

## TIMING CHAIN REMOVAL/INSTALLATION [SKYACTIV-D 2.2]

id0110s5801000

### Operation After Replacing Timing Chain

1. After replacing the timing chain, perform the following procedure.

STEP	ACTION	PAGE/CONDITION
1	Perform KOEO self-test procedure.	(See KOEO/KOER SELF TEST [SKYACTIV-D 2.2].)
2	Switch the ignition off.	—
3	Verify that the check engine light does not illuminate.	—
4	Perform KOER self-test procedure.	(See KOEO/KOER SELF TEST [SKYACTIV-D 2.2].)
5	Perform fuel injector injection amount correction.	(See FUEL INJECTOR INJECTION AMOUNT CORRECTION [SKYACTIV-D 2.2].)
6	Perform timing chain learning procedure.	(See TIMING CHAIN LEARNING [SKYACTIV-D 2.2].)
7	Clear the DTCs.	(See OBD READ/CLEAR DIAGNOSTIC TEST RESULTS [SKYACTIV-D 2.2].)
8	Switch the ignition off.	—

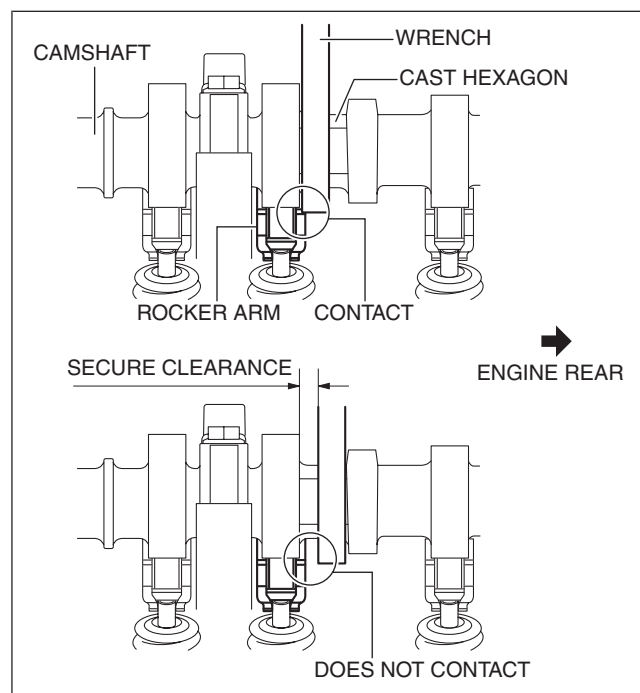
### Timing Chain Removal/Installation

#### Warning

- A hot engine can cause severe burns. Turn off the engine and wait until it is cool before servicing.

#### Caution

- When rotating the camshaft using a wrench on the cast hexagon, the wrench may contact the rocker arm and damage the rocker arm. To prevent damage to the rocker arm when holding the camshaft on the cast hexagon, use a wrench on the rear side of the engine as shown in the figure to secure a clearance between the cam.

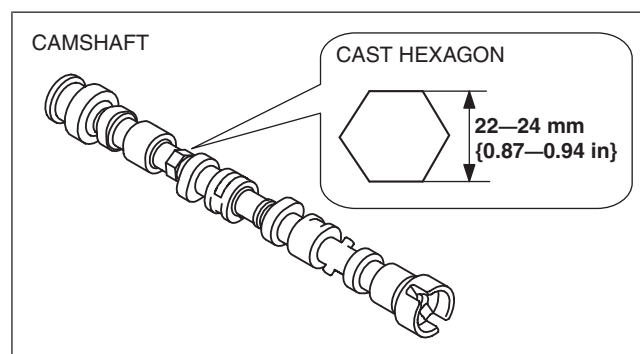


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#### Note

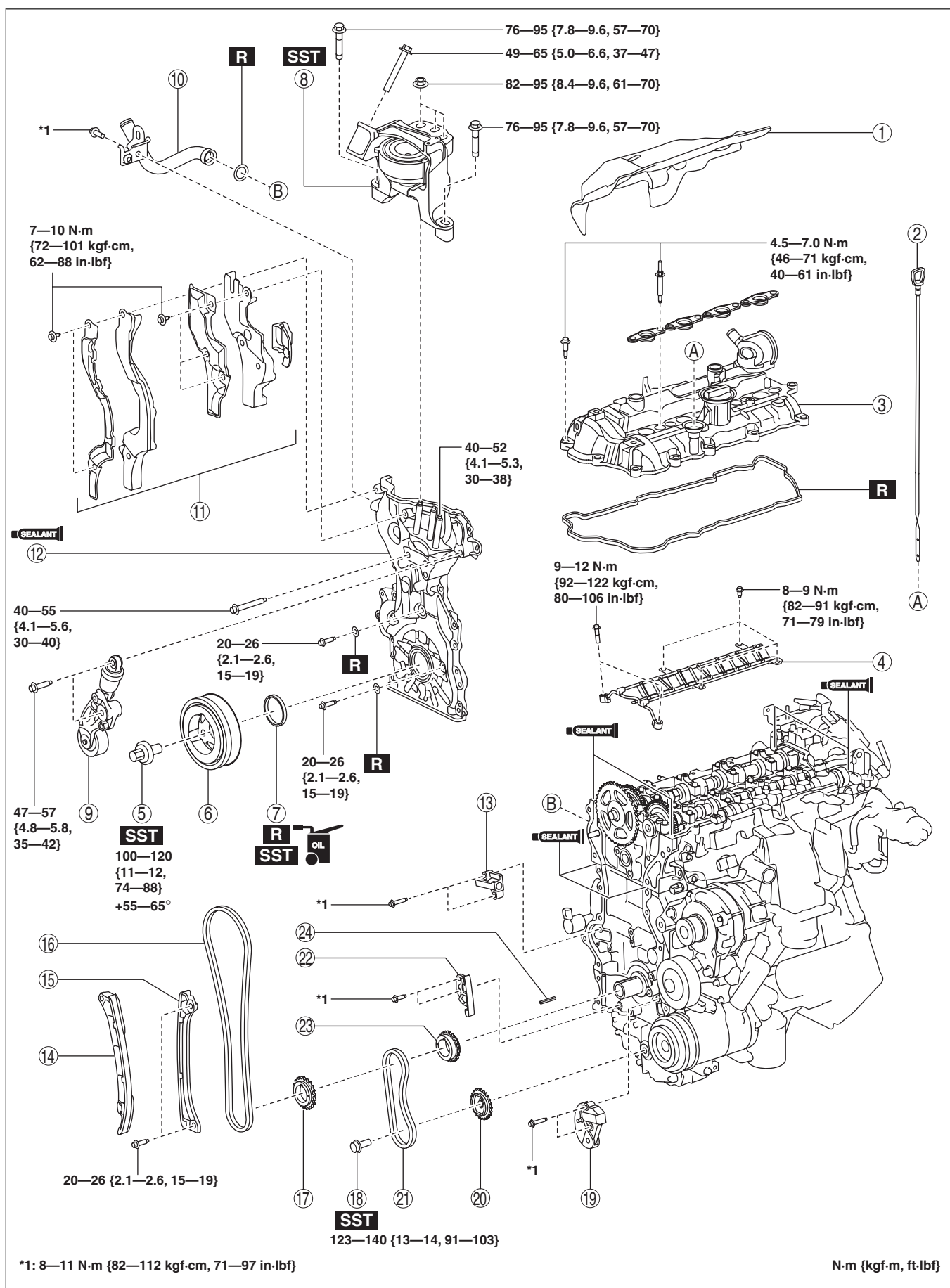
- Width at the cast hexagon of the camshaft is 22—24 mm {0.87—0.94 in}.

- Disconnect the negative battery cable. (See NEGATIVE BATTERY CABLE DISCONNECTION/CONNECTION [SKYACTIV-D 2.2].)
- Remove the engine cover. (See ENGINE COVER REMOVAL/INSTALLATION [SKYACTIV-D 2.2].)
- Remove the front under cover No.2. (See FRONT UNDER COVER No.2 REMOVAL/INSTALLATION.)
- Remove the splash shield. (See SPLASH SHIELD REMOVAL/INSTALLATION.)
- Remove the drive belt. (See DRIVE BELT REMOVAL/INSTALLATION [SKYACTIV-D 2.2].)
- Drain the engine oil. (See ENGINE OIL REPLACEMENT [SKYACTIV-D 2.2].)



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7. Remove the oil pan. (See OIL PAN REMOVAL/INSTALLATION [SKYACTIV-D 2.2].)
  8. Remove the fuel injectors. (See FUEL INJECTOR REMOVAL/INSTALLATION [SKYACTIV-D 2.2].)
  9. Drain the engine coolant. (See ENGINE COOLANT REPLACEMENT [SKYACTIV-D 2.2].)
  10. Remove in the order indicated in the table.
  11. Install in the reverse order of removal.
  12. Refill with the specified type and amount of the engine oil. (See ENGINE OIL REPLACEMENT [SKYACTIV-D 2.2].)
  13. Refill the engine coolant. (See ENGINE COOLANT REPLACEMENT [SKYACTIV-D 2.2].)
  14. Inspect for engine coolant leakage. (See ENGINE COOLANT LEAKAGE INSPECTION [SKYACTIV-D 2.2].)
  15. If the timing chain is replaced, perform "Operation After Replacing Timing Chain". (See Operation After Replacing Timing Chain.)
  16. Start the engine and inspect the following:
    - Leakage of engine oil.
    - Oil level (See ENGINE OIL LEVEL INSPECTION [SKYACTIV-D 2.2].)
    - Runout and contact of pulley and belt.
    - Idle speed (See ENGINE TUNE-UP [SKYACTIV-D 2.2].)



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1 Insulator  
(See Insulator installation note.)

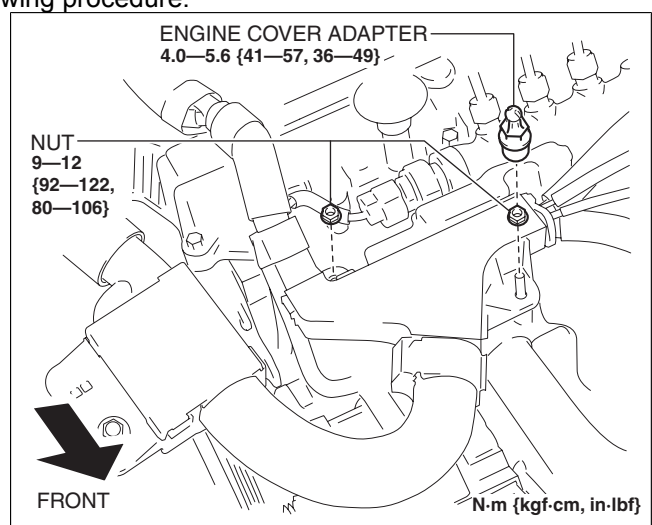
2 Dipstick

3	Cylinder head cover (See Cylinder head cover removal note.) (See Cylinder head cover installation note.)
4	Oil shower pipe (See Oil shower pipe installation note.)
5	Crankshaft pulley lock bolt (See FRONT OIL SEAL REPLACEMENT [SKYACTIV-D 2.2].)
6	Crankshaft pulley (See FRONT OIL SEAL REPLACEMENT [SKYACTIV-D 2.2].)
7	Front oil seal (See FRONT OIL SEAL REPLACEMENT [SKYACTIV-D 2.2].)
8	No.3 engine mount (See No.3 engine mount removal note.) (See No.3 engine mount installation note.)
9	Drive belt auto tensioner (See DRIVE BELT AUTO TENSIONER REMOVAL/ INSTALLATION [SKYACTIV-D 2.2].)
10	Water pipe (See Water pipe removal note.) (See Water pipe installation note.)
11	Noise suppression cover (No.1), noise suppression cover (No.2), seal rubber (See Noise suppression cover (No.1), noise suppression cover (No.2), seal rubber removal note.) (See Noise suppression cover (No.1), noise suppression cover (No.2), seal rubber installation note.)
12	Engine front cover (See Engine front cover removal note.) (See Engine front cover installation note.)

13	Timing chain tensioner (See Timing chain removal note.) (See Timing chain installation note.)
14	Timing chain tensioner arm (See Timing chain removal note.) (See Timing chain installation note.)
15	Timing chain guide (See Timing chain removal note.) (See Timing chain installation note.)
16	Timing chain (See Timing chain removal note.) (See Timing chain installation note.)
17	Crankshaft sprocket (See Timing chain removal note.) (See Timing chain installation note.)
18	Oil pump driven sprocket installation bolt (See Oil pump chain removal note.) (See Oil pump chain installation note.)
19	Oil pump chain tensioner (See Oil pump chain removal note.) (See Oil pump chain installation note.)
20	Oil pump driven sprocket (See Oil pump chain removal note.) (See Oil pump chain installation note.)
21	Oil pump chain (See Oil pump chain removal note.) (See Oil pump chain installation note.)
22	Oil pump chain guide
23	Oil pump drive sprocket
24	Key

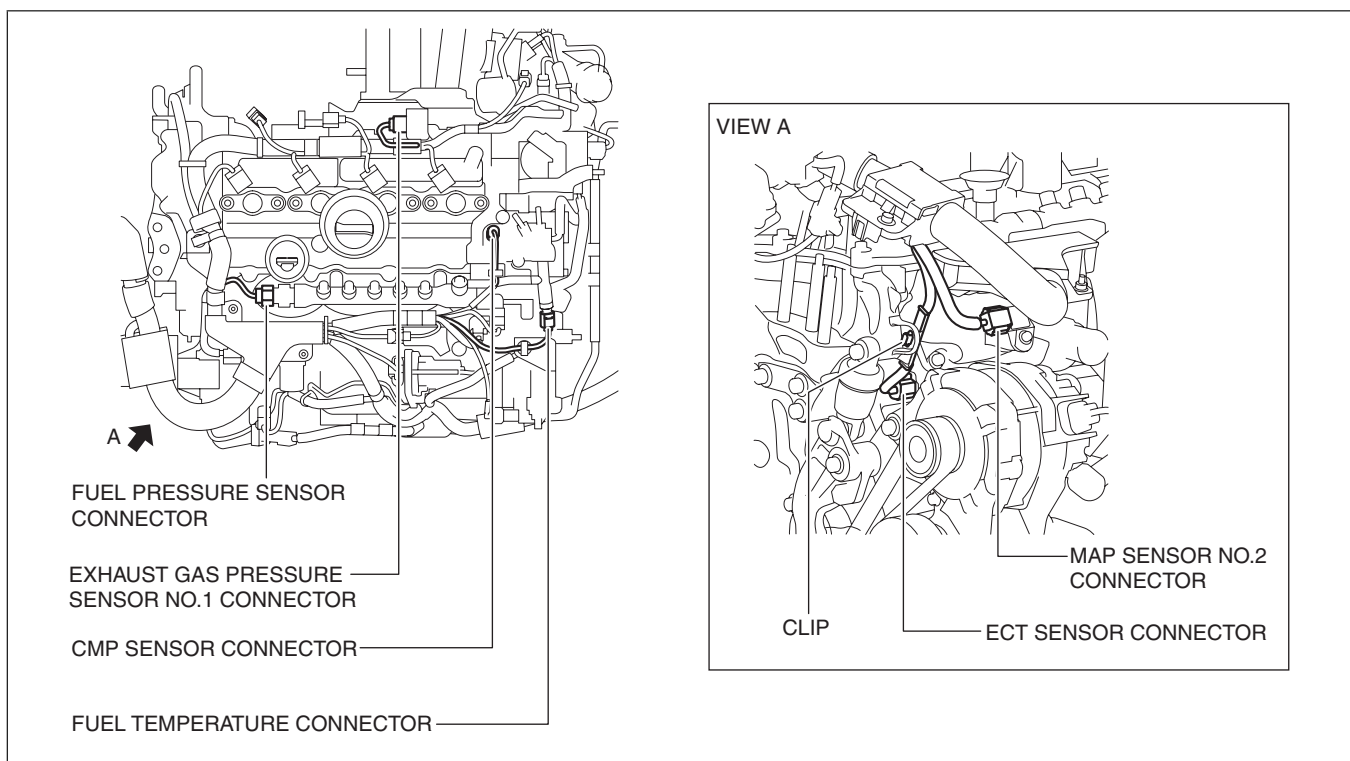
### Cylinder head cover removal note

1. Remove the fuel feed pipe. (See SUPPLY PUMP REMOVAL/INSTALLATION [SKYACTIV-D 2.2].)
2. Remove the injection pipe (supply pump side). (See INJECTION PIPE REMOVAL/INSTALLATION [SKYACTIV-D 2.2].)
3. Set the wiring harness and ground aside using the following procedure:
  - (1) Remove the engine cover adapter and nuts shown in the figure.



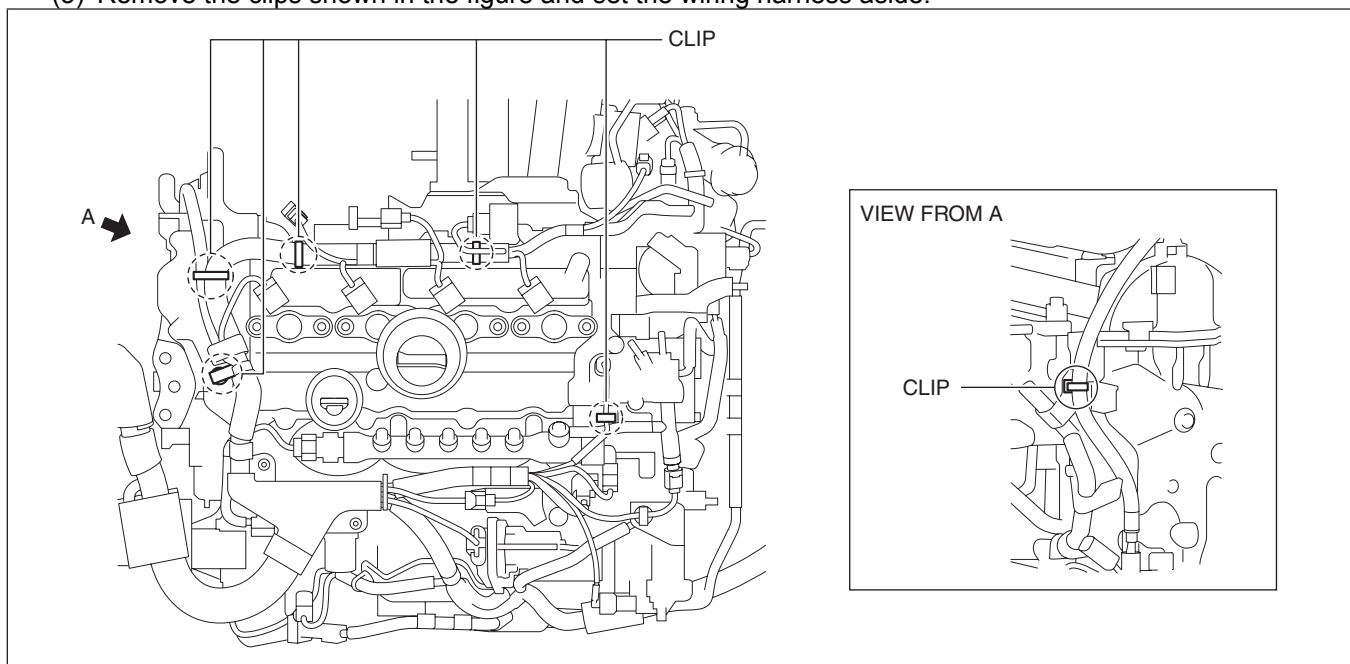
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- (2) Disconnect the connectors and clip shown in the figure.



