

**ENGINE SECTION 2**

This service manual has been prepared to provide SUBARU service personnel with the necessary information and data for the correct maintenance and repair of SUBARU vehicles.

This manual includes the procedures for maintenance, disassembling, reassembling, inspection and adjustment of components and diagnostics for guidance of experienced mechanics.

Please peruse and utilize this manual fully to ensure complete repair work for satisfying our customers by keeping their vehicle in optimum condition. When replacement of parts during repair work is needed, be sure to use SUBARU genuine parts.

All information, illustration and specifications contained in this manual are based on the latest product information available at the time of publication approval.

**FUEL INJECTION (FUEL SYSTEM) FU(H4DOTC)**

**EMISSION CONTROL (AUX. EMISSION CONTROL DEVICE) EC(H4DOTC)**

**INTAKE (INDUCTION) IN(H4DOTC)**

**MECHANICAL ME(H4DOTC)**

**EXHAUST EX(H4DOTC)**

**COOLING CO(H4DOTC)**

**LUBRICATION LU(H4DOTC)**

**SPEED CONTROL SYSTEM SP(H4DOTC)**

**IGNITION IG(H4DOTC)**

**STARTING/CHARGING SYSTEM SC(H4DOTC)**

**ENGINE (DIAGNOSTIC) EN(H4DOTC)**

# MECHANICAL

# *ME(H4DOTC)*

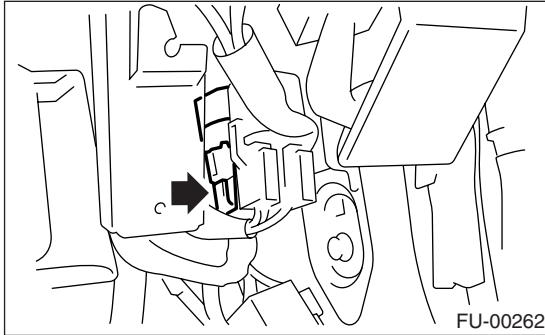
---

|                                     | <b>Page</b> |
|-------------------------------------|-------------|
| 1. General Description .....        | 2           |
| 2. Compression .....                | 31          |
| 3. Idle Speed .....                 | 32          |
| 4. Ignition Timing .....            | 33          |
| 5. Intake Manifold Vacuum.....      | 34          |
| 6. Engine Oil Pressure .....        | 35          |
| 7. Fuel Pressure .....              | 36          |
| 8. Valve Clearance .....            | 37          |
| 9. Engine Assembly .....            | 41          |
| 10. Engine Mounting .....           | 50          |
| 11. Preparation for Overhaul.....   | 51          |
| 12. V-belt.....                     | 52          |
| 13. Crank Pulley.....               | 55          |
| 14. Timing Belt Cover.....          | 57          |
| 15. Timing Belt Assembly.....       | 58          |
| 16. Cam Sprocket .....              | 67          |
| 17. Crank Sprocket .....            | 68          |
| 18. Camshaft.....                   | 69          |
| 19. Cylinder Head Assembly.....     | 76          |
| 20. Cylinder Block .....            | 84          |
| 21. Intake and Exhaust Valve .....  | 115         |
| 22. Piston .....                    | 116         |
| 23. Connecting Rod .....            | 117         |
| 24. Crankshaft.....                 | 118         |
| 25. Engine Trouble in General ..... | 119         |
| 26. Engine Noise .....              | 124         |

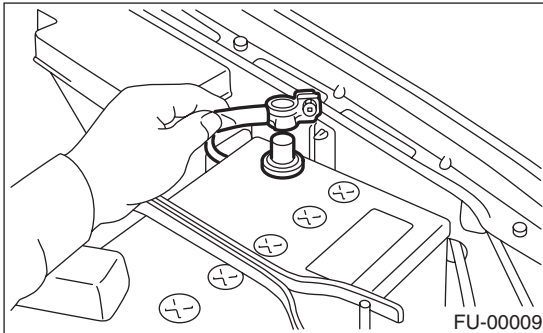
## 9. Engine Assembly

### A: REMOVAL

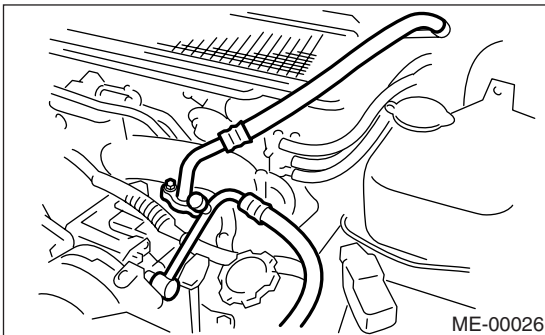
- 1) Set the vehicle on a lift.
- 2) Open the front hood fully, and then support with the hood stay.
- 3) Collect the refrigerant from A/C system.  
<Ref. to AC-26, Refrigerant Recovery Procedure.>
- 4) Release the fuel pressure.
  - (1) Disconnect the fuel pump relay connector.



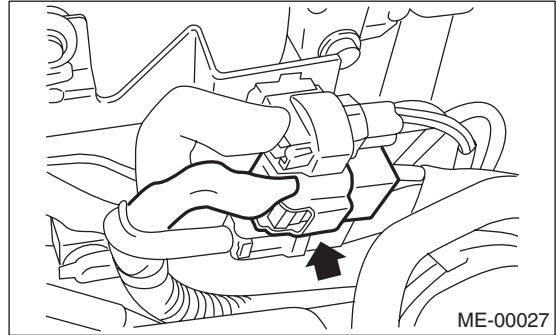
- (2) Start the engine, and run until stalls.
  - (3) After the engine stalls, crank it for 5 seconds more.
  - (4) Turn the ignition switch to OFF.
- 5) Remove the filler cap.
  - 6) Disconnect the ground cable from battery.



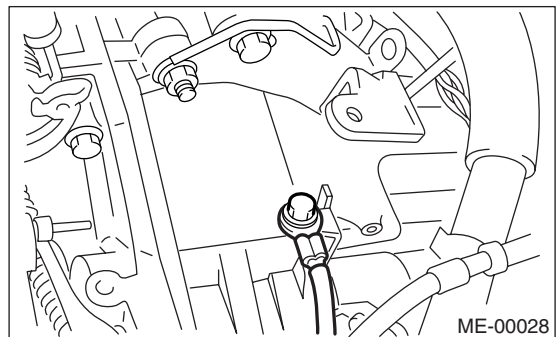
- 7) Remove the radiator from vehicle. <Ref. to CO(H4SO)-28, REMOVAL, Radiator.>
- 8) Remove the coolant filler tank. <Ref. to CO(H4SO)-42, REMOVAL, Coolant Filler Tank.>
- 9) Disconnect the A/C pressure hoses from A/C compressor.



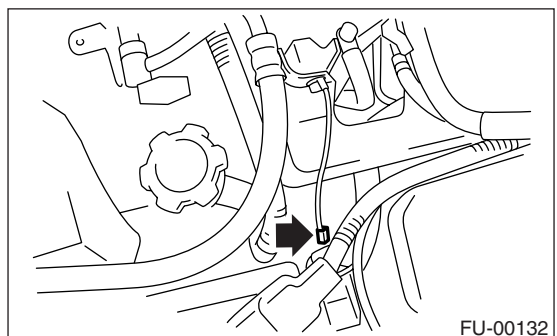
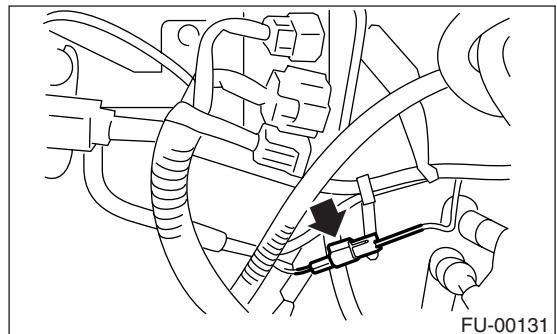
- 10) Remove the intercooler. <Ref. to IN(H4DOTC)-10, REMOVAL, Intercooler.>
- 11) Disconnect the following connectors and cable.
  - (1) Engine harness connector



- (2) Engine ground terminal



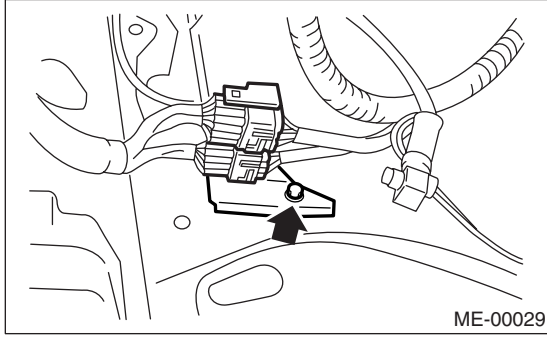
- (3) Disconnect the right and left side engine ground cables.



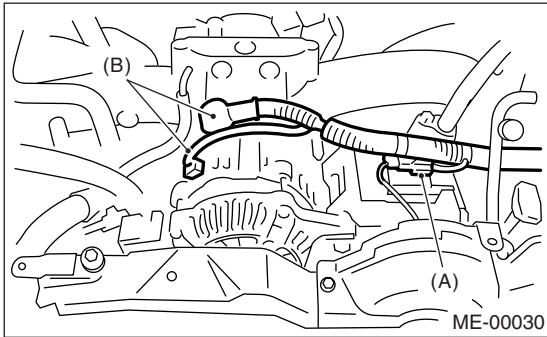
# Engine Assembly

## MECHANICAL

### (4) Engine harness connector

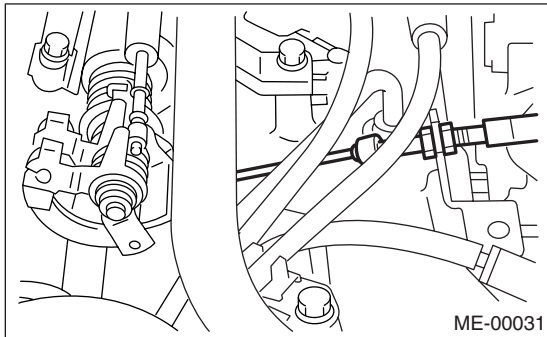


### (5) Generator connector, terminal and A/C compressor connectors

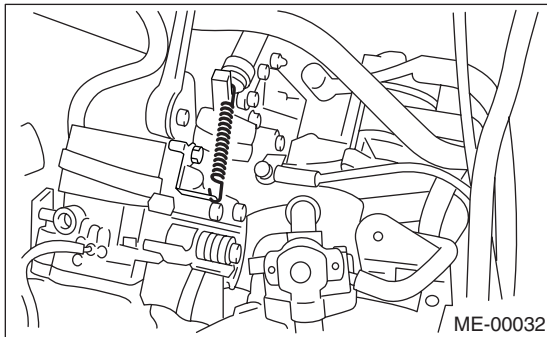


- (A) A/C compressor connector
- (B) Generator connector and terminal

### (6) Accelerator cable (2.0 L model)

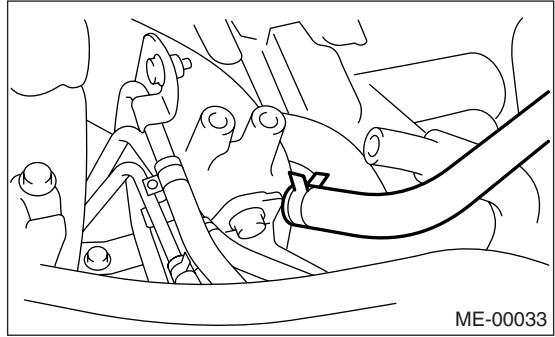


### (7) Clutch release spring (MT model)



### 12) Disconnect the following hoses.

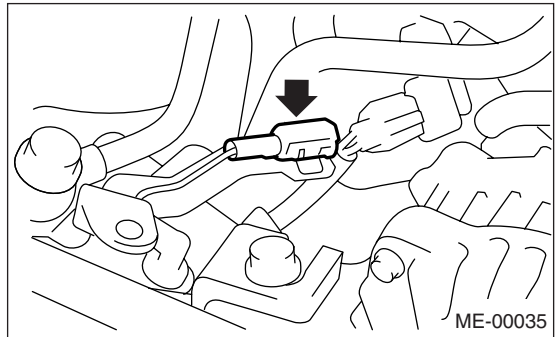
#### (1) Brake booster vacuum hose



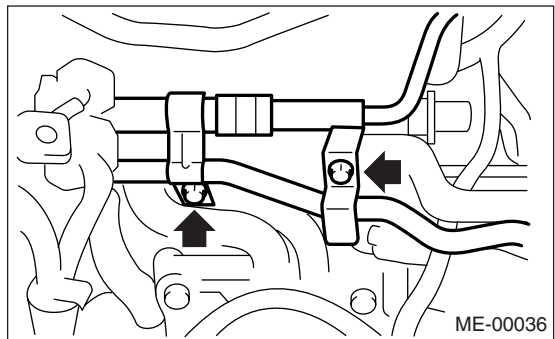
#### (2) Heater inlet outlet hose

### 13) Remove the power steering pump from bracket.

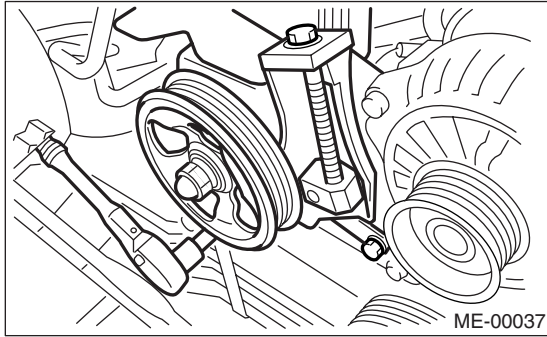
- (1) Loosen the lock bolt and slider bolt, and then remove the front side V-belt. <Ref. to ME(H4DOTC)-52, FRONT SIDE BELT, REMOVAL, V-belt.>
- (2) Disconnect the power steering switch connector.



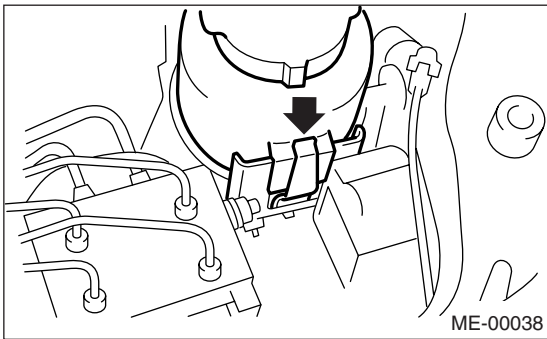
### (3) Remove the pipe with bracket from intake manifold.



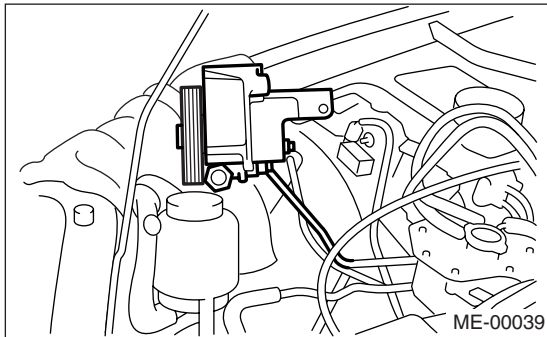
(4) Remove the power steering pump from engine.



(5) Remove the reservoir tank from bracket by pulling it upward.



(6) Place the power steering pump on RH side wheel apron.

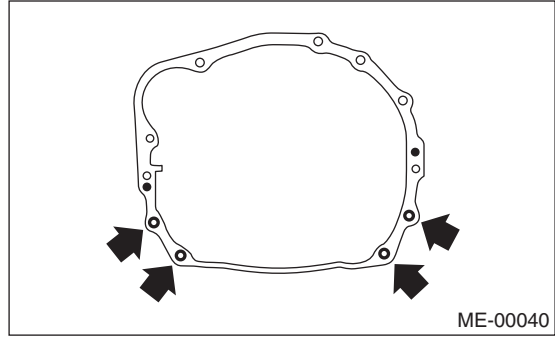


14) Lift-up the vehicle.

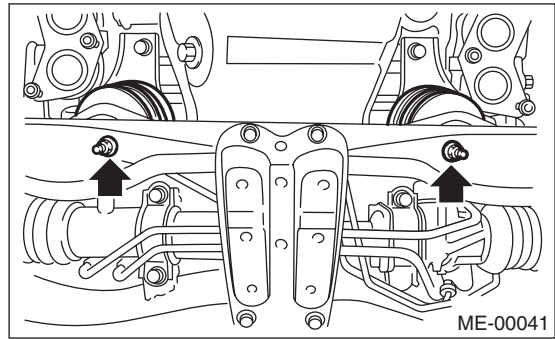
15) Remove the ATF cooler pipe from frame. (AT model)

16) Remove the center exhaust pipe. <Ref. to EX(H4DOTC)-9, REMOVAL, Center Exhaust Pipe.>

17) Remove the nuts which hold the lower side of transmission to engine.



18) Remove the nuts which install the front cushion rubber onto front crossmember.

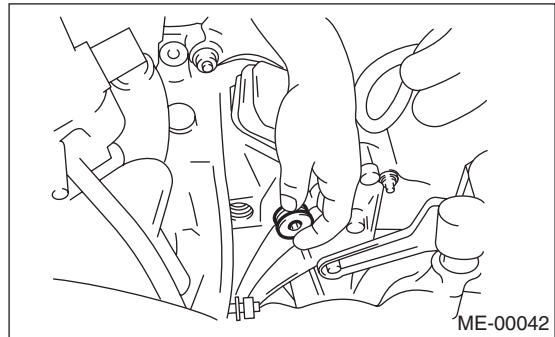


19) Lower the vehicle.

20) Separate the clutch release fork from release bearing. (MT model)

(1) Remove the clutch operating cylinder from transmission.

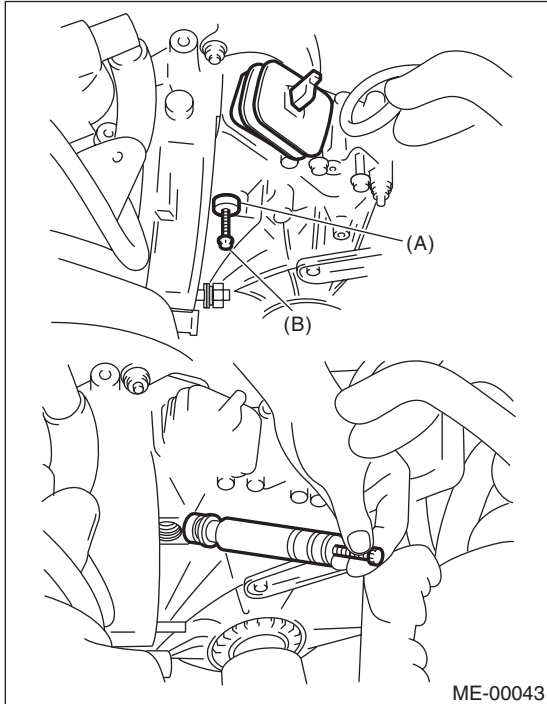
(2) Remove the plug using a 10 mm hexagon wrench.



# Engine Assembly

## MECHANICAL

- (3) Screw the 6 mm dia. bolt into release fork shaft, and remove it.



- (A) Shaft  
(B) Bolt

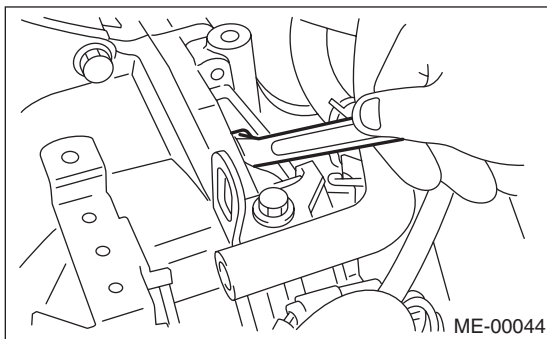
- (4) Raise the release fork, and then unfasten the release bearing tabs to free release fork.

