FUEL INJECTION (FUEL SYSTEMS)(STI)

FU(STI)

1. General Description
2. Throttle Body
3. Intake Manifold
4. Engine Coolant Temperature Sensor
5. Crankshaft Position Sensor
6. Camshaft Position Sensor
7. Knock Sensor
8. Throttle Position Sensor
9. Mass Air Flow and Intake Air Temperature Sensor
10. Manifold Absolute Pressure Sensor
11. Fuel Injector
12. Tumble Generator Valve Assembly
13. Tumble Generator Valve Actuator
14. Oil Flow Control Solenoid Valve
15. Wastegate Control Solenoid Valve
16. Front Oxygen (A/F) Sensor
17. Rear Oxygen Sensor
18. SI-DRIVE (SUBARU Intelligent Drive) Selector
19. Engine Control Module (ECM)
20. Main Relay
21. Oxygen Sensor Relay
22. Electronic Throttle Control Relay
23. Fuel Pump Relay
24. Fuel Pump Control Unit
25. Fuel
26. Fuel Tank Protector
27. Fuel Tank
28. Fuel Filler Pipe
29. Fuel Pump
30. Fuel Level Sensor
31. Fuel Sub Level Sensor
32. Fuel Filter
33. Pulsation Damper Assembly
34. Pressure Regulator & Damper Assembly
35. Fuel Delivery, Return and Evaporation Lines

36. Fuel System Trouble in General

FUEL INJECTION (FUEL SYSTEMS)(STI) > General Description

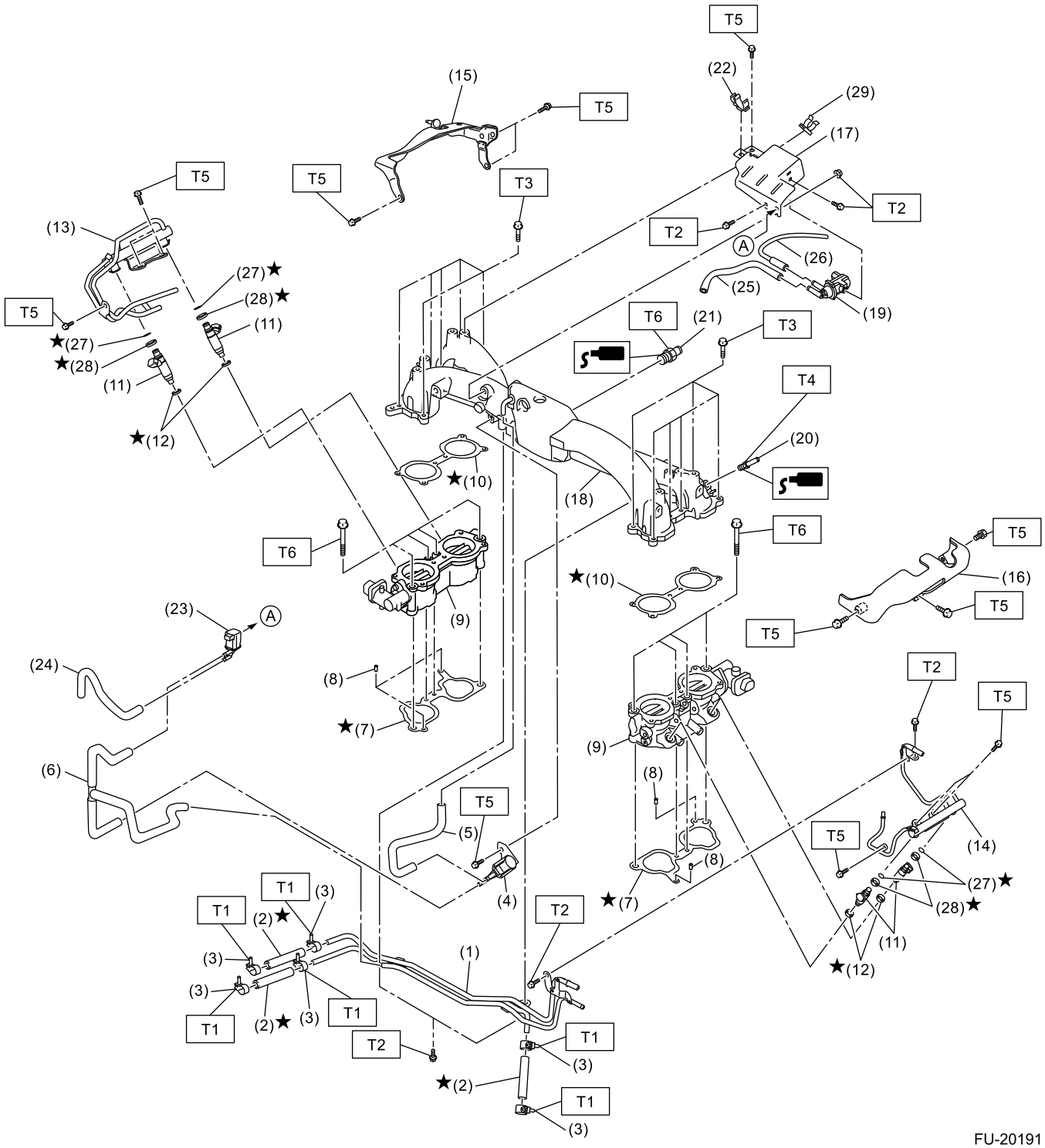
SPECIFICATION

Fuel tank	Capacity	60 L (15.9 US gal, 13.2 Imp gal)
	Location	Under rear seat
Fuel pump	Type	Impeller
	Shutoff discharge pressure	900 kPa (9.18 kg/cm^2, 130.5 psi) or less
	Discharge rate	175 L (46.2 US gal, 38.5 Imp gal)/h or more [12 V at 300 kPa (3.06 kg/cm^2, 43.5 psi)]
Fuel filter		In-tank type

FUEL INJECTION (FUEL SYSTEMS)(STI) > General Description

COMPONENT

1. INTAKE MANIFOLD



FU-20191

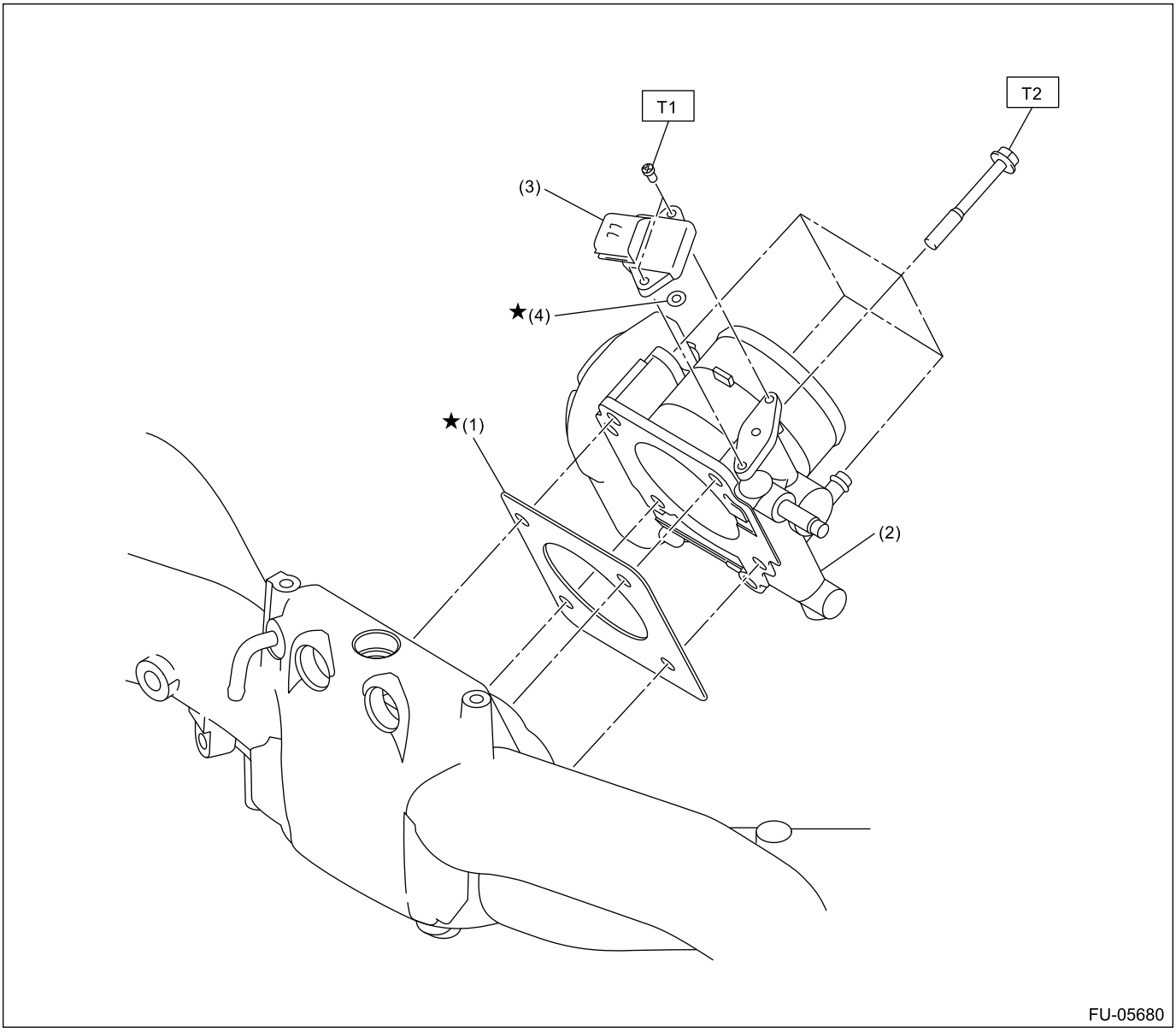
(1) Fuel pipe ASSY
(2) Fuel hose
(3) Clamp
(4) Purge control solenoid valve 1
(5) Vacuum hose A
(14) Fuel injector pipe LH
(15) Fuel pipe protector RH
(16) Fuel pipe protector LH
(17) Solenoid valve bracket
(18) Intake manifold
(27) O-ring
(28) Rubber
(29) Clip

Tightening torque: N·m (kgf-m, ft-lb)

(6) Vacuum control hose
(7) Intake manifold gasket
(8) Guide pin
(9) Tumble generator valve ASSY
(10) Tumble generator valve gasket
(11) Fuel injector
(12) Seal ring
(13) Fuel injector pipe RH
(19) Wastegate control solenoid valve
(20) Nipple
(21) Nipple
(22) Clip
(23) Purge control solenoid valve 2
(24) Vacuum hose
(25) Vacuum hose
(26) Air control hose

T1: 1.25 (0.1, 0.9)
T2: 6.4 (0.7, 4.7)
T3: 8.2 (0.8, 6.0)
T4: 17 (1.7, 12.5)
T5: 19 (1.9, 14.0)
T6: 25 (2.5, 18.4)

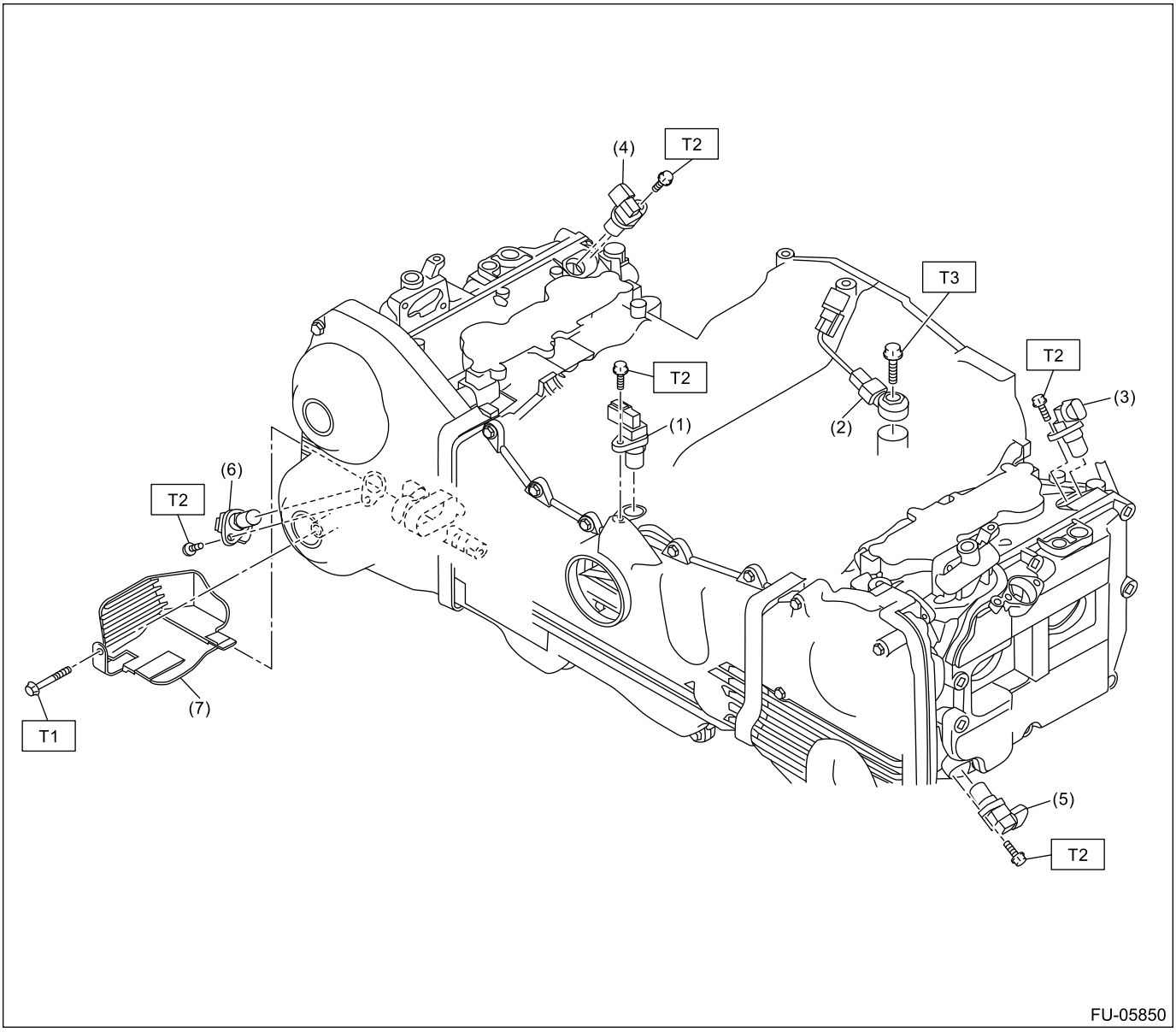
2. AIR INTAKE SYSTEM



(1) Gasket
(2) Throttle body
(3) Manifold absolute pressure sensor
(4) O-ring

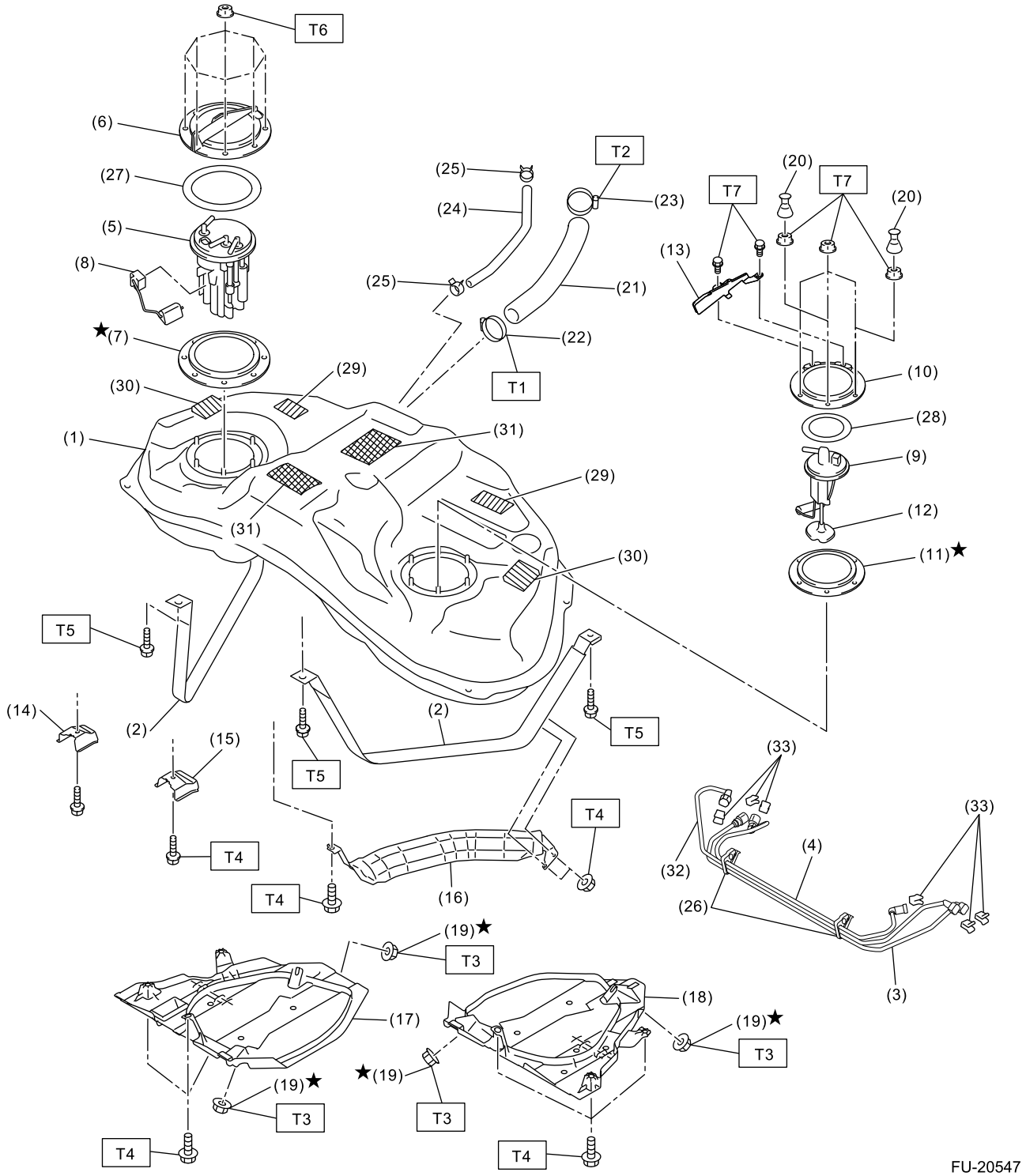
Tightening torque: N·m (kgf-m, ft-lb)
T1: 2 (0.2, 1.5)
T2: 8 (0.8, 5.9)

3. CRANKSHAFT POSITION, CAMSHAFT POSITION AND KNOCK SENSORS



(1)	Crankshaft position sensor	(5)	Exhaust camshaft position sensor LH	***Tightening torque: N·m (kgf-m, ft-lb)***	
(2)	Knock sensor	(6)	Exhaust camshaft position sensor RH	***T1: 5 (0.5, 3.7)***	
(3)	Intake camshaft position sensor LH	(7)	Engine harness cover	***T2: 6.4 (0.7, 4.7)***	
(4)	Intake camshaft position sensor RH			***T3: 24 (2.4, 17.7)***	

4. FUEL TANK

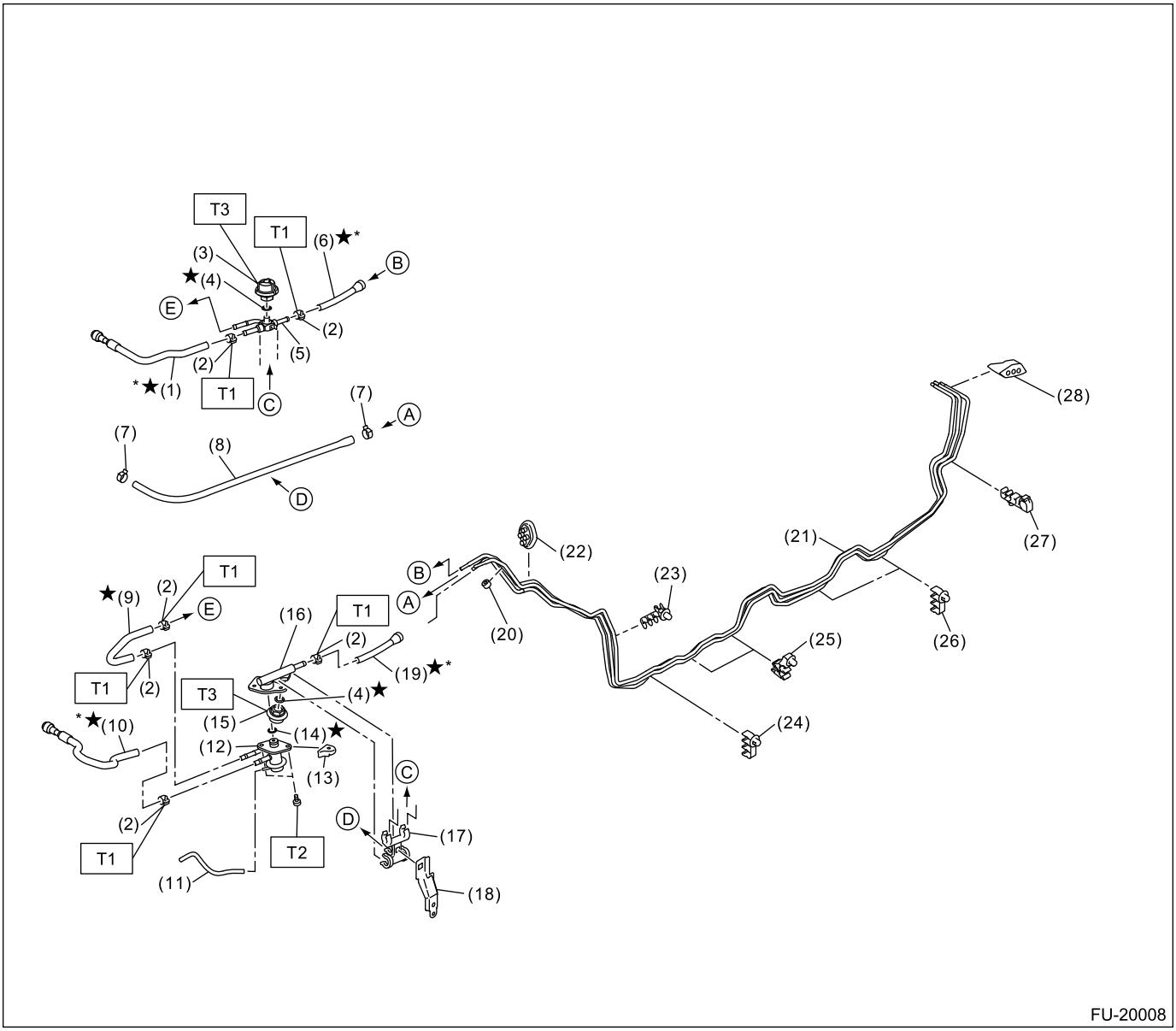


(1) Fuel tank
(2) Fuel tank band
(3) Fuel delivery tube
(4) Jet pump tube
(5) Fuel pump ASSY
(6) Fuel pump upper plate
(15) Stopper LH
(16) Heat shield cover
(17) Fuel tank protector RH
(18) Fuel tank protector LH
(19) Self-locking nut
(20) Rubber cap
(29) Cushion
(30) Cushion
(31) Cushion
(32) Return tube
(33) Retainer

(7)	Fuel pump gasket	(21)	Fuel filler hose	***Tightening torque: N·m (kgf-m, ft-lb)***
(8)	Fuel level sensor	(22)	Clamp	***T1: 2 (0.2, 1.5)***
(9)	Fuel sub level sensor	(23)	Clamp	***T2: 2.5 (0.3, 1.8)***
(10)	Fuel sub level sensor upper plate	(24)	Evaporation hose	***T3: 9 (0.9, 6.6)***
(11)	Fuel sub level sensor gasket	(25)	Clip	***T4: 18 (1.8, 13.3)***
(12)	Fuel sub level sensor filter	(26)	Tube clamp	***T5: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Tank>INSTALLATION.***
(13)	Fuel sub level sensor protector	(27)	Fuel pump upper plate cushion	***T6: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Pump>INSTALLATION.***
(14)	Stopper RH	(28)	Fuel sub level sensor upper plate cushion	***T7: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Sub Level Sensor>INSTALLATION.***

5. FUEL LINE

- Fuel line 1



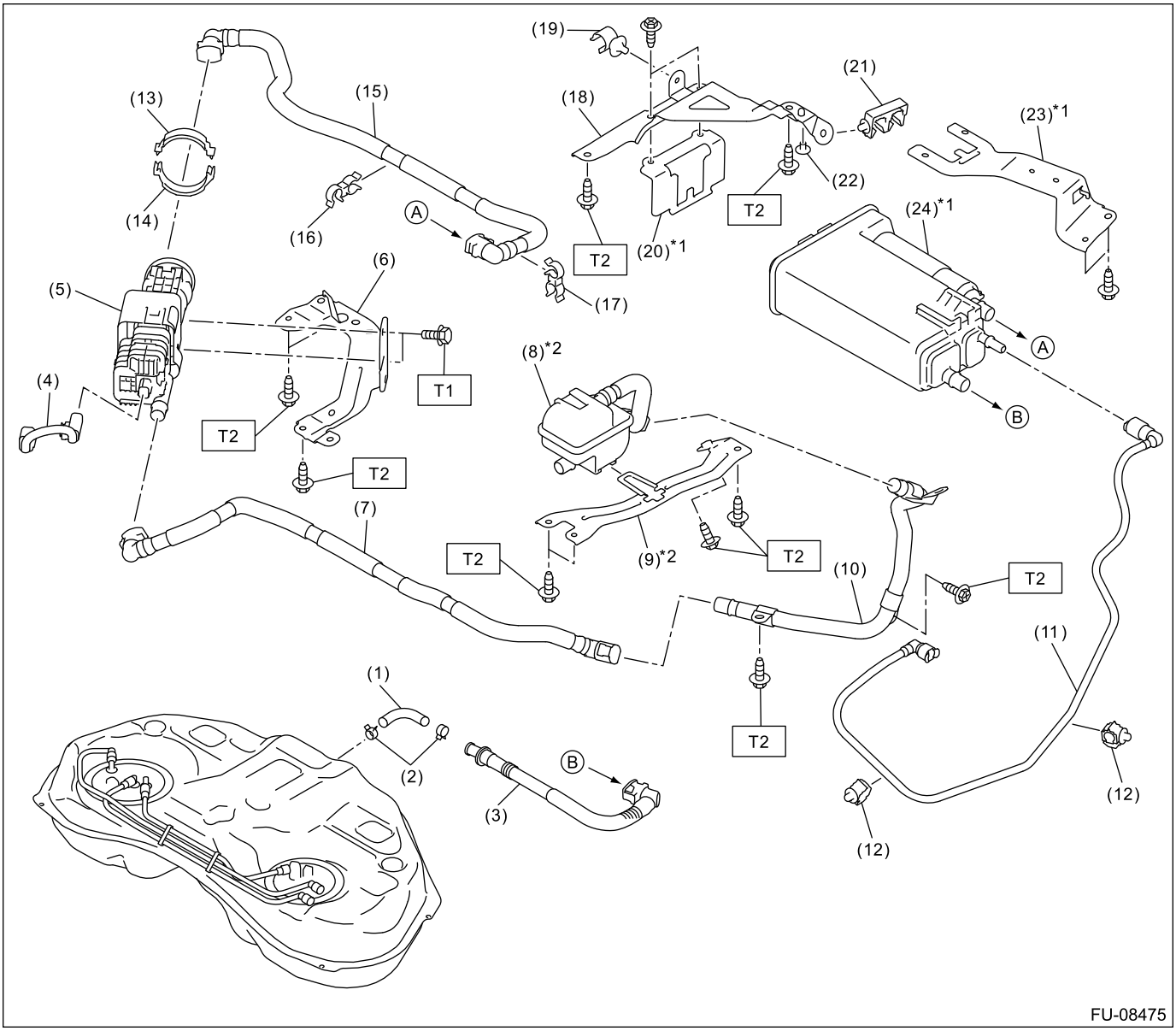
(1) Fuel delivery hose A
(2) Clamp
(3) Pulsation damper A
(4) Fuel pipe gasket
(5) Fuel by-pass pipe
(6) Fuel delivery hose B
(7) Clip
(8) Evaporation hose
(9) Fuel hose
(10) Fuel return hose A
(11) Vacuum hose
(12) Pressure regulator
(13) Fuel pipe protector
(14) O-ring
(15) Pulsation damper B
(16) Fuel holder ASSY
(17) Hose clamp
(18) Hose clamp bracket
(19) Fuel return hose B
(20) Bushing
(21) Fuel pipe ASSY
(22) Fuel pipe front grommet
(23) Pipe clamp
(24) Pipe clamp
(25) Pipe clamp
(26) Pipe clamp
(27) Pipe clamp
(28) Fuel pipe rear grommet

Tightening torque: N·m (kgf-m, ft-lb)

T1: 1.25 (0.1, 0.9)
T2: 6.4 (0.7, 4.7)
T3: 21.6 (2.2, 15.9)

∗ It can be reused if the quick connector side is disconnected.

- Fuel line 2



(1) Vent hose
(2) Clip
(3) Vent tube
(4) Harness
(5) Leak check valve ASSY
(6) Leak check valve bracket
(7) Drain tube A
(8) Drain filter
(9) Drain bracket
(10) Drain pipe
(11) Purge tube
(12) Tube clamp
(13) Clamp B
(14) Clamp A
(15) Drain tube B
(16) Tube clamp
(17) Tube clamp
(18) Canister bracket A
(19) Tube clamp
(20) Canister bracket B
(21) Tube clamp
(22) Clip
(23) Canister bracket C
(24) Canister

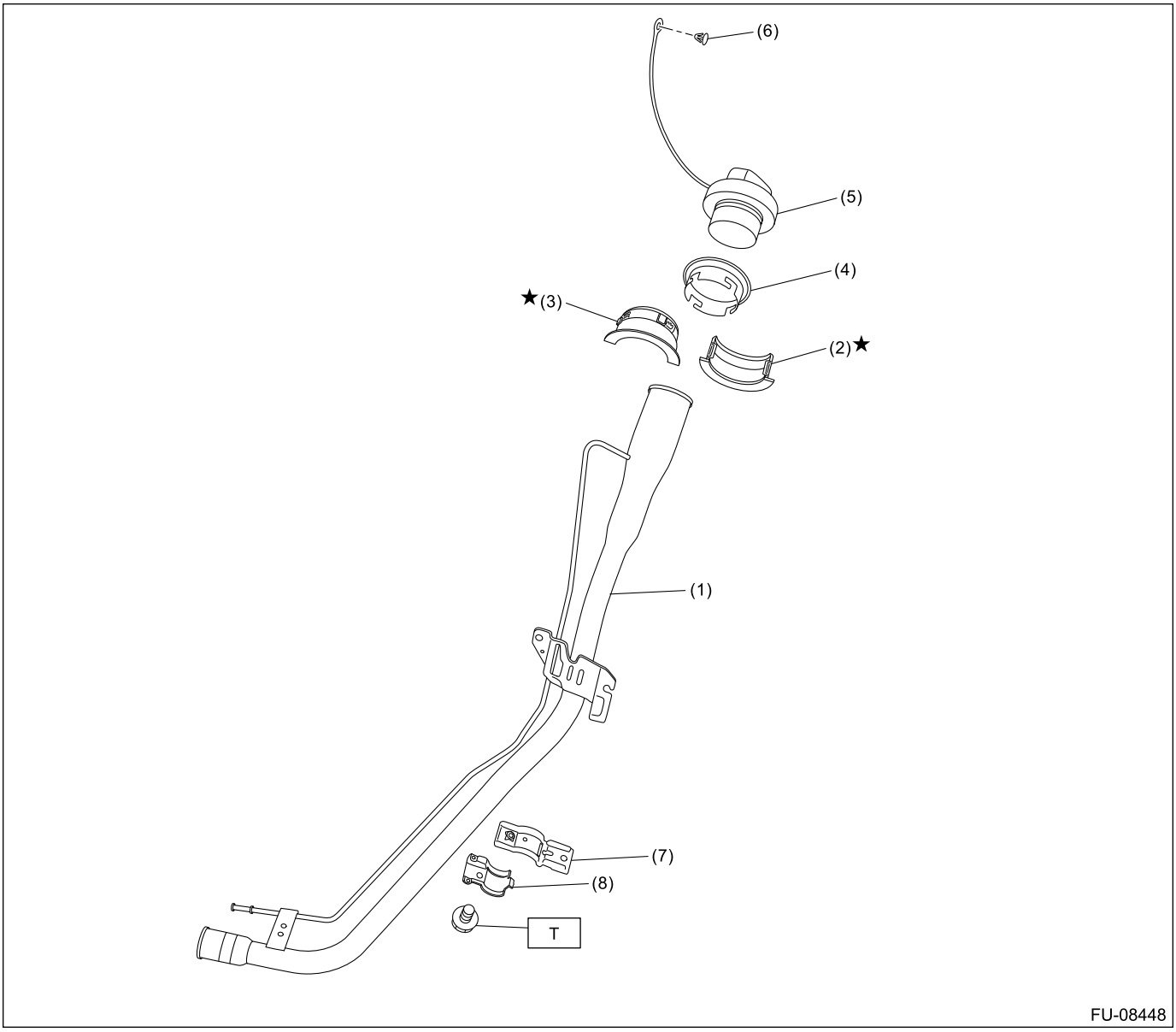
Tightening torque: N·m (kgf-m, ft-lb)

T1: 5.4 (0.6, 4.0)
T2: 7.5 (0.8, 5.5)

*1 The canister bracket cannot be separated from the canister. Therefore, be sure to replace both of them with new ones when replacing the canister or canister bracket.

*2 The drain filter cannot be separated from the drain bracket. Therefore, be sure to replace both of them with new ones when replacing the drain bracket or drain filter.

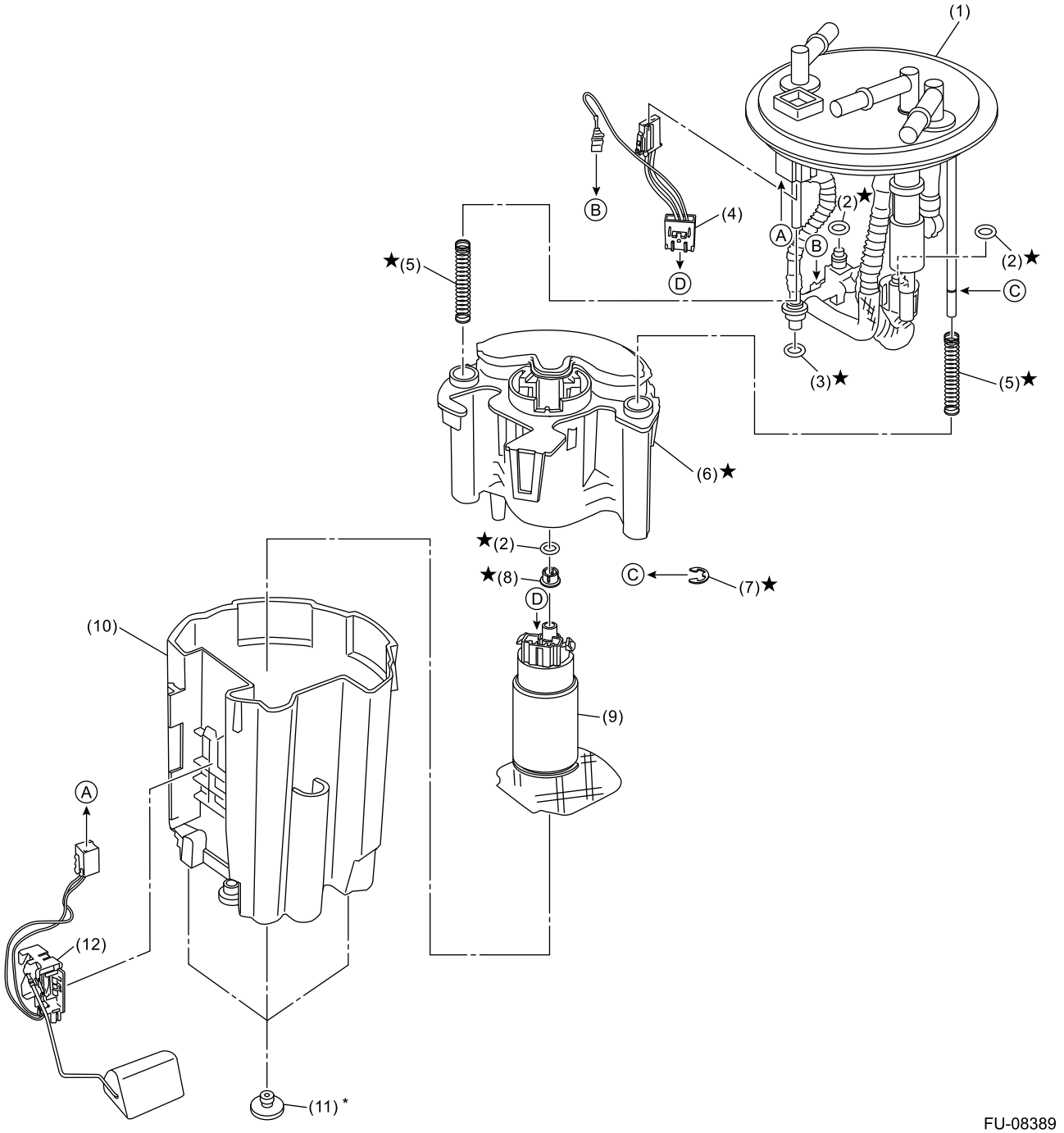
6. FUEL FILLER PIPE



(1) Fuel filler pipe ASSY
(2) Neck holder A
(3) Neck holder B
(4) Fuel filler pipe protector
(5) Fuel filler cap
(6) Clip
(7) Upper bracket
(8) Lower bracket

Tightening torque: N·m (kgf-m, ft-lb)
T: 7.5 (0.8, 5.5)

7. FUEL PUMP



(1) Sub tank bracket ASSY
(2) O-ring
(3) O-ring
(4) Fuel pump harness
(5) Spring
(6) Fuel filter
(7) Clip
(8) Spacer
(9) Pump ASSY
(10) Sub tank
(11) Cushion
(12) Fuel level sensor

* When removing the cushion from the fuel chamber assembly, replace it with a new part.

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Place “NO OPEN FLAMES” signs near the working area.
- Prepare a container and cloth to prevent scattering of fuels when performing work where fuels can be spilled. If the oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Always inspect for fuel leaks after removing/installing the fuel system components.
- Follow all government and local regulations concerning disposal of refuse when disposing fuel.
- Always use new application oil during work.

PREPARATION TOOL

1. SPECIAL TOOL

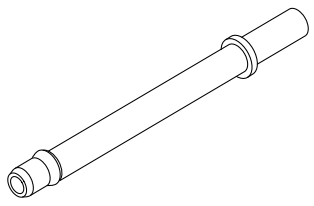
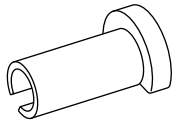
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18471AA000	18471AA000	FUEL PIPE ADAPTER	Used for draining fuel.

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST42099AE000	42099AE000	QUICK CONNECTOR RELEASE	Used for removing the quick connector.
 STSSM4	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

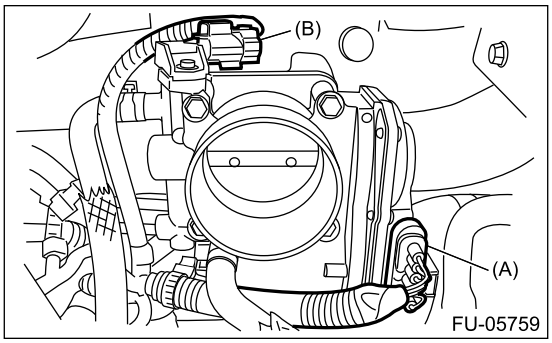
2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Oscilloscope	Used for inspecting the waveform of each sensor.
Mighty Vac	Used for inspecting the manifold absolute pressure sensor.
DST-i	Used together with Subaru Select Monitor 4.

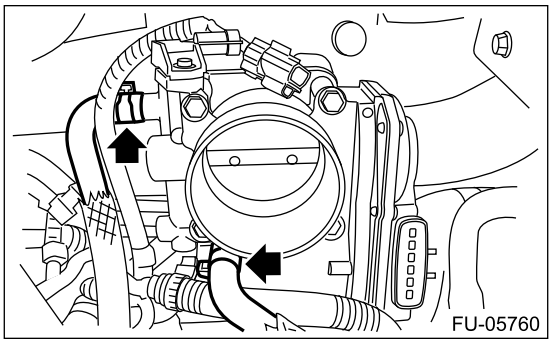
FUEL INJECTION (FUEL SYSTEMS)(STI) > Throttle Body

REMOVAL

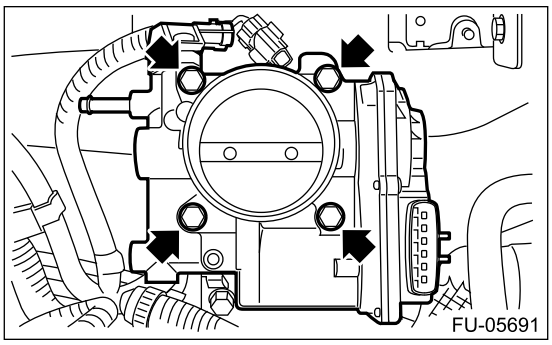
1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
5. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
6. Disconnect the connector (A) from the throttle position sensor, and the connector (B) from the manifold pressure sensor.



7. Disconnect the engine coolant hose from throttle body.



8. Remove the throttle body from the intake manifold.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Throttle Body

INSTALLATION

Install in the reverse order of removal.

Note:
Use a new gasket.
Tightening torque:
8 N·m (0.8 kgf-m, 5.9 ft-lb)

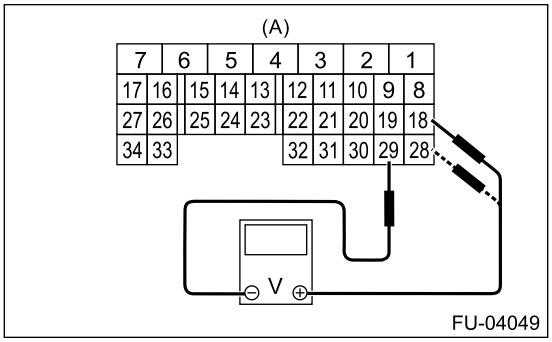
FUEL INJECTION (FUEL SYSTEMS)(STI) > Throttle Body

INSPECTION

1. THROTTLE SENSOR INSPECTION (METHOD WITH CIRCUIT TESTER)

Note:
Individual difference of the accelerator pedal may not be corrected sufficiently on the ECM side after DTCs were cleared or the battery was removed and installed on the vehicle. Therefore, when the reference voltage is not reached after following the procedure, repeat the ignition switch ON (engine OFF) and ignition switch OFF operations 40 times at intervals of three seconds or more, and then measure the voltage again.

1. After warming-up the engine, turn the ignition switch to OFF.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Turn the ignition switch to ON. (Engine OFF)
4. Check the voltage between ECM connector terminals when accelerator pedal is fully closed and fully open.
   Check
   - **When voltage is within standard values** → Normal
   - **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.
   - **If throttle sensor voltage does not change** → Go to step 5.



(A) To ECM connector

Throttle sensor	Accelerator pedal	Terminal No.	Standard
Main	Not depressed (full closed)	18 (+) and 29 (−)	Approx. 0.6 V

Throttle sensor	Accelerator pedal	Terminal No.	Standard
	Depressed (full opened)		Approx. 4.0 V
Sub	Not depressed (full closed)	28 (+) and 29 (−)	Approx. 1.48 V
	Depressed (full opened)		Approx. 4.17 V

5. Start the engine.
6. Check the voltage between ECM connector terminals when accelerator pedal is fully closed and fully open.
   Caution:
   When depressing the accelerator pedal to fully open, perform it in as short a time as possible, but within the range where the inspection result is not adversely affected.
   Note:
   Perform the inspection in the following conditions.
   - **For AT model or CVT model: Select lever is in "P" range.**
   - **For MT model: Gear shift lever is in the neutral position.**
   - **Parking brake activated**

   Check
   - **When voltage is within standard values** → Normal
   - **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.
7. After inspection, install the related parts in the reverse order of removal.

2. THROTTLE SENSOR INSPECTION (METHOD WITH SUBARU SELECT MONITOR)

Note:

- **Individual difference of the accelerator pedal may not be corrected sufficiently on the ECM side after DTCs were cleared or the battery was removed and installed on the vehicle. Therefore, using the Subaru Select Monitor, check that the accelerator opening angle signal indicates 100%, when the accelerator pedal is fully depressed, and then perform the inspection.**
- **If the accelerator opening angle signal does not indicate 100%, check the accelerator pedal.**
  Ref. to SPEED CONTROL SYSTEMS(STI)>Accelerator Pedal>INSPECTION > CHECK ACCELERATOR PEDAL SENSOR AREA (METHOD WITH SUBARU SELECT MONITOR).

1. After warming-up the engine, turn the ignition switch to OFF.
2. Turn the ignition switch to ON. (Engine OFF)

3. Using the Subaru Select Monitor, read the accelerator opening angle signal and throttle sensor voltage when accelerator pedal is fully closed and fully open. Ref. to ENGINE (DIAGNOSTICS) (STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA (NORMAL MODE).
Check
- **When voltage is within standard values** → Normal
- **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.
- **If throttle sensor voltage does not change** → Go to step 4.

Throttle sensor	Acceleration opening angle signal	Standard
Main	0.0%	Approx. 0.6 V
	100.0%	Approx. 3.96 V
Sub	0.0%	Approx. 1.48 V
	100.0%	Approx. 4.17 V

4. Start the engine.
5. Using the Subaru Select Monitor, read the accelerator opening angle signal and throttle sensor voltage when accelerator pedal is fully closed and fully open.
Caution:
When depressing the accelerator pedal to fully open, perform it in as short a time as possible, but within the range where the inspection result is not adversely affected.
Note:
Perform the inspection in the following conditions.
- **For AT model or CVT model: Select lever is in "P" range.**
- **For MT model: Gear shift lever is in the neutral position.**
- **Parking brake activated**

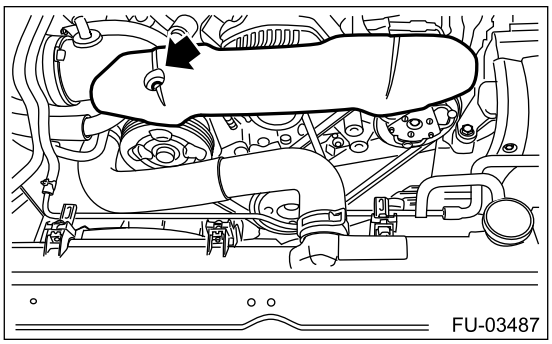
Check
- **When voltage is within standard values** → Normal
- **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.

3. OTHER INSPECTIONS

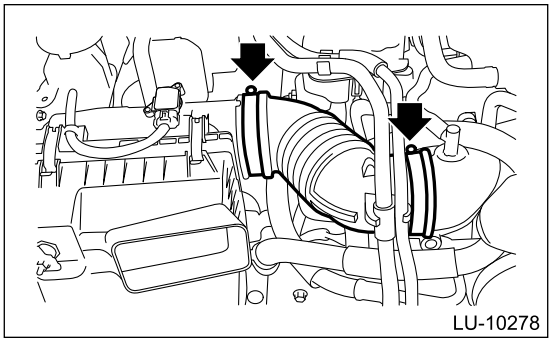
1. Check that the throttle body has no deformation, cracks or other damages.
2. Check that the engine coolant hose has no cracks, damage or loose part.

REMOVAL

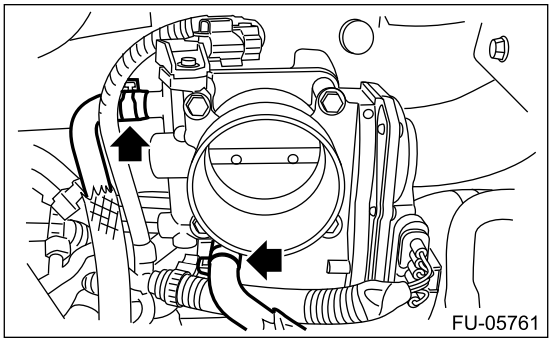
1. Remove the V-belt covers.



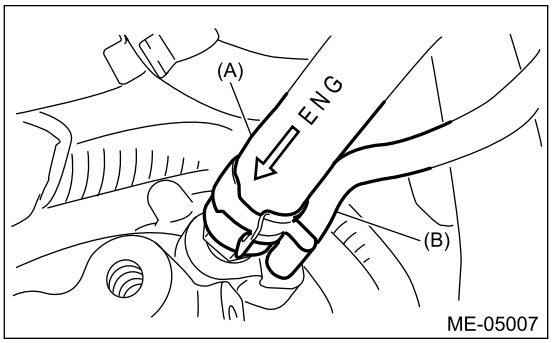
2. Collect the refrigerant from A/C system. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Recovery Procedure>PROCEDURE.
3. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
4. Disconnect the ground cable from battery.
5. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
6. Lift up the vehicle.
7. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
8. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
9. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
10. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
11. Remove the air intake boot.



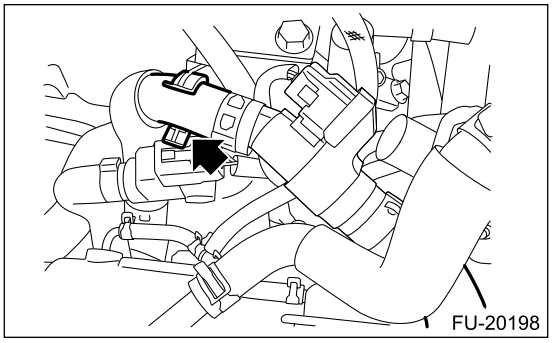
12. Remove the air by-pass valve. Ref. to INTAKE (INDUCTION)(STI)>Air By-pass Valve>REMOVAL.
13. Remove the generator. Ref. to STARTING/CHARGING SYSTEMS(STI)>Generator>REMOVAL.
14. Remove the coolant filler tank. Ref. to COOLING(STI)>Coolant Filler Tank>REMOVAL.
15. Disconnect the A/C pressure hoses from A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Hose and Pipe>REMOVAL.
16. Disconnect the engine coolant hose from throttle body.



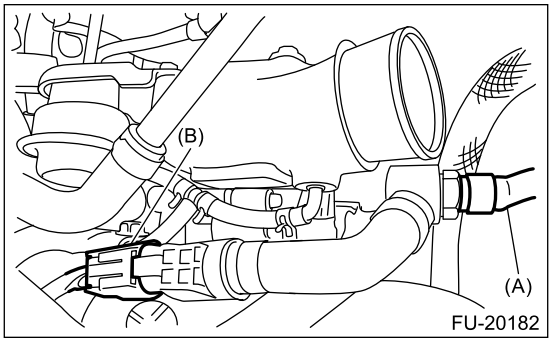
17. Disconnect the brake booster vacuum hose (A) and pressure regulator vacuum hose (B) from the intake manifold.



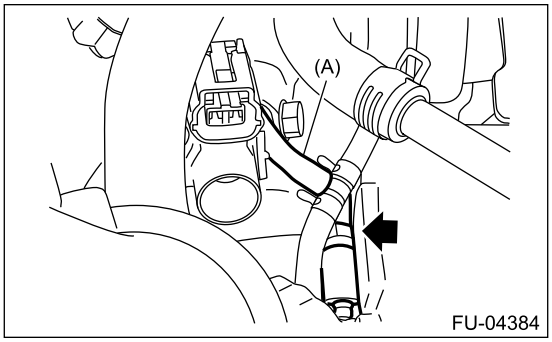
18. Remove the PCV hose from the clip.



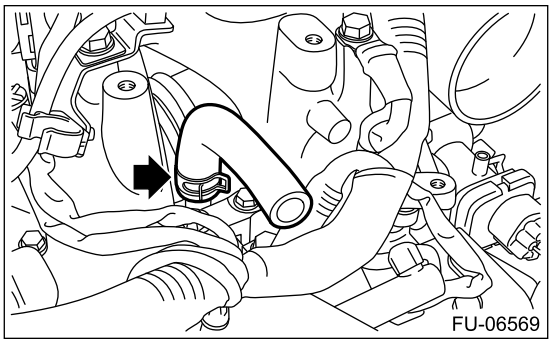
19. Disconnect the vacuum hose (A) and the connector (B) from the PCV hose assembly B.



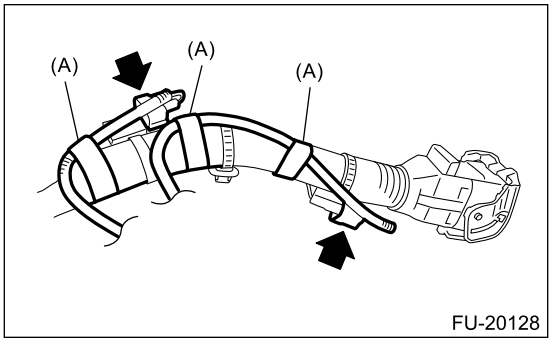
20. Disconnect the air control hose (A) from the waste gate actuator, and loosen the clamp which holds the intake duct to the turbocharger.



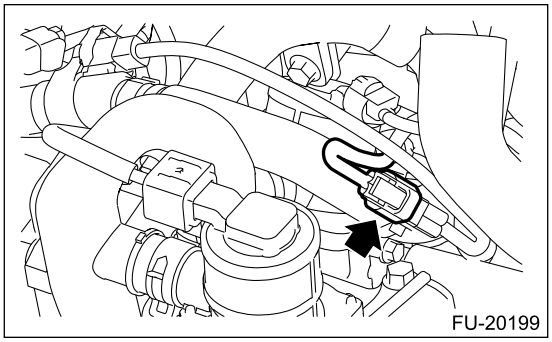
21. Remove the engine coolant hose from the water tank pipe.



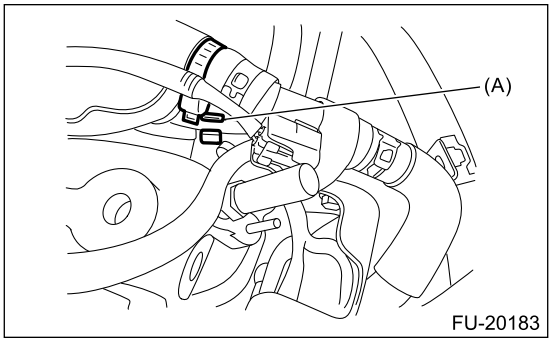
22. Remove the tape (A) fixing the leak diagnosis connector harness, and disconnect the leak diagnosis connector from the engine harness.



23. Disconnect the leak diagnosis connector from the leak diagnosis connector harness.

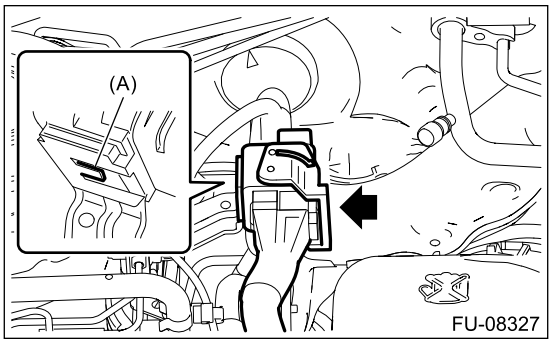


24. Remove the engine harness from clip (A).

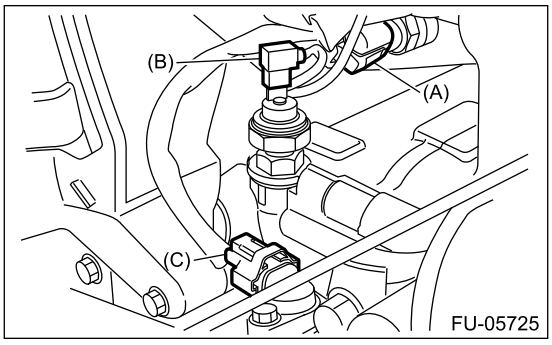


25. Disconnect the bulkhead harness connectors from the engine harness connectors.

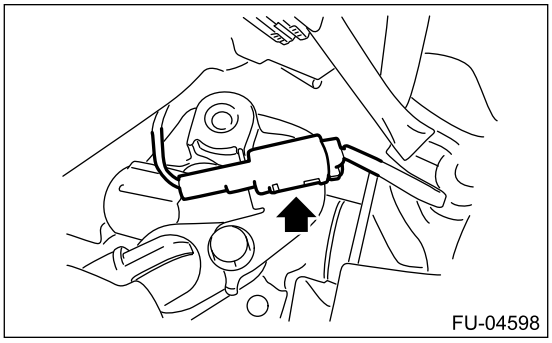
26. Lift the claw (A) and remove the engine harness connector from the engine harness bracket.



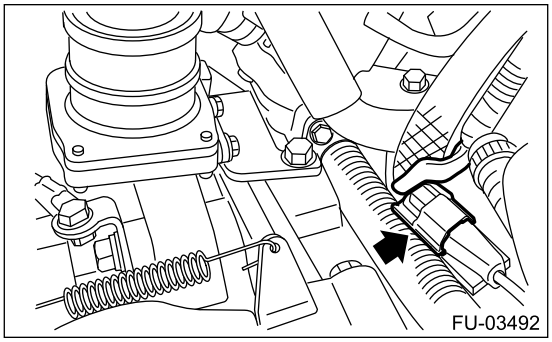
27. Disconnect the connector (A) from the engine coolant temperature sensor, connector (B) from the oil pressure switch, and connector (C) from the crankshaft position sensor.



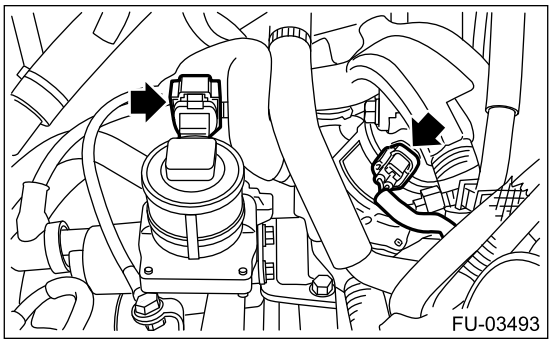
28. Disconnect the connector from power steering pump switch.



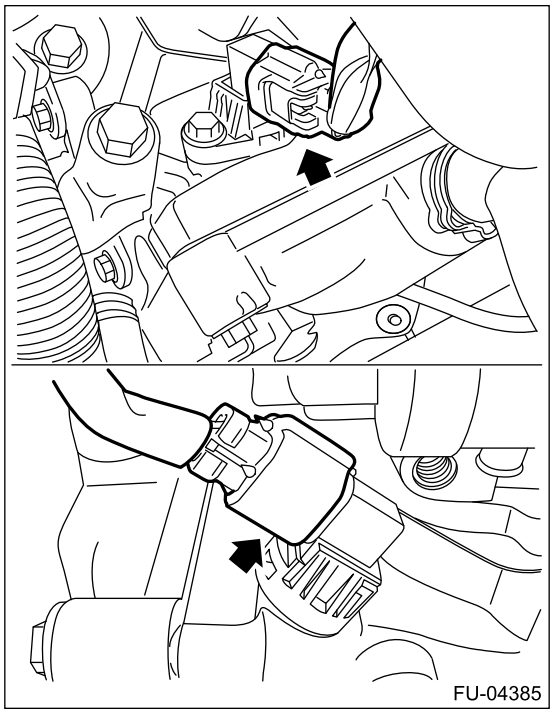
29. Disconnect the connector from the knock sensor.



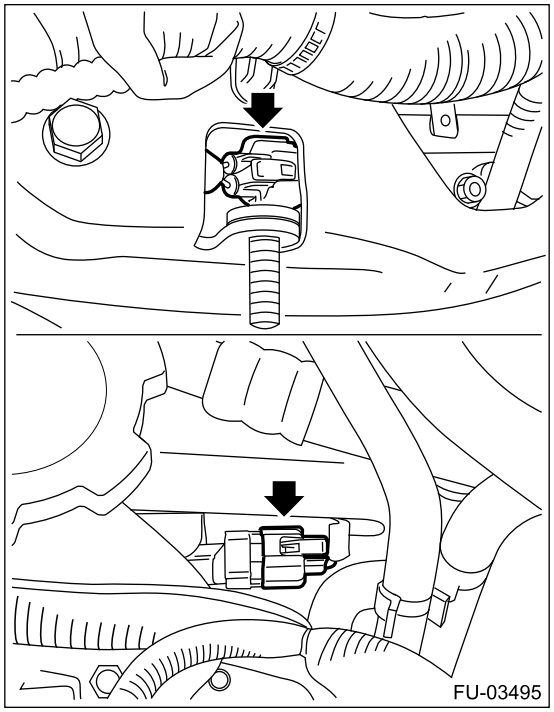
30. Disconnect the connector from the secondary air combination valve.



31. Disconnect the connector from the intake camshaft position sensor.

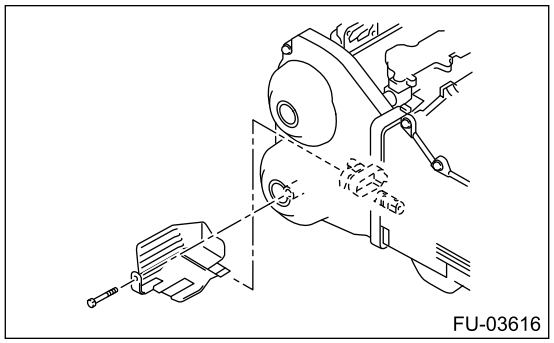


32. Disconnect the connector from the intake oil flow control solenoid valve.

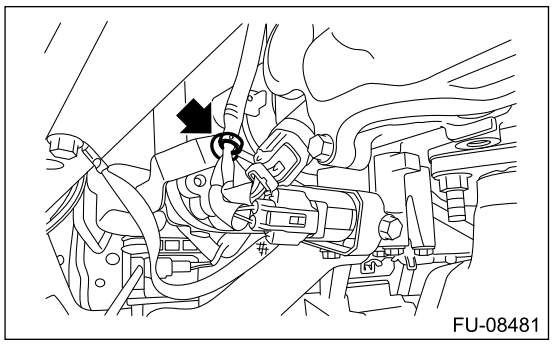


33. Lift up the vehicle.

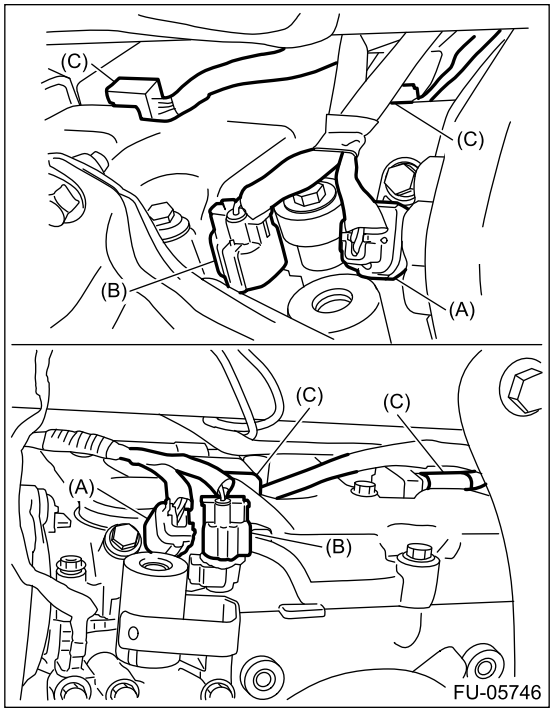
34. Remove the engine harness cover. (Right side only)



35. Remove the clip holding the engine harness. (Left side only)

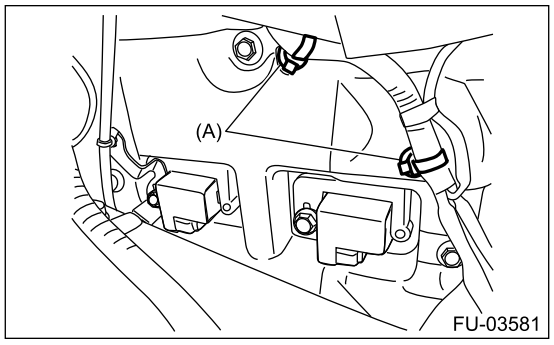


36. Disconnect connector (A) from the exhaust camshaft position sensor, connector (B) from the exhaust oil flow control solenoid valve, and connector (C) from the ignition coil.

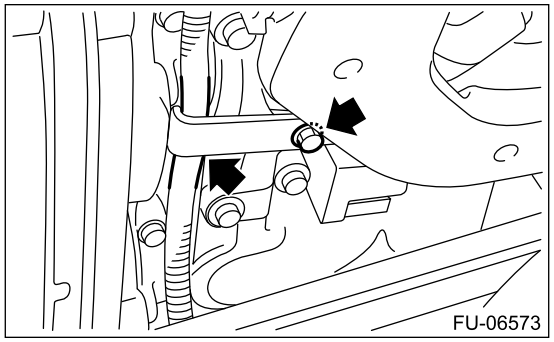


37. Lower the vehicle.

38. Remove the clip (A) which hold the engine harness to the rocker cover RH.



39. Remove the bolts that secure the air duct to the rocker cover LH, and remove the engine harness.



40. Disconnect the fuel delivery hose, fuel return hose and evaporation hose.

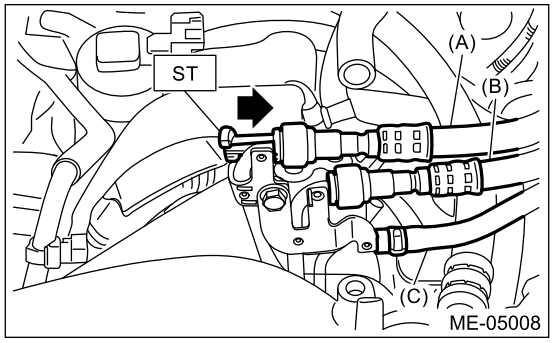
Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**

(1) Set the ST to the fuel pipe.

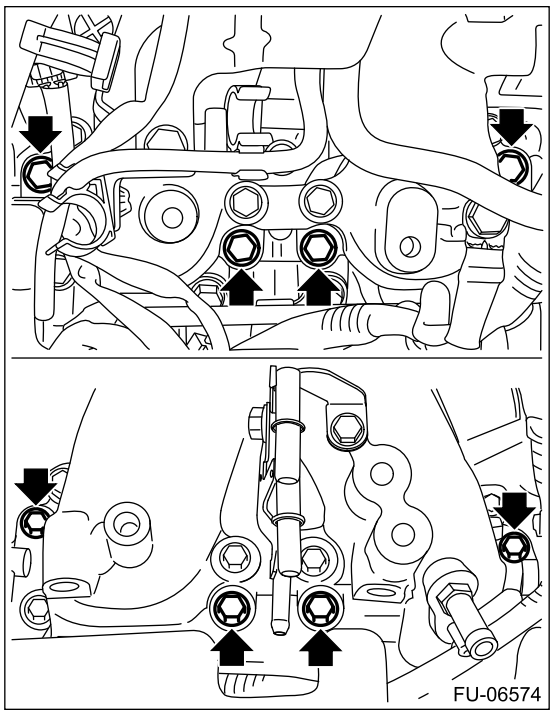
ST 42099AE000 QUICK CONNECTOR RELEASE

(2) Disconnect the quick connector of the fuel delivery hose and fuel return hose by pushing the ST in the direction of the arrow.
(3) Remove the clip and disconnect the evaporation hose from the fuel pipe.



(A) Fuel delivery hose
(B) Fuel return hose
(C) Evaporation hose

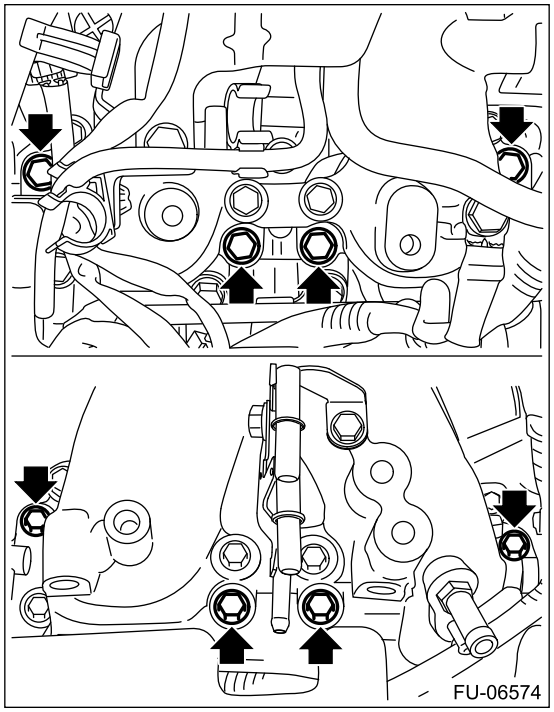
41. Remove the intake manifold from cylinder head.



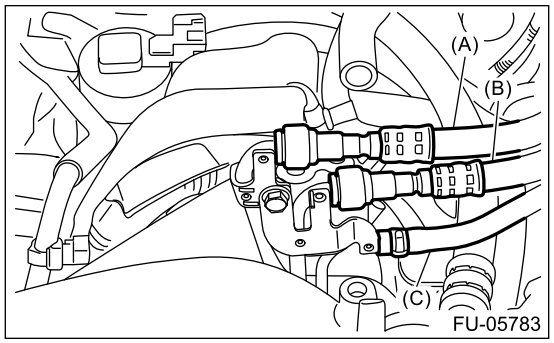
FUEL INJECTION (FUEL SYSTEMS)(STI) > Intake Manifold

INSTALLATION

1. Install the intake manifold onto cylinder heads.
Note:
Use a new gasket.
Tightening torque:
25 N·m (2.5 kgf-m, 18.4 ft-lb)



2. Connect the fuel delivery hose, fuel return hose, and evaporation hose.



(A) Fuel delivery hose

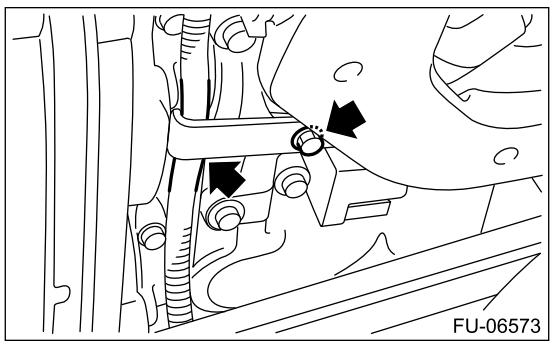
(B) Fuel return hose

(C) Evaporation hose

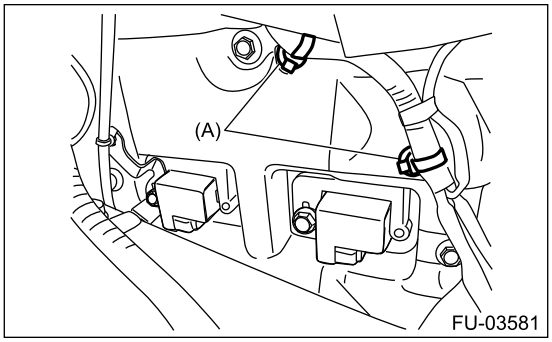
3. Fix the engine harness to the rocker cover LH with the air duct.

Tightening torque:

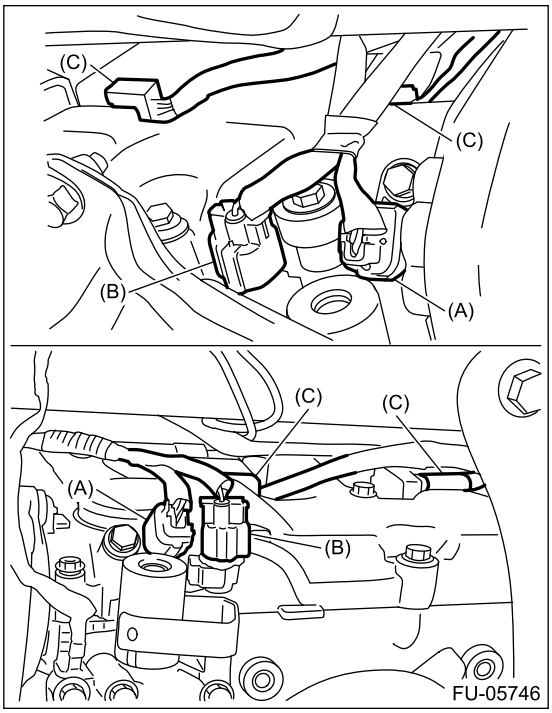
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



4. Fix the engine harness to the rocker cover RH with clips (A).



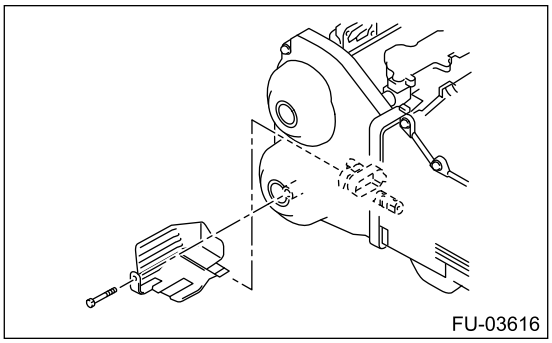
5. Lift up the vehicle.
6. Connect connector (A) to the exhaust camshaft position sensor, connector (B) to the exhaust oil flow control solenoid valve, connector (C) to the ignition coil.



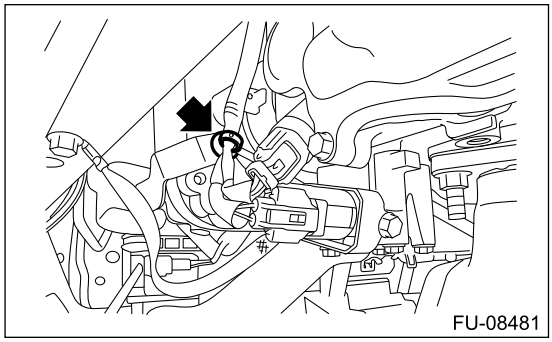
7. Install the engine harness cover. (Right side only)

Tightening torque:

5 N·m (0.5 kgf-m, 3.7 ft-lb)

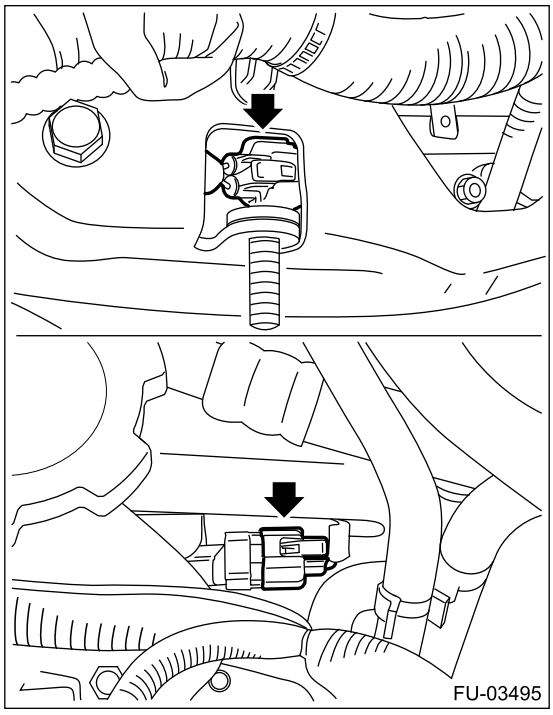


8. Install the clip securing the engine harness. (Left side only)

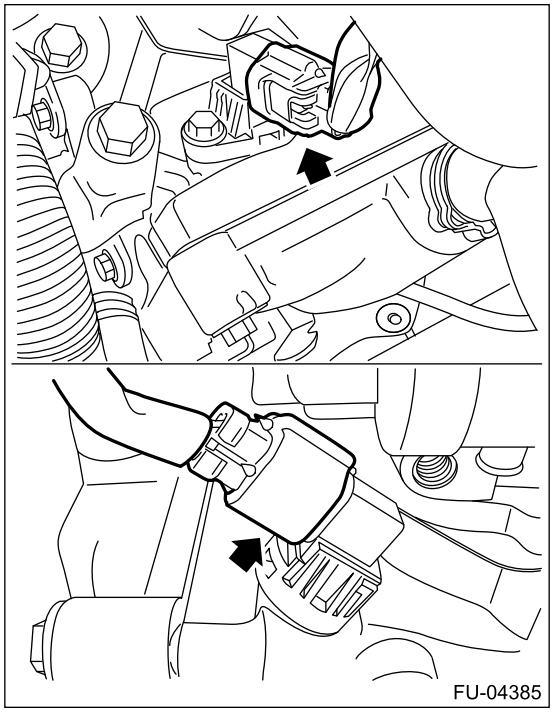


9. Lower the vehicle.

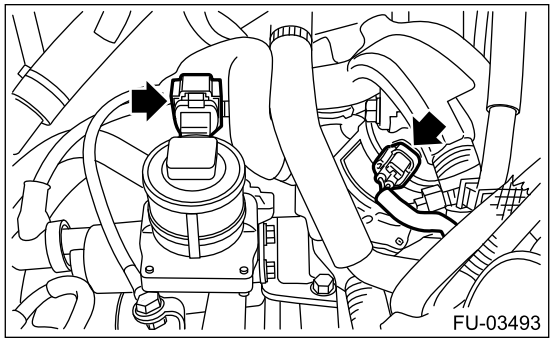
10. Connect the connector to the intake oil flow control solenoid valve.



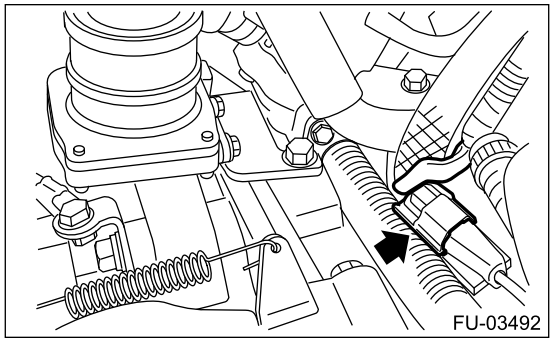
11. Connect the connector to the intake camshaft position sensor.



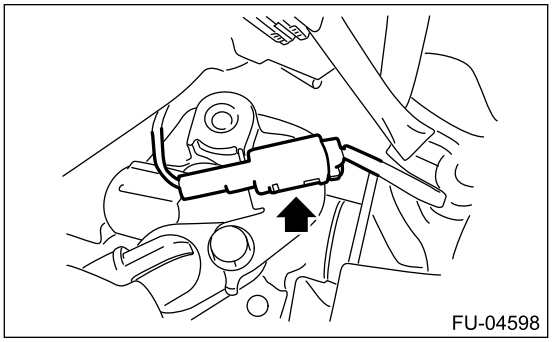
12. Connect the connector to the secondary air combination valve.



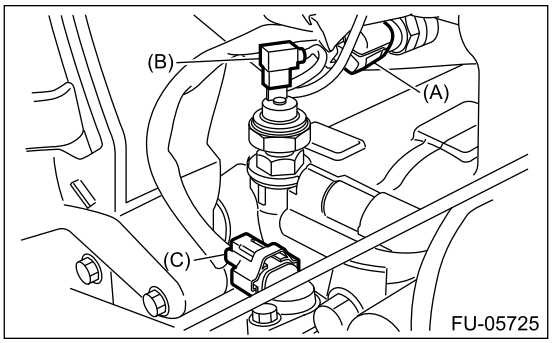
13. Connect the connector to the knock sensor.



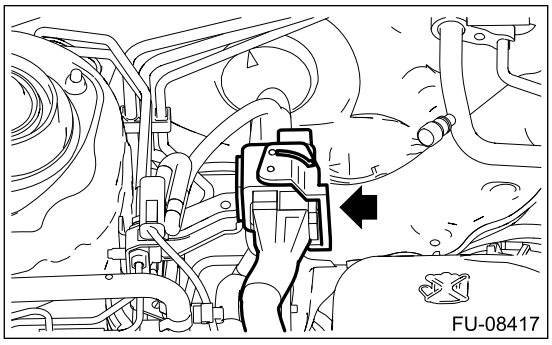
14. Connect the connector to the power steering pump switch.



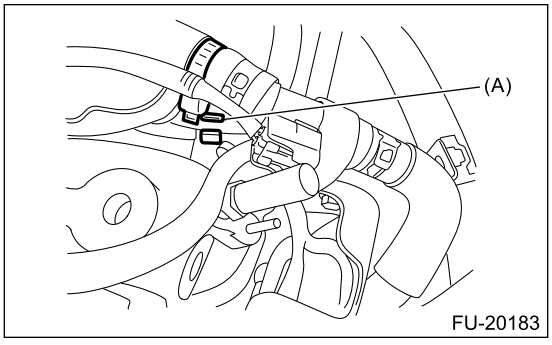
15. Connect the connector (A) to the engine coolant temperature sensor, connector (B) to the oil pressure switch, and the connector (C) to the crankshaft position sensor.



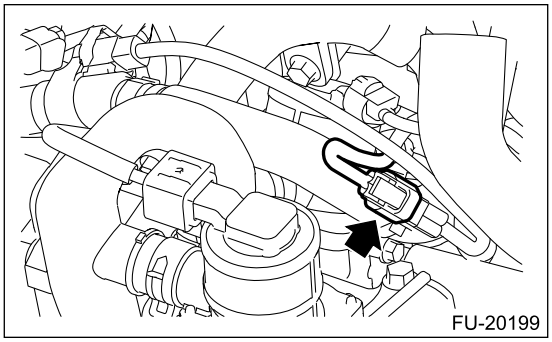
16. Install the engine harness connector to engine harness bracket, then connect the bulkhead harness connector to the engine harness connector.



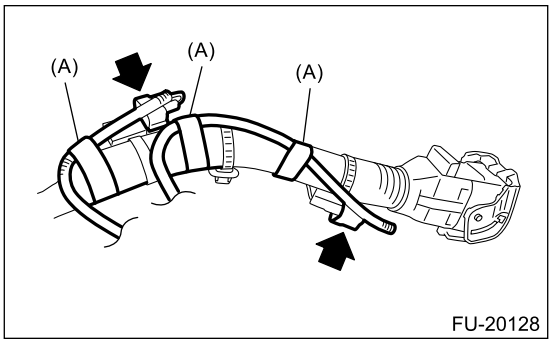
17. Install the engine harness to clip (A).



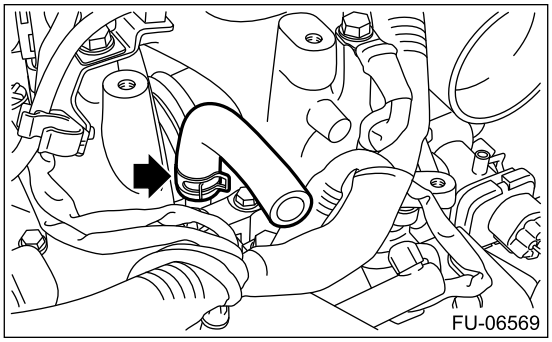
18. Connect the leak diagnosis connector to the leak diagnosis connector harness.



19. Connect the leak diagnosis connector to the engine harness, and secure the leak diagnosis connector harness with the tape (A) as shown in the figure below.



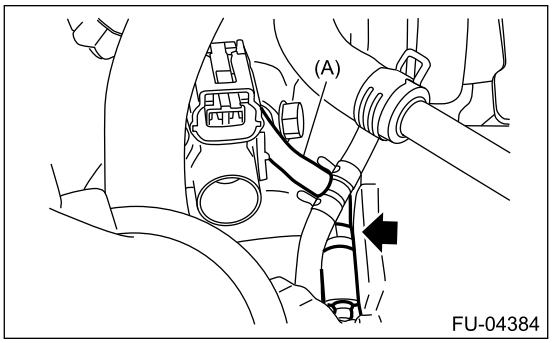
20. Install the engine coolant hose to the water tank pipe.



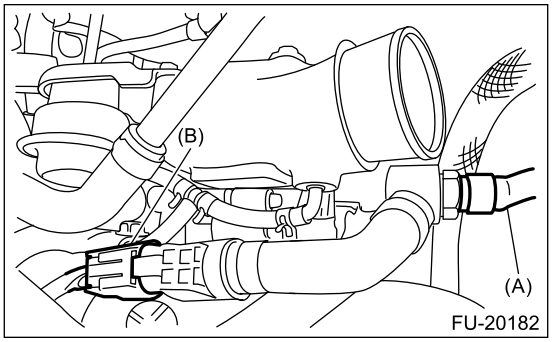
21. Connect the air control hose (A) to the wastegate actuator, and install the turbocharger to the intake duct.

Tightening torque:

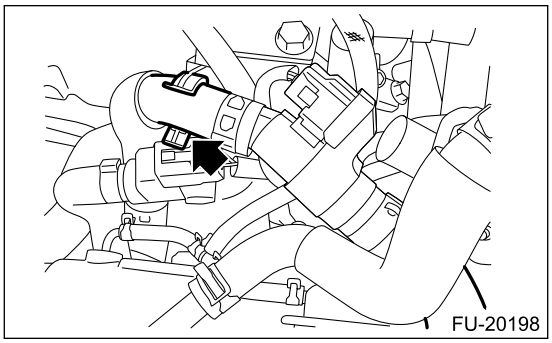
3 N·m (0.3 kgf-m, 2.2 ft-lb)



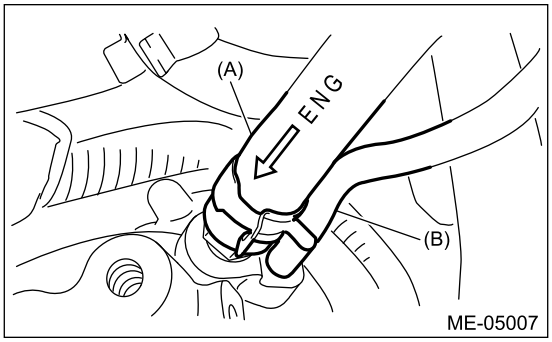
22. Connect the vacuum hose (A) and connector (B) to the PCV hose assembly B.



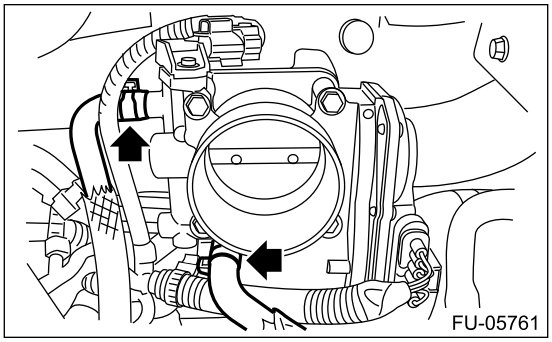
23. Install the PCV hose to the clip.



24. Connect the brake booster vacuum hose (A) and pressure regulator vacuum hose (B) to the intake manifold.



25. Connect the engine coolant hoses to throttle body.

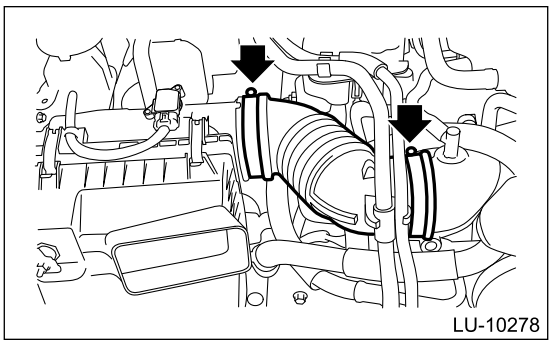


26. Install the A/C pressure hoses to A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Hose and Pipe>INSTALLATION.

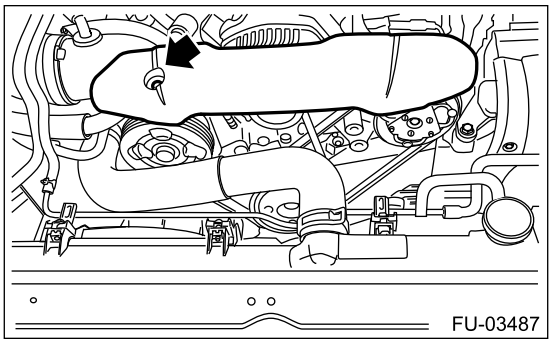
27. Install the coolant filler tank. Ref. to COOLING(STI)>Coolant Filler Tank>INSTALLATION.

28. Install the generator. Ref. to STARTING/CHARGING SYSTEMS(STI)>Generator>INSTALLATION.

29. Install the air by-pass valve. Ref. to INTAKE (INDUCTION)(STI)>Air By-pass Valve>INSTALLATION.
30. Install the air intake boot.
    Tightening torque:
    2.5 N·m (0.3 kgf-m, 1.8 ft-lb)



31. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.
32. Install the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>INSTALLATION.
33. Connect the battery ground terminal.
34. Lift up the vehicle.
35. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
36. Lower the vehicle.
37. Install the V-belt cover.
    Tightening torque:
    7 N·m (0.7 kgf-m, 5.2 ft-lb)

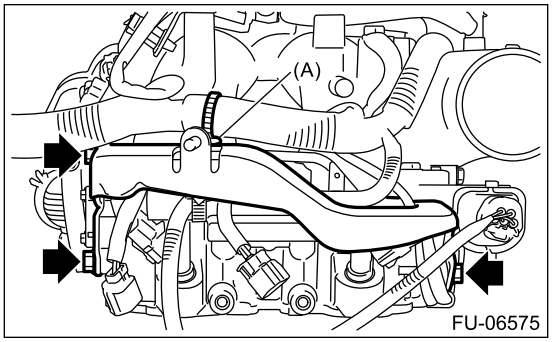


38. Fill engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
39. Charge the A/C system with refrigerant. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Charging Procedure>PROCEDURE.

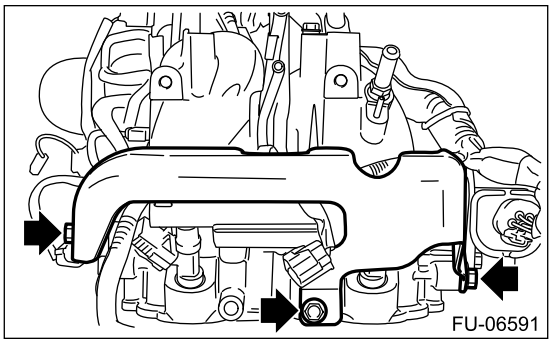
FUEL INJECTION (FUEL SYSTEMS)(STI) > Intake Manifold

DISASSEMBLY

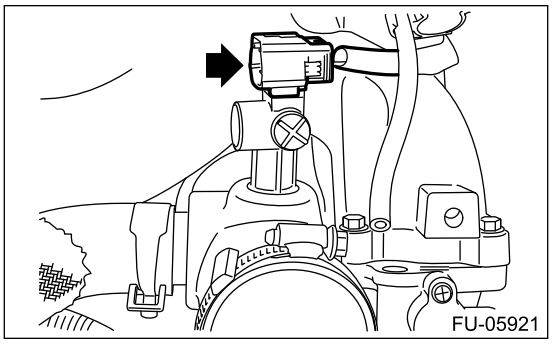
1. Remove clamp (A) holding the fuel pipe protector RH to the engine harness, and remove the fuel pipe protector RH.



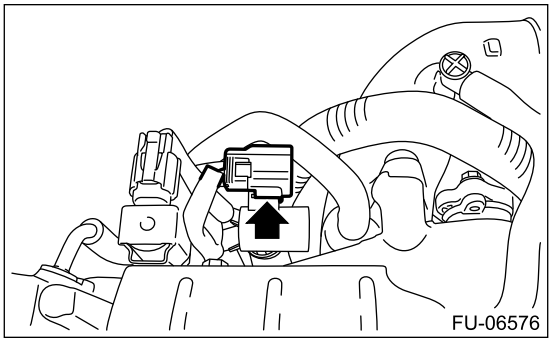
2. Remove the fuel pipe protector LH.



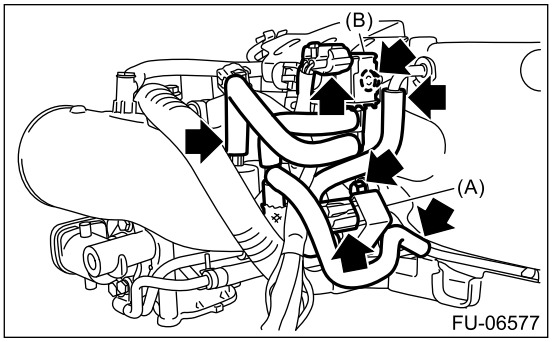
3. Remove the connector from the intake duct.



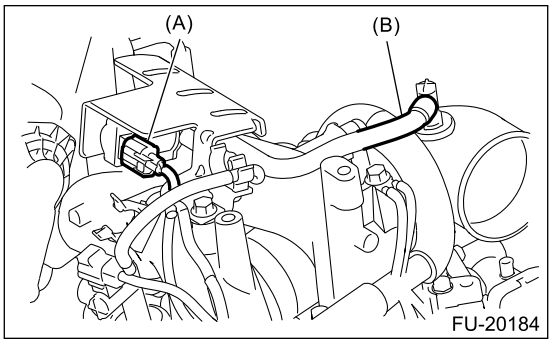
4. Remove the connector from the PCV hose assembly.



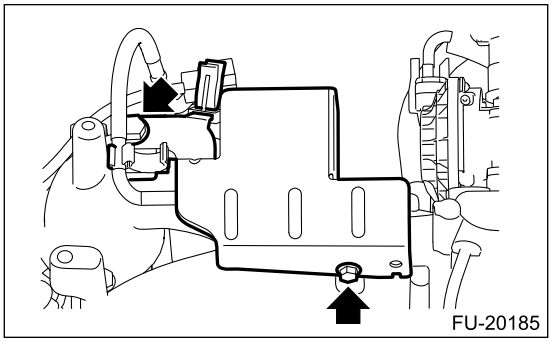
5. Remove purge control solenoid valve 1 (A) and purge control solenoid valve 2 (B).



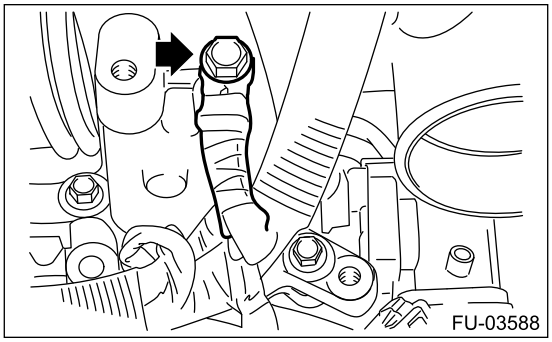
6. Disconnect the connector (A) from the wastegate control solenoid valve, and disconnect the vacuum hose (B) from the intake duct.



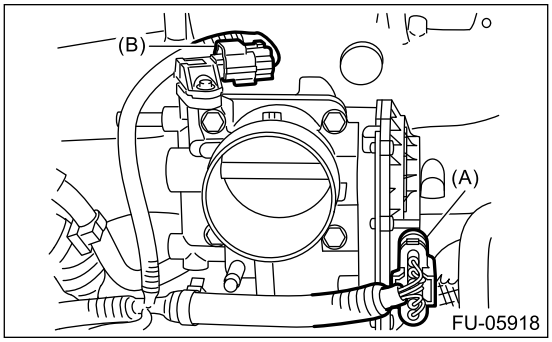
7. Remove the solenoid valve bracket together with the wastegate control solenoid valve.



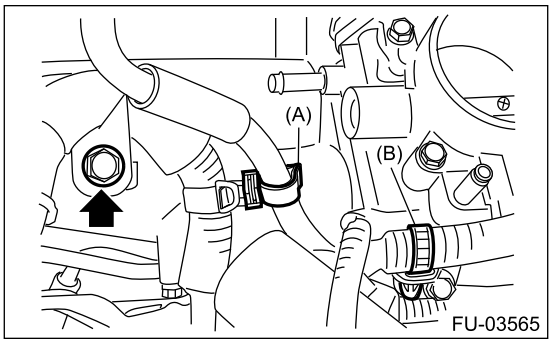
8. Remove the engine ground terminals from the intake manifold.



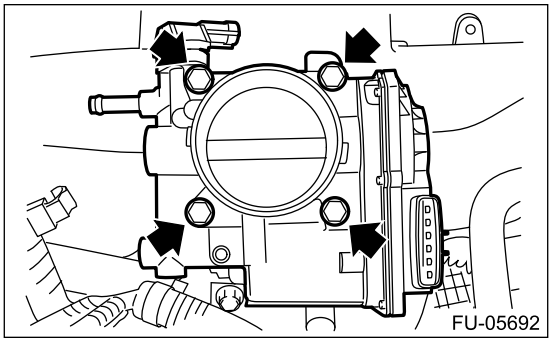
9. Disconnect the connector (A) from the throttle position sensor, and the connector (B) from the manifold pressure sensor.



10. Remove clip (A) holding the engine harness and vacuum hose, clip (B) holding the engine harness to the engine harness stay, and the bolt holding the engine harness to the intake manifold.

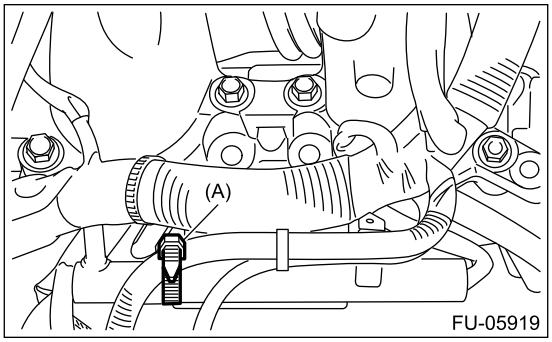


11. Remove the throttle body from the intake manifold.

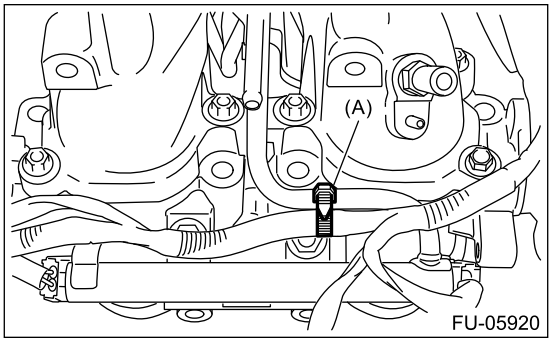


12. Remove the harness band (A) which holds the engine harness to the fuel injector pipe.

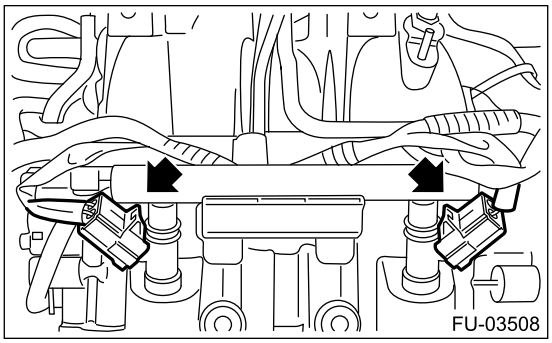
- RH side



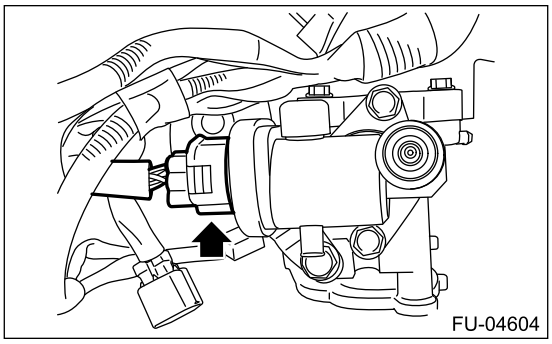
- LH side



13. Disconnect the connector from fuel injector.

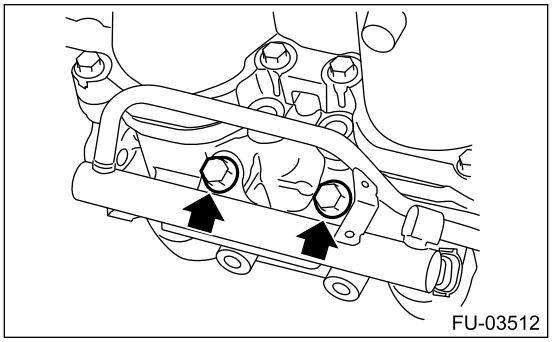


14. Disconnect the connector from the tumble generator valve assembly.

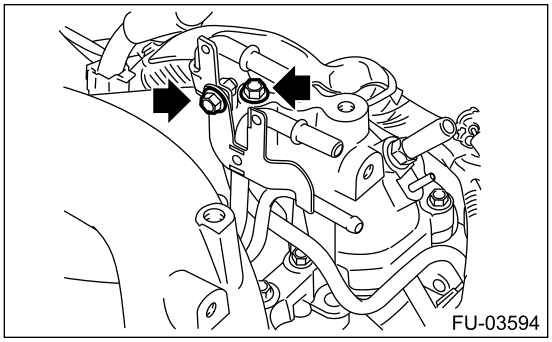


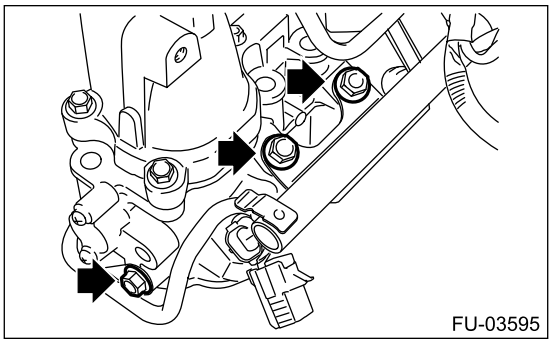
15. Remove the bolts which hold fuel injector pipe.

- RH side

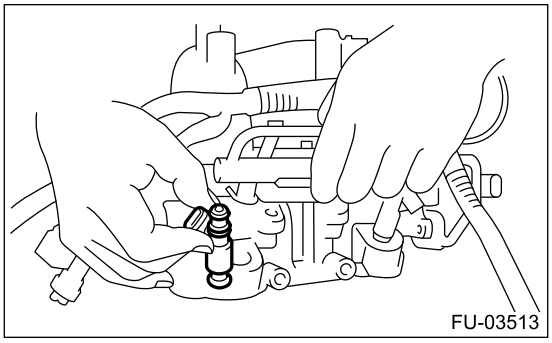


- LH side

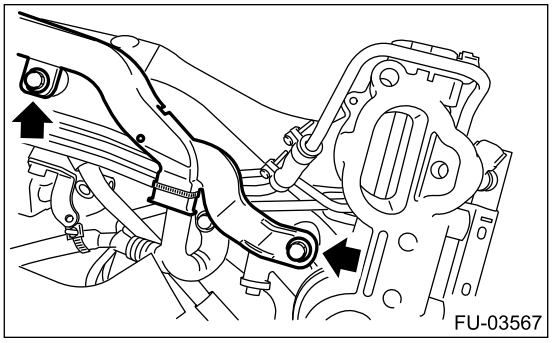




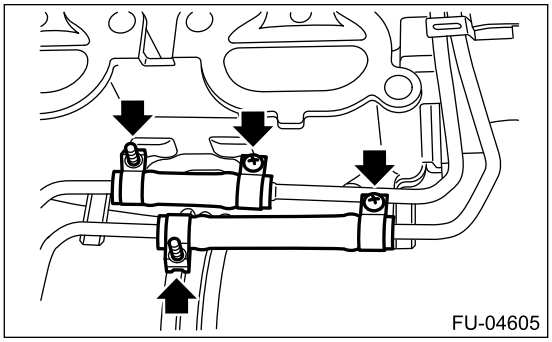
16. Remove the fuel injector.



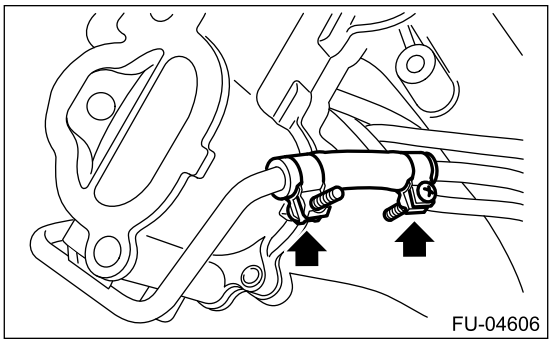
17. Remove the harness brackets holding the engine harness to the intake manifold, and remove the engine harness.



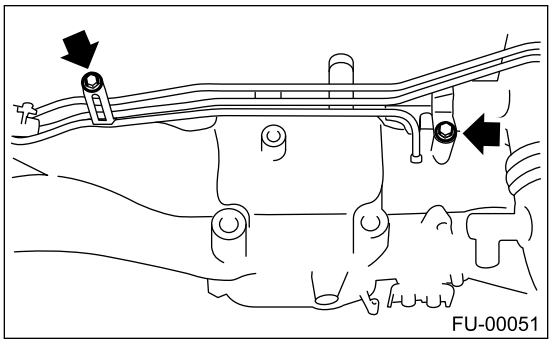
18. Loosen the clamp holding the RH side fuel hose to the fuel injector pipe RH, and remove the fuel injector pipe RH.



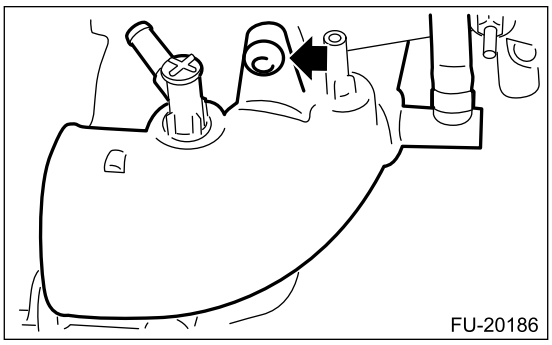
19. Loosen the clamp holding the LH side fuel hose to the fuel injector pipe LH, and remove the fuel injector pipe LH.



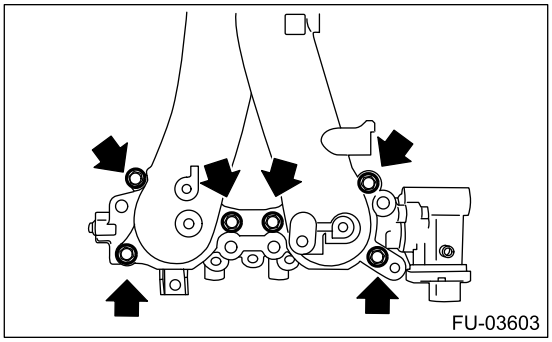
20. Remove the bolts holding the fuel pipe assembly to the intake manifold, and remove the fuel pipe assembly.



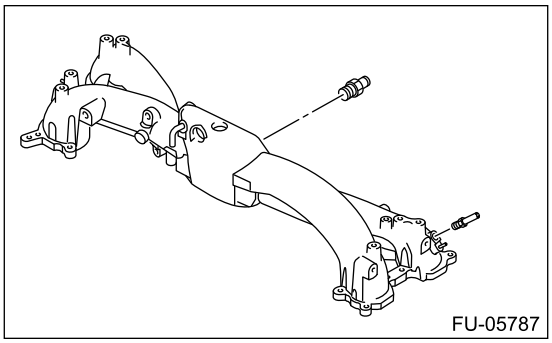
21. Remove the intake duct from intake manifold.



22. Remove the tumble generator valve assembly from the intake manifold.



23. Remove the nipple from the intake manifold.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Intake Manifold

ASSEMBLY

1. Apply liquid gasket to the nipple threads, and install the nipple to the intake manifold.

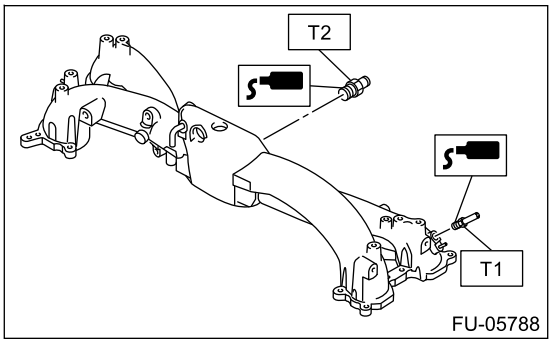
Liquid gasket:

THREE BOND 1105 (Part No. 004403010) or equivalent

Tightening torque:

T1: 17 N·m (1.7 kgf-m, 12.5 ft-lb)

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)



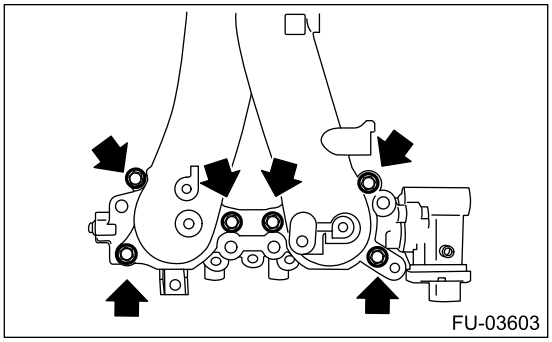
2. Install the tumble generator valve assembly onto intake manifold.

Note:

Use a new gasket.

Tightening torque:

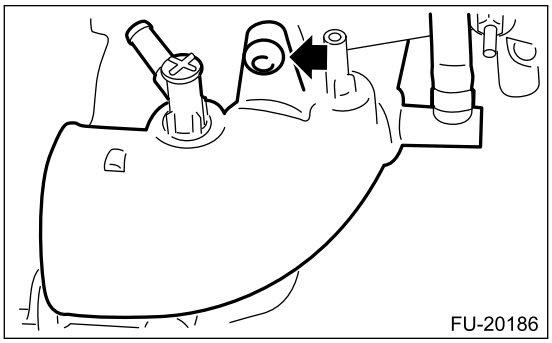
8.2 N·m (0.8 kgf-m, 6.0 ft-lb)



3. Install the air intake duct to the intake manifold.

Tightening torque:

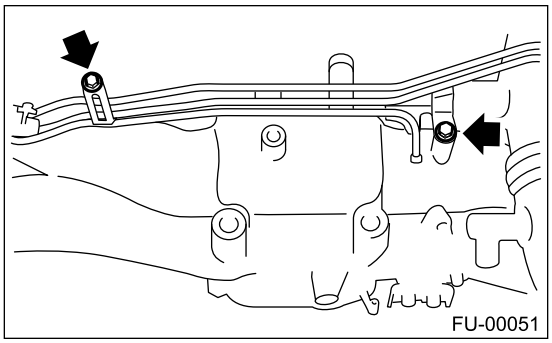
17 N·m (1.7 kgf-m, 12.5 ft-lb)



4. Install the fuel pipe assembly to the intake manifold.

Tightening torque:

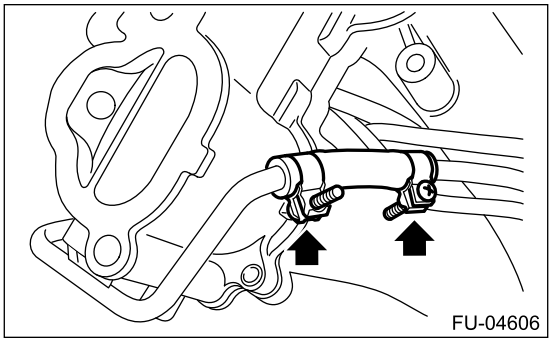
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



5. Install the fuel injector pipe LH and connect the LH side fuel hose to the fuel injector pipe LH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION > CONNECTING THE FUEL DELIVERY HOSE, FUEL RETURN HOSE AND FUEL HOSE.

Note:

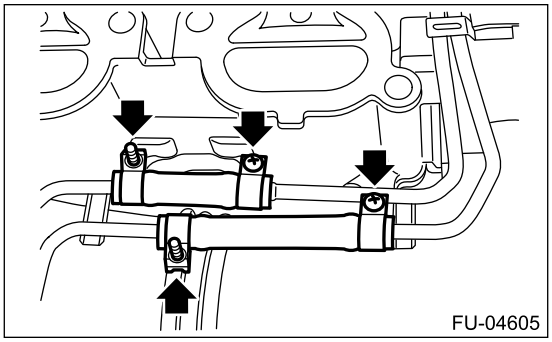
Use a new fuel hose.



6. Install the fuel injector pipe RH and connect the RH side fuel hose to the fuel injector pipe RH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION > CONNECTING THE FUEL DELIVERY HOSE, FUEL RETURN HOSE AND FUEL HOSE.

Note:

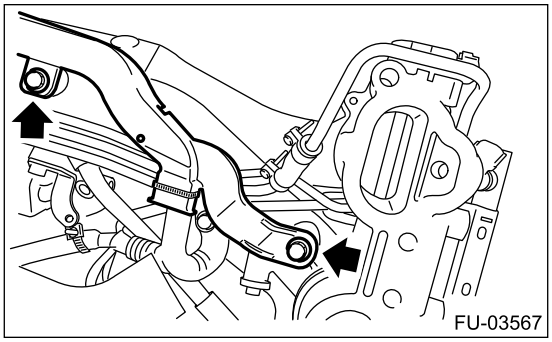
Use a new fuel hose.



7. Install the engine harness to the intake manifold and attach the harness brackets holding the engine harness.

Tightening torque:

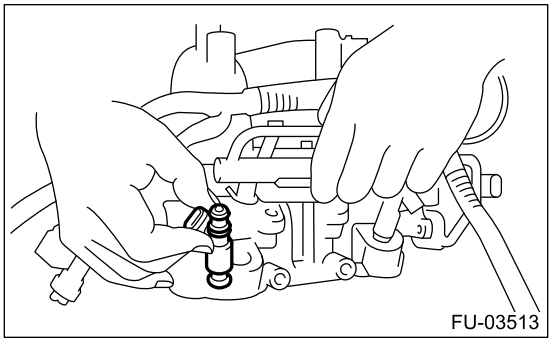
19 N·m (1.9 kgf-m, 14.0 ft-lb)



8. Install the fuel injector.

Note:

Use new O-rings, rubbers and seal rings.

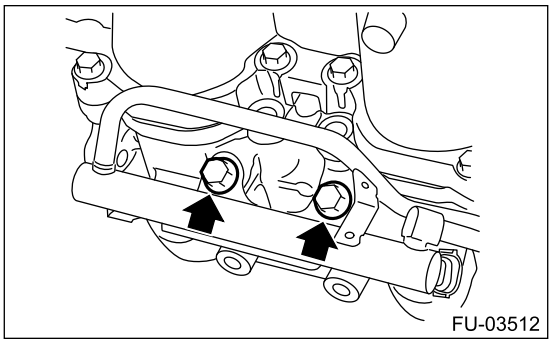


9. Install the bolts which hold fuel injector pipe.

- RH side

  Tightening torque:

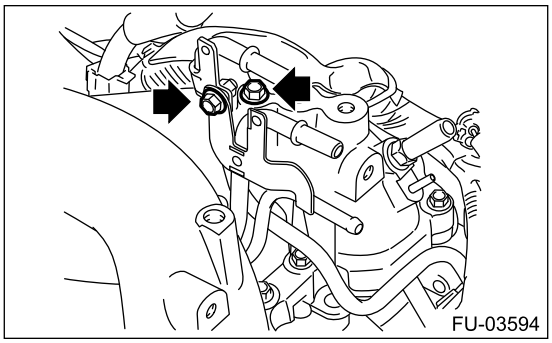
  19 N·m (1.9 kgf-m, 14.0 ft-lb)



- LH side

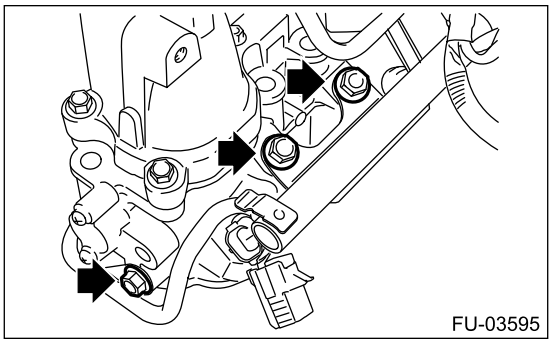
  Tightening torque:

  6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

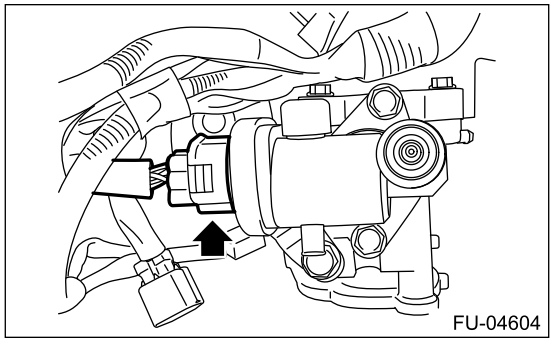


Tightening torque:

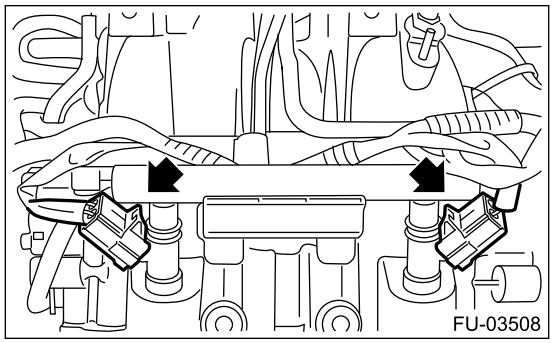
19 N·m (1.9 kgf-m, 14.0 ft-lb)



10. Connect the connector to the tumble generator valve assembly.

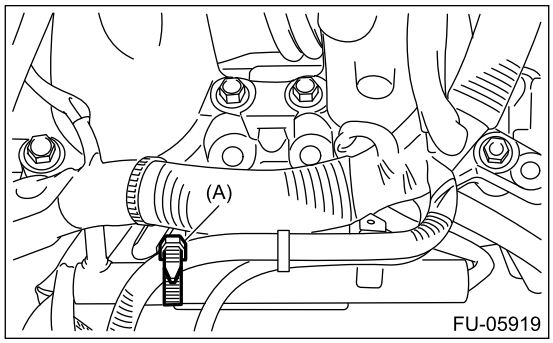


11. Connect the connectors to the fuel injector.

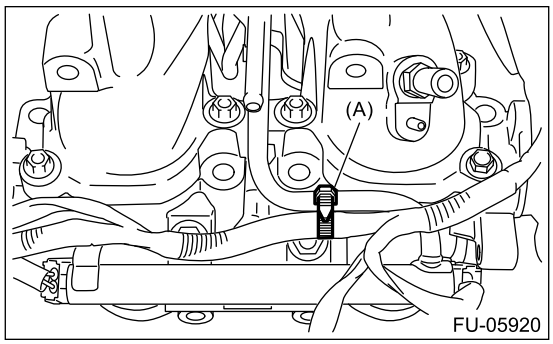


12. Secure the engine harness to the fuel injector pipe with the harness band (A).

- RH side



- LH side



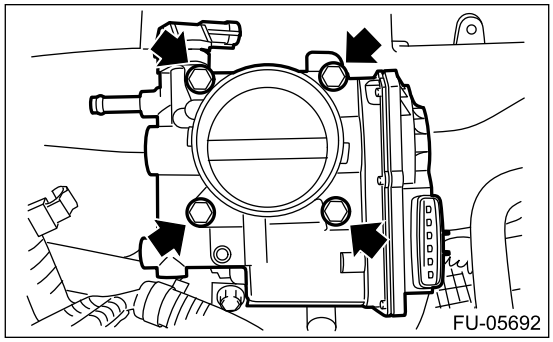
13. Install the throttle body to the intake manifold.

Note:

Use a new gasket.

Tightening torque:

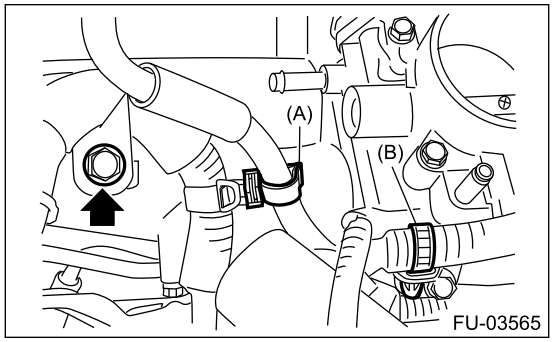
8 N·m (0.8 kgf-m, 5.9 ft-lb)



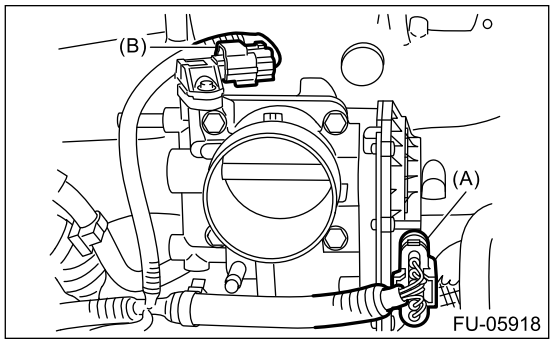
14. Secure the engine harness and vacuum hose using the clip (A), and secure the engine harness to the engine harness stay using the clip (B), and install the bolt which holds the engine harness to the intake manifold.

Tightening torque:

19 N·m (1.9 kgf-m,14.0 ft-lb)



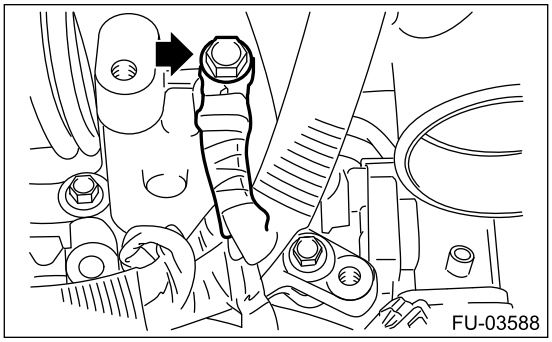
15. Connect connector (A) to the throttle position sensor and connector (B) to the manifold pressure sensor.



16. Install the engine ground terminal to intake manifold.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

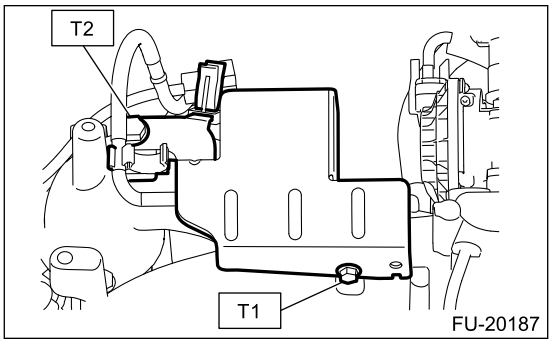


17. Install the solenoid valve bracket together with the wastegate control solenoid valve.

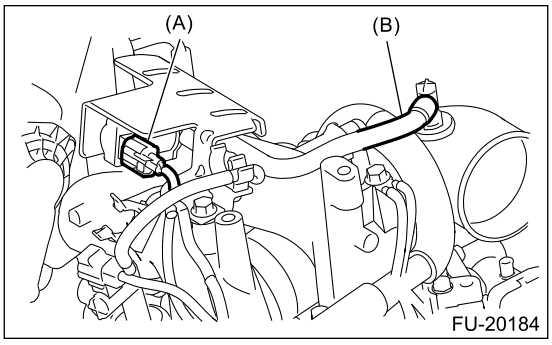
Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)



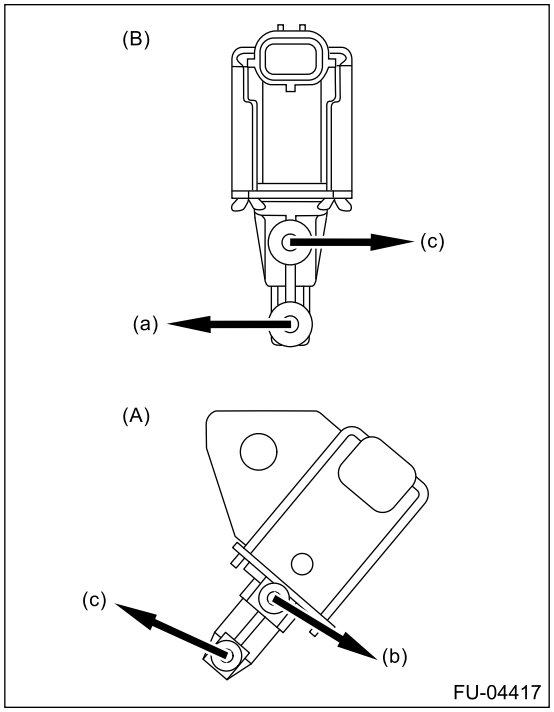
18. Connect the vacuum hose (B) to the intake duct, then connect the connector (A) to the wastegate control solenoid valve.



19. Install purge control solenoid valve 1 and purge control solenoid valve 2.

Note:

Connect the vacuum hose and vacuum control hose as shown in the figure.



(A) Purge control solenoid valve 1

(B) Purge control solenoid valve 2

(a) To intake duct

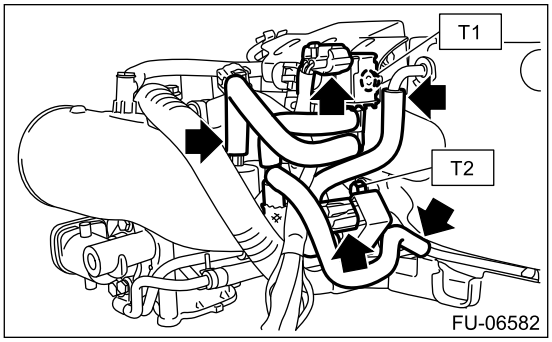
(b) To intake manifold

(c) To branching pipe → fuel pipe

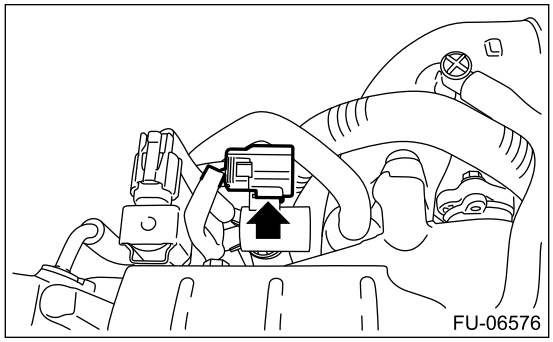
Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

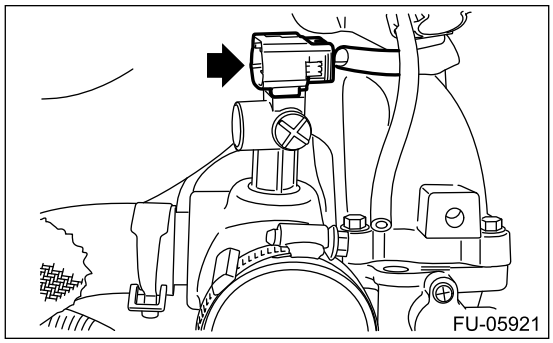
T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)



20. Attach the connector to the PCV hose assembly.



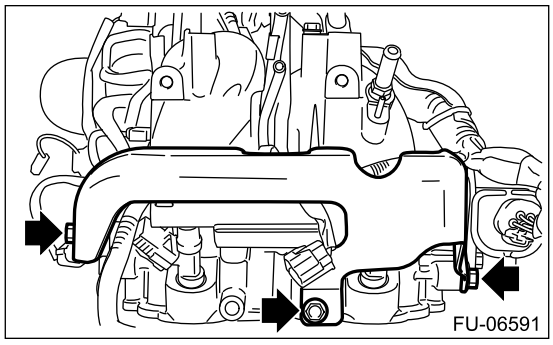
21. Install the connector to the intake duct.



22. Install the fuel pipe protector LH.

Tightening torque:

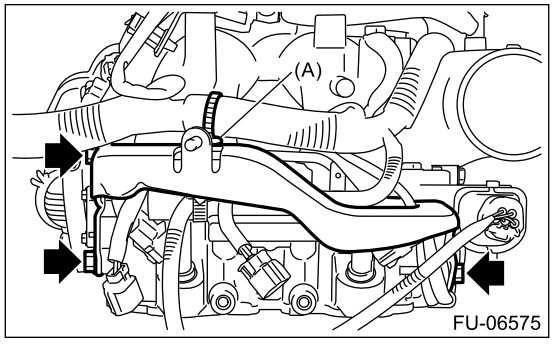
19 N·m (1.9 kgf-m, 14.0 ft-lb)



23. Install the fuel pipe protector RH, and secure the engine harness to the fuel pipe protector RH using the clip (A).

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)



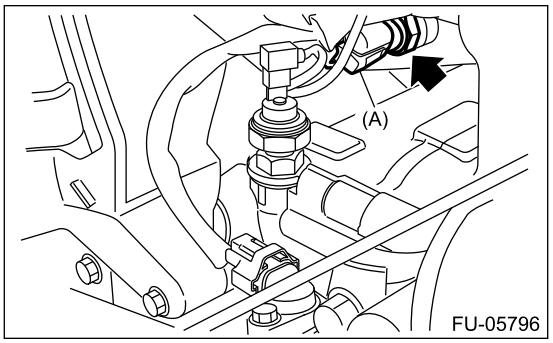
INSPECTION

1. Check that the intake manifold and fuel pipe have no deformation, cracks and other damages.
2. Check that the hose has no cracks, damage or loose part.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Engine Coolant Temperature Sensor

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the generator. Ref. to STARTING/CHARGING SYSTEMS(STI)>Generator>REMOVAL.
3. Drain engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
4. Disconnect the connector (A) from the engine coolant temperature sensor, and remove the engine coolant temperature sensor.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Engine Coolant Temperature Sensor

INSTALLATION

Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

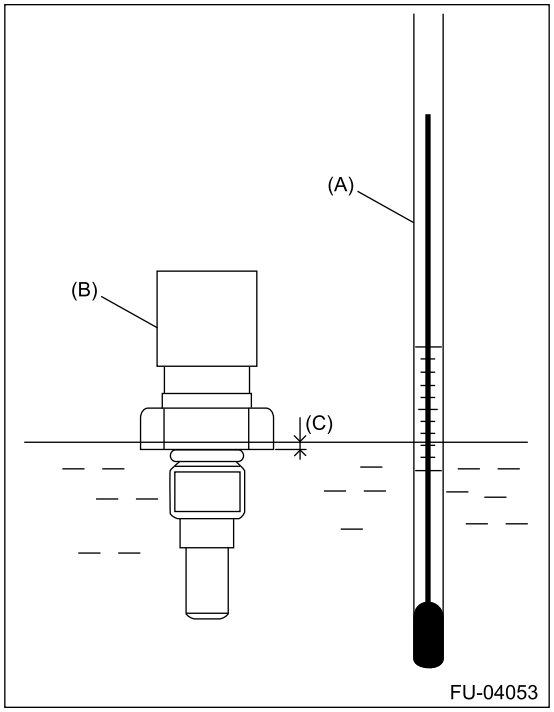
FUEL INJECTION (FUEL SYSTEMS)(STI) > Engine Coolant Temperature Sensor

INSPECTION

1. Check that the engine coolant temperature sensor has no deformation, cracks or other damages.
2. Immerse the engine coolant temperature sensor and a thermometer in water.

   Caution:

   Take care not to allow water to get into the engine coolant temperature sensor connector. Completely remove any water inside.



(A) Thermometer

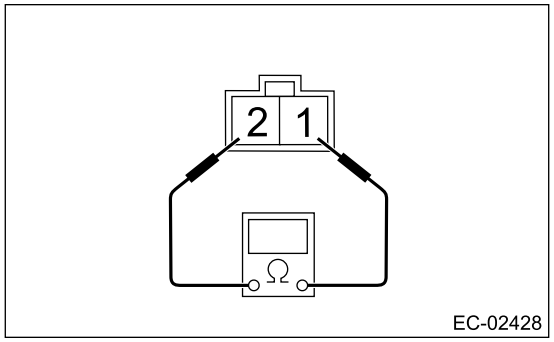
(B) Engine coolant temperature sensor

(C) Hexagonal part height: To approx. $^{1}/_{3}$

3. Raise water temperature gradually, measure the resistance between the engine coolant temperature sensor terminals when the temperature is 20°C (68°F) and 80°C (176°F).

Note:

Agitate the water for even temperature distribution.

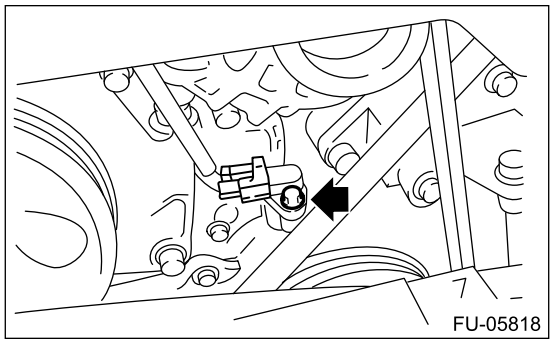


Water temperature	Terminal No.	Standard
20°C (68°F)	1 and 2	2.45±0.2 kΩ
80°C (176°F)		0.318±0.013 kΩ

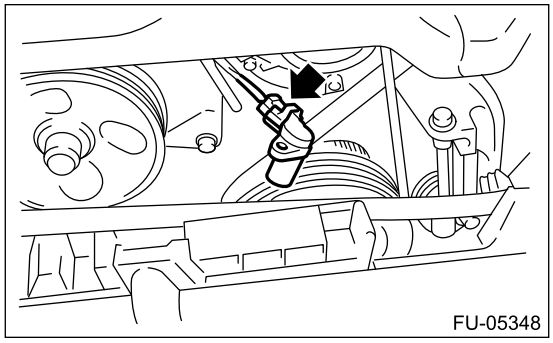
FUEL INJECTION (FUEL SYSTEMS)(STI) > Crankshaft Position Sensor

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the bolt which secures crankshaft position sensor to oil pump.



3. Remove the crankshaft position sensor, and disconnect the connector from the crankshaft position sensor.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Crankshaft Position Sensor

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

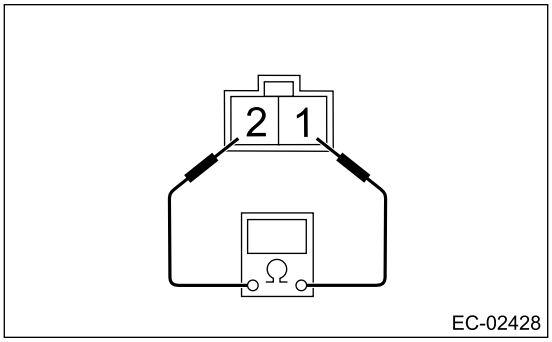
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Crankshaft Position Sensor

INSPECTION

1. CRANKSHAFT POSITION SENSOR (METHOD WITH CIRCUIT TESTER)

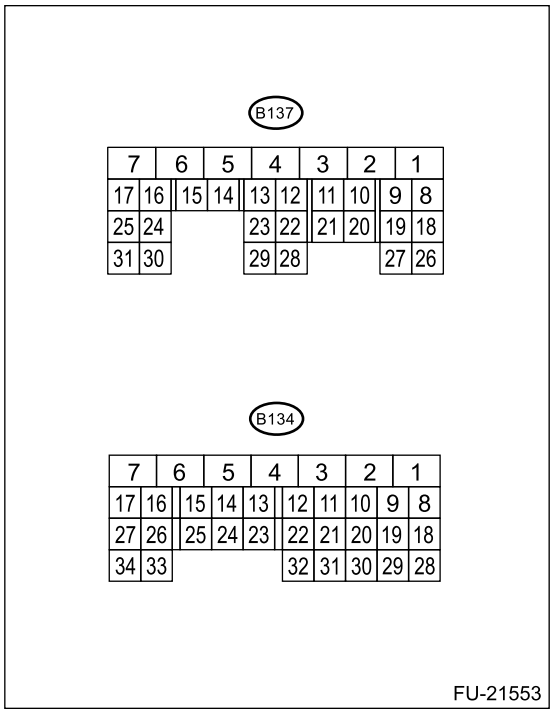
Measure the resistance between crankshaft position sensor terminals.



Terminal No.	Standard
1 and 2	2.04±0.204 kΩ

2. CRANKSHAFT POSITION SENSOR (METHOD WITH OSCILLOSCOPE)

1. Prepare an oscilloscope.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Connect the probe to ECM connector.



Terminal No.	Probe
(B137) No. 17	+
(B134) No. 3	–

4. Start the engine and let it idle.
5. Check the waveforms and voltage.
   Note:
   For waveform and voltage, refer to "Engine Control Module (ECM) I/O Signal". Ref. to ENGINE (DIAGNOSTICS)(STI)>Engine Control Module (ECM) I/O Signal>ELECTRICAL SPECIFICATION.
6. After inspection, install the related parts in the reverse order of removal.

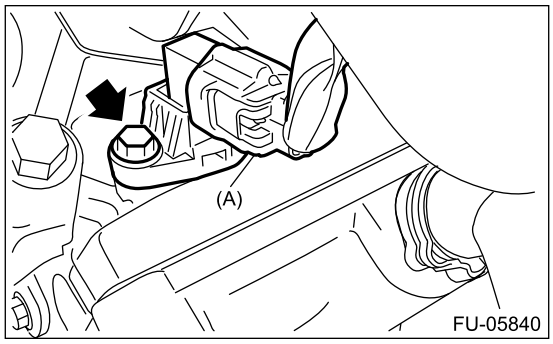
3. OTHER INSPECTIONS

Check that the crankshaft position sensor has no deformation, cracks or other damages.

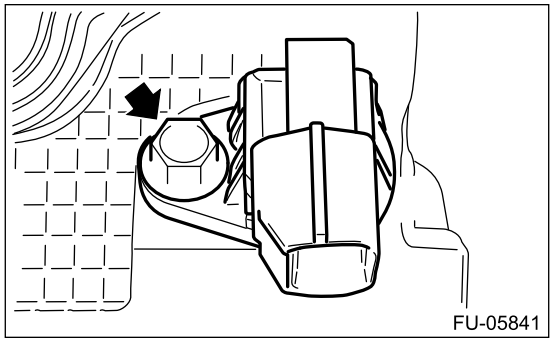
REMOVAL

1. INTAKE SIDE

- **Camshaft position sensor RH**
  1. Disconnect the ground cable from battery.
  2. Disconnect the connector (A) from the camshaft position sensor RH, and remove the camshaft position sensor RH from the rear side of the cylinder head.

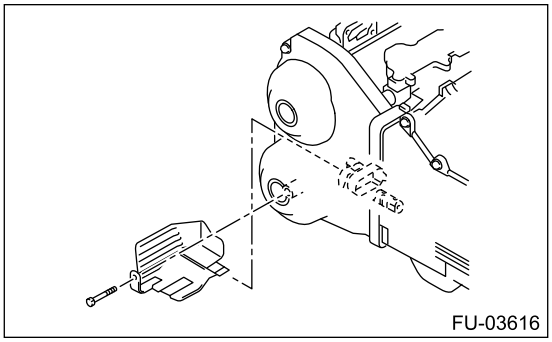


- **Camshaft position sensor LH**
  1. Disconnect the ground cable from battery.
  2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
  3. Remove the camshaft position sensor LH.

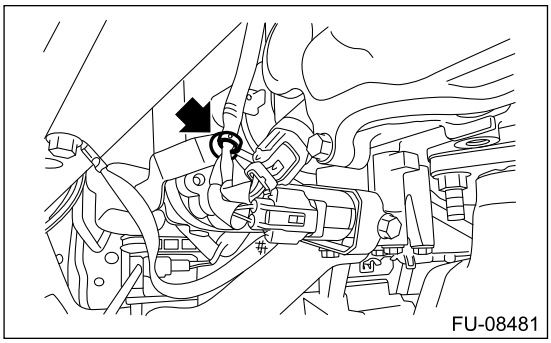


2. EXHAUST SIDE

1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Remove the engine harness cover. (Right side only)

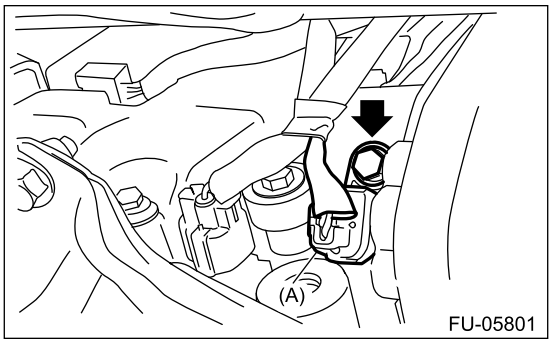


5. Remove the clip holding the engine harness. (Left side only)

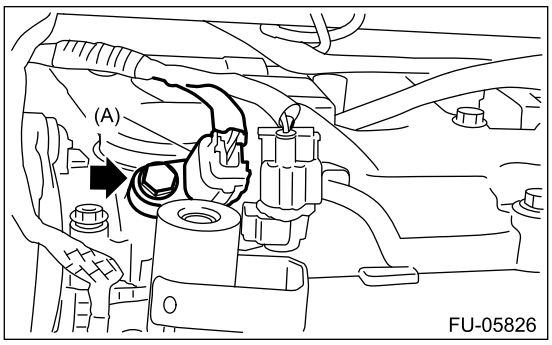


6. Disconnect connector (A) from the camshaft position sensor, and remove the camshaft position sensor from under the cylinder head.

- RH side



- LH side



FUEL INJECTION (FUEL SYSTEMS)(STI) > Camshaft Position Sensor

INSTALLATION

1. INTAKE SIDE

Install in the reverse order of removal.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

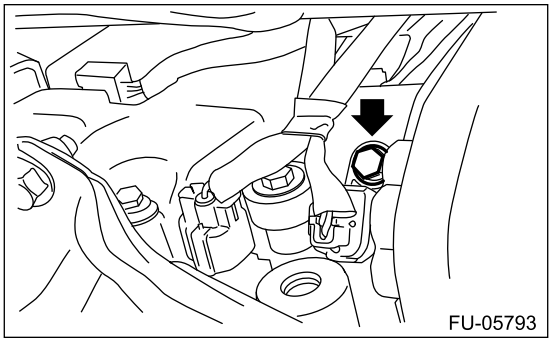
2. EXHAUST SIDE

Install in the reverse order of removal.

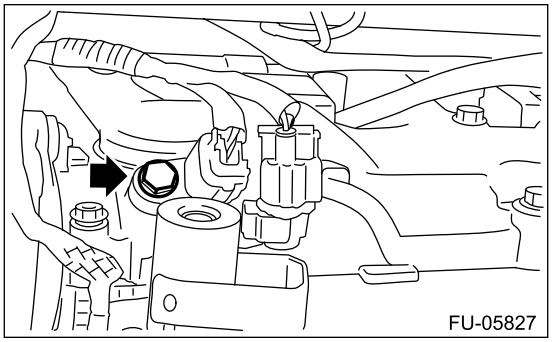
Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

- RH side

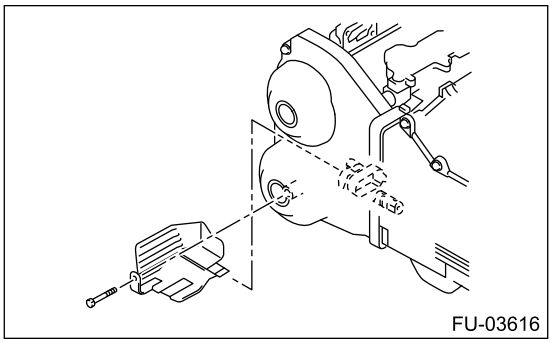


- LH side



Tightening torque:

5 N·m (0.5 kgf-m, 3.7 ft-lb)

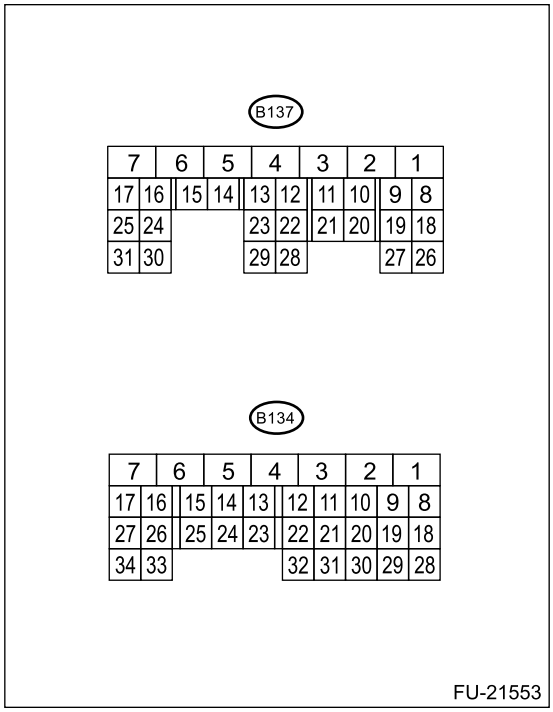


FUEL INJECTION (FUEL SYSTEMS)(STI) > Camshaft Position Sensor

INSPECTION

1. CAMSHAFT POSITION SENSOR (METHOD WITH OSCILLOSCOPE)

1. Prepare an oscilloscope.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Connect the probe to ECM connector.



Camshaft position sensor		Terminal No.	Probe
Intake	RH	(B137) No. 24	+
	LH	(B137) No. 16	+
Exhaust	RH	(B137) No. 23	+
	LH	(B137) No. 29	+
RH and LH		(B134) No. 3	–

4. Start the engine and let it idle.
5. Check the waveforms and voltage.
   Note:
   For waveform and voltage, refer to "Engine Control Module (ECM) I/O Signal". Ref. to ENGINE (DIAGNOSTICS)(STI)>Engine Control Module (ECM) I/O Signal>ELECTRICAL SPECIFICATION.
6. After inspection, install the related parts in the reverse order of removal.

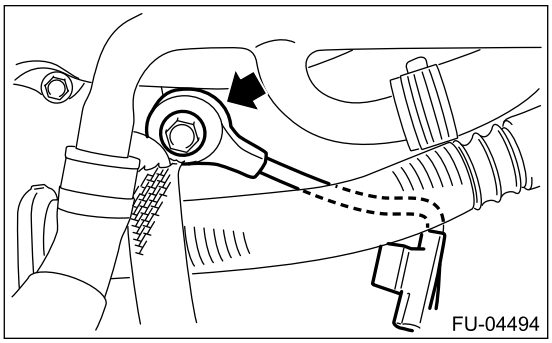
2. OTHER INSPECTIONS

Check that the camshaft position sensor has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Knock Sensor

REMOVAL

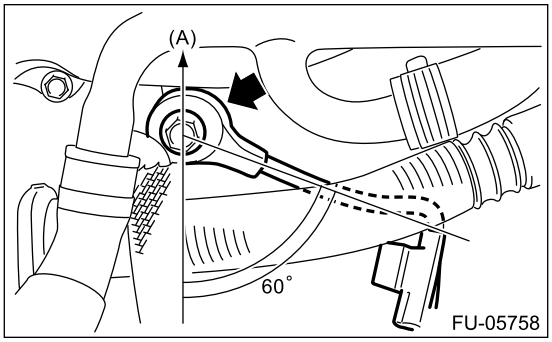
1. Disconnect the ground cable from battery.
2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
3. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
4. Remove the secondary air combination valve RH. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Combination Valve>REMOVAL.
5. Remove the knock sensor from cylinder block.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Knock Sensor

INSTALLATION

1. Install the knock sensor to the cylinder block.
   Note:
   The portion of the knock sensor cord that is pulled out must be positioned at a 60° angle relative to the engine rear.
   Tightening torque:
   24 N·m (2.4 kgf-m, 17.7 ft-lb)



(A) Front side of vehicle

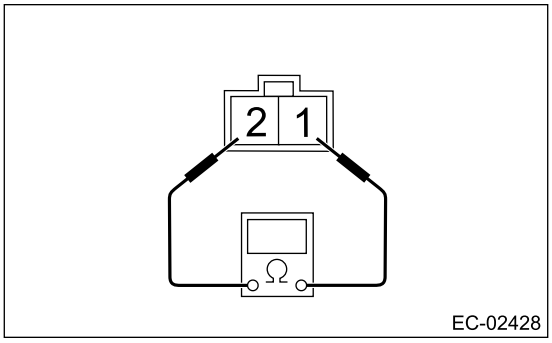
2. Install the secondary air combination valve RH. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Combination Valve>INSTALLATION > SECONDARY AIR COMBINATION VALVE RH.
3. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>INSTALLATION.
4. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.

