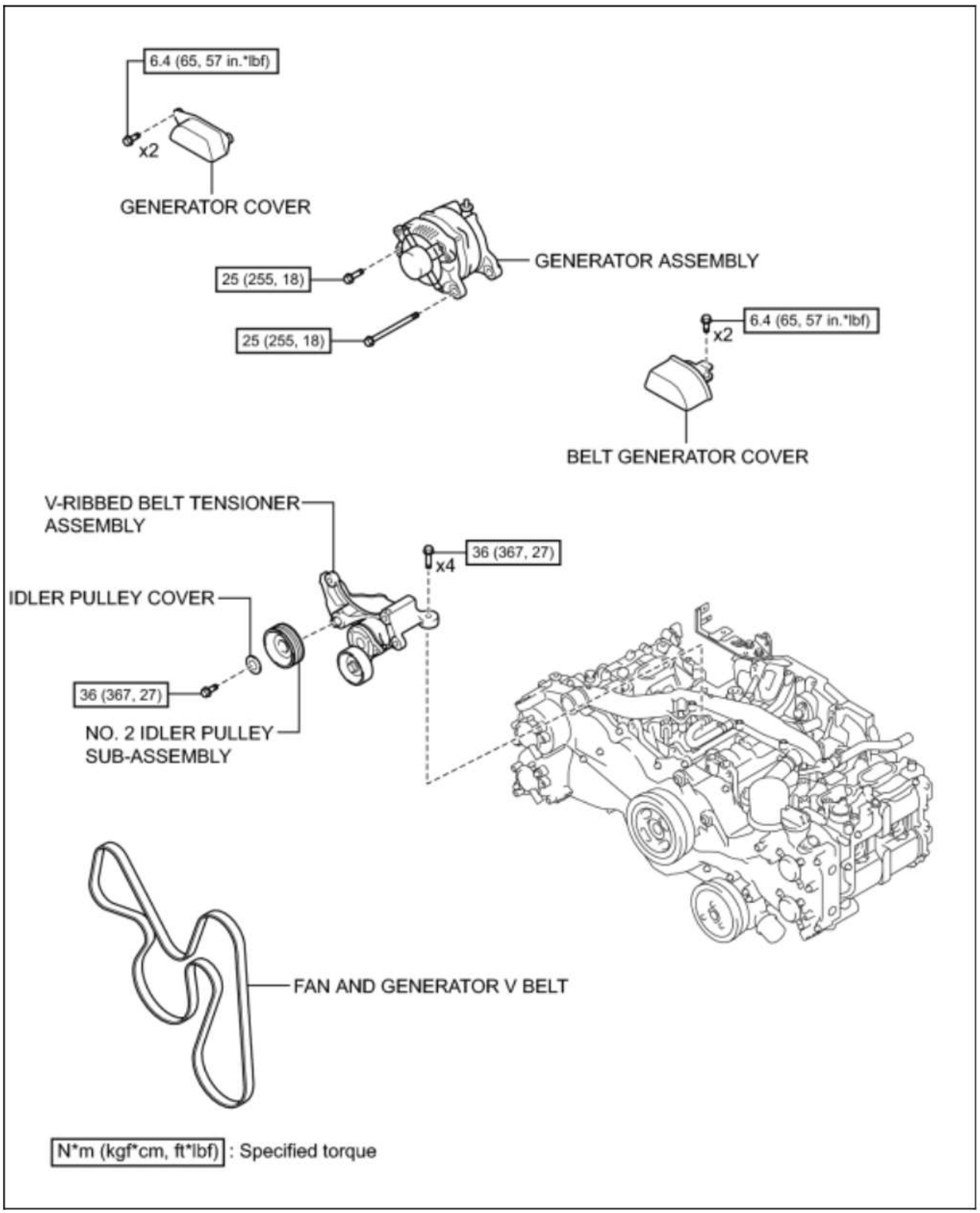
Last Modified: 4-14-2014	6.6 K	Doc ID: RM0000056U8008X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CAMSHAFT: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

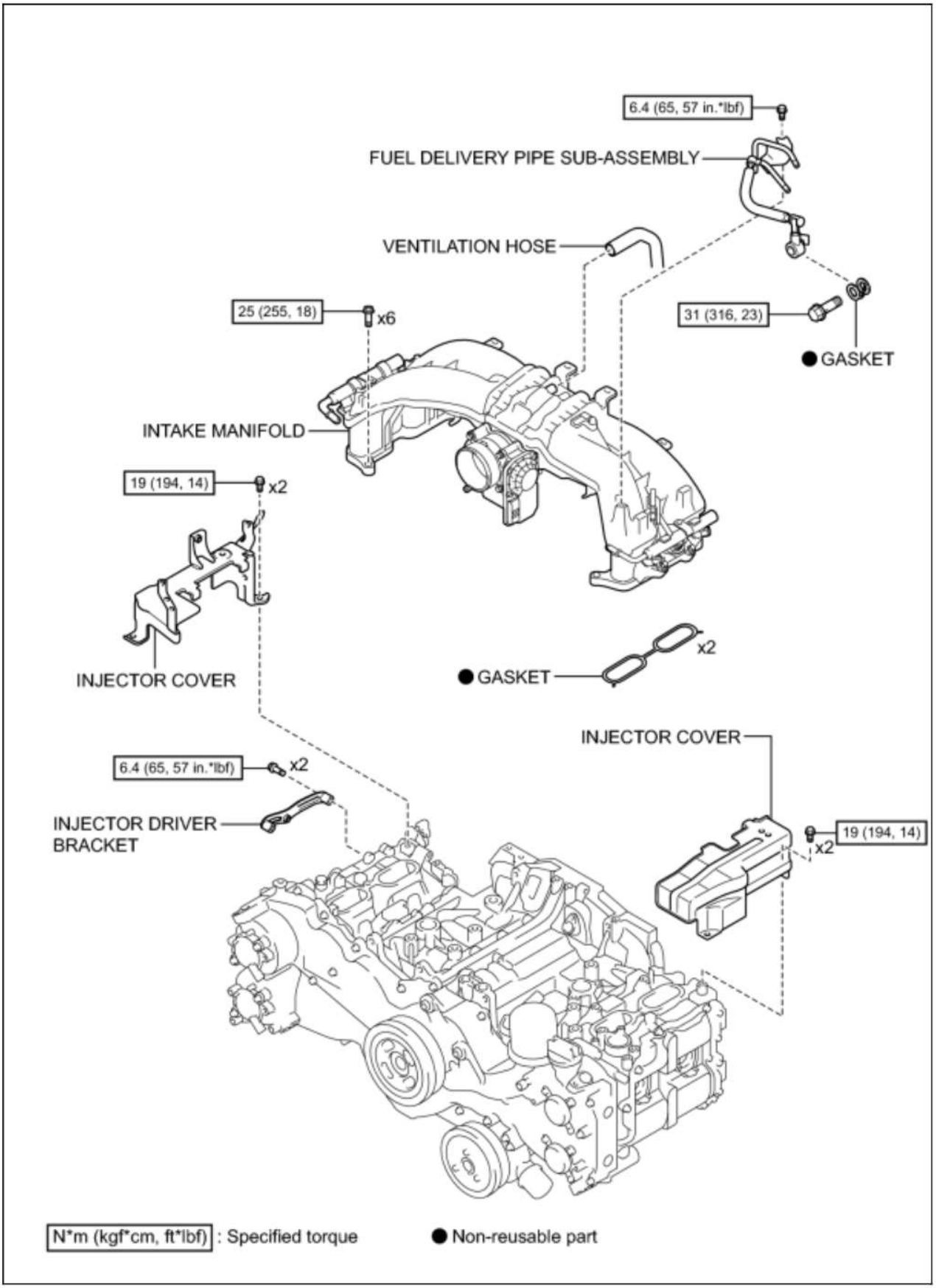
ILLUSTRATION

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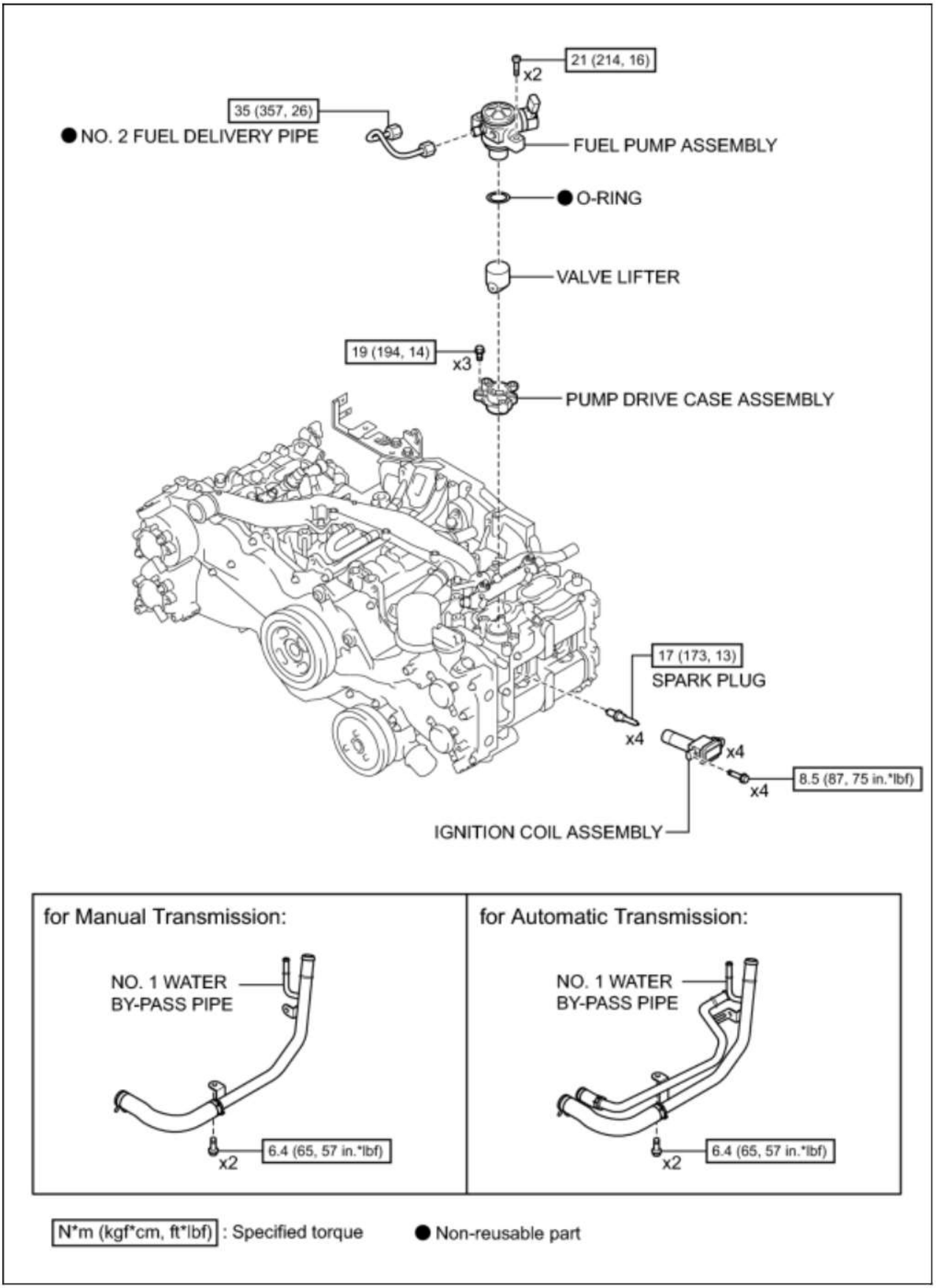
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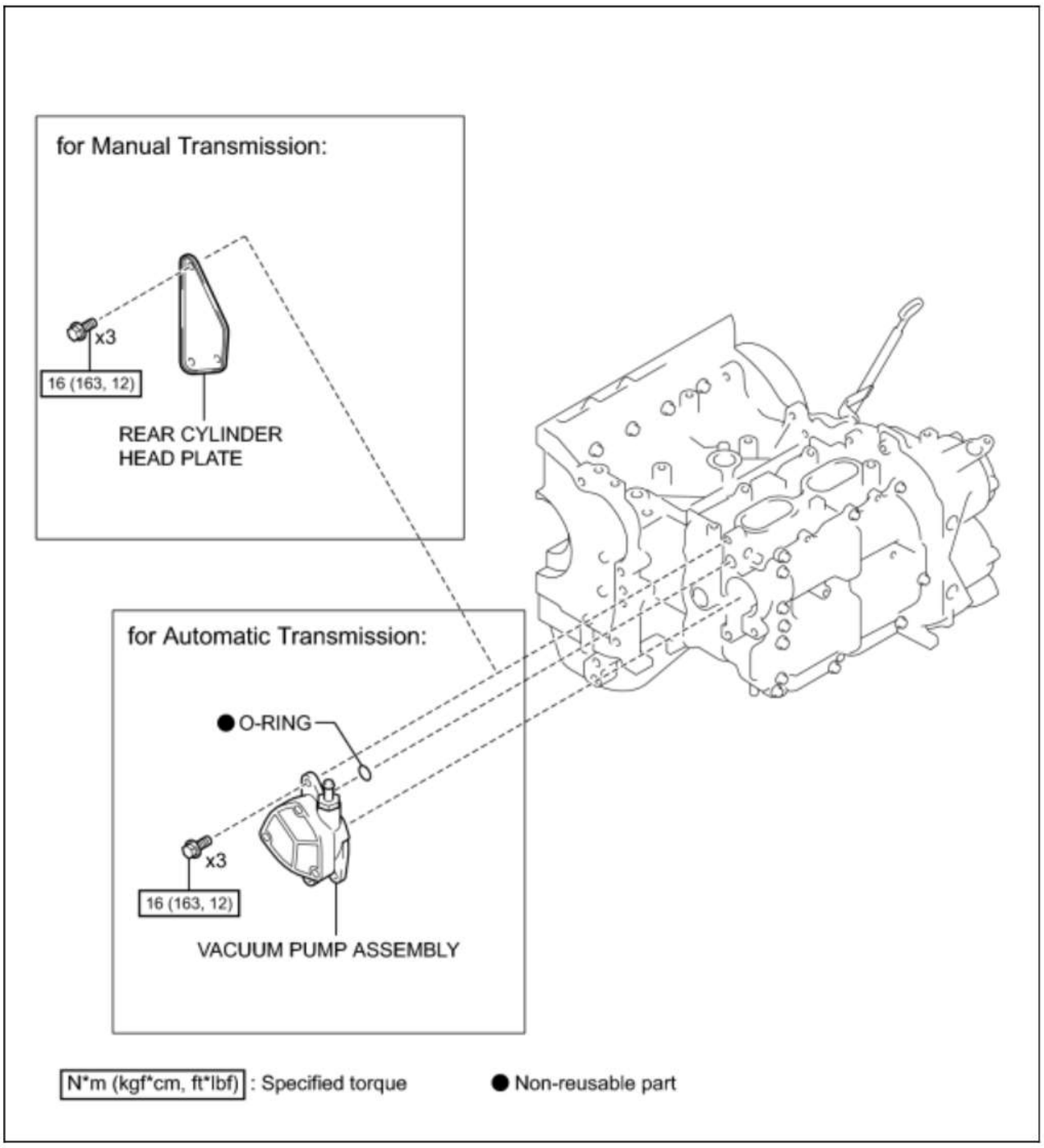
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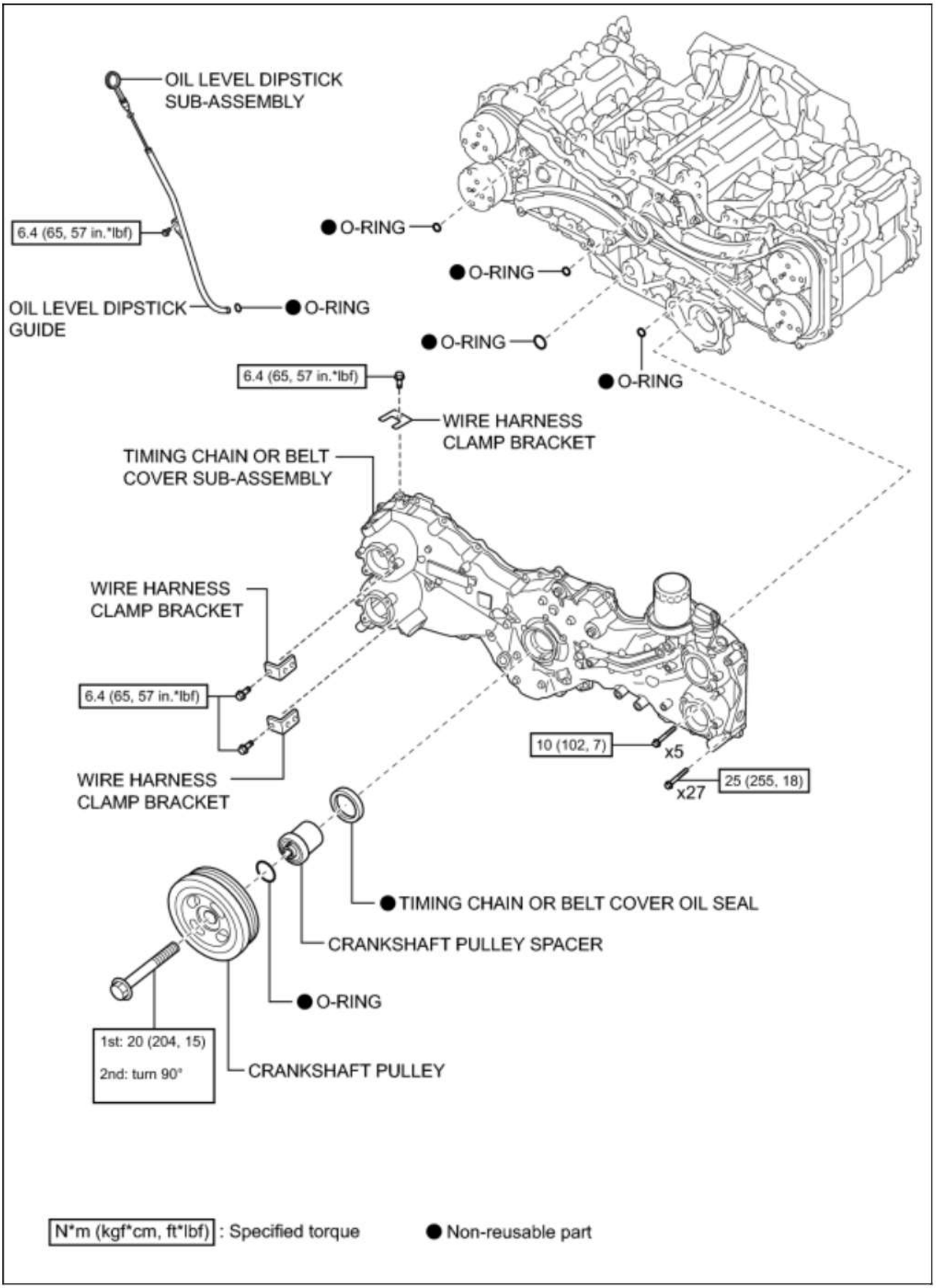
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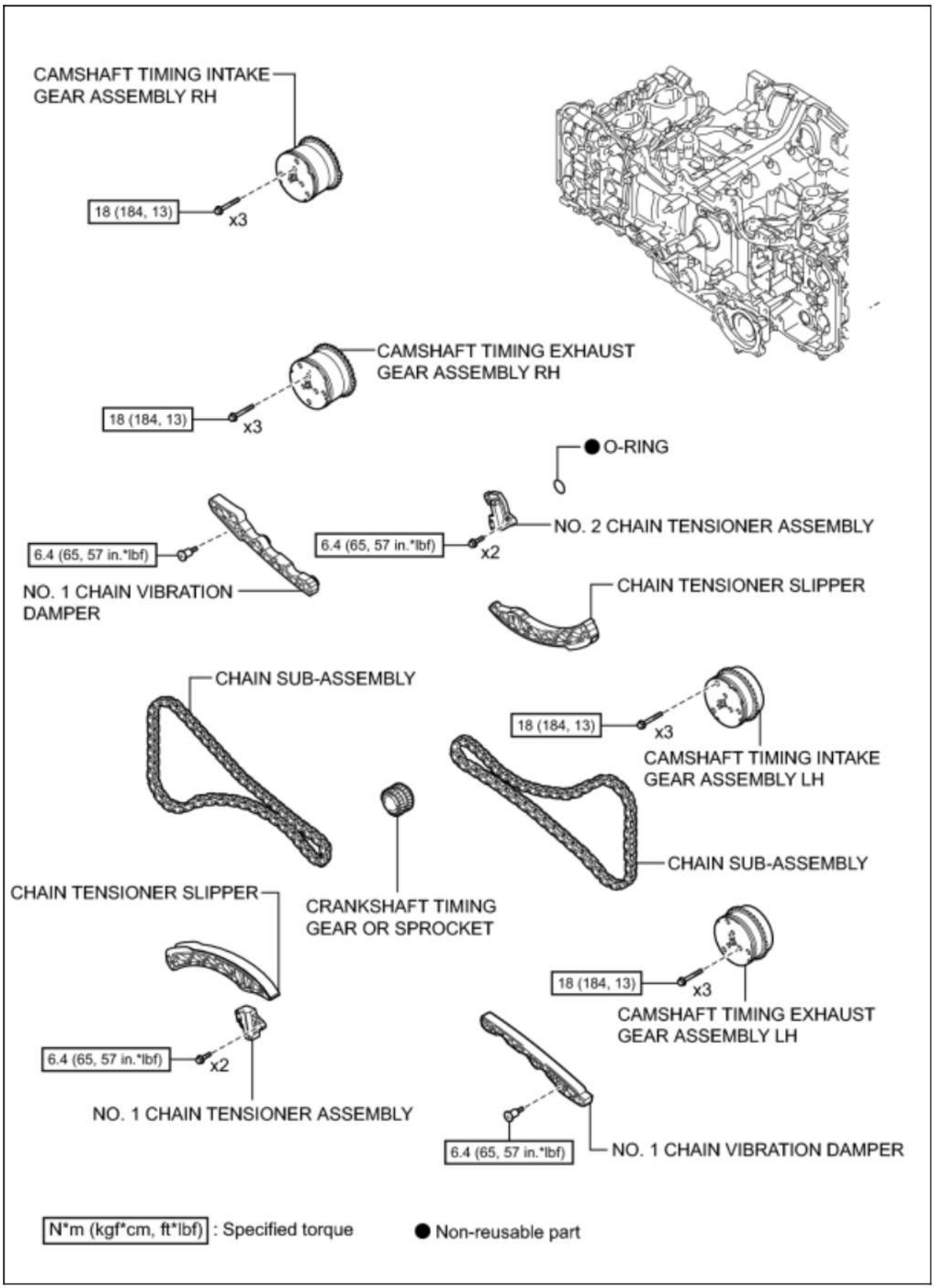
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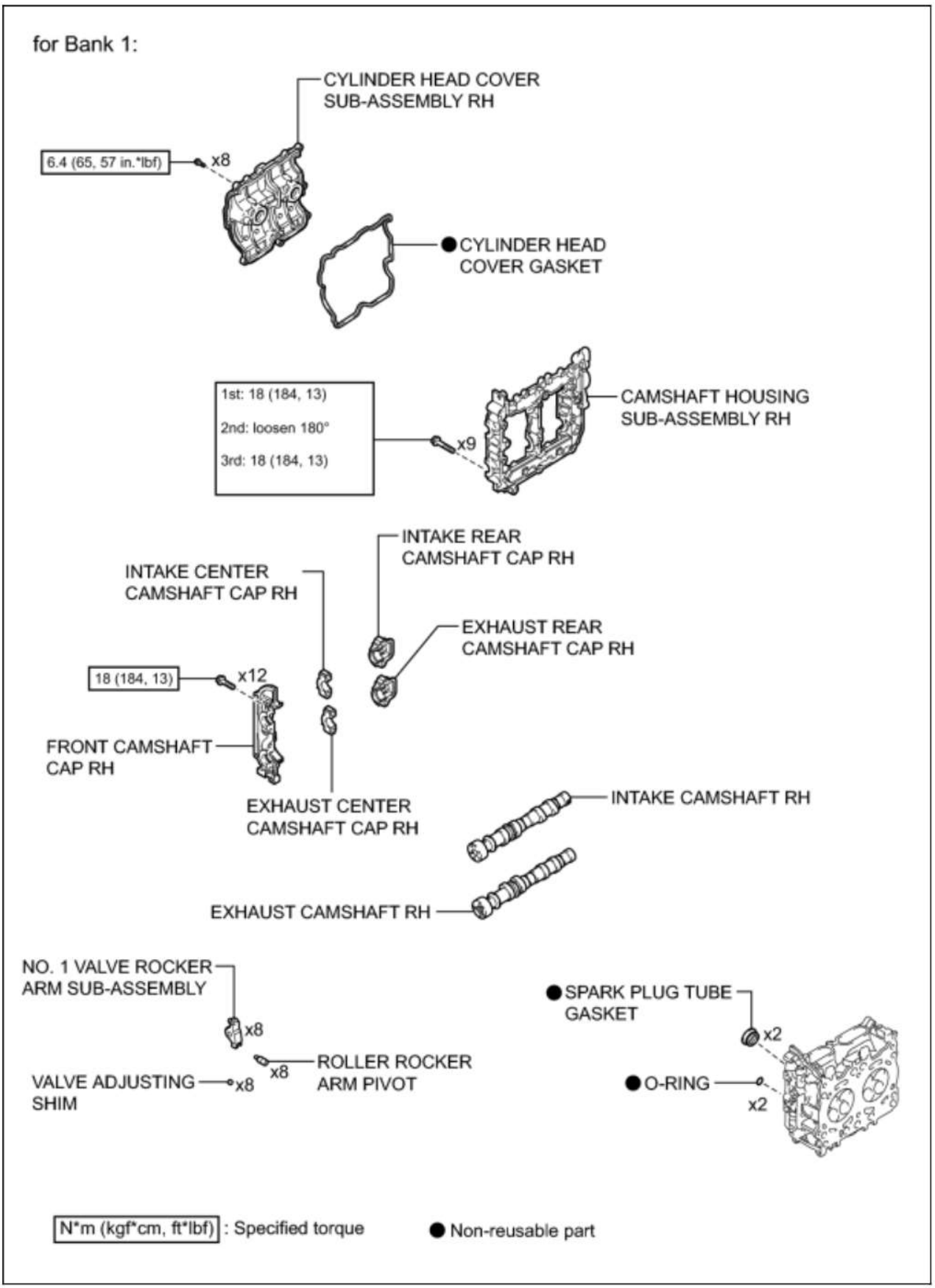
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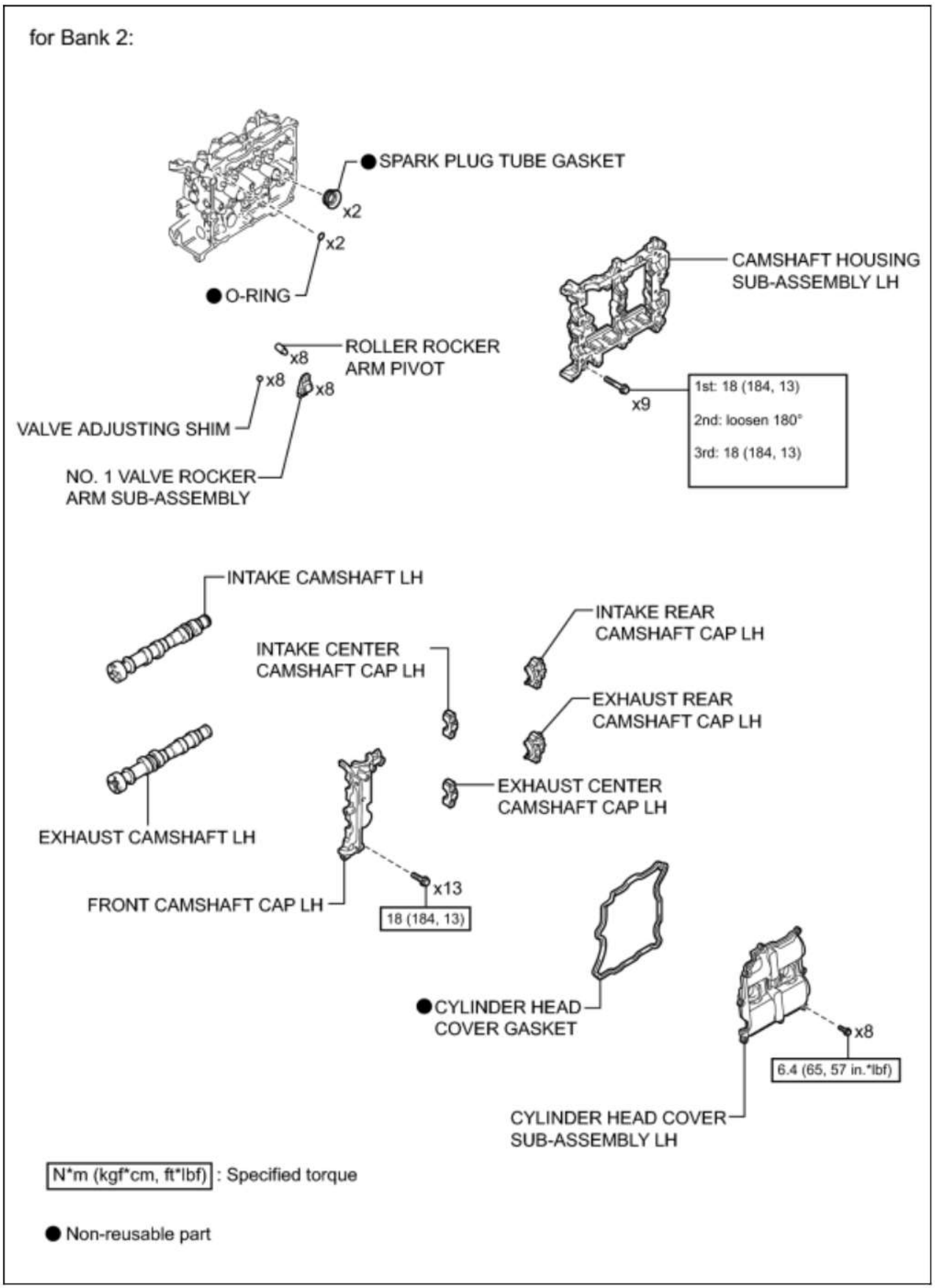
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ILLUSTRATION

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for Bank 2:



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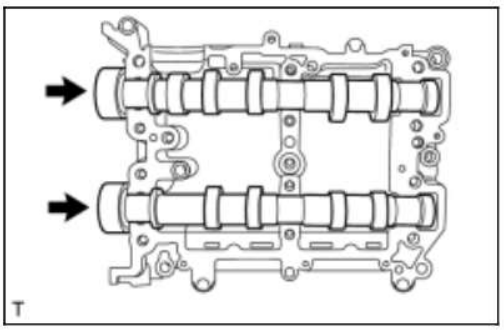
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Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CAMSHAFT: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL CAMSHAFT LH (for Bank 2)

(a) Apply engine oil to the journals of the camshaft housing sub-assembly LH.

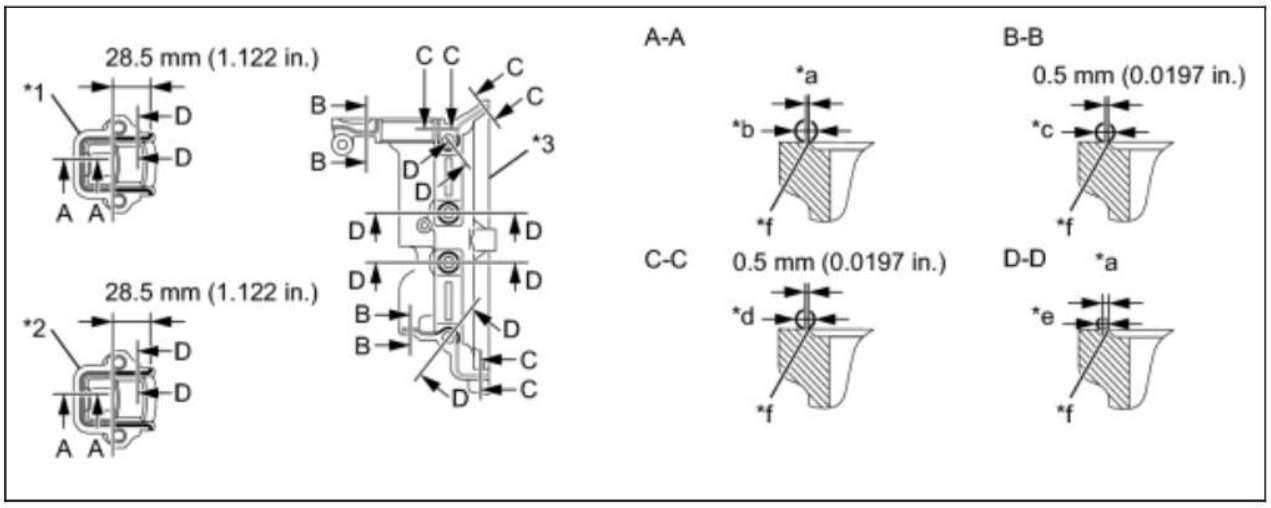
(b) Set the intake camshaft LH and the exhaust camshaft LH to the camshaft housing sub-assembly LH.



2. INSTALL CAMSHAFT CAP (for Bank 2)

(a) Apply the seal packing to the contact surface of the front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH as shown in the illustration.

Seal packing:
Three Bond 1217G, 1217H or equivalent



Text in Illustration

*1	Intake Rear Camshaft Cap LH	*2	Exhaust Rear Camshaft Cap LH
*3	Front Camshaft Cap LH	-	-
*a	Within 1.0 mm (0.0394 in.)	*b	φ3.0 to 4.0 mm (0.1181 to 0.1575 in.)
*c	φ2.5 to 3.5 mm (0.0984 to 0.1378 in.)	*d	φ2.5 to 4.0 mm (0.0984 to 0.1575 in.)
*e	φ1.5 to 2.5 mm (0.0591 to 0.0984 in.)	*f	Chamfer edge

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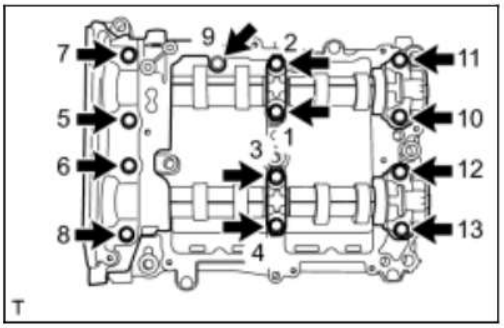
NOTICE:

- Clean and degrease the contact surface.
- Do not apply excessively seal packing as it may cause excess seal packing to flow toward the cam journal, resulting in engine seizure.
- Do not apply seal packing to the intake center camshaft cap LH and exhaust center camshaft cap LH.
- Install the camshaft caps within 5 minutes of applying the seal packing.

(b) Apply engine oil to the journals of the camshaft caps, and place them on the camshaft housing sub-assembly LH.

(c) Tighten the 13 bolts in the order shown in the illustration to install the front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH.

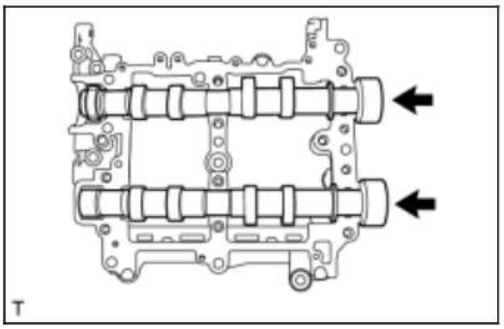
Torque:
18 N·m {184 kgf·cm, 13ft·lbf}



3. INSTALL CAMSHAFT RH (for Bank 1)

(a) Apply engine oil to the journals of the camshaft housing sub-assembly RH.

(b) Set the intake camshaft RH and the exhaust camshaft RH to the camshaft housing sub-assembly RH.

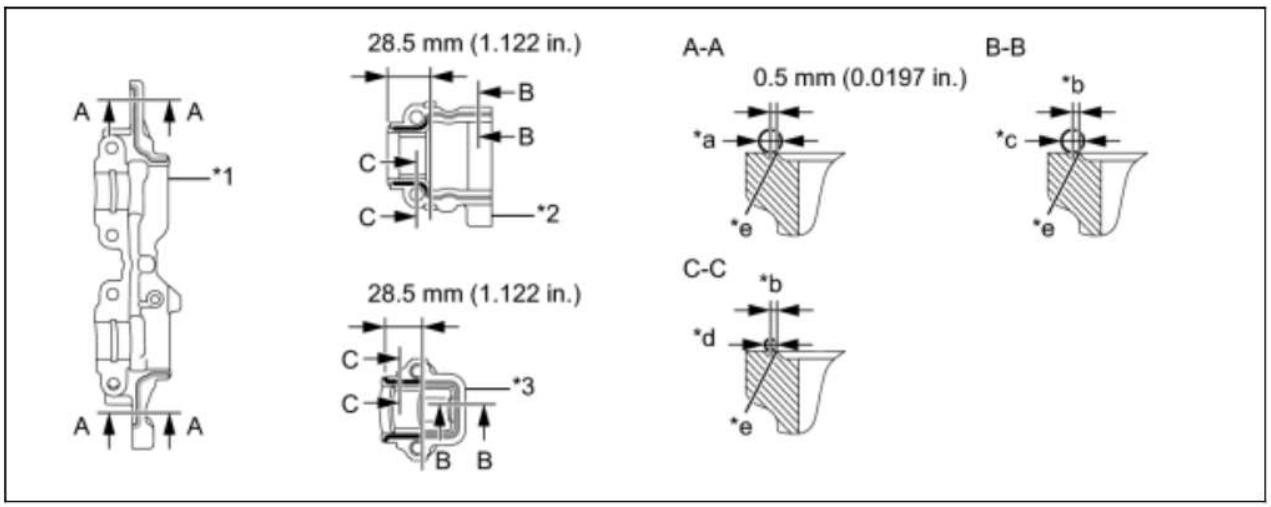


4. INSTALL CAMSHAFT CAP (for Bank 1)

(a) Apply the seal packing to the contact surface of the front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH as shown in the illustration.

Seal packing:
Three Bond 1217G, 1217H or equivalent

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Text in Illustration

*1	Front Camshaft Cap RH	*2	Intake Rear Camshaft Cap RH
*3	Exhaust Rear Camshaft Cap RH	-	-
a	φ2.5 to 4.0 mm (0.0984 to 0.1575 in.)	b	Within 1.0 mm (0.0394 in.)
c	φ3.0 to 4.0 mm (0.1181 to 0.1575 in.)	d	φ1.5 to 2.5 mm (0.0591 to 0.0984 in.)
e	Chamfer edge	-	-

NOTICE:

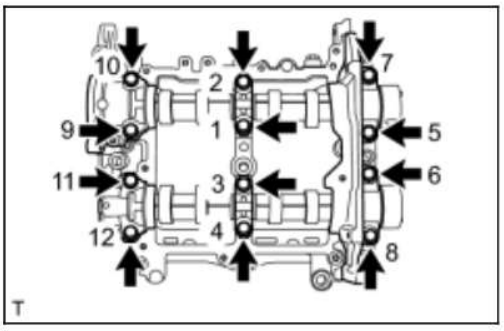
- Clean and degrease the contact surface.
- Do not apply excessively seal packing as it may cause excess seal packing to flow toward the cam journal, resulting in engine seizure.
- Do not apply seal packing to the intake center camshaft cap RH and exhaust center camshaft cap RH.
- Install the camshaft caps within 5 minutes of applying the seal packing.

(b) Apply engine oil to the journals of the camshaft caps, and place them on the camshaft housing sub-assembly RH.

(c) Tighten the 12 bolts in the order shown in the illustration to install the front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH.

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



5. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH INFO

6. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH INFO

7. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH INFO

8. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH INFO

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9. INSTALL INJECTOR DRIVER BRACKET INFO

10. INSTALL SPARK PLUG (for Bank 1) INFO

11. INSTALL IGNITION COIL ASSEMBLY (for Bank 1) INFO

12. INSTALL SPARK PLUG (for Bank 2) INFO

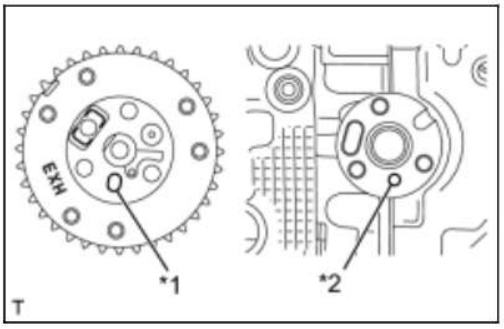
13. INSTALL IGNITION COIL ASSEMBLY (for Bank 2) INFO

14. INSTALL CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY LH

NOTICE:

Before installation, check that there is no foreign matter on the camshaft timing exhaust gear assembly LH and exhaust camshaft LH.

(a) Install the camshaft timing exhaust gear assembly LH while aligning the knock hole of the camshaft timing exhaust gear assembly LH with the knock pin of the exhaust camshaft LH.



Text in Illustration

*1	Knock Hole
*2	Knock Pin

(b) Using SST, hold the camshaft timing exhaust gear assembly LH, and tighten the 3 bolts with a socket "TORX" wrench E16.

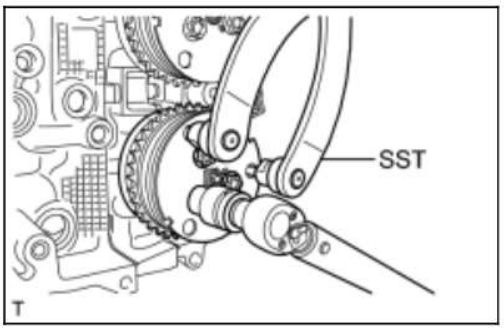
SST: 09960-10010

09962-01000

09963-00700

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}

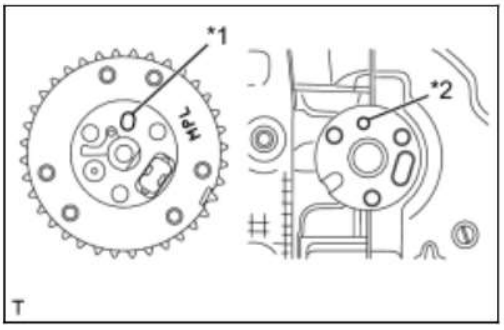


15. INSTALL CAMSHAFT TIMING INTAKE GEAR ASSEMBLY LH

NOTICE:

Before installation, check that there is no foreign matter on the camshaft timing intake gear assembly LH and intake camshaft LH.

(a) Install the camshaft timing exhaust gear assembly LH while aligning the knock hole of the camshaft timing intake gear assembly LH with the knock pin of the intake camshaft LH.



Text in Illustration

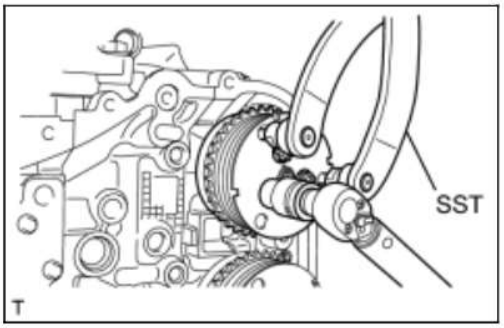
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*1	Knock Hole
*2	Knock Pin

(b) Using SST, hold the camshaft timing intake gear assembly LH, and tighten the 3 bolts with a socket "TORX" wrench E16.

SST: 09960-10010
09962-01000
09963-00700

Torque:
18 N·m {184 kgf·cm, 13ft·lbf}



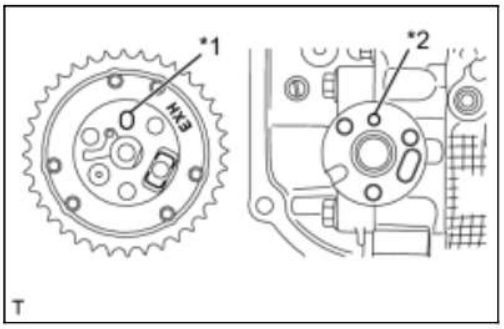
16. INSTALL CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY RH

NOTICE:
Before installation, check that there is no foreign matter on the camshaft timing exhaust gear assembly RH and exhaust camshaft RH.

(a) Install the camshaft timing intake gear assembly RH while aligning the knock hole of the camshaft timing exhaust gear assembly RH with the knock pin of the exhaust camshaft RH.

Text in Illustration

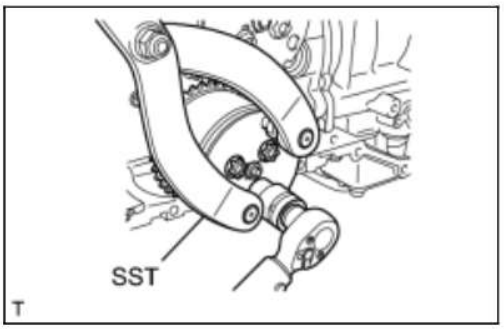
*1	Knock Hole
*2	Knock Pin



(b) Using SST, hold the camshaft timing exhaust gear assembly RH, and tighten the 3 bolts with a socket "TORX" wrench E16.

SST: 09960-10010
09962-01000
09963-00700

Torque:
18 N·m {184 kgf·cm, 13ft·lbf}



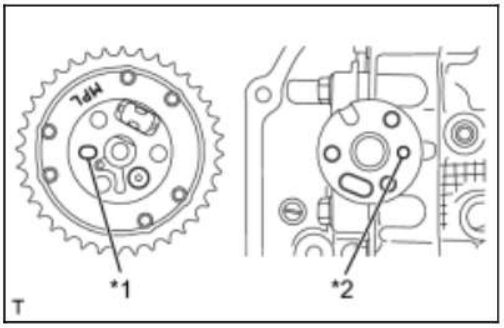
17. INSTALL CAMSHAFT TIMING INTAKE GEAR ASSEMBLY RH

NOTICE:
Before installation, check that there is no foreign matter on the camshaft timing intake gear

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assembly RH and intake camshaft RH.

(a) Install the camshaft timing intake gear assembly RH while aligning the knock hole of the camshaft timing intake gear assembly RH with the knock pin of the intake camshaft RH.

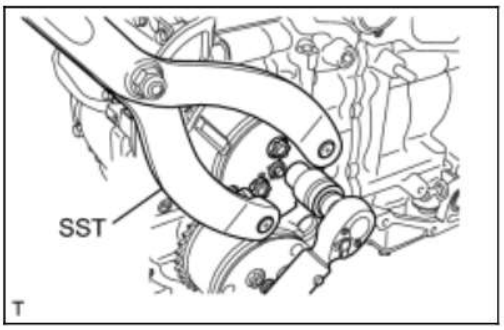


Text in Illustration

*1	Knock Hole
*2	Knock Pin

(b) Using SST, hold the camshaft timing intake gear assembly RH, and tighten the 3 bolts with a socket "TORX" wrench E16.

SST: 09960-10010
09962-01000
09963-00700
Torque:
18 N·m {184 kgf·cm, 13ft·lbf}



18. INSTALL CRANKSHAFT TIMING GEAR OR SPROCKET INFO
19. INSTALL CHAIN SUB-ASSEMBLY (for Bank 2) INFO
20. INSTALL CHAIN SUB-ASSEMBLY (for Bank 1) INFO
21. INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY INFO
22. CONNECT ENGINE WIRE INFO
23. INSTALL TIMING CHAIN OR BELT COVER OIL SEAL INFO
24. INSTALL CRANKSHAFT PULLEY INFO
25. INSTALL NO. 1 WATER BY-PASS PIPE (for Manual Transmission) INFO
26. INSTALL NO. 1 WATER BY-PASS PIPE (for Automatic Transmission) INFO
27. INSTALL REAR CYLINDER HEAD PLATE (for Manual Transmission) INFO
28. INSTALL VACUUM PUMP ASSEMBLY (for Automatic Transmission) INFO
29. INSTALL PUMP DRIVE CASE ASSEMBLY INFO
30. INSTALL VALVE LIFTER INFO
31. INSTALL FUEL PUMP ASSEMBLY INFO
32. INSTALL NO. 2 FUEL DELIVERY PIPE INFO
33. INSTALL INTAKE MANIFOLD INFO

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34. CONNECT VENTILATION HOSE INFO

35. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY INFO

36. INSTALL INJECTOR COVER (for Bank 2) INFO

37. INSTALL INJECTOR COVER (for Bank 1) INFO

38. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY INFO

39. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY INFO

40. INSTALL OIL LEVEL DIPSTICK GUIDE INFO

41. INSTALL GENERATOR ASSEMBLY INFO

42. INSTALL FAN AND GENERATOR V BELT INFO

43. INSTALL BELT GENERATOR COVER INFO

44. INSTALL GENERATOR COVER INFO

45. INSTALL ENGINE HANGER INFO

46. REMOVE ENGINE STAND

INFO



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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000056U900CX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CAMSHAFT: REMOVAL; 2013 MY FR-S [03/2012 -]		

REMOVAL

1. INSTALL ENGINE STAND

INFO

2. REMOVE ENGINE HANGER INFO

3. REMOVE GENERATOR COVER INFO

4. REMOVE BELT GENERATOR COVER INFO

5. REMOVE FAN AND GENERATOR V BELT INFO

6. REMOVE GENERATOR ASSEMBLY INFO

7. REMOVE OIL LEVEL DIPSTICK GUIDE INFO

8. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY INFO

9. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY INFO

10. REMOVE INJECTOR COVER (for Bank 1) INFO

11. REMOVE INJECTOR COVER (for Bank 2) INFO

12. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY INFO

13. SEPARATE VENTILATION HOSE INFO

14. REMOVE INTAKE MANIFOLD INFO

15. REMOVE NO. 2 FUEL DELIVERY PIPE INFO

16. REMOVE FUEL PUMP ASSEMBLY INFO

17. REMOVE VALVE LIFTER INFO

18. REMOVE PUMP DRIVE CASE ASSEMBLY INFO

19. REMOVE VACUUM PUMP ASSEMBLY (for Automatic Transmission) INFO

20. REMOVE REAR CYLINDER HEAD PLATE (for Manual Transmission) INFO

21. REMOVE NO. 1 WATER BY-PASS PIPE (for Automatic Transmission) INFO

22. REMOVE NO. 1 WATER BY-PASS PIPE (for Manual Transmission) INFO

23. REMOVE CRANKSHAFT PULLEY INFO

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24. REMOVE TIMING CHAIN OR BELT COVER OIL SEAL INFO

25. DISCONNECT ENGINE WIRE INFO

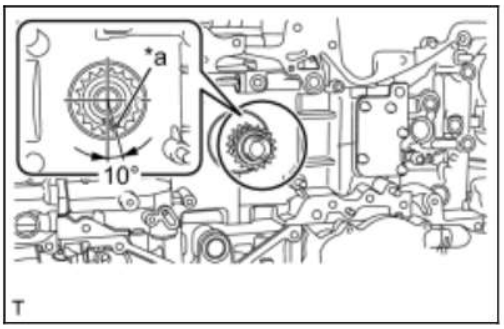
26. REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY INFO

27. REMOVE CHAIN SUB-ASSEMBLY (for Bank 1) INFO

28. REMOVE CHAIN SUB-ASSEMBLY (for Bank 2) INFO

29. ROTATE CRANKSHAFT AND CAMSHAFT

(a) Turn the crankshaft approximately 200° clockwise, and align the alignment mark as shown in the illustration.



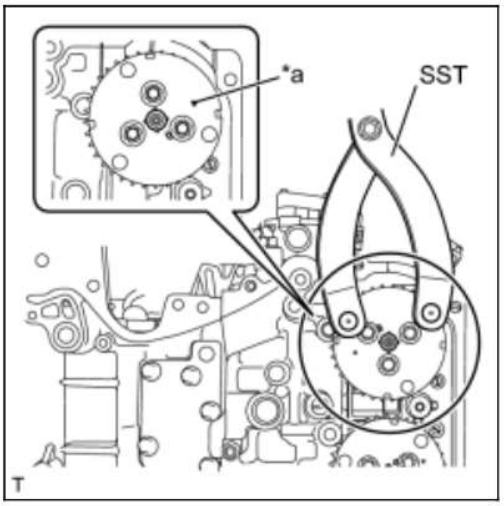
Text in Illustration

*a	Alignment Mark

NOTICE:

Do not turn the crankshaft counterclockwise except for a slight adjustment to correctly align the alignment mark. If not, the valves may come into contact with the piston.

(b) Using SST, turn the camshaft timing intake gear assembly LH approximately 180°clockwise, and align the alignment mark on the camshaft timing intake gear assembly LH to the position (zero-lift position) shown in the illustration.



Text in Illustration

*a	Alignment Mark

SST: 09960-10010
09962-01000
09963-00700

NOTICE:

After this work, when the intake valve and exhaust valve lift at the same time, the valve heads contact each other, causing the valve stems to bend. To avoid this, do not turn the intake camshaft LH and the exhaust camshaft LH more than the zero-lift range (the range where the camshafts can be turned lightly by hand).

(c) Remove the pulley bolt.

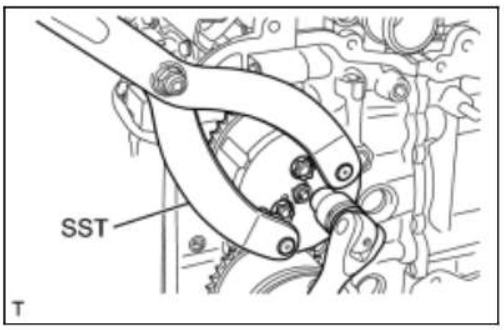
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30. REMOVE CRANKSHAFT TIMING GEAR OR SPROCKET INFO

31. REMOVE CAMSHAFT TIMING INTAKE GEAR ASSEMBLY RH

(a) Using SST, hold the camshaft timing intake gear assembly RH and remove the 3 bolts with a "TORX" socket wrench E16.

SST: 09960-10010
09962-01000
09963-00700

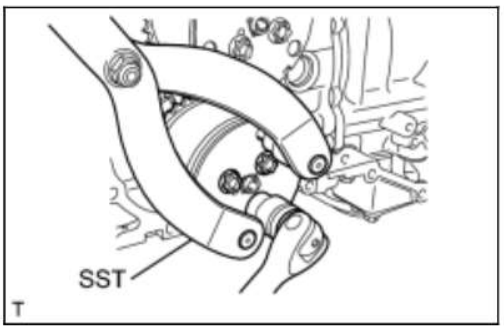


(b) Remove the camshaft timing intake gear assembly RH.

32. REMOVE CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY RH

(a) Using SST, hold the camshaft timing exhaust gear assembly RH and remove the 3 bolts with a "TORX" socket wrench E16.

SST: 09960-10010
09962-01000
09963-00700

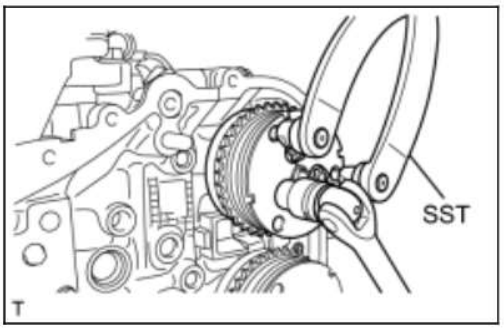


(b) Remove the camshaft timing exhaust gear assembly RH.

33. REMOVE CAMSHAFT TIMING INTAKE GEAR ASSEMBLY LH

(a) Using SST, hold the camshaft timing intake gear assembly LH and remove the 3 bolts with a "TORX" socket wrench E16.

SST: 09960-10010
09962-01000
09963-00700



(b) Remove the camshaft timing intake gear assembly LH.

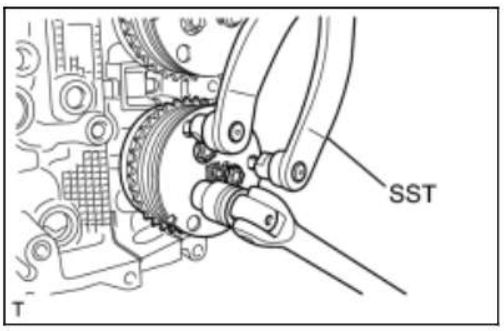
34. REMOVE CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY LH

(a) Using SST, hold the camshaft timing exhaust gear assembly LH and remove the 3 bolts with a "TORX" socket

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wrench E16.

SST: 09960-10010
09962-01000
09963-00700



(b) Remove the camshaft timing exhaust gear assembly LH.

35. REMOVE IGNITION COIL ASSEMBLY (for Bank 2) INFO

36. REMOVE SPARK PLUG (for Bank 2) INFO

37. REMOVE IGNITION COIL ASSEMBLY (for Bank 1) INFO

38. REMOVE SPARK PLUG (for Bank 1) INFO

39. REMOVE INJECTOR DRIVER BRACKET INFO

40. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH INFO

41. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH INFO

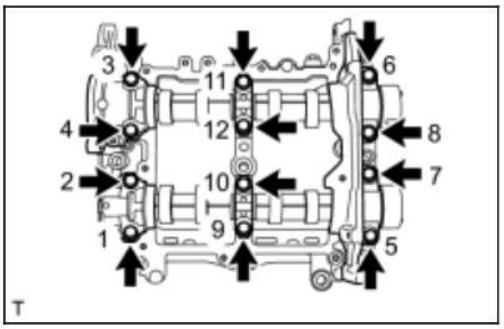
42. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH INFO

43. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH INFO

44. REMOVE CAMSHAFT CAP (for Bank 1)

(a) In several steps, uniformly loosen the 12 bolts in the order shown in the illustration, and remove the front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH, and exhaust rear camshaft cap RH.

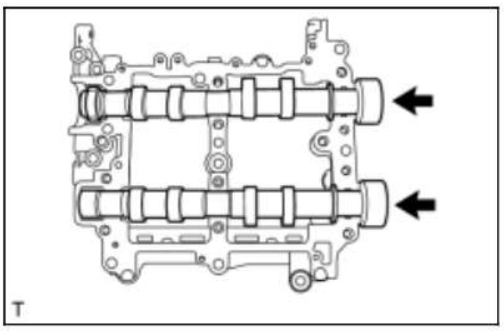
HINT:
Arrange the removed parts in the correct order.



45. REMOVE CAMSHAFT RH (for Bank 1)

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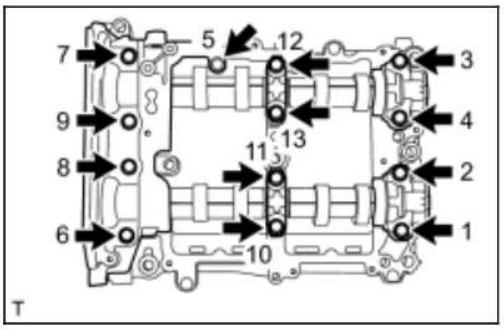
(a) Remove the intake camshaft RH and exhaust camshaft RH from the camshaft housing sub-assembly RH.



46. REMOVE CAMSHAFT CAP (for Bank 2)

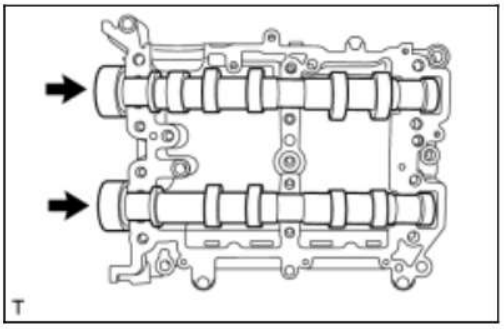
(a) In several steps, uniformly loosen the 13 bolts in the order shown in the illustration, and remove the front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH.

HINT:
Arrange the removed parts in the correct order.



47. REMOVE CAMSHAFT LH (for Bank 2)

(a) Remove the intake camshaft LH and exhaust camshaft LH from the camshaft housing sub-assembly LH.



TOYOTA

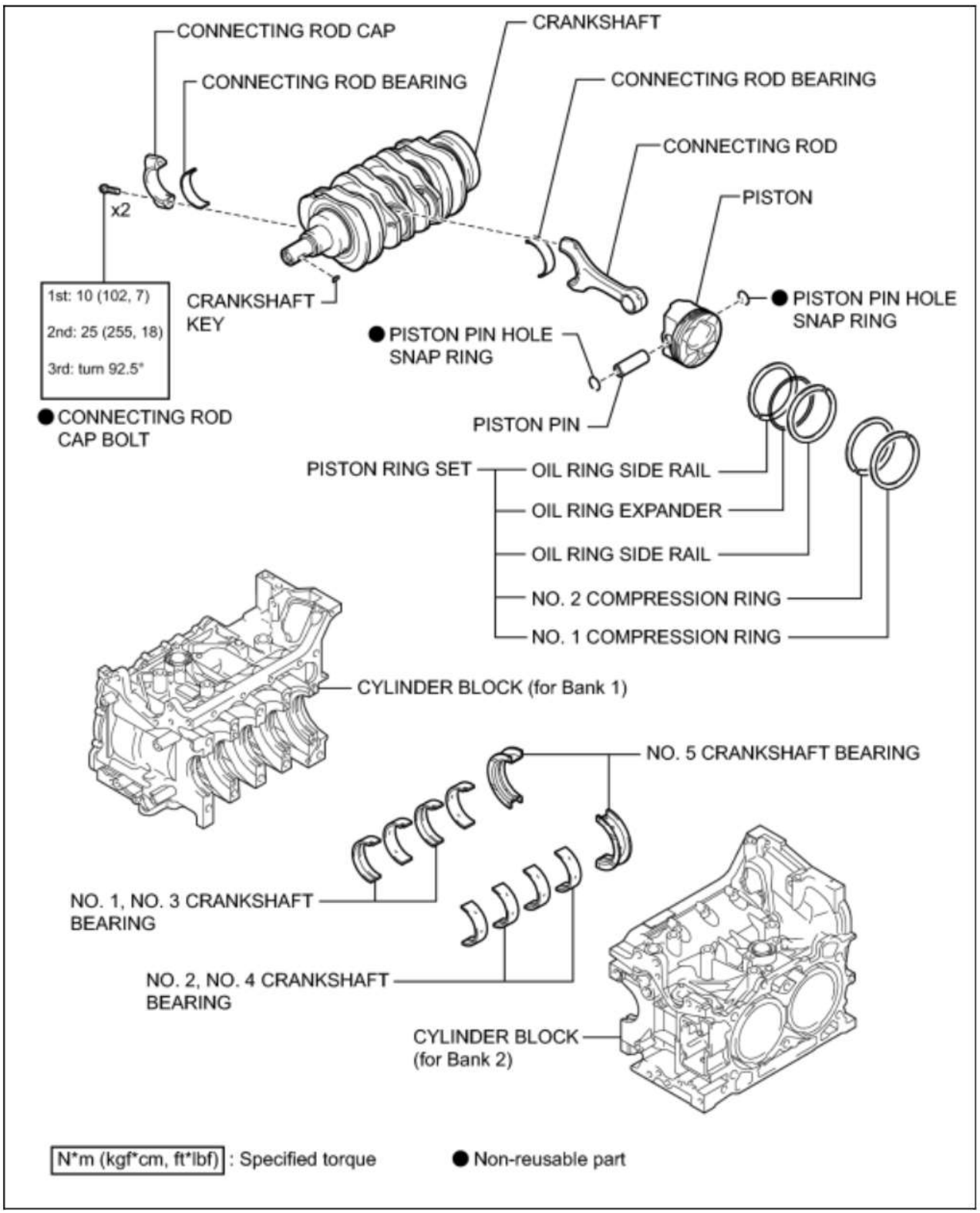
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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000000T4V07IX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER BLOCK: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

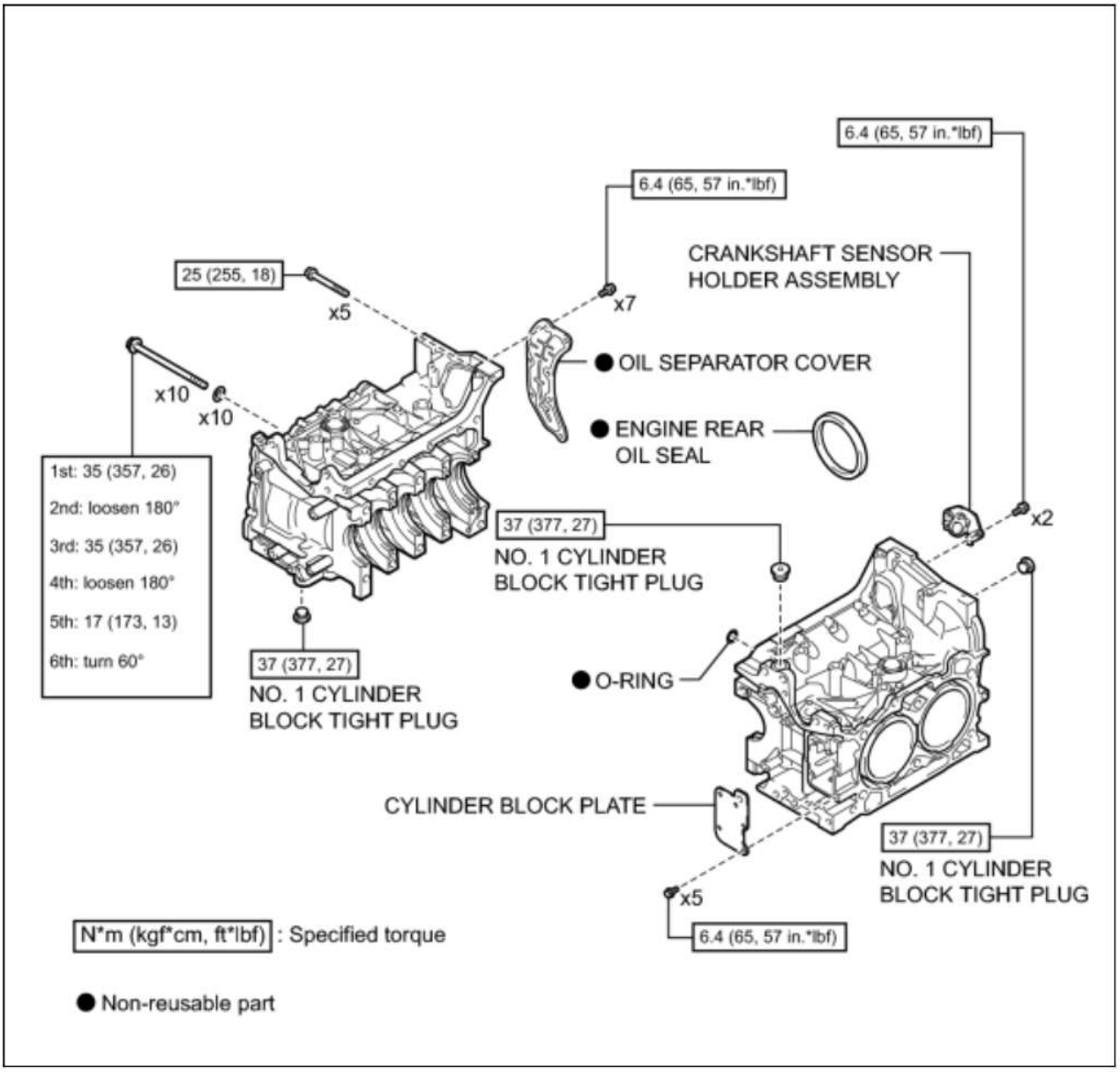
ILLUSTRATION

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ILLUSTRATION

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000T4X087X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER BLOCK: DISASSEMBLY; 2013 MY FR-S [03/2012 -]		

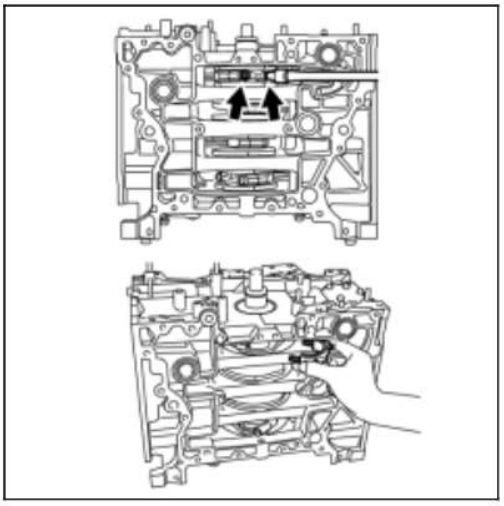
DISASSEMBLY

1. REMOVE PISTON SUB-ASSEMBLY WITH CONNECTING ROD

(a) Mark each connecting rod cap and piston with a cylinder number.

(b) Turn the crankshaft so that the connecting rod cap can be removed.

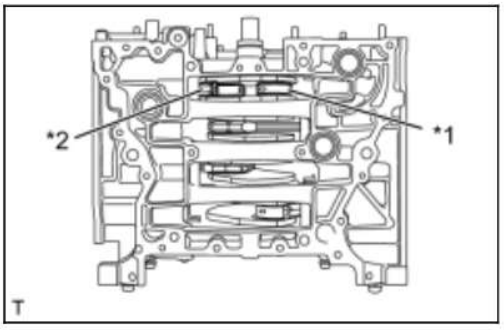
(c) Using a "TORX" socket wrench E14, remove the 2 connecting rod cap bolts and connecting rod cap.



(d) Turn the crankshaft and separate the crank pin from the connecting rod.

Text in Illustration

*1	Crank pin
*2	Connecting rod



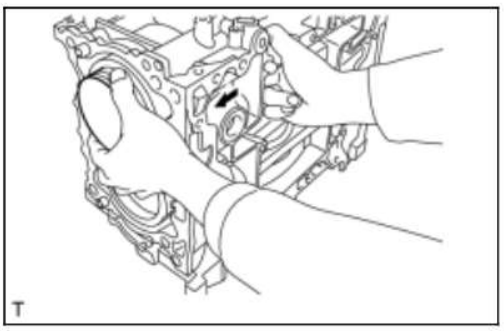
HINT:

Turn the crankshaft clockwise when removing the No. 1 or No. 3 piston with connecting rod, and turn it counterclockwise when removing the No. 2 or No. 4 piston with connecting rod.

(e) Push the connecting rod in the direction of the arrow, and

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remove the piston with connecting rod from the cylinder block.



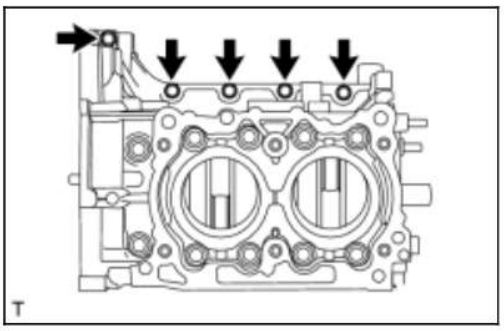
2. REMOVE CYLINDER BLOCK SUB-ASSEMBLY (for Bank 1)

NOTICE:

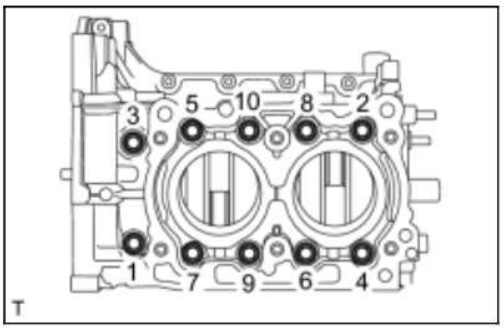
Place a cloth to avoid scratching the mating surface of the cylinder block during servicing.

(a) Operate the engine stand so that the bank 1 side faces upward.

(b) Remove the 5 bolts.



(c) Using a 12 mm socket wrench, loosen the 10 bolts in the order as shown in the illustration.



(d) Remove the 10 bolts and cylinder block (for bank 1).

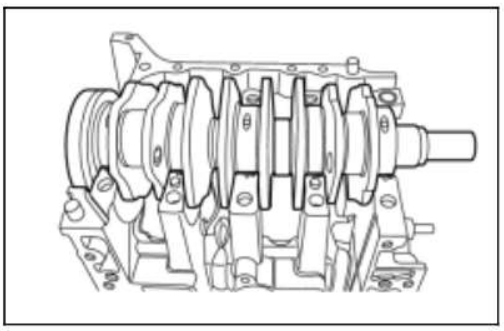
NOTICE:

Lift the cylinder block (for bank 1) slightly, and confirm that the crankshaft is remaining on the cylinder block (for bank 2). If the cylinder block (for bank 1) is lifted carelessly when separating, the crankshaft possibly having stuck to cylinder block (for bank 1) may fall off.

3. REMOVE CRANKSHAFT

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(a) Remove the crankshaft from the cylinder block (for bank 2).

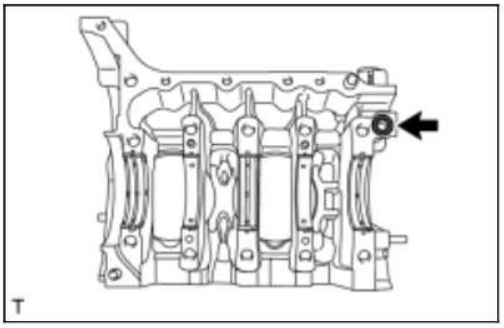


4. REMOVE REAR ENGINE OIL SEAL

(a) Remove the rear engine oil seal.

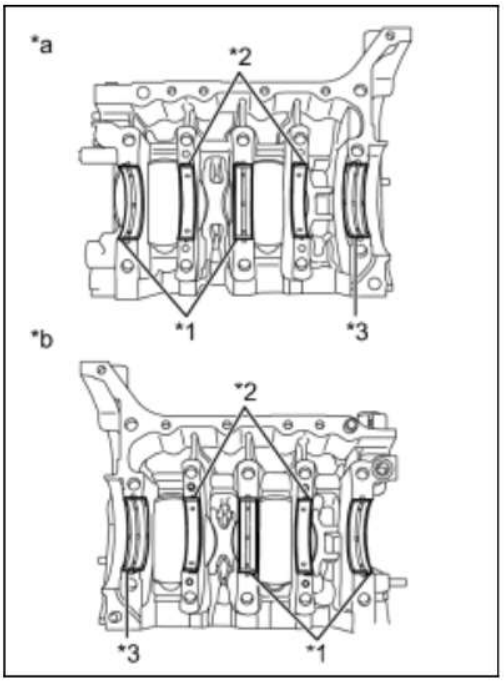
5. REMOVE O-RING

(a) Remove the O-ring from the cylinder block (for bank 2).



6. REMOVE CRANKSHAFT BEARING

(a) Remove the crankshaft bearings from the cylinder block (for bank 1) and cylinder block (for bank 2).



Text in Illustration

*1	No. 1 and No. 3 Crankshaft Bearing
*2	No. 2 and No. 4 Crankshaft Bearing
*3	No. 5 Crankshaft Bearing
*a	for Bank 1
*b	for Bank 2

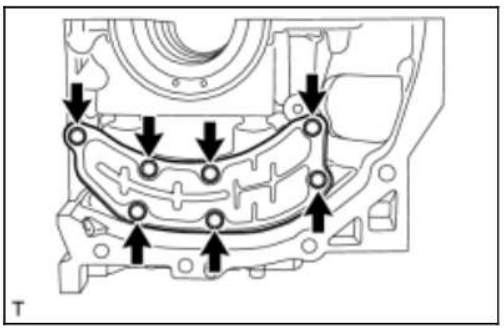
HINT:

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- Arrange the removed parts in the correct order.
- Push the bearing at the opposite end to locking lip to remove the bearing.

7. REMOVE OIL SEPARATOR COVER

(a) Remove the 7 bolts and oil separator cover from the cylinder block (for bank 1).

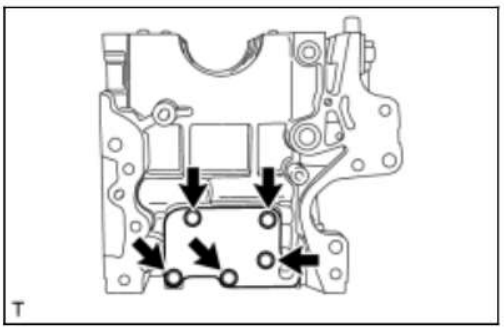


8. REMOVE CYLINDER BLOCK SUB-ASSEMBLY (for Bank 2)

(a) Remove the cylinder block sub-assembly (for bank 2) from the engine stand.

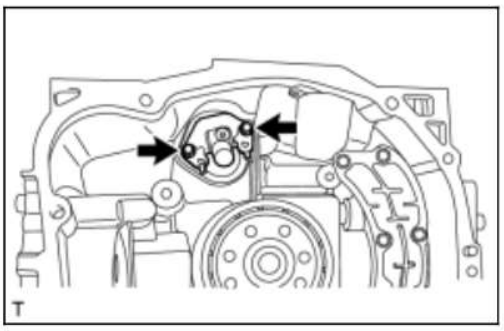
9. REMOVE CYLINDER BLOCK PLATE

(a) Remove the 5 bolts and cylinder block plate from the cylinder block (for bank 2).



10. REMOVE CRANKSHAFT SENSOR HOLDER ASSEMBLY

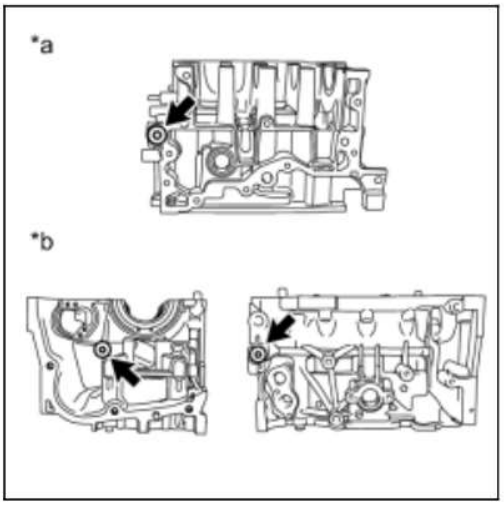
(a) Remove the 2 bolts and crankshaft sensor holder assembly from the cylinder block (for bank 2).



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11. REMOVE NO. 1 CYLINDER BLOCK TIGHT PLUG

(a) Remove the 3 No. 1 cylinder block tight plugs from the cylinder block (for bank 1) and cylinder block (for bank 2).



Text in Illustration

*a	for Bank 1
*b	for Bank 2

12. REMOVE CONNECTING ROD BEARING

(a) Remove the connecting rod bearings.

HINT:

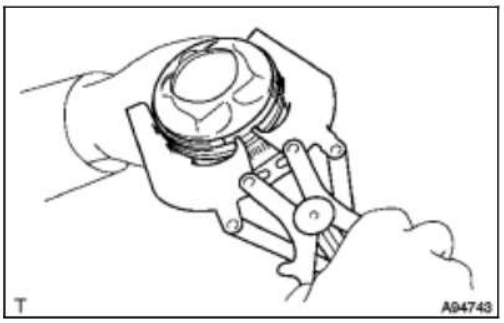
Arrange the removed parts in the correct order.

13. REMOVE PISTON RING SET

HINT:

Arrange the removed parts in the correct order.

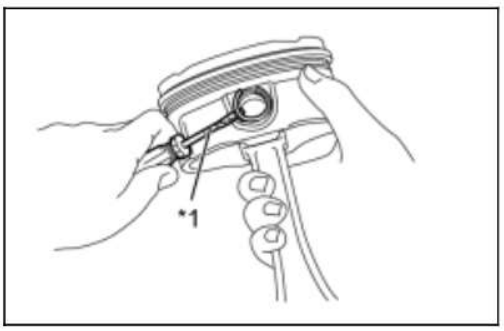
(a) Using a piston ring expander, remove the No. 1 compression ring and No. 2 compression ring in order.



(b) Remove the upper oil ring side rail, lower oil ring side rail and oil ring expander in order by hand.

14. REMOVE PISTON WITH PIN SUB-ASSEMBLY

(a) Using a screwdriver with its tip wrapped in protective tape, remove the piston pin hole snap ring on one end from the piston.



Text in Illustration

*1	Protective Tape

HINT:

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Be careful not to damage the piston and piston pin by wrapping the tip of the screwdriver with protective tape.

(b) Remove the piston pin from the piston.

(c) Using a screwdriver with its tip wrapped in protective tape, remove the piston pin hole snap ring on other end from the piston.

HINT:

Be careful not to damage the piston and piston pin by wrapping the tip of the screwdriver with protective tape.



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Last Modified: 4-14-2014	6.6 G	Doc ID: RM000000XCV08HX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER BLOCK: INSPECTION; 2013 MY FR-S [03/2012 -]		

INSPECTION

1. INSPECT CYLINDER BLOCK SUB-ASSEMBLY

(a) Visually check that there are no cracks, scratches or other damage.

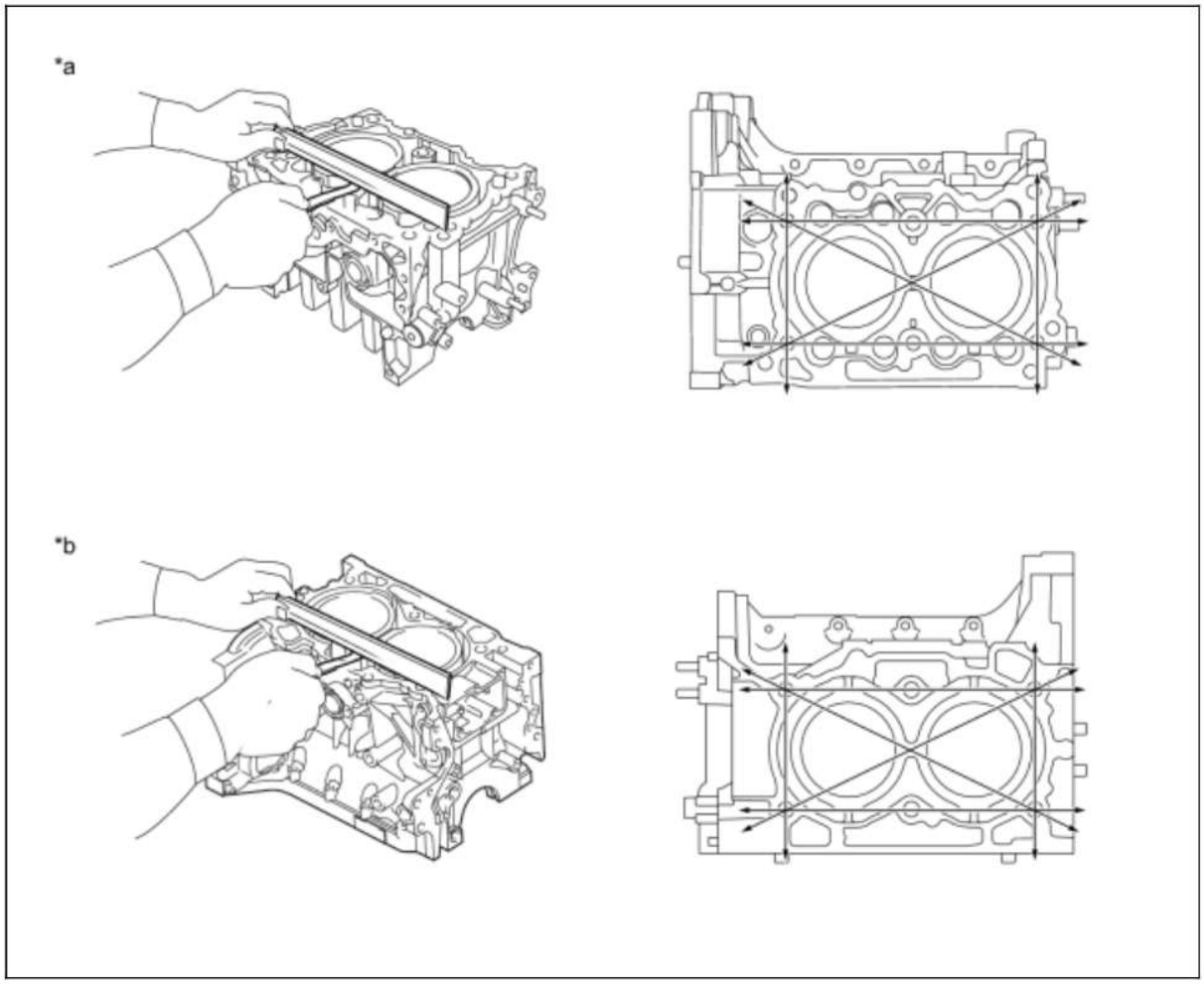
(b) Using a dye penetrant, check the important sections for fissures.

(c) Check that there are no signs of gas leak or water leak on gasket attachment surfaces.

(d) Check the oil passages for clogging.