### NOTE:

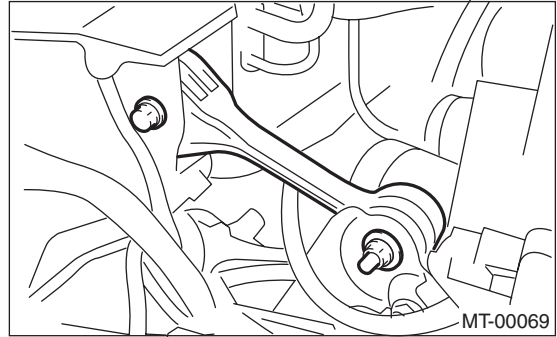
Step (4) is required to prevent interference with engine when removing the engine from transmission.

- 21) Separate the torque converter clutch from drive plate. (AT model)

- (1) Lower the vehicle.
- (2) Remove the service hole plug.
- (3) Remove the bolts which hold the torque converter clutch to drive plate.
- (4) Remove the other bolts while rotating the engine using socket wrench.



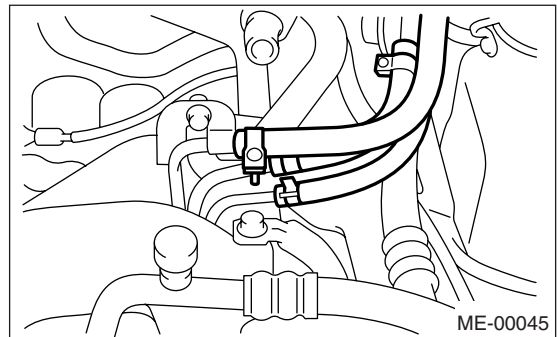
- 22) Remove the pitching stopper.



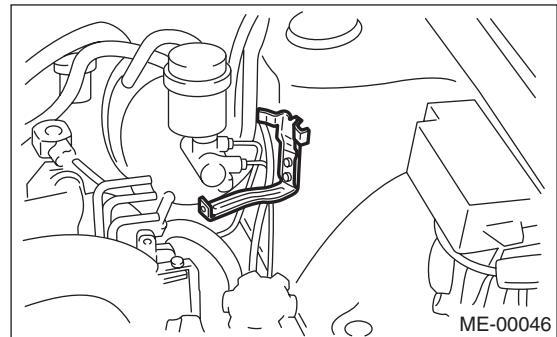
- 23) Disconnect the fuel delivery hose, return hose and evaporation hose.

### NOTE:

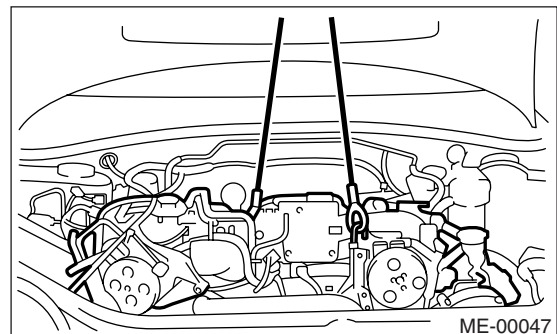
- Catch fuel from the hose into container.
- Disconnect the hose with its end wrapped with cloth to prevent fuel from splashing.



- 24) Remove the fuel filter and bracket.



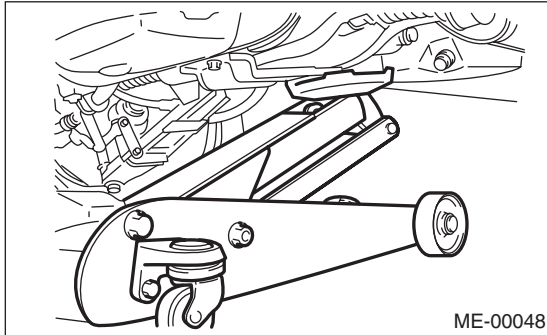
- 25) Support the engine with a lifting device and wire ropes.



26) Support the transmission with a garage jack.

**NOTE:**

Before moving the engine away from transmission, check to be sure no work has been overlooked. Doing this is very important in order to facilitate re-installation and because transmission lowers under its own weight.

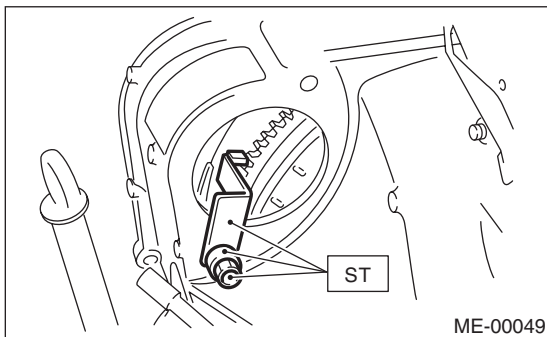


27) Separation of the engine and transmission.

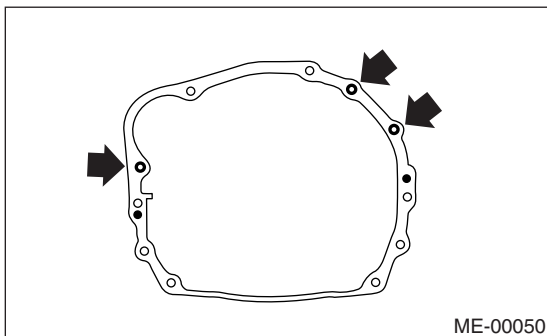
(1) Remove the starter. <Ref. to SC(H4SO)-6, REMOVAL, Starter.>

(2) Install the ST to torque converter clutch case. (AT model)

ST 498277200 STOPPER SET



(3) Remove the bolts which hold the right upper side of transmission to engine.



28) Remove the engine from vehicle.

(1) Slightly raise the engine.

(2) Raise the transmission with garage jack.

(3) Move the engine horizontally until the mainshaft is withdrawn from clutch cover.

(4) Slowly move the engine away from engine compartment.

**NOTE:**

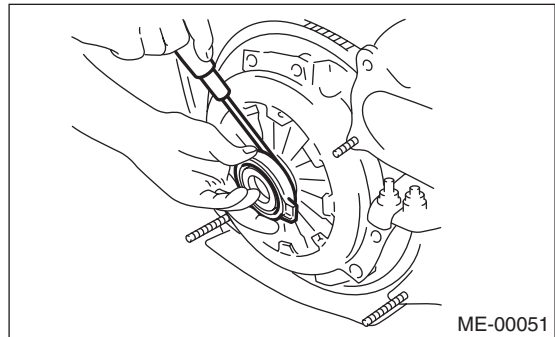
Be careful not to damage adjacent parts or body panels with crank pulley, oil pressure gauge, etc.

29) Remove the front cushion rubbers.

**B: INSTALLATION**

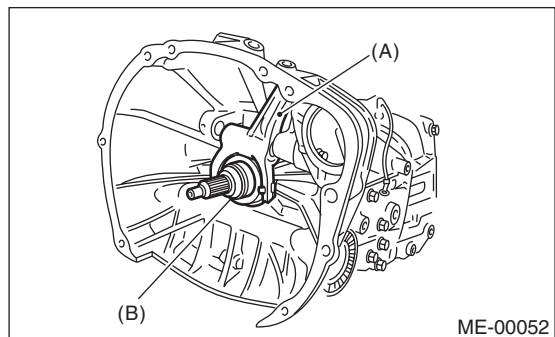
1) Install the clutch release fork and bearing onto transmission. (MT model)

(1) Remove the release bearing from clutch cover with flat type screw driver.



(2) Install the release bearing on transmission.

(3) Install the release fork into release bearing tab.



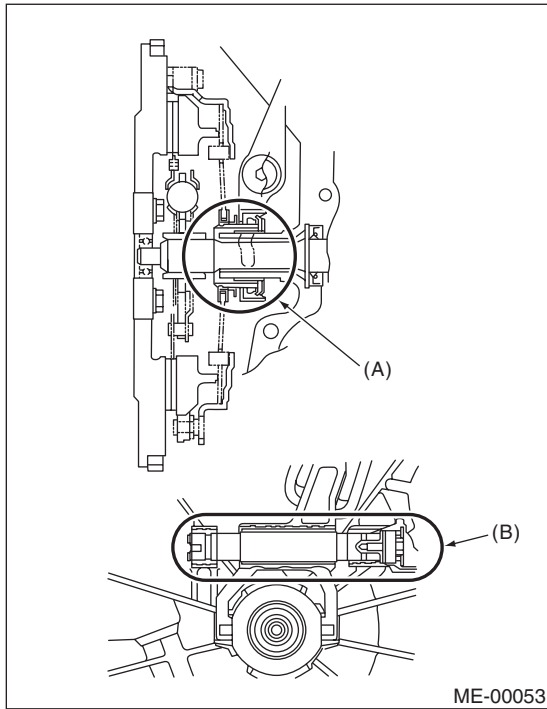
(A) Release fork

(B) Release bearing

# Engine Assembly

## MECHANICAL

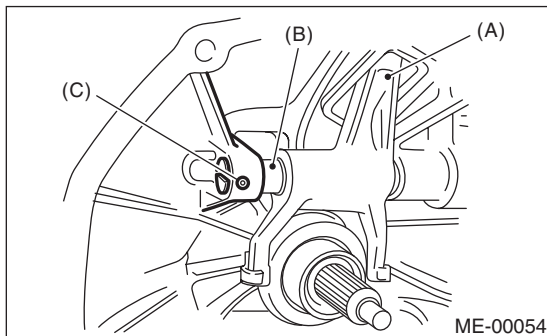
- (4) Apply grease to the specified points.
- Spline FX2200
  - Shaft SUNLIGHT 2



- (A) Spline (FX2200)  
(B) Shaft (SUNLIGHT 2)

- (5) Insert the release fork shaft into release fork.

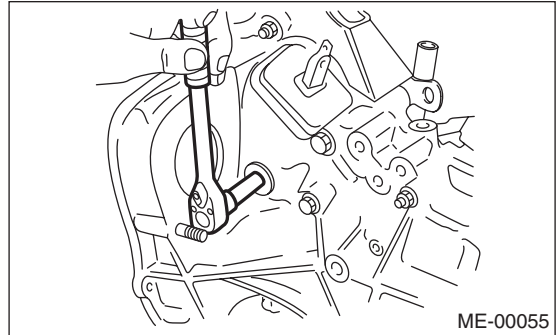
**CAUTION:**  
Make sure the cutout portion of release fork shaft contacts spring pin.



- (A) Release fork  
(B) Release shaft  
(C) Spring pin

- (6) Tighten the plug.

**Tightening torque:**  
**44 N·m (4.5 kgf·m, 32.5 ft·lb)**



- 2) Install the front cushion rubbers to engine.

**Tightening torque:**  
**35 N·m (3.6 kgf·m, 25.8 ft·lb)**

- 3) Install the engine onto transmission.  
(1) Position the engine in engine compartment, and then align it with the transmission.

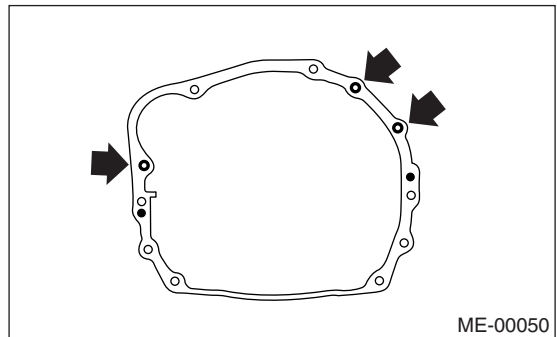
**NOTE:**

Be careful not to damage the adjacent parts or body panels with crank pulley, oil pressure gauge, etc.

- (2) Apply a small amount of grease to the splines of mainshaft. (MT model)

- 4) Tighten the bolts which hold the right upper side of transmission to engine.

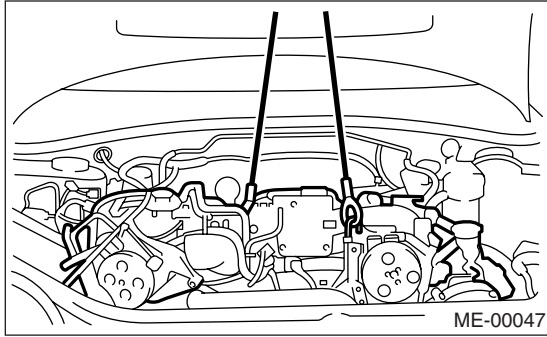
**Tightening torque:**  
**50 N·m (5.1 kgf·m, 36.9 ft·lb)**



- 5) Remove the lifting device and wire ropes.



6) Remove the garage jack.

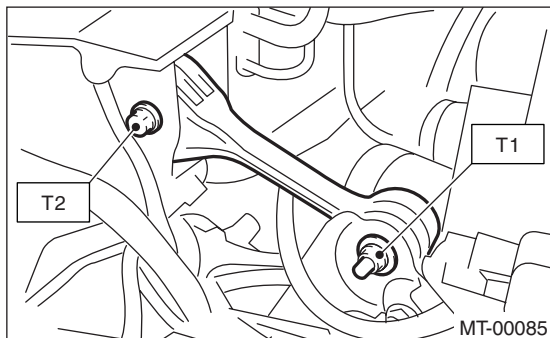


7) Install the pitching stopper.

**Tightening torque:**

**T1: 50 N·m (5.1 kgf-m, 37 ft-lb)**

**T2: 58 N·m (5.9 kgf-m, 43 ft-lb)**



8) Remove the ST from torque converter clutch case. (AT model)

**NOTE:**

Be careful not to drop the ST into torque converter clutch case when removing ST.

ST 498277200 STOPPER SET

9) Install the starter. <Ref. to SC(H4SO)-6, INSTALLATION, Starter.>

10) Install the torque converter clutch onto drive plate. (AT model)

(1) Tighten the bolts which hold the torque converter clutch to drive plate.

(2) Tighten other bolts while rotating the engine by using ST.

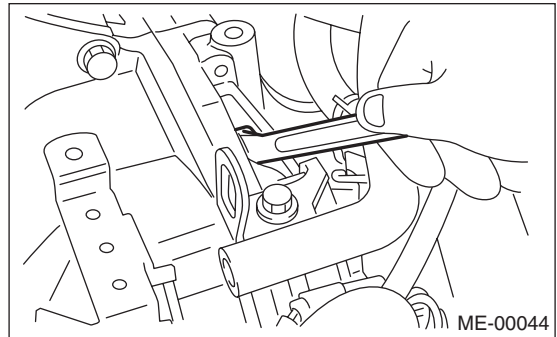
**CAUTION:**

**Be careful not to drop bolts into the torque converter clutch housing.**

ST 499977300 CRANK PULLEY WRENCH

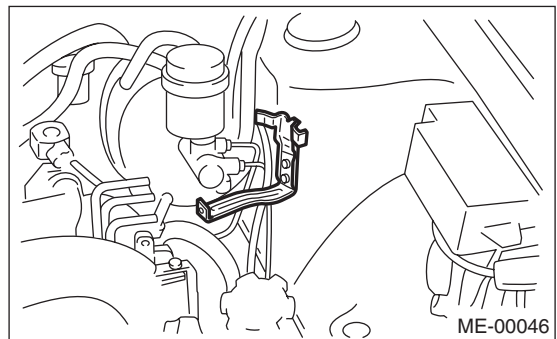
**Tightening torque:**

**25 N·m (2.5 kgf-m, 18.1 ft-lb)**



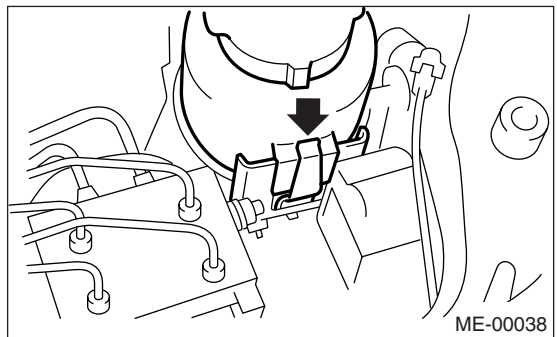
(3) Clog the service hole with plug.

11) Install the fuel filter and bracket.



12) Install the power steering pump on bracket.

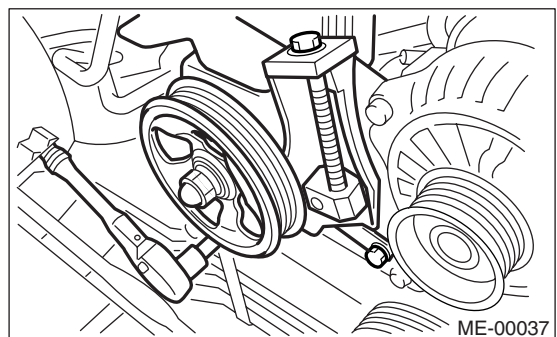
(1) Install the reservoir tank on bracket.



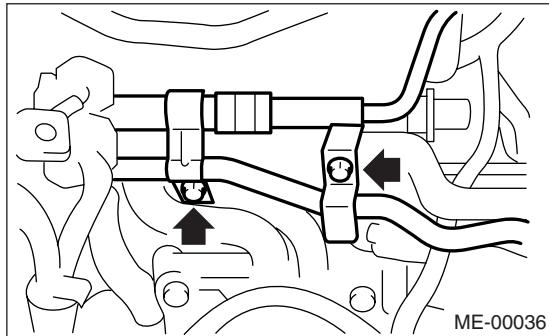
(2) Install the power steering pump.

**Tightening torque:**

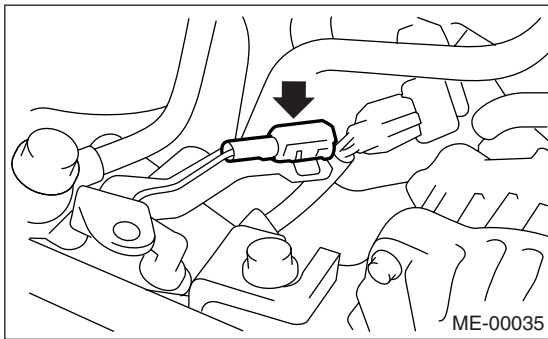
**20.1 N·m (2.05 kgf-m, 14.8 ft-lb)**



- (3) Install the power steering pipe bracket on intake manifold RH.



- (4) Connect the power steering switch connector.



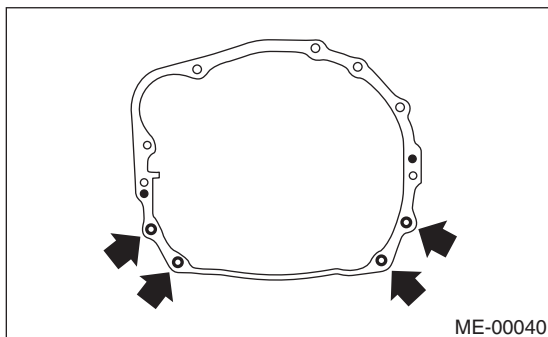
- (5) Install the front side V-belt, and adjust it.  
<Ref. to ME(H4DOTC)-52, FRONT SIDE BELT, INSTALLATION, V-belt.>

- 13) Lift-up the vehicle.

- 14) Tighten the nuts which hold the lower side of transmission to engine.

**Tightening torque:**

**50 N·m (5.1 kgf·m, 36.9 ft·lb)**



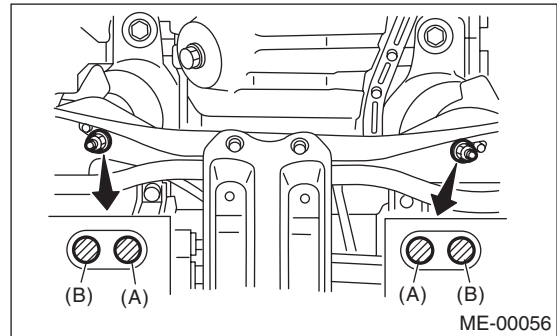
- 15) Tighten the nuts which install the front cushion rubber onto crossmember.

**Tightening torque:**

**85 N·m (8.7 kgf·m, 62.7 ft·lb)**

**NOTE:**

Make sure the front cushion rubber mounting bolts (A) and locator (B) are securely installed.



- 16) Install the ATF cooler pipe to frame. (AT model)

- 17) Install the center exhaust pipe.

<Ref. to EX(H4DOTC)-10, INSTALLATION, Center Exhaust Pipe.>

- 18) Lower the vehicle.

