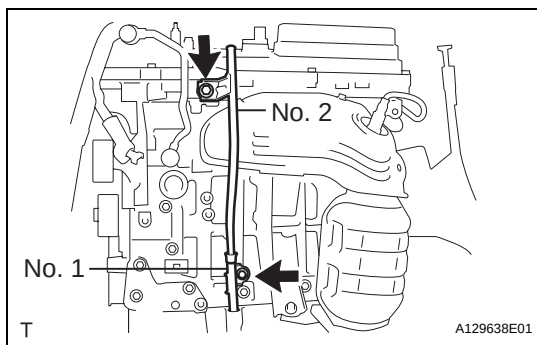
- (a) Install the No. 2 heat insulator with the 3 bolts.

Torque: 8.5 N*m (87 kgf*cm, 75 in.*lbf)

**12. INSTALL NO. 2 MANIFOLD STAY**

- (a) Install the No. 2 manifold stay with the bolt and nut.

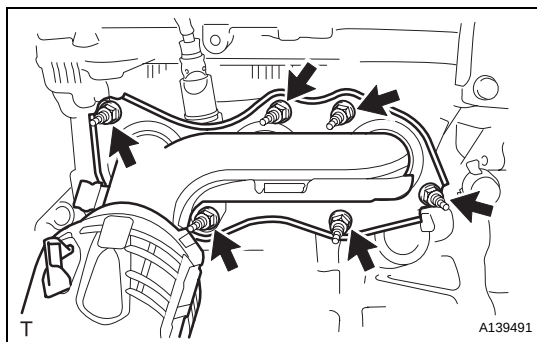
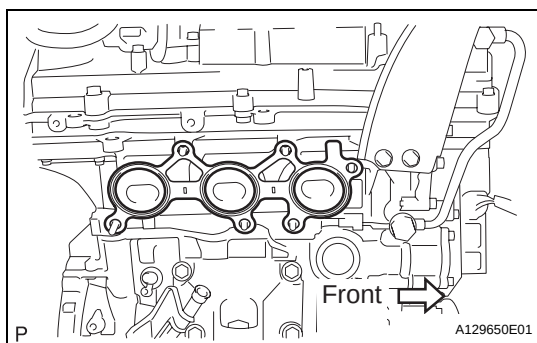
Torque: 34 N*m (347 kgf*cm, 25 ft.*lbf)

**13. INSTALL OIL DIPSTICK GUIDE**

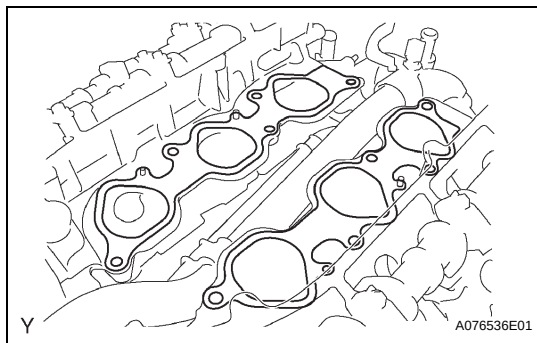
- Install 2 new O-rings to the guide.
- Apply a light coat of engine oil to the O-rings.
- Push in the guide end into the guide hole.
- Install the No. 1 guide with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- Install the No. 2 guide with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- Install the dipstick.

14. INSTALL GENERATOR ASSEMBLY (See page [CH-19](#))**15. INSTALL COMPRESSOR WITH PULLEY ASSEMBLY (See page [AC-221](#))****16. INSTALL FAN AND GENERATOR V BELT (See page [EM-8](#))****17. INSTALL EXHAUST MANIFOLD SUB-ASSEMBLY RH**

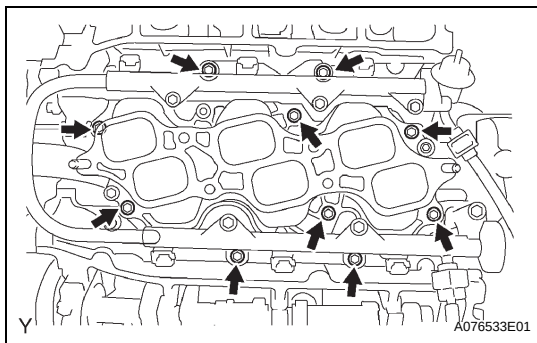
- Install a new gasket as shown in the illustration.



- Install the manifold with the 6 nuts.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

**18. INSTALL INTAKE MANIFOLD**

- Set a new gasket on each cylinder head.
NOTICE:
 - Align the port holes of the gasket and cylinder head.
 - Be careful of the installation direction.
- Set the intake manifold on the cylinder heads.



- (c) Install and uniformly tighten the 6 bolts and 4 nuts in several passes.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

- (d) Connect the 6 fuel injector connectors.

19. INSTALL FUEL INJECTOR ASSEMBLY (See page [FU-16](#))

20. INSTALL NO. 2 ENGINE MOUNTING STAY RH

- (a) Install the mounting stay with the bolt.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)

21. INSTALL IGNITION COIL ASSEMBLY

- (a) Install the 6 ignition coils with the 6 bolts to the cylinder head.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

22. INSTALL INTAKE AIR SURGE TANK ASSEMBLY

NOTICE:

Make sure there is no oil on the bolts. If there is oil on the bolts, clean them before installing them.

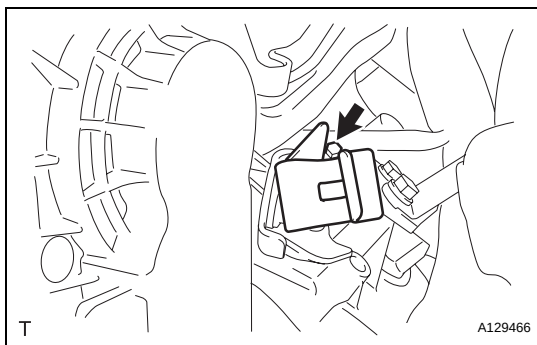
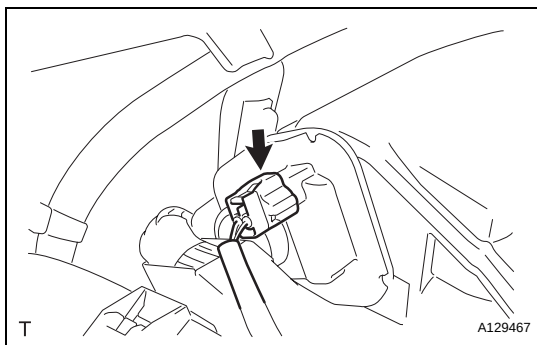
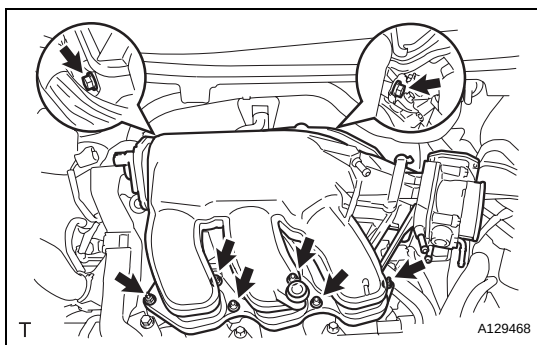
- (a) Install a new gasket to the surge tank.
(b) Using a 5 mm hexagon socket wrench, install the 4 bolts.

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

- (c) Install the surge tank with the 2 nuts and 2 bolts.

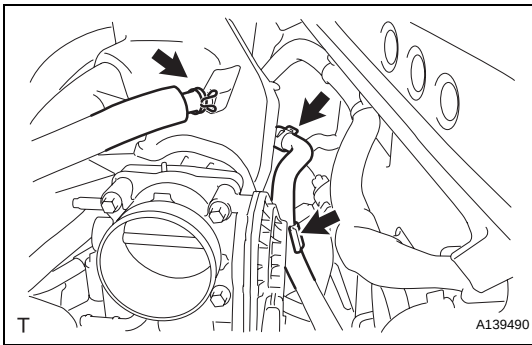
**Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt
16 N*m (163 kgf*cm, 12 ft.*lbf) for nut**

- (d) Connect the connector.

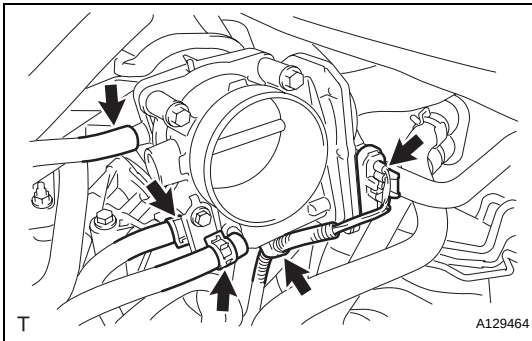


- (e) Install the vacuum hose clamp with the bolt.

Torque: 5.4 N*m (55 kgf*cm, 48 in.*lbf)



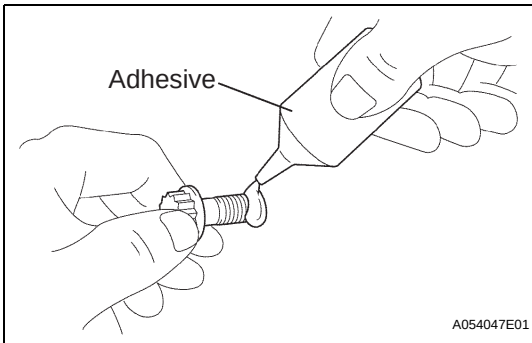
- (f) Connect the union to check valve hose.
- (g) Connect the No. 2 ventilation hose.



- (h) Install the clamp and connect the throttle body connector.
- (i) Connect the vapor feed hose.
- (j) Connect the 2 water by-pass hoses to the throttle body.

23. REMOVE ENGINE FROM ENGINE STAND

- (a) Install a sling device and chain block to the engine.
- (b) Remove the engine from the engine stand.

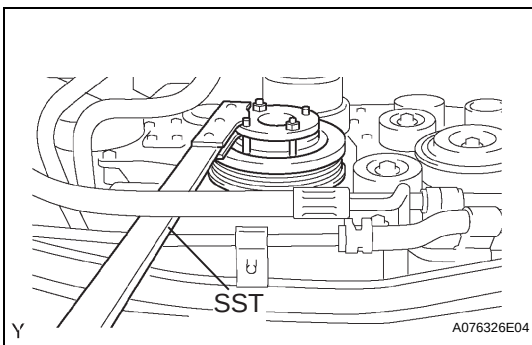


24. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY

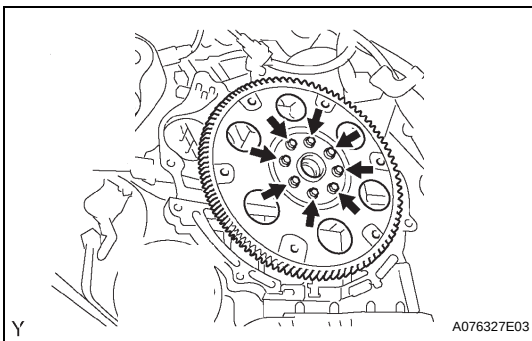
- (a) Clean the bolt and its hole.
- (b) Apply adhesive to 2 or 3 threads of the bolt end.

Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent



- (c) Using SST, hold the crankshaft.
SST 09213-70011, 09330-00021
- (d) Install the flywheel, drive plate and drive plate spacer on the crankshaft.



- (e) Uniformly install and tighten the 8 bolts in the sequence shown in the illustration.
Torque: 178 N*m (1,815 kgf*cm, 132 ft.*lbf)
NOTICE:
Do not start the engine for at least 1 hour after the installation.

25. INSTALL AUTOMATIC TRANSAXLE ASSEMBLY

- (a) 2WD:
Install the automatic transaxle (see page [AX-174](#)).

(b) 4WD:

Install the automatic transaxle (see page [AX-175](#)).

26. INSTALL TRANSFER ASSEMBLY (for 4WD) (See page [TF-75](#))

27. INSTALL STARTER ASSEMBLY (See page [ST-14](#))

28. INSTALL ENGINE WIRE

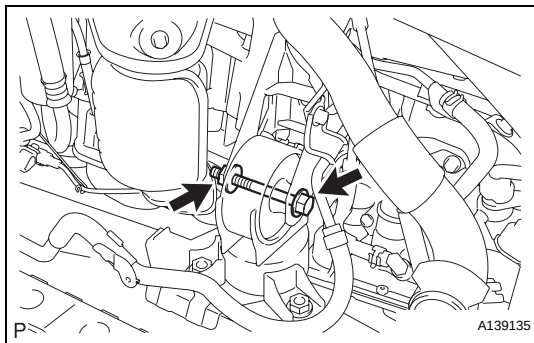
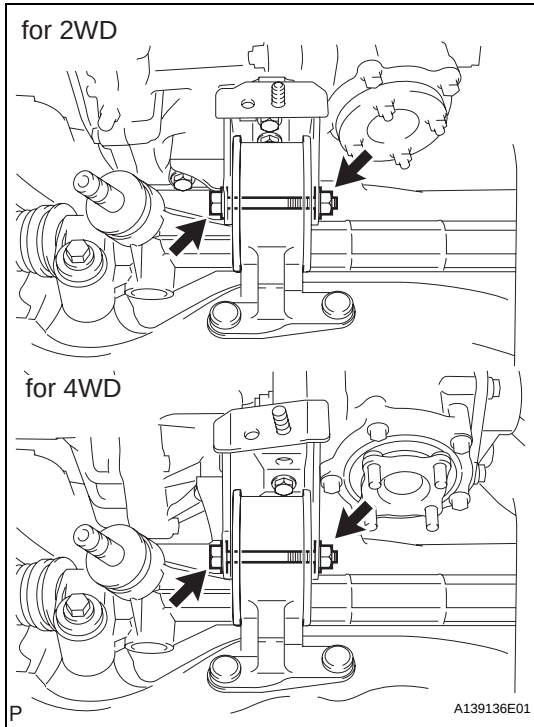
(a) Install the engine wire to the engine.

29. INSTALL FRONT SUSPENSION CROSSMEMBER SUB-ASSEMBLY

(a) Attach the engine together with the transaxle to the suspension crossmember and mounting.

(b) Install the bolt which secures the engine mounting bracket to the mounting insulator.

Torque: 95 N*m (969 kgf*cm, 70 ft.*lbf)



30. INSTALL FRONT CROSSMEMBER SUB-ASSEMBLY

(a) Install the bolt and nut which secures the engine mounting bracket to the mounting insulator.

Torque: 145 N*m (1,479 kgf*cm, 107 ft.*lbf)

31. INSTALL ENGINE WITH TRANSAXLE

(a) Place the engine on an engine lifter.

HINT:

Place the engine on wooden blocks or an equivalent so that the engine is level.

(b) Using the chain block, slowly install the engine to the vehicle and the intermediate shaft to the pinion.

CAUTION:

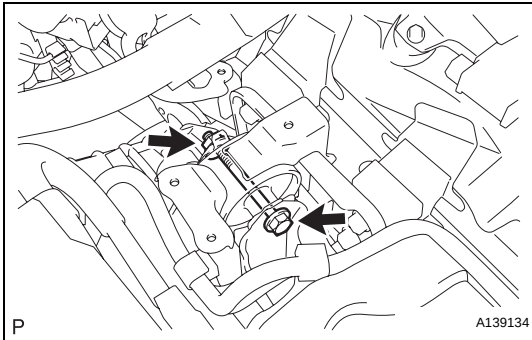
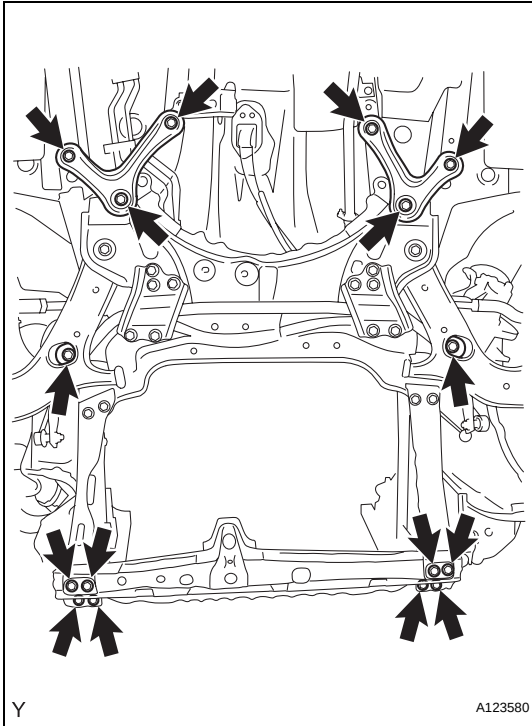
Do not raise the engine more than necessary. If the engine is raised excessively, the vehicle may also be lifted up.

NOTICE:

- Make sure that the engine is clear of all wiring and hoses.

- While raising the engine into the vehicle, do not allow it to contact the vehicle.
- Align the matchmarks on the intermediate shaft and pinion.

- (c) Temporarily install the suspension member and crossmember with the 10 bolts.
- (d) Temporarily install the member brace rear RH and LH with the 6 bolts.

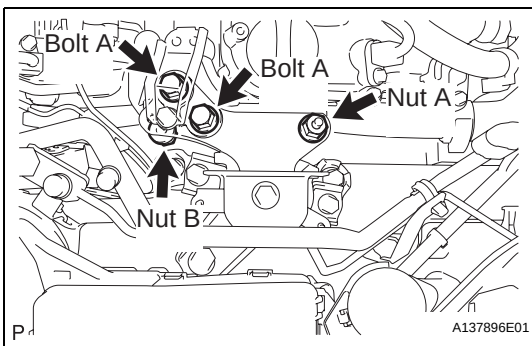


- (e) Install the engine mounting insulator LH with the bolt and nut.

Torque: 56 N*m (571 kgf*cm, 41 ft.*lbf)

NOTICE:

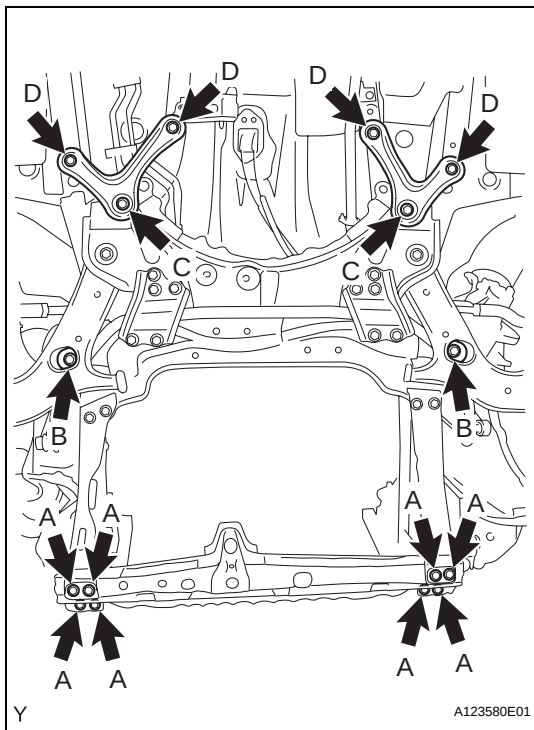
While holding the bolt in place, tighten the nut.



- (f) Install the engine mounting insulator RH with the 2 bolts and 2 nuts.

Torque: 95 N*m (969 kgf*cm, 70 ft.*lbf) for bolt and nut A

52 N*m (530 kgf*cm, 38 ft.*lbf) for nut B



- (g) Tighten the suspension member and crossmember's bolts.
Torque: 96 N*m (979 kgf*cm, 71 ft.*lbf) for bolt A
145 N*m (1,478 kgf*cm, 107 ft.*lbf) for bolt B
- (h) Tighten the member brace rear's bolts.
Torque: 145 N*m (1,478 kgf*cm, 107 ft.*lbf) for bolt C
93 N*m (948 kgf*cm, 69 ft.*lbf) for bolt D
- (i) Remove the sling device and chain block.
- (j) Remove the 2 bolts and No. 1 and No. 2 engine hangers.

32. INSTALL FRONT DRIVE SHAFT LH

- (a) 2WD:
Install the drive shaft (see page [DS-33](#)).
- (b) 4WD:
Install the drive shaft (see page [DS-66](#)).

33. INSTALL FRONT DRIVE SHAFT RH

- (a) 2WD:
Install the drive shaft (see page [DS-33](#)).
- (b) 4WD:
Install the drive shaft (see page [DS-66](#)).

34. CONNECT TIE ROD END SUB-ASSEMBLY LH (See page [PS-45](#))

35. CONNECT TIE ROD END SUB-ASSEMBLY RH (See page [PS-45](#))

36. CONNECT STEERING INTERMEDIATE SHAFT (See page [PS-44](#))

37. CONNECT FRONT STABILIZER LINK ASSEMBLY LH (See page [SP-31](#))

38. CONNECT FRONT STABILIZER LINK ASSEMBLY RH (See page [SP-31](#))

39. INSTALL FRONT AXLE HUB NUT LH

- (a) Install the hub nut (see page [AH-11](#)).

40. INSTALL FRONT AXLE HUB NUT RH

- (a) Install the hub nut (see page [AH-11](#)).

41. INSTALL FRONT WHEELS

42. INSTALL PROPELLER WITH CENTER BEARING SHAFT ASSEMBLY (See page [PR-5](#))

43. INSTALL CENTER EXHAUST PIPE ASSEMBLY (See page [EX-4](#))

44. INSTALL FRONT EXHAUST PIPE ASSEMBLY (See page [EX-4](#))

45. CONNECT TRANSMISSION CONTROL CABLE ASSEMBLY

- (a) 2WD:
Connect the control cable (see page [AX-154](#)).

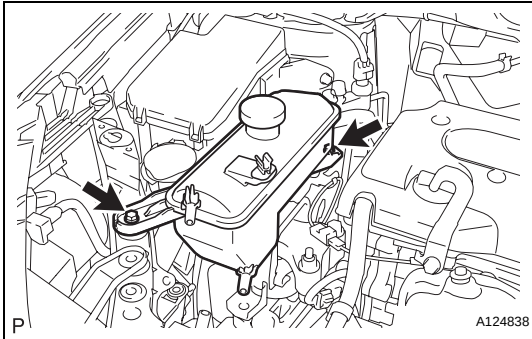
- (b) 4WD:
Connect the control cable (see page [AX-154](#)).

46. CONNECT RADIATOR HOSE INLET**47. CONNECT RADIATOR HOSE OUTLET****48. CONNECT OIL COOLER HOSE****49. CONNECT SUCTION HOSE SUB-ASSEMBLY** (See page [AC-221](#))**50. INSTALL DISCHARGE HOSE SUB-ASSEMBLY** (See page [AC-221](#))**51. INSTALL RADIATOR RESERVOIR TANK ASSEMBLY**

- (a) Install the reservoir tank with the 2 bolts.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)
- (b) Connect the 2 hoses

52. INSTALL ECM (See page [ES-471](#))**53. CONNECT HOSES AND CONNECTORS**

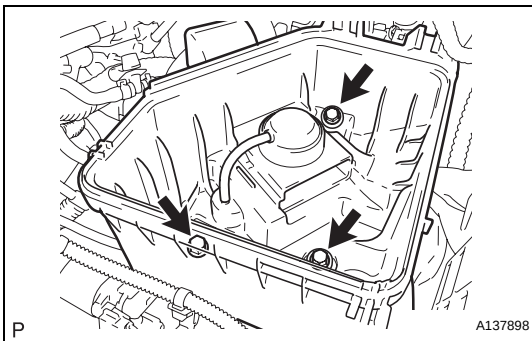
- (a) Connect the 2 ECM connectors.
- (b) Connect the 2 heater hoses.
- (c) Connect the fuel hoses.
- (d) Connect the starter wire with the nut.
Torque: 9.8 N*m (100 kgf*cm, 7 ft.*lbf)
- (e) Connect the 3 connectors and wire with the nut.
Torque: 12 N*m (122 kgf*cm, 9 ft.*lbf)
- (f) Install the engine room junction block cover (upper).

EM**54. INSTALL AIR CLEANER CASE**

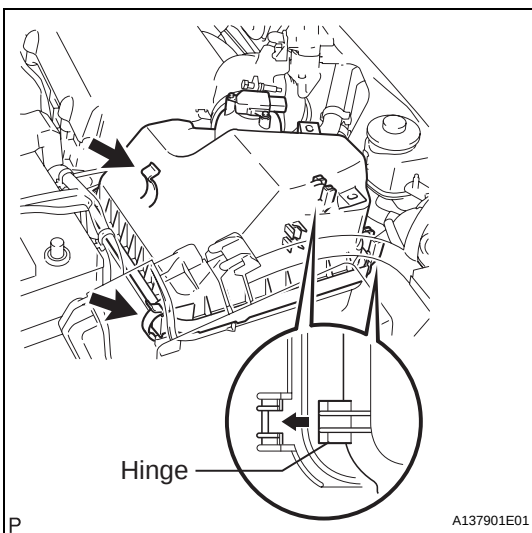
- (a) Install the air cleaner case with the 3 bolts.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)
- (b) Connect the harness clamp.

55. INSTALL AIR CLEANER CAP SUB-ASSEMBLY

- (a) Install the air cleaner filter element onto the air cleaner case.

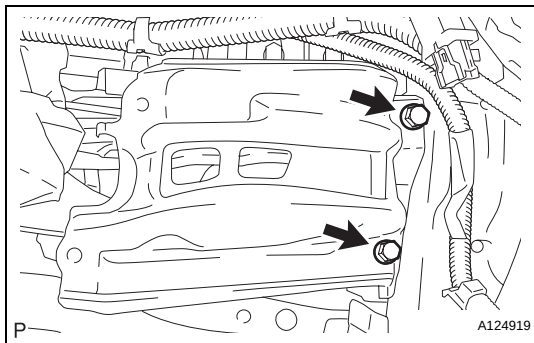


- (b) Insert the hinge part of the air cleaner cap into the air cleaner case, then hang the 2 hook clamps.



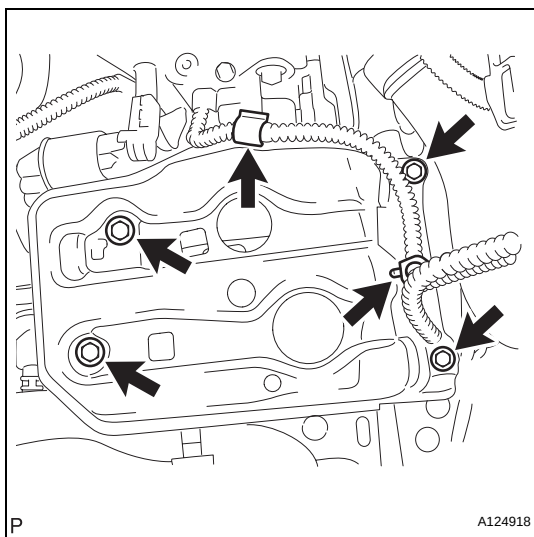


- (c) Tighten the No. 1 air cleaner hose clamp.
- (d) Connect the No. 2 ventilation hose to the air cleaner hose.
- (e) Connect the wire harness clamp and 3 vacuum hoses.
- (f) Connect the VSV (intake air control) connector.
- (g) Connect the mass air flow meter connector.



56. INSTALL BATTERY BRACKET REINFORCEMENT

- (a) Install the bracket reinforcement with the 2 bolts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)



57. INSTALL FRONT BATTERY BRACKET

- (a) Install the bracket front with the 4 bolts.
Torque: 19 N*m (194 kgf*cm, 14 ft.*lbf)
- (b) Attach the 2 wire harness clamps.

58. INSTALL BATTERY

59. REMOVE BATTERY CLAMP SUB-ASSEMBLY

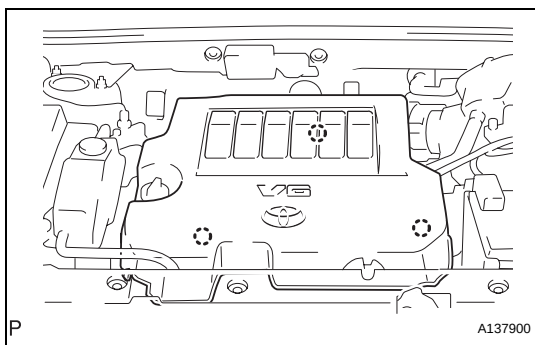
- (a) Attach the hook of the battery clamp to the battery bracket front.
- (b) Temporarily tighten the nut and install the bolt.
- (c) Adjust the battery clamp's position.
- (d) Fully tighten the nut and bolt.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)
- (e) Attach the 2 wire harness clamps.

60. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL

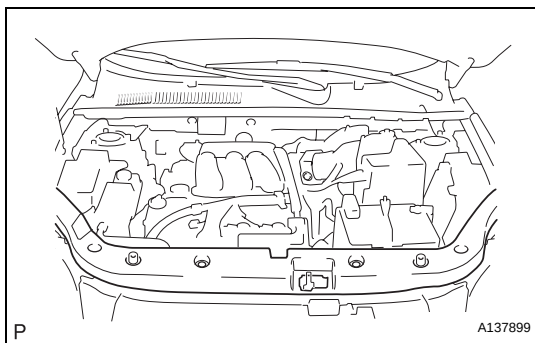
61. INSTALL HOOD SUB-ASSEMBLY

- (a) Install the hood (see page [ED-7](#)).
- (b) Adjust the hood (see page [ED-5](#)).

- 62. ADD AUTOMATIC TRANSAXLE FLUID**
 - (a) 2WD:
Add automatic transmission fluid (see page [AX-177](#)).
 - (b) 4WD:
Add automatic transmission fluid (see page [AX-178](#)).
- 63. ADD TRANSFER OIL (for 4WD) (See page [TF-45](#))**
- 64. ADD ENGINE OIL (See page [LU-6](#))**
- 65. ADD ENGINE COOLANT (See page [CO-8](#))**
- 66. CHARGE REFRIGERANT (See page [AC-172](#))**
- 67. CHECK FOR LEAKAGE OF REFRIGERANT (See page [AC-173](#))**
- 68. CHECK FOR ENGINE OIL LEAKS (See page [LU-6](#))**
- 69. CHECK FOR ENGINE COOLANT LEAKS (See page [CO-1](#))**
- 70. CHECK FOR FUEL LEAKS**
- 71. INSPECT EXHAUST GAS LEAKS**
- 72. INSPECT SHIFT LEVER POSITION**
 - (a) 2WD:
Inspect the shift lever position (see page [AX-159](#)).
 - (b) 4WD:
Inspect the shift lever position (see page [AX-158](#)).
- 73. ADJUST TRANSMISSION CONTROL CABLE**
 - (a) 2WD:
Adjust the shift lever position (see page [AX-159](#)).
 - (b) 4WD:
Adjust the shift lever position (see page [AX-159](#)).
- 74. INSTALL FRONT FLOOR COVER (See page [FU-39](#))**
- 75. INSTALL NO. 2 ENGINE UNDER COVER**
 - (a) Install the under cover with the 2 clips.
- 76. INSTALL REAR ENGINE UNDER COVER LH**
 - (a) Install the under cover with the 2 clips.
- 77. INSTALL REAR ENGINE UNDER COVER RH**
 - (a) Install the under cover with the 2 clips.
- 78. INSTALL NO. 1 ENGINE UNDER COVER**
 - (a) Install the under cover with the 4 bolts and 12 clips.

**79. INSTALL V-BANK COVER SUB-ASSEMBLY**

- (a) Attach the 3 clips to install the engine cover.

**80. INSTALL RADIATOR SUPPORT OPENING COVER**

- (a) Install the cover with the 9 clips.

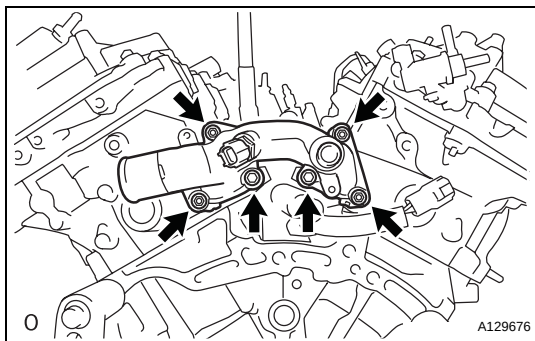
81. ADJUST FRONT WHEEL ALIGNMENT

- (a) Adjust the front wheel alignment (see page [SP-3](#)).

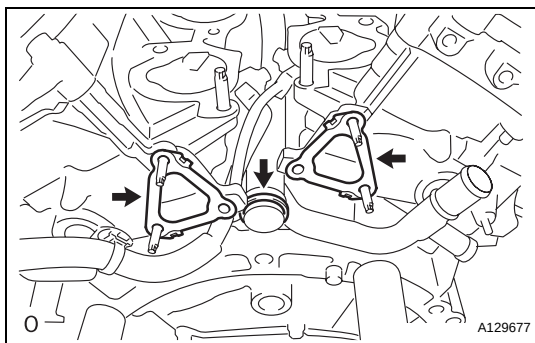
82. INSPECT IDLE SPEED (See page [EM-2](#))

DISASSEMBLY

1. REMOVE OIL FILLER CAP SUB-ASSEMBLY
2. REMOVE SPARK PLUG
3. REMOVE CAMSHAFT TIMING CONTROL VALVE ASSEMBLY (See page [ES-440](#))
4. REMOVE VVT SENSOR (See page [ES-443](#))
5. REMOVE WATER OUTLET
 - (a) Remove the 2 bolts, 4 nuts and water outlet.

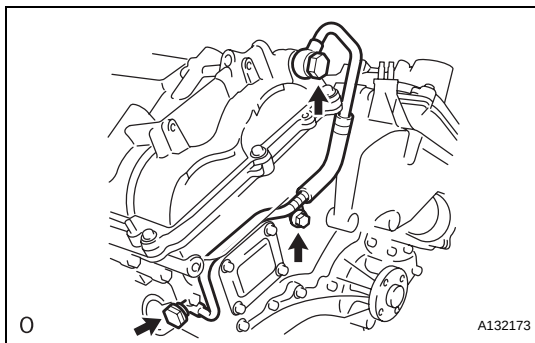


- (b) Remove the 2 gaskets and O-ring.



6. REMOVE OIL PIPE

- (a) Remove the bolt, 2 union bolts and oil pipe.
- (b) Remove the oil control valve filter RH and gaskets.

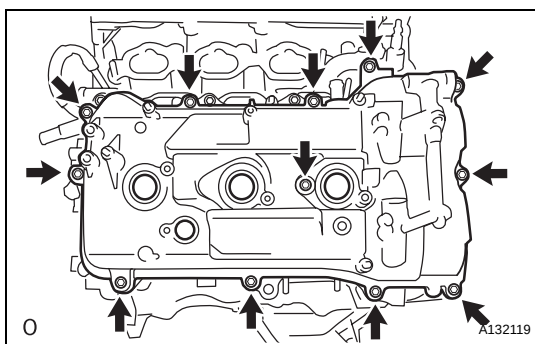


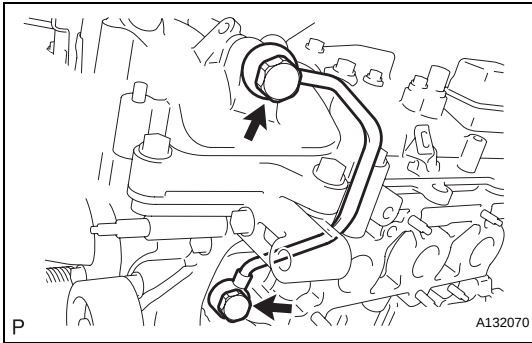
7. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)

- (a) Remove the 12 bolts, cylinder head cover and gasket.

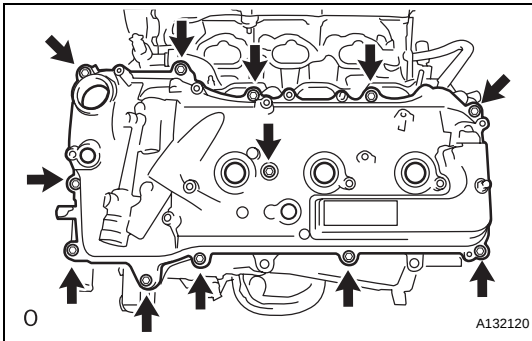
HINT:

Make sure the removed parts are returned to the same places they were removed from.



**8. REMOVE NO. 1 OIL PIPE**

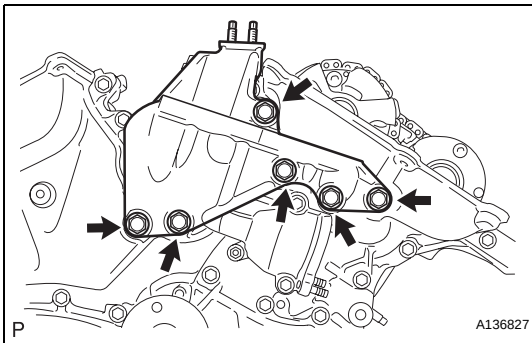
- (a) Remove the 2 union bolts and oil pipe.
- (b) Remove the oil control valve filter LH and gaskets.

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

- (a) Remove the 12 bolts, cylinder head cover and gasket.

HINT:

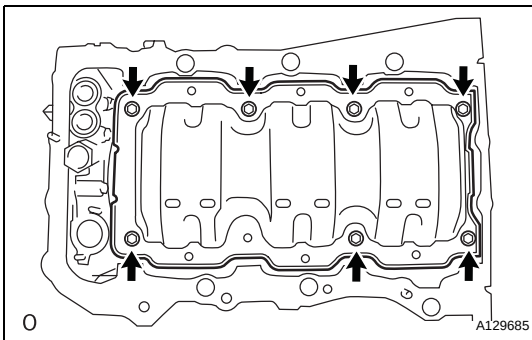
Make sure the removed parts are returned to the same places they were removed from.

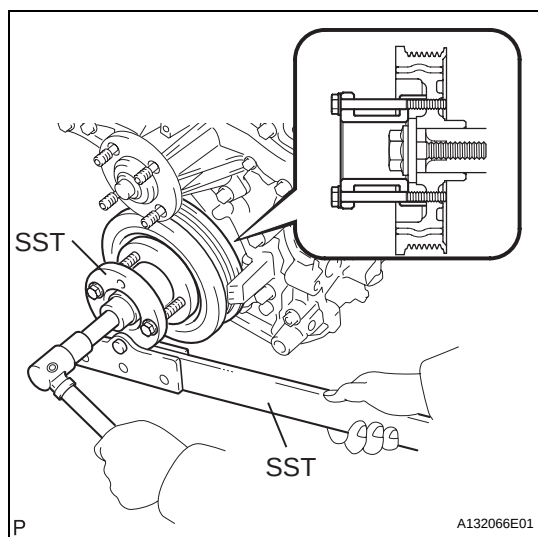
**10. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET**

- (a) Remove the 6 bolts and mounting bracket.

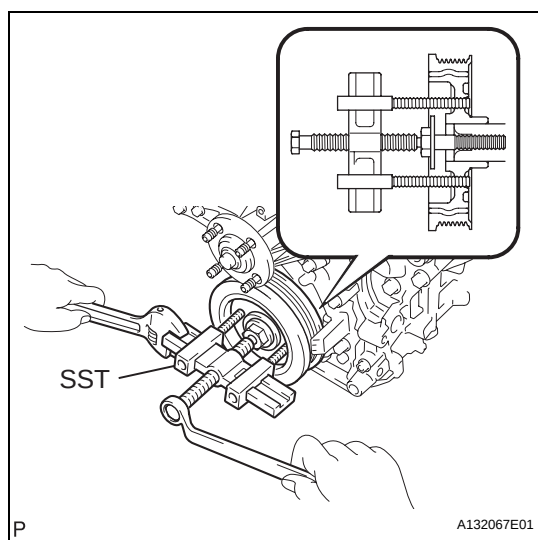
11. REMOVE WATER INLET HOUSING (See page [CO-12](#))**12. REMOVE OIL FILTER CAP ASSEMBLY (See page [LU-4](#))****13. REMOVE OIL FILTER ELEMENT (See page [LU-5](#))****14. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY (See page [LU-12](#))****15. REMOVE OIL STRAINER SUB-ASSEMBLY (See page [LU-13](#))****16. REMOVE OIL PAN SUB-ASSEMBLY (See page [LU-13](#))****17. REMOVE OIL PAN BAFFLE PLATE**

- (a) Remove the 7 bolts and baffle plate.

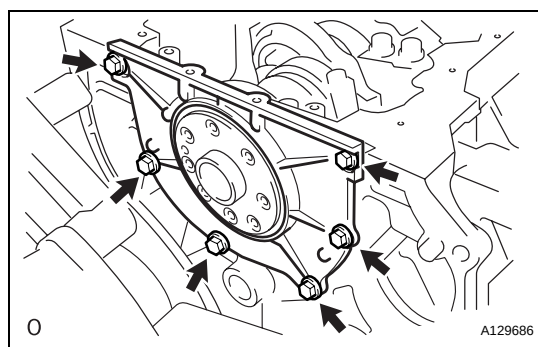


**18. REMOVE CRANKSHAFT PULLEY**

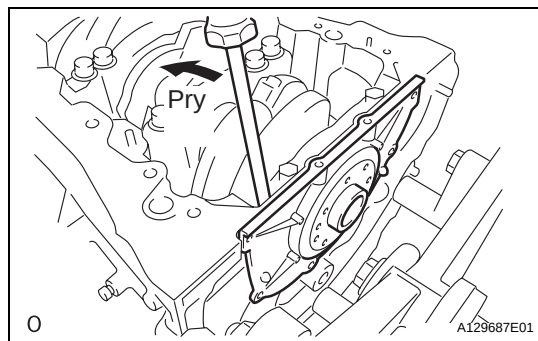
- (a) Using SST, loosen the crankshaft pulley set bolt.
SST 09213-70011 (09213-70020), 09330-00021



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

19. REMOVE WATER PUMP ASSEMBLY (See page [CO-13](#))**20. REMOVE ENGINE REAR OIL SEAL RETAINER**

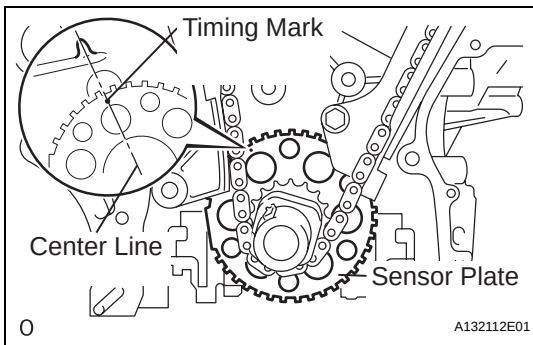
- (a) Remove the 6 bolts.



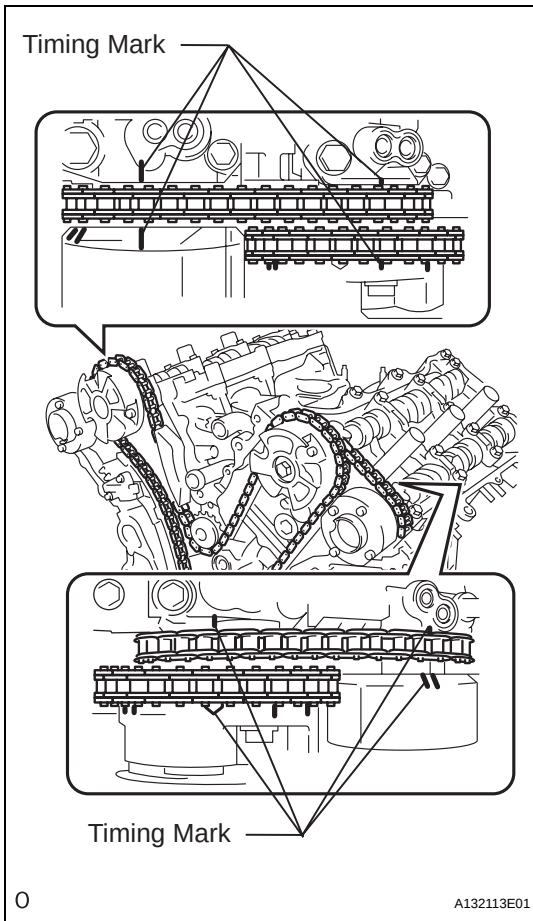
- (b) Using a screwdriver, pry out the oil seal retainer.
HINT:
 Tape the screwdriver tip before use.

21. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY (w/ Oil Pump) (See page [LU-14](#))**22. SET NO. 1 CYLINDER TO TDC / COMPRESSION**

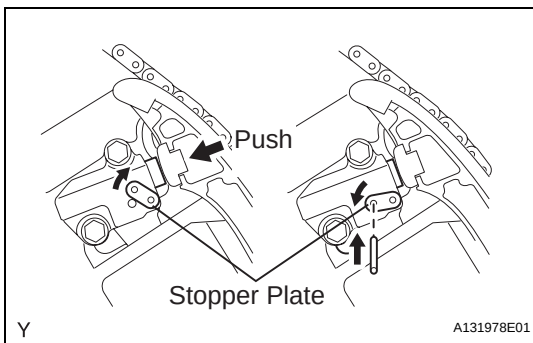
- (a) Temporarily tighten the pulley set bolt.



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



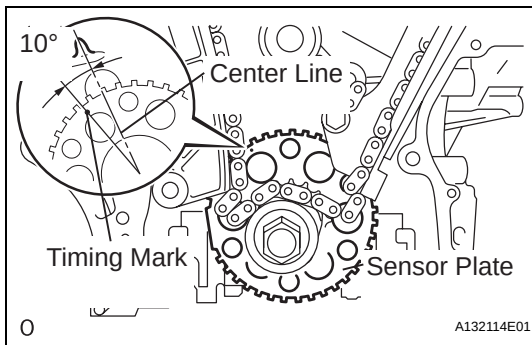
- (c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration. If not, turn the crankshaft 1 revolution (360°) and align the timing marks as above.



23. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

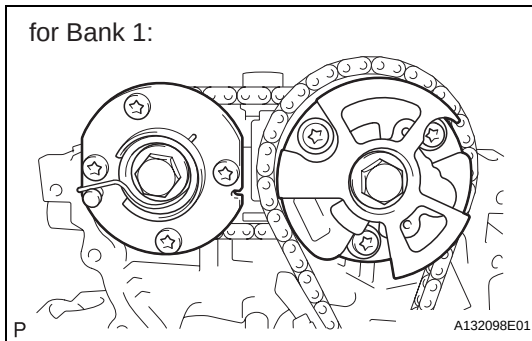
- Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.
- Move the stopper plate downward to set the lock, and insert a hexagon wrench into the stopper plate hole.
- Remove the 2 bolts and chain tensioner.

24. REMOVE CHAIN TENSIONER SLIPPER

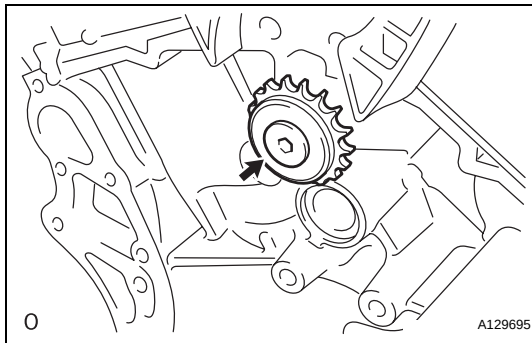


25. REMOVE NO. 1 CHAIN SUB-ASSEMBLY

- (a) Turn the crankshaft counterclockwise 10° to loosen the chain of the crankshaft timing gear.
- (b) Remove the chain from the crankshaft timing gear and place it on the crankshaft.

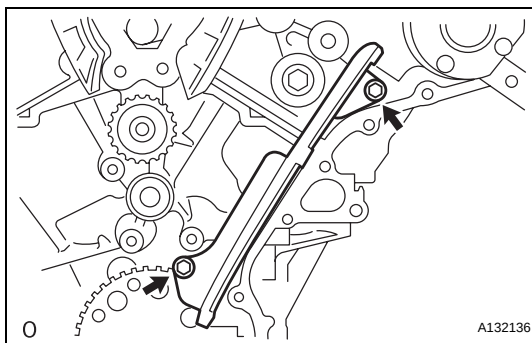


- (c) Turn the camshaft timing gear on the RH bank clockwise (approximately 60°) and set it as shown in the illustration. Be sure to loosen the chain between the center banks.
- (d) Remove the chain.



26. REMOVE IDLE SPROCKET ASSEMBLY

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



27. REMOVE NO. 1 CHAIN VIBRATION DAMPER

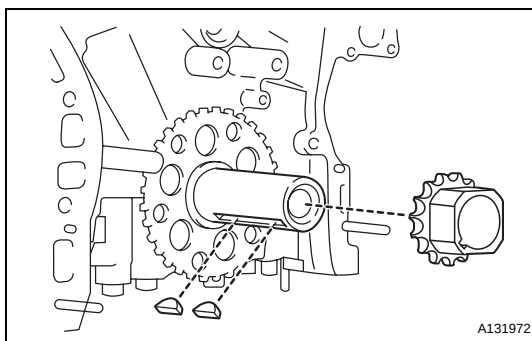
- (a) Remove the 2 bolts and vibration damper.

28. REMOVE NO. 2 CHAIN VIBRATION DAMPER

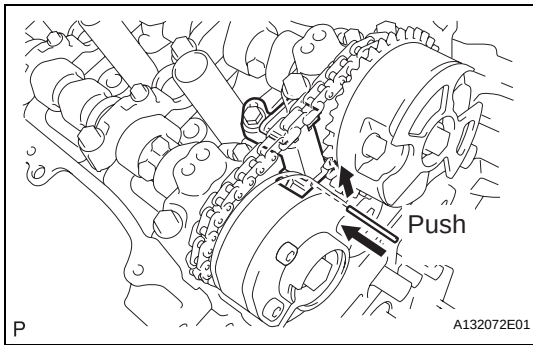
- (a) Remove the 2 chain vibration dampers.

29. REMOVE CRANKSHAFT TIMING GEAR OR SPROCKET

- (a) Remove the pulley set bolt.

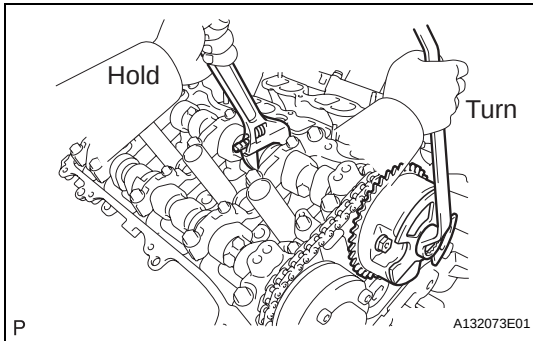


- (b) Remove the crankshaft timing gear from the crankshaft.
- (c) Remove the 2 pulley set keys from the crankshaft.



30. REMOVE CAMSHAFT TIMING GEAR ASSEMBLY (for Bank 1)

- (a) While raising up the No. 2 chain tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.



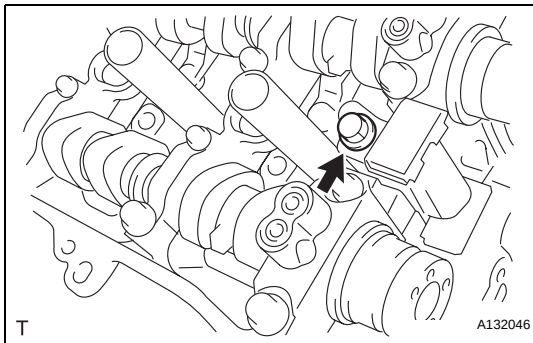
- (b) Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts and 2 camshaft timing gears.

NOTICE:

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

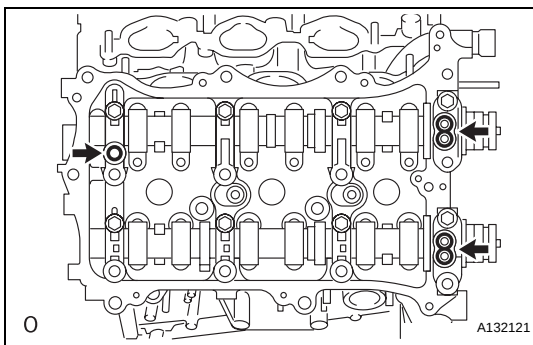
- (c) Remove the No. 2 chain.

EM



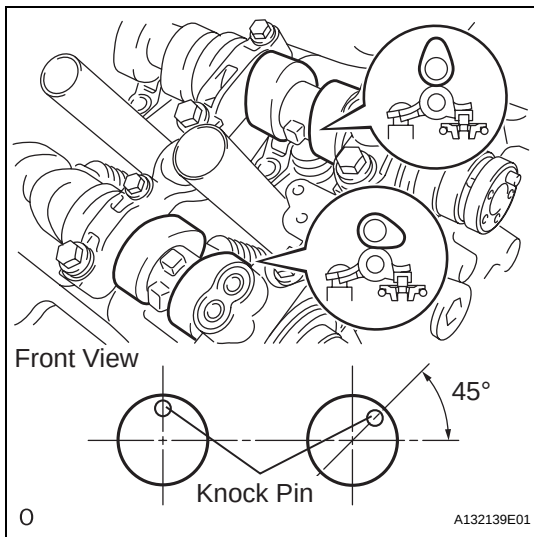
31. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

- (a) Remove the bolt and chain tensioner.

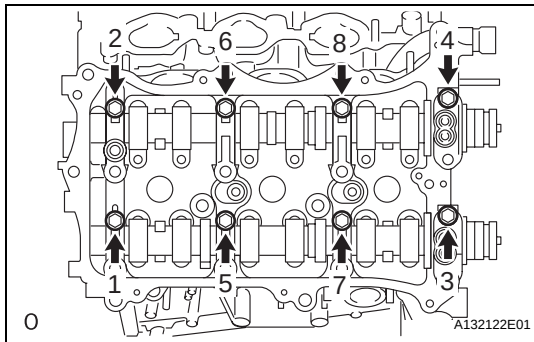


32. REMOVE CAMSHAFT (for Bank 1)

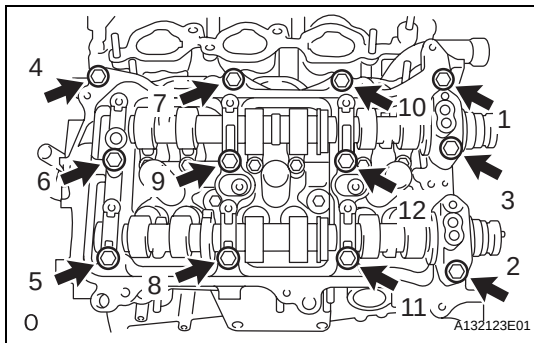
- (a) Remove the 3 gaskets.



- (b) Make sure that the knock pin of the camshaft is positioned as shown in the illustration.



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

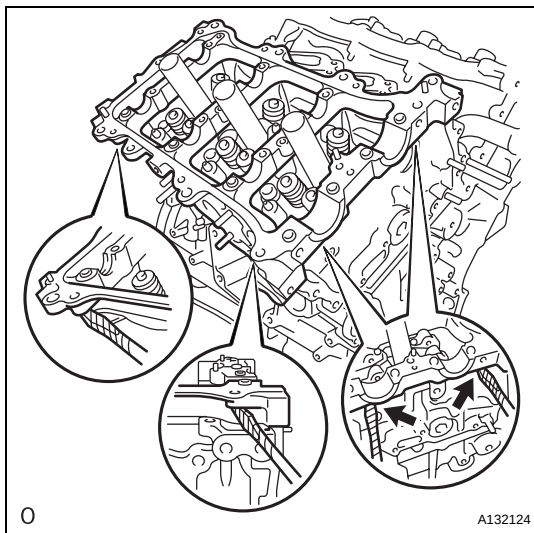


- (d) Uniformly loosen and remove the 12 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

Uniformly loosen the bolts while keeping the camshaft level.

- (e) Remove the 5 bearing caps.
(f) Remove the No. 1 and No. 2 camshafts.



33. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 1)

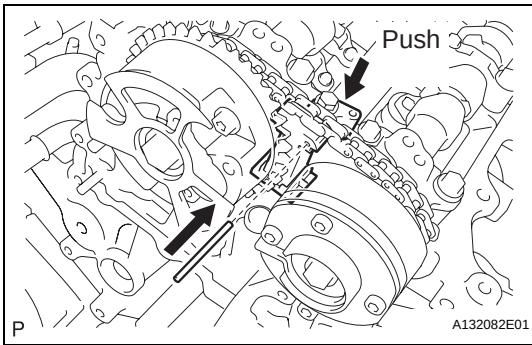
- (a) Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

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

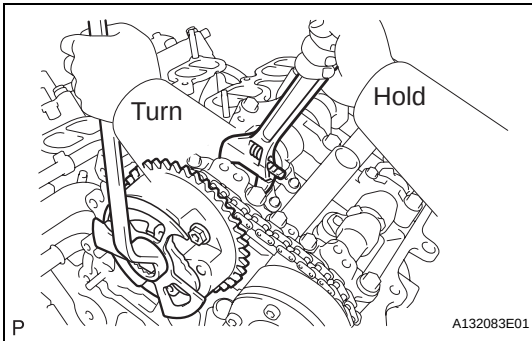
HINT:

Tape the screwdriver tip before use.



34. REMOVE CAMSHAFT TIMING GEAR ASSEMBLY (for Bank 2)

- (a) While pushing down the chain tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.



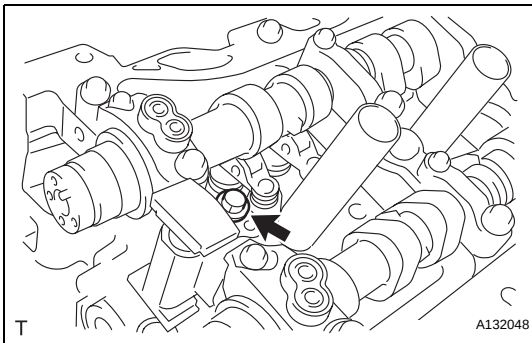
- (b) Hold the hexagonal portion of the camshaft with a wrench and remove the 2 bolts and 2 camshaft timing gears.

NOTICE:

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

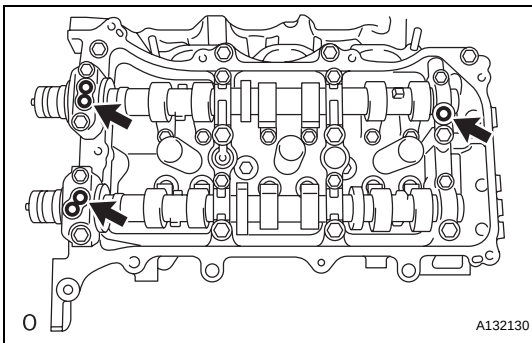
- (c) Remove the No. 2 chain.

EM



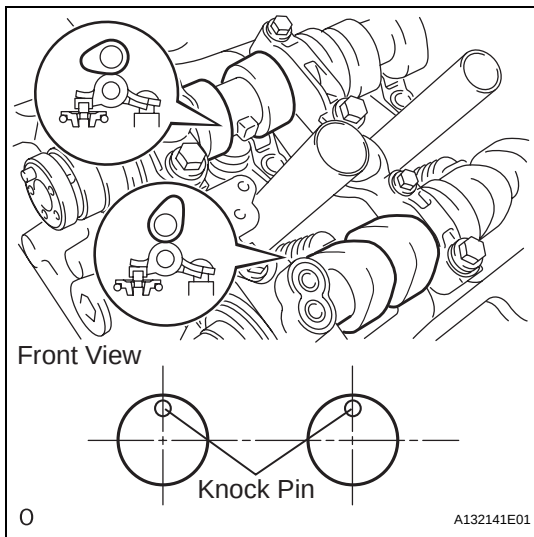
35. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

- (a) Remove the bolt and chain tensioner.

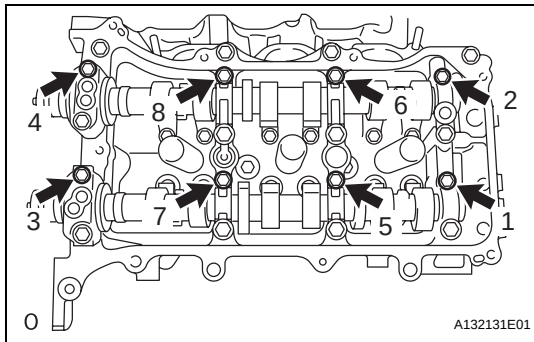


36. REMOVE CAMSHAFT SUB-ASSEMBLY (for Bank 2)

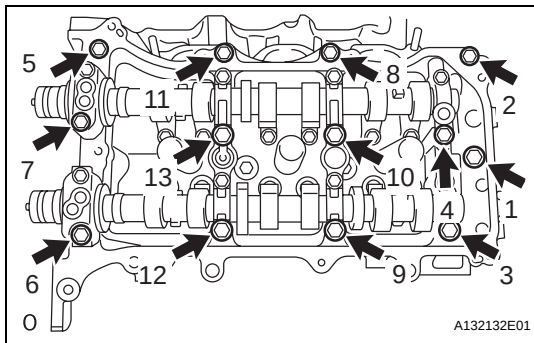
- (a) Remove the 3 gaskets.



- (b) Make sure that the knock pin of the camshaft is positioned as shown in the illustration.



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

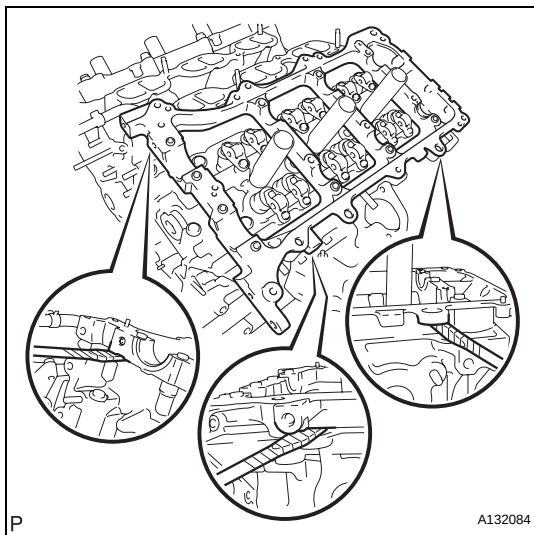


- (d) Uniformly loosen and remove the 13 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

Uniformly loosen the bolts while keeping the camshaft level.

- (e) Remove the 5 bearing caps.
(f) Remove the No. 3 and No. 4 camshafts.



37. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 2)

- (a) Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

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

HINT:

Tape the screwdriver tip before use.

38. REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

- (a) Remove the 24 valve rocker arms.

HINT:

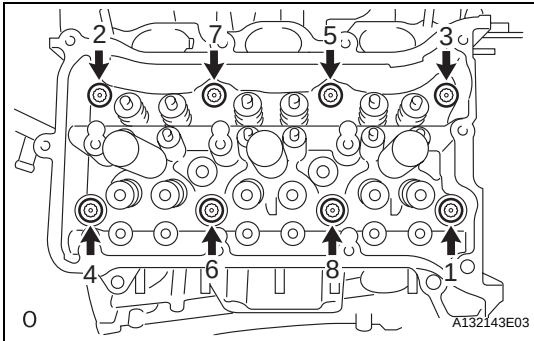
Arrange the removed parts in the correct order.

39. REMOVE VALVE LASH ADJUSTER ASSEMBLY

- (a) Remove the 24 valve lash adjusters from the cylinder head.

HINT:

Arrange the removed parts in the correct order.

**40. REMOVE CYLINDER HEAD SUB-ASSEMBLY (for Bank 1)**

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

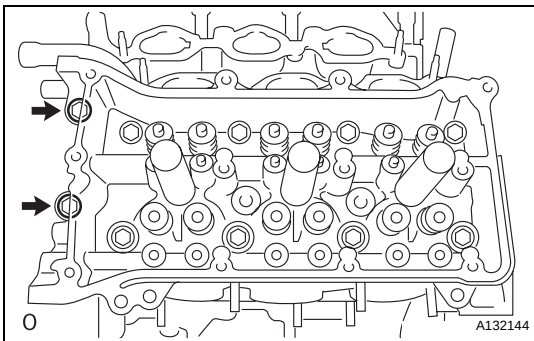
NOTICE:

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

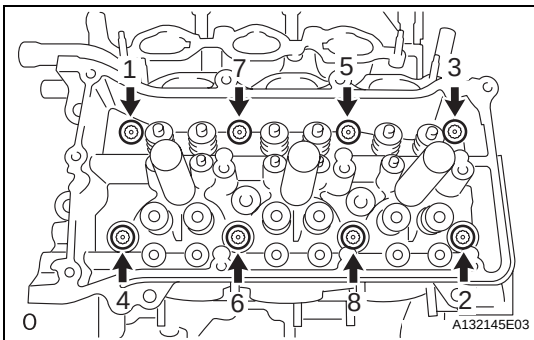
HINT:

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

- (b) Remove the cylinder head and gasket.

**41. REMOVE CYLINDER HEAD SUB-ASSEMBLY (for Bank 2)**

- (a) Uniformly loosen and remove the 2 bolts in the sequence shown in the illustration.



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

NOTICE:

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

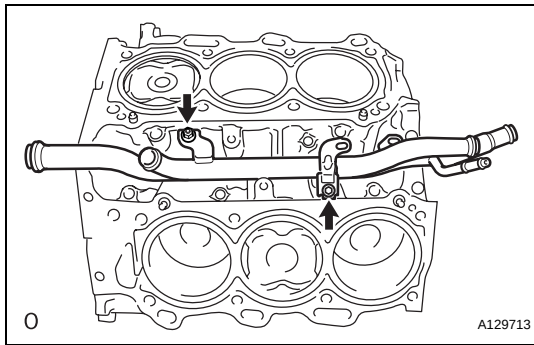
HINT:

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

- (c) Remove the cylinder head and gasket.

42. REMOVE WATER INLET PIPE

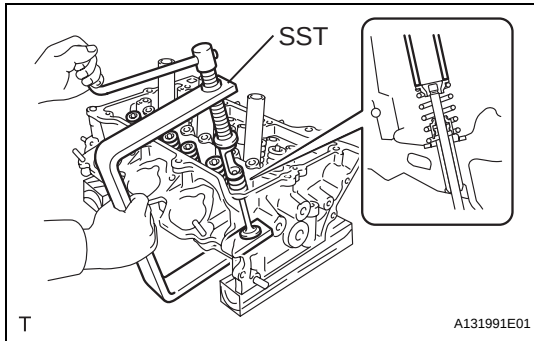
- (a) Disconnect the knock sensor wire.



- (b) Remove the 2 bolts and water outlet pipe.
- (c) Disconnect the water by-pass hose.

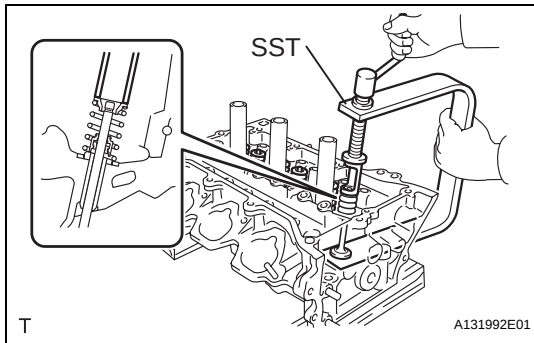
43. REMOVE VALVE STEM CAP

- (a) Remove the valve stem caps from the cylinder head.
- HINT:
Arrange the removed parts in the correct order.



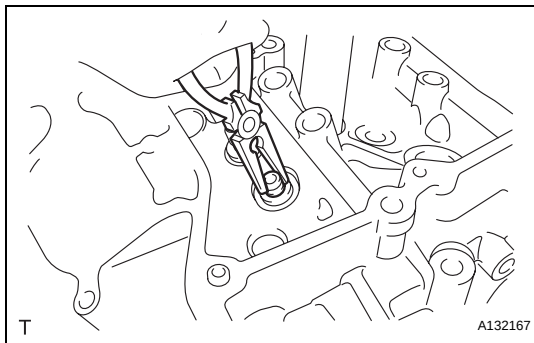
44. REMOVE INTAKE VALVE

- (a) Using SST and wooden blocks, compress the compression spring and remove the valve retainer lock.
- SST 09202-70020 (09202-00010)**
- (b) Remove the retainer, compression spring and valve.
- HINT:
Arrange the removed parts in the correct order.



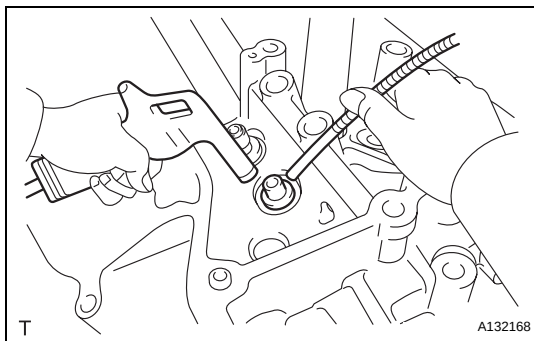
45. REMOVE EXHAUST VALVE

- (a) Using SST and wooden blocks, compress the compression spring and remove the valve retainer lock.
- SST 09202-70020 (09202-00010)**
- (b) Remove the retainer, compression spring and valve.
- HINT:
Arrange the removed parts in the correct order.



46. REMOVE VALVE STEM OIL SEAL

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



47. REMOVE VALVE SPRING SEAT

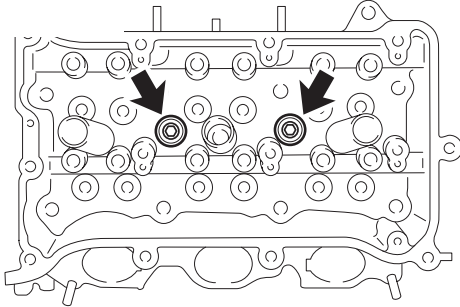
- (a) Using compressed air and a magnetic finger, remove the valve spring seat by blowing air onto it.

48. REMOVE NO. 1 STRAIGHT SCREW PLUG

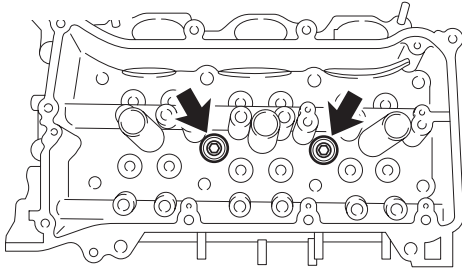
NOTICE:

If water leaks from the No. 1 screw plug or the plug is corroded, replace it.

for Bank 1:



for Bank 2:



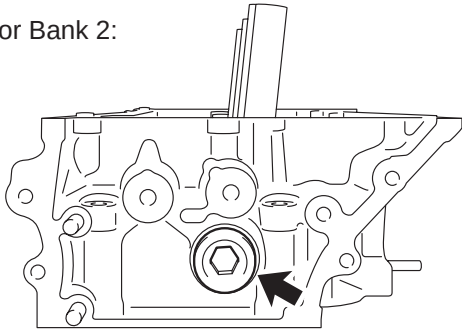
T

A131995E01

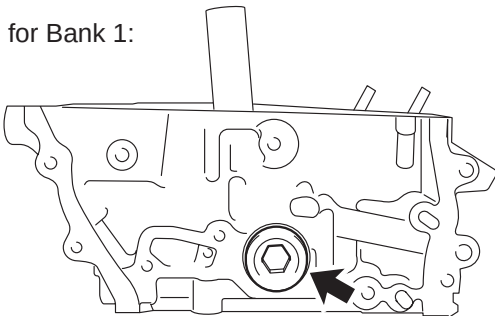
- (a) Using a 10 mm hexagon wrench, remove the 4 screw plugs and 4 gaskets.

EM

for Bank 2:



for Bank 1:



T

A131996E01

49. REMOVE NO. 2 STRAIGHT SCREW PLUG

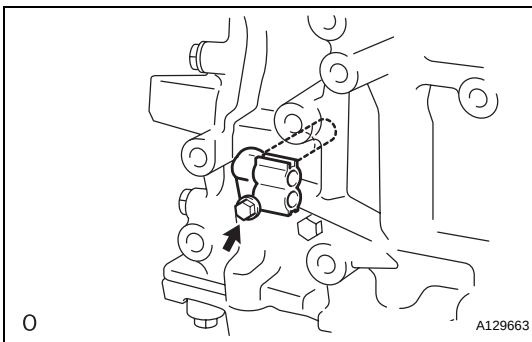
- (a) Using a 14 mm hexagon wrench, remove the 2 screw plugs and 2 gaskets.

NOTICE:

If water leaks from the No. 2 screw plug or the plug is corroded, replace it.

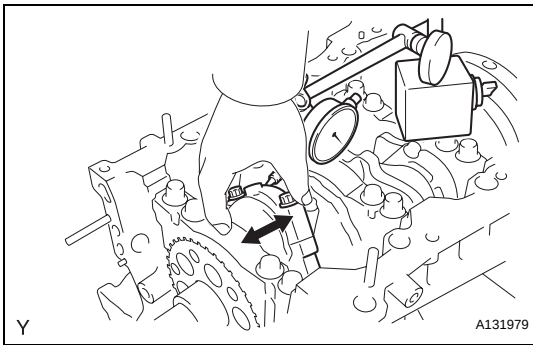
50. REMOVE CRANKSHAFT POSITION SENSOR

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



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**51. 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:

0.15 to 0.40 mm (0.0059 to 0.0157 in.)

Maximum thrust clearance:

0.50 mm (0.0197 in.)

If the thrust clearance is greater than the maximum, replace one or more connecting rods as necessary. If necessary, replace the crankshaft.

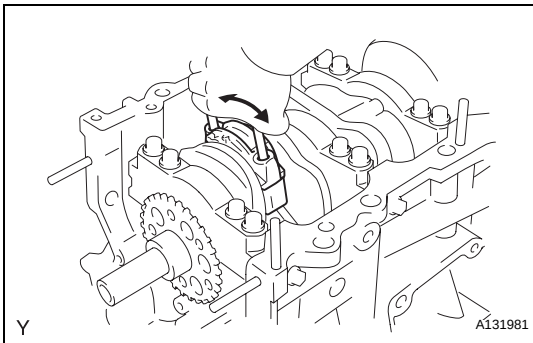
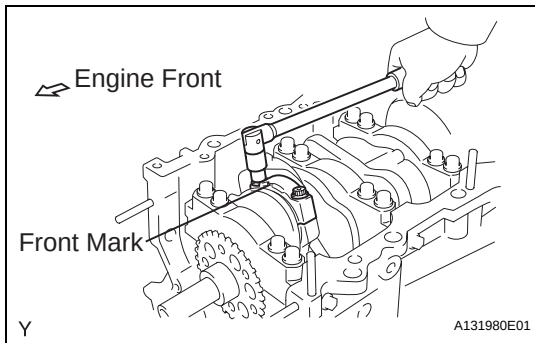
52. INSPECT CONNECTING ROD OIL CLEARANCE

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

NOTICE:

The front mark on the connecting rods and caps are for ensuring the correct reassembly.

- (b) Remove the 2 connecting rod cap bolts.

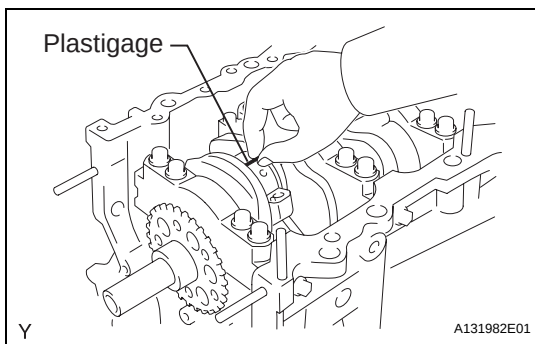


- (c) Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

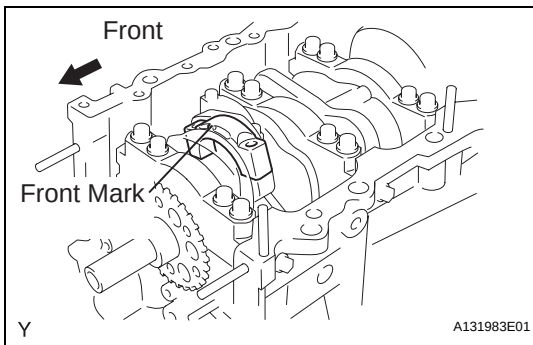
HINT:

Keep the lower bearing inserted to the connecting rod cap.

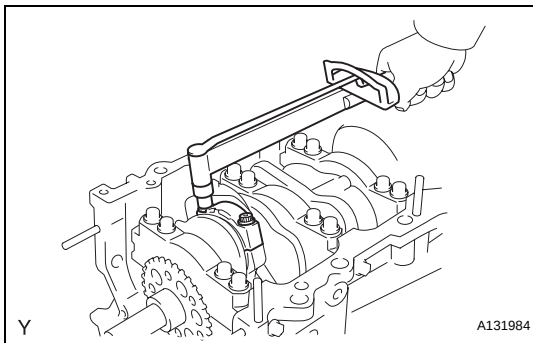
- (d) Clean the crank pin and bearing.
(e) Check the crank pin and bearing for pitting and scratches.



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



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

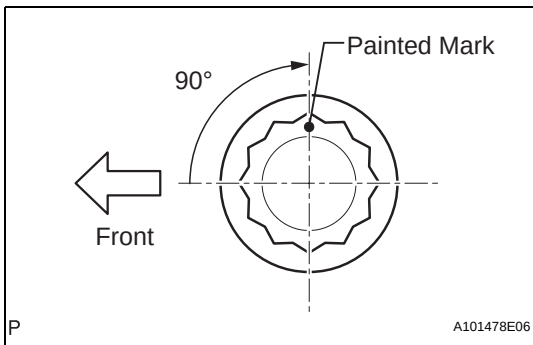


- (h) Install and alternately tighten the bolts of the connecting rod cap in several steps.

NOTICE:

Do not turn the crankshaft.

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

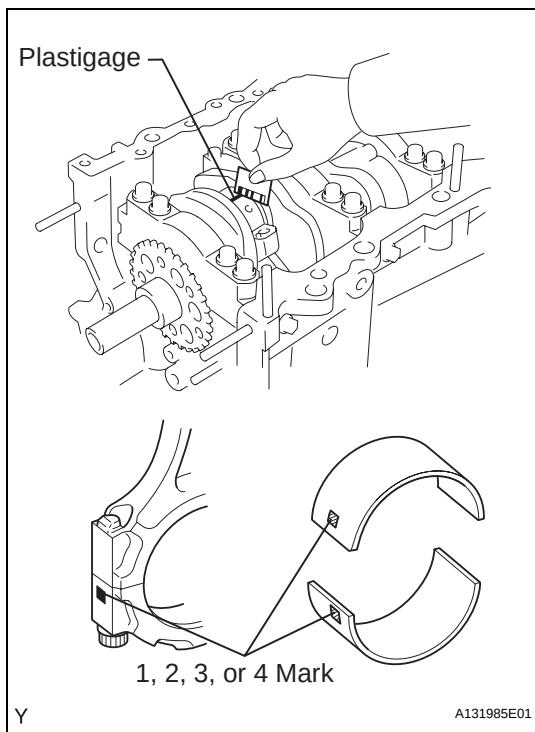


- (i) Mark the front side of each connecting cap bolt with paint.
 (j) Retighten the cap bolts by 90° as shown.
 (k) Check that the painted mark is now at a 90° angle to the front.

NOTICE:

Do not turn the crankshaft.

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



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

Standard oil clearance:

0.045 to 0.067 mm (0.0018 to 0.0026 in.)

Maximum oil clearance:

0.070 mm (0.0028 in.)

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

HINT:

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

Reference:

Connecting rod big end inside diameter

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

Standard sized bearing center wall thickness

Mark	Thickness
1	1.481 to 1.484 mm (0.0583 to 0.0584 in.)
2	1.484 to 1.497 mm (0.0584 to 0.0585 in.)
3	1.487 to 1.490 mm (0.0585 to 0.0587 in.)
4	1.490 to 1.493 mm (0.0587 to 0.0588 in.)

Crankshaft pin diameter:

52.992 to 53.000 mm (2.0863 to 2.0866 in.)

- (o) Completely remove the Plastigage.

53. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

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

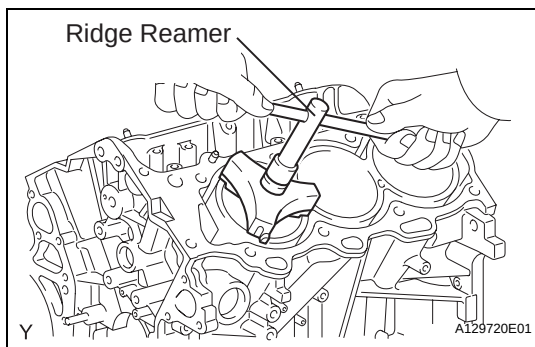
HINT:

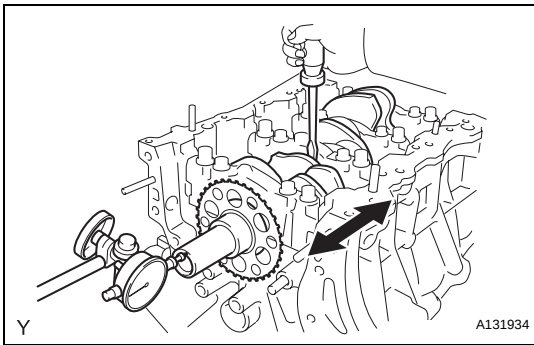
- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod in the correct order.

54. REMOVE CONNECTING ROD BEARING

HINT:

Arrange the removed parts in the correct order.



**55. 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:

0.04 to 0.24 mm (0.0016 to 0.0094 in.)

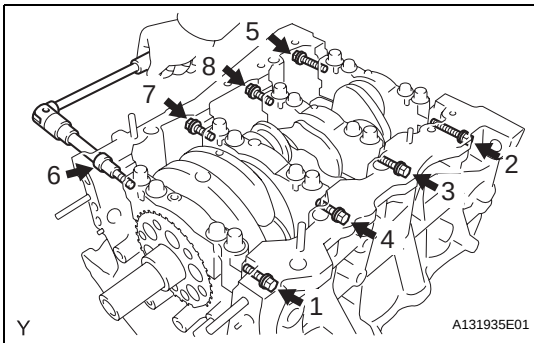
Maximum thrust clearance:

0.30 mm (0.0118 in.)

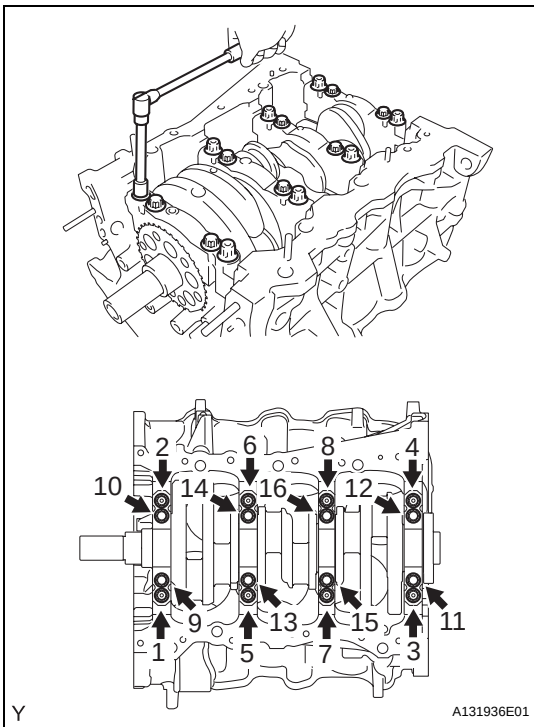
If the thrust clearance is greater than the maximum, replace the thrust washers as a set. If necessary, replace the crankshaft.

Standard thrust washer thickness:

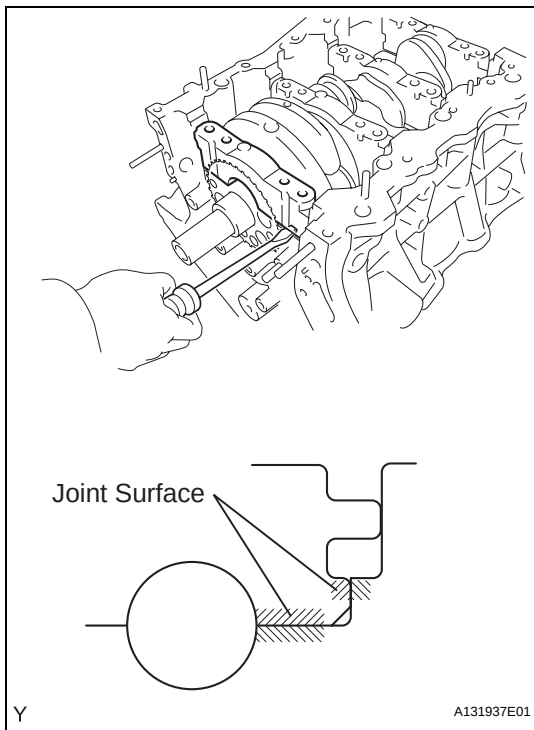
2.43 to 2.48 mm (0.0957 to 0.0976 in.)

**56. REMOVE CRANKSHAFT AND CRANKSHAFT OIL CLEARANCE**

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



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



- (c) Using a screwdriver, pry out the main bearing caps. Remove the 4 main bearing caps and lower bearings.

NOTICE:

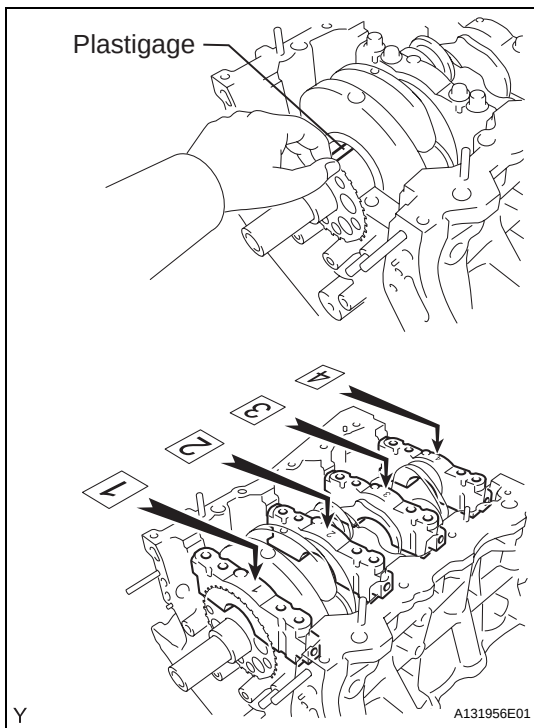
- Pry up the main cap little by little to the right and left in turns.
- Be careful not to damage the joint surface of the cylinder block and main bearing caps.

- (d) Clean each main journal and bearing.
 (e) Check each main journal and bearing for pitting and scratches.

HINT:

If the journal or bearing is damaged, replace the bearing.

- (f) Place the crankshaft on the cylinder block.



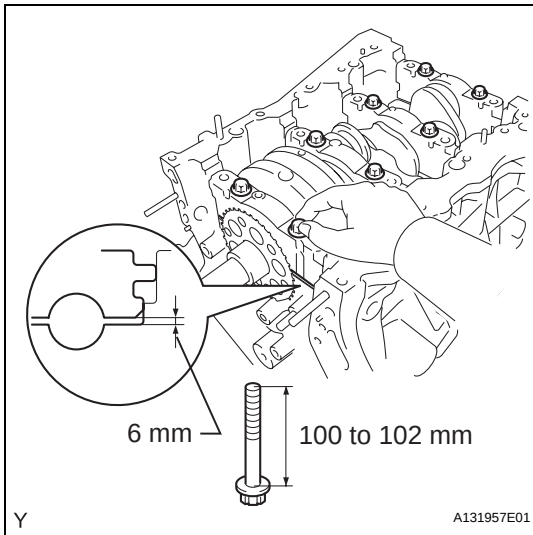
- (g) Lay a strip of Plastigage across each journal.

- (h) Examine the front marks and numbers and install the bearing caps on the cylinder block.

HINT:

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

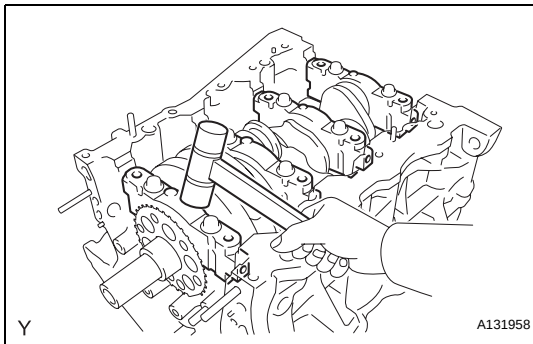
- (i) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
 (j) Place the crankshaft bearing cap on the cylinder block.



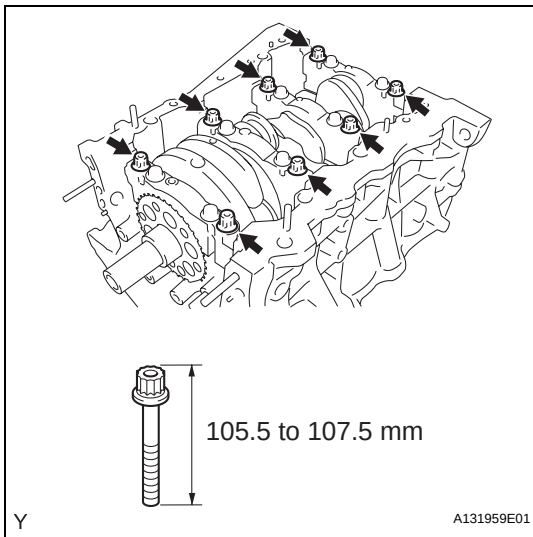
- (k) Install the main bearing cap with your hand until the clearance between the main bearing cap and the cylinder block is less than 6 mm (0.23 in.) by marking the 2 internal bearing cap bolts as a guide.

Bolt length:

100 to 102 mm (3.94 to 4.02 in.)



- (l) Using a plastic-faced hammer, lightly tap the bearing cap to ensure a proper fit.
- (m) Apply a light coat of engine oil on the threads and under the heads of the 8 main bearing cap bolts.



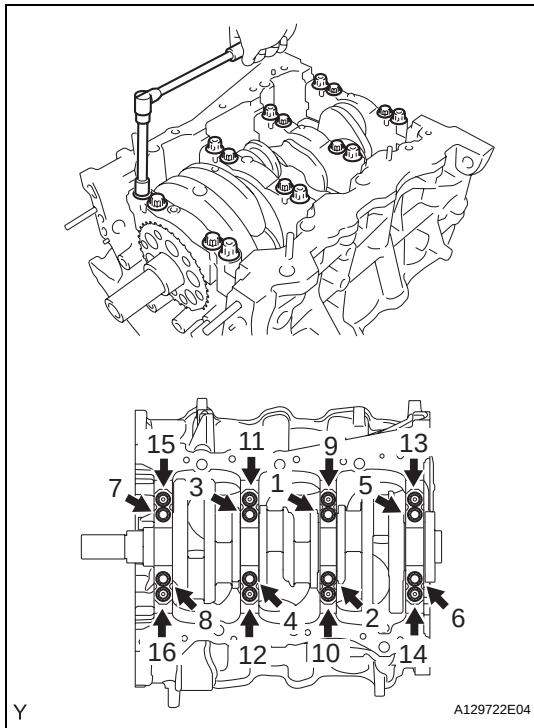
- (n) Install the 8 main bearing cap bolts to the outside positions.

Bolt length:

105.5 to 107.5 mm (4.15 to 4.23 in.)

HINT:

The main bearing cap bolts are tightened in 2 progressive steps.



(o) Step 1

- (1) Install and uniformly tighten the 16 main bearing cap bolts in the sequence shown in the illustration.

Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)

HINT:

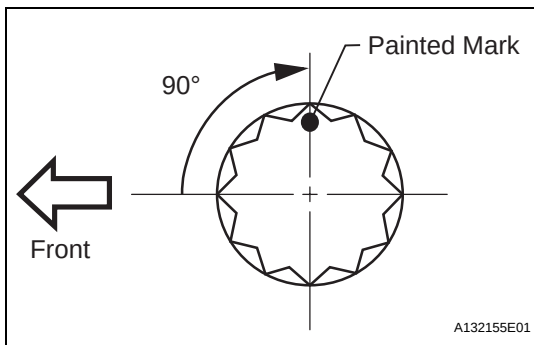
If any of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.

NOTICE:

Do not turn the crankshaft.

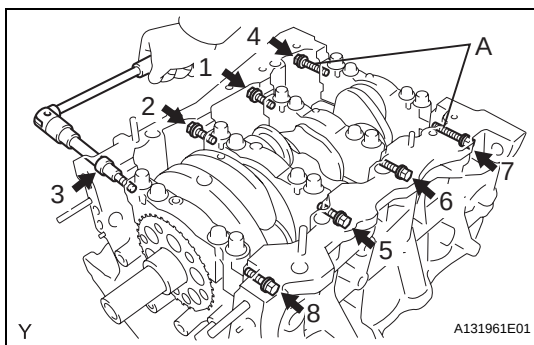
(p) Step 2

- (1) Mark the front of the bearing cap bolts with paint.



- (2) Retighten the bearing cap bolts by 90° as shown in the order shown in step 1.

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



- (q) Install and uniformly tighten the 8 main bearing cap bolts in several steps and in the sequence shown in the illustration.

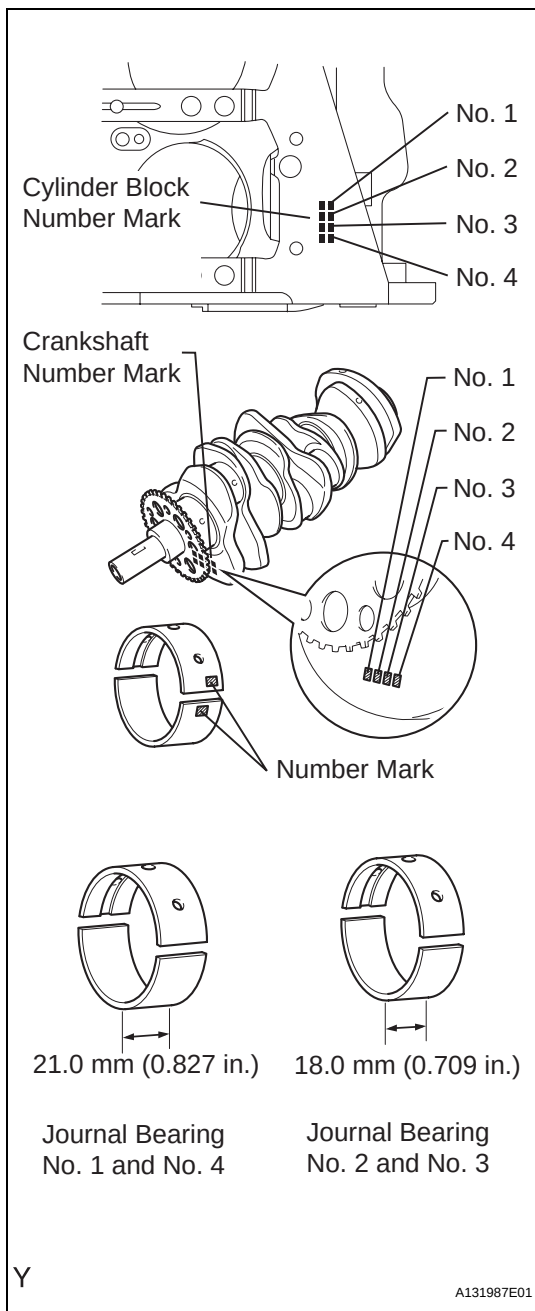
Torque: 52 N*m (530 kgf*cm, 38 ft.*lbf)

Bolt length:

45 mm (1.77 in.) for bolt A

30 mm (1.18 in.) for except bolt A

- (r) Remove the 24 bolts and bearing cap bolts.
- (s) Completely remove the Plastigage.



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

Journal bearing

Use Bearing	Cylinder Block Number Mark + Crankshaft Number Mark
1	0 - 5
2	6 - 11
3	12 - 17
4	18 - 23
5	24 - 28

EXAMPLE:

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

Standard crankshaft main journal diameter

Mark	Specified Condition
00	60.999 to 61.000 mm (2.4015 to 2.4016 in.)
01	60.998 to 60.999 mm (2.4015 to 2.4015 in.)
02	60.997 to 60.998 mm (2.4015 to 2.4015 in.)
03	60.996 to 60.997 mm (2.4014 to 2.4015 in.)
04	60.995 to 60.996 mm (2.4014 to 2.4014 in.)
05	60.994 to 60.995 mm (2.4013 to 2.4014 in.)
06	60.93 to 60.994 mm (2.4013 to 2.4013 in.)
07	60.992 to 60.993 mm (2.4013 to 2.4013 in.)
08	60.991 to 60.992 mm (2.4012 to 2.4013 in.)
09	60.990 to 60.991 mm (2.4012 to 2.4012 in.)
10	60.989 to 60.990 mm (2.4011 to 2.4012 in.)
11	60.988 to 60.989 mm (2.4011 to 2.4011 in.)

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

Mark	Specified Condition
1	2.500 to 2.503 mm (0.0984 to 0.0985 in.)
2	2.503 to 2.506 mm (0.0985 to 0.0987 in.)
3	2.506 to 2.509 mm (0.0987 to 0.0988 in.)

Mark	Specified Condition
4	2.509 to 2.512 mm (0.0988 to 0.0989 in.)
5	2.512 to 2.515 mm (0.0989 to 0.0990 in.)

No. 2 and No. 3 journal

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

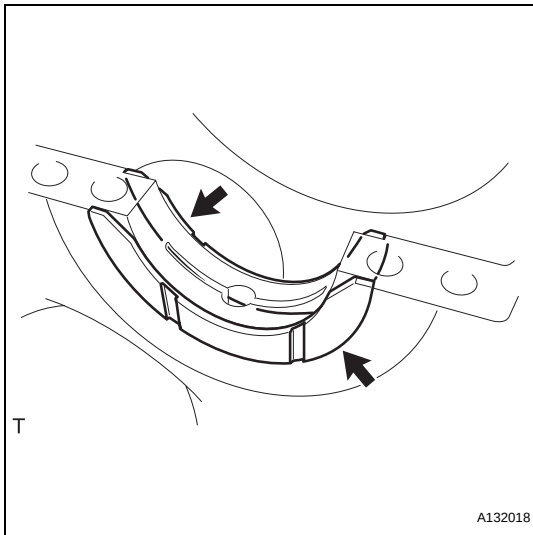
Standard lower bearing center wall thickness
No. 1 and No. 4 journal

Mark	Specified Condition
1	2.478 to 2.481 mm (0.0976 to 0.0977 in.)
2	2.481 to 2.484 mm (0.0977 to 0.0780 in.)
3	2.484 to 2.487 mm (0.0978 to 0.0979 in.)
4	2.487 to 2.490 mm (0.0979 to 0.0980 in.)
5	2.490 to 2.493 mm (0.0980 to 0.0981 in.)

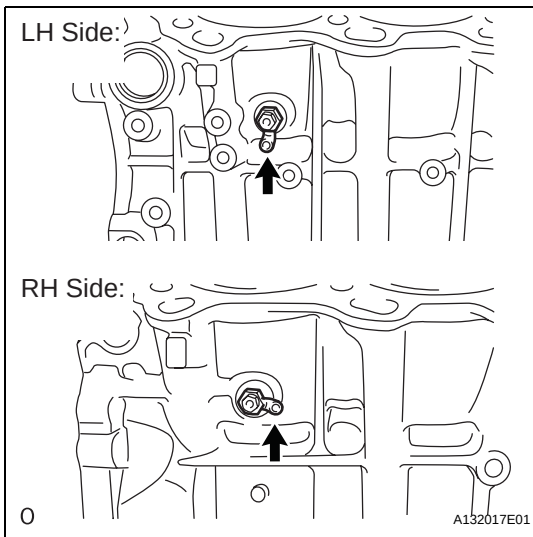
No. 2 and No. 3 journal

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

(u) Lift out the crankshaft.

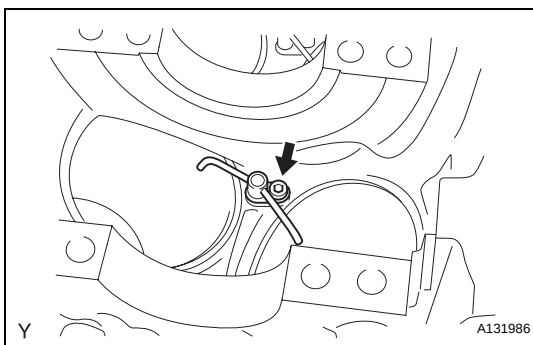


- (v) Remove the upper bearings and upper thrust washers from the cylinder block.
HINT:
Arrange the bearings and thrust washers in the correct order.



57. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

- (a) Remove the 2 water drain cocks from the cylinder block.
(b) Remove the water drain cock plugs from the water drain cocks.

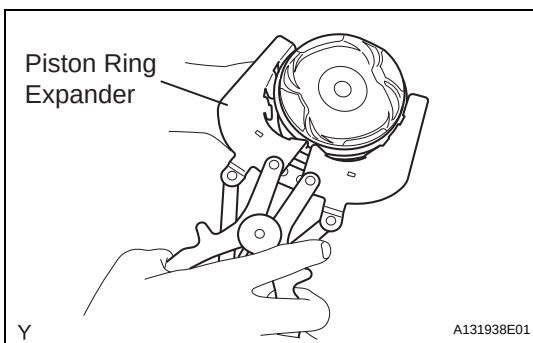


58. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

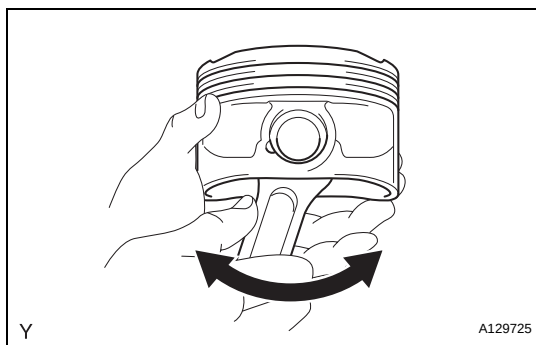
- (a) Using a 5 mm hexagon wrench, remove the 3 oil nozzles.
(b) Check the oil nozzles for damage or clogging. If necessary, replace the oil nozzle.

59. REMOVE PISTON RING SET

- HINT:
Arrange the piston rings in the correct order.



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

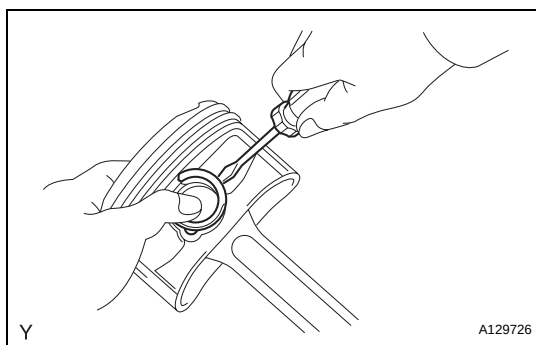
**60. REMOVE PISTON WITH PIN SUB-ASSEMBLY**

- (a) Check the fitting condition between the piston and piston pin.

- (1) Try to move the piston back and forth on the piston pin.

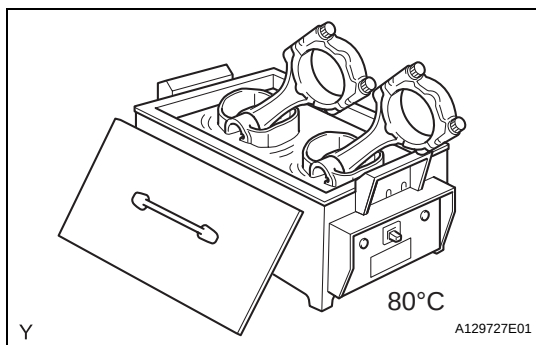
HINT:

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

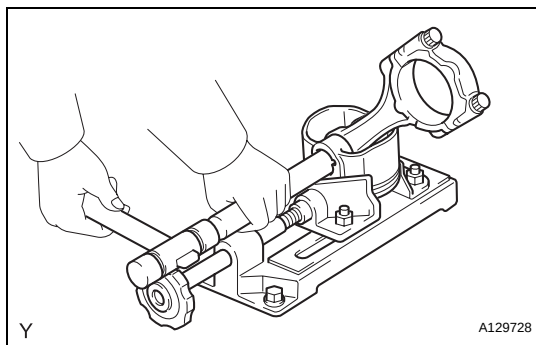


- (b) Disconnect the connecting rod from the piston.

- (1) Using a screwdriver, pry off the snap rings from the piston.



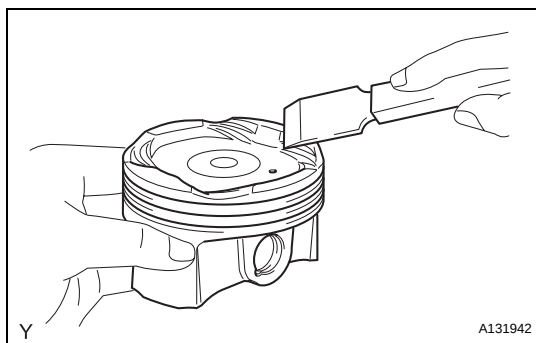
- (2) Gradually heat the piston to approximately 80°C (176°F).



- (3) Using a brass bar and plastic-faced hammer, lightly tap out the piston pin and remove the connecting rod.

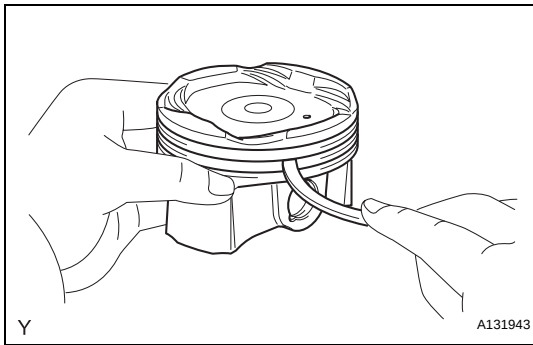
HINT:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.

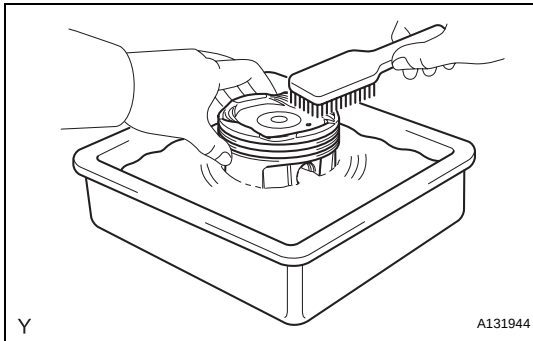


- (c) Clean piston.

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



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



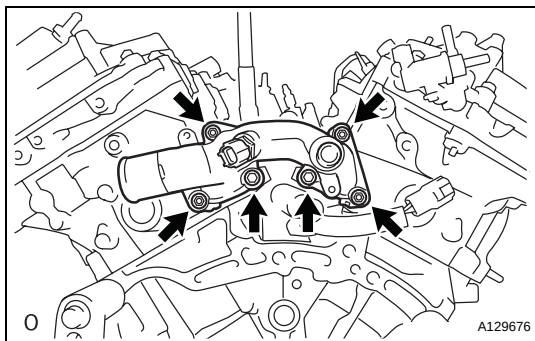
- (3) Using solvent and a brush, thoroughly clean the piston.

NOTICE:

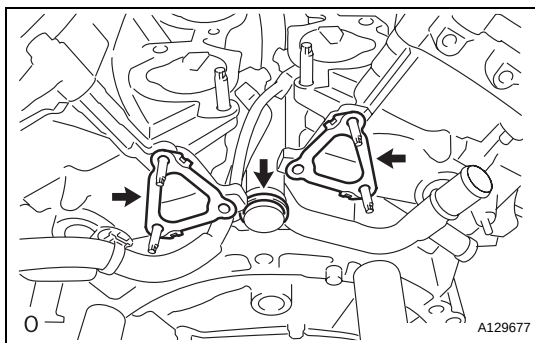
Do not use a wire brush.

DISASSEMBLY

1. REMOVE OIL FILLER CAP SUB-ASSEMBLY
2. REMOVE SPARK PLUG
3. REMOVE CAMSHAFT TIMING CONTROL VALVE ASSEMBLY (See page [ES-440](#))
4. REMOVE VVT SENSOR (See page [ES-443](#))
5. REMOVE WATER OUTLET
 - (a) Remove the 2 bolts, 4 nuts and water outlet.

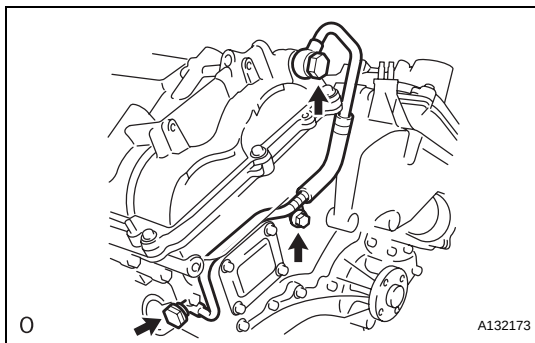


- (b) Remove the 2 gaskets and O-ring.



6. REMOVE OIL PIPE

- (a) Remove the bolt, 2 union bolts and oil pipe.
- (b) Remove the oil control valve filter RH and gaskets.

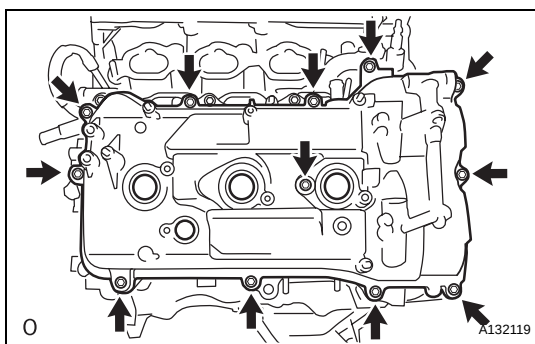


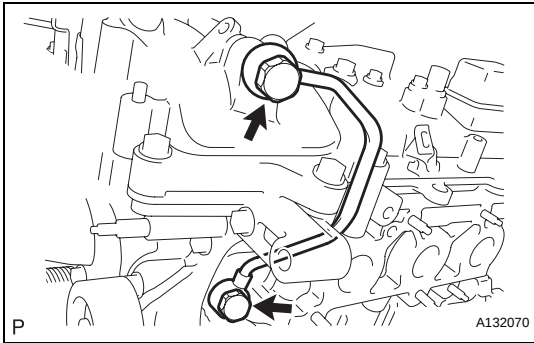
7. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)

- (a) Remove the 12 bolts, cylinder head cover and gasket.

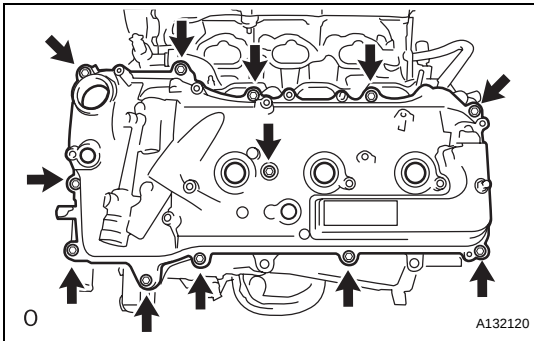
HINT:

Make sure the removed parts are returned to the same places they were removed from.



**8. REMOVE NO. 1 OIL PIPE**

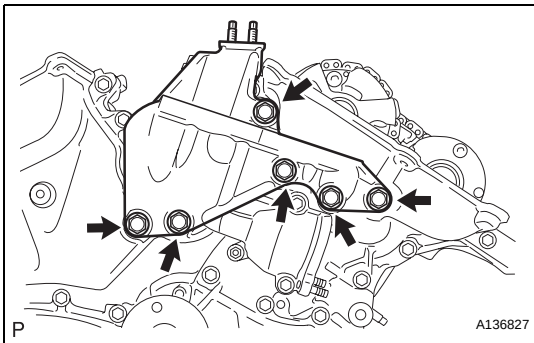
- (a) Remove the 2 union bolts and oil pipe.
- (b) Remove the oil control valve filter LH and gaskets.

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

- (a) Remove the 12 bolts, cylinder head cover and gasket.

HINT:

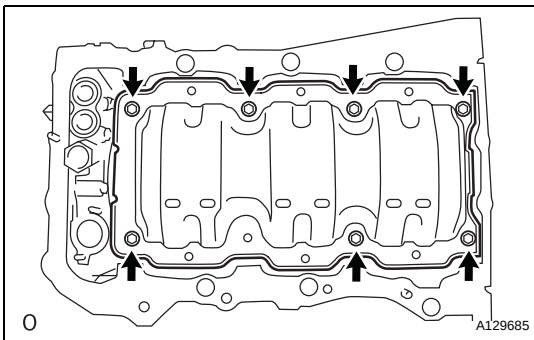
Make sure the removed parts are returned to the same places they were removed from.

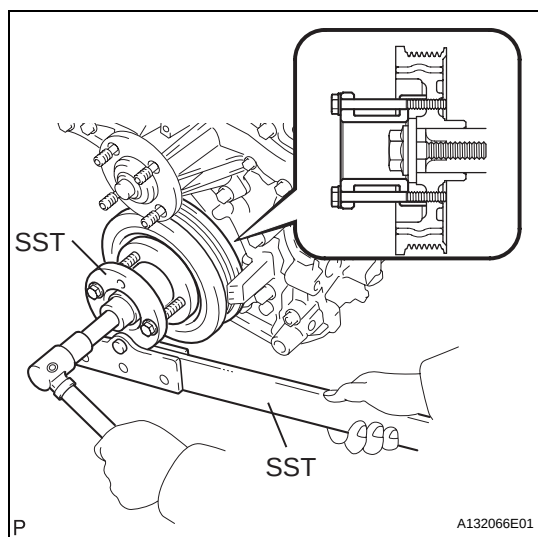
**10. REMOVE FRONT NO. 1 ENGINE MOUNTING BRACKET**

- (a) Remove the 6 bolts and mounting bracket.

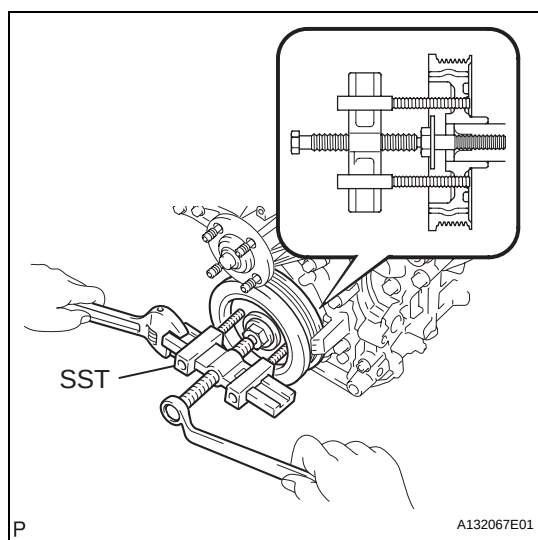
11. REMOVE WATER INLET HOUSING (See page [CO-12](#))**12. REMOVE OIL FILTER CAP ASSEMBLY (See page [LU-4](#))****13. REMOVE OIL FILTER ELEMENT (See page [LU-5](#))****14. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY (See page [LU-12](#))****15. REMOVE OIL STRAINER SUB-ASSEMBLY (See page [LU-13](#))****16. REMOVE OIL PAN SUB-ASSEMBLY (See page [LU-13](#))****17. REMOVE OIL PAN BAFFLE PLATE**

- (a) Remove the 7 bolts and baffle plate.

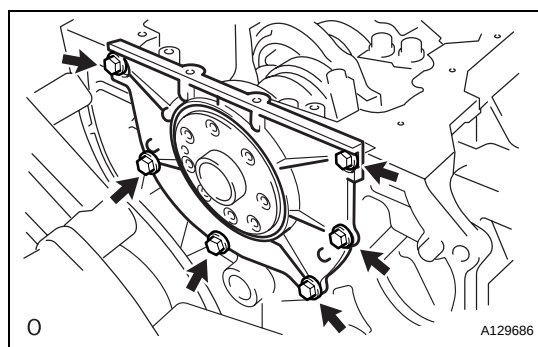


**18. REMOVE CRANKSHAFT PULLEY**

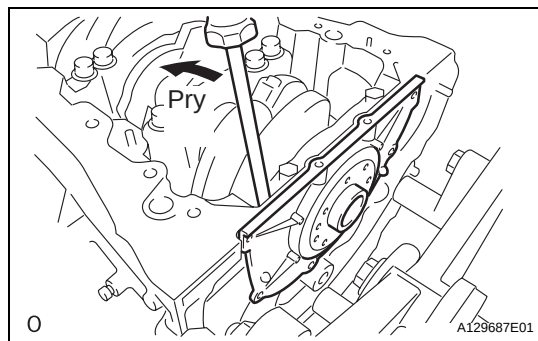
- (a) Using SST, loosen the crankshaft pulley set bolt.
SST 09213-70011 (09213-70020), 09330-00021



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

19. REMOVE WATER PUMP ASSEMBLY (See page [CO-13](#))**20. REMOVE ENGINE REAR OIL SEAL RETAINER**

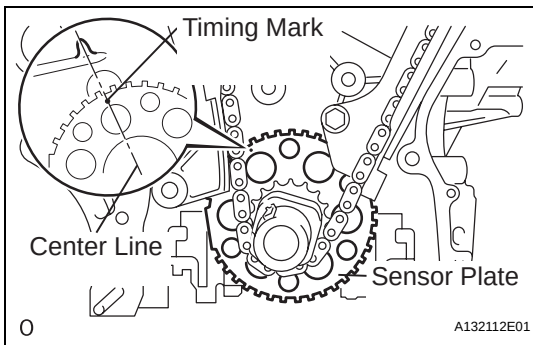
- (a) Remove the 6 bolts.



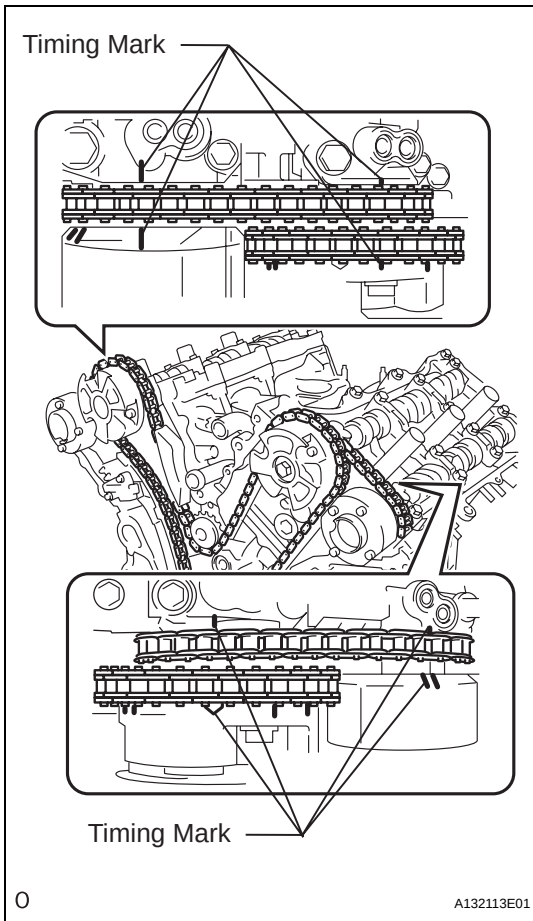
- (b) Using a screwdriver, pry out the oil seal retainer.
HINT:
 Tape the screwdriver tip before use.

21. REMOVE TIMING CHAIN COVER SUB-ASSEMBLY (w/ Oil Pump) (See page [LU-14](#))**22. SET NO. 1 CYLINDER TO TDC / COMPRESSION**

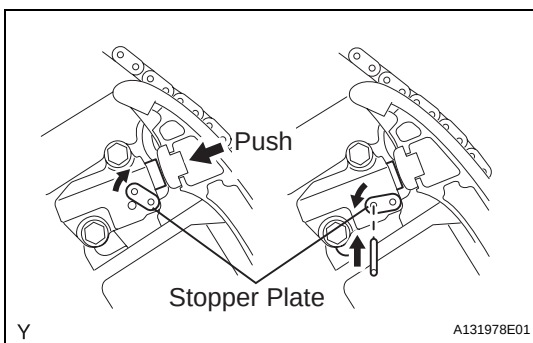
- (a) Temporarily tighten the pulley set bolt.



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



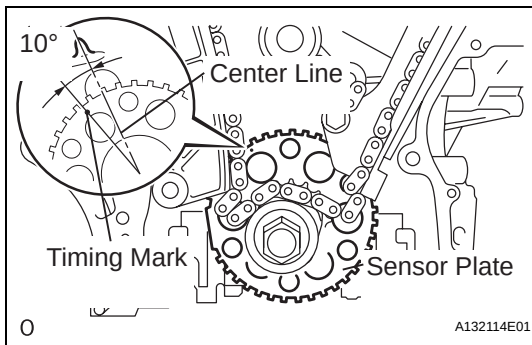
- (c) Check that the timing marks of the camshaft timing gears are aligned with the timing marks of the bearing cap as shown in the illustration. If not, turn the crankshaft 1 revolution (360°) and align the timing marks as above.



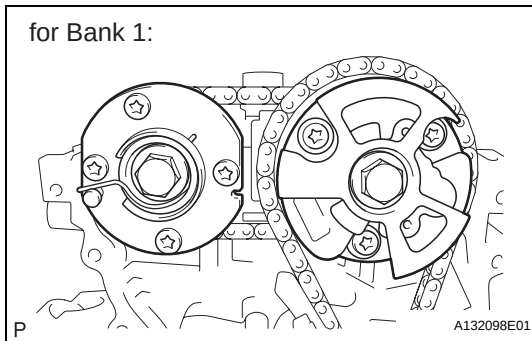
23. REMOVE NO. 1 CHAIN TENSIONER ASSEMBLY

- Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.
- Move the stopper plate downward to set the lock, and insert a hexagon wrench into the stopper plate hole.
- Remove the 2 bolts and chain tensioner.

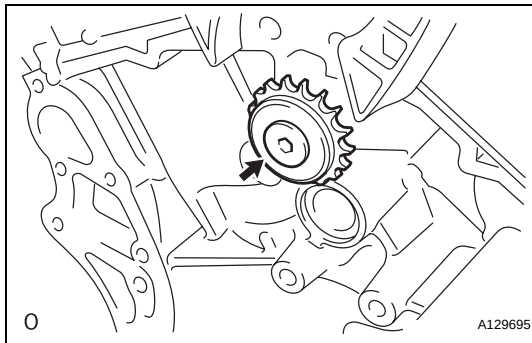
24. REMOVE CHAIN TENSIONER SLIPPER

**25. REMOVE NO. 1 CHAIN SUB-ASSEMBLY**

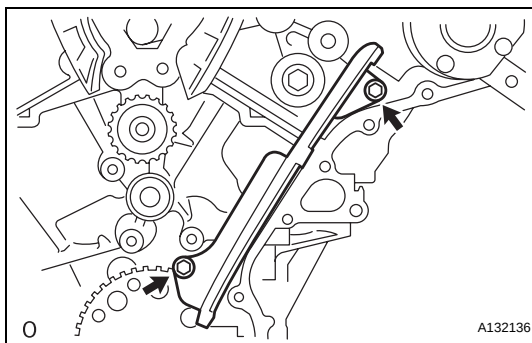
- (a) Turn the crankshaft counterclockwise 10° to loosen the chain of the crankshaft timing gear.
- (b) Remove the chain from the crankshaft timing gear and place it on the crankshaft.



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

**26. REMOVE IDLE SPROCKET ASSEMBLY**

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

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

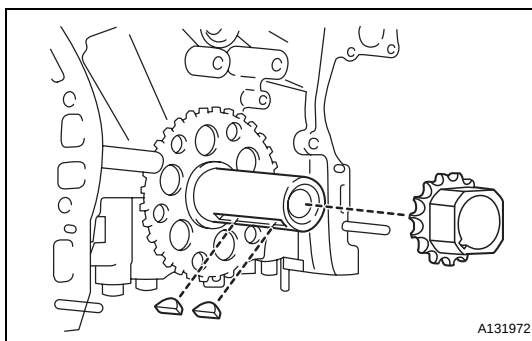
- (a) Remove the 2 bolts and vibration damper.

28. REMOVE NO. 2 CHAIN VIBRATION DAMPER

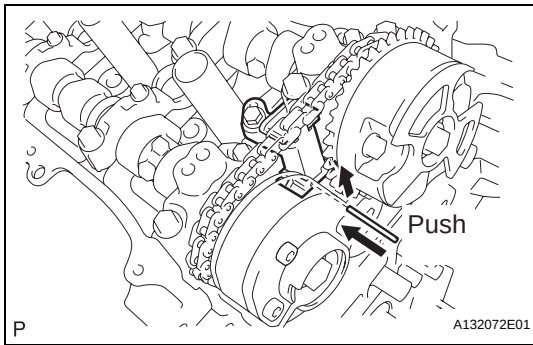
- (a) Remove the 2 chain vibration dampers.

29. REMOVE CRANKSHAFT TIMING GEAR OR SPROCKET

- (a) Remove the pulley set bolt.

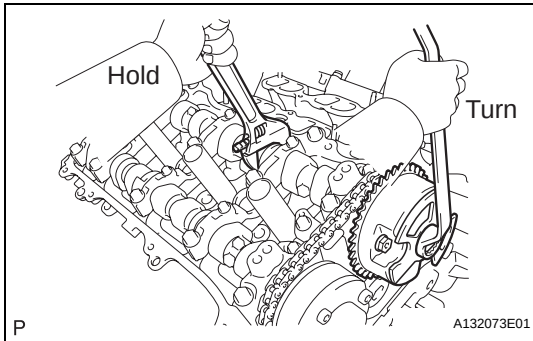


- (b) Remove the crankshaft timing gear from the crankshaft.
- (c) Remove the 2 pulley set keys from the crankshaft.



30. REMOVE CAMSHAFT TIMING GEAR ASSEMBLY (for Bank 1)

- (a) While raising up the No. 2 chain tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.



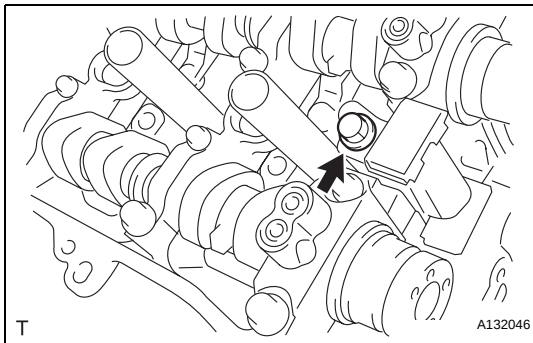
- (b) Hold the hexagonal portion of the camshaft with a wrench, and remove the 2 bolts and 2 camshaft timing gears.

NOTICE:

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

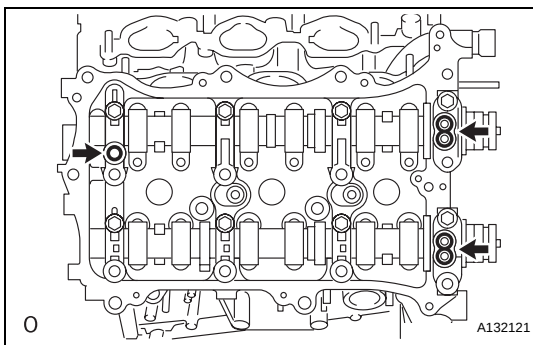
- (c) Remove the No. 2 chain.

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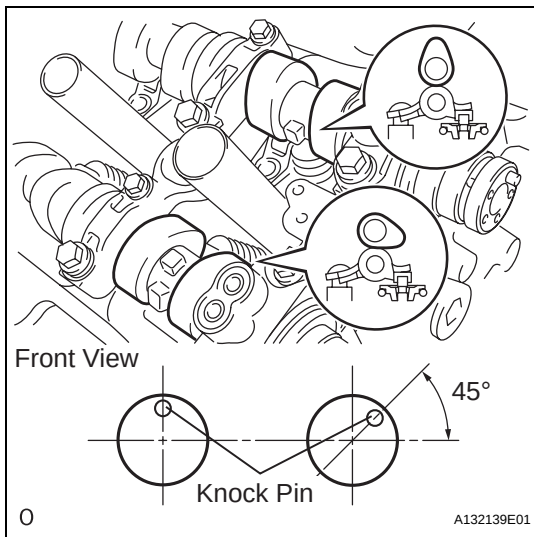
31. REMOVE NO. 2 CHAIN TENSIONER ASSEMBLY

- (a) Remove the bolt and chain tensioner.

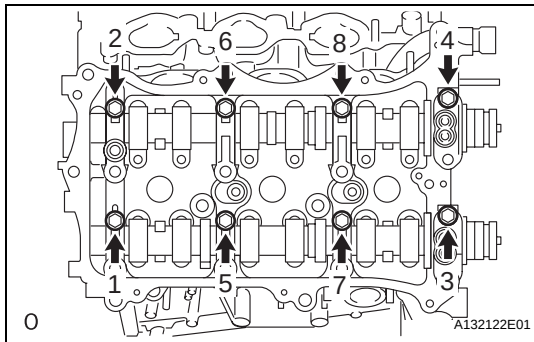


32. REMOVE CAMSHAFT (for Bank 1)

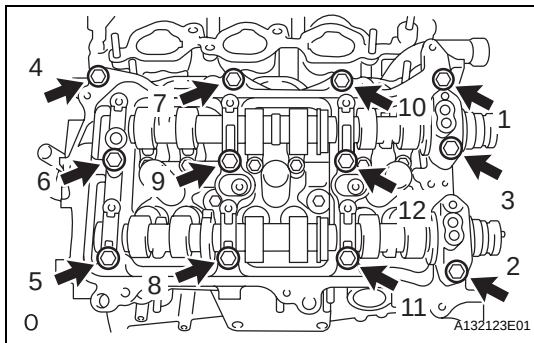
- (a) Remove the 3 gaskets.



- (b) Make sure that the knock pin of the camshaft is positioned as shown in the illustration.



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

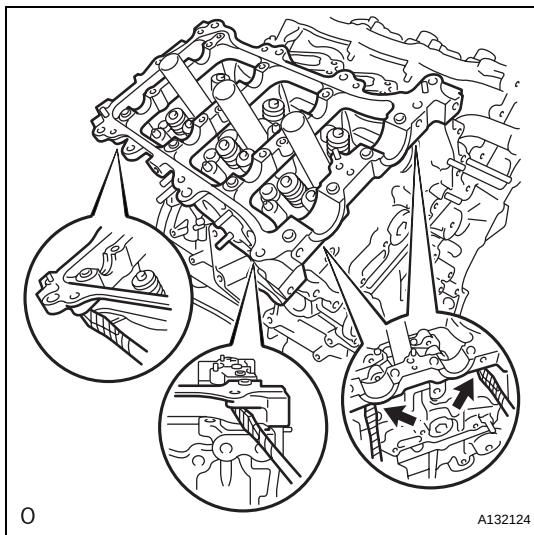


- (d) Uniformly loosen and remove the 12 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

Uniformly loosen the bolts while keeping the camshaft level.

- (e) Remove the 5 bearing caps.
(f) Remove the No. 1 and No. 2 camshafts.



33. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 1)

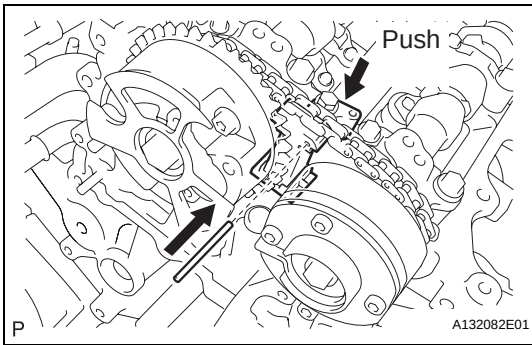
- (a) Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

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

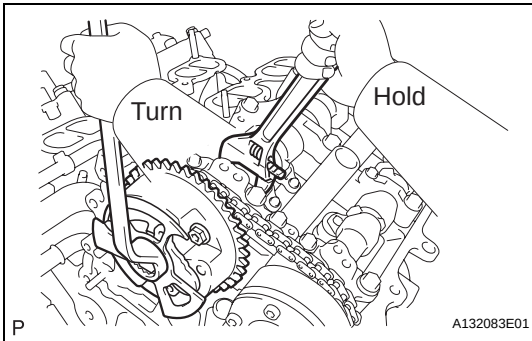
HINT:

Tape the screwdriver tip before use.



34. REMOVE CAMSHAFT TIMING GEAR ASSEMBLY (for Bank 2)

- (a) While pushing down the chain tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.



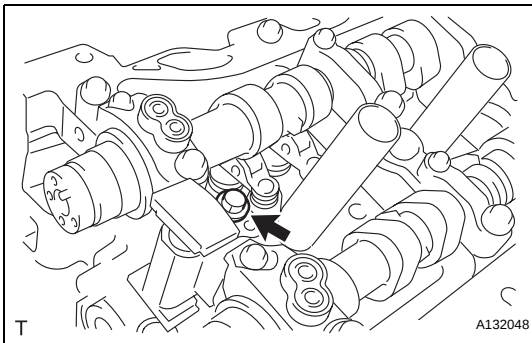
- (b) Hold the hexagonal portion of the camshaft with a wrench and remove the 2 bolts and 2 camshaft timing gears.

NOTICE:

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

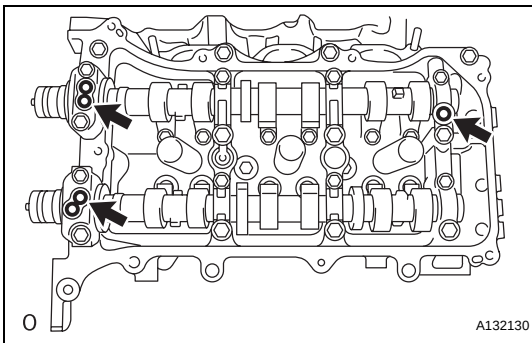
- (c) Remove the No. 2 chain.

EM



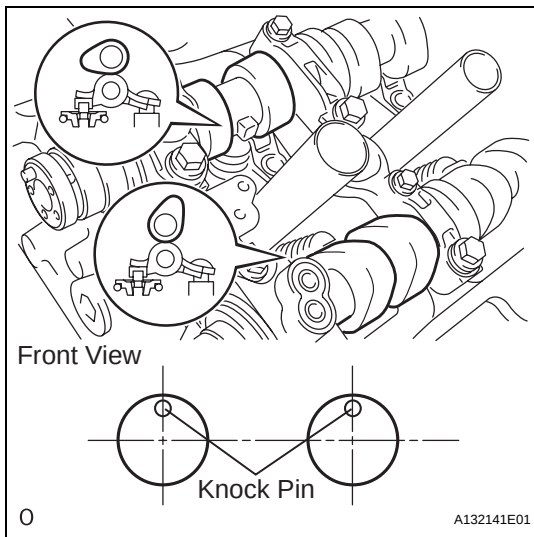
35. REMOVE NO. 3 CHAIN TENSIONER ASSEMBLY

- (a) Remove the bolt and chain tensioner.

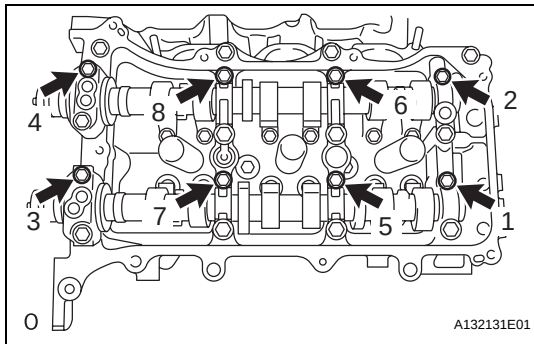


36. REMOVE CAMSHAFT SUB-ASSEMBLY (for Bank 2)

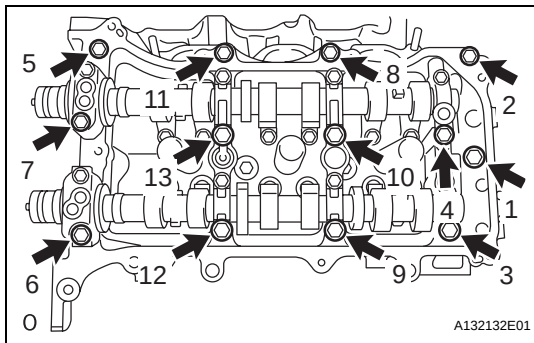
- (a) Remove the 3 gaskets.



- (b) Make sure that the knock pin of the camshaft is positioned as shown in the illustration.



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

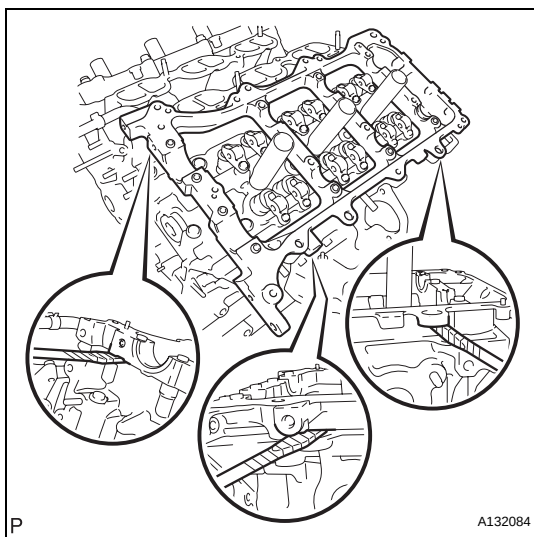


- (d) Uniformly loosen and remove the 13 bearing cap bolts in the sequence shown in the illustration.

NOTICE:

Uniformly loosen the bolts while keeping the camshaft level.

- (e) Remove the 5 bearing caps.
(f) Remove the No. 3 and No. 4 camshafts.



37. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 2)

- (a) Remove the camshaft housing by prying between the cylinder head and camshaft housing with a screwdriver.

NOTICE:

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

HINT:

Tape the screwdriver tip before use.

38. REMOVE NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

- (a) Remove the 24 valve rocker arms.

HINT:

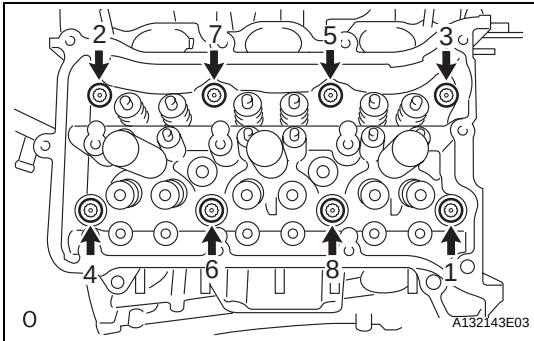
Arrange the removed parts in the correct order.

39. REMOVE VALVE LASH ADJUSTER ASSEMBLY

- (a) Remove the 24 valve lash adjusters from the cylinder head.

HINT:

Arrange the removed parts in the correct order.

**40. REMOVE CYLINDER HEAD SUB-ASSEMBLY (for Bank 1)**

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

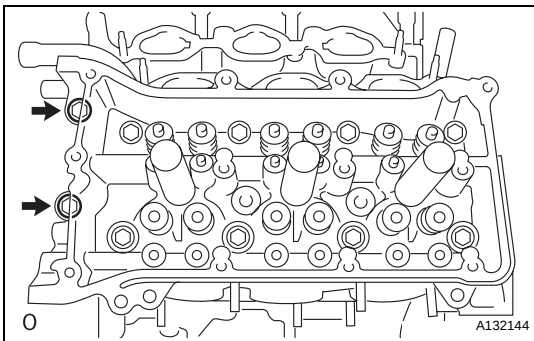
NOTICE:

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

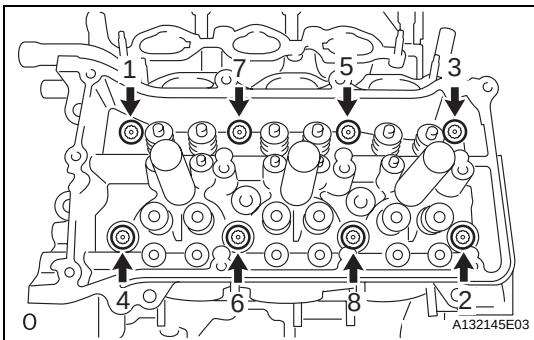
HINT:

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

- (b) Remove the cylinder head and gasket.

**41. REMOVE CYLINDER HEAD SUB-ASSEMBLY (for Bank 2)**

- (a) Uniformly loosen and remove the 2 bolts in the sequence shown in the illustration.



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

NOTICE:

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

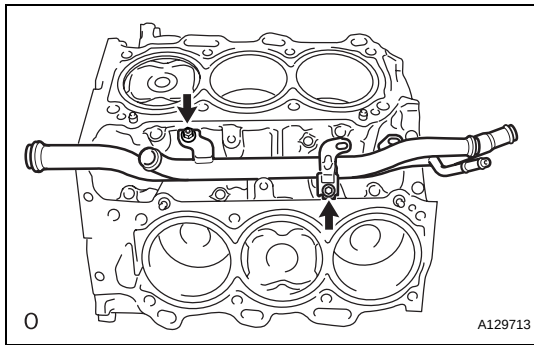
HINT:

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

- (c) Remove the cylinder head and gasket.

42. REMOVE WATER INLET PIPE

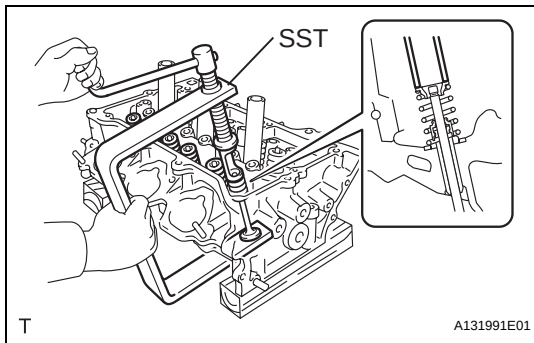
- (a) Disconnect the knock sensor wire.



- (b) Remove the 2 bolts and water outlet pipe.
- (c) Disconnect the water by-pass hose.

43. REMOVE VALVE STEM CAP

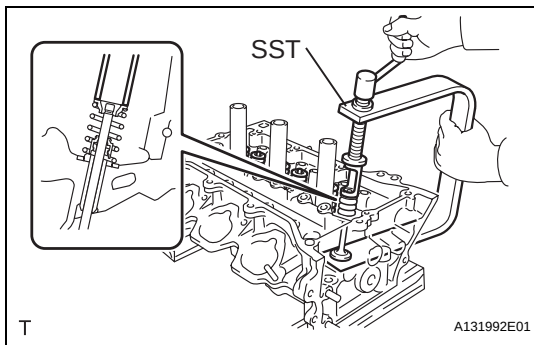
- (a) Remove the valve stem caps from the cylinder head.
- HINT:
Arrange the removed parts in the correct order.



44. REMOVE INTAKE VALVE

- (a) Using SST and wooden blocks, compress the compression spring and remove the valve retainer lock.
- SST 09202-70020 (09202-00010)**
 - (b) Remove the retainer, compression spring and valve.

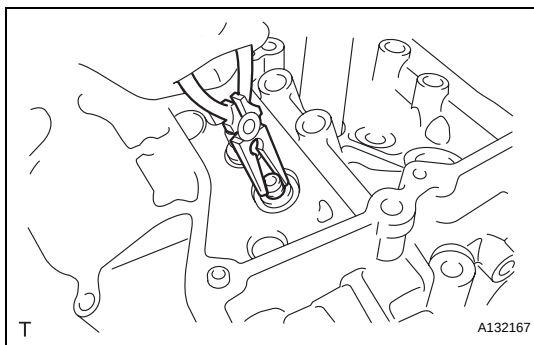
HINT:
Arrange the removed parts in the correct order.



45. REMOVE EXHAUST VALVE

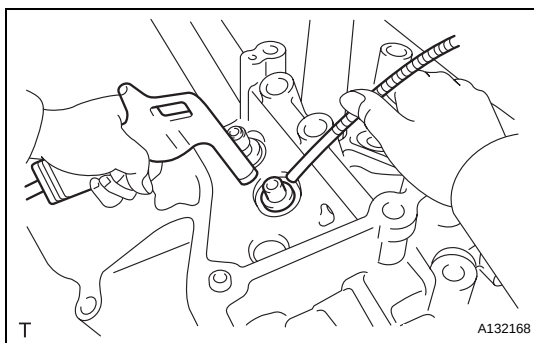
- (a) Using SST and wooden blocks, compress the compression spring and remove the valve retainer lock.
- SST 09202-70020 (09202-00010)**
 - (b) Remove the retainer, compression spring and valve.

HINT:
Arrange the removed parts in the correct order.



46. REMOVE VALVE STEM OIL SEAL

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



47. REMOVE VALVE SPRING SEAT

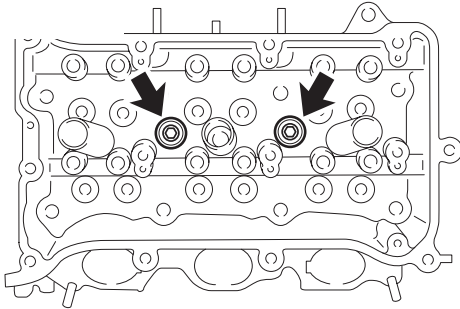
- (a) Using compressed air and a magnetic finger, remove the valve spring seat by blowing air onto it.

48. REMOVE NO. 1 STRAIGHT SCREW PLUG

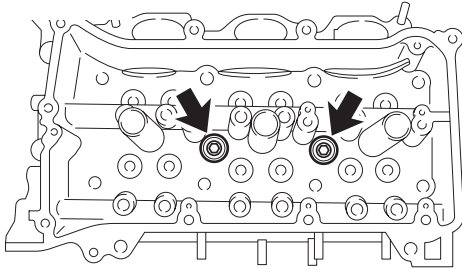
NOTICE:

If water leaks from the No. 1 screw plug or the plug is corroded, replace it.

for Bank 1:



for Bank 2:



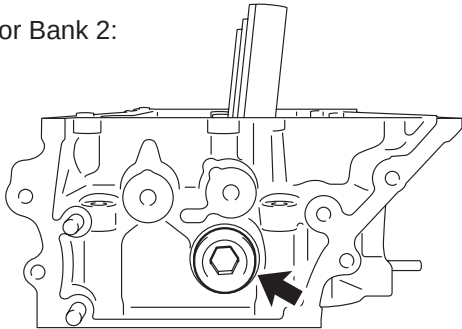
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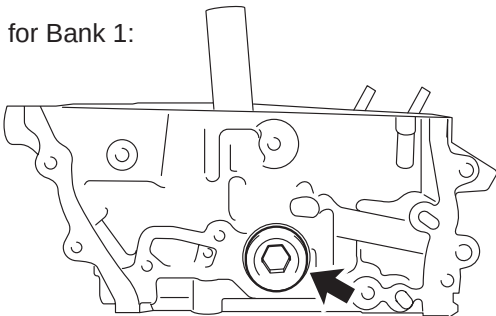
- (a) Using a 10 mm hexagon wrench, remove the 4 screw plugs and 4 gaskets.

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for Bank 2:



for Bank 1:



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49. REMOVE NO. 2 STRAIGHT SCREW PLUG

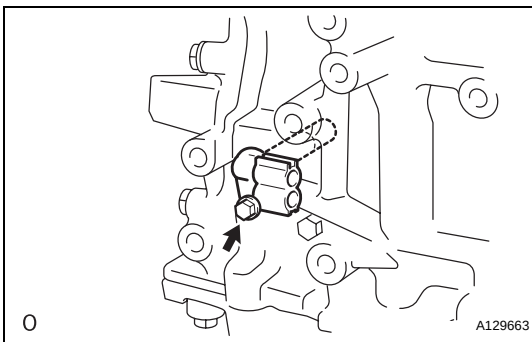
- (a) Using a 14 mm hexagon wrench, remove the 2 screw plugs and 2 gaskets.

NOTICE:

If water leaks from the No. 2 screw plug or the plug is corroded, replace it.

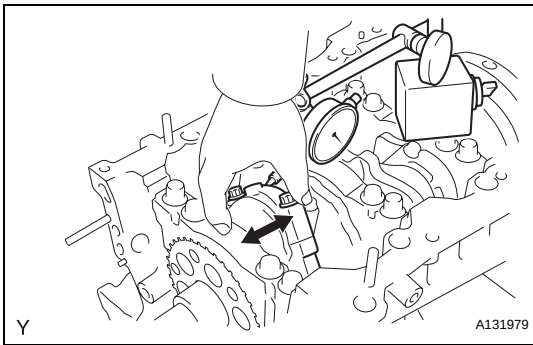
50. REMOVE CRANKSHAFT POSITION SENSOR

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



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**51. 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:

0.15 to 0.40 mm (0.0059 to 0.0157 in.)

Maximum thrust clearance:

0.50 mm (0.0197 in.)

If the thrust clearance is greater than the maximum, replace one or more connecting rods as necessary. If necessary, replace the crankshaft.

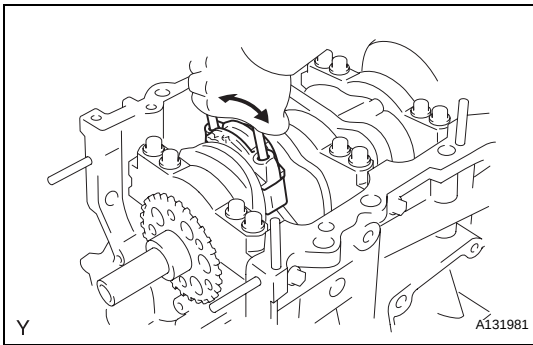
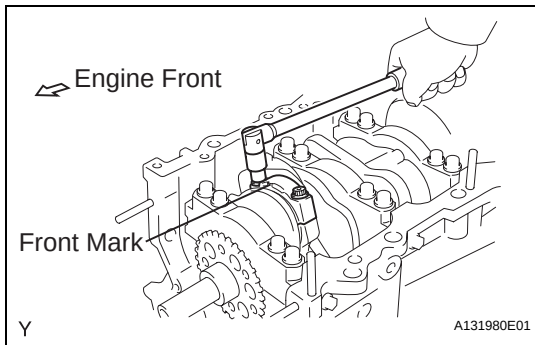
52. INSPECT CONNECTING ROD OIL CLEARANCE

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

NOTICE:

The front mark on the connecting rods and caps are for ensuring the correct reassembly.

- (b) Remove the 2 connecting rod cap bolts.

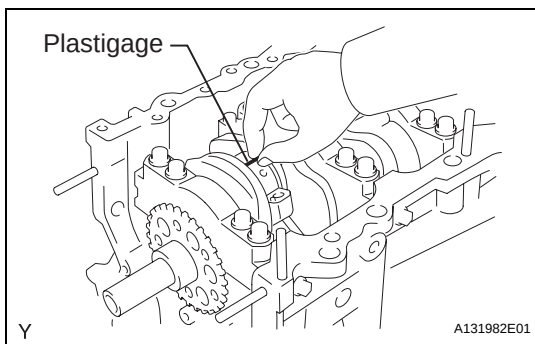


- (c) Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

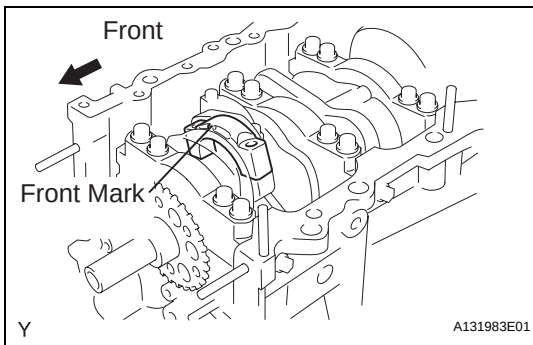
HINT:

Keep the lower bearing inserted to the connecting rod cap.

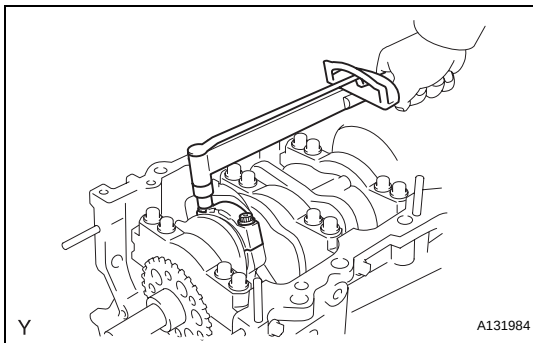
- (d) Clean the crank pin and bearing.
(e) Check the crank pin and bearing for pitting and scratches.



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



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

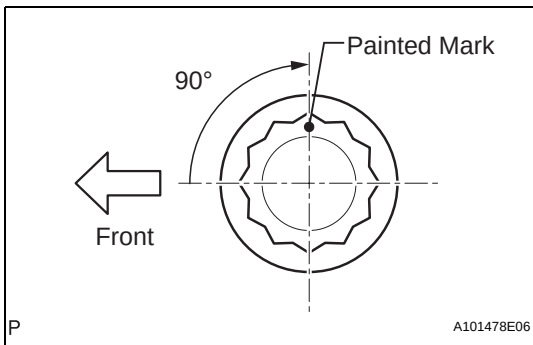


- (h) Install and alternately tighten the bolts of the connecting rod cap in several steps.

NOTICE:

Do not turn the crankshaft.

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

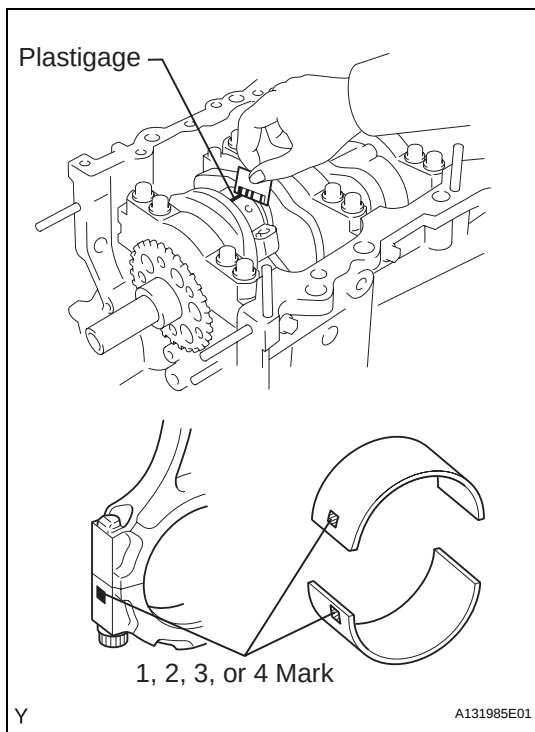


- (i) Mark the front side of each connecting cap bolt with paint.
 (j) Retighten the cap bolts by 90° as shown.
 (k) Check that the painted mark is now at a 90° angle to the front.

NOTICE:

Do not turn the crankshaft.

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



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

Standard oil clearance:

0.045 to 0.067 mm (0.0018 to 0.0026 in.)

Maximum oil clearance:

0.070 mm (0.0028 in.)

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

HINT:

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

Reference:

Connecting rod big end inside diameter

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

Standard sized bearing center wall thickness

Mark	Thickness
1	1.481 to 1.484 mm (0.0583 to 0.0584 in.)
2	1.484 to 1.497 mm (0.0584 to 0.0585 in.)
3	1.487 to 1.490 mm (0.0585 to 0.0587 in.)
4	1.490 to 1.493 mm (0.0587 to 0.0588 in.)

Crankshaft pin diameter:

52.992 to 53.000 mm (2.0863 to 2.0866 in.)

- (o) Completely remove the Plastigage.

53. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

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

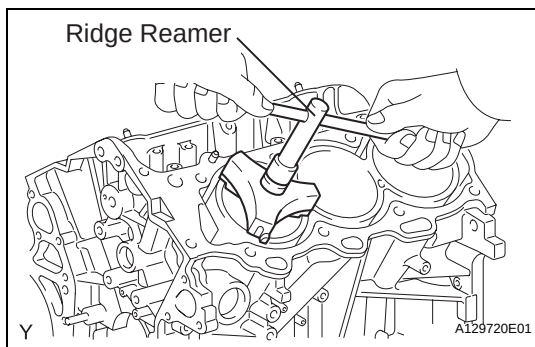
HINT:

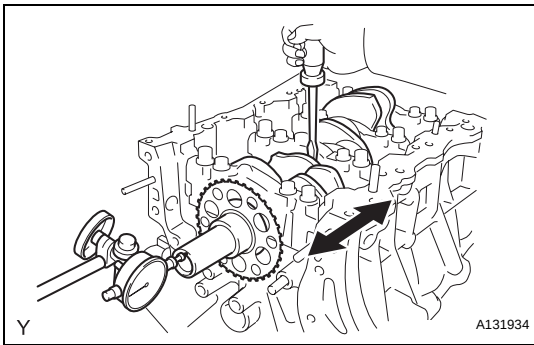
- Keep the bearing, connecting rod and cap together.
- Arrange the piston and connecting rod in the correct order.

54. REMOVE CONNECTING ROD BEARING

HINT:

Arrange the removed parts in the correct order.



**55. 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:

0.04 to 0.24 mm (0.0016 to 0.0094 in.)

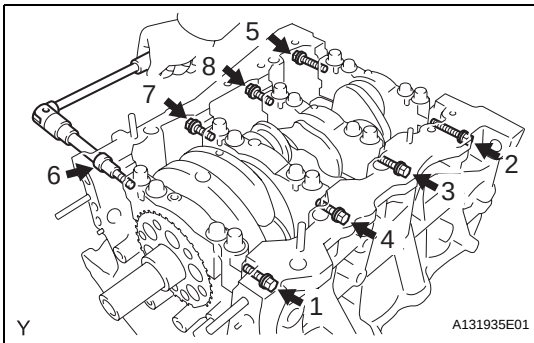
Maximum thrust clearance:

0.30 mm (0.0118 in.)

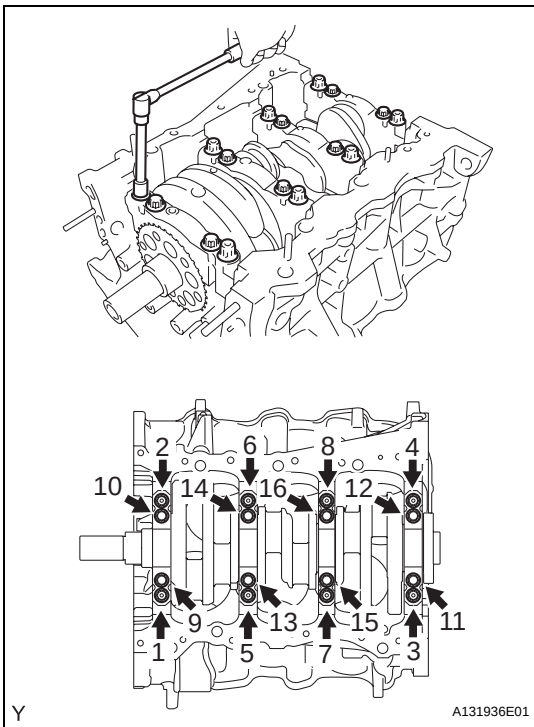
If the thrust clearance is greater than the maximum, replace the thrust washers as a set. If necessary, replace the crankshaft.

Standard thrust washer thickness:

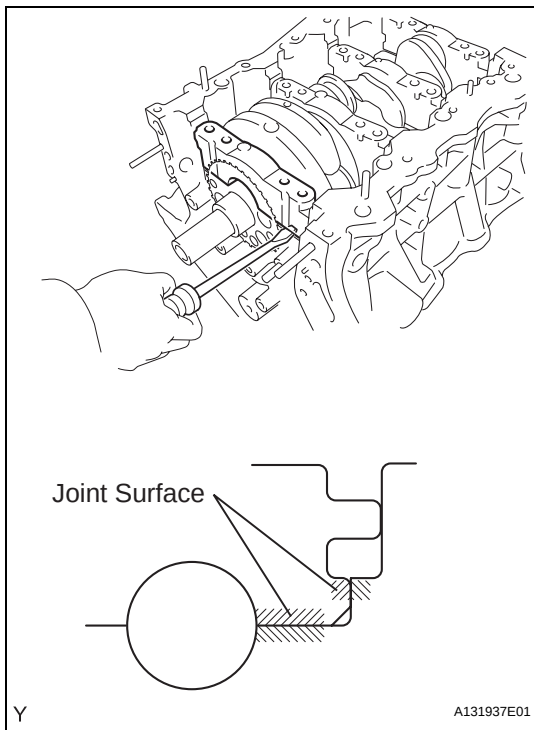
2.43 to 2.48 mm (0.0957 to 0.0976 in.)

**56. REMOVE CRANKSHAFT AND CRANKSHAFT OIL CLEARANCE**

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



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



- (c) Using a screwdriver, pry out the main bearing caps. Remove the 4 main bearing caps and lower bearings.

NOTICE:

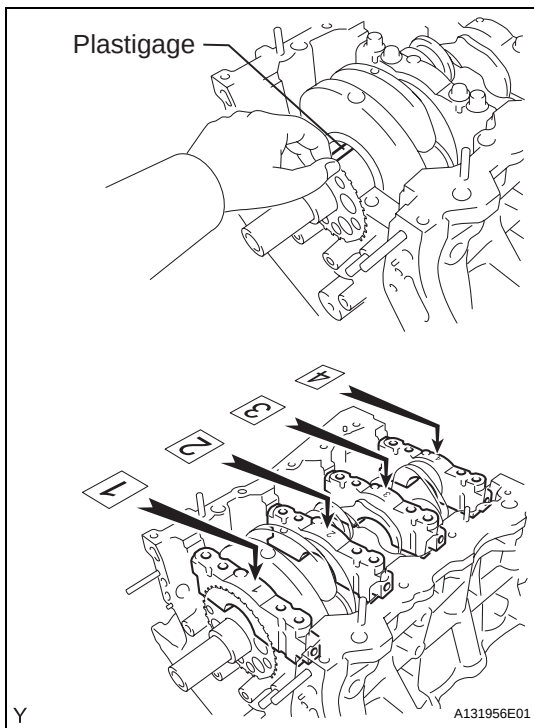
- Pry up the main cap little by little to the right and left in turns.
- Be careful not to damage the joint surface of the cylinder block and main bearing caps.

- (d) Clean each main journal and bearing.
 (e) Check each main journal and bearing for pitting and scratches.

HINT:

If the journal or bearing is damaged, replace the bearing.

- (f) Place the crankshaft on the cylinder block.



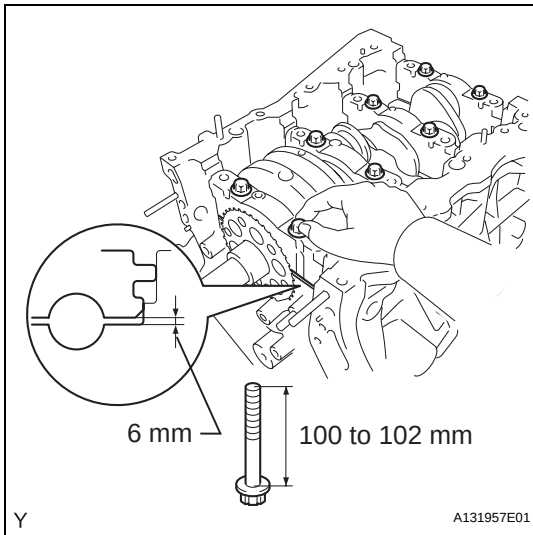
- (g) Lay a strip of Plastigage across each journal.

- (h) Examine the front marks and numbers and install the bearing caps on the cylinder block.

HINT:

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

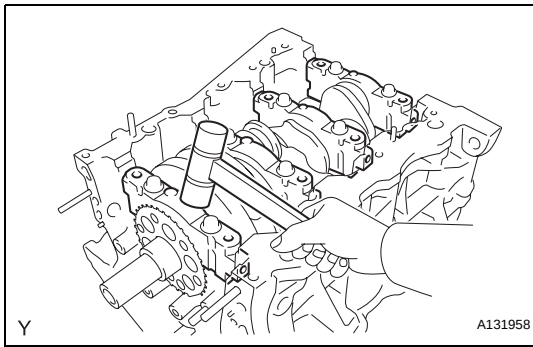
- (i) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
 (j) Place the crankshaft bearing cap on the cylinder block.



- (k) Install the main bearing cap with your hand until the clearance between the main bearing cap and the cylinder block is less than 6 mm (0.23 in.) by marking the 2 internal bearing cap bolts as a guide.

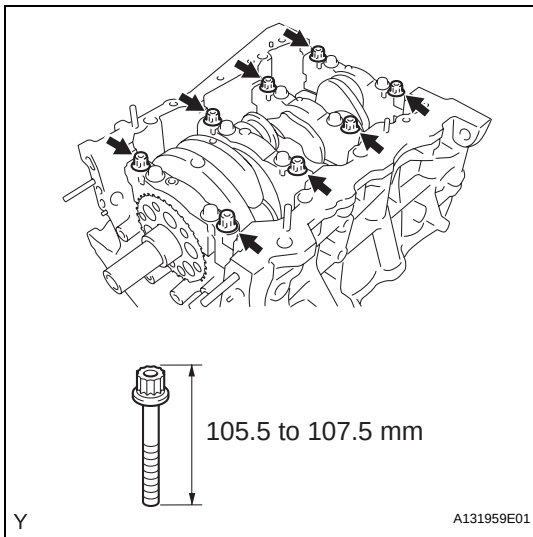
Bolt length:

100 to 102 mm (3.94 to 4.02 in.)



- (l) Using a plastic-faced hammer, lightly tap the bearing cap to ensure a proper fit.

- (m) Apply a light coat of engine oil on the threads and under the heads of the 8 main bearing cap bolts.



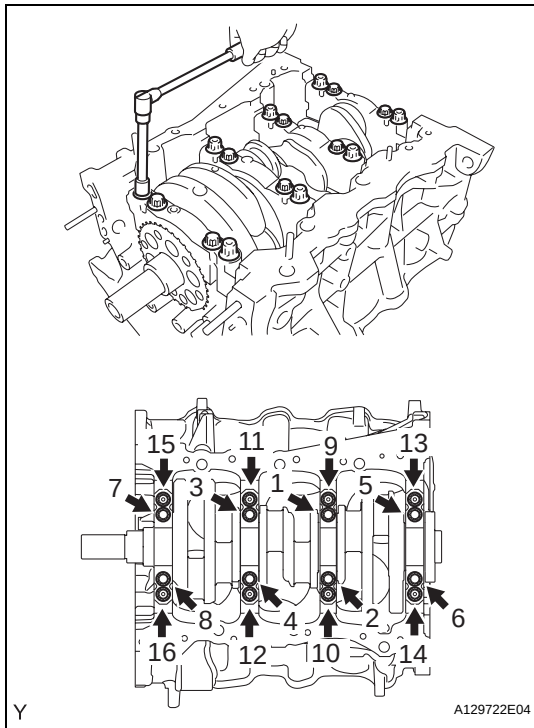
- (n) Install the 8 main bearing cap bolts to the outside positions.

Bolt length:

105.5 to 107.5 mm (4.15 to 4.23 in.)

HINT:

The main bearing cap bolts are tightened in 2 progressive steps.



(o) Step 1

- (1) Install and uniformly tighten the 16 main bearing cap bolts in the sequence shown in the illustration.

Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)

HINT:

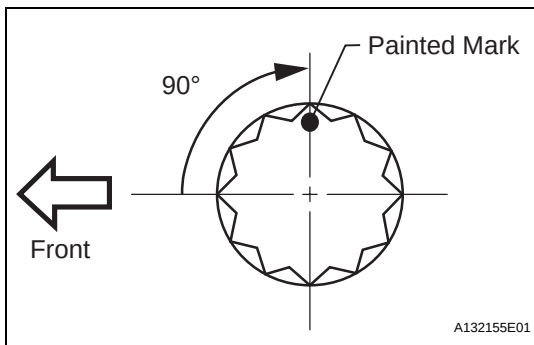
If any of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.

NOTICE:

Do not turn the crankshaft.

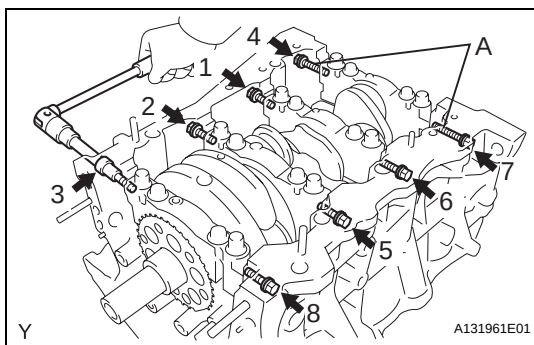
(p) Step 2

- (1) Mark the front of the bearing cap bolts with paint.



- (2) Retighten the bearing cap bolts by 90° as shown in the order shown in step 1.

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



- (q) Install and uniformly tighten the 8 main bearing cap bolts in several steps and in the sequence shown in the illustration.

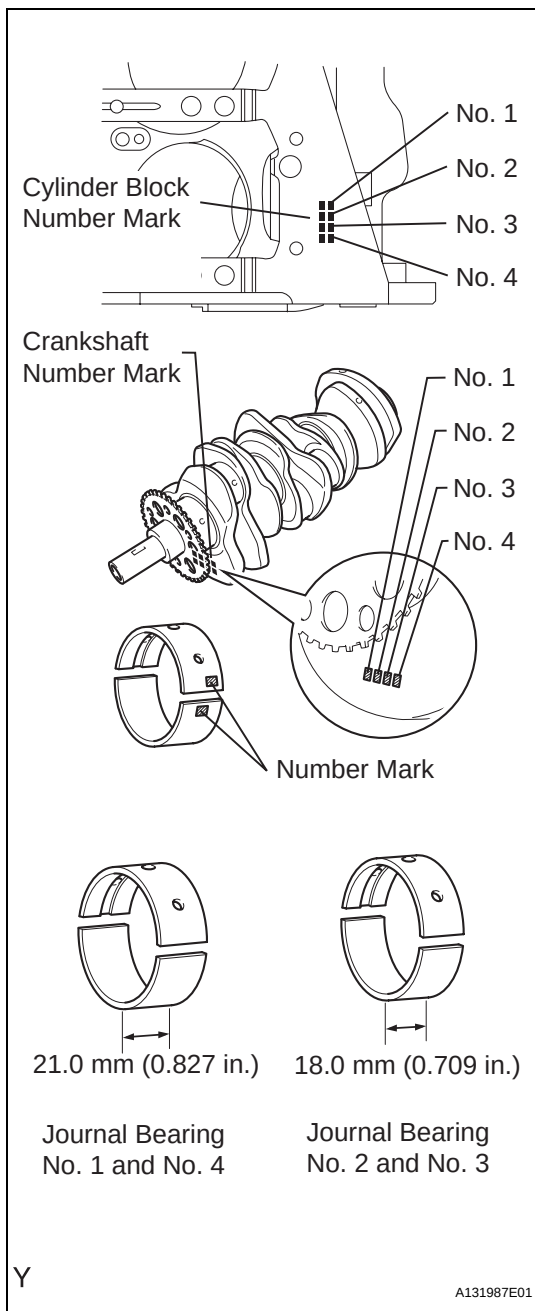
Torque: 52 N*m (530 kgf*cm, 38 ft.*lbf)

Bolt length:

45 mm (1.77 in.) for bolt A

30 mm (1.18 in.) for except bolt A

- (r) Remove the 24 bolts and bearing cap bolts.
- (s) Completely remove the Plastigage.



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

Journal bearing

Use Bearing	Cylinder Block Number Mark + Crankshaft Number Mark
1	0 - 5
2	6 - 11
3	12 - 17
4	18 - 23
5	24 - 28

EXAMPLE:

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

Standard crankshaft main journal diameter

Mark	Specified Condition
00	60.999 to 61.000 mm (2.4015 to 2.4016 in.)
01	60.998 to 60.999 mm (2.4015 to 2.4015 in.)
02	60.997 to 60.998 mm (2.4015 to 2.4015 in.)
03	60.996 to 60.997 mm (2.4014 to 2.4015 in.)
04	60.995 to 60.996 mm (2.4014 to 2.4014 in.)
05	60.994 to 60.995 mm (2.4013 to 2.4014 in.)
06	60.93 to 60.994 mm (2.4013 to 2.4013 in.)
07	60.992 to 60.993 mm (2.4013 to 2.4013 in.)
08	60.991 to 60.992 mm (2.4012 to 2.4013 in.)
09	60.990 to 60.991 mm (2.4012 to 2.4012 in.)
10	60.989 to 60.990 mm (2.4011 to 2.4012 in.)
11	60.988 to 60.989 mm (2.4.11 to 2.4011 in.)

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

Mark	Specified Condition
1	2.500 to 2.503 mm (0.0984 to 0.0985 in.)
2	2.503 to 2.506 mm (0.0985 to 0.0987 in.)
3	2.506 to 2.509 mm (0.0987 to 0.0988 in.)

Mark	Specified Condition
4	2.509 to 2.512 mm (0.0988 to 0.0989 in.)
5	2.512 to 2.515 mm (0.0989 to 0.0990 in.)

No. 2 and No. 3 journal

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

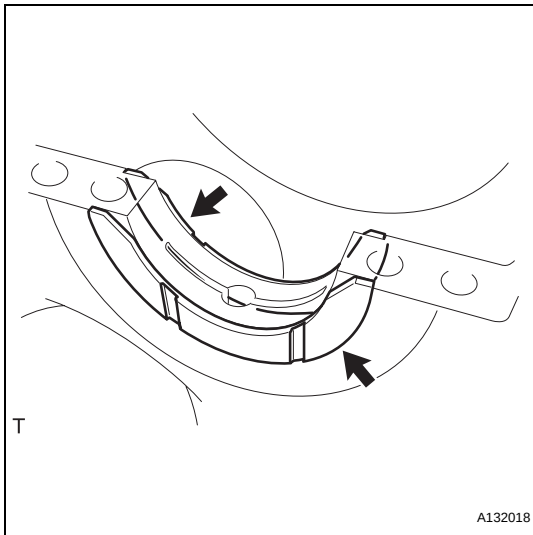
Standard lower bearing center wall thickness
No. 1 and No. 4 journal

Mark	Specified Condition
1	2.478 to 2.481 mm (0.0976 to 0.0977 in.)
2	2.481 to 2.484 mm (0.0977 to 0.0780 in.)
3	2.484 to 2.487 mm (0.0978 to 0.0979 in.)
4	2.487 to 2.490 mm (0.0979 to 0.0980 in.)
5	2.490 to 2.493 mm (0.0980 to 0.0981 in.)

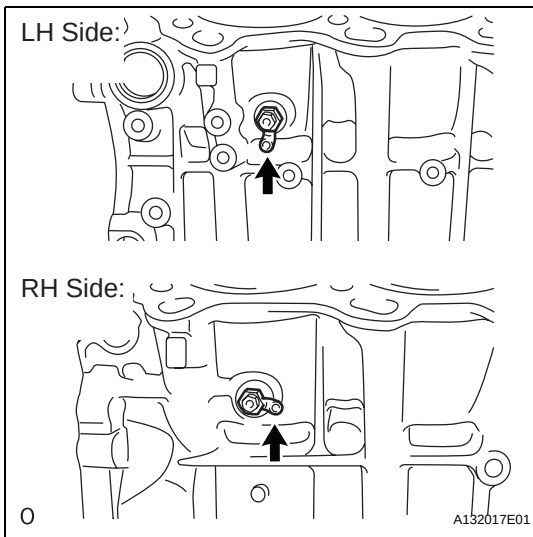
No. 2 and No. 3 journal

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

(u) Lift out the crankshaft.

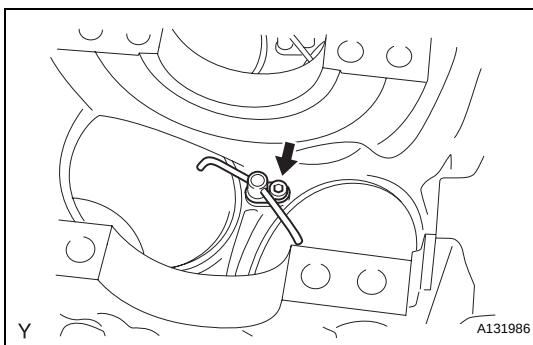


- (v) Remove the upper bearings and upper thrust washers from the cylinder block.
HINT:
Arrange the bearings and thrust washers in the correct order.



57. REMOVE CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

- (a) Remove the 2 water drain cocks from the cylinder block.
(b) Remove the water drain cock plugs from the water drain cocks.

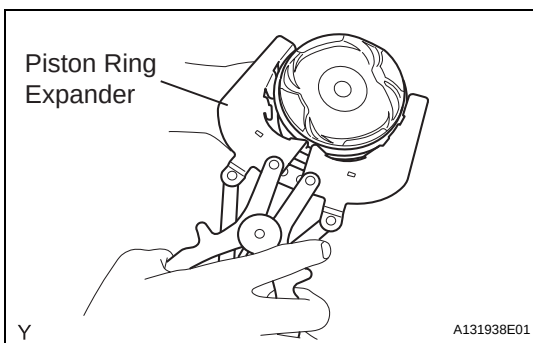


58. REMOVE NO. 1 OIL NOZZLE SUB-ASSEMBLY

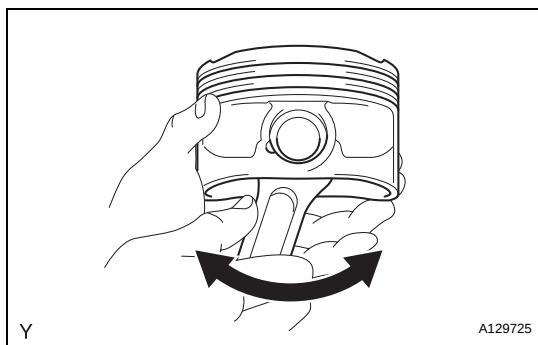
- (a) Using a 5 mm hexagon wrench, remove the 3 oil nozzles.
(b) Check the oil nozzles for damage or clogging. If necessary, replace the oil nozzle.

59. REMOVE PISTON RING SET

- HINT:
Arrange the piston rings in the correct order.



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

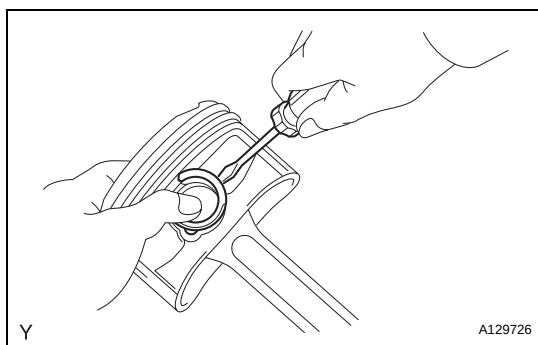
**60. REMOVE PISTON WITH PIN SUB-ASSEMBLY**

- (a) Check the fitting condition between the piston and piston pin.

- (1) Try to move the piston back and forth on the piston pin.

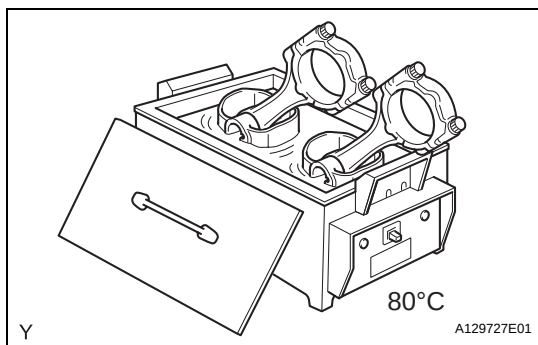
HINT:

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

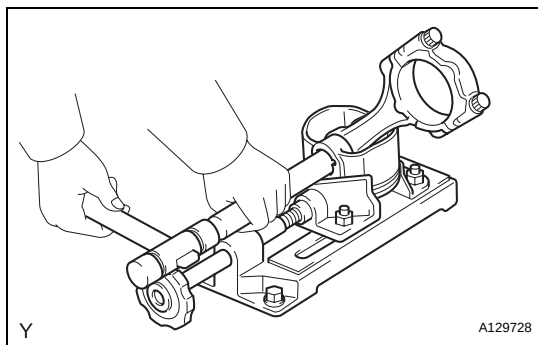


- (b) Disconnect the connecting rod from the piston.

- (1) Using a screwdriver, pry off the snap rings from the piston.



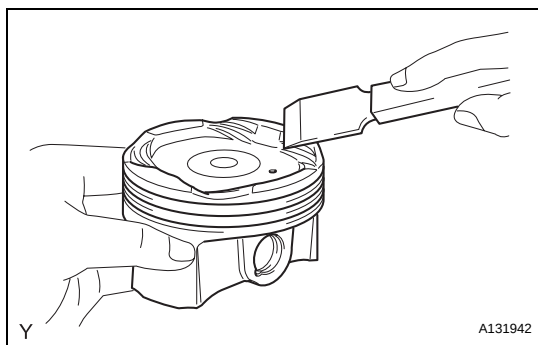
- (2) Gradually heat the piston to approximately 80°C (176°F).



- (3) Using a brass bar and plastic-faced hammer, lightly tap out the piston pin and remove the connecting rod.

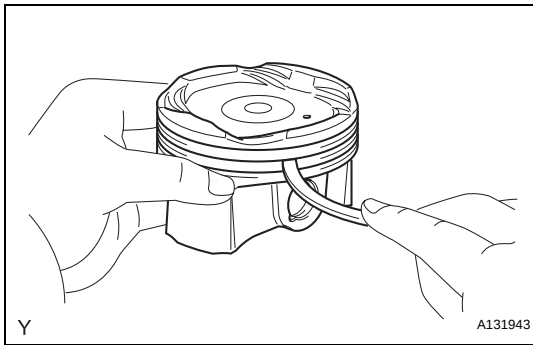
HINT:

- The piston and pin are a matched set.
- Arrange the pistons, pins, rings, connecting rods and bearings in the correct order.

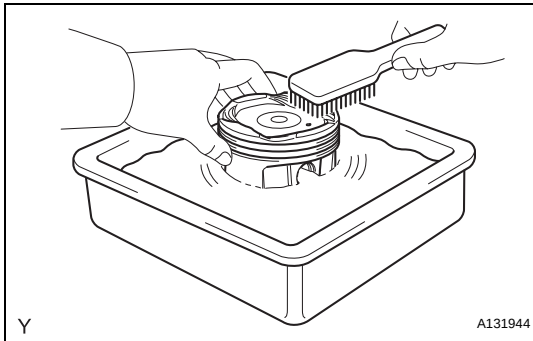


- (c) Clean piston.

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



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



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

NOTICE:

Do not use a wire brush.

INSPECTION

1. INSPECT VALVE LASH ADJUSTER ASSEMBLY

NOTICE:

- Keep the lash adjuster free from dirt and foreign objects.
- Only use clean engine oil.

- Place the lash adjuster into a container full of engine oil.
- Insert the SST's tip into the lash adjuster's plunger and use the tip to press down on the checkball inside the plunger.

SST 09276-75010

- Squeeze the SST and lash adjuster together to move the plunger up and down 5 to 6 times.
- Check the movement of the plunger and bleed the air.