2. INSPECT CYLINDER BLOCK FOR WARPAGE

(a) Using a precision straightedge and a feeler gauge, measure the surfaces that contact the cylinder head for warpage.



Text in Illustration

*a	for Bank 1	*b	for Bank 2

Maximum warpage:
0.025 mm (0.00098 in.)

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If the warpage is greater than the maximum, correct the surface by grinding it or replace the cylinder block.

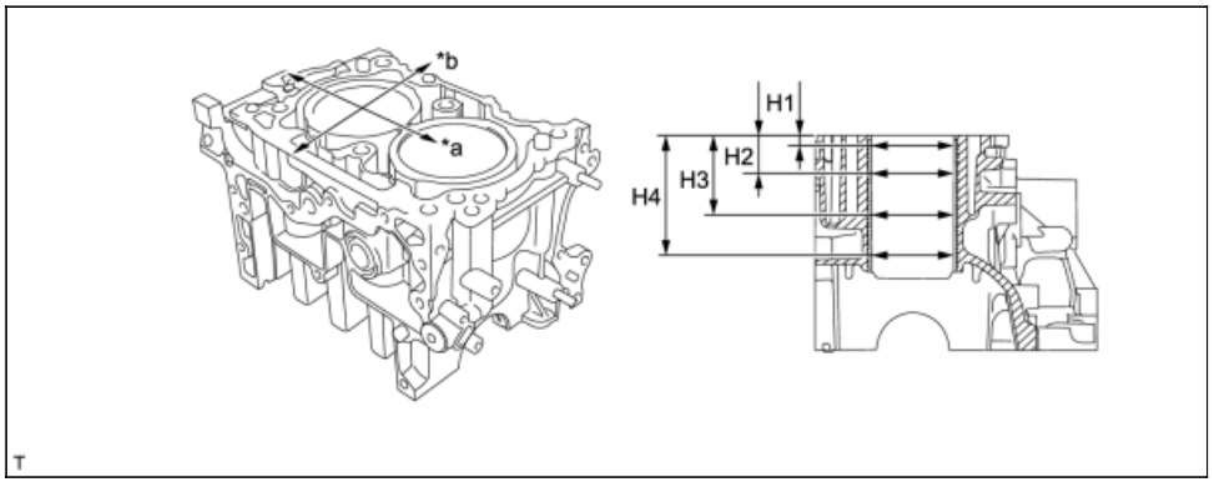
HINT:

Measurement should be performed at a temperature of 20°C (68°F).

Allowable minimum cylinder block height:
204.9 mm (8.067 in.)
Standard cylinder block height:
205.0 mm (8.071 in.)

3. INSPECT CYLINDER BORE

(a) Using a cylinder gauge, measure the cylinder bore diameter at positions shown in the illustration and check for taper and out-of-round.



Text in Illustration

*a	Piston pin direction	*b	Thrust direction

Standard

Cylinder bore size A	86.005 to 86.015 mm (3.38602 to 3.38641 in.)
Cylinder bore size B	85.995 to 86.005 mm (3.38562 to 3.38602 in.)

Maximum

Taper	0.030 mm (0.00118 in.)
Out-of-runout	0.010 mm (0.00039 in.)

Location

H1	10.0 mm (0.394 in.)
H2	45.0 mm (1.772 in.)
H3	80.0 mm (3.150 in.)
H4	115.0 mm (4.528 in.)

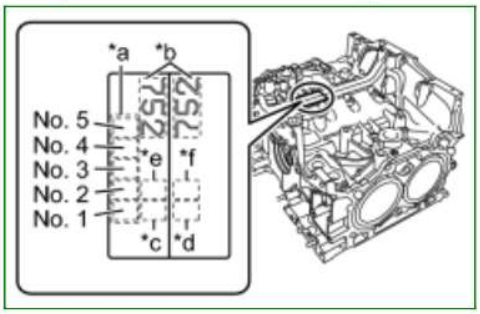
If the result is not as specified, perform boring and honing, or replace the cylinder block and piston as a

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set.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inside diameter of each cylinder bore in both the thrust and piston pin directions at the height shown in the illustration.
- The cylinder bore size is stamped on the upper face of the cylinder block.



Text in Illustration

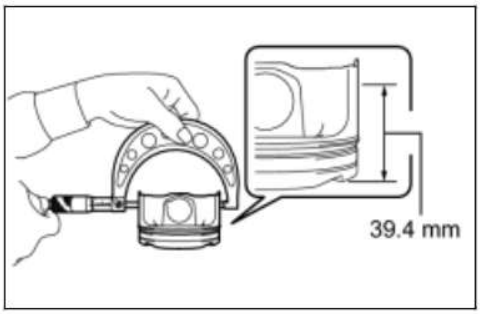
*a	Main journal size mark
*b	Cylinder block (for bank 1 / for bank 2) combination mark
*c	No. 1 cylinder bore size mark
*d	No. 2cylinder bore size mark
*e	No. 3 cylinder bore size mark
*f	No. 4 cylinder bore size mark

4. INSPECT PISTON DIAMETER

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin hole, and at a point 39.4 mm (1.551 in.) from the top of the piston head.

Standard

A grade	85.985 to 85.995 mm (3.38523 to 3.38562 in.)
B grade	85.975 to 85.985 mm (3.38484 to 3.38523 in.)
0.25 mm (0.0098 in.) over size	86.225 to 86.245 mm (3.39468 to 3.39547 in.)
0.50 mm (0.0197 in.) over size	86.475 to 86.495 mm (3.40452 to 3.40531 in.)



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

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of each piston in thrust direction at the height shown in the illustration.
- Standard sized pistons are classified into 2 grades, "A" and "B". These grades should be used as guide lines in selecting a

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These grades should be used as guide lines in selecting a standard piston diameter.

- If the piston is replaced, check the piston oil clearance, and select a suitable sized piston diameter.

5. INSPECT PISTON OIL CLEARANCE

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

Standard oil clearance:
0.010 to 0.030 mm (0.00039 to 0.00118 in.)

HINT:

- Oil clearance = maximum cylinder bore diameter - piston diameter
- If the result is not as specified, perform boring and honing, or replace the cylinder block and piston as a set.

6. REPAIR CYLINDER LINER

(a) If any of the inside diameter, taper, out-of-round or piston oil clearance is out of standard, or if there is any damage on the cylinder liner, rebore it to replace with an oversized piston.

Allowable maximum cylinder liner diameter:
86.505 mm (3.40570 in.)

If the inside diameter of cylinder liner is more than the maximum after boring and honing, replace the cylinder block and piston as a set.

HINT:

- When any of the cylinder liner needs to be rebored, all other cylinder bores must be rebored at the same time, and replaced with oversized pistons.
- Immediately after reboring, the inside diameter of the cylinder liner may differ from its actual diameter due to high temperature. Thus, when measuring the inside diameter of the cylinder liner, wait until it has cooled to the normal temperature of 20°C (68°F).

7. INSPECT PISTON WITH PIN

(a) Check the piston and piston pin for wear or cracks.

(b) Check the piston pin hole snap ring for distortion or wear.

(c) Check the piston ring groove for damage.

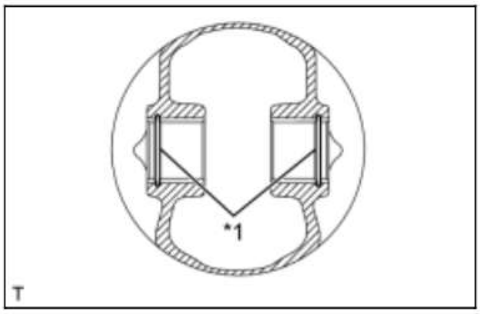
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(d) Check the piston pin hole snap ring groove for burr.

Text in Illustration

*1	Piston Pin Hole Snap Ring Groove

If any burr is found, remove the burr from the groove.



(e) Check if the piston pin can be pushed into the piston pin hole with your thumb.

HINT:

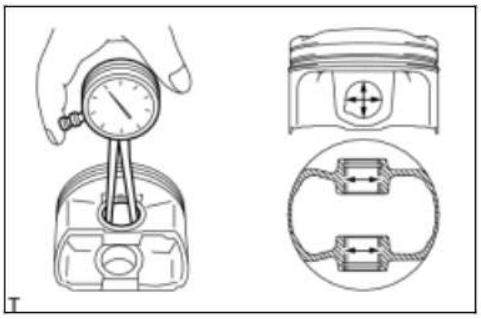
Measurement should be performed at a temperature of 20°C (68°F).

8. INSPECT CONNECTING ROD SMALL END BUSH

(a) Check the bushing at connecting rod small end bush for damage.

9. INSPECT PISTON PIN OIL CLEARANCE

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



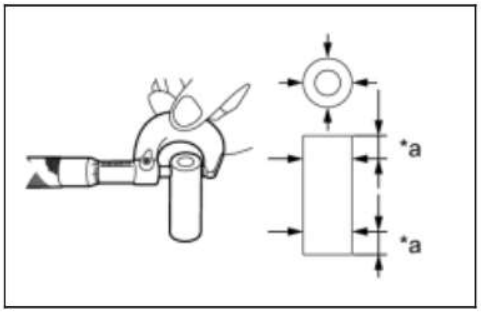
HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inside diameter of the piston pin hole at the 4 locations shown in the illustration, and take the maximum value.
- Record the measured value.

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

Text in Illustration

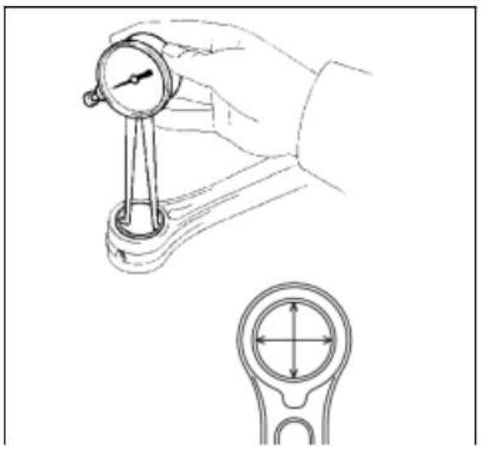
*a	10.0 mm (0.394 in.)



HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the outer diameter of the piston pin at the 4 locations shown in the illustration, and take the minimum value.
- Record the measured value.

(c) Using a caliper gauge, measure the inside diameter of bushing at connecting rod small end.



HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inside diameter of the bushing at the 4 locations shown in the illustration, and take the minimum value.
- Record the measured value.

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(d) Calculate the clearance between the piston pin hole and piston pin.

Standard oil clearance:
0.004 to 0.008 mm (0.00016 to 0.00031 in.)

If the clearance between the piston pin and piston pin hole is more than the maximum, replace the piston and piston pin as a set.

HINT:

Oil clearance = piston pin hole inside diameter - piston pin outer diameter

(e) Calculate the clearance between piston pin and bushing at connecting rod small end.

Standard oil clearance:
0.006 to 0.026 mm (0.00024 to 0.00102 in.)

If the clearance between the piston pin and bushing at connecting rod small end is more than the maximum, replace the connecting rod and piston pin as a set.

HINT:

Oil clearance = connecting rod small end inside diameter - piston pin outer diameter

10. INSPECT PISTON RING

(a) Make sure that the piston ring is not broken or damaged.

If the piston ring is broken or damaged, replace it with a new one.

HINT:

Use a piston ring of the same size as the piston to be used.

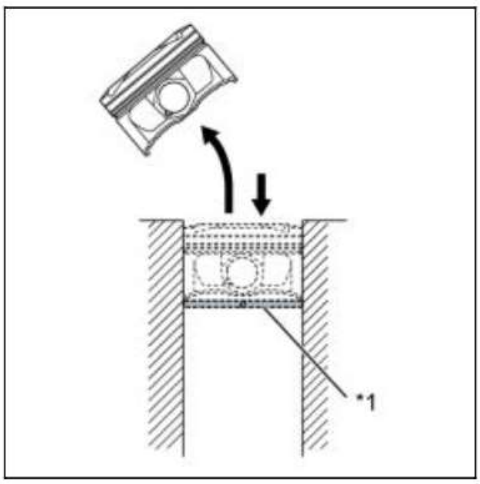
11. INSPECT PISTON RING END GAP

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(a) Using a piston, push the piston ring into the cylinder.

HINT:

Push the piston ring into the cylinder until the entire piston is inserted into the cylinder.



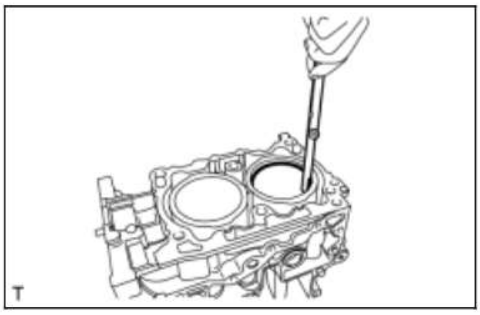
Text in Illustration

*1	Piston ring

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

Maximum end gap

No. 1	0.20 to 0.25 mm (0.00787 to 0.00984 in.)
No. 2	0.60 to 0.70 mm (0.02362 to 0.02756 in.)
Oil ring	0.10 to 0.35 mm (0.00394 to 0.01378 in.)



If the end gap is more than the maximum, replace the piston ring with a new one.

HINT:

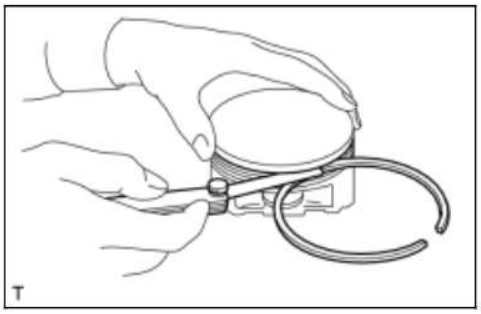
- Measurement should be performed at a temperature of 20°C (68°F).
- Use a piston ring of the same size as the piston to be used.

12. INSPECT RING GROOVE CLEARANCE

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

Maximum clearance

No. 1	0.030 to 0.080 mm (0.00118 to 0.00315 in.)
No. 2	0.030 to 0.070 mm (0.00118 to 0.00276 in.)



If the clearance is more than the maximum, replace the piston ring with a new one.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Before measuring the clearance, clean the piston ring groove and piston ring.
- Use a same sized piston ring with the piston when replacing it.

13. INSPECT CONNECTING ROD SUB-ASSEMBLY

(a) Check that the large or small end thrust surface is not damaged.

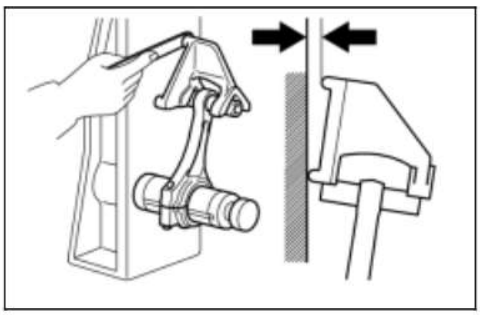
(b) Check the connecting rod assembly bearing for scar, peeling, seizure, melting or wear, etc.

(c) Using a rod aligner and feeler gauge, check the connecting rod sub-assembly for bend.

Maximum bend:

0.10 mm (0.0039 in.) per 100 mm (3.937 in.) in length

If the bend is more than the maximum, replace the connecting rod sub-assembly with a new one.



HINT:

Measurement should be performed at a temperature of 20°C (68°F).

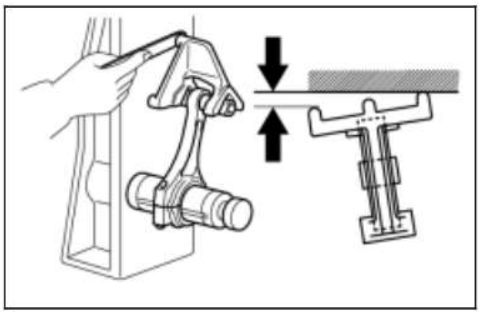
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(d) Using a rod aligner and feeler gauge, check the connecting rod sub-assembly for twist.

Maximum twist:

0.10 mm (0.0039 in.) per 100 mm (3.937 in.) in length

If the twist is more than the maximum, replace the connecting rod sub-assembly with a new one.



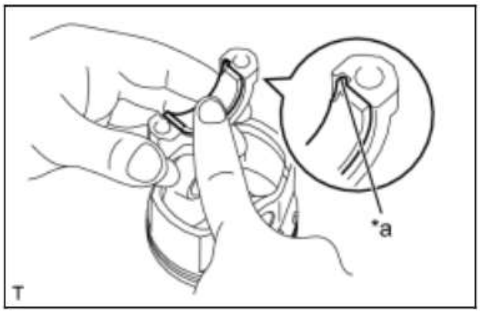
HINT:

Measurement should be performed at a temperature of 20°C (68°F).

14. INSPECT CONNECTING ROD THRUST CLEARANCE

(a) Clean the connecting rod bearings and crank pins, and apply engine oil to the crank pins. <*1>

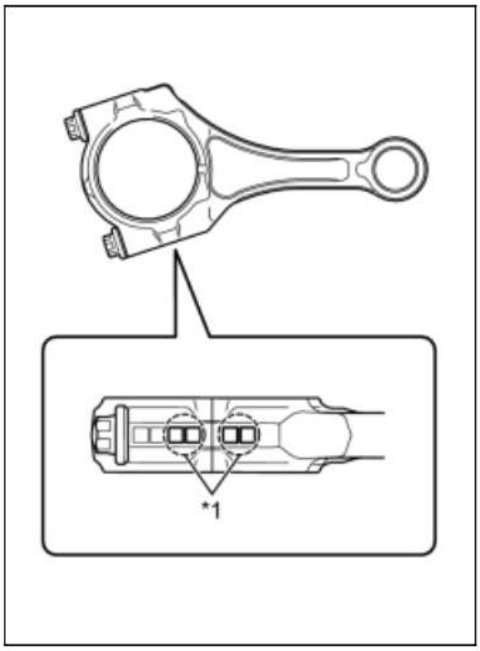
(b) Align the claw and attach the connecting rod bearing to the connecting rod.



Text in Illustration

*a	Claw

(c) Check the matching symbols and set the connecting rod, connecting rod cap and connecting rod cap bolts.



Text in Illustration

*1	Matching Symbol

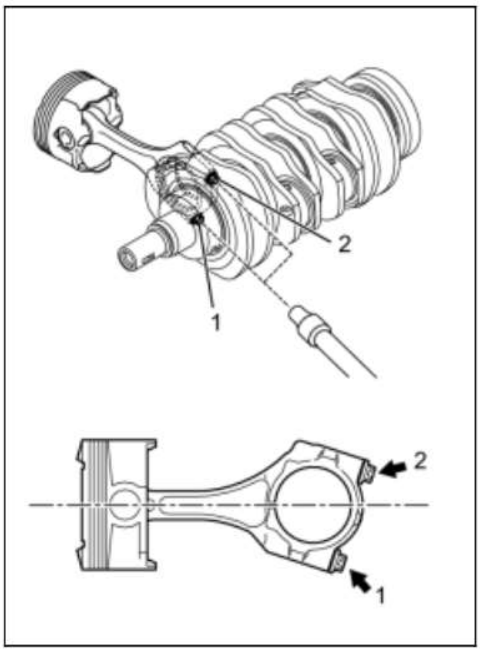
HINT:

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HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.

(e) Apply engine oil to the threads of the connecting rod cap bolts.



(f) Using a "TORX" socket wrench E14, tighten the 2 connecting rod cup bolts in the order shown in the illustration.

Torque:

10 N·m {102 kgf·cm, 7ft·lbf}

NOTICE:

- Securely hold the crankshaft during the operation.
- Be sure not to damage the crankshaft when securing it.

(g) Retighten the 2 connecting rod cup bolts in the same order as above. <*2>

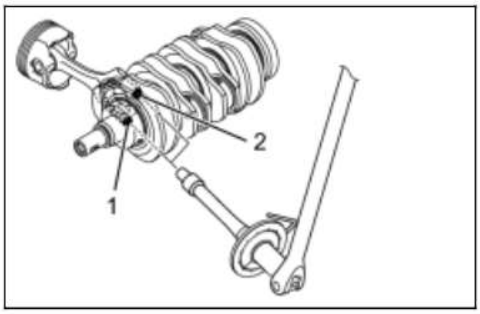
Torque:

25 N·m {255 kgf·cm, 18ft·lbf}

NOTICE:

- Securely hold the crankshaft during the operation.
- Be sure not to damage the crankshaft when securing it.

(h) In the same procedures from <*1> to <*2>, install the No. 2, No. 3 and No. 4 piston with connecting rods.



(i) Using a "TORX" socket wrench E14 and an angle gauge, tighten the connecting rod cup bolts for the No. 1 to No. 4 piston with connecting rods by additional 92.5°.

NOTICE:

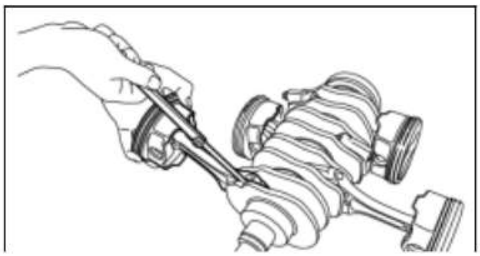
- Securely hold the crankshaft during the operation.
- Be sure not to damage the crankshaft when securing it.

(j) Using a feeler gauge, measure the thrust clearance for each connecting rod.

Standard thrust clearance:

0.070 to 0.330 mm (0.00276 to 0.01299 in.)

If the clearance is not within the standard, replace the connecting rod.



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HINT:

Measure the thrust clearance for each connecting rod at several points, and replace the connecting rod if there is uneven wear.

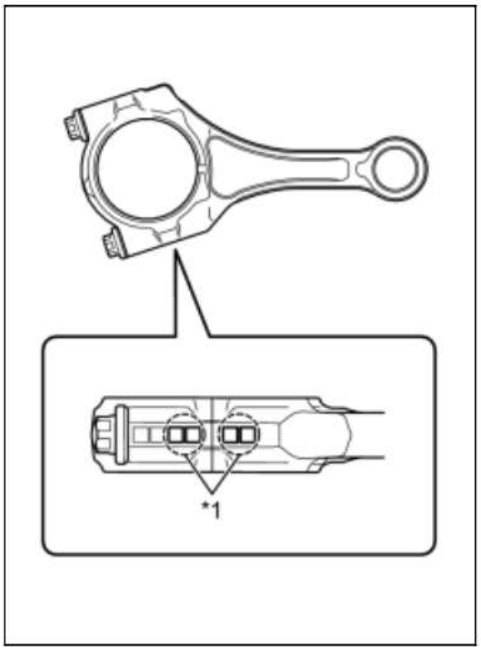


15. INSPECT CONNECTING ROD OIL CLEARANCE

(a) Clean the connecting rod bearings and crank pins, and apply engine oil to the crank pins. <*1>

(b) Attach the connecting rod bearings to the connecting rod and connecting rod cap.

(c) Lay a strip of Plastigage across the crank pin, and set the connecting rod and the connecting rod cap with the 2 connecting rod cap bolts after checking the matching symbols.



Text in Illustration

*1	Matching Symbol

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.

(d) Apply engine oil to the threads of the connecting rod cap bolts.

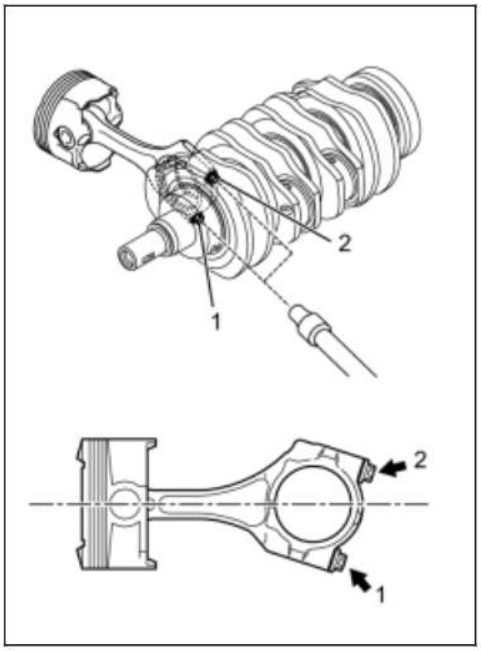
(e) Using a "TORX" socket wrench E14, tighten the 2 connecting rod cup bolts in the order shown in the illustration.

Torque:

10 N·m {102 kgf·cm, 7ft·lbf}

NOTICE:

- Do not turn the crankshaft.
- Securely hold the crankshaft during the operation.
- Be sure not to damage the crankshaft when securing it.



(f) Retighten the 2 connecting rod cup bolts in the same order as above. <*2>

Torque:

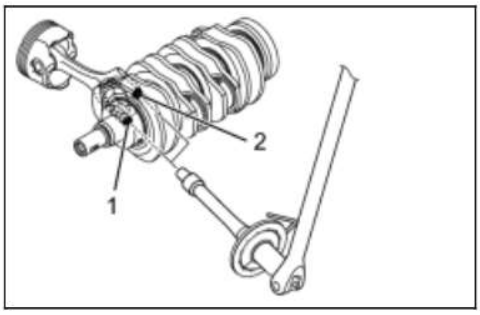
25 N·m {255 kgf·cm, 18ft·lbf}

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NOTICE:

- Do not turn the crankshaft.
- Securely hold the crankshaft during the operation.
- Be sure not to damage the crankshaft when securing it.

(g) In the same procedures from <*1> to <*2>, install the No. 2, No. 3 and No. 4 piston with connecting rods.



(h) Using a "TORX" socket wrench E14 and an angle gauge, tighten the connecting rod cup bolts for the No. 1 to No. 4 piston with connecting rods by additional 92.5°.

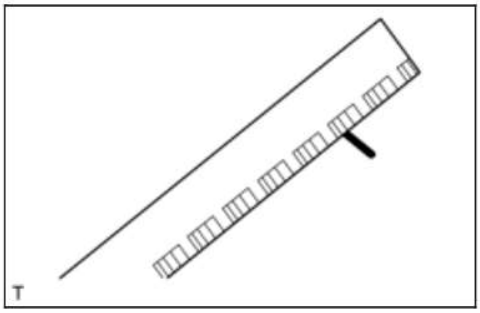
(i) Remove the connecting rod cup and measure the Plastigage at its widest point.

Standard oil clearance:
0.025 to 0.055 mm (0.00098 to 0.00217 in.)

NOTICE:
Completely remove the Plastigage after the inspection.

If the oil clearance is more than the maximum, replace the bearings.

HINT:
Measure the outer diameter of the crank pin using a micrometer, and select a suitable size connecting rod bearing when replacing the connecting rod bearing.



Standard

BEARING	BEARING SIZE (THICKNESS AT CENTER)	OUTER DIAMETER OF CRANK PIN
Standard	1.492 to 1.508 mm (0.05874 to 0.05937 in.)	49.976 to 50.000 mm (1.96756 to 1.96850 in.)
0.03 mm (0.0012 in.) Undersize	1.511 to 1.515 mm (0.05949 to 0.05965 in.)	49.946 to 49.970 mm (1.96637 to 1.96732 in.)
0.05 mm (0.0020 in.) Undersize	1.521 to 1.525 mm (0.05988 to 0.06004 in.)	49.926 to 49.950 mm (1.96559 to 1.96653 in.)
0.25 mm (0.0098 in.) Undersize	1.621 to 1.625 mm (0.06382 to 0.06398 in.)	49.726 to 49.750 mm (1.95771 to 1.95866 in.)

16. INSPECT CRANKSHAFT

(a) Using a dye penetrant, check the important sections for fissures.

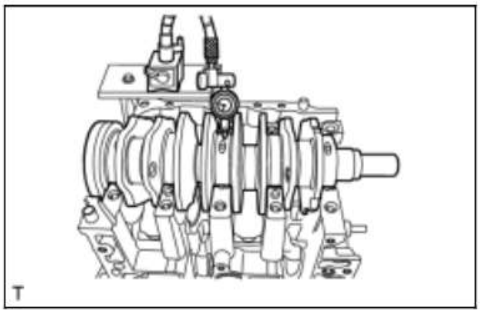
(b) Using a dial indicator, measure the circle runout at the center

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

Maximum circle runout:
0.035 mm (0.00138 in.)

If the circle runout is more than the maximum, grind to correct or replace the crankshaft.



HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- If a suitable V-block is not available, using just the No. 1 and No. 5 crankshaft bearings on the cylinder block, position the crankshaft on the cylinder block. Then, measure the crankshaft runout using a dial indicator.

(c) Using a micrometer, check the outer diameter of the crankshaft journal and crank pin for taper and out-of-round.

Maximum (Pin)

Taper	0.006 mm (0.00024 in.)
Out-of-runout	0.005 mm (0.00020 in.)

Maximum (Journal)

Taper	0.006 mm (0.00024 in.)
Out-of-runout	0.005 mm (0.00020 in.)

Allowable minimum diameter

Pin	47.726 mm (1.87897 in.)
Journal	67.735 mm (2.66673 in.)

If taper or out-of-round is more than the maximum, replace the connecting rod bearing or crankshaft bearing, and grind to correct or replace the crankshaft as required.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Select a suitable size connecting rod bearing or crankshaft bearing when replacing the connecting rod bearing or crankshaft bearing.
- When grinding to correct the crank journal or crank pin, finish them to the suitable dimensions as shown in the table below according to the undersize bearing to be used.

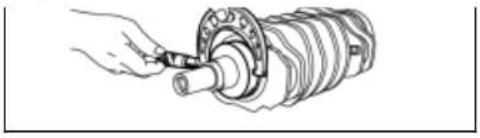


Standard

BEARING	CONNECTING ROD BEARING THICKNESS (AT CENTER)	CRANK PIN OUTER DIAMETER	CRANKSHAFT BEARING THICKNESS (AT CENTER)		CRANKSHAFT JOURNAL DIAMETER
			NO. 1 TO	NO. 5	

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			NO. 4		
Standard	1.492 to 1.508 mm (0.05874 to 0.05937 in.)	49.976 to 50.000 mm (1.96756 to 1.96850 in.)	2.495 to 2.513 mm (0.09823 to 0.09894 in.)	2.493 to 2.511 mm (0.09815 to 0.09886 in.)	67.985 to 68.009 mm (2.67657 to 2.67751 in.)
0.03 mm (0.0012 in.) Undersize	1.511 to 1.515 mm (0.05949 to 0.05965 in.)	49.946 to 49.970 mm (1.96637 to 1.96734 in.)	2.519 to 2.522 mm (0.09917 to 0.09929 in.)	2.517 to 2.520 mm (0.09909 to 0.09921 in.)	67.955 to 67.979 mm (2.67539 to 2.67633 in.)
0.05 mm (0.0020 in.) Undersize	1.521 to 1.525 mm (0.05988 to 0.06004 in.)	49.926 to 49.950 mm (1.96559 to 1.96653 in.)	2.529 to 2.532 mm (0.09957 to 0.09968 in.)	2.527 to 2.530 mm (0.09949 to 0.09961 in.)	67.935 to 67.959 mm (2.67460 to 2.67555 in.)
0.25 mm (0.0098 in.) Undersize	1.621 to 1.625 mm (0.06382 to 0.06398 in.)	49.726 to 49.750 mm (1.95771 to 1.95866 in.)	2.629 to 2.632 mm (0.10350 to 0.10362 in.)	2.627 to 2.630 mm (0.10342 to 0.10354 in.)	67.735 to 67.759 mm (2.66673 to 2.66767 in.)



17. INSPECT CRANKSHAFT BEARING

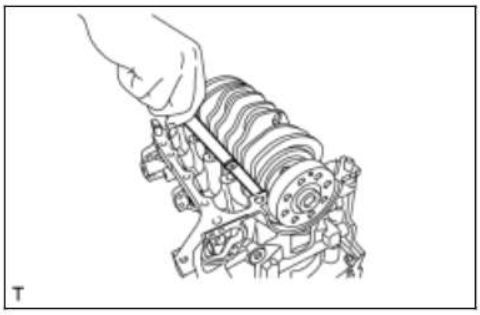
(a) Inspect the crankshaft bearing for scar, peeling, seizure, melting or wear, etc.

18. INSPECT CRANKSHAFT THRUST CLEARANCE

(a) Using a feeler gauge, check the thrust clearance of the crankshaft at No. 5 crankshaft bearing.

Standard clearance:
0.130 to 0.308 mm (0.00512 to 0.01213 in.)

If the thrust clearance is not within the standard, replace the No. 5 crankshaft bearing.



19. INSPECT CRANKSHAFT OIL CLEARANCE

(a) Remove the seal packing left on the cylinder block.

(b) Clean the crankshaft bearings and crankshaft journals.

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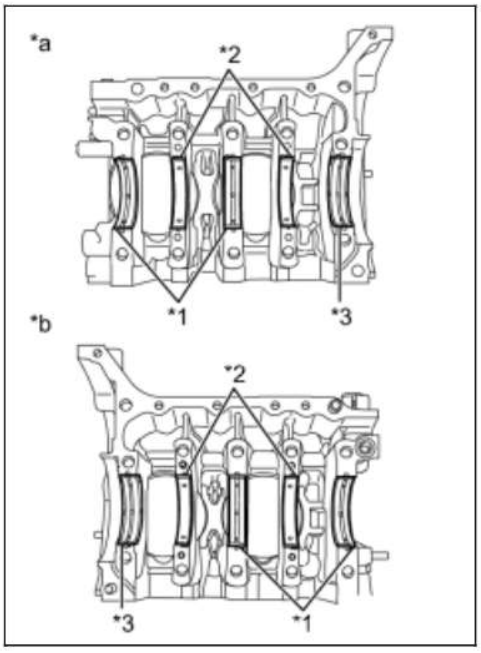
(c) Attach the crankshaft bearings to the cylinder block.

NOTICE:

- Be careful not to damage the matching surface of the cylinder block.
- The shapes of the No. 1 and No. 3 bearings are different from those of the No. 2 and No. 4 bearings. Be sure to attach them correctly.

Text in Illustration

*1	No. 1 and No. 3 crankshaft bearings (with grooves)
*2	No. 2 and No. 4 crankshaft bearings (without grooves)
*3	No. 5 crankshaft bearings
*a	for Bank 1
*b	for Bank 2



(d) Place the crankshaft on the cylinder block.

(e) Lay a strip of Plastigage across each camshaft journal.

(f) Place the cylinder block (for bank 1) on the cylinder block (for bank 2).

(g) Apply engine oil to the washers and cylinder block bolt threads.

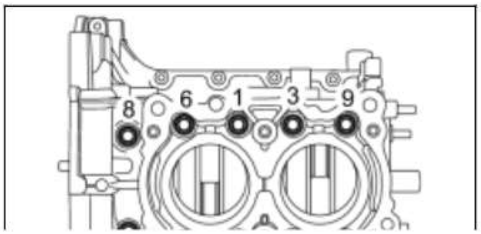
NOTICE:

To prevent engine oil from entering into the water jacket, do not apply a large amount.

(h) Using a 12 mm socket wrench, tighten the 10 bolts in the order shown in the illustration.

Torque:

35 N·m {357 kgf·cm, 26ft·lbf}



NOTICE:

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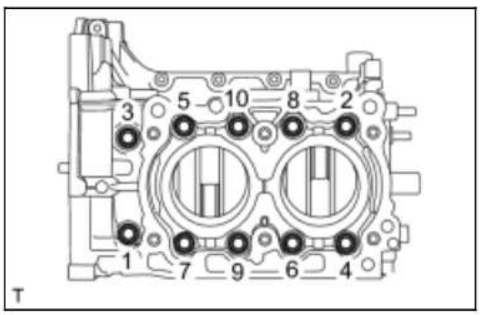
When tightening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(i) Using a 12 mm socket wrench, loosen the 10 bolts by 180 ° in the order shown in the illustration.

NOTICE:

When loosening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



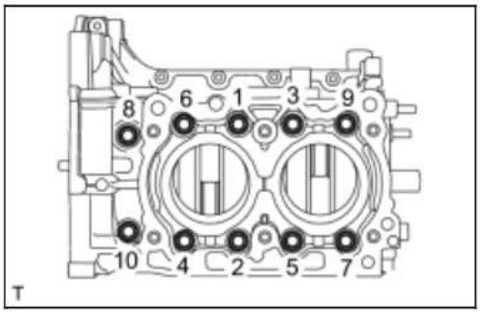
(j) Using a 12 mm socket wrench, tighten the 10 bolts in the order shown in the illustration.

Torque:

35 N·m {357 kgf·cm, 26ft·lbf}

NOTICE:

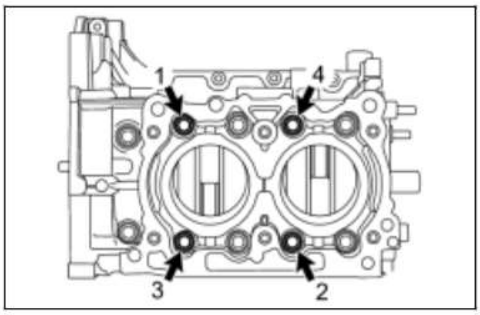
When tightening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(k) Using a 12 mm socket wrench, loosen the 4 bolts by 180 ° in the order shown in the illustration.

NOTICE:

When loosening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



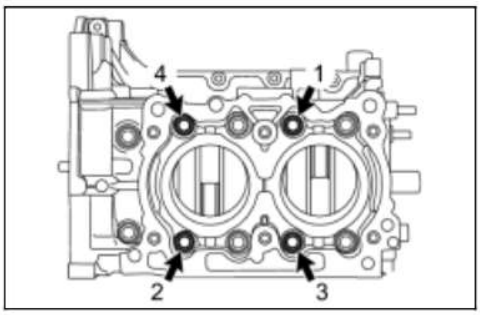
(l) Using a 12 mm socket wrench, tighten the 4 bolts in the order shown in the illustration.

Torque:

17 N·m {173 kgf·cm, 13ft·lbf}

NOTICE:

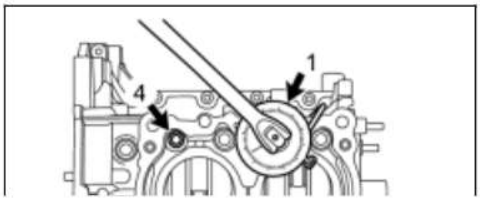
When tightening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(m) Using a 12 mm socket wrench and an angle gauge, tighten the 4 bolts by additional 60° in the order shown in the illustration.

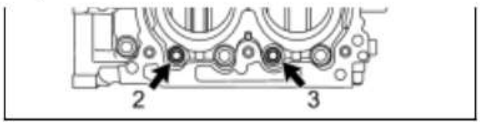
NOTICE:

When tightening the bolts, hold the cylinder block (for bank 2)



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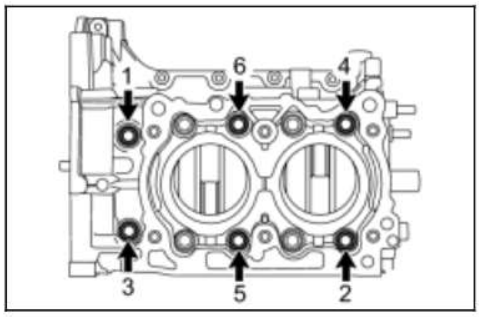
When tightening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(n) Using a 12 mm socket wrench, loosen the 6 bolts by 180 ° in the order shown in the illustration.

NOTICE:

When loosening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



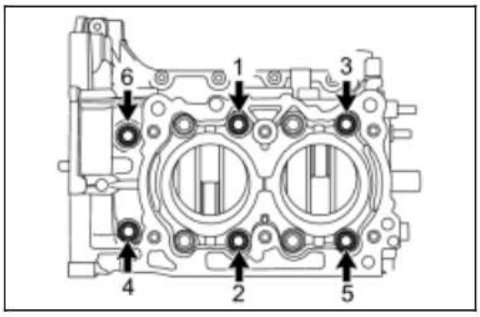
(o) Using a 12 mm socket wrench, tighten the 6 bolts in the order shown in the illustration.

Torque:

17 N·m {173 kgf·cm, 13ft·lbf}

NOTICE:

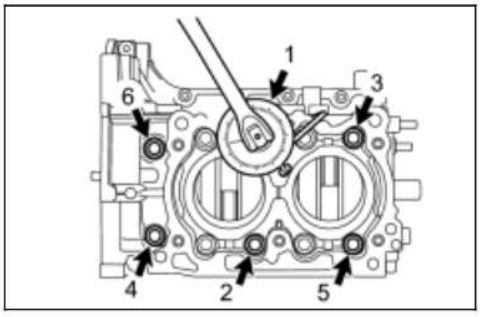
When tightening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



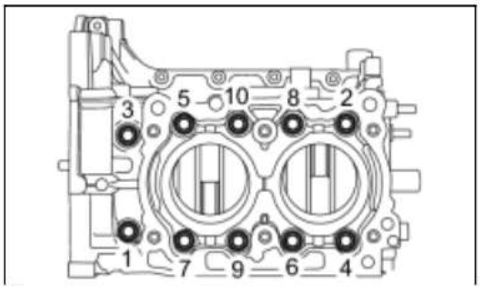
(p) Using a 12 mm socket wrench and an angle gauge, tighten the 6 bolts by additional 60° in the order shown in the illustration.

NOTICE:

When tightening the bolts, hold the cylinder block (for bank 2) while not holding the cylinder block (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(q) Using a 12 mm socket wrench, loosen the 10 bolts in the order shown in the illustration.



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(r) Remove the 10 bolts and cylinder block (for bank 1).

NOTICE:

Lift the cylinder block (for bank 1) slightly, and confirm that the crankshaft remains on the cylinder block (for bank 2). If the cylinder block (for bank 1) is lifted carelessly when separating, the crankshaft may fall off as it may have stuck to the cylinder block (for bank 1).

(s) Measure the Plastigage at its widest point.

Standard clearance:
0.013 to 0.031 mm (0.00051 to 0.00122 in.)

If the clearance is not within the standard, replace the crankshaft bearing, and grind to correct or replace the crankshaft as required.

NOTICE:

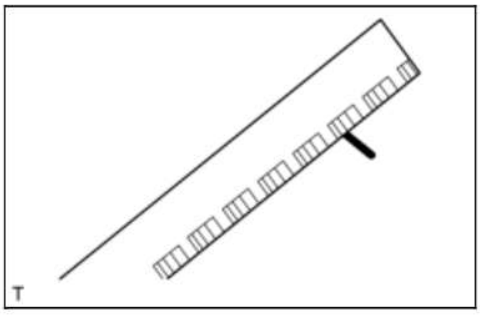
Completely remove the Plastigage after the inspection.

HINT:

- Select the suitable size connecting rod bearing or crankshaft bearing when replacing the connecting rod bearing or crankshaft bearing.
- When grinding to correct the crank journal or crank pin, finish them to the suitable dimensions as shown in the table below according to the undersize bearing to be used.

Standard

BEARING	CONNECTING ROD BEARING THICKNESS (AT CENTER)	CRANK PIN OUTER DIAMETER	CRANKSHAFT BEARING THICKNESS (AT CENTER)		CRANKSHAFT JOURNAL DIAMETER
			NO. 1 TO NO. 4	NO. 5	
Standard	1.492 to 1.508 mm (0.05874 to 0.05937 in.)	49.976 to 50.000 mm (1.96756 to 1.96850 in.)	2.495 to 2.513 mm (0.09823 to 0.09894 in.)	2.493 to 2.511 mm (0.09815 to 0.09886 in.)	67.985 to 68.009 mm (2.67657 to 2.67751 in.)
0.03 mm (0.0012 in.) Undersize	1.511 to 1.515 mm (0.05949 to 0.05965 in.)	49.946 to 49.970 mm (1.96637 to 1.96734 in.)	2.519 to 2.522 mm (0.09917 to 0.09929 in.)	2.517 to 2.520 mm (0.09909 to 0.09921 in.)	67.955 to 67.979 mm (2.67539 to 2.67633 in.)
0.05 mm (0.0020	1.521 to 1.525 mm	49.926 to 49.950 mm (1.96559	2.529 to 2.532 mm (0.09957	2.527 to 2.530 mm (0.09949	67.935 to 67.959 mm


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in.) Undersize	(0.05988 to 0.06004 in.)	to 1.96653 in.)	to 0.09968 in.)	to 0.09961 in.)	(2.67460 to 2.67555 in.)
0.25 mm (0.0098 in.) Undersize	1.621 to 1.625 mm (0.06382 to 0.06398 in.)	49.726 to 49.750 mm (1.95771 to 1.95866 in.)	2.629 to 2.632 mm (0.10350 to 0.10362 in.)	2.627 to 2.630 mm (0.10342 to 0.10354 in.)	67.735 to 67.759 mm (2.66673 to 2.66767 in.)

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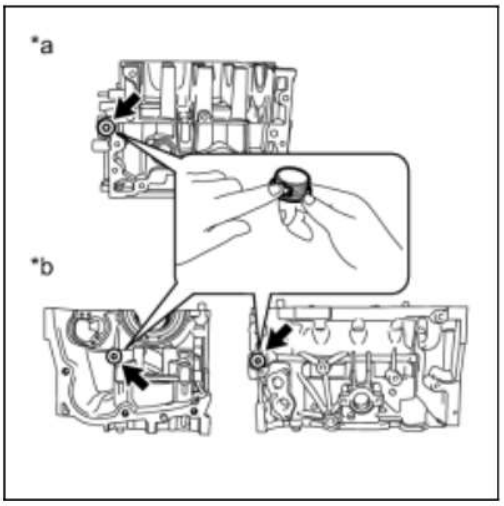
Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000T4Y0BEX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER BLOCK: REASSEMBLY; 2013 MY FR-S [03/2012 -]		

REASSEMBLY

1. INSTALL NO. 1 CYLINDER BLOCK TIGHT PLUG

NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder block and stabilize the cylinder block during servicing.
- Place a cloth to avoid scratching the mating surface of the cylinder block during servicing.



Text in Illustration

*a	for Bank 1
*b	for Bank 2

(a) Apply seal packing to the threaded portion of the No. 1 cylinder block tight plugs and install them to the cylinder block (for bank 1) and cylinder block (for bank 2).

Seal packing:

Three Bond 1105 or equivalent

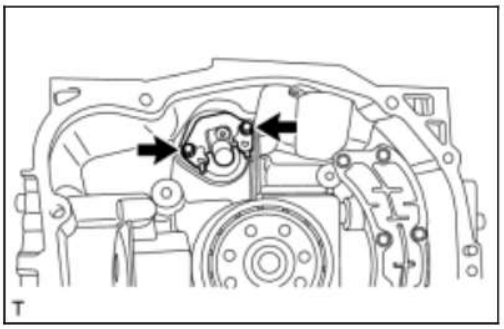
Torque:

37 N·m {377 kgf·cm, 27ft·lbf}

NOTICE:

Before applying seal packing, degrease the No. 1 cylinder block tight plugs and thread holes of the cylinder block (for bank 1) and cylinder block (for bank 2).

2. INSTALL CRANKSHAFT SENSOR HOLDER ASSEMBLY



(a) Install the crankshaft sensor holder assembly to the cylinder block (for bank 2) with the 2 bolts.

Torque:

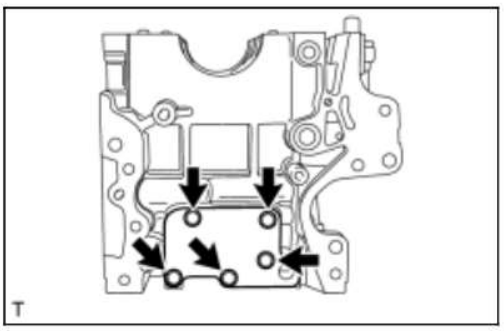
6.4 N·m {65 kgf·cm, 57in·lbf}

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3. INSTALL CYLINDER BLOCK PLATE

(a) Install the cylinder block plate to the cylinder block (for bank 2) with the 5 bolts.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}



4. INSTALL OIL SEPARATOR COVER

(a) Apply seal packing in a continuous line as shown in the illustration.

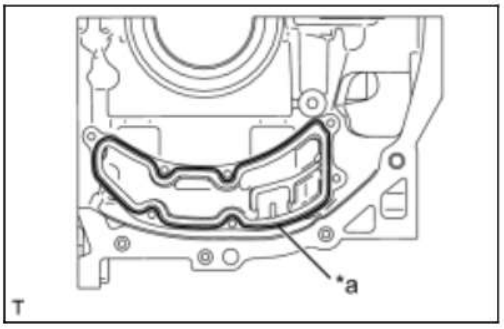
Seal packing:
Three Bond 1217G, 1217H or equivalent

Text in Illustration

*a	φ3.0 to 5.0 mm (0.118 to 0.197 in.)

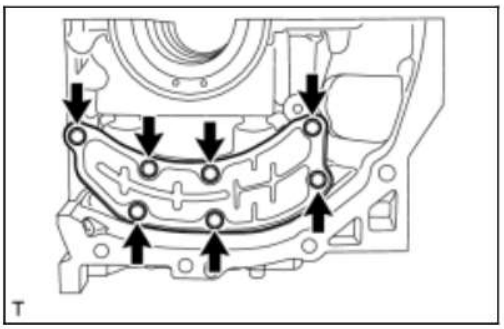
NOTICE:

- Clean and degrease the contact surface.
- Install the oil separator cover within 5 minutes of applying seal packing.



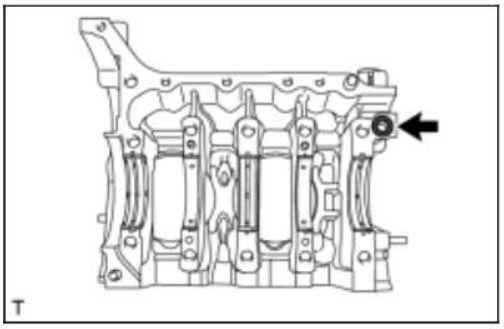
(b) Tight the 7 bolts in the order shown in the illustration to install the oil separator cover to the cylinder block (for bank 1).

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}



5. INSTALL O-RING

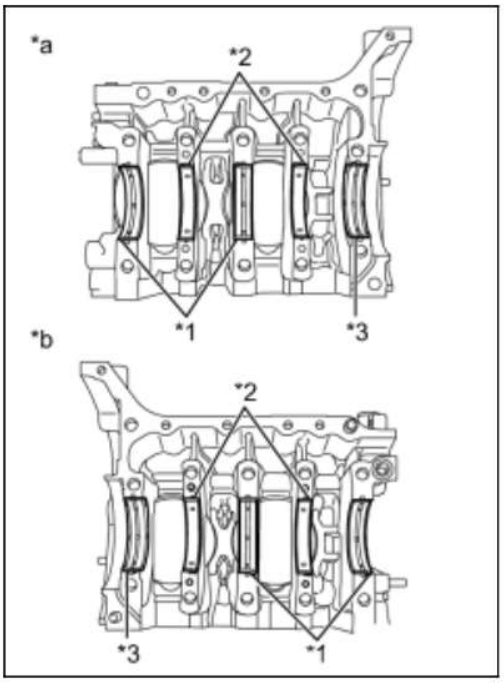
(a) Attach a new O-ring to the cylinder block (for bank 2).



6. INSTALL CRANKSHAFT BEARING

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(a) Apply engine oil to the crankshaft bearing, and install them to the cylinder block (for bank 1) and cylinder block (for bank 2).

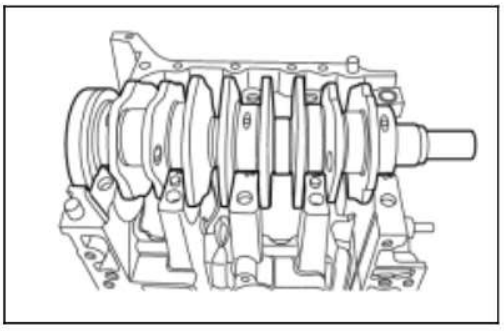


Text in Illustration

*1	No. 1 and No. 3 Bearings (with groove)
*2	No. 2 and No. 4 Bearings (without groove)
*3	No. 5 Bearing
*a	for Bank 1
*b	for Bank 2

NOTICE:

- Place a cloth to avoid scratching the mating surface of the cylinder block during servicing.
- The shapes of the No. 1 and No. 3 bearings are different from those of the No. 2 and No. 4 bearings. Be sure to install them in the right locations.



7. INSTALL CRANKSHAFT

(a) Apply engine oil to the crankshaft journals and place the crankshaft on the cylinder block (for bank 2).

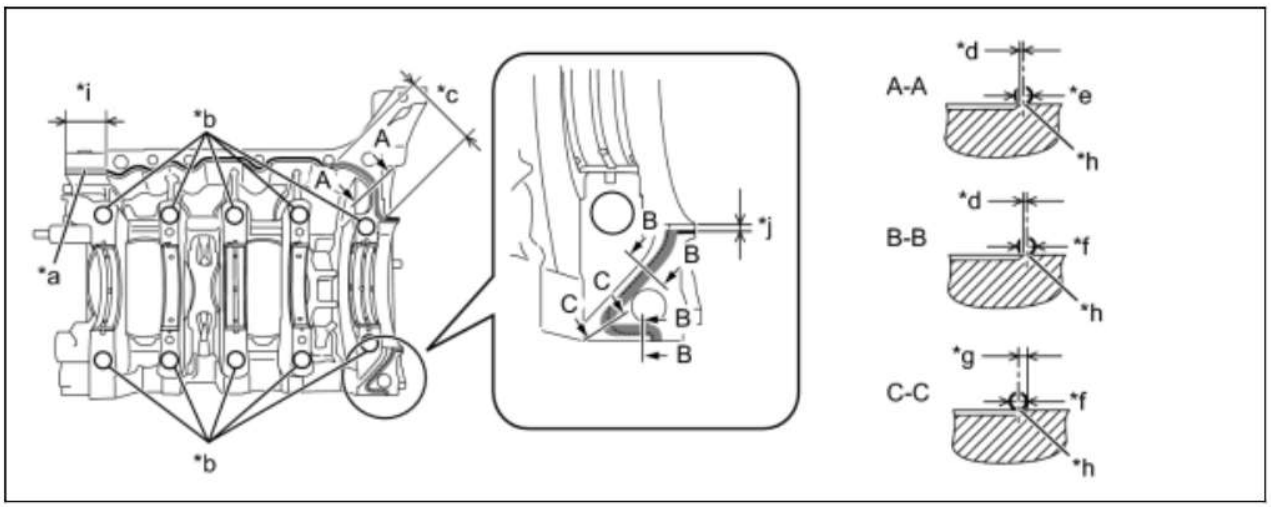
8. INSTALL CYLINDER BLOCK SUB-ASSEMBLY (for Bank 1)

(a) Apply seal packing to the mating surface of the cylinder block sub-assembly (for bank 1) as shown in the illustration.

Seal packing:

Three Bond 1217G, 1217H or equivalent

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Text in Illustration

*a	φ3.5 to 4.5 mm (0.138 to 0.177 in.)	*b	φ0.5to 1.5 mm (0.0197 to 0.0591 in.)
*c	Range of A-A	*d	Within 1.0 mm (0.039 in.)
*e	φ2.7 to 3.7 mm (0.106 to 0.146 in.)	*f	φ3.5 to 4.5 mm (0.138 to 0.177 in.)
*g	2.0 mm (0.079 in.)	*h	Chamfer edge
*i	36.0 mm (1.417 in.)	*j	2.5 mm (0.098 in.)

NOTICE:

- Do not let the seal packing overflow to the oil passage or crankshaft bearing because engine seizure may result.
- Clean and degrease the contact surface.
- Install the cylinder block sub-assembly (for bank 1) within 5 minutes of applying seal packing.

(b) Place the cylinder block sub-assembly (for bank 1) to the cylinder block sub-assembly (for bank 2).

(c) Apply engine oil to the washers and cylinder block bolt threads.

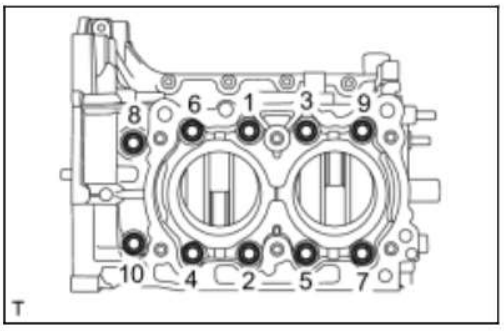
NOTICE:

To prevent engine oil from entering into the water jacket, do not apply a large amount.

(d) Using a 12 mm socket wrench, tighten the 10 bolts in the order shown in the illustration.

Torque:

35 N·m {357 kgf·cm, 26ft·lbf}



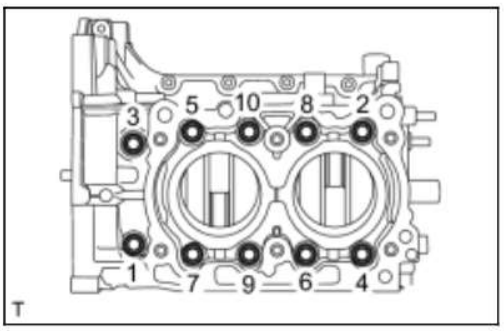
NOTICE:

When tightening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.

(e) Using a 12 mm socket wrench, loosen the 10 bolts by 180

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° in the order shown in the illustration.



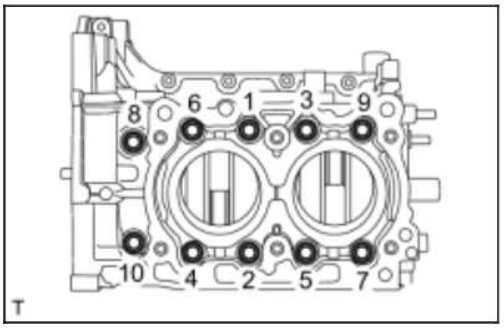
NOTICE:

When loosening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.

(f) Using a 12 mm socket wrench, tighten the 10 bolts in the order shown in the illustration.

Torque:

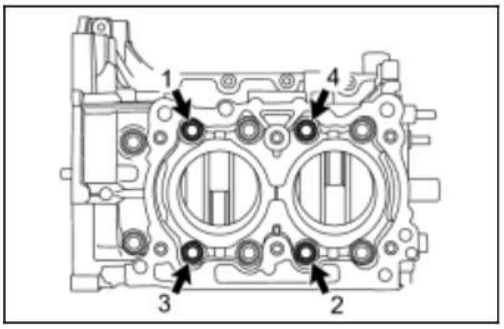
35 N·m {357 kgf·cm, 26ft·lbf}



NOTICE:

When tightening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.

(g) Using a 12 mm socket wrench, loosen the 4 bolts by 180 ° in the order shown in the illustration.



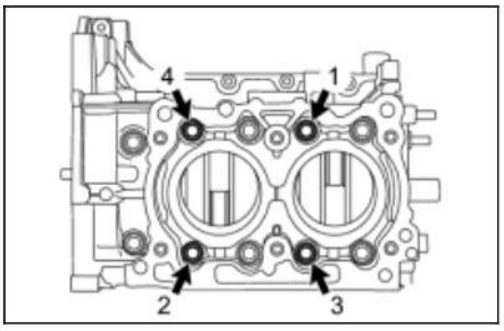
NOTICE:

When loosening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.

(h) Using a 12 mm socket wrench, tighten the 4 bolts in the order shown in the illustration.

Torque:

17 N·m {173 kgf·cm, 13ft·lbf}



NOTICE:

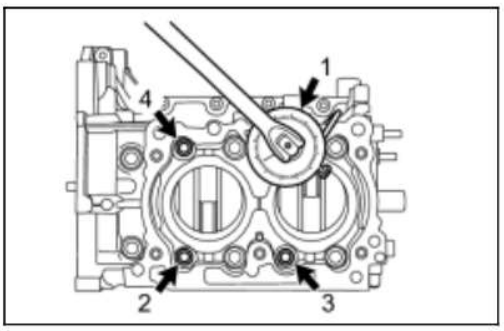
When tightening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.

(i) Using a 12 mm socket wrench and an angle gauge, tighten the 4 bolts by additional 60° in the order shown in the illustration.

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NOTICE:

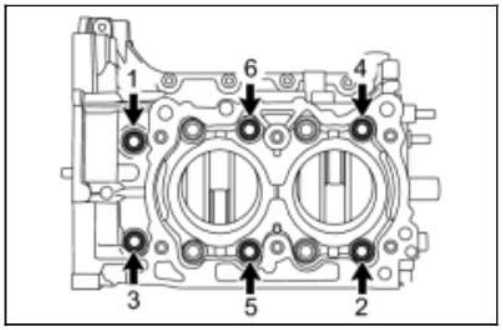
When tightening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(j) Using a 12 mm socket wrench, loosen the 6 bolts by 180 ° in the order shown in the illustration.

NOTICE:

When loosening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.



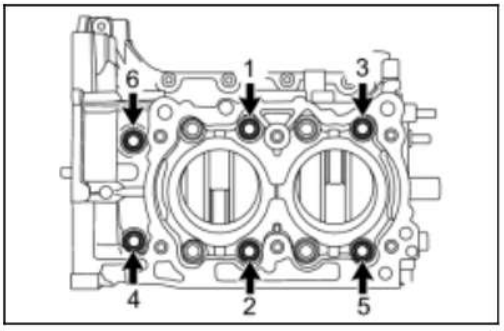
(k) Using a 12 mm socket wrench, tighten the 6 bolts in the order shown in the illustration.

Torque:

17 N·m {173 kgf·cm, 13ft·lbf}

NOTICE:

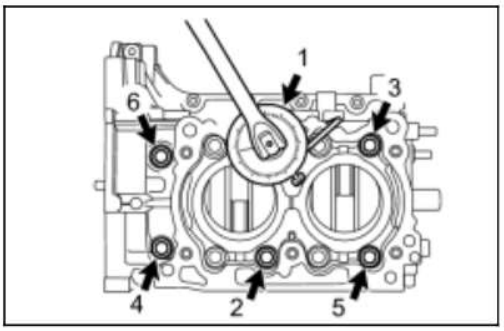
When tightening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(l) Using a 12 mm socket wrench and an angle gauge, tighten the 6 bolts by additional 60° in the order shown in the illustration.

NOTICE:

When tightening the bolts, hold the cylinder block sub-assembly (for bank 2) while not holding the cylinder block sub-assembly (for bank 1) to ensure the joint accuracy of the cylinder blocks.



(m) Tighten the 5 bolts.

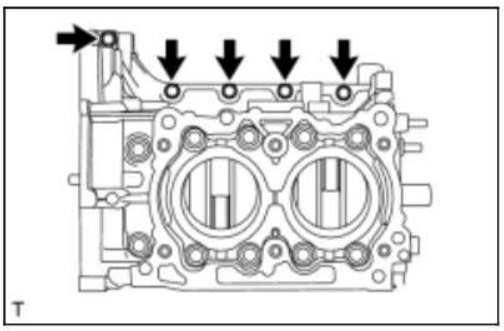
Torque:

25 N·m {255 kgf·cm, 18ft·lbf}

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HINT:

After tightening, if the seal packing is squeezed out in the seal surface area of the chain cover and oil pan sub-assembly, completely remove it. Seal packing on the chamfer area, however, should not be removed.



(n) Check that the crankshaft turns smoothly.

9. INSTALL REAR ENGINE OIL SEAL

(a) Apply a light coat of engine oil to a new rear engine oil seal inner periphery and outer periphery.

(b) Using SST and a hammer, tap in the rear engine oil seal uniformly to the position shown in the illustration.

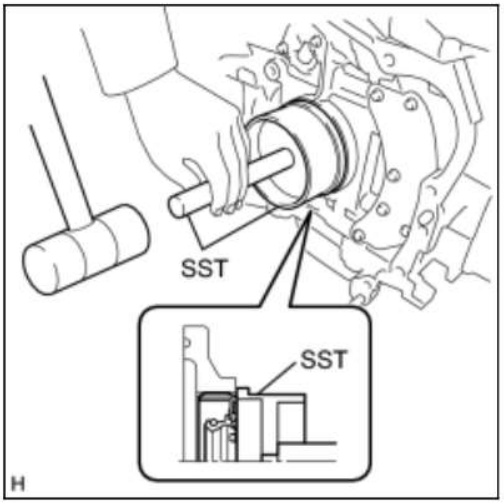
SST: 09223-15030

SST: 09950-70010

09951-07150

Oil seal tap-in depth:

0 to 1.0 mm (0 to 0.039 in.) from the cylinder block surface



NOTICE:

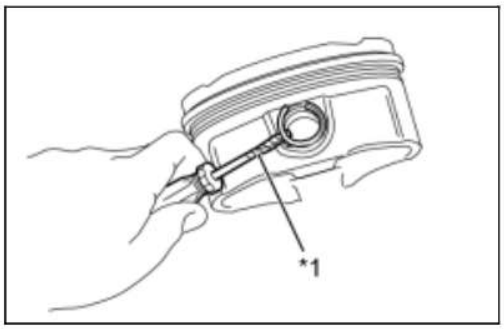
- Do not tap in the rear engine oil seal at an angle.
- Remove the engine oil from the crankshaft.
- Do not tap in the rear engine oil seal more than necessary.

10. INSTALL CYLINDER BLOCK SUB-ASSEMBLY

(a) Mount the cylinder block sub-assembly onto an engine stand.

11. INSTALL PISTON WITH PIN SUB-ASSEMBLY

(a) Using a screwdriver with its tip wrapped in protective tape, install the piston pin hole snap ring on one end of the piston.



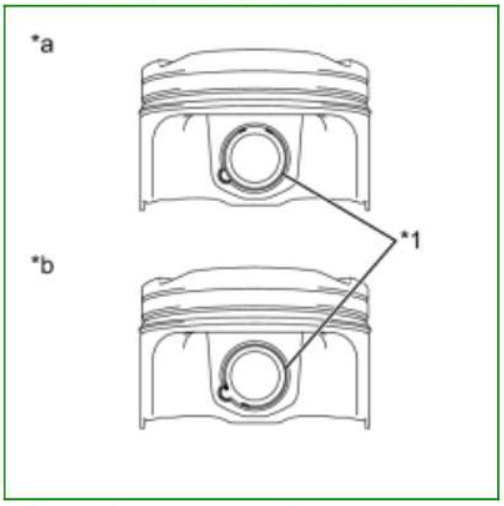
Text in Illustration

*1	Protective Tape

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HINT:

- Make sure that the piston pin hole snap ring is firmly attached into the piston pin hole snap ring groove.



- After installing the piston pin hole snap ring, rotate the piston pin hole snap ring so that its end part and the cutout portion of the piston pin hole snap ring groove do not match.

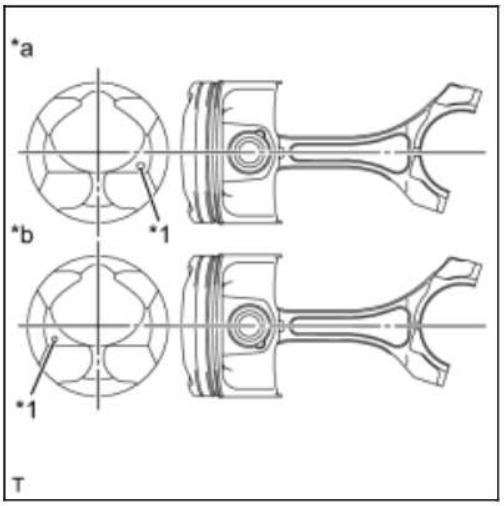
Text in Illustration

*1	Piston Pin Hole Snap Ring
*a	Correct
*b	Incorrect

(b) Make sure the directions of the piston front mark and connecting rod, and then set the piston to the connecting rod.

Text in Illustration

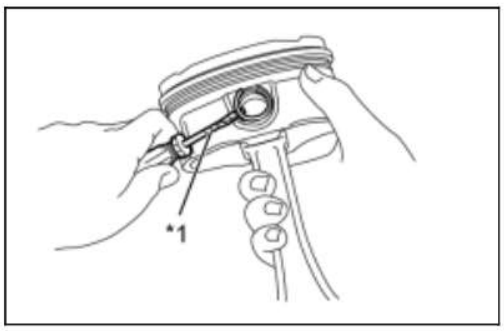
*1	Front Mark
*a	for Bank 1
*b	for Bank 2



(c) Apply engine oil to the piston pin and install it to the piston.

(d) Using a screwdriver with its tip wrapped in protective tape, install the piston pin hole snap ring to the piston.

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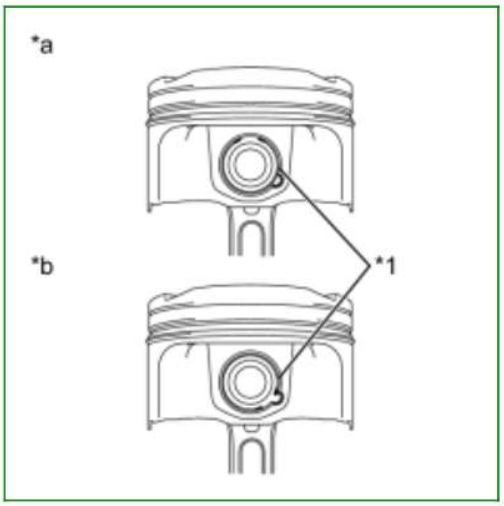


Text in Illustration

*1	Protective Tape

HINT:

- Make sure the piston pin hole snap ring is firmly attached into the piston pin hole snap ring groove.



- After installing the piston pin hole snap ring, rotate the piston pin hole snap ring so that its end part and the cutout portion of the piston pin hole snap ring groove do not match.

Text in Illustration

*1	Piston Pin Hole Snap Ring
*a	Correct
*b	Incorrect

12. INSTALL PISTON RING SET

(a) Install the oil ring expander, lower oil ring side rail and upper oil ring side rail in order by hand.

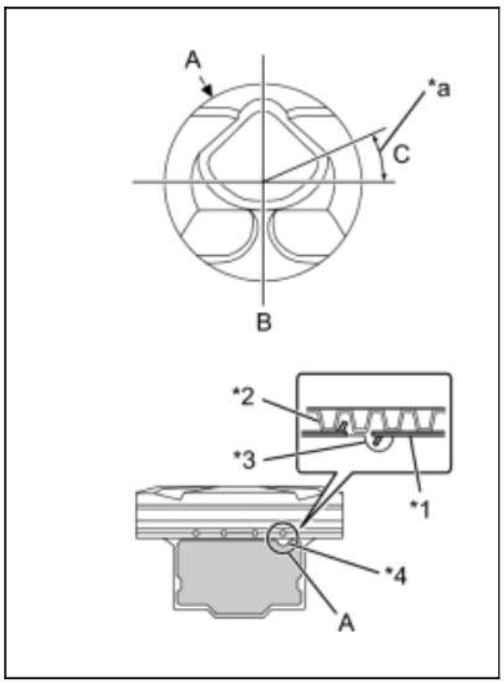
HINT:

The oil ring consists of the 2 oil ring side rails and oil ring expander.

(b) Set the oil ring expander ends at the location B in the illustration.

(c) Hook the stoppers at the both ends of the lower oil ring side rail into the oil return hole at the coating cutout portion A and the oil ring expander as shown in the illustration.

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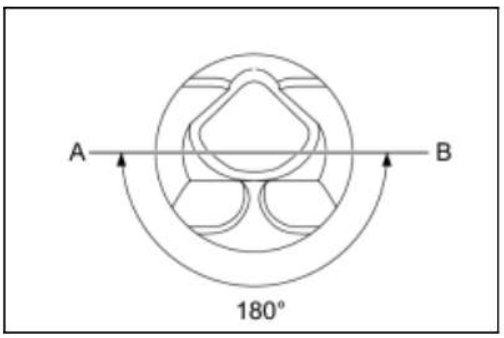
Text in Illustration

*1	Lower Oil Ring Side Rail
*2	Oil Ring Expander
*3	Oil Return Hole
*4	Coating Cutout
*a	0 to 20°
	Coating part

(d) Align the rail ends of the upper oil ring side rail within the range C and hook the stopper into the oil ring expander.

(e) Using a piston ring expander, install the No. 2 compression ring and No. 1 compression ring in order.

(f) Set the No. 1 compression ring ends at the location A or B in the illustration.



HINT:

The No. 1 compression ring ends can be set either at A or B.

(g) Set the No. 2 compression ring ends at the location A or B, that is 180° opposite of those of the No. 1 compression ring.

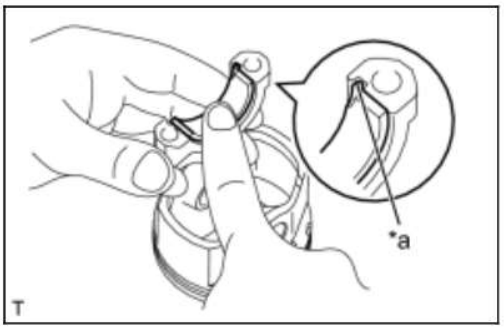
(h) Check that the piston rings and oil rings are correctly set.

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13. INSTALL PISTON SUB-ASSEMBLY WITH CONNECTING ROD

(a) Operate the engine stand so that the oil pan side faces upward.

(b) Install the connecting rod bearings to the connecting rod and connecting rod cap. <*1>



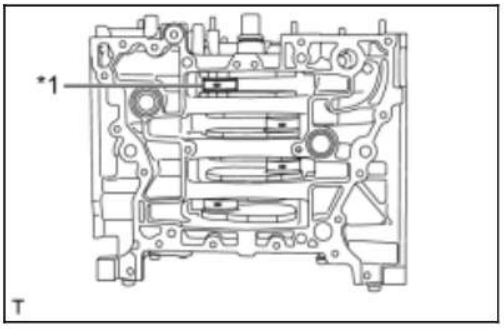
Text in Illustration

*a	Claw

(c) Check that the piston rings and oil rings are correctly set.

(d) Apply engine oil to the piston and inside the cylinder bore.

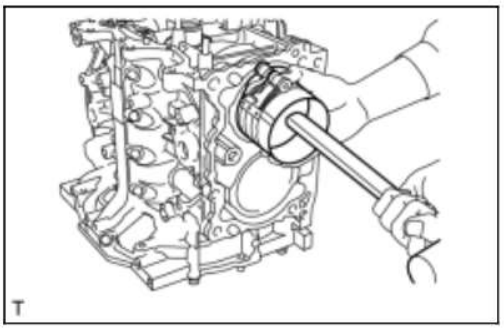
(e) Turn the crankshaft so that the crank pin is positioned at TDC.



Text in Illustration

*1	Crank Pin

(f) Squeeze the piston rings with a piston ring compressor, face the piston front mark toward the engine front side, and insert the piston with connecting rod into the cylinder block by lightly tapping on the piston top with a hammer handle, etc.



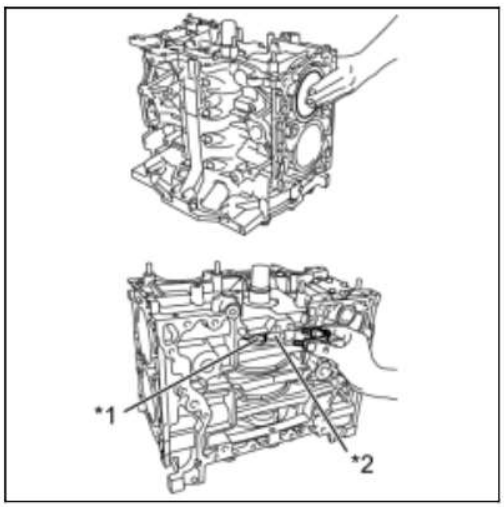
NOTICE:

- When inserting the piston with connecting rod, be careful not to scratch the cylinder bore or crank pin by connecting the rod edge.
- Be careful not to apply too much impact when inserting to prevent the connecting rod bearing from falling off.

(g) Apply engine oil to the seating face of the connecting rod cap and threads of the connecting rod cap bolts.

(h) While pushing the piston top, turn the crankshaft to position the crankshaft pin and connecting rod large end as shown in the illustration, and then attach the connecting rod cup with 2 new connecting rod cap bolts.

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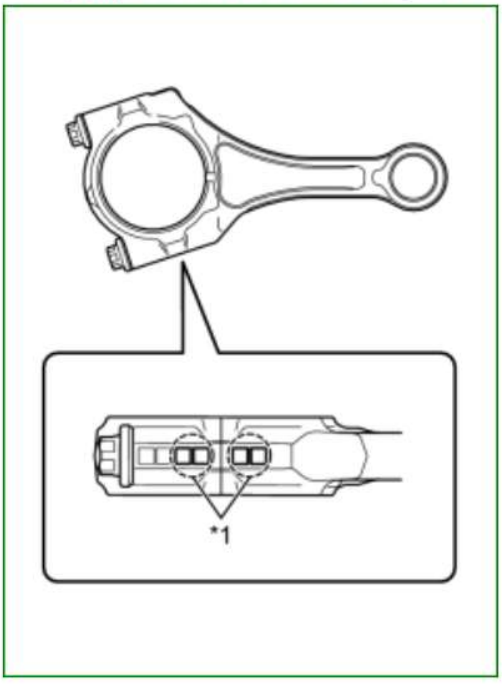


Text in Illustration

*1	Connecting Rod
*2	Crankshaft Pin

HINT:

- Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbols.



- Use new connecting rod cap bolts.
- Turn the crankshaft counterclockwise when installing the No. 1 or No. 3 piston with connecting rod, and turn the crankshaft clockwise when installing the No. 2 or No. 4 piston with connecting rod.

Text in Illustration

*1	Matching Symbol

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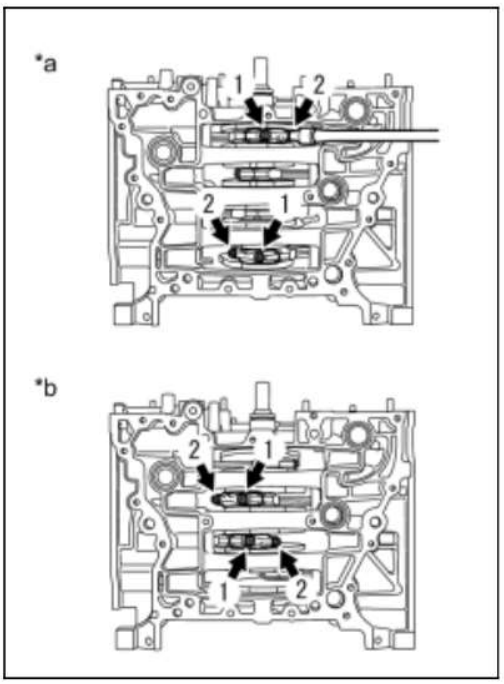
(i) Using a "TORX" socket wrench E14, tighten the 2 connecting rod cup bolts in the order shown in the illustration.

Torque:

10 N·m {102 kgf·cm, 7ft·lbf}

Text in Illustration

*a	No. 1 and No. 4
*b	No. 2 and No. 3



(j) Retighten the 2 connecting rod cup bolts in the same order as above. <*2>

Torque:

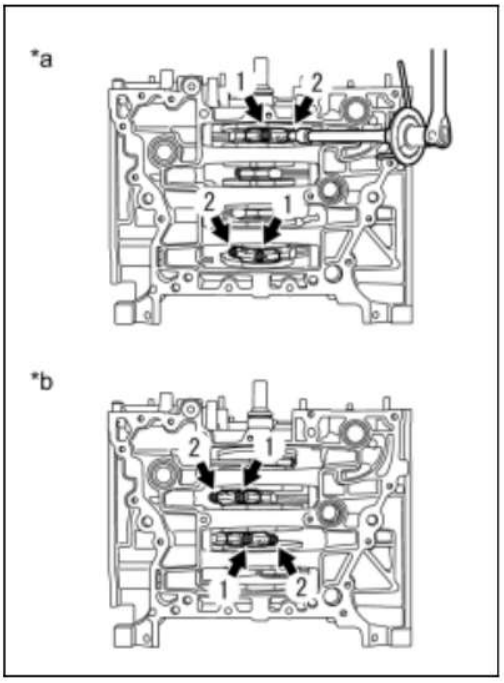
25 N·m {255 kgf·cm, 18ft·lbf}

(k) In the same procedures from <*1> to <*2>, install the No. 2, No. 3 and No. 4 piston with connecting rods.

(l) Using a "TORX" socket wrench E14 and an angle gauge, tighten the connecting rod cup bolts for the No. 1 to No. 4 piston with connecting rods by additional 92.5°.

Text in Illustration

*a	No. 1 and No. 4
*b	No. 2 and No. 3



(m) Check that the crankshaft can be turned smoothly.

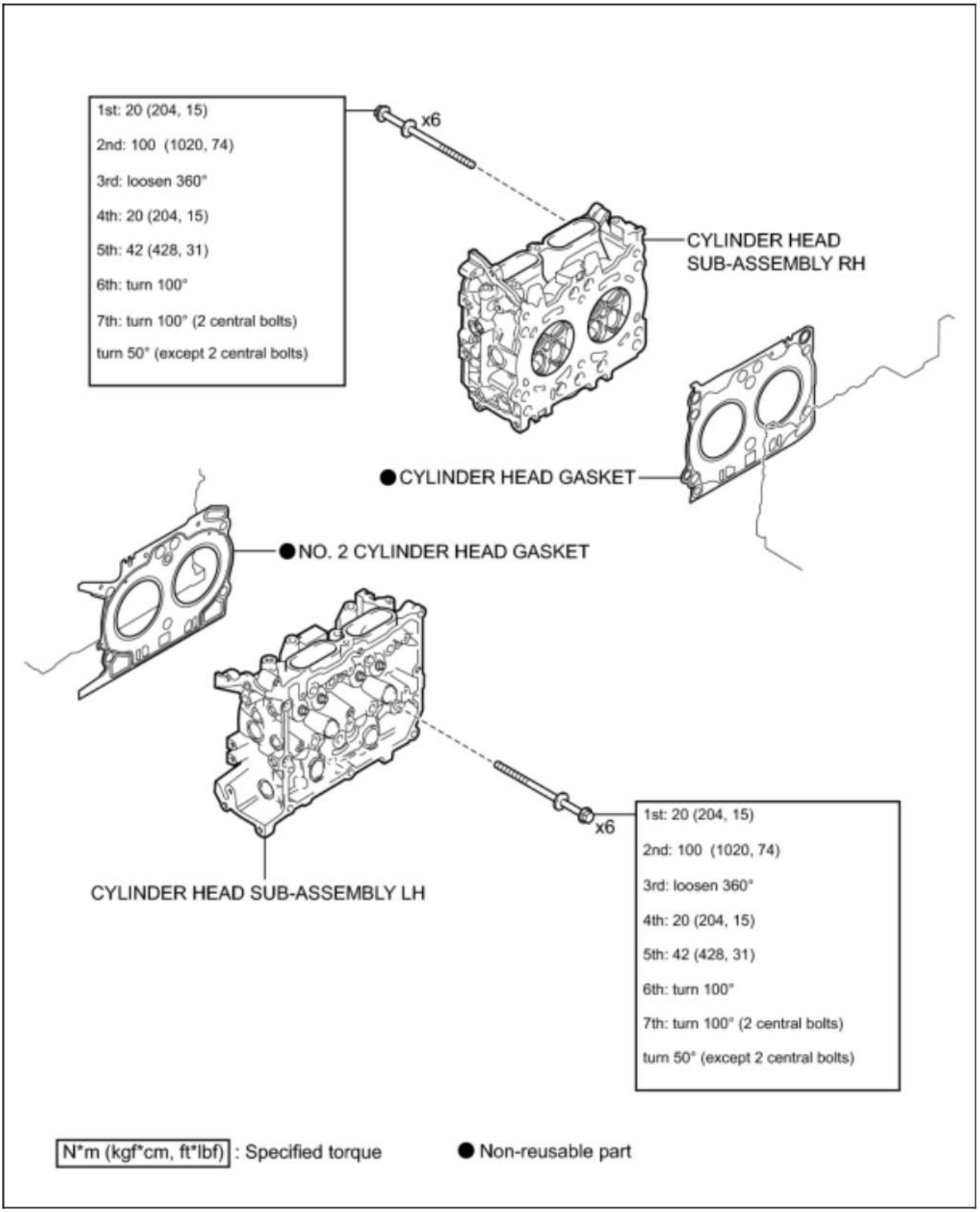
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Last Modified: 4-14-2014	6.6 K	Doc ID: RM00000591R000X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD GASKET: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

ILLUSTRATION

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000056U7008X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD GASKET: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL NO. 2 CYLINDER HEAD GASKET

(a) Operate the engine stand so that the bank 2 side faces upward.

(b) Clean the bolt holes in the cylinder block (bank 2).