- 19) Connect the following hoses:

- (1) Fuel delivery hose, return hose and evaporation hose
- (2) Heater inlet and outlet hoses
- (3) Brake booster vacuum hose

- 20) Connect the following connectors and terminals:

- (1) Engine ground terminal
- (2) Engine harness connectors
- (3) Generator connector and terminal
- (4) A/C compressor connectors

- 21) Connect the following cables:

- (1) Accelerator cable
- (2) Clutch release spring

- 22) After connecting each cable, adjust them.

- 23) Install the air intake system.

- (1) Install the intercooler. <Ref. to IN(H4DOTC)-11, INSTALLATION, Intercooler.>
- (2) Install the air cleaner element and air cleaner upper cover.
- (3) Install the engine harness connector bracket.
- (4) Install the filler hose to air cleaner case.

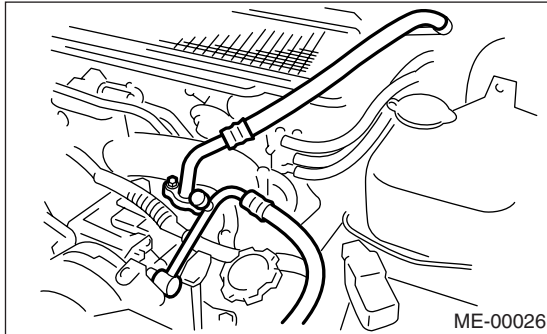
24) Install the A/C pressure hoses.

NOTE:

Use new O-rings.

**Tightening torque:**

**15 N·m (1.5 kgf·m, 10.8 ft·lb)**



25) Install the radiator. <Ref. to CO(H4SO)-30, INSTALLATION, Radiator.>

26) Install the coolant filler tank. <Ref. to CO(H4SO)-42, INSTALLATION, Coolant Filler Tank.>

27) Install the window washer tank.

28) Install the battery in the vehicle, and then connect the cables.

29) Fill coolant.

<Ref. to CO(H4SO)-19, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

30) Charge the A/C system with refrigerant.

<Ref. to AC-27, OPERATION, Refrigerant Charging Procedure.>

31) Remove the front hood stay, and close the front hood.

32) Take off the vehicle from lift arms.

## 10.Engine Mounting

### A: REMOVAL

- 1) Remove the engine assembly. <Ref. to ME(H4DOTC)-41, REMOVAL, Engine Assembly.>
- 2) Remove the engine mounting from engine assembly.

### B: INSTALLATION

Install in the reverse order of removal.

#### *Tightening torque:*

**ENGINE MOUNTING;**

**35 N·m (3.6 kgf-m, 25.8 ft-lb)**

### C: INSPECTION

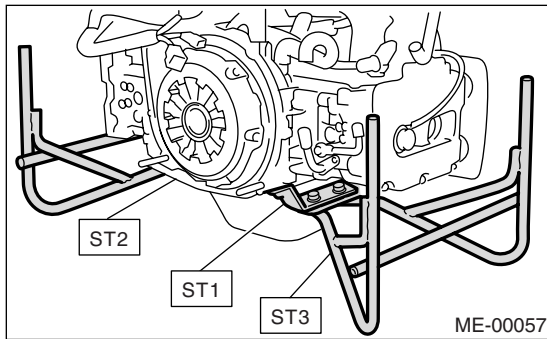
Make sure there are no cracks or other damage.

## 11. Preparation for Overhaul

### A: PROCEDURE

1) After removing the engine from body, secure it in the ST shown below.

|     |           |                            |
|-----|-----------|----------------------------|
| ST1 | 498457000 | ENGINE STAND ADAPTER<br>RH |
| ST2 | 498457100 | ENGINE STAND ADAPTER<br>LH |
| ST3 | 499817000 | ENGINE STAND               |



2) In this section the procedures described under each index are all connected and stated in order. It will be the complete procedure for overhauling of the engine itself when you go through all steps in the process.

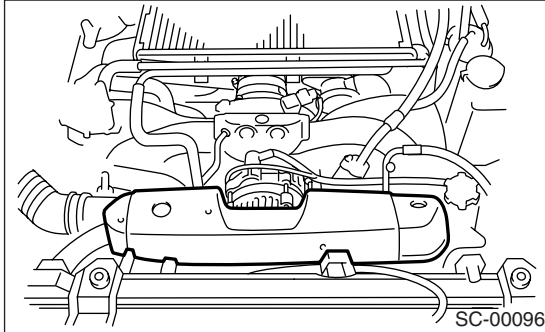
Therefore, in this section, to conduct the particular procedure within the flow of a section, you need to go back and conduct the procedure described previously in order to do that particular procedure.

## 12.V-belt

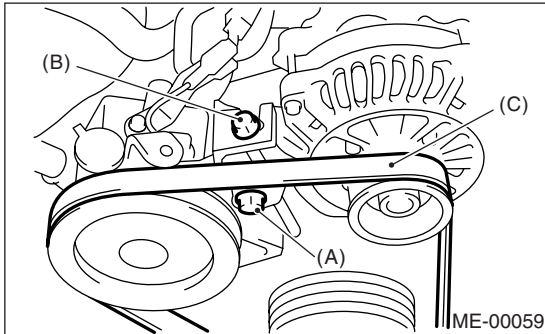
### A: REMOVAL

#### 1. FRONT SIDE BELT

- 1) Remove the V-belt cover.

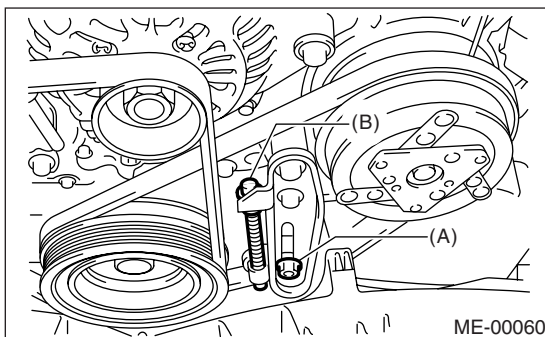


- 2) Loosen the lock bolt (A).
- 3) Loosen the slider bolt (B).
- 4) Remove the front side belt (C).



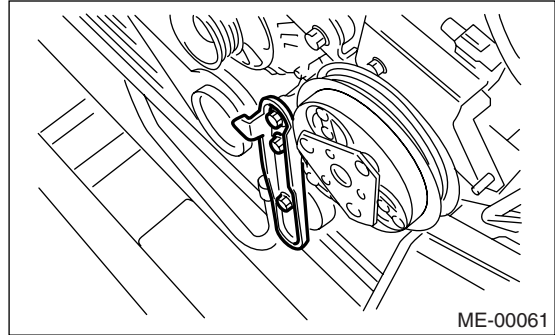
#### 2. REAR SIDE BELT

- 1) Loosen the lock nut (A).
- 2) Loosen the slider bolt (B).



- 3) Remove the A/C belt.

- 4) Remove the A/C belt tensioner.



### B: INSTALLATION

#### 1. FRONT SIDE BELT

##### CAUTION:

**Wipe off any oil or water on the belt and pulley.**

- 1) Install the belt (C), and tighten the slider bolt so as to obtain the specified belt tension <Ref. to ME(H4DOTC)-53, INSPECTION, V-belt.>
- 2) Tighten the lock bolt (A).
- 3) Tighten the slider bolt (B).

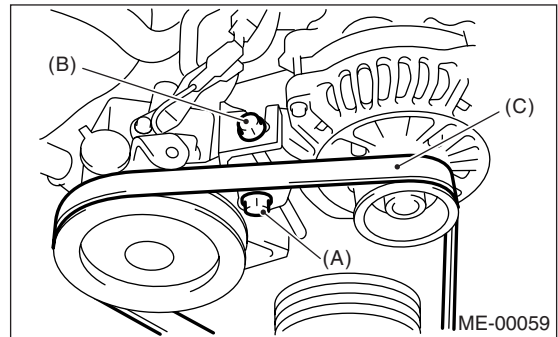
##### Tightening torque:

**Lock bolt through bolt:**

**25 N·m (2.5 kgf-m, 18.1 ft-lb)**

**Slider bolt:**

**8 N·m (0.8 kgf-m, 5.5 ft-lb)**



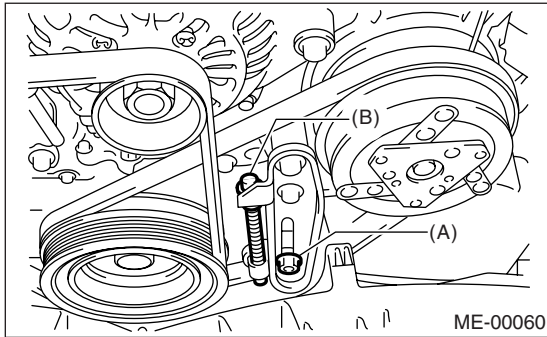
## 2. REAR SIDE BELT

- 1) Install the belt, and tighten the slider bolt (B) so as to obtain the specified belt tension. <Ref. to ME(H4DOTC)-53, INSPECTION, V-belt.>
- 2) Tighten the lock nut (A).

### Tightening torque:

**Lock nut (A);**

**22.6 N·m (2.3 kgf·m, 16.6 ft·lb)**



## C: INSPECTION

- 1) Replace the belts, if cracks, fraying or wear is found.
- 2) Check the drive belt tension and adjust it if necessary by changing generator installing position and/or idler pulley installing position.

### Belt tension (With using belt tension gauge)

**(A)**

**Replaced: 640 — 780 N (65 — 80 kgf, 144 — 175 lb)**

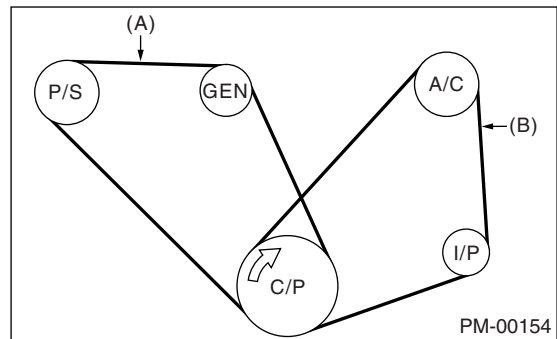
**Reused: 490 — 640 N (50 — 65 kgf, 110 — 144 lb)**

**(B)\***

**Replaced: 740 — 880 N (76 — 89 kgf, 167 — 197 lb)**

**Reused: 350 — 450 N (36 — 46 kgf, 78 — 101 lb)**

**\*: With air conditioner**



- (A) Front side belt
- (B) Rear side belt
- C/P Crank pulley
- GEN Generator
- P/S Power steering oil pump pulley
- A/C A/C compressor pulley
- I/P Idler pulley

**Belt tension (Without using belt tension gauge)**

**(A)**

**Replaced: 7 — 9 mm (0.276 — 0.354 in)**

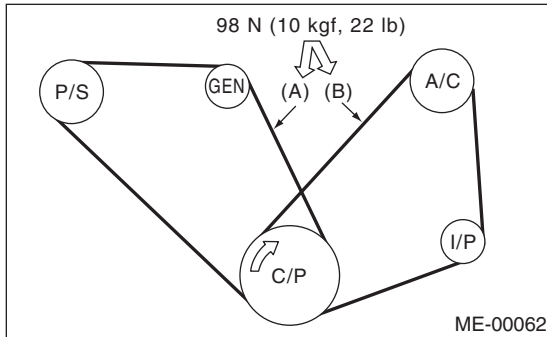
**Reused: 9 — 11 mm (0.354 — 0.433 in)**

**(B)\***

**Replaced: 7.5 — 8.5 mm (0.295 — 0.335 in)**

**Reused: 9.0 — 10.0 mm (0.354 — 0.394 in)**

**\*: With air conditioner**



(A) Front side belt

(B) Rear side belt

C/P Crank pulley

GEN Generator

P/S Power steering oil pump pulley

A/C Air conditioning compressor pulley

I/P Idler pulley



## 13. Crank Pulley

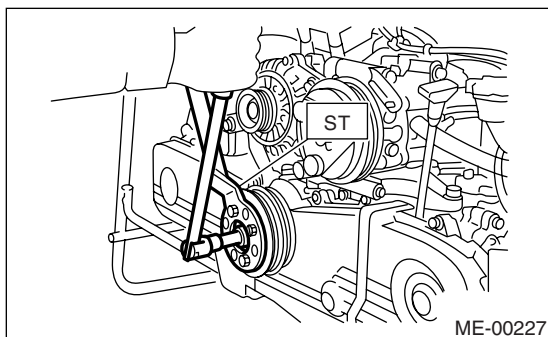
### A: REMOVAL

1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, REMOVAL, V-belt.>

2) Remove the crank pulley bolt. To lock the crankshaft, use ST.

ST 499977400 CRANK PULLEY WRENCH  
(2.0 L model)

ST 499977100 CRANK PULLEY WRENCH  
(2.5 L model)



3) Remove the crank pulley.

### B: INSTALLATION

#### 1. 2.0 L MODEL

1) Install the crank pulley.

2) Install the pulley bolt.

To lock the crankshaft, use ST.

ST 499977400 CRANK PULLEY WRENCH

(1) Clean the crank pulley thread using an air gun.

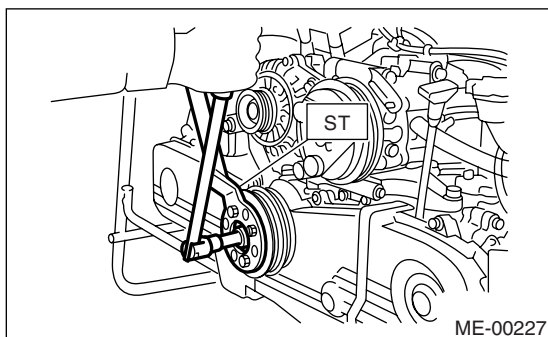
(2) Apply engine oil to the crank pulley bolt seat and thread.

(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kgf·m, 33 ft·lb).

(4) Tighten the crank pulley bolts.

**Tightening torque:**

**127 N·m (13 kgf·m, 94.0 ft·lb)**



3) Confirm that the tightening angle of crank pulley bolt is 45 degrees or more. If the tightening angle of crank pulley bolt is less than 45 degrees, conduct the following procedures.

### CAUTION:

**If the tightening angle of crankshaft pulley bolt is less than 45 degrees, the bolt should be damaged. In this case, the bolt must be replaced.**

(1) Replace the crankshaft pulley bolts and clean them.

### Crankshaft pulley bolt:

**12369AA011**

(2) Clean the crankshaft thread using an air gun.

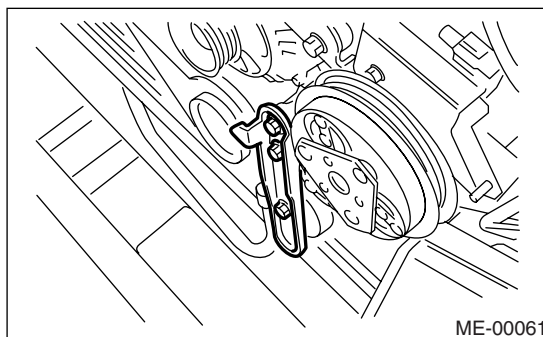
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kgf·m, 33 ft·lb).

(4) Tighten the crankshaft pulley bolts keeping them in an angle between 45 degrees and 60 degrees.

### NOTE:

Conduct the tightening procedures by confirming the turning angle of crankshaft pulley bolt referring to the gauge indicated on timing belt cover.

4) Install the A/C belt tensioner.



5) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

#### 2. 2.5 L MODEL

1) Install the crank pulley.

2) Install the pulley bolt.

To lock the crankshaft, use ST.

ST 499977100 CRANK PULLEY WRENCH

(1) Clean the crank pulley thread using an air gun.

(2) Apply engine oil to the crank pulley bolt seat and thread.

(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kgf·m, 33 ft·lb).

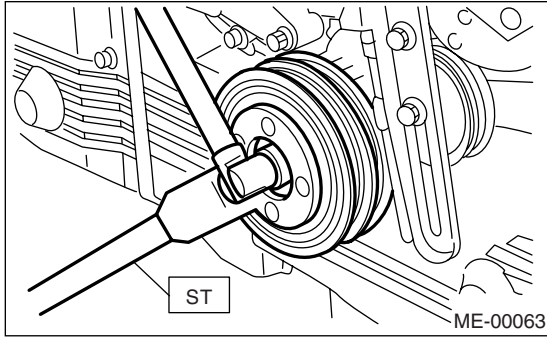
(4) Tighten the crank pulley bolts.

# Crank Pulley

MECHANICAL

## **Tightening torque:**

**180 N·m (18.3 kgf-m, 132.7 ft-lb)**



3) Confirm that the tightening angle of crank pulley bolt is 65 degrees or more. If the tightening angle of crank pulley bolt is less than 65 degrees, conduct the following procedures.

## **CAUTION:**

**If the tightening angle of crank pulley bolt is less than 65 degrees, the bolt should be damaged. In this case, the bolt must be replaced.**

(1) Replace the crank pulley bolts and clean them.

## **Crank pulley bolt:**

**12369AA011**

(2) Clean the crankshaft thread using an air gun.

(3) Apply engine oil to the crank pulley bolt seat and thread.

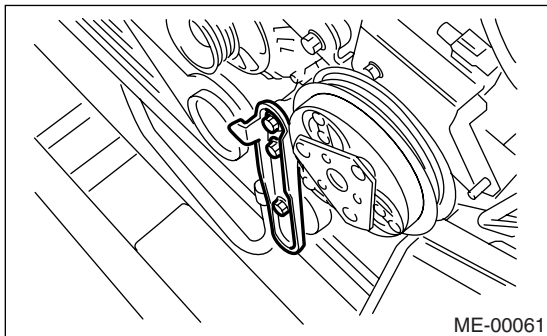
(4) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kgf-m, 33 ft-lb).

(5) Tighten the crank pulley bolts keeping them in an angle between 65 degrees and 75 degrees.

## **NOTE:**

Conduct the tightening procedures by confirming the turning angle of crank pulley bolt referring to the gauge indicated on timing belt cover.

4) Install the A/C belt tensioner.



5) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

## **C: INSPECTION**

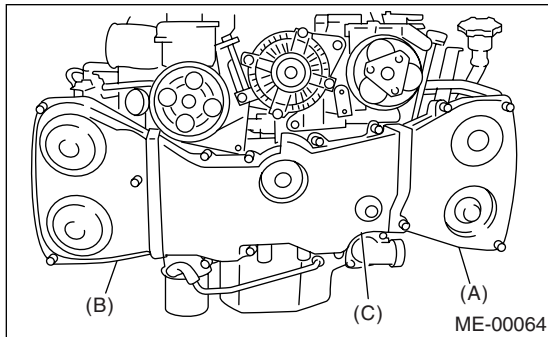
1) Make sure the V-belt is not worn or otherwise damaged.

2) Check the tension of the belt. <Ref. to ME(H4DOTC)-53, INSPECTION, V-belt.>

## 14. Timing Belt Cover

### A: REMOVAL

- 1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-55, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover (LH) (A).
- 4) Remove the timing belt cover (RH) (B).
- 5) Remove the front timing belt cover (C).



### B: INSTALLATION

- 1) Install the front timing belt cover (C).

#### **Tightening torque:**

**5 N·m (0.5 kgf-m, 3.6 ft-lb)**

- 2) Install the timing belt cover (RH) (B).

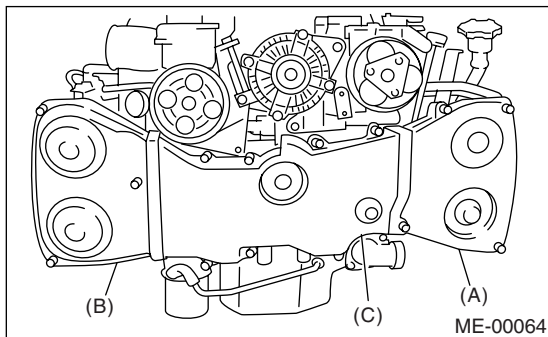
#### **Tightening torque:**

**5 N·m (0.5 kgf-m, 3.6 ft-lb)**

- 3) Install the timing belt cover (LH) (A).