5. Connect the battery ground terminal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Knock Sensor

INSPECTION

1. Check that the knock sensor has no deformation, cracks or other damages.
2. Measure the resistance between knock sensor terminals.



Terminal No.	Standard
1 and 2	560±28 kΩ

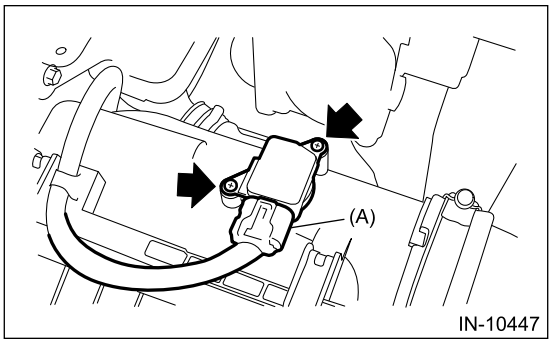
SPECIFICATION

Throttle body is a non-disassembled part, so do not remove the throttle position sensor from throttle body.
Refer to “Throttle Body” for removal and installation procedure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Throttle Body>REMOVAL. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Throttle Body>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Mass Air Flow and Intake Air Temperature Sensor

REMOVAL

1. Disconnect the ground cable from battery.
2. Disconnect the connector (A) from the mass air flow and intake air temperature sensor, and remove the mass air flow and intake air temperature sensor.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Mass Air Flow and Intake Air Temperature Sensor

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

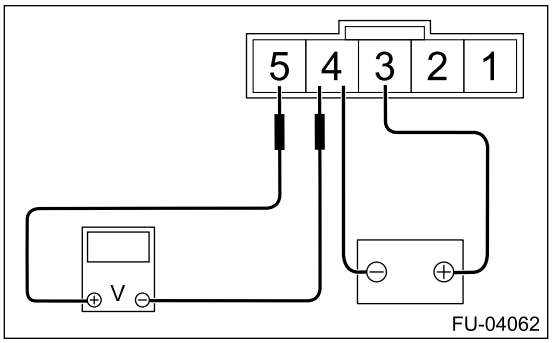
1 N·m (0.1 kgf-m, 0.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Mass Air Flow and Intake Air Temperature Sensor

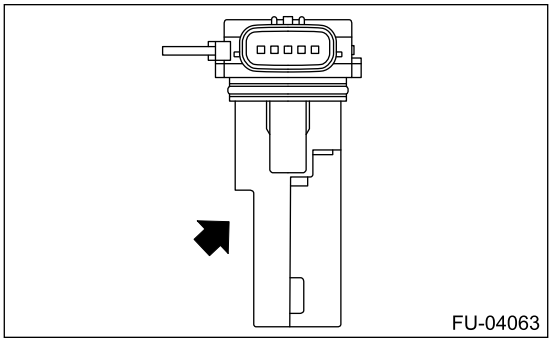
INSPECTION

1. CHECK THE MASS AIR FLOW SENSOR UNIT

1. Connect the battery positive terminal to terminal No. 3 and the battery ground terminal to terminal No. 4, and connect the circuit tester positive terminal to terminal No. 5 and the circuit tester ground terminal to terminal No. 4.

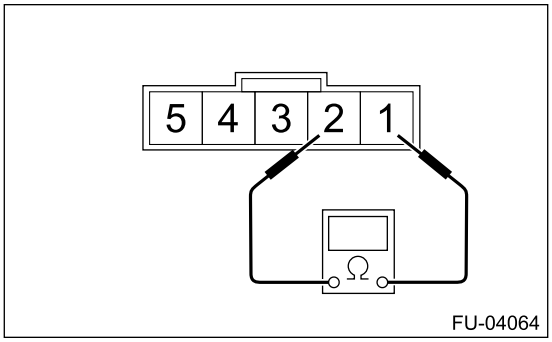


2. Check the voltage changes when air is blown to the mass air flow sensor unit in arrow direction.



2. CHECK THE INTAKE AIR TEMPERATURE SENSOR UNIT

Measure the resistance between intake air temperature sensor terminals.



Temperature	Terminal No.	Standard
−20°C (−4°F)	1 and 2	16.0±2.4 kΩ
20°C (68°F)		2.45±0.24 kΩ
60°C (140°F)		0.580±0.087 kΩ

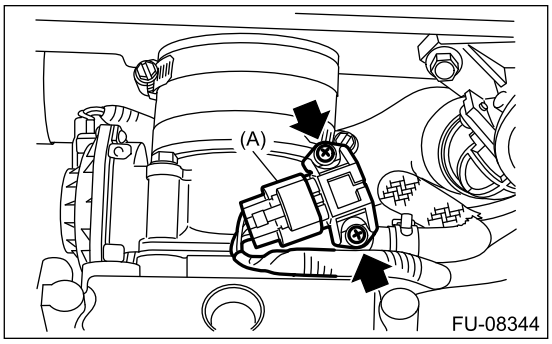
3. OTHER INSPECTIONS

1. Check that the mass air flow and intake air temperature sensor has no deformation, cracks or other damages.
2. Check that the mass air flow and intake air temperature sensor has no dirt.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Manifold Absolute Pressure Sensor

REMOVAL

1. Disconnect the ground cable from battery.
2. Disconnect the connector (A) from the manifold absolute pressure sensor, and remove the manifold absolute pressure sensor from throttle body.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Manifold Absolute Pressure Sensor

INSTALLATION

Install in the reverse order of removal.

Note:

Use new O-rings.

Tightening torque:

2 N·m (0.2 kgf-m, 1.5 ft-lb)

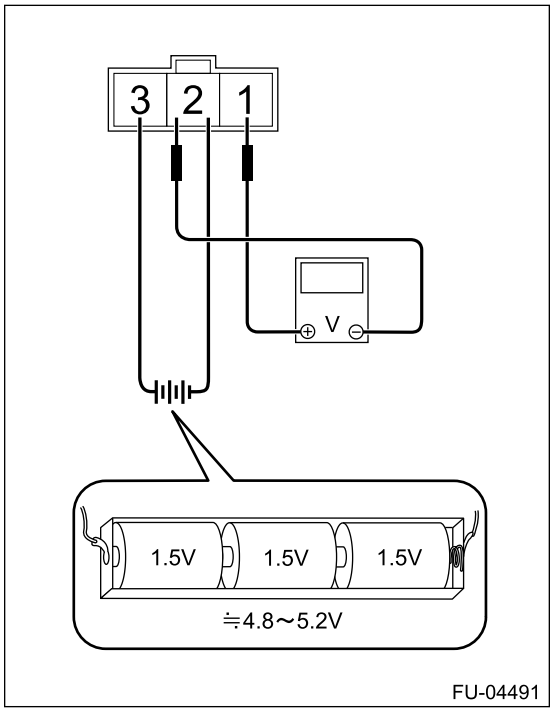
FUEL INJECTION (FUEL SYSTEMS)(STI) > Manifold Absolute Pressure Sensor

INSPECTION

1. Check that the manifold absolute pressure sensor has no deformation, cracks or other damages.
2. Connect dry-cell battery positive terminal to terminal No. 3 and dry-cell battery ground terminal to terminal No. 2, circuit tester positive terminal to terminal No. 1 and the circuit tester ground terminal to terminal No. 2.

   Note:

   - **Use new dry-cell batteries.**
   - **Using a circuit tester, check that the initial voltage of each dry-cell battery is 1.6 V or more. And also check that the voltage of three batteries in series is between 4.8 V and 5.2 V.**
   - **For power supply, 5 V DC constant voltage power source can also be used.**



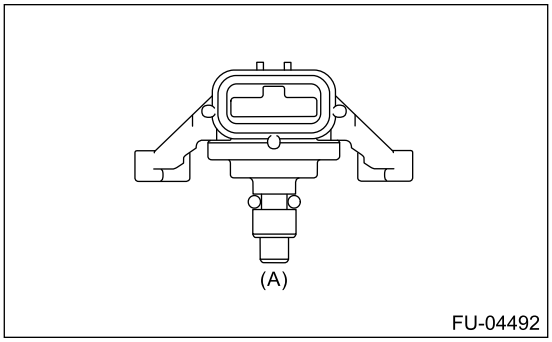
3. Check the voltage at a normal atmospheric pressure.

Note:

The atmospheric pressure at higher altitude is lower than normal. Therefore, the voltage is lower than the standard value.

Terminal No.	Standard
1 (+) and 2 (−)	Approx. 2.0 V (when 25°C (77°F))

4. Connect the Mighty Vac to the pressure port (A) of manifold absolute pressure sensor.



5. Check the voltage when generating vacuum and positive pressure using Mighty Vac.

Caution:

Do not apply or reduce pressure out of the range of −88 — 200 kPa (−0.9 — 2.04 kgf/cm^2, −12.8 — 29.0 psi). Doing so may damage the manifold absolute pressure sensor.

Note:

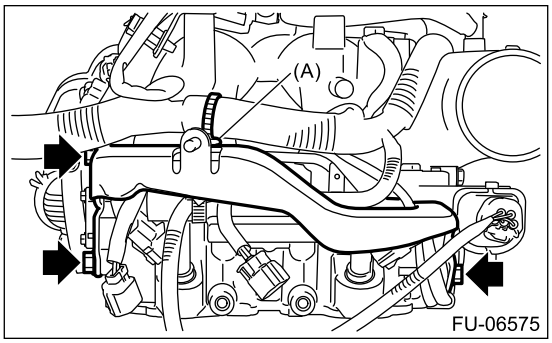
When vacuum occurs at the pressure port of manifold absolute pressure sensor, the voltage will drop from the value as in step 3). When positive pressure occurs, on the other hand, the voltage will rise.

Pressure	Terminal No.	Standard
−88 kPa (−0.9 kgf/cm^2, −12.8 psi)	1 (+) and 2 (−)	Approx. 0.8 V (when 25°C (77°F))
181 kPa (1.85 kgf/cm^2, 26.2 psi)		Approx. 4.7 V (when 25°C (77°F))

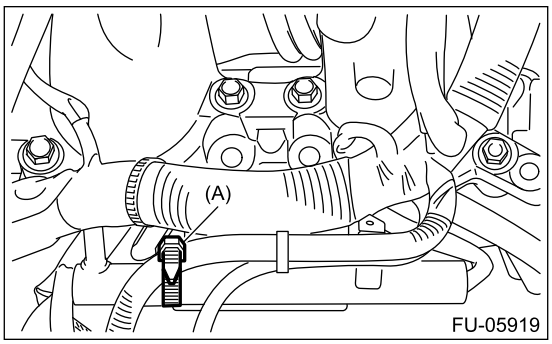
REMOVAL

1. RH SIDE

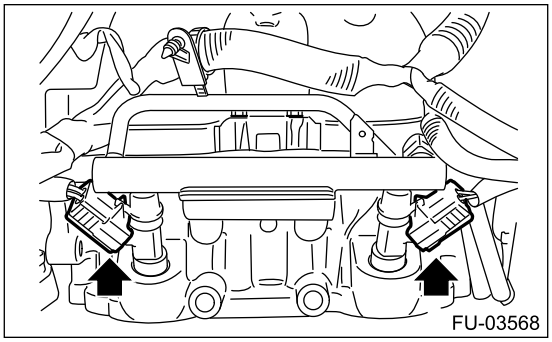
1. Disconnect the ground cable from battery.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Remove clip (A) holding the engine harness to the fuel pipe protector RH, and remove the fuel pipe protector RH from the intake manifold.



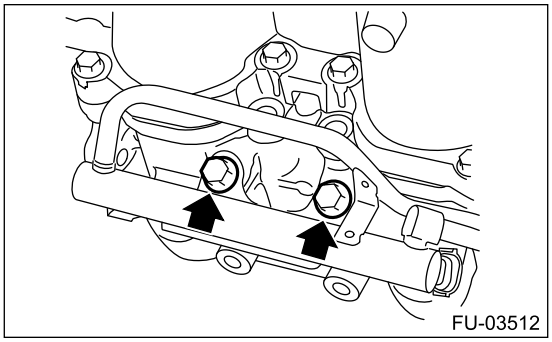
4. Remove the harness band (A) which holds the engine harness to the fuel injector pipe RH.



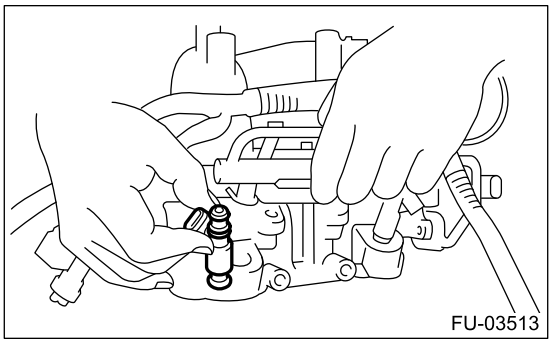
5. Disconnect the connector from fuel injector.



6. Remove the bolts which hold fuel injector pipe RH.

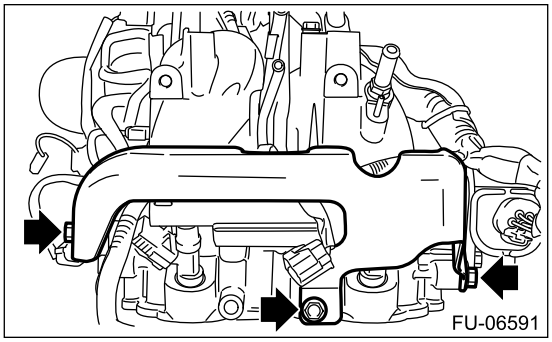


7. Remove the fuel injector.

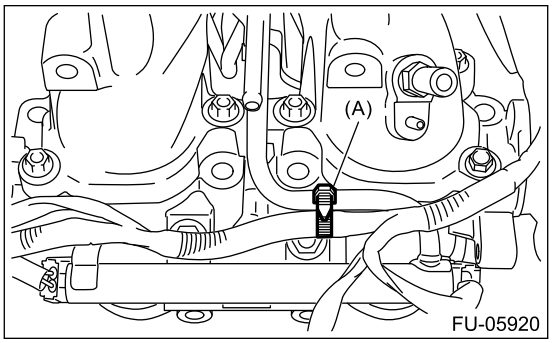


2. LH SIDE

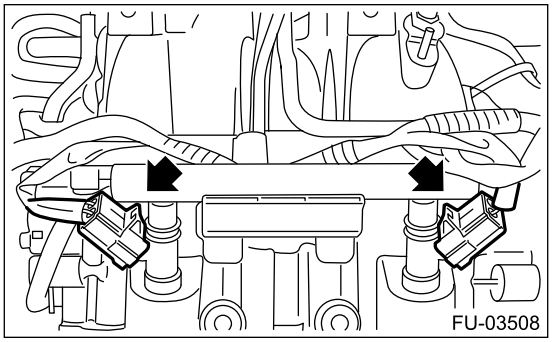
1. Disconnect the ground cable from battery.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Remove the fuel pipe protector LH from the intake manifold.



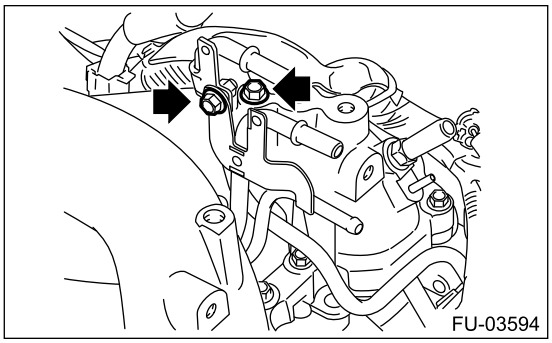
4. Remove the harness band (A) which holds the engine harness to the fuel injector pipe LH.

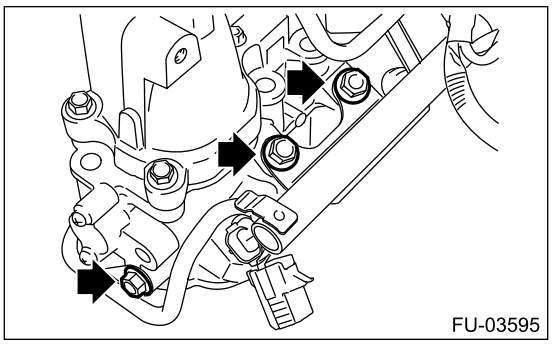


5. Disconnect the connector from fuel injector.

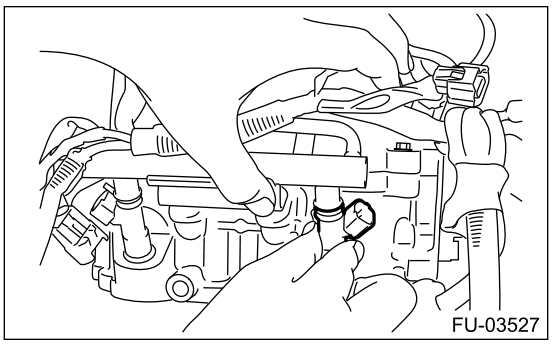


6. Remove the bolts which hold fuel injector pipe LH.





7. Remove the fuel injector.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Injector

INSTALLATION

1. RH SIDE

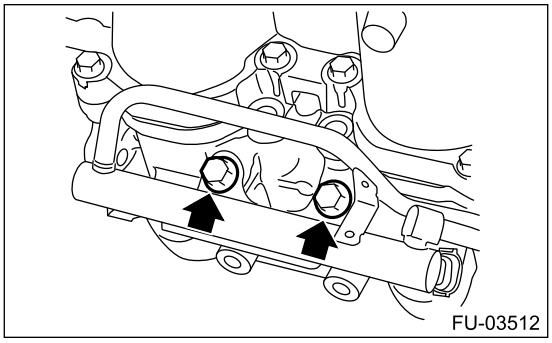
Install in the reverse order of removal.

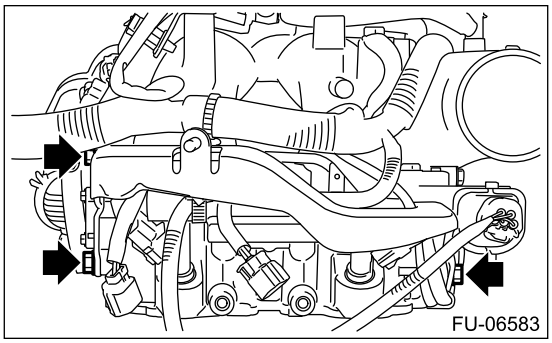
Note:

Use new O-rings, rubbers and seal rings.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)





2. LH SIDE

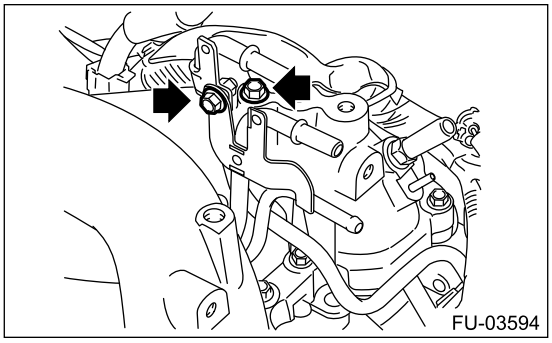
Install in the reverse order of removal.

Note:

Use new O-rings, rubbers and seal rings.

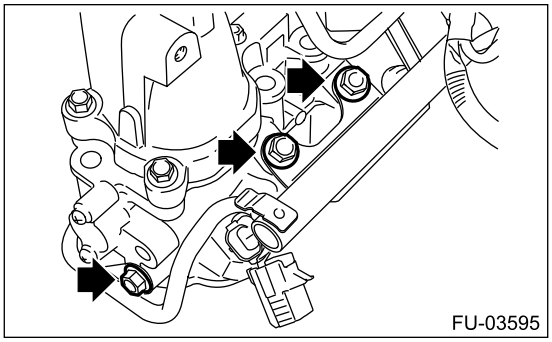
Tightening torque:

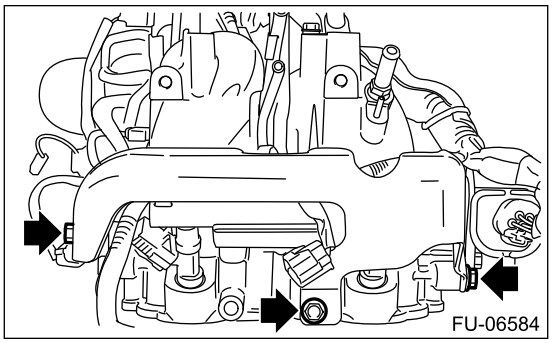
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

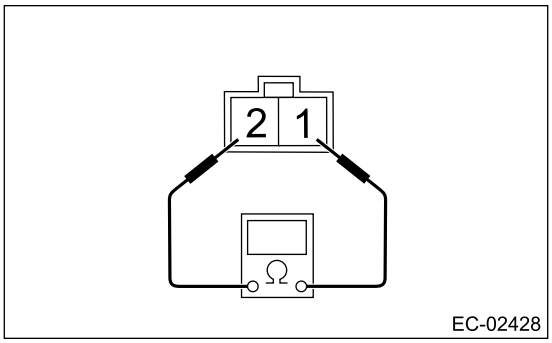




FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Injector

INSPECTION

1. Check that the fuel injector has no deformation, cracks or other damages.
2. Measure the resistance between fuel injector terminals.

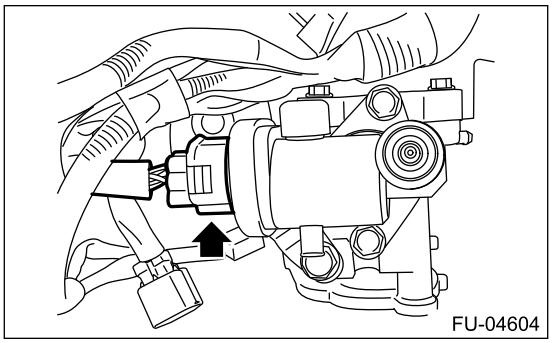


Terminal No.	Standard
1 and 2	Approx. 12.0 Ω (when 20°C (68°F))

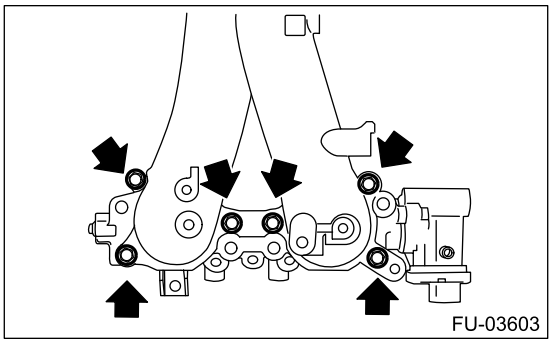
FUEL INJECTION (FUEL SYSTEMS)(STI) > Tumble Generator Valve Assembly

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Disconnect the connector from the tumble generator valve assembly.



4. Remove the fuel injector. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Injector>REMOVAL.
5. Remove the tumble generator valve assembly from the intake manifold.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Tumble Generator Valve Assembly

INSTALLATION

Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

8.2 N·m (0.8 kgf-m, 6.0 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Tumble Generator Valve Assembly

INSPECTION

1. Check that the tumble generator valve assembly has no deformation, cracks or other damages.
2. Check tumble generator valve for contamination or clogging.

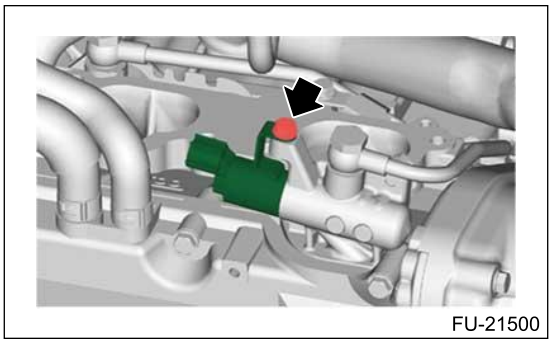
SPECIFICATION

The tumble generator valve assembly cannot be disassembled.
Refer to “Tumble Generator Valve Assembly” for removal and installation procedures. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Tumble Generator Valve Assembly>REMOVAL. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Tumble Generator Valve Assembly>INSTALLATION.

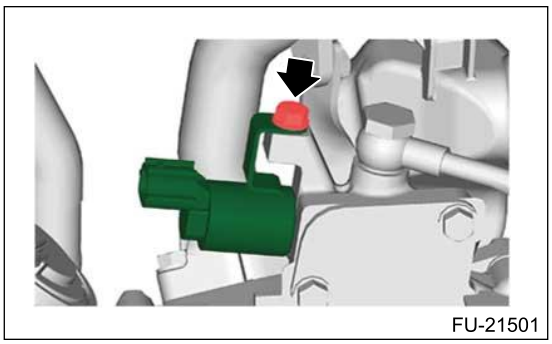
REMOVAL

1. INTAKE SIDE

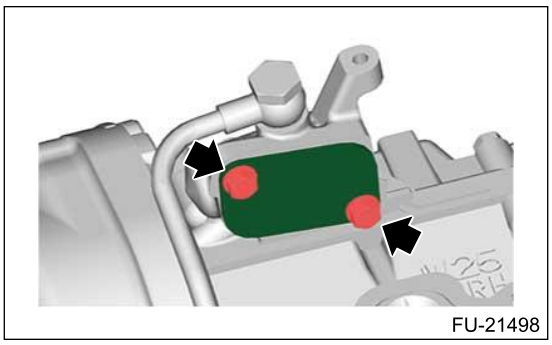
1. Disconnect the ground terminal from battery.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Remove the oil flow control solenoid valve.
   - RH


FU-21500

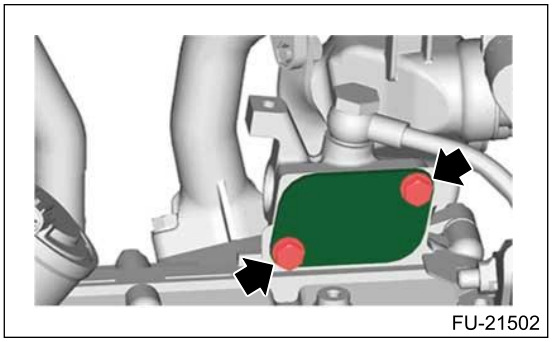
   - LH


FU-21501

4. Remove the oil return cover.
   Note:
   Perform this procedure only when it is necessary.
   - RH

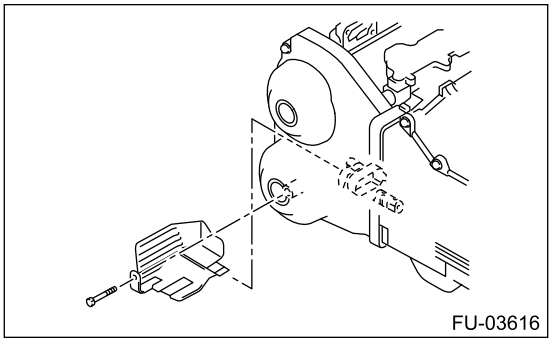

FU-21498

   - LH

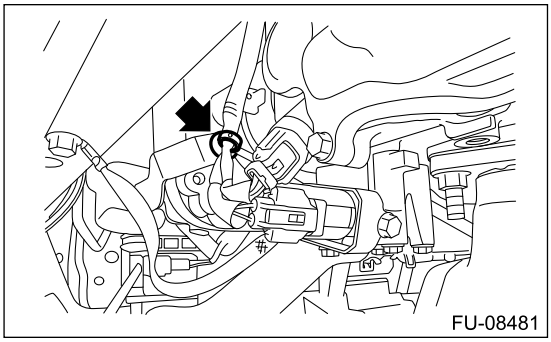


2. EXHAUST SIDE

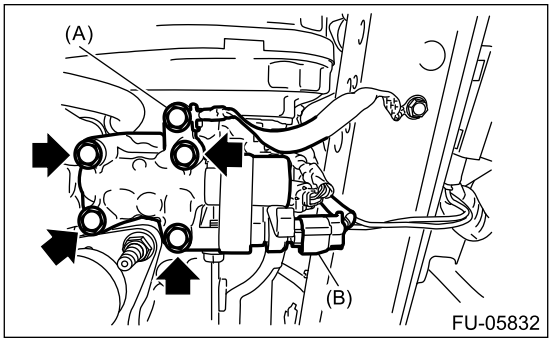
1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Remove the front exhaust pipe. (Right side only) Ref. to EXHAUST(STI)>Front Exhaust Pipe>REMOVAL.
5. Remove the engine harness cover. (Right side only)



6. Remove the clip holding the engine harness. (Left side only)



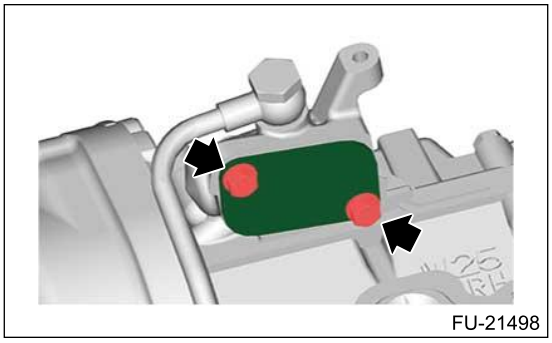
7. Disconnect the ground cable (A). (Left side only)
8. Disconnect the connector (B) from the oil flow control solenoid valve, and remove the oil flow control solenoid valve from the cylinder head.



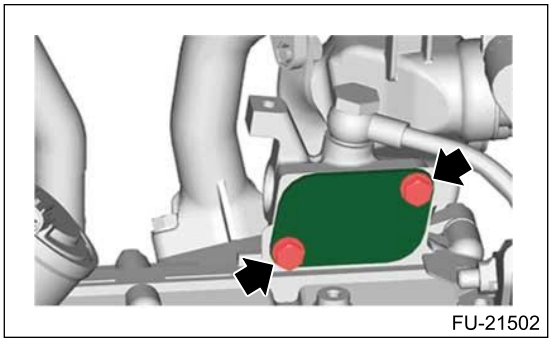
INSTALLATION

1. INTAKE SIDE

1. Apply liquid gasket to the two bolts securing oil return cover.
   Liquid gasket:
   THREE BOND 1324 (Part No. 004403042) or equivalent
2. Install the oil return cover.
   Note:
   Use a new gasket.
   Tightening torque:
   9 N·m (0.9 kgf-m, 6.6 ft-lb)
   - RH

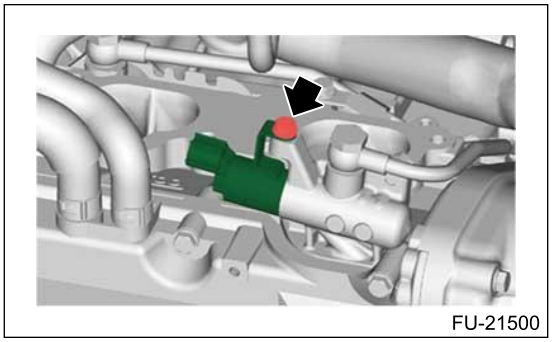


   - LH

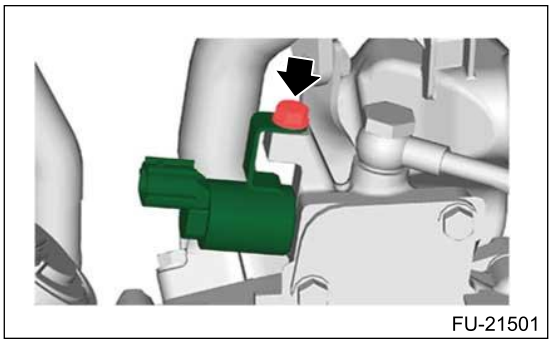


3. Install the oil flow control solenoid valve.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

- RH



- LH



4. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>INSTALLATION.
5. Connect the battery ground terminal.

2. EXHAUST SIDE

Install in the reverse order of removal.

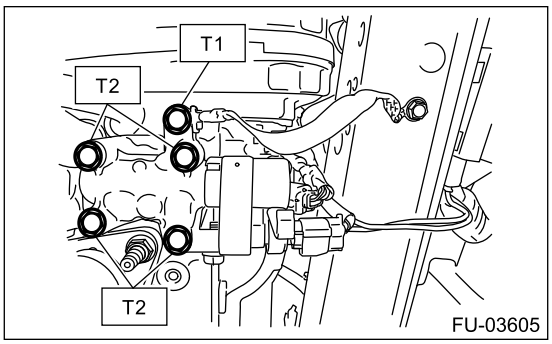
Note:

Use a new gasket.

Tightening torque:

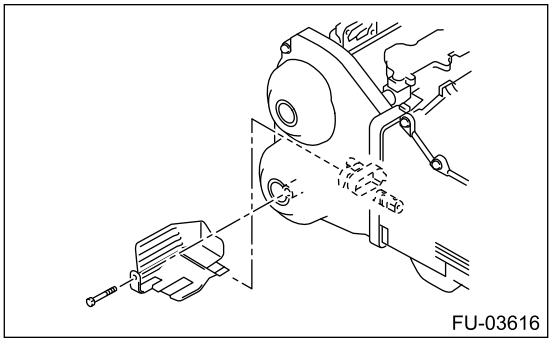
T1: 7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

T2: 10 N·m (1.0 kgf-m, 7.4 ft-lb)



Tightening torque:

5 N·m (0.5 kgf-m, 3.7 ft-lb)



FUEL INJECTION (FUEL SYSTEMS)(STI) > Oil Flow Control Solenoid Valve

DISASSEMBLY

1. INTAKE SIDE

The case of the oil flow control solenoid valve on the intake side is a single unit with the front camshaft cap.

2. EXHAUST SIDE

The oil flow control solenoid valve on the exhaust side cannot be disassembled.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Oil Flow Control Solenoid Valve

ASSEMBLY

1. INTAKE SIDE

The case of the oil flow control solenoid valve on the intake side is a single unit with the front camshaft cap.

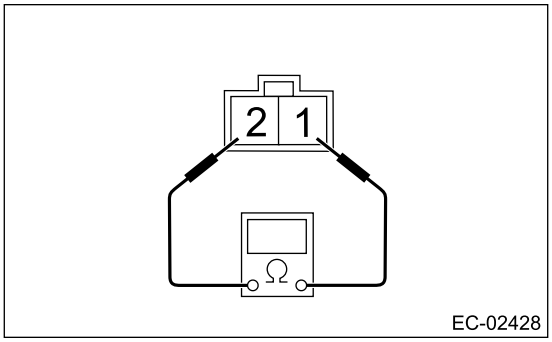
2. EXHAUST SIDE

The oil flow control solenoid valve on the exhaust side cannot be disassembled.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Oil Flow Control Solenoid Valve

INSPECTION

1. Check that the oil flow control solenoid valve has no deformation, cracks or other damages.
2. Measure the resistance between the oil flow control solenoid valve terminals.

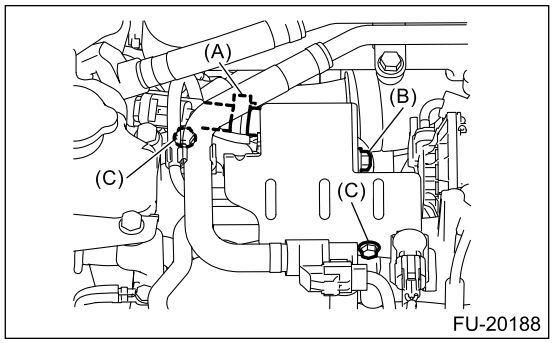


Terminal No.	Standard
1 and 2	7.4±0.5 Ω (when 20°C (68°F))

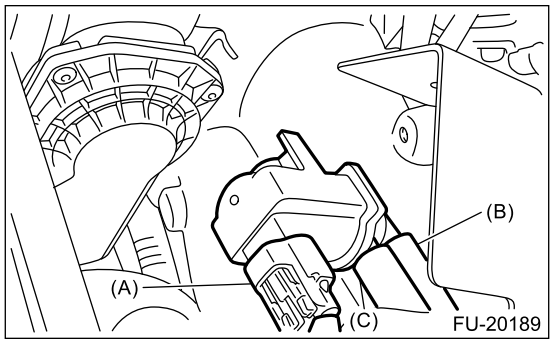
FUEL INJECTION (FUEL SYSTEMS)(STI) > Wastegate Control Solenoid Valve

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the vacuum hose from clip (A), and remove the bolt (B) which secures the wastegate control solenoid valve.
3. Remove the bolts (C) which secure solenoid valve bracket onto intake manifold.



4. Disconnect the connector (A) from the wastegate control solenoid valve.
5. Disconnect the vacuum hose (B) and air control hose (C) from the wastegate control solenoid valve, and remove the wastegate control solenoid valve.



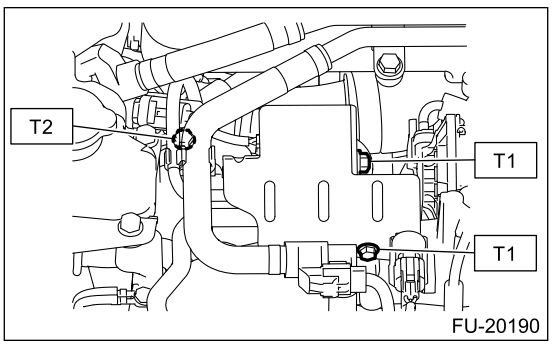
FUEL INJECTION (FUEL SYSTEMS)(STI) > Wastegate Control Solenoid Valve

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

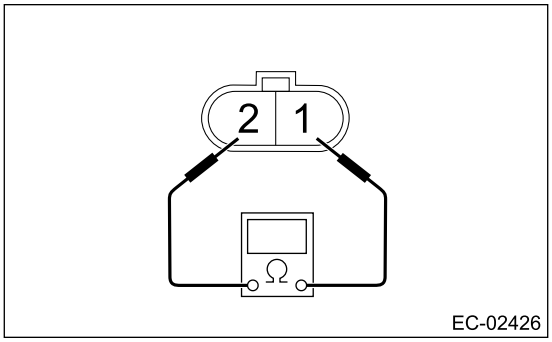
T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)



INSPECTION

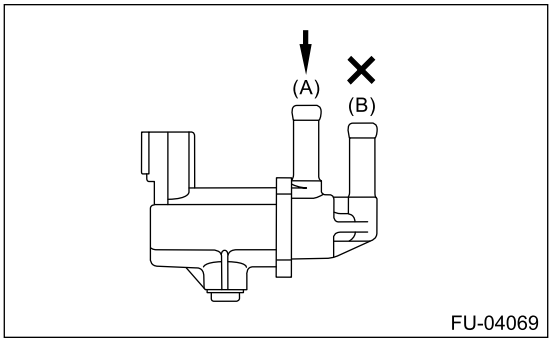
1. WASTEGATE CONTROL SOLENOID VALVE

1. Check that the wastegate control solenoid valve has no deformation, cracks or other damages.
2. Check the resistance between the wastegate control solenoid valve terminals.

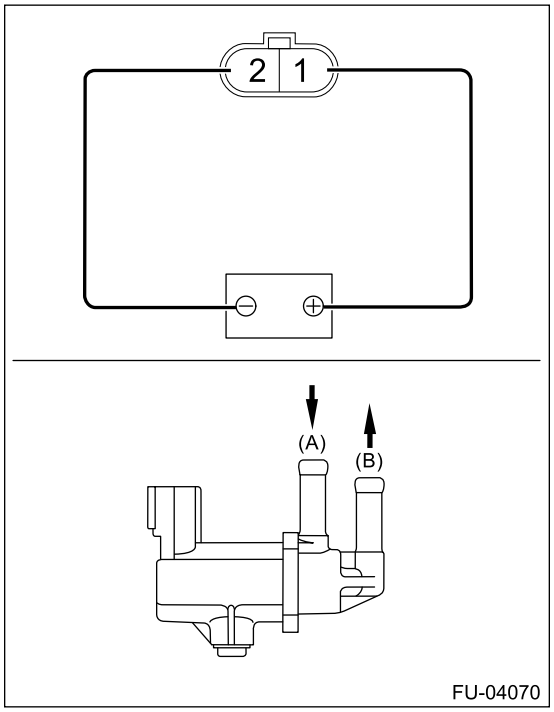


Terminal No.	Standard
1 and 2	28±2 Ω (when 20°C (68°F))

3. Check that air does not come out from (B) when air is blown into (A).



4. Connect the battery positive terminal to the terminal No. 1 and the battery negative terminal to the terminal No. 2. Check that air is discharged from (B), when supplying air to (A).



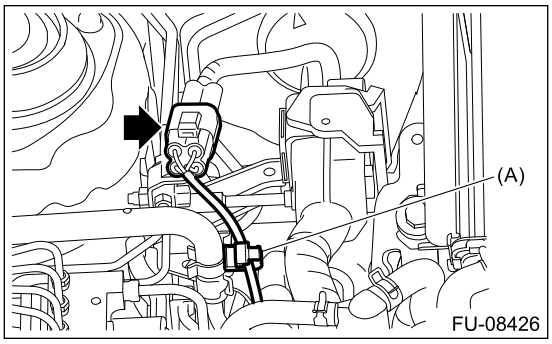
2. OTHER INSPECTIONS

Check that the vacuum hose and air control hose have no cracks, damage or loose part.

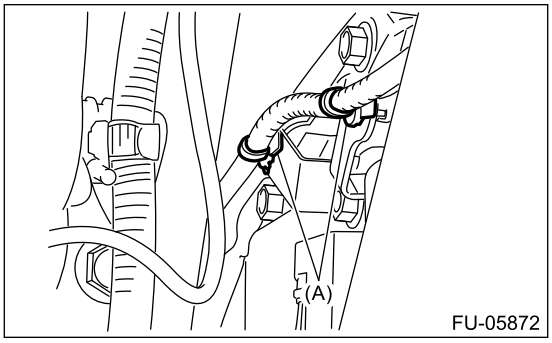
FUEL INJECTION (FUEL SYSTEMS)(STI) > Front Oxygen (A/F) Sensor

REMOVAL

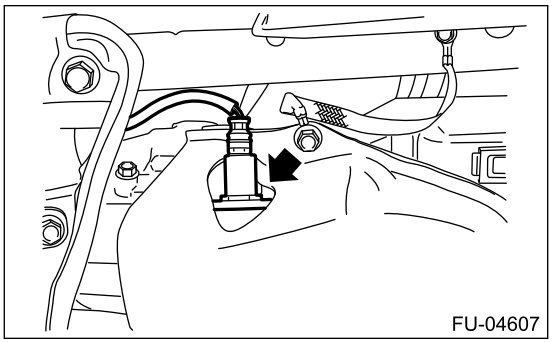
1. Disconnect the ground cable from battery.
2. Disconnect the connector from the front oxygen (A/F) sensor, and remove the clip (A) holding the return hose and front oxygen (A/F) sensor harness.



3. Remove the clips (A) holding the front oxygen (A/F) sensor harness to the engine harness stay.



4. Lift up the vehicle.
5. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
6. Apply spray-type lubricant (004301003) to the threaded portion of front oxygen (A/F) sensor, and leave it for one minute or more.
7. Remove the front oxygen (A/F) sensor.
   Caution:
   When removing the front oxygen (A/F) sensor, wait until exhaust pipe cools, otherwise it will damage the exhaust pipe.

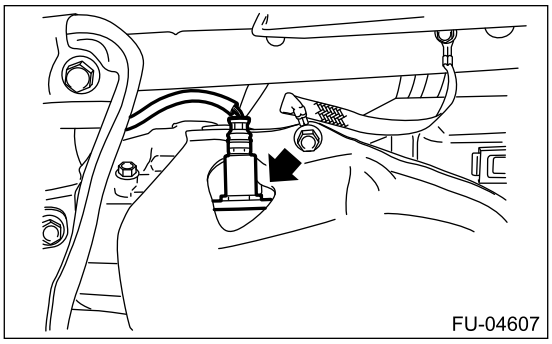


FUEL INJECTION (FUEL SYSTEMS)(STI) > Front Oxygen (A/F) Sensor

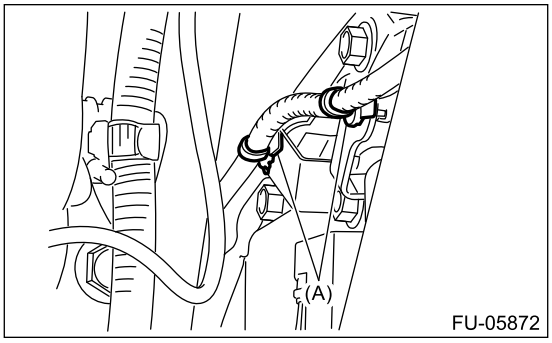
INSTALLATION

Caution:
If lubricant is spilt onto the exhaust pipe, wipe it off completely with cloth to avoid emission of smoke or causing a fire.

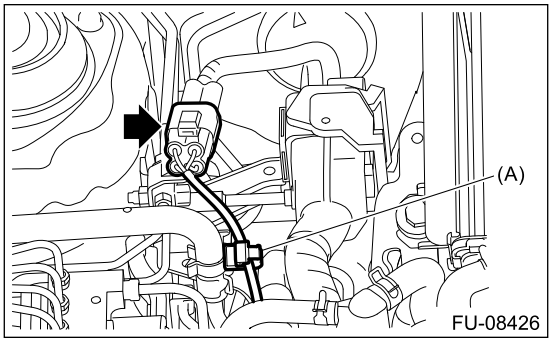
1. Before installing front oxygen (A/F) sensor, apply anti-seize compound only to the threaded portion of front oxygen (A/F) sensor to make the next removal easier.
   Caution:
   Never apply anti-seize compound to the protector of front oxygen (A/F) sensor.
   Anti-seize compound:
   NEVER-SEEZ NSN, JET LUBE SS-30 or equivalent
2. Install the front oxygen (A/F) sensor.
   Tightening torque:
   30 N·m (3.1 kgf-m, 22.1 ft-lb)



3. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
4. Lower the vehicle.
5. Secure the front oxygen (A/F) sensor harness to the engine harness stay using the clips (A).



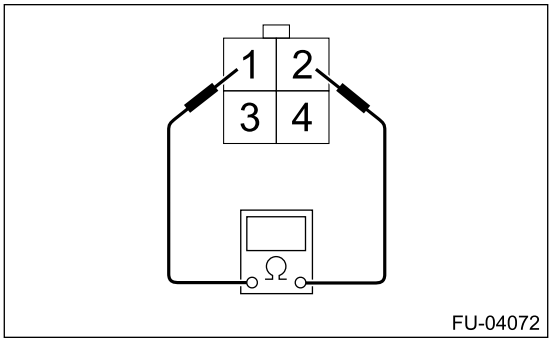
6. Connect the connector to the front oxygen (A/F) sensor, and secure the return hose and front oxygen (A/F) sensor harness using the clip (A).



7. Connect the battery ground terminal.

INSPECTION

1. Check that the front oxygen (A/F) sensor has no deformation, cracks or other damages.
2. Measure the resistance between front oxygen (A/F) sensor terminals.

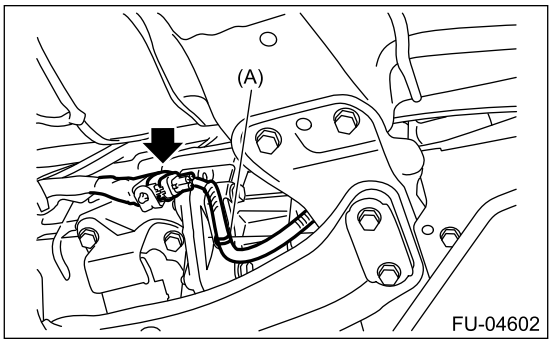


Terminal No.	Standard
1 and 2	2.4±0.24 Ω (when 20°C (68°F))

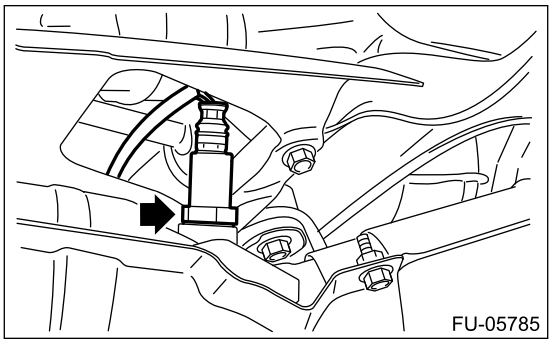
FUEL INJECTION (FUEL SYSTEMS)(STI) > Rear Oxygen Sensor

REMOVAL

1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the transmission under cover.
4. Disconnect the connector from the rear oxygen sensor, and remove the clip (A) holding the rear oxygen sensor harness.



5. Apply spray-type lubricant (004301003) to the threaded portion of rear oxygen sensor, and leave it for one minute or more.
6. Remove the rear oxygen sensor.
   Caution:
   When removing the rear oxygen sensor, wait until exhaust pipe cools, otherwise it will damage the exhaust pipe.



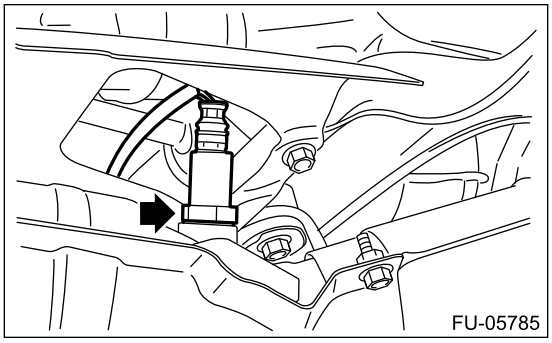
FUEL INJECTION (FUEL SYSTEMS)(STI) > Rear Oxygen Sensor

INSTALLATION

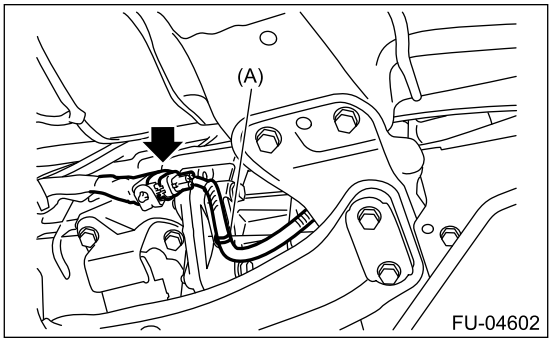
Caution:
If lubricant is spilt onto the exhaust pipe, wipe it off completely with cloth to avoid emission of smoke or causing a fire.

1. Before installing rear oxygen sensor, apply the anti-seize compound only to the threaded portion of rear oxygen sensor to make the next removal easier.
   Caution:
   Never apply anti-seize compound to the protector of rear oxygen sensor.
   Anti-seize compound:
   NEVER-SEEZ NSN, JET LUBE SS-30 or equivalent

2. Install the rear oxygen sensor.
   Tightening torque:
   21 N·m (2.1 kgf-m, 15.5 ft-lb)



3. Connect the connector to the rear oxygen sensor, and hold the rear oxygen sensor harness with the clip (A).

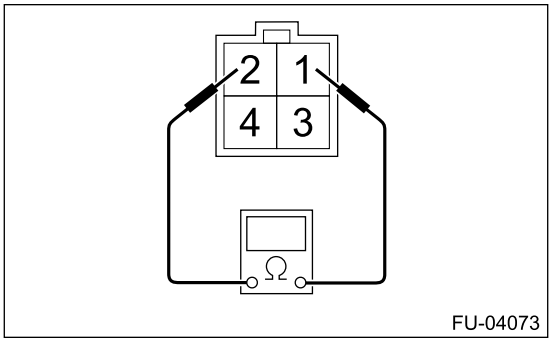


4. Install the transmission under cover.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
5. Lower the vehicle.
6. Connect the battery ground terminal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Rear Oxygen Sensor

INSPECTION

1. Check that the rear oxygen sensor has no deformation, cracks or other damages.
2. Measure the resistance between rear oxygen sensor terminals.

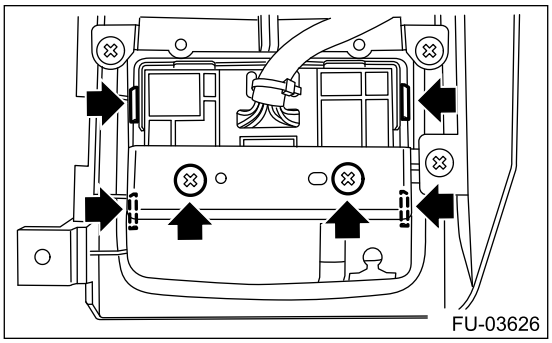


Terminal No.	Standard
1 and 2	$5.6^{+0.8}_{-0.6}$ Ω (when 20°C (68°F))

FUEL INJECTION (FUEL SYSTEMS)(STI) > SI-DRIVE (SUBARU Intelligent Drive) Selector

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the console box. Ref. to EXTERIOR/INTERIOR TRIM>Console Box>REMOVAL.
3. Remove the multi-selector switch connector from the console box.
4. Remove the screws and tabs holding the multi-selector switch to the console box and the multi-selector switch.



FUEL INJECTION (FUEL SYSTEMS)(STI) > SI-DRIVE (SUBARU Intelligent Drive) Selector

INSTALLATION

Install in the reverse order of removal.

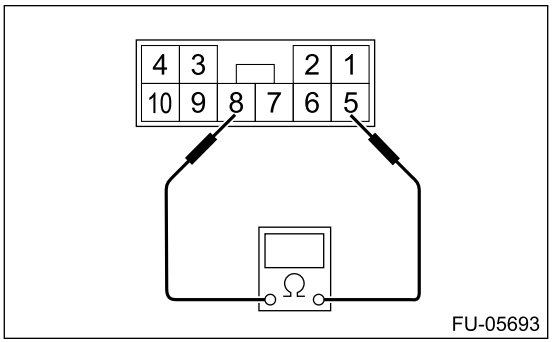
Tightening torque:

1.5 N·m (0.2 kgf-m, 1.1 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > SI-DRIVE (SUBARU Intelligent Drive) Selector

INSPECTION

1. Check that the multi select switch does not have deformation, cracks, or damage.
2. Check the resistance between the terminals at the SI-DRIVE selector.



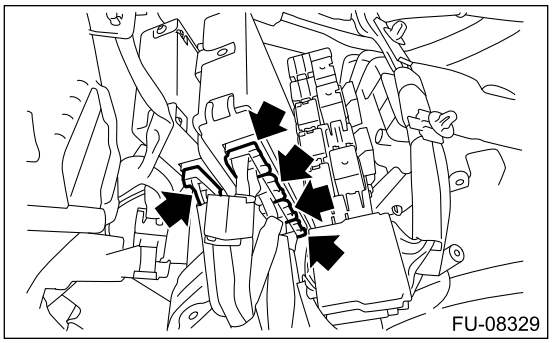
Switch position	Terminal No.	Standard
Sport (when turning the SI-DRIVE selector to the left)	5 and 8	Less than 1 Ω

Switch position	Terminal No.	Standard
Intelligent (when pressing the SI-DRIVE selector)		1±0.05 kΩ
Sport Sharp (when turning the SI-DRIVE selector to the right)		3.67±0.1835 kΩ

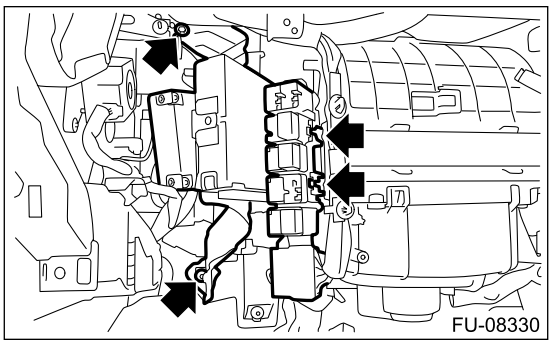
FUEL INJECTION (FUEL SYSTEMS)(STI) > Engine Control Module (ECM)

REMOVAL

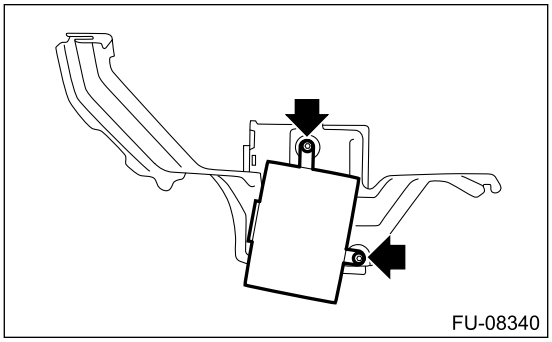
1. Disconnect the ground cable from battery.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Disconnect the connectors from the ECM and driver's control center differential control module.



4. Push down the claws, and remove the relay block.
5. Remove the bolts and nuts, and remove the ECM.



6. Remove the driver's control center differential control module.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Engine Control Module (ECM)

INSTALLATION

Install in the reverse order of removal.

Caution:

- **When the ECM of model with immobilizer has been replaced, be sure to perform the registration of immobilizer system.**
  - **For model without keyless access with push button start, refer to the Type B in "REGISTRATION MANUAL FOR IMMOBILIZER".**
  - **For model with keyless access with push button start, refer to the Type D in "REGISTRATION MANUAL FOR IMMOBILIZER".**
- **When the ECM has been replaced, be sure to perform the registration of VIN. Ref. to ENGINE (DIAGNOSTICS)(STI)>Subaru Select Monitor>OPERATION > V.I.N REGISTRATION.**
- **If replacing ECM or the bracket, replace both parts with new parts at a time.**
- **After installing the bracket to ECM, do not separate the bracket.**
- **If the bracket has been installed to ECM in the wrong direction, replace both parts to new parts.**

Note:

When replacing the ECM, be careful not to use the ECM of wrong specification to avoid any damage on the fuel injection system.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Engine Control Module (ECM)

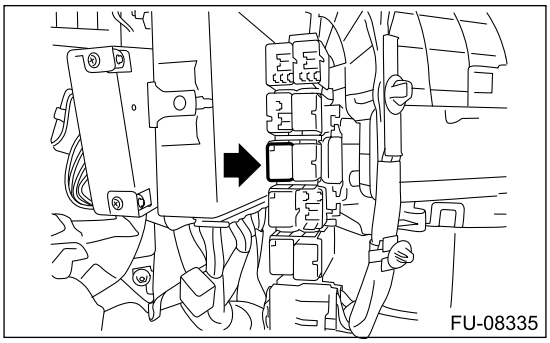
INSPECTION

Check that the ECM has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Main Relay

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Remove the main relay from relay block.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Main Relay

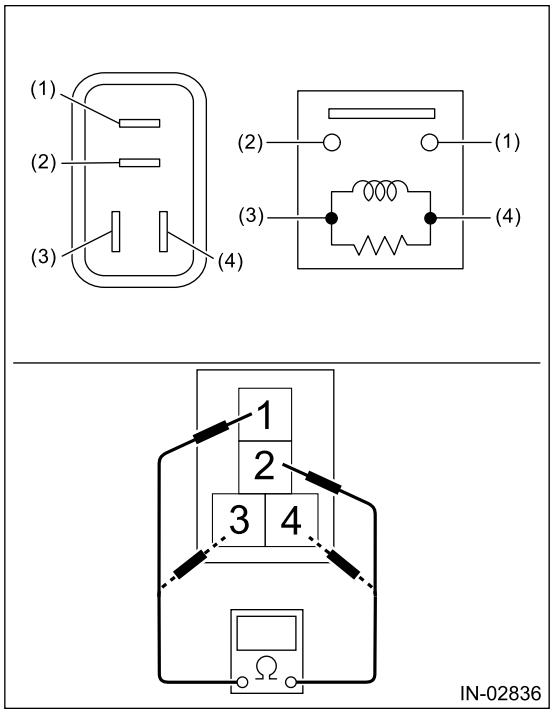
INSTALLATION

Install in the reverse order of removal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Main Relay

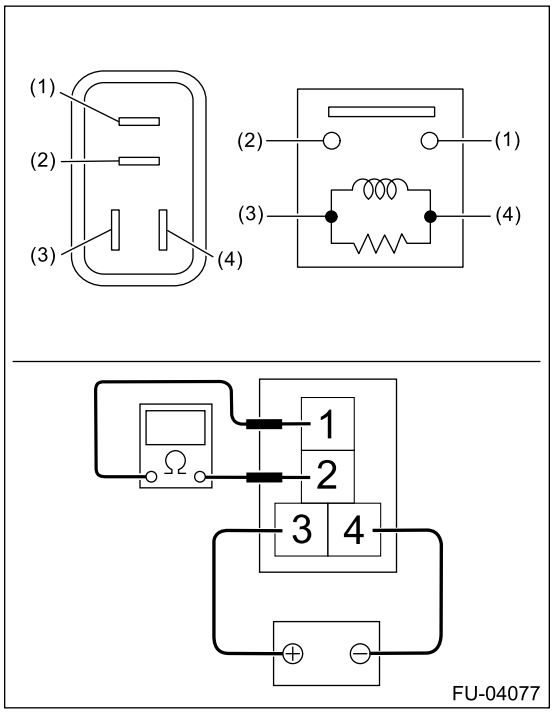
INSPECTION

1. Check that the main relay has no deformation, cracks or other damages.
2. Measure the resistance between main relay terminals.



Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	130.4 — 230.8 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the main relay terminals.

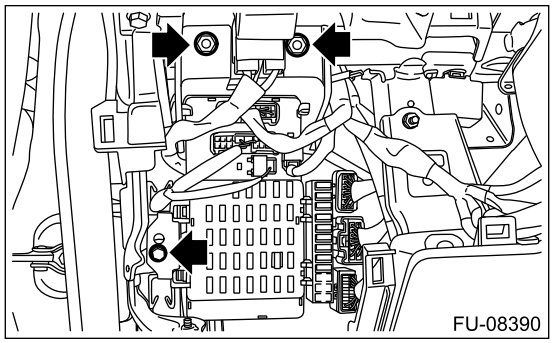


Terminal No.	Standard
1 and 2	Less than 1 Ω

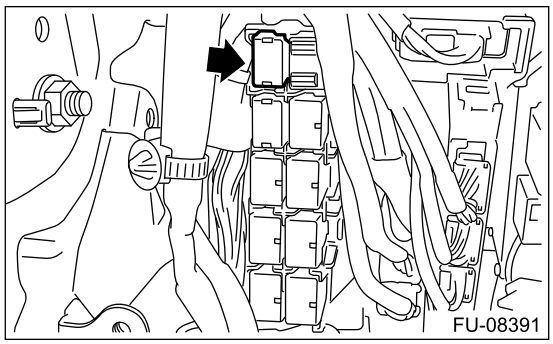
FUEL INJECTION (FUEL SYSTEMS)(STI) > Oxygen Sensor Relay

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the instrument panel lower cover. Ref. to EXTERIOR/INTERIOR TRIM>Instrument Panel Lower Cover>REMOVAL.
3. Remove the bolts and nuts securing the fuse block and move down the fuse block.



4. Remove the oxygen sensor relay from the relay block.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Oxygen Sensor Relay

INSTALLATION

Install in the reverse order of removal.

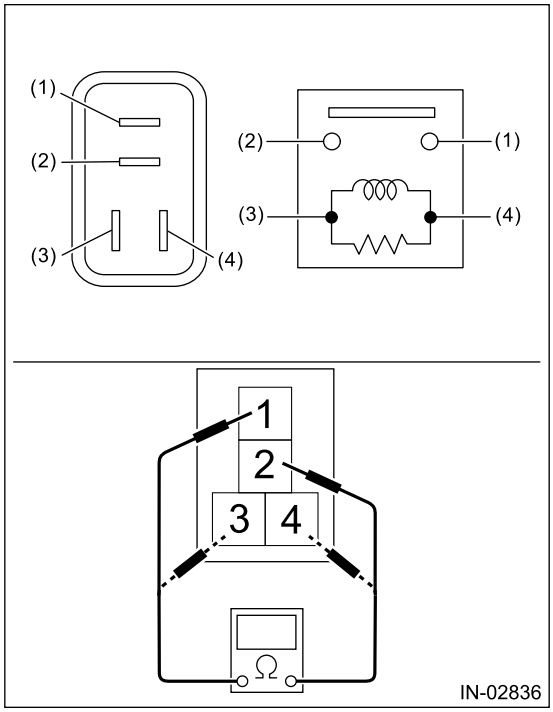
Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Oxygen Sensor Relay

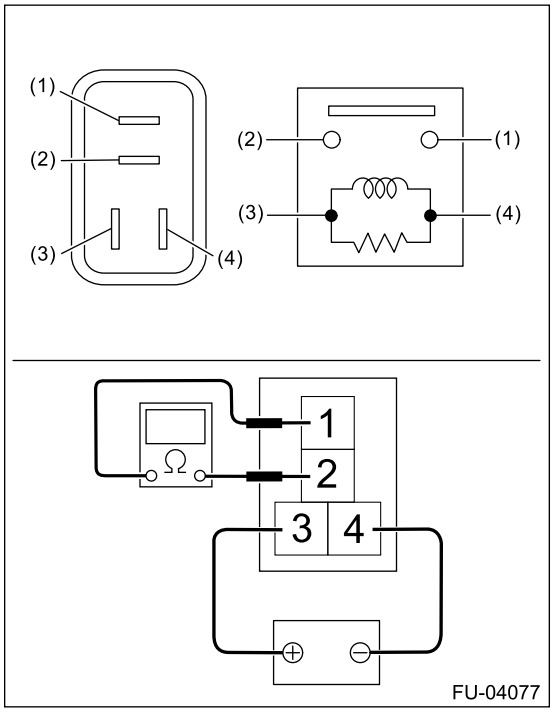
INSPECTION

1. Check that the oxygen sensor relay has no deformation, cracks or other damages.
2. Measure the resistance between oxygen sensor relay terminals.



Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	130.4 — 230.8 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between oxygen sensor relay terminals.

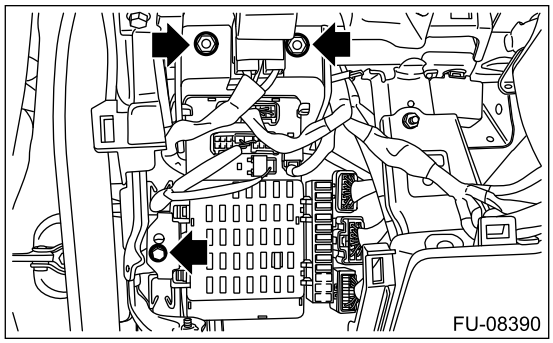


Terminal No.	Standard
1 and 2	Less than 1 Ω

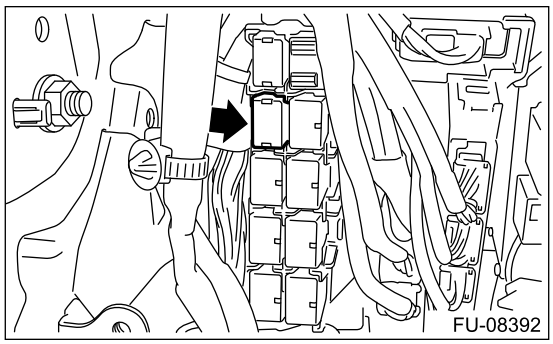
FUEL INJECTION (FUEL SYSTEMS)(STI) > Electronic Throttle Control Relay

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the instrument panel lower cover. Ref. to EXTERIOR/INTERIOR TRIM>Instrument Panel Lower Cover>REMOVAL.
3. Remove the bolts and nuts securing the fuse block and move down the fuse block.



4. Remove the electronic throttle control relay from the relay block.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Electronic Throttle Control Relay

INSTALLATION

Install in the reverse order of removal.

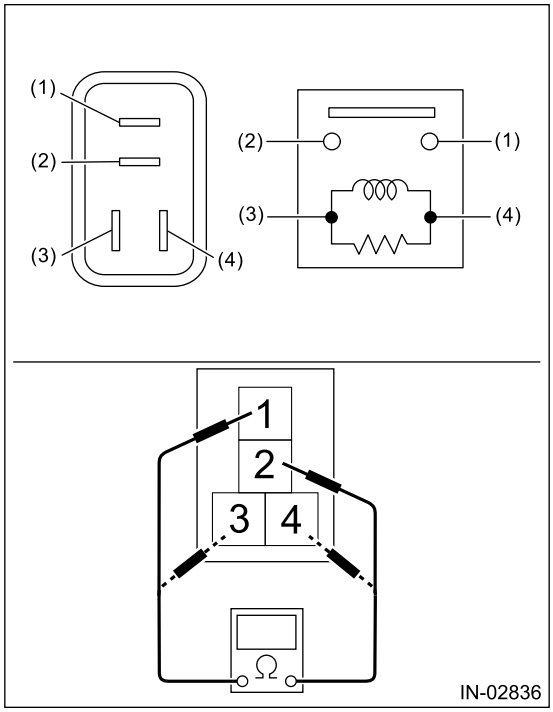
Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Electronic Throttle Control Relay

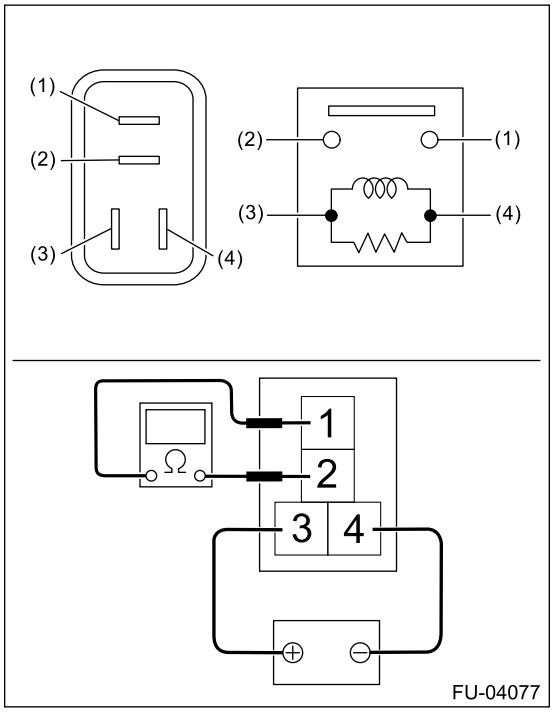
INSPECTION

1. Check that the electronic throttle control relay has no deformation, cracks or other damages.
2. Measure the resistance between electronic throttle control relay terminals.



Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	93.8 — 136.4 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the electronic throttle control relay terminals.

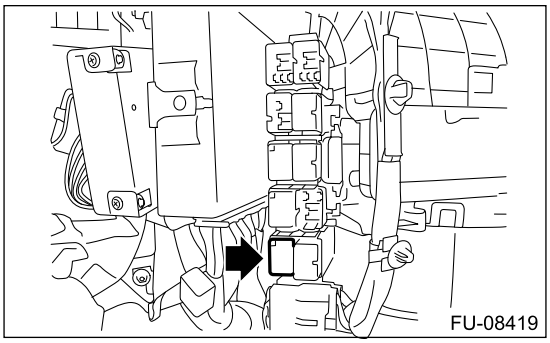


Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump Relay

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Remove the fuel pump relay from relay block.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump Relay

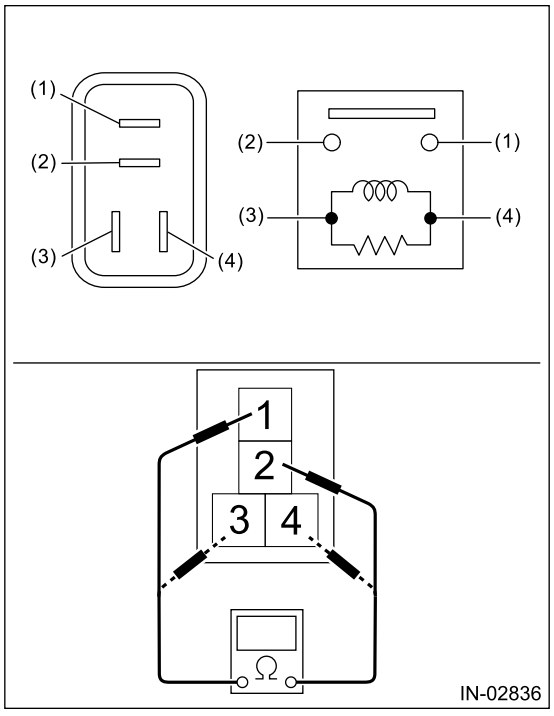
INSTALLATION

Install in the reverse order of removal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump Relay

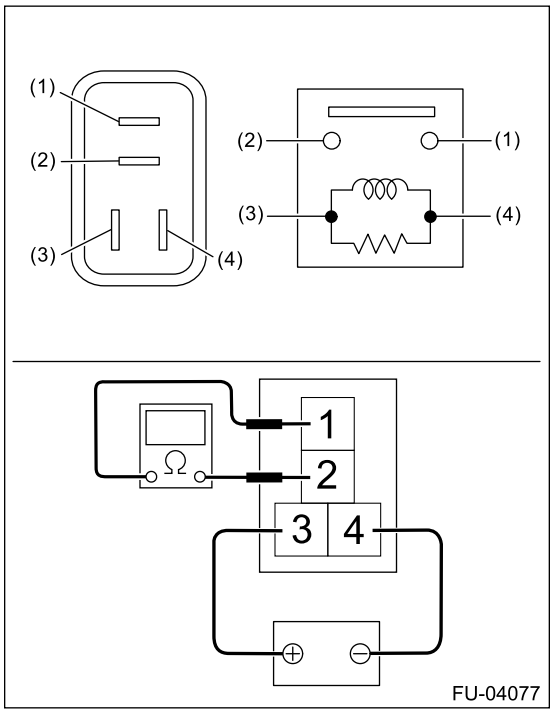
INSPECTION

1. Check that the fuel pump relay has no deformation, cracks or other damages.
2. Measure the resistance between fuel pump relay terminals.



Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	93.8 — 136.4 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the fuel pump relay terminals.

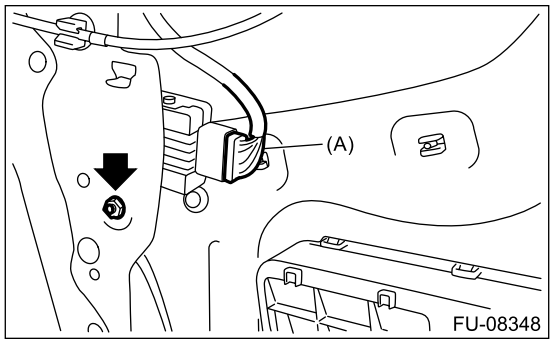


Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump Control Unit

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the right side trunk side trim. Ref. to EXTERIOR/INTERIOR TRIM>Trunk Room Trim>REMOVAL.
3. Disconnect the connector (A) from the fuel pump control unit, and remove the fuel pump control unit.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump Control Unit

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

5 N·m (0.5 kgf-m, 3.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump Control Unit

INSPECTION

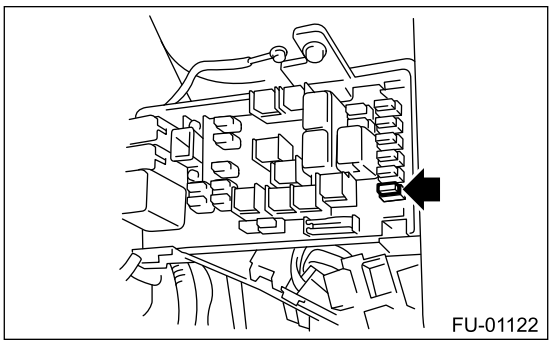
Check that the fuel pump control unit has no deformation, cracks or other damages.

PROCEDURE

1. RELEASING OF FUEL PRESSURE

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Remove the fuse of fuel pump from main fuse box.



2. Start the engine and run it until it stalls.
3. After the engine stalls, crank it for five more seconds.
4. Turn the ignition switch to OFF.
5. Install the fuse of fuel pump to the main fuse box.

2. DRAINING FUEL (WITH SUBARU SELECT MONITOR)

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.
Note:

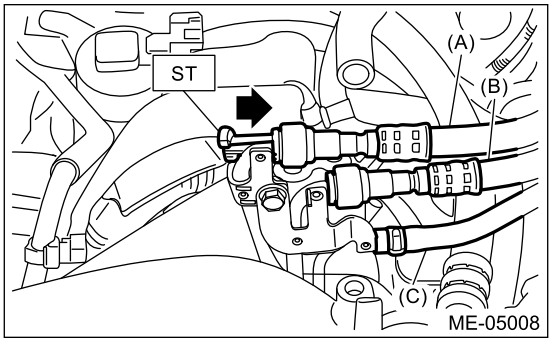
- **If the fuel pump cannot be driven, refer to the procedures for draining from the fuel filler hose. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (THROUGH THE FUEL FILLER HOSE).**
- **Be careful not to let the battery run-out.**
- **Be aware that the fuel may remain in the fuel tank after draining the fuel.**

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Attach ST to the fuel delivery pipe and push ST in the direction of arrow mark to disconnect the fuel delivery hose.

ST 42099AE000 QUICK CONNECTOR RELEASE

Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**



(A) Fuel delivery hose
(B) Fuel return hose
(C) Evaporation hose

3. Connect ST to the fuel delivery hose.

ST 18471AA000 FUEL PIPE ADAPTER

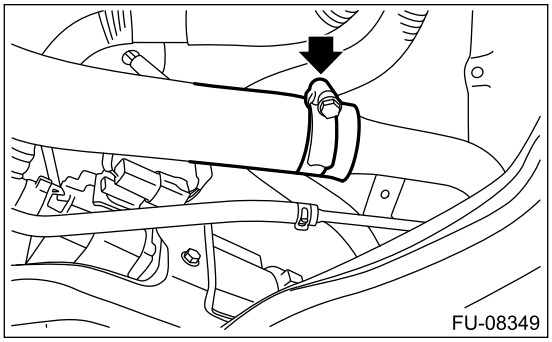
4. Connect the gasoline proof hose to ST and put the end of the hose in the container.
5. Drive the fuel pump and drain the fuel using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(STI)>Active Test>OPERATION.
   Caution:
   Be careful not to spill fuel.
6. Install the related parts in the reverse order after draining the fuel.

3. DRAINING FUEL (THROUGH THE FUEL FILLER HOSE)

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
- **Be careful not to spill fuel.**
- **Fuel may remain in the fuel filler pipe. Drain the fuel from the fuel filler pipe through the fill opening using the gasoline proof pump and the gasoline proof hose (ø10 or less) before the operation.**

Note:
Be aware that the fuel may remain in the fuel tank after draining the fuel.

1. Lift up the vehicle.
2. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
3. Drain the fuel from the fuel filler pipe through the filler opening using the gasoline proof pump and the gasoline proof hose (ø10 or less).
4. Disconnect the fuel filler hose from the fuel filler pipe assembly.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from hoses using a container or cloth.**



5. Set the container under the vehicle and insert the gasoline proof hose (ø10 or less) into the fuel filler hose to drain the fuel.

Caution:

Be careful not to spill fuel.

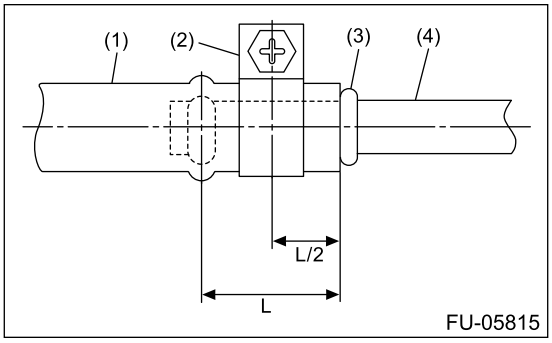
6. Install the related parts in the reverse order after draining the fuel.

Note:

Correctly insert the fuel filler hose to the spool, and then install the clamp as shown.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)



(1) Fuel filler hose

(2) Clamp

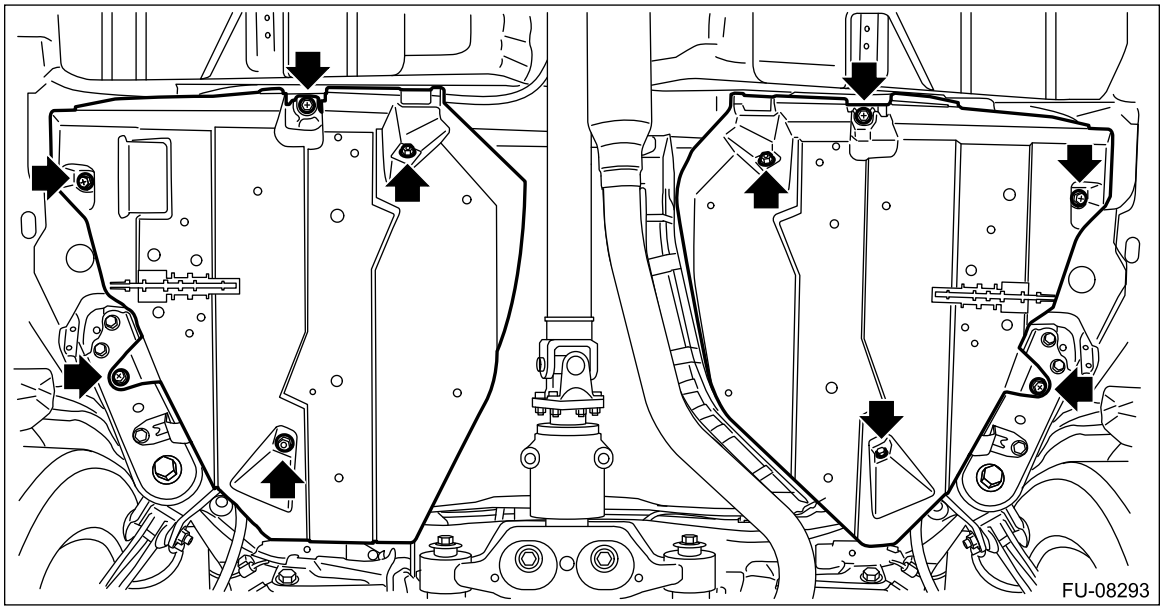
(3) Spool

(4) Fuel filler pipe

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Tank Protector

REMOVAL

1. Lift up the vehicle.
2. Remove the bolt and nuts and remove the fuel tank protector.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Tank Protector

INSTALLATION

Install in the reverse order of removal.

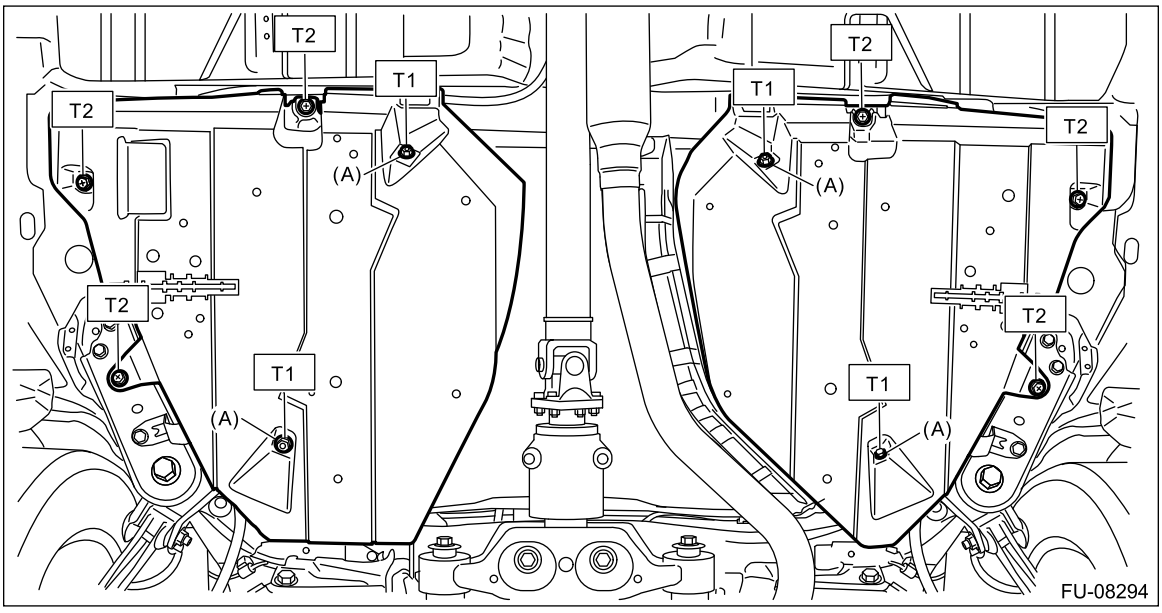
Note:

Use a new self-locking nut.

Tightening torque:

T1: 9 N·m (0.9 kgf-m, 6.6 ft-lb)

T2: 18 N·m (1.8 kgf-m, 13.3 ft-lb)



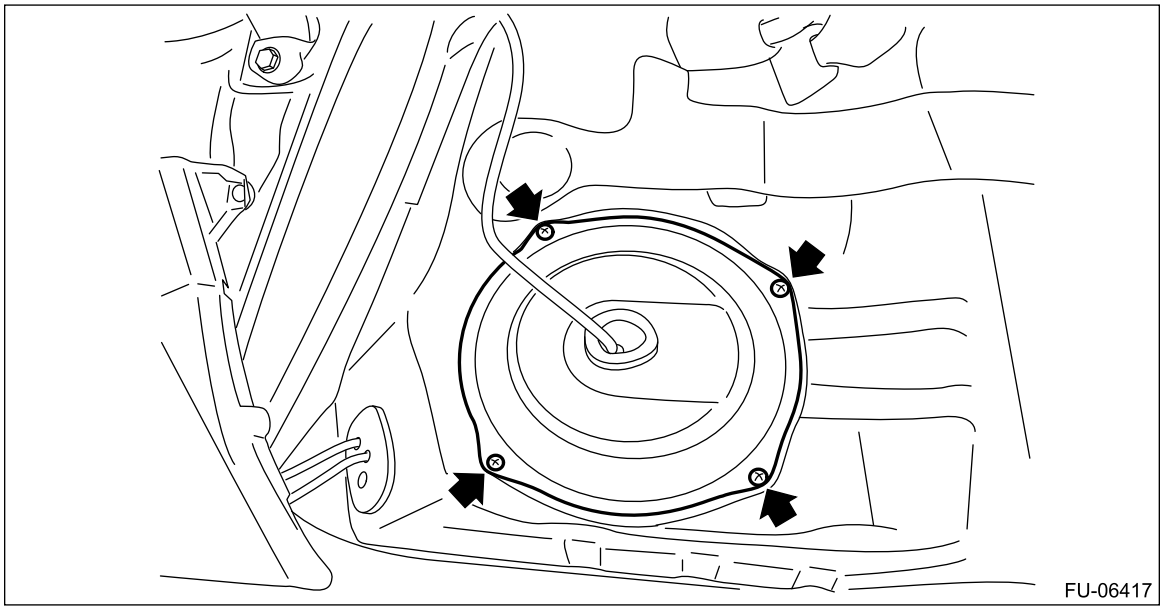
(A) Self-locking nut

REMOVAL

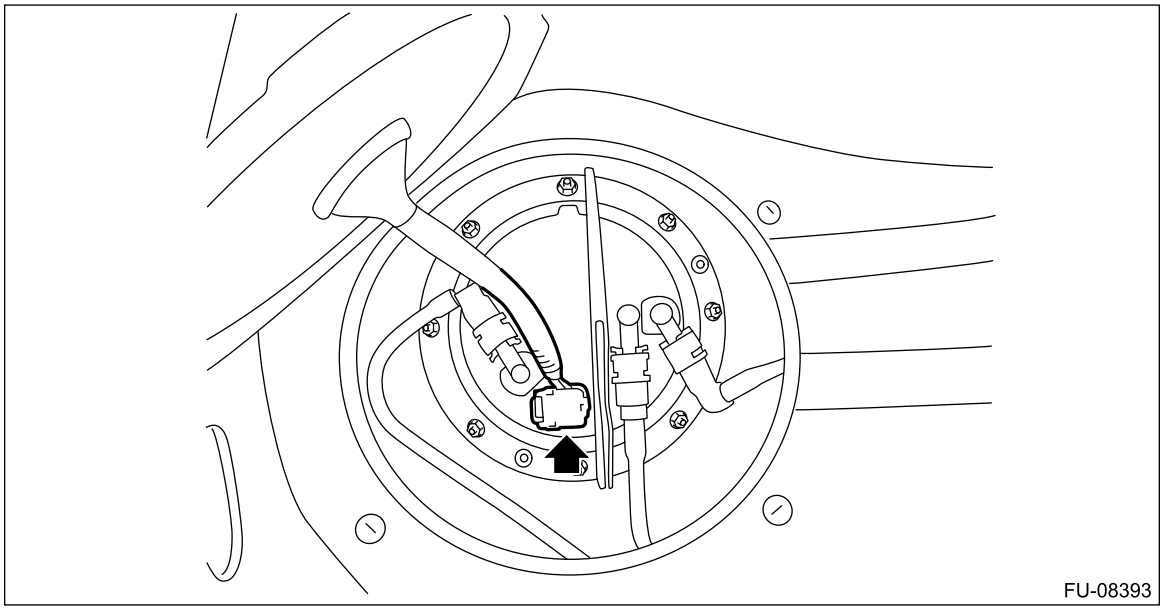
Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**

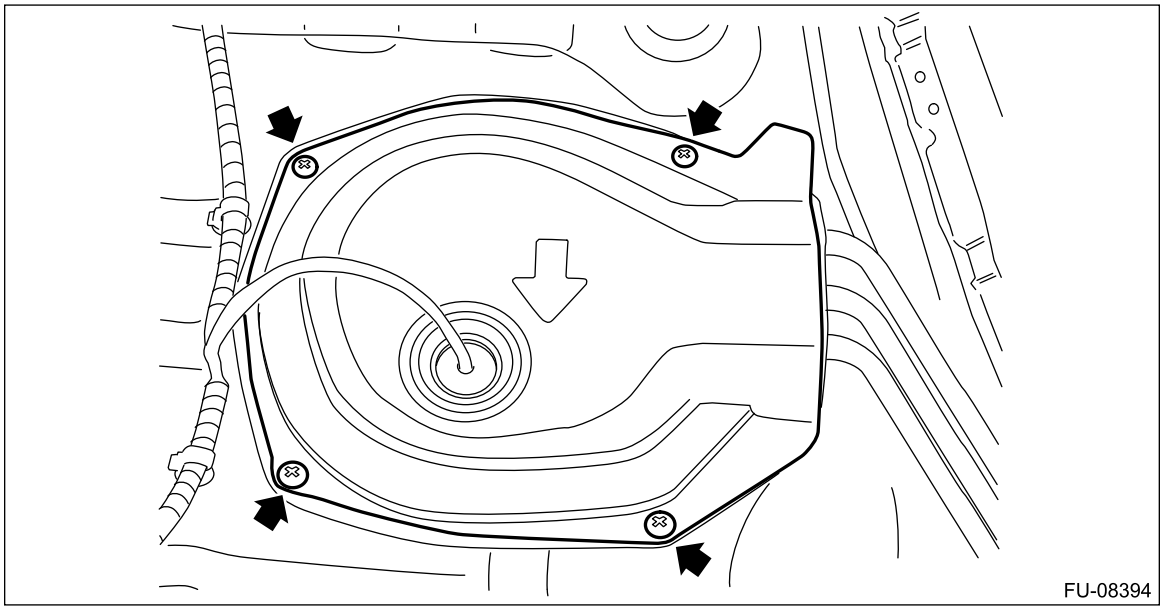
1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground cable from battery.
4. Remove the rear seat cushion. Ref. to SEATS>Rear Seat>REMOVAL.
5. Remove the service hole cover of fuel pump.



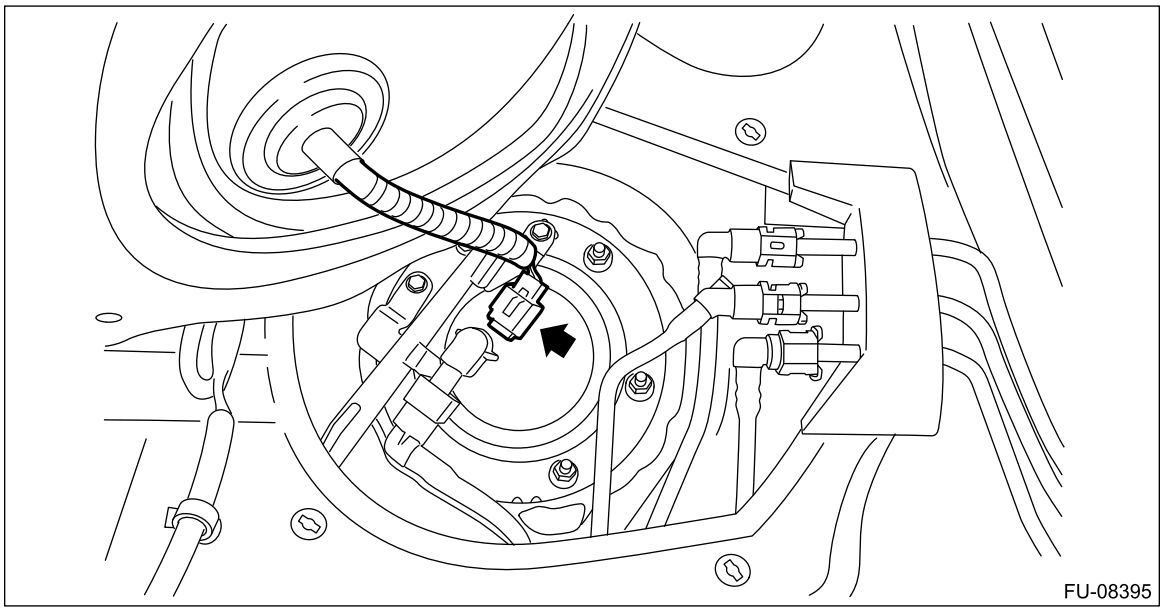
6. Disconnect connectors from the fuel pump, and move aside the service hole cover.



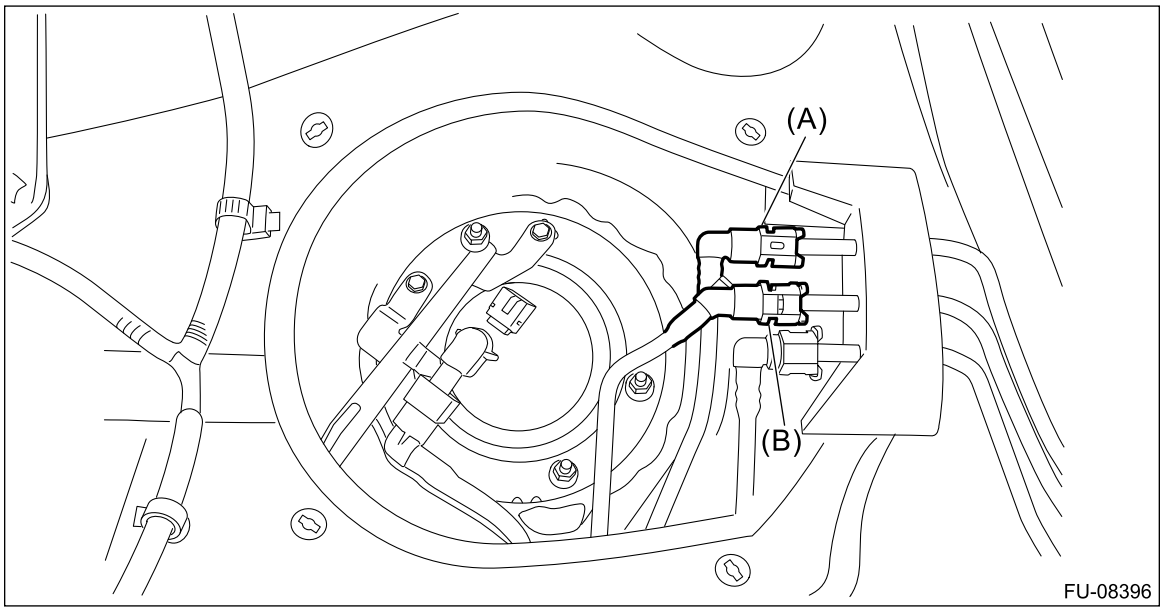
7. Remove the service hole cover of fuel sub level sensor.



8. Disconnect the connector from the fuel sub level sensor, and move aside the service hole cover.



9. Disconnect the quick connector of fuel delivery tube (A) and fuel return tube (B). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>REMOVAL.

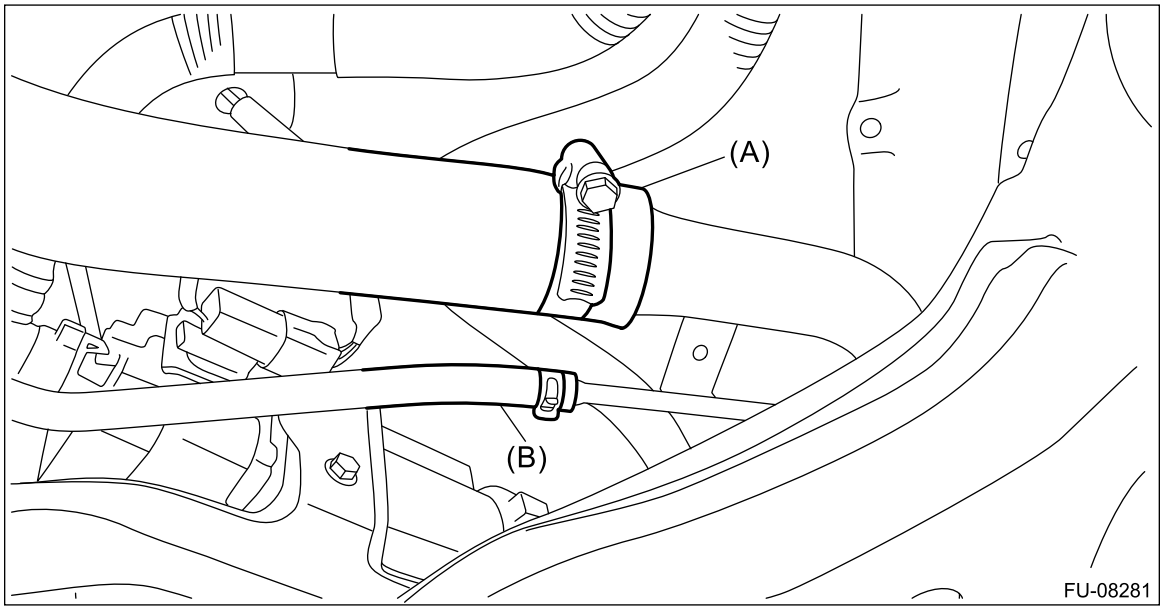


10. Lift up the vehicle.

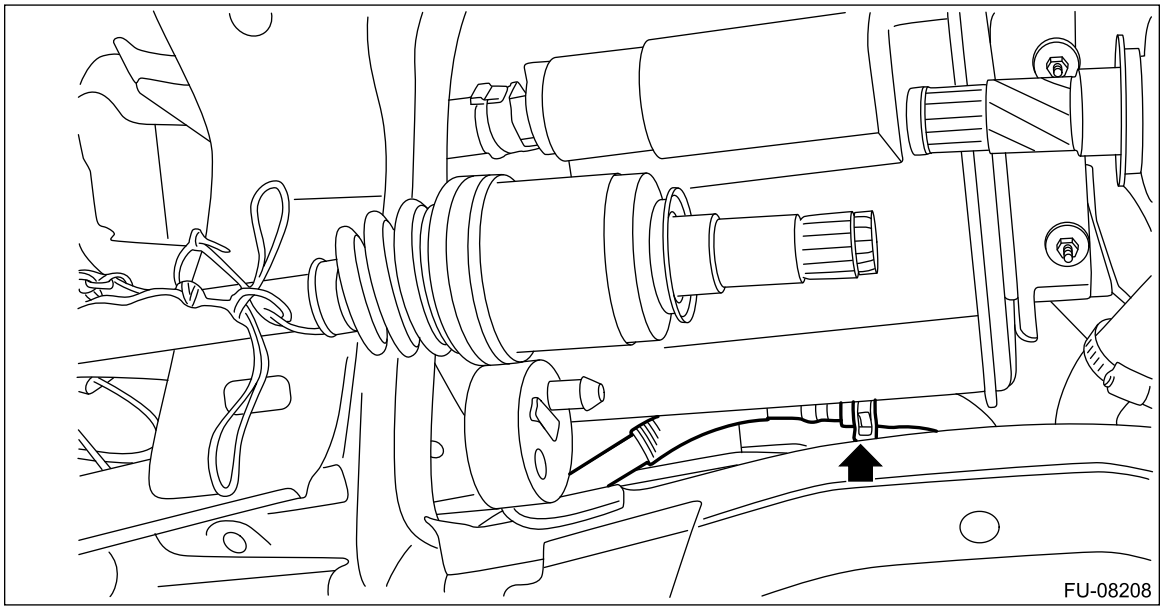
11. Remove the rear exhaust pipe. Ref. to EXHAUST(STI)>Rear Exhaust Pipe>REMOVAL.

12. Remove the rear differential. Ref. to DIFFERENTIALS>Rear Differential (T-type)>REMOVAL.

13. Disconnect the fuel filler hose (A) and evaporation hose (B) from the fuel filler pipe assembly.

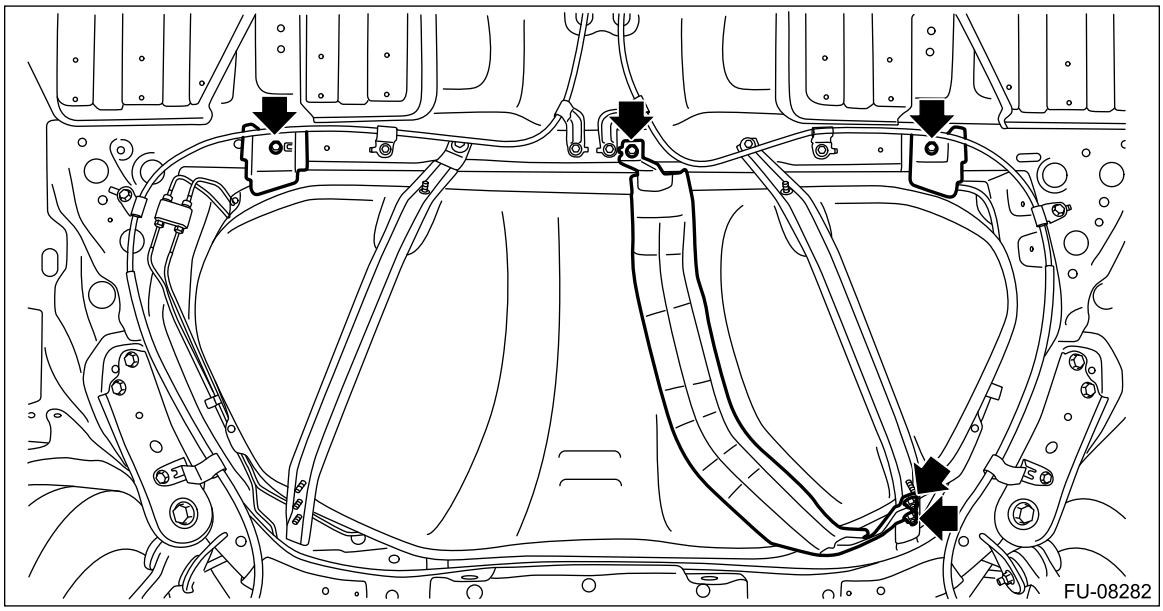


14. Disconnect the vent tube from vent hose.



15. Remove the fuel tank protector. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Tank Protector>REMOVAL.

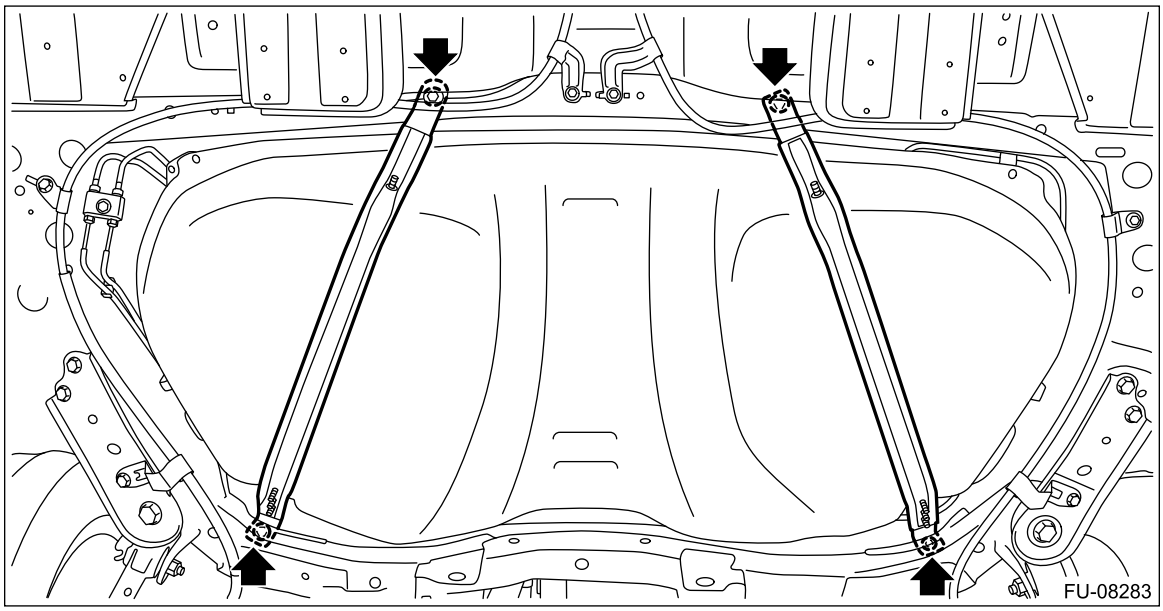
16. Remove the heat shield cover and stopper.



17. Support the fuel tank with a transmission jack, remove the bolts from the fuel tank band, and remove the fuel tank from the vehicle.

Warning:

- **A helper is required to perform this work.**
- **Fuel may remain in the fuel tank. This will cause the left and right sides to be unbalanced. Be careful not to drop the fuel tank.**



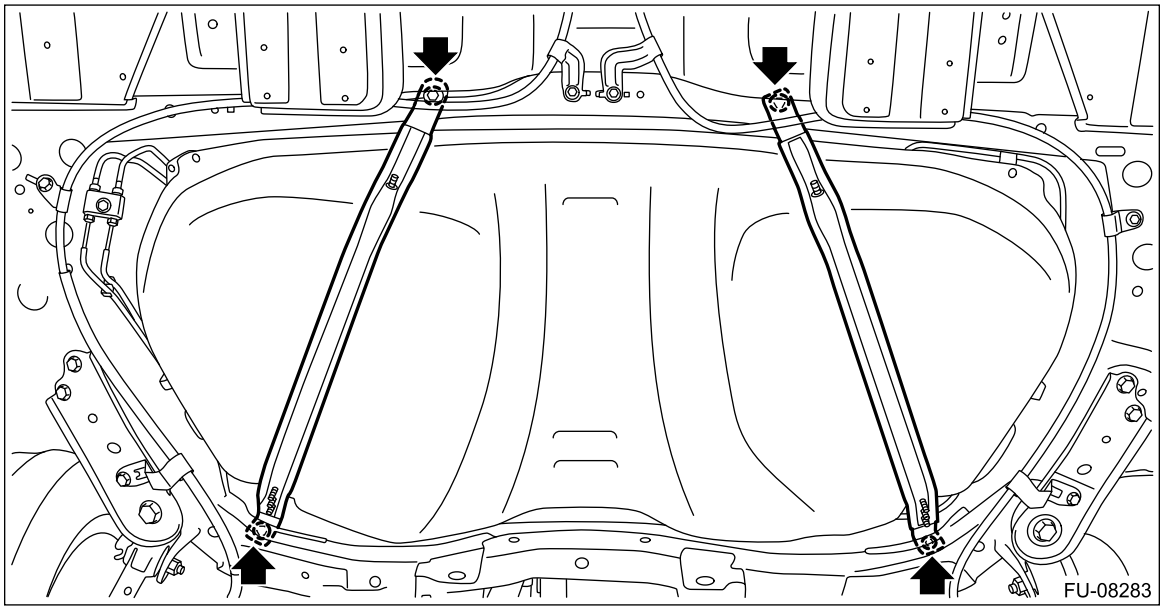
FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Tank

INSTALLATION

1. Support the fuel tank with a transmission jack, set the fuel tank in place, and temporarily tighten the bolts of the fuel tank band.

Warning:

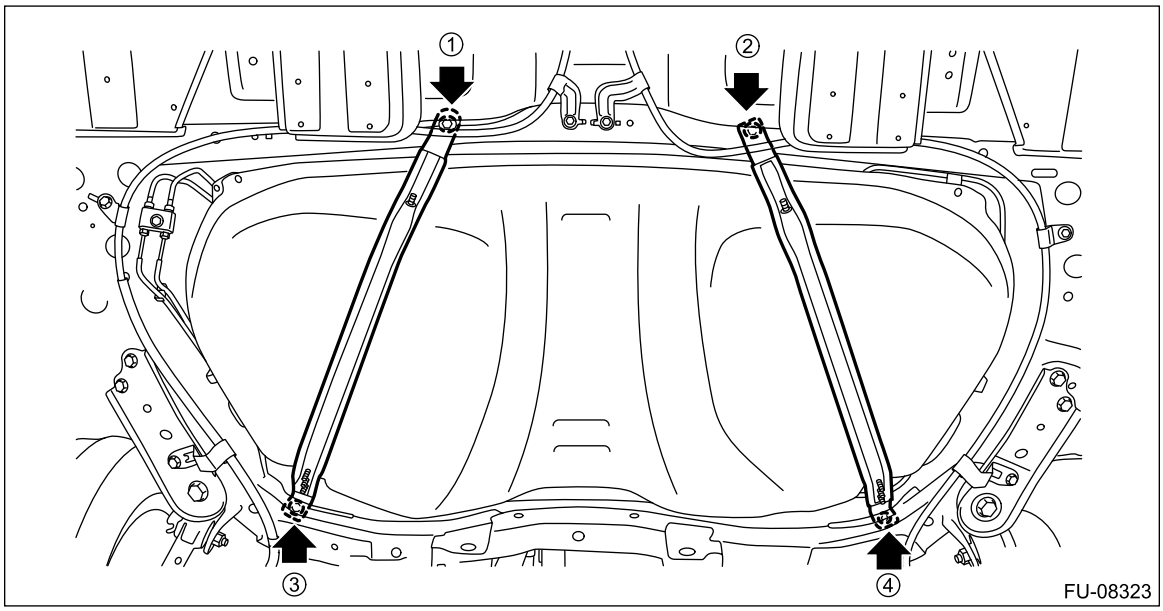
A helper is required to perform this work.



2. Tighten the bolts of the fuel tank band in the order shown in the figure.

Tightening torque:

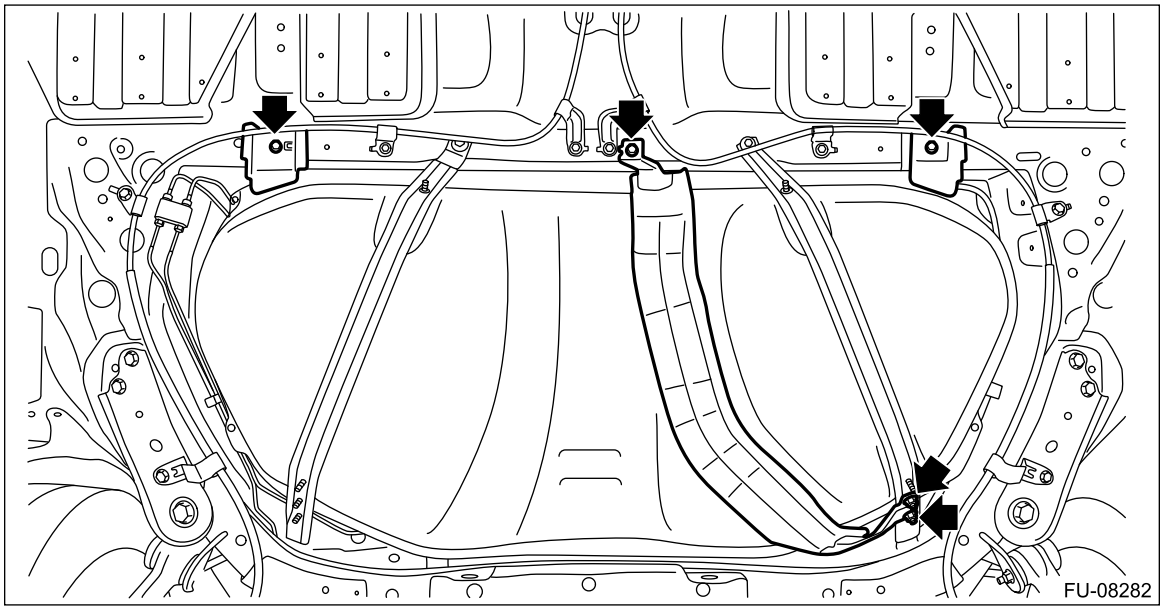
33 N·m (3.4 kgf-m, 24.3 ft-lb)



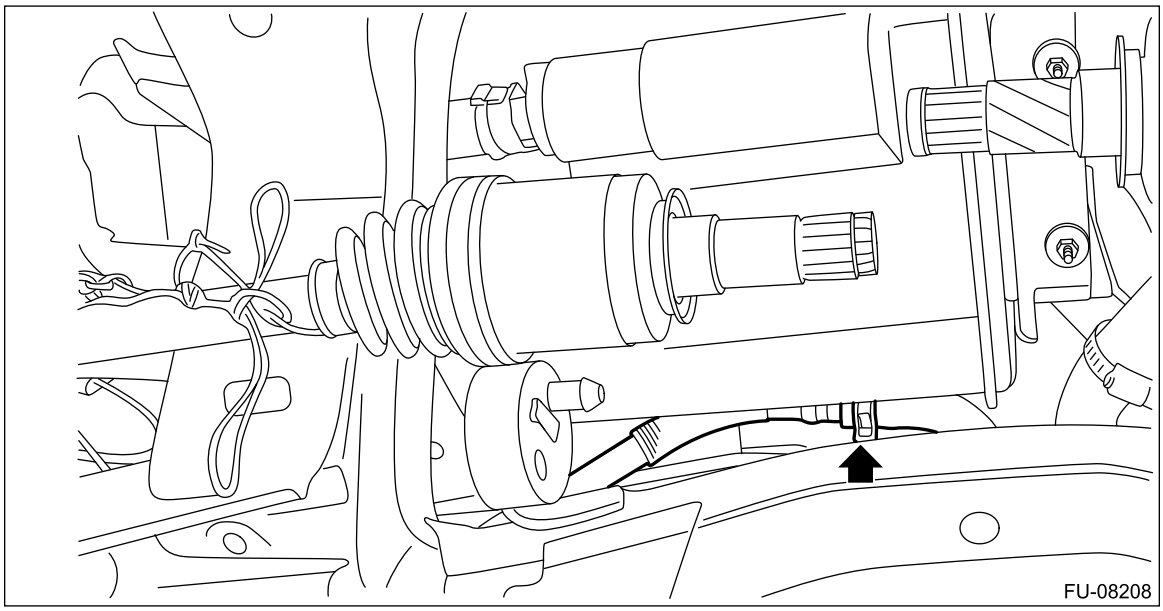
3. Install the heat shield cover and stopper.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



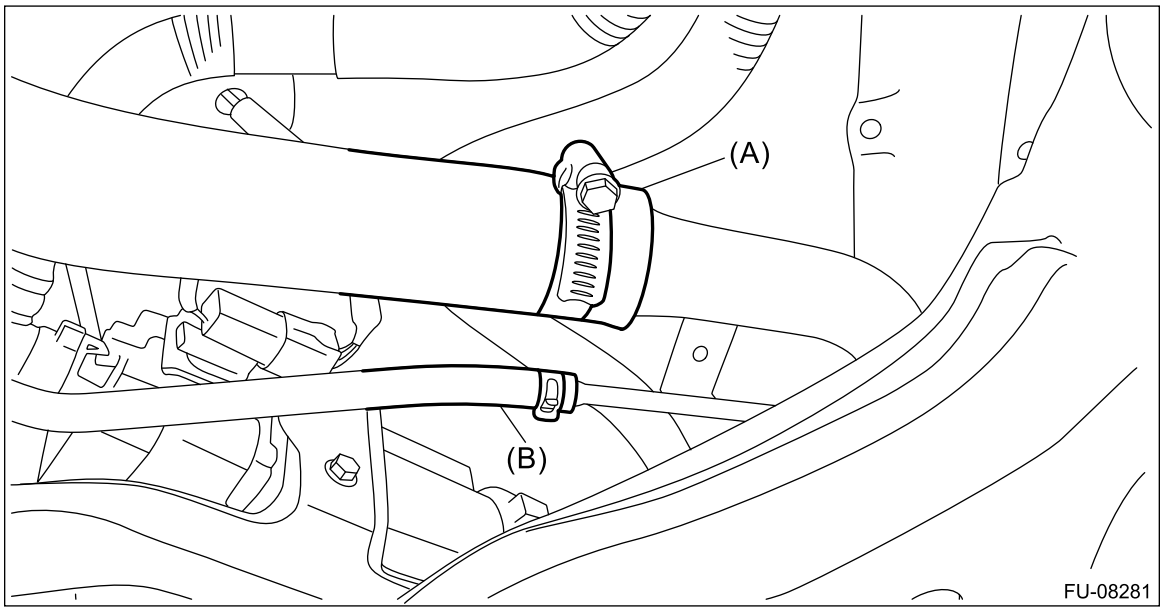
4. Install the fuel tank protector. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Tank Protector>INSTALLATION.
5. Connect the vent tube to the vent hose.

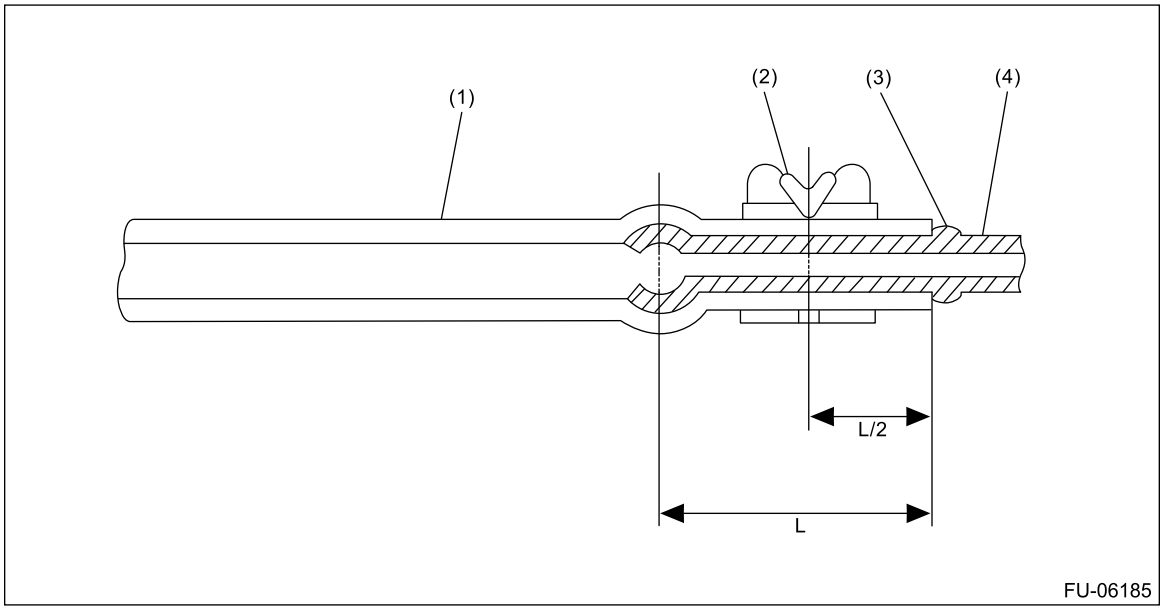


6. Securely insert the fuel filler hose (A) and evaporation hose (B) until the hose end contacts the spool, then attach the clamp or clip as shown in the figure.

Tightening torque:

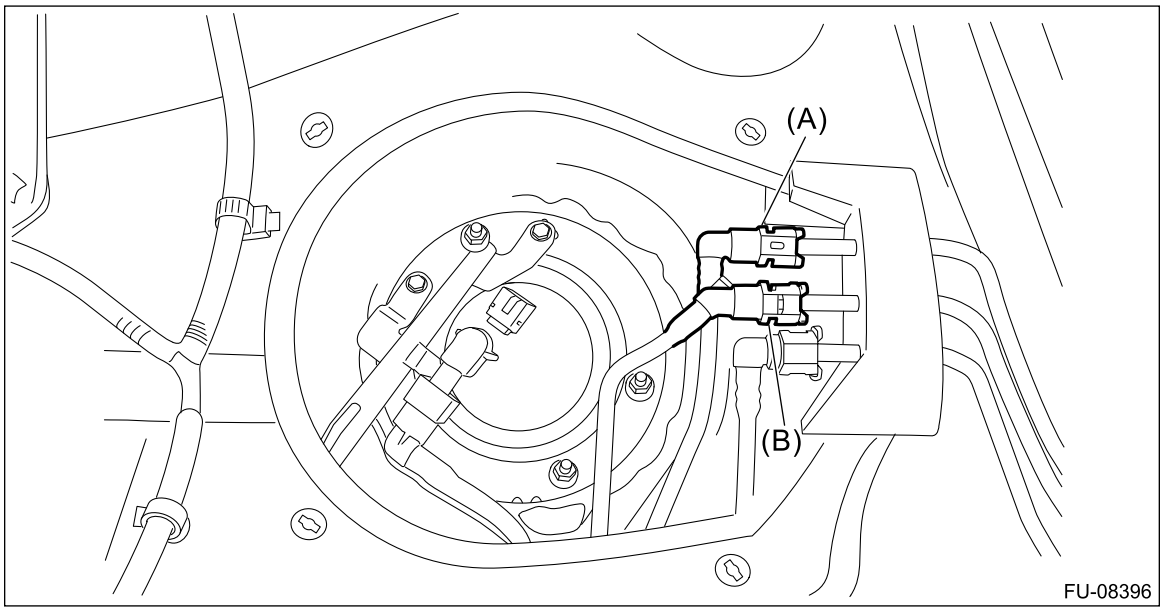
2.5 N·m (0.3 kgf-m, 1.8 ft-lb)





(1) Hose
(2) Clamp or clip
(3) Spool
(4) Pipe

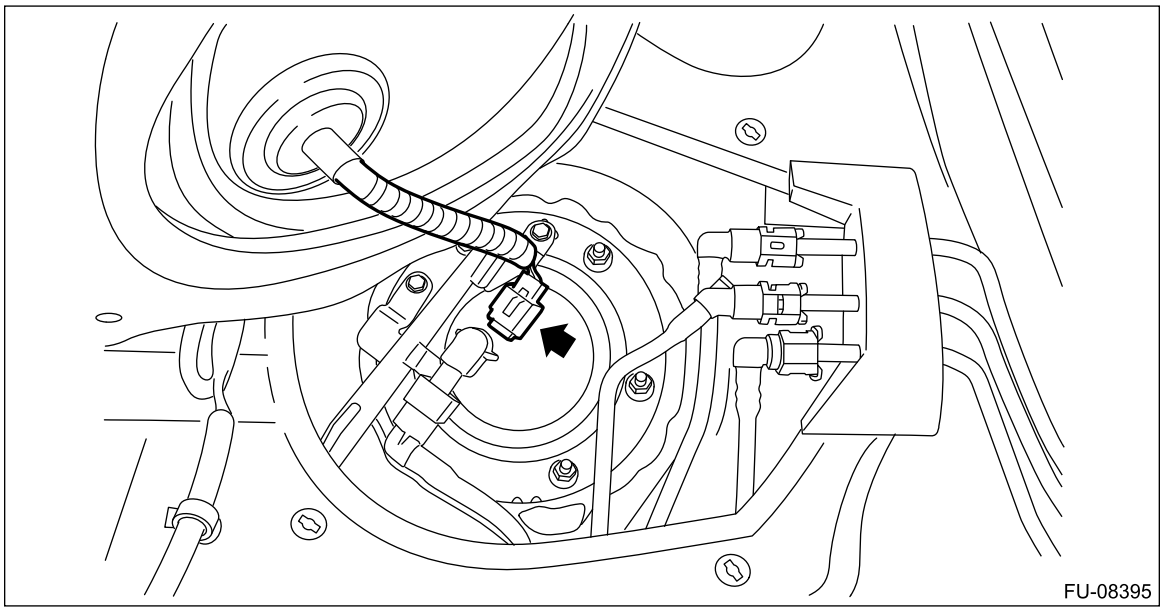
7. Install the rear differential. Ref. to DIFFERENTIALS>Rear Differential (T-type)>INSTALLATION.
8. Install the rear exhaust pipe. Ref. to EXHAUST(STI)>Rear Exhaust Pipe>INSTALLATION.
9. Connect the quick connector of fuel delivery tube (A) and fuel return tube (B). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION.
   Note:
   When connecting, be careful not to reverse the delivery side and return side.



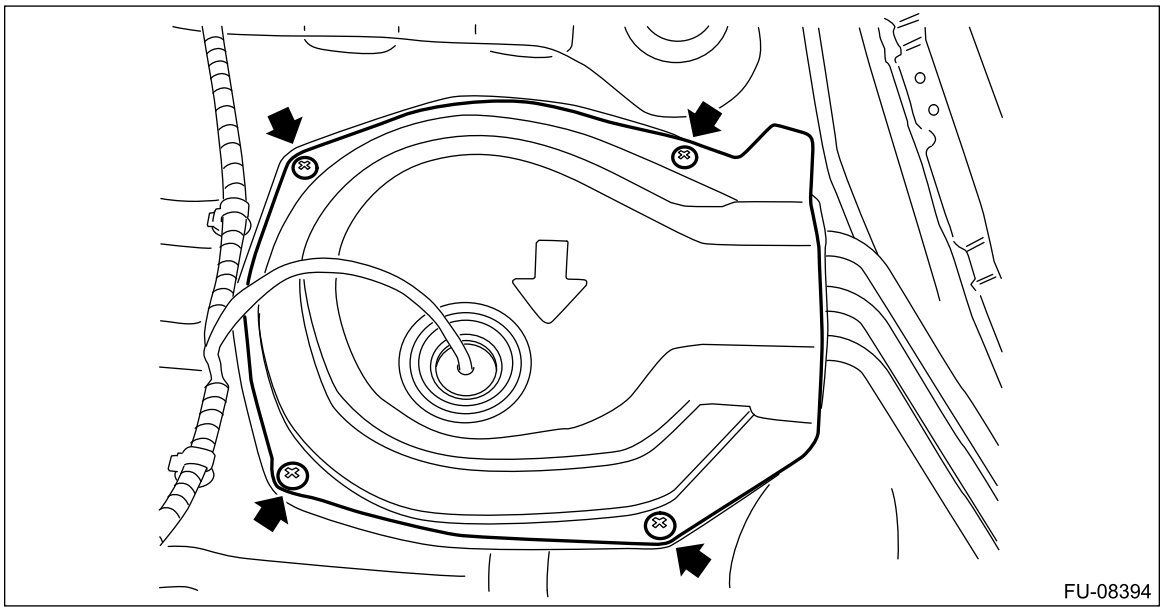
10. Connect the connector to the fuel sub level sensor.

Caution:

Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel sub level sensor and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.



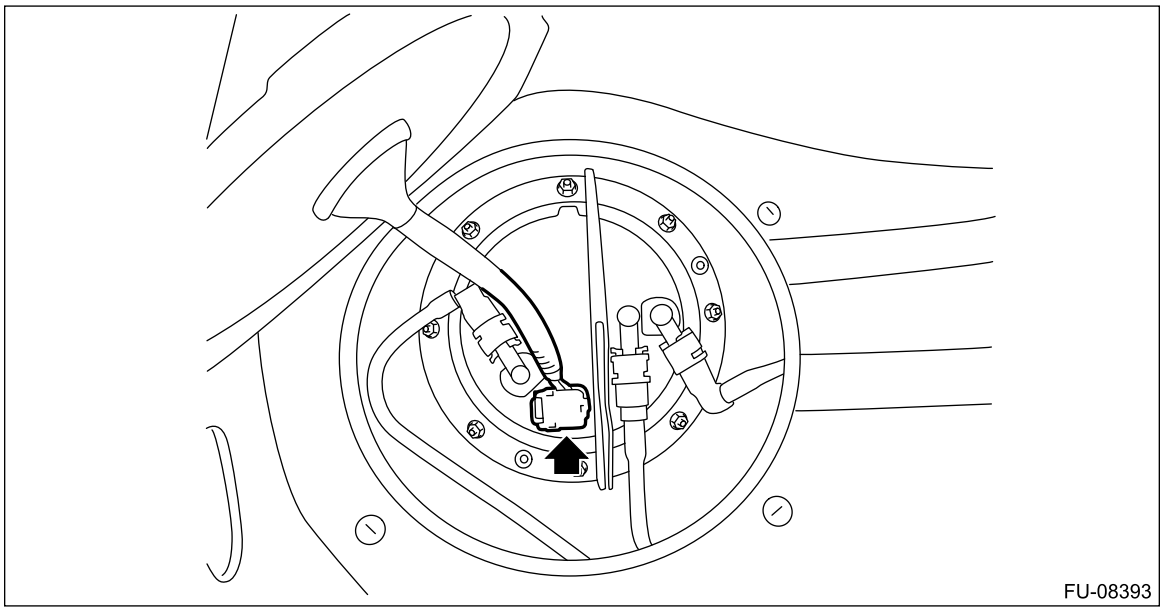
11. Install the service hole cover of fuel sub level sensor.



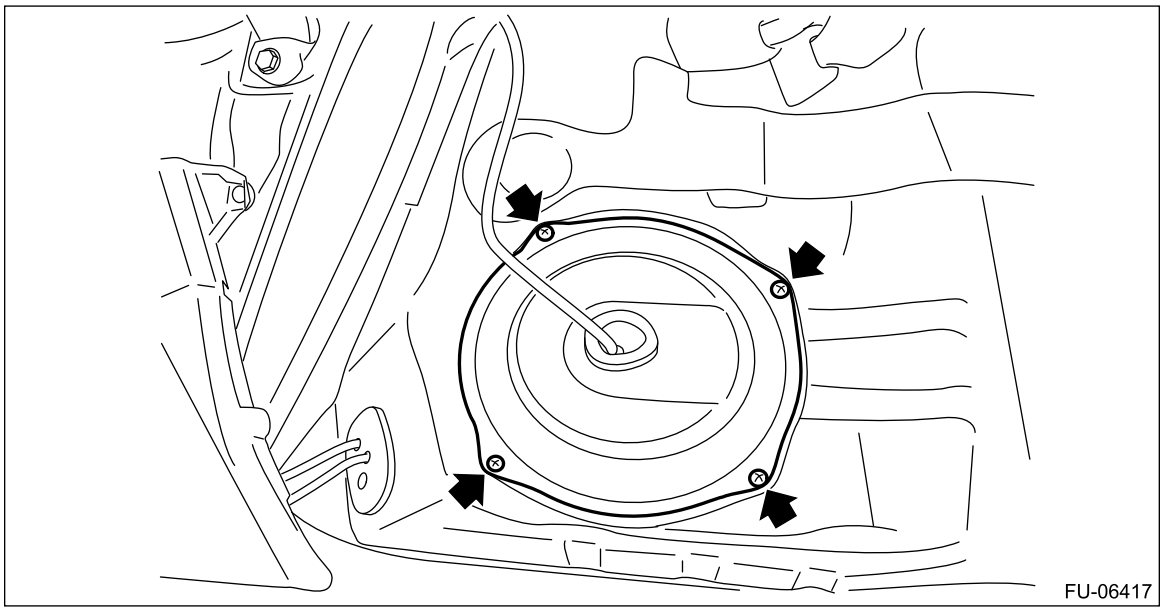
12. Connect the connector to the fuel pump.

Caution:

Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel pump and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.



13. Install the service hole cover of fuel pump.



14. Install the rear seat cushion. Ref. to SEATS>Rear Seat>INSTALLATION.

15. Connect the battery ground terminal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Tank

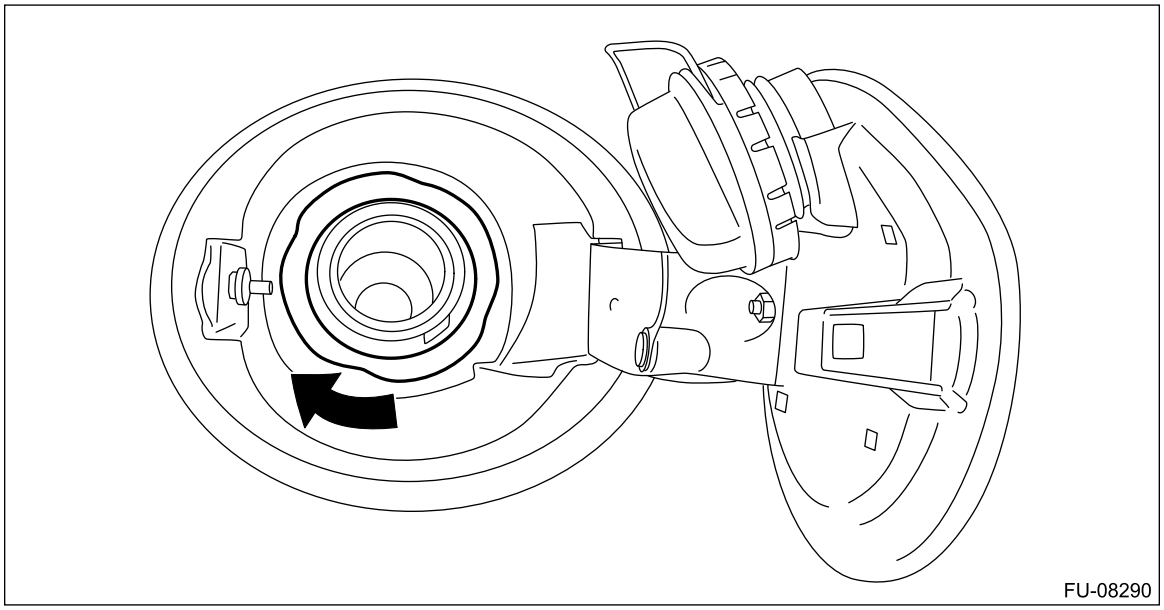
INSPECTION

1. Check that the fuel tank and fuel pipe have no deformation, cracks and other damages.
2. Check that the fuel hose and tube have no cracks, damage or loose part.

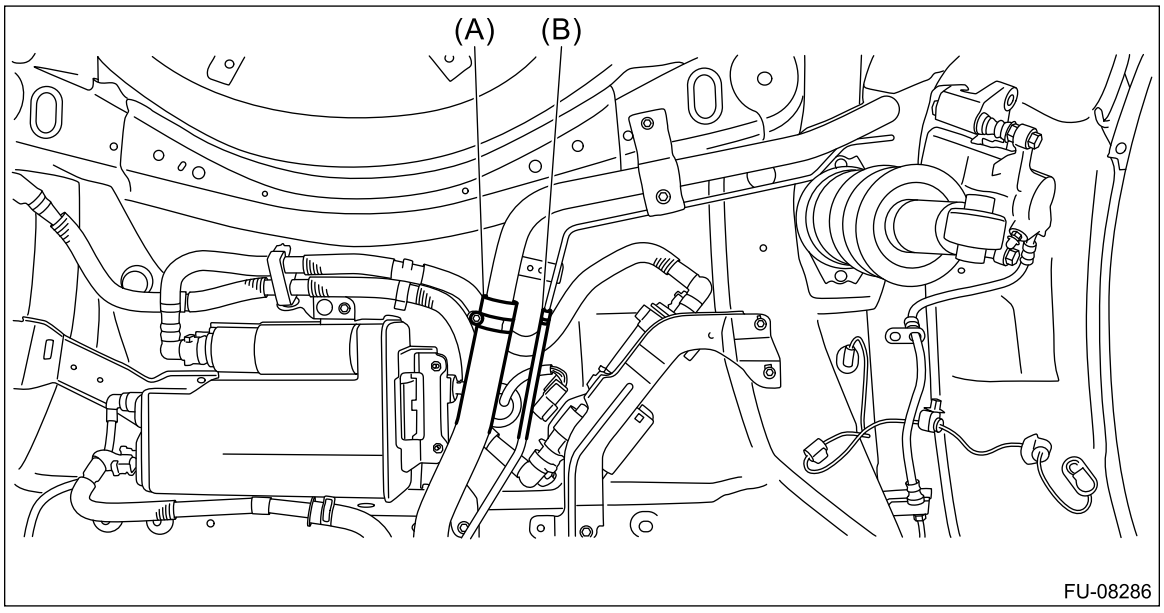
REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

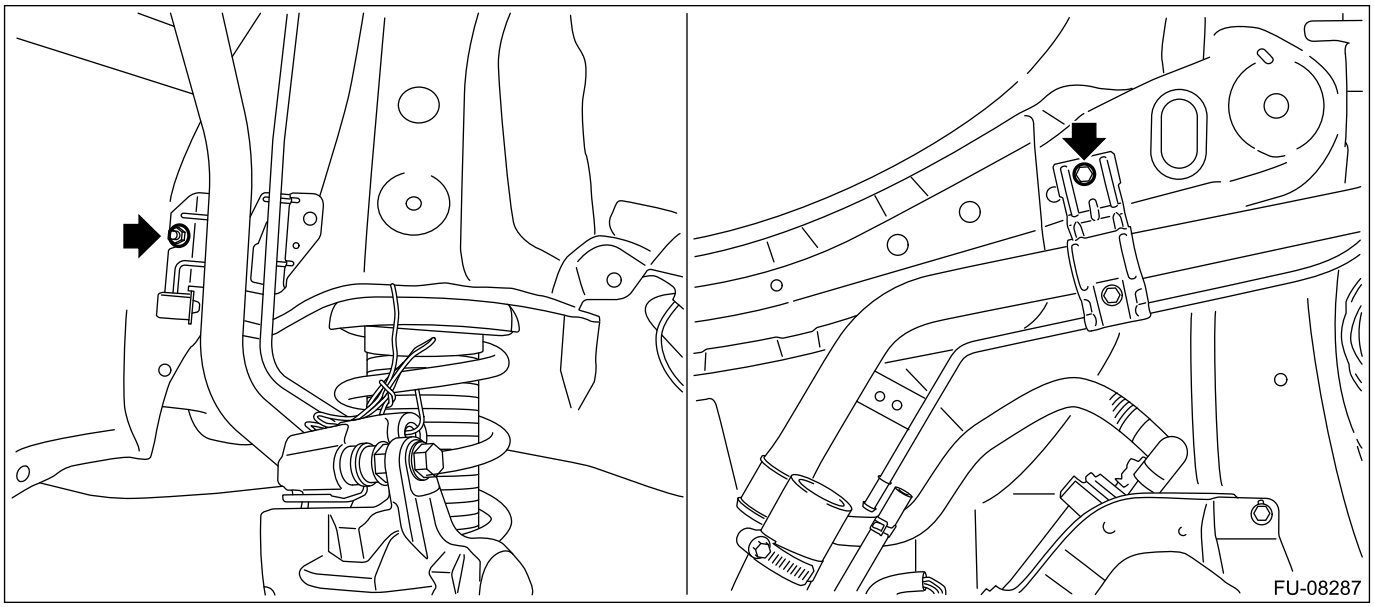
1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground cable from battery.
4. Open the fuel filler lid and remove the fuel filler cap.
5. Turn the fuel filler pipe protector in the direction of the arrow to unlock and remove it.



6. Remove the rear sub frame assembly. Ref. to REAR SUSPENSION>Rear Sub Frame>REMOVAL.
7. Remove the rear mud guard RH. Ref. to EXTERIOR/INTERIOR TRIM>Mud Guard>REMOVAL.
8. Disconnect the fuel filler hose (A) and evaporation hose (B) from the fuel filler pipe assembly.



9. Remove the bolts and nuts which secure the fuel filler pipe assembly to the vehicle.



10. Remove the fuel filler pipe assembly from the underside of the vehicle.

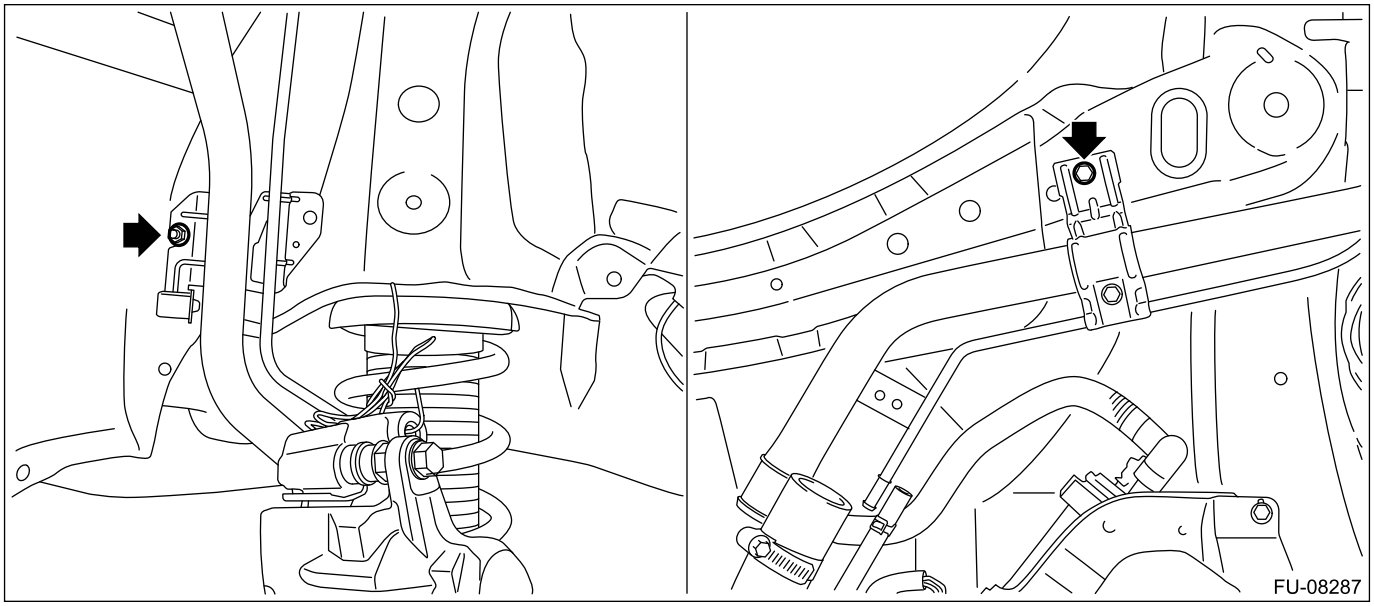
FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Filler Pipe

INSTALLATION

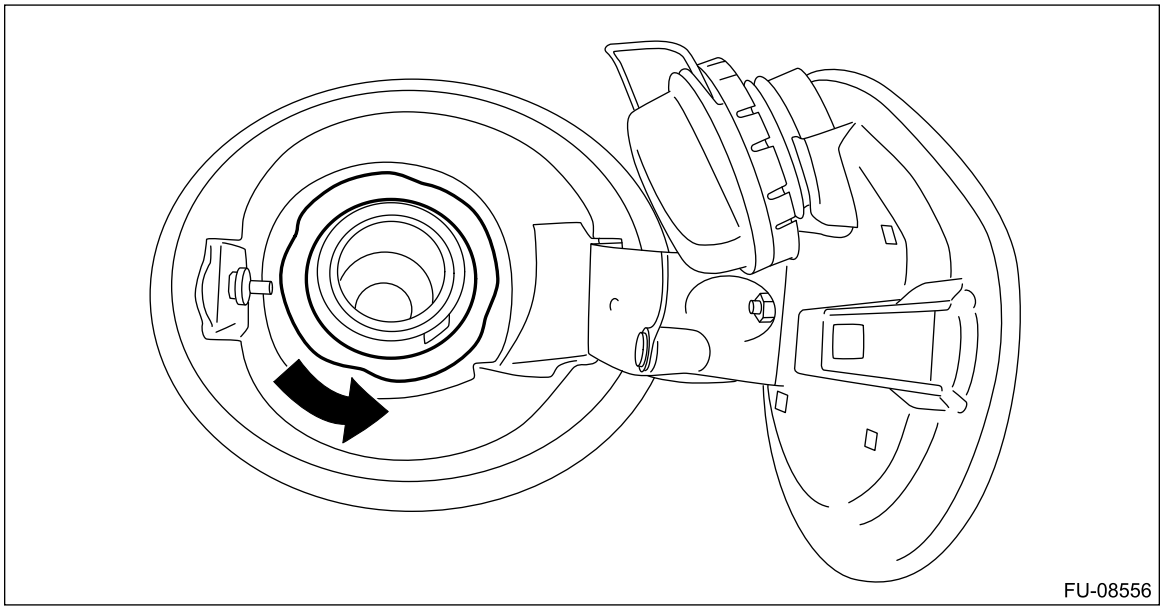
1. Open the fuel filler lid.
2. Insert the fuel filler pipe assembly from inside of the rear fender.
3. Install the fuel filler pipe assembly to the vehicle.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



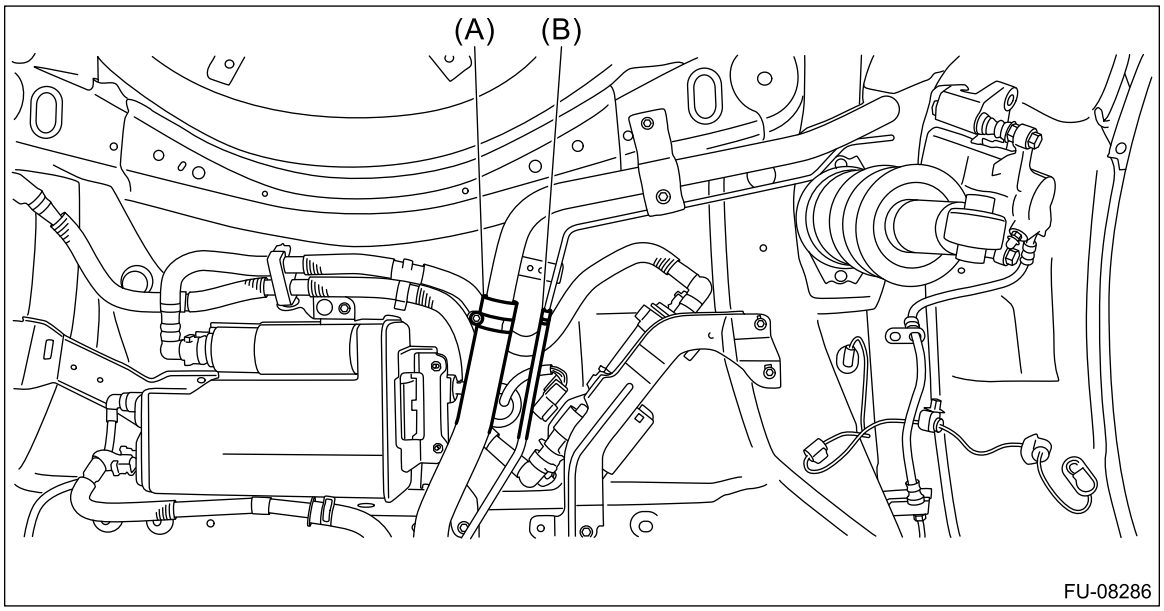
4. Align the cutout on the fuel filler pipe protector and the protrusion of the neck holder and insert them all the way, and then turn the fuel filler pipe protector in the direction of the arrow until it is locked.