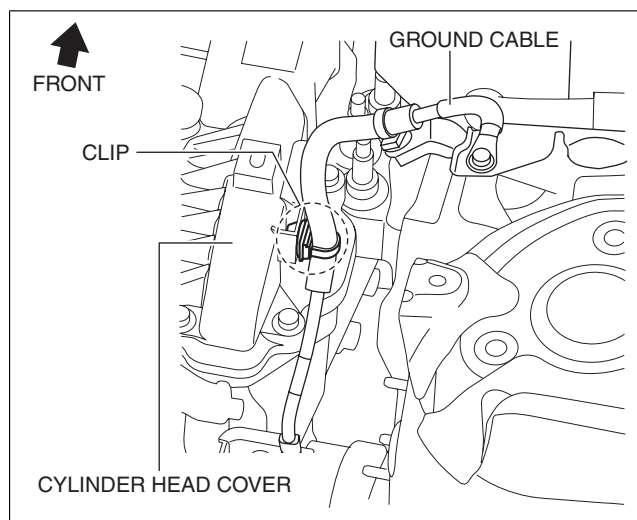
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(3) Remove the clips shown in the figure and set the wiring harness aside.



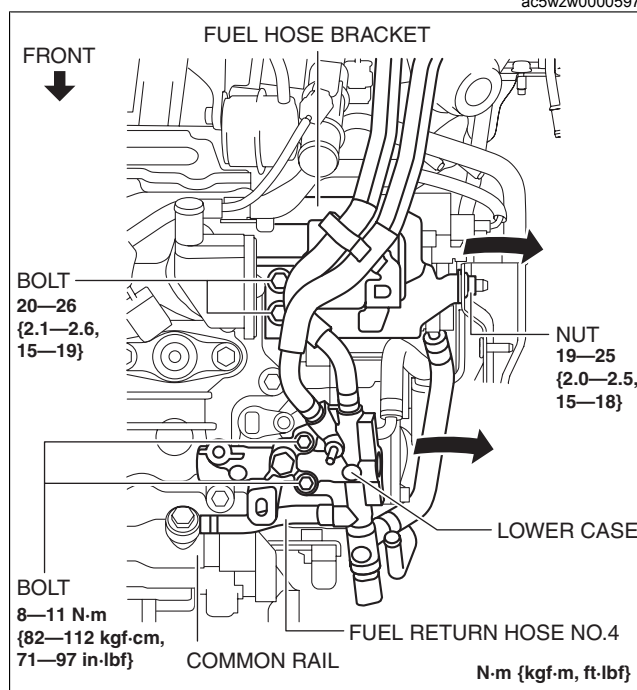
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- (4) Set the ground cable clip shown in the figure aside from the cylinder head cover.



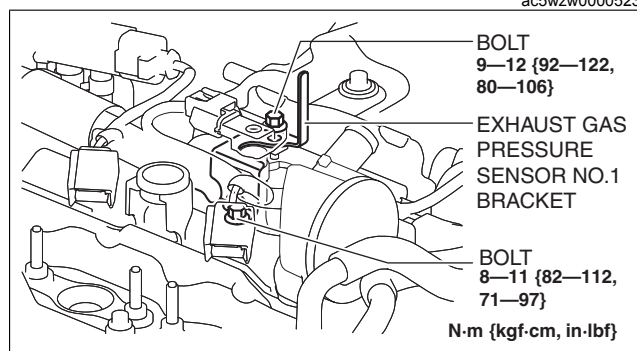
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4. Set the lower case and fuel hose bracket aside using the following procedure:
- (1) Disconnect the vacuum hose from the vacuum pump.
  - (2) Disconnect the fuel return hose No.4 from the common rail.
  - (3) Remove the fuel hose bracket installation bolts and nut with the fuel main hose and return hose No.1 connected.
  - (4) Remove the lower case with the fuel main hose and return hose No.1 and set it aside.



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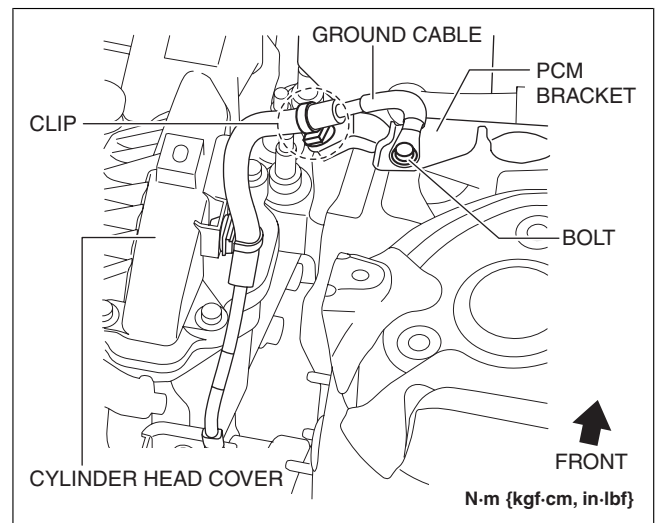
5. Remove the exhaust gas pressure sensor No.1 bracket.  
6. Remove the cylinder head cover.



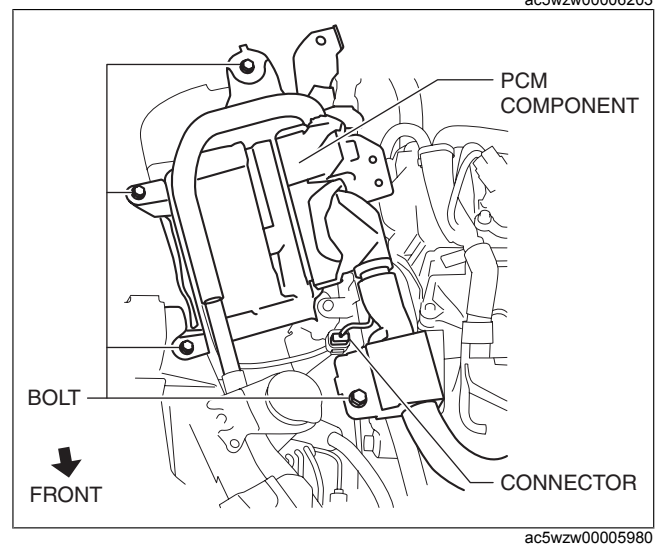
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### No.3 engine mount removal note

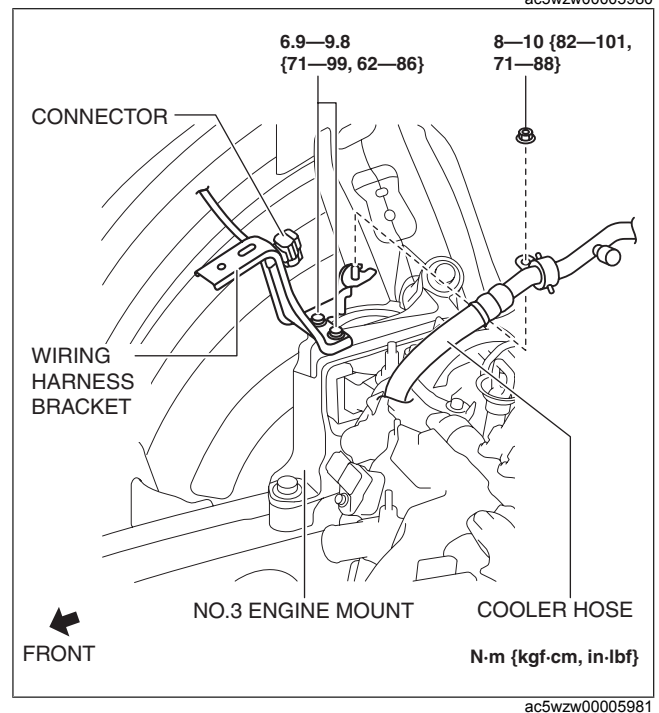
1. Remove the clip and bolt shown in the figure and set the ground cable aside.



2. Remove the bolts and connector shown in the figure and set the PCM component aside with the PCM connector connected.

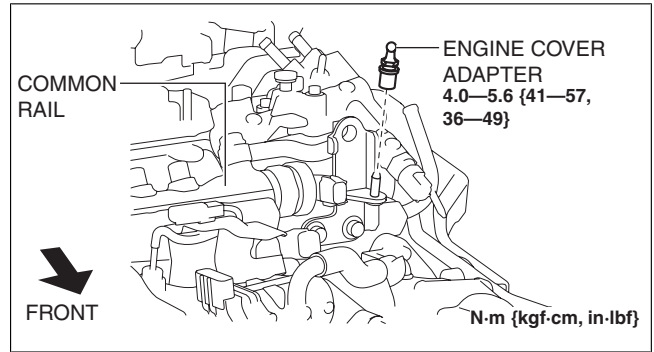


3. Set the connector and cooler hose shown in the figure aside and remove the wiring harness bracket.





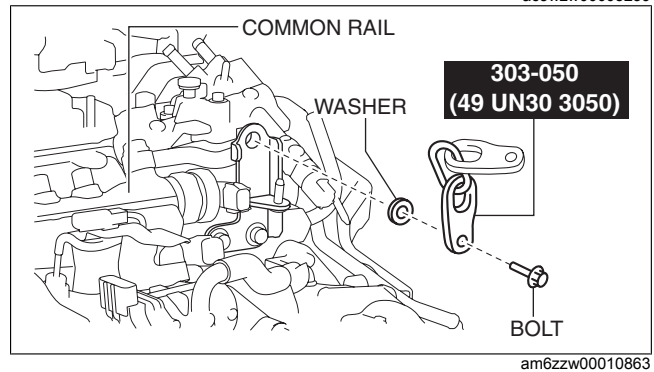
4. Remove the engine cover adapter shown in the figure.



5. Install the SST to the position shown in the figure using the following bolt and washer.

**Bolt:** part number 99794 1025 or an M10 x 1.25, length 25 mm {0.98 in}  
**Washer:** approx. 3 mm {0.1 in} thickness

**Tightening torque**  
38—51 N·m {3.9—5.2 kgf·m, 29—37 ft·lbf}



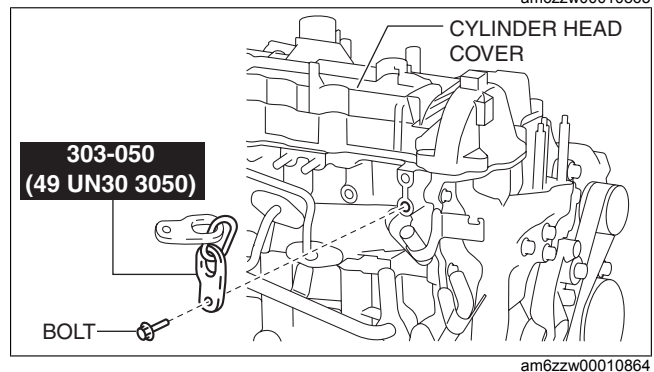
6. Install the SST to the position shown in the figure using the following bolt.

**Bolt:** part number 99794 1025 or an M10 x 1.25, length 25 mm {0.98 in}

**Tightening torque**  
38—51 N·m {3.9—5.2 kgf·m, 29—37 ft·lbf}

**Caution**

- Slots have been adopted for the No.3 engine mount installation holes. If the No.3 engine mount is deviated from the original position when installing the No.3 engine mount, engine noise or vibration could increase. Before removing the No.3 engine mount, place alignment marks on the No.3 engine mount and body so that they can be assembled to the same positions as before removal.

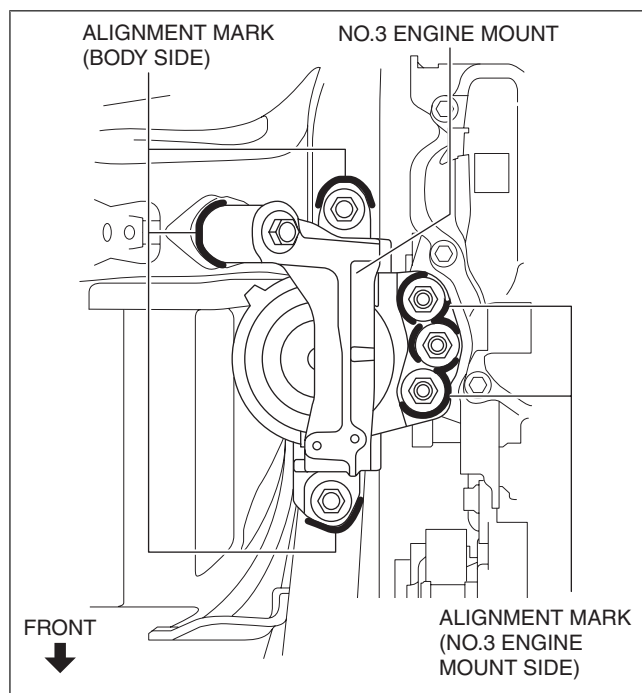




7. Place alignment marks on the locations shown in the figure so that they can be assembled to the same positions as before removal.

**Note**

- Paint so that the No.3 engine mount is framed on the body side and the outline of the nut is framed on the No.3 engine mount side.



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8. Install the **SST** using the following procedures.

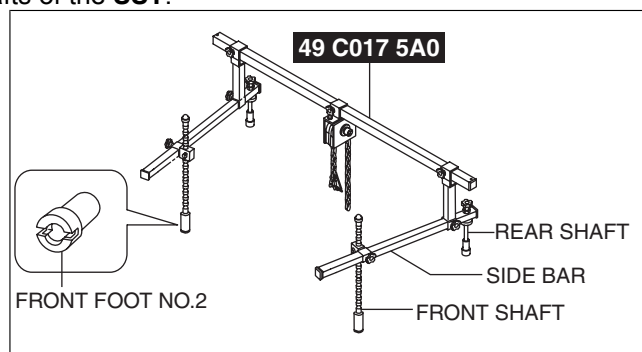
**Caution**

- Refer to the **SST** instruction manual for the basic handling procedure.

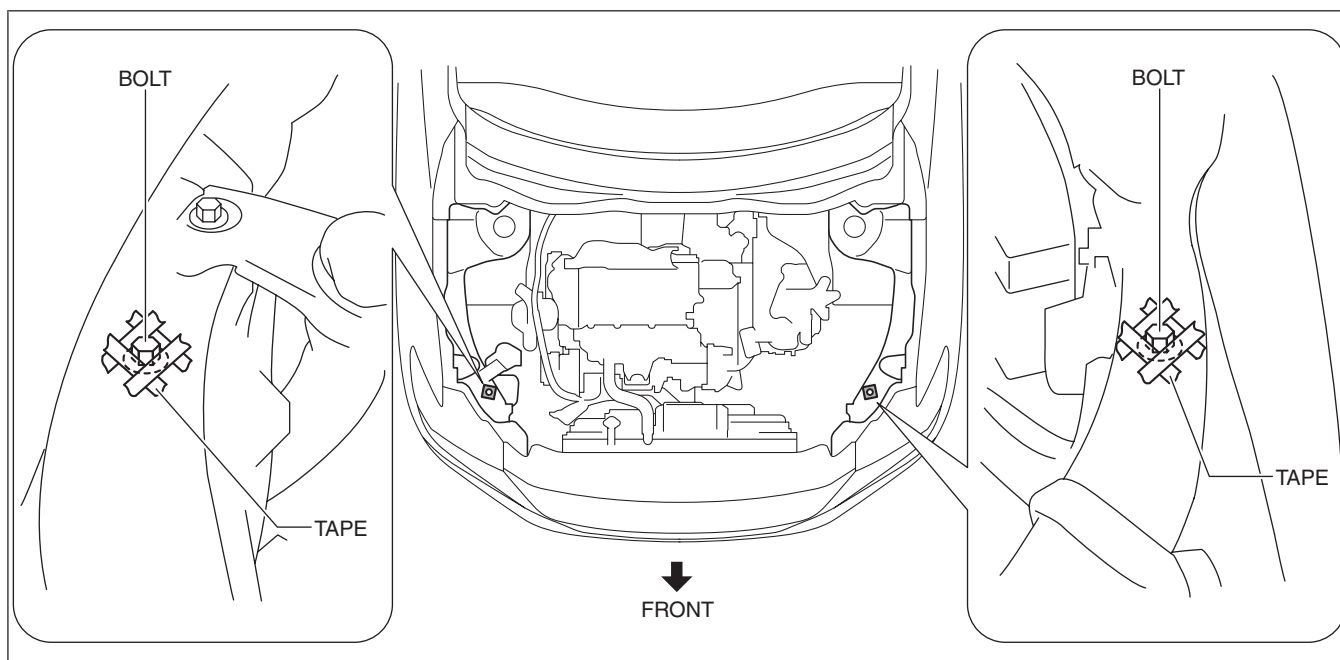
**Note**

- Install front feet No. 2 to the left and right front shafts of the **SST**.

- (1) Protect the positions shown in the figure using tape.