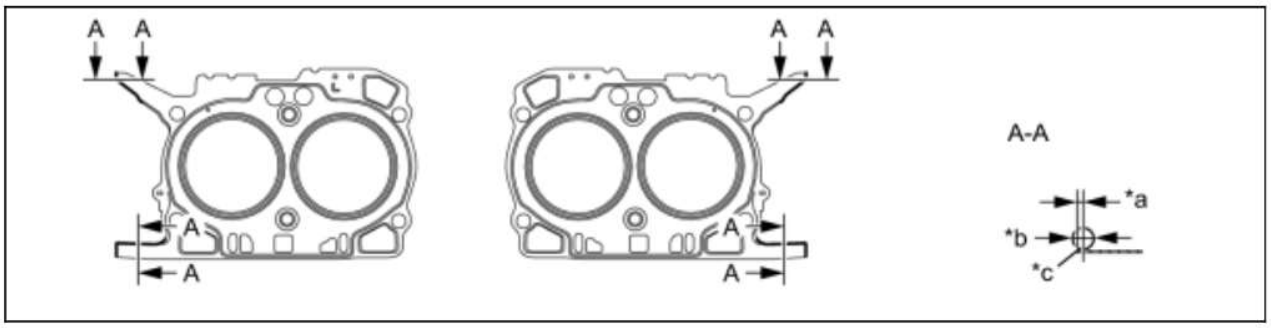
NOTICE:

To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant, etc.

(c) Apply the seal packing to both sides of the No. 2 cylinder head gasket as shown in the illustration.

Seal packing:

Three Bond 1217G, 1217H or equivalent



Text in Illustration

*a	0 to 1.0 mm (0 to 0.039in.)	*b	φ2,0 to 4.0 mm (0.079 to 0.158 in.)
*c	Edge of the gasket	-	-

NOTICE:

- Clean and degrease the contact surface.
- Install the cylinder head sub-assembly LH within 5 minutes of applying the seal packing.

(d) Place the No. 2 cylinder head gasket on the cylinder block (bank 2).

2. INSTALL CYLINDER HEAD SUB-ASSEMBLY LH

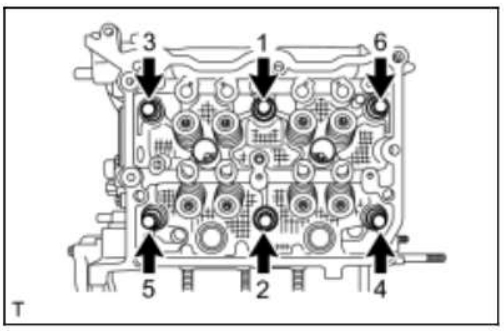
(a) Clean the threads of the cylinder head bolts and apply sufficient engine oil to the washers and threads of the bolts.

(b) Mount the cylinder head sub-assembly LH on the cylinder block (bank 2).

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(c) Tighten the 6 cylinder head bolts in the order shown in the illustration.

Torque:
20 N·m {204 kgf·cm, 15ft·lbf}



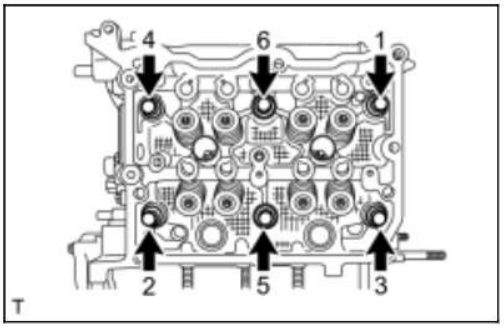
(d) Tighten the 6 cylinder head bolts further in the same order above.

Torque:
100 N·m {1020 kgf·cm, 74ft·lbf}

NOTICE:
If the bolt makes a stick-slip sound during tightening, repeat the procedure from the cylinder head gasket installation after cleaning and completely drying the bolt holes and contact surfaces.

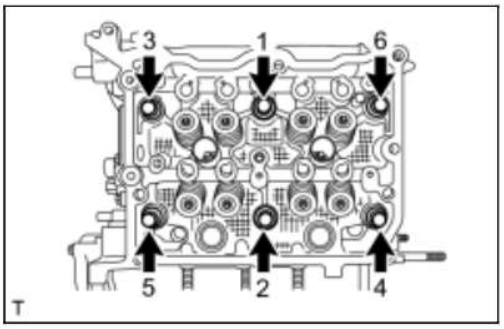
HINT:
In that case, the No. 2 cylinder head gasket can be reused.

(e) Loosen the 6 cylinder head bolts by 360 ° in the order shown in the illustration.



(f) Tighten the 6 cylinder head bolts in the order shown in the illustration.

Torque:
20 N·m {204 kgf·cm, 15ft·lbf}



(g) Tighten the 6 cylinder head bolts further in the same order above.

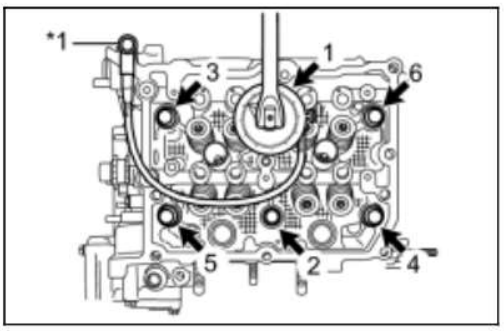
Torque:
42 N·m {428 kgf·cm, 31ft·lbf}

(h) Using an angle gauge, tighten the 6 cylinder head bolts another 100 ° in the order shown in the illustration.

HINT:

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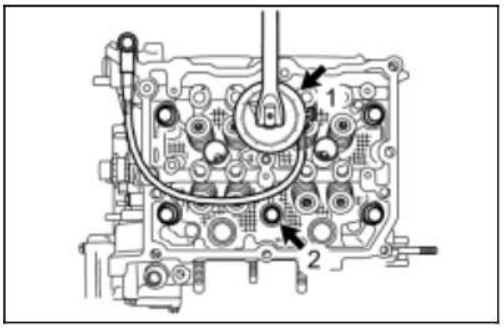
Temporarily install the appropriate bolt for angle gauge if necessary.



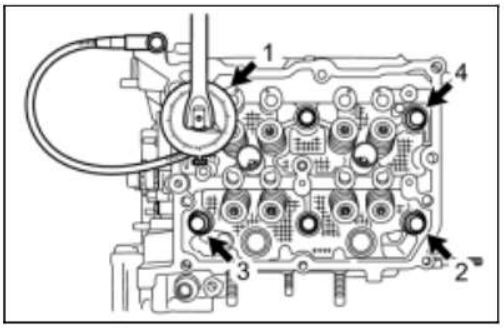
Text in Illustration

*1	Temporary Bolt

(i) Using an angle gauge, tighten the 2 cylinder head bolts another 100 ° in the order shown in the illustration.



(j) Using an angle gauge, tighten the 4 cylinder head bolts another 50 ° in the order shown in the illustration.



3. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH

INFO

4. INSTALL CYLINDER HEAD GASKET

(a) Operate the engine stand so that the bank 1 side faces upward.

(b) Clean the bolt holes in the cylinder block (bank 1).

NOTICE:

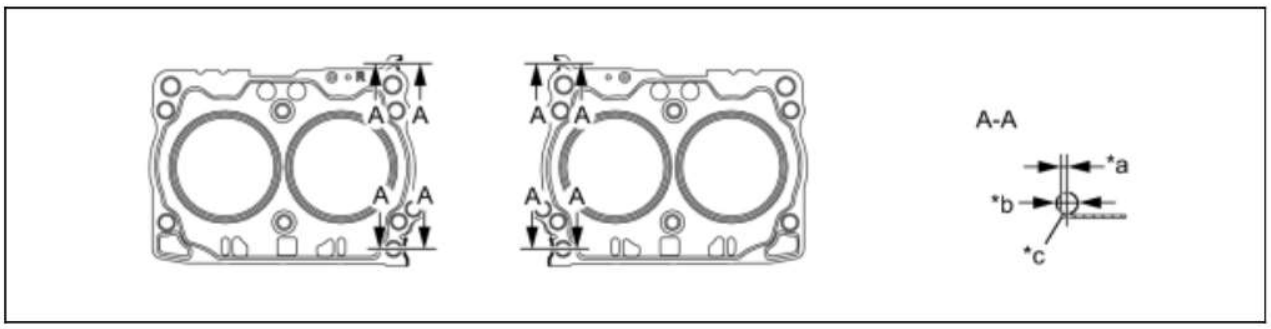
To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant, etc.

(c) Apply the seal packing to both sides of the cylinder head gasket as shown in the illustration.

Seal packing:

Three Bond 1217G, 1217H or equivalent

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Text in Illustration

*a	0 to 1.0 mm (0 to 0.039in.)	*b	φ2,0 to 4.0 mm (0.079 to 0.158 in.)
*c	Edge of the gasket	-	-

NOTICE:

- Clean and degrease the contact surface.
- Install the cylinder head sub-assembly RH within 5 minutes of applying the seal packing.

(d) Place the cylinder head gasket on the cylinder block (bank 1).

5. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH

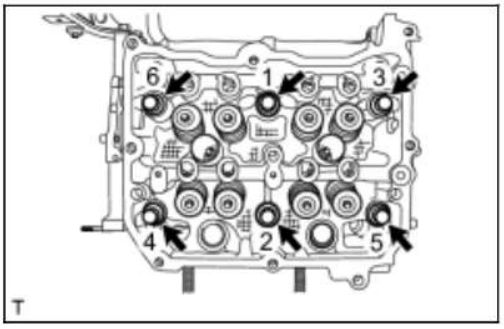
(a) Clean the threads of the cylinder head bolts and apply sufficient engine oil to the washers and threads of the bolts.

(b) Mount the cylinder head sub-assembly RH on the cylinder block (bank 1).

(c) Tighten the 6 cylinder head bolts in the order shown in the illustration.

Torque:

20 N·m {204 kgf·cm, 15ft·lbf}



(d) Tighten the 6 cylinder head bolts further in the same order as above.

Torque:

100 N·m {1020 kgf·cm, 74ft·lbf}

NOTICE:

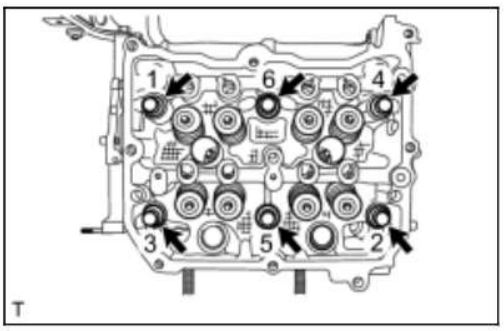
If the bolt makes a stick-slip sound during tightening, repeat the procedure from the cylinder head gasket installation after cleaning and completely drying the bolt holes and contact surfaces.

HINT:

In that case, the cylinder head gasket can be reused.

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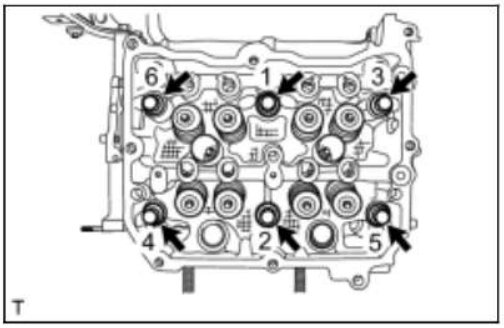
(e) Loosen the 6 cylinder head bolts by 360 ° in the order shown in the illustration.



(f) Tighten the 6 cylinder head bolts in the order shown in the illustration.

Torque:

20 N·m {204 kgf·cm, 15ft·lbf}



(g) Tighten the 6 cylinder head bolts further in the same order above.

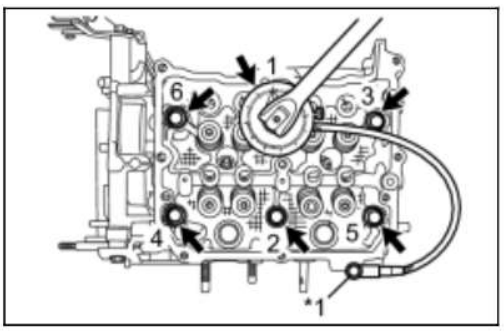
Torque:

42 N·m {428 kgf·cm, 31ft·lbf}

(h) Using an angle gauge, tighten the 6 cylinder head bolts another 100 ° in the order shown in the illustration.

HINT:

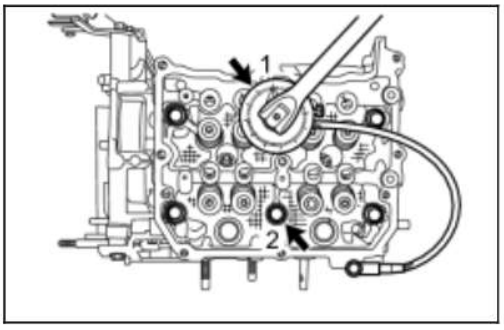
Temporarily install the appropriate bolt for angle gauge if necessary.



Text in Illustration

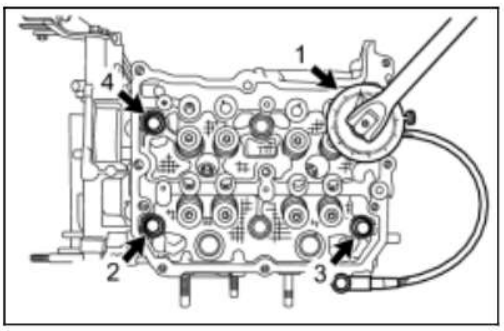
*1	Temporary Bolt

(i) Using an angle gauge, tighten the 2 cylinder head bolts another 100 ° in the order shown in the illustration.



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(j) Using an angle gauge, tighten the 4 cylinder head bolts another 50 ° in the order shown in the illustration.



6. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH

INFO

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000056U900AX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD GASKET: REMOVAL; 2013 MY FR-S [03/2012 -]		

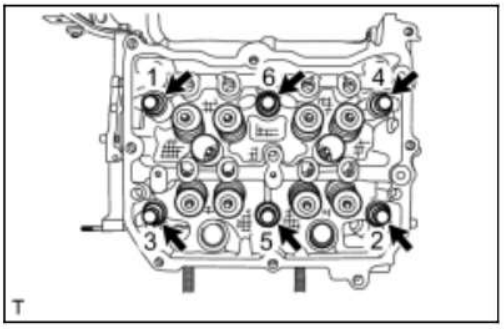
REMOVAL

1. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH

INFO

2. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH

(a) Loosen the 6 bolts in the order shown in the illustration.



(b) Lightly tap the cylinder head sub-assembly RH to separate it from the cylinder block (bank 1).

(c) Remove the cylinder head sub-assembly RH.

NOTICE:

Be careful not to scratch the mating surface of the cylinder head and cylinder block.

3. REMOVE CYLINDER HEAD GASKET

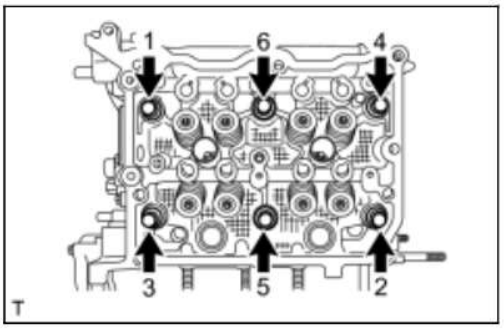
(a) Remove the cylinder head gasket.

4. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH

INFO

5. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH

(a) Loosen the 6 bolts in the order shown in the illustration.



(b) Lightly tap the cylinder head sub-assembly LH to separate it from the cylinder block (bank 2).

(c) Remove the cylinder head sub-assembly LH.

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NOTICE:

Be careful not to scratch the mating surface of the cylinder head and cylinder block.

6. REMOVE NO. 2 CYLINDER HEAD GASKET

(a) Remove the No. 2 cylinder head gasket.

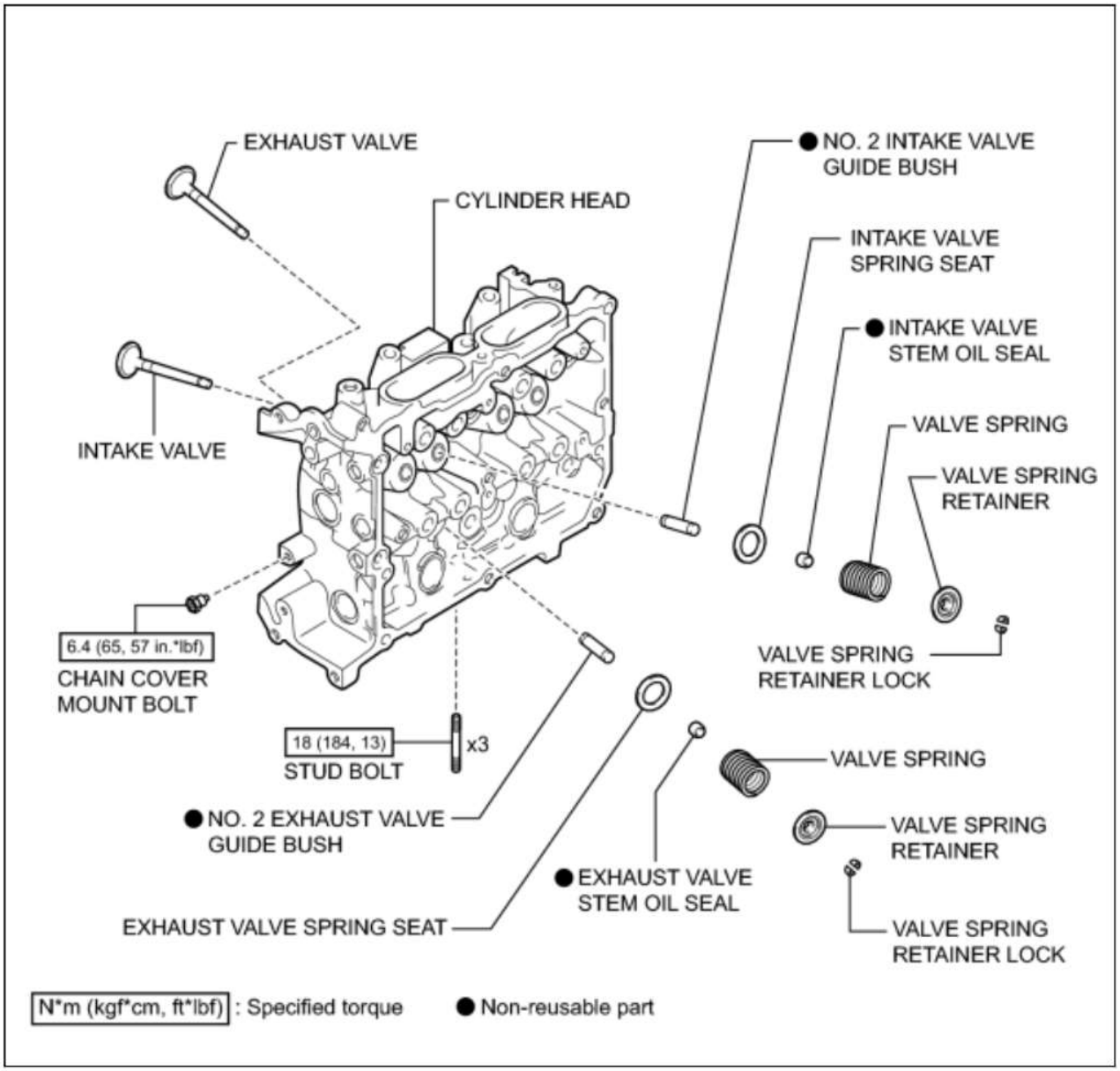


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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000000T4V07HX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

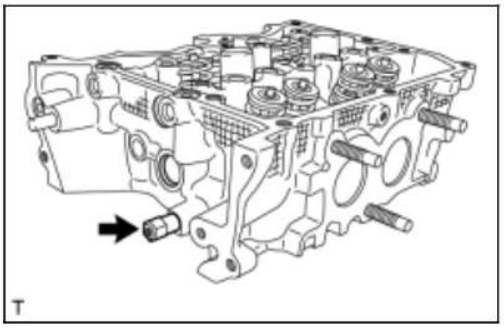
ILLUSTRATION



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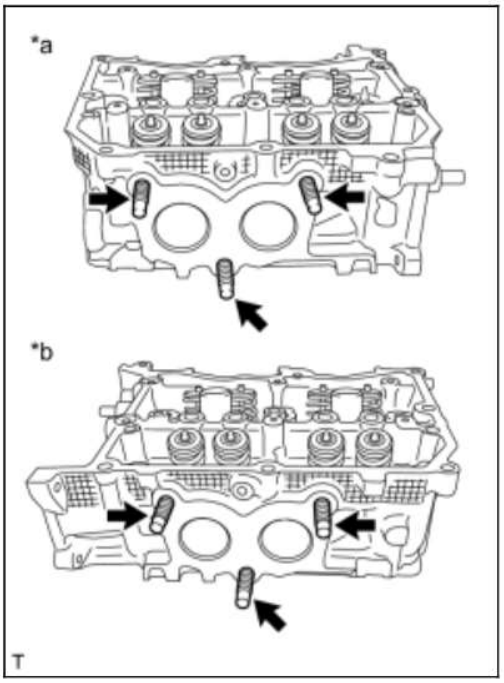
Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000T4X086X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD: DISASSEMBLY; 2013 MY FR-S [03/2012 -]		

DISASSEMBLY



1. REMOVE CHAIN COVER MOUNT BOLT

(a) Remove the chain cover mount bolt.



2. REMOVE STUD BOLT

HINT:

If any of the stud bolts is deformed or the threads are damaged, replace it.

(a) Remove the 6 stud bolts from the cylinder heads.

Text in Illustration

*a	for Bank 1
*b	for Bank 2

3. REMOVE INTAKE VALVE

NOTICE:

Place a cloth, etc. to avoid scratching the mating surface of the cylinder head during servicing.

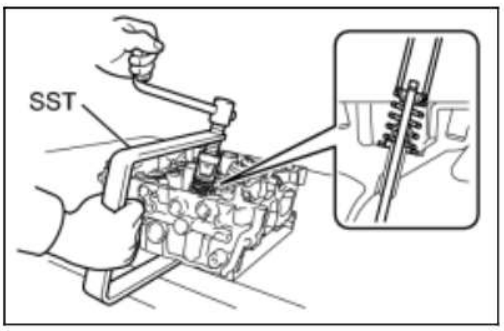
HINT:

- Mark each part to prevent confusion.
- Arrange the removed parts in the correct order.

(a) Using SST, compress the spring and remove the valve spring retainer locks.

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SST: 09202-70020
09202-00010
09202-01010
09202-01020



(b) Remove the valve, valve spring retainer, valve spring and valve spring seat.

4. REMOVE EXHAUST VALVE

CAUTION:

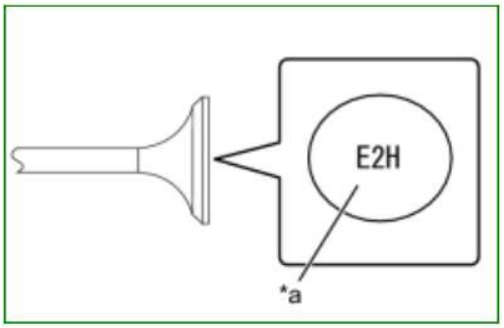
- The exhaust valve is encapsulated with metallic sodium. The metallic sodium is a strong alkaline and prone to cause a serious chemical reaction. Therefore, extra caution is required when handling or disposing the exhaust valve.
- Never disassemble the exhaust valve. The metallic sodium may cause blindness if it gets into your eyes, or cause burn injuries or chemical reactions resulting in fire if it comes into contact with your skin or any heat source.
- If the exhaust valve is damaged, after removing the valve, carry out processing of "Preparation for disposal" and "Disposal".
- Make sure to wear safety glasses and protective gloves when removing a damaged exhaust valve.
- Do not intentionally damage the exhaust valve to remove the metallic sodium.

NOTICE:

When it is determined that disposal procedure is dissolving, this may be performed.

HINT:

- The exhaust valve is encapsulated with metallic sodium. This is safe as long as it does not come into contact with air.
- The exhaust valve in which metallic sodium is encapsulated can be identified with the embossed mark.



Text in Illustration

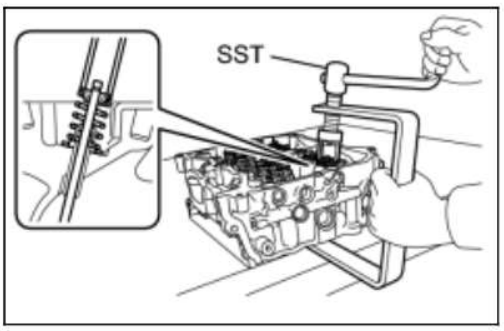
*a	Embossed mark (E2H is for FA20 Engine)

(a) Using SST, compress the spring and remove the valve spring retainer locks.

SST: 09202-70020

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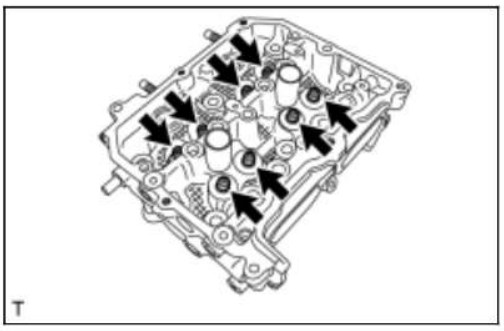
09202-00010
09202-01010
09202-01020



(b) Remove the valve, valve spring retainer, valve spring and valve spring seat.

5. REMOVE VALVE STEM OIL SEAL

(a) Remove the 8 valve stem oil seals.



NOTICE:

- Place a cloth, etc. to avoid scratching the mating surface of the cylinder head during servicing.
- Be careful not to damage the valve guide bushes and cylinder head.

6. DISPOSE OF EXHAUST VALVE

CAUTION:

- The exhaust valve is encapsulated with metallic sodium. The metallic sodium is a strong alkaline and prone to cause a serious chemical reaction. Therefore, extra caution is required when handling or disposing the exhaust valve.
- Never disassemble the exhaust valve. The metallic sodium may cause blindness if it gets into your eyes, or cause burn injuries or chemical reactions resulting in fire if it comes into contact with your skin or any heat source.
- If the exhaust valve is damaged, after removing the valve, carry out processing of "Preparation for disposal" and "Disposal".
- Make sure to wear safety glasses and protective gloves when removing a damaged exhaust valve.
- Do not intentionally damage the exhaust valve to remove the metallic sodium.

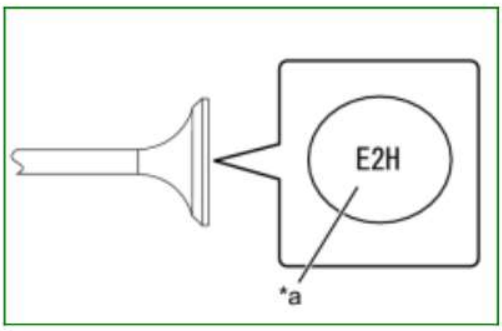
NOTICE:

When it is determined that disposal procedure is dissolving, this may be performed.

HINT:

- The exhaust valve is encapsulated with metallic sodium. This is safe as long as it does not come into contact with air.
- The metallic sodium within the exhaust valve can be identified using the embossed mark.

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Text in Illustration

*a	Embossed mark (E2H is for FA20 Engine)

(a) Preparation for disposal

CAUTION:

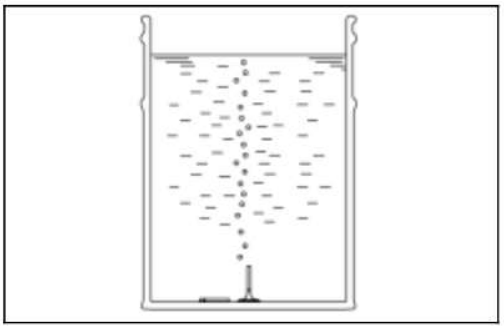
- Ensure a fire extinguisher is at hand.
- Wear safety glasses.
- Wear protective gloves.

(b) Disposal

(1) Wear protective gloves and then remove the damaged valve from the cylinder head.

(2) Place a large container (bucket or other container) in a well-ventilated area and fill it with water (at least 10 liters).

(3) Place the damaged exhaust valve inside the container in an upright position using large pliers or similar tool to submerge it under water.



CAUTION:

- Ensure the damaged exhaust valve is fully submerged in water.
- Keep any fire sparks or fire sources away from this container because hydrogen gas will be emitted from the chemical reaction.
- Because of serious chemical reaction, step back at least 2 to 3 m from the container.

(4) After the chemical reaction has completed (approximately 4 to 5 hours), using large pliers or similar tool, carefully remove the valve from the container, and then dispose of it according to the same procedures that are provided for other parts.

CAUTION:

- After the chemical reaction, be careful not to let used liquid (sodium hydrate) contact your skin. Should it contact your skin, immediately rinse it with plenty of water.
- After the chemical reaction, dispose of used liquid (sodium hydrate) according to all applicable government and local regulations.

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Last Modified: 4-14-2014	6.6 G	Doc ID: RM000000XCV08GX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD: INSPECTION; 2013 MY FR-S [03/2012 -]		

INSPECTION

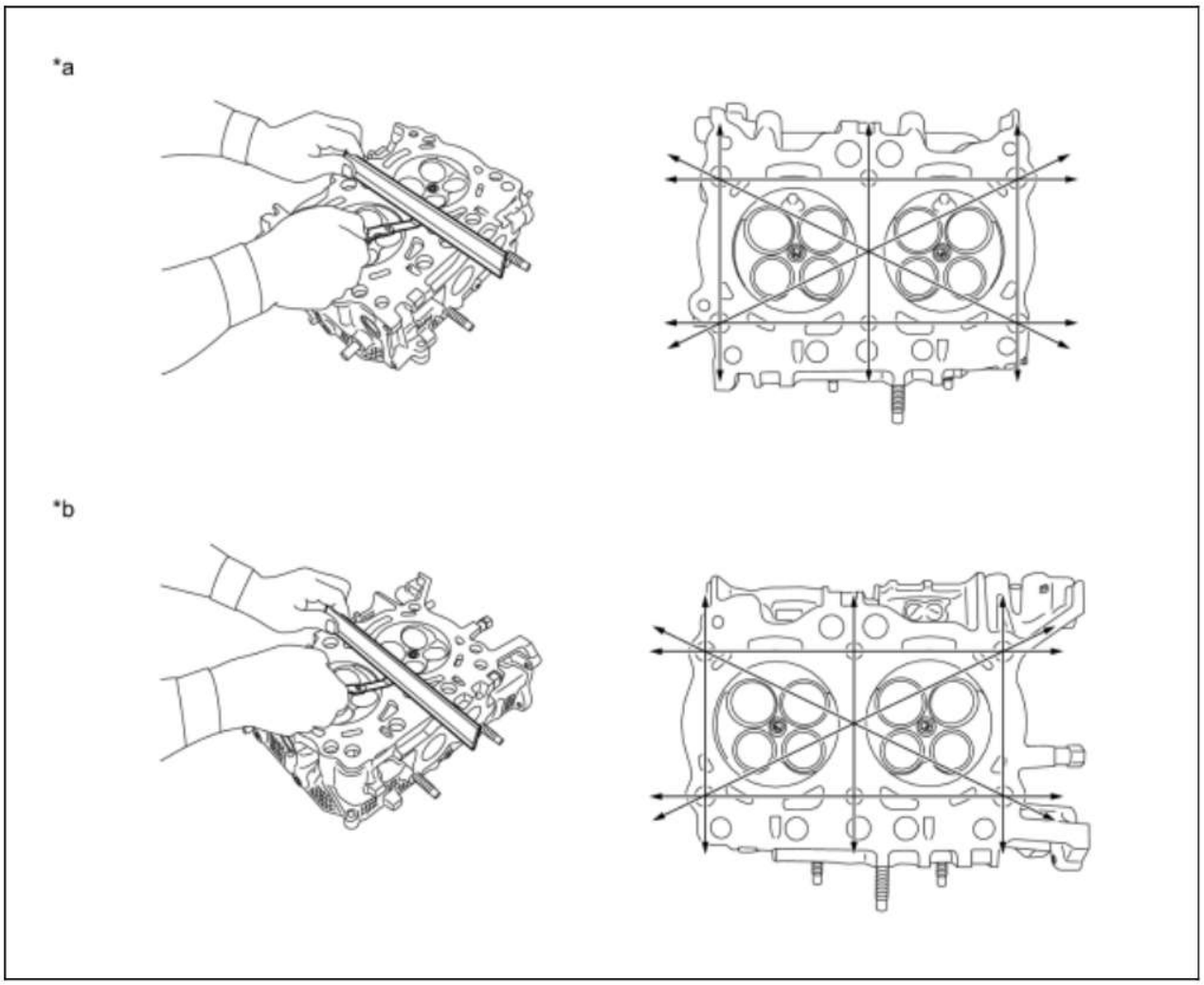
1. INSPECT CYLINDER HEAD SUB-ASSEMBLY

(a) Visually check that there are no cracks, scratches or other damage.

(b) Using a dye penetrant, check the important sections for fissures.

(c) Check that there are no signs of gas leak or water leak on gasket attachment surfaces.

(d) Using a precision straightedge and a feeler gauge, measure the surfaces that contact the cylinder block for warpage.



Text in Illustration

*a	for Bank 1	*b	for Bank 2

Maximum warpage:
0.035 mm (0.00138 in.)
Allowable minimum cylinder head height:

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98.4 mm (3.874 in.)

Standard cylinder head height:

98.5 mm (3.878 in.)

If the warpage is more than the maximum, correct the surface by grinding it or replace the cylinder head sub-assembly.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- If the cylinder head sub-assembly bolt tightening torques and tightening angles are uneven, cylinder head sub-assembly warpage may occur. During installation, make sure that tightening torques and tightening angles are correctly obtained.
- If the cylinder head sub-assembly is replaced, hand-lap the valve and valve seat with an abrasive compound.

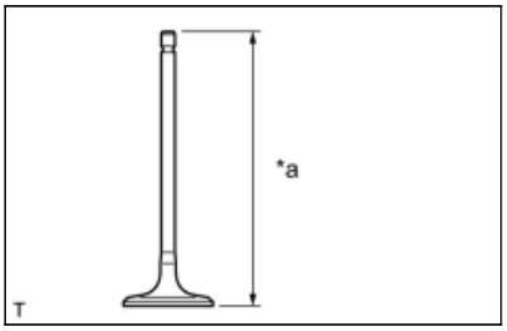
2. INSPECT INTAKE VALVE

(a) Check the valve flange and valve stem for damage, wear or deformation.

(b) Using a vernier caliper, measure the overall length of the valve.

Standard overall length:

103.3 mm (4.067 in.)



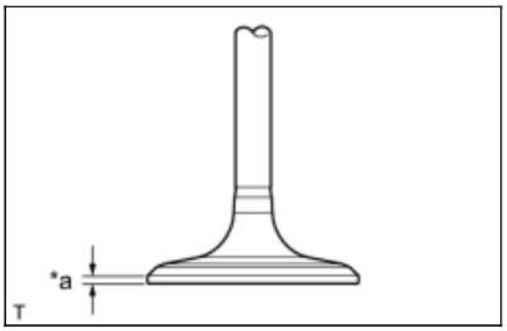
Text in Illustration

*a	Overall Length

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

Standard margin thickness:

0.8 to 1.2 mm (0.0315 to 0.0472 in.)



Text in Illustration

*a	Margin thickness

If the margin thickness is not as specified, replace the valve.

HINT:

- It is possible to differentiate between the intake valve and the exhaust valve by their overall length.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.

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

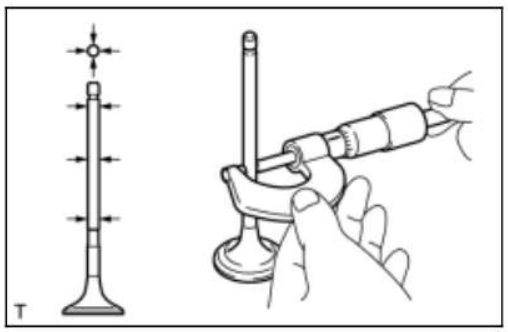
Standard valve stem diameter:

5.455 to 5.470 mm (0.2148 to 0.2154 in.)

If the valve stem diameter is not as specified, replace the

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valve.



HINT:

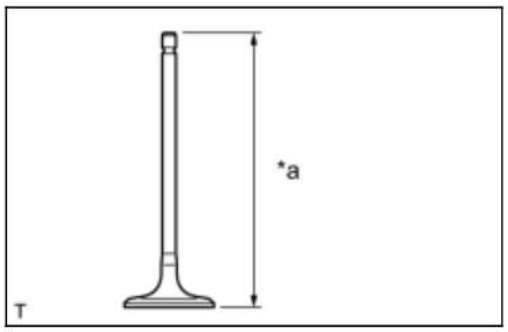
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the valve stem diameter at the 6 locations as shown in the illustration, and take the minimum value.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.

3. INSPECT EXHAUST VALVE

(a) Check the valve flange and valve stem for damage, wear or deformation.

(b) Using a vernier caliper, measure the overall length of the valve.

Standard overall length:
95.1 mm (3.744 in.)

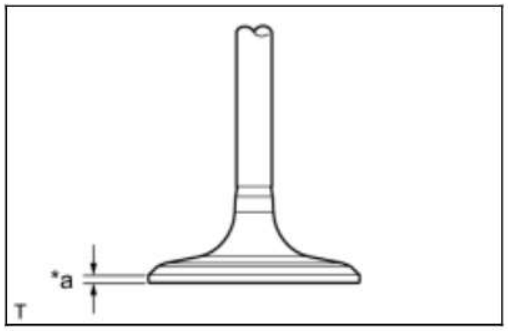


Text in Illustration

*a	Overall Length

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

Standard margin thickness:
1.0 to 1.4 mm (0.039 to 0.055 in.)



Text in Illustration

*a	Margin thickness

If the margin thickness is not as specified, replace the valve.

HINT:

- It is possible to differentiate between the intake valve and the exhaust valve by their overall length.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.

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

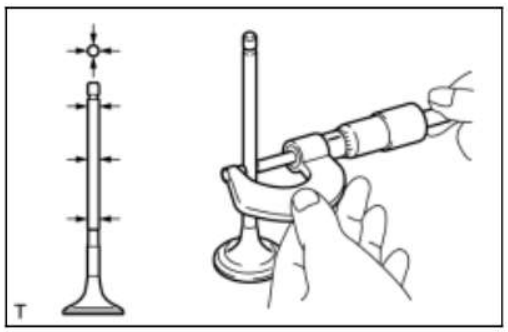
Standard valve stem diameter:
5.445 to 5.460 mm (0.21437 to 0.21496 in.)

If the valve stem diameter is not as specified, replace the valve.

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HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the valve stem diameter at the 6 locations as shown in the illustration, and take the minimum value.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.



4. INSPECT VALVE GUIDE BUSH OIL CLEARANCE

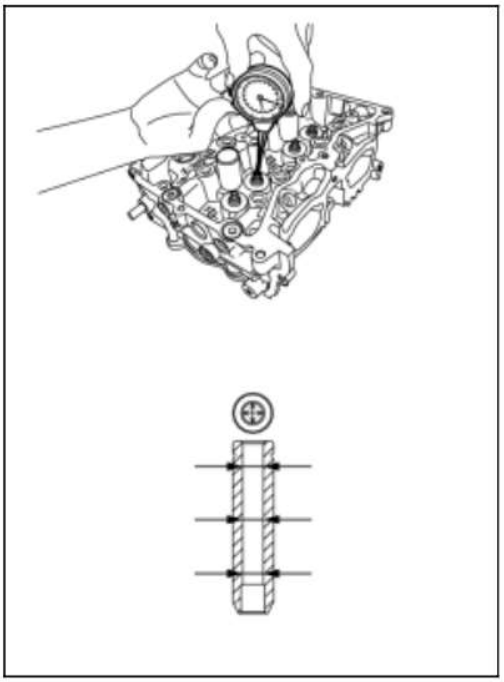
(a) Using a caliper gauge, measure the inside diameter of the valve guide bush.

Standard valve guide bush inside diameter:
5.500 to 5.512 mm (0.21654 to 0.21701 in.)

If the inside diameter is not as specified, replace the valve guide bush.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inside diameter of the valve guide bush at the 6 locations as shown in the illustration, and take the maximum value.



(b) Calculate the clearance between the valve guide bush and valve stem.

Standard Oil Clearance:

ITEM	SPECIFIED CONDITION
Intake	0.030 to 0.057 mm (0.00118 to 0.00224 in.)
Exhaust	0.040 to 0.067 mm (0.00157 to 0.00264 in.)

If the clearance between valve guide bush and valve stem is more the standard, replace the valve guide bush or valve, whichever shows the greater amount of wear or damage.

HINT:

- Subtract the valve stem diameter measurement from the inside diameter measurement of the valve guide bush.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.

5. INSPECT VALVE ADJUSTING SHIM CLEARANCE

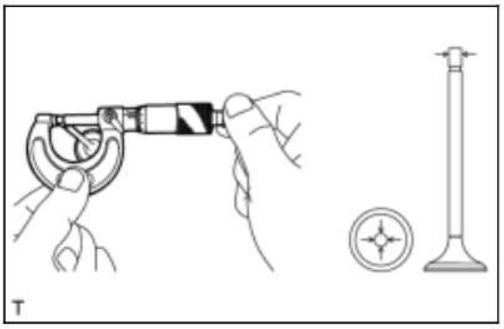
(a) Visually check the valve adjusting shim for damage.

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

Standard valve stem end diameter:

ITEM	SPECIFIED CONDITION
Intake	5.455 to 5.470 mm (0.21476 to 0.21535 in.)
Exhaust	5.445 to 5.460 mm (0.21437 to 0.21496 in.)



If the valve stem end diameter is not as specified, replace the valve.

HINT:

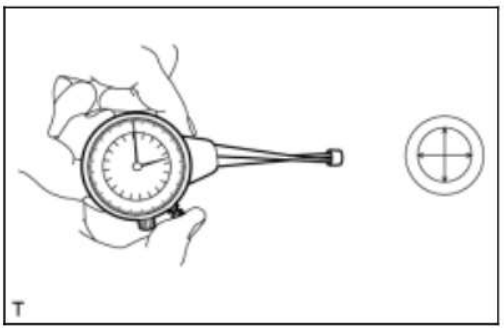
- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the valve stem end diameter at the 2 locations as shown in the illustration, and take the minimum value.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.

(c) Using a caliper gauge, measure the inside diameter of the valve adjusting shim.

Standard valve adjusting shim inside diameter:

5.500 to 5.560 mm (0.21654 to 0.21890 in.)

If the inside diameter is not as specified, replace the valve adjusting shim.



HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Measure the inside diameter of the valve adjusting shim at the 2 locations as shown in the illustration, and take the maximum value.
- If the valve adjusting shim needs to be replaced, check the valve clearance and select a suitable one.

(d) Calculate the clearance between the valve adjusting shim and valve stem end.

Standard Oil Clearance:

0.030 to 0.115 mm (0.00118 to 0.00453 in.)

If the clearance between valve adjusting shim and valve stem end exceeds the standard, replace the valve adjusting shim or valve, whichever shows the greater amount of wear or damage.

HINT:

- Subtract the valve stem end diameter measurement from the inside diameter measurement of the valve adjusting shim.
- If the valve is replaced, hand-lap the valve and valve seat with an abrasive compound.
- If the valve adjusting shim needs to be replaced, check the valve clearance and select a suitable one.

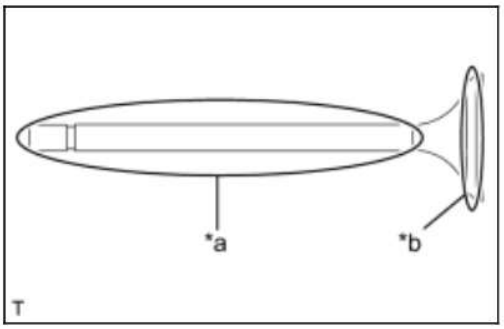
6. INSPECT INTAKE VALVE SEATS

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(a) Visually check the valve seat for damage or deformation.

(b) Clean the valve and valve seat.

(c) Apply a light coat of engine oil to the valve stem, and a light coat of Prussian blue uniformly to the valve face.

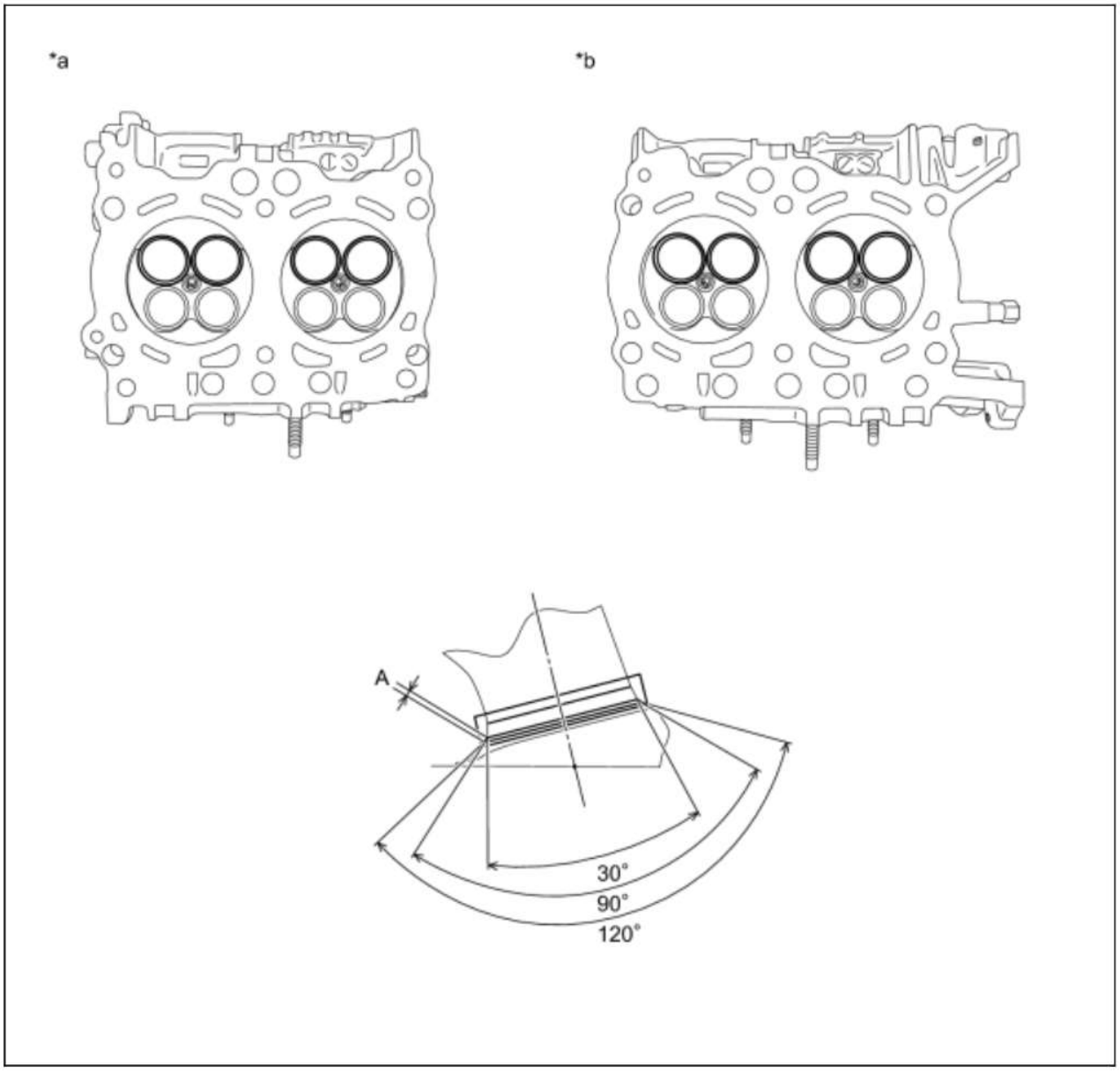


Text in Illustration

*a	Valve stem
*b	Valve face

(d) Insert the valve, and without rotating the valve, lightly press the valve face against the valve seat, and then pull it out.

(e) Using a vernier caliper, measure the width of the contact face shown in the illustration.



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Text in Illustration

*a	for Bank 1	*b	for Bank 2

Standard width (A):

0.8 to 1.6 mm (0.032 to 0.063 in.)

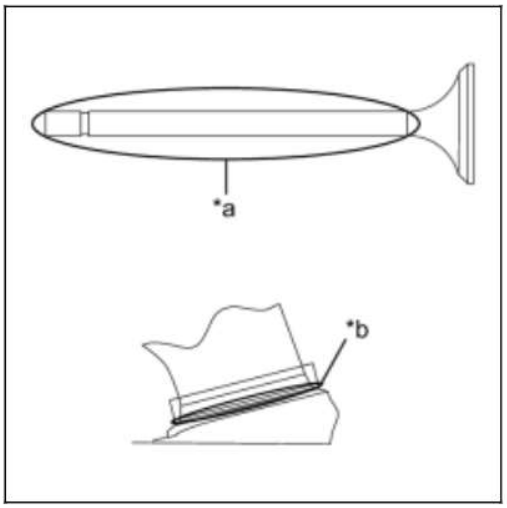
If the width is not as specified, repair the valve seat with a cutter.

HINT:

- Measure the width of the Prussian blue adhering to the valve seat.
- If the Prussian blue is not continually adhered on the valve seat, hand-lap the valve and valve seat with an abrasive compound.
- If the Prussian blue is still not continually adhered on the valve seat after lapping, repair the valve seat with a cutter.

(f) Completely remove the Prussian blue from the valve and valve seat.

(g) Apply a light coat of engine oil to the valve stem, and a light coat of Prussian blue uniformly to the valve seat face.



Text in Illustration

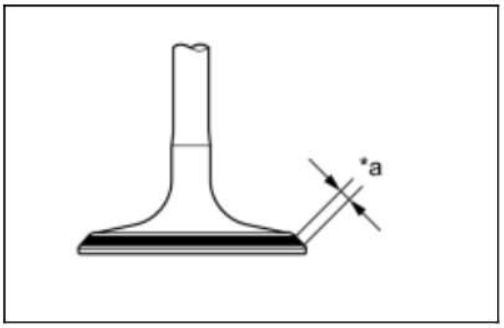
*a	Valve stem
*b	Contact face

(h) Insert the valve, and without rotating the valve, lightly press the valve face against the valve seat, and then pull it out.

(i) Check the location of the contact face shown in the illustration.

Standard contact face location:

Middle of the valve face at all circumference



Text in Illustration

*a	Contact face location

If the seat contact is not in the middle of the valve face, repair the valve seat with a cutter.

HINT:

Check the location of the Prussian blue adhering to the valve face.

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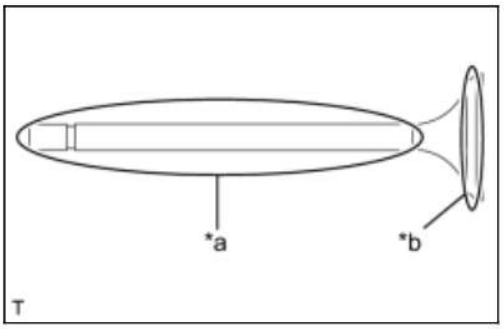
(j) Completely remove the Prussian blue from the valve and valve seat.

7. INSPECT EXHAUST VALVE SEATS

(a) Visually check the valve seat for damage or deformation.

(b) Clean the valve and valve seat.

(c) Apply a light coat of engine oil to the valve stem, and a light coat of Prussian blue uniformly to the valve face.



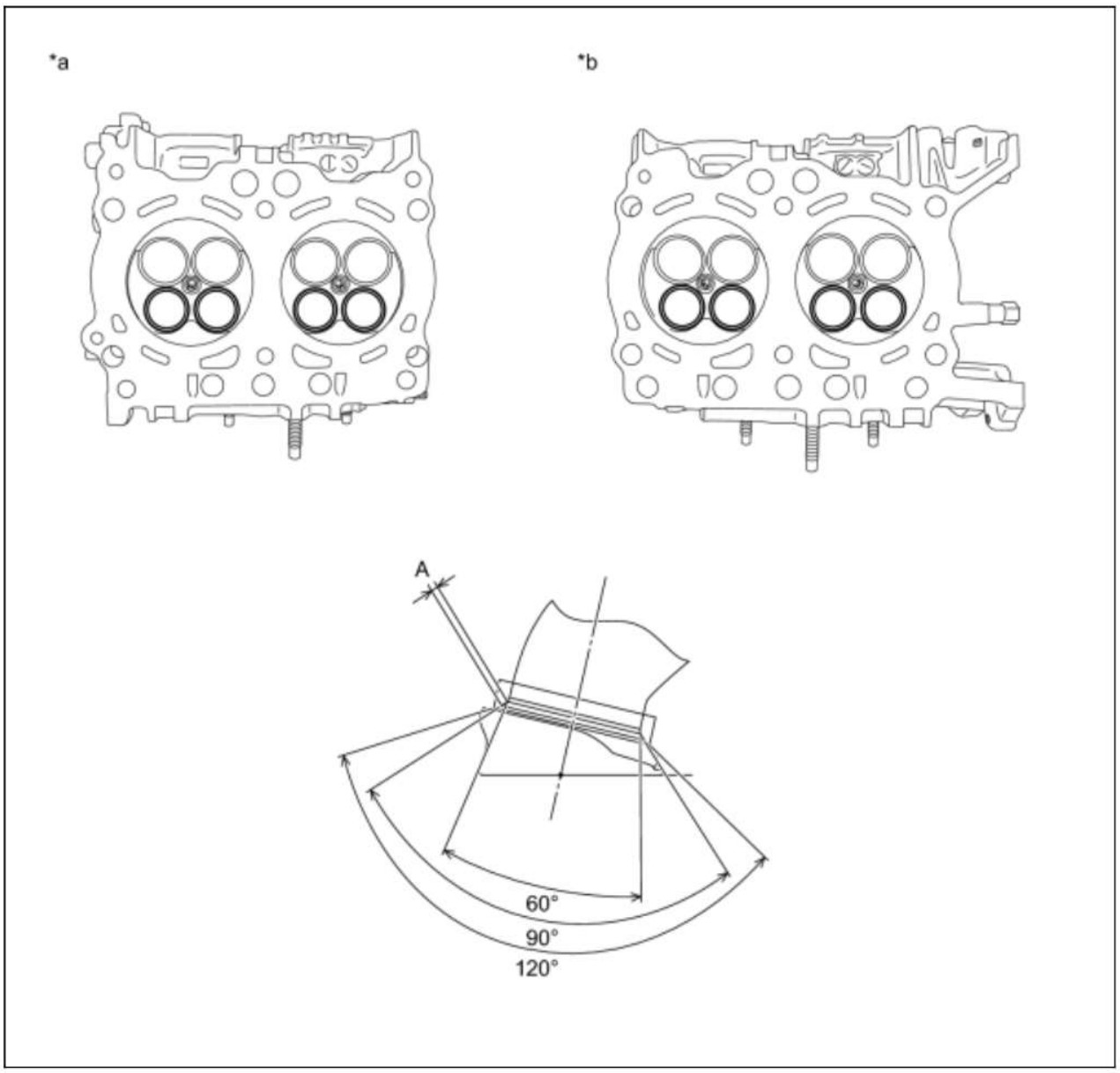
Text in Illustration

*a	Valve stem
*b	Valve face

(d) Insert the valve, and without rotating the valve, lightly press the valve face against the valve seat, and then pull it out.

(e) Using a vernier caliper, measure the width of the contact face shown in the illustration.

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Text in Illustration

*a	for Bank 1	*b	for Bank 2

Standard width (A):

1.1 to 1.7 mm (0.043 to 0.067 in.)

If the width is not as specified, repair the valve seat with a cutter.

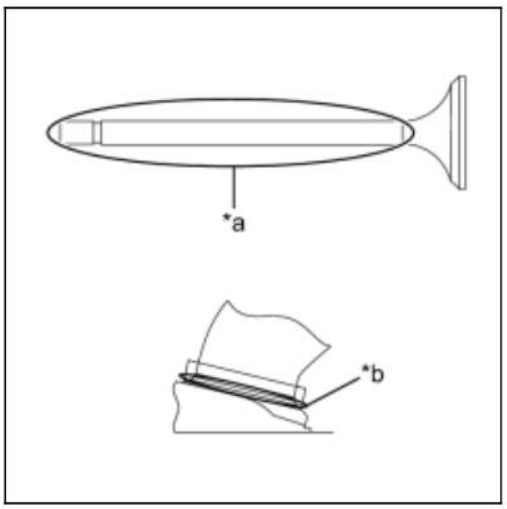
HINT:

- Measure the width of the Prussian blue adhering to the valve seat.
- If the Prussian blue is not continually adhered on the valve seat, hand-lap the valve and valve seat with an abrasive compound.
- If the Prussian blue is still not continually adhered on the valve seat after lapping, repair the valve seat with a cutter.

(f) Completely remove the Prussian blue from the valve and valve seat.

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(g) Apply a light coat of engine oil to the valve stem, and a light coat of Prussian blue uniformly to the valve seat face.



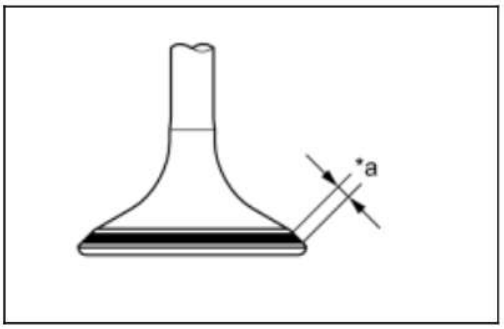
Text in Illustration

*a	Valve stem
*b	Contact face

(h) Insert the valve, and without rotating the valve, lightly press the valve face against the valve seat, and then pull it out.

(i) Check the location of the contact face shown in the illustration.

Standard contact face location:
Middle of the valve face at all circumference



Text in Illustration

*a	Contact face location

If the seat contact is not in the middle of the valve face, repair the valve seat with a cutter.

HINT:

Check the location of the Prussian blue adhering to the valve face.

(j) Completely remove the Prussian blue from the valve and valve seat.

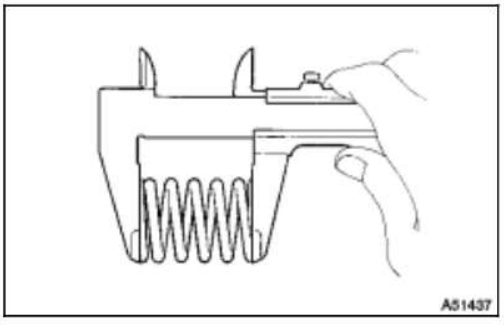
8. INSPECT VALVE SPRING

(a) Visually check the valve spring for damage or deformation.

(b) Using a vernier caliper, measure the free length of the valve spring.

Standard free length:
41.06 mm (1.617 in.)

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



HINT:

Measurement should be performed at a temperature of 20°C (68°F).

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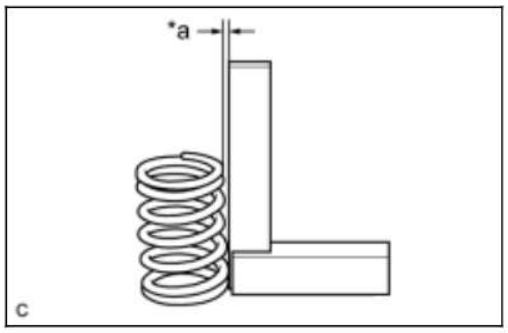
(c) Using a steel square, measure the deviation of the valve spring.

Maximum deviation:

Less than 1.8 mm (0.0710 in.)

Maximum angle:

2.5°



Text in Illustration

*a	Deviation

If the result is not as specified, replace the valve spring.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- To measure deviation of the valve spring, stand the valve spring on a level surface and measure its deviation at the top of the valve spring using a steel square.

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000T4Y0BDX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD: REASSEMBLY; 2013 MY FR-S [03/2012 -]		

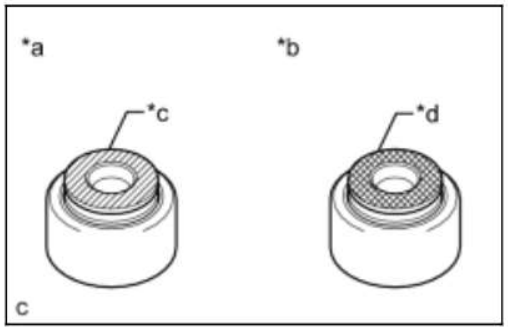
REASSEMBLY

1. INSTALL INTAKE VALVE STEM OIL SEAL

(a) Apply engine oil to new valve stem oil seals.

Text in Illustration

*a	for Intake
*b	for Exhaust
*c	Gray
*d	Light green



NOTICE:

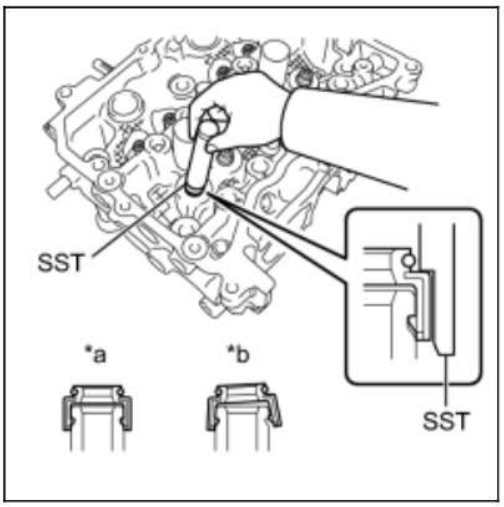
- Pay close attention to the colors when installing the oil seals.
- Installing the intake oil seal into the exhaust side or installing the exhaust oil seal to the intake side may cause installation problems later.

(b) Using SST, push in the oil seals by hand.

SST: 09201-41020

Text in Illustration

*a	Correct
*b	Incorrect



NOTICE:

- Place a cloth, etc. to avoid scratching the mating surface of the cylinder head during servicing.
- Do not tap SST with a plastic hummer to install the oil seals as it may damage the oil seals. Push in the oil seals by hand with SST.
- Do not install the oil seals at an angle.

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2. INSTALL EXHAUST VALVE STEM OIL SEAL

(a) Using SST, push in the oil seals by hand.

SST: 09201-41020

HINT:

Use the same procedure as for the intake oil seals.

3. INSTALL INTAKE VALVE

NOTICE:

Place a cloth to avoid scratching the mating surface of the cylinder head during servicing.

(a) Set the valve spring seat, valve spring and retainer onto the cylinder head.

HINT:

Install the valve spring to the cylinder head with the narrow pitch end facing the valve spring seat.

(b) Apply engine oil to the valve stem and insert the valve into the valve guide bush.

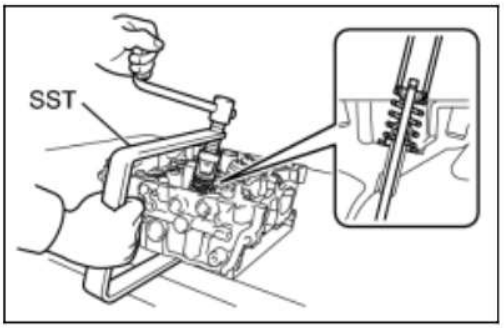
NOTICE:

When inserting the valve into the valve guide bush, use special care not to damage the oil seal lip.

(c) Apply engine oil to the valve spring retainer locks.

(d) Using SST, compress the valve spring and install the valve spring retainer locks.

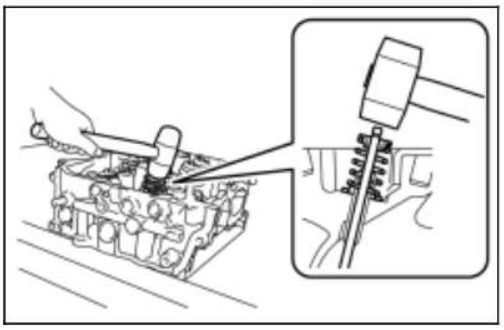
SST: 09202-70020
09202-00010
09202-01010
09202-01020



(e) Using a plastic hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to tap the retainer.



4. INSTALL EXHAUST VALVE

NOTICE:

Place a cloth to avoid scratching the mating surface of the cylinder head during servicing.

(a) Set the valve spring seat, valve spring and retainer onto the cylinder head.

HINT:

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Install the valve spring to the cylinder head with the narrow pitch end facing the valve spring seat.

(b) Apply engine oil to the valve stem and insert the valve into the valve guide bush.

NOTICE:

When inserting the valve into the valve guide bush, use special care not to damage the oil seal lip.

(c) Apply engine oil to the valve spring retainer locks.

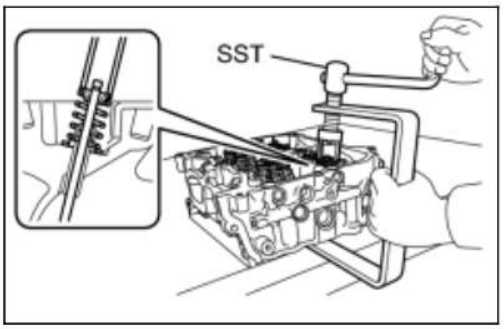
(d) Using SST, compress the valve spring and install the valve spring retainer locks.

SST: 09202-70020

09202-00010

09202-01010

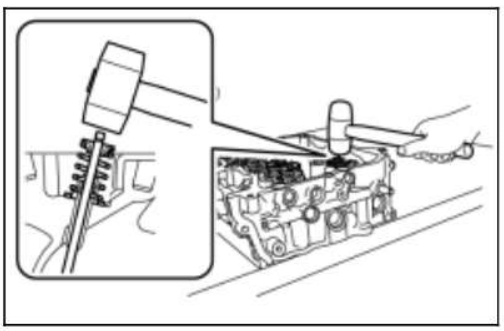
09202-01020



(e) Using a plastic hammer, lightly tap the valve stem tip to ensure a proper fit.

NOTICE:

Be careful not to tap the retainer.



5. INSTALL STUD BOLT

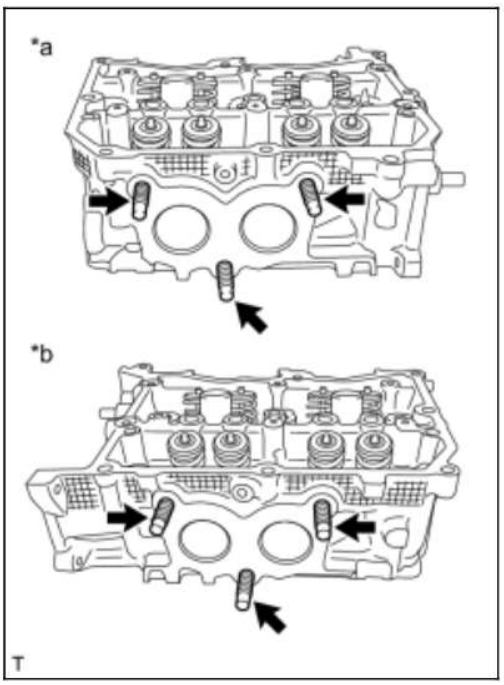
(a) Install the 6 stud bolts to the cylinder heads.

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}

Text in Illustration

*a	for Bank 1
*b	for Bank 2



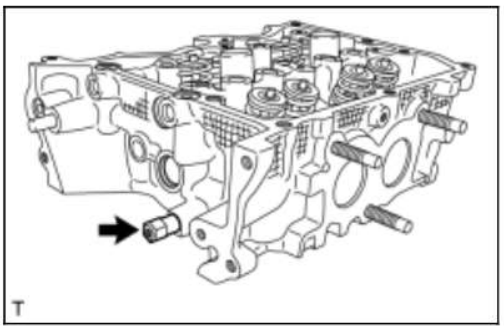
6. INSTALL CHAIN COVER MOUNT BOLT

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(a) Install the chain cover mount bolt to the cylinder head sub-assembly LH.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}



TOYOTA

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000035AU028X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD: REPAIR; 2013 MY FR-S [03/2012 -]		

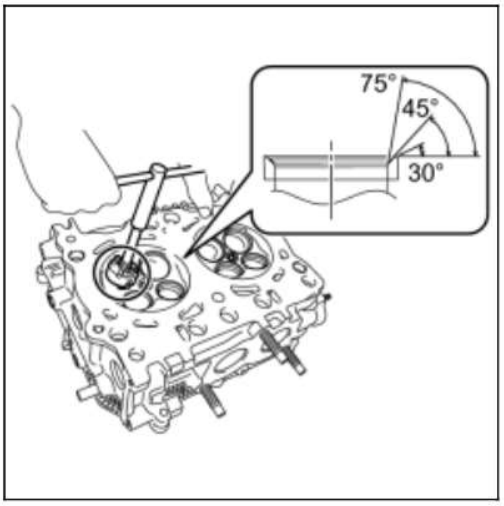
REPAIR

1. REPAIR INTAKE VALVE SEATS

NOTICE:

- Repair the seat while checking the seating position.
- Releasing the seat cutter pressure gradually helps to make the intake valve seat faces smoother.

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



(b) Hand-lap the valve and valve seat with an abrasive compound.

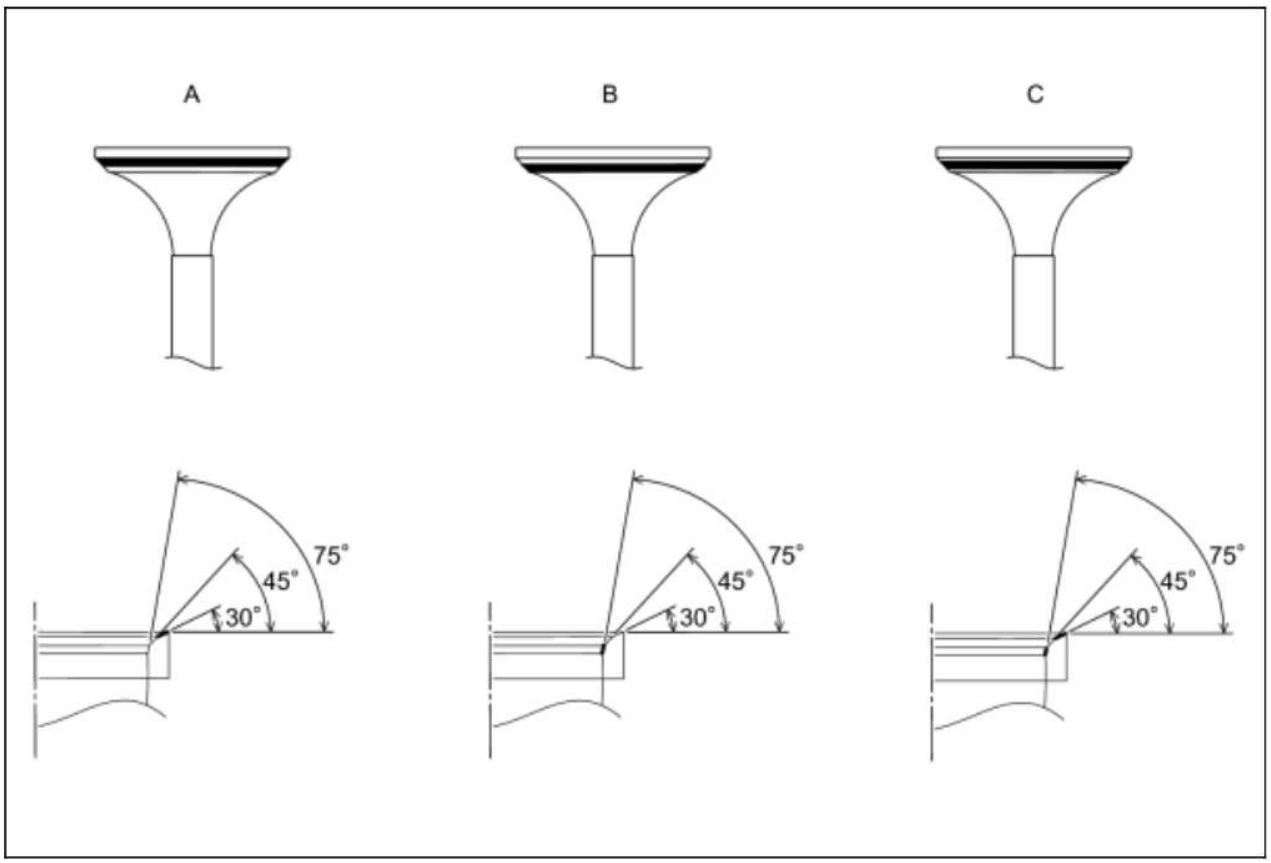
(c) Check the valve seating position.

HINT:

This procedure is necessary to select a cutter to be used in the following steps.

(d) Using 30° or 75° cutters, correct the valve seat so that the contact condition between the valve and valve seat is within the standard.

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NOTICE:

- Repair the seat while checking the seating position.
- Releasing the seat cutter pressure gradually helps to make the intake valve seat faces smoother.

HINT:

Select an appropriate cutter by referring to the following chart.

CONTACT POSITION	CUTTER TO BE SELECTED
A in the illustration	If the valve face position is high, use a 30° valve seat cutter in order to grind the surface so that the contact surface between the valve and the valve seat is at a standard value.
B in the illustration	If the valve face position is low, use a 75° valve seat cutter in order to grind the surface so that the contact surface between the valve and the valve seat is at a standard value.
C in the illustration	If the valve face position is centered, use a 30°and 75° valve seat cutter in order to grind the surface so that the contact surface between the valve and the valve seat is at a standard value.

(e) Hand-lap the valve and valve seat with an abrasive compound.

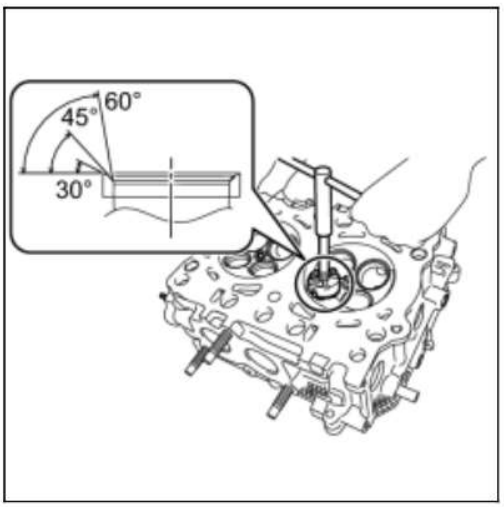
2. REPAIR EXHAUST VALVE SEATS

NOTICE:

- Repair the seat while checking the seating position.
- Releasing the seat cutter pressure gradually helps to make the intake valve seat faces smoother.

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



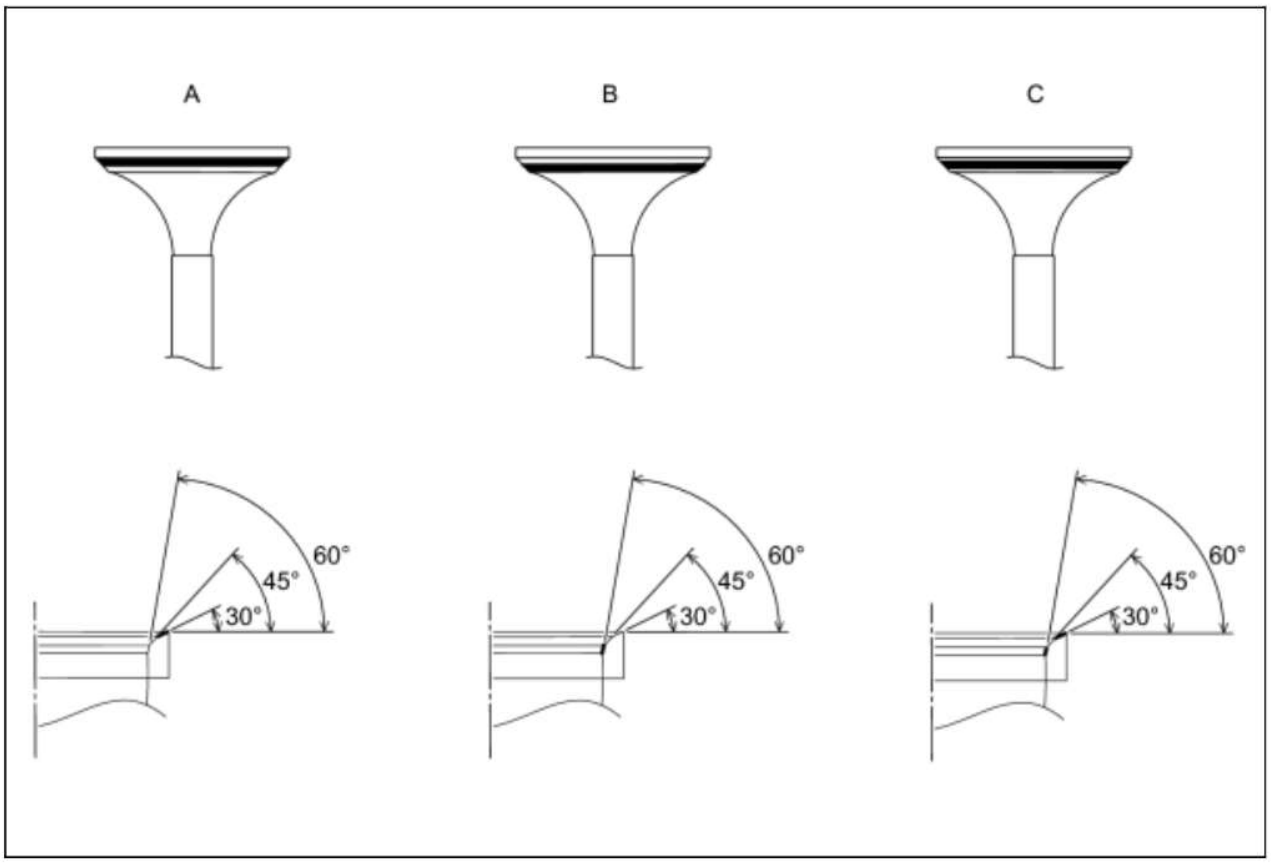
(b) Hand-lap the valve and valve seat with an abrasive compound.

(c) Check the valve seating position.

HINT:

This procedure is necessary to select a cutter to be used in the following steps.

(d) Using 30° or 60° cutters, correct the valve seat so that the contact condition between the valve and valve seat is within the standard.



NOTICE:

- Repair the seat while checking the seating position.
- Releasing the seat cutter pressure gradually helps to make the intake valve seat faces smoother.

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HINT:

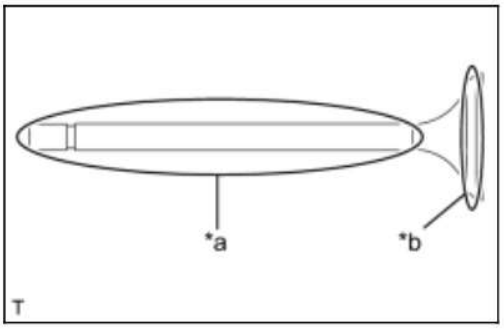
Select an appropriate cutter by referring to the following chart.

CONTACT POSITION	CUTTER TO BE SELECTED
A in the illustration	If the valve face position is high, use a 30° valve seat cutter in order to grind the surface so that the contact surface between the valve and the valve seat is at a standard value.
B in the illustration	If the valve face position is low, use a 60° valve seat cutter in order to grind the surface so that the contact surface between the valve and the valve seat is at a standard value.
C in the illustration	If the valve face position is centered, use a 30°and 60° valve seat cutter in order to grind the surface so that the contact surface between the valve and the valve seat is at a standard value.

(e) Hand-lap the valve and valve seat with an abrasive compound.

3. REPAIR VALVE

(a) Apply a light layer of engine oil to the valve stem, and a small amount of an abrasive compound uniformly to the valve face.



Text in Illustration

*a	Valve stem
*b	Valve face

HINT:

- Do not apply the abrasive compound more than necessary.
- Do not apply the abrasive compound to the valve stem as the valve stem may be affected.

(b) Slowly insert the valve stem into the valve guide bush and lap the valve and valve seat.

HINT:

- Lift the valve and strike the valve on the valve seat 2 times, and slightly rotate the valve. Repeat this set.
- The contact surface between the valve and the valve seat may become larger than the standard value, therefore, ensure that the valve is not continuously lapped by rotating while seated in the valve seat.
- While lapping, ensure that the valve is not removed from the valve guide bush by lifting too much.

(c) After lapping, completely remove the abrasive compound.

NOTICE:

Be sure to completely remove the abrasive compound as the remained compound could cause engine troubles.

(d) Check the valve seating position and width.

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000T4Y0BCX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: CYLINDER HEAD: REPLACEMENT; 2013 MY FR-S [03/2012 -]		

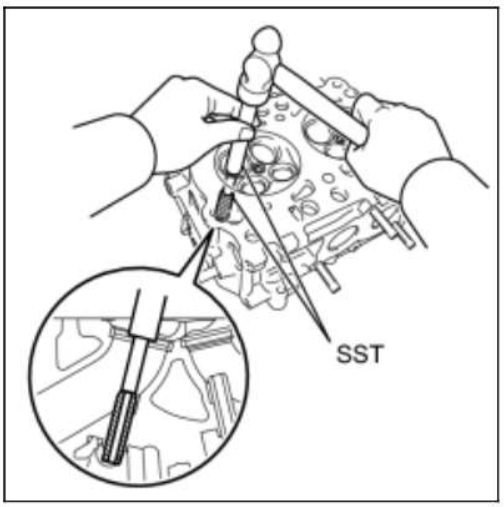
REPLACEMENT

1. REPLACE NO. 2 INTAKE VALVE GUIDE BUSH

(a) Place the cylinder block on wooden blocks with the combustion chamber side facing upward.

(b) Using SST and a hammer, tap out the No. 2 intake valve guide bush.

SST: 09201-10000
09201-01050
SST: 09950-70010
09951-07100

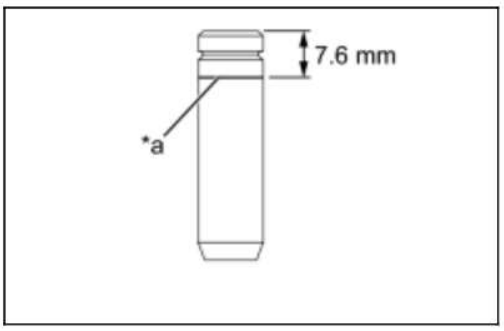


NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

(c) Before installing the No. 2 intake valve guide bush, make sure that neither scratches nor damages exist on the inner surface of cylinder head valve guide bush holes.

(d) Draw a reference line 7.6 mm (0.299 in.) below from the top face on a new No. 2 intake valve guide bush using a marker.



Text in Illustration

*a	Reference line

HINT:

Reference line is used as a guide when tapping-in the No. 2 intake valve guide bush.

(e) Place the cylinder block on wooden blocks with the combustion chamber side facing downward.

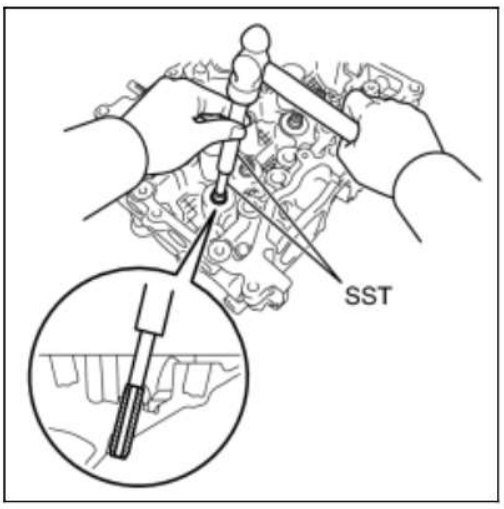
(f) Apply enough engine oil to the No. 2 intake valve guide bush, and set it on the cylinder head.

(g) Using SST and a hammer, tap in the No. 2 intake valve guide bush to the reference line.

SST: 09201-10000
09201-01050
SST: 09950-70010

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09951-07100

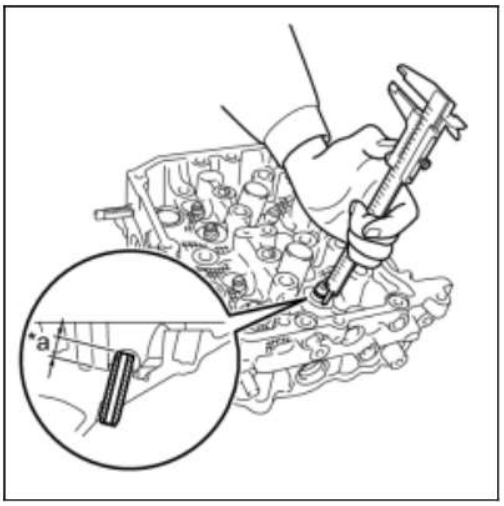


NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

(h) While measuring the No. 2 intake valve guide bush protrusion amount using a vernier caliper, tap in the No. 2 intake valve guide bush so that its height is within the standard.

Standard protrusion height:
11.4 to 11.8 mm (0.449 to 0.466 in.)



NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

HINT:

Use multiple small repetitions of tap-in and measurement in order not to excessively tap in the No. 2 intake valve guide bush.