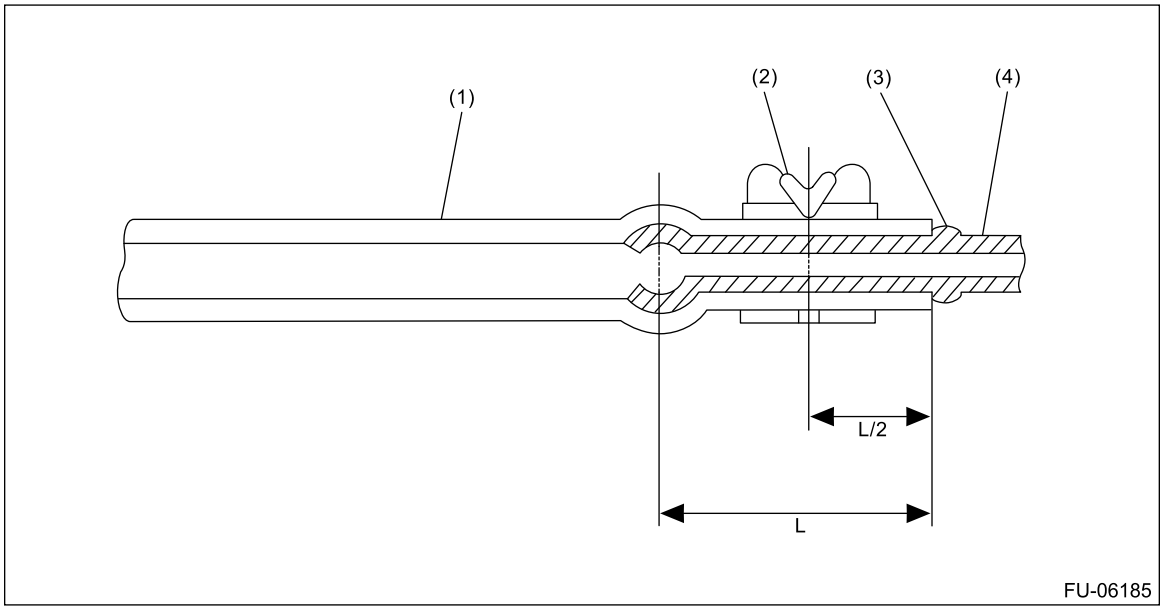


5. Securely insert the fuel filler hose (A) and evaporation hose (B) until the hose end contacts the spool, then attach the clamp or clip as shown in the figure.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)





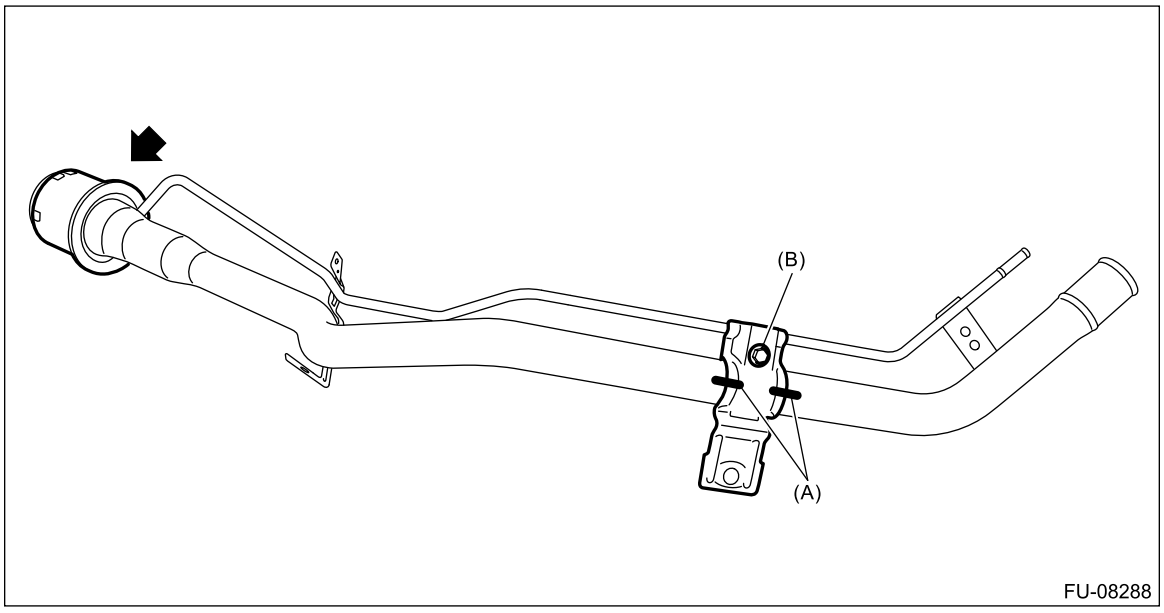
(1) Hose
(2) Clamp or clip
(3) Spool
(4) Pipe

6. Install the rear mud guard RH. Ref. to EXTERIOR/INTERIOR TRIM>Mud Guard>INSTALLATION.
7. Install the rear sub frame assembly. Ref. to REAR SUSPENSION>Rear Sub Frame>INSTALLATION.
8. Connect the battery ground terminal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Filler Pipe

DISASSEMBLY

1. Using a marker pen, make alignment marks (A) on the fuel filler pipe and the bracket.
2. Remove the bracket bolt (B) which secures the fuel filler pipe.
3. Remove the neck holder from the fuel filler pipe.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Filler Pipe

ASSEMBLY

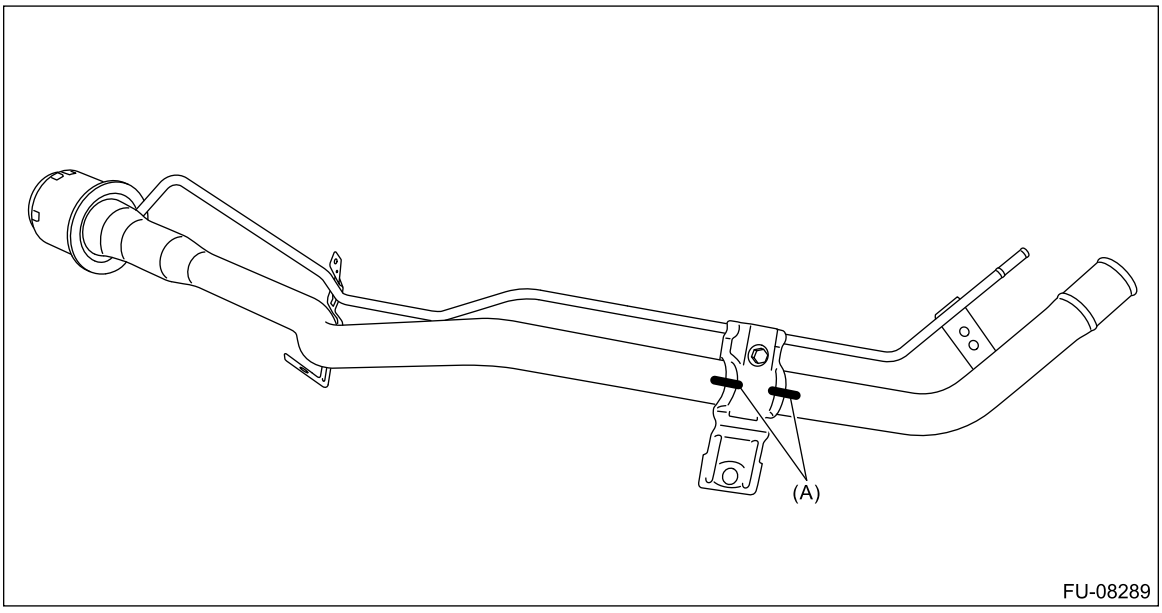
Assemble in the reverse order of disassembly.

Note:

- **Use a new neck holder.**
- **Install the bracket to the fuel filler pipe by aligning the alignment marks (A).**

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Filler Pipe

INSPECTION

1. Check that the fuel filler pipe assembly has no deformation, cracks or other damages.

2. Check that the fuel hose has no cracks, damage or loose part.

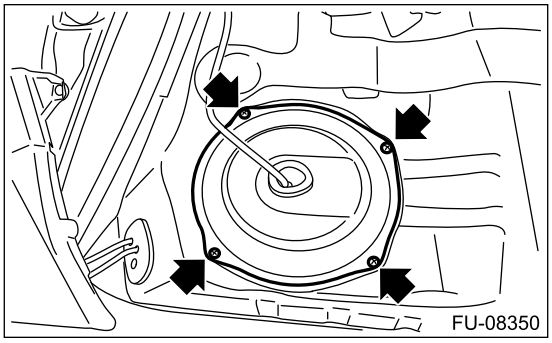
REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

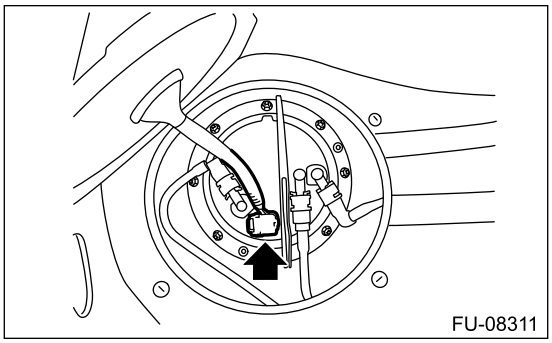
- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**

Note:
Fuel pump assembly consists of fuel pump, fuel filter and fuel level sensor.

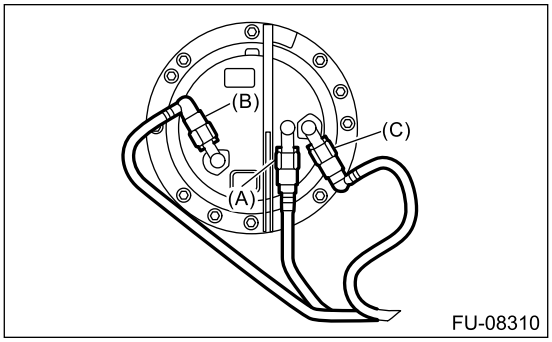
1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground cable from battery.
4. Remove the rear seat cushion. Ref. to SEATS>Rear Seat>REMOVAL.
5. Remove the service hole cover.



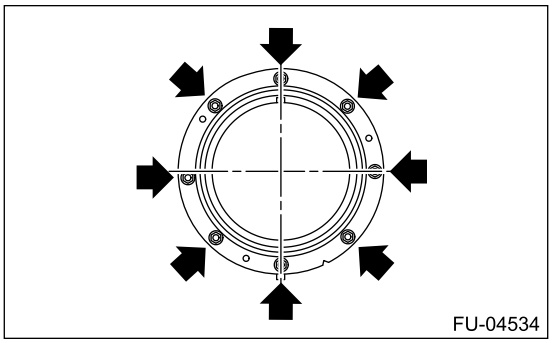
6. Disconnect the connector from fuel pump.



7. Disconnect the quick connectors of fuel delivery tube (A), fuel return tube (B), and jet pump tube (C). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>REMOVAL.



8. Remove the nuts which hold the fuel pump upper plate to the fuel tank.



9. Remove the fuel pump assembly from the fuel tank.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump

INSTALLATION

1. Install the fuel pump assembly to the fuel tank.

(1) Make sure the sealing portion is free from fuel or foreign matter before installation.

(2) Align the protrusion (A) of the gasket to the position shown in the figure, and install the gasket from the lower side of the fuel pump assembly.

Note:

Use a new gasket.

(3) Align the protrusion (C) of fuel pump upper plate cushion with the protrusion (C) of the fuel pump assembly as shown in the figure, and install the fuel pump upper plate cushion from the upper side of the fuel pump assembly.

(4) Align the cutout of the fuel pump upper plate with the protrusion (C), and install the fuel pump upper plate from the upper side of the fuel pump assembly so that the protrusions (B) (3 places) of the gasket fit the holes of the fuel pump upper plate.

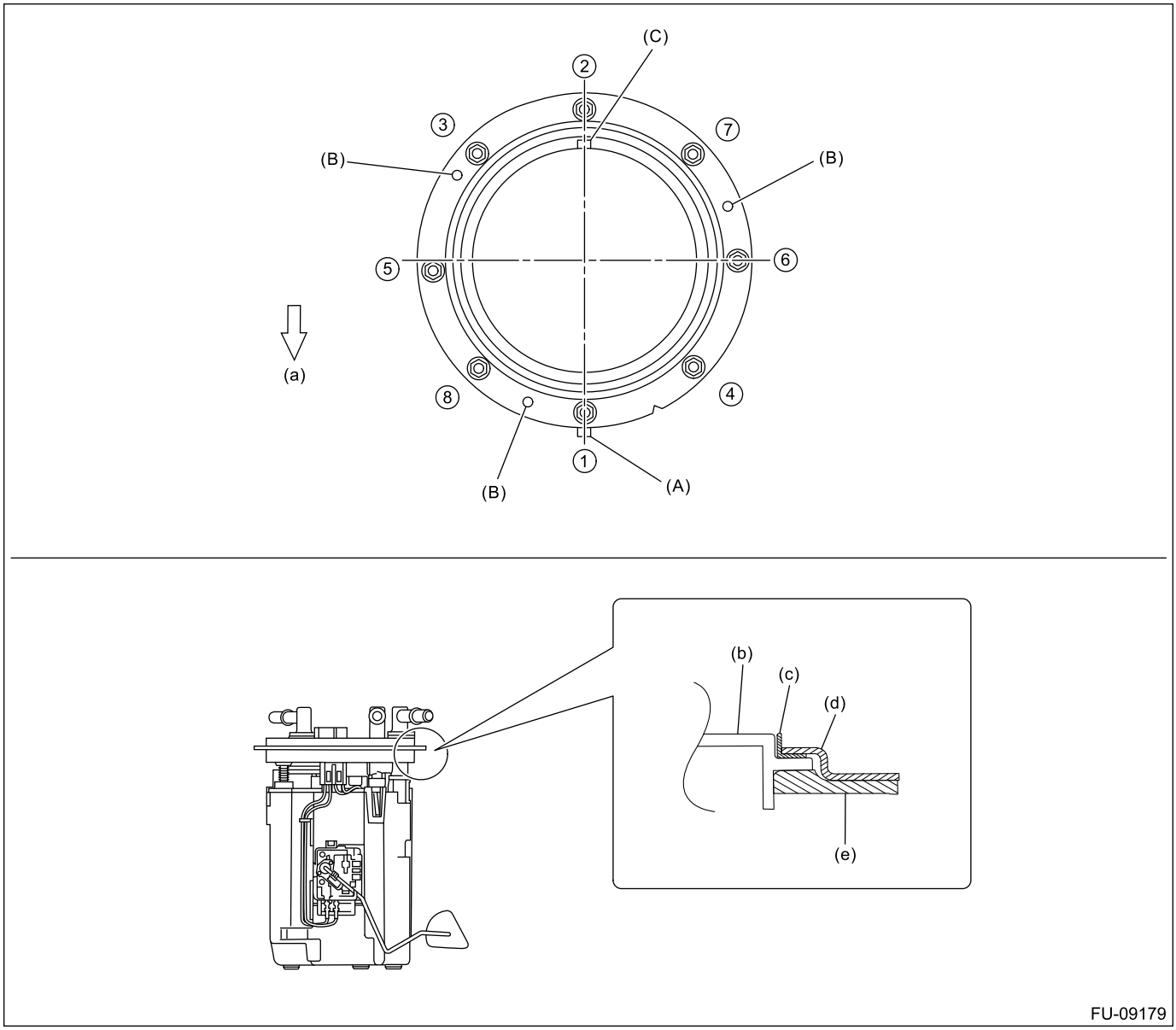
(5) Install the fuel pump assembly to the fuel tank in the direction shown in the figure, and tighten the nuts to the specified torque in the order as shown in the figure.

Caution:

Set the arm and float of the fuel level sensor while paying attention to prevent them from contacting the fuel tank. If the arm of the fuel level sensor is bent, the fuel gauge may not read correctly.

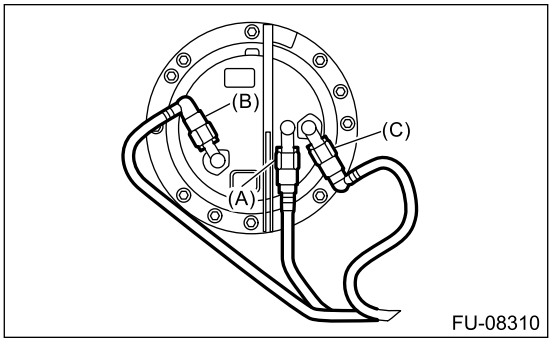
Tightening torque:

4.4 N·m (0.4 kgf-m, 3.2 ft-lb)

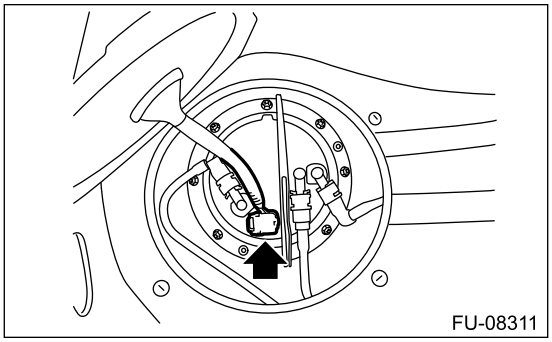


(a) Front side of vehicle
(b) Fuel pump ASSY
(c) Fuel pump upper plate cushion
(d) Fuel pump upper plate
(e) Gasket

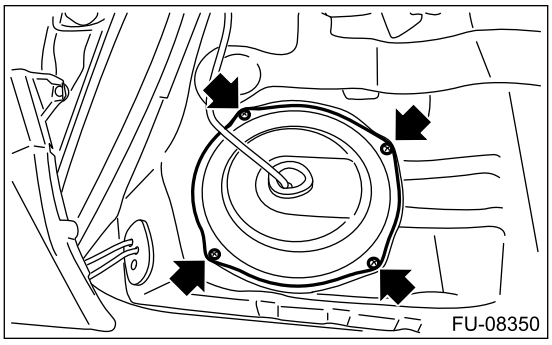
2. Connect the quick connectors of fuel delivery tube (A), fuel return tube (B), and jet pump tube (C). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION.



3. Connect the connector to the fuel pump.
   Caution:
   Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel pump and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.



4. Install the service hole cover.

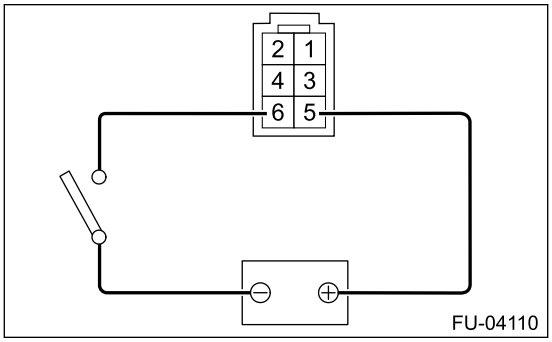


5. Install the rear seat cushion. Ref. to SEATS>Rear Seat>INSTALLATION.
6. Connect the battery ground terminal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Pump

INSPECTION

1. Check that the fuel pump has no deformation, cracks or other damages.
2. Connect the battery positive terminal to terminal No. 5 and the battery ground terminal to terminal No. 6, and inspect the fuel pump operation.
   Warning:
   - **Wipe off fuel completely.**
   - **Keep the battery as far apart from fuel pump as possible.**
   - **Do not run the fuel pump for a long time under non-load condition.**


2
1
4
3
6
5
FU-04110

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Level Sensor

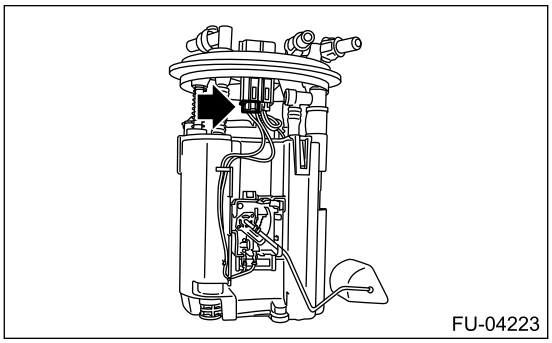
REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

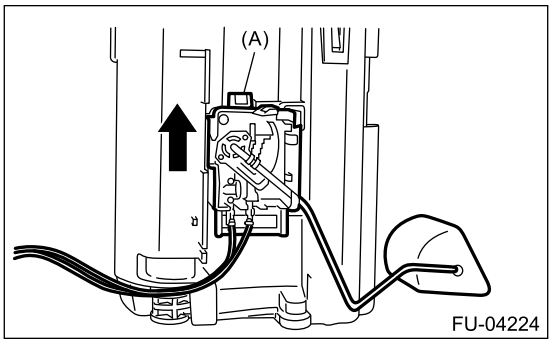
- **Be careful not to spill fuel.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**

Note:
The fuel level sensor is built in fuel pump assembly.

1. Remove the fuel pump assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Pump>REMOVAL.
2. Disconnect the fuel level sensor connector.



3. Slide the fuel level sensor in the direction of the arrow and remove the fuel level sensor by pressing the claw (A) of the fuel level sensor.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Level Sensor

INSTALLATION

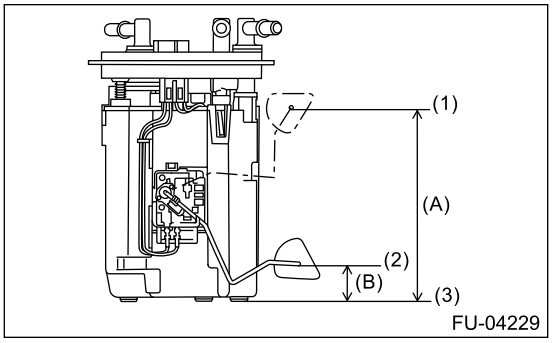
Install in the reverse order of removal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Level Sensor

INSPECTION

1. Check that the fuel level sensor has no damage.
2. Measure the fuel level sensor float position.

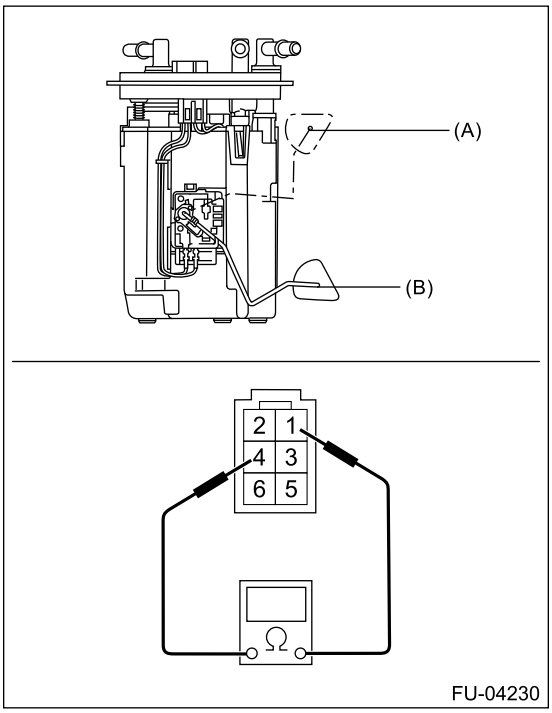
Note:
When inspecting the fuel level sensor, perform the work with the sensor installed to the fuel pump.



(1) FULL
(2) EMPTY
(3) Fuel tank seating surface

Float position	Standard
FULL to Fuel tank seating surface (A)	135±4 mm (5.315±0.157 in)
EMPTY to Fuel tank seating surface (B)	23.7±4 mm (0.933±0.157 in)

3. Measure the resistance between fuel level sensor terminals.



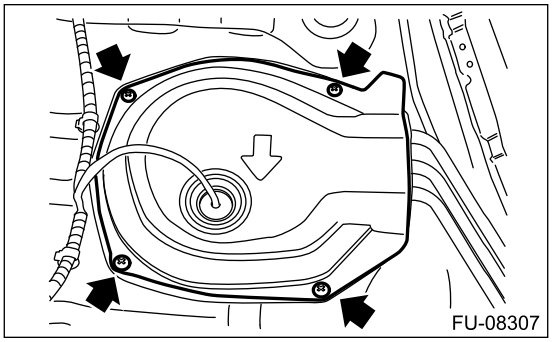
Float position	Terminal No.	Standard
FULL (A)	1 and 4	8.7±1.0 Ω
EMPTY (B)		139.1±2.0 Ω

REMOVAL

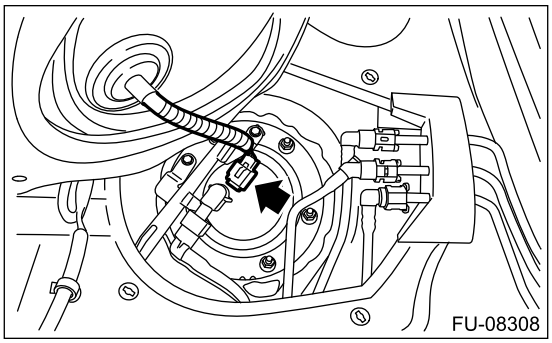
Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**

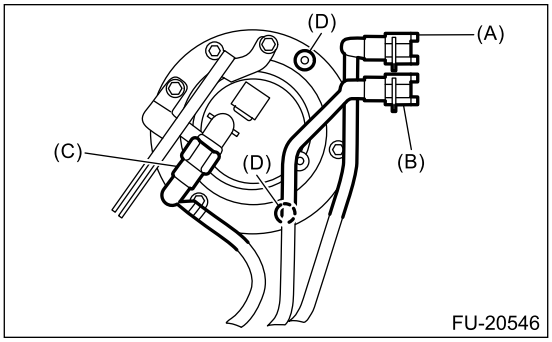
1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground cable from battery.
4. Remove the rear seat cushion. Ref. to SEATS>Rear Seat>REMOVAL.
5. Remove the service hole cover.



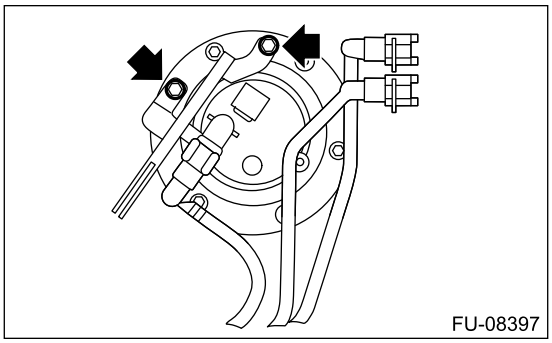
6. Disconnect the connector from the fuel sub level sensor.

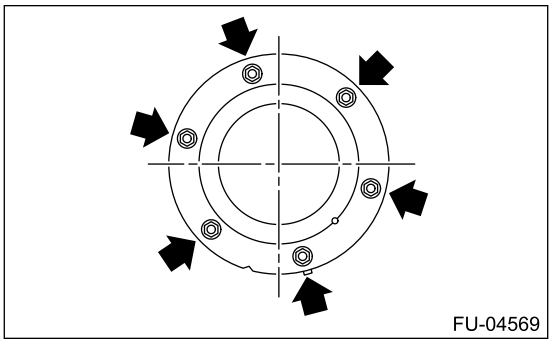


7. Disconnect the quick connectors of fuel delivery tube (A), fuel return tube (B), and jet pump tube (C). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>REMOVAL.
8. Remove the rubber cap (D) from the nut.



9. Remove the bolts and nuts which hold fuel sub level sensor protector and fuel sub level sensor upper plate to the fuel tank.





10. Remove the fuel sub level sensor from the fuel tank.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Sub Level Sensor

INSTALLATION

1. Install the fuel sub level sensor to the fuel tank.
(1) Make sure the sealing portion is free from fuel or foreign matter before installation.
(2) Align the cutout (B) as shown in the figure, and install the fuel sub level sensor upper plate cushion to the fuel sub level sensor upper plate.
(3) Align the cutout of the fuel sub level sensor upper plate with the protrusion (B) of the fuel sub level sensor as shown in the figure, and install the fuel sub level sensor upper plate from the upper side of the fuel sub level sensor.
(4) Install the gasket from the lower side of the fuel sub level sensor so that the protrusion (B) of the fuel sub level sensor and the protrusion (A) of the gasket are positioned as shown in the figure.
Note:
Use a new gasket.

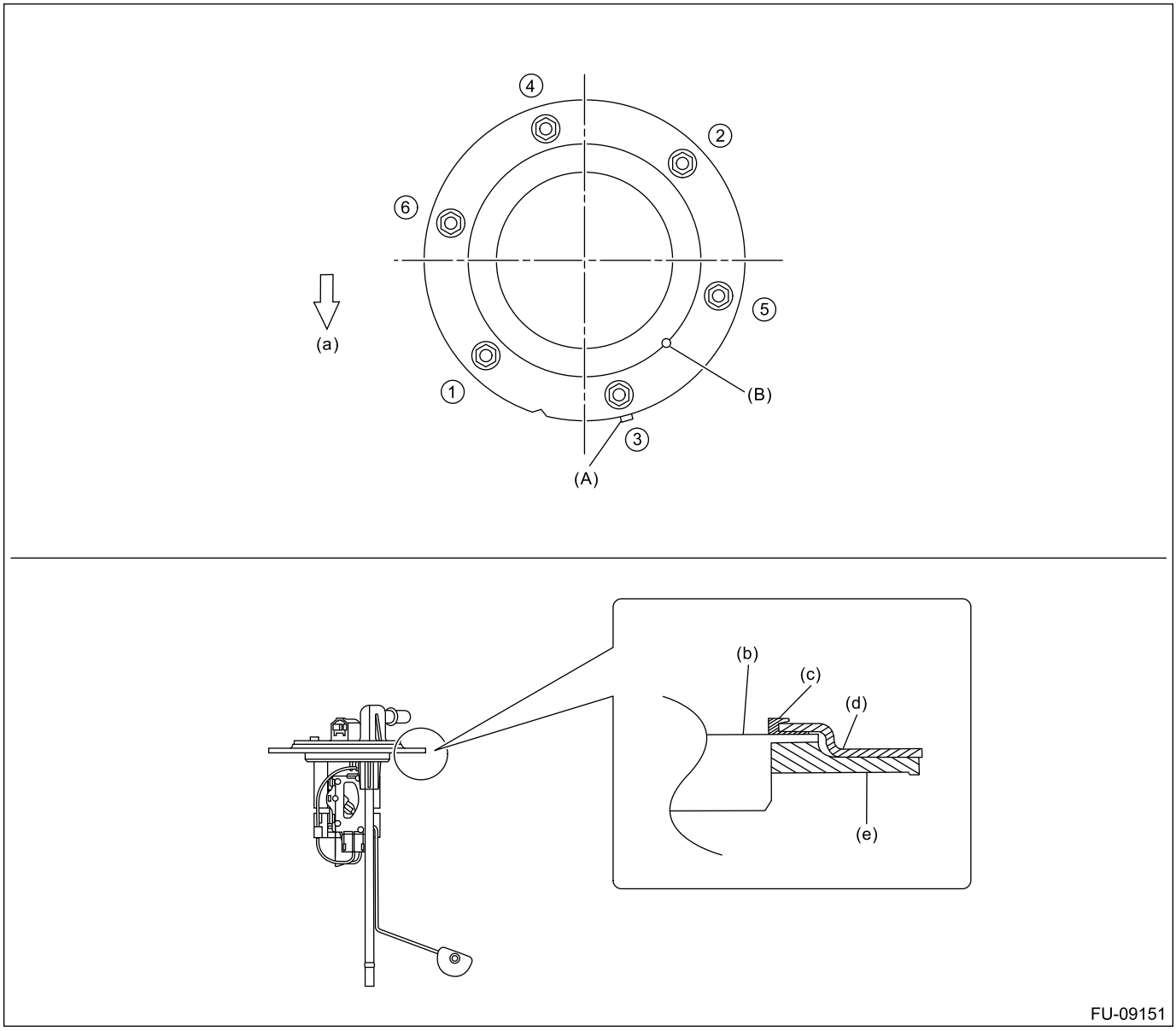
(5) Install the fuel sub level sensor to the fuel tank in the direction shown in the figure, and tighten the nuts to the specified torque in the order as shown in the figure.

Caution:

Set the arm and float of the fuel sub level sensor while paying attention to prevent them from contacting the fuel tank. If the arm of the fuel sub level sensor is bent, the fuel gauge may not read correctly.

Tightening torque:

4.4 N·m (0.4 kgf-m, 3.2 ft-lb)



(a) Front side of vehicle

(b) Fuel sub level sensor

(c) Fuel sub level sensor upper plate cushion

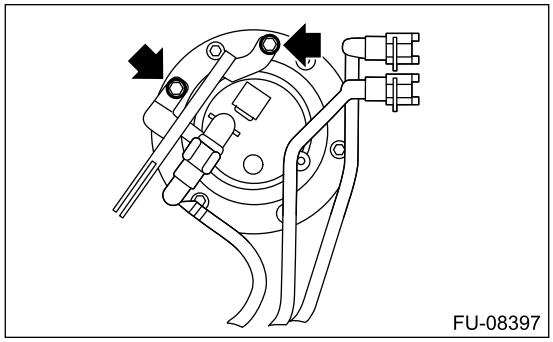
(d) Fuel sub level sensor upper plate

(e) Gasket

2. Install the bolt which secures the fuel sub level sensor protector to the fuel tank.

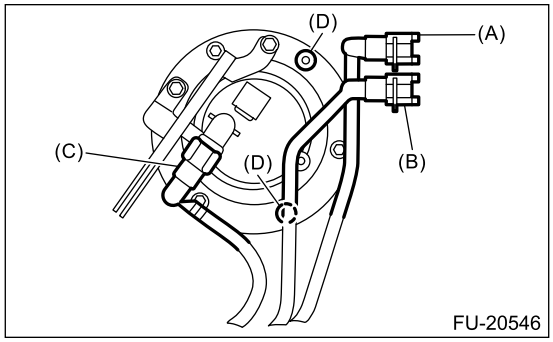
Tightening torque:

4.4 N·m (0.4 kgf-m, 3.2 ft-lb)



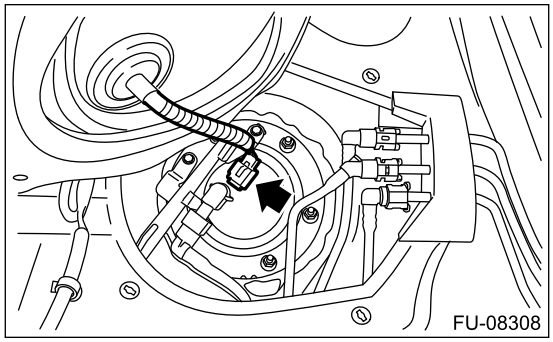
3. Connect the quick connectors of fuel delivery tube (A), fuel return tube (B), and jet pump tube (C).
Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION.

4. Attach the rubber cap (D) to the nut.

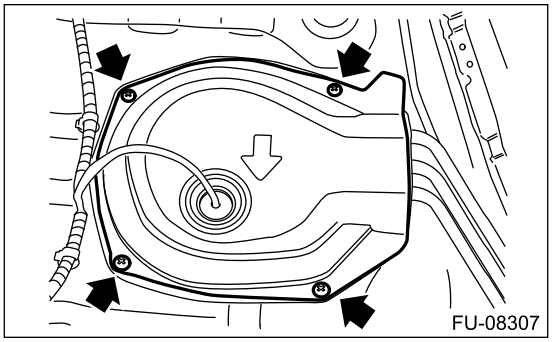


5. Connect the connector to the fuel sub level sensor.

Caution:
Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel sub level sensor and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.



6. Install the service hole cover.

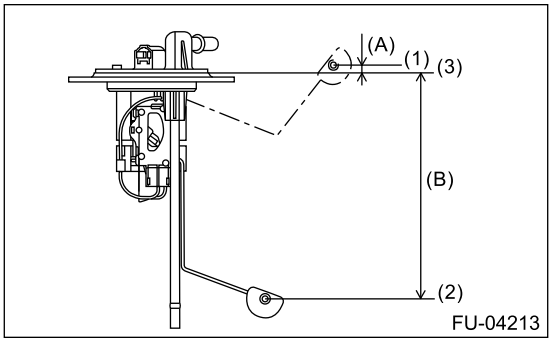


7. Install the rear seat cushion. Ref. to SEATS>Rear Seat>INSTALLATION.
8. Connect the battery ground terminal.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Sub Level Sensor

INSPECTION

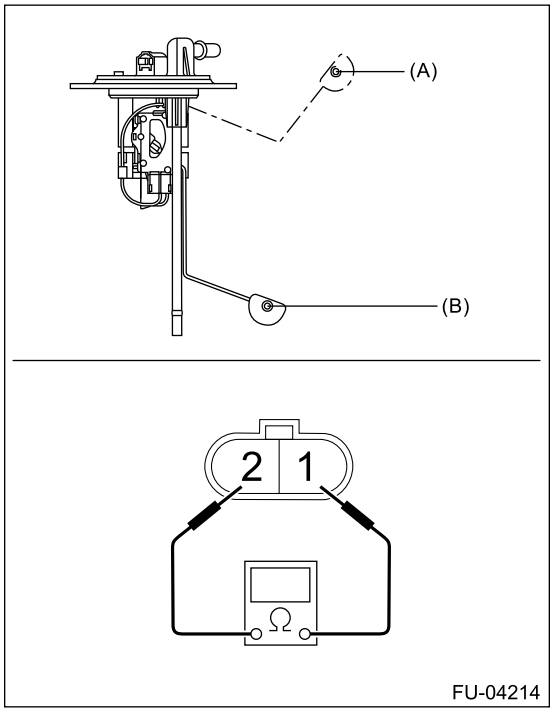
1. Check that the fuel sub level sensor has no damage.
2. Measure the fuel sub level sensor float position.



(1) FULL
(2) EMPTY
(3) Datum points

Float position	Standard
FULL to Datum point (A)	5.31±3.5 mm (0.209±0.138 in)
EMPTY to Datum point (B)	160.6±3.5 mm (6.323±0.138 in)

3. Measure the resistance between fuel sub level sensor terminals.



Float position	Terminal No.	Standard
FULL (A)	1 and 2	8.7±1.0 Ω
EMPTY (B)		270.9±4.0 Ω

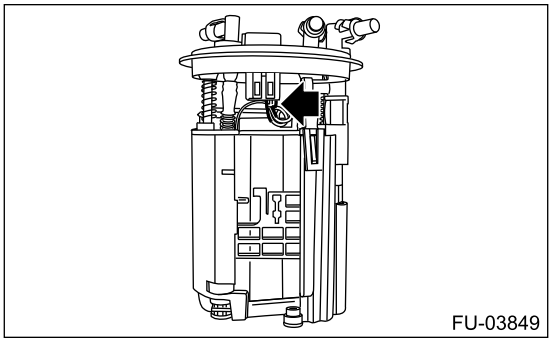
REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

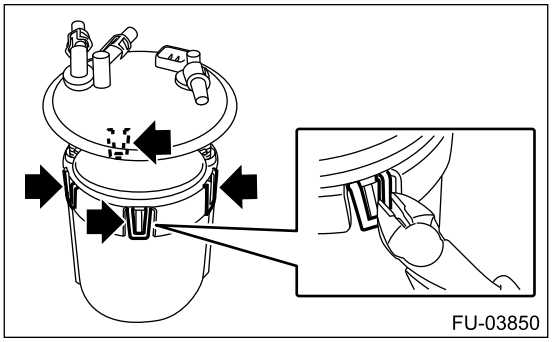
- **Be careful not to spill fuel.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**
- **Be careful not to drop or apply any impact to the fuel pump during work. This may deteriorate its performance.**

Note:
The fuel filter is built in fuel pump assembly.

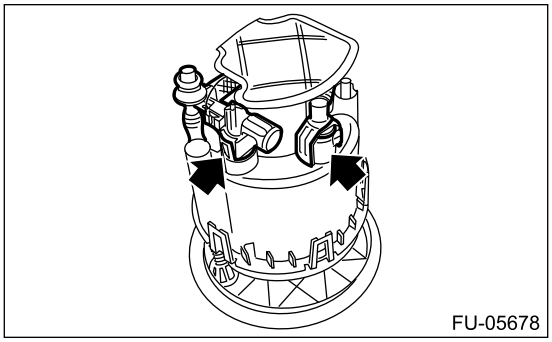
1. Remove the fuel pump assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Pump>REMOVAL.
2. Remove the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Level Sensor>REMOVAL.
3. Disconnect the pump assembly connector from sub tank bracket assembly.



4. Cut off the tab holders connecting the sub tank bracket assembly and the sub tank in four locations, and separate the sub tank bracket assembly and the sub tank.
   Caution:
   Be careful not to damage the sub tank.
   Note:
   If the O-ring is remaining on the sub tank, remove.



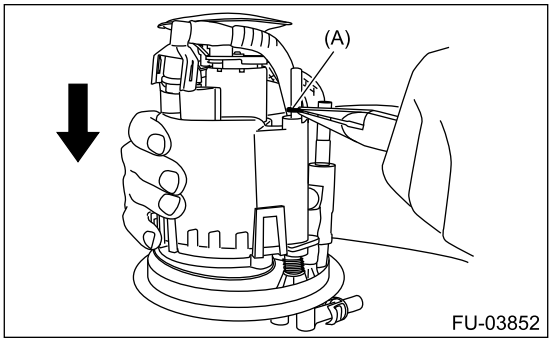
5. Disconnect two connectors of fuel delivery pipe from fuel filter assembly.



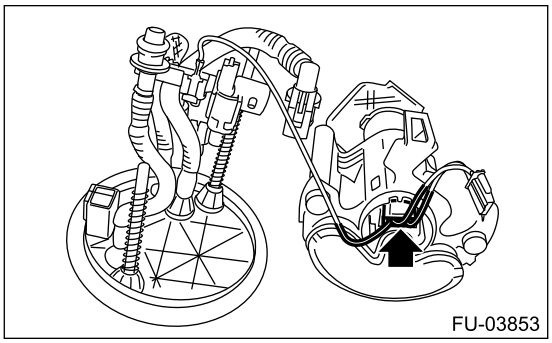
6. Push to compress the fuel filter assembly in the direction of the arrow, remove clip (A), and separate the sub tank bracket assembly and the fuel filter assembly.

Caution:

When separating the sub tank bracket assembly and the fuel filter assembly, be careful not to damage the ground wire.



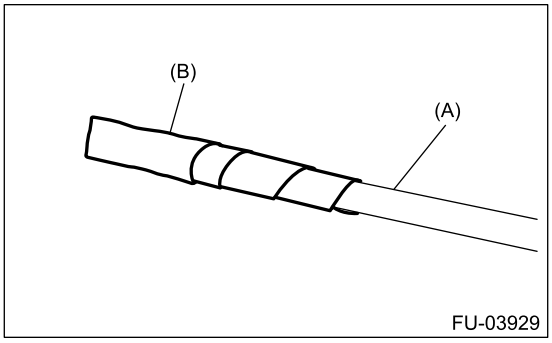
7. Disconnect the connector from the pump assembly.



8. Lift the two tab holders connecting the pump assembly to the fuel filter using a flat tip screwdriver (with a shaft diameter of approx. 3 mm (0.12 in)), etc., and separate the fuel filter and pump assembly.

Caution:

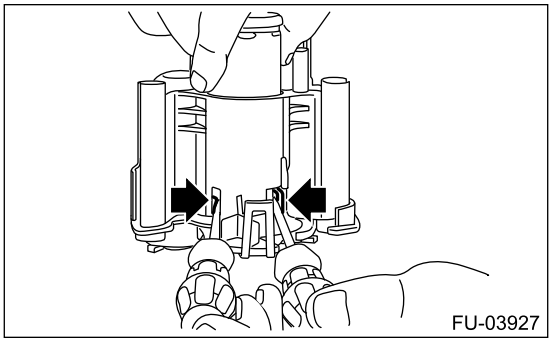
- **To prevent damaging the tabs of the pump assembly, wrap the tip of flat tip screwdriver (A), etc. with tape (B).**



- **Be careful not to drop or apply any impact to the pump assembly.**

Note:

If the spacer and O-ring are remaining on the pump assembly, remove them.



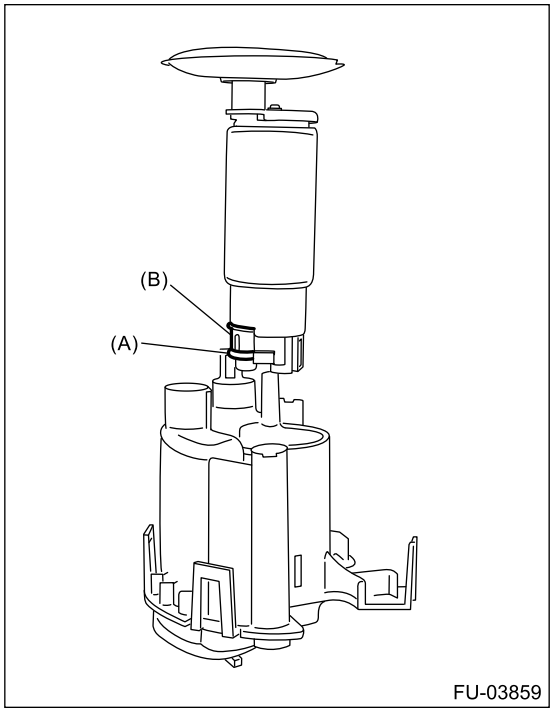
FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Filter

INSTALLATION

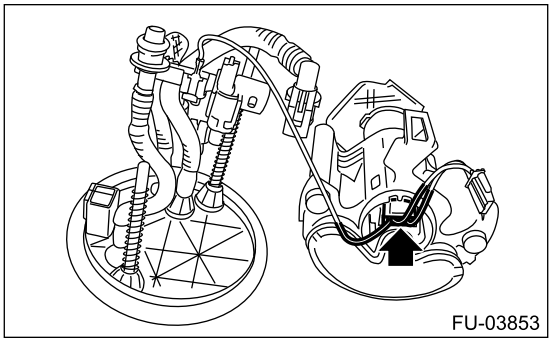
1. Assemble O-ring (A) and spacer (B) to the pump assembly and attach the pump assembly to the fuel filter.

   Note:

   - **Use new O-rings (8 mm (0.31 in) inner diameter).**
   - **Use a new spacer.**
   - **Apply gasoline to the O-ring.**
   - **Insert the pump assembly until a click is heard.**



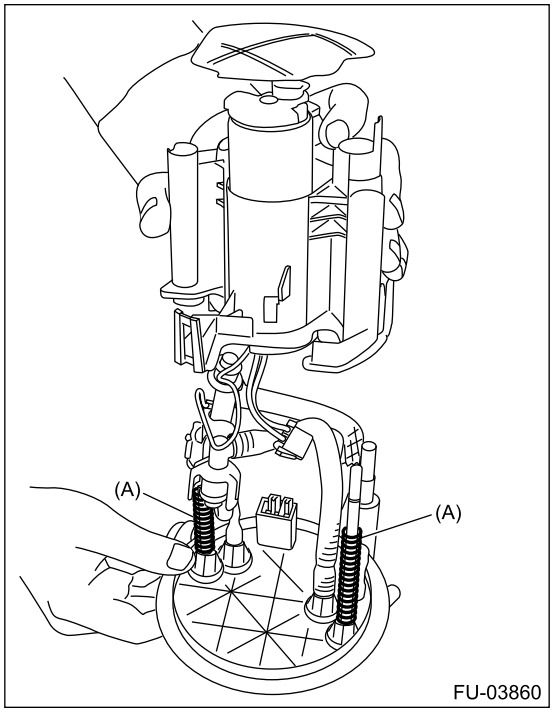
2. Connect the connector to the pump assembly.



3. Attach spring (A) to the metal rod of the sub tank bracket assembly, and assemble the fuel filter assembly.

Note:

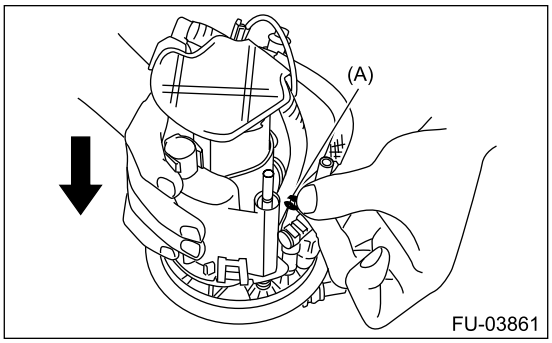
Use a new spring.



4. Push the fuel filter assembly in the direction of the arrow to compress, and attach clip (A).

Note:

Use a new clip.



5. Connect the fuel piping connector to the fuel filter assembly.

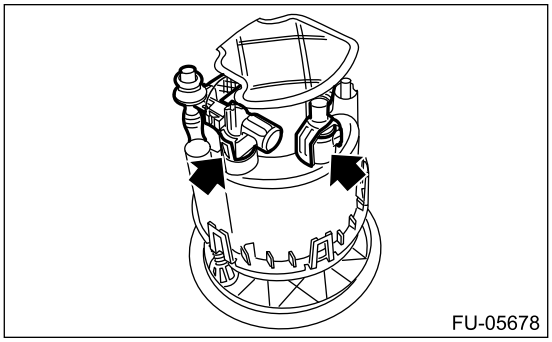
Note:

- **Use new O-rings.**
- **Apply gasoline to the O-ring.**
- **The O-rings of the black and white connectors are identified by a difference in diameter. Be careful not to confuse the two during assembly.**

O-ring inner diameter:

Black connector O-ring [Approx. 7 mm (0.28 in)]

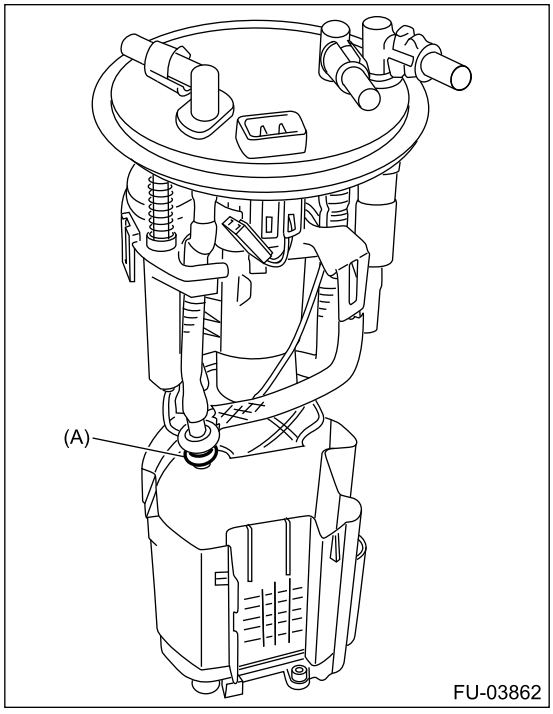
White connector O-ring [Approx. 8 mm (0.31 in)]



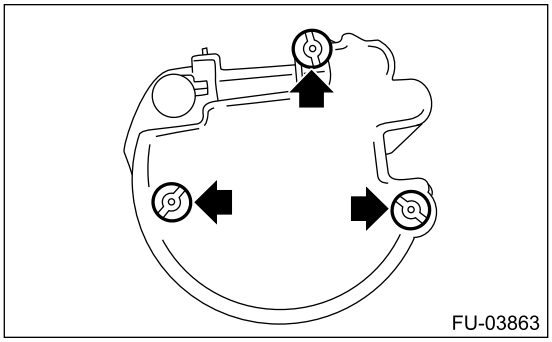
6. Attach the O-ring (A) to the fuel filter assembly, and attach the sub tank to the sub tank bracket assembly.

Note:

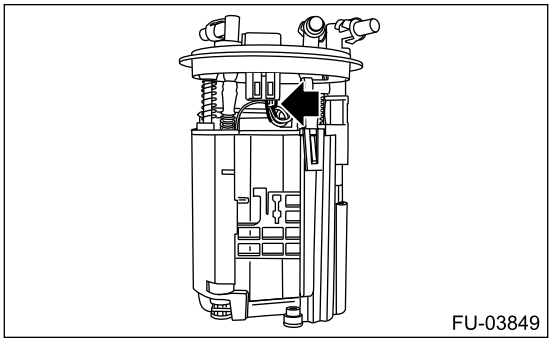
- **Use new O-rings (8 mm (0.31 in) inner diameter).**
- **Apply gasoline to the O-ring.**
- **Insert the pump assembly until a "pop" is heard.**



7. When removing the cushion from the sub tank, replace it with a new part.



8. Connect the pump assembly connector to the sub tank bracket assembly.



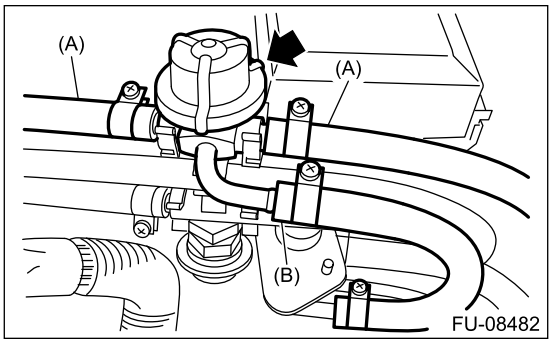
9. Install the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Level Sensor>INSTALLATION.
10. Inspect the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Level Sensor>INSPECTION.
11. Install the fuel pump assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Pump>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Pulsation Damper Assembly

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Disconnect the fuel delivery hose (A) and fuel hose (B) from the pulsation damper assembly, and remove the pulsation damper assembly.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Pulsation Damper Assembly

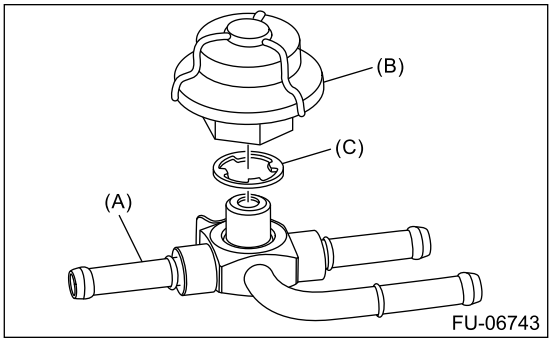
INSTALLATION

Install in the reverse order of removal.
Note:
- **Use new fuel delivery hose and fuel hose.**
- **For the information about connecting the fuel delivery hose and fuel hose, refer to "Fuel Delivery, Return and Evaporation Lines". Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION > CONNECTING THE FUEL DELIVERY HOSE, FUEL RETURN HOSE AND FUEL HOSE.**

FUEL INJECTION (FUEL SYSTEMS)(STI) > Pulsation Damper Assembly

DISASSEMBLY

Remove the pulsation damper and fuel pipe gasket from the fuel by-pass pipe.



(A) Fuel by-pass pipe
(B) Pulsation damper
(C) Fuel pipe gasket

FUEL INJECTION (FUEL SYSTEMS)(STI) > Pulsation Damper Assembly

ASSEMBLY

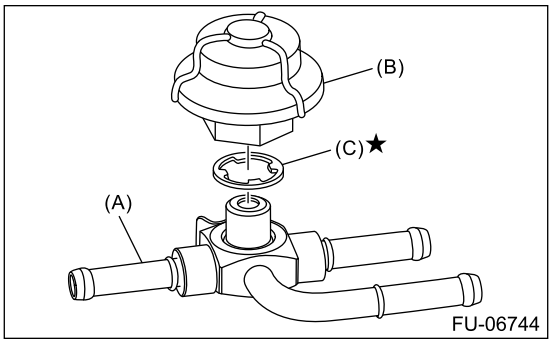
Install the fuel pipe gasket and pulsation damper to the fuel by-pass pipe.

Note:

Use a new fuel pipe gasket.

Tightening torque:

21.6 N·m (2.2 kgf-m, 15.9 ft-lb)



(A) Fuel by-pass pipe
(B) Pulsation damper
(C) Fuel pipe gasket

FUEL INJECTION (FUEL SYSTEMS)(STI) > Pulsation Damper Assembly

INSPECTION

1. Check that the pulsation damper assembly has no deformation, cracks or other damages.
2. Check that the fuel delivery hose and fuel hose have no cracks, damage or loose part.

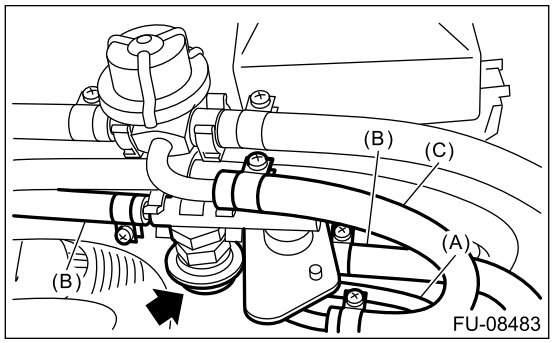
FUEL INJECTION (FUEL SYSTEMS)(STI) > Pressure Regulator & Damper Assembly

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Disconnect the vacuum hose (A) from the pressure regulator and damper assembly.
3. Disconnect the fuel return hose (B) and fuel hose (C) from the pressure regulator & damper assembly, and remove the fuel regulator & damper assembly.



FUEL INJECTION (FUEL SYSTEMS)(STI) > Pressure Regulator & Damper Assembly

INSTALLATION

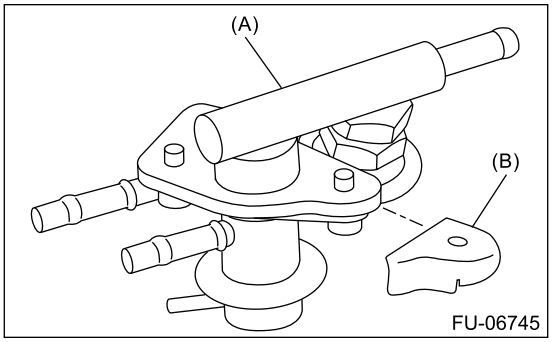
Install in the reverse order of removal.
Note:

- **Use new fuel return hose and fuel hose.**
- **For the information about connecting the fuel return hose and fuel hose, refer to "Fuel Delivery, Return and Evaporation Lines". Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Delivery, Return and Evaporation Lines>INSTALLATION > CONNECTING THE FUEL DELIVERY HOSE, FUEL RETURN HOSE AND FUEL HOSE.**

FUEL INJECTION (FUEL SYSTEMS)(STI) > Pressure Regulator & Damper Assembly

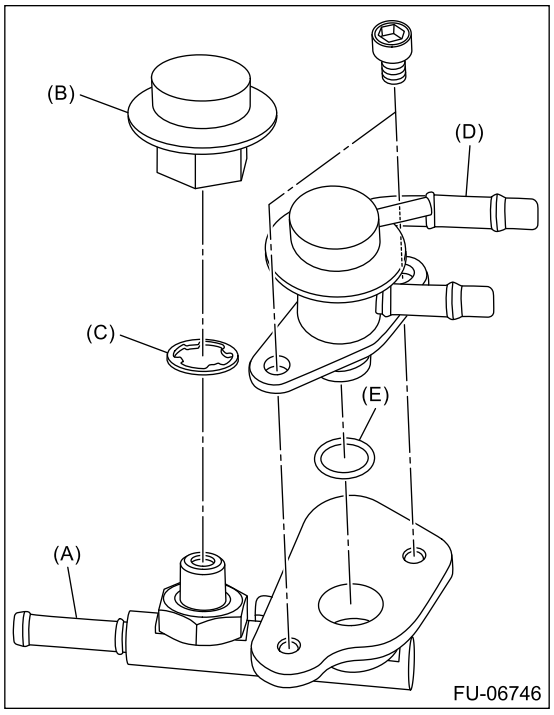
DISASSEMBLY

1. Remove the fuel pipe protector from the pressure regulator and damper assembly.



(A) Pressure regulator & damper ASSY
(B) Fuel pipe protector

2. Remove the pulsation damper and fuel pipe gasket from the fuel holder assembly, and remove the pressure regulator from the fuel holder assembly.



(A) Fuel holder ASSY
(B) Pulsation damper
(C) Fuel pipe gasket
(D) Pressure regulator
(E) O-ring

FUEL INJECTION (FUEL SYSTEMS)(STI) > Pressure Regulator & Damper Assembly

ASSEMBLY

1. Install the pressure regulator to the fuel holder assembly, and install the fuel pipe gasket and pulsation damper to the fuel holder assembly.

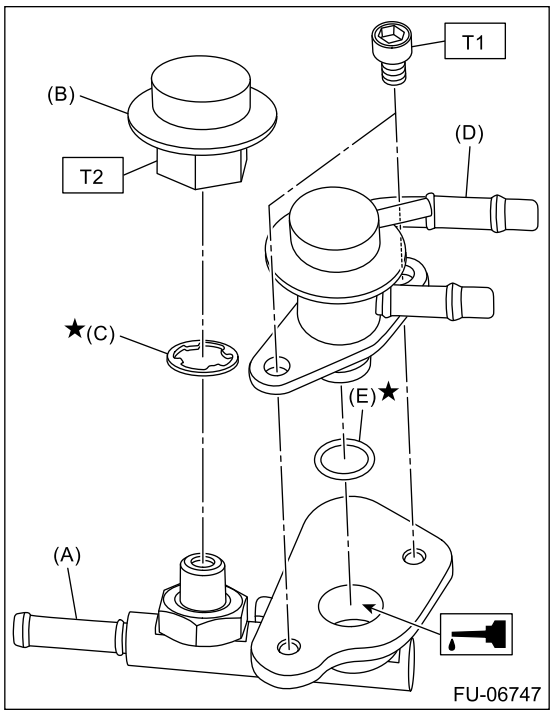
Note:

- **Use new O-rings and fuel pipe gaskets.**
- **Apply a thin coat of engine oil to the pressure regulator installation hole of fuel holder assembly.**

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 21.6 N·m (2.2 kgf-m, 15.9 ft-lb)



(A) Fuel holder ASSY

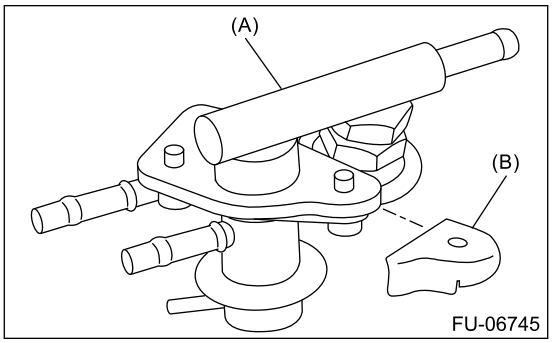
(B) Pulsation damper

(C) Fuel pipe gasket

(D) Pressure regulator

(E) O-ring

2. Install the fuel pipe protector to the pressure regulator and damper assembly.



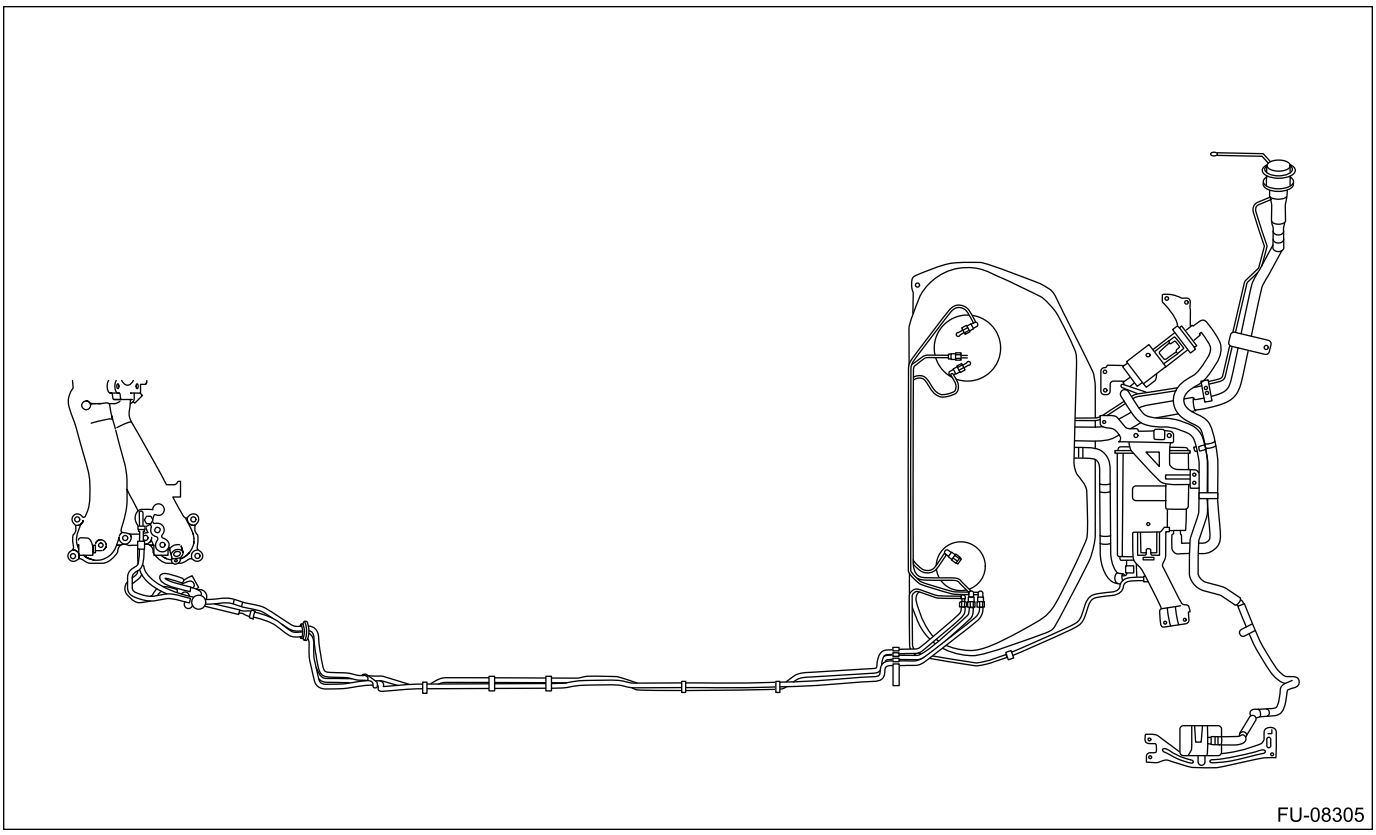
(A) Pressure regulator & damper ASSY

(B) Fuel pipe protector

INSPECTION

1. Check that the pressure regulator and damper assembly has no deformation, cracks or other damages.
2. Check that the vacuum hose, fuel return hose and fuel hose have no cracks, damage or loose part.

REMOVAL

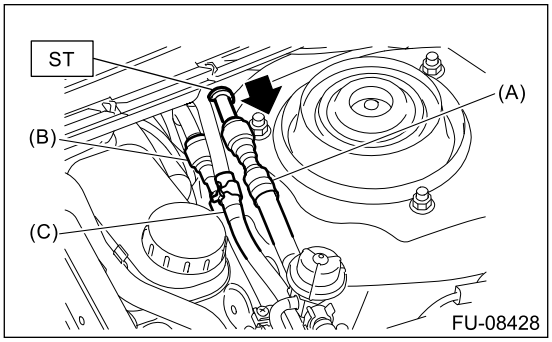


Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
3. Remove the floor mat. Ref. to EXTERIOR/INTERIOR TRIM>Floor Mat>REMOVAL.
4. In the engine compartment, disconnect the fuel delivery hoses, fuel return hoses and evaporation hoses.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from hoses using a container or cloth.**
   (1) Set the ST to the fuel pipe.

   ST 42099AE000 QUICK CONNECTOR RELEASE

   (2) Disconnect the quick connector of the fuel delivery hose and fuel return hose by pushing the ST in the direction of the arrow.
   (3) Remove the clip and disconnect the evaporation hose from the fuel pipe.



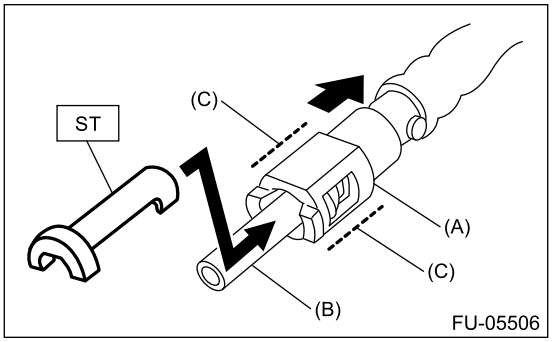
(A) Fuel delivery hose
(B) Fuel return hose
(C) Evaporation hose

5. Remove the fuel tank. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Tank>REMOVAL.
6. Disconnect the quick connector, and remove the fuel delivery tube, fuel return tube, and jet pump tube from the fuel tank.
   - When using ST
     1. Attach ST to the pipe and push ST in the direction of arrow mark to disconnect the quick connector.

        ST 42099AE000 QUICK CONNECTOR RELEASE

        Caution:
        - **Be careful not to spill fuel.**
        - **Catch the fuel from the tubes using a container or cloth.**
        - **To disconnect the connector, hold (C) shown in the figure and pull in axial direction.**
        - **If the connector and pipe are sticking to each other, push and pull the connector with ST pushed, and then pull the connector after it starts moving freely.**
        - **When disconnecting the connector, do not bend or twist the tube forcibly. If the tube is bent, replace with a new part.**

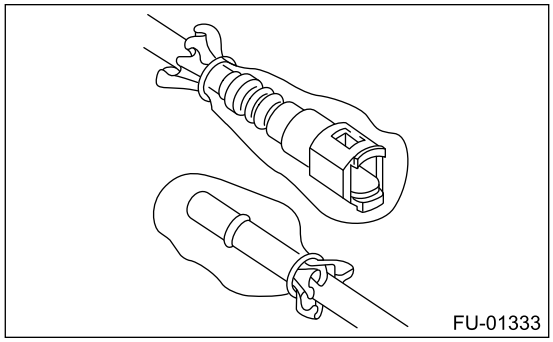
        Note:
        Clean the pipe and quick connector, if they are covered with dust.



(A) Quick connector
(B) Pipe
(C) Connector holding position

     2. To prevent from damaging or entering foreign matter, wrap the pipes and quick connectors with plastic bag etc.

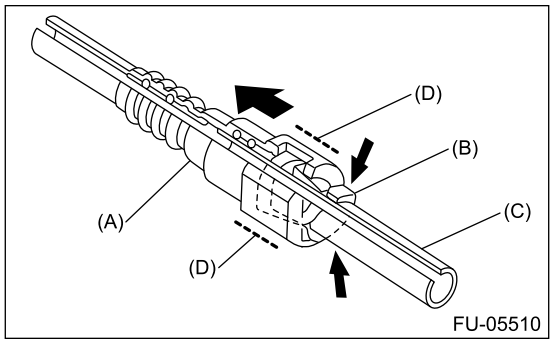
Caution:
When reusing the retainer, do not disconnect the retainer from the connector.



- When not using ST

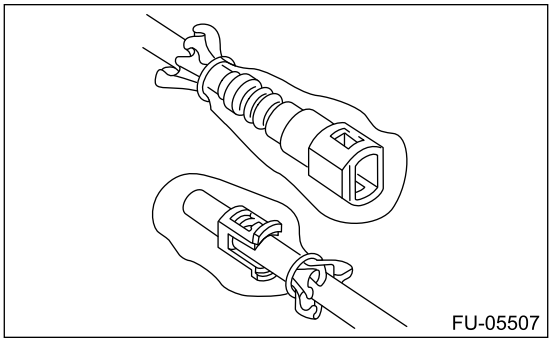
1. Push the retainer in the direction of the arrow, disconnect the quick connector from pipe.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from the tubes using a container or cloth.**
   - **To disconnect the connector, hold (D) shown in the figure and pull in axial direction.**
   - **If the connector and pipe are sticking to each other, push and pull the connector with the retainer pushed in the direction of the arrow, and then pull the connector after it starts moving freely.**
   - **When disconnecting the connector, do not bend or twist the tube forcibly. If the tube is bent, replace with a new part.**

   Note:
   Clean the pipe and quick connector, if they are covered with dust.

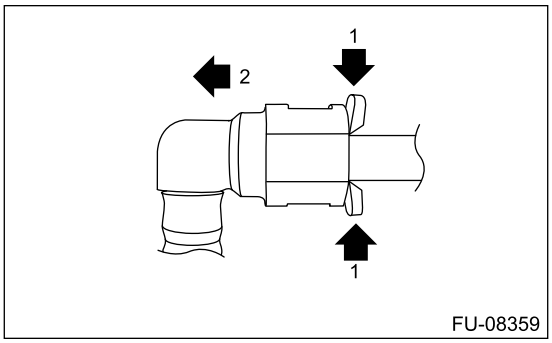


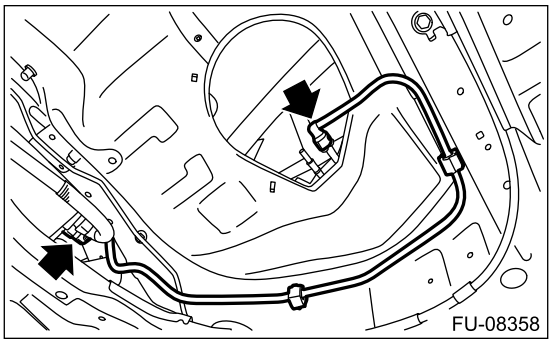
(A) Quick connector
(B) Retainer
(C) Pipe
(D) Connector holding position

2. To prevent from damaging or entering foreign matter, wrap the pipes and quick connectors with plastic bag etc.
   Caution:
   When reusing the retainer, do not disconnect the retainer from the pipe.



7. Disconnect the quick connector and remove the purge pipe.
   Note:
   Disconnect the quick connector as shown in the figure.





8. Remove the body integrated unit. Ref. to SECURITY AND LOCKS>Body Integrated Unit>REMOVAL.
9. Remove the fuel pipe assembly from vehicle.

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Delivery, Return and Evaporation Lines

INSTALLATION

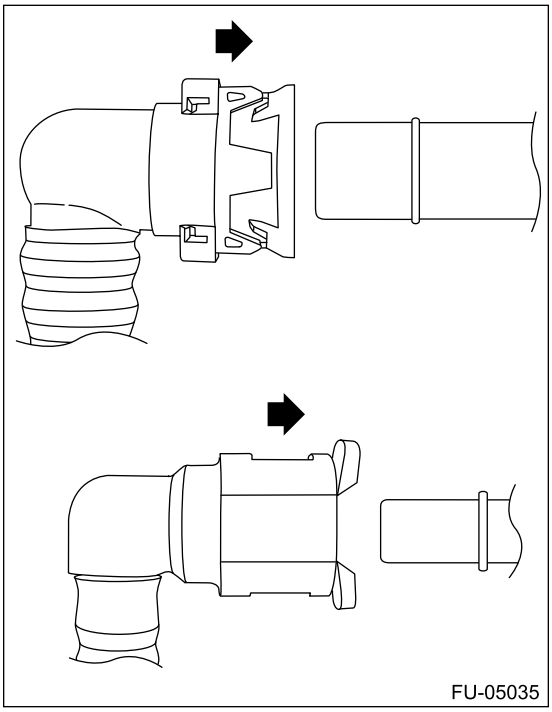
Install in the reverse order of removal while being careful of the following.

1. CONNECTING THE EVAPORATION LINE QUICK CONNECTOR

Note:
Connect the quick connector as shown in the figure.

Caution:

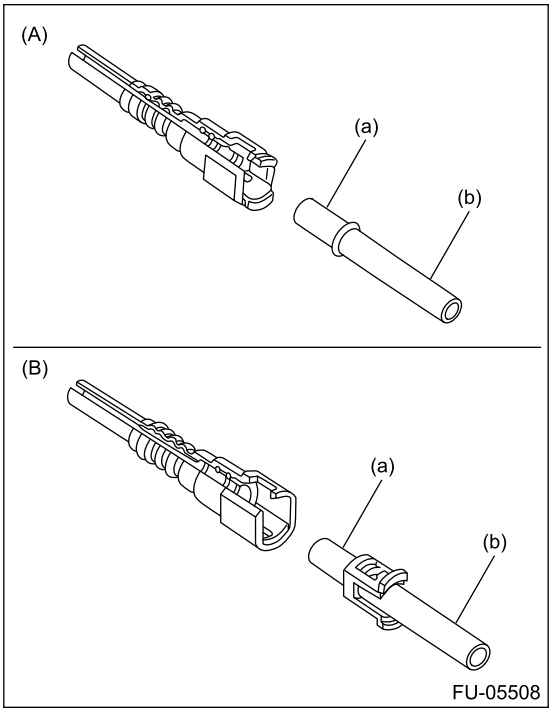
- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**



2. CONNECTING THE FUEL LINE QUICK CONNECTOR

Caution:

- **Make sure there are no damage or dust on connections. If necessary, clean seal surface of pipe.**



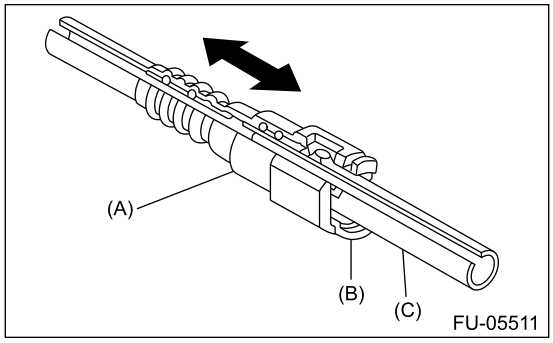
(A) When removed using the ST
(B) When removed without using the ST
(a) Seal surface
(b) Pipe

- **When reusing the retainer, make sure that neither scratches nor deformation exist on the retainer. If it is faulty, use a new part.**

1. Connect the quick connector to pipe.

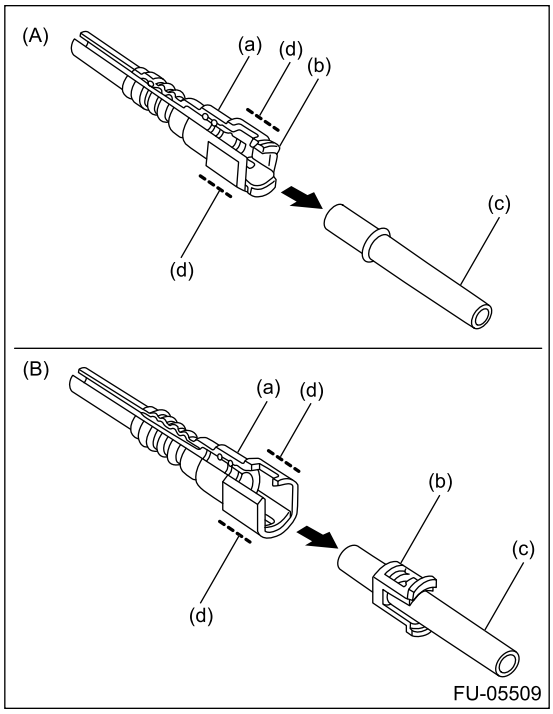
Caution:

- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**



(A) Quick connector
(B) Retainer
(C) Pipe

- **Make sure the two retainer pawls are engaged in their mating positions in the quick connector.**
- **Be sure to inspect tubes and their connections for any leakage of fuel.**
- **To connect the connector, hold (d) shown in the figure and push in axial direction.**
- **When connecting the connector, do not bend or twist the tube forcibly. If the tube is bent, replace with a new part.**



(A) When removed using the ST
(B) When removed without using the ST
(a) Quick connector
(b) Retainer

(c) Pipe

(d) Connector holding position

3. CONNECTING THE FUEL DELIVERY HOSE, FUEL RETURN HOSE AND FUEL HOSE

Connect the fuel delivery hose, fuel return hose, and fuel hose as shown in the figure.

Caution:

- **If the connection portion has a spool or stopper, do not allow the end of the hose to bend or ride over by inserting the hose too deep.**
- **Be sure to inspect hoses and their connections for any leakage of fuel.**

Note:

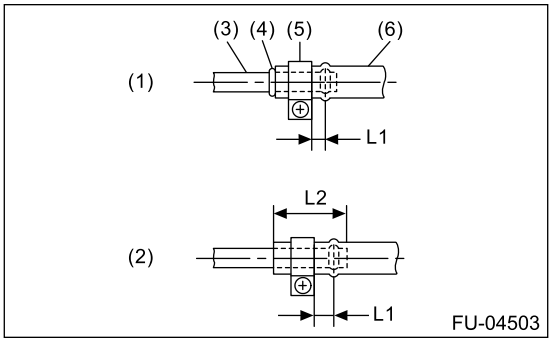
Use new fuel delivery hose, fuel return hose, and fuel hose.

Tightening torque:

1.25 N·m (0.1 kgf-m, 0.9 ft-lb)

L1: 2.5±1.5 mm (0.098±0.059 in)

L2: 22.5±2.5 mm (0.886±0.098 in)



(1) When there is a spool or bump

(2) When there is no spool or bump

(3) Pipe

(4) Spool or bump

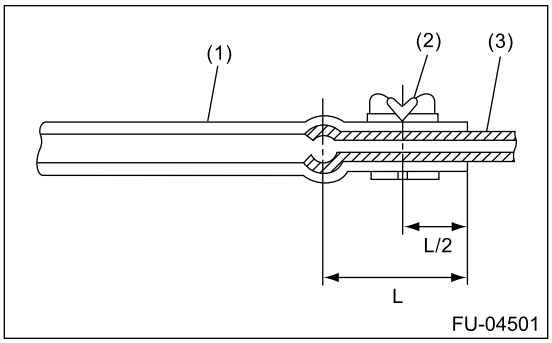
(5) Clamp

(6) Hose

4. EVAPORATION HOSE CONNECTION

Connect the evaporation hose to the pipe with an overlap of 15 to 20 mm (0.59 to 0.79 in).

L = 17.5±2.5 mm (0.689±0.098 in)



(1) Hose
(2) Clip
(3) Pipe

FUEL INJECTION (FUEL SYSTEMS)(STI) > Fuel Delivery, Return and Evaporation Lines

INSPECTION

1. Check that the fuel pipe has no deformation, cracks or other damages.
2. Check that the hose and tube have no cracks, damage or loose part.

INSPECTION

Trouble	Possible cause	Corrective action
Insufficient fuel supply to fuel injector	a. Fuel pump does not operate.	
	❍Defective terminal contact	Inspect contact, especially ground, and tighten it securely.
	❍Trouble in electromagnetic or electronic circuit parts	Replace the faulty parts.
	b. Decline of fuel pump function	Replace the fuel pump.
	c. Clogged fuel filter	Replace the fuel filter. Clean or replace the fuel tank if necessary.
	d. Clogged or bent fuel line pipe, hose or tube	Clean, correct or replace the fuel line pipe, hose or tube.
	e. Air is mixed in fuel system.	Check the fuel line connections, correct or replace the defective part.
	f. Damaged diaphragm of pressure regulator	Replace the pressure regulator.
Leakage or blow out of fuel	a. Loose connections of fuel line pipe, hose or tube	Check the fuel line connections, correct or replace the defective part.
	b. Cracked fuel line pipe, hose or tube	Replace the fuel line pipe, hose or tube.
	c. Cracked fuel tank or defective welding part	Replace the fuel tank.
	d. Clogged or bent fuel line pipe, hose or tube	Clean, correct or replace the fuel line pipe, hose or tube.
Gasoline smell inside of compartment	a. Loose connections of fuel line pipe, hose or tube	Check the fuel line connections, correct or replace the defective part.
	b. Defective canister	Replace the canister.
Defective fuel gauge	a. Defective operation of fuel level sensor	Replace the fuel level sensor.
	b. Defective operation of combination meter	Replace the combination meter.
Noise	a. Large operation noise or vibration of fuel pump	Replace the fuel pump.

Note:

- **When the vehicle is left unattended for an extended period of time, water may accumulate in the fuel tank. Fill fuel fully to prevent the problem.**
- **In snow-covered areas, mountainous areas, skiing areas, etc. where ambient temperatures drop to 0°C (32°F) or less throughout the winter season, use a water removing agent in the fuel system to prevent freezing fuel system and accumulating water.**
- **When water is accumulated in fuel filter, fill the water removing agent in the fuel tank.**
- **Before using water removing agent, follow the cautions noted on the bottle.**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)

EC(STI)

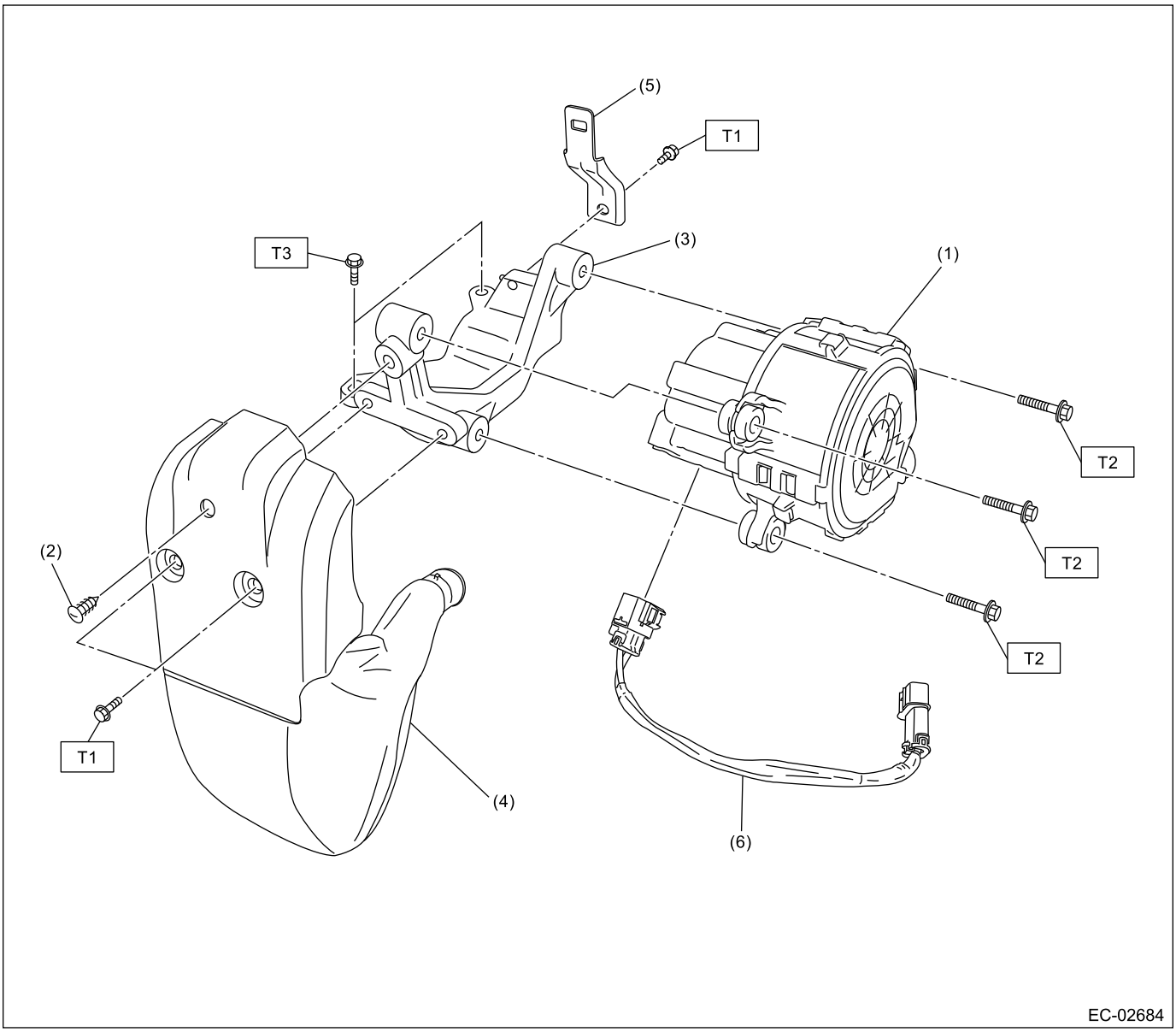
1. General Description
2. Front Catalytic Converter
3. Rear Catalytic Converter
4. Canister
5. Purge Control Solenoid Valve
6. Fuel Level Sensor
7. Fuel Sub Level Sensor
8. Drain Filter
9. Leak Check Valve Assembly
10. PCV Hose Assembly
11. PCV Valve
12. Secondary Air Pump
13. Secondary Air Pump Relay
14. Secondary Air Combination Valve

COMPONENT

1. CANISTER, PURGE CONTROL SOLENOID VALVE, DRAIN FILTER AND LEAK CHECK VALVE ASSEMBLY

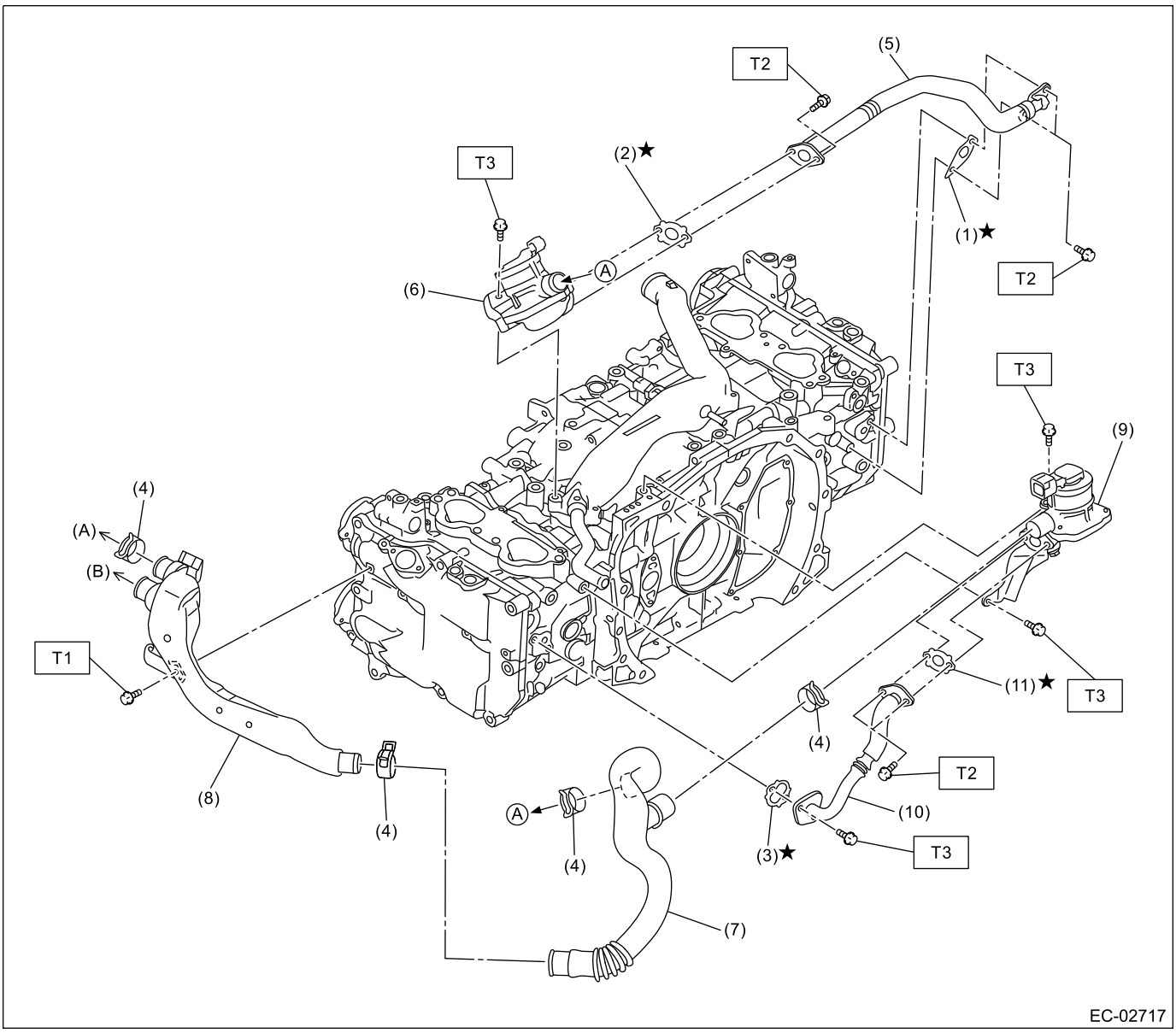
For components of canister, purge control solenoid valve, drain filter and leak check valve assembly, refer to FU (STI). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>General Description>COMPONENT.

2. SECONDARY AIR PUMP



(1)	Secondary air pump	(4)	Resonator	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Clip	(5)	Harness stay	***T1: 6.4 (0.7, 4.7)***
(3)	Secondary air pump bracket	(6)	Secondary air pump harness	***T2: 9 (0.9, 6.6)***
				T3: 19 (1.9, 14.0)

3. SECONDARY AIR COMBINATION VALVE



(A) To secondary air pump	(B) To resonator	
(1) Gasket	(7) Air duct A	***Tightening torque: N·m (kgf-m, ft-lb)***
(2) Gasket	(8) Air duct B	***T1: 6.4 (0.7, 4.7)***
(3) Gasket	(9) Secondary air combination valve LH	***T2: 9 (0.9, 6.6)***
(4) Clip	(10) Secondary air pipe LH	***T3: 19 (1.9, 14.0)***
(5) Secondary air pipe RH	(11) Gasket	
(6) Secondary air combination valve RH		

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

PREPARATION TOOL

1. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Clamp pincer	• Used for installing the PCV hose assembly. • This tool is made by OETIKER. Product No. 14100134

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Front Catalytic Converter

REMOVAL

The front catalytic converter is integrated into the center exhaust pipe (front). Refer to “Center Exhaust Pipe” for removal procedures. Ref. to EXHAUST(STI)>Center Exhaust Pipe>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Front Catalytic Converter

INSTALLATION

The front catalytic converter is integrated into the center exhaust pipe (front). Refer to “Center Exhaust Pipe” for installation procedures. Ref. to EXHAUST(STI)>Center Exhaust Pipe>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Front Catalytic Converter

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Rear Catalytic Converter

REMOVAL

The rear catalytic converter is integrated into the center exhaust pipe (rear). Refer to “Center Exhaust Pipe” for removal procedures. Ref. to EXHAUST(STI)>Center Exhaust Pipe>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Rear Catalytic Converter

INSTALLATION

The rear catalytic converter is integrated into the center exhaust pipe (rear). Refer to “Center Exhaust Pipe” for installation procedures. Ref. to EXHAUST(STI)>Center Exhaust Pipe>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Rear Catalytic Converter

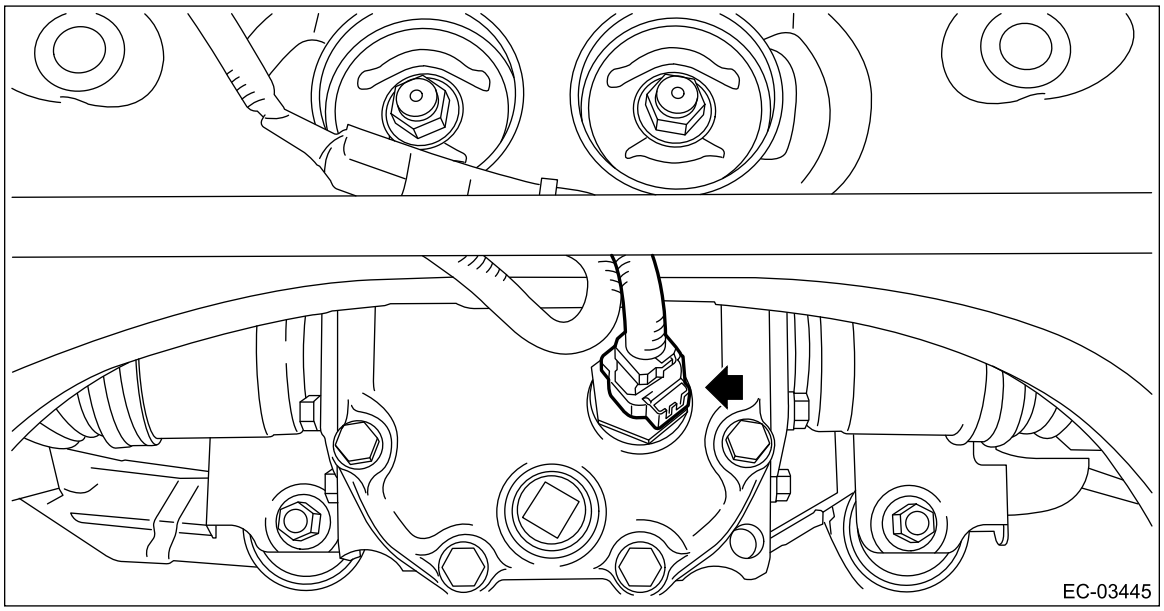
INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

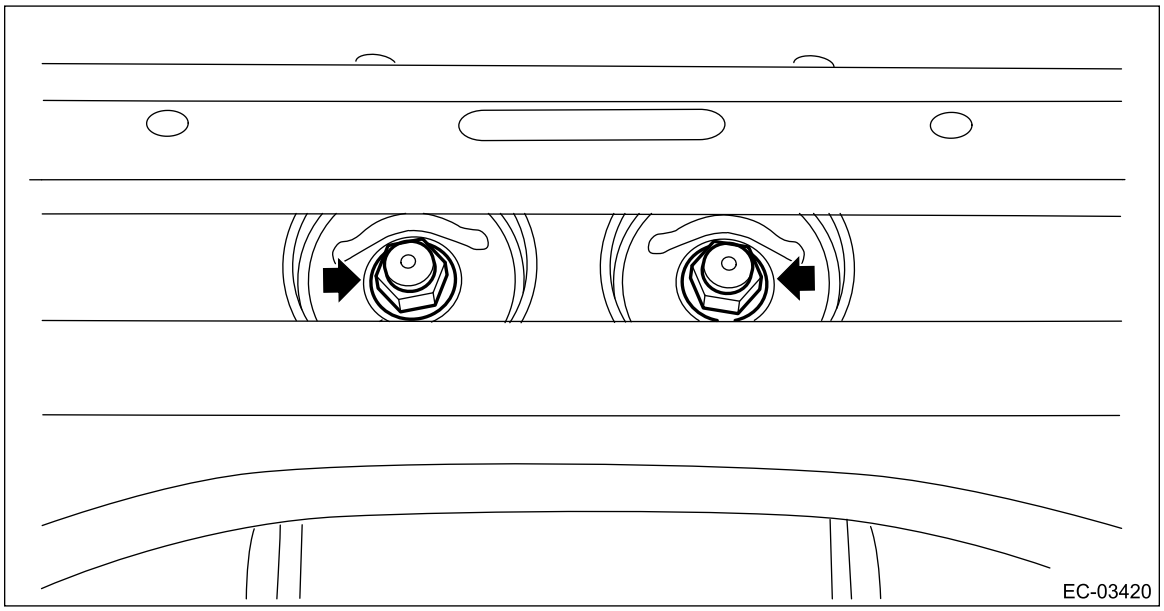
REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

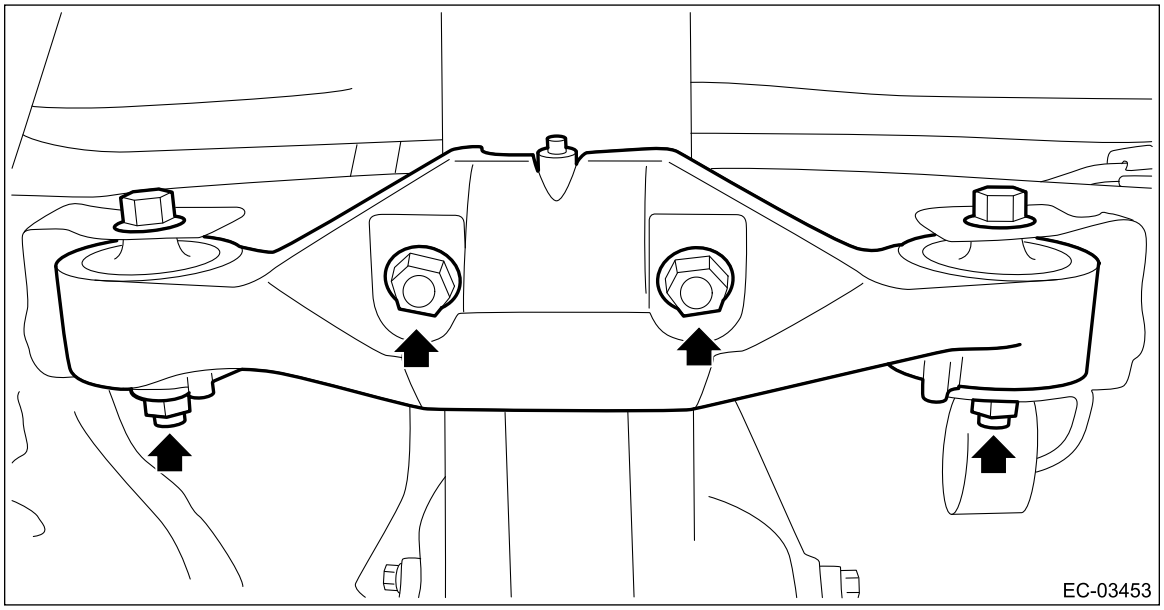
1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground cable from battery.
4. Lift up the vehicle.
5. Remove the rear exhaust pipe. Ref. to EXHAUST(STI)>Rear Exhaust Pipe>REMOVAL.
6. Remove the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>REMOVAL.
7. Support the rear differential with the transmission jack.
8. Disconnect the connector from oil temperature sensor.



9. Remove the self-locking nuts which hold the rear differential to the rear sub frame assembly.



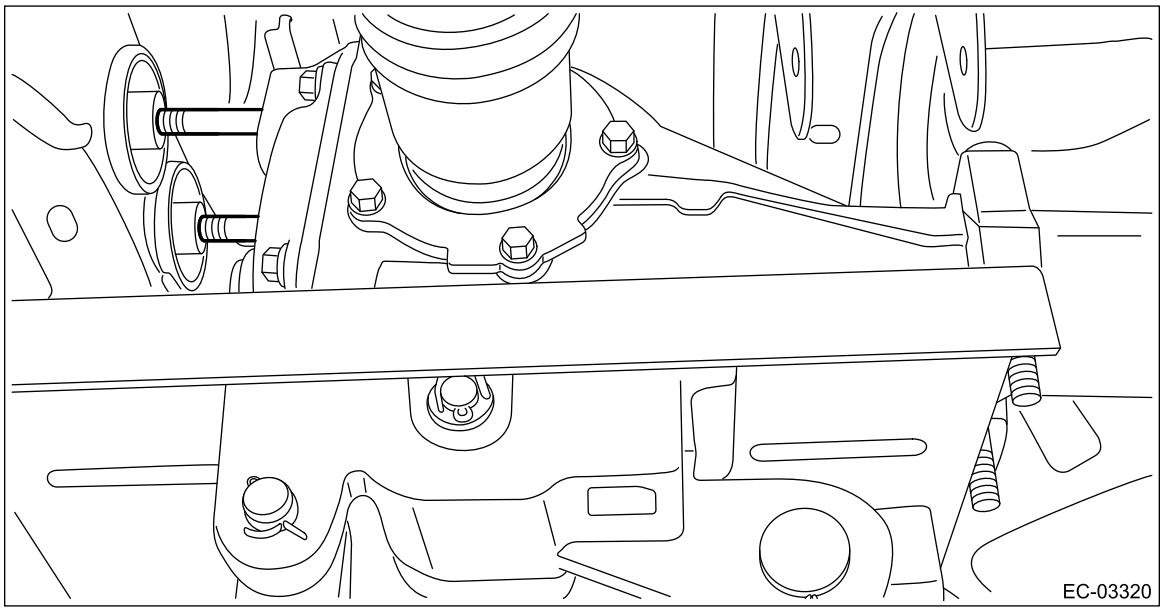
10. Remove the rear differential member from the rear sub frame assembly and the rear differential.



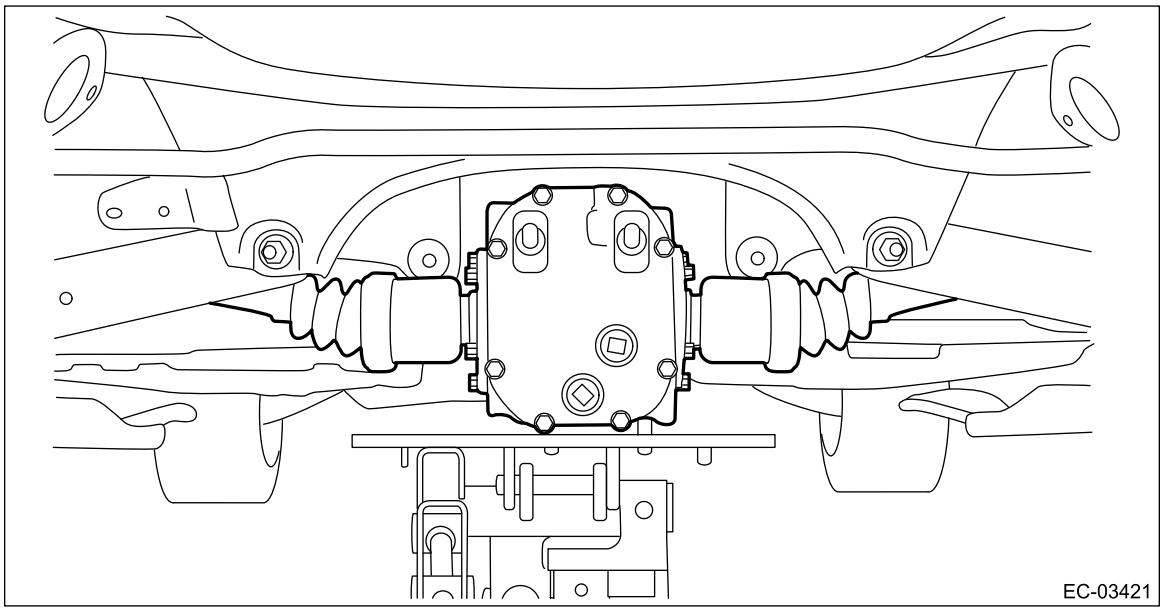
11. Lower the transmission jack gradually until the rear differential is at the position shown in the figure.

Note:

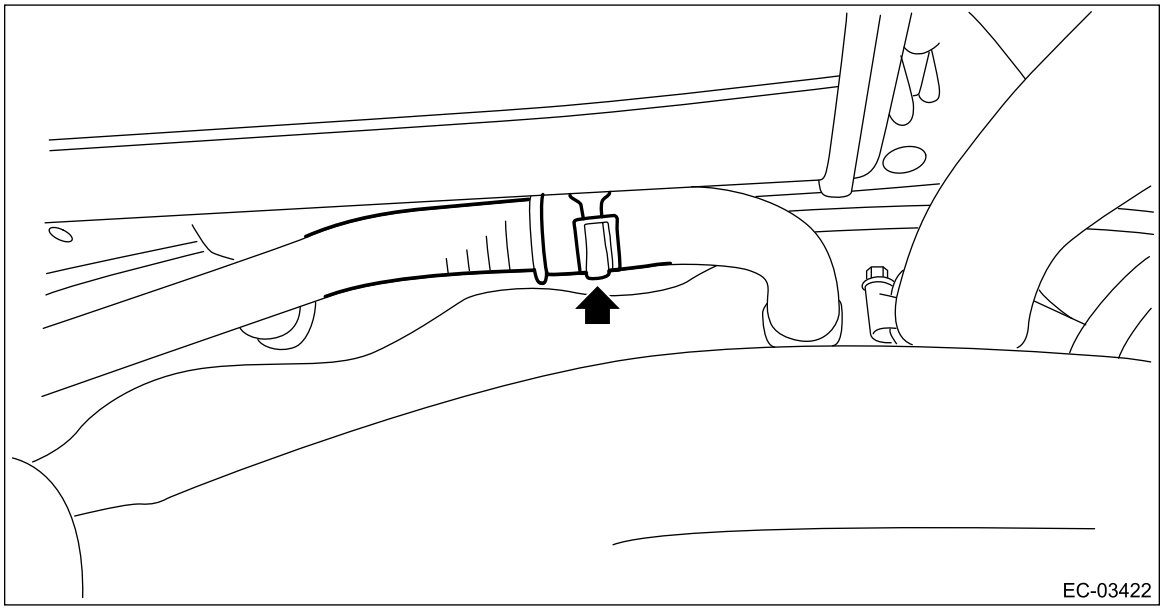
- **When pulling out the stud bolt from the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.**



- **Do not lower the rear differential excessively. Doing so may add extra load to the drive shaft or cause the falling-off of the drive shaft.**



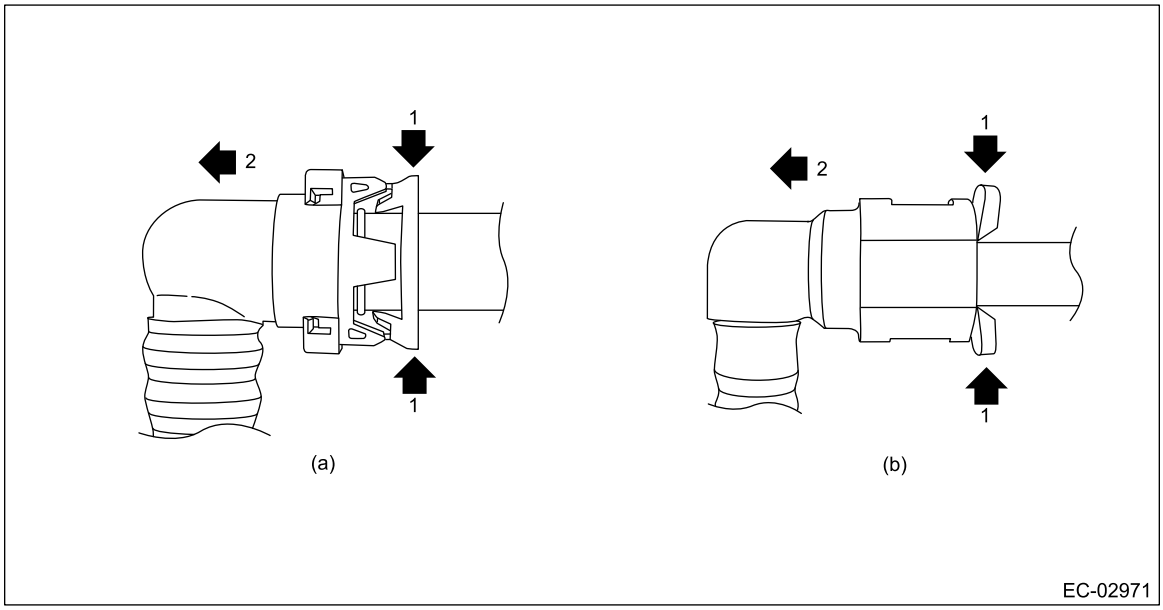
12. Disconnect the vent tube from vent hose.



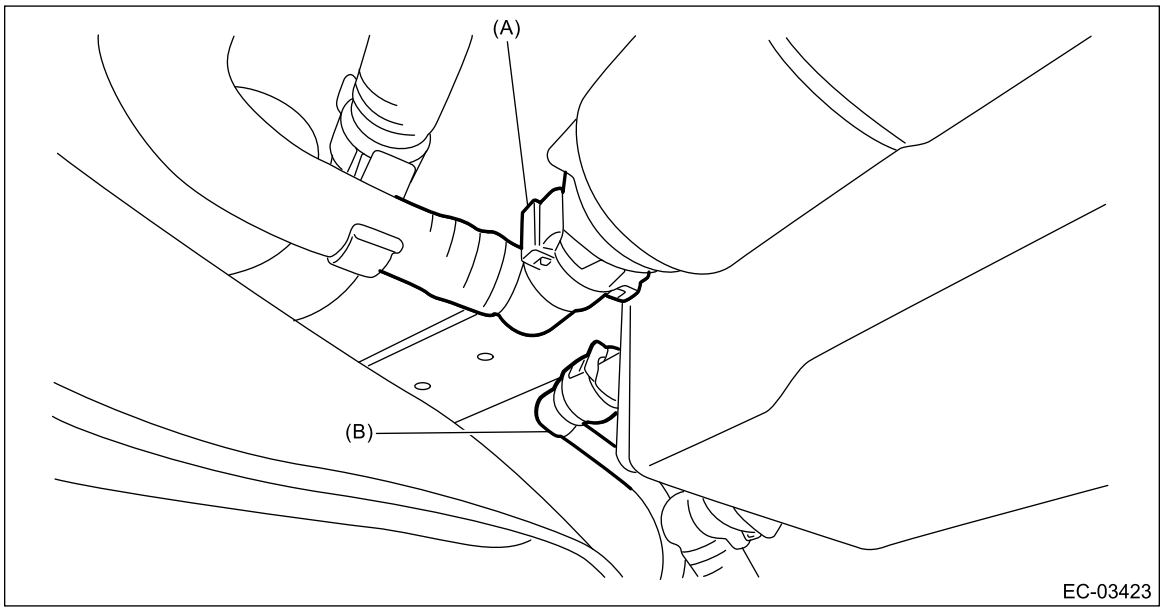
13. Disconnect the drain tube (A) and purge tube (B) from the canister.

Note:

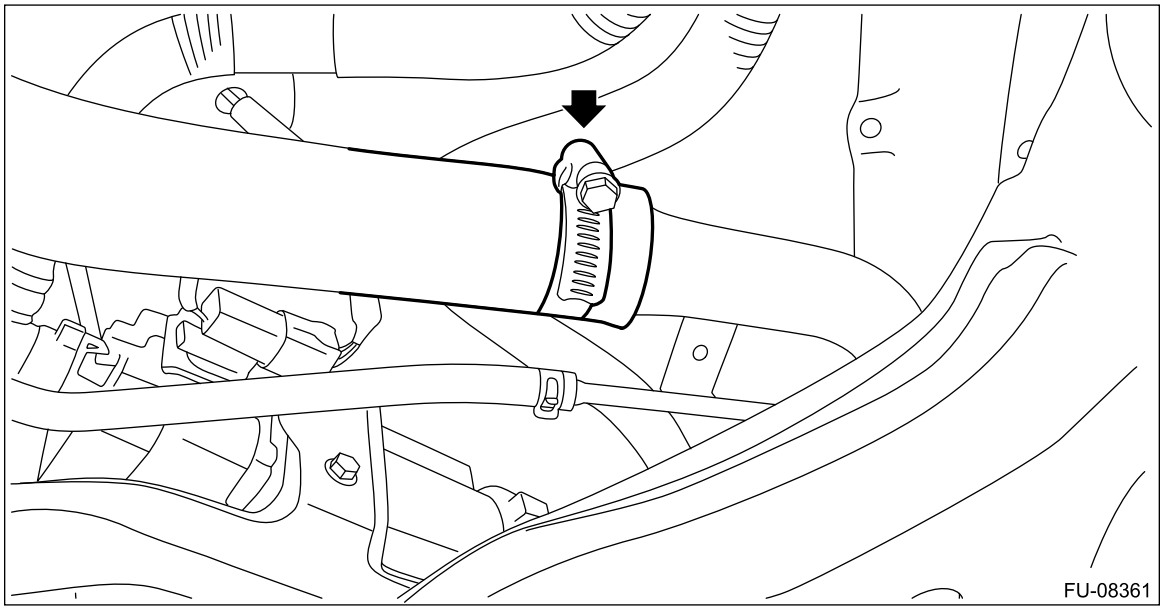
Disconnect the quick connector as shown in the figure.



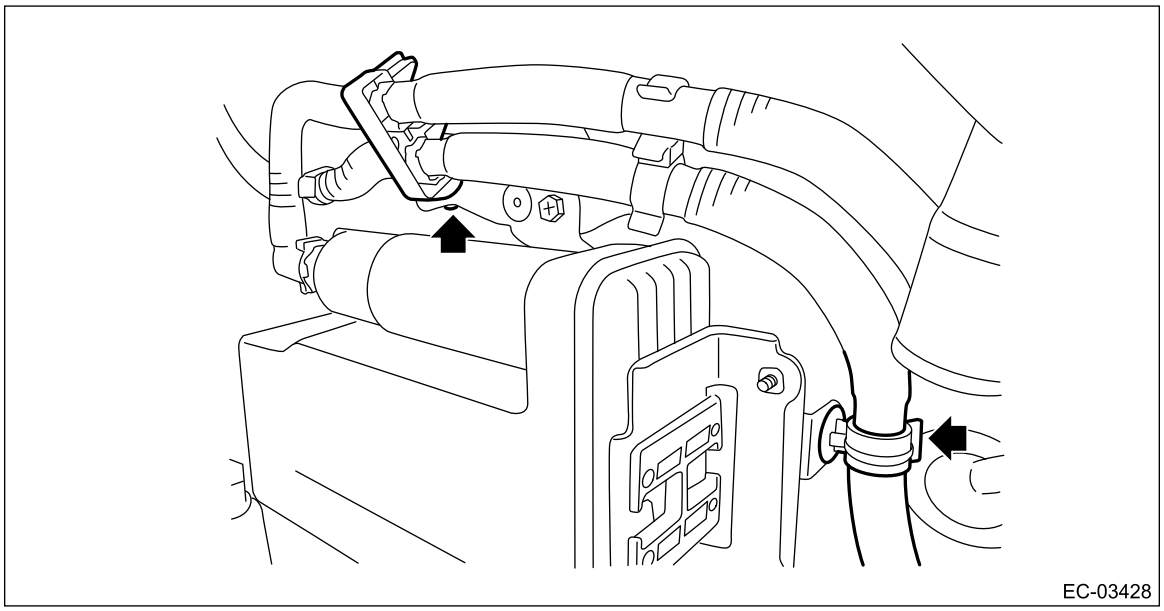
(a) Drain tube (b) Purge tube



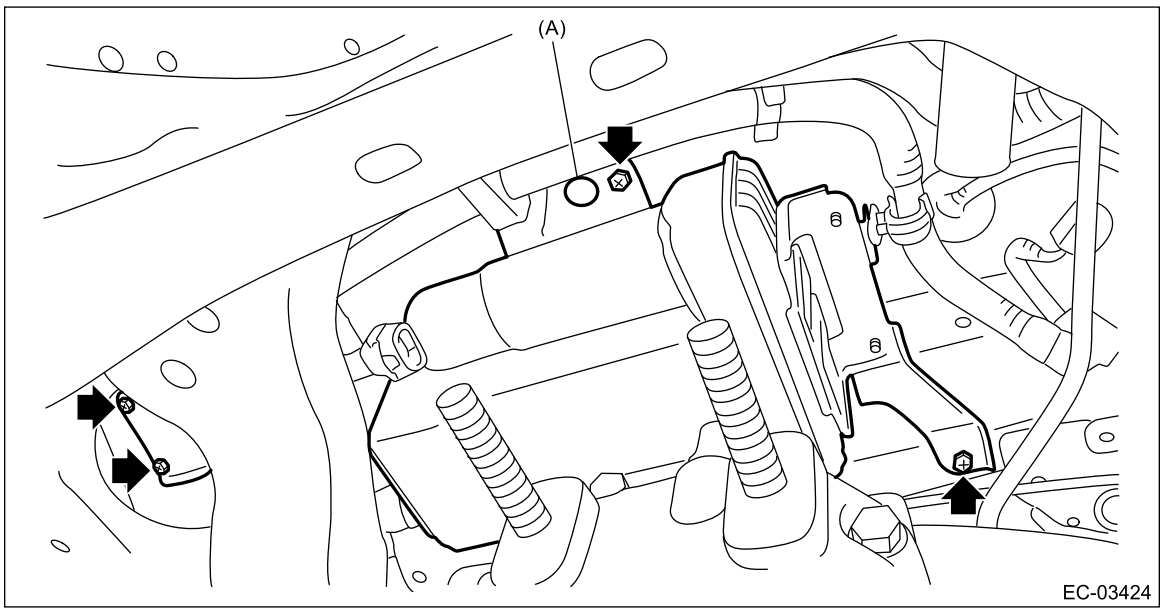
14. Disconnect the fuel filler hose from the fuel filler pipe assembly.



15. Remove the tube clamp from the canister bracket A, and remove the drain tube from the tube clamp.



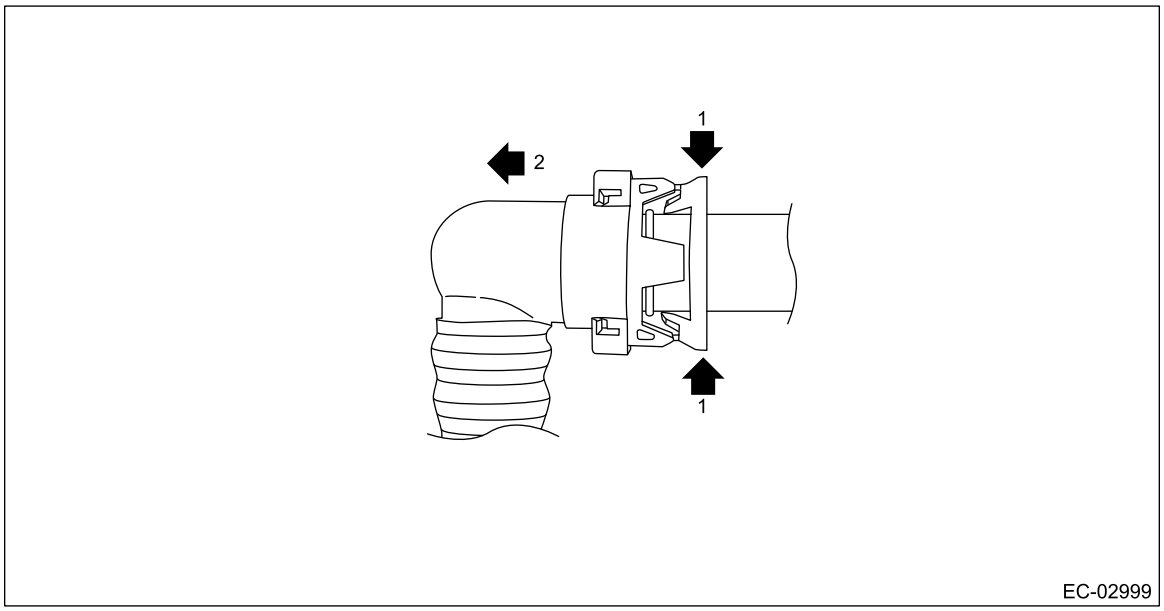
16. Remove the bolts and clip (A) securing the canister to the vehicle, and remove the canister.



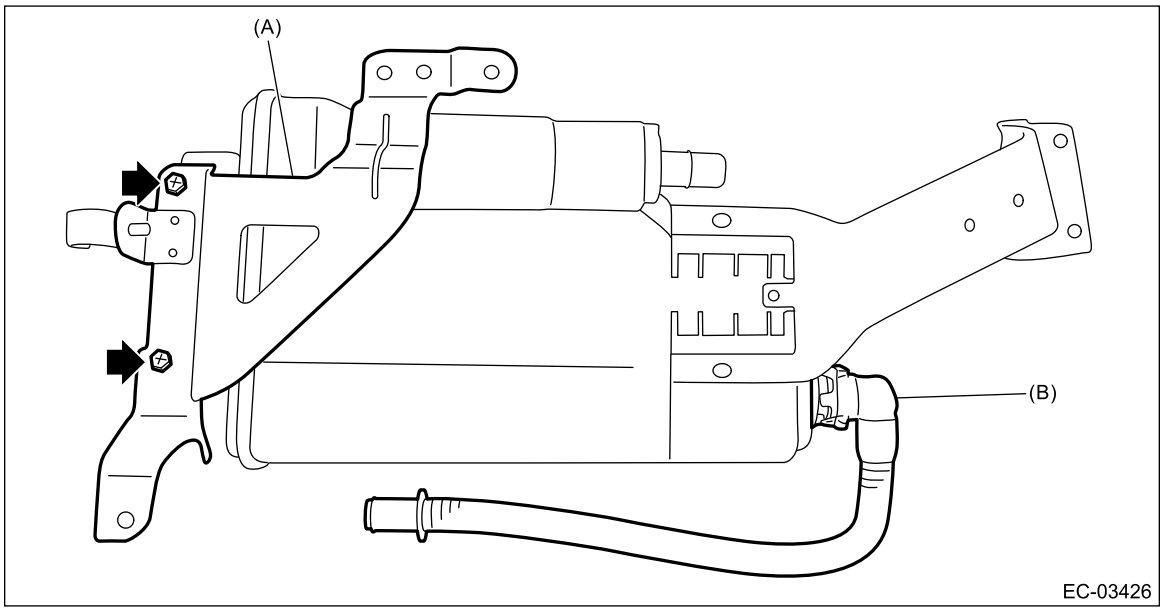
17. Disconnect the vent tube (B) from the canister and remove the canister bracket A (A).

Note:

- **Disconnect the quick connector as shown in the figure.**



- **The canister bracket cannot be separated from the canister. Therefore, be sure to replace both of them with new ones when replacing the canister or canister bracket.**



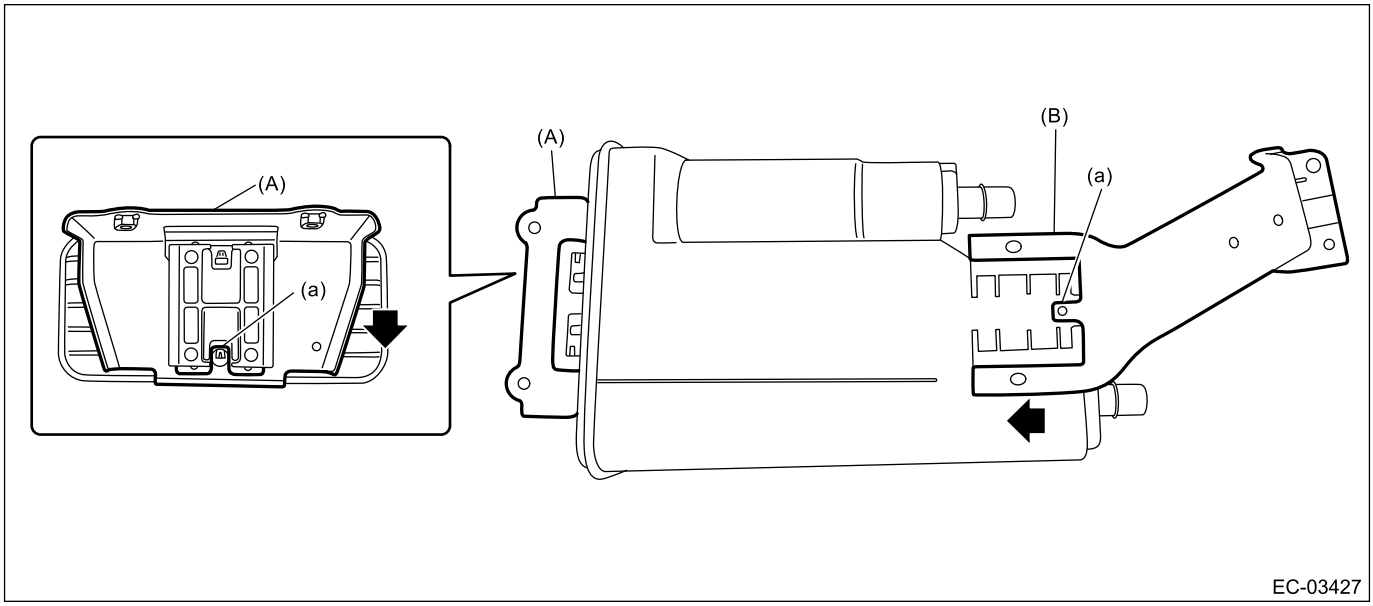
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Canister

INSTALLATION

1. Move it in the direction of the arrow and install the canister bracket B (A) and canister bracket C (B) to the canister.

Note:

- **Use a new canister and a canister bracket.**
- **Check that the claw (a) is securely tightened.**



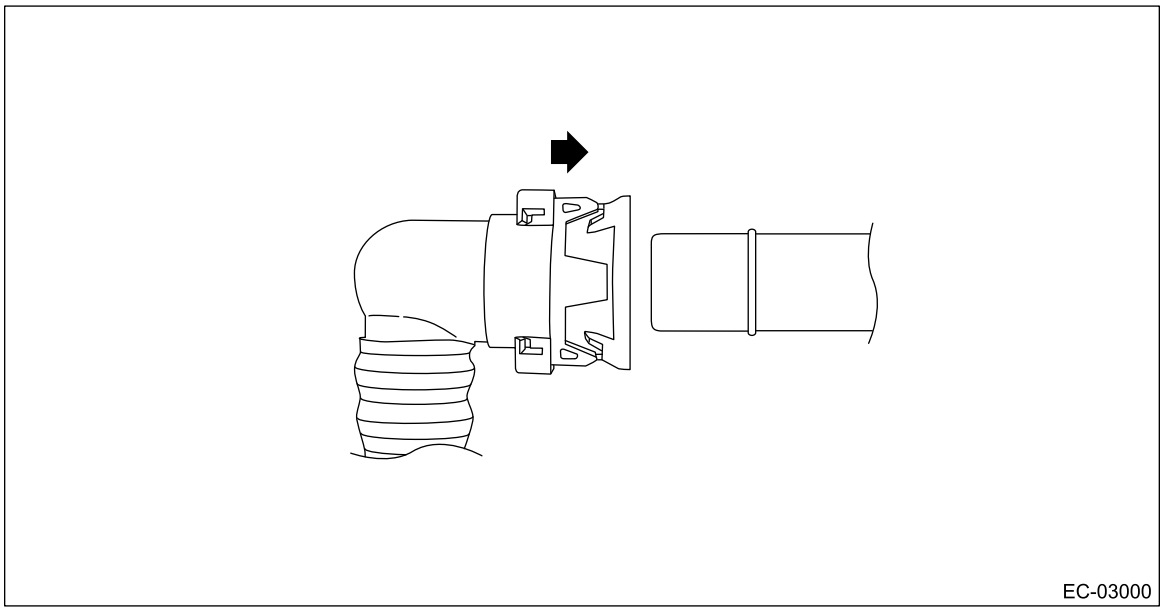
2. Connect the vent tube (B) to the canister and remove the canister bracket A (A).

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

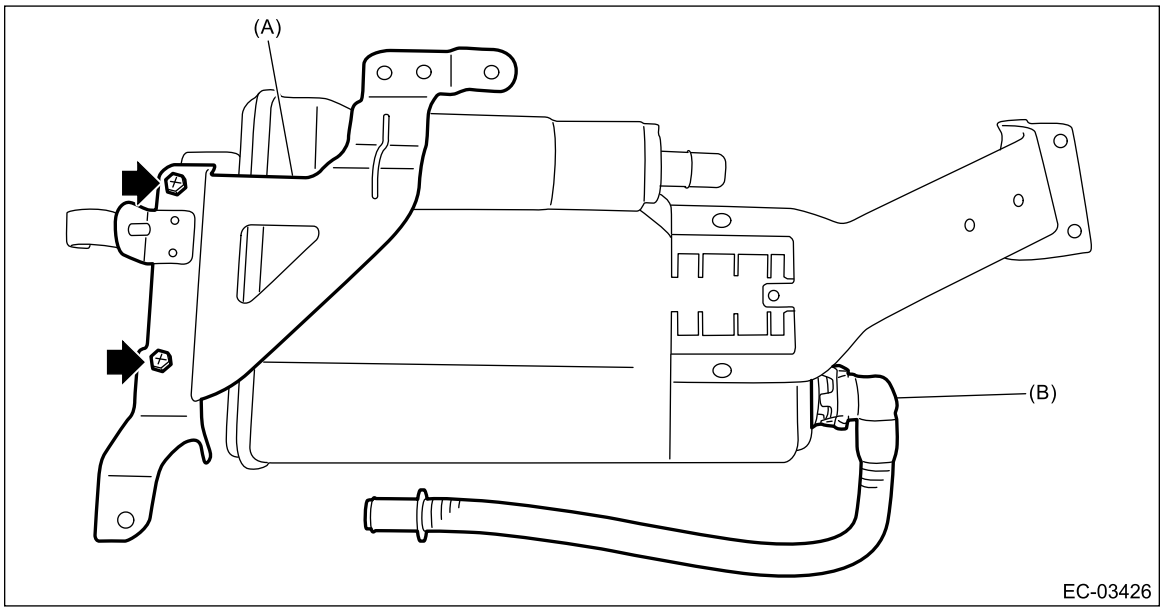
Note:

Install the quick connector as shown in the figure.



Tightening torque:

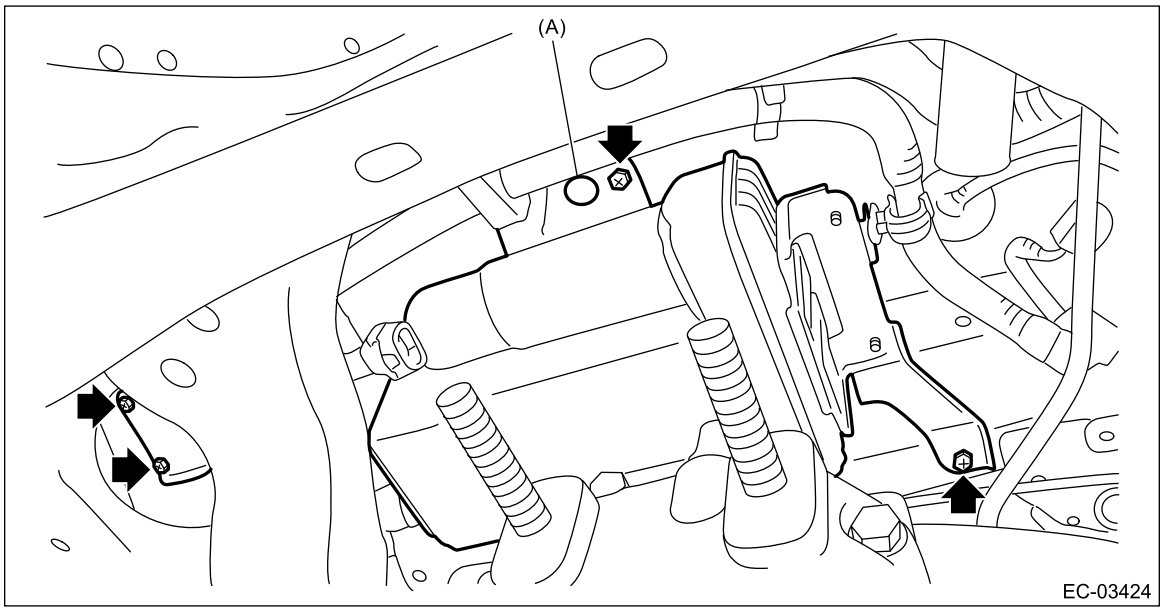
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



3. Set the canister to the vehicle, and attach the bolts and clip (A) which secure the canister.

Tightening torque:

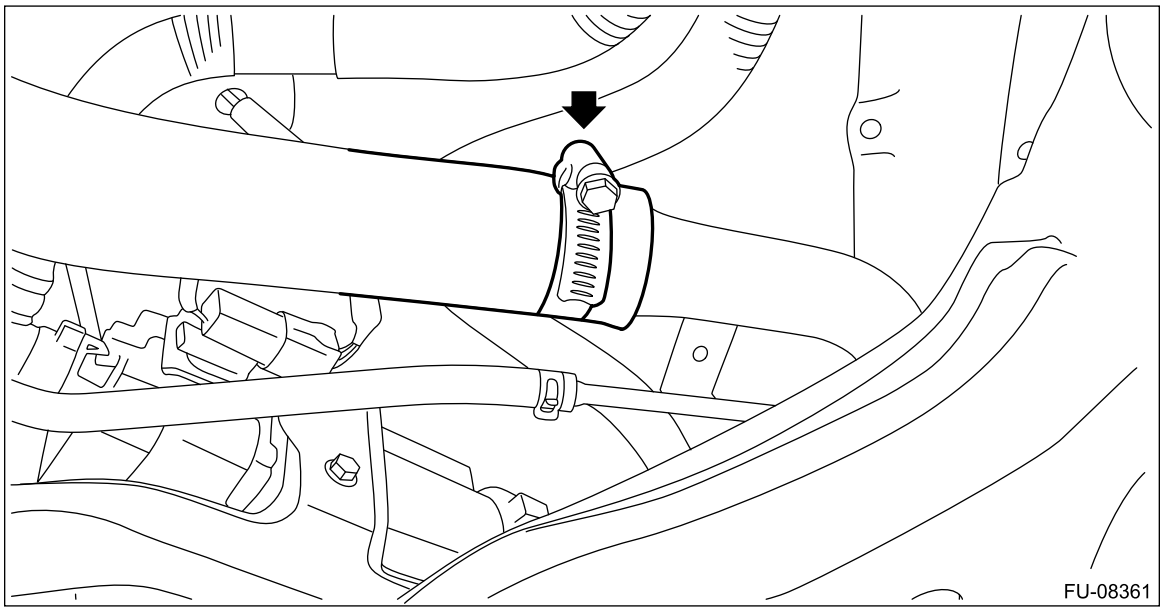
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

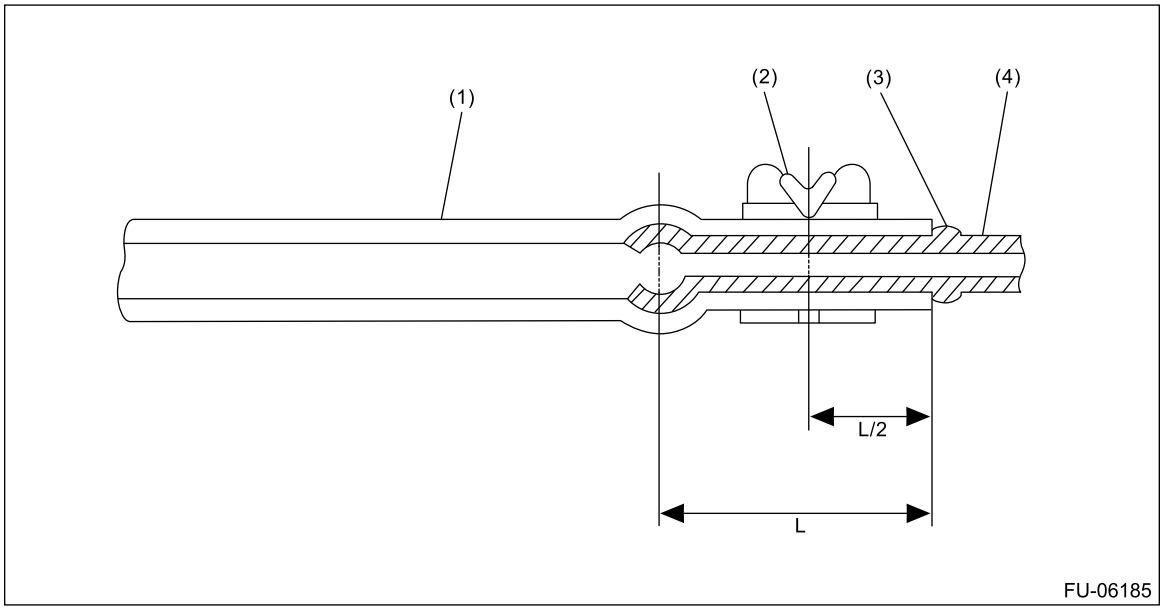


4. Correctly insert the fuel filler hose to the spool, and then install the clamp as shown.

Tightening torque:

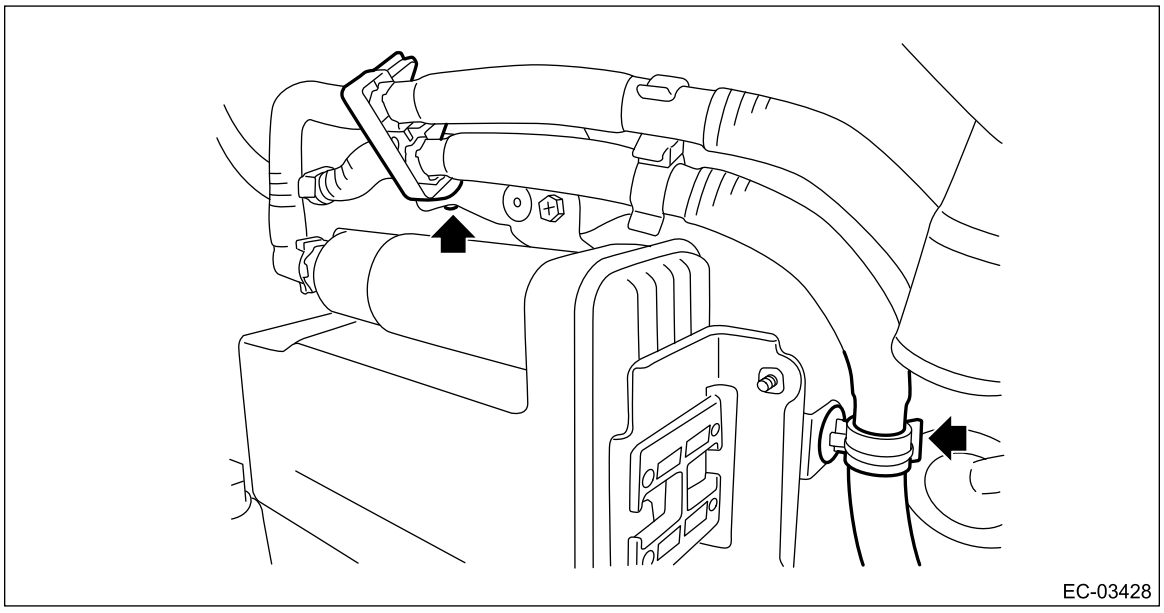
2.5 N·m (0.3 kgf-m, 1.8 ft-lb)





(1) Hose
(2) Clamp
(3) Spool
(4) Pipe

5. Install the tube clamp to the canister bracket A, and install the drain tube to the tube clamp.



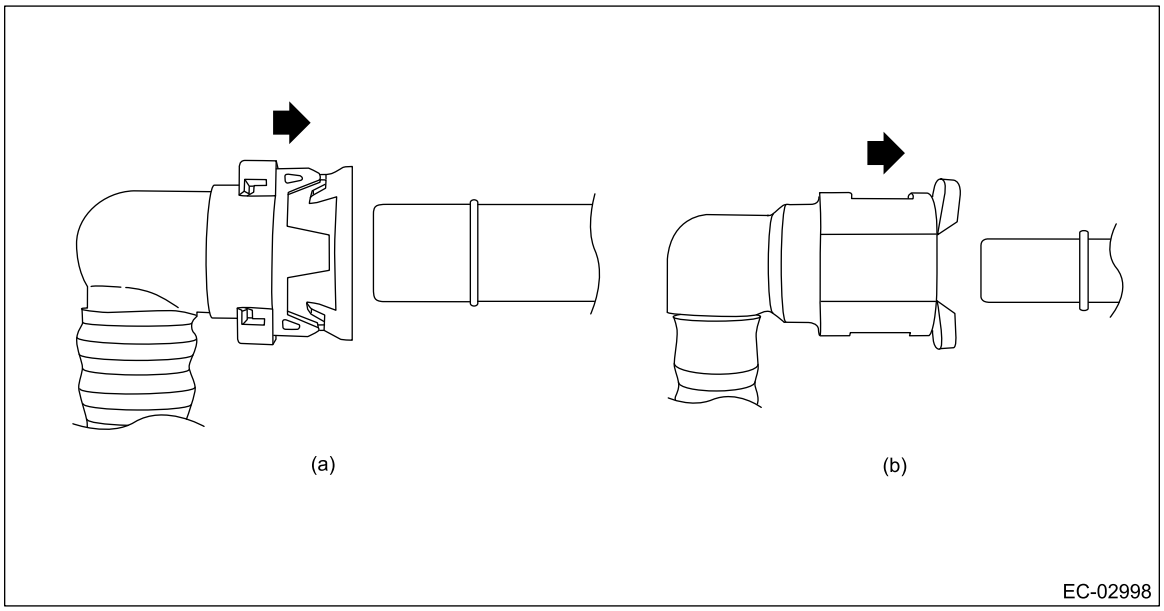
6. Connect the drain tube (A) and purge tube (B) to the canister.

Caution:

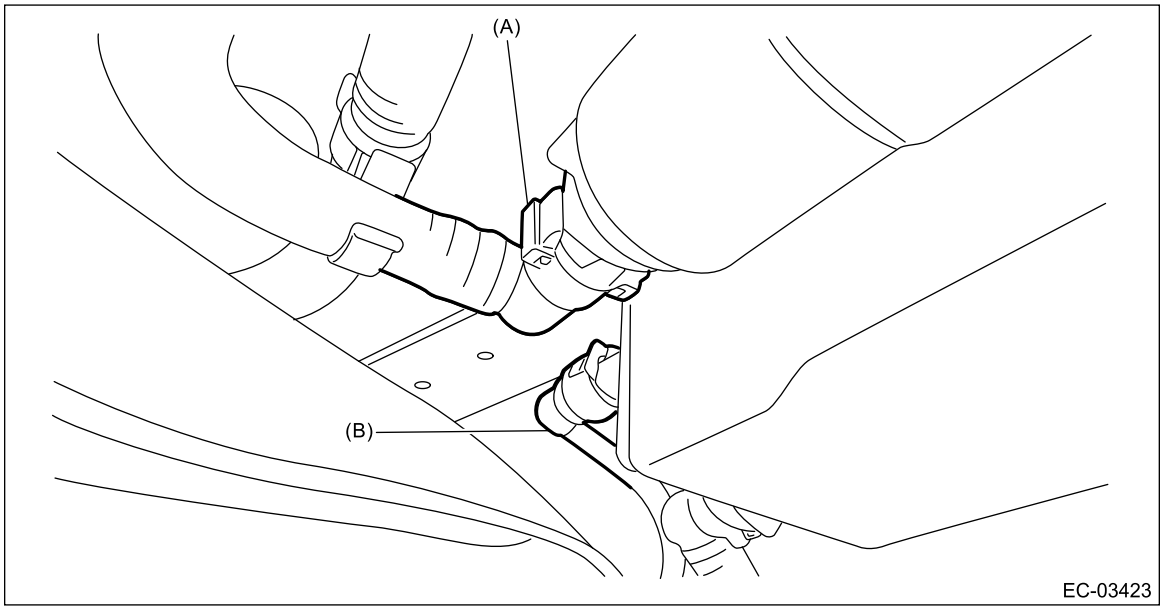
- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

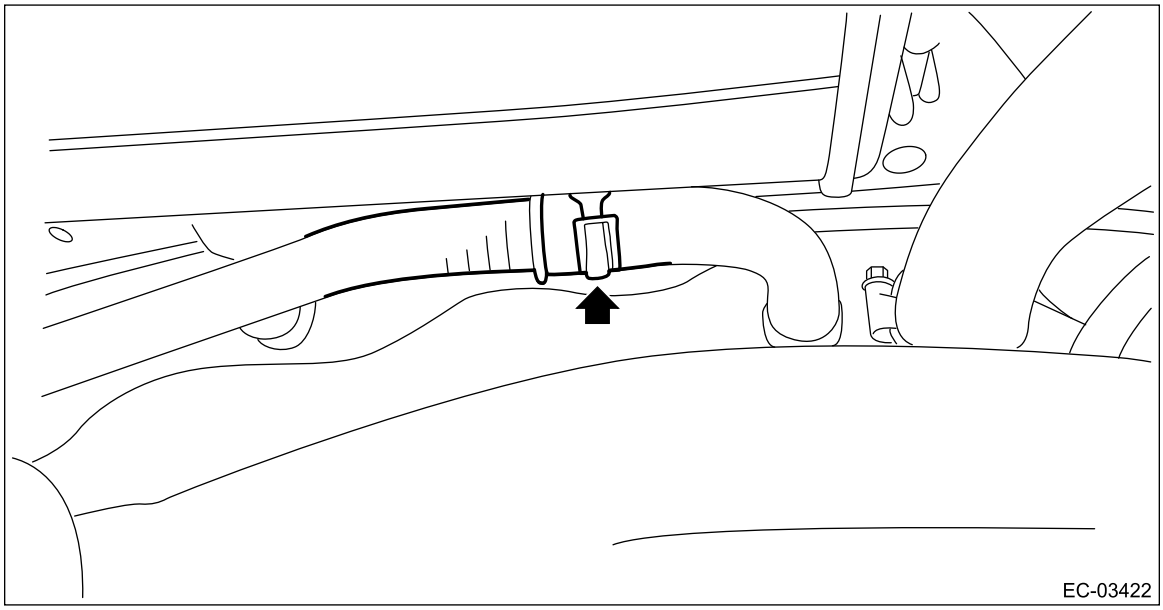
Install the quick connector as shown in the figure.