OK:

Plunger moves up and down.

NOTICE:

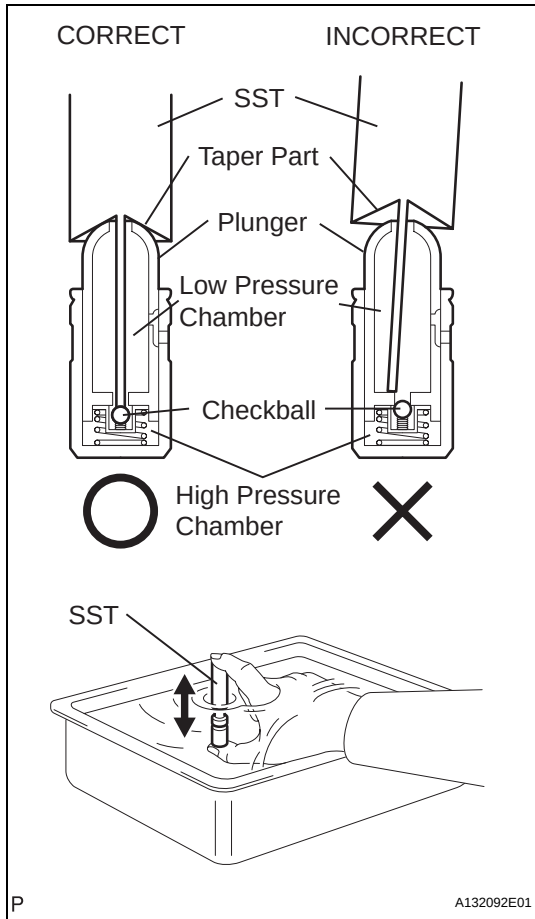
When bleeding high-pressure air from the compression chamber, make sure that the tip of the SST is actually pressing the checkball as shown in the illustration. If the checkball is not pressed, air will not bleed.

- After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with a finger.

OK:

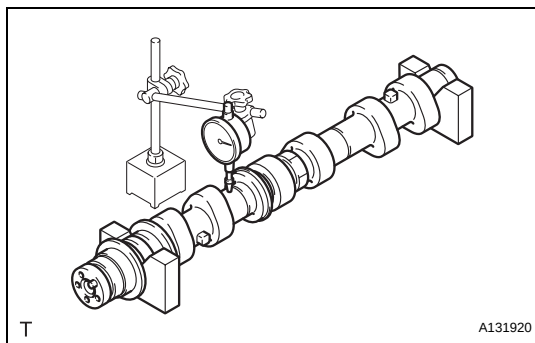
Plunger is very difficult to move.

If the result is not as specified, replace the lash adjuster.



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2. INSPECT CAMSHAFT

- Inspect the camshaft for runout.
 - Place the camshaft on V-blocks.
 - Using a dial indicator, measure the circle runout at the center journal.

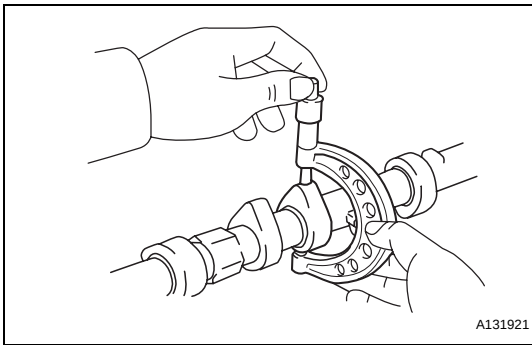
Maximum circle runout:

0.04 mm (0.0016 in.)

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

HINT:

Check the oil clearance after replacing the camshaft.



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

Standard cam lobe height

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

Maximum cam lobe height

Item	Specified Condition
Intake	44.166 mm (1.7388 in.)
Exhaust	44.112 mm (1.7367 in.)

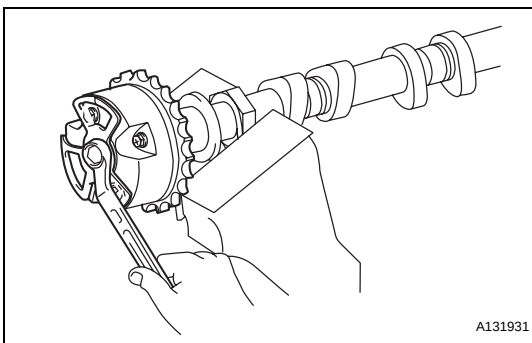
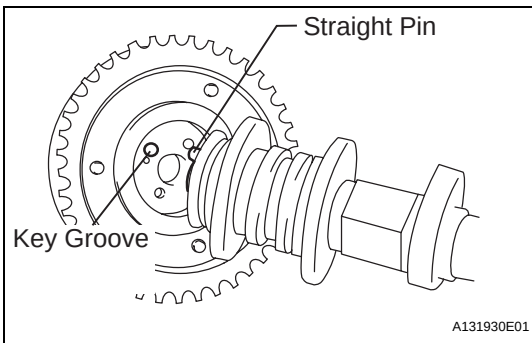
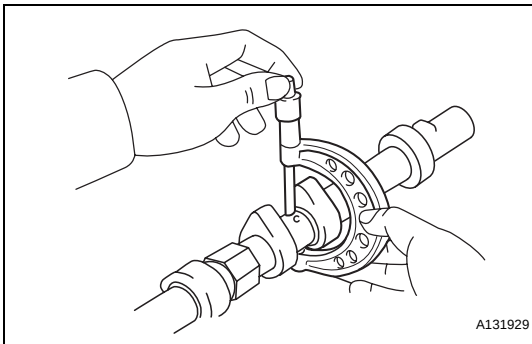
If the cam lobe height is less than the minimum, replace the camshaft.

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

Standard journal diameter

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

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



3. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

- (a) Clamp the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft in the vise.

- (b) Put the camshaft timing gear and camshaft together by aligning the key groove and straight pin.
 (c) Lightly press the gear against the camshaft, and turn the gear. Push further at the position where the pin enters the groove.

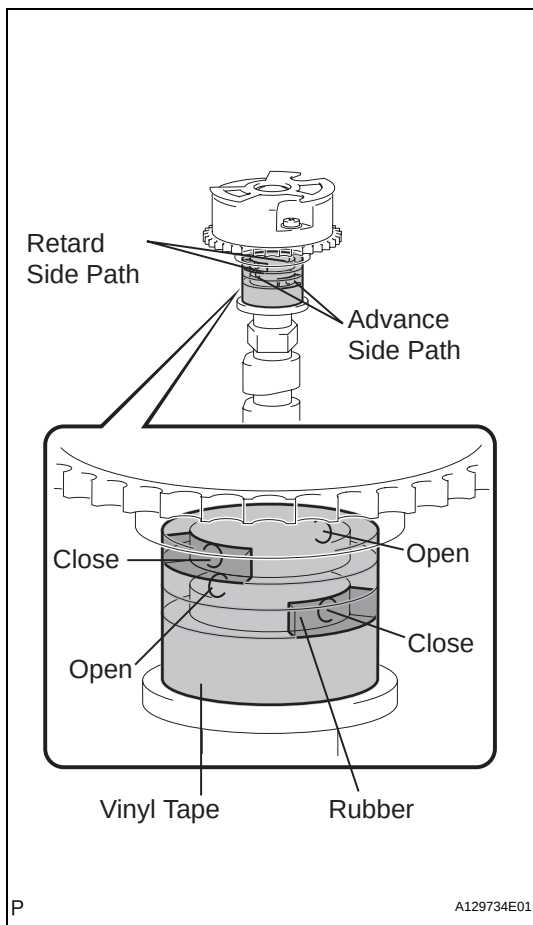
NOTICE:

Be sure not to turn the camshaft timing gear in the retard direction (the right angle).

- (d) Check that there is no clearance between the gear's fringe and the camshaft.
 (e) Tighten the flange bolt with the camshaft timing gear fixed in place.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)
 (f) Check the lock of the camshaft timing gear.
 (1) Clamp the camshaft in a vise, and confirm that the camshaft timing gear is locked.

NOTICE:

Be careful not to damage the camshaft.



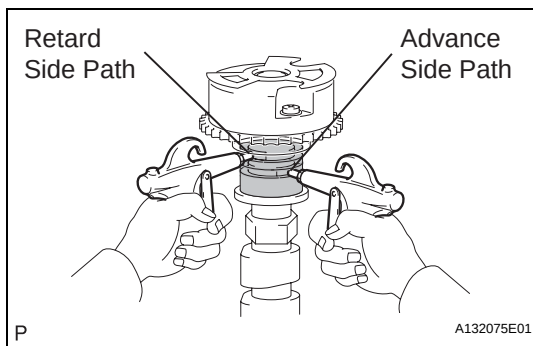
(g) Release the lock pin.

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

HINT:

2 advance side paths are provided in the groove of the camshaft. Plug one of the paths with a rubber piece.

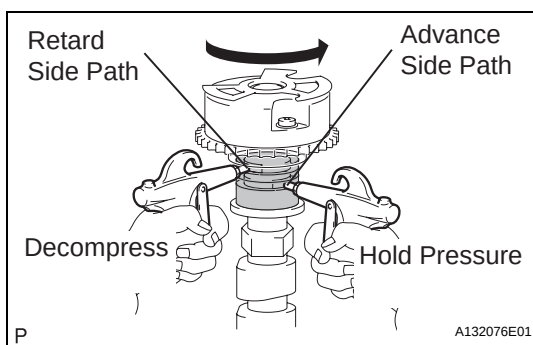
- (2) Break through the tape of the advance side path and the retard side path on the opposite side to the hole of the advance side path, as shown in the illustration.



- (3) Apply approximately 200 kPa (2.0 kgf/cm², 28 psi) of air pressure to the two broken paths.

CAUTION:

Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.



- (4) Check that the camshaft timing gear revolves in the advance direction when reducing the air pressure applied to the retard side path.

HINT:

This operation releases the lock pin for the most retarded position.

- (5) When the camshaft timing gear reaches the most advanced position, release the air pressure from the retard side path and advance side path, in that order.

NOTICE:

Do not release the air pressure from the advance side path first. The gear may abruptly shift in the retard direction and break the lock pin.

- (h) Check for smooth rotation.
 (1) Turn the camshaft timing gear within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.

NOTICE:

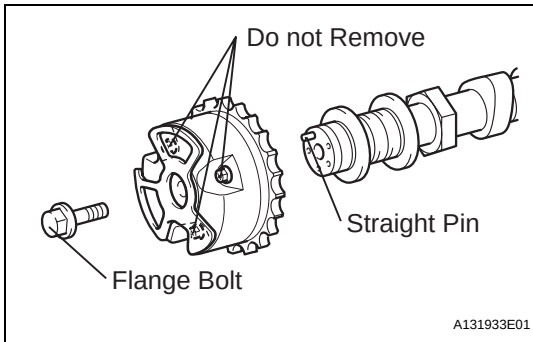
Do not use air pressure to perform the smooth rotation check.

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

- (j) Remove the flange bolt and camshaft timing gear.

NOTICE:

- **Be sure not to remove the other 3 bolts.**
- **If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.**



4. INSPECT CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY

- (a) Clamp the camshaft in a vise.

NOTICE:

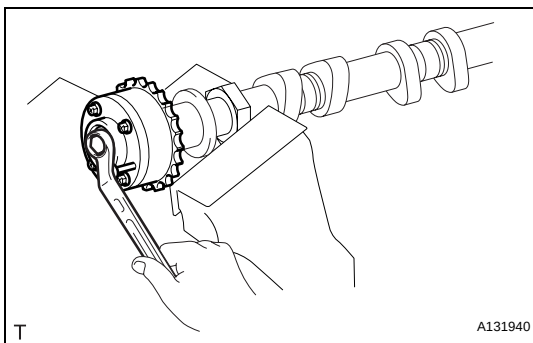
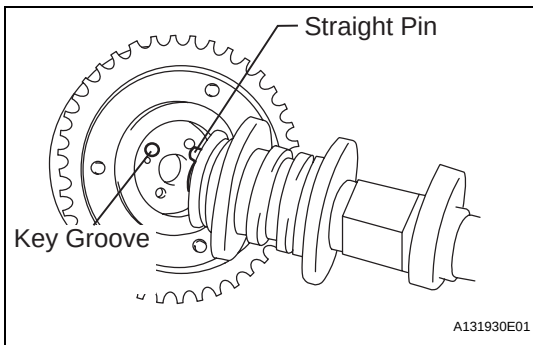
Be careful not to damage the camshaft in the vise.

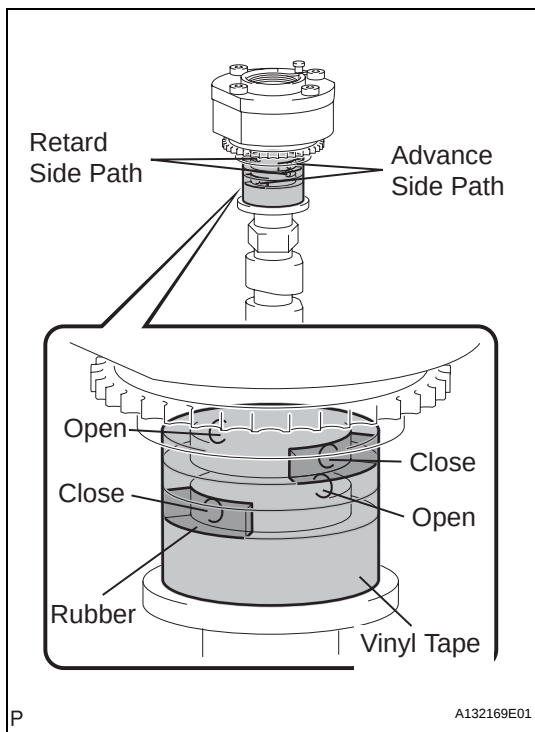
- (b) Put the camshaft timing exhaust gear and camshaft together by aligning the key groove and straight pin.
 (c) Lightly press the gear against the camshaft, and turn the gear. Push further at the position where the pin enters the groove.

CAUTION:

Be sure not to turn the camshaft timing exhaust gear in the retard direction (the right angle).

- (d) Check that there is no clearance between the gear's fringe and the camshaft.
 (e) Tighten the flange bolt with the camshaft timing exhaust gear fixed in place.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)
 (f) Check the camshaft timing exhaust gear lock.
 (1) Make sure that the camshaft timing exhaust gear is locked.





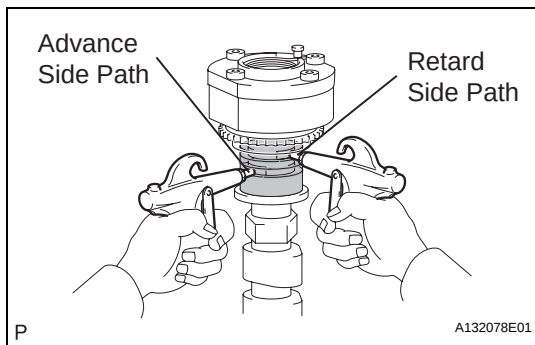
(g) Release the lock pin.

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

HINT:

4 oil paths are provided in the groove. Plug 2 paths with rubber pieces.

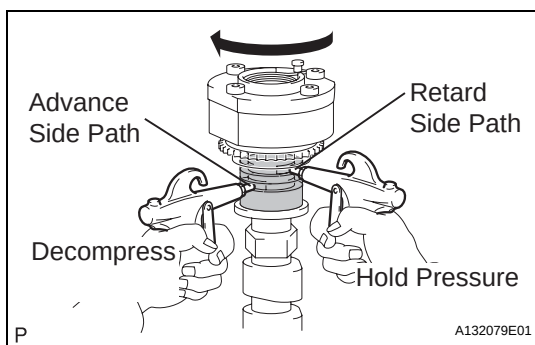
- (2) Prick a hole in the tape placed on the advance side path. Prick a hole in the tape placed on the retard side path on the opposite side to that of the advance side path, as shown in the illustration.



- (3) Apply approximately 200 kPa (2.0 kgf/cm², 28 psi) of air pressure to the two broken paths (the advance side path and the retard side path).

CAUTION:

Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.



- (4) Make sure that the camshaft timing exhaust gear turns in the retard direction when reducing the air pressure applied to the advance side path.

HINT:

The lock pin is released and the camshaft timing exhaust gear turns in the retard direction.

- (5) When the camshaft timing exhaust gear moves to the most retarded position, release the air pressure from the advance side path, and then release the air pressure from the retard side path.

NOTICE:

Be sure to release the air pressure from the advance side path first. If the air pressure of the retard side path is released first, the camshaft timing exhaust gear may abruptly shift in the advance direction and break the lock pin or other parts.

- (h) Check for smooth rotation.
- (1) Turn the camshaft timing exhaust gear within its movable range (18.5°) 2 or 3 times, but do not turn it to the most advanced position. Make sure that the gear turns smoothly.

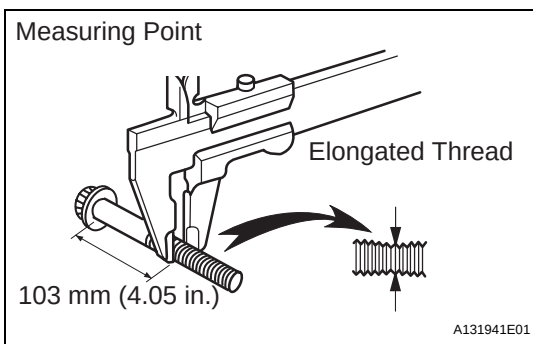
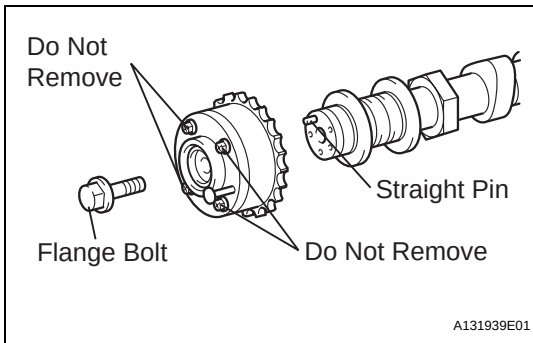
NOTICE:

When the air pressure is released from the advance side path and then from the retard side path, the gear automatically returns to the most advanced position due to the advance assist spring operation and locks. Gradually release the air pressure from the retard side path before performing the smooth rotation check.

- (i) Check the lock at the most advanced position.
- (1) Make sure that the camshaft timing exhaust gear is locked at the most advanced position.
- (j) Remove the flange bolt and camshaft timing exhaust gear.

NOTICE:

- Be sure not to remove the other 3 bolts.
- If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.

**5. INSPECT CYLINDER HEAD SET BOLT**

- (a) Using a vernier caliper, measure the minimum diameter of the elongated thread at the measuring point.

Minimum outside diameter:

10.70 mm (0.4213 in.)

HINT:

- If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the lowest diameter.
- If the diameter is less than the minimum, replace the cylinder head bolt.

6. INSPECT CHAIN SUB-ASSEMBLY

- (a) Using a spring scale, pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.
- (b) Using a vernier caliper, measure the length of 16 links.

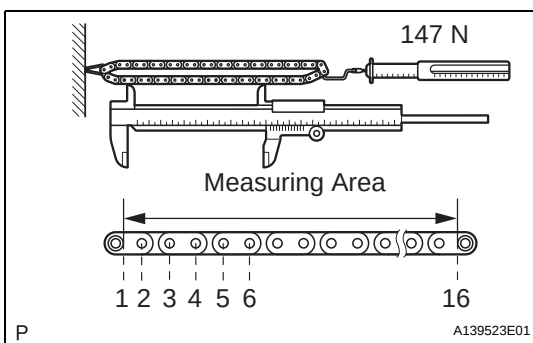
Maximum chain elongation:

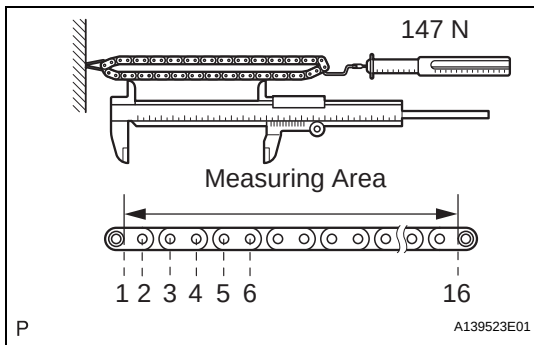
136.9 mm (5.389 in.)

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

NOTICE:

Perform the measurement at 3 random places. Inspect using the average of the measurements.





7. INSPECT NO. 2 CHAIN SUB-ASSEMBLY

- Pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.
- Using a vernier caliper, measure the length of 16 links.

Maximum chain elongation:

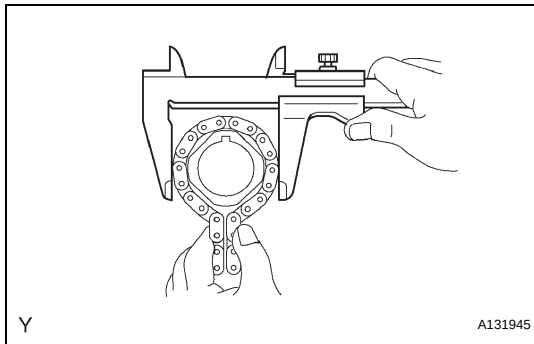
137.6 mm (5.417 in.)

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

NOTICE:

Perform the measurement at 3 random places.

Inspect using the average of the measurements.



8. INSPECT CRANKSHAFT TIMING GEAR OR SPROCKET

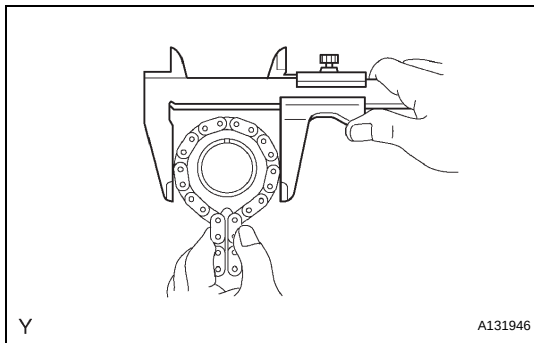
- Wrap the chain around the sprocket.
- Using a vernier caliper, measure the sprocket diameter with the chain.

Minimum sprocket diameter (w/ chain):

61.4 mm (2.417 in.)

HINT:

- The vernier caliper must contact the chain rollers for the measurement.
- If the diameter is less than the minimum, replace the chain and sprocket.



9. INSPECT IDLE SPROCKET ASSEMBLY

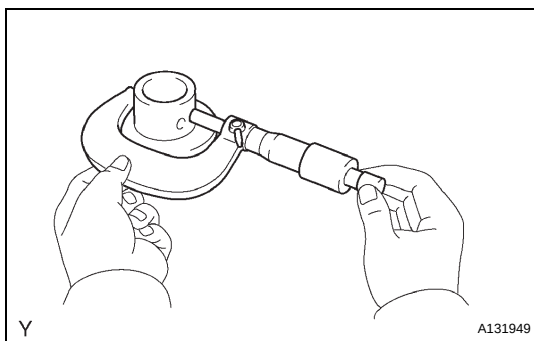
- Wrap the chain around the sprocket.
- Using a vernier caliper, measure the sprocket diameter with the chain.

Minimum sprocket diameter (w/ chain):

61.4 mm (2.417 in.)

HINT:

- The vernier caliper must contact the chain rollers for the measurement.
- If the diameter is less than the minimum, replace the chain and sprocket.

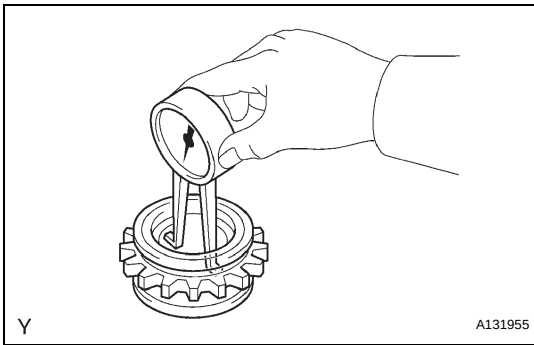


10. INSPECT IDLE GEAR SHAFT OIL CLEARANCE

- Using a micrometer, measure the idle gear shaft diameter.

Standard idle gear shaft diameter:

22.987 to 23.000 mm (0.9050 to 0.9055 in.)



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

Standard idle gear inside diameter:

23.02 to 23.03 mm (0.9062 to 0.9067 in.)

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

Standard oil clearance:

0.02 to 0.043 mm (0.0001 to 0.0017 in.)

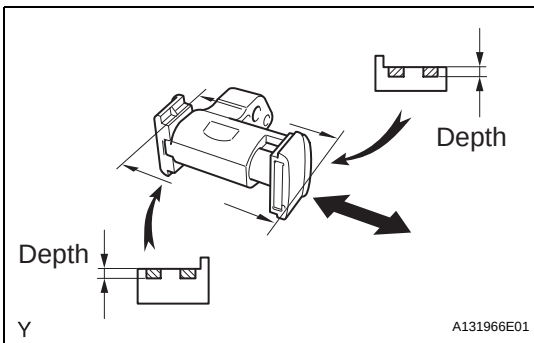
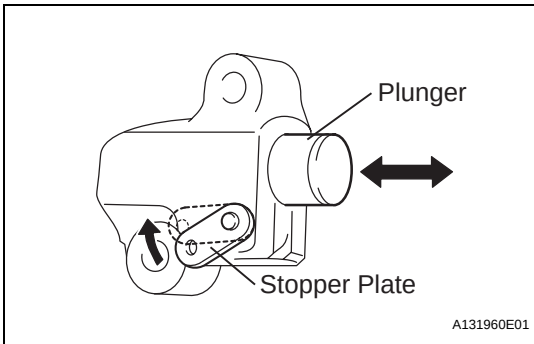
Maximum oil clearance:

0.043 mm (0.0017 in.)

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

11. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

- (a) Move the stopper plate upward to release the lock. Push the plunger and check that it moves smoothly. If necessary, replace the chain tensioner.



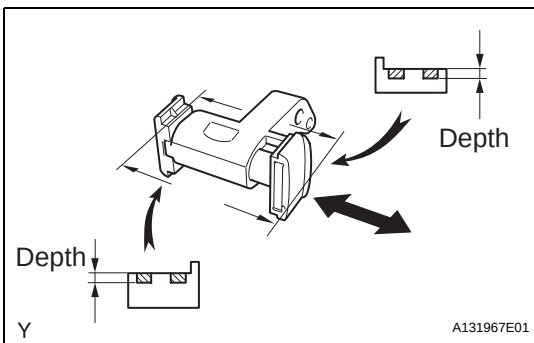
12. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

- (a) Check that the plunger moves smoothly.
(b) Measure the worn depth of the chain tensioner.

Maximum depth:

0.9 mm (0.035 in.)

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



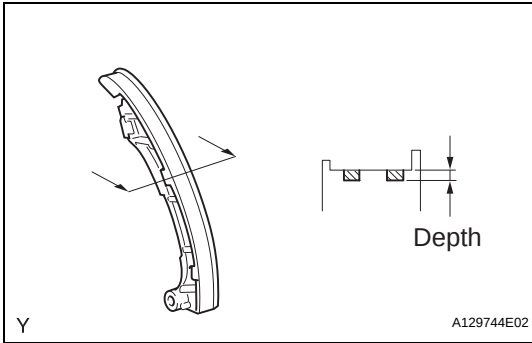
13. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

- (a) Check that the plunger moves smoothly.
(b) Measure the worn depth of the chain tensioner.

Maximum depth:

0.9 mm (0.035 in.)

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

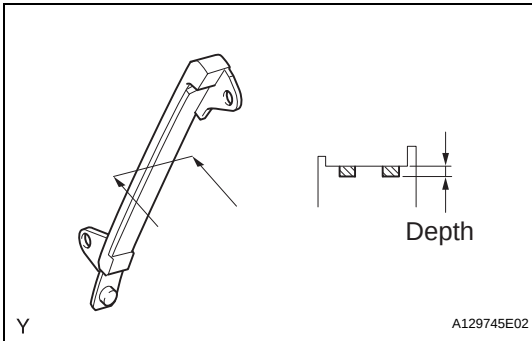
**14. INSPECT CHAIN TENSIONER SLIPPER**

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

Maximum depth:

1.0 mm (0.039 in.)

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

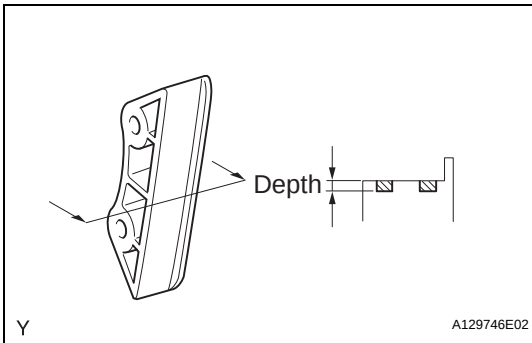
**15. INSPECT NO. 1 CHAIN VIBRATION DAMPER**

- (a) Measure the worn depth of the chain vibration damper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the chain vibration damper.

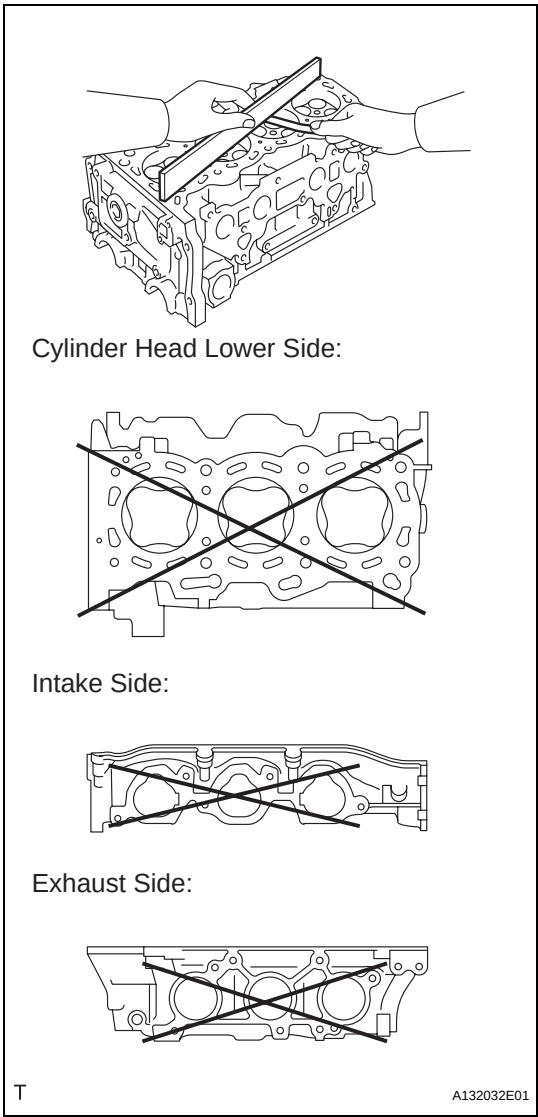
**16. INSPECT NO. 2 CHAIN VIBRATION DAMPER**

- (a) Measure the worn depth of the chain vibration damper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the chain vibration damper.



17. INSPECT CYLINDER HEAD SUB-ASSEMBLY

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

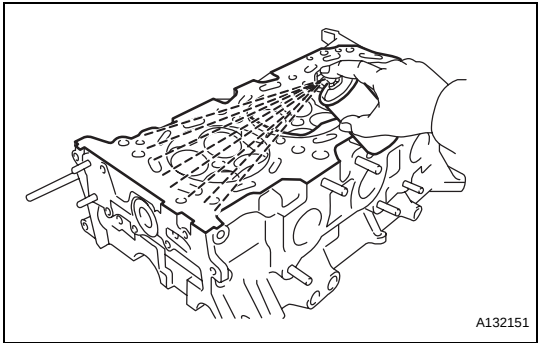
Standard warpage

Item	Specified Condition
Cylinder head lower side	0.05 mm (0.0020 in.)
Intake side	0.08 mm (0.0031 in.)
Exhaust side	0.08 mm (0.0031 in.)

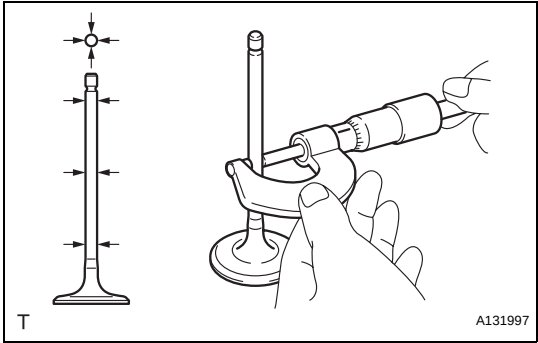
Maximum warpage:

0.10 mm (0.0039 in.)

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



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

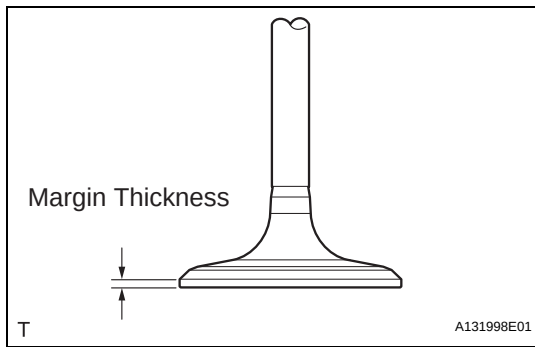


18. INSPECT INTAKE VALVE

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

Standard valve stem diameter:

5.470 to 5.485 mm (0.2154 to 0.2159 in.)



- (b) Using a vernier caliper, measure the valve head margin thickness.

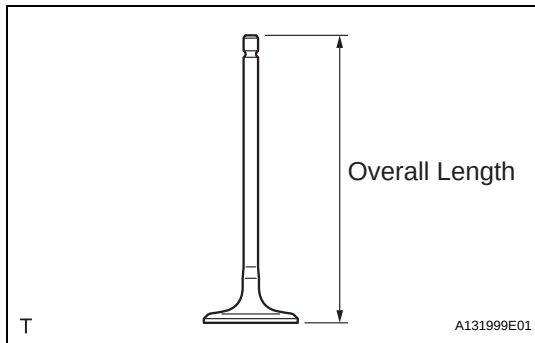
Standard margin thickness:

1.0 mm (0.0394 in.)

Minimum margin thickness:

0.50 mm (0.0197 in.)

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



- (c) Using a vernier caliper, measure the valve's overall length.

Standard overall length:

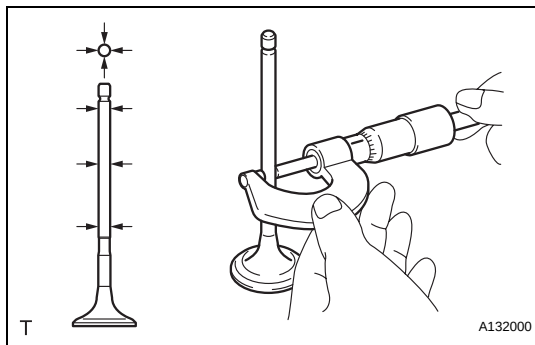
105.85 mm (4.1673 in.)

Minimum overall length:

105.35 mm (4.1476 in.)

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

EM

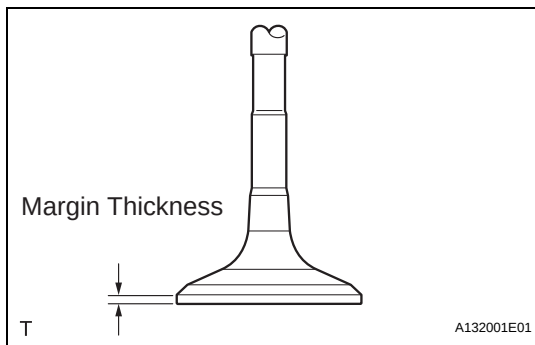


19. INSPECT EXHAUST VALVE

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

Standard valve stem diameter:

5.465 to 5.480 mm (0.2151 to 0.2157 in.)



- (b) Using a vernier caliper, measure the valve head margin thickness.

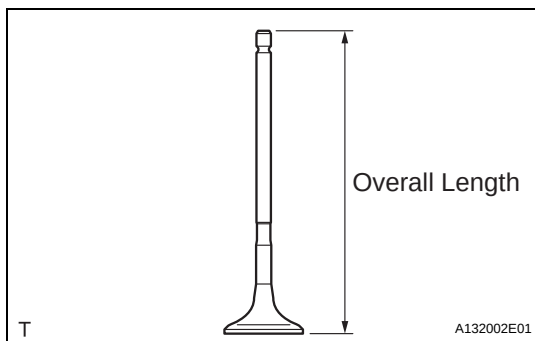
Standard margin thickness:

1.0 mm (0.0394 in.)

Minimum margin thickness:

0.50 mm (0.0197 in.)

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



- (c) Using a vernier caliper, measure the valve's overall length.

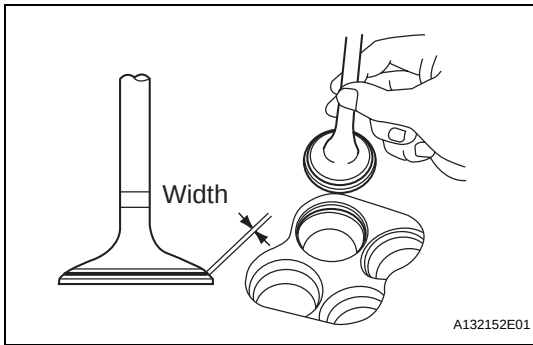
Standard overall length:

110.40 mm (4.3464 in.)

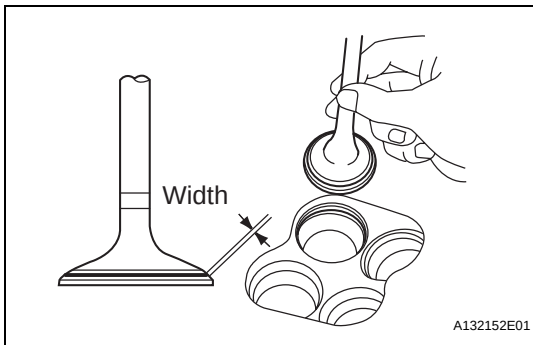
Minimum overall length:

109.90 mm (4.3268 in.)

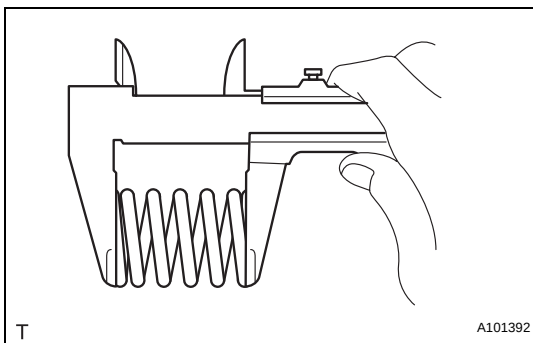
If the overall length is less than the minimum, replace the exhaust valve.

**20. INSPECT INTAKE VALVE SEAT**

- (a) Apply a light coat of Prussian blue to the valve face.
- (b) Lightly press the valve face against the valve seat.
- (c) Check the valve face and valve seat by using the following procedure.
 - (1) If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
 - (2) If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.
 - (3) Check that the valve seat contacts in the middle of the valve face with the width between 1.1 and 1.5 mm (0.043 and 0.059 in.).

**21. INSPECT EXHAUST VALVE SEAT**

- (a) Apply a light coat of Prussian blue to the valve face.
- (b) Lightly press the valve face against the valve seat.
- (c) Check the valve face and valve seat by using the following procedure.
 - (1) If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
 - (2) If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.
 - (3) Check that the valve seat contacts in the middle of the valve face with the width between 1.2 and 1.6 mm (0.047 and 0.063 in.).

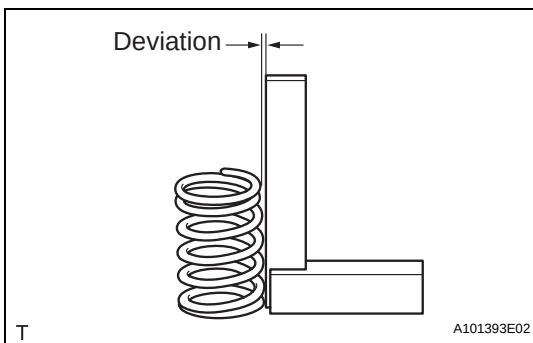
**22. INSPECT INNER COMPRESSION SPRING**

- (a) Using a vernier caliper, measure the free length of the inner compression spring.

Standard free length:

45.46 mm (1.7898 in.)

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



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

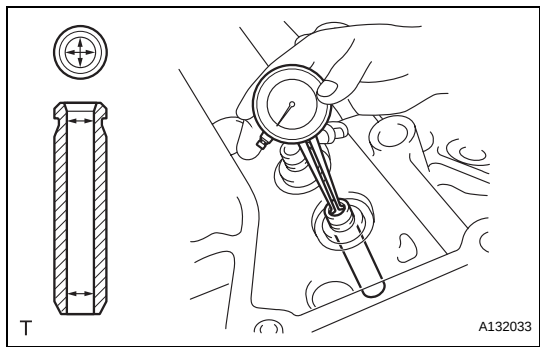
Maximum deviation:

1.0 mm (0.039 in.)

Maximum angle (reference):

2°

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



23. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

- (a) Using a caliper gauge, measure the inside diameter of the guide bush.

Standard bush inside diameter:
5.51 to 5.53 mm (0.2169 to 0.2177 in.)

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

Standard clearance

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

Maximum oil clearance

Item	Specified Condition
Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

HINT:

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

24. INSPECT CAMSHAFT THRUST CLEARANCE

- (a) Inspect the bank 1 camshafts.
- (1) Install the bank 1 camshafts.
 - (2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.08 to 0.13 mm (0.0031 to 0.0051 in.)

Maximum thrust clearance:
0.15 mm (0.006 in.)

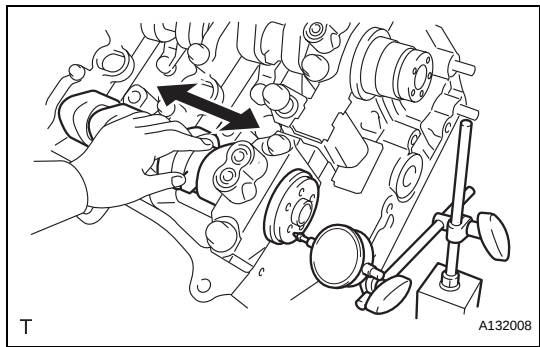
If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.

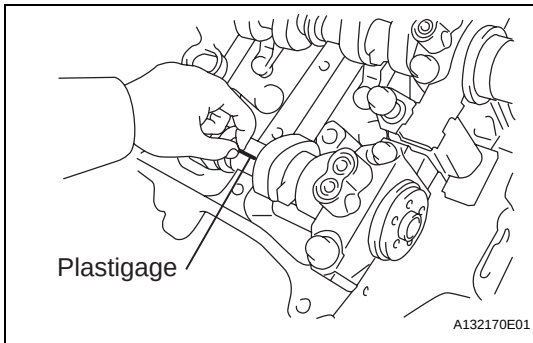
- (b) Inspect the bank 2 camshafts.
- (1) Install the bank 2 camshafts.
 - (2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.08 to 0.13 mm (0.0031 to 0.0051 in.)

Maximum thrust clearance:
0.15 mm (0.006 in.)

If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.





25. INSPECT CAMSHAFT OIL CLEARANCE

- Clean the bearing caps, camshaft housing and camshaft journals.
- Place the camshafts on the camshaft housing.
- Lay a strip of Plastigage across each of the camshaft journals.
- Install the bearing caps.

NOTICE:

Do not turn the camshaft.

- Remove the bearing caps.
- Measure the Plastigage at its widest point.

Standard oil clearance

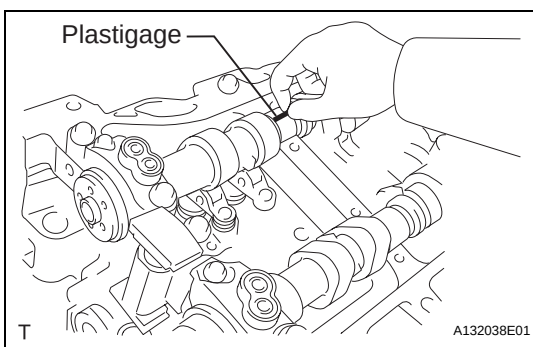
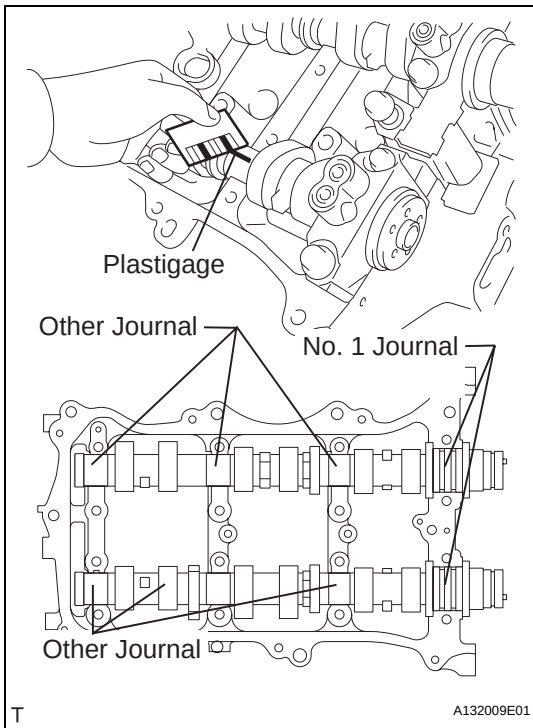
Item	Specified Condition
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journal	0.025 to 0.062 mm (0.0010 to 0.0024 in.)

Maximum oil clearance

Item	Specified Condition
No. 1 journal	0.10 mm (0.0039 in.)
Other journal	0.09 mm (0.0035 in.)

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

- Clean the bearing caps, camshaft housing and camshaft journals.
- Place the camshafts on the camshaft housing.

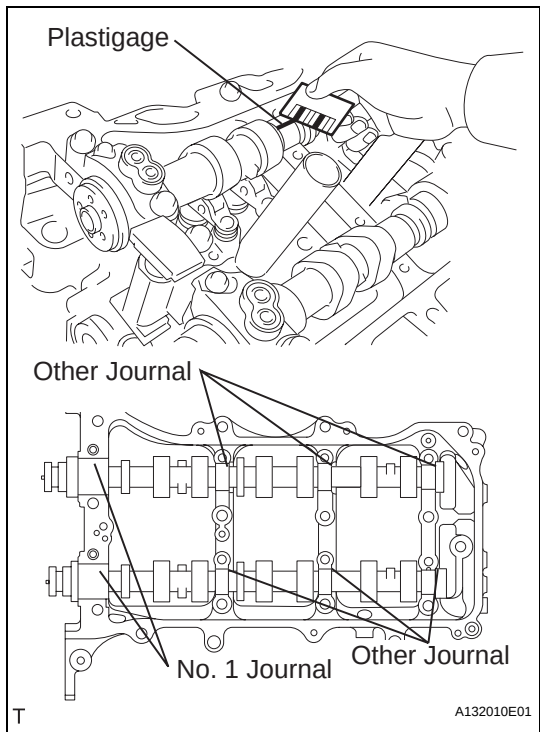


- Lay a strip of Plastigage across each of the camshaft journals.
- Install the bearing caps.

NOTICE:

Do not turn the camshaft.

- Remove the bearing caps.



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

Item	Specified Condition
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journal	0.025 to 0.062 mm (0.0010 to 0.0024 in.)

Maximum oil clearance

Item	Specified Condition
No. 1 journal	0.10 mm (0.0039 in.)
Other journal	0.09 mm (0.0035 in.)

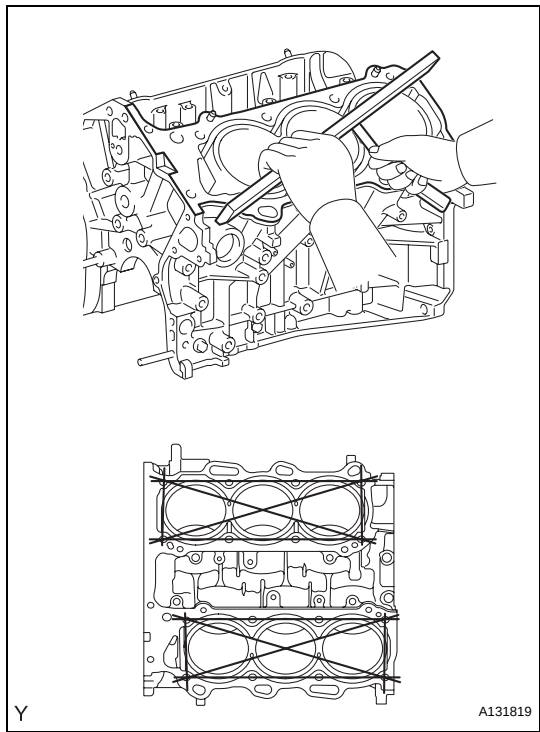
If the oil clearance is greater than the maximum, replace the camshaft. If necessary, replace the camshaft housing.

26. INSPECT CYLINDER BLOCK FOR WARPAGE

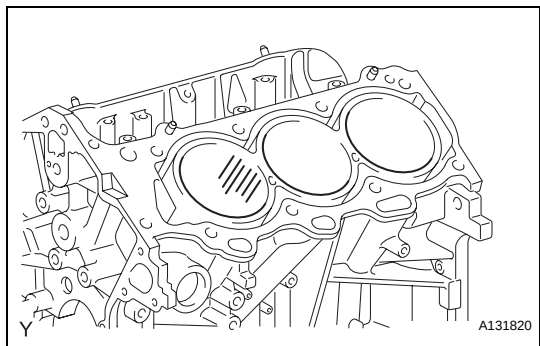
- (a) Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head gasket.

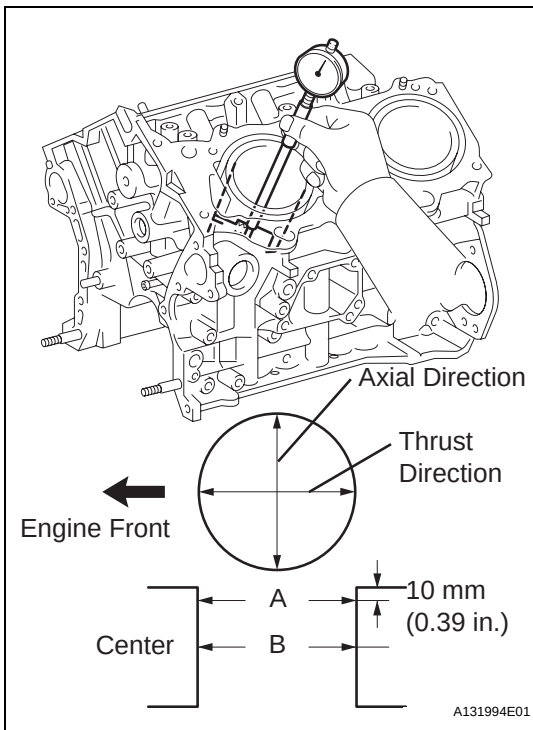
Maximum warpage:
0.07 mm (0.0028 in.)

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



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



**27. INSPECT CYLINDER BORE**

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

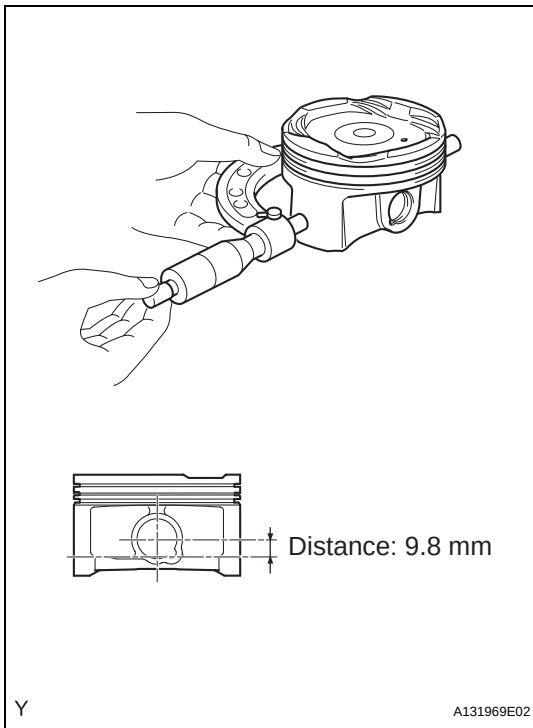
Standard diameter:

94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter:

94.200 mm (3.7087 in.)

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

**28. INSPECT PISTON SUB-ASSEMBLY WITH PIN**

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

Distance:

9.8 mm (0.3858 in.)

Standard diameter:

93.960 to 93.980 mm (3.6992 to 3.6999 in.)

Maximum diameter:

93.830 mm (3.6941 in.)

29. INSPECT PISTON OIL CLEARANCE

- (a) Measure the cylinder bore diameter in the thrust direction.
- (b) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

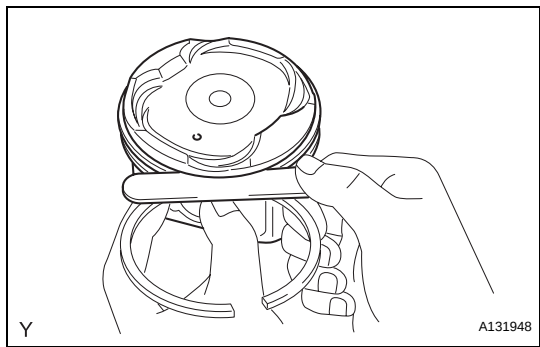
Standard oil clearance:

0.020 to 0.052 mm (0.0007 to 0.0020 in.)

Maximum oil clearance:

0.06 mm (0.0024 in.)

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



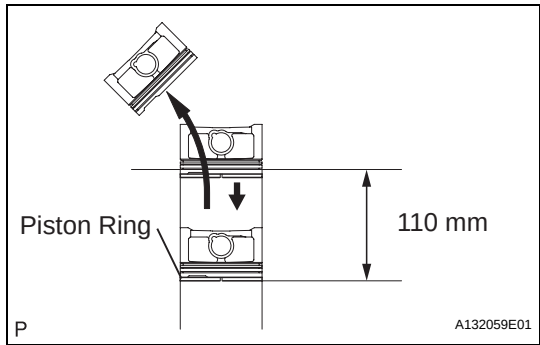
30. INSPECT RING GROOVE CLEARANCE

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

Standard ring groove clearance

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

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



31. INSPECT PISTON RING END GAP

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

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

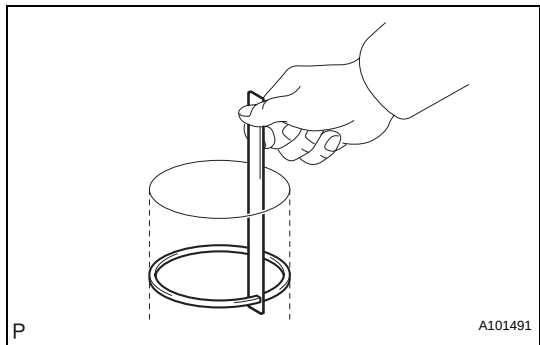
Standard end gap

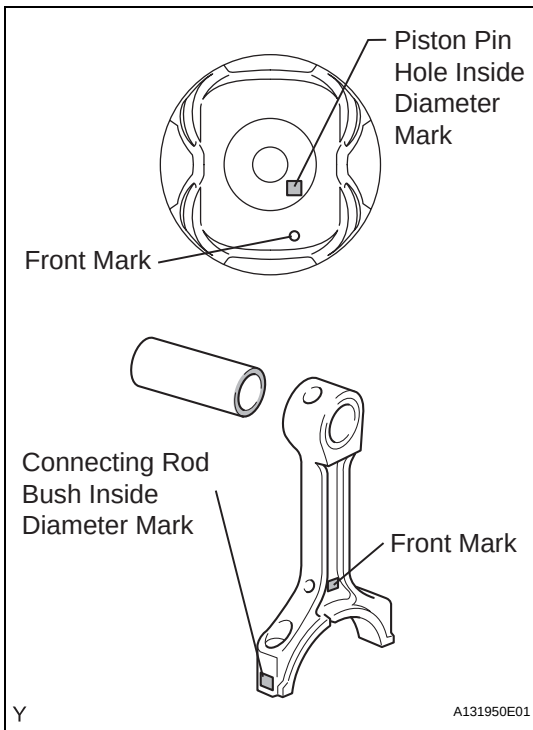
Item	Specified Condition
No. 1	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
No. 2	0.50 to 0.60 mm (0.0197 to 0.0236 in.)
Oil	0.10 to 0.40 mm (0.0039 to 0.0157 in.)

Maximum end gap

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

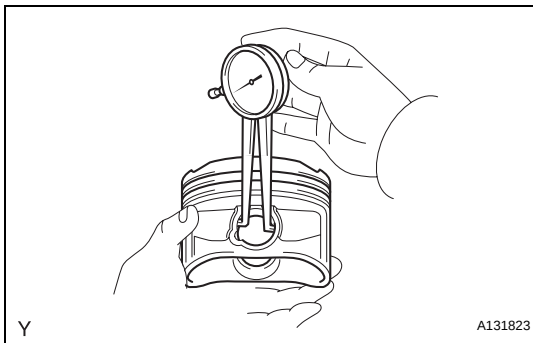
If the end gap is greater than the maximum, replace the piston ring. If the end gap is greater than the maximum even with a new piston ring, replace the cylinder block.





32. INSPECT PISTON PIN OIL CLEARANCE

- (a) Check each mark on the piston, piston pin and connecting rod.



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

Standard piston pin hole inside diameter

Mark	Specified Condition
A	22.001 to 22.004 mm (0.8662 to 0.8663 in.)
B	22.005 to 22.007 mm (0.8663 to 0.8664 in.)
C	22.008 to 22.010 mm (0.8665 to 0.8665 in.)

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

Standard piston pin diameter

Mark	Specified Condition
A	21.997 to 22.000 mm (0.8660 to 0.8661 in.)
B	22.001 to 22.003 mm (0.8662 to 0.8663 in.)
C	22.004 to 22.006 mm (0.8663 to 0.8664 in.)

- (d) Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:

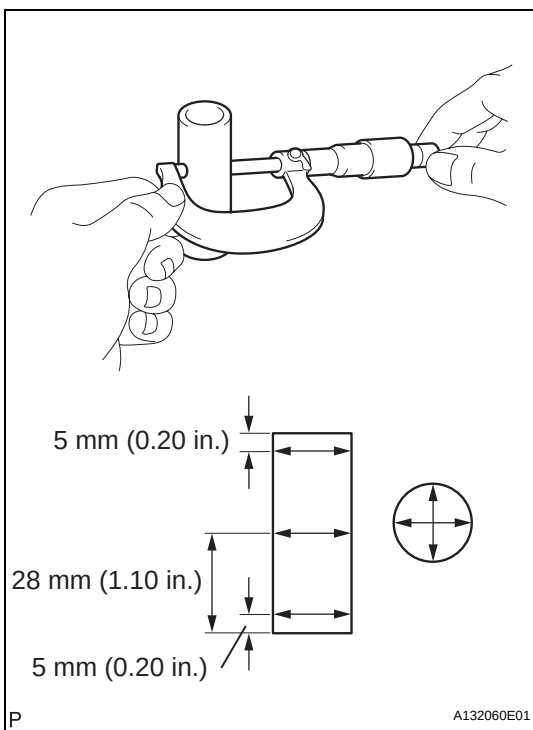
0.001 to 0.007 mm (0.00004 to 0.0003 in.)

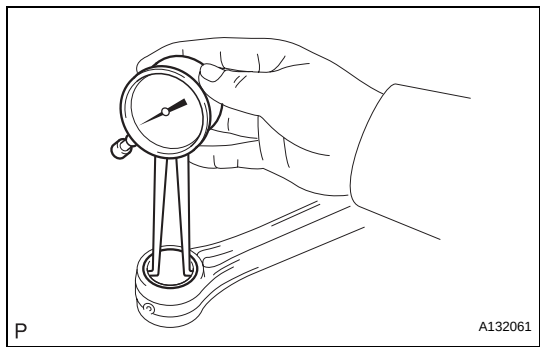
Maximum oil clearance:

0.015 mm (0.0006 in.)

HINT:

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





- (e) Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Standard bush inside diameter

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

- (f) Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance:

0.005 to 0.011 mm (0.0002 to 0.0004 in.)

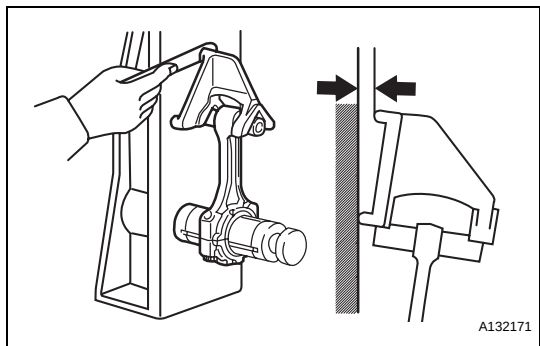
Maximum oil clearance:

0.03 mm (0.0012 in.)

HINT:

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

EM



33. INSPECT CONNECTING ROD SUB-ASSEMBLY

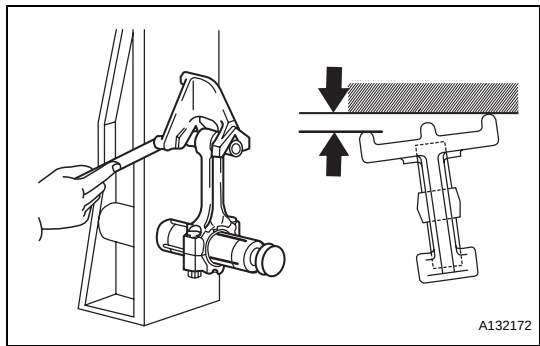
- (a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

- (1) Check for bend.

Maximum bend:

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

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

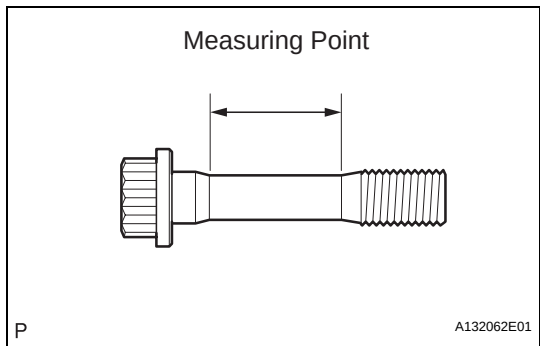


- (2) Check for twist.

Maximum twist:

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

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



34. INSPECT CONNECTING ROD BOLT

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

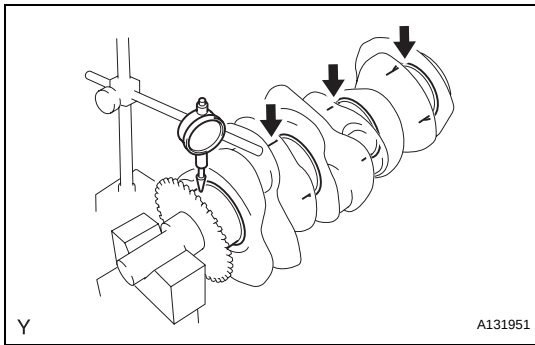
Standard diameter:

7.2 to 7.3 mm (0.283 to 0.287 in.)

Minimum diameter:

7.0 mm (0.276 in.)

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



35. INSPECT CRANKSHAFT

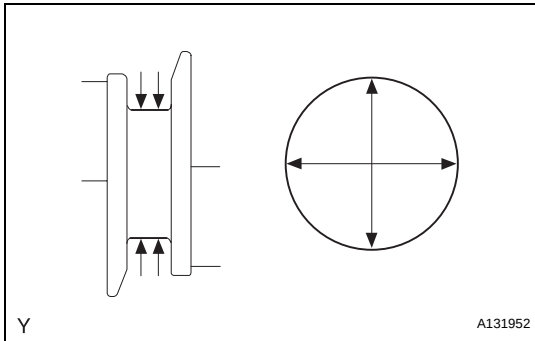
(a) Inspect for circle runout.

- (1) Place the crankshaft on the V-blocks.
- (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout:

0.06 mm (0.0024 in.)

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



(b) Inspect the main journals.

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

Standard journal diameter:

60.988 to 61.00 mm (2.4011 to 2.4016 in.)

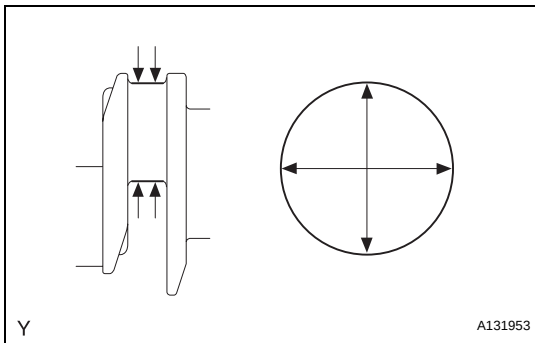
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

- (2) Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:

0.02 mm (0.0008 in.)

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



(c) Inspect the crank pin.

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

Standard crank pin diameter:

52.992 to 53.000 mm (2.0863 to 2.0866 in.)

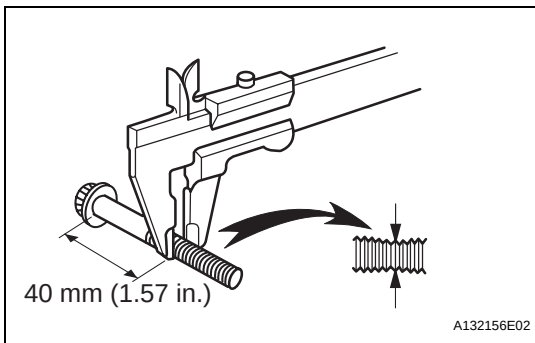
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

- (2) Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:

0.02 mm (0.0008 in.)

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



36. INSPECT CRANKSHAFT BEARING CAP SET BOLT

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

Standard diameter:

10.8 to 11.0 mm (0.4252 to 0.4331 in.)

Minimum diameter:

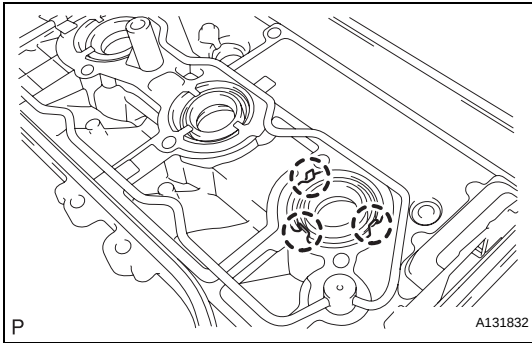
10.70 mm (0.4213 in.)

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

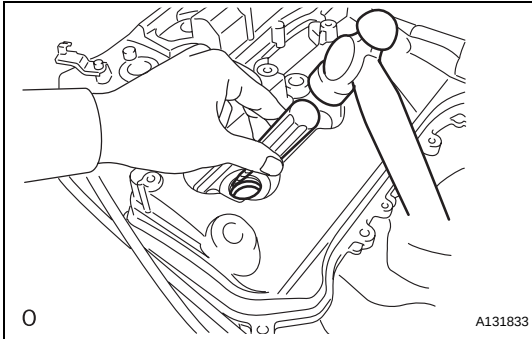
REPLACEMENT

1. REPLACE SPARK PLUG TUBE GASKET

- (a) Pry up the claws of the ventilation baffle plate.



- (b) Using a screwdriver with its tip taped and a hammer, tap out the 6 spark plug tube gaskets.

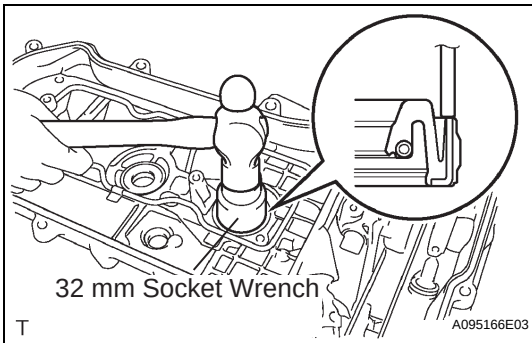


- (c) Using a 32 mm socket wrench, tap in 6 new spark plug tube gaskets to the head covers.

NOTICE:

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

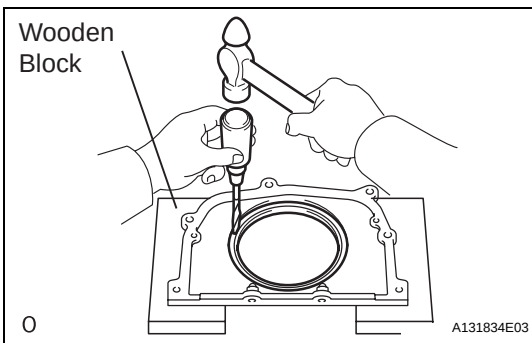
- (d) Return the claw of the ventilation baffle plate to its original position.



2. REPLACE ENGINE REAR OIL SEAL

- (a) Place the oil seal retainer on wooden blocks.

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

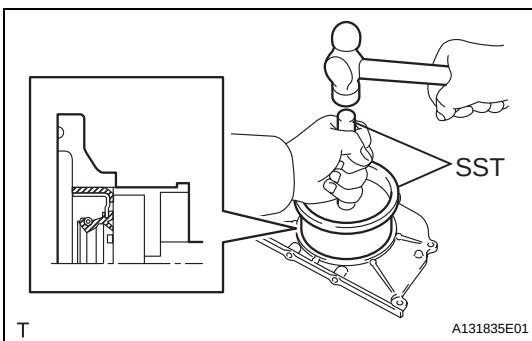


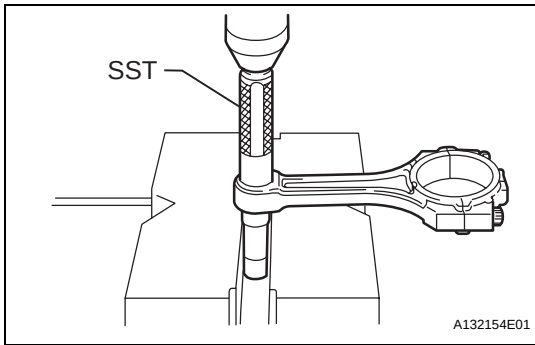
- (c) Using SST, tap in a new oil seal until its surface is flush with the oil seal retainer edge.

SST 09223-15030

NOTICE:

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

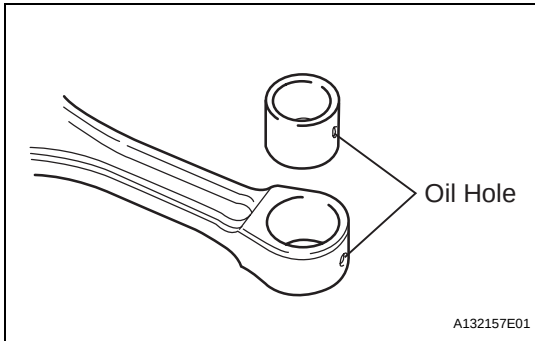




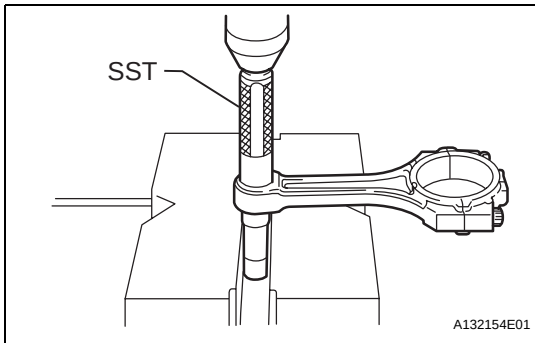
3. REPLACE CONNECTING ROD SMALL END BUSH

- (a) Using SST and a press, push out the bush.

SST 09222-30010

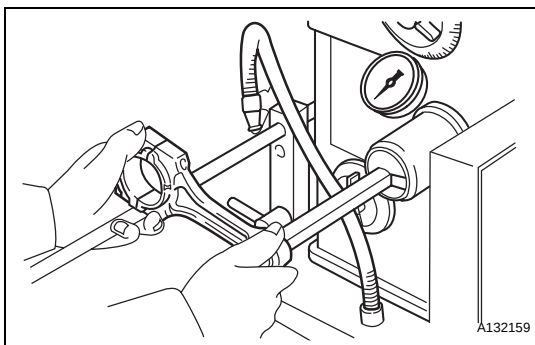


- (b) Align the oil holes of the new bush and connecting rod.

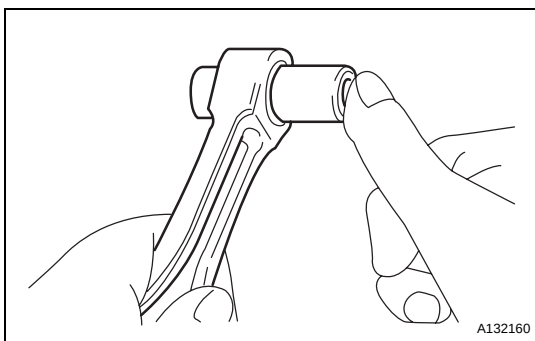


- (c) Using SST and a press, push in the bush.

SST 09222-30010



- (d) Using a pin hole grinder, hone the bush to obtain the standard specified clearance between the bush and piston pin.

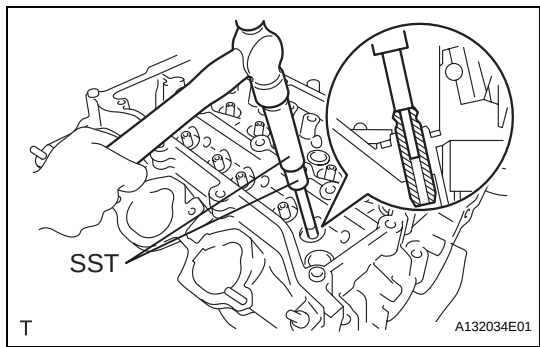


- (e) Coat the piston pin with engine oil. Push the piston pin into the connecting rod with your thumb to check that the piston pin fits at normal room temperature.

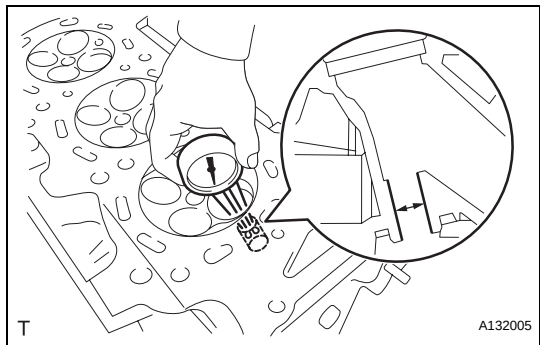
4. REPLACE INTAKE VALVE GUIDE BUSH

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

- (b) Place the cylinder head on wooden blocks.



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



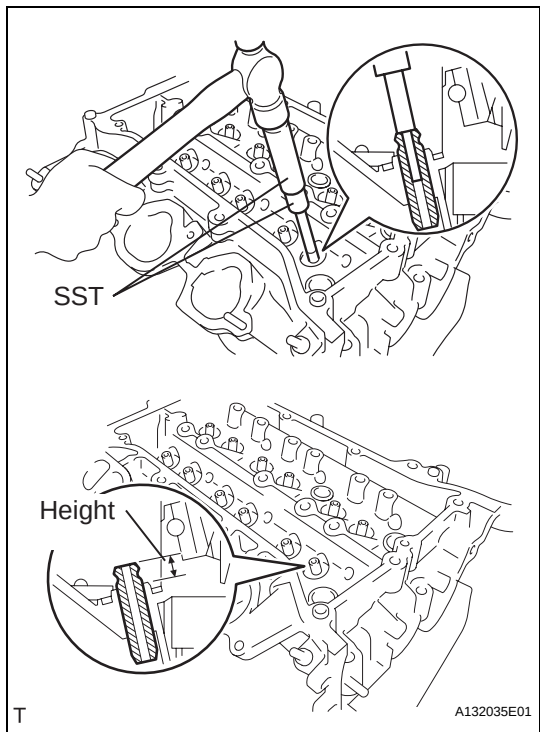
- (d) Using a caliper gauge, measure the bush bore diameter of the cylinder head.
Standard cylinder bore diameter:
10.285 to 10.306 mm (0.4049 to 0.4057 in.)
(e) Select a new guide bush (STD or O/S 0.05).
Standard bush bore diameter

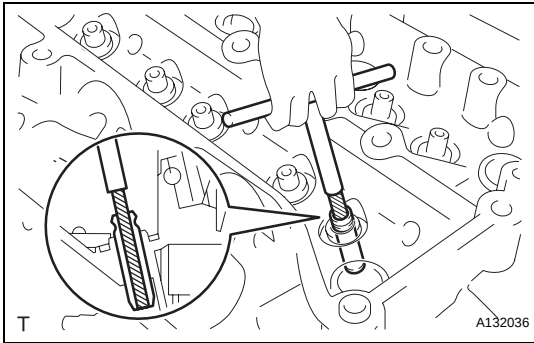
Bush Size	Specified Condition
Use STD	10.335 to 10.356 mm (0.4069 to 0.4077 in.)
Use O/S 0.05	10.285 to 10.306 mm (0.4049 to 0.4057 in.)

HINT:

- If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), machine the bush bore diameter to between 10.383 to 10.394 mm (0.4088 to 0.4092 in.).
 - If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), replace the cylinder head.
- (f) Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).
- (g) Using SST and a hammer, tap in a new guide bush to the specified protrusion height.

Standard protrusion height:
9.1 to 9.9 mm (0.3582 to 0.3900 in.)
SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

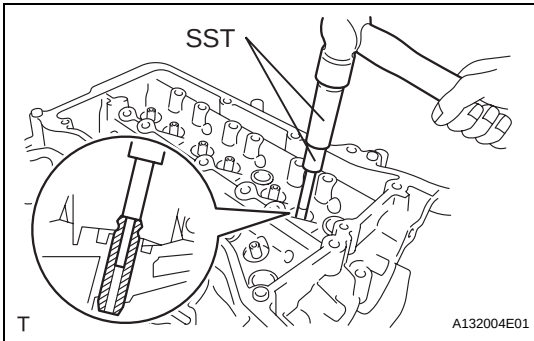




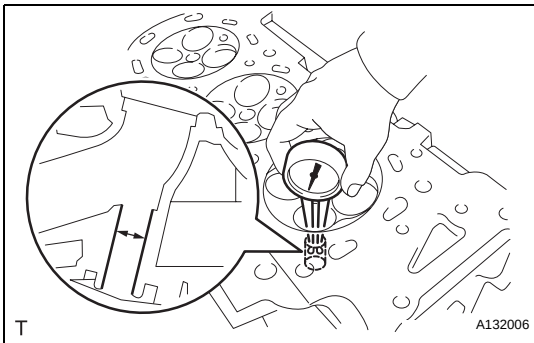
- (h) Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard specified clearance between the guide bush and valve stem.

5. REPLACE EXHAUST VALVE GUIDE BUSH

- (a) Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).
 (b) Place the cylinder head on wooden blocks.



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

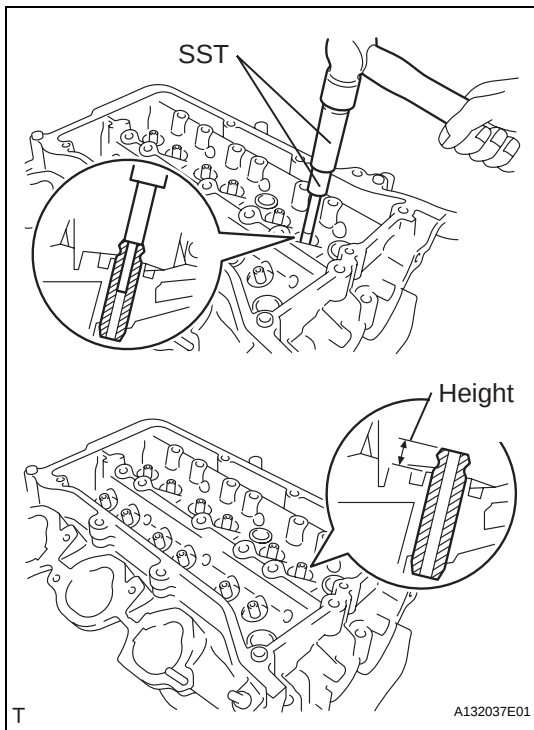


- (d) Using a caliper gauge, measure the bush bore diameter of the cylinder head.
Standard cylinder bore diameter:
10.285 to 10.306 mm (0.4049 to 0.4057 in.)
 (e) Select a new guide bush (STD or O/S 0.05).
Standard bush bore diameter

Bush Size	Specified Condition
Use STD	10.335 to 10.356 mm (0.4069 to 0.4077 in.)
Use O/S 0.05	10.285 to 10.306 mm (0.4049 to 0.4057 in.)

HINT:

- If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), machine the bush bore diameter to between 10.383 to 10.394 mm (0.4088 to 0.4092 in.).
 - If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), replace the cylinder head.
- (f) Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

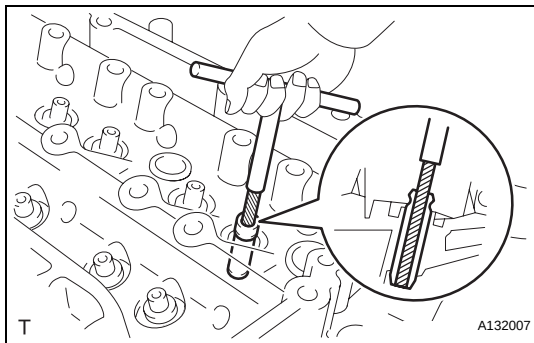


- (g) Using SST and a hammer, tap in a new guide bush to the specified protrusion height.

SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

Standard protrusion height:

9.30 to 9.70 mm (0.3661 to 0.3819 in.)



- (h) Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard specified clearance between the guide bush and valve stem.

6. REPLACE CYLINDER BLOCK TIGHT PLUG

NOTICE:

If water leaks from the tight plug or the plug corrodes, replace it.

- (a) Remove the tight plugs.

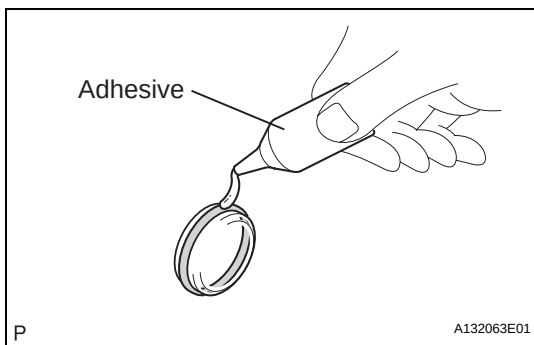
- (b) Apply adhesive around the tight plug.

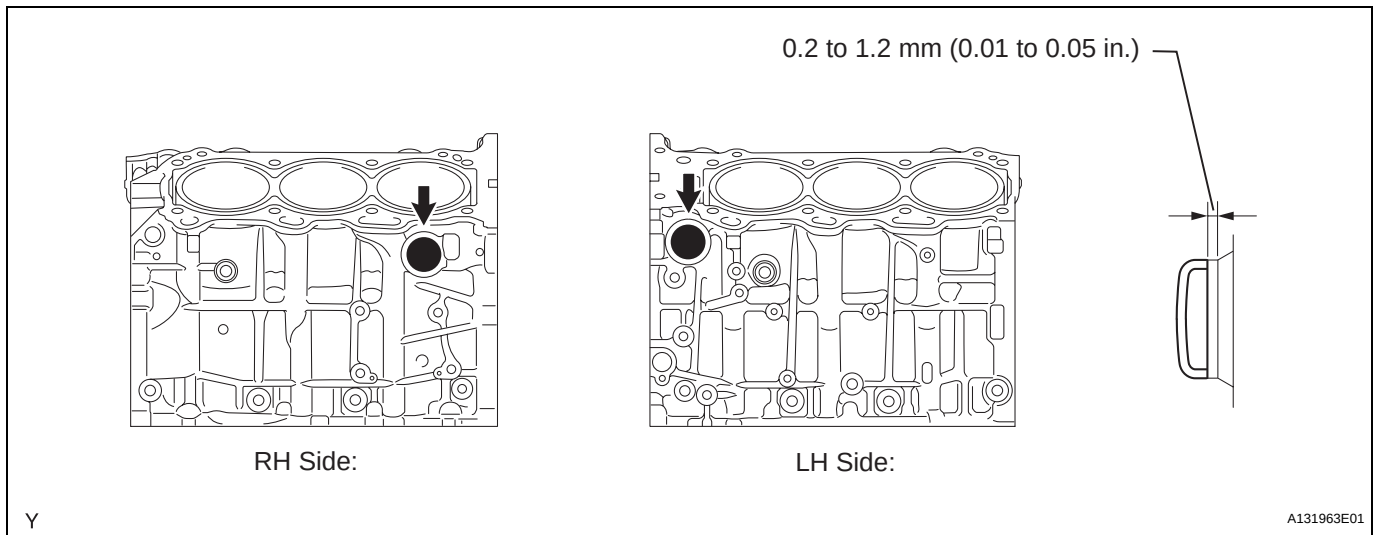
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent

- (c) Using SST and a hammer, tap in 2 new tight plugs as shown in the illustration.

SST 09950-60010 (09951-00340), 09950-70010 (09951-07100)





7. REPLACE CYLINDER BLOCK STUD BOLT

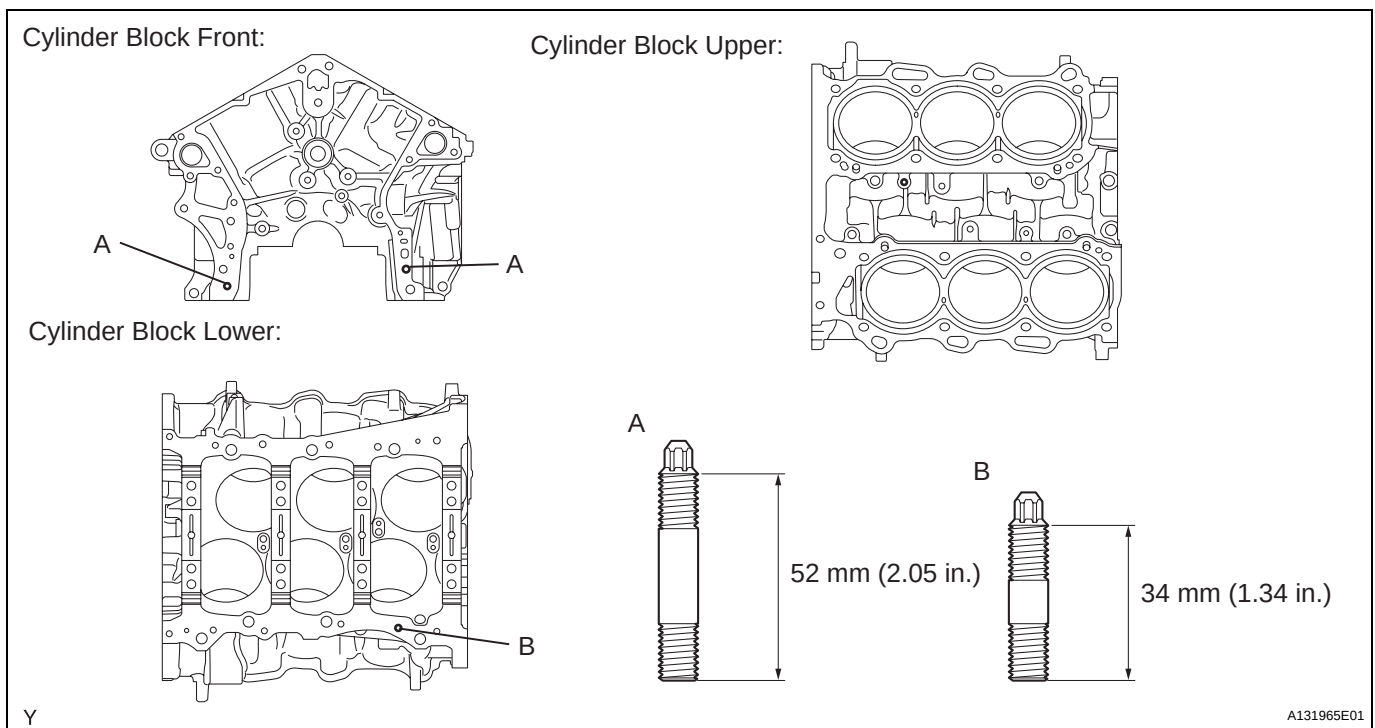
NOTICE:

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

- Remove the stud bolts.
- Using an E8 "torx" socket wrench, install the stud bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

EM



8. REPLACE CYLINDER BLOCK STRAIGHT PIN

NOTICE:

It is not necessary to remove the straight pin unless it is being replaced.

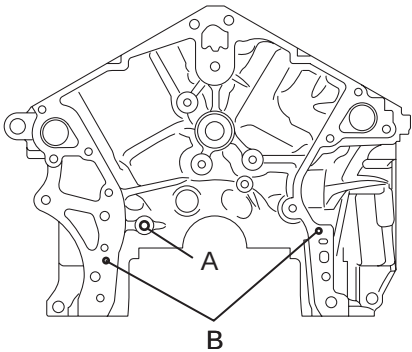
- Remove the straight pin.

- (b) Using a plastic-faced hammer, tap in new straight pins to the cylinder block.

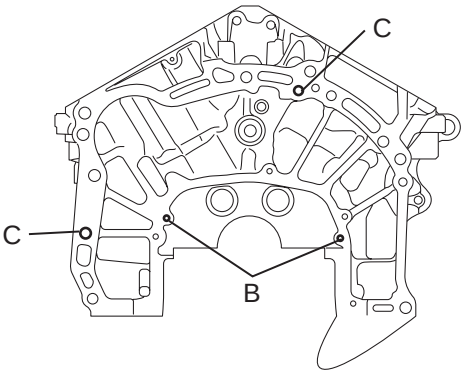
Standard protrusion

Item	Specified Condition
Pin A	23 mm (0.91 in.)
Pin B	6 mm (0.24 in.)
Pin C	11 mm (0.43 in.)
Pin D	9 mm (0.35 in.)