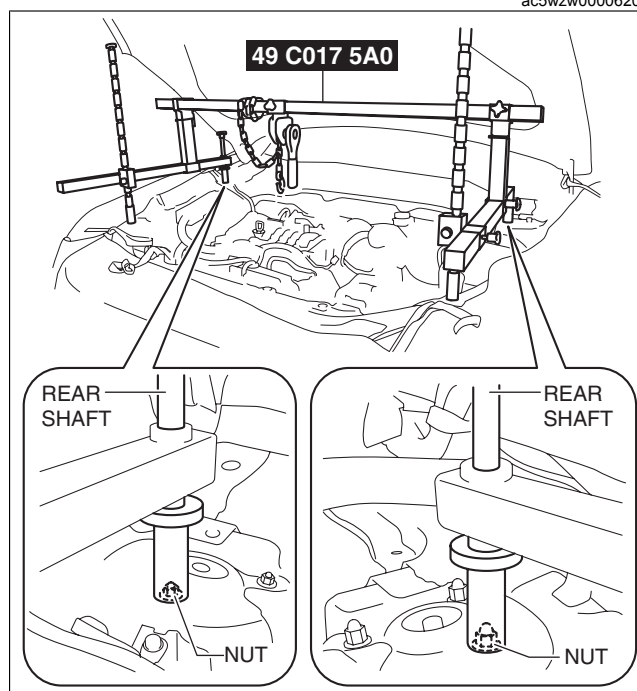


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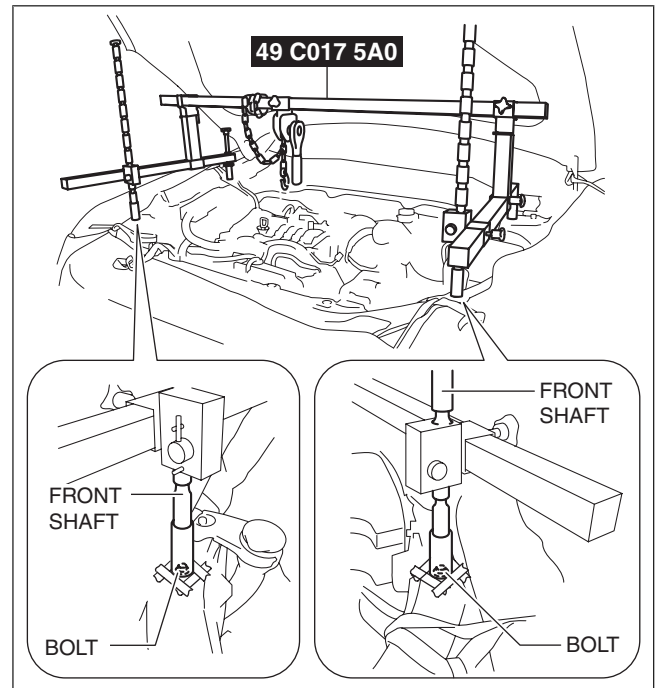
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- (2) As shown in the figure, set the rear shafts of the **SST** to the left and right shock absorber nuts.



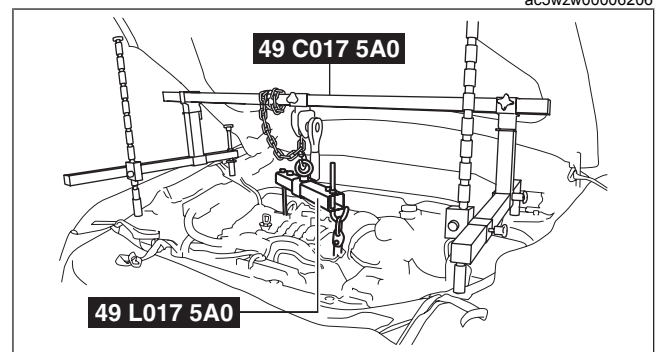
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- (3) As shown in the figure, set the front shafts of the SST to the left and right bolts.



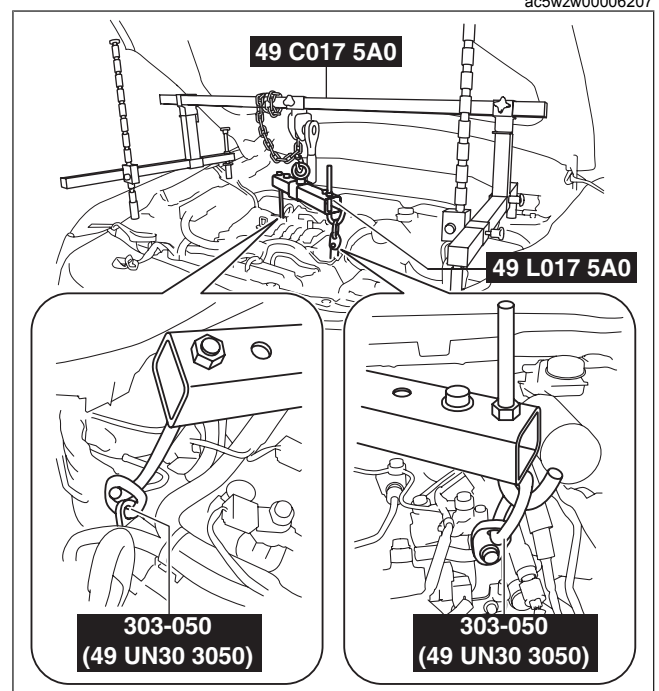
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- (4) Adjust the height of the left and right side bars of the **SST** so that they are leveled, then tighten each part.



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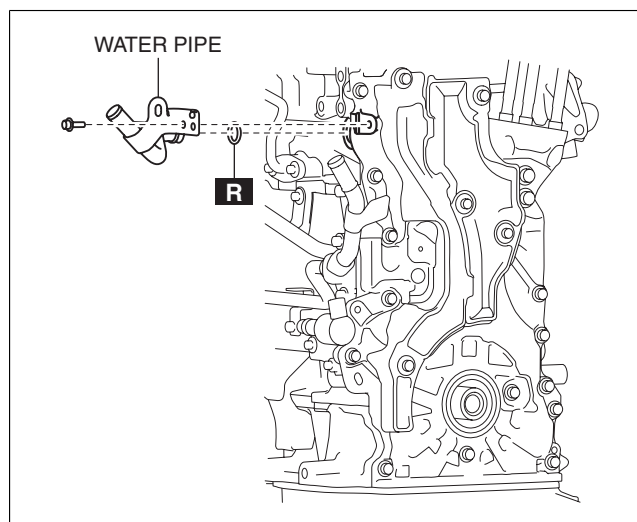
- (5) Install the SST (49 L017 5A0) to the SST (49 UN30 3050) with the hook of the SST (49 L017 5A0) facing outward.  
 (6) Adjust the height of the left and right side bars so that they are leveled, then tighten each part of the SST.  
 (7) Apply tension to the chain to secure the engine.  
 9. Remove the No.3 engine mount.



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### Water pipe removal note

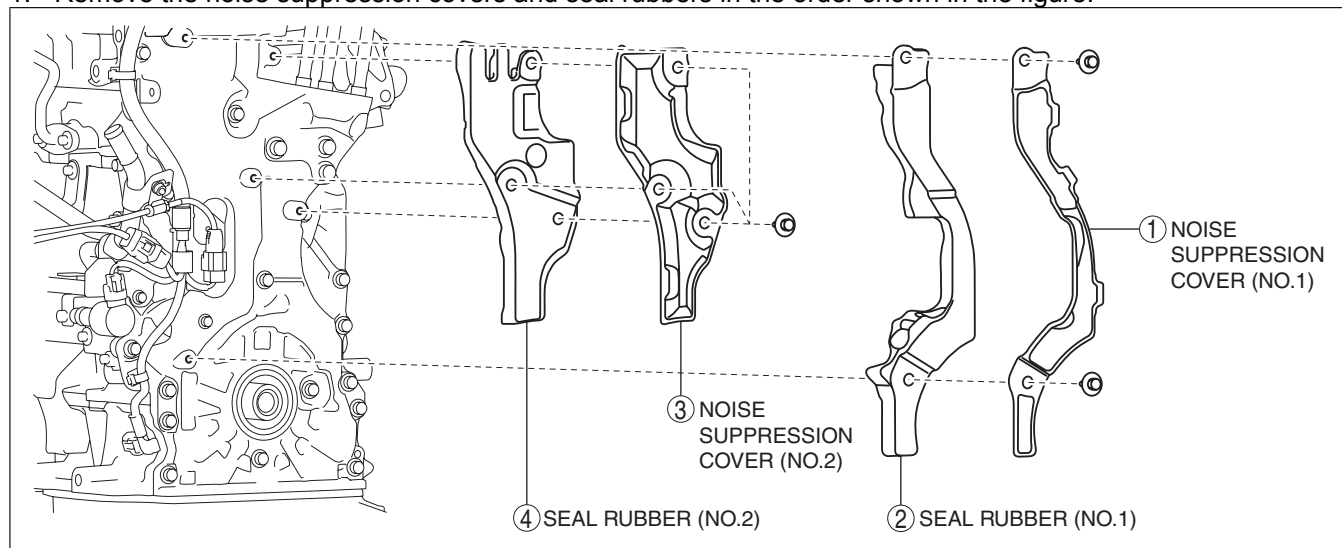
1. Remove the water pipe with the water hose connected and set it aside out of the way.



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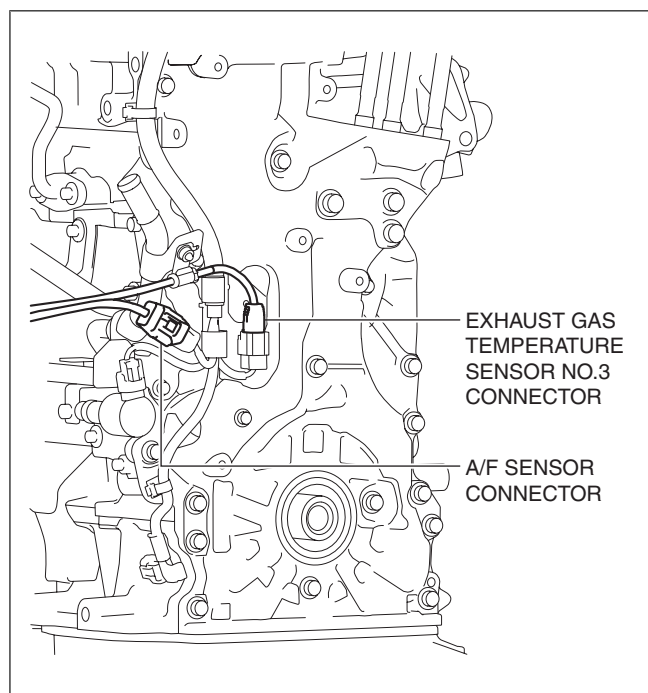
### Noise suppression cover (No.1), noise suppression cover (No.2), seal rubber removal note

1. Remove the noise suppression covers and seal rubbers in the order shown in the figure.



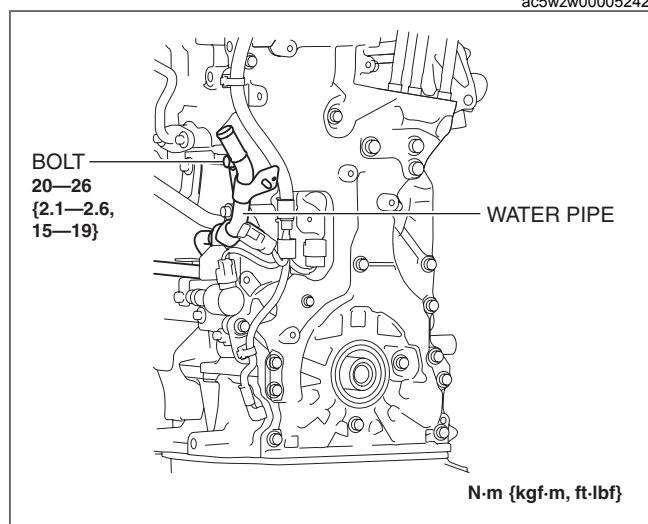
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2. Remove the connectors shown in the figure and set the wiring harness aside.



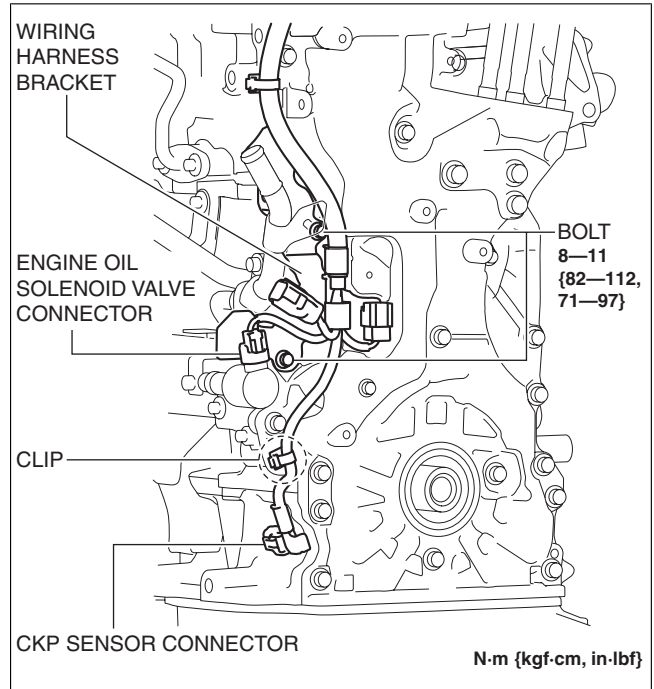
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3. Remove the water pipe installation bolt shown in the figure.

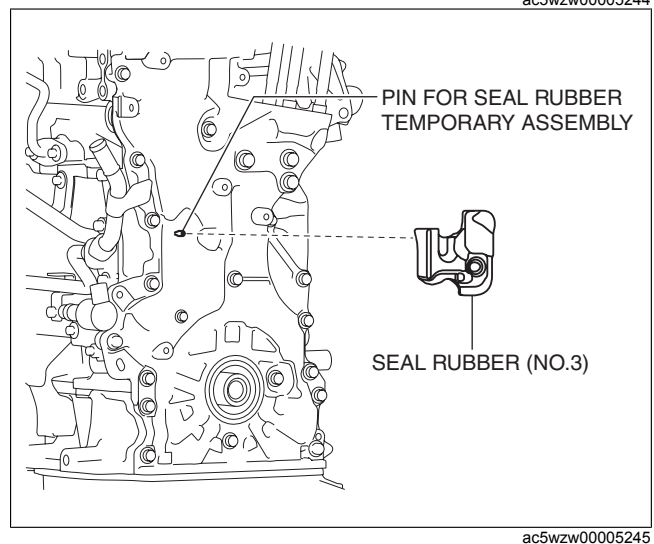


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4. Remove the connectors, clip, and bolts shown in the figure and set the wiring harness and wiring harness bracket aside.



5. Remove the seal rubber (No.3) shown in the figure.

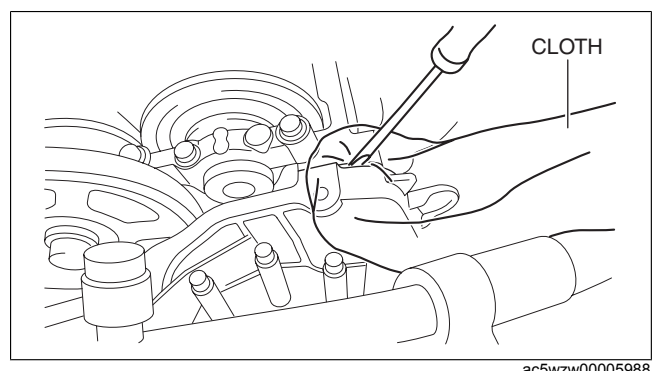


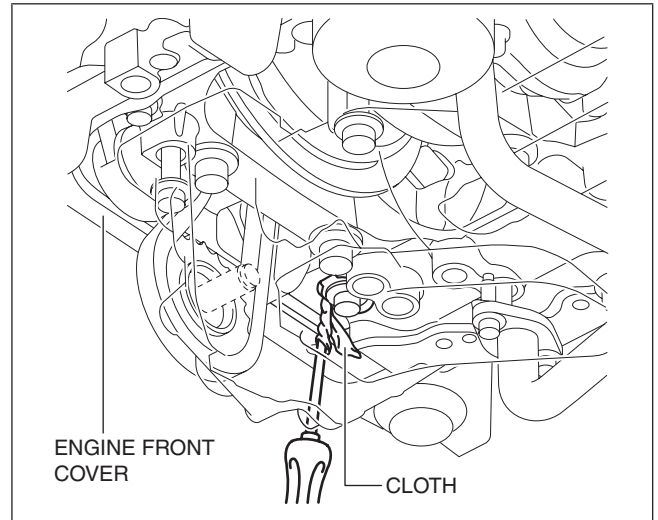
#### Engine front cover removal note

1. Remove the engine front cover installation bolt.
2. Using a screwdriver wrapped in a rag, peel the sealant away a little at a time, and remove the engine front cover.

#### Caution

- Do not apply excessive force to the screwdriver. Otherwise, the engine front cover could be damaged.
- Be careful not to scratch or damage the seal surface. Otherwise, it could cause oil leakage.