(a) Drain tube (b) Purge tube



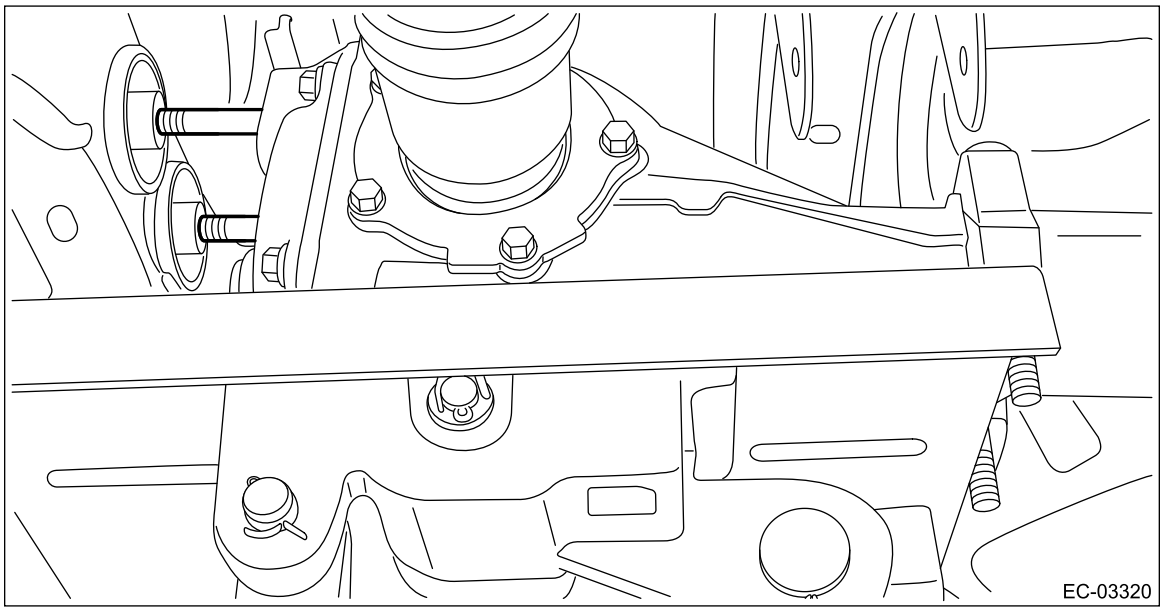
7. Connect the vent tube to the vent hose.



8. Lift up the transmission jack gradually, and set the rear differential to the rear sub frame assembly.

Note:

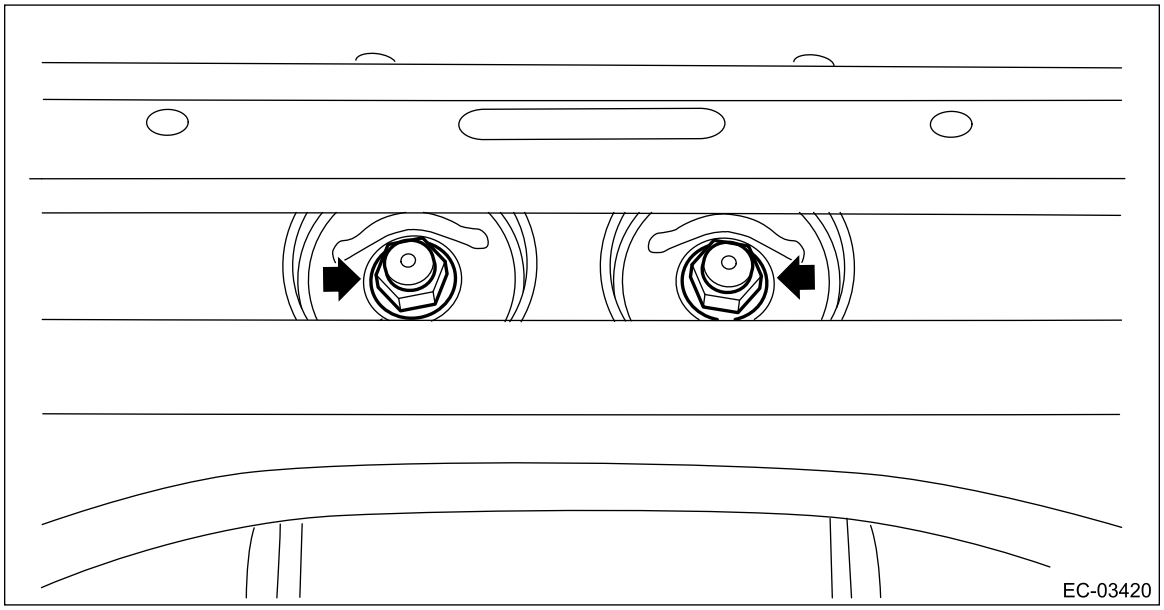
When inserting the stud bolt into the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.



9. Temporarily tighten the self-locking nuts which hold the rear differential to the rear sub frame assembly.

Note:

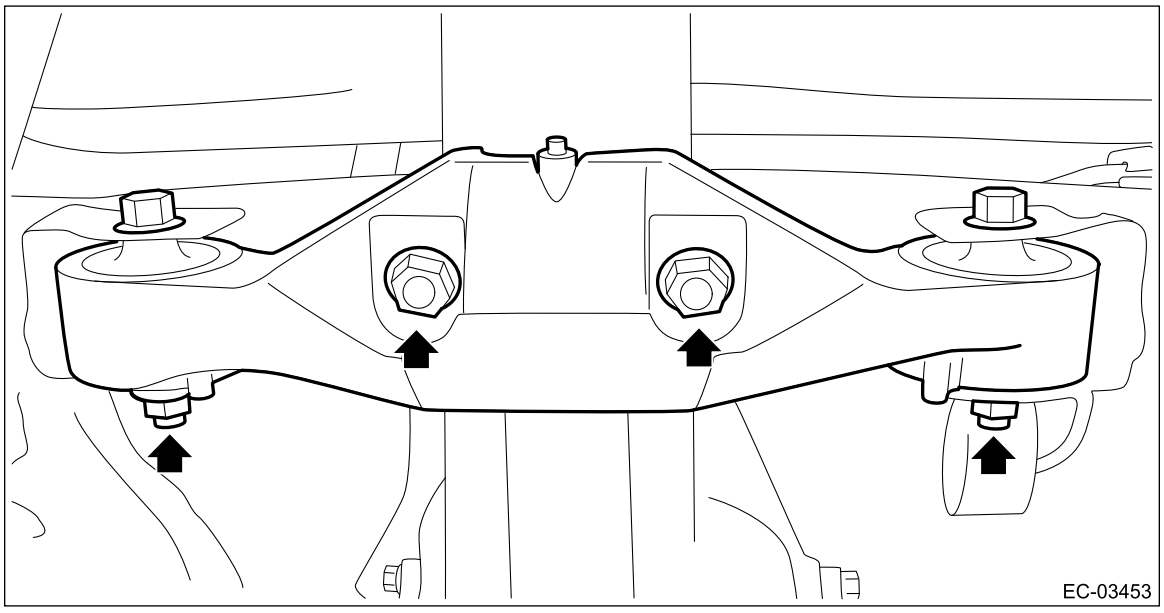
Use a new self-locking nut.



10. Set the rear differential member to the rear sub frame assembly and rear differential, and temporarily tighten the self-lock nuts which secure the rear differential member to the rear sub frame assembly and rear differential.

Note:

Use a new self-locking nut.



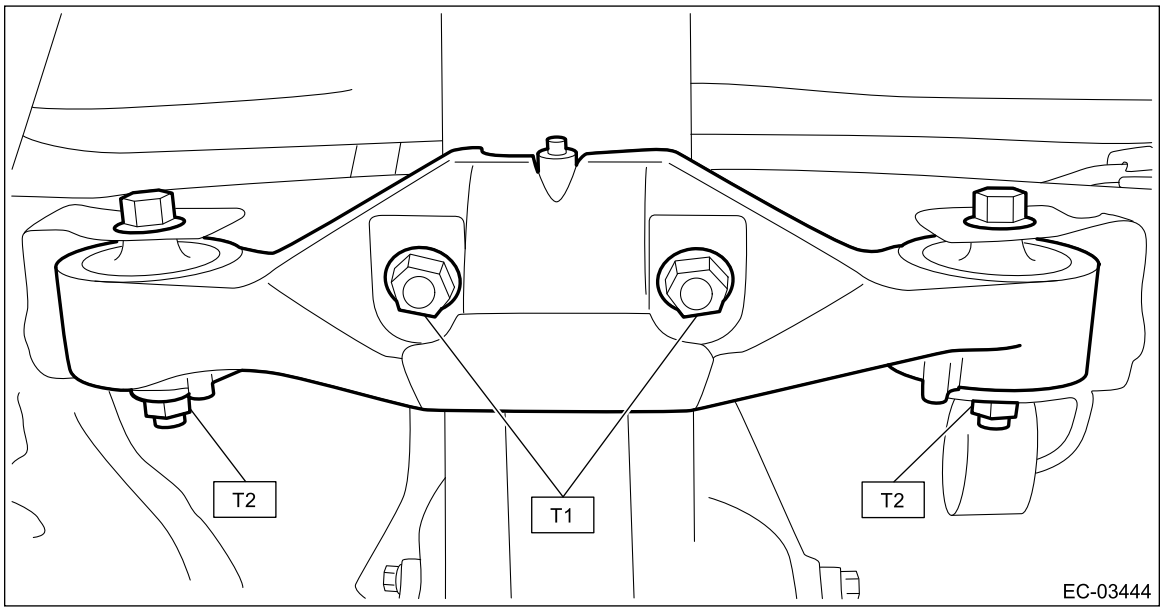
11. Remove the transmission jack from the rear differential.

12. Tighten the self-locking nuts which secure the rear differential member to the rear sub frame assembly and rear differential.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

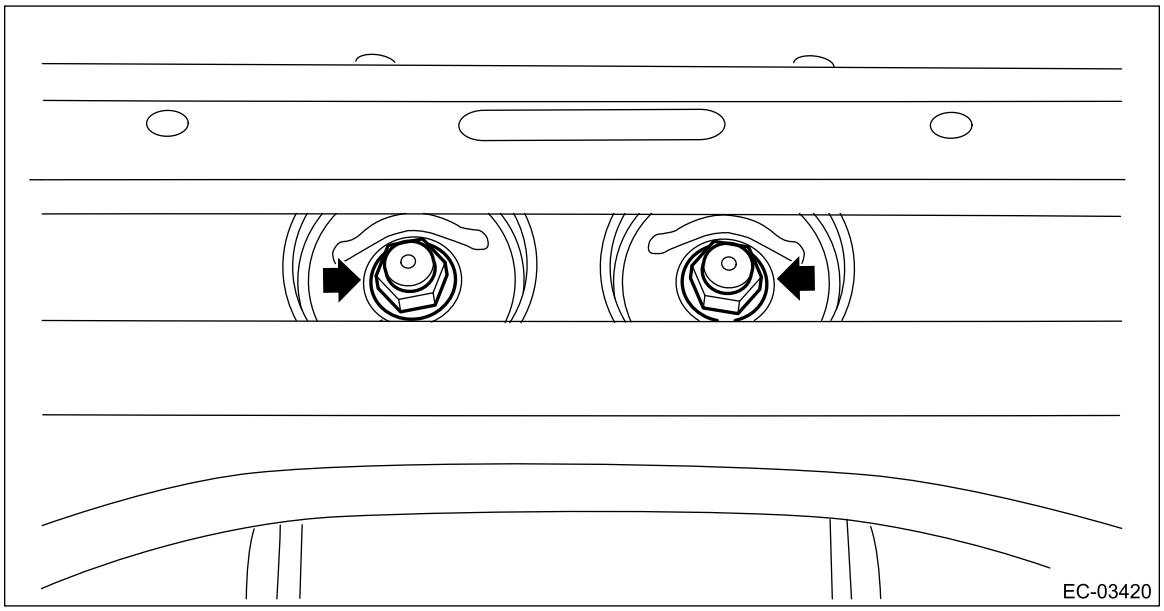
T2: 110 N·m (11.2 kgf-m, 81.1 ft-lb)



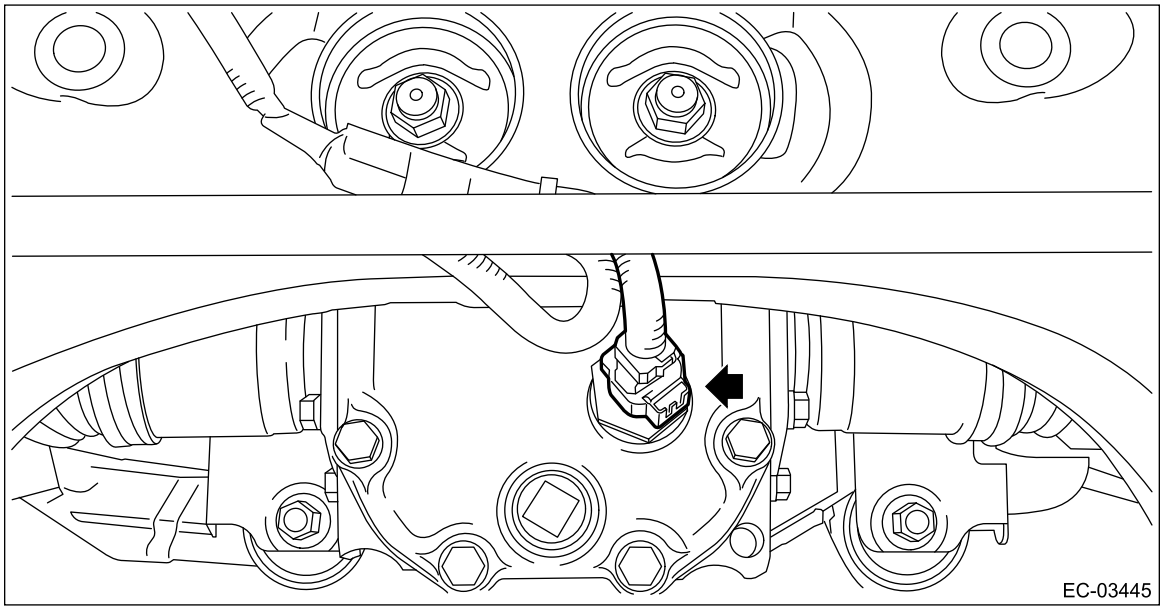
13. Tighten the self-locking nuts which secure the rear differential to the rear sub frame assembly.

Tightening torque:

70 N·m (7.1 kgf-m, 51.6 ft-lb)



14. Connect the connector to the oil temperature sensor.



15. Install the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>INSTALLATION.
16. Install the rear exhaust pipe. Ref. to EXHAUST(STI)>Rear Exhaust Pipe>INSTALLATION.
17. Lower the vehicle.
18. Connect the ground terminal to the battery.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Canister

INSPECTION

1. Check that the canister has no deformation, cracks or other damages.
2. Check that the tube has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Purge Control Solenoid Valve

REMOVAL

1. PURGE CONTROL SOLENOID VALVE 1

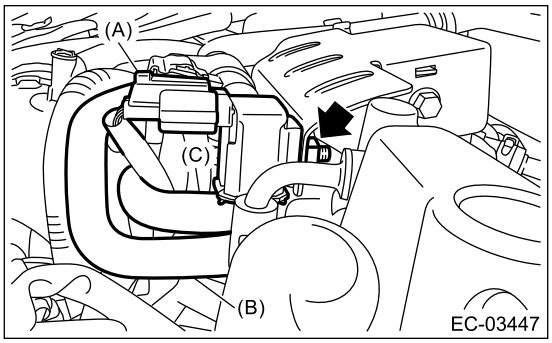
1. Disconnect the ground cable from battery.
2. Remove the bolts which secure purge control solenoid valve 1 to the intake manifold, and disconnect the connector from the purge control solenoid valve 1.



3. Disconnect the vacuum hose and the vacuum control hose from purge control solenoid valve 1.

2. PURGE CONTROL SOLENOID VALVE 2

1. Disconnect the ground cable from battery.
2. Disconnect connector (A), vacuum hose (B), and vacuum control hose (C) from purge control solenoid valve 2.
3. Remove purge control solenoid valve 2 from the solenoid valve bracket.



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Purge Control Solenoid Valve

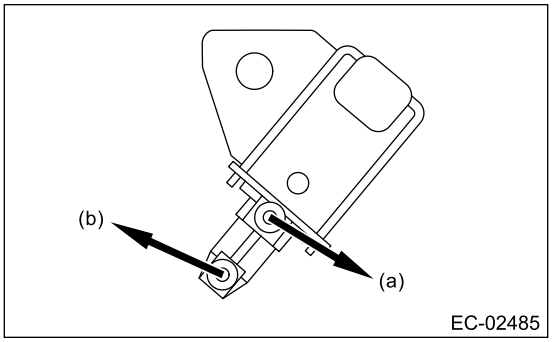
INSTALLATION

1. PURGE CONTROL SOLENOID VALVE 1

Install in the reverse order of removal.

Note:

Connect the vacuum hose and vacuum control hose as shown in the figure.



(a) To intake manifold

(b) To branching pipe → fuel pipe

Tightening torque:

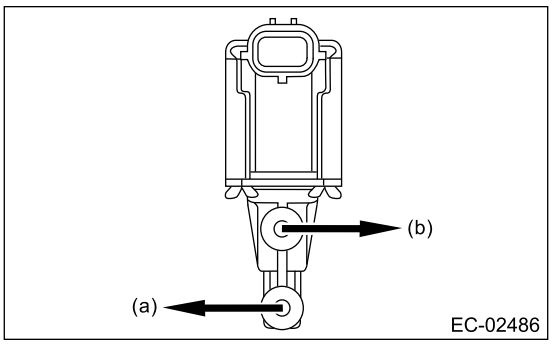
19 N·m (1.9 kgf-m, 14.0 ft-lb)

2. PURGE CONTROL SOLENOID VALVE 2

Install in the reverse order of removal.

Note:

Connect the vacuum hose and vacuum control hose as shown in the figure.



(a) To intake duct

(b) To branching pipe → fuel pipe

Tightening torque:

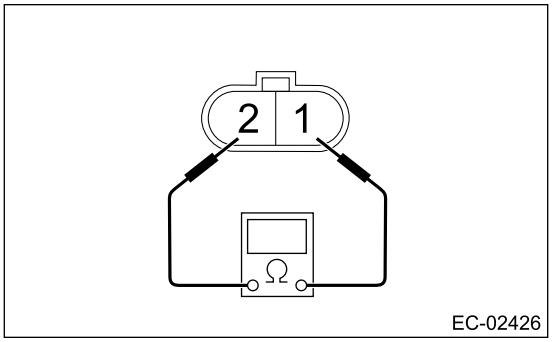
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Purge Control Solenoid Valve

INSPECTION

1. PURGE CONTROL SOLENOID VALVE

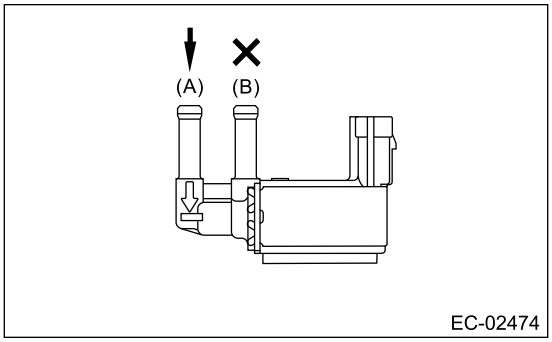
1. Check that the purge control solenoid valve has no deformation, cracks or other damages.
2. Measure the resistance between the purge control solenoid valve terminals.



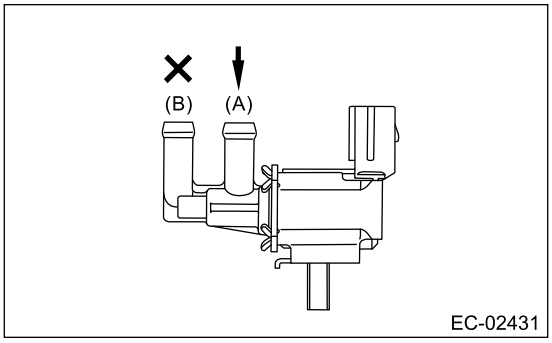
	Terminal No.	Standard
Purge control solenoid valve 1	1 and 2	32±2 Ω (when 20°C (68°F))
Purge control solenoid valve 2		24±3 Ω (when 20°C (68°F))

3. Check that air does not come out from (B) when air is blown into (A).

- Purge control solenoid valve 1

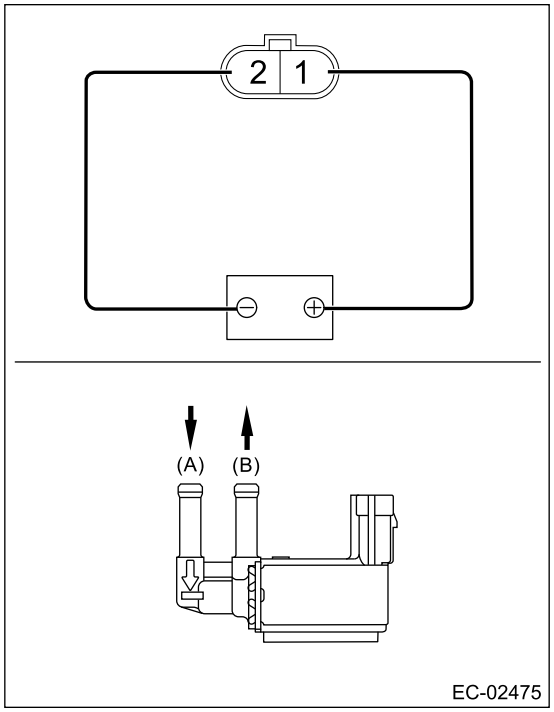


- Purge control solenoid valve 2

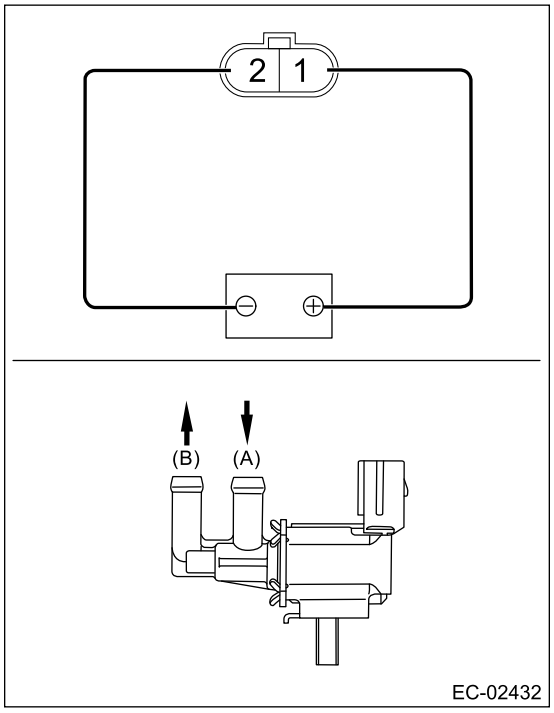


4. Connect the battery positive terminal to the terminal No. 1 and the battery negative terminal to the terminal No. 2. Check that air is discharged from (B), when supplying air to (A).

- Purge control solenoid valve 1



- Purge control solenoid valve 2



2. OTHER INSPECTIONS

Make sure the vacuum hoses and vacuum control hoses are not cracked or loose.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Fuel Level Sensor

REMOVAL

For removal procedures, refer to the "FU(STI)" section. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Level Sensor>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Fuel Level Sensor

INSTALLATION

For installation procedures, refer to the "FU(STI)" section. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Level Sensor>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Fuel Level Sensor

INSPECTION

For inspection procedures, refer to the "FU(STI)" section. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel Level Sensor>INSPECTION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Fuel Sub Level Sensor

REMOVAL

For removal procedures, refer to the "FU(STI)" section. Ref. to FUEL INJECTION (FUEL SYSTEMS) (STI)>Fuel Sub Level Sensor>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Fuel Sub Level Sensor

INSTALLATION

For installation procedures, refer to the "FU(STI)" section. Ref. to FUEL INJECTION (FUEL SYSTEMS) (STI)>Fuel Sub Level Sensor>INSTALLATION.

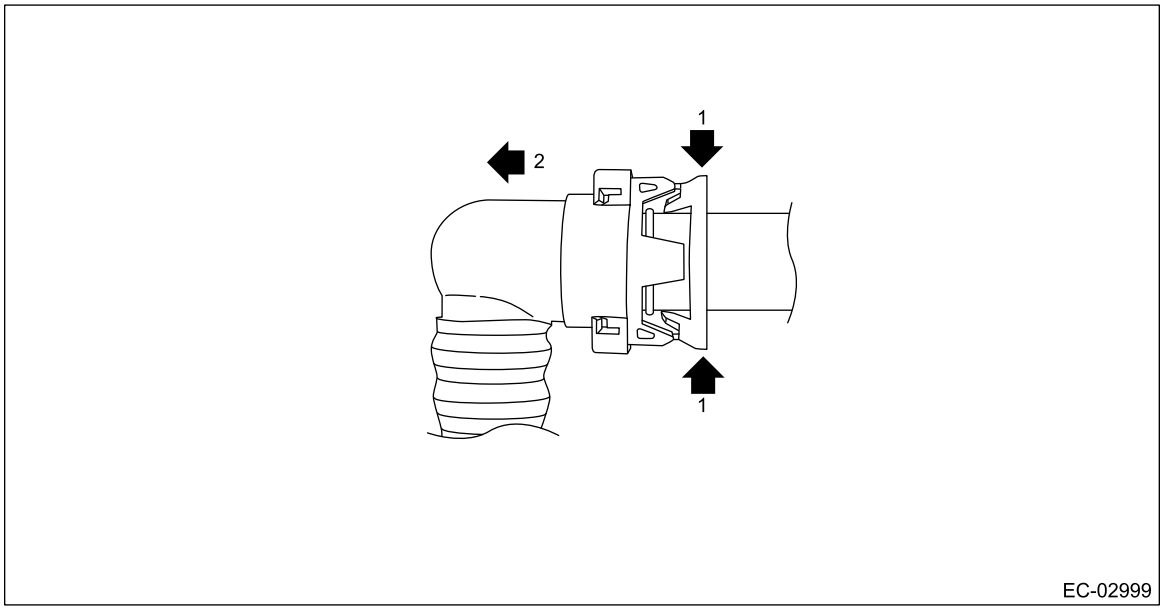
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Fuel Sub Level Sensor

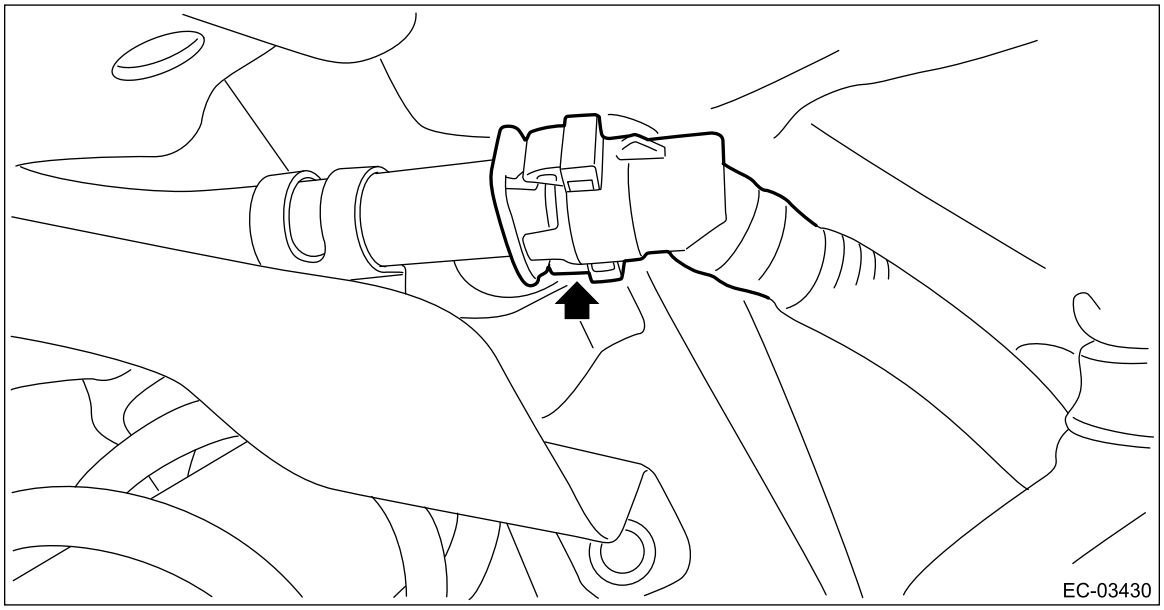
INSPECTION

For inspection procedures, refer to the "FU(STI)" section. Ref. to FUEL INJECTION (FUEL SYSTEMS) (STI)>Fuel Sub Level Sensor>INSPECTION.

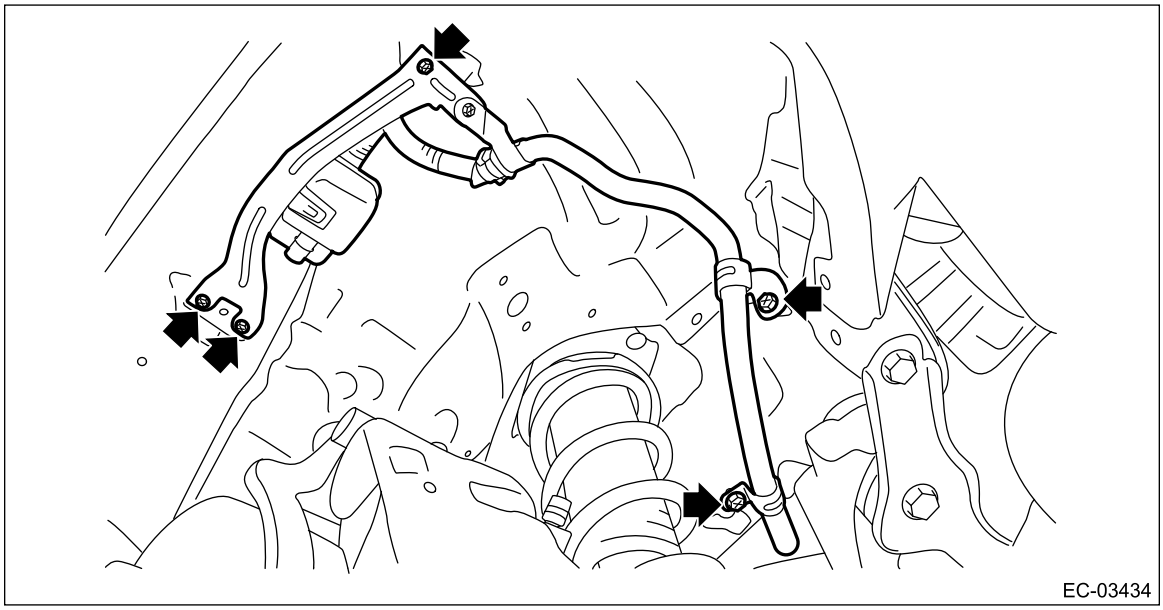
REMOVAL

1. Remove the rear wheel LH. Ref. to WHEEL AND TIRE SYSTEM>Tire and Wheel>REMOVAL.
2. Lift up the vehicle.
3. Remove the rear mud guard LH. Ref. to EXTERIOR/INTERIOR TRIM>Mud Guard>REMOVAL.
4. Disconnect the drain tube from the drain pipe.
   Note:
   Disconnect the quick connector as shown in the figure.





5. Remove the drain bracket and drain pipe from vehicle as a unit.

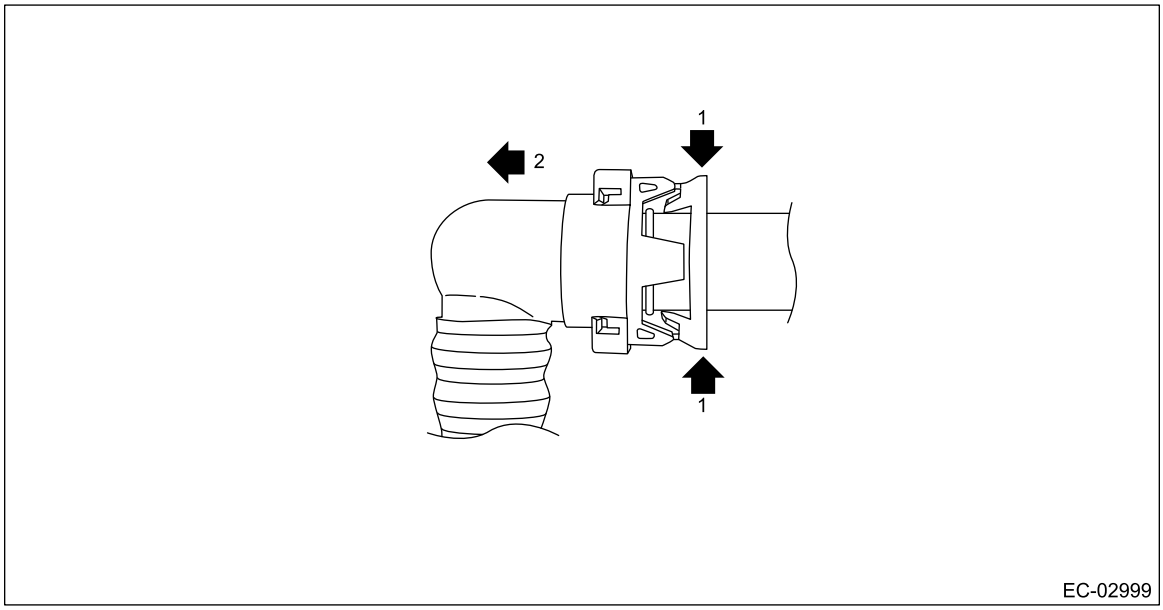


6. Remove the bolt (A) which holds drain pipe from the drain bracket.

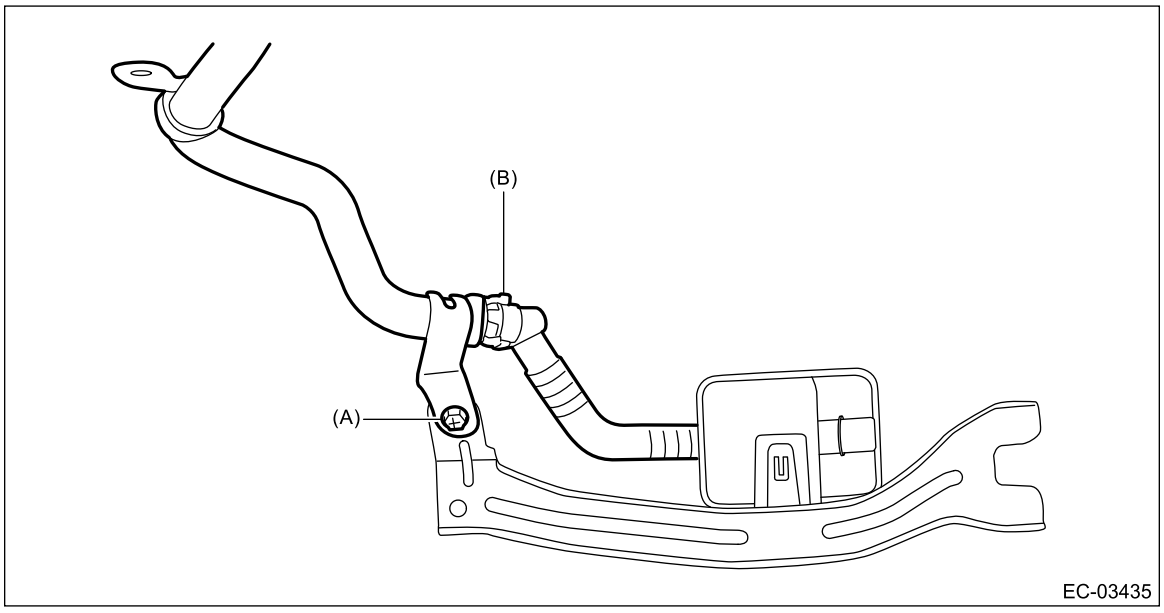
7. Disconnect the drain tube (B) from the drain pipe.

Note:

- **Disconnect the quick connector as shown in the figure.**



- **The drain filter cannot be separated from the drain bracket. Therefore, be sure to replace both of them with new ones when replacing the drain bracket or drain filter.**



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Drain Filter

INSTALLATION

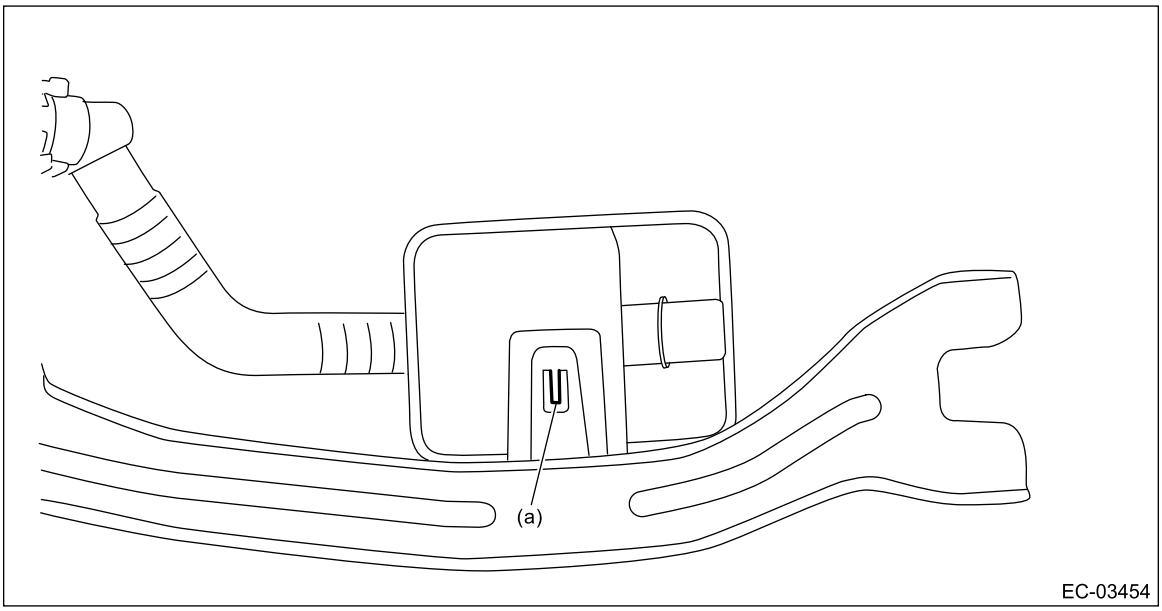
Install in the reverse order of removal.

Caution:

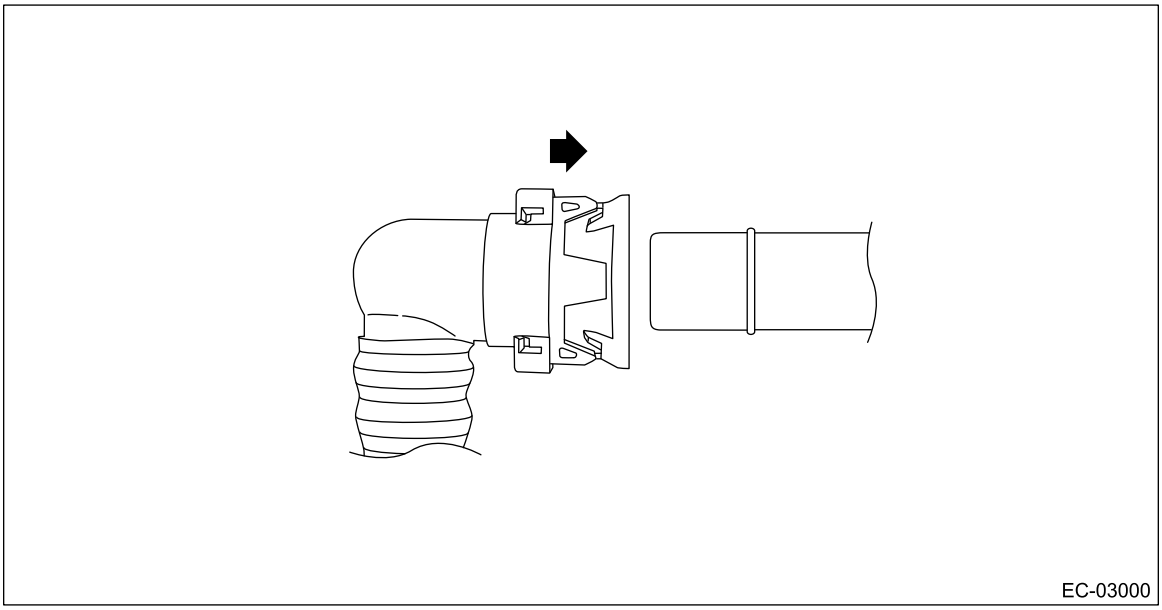
- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

- **Use a new drain bracket and a drain filter.**
- **Before installing the drain filter to the drain bracket, check that the claw (a) is securely tightened.**



- **Install the quick connector as shown in the figure.**



Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Drain Filter

INSPECTION

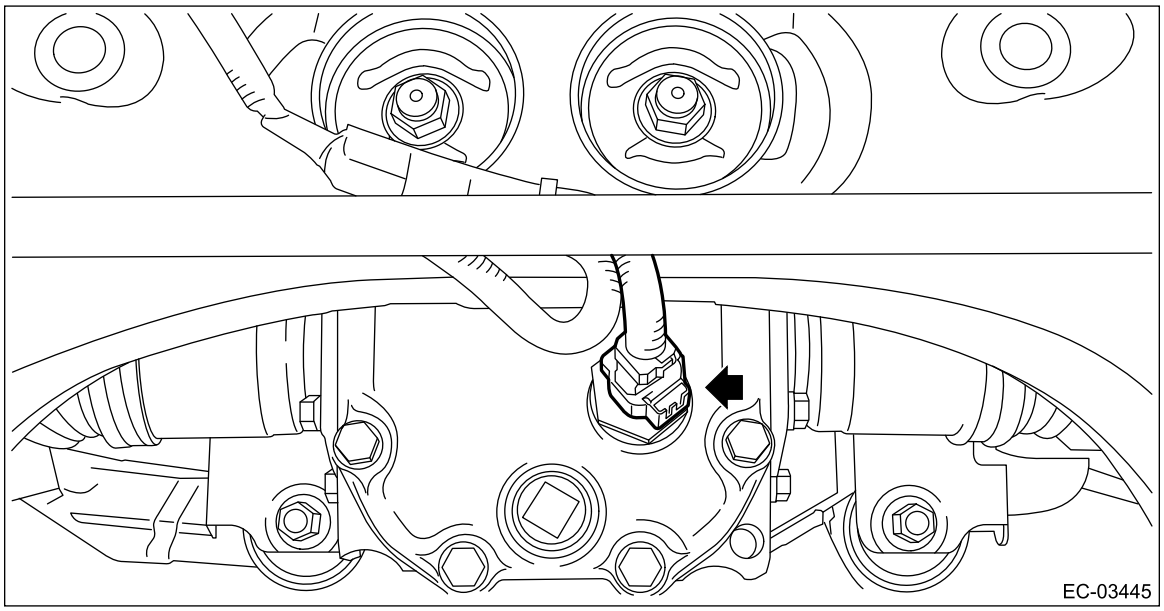
1. Check that the drain filter has no deformation, cracks or other damages.
2. Check that the tube has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Leak Check Valve Assembly

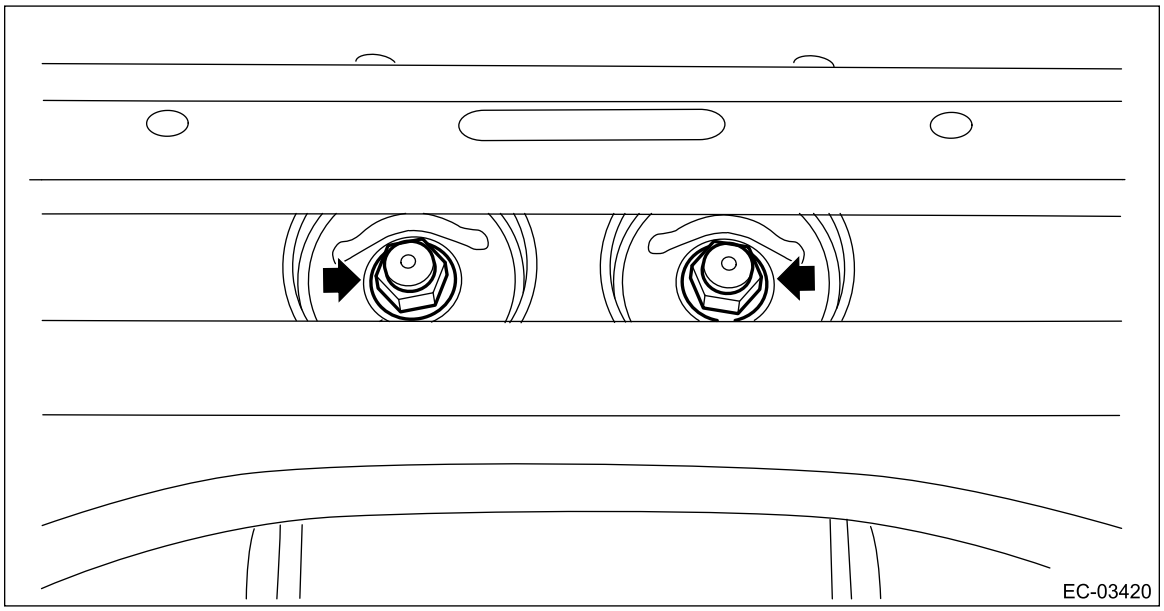
REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

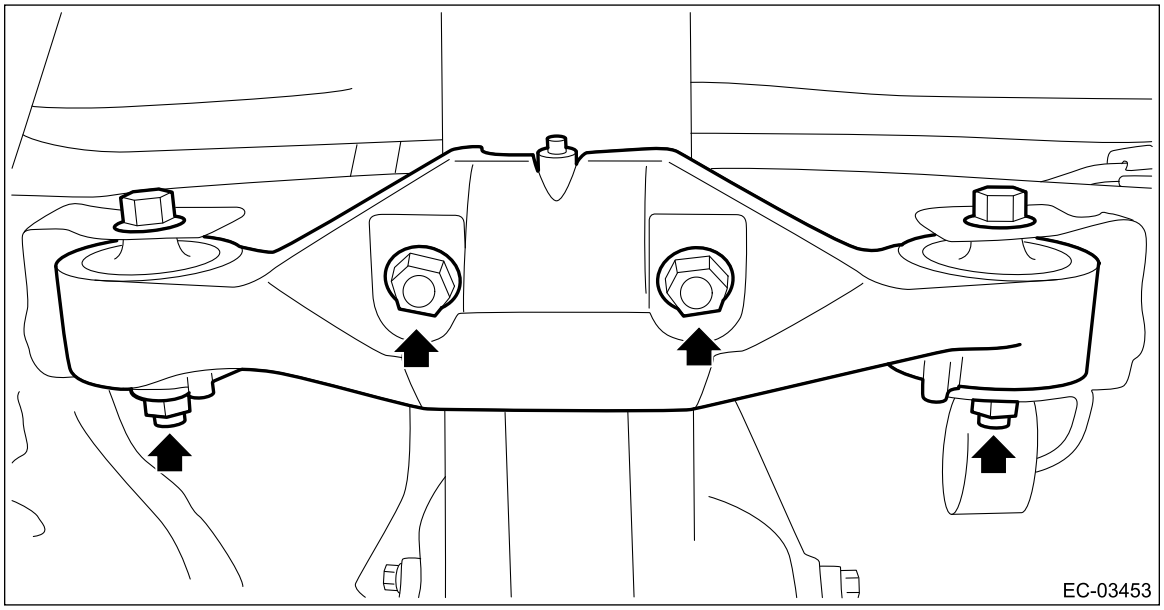
1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground cable from battery.
4. Lift up the vehicle.
5. Remove the rear exhaust pipe. Ref. to EXHAUST(STI)>Rear Exhaust Pipe>REMOVAL.
6. Remove the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>REMOVAL.
7. Support the rear differential with the transmission jack.
8. Disconnect the connector from oil temperature sensor.



9. Remove the self-locking nuts which hold the rear differential to the rear sub frame assembly.



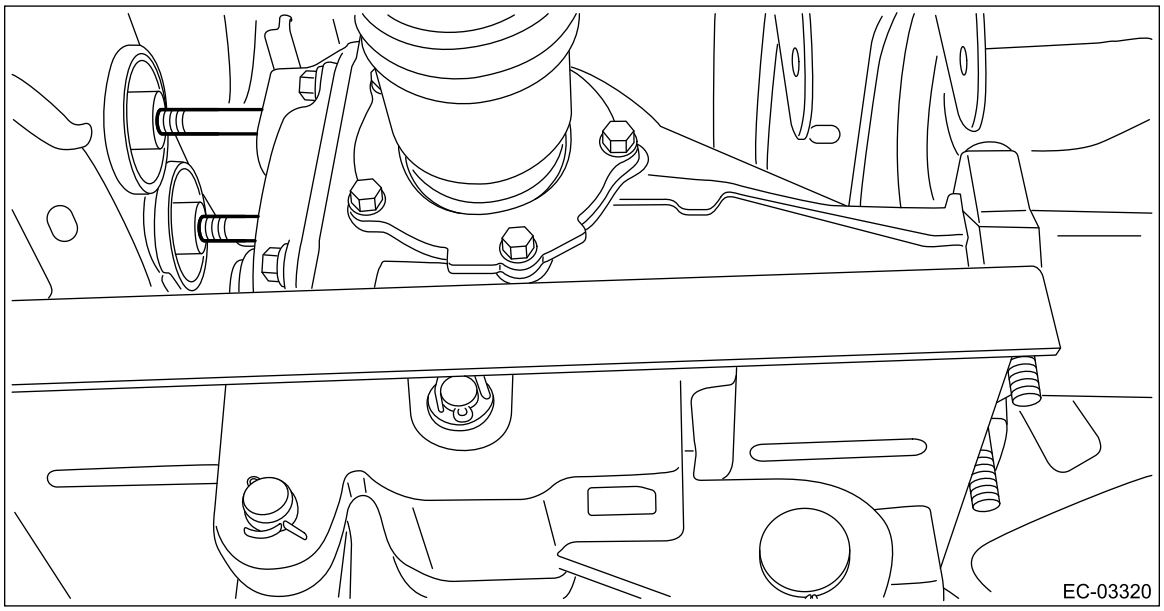
10. Remove the rear differential member from the rear sub frame assembly and the rear differential.



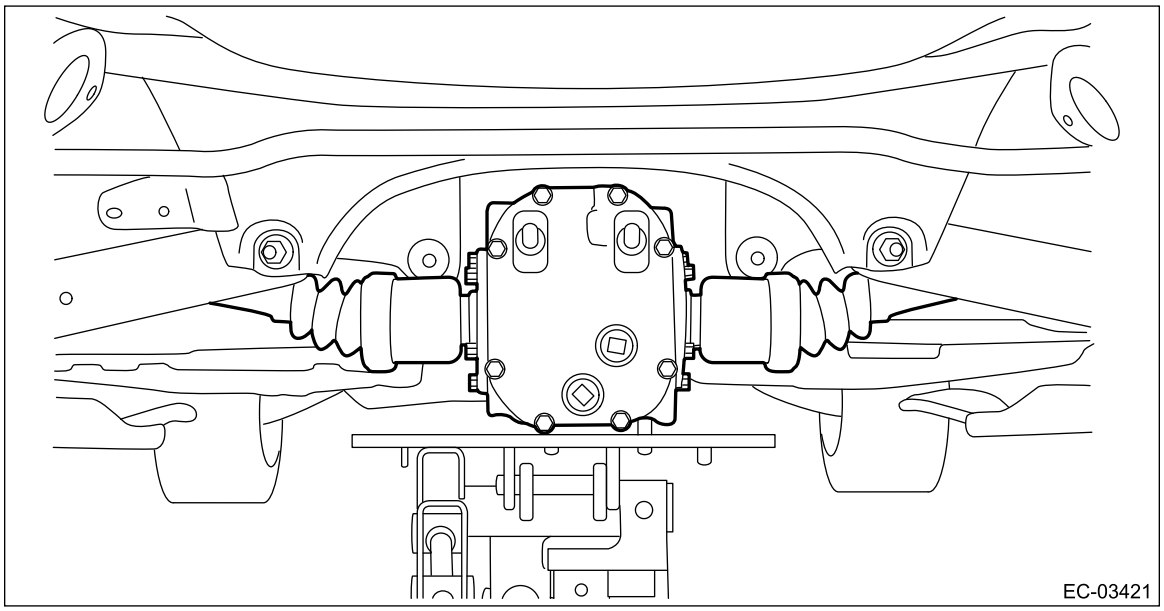
11. Lower the transmission jack gradually until the rear differential is at the position shown in the figure.

Note:

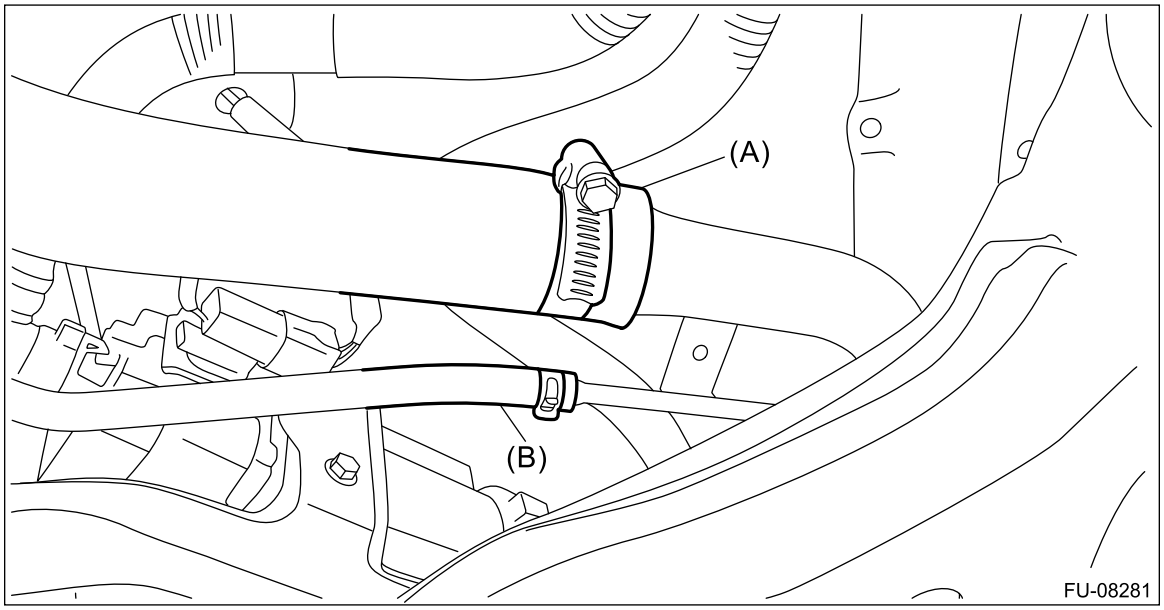
- **When pulling out the stud bolt from the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.**



- **Do not lower the rear differential excessively. Doing so may add extra load to the drive shaft or cause the falling-off of the drive shaft.**



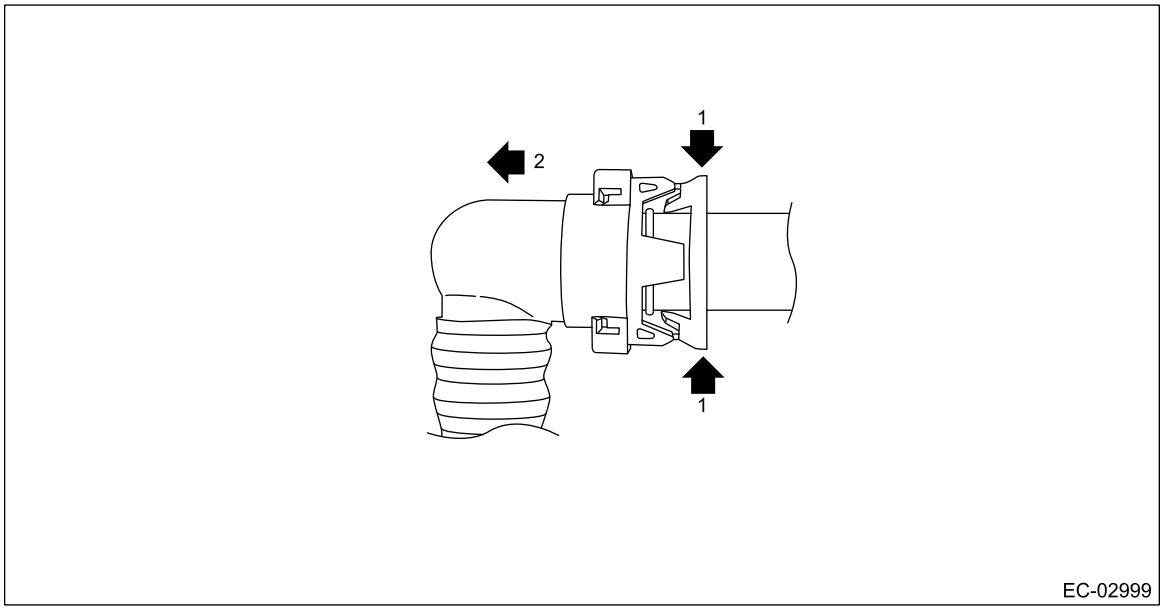
12. Disconnect the fuel filler hose (A) and evaporation hose (B) from the fuel filler pipe assembly.

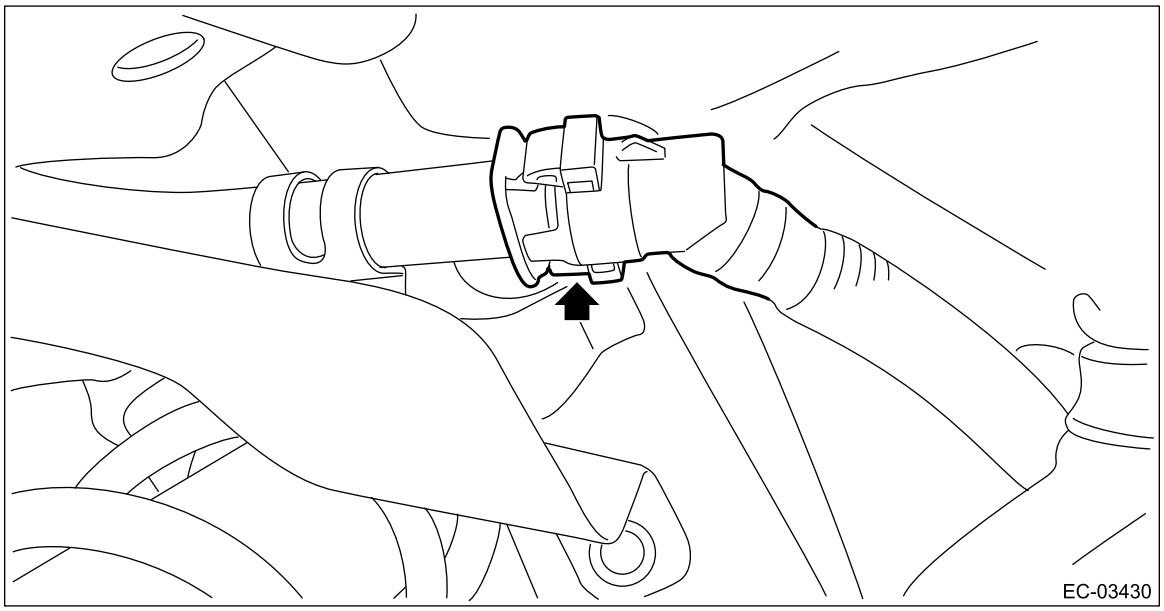


13. Disconnect the drain tube from the drain pipe.

Note:

Disconnect the quick connector as shown in the figure.

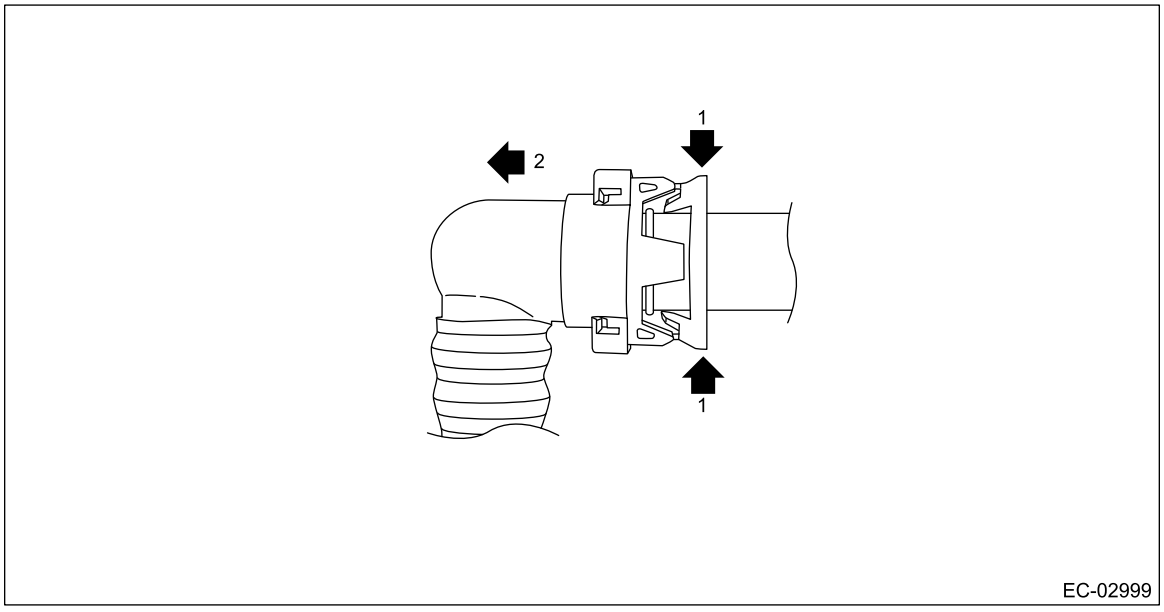




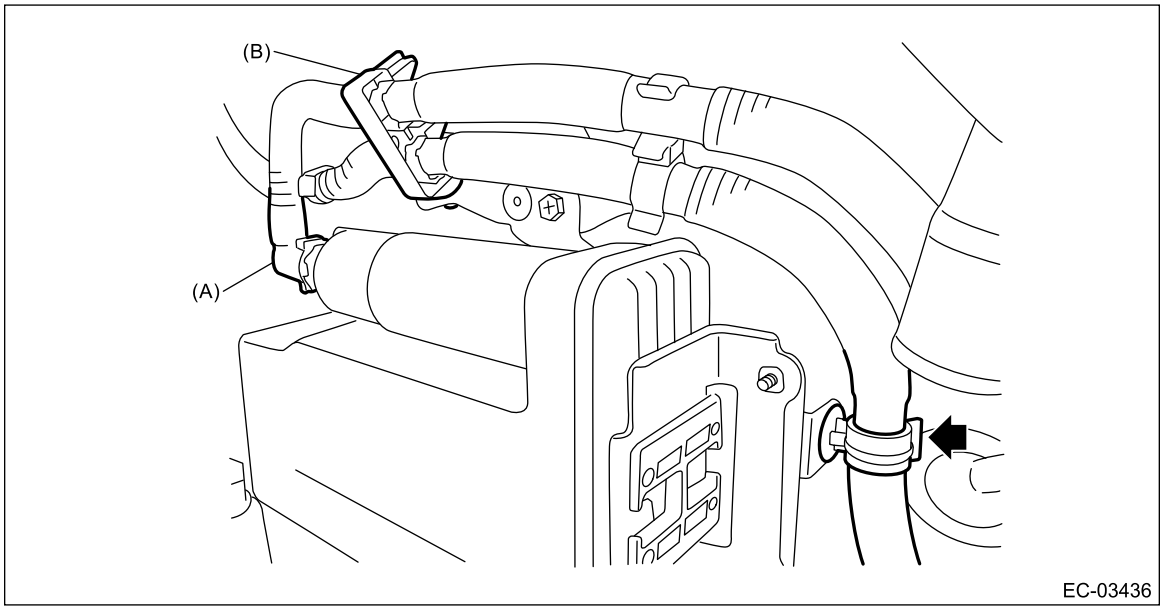
14. Disconnect the drain tube (A) from the canister.

Note:

Disconnect the quick connector as shown in the figure.

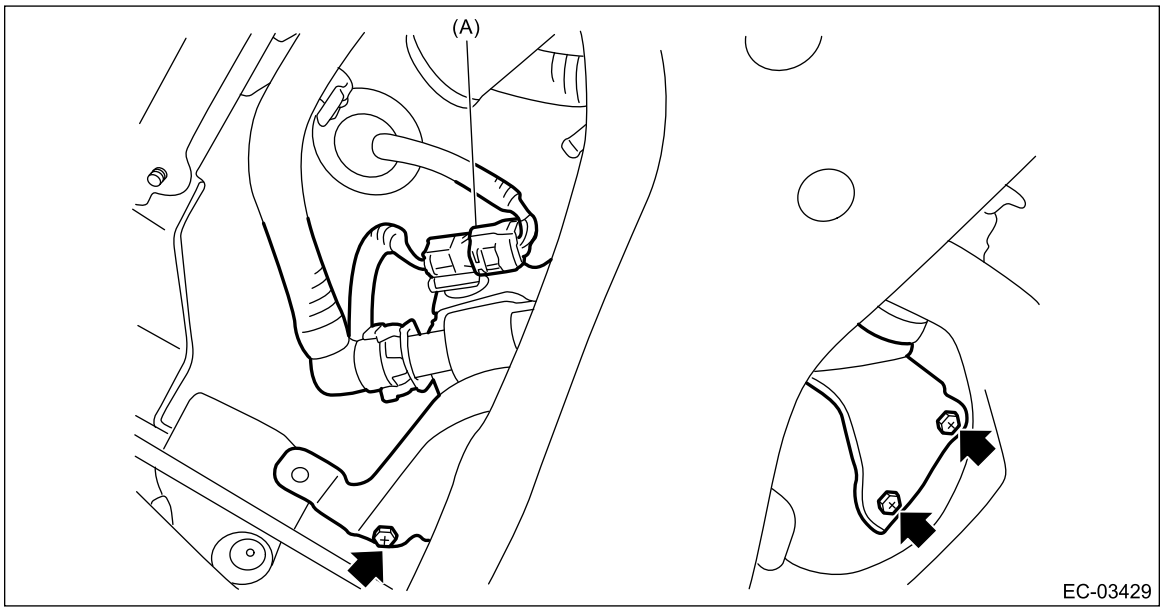


15. Remove the tube clamp (B) from the canister bracket A, and remove the drain tube from the tube clamp.



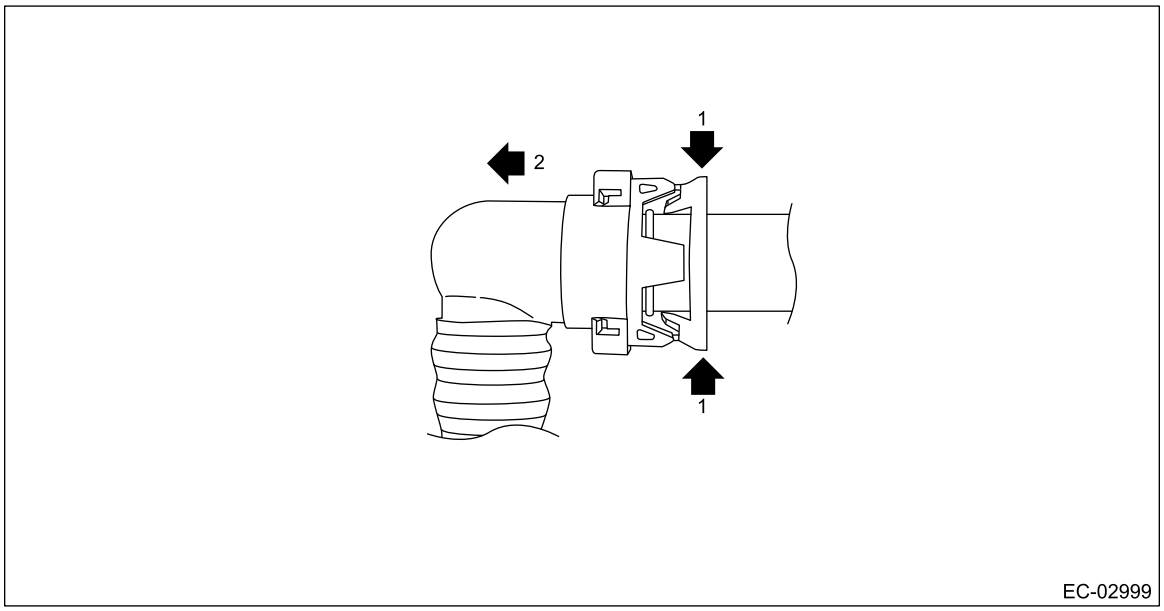
16. Disconnect the connector (A) from the leak check valve assembly.

17. Remove the bolts which hold the leak check valve assembly and remove the leak check valve assembly together with drain tube from vehicle.

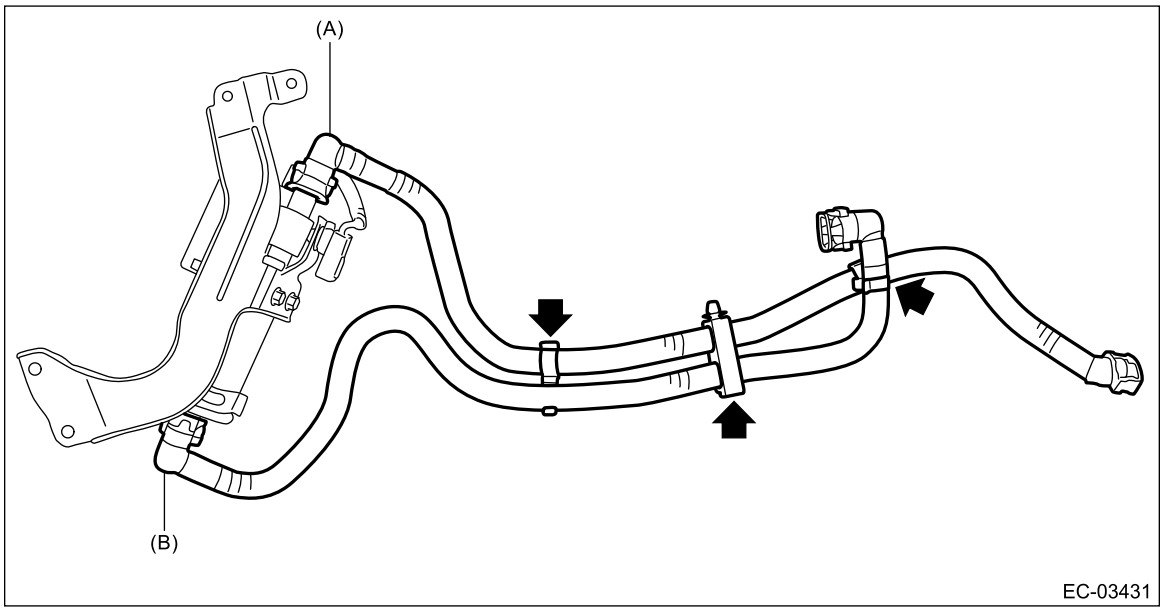


18. Disconnect the drain tube A (A) and drain tube B (B) from the leak check valve assembly.

Note:
Disconnect the quick connector as shown in the figure.



19. Remove the tube clamp from the drain tube A (A) and drain tube B (B).



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Leak Check Valve Assembly

INSTALLATION

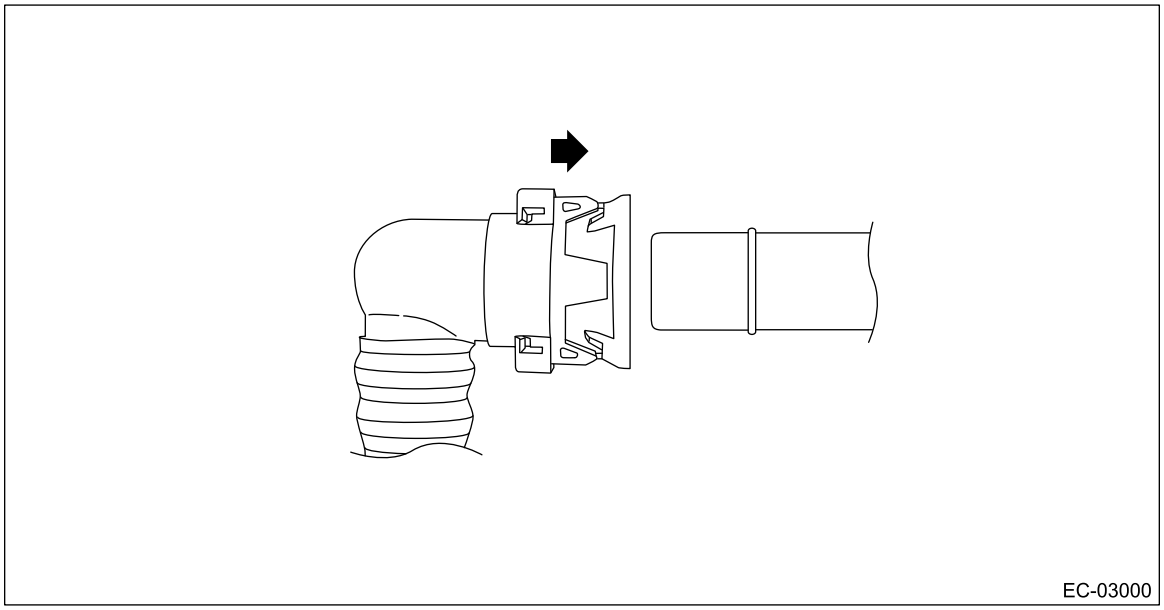
1. Connect the drain tube A (A) and drain tube B (B) to the leak check valve assembly.

Caution:

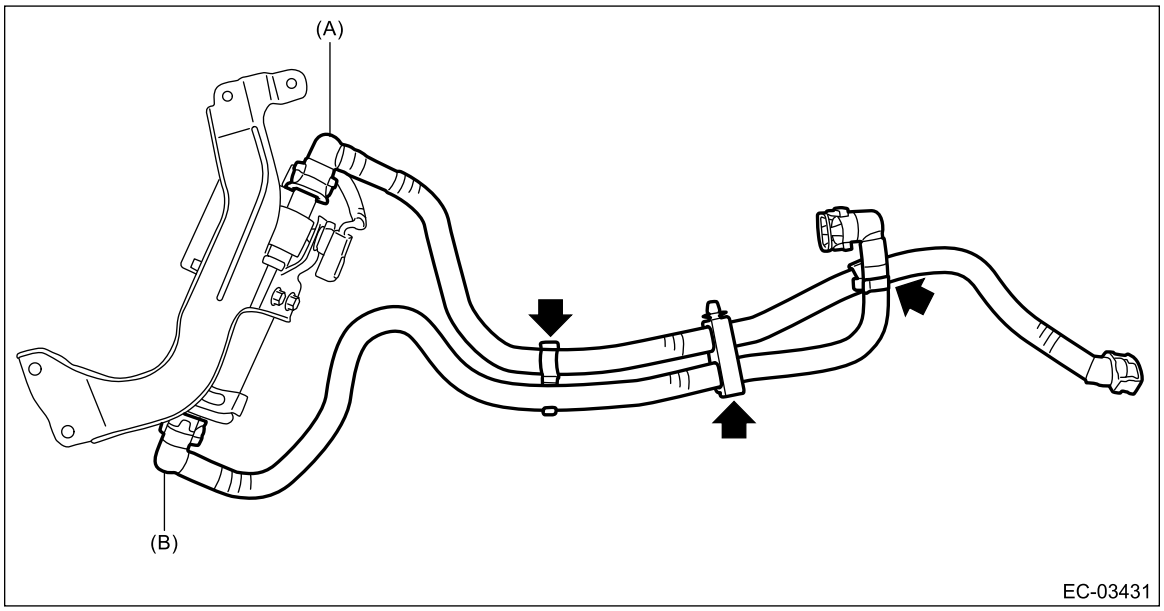
- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.



2. Install the tube clamp to the drain tube A (A) and drain tube B (B).

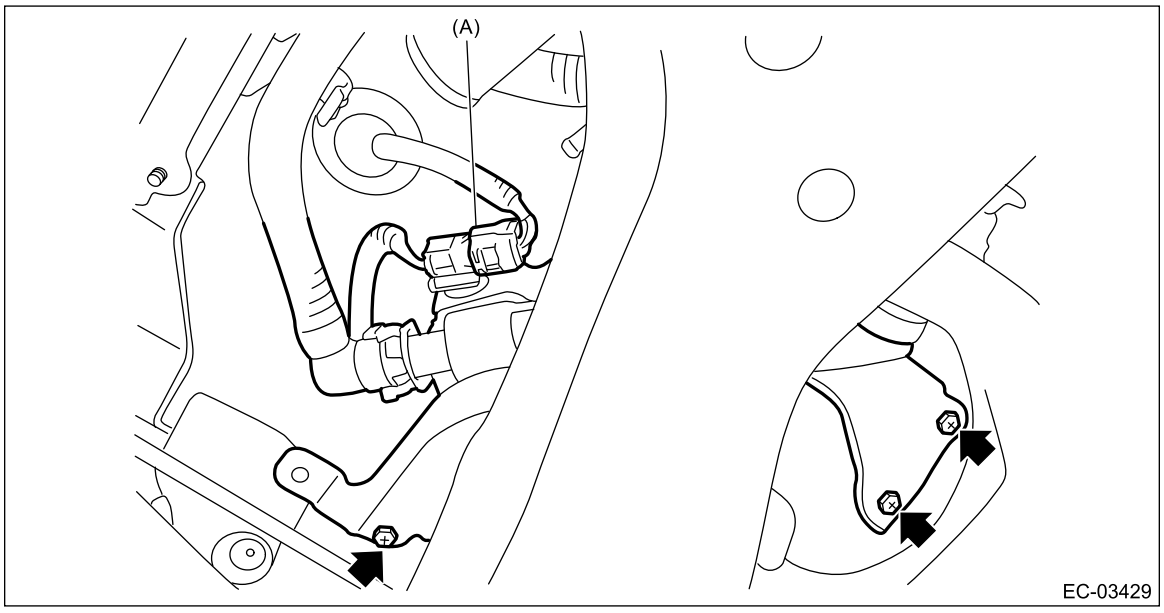


3. Set the leak check valve assembly together with drain tube to the vehicle and install the bolt which holds the leak check valve assembly.

   Tightening torque:

   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

4. Connect the connector (A) to the leak check valve assembly.



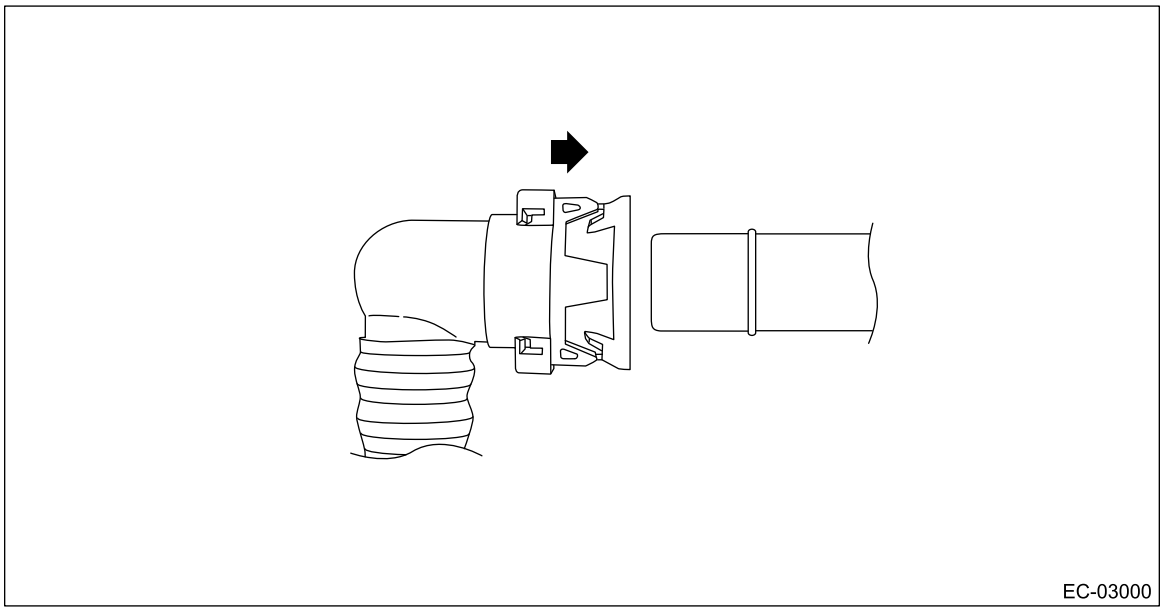
5. Connect the drain tube (A) to the canister.

Caution:

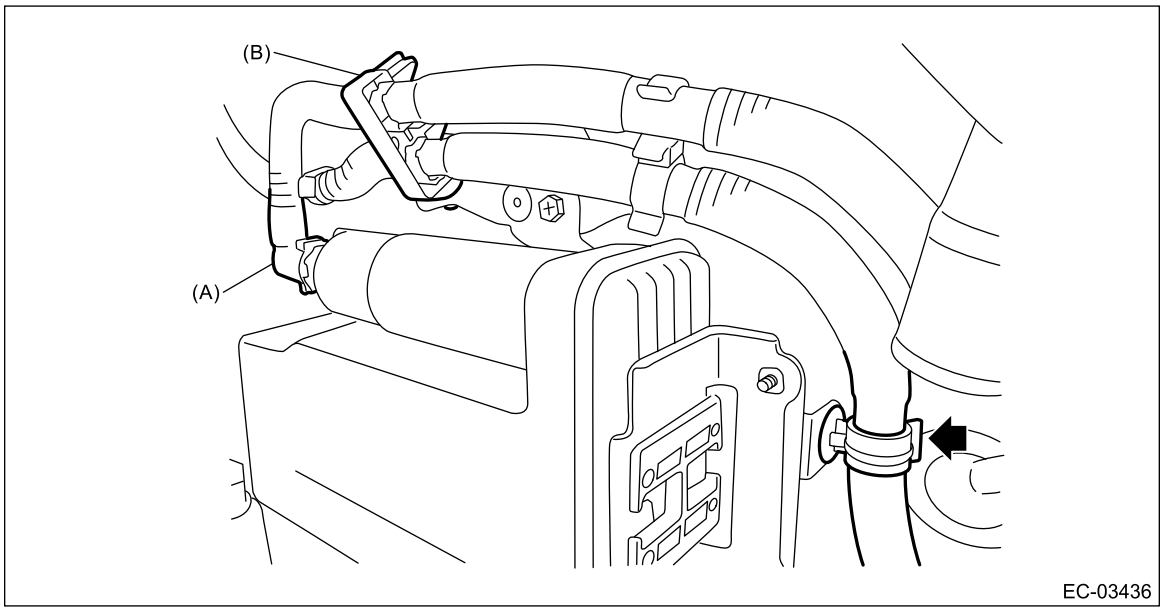
- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.



6. Install the tube clamp (B) to the canister bracket A, and install the drain tube to the tube clamp.



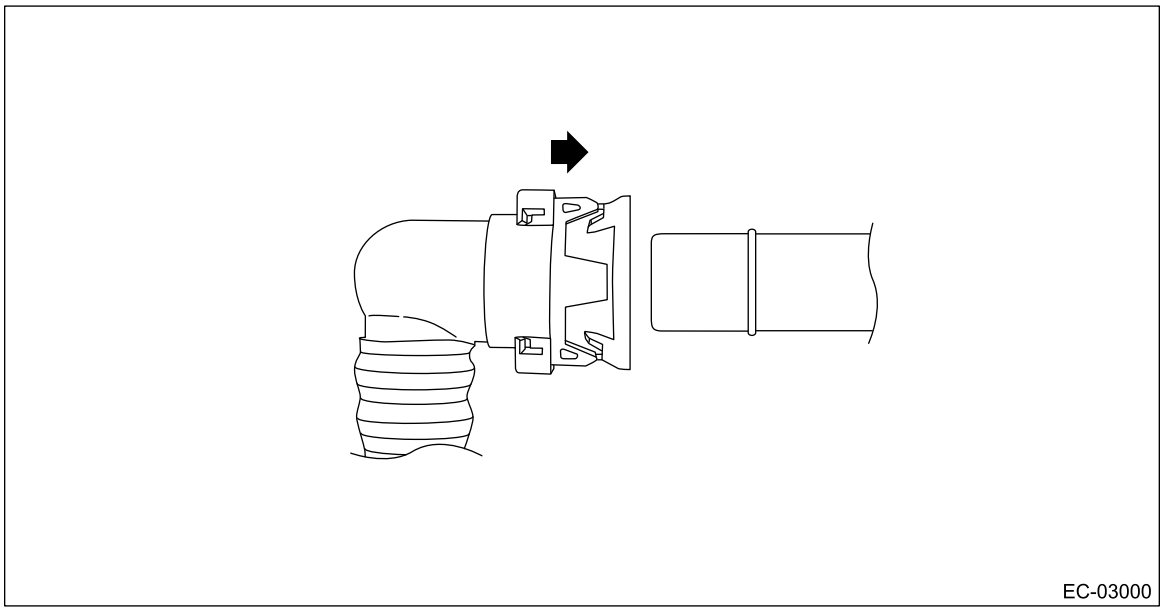
7. Connect the drain tube to the drain pipe.

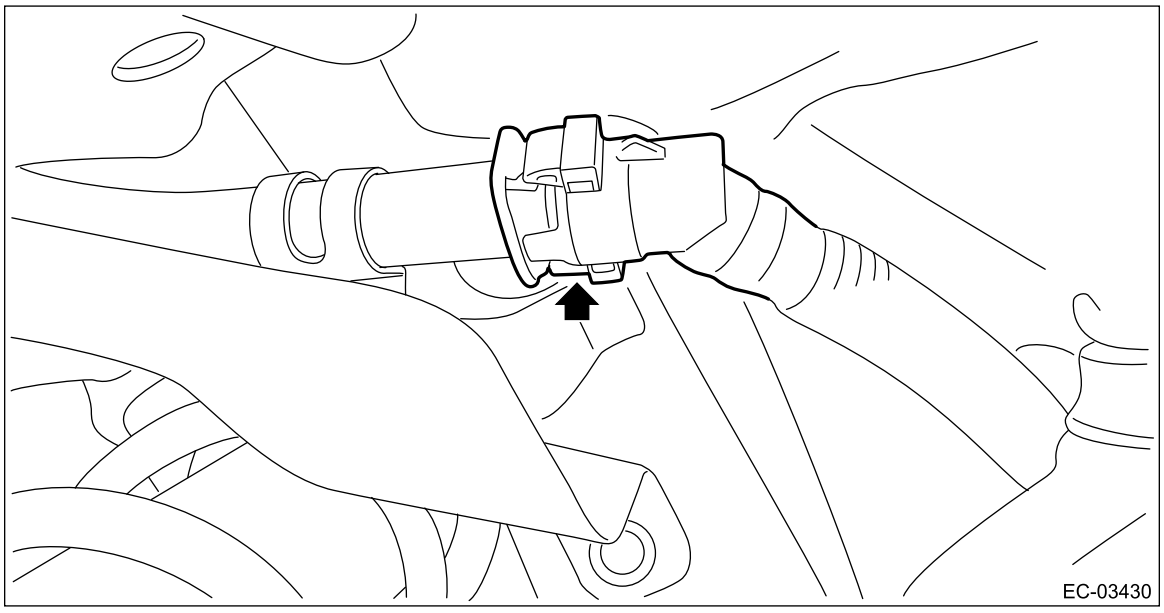
Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

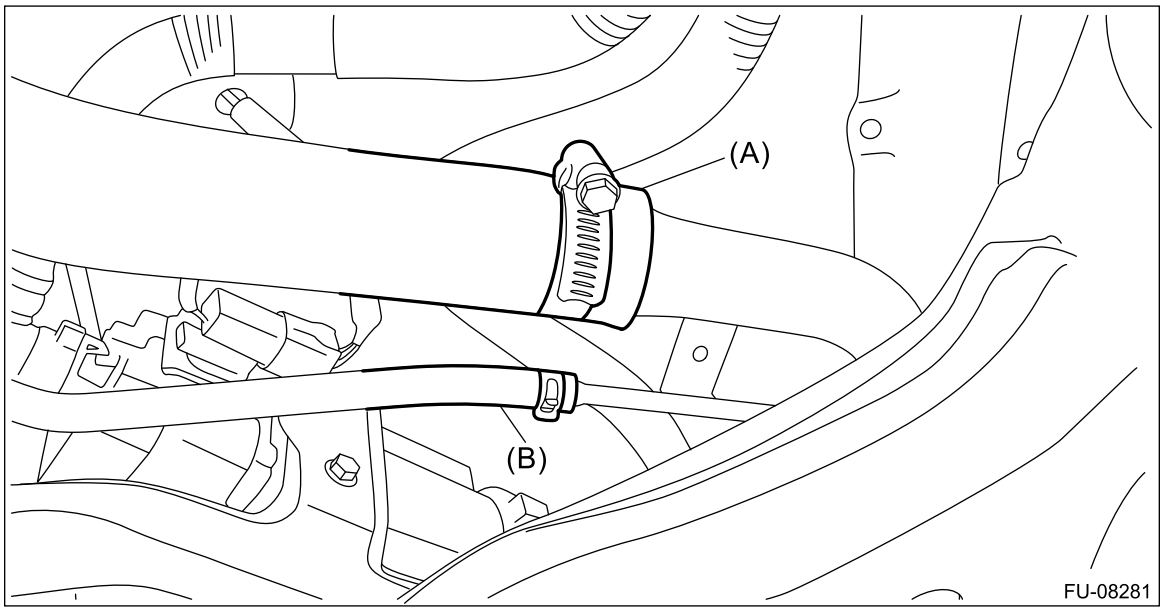


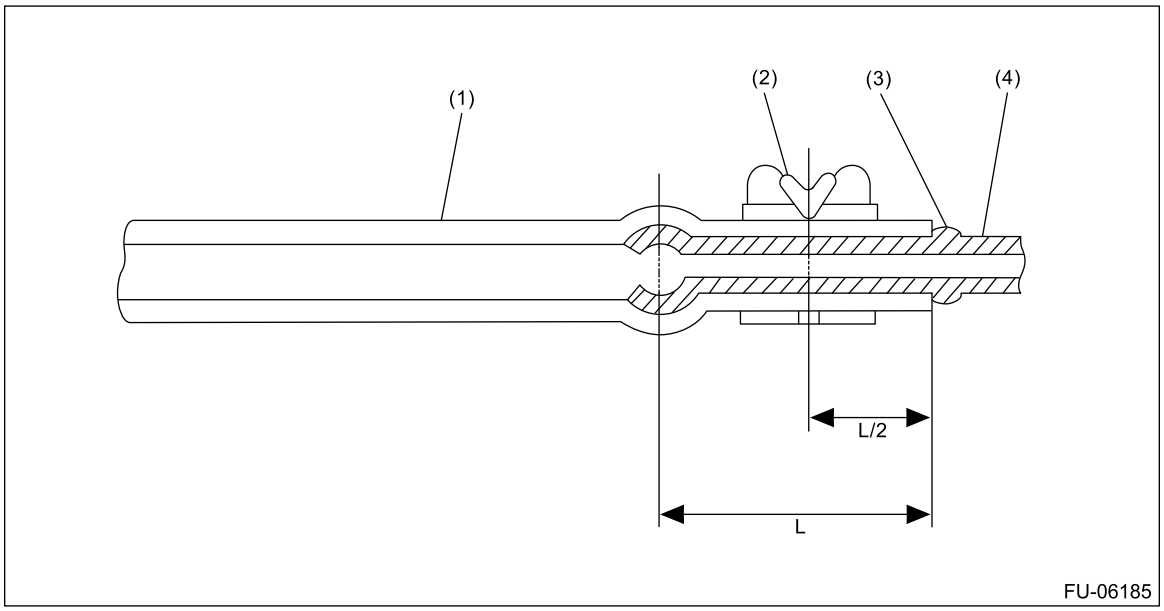


8. Securely insert the fuel filler hose (A) and evaporation hose (B) until the hose end contacts the spool, then attach the clamp and clip as shown in the figure.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)



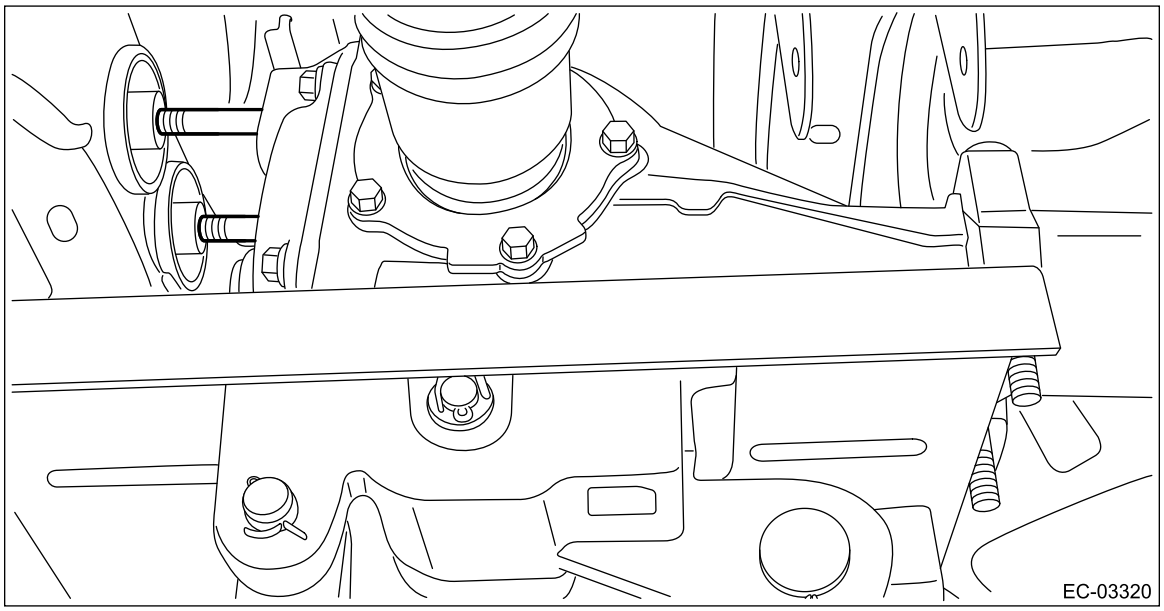


(1) Hose
(2) Clamp and clip
(3) Spool
(4) Pipe

9. Lift up the transmission jack gradually, and set the rear differential to the rear sub frame assembly.

Note:

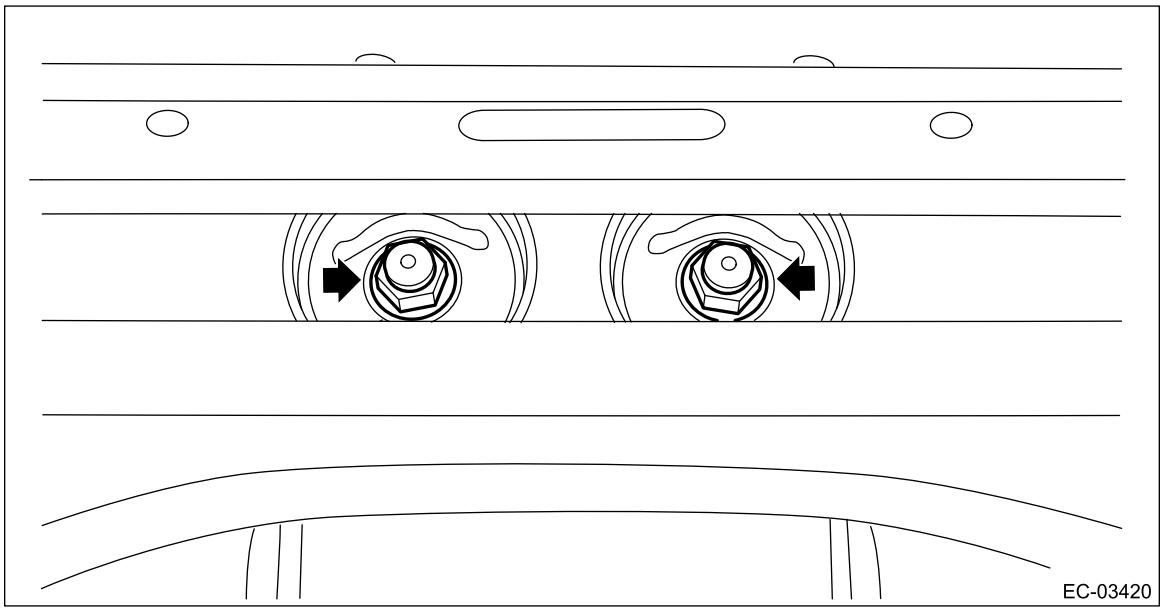
When inserting the stud bolt into the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.



10. Temporarily tighten the self-locking nuts which hold the rear differential to the rear sub frame assembly.

Note:

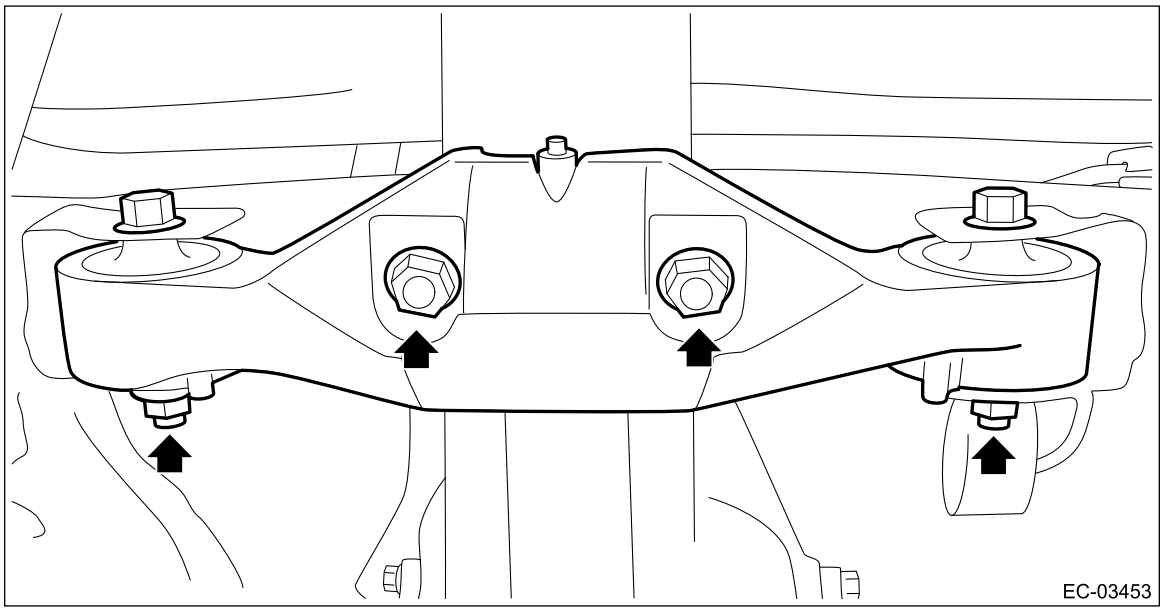
Use a new self-locking nut.



11. Set the rear differential member to the rear sub frame assembly and rear differential, and temporarily tighten the self-lock nuts which secure the rear differential member to the rear sub frame assembly and rear differential.

Note:

Use a new self-locking nut.



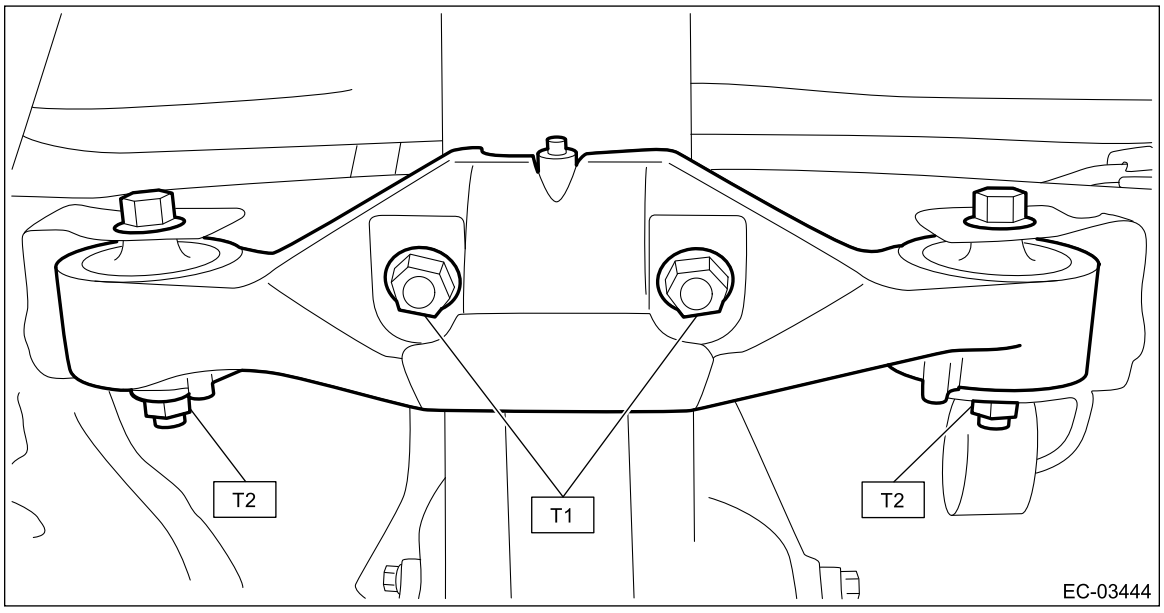
12. Remove the transmission jack from the rear differential.

13. Tighten the self-locking nuts which secure the rear differential member to the rear sub frame assembly and rear differential.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

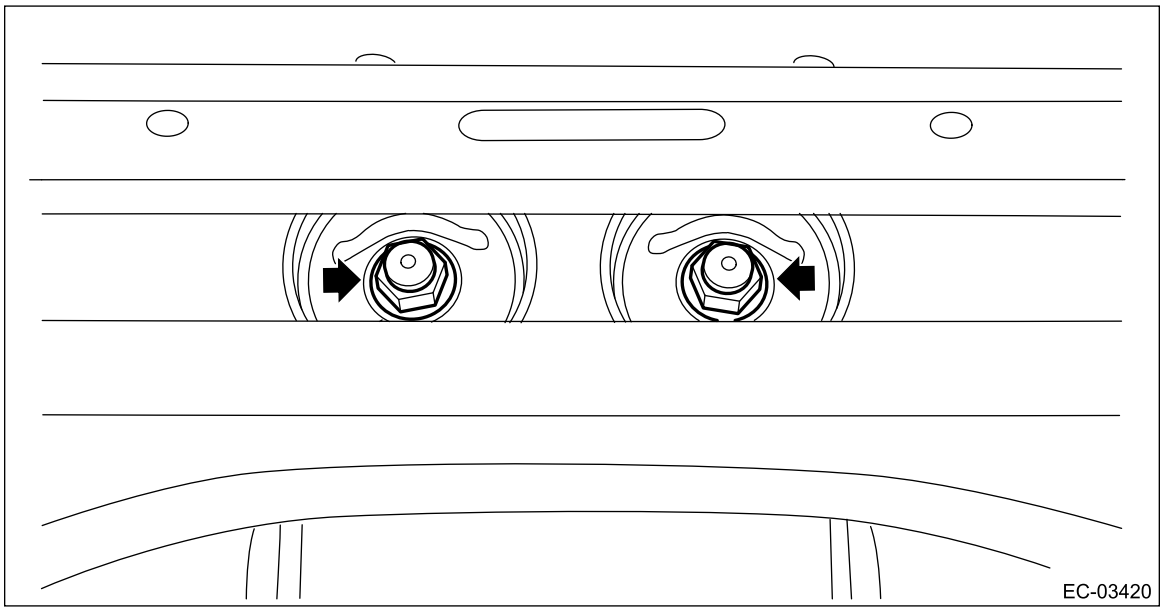
T2: 110 N·m (11.2 kgf-m, 81.1 ft-lb)



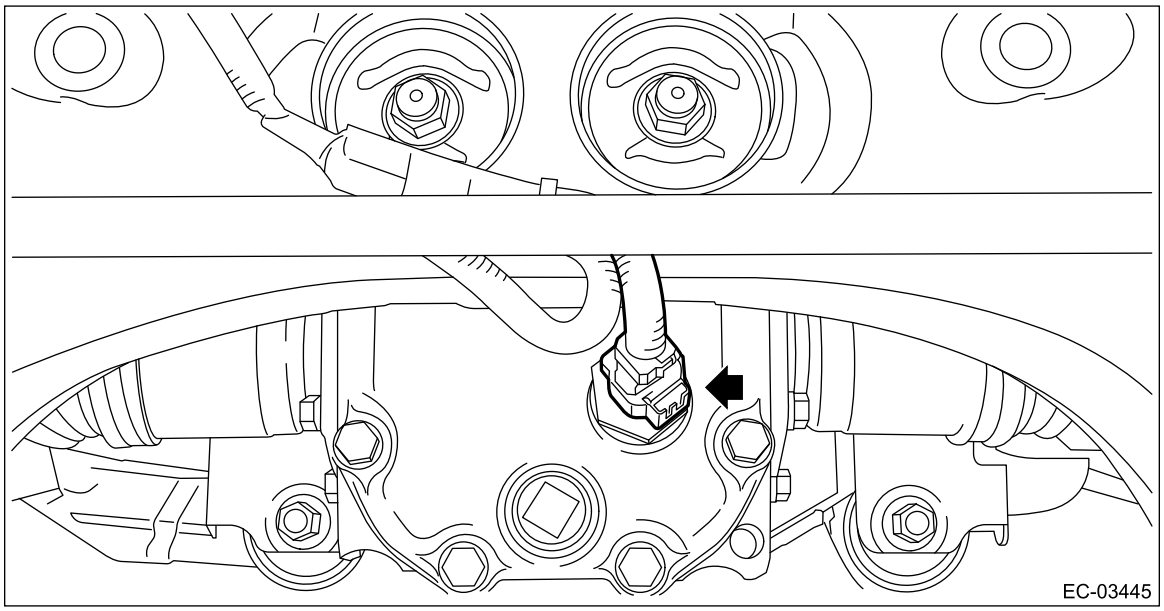
14. Tighten the self-locking nuts which secure the rear differential to the rear sub frame assembly.

Tightening torque:

70 N·m (7.1 kgf-m, 51.6 ft-lb)



15. Connect the connector to the oil temperature sensor.

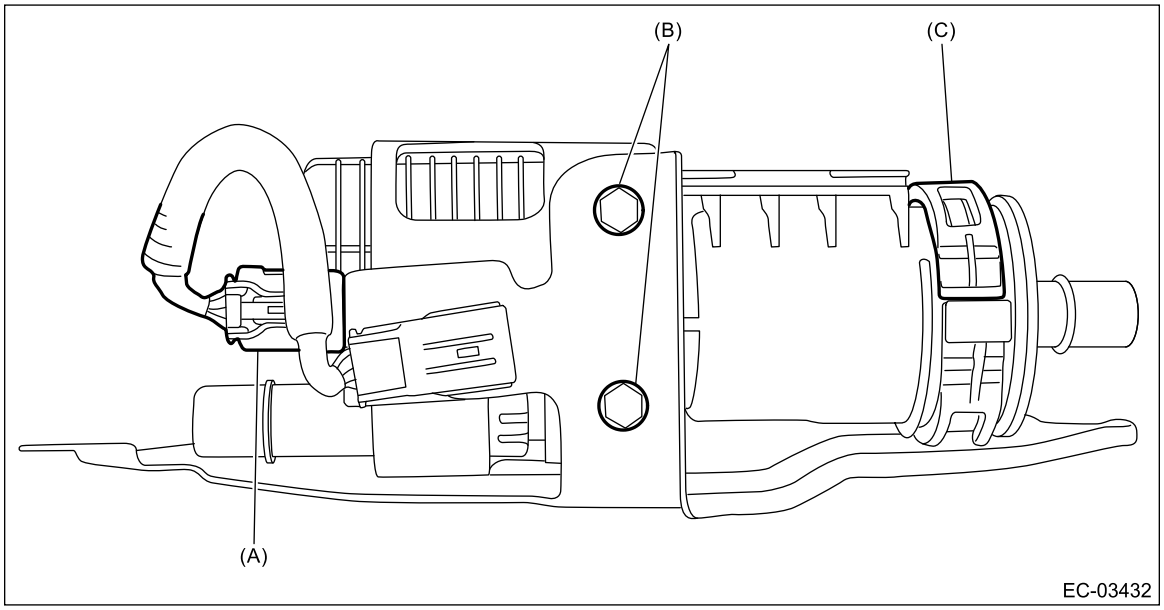


16. Install the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>INSTALLATION.
17. Install the rear exhaust pipe. Ref. to EXHAUST(STI)>Rear Exhaust Pipe>INSTALLATION.
18. Lower the vehicle.
19. Connect the ground terminal to the battery.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Leak Check Valve Assembly

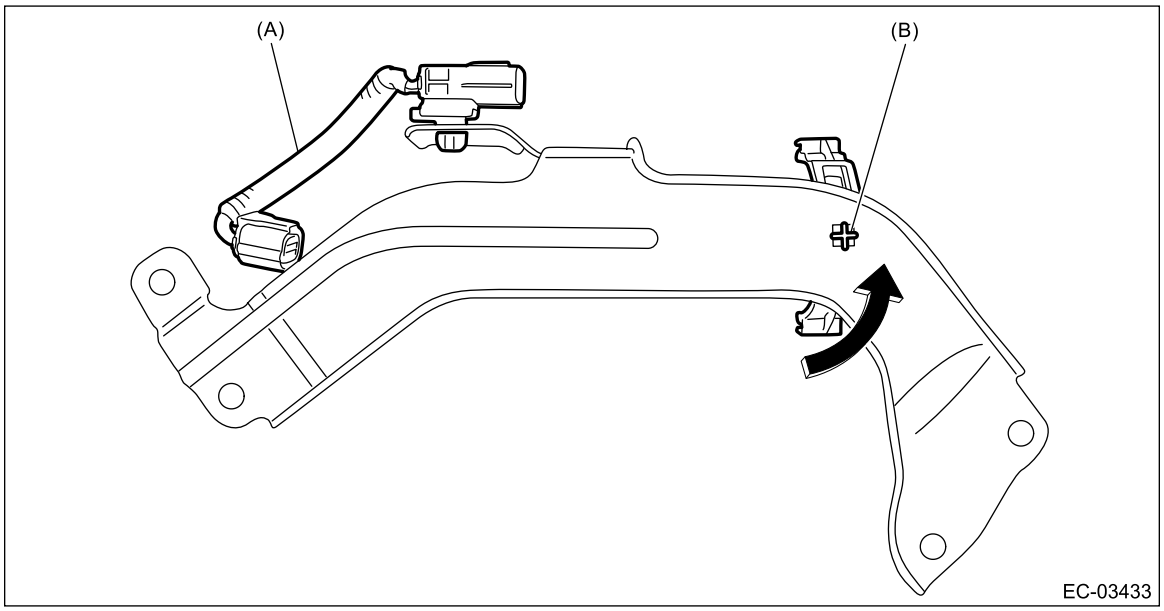
DISASSEMBLY

1. Disconnect the connector (A) from the leak check valve assembly.
2. Remove the bolt (B) securing the leak check valve assembly to the leak check valve bracket.
3. Remove the clamp B (C) which secures the leak check valve assembly, and remove the leak check valve assembly.



4. Remove the harness (A) from the leak check valve bracket.

5. Rotate the clamp A (B) in the direction of the arrow and remove it from the leak check valve bracket.



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Leak Check Valve Assembly

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

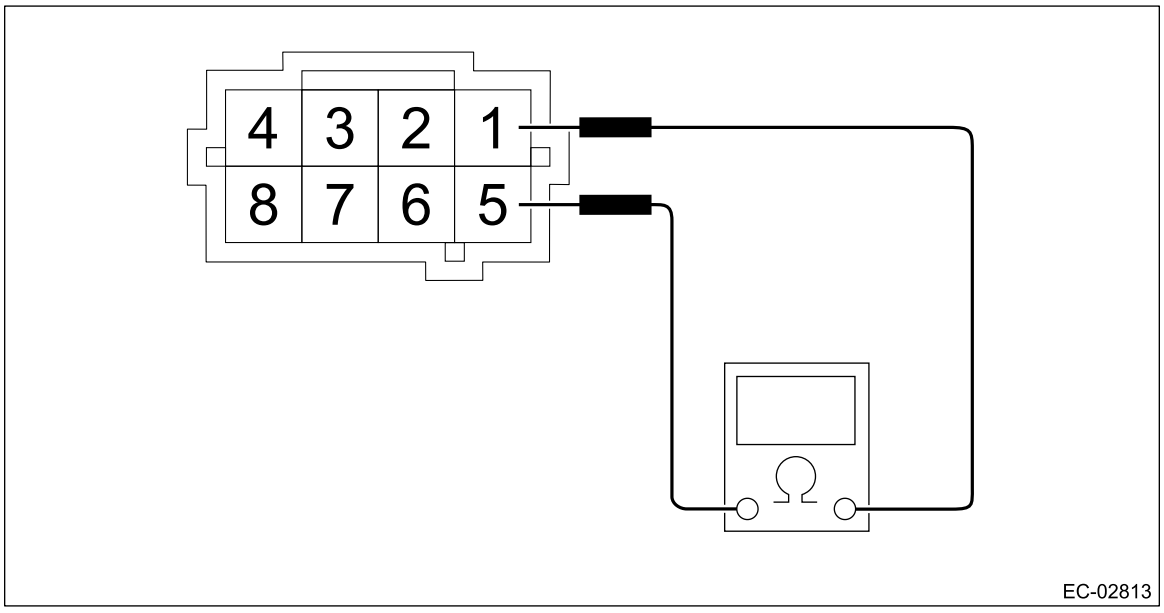
5.4 N·m (0.6 kgf-m, 4.0 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Leak Check Valve Assembly

INSPECTION

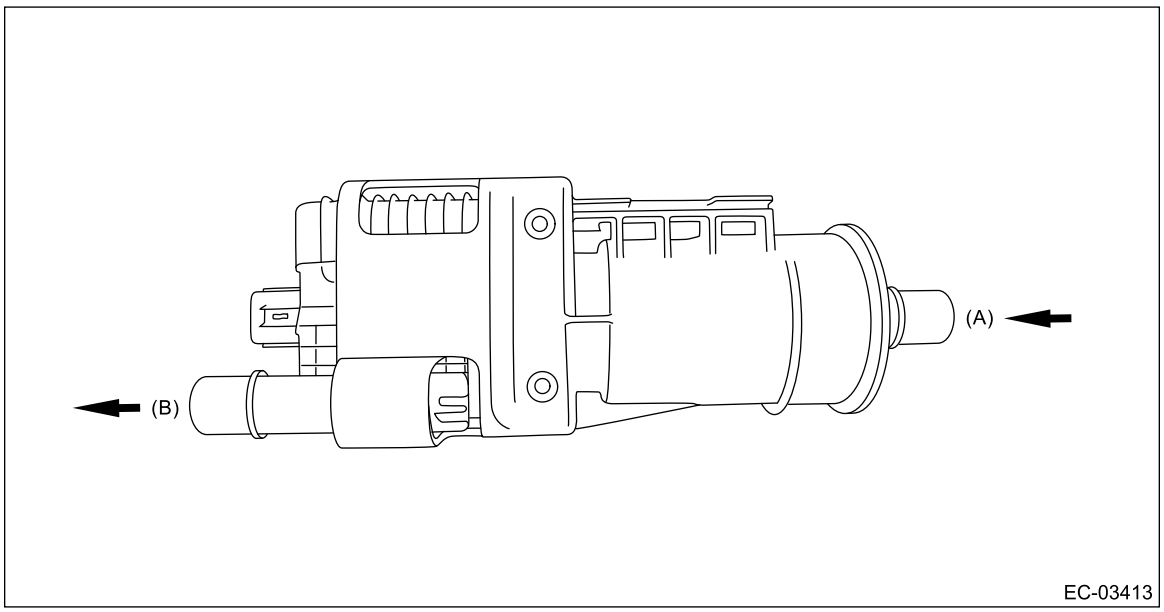
1. CHECK SWITCHING VALVE

1. Check the resistance between switching valve terminals.



Terminal No.	Standard
1 and 5	27^{+3}_{-2} Ω (when 20°C (68°F))
	31±4 Ω (when 60°C (140°F))

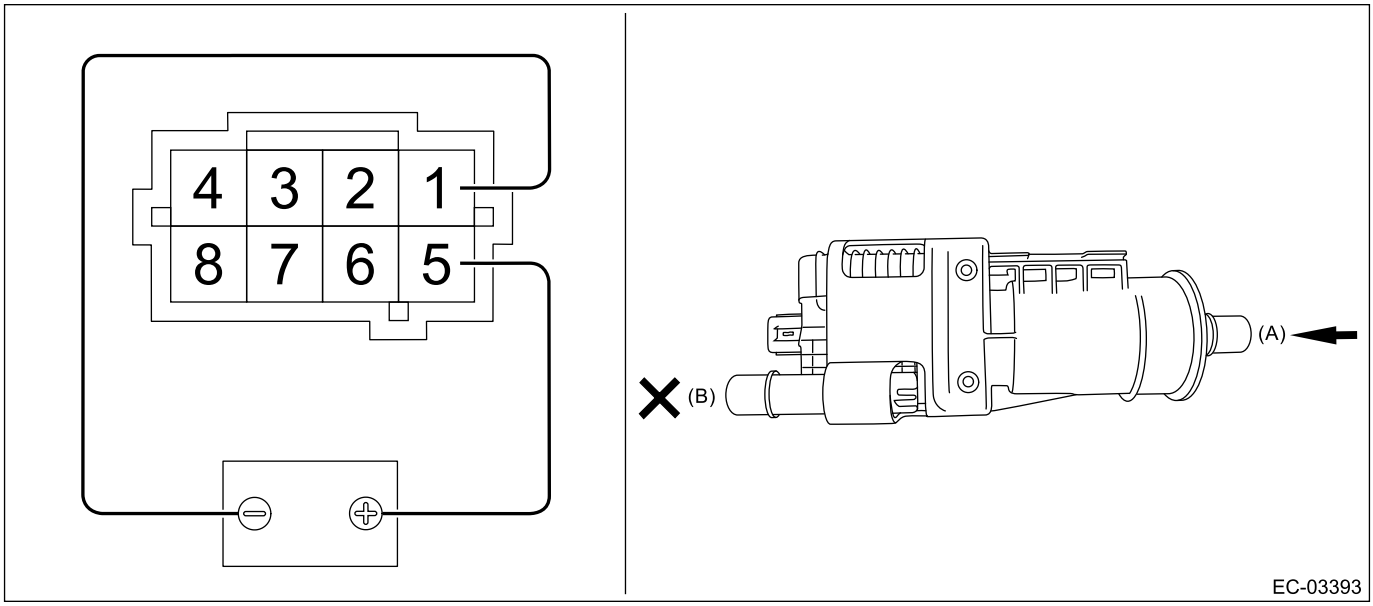
2. Check that air is discharged from (B) when air is blown into (A).



3. Connect the battery positive terminal to the terminal No. 5 and the battery negative terminal to the terminal No. 1. Check that air does not come out from (B) when air is blown into (A).

Note:

The purpose of this inspection is to check the valve movement, and it would be success if a large change of flow can be checked resulting from valve opening/closing. Therefore, it does not indicate a malfunction if a small amount of flow from (B) is detected when the valve is closed.

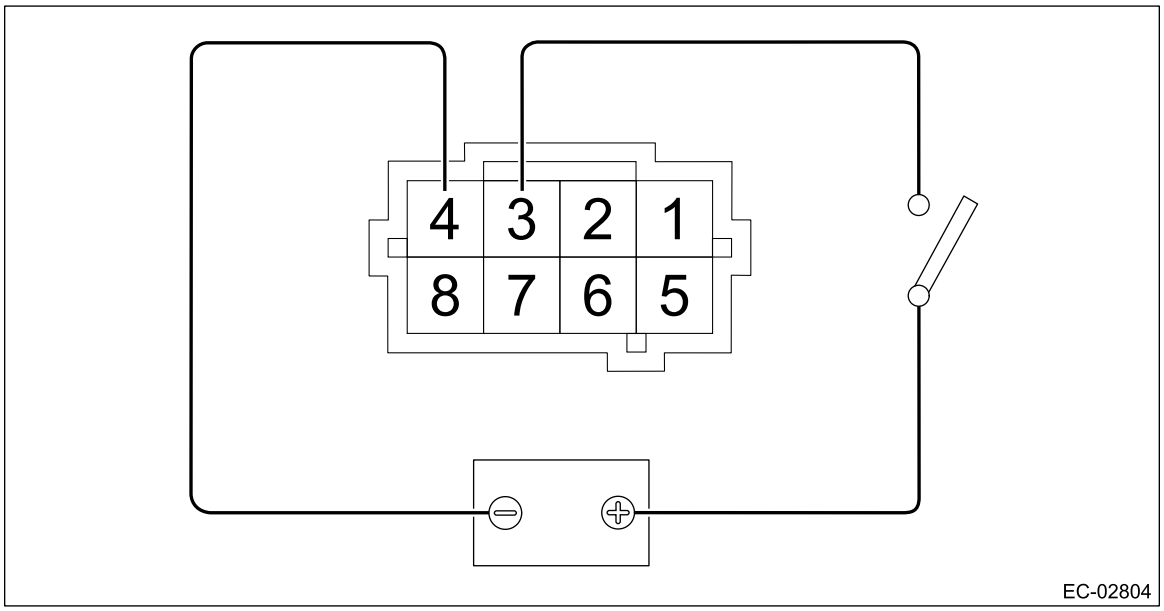


2. CHECK VACUUM PUMP

1. Connect the battery positive terminal to terminal No. 3 and the battery ground terminal to terminal No. 4, and inspect the vacuum pump operation.

   Caution:

   Do not operate the vacuum pump for 5 minutes or more.

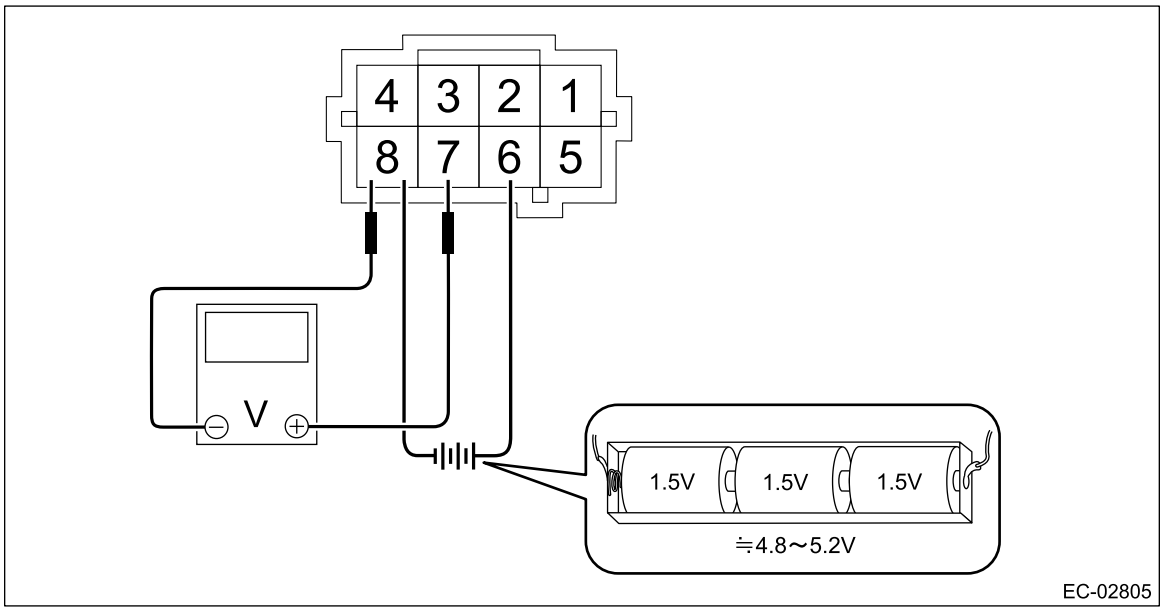


3. CHECK PRESSURE SENSOR

1. Connect dry-cell battery positive terminal to terminal No. 6 and dry-cell battery ground terminal to terminal No. 8, circuit tester positive terminal to terminal No. 7 and the circuit tester ground terminal to terminal No. 8.

Note:

- **Use new dry-cell batteries.**
- **Using a circuit tester, check that the initial voltage of each dry-cell battery is 1.6 V or more. And also check that the voltage of three batteries in series is between 4.8 V and 5.2 V.**
- **For power supply, 5 V DC constant voltage power source can also be used.**



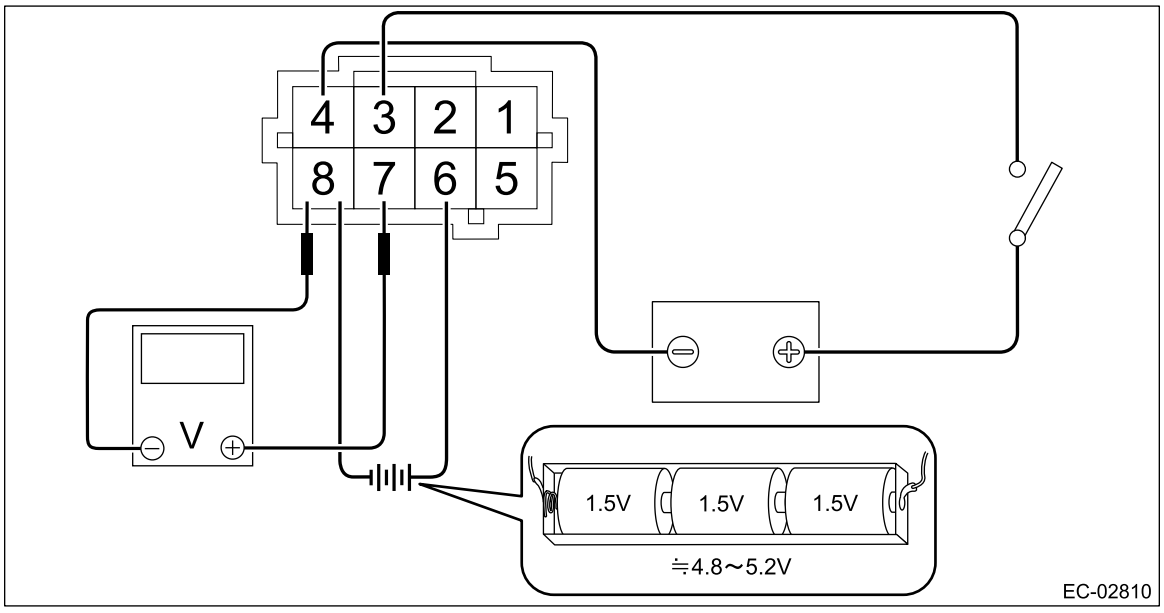
2. Check the voltage at a normal atmospheric pressure.

Note:

The atmospheric pressure at higher altitude is lower than normal. Therefore, the voltage is lower than the standard value.

Terminal No.	Standard
7 (+) and 8 (−)	Approx. 3.5 V (when 25°C (77°F))

3. Connect the battery positive terminal to terminal No. 3 and the battery ground terminal to terminal No. 4, and check that there is a voltage drop from the voltage measured in step 2) when the vacuum pump is operated.



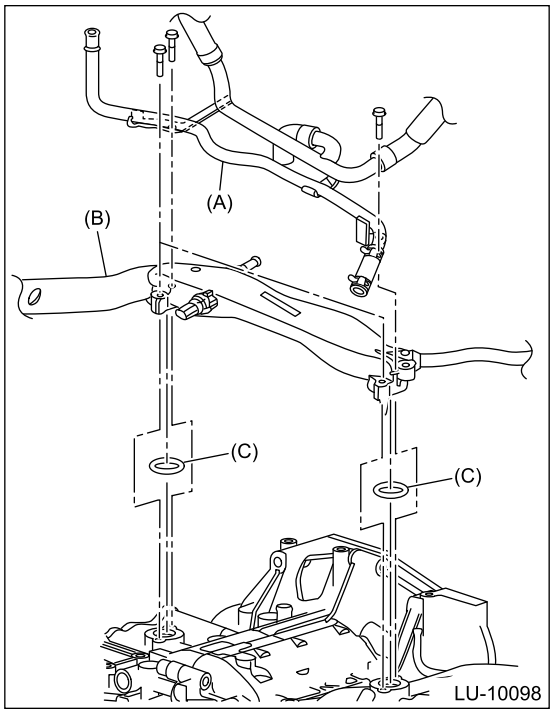
4. OTHER INSPECTIONS

1. Check that the leak check valve assembly and leak check valve bracket have no deformation, cracks or other damages.
2. Check that the tube has no cracks, damage or loose part.

REMOVAL

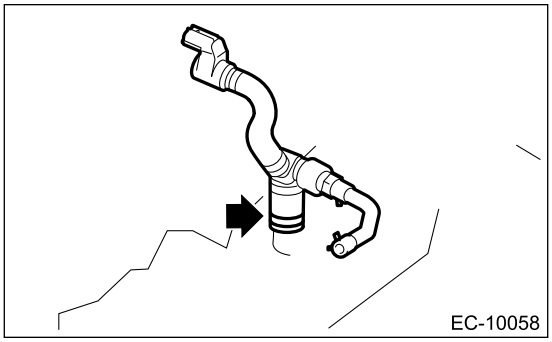
Caution:
Do not remove unless the hose and the leak diagnosis connector are broken.

1. Remove the engine from the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>REMOVAL.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Remove the bolt securing the water tank pipe assembly, and place the water tank pipe assembly aside so that it does not interfere with the work.
4. Remove the water pipe assembly.
   Note:
   Do not remove the radiator inlet hose and heater outlet hose.



(A) Water tank pipe ASSY
(B) Water pipe ASSY
(C) O-ring

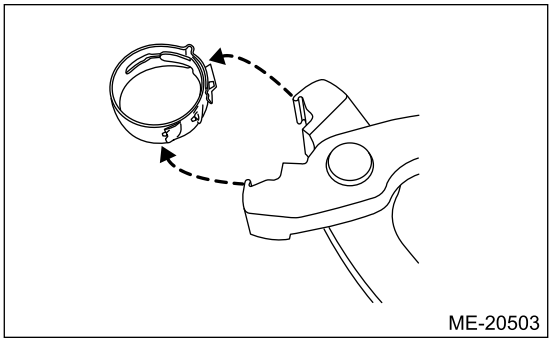
5. Remove the secondary air pipe RH. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Combination Valve>REMOVAL > SECONDARY AIR COMBINATION VALVE RH.
6. Break the clamp, and remove the PCV hose assembly from the cylinder block RH.

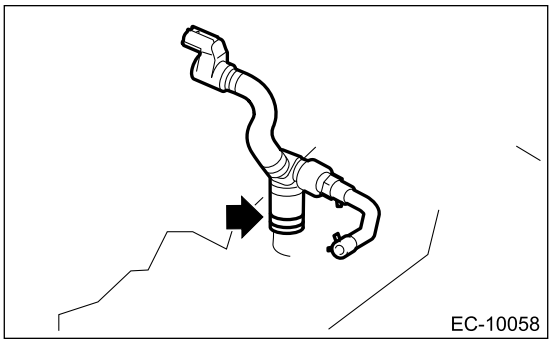


EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > PCV Hose Assembly

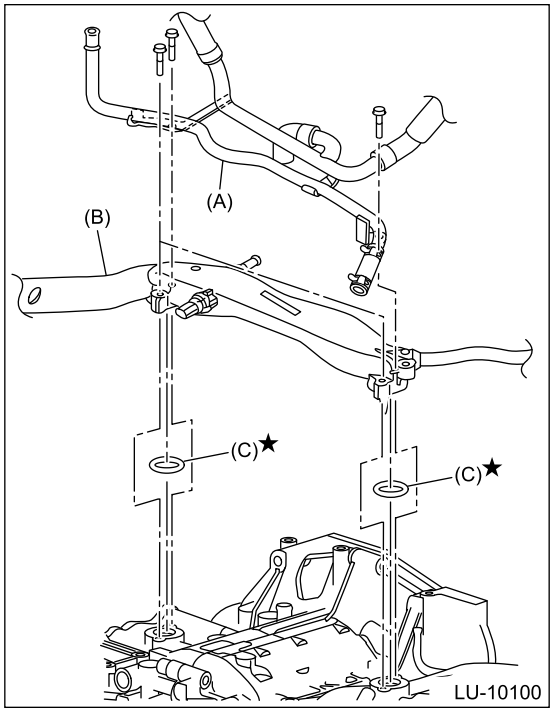
INSTALLATION

1. Install the PCV hose assembly to the cylinder block RH, and install the clamp using the Clamp pincer (14100134).
   Note:
   Use a new clamp.





2. Install the secondary air pipe RH. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Combination Valve>INSTALLATION > SECONDARY AIR COMBINATION VALVE RH.
3. Install the water tank pipe assembly and water pipe assembly.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



(A) Water tank pipe ASSY
(B) Water pipe ASSY
(C) O-ring

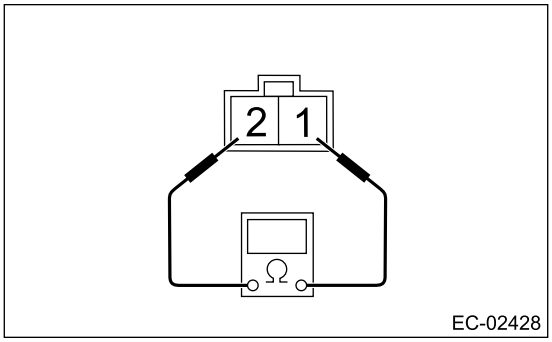
4. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>INSTALLATION.
5. Install the engine to the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > PCV Hose Assembly

INSPECTION

1. LEAK DIAGNOSIS CONNECTOR

1. Check that the leak diagnosis connector has no deformation, cracks or other damages.
2. Check the resistance between leak diagnosis connector terminals.



Terminal No.	Standard
1 and 2	Less than 1 Ω

2. OTHER INSPECTIONS

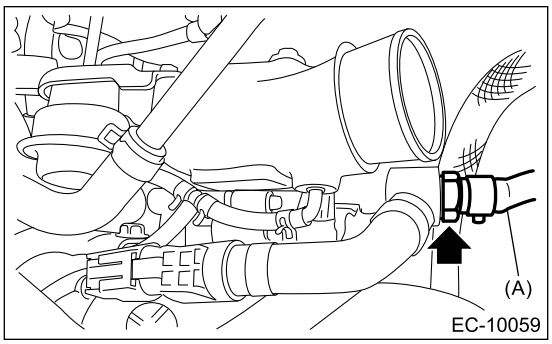
Check that the hose has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > PCV Valve

REMOVAL

Caution:
Do not remove unless the PCV valve is broken.

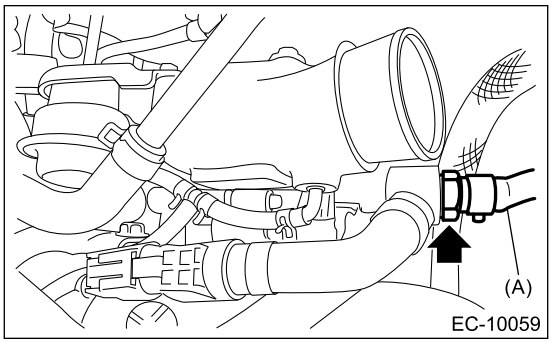
1. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
2. Disconnect the vacuum hose (A) from the PCV valve and remove the PCV valve from the PCV connector.



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > PCV Valve

INSTALLATION

1. Install the PCV valve to the PCV connector and connect the vacuum hose (A) to the PCV valve.
   Note:
   Apply liquid gasket to the bolt threads of PCV valve.
   Liquid gasket:
   THREE BOND 1324 (Part No. 004403042) or equivalent
   Tightening torque:
   22.5 N·m (2.3 kgf-m, 16.6 ft-lb)



2. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.

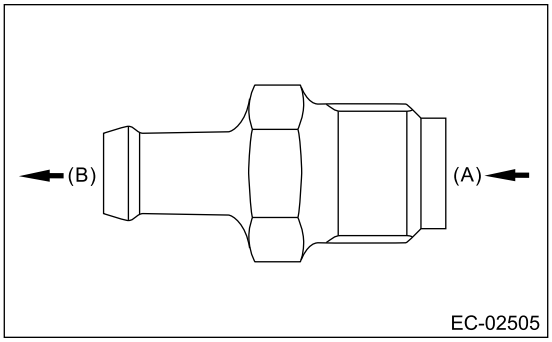
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > PCV Valve

INSPECTION

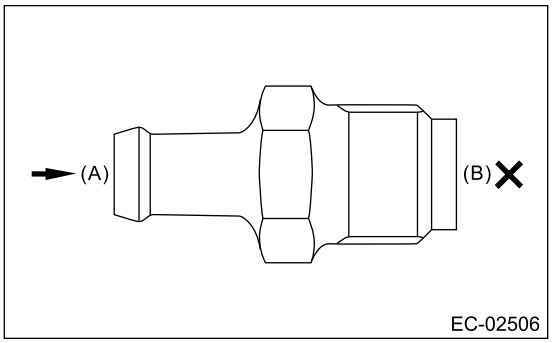
1. PCV VALVE

1. Check that the PCV valve has no deformation, cracks or other damages.

2. Check that air is discharged from (B) when air is blown into (A).



3. Check that air does not come out from (B) when air is blown into (A).



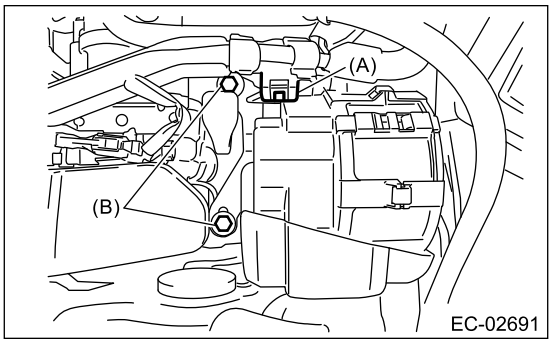
2. OTHER INSPECTIONS

Check the vacuum hose for cracks, damage or looseness.

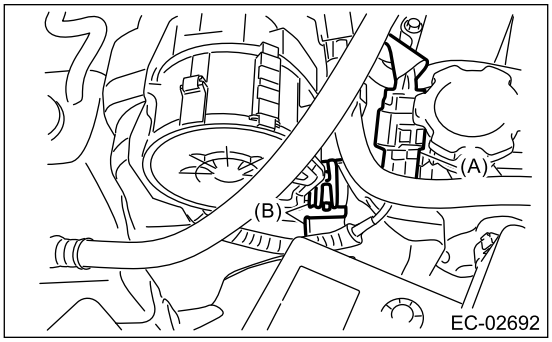
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Pump

REMOVAL

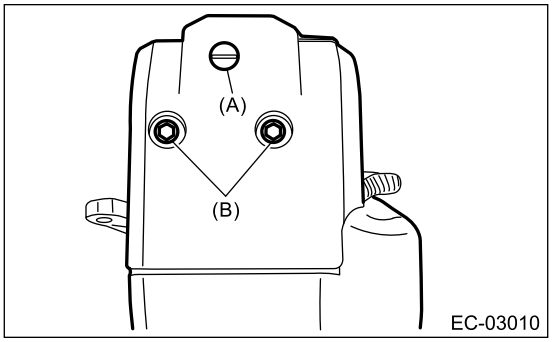
1. Disconnect the ground cable from battery.
2. Remove the clip (A) which holds the harness on the harness stay and remove the bolt (B) which holds the secondary air pump on the vehicle.



3. Disconnect the connector (A) and air duct (B) from secondary air pump.



4. Remove the secondary air pump from the vehicle and the resonator from the secondary air pump.



(A) Clip
(B) Bolt

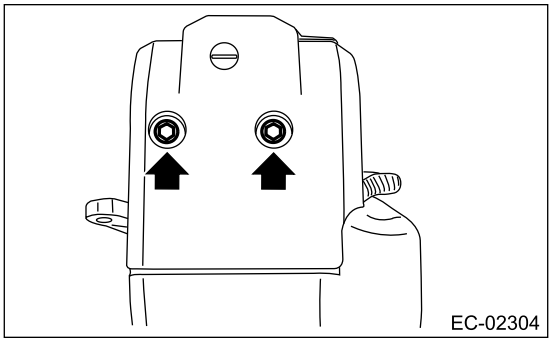
EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Pump

INSTALLATION

Install in the reverse order of removal.

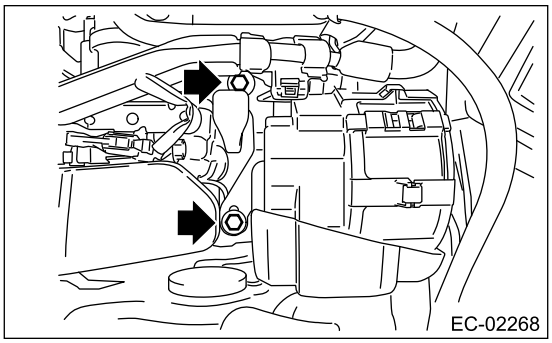
Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Pump

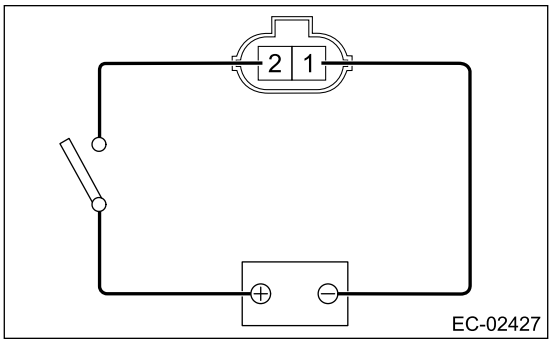
INSPECTION

1. SECONDARY AIR PUMP

1. Check that the secondary air pump has no deformation, cracks or other damages.
2. Connect battery positive terminal to the terminal No. 2 and battery negative terminal to the terminal No. 1, and inspect the secondary air pump operation.

   Caution:

   Do not operate the secondary air pump continuously for 80 seconds or more.



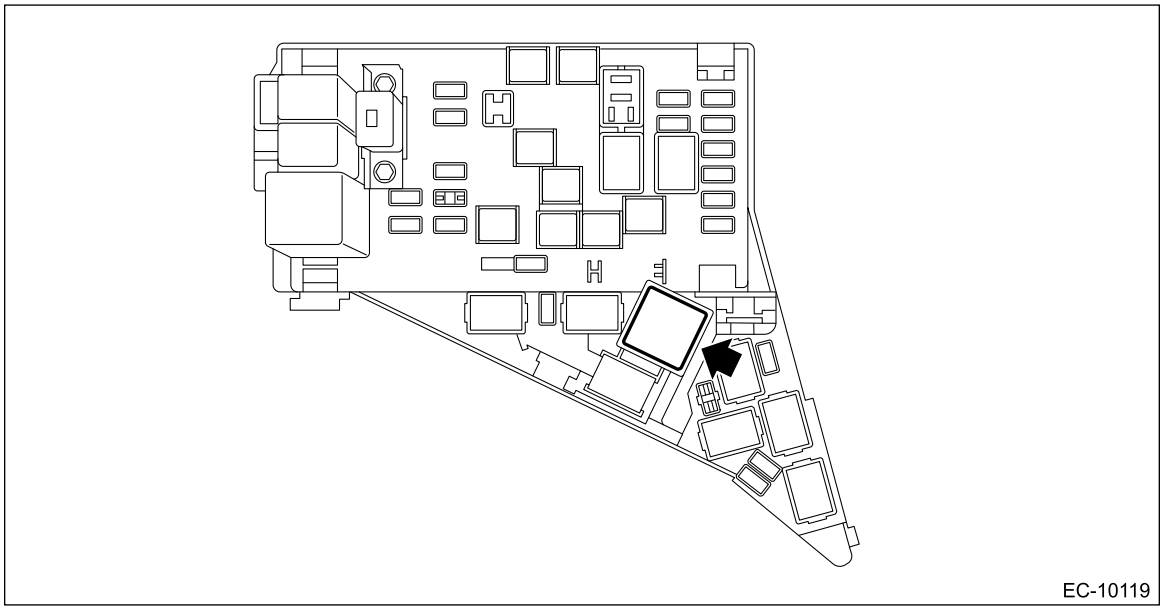
2. OTHER INSPECTIONS

Check that the air duct or resonator has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Pump Relay

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the secondary air pump relay from the main fuse box.



EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Pump Relay

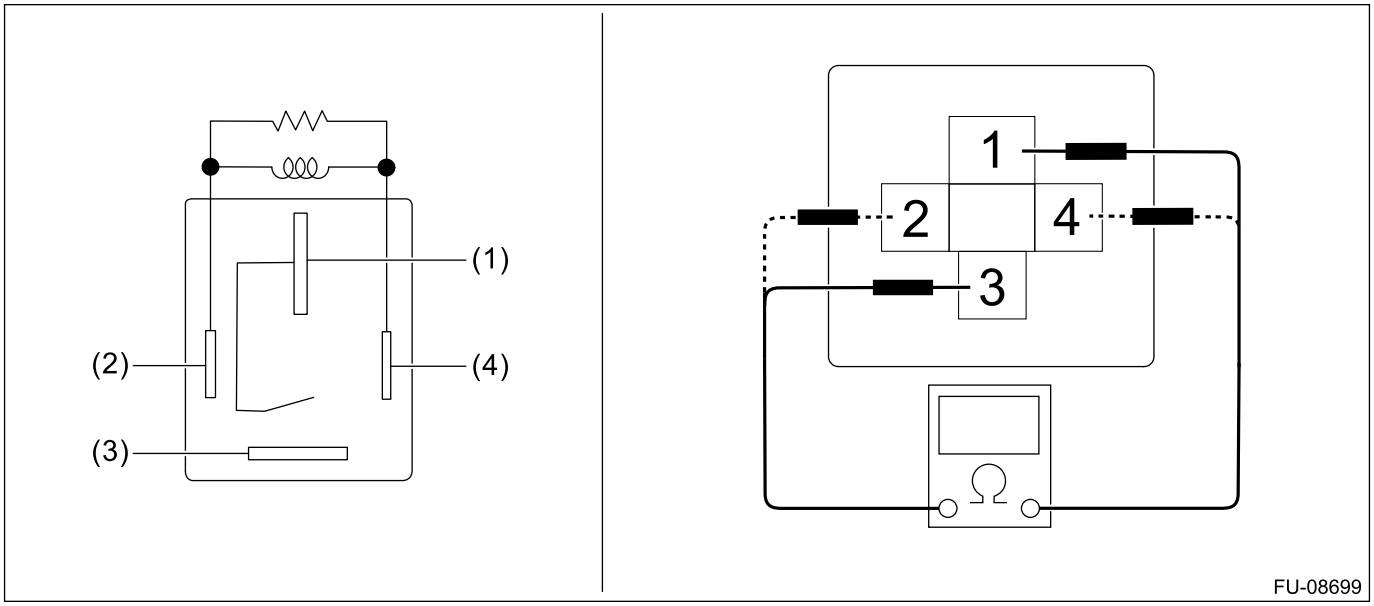
INSTALLATION

1. Install the secondary air pump relay to the main fuse box.
2. Connect the ground terminal to the battery.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Pump Relay

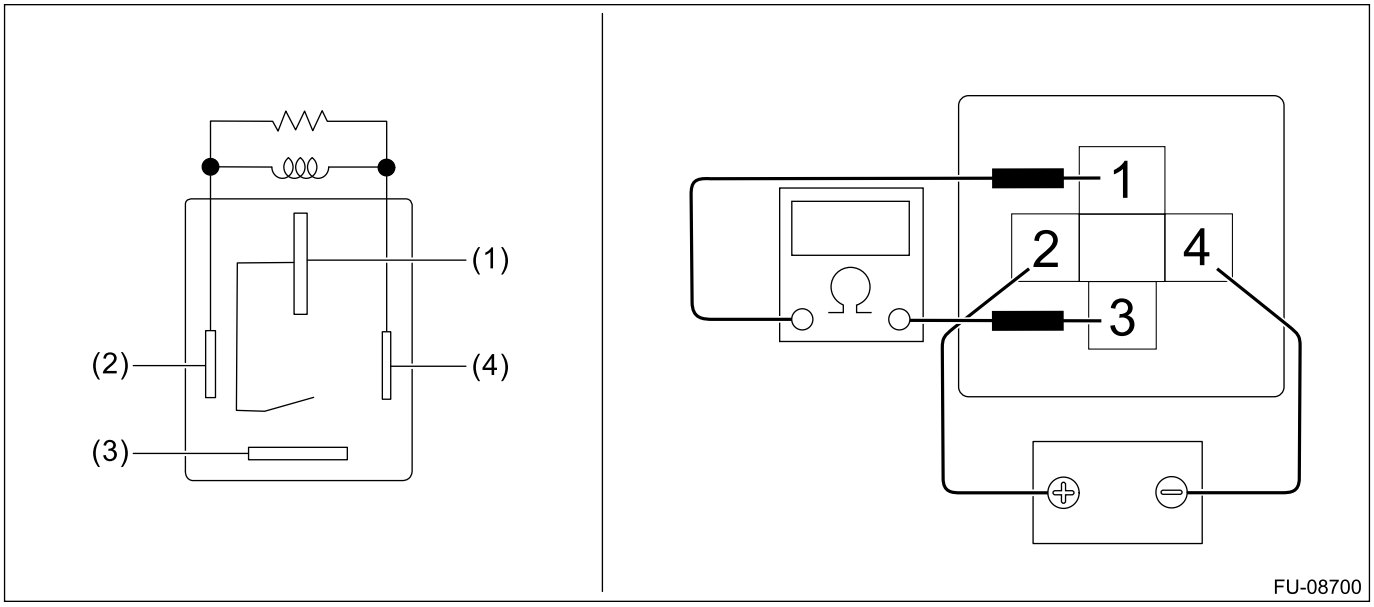
INSPECTION

1. Check that the secondary air pump relay has no deformation, cracks or other damages.
2. Check the resistance between secondary air pump relay terminals.