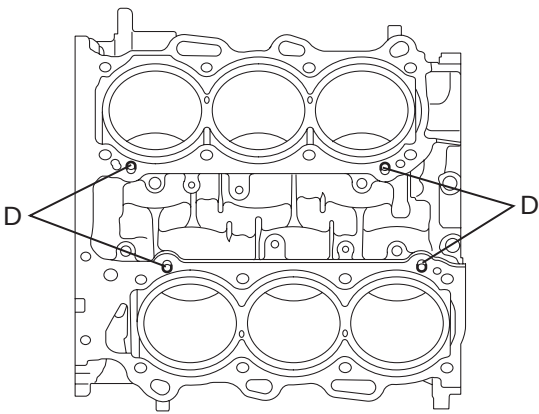
Cylinder Block Front:



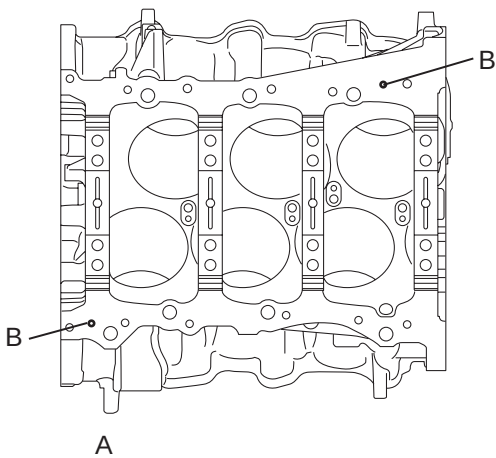
Cylinder Block Rear:



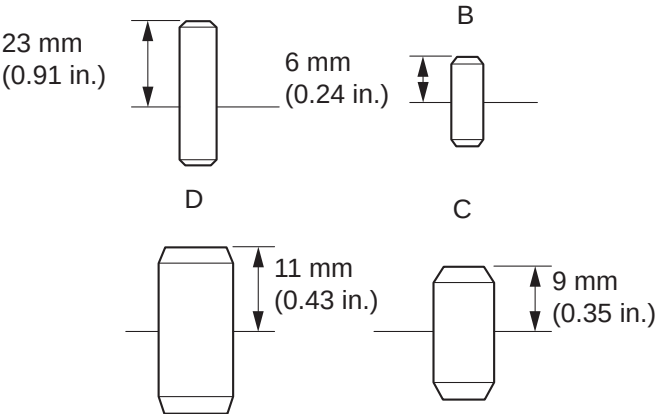
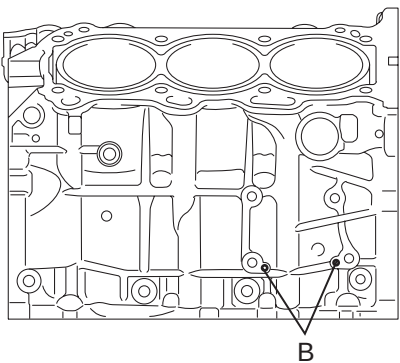
Cylinder Block Upper:



Cylinder Block Lower:



Cylinder Block RH Side:



9. REPLACE CYLINDER HEAD RING PIN**NOTICE:**

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

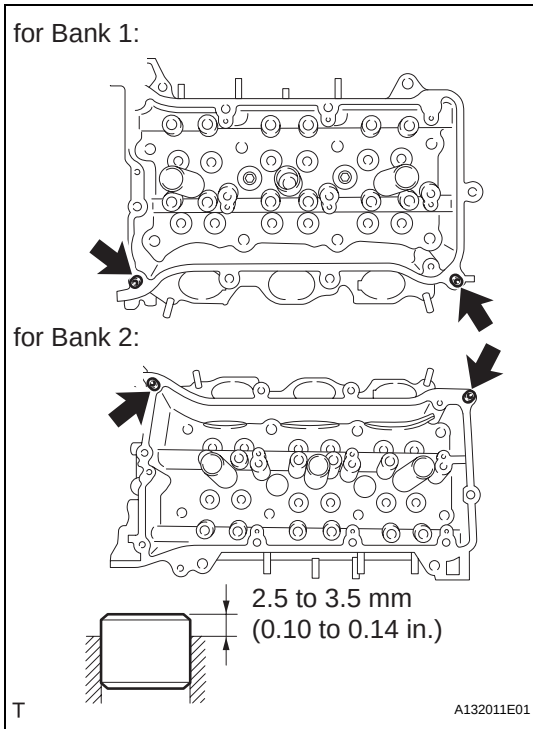
- (a) Remove the ring pins.
- (b) Using a plastic-faced hammer, tap in a new ring pin until the pin stops.

10. REPLACE CYLINDER HEAD STUD BOLT**NOTICE:**

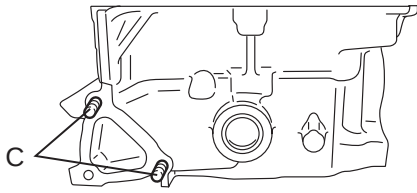
If a stud bolt is deformed or the threads are damaged, replace it.

- (a) Remove the stud bolts.
- (b) Using E6 and E8 "torx" socket wrenches, install the stud bolts.

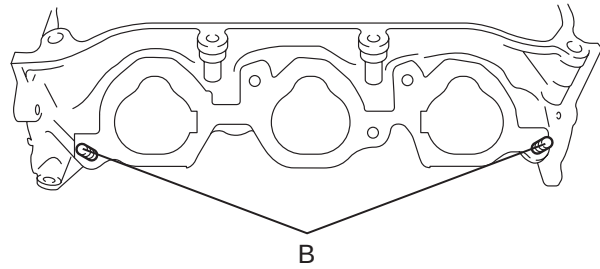
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf) for stud bolts A and B
4.0 N*m (41 kgf*cm, 35 in.*lbf) for stud bolt C

EM

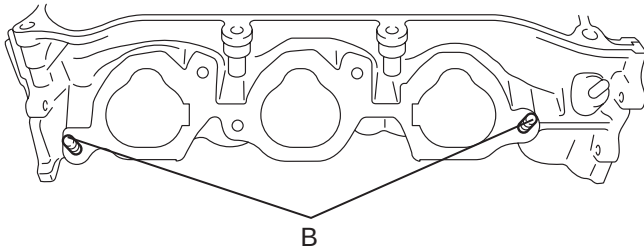
for Bank 1 Rear Side:



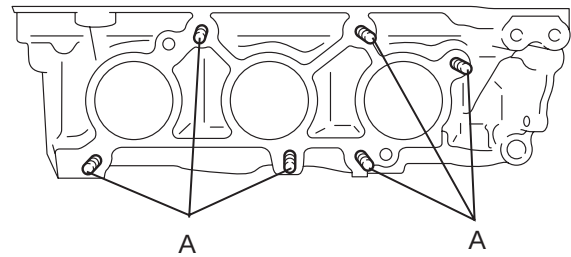
for Bank 1 Intake Side:



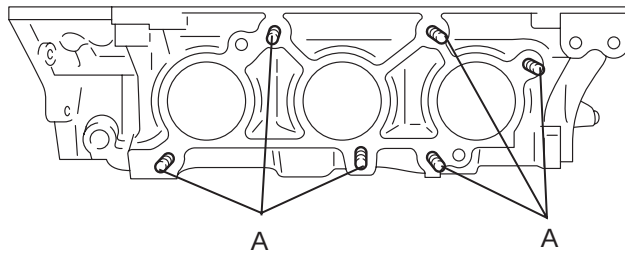
for Bank 2 Intake Side:



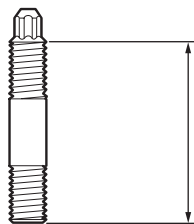
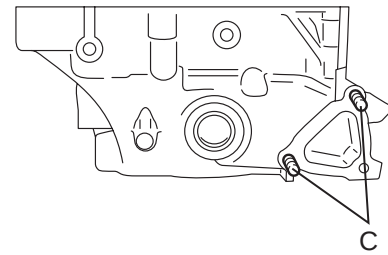
for Bank 1 Exhaust Side:



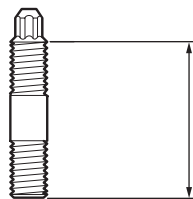
for Bank 2 Exhaust Side:



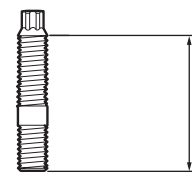
for Bank 2 Rear Side:



A



B



C

27 mm (1.06 in.)

T

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11. REPLACE CYLINDER HEAD SET STRAIGHT PIN**NOTICE:**

It is not necessary to remove the straight pin unless it is being replaced.

- (a) Using a plastic-faced hammer, tap in a new straight pin as shown in the illustration.

Standard protrusion height:

18.0 to 19.0 mm (0.71 to 0.75 in.)

INSPECTION

1. INSPECT VALVE LASH ADJUSTER ASSEMBLY

NOTICE:

- Keep the lash adjuster free from dirt and foreign objects.
- Only use clean engine oil.

- Place the lash adjuster into a container full of engine oil.
- Insert the SST's tip into the lash adjuster's plunger and use the tip to press down on the checkball inside the plunger.

SST 09276-75010

- Squeeze the SST and lash adjuster together to move the plunger up and down 5 to 6 times.
- Check the movement of the plunger and bleed the air.

OK:

Plunger moves up and down.

NOTICE:

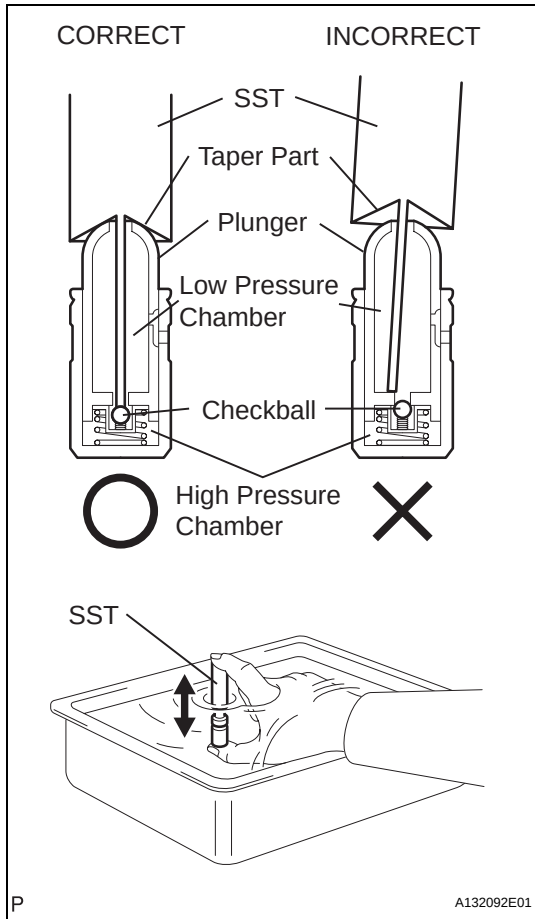
When bleeding high-pressure air from the compression chamber, make sure that the tip of the SST is actually pressing the checkball as shown in the illustration. If the checkball is not pressed, air will not bleed.

- After bleeding the air, remove SST. Then try to quickly and firmly press the plunger with a finger.

OK:

Plunger is very difficult to move.

If the result is not as specified, replace the lash adjuster.



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A132092E01

2. INSPECT CAMSHAFT

- Inspect the camshaft for runout.
 - Place the camshaft on V-blocks.
 - Using a dial indicator, measure the circle runout at the center journal.

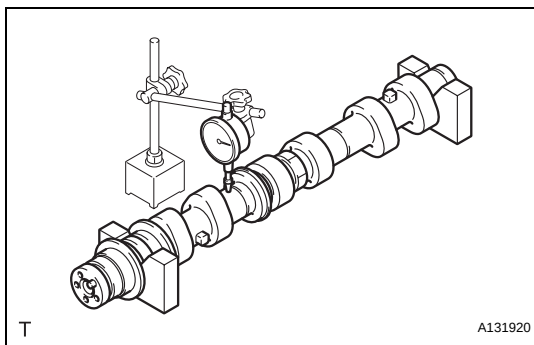
Maximum circle runout:

0.04 mm (0.0016 in.)

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

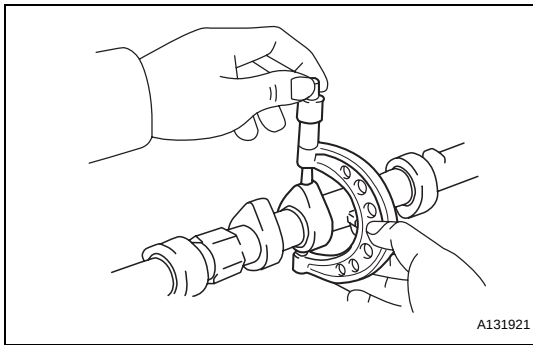
HINT:

Check the oil clearance after replacing the camshaft.



T

A131920



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

Standard cam lobe height

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

Maximum cam lobe height

Item	Specified Condition
Intake	44.166 mm (1.7388 in.)
Exhaust	44.112 mm (1.7367 in.)

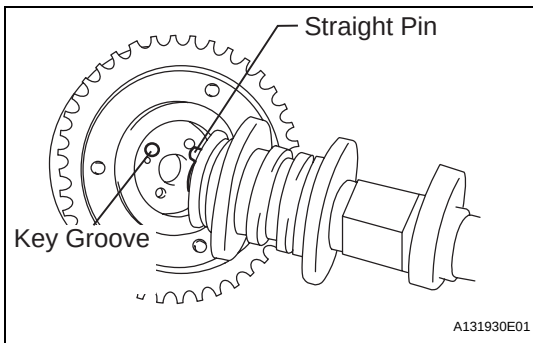
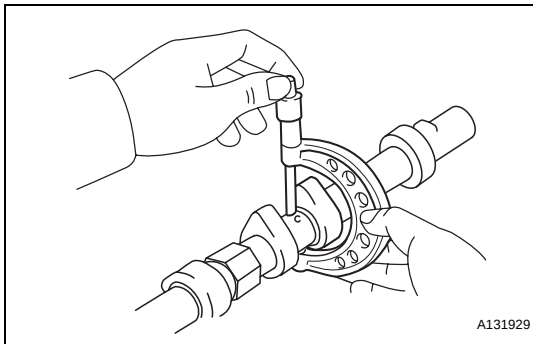
If the cam lobe height is less than the minimum, replace the camshaft.

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

Standard journal diameter

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

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



3. INSPECT CAMSHAFT TIMING GEAR ASSEMBLY

- (a) Clamp the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft in the vise.

- (b) Put the camshaft timing gear and camshaft together by aligning the key groove and straight pin.
- (c) Lightly press the gear against the camshaft, and turn the gear. Push further at the position where the pin enters the groove.

NOTICE:

Be sure not to turn the camshaft timing gear in the retard direction (the right angle).

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

- (e) Tighten the flange bolt with the camshaft timing gear fixed in place.

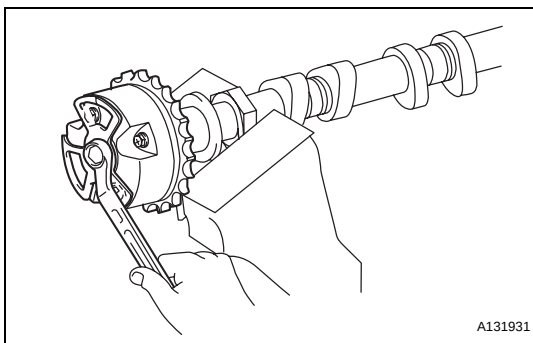
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

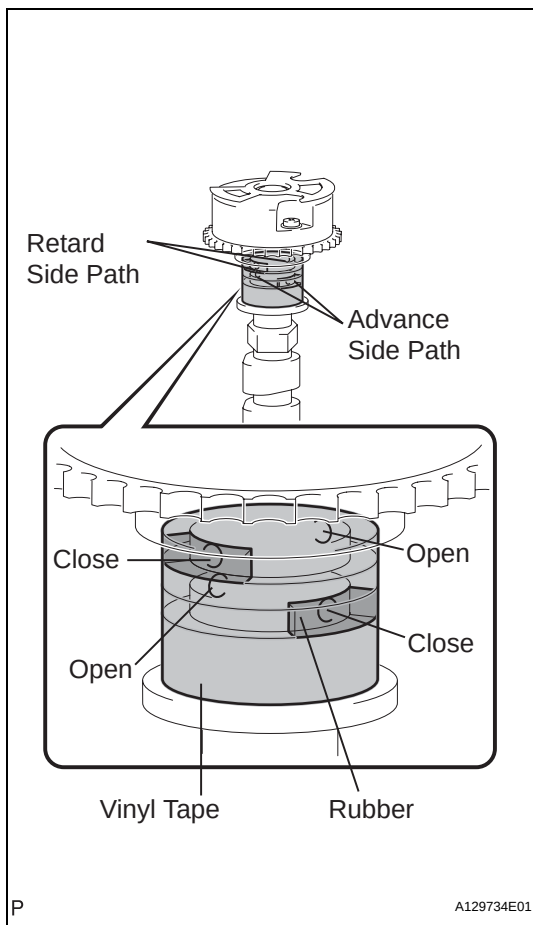
- (f) Check the lock of the camshaft timing gear.

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

NOTICE:

Be careful not to damage the camshaft.





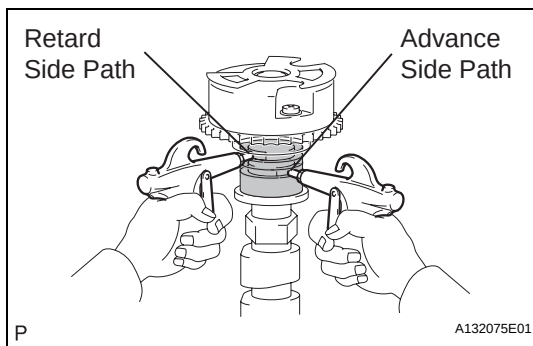
(g) Release the lock pin.

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

HINT:

2 advance side paths are provided in the groove of the camshaft. Plug one of the paths with a rubber piece.

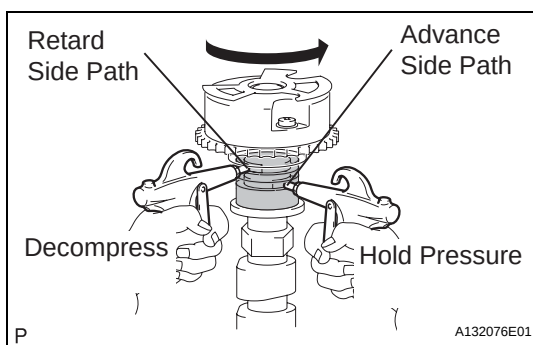
- (2) Break through the tape of the advance side path and the retard side path on the opposite side to the hole of the advance side path, as shown in the illustration.



- (3) Apply approximately 200 kPa (2.0 kgf/cm², 28 psi) of air pressure to the two broken paths.

CAUTION:

Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.



- (4) Check that the camshaft timing gear revolves in the advance direction when reducing the air pressure applied to the retard side path.

HINT:

This operation releases the lock pin for the most retarded position.

- (5) When the camshaft timing gear reaches the most advanced position, release the air pressure from the retard side path and advance side path, in that order.

NOTICE:

Do not release the air pressure from the advance side path first. The gear may abruptly shift in the retard direction and break the lock pin.

- (h) Check for smooth rotation.
 (1) Turn the camshaft timing gear within its movable range (21°) 2 or 3 times, but do not turn it to the most retarded position. Make sure that the gear turns smoothly.

NOTICE:

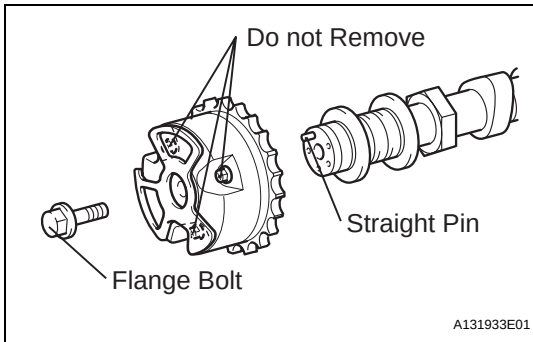
Do not use air pressure to perform the smooth rotation check.

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

- (j) Remove the flange bolt and camshaft timing gear.

NOTICE:

- **Be sure not to remove the other 3 bolts.**
- **If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.**



4. INSPECT CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY

- (a) Clamp the camshaft in a vise.

NOTICE:

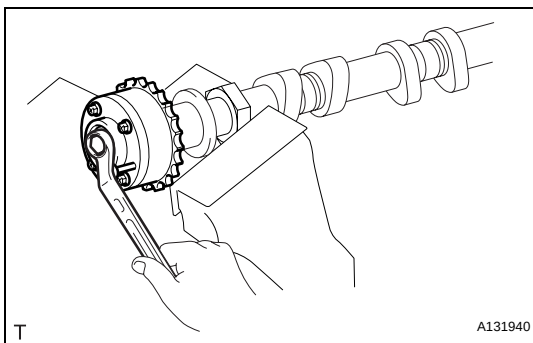
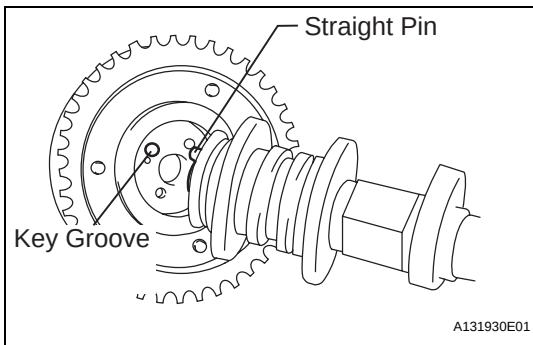
Be careful not to damage the camshaft in the vise.

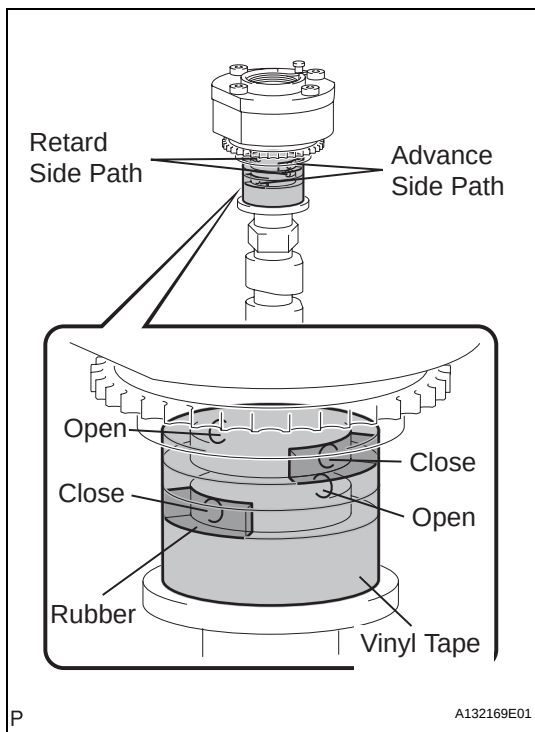
- (b) Put the camshaft timing exhaust gear and camshaft together by aligning the key groove and straight pin.
 (c) Lightly press the gear against the camshaft, and turn the gear. Push further at the position where the pin enters the groove.

CAUTION:

Be sure not to turn the camshaft timing exhaust gear in the retard direction (the right angle).

- (d) Check that there is no clearance between the gear's fringe and the camshaft.
 (e) Tighten the flange bolt with the camshaft timing exhaust gear fixed in place.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)
 (f) Check the camshaft timing exhaust gear lock.
 (1) Make sure that the camshaft timing exhaust gear is locked.





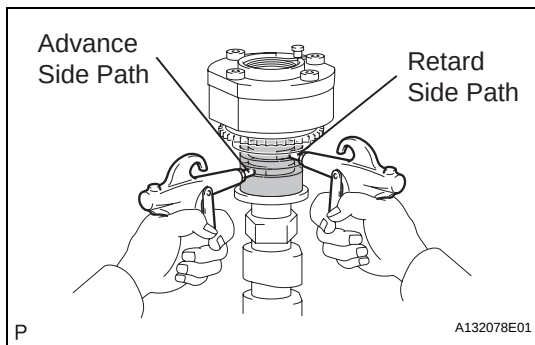
(g) Release the lock pin.

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

HINT:

4 oil paths are provided in the groove. Plug 2 paths with rubber pieces.

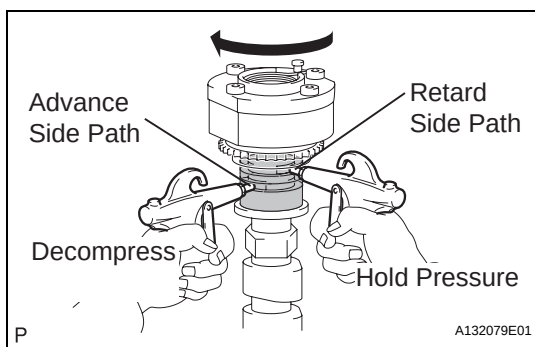
- (2) Prick a hole in the tape placed on the advance side path. Prick a hole in the tape placed on the retard side path on the opposite side to that of the advance side path, as shown in the illustration.



- (3) Apply approximately 200 kPa (2.0 kgf/cm², 28 psi) of air pressure to the two broken paths (the advance side path and the retard side path).

CAUTION:

Cover the paths with a piece of cloth when applying pressure to keep oil from splashing.



- (4) Make sure that the camshaft timing exhaust gear turns in the retard direction when reducing the air pressure applied to the advance side path.

HINT:

The lock pin is released and the camshaft timing exhaust gear turns in the retard direction.

- (5) When the camshaft timing exhaust gear moves to the most retarded position, release the air pressure from the advance side path, and then release the air pressure from the retard side path.

NOTICE:

Be sure to release the air pressure from the advance side path first. If the air pressure of the retard side path is released first, the camshaft timing exhaust gear may abruptly shift in the advance direction and break the lock pin or other parts.

- (h) Check for smooth rotation.
- (1) Turn the camshaft timing exhaust gear within its movable range (18.5°) 2 or 3 times, but do not turn it to the most advanced position. Make sure that the gear turns smoothly.

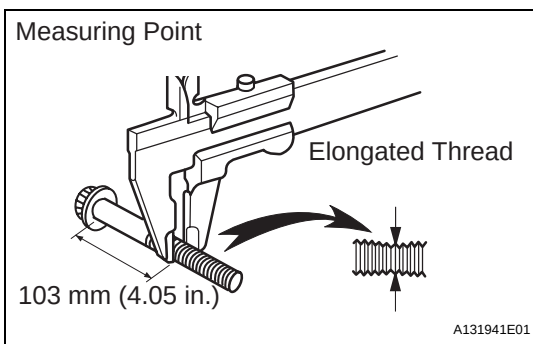
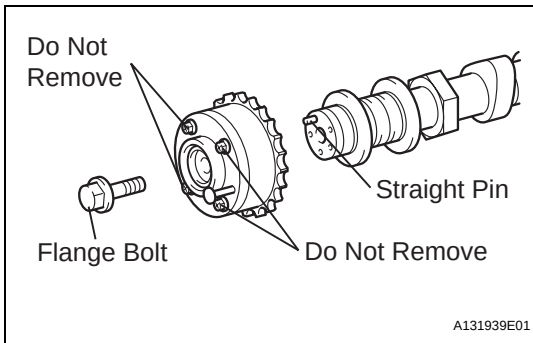
NOTICE:

When the air pressure is released from the advance side path and then from the retard side path, the gear automatically returns to the most advanced position due to the advance assist spring operation and locks. Gradually release the air pressure from the retard side path before performing the smooth rotation check.

- (i) Check the lock at the most advanced position.
- (1) Make sure that the camshaft timing exhaust gear is locked at the most advanced position.
- (j) Remove the flange bolt and camshaft timing exhaust gear.

NOTICE:

- Be sure not to remove the other 3 bolts.
- If planning to reuse the gear, be sure to release the straight pin lock before installing the gear.

**5. INSPECT CYLINDER HEAD SET BOLT**

- (a) Using a vernier caliper, measure the minimum diameter of the elongated thread at the measuring point.

Minimum outside diameter:

10.70 mm (0.4213 in.)

HINT:

- If a visual check reveals no excessively thin areas, check the center of the bolt (see illustration) and find the area that has the lowest diameter.
- If the diameter is less than the minimum, replace the cylinder head bolt.

6. INSPECT CHAIN SUB-ASSEMBLY

- (a) Using a spring scale, pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.
- (b) Using a vernier caliper, measure the length of 16 links.

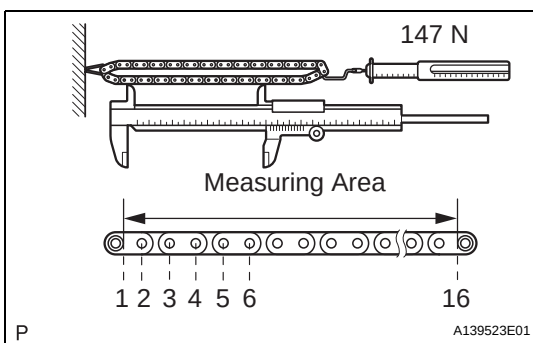
Maximum chain elongation:

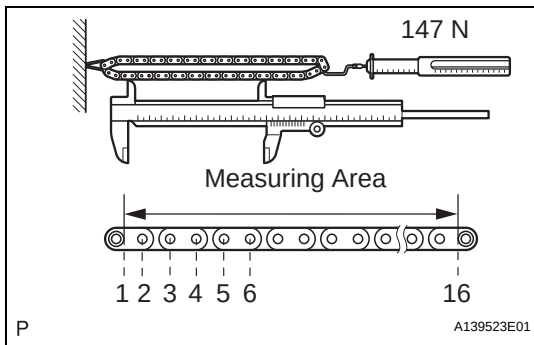
136.9 mm (5.389 in.)

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

NOTICE:

Perform the measurement at 3 random places. Inspect using the average of the measurements.





7. INSPECT NO. 2 CHAIN SUB-ASSEMBLY

- Pull the chain with a force of 147 N (15 kgf, 33 lbf) as shown in the illustration.
- Using a vernier caliper, measure the length of 16 links.

Maximum chain elongation:

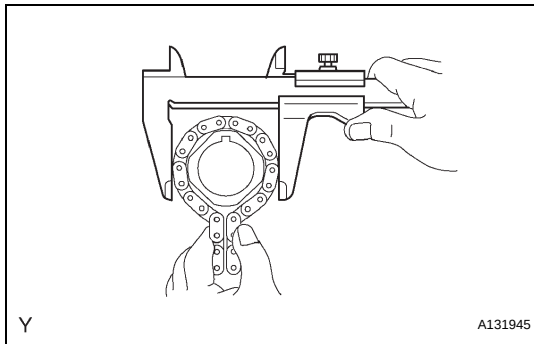
137.6 mm (5.417 in.)

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

NOTICE:

Perform the measurement at 3 random places.

Inspect using the average of the measurements.



8. INSPECT CRANKSHAFT TIMING GEAR OR SPROCKET

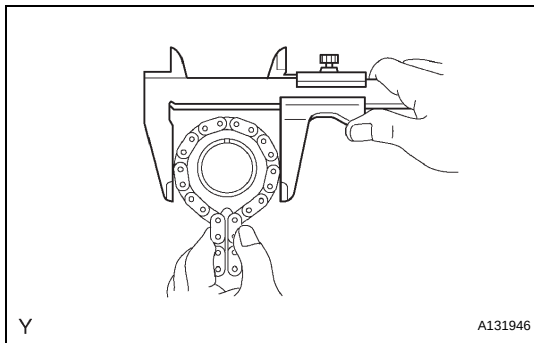
- Wrap the chain around the sprocket.
- Using a vernier caliper, measure the sprocket diameter with the chain.

Minimum sprocket diameter (w/ chain):

61.4 mm (2.417 in.)

HINT:

- The vernier caliper must contact the chain rollers for the measurement.
- If the diameter is less than the minimum, replace the chain and sprocket.



9. INSPECT IDLE SPROCKET ASSEMBLY

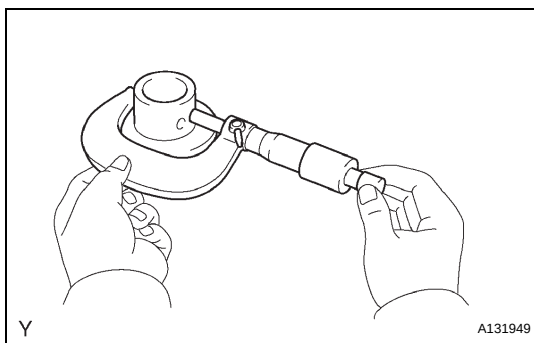
- Wrap the chain around the sprocket.
- Using a vernier caliper, measure the sprocket diameter with the chain.

Minimum sprocket diameter (w/ chain):

61.4 mm (2.417 in.)

HINT:

- The vernier caliper must contact the chain rollers for the measurement.
- If the diameter is less than the minimum, replace the chain and sprocket.

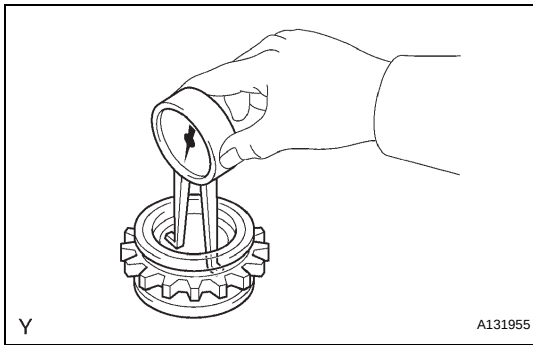


10. INSPECT IDLE GEAR SHAFT OIL CLEARANCE

- Using a micrometer, measure the idle gear shaft diameter.

Standard idle gear shaft diameter:

22.987 to 23.000 mm (0.9050 to 0.9055 in.)



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

Standard idle gear inside diameter:

23.02 to 23.03 mm (0.9062 to 0.9067 in.)

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

Standard oil clearance:

0.02 to 0.043 mm (0.0001 to 0.0017 in.)

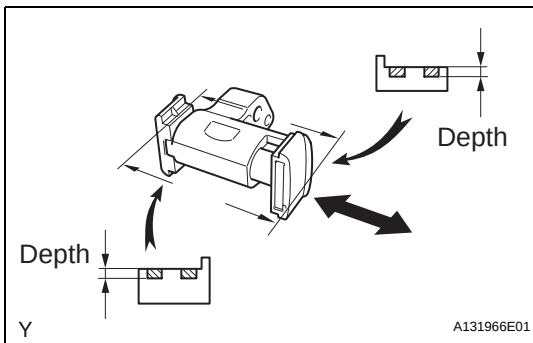
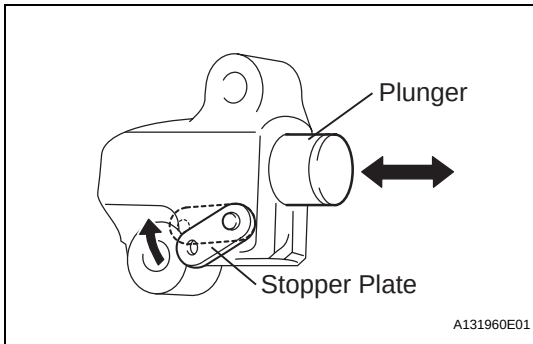
Maximum oil clearance:

0.043 mm (0.0017 in.)

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

11. INSPECT NO. 1 CHAIN TENSIONER ASSEMBLY

- (a) Move the stopper plate upward to release the lock. Push the plunger and check that it moves smoothly. If necessary, replace the chain tensioner.



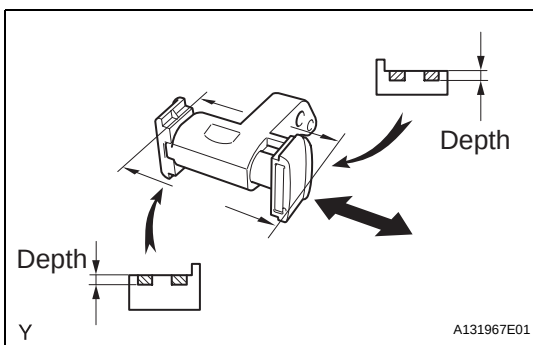
12. INSPECT NO. 2 CHAIN TENSIONER ASSEMBLY

- (a) Check that the plunger moves smoothly.
(b) Measure the worn depth of the chain tensioner.

Maximum depth:

0.9 mm (0.035 in.)

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



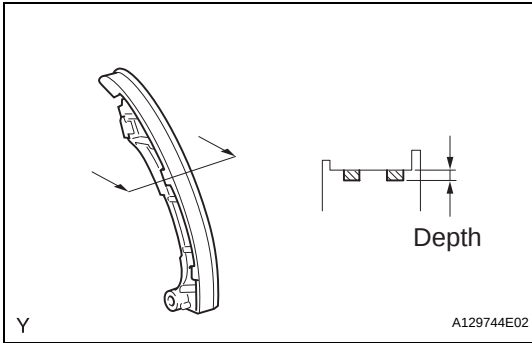
13. INSPECT NO. 3 CHAIN TENSIONER ASSEMBLY

- (a) Check that the plunger moves smoothly.
(b) Measure the worn depth of the chain tensioner.

Maximum depth:

0.9 mm (0.035 in.)

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

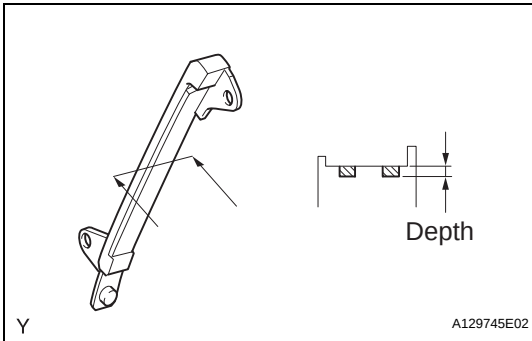
**14. INSPECT CHAIN TENSIONER SLIPPER**

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

Maximum depth:

1.0 mm (0.039 in.)

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

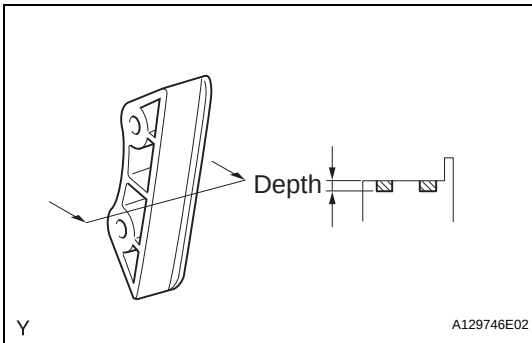
**15. INSPECT NO. 1 CHAIN VIBRATION DAMPER**

- (a) Measure the worn depth of the chain vibration damper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the chain vibration damper.

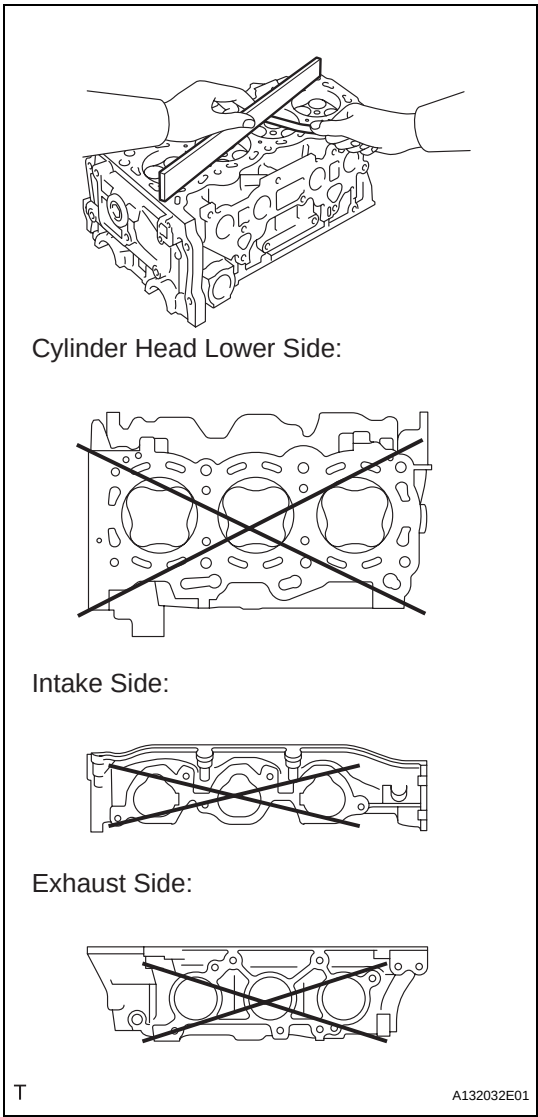
**16. INSPECT NO. 2 CHAIN VIBRATION DAMPER**

- (a) Measure the worn depth of the chain vibration damper.

Maximum depth:

1.0 mm (0.039 in.)

If the depth is greater than the maximum, replace the chain vibration damper.



17. INSPECT CYLINDER HEAD SUB-ASSEMBLY

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

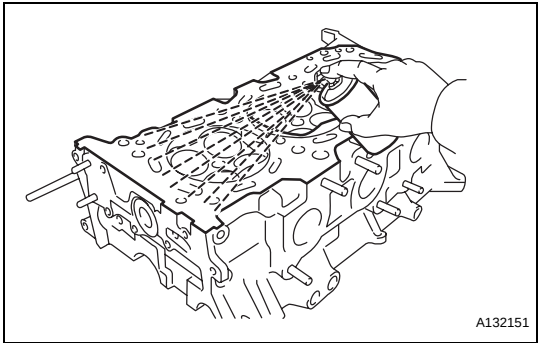
Standard warpage

Item	Specified Condition
Cylinder head lower side	0.05 mm (0.0020 in.)
Intake side	0.08 mm (0.0031 in.)
Exhaust side	0.08 mm (0.0031 in.)

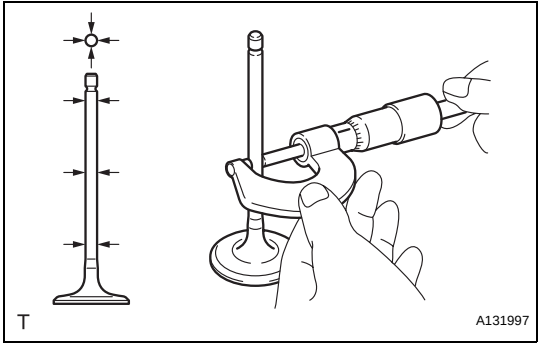
Maximum warpage:

0.10 mm (0.0039 in.)

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



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

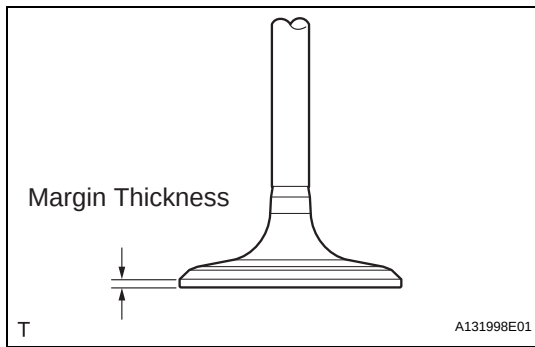


18. INSPECT INTAKE VALVE

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

Standard valve stem diameter:

5.470 to 5.485 mm (0.2154 to 0.2159 in.)



- (b) Using a vernier caliper, measure the valve head margin thickness.

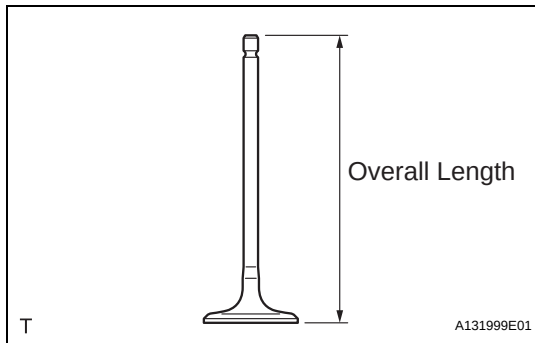
Standard margin thickness:

1.0 mm (0.0394 in.)

Minimum margin thickness:

0.50 mm (0.0197 in.)

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



- (c) Using a vernier caliper, measure the valve's overall length.

Standard overall length:

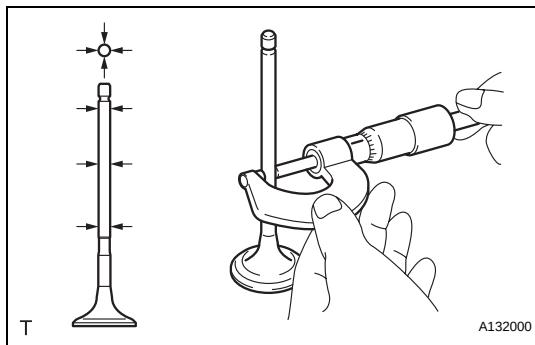
105.85 mm (4.1673 in.)

Minimum overall length:

105.35 mm (4.1476 in.)

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

EM

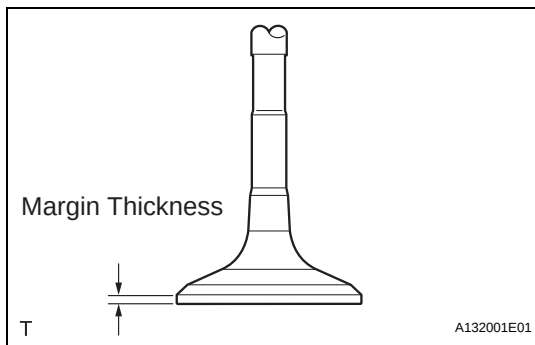


19. INSPECT EXHAUST VALVE

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

Standard valve stem diameter:

5.465 to 5.480 mm (0.2151 to 0.2157 in.)



- (b) Using a vernier caliper, measure the valve head margin thickness.

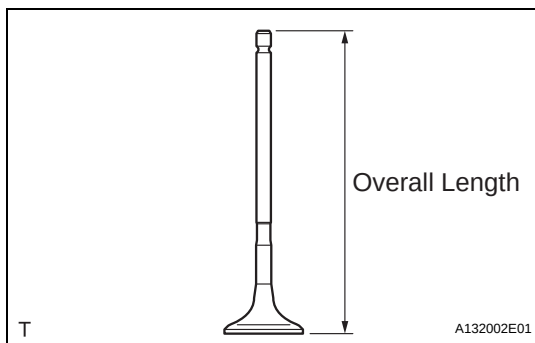
Standard margin thickness:

1.0 mm (0.0394 in.)

Minimum margin thickness:

0.50 mm (0.0197 in.)

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



- (c) Using a vernier caliper, measure the valve's overall length.

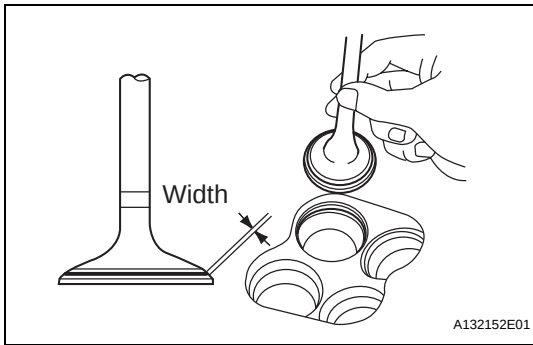
Standard overall length:

110.40 mm (4.3464 in.)

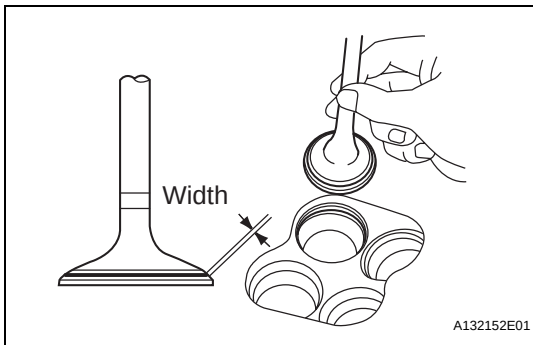
Minimum overall length:

109.90 mm (4.3268 in.)

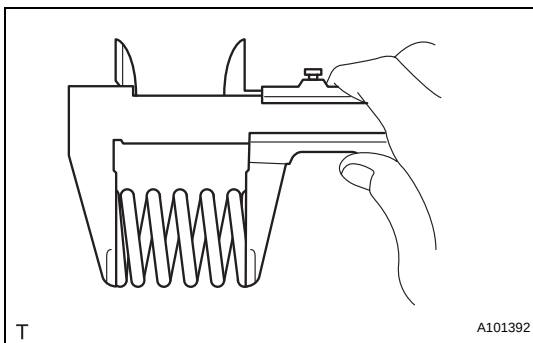
If the overall length is less than the minimum, replace the exhaust valve.

**20. INSPECT INTAKE VALVE SEAT**

- (a) Apply a light coat of Prussian blue to the valve face.
- (b) Lightly press the valve face against the valve seat.
- (c) Check the valve face and valve seat by using the following procedure.
 - (1) If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
 - (2) If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.
 - (3) Check that the valve seat contacts in the middle of the valve face with the width between 1.1 and 1.5 mm (0.043 and 0.059 in.).

**21. INSPECT EXHAUST VALVE SEAT**

- (a) Apply a light coat of Prussian blue to the valve face.
- (b) Lightly press the valve face against the valve seat.
- (c) Check the valve face and valve seat by using the following procedure.
 - (1) If Prussian blue appears around the entire valve face, the valve face is concentric. If not, replace the valve.
 - (2) If Prussian blue appears around the entire valve seat, the guide and valve face are concentric. If not, resurface the valve seat.
 - (3) Check that the valve seat contacts in the middle of the valve face with the width between 1.2 and 1.6 mm (0.047 and 0.063 in.).

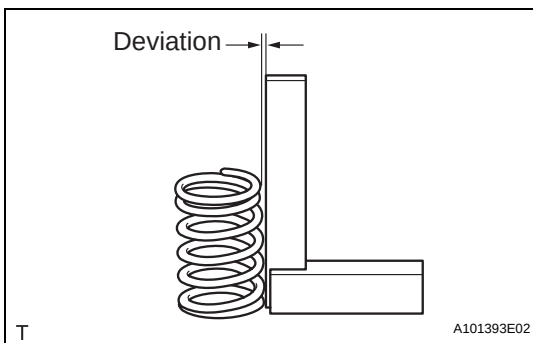
**22. INSPECT INNER COMPRESSION SPRING**

- (a) Using a vernier caliper, measure the free length of the inner compression spring.

Standard free length:

45.46 mm (1.7898 in.)

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



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

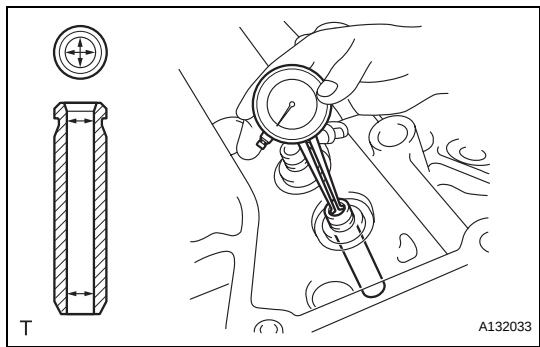
Maximum deviation:

1.0 mm (0.039 in.)

Maximum angle (reference):

2°

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



23. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

- (a) Using a caliper gauge, measure the inside diameter of the guide bush.

Standard bush inside diameter:
5.51 to 5.53 mm (0.2169 to 0.2177 in.)

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

Standard clearance

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

Maximum oil clearance

Item	Specified Condition
Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

HINT:

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

24. INSPECT CAMSHAFT THRUST CLEARANCE

- (a) Inspect the bank 1 camshafts.
- (1) Install the bank 1 camshafts.
 - (2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.08 to 0.13 mm (0.0031 to 0.0051 in.)

Maximum thrust clearance:
0.15 mm (0.006 in.)

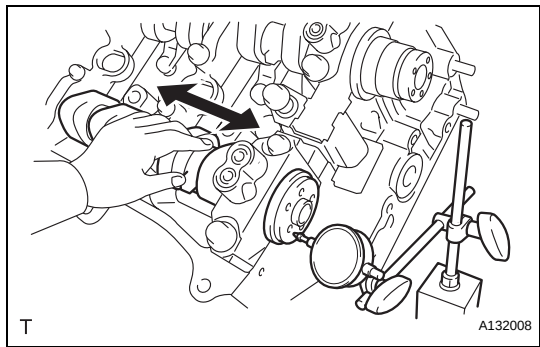
If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.

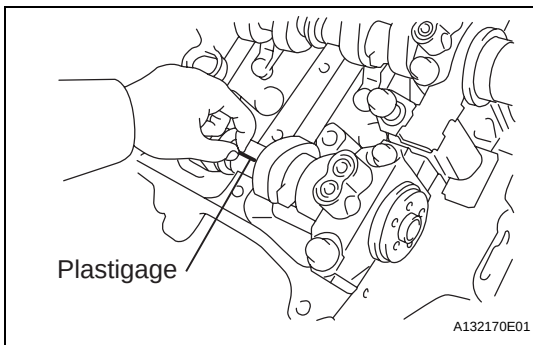
- (b) Inspect the bank 2 camshafts.
- (1) Install the bank 2 camshafts.
 - (2) Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.

Standard thrust clearance:
0.08 to 0.13 mm (0.0031 to 0.0051 in.)

Maximum thrust clearance:
0.15 mm (0.006 in.)

If the thrust clearance is greater than the maximum, replace the cylinder head. If the thrust surface is damaged, replace the camshaft.





25. INSPECT CAMSHAFT OIL CLEARANCE

- (a) Clean the bearing caps, camshaft housing and camshaft journals.
- (b) Place the camshafts on the camshaft housing.
- (c) Lay a strip of Plastigage across each of the camshaft journals.
- (d) Install the bearing caps.

NOTICE:

Do not turn the camshaft.

- (e) Remove the bearing caps.
- (f) Measure the Plastigage at its widest point.

Standard oil clearance

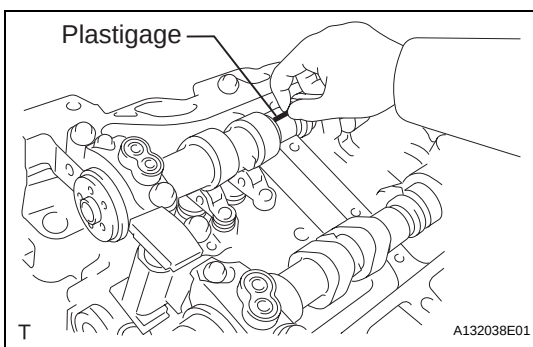
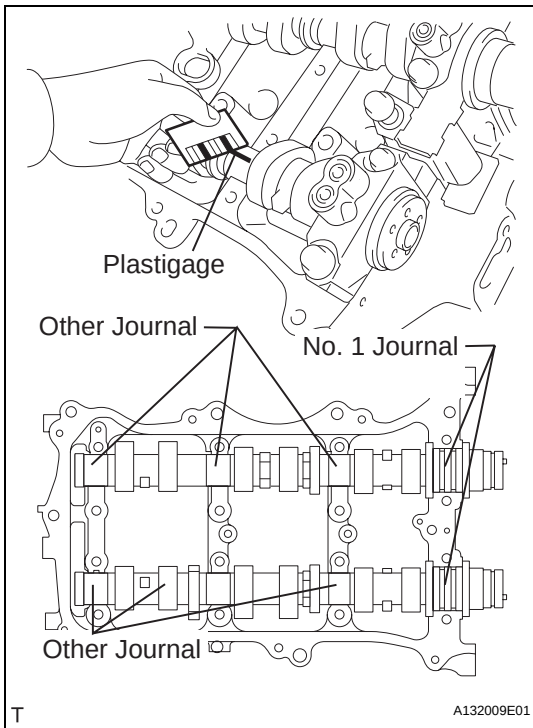
Item	Specified Condition
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journal	0.025 to 0.062 mm (0.0010 to 0.0024 in.)

Maximum oil clearance

Item	Specified Condition
No. 1 journal	0.10 mm (0.0039 in.)
Other journal	0.09 mm (0.0035 in.)

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

- (g) Clean the bearing caps, camshaft housing and camshaft journals.
- (h) Place the camshafts on the camshaft housing.

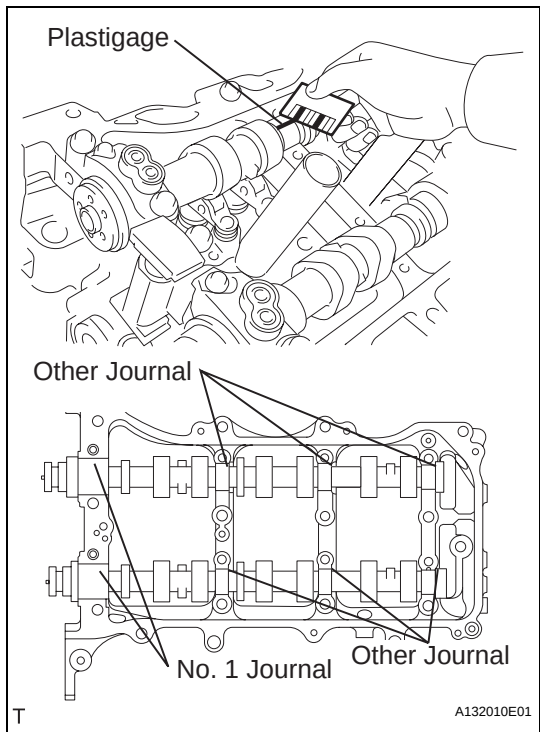


- (i) Lay a strip of Plastigage across each of the camshaft journals.
- (j) Install the bearing caps.

NOTICE:

Do not turn the camshaft.

- (k) Remove the bearing caps.



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

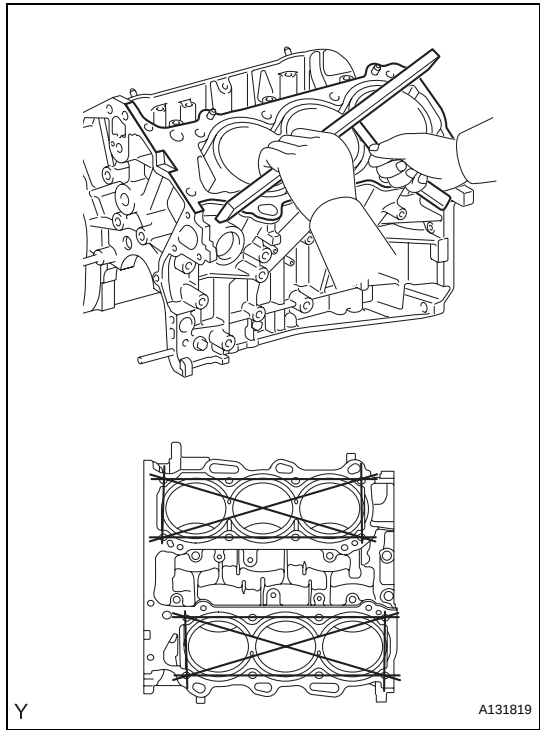
Item	Specified Condition
No. 1 journal	0.040 to 0.079 mm (0.0016 to 0.0031 in.)
Other journal	0.025 to 0.062 mm (0.0010 to 0.0024 in.)

Maximum oil clearance

Item	Specified Condition
No. 1 journal	0.10 mm (0.0039 in.)
Other journal	0.09 mm (0.0035 in.)

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

EM

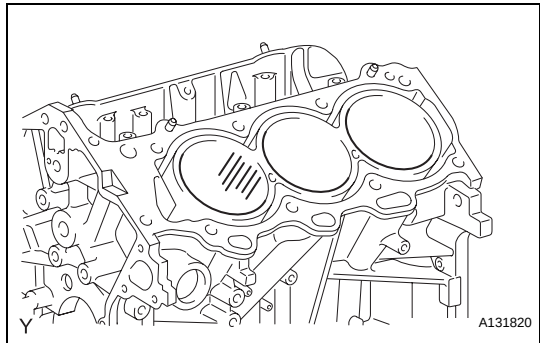


26. INSPECT CYLINDER BLOCK FOR WARPAGE

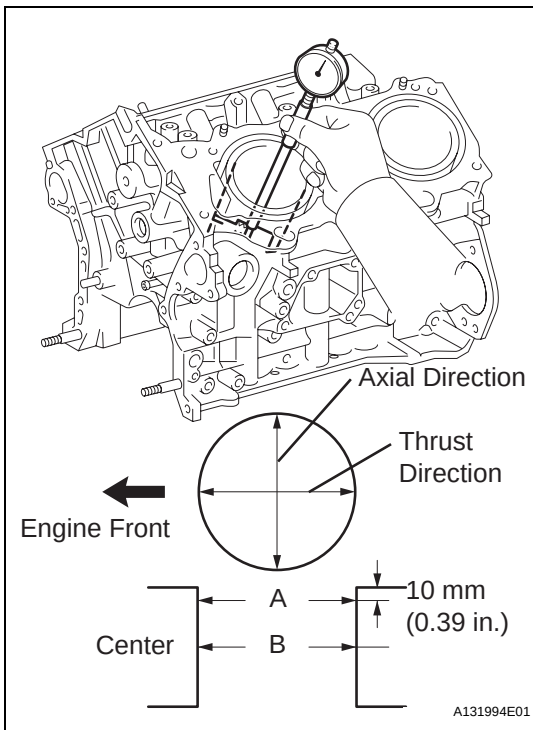
- (a) Using a precision straightedge and feeler gauge, measure the warpage of the contact surface of the cylinder head gasket.

Maximum warpage:
0.07 mm (0.0028 in.)

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



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

**27. INSPECT CYLINDER BORE**

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

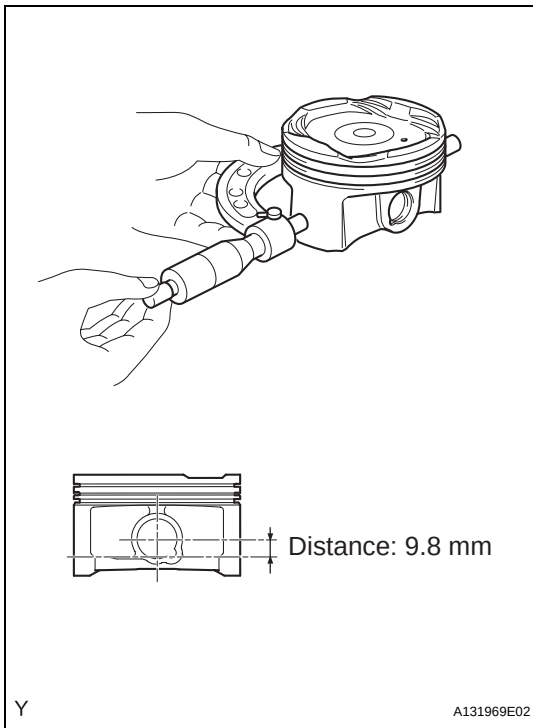
Standard diameter:

94.000 to 94.012 mm (3.7008 to 3.7013 in.)

Maximum diameter:

94.200 mm (3.7087 in.)

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

**28. INSPECT PISTON SUB-ASSEMBLY WITH PIN**

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

Distance:

9.8 mm (0.3858 in.)

Standard diameter:

93.960 to 93.980 mm (3.6992 to 3.6999 in.)

Maximum diameter:

93.830 mm (3.6941 in.)

29. INSPECT PISTON OIL CLEARANCE

- (a) Measure the cylinder bore diameter in the thrust direction.
- (b) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

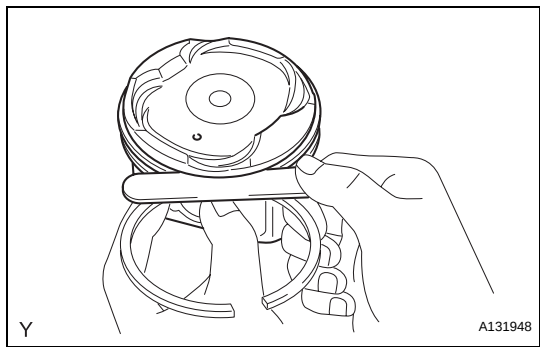
Standard oil clearance:

0.020 to 0.052 mm (0.0007 to 0.0020 in.)

Maximum oil clearance:

0.06 mm (0.0024 in.)

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



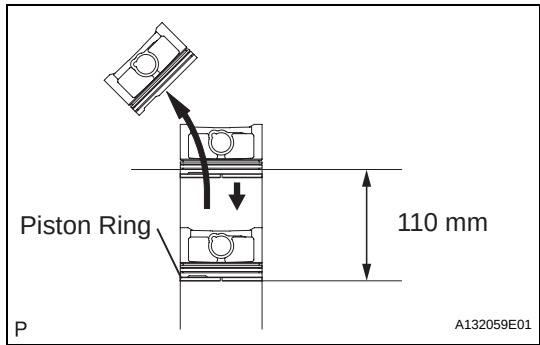
30. INSPECT RING GROOVE CLEARANCE

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

Standard ring groove clearance

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

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



31. INSPECT PISTON RING END GAP

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

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

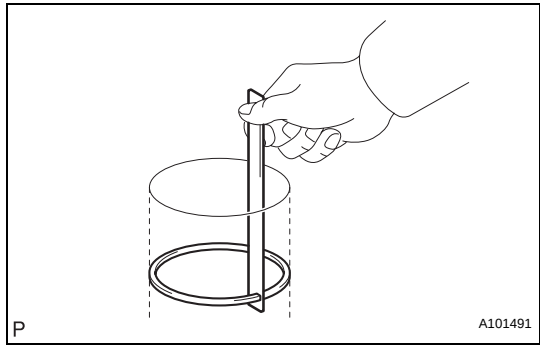
Standard end gap

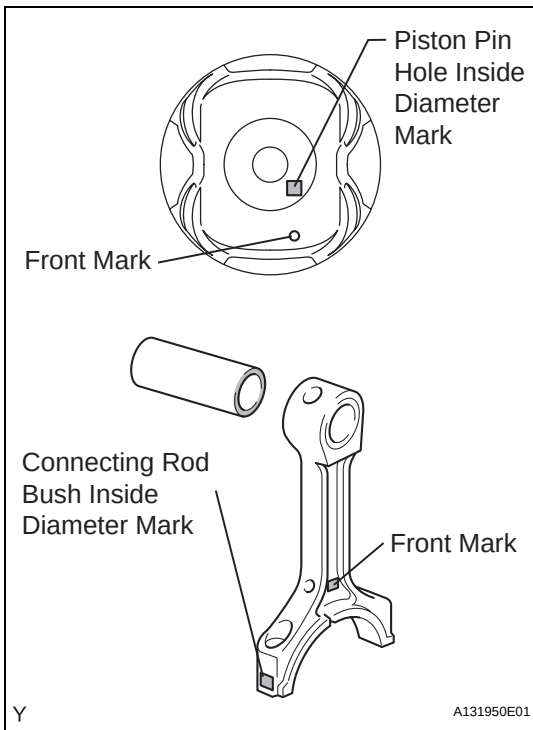
Item	Specified Condition
No. 1	0.25 to 0.35 mm (0.0098 to 0.0138 in.)
No. 2	0.50 to 0.60 mm (0.0197 to 0.0236 in.)
Oil	0.10 to 0.40 mm (0.0039 to 0.0157 in.)

Maximum end gap

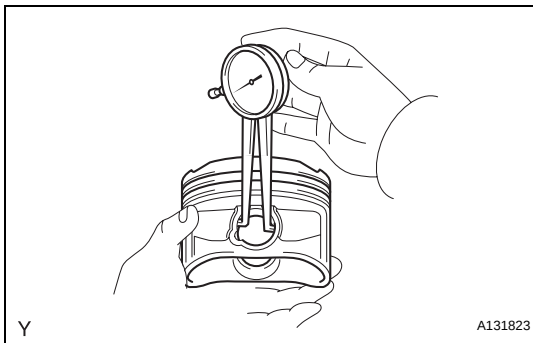
Item	Specified Condition
No. 1	0.50 mm (0.0197 in.)
No. 2	0.85 mm (0.0335 in.)
Oil	0.60 mm (0.0236 in.)

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



**32. INSPECT PISTON PIN OIL CLEARANCE**

- (a) Check each mark on the piston, piston pin and connecting rod.



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

Standard piston pin hole inside diameter

Mark	Specified Condition
A	22.001 to 22.004 mm (0.8662 to 0.8663 in.)
B	22.005 to 22.007 mm (0.8663 to 0.8664 in.)
C	22.008 to 22.010 mm (0.8665 to 0.8665 in.)

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

Standard piston pin diameter

Mark	Specified Condition
A	21.997 to 22.000 mm (0.8660 to 0.8661 in.)
B	22.001 to 22.003 mm (0.8662 to 0.8663 in.)
C	22.004 to 22.006 mm (0.8663 to 0.8664 in.)

- (d) Subtract the piston pin diameter measurement from the piston pin hole diameter measurement.

Standard oil clearance:

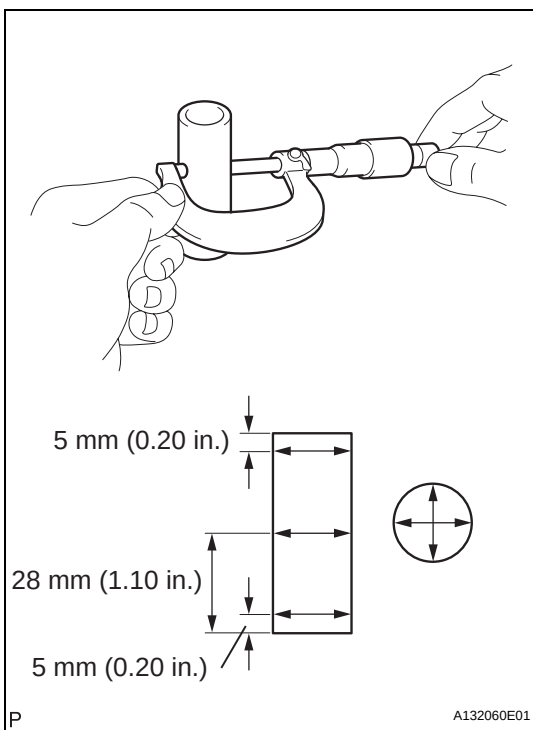
0.001 to 0.007 mm (0.00004 to 0.0003 in.)

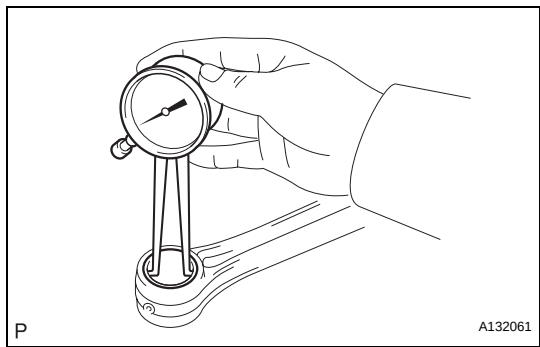
Maximum oil clearance:

0.015 mm (0.0006 in.)

HINT:

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





- (e) Using a caliper gauge, measure the inside diameter of the connecting rod bush.

Standard bush inside diameter

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

- (f) Subtract the piston pin diameter measurement from the bush inside diameter measurement.

Standard oil clearance:

0.005 to 0.011 mm (0.0002 to 0.0004 in.)

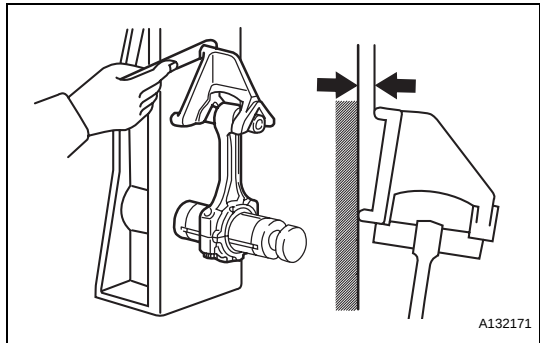
Maximum oil clearance:

0.03 mm (0.0012 in.)

HINT:

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

EM



33. INSPECT CONNECTING ROD SUB-ASSEMBLY

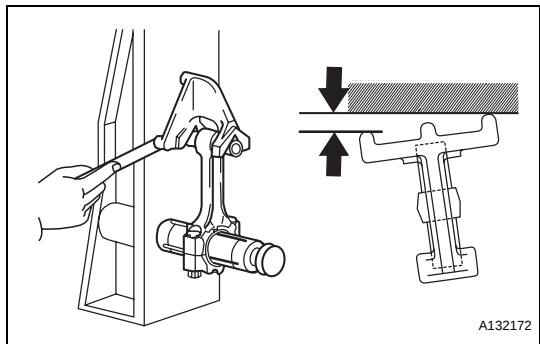
- (a) Using a rod aligner and feeler gauge, check the connecting rod alignment.

- (1) Check for bend.

Maximum bend:

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

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

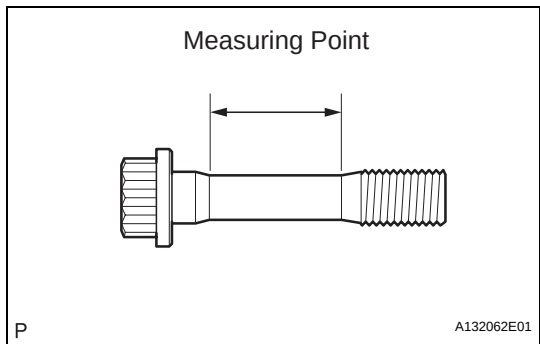


- (2) Check for twist.

Maximum twist:

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

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



34. INSPECT CONNECTING ROD BOLT

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

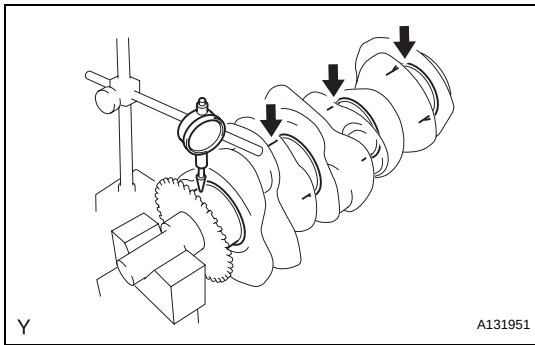
Standard diameter:

7.2 to 7.3 mm (0.283 to 0.287 in.)

Minimum diameter:

7.0 mm (0.276 in.)

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



35. INSPECT CRANKSHAFT

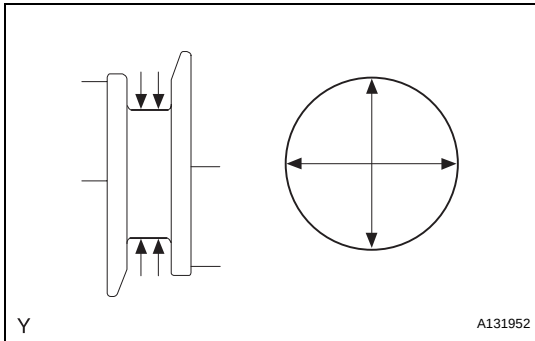
(a) Inspect for circle runout.

- (1) Place the crankshaft on the V-blocks.
- (2) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout:

0.06 mm (0.0024 in.)

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



(b) Inspect the main journals.

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

Standard journal diameter:

60.988 to 61.00 mm (2.4011 to 2.4016 in.)

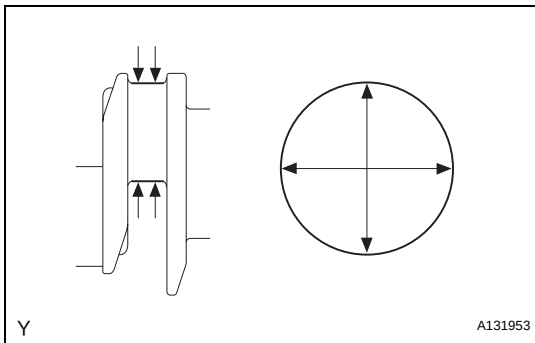
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

- (2) Check each main journal for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:

0.02 mm (0.0008 in.)

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



(c) Inspect the crank pin.

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

Standard crank pin diameter:

52.992 to 53.000 mm (2.0863 to 2.0866 in.)

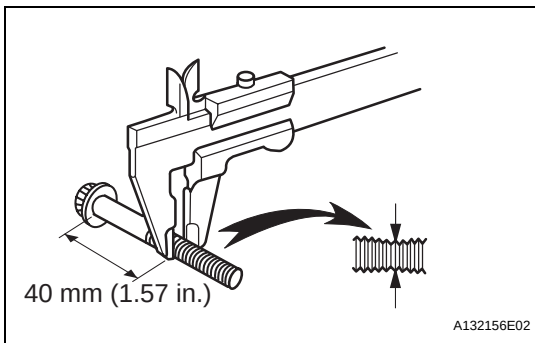
If the diameter is not as specified, check the oil clearance. If necessary, replace the crankshaft.

- (2) Check each crank pin for taper and out-of-round as shown in the illustration.

Maximum taper and out-of-round:

0.02 mm (0.0008 in.)

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



36. INSPECT CRANKSHAFT BEARING CAP SET BOLT

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

Standard diameter:

10.8 to 11.0 mm (0.4252 to 0.4331 in.)

Minimum diameter:

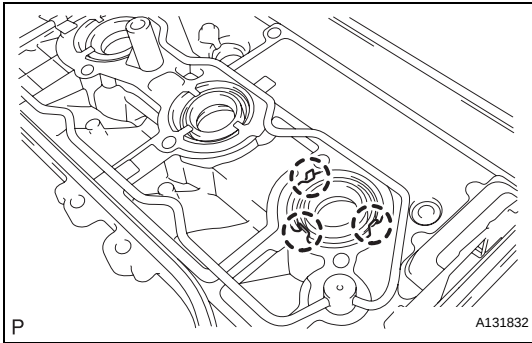
10.70 mm (0.4213 in.)

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

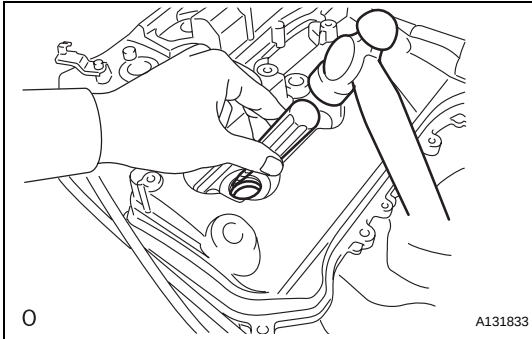
REPLACEMENT

1. REPLACE SPARK PLUG TUBE GASKET

- (a) Pry up the claws of the ventilation baffle plate.



- (b) Using a screwdriver with its tip taped and a hammer, tap out the 6 spark plug tube gaskets.

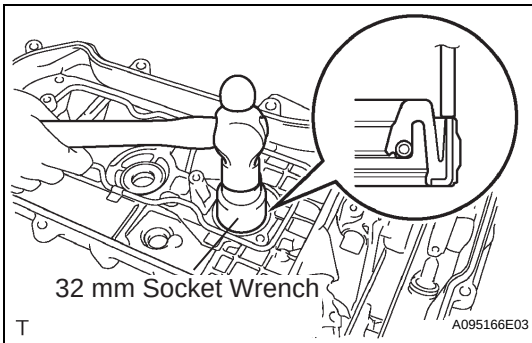


- (c) Using a 32 mm socket wrench, tap in 6 new spark plug tube gaskets to the head covers.

NOTICE:

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

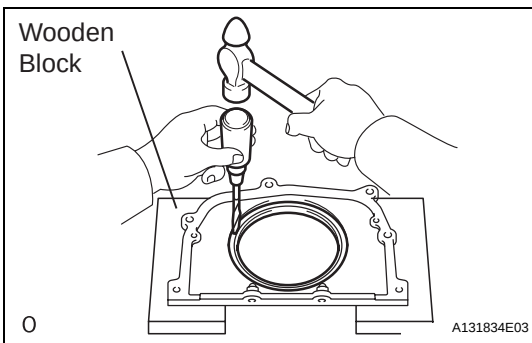
- (d) Return the claw of the ventilation baffle plate to its original position.



2. REPLACE ENGINE REAR OIL SEAL

- (a) Place the oil seal retainer on wooden blocks.

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

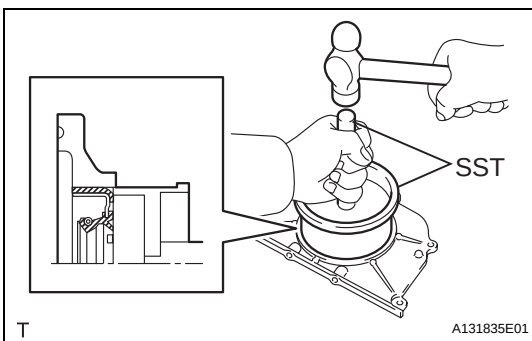


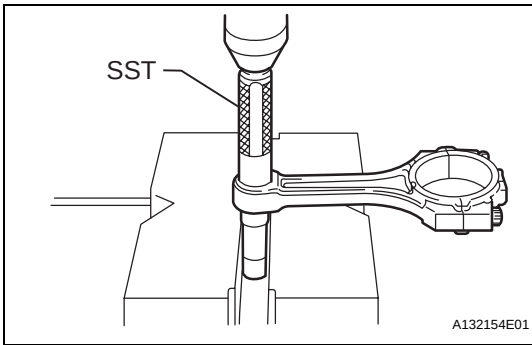
- (c) Using SST, tap in a new oil seal until its surface is flush with the oil seal retainer edge.

SST 09223-15030

NOTICE:

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

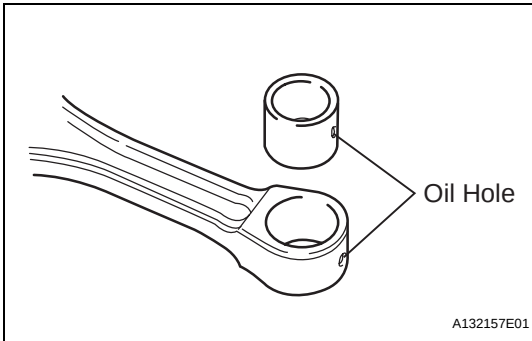




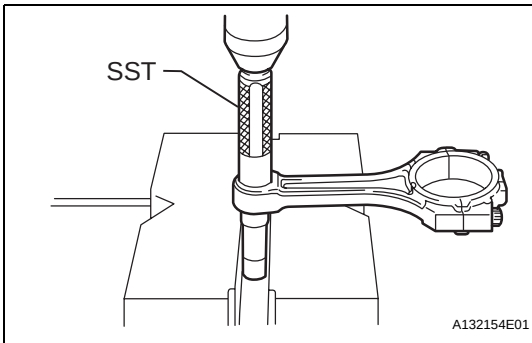
3. REPLACE CONNECTING ROD SMALL END BUSH

- (a) Using SST and a press, push out the bush.

SST 09222-30010

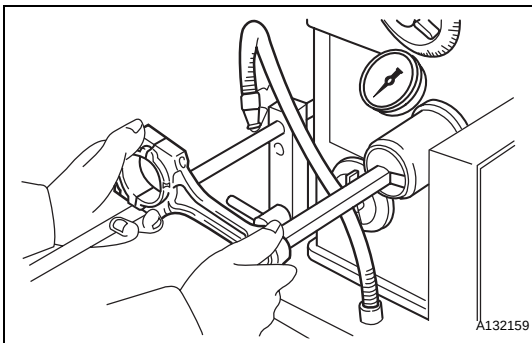


- (b) Align the oil holes of the new bush and connecting rod.

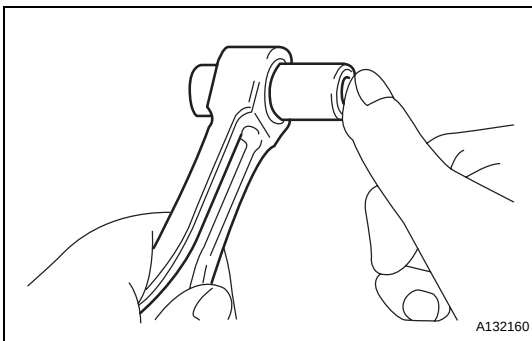


- (c) Using SST and a press, push in the bush.

SST 09222-30010



- (d) Using a pin hole grinder, hone the bush to obtain the standard specified clearance between the bush and piston pin.

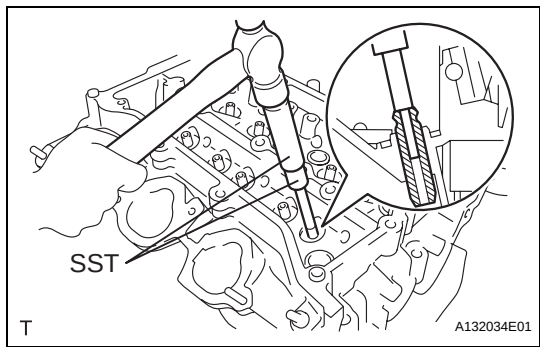


- (e) Coat the piston pin with engine oil. Push the piston pin into the connecting rod with your thumb to check that the piston pin fits at normal room temperature.

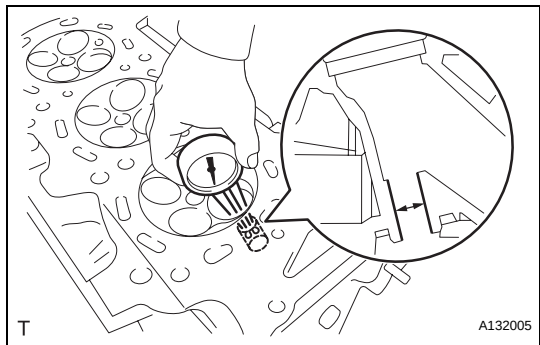
4. REPLACE INTAKE VALVE GUIDE BUSH

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

- (b) Place the cylinder head on wooden blocks.



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



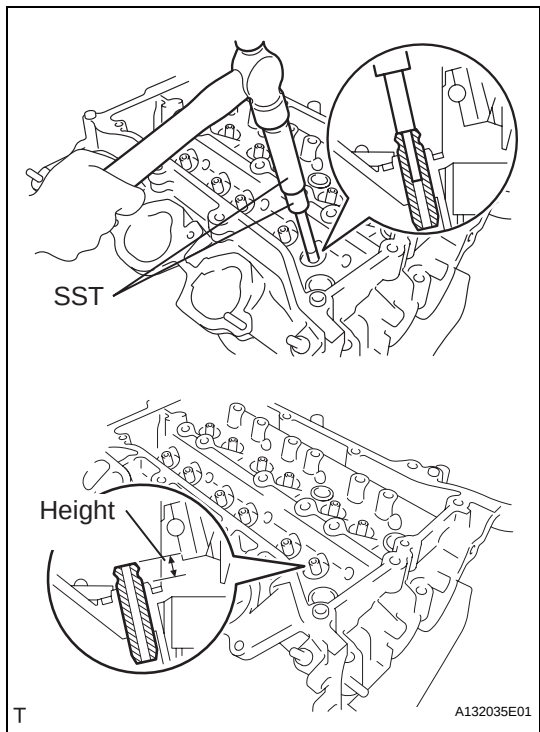
- (d) Using a caliper gauge, measure the bush bore diameter of the cylinder head.
Standard cylinder bore diameter:
10.285 to 10.306 mm (0.4049 to 0.4057 in.)
(e) Select a new guide bush (STD or O/S 0.05).
Standard bush bore diameter

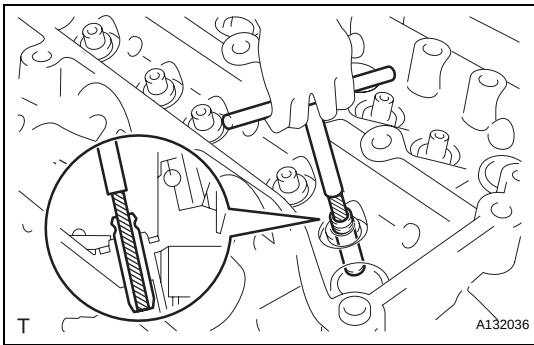
Bush Size	Specified Condition
Use STD	10.335 to 10.356 mm (0.4069 to 0.4077 in.)
Use O/S 0.05	10.285 to 10.306 mm (0.4049 to 0.4057 in.)

HINT:

- If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), machine the bush bore diameter to between 10.383 to 10.394 mm (0.4088 to 0.4092 in.).
 - If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), replace the cylinder head.
- (f) Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).
- (g) Using SST and a hammer, tap in a new guide bush to the specified protrusion height.

Standard protrusion height:
9.1 to 9.9 mm (0.3582 to 0.3900 in.)
SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

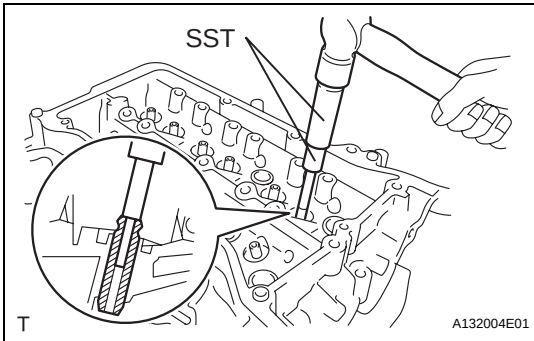




- (h) Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard specified clearance between the guide bush and valve stem.

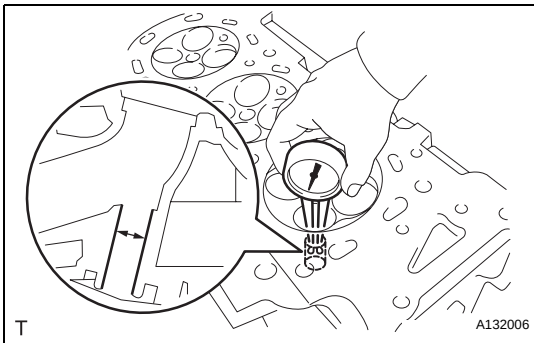
5. REPLACE EXHAUST VALVE GUIDE BUSH

- (a) Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).
 (b) Place the cylinder head on wooden blocks.



- (c) Using SST and a hammer, tap out the valve guide bush.

SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)



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

Standard cylinder bore diameter:

10.285 to 10.306 mm (0.4049 to 0.4057 in.)

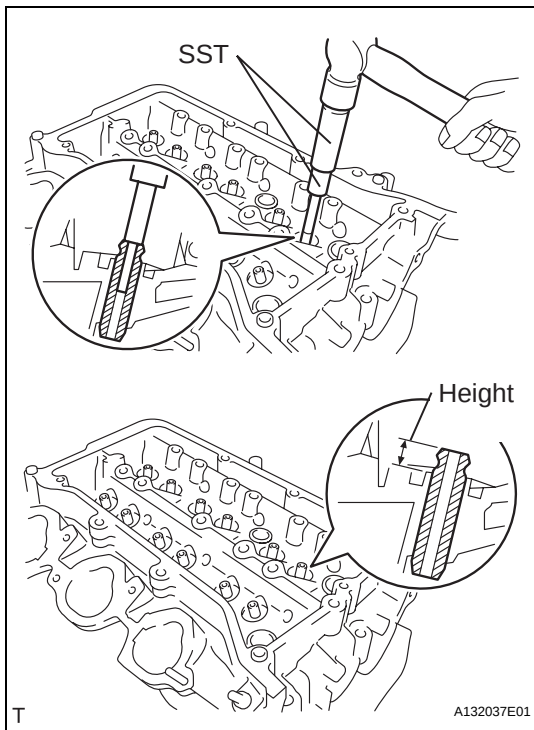
- (e) Select a new guide bush (STD or O/S 0.05).

Standard bush bore diameter

Bush Size	Specified Condition
Use STD	10.335 to 10.356 mm (0.4069 to 0.4077 in.)
Use O/S 0.05	10.285 to 10.306 mm (0.4049 to 0.4057 in.)

HINT:

- If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), machine the bush bore diameter to between 10.383 to 10.394 mm (0.4088 to 0.4092 in.).
 - If the bush bore diameter of the cylinder head is greater than 10.344 mm (0.4072 in.), replace the cylinder head.
- (f) Heat the cylinder head to approximately 80 to 100°C (176 to 212°F).

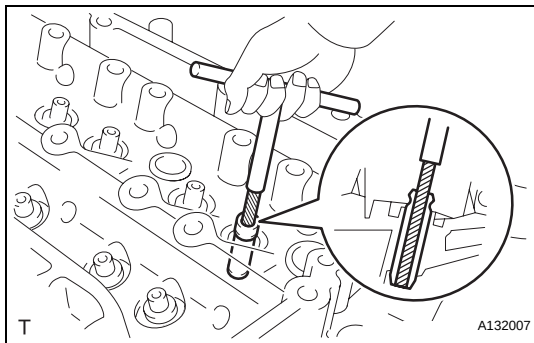


- (g) Using SST and a hammer, tap in a new guide bush to the specified protrusion height.

SST 09201-10000 (09201-01050), 09950-70010 (09951-07100)

Standard protrusion height:

9.30 to 9.70 mm (0.3661 to 0.3819 in.)



- (h) Using a sharp 5.5 mm reamer, ream the guide bush to obtain the standard specified clearance between the guide bush and valve stem.

6. REPLACE CYLINDER BLOCK TIGHT PLUG

NOTICE:

If water leaks from the tight plug or the plug corrodes, replace it.

- (a) Remove the tight plugs.