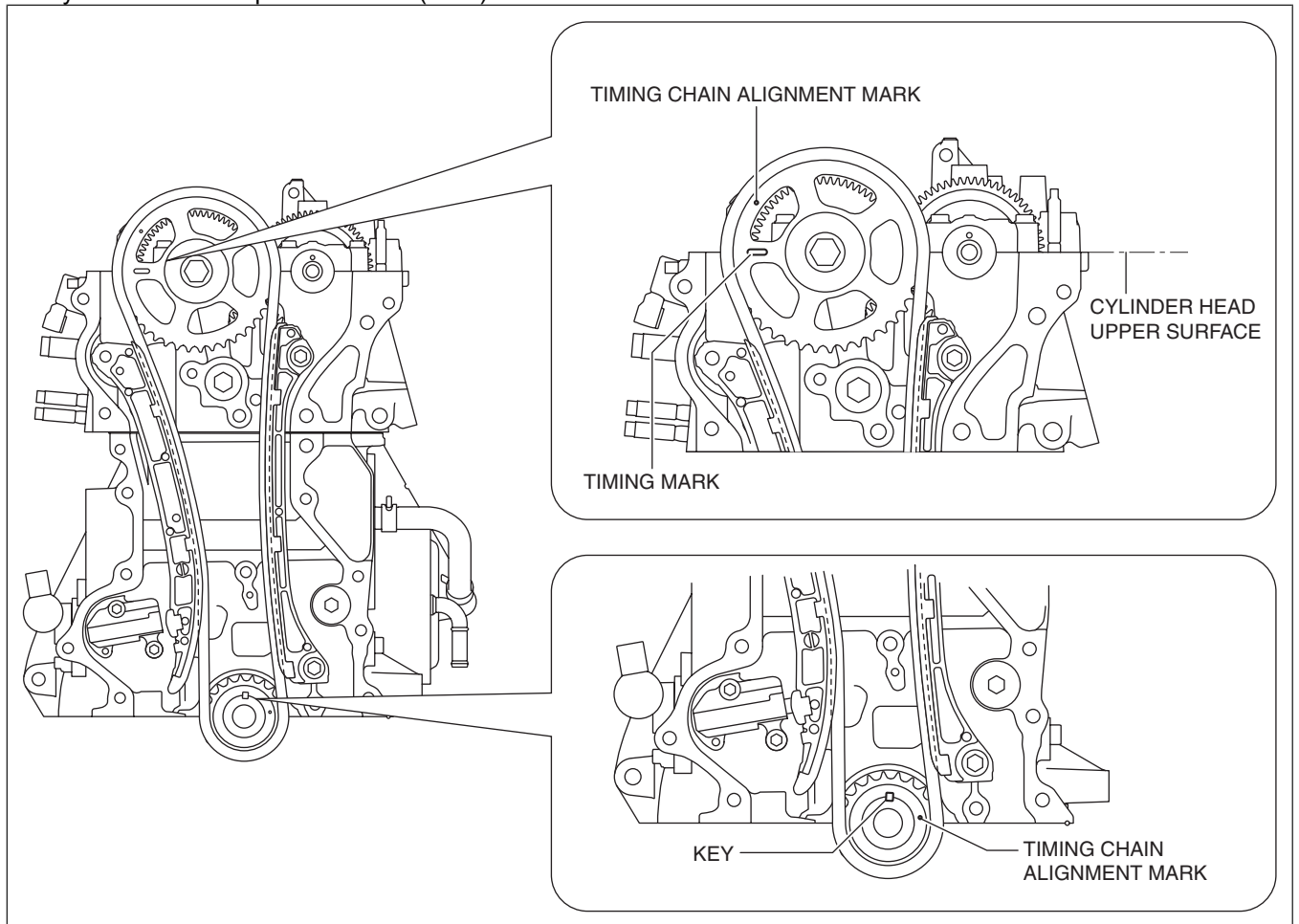




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### Timing chain removal note

1. Rotate the crankshaft clockwise to adjust the timing marks and the key position as shown in the figure, and set cylinder No.1 at top dead center (TDC).

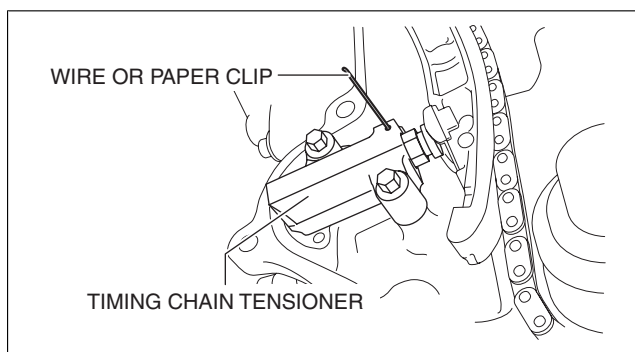


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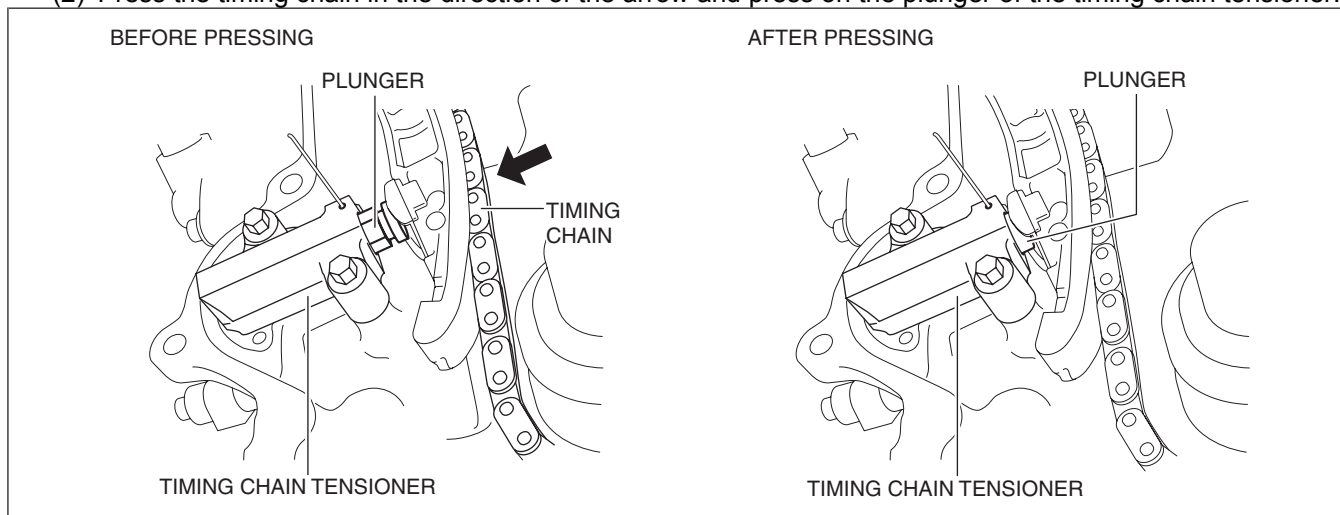
2. Loosen the timing chain tensioner using the following procedure:



- (1) Insert a wire with an approx. diameter of **1.4 mm {0.055 in}** or a paper clip into the body hole of the timing chain tensioner.



- (2) Press the timing chain in the direction of the arrow and press on the plunger of the timing chain tensioner.

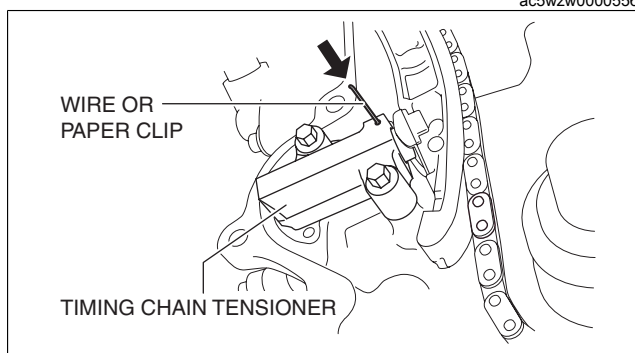


- (3) Press the wire or paper clip set in Step 1 further with the plunger pressed.

**Note**

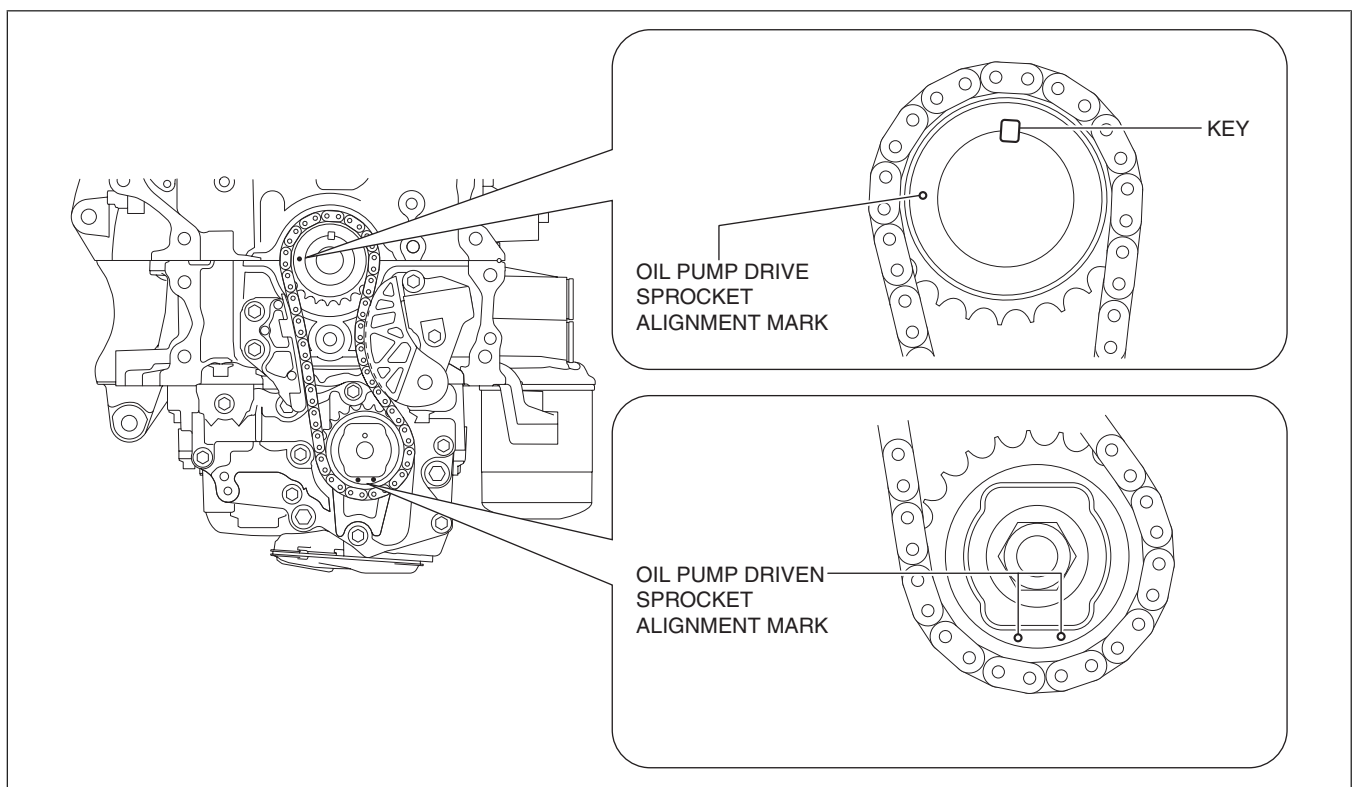
- The wire or paper clip secures the plunger, and the tension can be released.

3. Remove the timing chain tensioner and timing chain tensioner arm.
4. Remove the timing chain guide.
5. Remove the timing chain and crankshaft sprocket as a single unit.



**Oil pump chain removal note**

1. Verify that the oil pump driven sprocket alignment marks and key are aligned to the positions shown in the figure.



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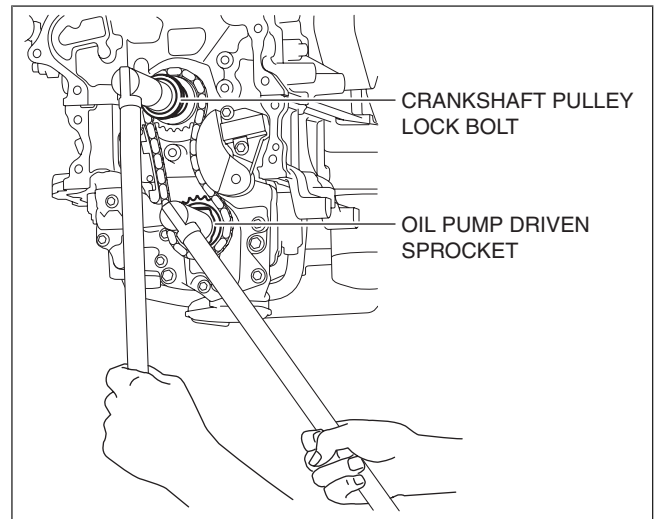
**Note**

- If they are not in the positions shown in the figure, rotate the crankshaft to set cylinder No.1 to top dead center (TDC).

2. Temporarily assemble the crankshaft pulley lock bolt, and lock the oil pump against rotation as shown in the figure.
3. Slightly loosen the oil pump driven sprocket installation bolt.

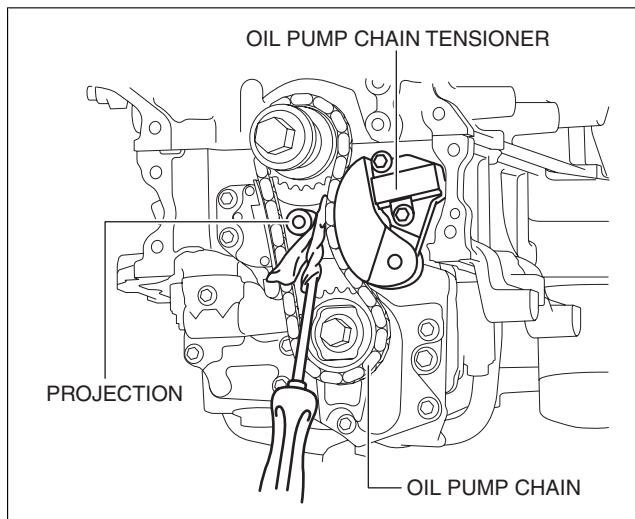
**Note**

- At this stage, only loosen the oil pump driven sprocket installation bolt, do not remove it. Remove the bolt after removing the oil pump chain tensioner.



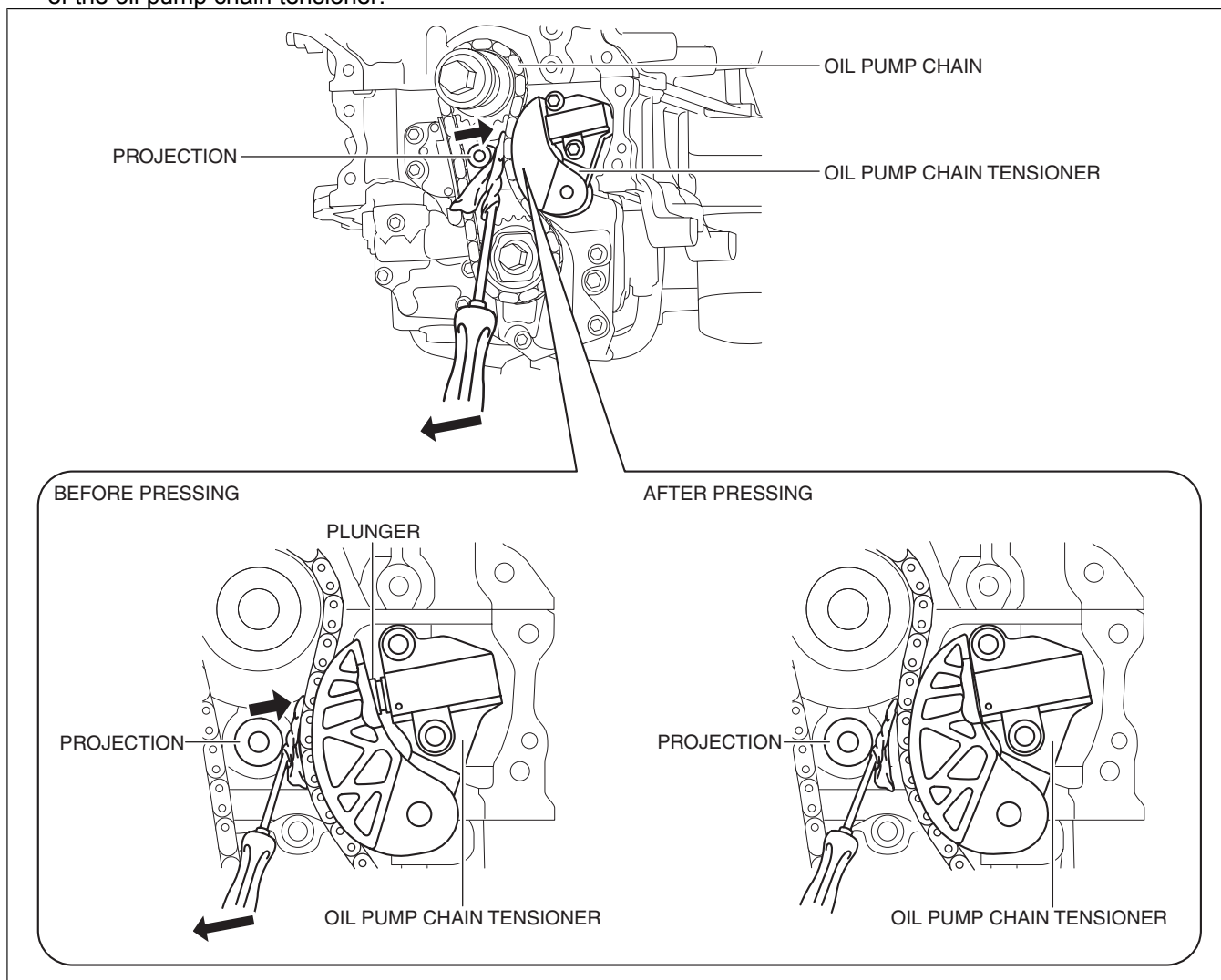
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4. Set a cloth wrapped flathead screwdriver in the gap between the lower cylinder block projection and the oil pump chain as shown in the figure.



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5. Move the screwdriver in the direction of the arrow and press the oil pump chain, and then press on the plunger of the oil pump chain tensioner.



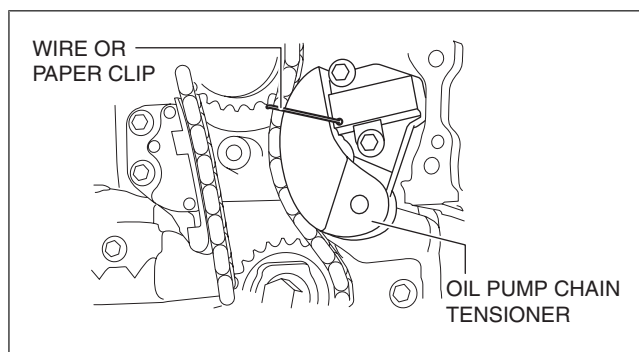
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6. Insert a wire with an approx. diameter of **1.4 mm {0.055 in}** or a paper clip into the body hole of the oil pump chain tensioner with the plunger pressed.