Terminal No.	Standard
1 and 3	1 MΩ or more
2 and 4	81.9 — 100.1 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 2 and battery ground terminal to terminal No. 4, and check the resistance between the secondary air pump relay terminals.

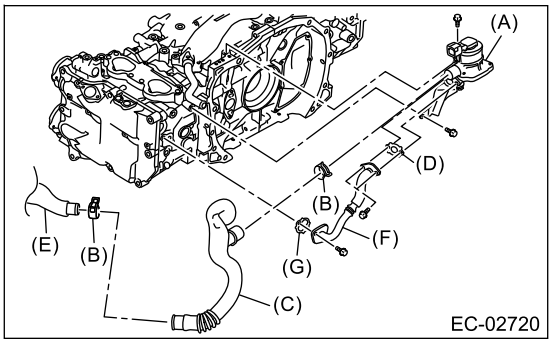


Terminal No.	Standard
1 and 3	Less than 1 Ω

REMOVAL

1. SECONDARY AIR COMBINATION VALVE LH

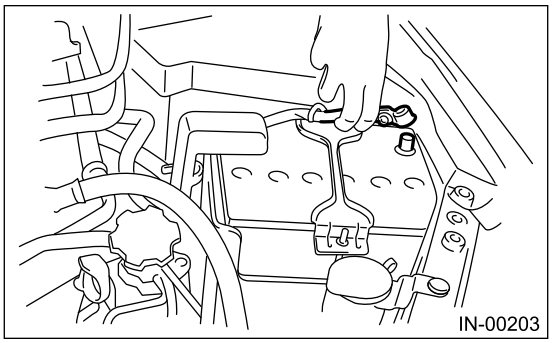
1. Disconnect the ground cable from battery.
2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
3. Disconnect the connector from the secondary air combination valve LH.
4. Disconnect the air duct A.
5. Remove the secondary air pipe LH.
6. Remove the secondary air combination valve LH.



(A) Secondary air combination valve LH
(B) Clip
(C) Air duct A
(D) Gasket
(E) Air duct B
(F) Secondary air pipe LH
(G) Gasket

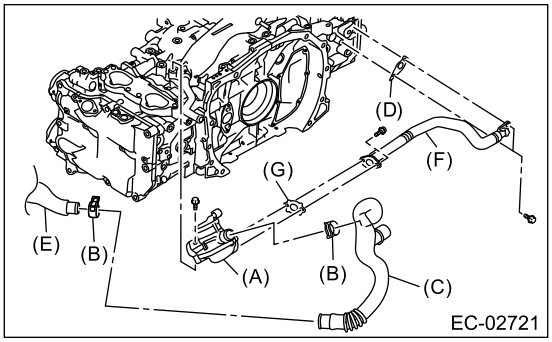
2. SECONDARY AIR COMBINATION VALVE RH

1. Disconnect the ground cable from battery.



2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
3. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
4. Disconnect the air duct A.

5. Disconnect the secondary air pipe RH.
6. Remove the secondary air combination valve RH.



(A) Secondary air combination valve RH
(B) Clip
(C) Air duct A
(D) Gasket
(E) Air duct B
(F) Secondary air pipe RH
(G) Gasket

7. Remove the turbocharger. Ref. to INTAKE (INDUCTION)(STI)>Turbocharger>REMOVAL.
8. Remove the secondary air pipe RH.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Combination Valve

INSTALLATION

1. SECONDARY AIR COMBINATION VALVE LH

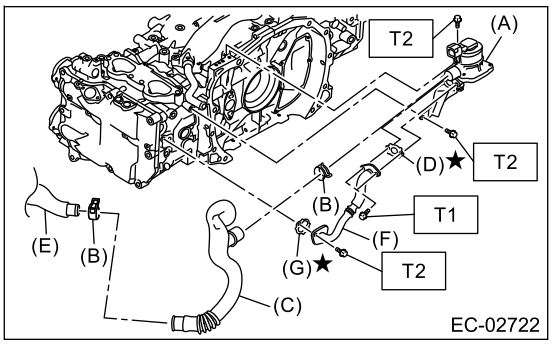
Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

T1: 9 N·m (0.9 kgf-m, 6.6 ft-lb)
T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)



(A) Secondary air combination valve LH
(B) Clip

(C) Air duct A
(D) Gasket
(E) Air duct B
(F) Secondary air pipe LH
(G) Gasket

2. SECONDARY AIR COMBINATION VALVE RH

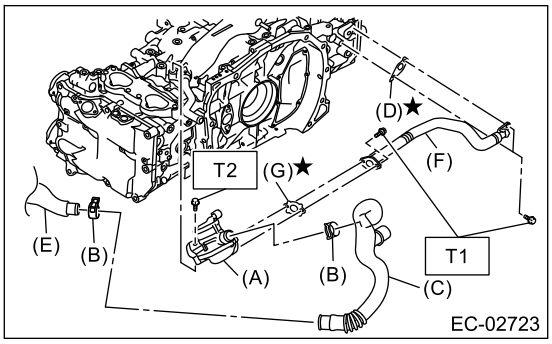
Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

T1: 9 N·m (0.9 kgf-m, 6.6 ft-lb)
T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)



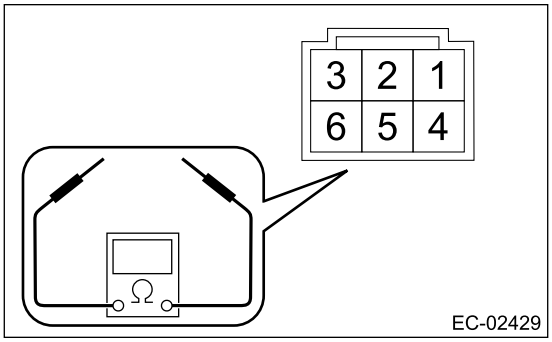
(A) Secondary air combination valve RH
(B) Clip
(C) Air duct A
(D) Gasket
(E) Air duct B
(F) Secondary air pipe RH
(G) Gasket

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI) > Secondary Air Combination Valve

INSPECTION

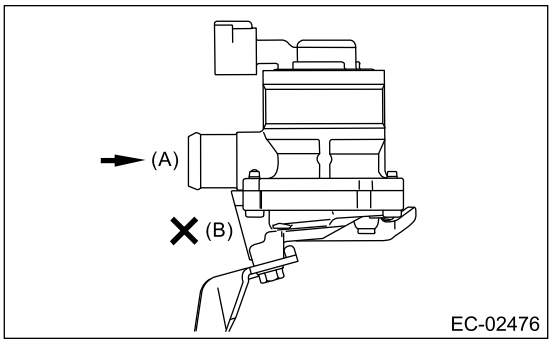
1. SECONDARY AIR COMBINATION VALVE LH

1. Check that the secondary air combination valve LH has no deformation, cracks or other damages.
2. Check the resistance between the terminals of secondary air combination valve LH.

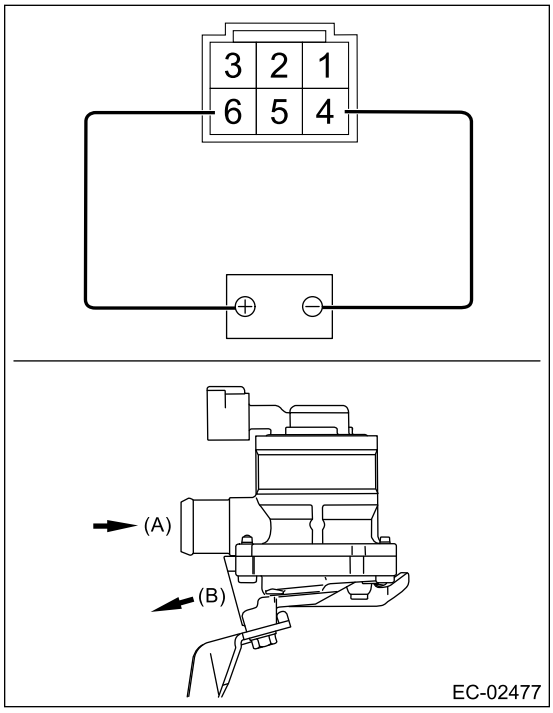


Terminal No.	Standard
4 and 6	5.0±0.5 Ω (when 20°C (68°F))
2 and 3	15 kΩ or less
1 and 2	4.5 kΩ or less

3. Check that air does not come out from (B) when air is blown into (A).

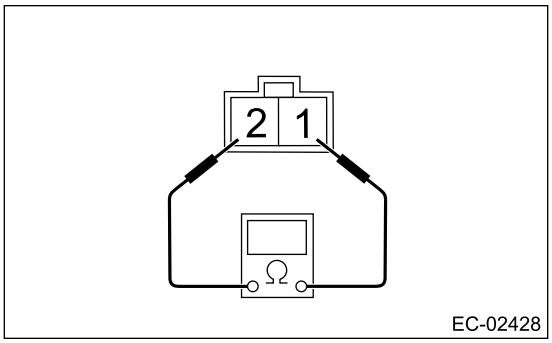


4. Connect the battery positive terminal to the terminal No. 6 and the battery negative terminal to the terminal No. 4. Check that air is discharged from (B), when supplying air to (A).



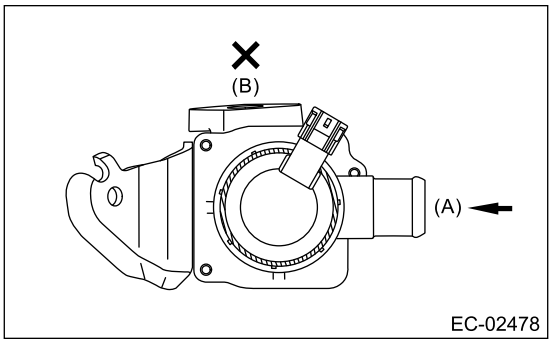
2. SECONDARY AIR COMBINATION VALVE RH

1. Check that the secondary air combination valve RH has no deformation, cracks or other damages.
2. Check the resistance between the terminals of secondary air combination valve RH.

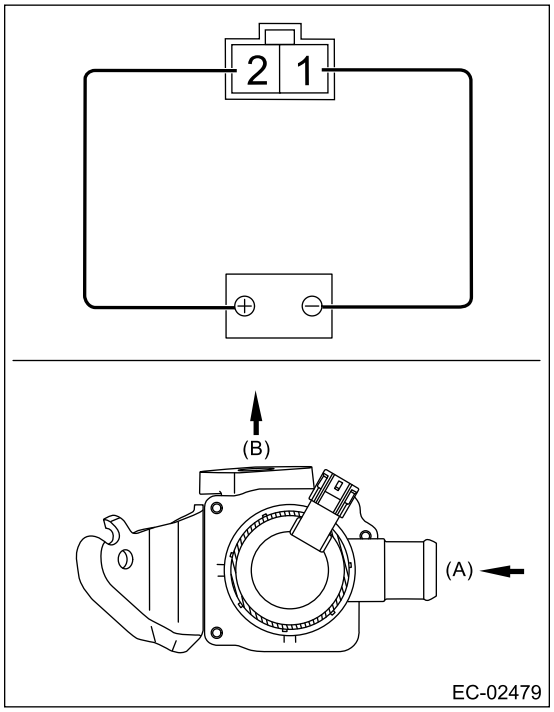


Terminal No.	Standard
1 and 2	5.0±0.5 Ω (when 20°C (68°F))

3. Check that air does not come out from (B) when air is blown into (A).



4. Connect the battery positive terminal to the terminal No. 2 and the battery negative terminal to the terminal No. 1. Check that air is discharged from (B), when supplying air to (A).



3. OTHER INSPECTIONS

1. Check that the secondary air pipe has no deformation, cracks or other damages.
2. Check that the air duct has no cracks, damage or loose part.

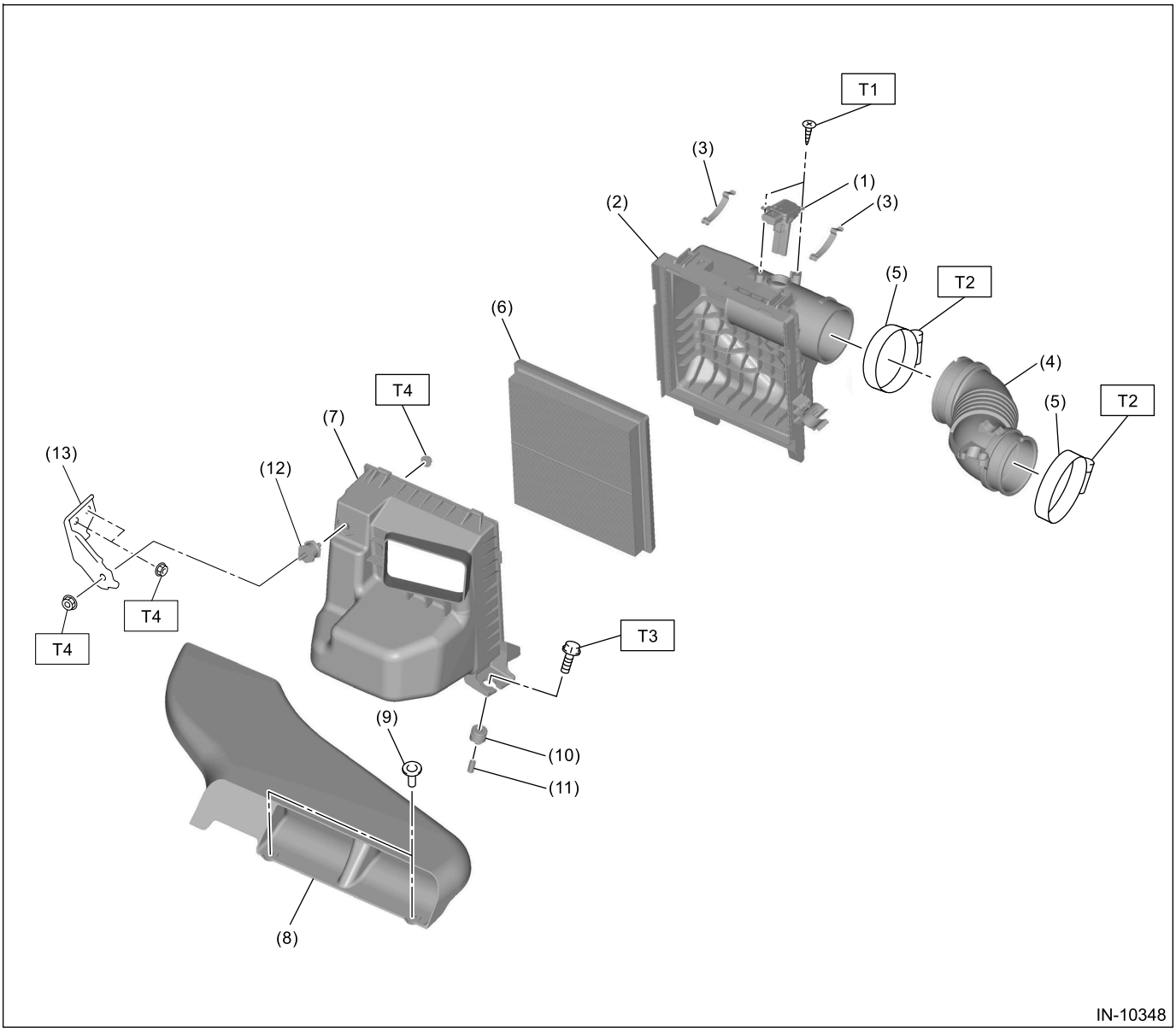
INTAKE (INDUCTION)(STI)

IN(STI)

1. General Description
2. Air Cleaner Element
3. Air Cleaner Case
4. Air Intake Duct
5. Intake Duct
6. Intercooler
7. Turbocharger
8. Air By-pass Valve

COMPONENT

1. AIR CLEANER

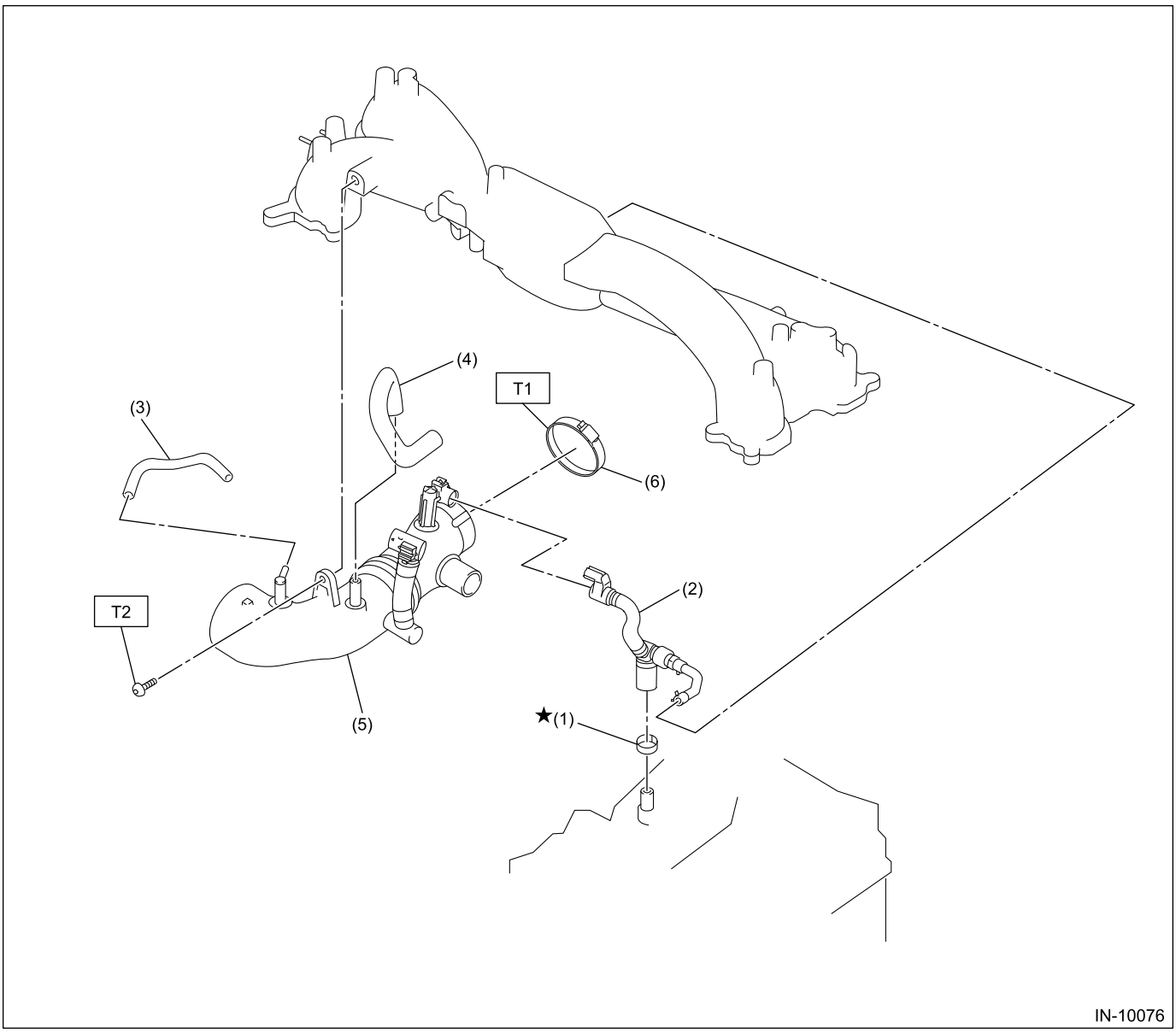


(1) Mass air flow and intake air temperature sensor
(2) Air cleaner case (rear)
(3) Clip
(4) Air intake boot
(5) Clamp
(6) Air cleaner element
(7) Air cleaner case (front)
(8) Air intake duct
(9) Clip
(10) Cushion
(11) Spacer
(12) Cushion
(13) Air cleaner case bracket

Tightening torque: N·m (kgf-m, ft-lb)

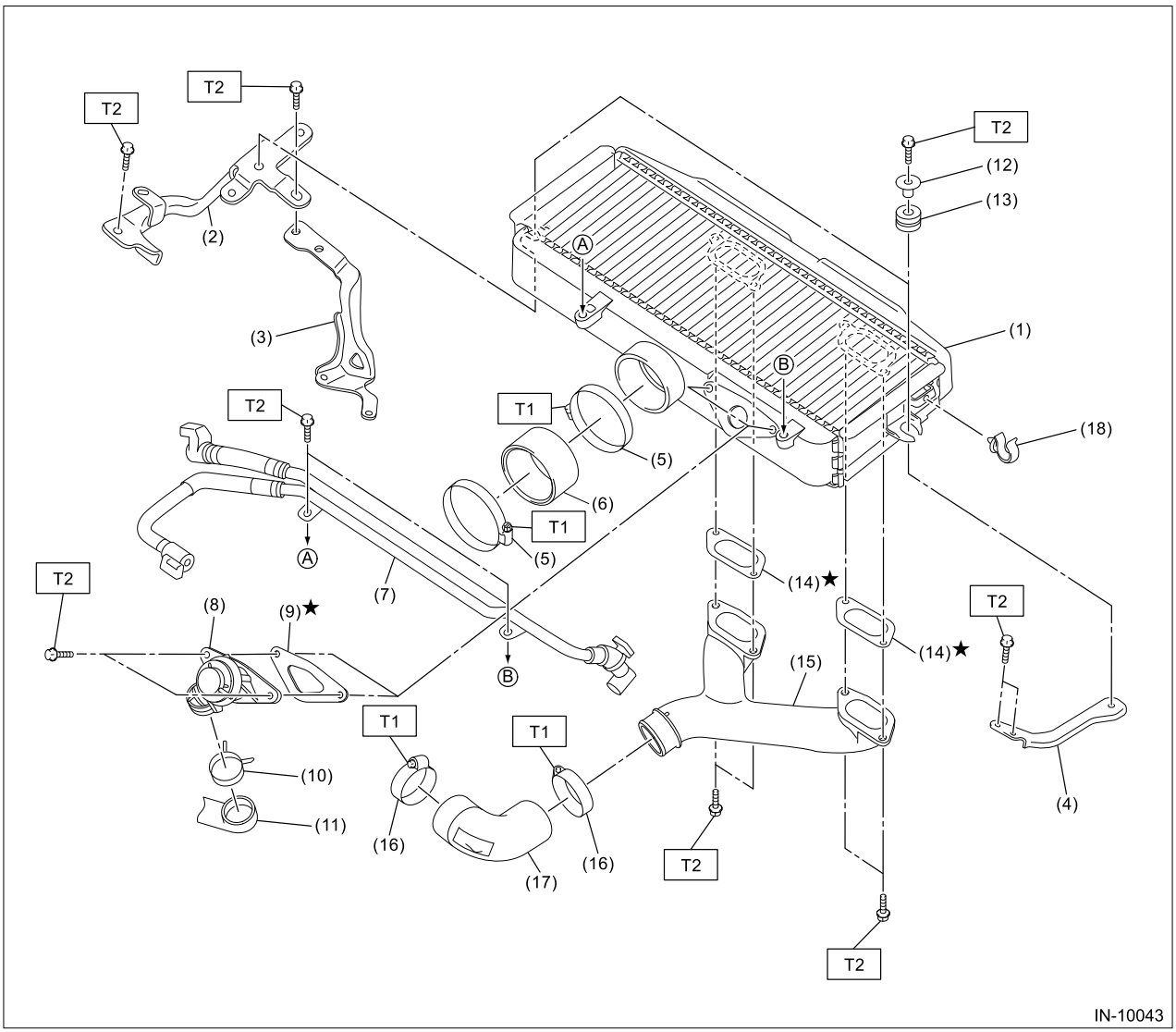
T1: 1 (0.1, 0.7)
T2: 2.5 (0.3, 1.8)
T3: 6 (0.6, 4.4)
T4: 7.5 (0.8, 5.5)

2. INTAKE DUCT



(1) Clamp	(4) Vacuum hose B	***Tightening torque: N·m (kgf-m, ft-lb)***
(2) PCV hose ASSY	(5) Intake duct	***T1: 3 (0.3, 2.2)***
(3) Vacuum hose A	(6) Clamp	***T2: 17 (1.7, 12.5)***

3. INTERCOOLER

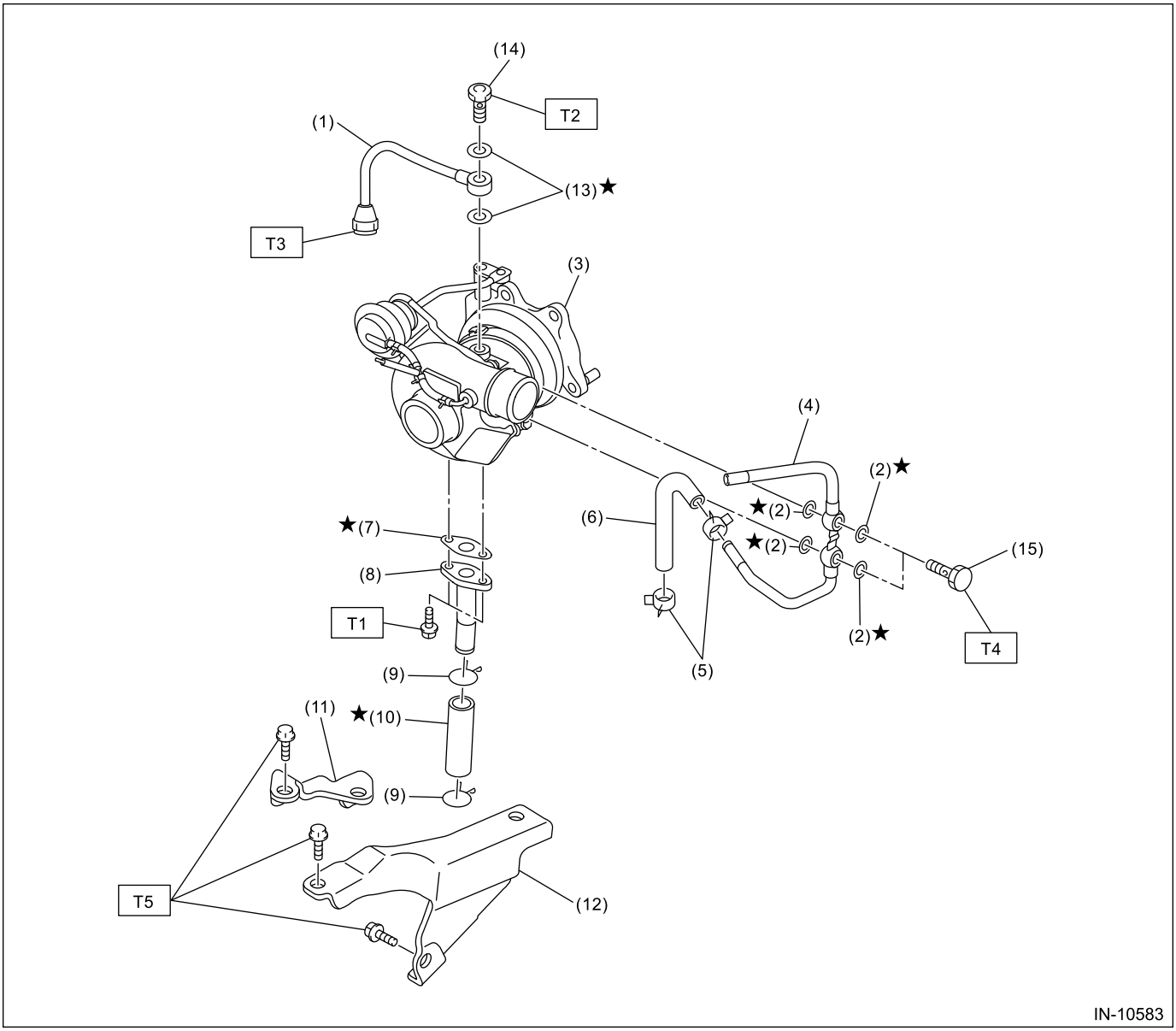


(1) Intercooler
(2) Intercooler stay RH No. 1
(3) Intercooler stay RH No. 2
(4) Intercooler stay LH
(5) Clamp
(6) Air duct hose
(7) PCV pipe ASSY
(8) Air by-pass valve
(9) Gasket
(10) Clip
(11) Air by-pass hose
(12) Spacer
(13) Cushion
(14) Gasket
(15) Intercooler duct
(16) Clamp
(17) Intake duct
(18) Clip

Tightening torque: N·m (kgf-m, ft-lb)

T1: 3 (0.3, 2.2)
T2: 16 (1.6, 11.8)

4. TURBOCHARGER



(1) Oil inlet pipe	(9) Clip	***Tightening torque: N·m (kgf-m, ft-lb)***
(2) Gasket	(10) Oil outlet hose	***T1: 4.9 (0.5, 3.6)***
(3) Turbocharger	(11) Turbocharger stay RH	***T2: 16 (1.6, 11.8)***
(4) Water pipe	(12) Turbocharger stay LH	***T3: 20 (2.0, 14.8)***
(5) Clip	(13) Gasket	***T4: 23 (2.3, 17.0)***
(6) Engine coolant hose	(14) Union bolt A	***T5: 33 (3.4, 24.3)***
(7) Gasket	(15) Union bolt B	
(8) Oil outlet pipe		

INTAKE (INDUCTION)(STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

PREPARATION TOOL

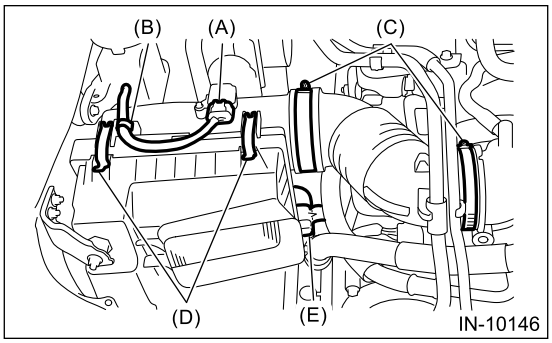
1. GENERAL TOOL

TOOL NAME	REMARKS
Mighty Vac	Used for checking waste gate actuator and air by-pass valve.

INTAKE (INDUCTION)(STI) > Air Cleaner Element

REMOVAL

1. Disconnect the ground cable from battery.
2. Disconnect the connector (A) from the mass air flow and intake air temperature sensor, and remove the harness clip (B).
3. Loosen the clamp (C) which holds the air intake boot.
4. Remove the clips (D) from the air cleaner case (front).
5. Remove the power steering oil pressure hose (suction hose) (E) from the air cleaner case (rear).



6. Remove the air cleaner case (rear) and air intake boot.
7. Remove the air cleaner element.

INTAKE (INDUCTION)(STI) > Air Cleaner Element

INSTALLATION

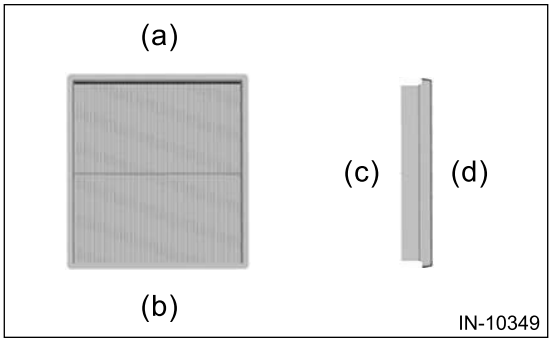
Install in the reverse order of removal.

Caution:

Be sure to use SUBARU genuine air cleaner element depending on the engine type when replacing the air cleaner elements. Using other air cleaner element may affect the engine performance.

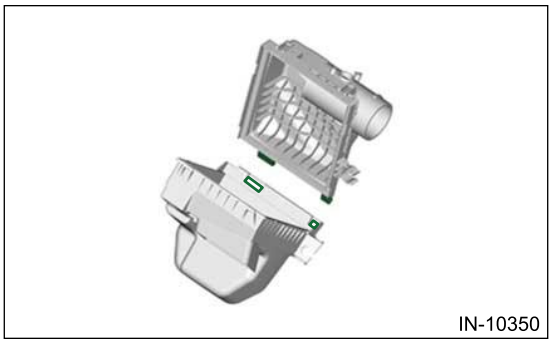
Note:

- **Check that there is no dirt or dust within the air cleaner case. If any dirt or dust is found, clean it.**
- **Install the air cleaner element as shown in the figure.**



(a) Upside
(b) Downside
(c) Air cleaner case (front) side
(d) Air cleaner case (rear) side

- **When setting the air cleaner case (rear), align the protrusion of the air cleaner case (rear) to the air cleaner case (front) to insert.**



Tightening torque:
2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

INTAKE (INDUCTION)(STI) > Air Cleaner Element

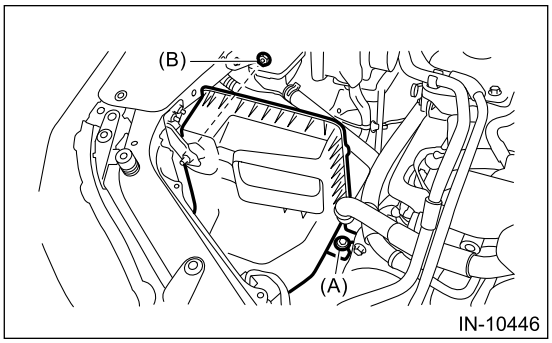
INSPECTION

1. Check that the air cleaner element has no deformation, cracks or other damages.
2. Check the air cleaner element for excessive dirt.

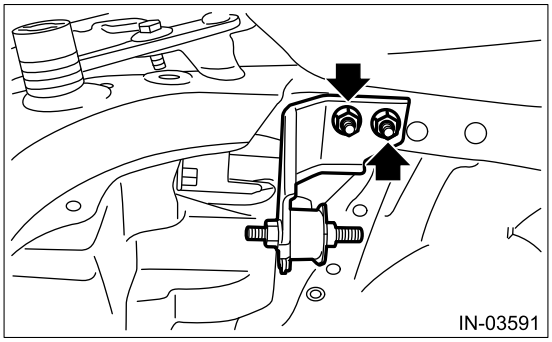
INTAKE (INDUCTION)(STI) > Air Cleaner Case

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
3. Remove the air cleaner element. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Element>REMOVAL.
4. Remove the bolt (A) and nut (B), and remove the air cleaner case (front).



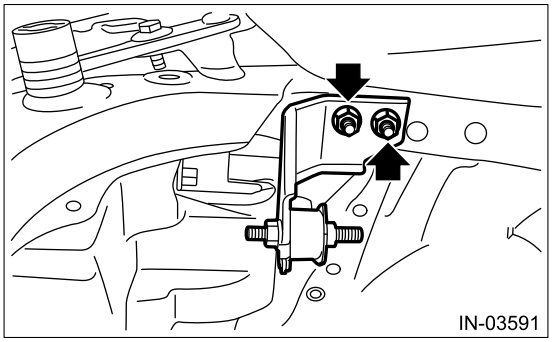
5. Remove the air cleaner case bracket from the vehicle.



INTAKE (INDUCTION)(STI) > Air Cleaner Case

INSTALLATION

1. Install the air cleaner case bracket to the vehicle.
   Tightening torque:
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

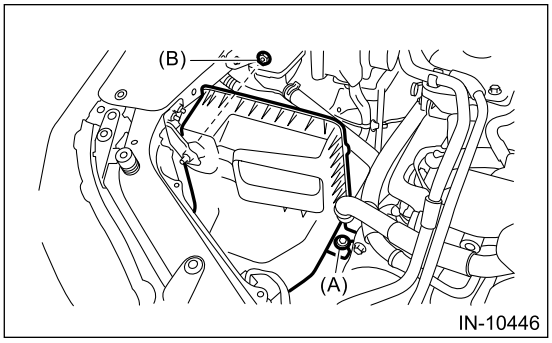


2. Set the air cleaner case (front) and install the bolt (A) and nut (B).
   Tightening torque:
   Bolt (A)

6 N·m (0.6 kgf-m, 4.4 ft-lb)

Nut (B)

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



3. Install the air cleaner element. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Element>INSTALLATION.
4. Install the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>INSTALLATION.
5. Connect the battery ground terminal.

INTAKE (INDUCTION)(STI) > Air Cleaner Case

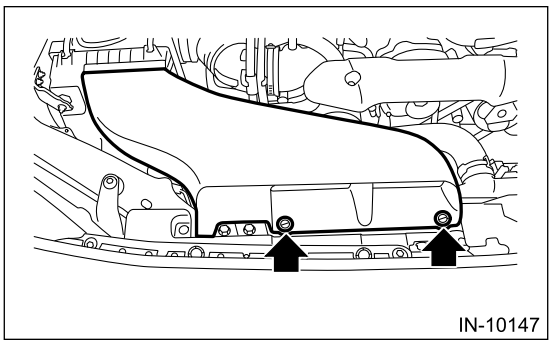
INSPECTION

1. Check that the air cleaner case has no deformation, cracks or other damages.
2. Check that the air intake boot has no cracks, damage or loose part.

INTAKE (INDUCTION)(STI) > Air Intake Duct

REMOVAL

Remove the clip which secures the air intake duct, and remove the air intake duct.



INTAKE (INDUCTION)(STI) > Air Intake Duct

INSTALLATION

Install in the reverse order of removal.

INTAKE (INDUCTION)(STI) > Air Intake Duct

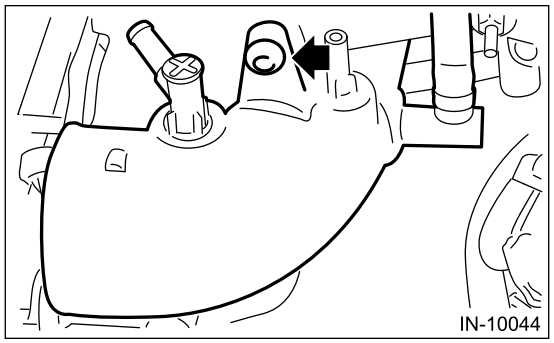
INSPECTION

1. Check that the air intake duct has no deformation, cracks or other damages.
2. Inspect that no foreign objects are mixed in the air intake duct.

INTAKE (INDUCTION)(STI) > Intake Duct

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Remove the sensor, engine harness and fuel pipe from the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>DISASSEMBLY.
4. Remove the intake duct from intake manifold.



INTAKE (INDUCTION)(STI) > Intake Duct

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

17 N·m (1.7 kgf-m, 12.5 ft-lb)

INTAKE (INDUCTION)(STI) > Intake Duct

INSPECTION

1. LEAK DIAGNOSIS CONNECTOR

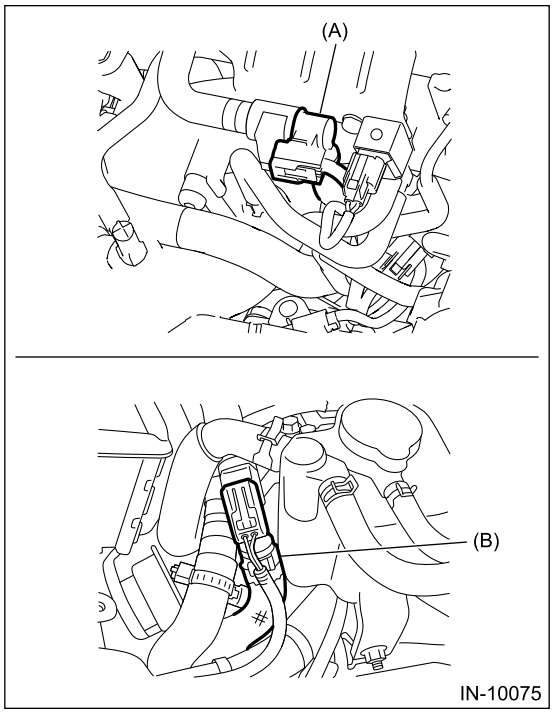
Refer to “PCV Pipe Assembly” for inspection of leak diagnosis connector. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>PCV Hose Assembly>INSPECTION > LEAK DIAGNOSIS CONNECTOR.

2. OTHER INSPECTIONS

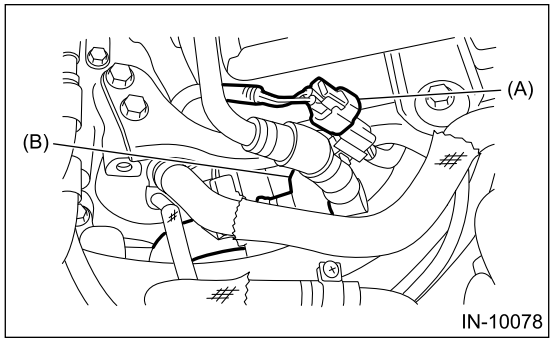
Check that the intake duct has no deformation, cracks or other damages.

REMOVAL

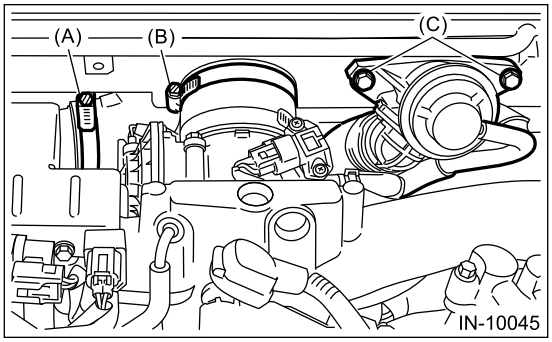
1. Disconnect the ground cable from battery.
2. Unlock the leak diagnosis connector, and disconnect the PCV hoses (A) and (B) from the PCV pipe assembly.



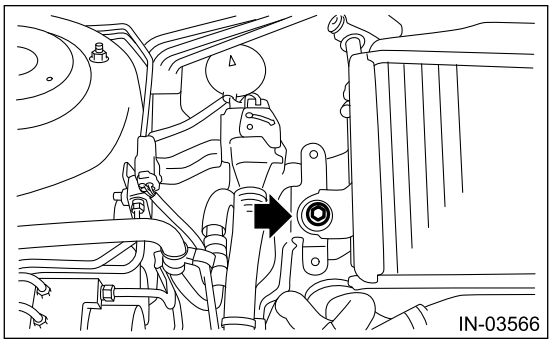
3. Disconnect the connector (A) from the PCV pipe assembly.
4. Unlock the leak diagnosis connector, and disconnect the PCV hose (B) from the PCV pipe assembly.



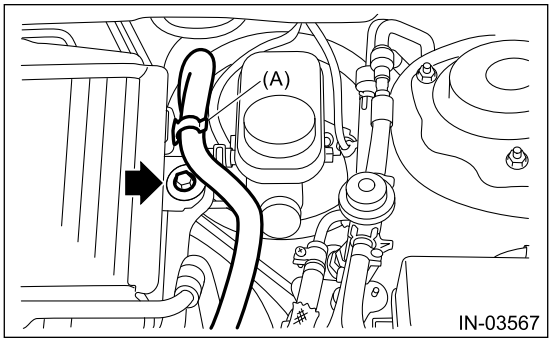
5. Loosen the clamp (A) holding the intake duct to the turbocharger.
6. Loosen the clamp (B) holding the air duct hose to the intercooler.
7. Remove the bolts (C) securing the air by-pass valve to the intercooler, and disconnect the air by-pass valve.



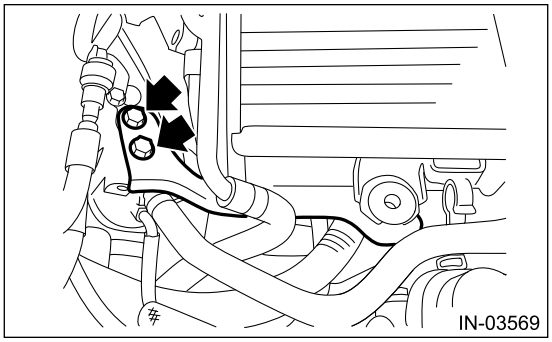
8. Remove the bolts which secure the intercooler to the intercooler stay RH No. 1.



9. Remove the brake booster vacuum hose from the intercooler clip (A), and remove the bolts which secure the intercooler to the intercooler stay LH.

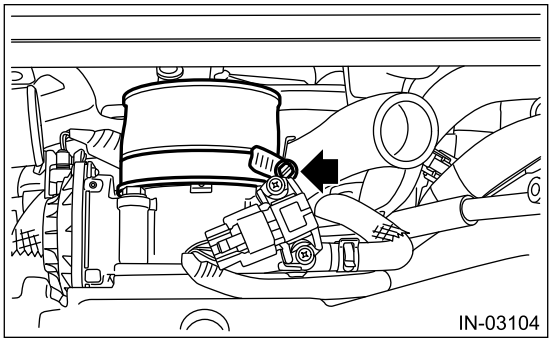


10. Remove the intercooler stay LH.

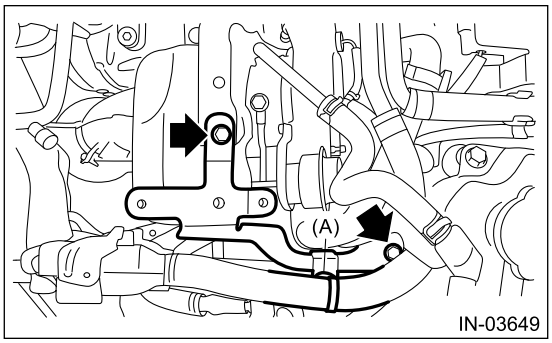


11. Remove the intercooler.

12. Remove the air duct hose from the throttle body.



13. Remove clip (A) holding the engine harness to the intercooler stay RH No. 1, and remove the intercooler stay RH No. 1.



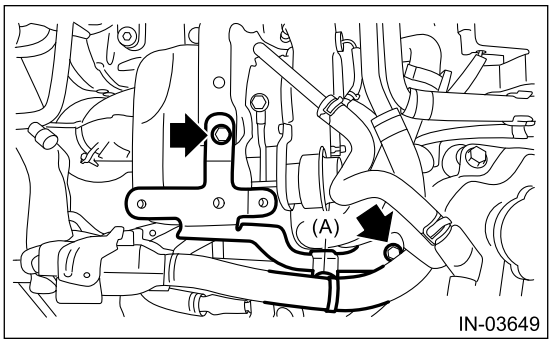
INTAKE (INDUCTION)(STI) > Intercooler

INSTALLATION

1. Install the intercooler stay RH No. 1, and install the clip (A) which secures the engine harness to the intercooler stay RH No. 1.

Tightening torque:

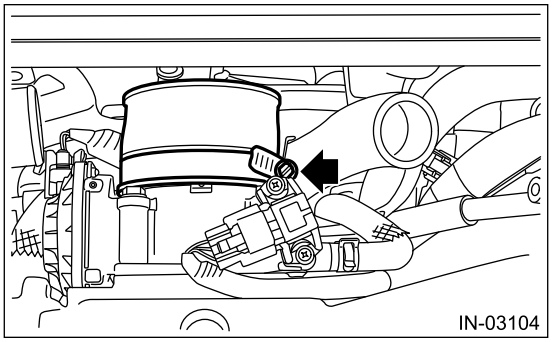
16 N·m (1.6 kgf-m, 11.8 ft-lb)



2. Attach the air duct hose to the throttle body.

Tightening torque:

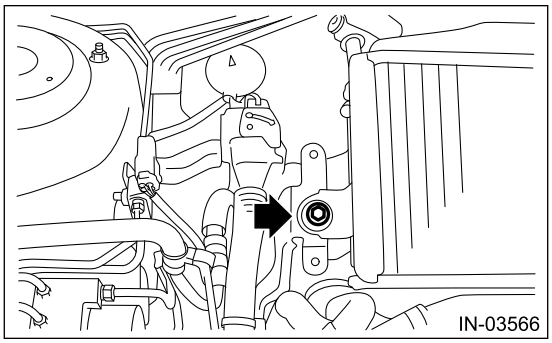
3 N·m (0.3 kgf-m, 2.2 ft-lb)



3. Set the intercooler to the vehicle, and install the bolts securing the intercooler to the intercooler stay RH No. 1.

Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)



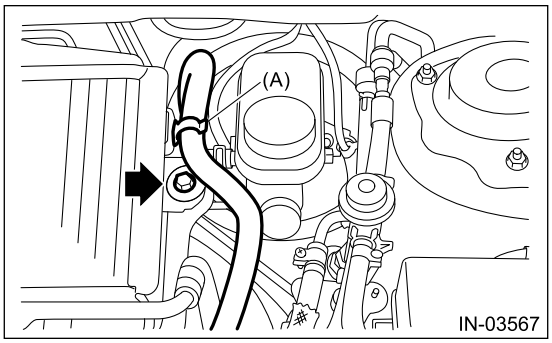
4. Temporarily tighten the bolt securing the intercooler stay LH to the intake manifold.



5. Install the bolts which secure the intercooler to the intercooler stay LH, and install the brake booster vacuum hose to the clip (A).

Tightening torque:

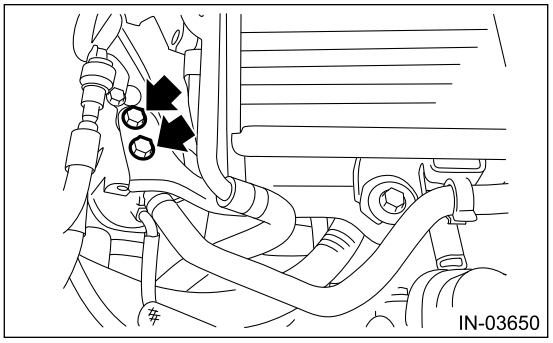
16 N·m (1.6 kgf-m, 11.8 ft-lb)



6. Tighten the bolt securing the intercooler stay LH to the intake manifold.

Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)



7. Tighten the clamp (A) which secures the intake duct to the turbocharger.
8. Tighten the clamp (B) which secures the air duct hose to the intercooler.
9. Install the bolts (C) which secures the air by-pass valve to the intercooler, and install the air by-pass valve.

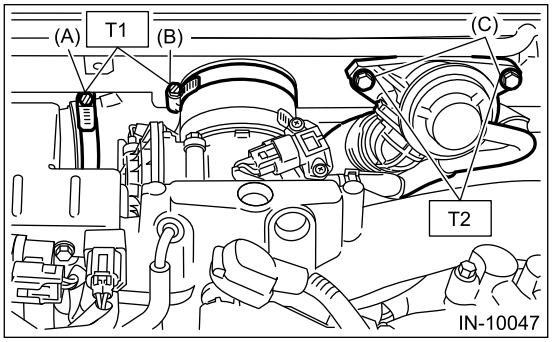
Note:

Use a new gasket.

Tightening torque:

T1: 3 N·m (0.3 kgf-m, 2.2 ft-lb)

T2: 16 N·m (1.6 kgf-m, 11.8 ft-lb)

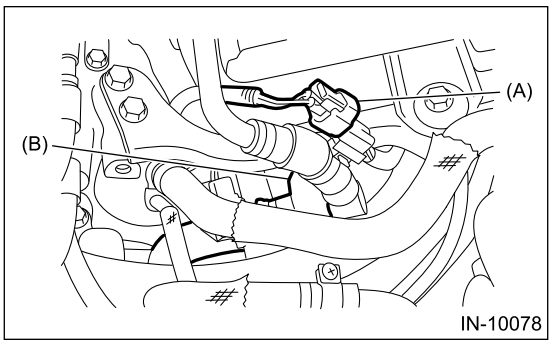


10. Connect the PCV hose (B) to PCV pipe assembly.

Note:

Make sure that the leak diagnosis connector is connected securely.

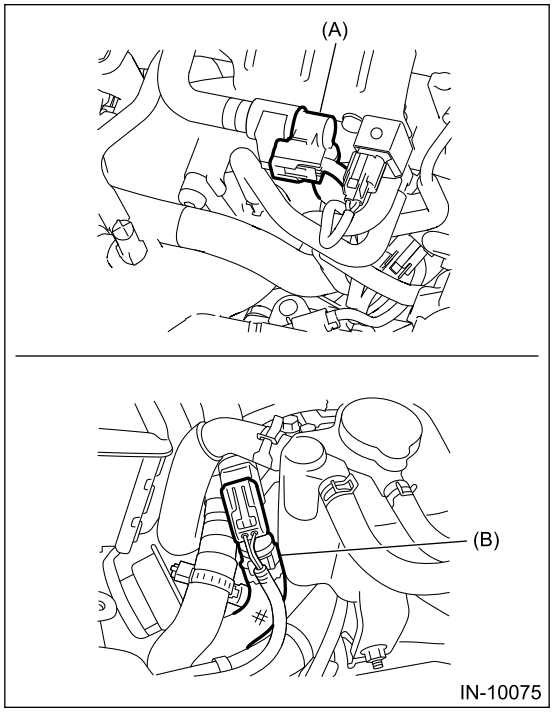
11. Connect the connector (A) to the PCV pipe assembly.



12. Connect the PCV hoses (A) and (B) to the PCV pipe assembly.

Note:

Make sure that the leak diagnosis connector is connected securely.

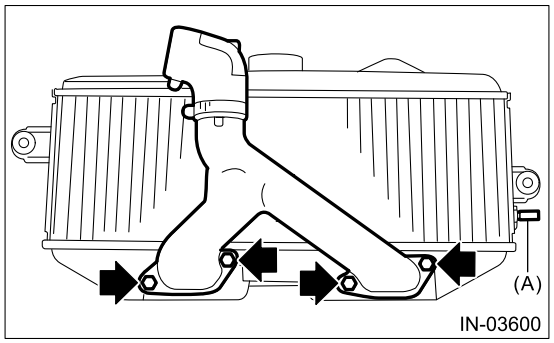


13. Connect the battery ground terminal.

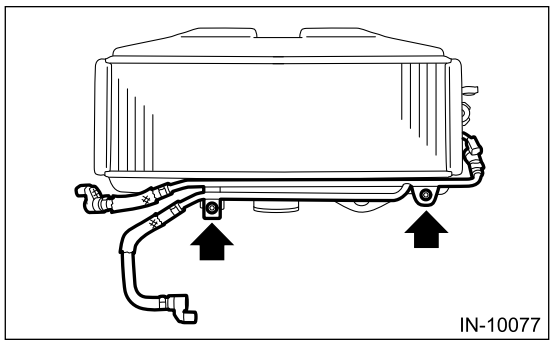
INTAKE (INDUCTION)(STI) > Intercooler

DISASSEMBLY

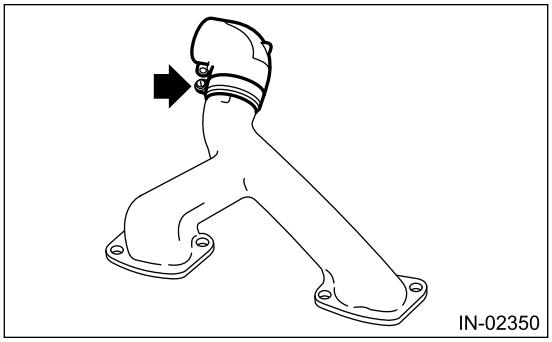
1. Remove the clip (A) and intercooler duct from the intercooler.



2. Remove the PCV pipe assembly from the intercooler.



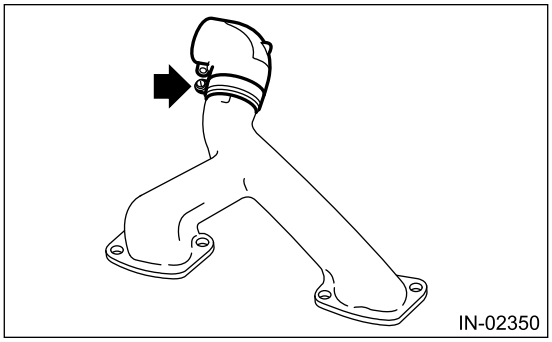
3. Remove the intake duct from intercooler duct.



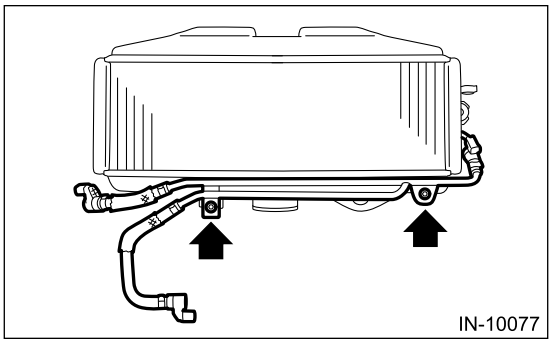
INTAKE (INDUCTION)(STI) > Intercooler

ASSEMBLY

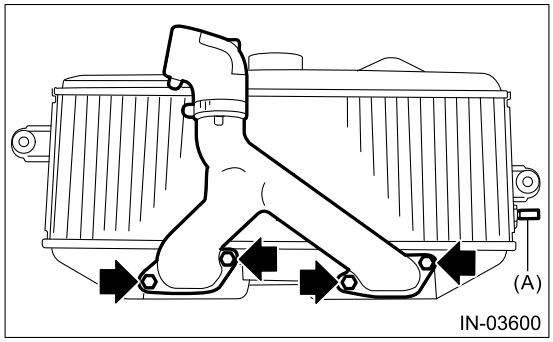
1. Install the intake duct to the intercooler duct.
   Tightening torque:
   3 N·m (0.3 kgf-m, 2.2 ft-lb)



2. Install the PCV pipe assembly to the intercooler.
   Tightening torque:
   16 N·m (1.6 kgf-m, 11.8 ft-lb)



3. Install the clip (A) and intercooler duct to the intercooler.
   Note:
   Use a new gasket.
   Tightening torque:
   16 N·m (1.6 kgf-m, 11.8 ft-lb)



INTAKE (INDUCTION)(STI) > Intercooler

INSPECTION

1. LEAK DIAGNOSIS CONNECTOR

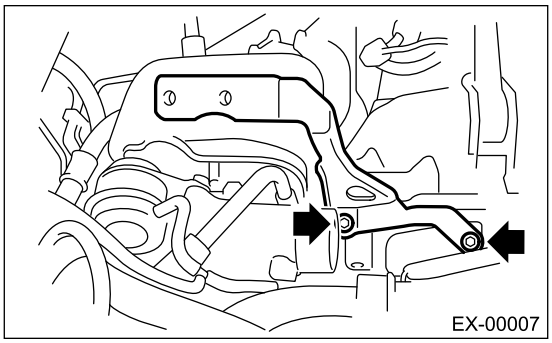
Refer to “PCV Pipe Assembly” for inspection of leak diagnosis connector. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>PCV Hose Assembly>INSPECTION > LEAK DIAGNOSIS CONNECTOR.

2. OTHER INSPECTIONS

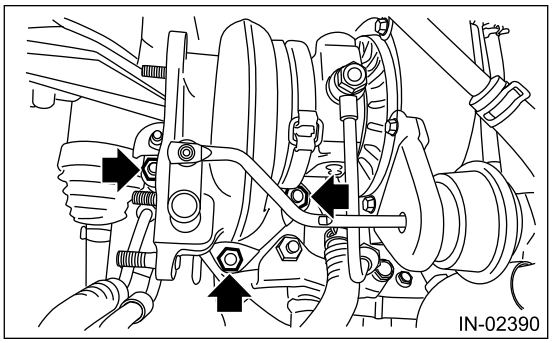
1. Check that the intercooler, intercooler ducts and PCV pipe assembly have no deformation, cracks or other damages.
2. Check that the hose and intake duct have no cracks, damage or loose part.

REMOVAL

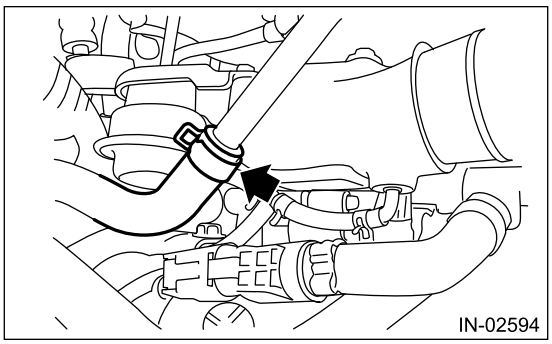
1. Disconnect the ground cable from battery.
2. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
3. Lower the vehicle.
4. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
5. Remove the intercooler stay RH No. 2.



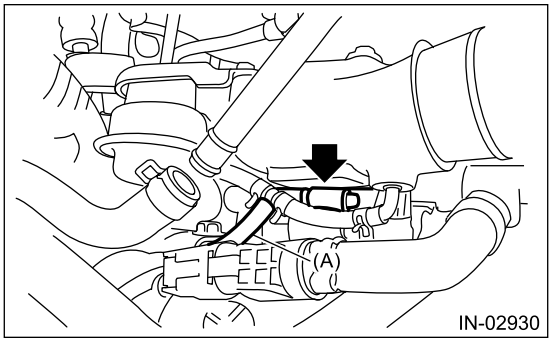
6. Remove the center exhaust pipe. Ref. to EXHAUST(STI)>Center Exhaust Pipe>REMOVAL.
7. Lower the vehicle.
8. Remove the joint pipe from the turbocharger.



9. Disconnect the engine coolant hose from the upper side of the water pipe.



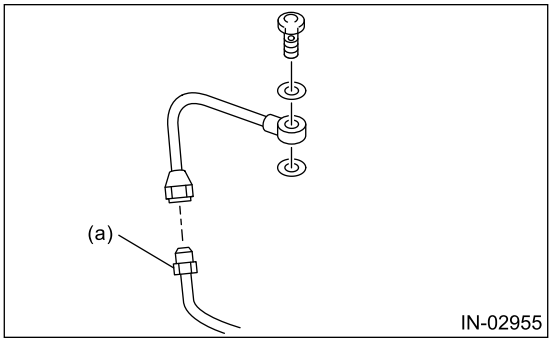
10. Disconnect the air control hose (A), and loosen the clamp holding the intake duct to the turbocharger.

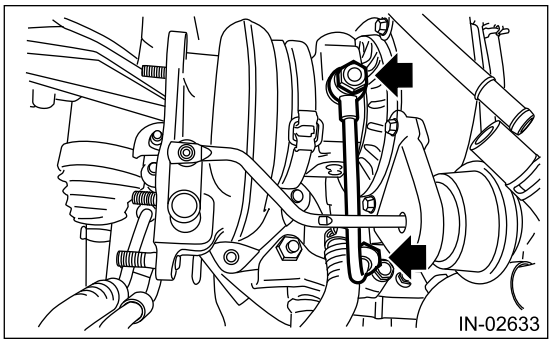


11. Remove the oil inlet pipe from the turbocharger.

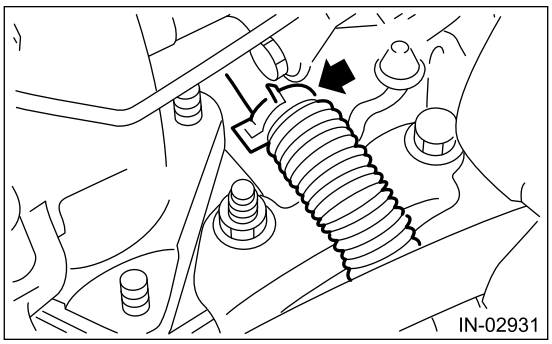
Caution:

In order to prevent damaging the oil pipe on the cylinder head side, fix the section (a) shown in the figure when loosing the oil inlet pipe flare nut, and avoid the part from rotating together while loosening the nut.

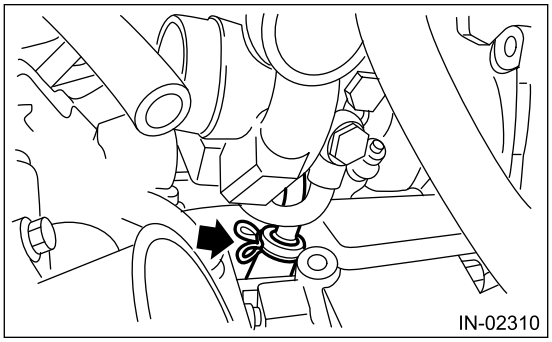




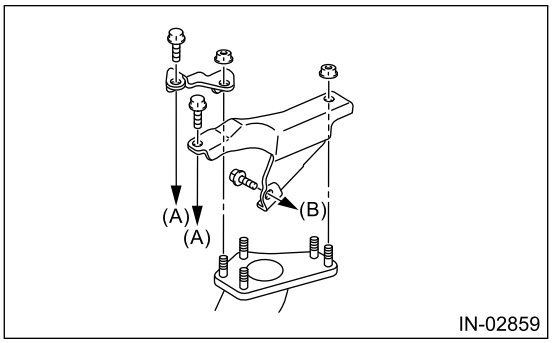
12. Disconnect the engine coolant hose from the lower side of the water pipe.



13. Disconnect the oil outlet hose from the oil outlet pipe, and remove the turbocharger.



14. Remove the turbocharger stay.



(A) To cylinder head RH

(B) To cylinder block RH

INTAKE (INDUCTION)(STI) > Turbocharger

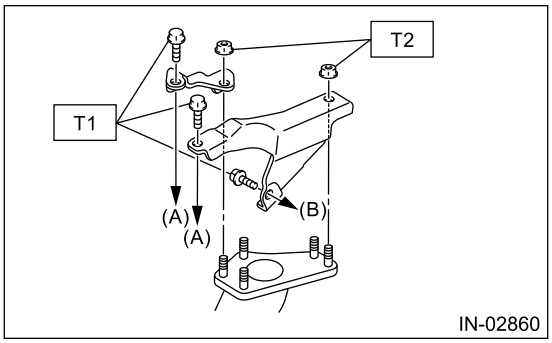
INSTALLATION

1. Install the turbocharger stay.

Tightening torque:

T1: 33 N·m (3.4 kgf-m, 24.3 ft-lb)

T2: 42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



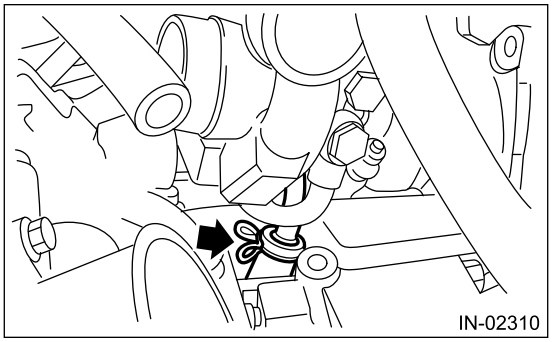
(A) To cylinder head RH

(B) To cylinder block RH

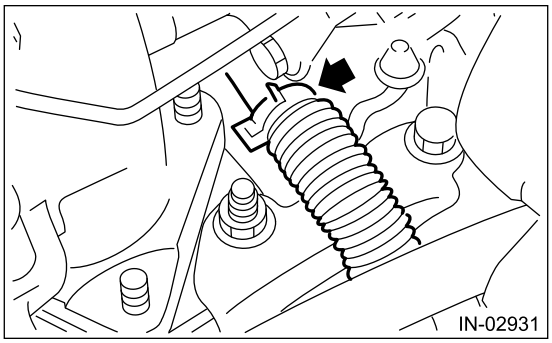
2. Connect the oil outlet hose to the oil outlet pipe.

Note:

Use a new oil outlet hose.



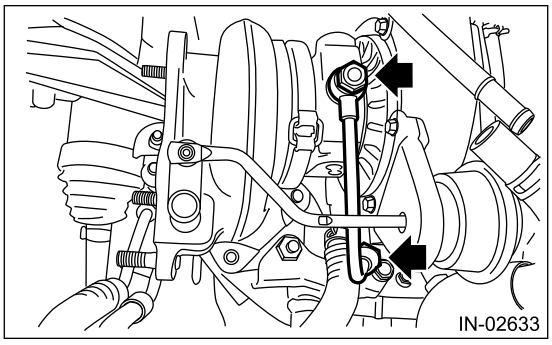
3. Connect the engine coolant hose to the lower side of the water pipe.



4. Temporarily tighten the union bolts and flare nuts which secure the oil inlet pipe to the turbocharger.

Note:

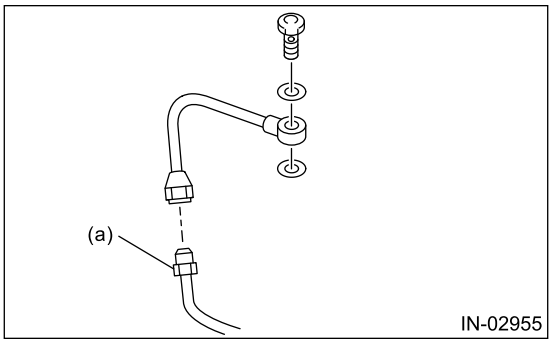
Use a new gasket.



5. Tighten the union bolts and flare nuts which secure the oil inlet pipe to the turbocharger.

Caution:

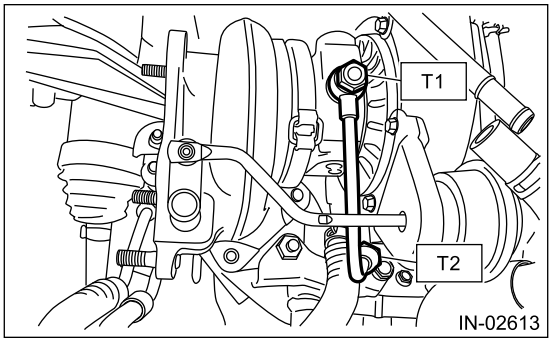
In order to prevent damaging the oil pipe on the cylinder head side, fix the section (a) shown in the figure when tightening the oil inlet pipe flare nut, and avoid the part from rotating together while tightening the nut.



Tightening torque:

T1: 16 N·m (1.6 kgf-m, 11.8 ft-lb)

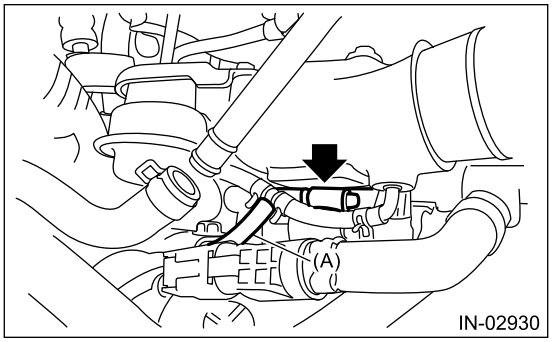
T2: 20 N·m (2.0 kgf-m, 14.8 ft-lb)



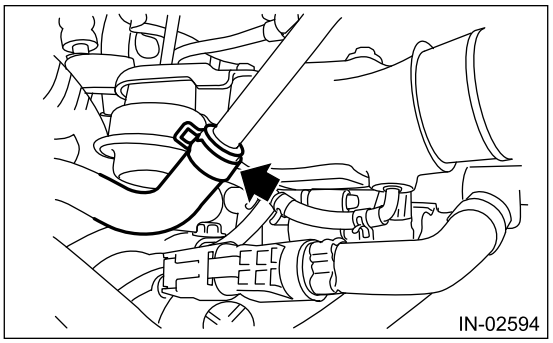
6. Connect the air control hose (A), and install the intake duct to the turbocharger.

Tightening torque:

3 N·m (0.3 kgf-m, 2.2 ft-lb)



7. Connect the engine coolant hoses to the upper side of the water pipe.



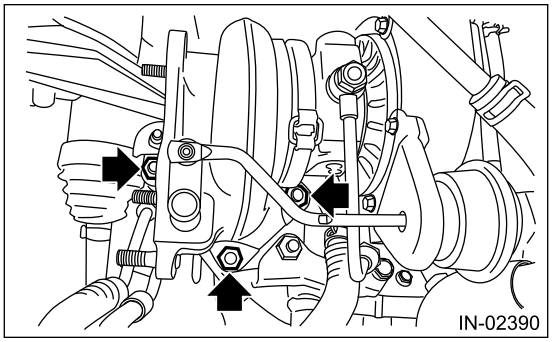
8. Install the joint pipe to turbocharger.

Note:

Use a new gasket.

Tightening torque:

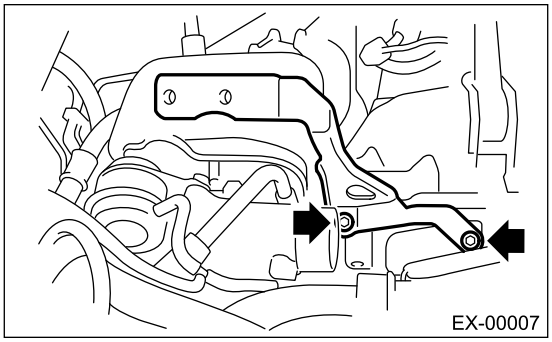
42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



9. Lift up the vehicle.
10. Install the center exhaust pipe. Ref. to EXHAUST(STI)>Center Exhaust Pipe>INSTALLATION.
11. Lower the vehicle.
12. Install the intercooler stay RH No. 2.

Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)



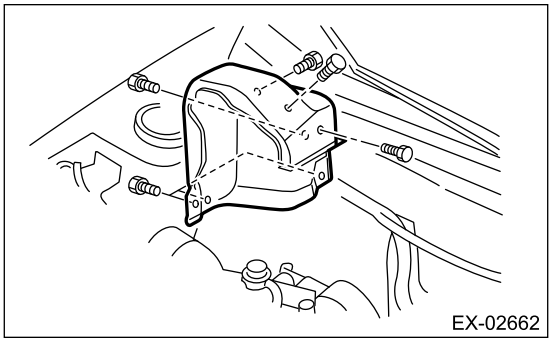
13. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.
14. Connect the battery ground terminal.
15. Fill engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

INTAKE (INDUCTION)(STI) > Turbocharger

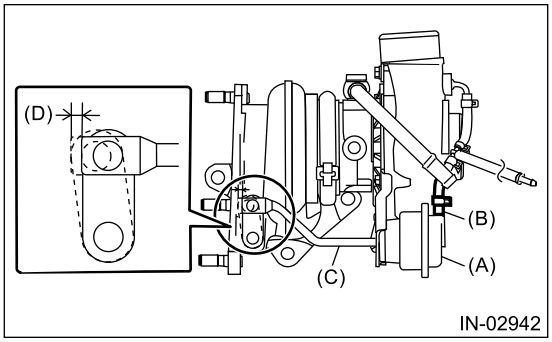
INSPECTION

1. WASTE GATE ACTUATOR

1. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
2. Remove the turbocharger upper cover.



3. Remove the boost hose (B) from the waste gate actuator (A) of the turbocharger, and connect the Mighty Vac to the waste gate actuator (A).



(A) Waste gate actuator
(B) Boost hose
(C) Control rod
(D) Control rod stroke

4. Pressurize slowly with the Mighty Vac, and measure the pressure when the control rod stroke (D) becomes 2 mm (0.08 in). If it is not within the standard, replace the turbocharger assembly.
Caution:
Do not pressurize over 89.9 kPa (0.92 kg/cm^2, 13.0 psi) to prevent damaging the waste gate actuator.
Operating pressure (control rod stroke 2 mm (0.08 in)):
Standard
74.7 — 80.8 kPa (0.76 — 0.82 kg/cm^2, 10.8 — 11.7 psi)
5. After inspection, install the related parts in the reverse order of removal.
Tightening torque:
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

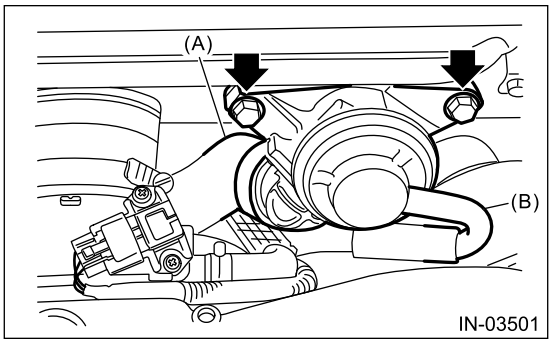
2. OTHER INSPECTIONS

1. Check that the turbocharger, turbocharger stay and pipe have no deformation, cracks or other damages.
2. Check that the hose and intake duct have no cracks, damage or loose part.
3. Check that there are no oil leakage or water leakage from the pipe attachment section.

INTAKE (INDUCTION)(STI) > Air By-pass Valve

REMOVAL

Remove the air by-pass valve from the intercooler, and then disconnect air by-pass hose (A) and vacuum hose (B) from the air by-pass valve.



INTAKE (INDUCTION)(STI) > Air By-pass Valve

INSTALLATION

Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

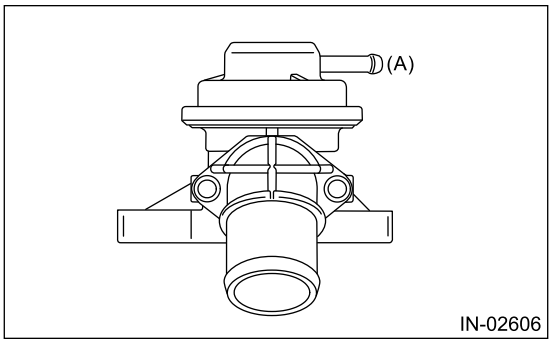
16 N·m (1.6 kgf-m, 11.8 ft-lb)

INTAKE (INDUCTION)(STI) > Air By-pass Valve

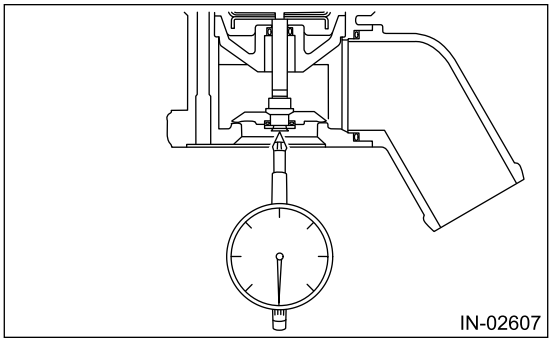
INSPECTION

1. AIR BY-PASS VALVE

1. Check that the air by-pass valve has no deformation, cracks or other damages.
2. Connect the Mighty Vac to the nipple (A) of the air by-pass valve.



3. Using the Mighty Vac, generate the vacuum pressure to −93.3 kPa (−0.95 kg/cm^2, −13.5 psi). Check that the Mighty Vac gauge needle indication holds 10 seconds without dropping down to lower than −92.6 kPa (−0.94 kg/cm^2, −13.4 psi).
4. Set a dial gauge to the end of valve rod of the air by-pass valve.



5. Slowly generate vacuum pressure with the Mighty Vac and check the pressure when the needle of the dial gauge (valve stroke) becomes 0.5 mm (0.02 in). If it is not within the standard, replace the air by-pass valve.

Opening pressure (valve stroke 0.5 mm (0.02 in)):

Standard

−62.7 — −70.7 kPa (−0.64 — −0.72 kg/cm^2, −9.09 — −10.3 psi)

6. Increase vacuum pressure more than 5) and check the pressure when the needle of the dial gauge (valve stroke) becomes 7.5 mm (0.3 in). If it is not within the standard, replace the air by-pass valve.

Full open pressure (valve stroke 7.5 mm (0.3 in)):

Standard

−102.7 — −117.3 kPa (−1.05 — −1.20 kg/cm^2, −14.9 — −17.0 psi)

2. OTHER INSPECTIONS

Check that the vacuum hose and air by-pass pipe have no cracks, damage or loose part.

MECHANICAL(STI)

ME(STI)

1. General Description
2. Compression
3. Idle Speed
4. Ignition Timing
5. Intake Manifold Vacuum
6. Engine Oil Pressure
7. Fuel Pressure
8. Valve Clearance
9. Engine Assembly
10. Engine Mounting
11. Preparation for Overhaul
12. V-belt
13. Crank Pulley
14. Timing Belt Cover
15. Timing Belt
16. Cam Sprocket
17. Crank Sprocket
18. Camshaft
19. Cylinder Head
20. Cylinder Block
21. Intake and Exhaust Valve
22. Piston
23. Connecting Rod
24. Crankshaft
25. Symptoms and causes
26. Engine Noise

SPECIFICATION

Engine	Model				2.5 L
	Cylinder arrangement				Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine
	Valve system mechanism				Belt driven, double overhead camshaft, 4-valve/cylinder
	Bore × Stroke	mm (in)			99.5 × 79.0 (3.92 × 3.11)
	Displacement	cm^3 (cu in)			2,457 (150)
	Compression ratio				8.2
	Compression pressure (at 200 — 300 r/min)	kPa (kg/cm^2, psi)	Standard		981 — 1,177 (10 — 12, 142 — 171)
	Number of piston rings				Compression ring: 2 Oil ring: 1
	Intake valve timing		Open	Max. retard	ATDC 5°
				Min. advance	BTDC 47°
			Close	Max. retard	ABDC 65°
				Min. advance	ABDC 13°
	Exhaust valve timing		Open	Max. retard	BBDC 28°
				Min. advance	BBDC 72°
			Close	Max. retard	ATDC 32°
				Min. advance	BTDC 12°
	Valve clearance	mm (in)	Inspection value	Intake	$0.20^{+0.04}_{-0.06}$ ($0.0079^{+0.0016}_{-0.0024}$)
				Exhaust	0.35±0.05 (0.0138±0.0020)

		Adjustment value	Intake		$0.20^{+0.01}_{-0.03}$ ($0.0079^{+0.0004}_{-0.0012}$)
			Exhaust		0.35±0.02 (0.0138±0.0008)
	Idle speed (Gear shift lever is in neutral) r/min		No load	Standard	700±100
			A/C ON	Standard	750±100
	Ignition order				1 → 3 → 2 → 4
	Ignition timing BTDC/{r/min}			Standard	15°±10°/700

Note:
OS: Oversize US: Undersize

Belt tension adjuster	Adjuster rod protrusion amount mm (in)			5.2 — 6.2 (0.2047 — 0.2441)
Camshaft	Bending limit mm (in)			0.020 (0.0008)
	Cam lobe height mm (in)	Intake	Standard	46.55 — 46.65 (1.8327 — 1.8366)
		Exhaust	Standard	46.75 — 46.85 (1.8405 — 1.8445)
	Cam base circle diameter mm (in)		Standard	37.0 (1.4567)
	Journal O.D. mm (in)	Front	Standard	37.946 — 37.963 (1.4939 — 1.4946)
		Center, rear	Standard	29.946 — 29.963 (1.1790 — 1.1796)
	Oil clearance mm (in)		Standard	0.037 — 0.072 (0.0015 — 0.0028)
	Thrust clearance mm (in)		Standard	0.068 — 0.116 (0.0027 — 0.0047)
Cylinder head	Warping limit (Mating surface with cylinder block) mm (in)			0.035 (0.0014)
	Grinding limit mm (in)			0.3 (0.0118)
	Standard height mm (in)			127.5 (5.0197)
Valve seat	Seating angle between valve and valve seat			90°
	Contacting width between valve and valve seat mm (in)	Intake	Standard	0.6 — 1.4 (0.0236 — 0.0551)

		Exhaust	Standard	1.2 — 1.8 (0.0472 — 0.0709)
Valve guide	Clearance between the valve guide and valve stem mm (in)	Intake	Standard	0.030 — 0.057 (0.0012 — 0.0022)
		Exhaust	Standard	0.040 — 0.067 (0.0016 — 0.0026)
	Inside diameter mm (in)			6.000 — 6.012 (0.2362 — 0.2367)
	Valve stem outer diameters mm (in)	Intake		5.955 — 5.970 (0.2344 — 0.2350)
		Exhaust		5.945 — 5.960 (0.2341 — 0.2346)
	Valve guide protrusion amount mm (in)			15.8 — 16.2 (0.6220 — 0.6378)
Valve	Head edge thickness mm (in)	Intake	Standard	1.0 — 1.4 (0.0394 — 0.0551)
		Exhaust	Standard	1.3 — 1.7 (0.0512 — 0.0669)
	Overall length mm (in)	Intake		104.4 (4.1102)
		Exhaust		104.65 (4.1201)
Valve spring	Free length (reference) mm (in)			53.48 (2.1055)
	Tension/spring height N (kgf, lb)/mm (in)		Set	204.6 — 235.4 (20.86 — 24.00, 46.00 — 52.93)/36.0 (1.4173)
			Lift	363.5 — 401.7 (37.07 — 40.96, 81.73 — 90.32)/26.7 (1.0512)
	Squareness			2.5°, 2.3 mm (0.0906 in) or less
Valve lifter	Outer diameter mm (in)		Standard	34.959 — 34.975 (1.3763 — 1.3770)
	Valve lifter mating surface inner diameter mm (in)		Standard	34.994 — 35.016 (1.3777 — 1.3786)
	Valve lifter and valve lifter mating surface clearance mm (in)		Standard	0.019 — 0.057 (0.0007 — 0.0022)
Cylinder block	Warping limit (Mating surface with cylinder head) mm (in)			0.025 (0.0010)
	Grinding limit mm (in)			0.1 (0.0039)
	Standard height mm (in)			201.0 (7.9134)
	Cylindricality mm (in)		Limit	0.015 (0.0006)
	Out-of-roundness mm (in)		Limit	0.010 (0.0004)

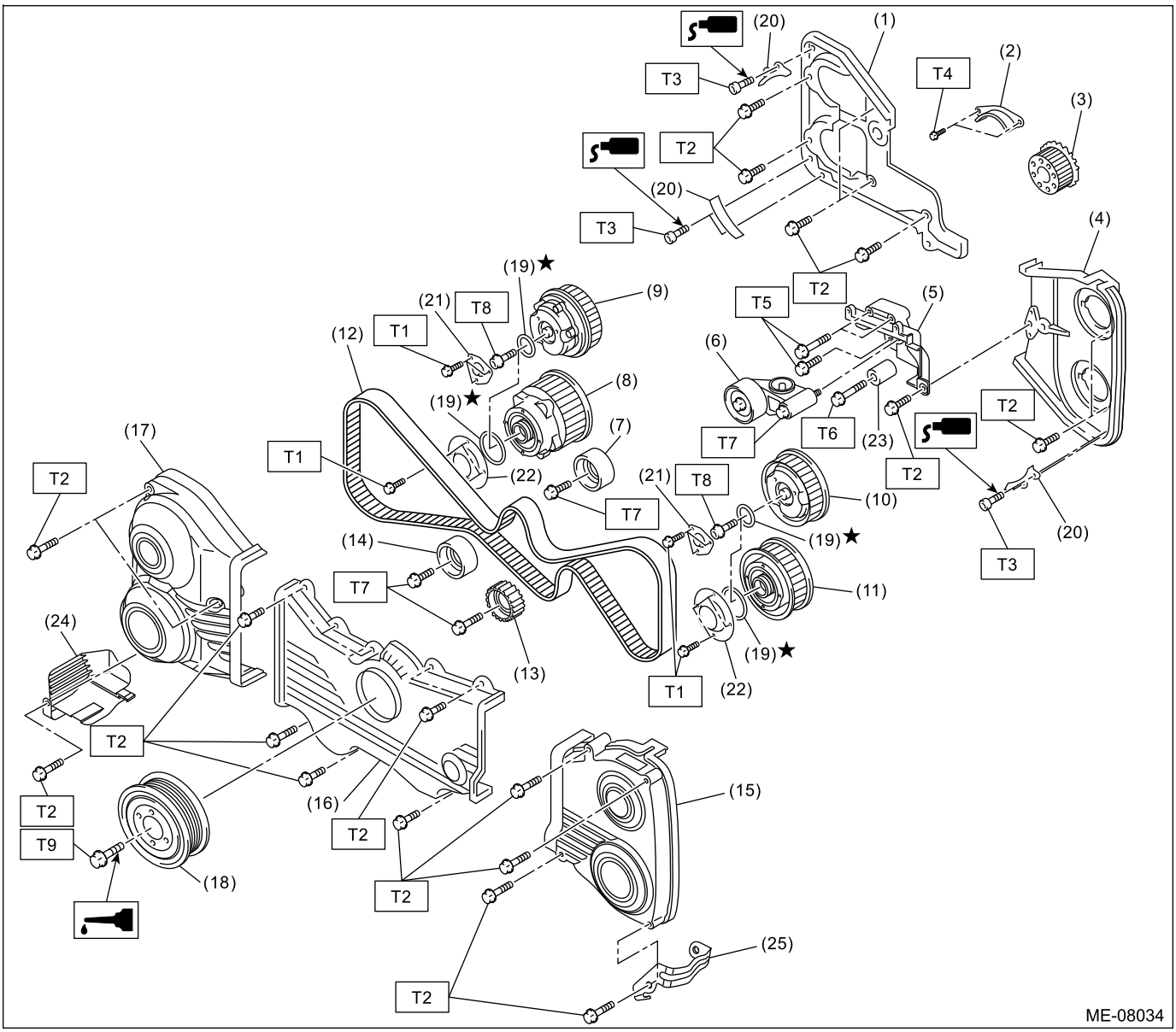
	Clearance between cylinder and piston at 20°C (68°F)	mm (in)	Standard	−0.010 — 0.010 (−0.0004 — 0.0004)
	Cylinder inner diameter boring limit (diameter)	mm (in)		To 100.005 (3.9372)
Piston	Piston grade point	mm (in)		38.2 (1.5039)
	Outer diameter	mm (in)	Standard	A	99.505 — 99.515 (3.9175 — 3.9179)
				B	99.495 — 99.505 (3.9171 — 3.9175)
			0.25 (0.0098) OS		99.745 — 99.765 (3.9270 — 3.9278)
			0.50 (0.0197) OS		99.995 — 100.015 (3.9368 — 3.9376)
Piston pin	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).
	Clearance between piston pin hole and piston pin	mm (in)	Standard		0.004 — 0.008 (0.0002 — 0.0003)
Piston ring	Piston ring gap	mm (in)	Top ring	Standard	0.23 — 0.28 (0.0091 — 0.0110)
			Second ring	Standard	0.37 — 0.52 (0.015 — 0.0205)
			Oil ring	Standard	0.20 — 0.50 (0.0079 — 0.0197)
	Clearance between piston ring and piston ring groove	mm (in)	Top ring	Standard	0.040 — 0.080 (0.0016 — 0.0031)
			Second ring	Standard	0.030 — 0.070 (0.0012 — 0.0028)
Connecting rod and connecting rod bearing	Bend or twist per 100 mm (3.9370 in) in length	mm (in)		Limit	0.10 (0.0039)
	Thrust clearance	mm (in)		Standard	0.070 — 0.330 (0.0028 — 0.0130)
	Oil clearance	mm (in)		Standard	0.017 — 0.045 (0.0007 — 0.0018)
	Bearing size (Thickness at center)	mm (in)	Standard		1.490 — 1.506 (0.0587 — 0.0593)
			0.03 (0.0012) US		1.504 — 1.512 (0.0592 — 0.0595)
			0.05 (0.0020) US		1.514 — 1.522 (0.0596 — 0.0599)

			0.25 (0.0098) US	1.614 — 1.622 (0.0635 — 0.0639)
Bushing of small end	Clearance between piston pin and bushing	mm (in)	Standard	0 — 0.022 (0 — 0.0009)
Crankshaft and crankshaft bearing	Bending limit		mm (in)	0.035 (0.0014)
	Crank pin	Cylindricality mm (in)	Limit	0.004 (0.0002)
		Out-of-roundness mm (in)	Limit	0.003 (0.0001)
		Grinding limit (dia.) mm (in)		To 51.734 (2.0368)
	Crank journal	Cylindricality mm (in)	Limit	0.006 (0.0002)
		Out-of-roundness mm (in)	Limit	0.005 (0.0002)
		Grinding limit (dia.) mm (in)		To 59.742 (2.3520)
	Crank pin outer diameter	mm (in)	Standard	51.976 — 52.000 (2.0463 — 2.0472)
			0.03 (0.0012) US	51.954 — 51.970 (2.0454 — 2.0461)
			0.05 (0.0020) US	51.934 — 51.950 (2.0447 — 2.0453)
			0.25 (0.0098) US	51.734 — 51.750 (2.0368 — 2.0374)
	Crank journal outer diameter	mm (in)	Standard	59.984 — 60.008 (2.3616 — 2.3625)
			0.03 (0.0012) US	59.962 — 59.978 (2.3607 — 2.3613)
			0.05 (0.0020) US	59.942 — 59.958 (2.3599 — 2.3605)
			0.25 (0.0098) US	59.742 — 59.758 (2.3520 — 2.3527)

	Bearing size (Thickness at center)	mm (in)	#1, #3	Standard	1.998 — 2.015 (0.0787 — 0.0793)
				0.03 (0.0012) US	2.017 — 2.020 (0.0794 — 0.0795)
				0.05 (0.0020) US	2.027 — 2.030 (0.0798 — 0.0799)
				0.25 (0.0098) US	2.127 — 2.130 (0.0837 — 0.0839)
			#2, #4, #5	Standard	2.000 — 2.017 (0.0787 — 0.0794)
				0.03 (0.0012) US	2.019 — 2.022 (0.0795 — 0.0796)
				0.05 (0.0020) US	2.029 — 2.032 (0.0799 — 0.0800)
				0.25 (0.0098) US	2.129 — 2.132 (0.0838 — 0.0839)
	Thrust clearance			mm (in)	Standard	0.030 — 0.115 (0.0012 — 0.0045)
	Oil clearance			mm (in)	Standard	0.010 — 0.030 (0.0004 — 0.0012)

COMPONENT

1. TIMING BELT



(1) Timing belt cover No. 2 RH
(2) Timing belt guide
(3) Crank sprocket
(4) Timing belt cover No. 2 LH
(5) Tensioner bracket
(6) Automatic belt tension adjuster ASSY
(7) Belt idler
(8) Exhaust cam sprocket RH
(9) Intake cam sprocket RH
(10) Intake cam sprocket LH
(13) Belt idler No. 2
(14) Belt idler
(15) Timing belt cover LH
(16) Front belt cover
(17) Timing belt cover RH
(18) Crank pulley
(19) O-ring
(20) Timing belt guide
(21) Intake actuator cover
(22) Exhaust actuator cover
(25) Engine harness stay

Tightening torque: N·m (kgf-m, ft-lb)

T1: 3.4 (0.3, 2.5)
T2: 5 (0.5, 3.7)
T3: 6.4 (0.7, 4.7)
T4: 9.75 (1.0, 7.2)
T5: 24.5 (2.5, 18.1)
T6: 25 (2.5, 18.4)
T7: 39 (4.0, 28.8)

(11) Exhaust cam sprocket LH

(12) Timing belt

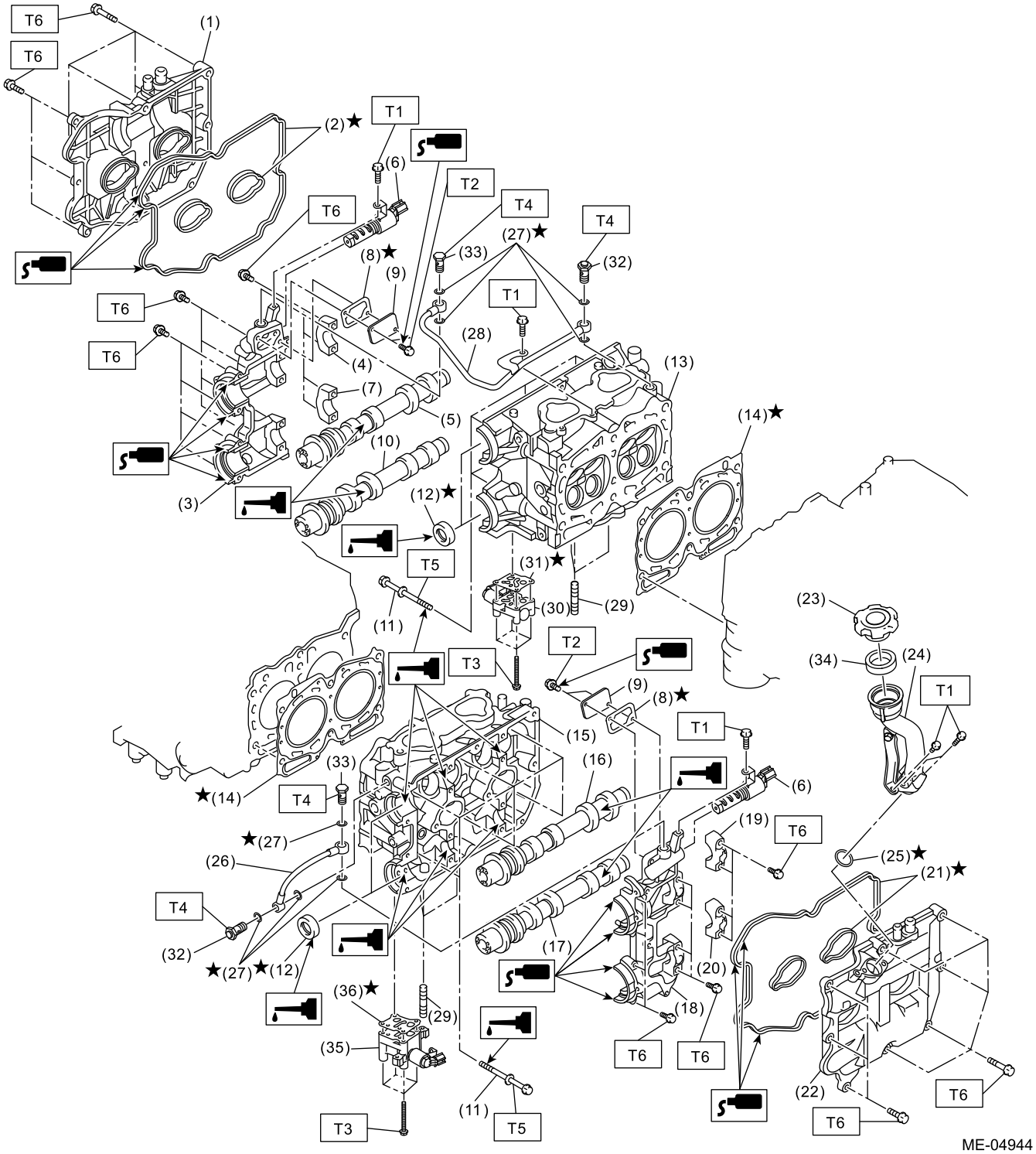
(23) Belt idler

(24) Engine harness cover

T8: ***Ref. to MECHANICAL(STI)>Cam Sprocket>INSTALLATION.***

T9: ***Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.***

2. CYLINDER HEAD AND CAMSHAFT



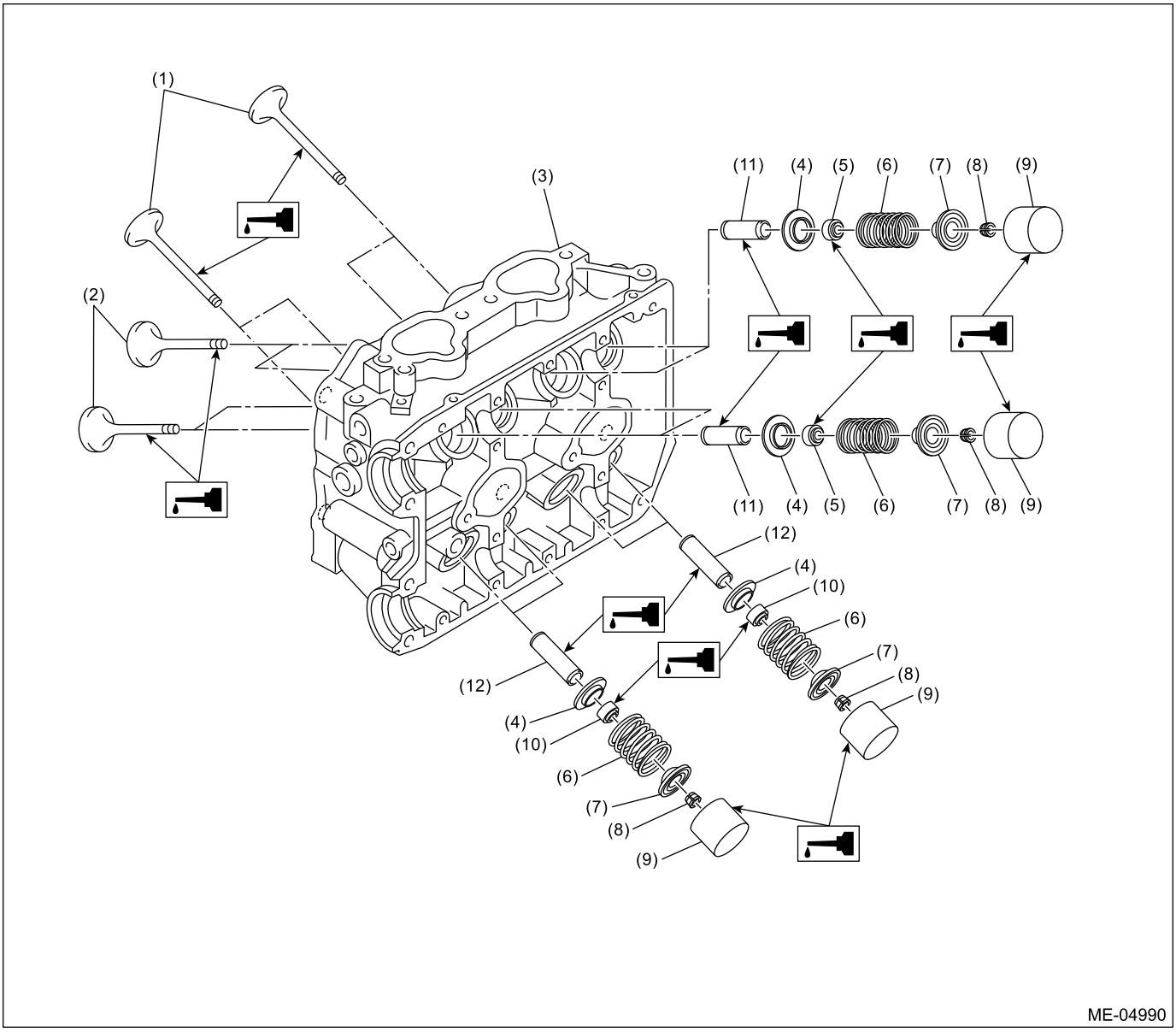
(1) Rocker cover RH
(2) Rocker cover gasket RH
(3) Front camshaft cap RH
(4) Intake camshaft cap RH
(16) Intake camshaft LH
(17) Exhaust camshaft LH
(18) Front camshaft cap LH
(19) Intake camshaft cap LH
(31) Gasket RH
(32) Union bolt with filter (with protrusion)
(33) Union bolt without filter (without protrusion)
(34) Gasket

(5) Intake camshaft RH
(6) Intake oil flow control solenoid valve
(7) Exhaust camshaft cap RH
(8) Gasket
(9) Oil return cover
(10) Exhaust camshaft RH
(11) Cylinder head bolt
(12) Oil seal
(13) Cylinder head RH
(14) Cylinder head gasket
(15) Cylinder head LH
(20) Exhaust camshaft cap LH
(21) Rocker cover gasket LH
(22) Rocker cover LH
(23) Oil filler cap
(24) Oil filler duct
(25) O-ring
(26) Oil pipe LH
(27) Gasket
(28) Oil pipe RH
(29) Stud bolt
(30) Exhaust oil flow control solenoid valve RH
(35) Exhaust oil flow control solenoid valve LH
(36) Gasket LH

Tightening torque: N·m (kgf-m, ft-lb)

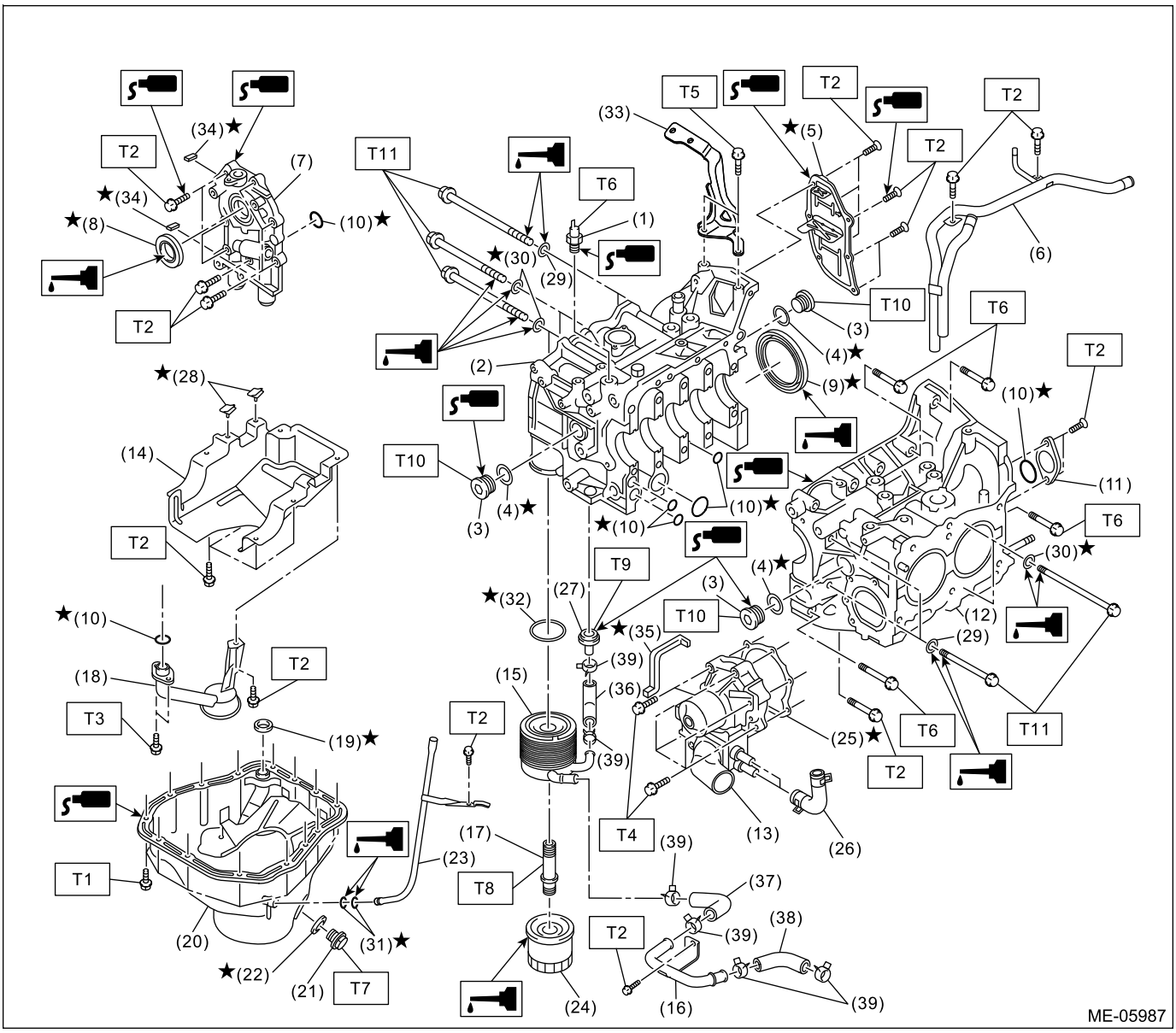
T1: 6.4 (0.7, 4.7)
T2: 9 (0.9, 6.6)
T3: 10 (1.0, 7.4)
T4: 31.5 (3.2, 23.2)
T5: Ref. to MECHANICAL(STI)>Cylinder Head>INSTALLATION.
T6: Ref. to MECHANICAL(STI)>Camshaft>INSTALLATION.

3. CYLINDER HEAD AND VALVE ASSEMBLY



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

4. CYLINDER BLOCK



(1) Oil pressure switch
(2) Cylinder block RH
(3) Service hole plug
(4) Gasket
(5) Oil separator cover
(6) Water by-pass pipe
(7) Oil pump
(8) Front oil seal
(9) Rear oil seal
(10) O-ring
(11) Service hole cover
(12) Cylinder block LH
(19) Gasket
(20) Oil pan
(21) Drain plug
(22) Drain plug gasket
(23) Oil level gauge guide
(24) Oil filter
(25) Gasket
(26) Water pump hose
(27) Nipple
(28) Seal
(29) Washer
(30) Seal washer
(37) Oil cooler hose B
(38) Oil cooler hose C
(39) Clip

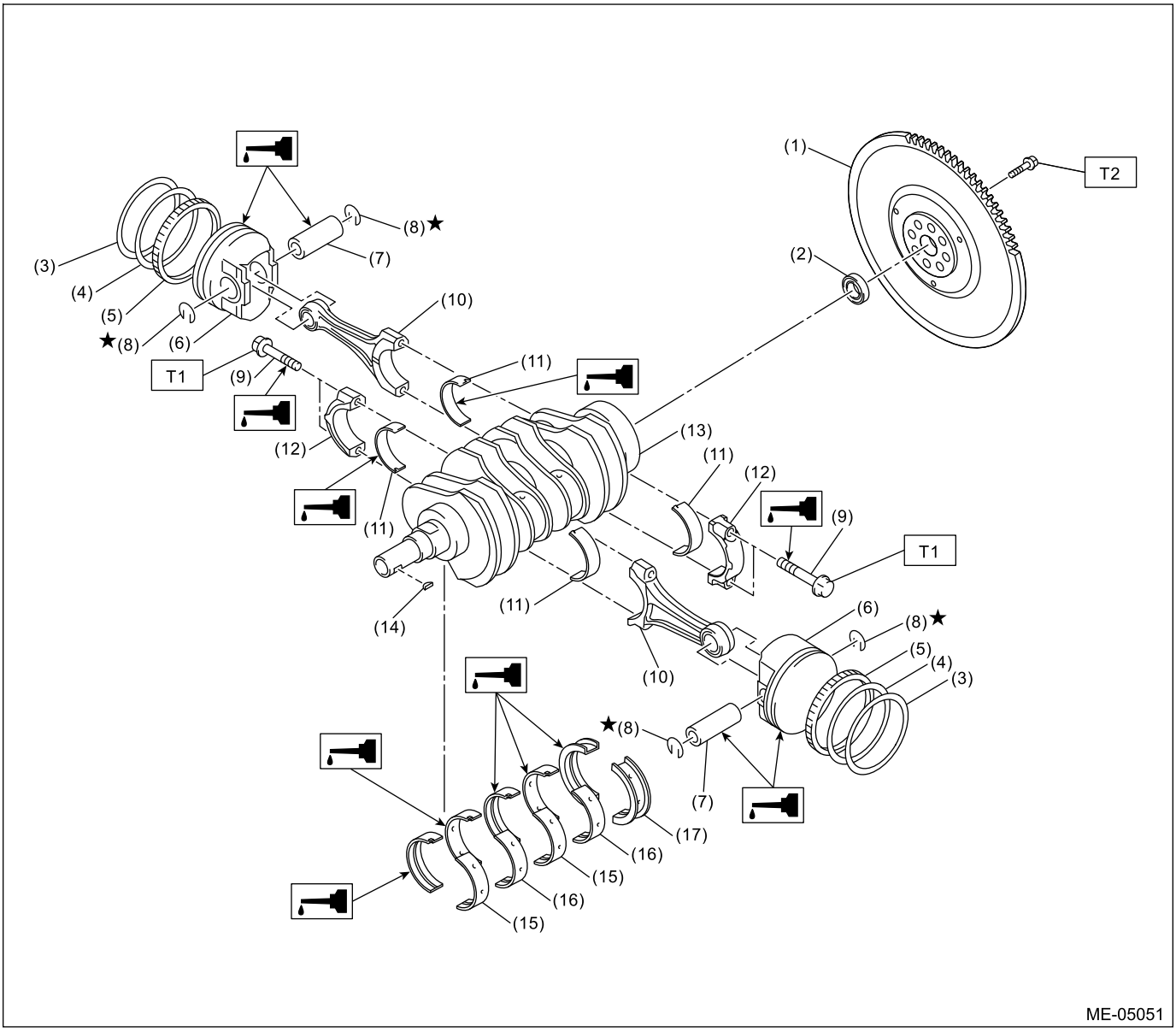
Tightening torque: N·m (kgf-m, ft-lb)

T1: 5 (0.5, 3.7)
T2: 6.4 (0.7, 4.7)
T3: 10 (1.0, 7.4)
T4: First 12 (1.2, 8.9)
Second 12 (1.2, 8.9)
T5: 16 (1.6, 11.8)
T6: 25 (2.5, 18.4)

(13) Water pump
(14) Baffle plate
(15) Oil cooler
(16) Oil cooler pipe
(17) Connector
(18) Oil strainer
(31) O-ring
(32) Gasket
(33) Intercooler stay RH No. 2 (engine rear hanger)
(34) Oil pump seal
(35) Water pump sealing
(36) Oil cooler hose A

T7: 46.5 (4.7, 34.3)
T8: 54 (5.5, 39.8)
T9: 69 (7.0, 50.9)
T10: 70 (7.1, 51.6)
T11: Ref. to MECHANICAL(STI)>Cylinder Block>INSTALLATION.

5. CRANKSHAFT AND PISTON



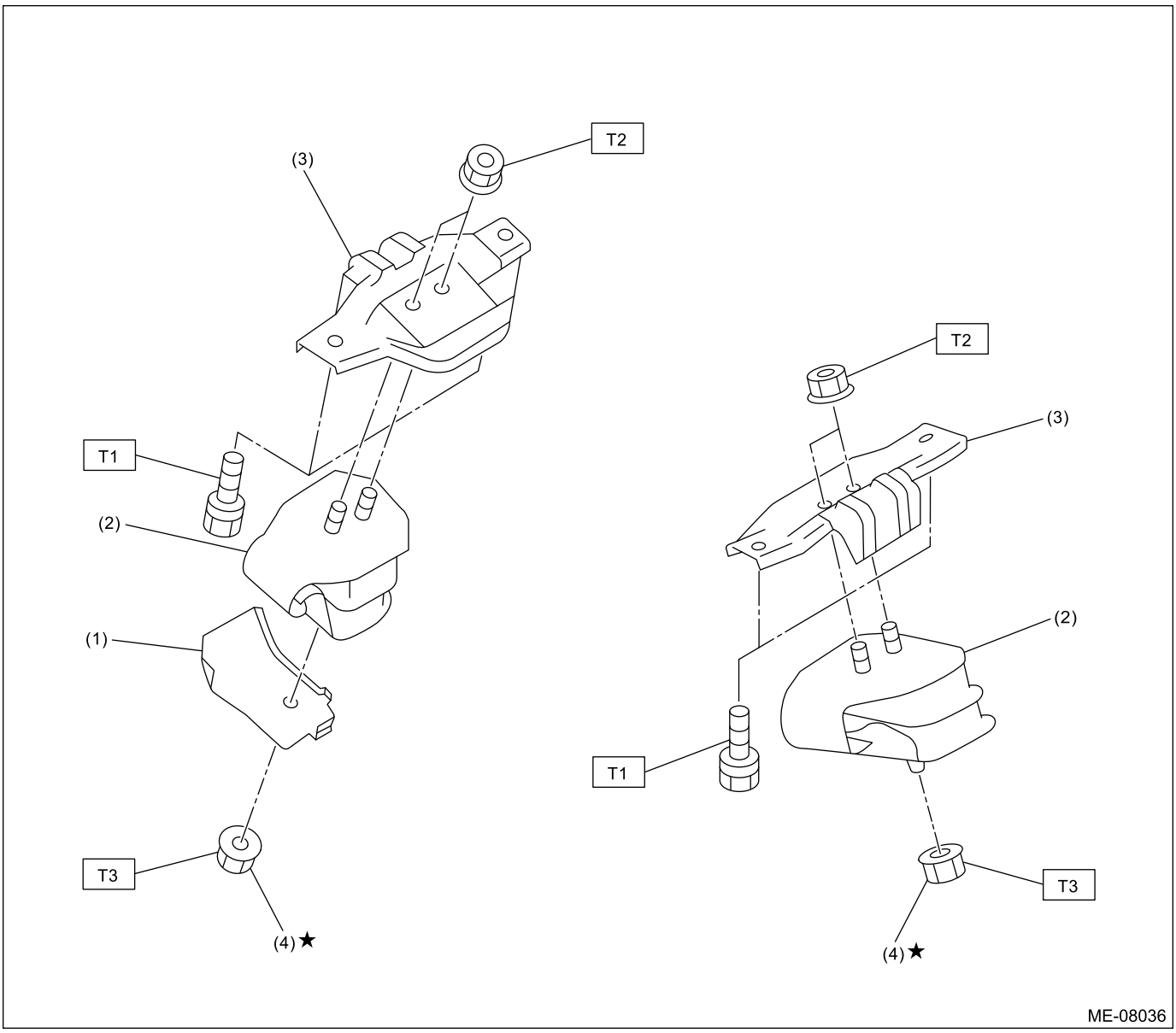
(1) Flywheel
(2) Ball bearing
(3) Top ring
(4) Second ring
(5) Oil ring
(6) Piston
(7) Piston pin
(8) Snap ring
(9) Connecting rod bolt
(10) Connecting rod
(11) Connecting rod bearing
(12) Connecting rod cap
(13) Crankshaft
(14) Woodruff key
(15) Crankshaft bearing #1, #3
(16) Crankshaft bearing #2, #4
(17) Crankshaft bearing #5

Tightening torque: N·m (kgf-m, ft-lb)

T1: 52 (5.3, 38.4)

T2: Ref. to CLUTCH SYSTEM>Flywheel>INSTALLATION.

6. ENGINE MOUNTING



(1)	Heat shield cover	(3)	Front engine mounting bracket	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Front cushion rubber	(4)	Nut	***T1: 35 (3.6, 25.8)***
				T2: 42 (4.3, 31.0)
				T3: 60 (6.1, 44.3)

MECHANICAL(STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.

- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove or install the engine in an area where chain hoists, lifting devices, etc. are available for ready use. When lifting up the vehicle, make sure to support the vehicle at the jack-up points.
- Be careful not to let any oil or grease contact the clutch disc, flywheel or timing belt.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil when being assembled.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- Always use new application oil during work.

PREPARATION TOOL

1. SPECIAL TOOL

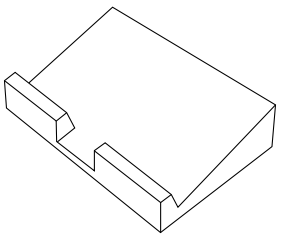
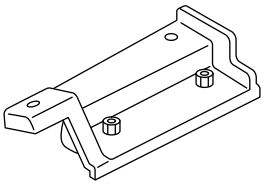
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498267600	498267600	CYLINDER HEAD TABLE	• Used for replacing valve guides. • Used for removing and installing valve spring.
 ST-498457000	498457000	ENGINE STAND ADAPTER RH	Used together with ENGINE STAND (499817100).

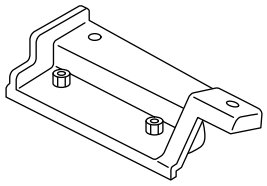
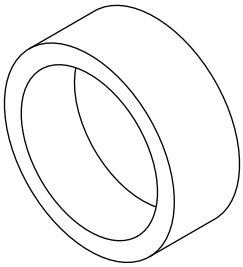
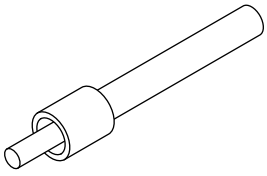
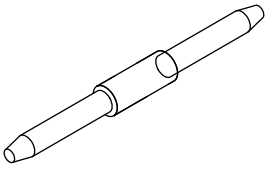
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-498457100	498457100	ENGINE STAND ADAPTER LH	Used together with ENGINE STAND (499817100).
 ST-498747300	498747300	PISTON GUIDE	Used for installing the piston into the cylinder.
 ST-498857100	498857100	VALVE OIL SEAL GUIDE	Used for press-fitting of intake valve guide oil seals and exhaust valve guide oil seals.
 ST-499017100	499017100	PISTON PIN GUIDE	Used for installing piston pin, piston and connecting rod.

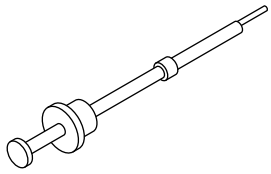
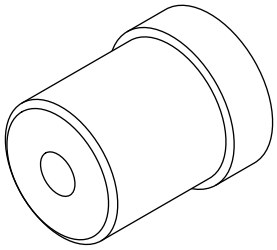
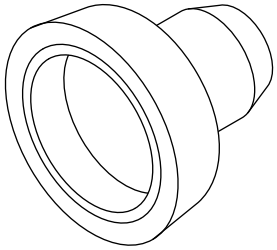
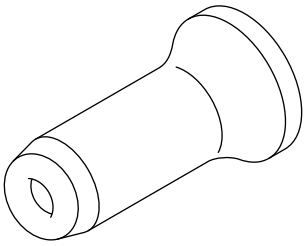
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499097700	499097700	PISTON PIN REMOVER ASSY	Used for removing piston pin.
 ST-499587100	499587100	OIL SEAL INSTALLER	Used for installing oil pump oil seal.
 ST-499587200	499587200	CRANKSHAFT OIL SEAL INSTALLER	• Used for installing crankshaft oil seal. • Used together with CRANKSHAFT OIL SEAL GUIDE (499597100).
 ST-499587600	499587600	OIL SEAL INSTALLER	Used for installing the camshaft oil seal.

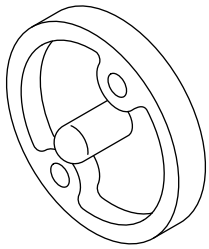
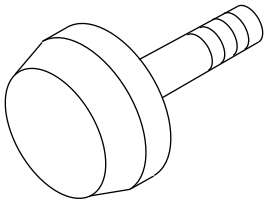
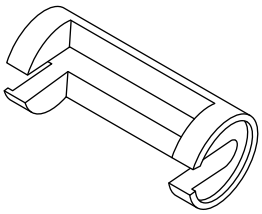
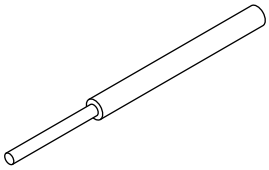
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499597100	499597100	CRANKSHAFT OIL SEAL GUIDE	• Used for installing crankshaft oil seal. • Used together with CRANKSHAFT OIL SEAL INSTALLER (499587200).
 ST-499597200	499597200	OIL SEAL GUIDE	• Used for installing the camshaft oil seal. • Used together with OIL SEAL INSTALLER (499587600).
 ST-499718000	499718000	VALVE SPRING REMOVER	Used for removing and installing valve spring.
 ST-499767200	499767200	VALVE GUIDE REMOVER	Used for removing valve guides.

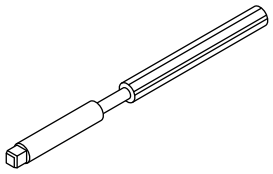
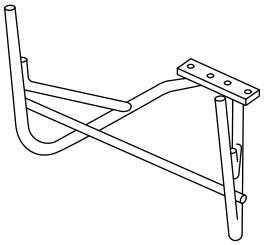
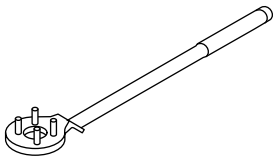
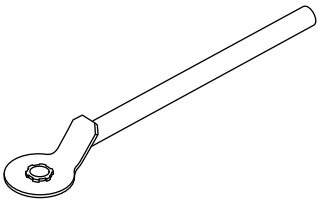
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499767400	499767400	VALVE GUIDE REAMER	Used for reaming valve guides.
 ST-499817100	499817100	ENGINE STAND	• Used for disassembling and assembling engine. • Used together with ENGINE STAND ADAPTER RH (498457000) & LH (498457100).
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used for removing and installing the crank pulley.
 ST-499977500	499977500	CAM SPROCKET WRENCH	Used for removing and installing intake cam sprocket and exhaust cam sprocket.

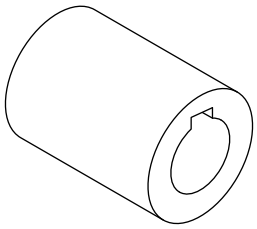
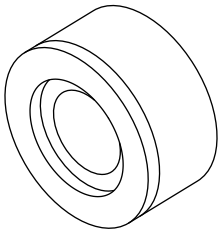
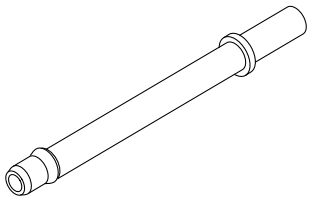
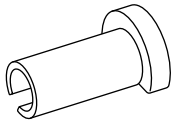
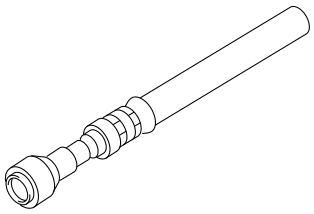
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499987500	499987500	CRANKSHAFT SOCKET	Used for rotating crankshaft.
 ST18251AA020	18251AA020	VALVE GUIDE ADJUSTER	Used for installing intake valve guides and exhaust valve guides.
 ST18471AA000	18471AA000	FUEL PIPE ADAPTER	Used for inspecting the fuel pressure.
 ST42099AE000	42099AE000	QUICK CONNECTOR RELEASE	Used for removing the quick connector.

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST42075AG690	42075AG690	FUEL HOSE	Used for inspecting the fuel pressure. **Note:** **This is the SUBARU genuine part.**
 STSSM4	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

2. GENERAL TOOL

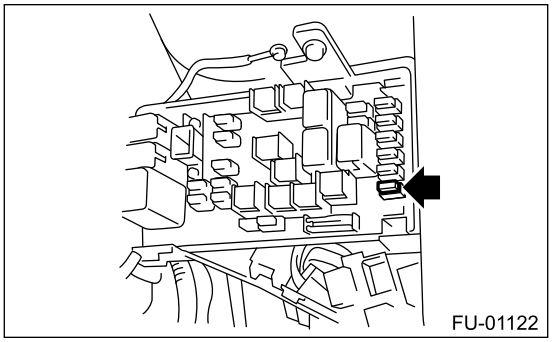
TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.
Timing light	Used for measuring ignition timing.
Vacuum gauge	Used for measuring intake manifold vacuum.
Oil pressure gauge	Used for measuring engine oil pressure.
Fuel pressure gauge	Used for measuring fuel pressure.
Thickness gauge	Used for various inspections.
DST-i	Used together with Subaru Select Monitor 4.
Clamp pincer	• Used for installing the PCV hose, vacuum hose and water tank pipe assembly. • This tool is made by OETIKER. Product No. 14100134

INSPECTION

Caution:
After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.
Note:

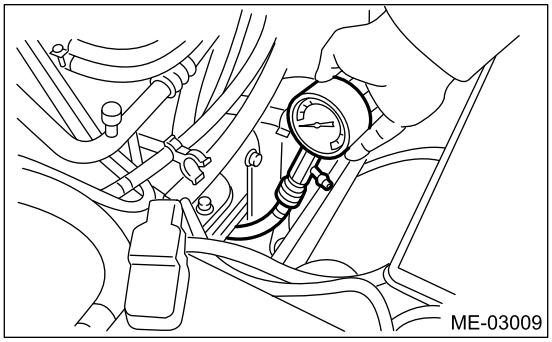
- **Before checking the compression pressure, the compression condition of each cylinder can be confirmed as a guide by using the compression measurement mode in Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(STI)>Active Test>OPERATION.**
- **In the compression measurement mode, the compression condition is judged by each cylinder speed. The high speed cylinder has low compression pressure and low speed cylinder has high compression pressure.**

1. After warming-up the engine, turn the ignition switch to OFF.
2. Make sure that the battery is fully charged.
3. Remove the fuse of fuel pump from main fuse box.



4. Start the engine and run it until it stalls.
5. After the engine stalls, crank it for five more seconds.
6. Turn the ignition switch to OFF.
7. Remove all spark plugs. Ref. to IGNITION(STI)>Spark Plug>REMOVAL.
8. Depress the accelerator pedal to full throttle.
9. Check the starter motor for satisfactory performance and operation.
10. Install the compression gauge to the spark plug hole.

    Note:
    When using a screw-in type compression gauge, the screw should be less than 18 mm (0.71 in) long.



11. Crank the engine by starter motor and read the value when the needle of the compression gauge becomes stable.

Note:

- **Perform at least two measurements per cylinder, and make sure that the values are correct.**
- **If the compression pressure is out of standard, check or adjust the pistons, valves and cylinders.**

Compression pressure:

At 200 — 300 r/min

Standard

981 — 1,177 kPa (10 — 12 kg/cm^2, 142 — 171 psi)

Difference between cylinders

49 kPa (0.5 kg/cm^2, 7 psi) or less

12. After inspection, install the related parts in the reverse order of removal.

INSPECTION

1. Before checking the idle speed, check the following item:
   (1) Check the air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and hoses are connected properly.
   (2) Check the malfunction indicator light does not illuminate.
2. Warm up the engine.
3. Read the engine idle speed using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA (NORMAL MODE).
   Note:
   - **Idle speed cannot be adjusted manually, because the idle speed is automatically adjusted.**
   - **If idle speed is out of standard, refer to the General Diagnosis Table under "Engine Control System". Ref. to ENGINE (DIAGNOSTICS)(STI)>Basic Diagnostic Procedure.**

   (1) Check the idle speed when no-loaded. (Headlight, heater fan, rear defroster, radiator fan, A/C and etc. are OFF)
   Idle speed (no load and gear shift lever in neutral position):
   Standard
   700±100 r/min
   (2) Check the idle speed when loaded. (Turn the A/C switch to ON and operate the compressor for at least one minute before measurement.)
   Idle speed (A/C ON and gear shift lever in neutral position):
   Standard
   750±100 r/min

INSPECTION

Caution:
After warming-up, engine becomes very hot. Be careful not to burn yourself at measurement.

1. METHOD WITH SUBARU SELECT MONITOR

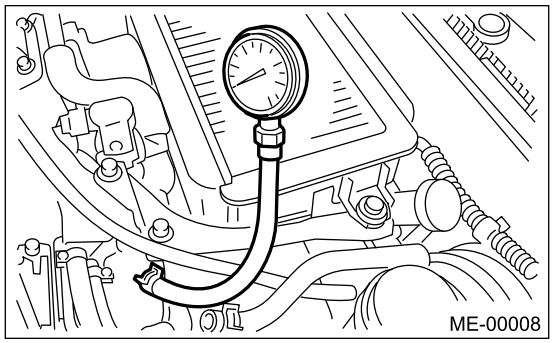
1. Before checking the ignition timing, check the following item:
   (1) Check the air cleaner element is free from clogging, spark plugs are in good condition, and hoses are connected properly.
   (2) Check the malfunction indicator light does not illuminate.
2. Warm up the engine.
3. Read the ignition timing using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA (NORMAL MODE).
   Note:
   If ignition timing is out of standard, check the ignition control system. Refer to "Engine Control System". Ref. to ENGINE (DIAGNOSTICS)(STI)>Basic Diagnostic Procedure.
   Ignition timing [BTDC/{r/min}]:
   Standard
   15°±10°/700

2. METHOD WITH TIMING LIGHT

1. Before checking the ignition timing, check the following item:
   (1) Check the air cleaner element is free from clogging, spark plugs are in good condition, and hoses are connected properly.
   (2) Check the malfunction indicator light does not illuminate.
2. Warm up the engine.
3. Stop the engine, and turn the ignition switch to OFF.
4. Disconnect the ground cable from battery.
5. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
6. Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Case>REMOVAL.
7. Connect the timing light to the power wire of #1 ignition coil.
8. Install the air cleaner case. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Case>INSTALLATION.
9. Connect the battery ground terminal.
10. Start the engine, turn the timing light to the crank pulley, and check the ignition timing through the timing belt cover gauge.
    Note:
    If ignition timing is out of standard, check the ignition control system. Refer to "Engine Control System". Ref. to ENGINE (DIAGNOSTICS)(STI)>Basic Diagnostic Procedure.
    Ignition timing [BTDC/{r/min}]:
    Standard
    15°±10°/700
11. After inspection, install the related parts in the reverse order of removal.

INSPECTION

1. Warm up the engine.
2. Disconnect the brake booster vacuum hose from the intake manifold, and attach the vacuum gauge.

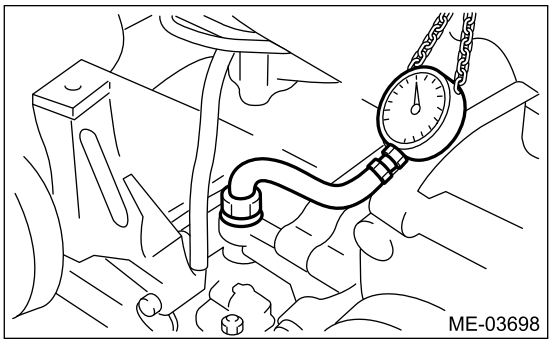


3. Keep the engine at idle speed and read the vacuum gauge indication.
   Note:
   Condition of engine inside can be diagnosed by observing the behavior of the vacuum gauge needle as described in table below.
   Intake manifold vacuum (at idling, A/C OFF):
   Standard
   −65.3 kPa (−490 mmHg, −19.29 inHg) or more
4. After inspection, install the related parts in the reverse order of removal.

Diagnosis of engine condition by inspection of intake manifold vacuum	
Vacuum gauge needle behavior	**Possible engine condition**
1. Needle is steady but lower than standard value. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket, disconnection or damage of vacuum hose
2. Needle intermittently drops to position lower than standard value.	Leakage around cylinder
3. Needle drops suddenly and intermittently from standard value.	Sticky valve
4. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs
5. Needle vibrates above and below standard value in narrow range.	Defective ignition system

INSPECTION

1. Disconnect the ground terminal from battery.
2. Remove the oil pressure switch. Ref. to LUBRICATION(STI)>Oil Pressure Switch>REMOVAL.
3. Install the oil pressure gauge to cylinder block.



4. Install the generator. Ref. to STARTING/CHARGING SYSTEMS(STI)>Generator>INSTALLATION.
5. Connect the battery ground terminal.
6. Start the engine, and check the oil pressure.

Note:

- **Standard value is based on an engine oil temperature of 80°C (176°F).**
- **If the oil pressure is out of specification, check oil pump, oil filter and lubrication line. Ref. to LUBRICATION(STI)>Engine Lubrication System Trouble in General>INSPECTION.**
- **If the oil pressure warning light is ON and oil pressure is within specification, check the oil pressure switch. Ref. to LUBRICATION(STI)>Engine Lubrication System Trouble in General>INSPECTION.**

Engine oil pressure:

Idle speed (no load, gear shift lever in neutral position)

Standard

102 kPa (1.0 kg/cm^2, 14.8 psi) or more

At 3,000 r/min

Standard

451 kPa (4.6 kg/cm^2, 65.4 psi) or more

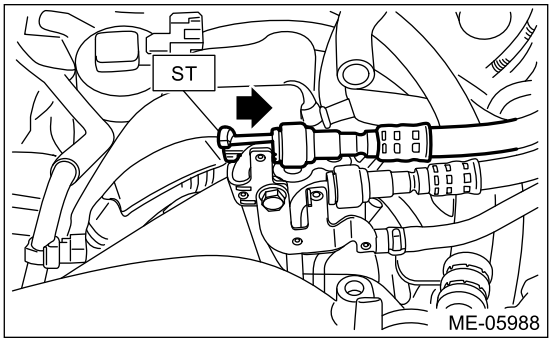
7. After inspection, install the related parts in the reverse order of removal.

INSPECTION

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
3. Disconnect the fuel delivery hose from the fuel delivery pipe, and connect the fuel pressure gauge.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from hoses using a container or cloth.**

   (1) Attach ST to the fuel delivery pipe and push ST in the direction of arrow mark to disconnect the quick connector of the fuel delivery hose.

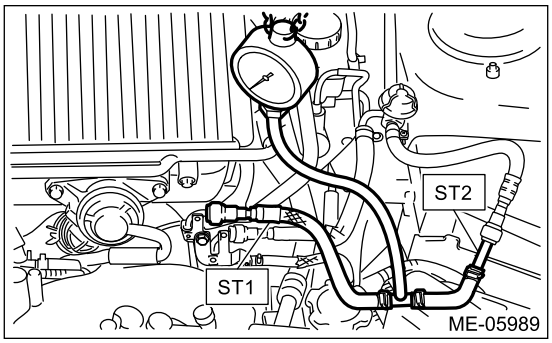
   ST 42099AE000 QUICK CONNECTOR RELEASE



   (2) Connect the fuel pressure gauge with ST1 and ST2.
   Note:
   ST1 is a SUBARU genuine part.

   ST1 42075AG690 FUEL HOSE

   ST2 18471AA000 FUEL PIPE ADAPTER



4. Start the engine.
5. Check the fuel pressure while disconnecting pressure regulator vacuum hose from intake manifold.

Note:

- **The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kg/cm^2, 1 to 3 psi) higher than standard values during high-altitude operations.**
- **If the fuel pressure is out of specification, check or replace the fuel pump, fuel line, pressure regulator & damper assembly, and pressure regulator vacuum hose.**

Fuel pressure:

Standard

284 — 314 kPa (2.9 — 3.2 kg/cm^2, 41 — 46 psi)

6. After connecting the vacuum hose to the pressure regulator, check the fuel pressure again.

Note:

- **The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kg/cm^2, 1 to 3 psi) higher than standard values during high-altitude operations.**
- **If the fuel pressure is out of specification, check or replace the fuel pump, fuel line, pressure regulator & damper assembly, and pressure regulator vacuum hose.**

Fuel pressure:

Standard

230 — 260 kPa (2.4 — 2.7 kg/cm^2, 33 — 38 psi)

7. After inspection, install the related parts in the reverse order of removal.

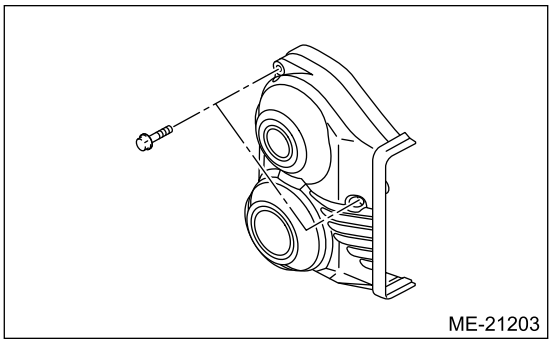
Caution:

- **Before removing the fuel pressure gauge, release the fuel pressure.**
- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**

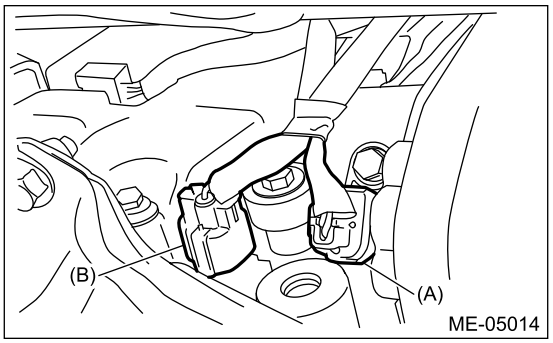
INSPECTION

Caution:
If engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.
Note:
Inspection and adjustment of valve clearance should be performed while engine is cold.

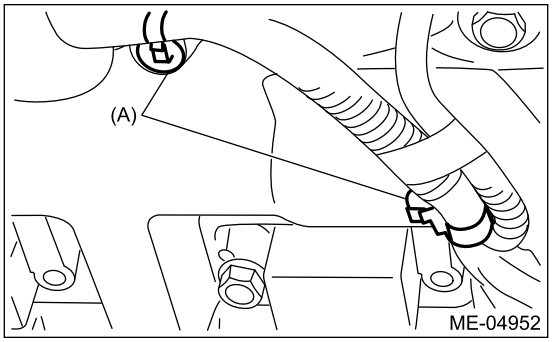
1. Disconnect the ground cable from battery.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
3. Remove the bolts (2 places) which secures timing belt cover RH.



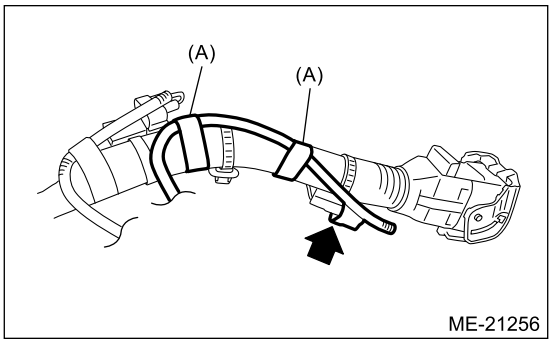
4. Lift up the vehicle.
5. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
6. Remove the remaining bolts which secure timing belt cover RH together with engine harness cover, then remove the timing belt cover RH.
7. Lower the vehicle.
8. When inspecting #1 and #3 cylinders
   (1) Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Case>REMOVAL.
   (2) Disconnect the connector (A) from the exhaust camshaft position sensor RH and the connector (B) form the exhaust oil flow control solenoid valve RH.



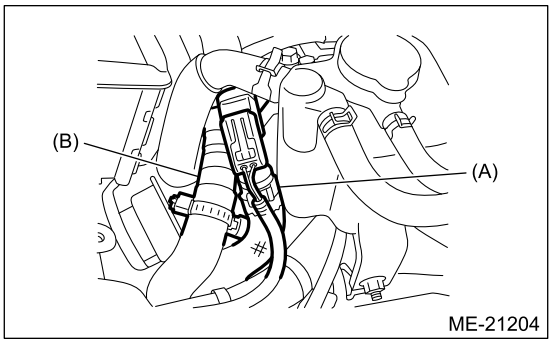
   (3) Remove the clip (A) which hold the engine harness to the rocker cover RH.



(4) Remove the ignition coil. Ref. to IGNITION(STI)>Ignition Coil>REMOVAL.
(5) Place a suitable container under the vehicle.
(6) Remove the tape (A) fixing the leak diagnosis connector harness, and disconnect the leak diagnosis connector from the engine harness.

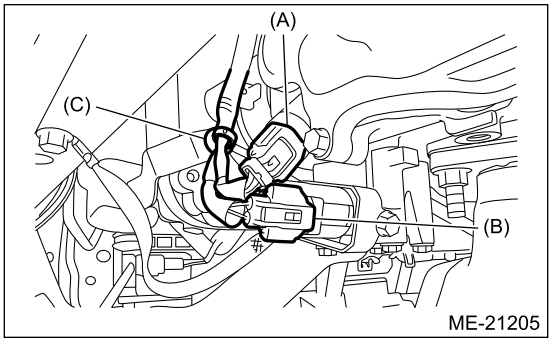


(7) Unlock the leak diagnosis connector, and disconnect the PCV hose (A) and vacuum hose (B).

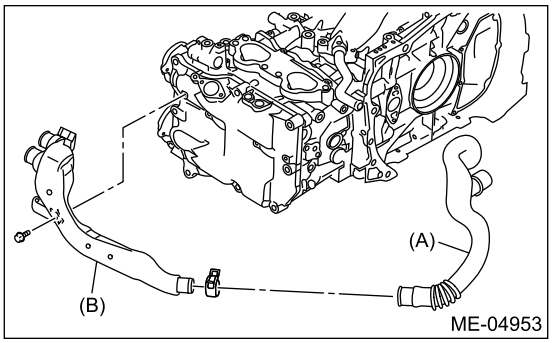


(8) Remove the rocker cover RH.

9. When inspecting #2 and #4 cylinders
(1) Remove the battery. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>REMOVAL.
(2) Remove the secondary air pump. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Pump>REMOVAL.
(3) Disconnect the connector (A) from the exhaust camshaft position sensor LH and the connector (B) form the exhaust oil flow control solenoid valve LH.
(4) Remove the clip (C) holding the engine harness.



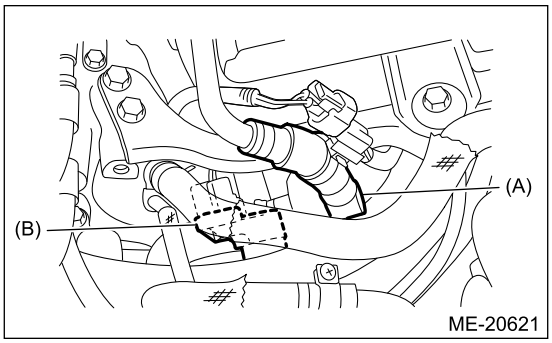
(5) Remove the air duct B (B) from the rocker cover LH and the air duct A (A).



(6) Remove the ignition coil. Ref. to IGNITION(STI)>Ignition Coil>REMOVAL.

(7) Place a suitable container under the vehicle.

(8) Unlock the leak diagnosis connector, and disconnect the PCV hose (A) and vacuum hose (B).



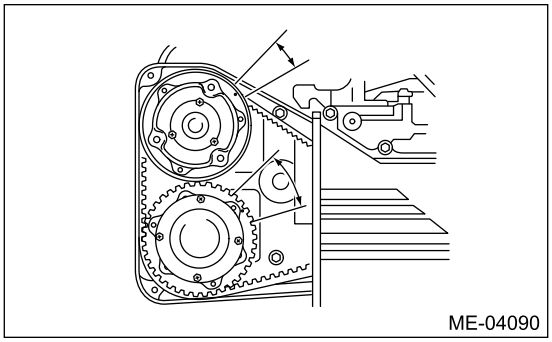
(9) Remove the rocker cover LH.

10. Turn the crank pulley clockwise until the round mark on the camshaft sprocket is set to position shown in the figure.

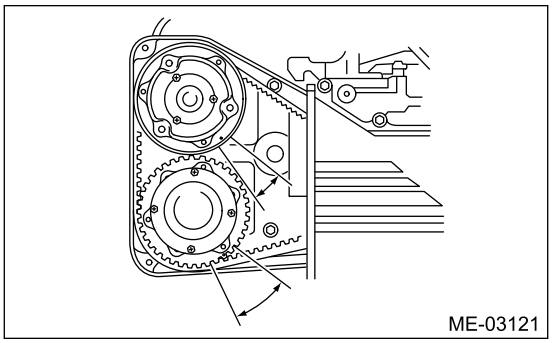
Note:

Turn the crank pulley using a socket wrench.

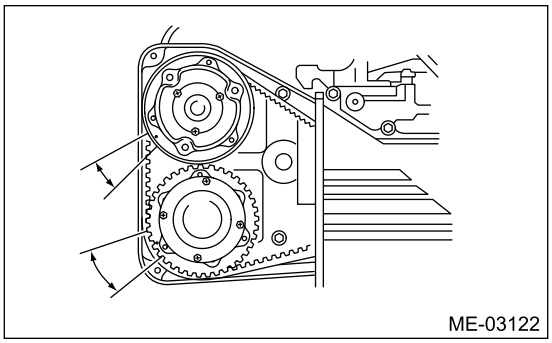
- Measurement of clearance of #1 cylinder intake valve and #3 cylinder exhaust valve



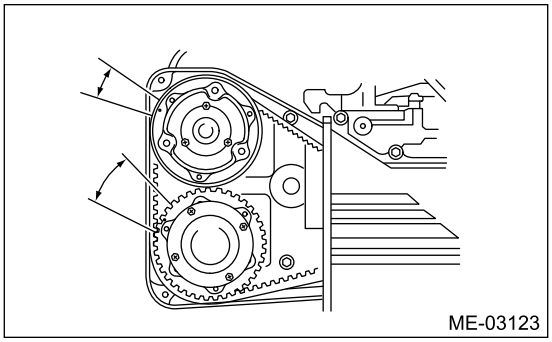
- Measurement of clearance of #2 cylinder exhaust valve and #3 cylinder intake valve



- Measurement of clearance of #2 cylinder intake valve and #4 cylinder exhaust valve



- Measurement of clearance of #1 cylinder exhaust valve and #4 cylinder intake valve



11. Measure the clearance of intake valve and exhaust valve using thickness gauge (A).

Note:

- **Insert a thickness gauge in a direction as horizontal as possible with respect to the valve lifter.**
- **Lift up the vehicle, and then measure the exhaust valve clearances.**
- **If the measured value is not within the inspection value, take notes of the value in order to adjust the valve clearance later on.**

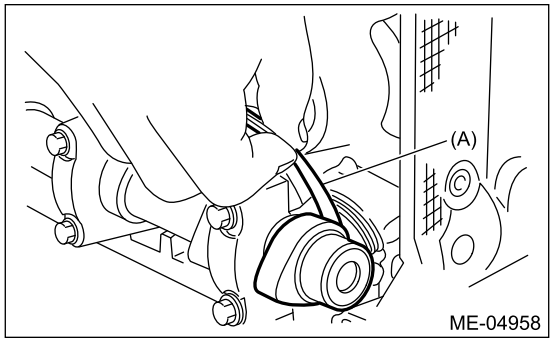
Valve clearance (inspection value):

Intake

$0.20^{+0.04}_{-0.06}$ mm ($0.0079^{+0.0016}_{-0.0024}$ in)

Exhaust

0.35±0.05 mm (0.0138±0.0020 in)



12. If necessary, adjust the valve clearance. Ref. to MECHANICAL(STI)>Valve Clearance>ADJUSTMENT.

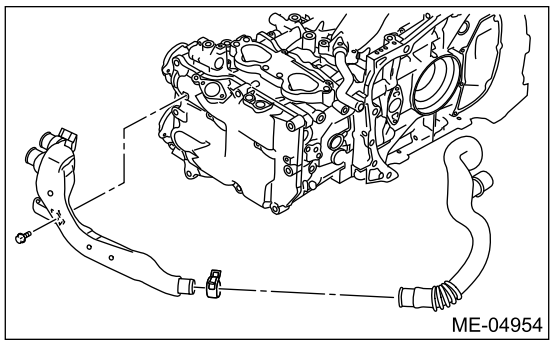
13. After inspection, install the related parts in the reverse order of removal.