Text in Illustration

*a	Protrusion height

(i) Place the cylinder block on wooden blocks with the combustion chamber side facing upward.

NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

(j) Using a reamer, ream the No. 2 intake valve guide bush to obtain the standard clearance between the No. 2 intake valve guide bush and valve stem.

Standard inside diameter:
5.500 to 5.512 mm (0.21654 to 0.21701 in.) at 20°C (68°F)

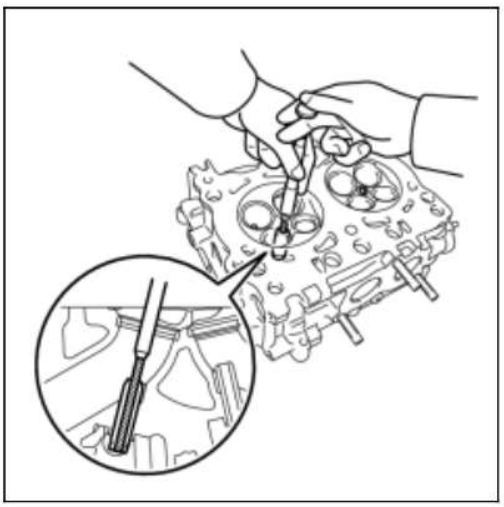
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NOTICE:

While gradually widening the reamer diameter, ream the No. 2 intake valve guide bush uniformly so that the oil clearance is within the standard.

HINT:

- Apply engine oil to the reamer when reaming.
- If the inner surface of No. 2 intake valve guide bush is damaged, slightly grind the edge of the reamer with 400-grit sandpaper.
- If the inner surface of No. 2 intake valve guide bush becomes lustrous and the reamer does not chip, use a new reamer or correct the reamer.



(k) After reaming, remove chips and clean the No. 2 intake valve guide bush.

(l) Measure the inside diameter of the No. 2 intake valve guide bush and confirm the oil clearance.

(m) Check the contact condition between the valve and valve seat.

2. REPLACE NO. 2 EXHAUST VALVE GUIDE BUSH

(a) Place the cylinder block on wooden blocks with the combustion chamber side facing upward.

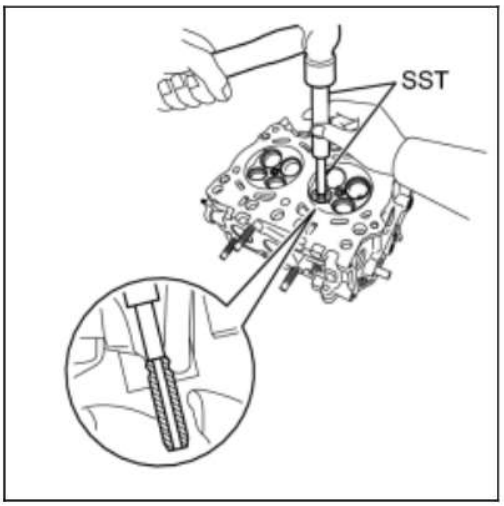
(b) Using SST and a hammer, tap out the No. 2 exhaust valve guide bush.

SST: 09201-10000

09201-01050

SST: 09950-70010

09951-07100



NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

(c) Before installing the No. 2 exhaust valve guide bush, make sure that neither scratches nor damages exist on the inner surface of cylinder head valve guide bush holes.

(d) Draw a reference line 7.6 mm (0.299 in.) below from the top face on a new No. 2 exhaust valve guide bush using a marker.

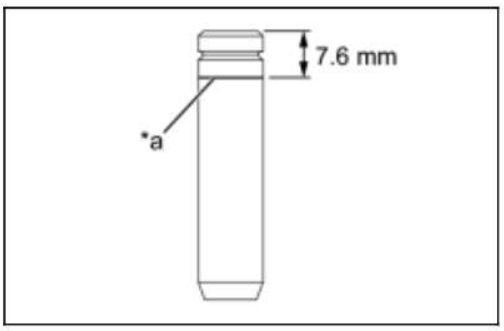
Text in Illustration

*a	Reference line

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HINT:

Reference line is used as a guide when tapping-in the No. 2 exhaust valve guide bush.



(e) Place the cylinder block on wooden blocks with the combustion chamber side facing downward.

(f) Apply enough engine oil to the No. 2 exhaust valve guide bush, and set it on the cylinder head.

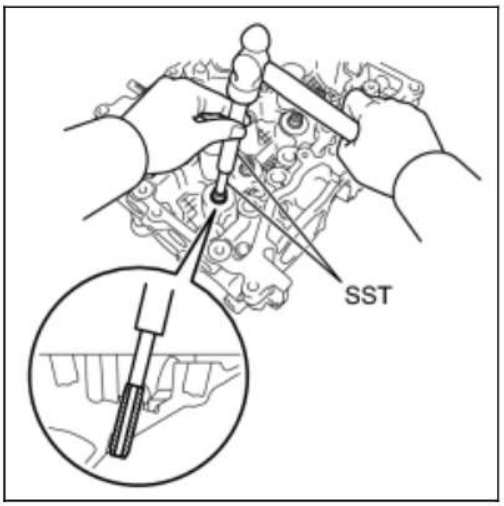
(g) Using SST and a hammer, tap in the No. 2 exhaust valve guide bush to the reference line.

SST: 09201-10000

09201-01050

SST: 09950-70010

09951-07100



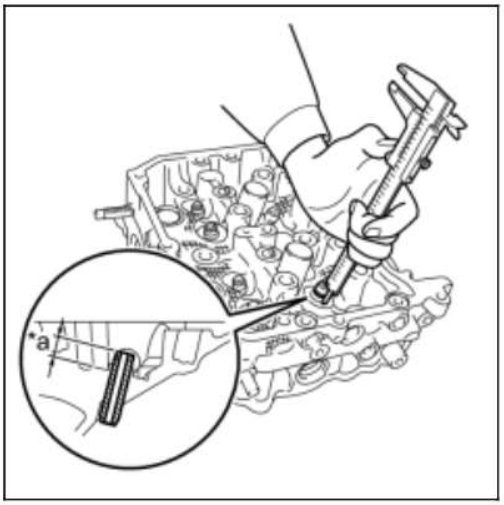
NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

(h) While measuring the No. 2 exhaust valve guide bush protrusion amount using a vernier caliper, tap in the No. 2 exhaust valve guide bush so that its height is within the standard.

Standard protrusion height:

11.4 to 11.8 mm (0.449 to 0.466 in.)



NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

HINT:

Use multiple small repetitions of tap-in and measurement in order not to excessively tap in the No. 2 exhaust valve guide bush.

Text in Illustration

*a	Protrusion height

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(i) Place the cylinder block on wooden blocks with the combustion chamber side facing upward.

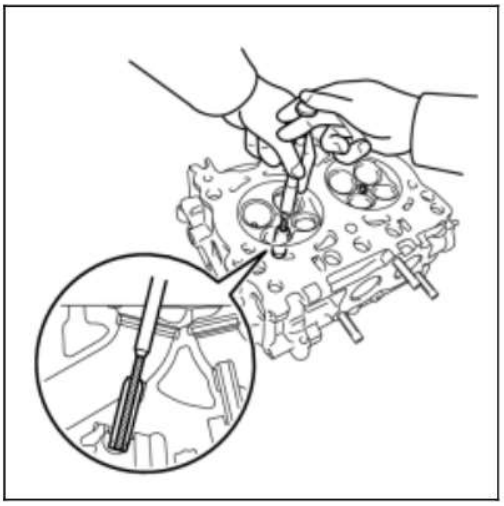
NOTICE:

- Place wooden blocks wrapped in a cloth under the cylinder head and stabilize the cylinder head during servicing.
- Use special care not to damage the cylinder head.

(j) Using a reamer, ream the No. 2 exhaust valve guide bush to obtain the standard clearance between the No. 2 exhaust valve guide bush and valve stem.

Standard inside diameter:

5.500 to 5.512 mm (0.21654 to 0.21701 in.) at 20°C (68°F)



NOTICE:

While gradually widening the reamer diameter, ream the No. 2 exhaust valve guide bush uniformly so that the oil clearance is within the standard.

HINT:

- Apply engine oil to the reamer when reaming.
- If the inner surface of No. 2 exhaust valve guide bush is damaged, slightly grind the edge of the reamer with 400-grit sandpaper.
- If the inner surface of No. 2 exhaust valve guide bush becomes lustrous and the reamer does not chip, use a new reamer or correct the reamer.

(k) After reaming, remove chips and clean the No. 2 exhaust valve guide bush.

(l) Measure the inside diameter of the No. 2 exhaust valve guide bush and confirm the oil clearance.

(m) Check the contact condition between the valve and valve seat.

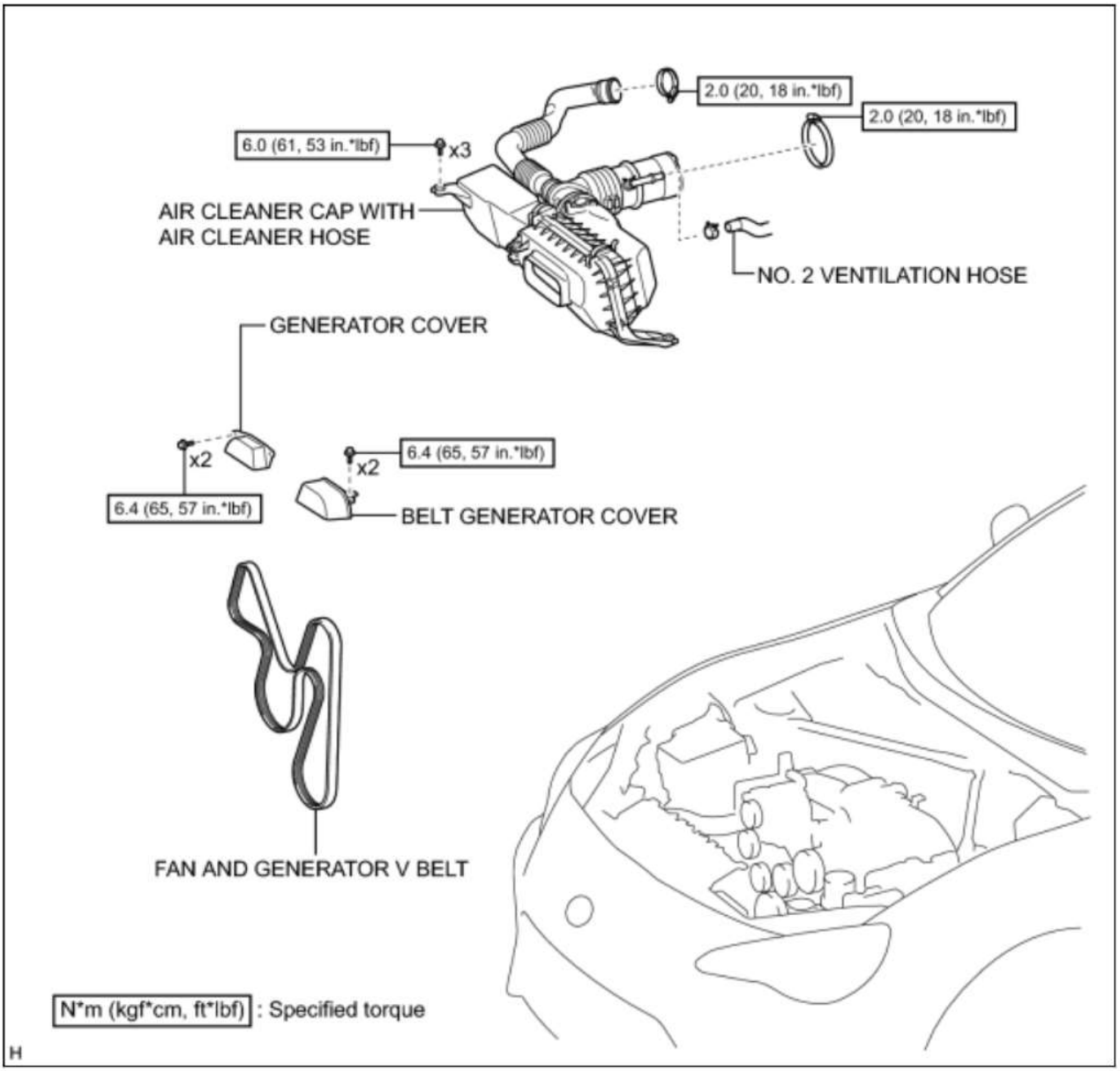
TOYOTA

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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000000T3R03YX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: DRIVE BELT: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

ILLUSTRATION



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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000TXU067X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: DRIVE BELT: INSTALLATION; 2013 MY FR-S [03/2012 -]		

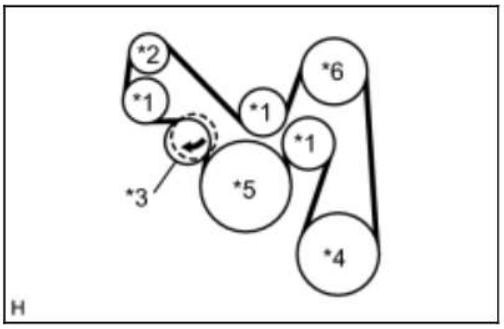
INSTALLATION

1. INSTALL FAN AND GENERATOR V BELT

(a) Set the fan and generator V belt onto every part.

Text in Illustration

*1	Idler
*2	Generator
*3	Tensioner
*4	Water Pump
*5	Crankshaft
*6	A/C Compressor



(b) While turning the belt tensioner clockwise, remove the 3 mm (0.118 in.) hexagon wrench.

NOTICE:

Make sure that the fan and generator V belt is properly installed to each pulley.

(c) Check that the fan and generator V belt fits properly in the ribbed grooves.

HINT:

Make sure to check by hand that the fan and generator V belt have not slipped out of the grooves on the bottom of the pulley.

2. INSTALL BELT GENERATOR COVER

(a) Install the belt generator cover with the 2 blots.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(b) Engage the 2 wire harness clamps and install the wire harness to the belt generator cover.

3. INSTALL GENERATOR COVER

(a) Install the generator cover with the 2 blots.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

4. INSTALL AIR CLEANER CAP WITH AIR CLEANER HOSE

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(a) Install the air cleaner cap with air cleaner hose with the 3 blots.

Torque:

6.0 N·m {61 kgf·cm, 53in·lbf}

(b) Install the air cleaner cap with air cleaner hose with the 2 hose clamps.

Torque:

2.0 N·m {20 kgf·cm, 18in·lbf}

(c) Connect the No. 2 ventilation hose.

(d) Connect the mass air flow meter connector.

(e) Engage the wire harness clamp and install the wire harness to the air cleaner cap.



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Last Modified: 4-14-2014	6.6 G	Doc ID: RM0000041LH006X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: DRIVE BELT: ON-VEHICLE INSPECTION; 2013 MY FR-S [03/2012 -]		

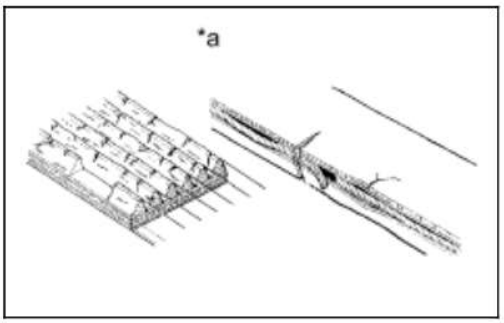
ON-VEHICLE INSPECTION

1. INSPECT FAN AND GENERATOR V BELT

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

Text in Illustration

*a	INCORRECT



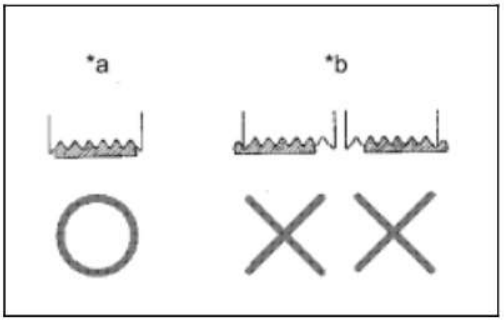
If any of the following defects is found, replace the fan and generator V belt.

- The belt is cracked.
- The belt is worn out to the extent that the cords are exposed.
- The belt has chunks missing from the ribs.

(b) Check that the belt fits properly in the ribbed grooves.

Text in Illustration

*a	CORRECT
*b	INCORRECT



HINT:

Check with your hand to confirm that the belt has not slipped out of the grooves on the bottom of the pulley. If it has slipped out, replace the fan and generator V belt. Install the new fan and generator V belt.

TOYOTA

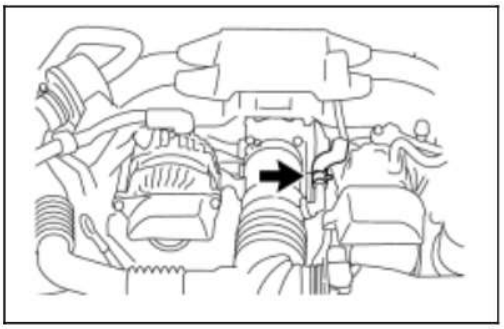
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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000TXV06BX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: DRIVE BELT: REMOVAL; 2013 MY FR-S [03/2012 -]		

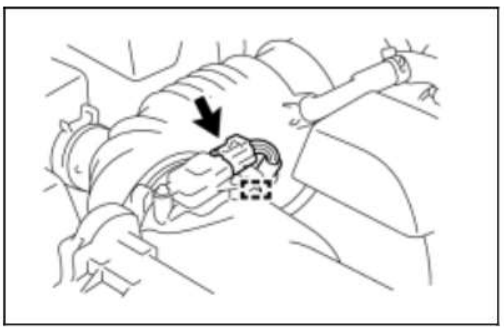
REMOVAL

1. REMOVE AIR CLEANER CAP WITH AIR CLEANER HOSE

(a) Loosen the hose clamp and disconnect the No. 2 ventilation hose.

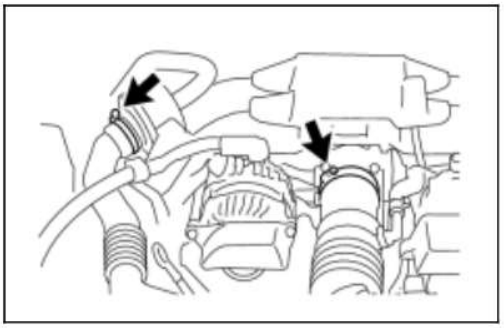


(b) Disconnect the mass air flow meter connector.



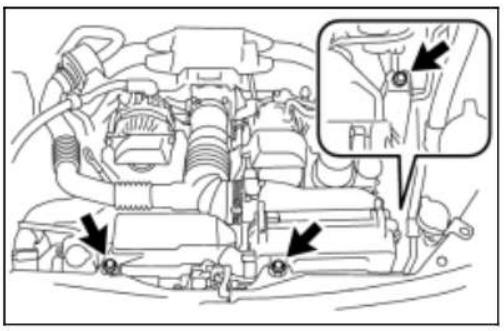
(c) Disengage the clamp and separate the wire harness from the air cleaner cap.

(d) Loosen the 2 hose clamps.



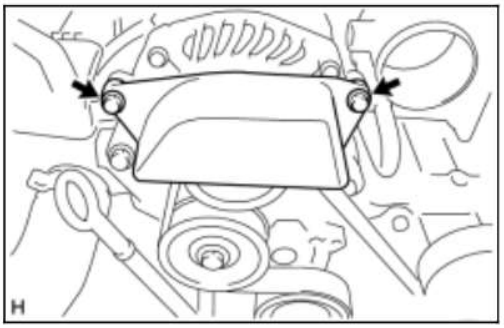
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(e) Remove the 3 bolts and the air cleaner cap with air cleaner hose.



2. REMOVE GENERATOR COVER

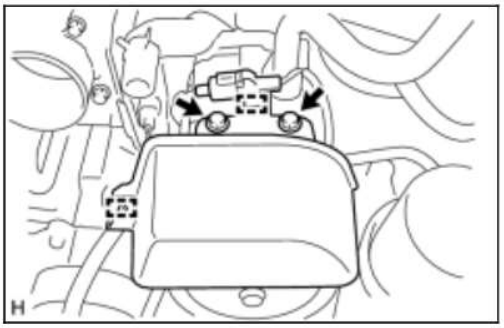
(a) Remove the 2 bolts and generator cover.



3. REMOVE BELT GENERATOR COVER

(a) Disengage the 2 clamps and separate the wire harness from the belt generator cover.

(b) Remove the 2 bolts and belt generator cover.

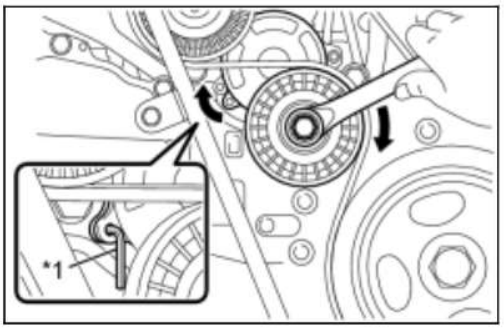


4. REMOVE FAN AND GENERATOR V BELT

(a) While turning the belt tensioner clockwise, align the holes and insert a 3 mm (0.118 in.) hexagon wrench into the holes to hold the belt tensioner.

Text in Illustration

*1	Hexagon Wrench



HINT:

The pulley bolt for the belt tensioner has a left-hand thread.

(b) Remove the fan and generator V belt from the belt tensioner.

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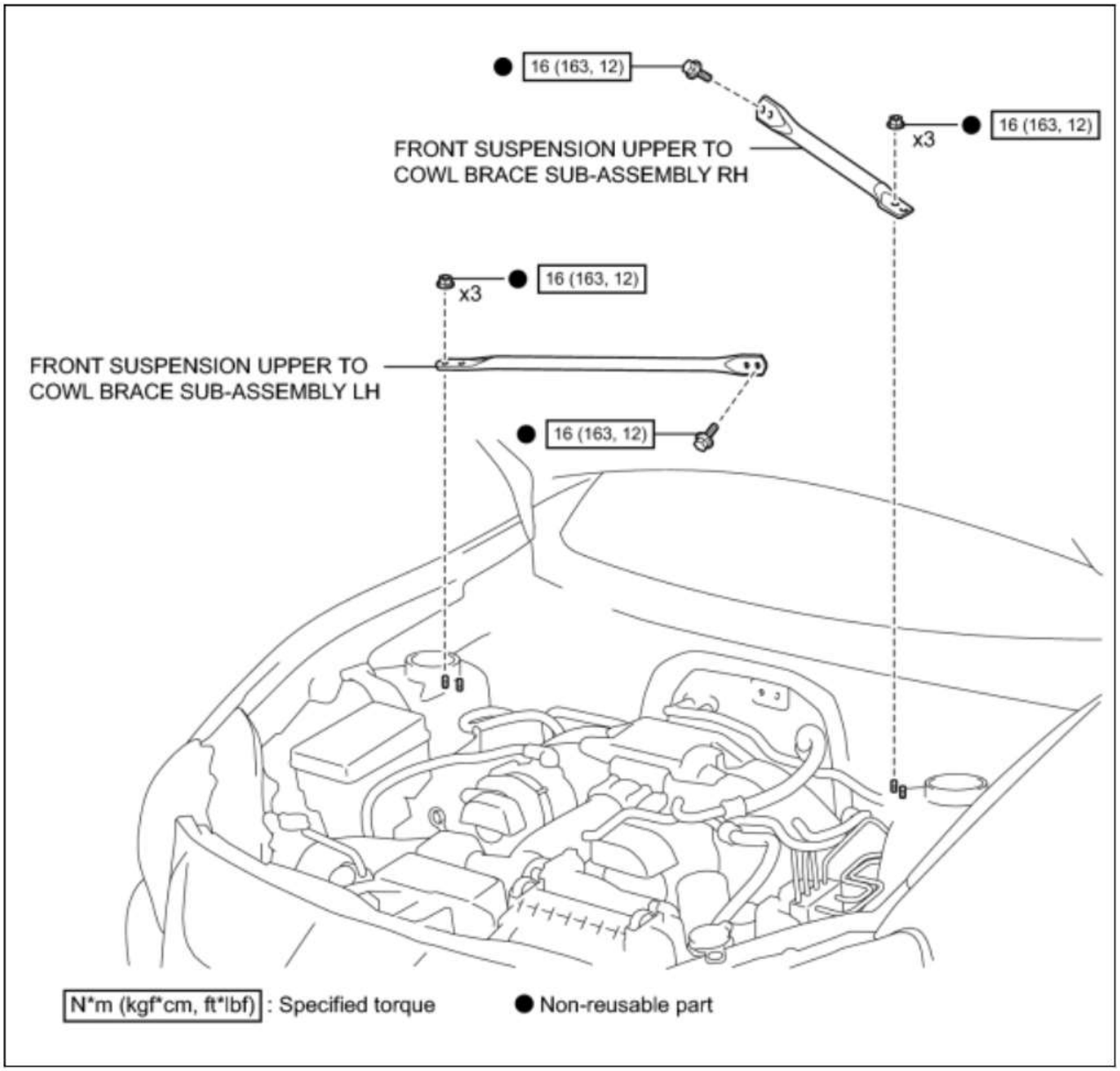


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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000003IC9006X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE ASSEMBLY: COMPONENTS; 2013 MY FR-S [03/2012 -]		

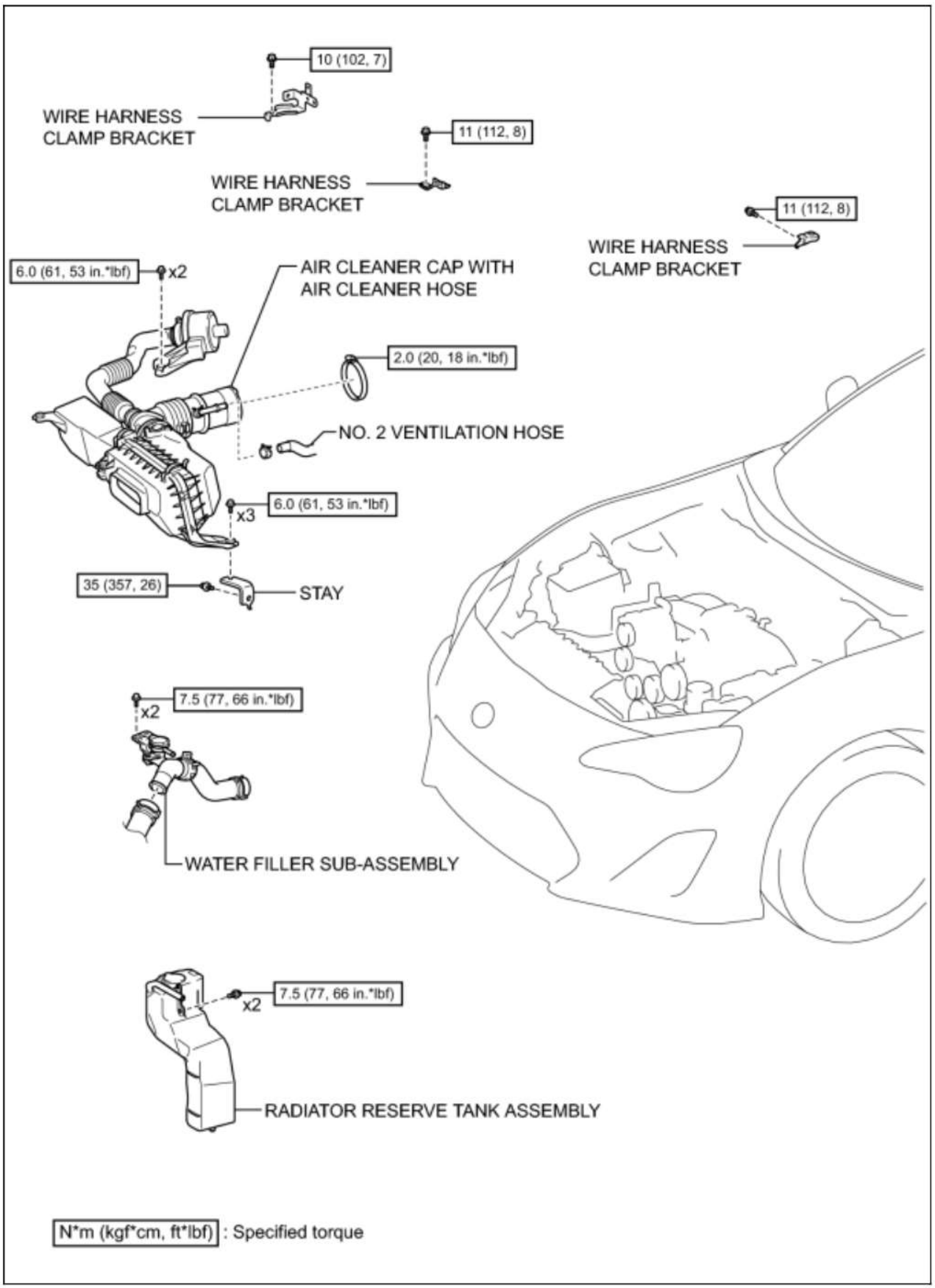
COMPONENTS

ILLUSTRATION



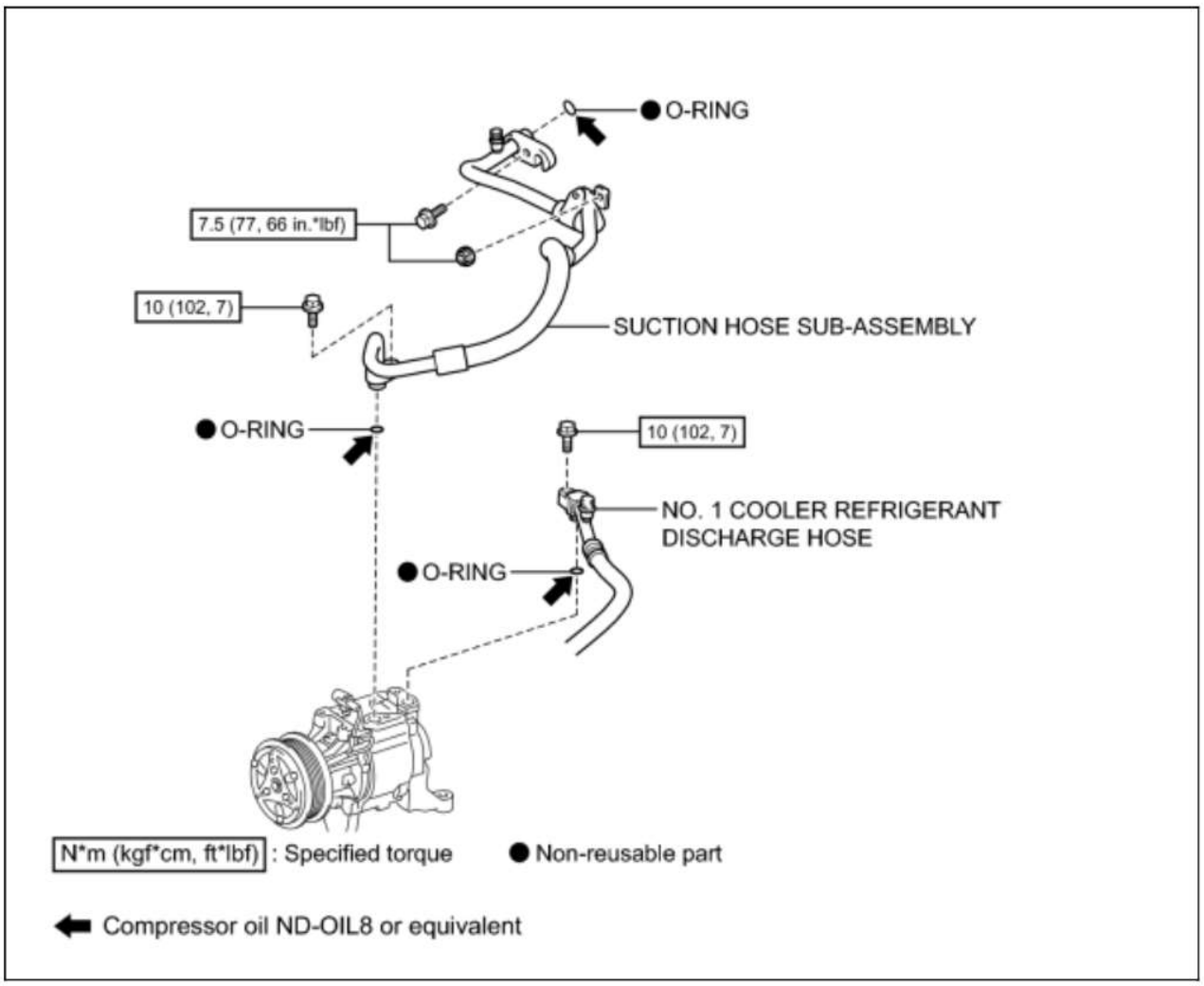
ILLUSTRATION

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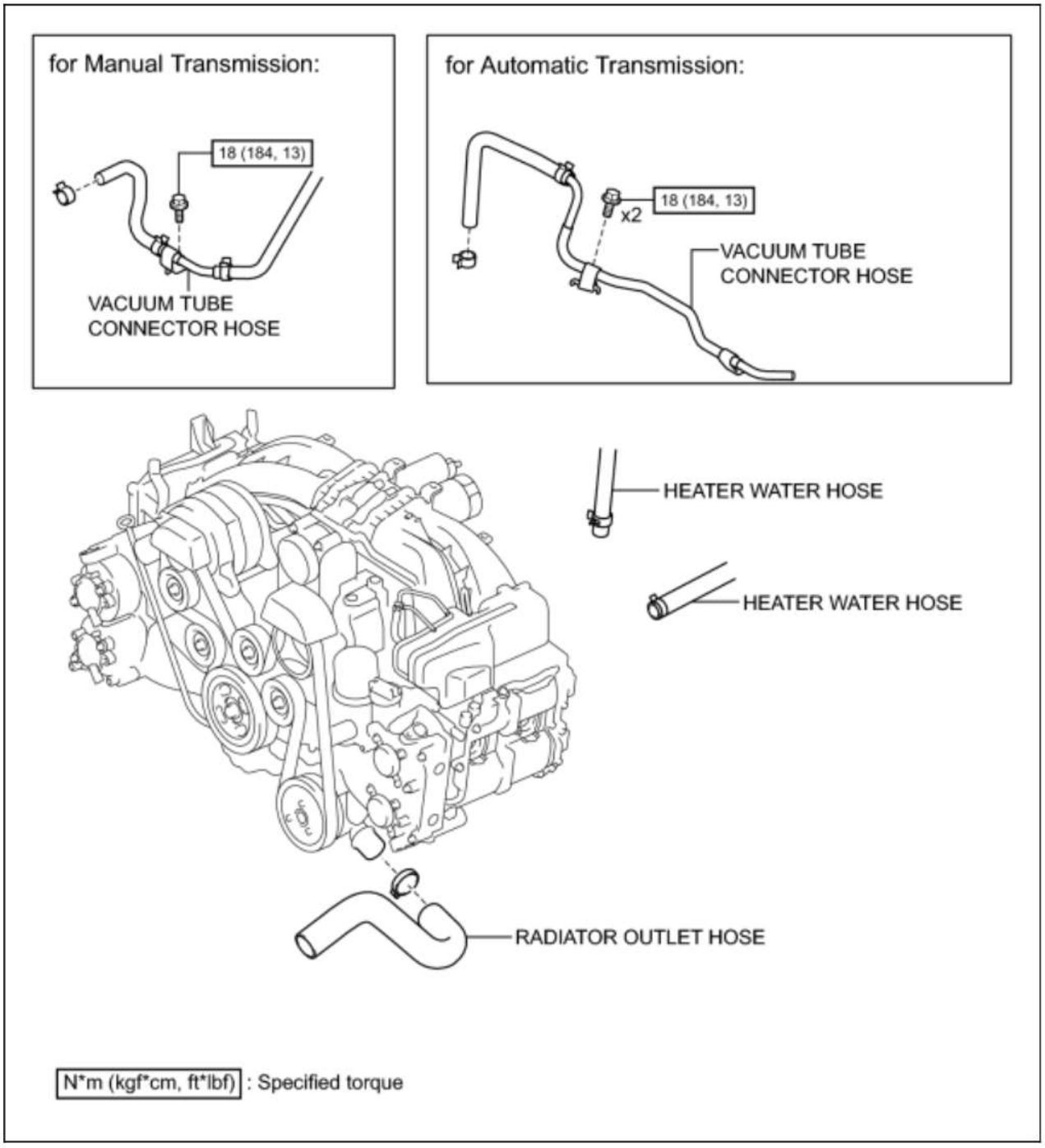
ILLUSTRATION

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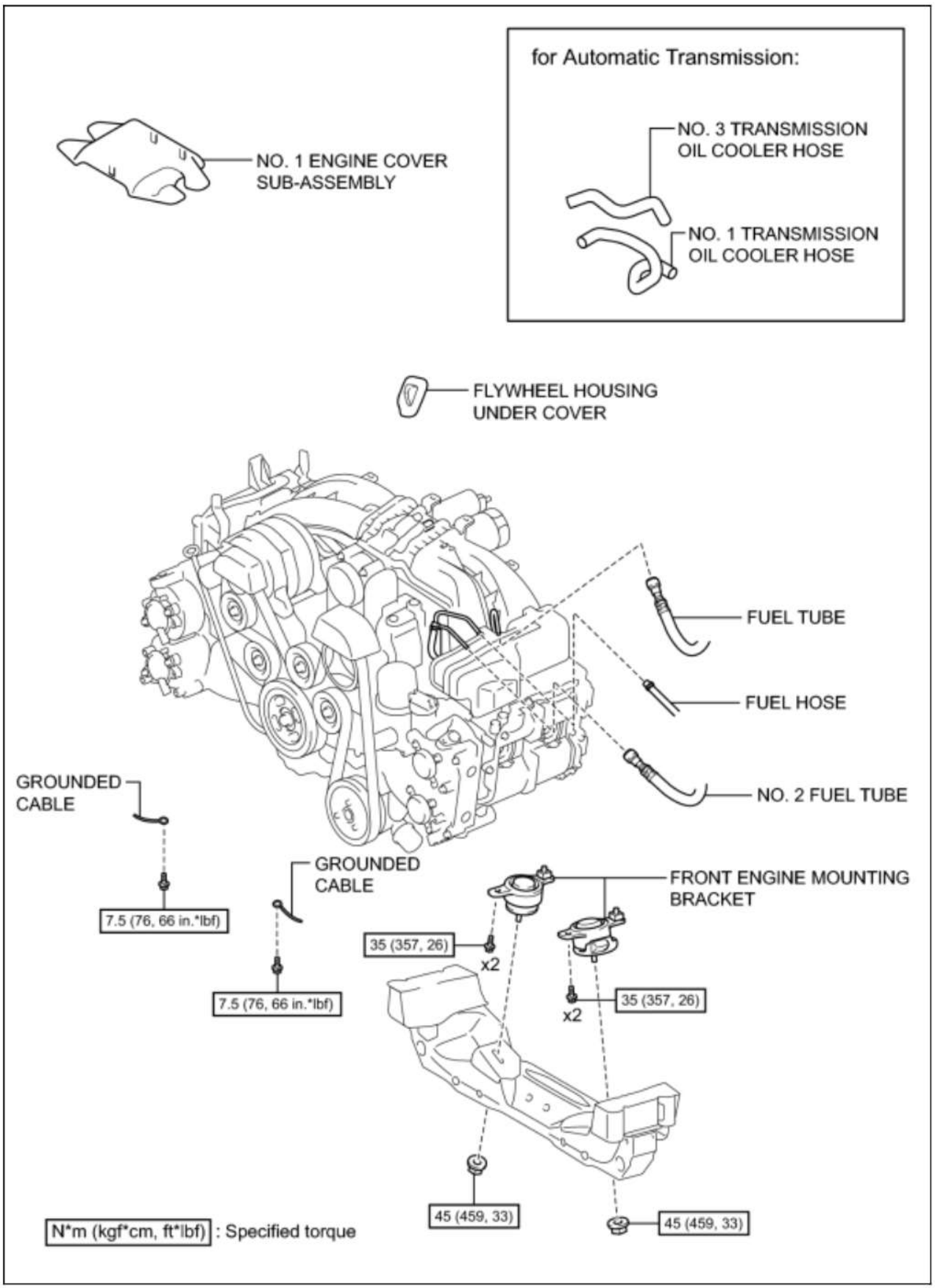
ILLUSTRATION

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ILLUSTRATION

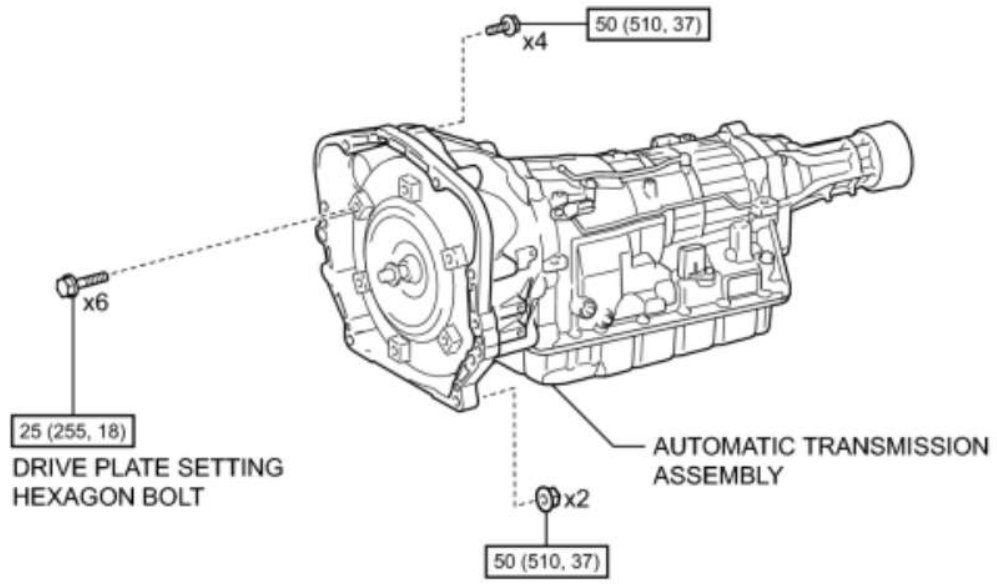
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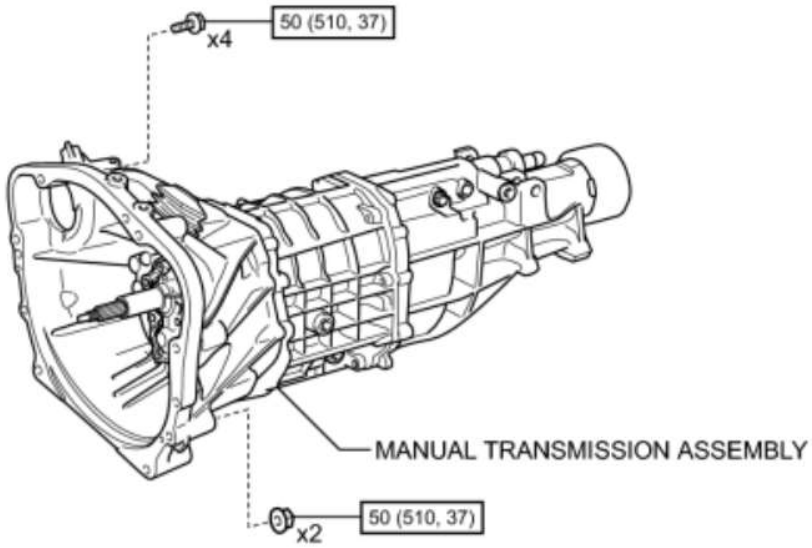
ILLUSTRATION

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for Automatic Transmission:



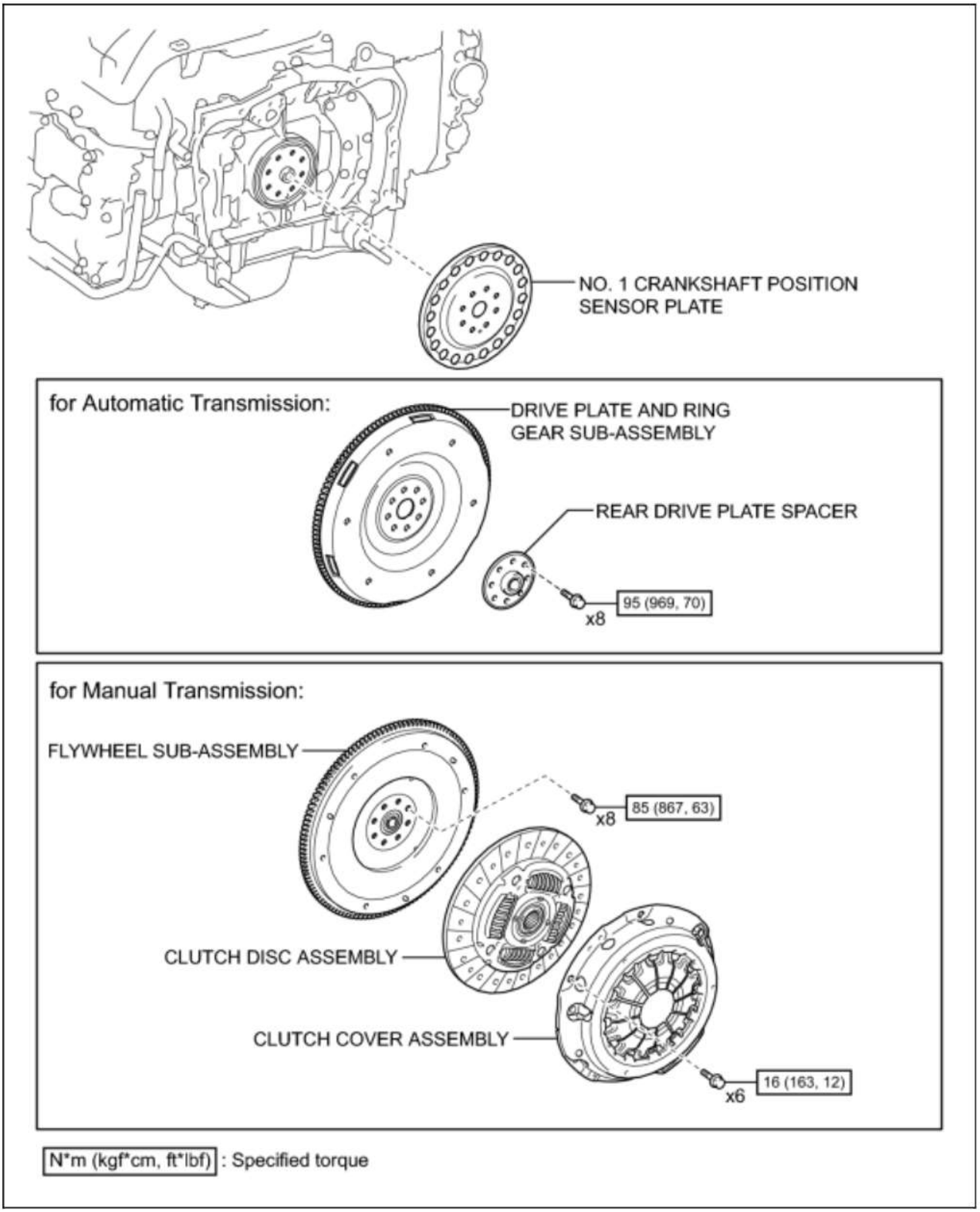
for Manual Transmission:



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

ILLUSTRATION

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000N8101BX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE ASSEMBLY: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL FRONT ENGINE MOUNTING BRACKET

(a) Install the 2 front engine mounting brackets with the 4 bolts.

Torque:

45 N·m {459 kgf·cm, 33ft·lbf}

2. REMOVE ENGINE STAND

(a) Attach an engine sling device and hang the engine with a chain block.

NOTICE:

With the exception of installing the engine assembly to an engine stand or removing the engine assembly from an engine stand, do not perform any work on the engine while it is suspended, as doing so is dangerous.

(b) Remove the engine stand from the engine.

3. INSTALL NO. 1 CRANKSHAFT POSITION SENSOR PLATE INFO

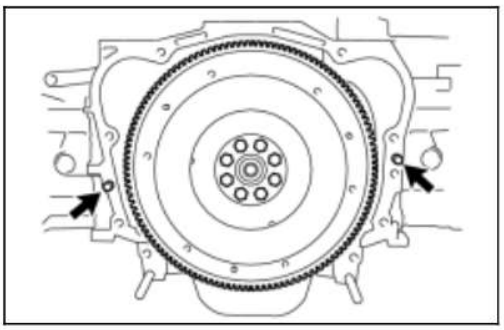
4. INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission) INFO

5. INSTALL CLUTCH DISC ASSEMBLY (for Manual Transmission) INFO

6. INSTALL CLUTCH COVER ASSEMBLY (for Manual Transmission) INFO

7. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission) INFO

8. INSTALL ENGINE ASSEMBLY



(a) Confirm that 2 knock pins are on the transmission contact surface of the engine block before transmission installation.

(b) Keeping the engine assembly and the transmission assembly in a horizontal position, align the knock pins with each hole on the transmission assembly and install the bolt.

Torque:

50 N·m {510 kgf·cm, 37ft·lbf}

9. REMOVE ENGINE HANGER INFO

10. CONNECT FUEL HOSE

(a) Connect the fuel tube and No. 2 fuel tube to the fuel pipe INFO .

(b) Connect the No. 2 fuel vapor feed hose to the fuel pipe.

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11. INSTALL DRIVE PLATE SETTING HEXAGON BOLT (for Automatic Transmission) INFO

12. INSTALL FLYWHEEL HOUSING UNDER COVER INFO

13. INSTALL FRONT CROSS MEMBER SUB-ASSEMBLY

(a) Install the front suspension crossmember sub-assembly with the 2 nuts.

Torque:
45 N·m {459 kgf·cm, 33ft·lbf}

14. INSTALL MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

(a) Install the 3 bolts and 2nuts.

Torque:
50 N·m {510 kgf·cm, 37ft·lbf}

15. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

(a) Install the 3 bolts and 2nuts.

Torque:
50 N·m {510 kgf·cm, 37ft·lbf}

16. INSTALL FRONT STABILIZER BAR (for Automatic Transmission)

INFO

17. INSTALL EARTH CABLE

(a) Install the 2 grounded cables with the 2 bolts.

Torque:
7.5 N·m {77 kgf·cm, 66in·lbf}

18. CONNECT RADIATOR OUTLET HOSE

(a) Install the clamp and connect the radiator outlet hose.

19. CONNECT NO. 3 TRANSMISSION OIL COOLER HOSE (for Automatic Transmission)

(a) Connect the No. 3 transmission oil cooler hose.

20. INSTALL STARTER ASSEMBLY

INFO

21. CONNECT NO. 1 COOLER REFRIGERANT DISCHARGE HOSE INFO

22. INSTALL SUCTION HOSE SUB-ASSEMBLY

(a) Remove the attached vinyl tape from the hose.

(b) Apply sufficient compressor oil to a new O-ring and the fitting surface of the compressor assembly with pulley.

Compressor oil:
ND-OIL 8 or equivalent

(c) Install the O-ring onto the suction hose sub-assembly.

(d) Install the suction hose sub-assembly onto the compressor assembly with pulley with the bolt.

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Torque:
10 N·m {102 kgf·cm, 7ft·lbf}

(e) Remove the vinyl tape from the pipe.

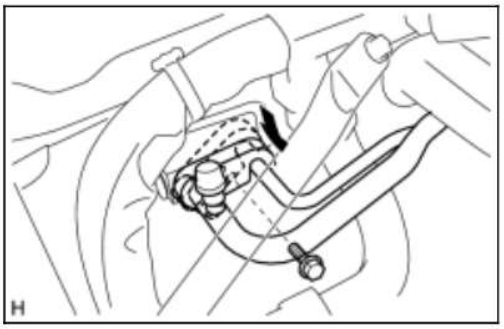
(f) Sufficiently apply compressor oil to a new O-ring and the fitting surface of the suction pipe sub-assembly.

Compressor oil:
ND-OIL 8 or equivalent

(g) Connect the O-ring to the suction pipe sub-assembly.

(h) Connect the suction pipe sub-assembly.

(i) Rotate the hook connector in the direction indicated by the arrow in the illustration.



(j) Insert the pipe joint into the cooler expansion valve securely and tighten the bolt.

Torque:
7.5 N·m {77 kgf·cm, 66in·lbf}

(k) Install the suction pipe sub-assembly with the nut.

Torque:
10 N·m {102 kgf·cm, 7ft·lbf}

23. INSTALL NO. 1 TRANSMISSION OIL COOLER HOSE (for Automatic Transmission)

(a) Connect the No. 1 transmission oil cooler hose.

24. CONNECT HEATER WATER HOSE

(a) Install the 2 hose clamps and connect 2 heater water hoses.

25. INSTALL EXHAUST MANIFOLD

INFO

26. CONNECT VACUUM TUBE CONNECTOR HOSE (for Manual Transmission)

(a) Connect the vacuum tube connector hose with the bolt.

Torque:
18 N·m {184 kgf·cm, 13ft·lbf}

(b) Connect the vacuum tube connector hose.

27. CONNECT VACUUM TUBE CONNECTOR HOSE (for Automatic Transmission)

(a) Connect the vacuum tube connector hose with the 2 bolts.

Torque:
18 N·m {184 kgf·cm, 13ft·lbf}

(b) Connect the vacuum tube connector hose.

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28. INSTALL NO. 1 ENGINE COVER SUB-ASSEMBLY INFO

29. CONNECT ENGINE WIRE

(a) Connect the generator connector and connect the clamp.

(b) Connect the generator wire with the nut.

Torque:
16 N·m {163 kgf·cm, 12ft·lbf}

(c) Install the terminal cap.

(d) Connect the 5 wire harness clamps.

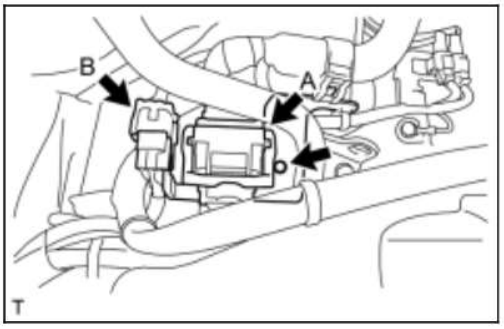
(e) Install the 2 wire harness clamp brackets with the 2 bolts.

Torque:
11 N·m {112 kgf·cm, 8ft·lbf}

(f) Connect the 2 wire harness clamps to the 2 wire harness clamp brackets.

(g) Connect the wire harness clamp to the No. 2 engine hanger.

(h) Connect the connector (B).



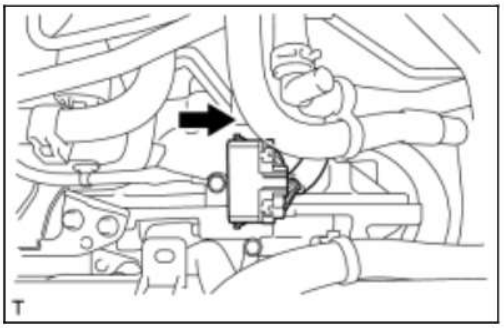
(i) Connect the wire harness connector (A) and securely lock the connector.

(j) Install the wire harness clamp bracket to the No. 2 engine hanger with the bolt.

Torque:
10 N·m {102 kgf·cm, 7ft·lbf}

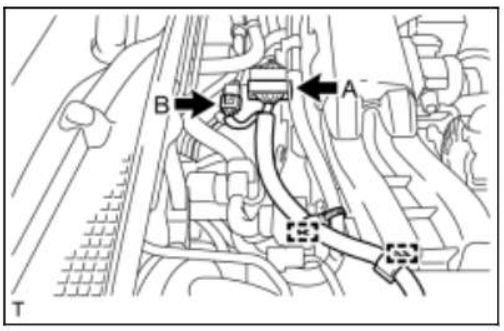
(k) for Automatic Transmission:

(1) Slide the connector in the direction shown in the diagram, and connect the wire harness.



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(2) Connect the 2 wire harness clamps.



(3) Connect the wire harness connector (A) and securely lock the connector.

(4) Connect the connector (B).

30. INSTALL INJECTOR DRIVER INFO

31. INSTALL WATER FILLER SUB-ASSEMBLY

(a) Install the 2 clamps and connect the water filler sub-assembly.

(b) Install the water filler sub-assembly with 2 bolts.

Torque:
7.5 N·m {77 kgf·cm, 66in·lbf}

32. INSTALL RADIATOR RESERVE TANK ASSEMBLY INFO

33. INSTALL AIR CLEANER CAP WITH AIR CLEANER HOSE

(a) Install the stay with bolt to the body.

Torque:
35 N·m {357 kgf·cm, 26ft·lbf}

(b) Install the air cleaner assembly with hose with the 3 bolts.

Torque:
6.0 N·m {61 kgf·cm, 53in·lbf}

(c) Install the hose clamp.

Torque:
2.0 N·m {20 kgf·cm, 18in·lbf}

(d) Connect the clamp and wire harness to the air cleaner cap.

(e) Connect the mass air flow meter connector.

(f) Connect the No. 2 ventilation hose.

(g) Install the 2 bolts and the chamber duct with chamber.

Torque:
6.0 N·m {61 kgf·cm, 53in·lbf}

(h) Connect the hose.

34. INSTALL FRONT SUSPENSION UPPER TO COWL BRACE SUB-ASSEMBLY LH INFO

35. INSTALL FRONT SUSPENSION UPPER TO COWL BRACE SUB-ASSEMBLY RH INFO

36. ADD ENGINE OIL INFO

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37. CONNECT CABLE TO NEGATIVE BATTERY TERMINAL INFO

38. ADD ENGINE COOLANT INFO

39. CHARGE WITH REFRIGERANT

INFO

40. CHECK FOR ENGINE COOLANT LEAK INFO

41. CHECK FOR ENGINE OIL LEAK INFO

42. CHECK FOR FUEL LEAK INFO

43. CHECK FOR EXHAUST GAS LEAK INFO

44. INSPECT FOR REFRIGERANT LEAK

INFO

45. INSPECT THROTTLE WITH MOTOR BODY ASSEMBLY INFO

46. INSPECT IGNITION TIMING INFO

47. INSPECT ENGINE IDLE SPEED INFO

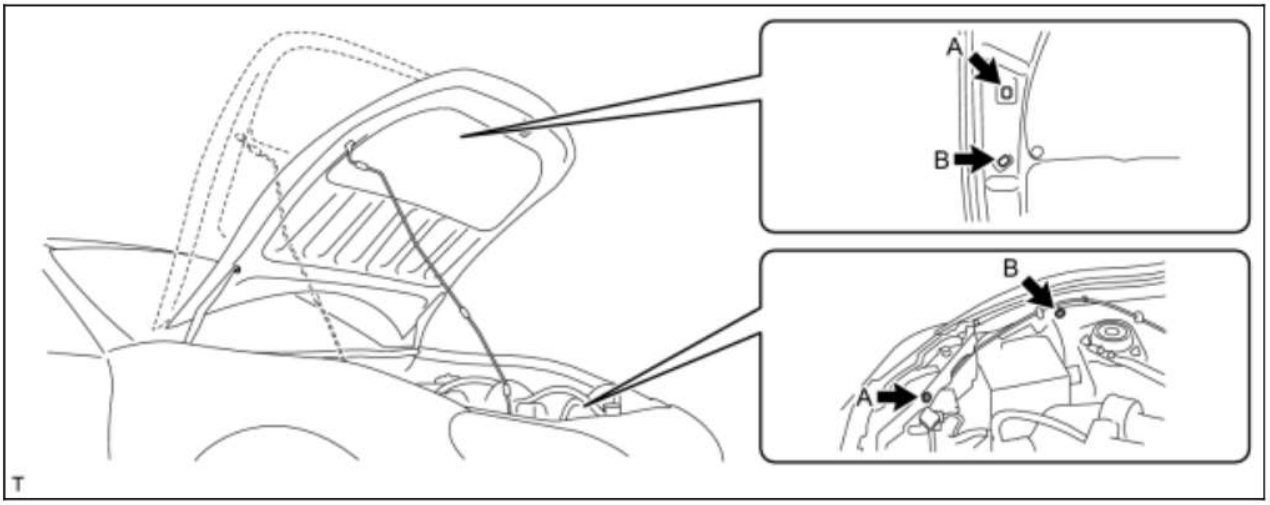
48. INSPECT CO/ HC INFO

49. INSPECT ENGINE COOLANT LEVEL INFO

50. INSPECT ENGINE OIL LEVEL INFO

51. SET HOOD SUB-ASSEMBLY

(a) Change the front hood stay position from B to A, and store the front hood stay.



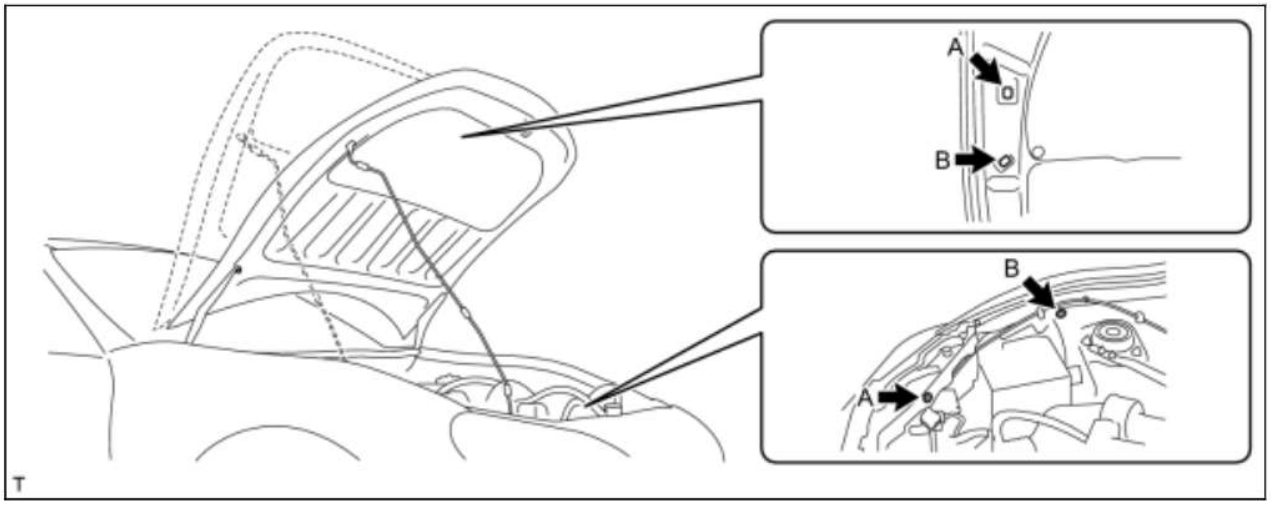
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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000N82013X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE ASSEMBLY: REMOVAL; 2013 MY FR-S [03/2012 -]		

REMOVAL

1. SET HOOD SUB-ASSEMBLY



(a) Change the front hood stay position from A to B, and support the hood sub-assembly at position B.

2. RECOVER REFRIGERANT FROM REFRIGERATION SYSTEM

INFO

3. DISCHARGE FUEL SYSTEM PRESSURE

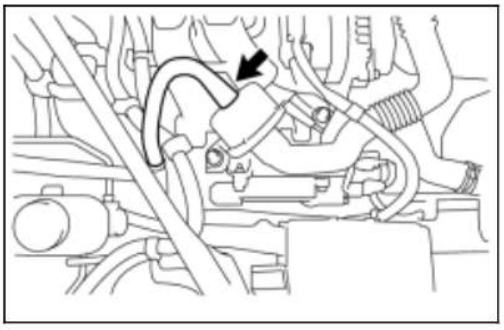
INFO

4. DISCONNECT CABLE FROM NEGATIVE BATTERY TERMINAL INFO

5. REMOVE FRONT SUSPENSION UPPER TO COWL BRACE SUB-ASSEMBLY LH INFO

6. REMOVE FRONT SUSPENSION UPPER TO COWL BRACE SUB-ASSEMBLY RH INFO

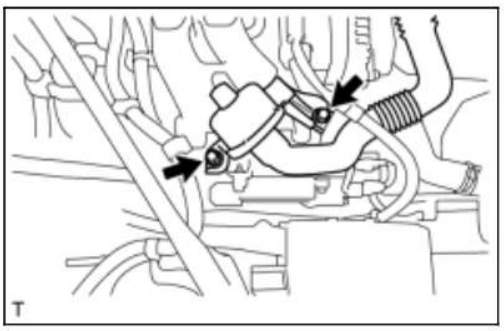
7. REMOVE AIR CLEANER CAP WITH AIR CLEANER HOSE



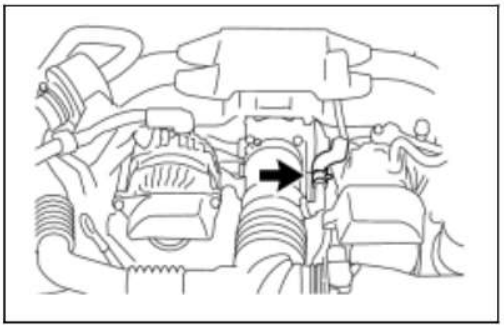
(a) Disconnect the hose.

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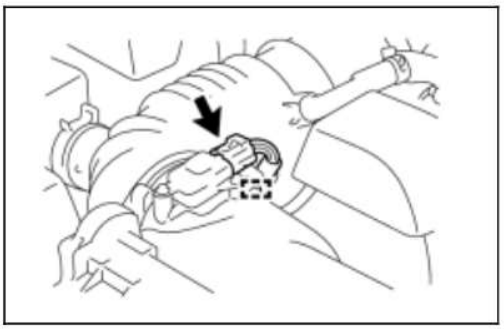
(b) Remove the 2 bolts and disconnect the chamber.



(c) Loosen the hose clamp and disconnect the No. 2 ventilation hose.

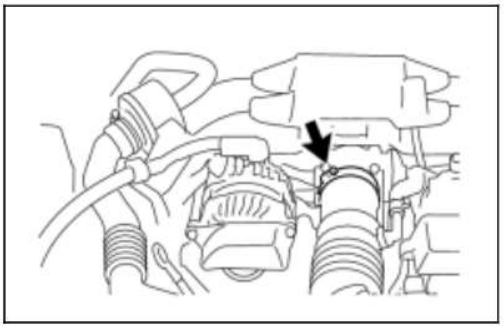


(d) Disconnect the mass air flow meter connector.



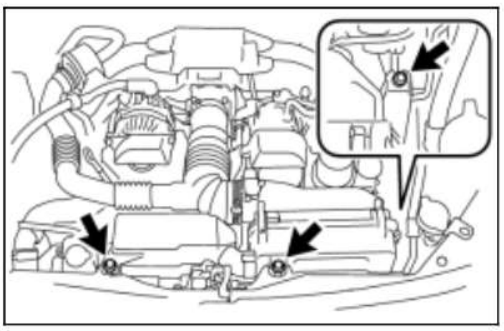
(e) Disengage the clamp and separate the wire harness from the air cleaner cap.

(f) Loosen the hose clamp.

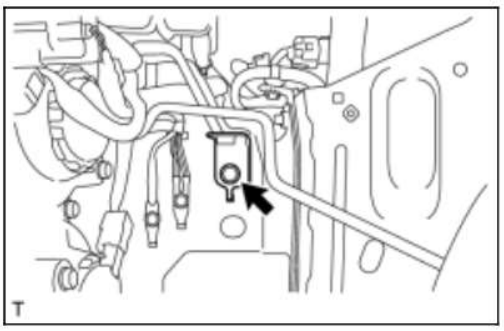


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(g) Remove the 3 bolts and air cleaner cap with air cleaner hose.



(h) Remove the bolt and stay from the body.



8. DRAIN ENGINE OIL INFO

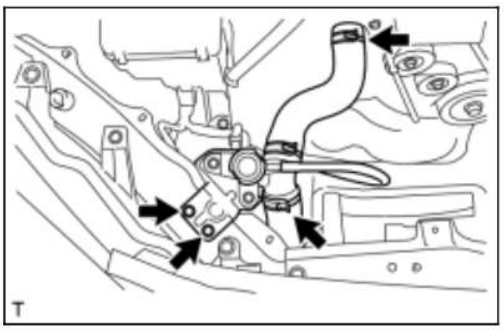
9. DRAIN ENGINE COOLANT INFO

10. REMOVE RADIATOR RESERVE TANK ASSEMBLY INFO

11. REMOVE WATER FILLER SUB-ASSEMBLY

(a) Remove the 2 bolts and disconnect the water filler sub-assembly.

(b) Remove the 2 clamps and water filler sub-assembly.



12. REMOVE INJECTOR DRIVER INFO

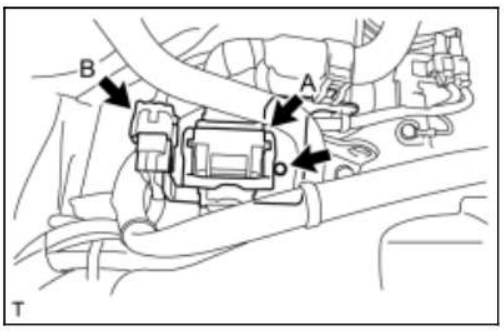
13. DISCONNECT ENGINE WIRE

HINT:

Fix the disconnected harness components with tape to keep them out of the way.

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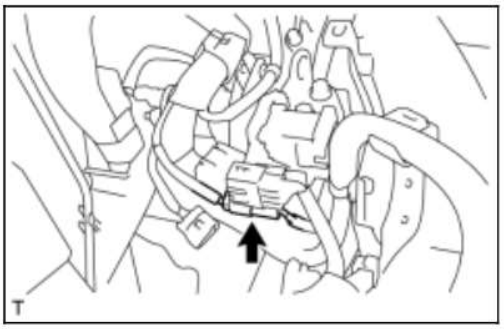
(a) Remove the bolt and wire harness clamp bracket from the No. 2 engine hanger.



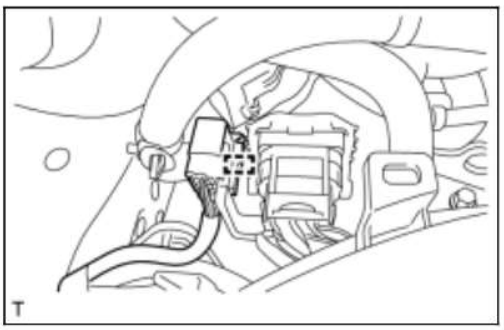
(b) Release the lock of connector (A) and disconnect the connector.

(c) Disconnect the connector (B).

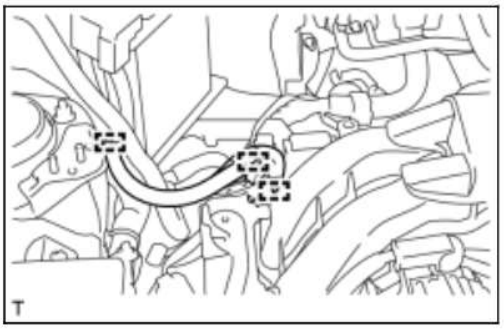
(d) Disconnect the connector.



(e) Disconnect the wire harness clamp and wire harness from the No. 2 engine hanger.



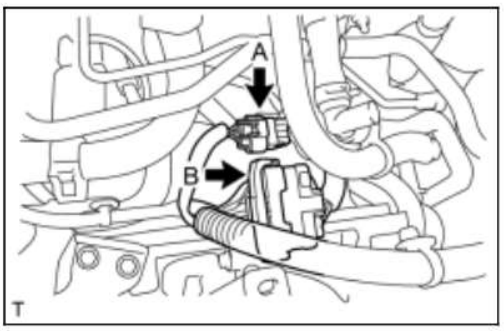
(f) Disconnect the 3 wire harness clamps.



(g) for Automatic Transmission:

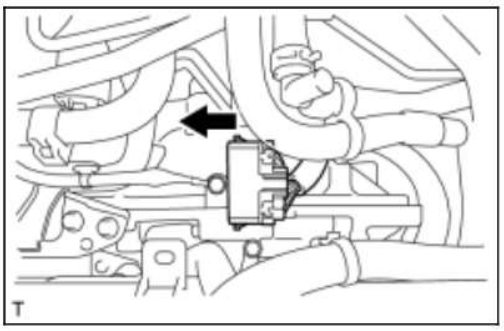
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(1) Release the lock of connector (A) and disconnect the connector.

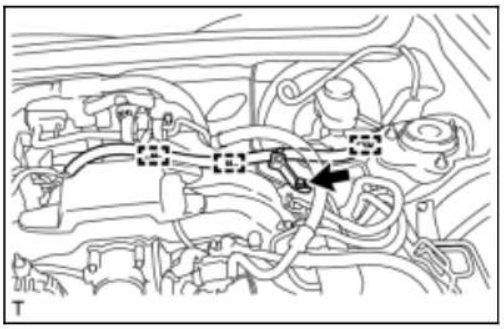


(2) Disconnect the connector (B).

(3) Slide the connector in the direction shown in the illustration, and disconnect the wire harness.

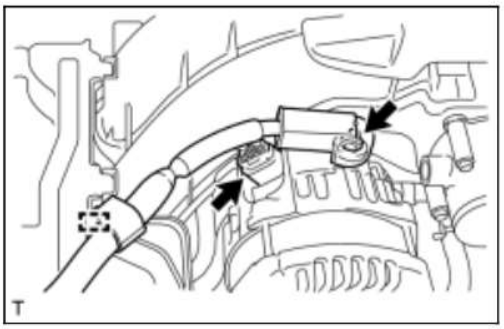


(4) Disconnect the 3 wire harness clamps.



(5) Remove the bolt and wire harness clamp bracket.

(h) Disconnect the terminal cap.



(i) Remove the nut and disconnect the wire harness from terminal B.

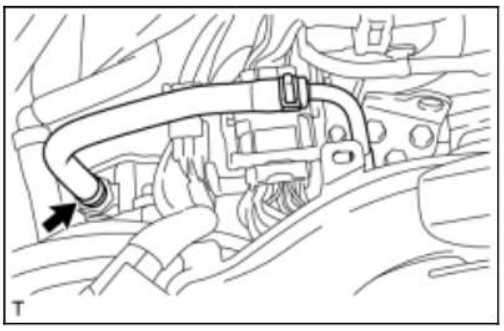
(j) Disconnect the generator connector and disengage the clamp.

14. REMOVE NO. 1 ENGINE COVER SUB-ASSEMBLY INFO

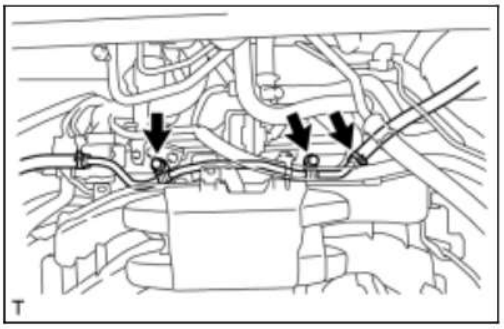
15. DISCONNECT VACUUM TUBE CONNECTOR HOSE (for Automatic Transmission)

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(a) Loosen the hose clamp and disconnect the vacuum tube connector hose.



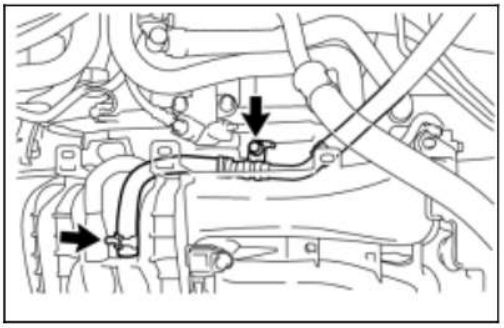
(b) Remove the 2 bolts and disconnect the vacuum tube connector hose.



(c) Loosen the hose clamp and remove the vacuum tube connector hose.

16. DISCONNECT VACUUM TUBE CONNECTOR HOSE (for Manual Transmission)

(a) Loosen the hose clamp and disconnect the vacuum tube connector hose from the intake manifold.



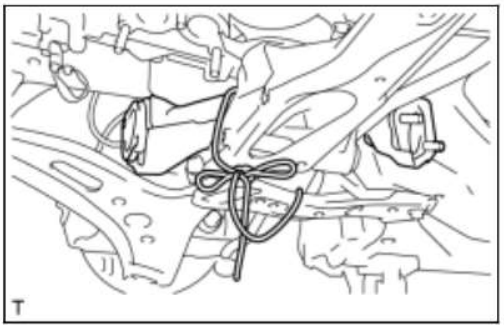
(b) Remove the bolt and disconnect the vacuum tube connector hose.

17. REMOVE EXHAUST MANIFOLD

INFO

18. FIX FRONT EXHAUST PIPE SUB-ASSEMBLY (for Manual Transmission)

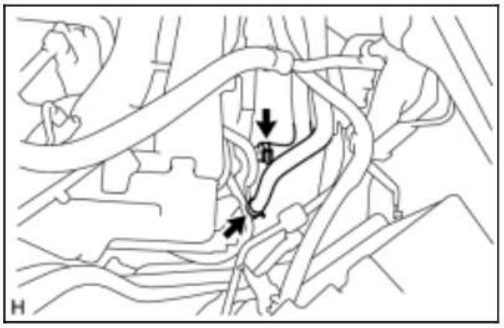
(a) Tie the front exhaust pipe sub-assembly to the front cross member sub-assembly with rope.



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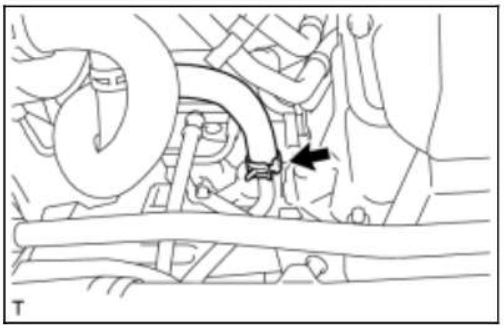
19. DISCONNECT HEATER WATER HOSE

(a) Loosen the 2 hose clamps and disconnect the 2 heater water hoses.



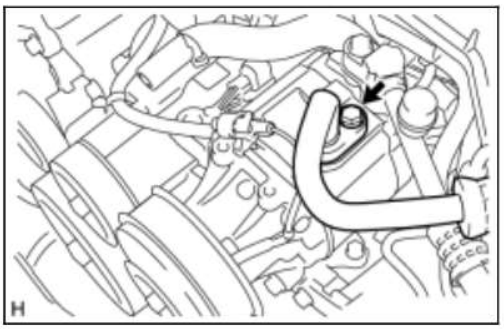
20. DISCONNECT NO. 1 TRANSMISSION OIL COOLER HOSE (for Automatic Transmission)

(a) Loosen the clip and disconnect the No. 1 transmission oil cooler hose.



21. REMOVE SUCTION HOSE SUB-ASSEMBLY

(a) Remove the bolt and disconnect the suction hose sub-assembly from the compressor assembly with pulley.

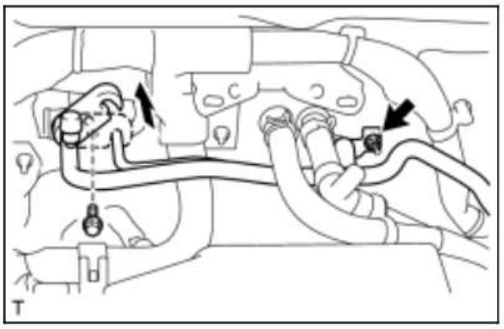


(b) Remove the O-ring from the discharge hose sub-assembly.

NOTICE:

Seal the openings of the disconnected parts using vinyl tape to prevent entry of moisture and foreign matter.

(c) Remove the bolt and slide the hook connector.



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(d) Remove the nut and suction pipe sub-assembly.

(e) Remove the O-ring from the suction pipe sub-assembly.

NOTICE:

Seal the openings of the disconnected parts using vinyl tape to prevent entry of moisture and foreign matter.

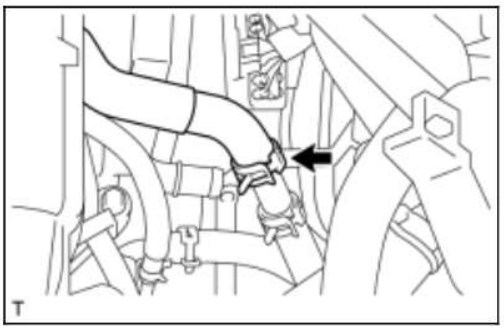
22. DISCONNECT NO. 1 COOLER REFRIGERANT DISCHARGE HOSE INFO

23. REMOVE STARTER ASSEMBLY

INFO

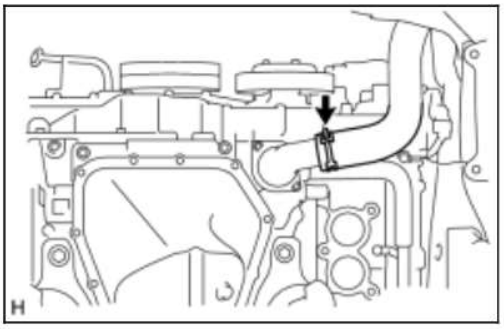
24. DISCONNECT NO. 3 TRANSMISSION OIL COOLER HOSE (for Automatic Transmission)

(a) Loosen the clip and disconnect the No. 3 transmission oil cooler hose.



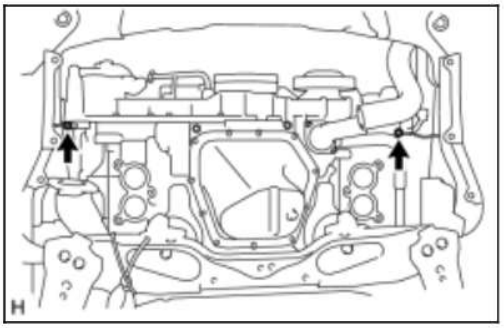
25. DISCONNECT RADIATOR OUTLET HOSE

(a) Loosen the clip and disconnect the radiator outlet hose.



26. DISCONNECT GROUNDED CABLE

(a) Remove the 2 bolts and disconnect the 2 grounded cables.



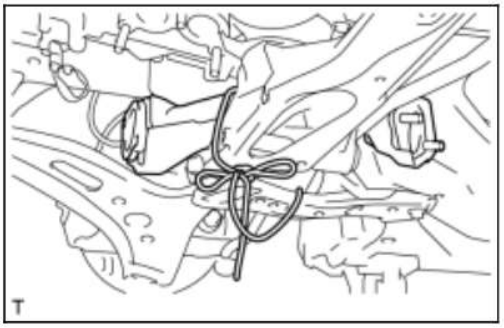
27. REMOVE FRONT STABILIZER BAR (for Automatic Transmission)

INFO

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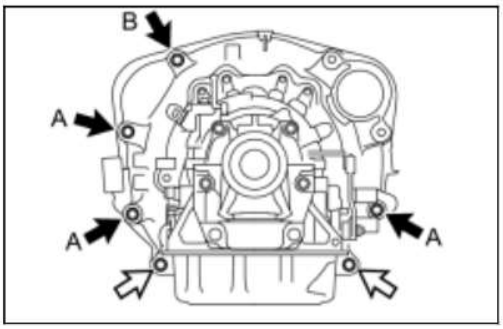
28. FIX FRONT EXHAUST PIPE ASSEMBLY (for Automatic Transmission)

(a) Tie the front exhaust pipe assembly to the front cross member sub-assembly with rope.



29. SEPARATE AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

(a) Remove the 3 bolts and 2 nuts.



Text in Illustration

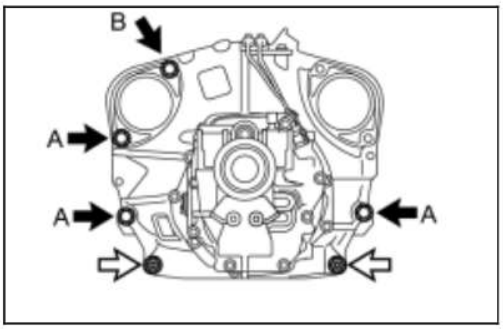
➡	Bolt
⇨	Nut

NOTICE:

In order to prevent dropping, do not remove bolt B.

30. REMOVE MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

(a) Remove the 3 bolts and 2 nuts.



Text in Illustration

➡	Bolt

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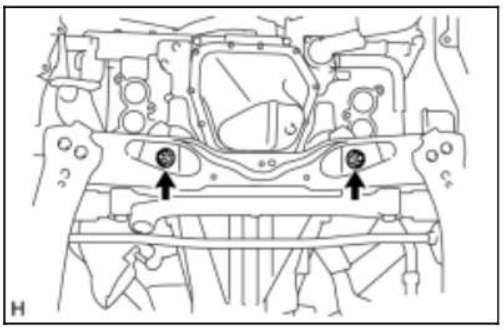
⇨	Nut

NOTICE:

In order to prevent dropping, do not remove bolt B.