#### **Tightening torque:**

**5 N·m (0.5 kgf-m, 3.6 ft-lb)**



- 4) Install the crank pulley. <Ref. to ME(H4DOTC)-55, INSTALLATION, Crank Pulley.>
- 5) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

### C: INSPECTION

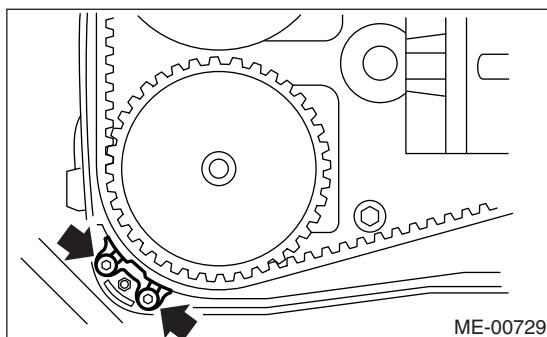
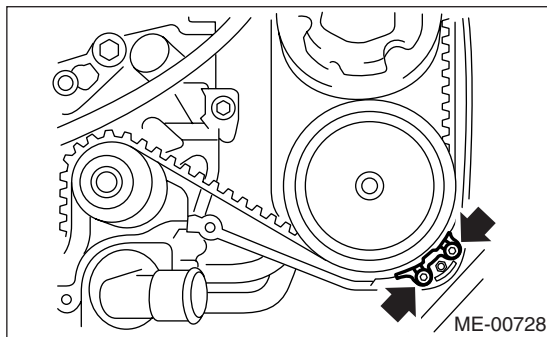
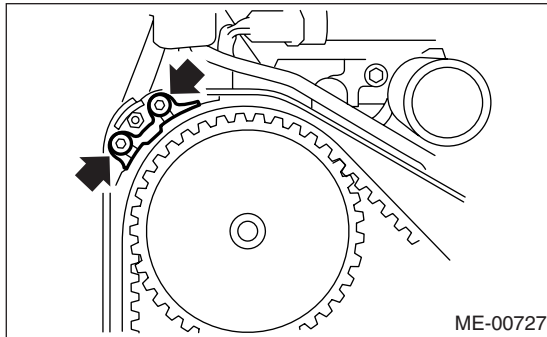
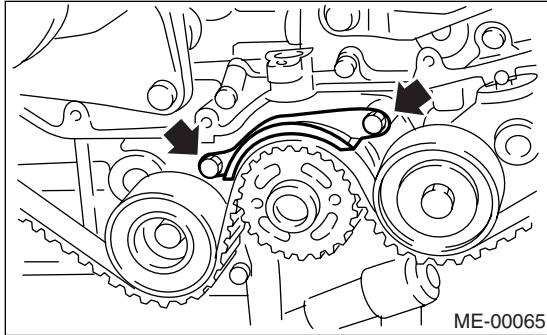
Make sure the cover is not damaged.

## 15. Timing Belt Assembly

### A: REMOVAL

#### 1. TIMING BELT

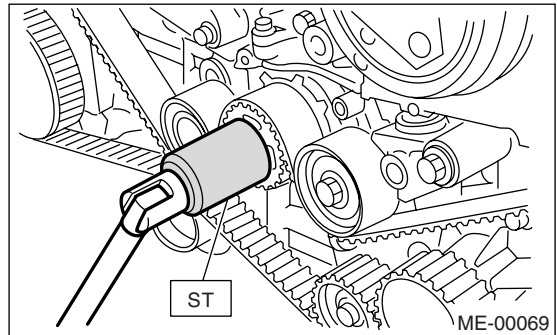
- 1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-55, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-57, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt guides. (MT model)



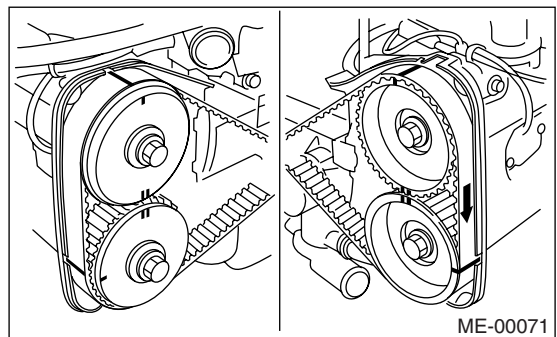
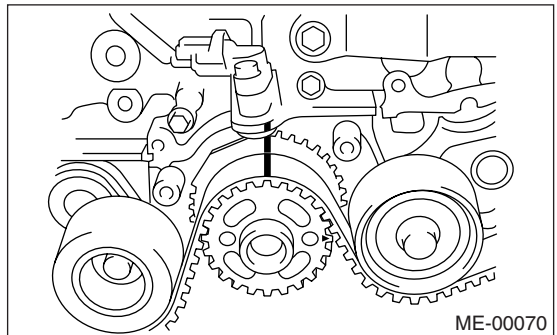
- 5) If the alignment mark and/or arrow mark (which indicates rotation direction) on timing belt fade away, put new marks before removing the timing belt as follows:

- (1) Turn the crankshaft using ST, and align the alignment marks on crankshaft sprocket, intake camshaft sprocket (LH), exhaust camshaft sprocket (LH), intake camshaft sprocket (RH) and exhaust camshaft sprocket (RH) with notches of timing belt cover and cylinder block.

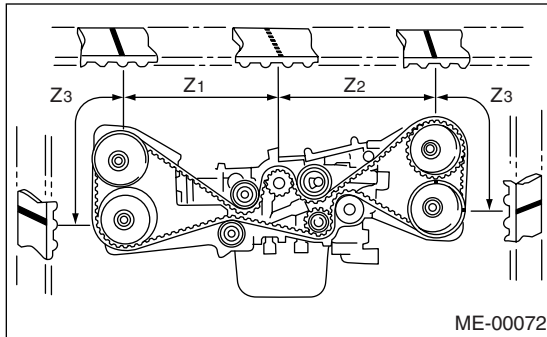
ST 499987500 CRANKSHAFT SOCKET



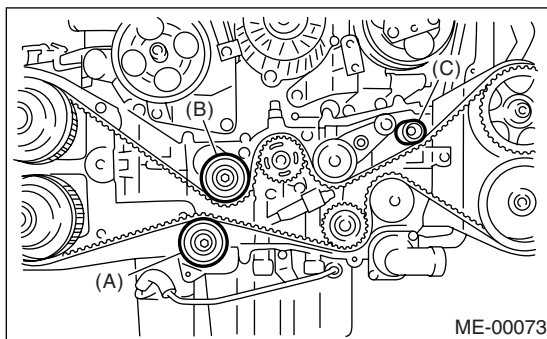
- (2) Using white paint, put alignment and/or arrow marks on the timing belts in relation to the sprockets.



$Z_1$ : 54.5 tooth length  
 $Z_2$ : 51 tooth length  
 $Z_3$ : 28 tooth length



6) Remove the belt idler (A).



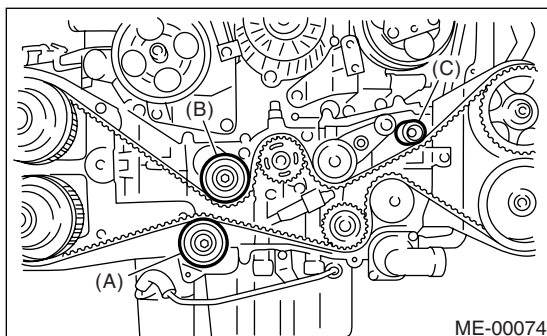
7) Remove the timing belt.

**CAUTION:**

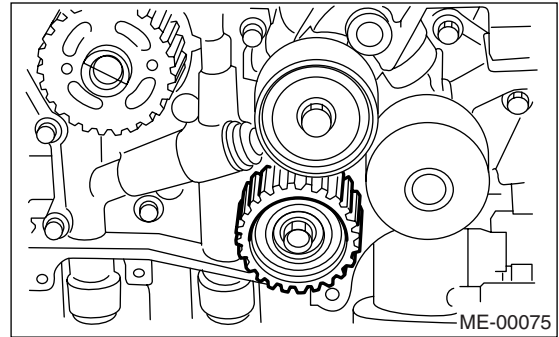
After the timing belt has been removed, never rotate the intake and exhaust, camshaft sprocket. If the camshaft sprocket is rotated, the intake and exhaust valve heads strike together and valve stems are bent.

**2. BELT IDLER AND AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY**

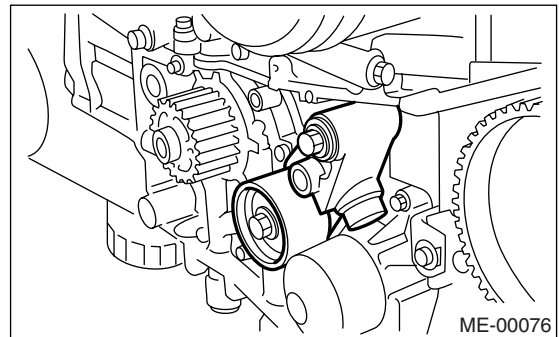
1) Remove the belt idler (B) and (C).



2) Remove the belt idler No. 2.



3) Remove the automatic belt tension adjuster assembly.



**B: INSTALLATION**

**1. AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER**

1) Preparation for installation of automatic belt tension adjuster assembly:

**NOTE:**

- Always use a vertical type pressing tool to move the adjuster rod down.
- Do not use a lateral type vise.
- Push the adjuster rod vertically.
- Be sure to slowly move the adjuster rod down applying a pressure of 294 N (30 kgf, 66 lb).
- Press-in the push adjuster rod gradually taking more than 3 minutes.
- Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lb).
- Press the adjuster rod as far as the end surface of cylinder. Do not press the adjuster rod into the cylinder. Doing so may damage the cylinder.

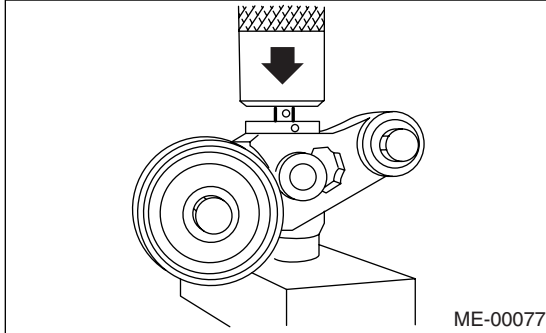
# Timing Belt Assembly

## MECHANICAL

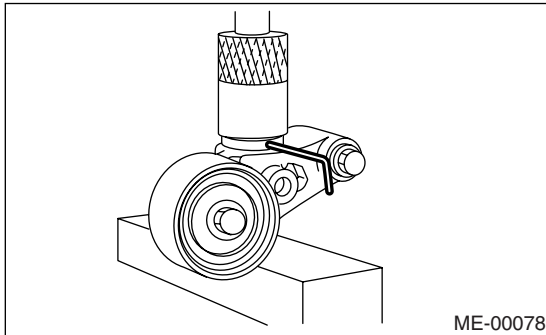
- Do not release the press pressure until stopper pin is completely inserted.

(1) Attach the automatic belt tension adjuster assembly to the vertical pressing tool.

(2) Slowly move the adjuster rod down with a pressure of 294 N (30 kgf, 66 lb) until the adjuster rod is aligned with the stopper pin hole in the cylinder.



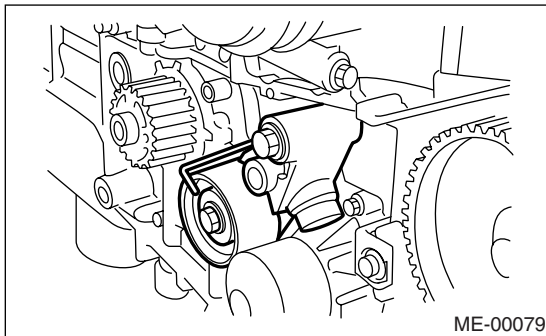
(3) With a 2 mm (0.08 in) dia. stopper pin or a 2 mm (0.08 in) (nominal) dia. hex bar wrench inserted into the stopper pin hole in the cylinder, secure the adjuster rod.



- 2) Install the automatic belt tension adjuster assembly.

**Tightening torque:**

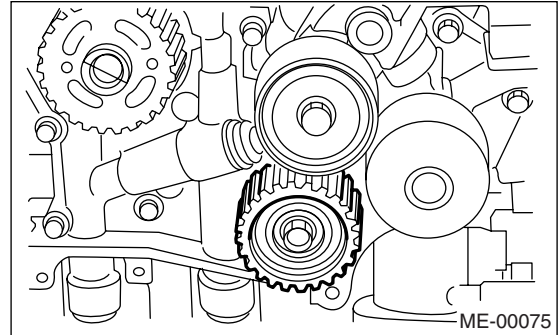
**39 N·m (4.0 kgf·m, 28.9 ft·lb)**



- 3) Install the belt idler No. 2.

**Tightening torque:**

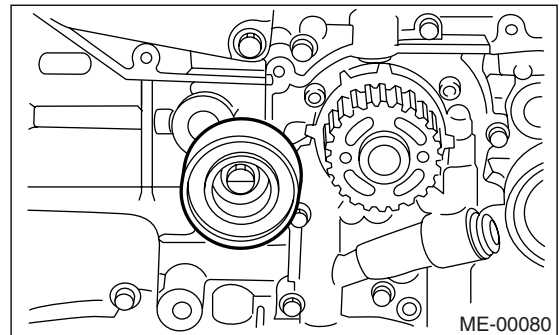
**39 N·m (4.0 kgf·m, 28.9 ft·lb)**



- 4) Install the belt idler.

**Tightening torque:**

**39 N·m (4.0 kgf·m, 28.9 ft·lb)**

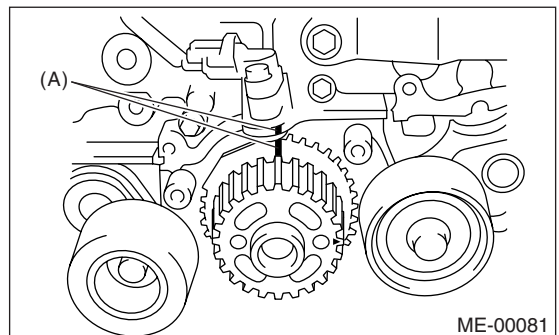


## 2. TIMING BELT

- 1) Preparation for installation of automatic belt tension adjuster assembly. <Ref. to ME(H4DOTC)-60, AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER, INSTALLATION, Timing Belt Assembly.>

- 2) Crankshaft and camshaft sprocket alignment.

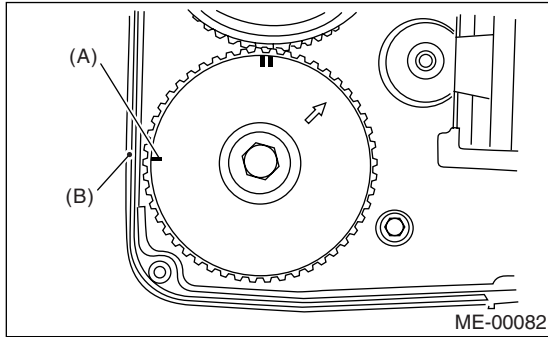
(1) Align mark (A) on the crankshaft sprocket with mark on the oil pump cover at cylinder block.



# Timing Belt Assembly

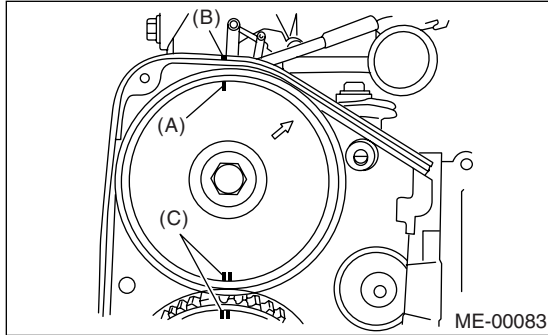
MECHANICAL

(2) Align single line mark (A) on the exhaust camshaft sprocket (RH) with notch (B) on timing belt cover.

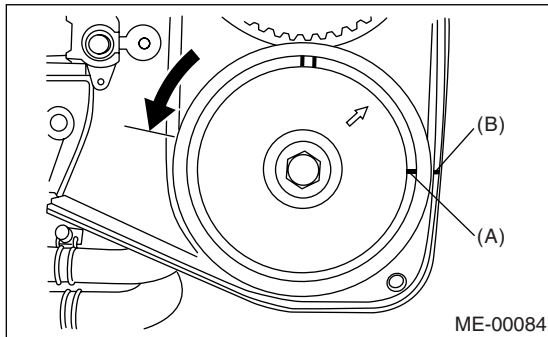


(3) Align single line mark (A) on the intake camshaft sprocket (RH) with notch (B) on timing belt cover.

(Make sure double lines (C) on intake camshaft and exhaust camshaft sprockets are aligned.)



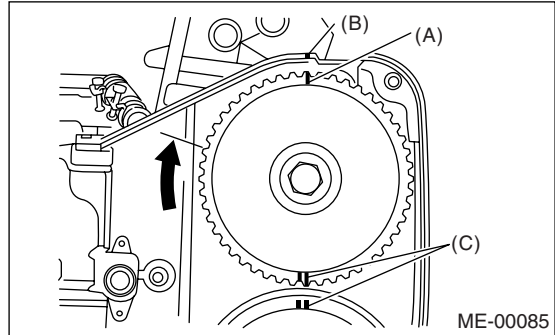
(4) Align single line mark (A) on exhaust camshaft sprocket (LH) with notch (B) on timing belt cover by turning the sprocket counterclockwise (as viewed from front of engine).



(5) Align the single line mark (A) on intake camshaft sprocket (LH) with notch (B) on timing belt

cover by turning the sprocket clockwise (as viewed from front of engine).

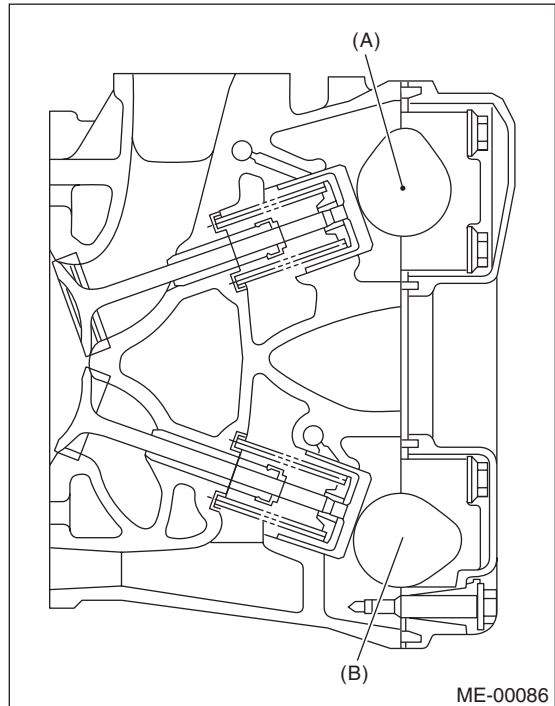
Ensure the double lines (C) on intake and exhaust camshaft sprockets are aligned.



(6) Ensure the camshaft and crankshaft sprockets are positioned properly.

## CAUTION:

- Intake and exhaust camshafts for this DOHC engine can be independently rotated with the timing belts removed. As can be seen from the figure, if the intake and exhaust valves are lifted simultaneously, their heads will interfere with each other, resulting in bent valves.