Note:

Refer to "Camshaft" when installing the rocker cover. Ref. to MECHANICAL(STI)>Camshaft>INSTALLATION.

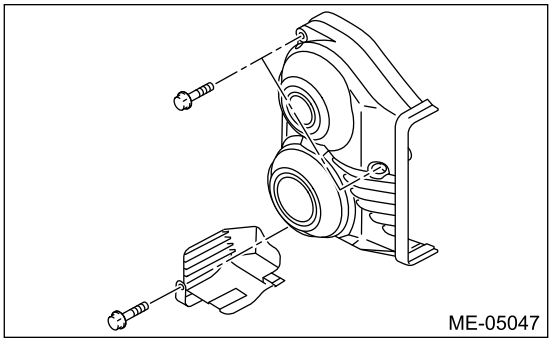
Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



Tightening torque:

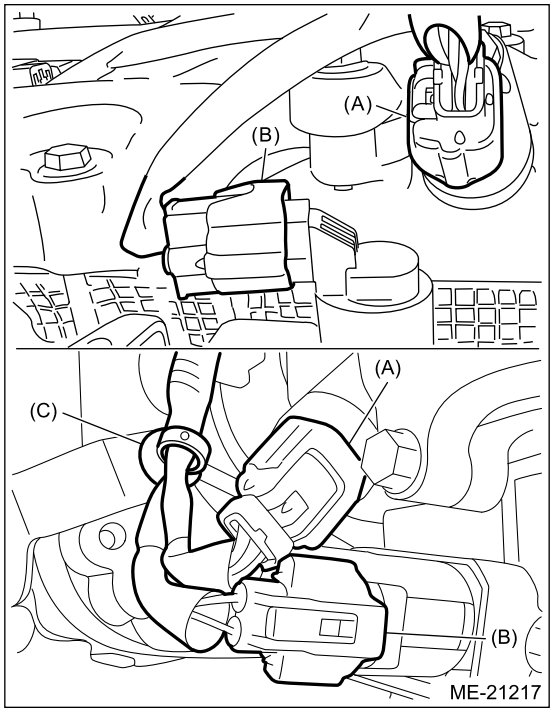
5 N·m (0.5 kgf-m, 3.7 ft-lb)



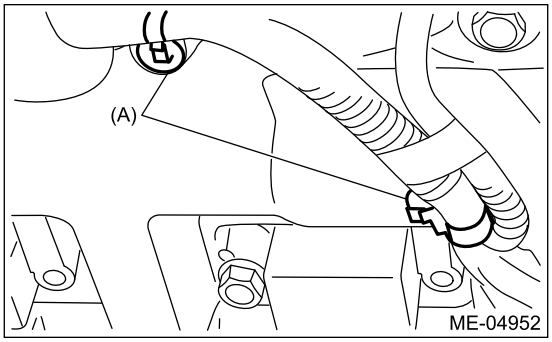
MECHANICAL(STI) > Valve Clearance

ADJUSTMENT

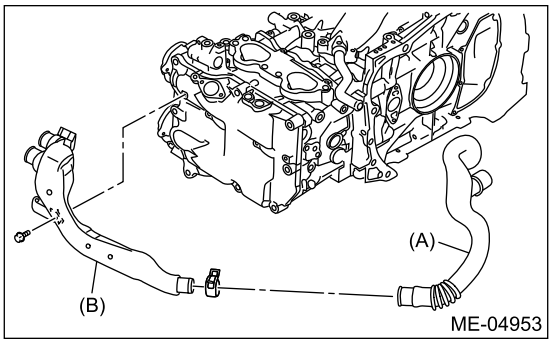
1. Remove the engine from the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>REMOVAL.
2. Measure all the valve clearances.
   (1) Remove the timing belt cover RH. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
   (2) Disconnect the connector (A) from the exhaust camshaft position sensor and the connector (B) from the exhaust oil flow control solenoid valve LH.
   (3) Remove the clip (C) holding the engine harness.



   (4) Remove the clip (A) which hold the engine harness to the rocker cover RH.



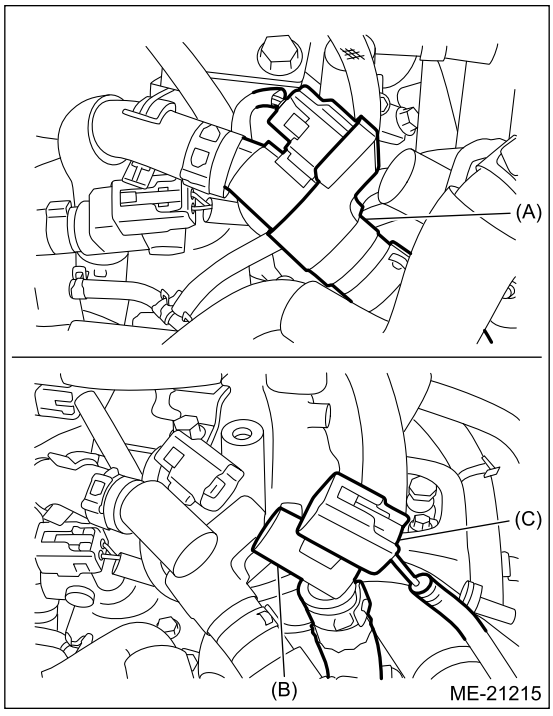
(5) Remove the air duct B (B) from the rocker cover LH and the air duct A (A).



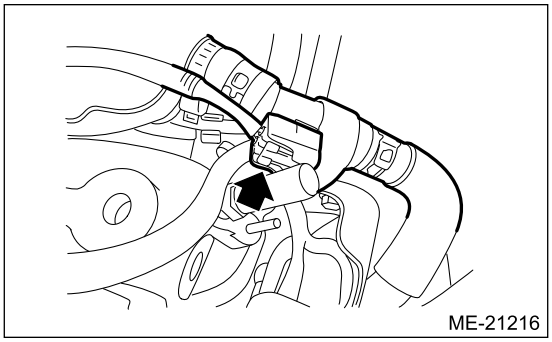
(6) Remove the ignition coil. Ref. to IGNITION(STI)>Ignition Coil>REMOVAL.

(7) Unlock the leak diagnosis connector, and disconnect the vacuum hose (A).

(8) Remove the leak diagnosis connector (C) from the PCV hose (B).



(9) Unlock the leak diagnosis connector, and disconnect the vacuum hose.



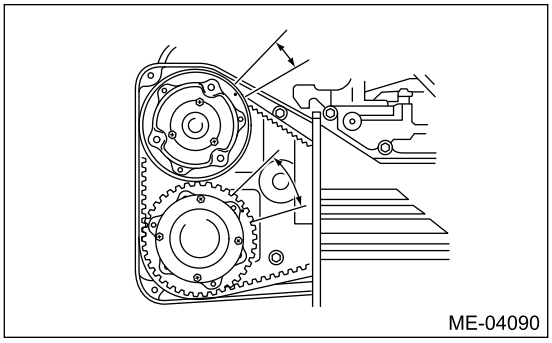
(10)Remove the rocker cover.

(11)Turn the crank pulley clockwise until the round mark on the camshaft sprocket is set to position shown in the figure.

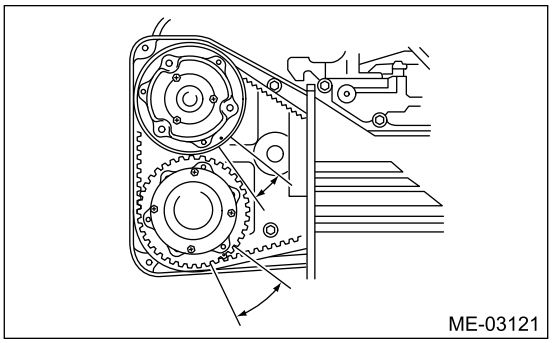
Note:

Turn the crank pulley using a socket wrench.

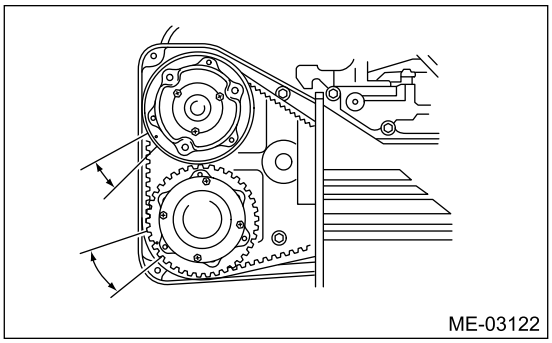
- **Measurement of clearance of #1 cylinder intake valve and #3 cylinder exhaust valve**



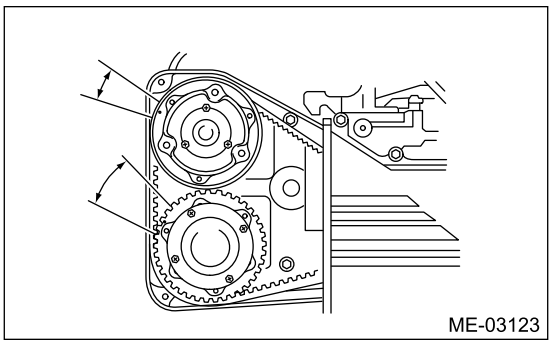
- **Measurement of clearance of #2 cylinder exhaust valve and #3 cylinder intake valve**



- **Measurement of clearance of #2 cylinder intake valve and #4 cylinder exhaust valve**



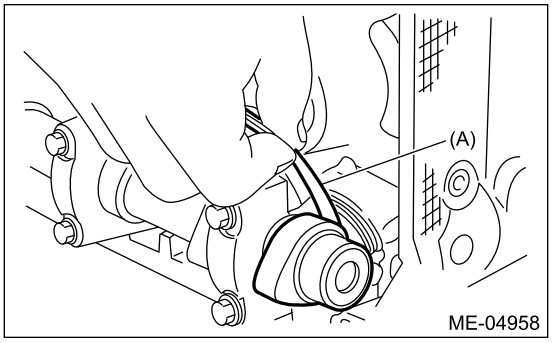
- **Measurement of clearance of #1 cylinder exhaust valve and #4 cylinder intake valve**



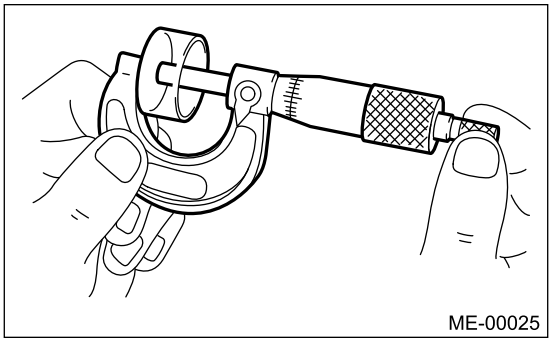
(12)Measure the clearance of intake valve and exhaust valve using thickness gauge (A).

Note:

- **Insert a thickness gauge in a direction as horizontal as possible with respect to the valve lifter.**
- **Record the measured value of each valve clearance.**



3. Remove the camshaft. Ref. to MECHANICAL(STI)>Camshaft>REMOVAL.
4. Remove the valve lifter.
5. Measure the thickness of valve lifter using micrometer.



6. Select a valve lifter of suitable thickness using the measured valve clearance and valve lifter thickness, and install it.

   Note:

   Use a new valve lifter.

Unit: mm (in)
Intake valve: S = (V + T) − 0.19 (0.0075) Exhaust valve: S = (V + T) − 0.35 (0.0138)
S: Valve lifter thickness required V: Measured valve clearance T: Current valve lifter thickness

7. Install the camshaft. Ref. to MECHANICAL(STI)>Camshaft>INSTALLATION.
8. Install the cam sprocket. Ref. to MECHANICAL(STI)>Cam Sprocket>INSTALLATION.
9. Install the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION > TIMING BELT.
10. Measure all valves for valve clearance again at this time. If the valve clearance is not within the adjustment value, repeat the procedure over again from step 3).

    Valve clearance (adjustment value):

    Intake

    $0.20^{+0.01}_{-0.03}$ mm ($0.0079^{+0.0004}_{-0.0012}$ in)

    Exhaust

0.35±0.02 mm (0.0138±0.0008 in)

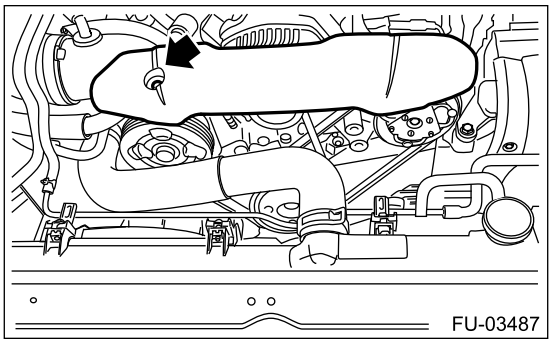
11. After adjustment, install the related parts in the reverse order of removal.

Note:

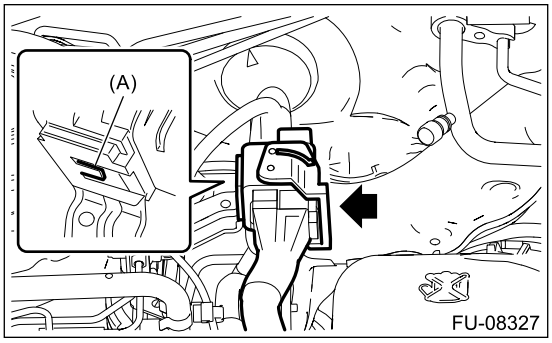
Refer to "Camshaft" when installing the related parts. **Ref. to MECHANICAL(STI)>Camshaft>INSTALLATION.**

REMOVAL

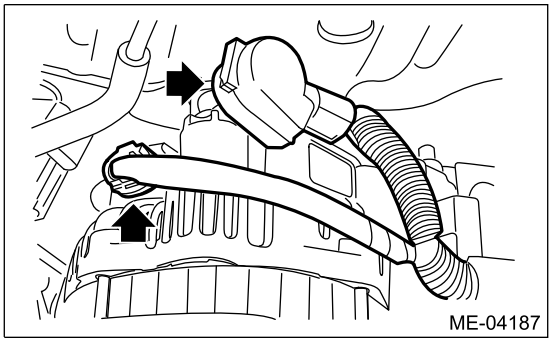
1. Remove the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>DISASSEMBLY.
2. Fully open the front hood. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
3. Remove the V-belt covers.



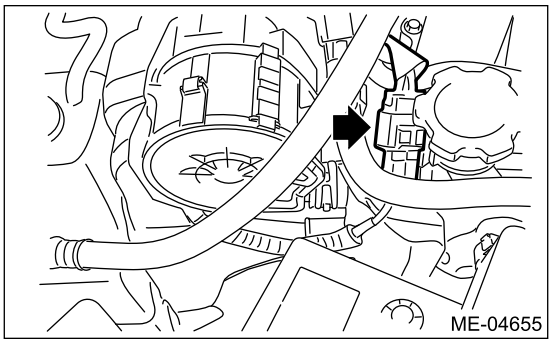
4. Collect the refrigerant from A/C system. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Recovery Procedure.
5. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
6. Remove the battery. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>REMOVAL.
7. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
8. Remove the air intake duct and air cleaner case (rear). Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Case>REMOVAL.
9. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
10. Remove the radiator. Ref. to COOLING(STI)>Radiator>REMOVAL.
11. Remove the coolant filler tank. Ref. to COOLING(STI)>Coolant Filler Tank>REMOVAL.
12. Disconnect the bulkhead harness connectors from the engine harness connectors.
13. Lift the claw (A) and remove the engine harness connector from the engine harness bracket.



14. Disconnect the following connectors and terminals.
    (1) Generator connector and terminal

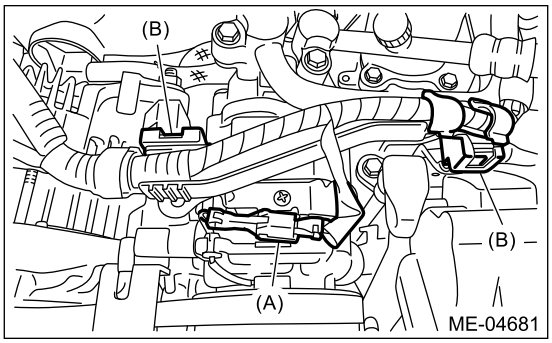


(2) Secondary air pump connector



15. Disconnect connector (A) from the A/C compressor.

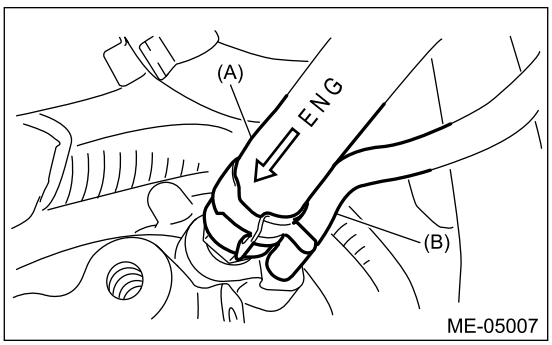
16. Remove the clip (B) securing the generator cord, and move the generator cord to the left side wheel apron.



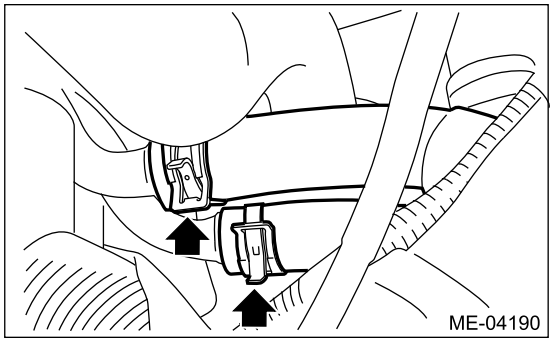
17. Disconnect the following hoses.

(1) A/C pressure hose Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Hose and Pipe>REMOVAL.

(2) Brake booster vacuum hose (A) and pressure regulator vacuum hose (B)



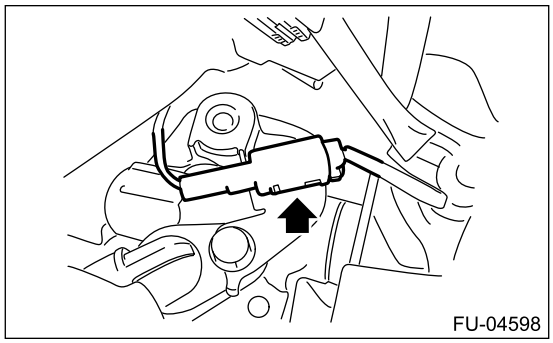
(3) Heater inlet hose and heater outlet hose



18. Remove the power steering pump.

(1) Remove the front side belt. Ref. to MECHANICAL(STI)>V-belt>REMOVAL > FRONT SIDE BELT.

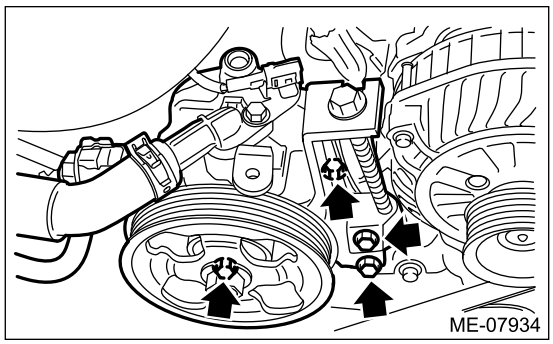
(2) Disconnect the connector from power steering pump switch.



(3) Remove the bolt which holds purge control solenoid valve 1 onto intake manifold.



(4) Remove the power steering pump from the engine.



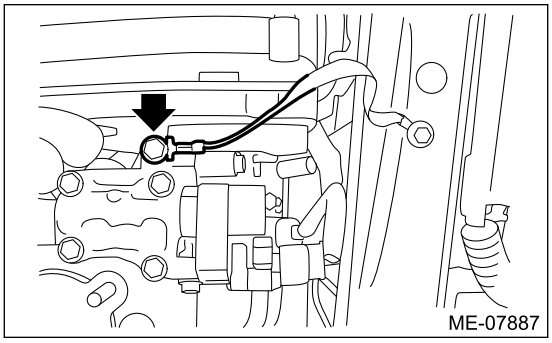
(5) Place the power steering pump on the right side wheel apron.

19. Remove the center exhaust pipe. Ref. to EXHAUST(STI)>Center Exhaust Pipe>REMOVAL.

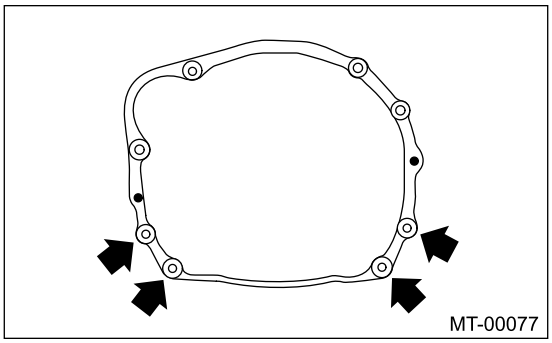
20. Remove the turbocharger. Ref. to INTAKE (INDUCTION)(STI)>Turbocharger>REMOVAL.

21. Remove the joint pipe and front exhaust pipe. Ref. to EXHAUST(STI)>Joint Pipe>REMOVAL. Ref. to EXHAUST(STI)>Front Exhaust Pipe>REMOVAL.

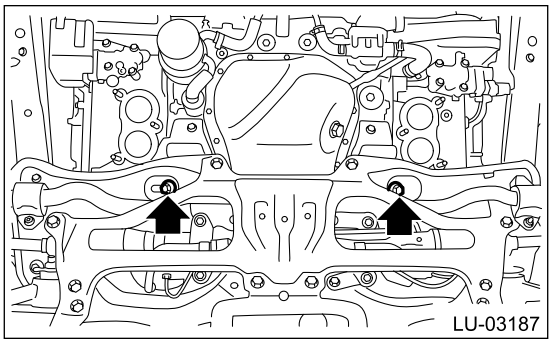
22. Disconnect the ground cable on the engine side.



23. Remove the bolts and nuts which hold the lower side of transmission to the engine.



24. Remove the nuts which secure the engine mounting to the front crossmember.



25. Lower the vehicle.

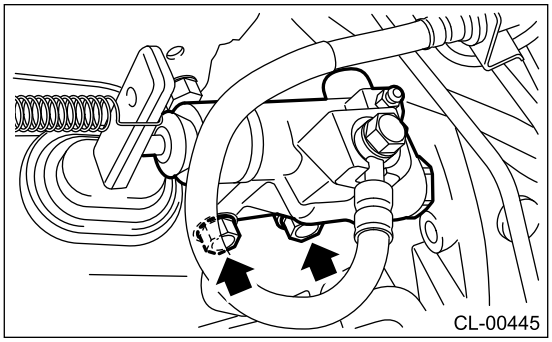
26. Remove the starter. Ref. to STARTING/CHARGING SYSTEMS(STI)>Starter>REMOVAL.

27. Separate the release lever from the release bearing.

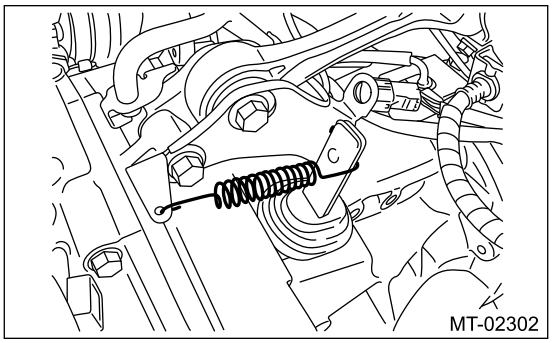
Note:
This procedure is required to remove engine with the release bearing assembled to the clutch cover.

(1) Remove the operating cylinder from the transmission.

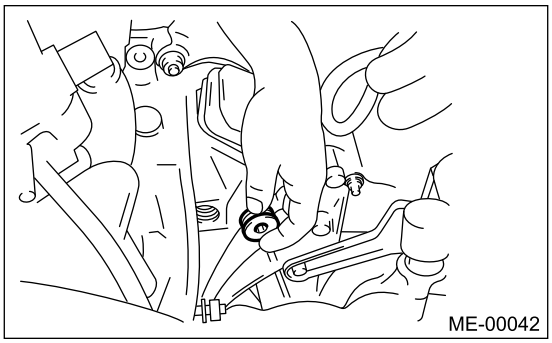
Note:
Move the removed operating cylinders to a location that does not interfere operation.



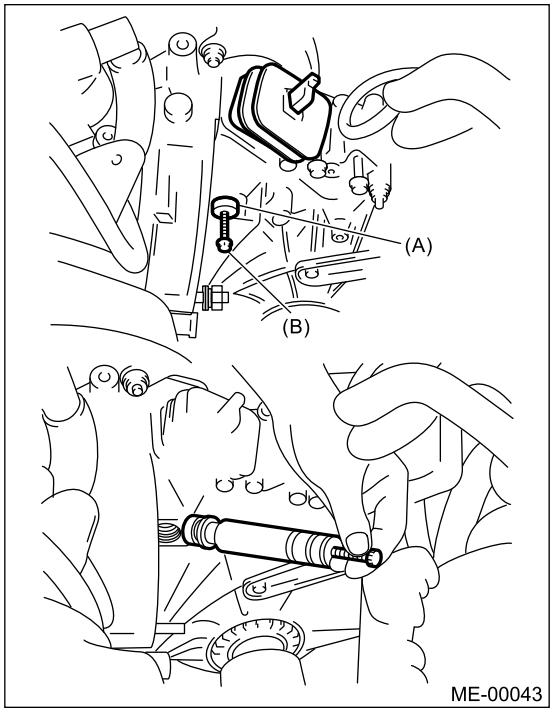
(2) Remove the return spring from the release lever.



(3) Remove the service hole plug using a hexagon wrench.



(4) Attach a 6-mm bolt to the clutch release lever shaft, and pull out the clutch release lever shaft.

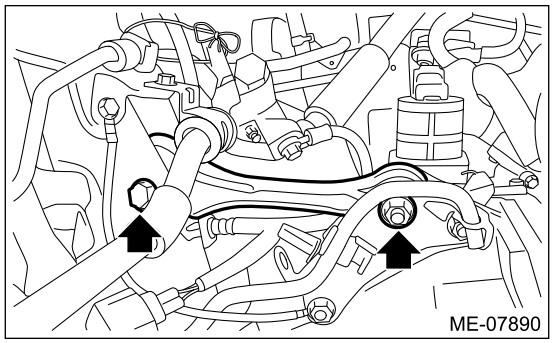


(A) Clutch release lever shaft

(B) Bolt

(5) Lift the release lever, and remove the release lever from the claw of the release bearing. Pull the release lever to the engine side, and make it so that it moves freely.

28. Remove the pitching stopper.



29. Disconnect the fuel delivery hose, fuel return hose and evaporation hose.

Caution:

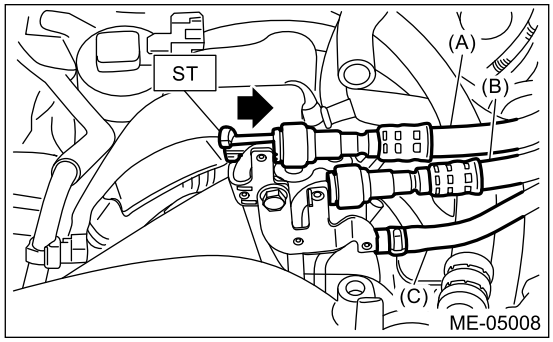
- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**

(1) Set the ST to the fuel pipe.

ST 42099AE000 QUICK CONNECTOR RELEASE

(2) Disconnect the quick connector of the fuel delivery hose and fuel return hose by pushing the ST in the direction of the arrow.

(3) Remove the clip and disconnect the evaporation hose from the fuel pipe.



(A) Fuel delivery hose

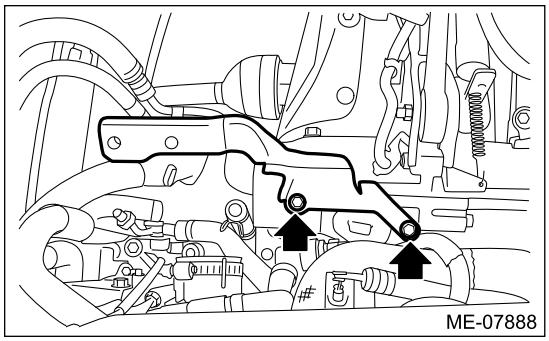
(B) Fuel return hose

(C) Evaporation hose

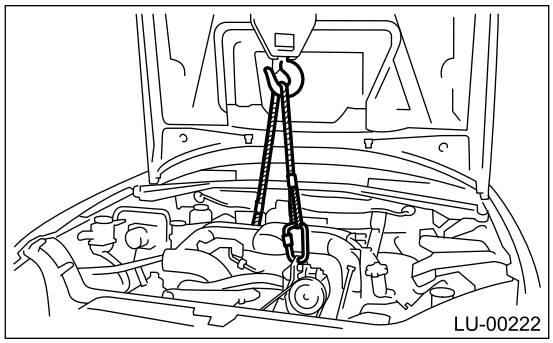
30. Install the intercooler stay RH No. 2.

Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)



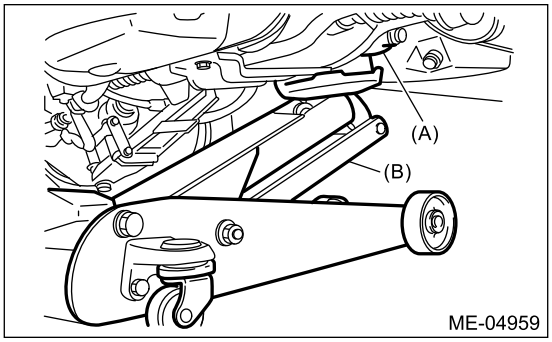
31. Support the engine with a lifting device and wire ropes.



32. Support the transmission with a garage jack.

Caution:

Be sure to perform this procedure to prevent the transmission from lowering by its own weight.



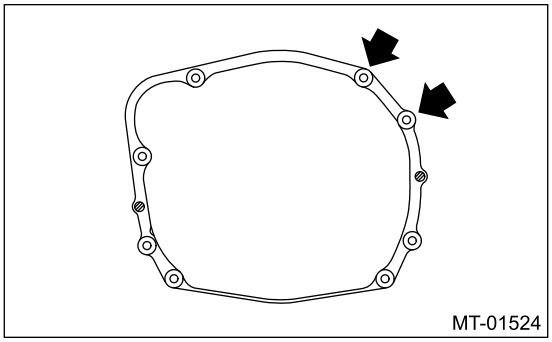
(A) Transmission

(B) Garage jack

33. Remove the bolts which hold the upper side of the transmission to the engine.

Caution:

Before removing the engine away from transmission, check to be sure no work has been overlooked.



34. Remove the engine from the vehicle.

Note:

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

(1) Slightly raise the engine.

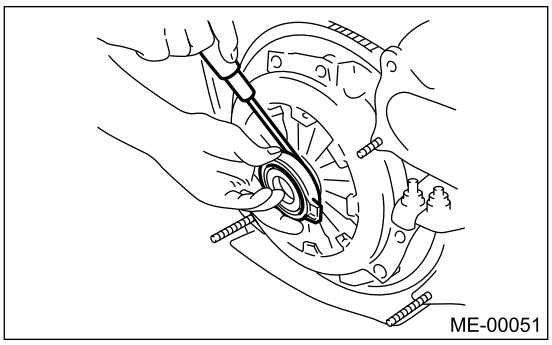
(2) Raise the transmission with garage jack.

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

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

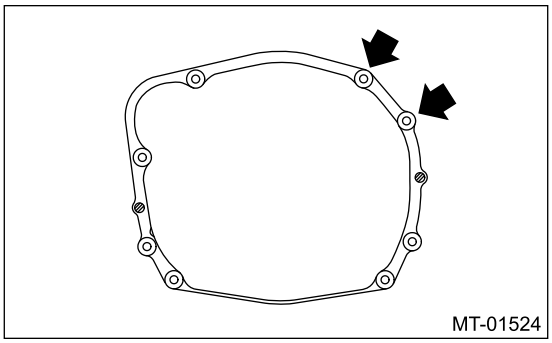
35. Remove the engine mounting from the engine.

36. Using a flat tip screwdriver, remove the release bearing from the clutch cover.

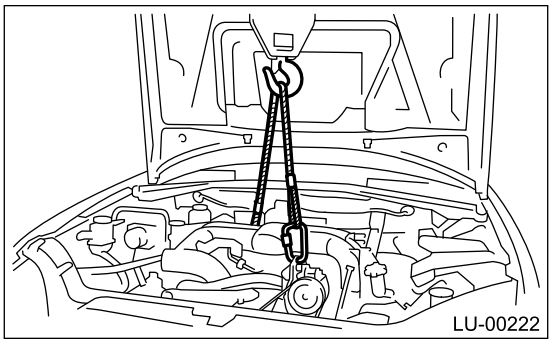


INSTALLATION

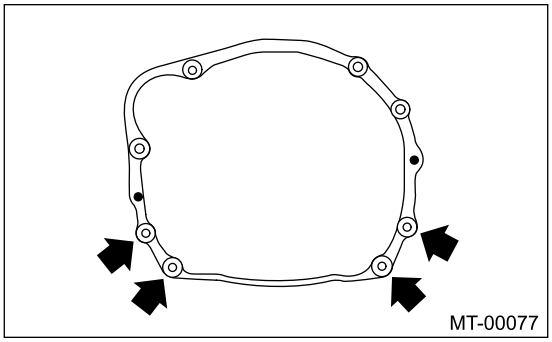
1. Set the release lever, release bearing and clutch release lever shaft to the transmission. Ref. to CLUTCH SYSTEM>Release Bearing and Lever>INSTALLATION > STI MODEL.
2. Install the engine mounting onto the engine.
   Tightening torque:
   35 N·m (3.6 kgf-m, 25.8 ft-lb)
3. Position the engine in engine compartment and align it with transmission.
   Note:
   Be careful not to damage adjacent parts or body panels with crank pulley, oil level gauge, etc.
4. Install the bolts which hold 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. Lift up the vehicle.
8. Install the bolts and nuts which hold lower side of the transmission to engine.
   Tightening torque:
   50 N·m (5.1 kgf-m, 36.9 ft-lb)



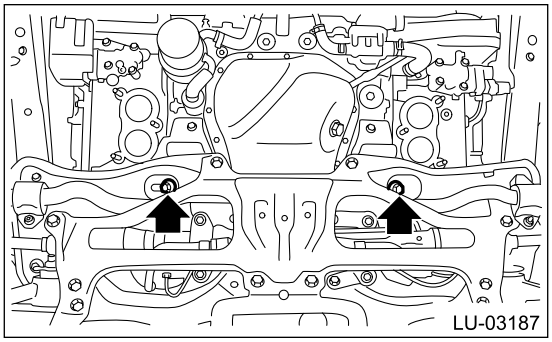
9. Install the nuts which hold the engine mounting to the front crossmember.

Note:

Use a new nut.

Tightening torque:

60 N·m (6.1 kgf-m, 44.3 ft-lb)

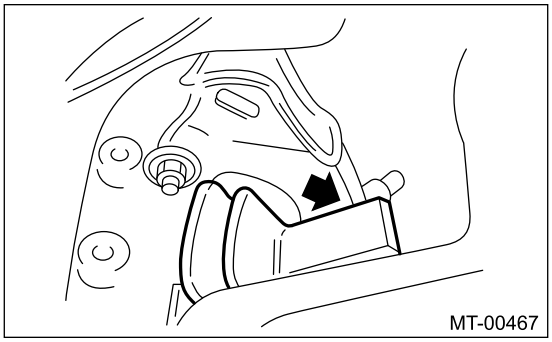


10. Lower the vehicle.

11. Make sure that the release bearing is completely inserted.

Note:

- **Push the release lever towards the operating cylinder side until a clicking sound is heard. Pull the release lever towards the engine side. If the release lever is not in contact with the case, the setting is complete.**
- **Confirm that the boot cover is set securely.**

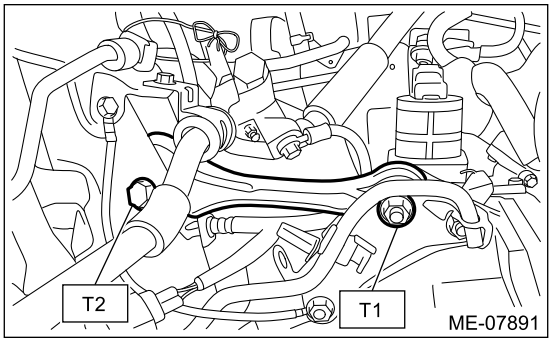


12. Install the pitching stopper.

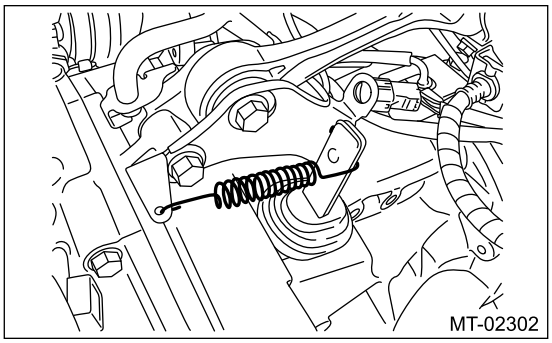
Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)



13. Install the return spring.



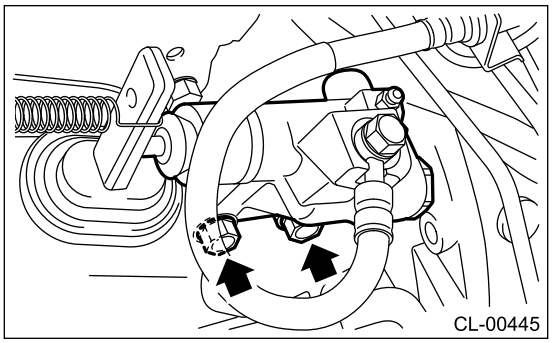
14. Install the operating cylinder.

Note:

Check that the clutch hose is routed properly.

Tightening torque:

41 N·m (4.2 kgf-m, 30.2 ft-lb)



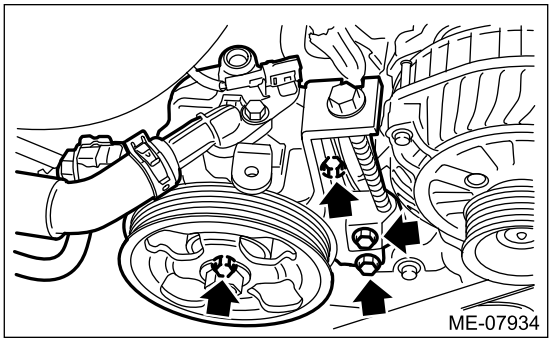
15. Install the starter. Ref. to STARTING/CHARGING SYSTEMS(STI)>Starter>INSTALLATION.

16. Install the power steering pump.

(1) Install the power steering pump onto the engine.

Tightening torque:

Refer to "COMPONENT" of "Power Steering" for the tightening torque. Ref. to POWER ASSISTED SYSTEM (POWER STEERING)>General Description>COMPONENT.



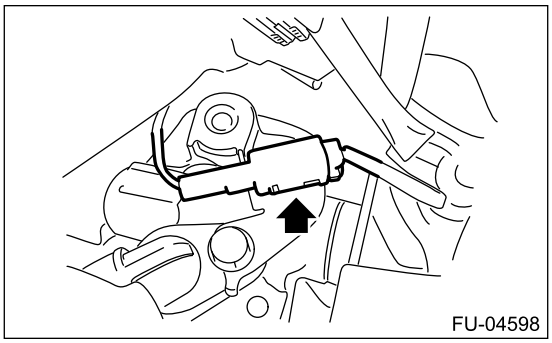
(2) Install the purge control solenoid valve 1 to the intake manifold.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

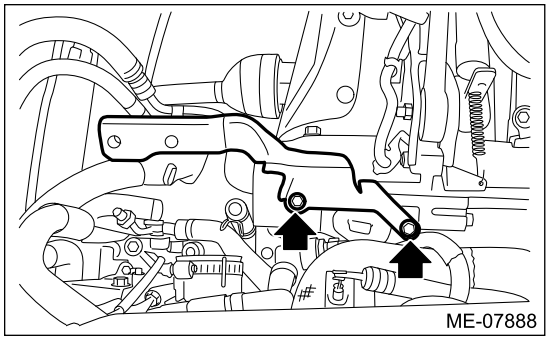


(3) Connect the connector to the power steering pump switch.



(4) Install the front side belt. Ref. to MECHANICAL(STI)>V-belt>INSTALLATION > FRONT SIDE BELT.

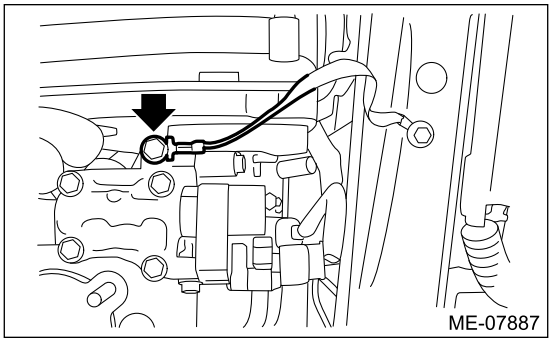
17. Remove the intercooler stay RH No. 2.



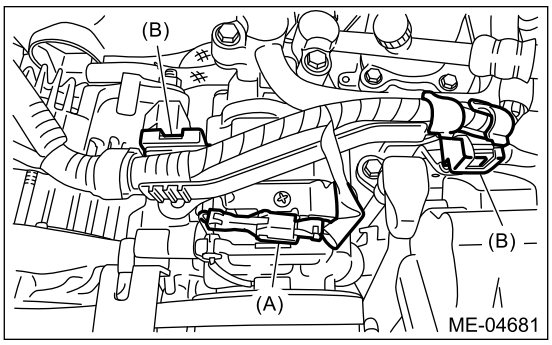
18. Lift up the vehicle.

19. Connect the ground cable.

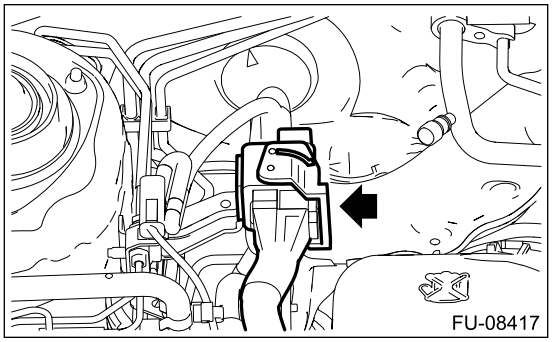
Tightening torque:
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



20. Install the joint pipe and front exhaust pipe. Ref. to EXHAUST(STI)>Front Exhaust Pipe>INSTALLATION. Ref. to EXHAUST(STI)>Joint Pipe>INSTALLATION.
21. Install the turbocharger. Ref. to INTAKE (INDUCTION)(STI)>Turbocharger>INSTALLATION.
22. Install the center exhaust pipe. Ref. to EXHAUST(STI)>Center Exhaust Pipe>INSTALLATION.
23. Connect the following hoses.
(1) Fuel delivery hose, fuel return hose and evaporation hose
(2) Heater inlet hose and heater outlet hose
(3) Brake booster vacuum hose and pressure regulator vacuum hose
(4) A/C pressure hose Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Hose and Pipe>INSTALLATION.
24. Secure the generator cord using the clip (B) and connect the connector (A) to A/C compressor.



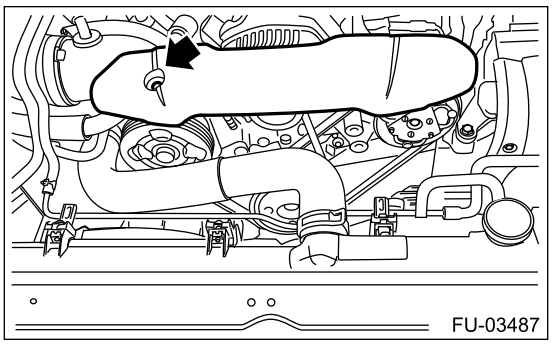
25. Connect the following connectors and terminals.
(1) Generator connector and terminal
Tightening torque:
15.5 N·m (1.6 kgf-m, 11.4 ft-lb)
(2) Secondary air pump connector
26. Install the engine harness connector to engine harness bracket, then connect the bulkhead harness connector to the engine harness connector.



27. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.
28. Install the radiator. Ref. to COOLING(STI)>Radiator>INSTALLATION.
29. Install the coolant filler tank. Ref. to COOLING(STI)>Coolant Filler Tank>INSTALLATION.
30. Install the air cleaner case and air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Case>INSTALLATION. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>INSTALLATION.
31. Install the battery. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>INSTALLATION.
32. Fill engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
33. Charge the A/C system with refrigerant. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Charging Procedure>PROCEDURE.
34. Install the V-belt cover.

    Tightening torque:

    7 N·m (0.7 kgf-m, 5.2 ft-lb)



35. Set the front hood to the normal position. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
36. Install the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>ASSEMBLY.
37. Close the front hood.

MECHANICAL(STI) > Engine Assembly

INSPECTION

1. Check that pipes, hoses, connectors and clamps are installed firmly.
2. Check the engine coolant is at specified level.
3. Start the engine and check for exhaust gas, engine coolant, leaks of fuel, etc. Also check for noise and vibrations.

MECHANICAL(STI) > Engine Mounting

REMOVAL

1. Remove the front crossmember. Ref. to FRONT SUSPENSION>Front Crossmember>REMOVAL.
2. Remove the engine mounting from the engine.

MECHANICAL(STI) > Engine Mounting

INSTALLATION

Install in the reverse order of removal.

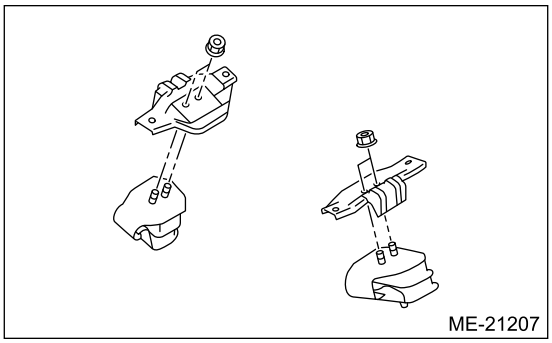
Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

MECHANICAL(STI) > Engine Mounting

DISASSEMBLY

Remove the front cushion rubber from the front engine mounting bracket.



MECHANICAL(STI) > Engine Mounting

ASSEMBLY

Install in the reverse order of removal.

Tightening torque:

42 N·m (4.3 kgf-m, 31.0 ft-lb)

MECHANICAL(STI) > Engine Mounting

INSPECTION

Make sure that there are no cracks or other damages.

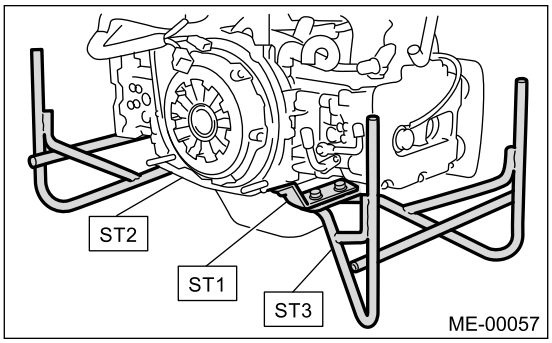
PROCEDURE

1. After removing the engine from vehicle body, attach the ST to the engine as shown in the figure.

   ST1 498457000 ENGINE STAND ADAPTER RH

   ST2 498457100 ENGINE STAND ADAPTER LH

   ST3 499817100 ENGINE STAND



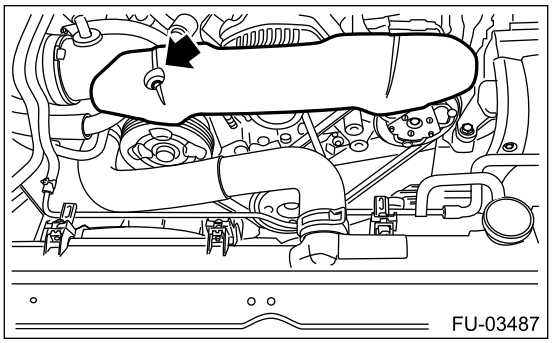
2. In this section the procedures described under each index are all connected and stated in order. The procedure for overhauling of the engine will be completed when you go through all steps in the process.
   Therefore, in this section, to conduct the particular procedure within the flow of a section, you need to go back and conduct the procedure described previously in order to do that particular procedure.

REMOVAL

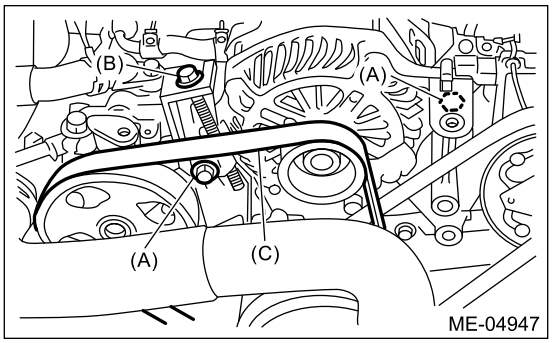
Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. FRONT SIDE BELT

1. Remove the V-belt covers.

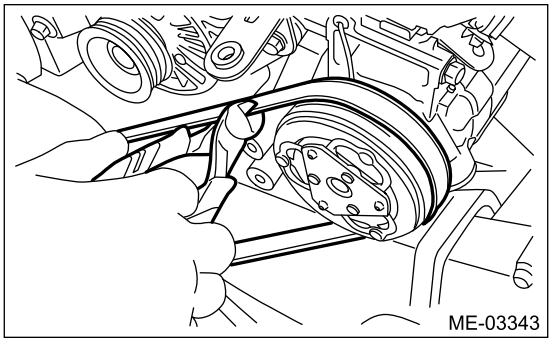


2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
3. Loosen the bolt (A).
4. Loosen the slider bolt (B).
5. Remove the front side belt (C).



2. REAR SIDE BELT

1. Remove the front side belt. Ref. to MECHANICAL(STI)>V-belt>REMOVAL > FRONT SIDE BELT.
2. Cut the rear side belt with a wire cutter, etc., and discard.



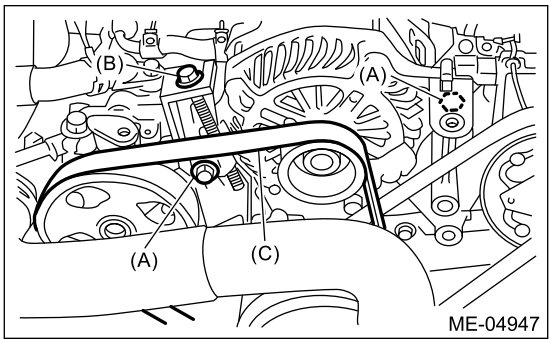
INSTALLATION

1. FRONT SIDE BELT

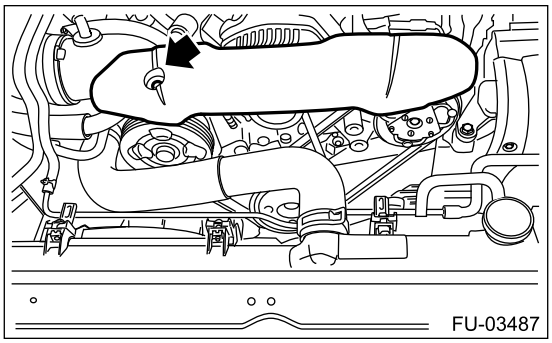
Caution:

- **When reusing the front side belt, wipe off dust and water with cloth.**
- **Do not use the front side belt if there is any oil, grease or coolant on the belt.**
- **Be careful not to rub the belt end surface with bare hands; exposed core may cause injury.**

1. Wipe off any dust, oil and water on the groove of each pulley with cloth.
2. Install the front side belt (C), and adjust the slider bolt (B) so as to obtain the specified belt tension.
   Ref. to MECHANICAL(STI)>V-belt>INSPECTION.
3. Tighten the bolt (A).
4. Tighten the slider bolt (B).
   Tightening torque:
   Bolt (A)
   25 N·m (2.5 kgf-m, 18.4 ft-lb)
   Slider bolt (B)
   8 N·m (0.8 kgf-m, 5.9 ft-lb)



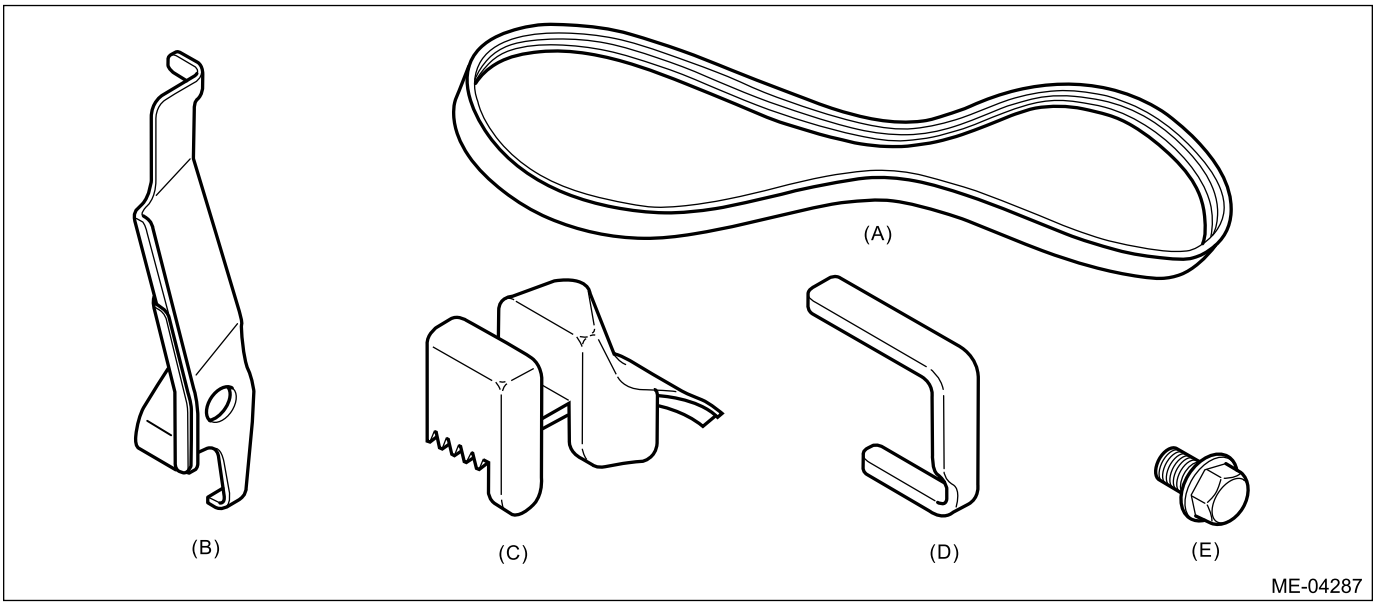
5. Install the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>INSTALLATION.
6. Install the V-belt cover.
   Tightening torque:
   7 N·m (0.7 kgf-m, 5.2 ft-lb)



2. REAR SIDE BELT

Caution:

- **Do not re-use the rear side belt.**
- **Be careful not to let oil, grease or coolant contact a new rear side belt.**
- **Be careful not to rub the belt end surface with bare hands; exposed core may cause injury.**
- **To install the rear side belt, always use the provided tools (belt stopper, belt guide, belt guide holder, and bolt).**

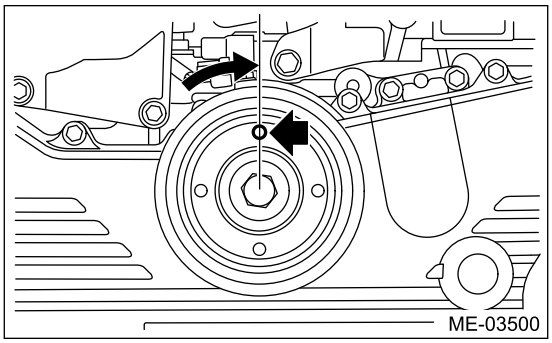


(A) Rear side belt
(B) Belt stopper
(C) Belt guide
(D) Belt guide holder
(E) Bolt

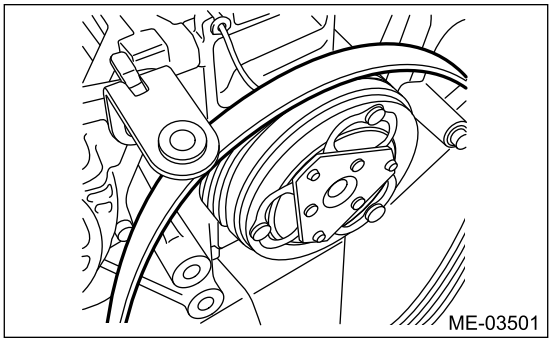
1. Wipe off any dust, oil and water on the groove of each pulley with cloth.
2. Wipe off any oil, water, dirt, and rust on the front of the crank pulley with cloth.
3. Slowly turn the crank pulley clockwise so that the service hole of the crank pulley comes around the top.

   Caution:

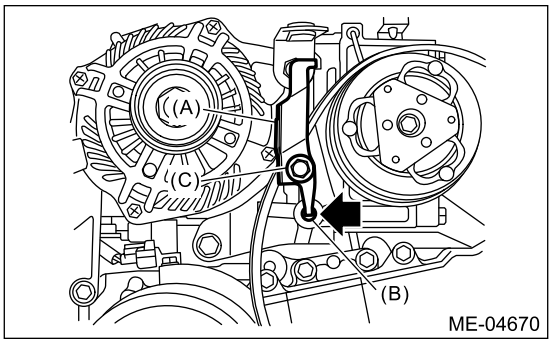
   Do not turn the crank pulley counterclockwise.



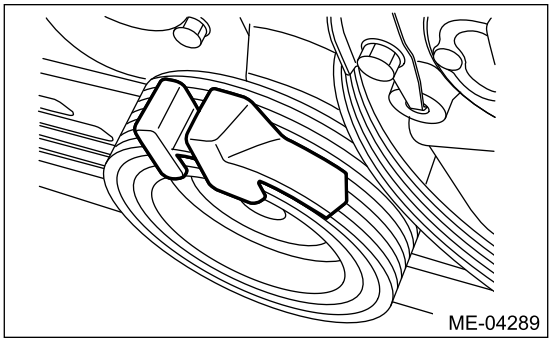
4. Hook a new rear side belt on the A/C compressor pulley.



5. As shown in the figure, insert the claw of the belt stopper (A) to the lower hole (B) of the compressor bracket, then attach with bolt (C).



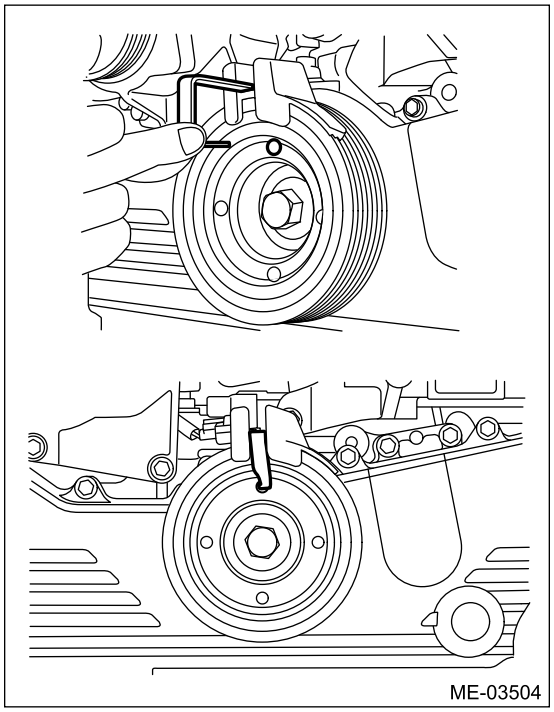
6. Place the belt guide while aligning it with the belt line of the crank pulley on the front side belt side.



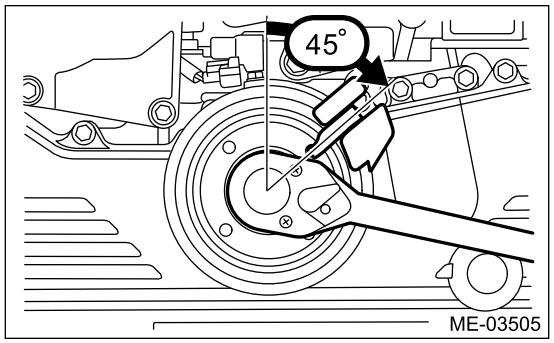
7. Insert the belt guide holder into the service hole of the crank pulley so that the belt guide comes in between.

Note:

Place the belt guide holder with the longer side up.



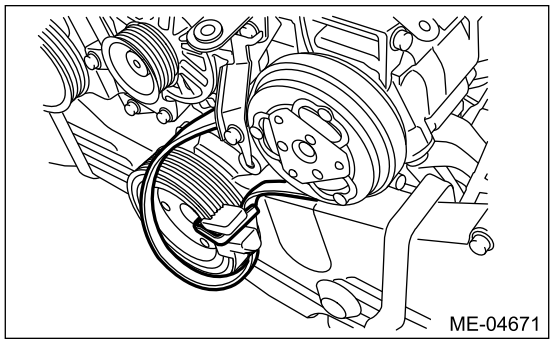
8. Slowly turn the crank pulley clockwise until the belt guide comes to approximately 45°.



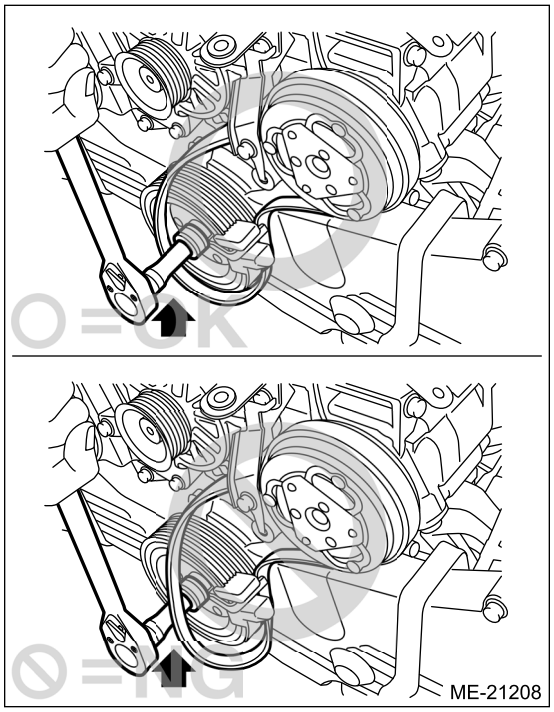
9. Place the rib surface of the rear side belt into the crank pulley groove, so that the rear side belt comes in between the belt guide holder.

Caution:

When it is difficult to place the rear side belt to the crank pulley groove, pull out the belt guide holder half way, then place the rear side belt into the groove so that it comes in between the belt guide holder.



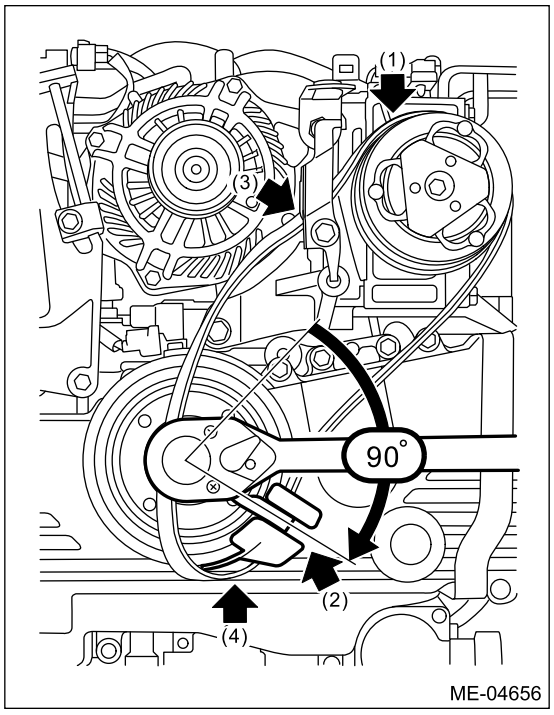
10. Place the tool through the loop of the rear side belt, and set on the crank pulley bolt.



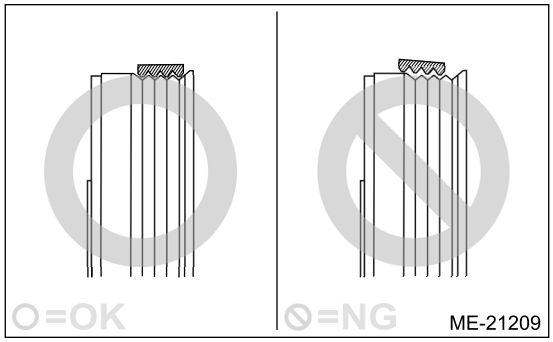
11. While checking the following, slowly turn the crank pulley approximately 90° clockwise so that the belt guide comes to the position shown in the figure.

Caution:

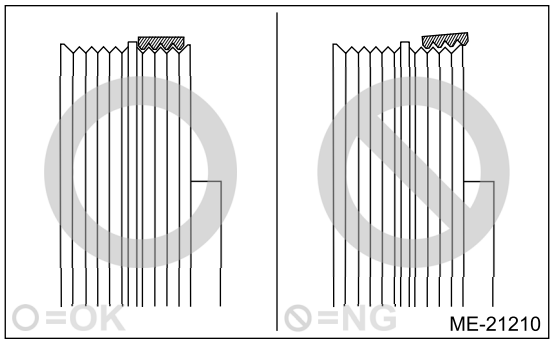
When turning the crank pulley, always make sure that the belt guide is not off from the crank pulley groove.



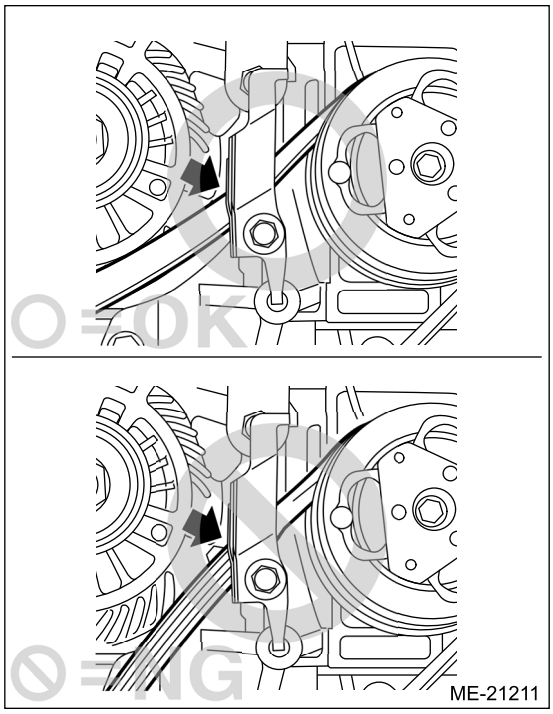
(1) The rib of the rear side belt is securely placed on the groove of the A/C compressor pulley.



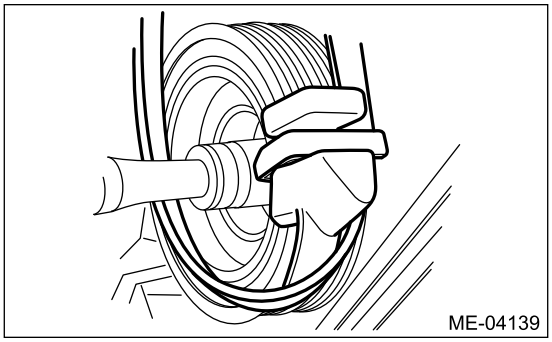
(2) The rib of the rear side belt is securely placed on the groove of the crank pulley.



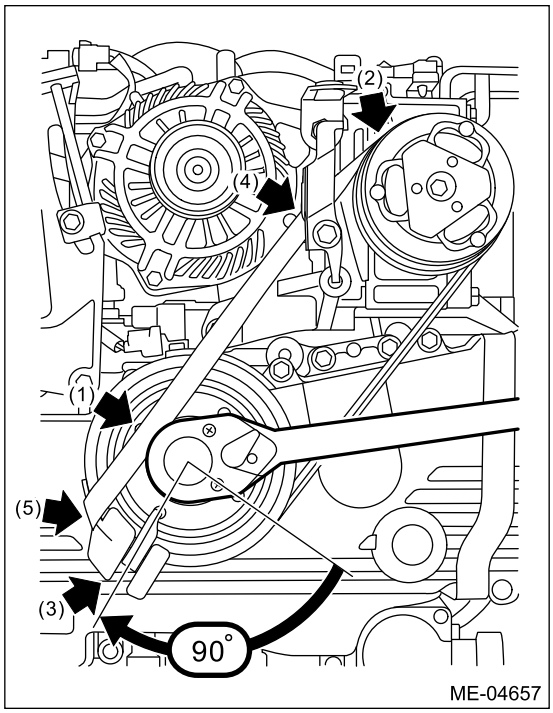
(3) The surface of the rear side belt is held by the belt stopper.



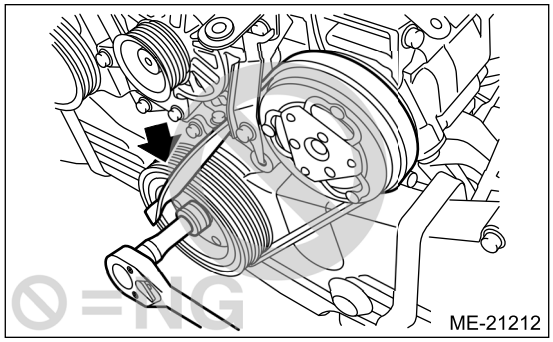
(4) The rear side belt is securely placed on the belt guide.



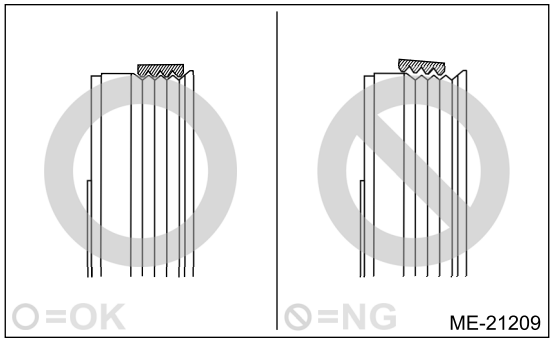
12. While checking the following, slowly turn the crank pulley approximately 90° clockwise so that the belt guide comes to the position shown in the figure.



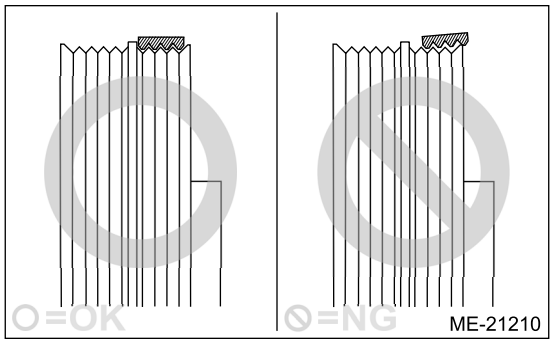
(1) The rear side belt is not twisted.



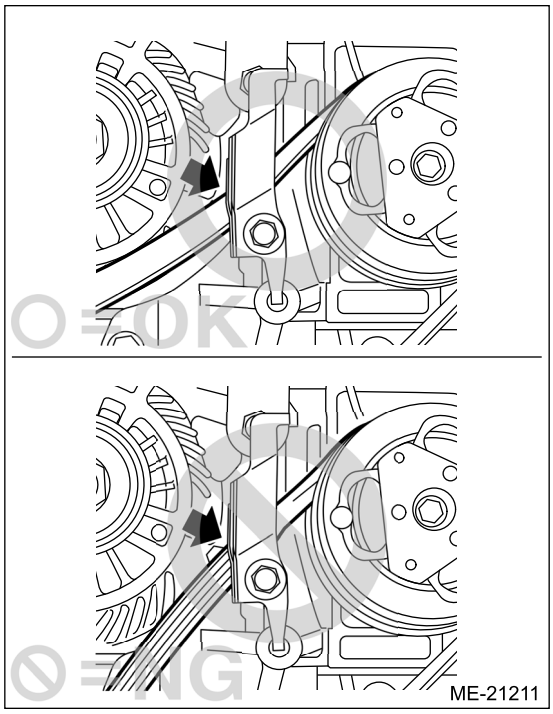
(2) The rib of the rear side belt is securely placed on the groove of the A/C compressor pulley.



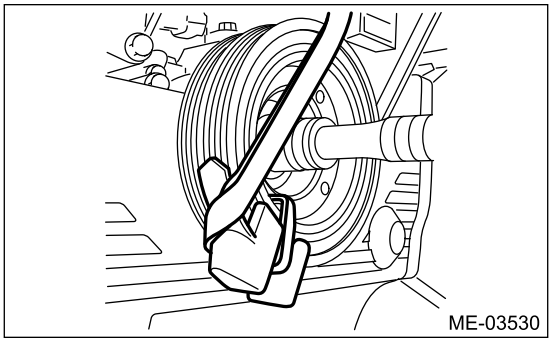
(3) The rib of the rear side belt is securely placed on the groove of the crank pulley.



(4) The surface of the rear side belt is held by the belt stopper.



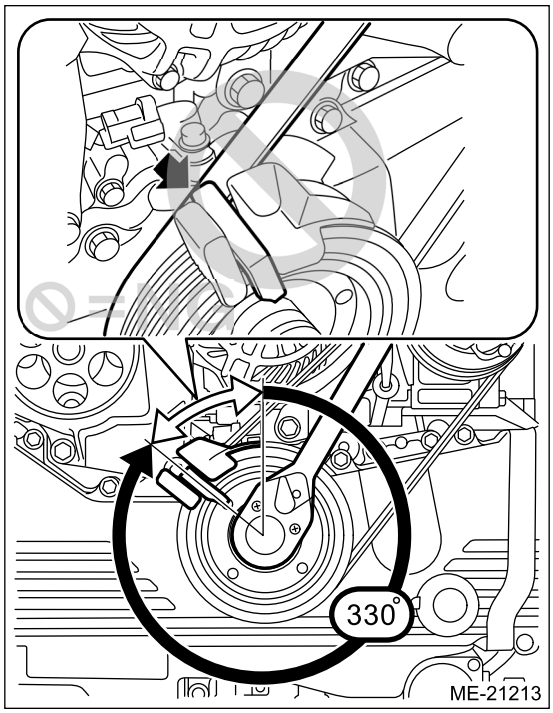
(5) The rear side belt is securely placed on the belt guide.



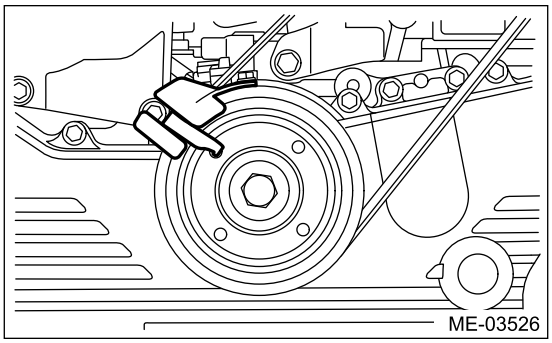
13. Slowly turn the crank pulley clockwise, and install the rear side belt.

Caution:

Be careful that the total of procedures 8), 11), 12) and 13) does not exceed 330°; failure to do so may cause damage to the rear side belt and fall of the belt guide holder.



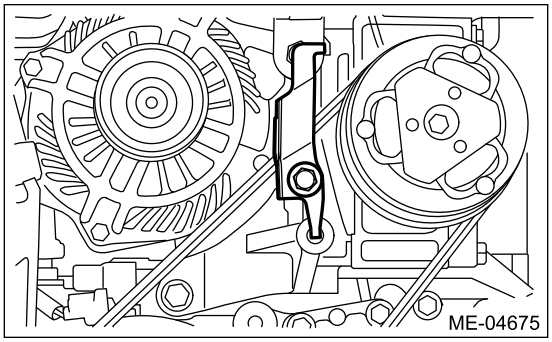
14. Remove the belt guide and belt guide holder from the crank pulley.



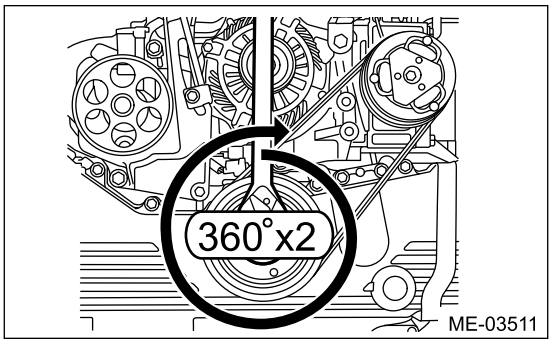
15. Remove the belt stopper from the compressor bracket.

Caution:

Always remove the belt stopper; failure to do so may cause smoke, fire, or belt cutting.



16. Make sure that the belt rib is securely installed on the groove of each pulley, then turn the crank pulley slowly, twice in the clockwise direction, to seat the rear side belt properly.



17. Discard the provided tools (belt stopper, belt guide, belt guide holder, and bolt) that are used.

18. Install the front side belt. Ref. to MECHANICAL(STI)>V-belt>INSTALLATION > FRONT SIDE BELT.

MECHANICAL(STI) > V-belt

INSPECTION

1. FRONT SIDE BELT

Caution:
Check and adjust the front side belt tension so that it is within the specified range. Using the belt with a tension out of the specified range may result in a fault such as the following:

- **If the front side belt tension is higher, unexpected force is generated at the power steering oil pump, generator and crankshaft bearing, causing abnormal noise due to abnormal wear of the bearing.**
- **If the front side belt tension is lower, the front side belt and crank pulley slip, causing abnormally high temperature on the crank pulley due to frictional heat. If this condition repeatedly occurs, the front side belt may abnormally wear, causing abnormal noise, front side belt damage or crank pulley damage.**

1. Replace the front side belt, if crack, fraying or wear is found.

2. Check the front side belt tension and adjust it if necessary by changing the generator installing position.

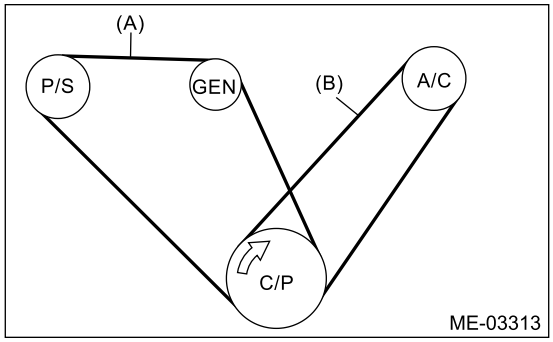
Front side belt tension (with belt tension gauge):

When installing new parts

640 — 780 N (65 — 80 kgf, 144 — 175 lbf)

At inspection

490 — 640 N (50 — 65 kgf, 110 — 144 lbf)



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

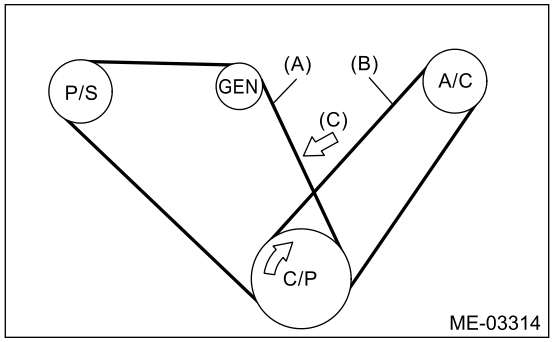
Front side belt tension (without belt tension gauge):

When installing new parts

7 — 9 mm (0.276 — 0.354 in)

At inspection

9 — 11 mm (0.354 — 0.433 in)



(A) Front side belt
(B) Rear side belt
(C) 98 N (10 kgf, 22 lbf)
C/P Crank pulley
GEN Generator pulley
P/S Power steering oil pump pulley
A/C A/C compressor pulley

3. Start the engine and confirm that the V-belt rotates smoothly and no abnormal noise is emitted.

2. REAR SIDE BELT

Replace the rear side belt, if crack, fraying or wear is found, or noise is emitted.

Note:

For the rear side belt, a stretch type belt is used, and therefore, it is not necessary to check deflection nor tension.

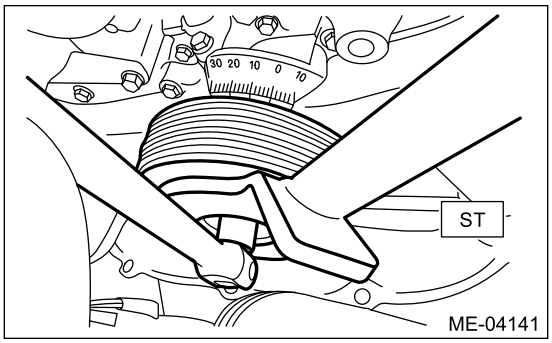
MECHANICAL(STI) > Crank Pulley

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. Remove the V-belts. Ref. to MECHANICAL(STI)>V-belt>REMOVAL.
2. Use the ST to lock the crank pulley, and remove the crank pulley bolt.

ST 499977100 CRANK PULLEY WRENCH



3. Remove the crank pulley.

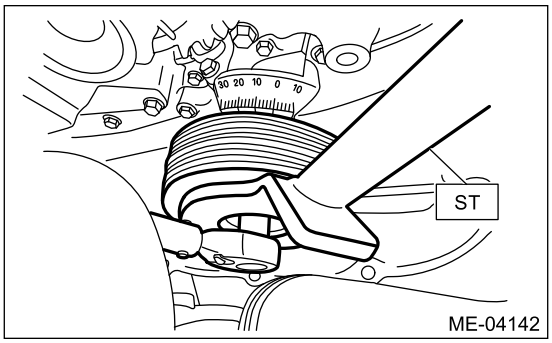
MECHANICAL(STI) > Crank Pulley

INSTALLATION

1. Clean the crankshaft thread using compressed air.
2. Install the crank pulley.
3. Apply engine oil to the crank pulley bolt seat and thread.
4. Tighten the crank pulley bolts.
   (1) Use the ST to lock the crank pulley, and temporarily tighten the crank pulley bolt.

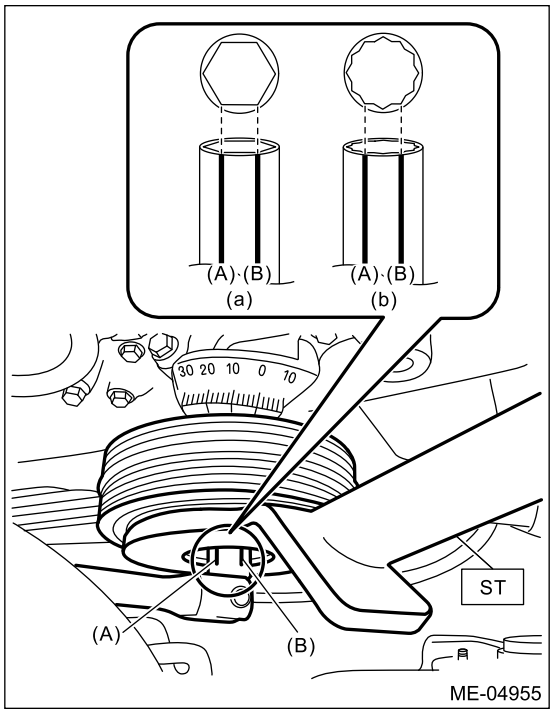
ST 499977100 CRANK PULLEY WRENCH

Tightening torque:
47 N·m (4.8 kgf-m, 34.7 ft-lb)



   (2) Draw reference lines (A) and (B) using a marker to set the socket to the crank pulley bolt as shown in the figure.
   Note:
   Set the socket onto the crank pulley bolt so that reference lines (A) and (B) is visible.

ST 499977100 CRANK PULLEY WRENCH

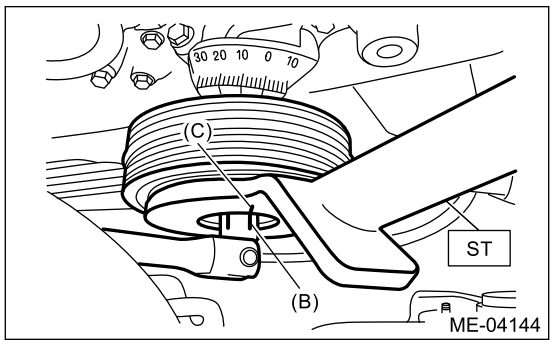


(a) When using 6-point socket

(b) When using 12-point socket

(3) Draw end line (C) on ST using a marker at the same position as reference line (B) drawn on the socket in step (2).

ST 499977100 CRANK PULLEY WRENCH



(4) Use the ST to lock the crank pulley, and tighten the crank pulley bolt to the angle where reference line (A) and end line (C) are aligned.

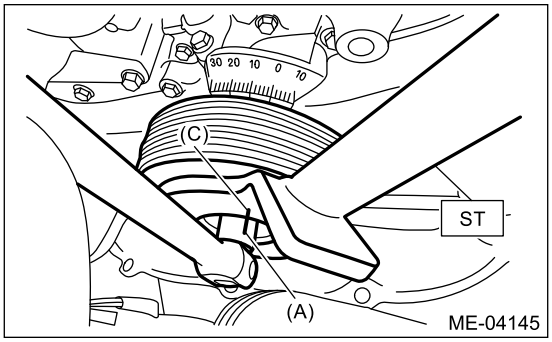
Note:

It should be approx. 60° when reference line (A) and end line (C) are aligned.

ST 499977100 CRANK PULLEY WRENCH

Tightening angle:

60°±5°



5. Install the V-belts. Ref. to MECHANICAL(STI)>V-belt>INSTALLATION.

MECHANICAL(STI) > Crank Pulley

INSPECTION

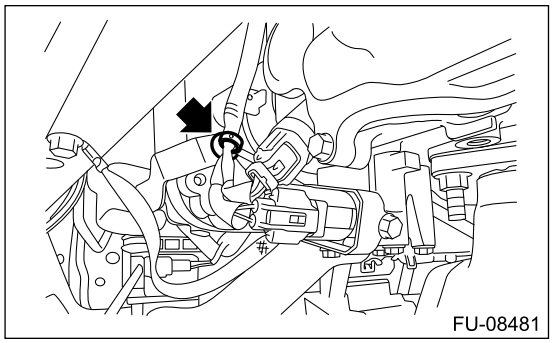
1. Check that the crank pulley has no deformation, cracks or other damages.

MECHANICAL(STI) > Timing Belt Cover

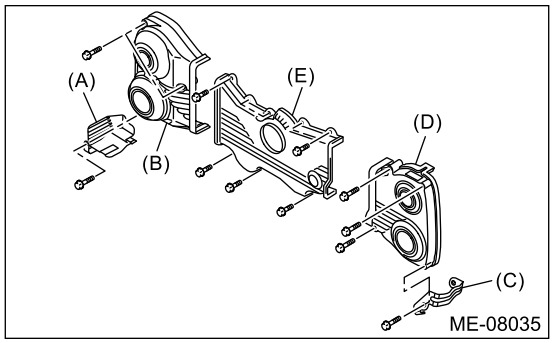
REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Remove the front under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
2. Remove the secondary air pump. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Pump>REMOVAL.
3. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
4. Remove the clip holding the engine harness on the engine harness stay.



5. Remove the timing belt cover RH (B) together with the engine harness cover (A).
6. Remove the timing belt cover LH (D) together with the engine harness stay (C).
7. Remove front timing belt cover (E).

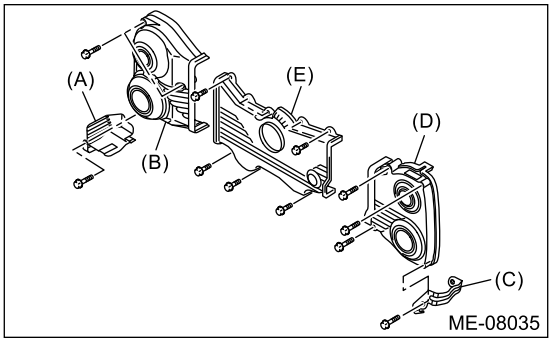


MECHANICAL(STI) > Timing Belt Cover

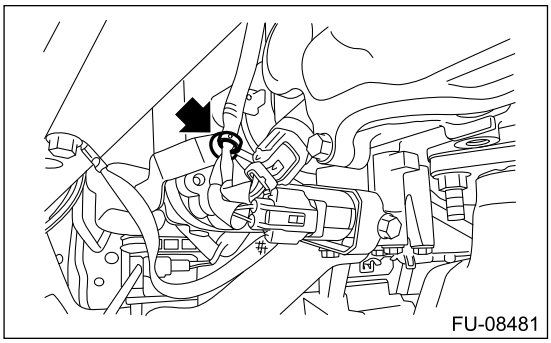
INSTALLATION

1. Install front timing belt cover (E).
   Tightening torque:
   5 N·m (0.5 kgf-m, 3.7 ft-lb)
2. Install the timing belt cover LH (D) together with the engine harness stay (C).
   Tightening torque:
   5 N·m (0.5 kgf-m, 3.7 ft-lb)

3. Install the timing belt cover RH (B) together with the engine harness cover (A).
Tightening torque:
5 N·m (0.5 kgf-m, 3.7 ft-lb)



4. Secure the engine harness to the engine harness stay using the clip.



5. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.
6. Install the secondary air pump. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Pump>INSTALLATION.
7. When working on the vehicle
Note:
When working on the vehicle, perform the following steps also.
(1) Install the front under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.

MECHANICAL(STI) > Timing Belt Cover

INSPECTION

Check the timing belt cover for damage.

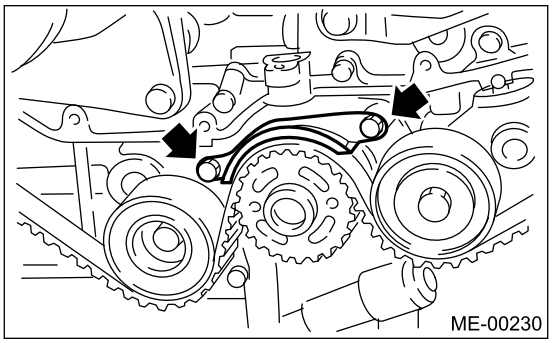
REMOVAL

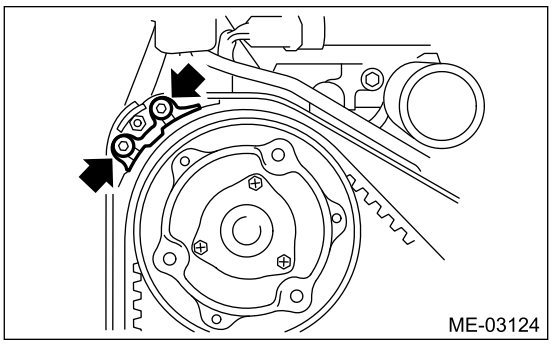
Note:

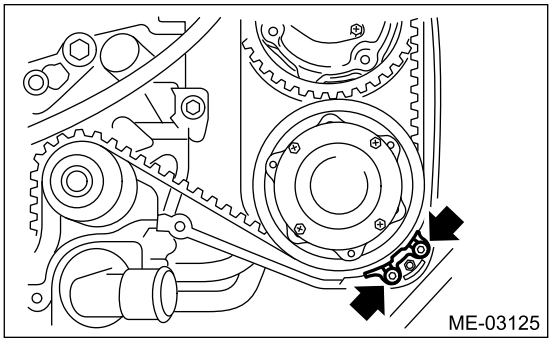
- **When replacing a single part, perform the work with the engine assembly installed to body.**
- **When performing the work with the engine installed to body, the following parts must also be removed/installed.**
  - **Radiator main fan motor assembly Ref. to COOLING(STI)>Radiator Main Fan and Fan Motor>REMOVAL. Ref. to COOLING(STI)>Radiator Main Fan and Fan Motor>INSTALLATION.**
  - **Radiator sub fan motor assembly Ref. to COOLING(STI)>Radiator Sub Fan and Fan Motor>REMOVAL. Ref. to COOLING(STI)>Radiator Sub Fan and Fan Motor>INSTALLATION.**
- **When performing the work with the engine installed to body, protect the radiator with cardboards or blankets.**

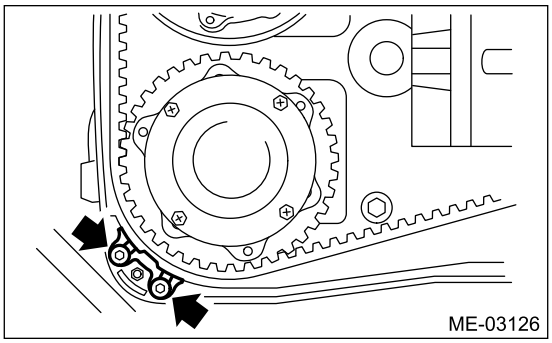
1. TIMING BELT

1. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
2. Remove the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
3. Remove the timing belt guide.





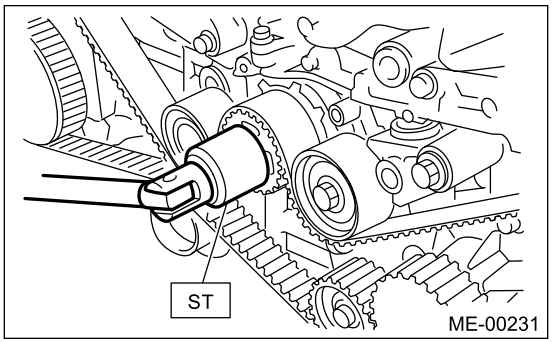




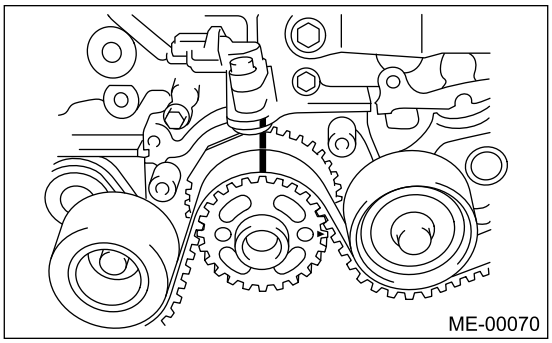
4. If the alignment mark or arrow mark (which indicates the direction of rotation) on timing belt fade away, put new marks before removing the timing belt as shown in procedures below.

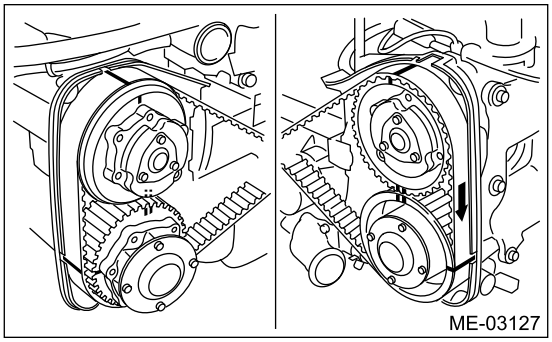
(1) Turn the crankshaft using ST, and align the alignment marks on crank sprocket, intake cam sprocket LH, exhaust cam sprocket LH, intake cam sprocket RH and exhaust cam sprocket RH with marks on oil pump and notches of timing belt cover.

ST 499987500 CRANKSHAFT SOCKET



(2) Using white paint, put an alignment mark or an arrow mark on timing belts in relation to the crank sprocket and cam sprockets.

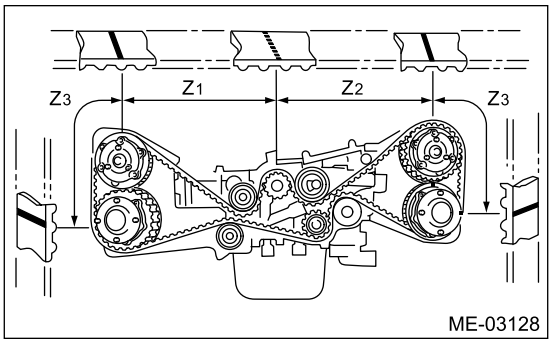




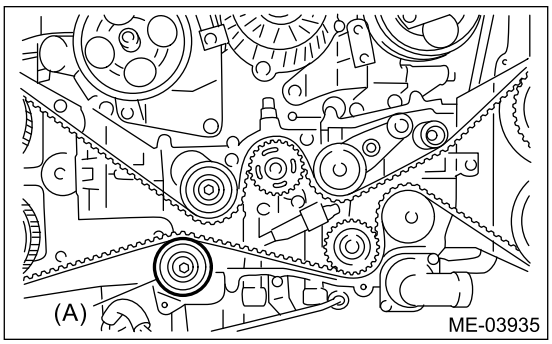
Z_1: 54.5 teeth

Z_2: 51 teeth

Z_3: 28 teeth



5. Remove the belt idler (A).



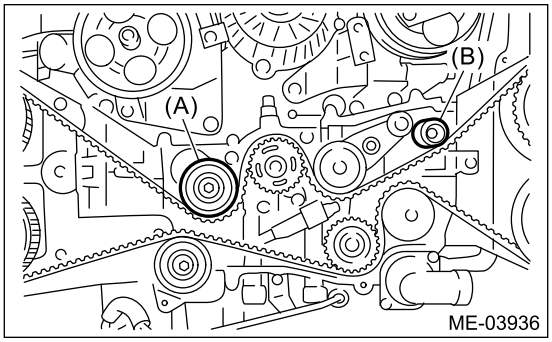
6. Remove the timing belt.

Caution:

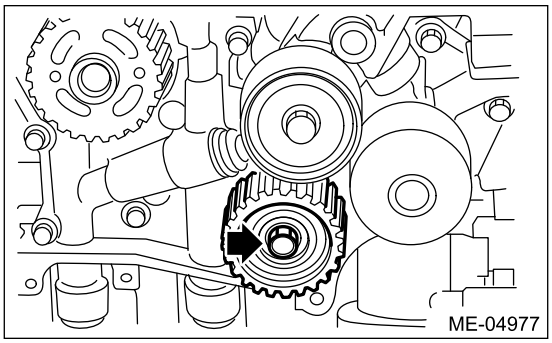
After the timing belt has been removed, never rotate the intake and exhaust sprocket. If the cam sprocket is rotated, the intake and exhaust valve heads strike together and valve stems are bent.

2. AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER

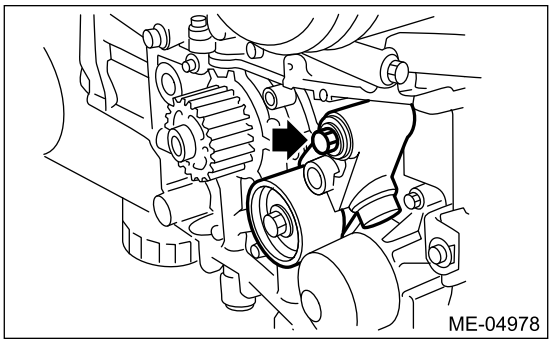
1. Remove the belt idler (A) and (B).



2. Remove the belt idler No. 2.



3. Remove the automatic belt tension adjuster assembly.



MECHANICAL(STI) > Timing Belt

INSTALLATION

1. AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER

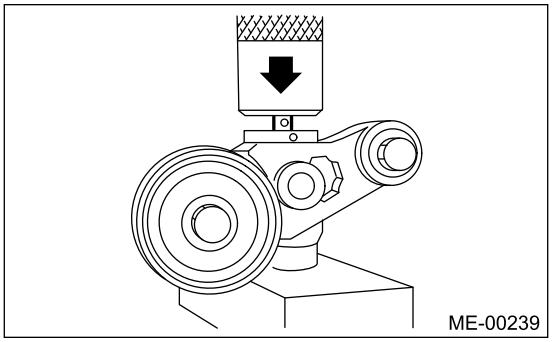
1. Prepare for installation of the automatic belt tension adjuster assembly.

Caution:

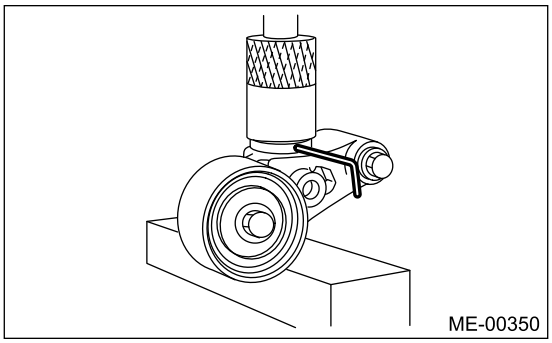
- **Always use a vertical type pressing tool to move the adjuster rod down.**
- **Do not use a lateral type vise.**
- **Push the adjuster rod vertically.**
- **Press-in the push adjuster rod gradually taking three minutes or more.**
- **Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lbf).**
- **Push in the adjuster rod to the end face of the cylinder. However, do not press the adjuster rod below the end face of the cylinder. Doing so may damage the cylinder.**
- **Do not release the press pressure until stopper pin is completely inserted.**

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

(2) Slowly push in the adjuster rod with a pressure of 165 N (16.8 kgf, 37.1 lbf) or more until the adjuster rod is aligned with the stopper pin hole in the cylinder.



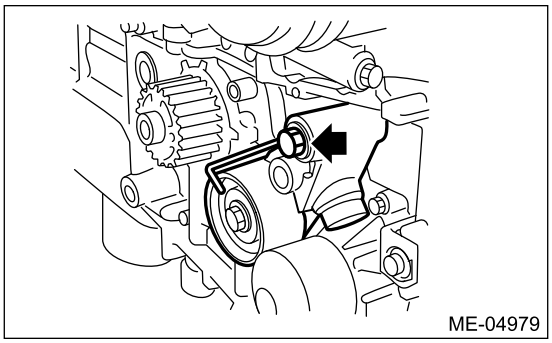
(3) With a 2 mm (0.0787 in) dia. stopper pin or a 2 mm (nominal) dia. hex wrench inserted into the stopper pin hole in cylinder, secure the adjuster rod.



2. Install the automatic belt tension adjuster assembly.

Tightening torque:

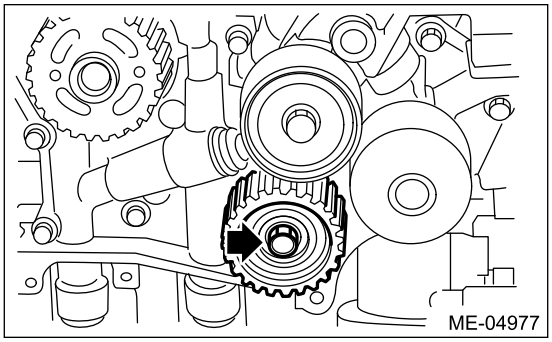
39 N·m (4.0 kgf-m, 28.8 ft-lb)



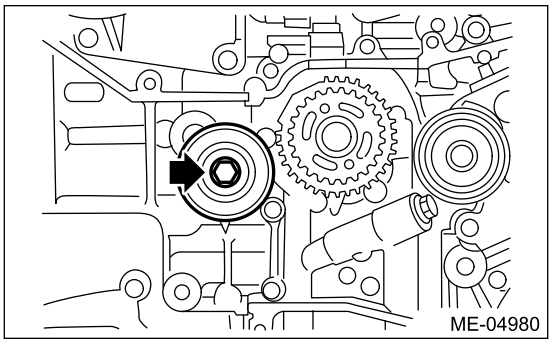
3. Install the belt idler No. 2.

Tightening torque:

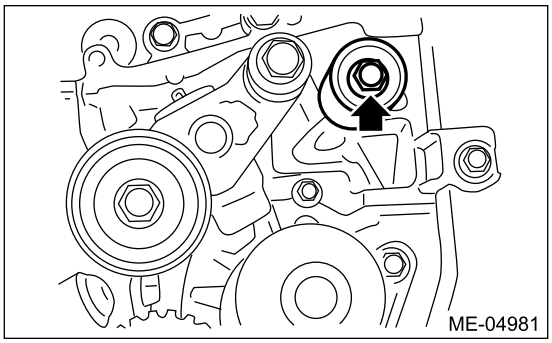
39 N·m (4.0 kgf-m, 28.8 ft-lb)



4. Install the belt idlers.
   Tightening torque:
   39 N·m (4.0 kgf-m, 28.8 ft-lb)

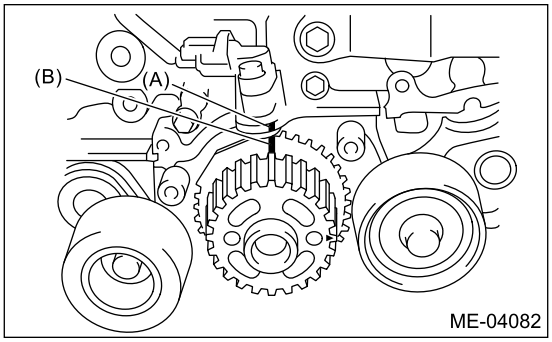


Tightening torque:
25 N·m (2.5 kgf-m, 18.4 ft-lb)

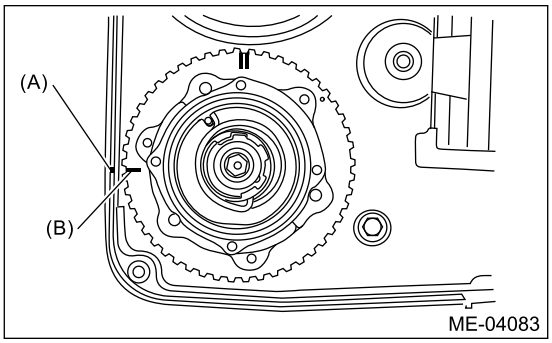


2. TIMING BELT

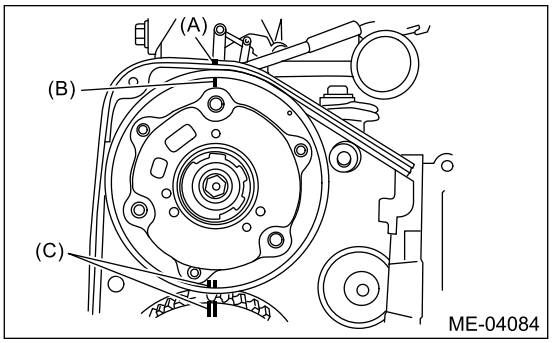
1. Prepare for installation of the automatic belt tension adjuster assembly. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION > AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER.
2. Align the mark (B) on crank sprocket with the mark (A) on oil pump.



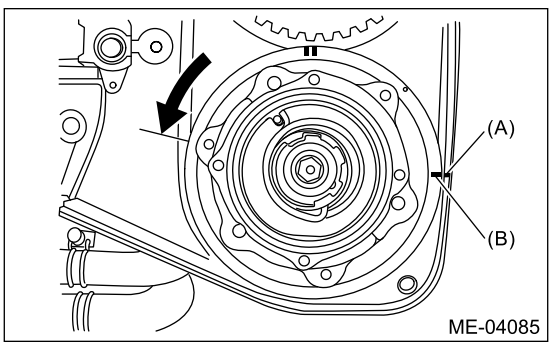
3. Align the single line mark (B) on the exhaust cam sprocket RH with notch (A) on the timing belt cover.



4. Align the single line mark (B) on the intake cam sprocket RH with notch (A) on the timing belt cover. Make sure that the double line marks (C) on intake cam sprocket and exhaust cam sprocket are aligned.

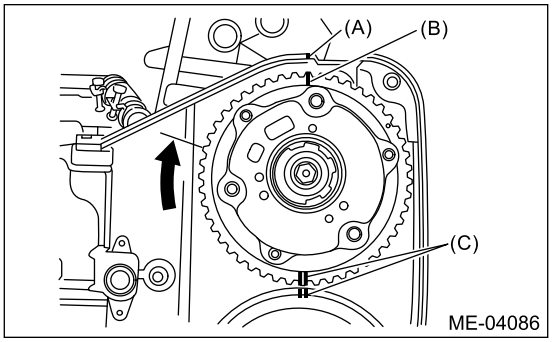


5. Align the single line mark (B) on exhaust cam sprocket LH with notch (A) on the timing belt cover by turning the sprocket counterclockwise (as viewed from front of engine).



6. Align the single line mark (B) on intake cam sprocket LH with notch (A) on the timing belt cover by turning the sprocket clockwise (as viewed from front of engine). Make sure that the double line

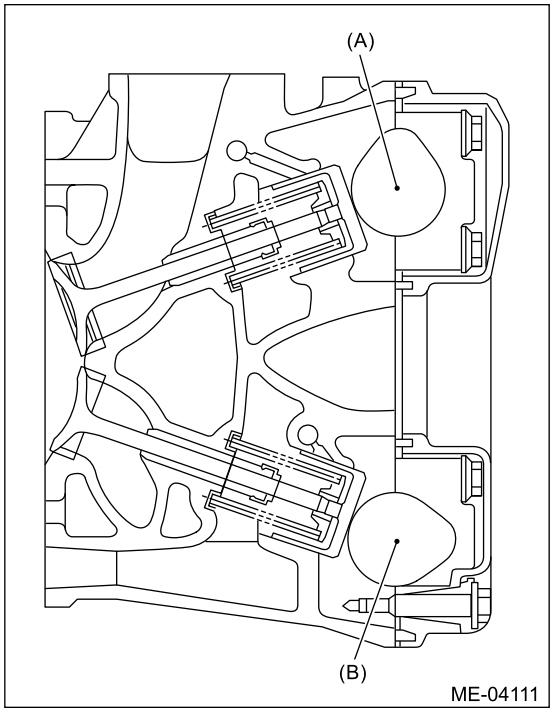
marks (C) on intake cam sprocket and exhaust cam sprocket are aligned.



7. Make sure that the cam and crank sprockets are positioned properly.

Caution:

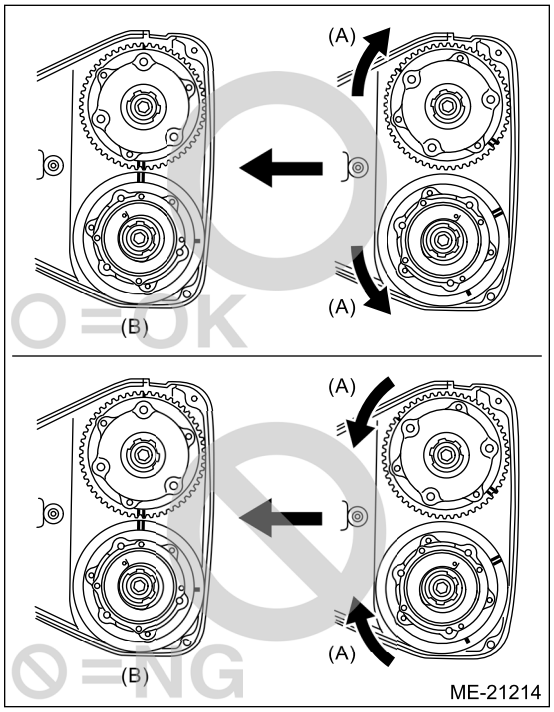
- **Intake camshaft and exhaust camshaft for DOHC engine can be independently rotated with the timing belts removed. As can be seen from the figure, if the intake and exhaust valves are lifted simultaneously, heads will interfere with each other, resulting in bent valves.**



(A) Intake camshaft

(B) Exhaust camshaft

- **When the timing belts are not installed, four camshafts are held at the "zero-lift" position, where all cams on camshafts are not pushing down on the intake and exhaust valves. (Under this condition, all valves remain unlifted.)**
- **When the camshafts are rotated to install the timing belts, #2 intake and #4 exhaust cam of camshaft LH are held, pushing their corresponding valves down. (Under this condition, these valves are held lifted.) Camshaft RH are held so that their cams do not push the valves down.**
- **Camshafts LH must be rotated from the zero-lift position to the position where the timing belt is to be installed with the smallest possible angle, 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 lower side of the figure. Doing this may cause both the intake and exhaust valves to lift simultaneously, resulting in mutual interference of valve heads.**



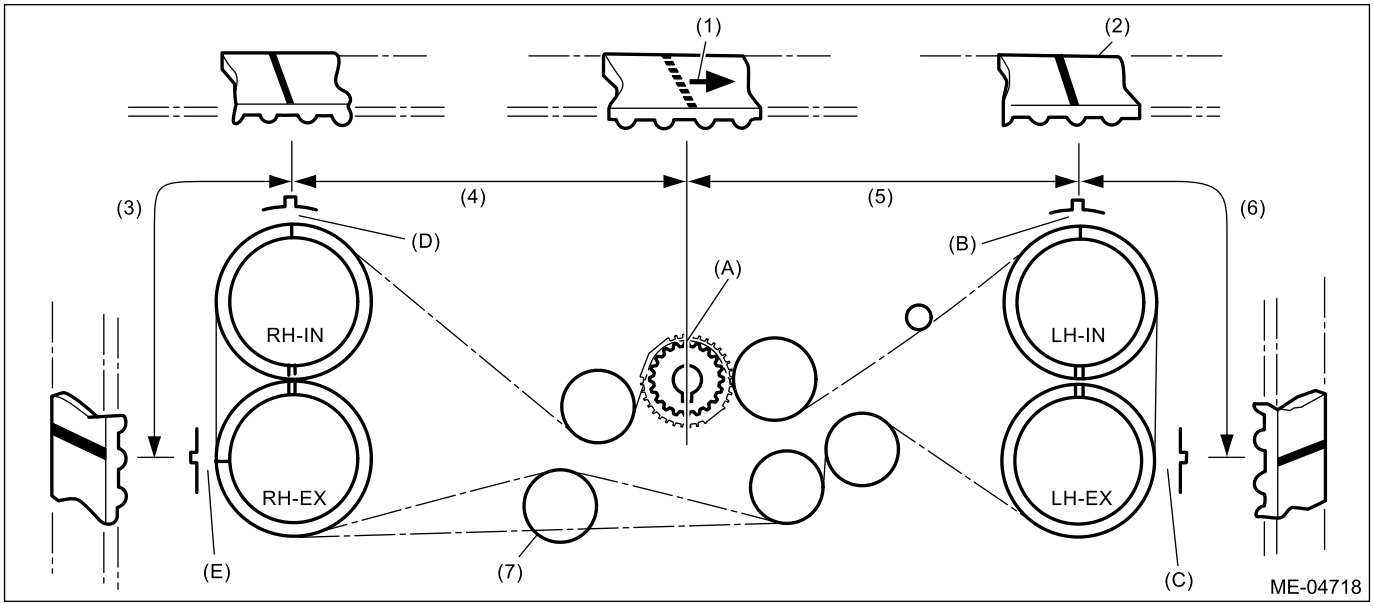
(A) Direction of rotation

(B) Timing belt installation position

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

Caution:

- **If the timing belt slips by 1 or more teeth, the valve and piston may hit each other.**
- **Make sure that the direction of belt rotation is correct.**



(1) Arrow mark

(2) Timing belt

(3) 28 teeth

(4) 54.5 teeth

(5) 51 teeth

(6) 28 teeth

(7) Install it in the end

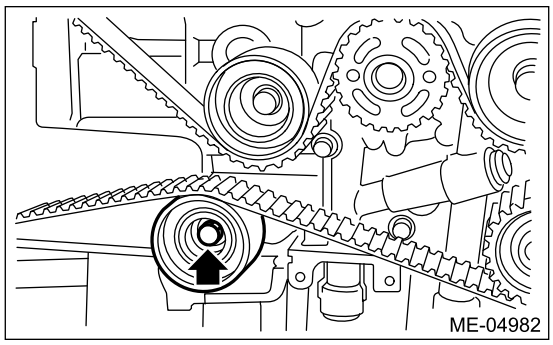
9. Install the belt idlers.

Tightening torque:

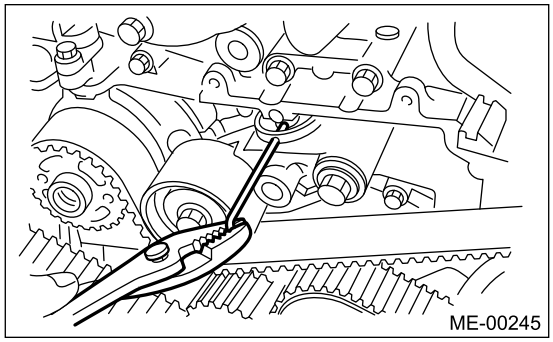
39 N·m (4.0 kgf-m, 28.8 ft-lb)

Note:

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



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



11. Install the timing belt guide.

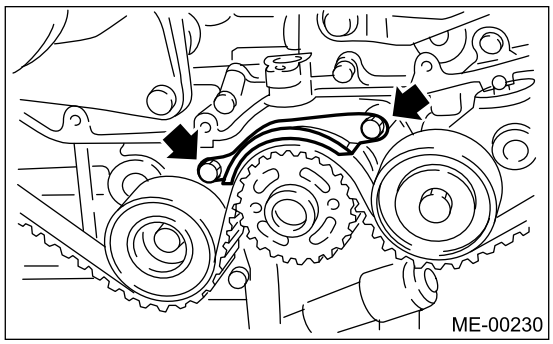
(1) Temporarily tighten the bolts mounting the timing belt guide.

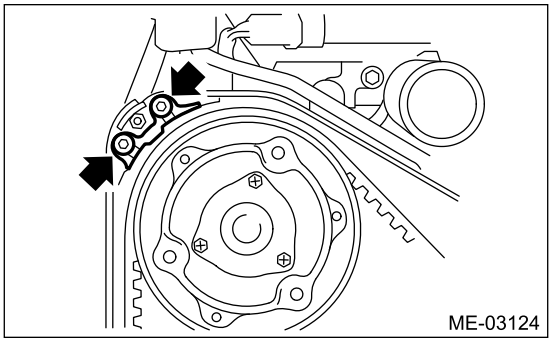
Note:

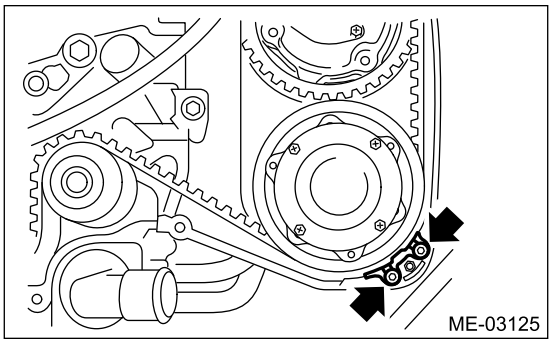
- **Before installing the timing belt guide, clean the timing belt guide mounting bolt holes of the timing belt cover No. 2.**
- **Apply liquid gasket to the thread of the timing belt guide mounting bolt on the cam sprocket section. (When reusing bolts)**

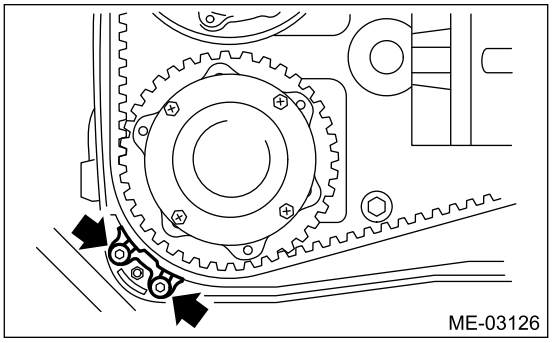
  Liquid gasket:

  THREE BOND 1324 (Part No. 004403042) or equivalent





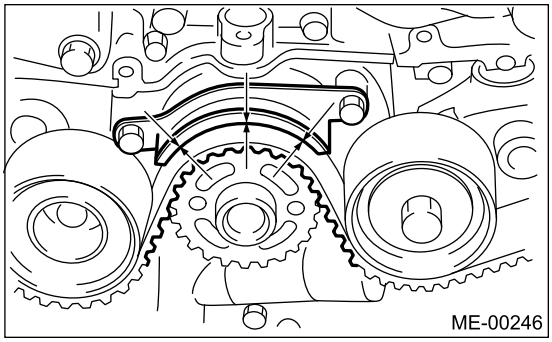


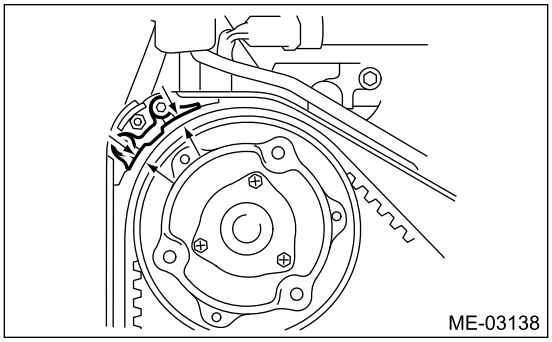


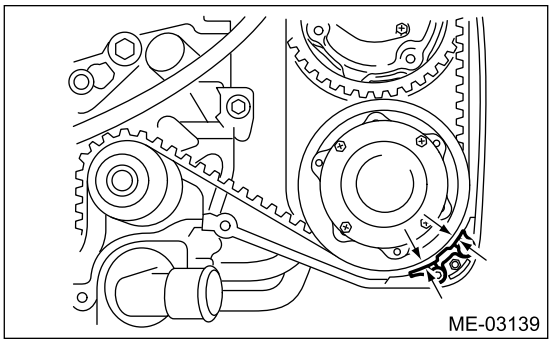
(2) Adjust the clearance between timing belt and timing belt guide using a thickness gauge and tighten.

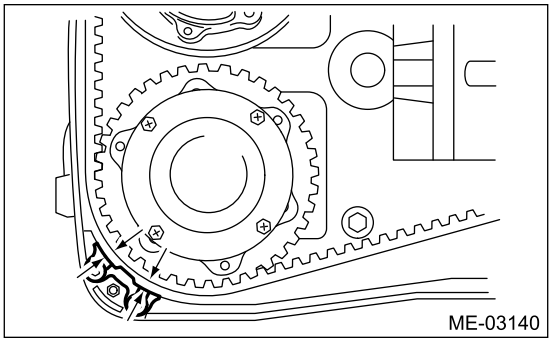
Clearance:

1.0±0.5 mm (0.0394±0.0197 in)



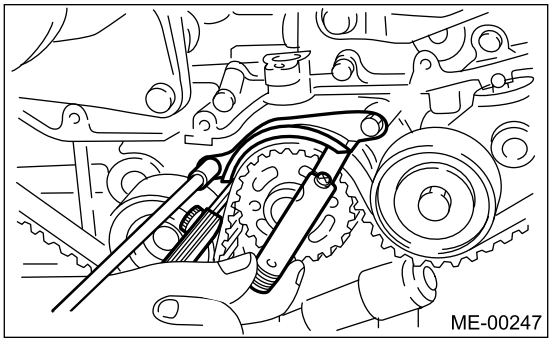






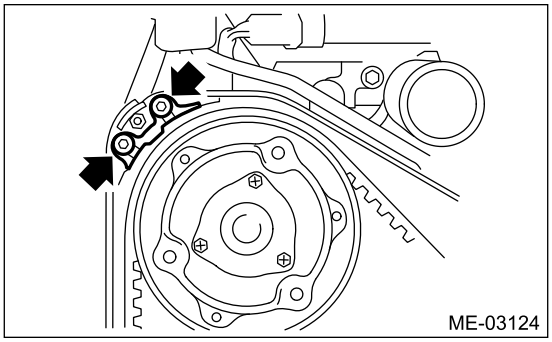
Tightening torque:

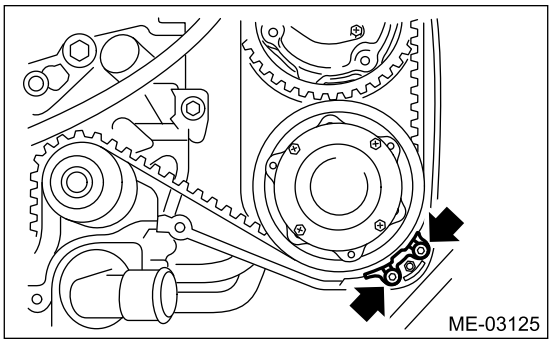
9.75 N·m (1.0 kgf-m, 7.2 ft-lb)

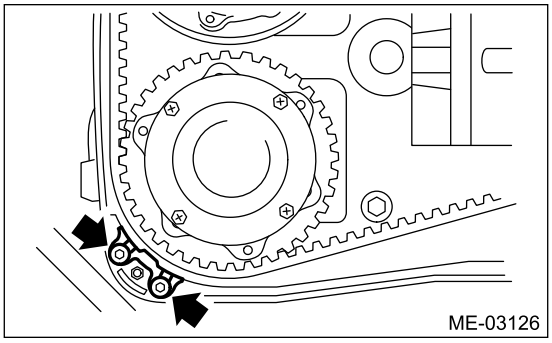


Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)







12. Install the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>INSTALLATION.

13. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.

MECHANICAL(STI) > Timing Belt

INSPECTION

1. TIMING BELT

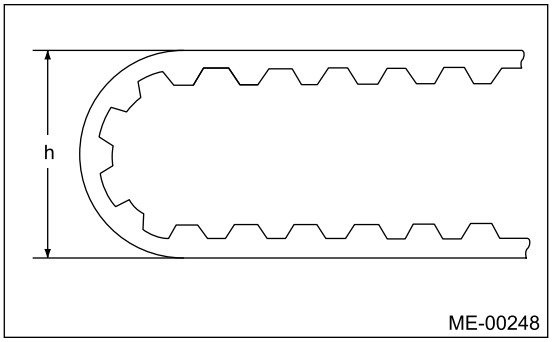
1. Check the timing belt teeth for breaks, cracks or wear. If any fault is found, replace the timing belt.
2. Check the condition on the back surface of the timing belt. If cracks are found, replace the timing belt.

Caution:

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

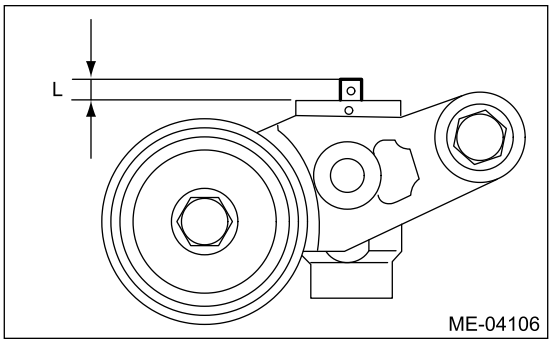
In radial diameter h:

60 mm (2.36 in) or more



2. AUTOMATIC BELT TENSION ADJUSTER

1. Visually check the oil seals for leaks, and rod ends for abnormal wear and scratches. If necessary, replace the automatic belt tension adjuster assembly.
   Note:
   Slight traces of oil at the rod oil seal does not indicate a problem.
2. Check that the adjuster rod does not move when a pressure of 165 N (16.8 kgf, 37.1 lbf) is applied to it. This is to check adjuster rod stiffness.
3. If the adjuster rod is not stiff enough and moves freely when applying 165 N (16.8 kgf, 37.1 lbf), check it using the following procedures:
   (1) Slowly press the adjuster rod down to the end surface of cylinder. Repeat this operation two to three times.
   (2) With the adjuster rod moved all the way up, apply a pressure of 165 N (16.8 kgf, 37.1 lbf) to it, and 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 part.
   Caution:
   - **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 three minutes or more.**
   - **Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lbf).**
   - **Push in the adjuster rod to the end face of the cylinder. However, do not press the adjuster rod below the end face of the cylinder. Doing so may damage the cylinder.**
4. Measure the amount of adjuster rod protrusion "L" from the end surface of the cylinder. If it is not within specifications, replace the automatic belt tension adjuster assembly with a new part.
   Protrusion amount of adjuster rod L:
   5.2 — 6.2 mm (0.2047 — 0.2441 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 automatic belt tension adjuster assembly with a new part if faulty.
2. Check the belt tension pulley for smooth rotation. Replace the automatic belt tension adjuster assembly with a new part if abnormal noise or excessive play occurs.
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 occurs.
2. Check the outer contacting surfaces of idler pulley for abnormal wear and scratches.
3. Check the belt idler for grease leakage.

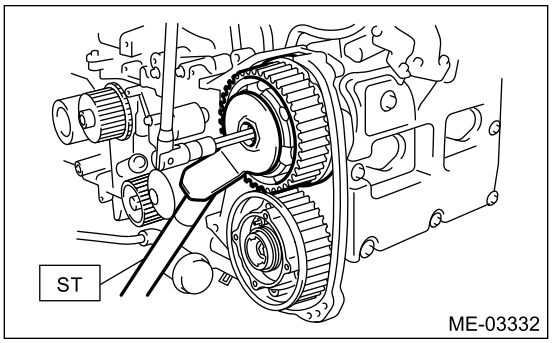
MECHANICAL(STI) > Cam Sprocket

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
2. Remove the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
3. Remove the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>REMOVAL.
4. Remove the actuator covers of the intake and exhaust cam sprockets.
5. Use the ST to lock the cam sprocket, and remove the cam sprocket bolt.

ST 499977500 CAM SPROCKET WRENCH



6. Remove the cam sprocket.

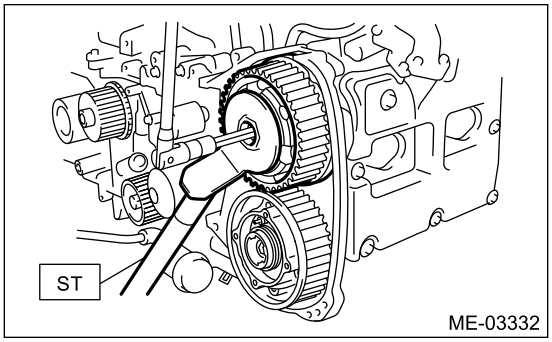
MECHANICAL(STI) > Cam Sprocket

INSTALLATION

1. Install the cam sprocket.
2. Use the ST to lock the cam sprocket, and install the cam sprocket bolt.
   Note:
   Do not confuse cam sprockets (LH) and (RH), and (INT) and (EXH) during installation.

   ST 499977500 CAM SPROCKET WRENCH

   Tightening torque:
   Tighten to 30 N·m (3.1 kgf-m, 22.1 ft-lb) of torque, and then tighten further by 45°.



3. Attach the actuator covers of the intake and exhaust cam sprockets.

Note:
Use new O-rings.
Tightening torque:
3.4 N·m (0.3 kgf-m, 2.5 ft-lb)

4. Install the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION.
5. Install the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>INSTALLATION.
6. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.

MECHANICAL(STI) > Cam Sprocket

INSPECTION

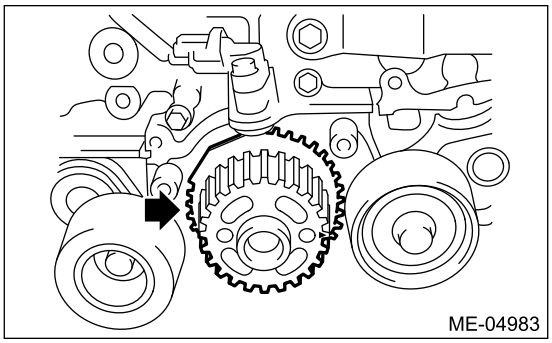
1. Check the cam sprocket teeth for abnormal wear and scratches.
2. Make sure there is no free play between cam sprocket and key.

MECHANICAL(STI) > Crank Sprocket

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

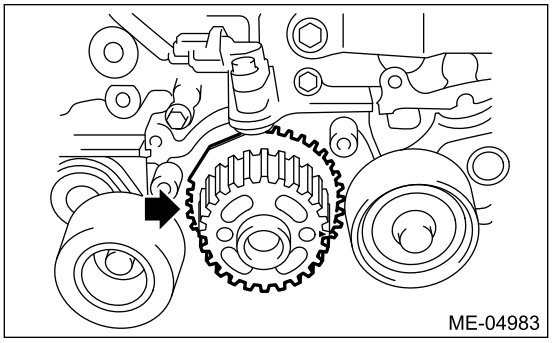
1. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
2. Remove the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
3. Remove the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>REMOVAL.
4. Remove the crank sprocket.



MECHANICAL(STI) > Crank Sprocket

INSTALLATION

1. Install the crank sprocket.



2. Install the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION.
3. Install the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>INSTALLATION.
4. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.

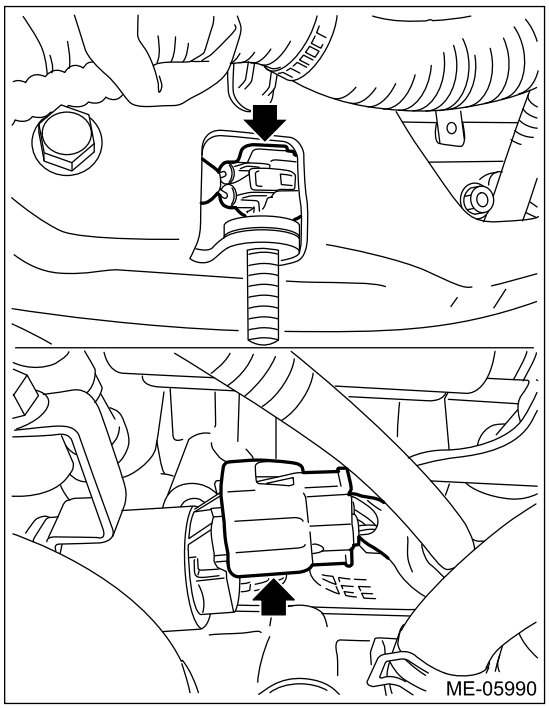
MECHANICAL(STI) > Crank Sprocket

INSPECTION

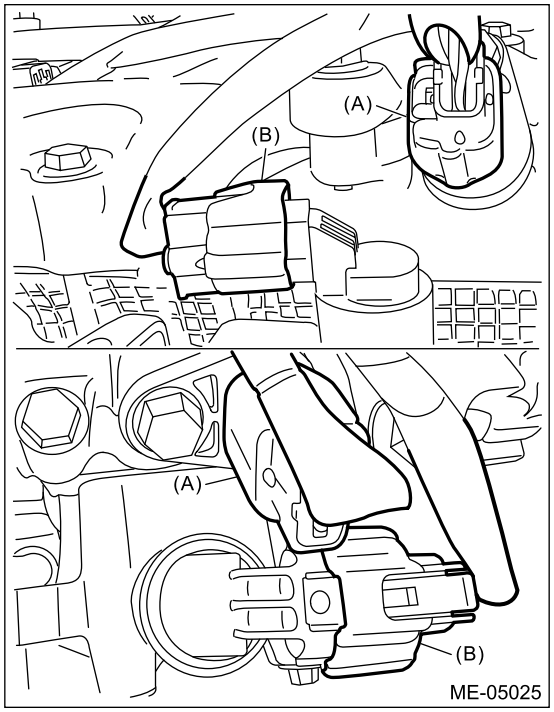
1. Check the crank sprocket teeth for abnormal wear and scratches.
2. Make sure there is no free play between crank sprocket and key.
3. Check the crank sprocket protrusion used for sensor for damage and contamination of foreign matter.

REMOVAL

1. Remove the engine from the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>REMOVAL.
2. Remove the rear side belt. Ref. to MECHANICAL(STI)>V-belt>REMOVAL > REAR SIDE BELT.
3. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
4. Remove the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
5. Remove the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>REMOVAL.
6. Remove the cam sprocket. Ref. to MECHANICAL(STI)>Cam Sprocket>REMOVAL.
7. Disconnect the connector from the intake oil flow control solenoid valve.



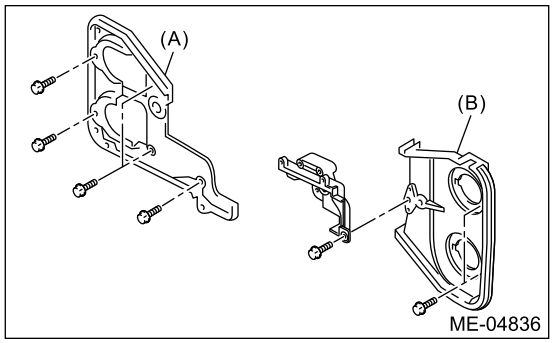
8. Disconnect the connector (A) from the exhaust camshaft position sensor and the connector (B) from the exhaust oil flow control solenoid valve LH.



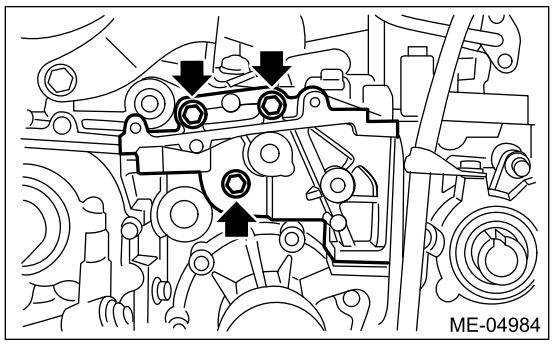
9. Remove the timing belt cover No. 2 RH (A) and timing belt cover No. 2 LH (B).

Note:

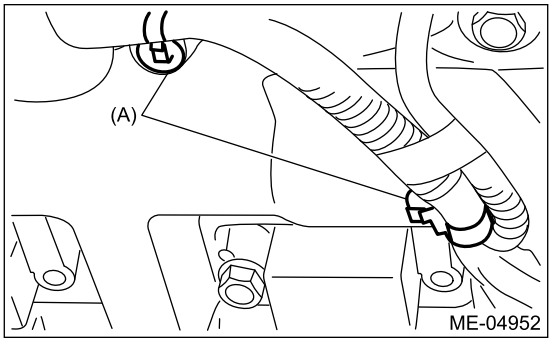
When removing the timing belt cover, be careful not to damage the seal rubber.



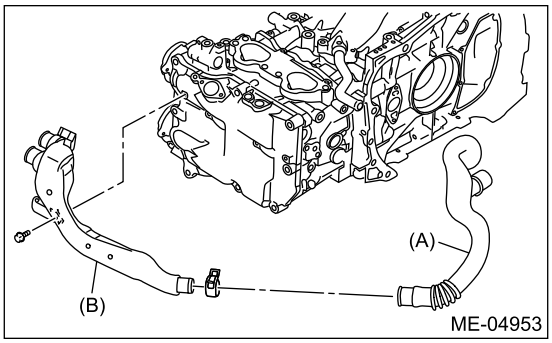
10. Remove the tensioner bracket.



11. Remove the clip (A) which hold the engine harness to the rocker cover RH.



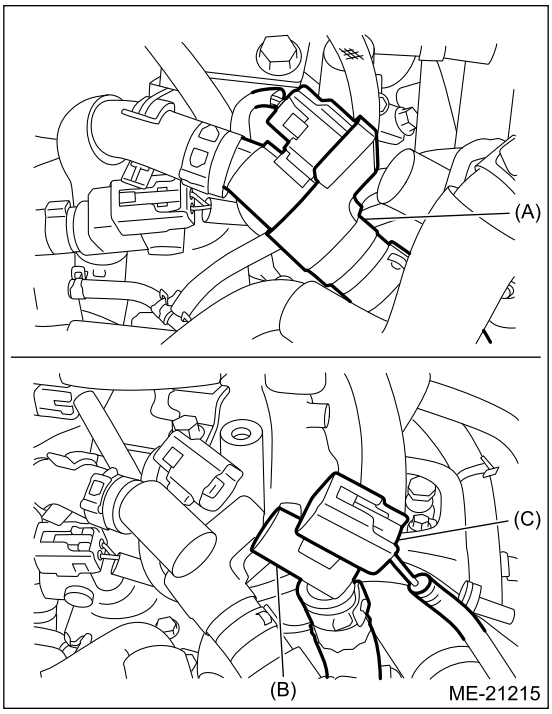
12. Remove the air duct B (B) from the rocker cover LH and the air duct A (A).



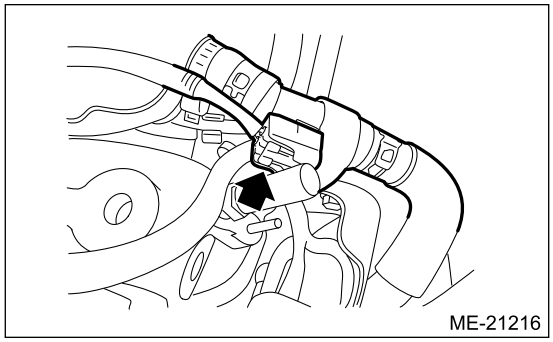
13. Remove the ignition coil. Ref. to IGNITION(STI)>Ignition Coil>REMOVAL.

14. Unlock the leak diagnosis connector, and disconnect the vacuum hose (A).

15. Remove the leak diagnosis connector (C) from the PCV hose (B).

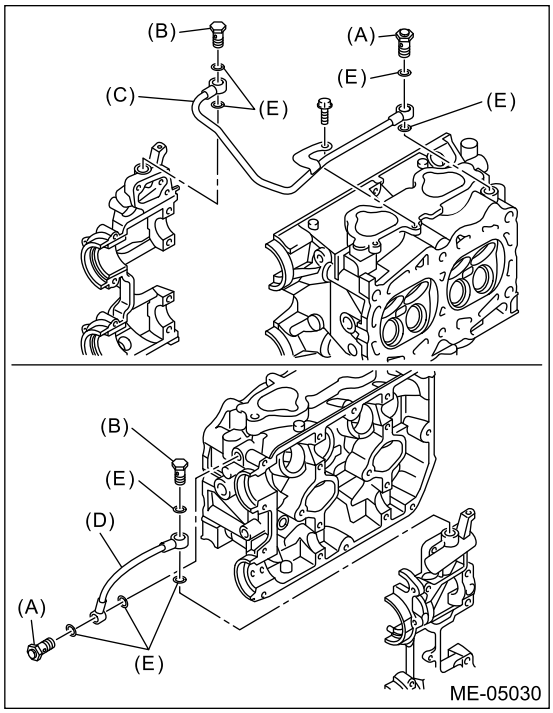


16. Unlock the leak diagnosis connector, and disconnect the vacuum hose.



17. Remove the rocker cover.

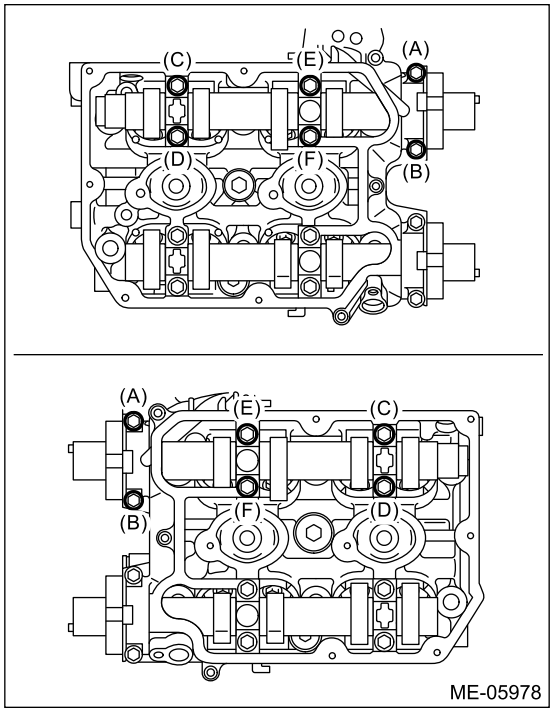
18. Remove the union bolt without filter (without protrusion) which secures the oil pipe to the front camshaft cap. (If cylinder head is not removed)



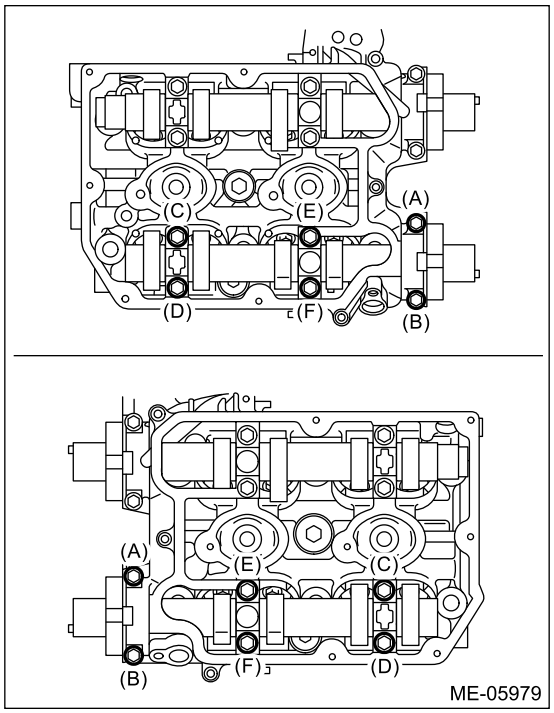
(A) Union bolt with filter (with protrusion)
(B) Union bolt without filter (without protrusion)
(C) Oil pipe RH
(D) Oil pipe LH
(E) Gasket

19. Remove the oil pipe. (If cylinder head is removed) Ref. to LUBRICATION(STI)>Oil Pipe>REMOVAL.

20. Loosen the upper side of the front camshaft cap and the intake camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.



21. Loosen the lower side of the front camshaft cap and the exhaust camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.



22. Remove the front camshaft cap.

23. Remove the intake camshaft caps and intake camshaft.

24. Remove the exhaust camshaft caps and exhaust camshaft.

Note:

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

25. Remove the oil seal.

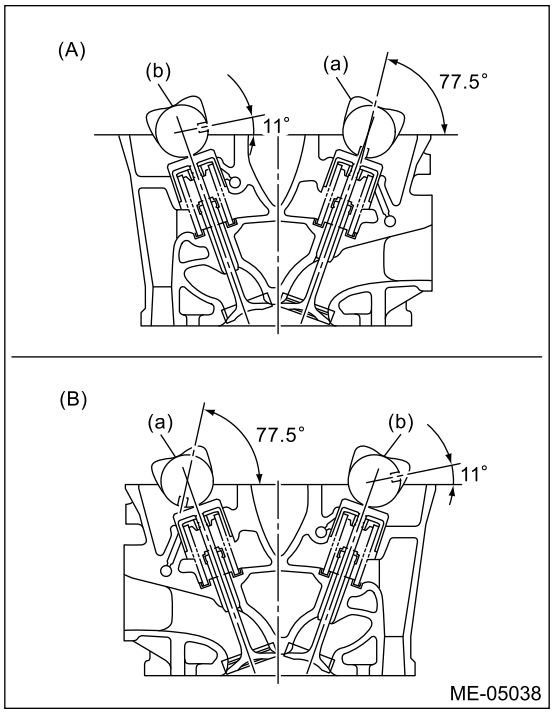
Caution:
Do not scratch the journal surface when removing the oil seal.

MECHANICAL(STI) > Camshaft

INSTALLATION

1. Install the camshaft.
   Apply engine oil to the cylinder head at camshaft journal installation location before installing the camshaft. Install the camshaft so that each valve is close to or in contact with base circle of the cam lobe.
   Note:
   - **Set the camshaft to the position shown in the figure.**
   - **When set at the position shown in the figure, it is not necessary to rotate the camshaft RH when installing the timing belt, but it is necessary to rotate the camshaft LH slightly.**

   Intake camshaft LH:
   Rotate 80° clockwise.
   Exhaust camshaft LH:
   Rotate 45° counterclockwise.