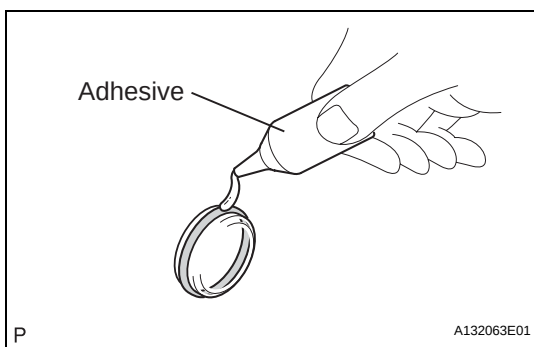
- (b) Apply adhesive around the tight plug.

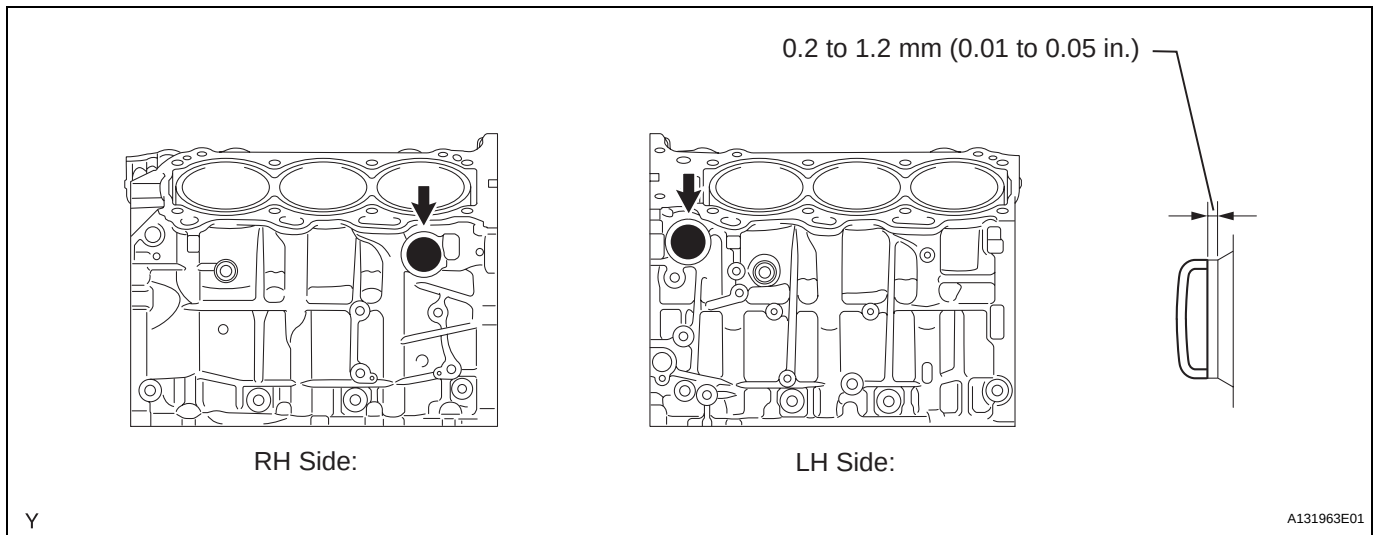
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent

- (c) Using SST and a hammer, tap in 2 new tight plugs as shown in the illustration.

SST 09950-60010 (09951-00340), 09950-70010 (09951-07100)





7. REPLACE CYLINDER BLOCK STUD BOLT

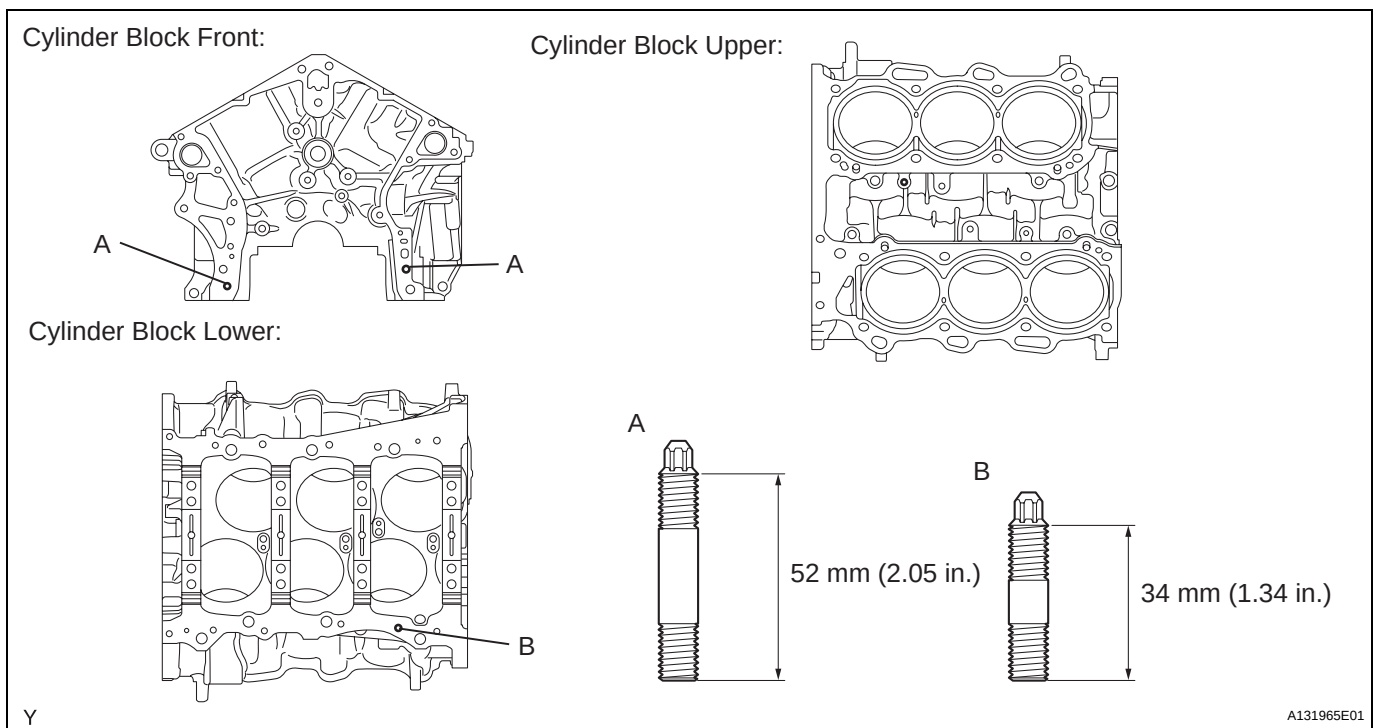
NOTICE:

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

- Remove the stud bolts.
- Using an E8 "torx" socket wrench, install the stud bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

EM



8. REPLACE CYLINDER BLOCK STRAIGHT PIN

NOTICE:

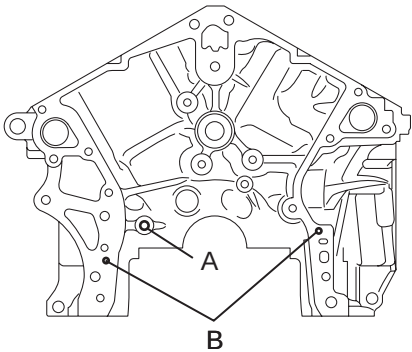
It is not necessary to remove the straight pin unless it is being replaced.

- Remove the straight pin.

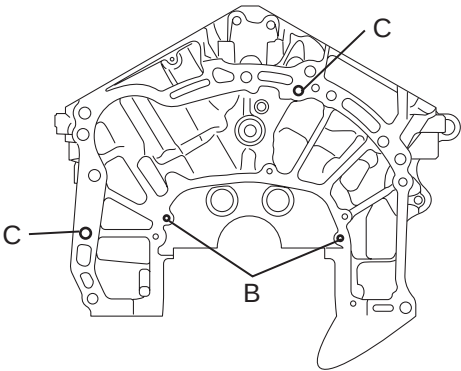
- (b) Using a plastic-faced hammer, tap in new straight pins to the cylinder block.
- Standard protrusion**

Item	Specified Condition
Pin A	23 mm (0.91 in.)
Pin B	6 mm (0.24 in.)
Pin C	11 mm (0.43 in.)
Pin D	9 mm (0.35 in.)

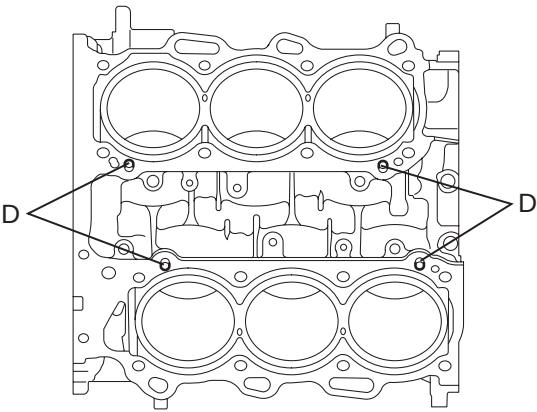
Cylinder Block Front:



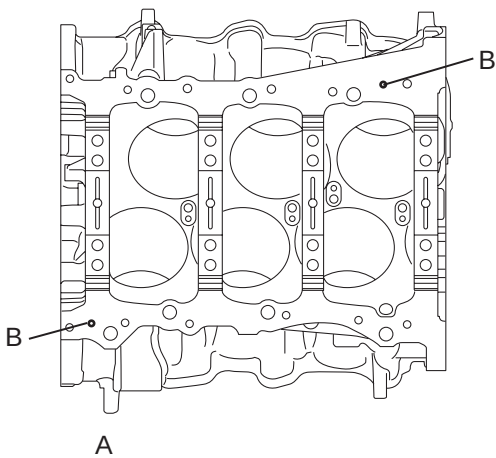
Cylinder Block Rear:



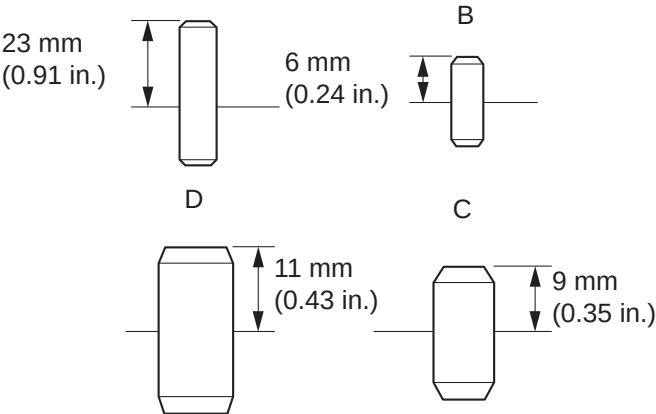
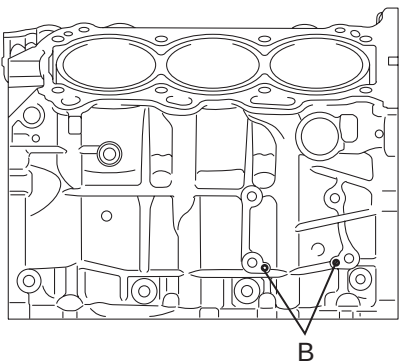
Cylinder Block Upper:



Cylinder Block Lower:



Cylinder Block RH Side:



9. REPLACE CYLINDER HEAD RING PIN**NOTICE:**

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

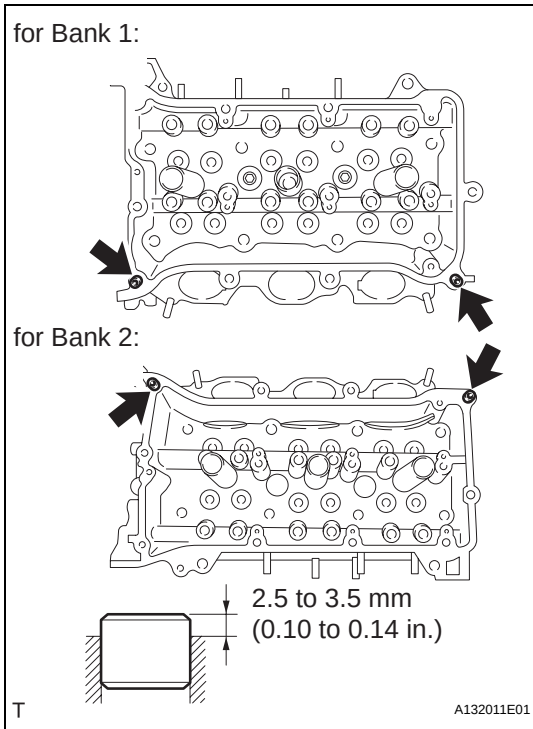
- (a) Remove the ring pins.
- (b) Using a plastic-faced hammer, tap in a new ring pin until the pin stops.

10. REPLACE CYLINDER HEAD STUD BOLT**NOTICE:**

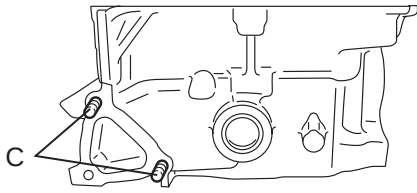
If a stud bolt is deformed or the threads are damaged, replace it.

- (a) Remove the stud bolts.
- (b) Using E6 and E8 "torx" socket wrenches, install the stud bolts.

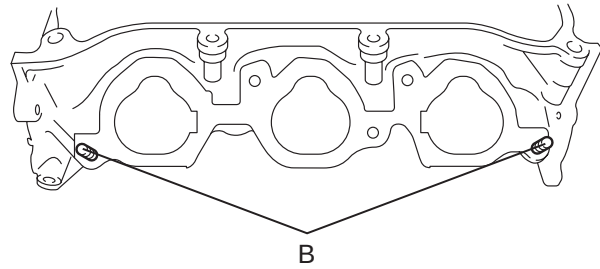
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf) for stud bolts A and B
4.0 N*m (41 kgf*cm, 35 in.*lbf) for stud bolt C

EM

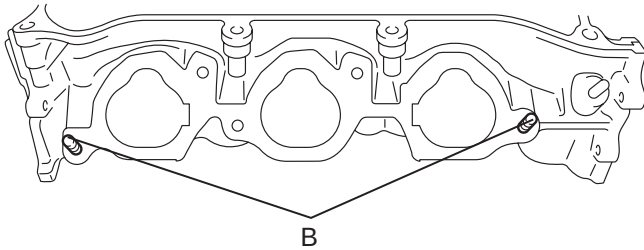
for Bank 1 Rear Side:



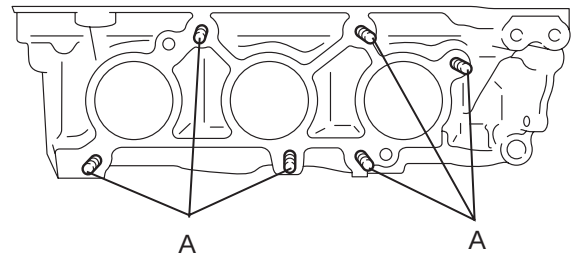
for Bank 1 Intake Side:



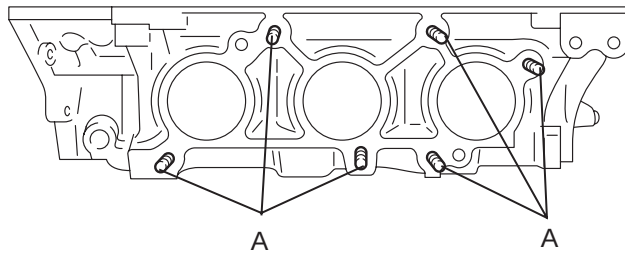
for Bank 2 Intake Side:



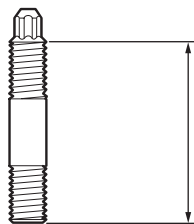
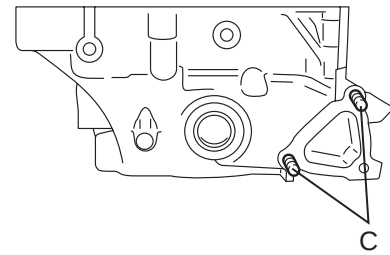
for Bank 1 Exhaust Side:



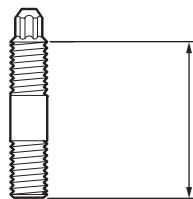
for Bank 2 Exhaust Side:



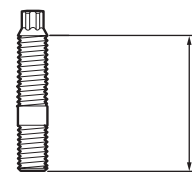
for Bank 2 Rear Side:



A



B



C

27 mm (1.06 in.)

T

A132039E01

11. REPLACE CYLINDER HEAD SET STRAIGHT PIN**NOTICE:**

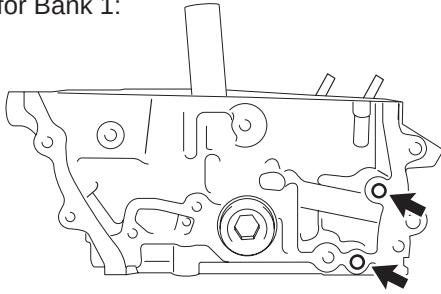
It is not necessary to remove the straight pin unless it is being replaced.

- (a) Using a plastic-faced hammer, tap in a new straight pin as shown in the illustration.

Standard protrusion height:

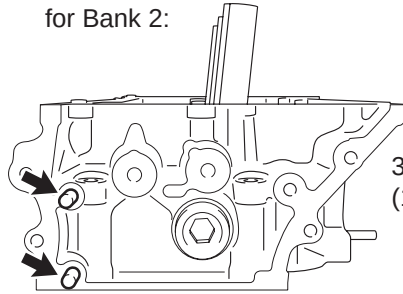
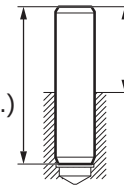
18.0 to 19.0 mm (0.71 to 0.75 in.)

for Bank 1:



T

for Bank 2:

34 mm
(1.34 in.)18.0 to 19.0 mm
(0.71 to 0.75 in.)

A132040E01

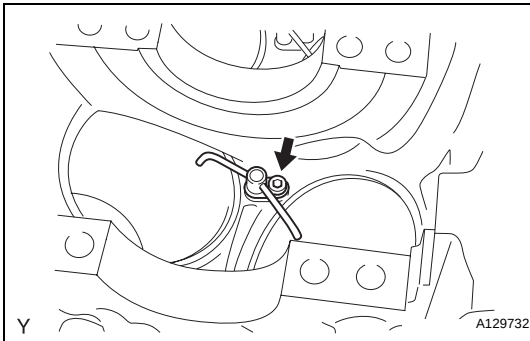
REASSEMBLY

1. INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY

- (a) Using a 5 mm hexagon wrench, install the 3 oil nozzles with the bolts.

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

EM



Y

A129732

2. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

- (a) Apply adhesive around the drain cocks.

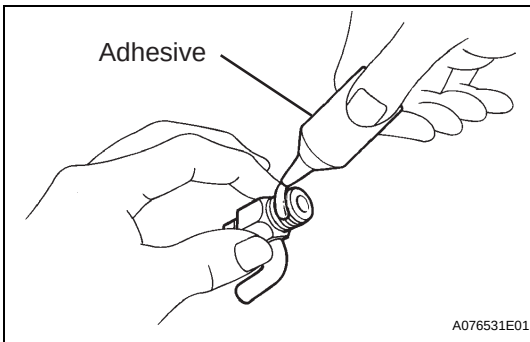
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent

- (b) Install the cylinder block water drain cocks.

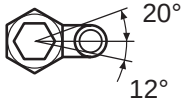
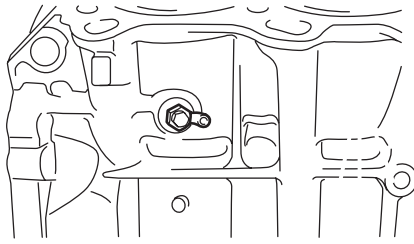
- (1) Temporarily install the drain cocks.

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

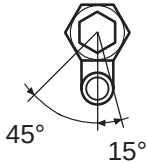
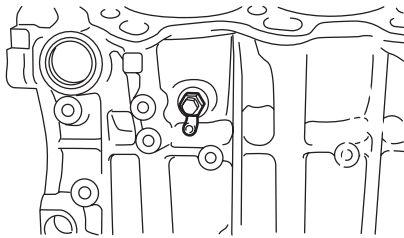


A076531E01

RH Side:



LH Side:



A131970E01

- (2) Within one full rotation, tighten the drain cock to the angle shown in the illustration.

Torque: 45 N*m (459 kgf*cm, 33 ft.*lbf)

NOTICE:

Do not loosen the drain cock to adjust it. If an adjustment is necessary, remove the drain cock and reinstall it.

- (c) Install the water drain cock plug to the water drain cocks.

Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

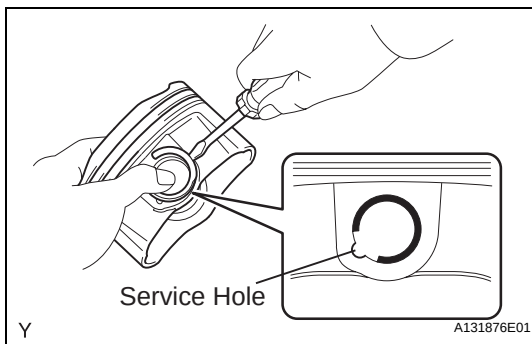
EM

3. INSTALL PISTON WITH PIN SUB-ASSEMBLY

- (a) Using a screwdriver, install a new snap ring at one end of the piston pin hole.

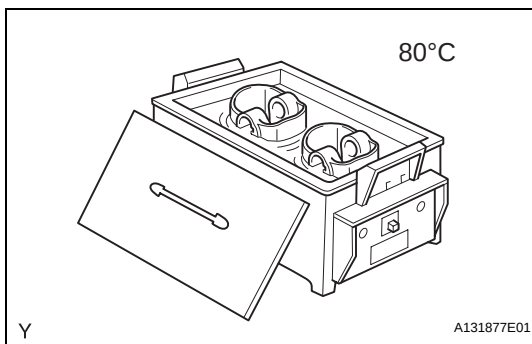
HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



Y

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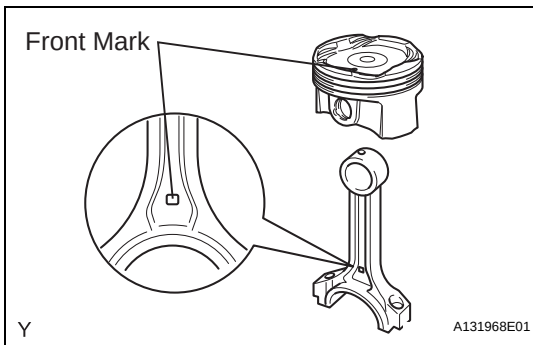


Y

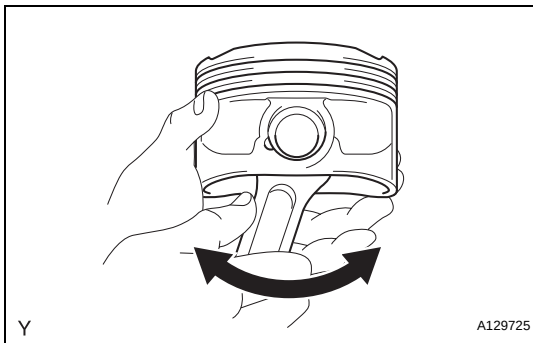
A131877E01

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

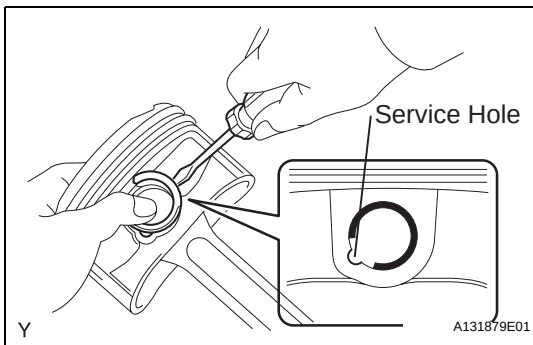
- (c) Coat the piston pin with engine oil.



- (d) Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.
HINT:
The piston and pin are a matched set.



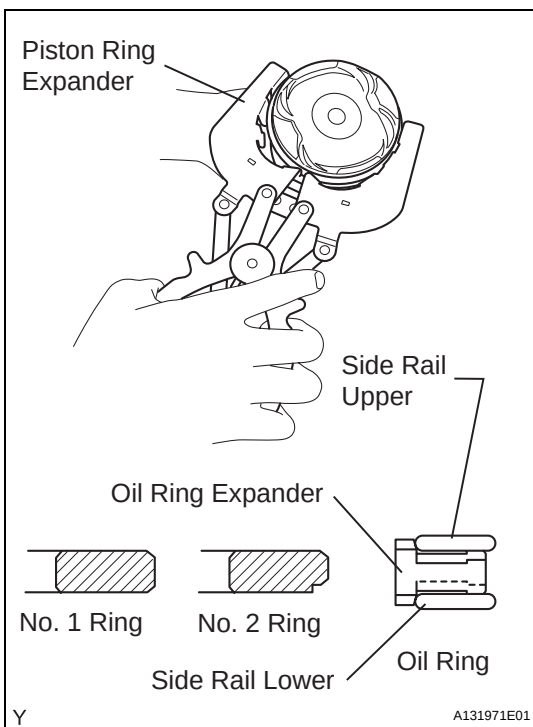
- (e) Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.



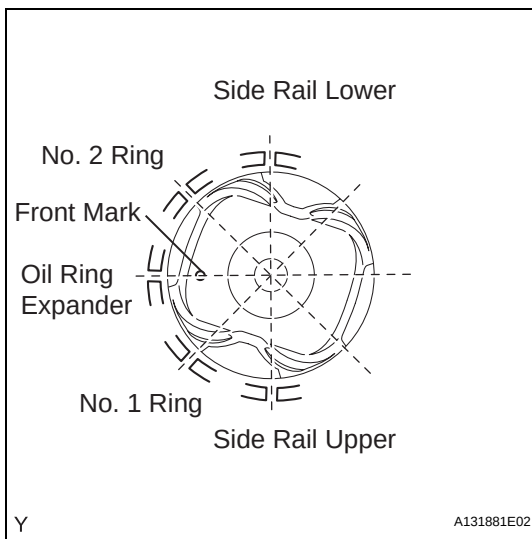
- (f) Using a screwdriver, install a new snap ring at the other end of the piston pin hole.
HINT:
Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.

4. INSTALL PISTON RING SET

- (a) Install the oil ring expander and 2 side rails by hand.



- (b) Using a piston ring expander, install the 2 compression rings so that the painted marks are positioned as shown in the illustration.



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

NOTICE:

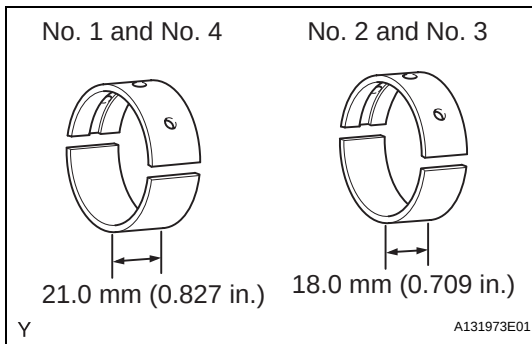
Do not align the ring ends.

5. INSTALL CRANKSHAFT BEARING

NOTICE:

Main bearings come in widths between 18.0 mm (0.709 in.) and 21.0 mm (0.827 in.). Install the 21.0 mm (0.827 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing cap. Install the 18.0 mm (0.709 in.) bearings in the No. 2 and No. 3 positions.

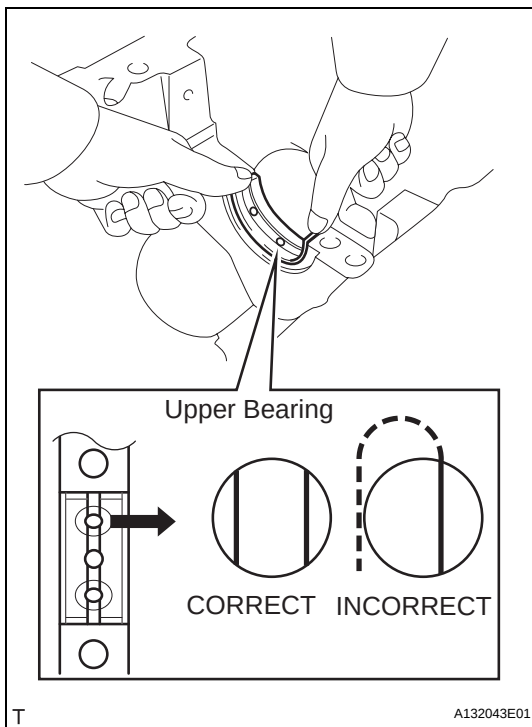
- (a) Clean the main journal and both surfaces of the bearing.

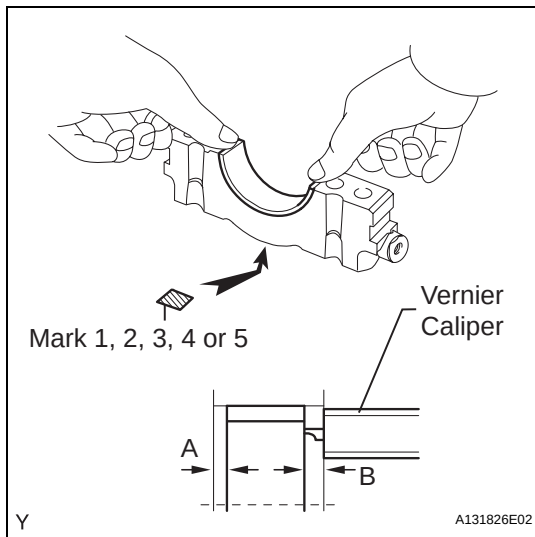


- (b) Install the upper bearing.
- (1) Install the upper bearing to the cylinder block as shown in the illustration.

NOTICE:

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





(c) Install the lower bearing.

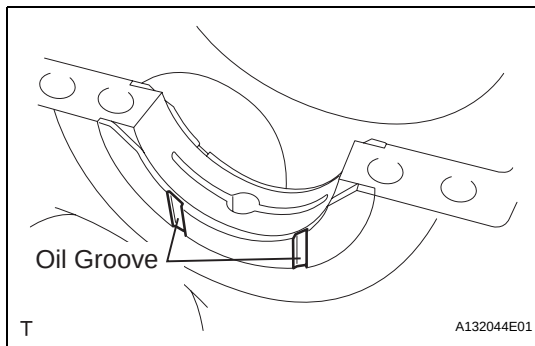
- (1) Install the lower bearing to the bearing cap.
- (2) Using a vernier caliper, measure the distance between the bearing cap's edge and the lower bearing's edge.

Dimension (A - B):

0.7 mm (0.028 in.) or less.

NOTICE:

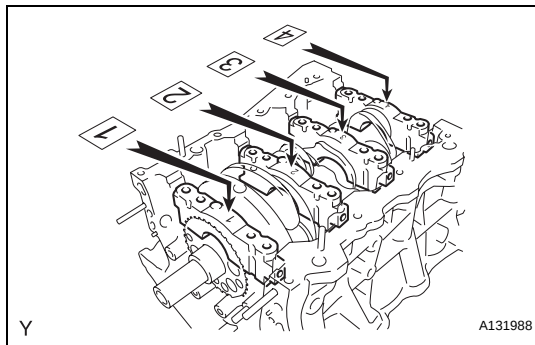
Do not apply engine oil to the bearing's contact area and underside.



6. INSTALL CRANKSHAFT

- (a) Install the 2 thrust washers under the No. 2 journal position of the cylinder block with the oil grooves facing outward.
- (b) Apply engine oil to the upper bearing, then place the crankshaft on the cylinder block.

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- (c) Confirm the front marks and numbers of the main bearing caps and install the bearing caps on the cylinder block.

HINT:

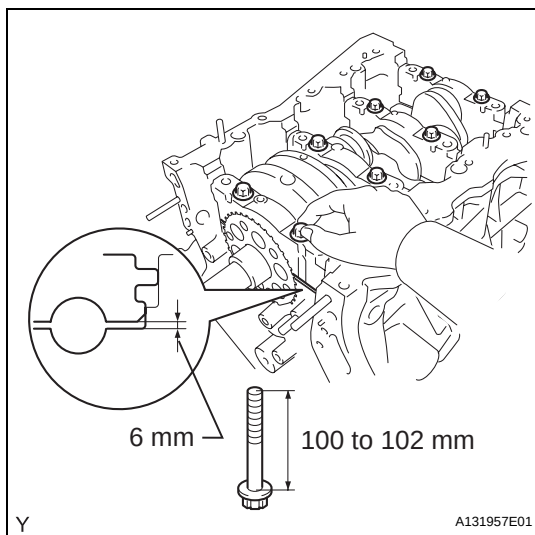
A number is marked on each main bearing cap to indicate the installation position.

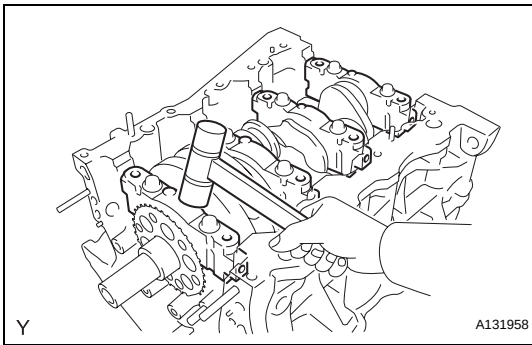
- (d) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
- (e) Temporarily install the 8 main bearing cap bolts to the inside positions.

- (f) Insert the main bearing cap by hand until the clearance between the main bearing cap and the cylinder block is less than 6 mm (0.23 in.) by marking the 2 internal bearing cap bolts as a guide.

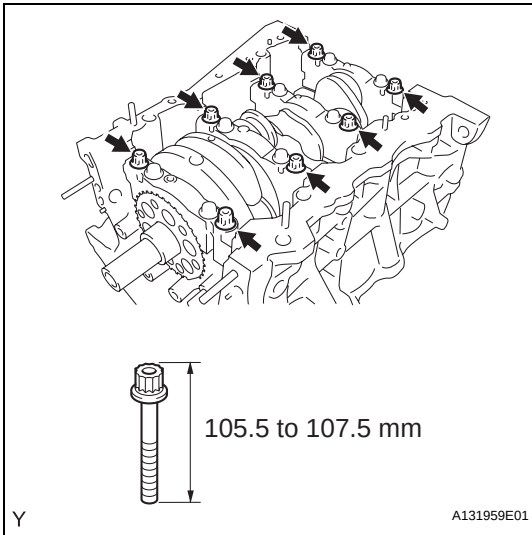
Bolt length:

100.0 to 102.0 mm (3.937 to 4.016 in.)





- (g) Using a plastic-faced hammer, lightly tap the bearing cap to ensure a proper fit.
- (h) Apply a light coat of engine oil to the threads and under the heads of the 8 main bearing cap bolts.



- (i) Install the 8 main bearing cap bolts to the outside positions.

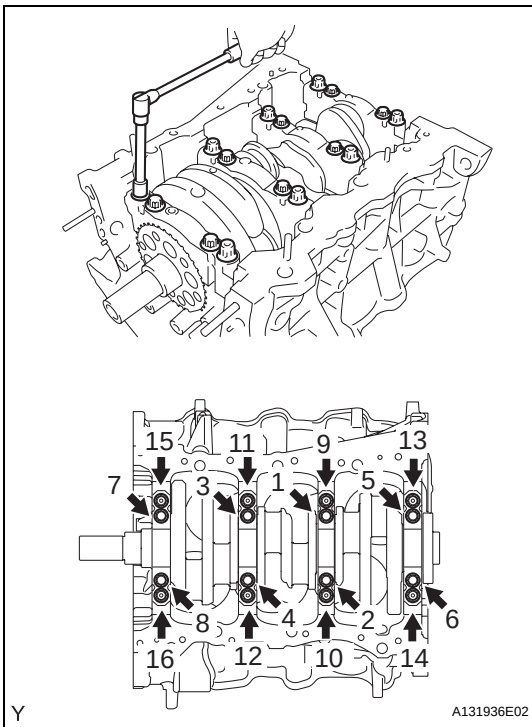
Bolt length:

105.5 to 107.5 mm (4.154 to 4.232 in.)

- (j) Install the crankshaft bearing cap bolts.

HINT:

The main bearing cap bolts are tightened in 2 progressive steps.

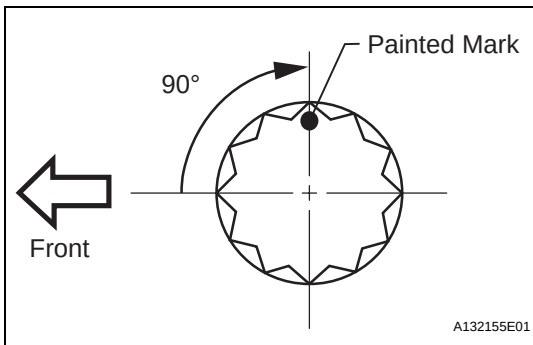


- (k) Step 1

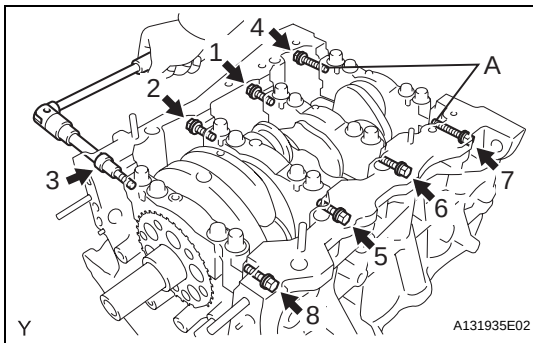
- (1) Install and uniformly tighten the 16 main bearing cap bolts in the sequence shown in the illustration.

Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)

If any of the main bearing cap bolts does not meet the specified torque, replace it.



- (l) Step 2
 - (1) Mark the front of the bearing cap bolts with paint.
 - (2) Tighten the bearing cap bolts another 90° in the order shown in step 1.
 - (3) Check that the painted mark is now at a 90° angle to the front.
- (m) Check that the crankshaft turns smoothly.



- (n) Install and uniformly tighten the 8 main bearing cap bolts in several steps, in the sequence shown in the illustration.

Torque: 52 N*m (530 kgf*cm, 38 ft.*lbf)

Bolt length:

45 mm (1.77 in.) for bolt A

30 mm (1.18 in.) for except bolt A

- (o) Check that the crankshaft turns smoothly.

7. INSTALL CONNECTING ROD BEARING

- (a) Install the connecting rod bearing to the connecting rod and bearing cap.
- (b) Using a vernier caliper, measure the distance between the connecting rod's and bearing cap's edges, and each connecting rod bearing's edge.

Dimension (A - B):

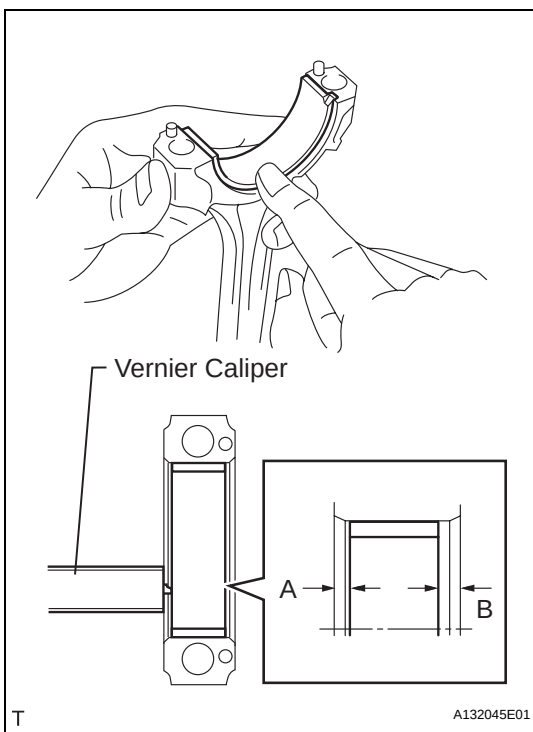
0.7 mm (0.028 in.) or less

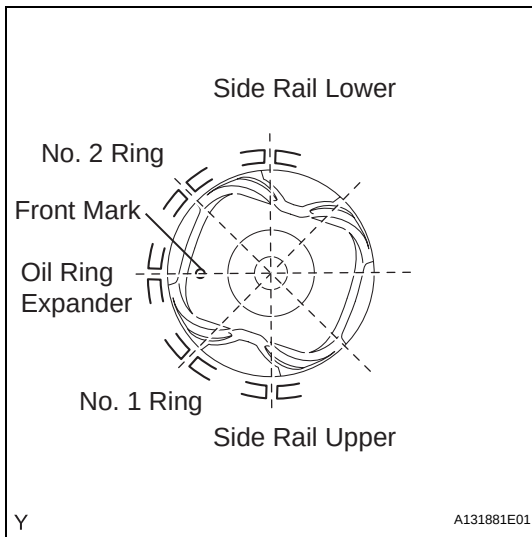
NOTICE:

Do not apply engine oil to the bearing's contact area and underside.

8. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD

- (a) Apply engine oil to the cylinder walls, the pistons, and the surfaces of the connecting rod bearings.

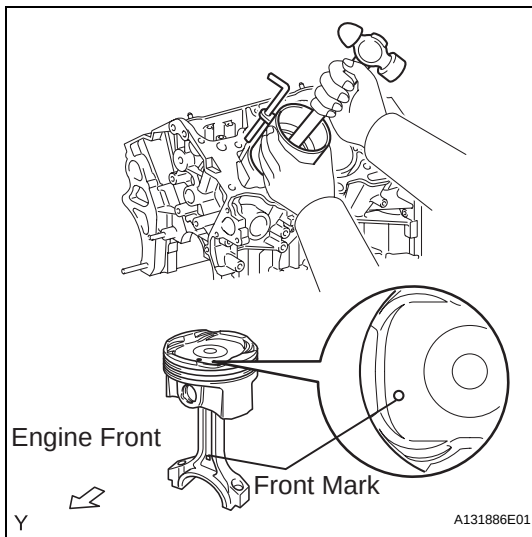




- (b) Position the piston rings so that the ring ends are as shown in the illustration.

NOTICE:

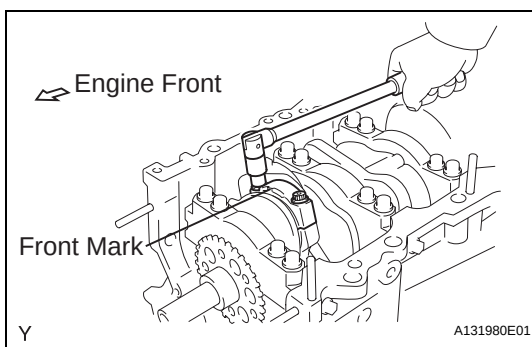
Do not align the ring ends.



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

NOTICE:

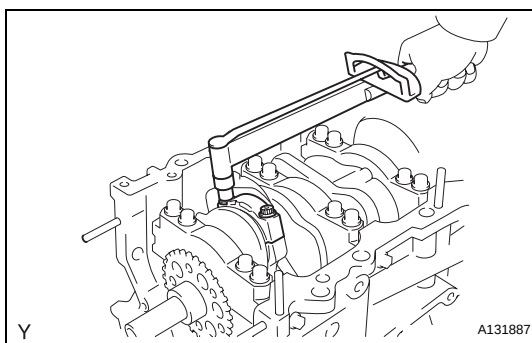
Match the numbered connecting rod cap with the connecting rod.



- (d) Check that the front mark of the connecting rod cap is facing forward.
- (e) Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.
- (f) Install the connecting cap bolts.

HINT:

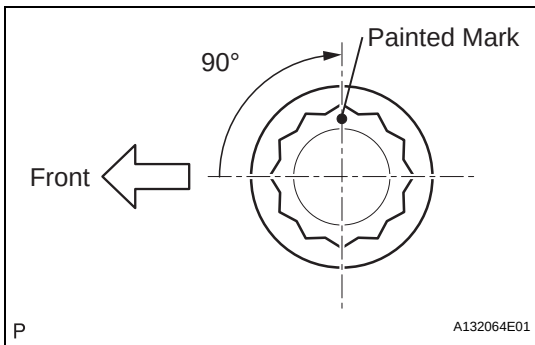
The connecting cap bolts are tightened in 2 progressive steps.



- (g) Step 1

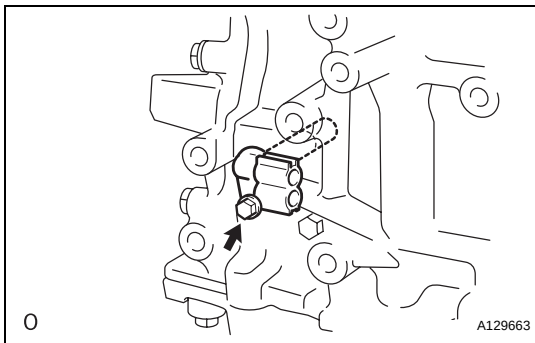
- (1) Install and alternately tighten the bolts of the connecting rod cap in several steps.

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)



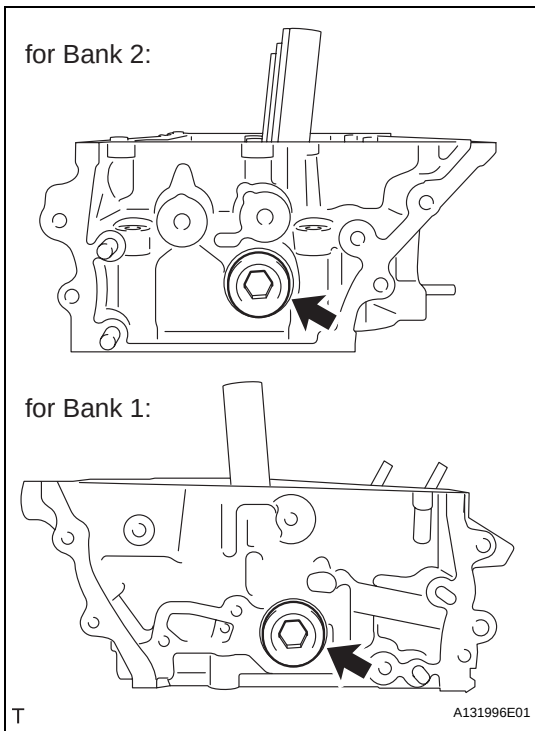
(h) Step 2

- (1) Mark the front side of each connecting cap bolt with paint.
 - (2) Tighten the cap bolts another 90° as shown in the illustration in the order in step 1.
 - (3) Check that the painted mark is now at a 90° angle to the front.
- (i) Check that the crankshaft turns smoothly.



9. INSTALL CRANKSHAFT POSITION SENSOR

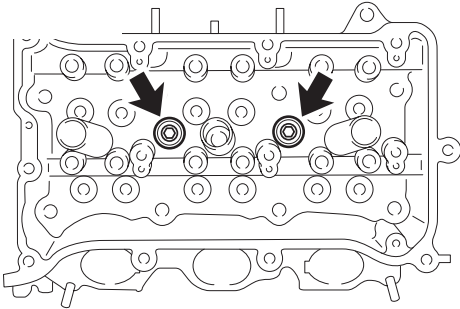
- (a) Install the crankshaft position sensor with the bolt.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)



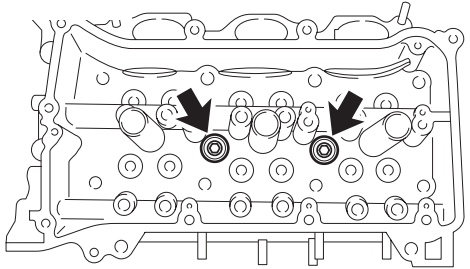
10. INSTALL NO. 2 STRAIGHT SCREW PLUG

- (a) Using a 14 mm hexagon wrench, install 2 new gaskets and the 2 straight screw plugs.
Torque: 80 N*m (816 kgf*cm, 59 ft.*lbf)

for Bank 1:



for Bank 2:



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11. INSTALL NO. 1 STRAIGHT SCREW PLUG

- (a) Using a 10 mm hexagon wrench, install 4 new gaskets and the straight screw plugs.

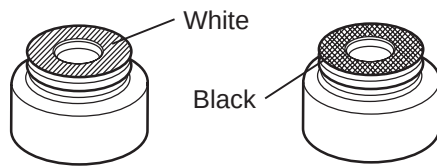
Torque: 44 N*m (449 kgf*cm, 32 ft.*lbf)

12. INSTALL VALVE SPRING SEAT

- (a) Install the valve spring seats to the cylinder head.

Intake Side

Exhaust Side



White
Black

A131926E01

13. INSTALL INTAKE VALVE STEM OIL SEAL

- (a) Apply a light coat of engine oil to new oil seals.

NOTICE:

Pay attention when installing the intake and exhaust oil seals. For example, installing the intake oil seal into the exhaust side or installing the exhaust oil seal to the intake side can cause installation problems later.

HINT:

The intake valve oil seals are white and the exhaust valve oil seals are black.

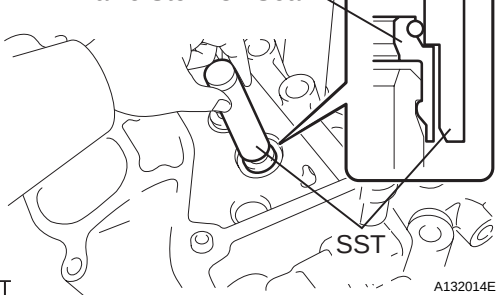
- (b) Using SST, push in the oil seals.

SST 09201-41020

NOTICE:

Failure to use SST will cause the seal to be damaged or improperly seated.

Valve Stem Oil Seal



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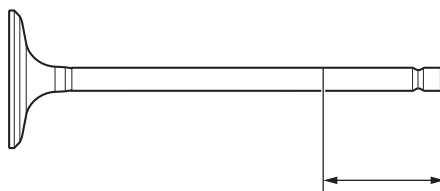
14. INSTALL INTAKE VALVE

- (a) Apply plenty of engine oil to the tip area of the intake valve shown in the illustration.

- (b) Install the valve, compression spring and spring retainer to the cylinder head.

NOTICE:

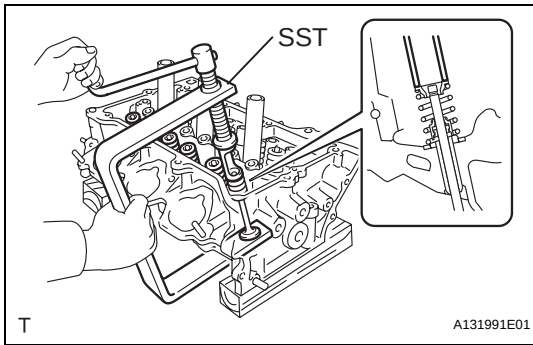
Install the same parts in the same combination to original locations.



40 mm (1.57 in.) or more

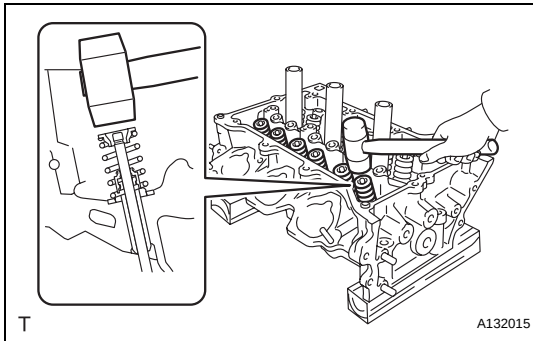
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- (c) Using SST and wooden blocks, compress the spring and install the retainer lock.

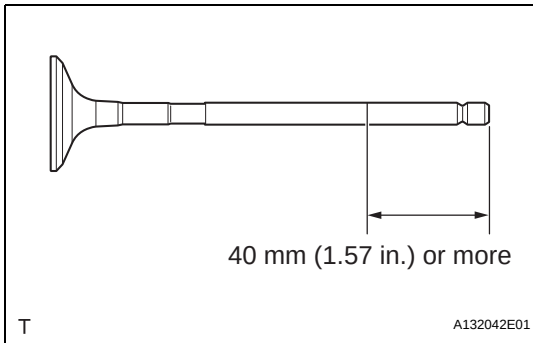
SST 09202-70020 (09202-00010)



- (d) Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the retainer.

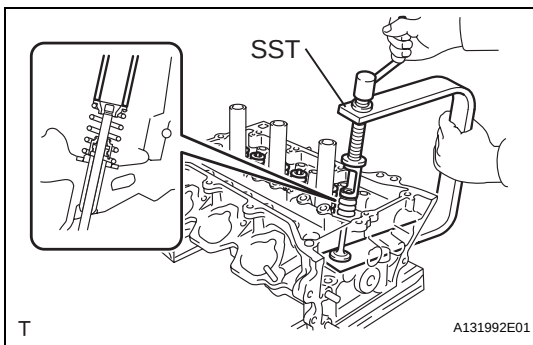


15. INSTALL EXHAUST VALVE

- (a) Apply plenty of engine oil to the tip area of the exhaust valve shown in the illustration.
(b) Install the valve, compression spring and spring retainer to the cylinder head.

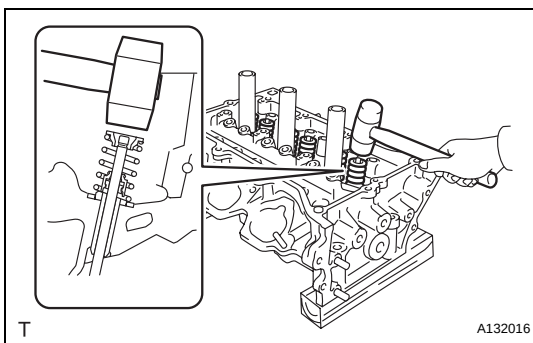
NOTICE:

Install the same parts in the same combination to their original locations.



- (c) Using SST and wooden blocks, compress the spring and install the retainer lock.

SST 09202-70020 (09202-00010)



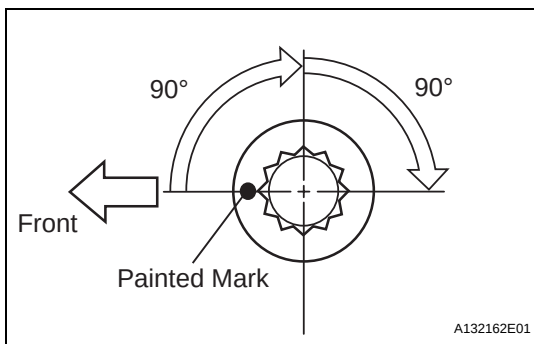
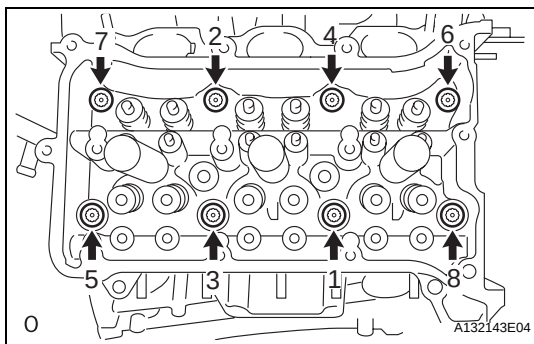
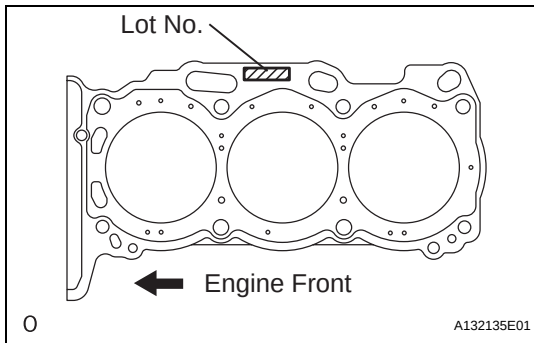
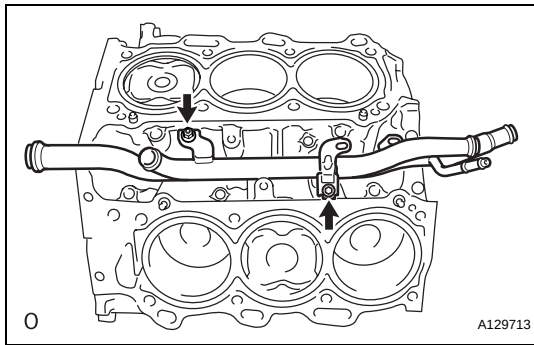
- (d) Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the retainer.

16. INSTALL VALVE STEM CAP

- (a) Apply a light coat of engine oil to the valve stem caps.
(b) Install the valve stem caps to the cylinder head.



17. INSTALL WATER INLET PIPE

- (a) Install the water inlet pipe with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
- (b) Install the water by-pass hose.

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

- (a) Check the piston protrusions for each cylinder.
 - (1) Clean the cylinder block with solvent.
 - (2) Set the piston of the cylinder to be measured to slightly before TDC.

- (b) Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

NOTICE:

- Be careful of the installation direction.
- Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.

- (c) Place the cylinder head on the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

- (d) Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

- (e) Step 1

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

Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)

- (f) Step 2

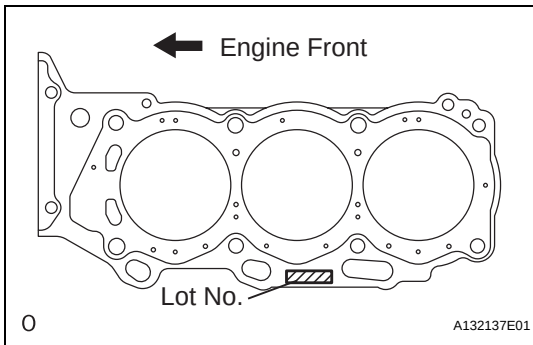
- (1) Mark the cylinder head bolt head with paint as shown in the illustration.
- (2) Tighten the cylinder heads bolts another 90° in the sequence shown in step 1.

- (g) Step 3

- (1) Tighten the cylinder head bolts by an additional 90° in the sequence shown in step 1.
- (2) Check that the painted mark is now facing rearward.

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

- (a) Check the piston protrusions for each cylinder.
 - (1) Clean the cylinder block with solvent.



- (2) Set the piston of the cylinder to be measured to slightly before TDC.

- (b) Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

NOTICE:

- Be careful of the installation direction.
- Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.

- (c) Place the cylinder head on the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

HINT:

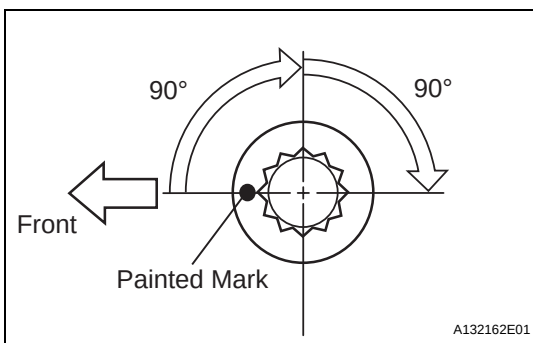
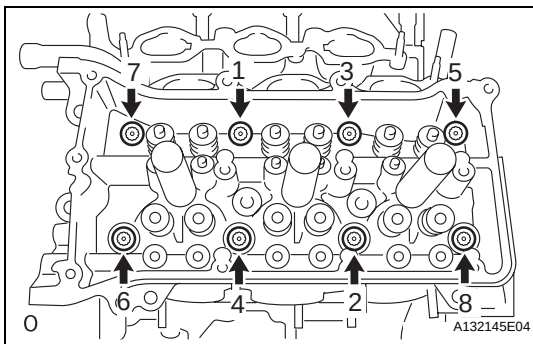
The cylinder head bolts are tightened in 3 progressive steps.

- (d) Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

- (e) Step 1

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

Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)



- (f) Step 2

- (1) Mark the cylinder head bolt heads with paint as shown in the illustration.
- (2) Tighten the cylinder head bolts another 90° in the sequence shown in step 1.

- (g) Step 3

- (1) Tighten the cylinder head bolts by an additional 90° in the sequence shown in step 1.
- (2) Check that the painted mark is now facing rearward.

- (h) Install the 2 bolts in the order shown in the illustration.

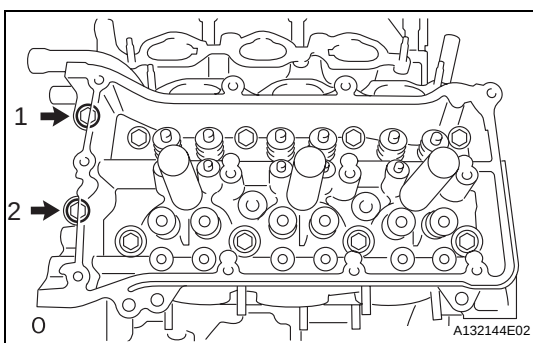
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

20. INSTALL VALVE LASH ADJUSTER ASSEMBLY

- (a) Be sure to inspect the valve lash adjuster before installing it (see page [EM-75](#)).
- (b) Install the lash adjusters.

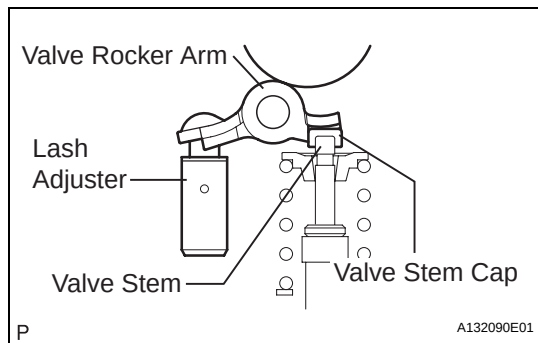
NOTICE:

Install the lash adjuster at the same place it was removed from.

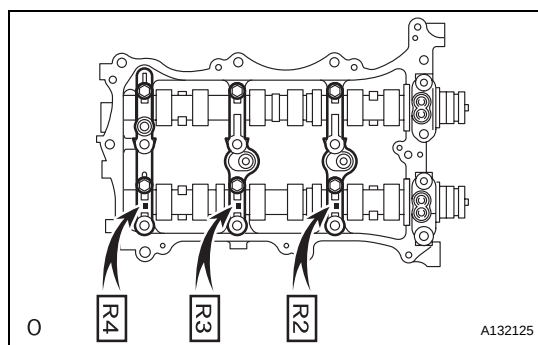


21. INSTALL NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

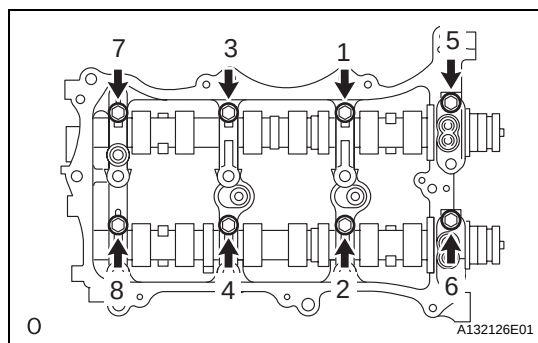
- (a) Apply engine oil to the lash adjuster tips and valve stem cap ends.
- (b) Make sure that the valve rocker arms are installed as shown in the illustration.

**22. INSTALL CAMSHAFT BEARING CAP (for Bank 1)**

- (a) Apply engine oil to the camshaft journals, camshaft housings and bearing caps.
- (b) Install the No. 1 camshaft and No. 2 camshaft to the camshaft housing.

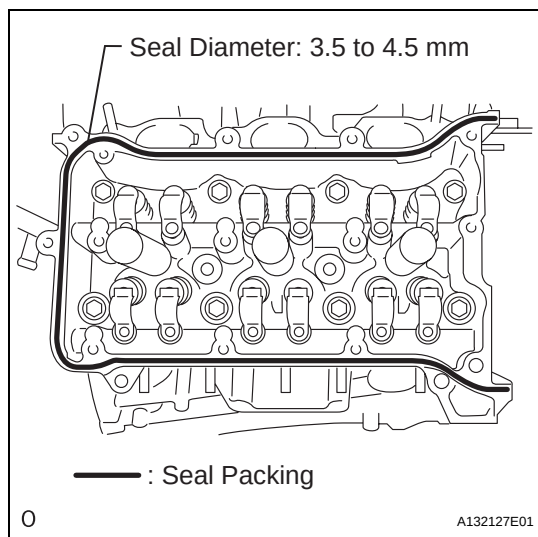


- (c) Confirm the marks and numbers on the camshaft bearing caps and place them each in their proper position and direction.



- (d) Temporarily install the 8 bolts in the order shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

**23. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 1)**

- (a) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

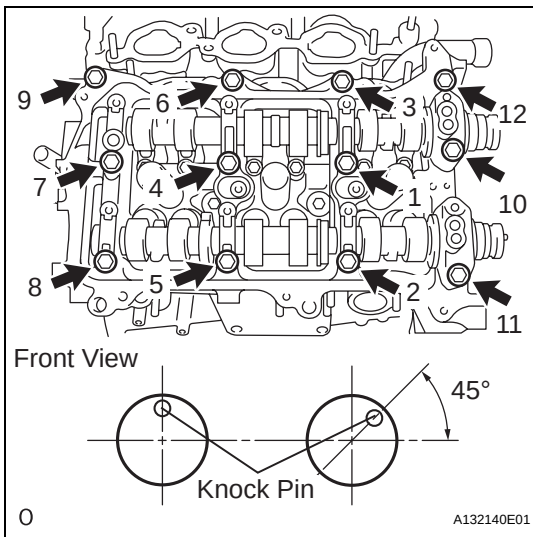
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

Standard seal diameter:

3.5 to 4.5 mm (0.138 to 0.177 in.)

NOTICE:

- Remove any oil from the contact surface.
- Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after the installation.

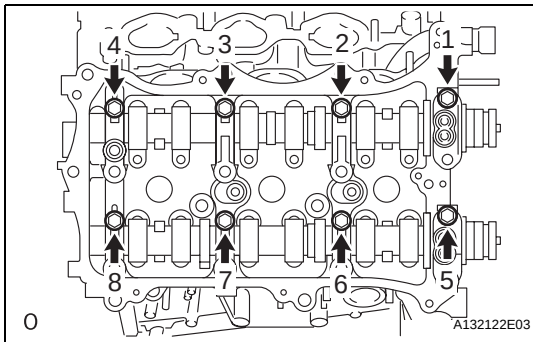


- (b) Install the camshaft housing, and install the 12 bolts in the order shown in the illustration.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

NOTICE:

Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.

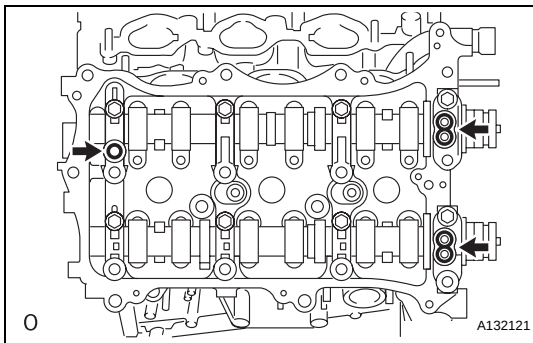


- (c) Tighten the 8 bolts in the order shown in the illustration.

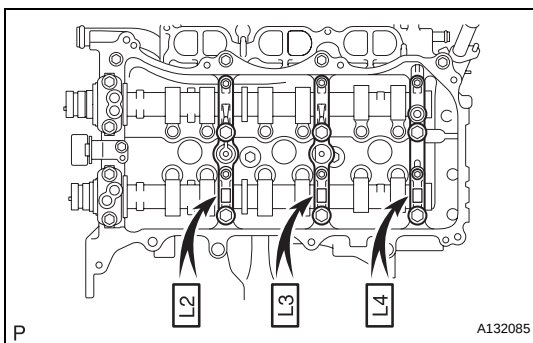
Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

NOTICE:

Thoroughly wipe clean any seal packing.

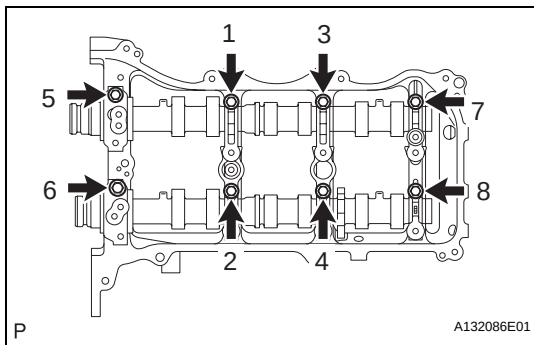


- (d) Install 3 new gaskets.



24. INSTALL CAMSHAFT BEARING CAP (for Bank 2)

- Apply engine oil to the camshaft journals, camshaft housings and bearing caps.
- Install the camshaft No. 3 and camshaft No. 4 to the camshaft housing.
- Confirm the marks and numbers on the camshaft bearing caps and place them each in their proper position and direction.



- (d) Temporarily install the 8 bolts in the order shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

25. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 2)

- (a) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

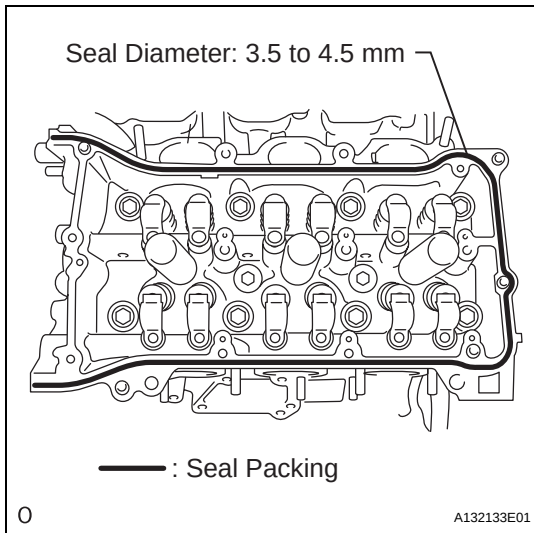
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

Standard seal diameter:

3.5 to 4.5 mm (0.138 to 0.177 in.)

NOTICE:

- Remove any oil from the contact surface.
- Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after the installation.

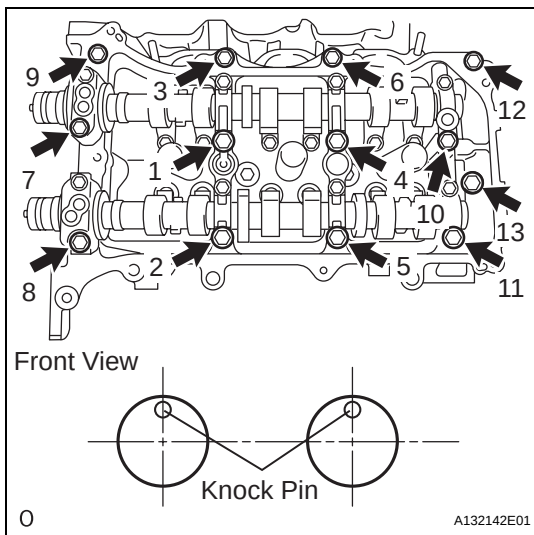


- (b) Install the camshaft housing and tighten the 13 bolts in the order shown in the illustration.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

NOTICE:

Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.

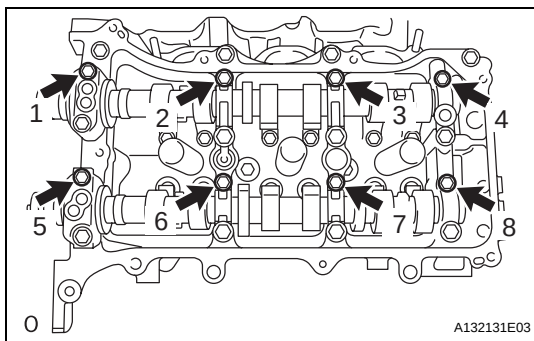


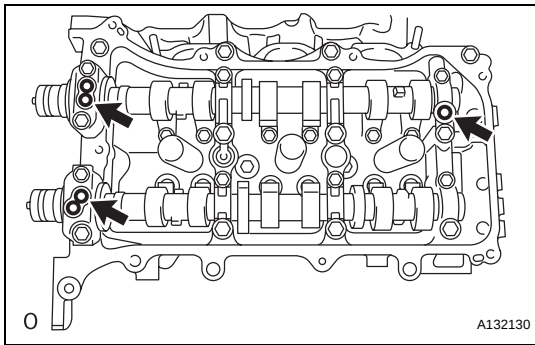
- (c) Tighten the 8 bolts in the order shown in the illustration.

Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

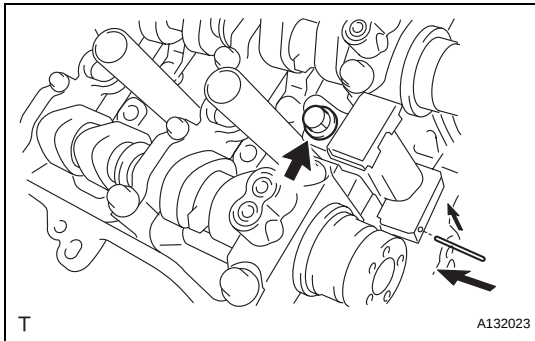
NOTICE:

Thoroughly wipe clean any seal packing.



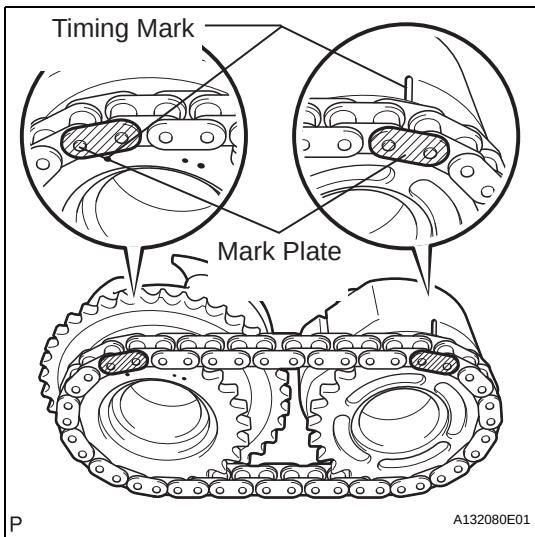


(d) Install 3 new gaskets.



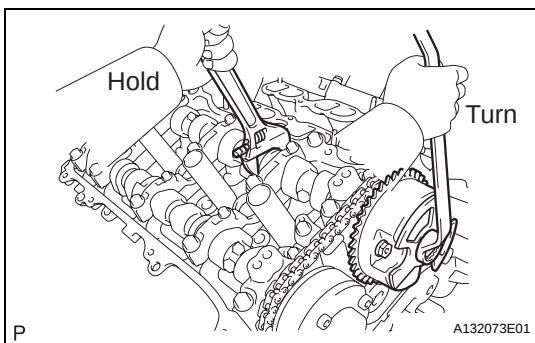
26. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

- (a) Install the chain tensioner with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- (b) While pushing in the tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.

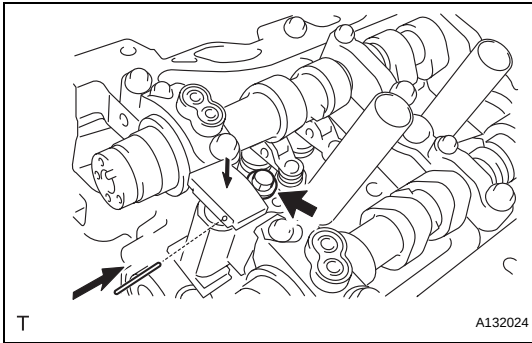


27. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

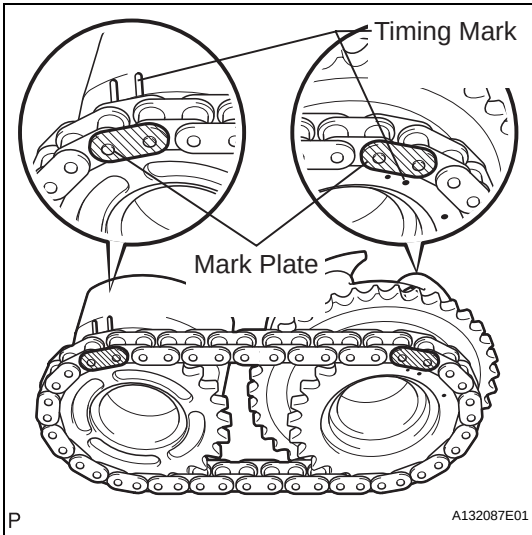
- (a) Align the mark plate (yellow) with the timing marks (1 dot mark) of the camshaft timing gears as shown in the illustration.
- (b) Apply a small amount of engine oil to the bolt threads and bolt-seating surface.
- (c) Align the knock pin of the camshaft with the pin hole of the camshaft timing gear. Install the camshaft timing gear and camshaft timing exhaust gear with the No. 2 chain installed.



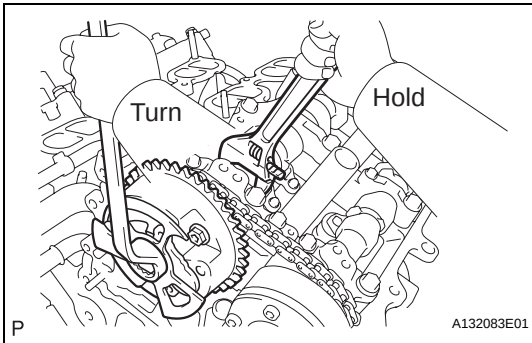
- (d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)
- (e) Remove the pin from the No. 2 chain tensioner.

**28. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY**

- (a) Install the chain tensioner with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- (b) While pushing in the tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.

**29. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)**

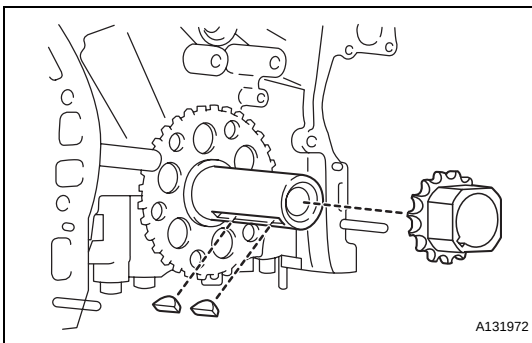
- (a) Align the mark plate (yellow) with the timing marks (2 dot mark) of the camshaft timing gears as shown in the illustration.
- (b) Apply a small amount of engine oil to the bolt threads and bolt-seating surface.
- (c) Align the knock pin of the camshaft with the pin hole of the camshaft timing gear. Install the camshaft timing gear and camshaft timing exhaust gear with the No. 2 chain installed.



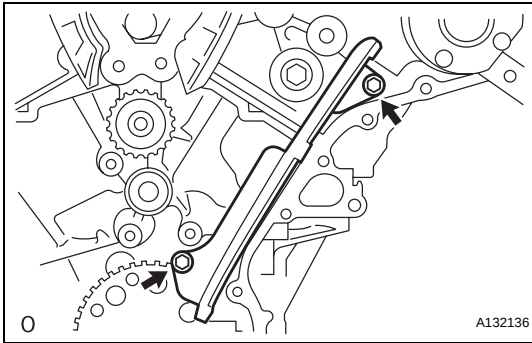
- (d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.

Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

- (e) Remove the pin from the No. 2 chain tensioner.

**30. INSTALL CRANKSHAFT TIMING GEAR OR SPROCKET**

- (a) Install the timing gear set keys and timing gear as shown in the illustration.

**31. INSTALL NO. 1 CHAIN VIBRATION DAMPER**

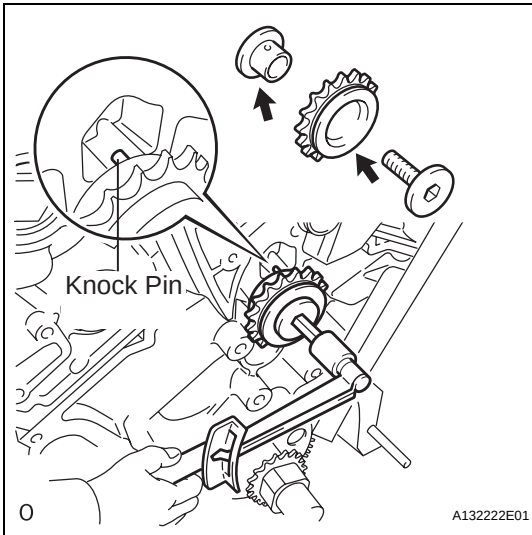
- (a) Install the chain vibration damper with the 2 bolts.
Torque: 23 N*m (235 kgf*cm, 17 ft.*lbf)

32. INSTALL NO. 2 CHAIN VIBRATION DAMPER

- (a) Install the 2 chain vibration damper.

33. INSTALL IDLE SPROCKET ASSEMBLY

- (a) Apply a light coat of engine oil to the rotating surface of the No. 1 idle gear shaft.



- (b) Temporarily install the No. 1 idle gear shaft and idle sprocket with the No. 2 idle gear shaft while aligning the knock pin of the No. 1 idle gear shaft with the knock pin groove of the cylinder block.

NOTICE:

Be careful of the idle gear direction.

- (c) Using a 10 mm hexagon wrench, tighten the No. 2 idle gear shaft.

Torque: 60 N*m (612 kgf*cm, 44 ft.*lbf)

EM**34. INSTALL CHAIN SUB-ASSEMBLY**

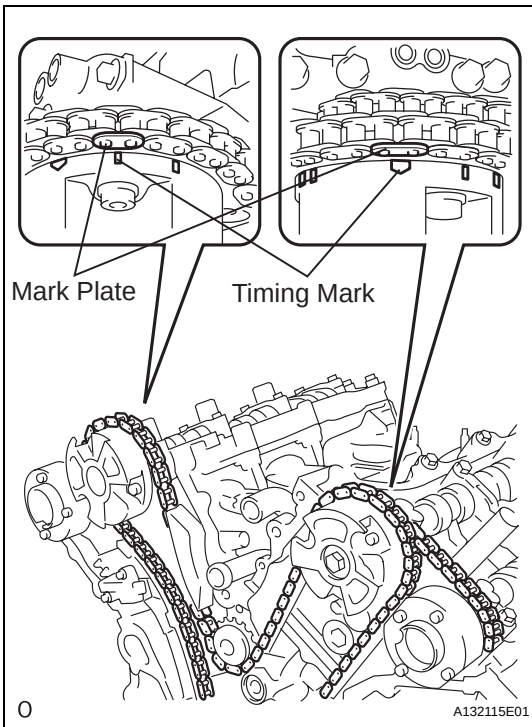
- (a) Align the mark plate and timing mark as shown in the illustration and install the chain.

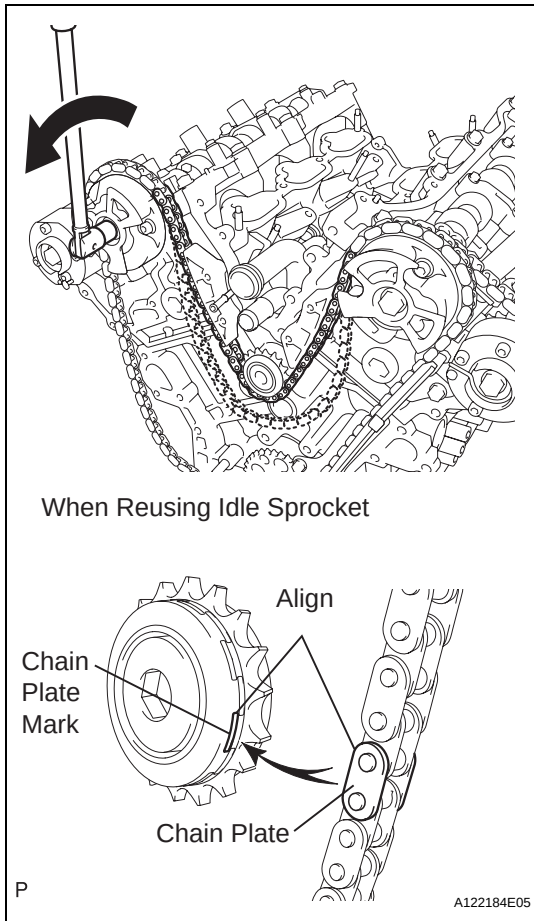
NOTICE:

Do not pass the chain over the crankshaft, just put it on it.

HINT:

The chain mark plate is orange.

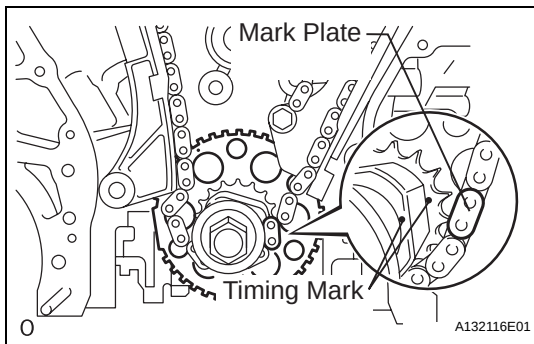




- (b) Turn the camshaft timing gear on the bank 1 counterclockwise to tighten the chain between the banks.

NOTICE:

If reusing the idle sprocket, align one of the idle sprocket's chain plate marks with one of the chain's chain plates when installing the idle sprocket.

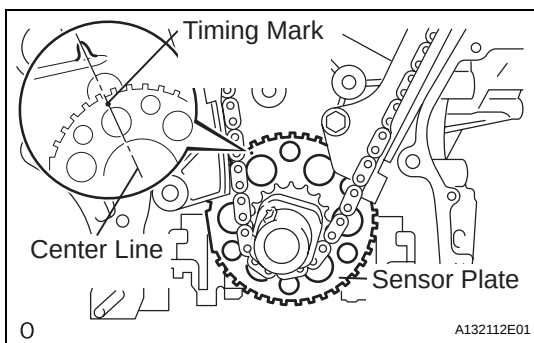


- (c) Align the mark plate and timing mark as shown in the illustration and install the chain onto the crankshaft timing gear.

HINT:

The chain mark plate is yellow.

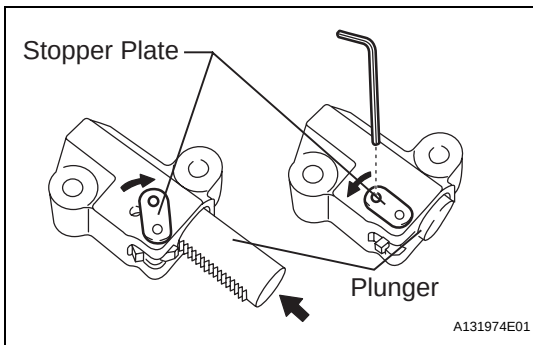
- (d) Temporarily tighten the pulley set bolt.



- (e) Turn the crankshaft clockwise to set it to the bank 1 block bore center line (TDC / compression).

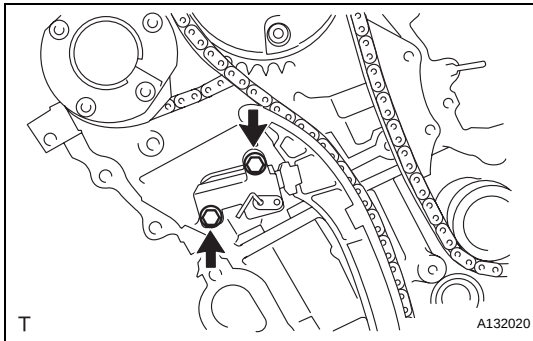
35. INSTALL CHAIN TENSIONER SLIPPER

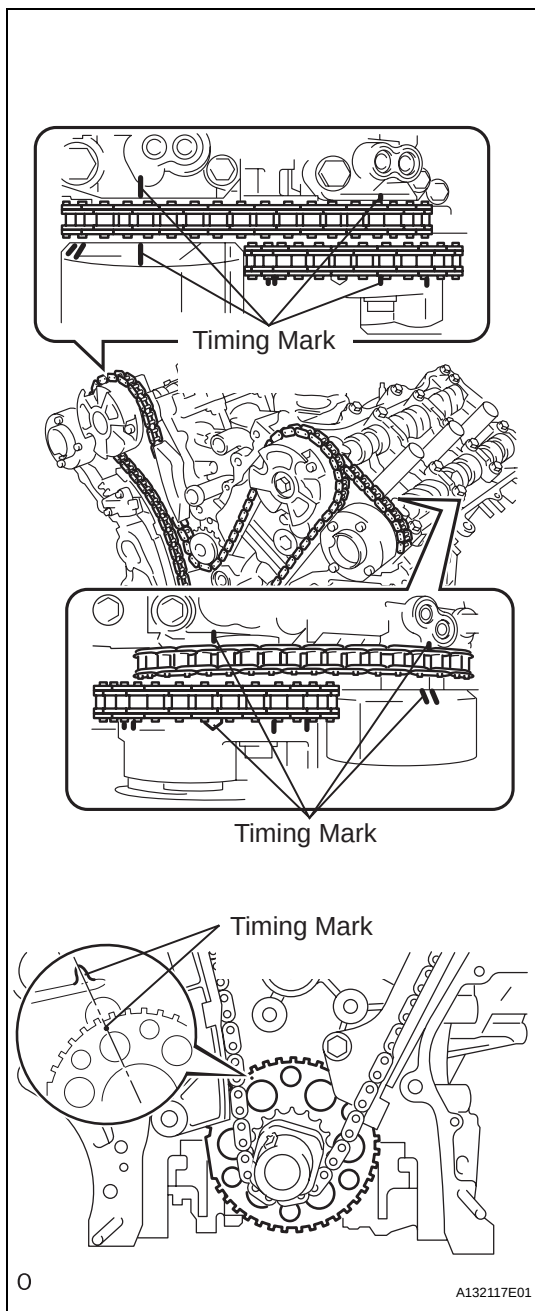
- (a) Install the chain tensioner slipper.

**36. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY**

- (a) Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.
- (b) Move the stopper plate downward to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

- (c) Install the chain tensioner with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

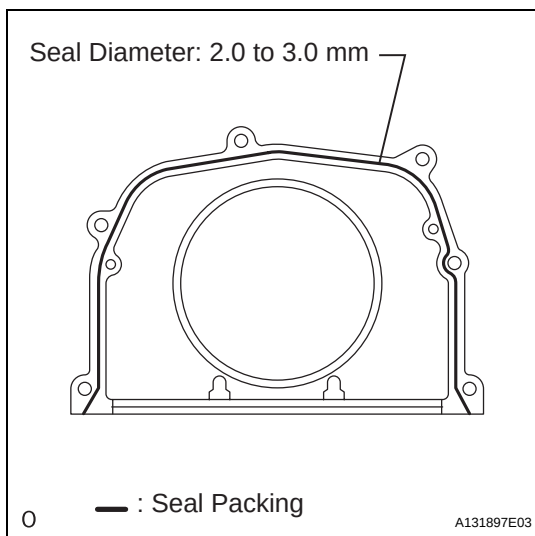




- (d) Remove the lock pin of the chain tensioner. Check that each timing mark is aligned with the crankshaft at the TDC / compression.
- (e) Remove the pulley set bolt.

37. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY (w/ Oil Pump) (See page [LU-17](#))

38. INSTALL WATER PUMP ASSEMBLY (See page [CO-13](#))



39. INSTALL ENGINE REAR OIL SEAL RETAINER

- (a) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

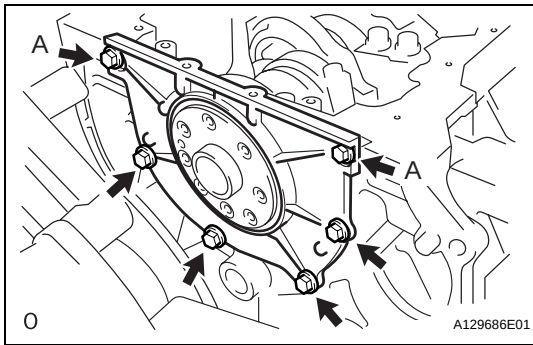
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

Standard seal diameter:

2.0 to 3.0 mm (0.079 to 0.118 in.)

NOTICE:

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



- (b) Install the oil seal retainer with the 6 bolts.