**Note**

- The wire or paper clip secures the plunger, and the tension can be released.

7. Remove the oil pump chain tensioner.
8. Remove the oil pump chain and oil pump driven sprocket as a single unit.
9. Remove the temporarily assembled crankshaft pulley lock bolt.



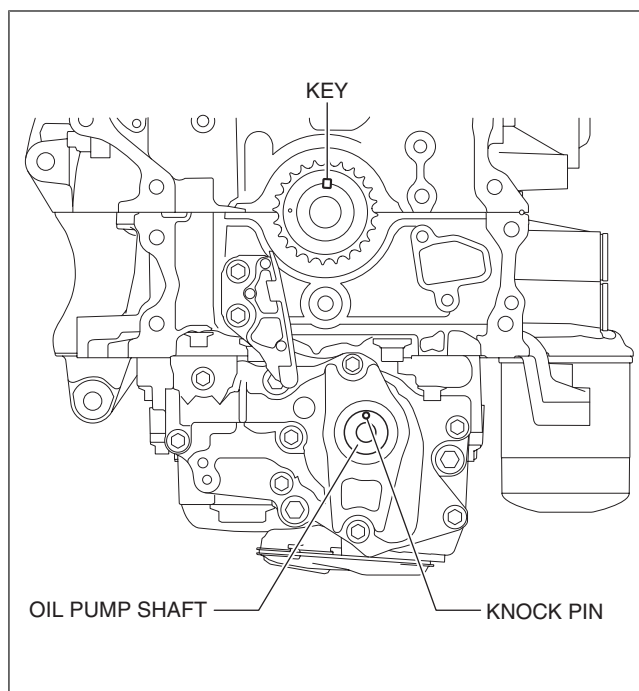
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**Oil pump chain installation note**

1. Verify that the key and knock pin are aligned to the positions shown in the figure.
  - If they are not in the positions shown in the figure, rotate the crankshaft and balancer shaft (No.1) to set cylinder No.1 to top dead center (TDC).

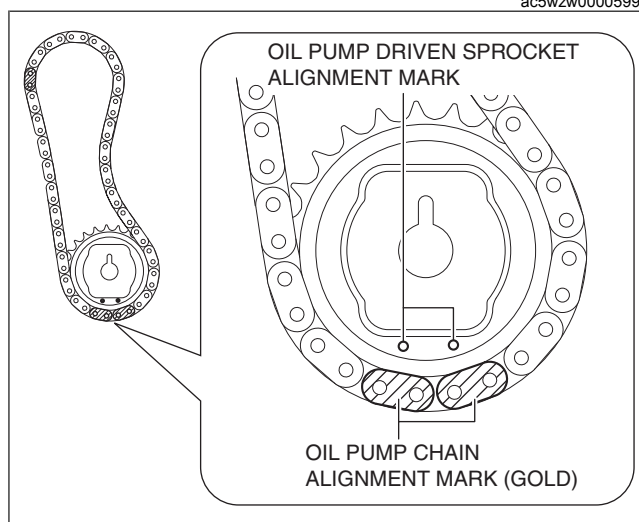
**Note**

- When rotating the balancer shaft (No.1), temporarily assemble the oil pump driven sprocket and rotate while holding the sprocket with a hand.



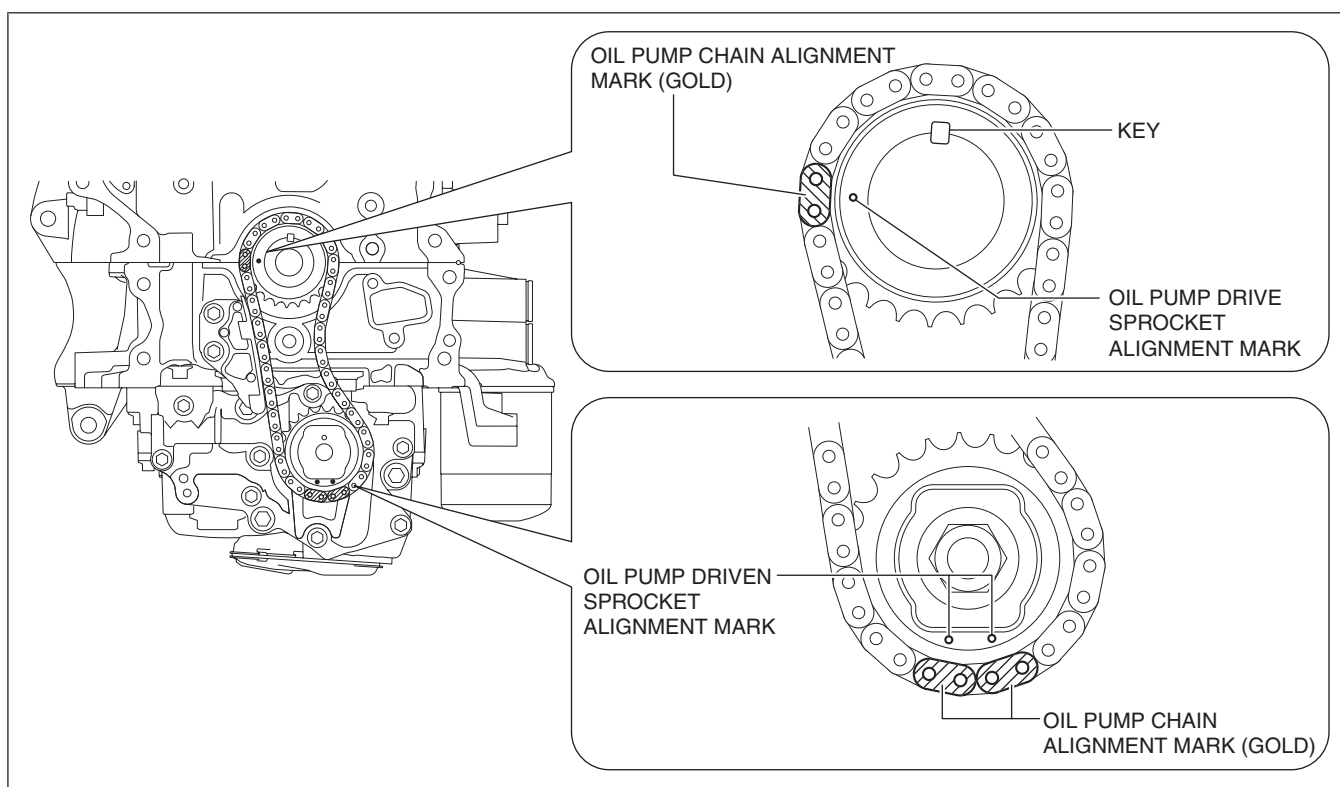
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2. Align the oil pump chain alignment marks with the oil pump driven sprocket alignment marks.



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3. Install the oil pump chain and oil pump driven sprocket as a single unit while aligning the alignment marks on each sprocket and oil pump chain as shown in the figure.



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4. Temporarily tighten the oil pump driven sprocket installation bolt.
5. Install the oil pump chain tensioner.

#### Caution

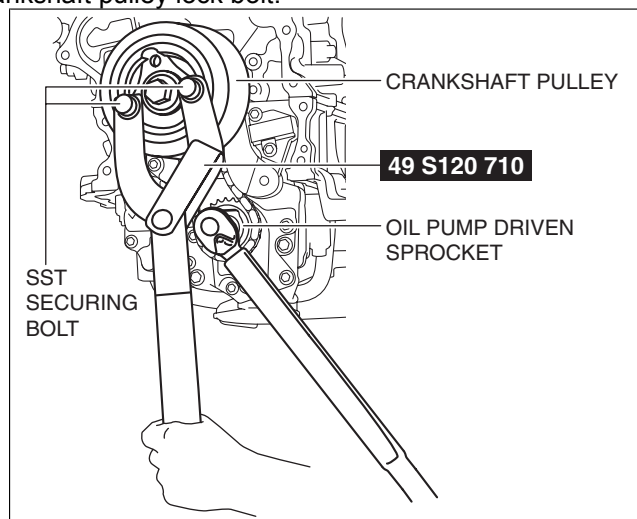
- At this stage, do not remove the wire or paper clip installed to the oil pump chain tensioner.

6. Tighten the oil pump driven sprocket installation bolt using the following procedure:
  - (1) Temporarily assemble the crankshaft pulley and crankshaft pulley lock bolt.
  - (2) Install the SST shown in the figure and lock the oil pump against rotation. (See FRONT OIL SEAL REPLACEMENT [SKYACTIV-D 2.2].)
  - (3) Tighten the oil pump driven sprocket installation bolt.

#### Tightening torque

**123—140 N·m {13—14 kgf·m, 91—103 ft·lbf}**

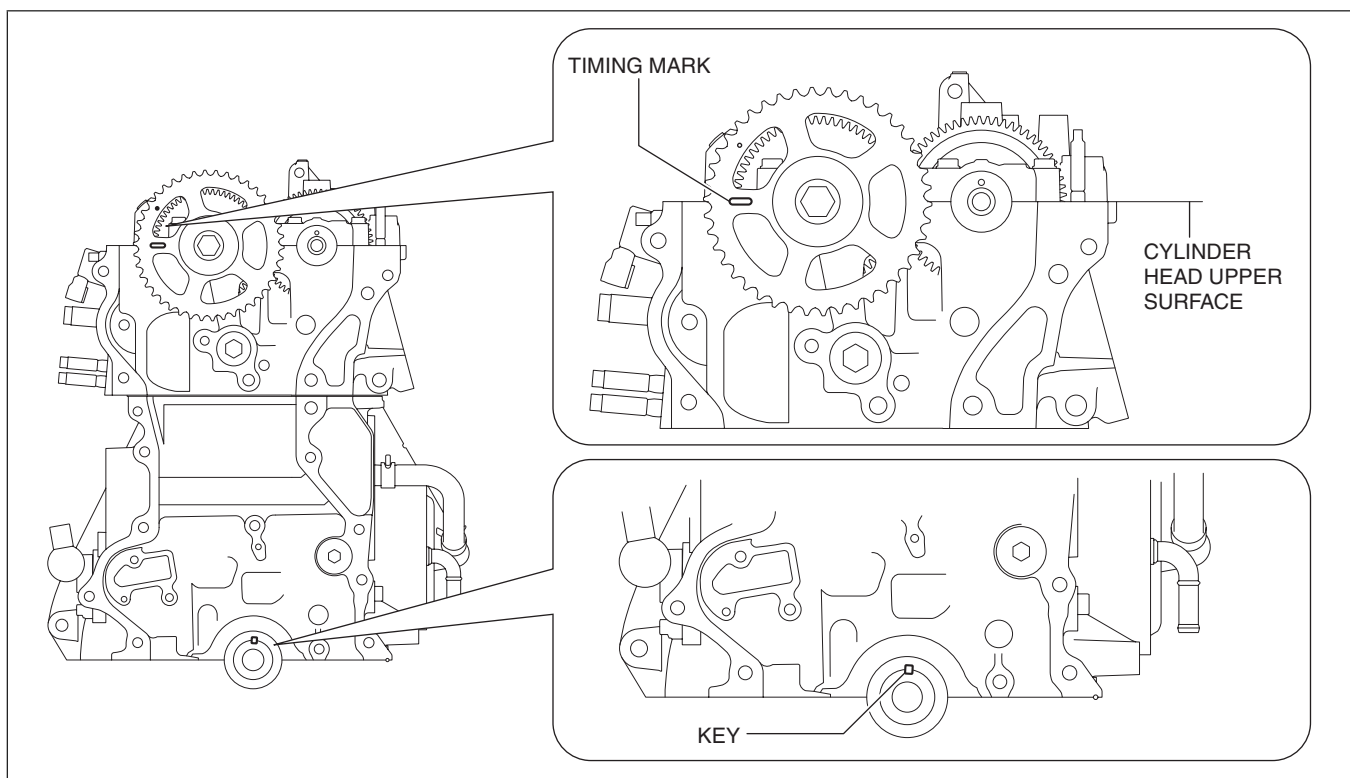
7. Remove the temporarily assembled crankshaft pulley and crankshaft pulley lock bolt.
8. Remove the wire or paper clip installed to the oil pump chain tensioner and apply tension to the oil pump chain.
  - If a new oil pump chain tensioner is used, remove the installed stopper.



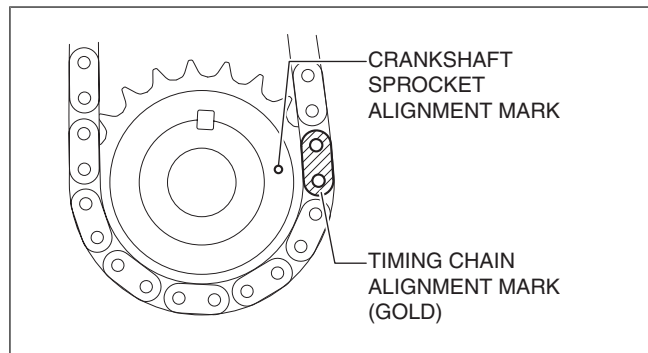
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#### Timing chain installation note

1. Verify that the timing marks and the key are aligned to the position shown in the figure.

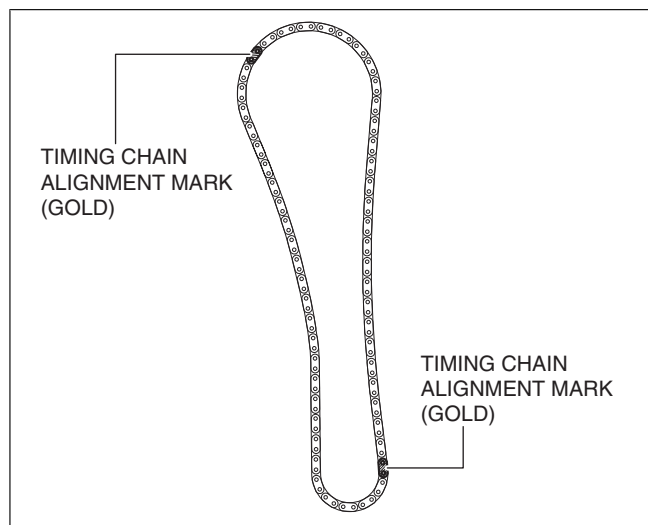


- If they are not in the positions shown in the figure, rotate the camshaft and crankshaft to set the cylinder No. 1 top dead center (TDC).
2. Align the timing chain alignment mark with the crankshaft sprocket alignment mark.

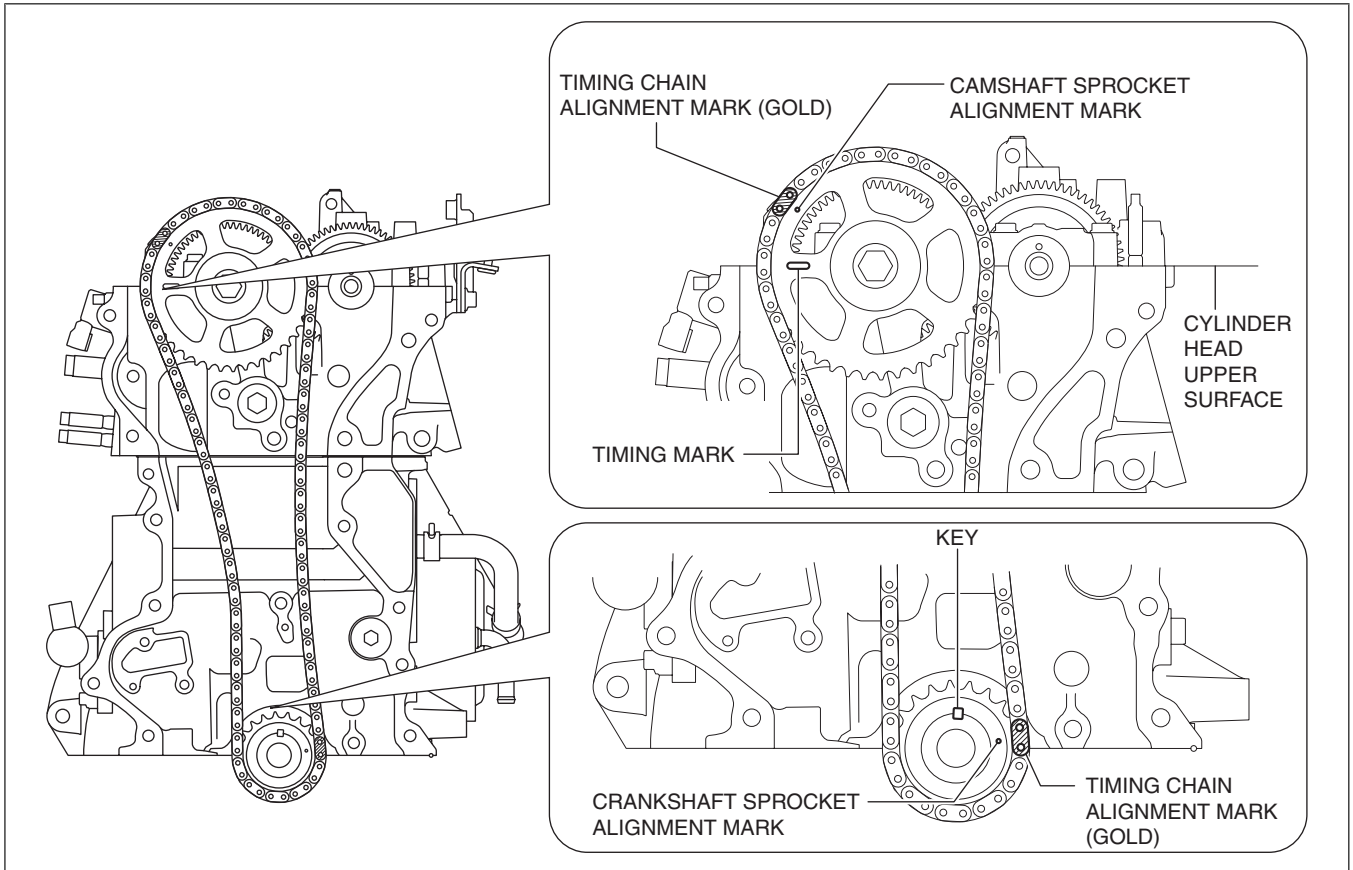


#### Note

- There are two timing chain alignment marks as shown in the figure. When assembling the timing chain and crankshaft sprocket, either timing chain alignment mark can be used.