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

2. Install the camshaft cap.
   (1) Apply small amount of liquid gasket to the mating surface of cap.

Note:

- **Install within 5 min. after applying liquid gasket.**
- **Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to come out and flow toward oil seal, resulting in oil leak.**

Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

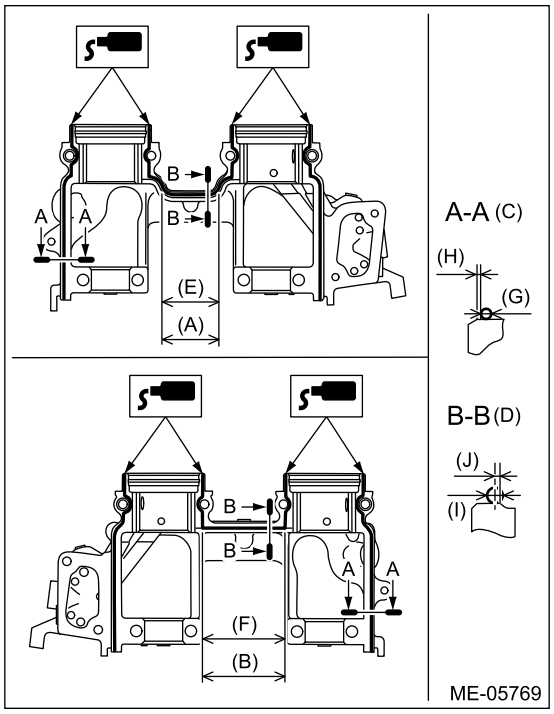
Liquid gasket applying diameter:

Mating surfaces other than ranges A and B

2±0.5 mm (0.0787±0.0197 in)

Mating surfaces of ranges A and B

3±1 mm (0.1181±0.0394 in)



(A) Range A

(B) Range B

(C) Liquid gasket applying position of mating surfaces of ranges other than A and B

(D) Liquid gasket applying position of mating surfaces of ranges A and B

(E) 44.8 mm (1.7638 in)

(F) 65 mm (2.5591 in)

(G) ⌀2±0.5 mm (0.0787±0.0197 in)

(H) 0.5±0.5 mm (0.0197±0.0197 in)

(I) ⌀3±1 mm (0.1181±0.0394 in)

(J) 1 mm (0.0394 in) or less

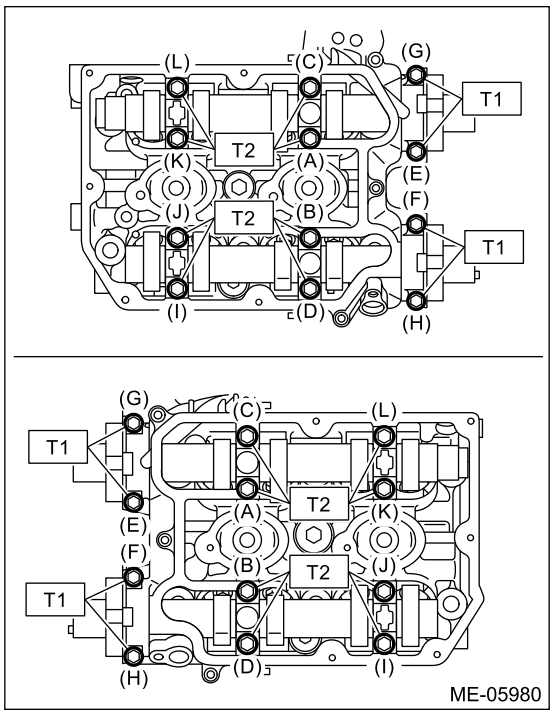
(2) Apply a thin coat of engine oil to the cap journal surface, and install the camshaft cap to the camshaft.

(3) Gradually tighten the camshaft cap in at least two steps, in alphabetical order shown in the figure, and then tighten to the specified torque.

Tightening torque:

T1: 9.75 N·m (1.0 kgf-m, 7.2 ft-lb)

T2: 20 N·m (2.0 kgf-m, 14.8 ft-lb)



(4) After tightening the camshaft cap, ensure the camshaft rotates only slightly while holding it at base circle.

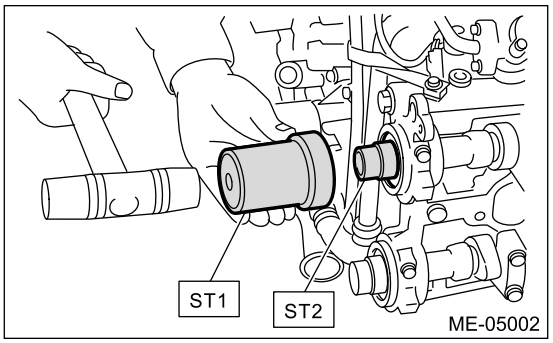
3. Apply a thin coat of engine oil to the periphery of the camshaft oil seal and oil seal lip, and install the oil seal on the camshaft using ST1 and ST2.

Note:

Use a new oil seal.

ST1 499587600 OIL SEAL INSTALLER

ST2 499597200 OIL SEAL GUIDE



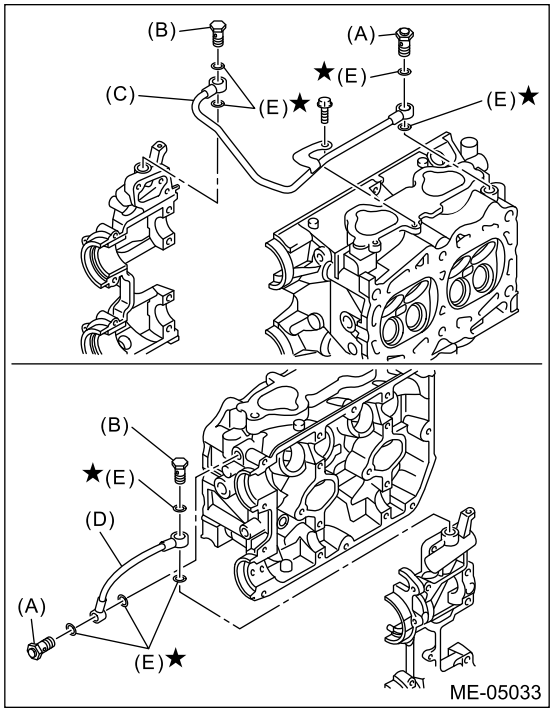
4. Install the oil pipe to the front camshaft cap using the union bolt without filter (without protrusion). (If cylinder head is not removed)

Note:

Use a new gasket.

Tightening torque:

31.5 N·m (3.2 kgf-m, 23.2 ft-lb)



(A) Union bolt with filter (with protrusion)

(B) Union bolt without filter (without protrusion)

(C) Oil pipe RH

(D) Oil pipe LH

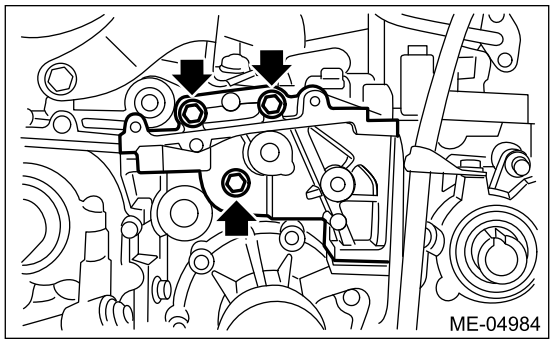
(E) Gasket

5. Install the oil pipe. (If cylinder head is removed) Ref. to LUBRICATION(STI)>Oil Pipe>INSTALLATION.

6. Install the tensioner bracket.

Tightening torque:

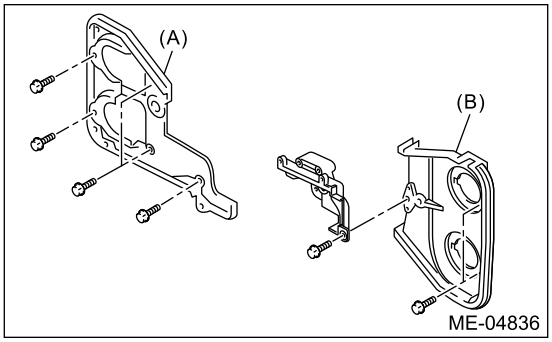
24.5 N·m (2.5 kgf-m, 18.1 ft-lb)



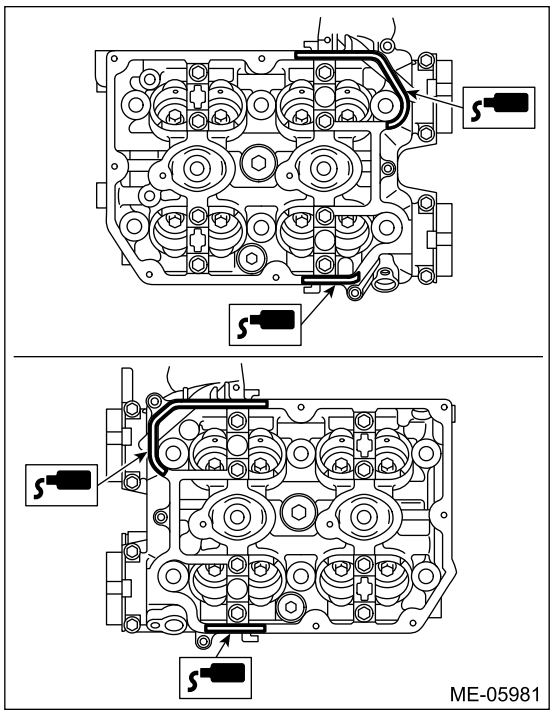
7. Install the timing belt cover No. 2 RH (A) and timing belt cover No. 2 LH (B).

Tightening torque:

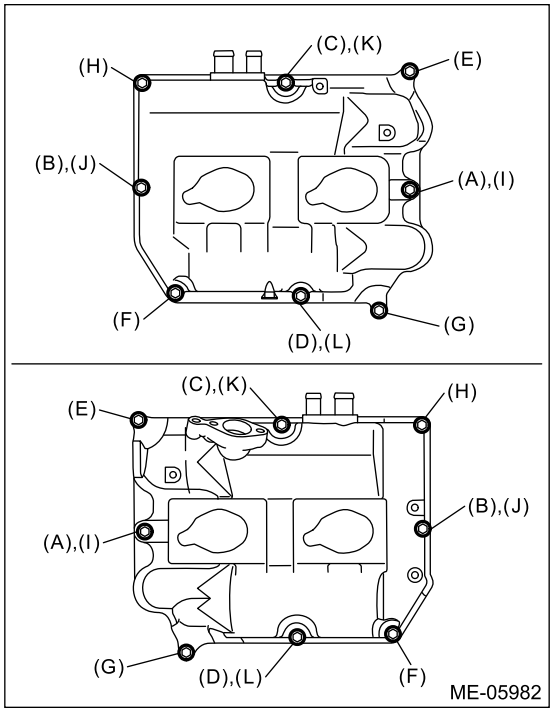
5 N·m (0.5 kgf-m, 3.7 ft-lb)



8. Install the cam sprocket. Ref. to MECHANICAL(STI)>Cam Sprocket>INSTALLATION.
9. Install the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION.
10. Adjust the valve clearance. Ref. to MECHANICAL(STI)>Valve Clearance>ADJUSTMENT.
11. Install the rocker cover.
    (1) Install the rocker cover gasket to the rocker cover. (Outer section and ignition coil section)
        Note:
        Use a new rocker cover gasket.
    (2) Apply liquid gasket to the specified point of the cylinder head.
        Note:
        Install within 5 min. after applying liquid gasket.
        Liquid gasket:
        THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent



    (3) Install the rocker cover onto cylinder heads. Ensure the gasket is properly positioned during installation.
    (4) Temporarily tighten the rocker cover bolts in alphabetical order shown in the figure, and then tighten to specified torque in alphabetical order.
        Tightening torque:
        6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

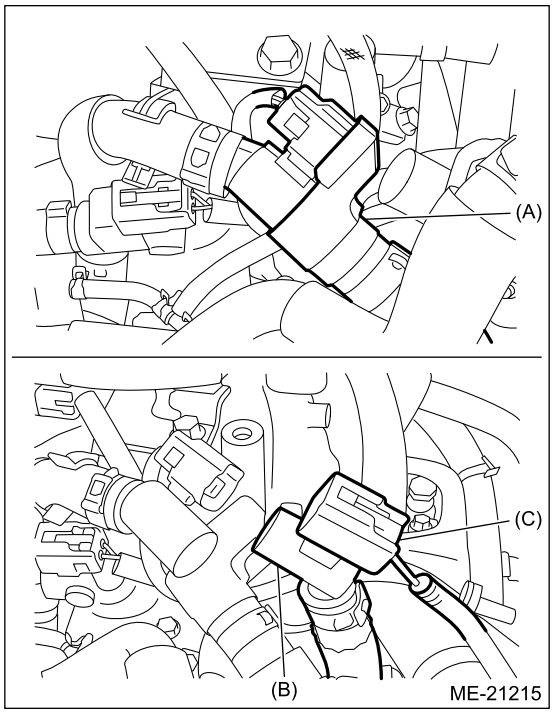


12. Install the leak diagnosis connector (C) to the PCV hose (B).

13. Connect the vacuum hose (A).

Note:

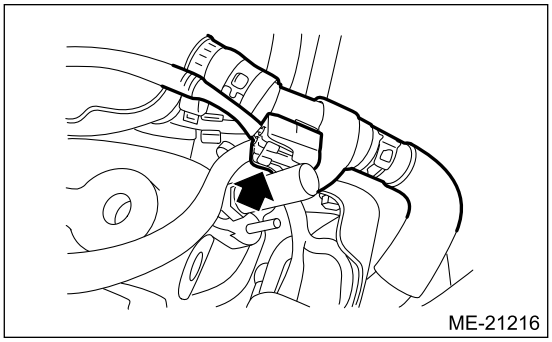
Make sure that the leak diagnosis connector is connected securely.



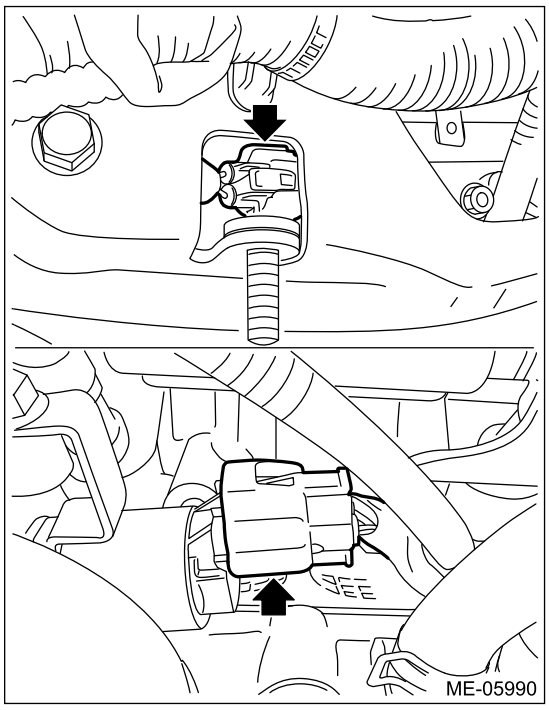
14. Connect the vacuum hose.

Note:

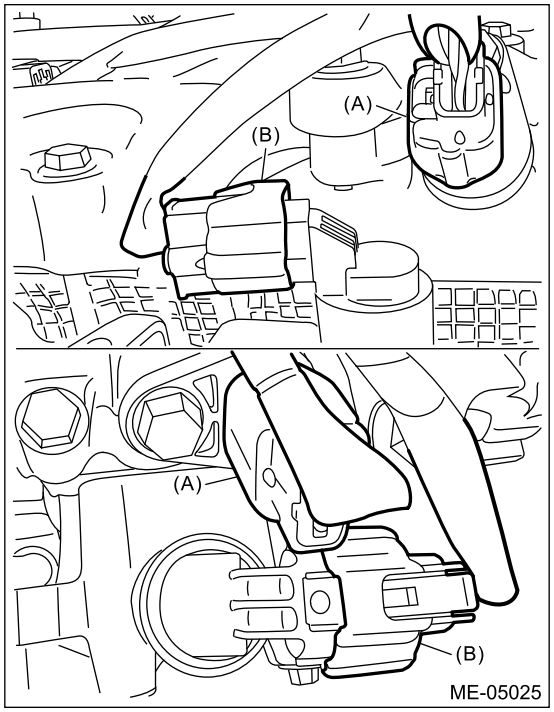
Make sure that the leak diagnosis connector is connected securely.



15. Connect the connector to the intake oil flow control solenoid valve.



16. Connect the connector (A) to the exhaust camshaft position sensor and the connector (B) to the exhaust oil flow control solenoid valve LH.

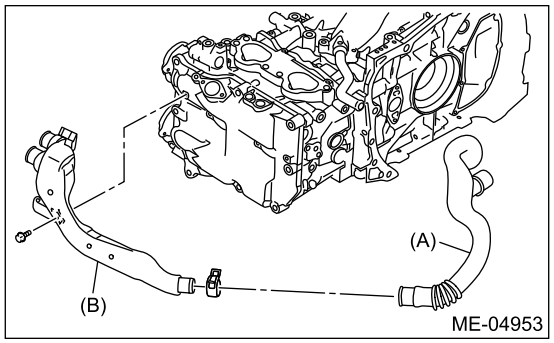


17. Install the ignition coil. Ref. to IGNITION(STI)>Ignition Coil>INSTALLATION.

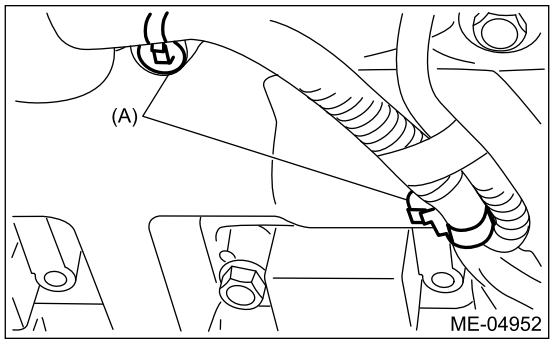
18. Install the air duct B (B) to the rocker cover LH and the air duct A (A).

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



19. Fix the engine harness to the rocker cover RH with clips (A).



20. Install the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>INSTALLATION.

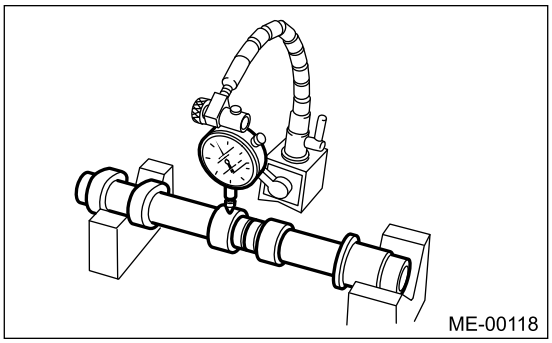
21. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.

22. Install the rear side belt. Ref. to MECHANICAL(STI)>V-belt>INSTALLATION > REAR SIDE BELT.

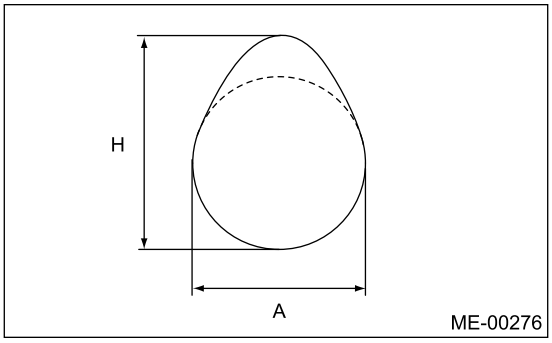
23. Install the engine to the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>INSTALLATION.

INSPECTION

1. Measure the bend, and repair or replace if necessary.
   Camshaft bend limit:
   0.020 mm (0.0008 in)



2. Check the journal for damage and wear. Replace if faulty.
3. Check the cutout portion used for camshaft sensor for damage. Replace if faulty.
4. Check the cam face condition, and remove the minor faults by grinding with oil stone. If offset wear occurs, replace it.
5. Measure the cam lobe height "H" and cam base circle diameter "A". If it exceeds the standard or offset wear occurs, replace it.
   Cam lobe height H:
   Standard
   Intake
   46.55 — 46.65 mm (1.8327 — 1.8366 in)
   Exhaust
   46.75 — 46.85 mm (1.8405 — 1.8445 in)
   Cam base circle diameter A:
   Standard
   37.0 mm (1.4567 in)



6. Measure the outside diameter of camshaft journal. If the journal diameter is not within specification, check the oil clearance.

	Camshaft journal	
	Front	**Center, rear**
Standard	37.946 — 37.963 (1.4939 —	29.946 — 29.963 (1.1790 —

	Camshaft journal	
	Front	Center, rear
mm (in)	1.4946)	1.1796)

7. Measure the oil clearance of camshaft journal.

(1) Clean the camshaft cap and cylinder head camshaft journal.

(2) Place the camshaft on cylinder head. (Without installing the valve lifter)

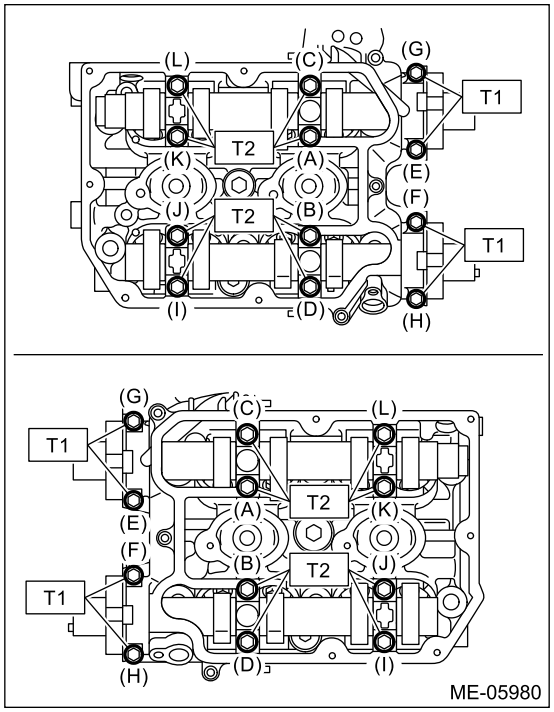
(3) Place a plastigauge across each camshaft journals.

(4) Gradually tighten the camshaft cap in at least two steps, in alphabetical order shown in the figure, and then tighten to the specified torque. Do not turn the camshaft.

Tightening torque:

T1: 9.75 N·m (1.0 kgf-m, 7.2 ft-lb)

T2: 20 N·m (2.0 kgf-m, 14.8 ft-lb)



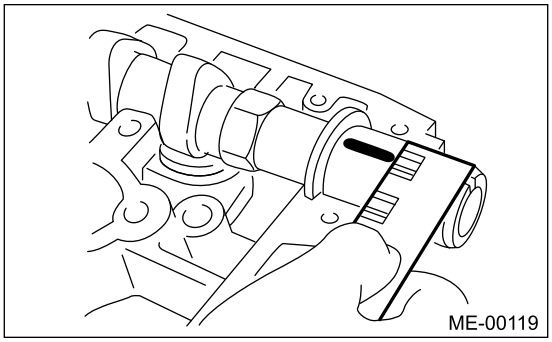
(5) Remove the camshaft cap.

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

Camshaft oil clearance:

Standard

0.037 — 0.072 mm (0.0015 — 0.0028 in)



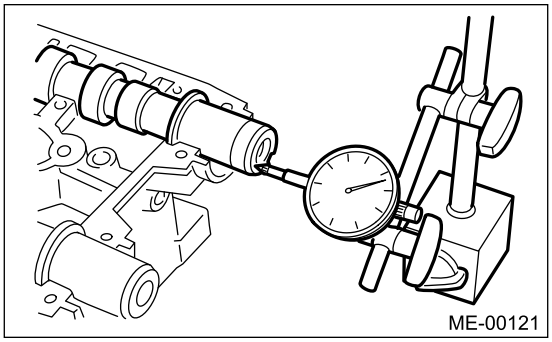
(7) Completely remove the plastigauge.

8. Measure the thrust clearance with setting the dial gauge at end surface of camshaft. If the thrust clearance is not within the standard or there is offset wear, replace the camshaft caps and cylinder head as a set. If necessary replace the camshaft.

Camshaft thrust clearance:

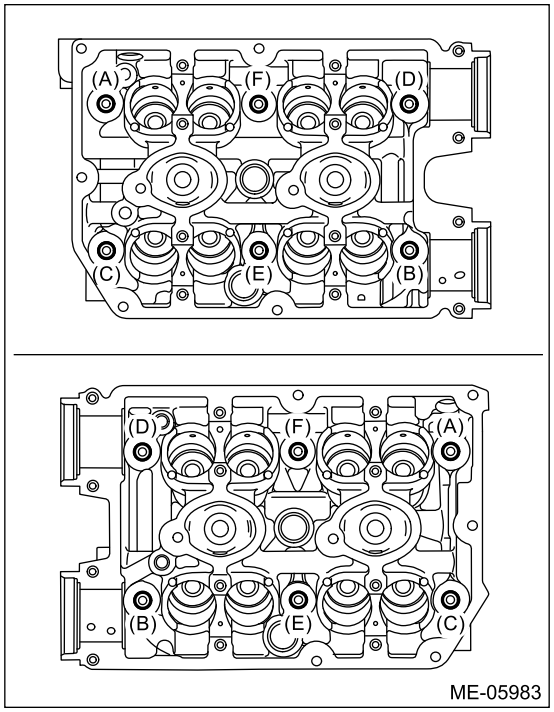
Standard

0.068 — 0.116 mm (0.0027 — 0.0047 in)

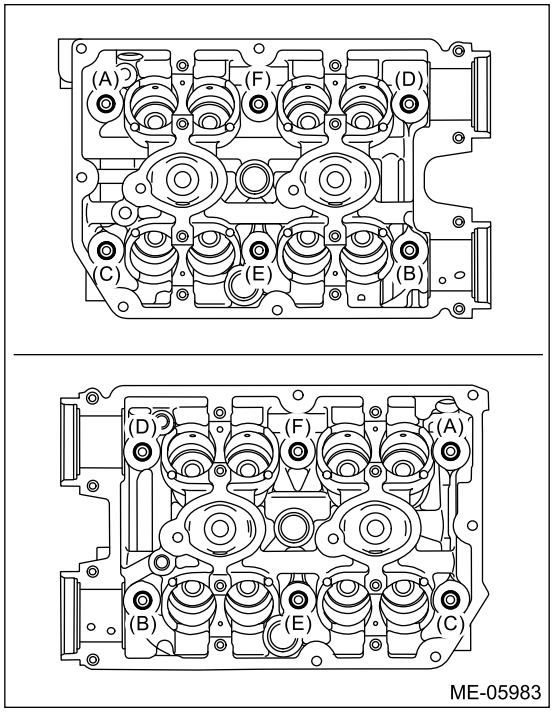


REMOVAL

1. Remove the engine from the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>REMOVAL.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
3. Remove the secondary air combination valve. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Combination Valve>REMOVAL.
4. Remove the camshaft. Ref. to MECHANICAL(STI)>Camshaft>REMOVAL.
5. Remove the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Compressor>REMOVAL > STI MODEL.
6. Remove the oil level gauge guide. (LH side only)
7. Remove the cylinder head bolts in alphabetical order shown in the figure.
   Note:
   Leave the bolts (A) and (D) engaged by three or four threads to prevent the cylinder head from falling.



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



9. Remove the cylinder head gasket.

Caution:

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

MECHANICAL(STI) > Cylinder Head

INSTALLATION

1. Install the cylinder head to the cylinder block.

Caution:

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

Note:

Use a new cylinder head gasket.

(1) Clean the bolt threads and the bolt holes in the cylinder block.

Caution:

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

(2) Apply a sufficient coat of engine oil to the washer and bolt thread.

(3) Tighten all bolts to 40 N·m (4.1 kgf-m, 29.5 ft-lb) in alphabetical order.

(4) Retighten all bolts to 69 N·m (7.0 kgf-m, 50.9 ft-lb) in alphabetical order.

Caution:

If the bolt makes stick-slip sound during tightening, repeat the procedure from step (1). In this case, the cylinder head gasket can be reused.

(5) Loosen all the bolts by 180° in the reverse order of installing, and loosen them further by 180°.

(6) Tighten all bolts to 40 N·m (4.1 kgf-m, 29.5 ft-lb) in alphabetical order.

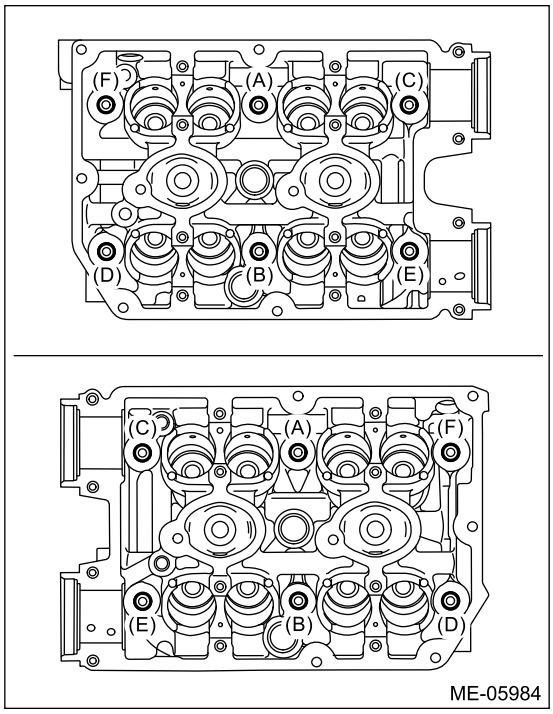
(7) Retighten all bolts to 69 N·m (7.0 kgf-m, 50.9 ft-lb) in alphabetical order.

(8) Loosen the bolts E, D, and A by 360° in this order.

(9) Tighten the bolts A, D, and E to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in this order.

(10)Tighten the bolts A, D, and E to 30 N·m (3.1 kgf-m, 22.1 ft-lb) in this order.

(11)Further tighten the bolts A, D, and E by 98 — 102° in this order.
(12)Further tighten the bolt A by 123 — 127°.
(13)Further tighten the bolts D and E by 78 — 82° in this order.
(14)Loosen the bolts F, C, and B by 360° in this order.
(15)Tighten the bolts B, C, and F to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in this order.
(16)Tighten the bolts B, C, and F to 30 N·m (3.1 kgf-m, 22.1 ft-lb) in this order.
(17)Further tighten the bolts B, C, and F by 98 — 102° in this order.
(18)Further tighten the bolt B by 123 — 127°.
(19)Further tighten the bolts C and F by 78 — 82° in this order.



2. Install the oil level gauge guide. (LH side only)
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
3. Install the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Compressor>INSTALLATION > STI MODEL.
4. Install the camshaft. Ref. to MECHANICAL(STI)>Camshaft>INSTALLATION.
5. Install the secondary air combination valve. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Combination Valve>INSTALLATION.
6. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>INSTALLATION.
7. Install the engine to the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>INSTALLATION.

MECHANICAL(STI) > Cylinder Head

DISASSEMBLY

1. Remove the valve lifter.
2. Place the cylinder head on ST1.

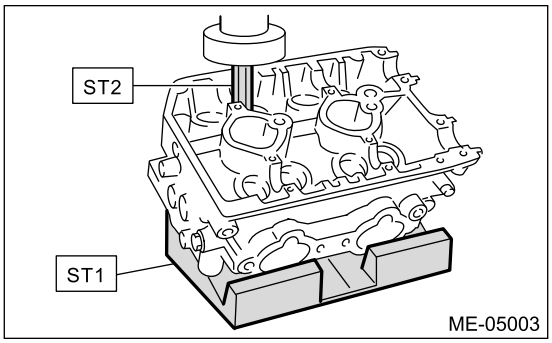
ST1 498267600 CYLINDER HEAD TABLE

3. Using ST2, compress the valve spring and remove the valve spring retainer key. Remove each valve and valve spring.

ST2 499718000 VALVE SPRING REMOVER

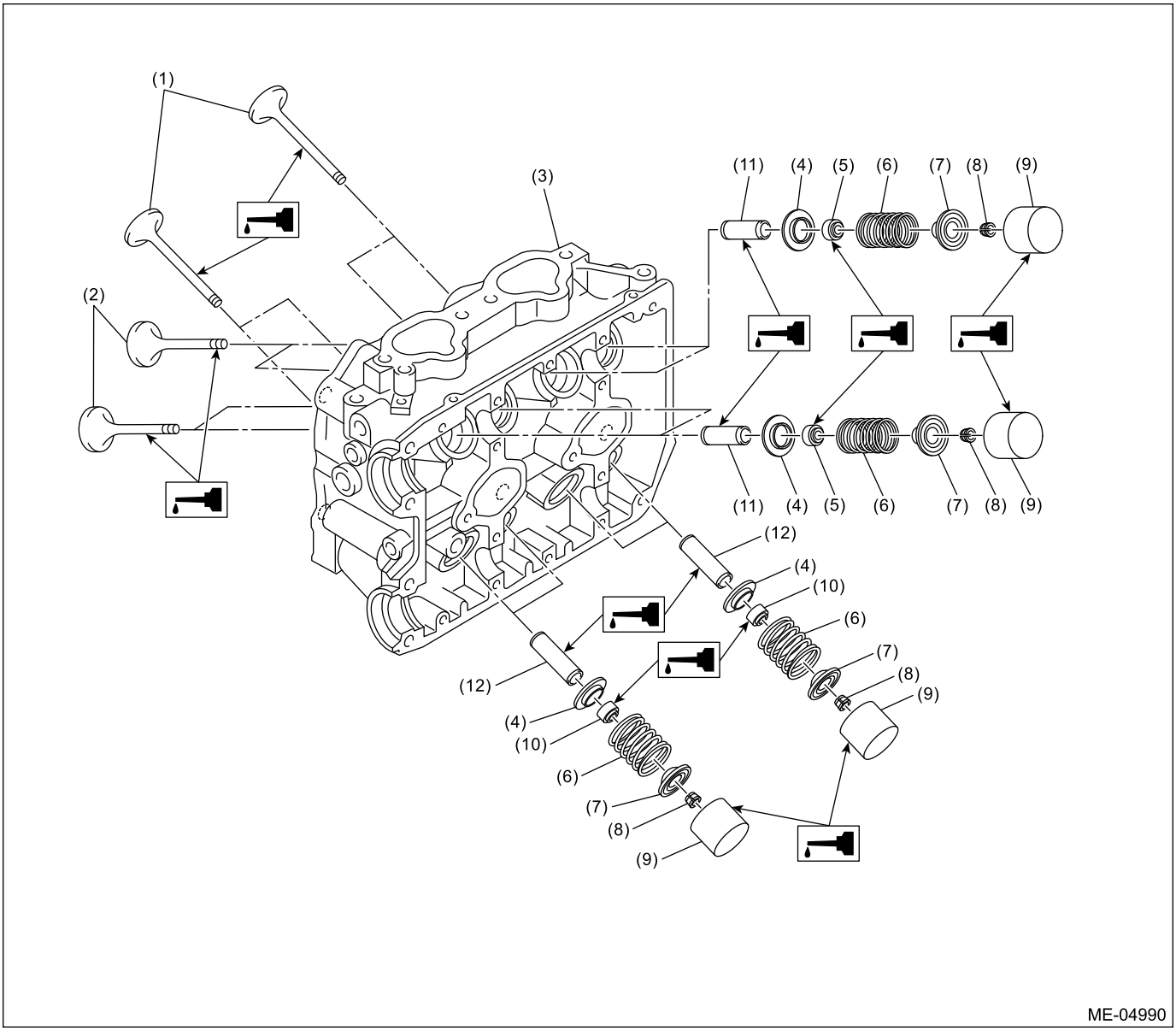
Note:

- **Mark each valve to prevent confusion.**
- **Pay careful attention not to damage the lips of intake valve oil seals and exhaust valve oil seals.**
- **Keep all the removed parts in order for re-installing in their original positions.**
- **For removal and installation procedures of the valve guide, intake valve oil seal and exhaust valve oil seal, refer to "INSPECTION". Ref. to MECHANICAL(STI)>Cylinder Head>INSPECTION > VALVE GUIDE. Ref. to MECHANICAL(STI)>Cylinder Head>INSPECTION > INTAKE AND EXHAUST VALVE OIL SEAL.**



MECHANICAL(STI) > Cylinder Head

ASSEMBLY



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

1. Install the valve spring and valve.

(1) Coat the valve 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.

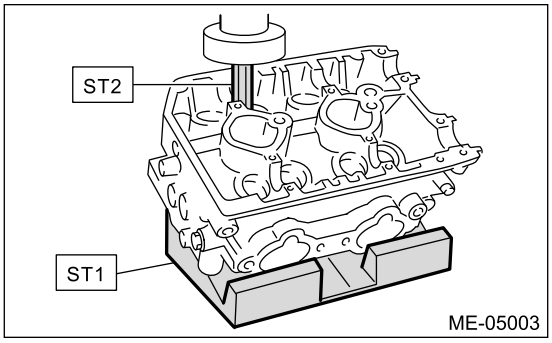
ST1 498267600 CYLINDER HEAD TABLE

(3) Install the valve spring and valve spring retainer.

Note:
Be sure to install the valve spring with its close-coiled end facing the cylinder head side.

(4) Set the ST2 on valve spring.

ST2 499718000 VALVE SPRING REMOVER



(5) Compress the valve spring and fit the valve spring retainer key.

(6) After installing, tap the valve spring retainers lightly with a plastic hammer for better seating.

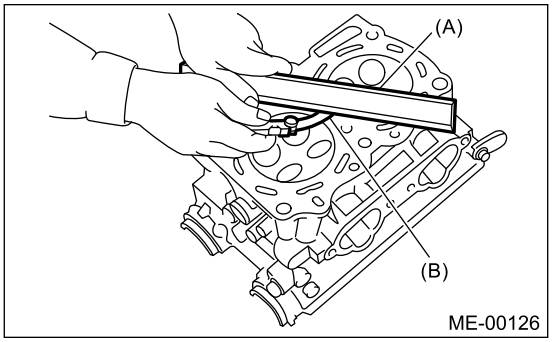
2. Apply oil to the surface of valve lifter.
3. Install the valve lifter.

MECHANICAL(STI) > Cylinder Head

INSPECTION

1. CYLINDER HEAD

1. Check for cracks or damage. Use liquid penetrant tester on the important sections to check for fissures. Check that there are no marks of gas leaking or water leaking on gasket installing surface.
2. Measure the warping of the cylinder head surface that mates with cylinder block using a straight edge (A) and thickness gauge (B).
   If the warping exceeds the limit, correct the surface by grinding it with a surface grinder.
   Warping limit:
   0.035 mm (0.0014 in)
   Grinding limit:
   0.3 mm (0.0118 in)
   Standard height of cylinder head:
   127.5 mm (5.0197 in)
   Note:
   Uneven torque for the cylinder head bolts can cause warpage. When reinstalling, pay special attention to the torque so as to tighten evenly.



2. VALVE SEAT

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

Contacting width W between valve and valve seat:

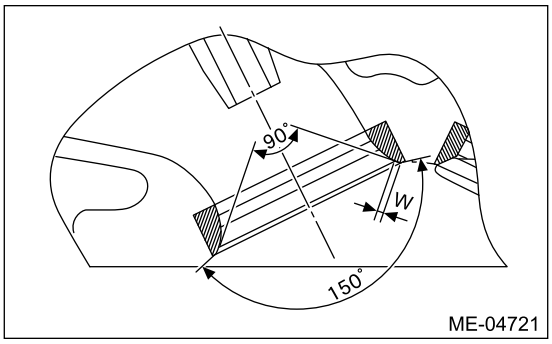
Standard

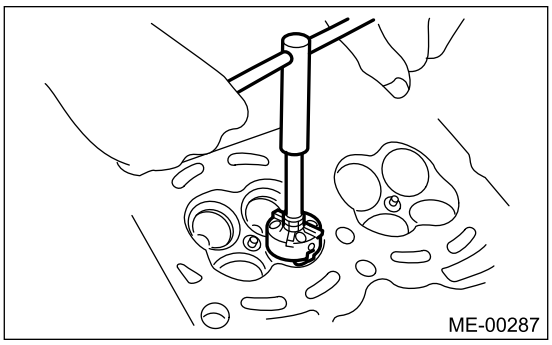
Intake

0.6 — 1.4 mm (0.0236 — 0.0551 in)

Exhaust

1.2 — 1.8 mm (0.0472 — 0.0709 in)





3. VALVE GUIDE

1. Check the clearance between valve guide and valve stem. The clearance can be checked by measuring the outer diameter of valve stem with a micrometer and the inner diameter of valve guide with a caliper gauge 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)

2. If the clearance between valve guide and valve stem exceeds the standard, replace the valve guide or valve itself, whichever shows the greater amount of wear or damage. 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

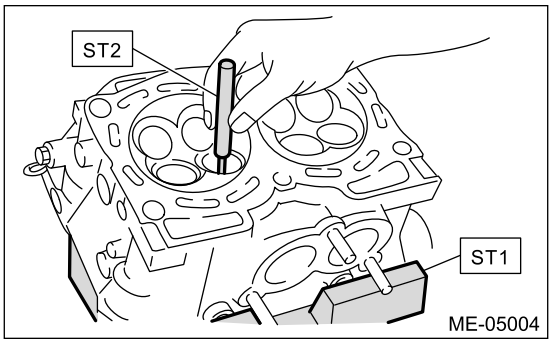
5.945 — 5.960 mm (0.2341 — 0.2346 in)

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

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

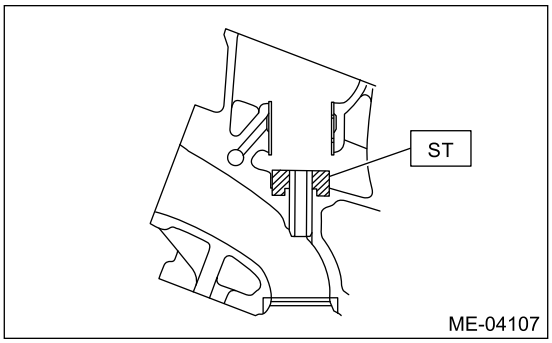
ST1 498267600 CYLINDER HEAD TABLE

ST2 499767200 VALVE GUIDE REMOVER



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

ST 18251AA020 VALVE GUIDE ADJUSTER

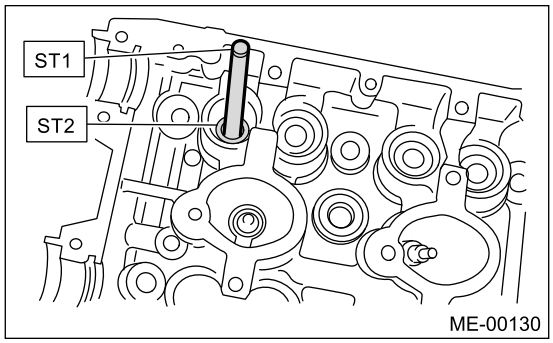


(4) Before installing a new valve guide, make sure that neither scratches nor damages exist on the inner surface of valve guide holes in cylinder head.

(5) Put a new valve guide, coated with sufficient oil, in the cylinder head, and insert the 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

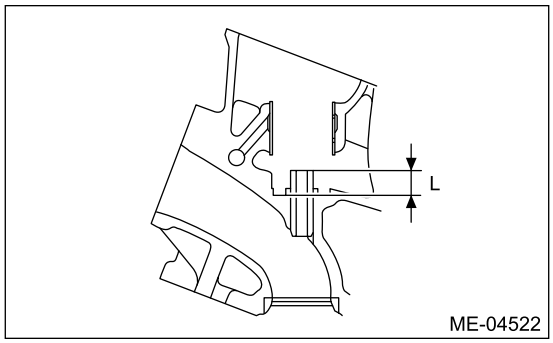
ST2 18251AA020 VALVE GUIDE ADJUSTER



(6) Check the valve guide protrusion amount "L".

Valve guide protrusion amount L:

15.8 — 16.2 mm (0.6220 — 0.6378 in)

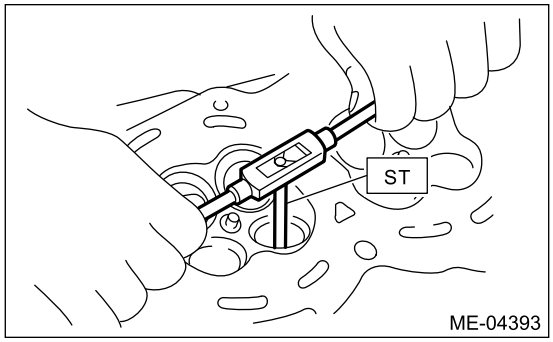


(7) Ream the inside of valve guide using ST. Put the ST in valve guide, and rotate the ST slowly clockwise while pushing it lightly. Bring the ST back while rotating it clockwise.

Note:

- **Apply engine oil to the ST when reaming.**
- **If the inner surface of valve guide is damaged, the edge of ST should be slightly ground with oil stone.**
- **If the inner surface of valve guide becomes lustrous and the ST does not chip, use a new ST or remedy the ST.**

ST 499767400 VALVE GUIDE REAMER

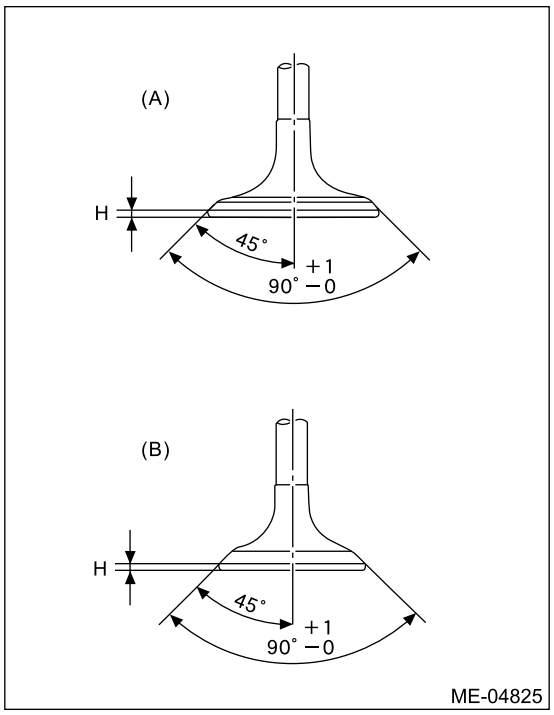


(8) After reaming, clean the valve guide to remove chips.

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

4. INTAKE AND EXHAUST VALVE

1. Inspect the flange of valve and valve stem, and replace the valve with a new part if damaged, worn, deformed, or if dimension “H” in the figure is outside of the specified limit.
   Head edge thickness H:
   Standard
   Intake (A)
   1.0 — 1.4 mm (0.0394 — 0.0551 in)
   Exhaust (B)
   1.3 — 1.7 mm (0.0512 — 0.0669 in)

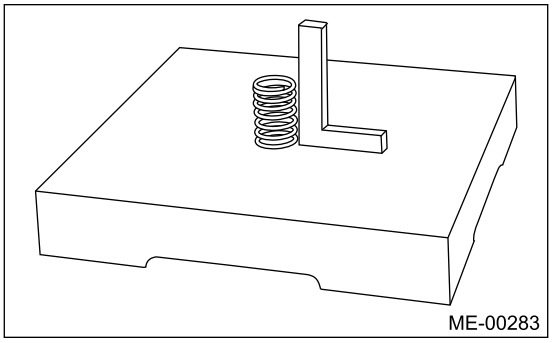


2. Put a small amount of grinding compound on the valve seat surface, and lap the valve and valve seat surface. Replace with a new valve oil seal after lapping.
   Note:
   It is possible to differentiate between the intake valve and the exhaust valve by their overall length.
   Valve overall length:
   Intake
   104.4 mm (4.1102 in)
   Exhaust
   104.65 mm (4.1201 in)

5. VALVE SPRING

1. Check the valve springs for damage, free length (reference), and tension. Replace the valve spring if it is not within the standard value presented in the table.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **The free length of the valve spring is described as a reference. There is no need to replace the valve spring if the free length of the valve spring alone is out of standard.**
2. To measure the squareness of the valve spring, stand the valve spring on a surface plate and measure its deflection at the top of the valve spring using a try square.

Free length (reference) mm (in)		53.48 (2.1055)
Tension/spring height N (kgf, lbf)/mm (in)	Set	204.6 — 235.4 (20.86 — 24.00, 46.00 — 52.93)/36.0 (1.4173)
	Lift	363.5 — 401.7 (37.07 — 40.96, 81.73 — 90.32)/26.7 (1.0512)
Squareness		2.5°, 2.3 mm (0.0906 in) or less



6. INTAKE AND EXHAUST VALVE OIL SEAL

1. For the following, replace the oil seal with a new part. See the procedure 2) and subsequent for replacement procedures.
   - When the lip is damaged.
   - When the spring is out of the specified position.
   - When readjusting the surfaces of valve and valve seat.
   - When replacing the valve guide.
2. Place the cylinder head on ST1, and use ST2 to press-fit the oil seal.

   ST1 498267600 CYLINDER HEAD TABLE

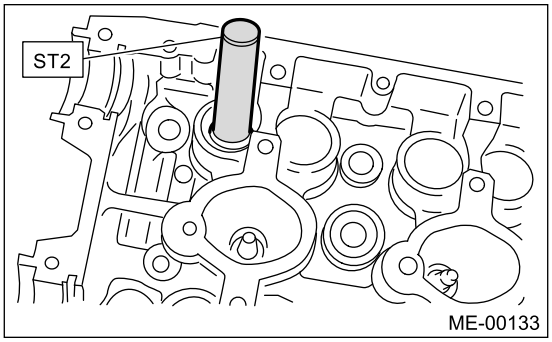
   ST2 498857100 VALVE OIL SEAL GUIDE

   Note:
   - **Apply engine oil to oil seal before press-fitting.**
   - **When press-fitting the oil seal, do not use a hammer to strike in.**
   - **The intake valve oil seals and exhaust valve oil seals are distinguished by their colors.**

   Color of rubber part:

   Intake [Gray]

   Exhaust [Green]



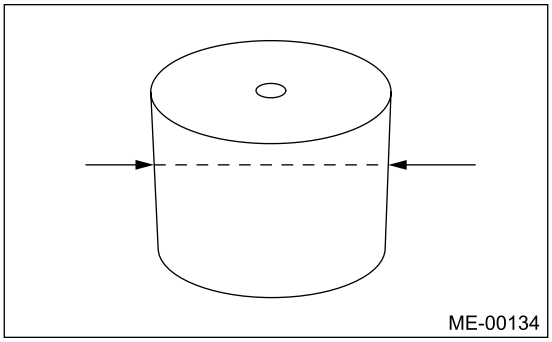
7. VALVE LIFTER

1. Check the valve lifter visually.
2. Measure the outer diameter of valve lifter.

Outer diameter of valve lifter:

Standard

34.959 — 34.975 mm (1.3763 — 1.3770 in)

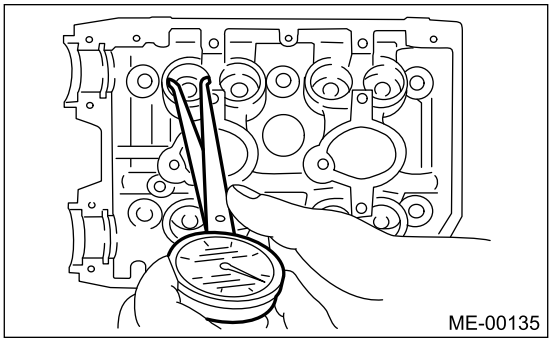


3. Measure the inner diameter of valve lifter mating surface on cylinder head.

Valve lifter mating surface inner diameter:

Standard

34.994 — 35.016 mm (1.3777 — 1.3786 in)



4. Check the clearance between valve lifter and valve lifter mating surface. The clearance can be checked by measuring the outer diameter of valve lifter and the inner diameter of valve lifter. If it exceeds the standard or offset wear occurs, replace the cylinder head.

Valve lifter and valve lifter mating surface clearance:

Standard

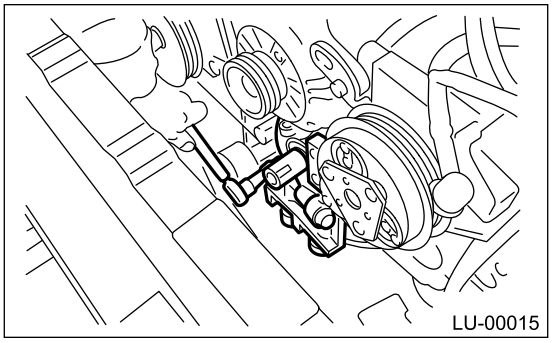
0.019 — 0.057 mm (0.0007 — 0.0022 in)

REMOVAL

Note:
Before conducting this procedure, drain the engine oil completely.

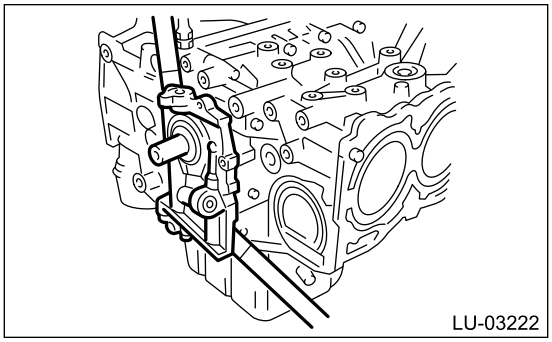
1. Remove the engine from the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>REMOVAL.
2. Remove the cylinder head. Ref. to MECHANICAL(STI)>Cylinder Head>REMOVAL.
3. Remove the crank sprocket. Ref. to MECHANICAL(STI)>Crank Sprocket>REMOVAL.
4. Remove the clutch disc and cover. Ref. to CLUTCH SYSTEM>Clutch Disc and Cover>REMOVAL.
5. Remove the flywheel. Ref. to CLUTCH SYSTEM>Flywheel>REMOVAL.
6. Remove the oil separator cover.
7. Remove the water by-pass pipe for heater.
8. Remove the oil filter. Ref. to LUBRICATION(STI)>Engine Oil Filter>REMOVAL.
9. Remove the oil cooler. Ref. to LUBRICATION(STI)>Engine Oil Cooler>REMOVAL.
10. Remove the water pump. Ref. to COOLING(STI)>Water Pump>REMOVAL.
11. Remove the bolts which secure oil pump to cylinder block.

    Note:
    When disassembling and checking the oil pump, loosen the relief valve plug before removing the oil pump.



12. Remove the oil pump from cylinder block using a crowbar.

    Caution:
    Be careful not to scratch the mating surface of the cylinder block and oil pump.



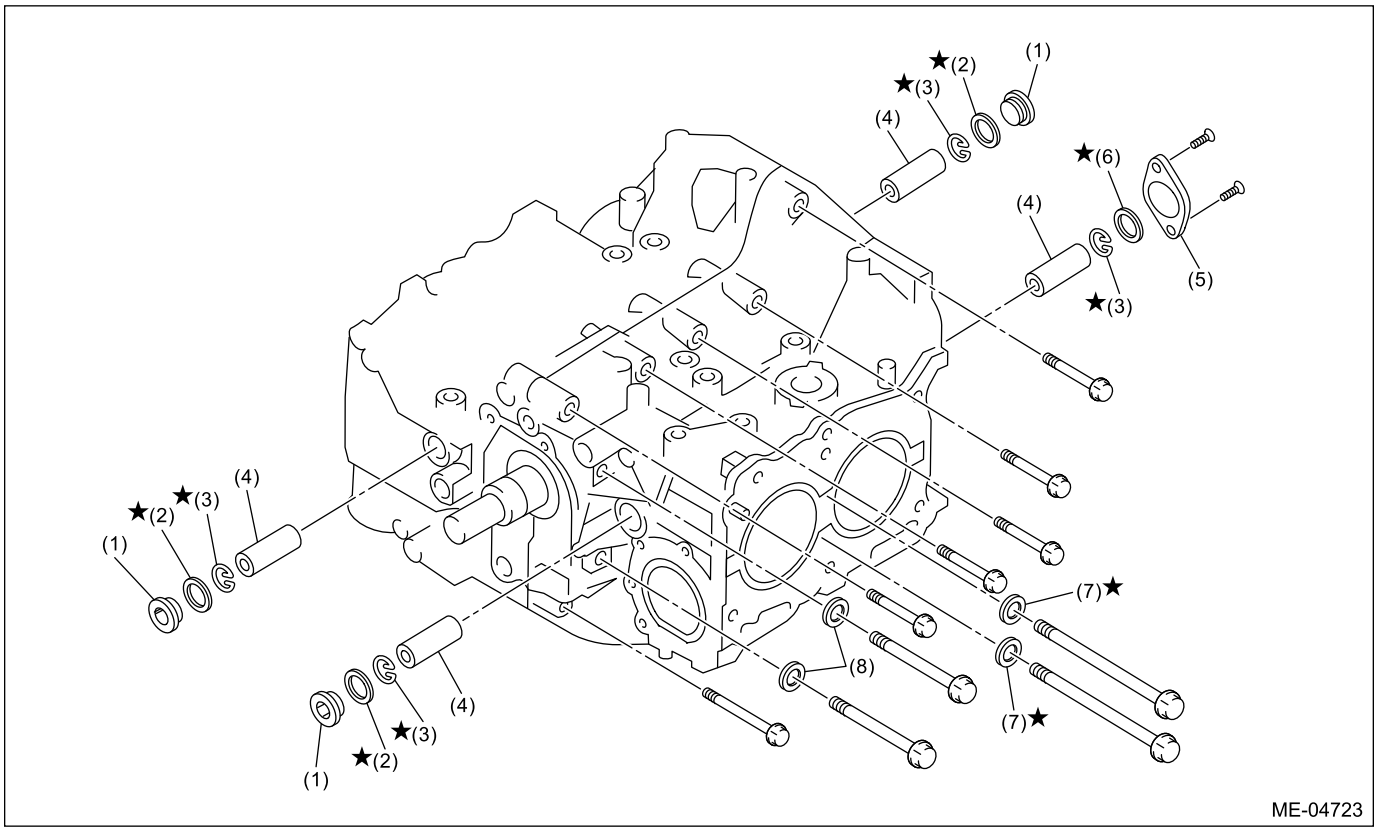
13. Remove the front oil seal from the oil pump.
14. Remove the oil pan.
    (1) Set the part so that the cylinder block LH is on the upper side.
    (2) Remove the bolts which secure oil pan to cylinder block.
    (3) Insert an oil pan cutter blade between cylinder block-to-oil pan clearance and remove the oil pan.

Caution:
Do not use a screwdriver or similar tools in place of oil pan cutter.

15. Remove the oil strainer.

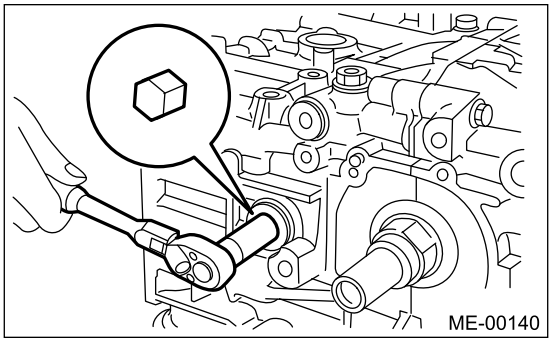
16. Remove the baffle plate.

17. Break the clamp which secures the water tank pipe assembly to the cylinder block RH, and remove the water pipe assembly along with the water tank pipe assembly from the cylinder block RH.



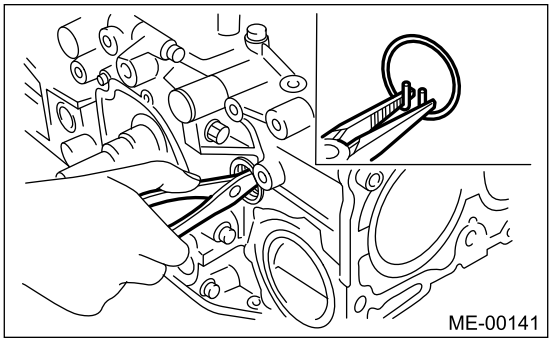
(1) Service hole plug
(2) Gasket
(3) Snap ring
(4) Piston pin
(5) Service hole cover
(6) O-ring
(7) Seal washer
(8) Washer

18. Remove the service hole plugs using a hexagon wrench [14 mm].



19. Remove the service hole cover.

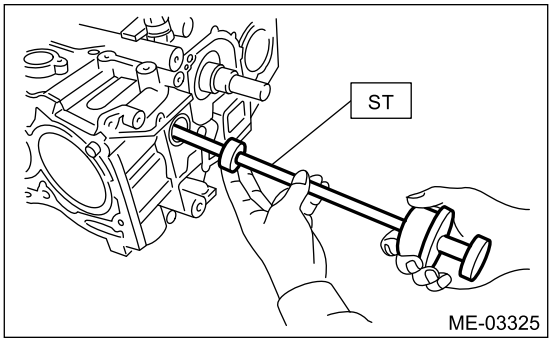
20. Rotate the crankshaft to bring #1 and #2 pistons to bottom dead center position, then remove the piston snap ring through service hole of #1 and #2 cylinders.



21. Draw out the piston pin from #1 and #2 pistons using ST.

ST 499097700 PISTON PIN REMOVER ASSY

Note:
Be careful not to confuse the original combination of piston, piston pin and cylinder.



22. Similarly draw out the piston pins from #3 and #4 pistons.

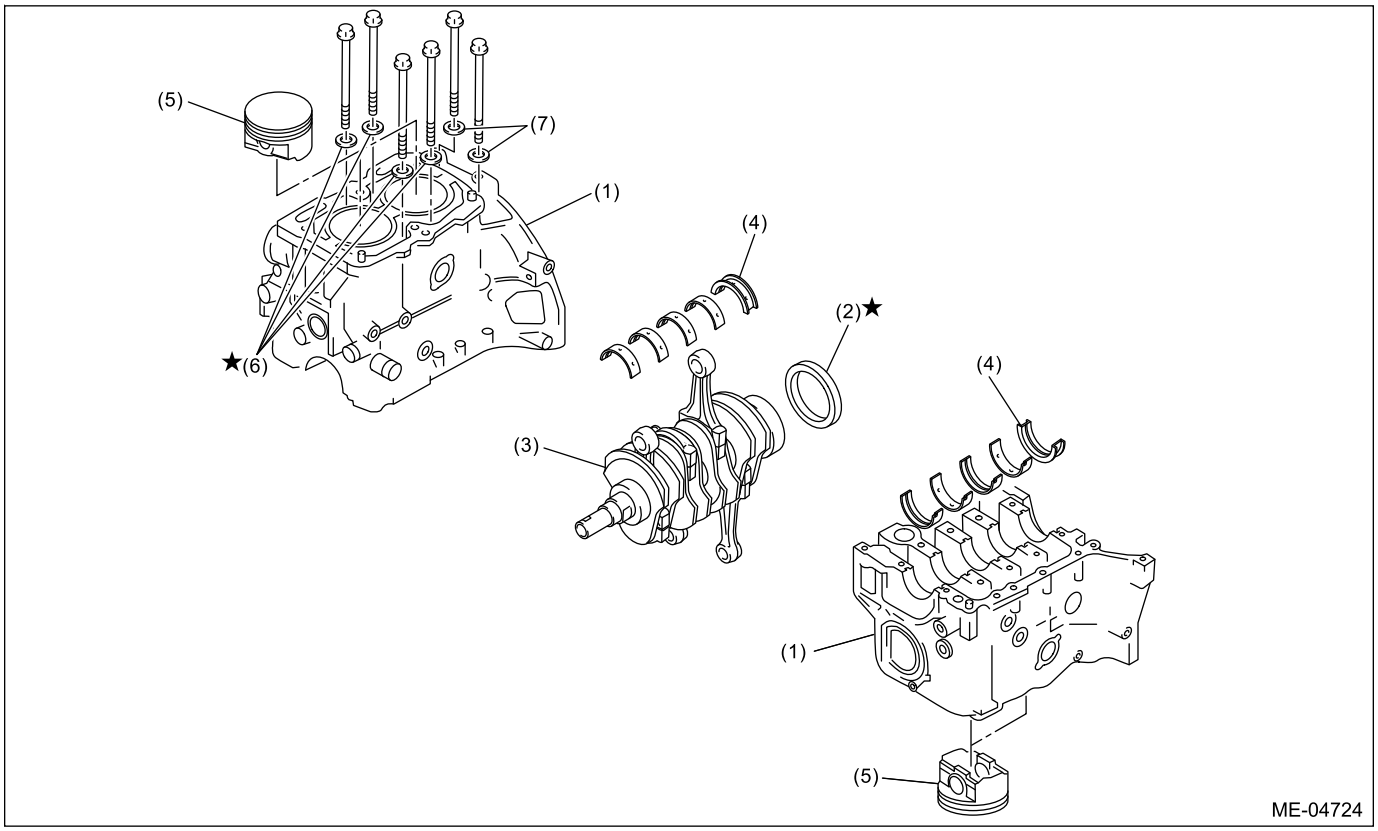
23. Remove the cylinder block connecting bolt on the RH side.

24. Loosen the cylinder block connecting bolt on the LH side by 2 to 3 turns.

25. Set the part so that the cylinder block LH is on the upper side, and remove the cylinder block connecting bolt.

26. Separate the cylinder block LH and RH.

Note:
When separating the cylinder block, do not allow the connecting rod to fall or damage the cylinder block.



(1) Cylinder block
(2) Rear oil seal
(3) Crankshaft
(4) Crankshaft bearing
(5) Piston
(6) Seal washer
(7) Washer

27. Remove the rear oil seal.
28. Remove the crankshaft together with connecting rod.
29. Remove the crankshaft bearings from cylinder block using a hammer handle.

Note:

- **Press the crankshaft bearing at the end opposite to locking lip to remove.**
- **Be careful not to confuse the crankshaft bearing combination.**

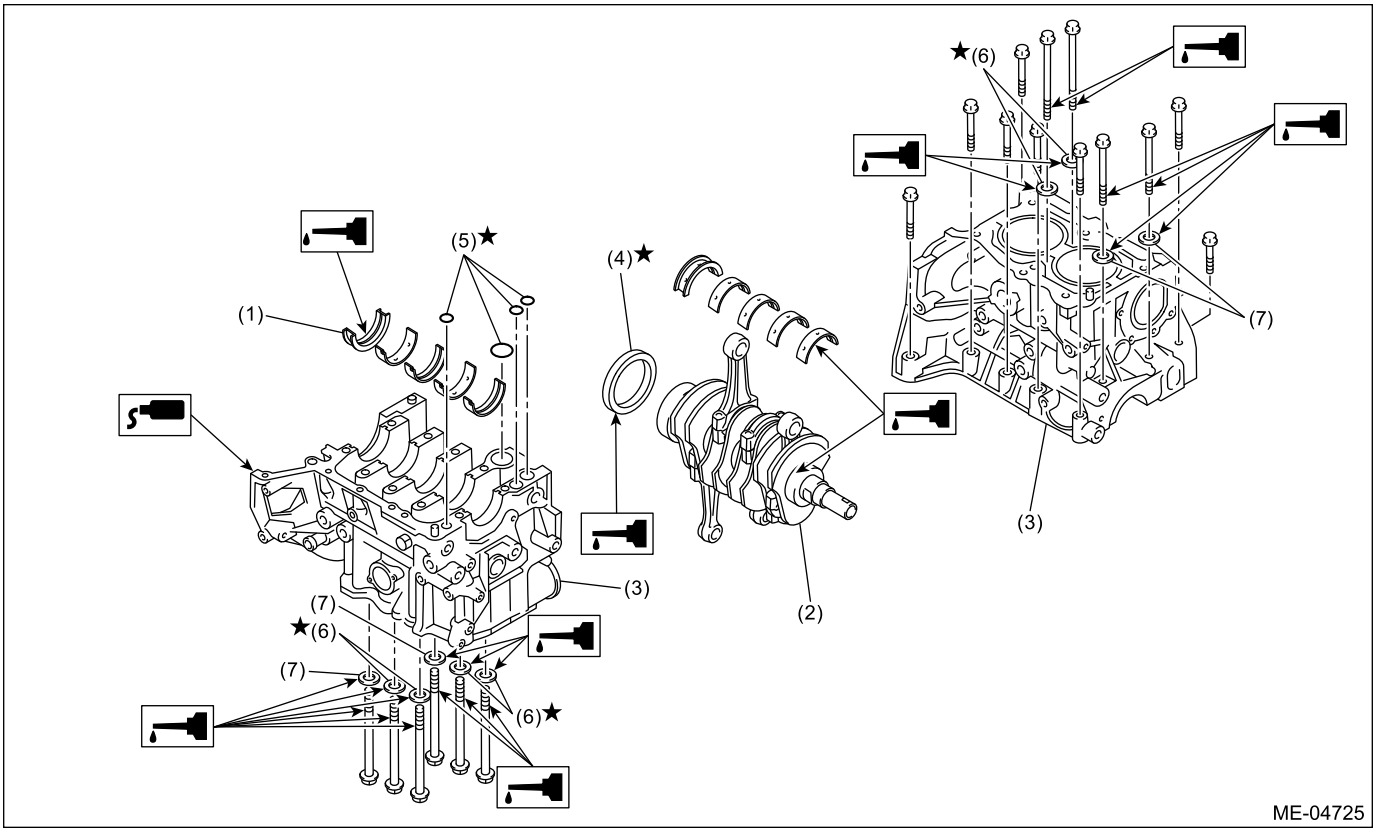
30. Remove each piston from the cylinder block using a wooden bar or hammer handle.

Note:

Be careful not to confuse the original combination of piston and cylinder.

MECHANICAL(STI) > Cylinder Block

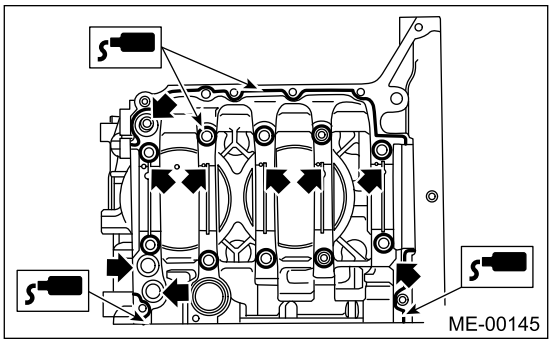
INSTALLATION



(1) Crankshaft bearing
(2) Crankshaft
(3) Cylinder block
(4) Rear oil seal
(5) O-ring
(6) Seal washer
(7) Washer

1. Remove oil on the mating surface of cylinder block before installation. Apply a coat of engine oil to the bearing and crankshaft journal.
2. Position the crankshaft and O-ring on cylinder block RH.
   Note:
   Use new O-rings.
3. Apply liquid gasket to the mating surfaces of cylinder block RH, and position cylinder block LH.
   Note:
   - **Install within 5 min. after applying liquid gasket.**
   - **Do not allow liquid gasket to jut into O-ring grooves, oil passages, bearing grooves, etc.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent



4. Apply a coat of engine oil to the washer and bolt thread.

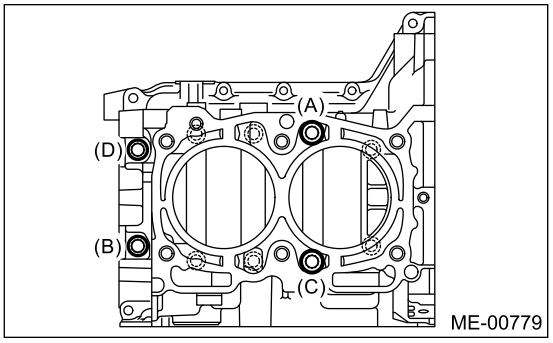
Note:

Use a new seal washer.

5. Tighten the 10 mm cylinder block connecting bolts on the LH side (A — D) in alphabetical order.

Tightening torque:

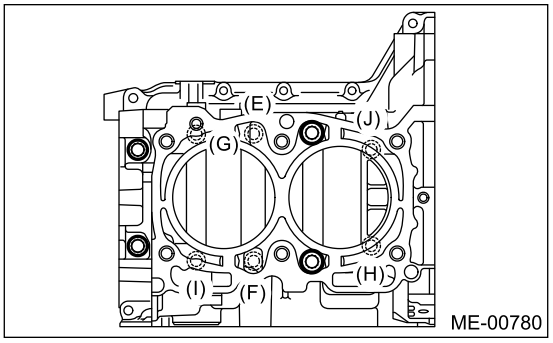
10 N·m (1.0 kgf-m, 7.4 ft-lb)



6. Tighten the 10 mm cylinder block connecting bolts on the RH side (E — J) in alphabetical order.

Tightening torque:

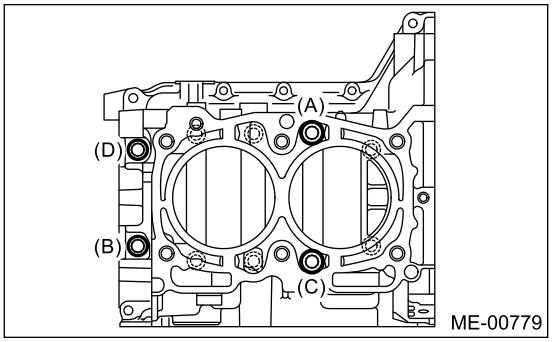
10 N·m (1.0 kgf-m, 7.4 ft-lb)



7. Tighten the LH side cylinder block connecting bolts (A — D) further in alphabetical order.

Tightening torque:

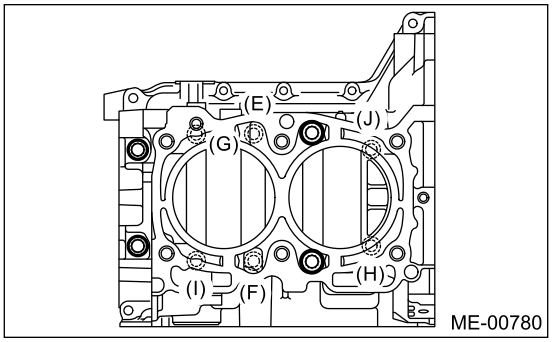
18 N·m (1.8 kgf-m, 13.3 ft-lb)



8. Tighten the RH side cylinder block connecting bolts (E — J) further in alphabetical order.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



9. Tighten the LH side cylinder block connecting bolts (A — D) further in alphabetical order.

- (A), (C): Angle tightening

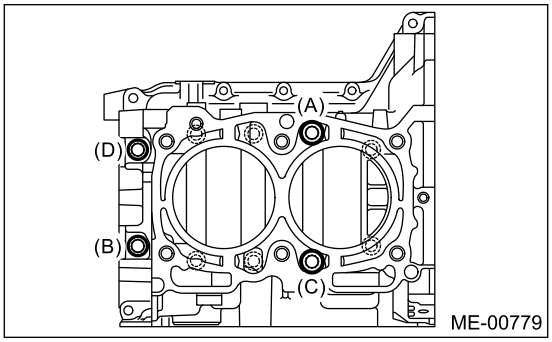
  Tightening angle:

  90°

- (B), (D): Torque tightening

  Tightening torque:

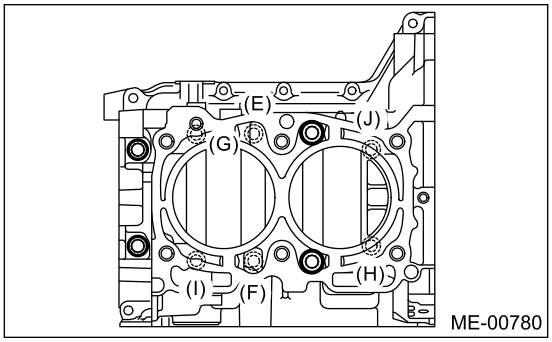
  40 N·m (4.1 kgf-m, 29.5 ft-lb)



10. Tighten the RH side cylinder block connecting bolts (E — J) further in alphabetical order.

Tightening angle:

90°

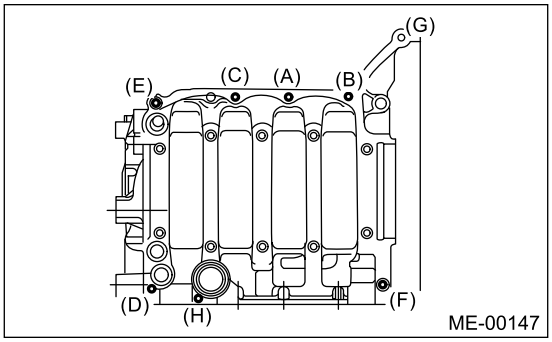


11. Tighten the 8 mm and 6 mm cylinder block connecting bolts on the LH side (A — H) in alphabetical order.

Tightening torque:

(A) — (G): 25 N·m (2.5 kgf-m, 18.4 ft-lb)

(H): 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

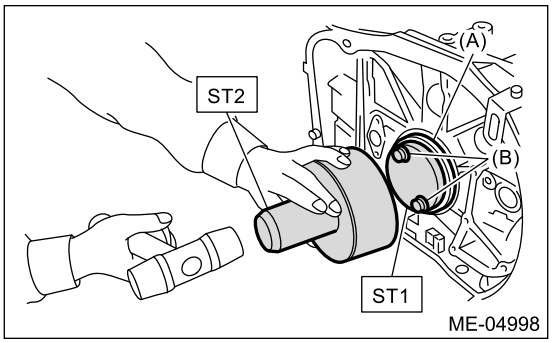


12. Apply a coat of engine oil to the oil seal inner periphery and outer periphery, and install the rear oil seal using ST1 and ST2.

Note:

Use a new rear oil seal.

ST1	**499597100**	**CRANKSHAFT OIL SEAL GUIDE**
ST2	**499587200**	**CRANKSHAFT OIL SEAL INSTALLER**

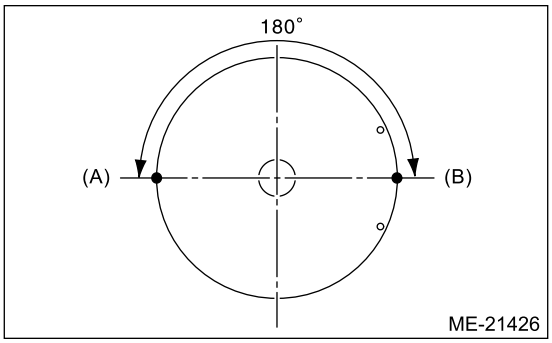


(A) Rear oil seal

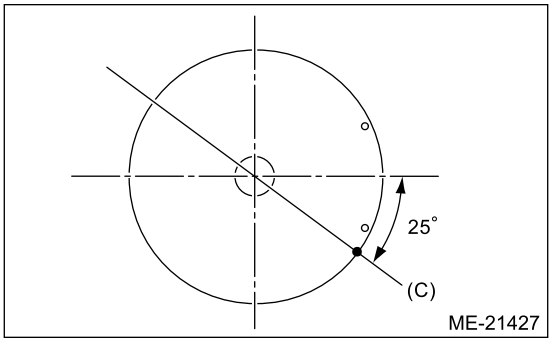
(B) Flywheel attachment bolt

13. Position the top ring gap at (A) or (B) in the figure.

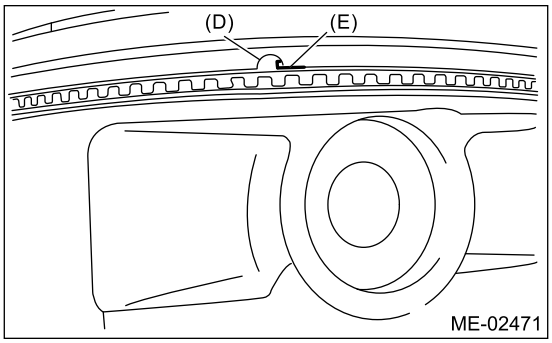
14. Position the second ring gap at 180° on the reverse side the top ring gap.



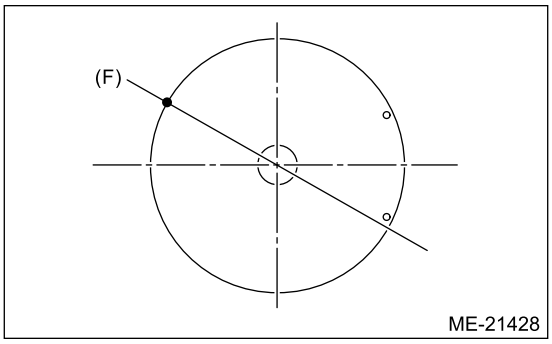
15. Position the upper rail gap at (C) in the figure.



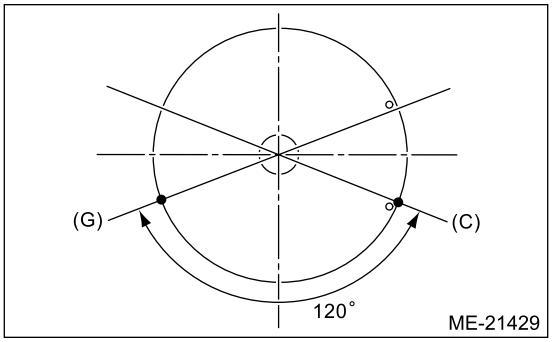
16. Align the upper rail spin stopper (E) to the side hole (D) on the piston.



17. Position the expander gap at (F) in the figure on the 180° opposite direction of (C).



18. Set the lower rail gap at position (G), located 120° clockwise from (C) in the figure.



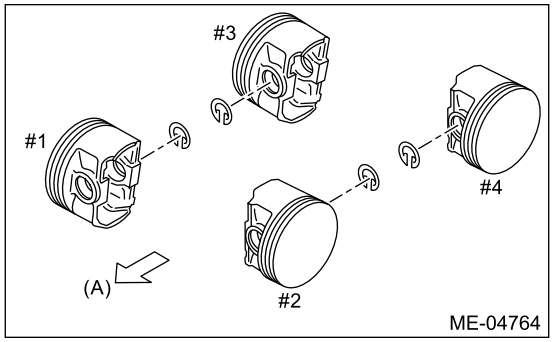
Note:

- **Make sure ring gaps do not face the same direction.**
- **Make sure ring gaps are not within the piston skirt area.**

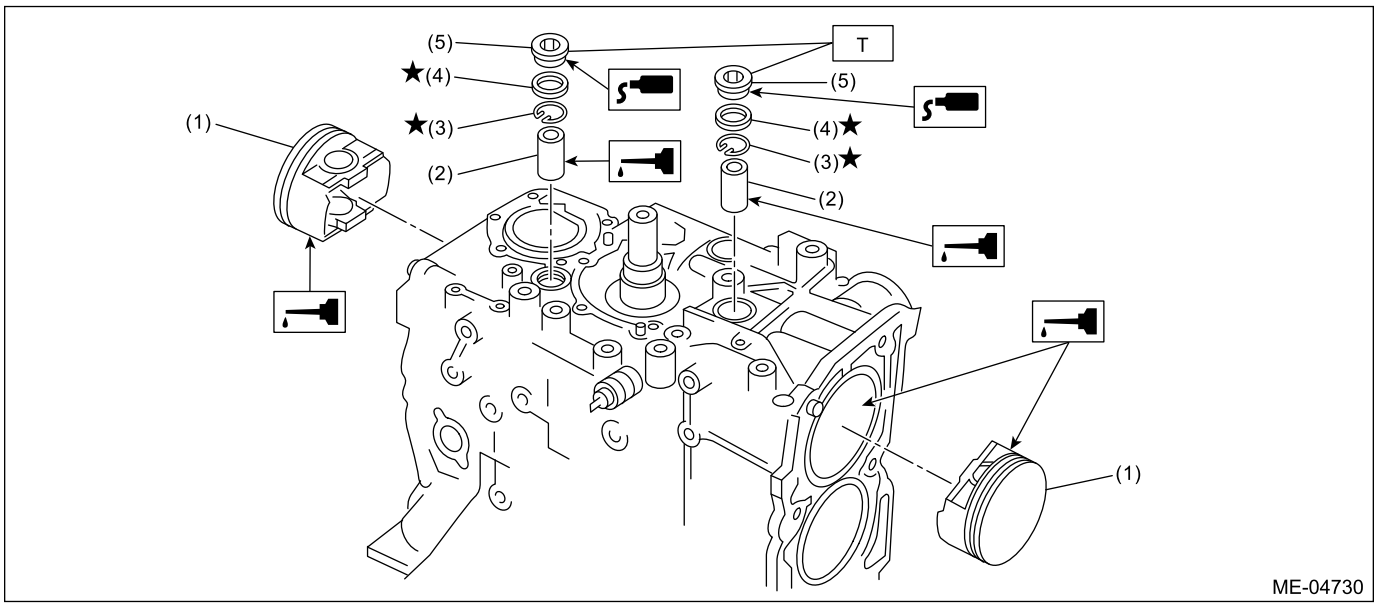
19. Install the snap ring.

Before positioning the piston on the cylinder block, attach the snap ring in the service hole of the cylinder block, and the piston hole on the opposite side.

Note:
Use new snap rings.



(A) Front side



(1) Piston
(2) Piston pin
(3) Snap ring
(4) Gasket
(5) Service hole plug

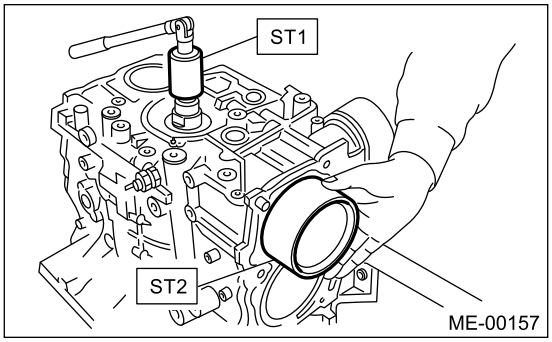
Tightening torque: N·m (kgf-m, ft-lb)
T: 70 (7.1, 51.6)

20. Install the piston.
(1) Set the parts so that the #1 and #2 cylinders are on the upper side.
(2) Using the ST1, turn the crankshaft so that #1 and #2 connecting rods are set at bottom dead center.

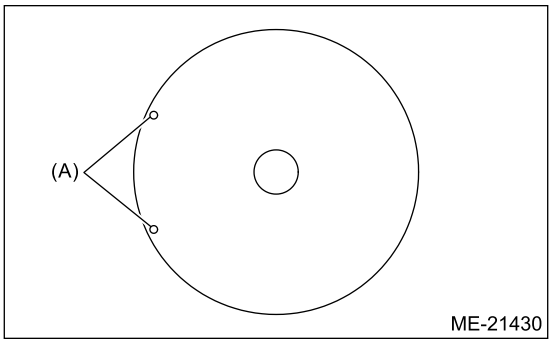
ST1 499987500 CRANKSHAFT SOCKET

(3) Apply a coat of engine oil to the pistons and cylinders and insert pistons in their cylinders using ST2.

ST2 498747300 PISTON GUIDE



Note:
Face the piston front mark towards the front of the engine.



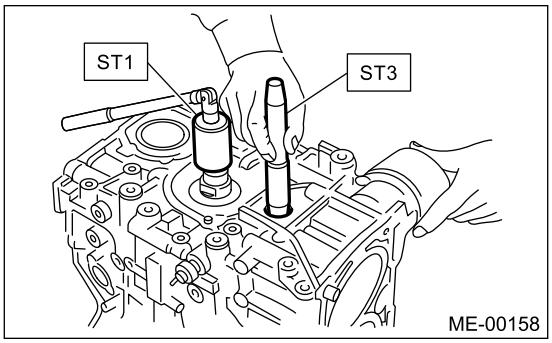
(A) Front mark

21. Install the piston pin.

(1) Apply a coat of engine oil to ST3.

(2) Insert ST3 into the service hole to align the piston pin hole and the connecting rod small end.

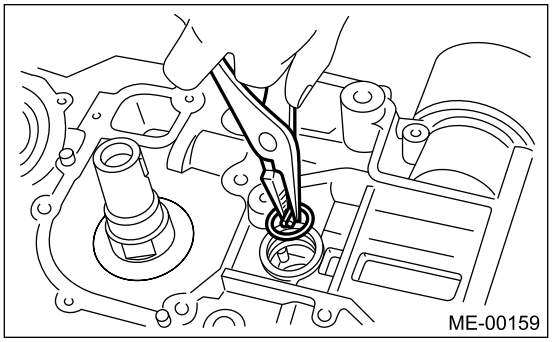
ST3 499017100 PISTON PIN GUIDE



(3) Apply a thin coat of engine oil to piston pin, and insert the piston pin into piston and connecting rod through service hole.

(4) Install the snap ring.

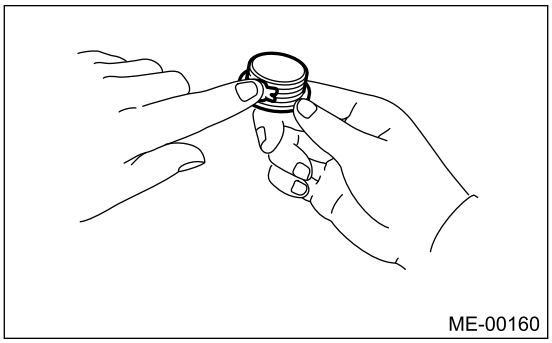
Note:
Use new snap rings.



(5) Apply liquid gasket to the threaded portion of the service hole plug.

Liquid gasket:

THREE BOND 1105 (Part No. 004403010) or equivalent



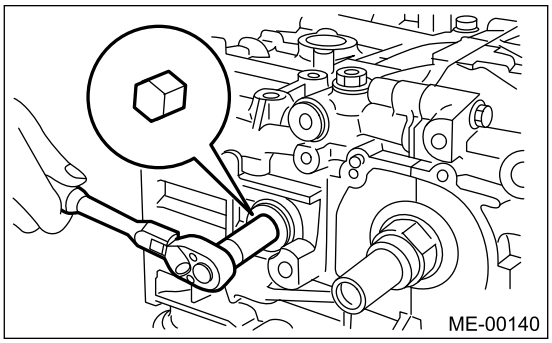
(6) Install the service hole plug and gasket.

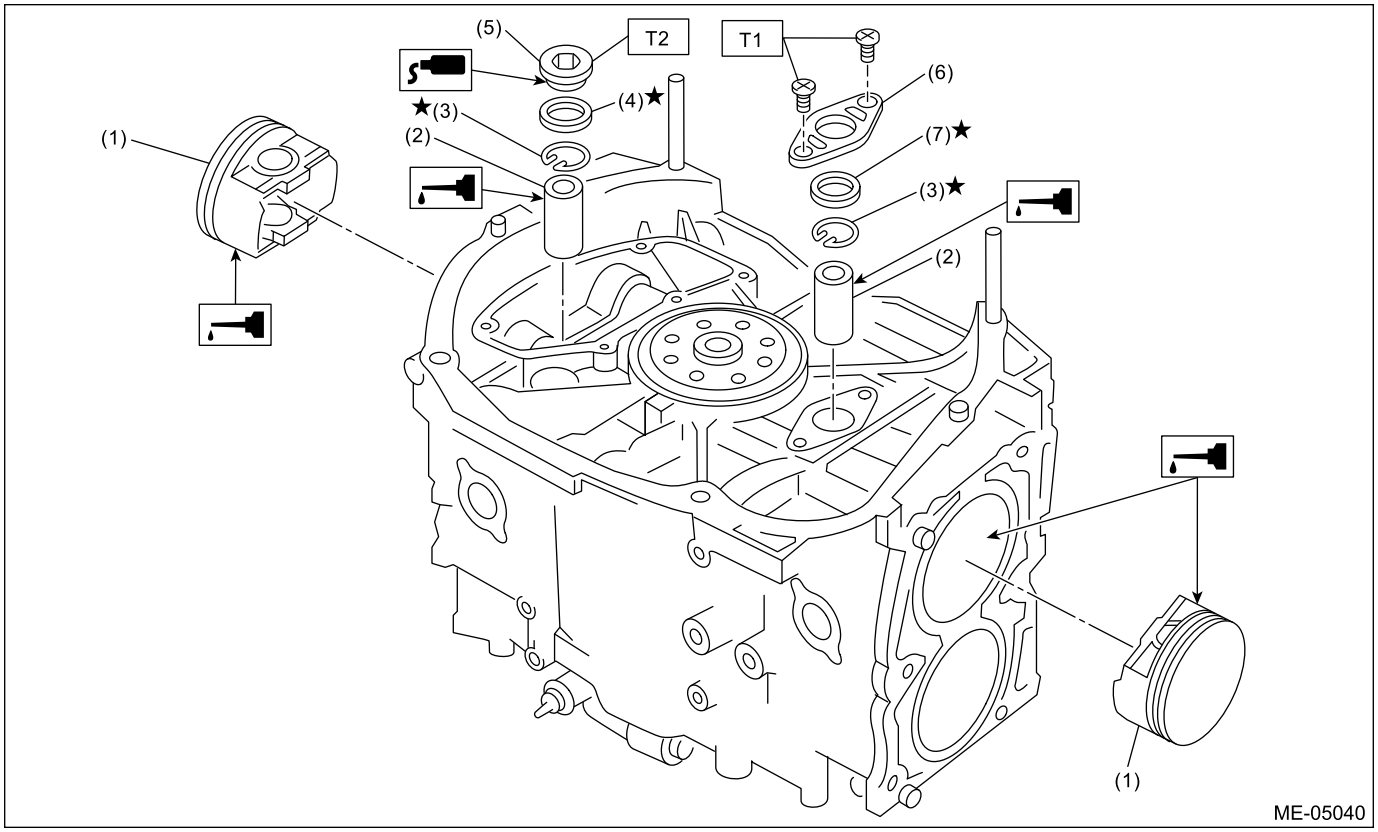
Note:

Use a new gasket.

Tightening torque:

70 N·m (7.1 kgf-m, 51.6 ft-lb)





(1)	Piston	(5)	Service hole plug	***Tightening torque: N·m (kgf-m, ft-lb)***	
(2)	Piston pin	(6)	Service hole cover	***T1: 6.4 (0.7, 4.7)***	
(3)	Snap ring	(7)	O-ring	***T2: 70 (7.1, 51.6)***	
(4)	Gasket				

(7) Set the parts so that the #3 and #4 cylinders are on the upper side. Following the same procedures as used for #1 and #2 cylinders, install the pistons and piston pins.

(8) Install the service hole cover.

Note:

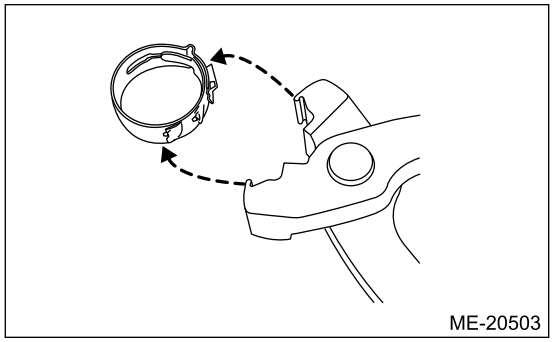
Use new O-rings.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

22. Install the water pipe assembly along with the water tank pipe assembly to the cylinder block RH, and install the clamp using the Clamp pincer (14100134).

Note:
Use new O-rings and clamps.



Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

23. Install the baffle plate.

Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

24. Install the oil strainer.

Note:
Use new O-rings.

Tightening torque:
10 N·m (1.0 kgf-m, 7.4 ft-lb)

25. Tighten the oil strainer stay together with the baffle plate.

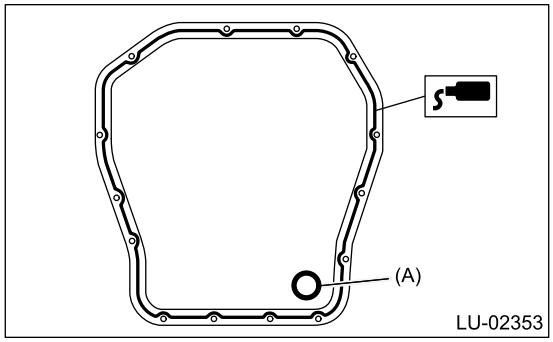
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

26. Apply liquid gasket to the mating surfaces of oil pan, and install the oil pan.

Note:
Install within 5 min. after applying liquid gasket.

Liquid gasket:
THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

Tightening torque:
5 N·m (0.5 kgf-m, 3.7 ft-lb)



(A) Gasket

27. Apply liquid gasket to the mating surface of oil separator cover and the threaded portion of bolt (A) shown in the figure (when reusing the bolt), and then install the oil separator cover.

Note:

- **Install within 5 min. after applying liquid gasket.**
- **Use new oil separator cover.**

Liquid gasket:

Mating surface

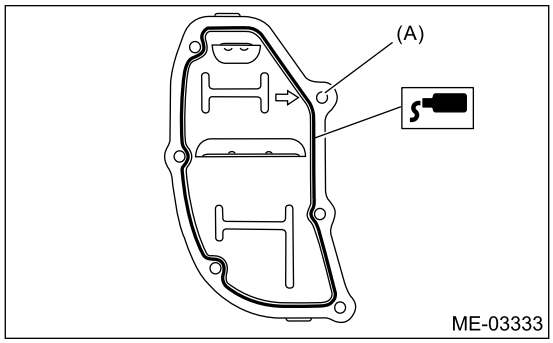
THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

Bolt thread (A) (when reusing the bolt)

THREE BOND 1324 (Part No. 004403042) or equivalent

Tightening torque:

6.4 N·m (0.65 kgf-m, 4.7 ft-lb)



28. Install the flywheel. Ref. to CLUTCH SYSTEM>Flywheel>INSTALLATION.

29. Install the clutch disc and cover. Ref. to CLUTCH SYSTEM>Clutch Disc and Cover>INSTALLATION.

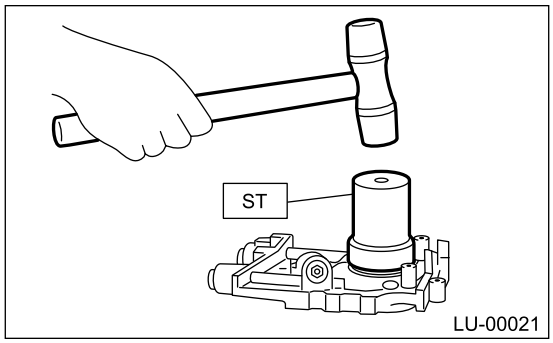
30. Install the oil pump.

(1) Using the ST, install the front oil seal.

ST 499587100 OIL SEAL INSTALLER

Note:

Use a new front oil seal.



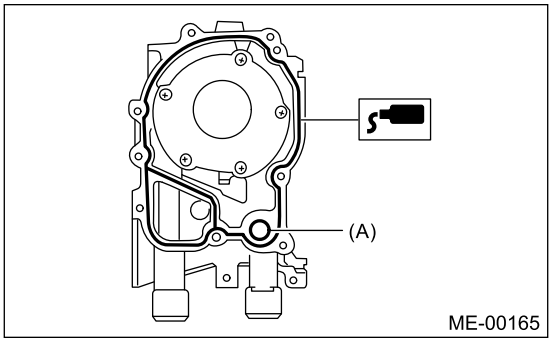
(2) Apply liquid gasket to the mating surfaces of oil pump.

Note:

Install within 5 min. after applying liquid gasket.

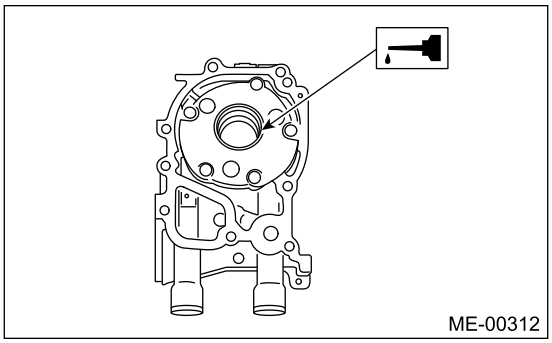
Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent



(A) O-ring

(3) Apply a thin coat of engine oil to the inside of front oil seal.



(4) Install the oil pump to cylinder block.

Caution:

- **Be careful not to damage the front oil seal during installation.**
- **Make sure the front oil seal lip is not folded.**

Note:

- **Align the flat surface of oil pump's inner rotor with that of crankshaft before installation.**
- **Use new O-rings.**
- **Do not forget to assemble O-rings.**

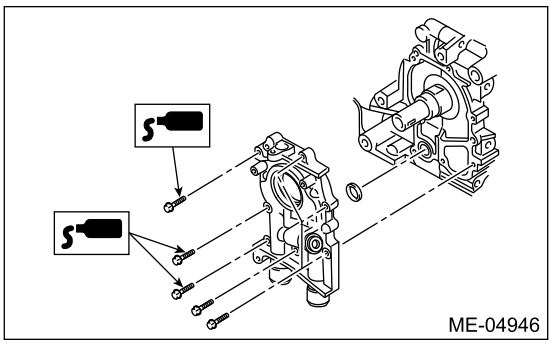
(5) Apply liquid gasket to the three bolts thread shown in figure. (When reusing bolts)

Liquid gasket:

THREE BOND 1324 (Part No. 004403042) or equivalent

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



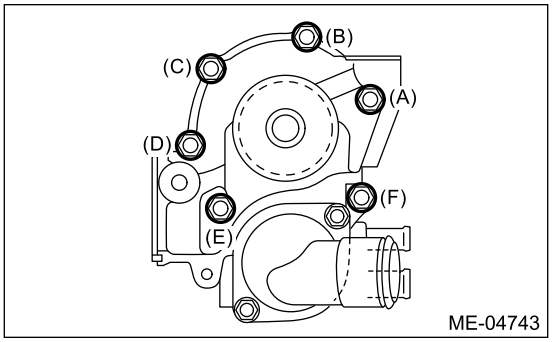
31. Install the water pump and gasket.

Note:

- **When installing the water pump, tighten bolts in two stages in alphabetical order as shown in the figure.**
- **Use a new gasket.**

Tightening torque:

First: 12 N·m (1.2 kgf-m, 8.9 ft-lb)
Second: 12 N·m (1.2 kgf-m, 8.9 ft-lb)



32. Install the water by-pass pipe for heater.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

33. Install the oil cooler. Ref. to LUBRICATION(STI)>Engine Oil Cooler>INSTALLATION.

34. Install the oil filter. Ref. to LUBRICATION(STI)>Engine Oil Filter>INSTALLATION.

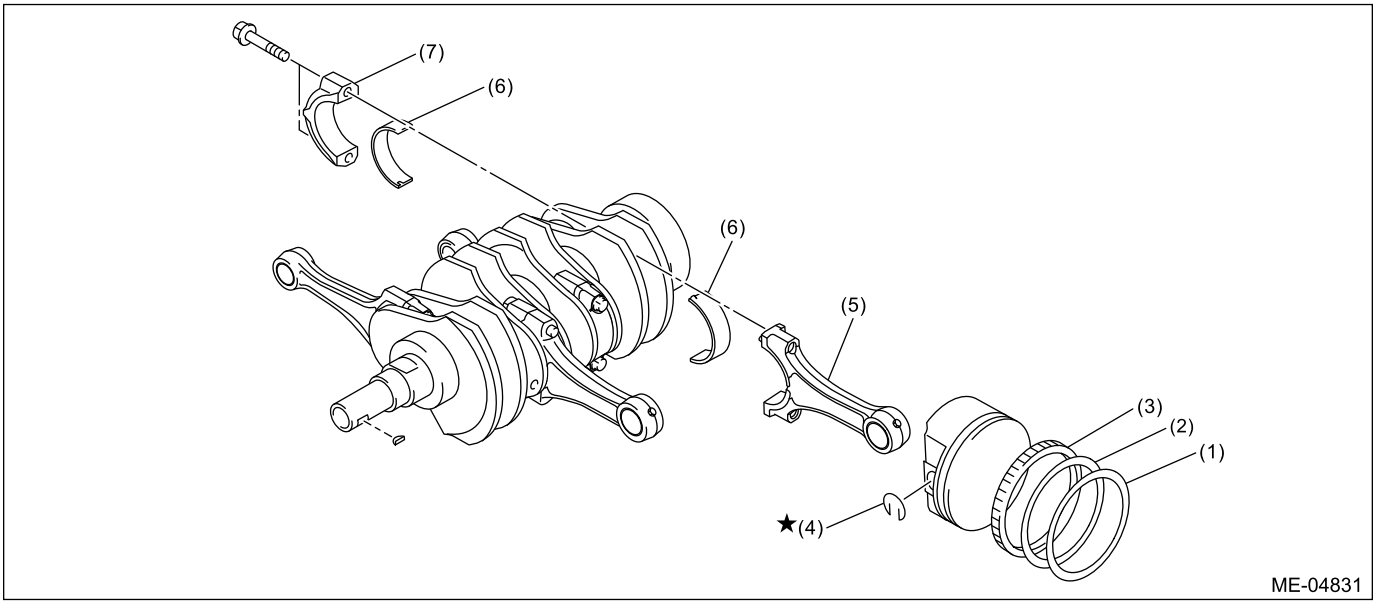
35. Install the crank sprocket. Ref. to MECHANICAL(STI)>Crank Sprocket>INSTALLATION.

36. Install the cylinder head. Ref. to MECHANICAL(STI)>Cylinder Head>INSTALLATION.

37. Install the engine to the vehicle. Ref. to MECHANICAL(STI)>Engine Assembly>INSTALLATION.

MECHANICAL(STI) > Cylinder Block

DISASSEMBLY



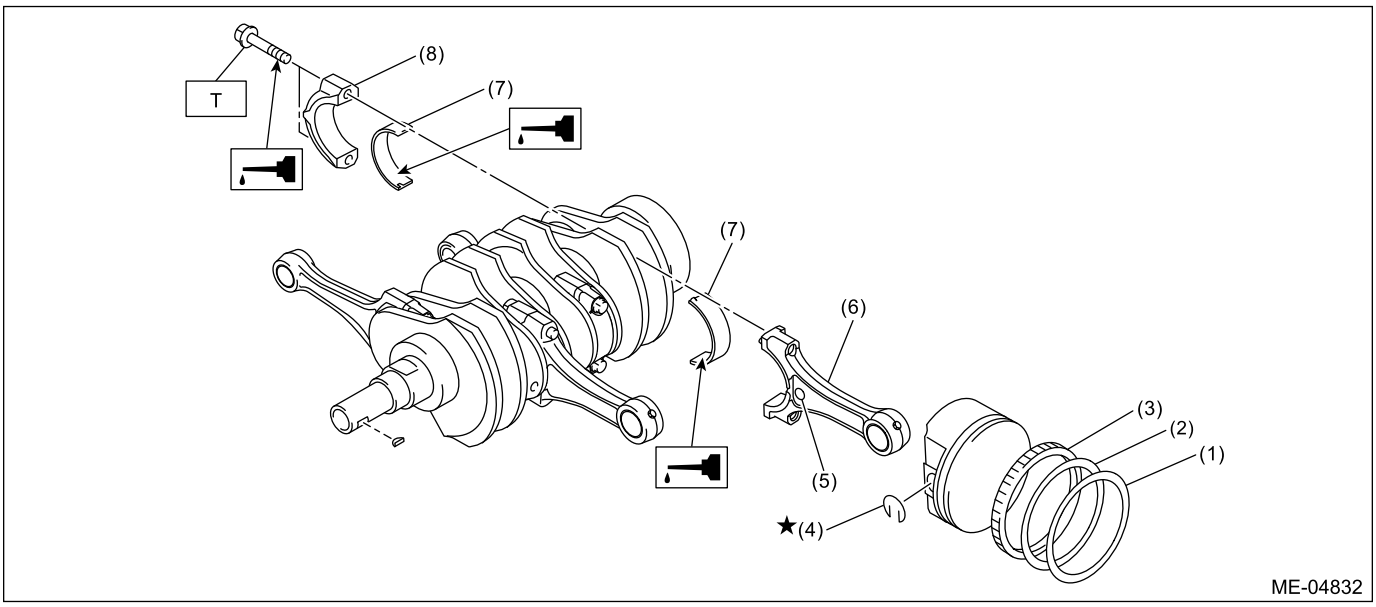
(1) Top ring
(2) Second ring
(4) Snap ring
(5) Connecting rod
(6) Connecting rod bearing
(7) Connecting rod cap

(3) Oil ring

1. Remove the connecting rod cap.
2. Remove the connecting rod bearing.
   Note:
   Keep the removed connecting rods, connecting rod caps and bearings in order so that they are kept in their original combinations/groups, and not mixed together.
3. Remove the piston rings using piston ring expander.
4. Remove the oil ring by hand.
   Note:
   Arrange the removed piston rings in proper order, to prevent confusion.
5. Remove the snap ring.

MECHANICAL(STI) > Cylinder Block

ASSEMBLY



(1) Top ring	(5) Side mark	***Tightening torque: N·m (kgf-m, ft-lb)***
(2) Second ring	(6) Connecting rod	***T: 52 (5.3, 38.4)***
(3) Oil ring	(7) Connecting rod bearing	
(4) Snap ring	(8) Connecting rod cap	

1. Apply engine oil to the surface of the connecting rod bearings, and install the connecting rod bearings on connecting rods and connecting rod caps.
2. Position each connecting rod with the side with a side mark facing forward, and install it.
3. Attach the connecting rod cap and tighten it with connecting rod bolt. Make sure the arrow on connecting rod cap faces the front during installation.
   Note:
   - **Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.**
   - **When tightening the connecting rod bolts, apply oil on the threads.**

Tightening torque:

52 N·m (5.3 kgf-m, 38.4 ft-lb)

4. Install the oil ring upper rail, expander and lower rail by hand.
5. Install the second ring using piston ring expander.

   Note:

   Assemble so that the piston ring mark "R" faces the top side of the piston.
6. Install the top ring using piston ring expander.

   Note:

   Assemble so that the piston ring mark "RV" faces the top side of the piston.

INSPECTION

1. CYLINDER BLOCK

1. Check for cracks or damage. Use liquid penetrant tester on the important sections to check for fissures. Check that there are no marks of gas leaking or water leaking on gasket installing surface.
2. Check the oil passages for clogging.
3. Inspect the cylinder head surface that mates with cylinder block for warping by using a straight edge, and correct by grinding if necessary.

   Warping limit:

   0.025 mm (0.0010 in)

   Grinding limit:

   0.1 mm (0.0039 in)

   Standard height of cylinder block:

   201.0 mm (7.9134 in)

2. CYLINDER AND PISTON

1. The cylinder bore size is stamped on the front upper face of the cylinder block.

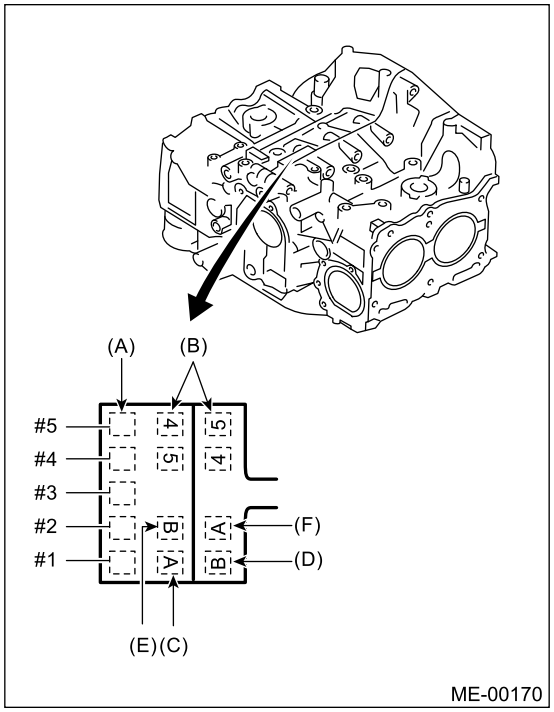
   Note:

   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as guide lines in selecting a standard piston.**

   Standard diameter:

   A: 99.505 — 99.515 mm (3.9175 — 3.9179 in)

   B: 99.495 — 99.505 mm (3.9171 — 3.9175 in)



(A) Main journal size mark

(B) Cylinder block (RH) – (LH) combination mark

(C) #1 cylinder bore size mark

(D) #2 cylinder bore size mark

(E) #3 cylinder bore size mark

(F) #4 cylinder bore size mark

2. Measure inner diameter of each cylinder.

Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights as shown in the figure, using a cylinder bore gauge.

Note:

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

Cylindricality:

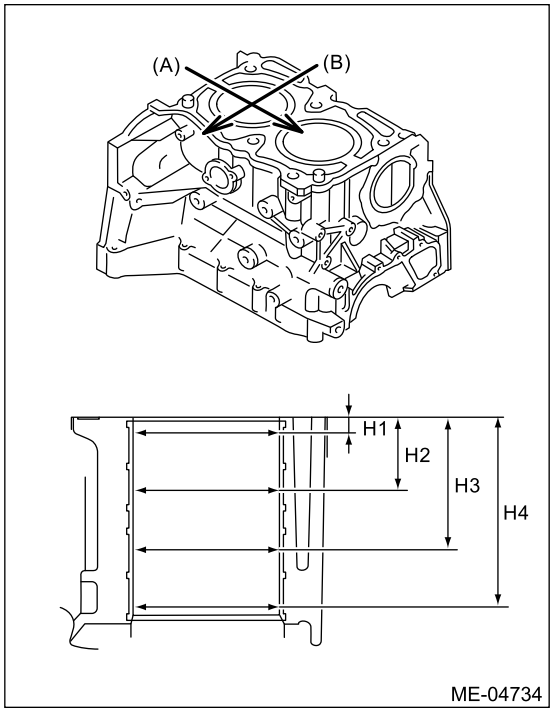
Limit

0.015 mm (0.0006 in)

Out-of-roundness:

Limit

0.010 mm (0.0004 in)



(A) Piston pin direction
(B) Thrust direction
H1: 10 mm (0.3937 in)
H2: 45 mm (1.7717 in)
H3: 80 mm (3.1496 in)
H4: 115 mm (4.5276 in)

3. When the piston is to be replaced due to general or cylinder wear, select a suitable sized piston by measuring the piston clearance.

4. Measure outer diameter of each piston.
Measure the outer diameter of each piston at the height as shown in the figure. (Thrust direction)

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

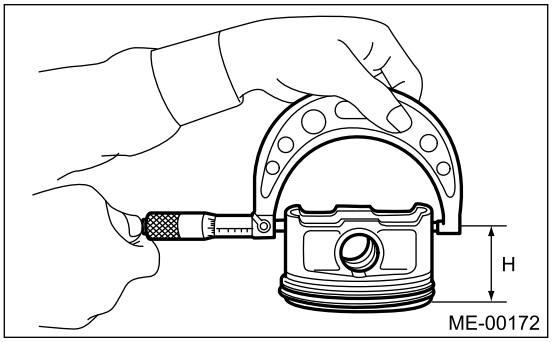
Piston grade point H:
38.2 mm (1.5039 in)

Piston outer diameter:

Standard
A: 99.505 — 99.515 mm (3.9175 — 3.9179 in)
B: 99.495 — 99.505 mm (3.9171 — 3.9175 in)

0.25 mm (0.0098 in) oversize
99.745 — 99.765 mm (3.9270 — 3.9278 in)

0.50 mm (0.0197 in) oversize
99.995 — 100.015 mm (3.9368 — 3.9376 in)



5. Calculate the clearance between cylinder and piston.

Note:

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

Clearance between cylinder and piston at 20°C (68°F):

Standard

−0.010 — 0.010 mm (−0.0004 — 0.0004 in)

6. Boring and honing

(1) If any of the measured value of cylindricality, out-of-roundness or cylinder-to-piston clearance is out of standard or if there is any damage on the cylinder wall, rebore it to replace with an oversize piston.

Caution:

When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and replaced with oversize pistons.

(2) If the cylinder inner diameter exceeds the limit after boring and honing, replace the cylinder block.

Note:

Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, when measuring the cylinder diameter, wait until it has cooled to room temperature.

Cylinder inner diameter boring limit (diameter):

To 100.005 mm (3.9372 in)

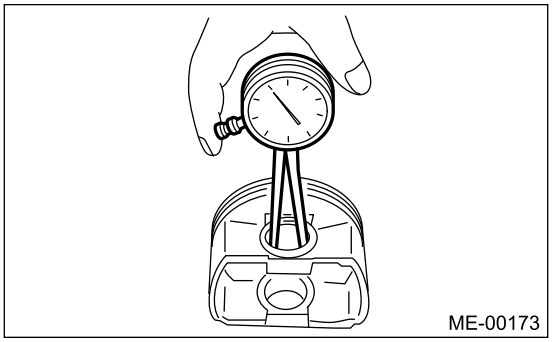
3. PISTON AND PISTON PIN

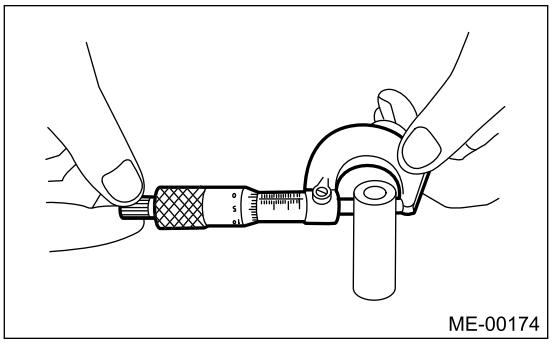
1. Check the piston and piston pin for damage, cracks or wear. Replace if faulty.
2. Check the piston ring groove for wear or damage. Replace if faulty.
3. Make sure that the piston pin can be inserted into the piston pin hole with a thumb at 20°C (68°F). Replace if faulty.

Clearance between piston pin hole and piston pin:

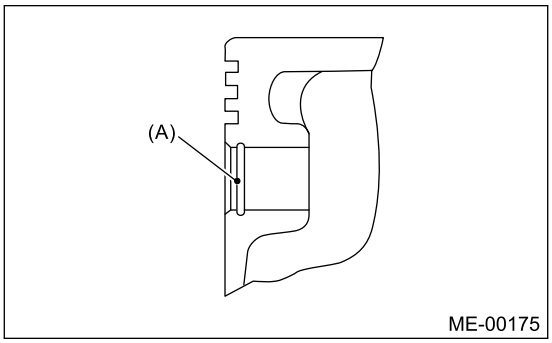
Standard

0.004 — 0.008 mm (0.0002 — 0.0003 in)





4. Check the snap ring installation groove (A) on the piston for burr. If necessary, remove burr from the groove so that the piston pin can lightly move.



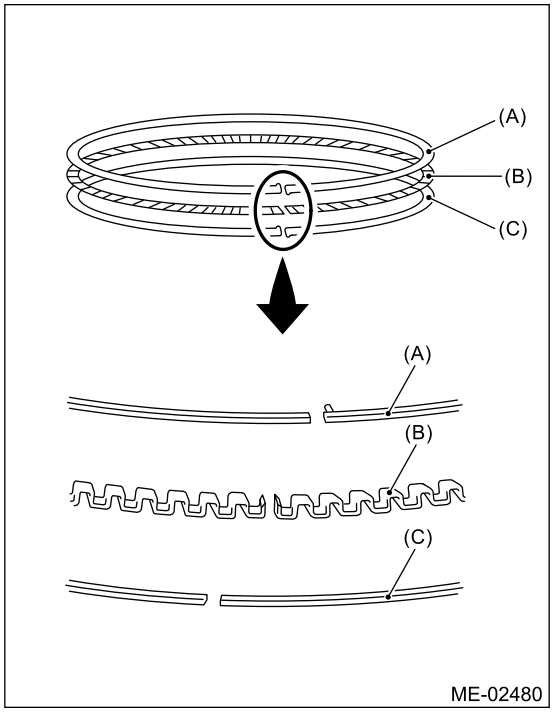
5. Check the snap ring for distortion, cracks and wear.

4. PISTON RING

1. If the piston ring is broken, damaged or worn, or if its tension is insufficient, or when the piston is replaced, replace the piston ring with a new part of the same size as piston.

Note:

- **The top ring and second ring have the mark to determine the direction for installing. When installing the ring to piston, face marks to the top side.**
- **Oil ring consists of the upper rail, expander and lower rail. When installing oil ring on piston, be careful of the direction of each rail.**



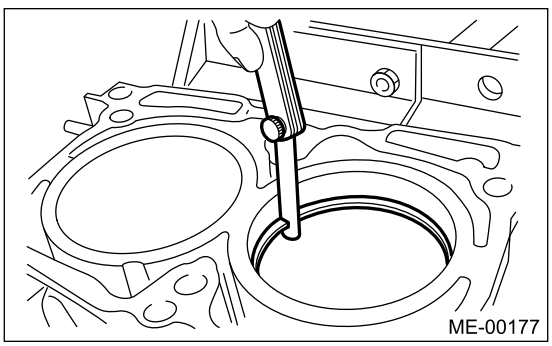
(A) Upper rail

(B) Expander

(C) Lower rail

2. Using the piston, insert the piston ring and oil ring into the cylinder block so that they are perpendicular to the cylinder wall, and measure the piston ring gap using a thickness gauge.

		Standard mm (in)
Piston ring gap	Top ring	0.23 — 0.28 (0.0091 — 0.0110)
	Second ring	0.37 — 0.52 (0.015 — 0.0205)
	Oil ring rail	0.20 — 0.50 (0.0079 — 0.0197)

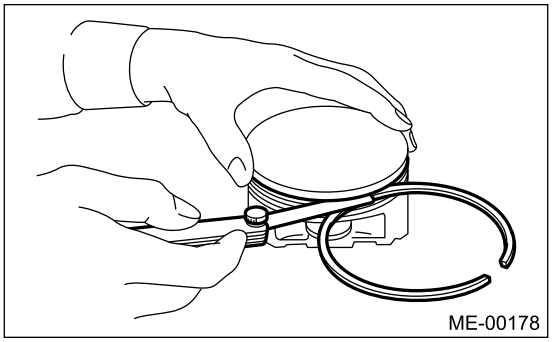


3. Fit the piston ring straight into the piston ring groove, then measure the clearance between piston ring and piston ring groove with a thickness gauge.

Note:

Before measuring the clearance, clean the piston ring groove and piston ring.

		Standard mm (in)
Clearance between piston ring and piston ring groove	Top ring	0.040 — 0.080 (0.0016 — 0.0031)
	Second ring	0.030 — 0.070 (0.0012 — 0.0028)

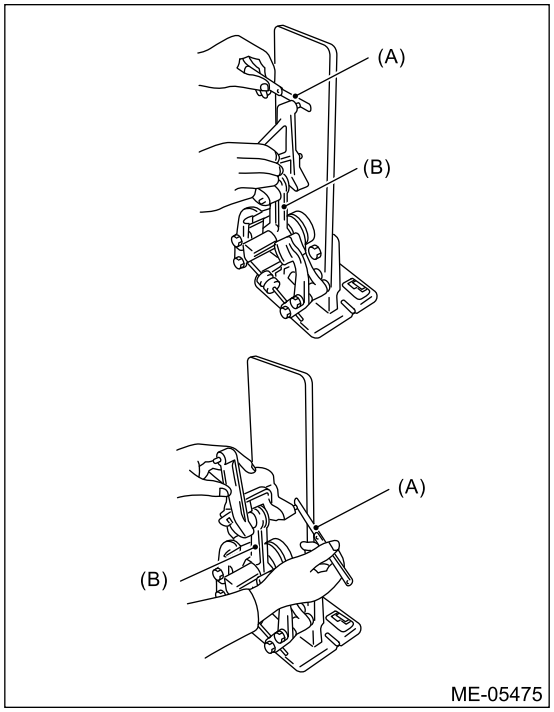


5. CONNECTING ROD

1. Replace the connecting rod, if the large or small end thrust surface is damaged.
2. Check for bend or twist using a connecting rod aligner. Replace the connecting rod if the bend or twist exceeds the limit.

Limit of bend or twist per 100 mm (3.9370 in) in length:

0.10 mm (0.0039 in)



(A) Thickness gauge

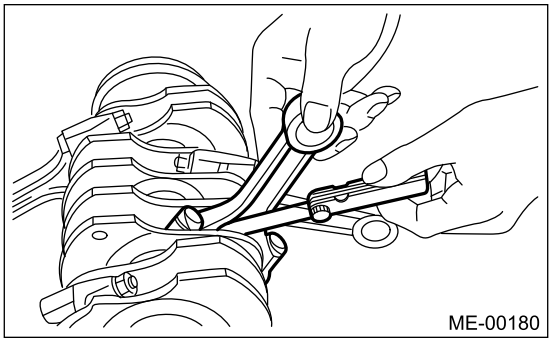
(B) Connecting rod

3. Install the connecting rod with bearings attached to the crankshaft, and using a thickness gauge, measure the thrust clearance. If the thrust clearance exceeds the standard or uneven wear is found, replace the connecting rod.

Connecting rod thrust clearance:

Standard

0.070 — 0.330 mm (0.0028 — 0.0130 in)



4. Inspect the connecting rod bearing for scar, peeling, seizure, melting, wear, etc.
5. Measure the oil clearance on each connecting rod bearing using plastigauge. If any oil clearance is not within the standard, replace the defective bearing with a new part of standard size or undersize as necessary.

Connecting rod oil clearance:

Standard

0.017 — 0.045 mm (0.0007 — 0.0018 in)

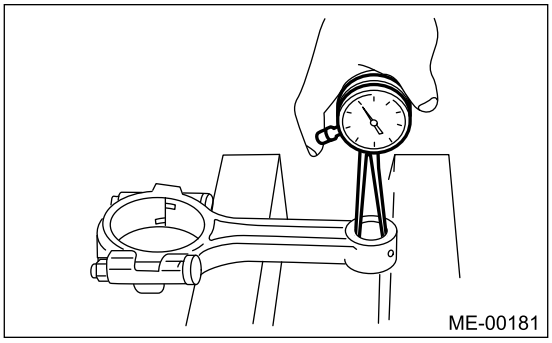
Unit: mm (in)		
Bearing	**Bearing size (Thickness at center)**	**Outer diameter of crank pin**
Standard	1.490 — 1.506 (0.0587 — 0.0593)	51.976 — 52.000 (2.0463 — 2.0472)
0.03 (0.0012) Undersize	1.504 — 1.512 (0.0592 — 0.0595)	51.954 — 51.970 (2.0454 — 2.0461)
0.05 (0.0020) Undersize	1.514 — 1.522 (0.0596 — 0.0599)	51.934 — 51.950 (2.0447 — 2.0453)
0.25 (0.0098) Undersize	1.614 — 1.622 (0.0635 — 0.0639)	51.734 — 51.750 (2.0368 — 2.0374)

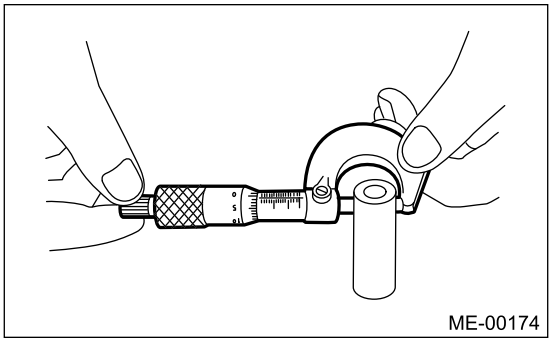
6. Inspect the bushing at connecting rod small end, and replace the connecting rod if it is worn or damaged.
7. Measure the piston pin clearance at connecting rod small end. If the measured value is not within the standard, replace the connecting rod and piston pin as a set.

Clearance between piston pin and bushing:

Standard

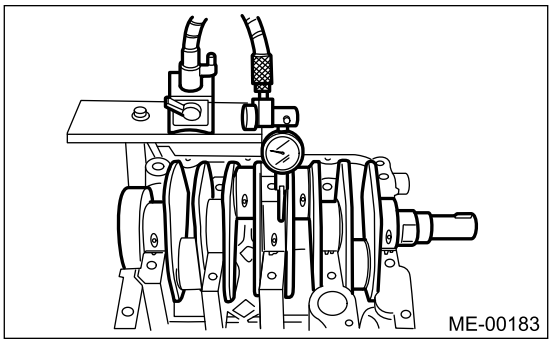
0 — 0.022 mm (0 — 0.0009 in)





6. CRANKSHAFT AND CRANKSHAFT BEARING

1. Clean the crankshaft completely, and check it for cracks using liquid penetrant tester. If defective, replace the crankshaft.
2. Measure warping of the crankshaft. If it exceeds the limit, correct or replace it.
   Note:
   If a suitable V-block is not available, using just the #1 and #5 crankshaft bearings on cylinder block, position the crankshaft on cylinder block. Then, measure the crankshaft bend using a dial gauge.
   Crankshaft bend limit:
   0.035 mm (0.0014 in)



3. Inspect the crank journal and crank pin for wear. If they are not within the standard, replace the bearing with a suitable (undersize) one, and replace or grind to correct the crankshaft as necessary. When grinding the crank journal or crank pin, finish them to the specified dimensions according to the undersize bearing to be used.
   Crank pin:
   Cylindricality
   Limit
   0.004 mm (0.0002 in)
   Out-of-roundness
   Limit
   0.003 mm (0.0001 in)
   Grinding limit (dia.)
   To 51.734 mm (2.0368 in)
   Crank journal:
   Cylindricality
   Limit
   0.006 mm (0.0002 in)

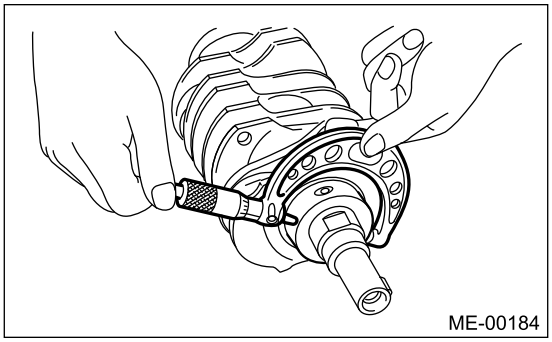
Out-of-roundness

Limit

0.005 mm (0.0002 in)

Grinding limit (dia.)

To 59.742 mm (2.3520 in)



Unit: mm (in)

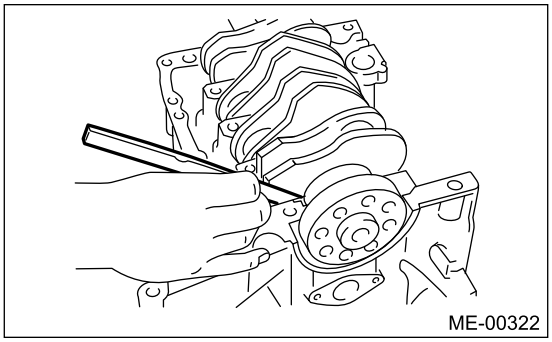
		Crank journal diameter		Crank pin outer diameter
		#1, #3	#2, #4, #5	
Standard	Journal O.D.	59.984 — 60.008 (2.3616 — 2.3625)	59.984 — 60.008 (2.3616 — 2.3625)	51.976 — 52.000 (2.0463 — 2.0472)
	Bearing size (Thickness at center)	1.998 — 2.015 (0.0787 — 0.0793)	2.000 — 2.017 (0.0787 — 0.0794)	1.490 — 1.506 (0.0587 — 0.0593)
0.03 (0.0012) Undersize	Journal O.D.	59.962 — 59.978 (2.3607 — 2.3613)	59.962 — 59.978 (2.3607 — 2.3613)	51.954 — 51.970 (2.0454 — 2.0461)
	Bearing size (Thickness at center)	2.017 — 2.020 (0.0794 — 0.0795)	2.019 — 2.022 (0.0795 — 0.0796)	1.504 — 1.512 (0.0592 — 0.0595)
0.05 (0.0020) Undersize	Journal O.D.	59.942 — 59.958 (2.3599 — 2.3605)	59.942 — 59.958 (2.3599 — 2.3605)	51.934 — 51.950 (2.0447 — 2.0453)
	Bearing size (Thickness at center)	2.027 — 2.030 (0.0798 — 0.0799)	2.029 — 2.032 (0.0799 — 0.0800)	1.514 — 1.522 (0.0596 — 0.0599)
0.25 (0.0098) Undersize	Journal O.D.	59.742 — 59.758 (2.3520 — 2.3527)	59.742 — 59.758 (2.3520 — 2.3527)	51.734 — 51.750 (2.0368 — 2.0374)
	Bearing size (Thickness at center)	2.127 — 2.130 (0.0837 — 0.0839)	2.129 — 2.132 (0.0838 — 0.0839)	1.614 — 1.622 (0.0635 — 0.0639)

4. Use a thickness gauge to measure the thrust clearance of crankshaft at #5 crank journal bearing. If clearance exceeds the standard, replace the bearing.

Crankshaft thrust clearance:

Standard

0.030 — 0.115 mm (0.0012 — 0.0045 in)



5. Inspect individual crankshaft bearings for signs of flaking, seizure, melting and wear.
6. Measure the oil clearance on each crankshaft bearing using plastigauge. If the measured value is out of standard, replace the defective bearing with an undersize one, and replace or grind to correct the crankshaft as necessary.

Crankshaft oil clearance:

Standard

0.010 — 0.030 mm (0.0004 — 0.0012 in)

SPECIFICATION

Refer to “Cylinder Head” for removal and installation procedures of the intake and exhaust valves. Ref. to MECHANICAL(STI)>Cylinder Head>REMOVAL. Ref. to MECHANICAL(STI)>Cylinder Head>INSTALLATION.

SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of pistons. Ref. to MECHANICAL(STI)>Cylinder Block>REMOVAL. Ref. to MECHANICAL(STI)>Cylinder Block>INSTALLATION.

SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of connecting rod. Ref. to MECHANICAL(STI)>Cylinder Block>REMOVAL. Ref. to MECHANICAL(STI)>Cylinder Block>INSTALLATION.

SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of the crankshaft. Ref. to MECHANICAL(STI)>Cylinder Block>REMOVAL. Ref. to MECHANICAL(STI)>Cylinder Block>INSTALLATION.

INSPECTION

Note:
The "RANK" shown in the chart shows the possibilities of the cause of trouble in order from "Very often" to "Rarely".
A — Very often
B — Sometimes
C — Rarely

Symptoms	Problem parts etc.	Possible cause	RANK
1. Engine does not start.			
1) Starter does not turn.	Starter	Defective battery-to-starter harness	B
		Defective starter switch	C
		Defective clutch start switch	C
		Defective starter	B
	Battery	Improper connection of terminal	A
		Run-down battery	A
		Defective charging system	B
	Friction	Seizure of crankshaft and connecting rod bearing	C
		Seized camshaft	C
		Seized or stuck piston and cylinder	C
	Immobilizer system Ref. to IMMOBILIZER (DIAGNOSTICS)>Basic Diagnostic Procedure.		A
2) Initial combustion does not occur.	Starter	Defective starter	C
	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Fuel line	Defective fuel pump and relay	A
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing belt	Degradation, etc.	B
		Defective timing	B
	Compression	Incorrect valve clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C

Symptoms	Problem parts etc.	Possible cause	RANK
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
3) Initial combustion occurs.	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Defective intake manifold gasket	B
		Defective throttle body gasket	B
	Fuel line	Defective fuel pump and relay	C
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing belt	Degradation, etc.	B
		Defective timing	B
	Compression	Incorrect valve clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
4) Engine stalls after initial combustion.	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	B
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	C
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Dirty air cleaner element	C
		Air by-pass valve malfunction	C
	Fuel line	Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing belt	Degradation, etc.	B
		Defective timing	B
	Compression	Incorrect valve clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C

Symptoms	Problem parts etc.	Possible cause	RANK
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
2. Rough idle and engine stall	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	A
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	C
		Loosened oil filler cap	B
		Dirty air cleaner element	C
		Air by-pass valve malfunction	B
	Fuel line	Defective fuel pump and relay	C
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing belt	Defective timing	C
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective cylinder head gasket	B
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	B
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Lubrication system	Incorrect oil pressure	B
		Defective rocker cover gasket	C
	Cooling system	Over-heating	C
	Other	Evaporative emission control system malfunction	A
		Stuck or damaged throttle valve	B
3. Low output, hesitation and poor	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A

Symptoms	Problem parts etc.	Possible cause	RANK
acceleration	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	B
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	B
		Loosened oil filler cap	B
		Dirty air cleaner element	A
		Air by-pass valve malfunction	B
	Fuel line	Defective fuel pump and relay	B
		Clogged fuel line	B
		Lack of fuel or insufficient fuel	C
	Timing belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective cylinder head gasket	B
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Lubrication system	Incorrect oil pressure	B
	Cooling system	Over-heating	C
		Over-cooling	C
	Other	Evaporative emission control system malfunction	A
4. Surging	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	A
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	B
		Loosened oil filler cap	B
		Dirty air cleaner element	B
		Air by-pass valve malfunction	B

Symptoms	Problem parts etc.	Possible cause	RANK
	Fuel line	Defective fuel pump and relay	B
		Clogged fuel line	B
		Lack of fuel or insufficient fuel	C
	Timing belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	C
5. Engine does not return to idle.	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked vacuum hose	A
	Other	Stuck or damaged throttle valve	A
6. Dieseling (run-on)	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	B
7. After burning in exhaust system	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	C
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	B
		Defective PCV valve	B
		Loosened oil filler cap	C
		Air by-pass valve malfunction	C
	Timing belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C

Symptoms	Problem parts etc.	Possible cause	RANK
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C
	Other	Evaporative emission control system malfunction	C
8. Knocking	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened oil filler cap	B
	Timing belt	Defective timing	B
	Compression	Incorrect valve clearance	C
		Incorrect valve timing	B
	Cooling system	Over-heating	A
9. Excessive engine oil consumption	Intake system	Loosened or cracked PCV hose	A
		Defective PCV valve	B
		Loosened oil filler cap	C
	Compression	Defective valve stem	A
		Worn or stuck piston rings, cylinder and piston	A
	Lubrication system	Loosened oil pump attaching bolts and defective gasket	B
		Defective oil filter gasket	B
		Defective crankshaft oil seal	B
		Defective rocker cover gasket	B
		Loosened oil drain plug or defective gasket	B
		Loosened oil pan fitting bolts or defective oil pan	B
10. Excessive fuel consumption	Engine control system Ref. to ENGINE (DIAGNOSTICS) (STI)>Basic Diagnostic Procedure.		A
	Intake system	Dirty air cleaner element	A
	Timing belt	Defective timing	B
	Compression	Incorrect valve clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	B

Symptoms	Problem parts etc.	Possible cause	RANK
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	B
		Incorrect valve timing	B
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C

INSPECTION

Type of sound	Condition	Possible cause
Regular clicking sound	Sound increases as engine speed increases.	• Valve mechanism is defective • Incorrect valve clearance • Worn camshaft • Broken valve spring
Heavy and dull clank	Oil pressure is low.	• Worn crankshaft main bearing • Worn connecting rod bearing (large end)
	Oil pressure is normal.	• Loosened flywheel mounting bolt • Damaged engine mounting
High-pitched clank	Sound is noticeable when accelerating with an overload condition.	• Ignition timing advanced • Accumulation of carbon inside combustion chamber • Wrong heat range of spark plug • Improper octane value gasoline
Clank noise when engine speed is between 1,000 and 2,000 r/min	Sound is reduced when the fuel injector connector of the noisy cylinder is disconnected.*	• Worn crankshaft main bearing • Worn connecting rod bearing (large end)
Knocking sound when engine is operating under idling speed and engine is warm	Sound is reduced when the fuel injector connector of the noisy cylinder is disconnected.*	• Worn cylinder liner and piston ring • Broken or stuck piston ring • Worn piston pin and hole at piston end of connecting rod
	Sound is not reduced if each fuel injector connector is disconnected in turn.*	• Unusually worn valve lifter • Worn cam sprocket • Worn camshaft journal bore in cylinder head
Squeaky sound	—	• Insufficient generator lubrication
Rubbing sound	—	• Poor contact of generator brush and rotor
Gear scream when starting engine	—	• Defective ignition starter switch • Worn gear and starter pinion
Sound like polishing glass with a dry cloth	—	• Loose V-belt • Defective water pump shaft
Hissing sound	—	• Insufficient compression • Air leakage in air intake system, hose, connection or manifold
Timing belt noise	—	• Loose timing belt • Timing belt contacting with adjacent part
Valve noise	—	• Incorrect valve clearance

* When disconnecting the fuel injector connector, the malfunction indicator light illuminates and DTC is stored in ECM memory.
Therefore, perform the Clear Memory Mode Ref. to ENGINE (DIAGNOSTICS)(STI)>Clear Memory Mode>OPERATION. and inspection mode Ref. to ENGINE (DIAGNOSTICS)(STI)>Inspection Mode>PROCEDURE. after connecting the fuel injector connector.

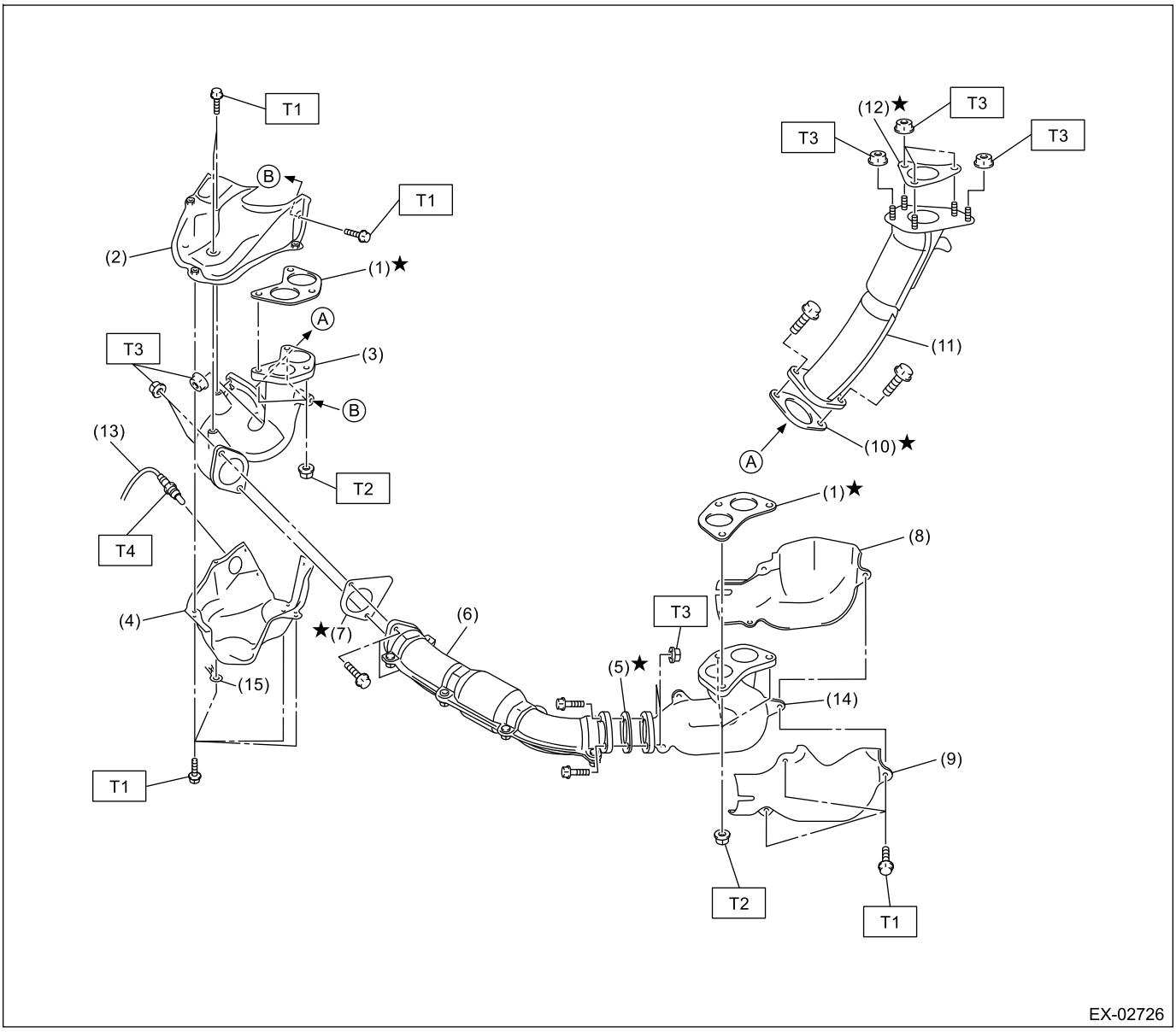
EXHAUST(STI)

EX(STI)

1. General Description
2. Front Exhaust Pipe
3. Center Exhaust Pipe
4. Joint Pipe
5. Rear Exhaust Pipe
6. Muffler

COMPONENT

1. FRONT EXHAUST PIPE

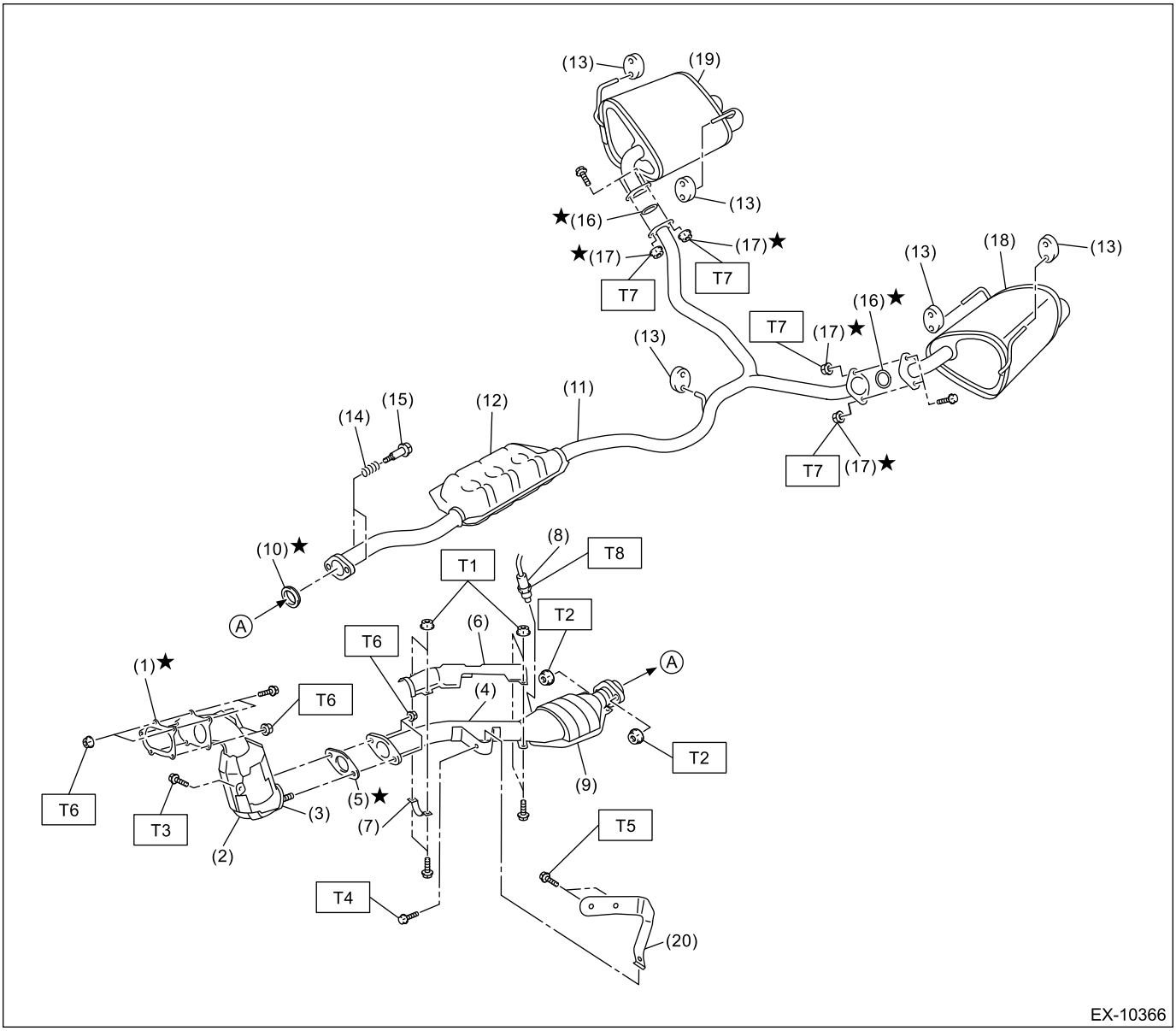


EX-02726

(1) Gasket	(8) Exhaust manifold LH inner cover	(15) Ground cable
(2) Exhaust manifold RH upper cover	(9) Exhaust manifold LH outer cover	
(3) Exhaust manifold RH	(10) Gasket	***Tightening torque: N·m (kgf-m, ft-lb)***
(4) Exhaust manifold RH lower cover	(11) Joint pipe	***T1: 19 (1.9, 14.0)***
(5) Gasket	(12) Gasket	***T2: 40 (4.1, 29.5)***
(6) Front exhaust pipe	(13) Front oxygen (A/F) sensor	***T3: 42.5 (4.3, 31.3)***
(7) Gasket	(14) Exhaust manifold LH	***T4: Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Front***

Oxygen (A/F) Sensor>INSTALLATION.