31. SEPARATE FRONT CROSS MEMBER SUB-ASSEMBLY

(a) Remove the 2 nuts from the front cross member sub-assembly.



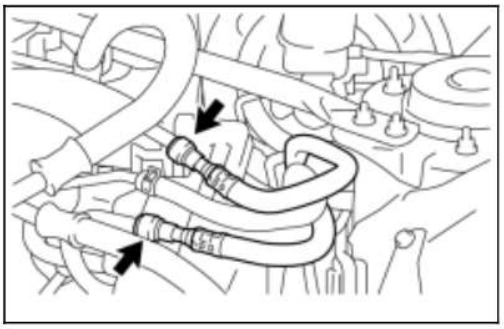
32. REMOVE FLYWHEEL HOUSING UNDER COVER INFO

33. REMOVE DRIVE PLATE SETTING HEXAGON BOLT (for Automatic Transmission) INFO

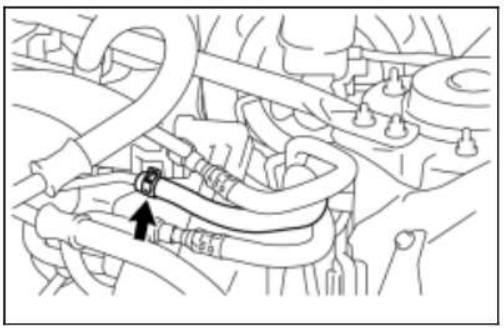
34. SEPARATE FUEL HOSE

(a) Using SST, disconnect the fuel tube and No. 2 fuel tube from the fuel pipe INFO .

SST: SU003-03936



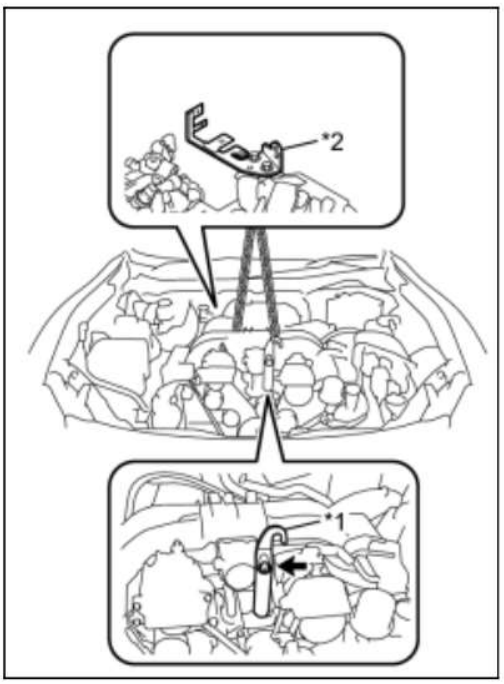
(b) Remove the clamp and disconnect the No. 2 fuel vapor feed hose from the fuel pipe.



35. INSTALL ENGINE HANGER

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(a) Install the engine hanger with the bolt, as shown in the illustration.



Text in Illustration

*1	No. 1 Engine Hanger
*2	No. 2 Engine Hanger

Torque:

43 N·m {439 kgf·cm, 32ft·lbf}

No. 1 Engine Hanger	12281-38030
Bolt	90119-14120

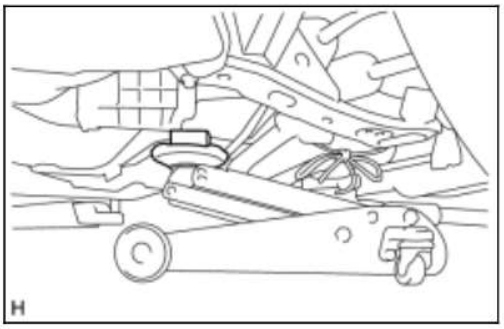
(b) Use an engine sling device and a mini crane to hold the engine.

36. SUPPORT TRANSMISSION ASSEMBLY

(a) Support the transmission assembly clutch housing with a jack.

NOTICE:

Support the transmission assembly until the installation of the engine assembly is completed.



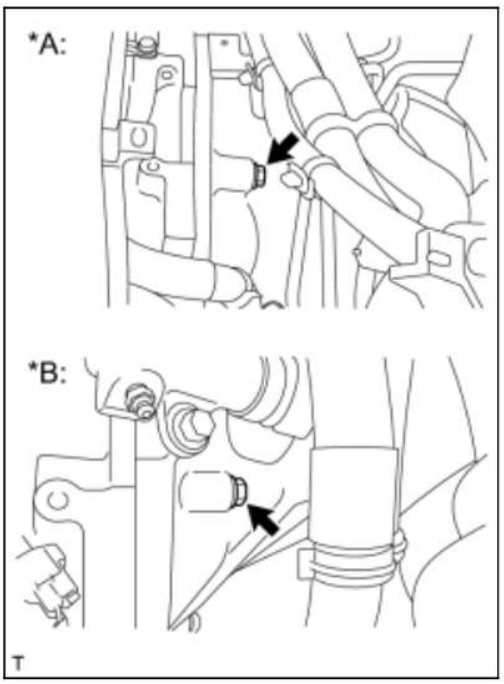
37. REMOVE ENGINE ASSEMBLY

(a) Remove the bolt from the transmission assembly.

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Text in Illustration

*A	for Automatic Transmission
*B	for Manual Transmission



(b) Hoist the engine assembly up with an engine sling device and a mini crane.

38. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission) INFO

39. REMOVE CLUTCH COVER ASSEMBLY (for Manual Transmission) INFO

40. REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission) INFO

41. REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission) INFO

42. REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE INFO

43. INSTALL ENGINE STAND

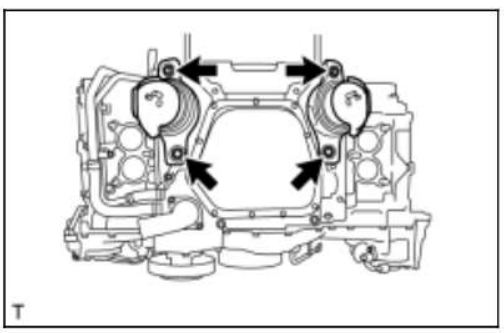
(a) Set the engine on an engine stand.

NOTICE:

With the exception of installing the engine assembly to an engine stand or removing the engine assembly from an engine stand, do not perform any work on the engine while it is suspended, as doing so is dangerous.

44. REMOVE FRONT ENGINE MOUNTING BRACKET

(a) Remove the 4 bolts and 2 front engine mounting brackets.



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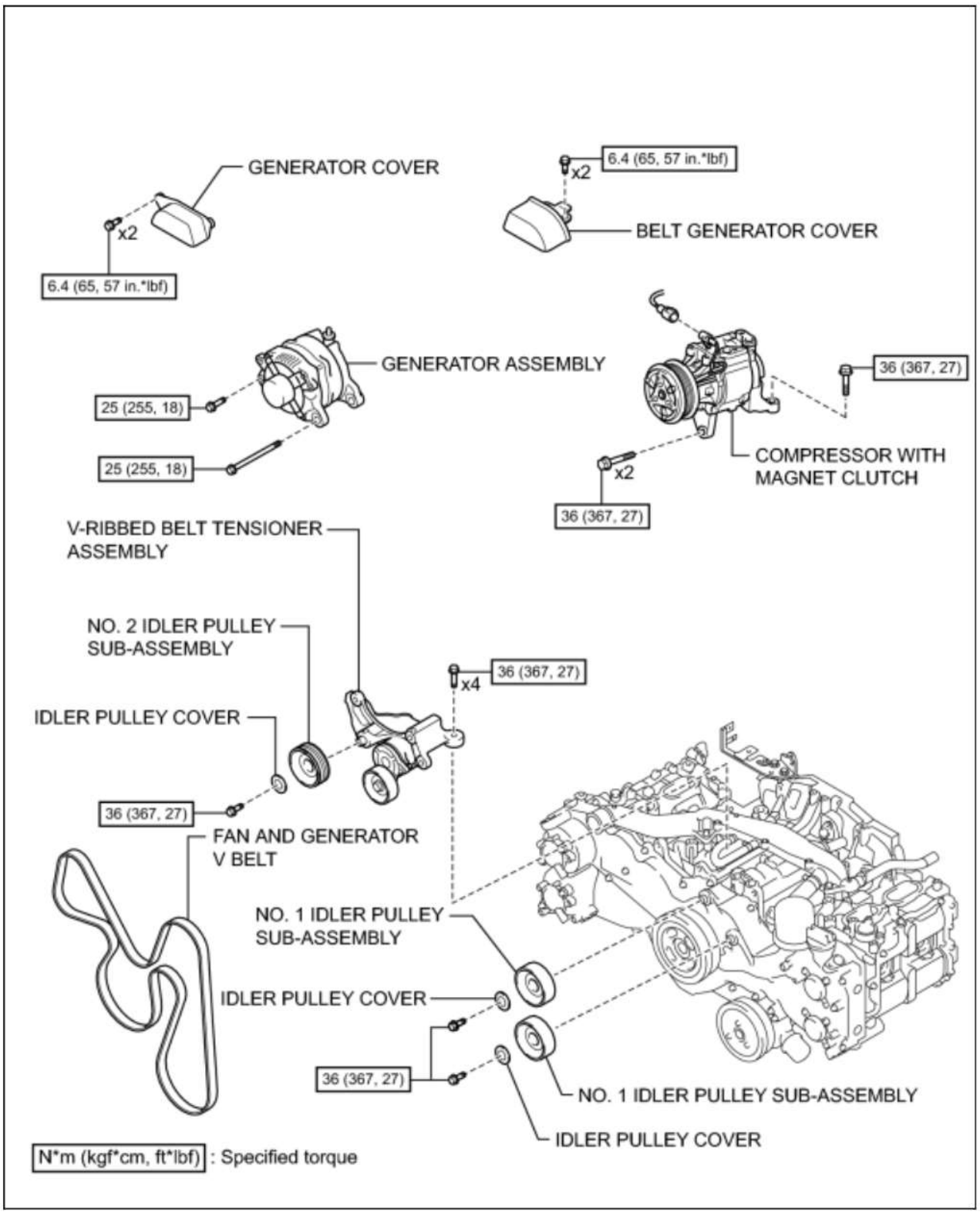
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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000000T4V07GX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE UNIT: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

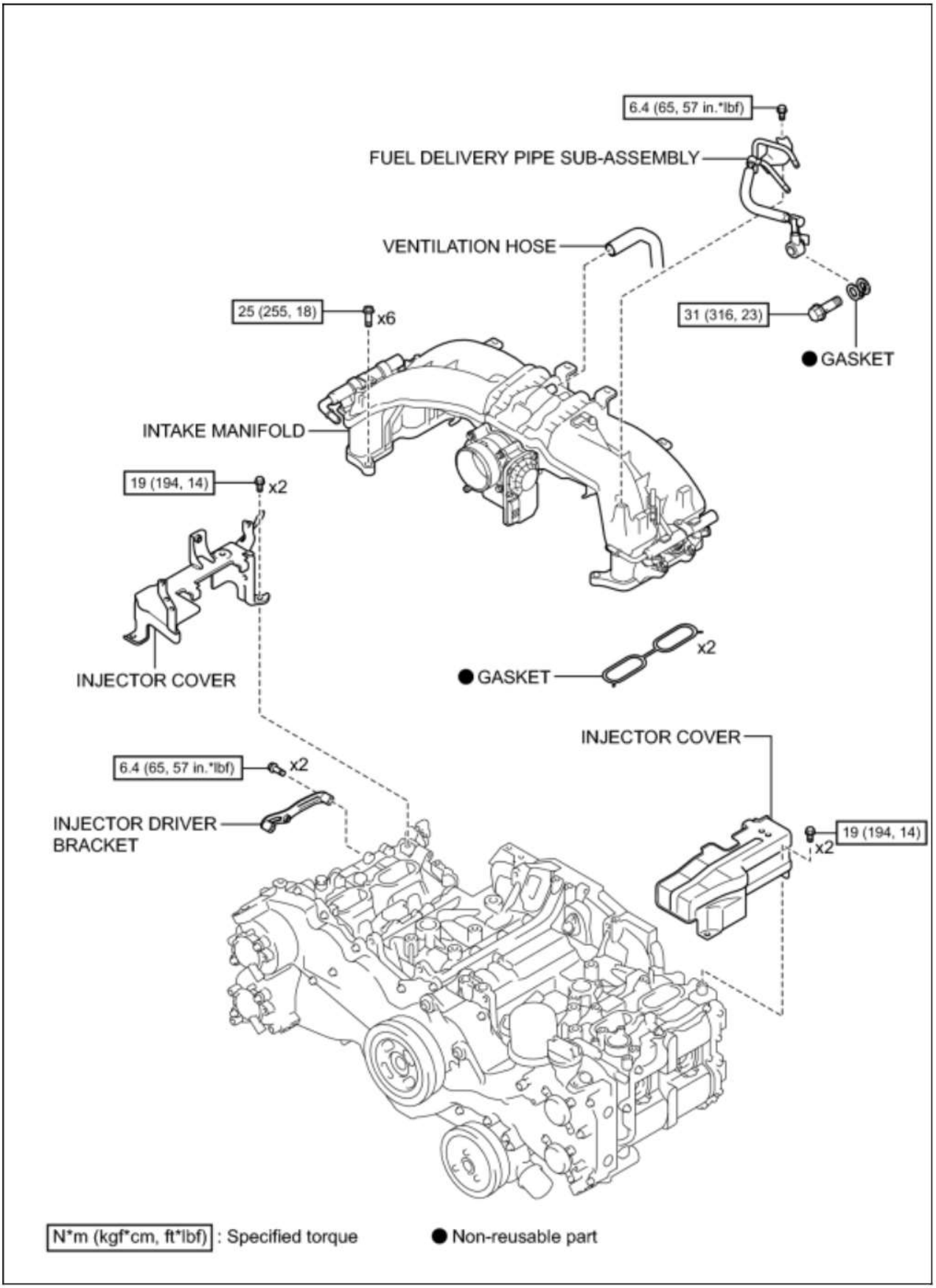
ILLUSTRATION

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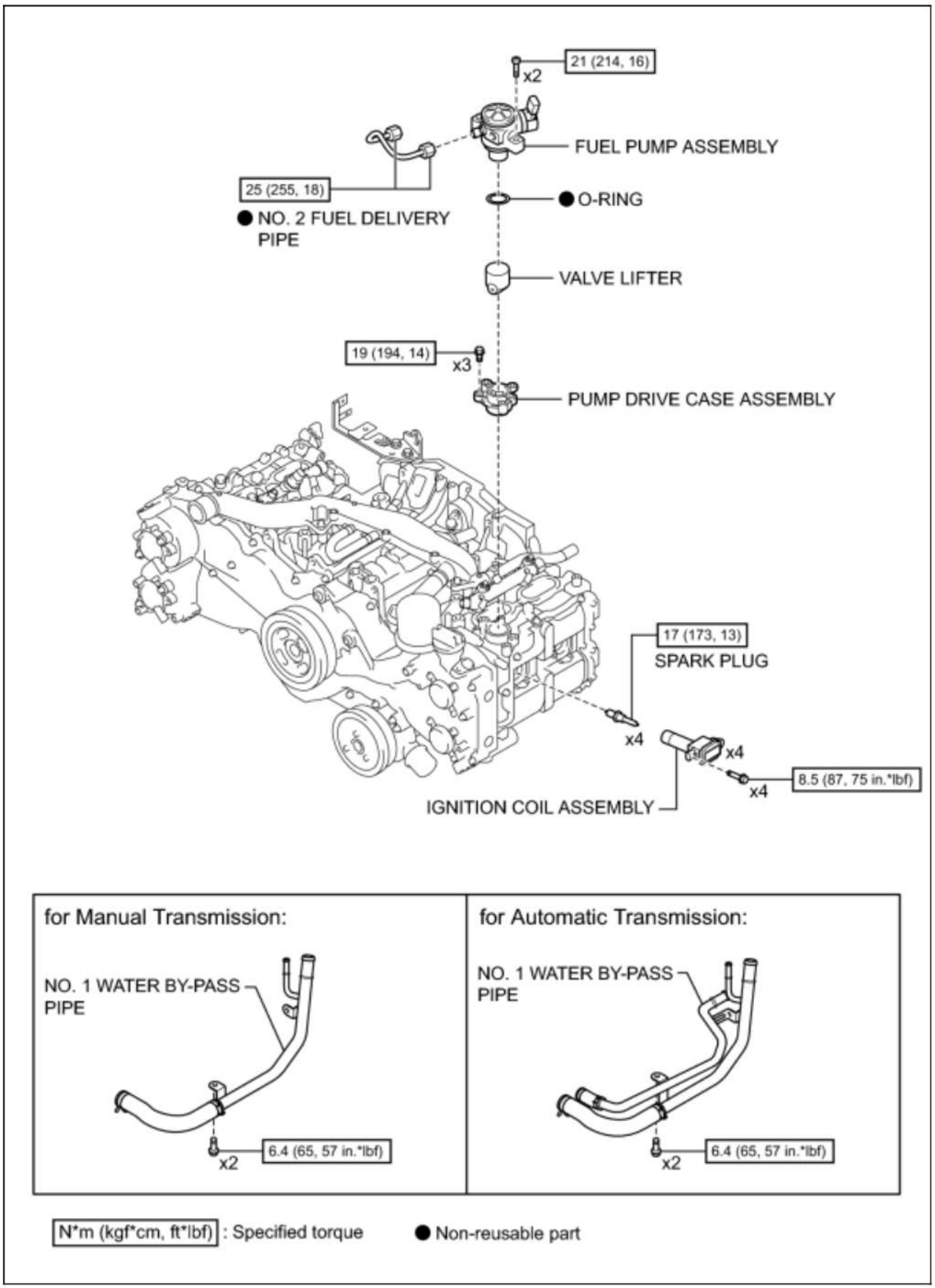
ILLUSTRATION

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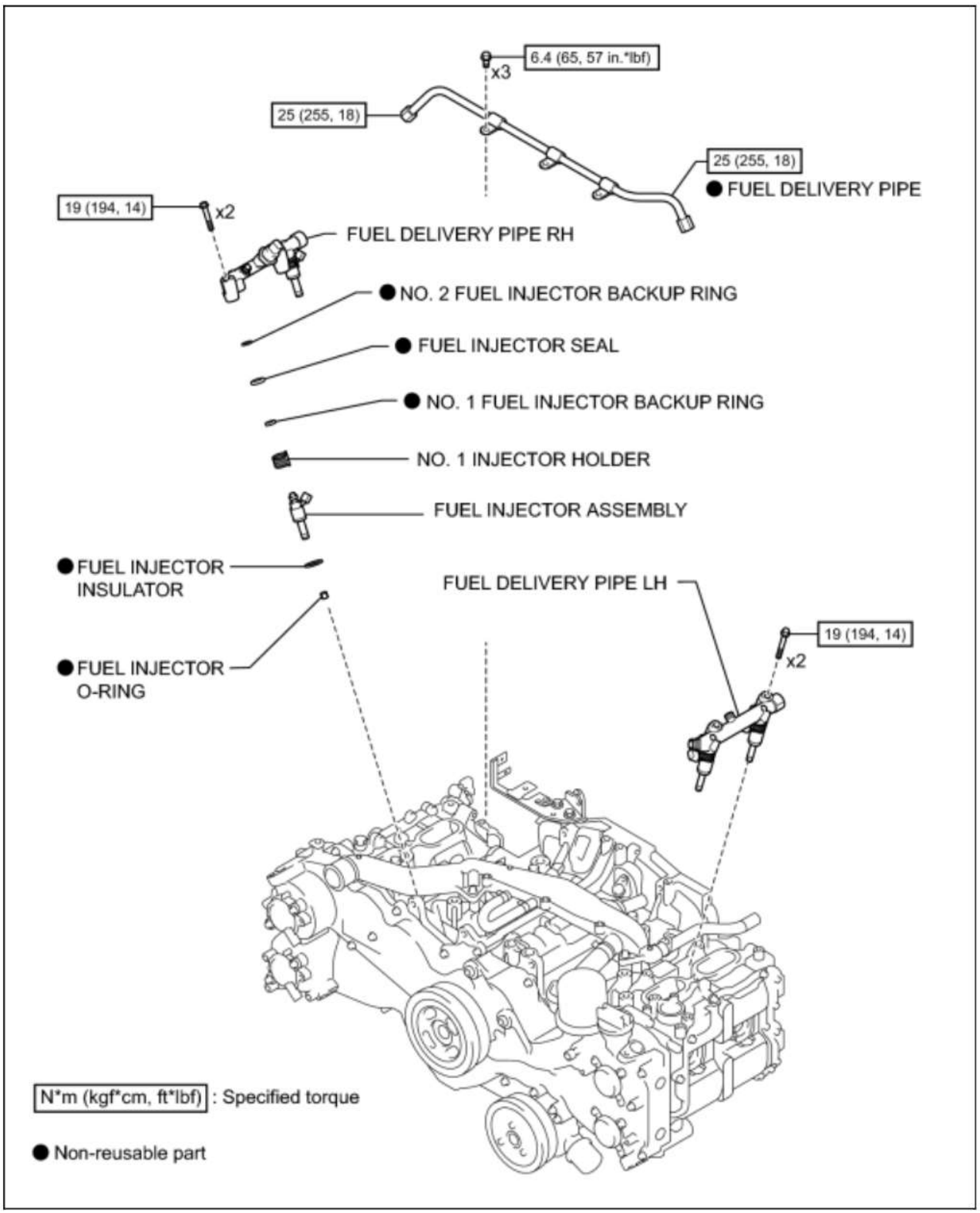
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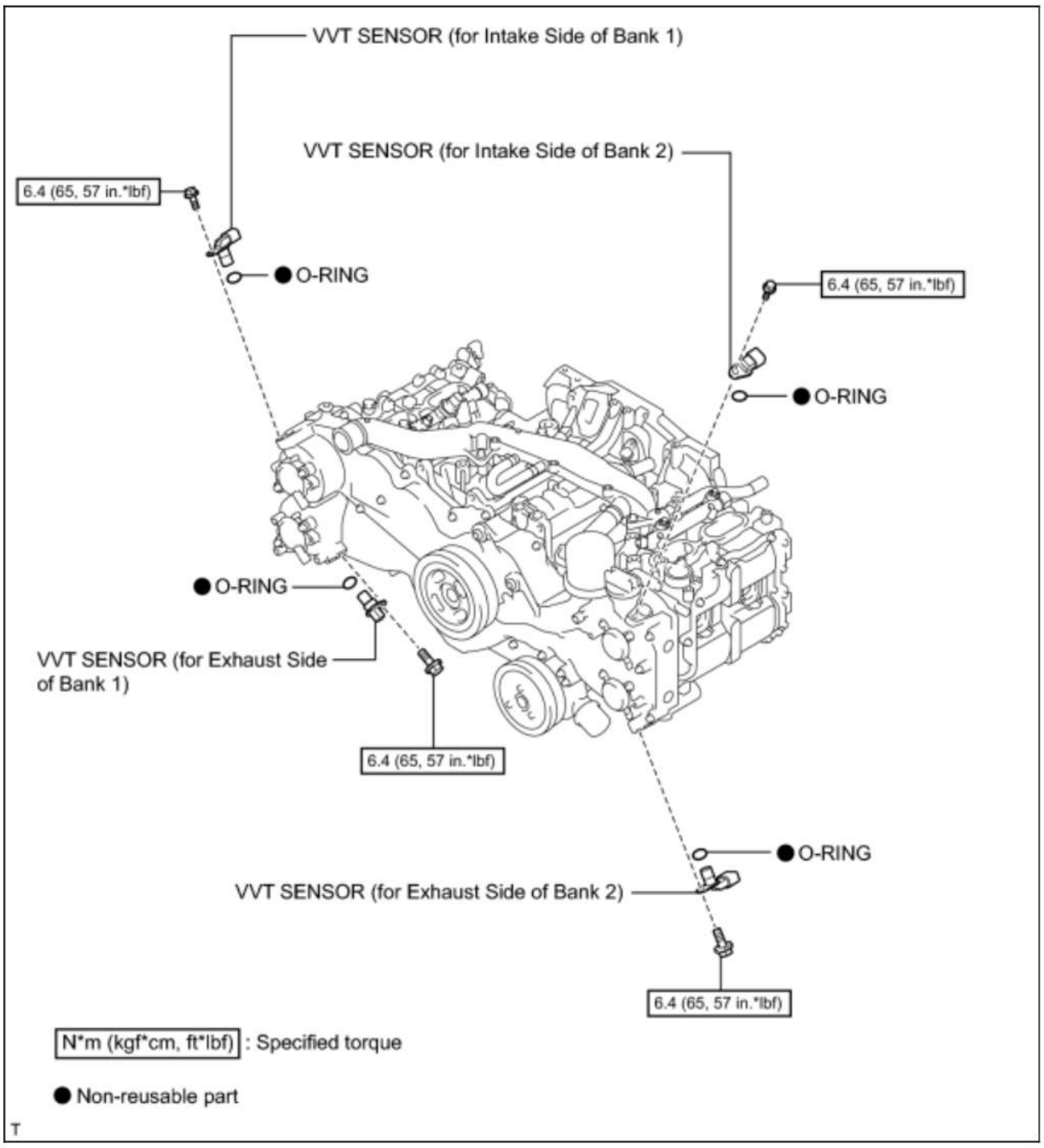
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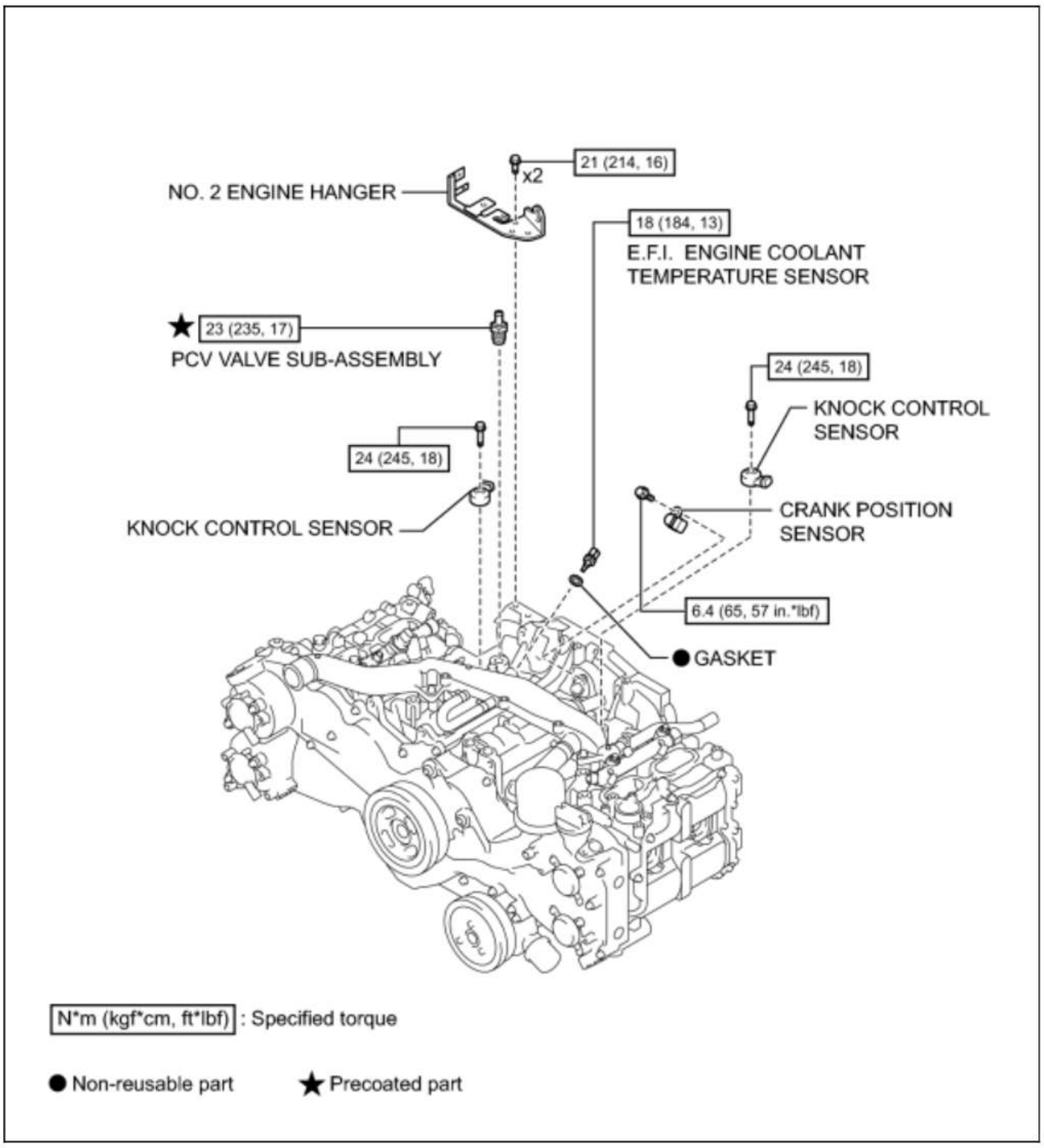
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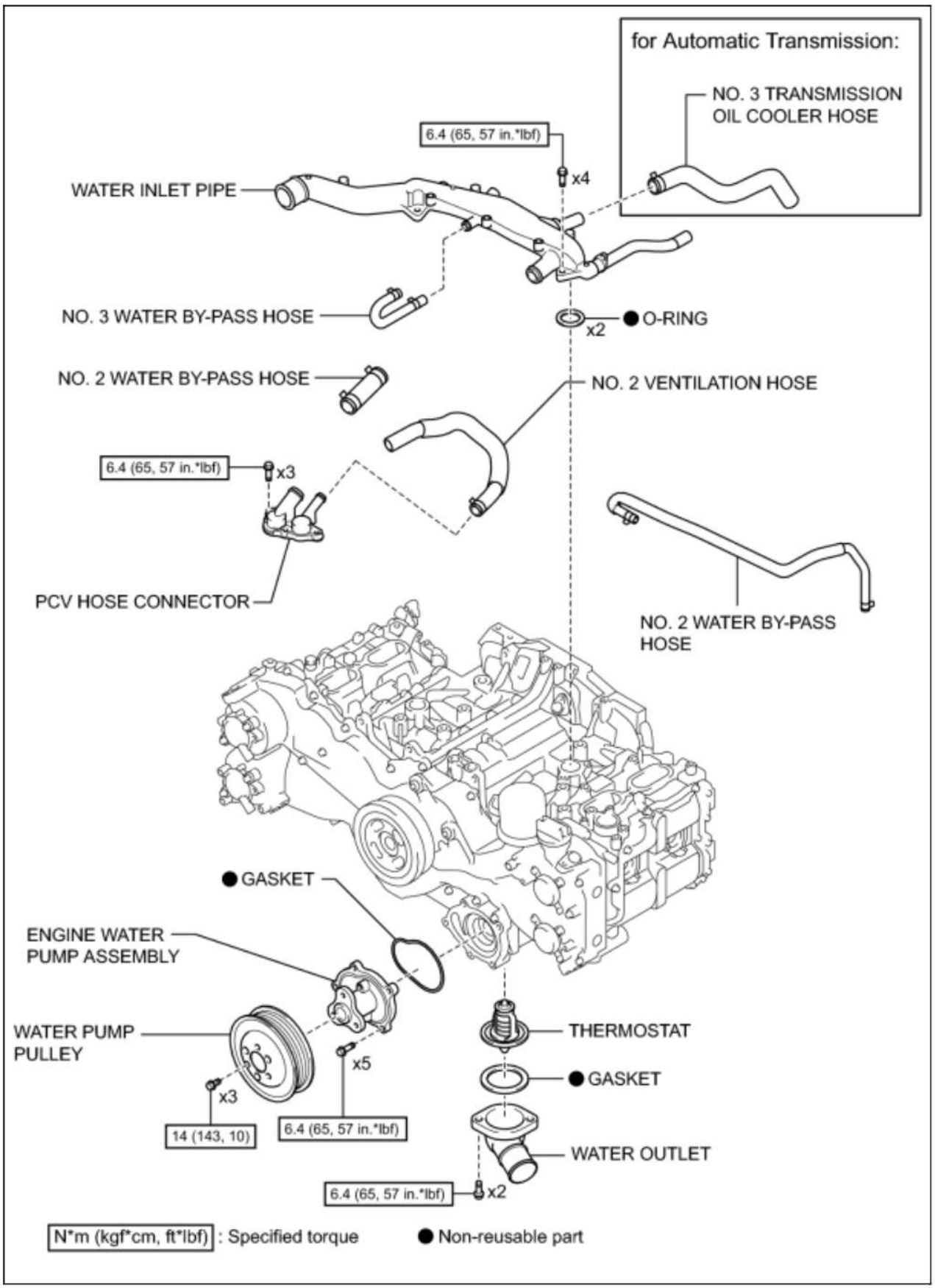
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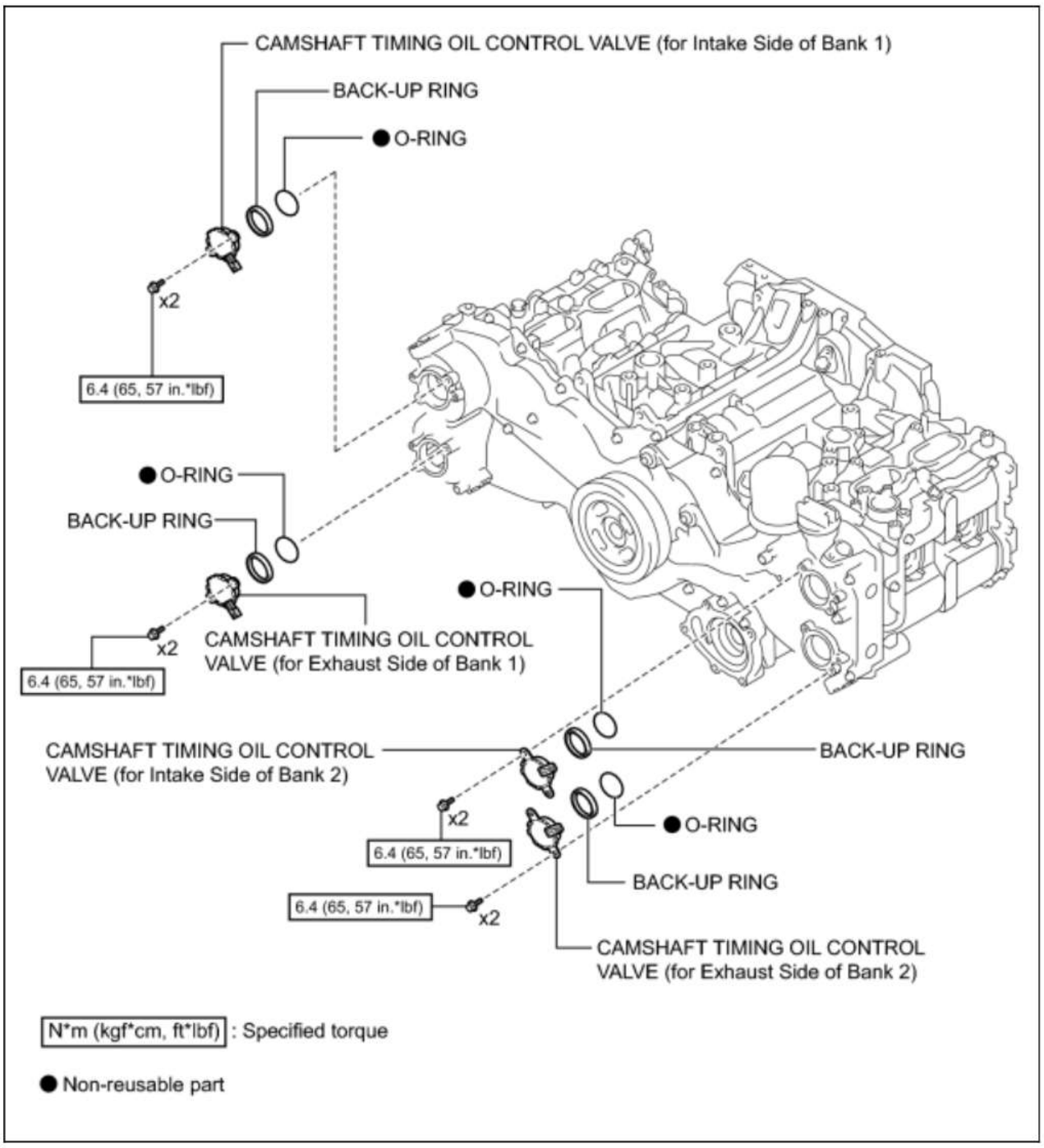
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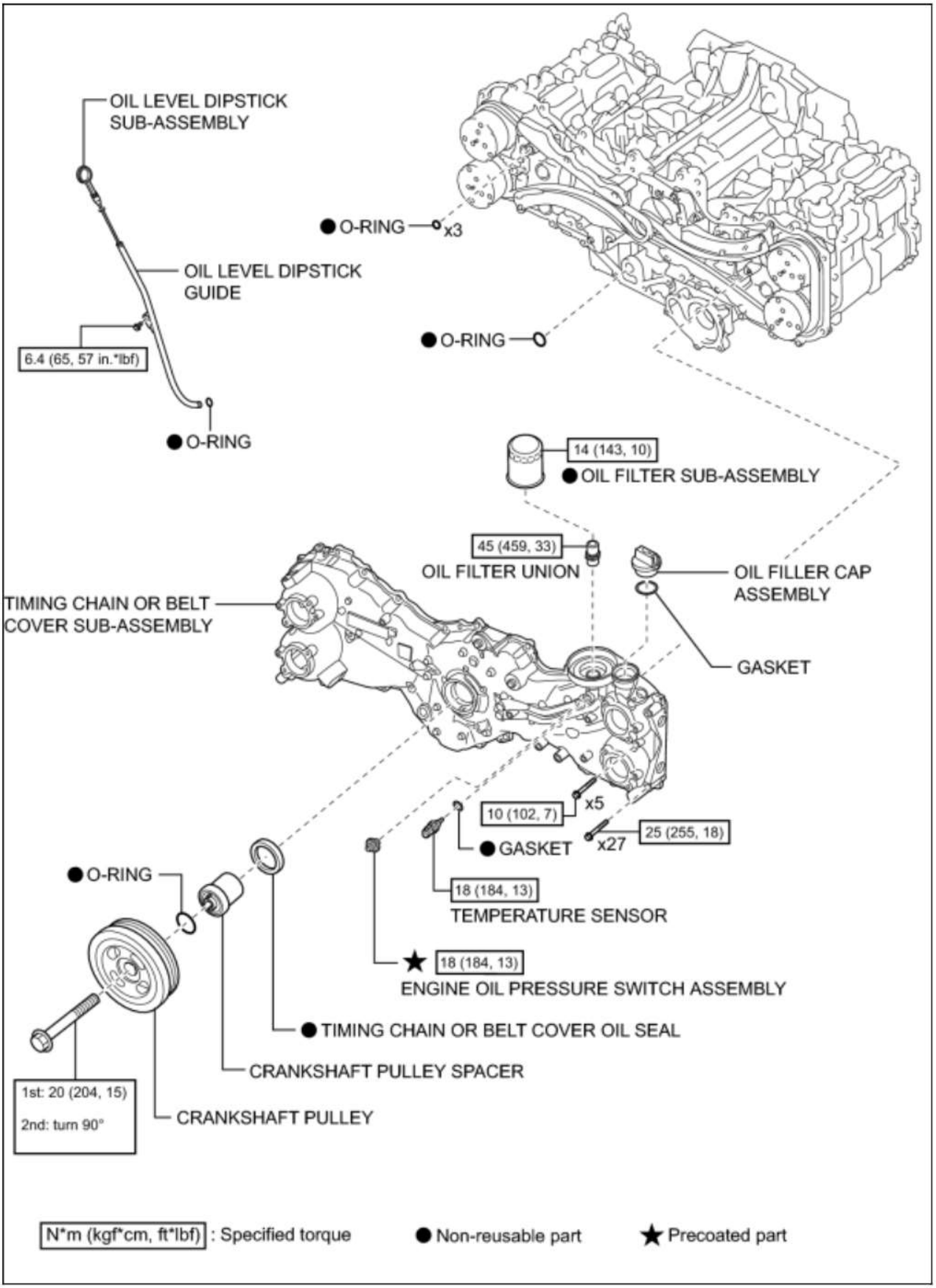
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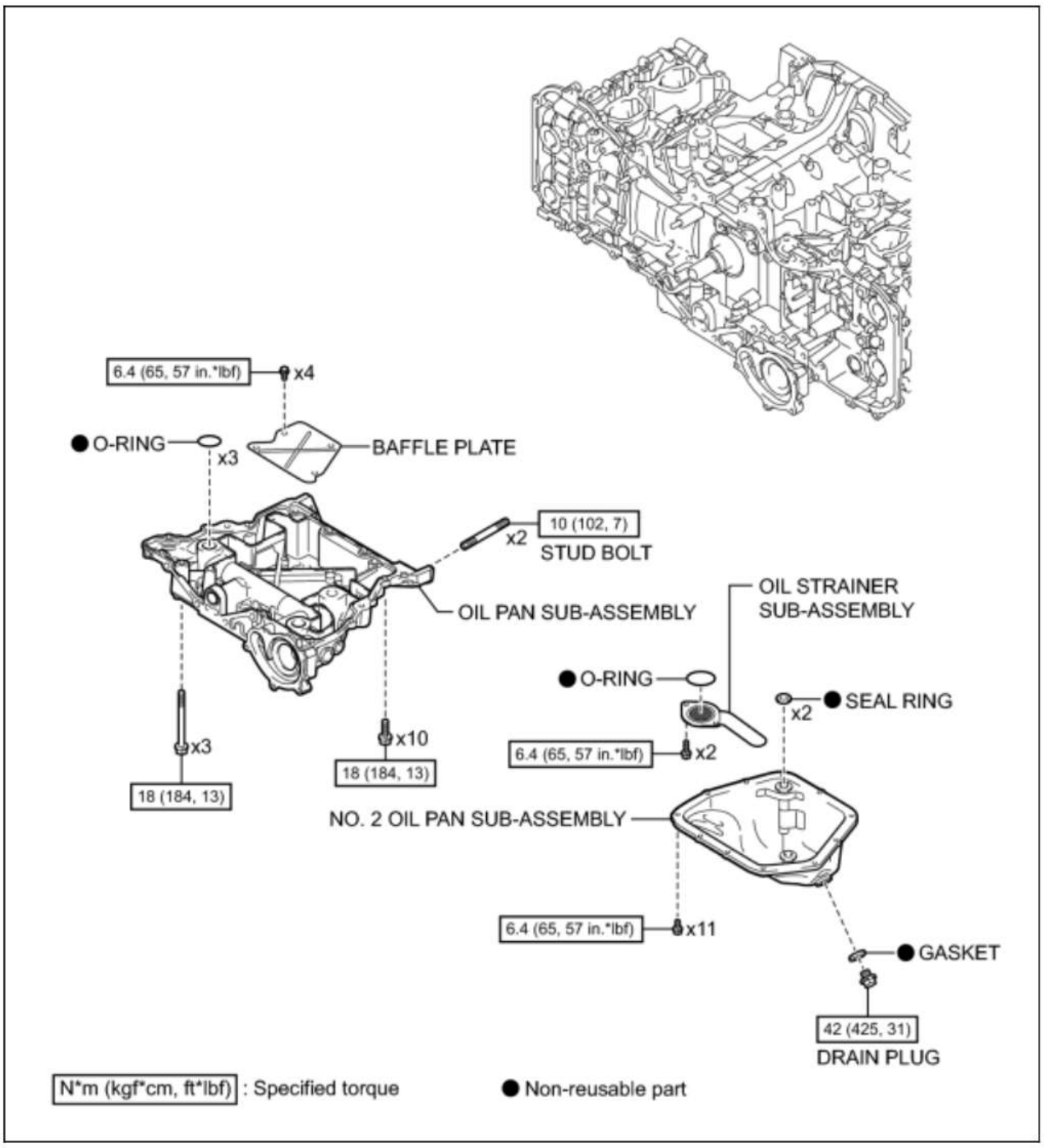
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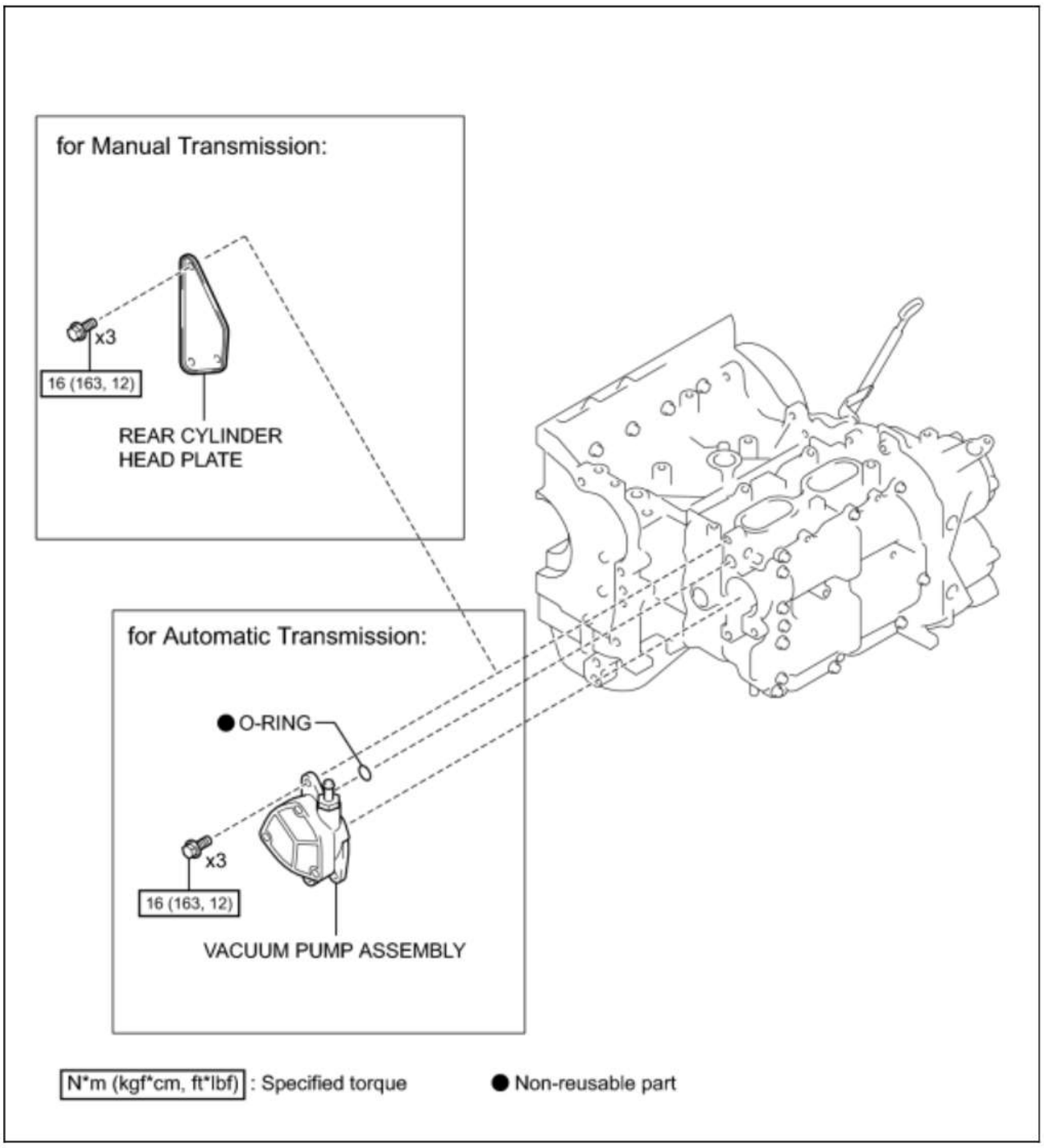
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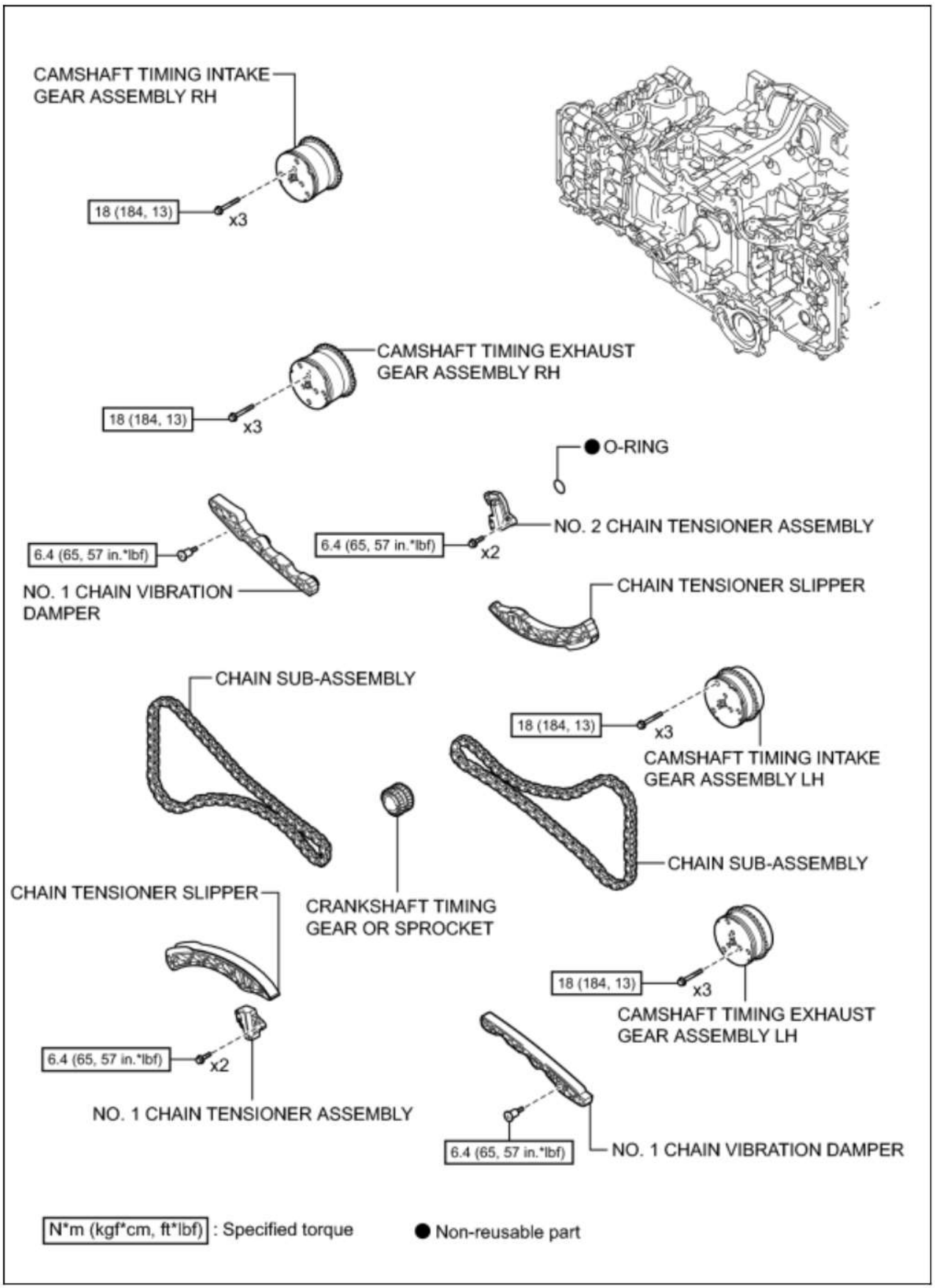
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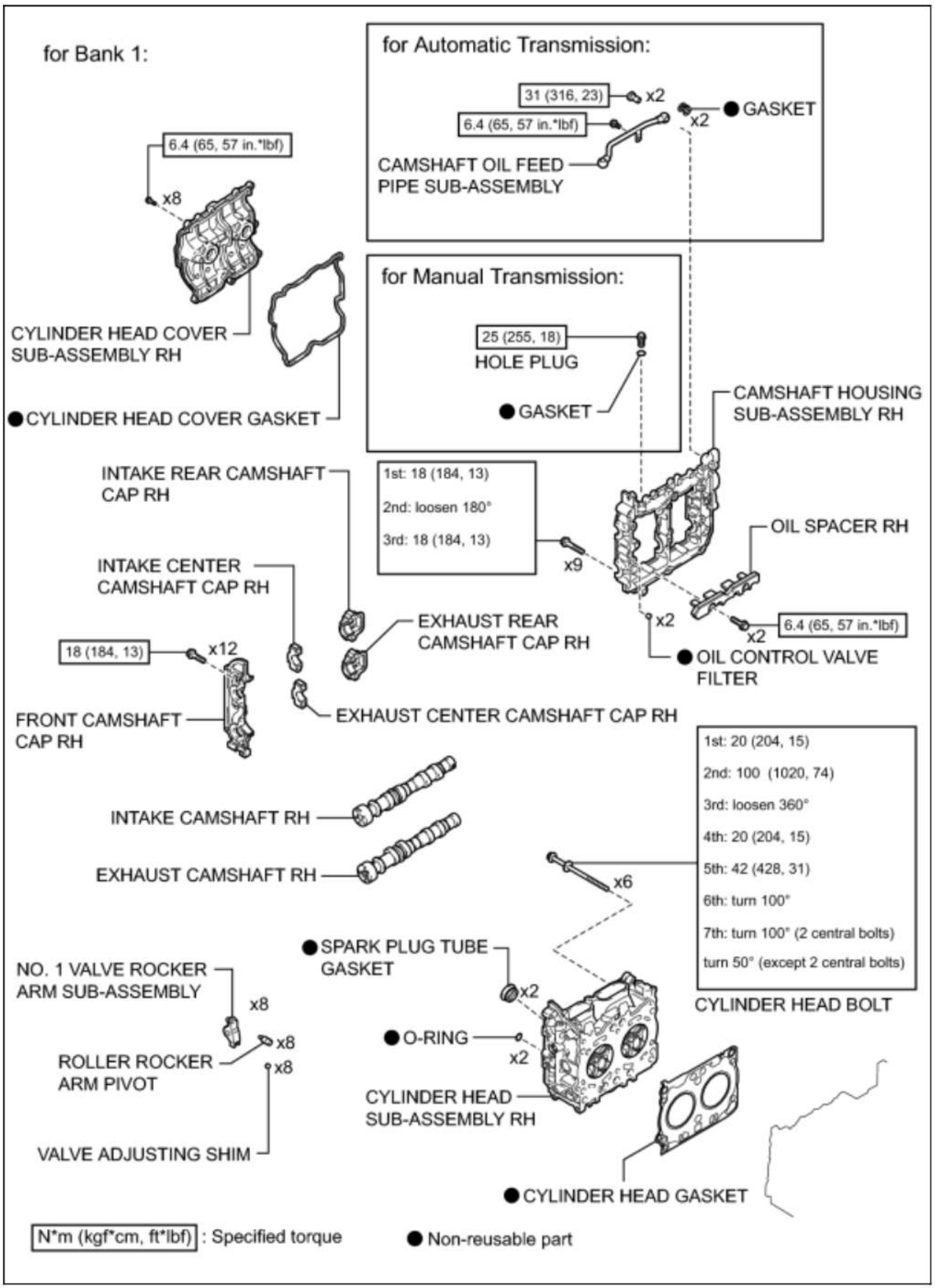
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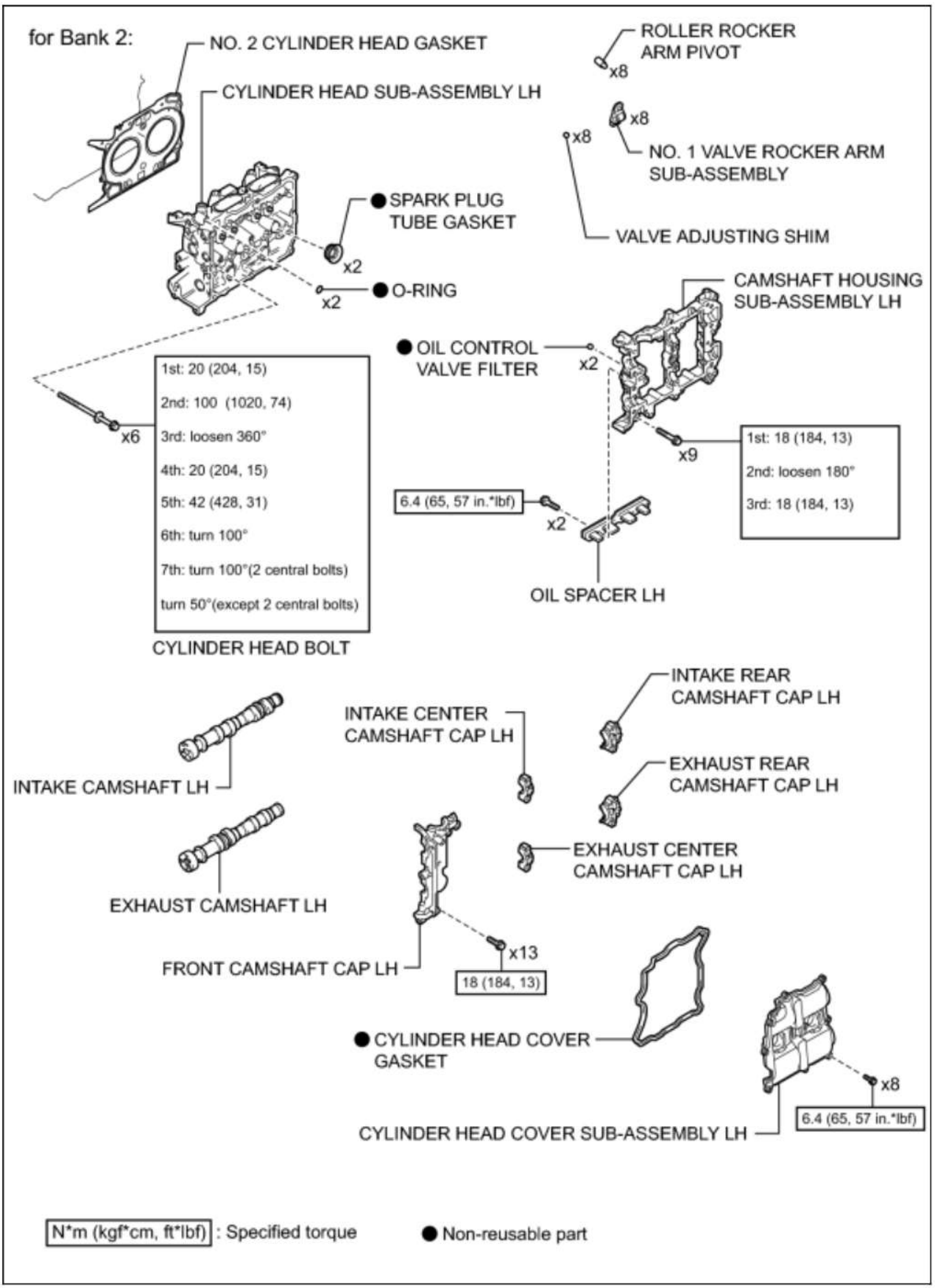
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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000021ZT04OX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE UNIT: DISASSEMBLY; 2013 MY FR-S [03/2012 -]		

DISASSEMBLY

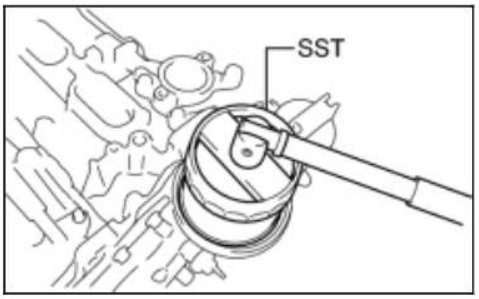
1. REMOVE OIL FILLER CAP ASSEMBLY

(a) Remove the oil filler cap assembly.

2. REMOVE OIL FILTER SUB-ASSEMBLY

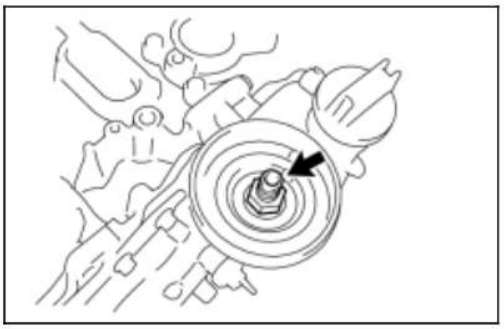
(a) Using SST, remove the oil filter sub-assembly.

SST: 09228-22020



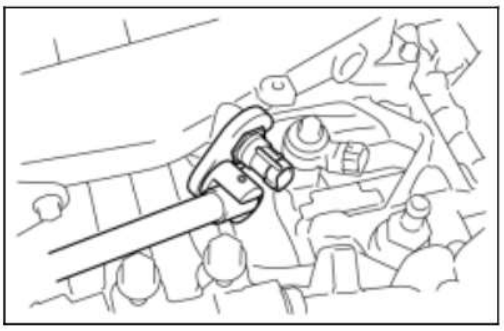
3. REMOVE OIL FILTER UNION

(a) Using a 24 mm deep socket wrench, remove the oil filter union.



4. REMOVE E.F.I. ENGINE COOLANT TEMPERATURE SENSOR

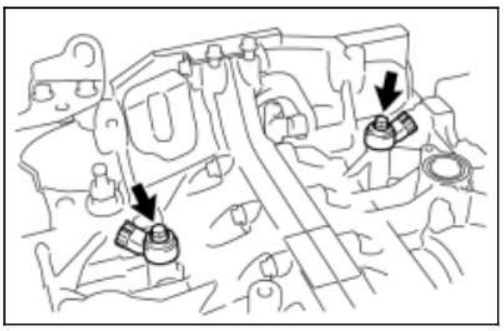
(a) Using a 19 mm union nut wrench, remove the E.F.I. engine coolant temperature sensor.



5. REMOVE KNOCK CONTROL SENSOR

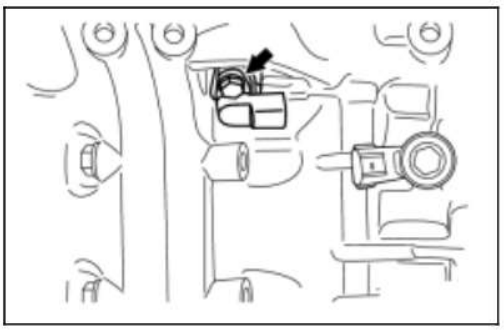
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(a) Remove the 2 bolts and 2 knock control sensors.



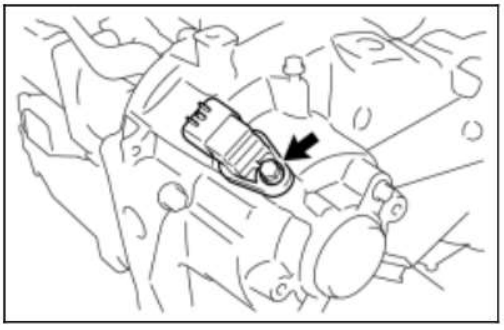
6. REMOVE CRANK POSITION SENSOR

(a) Remove the bolt and crank position sensor.



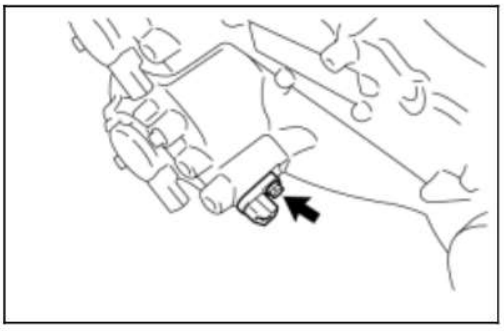
7. REMOVE VVT SENSOR

(a) Remove the bolt and VVT sensor (for intake side of bank 1).



(b) Remove the O-ring from the VVT sensor.

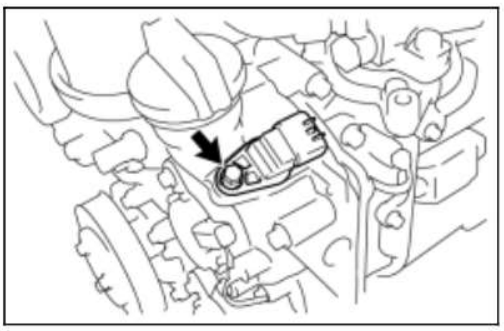
(c) Remove the bolt and VVT sensor (for exhaust side of bank 1).



(d) Remove the O-ring from the VVT sensor.

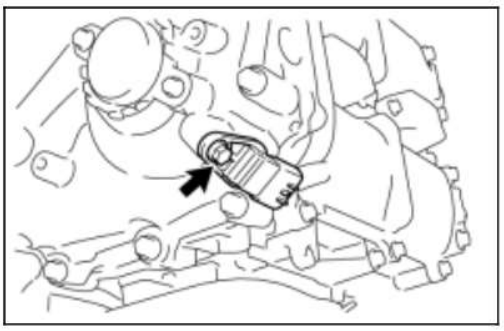
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(e) Remove the bolt and VVT sensor (for intake side of bank 2).



(f) Remove the O-ring from the VVT sensor.

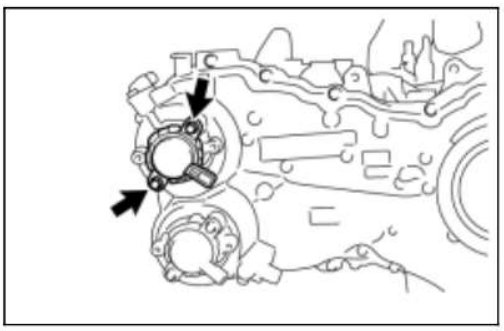
(g) Remove the bolt and VVT sensor (for exhaust side of bank 2).



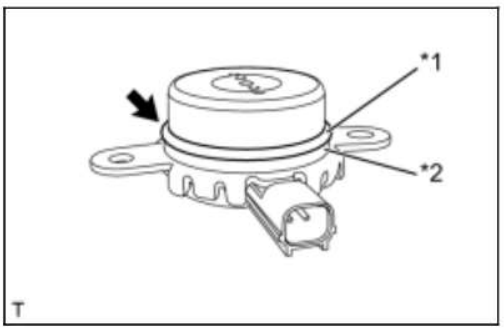
(h) Remove the O-ring from the VVT sensor.

8. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE

(a) Remove the 2 bolts and camshaft timing oil control valve (for intake side of bank 1).



(b) Remove the O-ring from the camshaft timing oil control valve.



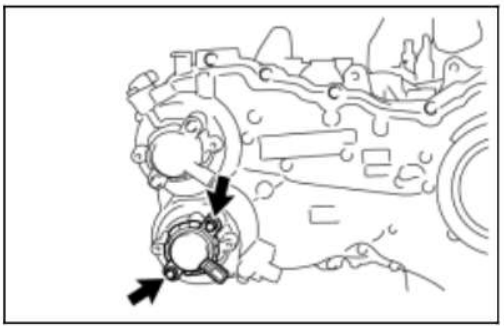
(c) Remove the back-up ring from the camshaft timing oil control valve.

Text in Illustration

*1	O-ring

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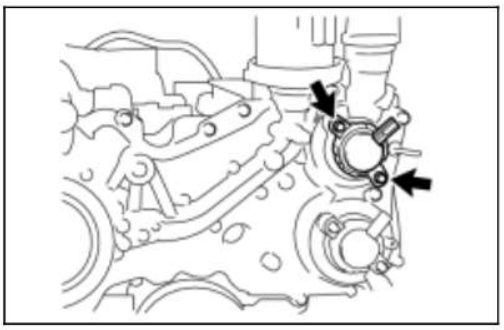
*2	Back-up Ring



(d) Remove the 2 bolts and camshaft timing oil control valve (for exhaust side of bank 1).

(e) Remove the O-ring from the camshaft timing oil control valve.

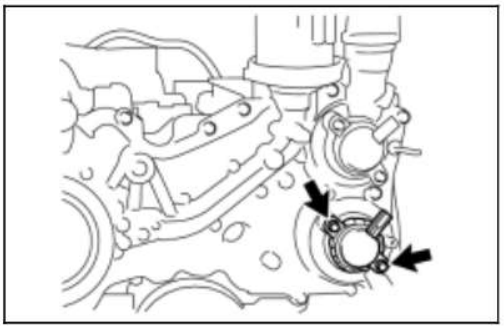
(f) Remove the back-up ring from the camshaft timing oil control valve.



(g) Remove the 2 bolts and camshaft timing oil control valve (for intake side of bank 2).

(h) Remove the O-ring from the camshaft timing oil control valve.

(i) Remove the back-up ring from the camshaft timing oil control valve.



(j) Remove the 2 bolts and camshaft timing oil control valve (for exhaust side of bank 2).

(k) Remove the O-ring from the camshaft timing oil control valve.

(l) Remove the back-up ring from the camshaft timing oil control valve.

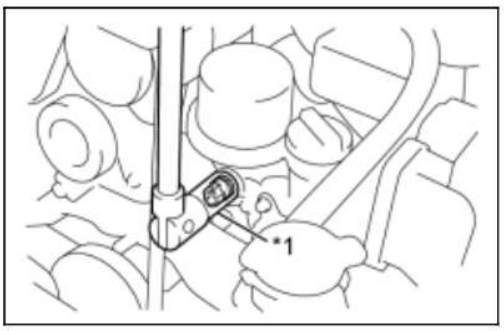
9. REMOVE TEMPERATURE SENSOR

(a) Using a 19 mm deep socket wrench, remove the temperature sensor.

NOTICE:

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Use a cloth or the like to prevent engine oil from splashing.



Text in Illustration

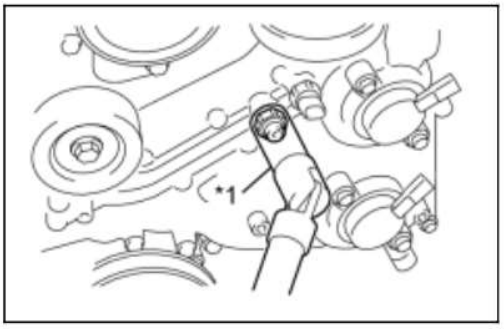
*1	19 mm Deep Socket Wrench

10. REMOVE ENGINE OIL PRESSURE SWITCH ASSEMBLY

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

NOTICE:

Use a cloth or the like to prevent engine oil from splashing.

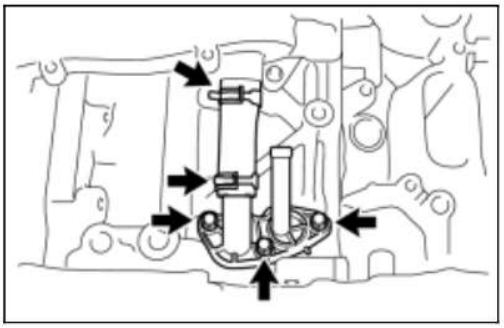


Text in Illustration

*1	24 mm deep socket wrench

11. REMOVE PCV HOSE CONNECTOR

(a) Remove the 3 bolts and PCV hose connector.

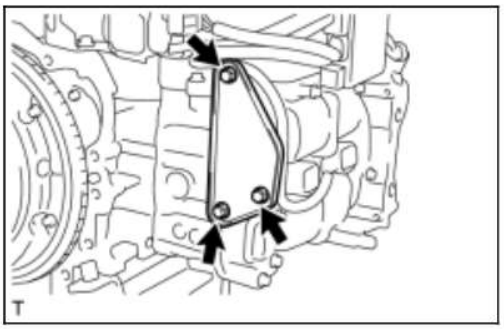


(b) Loosen the 2 clips and remove the No. 2 water by-pass hose from the PCV hose connector.

12. REMOVE VACUUM PUMP ASSEMBLY (for Automatic Transmission) INFO

13. REMOVE REAR CYLINDER HEAD PLATE (for Manual Transmission)

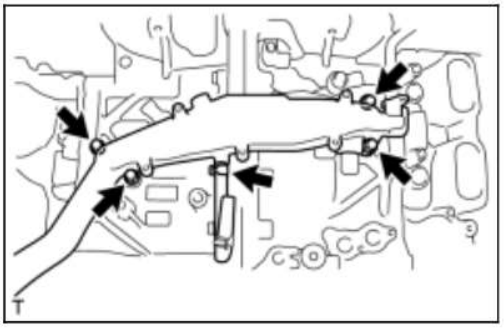
(a) Remove the 3 bolts and rear cylinder head plate.



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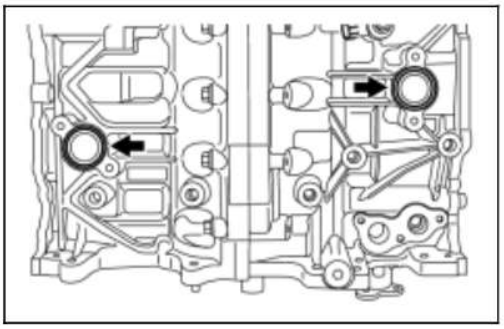
14. REMOVE WATER INLET PIPE

(a) Disconnect the No. 3 water by-pass hose.



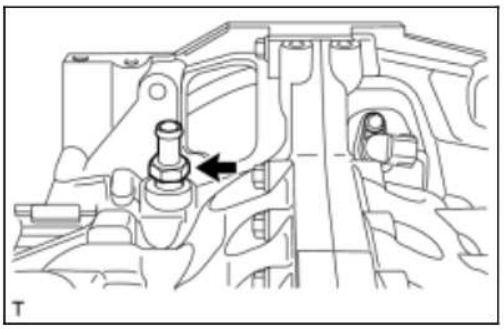
(b) Remove the 4 bolts and water inlet pipe.

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



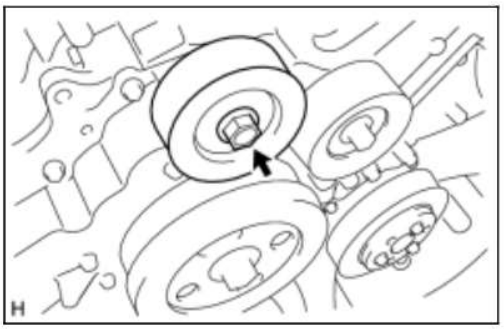
15. REMOVE PCV VALVE SUB-ASSEMBLY

(a) Using a 19 mm deep socket wrench, remove the PCV valve sub-assembly.



16. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

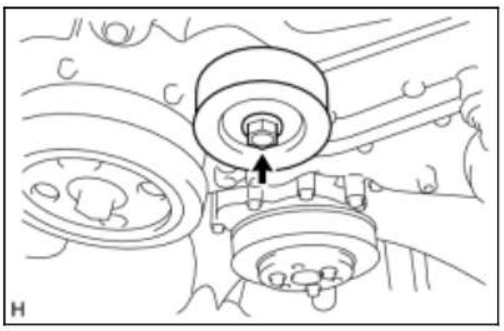
(a) Remove the bolt, No. 1 idler pulley sub-assembly and idler pulley cover.



17. REMOVE NO. 1 IDLER PULLEY SUB-ASSEMBLY

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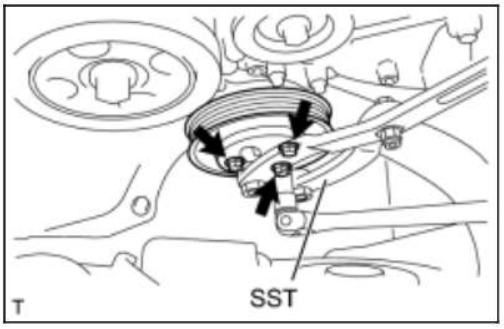
(a) Remove the bolt, No. 1 idler pulley sub-assembly and idler pulley cover.



18. REMOVE WATER PUMP PULLEY

(a) Using SST, hold the water pump pulley.

SST: 09960-10010
09962-01000
09963-00700



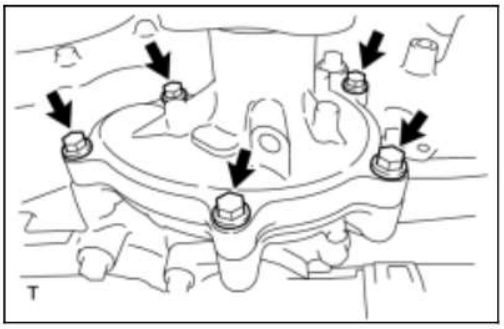
(b) Remove the 3 bolts and water pump pulley.

NOTICE:

Be careful not to let SST slip during the work.

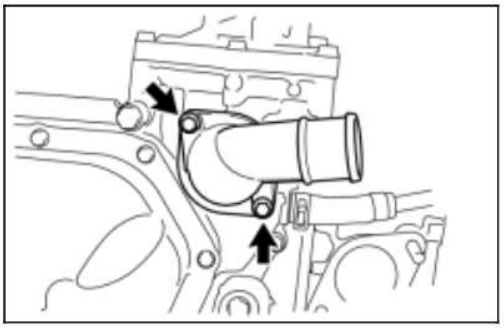
19. REMOVE ENGINE WATER PUMP ASSEMBLY

(a) Remove the 5 bolts, engine water pump assembly and gasket.



20. REMOVE WATER OUTLET

(a) Remove the 2 bolts and water outlet.



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21. REMOVE THERMOSTAT

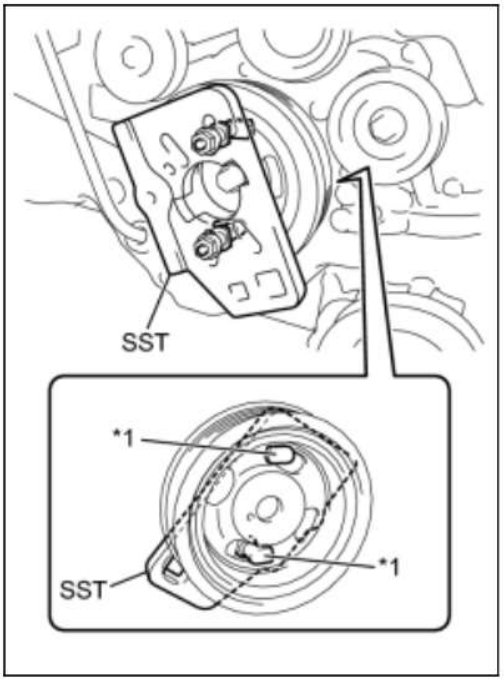
(a) Remove the thermostat.

(b) Remove the gasket from the thermostat.

NOTICE:

Be careful not to let SST slip during the work.

22. REMOVE CRANKSHAFT PULLEY



(a) Install SST to the crankshaft pulley.

SST: 09213-80010
90179-10016
09213-08010
09213-08110

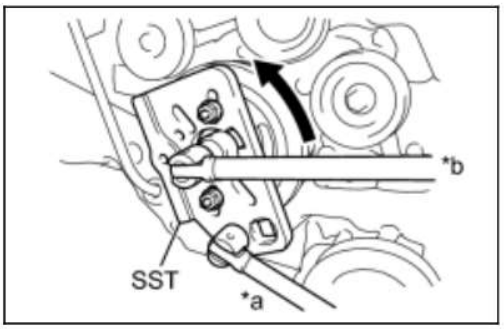
HINT:

Position the projections on SST in the direction as shown in the illustration to prevent SST from separating from the crankshaft pulley.

Text in Illustration

*1	Claw

(b) Using SST, hold the crankshaft pulley and loosen the crankshaft pulley set bolt.



SST: 09213-80010
90179-10016
09213-08010
09213-08110

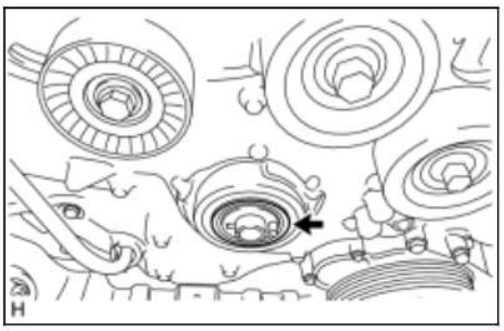
Text in Illustration

*a	Hold
*b	Turn

(c) Remove the crankshaft pulley.

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(d) Remove the O-ring and crankshaft pulley spacer.

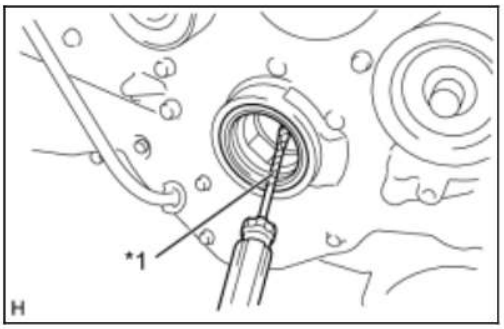


23. REMOVE TIMING CHAIN OR BELT COVER OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the timing chain or belt cover oil seal.

Text in Illustration

*1	Protective Tape



NOTICE:

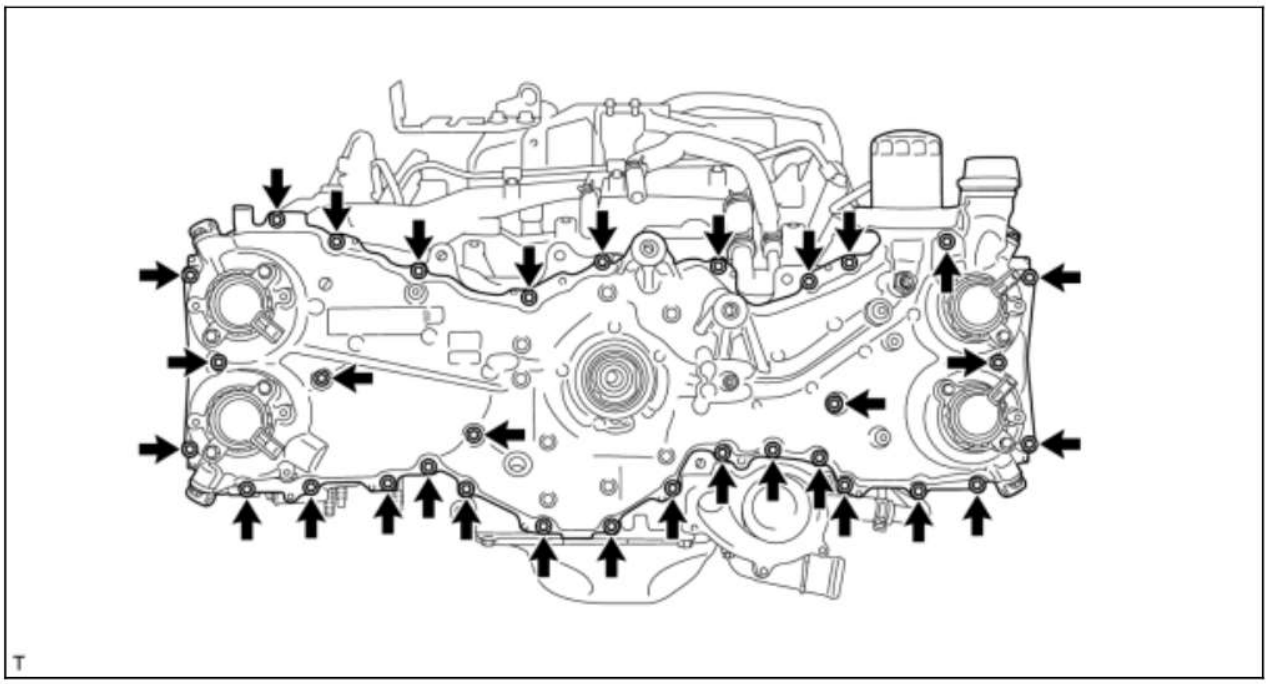
After the removal, check the crankshaft for damage. If it is damaged, smooth the surface with 400-grit sandpaper.

HINT:

Tape the screwdriver tip before use.