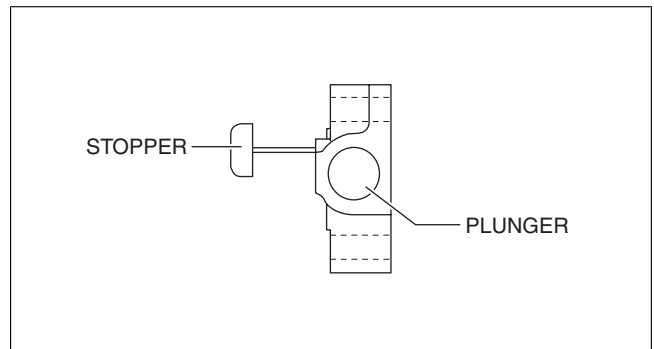


3. Install the timing chain and crankshaft sprocket as a single unit while aligning the marks on each sprocket and the timing chain as shown in the figure.



ac5wzw00005995

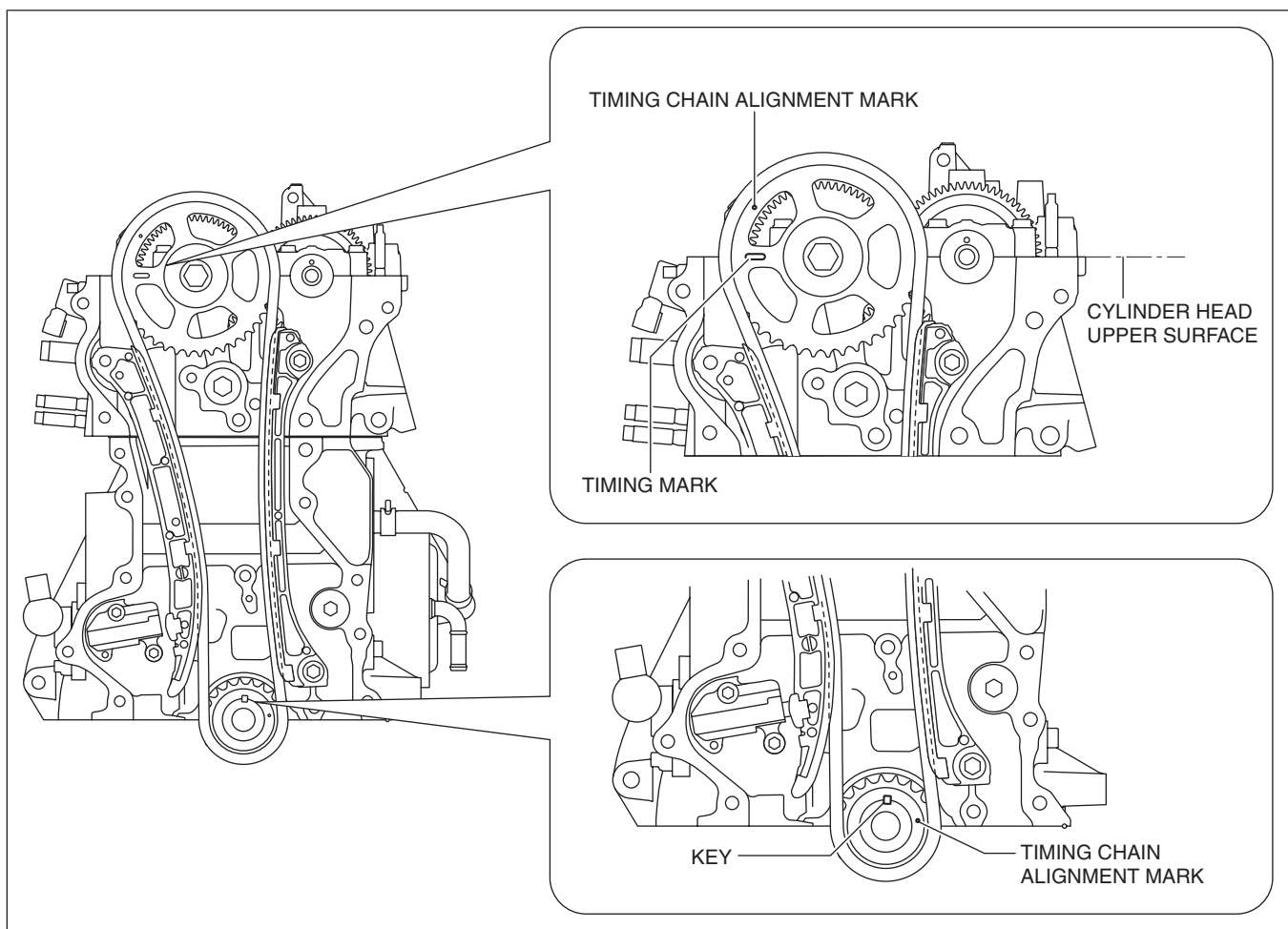
4. Install the timing chain guide.
5. Install the timing chain tensioner arm.
6. Install the timing chain tensioner.
7. After installing the timing chain tensioner, remove the installed wire or paper clip, and then apply tension to the timing chain.
  - If a new chain tensioner is used, remove the installed stopper.
8. Verify that there is no looseness in the timing chain, and re-verify that each sprocket is in the specified location.



ac5wzw00005996

9. Rotate the crankshaft clockwise two turns and inspect the valve timing.



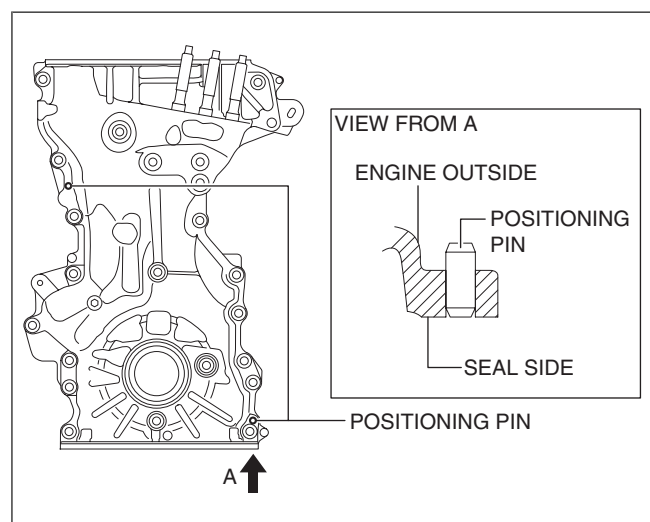


ac5wzw00005990

## Engine front cover installation note

### Note

- For a new engine front cover, the positioning pins in the two locations shown in the figure project to the outside of the engine.

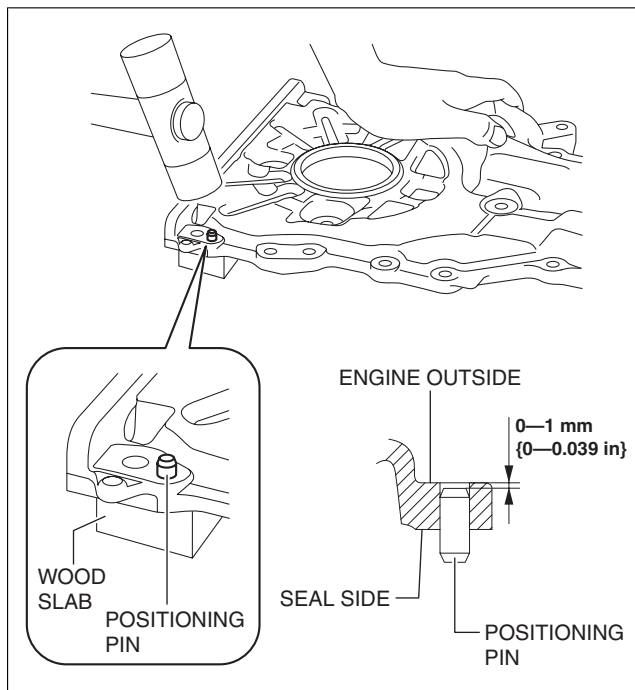


ac5wzw00005997

1. If the engine front cover is newly replaced, tap the positioning pins in the two locations to the seal surface side.
2. Completely clean and remove any oil, dirt, sealant or other foreign matter that may be adhering to the engine front cover, cylinder head, and cylinder block.
3. When reusing an engine front cover installation bolts, remove sealant adhering to the bolts.

**Caution**

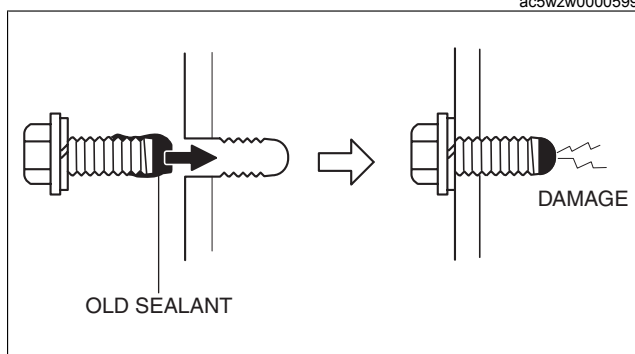
- **Apply the silicon sealant in a single, unbroken line.**
- **To prevent silicone sealant from hardening, adhere the engine front cover and the cylinder block firmly within 10 min. after applying silicone sealant. After adhering them, tighten the installation bolts immediately.**



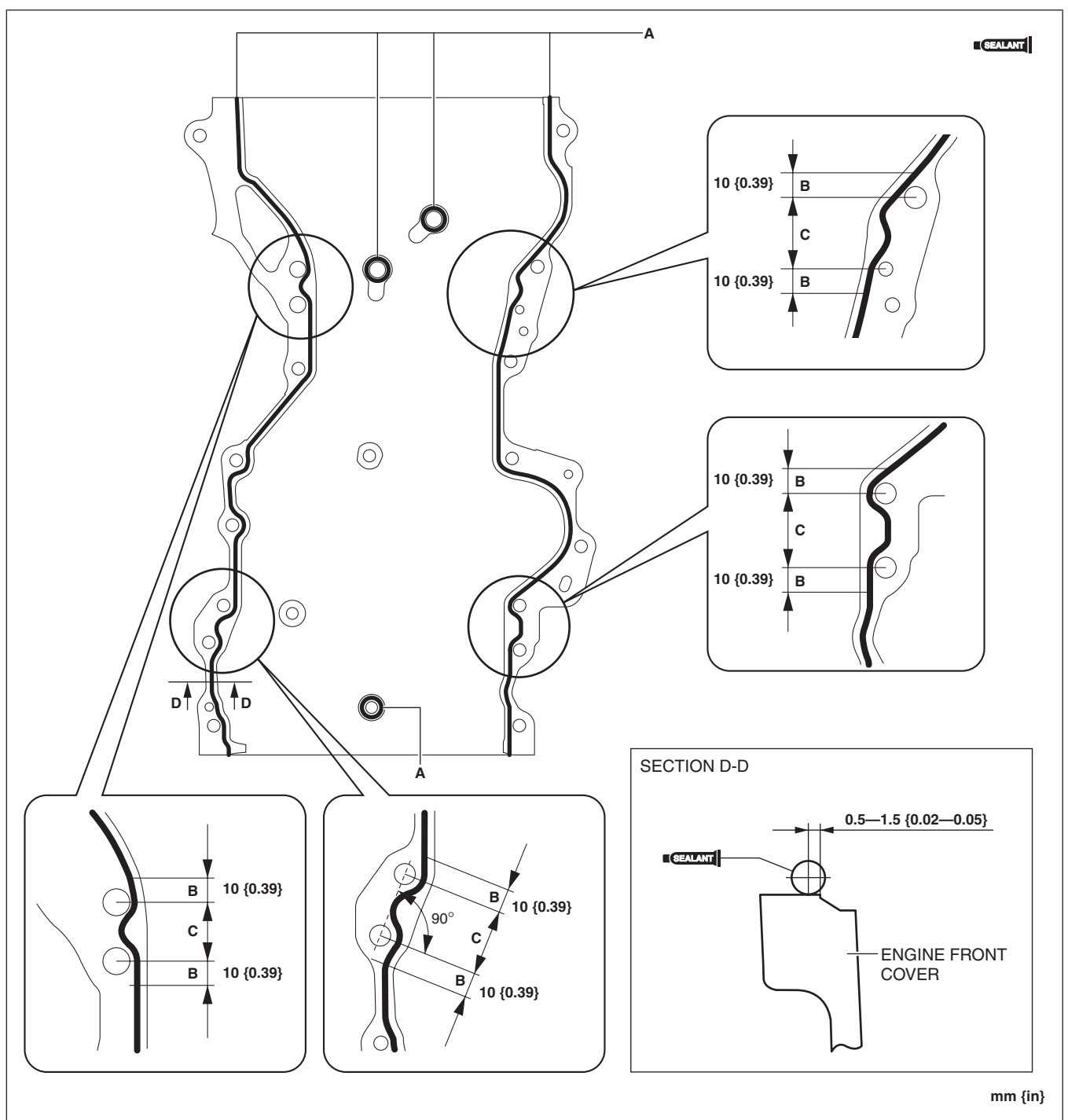
ac5wzw00005998

- **If a bolt with sealant adhering to it is used, it could result in cracks in the cylinder head and cylinder block.**

4. Apply silicone sealant to the engine front cover as shown in the figure.



ac5wzw00005999



ac5wzw00006000

#### Bead thickness

- A: 2—6 mm {0.1—0.2 in}
- B: 4—6 mm {0.16—0.23 in}
- C: 4—8 mm {0.2—0.3 in}

5. Apply silicone sealant to the areas shown in the figure.

**Caution**

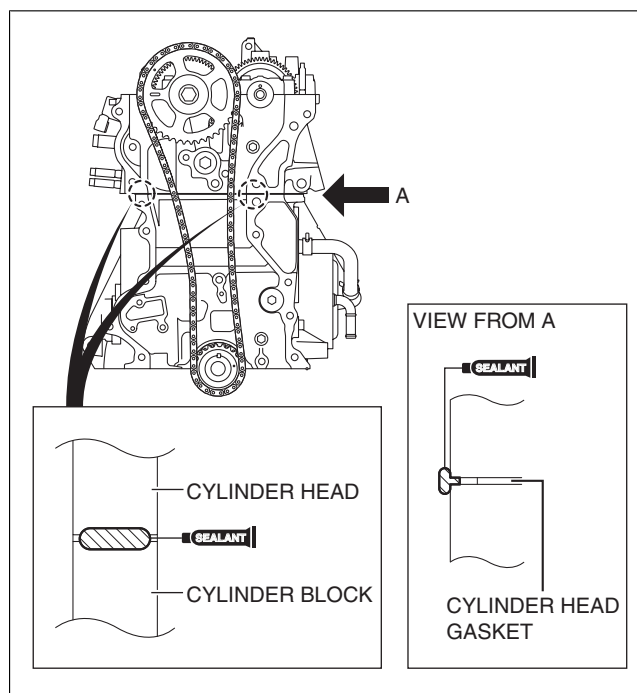
- Apply the silicone sealant so that it goes into the cylinder head gasket.

6. Install the engine front cover to the engine.

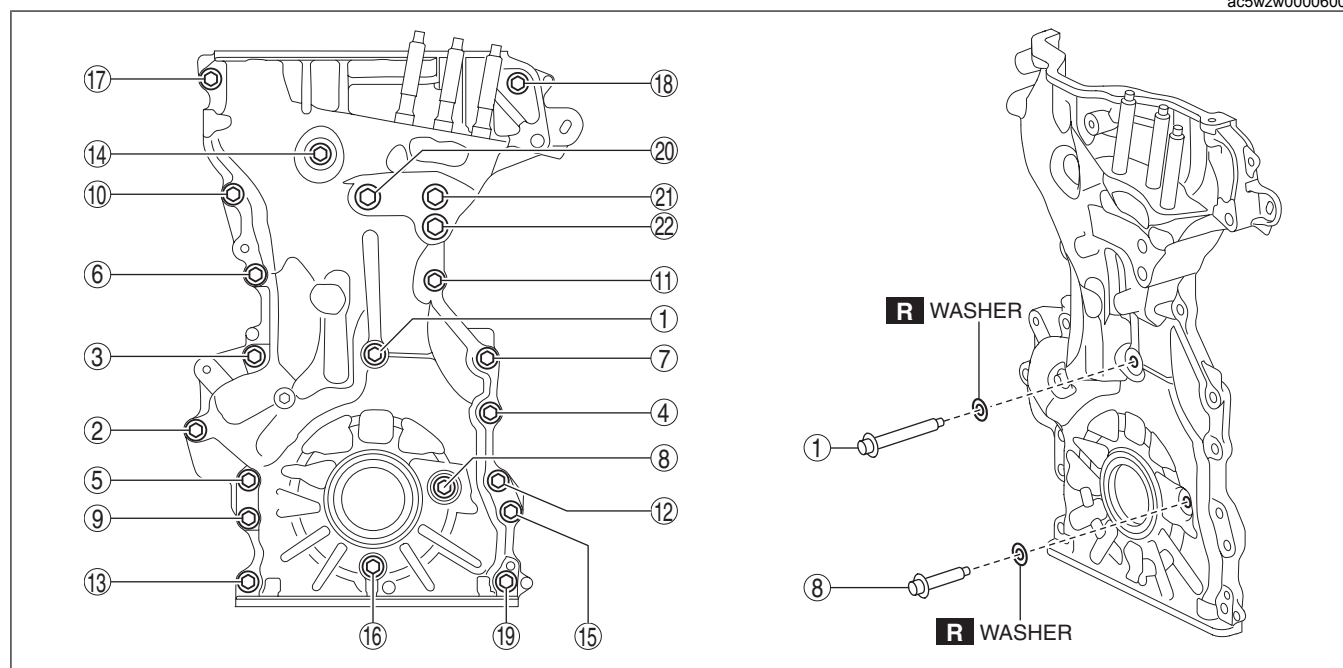
**Caution**

- For the number 1 and 8 bolts of the tightening order, install the bolts with new washers.