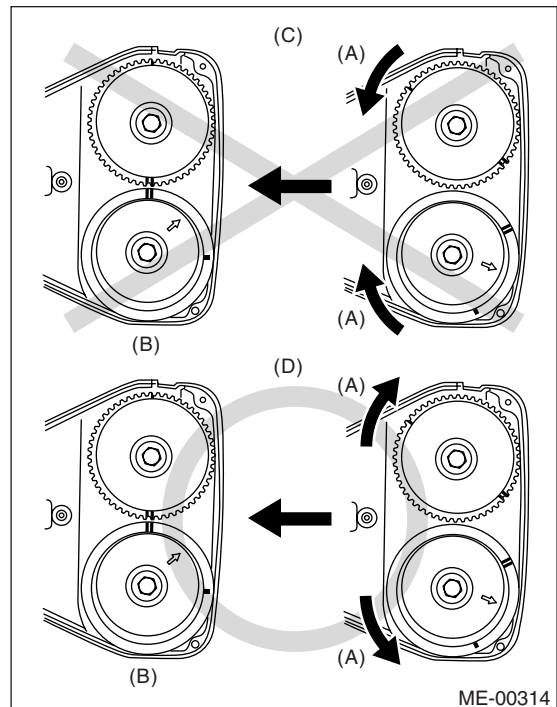
(A) Intake camshaft

(B) Exhaust camshaft

# Timing Belt Assembly

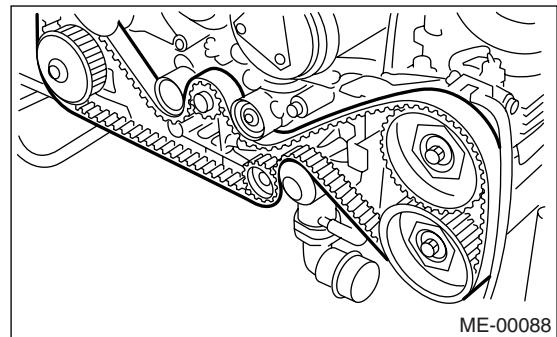
## MECHANICAL

- When the timing belts are not installed, four camshafts are held at the “zero-lift” position, where all cams on camshafts do not push the intake and exhaust valves down. (Under this condition, all valves remain unlifted.)
- When the camshafts are rotated to install the timing belts, #2 intake and #4 exhaust cam of camshafts (LH) are held to push their corresponding valves down. (Under this condition, these valves are held lifted.) Camshafts (RH) are held so that their cams do not push valves down.
- Camshafts (LH) must be rotated from the “zero-lift” position to the position where the timing belt is to be installed at as small an angle as possible, in order to prevent mutual interference of intake and exhaust valve heads.
- Do not allow the camshafts to rotate in the direction shown in the figure as this causes both intake and exhaust valves to lift simultaneously, resulting in interference with their heads.



- (A) Rotating direction
- (B) Timing belt installation position
- (C) Bad example
- (D) Good example

### 3) Installation of timing belt:





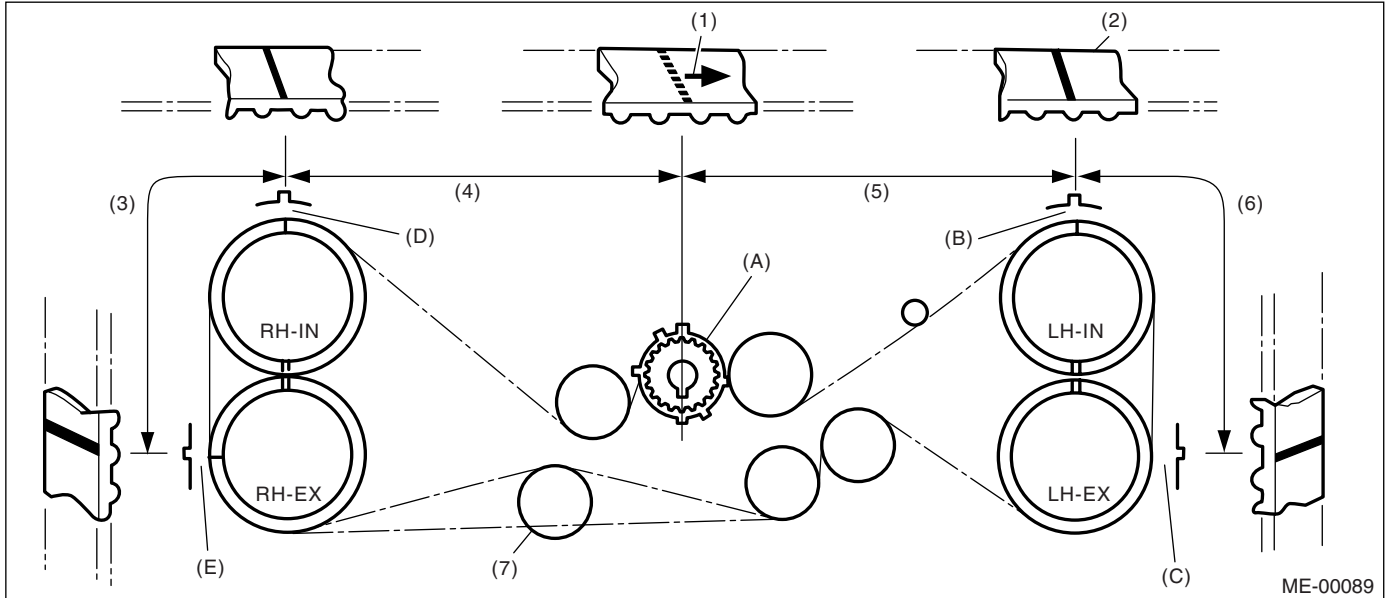
# Timing Belt Assembly

MECHANICAL

Align the alignment mark on timing belt with marks on sprockets in alphabetical order shown in the figure. While aligning marks, position the timing belt properly.

## CAUTION:

- Disengagement of more than three timing belt teeth may result in interference between the valve and piston.
- Ensure the belt's rotating direction is correct.



- |                     |                       |                           |
|---------------------|-----------------------|---------------------------|
| (1) Arrow mark      | (4) 54.5 tooth length | (7) Install it in the end |
| (2) Timing belt     | (5) 51 tooth length   |                           |
| (3) 28 tooth length | (6) 28 tooth length   |                           |

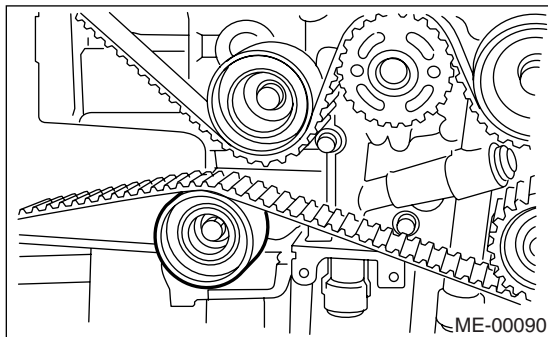
4) Install the belt idlers.

## Tightening torque:

**39 N·m (4.0 kgf·m, 28.9 ft·lb)**

## NOTE:

Make sure that the marks on the timing belt and sprockets are aligned.



5) After ensuring that the marks on the timing belt and sprockets are aligned, remove the stopper pin from tensioner adjuster.

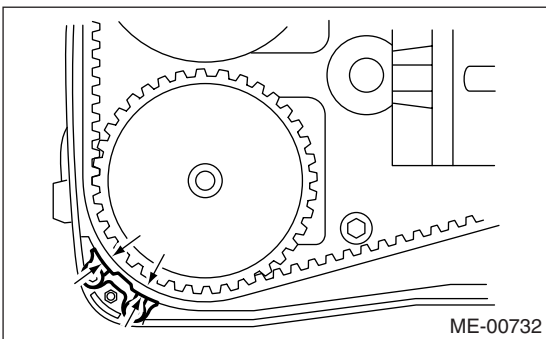
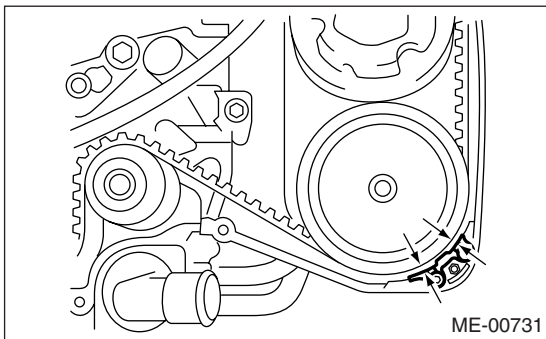
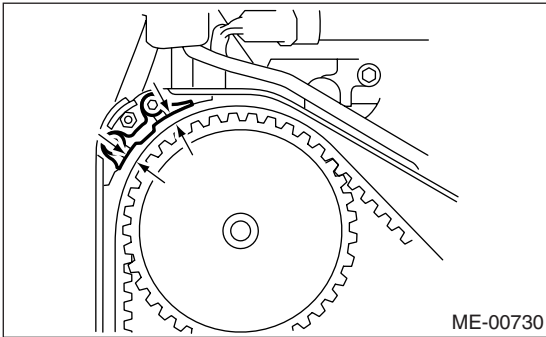
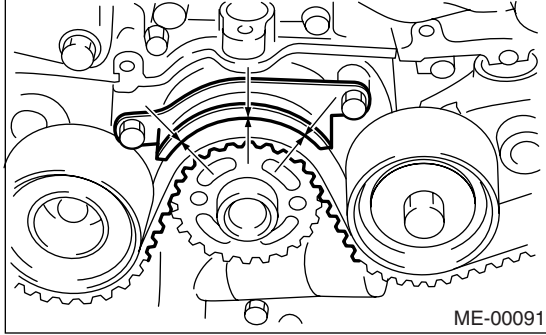
# Timing Belt Assembly

## MECHANICAL

- 6) Install the timing belt guide. (MT model)  
(1) Temporarily tighten the bolts.  
(2) Check and adjust the clearance between timing belt and timing belt guide.

**Clearance:**

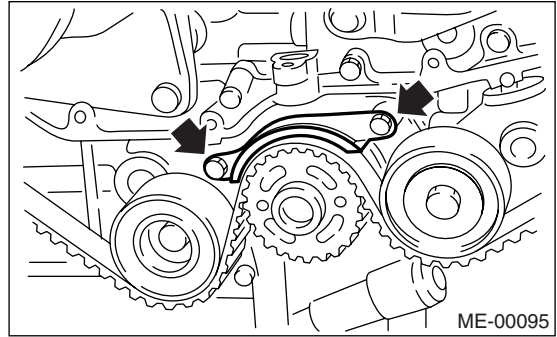
**$1.0 \pm 0.5 \text{ mm}$  ( $0.039 \pm 0.020 \text{ in}$ )**



- (3) Tighten the bolts.

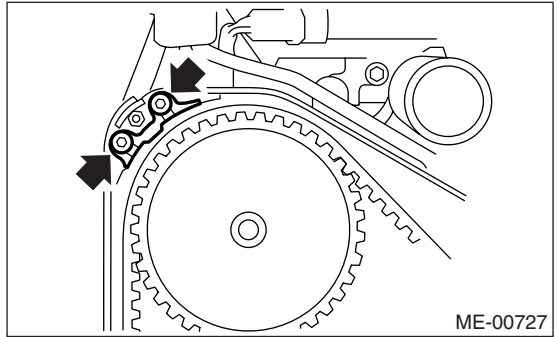
**Tightening torque:**

**$10 \text{ N}\cdot\text{m}$  ( $1.0 \text{ kgf}\cdot\text{m}$ ,  $7.2 \text{ ft}\cdot\text{lb}$ )**



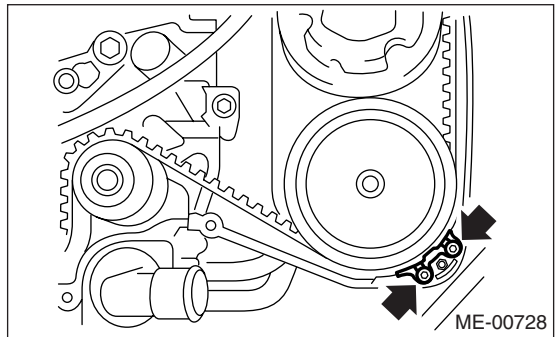
**Tightening torque:**

**$6.4 \text{ N}\cdot\text{m}$  ( $0.7 \text{ kgf}\cdot\text{m}$ ,  $5.1 \text{ ft}\cdot\text{lb}$ )**



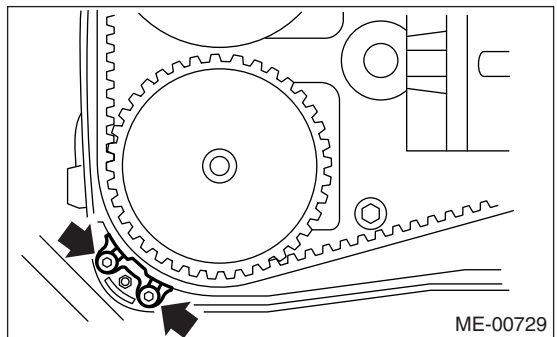
**Tightening torque:**

**$6.4 \text{ N}\cdot\text{m}$  ( $0.7 \text{ kgf}\cdot\text{m}$ ,  $5.1 \text{ ft}\cdot\text{lb}$ )**



**Tightening torque:**

**$6.4 \text{ N}\cdot\text{m}$  ( $0.7 \text{ kgf}\cdot\text{m}$ ,  $5.1 \text{ ft}\cdot\text{lb}$ )**



7) Install the timing belt cover. <Ref. to ME(H4DOTC)-57, INSTALLATION, Timing Belt Cover.>

8) Install the crank pulley. <Ref. to ME(H4DOTC)-55, INSTALLATION, Crank Pulley.>

9) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

## C: INSPECTION

### 1. TIMING BELT

1) Check the timing belt teeth for breaks, cracks, and wear. If any fault is found, replace the belt.

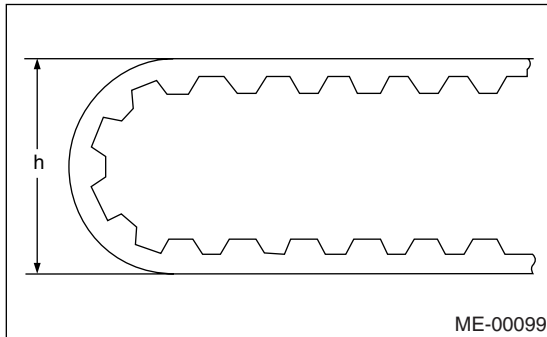
2) Check the condition of back side of belt; if any crack is found, replace the belt.

#### NOTE:

- Be careful not to let oil, grease or coolant contact the belt. Remove quickly and thoroughly if this happens.
- Do not bend the belt sharply.

#### **Bending radius: h**

**60 mm (2.36 in) or more**



### 2. AUTOMATIC BELT TENSION ADJUST-ER

1) Visually check the oil seals for leaks, and rod ends for abnormal wear or scratches. If necessary, replace the automatic belt tension adjuster assembly.

#### NOTE:

Slight traces of oil at rod's oil seal does not indicate a problem.

2) Check that the adjuster rod does not move when a pressure of 294 N (30 kgf, 66 lb) is applied to it. This is to check adjuster rod stiffness.

3) If the adjuster rod is not stiff and moves freely when applying 294 N (30 kgf, 66 lb), check it using the following procedures:

(1) Slowly press the adjuster rod down to the end surface of the cylinder. Repeat this motion 2 or 3 times.

(2) With the adjuster rod moved all the way up, apply a pressure of 294 N (30 kgf, 66 lb) to it. Check the adjuster rod stiffness.

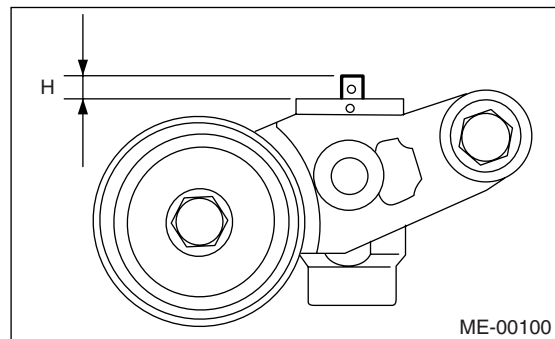
(3) If the adjuster rod is not stiff and moves down, replace the automatic belt tension adjuster assembly with a new one.

#### NOTE:

- Always use a vertical type pressing tool to move the adjuster rod down.
  - Do not use a lateral type vise.
  - Push the adjuster rod vertically.
  - Press-in the push adjuster rod gradually taking more than 3 minutes.
  - Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lb).
  - Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into the cylinder. Doing so may damage the cylinder.
- 4) Measure the extension of rod beyond the body. If it is not within specifications, replace with a new one.

#### **Rod extension: H**

**6.2±0.5 mm (0.244±0.020 in)**



### 3. BELT TENSION PULLEY

1) Check the mating surfaces of timing belt and contact point of adjuster rod for abnormal wear or scratches. Replace the belt tension pulley if faulty.

2) Check the belt tension pulley for smooth rotation. Replace if noise or excessive play is noted.

3) Check the belt tension pulley for grease leakage.

### 4. BELT IDLER

1) Check the belt idler for smooth rotation. Replace if noise or excessive play is noted.

2) Check the outer contacting surfaces of idler pulley for abnormal wear and scratches.

3) Check the belt idler for grease leakage.

# Cam Sprocket

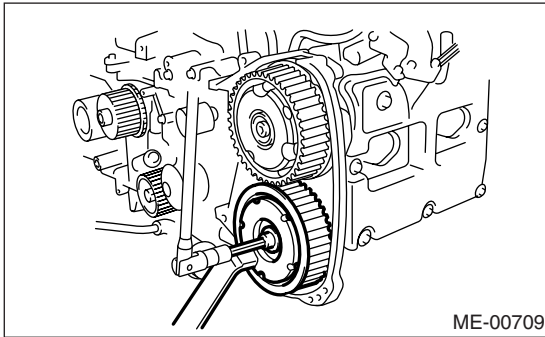
MECHANICAL

## 16. Cam Sprocket

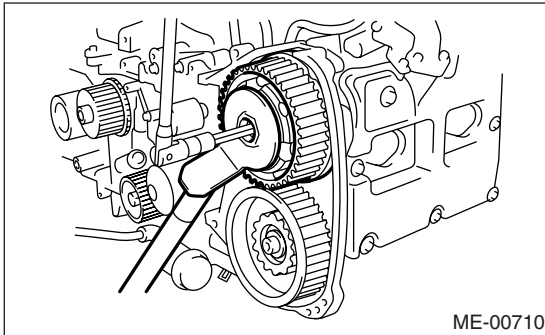
### A: REMOVAL

- 1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-55, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-57, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt assembly. <Ref. to ME(H4DOTC)-58, REMOVAL, Timing Belt Assembly.>
- 5) Remove the camshaft position sensor. (2.0 L model) <Ref. to FU(H4DOTC)-31, REMOVAL, Camshaft Position Sensor.>
- 6) Remove the cam sprockets. To lock the camshaft, use ST.

ST 499207400 CAM SPROCKET WRENCH



ST 499977500 CAM SPROCKET WRENCH



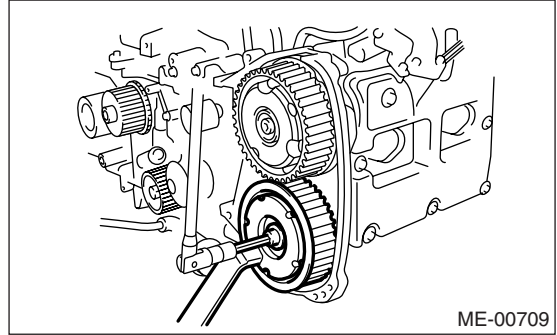
### B: INSTALLATION

- 1) Install the cam sprocket. To lock the camshaft, use ST.

ST 499207400 CAM SPROCKET WRENCH

#### Tightening torque:

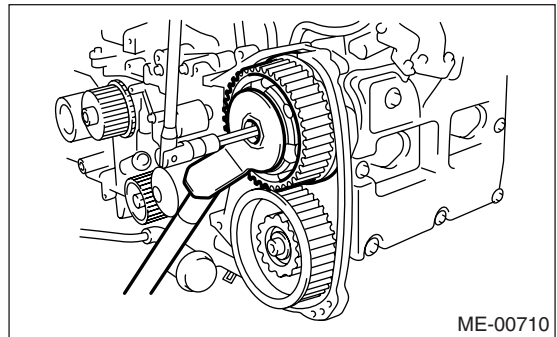
**98 N·m (10 kgf-m, 72.4 ft-lb)**



ST 499977500 CAM SPROCKET WRENCH

#### Tightening torque:

**Tighten to 29.5 N·m (3.0 kgf-m, 21.8 ft-lb) of torque, and then tighten further by 45°**



- 2) Install the camshaft position sensor. <Ref. to FU(H4DOTC)-31, INSTALLATION, Camshaft Position Sensor.>

- 3) Install the timing belt assembly. <Ref. to ME(H4DOTC)-60, INSTALLATION, Timing Belt Assembly.>

- 4) Install the timing belt cover. <Ref. to ME(H4DOTC)-57, INSTALLATION, Timing Belt Cover.>

- 5) Install the crank pulley. <Ref. to ME(H4DOTC)-55, INSTALLATION, Crank Pulley.>

- 6) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

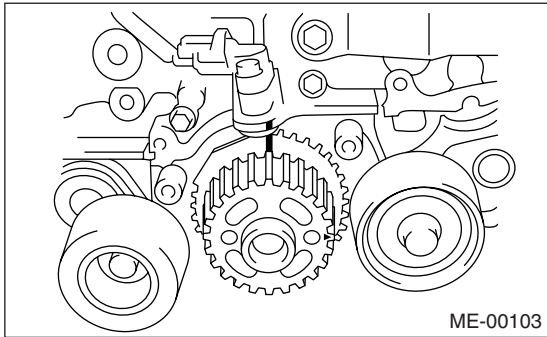
### C: INSPECTION

- 1) Check the sprocket teeth for abnormal wear and scratches.
- 2) Make sure there is no free play between sprocket and key.
- 3) Check the cam sprocket notch used for sensor for damage and contamination of foreign matter.