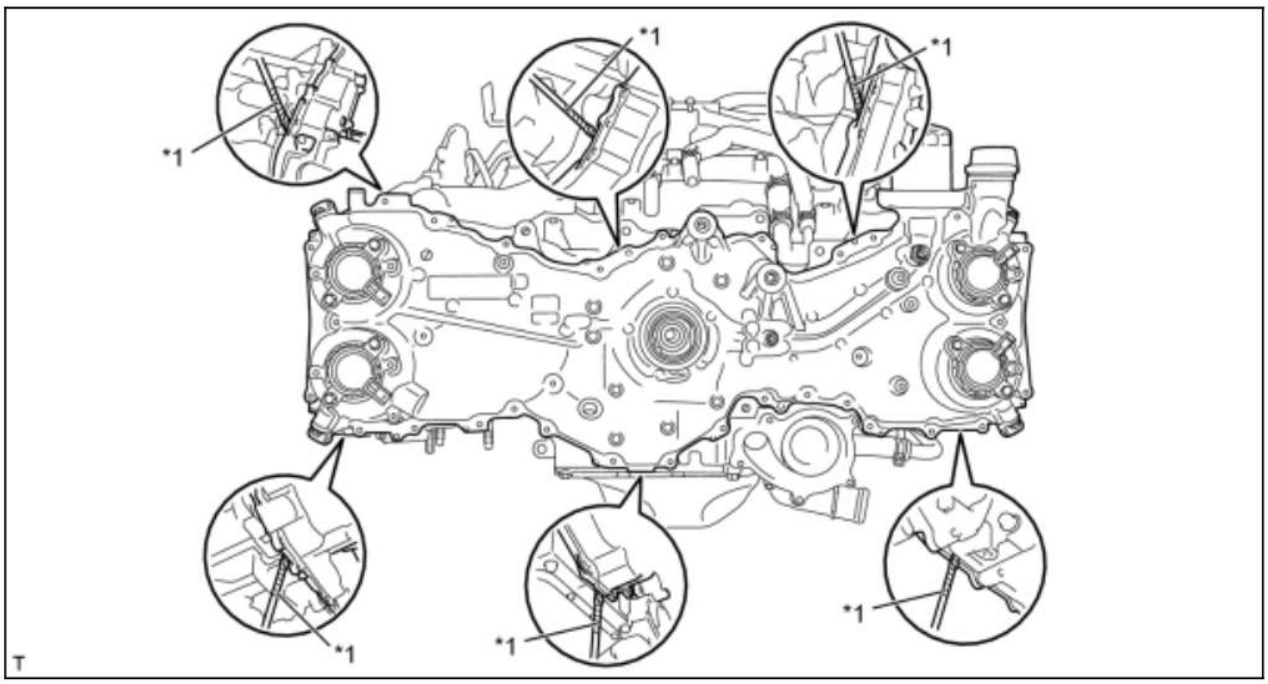
24. REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

(a) Remove the 32 bolts.



(b) Using a screwdriver with its tip wrapped in protective tape, remove the timing chain or belt cover sub-assembly by prying between the timing chain or belt cover sub-assembly and cylinder head or cylinder block.

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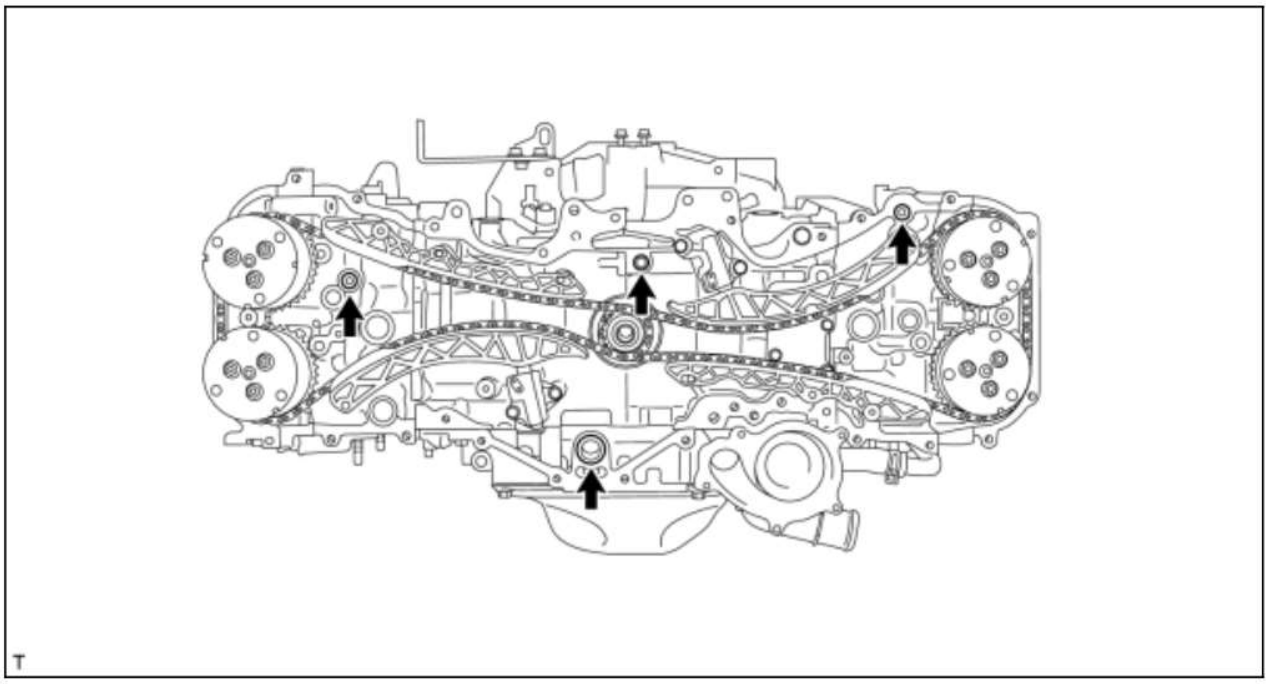
Text in Illustration

*1	Protective Tape	-	-

NOTICE:

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

(c) Remove the 4 O-rings.

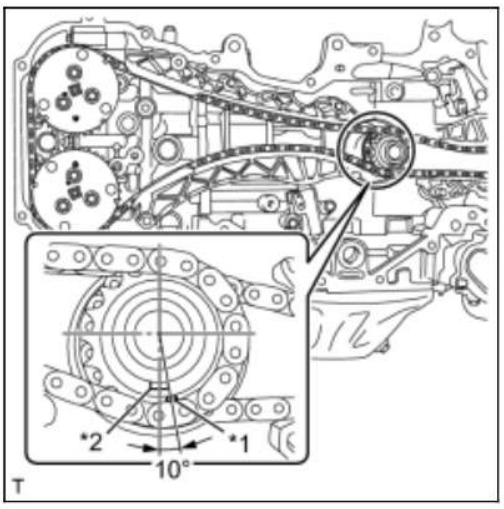


25. REMOVE CHAIN SUB-ASSEMBLY (for Bank 1)

(a) Temporarily install the crank pulley bolt to the crankshaft.

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(b) Turn the crankshaft and align the alignment marks of the crankshaft timing gear or sprocket, camshaft timing intake gear assembly RH and camshaft timing exhaust gear assembly RH.



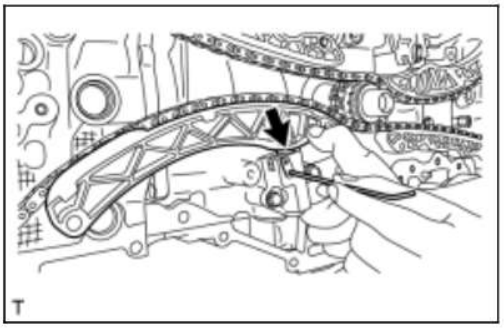
HINT:

The crankshaft key faces downward at this time.

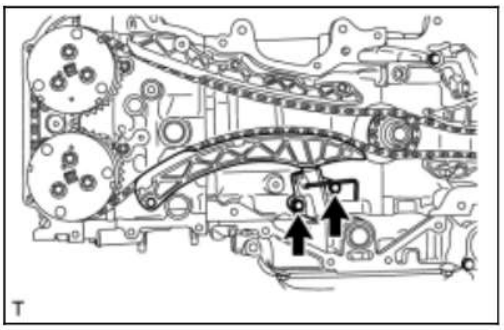
Text in Illustration

*1	Alignment Mark
*2	Key

(c) Push down the chain tensioner slipper and retain the plunger by inserting a 2.5 mm (0.098 in.) diameter hexagonal wrench into the No. 1 chain tensioner assembly through the stopper plate.

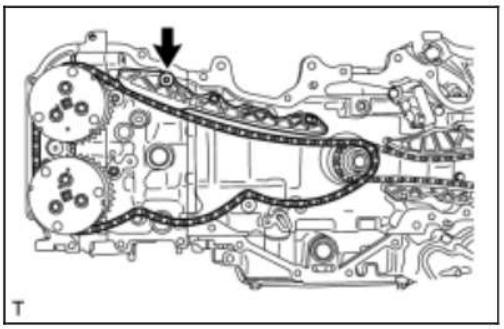


(d) Remove the 2 bolts and No. 1 chain tensioner assembly.



(e) Remove the chain tensioner slipper.

(f) Using a 5 mm hexagonal wrench, remove the bolt and No. 1 chain vibration damper.



(g) Remove the chain sub- assembly (for bank 1).

NOTICE:

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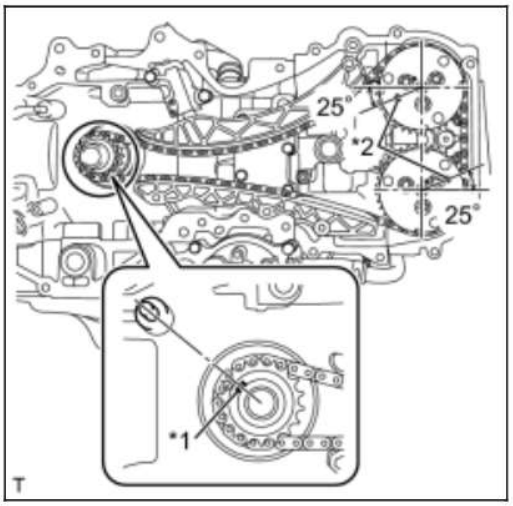
- With the chain sub- assembly (for bank 1) removed, the valve heads may contact each other if the camshafts are turned, causing the valve stems to bend.
- To avoid this, do not turn the intake camshaft RH and the exhaust camshaft RH more than zero-lift range (The range where camshafts can be turned lightly by hand).

HINT:

Arrange the removed parts in the correct order.

26. REMOVE CHAIN SUB-ASSEMBLY (for Bank 2)

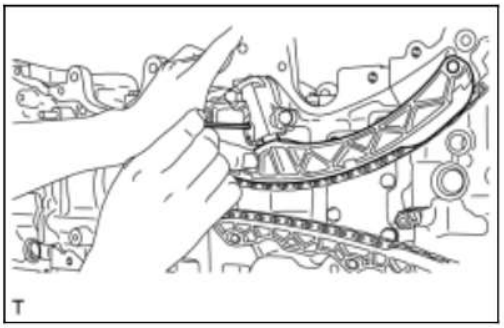
(a) Turn the crankshaft and position each alignment mark on the crankshaft timing gear or sprocket, camshaft timing intake gear assembly LH and camshaft timing exhaust gear assembly LH as shown in the illustration.



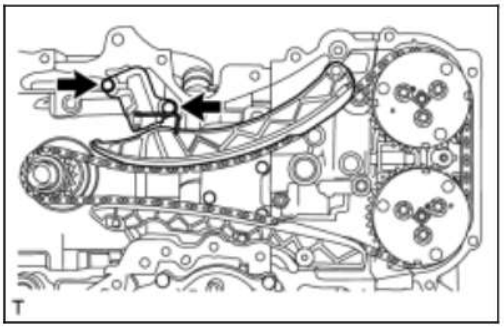
Text in Illustration

*1	Key
*2	Alignment Mark

(b) Push the chain tensioner slipper and retain the plunger by inserting an approximately 1 mm (0.039 in.) diameter wire into the No. 2 chain tensioner assembly through the stopper plate .



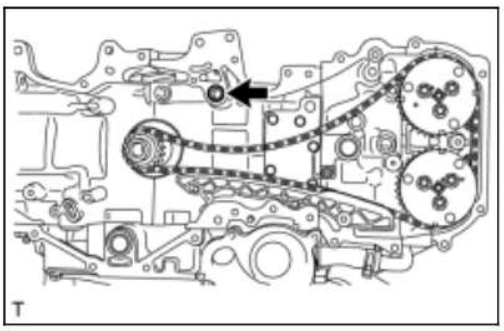
(c) Remove the 2 bolts and No. 2 chain tensioner assembly.



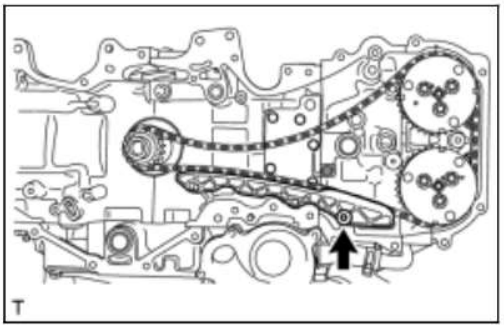
(d) Remove the chain tensioner slipper.

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(e) Remove the O-ring from the cylinder block.



(f) Using a 5 mm socket hexagon wrench, remove the bolt and No. 1 chain vibration damper.



(g) Remove the chain sub-assembly (for bank 2).

NOTICE:

- With the chain sub-assembly (for bank 2) removed, the valve heads may contact each other if the camshafts are turned, causing the valve stems to bend. To avoid this, do not turn the exhaust camshaft LH more than zero-lift rang (The range where the camshaft can be turned lightly by hand).
- At this time, No. 1 and No. 4 pistons are located near TDC. If the intake camshaft is turned, the valves may come into contact with the piston, causing the valve stems to bend. To avoid this, do not turn the intake camshaft LH.

HINT:

Arrange the removed parts in the correct order.

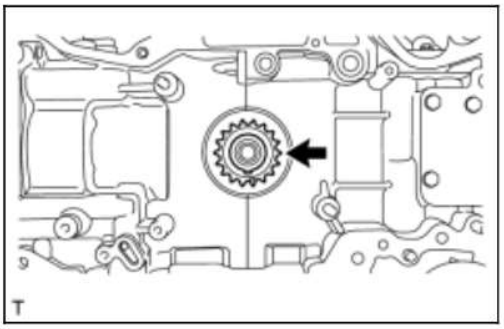
27. ROTATE CRANK SHAFT AND CAMSHAFT INFO

28. REMOVE CRANKSHAFT TIMING GEAR OR SPROCKET

(a) Remove the crankshaft timing gear or sprocket.

HINT:

Make sure the front-back direction and make a mark for installation if necessary.



29. REMOVE CAMSHAFT TIMING INTAKE GEAR ASSEMBLY RH INFO

30. REMOVE CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY RH INFO

31. REMOVE CAMSHAFT TIMING INTAKE GEAR ASSEMBLY LH INFO

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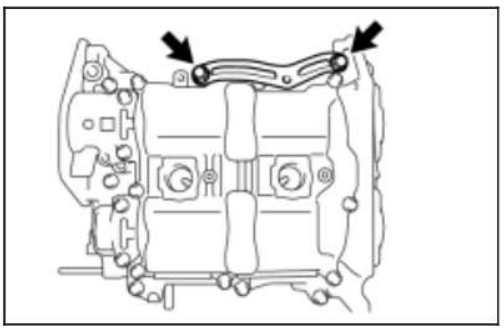
32. REMOVE CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY LH INFO

33. REMOVE SPARK PLUG

(a) Using a 14 mm spark plug wrench, remove the 4 spark plugs.

34. REMOVE INJECTOR DRIVER BRACKET

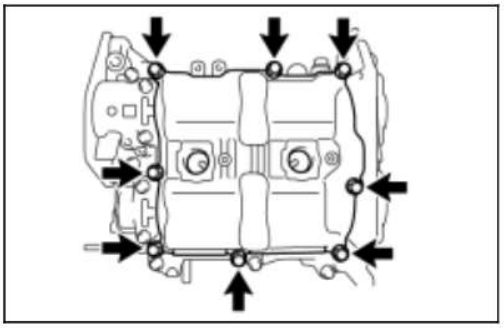
(a) Remove the 2 bolts and injector driver bracket.



35. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH

(a) Operate the engine stand so that the bank 1 side faces upward.

(b) Remove the 8 bolts.



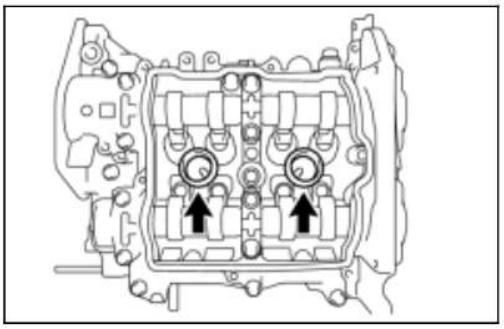
(c) Using a screwdriver with its tip wrapped in protective tape, remove the cylinder head cover sub-assembly RH.

NOTICE:

Do not damage the camshaft housing sub-assembly RH, cam caps and cylinder head cover sub-assembly RH.

(d) Remove the cylinder head cover gasket.

(e) Remove the 2 spark plug tube gaskets.



NOTICE:

When removing the seal packing left on the camshaft housing sub-assembly RH using a scraper, use special care not to damage the camshafts.

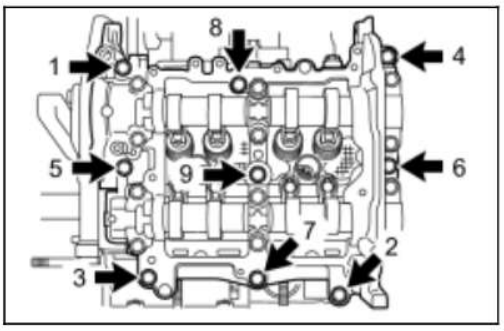
36. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY RH

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NOTICE:

Do not remove the intake and exhaust camshafts first as it may cause a deformation of the cylinder head sub-assembly.

(a) Loosen the 9 bolts in the order shown in the illustration and remove them.



(b) Using a screwdriver with its tip wrapped in protective tape, remove the camshaft housing sub-assembly RH.

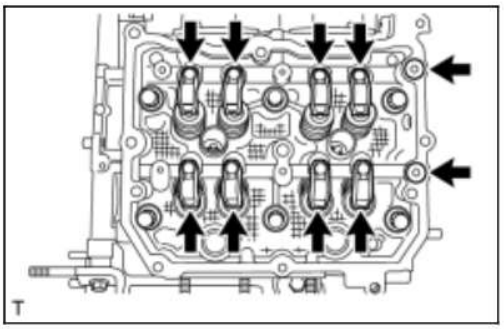
NOTICE:

Do not damage the cylinder head sub-assembly RH and camshaft housing sub-assembly RH.

(c) Remove the 2 O-rings and 8 No. 1 valve rocker arm sub-assemblies from the cylinder head sub-assembly.

HINT:

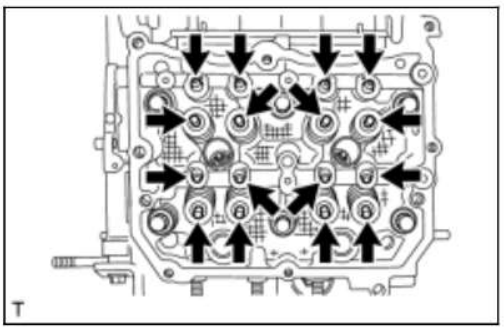
Arrange the removed parts in the correct order.



(d) Remove the 8 valve adjusting shims and 8 roller rocker arm pivots from the cylinder head sub-assembly.

HINT:

Arrange the removed parts in the correct order.



37. REMOVE CYLINDER HEAD SUB-ASSEMBLY RH INFO

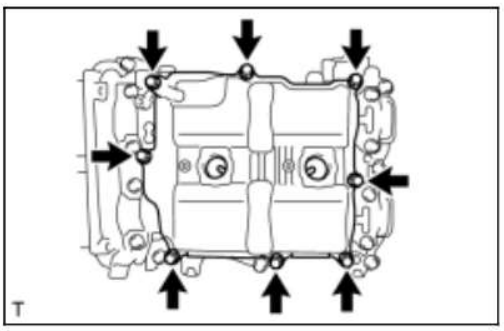
38. REMOVE CYLINDER HEAD GASKET INFO

39. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH

(a) Operate the engine stand so that the bank 2 side faces upward.

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(b) Remove the 8 bolts.



(c) Using a screwdriver with its tip wrapped in protective tape, remove the cylinder head cover sub-assembly LH.

NOTICE:

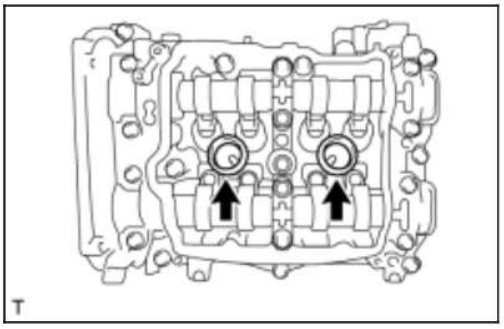
Do not damage the camshaft housing sub-assembly LH, cam caps and cylinder head cover sub-assembly LH.

(d) Remove the cylinder head cover gasket.

(e) Remove the 2 spark plug tube gaskets.

NOTICE:

When removing the seal packing left on the camshaft housing sub-assembly LH using a scraper, use special care not to damage the camshafts.

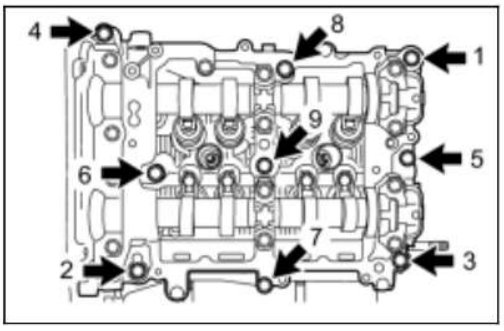


40. REMOVE CAMSHAFT HOUSING SUB-ASSEMBLY LH

NOTICE:

Do not remove the intake and exhaust camshafts first as it may cause a deformation of the camshaft housing sub-assembly LH.

(a) Loosen the 9 bolts in the order shown in the illustration and remove them.



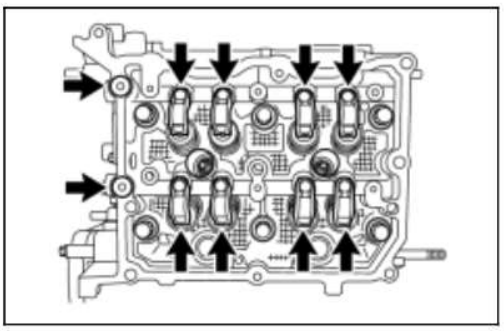
(b) Using a screwdriver with its tip wrapped in protective tape, remove the camshaft housing sub-assembly LH.

NOTICE:

Do not damage the cylinder head sub-assembly LH and camshaft housing sub-assembly LH.

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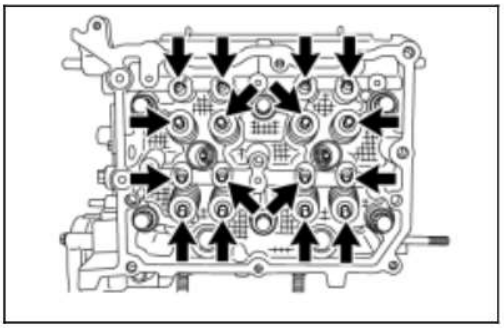
(c) Remove the 2 O-rings and 8 No. 1 valve rocker arm sub-assemblies from the cylinder head sub-assembly LH.



HINT:

Arrange the removed parts in the correct order.

(d) Remove the 8 valve adjusting shims and 8 roller rocker arm pivots from the cylinder head sub-assembly LH.



HINT:

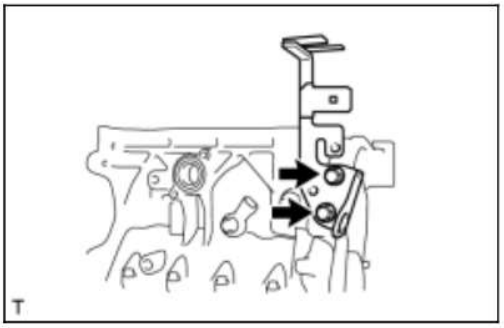
Arrange the removed parts in the correct order.

41. REMOVE CYLINDER HEAD SUB-ASSEMBLY LH INFO

42. REMOVE NO. 2 CYLINDER HEAD GASKET INFO

43. REMOVE NO. 2 ENGINE HANGER

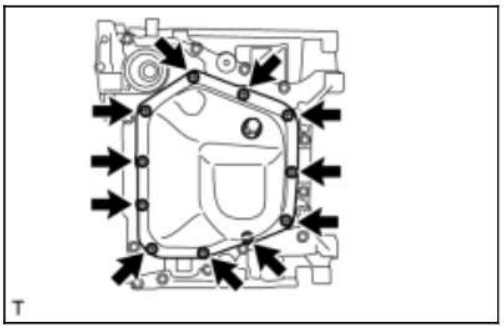
(a) Remove the 2 bolts and No. 2 engine hanger from the cylinder block (for bank 1).



44. REMOVE NO. 2 OIL PAN SUB-ASSEMBLY

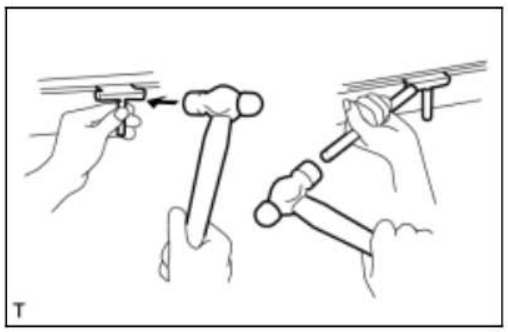
(a) Remove the drain plug and gasket.

(b) Remove the 11 bolts.



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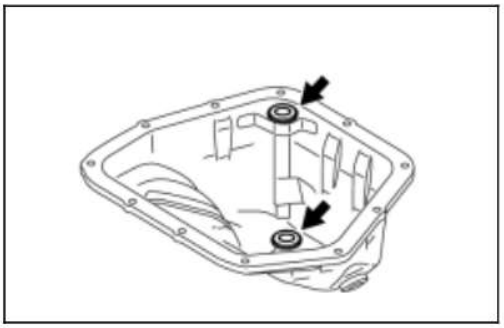
(c) Using an oil pan seal cutter, remove the No. 2 oil pan sub-assembly.



NOTICE:

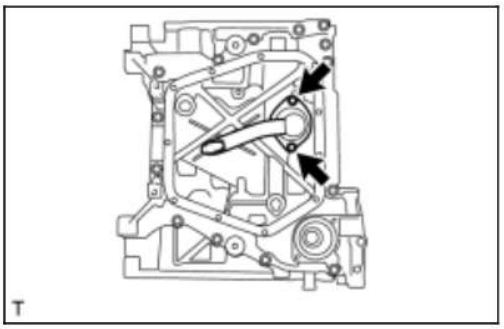
Do not damage the contact surface and flange part of the No. 2 oil pan sub-assembly.

(d) Remove the 2 seal rings from the No. 2 oil pan sub-assembly.



45. REMOVE OIL STRAINER SUB-ASSEMBLY

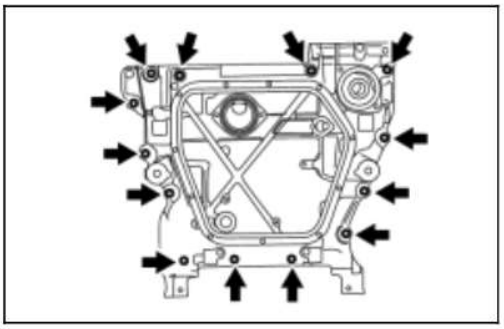
(a) Remove the 2 bolts and oil strainer sub-assembly.



(b) Remove the O-ring.

46. REMOVE OIL PAN SUB-ASSEMBLY

(a) Remove the 13 bolts.



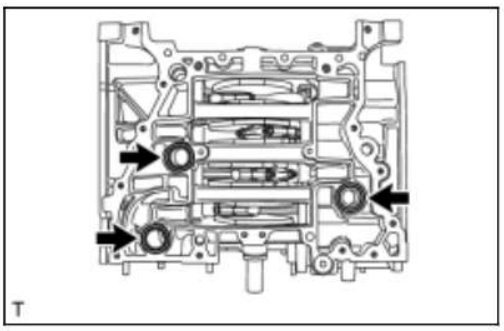
(b) Using a screwdriver with its tip wrapped in protective tape, remove the oil pan sub-assembly.

NOTICE:

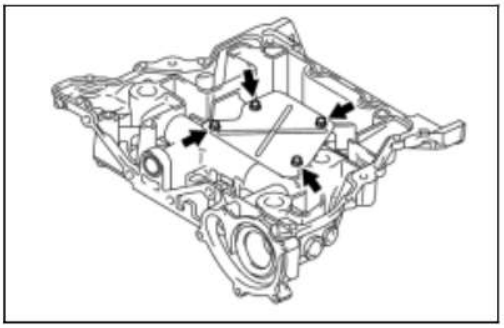
Do not damage the cylinder block and oil pan sub-assembly.

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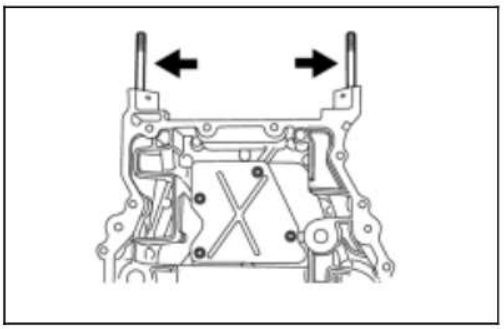
(c) Remove the 3 O-rings from the cylinder block.



(d) Remove the 4 bolts and baffle plate from the oil pan sub-assembly.



(e) Remove the 2 stud bolts from the oil pan sub-assembly.

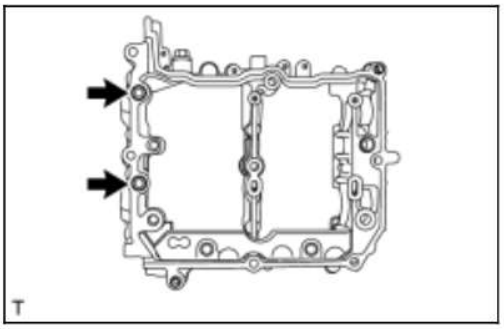


47. REMOVE CAMSHAFT BEARING CAP (for Bank 1) INFO

48. REMOVE CAMSHAFT (for Bank 1) INFO

49. REMOVE OIL CONTROL VALVE FILTER (for Bank 1)

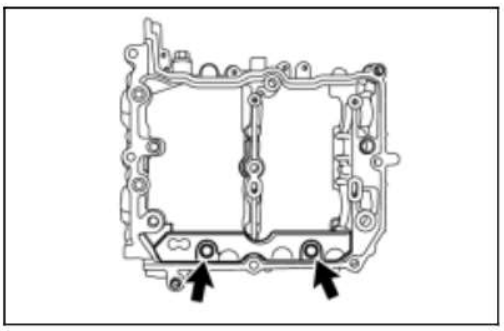
(a) Remove the 2 oil control valve filters from the camshaft housing sub-assembly RH.



50. REMOVE OIL SPACER RH

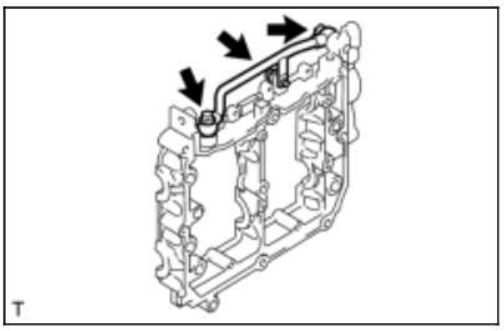
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(a) Remove the 2 bolts and oil spacer RH.



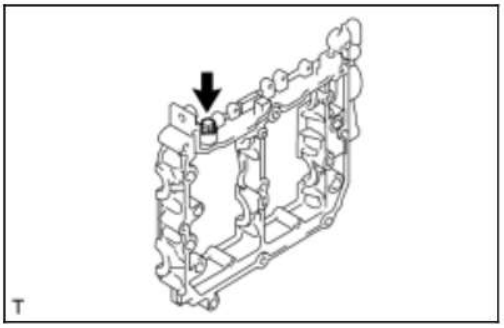
51. REMOVE CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY (for Automatic Transmission)

(a) Remove the 2 union bolts, the bolt, camshaft oil feed pipe sub-assembly and 2 gaskets from the camshaft housing sub-assembly RH.



52. REMOVE HOLE PLUG (for Manual Transmission)

(a) Remove the hole plug and gasket from the camshaft housing sub-assembly RH.

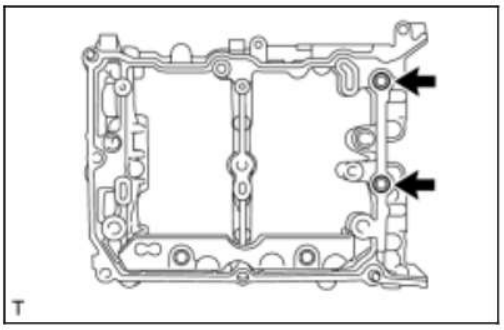


53. REMOVE CAMSHAFT BEARING CAP (for Bank 2) INFO

54. REMOVE CAMSHAFT (for Bank 2) INFO

55. REMOVE OIL CONTROL VALVE FILTER (for Bank 2)

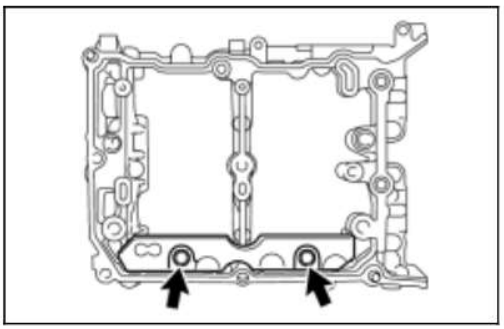
(a) Remove the 2 oil control valve filters from the camshaft housing sub-assembly LH.



56. REMOVE OIL SPACER LH

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(a) Remove the 2 bolts and oil spacer LH.



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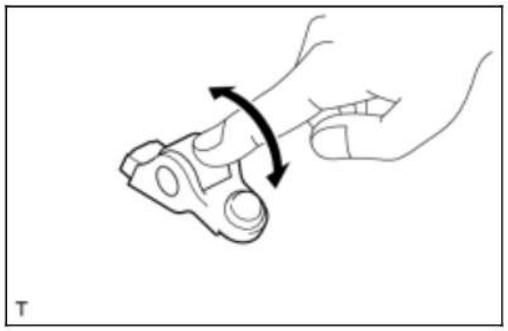
Last Modified: 4-14-2014	6.6 G	Doc ID: RM000000XCV08FX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE UNIT: INSPECTION; 2013 MY FR-S [03/2012 -]		

INSPECTION

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

(a) Check that the roller moves smoothly by rotating it by hand.

Replace the No. 1 valve rocker arm sub-assembly if the roller does not rotate smoothly.



2. INSPECT CHAIN SUB-ASSEMBLY

(a) Check the chain sub-assembly for deformation, cracks or other damages.

If the chain sub-assembly has any defects, replace it.

3. INSPECT CAMSHAFT TIMING GEAR

(a) Check the camshaft timing gear teeth for abnormal wear and scratches.

If the camshaft timing gear has any defects, replace it.

4. INSPECT CRANKSHAFT TIMING GEAR OR SPROCKET

(a) Check the crankshaft timing gear or sprocket teeth for abnormal wear and scratches.

If necessary, replace it.

(b) Check that there is no play between the crankshaft timing gear or sprocket and the key.

If necessary, replace the crankshaft timing gear or sprocket or the key.

5. INSPECT CHAIN TENSIONER SLIPPER

(a) Check the chain tensioner slipper for deformation, cracks or other damages.

6. INSPECT NO. 1 CHAIN VIBRATION DAMPER

(a) Check the No. 1 chain vibration damper for deformation, cracks or other damages.

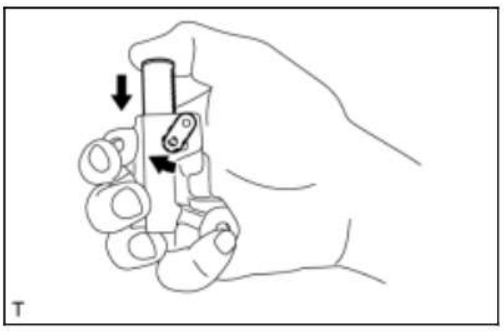
7. INSPECT CHAIN TENSIONER ASSEMBLY

(a) Check the chain tensioner assembly for deformation, cracks or other damages.

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(b) Check that the plunger moves smoothly when it is unlocked.

If the plunger does not move smoothly, replace the chain tensioner assembly.



(c) Check that the plunger does not move when it is locked.

8. INSPECT CAMSHAFT HOUSING SUB-ASSEMBLY

(a) Visually check the oil control valve filters, and if clogging is found, replace them with new ones.

(b) Check the camshaft housing sub-assembly journals for damage and wear. Replace the camshaft housing sub-assembly if necessary.

9. INSPECT CAMSHAFT

(a) Check the camshaft journals for damage and wear.

Replace the camshaft if necessary.

(b) Check the cam face condition.

Replace the camshaft if uneven wear is found.

HINT:

Remove the minor faults by smoothing the surface with 400-grit sandpaper.

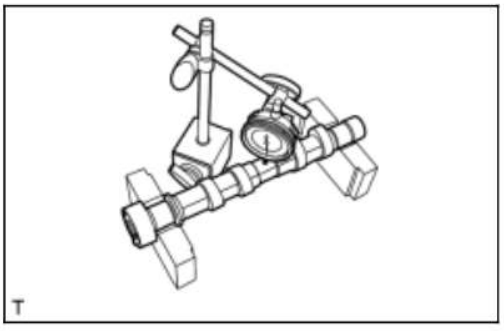
(c) Inspect for runout.

(1) Place the camshaft on V-blocks.

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

Maximum circle runout:
0.020 mm (0.00079 in.)

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



HINT:

Measurement should be performed at a temperature of 20°C (68°F).

(d) Inspect for cam height.

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

Standard height (Intake):

POSITION	STANDARD

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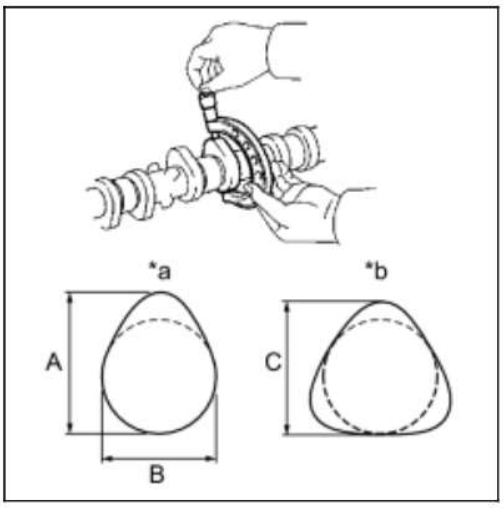
A	40.82 to 40.92 mm (1.6083 to 1.6110 in.)
B	34.0 mm (1.3386 in.)

Standard height (Exhaust):

POSITION	STANDARD
A	40.72 to 40.82 mm (1.6031 to 1.6071 in.)
B	34.0 mm (1.3386 in.)

Standard height (For fuel pump):

POSITION	STANDARD
C	40.55 to 40.65



Text in Illustration

*a	For Valve
*b	For Fuel Pump

If the result is not as specified, replace the camshaft.

HINT:

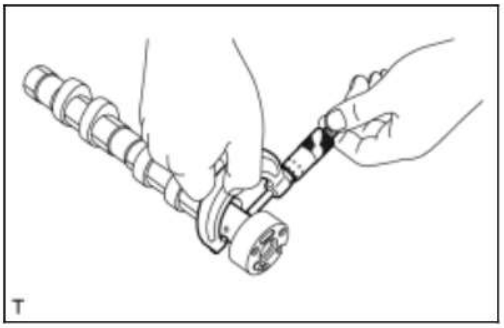
Measurement should be performed at a temperature of 20°C (68°F).

(e) Inspect for camshaft journals.

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

Standard journal diameter:
25.946 to 25.963 mm (1.02149 to 1.02216 in.)

If the result is not as specified, check the oil clearance.



HINT:

Measurement should be performed at a temperature of 20°C (68°F).

10. INSPECT CAMSHAFT OIL CLEARANCE

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

Standard thrust clearance:
0.0068 to 0.1160 mm (0.00027 to 0.00457 in.)

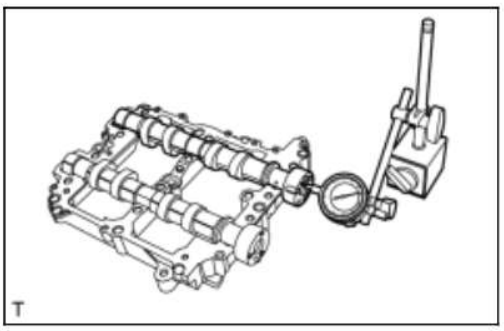
If the clearance is not as specified or if uneven wear is found, replace each camshaft cap and camshaft housing

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as a set. If necessary replace the camshaft.

HINT:

- Measurement should be performed at a temperature of 20°C (68°F).
- Set the dial indicator at the end surface of the camshaft.



11. INSPECT CAMSHAFT OIL CLEARANCE

HINT:

Measurement should be performed at a temperature of 20°C (68°F).

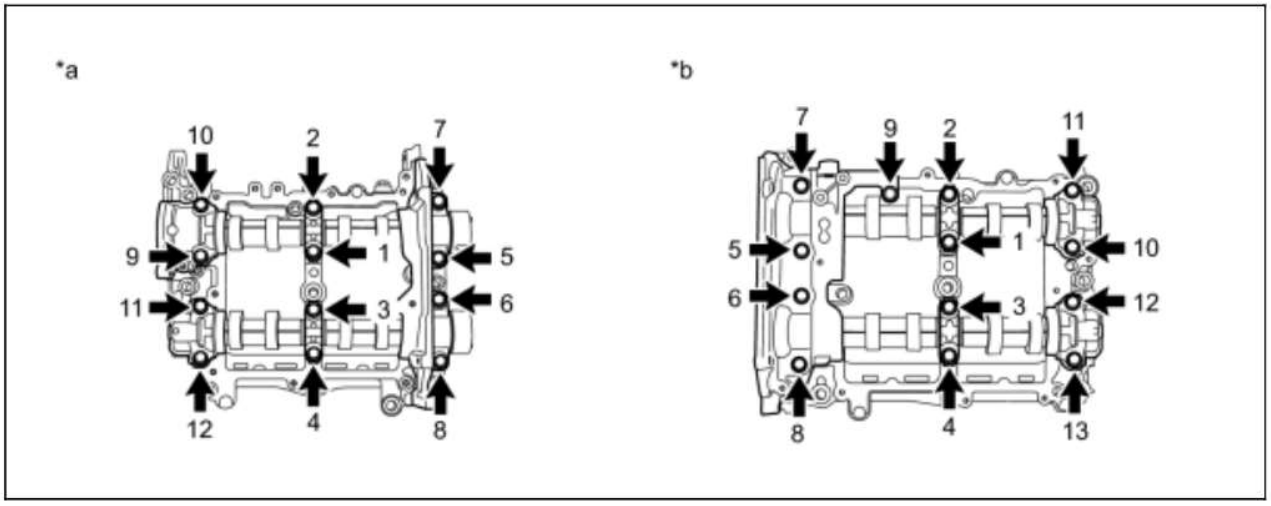
(a) Remove the seal packing from camshaft housing and front camshaft cap, intake rear camshaft cap and exhaust rear camshaft cap.

(b) Clean each camshaft cap and camshaft housing journal.

(c) Set the camshafts on the camshaft housing.

(d) Place a plastigauge across the camshaft journals and set the camshaft caps.

(e) Tighten the bolts in the order shown in the illustration to install the front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap.



Text in Illustration

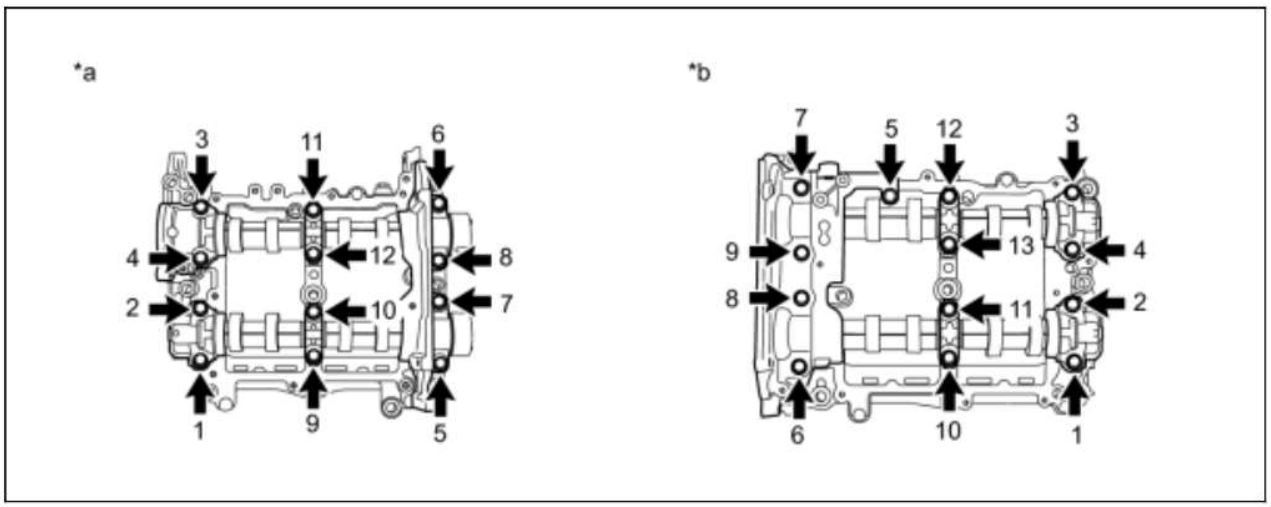
*a	for Bank 1	*b	for Bank 2

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}

(f) Using several steps, uniformly loosen the bolts in the order shown in the illustration, and remove the front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap.

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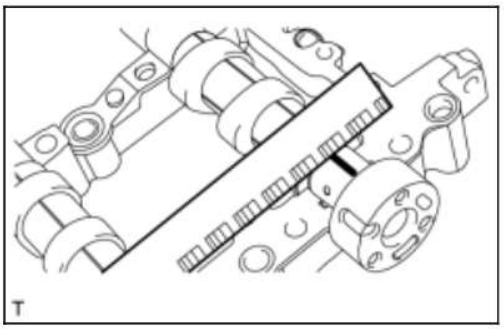
Text in Illustration

*a	for Bank 1	*b	for Bank 2

(g) Measure the widest point of the plastigauge on each journal.

Standard oil clearance:
0.037 to 0.072 mm (0.00146 to 0.00283 in.)

If the clearance is not as specified, replace each camshaft cap and camshaft housing as a set. If necessary, replace the camshaft.



(h) Completely remove the plastigauge.

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000N81019X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE UNIT: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL IGNITION COIL ASSEMBLY

(a) Install the 4 ignition coils with the 4 bolts.

Torque:

8.5 N·m {87 kgf·cm, 75in·lbf}

2. INSTALL NO. 1 WATER BY-PASS PIPE (for Manual Transmission)

(a) Install the No. 1 water by-pass pipe with the 2 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(b) Connect the water by-pass hose with the hose clamp.

3. INSTALL NO. 1 WATER BY-PASS PIPE (for Automatic Transmission)

(a) Install the No. 1 water by-pass pipe with the 2 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

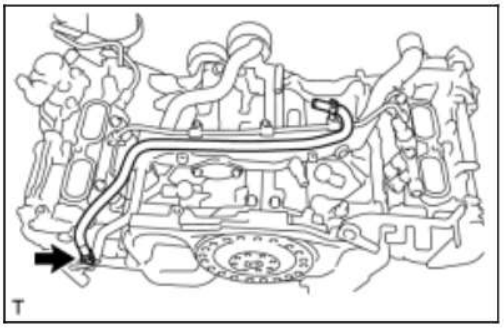
(b) Connect the 2 water by-pass hoses with the 2 hose clamps.

4. CONNECT NO. 3 TRANSMISSION OIL COOLER HOSE (for Automatic Transmission)

(a) Connect the No. 3 transmission oil cooler hose with the hose clamp.

5. INSTALL NO. 2 WATER BY-PASS HOSE

(a) Connect the No. 2 water by-pass hose with the clamp.



6. CONNECT NO. 2 VENTILATION HOSE

(a) Connect the No. 2 ventilation hose.

7. INSTALL ENGINE WIRE

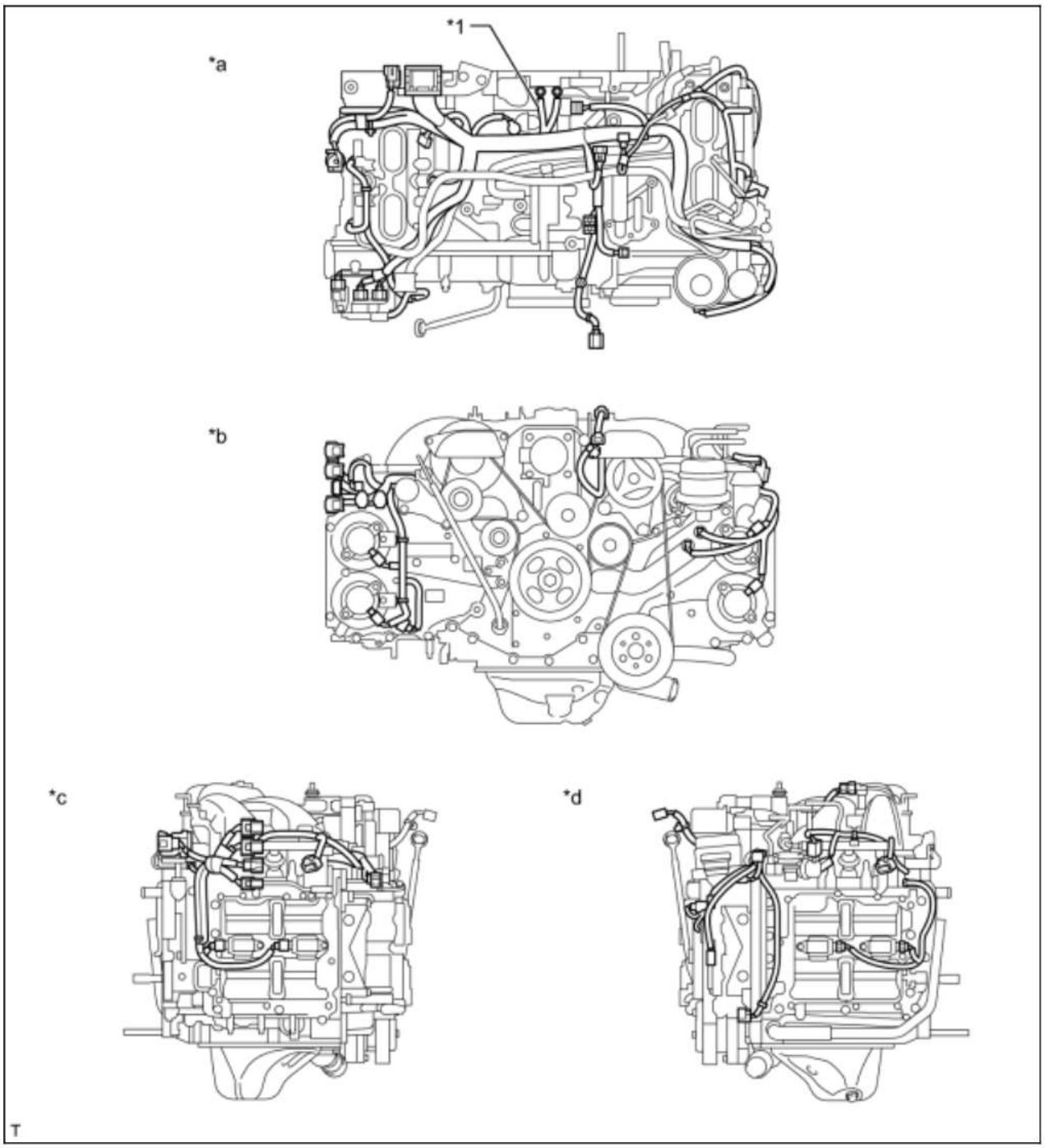
(a) Connect the ground wire with the 2 bolts.

Torque:

19 N·m {194 kgf·cm, 14ft·lbf}

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(b) Connect each connector and each clamp to fix the engine wire as shown in the illustration, and check that the engine wire is correctly installed.



Text in Illustration

*1	Ground Wire	-	-
*a	Upper side	*b	Front side
*c	Right side	*d	Left side

8. INSTALL PUMP DRIVE CASE ASSEMBLY INFO

9. INSTALL VALVE LIFTER INFO

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10. INSTALL FUEL PUMP ASSEMBLY INFO

11. INSTALL FUEL INJECTOR O-RING INFO

12. INSTALL FUEL INJECTOR ASSEMBLY INFO

13. INSTALL FUEL DELIVERY PIPE LH INFO

14. INSTALL FUEL DELIVERY PIPE RH INFO

15. INSTALL FUEL DELIVERY PIPE INFO

16. INSTALL NO. 2 FUEL DELIVERY PIPE INFO

17. INSTALL INTAKE MANIFOLD

(a) Install 2 new gaskets to the intake manifold.

(b) Install the intake manifold with the 6 bolts.

Torque:

25 N·m {255 kgf·cm, 18ft·lbf}

(c) Engage the 2 clamps and connect the 4 connectors.

(d) Connect the fuel pump connector.

(e) Connect the No. 1 vacuum switching valve assembly connector.

(f) Connect the vacuum sensor connector.

(g) Connect the 2 water by-pass hoses to the throttle body assembly.

(h) Connect the throttle body assembly connector.

18. CONNECT VENTILATION HOSE INFO

19. INSTALL FUEL DELIVERY PIPE SUB-ASSEMBLY

(a) Install the fuel delivery pipe sub-assembly to the fuel pump assembly with a new gasket and the union bolt.

Torque:

31 N·m {316 kgf·cm, 23ft·lbf}

(b) Connect the No. 2 fuel vapor feed hose.

(c) Install the bolt and connect the fuel delivery pipe sub-assembly.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

20. INSTALL INJECTOR COVER (for Bank 2)

(a) Install the injector cover to the intake manifold with the 2 bolts.

Torque:

19 N·m {194 kgf·cm, 14ft·lbf}

21. INSTALL INJECTOR COVER (for Bank 1)

(a) Install the injector cover to the intake manifold with the 2 bolts.

Torque:

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19 N·m {194 kgf·cm, 14ft·lbf}

22. INSTALL COMPRESSOR WITH MAGNET CLUTCH INFO

23. INSTALL V-RIBBED BELT TENSIONER ASSEMBLY INFO

24. INSTALL NO. 2 IDLER PULLEY SUB-ASSEMBLY INFO

25. INSTALL OIL LEVEL DIPSTICK GUIDE INFO

26. INSTALL GENERATOR ASSEMBLY

(a) Install the generator assembly with the 2 bolts.

Torque:

25 N·m {255 kgf·cm, 18ft·lbf}

27. INSTALL FAN AND GENERATOR V BELT INFO

28. INSTALL BELT GENERATOR COVER INFO

29. INSTALL GENERATOR COVER INFO

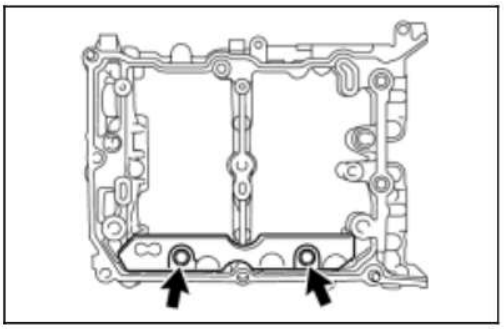
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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000T4Y0BBX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE UNIT: REASSEMBLY; 2013 MY FR-S [03/2012 -]		

REASSEMBLY

1. INSTALL OIL SPACER LH

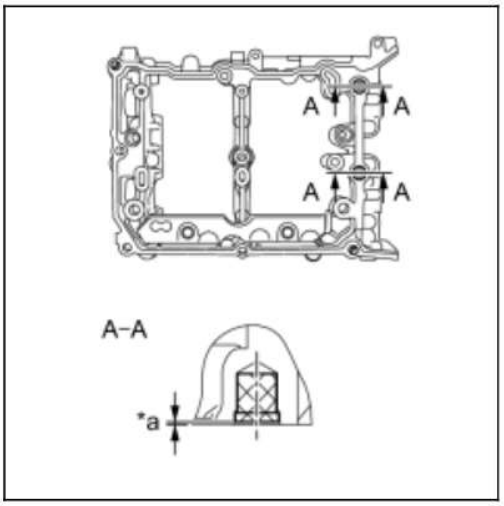


(a) Install the oil spacer LH with the 2 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

2. INSTALL OIL CONTROL VALVE FILTER (for Bank 2)



(a) Install 2 new oil control valve filters to the camshaft housing sub-assembly LH as shown in the illustration.

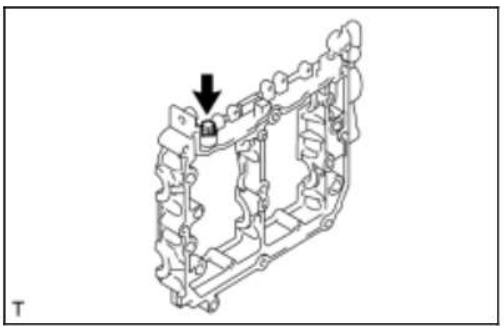
Text in Illustration

*a	0 to 0.5 mm (0 to 0.0197 in.) from the face of the camshaft housing sub-assembly LH

3. INSTALL CAMSHAFT (for Bank 2) INFO

4. INSTALL CAMSHAFT CAP (for Bank 2) INFO

5. INSTALL HOLE PLUG (for Manual Transmission)



(a) Install a new gasket and the hole plug to the camshaft housing sub-assembly RH.

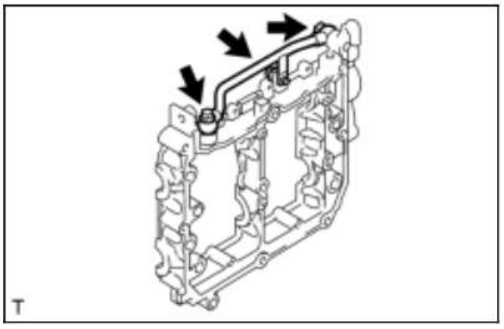
Torque:

25 N·m {255 kgf·cm, 18ft·lbf}

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6. INSTALL CAMSHAFT OIL FEED PIPE SUB-ASSEMBLY (for Automatic Transmission)

(a) Temporarily install 2 new gaskets and the camshaft oil feed pipe sub-assembly with the bolt and 2 union bolts.



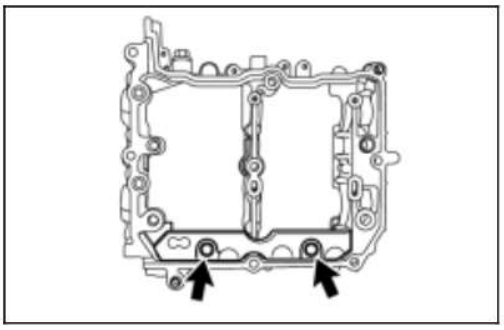
(b) Tighten the 2 union bolts to the specified torque.

Torque:
31 N·m {316 kgf·cm, 23ft·lbf}

(c) Tighten the bolt to the specified torque.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

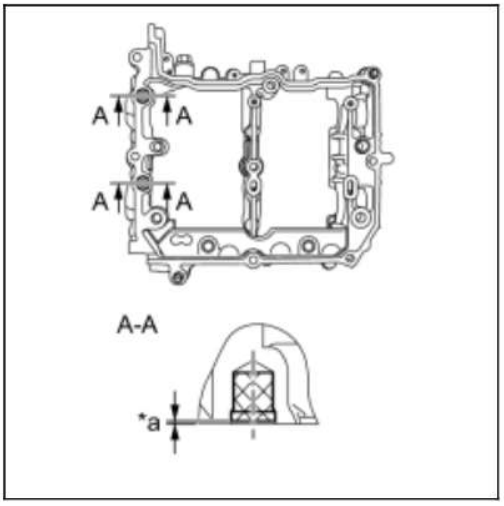
7. INSTALL OIL SPACER RH



(a) Install the oil spacer RH with the 2 bolts.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

8. INSTALL OIL CONTROL VALVE FILTER (for Bank 1)



(a) Install 2 new oil control valve filters to the camshaft housing sub-assembly RH as shown in the illustration.

Text in Illustration

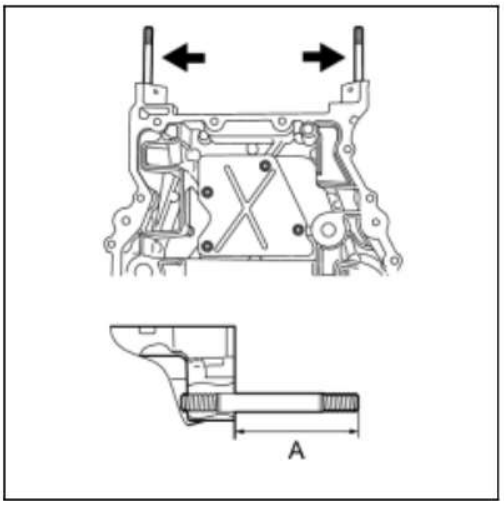
*a	0 to 0.5 mm (0 to 0.0197 in.) from the face of the camshaft housing sub-assembly RH

9. INSTALL CAMSHAFT (for Bank 1) INFO

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10. INSTALL CAMSHAFT CAP (for Bank 1) INFO

11. INSTALL OIL PAN SUB-ASSEMBLY



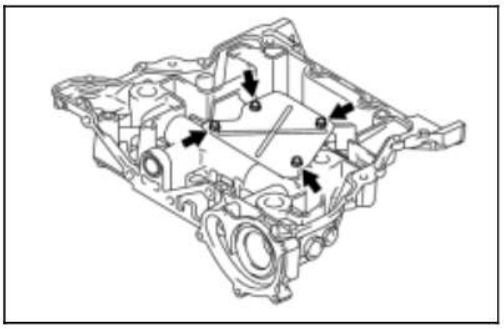
(a) Install the 2 stud bolts to the oil pan sub-assembly.

Torque:

10 N·m {102 kgf·cm, 7ft·lbf}

Standard height (A):

70.0 mm (2.756 in.)



(b) Install the baffle plate to the oil pan sub-assembly with the 4 bolts.

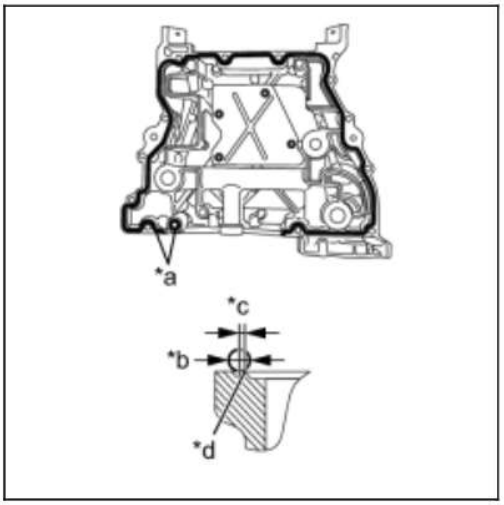
Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(c) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

Three Bond 1217G, 1217H or equivalent



Text in Illustration

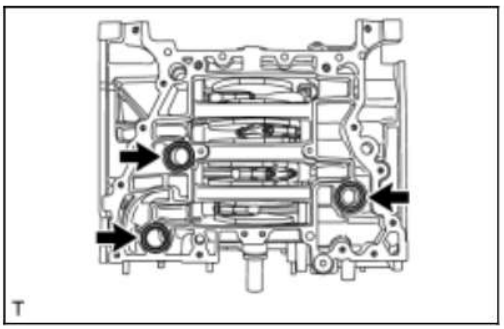
*a	Seal Packing
*b	φ4.0 to 6.0 mm (0.158 to 0.236 in.)
*c	1.5 mm (0.059 in.)
*d	Chamfer edge

NOTICE:

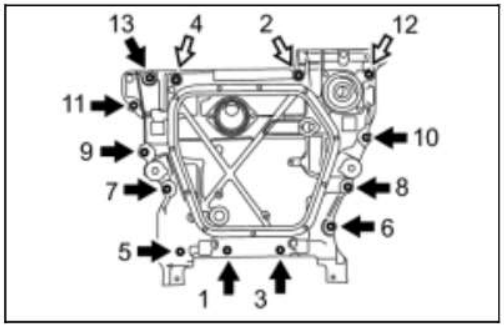
- Clean and degrease the contact surface.
- Install the oil pan sub-assembly within 5 minutes of applying seal packing.
- Apply seal packing 1.5 mm (0.0591 in.) away from the outer side of the chamfer edge. However, it is allowed to apply the seal packing on the chamfer around the bolt hole.

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(d) Install 3 new O-rings to the cylinder block.



(e) Tighten the 13 bolts in the order shown in the illustration to install the oil pan sub-assembly to the cylinder block.



Text in Illustration

➡	Bolt A
⇨	Bolt B

Length of bolt A:
25.0 mm (0.984 in.)
Length of bolt B:
75.0 mm (2.953 in.)

HINT:

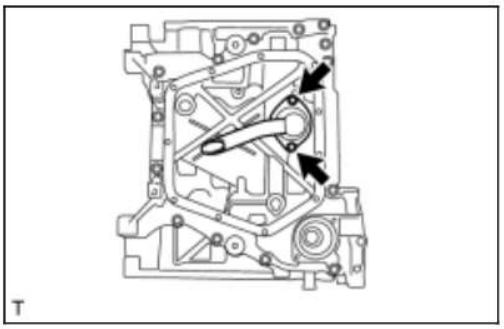
After tightening the bolts, if the seal packing is squeezed out onto the seal surface of the chain cover, completely remove it.

12. INSTALL OIL STRAINER SUB-ASSEMBLY

(a) Install a new O-ring.

(b) Install the oil strainer sub-assembly to the oil pan sub-assembly with the 2 bolts.

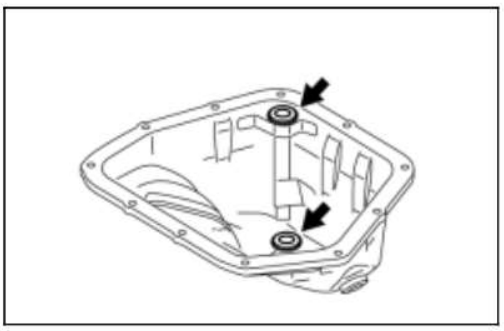
Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}



13. INSTALL NO. 2 OIL PAN SUB-ASSEMBLY

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(a) Install 2 new oil pan seal rings to the No. 2 oil pan sub-assembly.



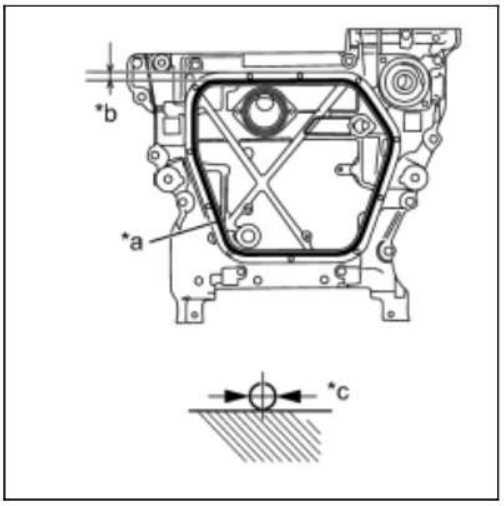
(b) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

Three Bond 1217G, 1217H or equivalent

NOTICE:

- Clean and degrease the contact surface.
- Install the No. 2 oil pan sub-assembly within 5 minutes of applying seal packing.



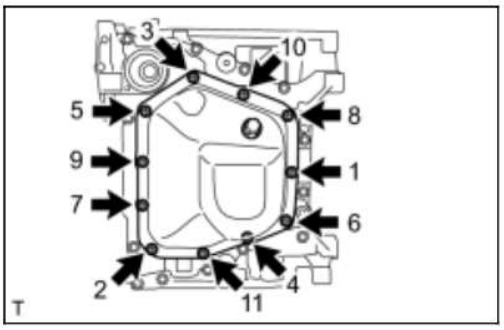
Text in Illustration

*a	Seal Packing
*b	9.5 mm (0.374 in.)
*c	φ4.0 to 6.0 mm (0.158 to 0.236 in.)

(c) Tighten the 11 bolts in the order shown in the illustration to install the No. 2 oil pan sub-assembly.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}



(d) Install a new gasket and the drain plug.

Torque:

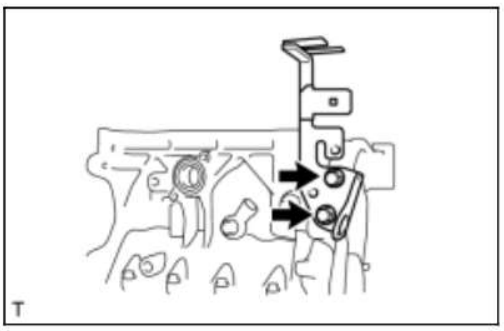
42 N·m {425 kgf·cm, 31ft·lbf}

14. INSTALL NO. 2 ENGINE HANGER

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(a) Install the No. 2 engine hanger to the cylinder block (for bank 1) with the 2 bolts.

Torque:
21 N·m {214 kgf·cm, 16ft·lbf}

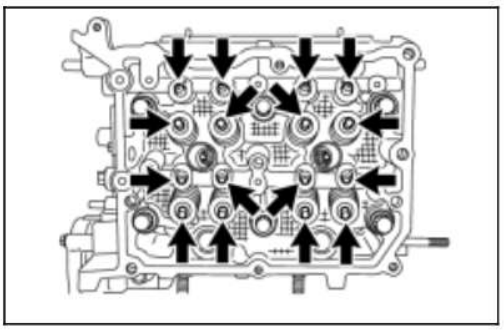


15. INSTALL NO. 2 CYLINDER HEAD GASKET INFO

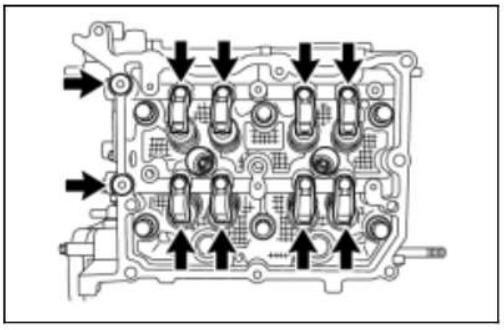
16. INSTALL CYLINDER HEAD SUB-ASSEMBLY LH INFO

17. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY LH

(a) Apply engine oil to the 8 valve adjusting shims and 8 roller rocker arm pivots, and then install them to the cylinder head sub-assembly LH.



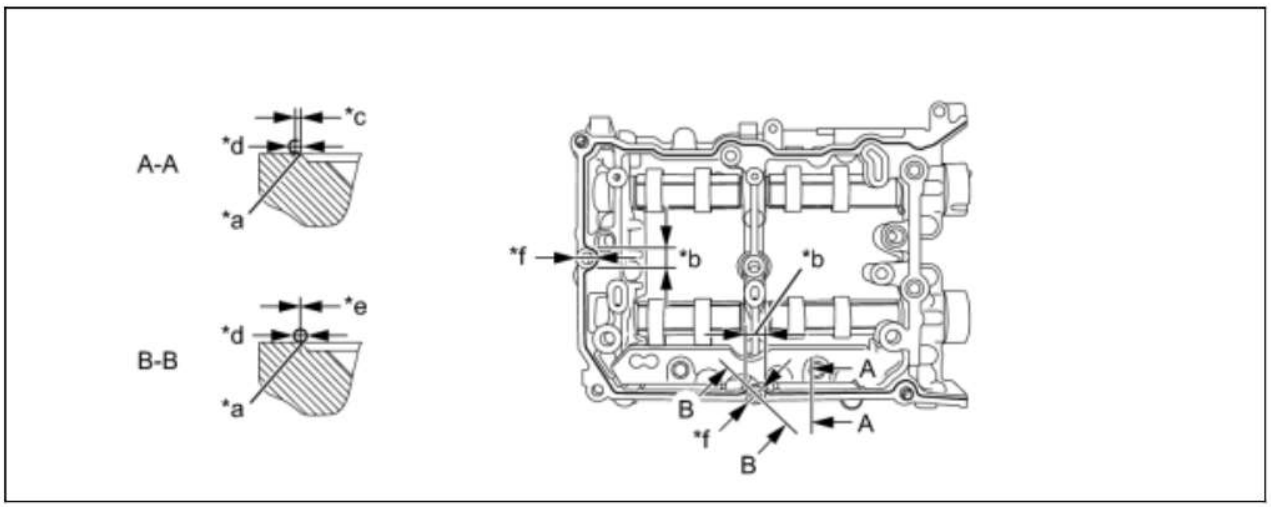
(b) Apply engine oil to 2 new O-rings and the 8 No. 1 valve rocker arm sub-assemblies, and then install them to the cylinder head sub-assembly LH.



(c) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Three Bond 1217G, 1217H or equivalent

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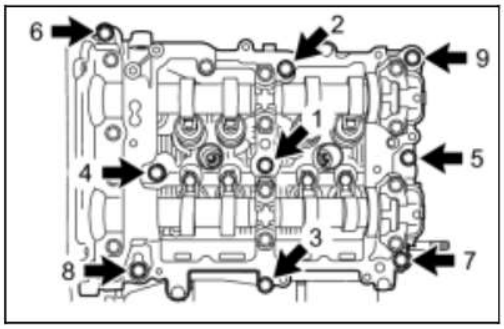
Text in Illustration

*a	Chamfer edge	*b	Range of B-B
*c	within 1.0 mm (0.0394 in.)	*d	φ2.5 to 3.5 mm (0.098 to 0.138 in.)
*e	-0.5 to 0.5 mm (-0.0197 to 0.0197 in.)	*f	18.0 mm (0.709 in.)

NOTICE:

- Clean and degrease the contact surface.
- Do not apply excessive seal packing.
- Install the camshaft housing sub-assembly LH within 5 minutes of applying seal packing.
- After tightening the bolts, if the seal packing is squeezed out onto the seal surface of the chain cover, completely remove it.

(d) Tighten the 9 bolts in the order shown in the illustration to install the camshaft housing sub-assembly LH.



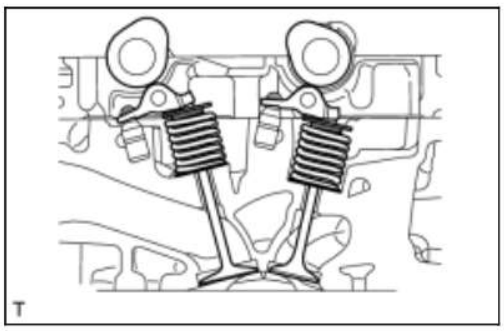
Torque:

18 N·m {184 kgf·cm, 13ft·lbf}

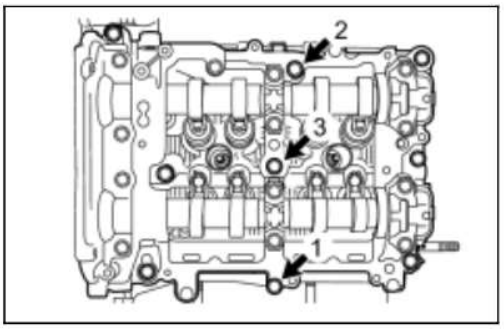
HINT:

Set the intake camshaft LH and the exhaust camshaft LH to the zero-lift position.

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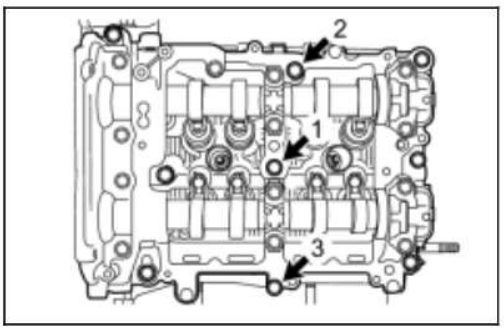
(e) Loosen the 3 bolts by 180° in the order shown in the illustration.



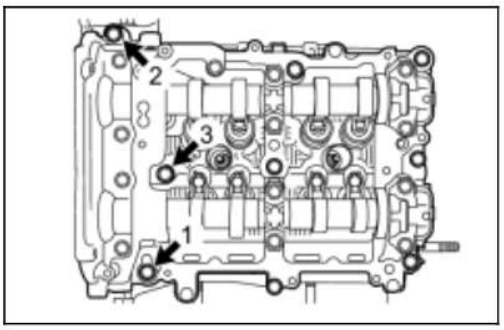
(f) Tighten the 3 bolts in the order shown in the illustration.

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



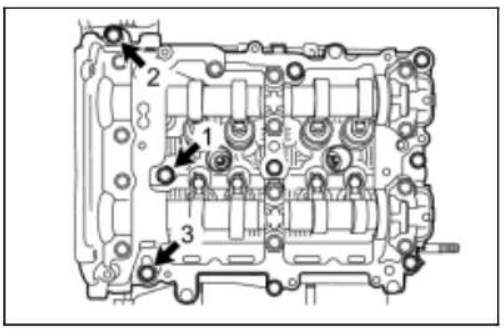
(g) Loosen the 3 bolts by 180° in the order shown in the illustration.



(h) Tighten the 3 bolts in the order shown in the illustration.

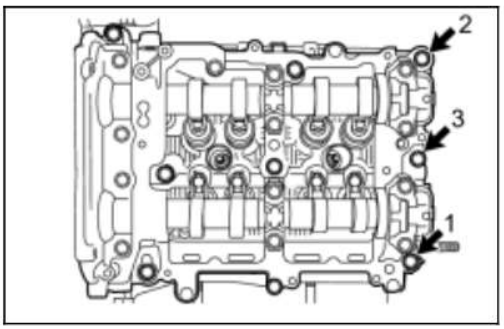
Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



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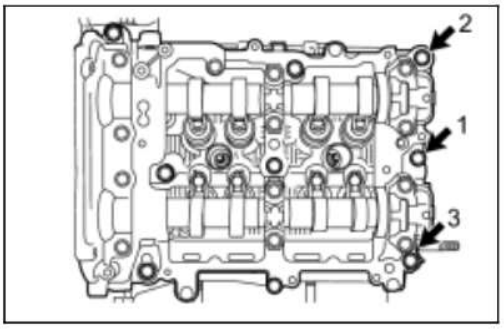
(i) Loosen the 3 bolts by 180° in the order shown in the illustration.



(j) Tighten the 3 bolts in the order shown in the illustration.

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



HINT:

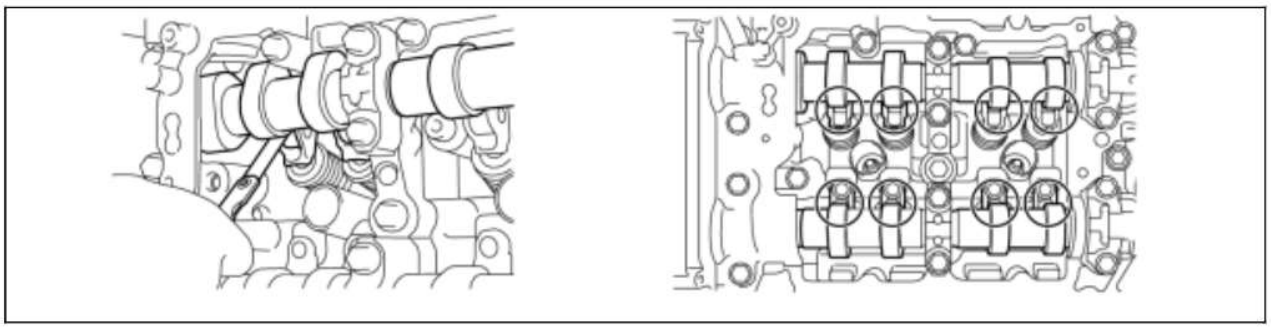
After tightening the bolts, if the seal packing is squeezed out onto the seal surface of the chain cover, completely remove it.

18. INSPECT VALVE CLEARANCE (for Bank 2)

NOTICE:

With the chain sub-assembly (for bank 2) removed, valve heads may contact each other if the camshafts are turned, causing the valve stems to bend. To avoid this, do not turn the intake camshaft LH and exhaust camshaft LH more than the zero-lift rang (The range where the camshafts can be turned lightly by hand).

(a) Using a feeler gauge, check the valve clearance between the cam base circle and the roller surface of the No. 1 valve rocker arm sub-assembly.



Standard valve clearance (cold):

0.10 to 0.16 mm (0.0039 to 0.0063 in.) for intake

0.21 to 0.27 mm (0.0083 to 0.0106 in.) for exhaust

HINT:

- Set the intake camshaft LH and the exhaust camshaft LH to the zero-lift position.
- If the clearance is not as specified, take notes of the value in order to adjust the valve clearance later on.

19. ADJUST VALVE CLEARANCE (for Bank 2)

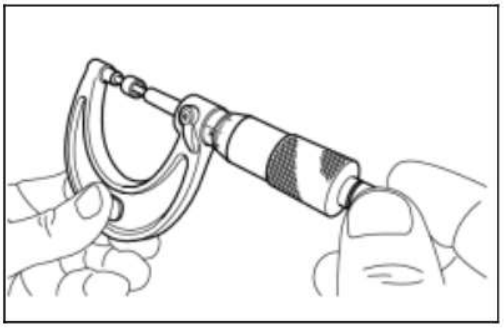
(a) Remove the camshaft housing sub-assembly LH.

(b) Remove the No. 1 valve rocker arm sub-assemblies.

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(c) Remove the valve adjusting shims.

(d) Using a micrometer, measure the thickness of the valve adjusting shims.



(e) Calculate the thickness of the valve adjusting shim so that the valve clearance comes within the specified values.

Intake side:
A = B + (C - 0.13 mm (0.0051 in.) x 1.54
Exhaust side:
A = B + (C - 0.24 mm (0.0094 in.) x 1.69
A:
Required valve adjusting shim thickness
B:
Removed valve adjusting shim thickness
C:
Measured valve clearance

(f) Apply engine oil to the inner face of the valve adjusting shims and install them to the valves.

NOTICE:
Check if the shims can be rotated smoothly on the valves.

(g) Install the No. 1 valve rocker arm sub-assemblies.

(h) Install the camshaft housing sub-assembly LH.

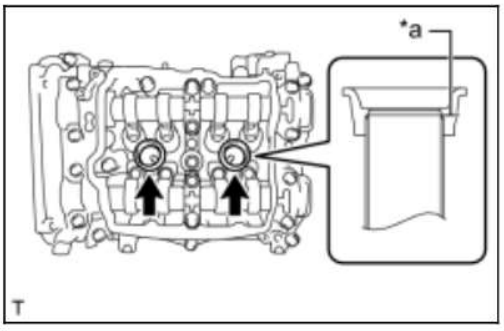
(i) Check that the No. 1 valve rocker arm sub-assemblies are correctly installed.

20. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH

(a) Apply a light layer of engine oil to 2 new spark plug tube gaskets and install them to the spark plug tubes as shown in the illustration.

Text in Illustration

*a	Spark plug tube edge



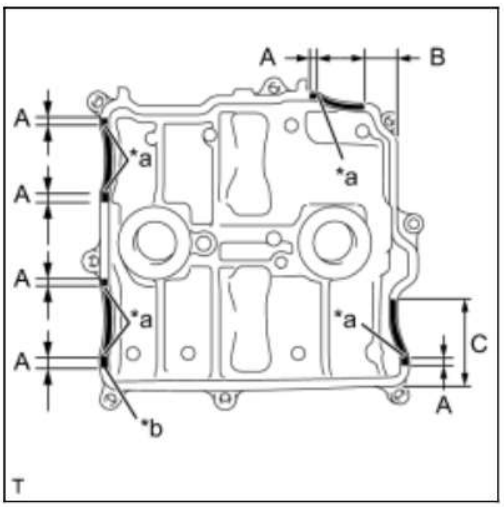
(b) Install a new cylinder head cover gasket to the cylinder head cover sub-assembly LH.

(c) Apply seal packing to the mating surface of cylinder head cover sub-assembly LH as shown in the illustration.

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Seal packing:
Three Bond 1217G, 1217H or equivalent

AREA	APPLICATION LENGTH
A	10.0 mm (0.394 in.) or more
B	18.8 mm (0.740 in.) or more
C	63.0 mm (2.480 in.) or more

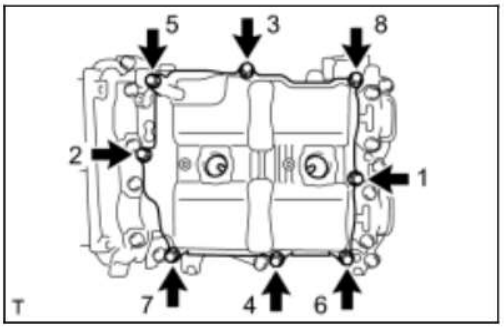


Text in Illustration

*a	Arch starting point
*b	φ2,0 to 4.0 mm (0.079 to 0.158 in.)