7. Tighten the engine front cover installation bolts in the order shown in the figure.



ac5wzw00006001



am6zzw00010108

**Tightening torque**

Installation position	Tightening torque
1—19	20—26 N·m {2.1—2.6 kgf·m, 15—19 ft·lbf}
20—22	40—55 N·m {4.1—5.6 kgf·m, 30—40 ft·lbf}

### Noise suppression cover (No.1), noise suppression cover (No.2), seal rubber installation note

1. Temporarily put the seal rubber (No.3) on the engine front cover.
2. Install the wiring harness and wiring harness bracket.

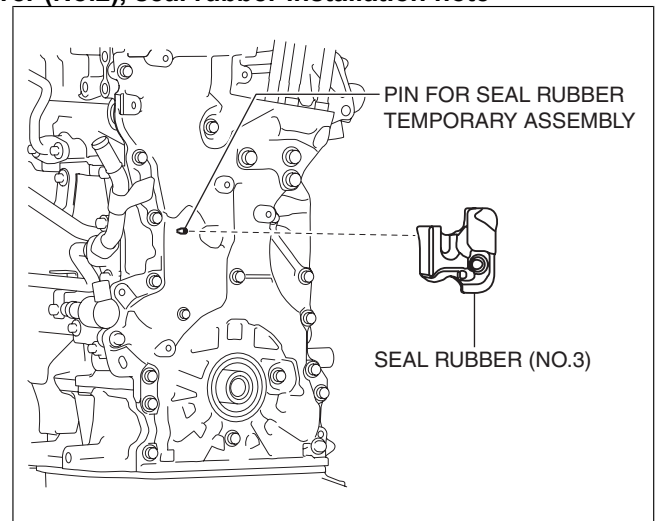
#### Note

- The seal rubber (No.3) can be fixed by installing the wiring harness bracket.

3. Tighten the water pipe installation bolt.
4. Connect the exhaust gas temperature sensor No.3 connector and A/F sensor connector.

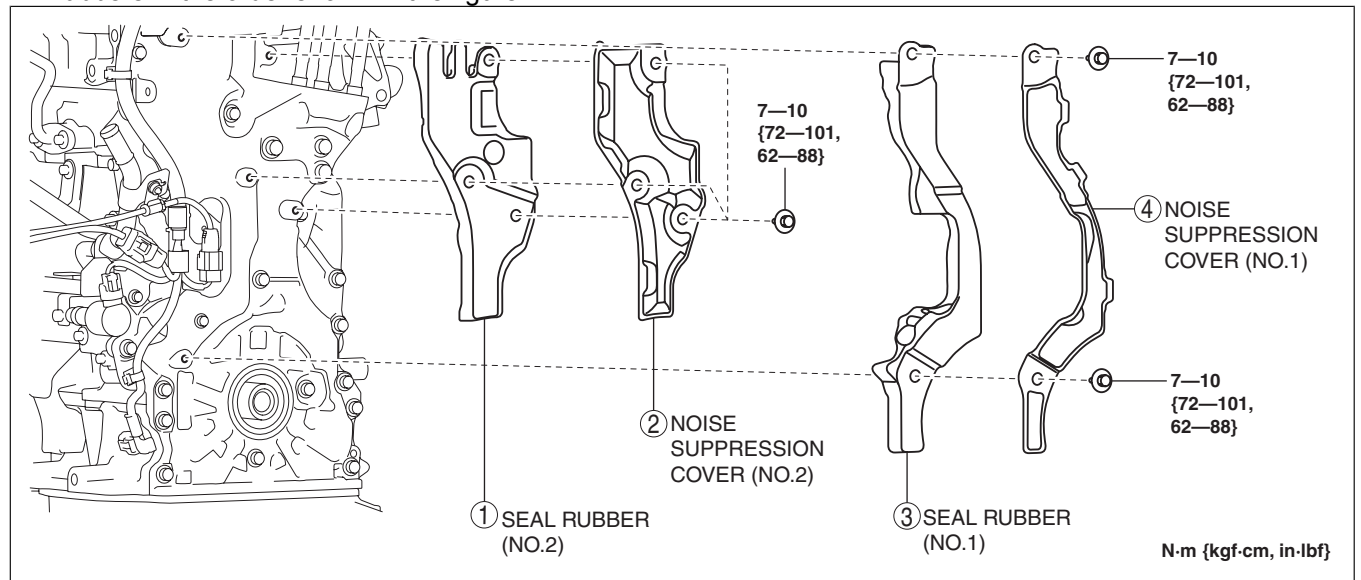
#### Caution

- Be careful that the covers and seal rubbers do not get hung up on the noise suppression cover installation bolts.



ac5wzw00005245

5. Install the noise suppression covers and seal rubbers in the order shown in the figure.



ac5wzw00005253

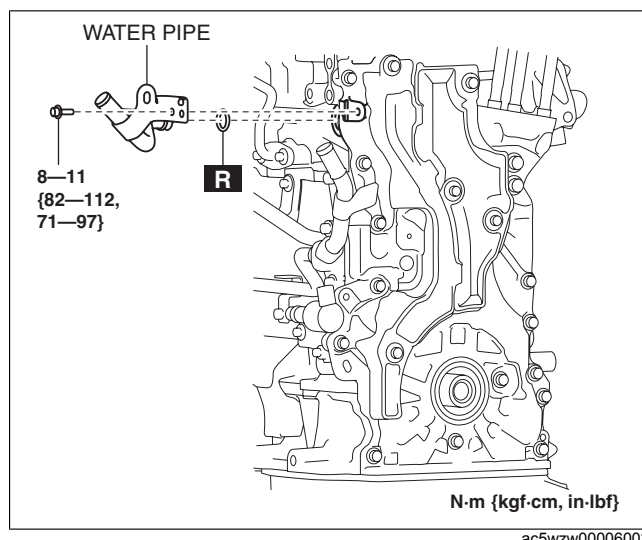
### Water pipe installation note

#### Caution

- Do not apply oil (such as engine oil, ATF) to the O-ring. Otherwise, the O-ring could swell causing a seal malfunction.
- Install the water pipe so as not to damage the O-ring. Otherwise, it could cause a seal malfunction.

1. Install the water pipe following procedure:  
(1) Apply engine coolant to the O-ring.

(2) Install the water pipe.



### No.3 engine mount installation note

#### Caution

- If the No.3 engine mount is deviated from the original position when installing the No.3 engine mount, engine noise or vibration could increase. When installing the No.3 engine mount, align the alignment mark placed during removal and install it to the original position.

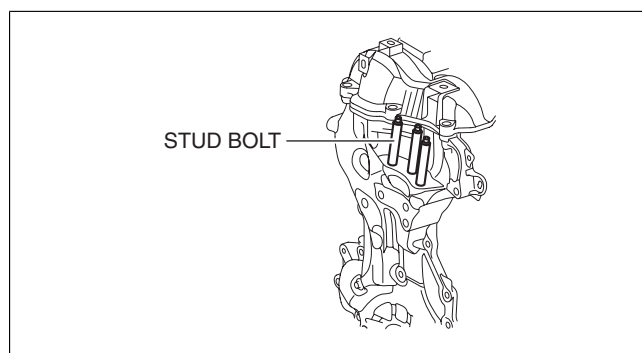
#### Note

- When replacing the No.3 engine mount, place a mark at the same position as the one placed before removal.
- If the No.3 engine mount nut is loosened, tighten the engine front cover stud bolts because they may have loosened.

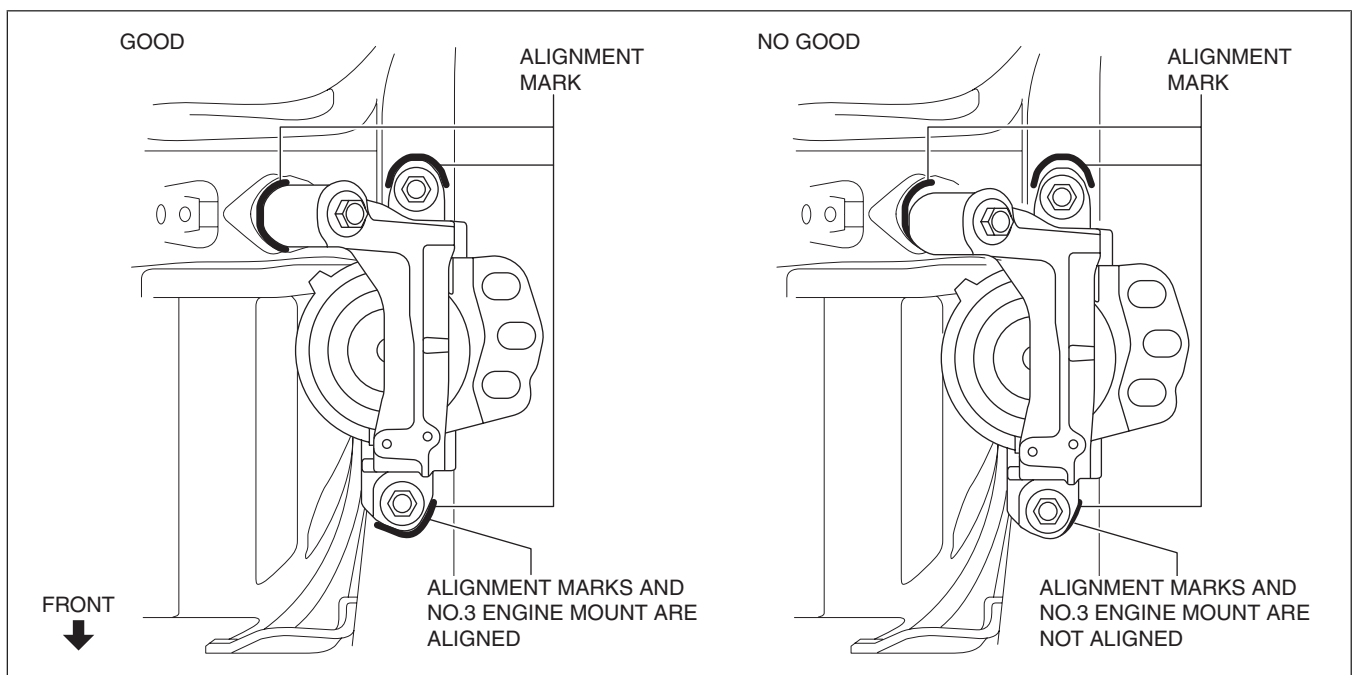
1. Tighten the engine front cover stud bolts.

#### Tightening torque

40—52 N·m {4.1—5.3 kgf·m, 30—38 ft·lbf}

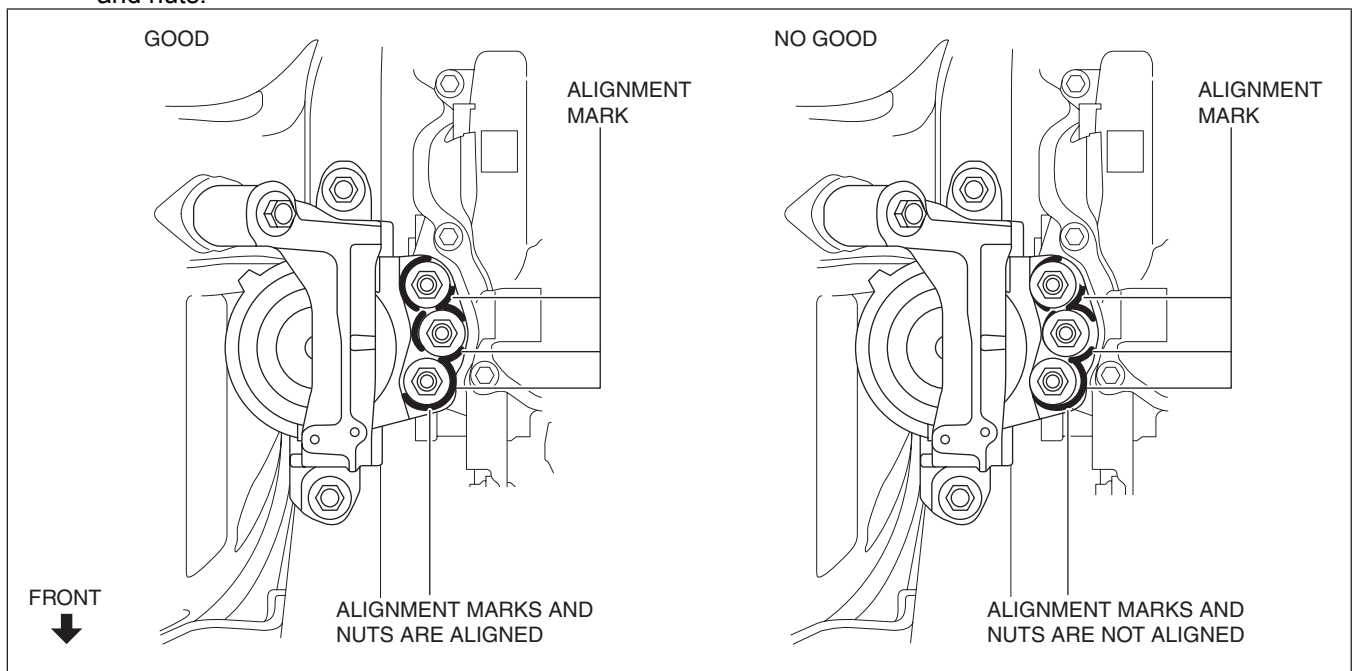


2. Temporarily tighten the No.3 engine mount installation bolts and nuts using the following procedure:
  - (1) Align the alignment marks on the body side and No.3 engine mount, and temporarily tighten the bolts shown in the figure.



ac5wzw00006209

- (2) Temporarily tighten the nuts shown in the figure while aligning the alignment marks of the No.3 engine mount and nuts.



ac5wzw00006210

**Note**

- If the alignment marks are deviated, align the alignment marks while slightly moving the engine and temporarily tighten the nuts.

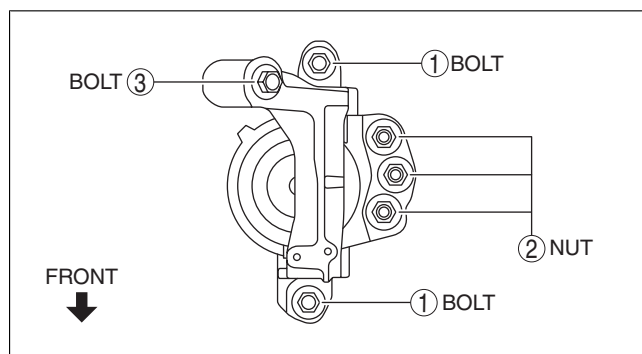


3. Tighten the No.3 engine mount installation bolts and nuts in the order as shown in the figure.

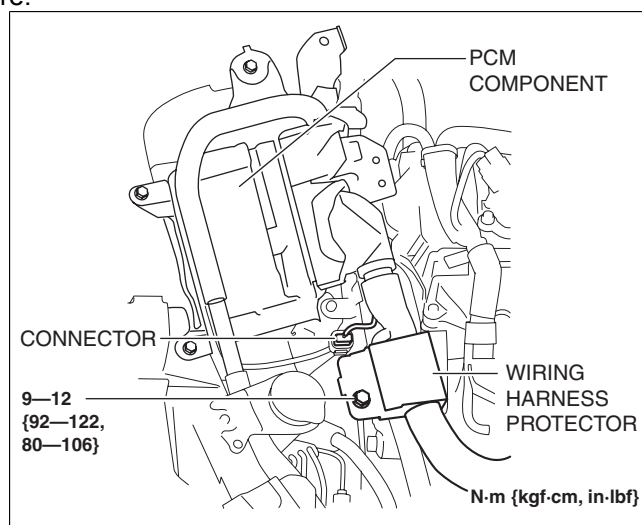
#### Tightening torque

No.	Tightening torque
1	76—95 N·m {7.8—9.6 kgf·m, 57—70 ft·lbf}
2	82—95 N·m {8.4—9.6 kgf·m, 61—70 ft·lbf}
3	49—65 N·m {5.0—6.6 kgf·m, 37—47 ft·lbf}

4. Remove the **SST**.
5. Install the wiring harness bracket, cooler hose and connector.
6. Install the PCM component using the following procedure:
  - (1) Install the wiring harness protector and connector.

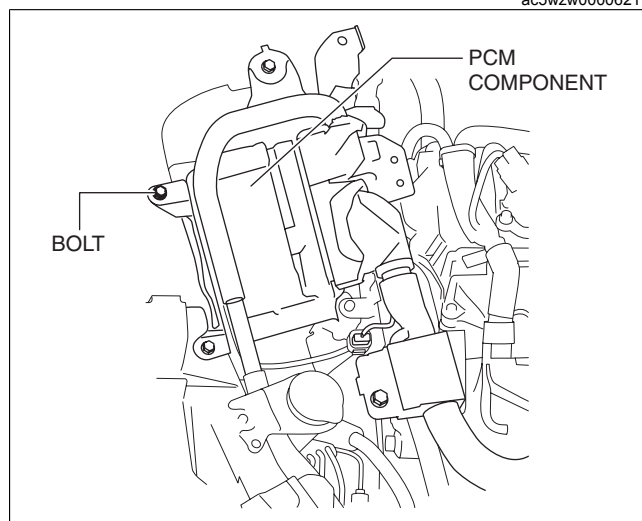


ac5wzw00006005



ac5wzw00006211

- (2) Temporarily tighten the bolt shown in the figure.

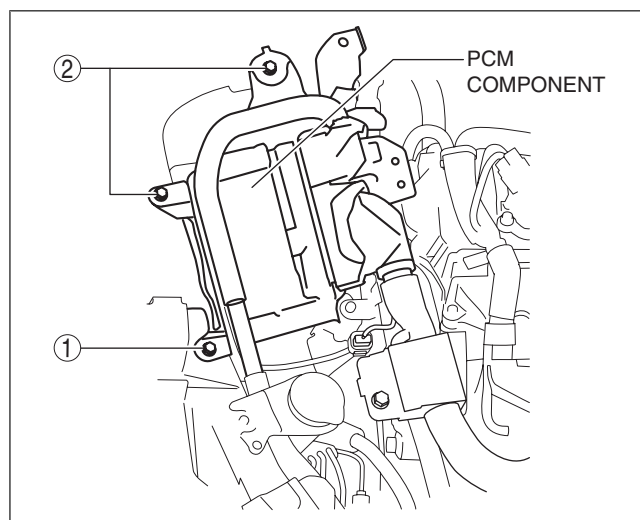


ac5wzw00006007

- (3) Tighten the PCM component installation bolts in the order shown in the figure.