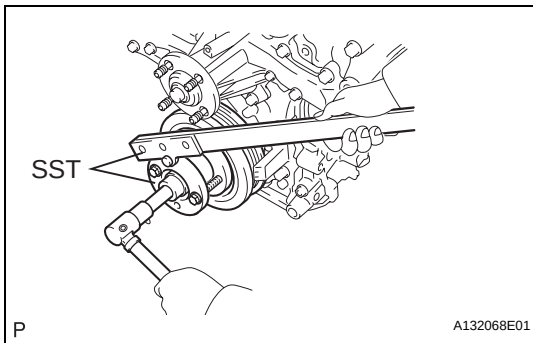
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTICE:

Apply adhesive 1324 to the 2 bolts labeled A.

Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent



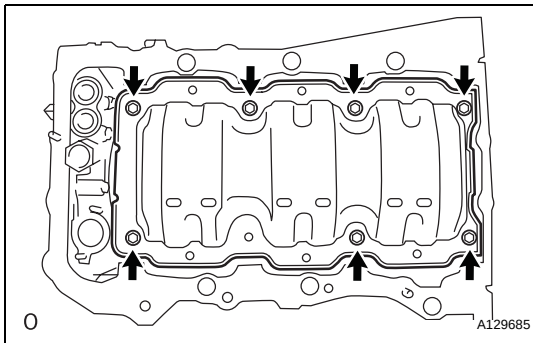
40. INSTALL CRANKSHAFT PULLEY

- (a) Align the pulley set key with the key groove of the pulley, and slide on the pulley.

- (b) Using SST, install the pulley bolt.

SST 09213-70011 (09213-70020), 09330-00021

Torque: 250 N*m (2,549 kgf*cm, 184 ft.*lbf)



41. INSTALL OIL PAN BAFFLE PLATE

- (a) Install the oil pan baffle plate with the 7 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

42. INSTALL OIL PAN SUB-ASSEMBLY (See page [LU-21](#))

43. INSTALL OIL STRAINER SUB-ASSEMBLY (See page [LU-22](#))

44. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY (See page [LU-22](#))

45. INSTALL OIL FILTER ELEMENT (See page [LU-5](#))

46. INSTALL OIL FILTER CAP SUB-ASSEMBLY (See page [LU-5](#))

47. INSTALL WATER INLET HOUSING (See page [CO-14](#))

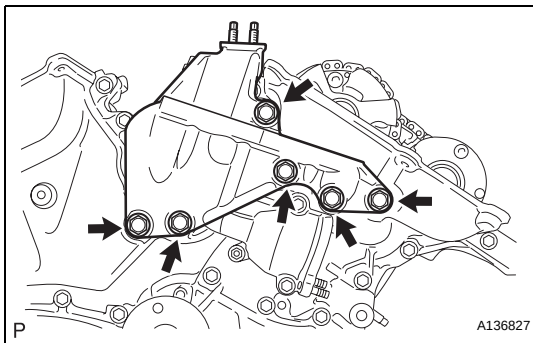
48. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET

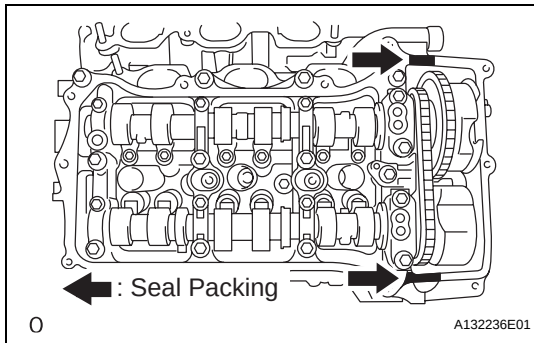
- (a) Install the engine mounting bracket with the 6 bolts.

Torque: 54 N*m (551 kgf*cm, 40 ft.*lbf)

NOTICE:

- Install the water inlet and mounting bracket within 15 minutes after installing the chain cover.
- Do not start the engine for at least 2 hours after the installation.





49. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)

- (a) Apply seal packing as shown in the illustration.

Seal packing:

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

NOTICE:

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

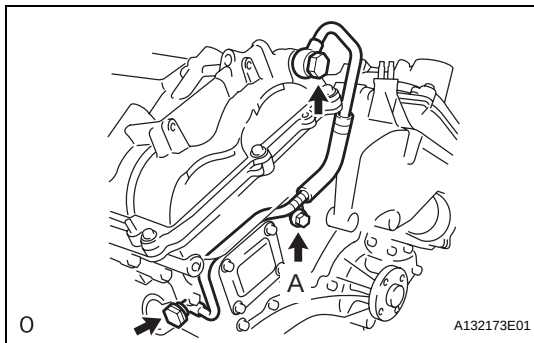
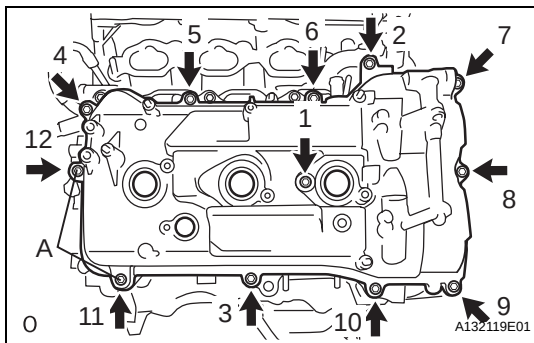
- (b) Install the gasket to the head cover.

- (c) Install the head cover with the 12 bolts in the order shown in the illustration.

**Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt A
10 N*m (102 kgf*cm, 7 ft.*lbf) for except bolt A**

HINT:

Make sure the tightening torque of bolt 1 and 11 is correct.



50. INSTALL OIL PIPE

- (a) Make sure that there is no foreign matter on the mesh of the oil control valve filter.
- (b) Install the oil control valve filter to the oil pipe union. Install 2 new gaskets and temporarily install the oil pipe (on the head cover side) with the oil pipe union.

NOTICE:

Remove any oil from the contact surface.

- (c) Install a new gasket and temporarily install the oil pipe (on the cylinder head side) with the oil pipe union.

NOTICE:

Remove any oil from the contact surface.

- (d) Install bolt A to the cylinder head.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

- (e) Tighten the 2 oil pipe union bolts.

Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)

51. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 2)

- (a) Apply seal packing as shown in the illustration.

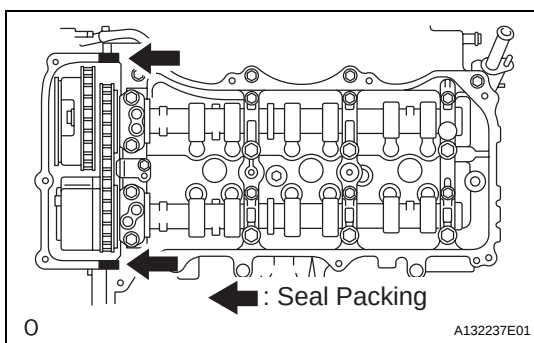
Seal packing:

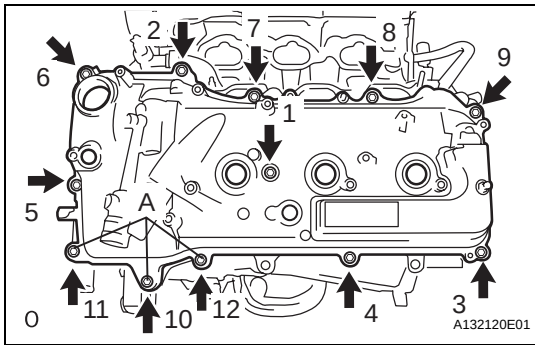
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

NOTICE:

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

- (b) Install the gasket to the head cover.



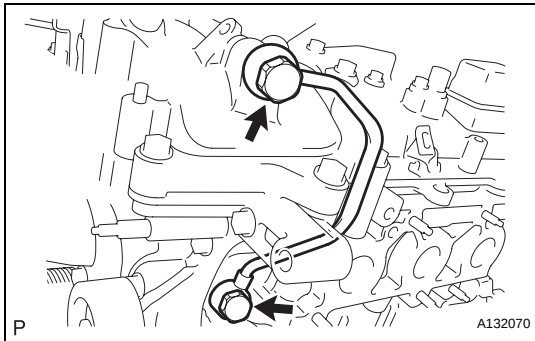


- (c) Install the head cover with the 12 bolts in the order in the illustration.

**Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt A
10 N*m (102 kgf*cm, 7 ft.*lbf) for except bolt A**

HINT:

Make sure the tightening torque of bolts 1 and 10 is correct.



52. INSTALL NO. 1 OIL PIPE

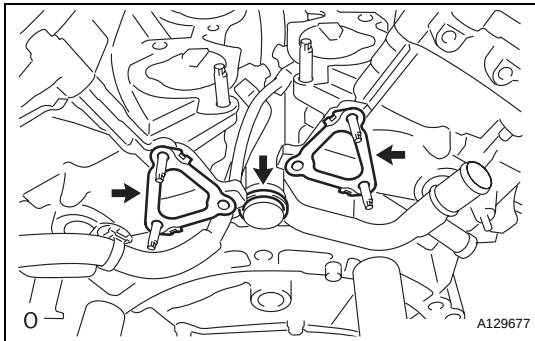
- Make sure that there is no foreign matter on the mesh of the oil control valve filter.
- Install the oil control valve filter to the oil pipe union. Install 2 new gaskets and temporarily install the oil pipe (on the head cover side) with the oil pipe union.
- Install a new gasket and temporarily install the oil pipe (on the cylinder head side) with the oil pipe union.

NOTICE:

Remove any oil from the contact surface.

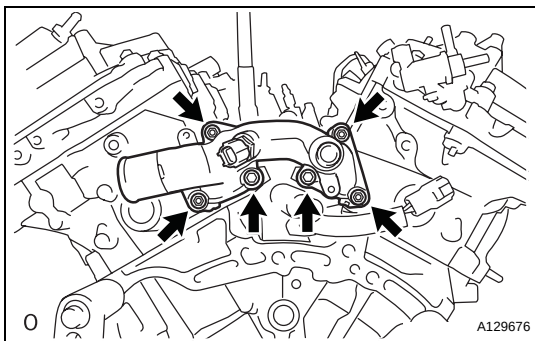
- Tighten the 2 oil pipe union bolts.

Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)



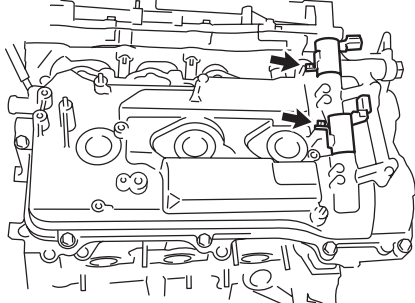
53. INSTALL WATER OUTLET

- Install 2 new gaskets and a new O-ring.
- Apply soapy water to the O-ring.

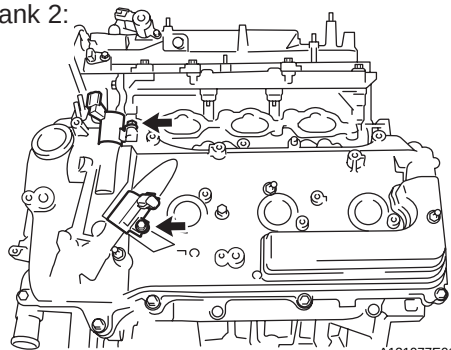


- Install the water outlet with the 2 bolts and 4 nuts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

for Bank 1:



for Bank 2:



0

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54. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

- (a) Install the 4 camshaft timing oil control valves with the 4 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

55. INSTALL VVT SENSOR

- (a) Install the 4 VVT sensors with the 4 bolts.

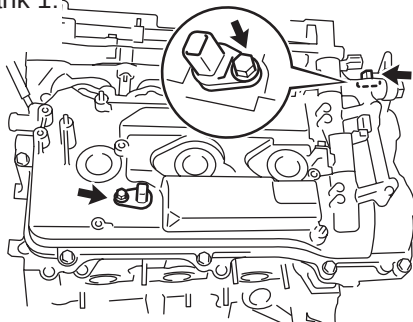
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

56. INSTALL SPARK PLUG

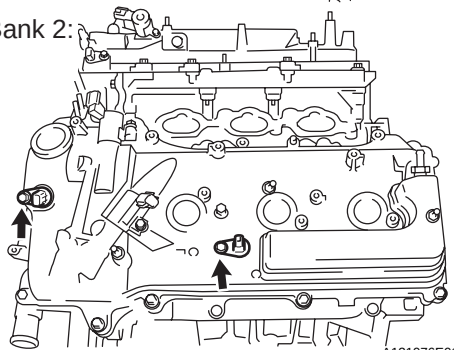
- (a) Install the 6 spark plugs.

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

for Bank 1:



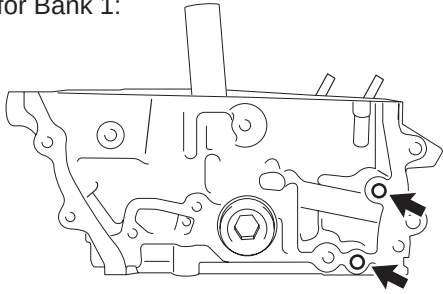
for Bank 2:



0

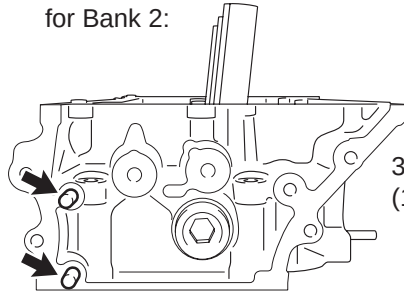
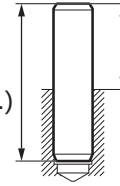
A131976E01

for Bank 1:



T

for Bank 2:

34 mm
(1.34 in.)18.0 to 19.0 mm
(0.71 to 0.75 in.)

A132040E01

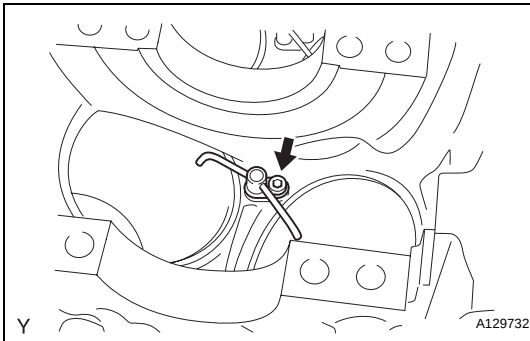
REASSEMBLY

1. INSTALL NO. 1 OIL NOZZLE SUB-ASSEMBLY

- (a) Using a 5 mm hexagon wrench, install the 3 oil nozzles with the bolts.

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

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2. INSTALL CYLINDER BLOCK WATER DRAIN COCK SUB-ASSEMBLY

- (a) Apply adhesive around the drain cocks.

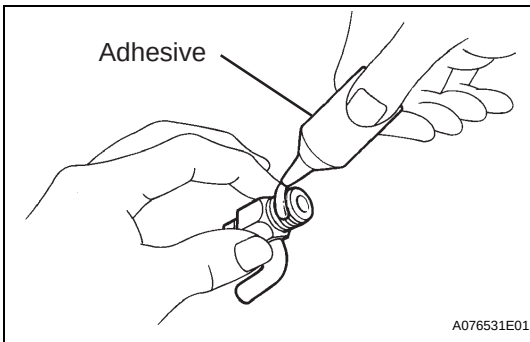
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent

- (b) Install the cylinder block water drain cocks.

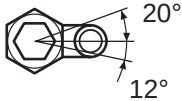
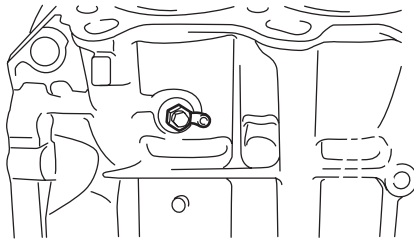
- (1) Temporarily install the drain cocks.

Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)

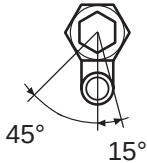
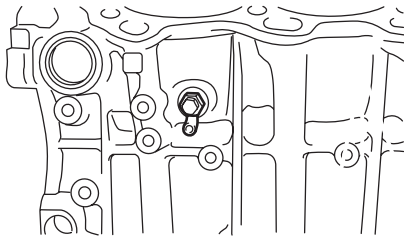


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RH Side:



LH Side:



A131970E01

- (2) Within one full rotation, tighten the drain cock to the angle shown in the illustration.

Torque: 45 N*m (459 kgf*cm, 33 ft.*lbf)

NOTICE:

Do not loosen the drain cock to adjust it. If an adjustment is necessary, remove the drain cock and reinstall it.

- (c) Install the water drain cock plug to the water drain cocks.

Torque: 13 N*m (130 kgf*cm, 9 ft.*lbf)

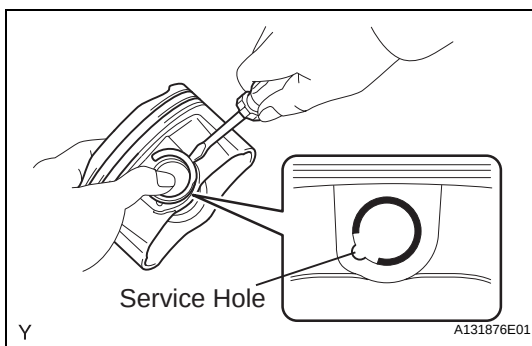
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3. INSTALL PISTON WITH PIN SUB-ASSEMBLY

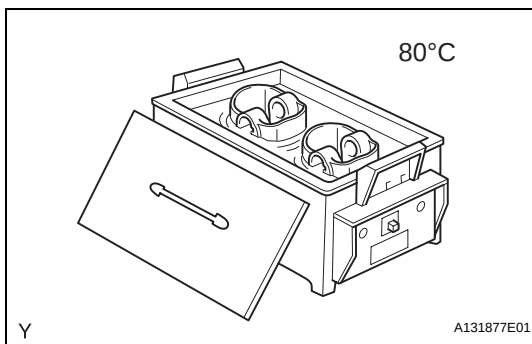
- (a) Using a screwdriver, install a new snap ring at one end of the piston pin hole.

HINT:

Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.



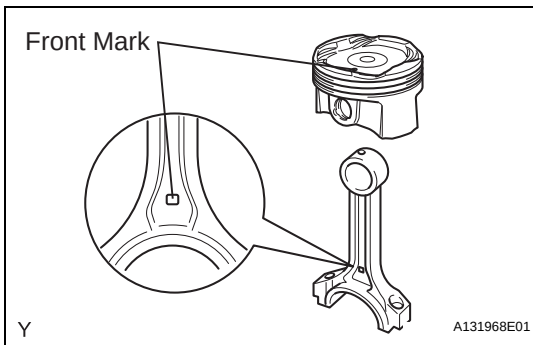
A131876E01



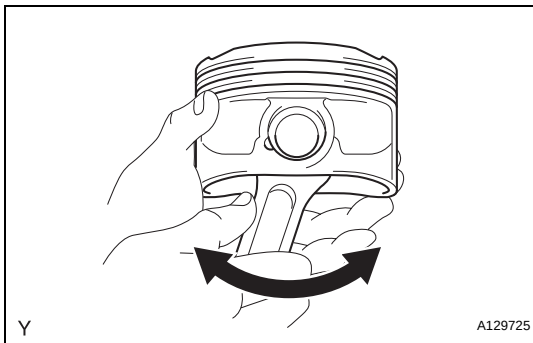
A131877E01

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

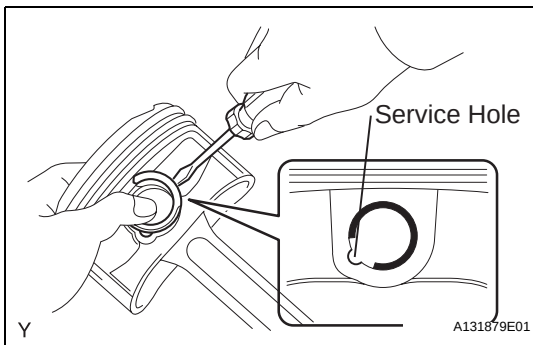
- (c) Coat the piston pin with engine oil.



- (d) Align the front marks of the piston and connecting rod, and push in the piston pin with your thumb.
HINT:
The piston and pin are a matched set.



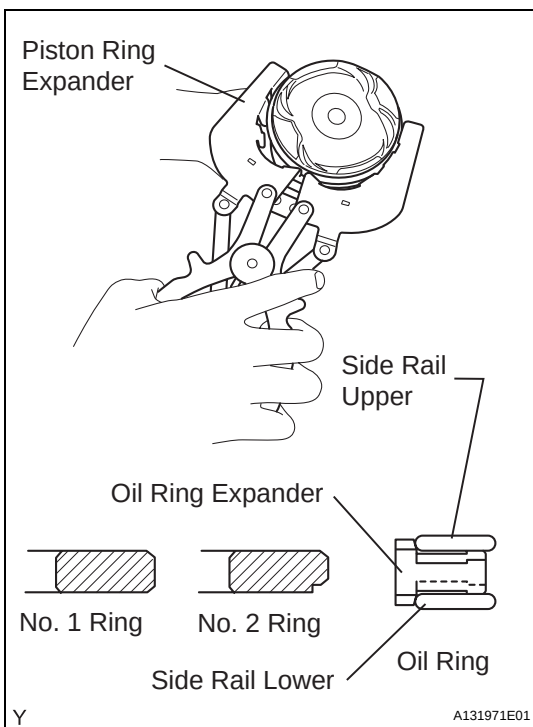
- (e) Check the fitting condition between the piston and piston pin by trying to move the piston back and forth on the piston pin.



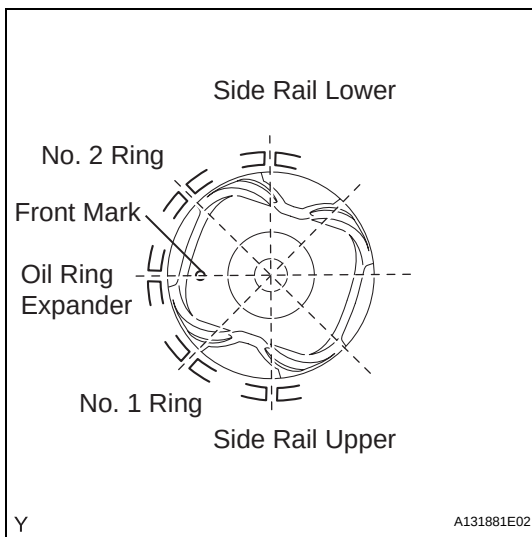
- (f) Using a screwdriver, install a new snap ring at the other end of the piston pin hole.
HINT:
Be sure that the end gap of the snap ring is not aligned with the pin hole cutout portion of the piston.

4. INSTALL PISTON RING SET

- (a) Install the oil ring expander and 2 side rails by hand.



- (b) Using a piston ring expander, install the 2 compression rings so that the painted marks are positioned as shown in the illustration.



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

NOTICE:

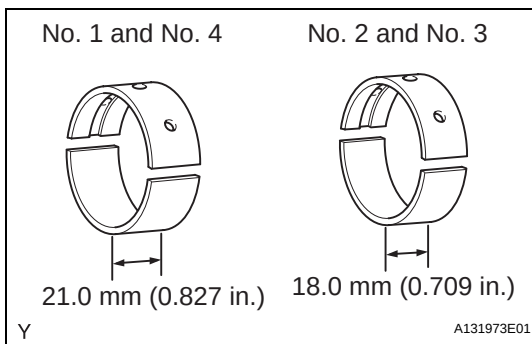
Do not align the ring ends.

5. INSTALL CRANKSHAFT BEARING

NOTICE:

Main bearings come in widths between 18.0 mm (0.709 in.) and 21.0 mm (0.827 in.). Install the 21.0 mm (0.827 in.) bearings in the No. 1 and No. 4 cylinder block journal positions with the main bearing cap. Install the 18.0 mm (0.709 in.) bearings in the No. 2 and No. 3 positions.

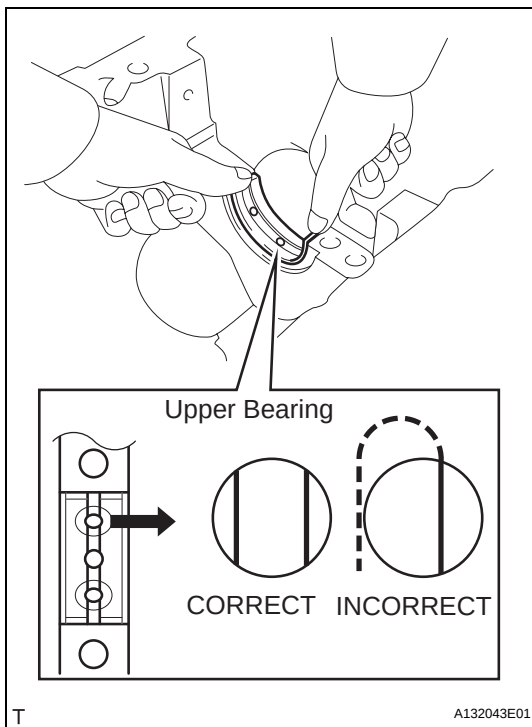
- (a) Clean the main journal and both surfaces of the bearing.

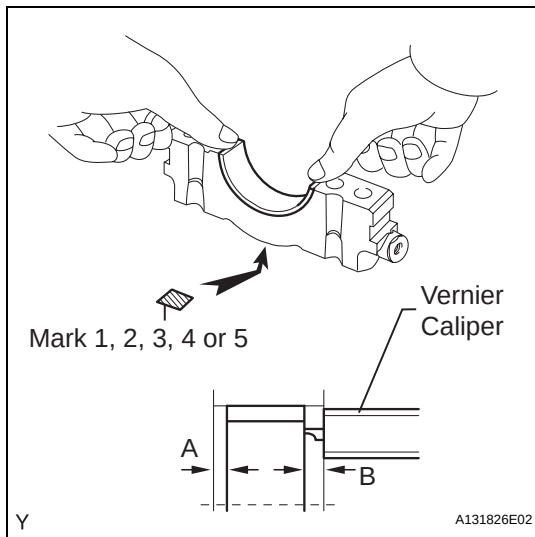


- (b) Install the upper bearing.
- (1) Install the upper bearing to the cylinder block as shown in the illustration.

NOTICE:

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





(c) Install the lower bearing.

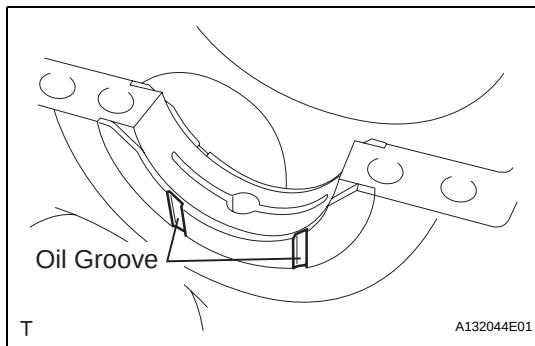
- (1) Install the lower bearing to the bearing cap.
- (2) Using a vernier caliper, measure the distance between the bearing cap's edge and the lower bearing's edge.

Dimension (A - B):

0.7 mm (0.028 in.) or less.

NOTICE:

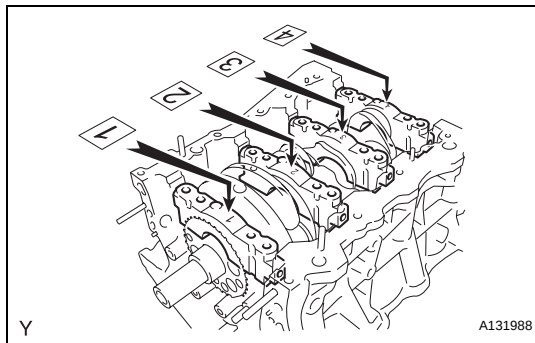
Do not apply engine oil to the bearing's contact area and underside.



6. INSTALL CRANKSHAFT

- (a) Install the 2 thrust washers under the No. 2 journal position of the cylinder block with the oil grooves facing outward.
- (b) Apply engine oil to the upper bearing, then place the crankshaft on the cylinder block.

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- (c) Confirm the front marks and numbers of the main bearing caps and install the bearing caps on the cylinder block.

HINT:

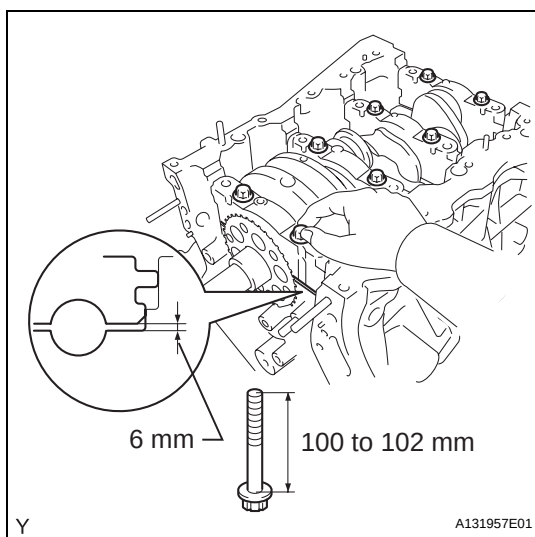
A number is marked on each main bearing cap to indicate the installation position.

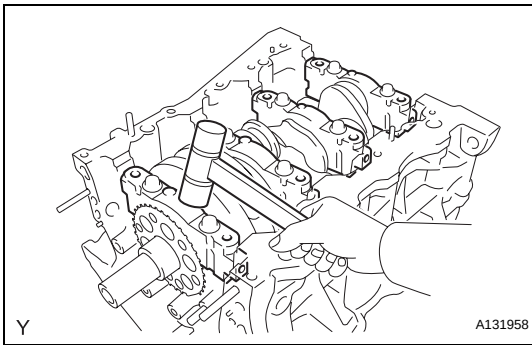
- (d) Apply a light coat of engine oil on the threads and under the heads of the bearing cap bolts.
- (e) Temporarily install the 8 main bearing cap bolts to the inside positions.

- (f) Insert the main bearing cap by hand until the clearance between the main bearing cap and the cylinder block is less than 6 mm (0.23 in.) by marking the 2 internal bearing cap bolts as a guide.

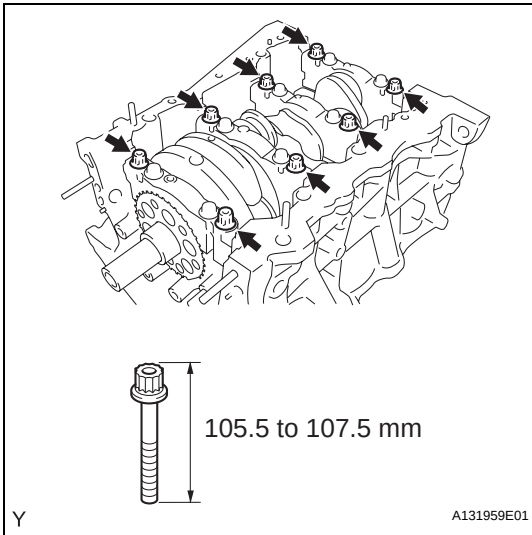
Bolt length:

100.0 to 102.0 mm (3.937 to 4.016 in.)





- (g) Using a plastic-faced hammer, lightly tap the bearing cap to ensure a proper fit.
- (h) Apply a light coat of engine oil to the threads and under the heads of the 8 main bearing cap bolts.



- (i) Install the 8 main bearing cap bolts to the outside positions.

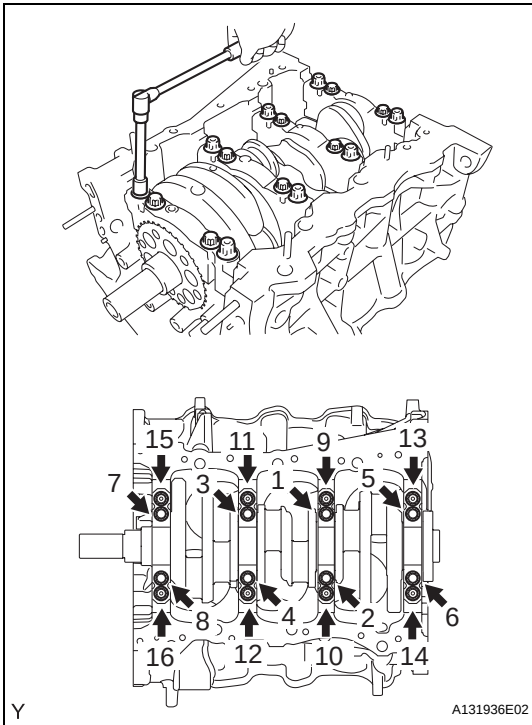
Bolt length:

105.5 to 107.5 mm (4.154 to 4.232 in.)

- (j) Install the crankshaft bearing cap bolts.

HINT:

The main bearing cap bolts are tightened in 2 progressive steps.

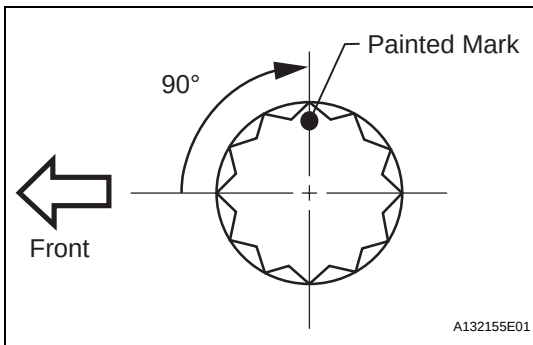


- (k) Step 1

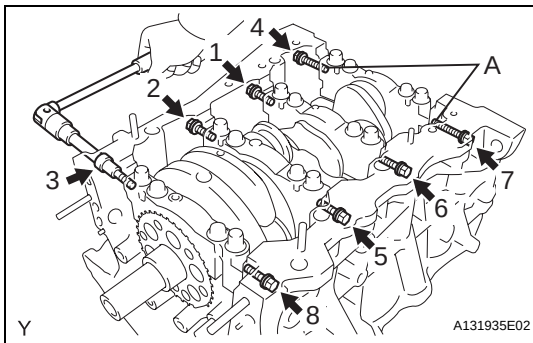
- (1) Install and uniformly tighten the 16 main bearing cap bolts in the sequence shown in the illustration.

Torque: 61 N*m (622 kgf*cm, 45 ft.*lbf)

If any of the main bearing cap bolts does not meet the specified torque, replace it.



- (l) Step 2
 - (1) Mark the front of the bearing cap bolts with paint.
 - (2) Tighten the bearing cap bolts another 90° in the order shown in step 1.
 - (3) Check that the painted mark is now at a 90° angle to the front.
- (m) Check that the crankshaft turns smoothly.



- (n) Install and uniformly tighten the 8 main bearing cap bolts in several steps, in the sequence shown in the illustration.

Torque: 52 N*m (530 kgf*cm, 38 ft.*lbf)

Bolt length:

45 mm (1.77 in.) for bolt A

30 mm (1.18 in.) for except bolt A

- (o) Check that the crankshaft turns smoothly.

7. INSTALL CONNECTING ROD BEARING

- (a) Install the connecting rod bearing to the connecting rod and bearing cap.
- (b) Using a vernier caliper, measure the distance between the connecting rod's and bearing cap's edges, and each connecting rod bearing's edge.

Dimension (A - B):

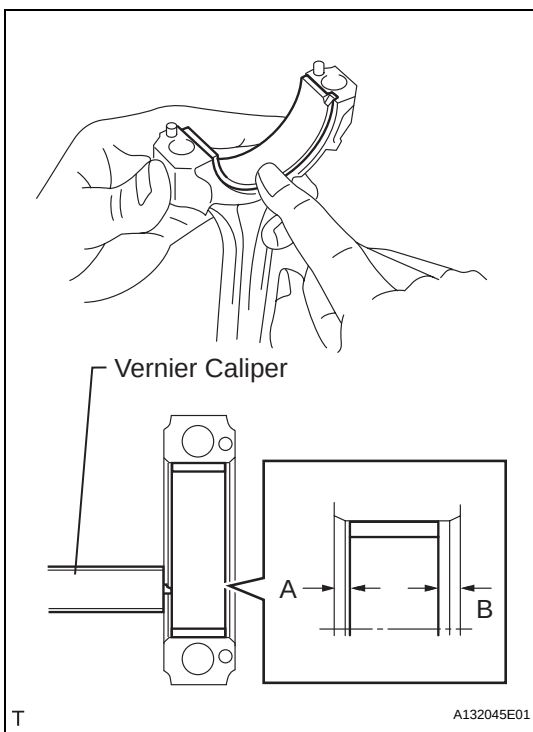
0.7 mm (0.028 in.) or less

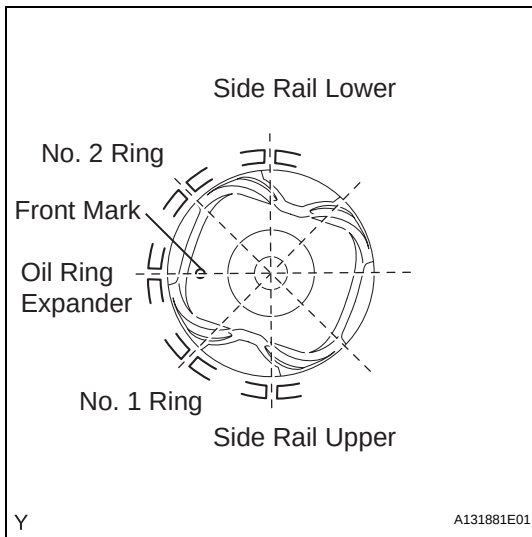
NOTICE:

Do not apply engine oil to the bearing's contact area and underside.

8. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD

- (a) Apply engine oil to the cylinder walls, the pistons, and the surfaces of the connecting rod bearings.

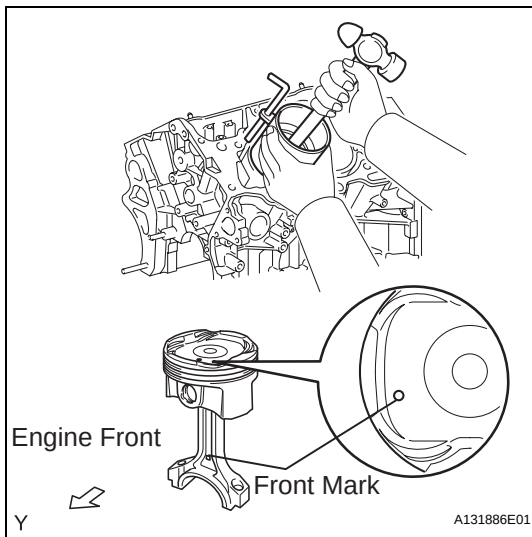




- (b) Position the piston rings so that the ring ends are as shown in the illustration.

NOTICE:

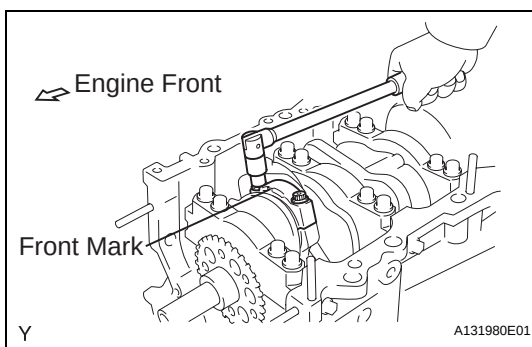
Do not align the ring ends.



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

NOTICE:

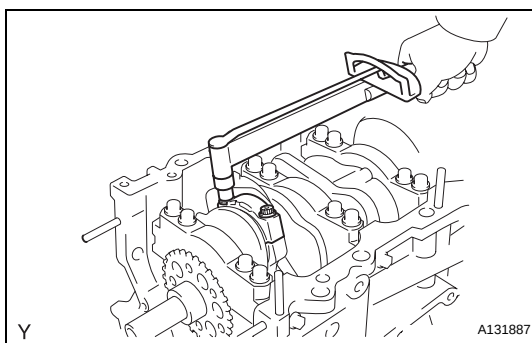
Match the numbered connecting rod cap with the connecting rod.



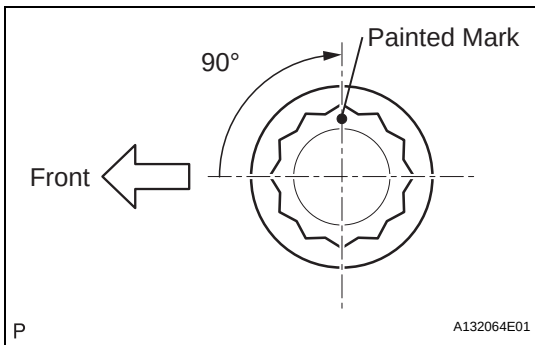
- (d) Check that the front mark of the connecting rod cap is facing forward.
 (e) Apply a light coat of engine oil to the threads and under the heads of the connecting rod cap bolts.
 (f) Install the connecting cap bolts.

HINT:

The connecting cap bolts are tightened in 2 progressive steps.

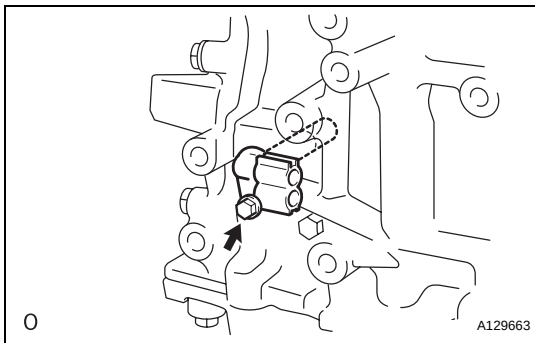


- (g) Step 1
 (1) Install and alternately tighten the bolts of the connecting rod cap in several steps.
Torque: 25 N*m (255 kgf*cm, 18 ft.*lbf)



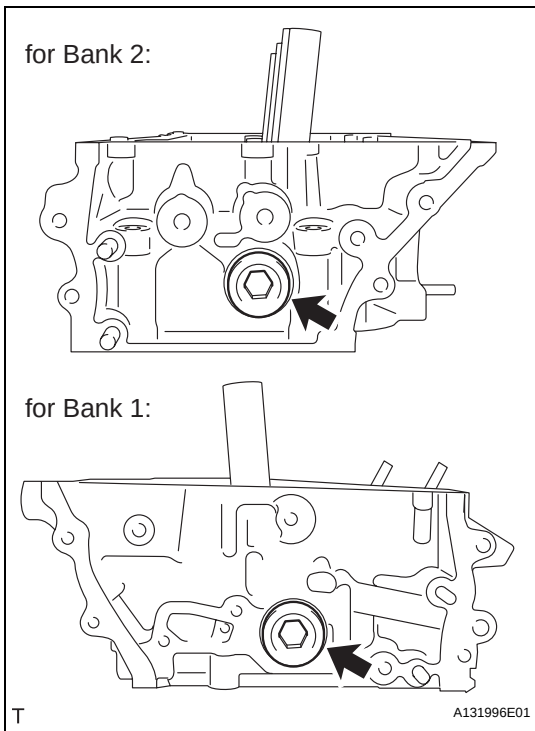
(h) Step 2

- (1) Mark the front side of each connecting cap bolt with paint.
 - (2) Tighten the cap bolts another 90° as shown in the illustration in the order in step 1.
 - (3) Check that the painted mark is now at a 90° angle to the front.
- (i) Check that the crankshaft turns smoothly.



9. INSTALL CRANKSHAFT POSITION SENSOR

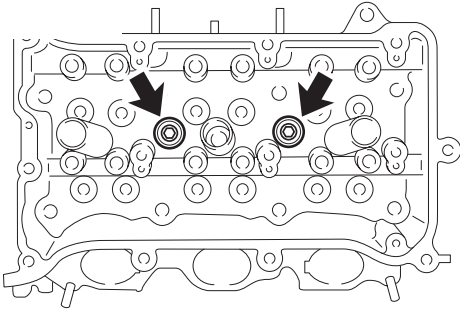
- (a) Install the crankshaft position sensor with the bolt.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)



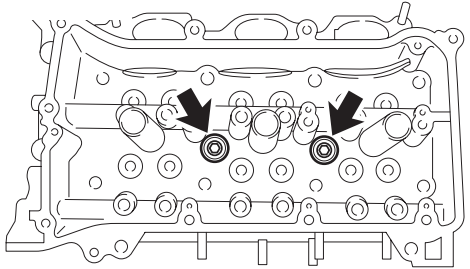
10. INSTALL NO. 2 STRAIGHT SCREW PLUG

- (a) Using a 14 mm hexagon wrench, install 2 new gaskets and the 2 straight screw plugs.
Torque: 80 N*m (816 kgf*cm, 59 ft.*lbf)

for Bank 1:



for Bank 2:



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11. INSTALL NO. 1 STRAIGHT SCREW PLUG

- (a) Using a 10 mm hexagon wrench, install 4 new gaskets and the straight screw plugs.

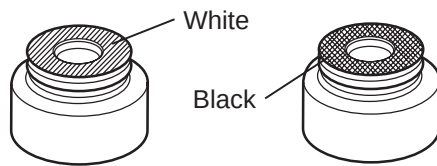
Torque: 44 N*m (449 kgf*cm, 32 ft.*lbf)

12. INSTALL VALVE SPRING SEAT

- (a) Install the valve spring seats to the cylinder head.

Intake Side

Exhaust Side



A131926E01

13. INSTALL INTAKE VALVE STEM OIL SEAL

- (a) Apply a light coat of engine oil to new oil seals.

NOTICE:

Pay attention when installing the intake and exhaust oil seals. For example, installing the intake oil seal into the exhaust side or installing the exhaust oil seal to the intake side can cause installation problems later.

HINT:

The intake valve oil seals are white and the exhaust valve oil seals are black.

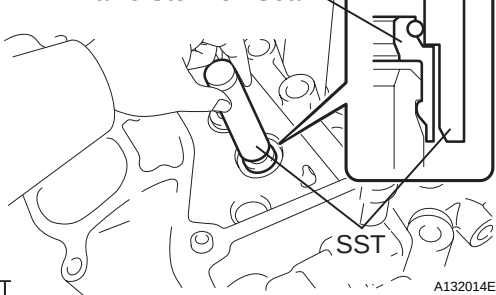
- (b) Using SST, push in the oil seals.

SST 09201-41020

NOTICE:

Failure to use SST will cause the seal to be damaged or improperly seated.

Valve Stem Oil Seal



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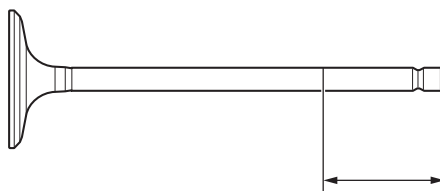
14. INSTALL INTAKE VALVE

- (a) Apply plenty of engine oil to the tip area of the intake valve shown in the illustration.

- (b) Install the valve, compression spring and spring retainer to the cylinder head.

NOTICE:

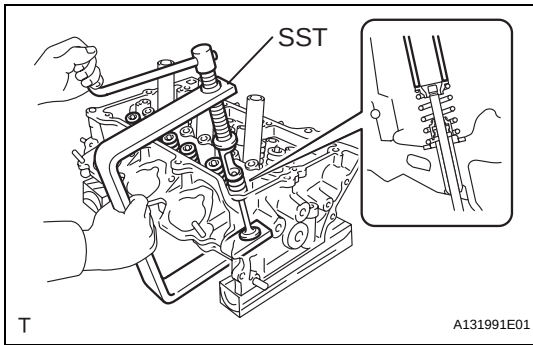
Install the same parts in the same combination to original locations.



40 mm (1.57 in.) or more

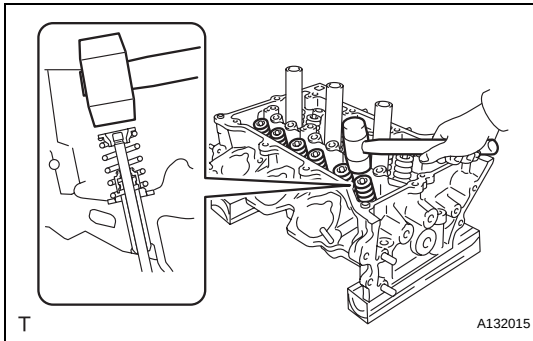
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- (c) Using SST and wooden blocks, compress the spring and install the retainer lock.

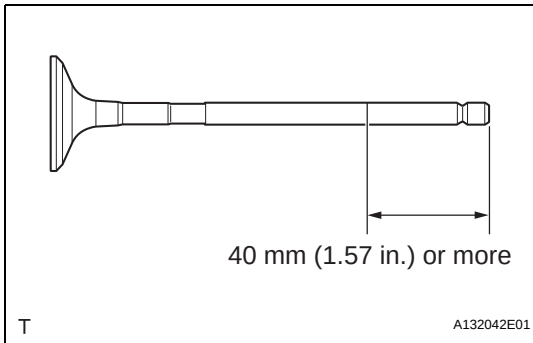
SST 09202-70020 (09202-00010)



- (d) Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the retainer.

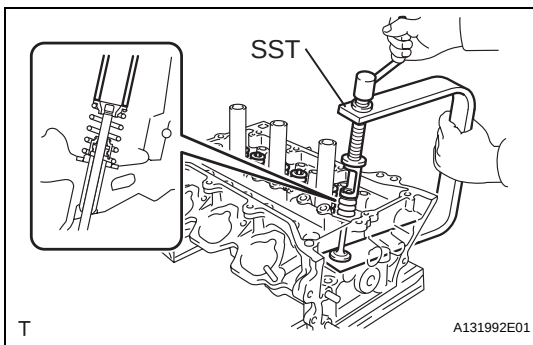


15. INSTALL EXHAUST VALVE

- (a) Apply plenty of engine oil to the tip area of the exhaust valve shown in the illustration.
(b) Install the valve, compression spring and spring retainer to the cylinder head.

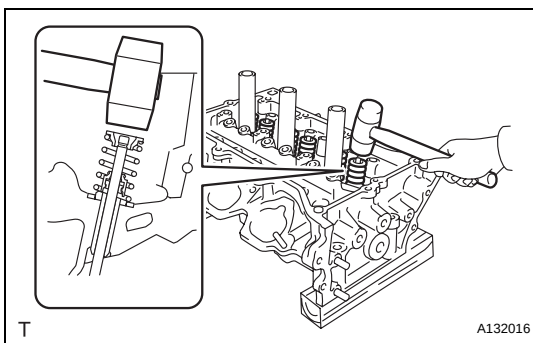
NOTICE:

Install the same parts in the same combination to their original locations.



- (c) Using SST and wooden blocks, compress the spring and install the retainer lock.

SST 09202-70020 (09202-00010)



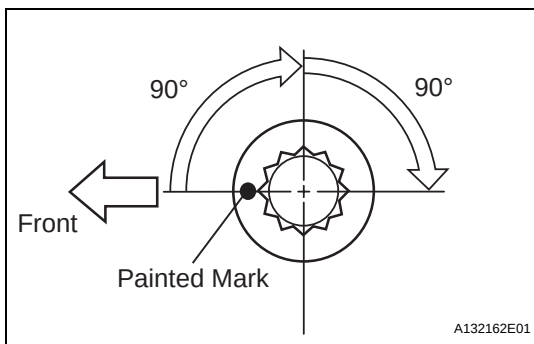
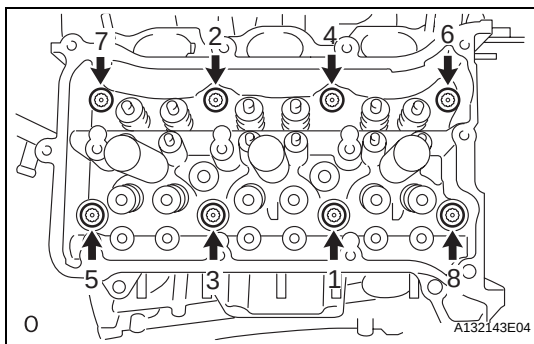
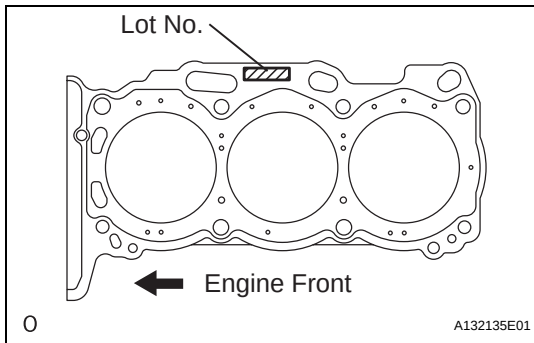
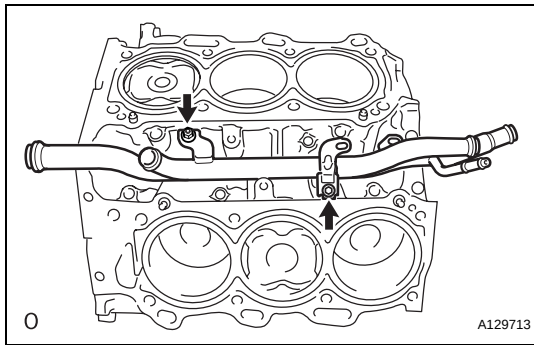
- (d) Using a plastic-faced hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to damage the retainer.

16. INSTALL VALVE STEM CAP

- (a) Apply a light coat of engine oil to the valve stem caps.
(b) Install the valve stem caps to the cylinder head.



17. INSTALL WATER INLET PIPE

- (a) Install the water inlet pipe with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
- (b) Install the water by-pass hose.

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

- (a) Check the piston protrusions for each cylinder.
 - (1) Clean the cylinder block with solvent.
 - (2) Set the piston of the cylinder to be measured to slightly before TDC.

- (b) Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

NOTICE:

- Be careful of the installation direction.
- Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.

- (c) Place the cylinder head on the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

HINT:

The cylinder head bolts are tightened in 3 progressive steps.

- (d) Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

- (e) Step 1

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

Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)

- (f) Step 2

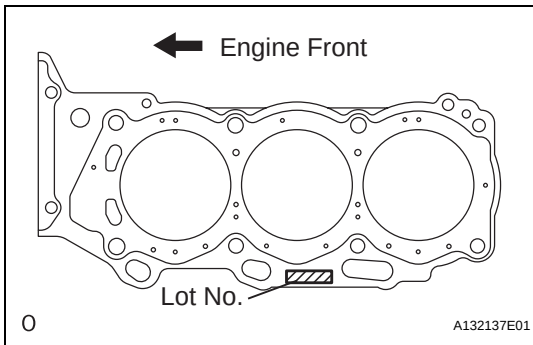
- (1) Mark the cylinder head bolt head with paint as shown in the illustration.
- (2) Tighten the cylinder heads bolts another 90° in the sequence shown in step 1.

- (g) Step 3

- (1) Tighten the cylinder head bolts by an additional 90° in the sequence shown in step 1.
- (2) Check that the painted mark is now facing rearward.

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

- (a) Check the piston protrusions for each cylinder.
 - (1) Clean the cylinder block with solvent.



- (2) Set the piston of the cylinder to be measured to slightly before TDC.

- (b) Place the cylinder head gasket on the cylinder block surface with the front face of the Lot No. stamp upward.

NOTICE:

- Be careful of the installation direction.
- Gently place the cylinder head in order not to damage the gasket with the bottom part of the head.

- (c) Place the cylinder head on the cylinder block.

NOTICE:

Ensure that no oil is on the mounting surface of the cylinder head.

HINT:

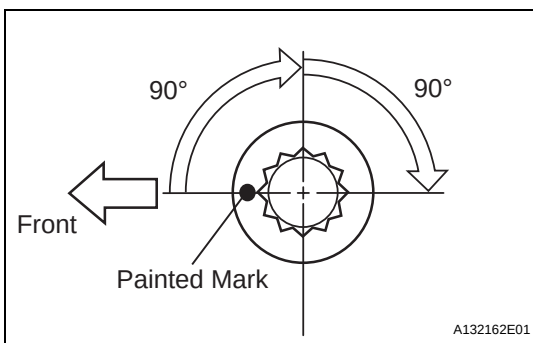
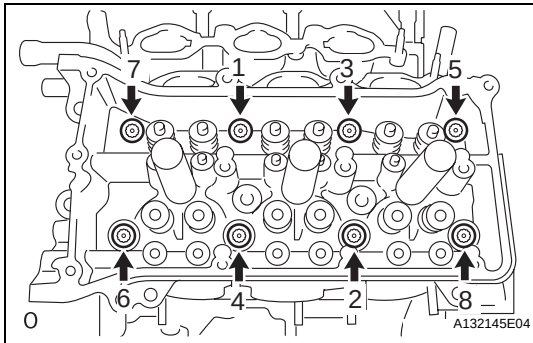
The cylinder head bolts are tightened in 3 progressive steps.

- (d) Apply a light coat of engine oil to the threads and under the heads of the cylinder head bolts.

- (e) Step 1

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

Torque: 36 N*m (367 kgf*cm, 27 ft.*lbf)



- (f) Step 2

- (1) Mark the cylinder head bolt heads with paint as shown in the illustration.
- (2) Tighten the cylinder head bolts another 90° in the sequence shown in step 1.

- (g) Step 3

- (1) Tighten the cylinder head bolts by an additional 90° in the sequence shown in step 1.
- (2) Check that the painted mark is now facing rearward.

- (h) Install the 2 bolts in the order shown in the illustration.

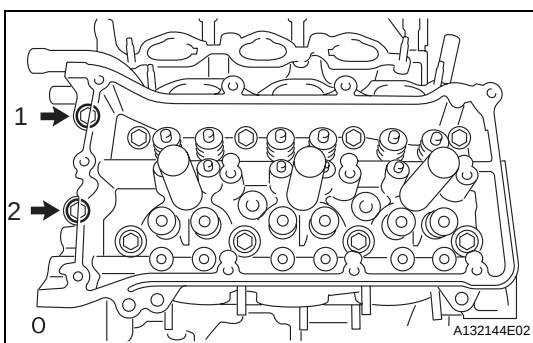
Torque: 30 N*m (306 kgf*cm, 22 ft.*lbf)

20. INSTALL VALVE LASH ADJUSTER ASSEMBLY

- (a) Be sure to inspect the valve lash adjuster before installing it (see page [EM-75](#)).
- (b) Install the lash adjusters.

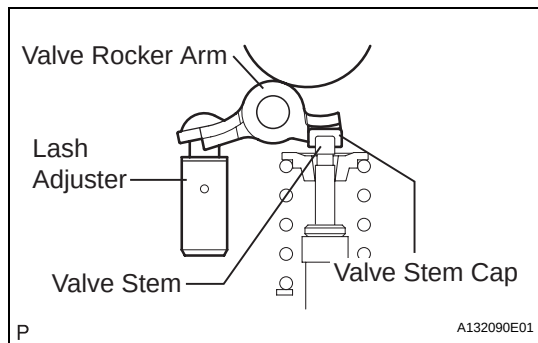
NOTICE:

Install the lash adjuster at the same place it was removed from.

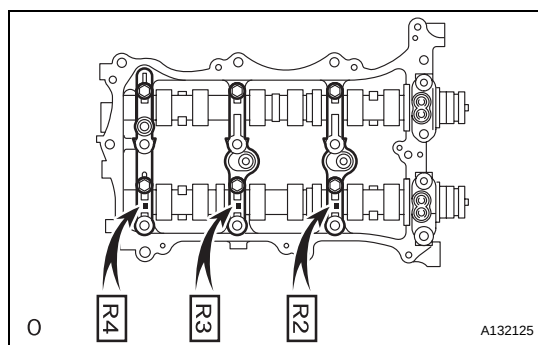


21. INSTALL NO. 1 VALVE ROCKER ARM SUB-ASSEMBLY

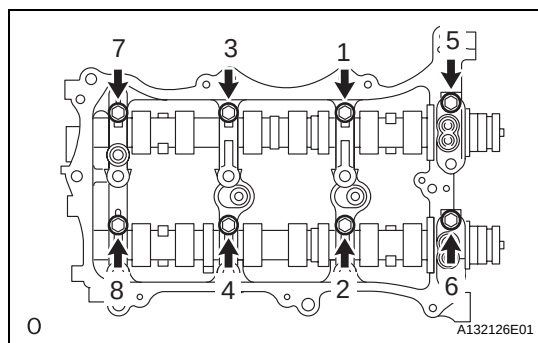
- Apply engine oil to the lash adjuster tips and valve stem cap ends.
- Make sure that the valve rocker arms are installed as shown in the illustration.

**22. INSTALL CAMSHAFT BEARING CAP (for Bank 1)**

- Apply engine oil to the camshaft journals, camshaft housings and bearing caps.
- Install the No. 1 camshaft and No. 2 camshaft to the camshaft housing.

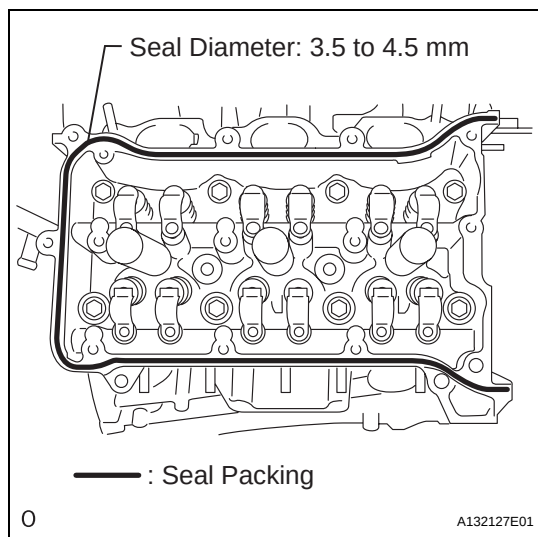


- Confirm the marks and numbers on the camshaft bearing caps and place them each in their proper position and direction.



- Temporarily install the 8 bolts in the order shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

**23. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 1)**

- Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

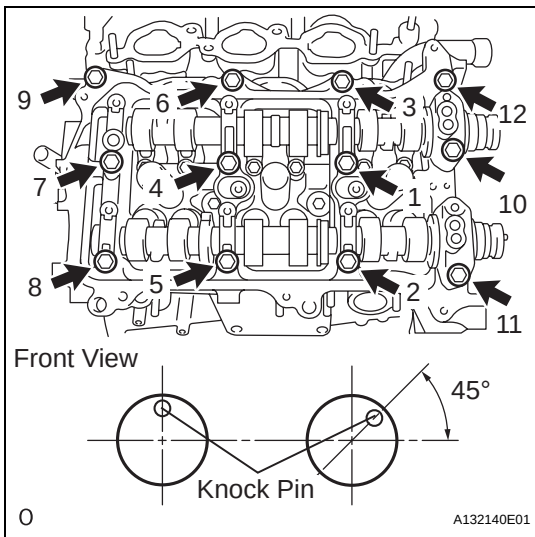
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

Standard seal diameter:

3.5 to 4.5 mm (0.138 to 0.177 in.)

NOTICE:

- Remove any oil from the contact surface.
- Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after the installation.

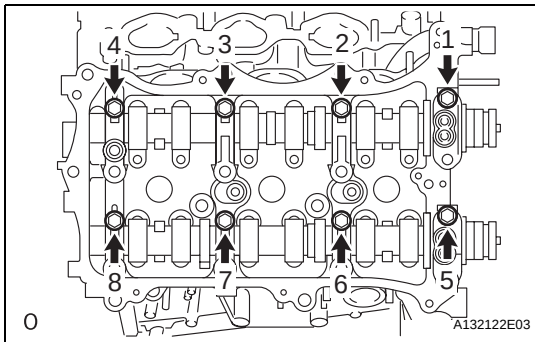


- (b) Install the camshaft housing, and install the 12 bolts in the order shown in the illustration.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

NOTICE:

Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.

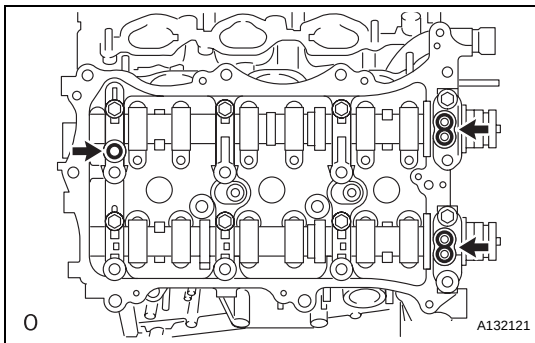


- (c) Tighten the 8 bolts in the order shown in the illustration.

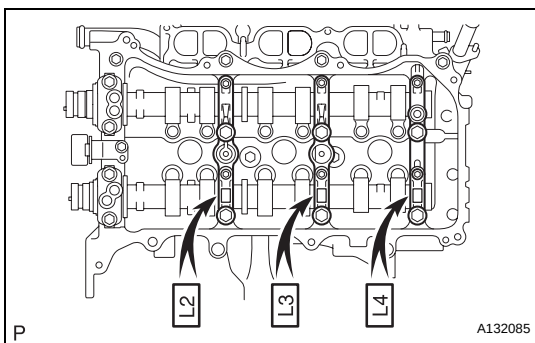
Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

NOTICE:

Thoroughly wipe clean any seal packing.

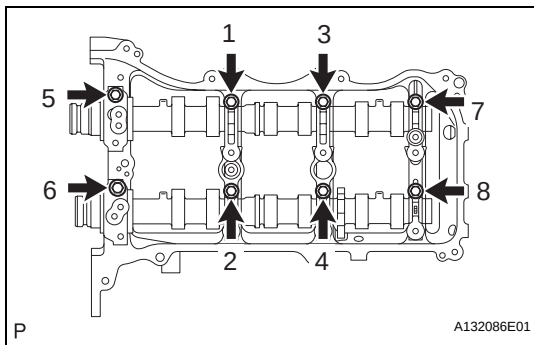


- (d) Install 3 new gaskets.



24. INSTALL CAMSHAFT BEARING CAP (for Bank 2)

- Apply engine oil to the camshaft journals, camshaft housings and bearing caps.
- Install the camshaft No. 3 and camshaft No. 4 to the camshaft housing.
- Confirm the marks and numbers on the camshaft bearing caps and place them each in their proper position and direction.



- (d) Temporarily install the 8 bolts in the order shown in the illustration.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

25. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY (for Bank 2)

- (a) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

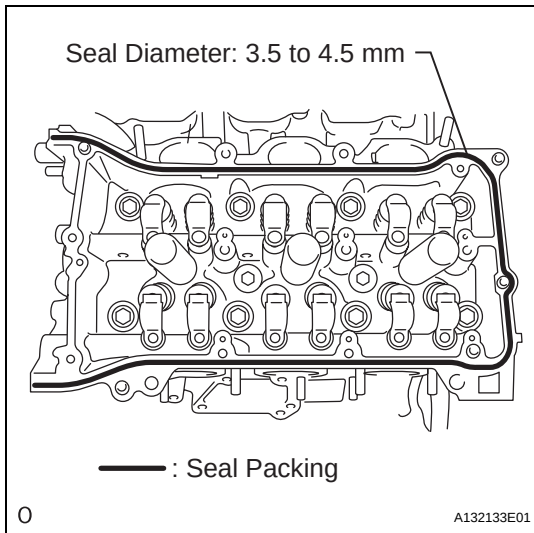
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

Standard seal diameter:

3.5 to 4.5 mm (0.138 to 0.177 in.)

NOTICE:

- Remove any oil from the contact surface.
- Install the camshaft housing within 3 minutes and tighten the bolts within 15 minutes after applying seal packing.
- Do not start the engine for at least 2 hours after the installation.

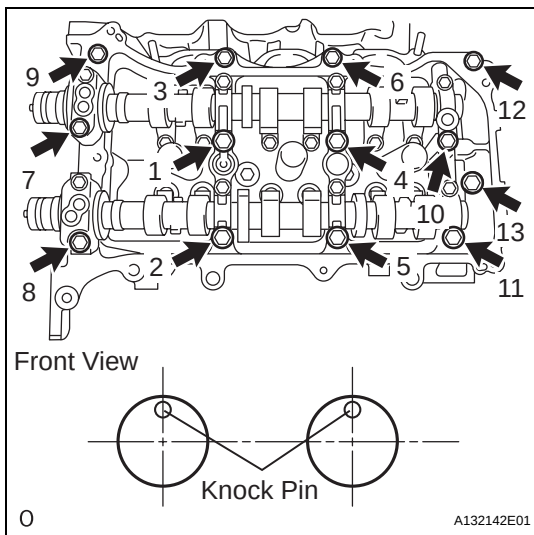


- (b) Install the camshaft housing and tighten the 13 bolts in the order shown in the illustration.

Torque: 28 N*m (286 kgf*cm, 21 ft.*lbf)

NOTICE:

Make sure that the knock pin of the camshaft is positioned as shown in the illustration before installing the camshaft housing.

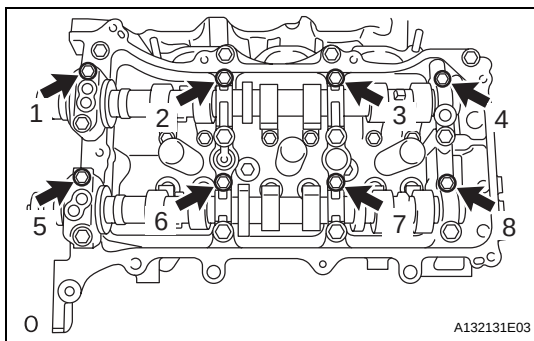


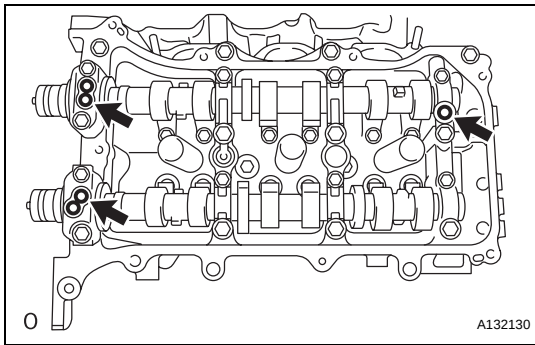
- (c) Tighten the 8 bolts in the order shown in the illustration.

Torque: 16 N*m (163 kgf*cm, 12 ft.*lbf)

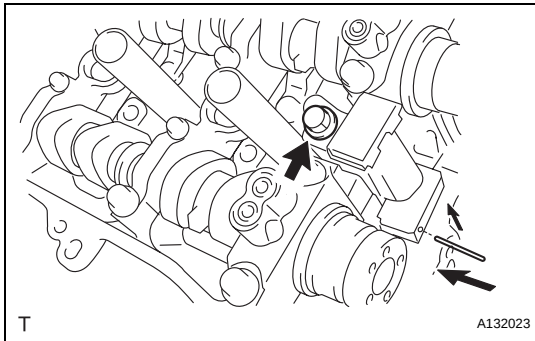
NOTICE:

Thoroughly wipe clean any seal packing.



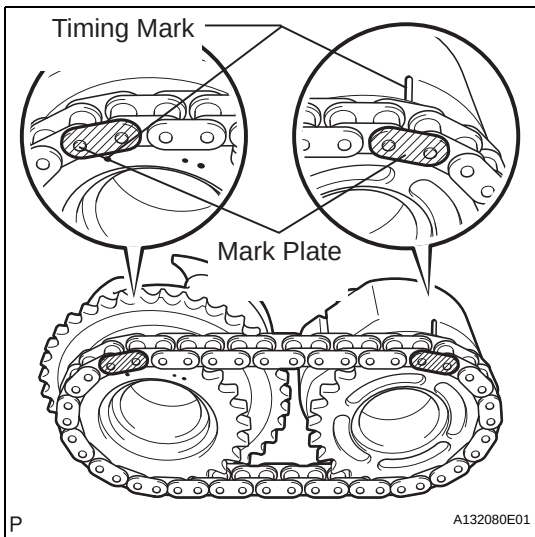


(d) Install 3 new gaskets.



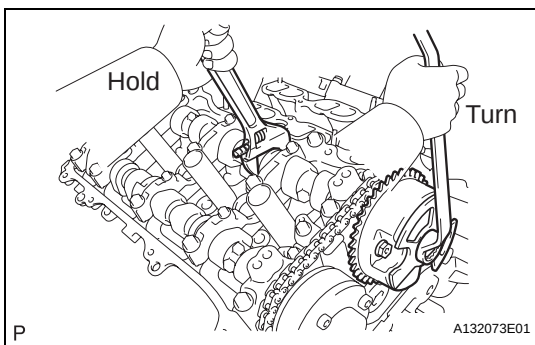
26. INSTALL NO. 2 CHAIN TENSIONER ASSEMBLY

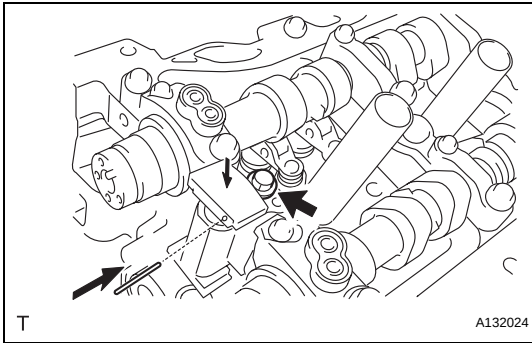
- Install the chain tensioner with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- While pushing in the tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.



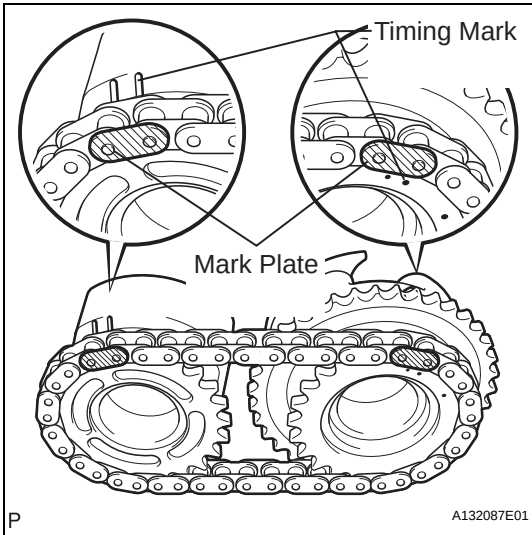
27. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 1)

- Align the mark plate (yellow) with the timing marks (1 dot mark) of the camshaft timing gears as shown in the illustration.
- Apply a small amount of engine oil to the bolt threads and bolt-seating surface.
- Align the knock pin of the camshaft with the pin hole of the camshaft timing gear. Install the camshaft timing gear and camshaft timing exhaust gear with the No. 2 chain installed.
- Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.
Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)
- Remove the pin from the No. 2 chain tensioner.

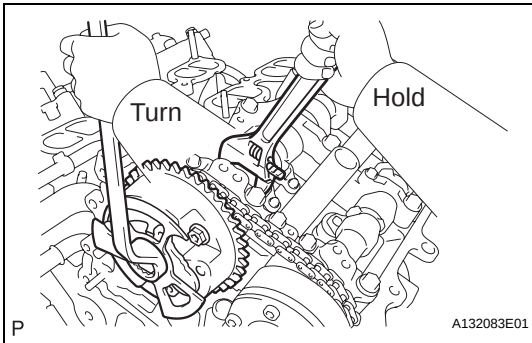


**28. INSTALL NO. 3 CHAIN TENSIONER ASSEMBLY**

- (a) Install the chain tensioner with the bolt.
Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf)
- (b) While pushing in the tensioner, insert a pin of $\phi 1.0$ mm (0.039 in.) into the hole to fix it in place.

**29. INSTALL CAMSHAFT TIMING GEARS AND NO. 2 CHAIN (for Bank 2)**

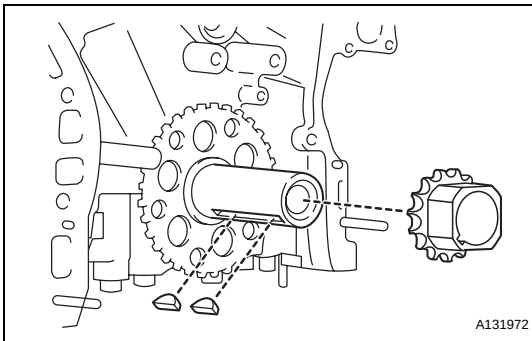
- (a) Align the mark plate (yellow) with the timing marks (2 dot mark) of the camshaft timing gears as shown in the illustration.
- (b) Apply a small amount of engine oil to the bolt threads and bolt-seating surface.
- (c) Align the knock pin of the camshaft with the pin hole of the camshaft timing gear. Install the camshaft timing gear and camshaft timing exhaust gear with the No. 2 chain installed.



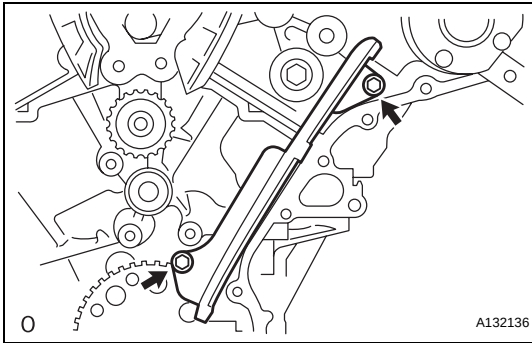
- (d) Hold the hexagonal portion of the camshaft with a wrench, and tighten the 2 bolts.

Torque: 100 N*m (1,020 kgf*cm, 74 ft.*lbf)

- (e) Remove the pin from the No. 2 chain tensioner.

**30. INSTALL CRANKSHAFT TIMING GEAR OR SPROCKET**

- (a) Install the timing gear set keys and timing gear as shown in the illustration.

**31. INSTALL NO. 1 CHAIN VIBRATION DAMPER**

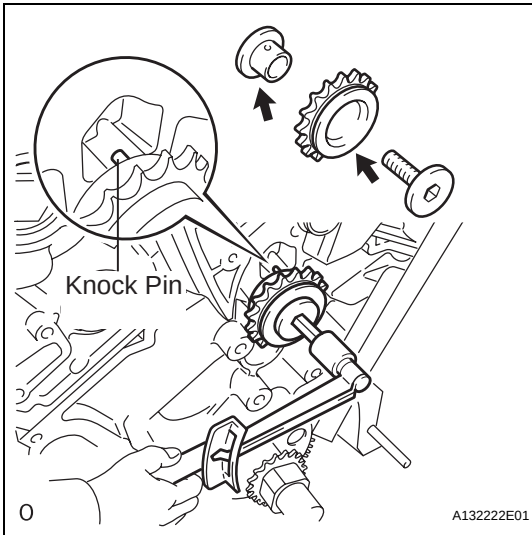
- (a) Install the chain vibration damper with the 2 bolts.
Torque: 23 N*m (235 kgf*cm, 17 ft.*lbf)

32. INSTALL NO. 2 CHAIN VIBRATION DAMPER

- (a) Install the 2 chain vibration damper.

33. INSTALL IDLE SPROCKET ASSEMBLY

- (a) Apply a light coat of engine oil to the rotating surface of the No. 1 idle gear shaft.



- (b) Temporarily install the No. 1 idle gear shaft and idle sprocket with the No. 2 idle gear shaft while aligning the knock pin of the No. 1 idle gear shaft with the knock pin groove of the cylinder block.

NOTICE:

Be careful of the idle gear direction.

- (c) Using a 10 mm hexagon wrench, tighten the No. 2 idle gear shaft.

Torque: 60 N*m (612 kgf*cm, 44 ft.*lbf)

EM**34. INSTALL CHAIN SUB-ASSEMBLY**

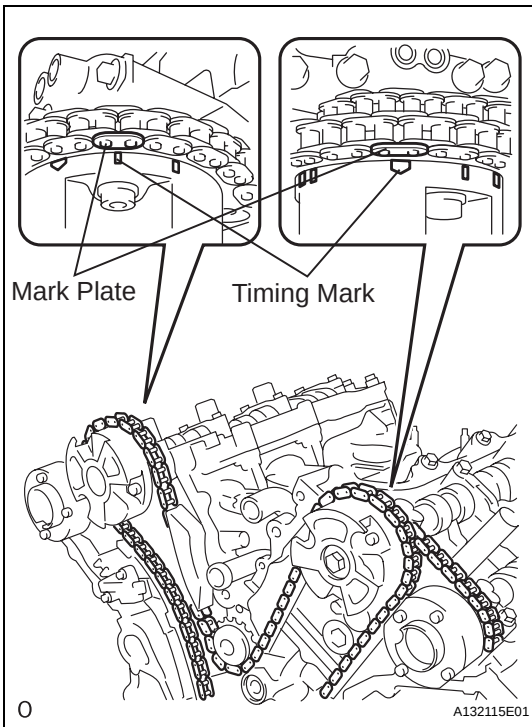
- (a) Align the mark plate and timing mark as shown in the illustration and install the chain.

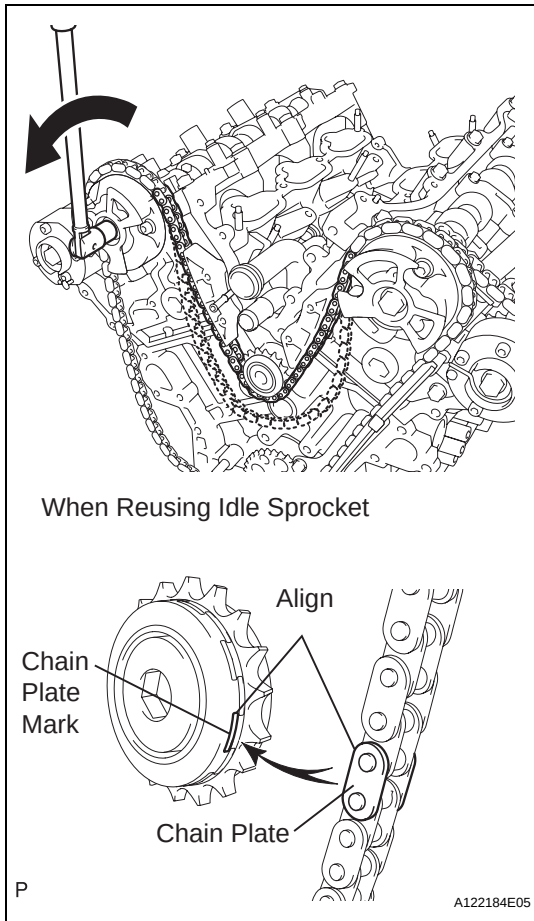
NOTICE:

Do not pass the chain over the crankshaft, just put it on it.

HINT:

The chain mark plate is orange.

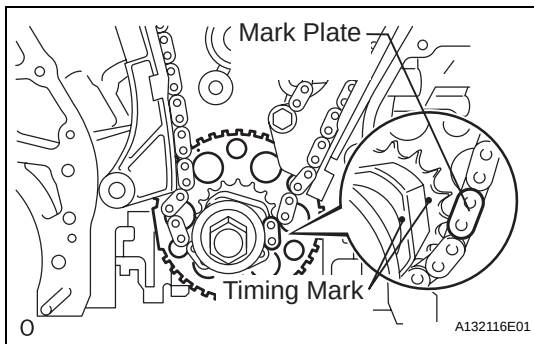




- (b) Turn the camshaft timing gear on the bank 1 counterclockwise to tighten the chain between the banks.

NOTICE:

If reusing the idle sprocket, align one of the idle sprocket's chain plate marks with one of the chain's chain plates when installing the idle sprocket.

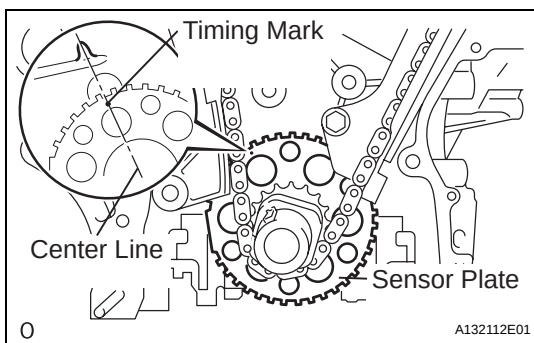


- (c) Align the mark plate and timing mark as shown in the illustration and install the chain onto the crankshaft timing gear.

HINT:

The chain mark plate is yellow.

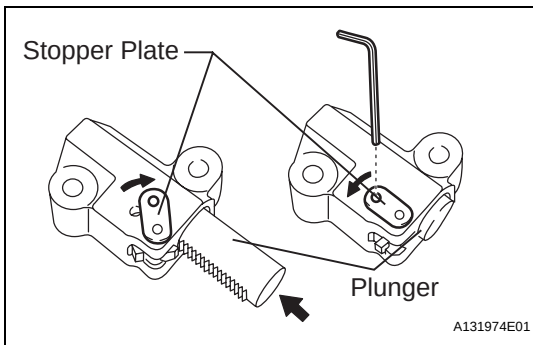
- (d) Temporarily tighten the pulley set bolt.



- (e) Turn the crankshaft clockwise to set it to the bank 1 block bore center line (TDC / compression).

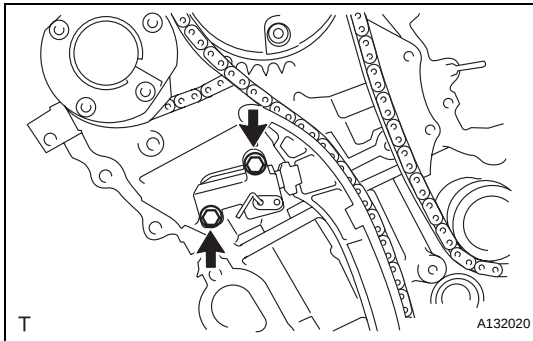
35. INSTALL CHAIN TENSIONER SLIPPER

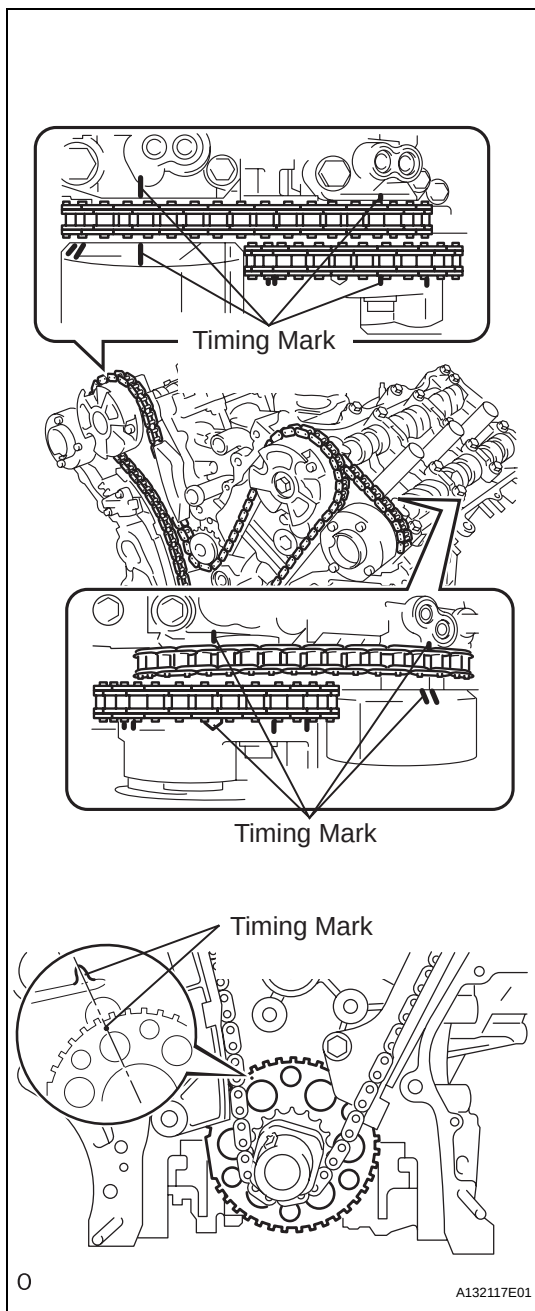
- (a) Install the chain tensioner slipper.

**36. INSTALL NO. 1 CHAIN TENSIONER ASSEMBLY**

- (a) Move the stopper plate upward to release the lock, and push the plunger deep into the tensioner.
- (b) Move the stopper plate downward to set the lock, and insert a hexagon wrench into the hole of the stopper plate.

- (c) Install the chain tensioner with the 2 bolts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

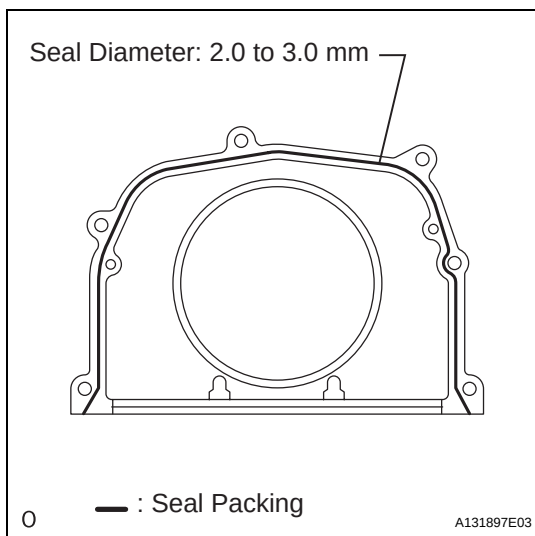




- (d) Remove the lock pin of the chain tensioner. Check that each timing mark is aligned with the crankshaft at the TDC / compression.
- (e) Remove the pulley set bolt.

37. INSTALL TIMING CHAIN COVER SUB-ASSEMBLY (w/ Oil Pump) (See page [LU-17](#))

38. INSTALL WATER PUMP ASSEMBLY (See page [CO-13](#))



39. INSTALL ENGINE REAR OIL SEAL RETAINER

- (a) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

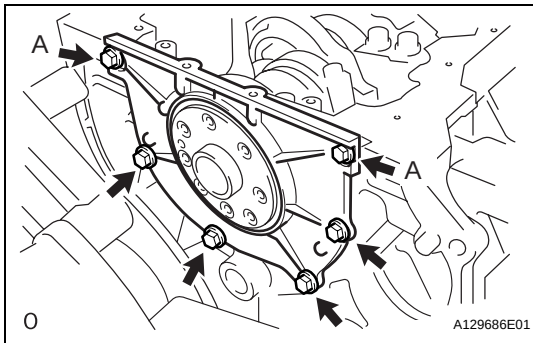
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

Standard seal diameter:

2.0 to 3.0 mm (0.079 to 0.118 in.)

NOTICE:

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



- (b) Install the oil seal retainer with the 6 bolts.

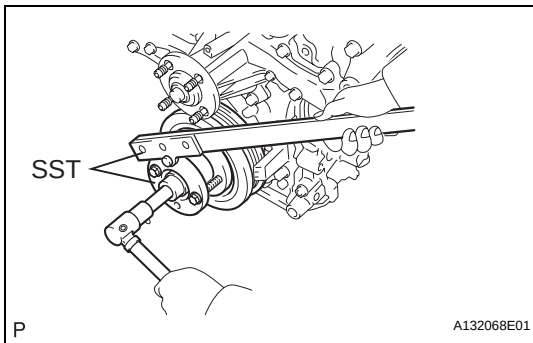
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

NOTICE:

Apply adhesive 1324 to the 2 bolts labeled A.

Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or Equivalent



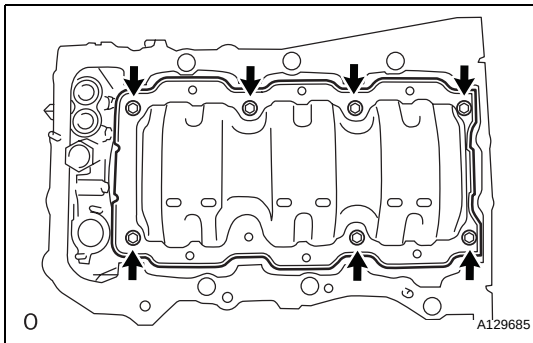
40. INSTALL CRANKSHAFT PULLEY

- (a) Align the pulley set key with the key groove of the pulley, and slide on the pulley.