## 17.Crank Sprocket

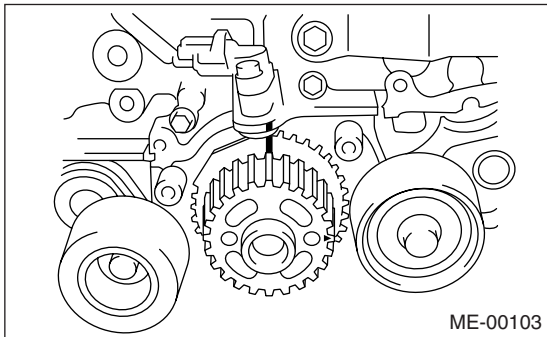
### A: REMOVAL

- 1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-55, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-57, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt assembly. <Ref. to ME(H4DOTC)-58, REMOVAL, Timing Belt Assembly.>
- 5) Remove the cam sprocket. <Ref. to ME(H4DOTC)-67, REMOVAL, Cam Sprocket.>
- 6) Remove the crank sprocket.



### B: INSTALLATION

- 1) Install the crank sprocket.



- 2) Install the cam sprocket. <Ref. to ME(H4DOTC)-67, INSTALLATION, Cam Sprocket.>
- 3) Install the timing belt assembly. <Ref. to ME(H4DOTC)-60, INSTALLATION, Timing Belt Assembly.>
- 4) Install the timing belt cover. <Ref. to ME(H4DOTC)-57, INSTALLATION, Timing Belt Cover.>
- 5) Install the crank pulley. <Ref. to ME(H4DOTC)-55, INSTALLATION, Crank Pulley.>
- 6) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

### C: INSPECTION

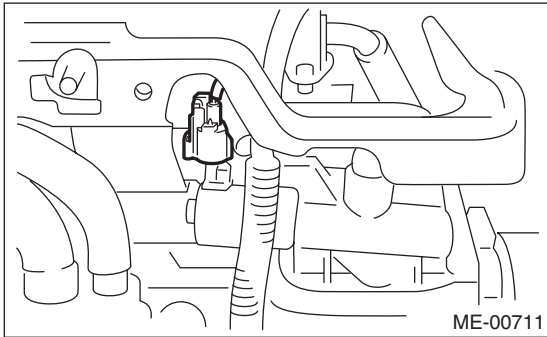
- 1) Check the sprocket teeth for abnormal wear and scratches.

- 2) Make sure there is no free play between sprocket and key.
- 3) Check the crank sprocket notch used for sensor for damage and contamination of foreign matter.

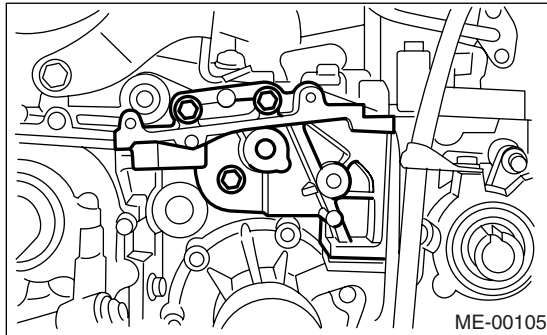
## 18. Camshaft

### A: REMOVAL

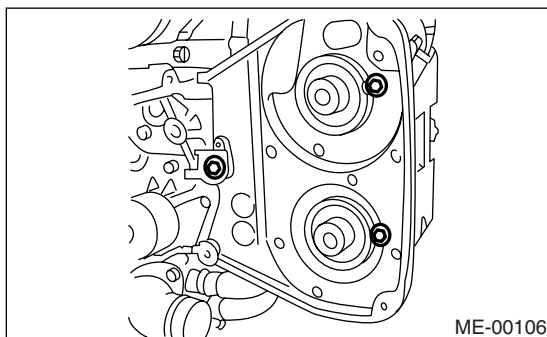
- 1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-55, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-57, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt assembly. <Ref. to ME(H4DOTC)-58, REMOVAL, Timing Belt Assembly.>
- 5) Remove the cam sprocket. <Ref. to ME(H4DOTC)-67, REMOVAL, Cam Sprocket.>
- 6) Remove the crank sprocket. <Ref. to ME(H4DOTC)-68, REMOVAL, Crank Sprocket.>
- 7) Disconnect the oil flow control solenoid valve assembly connector.



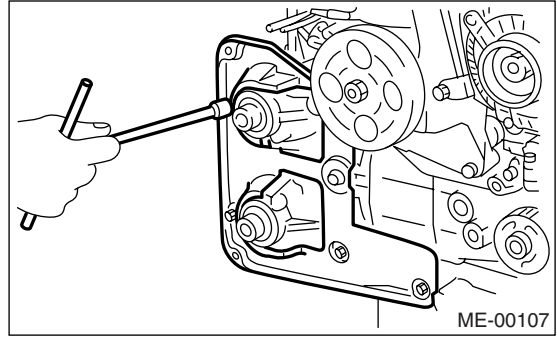
- 8) Remove the tensioner bracket.



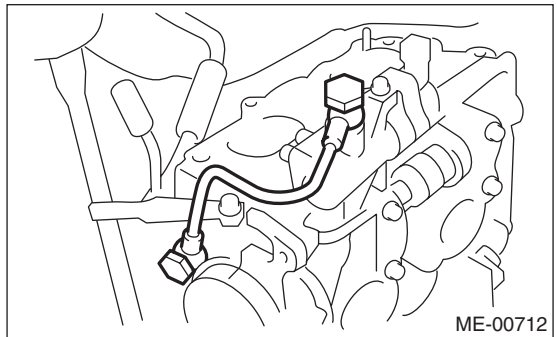
- 9) Remove the timing belt cover No. 2 (LH).



- 10) Remove the timing belt cover No. 2 (RH).

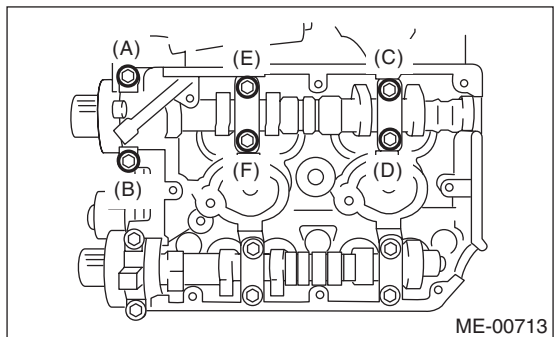


- 11) Remove the spark plug cord.
- 12) Remove the oil level gauge guide. (LH side)
- 13) Remove the rocker cover and gasket.
- 14) Remove the oil pipe.

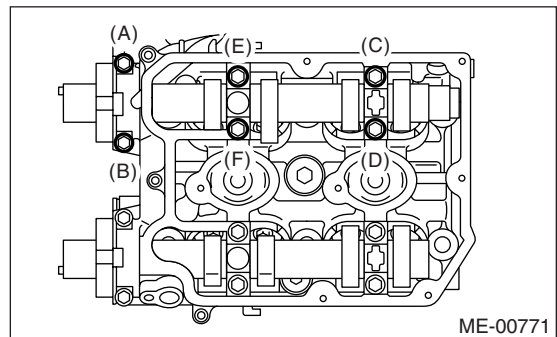


- 15) Loosen the variable oil flow control solenoid valve assembly and intake camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.

- 2.0 L MODEL



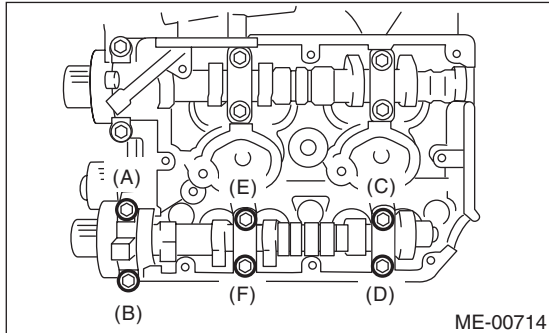
- 2.5 L MODEL



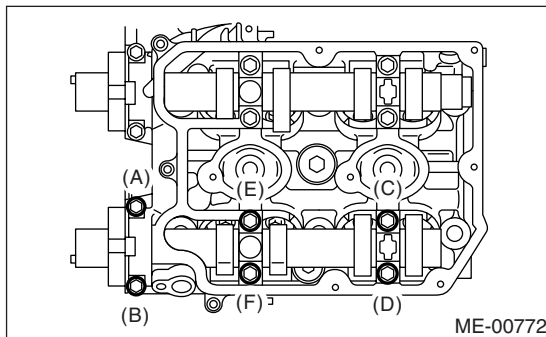
16) Remove the oil flow control solenoid valve assembly, intake camshaft cap, and camshaft.

17) Loosen the exhaust camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.

- 2.0 L MODEL



- 2.5 L MODEL



18) Remove the exhaust camshaft cap and camshaft.

**NOTE:**

Arrange the camshaft caps in order so that they can be installed in their original positions.

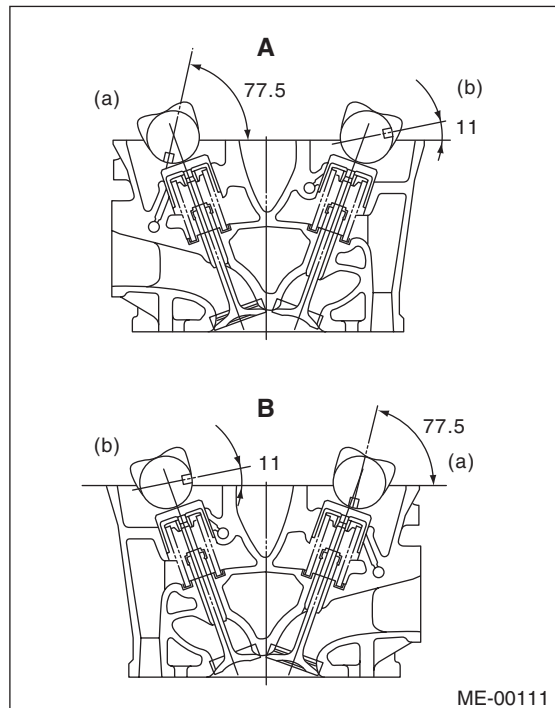
19) Similarly, remove the camshafts (RH) and related parts.

## B: INSTALLATION

1) Camshaft installation: Apply engine oil to cylinder head at camshaft bearing location before installing the camshaft. Install the camshaft so that each valve is close to or in contact with “base circle” of cam lobe.

**NOTE:**

- When the camshafts are positioned as shown in the figure, camshafts need to be rotated at a minimum with the timing belt during installation.
- Camshaft (RH) need not be rotated when set at position shown in the figure. Intake camshaft (LH): Rotate 80° clockwise. Exhaust camshaft (LH): Rotate 45° counterclockwise.



- A Cylinder head (LH)
- B Cylinder head (RH)
- (a) Intake camshaft
- (b) Exhaust camshaft

2) Camshaft cap and oil flow control solenoid valve assembly installation:

- (1) Apply liquid gasket sparingly to cap mating surface.

**NOTE:**

Do not apply liquid gasket excessively. Failure to do so may cause excess packing to come out and flow toward the oil seal, resulting in oil leaks.

# Camshaft

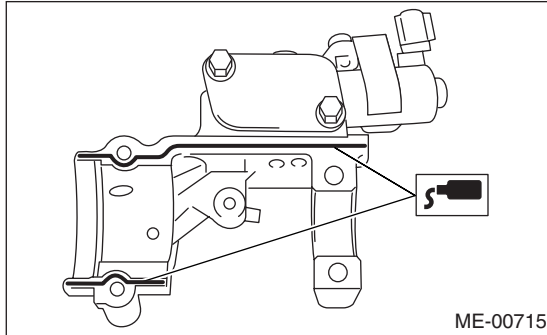
MECHANICAL

## Liquid gasket:

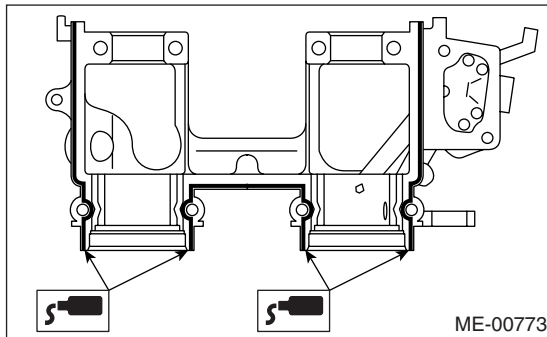
Part No. 004403007

**THREE BOND 1215 or equivalent**

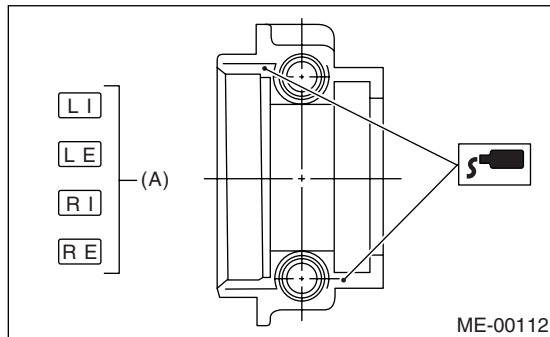
- 2.0 L MODEL



- 2.5 L MODEL



(2) Apply engine oil to cap bearing surface and install the cap on camshaft as shown by identification mark (A).



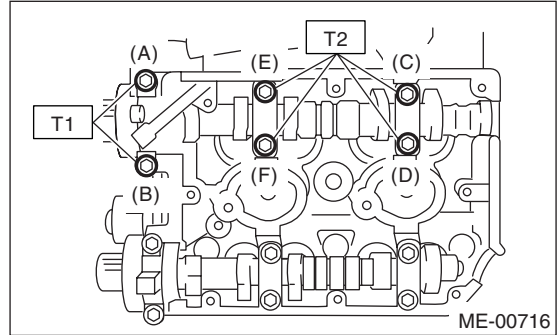
(3) Gradually tighten the camshaft cap and oil control valve assembly in at least two stages in alphabetical sequence shown in the figure, and then tighten to specified torque.

## Tightening torque:

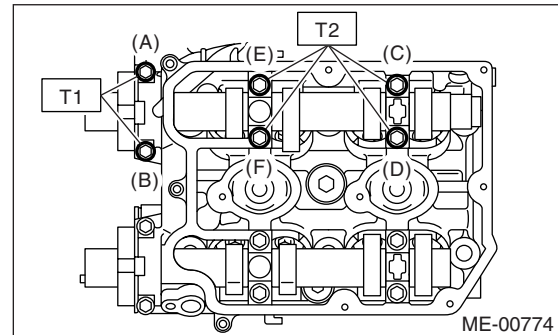
**T1: 10 N·m (1.0 kgf·m, 7 ft·lb)**

**T2: 20 N·m (2.0 kgf·m, 14.5 ft·lb)**

- 2.0 L MODEL



- 2.5 L MODEL



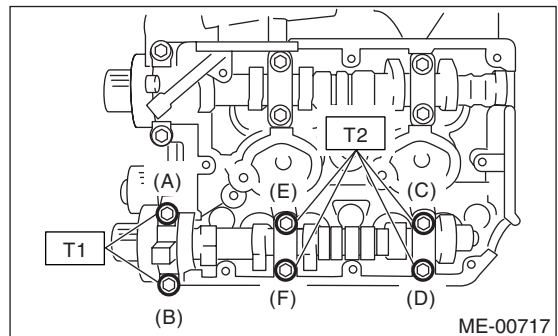
(4) Similarly, tighten cap on the exhaust side. After tightening cap, ensure the camshaft rotates only slightly while holding it at “base” circle.

## Tightening torque:

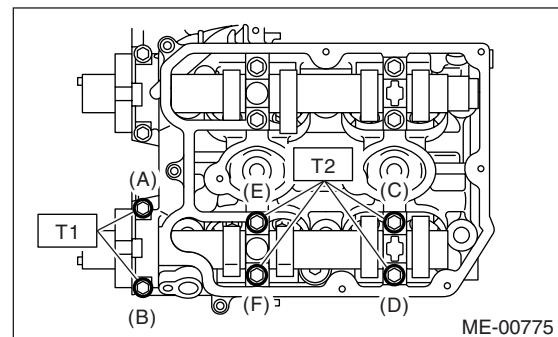
**T1: 10 N·m (1.0 kgf·m, 7 ft·lb)**

**T2: 20 N·m (2.0 kgf·m, 14.5 ft·lb)**

- 2.0 L MODEL



- 2.5 L MODEL



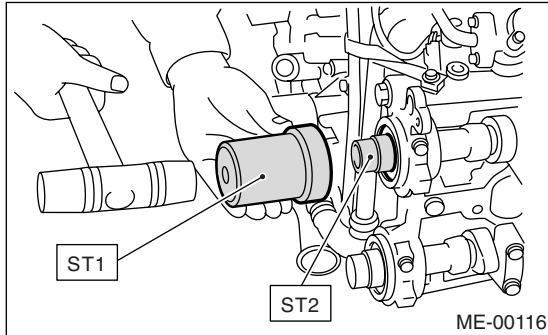


3) Camshaft oil seal installation: Apply grease to new oil seal lips and press onto front end of camshaft by using ST1 and ST2.

**NOTE:**

Use a new oil seal.

- ST1 499587600 OIL SEAL INSTALLER
- ST2 499597200 OIL SEAL GUIDE



4) Rocker cover installation:

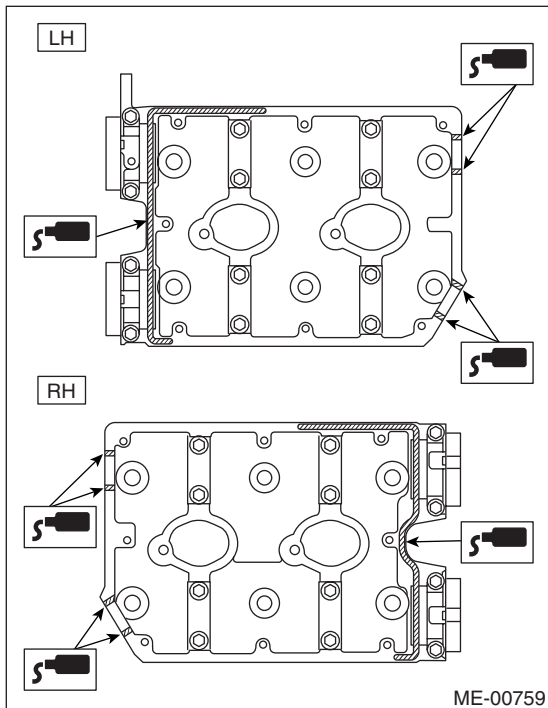
- (1) Install the gasket on rocker cover. Install the peripheral gasket and ignition coil gasket.
- (2) Apply liquid gasket to four front open edges of peripheral gasket.