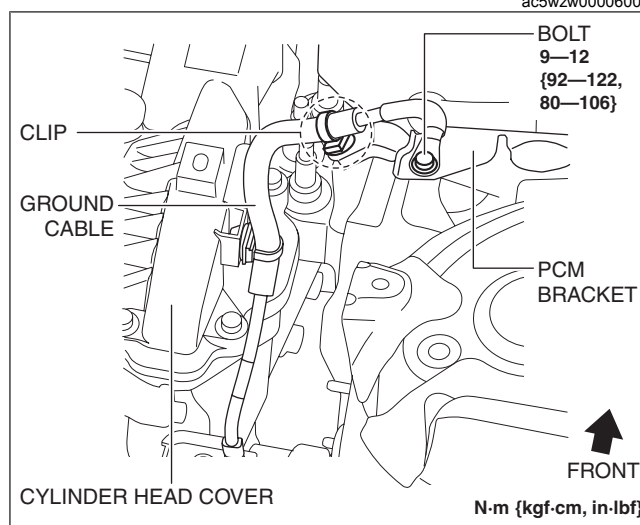
#### Tightening torque

9—10 N·m {92—101 kgf·cm, 80—88 in·lbf}



ac5wzw00006008

7. Install the ground cable to the PCM bracket.



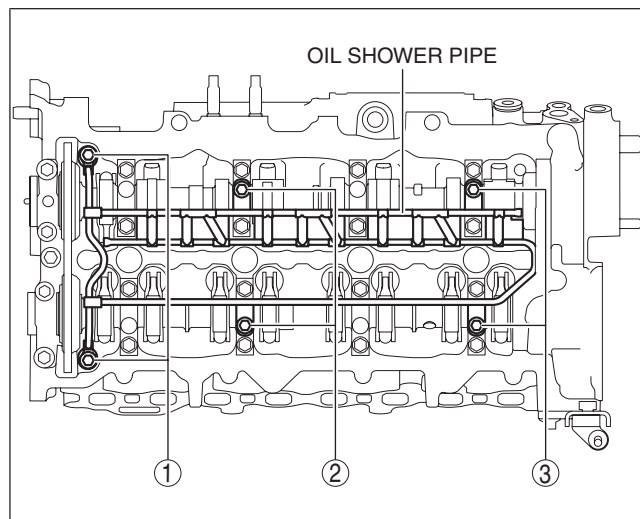
ac5wzw00006212

#### Oil shower pipe installation note

1. Install the oil shower pipe in the order shown in the figure.

#### Tightening torque

Installation position	Tightening torque
1	9—12 N·m {92—122 kgf·cm, 80—106 in·lbf}
2, 3	8.0—9.0 N·m {82—91 kgf·cm, 71—79 in·lbf}



ac5wzw00006009

#### Cylinder head cover installation note

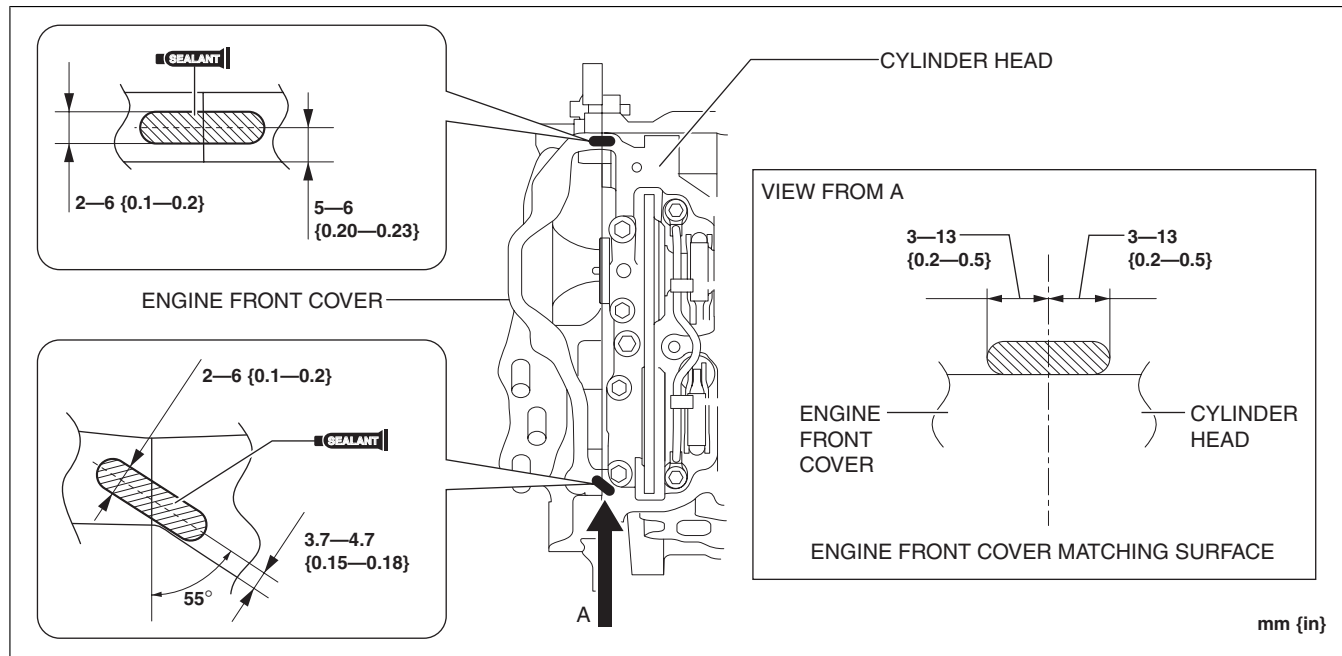
##### Caution

- To assure the sealing performance of the cylinder head cover, be careful of the following:
  - Verify that the cylinder head cover gasket is inserted into the cylinder head cover groove and install the cylinder head cover.
  - Completely clean and remove any oil, dirt, sealant or other foreign matter from the seal surface.

- To prevent silicone sealant from hardening, adhere the cylinder head cover and the cylinder head firmly within 10 min. after applying silicone sealant. After adhering them, tighten the installation bolts immediately.

1. Insert a new cylinder head cover gasket into the cylinder head cover groove.
2. Apply silicone sealant to the areas shown in the figure.

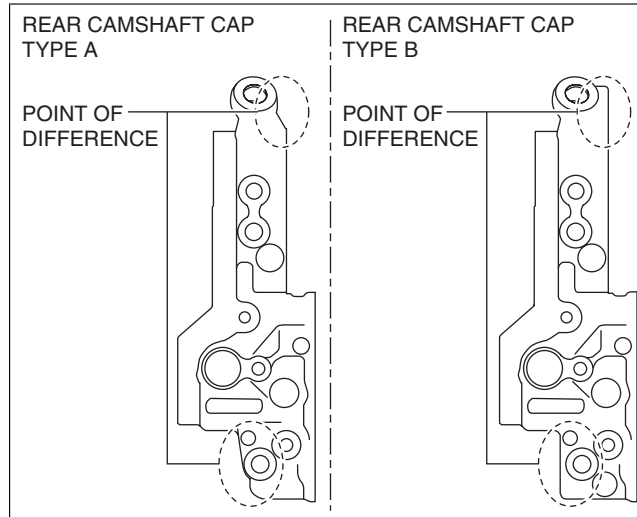
#### Engine front side



bes2ze00000103

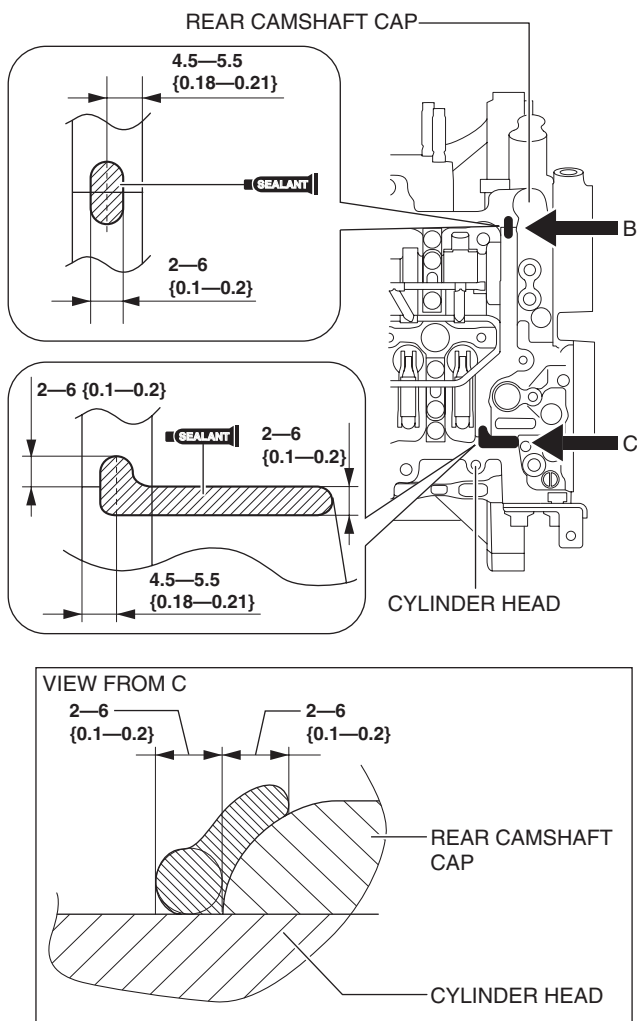
#### Engine rear side

- There are two types of rear camshaft caps and the application procedures for the silicone sealant differ. Verify the shape of the rear camshaft cap beforehand and apply silicone sealant as shown in the figure.

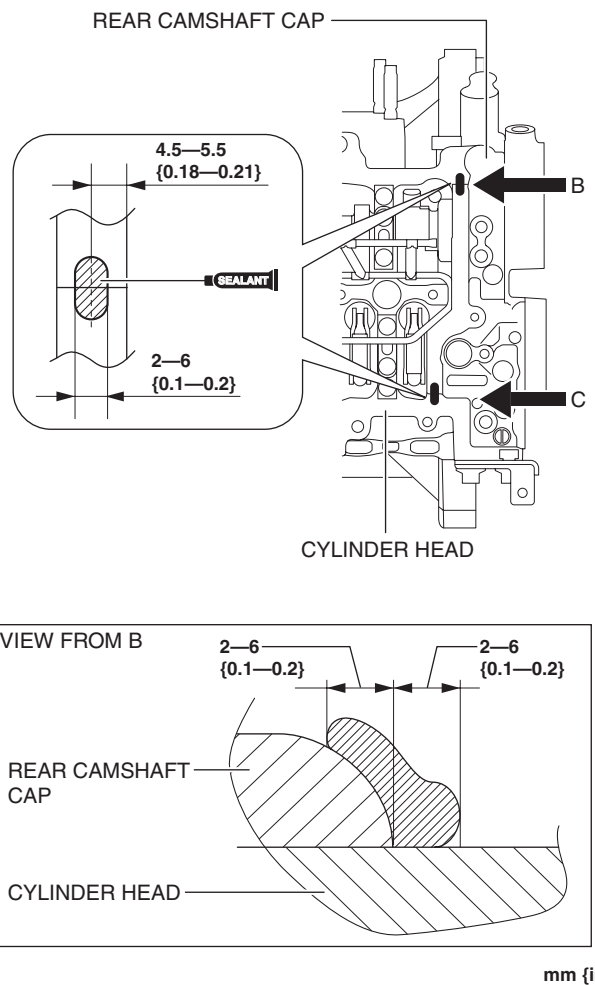


bes2ze00000104

### REAR CAMSHAFT CAP IS TYPE A



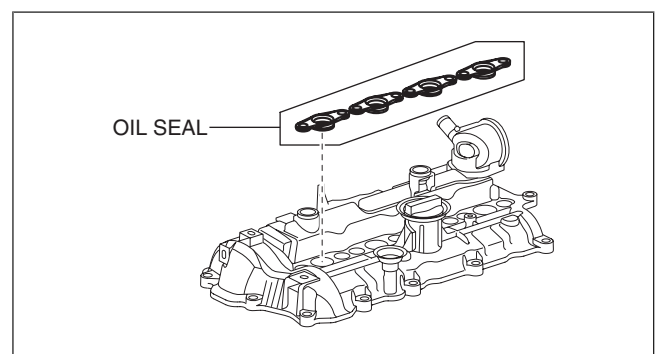
### REAR CAMSHAFT CAP IS TYPE B



mm {in}

bes2ze00000105

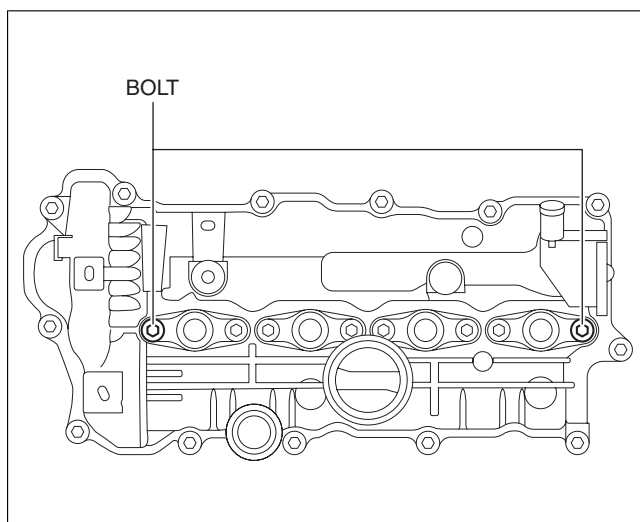
3. Install the cylinder head cover.
  - Verify that the oil seal shown in the figure is not damage, and replace the oil seal if it is damaged.



ac5wzw00005571

4. Tighten the cylinder head cover installation bolts using the following procedure:

- (1) Temporarily tighten the two bolts shown in the figure.

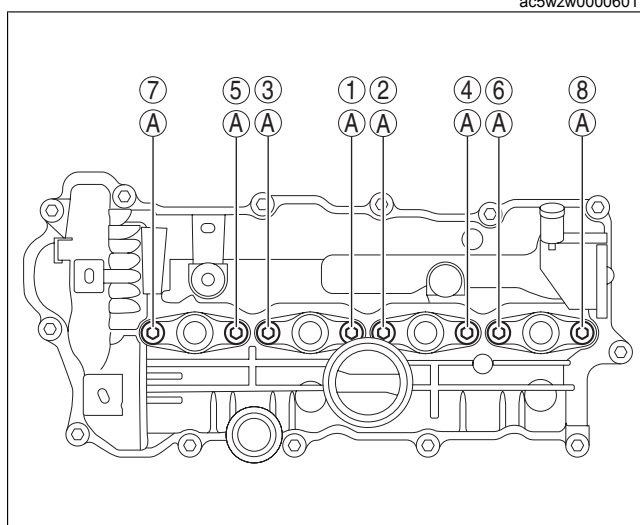


ac5wzw00006011

- (2) Tighten installation bolts A in the order shown in the figure.

**Tightening torque**

**4.5—7.0 N·m {46—71 kgf·cm, 40—61 in·lbf}**



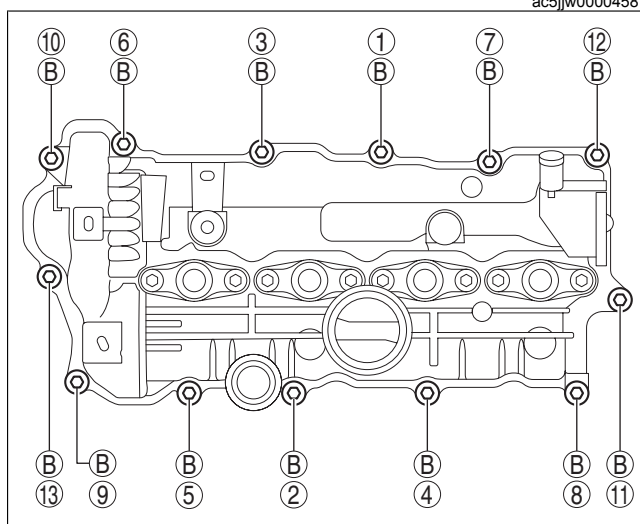
ac5jjw00004581

- (3) Tighten installation bolts B in the order shown in the figure.

**Tightening torque**

**4.5—7.0 N·m {46—71 kgf·cm, 40—61 in·lbf}**

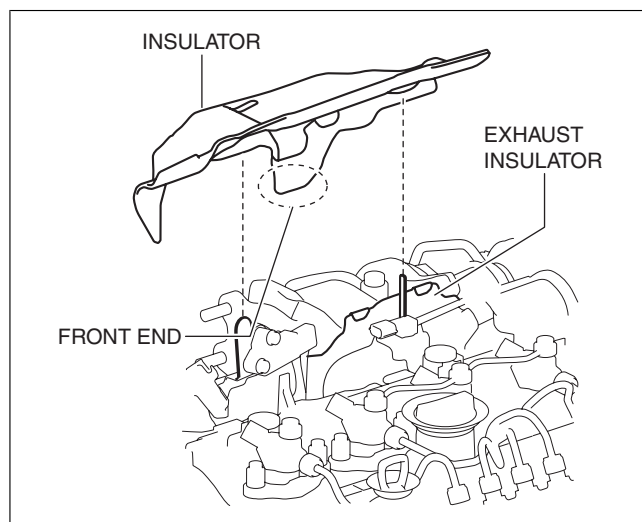
5. Install in the reverse order of removal.



ac5jjw00004582

### Insulator installation note

1. Install the insulator using the following procedure.
  - (1) Align the position so that the front end of the insulator is positioned at the front side of the vehicle from the exhaust insulator.
  - (2) Insert the insulator until it contacts completely.



ac5wzw00005016