- (b) Using SST, install the pulley bolt.

SST 09213-70011 (09213-70020), 09330-00021

Torque: 250 N*m (2,549 kgf*cm, 184 ft.*lbf)



41. INSTALL OIL PAN BAFFLE PLATE

- (a) Install the oil pan baffle plate with the 7 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

42. INSTALL OIL PAN SUB-ASSEMBLY (See page [LU-21](#))

43. INSTALL OIL STRAINER SUB-ASSEMBLY (See page [LU-22](#))

44. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY (See page [LU-22](#))

45. INSTALL OIL FILTER ELEMENT (See page [LU-5](#))

46. INSTALL OIL FILTER CAP SUB-ASSEMBLY (See page [LU-5](#))

47. INSTALL WATER INLET HOUSING (See page [CO-14](#))

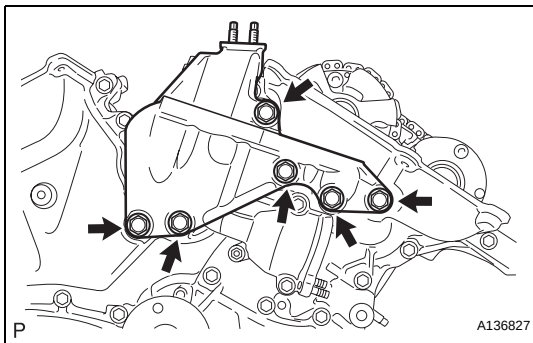
48. INSTALL FRONT NO. 1 ENGINE MOUNTING BRACKET

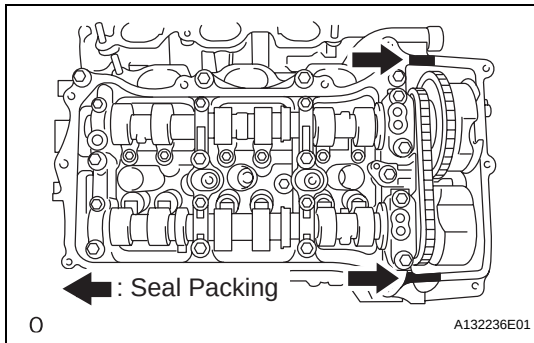
- (a) Install the engine mounting bracket with the 6 bolts.

Torque: 54 N*m (551 kgf*cm, 40 ft.*lbf)

NOTICE:

- Install the water inlet and mounting bracket within 15 minutes after installing the chain cover.
- Do not start the engine for at least 2 hours after the installation.





49. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 1)

- (a) Apply seal packing as shown in the illustration.

Seal packing:

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

NOTICE:

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

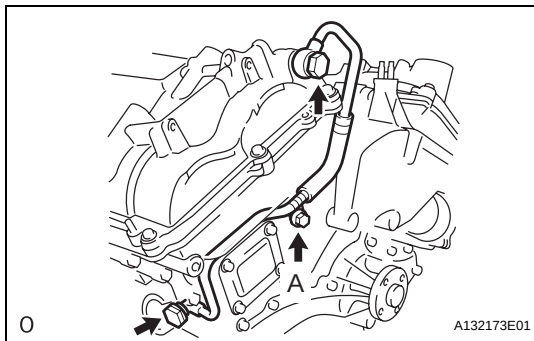
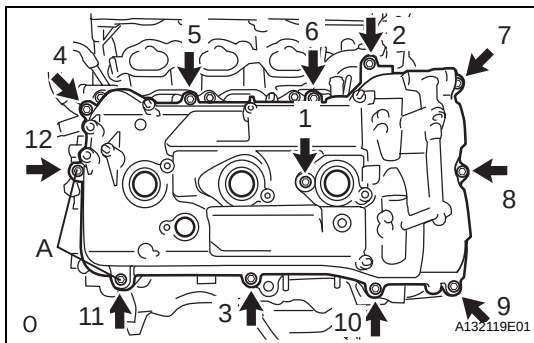
- (b) Install the gasket to the head cover.

- (c) Install the head cover with the 12 bolts in the order shown in the illustration.

Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt A
10 N*m (102 kgf*cm, 7 ft.*lbf) for except bolt A

HINT:

Make sure the tightening torque of bolt 1 and 11 is correct.



50. INSTALL OIL PIPE

- (a) Make sure that there is no foreign matter on the mesh of the oil control valve filter.
- (b) Install the oil control valve filter to the oil pipe union. Install 2 new gaskets and temporarily install the oil pipe (on the head cover side) with the oil pipe union.

NOTICE:

Remove any oil from the contact surface.

- (c) Install a new gasket and temporarily install the oil pipe (on the cylinder head side) with the oil pipe union.

NOTICE:

Remove any oil from the contact surface.

- (d) Install bolt A to the cylinder head.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)
- (e) Tighten the 2 oil pipe union bolts.
Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)

51. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY (for Bank 2)

- (a) Apply seal packing as shown in the illustration.

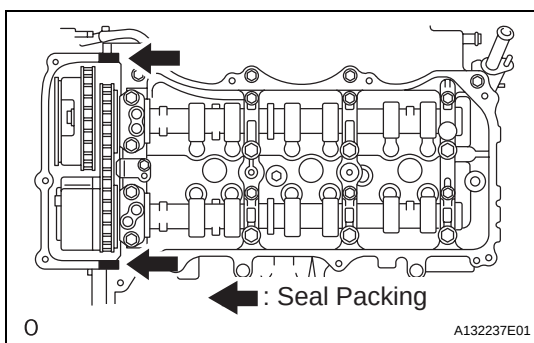
Seal packing:

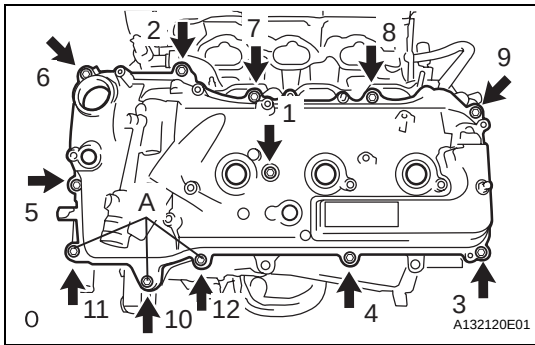
Toyota Genuine Seal Packing Block, Three Bond 1207B or Equivalent

NOTICE:

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

- (b) Install the gasket to the head cover.



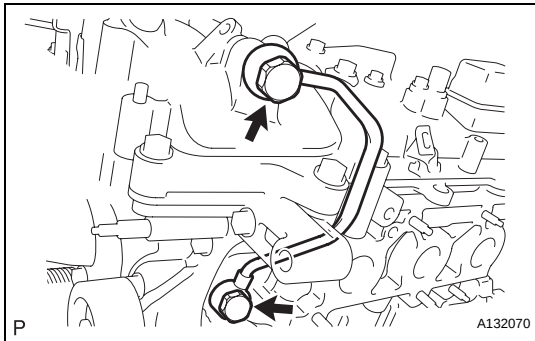


- (c) Install the head cover with the 12 bolts in the order in the illustration.

**Torque: 21 N*m (214 kgf*cm, 15 ft.*lbf) for bolt A
10 N*m (102 kgf*cm, 7 ft.*lbf) for except bolt A**

HINT:

Make sure the tightening torque of bolts 1 and 10 is correct.



52. INSTALL NO. 1 OIL PIPE

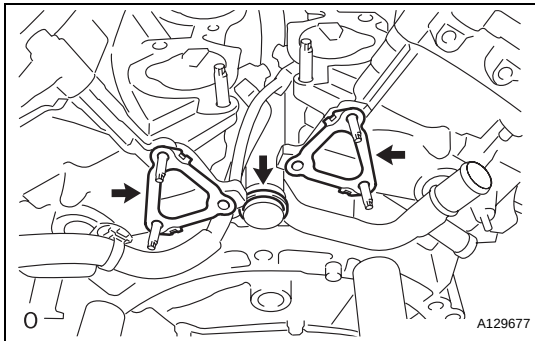
- Make sure that there is no foreign matter on the mesh of the oil control valve filter.
- Install the oil control valve filter to the oil pipe union. Install 2 new gaskets and temporarily install the oil pipe (on the head cover side) with the oil pipe union.
- Install a new gasket and temporarily install the oil pipe (on the cylinder head side) with the oil pipe union.

NOTICE:

Remove any oil from the contact surface.

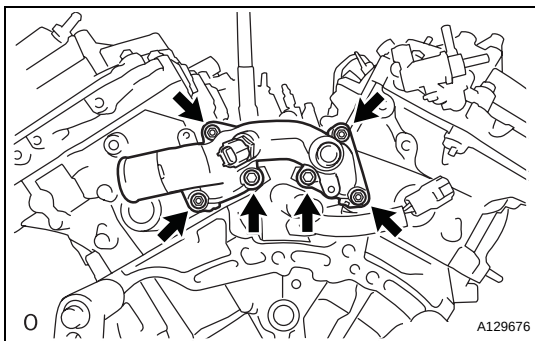
- Tighten the 2 oil pipe union bolts.

Torque: 65 N*m (663 kgf*cm, 48 ft.*lbf)



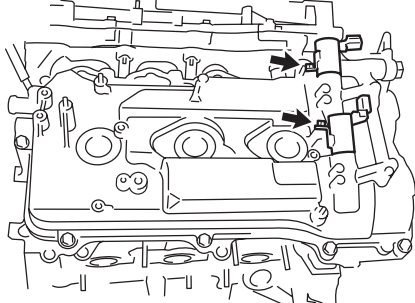
53. INSTALL WATER OUTLET

- Install 2 new gaskets and a new O-ring.
- Apply soapy water to the O-ring.

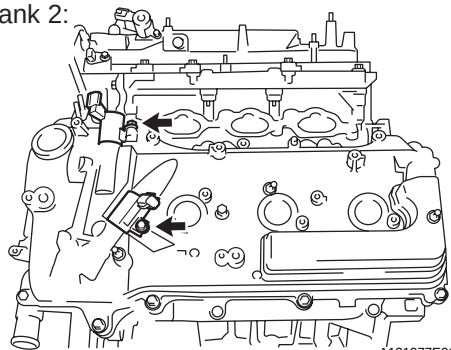


- Install the water outlet with the 2 bolts and 4 nuts.
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

for Bank 1:



for Bank 2:



0

A131977E01

54. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE ASSEMBLY

- (a) Install the 4 camshaft timing oil control valves with the 4 bolts.

Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

55. INSTALL VVT SENSOR

- (a) Install the 4 VVT sensors with the 4 bolts.

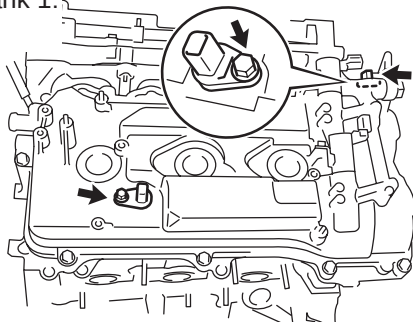
Torque: 10 N*m (102 kgf*cm, 7 ft.*lbf)

56. INSTALL SPARK PLUG

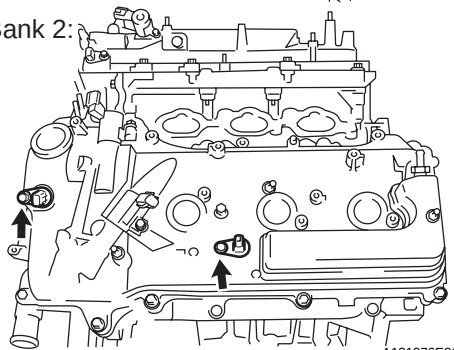
- (a) Install the 6 spark plugs.

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

for Bank 1:



for Bank 2:



0

A131976E01

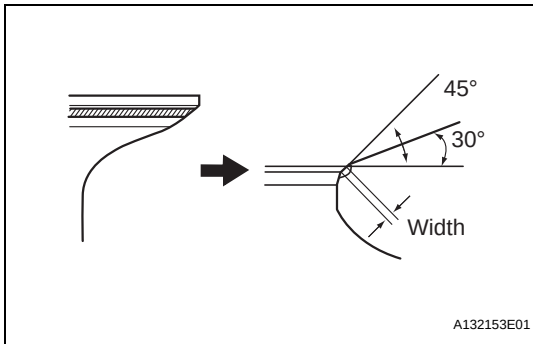
REPAIR

1. REPAIR INTAKE VALVE SEAT

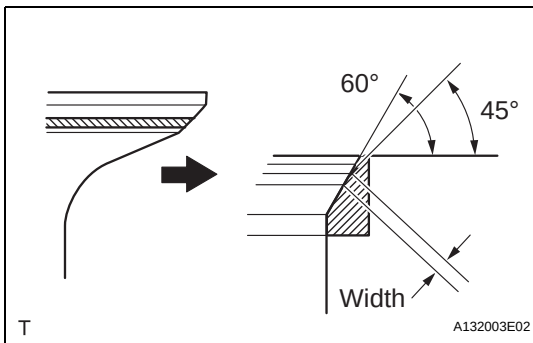
NOTICE:

Keep the lip free from foreign matter.

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



- (b) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.
- (c) Hand-lap the valve and valve seat with an abrasive compound.
- (d) Check the valve seating position.

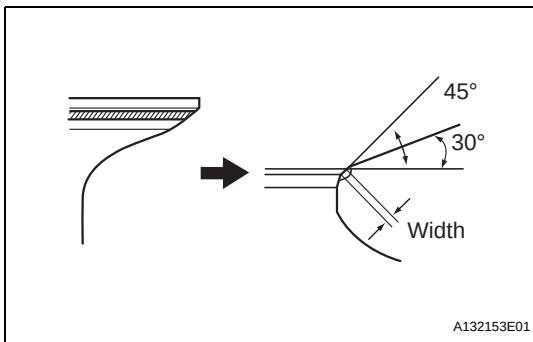


2. REPAIR EXHAUST VALVE SEAT

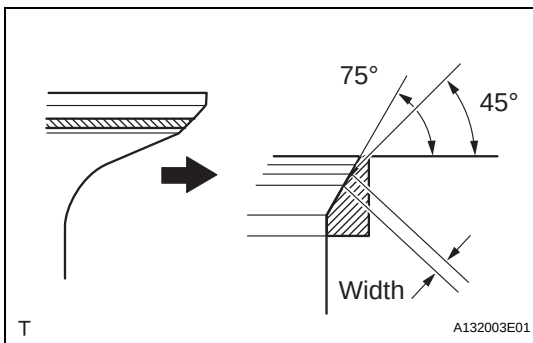
NOTICE:

Keep the lip free from foreign matter.

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



- (b) If the seating is too low on the valve face, use 45° and 75° cutters to correct the seat.
- (c) Hand-lap the valve and valve seat with an abrasive compound.
- (d) Check the valve seating position.



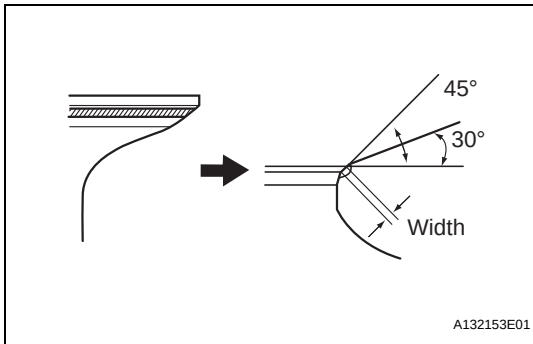
REPAIR

1. REPAIR INTAKE VALVE SEAT

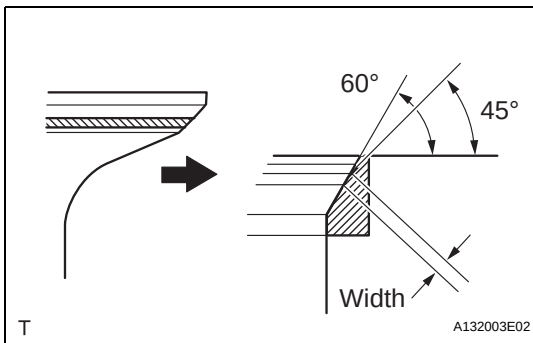
NOTICE:

Keep the lip free from foreign matter.

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



- (b) If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.
- (c) Hand-lap the valve and valve seat with an abrasive compound.
- (d) Check the valve seating position.

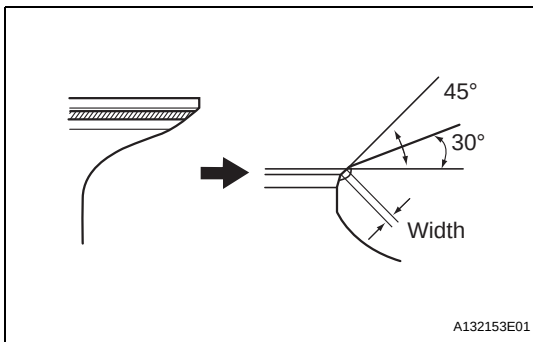


2. REPAIR EXHAUST VALVE SEAT

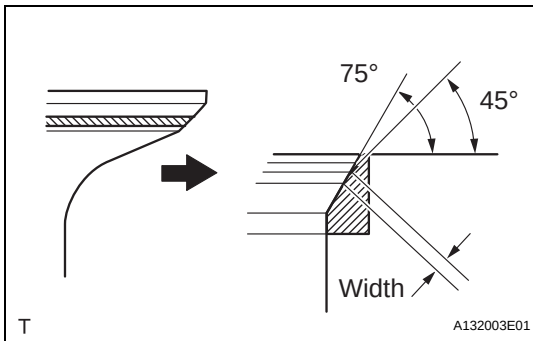
NOTICE:

Keep the lip free from foreign matter.

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



- (b) If the seating is too low on the valve face, use 45° and 75° cutters to correct the seat.
- (c) Hand-lap the valve and valve seat with an abrasive compound.
- (d) Check the valve seating position.



ENGINE

ON-VEHICLE INSPECTION

1. INSPECT VALVE LASH ADJUSTER NOISE

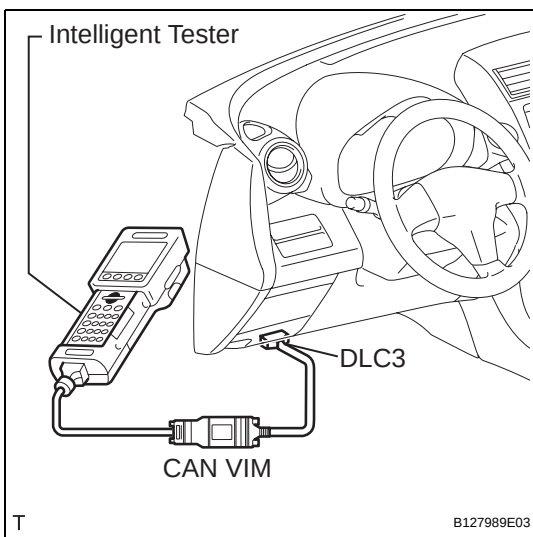
- (a) Rev up the engine several times. Check that the engine does not emit unusual noises.
If unusual noises occur, warm up the engine and idle it for over 30 minutes. Then perform the inspection above again.
If any defects or problems are found during the inspection above, perform a lash adjuster inspection.

2. INSPECT IGNITION TIMING

- (a) Warm up the engine and stop the engine.

NOTICE:

A warmed up engine should have an engine coolant temperature of over 80°C (176°F), have an engine oil temperature of 60°C (140°F), and the engine rpm should be stabilized.



- (b) When using the intelligent tester:
 - (1) Connect the intelligent tester to the DLC3.
 - (2) Start the engine and idle it.
 - (3) Push the intelligent tester main switch ON.
 - (4) Select the following menu items: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / IGN ADVANCE.

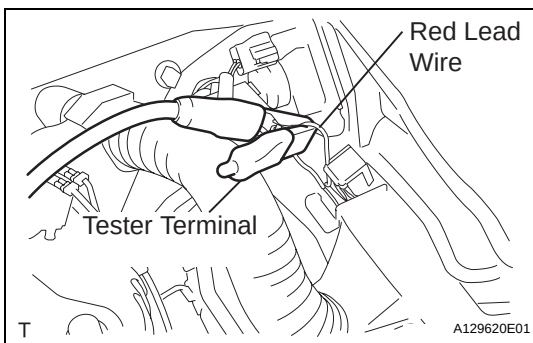
Standard ignition timing:

8 to 12° BTDC @ idle

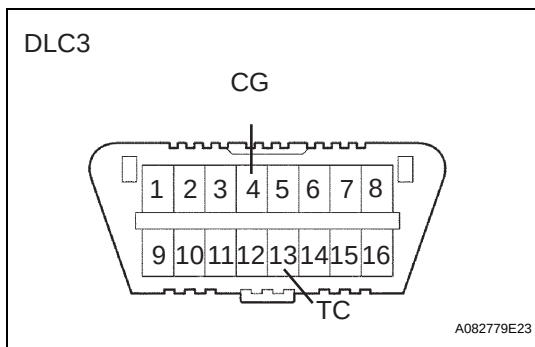
HINT:

Please refer to the intelligent tester operator's manual for further details.

- (c) When not using the intelligent tester:
 - (1) Remove the V-bank cover (see page [EM-21](#)).



- (2) Connect the tester terminal of a timing light to the red lead wire as shown in the illustration.
HINT:
Use a timing light that detects primary signals.



- (3) Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.

SST 09843-18040

NOTICE:

- **Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.**
- **When checking the ignition timing, the transmission should be in the neutral position.**

- (4) Using a timing light, check the ignition timing.

Standard ignition timing:

8 to 12° BTDC @ idle

NOTICE:

When checking the ignition timing, the transmission should be in the neutral position.

HINT:

Run the engine at 1,000 to 1,300 rpm for 5 seconds, and then check that the engine rpm returns to idle speed.

- (5) Remove the SST from the DLC3.

- (6) Check the ignition timing.

Standard ignition timing:

5 to 15° BTDC @ idle

- (7) Check that the ignition timing advances immediately when the engine speed is increased.

- (8) Disconnect the timing light from the engine.

- (9) Install the V-bank cover (see page [EM-42](#)).

3. INSPECT ENGINE IDLE SPEED

- (a) Warm up and stop the engine.

NOTICE:

A warmed up engine should have an engine coolant temperature of over 80°C (176°F) and an engine oil temperature of 60°C (140°F), and the engine rpm should be stabilized.

- (b) When using the intelligent tester:

- (1) Connect the intelligent tester to the DLC3.

NOTICE:

Switch off all accessories and A/C before connecting the intelligent tester.

- (2) Race the engine at 2,500 rpm for approximately 90 seconds.

- (3) Push the intelligent tester main switch ON.

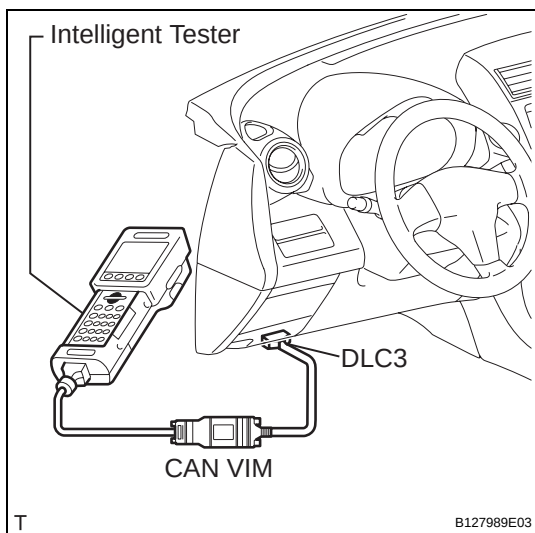
- (4) Select the tester menus: DIAGNOSIS / ENHANCED OBD II / DATA LIST / PRIMARY / ENGINE SPD.

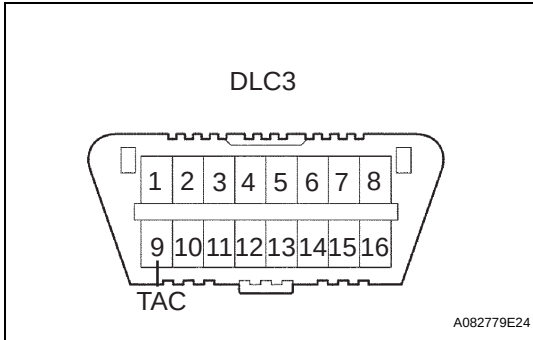
Standard idle speed:

600 to 700 rpm

NOTICE:

When checking the idle speed, the transmission should be in the neutral position.



**HINT:**

Please refer to the intelligent tester operator's manual for further details.

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

- (5) Disconnect the intelligent tester from the DLC3.
- (c) When not using the intelligent tester:
 - (1) Using SST, connect the tachometer probe to terminal 9 (TAC) of the DLC3.

SST 09843-18040

NOTICE:

Confirm the terminal numbers before connecting them. Connecting the wrong terminals can damage the engine.

- (2) Race the engine at 2,500 rpm for approximately 90 seconds.
- (3) Check the idle speed.

Standard idle speed:

600 to 700 rpm (Transmission neutral position)

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

- (4) Disconnect the tachometer from the DLC3.

4. INSPECT COMPRESSION

- (a) Warm up and stop the engine.

NOTICE:

A warmed up engine should have an engine coolant temperature of over 80°C (176°F) and an engine oil temperature of 60°C (140°F), and the engine rpm should be stabilized.

- (b) Disconnect the injector connectors.
- (c) Remove the intake air surge tank (see page [EM-27](#)).
- (d) Remove the 6 ignition coils (see page [EM-28](#)).
- (e) Remove the 6 spark plugs.
- (f) Inspect the cylinder compression pressure.

- (1) Insert a compression gauge into the spark plug hole.
- (2) While cranking the engine, measure the compression pressure.

HINT:

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

NOTICE:

The measurement must be done as quickly as possible.

Compression pressure:

1,400 kPa (14 kgf/cm², 199 psi) or more

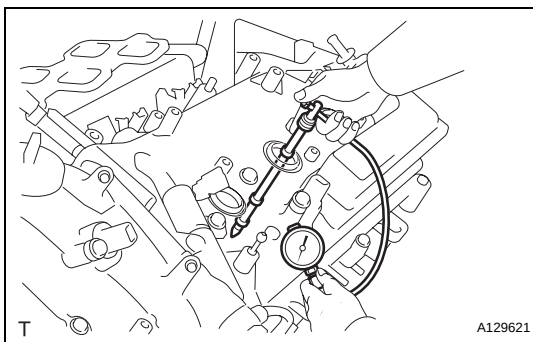
Minimum pressure:

980 kPa (10.0 kgf/cm², 142 psi)

Difference between each cylinder:

100 kPa (1.0 kgf/cm², 15 psi) or less

- (3) Perform the inspection above for each cylinder.



- (4) If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole. Then perform the first 3 steps under "Inspect the cylinder compression pressure" for the cylinders with low compression.

HINT:

- If adding oil helps the compression, it is likely that the piston rings and / or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be stuck or seated improperly, or there may be leakage in the gasket.

- (g) Install the 6 spark plugs.
 (h) Install the 6 ignition coils (see page [EM-34](#)).
 (i) Install the intake air surge tank (see page [EM-34](#)).
 (j) Connect the injector connectors.

5. INSPECT CO/HC

HINT:

This check is for determining whether or not the idle CO / HC complies with regulations.

- (a) Start the engine.
 (b) Keep the engine speed at 2,500 rpm for approximately 180 seconds.
 (c) Insert a CO / HC meter testing probe at least 40 cm (1.3 ft.) into the tailpipe during idling.
 (d) Immediately check the CO / HC concentration at idle and / or 2,500 rpm.

HINT:

- When performing the 2 mode (2,500 rpm and idle) test, follow the measurement order prescribed by the applicable local regulations.
 - If the CO / HC concentration does not comply with regulations, troubleshoot in the order given below.
- (1) Check the air fuel ratio sensor and heated oxygen sensor operation.
 (2) See the table below for the possible cause, then inspect and correct the applicable causes if necessary.

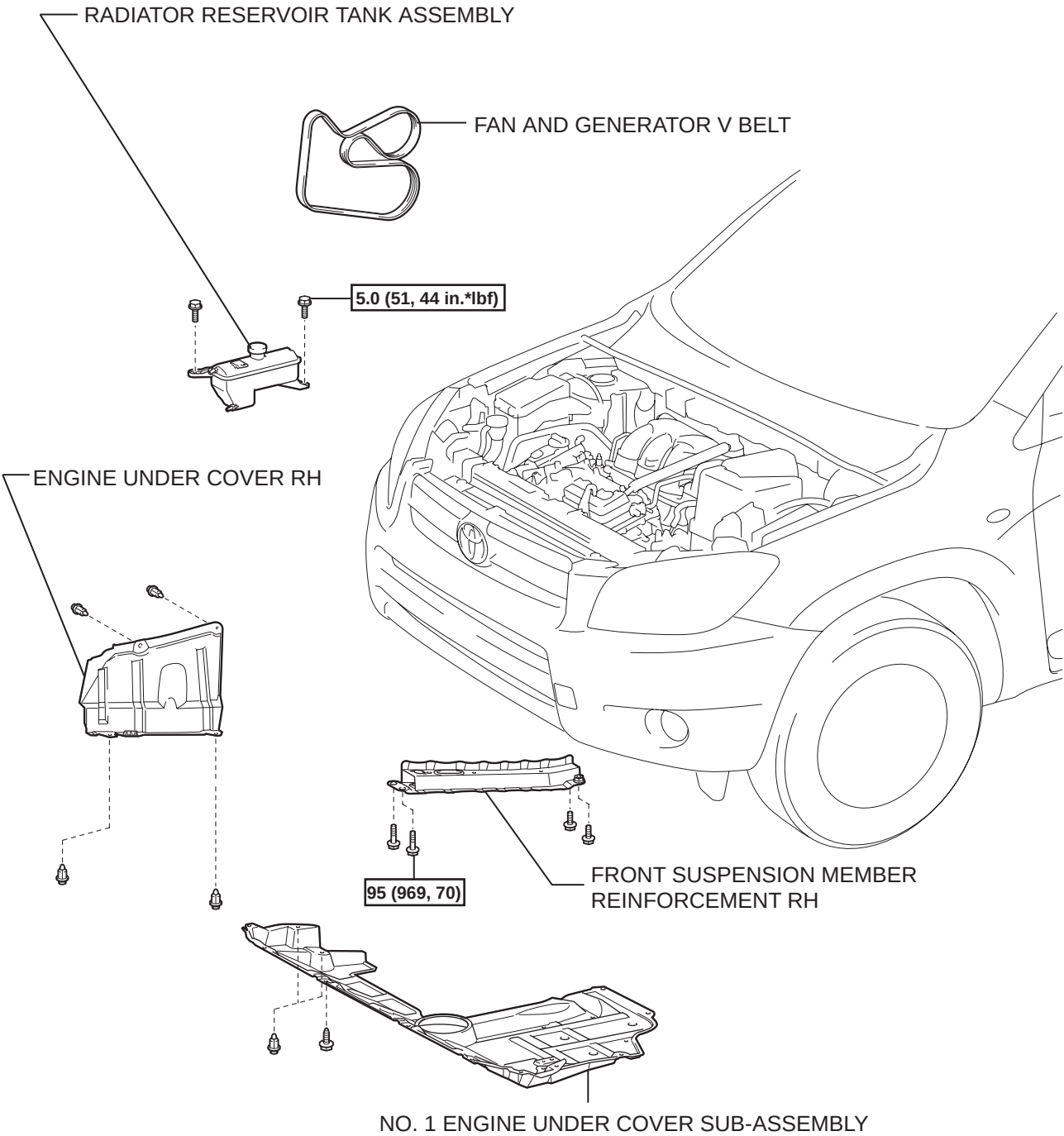
CO	HC	Symptom	Causes
Normal	High	Rough idle	1. Faulty ignitions – Incorrect timing – Fouled, shorted or improperly gapped plugs 2. Leaky intake and exhaust valves 3. Leaky cylinder
Low	High	Rough idle (Fluctuating HC reading)	1. Vacuum leaks – PCV hose – Intake manifold – Throttle body 2. Lean mixture causing misfire

CO	HC	Symptom	Causes
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Faulty fuel SFI system – Faulty pressure – Defective ECT sensor – Faulty ECM – Faulty injector – Faulty throttle position sensor – Faulty MAF sensor

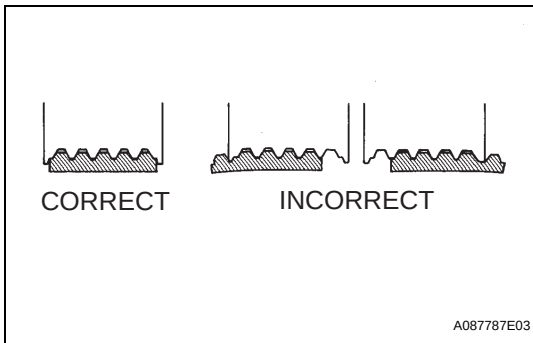
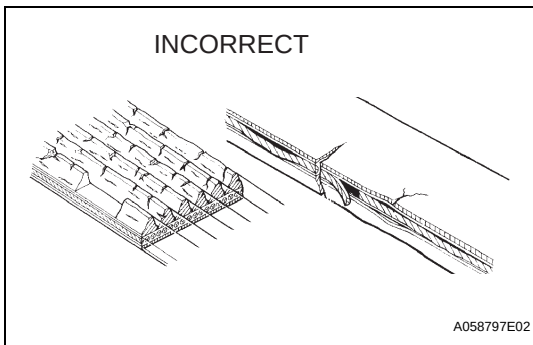
DRIVE BELT

COMPONENTS

EM



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



ON-VEHICLE INSPECTION

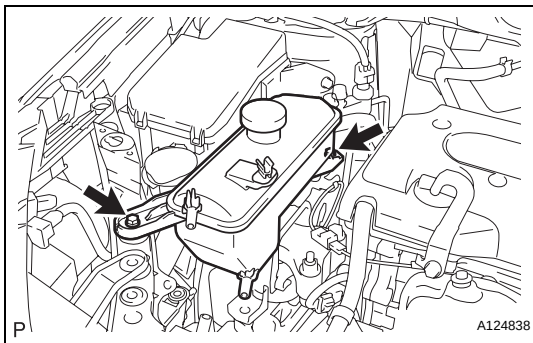
1. INSPECT FAN AND GENERATOR V BELT

- (a) Visually check the drive belt for excessive wear, frayed cords, etc. If any defect is found, replace the drive belt.

HINT:

Cracks on the rib side of a drive belt are considered acceptable. If the drive belt has chunks missing from the ribs, it should be replaced.

- (b) After installing the drive belt, check that it fits properly in the ribbed grooves. Check with your hand to confirm that the belt has not slipped out of the grooves on the bottom of the crank pulley.



REMOVAL

1. DISCONNECT RADIATOR RESERVOIR TANK ASSEMBLY

- (a) Remove the 2 bolts and disconnect the reservoir tank.

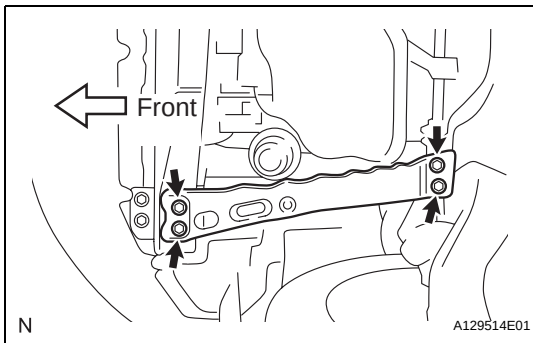
2. REMOVE NO. 1 ENGINE UNDER COVER SUB-ASSEMBLY (See page [EM-21](#))

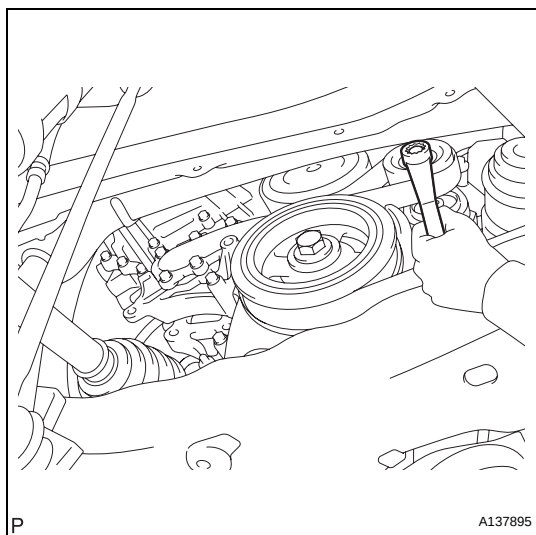
3. REMOVE ENGINE UNDER COVER RH

- (a) Remove the 2 clips and engine under cover.

4. REMOVE FRONT SUSPENSION MEMBER REINFORCEMENT RH

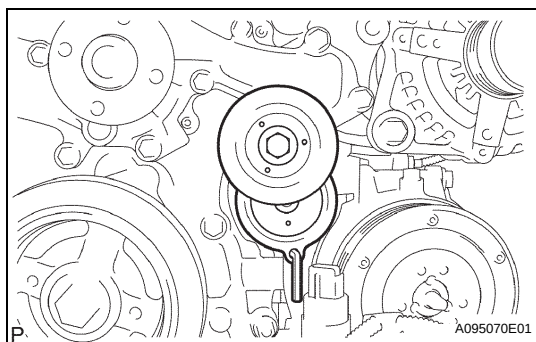
- (a) Remove the 4 bolts and reinforcement.



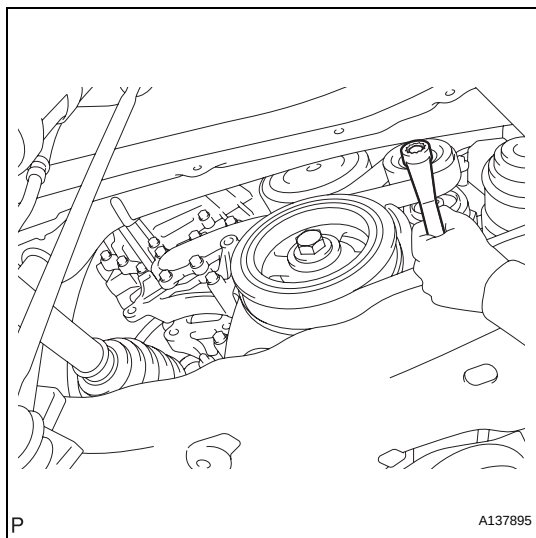


5. REMOVE FAN AND GENERATOR V BELT

- (a) Rotate the tensioner pulley counterclockwise to loosen the belt tension. Then remove the V-ribbed belt.



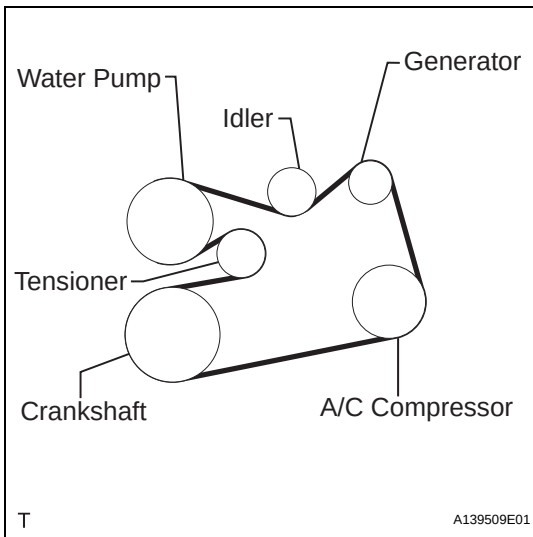
- (b) While turning the belt tensioner counterclockwise, align its holes, and then insert the 5 mm bi-hexagon wrench into the holes to fix the V-ribbed belt tensioner in place.



INSTALLATION

1. INSTALL FAN AND GENERATOR V BELT

- (a) Rotate the tensioner pulley counterclockwise, and then install the V-ribbed belt.

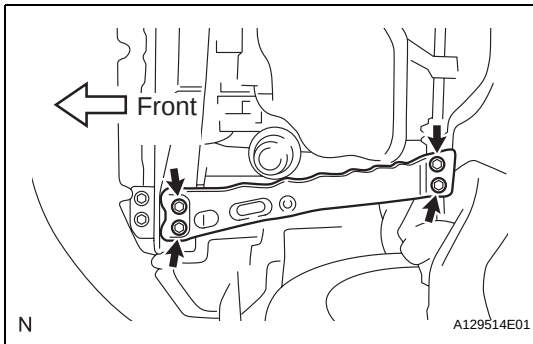


(b) If it is difficult to install the V-ribbed belt, perform the following procedure.

- (1) Put the V-ribbed belt on everything except the tensioner pulley as shown in the illustration.
- (2) While releasing the belt tension by turning the belt tensioner counterclockwise, put the V-ribbed belt on the tensioner pulley.

NOTICE:

- Put the backside of the V-ribbed belt on the tensioner pulley and idler pulley.
- Check that the V-ribbed belt is properly set to each pulley.



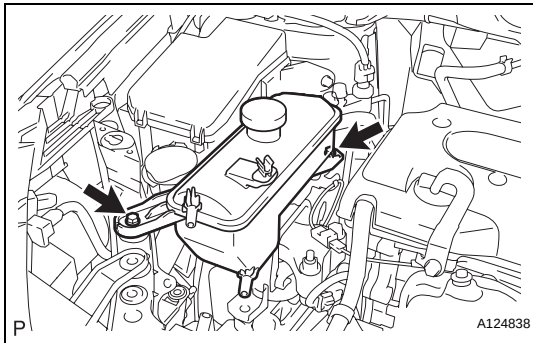
2. INSTALL FRONT SUSPENSION MEMBER REINFORCEMENT RH

- (a) Install the reinforcement with the 4 bolts.
Torque: 95 N*m (969 kgf*cm, 70 ft.*lbf)

3. INSTALL ENGINE UNDER COVER RH

- (a) Install the engine under cover with the 2 clips.

4. INSTALL NO. 1 ENGINE UNDER COVER (See page EM-41)

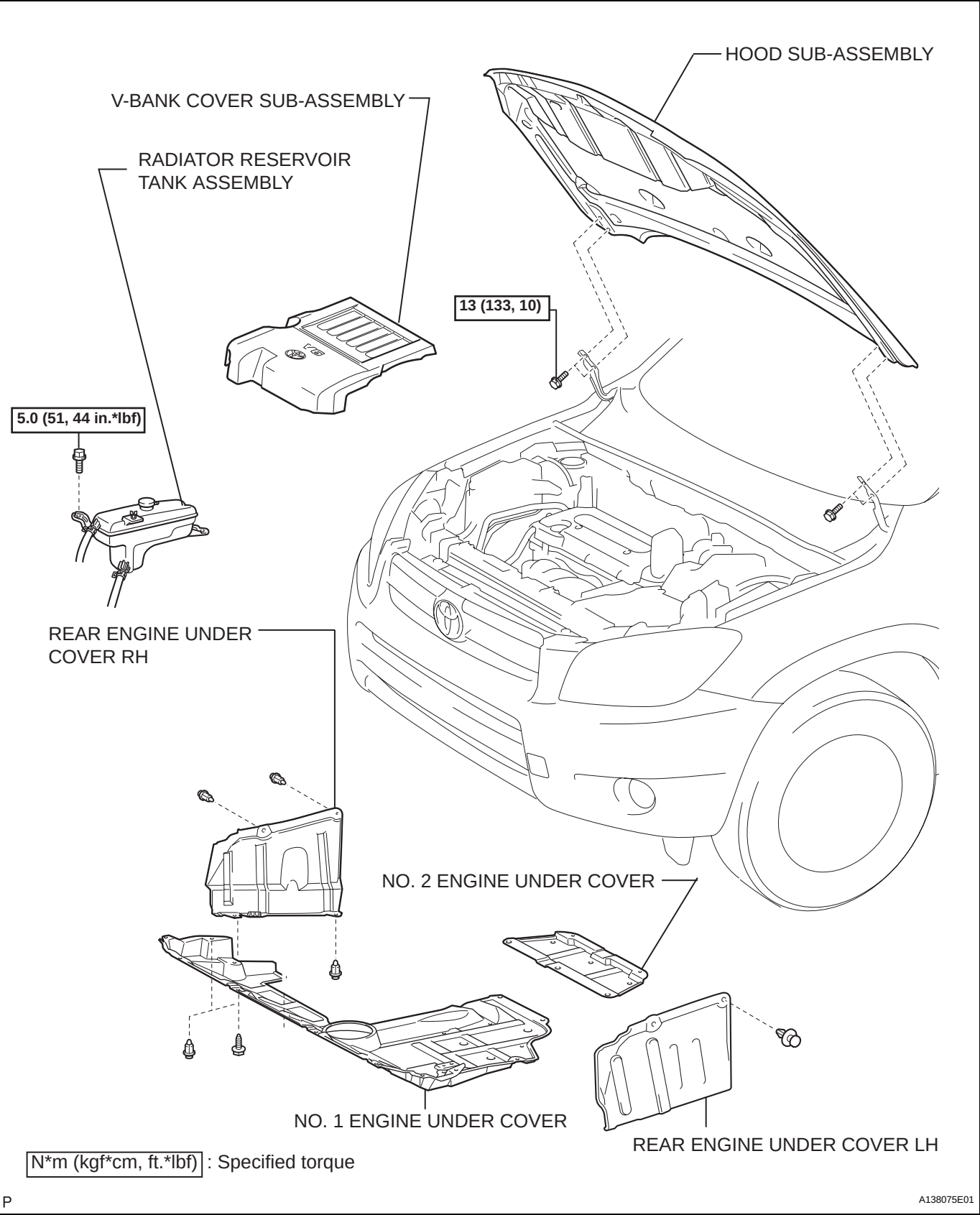


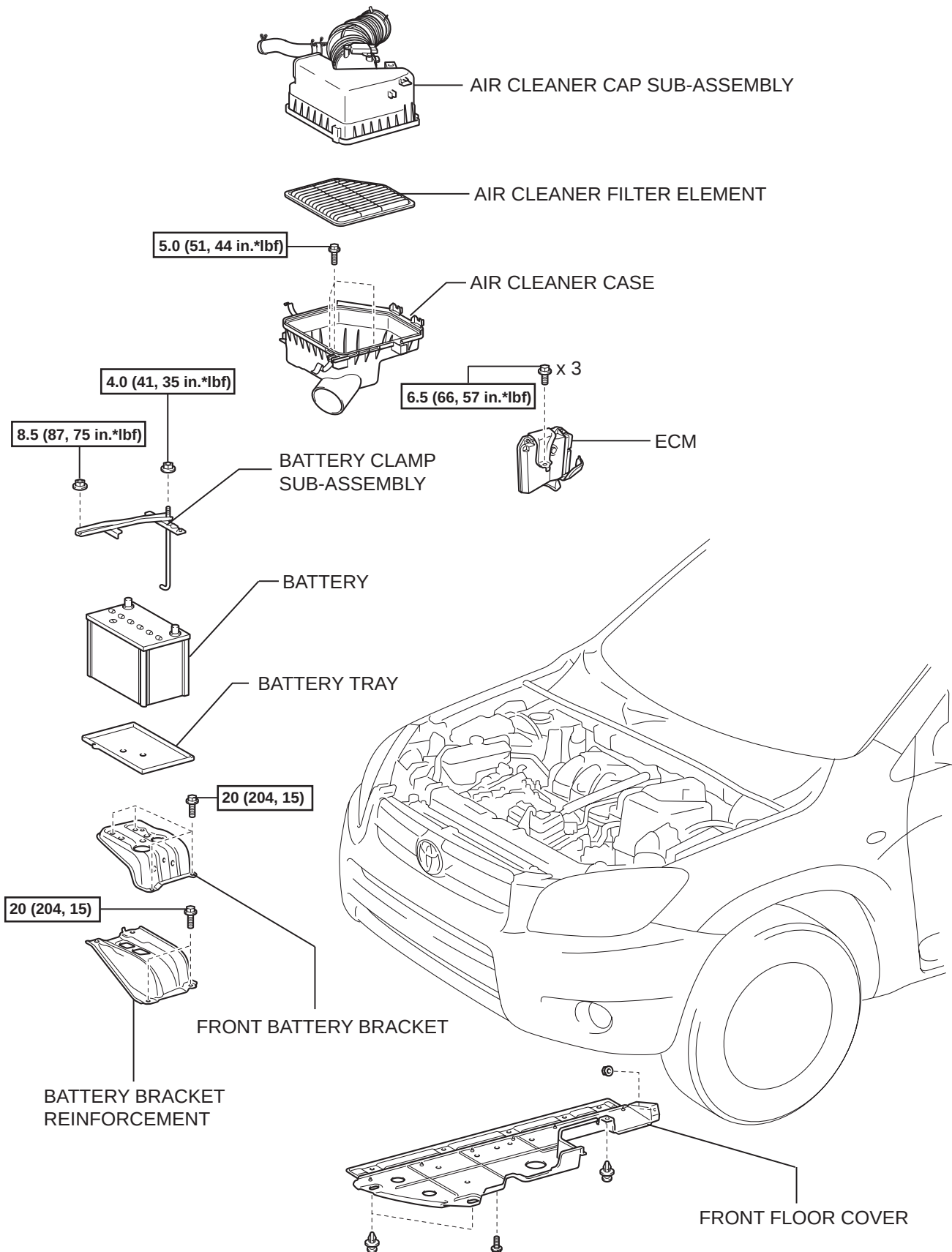
5. CONNECT RADIATOR RESERVOIR TANK ASSEMBLY

- (a) Connect the reservoir tank with the 2 bolts.
Torque: 5.0 N*m (51 kgf*cm, 44 in.*lbf)

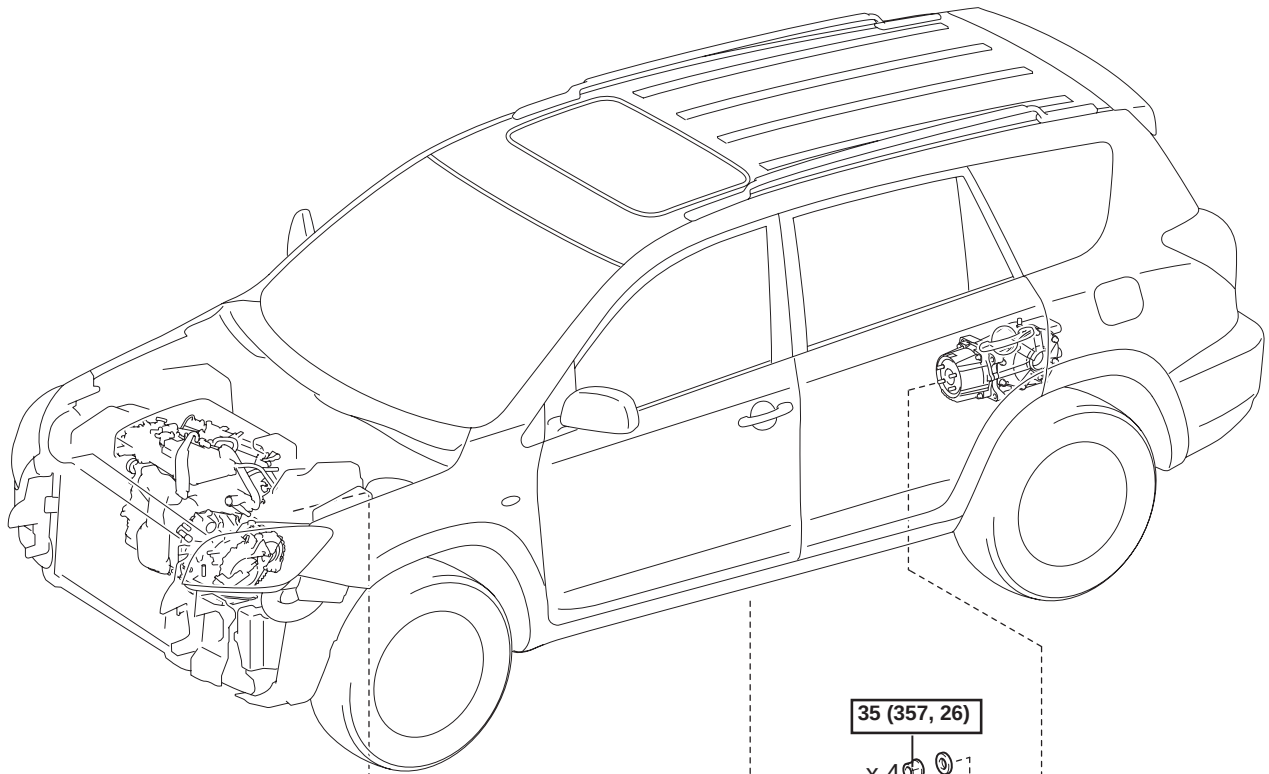
ENGINE ASSEMBLY

COMPONENTS

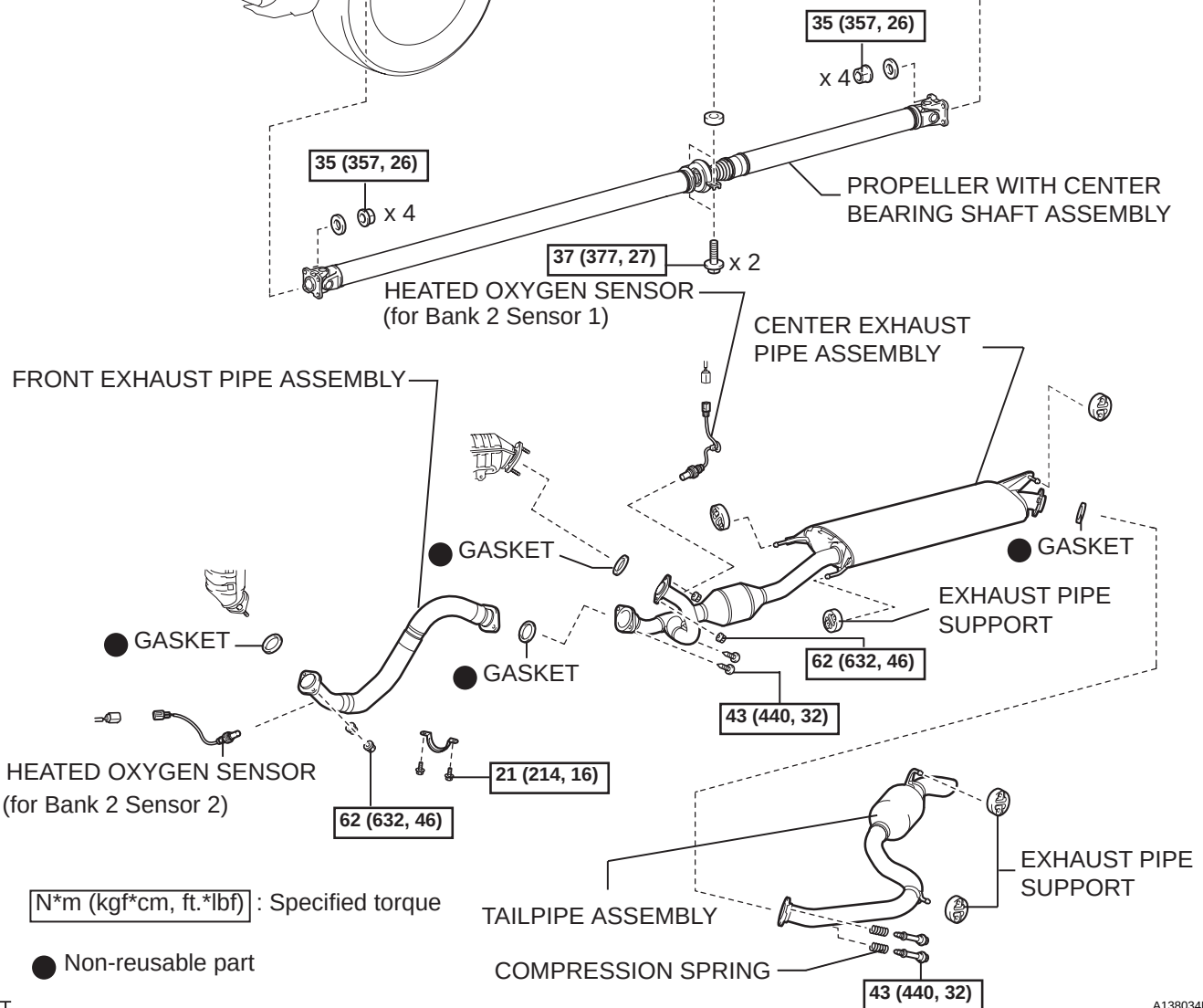




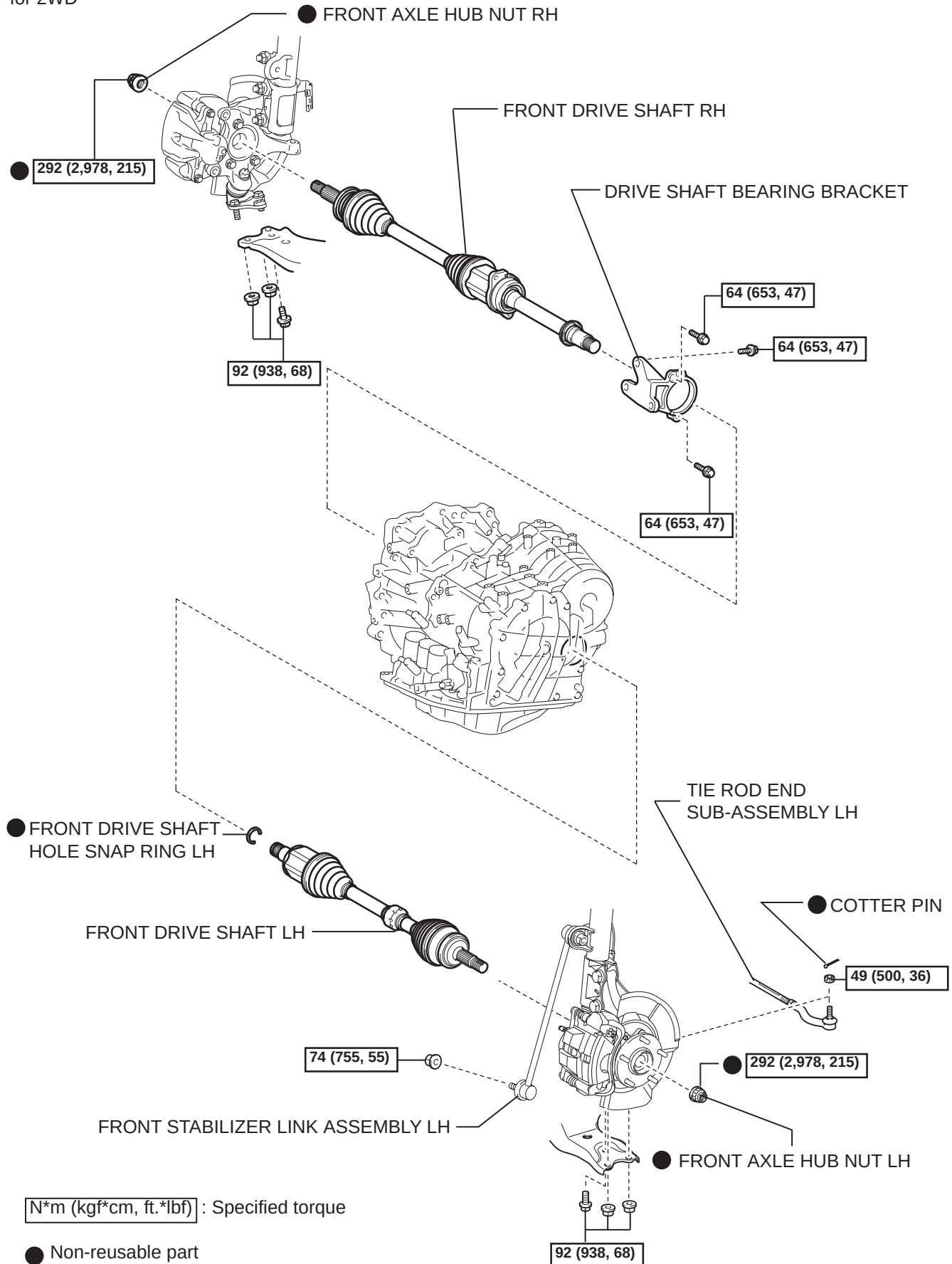
N*m (kgf*cm, ft.*lbf) : Specified torque



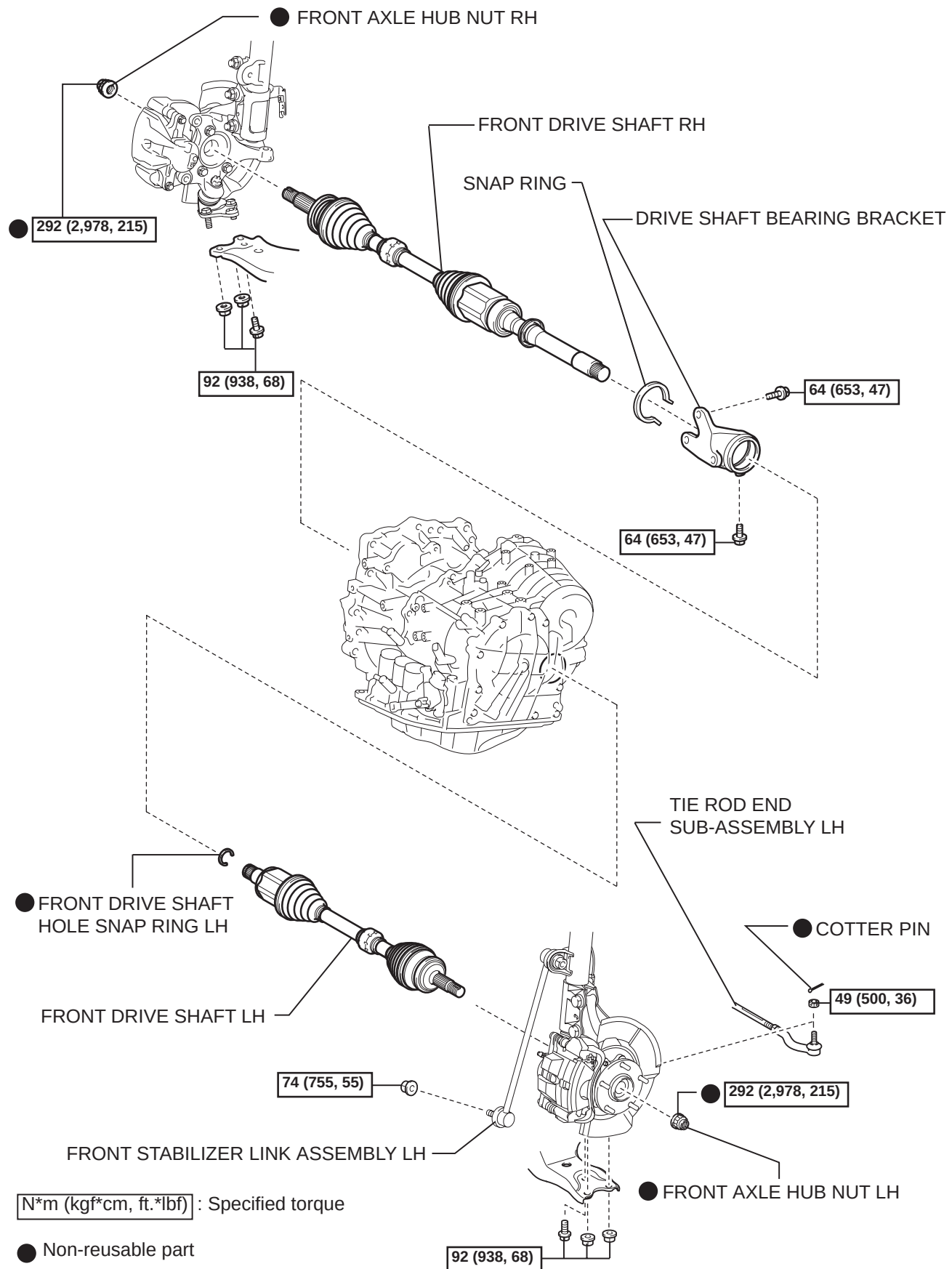
EM

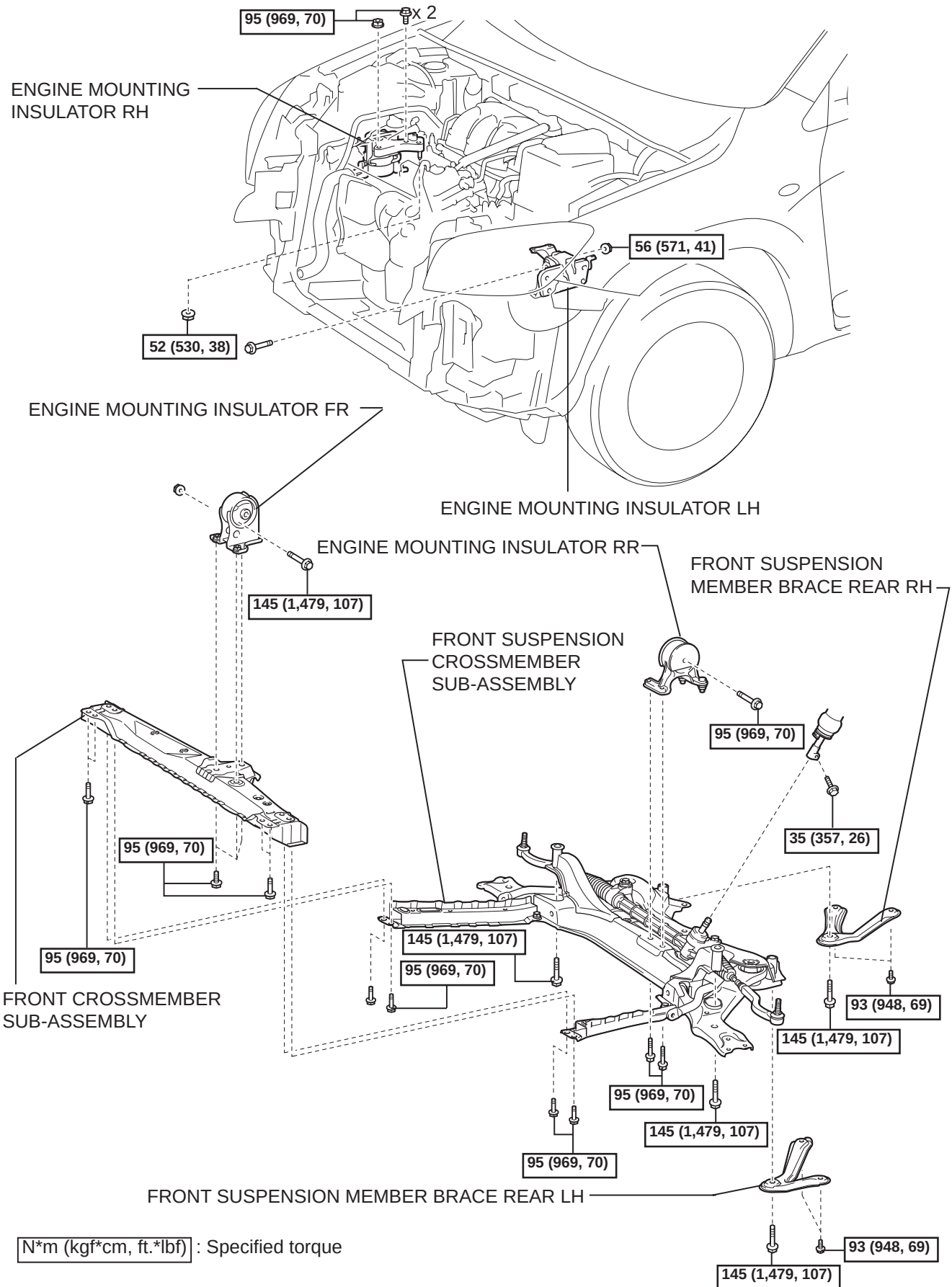


for 2WD

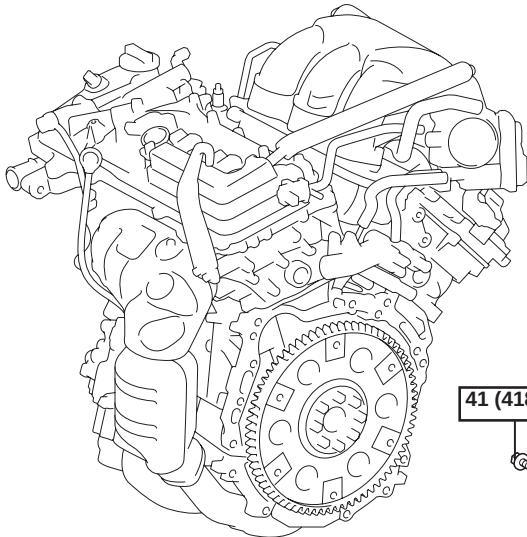
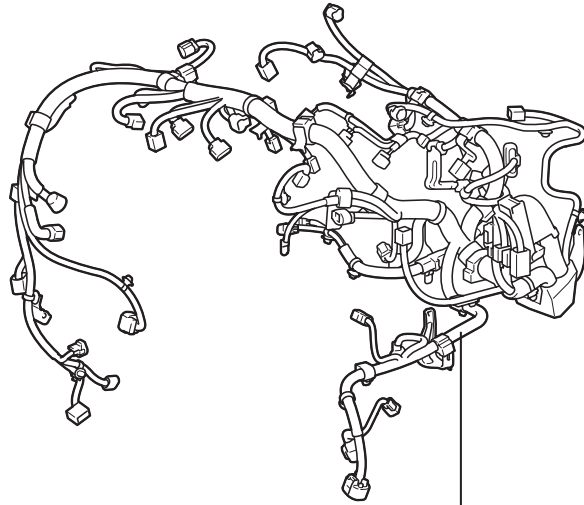
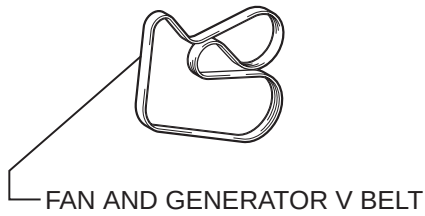


for 4WD



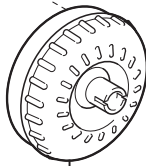


for 2WD



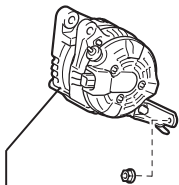
41 (418, 30)

x 3

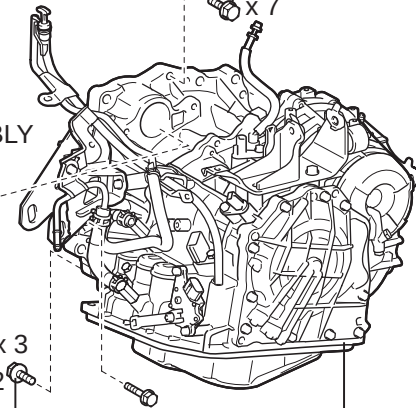
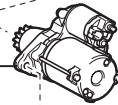


64 (653, 47)

x 7



STARTER ASSEMBLY



O-RING

x 3

x 2

37 (377, 27)

37 (377, 27)

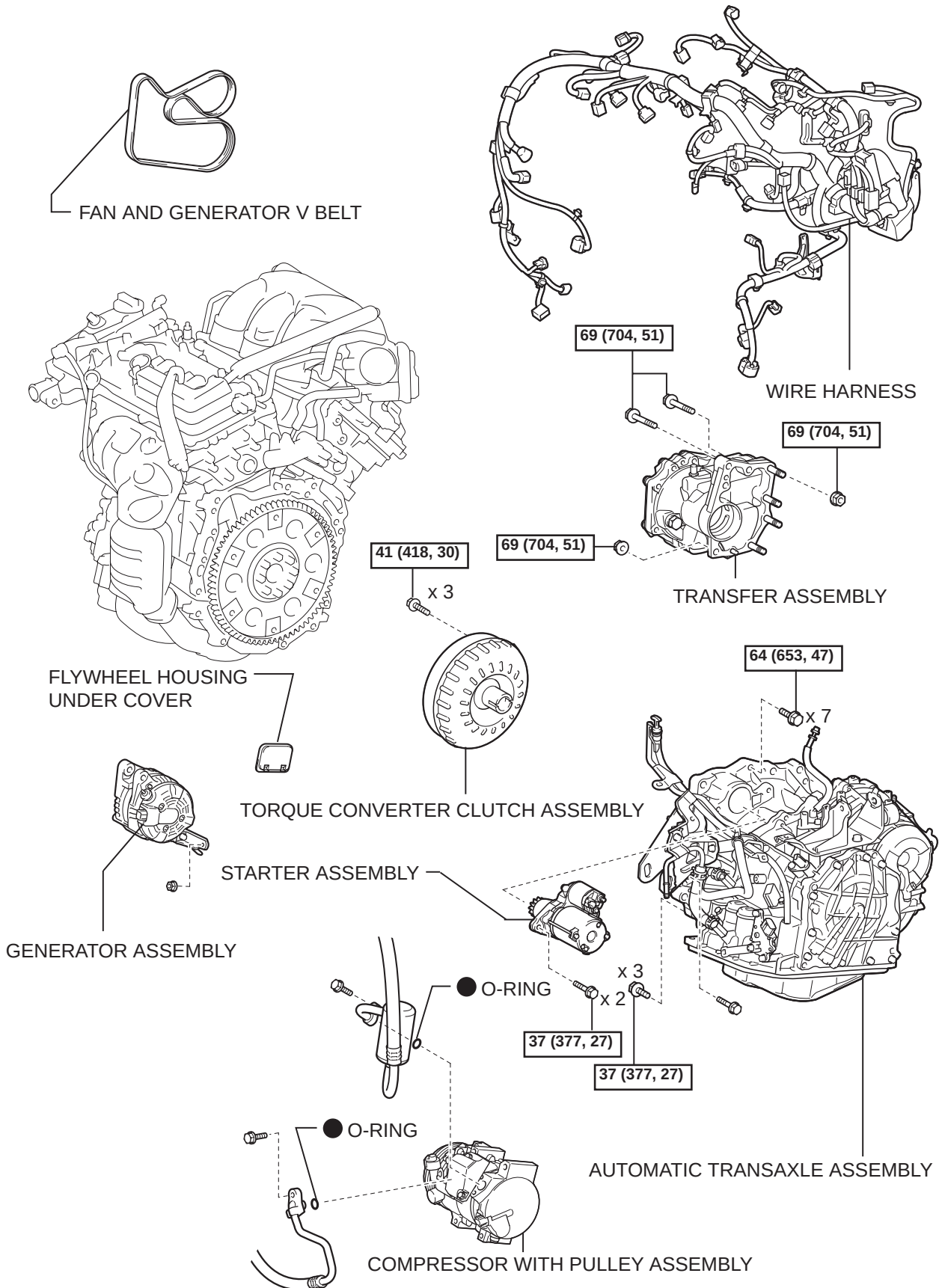


O-RING



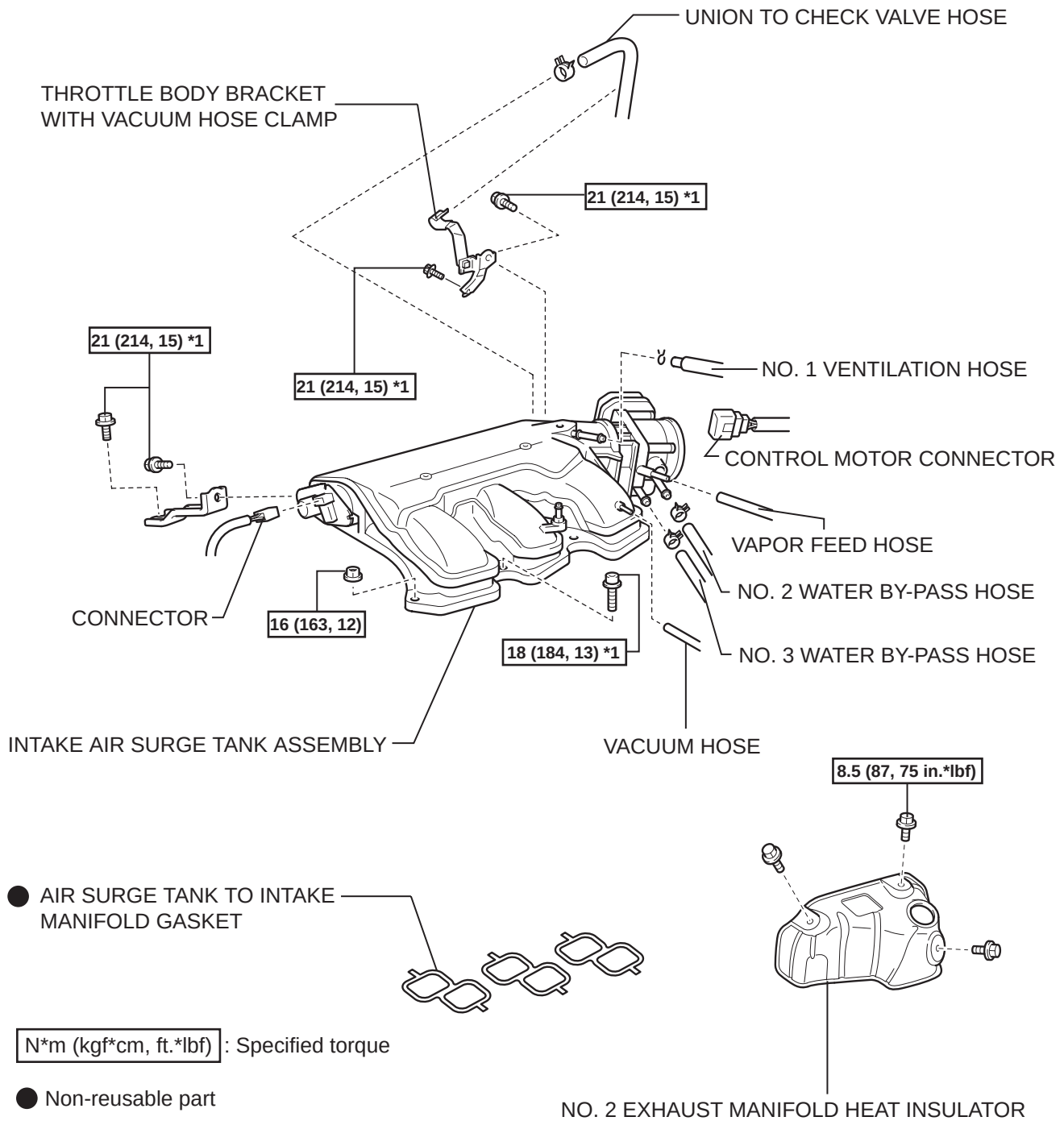
N*m (kgf*cm, ft.*lbf) : Specified torque ● Non-reusable part

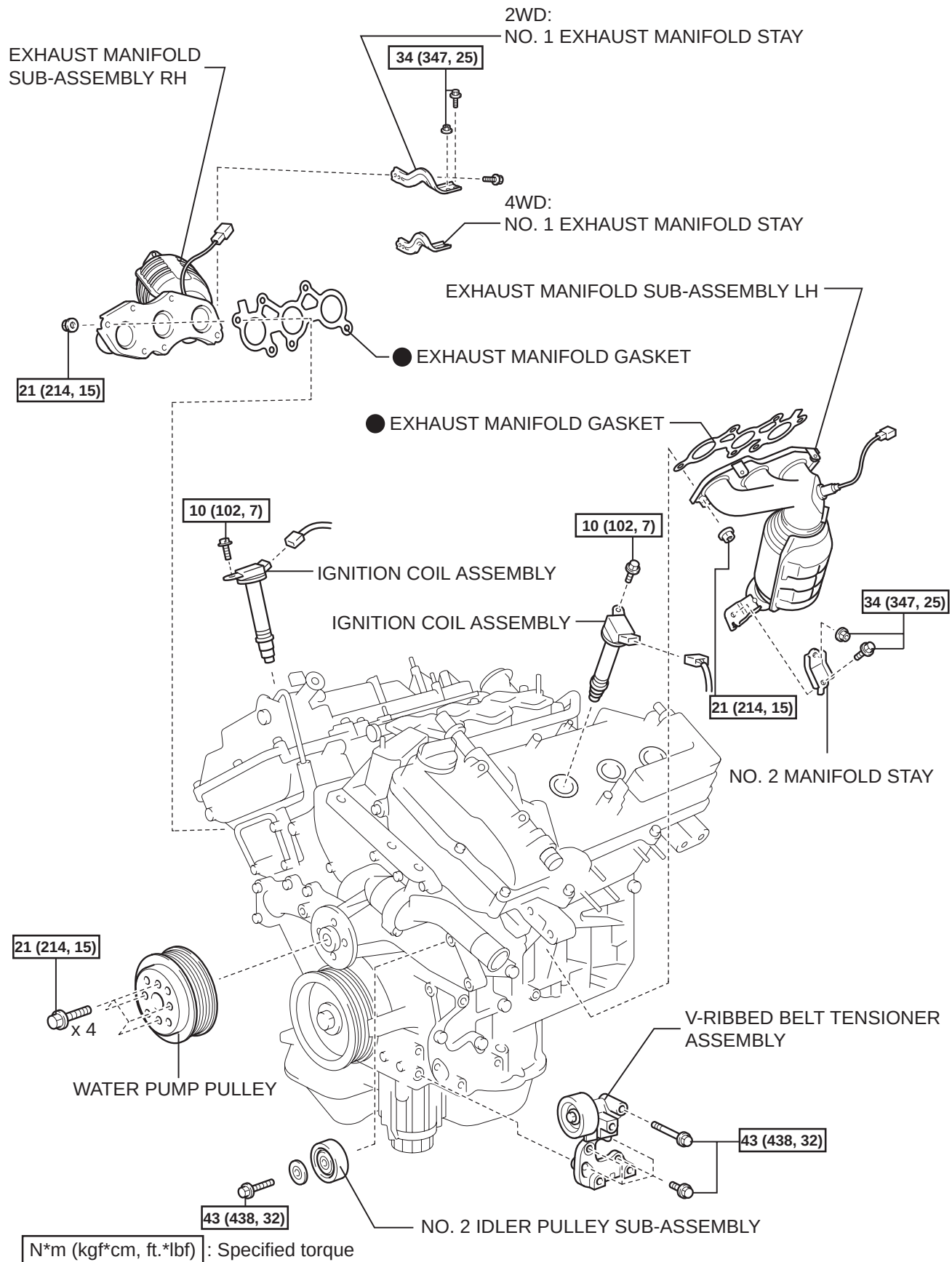
for 4WD



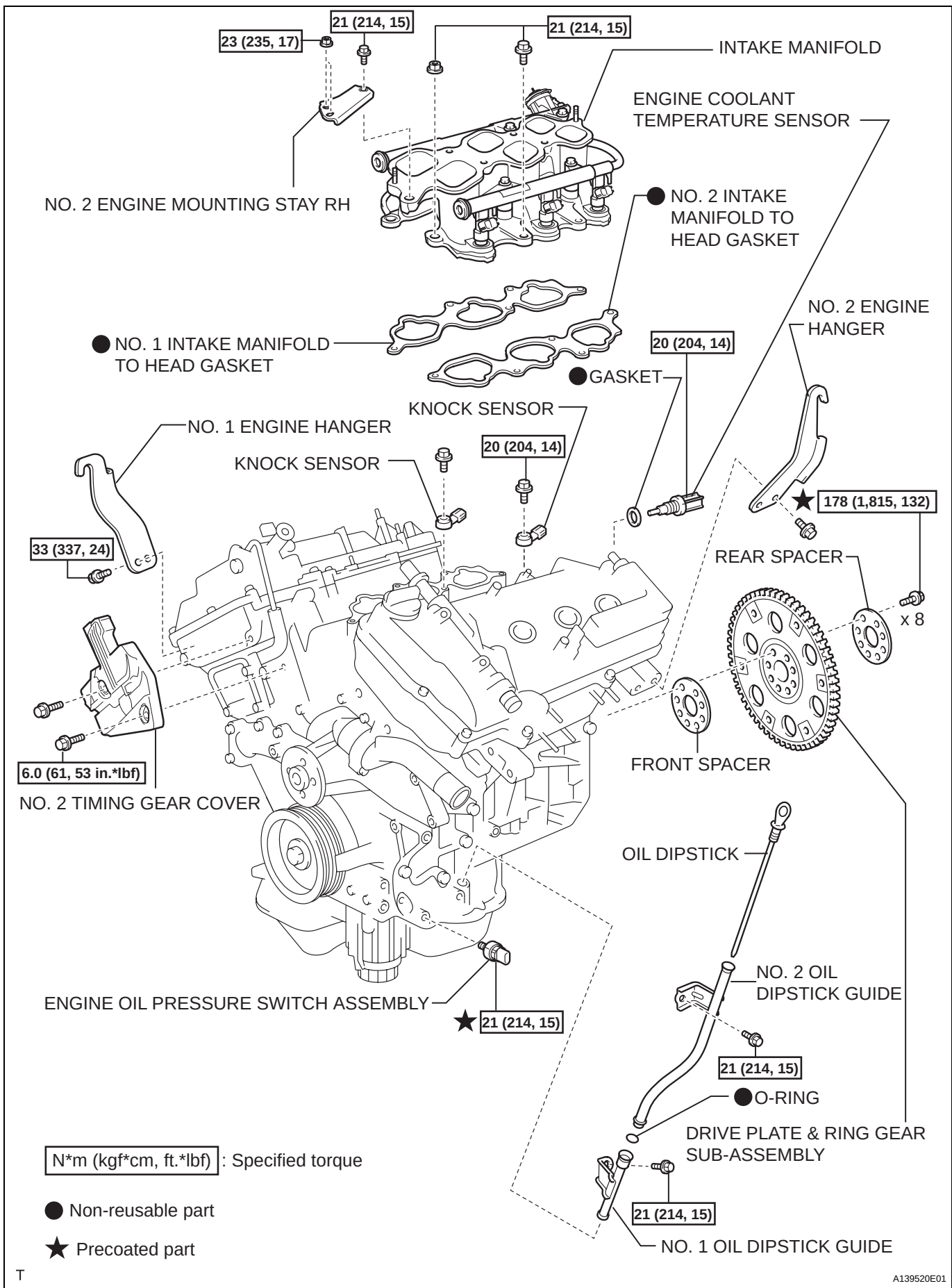
N*m (kgf*cm, ft.*lbf) : Specified torque ● Non-reusable part