(d) Tighten the 8 bolts in the order shown in the illustration and install the cylinder head cover sub-assembly LH.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

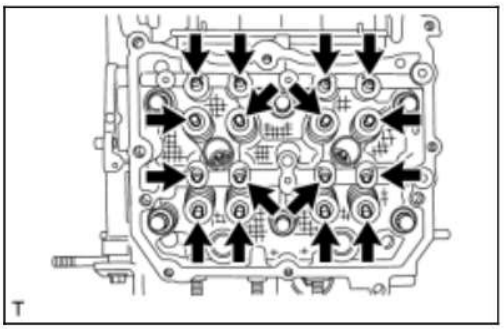


21. INSTALL CYLINDER HEAD GASKET INFO

22. INSTALL CYLINDER HEAD SUB-ASSEMBLY RH INFO

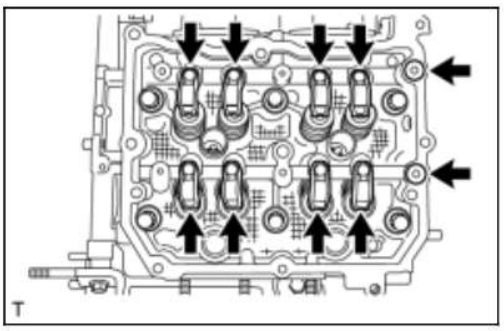
23. INSTALL CAMSHAFT HOUSING SUB-ASSEMBLY RH

(a) Apply engine oil to the 8 valve adjusting shims and 8 roller rocker arm pivots, and then install them to the cylinder head sub-assembly.



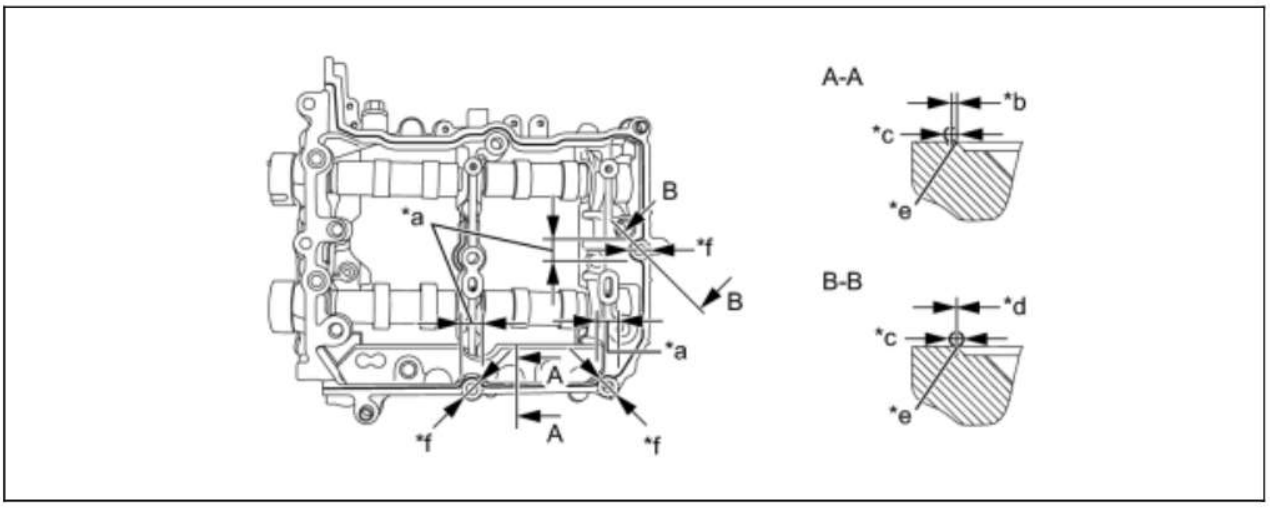
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(b) Apply engine oil to 2 new O-rings and the 8 No. 1 valve rocker arm sub-assemblies, and then install them to the cylinder head sub-assembly.



(c) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:
Three Bond 1217G, 1217H or equivalent



Text in Illustration

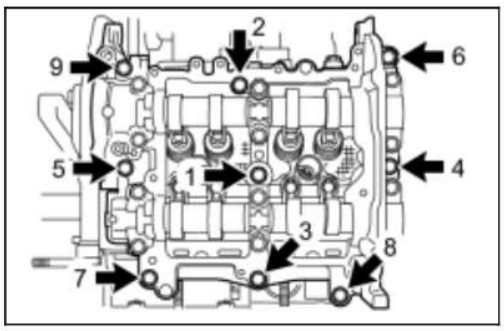
*a	Range of B-B	*b	0 to 1.0 mm (0 to 0.0394 in.)
*c	φ2.5 to 3.5 mm (0.098 to 0.138 in.)	*d	-0.5 to 0.5 mm (-0.0197 to 0.0197 in.)
*e	Chamfer edge	*f	18.0 mm (0.709 in.)

NOTICE:

- Clean and degrease the contact surface.
- Do not apply excessive seal packing.
- Install the camshaft housing sub-assembly RH within 5 minutes of applying seal packing.
- After tightening the bolts, if the seal packing is squeezed out onto the seal surface of the chain cover, completely remove it.

(d) Tighten the 9 bolts in the order shown in the illustration to install the camshaft housing sub-assembly RH.

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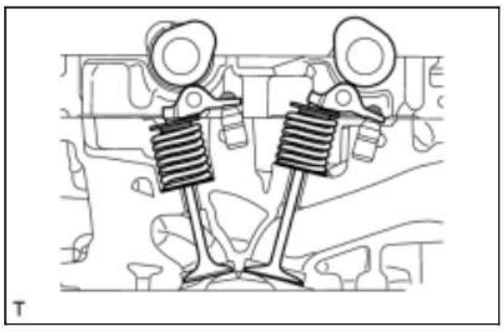


Torque:

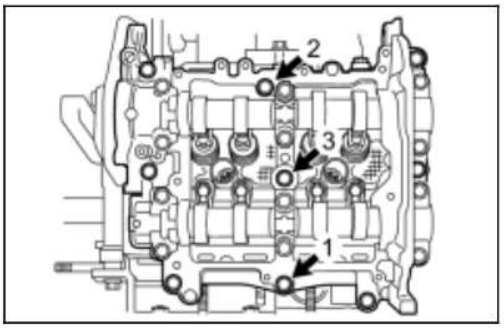
18 N·m {184 kgf·cm, 13ft·lbf}

HINT:

Set the intake camshaft RH and the exhaust camshaft RH to the zero-lift position.



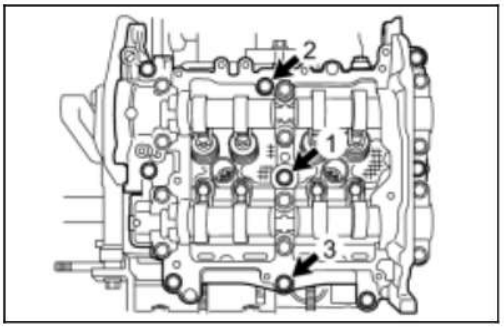
(e) Loosen the 3 bolts by 180° in the order shown in the illustration.



(f) Tighten the 3 bolts in the order shown in the illustration.

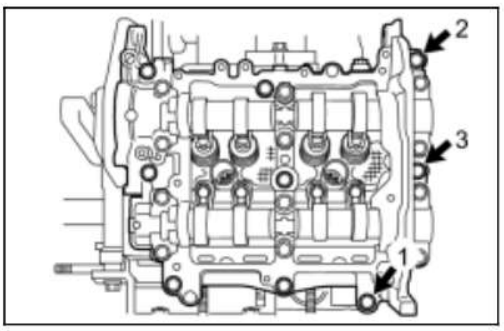
Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



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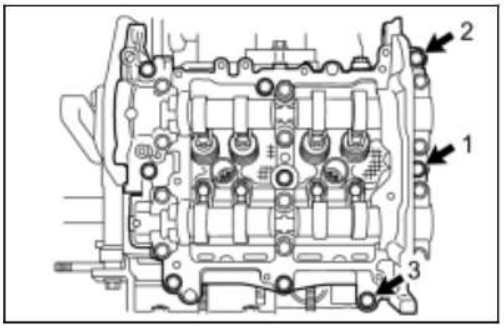
(g) Loosen the 3 bolts by 180° in the order shown in the illustration.



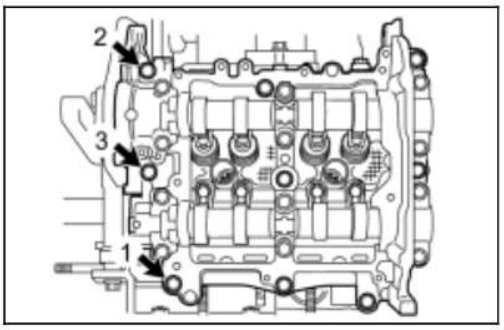
(h) Tighten the 3 bolts in the order shown in the illustration.

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



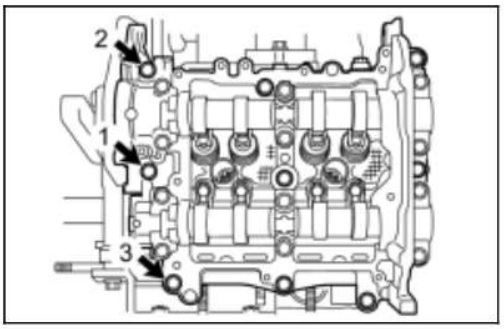
(i) Loosen the 3 bolts by 180° in the order shown in the illustration.



(j) Tighten the 3 bolts in the order shown in the illustration.

Torque:

18 N·m {184 kgf·cm, 13ft·lbf}



HINT:

After tightening the bolts, if the seal packing is squeezed out onto the seal surface of the chain cover, completely remove it.

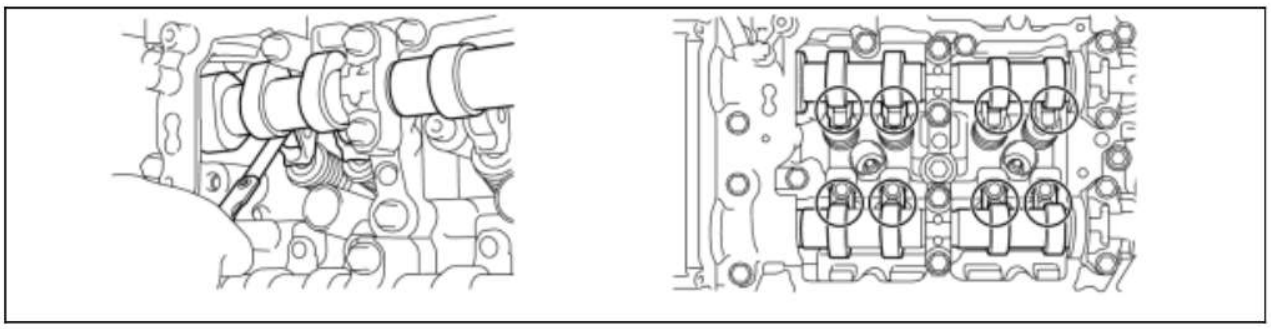
24. INSPECT VALVE CLEARANCE (for Bank 1)

NOTICE:

With the chain sub-assembly (for bank 1) removed, valve heads may contact each other if the camshafts are turned, causing the valve stems to bend. To avoid this, do not turn the intake camshaft RH and exhaust camshaft RH more than the zero-lift rang (The range where the camshafts can be turned lightly by hand).

(a) Using a feeler gauge, check the valve clearance between the cam base circle and the roller surface of the No. 1 valve rocker arm sub-assembly.

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Standard valve clearance (cold):

0.10 to 0.16 mm (0.0039 to 0.0063 in.) for intake

0.21 to 0.27 mm (0.0083 to 0.0106 in.) for exhaust

HINT:

- Set the intake camshaft RH and the exhaust camshaft RH to the zero-lift position.
- If the clearance is not as specified, take notes of the value in order to adjust the valve clearance later on.

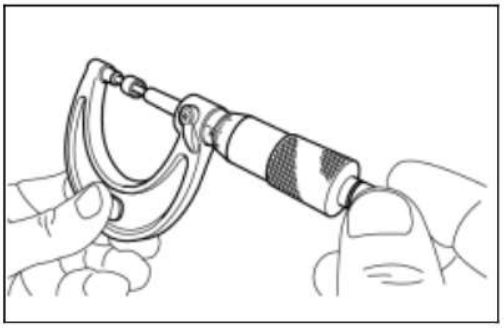
25. ADJUST VALVE CLEARANCE (for Bank 1)

(a) Remove the camshaft housing sub-assembly RH.

(b) Remove the No. 1 valve rocker arm sub-assemblies.

(c) Remove the valve adjusting shims.

(d) Using a micrometer, measure the thickness of the valve adjusting shims.



(e) Calculate the thickness of the valve adjusting shim so that the valve clearance comes within the specified values.

Intake side:

A = B + (C - 0.13 mm (0.0051 in.) x 1.54

Exhaust side:

A = B + (C - 0.24 mm (0.0094 in.) x 1.69

A:

Required valve adjusting shim thickness

B:

Removed valve adjusting shim thickness

C:

Measured valve clearance

(f) Apply engine oil to the inner face of the valve adjusting shims and install them to the valves.

NOTICE:

Check if the shims can be rotated smoothly on the valves.

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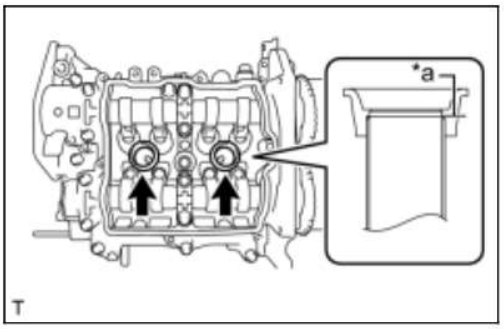
(g) Install the No. 1 valve rocker arm sub-assemblies.

(h) Install the camshaft housing sub-assembly RH.

(i) Check that the No. 1 valve rocker arm sub-assemblies are correctly installed.

26. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH

(a) Apply a light layer of engine oil to 2 new spark plug tube gaskets and install them to the spark plug tubes as shown in the illustration.



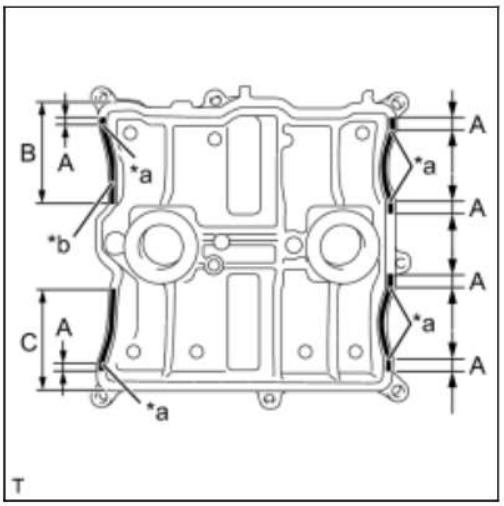
Text in Illustration

*a	Spark plug tube edge

(b) Install a new cylinder head cover gasket to the cylinder head cover sub-assembly RH.

(c) Apply seal packing to the mating surface of cylinder head cover sub-assembly RH as shown in the illustration.

Seal packing:
Three Bond 1217G, 1217H or equivalent

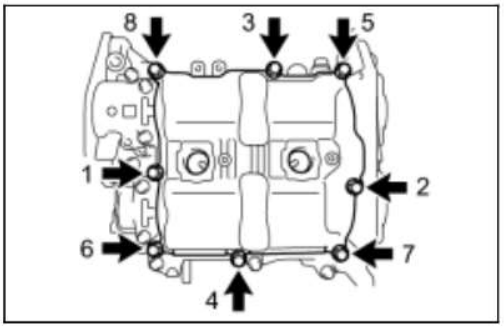


AREA	APPLICATION LENGTH
A	10.0 mm (0.394 in.) or more
B	68.0 mm (2.677 in.) or more
C	70.7 mm (2.784 in.) or more

Text in Illustration

*a	Arch starting point
*b	φ2,0 to 4.0 mm (0.079 to 0.158 in.)

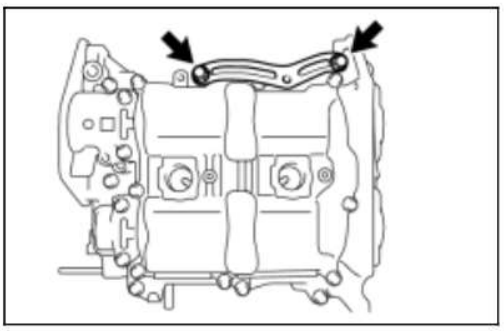
(d) Tighten the 8 bolts in the order shown in the illustration and install the cylinder head cover sub-assembly RH.



Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

27. INSTALL INJECTOR DRIVER BRACKET

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(a) Install the injector driver bracket with the 2 bolts.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

28. INSTALL SPARK PLUG

(a) Using a 14 mm spark plug wrench, install the 4 spark plugs.

Torque:
17 N·m {173 kgf·cm, 13ft·lbf}

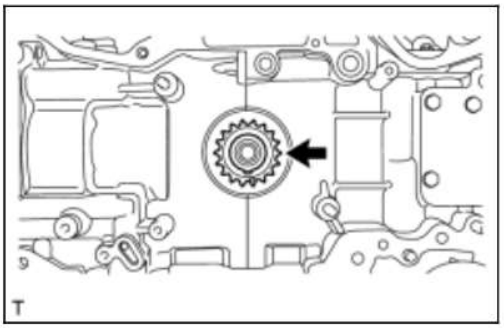
29. INSTALL CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY LH INFO

30. INSTALL CAMSHAFT TIMING INTAKE GEAR ASSEMBLY LH INFO

31. INSTALL CAMSHAFT TIMING EXHAUST GEAR ASSEMBLY RH INFO

32. INSTALL CAMSHAFT TIMING INTAKE GEAR ASSEMBLY RH INFO

33. INSTALL CRANKSHAFT TIMING GEAR OR SPROCKET



(a) Install the crankshaft timing gear or sprocket.

HINT:
The crankshaft timing gear or sprocket should be installed as it was before.

34. INSTALL CHAIN SUB-ASSEMBLY (for Bank 2)

NOTICE:
Do not allow any foreign matter to adhere or to enter into the component parts during installation.

HINT:
Apply engine oil to all component parts of the chain sub-assembly.

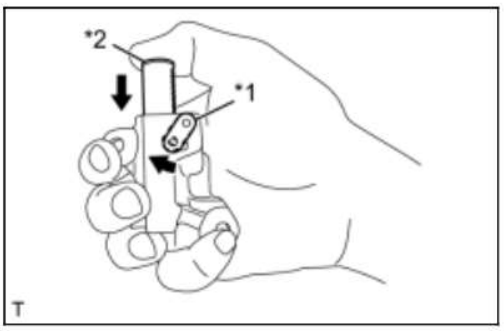
(a) Temporarily install the crank pulley bolt to the crankshaft.

(b) Move the link plate in the direction of the arrow in the illustration to press in the plunger.

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Text in Illustration

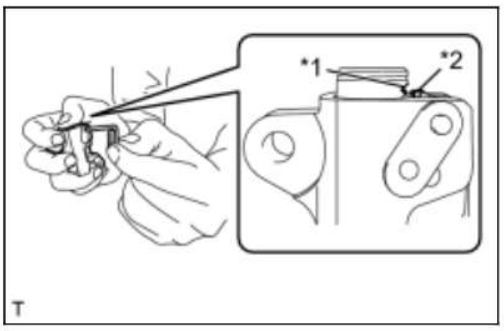
*1	Link Plate
*2	Plunger



(c) Insert an approximately 1 mm (0.0394 in.) diameter wire or the like into the chain tensioner assembly through the stopper pin hole, and hold the plunger.

Text in Illustration

*1	First notch of the plunger rack
*2	Stopper Tooth



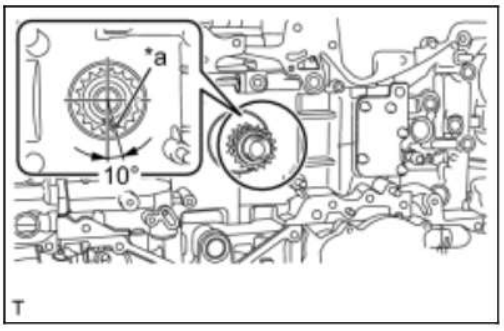
HINT:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner assembly are not aligned, check that the first notch of the plunger rack is engaged with the stopper tooth. If not engaged, retract the plunger a little so that the first notch of the plunger rack is engaged with the stopper tooth.

(d) Check that the crankshaft timing gear or sprocket is located at the position shown in the illustration. If not, turn the crankshaft to align the crankshaft timing gear or sprocket alignment mark as shown in the illustration.

Text in Illustration

*a	Alignment Mark



NOTICE:

Make sure to perform this operation to prevent the valves and pistons from contacting each other.

(e) Using SST, turn the camshaft timing intake gear assembly LH and align the alignment mark as shown in the illustration.

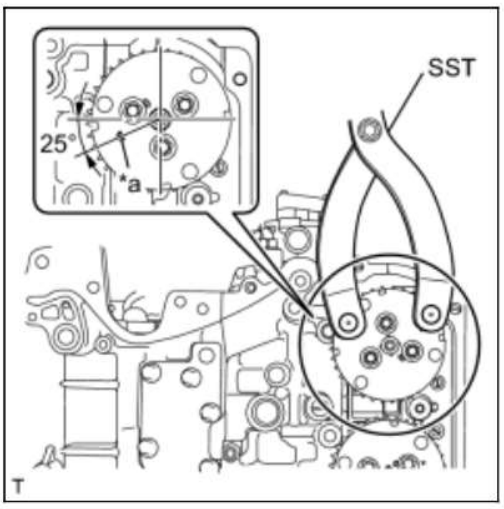
SST: 09960-10010
09962-01000

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09963-00700

Text in Illustration

*a	Alignment Mark



NOTICE:

Do not turn the exhaust camshaft LH. If the exhaust camshaft LH is turned, valve heads may come into contact with each other, causing the valve stems to bend.

(f) Remove the crank pulley bolt from the crankshaft.

(g) Temporarily install the crankshaft pulley spacer and crankshaft pulley to the crankshaft with the crank pulley bolt.

HINT:

Put a mark on the crankshaft pulley to mark the position of the crankshaft timing gear key.

(h) Using SST, turn the crankshaft counterclockwise by 200° and align the crankshaft key as shown in the illustration.

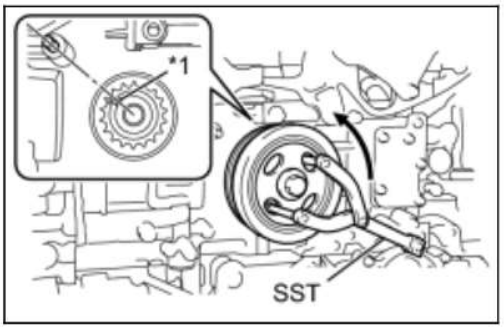
SST: 09960-10010

09962-01000

09963-01000

Text in Illustration

*1	Key



NOTICE:

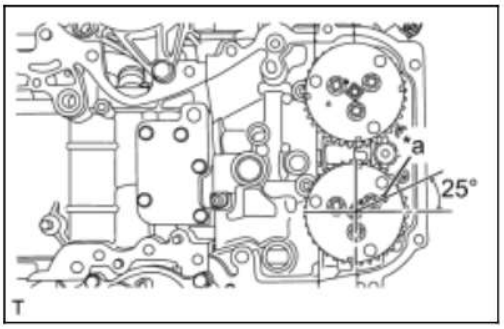
Never turn the crankshaft clockwise because the valves may come into contact with the piston. Turning the crankshaft clockwise is only allowed when adjusting the key position precisely.

(i) Remove the crank pulley bolt, crankshaft pulley and crankshaft pulley spacer.

(j) Align the alignment mark on the camshaft timing exhaust gear assembly LH as shown in the illustration.

Text in Illustration

*a	Alignment Mark

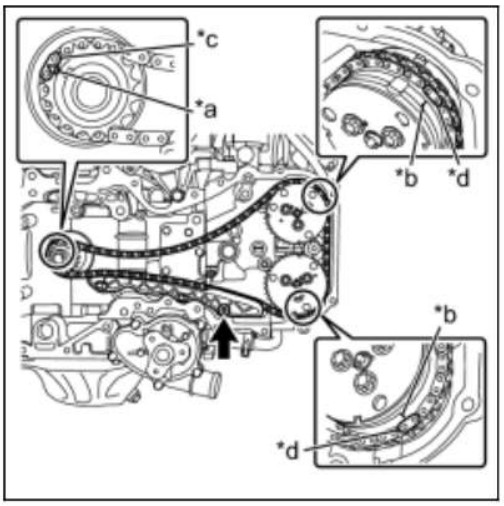


NOTICE:

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To avoid damaging the valves, do not turn the camshaft timing exhaust gear assembly LH more than the zero-lift range (The range where camshaft timing exhaust gear assembly LH can be turned lightly by hand).

(k) Align the chain mark plate (blue) with the alignment mark on the crankshaft timing gear or sprocket.



Text in Illustration

*a	Alignment mark
*b	Timing mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)

(l) Align the chain mark plate (pink) with the timing mark on the camshaft timing intake gear assembly LH.

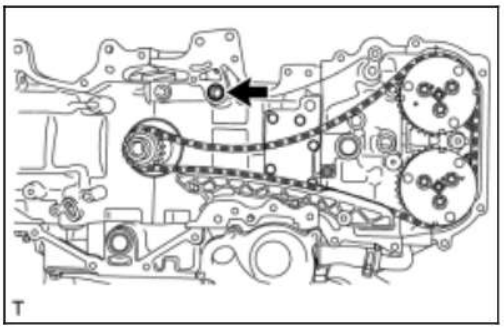
(m) Align the chain mark plate (pink) with the timing mark on the camshaft timing exhaust gear assembly LH.

(n) Using a 5 mm hexagon socket wrench, install the No. 1 chain vibration damper with the bolt.

Torque:
6.4 N·m {65 kgf·cm, 57 in·lbf}

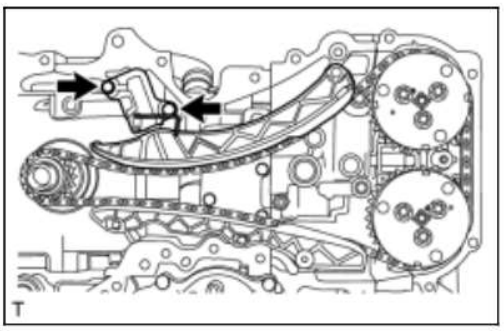
HINT:
Apply engine oil to the bolt before install it.

(o) Install a new O-ring to the cylinder block (for bank 2).



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(p) Install the chain tensioner slipper.



(q) Install the No. 2 chain tensioner assembly with the 2 bolts.

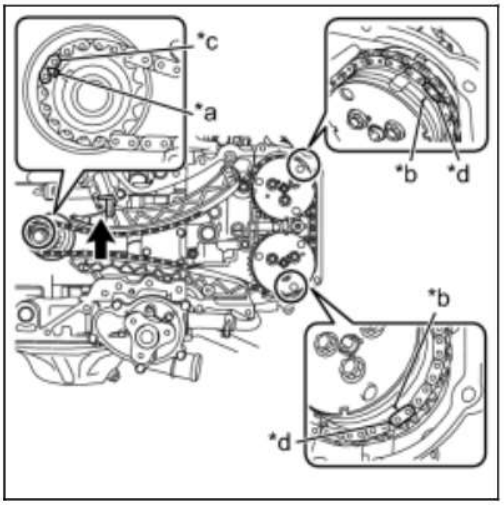
Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(r) Check that the chain is correctly installed.

Text in Illustration

*a	Alignment mark
*b	Timing mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)



(1) Chain mark plate (blue) is aligned with the alignment mark on the crankshaft timing gear or sprocket.

(2) Chain mark plate (pink) is aligned with the timing mark on the camshaft timing intake gear assembly LH.

(3) Chain mark plate (pink) is aligned with the timing mark on the camshaft timing exhaust gear assembly LH.

(s) Pull out the wire or the like from the No. 2 chain tensioner assembly.

(t) Temporarily install the crank pulley bolt to the crankshaft.

(u) Turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

NOTICE:

Be sure to perform this confirmation.

35. INSTALL CHAIN SUB-ASSEMBLY (for Bank 1)

NOTICE:

Do not allow any foreign matter to adhere or to enter into the component parts during installation.

HINT:

Apply engine oil to all component parts of the chain sub-assembly.

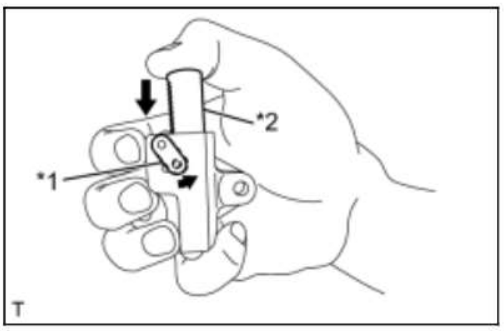
(a) Move the link plate in the direction of the arrow in the

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illustration to press in the plunger.

Text in Illustration

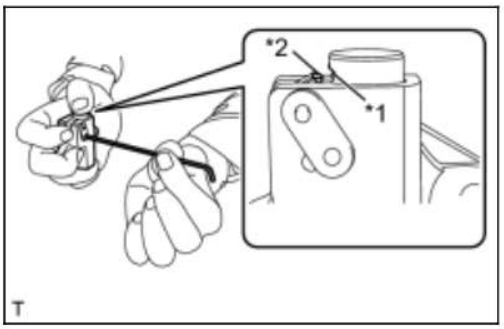
*1	Link Plate
*2	Plunger



(b) Insert a 2.5 mm (0.098 in.) diameter hexagon wrench into the No. 1 chain tensioner assembly through the stopper pin hole, and hold the plunger.

Text in Illustration

*1	First notch of the plunger rack
*2	Stopper Tooth



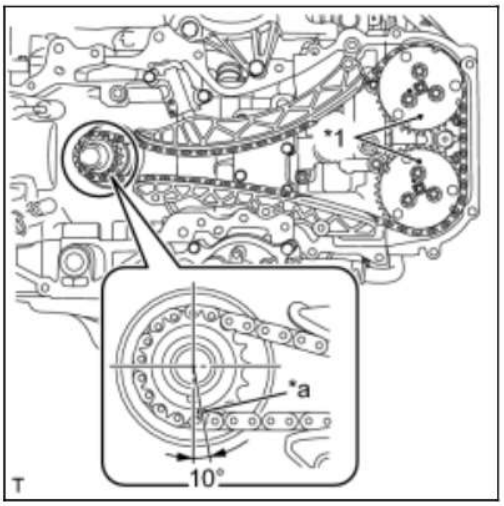
HINT:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner assembly are not aligned, check that the first notch of the plunger rack is engaged with the stopper tooth. If not engaged, retract the plunger a little so that the first notch of the plunger rack is engaged with the stopper tooth.

(c) Turn the crankshaft and align the alignment marks of the crankshaft timing gear or sprocket, camshaft timing intake gear assembly LH and camshaft timing exhaust gear assembly LH as shown in the illustration.

Text in Illustration

*a	Alignment Mark



HINT:

When the marks are aligned as shown in the illustration, crankshaft key faces directly underneath.

(d) Align the alignment marks of the camshaft timing intake gear assembly RH and camshaft timing exhaust gear assembly RH as shown in the illustration.

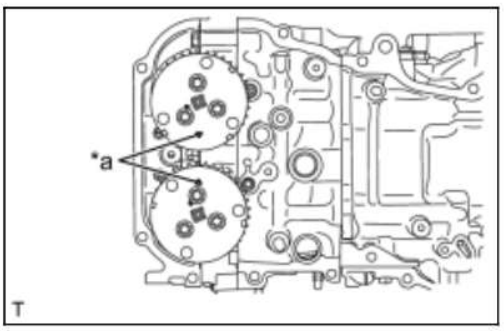
Text in Illustration

*a	Alignment Mark

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NOTICE:

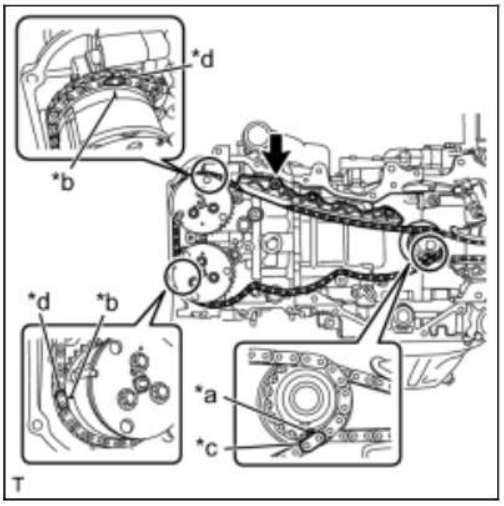
To avoid damaging the valves, do not turn the camshaft timing intake gear assembly RH and camshaft timing exhaust gear assembly RH more than the zero-lift range (The range where the camshafts can be turned lightly by hand).



(e) Align the chain mark plate (blue) with the alignment mark on the crankshaft timing gear or sprocket.

Text in Illustration

*a	Alignment mark
*b	Timing mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)



(f) Align the chain mark plate (pink) with the timing mark on the camshaft timing intake gear assembly RH.

(g) Align the chain mark plate (pink) with the timing mark on the camshaft timing exhaust gear assembly RH.

(h) Using a 5 mm hexagon socket wrench, install the No. 1 chain vibration damper with the bolt.

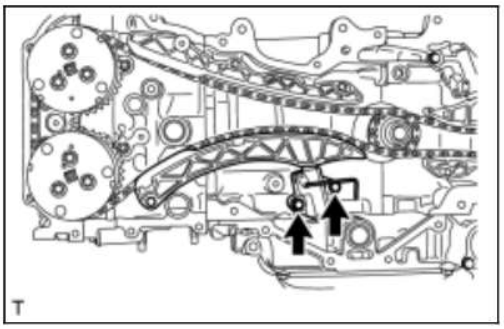
Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

HINT:

Apply engine oil to the bolt before install it.

(i) Install the chain tensioner slipper.



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

Torque:

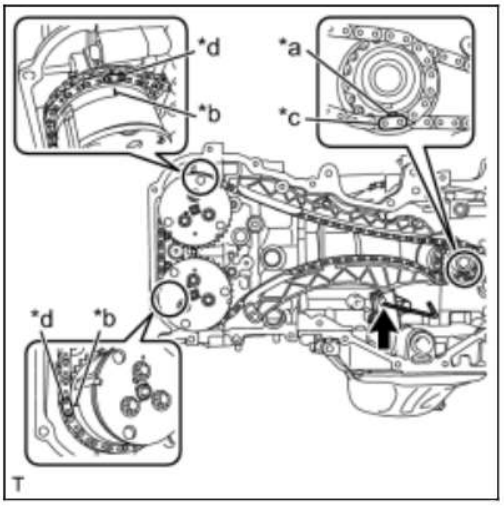
6.4 N·m {65 kgf·cm, 57in·lbf}

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(k) Check that the chain is correctly installed.

Text in Illustration

*a	Alignment mark
*b	Timing mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)



(1) Chain mark plate (blue) is aligned with the alignment mark on the crankshaft timing gear or sprocket.

(2) Chain mark plate (pink) is aligned with the timing mark on the camshaft timing intake gear assembly RH.

(3) Chain mark plate (pink) is aligned with the timing mark on the camshaft timing exhaust gear assembly RH.

(l) Pull out the hexagon wrench from the No. 1 chain tensioner assembly.

(m) Turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

NOTICE:

Be sure to perform this confirmation.

(n) Remove the crank pulley bolt.

36. INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

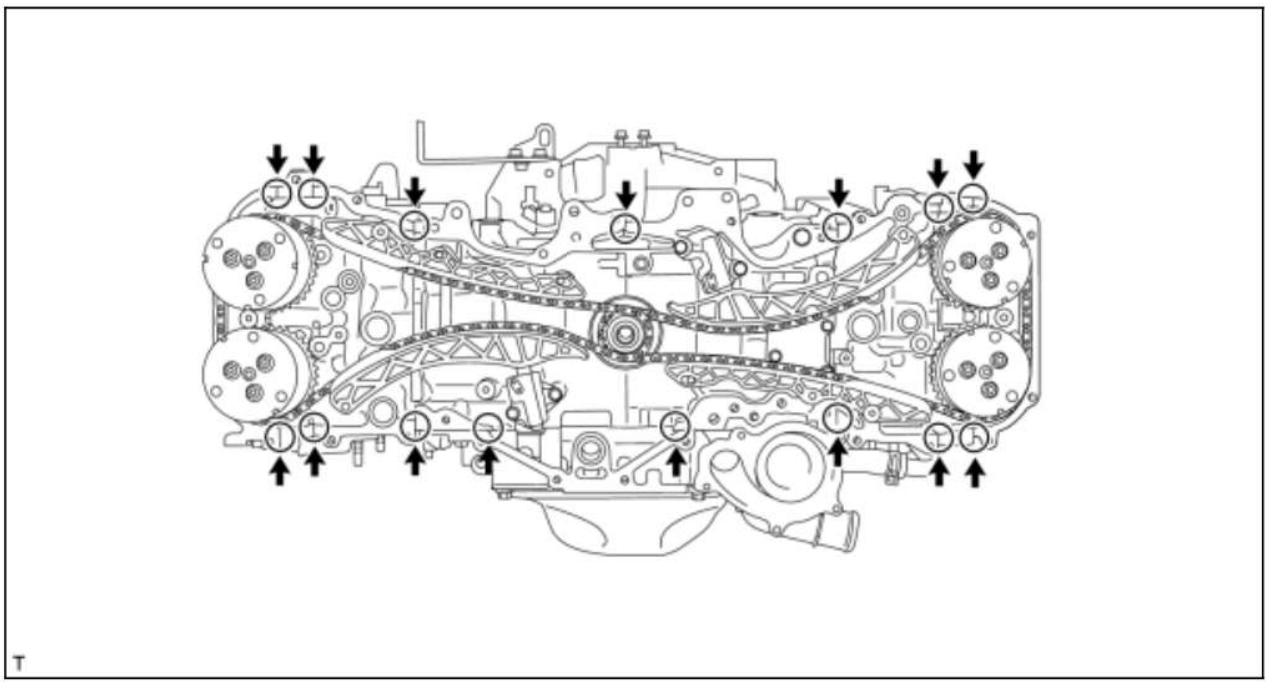
(a) Apply a light layer of engine oil to 4 new O-rings and attach them to the engine.

(b) Clean and degrease the contact surface.

(c) If there are gaps at positions shown in the illustration, fill up with seal packing.

Seal packing:
Three Bond 1217G, 1217H or equivalent

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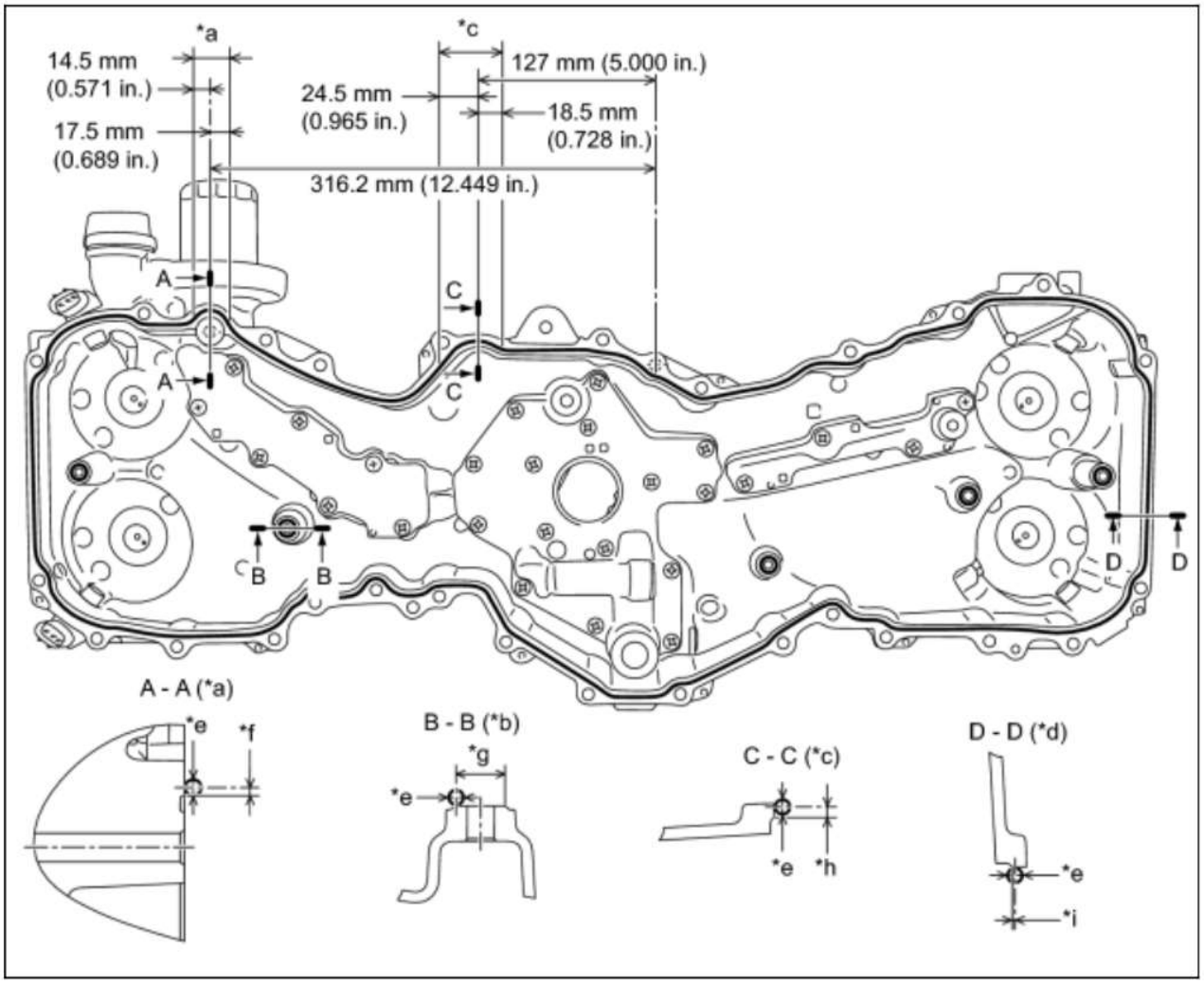


T

(d) Apply seal packing in a continuous line as shown in the illustration.

Seal packing:

Three Bond 1217G, 1217H or equivalent



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Text in Illustration

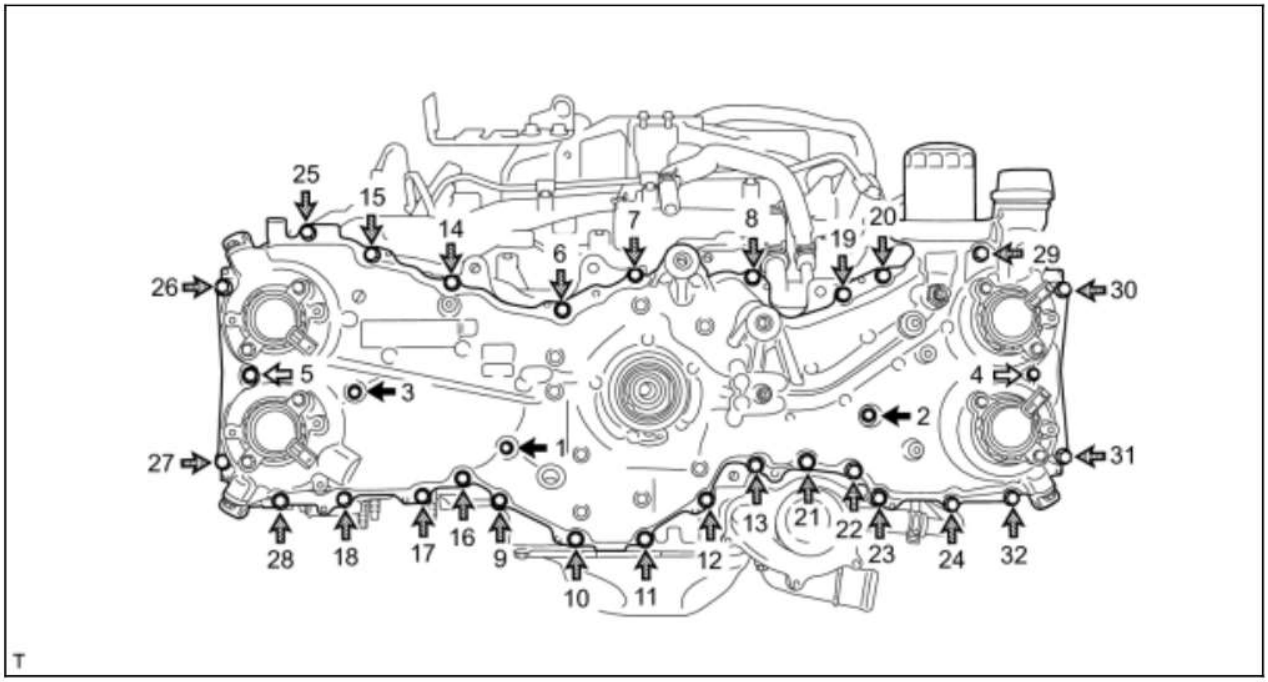
*a	Area A	*b	Boss (5 locations)
*c	Area B	*d	Other than ranges A and B
*e	φ3.5 to 4.5 mm (0.138 to 0.177 in.)	*f	2.0 mm (0.079 in.)
*g	φ12 mm (0.472 in.)	*h	2.5 mm (0.098 in.)
*i	0.5 mm (0.0197 in.)	-	-

NOTICE:

- Clean and degrease the contact surface.
- Install the chain cover within 5 minutes and tighten the bolts within 15 minutes of applying seal packing.
- Do not add engine oil within 30 minutes of installation.
- Do not start the engine within 30 minutes of installation.

(e) Temporarily install the timing chain or belt cover sub-assembly with the 32 bolts.

(f) Securely tighten the 32 bolts in the order as shown in the illustration.



Text in Illustration

➡	Bolt A	⇨	Bolt B
⇛	Bolt C	⇨	Bolt D

Torque:

Bolt A and B -

10 N·m {102 kgf·cm, 7ft·lbf}

Bolt C and D -

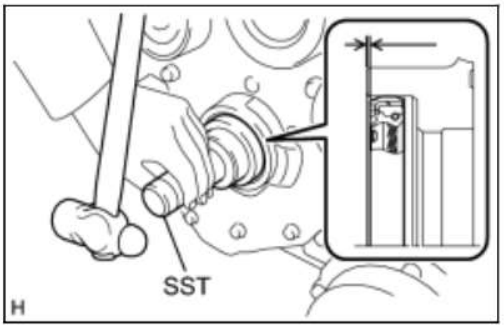
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25 N·m {255 kgf·cm, 18ft·lbf}

Bolt Length:

ITEM	LENGTH	ITEM	LENGTH
Bolt A	20 mm (0.787 in.)	Bolt B	50 mm (1.969 in.)
Bolt C	25 mm (0.984 in.)	Bolt D	60 mm (2.362 in.)

37. INSTALL TIMING CHAIN COVER OIL SEAL



(a) Apply engine oil to a new oil seal lip.

NOTICE:

- Keep the lip free from foreign matter.
- Do not apply engine oil to the dust seal section.

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

SST: 09223-22010

NOTICE:

- Do not tap the oil seal at an angle.
- Do not deform the oil seal.

HINT:

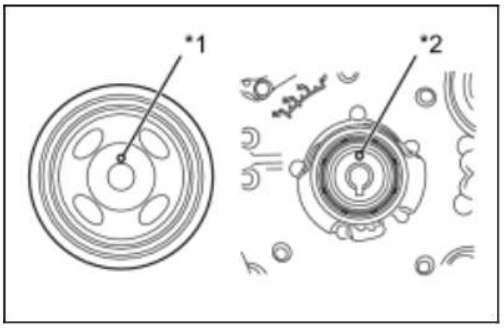
Alternatively, the tapping depth of the timing chain cover oil seal can be 0 to -1.0 mm (0 to -0.0394 in.) from the timing chain cover end surface.

38. INSTALL CRANKSHAFT PULLEY

(a) Install the crankshaft pulley spacer.

(b) Install a new O-ring to the crankshaft pulley spacer.

(c) Install the crankshaft pulley while aligning the knock hole of the pulley with the knock pin on the crankshaft pulley spacer.



Text in Illustration

*1	Knock Hole
*2	Knock Pin

(d) Apply engine oil to threads and seat sections of the crankshaft pulley set bolt.

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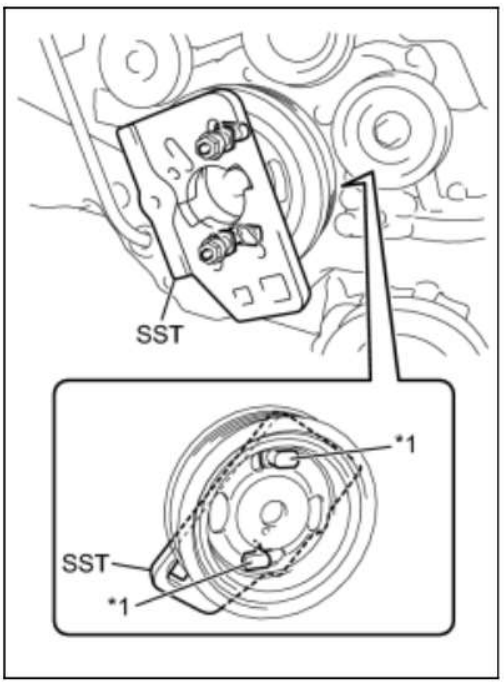
(e) Install SST to the crankshaft pulley.

SST: 09213-80010

90179-10016

09213-08010

09213-08110



HINT:

Position the projections on SST in the direction as shown in the illustration to prevent SST from separating from the crankshaft pulley.

Text in Illustration

*1	Claw

(f) Using SST, hold the crankshaft pulley and tighten the crankshaft pulley set bolt.

SST: 09213-80010

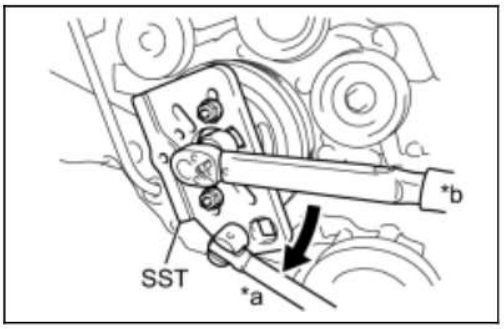
90179-10016

09213-08010

09213-08110

Torque:

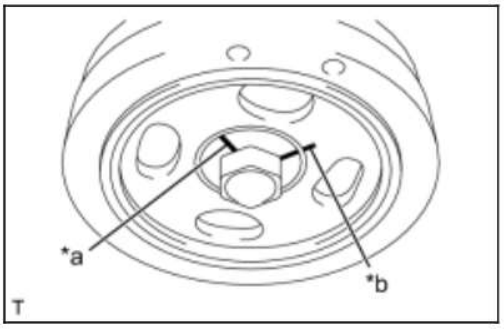
20 N·m {204 kgf·cm, 15ft·lbf}



Text in Illustration

*a	Hold
*b	Turn

(g) Using a marker, draw the reference line (A) on the crankshaft pulley set bolt and also the reference line (B) on the crank pulley according to the line engraved around the crankshaft pulley set bolt head as shown in the illustration.



Text in Illustration

*a	Reference Line A
*b	Reference Line B

HINT:

There are carved lines on the crankshaft pulley set bolt head every 90°.

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(h) Using SST, hold the crankshaft pulley, and tighten the crankshaft pulley set bolt by 90° until the reference lines A and B are aligned.

SST: 09213-80010

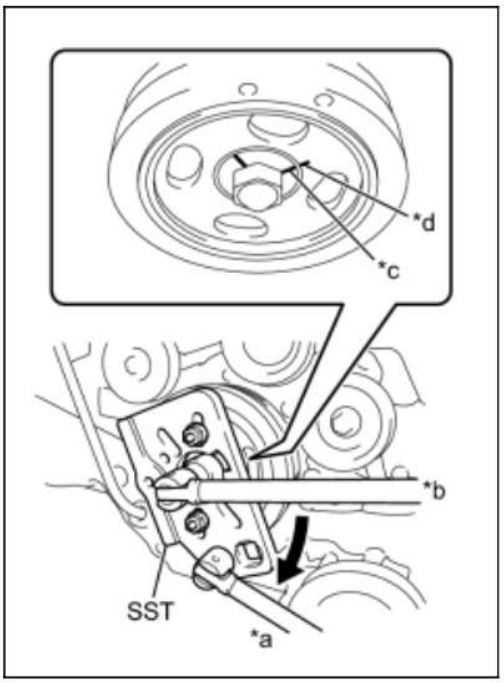
90179-10016

09213-08010

09213-08110

Text in Illustration

*a	Hold
*b	Turn
*c	Reference Line A
*d	Reference Line B



39. INSTALL THERMOSTAT

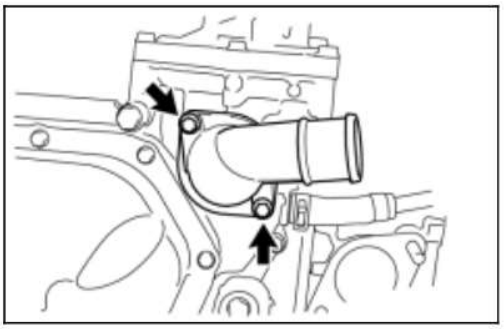
(a) Attach a new gasket to the thermostat.

40. INSTALL WATER OUTLET

(a) Install the thermostat and water outlet with the 2 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

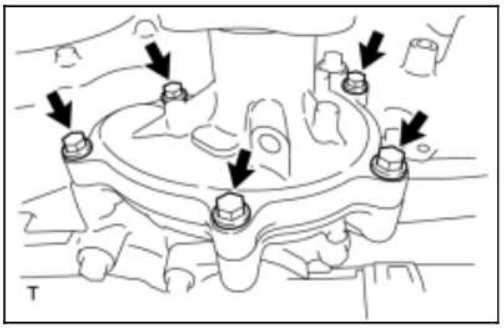


41. INSTALL ENGINE WATER PUMP ASSEMBLY

(a) Install a new gasket and the water pump assembly with the 5 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}



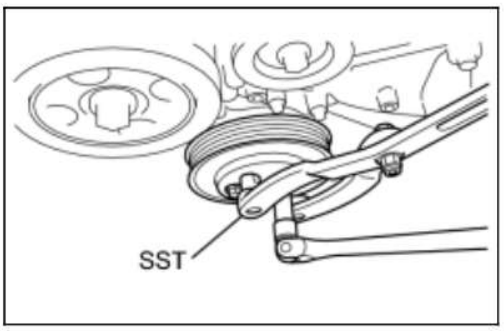
42. INSTALL WATER PUMP PULLEY

(a) Temporarily install the water pump pulley with the 3 bolts.

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(b) Using SST, hold the water pump pulley.

SST: 09960-10010
09962-01000
09963-00700



(c) Securely tighten the 3 bolts.

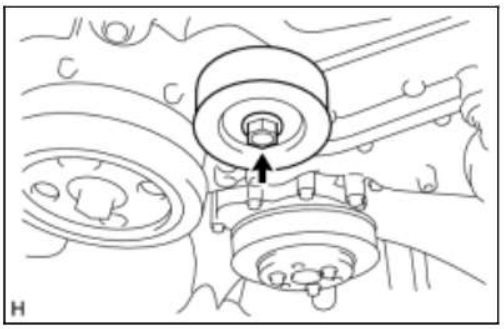
NOTICE:
Be careful not to let SST slip during the work.

Torque:
14 N·m {143 kgf·cm, 10ft·lbf}

43. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

(a) Install the idler pulley cover and No. 1 idler pulley sub-assembly with the bolt.

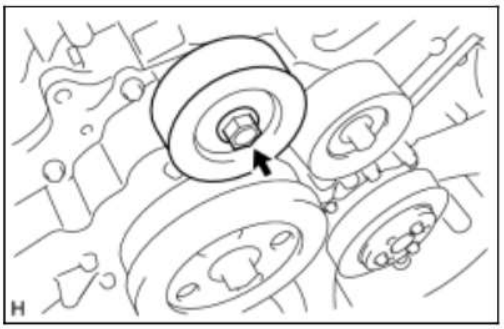
Torque:
36 N·m {367 kgf·cm, 27ft·lbf}



44. INSTALL NO. 1 IDLER PULLEY SUB-ASSEMBLY

(a) Install the idler pulley cover and No. 1 idler pulley sub-assembly with the bolt.

Torque:
36 N·m {367 kgf·cm, 27ft·lbf}



45. INSTALL PCV VALVE SUB-ASSEMBLY

(a) Apply adhesive to 2 or 3 threads of the PCV valve sub-assembly.

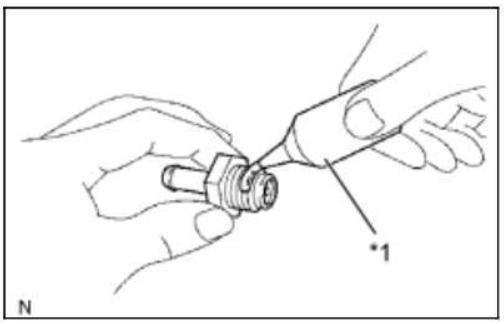
Adhesive:

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Three Bond 1141G or equivalent

Text in Illustration

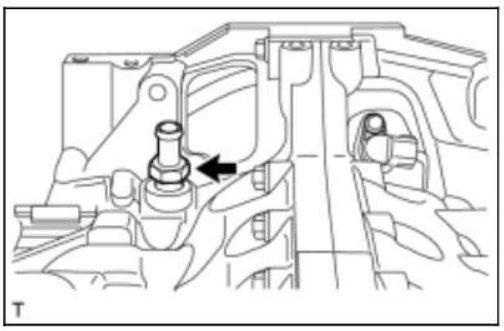
*1	Adhesive 1141G



(b) Using a 19 mm deep socket wrench, install the PCV valve sub-assembly.

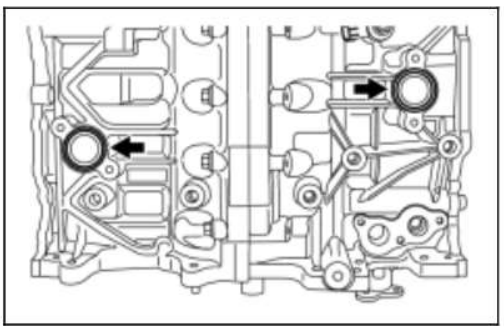
Torque:

23 N·m {235 kgf·cm, 17ft·lbf}



46. INSTALL WATER INLET PIPE

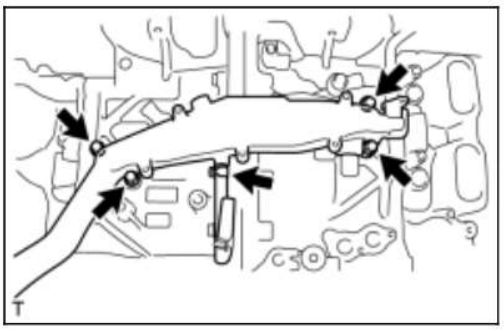
(a) Attach 2 new O-rings to the cylinder block.



(b) Install the water inlet pipe with the 4 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}



(c) Connect the No. 3 water by-pass hose with the clamp.

47. INSTALL REAR CYLINDER HEAD PLATE (for Manual Transmission)

(a) Apply seal packing in a continuous line as shown in the illustration.

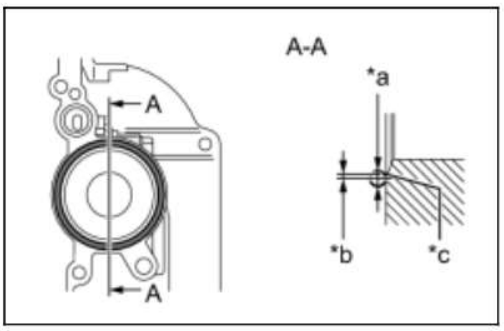
Seal packing:

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Three Bond 1217G, 1217H or equivalent

Text in Illustration

*a	φ2,0 to 4.0 mm (0.079 to 0.158 in.)
*b	Within 1.0 mm (0.0394 in.)
*c	Chamfer edge



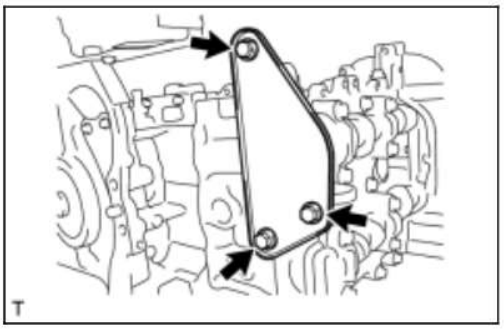
NOTICE:

- Clean and degrease the contact surface.
- Install the rear cylinder head plate within 5 minutes of applying seal packing.

(b) Install the rear cylinder head plate with the 3 bolts.

Torque:

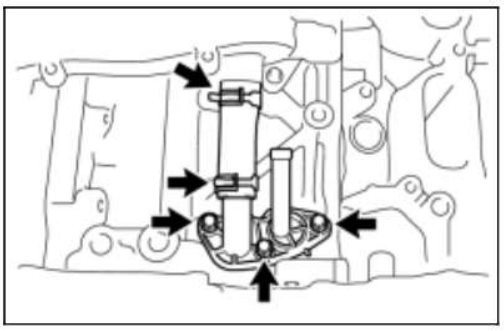
16 N·m {163 kgf·cm, 12ft·lbf}



48. INSTALL VACUUM PUMP ASSEMBLY (for Automatic Transmission) INFO

49. INSTALL PCV HOSE CONNECTOR

(a) Connect the No. 2 water by-pass hose to the PCV hose connector and water inlet pipe with the clips.



(b) Install the PCV hose connector with the 3 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

50. INSTALL ENGINE OIL PRESSURE SWITCH ASSEMBLY

(a) Clean and degrease the threads of the engine oil pressure switch assembly.

(b) Apply adhesive 1324 to the threads of the engine oil pressure switch assembly.

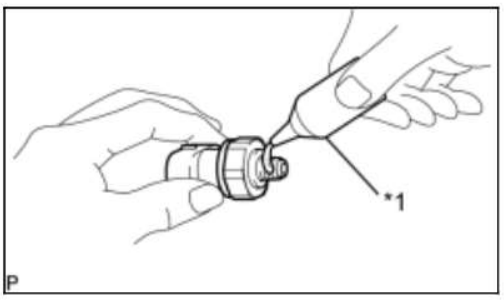
Adhesive:

Toyota Genuine Adhesive 1324, Three Bond 1324 or equivalent

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Text in Illustration

*1	Adhesive 1324



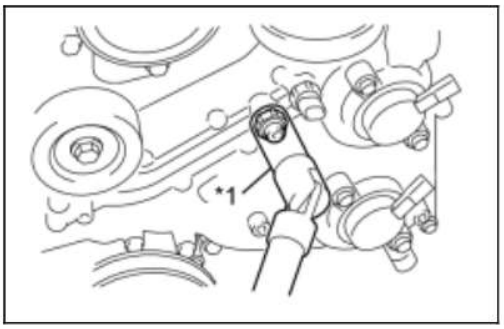
NOTICE:

Keep the oil hole free from adhesive.

(c) Using a 24 mm deep socket wrench, install the engine oil pressure switch assembly.

Text in Illustration

*1	24 mm Deep Socket Wrench



Torque:

18 N·m {184 kgf·cm, 13ft·lbf}

NOTICE:

Do not start the engine for at least 1 hour after installation.

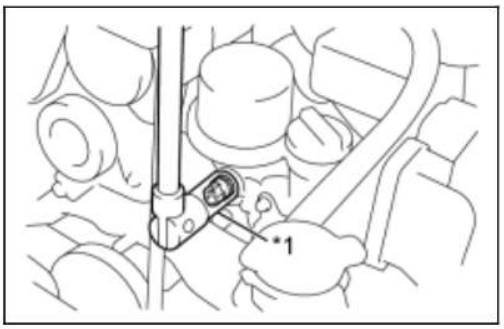
51. INSTALL TEMPERATURE SENSOR

(a) Attach a new gasket to the temperature sensor.

(b) Using a 19 mm deep socket wrench, install the temperature sensor.

Text in Illustration

*1	19 mm Deep Socket Wrench



Torque:

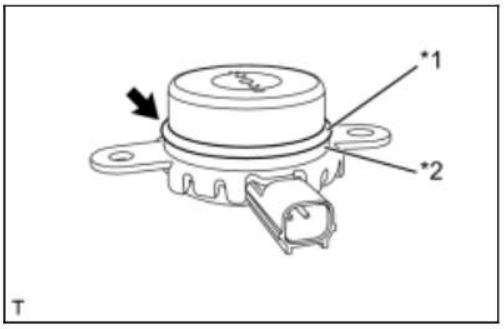
18 N·m {184 kgf·cm, 13ft·lbf}

52. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE

(a) Install the back-up ring to the camshaft timing oil control valve (for exhaust side of bank 2).

Text in Illustration

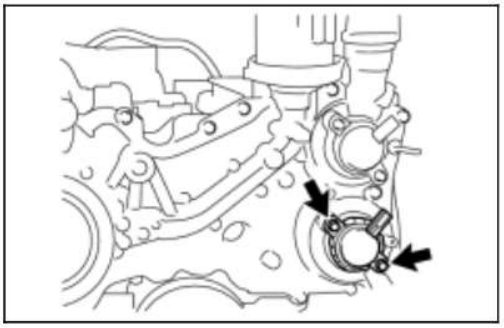
*1	O-ring
*2	Back-up ring



(b) Install a new O-ring to the camshaft timing oil control valve (for exhaust side of bank 2).

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(c) Apply a light coat of engine oil to the O-ring.



(d) Install the camshaft timing oil control valve (for exhaust side of bank 2) with the 2 bolts.

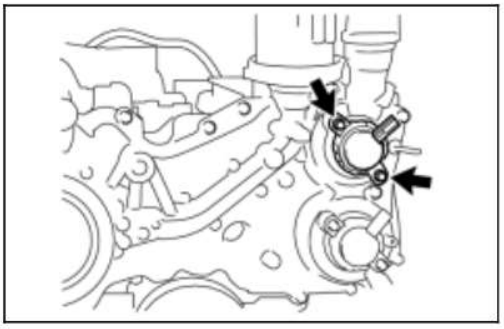
Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(e) Install the back-up ring to the camshaft timing oil control valve (for intake side of bank 2).

(f) Install a new O-ring to the camshaft timing oil control valve (for intake side of bank 2).

(g) Apply a light coat of engine oil to the O-ring.



(h) Install the camshaft timing oil control valve (for intake side of bank 2) with the 2 bolts.

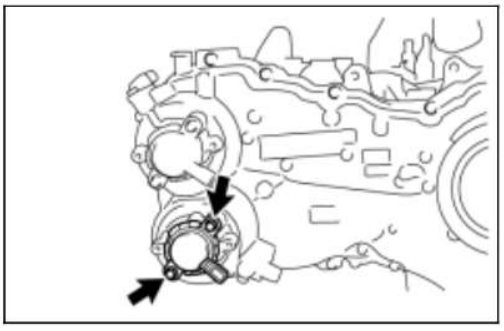
Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(i) Install the back-up ring to the camshaft timing oil control valve (for exhaust side of bank 1).

(j) Install a new O-ring to the camshaft timing oil control valve (for exhaust side of bank 1).

(k) Apply a light coat of engine oil to the O-ring.



(l) Install the camshaft timing oil control valve (for exhaust side of bank 1) with the 2 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(m) Install the back-up ring to the camshaft timing oil control valve (for intake side of bank 1).

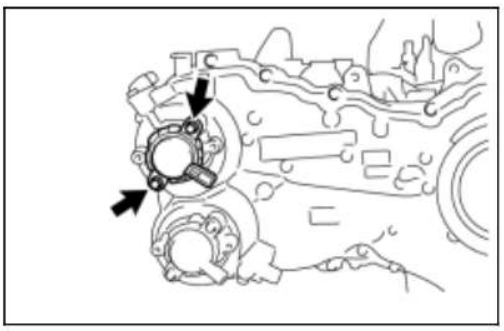
(n) Install a new O-ring to the camshaft timing oil control valve (for intake side of bank 1).

(o) Apply a light coat of engine oil to the O-ring.

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(p) Install the camshaft timing oil control valve (for intake side of bank 1) with the 2 bolts.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}



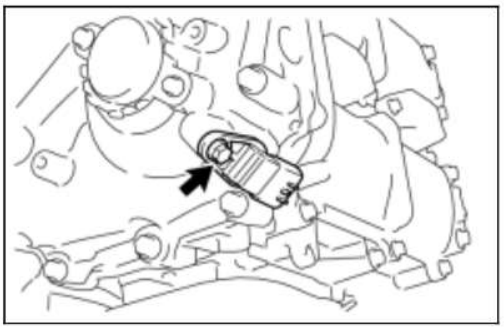
53. INSTALL VVT SENSOR

(a) Install a new O-ring to the VVT sensor (for exhaust side of bank 2).

(b) Apply a light coat of engine oil to the O-ring.

(c) Install the VVT sensor (for exhaust side of bank 2) with the bolt.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

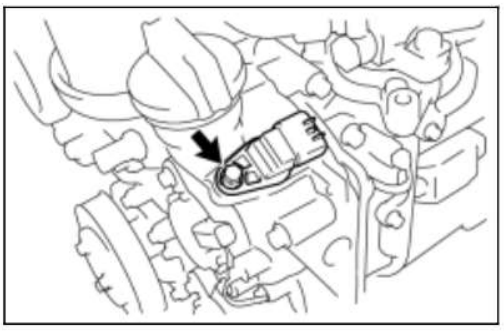


(d) Install a new O-ring to the VVT sensor (for intake side of bank 2).

(e) Apply a light coat of engine oil to the O-ring.

(f) Install the VVT sensor (for intake side of bank 2) with the bolt.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

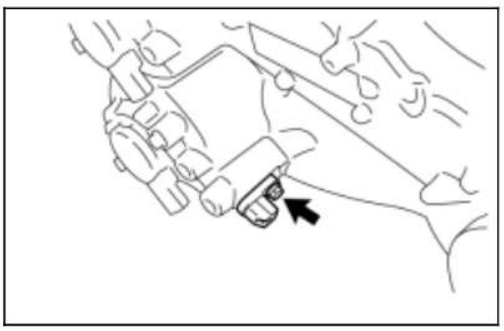


(g) Install a new O-ring to the VVT sensor (for exhaust side of bank 1).

(h) Apply a light coat of engine oil to the O-ring.

(i) Install the VVT sensor (for exhaust side of bank 1) with the bolt.

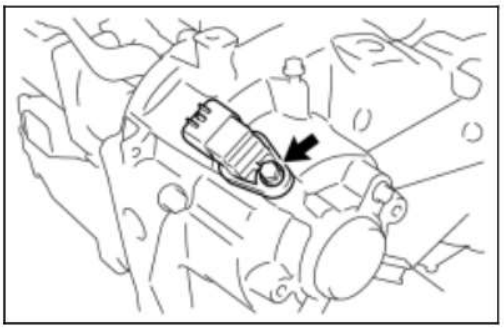
Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}



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(j) Install a new O-ring to the VVT sensor (for intake side of bank 1).

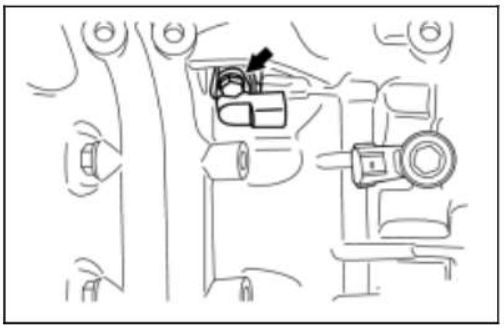
(k) Apply a light coat of engine oil to the O-ring.



(l) Install the VVT sensor (for intake side of bank 1) with the bolt.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

54. INSTALL CRANK POSITION SENSOR



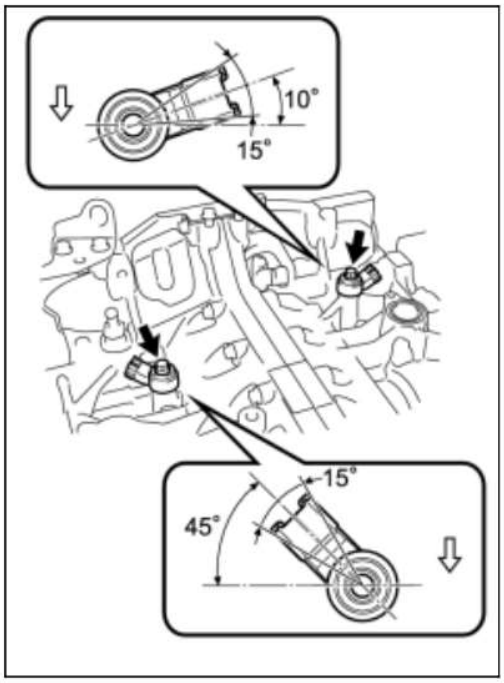
(a) Install the crank position sensor with the bolt.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

55. INSTALL KNOCK CONTROL SENSOR

(a) Install the 2 knock control sensors onto the cylinder block with the 2 bolts as shown in the illustration.

Torque:
24 N·m {245 kgf·cm, 18ft·lbf}



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Text in Illustration

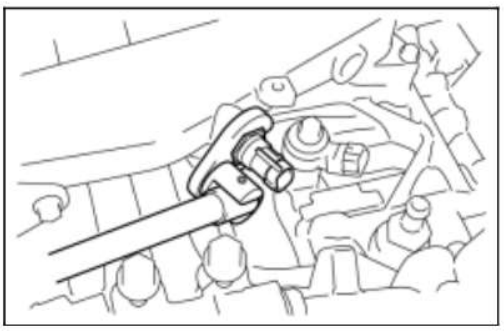
⇨	Engine front

56. INSTALL E.F.I. WATER TEMPERATURE SENSOR

(a) Using a 19 mm union nut wrench, install a new gasket and the E.F.I. water temperature sensor.

Torque:
18 N·m {184 kgf·cm, 13ft·lbf}

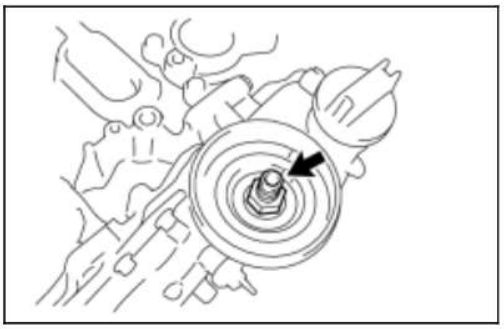
NOTICE:
Use the formula to calculate special torque values for situations where a union nut wrench is combined with a torque wrench INFO .



57. INSTALL OIL FILTER UNION

(a) Using a 24 mm deep socket wrench, install the oil filter union.

Torque:
45 N·m {459 kgf·cm, 33ft·lbf}



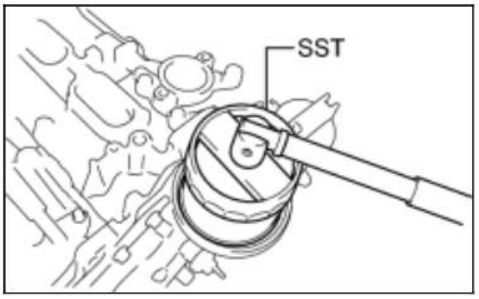
58. INSTALL OIL FILTER SUB-ASSEMBLY

(a) Apply engine oil to the installation surface of the oil filter sub-assembly.

(b) Using SST, install the oil filter sub-assembly.

SST: 09228-22020

Torque:
14 N·m {143 kgf·cm, 10ft·lbf}



59. INSTALL OIL FILLER CAP ASSEMBLY

(a) Install the oil filler cap assembly.

TOYOTA

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM000000N82011X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE UNIT: REMOVAL; 2013 MY FR-S [03/2012 -]		

REMOVAL

CAUTION:

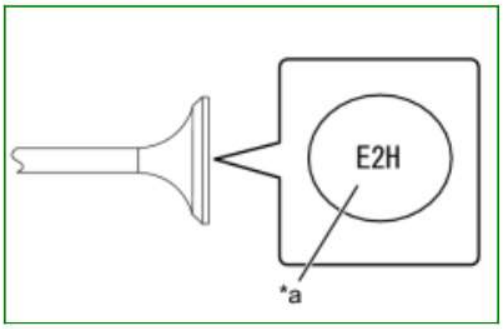
- The exhaust valve is encapsulated with metallic sodium. The metallic sodium is a strong alkaline and prone to cause a serious chemical reaction. Therefore, extra caution is required when handling or disposing the exhaust valve.
- Never disassemble the exhaust valve. The metallic sodium may cause blindness if it gets into your eyes, or cause burn injuries or chemical reactions resulting in fire if it comes into contact with your skin or any heat source.
- If the exhaust valve is damaged, after removing the valve, carry out processing of "Preparation for disposal" and "Disposal".
- Make sure to wear safety glasses and protective gloves when removing a damaged exhaust valve.
- Do not intentionally damage the exhaust valve to remove the metallic sodium.

NOTICE:

When it is determined that disposal procedure is dissolving, this may be performed.

HINT:

- The exhaust valve is encapsulated with metallic sodium. This is safe as long as it does not come into contact with air.
- The exhaust valve in which metallic sodium is encapsulated can be identified with the embossed mark.



- For removal of the exhaust valve, INFO .
- For disposal of the exhaust valve, INFO .

Text in Illustration

*a	Embossed mark (E2H is for FA20 Engine)

1. REMOVE ENGINE HANGERS

(a) Remove the bolt and engine hanger.

2. REMOVE GENERATOR COVER INFO

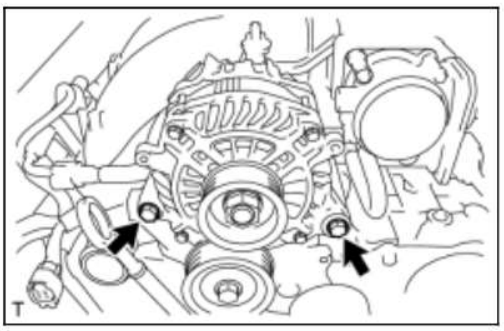
3. REMOVE BELT GENERATOR COVER INFO

4. REMOVE FAN AND GENERATOR V BELT INFO

5. REMOVE GENERATOR ASSEMBLY

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(a) Remove the 2 bolts and generator assembly.



6. REMOVE OIL LEVEL DIPSTICK GUIDE INFO

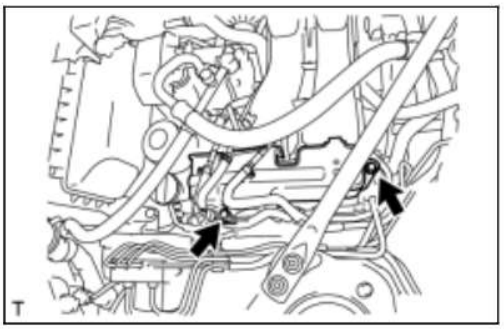
7. REMOVE NO. 2 IDLER PULLEY SUB-ASSEMBLY INFO

8. REMOVE V-RIBBED BELT TENSIONER ASSEMBLY INFO

9. REMOVE COMPRESSOR WITH MAGNET CLUTCH INFO

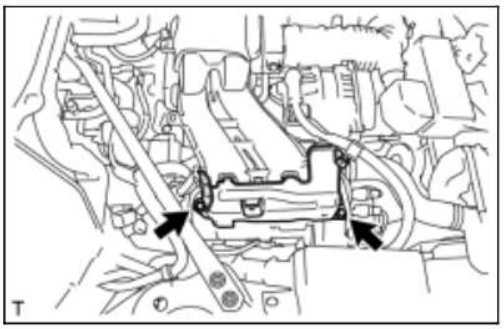
10. REMOVE INJECTOR COVER (for Bank 2)

(a) Remove the 2 bolts and injector cover.



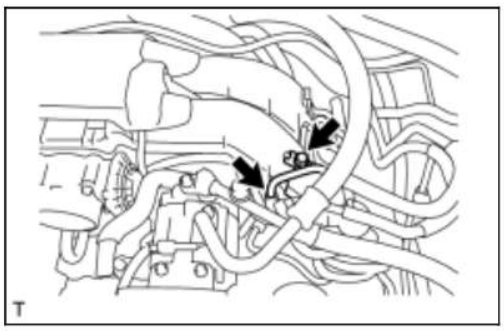
11. REMOVE INJECTOR COVER (for Bank 1)

(a) Remove the 2 bolts and injector cover.



12. REMOVE FUEL DELIVERY PIPE SUB-ASSEMBLY

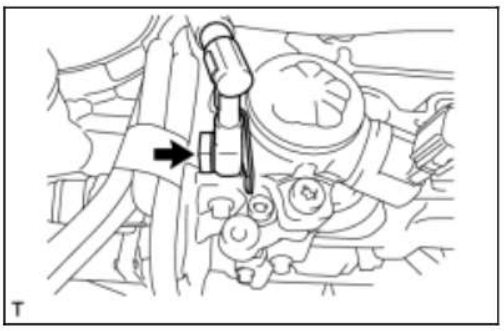
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(a) Remove the bolt and disconnect the fuel delivery pipe sub-assembly.

(b) Disconnect the No. 2 fuel vapor feed hose.

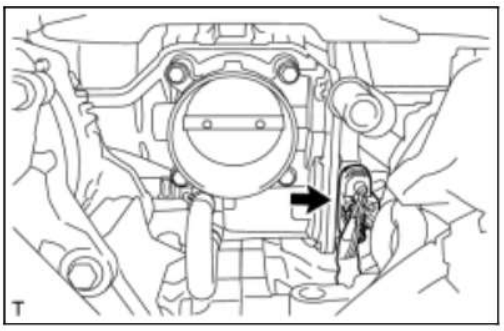
(c) Remove the union bolt and gasket, and disconnect the fuel delivery pipe sub-assembly.



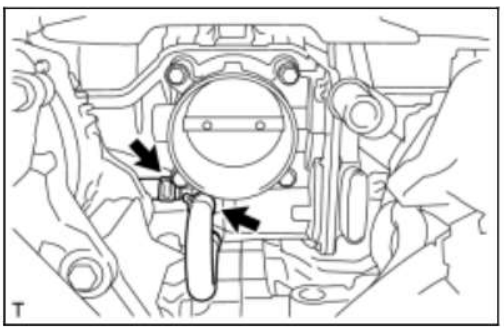
13. SEPARATE VENTILATION HOSE INFO

14. REMOVE INTAKE MANIFOLD

(a) Disconnect the throttle body assembly connector.

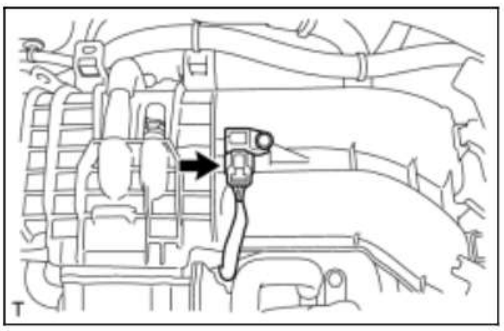


(b) Disconnect the 2 water by-pass hoses from the throttle body assembly.

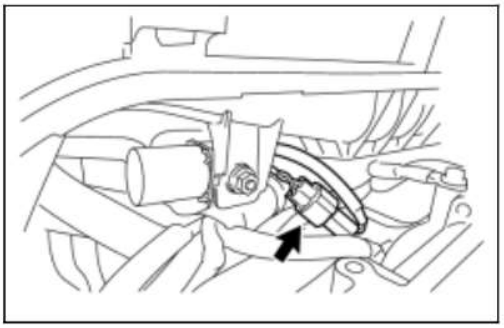


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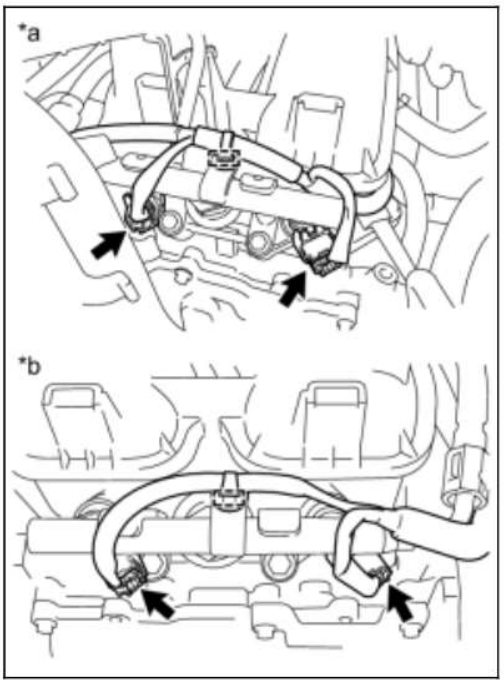
(c) Disconnect the vacuum sensor connector.