**Liquid gasket:**

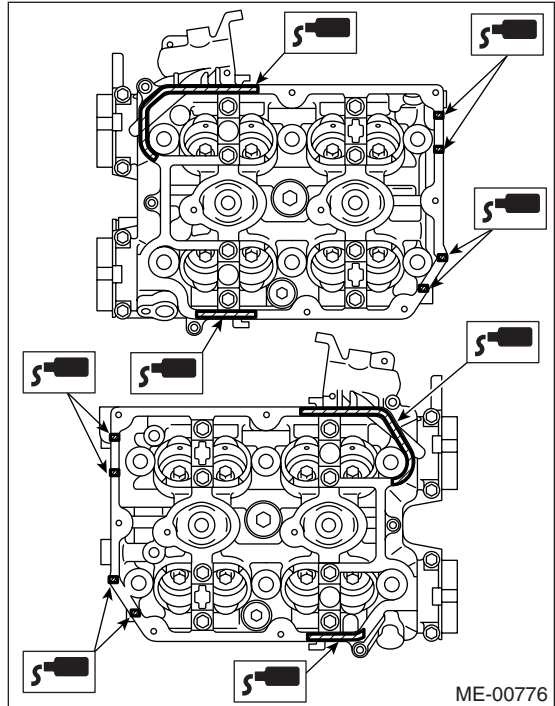
**Part No. 004403007**

**THREE BOND 1215 or equivalent**

- 2.0 L MODEL



- 2.5 L MODEL

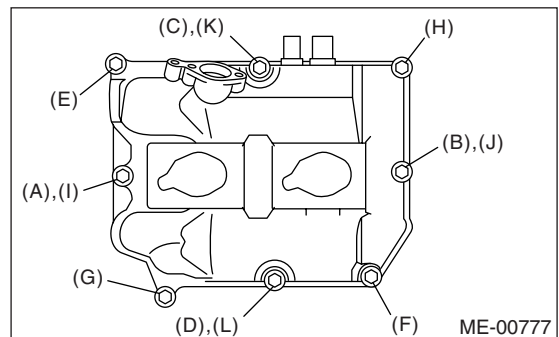


(3) Install the rocker cover on cylinder head. Ensure the gasket is properly positioned during installation.

(4) Tighten the rocker cover tightening bolt in alphabetical sequence shown in the figure, and then tighten to specified torque.

**Tightening torque:**

**6.4 N·m (0.65 kgf·m, 4.7 ft·lb)**



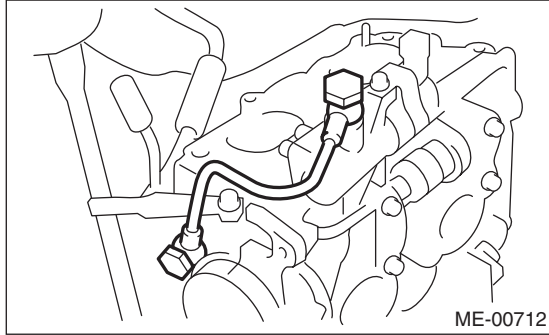
# Camshaft

## MECHANICAL

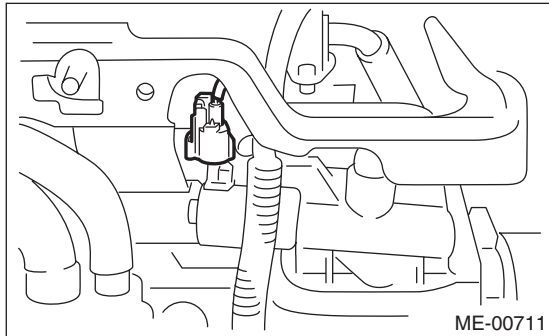
5) Install the oil pipe.

**Tightening torque:**

**30 N·m (3.1 kgf·m, 22.1 ft·lb)**



6) Connect the oil flow control solenoid valve connector.



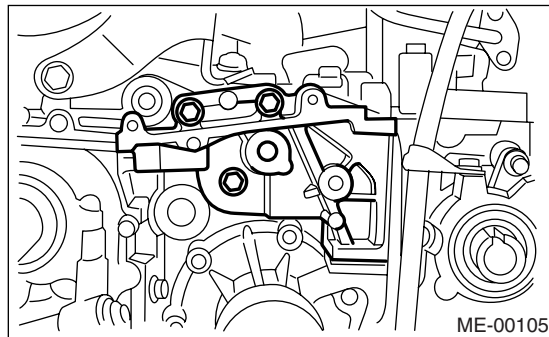
7) Install the spark plug cord.

8) Similarly, install the parts on right-hand side.

9) Install the tensioner bracket.

**Tightening torque:**

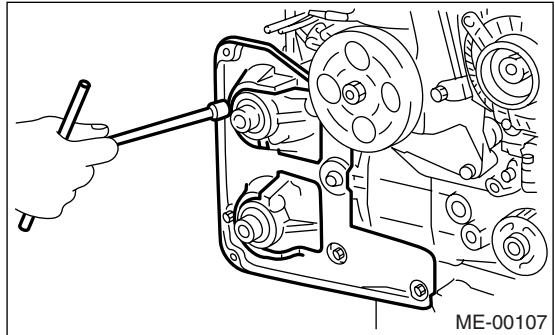
**25 N·m (2.5 kgf·m, 18.1 ft·lb)**



10) Install the timing belt cover No. 2 (RH).

**Tightening torque:**

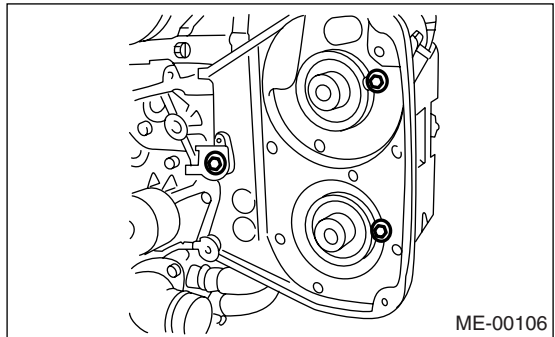
**5 N·m (0.5 kgf·m, 3.6 ft·lb)**



11) Install the timing belt cover No. 2 (LH).

**Tightening torque:**

**5 N·m (0.5 kgf·m, 3.6 ft·lb)**



12) Install the crank sprocket. <Ref. to ME(H4DOTC)-68, INSTALLATION, Crank Sprocket.>

13) Install the cam sprockets. <Ref. to ME(H4DOTC)-67, INSTALLATION, Cam Sprocket.>

14) Install the timing belt assembly. <Ref. to ME(H4DOTC)-60, INSTALLATION, Timing Belt Assembly.>

15) Install the timing belt cover. <Ref. to ME(H4DOTC)-57, INSTALLATION, Timing Belt Cover.>

16) Install the crank pulley. <Ref. to ME(H4DOTC)-55, INSTALLATION, Crank Pulley.>

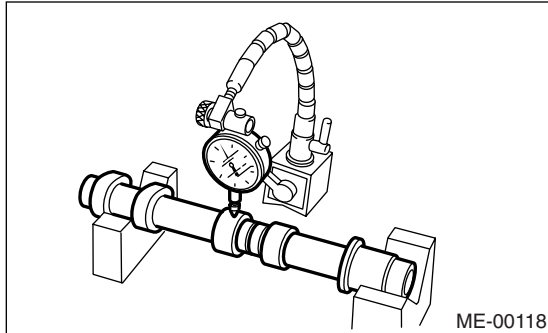
17) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

## C: INSPECTION

1) Measure the bend, and repair or replace if necessary.

**Limit:**

**0.020 mm (0.0008 in)**



2) Check the journal for damage and wear. Replace if faulty.

3) Measure the outside diameter of camshaft journal. If the journal diameter is not as specified, check the oil clearance.

|          | Camshaft journal                           |  |
|----------|--|--|
|          | Front                                      | Center, rear                               |
| Standard | 37.946 — 37.963 mm<br>(1.4939 — 1.4946 in) | 29.946 — 29.963 mm<br>(1.1790 — 1.1796 in) |

4) Measurement of the camshaft journal oil clearance:

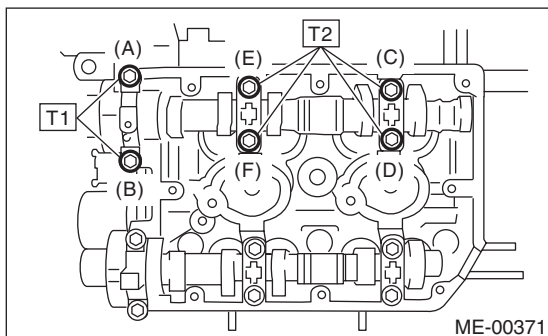
- (1) Clean the bearing caps and camshaft journals.
- (2) Place the camshafts on cylinder head. (Without installing the valve rocker.)
- (3) Place a plastigage across each of the camshaft journals.
- (4) Gradually tighten the cap in at least two stages in alphabetical sequence shown in the figure, and then tighten to specified torque. Do not turn the camshaft.

**Tightening torque:**

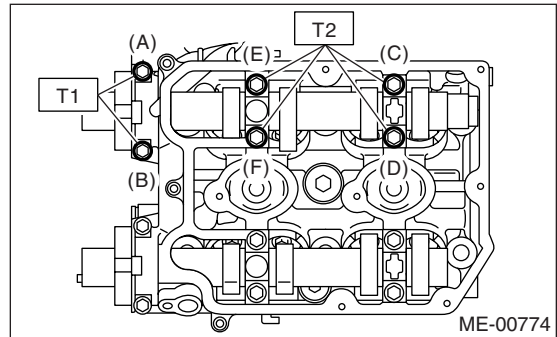
**T1: 10 N·m (1.0 kgf·m, 7.2 ft·lb)**

**T2: 20 N·m (2.0 kgf·m, 14.5 ft·lb)**

- 2.0 L MODEL



- 2.5 L MODEL



(5) Remove the bearing caps.

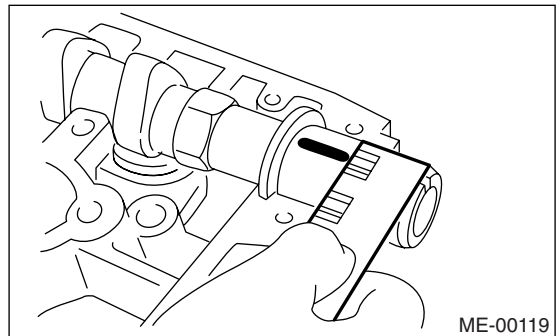
(6) Measure the widest point of plastigage on each journal. If the oil clearance exceeds the limit, replace the camshaft. If necessary, replace the camshaft caps and cylinder head as a set.

**Standard:**

**0.037 — 0.072 mm (0.0015 — 0.0028 in)**

**Limit:**

**0.10 mm (0.0039 in)**



(7) Completely remove the plastigage.

5) Check the cam face condition; remove the minor faults by grinding with oil stone. Measure the cam height H, replace if the limit has been exceeded.

**Cam height: H**

**Standard:**

**2.0 L MODEL**

**Intake:**

**44.75 — 44.85 mm (1.762 — 1.766 in)**

**Exhaust:**

**44.75 — 44.85 mm (1.762 — 1.766 in)**

**2.5 L MODEL**

**Intake:**

**46.55 — 46.65 mm (1.833 — 1.837 in)**

**Exhaust:**

**46.75 — 46.85 mm (1.841 — 1.844 in)**

# Camshaft

MECHANICAL

**Limit:**

## 2.0 L MODEL

**Intake:**

44.65 mm (1.758 in)

**Exhaust:**

44.65 mm (1.758 in)

## 2.5 L MODEL

**Intake:**

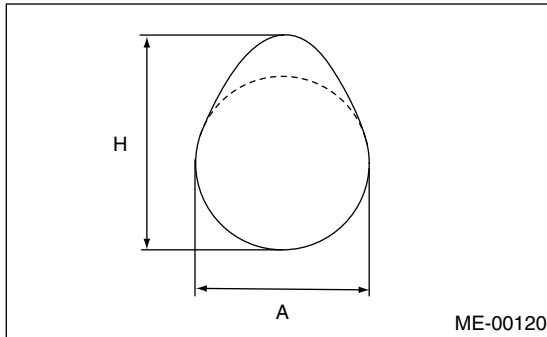
46.45 mm (1.829 in)

**Exhaust:**

46.65 mm (1.837 in)

**Cam base circle diameter A:**

37.0 mm (1.457 in)



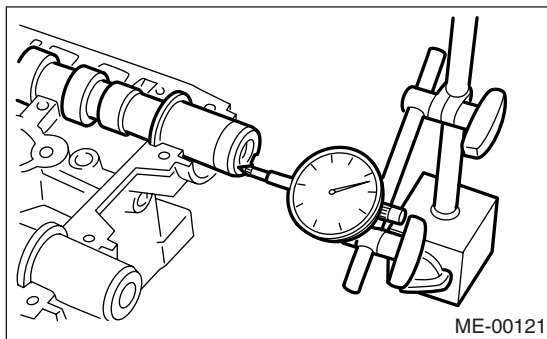
6) Measure the thrust clearance of camshaft with dial gauge. If the clearance exceeds the limit, replace the caps and cylinder head as a set. If necessary, replace the camshaft.

**Standard:**

0.068 — 0.116 mm (0.0027 — 0.0046 in)

**Limit:**

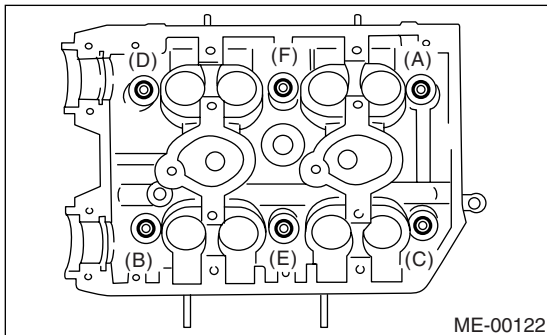
0.14 mm (0.0055 in)



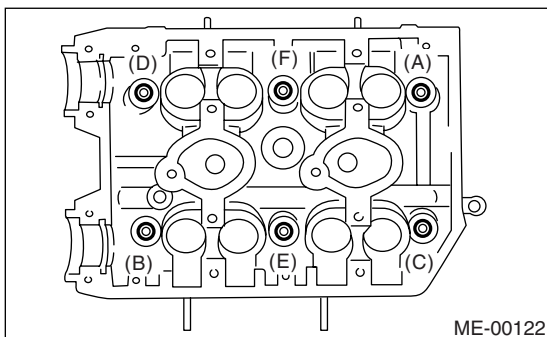
## 19. Cylinder Head Assembly

### A: REMOVAL

- 1) Remove the V-belt. <Ref. to ME(H4DOTC)-52, REMOVAL, V-belt.>
- 2) Remove the crank pulley. <Ref. to ME(H4DOTC)-55, REMOVAL, Crank Pulley.>
- 3) Remove the timing belt cover. <Ref. to ME(H4DOTC)-57, REMOVAL, Timing Belt Cover.>
- 4) Remove the timing belt assembly. <Ref. to ME(H4DOTC)-58, REMOVAL, Timing Belt Assembly.>
- 5) Remove the cam sprocket. <Ref. to ME(H4DOTC)-67, REMOVAL, Cam Sprocket.>
- 6) Remove the intake manifold. <Ref. to FU(H4DOTC)-14, REMOVAL, Intake Manifold.>
- 7) Remove the bolt which installs the A/C compressor bracket on cylinder head.
- 8) Remove the camshaft. <Ref. to ME(H4DOTC)-69, REMOVAL, Camshaft.>
- 9) Remove the cylinder head bolts in alphabetical sequence shown in the figure.  
Leave bolts (A) and (D) engaged by three or four threads to prevent the cylinder head from falling.



- 10) While tapping the cylinder head with a plastic hammer, separate it from cylinder block. Remove the bolts (A) and (D) to remove cylinder head.



- 11) Remove the cylinder head gasket.

### NOTE:

Do not scratch the mating surface of cylinder head and cylinder block.

- 12) Similarly, remove the cylinder head (RH).

### B: INSTALLATION

- 1) Install the cylinder head and gaskets on cylinder block.

### NOTE:

- Use new cylinder head gaskets.
  - Be careful not to scratch the mating surface of cylinder head and cylinder block.
- 2) Tighten the cylinder head bolts.
    - (1) Apply a coat of engine oil to the washers and bolt threads.
    - (2) Tighten all bolts to 29 N·m (3.0 kgf-m, 22 ft-lb) in alphabetical sequence.
    - (3) Tighten all bolts to 69 N·m (7.0 kgf-m, 51 ft-lb) in alphabetical sequence again.
    - (4) Back off all bolts by 180° first; back them off by 180° again in reverse order of installation.
    - (5) Tighten all bolts to 49 N·m (5.0 kgf-m, 36 ft-lb) in alphabetical sequence.
    - (6) Tighten all bolts 80 to 90° in alphabetical sequence.
    - (7) Tighten all bolts by 40 to 45° in alphabetical sequence again.

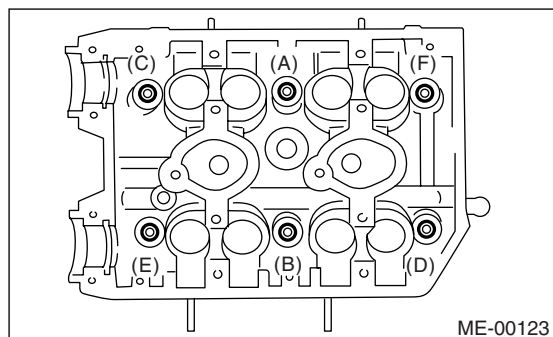
### NOTE:

Do not tighten the bolts by more than 45°.

- (8) Further tighten all bolts (A) and (B) by 40 to 45°.

### NOTE:

Ensure that the total “re-tightening angle” in the previous two steps do not exceed 90°.



- 3) Install the camshaft. <Ref. to ME(H4DOTC)-70, INSTALLATION, Camshaft.>
- 4) Install the A/C compressor bracket on cylinder head.
- 5) Install the intake manifold. <Ref. to FU(H4DOTC)-17, INSTALLATION, Intake Manifold.>
- 6) Install the cam sprocket. <Ref. to ME(H4DOTC)-67, INSTALLATION, Cam Sprocket.>

# Cylinder Head Assembly

## MECHANICAL

---

7) Install the timing belt assembly. <Ref. to ME(H4DOTC)-60, INSTALLATION, Timing Belt Assembly.>

8) Install the timing belt cover. <Ref. to ME(H4DOTC)-57, INSTALLATION, Timing Belt Cover.>

9) Install the crank pulley. <Ref. to ME(H4DOTC)-55, INSTALLATION, Crank Pulley.>

10) Install the V-belt. <Ref. to ME(H4DOTC)-52, INSTALLATION, V-belt.>

## C: DISASSEMBLY

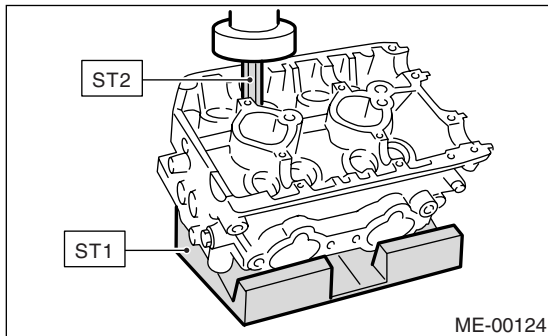
1) Remove the valve lifters.

2) Compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

ST1 498267600 CYLINDER HEAD TABLE  
ST2 499718000 VALVE SPRING REMOVER

### NOTE:

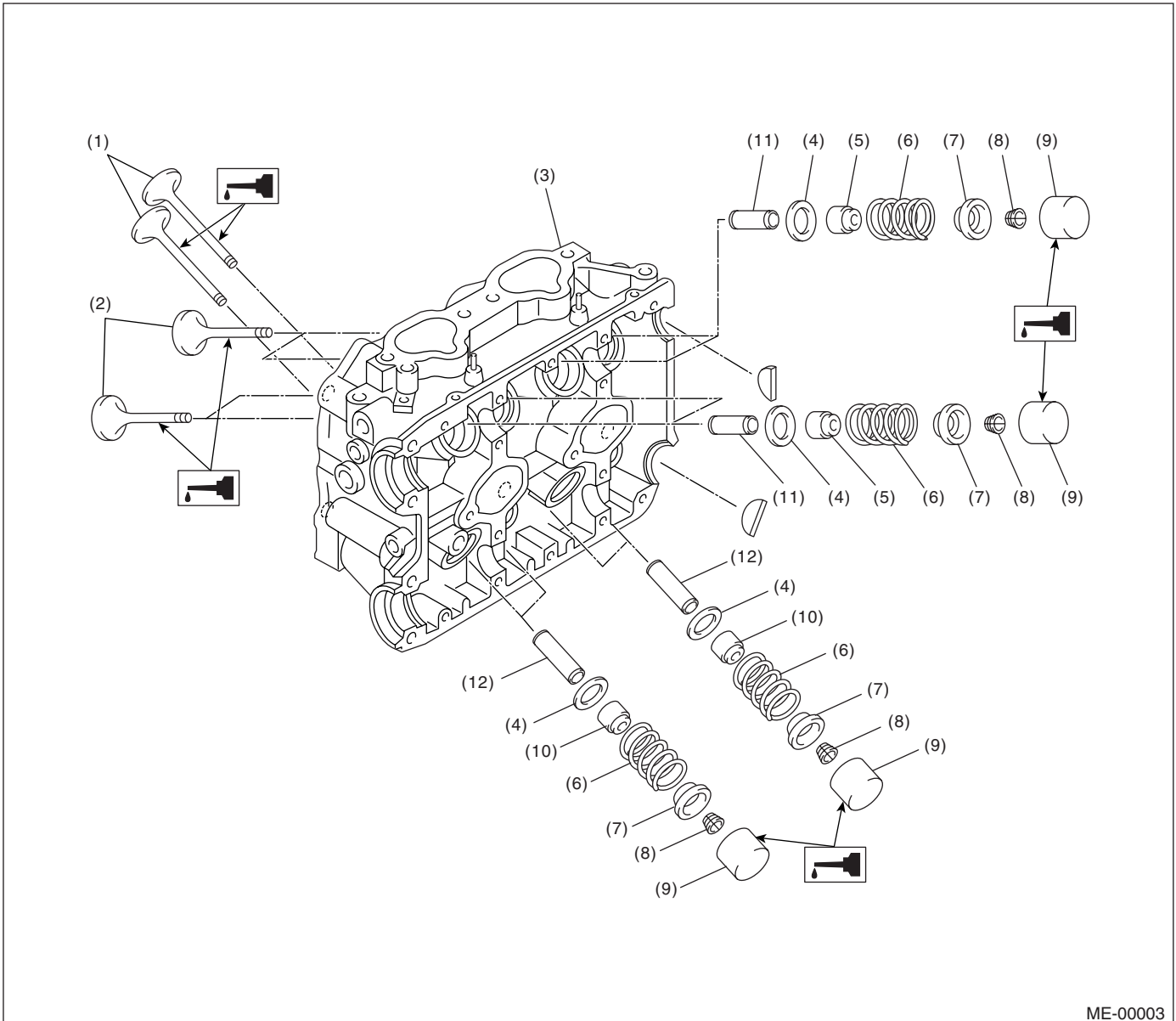
- Keep the removed parts in order for re-installing in their original positions.
- Mark each valve to prevent confusion.
- Use extreme care not to damage the lips of the intake valve oil seals and exhaust valve oil seals.



# Cylinder Head Assembly

MECHANICAL

## D: ASSEMBLY



ME-00003

- |                       |                           |                             |
|-----------------------|---------------------------|-----------------------------|
| (1) Exhaust valve     | (5) Intake valve oil seal | (9) Valve lifter            |
| (2) Intake valve      | (6) Valve spring          | (10) Exhaust valve oil seal |
| (3) Cylinder head     | (7) Retainer              | (11) Intake valve guide     |
| (4) Valve spring seat | (8) Retainer key          | (12) Exhaust valve guide    |

# Cylinder Head Assembly

## MECHANICAL

- 1) Installation of valve spring and valve.
  - (1) Coat the stem of each valve with engine oil and insert the valve into valve guide.

### NOTE:

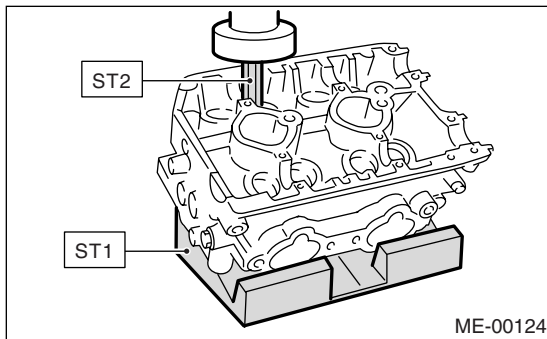
When inserting the valve into valve guide, use special care not to damage the oil seal lip.

- (2) Set the cylinder head on ST1.
- (3) Install the valve spring and retainer using ST2.

ST1 498267600 CYLINDER HEAD TABLE  
ST2 499718000 VALVE SPRING REMOVER

### NOTE:

Be sure to install the valve springs with their close-coiled end facing the seat on cylinder head.



- (4) Compress the valve spring, and then fit the valve spring retainer key.
  - (5) After installing, tap the valve spring retainers lightly with wooden hammer for better seating.
- 2) Apply oil to the surface of the valve lifter.
  - 3) Install the valve lifter.

## E: INSPECTION

### 1. CYLINDER HEAD

- 1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect the important areas by means of red check.
- 2) Measure the warping of the cylinder head surface that mates with crankcase by using a straight edge (A) and thickness gauge (B). If the warping exceeds 0.05 mm (0.0020 in), regrind the surface with a surface grinder.

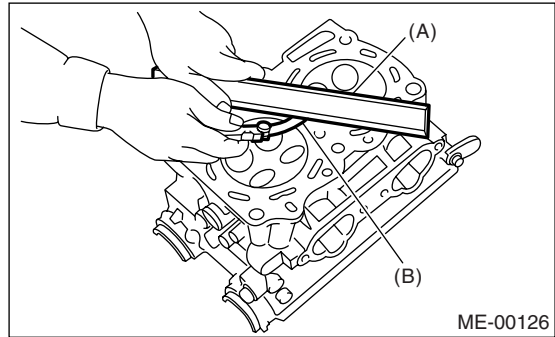
**Warping limit:**  
0.05 mm (0.0020 in)

**Grinding limit:**  
0.3 mm (0.012 in)

**Standard height of cylinder head:**  
127.5 mm (5.02 in)

### NOTE:

Uneven torque for the cylinder head nuts can cause warping. When reassembling, pay special attention to the torque so as to tighten evenly.



### 2. VALVE SEAT

Inspect the intake and exhaust valve seats, and then correct the contact surfaces with valve seat cutter if they are defective or when valve guides are replaced.

**Valve seat width:  $W$**

#### Intake

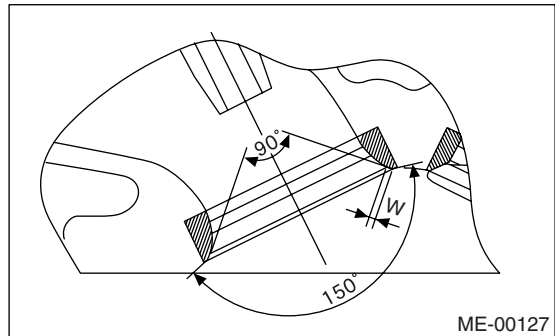
**Standard**  
1.0 mm (0.039 in)

**Limit**  
1.7 mm (0.067 in)

#### Exhaust

**Standard**  
1.5 mm (0.059 in)

**Limit**  
2.2 mm (0.087 in)





## 3. VALVE GUIDE

1) Check the clearance between valve guide and stem. The clearance can be checked by measuring the outside diameter of valve stem and the inside diameter of valve guide with outside and inside micrometers respectively.

**Clearance between the valve guide and valve stem:**

**Standard**

**Intake**

**0.030 — 0.057 mm (0.0012 — 0.0022 in)**

**Exhaust**

**0.040 — 0.067 mm (0.0016 — 0.0026 in)**

**Limit**

**0.15 mm (0.0059 in)**

2) If the clearance between valve guide and stem exceeds the limit, replace the valve guide or valve itself whichever shows greater amount of wear. See the following procedure for valve guide replacement.

**Valve guide inner diameter:**

**6.000 — 6.012 mm (0.2362 — 0.2367 in)**

**Valve stem outer diameters:**

**Intake**

**5.955 — 5.970 mm (0.2344 — 0.2350 in)**

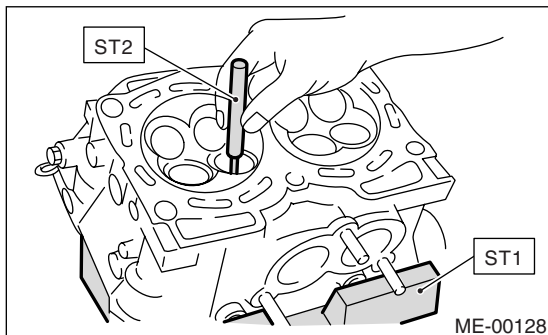
**Exhaust**

**5.945 — 5.960 mm (0.2341 — 0.2346 in)**

(1) Place the cylinder head on ST1 with the combustion chamber upward so that valve guides enter the holes in ST1.

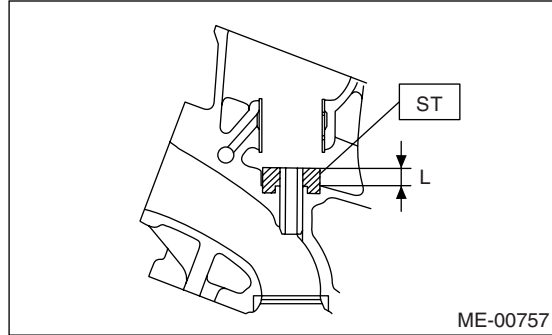
(2) Insert the ST2 into valve guide and press it down to remove the valve guide.

ST1 498267600 CYLINDER HEAD TABLE  
ST2 499767200 VALVE GUIDE REMOVER



(3) Turn the cylinder head upside down and place ST as shown in the figure.

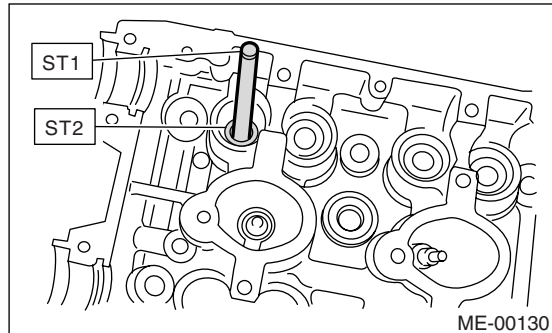
ST 18251AA020 VALVE GUIDE ADJUSTER



(4) Before installing a new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.

(5) Put a new valve guide, coated with sufficient oil, in cylinder head, and insert ST1 into valve guide. Press in until the valve guide upper end is flush with the upper surface of ST2.

ST1 499767200 VALVE GUIDE REMOVER  
ST2 18251AA020 VALVE GUIDE ADJUSTER



(6) Check the valve guide protrusion.

**Valve guide protrusion: L**

**15.8 — 16.2 mm (0.622 — 0.638 in)**

(7) Ream the inside of valve guide with ST. Gently rotate the reamer clockwise while pressing it lightly into the valve guide, and return it also rotating clockwise.

(8) After reaming, clean the valve guide to remove chips.

ST 499767400 VALVE GUIDE REAMER

**CAUTION:**

**Apply engine oil to ST when reaming.**

**NOTE:**

- If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.
- If the inner surface of the valve guide becomes lustrous and the reamer does not chip, use a new reamer or remedy the reamer.

# Cylinder Head Assembly

## MECHANICAL

(9) Recheck the contact condition between valve and valve seat after replacing the valve guide.

### 4. INTAKE AND EXHAUST VALVE

1) Inspect the flange and stem of valve, and replace if damaged, worn, or deformed, or if "H" is less than the specified limit.

**H:**

#### Intake (A)

**Standard**

1.2 mm (0.047 in)

**Limit**

0.8 mm (0.031 in)

#### Exhaust (B)

**Standard**

1.5 mm (0.059 in)

**Limit**

0.8 mm (0.031 in)

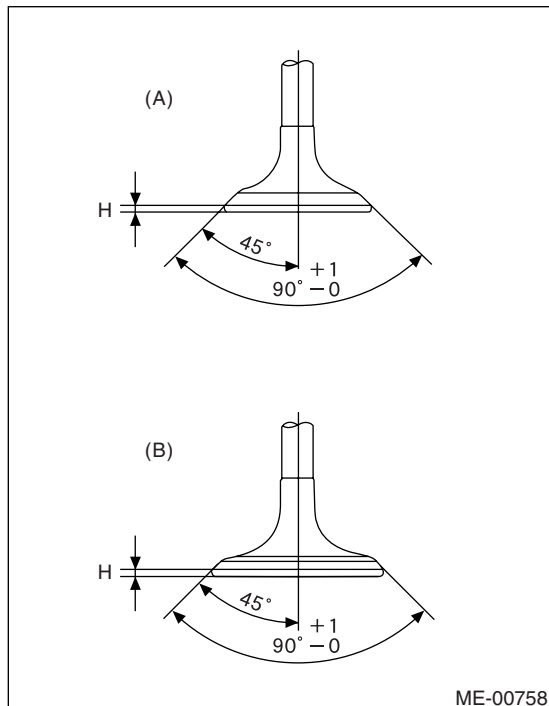
#### Valve overall length:

**Intake (A)**

104.4 mm (4.110 in)

**Exhaust (B)**

104.65 mm (4.120 in)



2) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. Install a new valve oil seal after lapping.

**NOTE:**

- Replace intake valve oil seal with a new one if the valve and seat are lapped.
- Differentiate intake valve and exhaust valve by overall length.

### 5. VALVE SPRINGS

1) Check the valve springs for damage, free length, and tension. Replace the valve spring if it is not within specifications presented in the table.

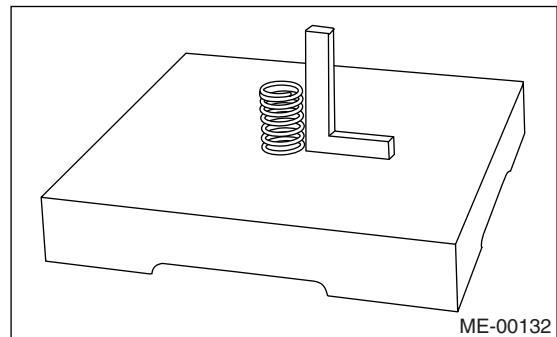
2) To measure the squareness of valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.

- 2.0 L model

|                       |      | Valve spring  |
|-----------------------|------|---|
| Free length           |      | 44.67 mm (1.759 in)   |
| Tension/spring height | Set  | 206 — 236 N<br>(21.0 — 24.1 kgf, 46.3 — 53.1 lb)<br>/36.0 mm (1.417 in) |
|                       | Lift | 485 — 537 N (49.5 — 54.8 kgf, 109 — 121 lb) /26.6 mm (1.041 in)         |
| Squareness            |      | 2.5°, 2.0 mm (0.079 in)   |

- 2.5 L model

|                       |      | Valve spring  |
|-----------------------|------|---|
| Free length           |      | 47.32 mm (1.863 in)   |
| Tension/spring height | Set  | 205 — 235 N<br>(20.9 — 24.0 kgf, 46.1 — 52.8 lb)<br>/36.0 mm (1.417 in) |
|                       | Lift | 426 — 490 N (43.4 — 50.0 kgf, 95.8 — 110 lb) /26.5 mm (1.04 in)         |
| Squareness            |      | 2.5°, 2.1 mm (0.083 in)   |



## 6. INTAKE AND EXHAUST VALVE OIL SEAL

1) Replace the oil seal with a new one in the following condition, Refer to procedure 2) for replacement procedure.

- Lip portion is damaged.
- Spring is out of place.
- Valve and valve seat are reconditioned.
- Valve guide is replaced.

2) Place the cylinder head on ST1.

3) Press-fit oil seal to the specified dimension indicated in the figure by using ST2.

ST1 498267600 CYLINDER HEAD TABLE

ST2 499718000 VALVE SPRING REMOVER

### CAUTION:

- Apply engine oil to oil seal before press-fit.
- When press-fitting oil seal, do not use hammer or strike in.
- Differentiate between the intake valve oil seal and exhaust valve oil seal by noting their difference in color.

### Color of rubber part:

Intake [Black]

Exhaust [Brown]

### Color of spring part:

#### 2.0 L model

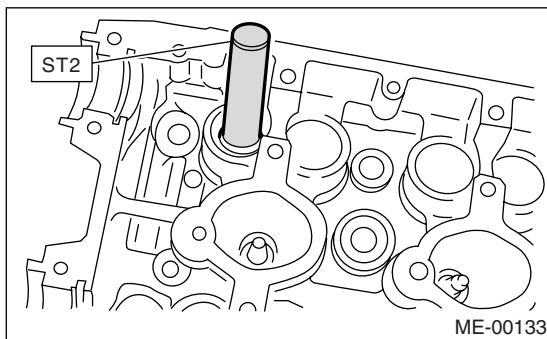
Intake [Yellow]

Exhaust [Yellow]

#### 2.5 L model

Intake [White]

Exhaust [White]

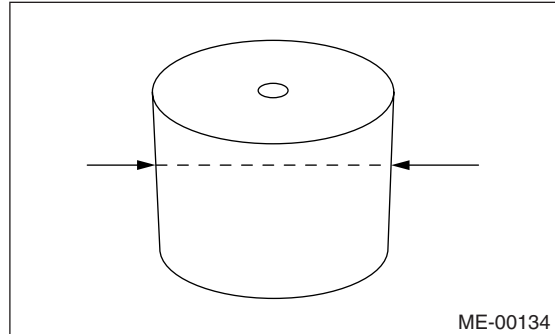


## 7. VALVE LIFTER

- 1) Visually check the valve lifter.
- 2) Measure the outer diameter of valve lifter.

### Outer diameter:

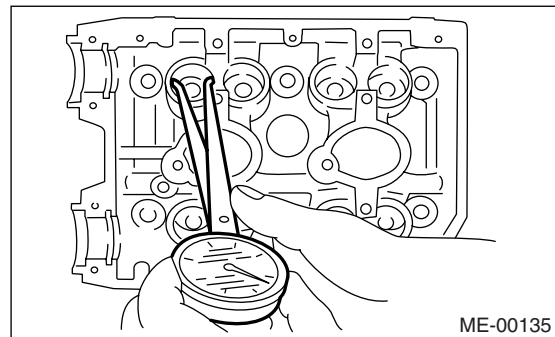
**34.959 — 34.975 mm (1.3763 — 1.3770 in)**



- 3) Measure the inner diameter of valve lifter mating part on cylinder head.

### Inner diameter:

**34.994 — 35.016 mm (1.3777 — 1.3786 in)**



### NOTE:

If difference between outer diameter of valve lifter and inner diameter of valve lifter mating part is over the limit, replace the cylinder head.

### Standard:

**0.019 — 0.057 mm (0.0007 — 0.0022 in)**

### Limit:

**0.100 mm (0.0039 in)**

## F: DISPOSAL

### CAUTION:

- **Metallic sodium is enclosed in the exhaust valve. Metallic sodium is extremely alkaline and may produce severe chemical reactions. Full consideration must therefore be given to the following points when handling or disposing of the valve.**
- **Since metallic sodium may cause blindness if contacted with the eyes, burns if contacted with the skin, and fire, do not deliberately take the valve apart.**

If the valve is damaged, remove the valve and neutralize it by immersing it in water, and dispose of it in the same way that general steel materials are disposed of. The disposal method is described in the following.

- 1) Wearing rubber gloves, remove the damaged valve from the cylinder head.
- 2) Prepare a large receptacle (bucket or other container) in a well ventilated location, and fill the receptacle with water (at least 10 ℓ (10 US qt, 9 Imp qt)).
- 3) Immerse the damaged valve in the receptacle.

### CAUTION:

**A severe reaction may occur, so stand at least 2 — 3 m from the receptacle. Because the reaction will produce hydrogen gas, moreover, keep the receptacle away from sparks or flames.**

- 4) Once the reaction is completed (about 4 — 5 hours have elapsed), carefully remove the valve using large pincers so that the reaction liquid does not contact your skin, and dispose of it with other parts that are being disposed of.
- 5) The reaction liquid is a strong alkaline solution, so it must be disposed of in accordance with local regulations.

### CAUTION:

**Make sure the reaction liquid does not contact your skin. If contact with skin occurs, immediately wash the affected area with large quantities of water.**