EM



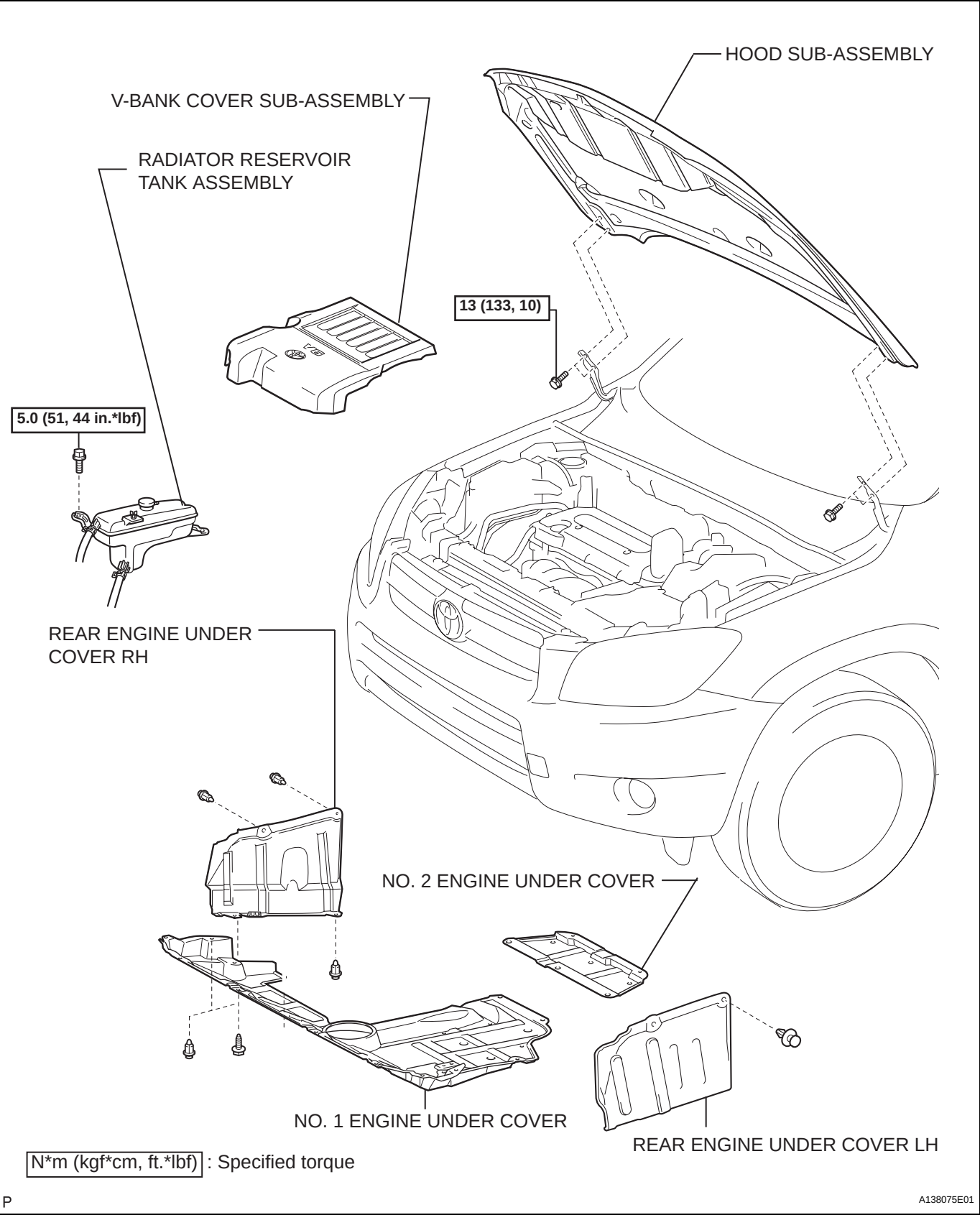


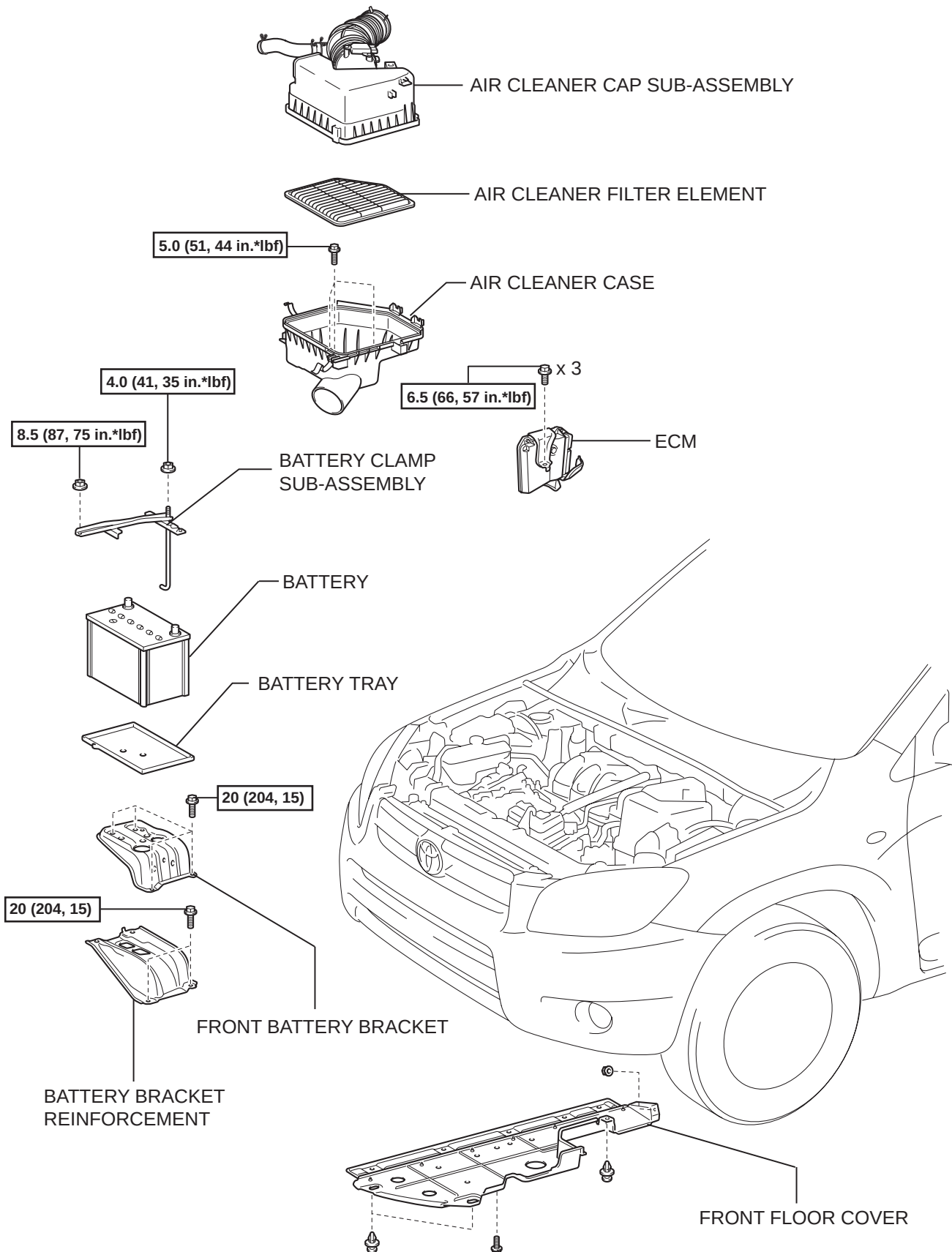
EM



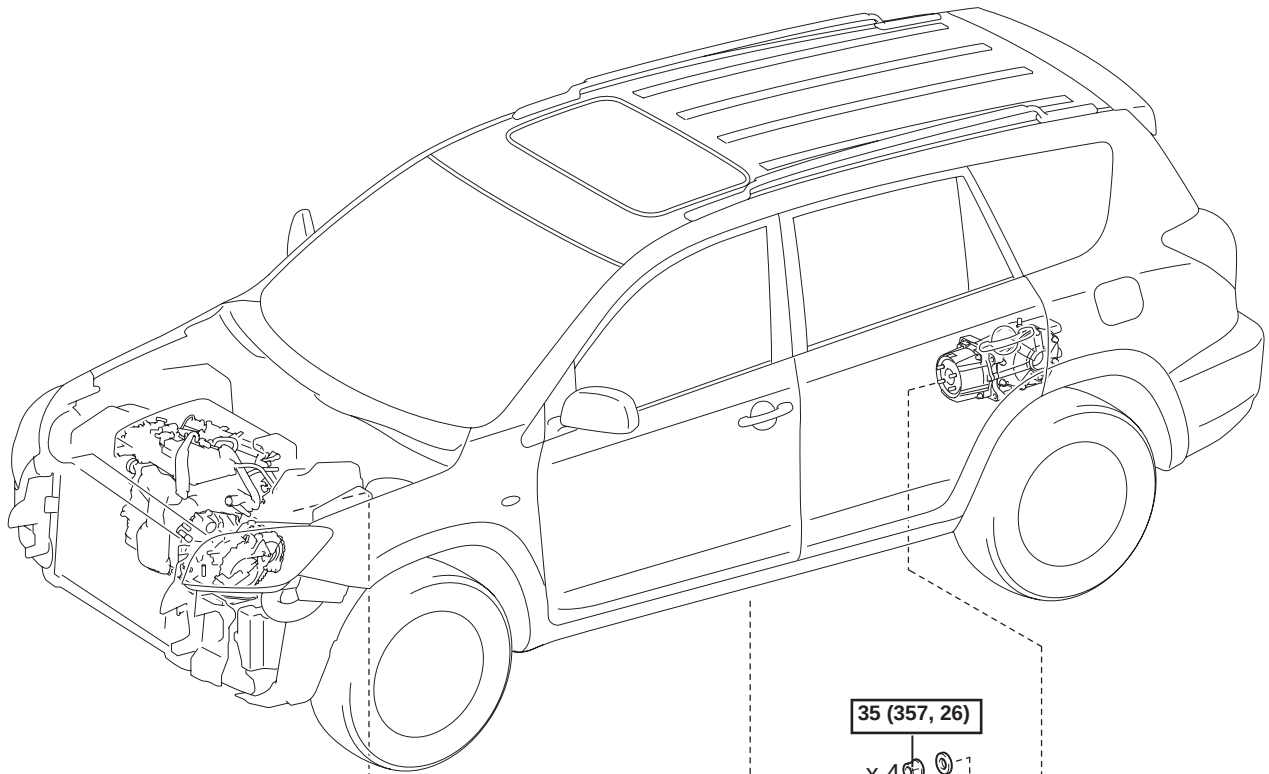
ENGINE ASSEMBLY

COMPONENTS

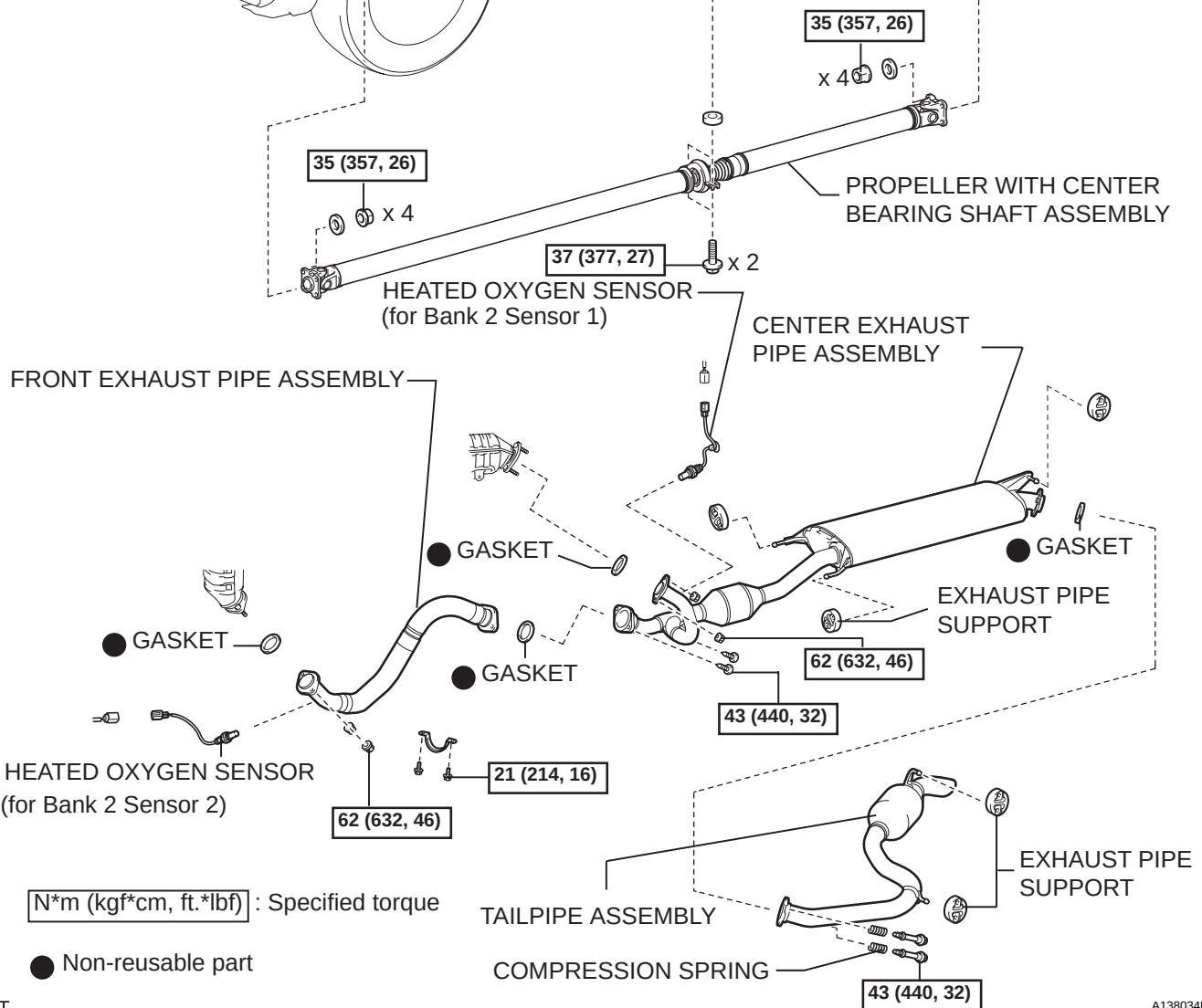




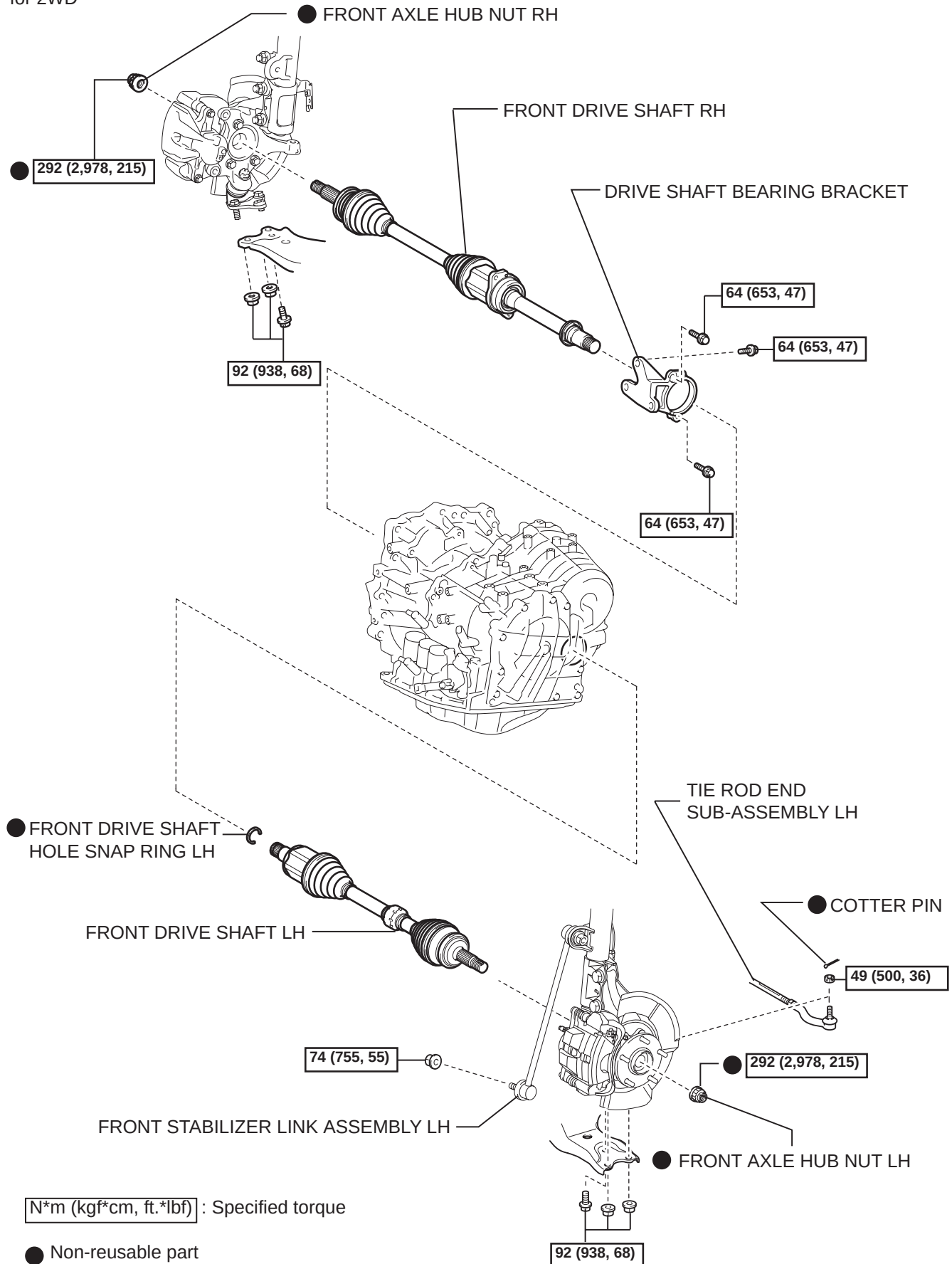
N*m (kgf*cm, ft.*lbf) : Specified torque



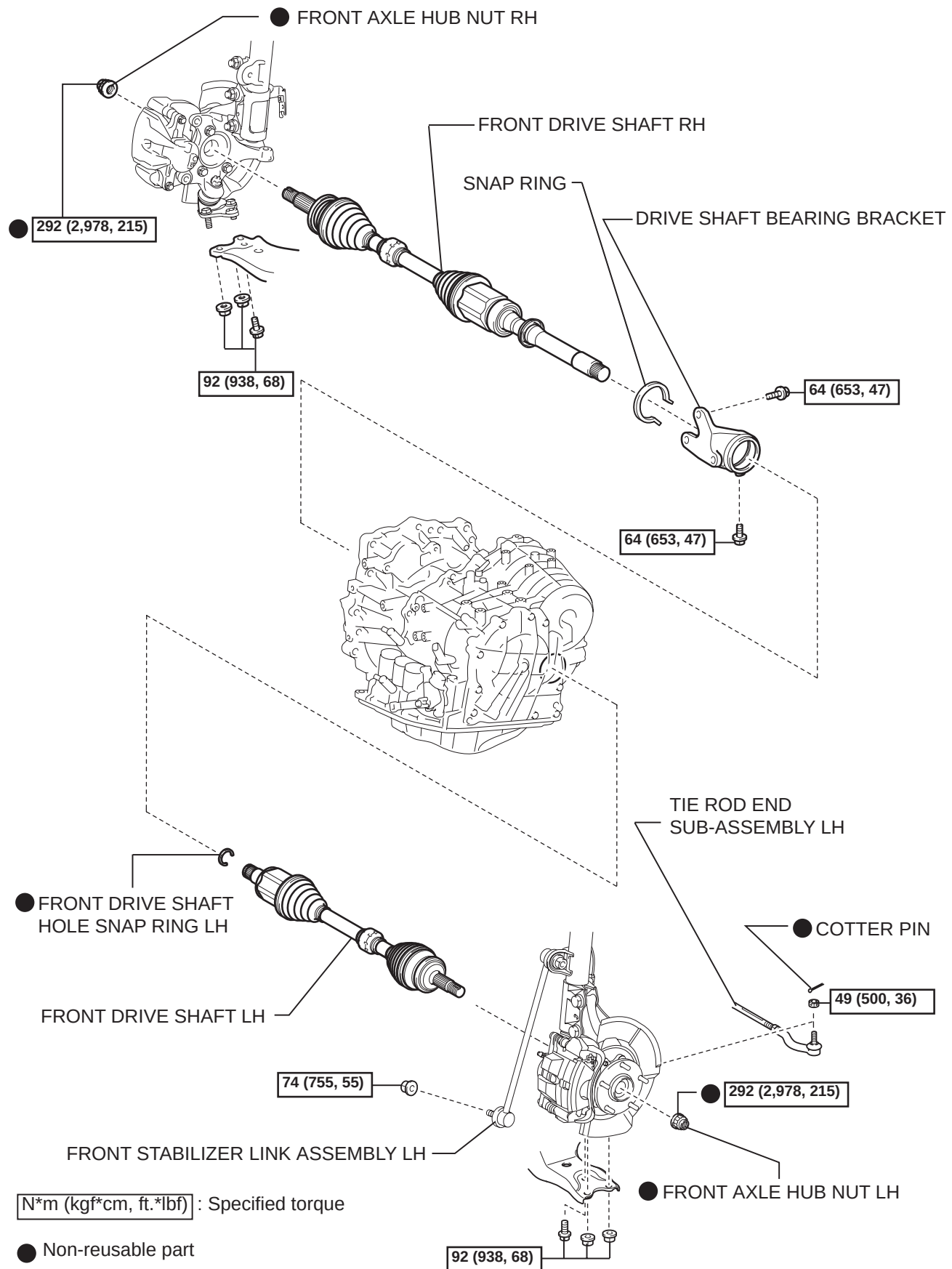
EM

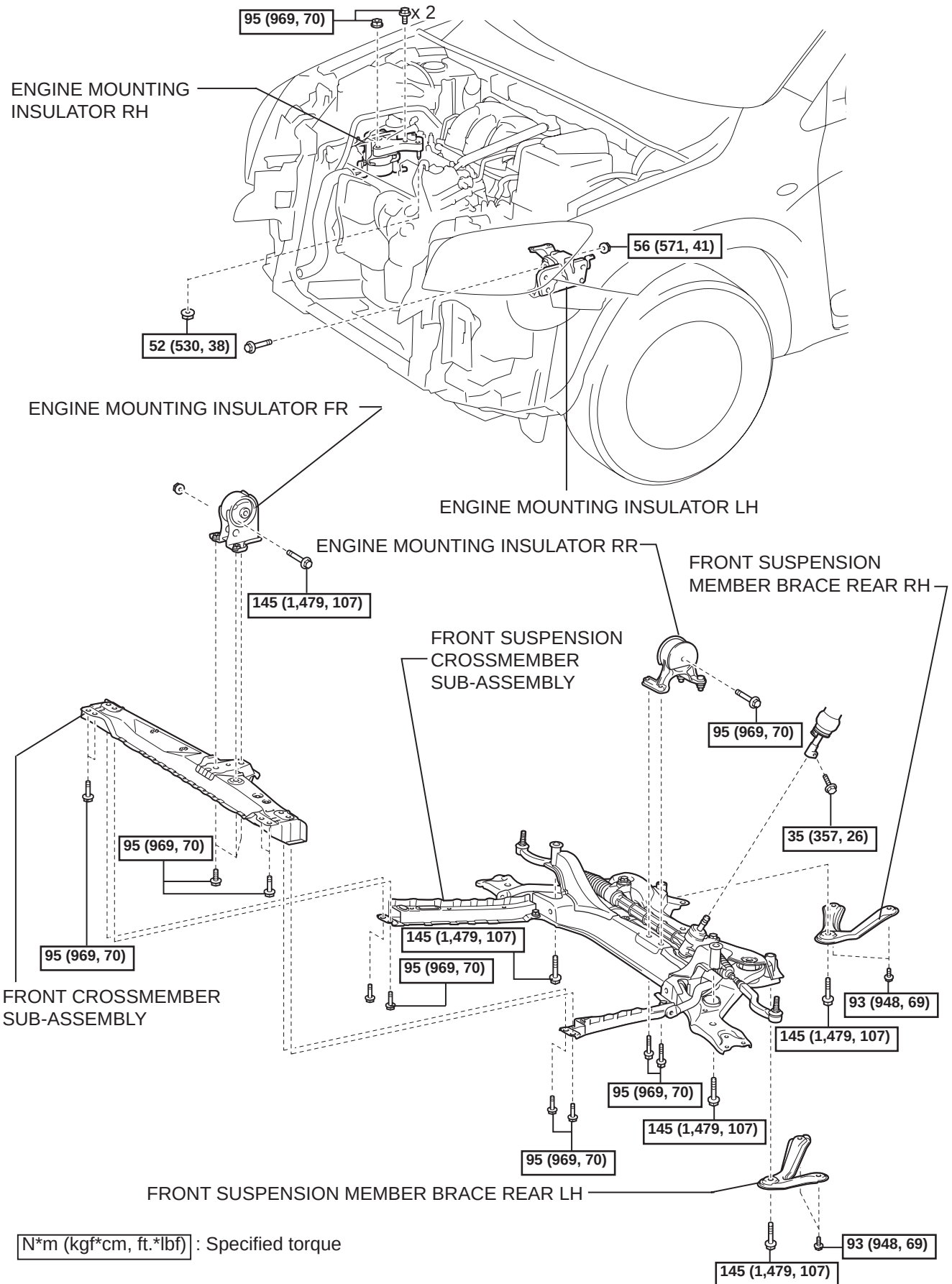


for 2WD

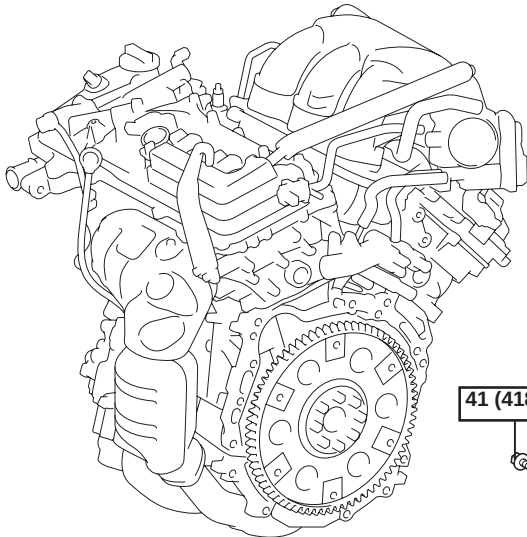
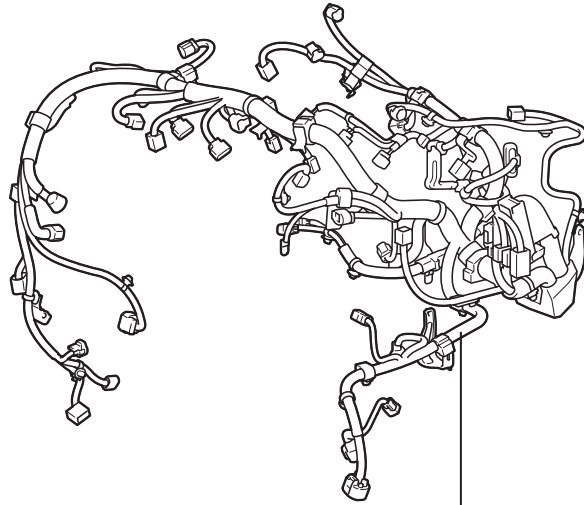
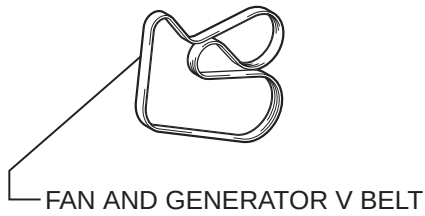


for 4WD



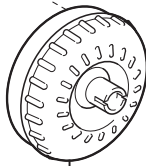


for 2WD



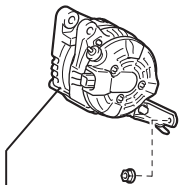
41 (418, 30)

x 3

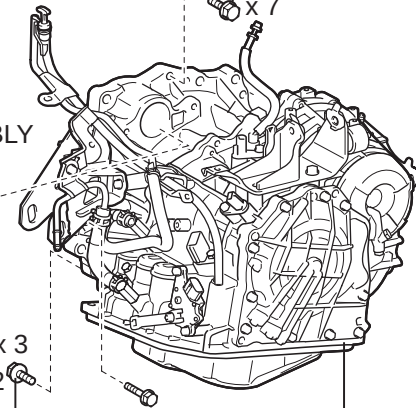
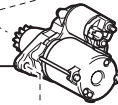


64 (653, 47)

x 7



STARTER ASSEMBLY



O-RING

x 3

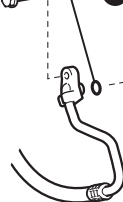
x 2

37 (377, 27)

37 (377, 27)

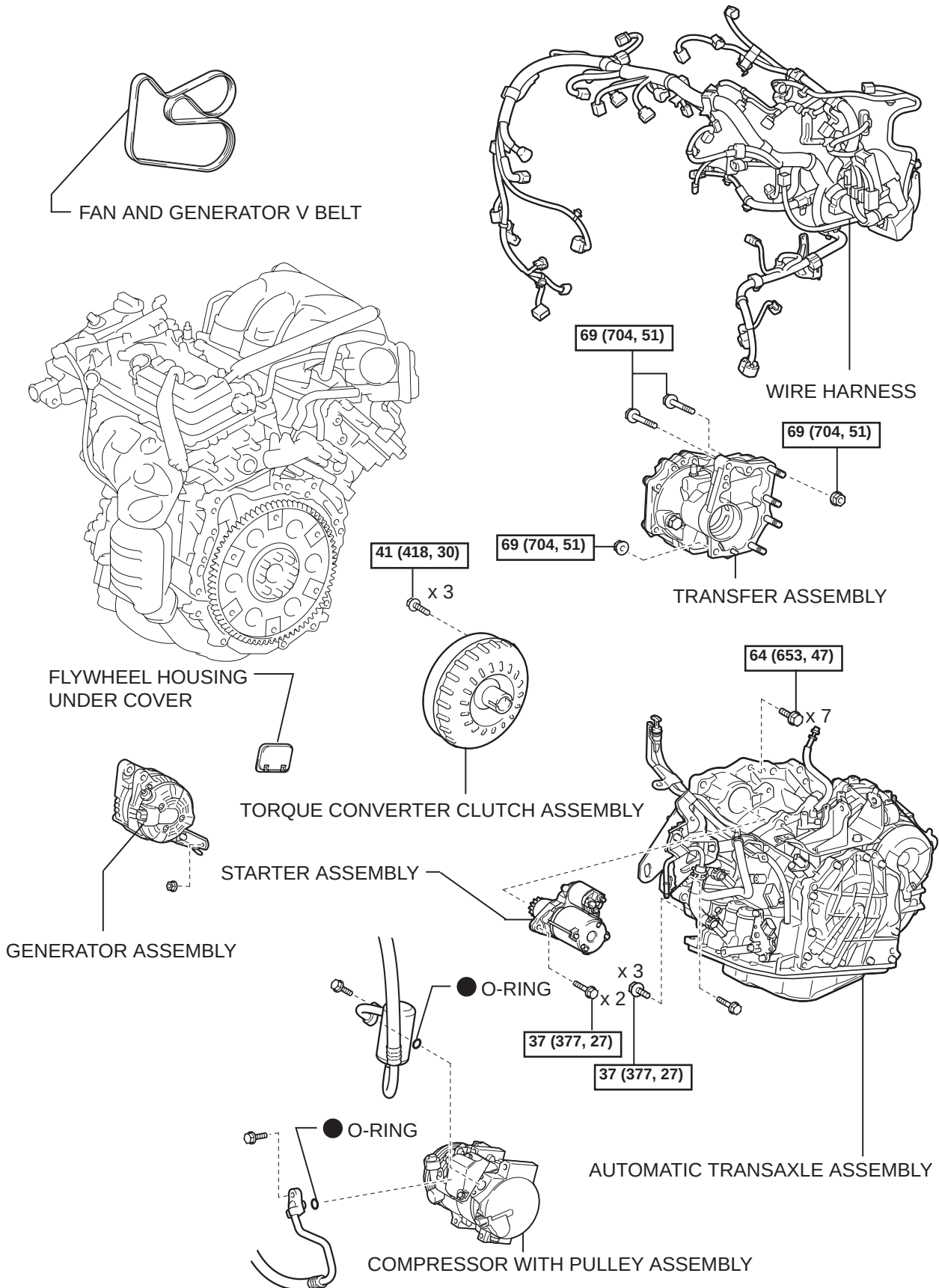


O-RING



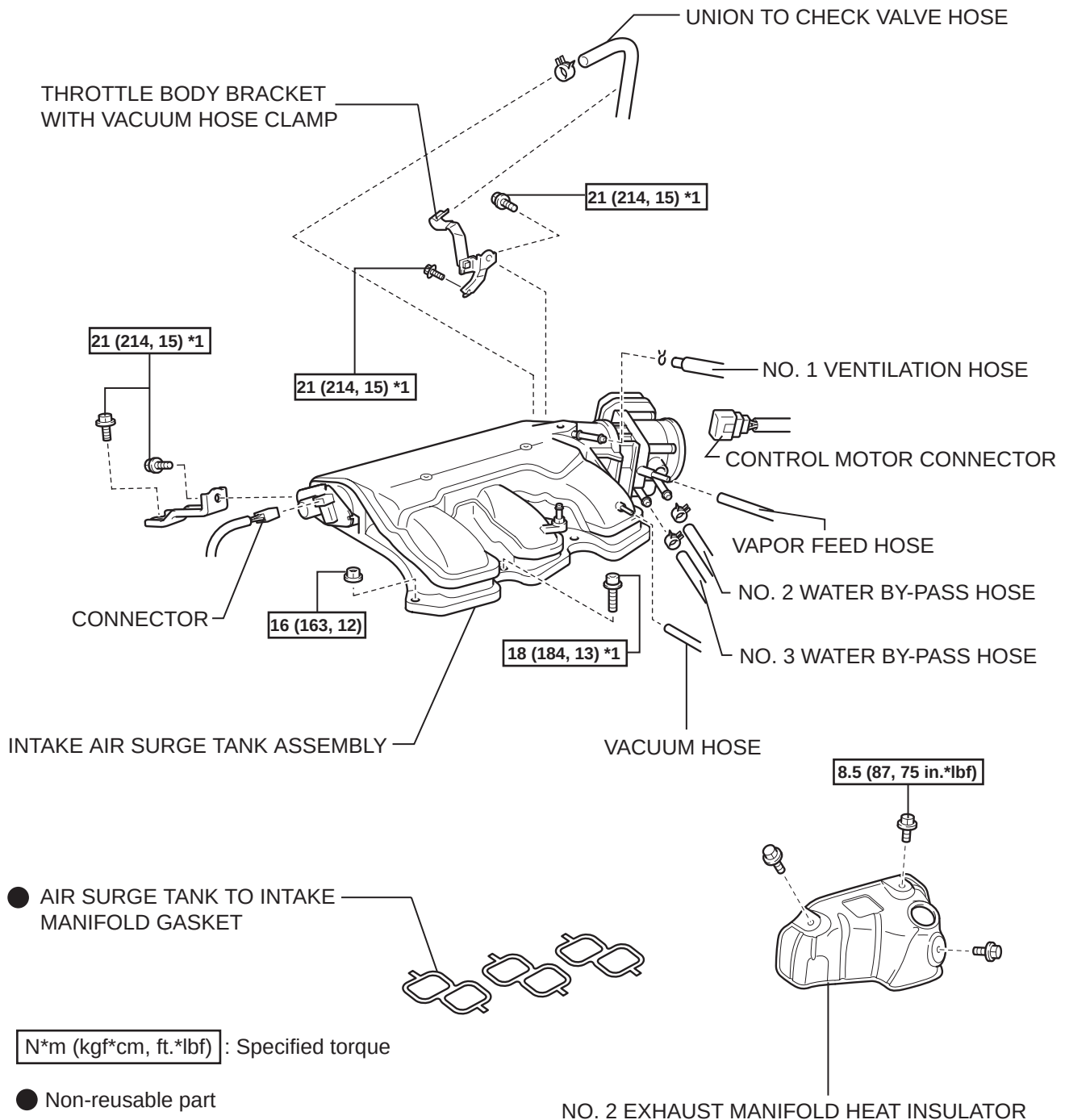
N*m (kgf*cm, ft.*lbf) : Specified torque ● Non-reusable part

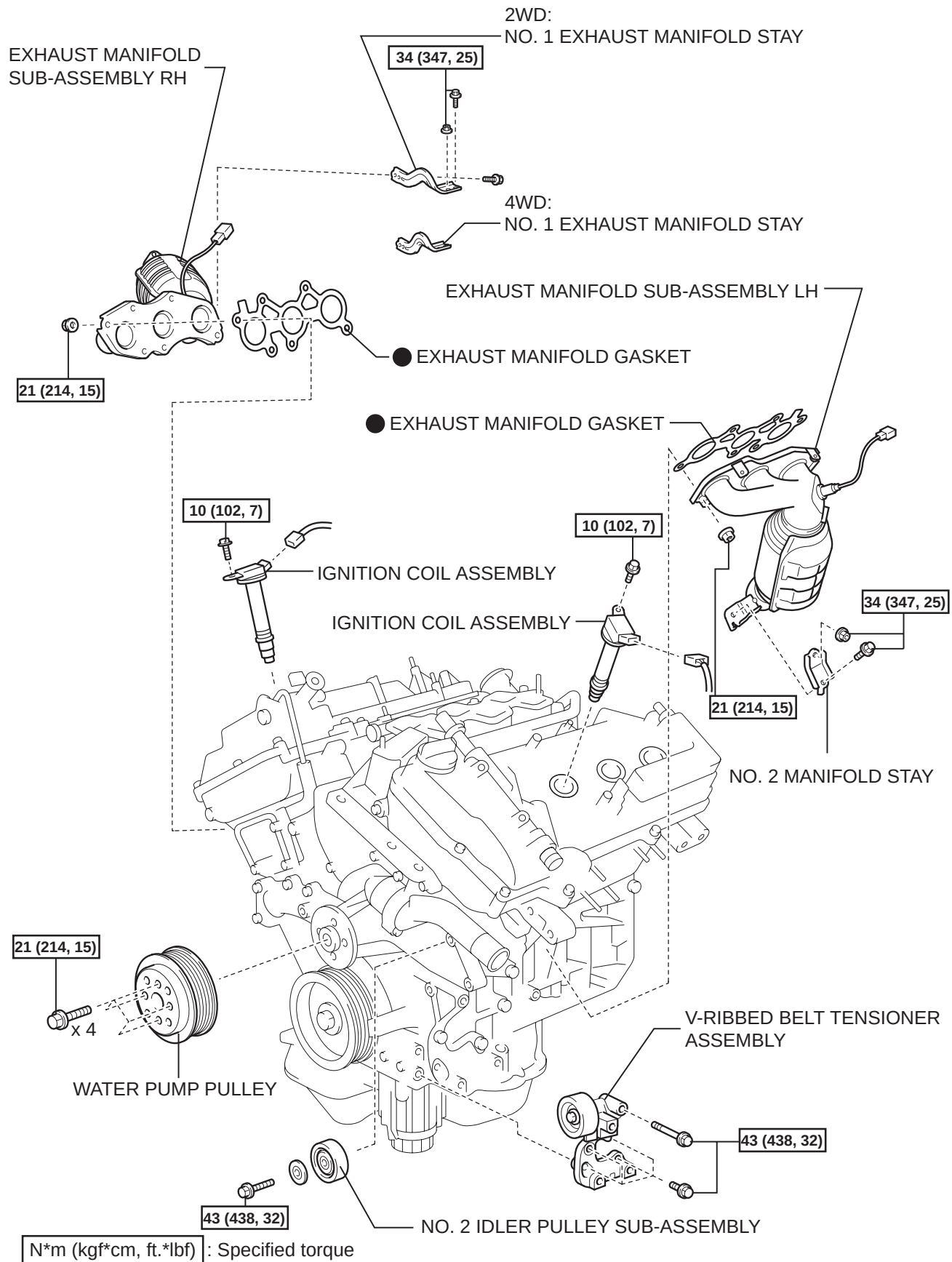
for 4WD



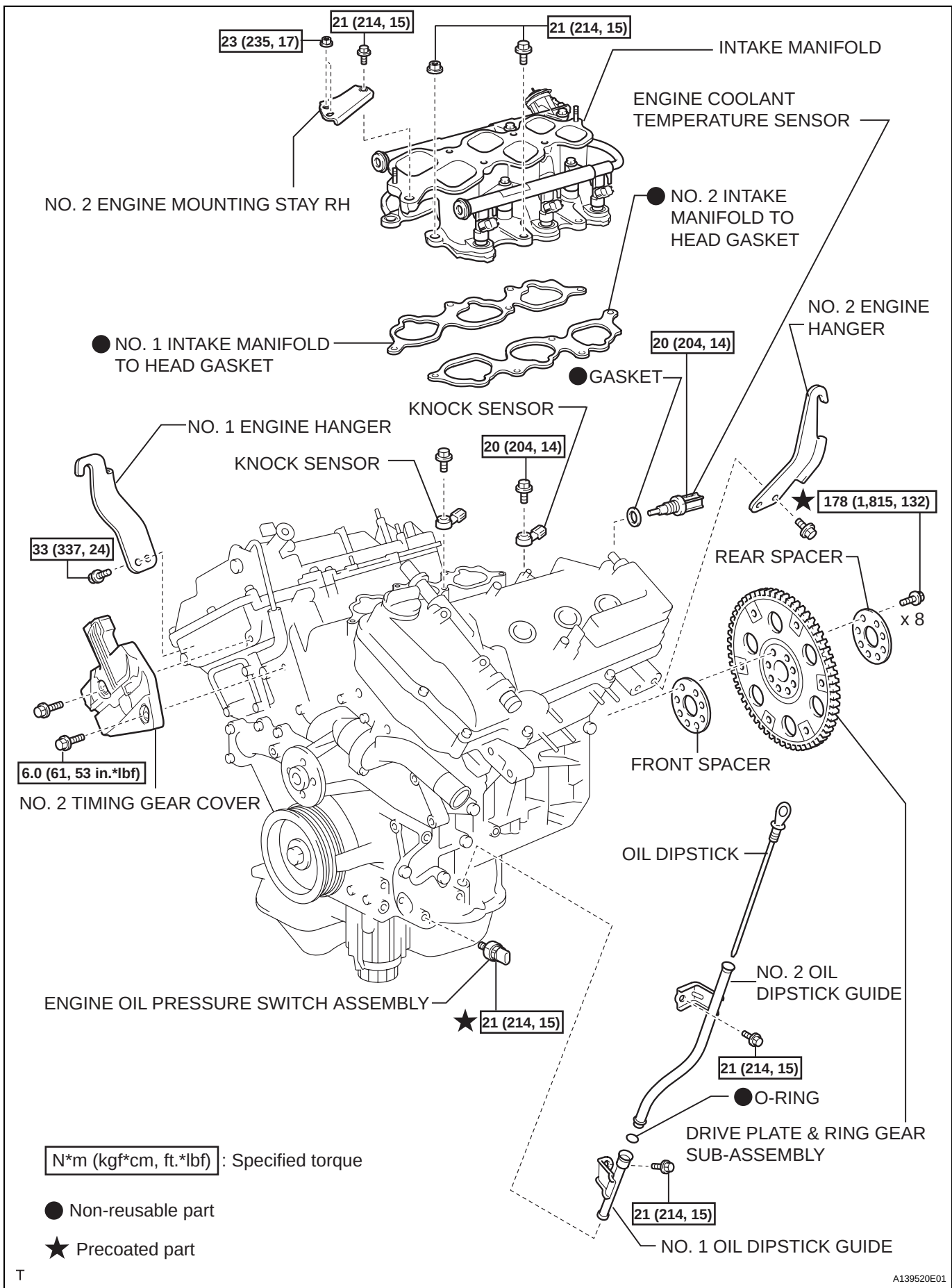
N*m (kgf*cm, ft.*lbf) : Specified torque ● Non-reusable part

EM





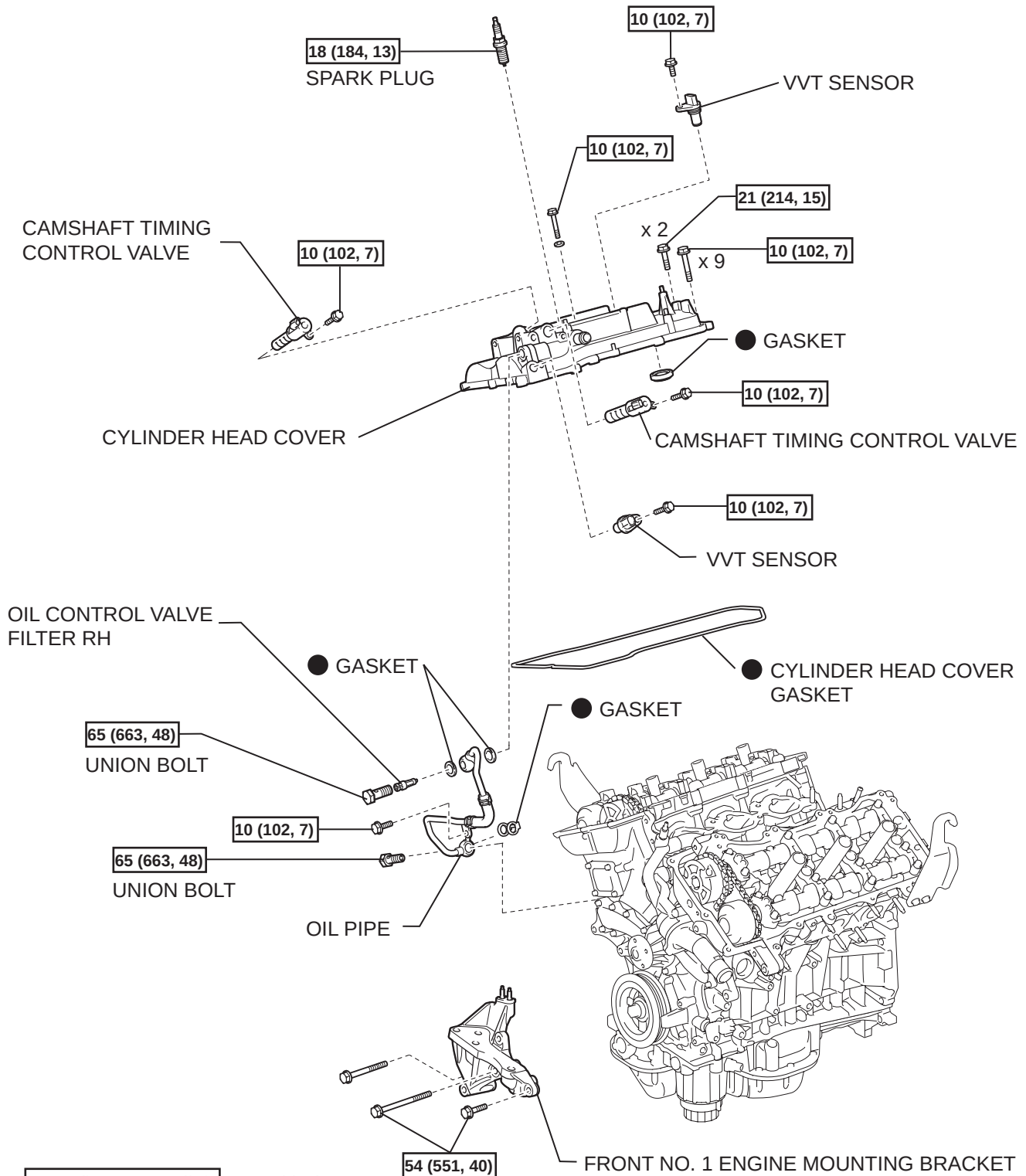
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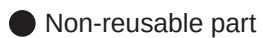


ENGINE UNIT

COMPONENTS

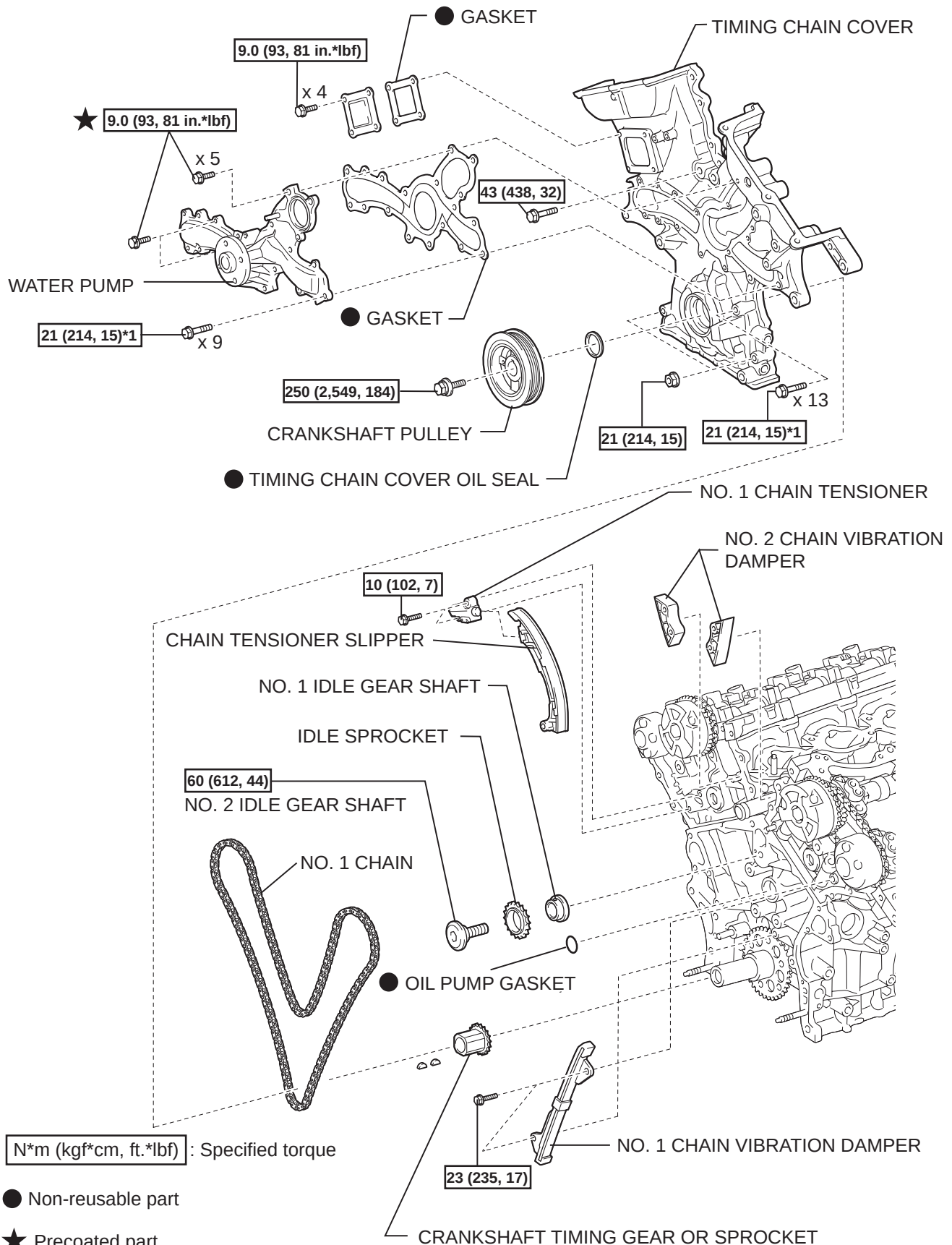
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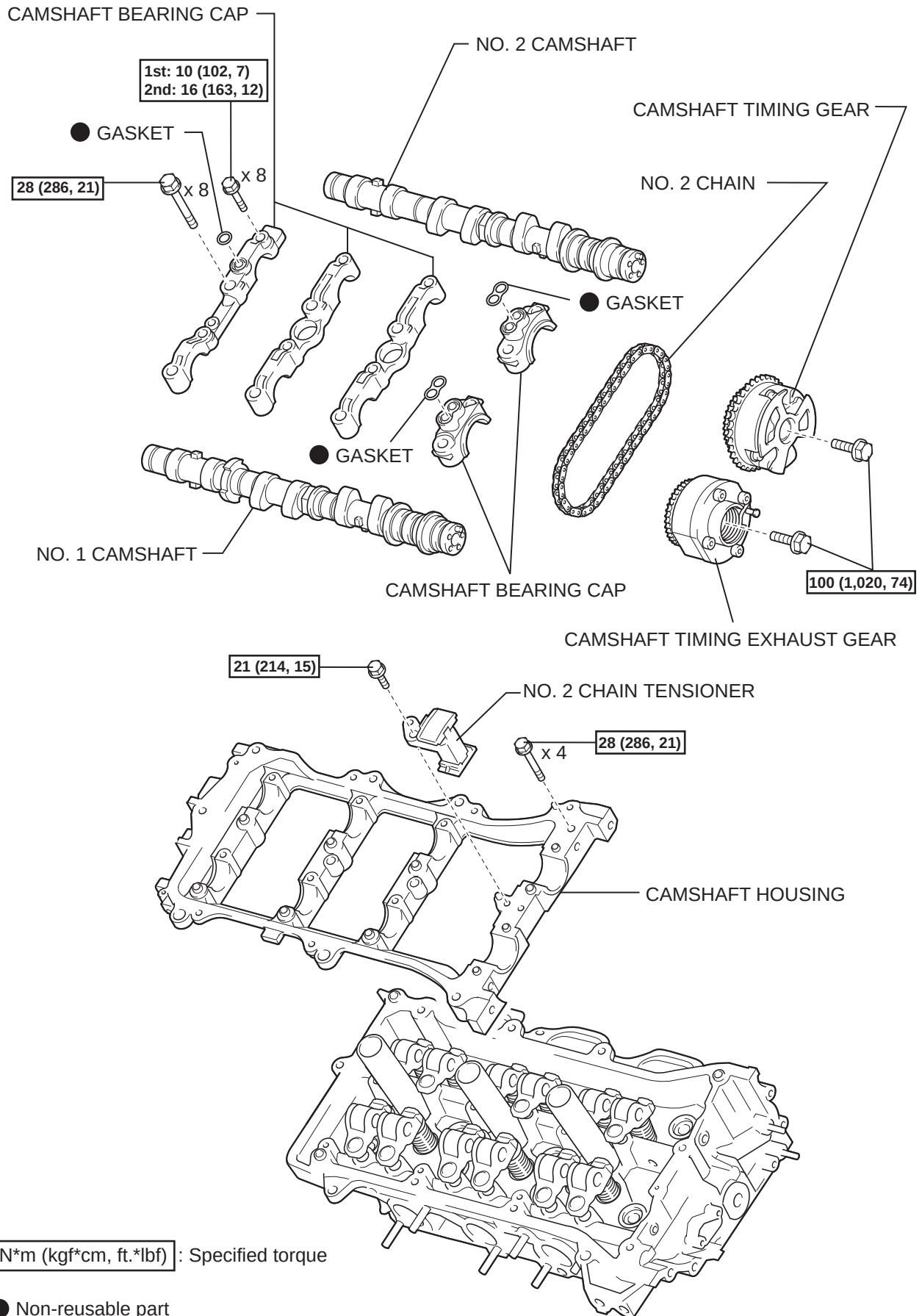




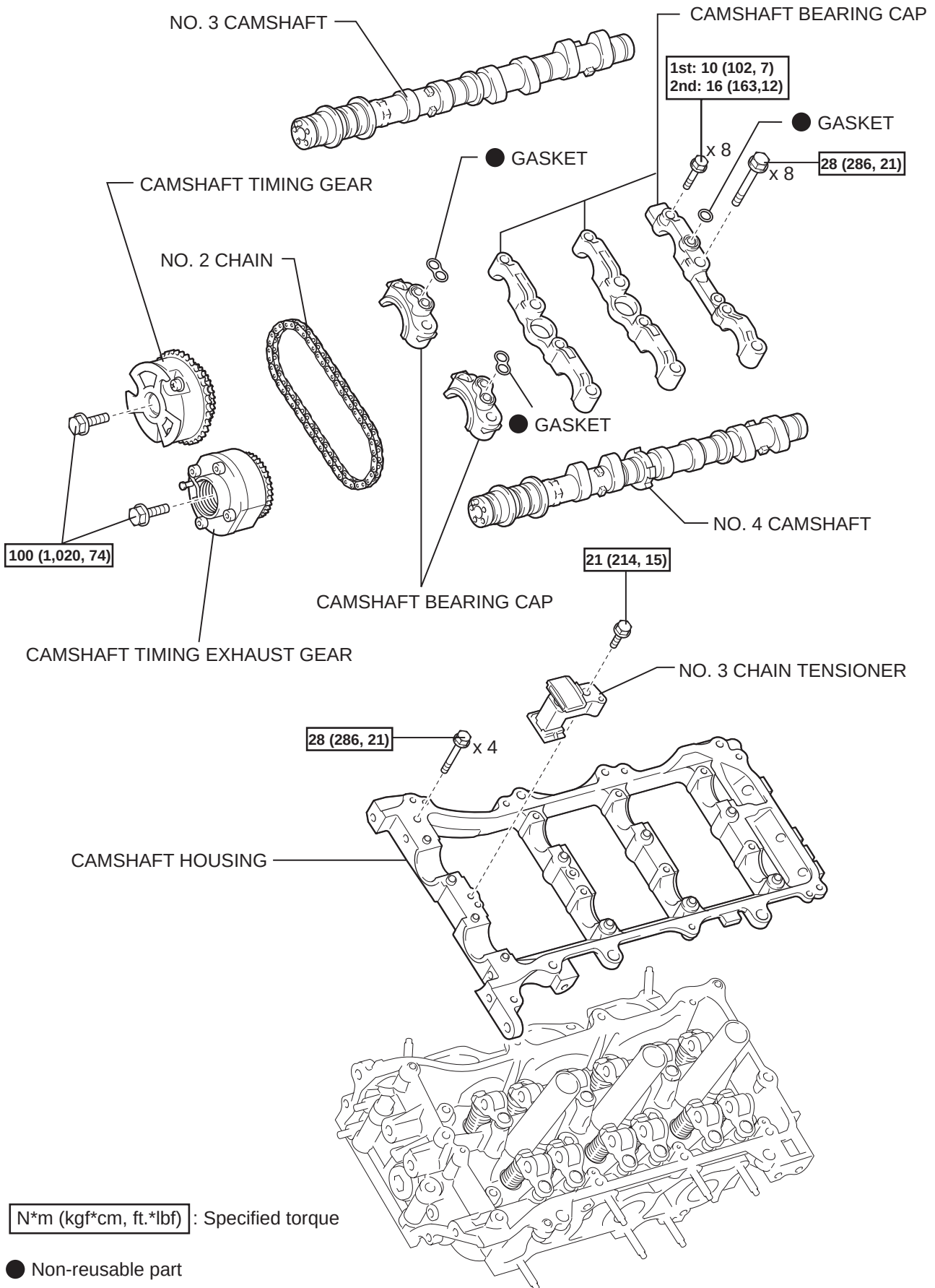


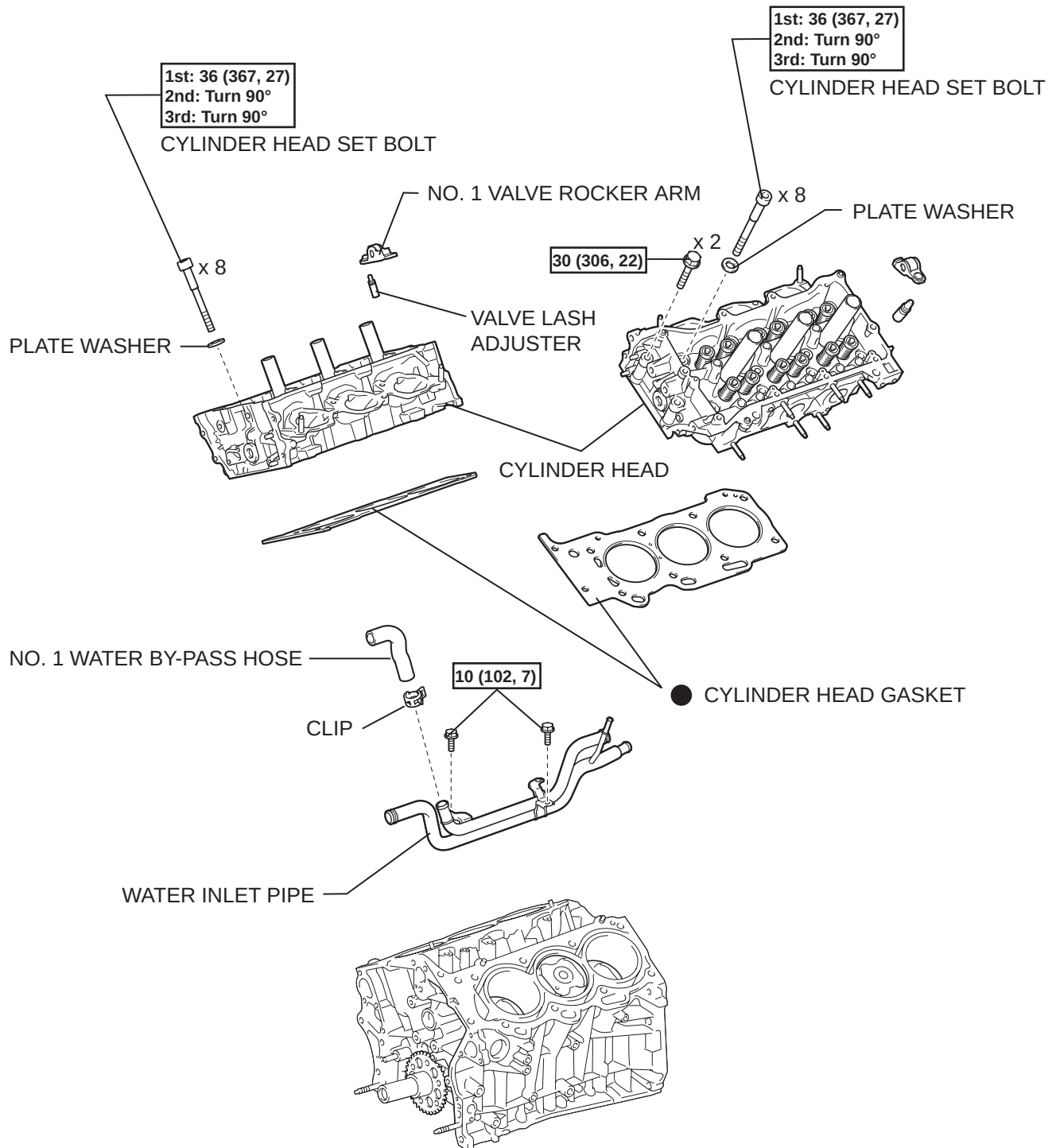
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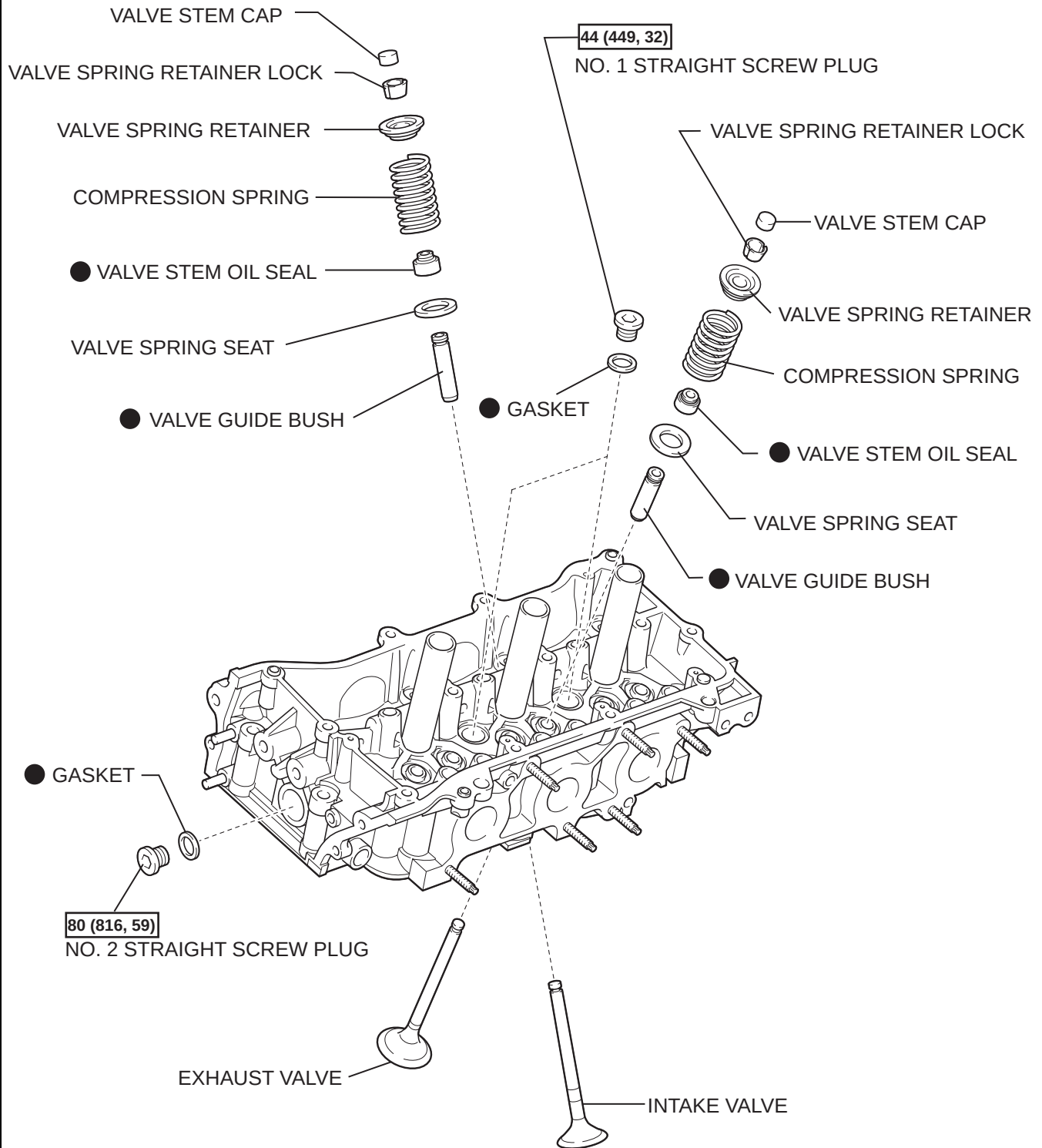
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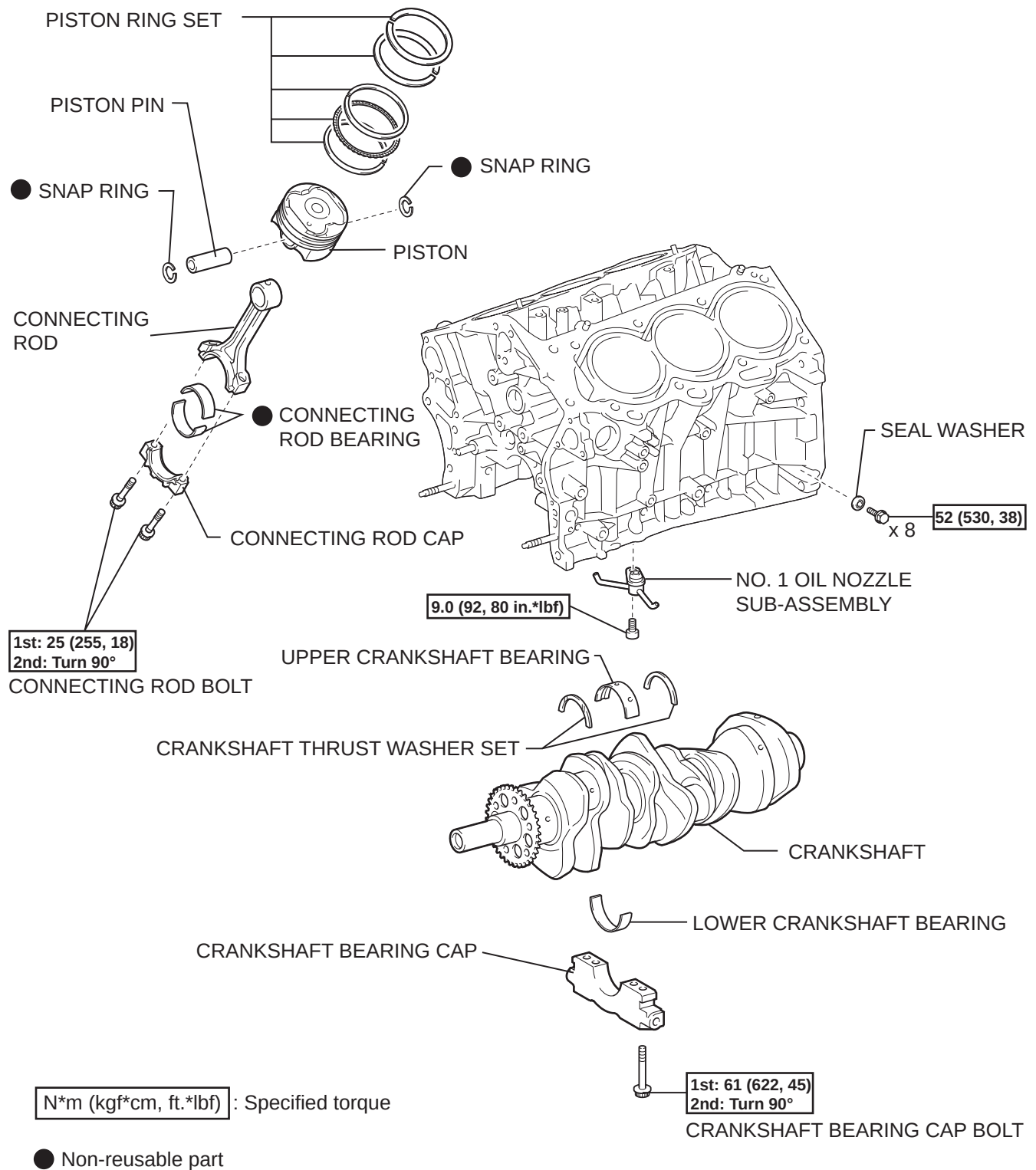
N*m (kgf*cm, ft.*lbf) : Specified torque

● Non-reusable part



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

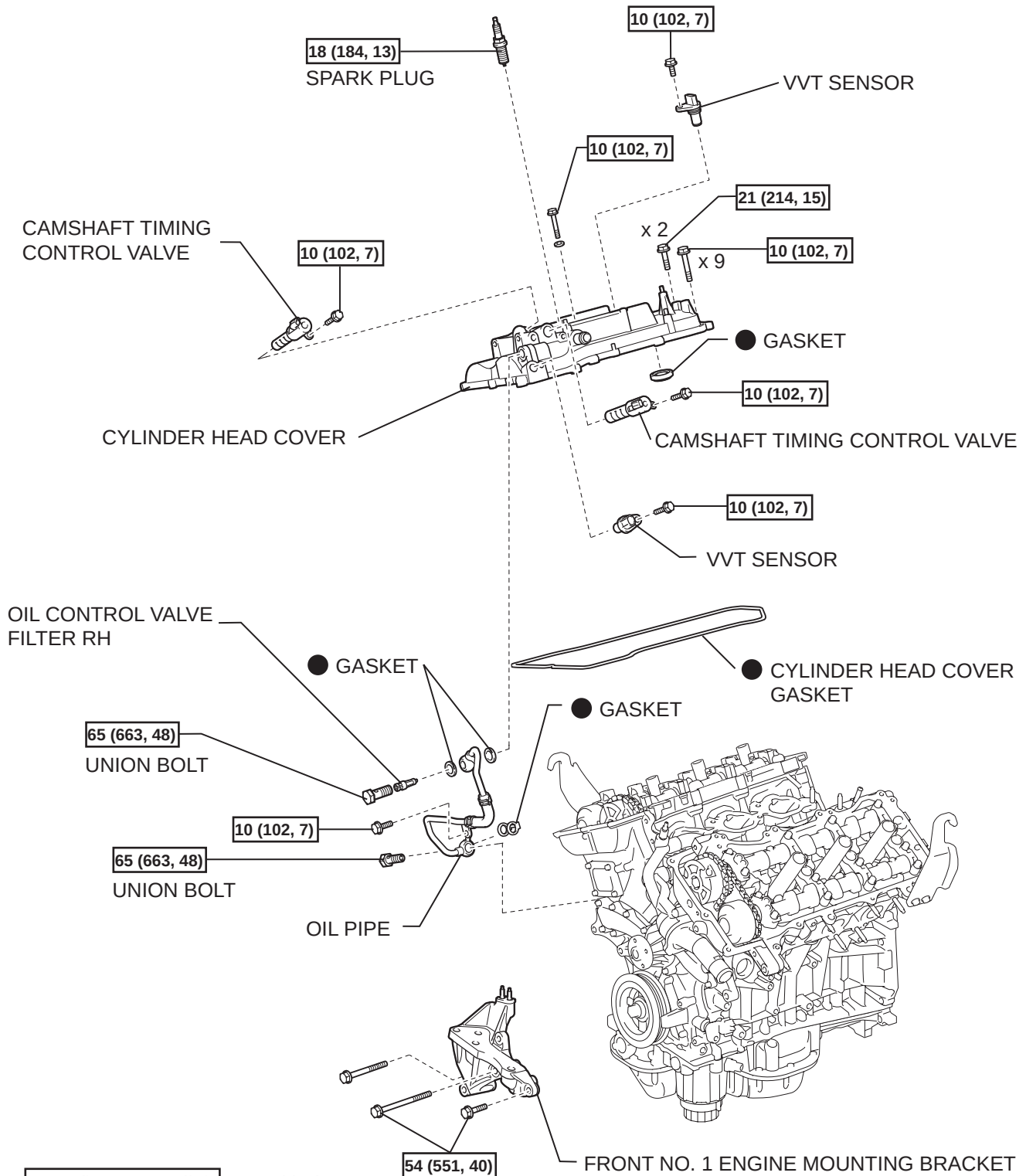
● Non-reusable part



ENGINE UNIT

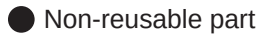
COMPONENTS

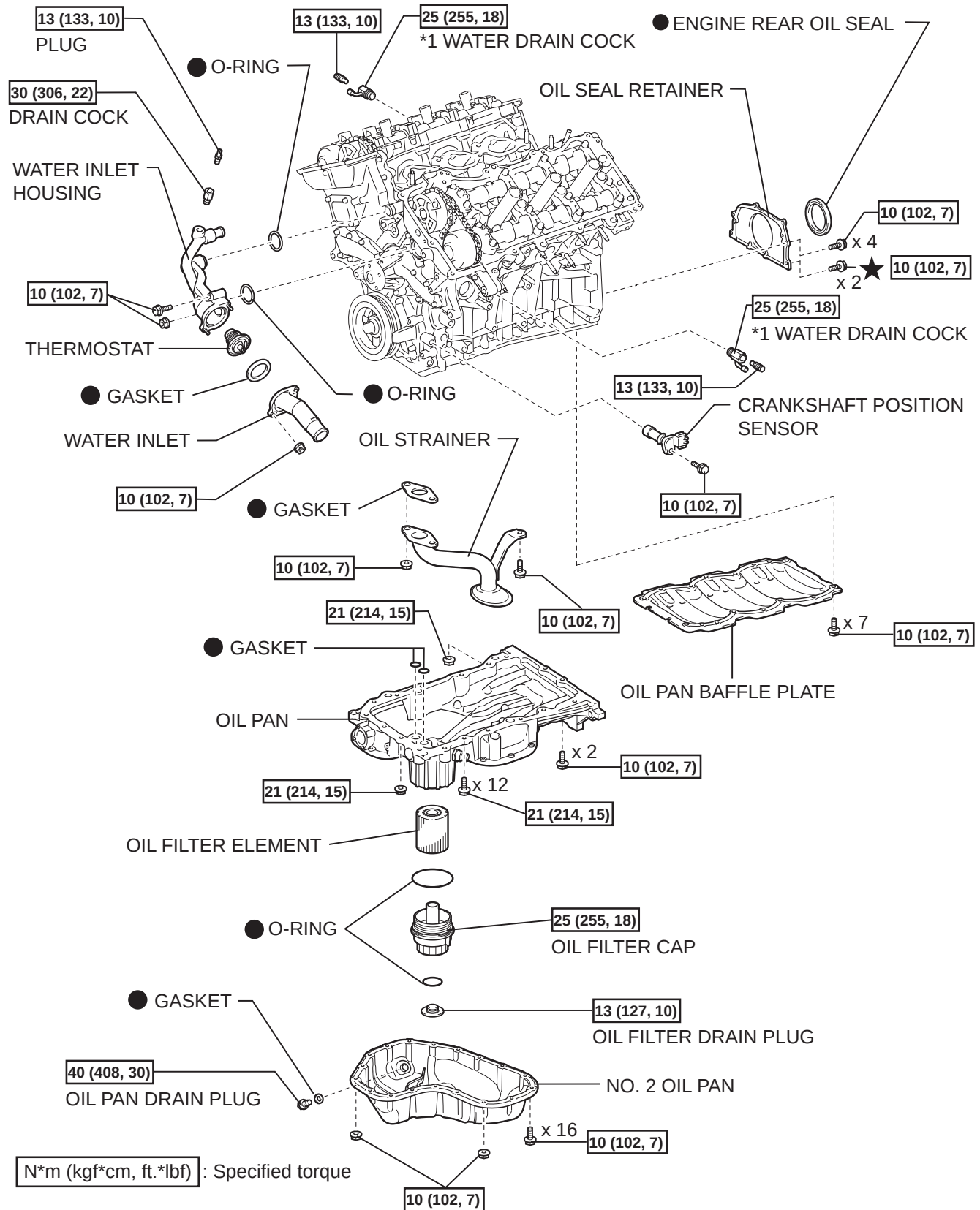
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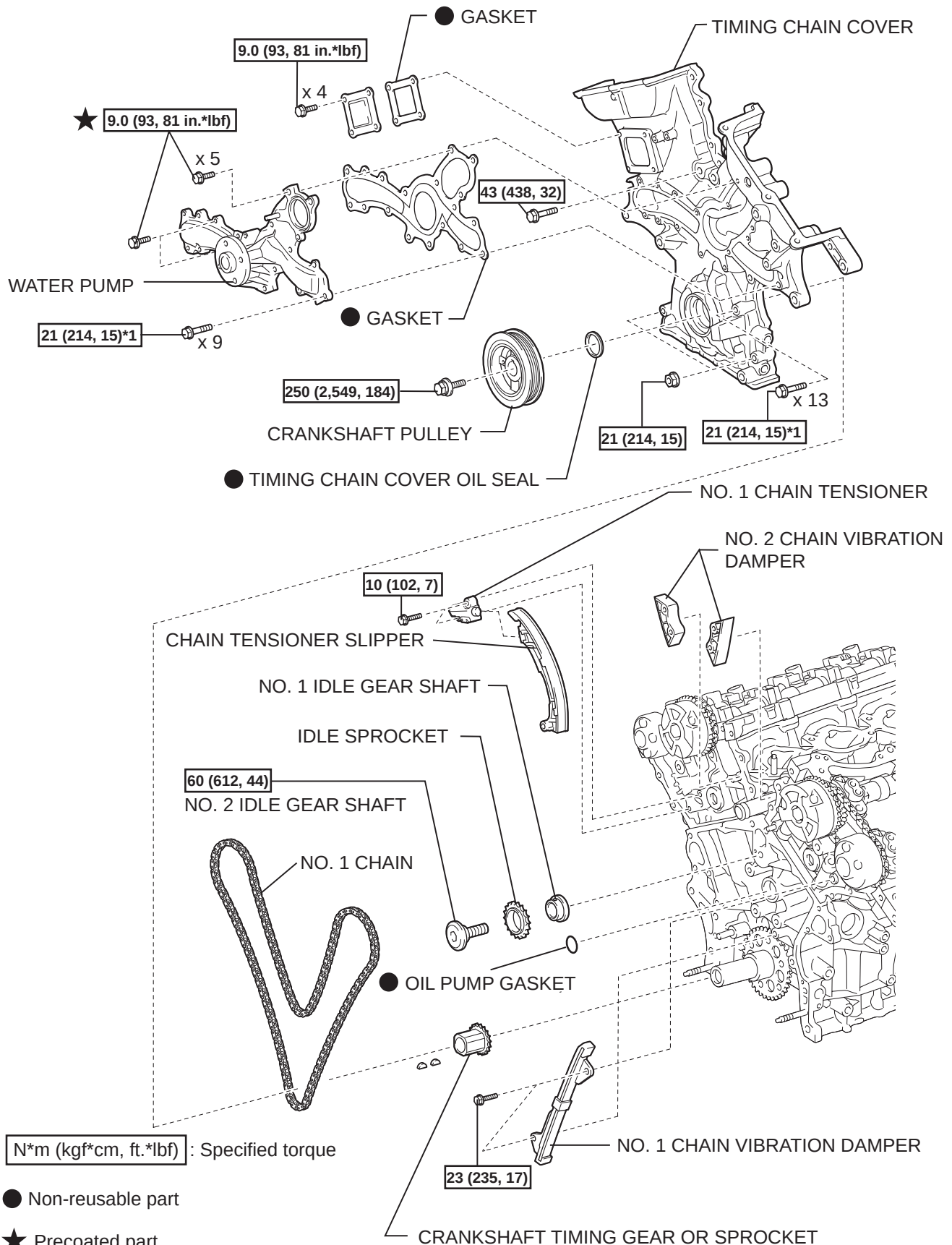
N*m (kgf*cm, ft.*lbf) : Specified torque

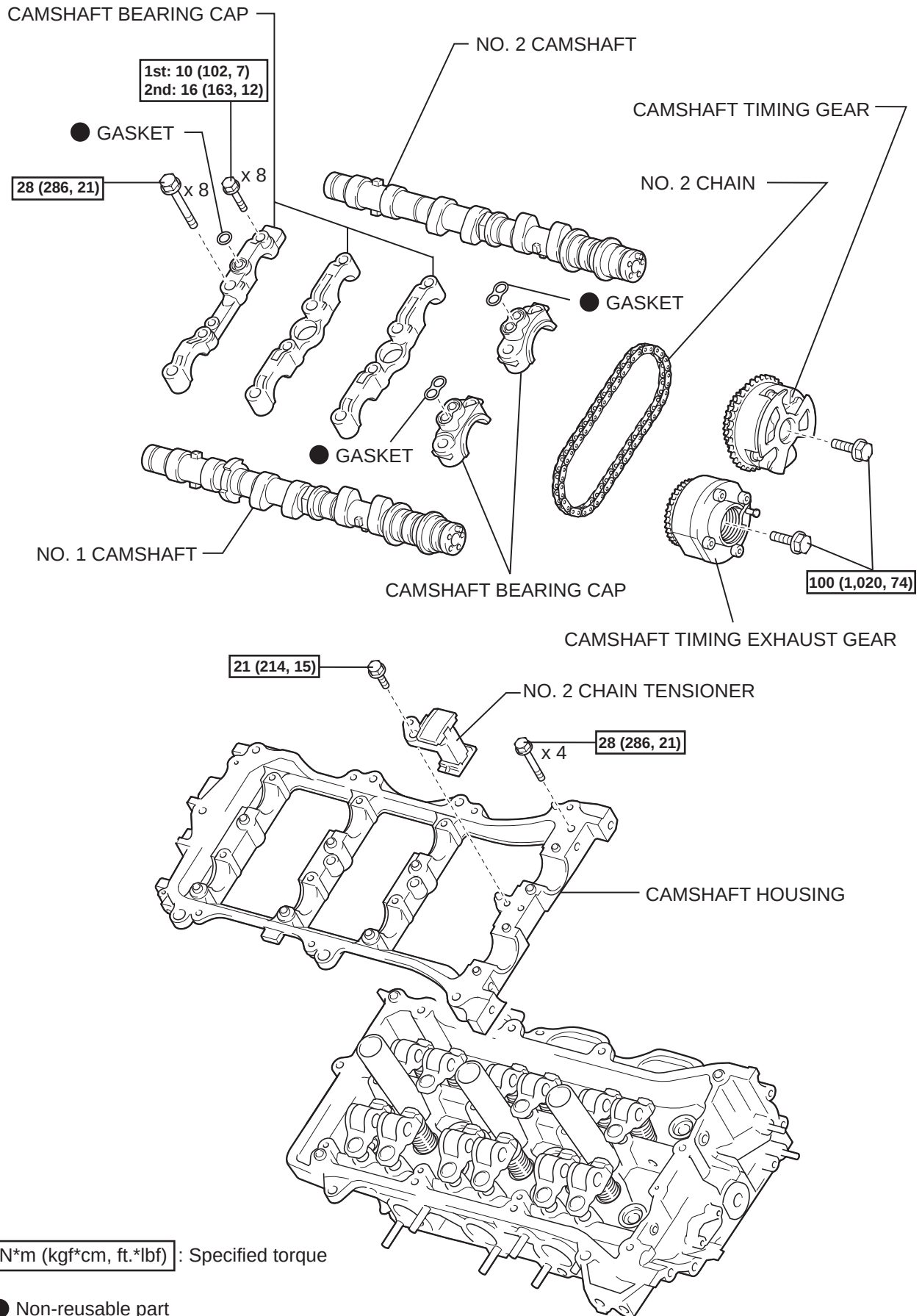
● Non-reusable part



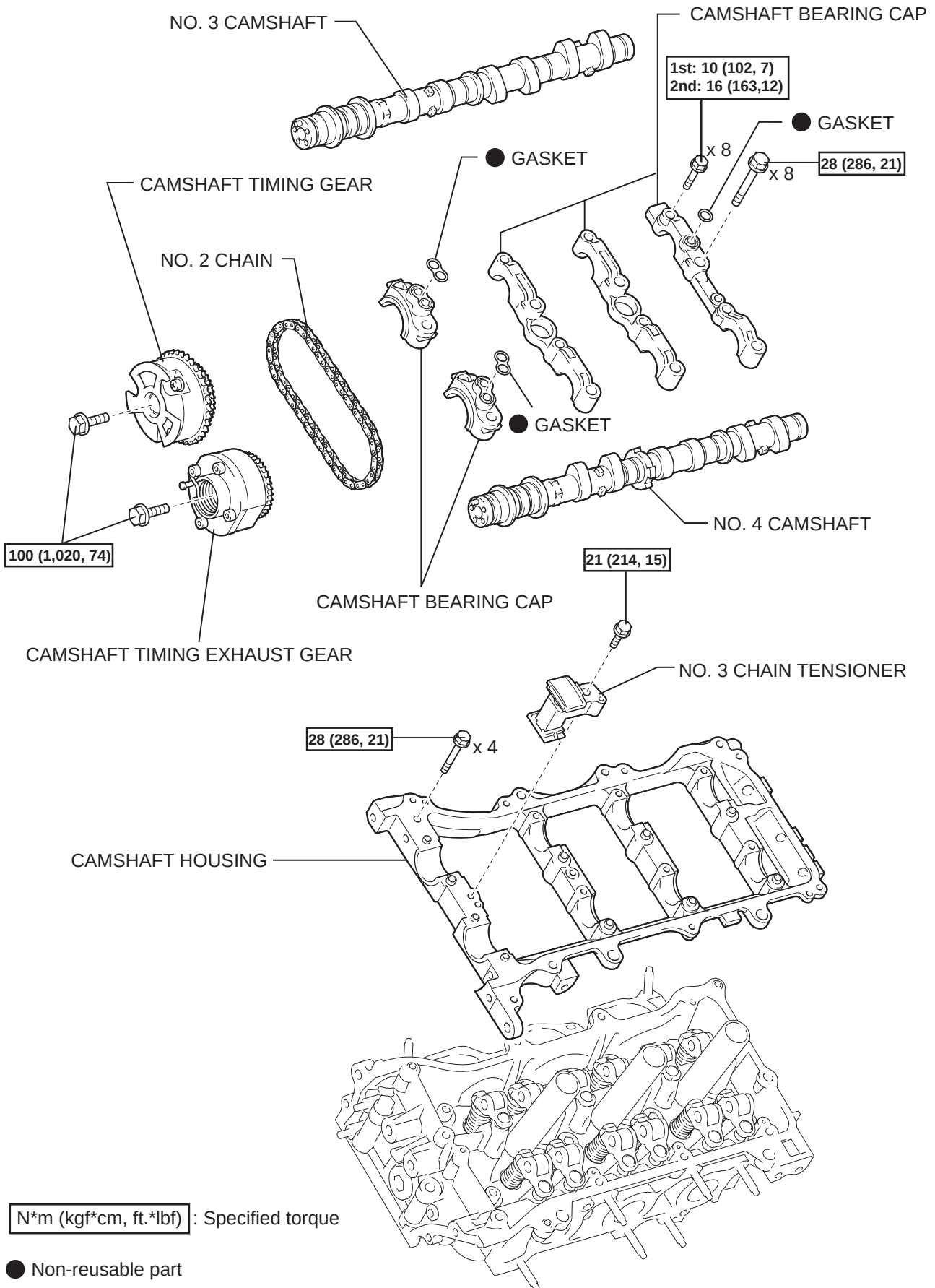


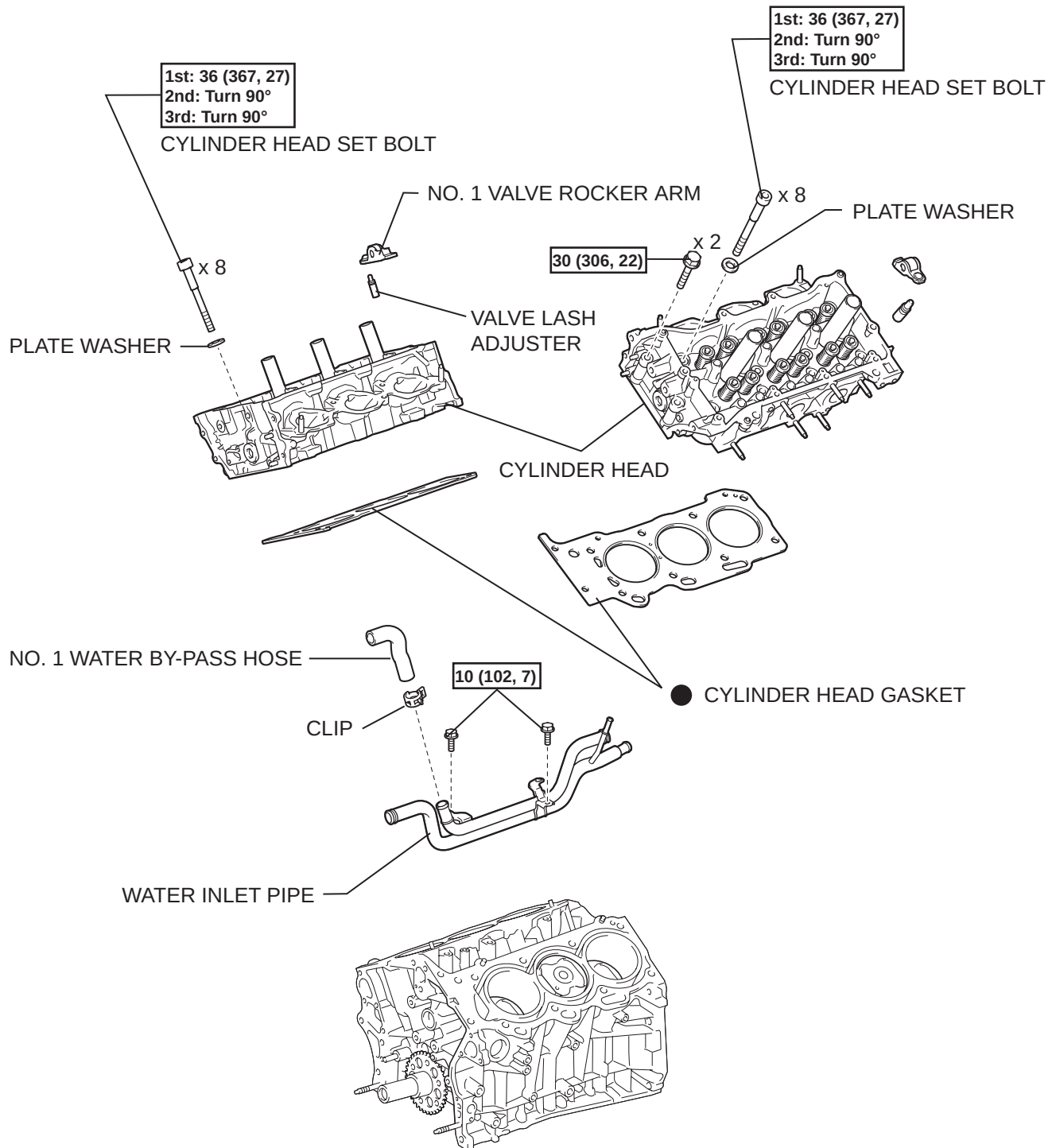
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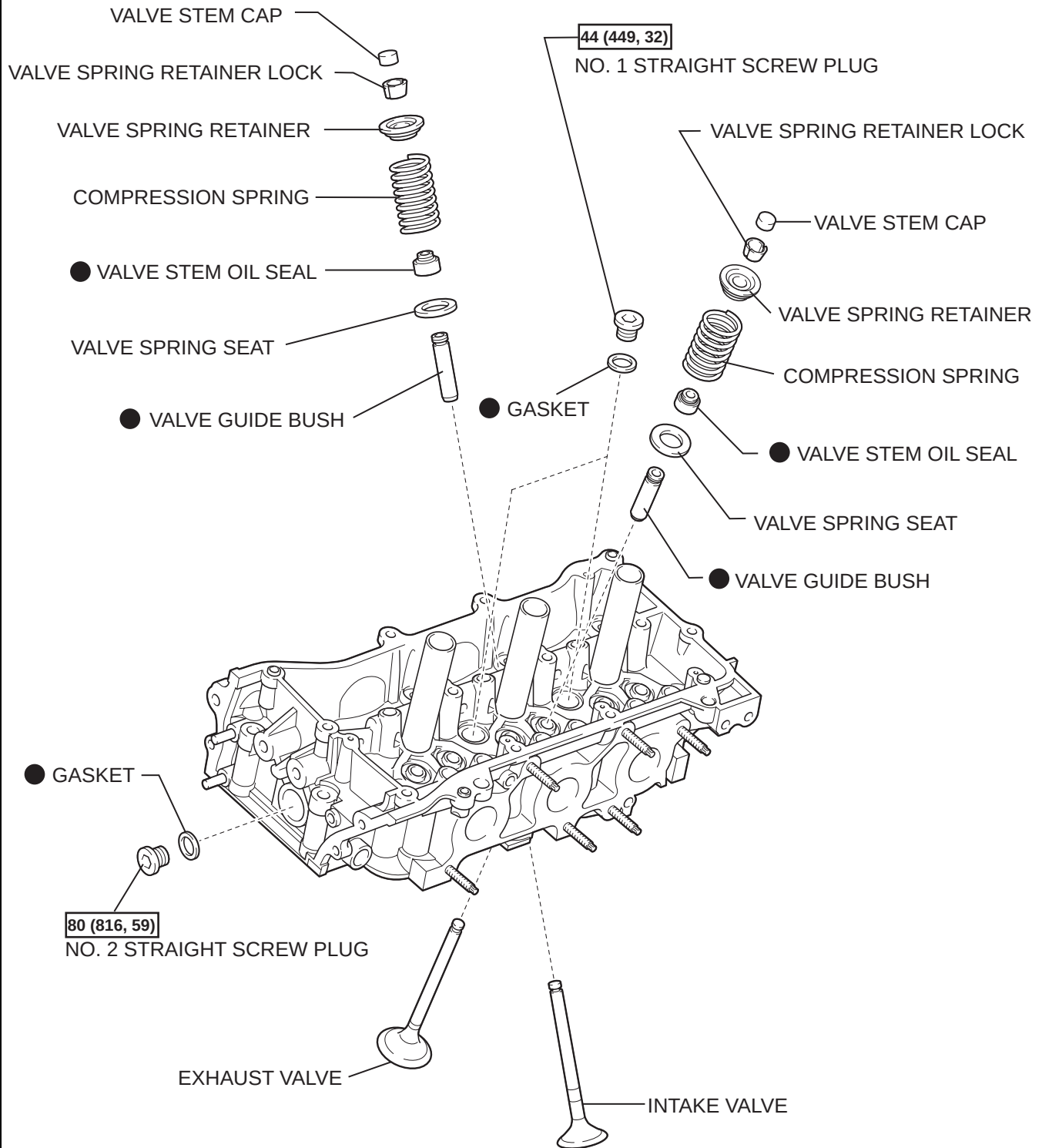
EM





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

● Non-reusable part



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

● Non-reusable part