(d) Disconnect the No. 1 vacuum switching valve assembly connector.



(e) Disengage the 2 clamps and disconnect the 4 connectors.



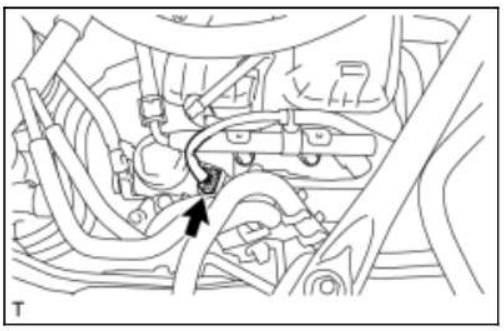
Text in Illustration

*a	for Bank 2
*b	for Bank 1

(f) Disconnect the wire harness.

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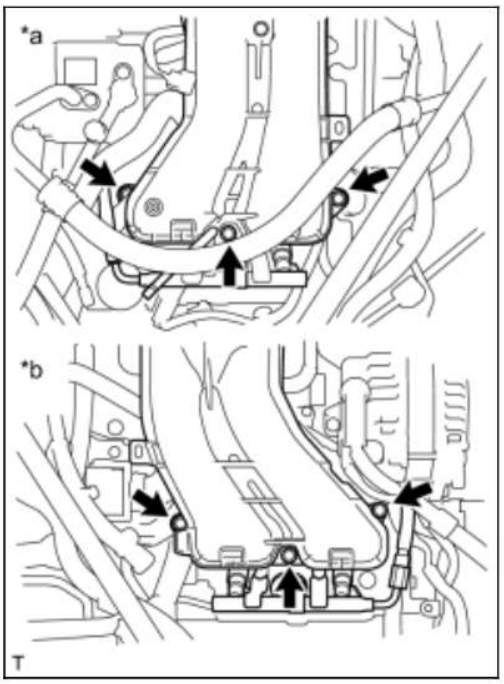
(g) Disconnect the fuel pump connector.



(h) Remove the 6 bolts, intake manifold and 2 gaskets.

Text in Illustration

*a	for Bank 2
*b	for Bank 1



15. REMOVE NO. 2 FUEL DELIVERY PIPE INFO

16. REMOVE FUEL DELIVERY PIPE INFO

17. REMOVE FUEL DELIVERY PIPE LH INFO

18. REMOVE FUEL DELIVERY PIPE RH INFO

19. REMOVE FUEL INJECTOR ASSEMBLY INFO

20. REMOVE FUEL INJECTOR O-RING INFO

21. REMOVE FUEL PUMP ASSEMBLY INFO

22. REMOVE VALVE LIFTER INFO

23. REMOVE PUMP DRIVE CASE ASSEMBLY INFO

24. REMOVE ENGINE WIRE

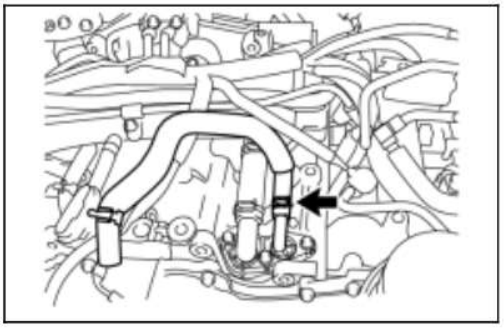
(a) Remove the 2 bolts and separate the ground wire harness.

(b) Disconnect each connector and clamp, and remove the engine wire.

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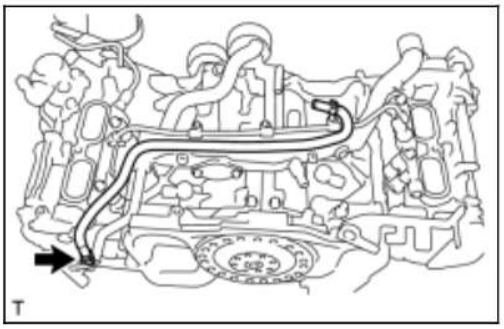
25. REMOVE NO. 2 VENTILATION HOSE

(a) Disconnect the No. 2 ventilation hose.



26. REMOVE NO. 2 WATER BY-PASS HOSE

(a) Disconnect the No. 2 water by-pass hose.



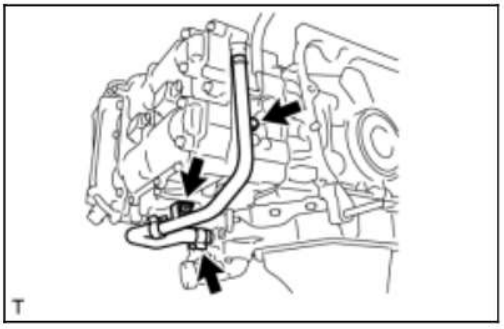
27. REMOVE NO. 3 TRANSMISSION OIL COOLER HOSE (for Automatic Transmission)

(a) Disconnect the No. 3 transmission oil cooler hose.

28. REMOVE NO. 1 WATER BY-PASS PIPE (for Manual Transmission)

(a) Loosen the hose clip and disconnect the water by-pass hose.

(b) Remove the 2 bolts and the No. 1 water by-pass pipe.



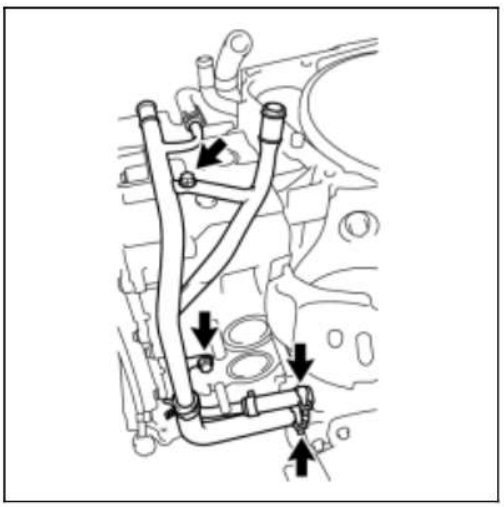
29. REMOVE NO. 1 WATER BY-PASS PIPE (for Automatic Transmission)

(a) Loosen the 2 hose clips and disconnect the 2 water by-

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pass hoses.

(b) Remove the 2 bolts and No. 1 water by-pass pipe.



30. REMOVE IGNITION COIL ASSEMBLY

(a) Remove the 4 bolts and 4 ignition coil assemblies.

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Last Modified: 4-14-2014	6.6 G	Doc ID: RM000000U3S02RX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: ENGINE: ON-VEHICLE INSPECTION; 2013 MY FR-S [03/2012 -]		

ON-VEHICLE INSPECTION

1. INSPECT ENGINE COOLANT

INFO

2. INSPECT ENGINE OIL

INFO

3. INSPECT BATTERY

INFO

4. INSPECT AIR CLEANER FILTER ELEMENT SUB-ASSEMBLY

INFO

5. INSPECT SPARK PLUG

INFO

6. INSPECT V-RIBBED BELT TENSIONER ASSEMBLY

(a) Remove the fan and generator V belt INFO .

(b) Check that nothing gets caught in the tensioner by turning it clockwise and counterclockwise.

If a any malfunction exists, replace the tensioner.

(c) Install the fan and generator V belt INFO .

7. INSPECT IGNITION TIMING

(a) Warm up and stop the engine.

(b) When using the Techstream:

(1) Connect the Techstream to the DLC3.

(2) Start the engine and idle it.

(3) Turn the Techstream on.

(4) Enter the following menus: Powertrain / Engine and ECT / Data List / IGN Advance.

Standard ignition timing:
-5 to 10° BTDC at idle

NOTICE:

- Switch off all the accessories and the A/C before connecting the Techstream.
- When checking the idle speed, the transmission should be in neutral.

HINT:

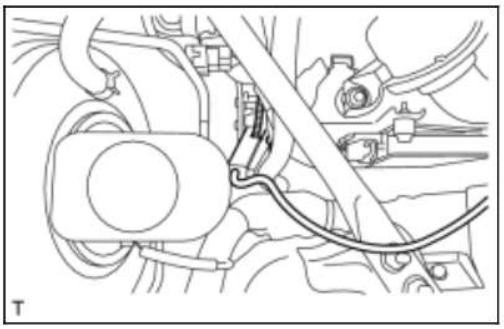
Refer to the Techstream operator's manual for further details.

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(5) Check that the ignition timing advances immediately when the engine speed is increased.

(c) When not using the Techstream:

(1) Connect the tester probe of a timing light to the wire of the ignition connector for the No. 1 cylinder.

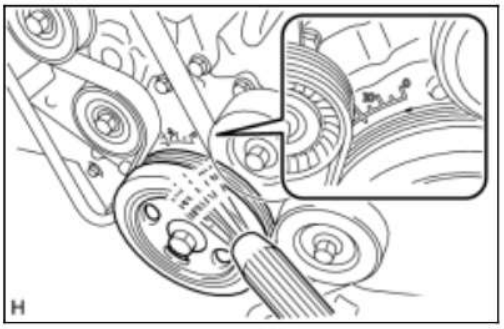


HINT:

Use a timing light that detects the primary current.

(2) Using the timing light, check the ignition timing.

Standard ignition timing:
-5 to 10° BTDC at idle



NOTICE:

When checking the ignition timing, the transmission should be in neutral.

(3) Check that the ignition timing advances immediately when the engine speed is increased.

(4) Disconnect the timing light from the engine.

8. INSPECT ENGINE IDLE SPEED

(a) Warm up and stop the engine.

(b) When using the Techstream:

(1) Connect the Techstream to the DLC3.

NOTICE:

Switch off all the accessories and the A/C before connecting the Techstream.

(2) Race the engine at 2500 rpm for approximately 90 seconds.

(3) Turn the Techstream on.

(4) Enter the following menus: Powertrain / Engine and ECT / Data List / Engine Speed.

Standard Idle Speed:

TRANSMISSION	IDLING SPEED
for Automatic Transmission	600 to 800 rpm
for Manual Transmission	550 to 750 rpm

NOTICE:

When checking the idle speed, the transmission should be in neutral.

HINT:

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Refer to the Techstream operator's manual for further details.

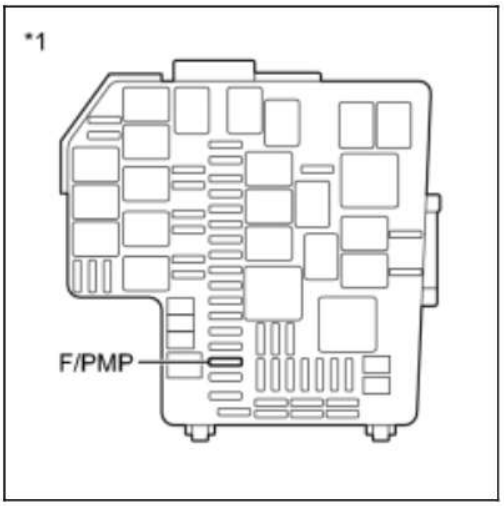
If the idle speed is not as specified, check the air intake system.

(5) Disconnect the Techstream from the DLC3.

9. INSPECT COMPRESSION

(a) Check for DTCs INFO .

(b) Remove the relay block cover.



(c) Remove the F/PMP fuse.

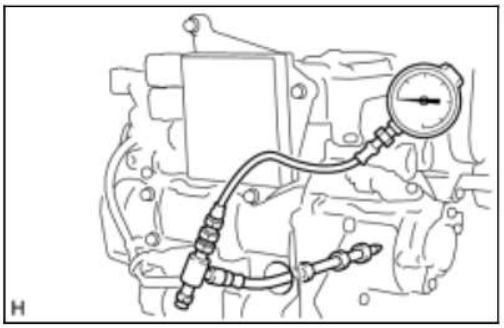
Text in Illustration

*1	Engine Room Relay Block

(d) Warm up and stop the engine.

(e) Remove the 4 spark plugs INFO .

(f) Insert a compression gauge into the spark plug hole.



(g) Inspect the cylinder compression pressure.

(1) 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 performed as quickly as possible.

Standard compression pressure:

1750 kPa (17.8 kgf/cm ^{2} , 254 psi) or higher

Minimum pressure:

1150 kPa (11.7 kgf/cm ^{2} , 167 psi)

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Difference between each cylinder:

200 kPa (2.0 kgf/cm ^{2} , 29 psi) or less

HINT:

If the cylinder compression is low, pour a small amount of engine oil into the cylinder through the spark plug hole and inspect the compression again. Then perform the 2 steps above for the cylinders with low compression.

- If adding oil increases the compression, the piston rings and/or cylinder bore may be worn or damaged.
- If the pressure stays low, a valve may be stuck or seated improperly, or there may be leakage from the gasket.

(h) Install the 4 spark plugs INFO .

(i) Reinstall the F/PMP fuse.

(j) Install the relay block cover.

(k) Clear the DTC INFO .

10. INSPECT CO/ HC

HINT:

This check is for determining whether or not the idle CO/HC complies with regulations.

(a) Start the engine.

(b) Maintain the engine speed at 2500 rpm for approximately 180 seconds.

(c) Insert a CO/HC meter testing probe at least 40 cm (1.31 ft) into the tailpipe during idling.

(d) Immediately check the CO/HC concentration at idle and/or 2500 rpm.

HINT:

- When performing the 2 mode (2500 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 A/F sensor INFO and heated oxygen sensor INFO operation.

(2) Refer to the table below for the possible cause, and then inspect and correct the applicable causes if necessary.

CO	HC	SYMPTOM	CAUSES
Normal	High	Rough idle	1. Faulty ignition: ◦ Incorrect timing ◦ Plugs are contaminated or shorted, or plug gaps are incorrect 2. Incorrect valve clearance 3. Leaky intake and exhaust valves 4. Leaky cylinders
		Rough idle	1. Vacuum leaks: ◦ Ventilation hoses

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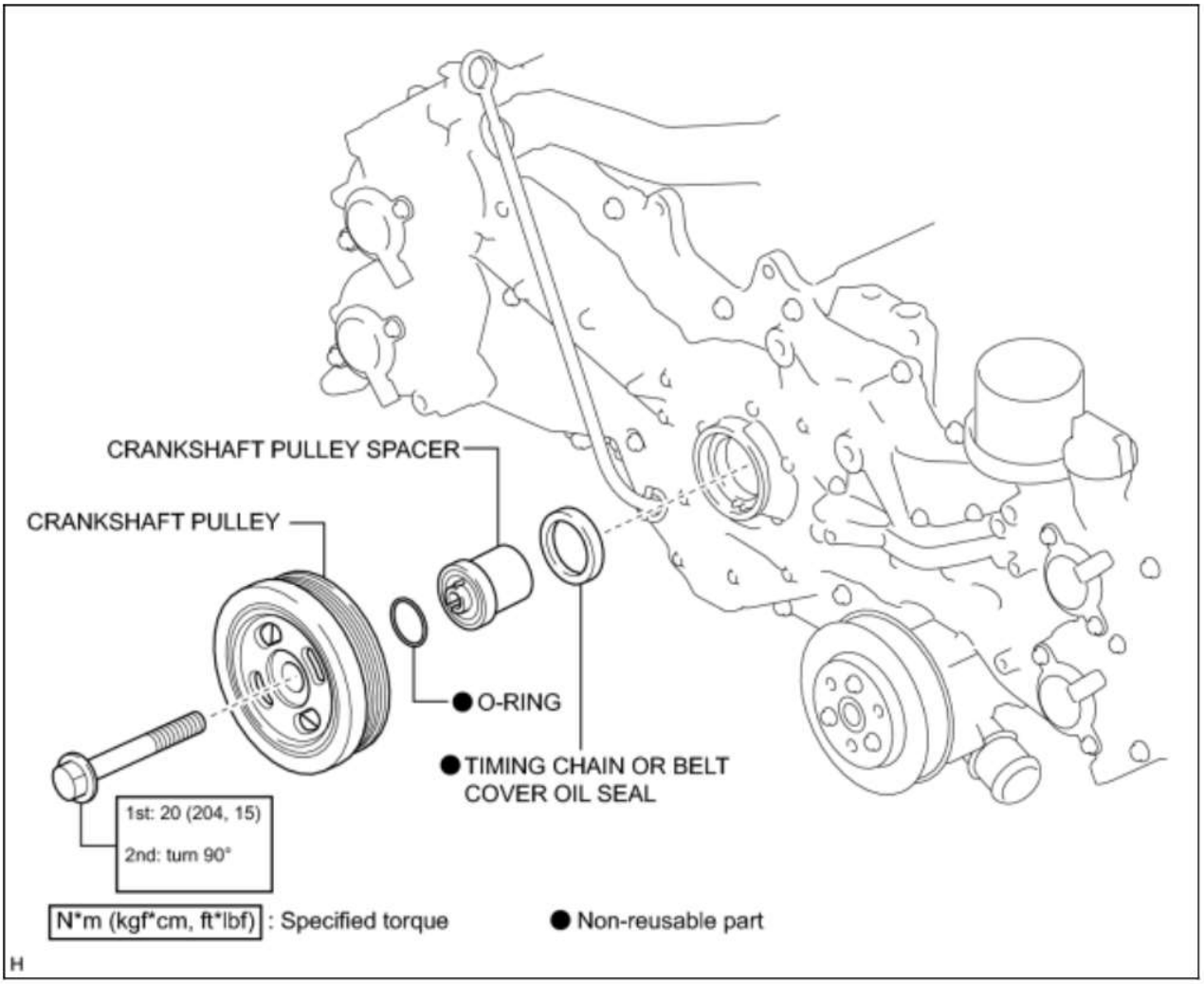
Low	High	(Fluctuating HC reading)	◦ Intake manifold ◦ Throttle body 2. Lean mixture causing misfire
High	High	Rough idle (Black smoke from exhaust)	1. Restricted air filter 2. Plugged PCV valve 3. Faulty EFI system: ◦ Faulty pressure regulator ◦ Defective engine coolant temperature sensor ◦ Faulty mass air flow meter ◦ Faulty ECM ◦ Faulty injectors ◦ Faulty throttle position sensor

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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000002S5D01AX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: FRONT CRANKSHAFT OIL SEAL: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

ILLUSTRATION



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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000041LD007X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: FRONT CRANKSHAFT OIL SEAL: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL TIMING CHAIN OR BELT COVER OIL SEAL

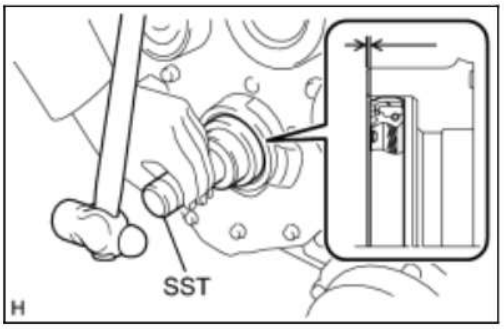
(a) Apply engine oil to the lip of a new timing chain or belt cover oil seal.

NOTICE:

- Keep the lip free of foreign matter.
- Do not apply engine oil to the dust seal section.

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

SST: 09223-22010



NOTICE:

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

HINT:

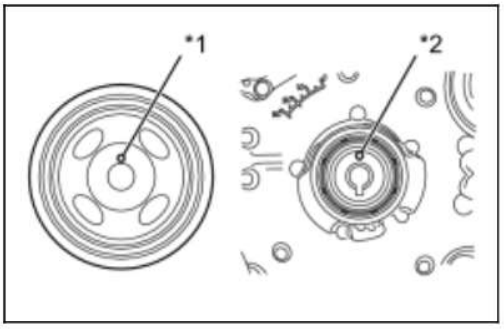
Alternatively, the tapping depth of the timing chain or belt cover oil seal can be 0 to -1.0 mm (0 to -0.039 in.) from the timing chain cover end surface.

2. INSTALL CRANKSHAFT PULLEY

(a) Install the crankshaft pulley spacer.

(b) Install a new O-ring to the crankshaft pulley spacer.

(c) Install the crankshaft pulley while aligning the knock hole of the pulley with the knock pin on the crankshaft pulley spacer.



Text in Illustration

*1	Knock Hole
*2	Knock Pin

(d) Install SST to the crankshaft pulley.

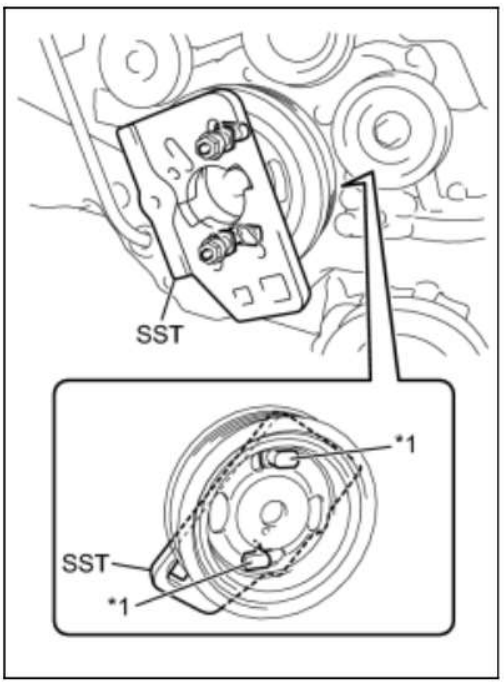
SST: 09213-80010

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90179-10016
09213-08010
09213-08110

HINT:

Position the projections on SST in the direction as shown in the illustration to prevent SST from separating from the crankshaft pulley.



Text in Illustration

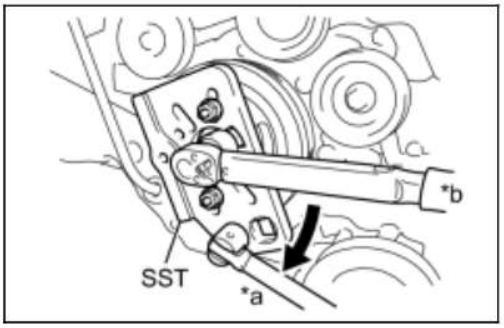
*1	Claw

(e) Apply engine oil to the crankshaft pulley set bolt.

(f) Using SST, hold the crankshaft pulley and tighten the crankshaft pulley set bolt.

SST: 09213-80010
90179-10016
09213-08010
09213-08110

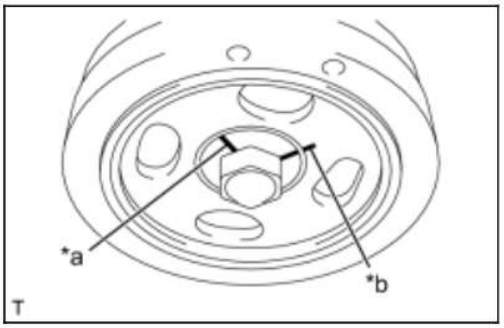
Torque:
20 N·m {204 kgf·cm, 15ft·lbf}



Text in Illustration

*a	Hold
*b	Turn

(g) Using a marker, draw the reference line (A) on the crankshaft pulley set bolt and also the reference line (B) on the crank pulley according to the line engraved around the crankshaft pulley set bolt head as shown in the illustration.



Text in Illustration

*a	Reference Line A
*b	Reference Line B

HINT:

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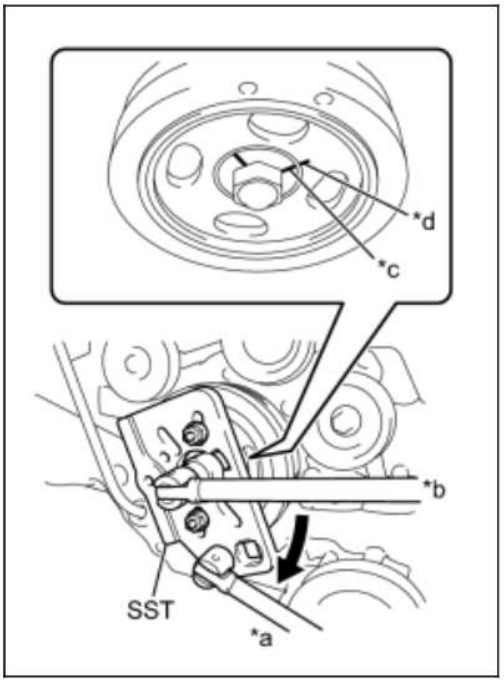
There are carved lines on the crankshaft pulley set bolt head every 90°.

(h) Using SST, hold the crankshaft pulley, and tighten the crankshaft pulley set bolt by 90° until the reference lines A and B are aligned.

SST: 09213-80010
90179-10016
09213-08010
09213-08110

Text in Illustration

*a	Hold
*b	Turn
*c	Reference Line A
*d	Reference Line B



3. INSTALL FAN AND GENERATOR V BELT

INFO

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000041LE007X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: FRONT CRANKSHAFT OIL SEAL: REMOVAL; 2013 MY FR-S [03/2012 -]		

REMOVAL

1. REMOVE FAN AND GENERATOR V BELT

INFO

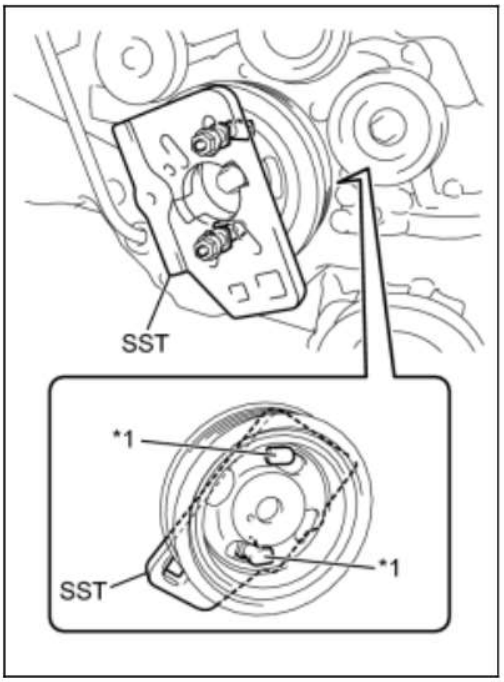
2. REMOVE CRANKSHAFT PULLEY

(a) Install SST to the crankshaft pulley.

SST: 09213-80010
90179-10016
09213-08010
09213-08110

HINT:

Position the projections on SST in the direction as shown in the illustration to prevent SST from separating from the crankshaft pulley.

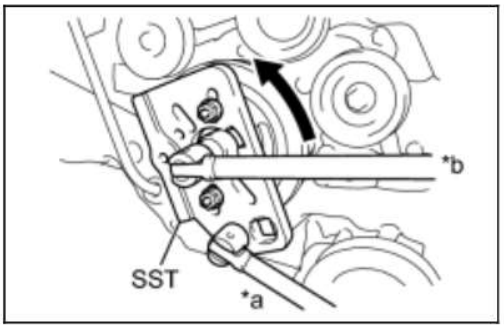


Text in Illustration

*1	Claw

(b) Using SST, hold the crankshaft pulley and loosen the crankshaft pulley set bolt.

SST: 09213-80010
90179-10016
09213-08010
09213-08110



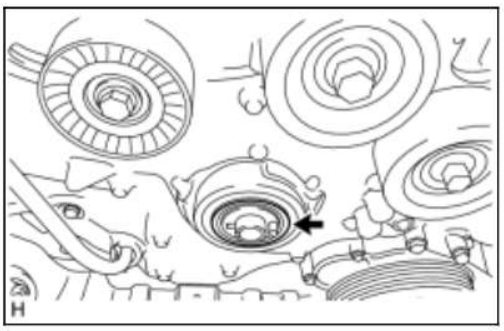
Text in Illustration

*a	Hold
*b	Turn

(c) Remove the crankshaft pulley.

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(d) Remove the O-ring and crankshaft pulley spacer.

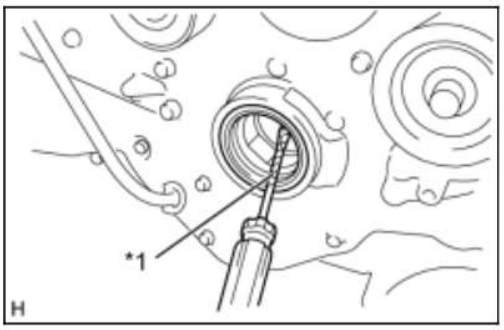


3. REMOVE TIMING CHAIN OR BELT COVER OIL SEAL

(a) Using a screwdriver with its tip wrapped in protective tape, pry out the timing chain or belt cover oil seal.

Text in Illustration

*1	Protective Tape



NOTICE:

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

HINT:

Tape the screwdriver tip before use.

TOYOTA

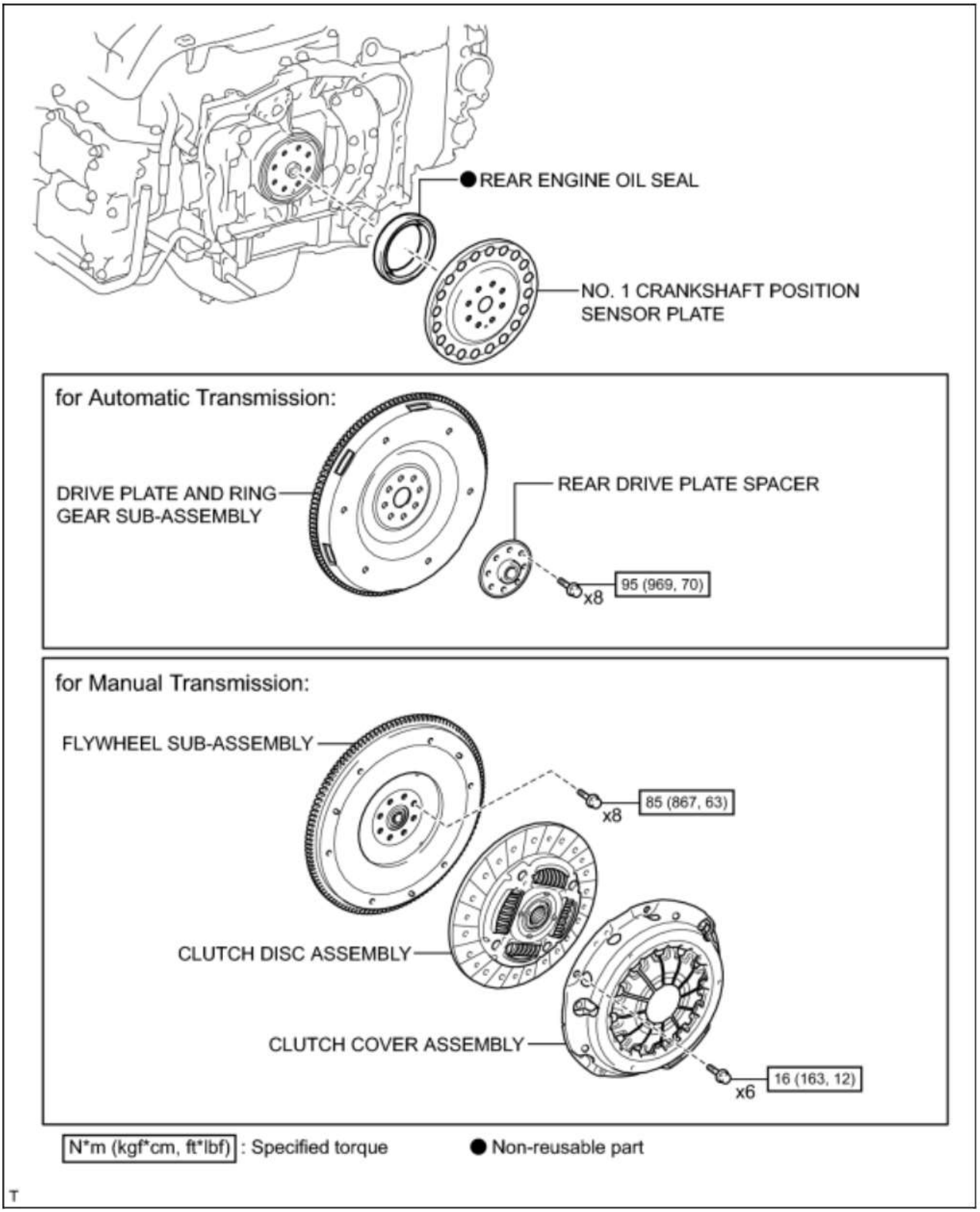
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Last Modified: 4-14-2014	6.6 K	Doc ID: RM000004I0M003X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: REAR CRANKSHAFT OIL SEAL: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

ILLUSTRATION

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000041LF007X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: REAR CRANKSHAFT OIL SEAL: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL REAR ENGINE OIL SEAL

(a) Apply engine oil to the lip of a new rear engine oil seal.

NOTICE:

Keep the lip free of foreign matter.

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

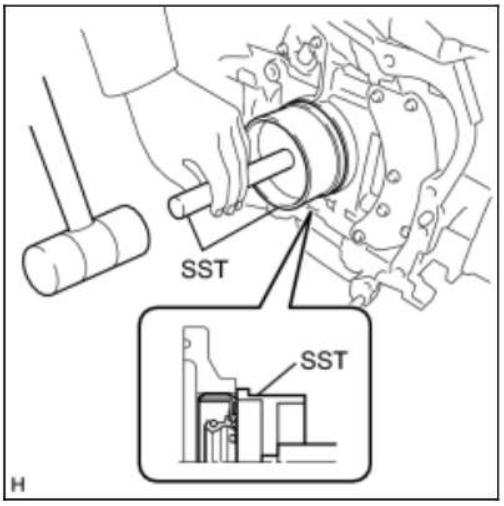
SST: 09223-15030

SST: 09950-70010

09951-07150

Oil seal tap in depth:

0 to 1.0 mm (0 to 0.0394 in.)



NOTICE:

- Wipe any extra grease off of the crankshaft.
- Keep the lip free of foreign matter.
- Do not tap on the oil seal at an angle.

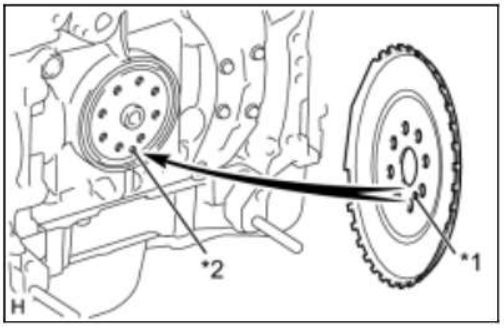
2. INSTALL NO. 1 CRANKSHAFT POSITION SENSOR PLATE

(a) Clean the 8 bolts and 8 bolt holes.

(b) Install the No. 1 crankshaft position sensor plate.

Text in Illustration

*1	Pin Hole
*2	Pin



HINT:

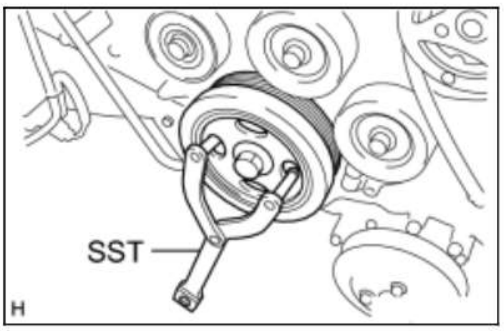
Align the pin of the front drive spacer with the pin hole of the crankshaft.

3. INSTALL FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

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(a) Using SST, hold the crankshaft pulley.

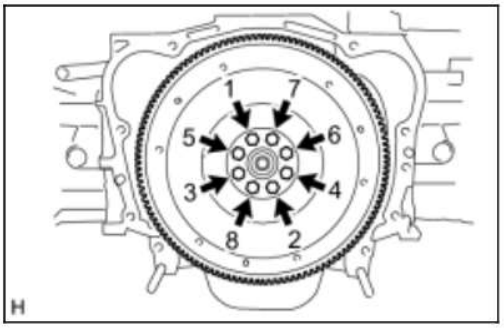
SST: 09960-10010
09962-01000
09963-01000



(b) Install the flywheel sub-assembly onto the crankshaft.

(c) In several steps, uniformly install and tighten the 8 bolts in the sequence shown in the illustration.

Torque:
85 N·m {867 kgf·cm, 63ft·lbf}



4. INSTALL CLUTCH DISC ASSEMBLY (for Manual Transmission) INFO

5. INSTALL CLUTCH COVER ASSEMBLY (for Manual Transmission) INFO

6. INSTALL DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

(a) Using SST, hold the crankshaft pulley.

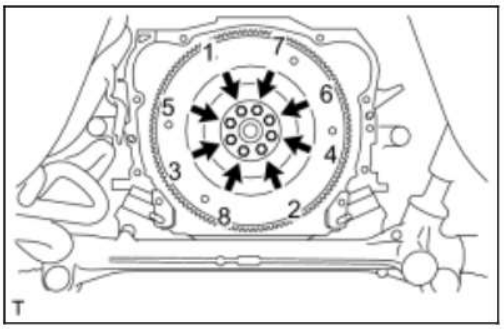
SST: 09960-10010
09962-01000
09963-01000



(b) Install the drive plate and ring gear sub-assembly and rear drive plate spacer onto the crankshaft.

(c) In several steps, uniformly install and tighten the 8 bolts in the sequence shown in the illustration.

Torque:
95 N·m {969 kgf·cm, 70ft·lbf}



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7. REMOVE MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

INFO

8. INSTALL AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

INFO

9. INSPECT FOR OIL LEAK



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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000041LG007X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: REAR CRANKSHAFT OIL SEAL: REMOVAL; 2013 MY FR-S [03/2012 -]		

REMOVAL

1. REMOVE AUTOMATIC TRANSMISSION ASSEMBLY (for Automatic Transmission)

INFO

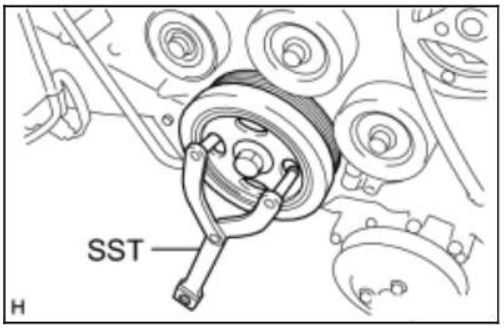
2. REMOVE MANUAL TRANSMISSION ASSEMBLY (for Manual Transmission)

INFO

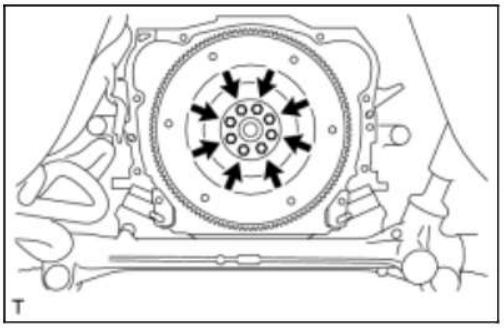
3. REMOVE DRIVE PLATE AND RING GEAR SUB-ASSEMBLY (for Automatic Transmission)

(a) Using SST, hold the crankshaft.

SST: 09960-10010
09962-01000
09963-01000



(b) Remove the 8 bolts, drive plate and ring gear sub-assembly and rear drive plate spacer.



4. REMOVE CLUTCH COVER ASSEMBLY (for Manual Transmission) INFO

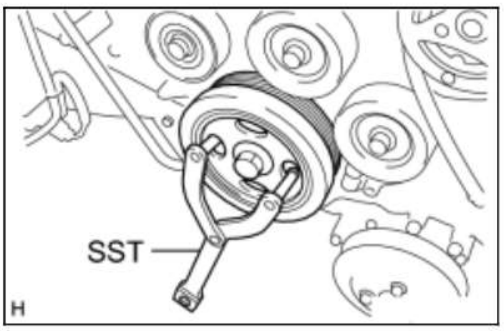
5. REMOVE CLUTCH DISC ASSEMBLY (for Manual Transmission) INFO

6. REMOVE FLYWHEEL SUB-ASSEMBLY (for Manual Transmission)

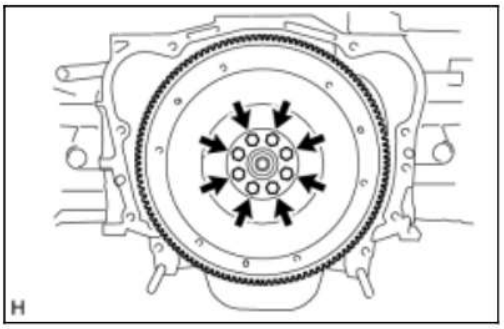
(a) Using SST, hold the crankshaft.

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SST: 09960-10010
09962-01000
09963-01000



(b) Remove the 8 bolts and flywheel sub-assembly.



7. REMOVE NO. 1 CRANKSHAFT POSITION SENSOR PLATE

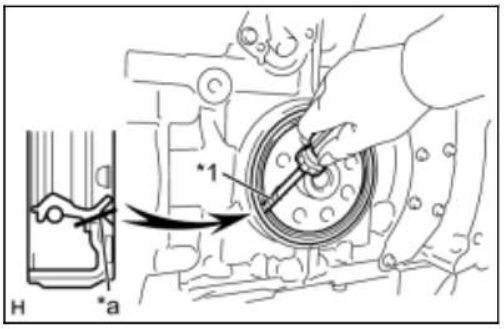
(a) Remove the No. 1 crankshaft position sensor plate.

8. REMOVE REAR ENGINE OIL SEAL

(a) Using a knife, cut through the oil seal lip.

Text in Illustration

*1	Protective Tape
*a	Cut position



(b) Using a screwdriver with its tip taped, pry out the rear engine oil seal.

NOTICE:

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

HINT:

Tape the screwdriver tip before use.

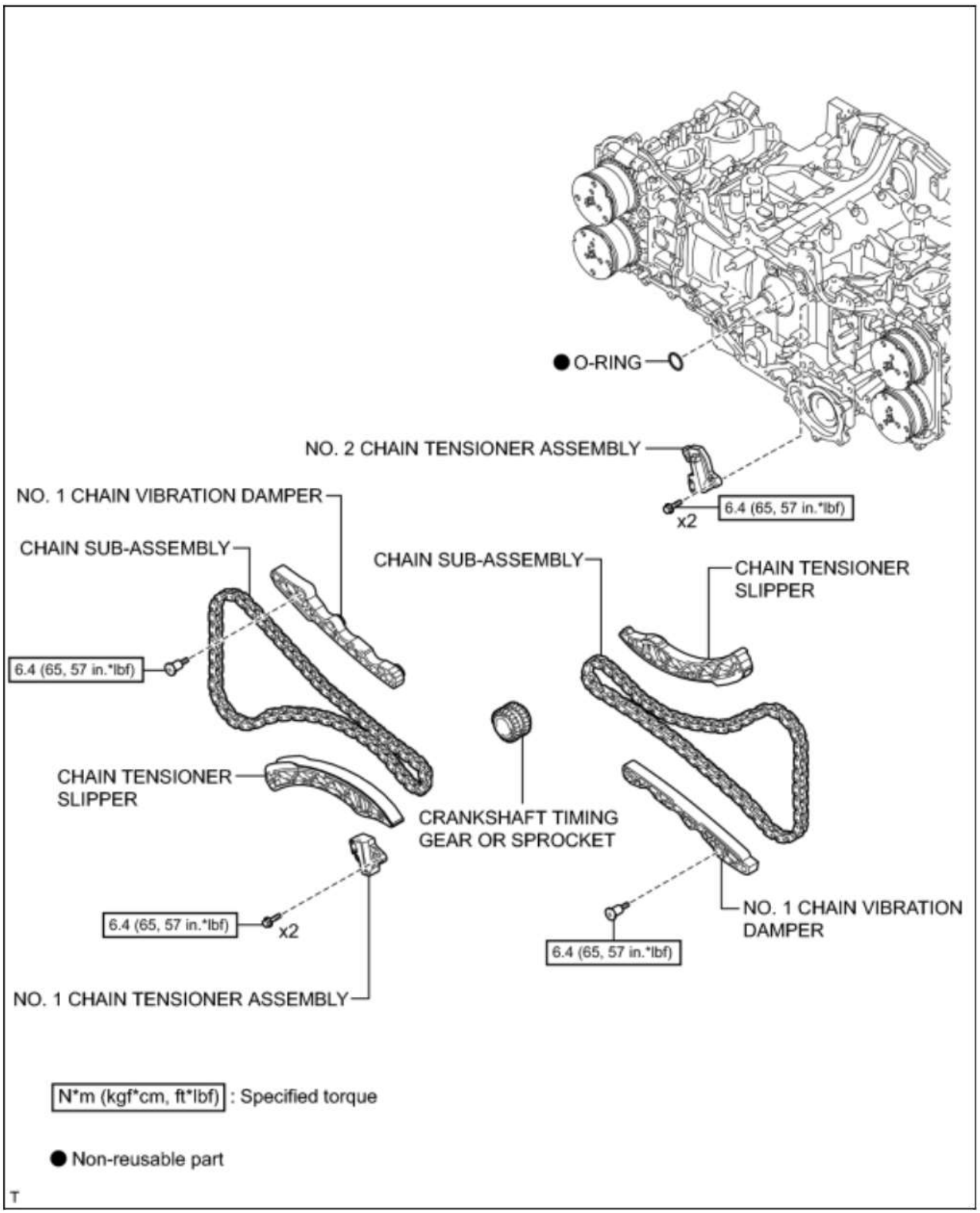
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Last Modified: 4-14-2014	6.6 K	Doc ID: RM00000591S000X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: TIMING CHAIN: COMPONENTS; 2013 MY FR-S [03/2012 -]		

COMPONENTS

ILLUSTRATION

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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000056U7009X
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: TIMING CHAIN: INSTALLATION; 2013 MY FR-S [03/2012 -]		

INSTALLATION

1. INSTALL CHAIN SUB-ASSEMBLY (for Bank 2)

NOTICE:

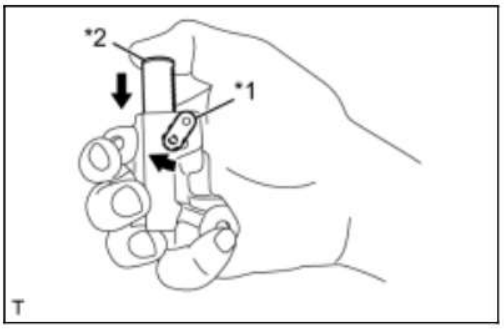
Do not allow any foreign matter to adhere onto or to enter into the component parts during installation.

HINT:

Apply engine oil to all component parts of the chain sub-assembly.

(a) Temporarily install the pulley bolt to the crankshaft.

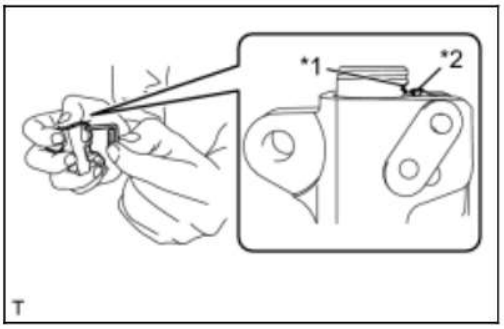
(b) Move the link plate in the direction of the arrow in the illustration to press in the plunger.



Text in Illustration

*1	Link Plate
*2	Plunger

(c) Insert an approximately 1 mm (0.039 in.) wire or the like into the chain tensioner through the stopper pin hole, and hold the plunger.



HINT:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of the plunger rack is engaged with the stopper tooth. If not engaged, retract the plunger a little so that the first notch of the plunger rack is engaged with the stopper tooth.

Text in Illustration

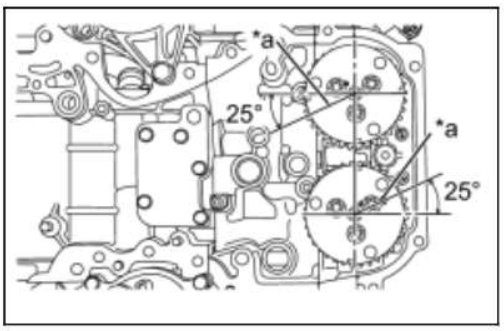
*1	First notch of the plunger rack
*2	Stopper Tooth

(d) Align the alignment mark on the camshaft timing intake gear assembly LH and camshaft timing exhaust gear assembly LH with the position shown in the illustration.

NOTICE:

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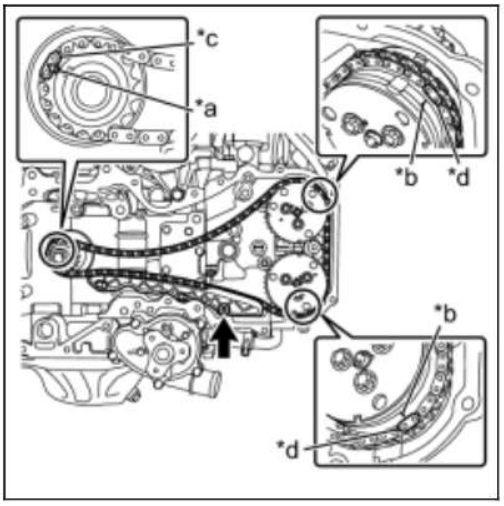
To avoid damaging the valves, do not turn the camshaft timing intake gear assemblies more than the zero-lift range (the range where camshaft timing intake gear assembles can be turned lightly by hand).



Text in Illustration

*a	Alignment Mark

(e) Align the timing chain mark plate (blue) with the alignment mark of the crankshaft timing gear or sprocket.



Text in Illustration

*a	Alignment Mark
*b	Timing Mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)

(f) Align the timing chain mark plate (pink) with the timing mark on the camshaft timing intake gear assembly LH.

(g) Align the timing chain mark plate (pink) with the timing mark on the camshaft timing exhaust gear assembly LH.

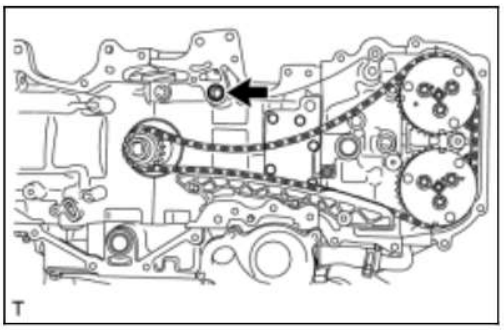
(h) Apply engine oil to the bolt.

(i) Using a 5 mm hexagon socket wrench, install the No. 1 chain vibration damper with the bolt.

Torque:

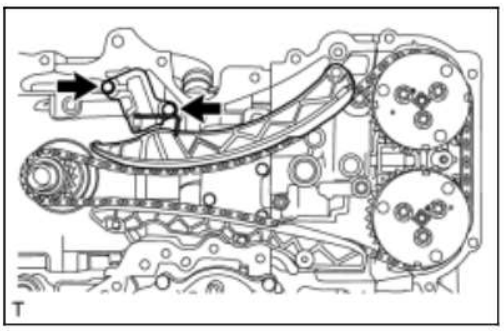
6.4 N·m {65 kgf·cm, 57in·lbf}

(j) Install a new O-ring to the cylinder block (bank 2).



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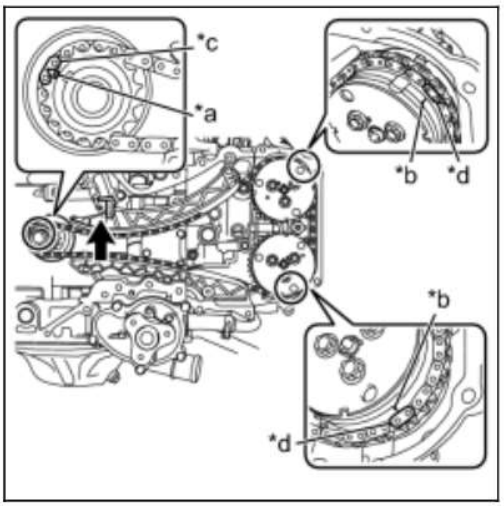
(k) Install the chain tensioner slipper.



(l) Install the No. 2 chain tensioner assembly with the 2 bolts.

Torque:
6.4 N·m {65 kgf·cm, 57in·lbf}

(m) Check that the chain is correctly installed.



Text in Illustration

*a	Alignment Mark
*b	Timing Mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)

(1) Timing chain mark plate (blue) is aligned with the alignment mark on the crankshaft timing gear or sprocket.

(2) Timing chain mark plate (pink) is aligned with the timing mark on the camshaft timing intake gear assembly LH.

(3) Timing chain mark plate (pink) is aligned with the timing mark on the camshaft timing exhaust gear assembly LH.

(n) Pull out the wire or the like from the No. 2 chain tensioner assembly.

(o) Temporarily install the pulley bolt to the crankshaft.

(p) Turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

NOTICE:
Be sure to perform this confirmation.

2. INSTALL CHAIN SUB-ASSEMBLY (for Bank 1)

NOTICE:

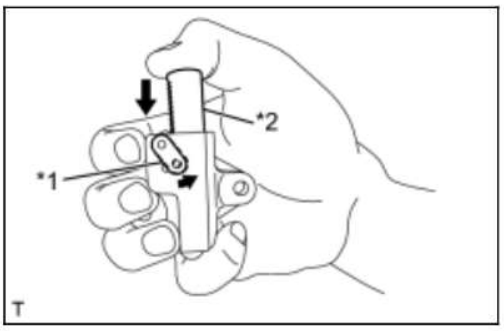
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Do not allow any foreign matter to adhere onto or to enter into the component parts during installation.

HINT:

Apply engine oil to all component parts of the chain sub-assembly.

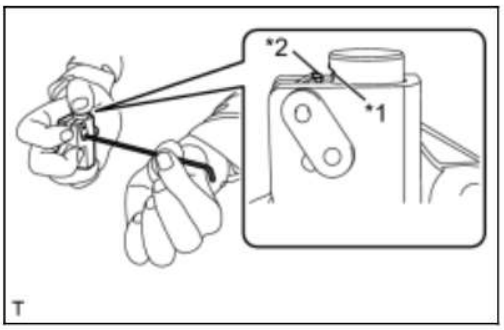
(a) Move the link plate in the direction of the arrow in the illustration to press in the plunger.



Text in Illustration

*1	Link Plate
*2	Plunger

(b) Insert a 2.5 mm (0.098 in.) hexagon wrench into the No. 1 chain tensioner assembly through the stopper pin hole, and hold the plunger.



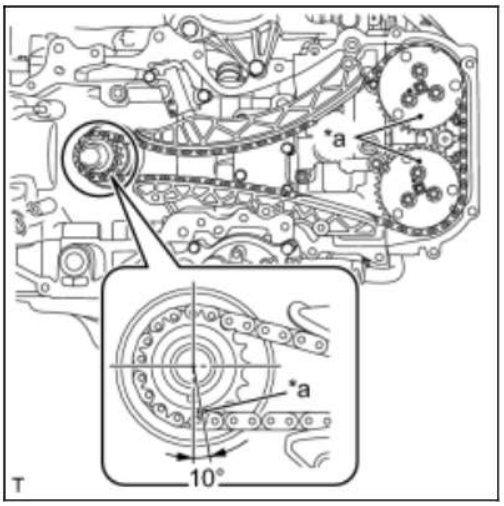
Text in Illustration

*1	First notch of the plunger rack
*2	Stopper Tooth

HINT:

If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of the plunger rack is engaged with the stopper tooth. If not engaged, retract the plunger a little so that the first notch of the plunger rack is engaged with the stopper tooth.

(c) Turn the crankshaft and align the alignment marks of the crankshaft timing gear or sprocket, camshaft timing intake gear assembly LH and camshaft timing exhaust gear assembly LH shown in the illustration.



Text in Illustration

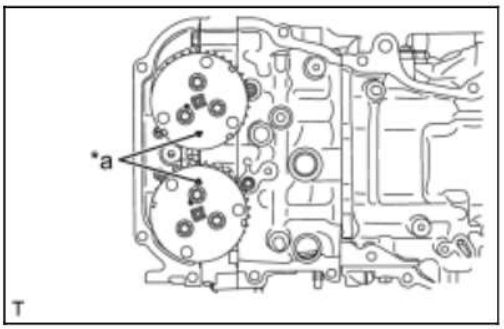
*a	Alignment Mark

HINT:

When the marks are aligned with the positions in the illustration, crankshaft key faces directly underneath.

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(d) Align the alignment marks of the camshaft timing intake gear assembly RH and camshaft timing exhaust gear assembly RH as shown in the illustration.



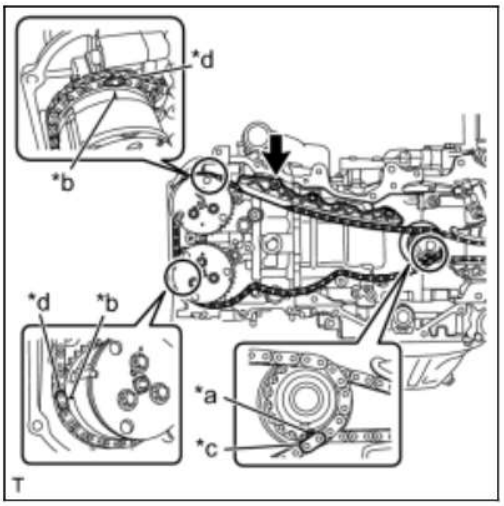
NOTICE:

To avoid damaging the valves, do not turn the camshaft timing intake gear assembly RH and camshaft more than the zero-lift range (the range where the camshaft timing intake gear assembles can be turned lightly by hand).

Text in Illustration

*a	Alignment Mark

(e) Align the timing chain mark plate (blue) with the alignment mark on the crankshaft timing gear or sprocket.



Text in Illustration

*a	Alignment Mark
*b	Timing Mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)

(f) Align the timing chain mark plate (pink) with the timing mark on the camshaft timing intake gear assembly RH.

(g) Align the timing chain mark plate (pink) with the timing mark on the camshaft timing exhaust gear assembly RH.

(h) Apply engine oil to the bolt.

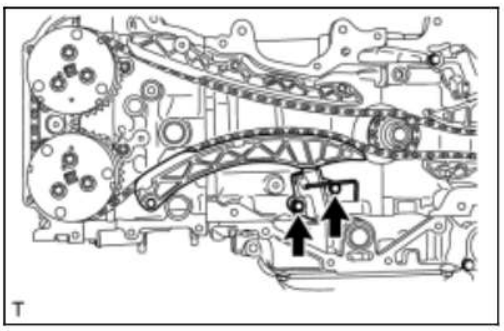
(i) Using a 5 mm hexagon socket wrench, install the No. 1 chain vibration damper with the bolt.

Torque:

6.4 N·m {65 kgf·cm, 57 in·lbf}

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(j) Install the chain tensioner slipper.

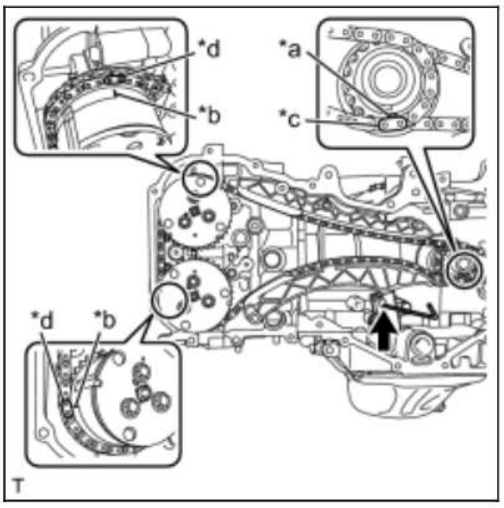


(k) Install the No. 1 chain tensioner assembly with the 2 bolts.

Torque:

6.4 N·m {65 kgf·cm, 57in·lbf}

(l) Check that the chain is correctly installed.



Text in Illustration

*a	Alignment Mark
*b	Timing Mark
*c	Mark plate (Blue)
*d	Mark plate (Pink)

(1) Timing chain mark plate (blue) is aligned with the alignment mark on the crankshaft timing gear or sprocket.

(2) Timing chain mark plate (pink) is aligned with the timing mark on the camshaft timing intake gear assembly RH.

(3) Timing chain mark plate (pink) is aligned with the timing mark on the camshaft timing exhaust gear assembly RH.

(m) Pull out the hexagon wrench from the No. 1 chain tensioner assembly.

(n) Turn the crankshaft clockwise, and make sure that there are no abnormal conditions.

NOTICE:

Be sure to perform this confirmation.

(o) Remove the pulley bolt.

3. INSTALL TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

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INFO



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Last Modified: 4-14-2014	6.6 A	Doc ID: RM0000056U900BX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: TIMING CHAIN: REMOVAL; 2013 MY FR-S [03/2012 -]		

REMOVAL

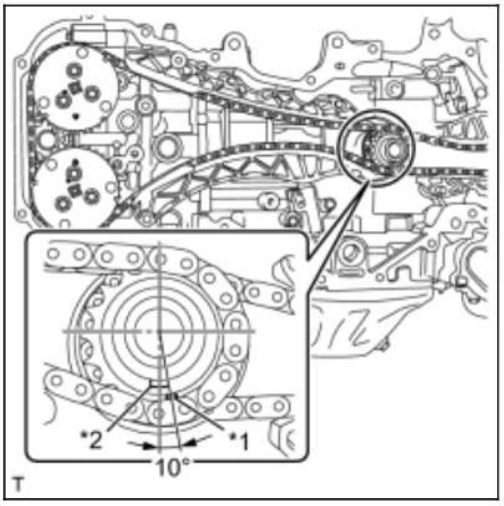
1. REMOVE TIMING CHAIN OR BELT COVER SUB-ASSEMBLY

INFO

2. REMOVE CHAIN SUB-ASSEMBLY (for Bank 1)

(a) Temporarily install the pulley bolt to the crankshaft.

(b) Turn the crankshaft and align the alignment marks of the crankshaft timing gear or sprocket, camshaft timing intake gear assembly RH and camshaft timing exhaust gear assembly RH.



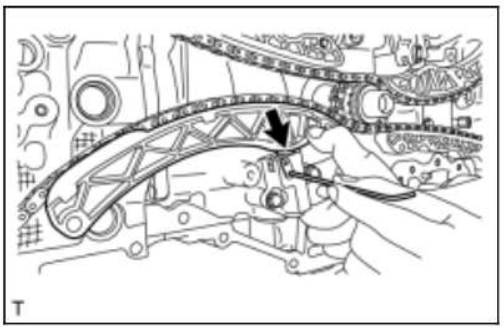
Text in Illustration

*1	Alignment Mark
*2	Key

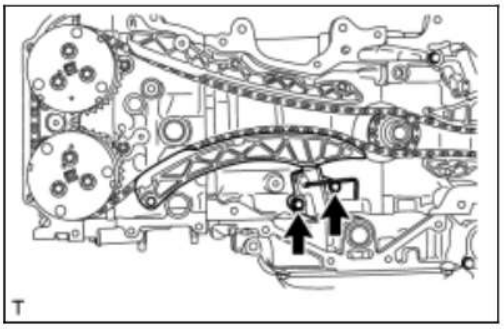
HINT:

The crankshaft key faces downward at this time.

(c) Push down the chain tensioner slipper and insert a 2.5 mm (0.098 in.) hexagonal wrench through the stopper plate into the No. 1 chain tensioner assembly.



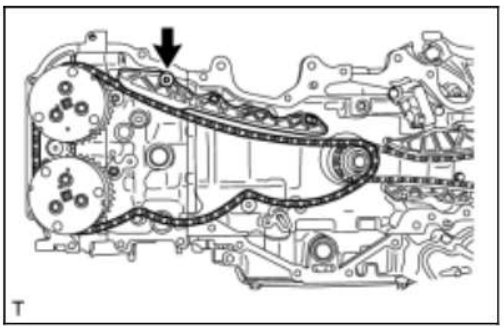
(d) Remove the 2 bolts and No. 1 chain tensioner assembly.



(e) Remove the chain tensioner slipper.

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(f) Using a 5 mm hexagonal wrench, remove the bolt and No. 1 chain vibration damper.



(g) Remove the chain sub-assembly.

NOTICE:

- With the chain sub-assembly removed, the valve heads may contact each other if the camshafts are turned, causing the valve stems to bend.
- To avoid this, do not turn the intake camshaft RH and the exhaust camshaft RH more than the zero-lift range (the range where camshafts can be turned lightly by hand).

HINT:

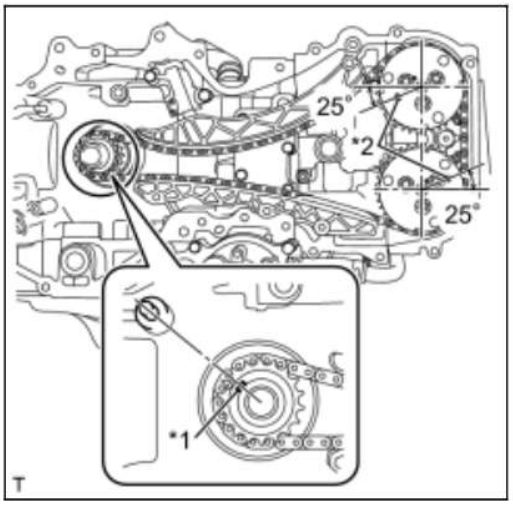
Arrange the removed parts in the correct order.

3. REMOVE CHAIN SUB-ASSEMBLY (for Bank 2)

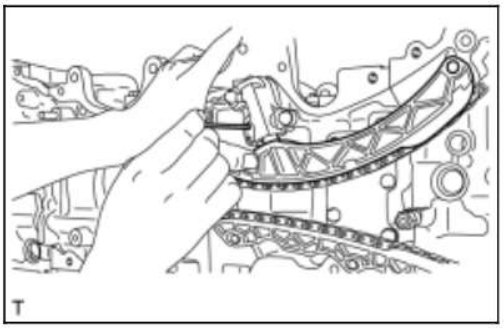
(a) Turn the crankshaft and position each alignment mark on the crankshaft timing gear or sprocket, camshaft timing intake gear assembly LH and camshaft timing exhaust gear assembly LH as shown in the illustration.

Text in Illustration

*1	Key
*2	Alignment Mark

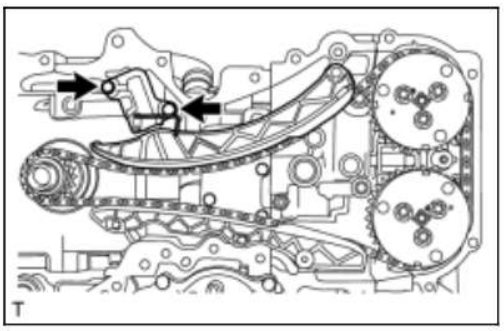


(b) Push the chain tensioner slipper and retain the plunger by inserting an approximately 1 mm (0.039 in.) wire through the stopper plate into the No. 2 chain tensioner assembly.



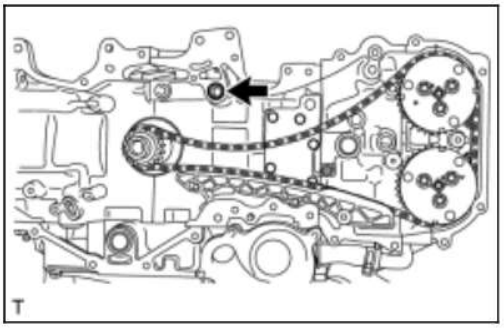
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(c) Remove the 2 bolts and No. 2 chain tensioner assembly.

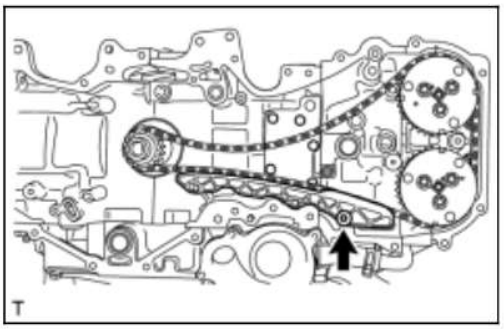


(d) Remove the chain tensioner slipper.

(e) Remove the O-ring from the cylinder block (bank 2).



(f) Using a 5 mm socket hexagon wrench, remove the bolt and No. 1 chain vibration damper.



(g) Remove the chain sub-assembly.

NOTICE:

- With the chain sub-assembly removed, the valve heads may contact each other if the camshafts are turned, causing the valve stems to bend. To avoid this, do not turn the exhaust camshaft LH more than the zero-lift range (the range where the camshaft can be turned lightly by hand).
- At this time, the No. 1 and No. 4 pistons are located near TDC. If the intake camshaft is turned, the valves may come into contact with the piston, causing the valve stems to bend. To avoid this, do not turn the intake camshaft LH.

HINT:

Arrange the removed parts in the correct order.

(h) Remove the pulley bolt.

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Last Modified: 4-14-2014	6.6 N	Doc ID: RM000000RRR00NX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: VALVE CLEARANCE: ADJUSTMENT; 2013 MY FR-S [03/2012 -]		

ADJUSTMENT

1. REMOVE IGNITION COIL ASSEMBLY

INFO

2. REMOVE INJECTOR COVER (for Bank 1) INFO

3. REMOVE INJECTOR DRIVER BRACKET INFO

4. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY RH INFO

5. REMOVE CYLINDER HEAD COVER SUB-ASSEMBLY LH INFO

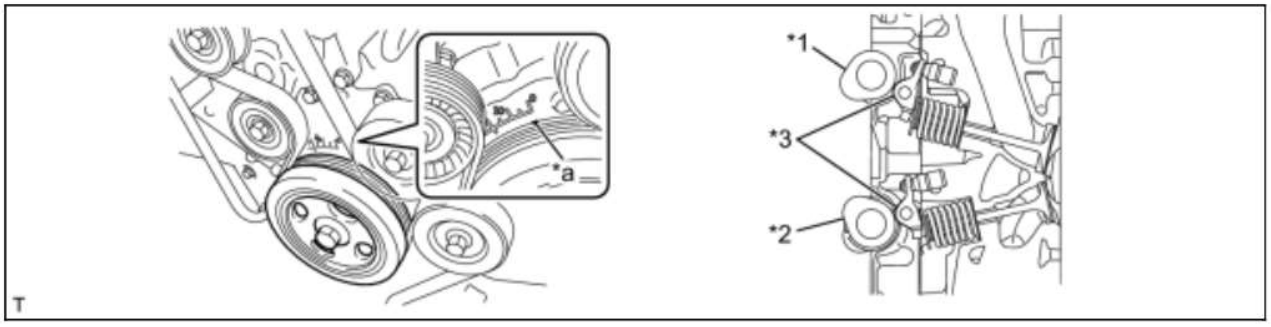
6. INSPECT VALVE CLEARANCE

NOTICE:

Inspect the valve clearance when the engine is cold.

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

(1) Turn the crankshaft clockwise to align the timing mark on the crankshaft pulley with the indicator of the timing chain cover.



Text in Illustration

*1	Intake Camshaft	*2	Exhaust Camshaft
*3	No. 1 Valve Rocker Arm Sub-assembly	-	-
*a	Timing Mark	-	-

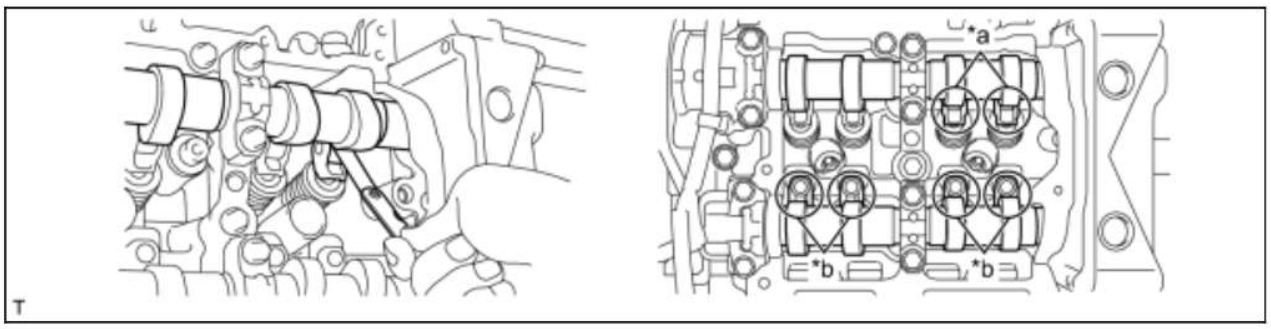
(b) At this time, check that the intake camshaft and exhaust camshaft do not depress the No. 1 cylinder intake side No. 1 valve rocker arm sub-assembly (intake valve) and exhaust side No. 1 valve rocker arm sub-assembly (exhaust valve).

HINT:

If the No. 1 valve rocker arm sub-assembly (valve) is depressed, turn the crank pulley by 360° in order to make the No. 1 cylinder piston at TDC/compression.

(c) Inspect the valve clearance indicated in the illustration.

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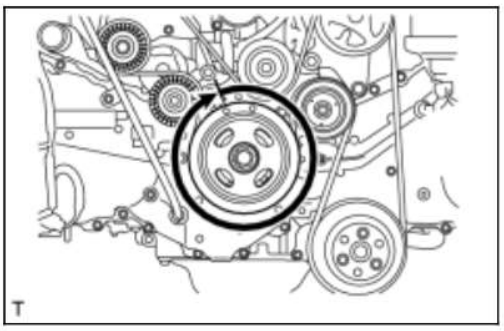
Text in Illustration

*a	Intake Side	*b	Exhaust Side

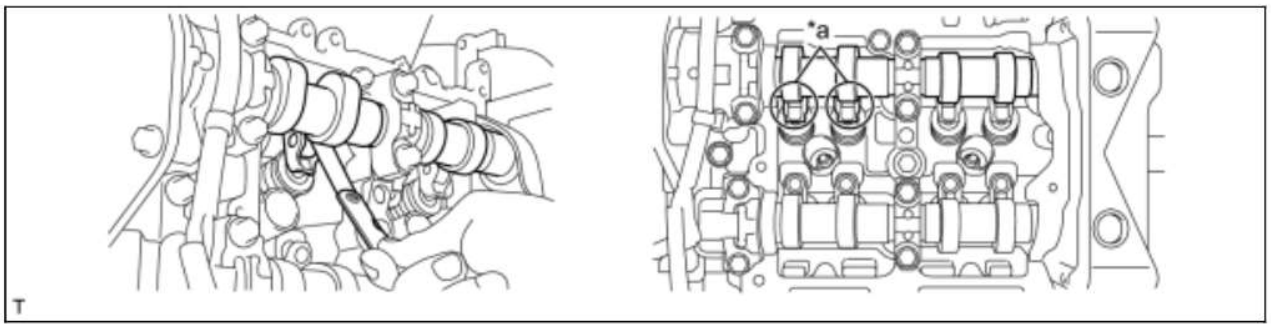
(d) Measure the clearance between the surface of the cam base circle and the roller surface of the No. 1 valve rocker arm sub-assembly using a feeler gauge.

Standard Valve Clearance (Cold):
Intake 0.10 to 0.16 mm (0.0039 to 0.0063 in.)
Exhaust 0.21 to 0.27 mm (0.0083 to 0.0106 in.)

(e) Turn the crank pulley by 360°.



(f) Inspect the valve clearance indicated in the illustration.



Text in Illustration

*a	Intake Side	-	-

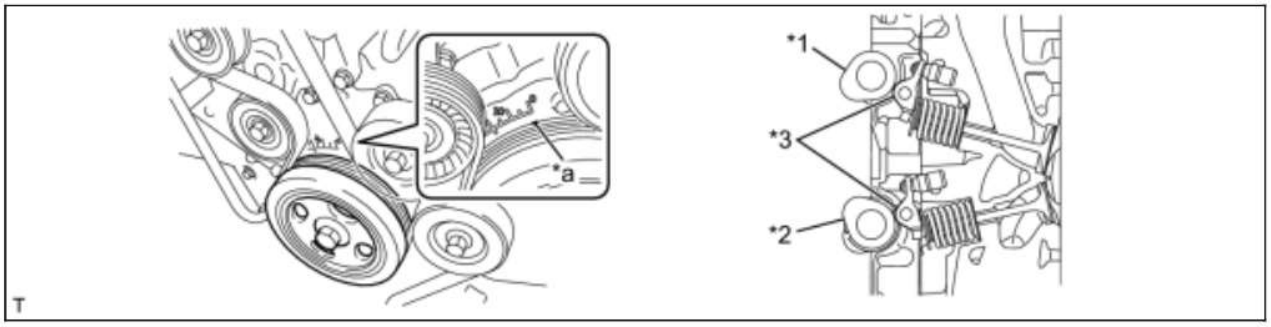
(g) Measure the clearance between the surface of the cam base circle and the roller surface of the No. 1 valve rocker arm sub-assembly using a feeler gauge.

Standard Valve Clearance (Cold):
Intake 0.10 to 0.16 mm (0.0039 to 0.0063 in.)

(h) Turn the crank pulley clockwise, set the No. 2 cylinder at TDC/compression, and then align the

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timing mark (notch) with 0° position of the timing chain cover.



Text in Illustration

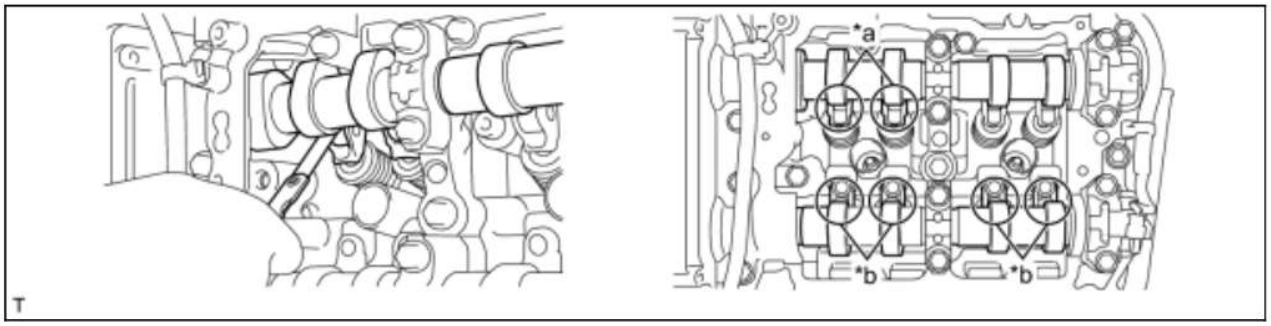
*1	Intake Camshaft	*2	Exhaust Camshaft
*3	No. 1 Valve Rocker Arm Sub-assembly	-	-
*a	Timing Mark	-	-

(i) At this time, check that the intake camshaft and exhaust camshaft do not depress the No. 2 cylinder intake side No. 1 valve rocker arm sub-assembly (intake valve) and exhaust side No. 1 valve rocker arm sub-assembly (exhaust valve).

HINT:

If the No. 1 valve rocker arm sub-assembly (valve) is depressed, turn the crank pulley by 360° in order to make the No. 2 cylinder piston at TDC/compression.

(j) Inspect the valve clearance indicated in the illustration.



Text in Illustration

*a	Intake Side	*b	Exhaust Side

(k) Measure the clearance between the surface of the cam base circle and the roller surface of the No. 1 valve rocker arm sub-assembly using a feeler gauge.

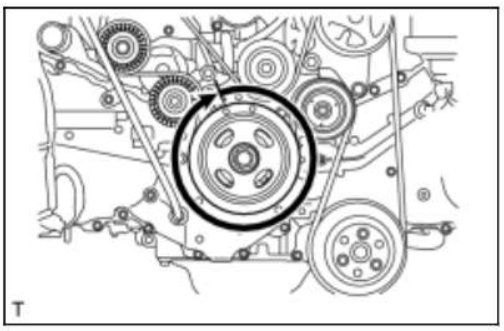
Standard Valve Clearance (Cold):

Intake 0.10 to 0.16 mm (0.0039 to 0.0063 in.)

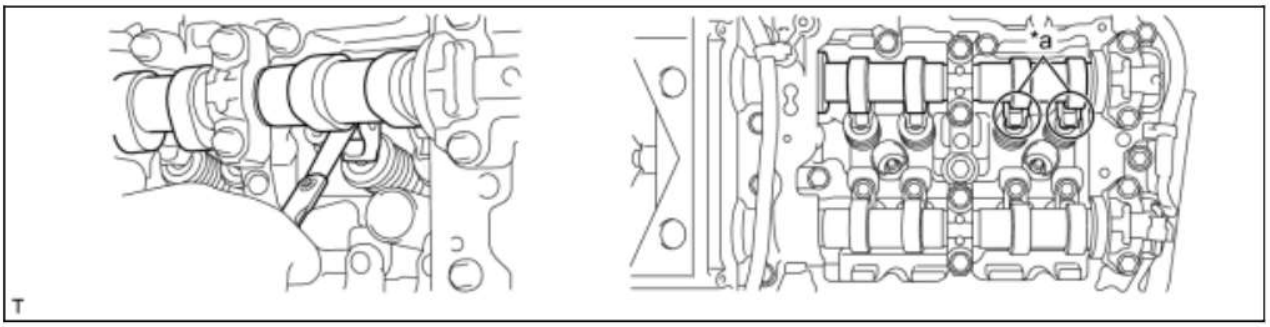
Exhaust 0.21 to 0.27 mm (0.0083 to 0.0106 in.)

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(l) Turn the crank pulley by 360°.



(m) Inspect the valve clearance indicated in the illustration.



Text in Illustration

*a	Intake Side	-	-

(n) Measure the clearance between the surface of the cam base circle and the roller surface of the No. 1 valve rocker arm sub-assembly using a feeler gauge.

Standard Valve Clearance (Cold):
Intake 0.10 to 0.16 mm (0.0039 to 0.0063 in.)

7. ADJUST VALVE CLEARANCE

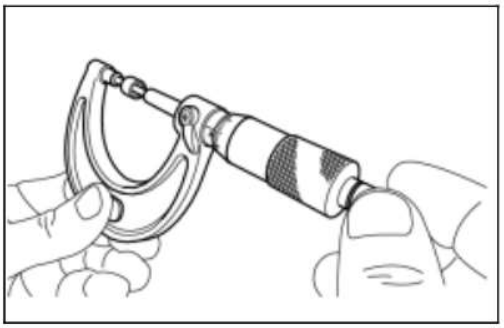
(a) Remove the camshaft housing sub-assembly.

INFO

(b) Remove the No. 1 valve rocker arm sub-assemblies.

(c) Remove the valve adjusting shims.

(d) Using a micrometer, measure the thickness of the removed valve adjusting shims.



(e) Calculate the thickness of the valve adjusting shim so that the valve clearance comes within the specified values.

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Intake Side:

A = B + [C - 0.13 mm (0.0051 in.)] x 1.54

Exhaust Side:

A = B + [C - 0.24 mm (0.0094 in.)] x 1.69

A:

Required valve adjusting shim thickness

B:

Removed valve adjusting shim thickness

C:

Measured valve clearance

(f) Apply engine oil to the inner face of the valve adjusting shim, and install it to the valve.

NOTICE:

Check whether valve adjusting shim can be rotated smoothly on the valve.

(g) Install the No. 1 valve rocker arm sub-assemblies.

(h) Install the camshaft housing sub-assembly.

INFO

8. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY LH INFO

9. INSTALL CYLINDER HEAD COVER SUB-ASSEMBLY RH INFO

10. INSTALL INJECTOR DRIVER BRACKET INFO

11. INSTALL INJECTOR COVER (for Bank 1) INFO

12. INSTALL IGNITION COIL ASSEMBLY

INFO



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Last Modified: 4-14-2014	6.6 G	Doc ID: RM00000409400QX
Model Year: 2013	Model: FR-S	Prod Date Range: [03/2012 -]
Title: FA20 ENGINE MECHANICAL: VALVE CLEARANCE: ON-VEHICLE INSPECTION; 2013 MY FR-S [03/2012 -]		

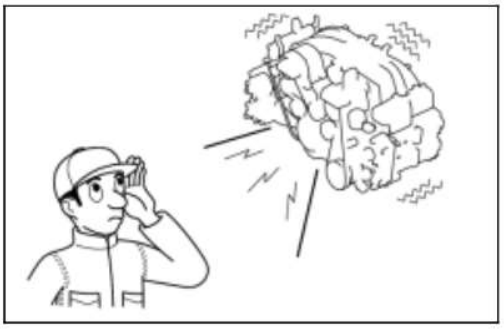
ON-VEHICLE INSPECTION

1. INSPECT VALVE CLEARANCE

(a) Check for noise and vibration

(1) Check for valve noise or a rough idle.

(2) Judge whether the valve clearance needs to be adjusted.



HINT:

If the valve noise is too loud or the idle is rough, inspect the valve clearance INFO .

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