2. CENTER AND REAR EXHAUST PIPE, AND MUFFLER



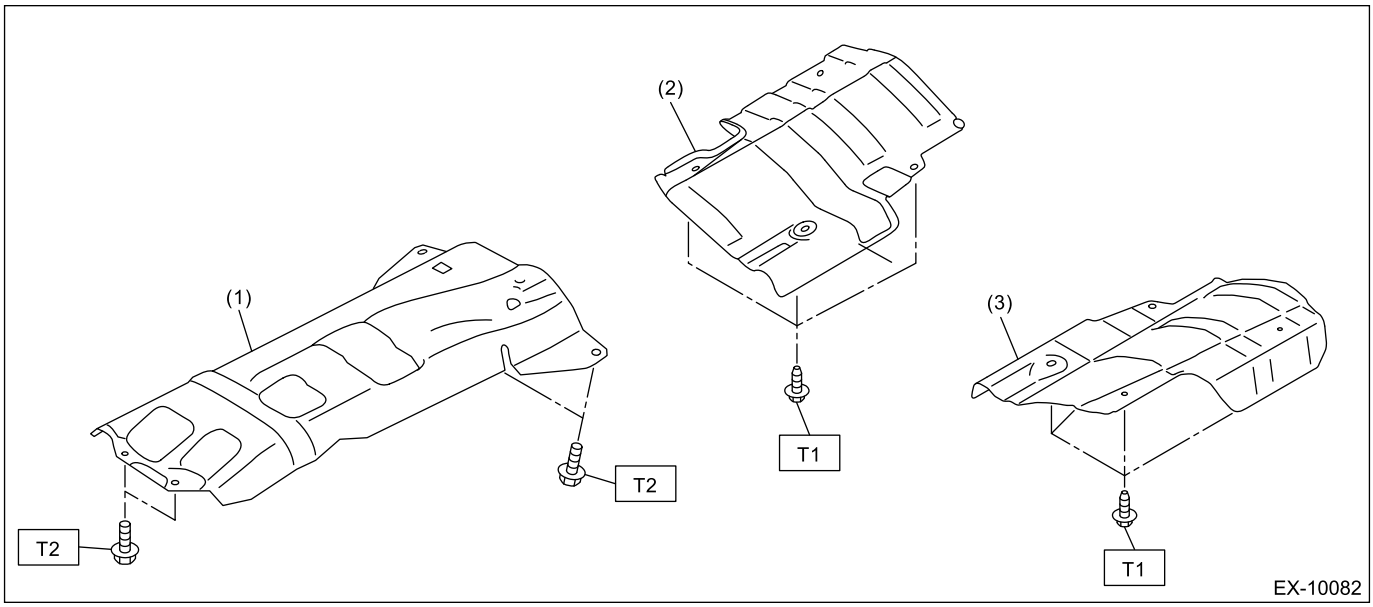
(1) Gasket	(12) Chamber	***Tightening torque: N·m (kgf-m, ft-lb)***
(2) Front catalytic converter	(13) Cushion rubber	***T1: 13 (1.3, 9.6)***
(3) Center exhaust pipe (front)	(14) Spring	***T2: 18 (1.8, 13.3)***
(4) Center exhaust pipe (rear)	(15) Bolt	***T3: 30 (3.1, 22.1)***
(5) Gasket	(16) Gasket	***T4: 35 (3.6, 25.8)***
(6) Center exhaust pipe upper cover	(17) Self-locking nut	***T5: 40 (4.1, 29.5)***
(7) Clamp	(18) Muffler LH	***T6: 42.5 (4.3, 31.3)***
(8) Rear oxygen sensor	(19) Muffler RH	***T7: 48 (4.9, 35.4)***
(9) Rear catalytic converter	(20) Hanger bracket	***T8: Ref. to FUEL INJECTION (FUEL***

SYSTEMS)(STI)>Rear Oxygen Sensor>INSTALLATION.

(10) Gasket

(11) Rear exhaust pipe

3. HEAT SHIELD COVER



(1) Center exhaust cover

(2) Rear exhaust cover RH

(3) Rear exhaust cover LH

Tightening torque: N·m (kgf-m, ft-lb)

T1: 10 (1.0, 7.4)

T2: 18 (1.8, 13.3)

EXHAUST(STI) > General Description

CAUTION

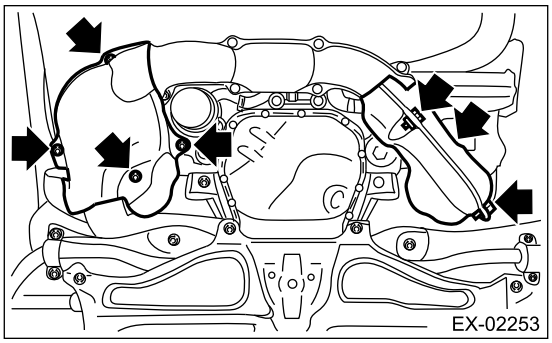
- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.

- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- If any grease adheres to the exhaust pipe, wipe it off. Otherwise a fire may happen.

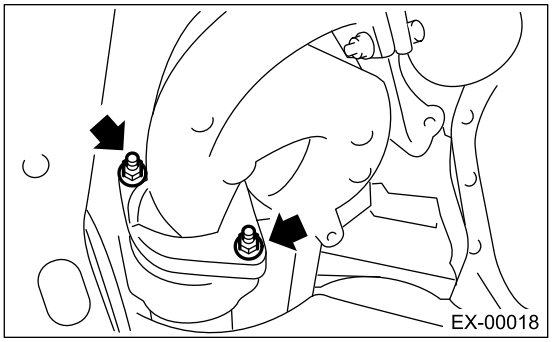
REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

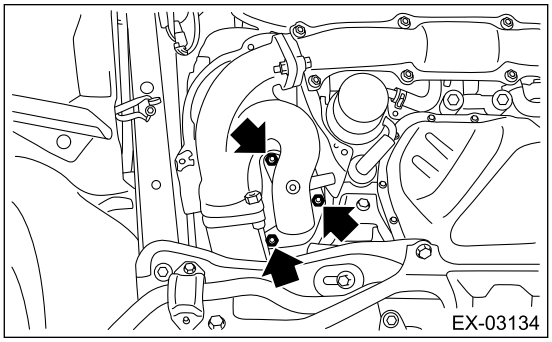
1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Remove the front oxygen (A/F) sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Front Oxygen (A/F) Sensor>REMOVAL.
5. Remove the exhaust manifold RH lower cover and exhaust manifold LH cover.

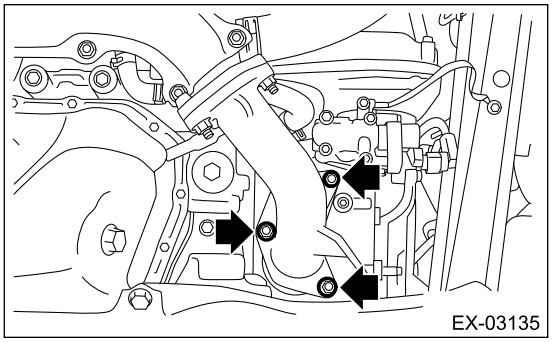


6. Remove the bolts and nuts which hold joint pipe onto exhaust manifold RH.



7. While holding the front exhaust pipe with one hand, remove the nuts which hold the exhaust manifold to the cylinder head exhaust port and remove the front exhaust pipe.

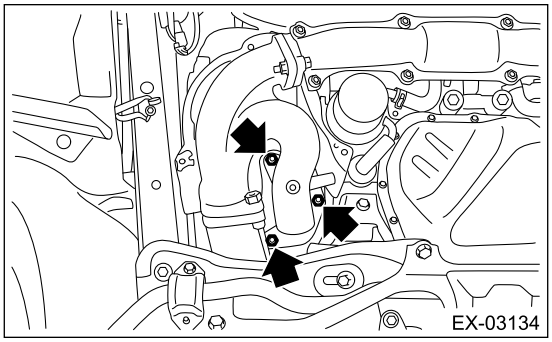


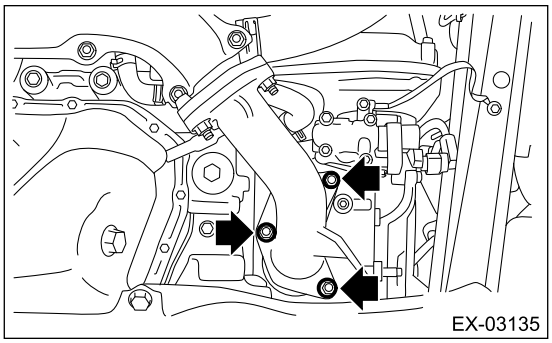


EXHAUST(STI) > Front Exhaust Pipe

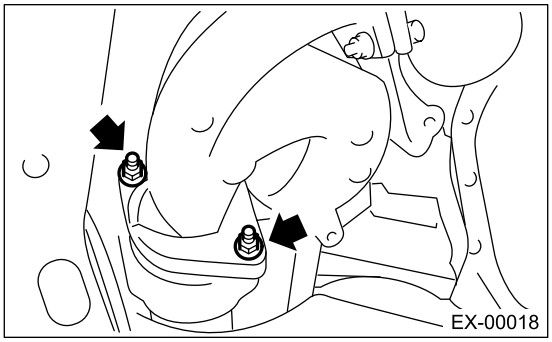
INSTALLATION

1. Install the front exhaust pipe.
   Note:
   Use a new gasket.
   Tightening torque:
   40 N·m (4.1 kgf-m, 29.5 ft-lb)

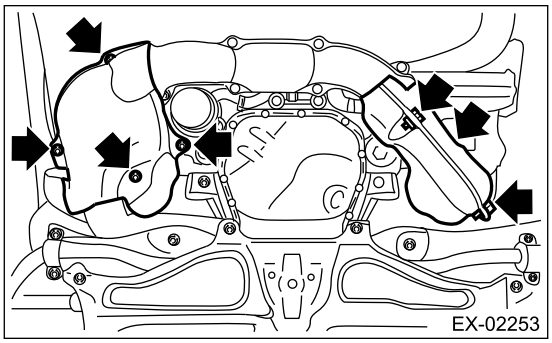




2. Install the joint pipe to the exhaust manifold RH.
   Note:
   Use a new gasket.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



3. Install the exhaust manifold RH lower cover and exhaust manifold LH cover.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)

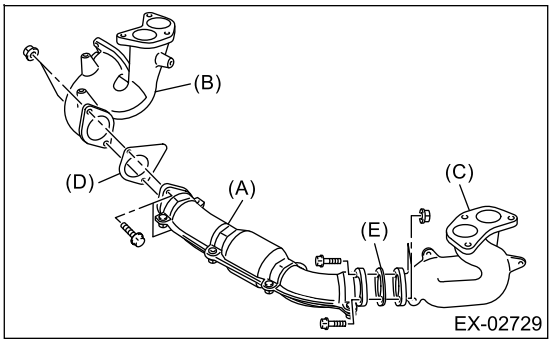


4. Install the front oxygen (A/F) sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Front Oxygen (A/F) Sensor>INSTALLATION.
5. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
6. Lower the vehicle.
7. Connect the battery ground terminal.

EXHAUST(STI) > Front Exhaust Pipe

DISASSEMBLY

1. Remove the exhaust manifold RH upper cover.
2. Remove the exhaust manifold RH and the exhaust manifold LH from the front exhaust pipe.



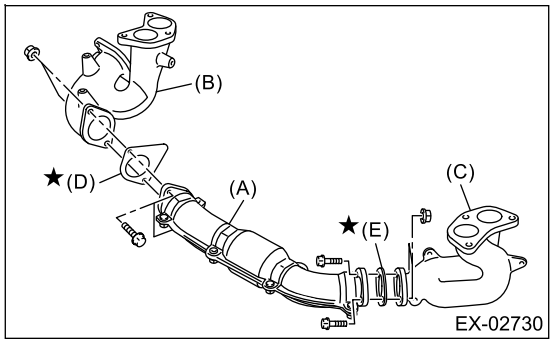
(A) Front exhaust pipe
(B) Exhaust manifold RH
(C) Exhaust manifold LH
(D) Gasket

(E) Gasket

EXHAUST(STI) > Front Exhaust Pipe

ASSEMBLY

1. Install the exhaust manifold RH and the exhaust manifold LH to the front exhaust pipe.
   Note:
   Use a new gasket.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



(A) Front exhaust pipe
(B) Exhaust manifold RH
(C) Exhaust manifold LH
(D) Gasket
(E) Gasket

2. Install the exhaust manifold RH upper cover.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)

EXHAUST(STI) > Front Exhaust Pipe

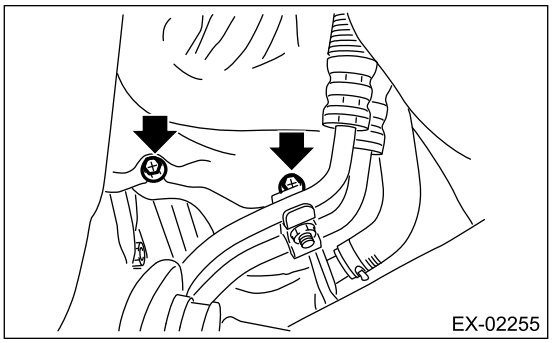
INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

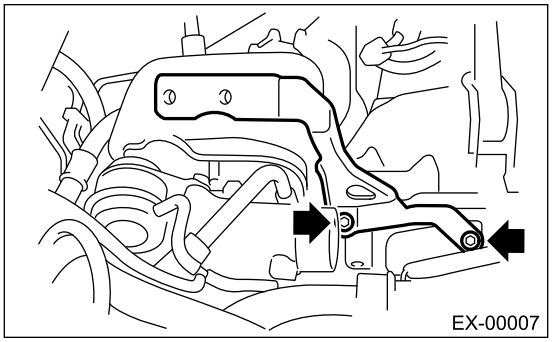
REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

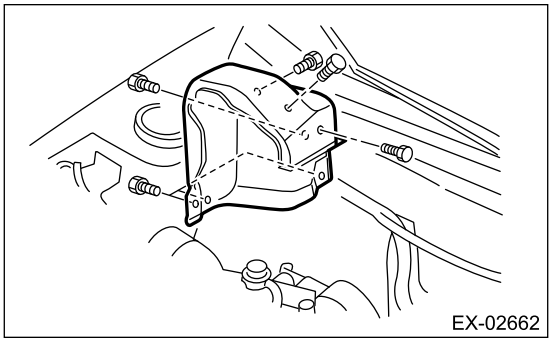
1. Disconnect the ground cable from battery.
2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
3. Lift up the vehicle.
4. Remove the transmission under cover.
5. Remove the bolts which secure the lower side of the turbocharger lower cover.



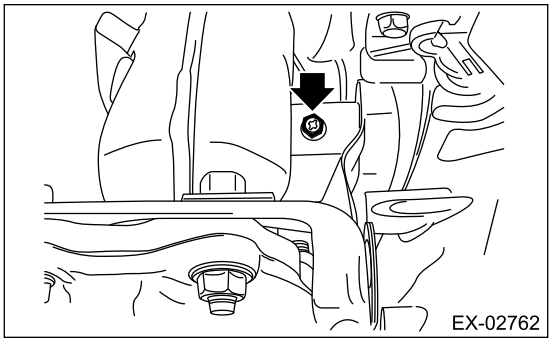
6. Lower the vehicle.
7. Remove the intercooler stay RH No. 2.



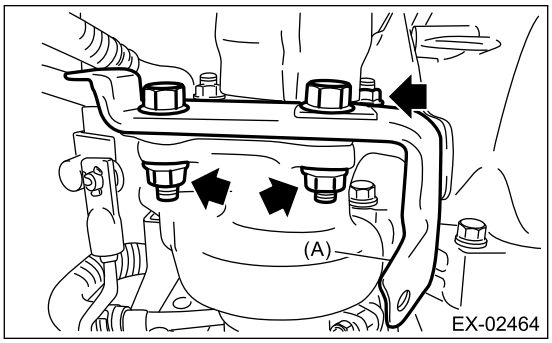
8. Remove the turbocharger upper cover.



9. Remove the bolts which hold the upper side of the turbocharger lower cover.

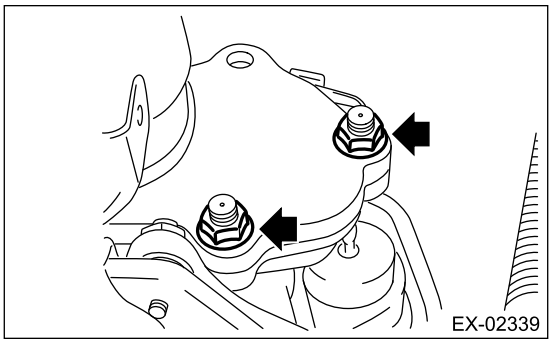


10. Remove the upper side bolts and nuts that hold the center exhaust pipe on the turbocharger, and remove the turbocharger cover stay (A).

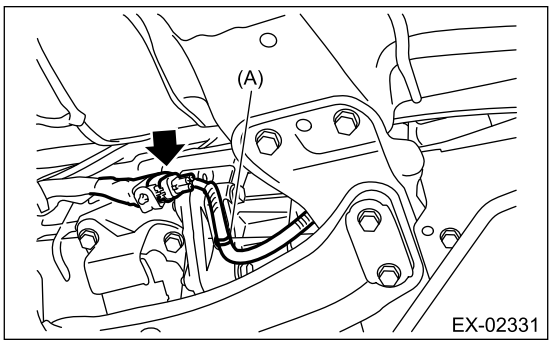


11. Lift up the vehicle.

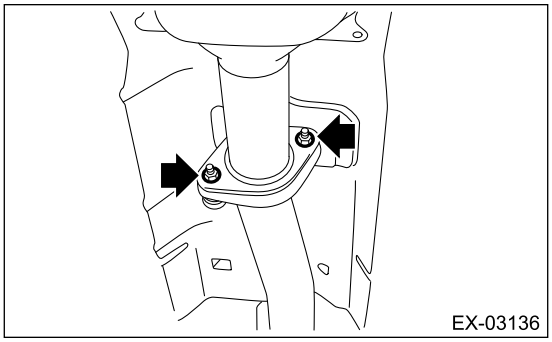
12. Remove the lower side nuts (two places) that hold the center exhaust pipe on the turbocharger.



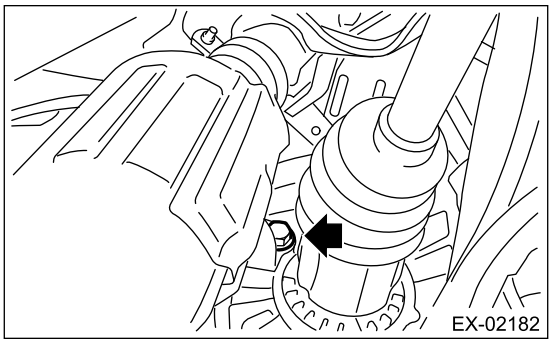
13. Disconnect the connector from the rear oxygen sensor, and remove the clip (A) holding the rear oxygen sensor harness.



14. Remove the rear exhaust pipe from center exhaust pipe.



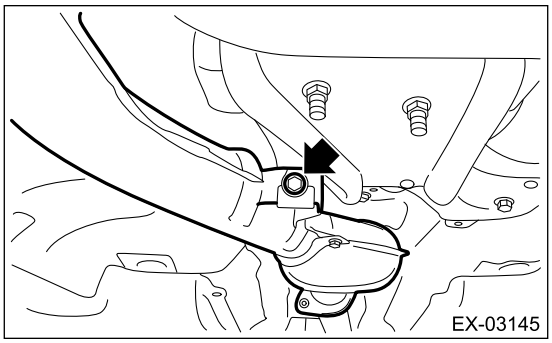
15. Remove the bolt which holds center exhaust pipe to transmission.



16. Remove the bolt which holds center exhaust pipe to hanger bracket, and remove the center exhaust pipe.

Caution:

Be careful not to drop the center exhaust pipe.



17. Remove the turbocharger lower cover.

EXHAUST(STI) > Center Exhaust Pipe

INSTALLATION

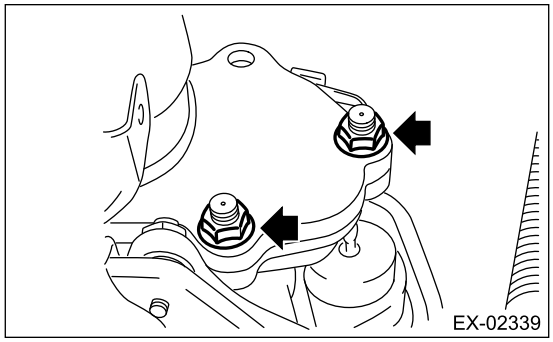
1. Set the turbocharger lower cover, and temporarily tighten the bolts that hold the lower side of the turbocharger lower cover.
2. Install the center exhaust pipe and temporarily tighten the bolt which holds center exhaust pipe to hanger bracket.
3. Temporarily tighten the bolt which holds the center exhaust pipe to the transmission.
4. Install the center exhaust pipe along with the turbocharger cover stay (A) to the turbocharger.

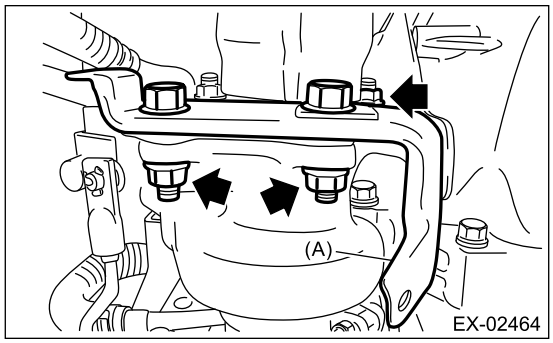
   Note:

   Use a new gasket.

   Tightening torque:

42.5 N·m (4.3 kgf-m, 31.3 ft-lb)





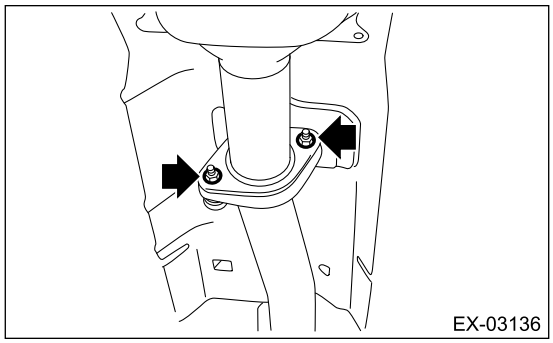
5. Install the rear exhaust pipe to center exhaust pipe.

Note:

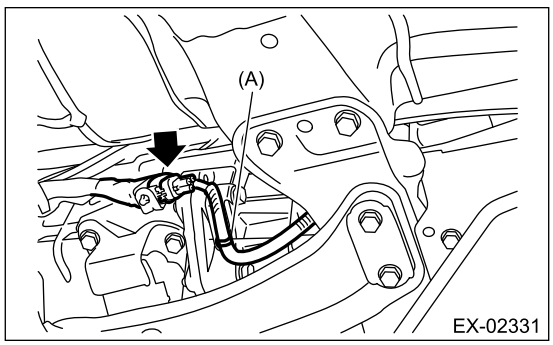
Use a new gasket.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)



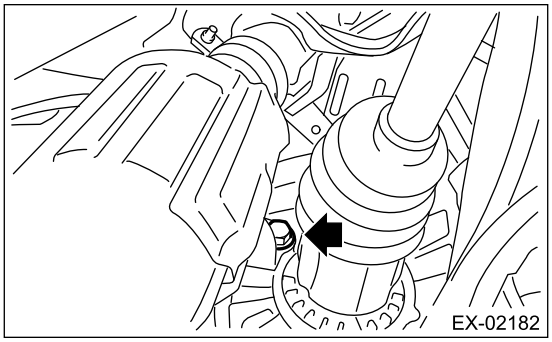
6. Connect the connector to the rear oxygen sensor, and hold the rear oxygen sensor harness with the clip (A).



7. Tighten the bolt which holds center exhaust pipe to transmission.

Tightening torque:

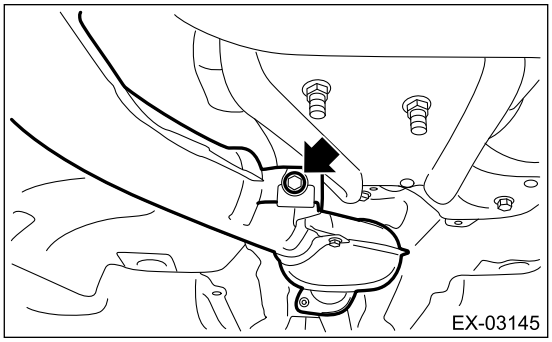
30 N·m (3.1 kgf-m, 22.1 ft-lb)



8. Tighten the bolts which secure the center exhaust pipe to the hanger bracket.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

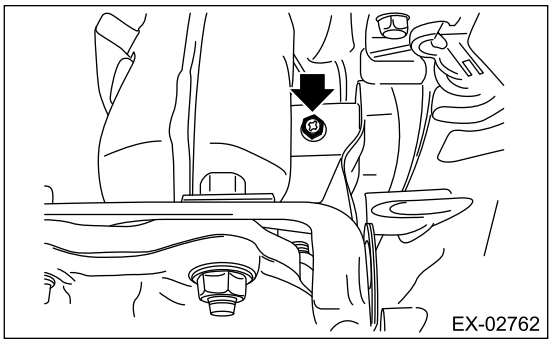


9. Lower the vehicle.

10. Attach the bolt which holds the upper side of the turbocharger lower cover.

Tightening torque:

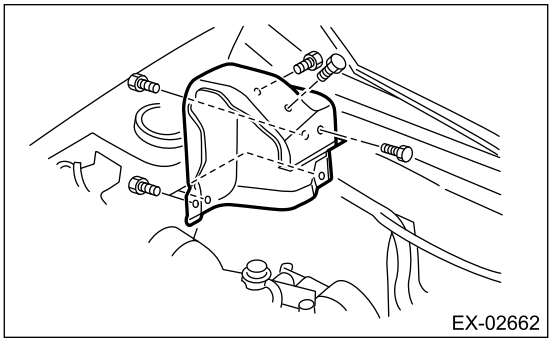
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



11. Attach the turbocharger upper cover.

Tightening torque:

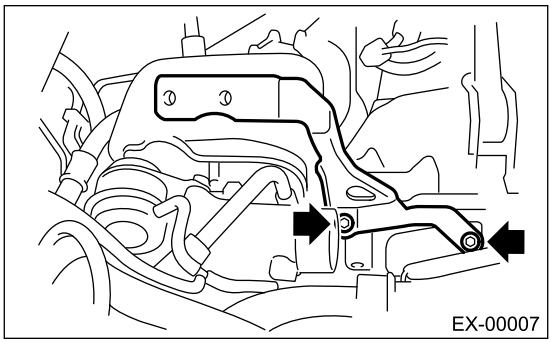
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



12. Install the intercooler stay RH No. 2.

Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)

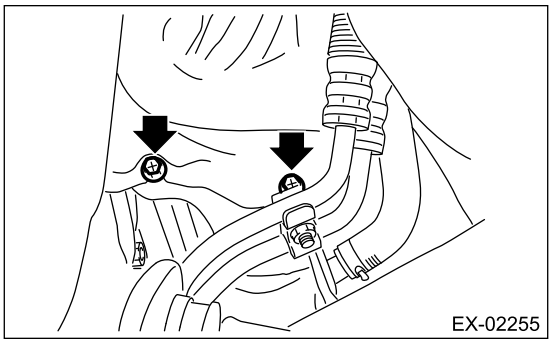


13. Lift up the vehicle.

14. Tighten the bolts that secure the lower side of the turbocharger lower cover.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



15. Install the transmission under cover.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

16. Lower the vehicle.

17. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.

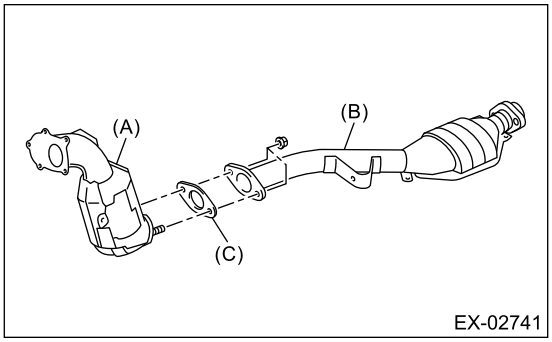
18. Connect the battery ground terminal.

EXHAUST(STI) > Center Exhaust Pipe

DISASSEMBLY

1. Remove the rear oxygen sensor from the center exhaust pipe (rear). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Rear Oxygen Sensor>REMOVAL.

2. Remove the center exhaust pipe upper cover.
3. Remove the center exhaust pipe (rear) from the center exhaust pipe (front).

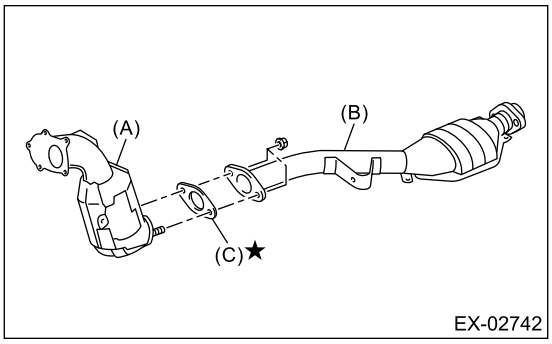


(A) Center exhaust pipe (front)
(B) Center exhaust pipe (rear)
(C) Gasket

EXHAUST(STI) > Center Exhaust Pipe

ASSEMBLY

1. Assemble the center exhaust pipe (rear) to the center exhaust pipe (front).
   Note:
   Use a new gasket.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



(A) Center exhaust pipe (front)
(B) Center exhaust pipe (rear)
(C) Gasket

2. Install the center exhaust pipe upper cover.
   Tightening torque:
   13 N·m (1.3 kgf-m, 9.6 ft-lb)
3. Install the rear oxygen sensor to the center exhaust pipe (rear). Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Rear Oxygen Sensor>INSTALLATION.

EXHAUST(STI) > Center Exhaust Pipe

INSPECTION

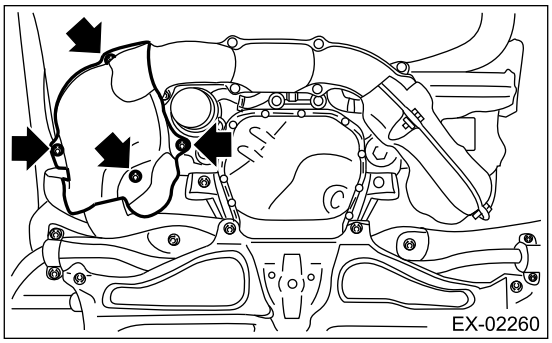
1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

EXHAUST(STI) > Joint Pipe

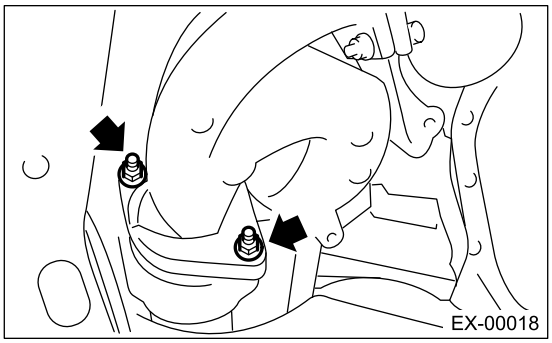
REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Remove the front oxygen (A/F) sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Front Oxygen (A/F) Sensor>REMOVAL.
5. Remove the exhaust manifold RH lower cover.



6. Remove the bolts and nuts which hold exhaust manifold RH onto joint pipe.



7. Remove the center exhaust pipe. Ref. to EXHAUST(STI)>Center Exhaust Pipe>REMOVAL.
8. Remove the turbocharger. Ref. to INTAKE (INDUCTION)(STI)>Turbocharger>REMOVAL.
9. Take off the joint pipe in the upward direction.

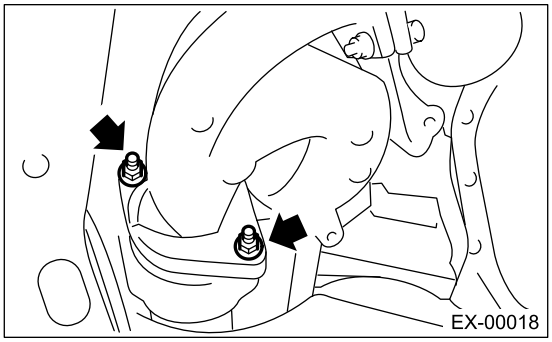
EXHAUST(STI) > Joint Pipe

INSTALLATION

Install in the reverse order of removal.

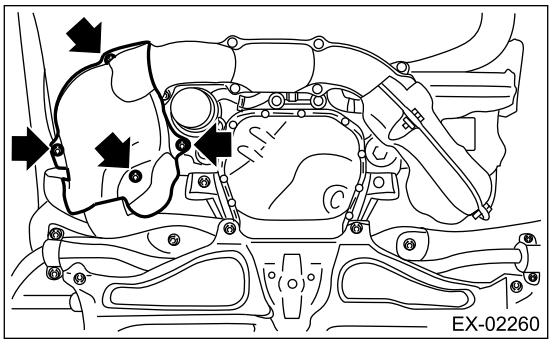
Note:
Use a new gasket.

Tightening torque:
42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)



EXHAUST(STI) > Joint Pipe

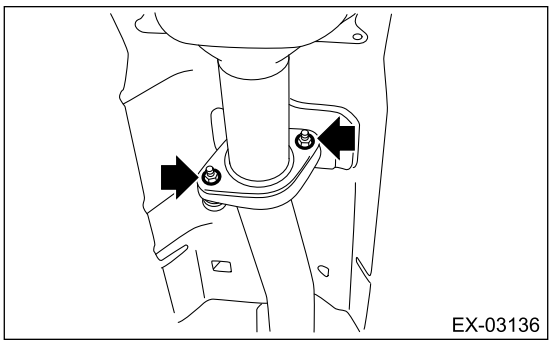
INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

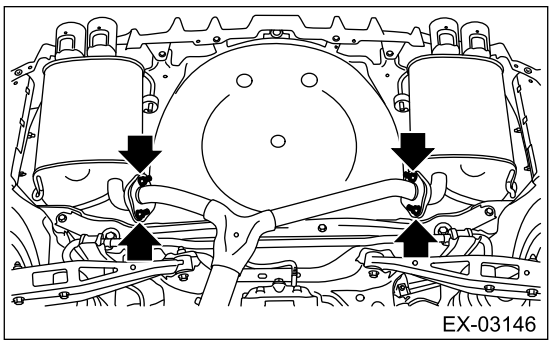
REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

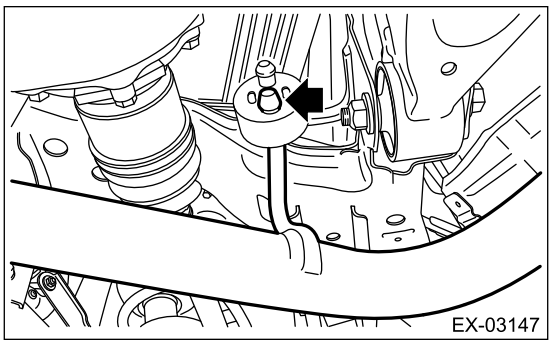
1. Lift up the vehicle.
2. Remove the center exhaust pipe from rear exhaust pipe.



3. Remove the muffler from rear exhaust pipe.
   Caution:
   Be careful not to drop the rear exhaust pipe.



4. Apply a coat of spray type lubricant to the mating area of cushion rubber.
5. Remove the rear exhaust pipe from the cushion rubber.
   Caution:
   Be careful not to let the muffler contact the rear bumper.

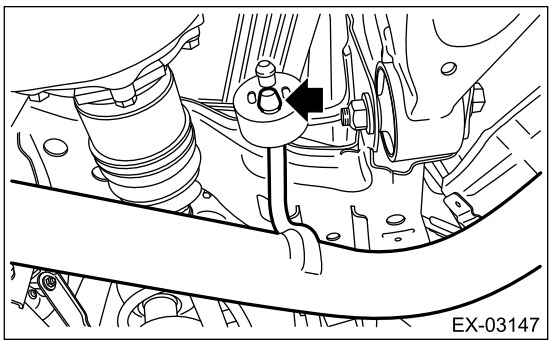


INSTALLATION

1. Apply a coat of spray type lubricant to the mating area of cushion rubber.
2. Install the rear exhaust pipe to cushion rubber.

   Note:

   After assembling, degrease the lubricant which was applied to the cushion rubber while removing/installing.



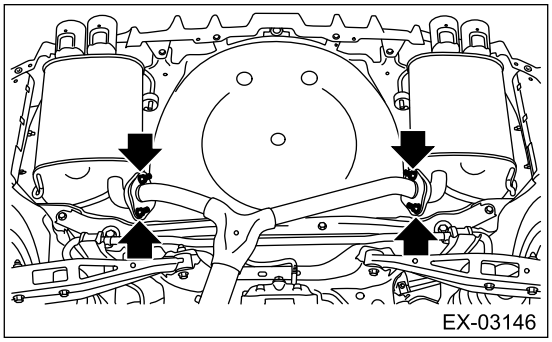
3. Install the rear exhaust pipe to the muffler.

   Note:

   Use a new gasket and self-locking nut.

   Tightening torque:

   48 N·m (4.9 kgf-m, 35.4 ft-lb)



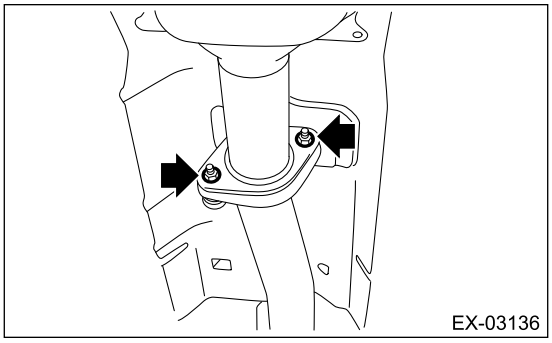
4. Install the center exhaust pipe to rear exhaust pipe.

   Note:

   Use a new gasket.

   Tightening torque:

   18 N·m (1.8 kgf-m, 13.3 ft-lb)



5. Lower the vehicle.

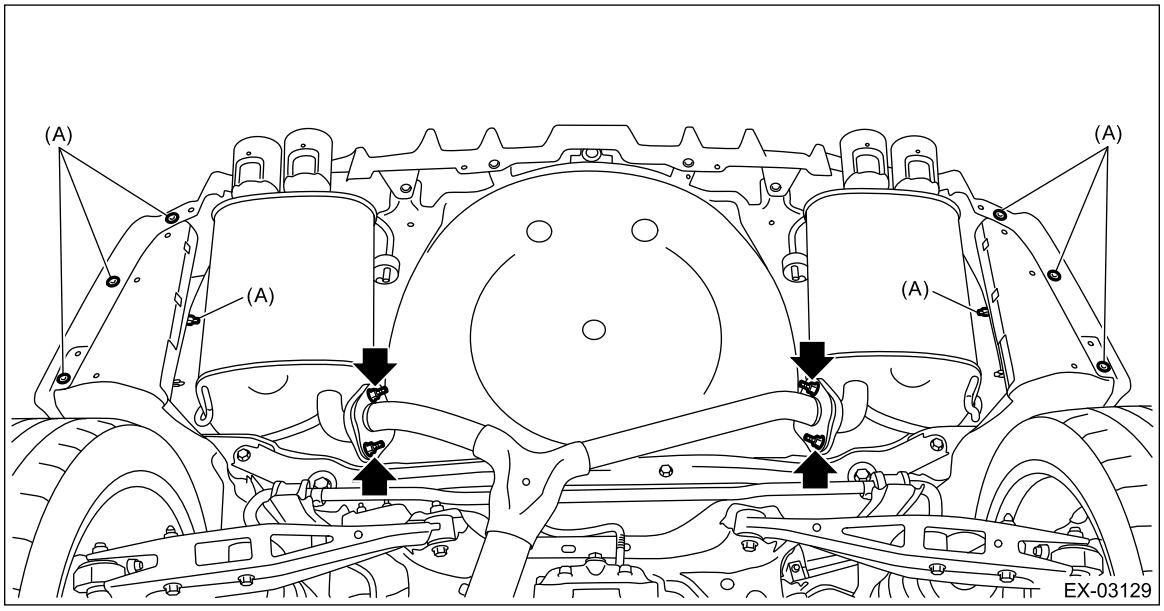
INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.
3. Check the cushion rubber for wear or crack.

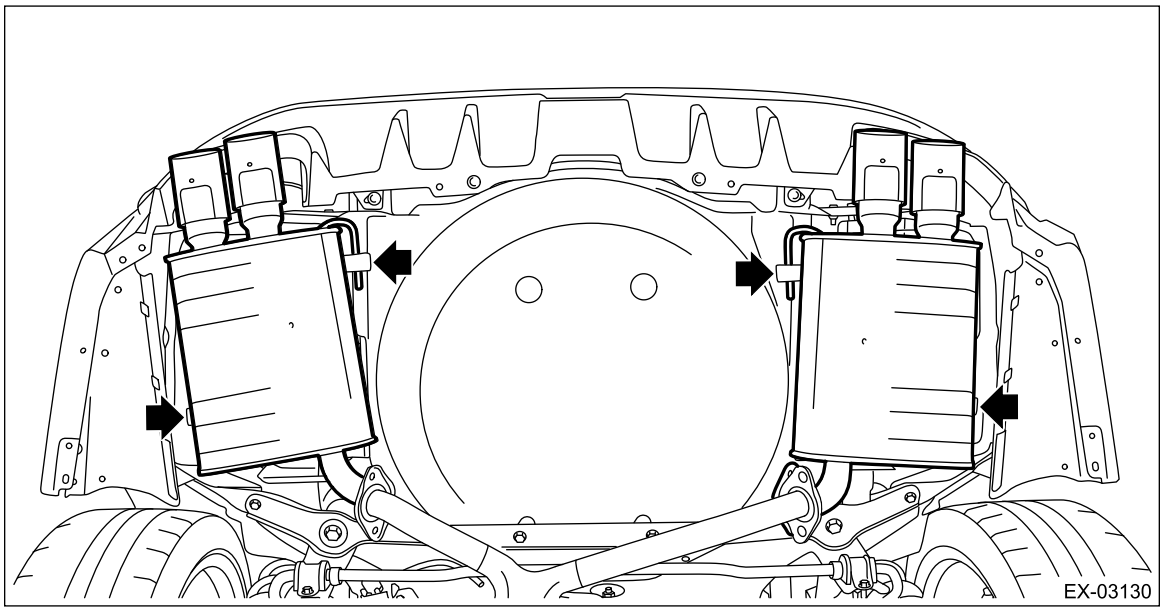
REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

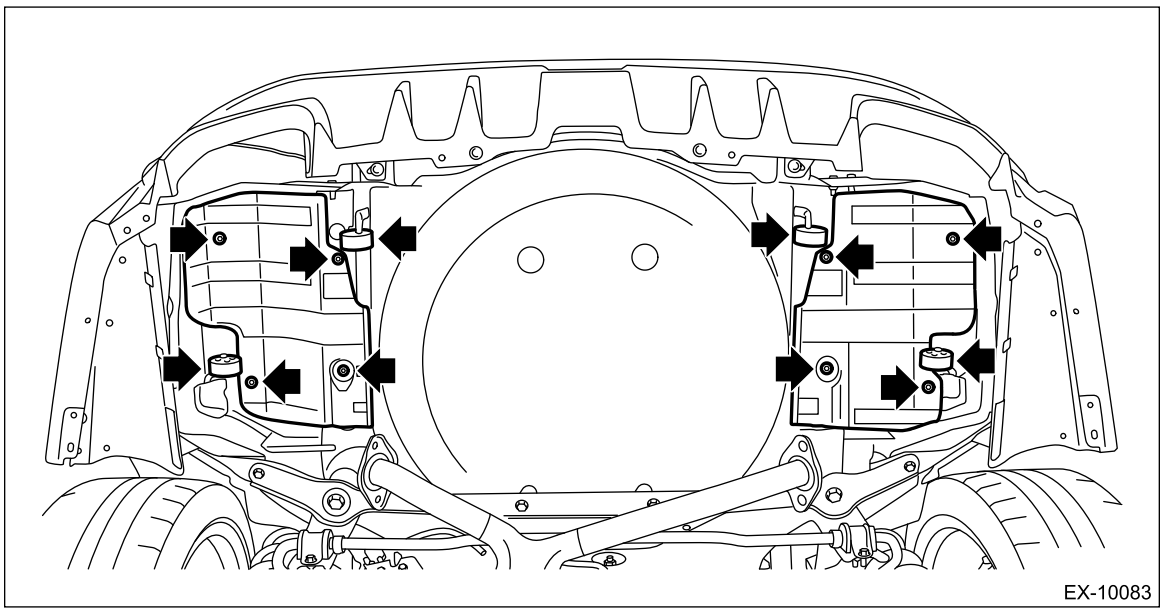
1. Lift up the vehicle.
2. Remove the clip (A) which holds the cover - rear bumper side to the vehicle and rear bumper.
   Note:
   This procedure is required to facilitate the removal/installation of the muffler.
3. Remove the bolts and self-locking nuts which secure the rear exhaust pipe to the muffler.



4. Apply a coat of spray type lubricant to the mating area of cushion rubber.
5. Remove the muffler from the cushion rubber.
   Caution:
   Be careful not to drop the muffler during removal.



6. Remove the cushion rubber and rear exhaust cover from the vehicle.



EXHAUST(STI) > Muffler

INSTALLATION

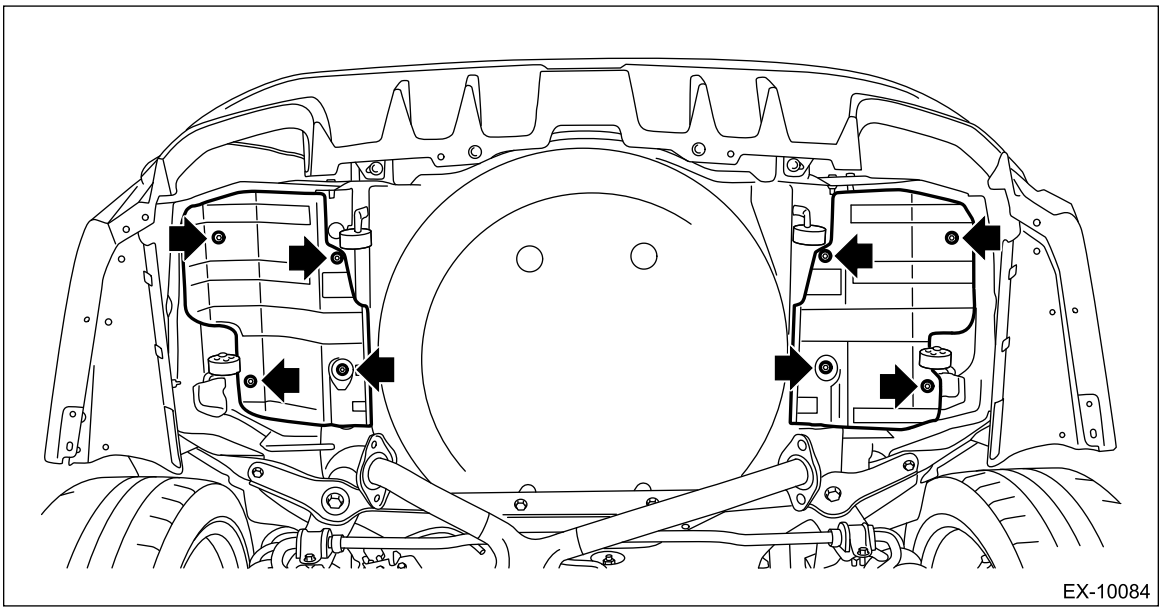
Install in the reverse order of removal.

Note:

- **Use a new gasket and self-locking nut.**
- **After assembling, degrease the lubricant which was applied to the cushion rubber while removing/installing.**

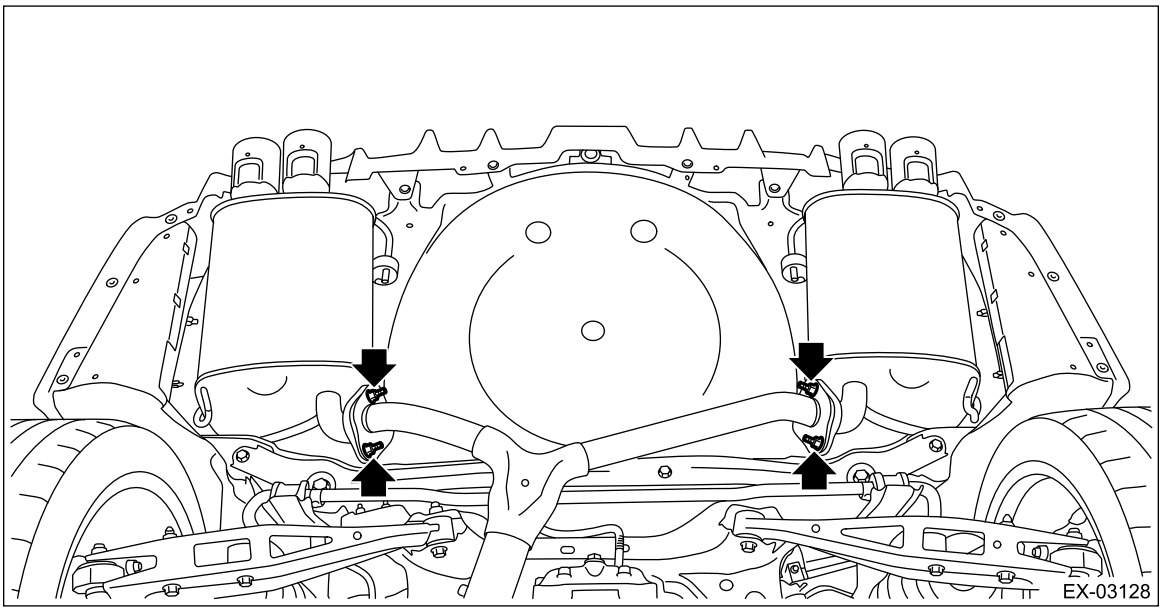
Tightening torque:

10 N·m (1.0 kgf-m, 7.4 ft-lb)



Tightening torque:

48 N·m (4.9 kgf-m, 35.4 ft-lb)



EXHAUST(STI) > Muffler

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.
3. Check the cushion rubber for wear or crack.

COOLING(STI)

CO(STI)

1. General Description
2. Radiator Fan System
3. Engine Coolant
4. Water Pump
5. Thermostat
6. Radiator
7. Radiator Cap
8. Radiator Main Fan and Fan Motor
9. Radiator Sub Fan and Fan Motor
10. Reservoir Tank
11. Coolant Filler Tank
12. Engine Cooling System Trouble in General

SPECIFICATION

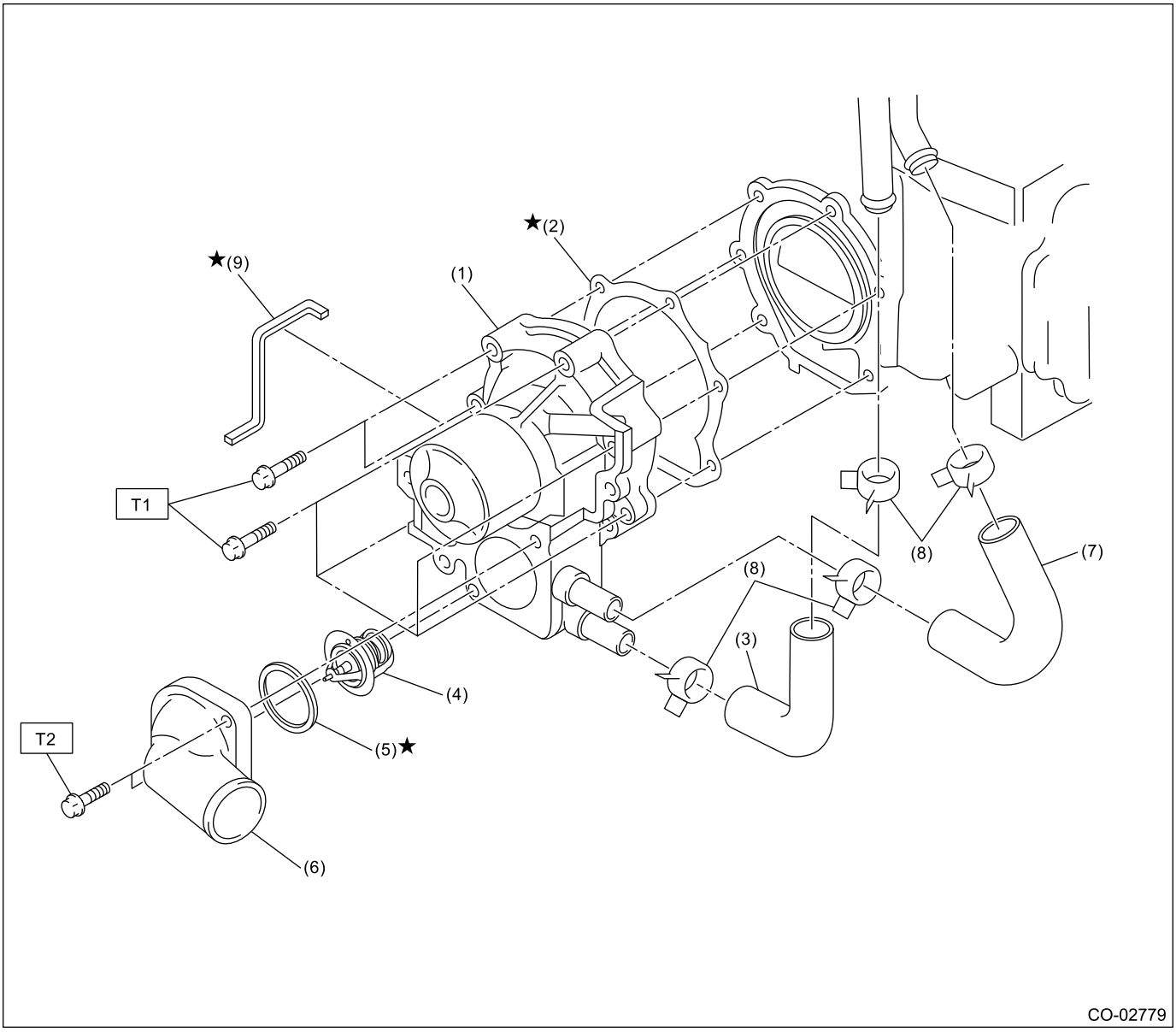
Cooling system					Electric fan + Forced engine coolant circulation system
Total engine coolant capacity			L (US qt, Imp qt)		Approx. 7.7 (8.2, 6.8)
Water pump	Type				Centrifugal impeller type
	Discharge performance	Discharge rate	L (US gal, Imp gal)/min		200 (52.8, 44.0)
		Pump speed — System pressure			6,000 r/min — 225.4 kPa (23.0 mAq)
		Engine coolant temperature			80°C (176°F)
	Impeller diameter		mm (in)		76 (2.99)
	Number of impeller vanes				8
	Pump pulley diameter		mm (in)		60 (2.36)
	Clearance between impeller and pump case		mm (in)	Standard	0.5 — 1.5 (0.020 — 0.059)
Thermostat	Type				Wax pellet type
	Starting temperature to open				76 — 80°C (169 — 176°F)
	Full open temperature				91°C (196°F)
	Valve lift		mm (in)		9.0 (0.354) or more
	Valve opening size		mm (in)		35 (1.38)
Radiator fan	Motor input	Main fan	W		160
		Sub fan	W		160
	Fan diameter / Blade	Main fan			320 mm (12.6 in)/9
		Sub fan			320 mm (12.6 in)/11
Radiator	Type				Down flow
	Core dimensions	Width × Height × Thickness	mm (in)		687.4 × 340 × 16 (27.06 × 13.39 × 0.63)
	Pressure range in which cap valve is open	Coolant filler tank side	kPa (kg/cm^2, psi)	Positive pressure side	Standard	93 — 123 (0.95 — 1.25, 14 — 18)
					Limit	83 (0.85, 12)
				Negative pressure side	Standard	−1.0 ——4.9 (−0.01 — −0.05, −0.1 ——0.7)
		Radiator side	kPa (kg/cm^2, psi)	Positive pressure side only	Standard	122 — 152 (1.24 — 1.55, 18 — 22)
					Limit	112 (1.14, 16)
	Fins				Corrugated fin type

Reservoir tank	Capacity	L (US qt, Imp qt)	0.45 (0.48, 0.40)

	Recommended materials	Item number	Alternative
Engine coolant	SUBARU SUPER COOLANT (concentrated type)	—	—
	SUBARU SUPER COOLANT (diluted type)	K0670Y0001	
Water for dilution	Distilled water	—	Soft water or tap water
Cooling system protective agent	Cooling system conditioner	SOA345001	—

COMPONENT

1. WATER PUMP

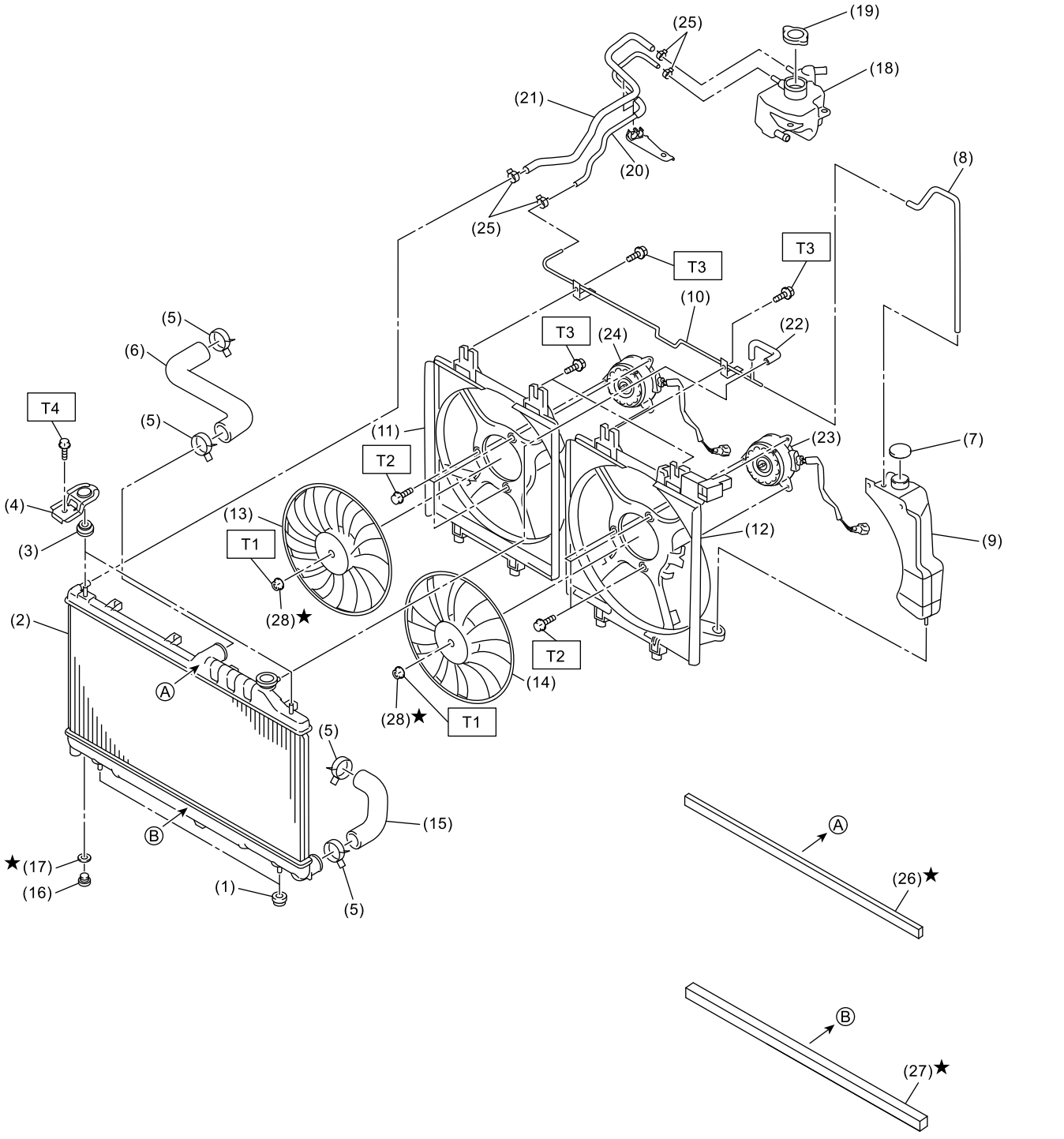


(1) Water pump ASSY
(2) Gasket
(3) Heater by-pass hose
(4) Thermostat
(5) Gasket
(6) Thermostat cover
(7) Coolant filler by-pass hose
(8) Clip
(9) Water pump sealing

Tightening torque: N·m (kgf-m, ft-lb)

T1: First 12 (1.2, 8.9)
Second 12 (1.2, 8.9)
T2: 12 (1.2, 8.9)

2. RADIATOR & RADIATOR FAN



CO-10172

(1) Radiator lower cushion
(2) Radiator
(3) Radiator upper cushion
(4) Radiator upper bracket
(5) Clip
(13) Radiator sub fan
(14) Radiator main fan
(15) Radiator outlet hose
(16) Radiator drain plug
(17) O-ring
(25) Clip
(26) Radiator upper gasket
(27) Radiator lower gasket
(28) Nut (with lock agent)

(6)	Radiator inlet hose	(18)	Engine coolant filler tank	***Tightening torque: N·m (kgf-m, ft-lb)***
(7)	Engine coolant reservoir tank cap	(19)	Radiator cap (coolant filler tank cap)	***T1: 3.43 (0.35, 2.53)***
(8)	Over flow hose A	(20)	Engine coolant hose A	***T2: 4.41 (0.45, 3.25)***
(9)	Engine coolant reservoir tank	(21)	Engine coolant hose B	***T3: 7.5 (0.8, 5.5)***
(10)	Over flow pipe	(22)	Over flow hose B	***T4: 12 (1.2, 8.9)***
(11)	Radiator sub fan shroud	(23)	Main fan motor	
(12)	Radiator main fan shroud	(24)	Sub fan motor	

COOLING(STI) > General Description

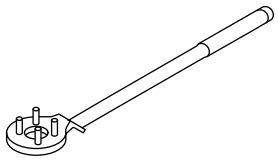
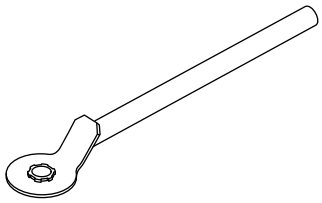
CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Prepare a container and cloth to prevent scattering of engine coolant when performing work where engine coolant can be spilled. If the oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- Follow all government and local regulations concerning disposal of refuse when disposing engine coolant.

COOLING(STI) > General Description

PREPARATION TOOL

1. SPECIAL TOOL

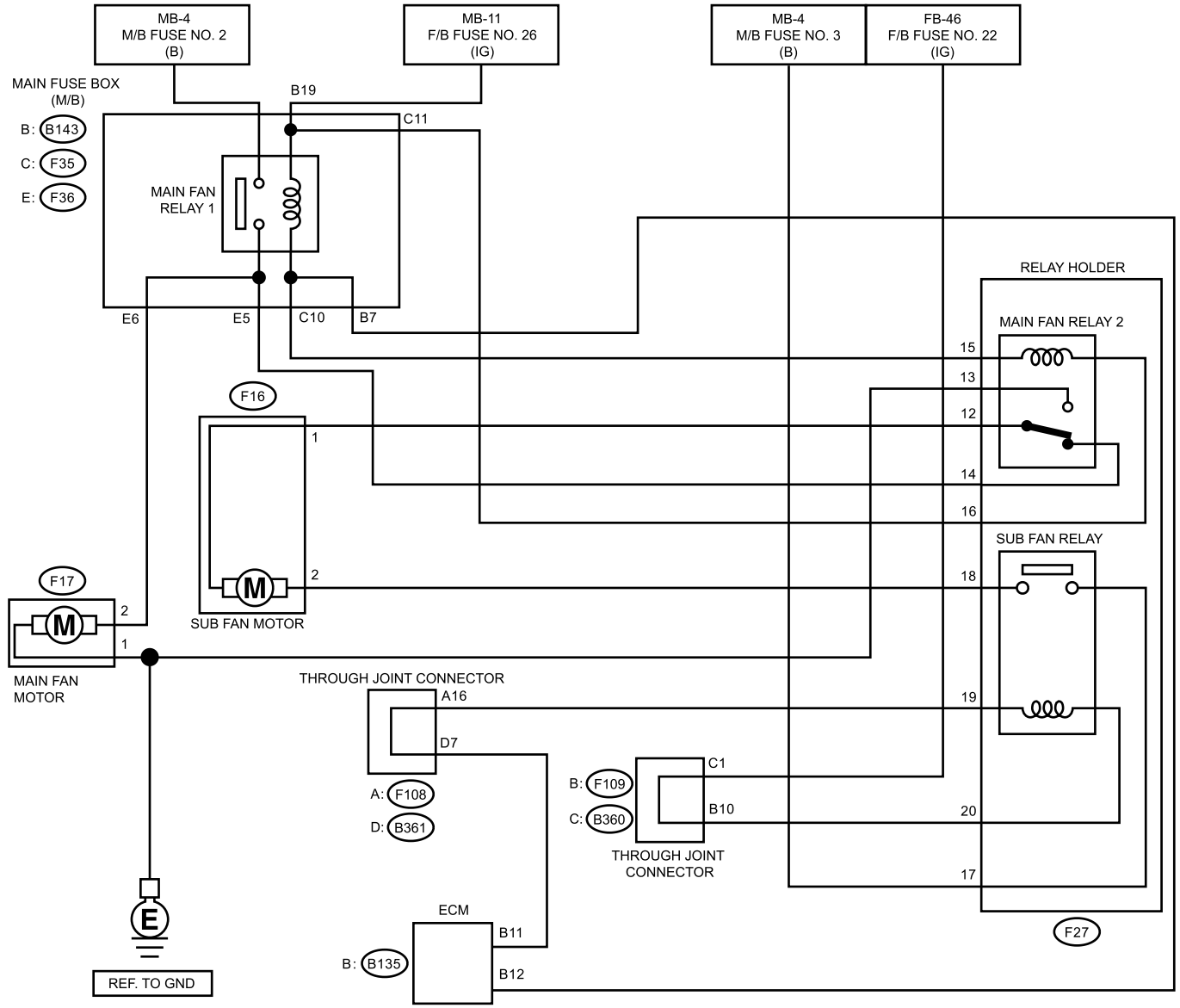
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used for removing and installing the crank pulley.
 ST-499977500	499977500	CAM SPROCKET WRENCH	Used for removing and installing intake cam sprocket and exhaust cam sprocket.
 STSSM4	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

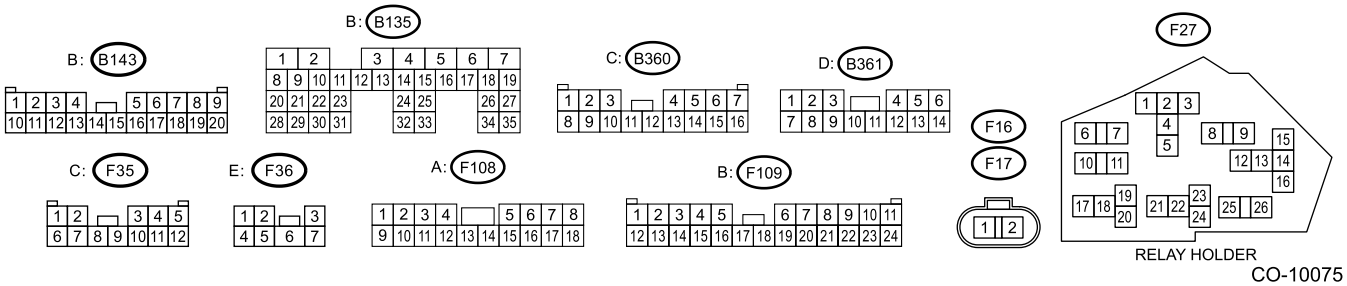
2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Radiator cap tester	Used for checking radiator and radiator cap.
DST-i	Used together with Subaru Select Monitor 4.

WIRING DIAGRAM

Radiator fan system Ref. to WIRING SYSTEM>Radiator Fan System>WIRING DIAGRAM.





CO-10075

INSPECTION

Operating condition:

Vehicle speed	A/C compressor load	Engine coolant temperature		
		Increase: 89°C (192°F) or less Decrease: 87°C (189°F) or less	Increase: 90 — 95°C (194 — 203°F) Decrease: 88 — 90°C (190 — 194°F)	Increase: 96°C (205°F) or more Decrease: 91°C (196°F) or more
		Radiator fan operation	Radiator fan operation	Radiator fan operation
During acceleration: 19 km/h (12 MPH) or less* During deceleration: 10 km/h (6 MPH) or less*	OFF	OFF	Low-Speed	High-Speed
	Low	Low-Speed	Low-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
During acceleration: 20 — 69 km/h (12 — 43 MPH) During deceleration: 11 — 64 km/h (7 — 40 MPH)	OFF	OFF	Low-Speed	High-Speed
	Low	High-Speed	High-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
During acceleration: 70 — 105 km/h (43 — 65 MPH) During deceleration: 65 — 100 km/h (40 — 62 MPH)	OFF	OFF	Low-Speed	High-Speed
	Low	High-Speed	High-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
During acceleration: 106 km/h (66 MPH) or more During deceleration: 101	OFF	OFF	High-Speed	High-Speed
	Low	High-Speed	High-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed

Vehicle speed	A/C compressor load	Engine coolant temperature		
		Increase: 89°C (192°F) or less Decrease: 87°C (189°F) or less	Increase: 90 — 95°C (194 — 203°F) Decrease: 88 — 90°C (190 — 194°F)	Increase: 96°C (205°F) or more Decrease: 91°C (196°F) or more
		Radiator fan operation	Radiator fan operation	Radiator fan operation
km/h (63 MPH) or more	*			

*: Including the condition under which vehicle is stopped (0 km/h (0 MPH)).

Diagnosis:

Radiator main fan and radiator sub fan do not rotate under the above operating conditions.

1. CHECK OPERATION OF RADIATOR FAN.

1. Install the delivery mode fuse.
2. Turn the ignition switch to ON.
3. Using the Subaru Select Monitor, perform the active test for the radiator fan relay.

   Note:
   - **When performing the active test for the radiator fan relay using the Subaru Select Monitor, the radiator main fan and radiator sub fan will repeat low speed revolution → high speed revolution → OFF in this order.**
   - **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

Do the radiator main fans and radiator sub fans rotate at low speed?

Yes — Go to 2.

No — Go to 3.

2. CHECK OPERATION OF RADIATOR FAN.

Using the Subaru Select Monitor, perform the active test for the radiator fan relay.

Note:

- **When performing the active test for the radiator fan relay using the Subaru Select Monitor, the radiator main fan and radiator sub fan will repeat low speed revolution → high speed revolution → OFF in this order.**
- **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

Do the radiator main fans and radiator sub fans rotate at high speed?

Yes	Radiator main fan system is normal.
No	Go to 27.

3. CHECK POWER SUPPLY TO SUB FAN RELAY.

1. Turn the ignition switch to OFF.
2. Remove the sub fan relay.
3. Measure the voltage between the sub fan relay terminal and chassis ground.
   Connector & terminal
   (F27) No. 17 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes	Go to 4.
No	Go to 5.

4. CHECK POWER SUPPLY TO SUB FAN RELAY.

1. Turn the ignition switch to ON.
2. Measure the voltage between the sub fan relay terminal and chassis ground.
   Connector & terminal
   (F27) No. 20 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes	Go to 7.
No	Go to 6.

5. CHECK FUSE.

1. Remove the fuse No. 3.
2. Check the condition of fuse.

Is the fuse blown out?

Yes	Replace the fuse.
No	Repair the power supply line.

6. CHECK FUSE.

1. Turn the ignition switch to OFF.
2. Remove the fuse No. 22.
3. Check the condition of fuse.

Is the fuse blown out?

Yes	Replace the fuse.
No	Repair the power supply line.

7. CHECK SUB FAN RELAY.

Measure the resistance between sub fan relay switch terminals.

Is the resistance 1 MΩ or more?

Yes	Go to 8.
No	Replace the sub fan relay. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

8. CHECK SUB FAN RELAY.

1. Connect the battery to the terminal on the sub fan relay coil side.
2. Measure the resistance between sub fan relay switch terminals.

Is the resistance less than 1 Ω?

Yes	Go to 9.
No	Replace the sub fan relay. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

9. CHECK HARNESS BETWEEN SUB FAN RELAY TERMINAL AND SUB FAN MOTOR CONNECTOR.

1. Turn the ignition switch to OFF.
2. Disconnect the connector from the sub fan motor.
3. Measure the resistance of harness between the sub fan relay terminal and sub fan motor connector.
   Connector & terminal
   (F16) No. 2 — (F27) No. 18:

Is the resistance less than 1 Ω?

Yes	Go to 10.
No	Repair the open circuit of harness between sub fan relay terminal and sub fan motor connector.

10. CHECK HARNESS BETWEEN SUB FAN MOTOR CONNECTOR AND MAIN FAN RELAY 2 CONNECTOR.

1. Remove the main fan relay 2.
2. Measure the resistance of harness between sub fan motor connector and main fan relay 2 connector.
   Connector & terminal
   (F16) No. 1 — (F27) No. 12:

Is the resistance less than 1 Ω?

Yes	Go to 11.
No	Repair the open circuit of the harness between sub fan motor connector and main fan relay 2 connector.

11. CHECK FOR POOR CONTACT.

Check poor contact of sub fan motor connector.

Is there poor contact of the sub fan motor connector?

Yes	Repair the poor contact of sub fan motor connector.
No	Go to 12.

12. CHECK SUB FAN MOTOR.

Connect the battery positive (+) terminal to terminal No. 2 of the sub fan motor, and the ground (−) terminal to terminal No. 1.

Does the radiator sub fan rotate?

Yes	Go to 13.
No	Replace the sub fan motor. Ref. to COOLING(STI)>Radiator Sub Fan and Fan Motor.

13. CHECK MAIN FAN RELAY 2.

Measure the resistance between terminals of main fan relay 2 switch (always ON side).

Is the resistance less than 1 Ω?

Yes	Go to 14.
No	Replace the main fan relay 2. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

14. CHECK HARNESS BETWEEN MAIN FAN RELAY 2 AND MAIN FAN MOTOR CONNECTOR.

1. Disconnect the connector from the main fan motor.
2. Measure the resistance of the harness between main fan relay 2 terminal and main fan motor connector.
   Connector & terminal
   (F17) No. 2 — (F27) No. 14:

Is the resistance less than 1 Ω?

Yes	Go to 15.
No	Repair the open circuit of the harness between main fan relay 2 terminal and main fan motor connector.

15. CHECK GROUND CIRCUIT OF MAIN FAN MOTOR.

Measure the resistance between main fan motor connector and chassis ground.
Connector & terminal
(F17) No. 1 — Chassis ground:

Is the resistance less than 5 Ω?

Yes	Go to 16.
No	Repair the open circuit of the harness between main fan motor connector and chassis ground.

16. CHECK FOR POOR CONTACT.

Check poor contact of main fan motor connector.

Is there poor contact of the main fan motor connector?

Yes	Repair the poor contact of main fan motor connector.
No	Go to 17.

17. CHECK MAIN FAN MOTOR.

Connect the battery positive (+) terminal to terminal No. 2 of the main fan motor, and the ground (−) terminal to terminal No. 1.

Does the radiator main fan rotate?

Yes	Go to 18.
No	Replace the main fan motor. Ref. to COOLING(STI)>Radiator Main Fan and Fan Motor.

18. CHECK HARNESS BETWEEN SUB FAN RELAY AND ECM.

1. Disconnect the connector from ECM.
2. Measure the resistance between the sub fan relay terminal and ECM connector.
   Connector & terminal
   (B135) No. 11 — (F27) No. 19:

Is the resistance less than 1 Ω?

Yes	Go to 19.
No	Repair the open circuit of harness between sub fan relay terminal and ECM.

19. CHECK FOR POOR CONTACT.

Check for poor contact of ECM connector.

Is there poor contact of ECM connector?

Yes	Repair the poor contact of ECM connector.
No	Check the DTC. Repair the trouble cause. Ref. to ENGINE (DIAGNOSTICS)(STI)>Read Diagnostic Trouble Code (DTC).

20. CHECK MAIN FAN RELAY 1.

1. Turn the ignition switch to OFF.
2. Remove the main fan relay 1.
3. Measure the resistance between terminals of main fan relay 1 switch.

Is the resistance 1 MΩ or more?

Yes	Go to 21.
No	Replace the main fan relay 1. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

21. CHECK MAIN FAN RELAY 1.

1. Connect the main fan relay 1 coil side terminal to the battery.
2. Measure the resistance between terminals of main fan relay 1 switch.

Is the resistance less than 1 Ω?

Yes	Go to 22.
No	Replace the main fan relay 1. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

22. CHECK HARNESS BETWEEN MAIN FAN RELAY 1 AND MAIN FAN MOTOR CONNECTOR.

1. Disconnect the connector from the main fan motor.
2. Measure the resistance of the harness between main fan relay 1 terminal and main fan motor connector.
   Connector & terminal
   (F17) No. 2 — (F36) No. 6:

Is the resistance less than 1 Ω?

Yes	Go to 23.
No	Repair the open circuit of the harness between main fan relay 1 terminal and main fan motor connector.

23. CHECK HARNESS BETWEEN MAIN FAN RELAY 1 AND ECM.

1. Disconnect the connector from ECM.
2. Measure the resistance between main fan relay 1 terminal and ECM connector.
   Connector & terminal
   (B135) No. 12 — (B143) No. 7:

Is the resistance less than 1 Ω?

Yes	Go to 24.
No	Repair the open circuit of the harness between main fan relay 1 terminal and ECM.

24. CHECK HARNESS BETWEEN MAIN FAN RELAY 2 AND ECM.

Measure the resistance between main fan relay 2 terminal and ECM connector.

Connector & terminal

(B135) No. 12 — (F27) No. 15:

Is the resistance less than 1 Ω?

Yes	Go to 25.
No	Repair the open circuit of the harness between main fan relay 2 terminal and ECM.

25. CHECK FUSE.

1. Remove the fuse No. 2 and No. 26.
2. Check the condition of fuse.

Is the fuse blown out?

Yes	Replace the fuse.
No	Go to 26.

26. CHECK FOR POOR CONTACT.

Check for poor contact of ECM connector.

Is there poor contact of ECM connector?

Yes	Repair the poor contact of ECM connector.
No	Repair the power supply circuit to the main fuse box.

27. CHECK OPERATION OF RADIATOR FAN.

If the both fans do not rotate at high speed in the condition of step 2, check whether the radiator sub fan is rotating.

Does the radiator sub fan rotate?

Yes — Go to 20.

No — Go to 28.

28. CHECK GROUND CIRCUIT OF MAIN FAN RELAY 2.

1. Turn the ignition switch to OFF.
2. Remove the main fan relay 2.
3. Measure the resistance between main fan relay 2 terminal and chassis ground.
   Connector & terminal
   (F27) No. 13 — Chassis ground:

Is the resistance less than 1 Ω?

Yes — Go to 29.

No — Repair the open circuit of harness between main fan relay 2 and chassis ground.

29. CHECK POWER SUPPLY TO MAIN FAN RELAY 2.

1. Turn the ignition switch to ON.
2. Measure the voltage between main fan relay 2 terminal and chassis ground.
   Connector & terminal
   (F27) No. 16 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes — Go to 30.

No — Repair the power supply line.

30. CHECK MAIN FAN RELAY 2.

Measure the resistance between terminals of main fan relay 2 switch (always OFF side).

Is the resistance 1 MΩ or more?

Yes	Go to 31.
No	Replace the main fan relay 2. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

31. CHECK MAIN FAN RELAY 2.

1. Connect the main fan relay 2 coil side terminal to the battery.
2. Measure the resistance between terminals of main fan relay 2 switch (always OFF side).

Is the resistance less than 1 Ω?

Yes	Go to 23.
No	Replace the main fan relay 2. Ref. to ENGINE (DIAGNOSTICS)(STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

INSPECTION

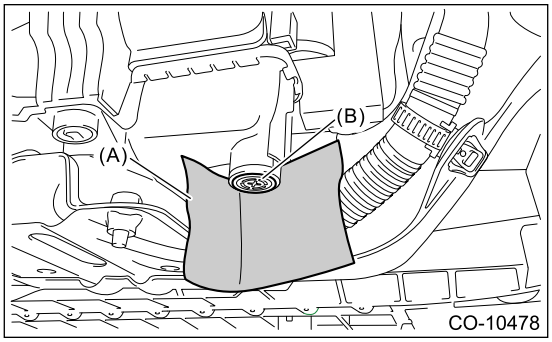
Note:
When adding the engine coolant, always use SUBARU Super Coolant.

1. Park the vehicle on a level surface.
2. Check the engine coolant amount, and if the coolant level is low, check for the coolant leakage, and then add the engine coolant.
   (1) Make sure the engine coolant level in the reservoir tank is between "FULL" and "LOW" with the engine in a cold condition.
   (2) Open the cap of coolant filler tank, and check that the engine coolant is filled up to the filler neck position.

REPLACEMENT

1. DRAINING OF ENGINE COOLANT

1. Lift up the vehicle.
2. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
3. Set a vinyl sheet (A), etc. at the base of drain plug.
   Caution:
   This operation is required to prevent engine coolant from scattering around.
4. Remove the drain plug (B) to drain engine coolant into container.
   Note:
   Remove the coolant filler tank cap so that engine coolant will drain faster.

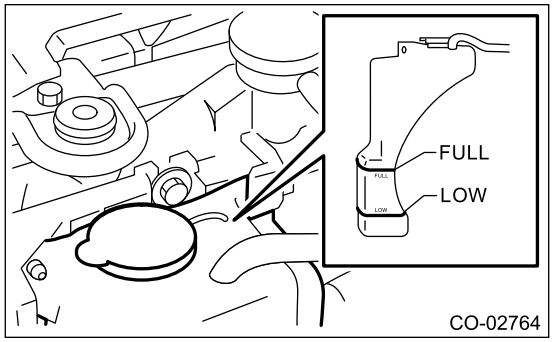


5. Install the drain plug.
   Note:
   Use new O-rings.
6. Remove the vinyl sheet, etc.
7. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.

2. FILLING OF ENGINE COOLANT

Caution:
During work, set the gear shift lever to the neutral position and do not shift the lever.

1. Pour cooling system conditioner through the filler neck of coolant filler tank.
   Cooling system protective agent:
   Refer to "SPECIFICATION" for cooling system protective agent. Ref. to COOLING(STI)>General Description>SPECIFICATION.
2. Fill the engine coolant into coolant filler tank up to the filler neck position.
   Recommended engine coolant:
   Refer to "SPECIFICATION" for recommended engine coolant. Ref. to COOLING(STI)>General Description>SPECIFICATION.
   Engine coolant level:
   Refer to "SPECIFICATION" for engine coolant level. Ref. to COOLING(STI)>General Description>SPECIFICATION.
   Engine coolant concentration:
   Refer to "ADJUSTMENT" for the recommended engine coolant concentration. Ref. to COOLING(STI)>Engine Coolant>ADJUSTMENT.
   Caution:
   Do not confuse the cap of coolant filler tank and cap of radiator.
   Note:
   - **When pouring the engine coolant, the radiator side cap must not be removed.**
   - **The SUBARU Super Coolant contains anti-freeze and anti-rust agents, and is especially made for Subaru engines with an aluminum cylinder block. Be sure to use SUBARU Super Coolant, since other coolant may cause corrosion.**
3. Fill engine coolant into the reservoir tank up to "FULL" level.



4. Close the coolant filler tank cap, and start the engine. Race 5 to 6 times at 3,000 r/min or less, then stop the engine. (Complete this operation within 40 seconds.)
5. Wait for one minute after the engine stops, then open the coolant filler tank cap. If the engine coolant level drops, add engine coolant into coolant filler tank up to the filler neck position.
6. Perform the procedures 4) and 5) again.
7. Attach the coolant filler tank and reservoir tank cap properly.
8. Start the engine and operate the heater at maximum hot position and the blower speed setting to "LO". (A/C OFF)
9. Run the engine at 3,000 r/min or less until radiator fan starts and stops.
   Note:
   Be careful with the engine coolant temperature to prevent overheating.
10. Stop the engine and wait until the engine coolant temperature lowers to 30°C (86°F) or less.
11. Open the coolant filler tank cap. If the engine coolant level drops, add engine coolant into the coolant filler tank up to the filler neck position and the reservoir tank to "FULL" level.
12. Attach the coolant filler tank and reservoir tank cap properly.

13. Set the heater setting to maximum hot position and the blower speed setting to “LO” and start the engine. Perform racing at 3,000 r/min or less. If the flowing sound is heard from the heater core, repeat the procedures from step 9).

COOLING(STI) > Engine Coolant

ADJUSTMENT

1. PROCEDURE TO ADJUST THE SUBARU SUPER COOLANT CONCENTRATION

Caution:
Use the SUBARU Super Coolant with a 50 — 60% concentration in order to obtain maximum anti-freeze and anti-rust performance.

To adjust the concentration of SUBARU Super Coolant according to temperature, find the proper SUBARU Super Coolant concentration in the table, and add dilution water to the SUBARU Super Coolant (concentrated type) until it reaches the proper dilution.

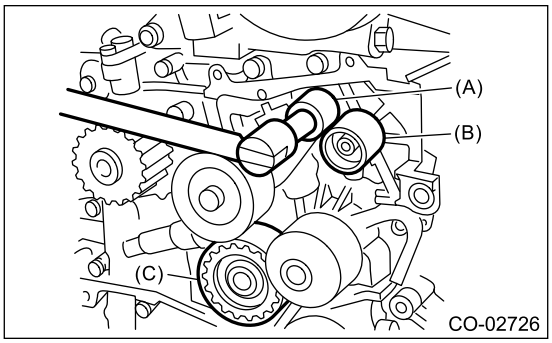
Relationship of SUBARU Super Coolant concentration and freezing temperature			
SUBARU Super Coolant concentration	50%	55%	60%
Freezing temperature	−36°C (−33°F)	−41°C (−42°F)	−50°C (−58°F)

Engine coolant and diluting water:

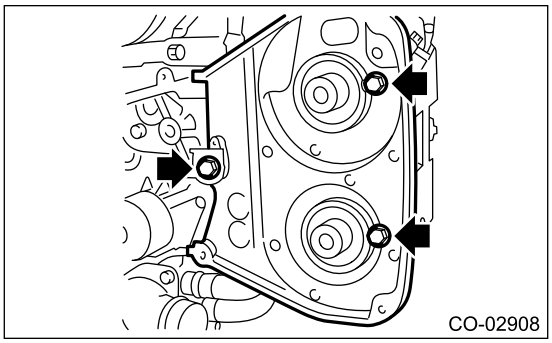
Refer to “SPECIFICATION” for recommended engine coolant and diluting water. Ref. to COOLING(STI)>General Description>SPECIFICATION.

REMOVAL

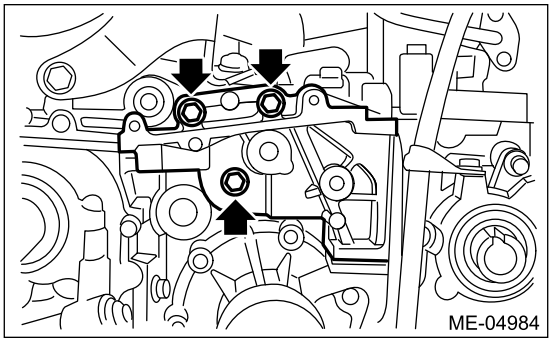
1. Remove the radiator. Ref. to COOLING(STI)>Radiator>REMOVAL.
2. Remove the V-belts. Ref. to MECHANICAL(STI)>V-belt>REMOVAL.
3. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
4. Remove the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
5. Remove the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>REMOVAL.
6. Remove the automatic belt tension adjuster (A).
7. Remove the belt idler (B).
8. Remove the belt idler No. 2 (C).



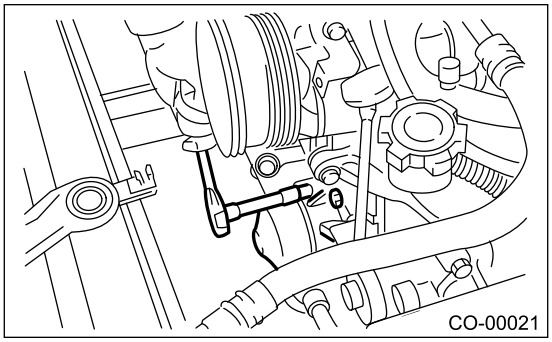
9. Remove the cam sprocket LH. Ref. to MECHANICAL(STI)>Cam Sprocket>REMOVAL.
10. Remove the belt cover No. 2 LH.



11. Remove the tensioner bracket.



12. Disconnect the hose from water pump.
13. Remove the water pump.



COOLING(STI) > Water Pump

INSTALLATION

1. Install the water pump onto cylinder block LH.

   Note:
   - **Use a new gasket.**
   - **When installing the water pump, tighten the bolts in two stages in alphabetical sequence as shown in figure.**

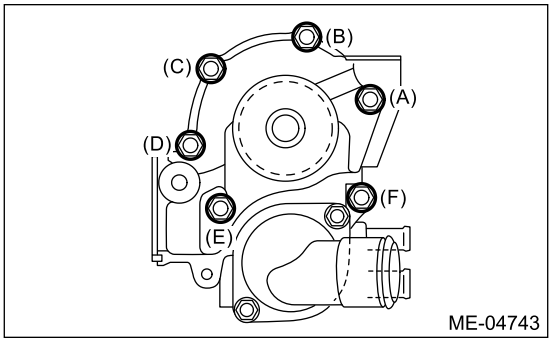
   Tightening torque:

   First:

   12 N·m (1.2 kgf-m, 8.9 ft-lb)

   Second:

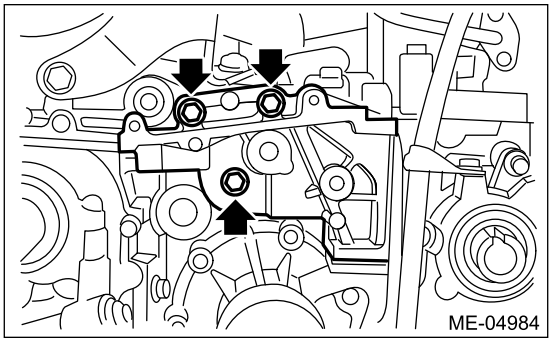
   12 N·m (1.2 kgf-m, 8.9 ft-lb)



2. Install the hose to water pump.
3. Install the tensioner bracket.

   Tightening torque:

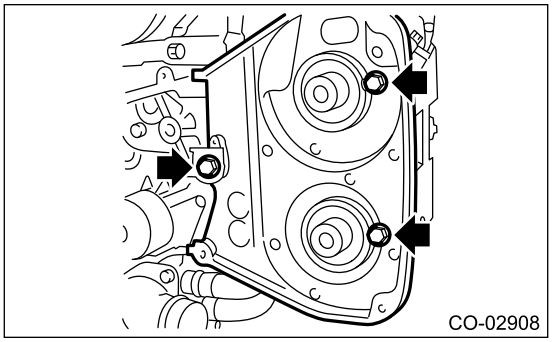
   24.5 N·m (2.5 kgf-m, 18.1 ft-lb)



4. Install the belt cover No. 2 LH.

Tightening torque:

5 N·m (0.5 kgf-m, 3.7 ft-lb)



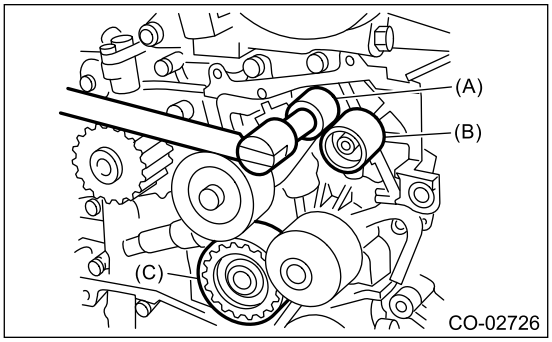
5. Install the cam sprocket LH. Ref. to MECHANICAL(STI)>Cam Sprocket>INSTALLATION.
6. Install the belt idler No. 2 (C).

   Tightening torque:

   39 N·m (4.0 kgf-m, 28.8 ft-lb)
7. Install the belt idler (B).

   Tightening torque:

   25 N·m (2.5 kgf-m, 18.4 ft-lb)
8. Install the automatic belt tension adjuster (A) with the tension rod held by a pin. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION > AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER.



9. Install the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION > TIMING BELT.
10. Install the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>INSTALLATION.
11. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.
12. Install the V-belts. Ref. to MECHANICAL(STI)>V-belt>INSTALLATION.
13. Install the radiator. Ref. to COOLING(STI)>Radiator>INSTALLATION.

COOLING(STI) > Water Pump

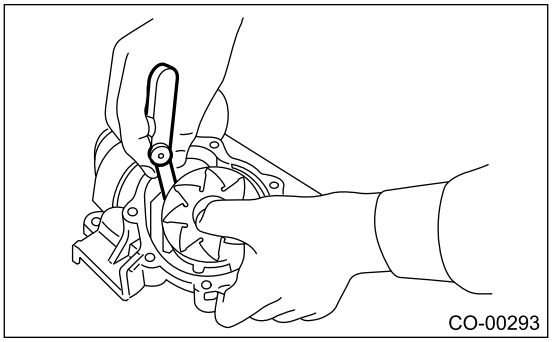
INSPECTION

1. Check the water pump bearing for smooth rotation.
2. Check the water pump pulley for abnormalities.
3. Make sure the impeller is not abnormally deformed or damaged.
4. Inspect the clearance between impeller and pump case.

   Clearance between impeller and pump case:

   Standard

   0.5 — 1.5 mm (0.020 — 0.059 in)

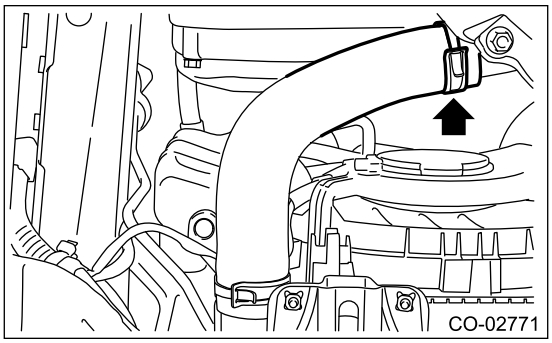


5. After water pump installation, check pulley shaft for engine coolant leaks or noise. If leaks or noise are noted, replace the water pump assembly.

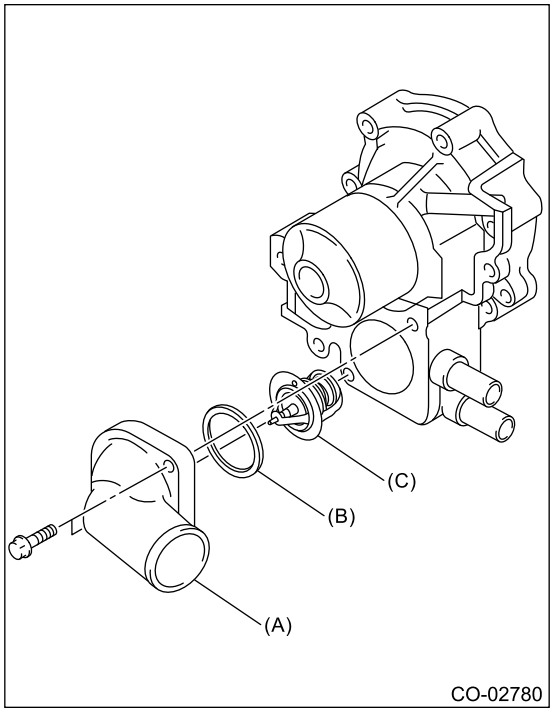
COOLING(STI) > Thermostat

REMOVAL

1. Drain engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
2. Disconnect the radiator outlet hose from thermostat cover.



3. Remove the thermostat cover, and then remove the gasket and thermostat.



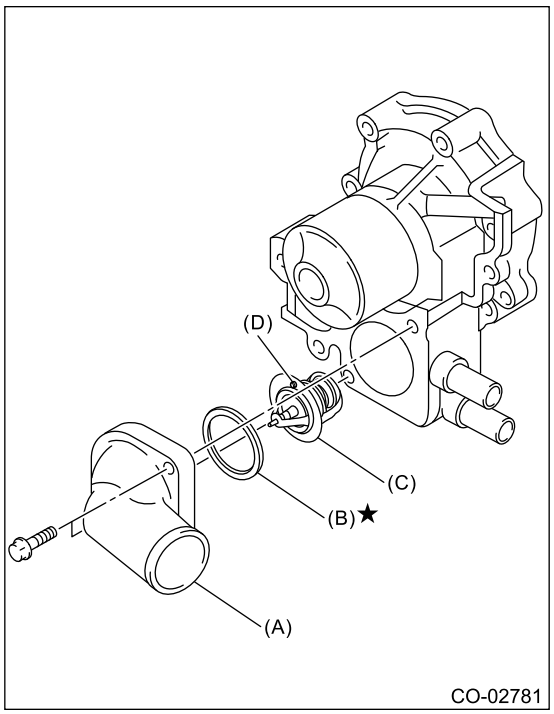
(A) Thermostat cover
(B) Gasket
(C) Thermostat

COOLING(STI) > Thermostat

INSTALLATION

1. Install a gasket to thermostat.
   Note:
   Use a new gasket.

2. Install the thermostat and thermostat cover.
   Note:
   Install the parts with the jiggle pin facing upward.
   Tightening torque:
   12 N·m (1.2 kgf-m, 8.9 ft-lb)



(A) Thermostat cover
(B) Gasket
(C) Thermostat
(D) Jiggle pin

3. Connect the radiator outlet hose to thermostat cover.
4. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
5. Lower the vehicle.
6. Fill engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

COOLING(STI) > Thermostat

INSPECTION

1. Check that the thermostat does not have deformation, cracks or damage.
2. Check that the thermostat valve closes completely at an ambient temperature.
3. Immerse the thermostat and a thermometer in water. Raise water temperature gradually, and check the temperature and valve lift when the valve begins to open and when the valve is fully opened. Replace the thermostat if faulty.

Note:

- **During the test, agitate the water for even temperature distribution.**
- **Leave the thermostat in the boiling water for five minutes or more before measuring the valve lift.**
- **Hold the thermostat with a wire or the like to avoid contacting the container.**

Starting temperature to open:

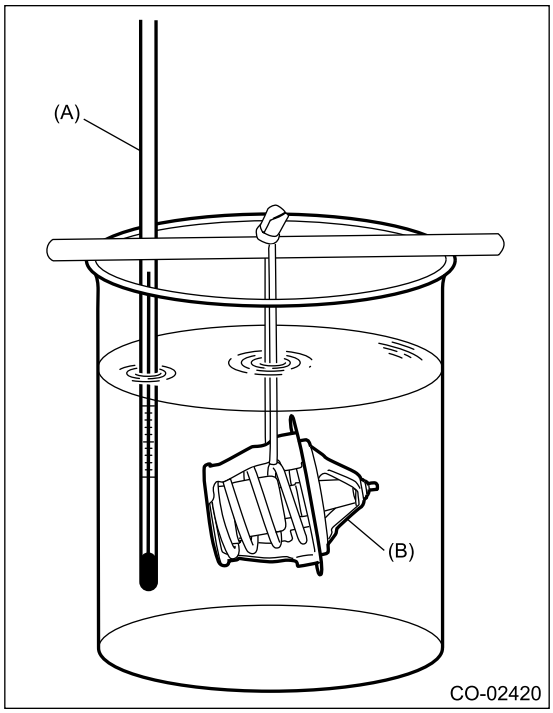
76 — 80°C (169 — 176°F)

Full open temperature:

91°C (196°F)

Total valve lift:

9.0 mm (0.354 in) or more



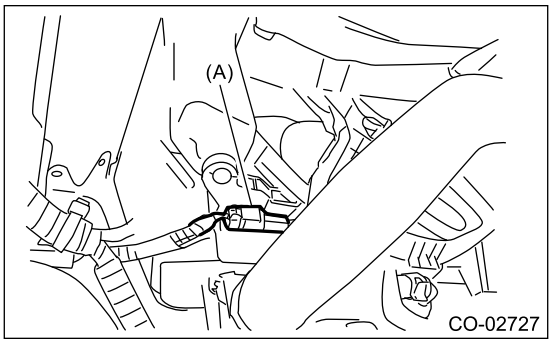
(A) Thermometer

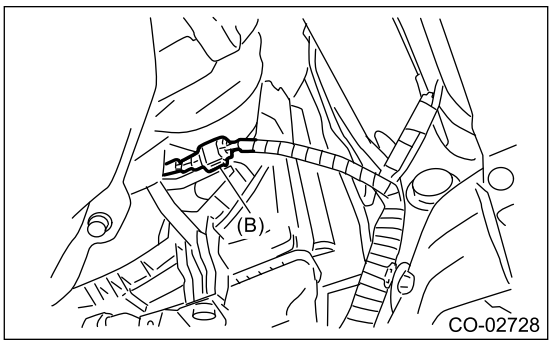
(B) Thermostat

REMOVAL

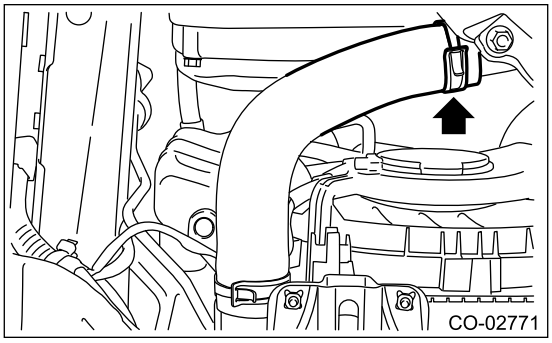
Caution:
The radiator is pressurized when the engine and radiator are hot. Wait until engine and radiator cool down before working on the radiator.

1. Disconnect the ground cable from battery.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
3. Remove the reservoir tank. Ref. to COOLING(STI)>Reservoir Tank>REMOVAL.
4. Drain engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
5. Disconnect the connector (A) from the main fan motor and the connector (B) from the sub fan motor.

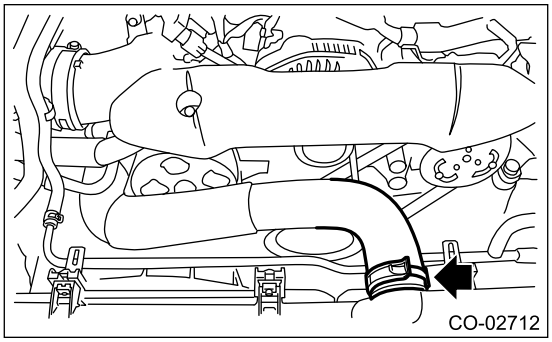




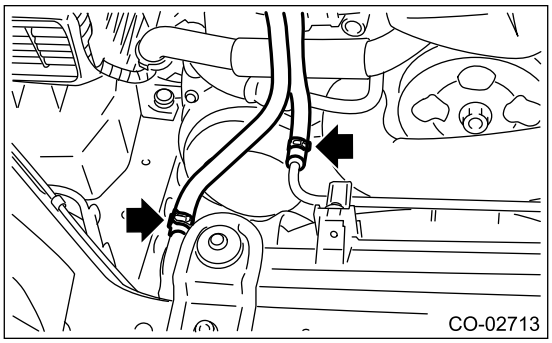
6. Disconnect the radiator outlet hose from thermostat cover.



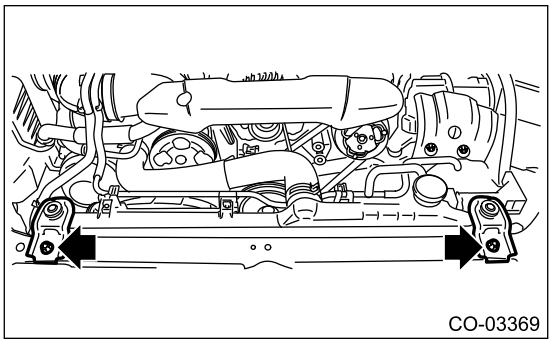
7. Lower the vehicle.
8. Disconnect the radiator inlet hose from the radiator.



9. Disconnect the two engine coolant hoses from the radiator and over flow pipe.



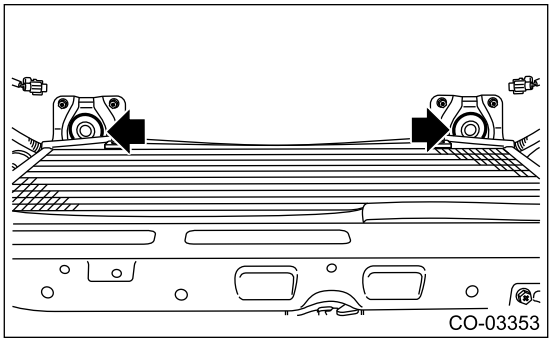
10. Remove the radiator upper brackets.



11. Move the radiator to the left while lifting it upward.

12. Lift the radiator up and remove the radiator from vehicle.

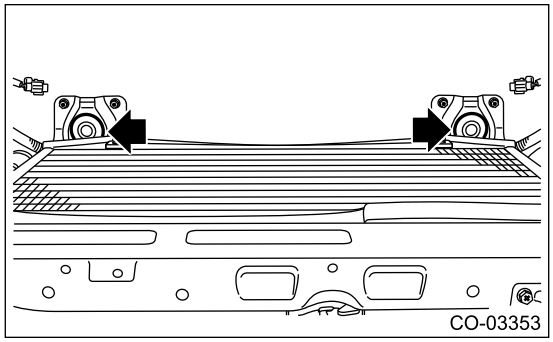
13. Remove the radiator lower cushion from the radiator lower bracket.



COOLING(STI) > Radiator

INSTALLATION

1. Attach the radiator lower cushion to the radiator lower bracket.



2. Install the radiator to vehicle.

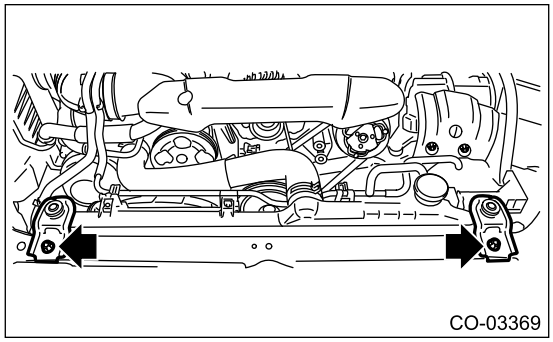
Note:

Make pins on the lower side of radiator be fitted into the radiator lower cushions.

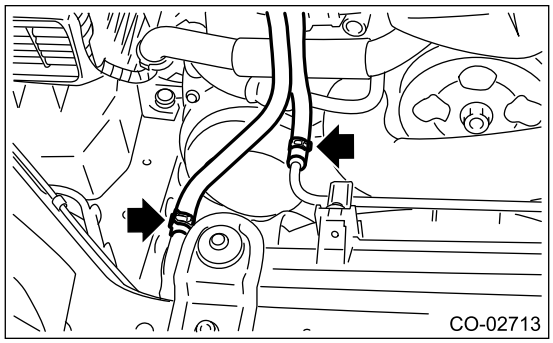
3. Install the radiator upper brackets.

Tightening torque:

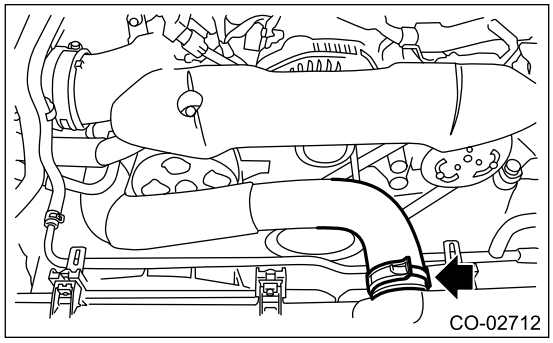
12 N·m (1.2 kgf-m, 8.9 ft-lb)



4. Connect the two engine coolant hoses to the radiator and over flow pipe.

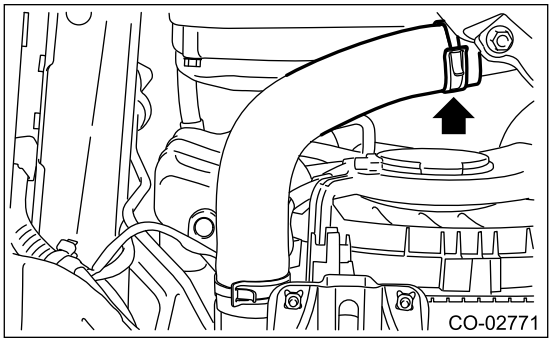


5. Connect the radiator inlet hose.

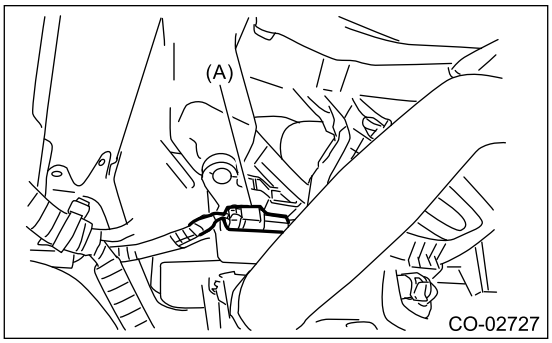


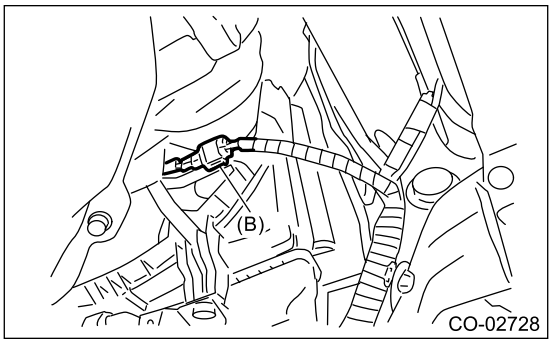
6. Lift up the vehicle.

7. Connect the radiator outlet hose.



8. Connect the connector (A) to the main fan motor and the connector (B) to the sub fan motor.



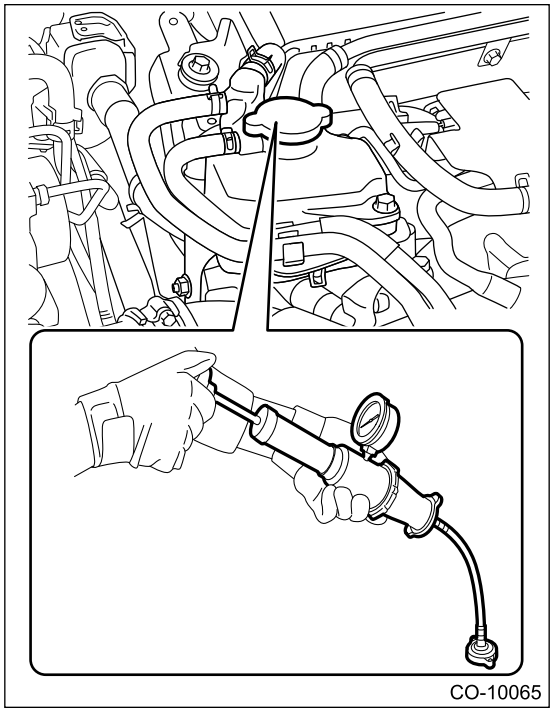


9. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
10. Lower the vehicle.
11. Install the reservoir tank. Ref. to COOLING(STI)>Reservoir Tank>INSTALLATION.
12. Install the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>INSTALLATION.
13. Connect the battery ground terminal.
14. Fill engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

COOLING(STI) > Radiator

INSPECTION

1. Check that the radiator does not have deformation, cracks or damage.
2. Check that the hose has no cracks, damage or loose part.
3. Remove the coolant filler tank cap, fill the coolant filler tank with engine coolant, then install the radiator cap tester to the filler neck of coolant filler tank.

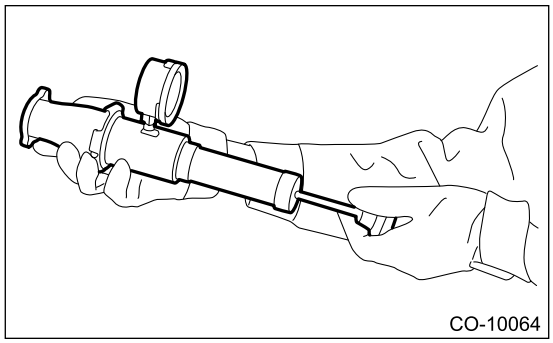


4. Apply a pressure of 122 kPa (1.2 kg/cm^2, 18 psi) to the radiator and check the following points:
   - Leakage from the radiator or its vicinity
   - Leakage from the hose or its connections

   Caution:
   - **Inspection must be carried out at the side of coolant filler tank, not at the side of radiator.**
   - **Engine should be turned off.**
   - **Wipe engine coolant from check points in advance.**
   - **Be careful not to deform the filler neck of the coolant filler tank when installing and removing the radiator cap tester.**
   - **Be careful of engine coolant from spurting out when removing the radiator cap tester.**

INSPECTION

1. Check that the radiator cap does not have deformation, cracks or damage.
2. Attach the radiator cap tester to radiator cap.



3. Increase pressure until the radiator cap tester gauge needle stops. Radiator cap is functioning properly if it holds the service limit pressure for 5 — 6 seconds. Replace the radiator cap if its valve opens at less than the service limit.

Caution:

- **Be sure to remove foreign matter and rust from the cap in advance. Otherwise, results of pressure test will be incorrect.**
- **Do not confuse the cap of coolant filler tank and cap of radiator.**

Coolant filler tank side:

Standard

93 — 123 kPa (0.95 — 1.25 kg/cm^2, 14 — 18 psi)

Limit

83 kPa (0.85 kg/cm^2, 12 psi)

Radiator side:

Standard

122 — 152 kPa (1.24 — 1.55 kg/cm^2, 18 — 22 psi)

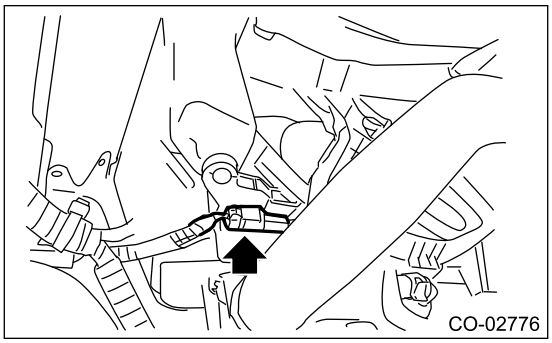
Limit

112 kPa (1.14 kg/cm^2, 16 psi)

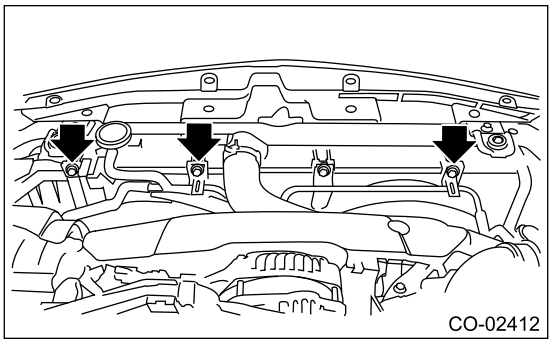
COOLING(STI) > Radiator Main Fan and Fan Motor

REMOVAL

1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Disconnect the connector from the main fan motor.



5. Lower the vehicle.
6. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
7. Remove the reservoir tank. Ref. to COOLING(STI)>Reservoir Tank>REMOVAL.
8. Remove the bolts which secure the radiator main fan motor assembly and the over flow pipe.



9. Remove the radiator main fan motor assembly from the upper side of the vehicle.

COOLING(STI) > Radiator Main Fan and Fan Motor

INSTALLATION

Install in the reverse order of removal.

Caution:

Check if the radiator hose and the over flow hose are properly connected.

Tightening torque:

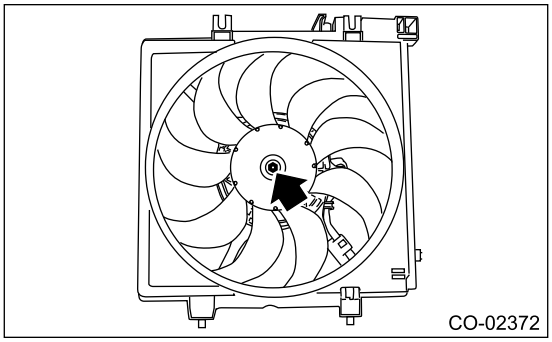
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

COOLING(STI) > Radiator Main Fan and Fan Motor

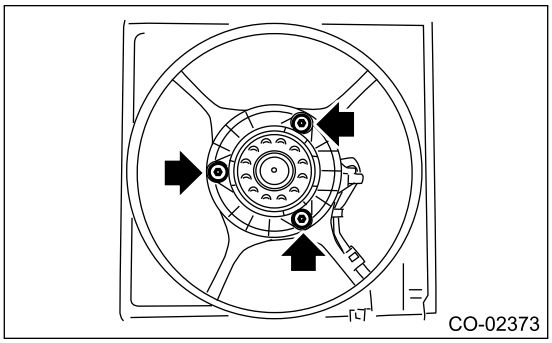
DISASSEMBLY

1. Remove the clip which holds the main fan motor connector onto the radiator main fan shroud.
2. Disconnect the radiator main fan from the main fan motor.

Note:
Remove the lock agent from the threaded portion of the main fan motor.



3. Disconnect the main fan motor from the radiator main fan shroud.



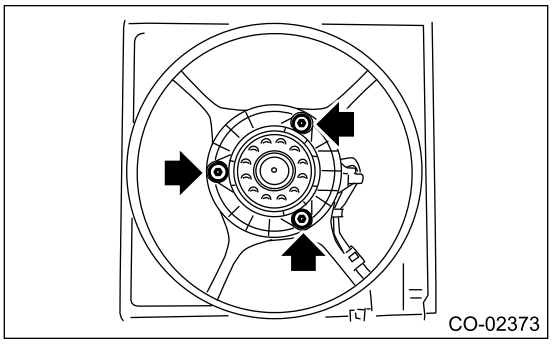
COOLING(STI) > Radiator Main Fan and Fan Motor

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

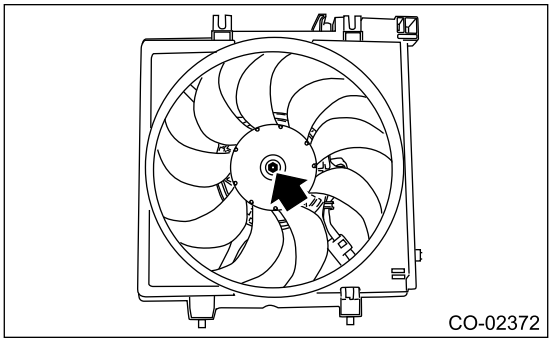
4.41 N·m (0.45 kgf-m, 3.25 ft-lb)



Caution:
Be sure to use a new nut (with lock agent).

Tightening torque:

3.4 N·m (0.3 kgf-m, 2.5 ft-lb)



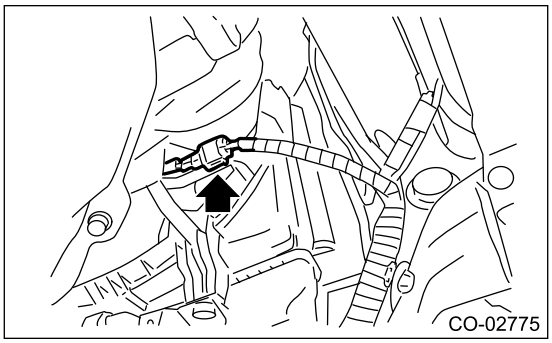
INSPECTION

Check that the radiator main fan, radiator main fan shroud and main fan motor do not have deformation, cracks or damage.

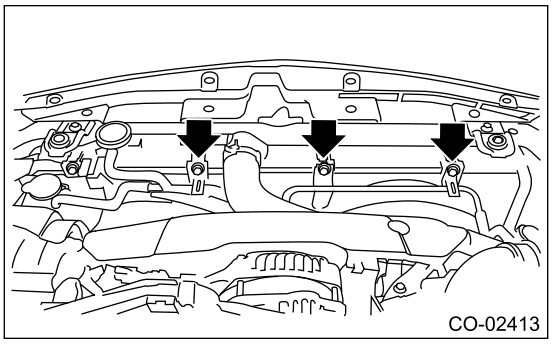
COOLING(STI) > Radiator Sub Fan and Fan Motor

REMOVAL

1. Disconnect the ground cable from battery.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Disconnect the connector from the sub fan motor.



5. Lower the vehicle.
6. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
7. Remove the bolts which secure the radiator sub fan motor assembly and the over flow pipe.



8. Raise the radiator sub fan motor assembly slightly, remove the pin at the lower part of the radiator sub fan motor assembly from the radiator hole, and remove the radiator sub fan motor assembly from the lower side of the vehicle.

COOLING(STI) > Radiator Sub Fan and Fan Motor

INSTALLATION

Install in the reverse order of removal.

Caution:

Check if the radiator hose and the over flow hose are properly connected.

Tightening torque:

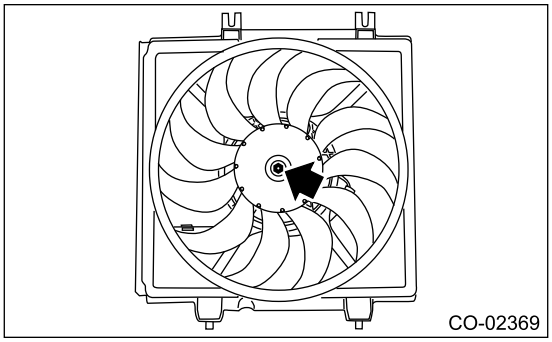
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

COOLING(STI) > Radiator Sub Fan and Fan Motor

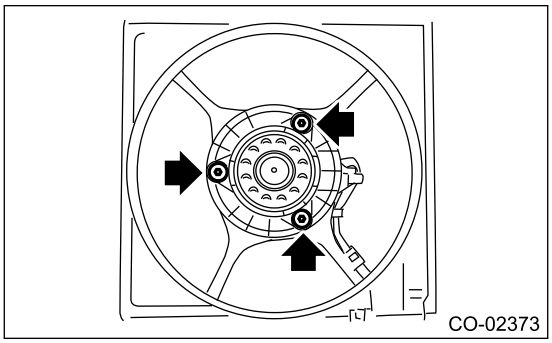
DISASSEMBLY

1. Remove the clip which holds the sub fan motor connector onto the radiator sub fan shroud.
2. Disconnect the radiator sub fan from the sub fan motor.

Note:
Remove the lock agent from the threaded portion of the sub fan motor.



3. Disconnect the sub fan motor from the radiator sub fan shroud.



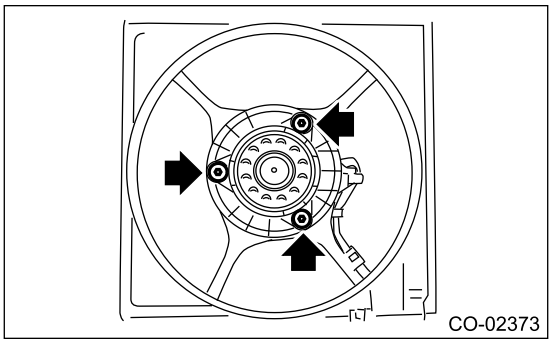
COOLING(STI) > Radiator Sub Fan and Fan Motor

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

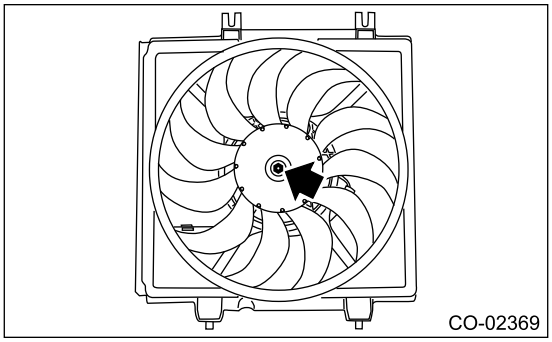
4.41 N·m (0.45 kgf-m, 3.25 ft-lb)



Caution:
Be sure to use a new nut (with lock agent).

Tightening torque:

3.4 N·m (0.3 kgf-m, 2.5 ft-lb)



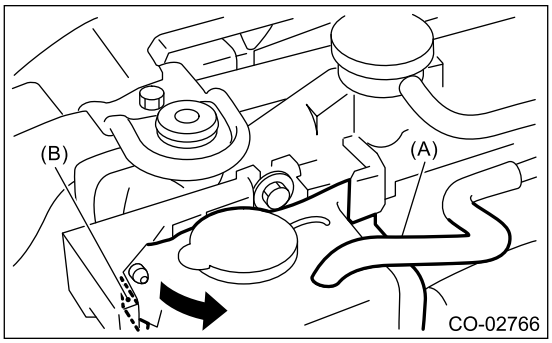
INSPECTION

Check that the radiator sub fan, radiator sub fan shroud and sub fan motor do not have deformation, cracks or damage.

COOLING(STI) > Reservoir Tank

REMOVAL

1. Pull out the over flow hose (A).
2. Pull out the reservoir tank to the arrow direction while pushing the claw (B).



COOLING(STI) > Reservoir Tank

INSTALLATION

Install in the reverse order of removal.

COOLING(STI) > Reservoir Tank

INSPECTION

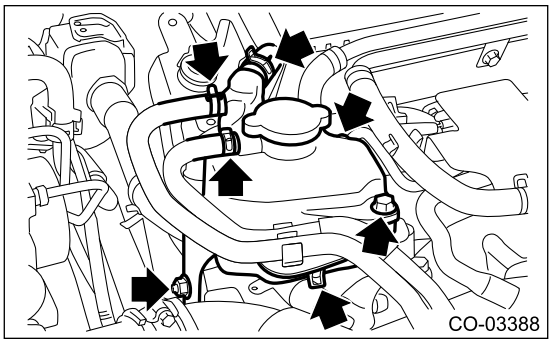
1. Check that the reservoir tank does not have deformation, cracks or damage.
2. Make sure the over flow hoses are not cracked, damaged or loose.
3. Make sure the engine coolant level is between “FULL” and “LOW”.

COOLING(STI) > Coolant Filler Tank

REMOVAL

Caution:
The coolant filler tank is pressurized when the engine and radiator are hot. Wait until engine and radiator cool down before working on the coolant filler tank.

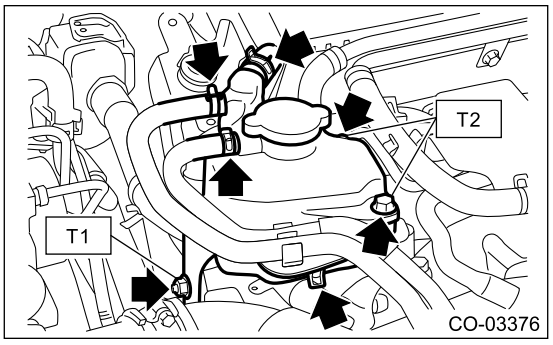
1. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
2. Disconnect the engine coolant hoses from coolant filler tank.
3. Remove the bolt and nut which secure the coolant filler tank.
4. Remove the coolant filler tank.



COOLING(STI) > Coolant Filler Tank

INSTALLATION

1. Install in the reverse order of removal.
   Tightening torque:
   T1: 13 N·m (1.3 kgf-m, 9.6 ft-lb)
   T2: 16 N·m (1.6 kgf-m, 11.8 ft-lb)



COOLING(STI) > Coolant Filler Tank

INSPECTION

1. Check that the coolant filler tank does not have deformation, cracks or damage.
2. Check that the engine coolant hose has no cracks, damage or loose part.

INSPECTION

Trouble	Possible cause	Corrective action
Over-heating	a. Insufficient engine coolant	Replenish engine coolant, inspect for leakage, and repair it if necessary.
	b. Loose timing belt	Repair or replace timing belt tensioner.
	c. Oil on timing belt	Replace.
	d. Malfunction of thermostat	Replace.
	e. Malfunction of water pump	Replace.
	f. Clogged engine coolant passage	Clean.
	g. Improper ignition timing	Inspect and repair ignition control system. Ref. to ENGINE (DIAGNOSTICS)(STI)>Basic Diagnostic Procedure>PROCEDURE.
	h. Clogged or leaking radiator	Clean, repair or replace.
	i. Defective radiator fan	Replace.
	j. Improper engine oil in engine coolant	Replace the engine coolant. If ineffective, check, repair or replace engine components.
	k. Air/fuel mixture ratio too lean	Inspect and repair the fuel injection system. Ref. to ENGINE (DIAGNOSTICS)(STI)>Basic Diagnostic Procedure>PROCEDURE.
	l. Excessive back pressure in exhaust system	Clean or replace.
	m. Insufficient clearance between piston and cylinder	Adjust or replace.
	n. Slipping clutch	Repair or replace.
	o. Dragging brake	Adjust.
	p. Defective radiator fan	Inspect the radiator fan relay, engine coolant temperature sensor or fan motor and replace them.
Over-cooling	a. Ambient temperature extremely low	Partly cover radiator front area.
	b. Defective thermostat	Replace.
Engine coolant leaks	a. Loosened or damaged connecting units on hoses	Repair or replace.
	b. Leakage from water pump	Replace.
	c. Leakage from water pipe	Repair or replace.
	d. Leakage around cylinder head gasket	Retighten cylinder head bolts or replace cylinder head gasket.

Trouble	Possible cause	Corrective action
	e. Damaged or cracked cylinder head and cylinder block	Repair or replace.
	f. Damaged or cracked thermostat cover	Repair or replace.
	g. Leakage from radiator	Repair or replace.
Noise	a. Timing belt problem	Replace.
	b. Defective radiator fan	Replace.
	c. Defective water pump bearing	Replace water pump.
	d. Defective water pump mechanical seal	Replace water pump.

LUBRICATION(STI)

LU(STI)

1. General Description
2. Oil Pressure System
3. Engine Oil
4. Oil Pump
5. Oil Pan and Strainer
6. Oil Pressure Switch
7. Engine Oil Cooler
8. Oil Pipe
9. Engine Oil Filter
10. Engine Lubrication System Trouble in General

SPECIFICATION

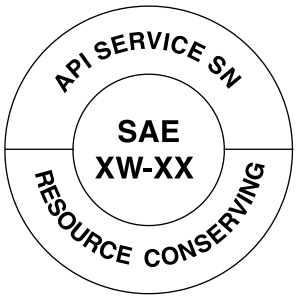
Lubrication method					Forced lubrication
Oil pump	Pump type				Trochoid type
	Number of teeth	Inner rotor			9
		Outer rotor			10
	Outer rotor diameter × Thickness			mm (in)	78 × 11 (3.07 × 0.43)
	Tip clearance between inner and outer rotors			mm (in)	Standard	0.04 — 0.14 (0.0016 — 0.0055)
	Case clearance between outer rotor and pump case			mm (in)	Standard	0.10 — 0.175 (0.0039 — 0.0069)
	Side clearance between inner rotor and pump case			mm (in)	Standard	0.02 — 0.07 (0.0008 — 0.0028)
	Relief valve spring	Free length		mm (in)	73.7 (2.902)
		Installed length		mm (in)	54.7 (2.154)
		Load when installed		N (kgf, lbf)	93.1 (9.49, 20.93)
	Performance (Oil temperature 80°C (176°F))	600 r/min	Discharge pressure	kPa (kg/cm^2, psi)	98 (1.0, 14)
			Discharge rate	L (US qt, Imp qt)/min	6.4 (6.8, 5.6) or more
		6,000 r/min	Discharge pressure	kPa (kg/cm^2, psi)	392 (4.0, 56.8)
			Discharge rate	L (US qt, Imp qt)/min	63.0 (66.6, 55.4) or more
	Relief valve working pressure			kPa (kg/cm^2, psi)	538 (5.5, 78)
Oil filter	Filter type				Full-flow filter type
	Filtration area	Outer diameter: 68 mm (2.68 in) (black)		cm^2 (sq in)	800 (124)
		Outer diameter: 67.4 mm (2.65 in) (blue)			555 (86)
	By-pass valve opening pressure			kPa (kg/cm^2, psi)	160 (1.63, 23.2)

	Outer diameter × Width mm (in)	Outer diameter: 68 mm (2.68 in) (black)	68 × 65 (2.68 × 2.56)
		Outer diameter: 67.4 mm (2.65 in) (blue)	67.4 × 65.3 (2.65 × 2.57)
	Installation screw specifications		M 20 × 1.5
Oil pressure switch	Type		Immersed contact point type
	Operating voltage — power consumption		12 V — 3.4 W or less
	Warning light operating pressure	kPa (kg/cm^2, psi)	14.7 (0.15, 2.1)
	Proof pressure	kPa (kg/cm^2, psi)	1,180 (12, 171.1) or more
Engine oil	Total capacity (at overhaul)	L (US qt, Imp qt)	5.0 (5.3, 4.4)
	When replacing engine oil and oil filter	L (US qt, Imp qt)	4.3 (4.5, 3.8)
	When replacing engine oil only	L (US qt, Imp qt)	4.0 (4.2, 3.5)

Specified oil:

Caution:

- **Use 5W-30 (synthetic oil).**
- **It is acceptable to fill an engine with oil of another brand when replacing the oil, but make sure to use the following engine oil specified by Subaru.**

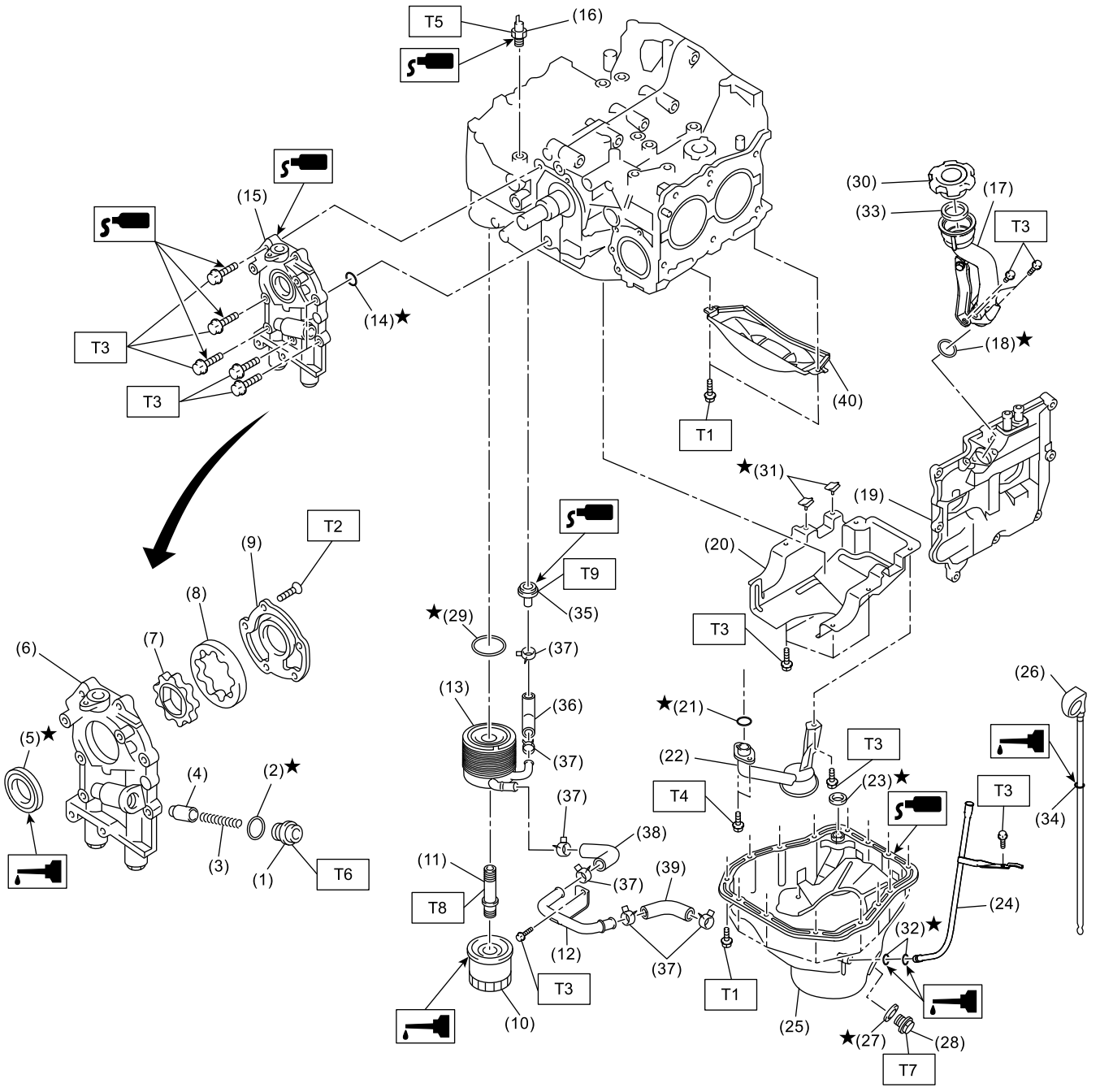
Engine oil standard		SAE viscosity No.
 RM-00081 Those with SN or SN PLUS "Resource Conserving" logo in case of API standard.	or	 RM-00002 Those with GF-5 "starburst mark" displayed on top of the container in case of ILSAC standard.	5W-30 (synthetic oil)

Note:

The proper viscosity oil helps the engine maintain its ideal temperature, and cranking speed increased by reducing viscosity friction in hot condition.

COMPONENT

1. OIL PUMP AND OIL PAN



LU-10099

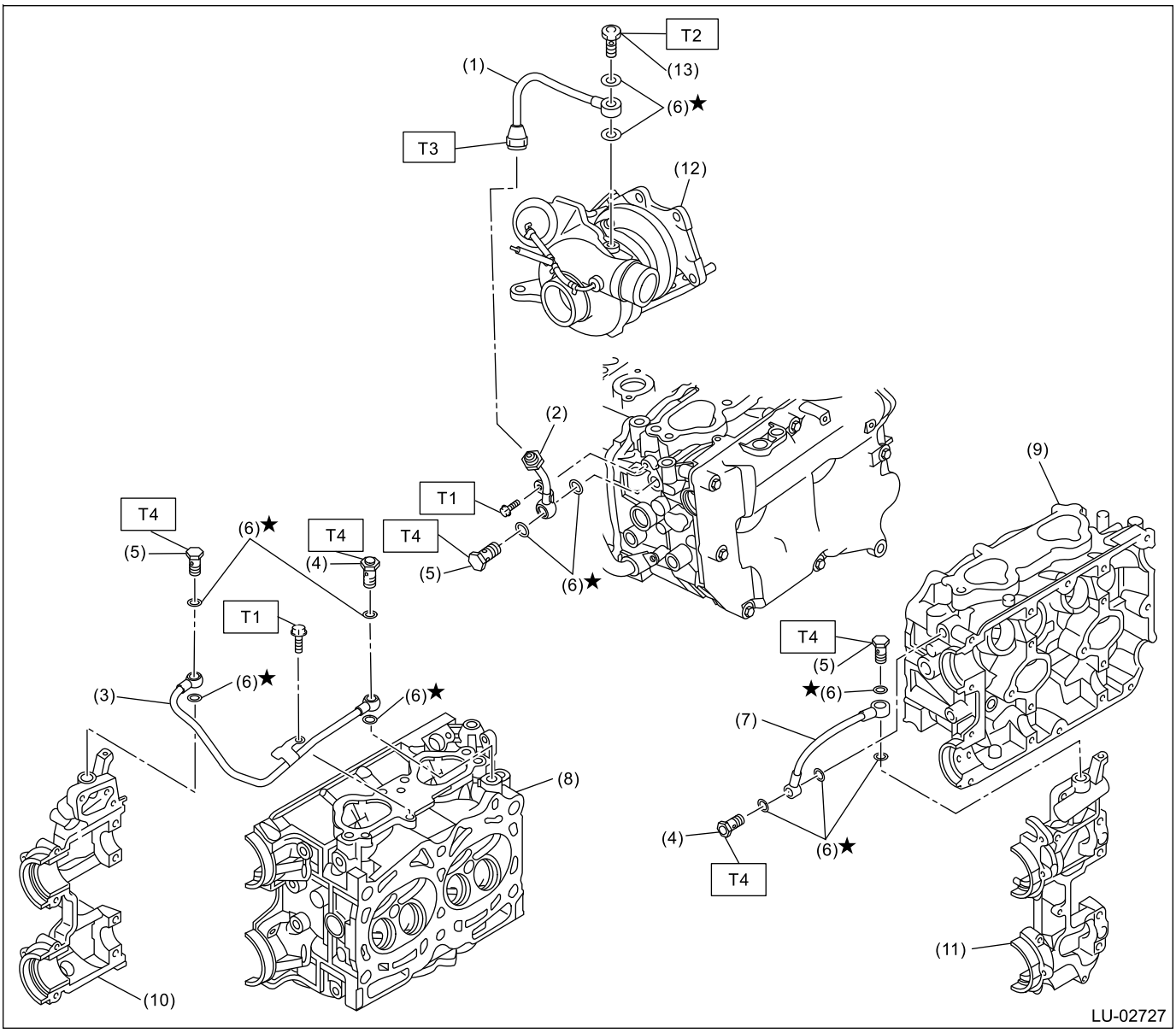
(1) Plug
(2) Gasket
(3) Relief valve spring
(4) Relief valve
(5) Front oil seal
(19) Rocker cover
(20) Baffle plate
(21) O-ring
(22) Oil strainer
(23) Gasket
(37) Clip
(38) Oil cooler hose B
(39) Oil cooler hose C
(40) Clutch housing cover

(6) Oil pump case
(7) Inner rotor
(8) Outer rotor
(9) Oil pump cover
(10) Oil filter
(11) Oil cooler connector
(12) Oil cooler pipe
(13) Oil cooler
(14) O-ring
(15) Oil pump ASSY
(16) Oil pressure switch
(17) Oil filler duct
(18) O-ring
(24) Oil level gauge guide
(25) Oil pan
(26) Oil level gauge
(27) Drain plug gasket
(28) Drain plug
(29) Gasket
(30) Oil filler cap
(31) Seal
(32) O-ring
(33) Gasket
(34) O-ring
(35) Nipple
(36) Oil cooler hose A

Tightening torque: N·m (kgf-m, ft-lb)

T1: 5 (0.5, 3.7)
T2: 5.4 (0.6, 4.0)
T3: 6.4 (0.7, 4.7)
T4: 10 (1.0, 7.0)
T5: 25 (2.5, 18.4)
T6: 44 (4.5, 32.5)
T7: 46.5 (4.7, 34.3)
T8: 54 (5.5, 39.8)
T9: 69 (7.0, 50.9)

2. OIL PIPE



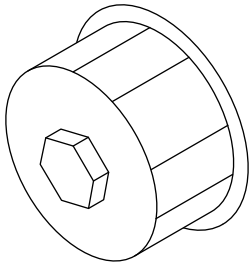
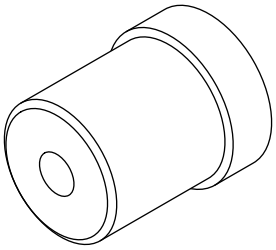
(1)	Oil inlet pipe	(8)	Cylinder head RH	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Turbocharger oil pipe	(9)	Cylinder head LH	***T1: 6.4 (0.7, 4.7)***
(3)	Oil pipe RH	(10)	Front camshaft cap RH	***T2: 16 (1.6, 11.8)***
(4)	Union bolt with filter (with protrusion)	(11)	Front camshaft cap LH	***T3: 20 (2.0, 14.8)***
(5)	Union bolt without filter (without protrusion)	(12)	Turbocharger	***T4: 31.5 (3.2, 23.2)***
(6)	Gasket	(13)	Union bolt without filter (with protrusion)	
(7)	Oil pipe LH			

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Prepare a container and cloth when performing work which oil possibly spills. If oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emitting smoke or causing a fire.
- Follow all government and local regulations concerning disposal of refuse when disposing of oil.
- Always use new application oil during work.

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST18332AA000	18332AA000	OIL FILTER WRENCH	Used for removing and installing oil filter (black). (Outer diameter: 68 mm (2.68 in)) **Note:** • **This tool is made by KYOTO TOOL CO., LTD. (KTC). Item number: AVSA-067** • **To make it easier to obtain, it has been specified as a special tool.**
 ST-499587100	499587100	OIL SEAL INSTALLER	Used for installing oil seal into oil pump.
 STSSM4	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

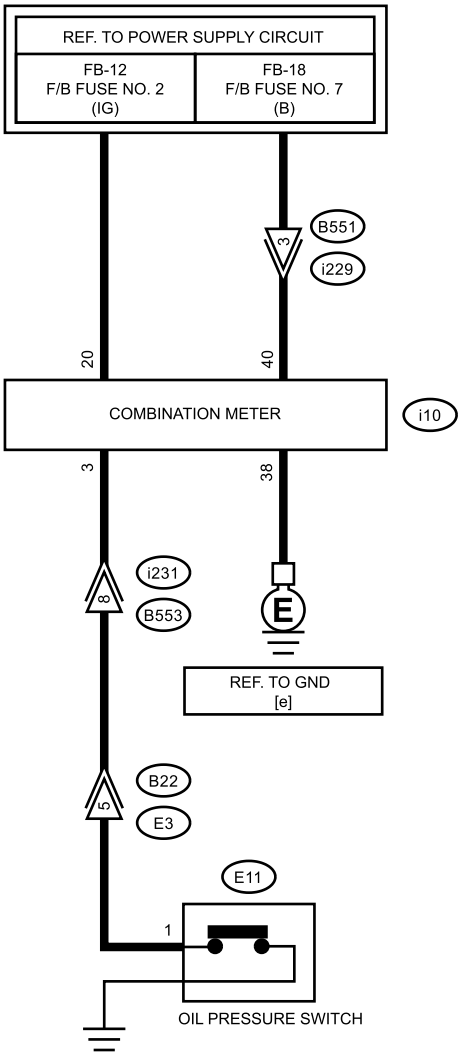
2. GENERAL TOOL

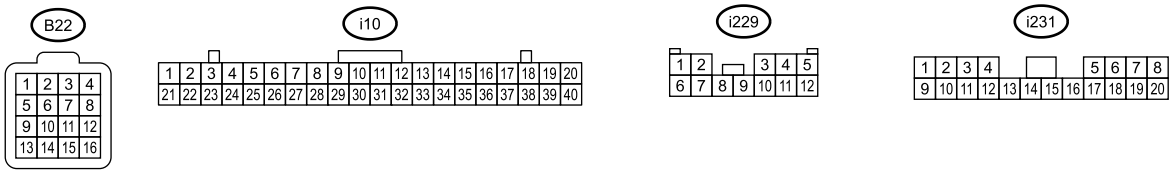
TOOL NAME	REMARKS
Oil filter wrench (65/67 mm 14 Flutes)	Used for removing and installing oil filter (blue). (Outer diameter: 67.4 mm (2.65 in)) **Caution:** **When using this oil filter wrench, be careful not to damage the oil filter.**
Circuit tester	Used for measuring resistance, voltage and current.

LUBRICATION(STI) > Oil Pressure System

WIRING DIAGRAM

Oil pressure warning system Ref. to WIRING SYSTEM>Oil Pressure Warning Light System>WIRING DIAGRAM.





LU-10085

LUBRICATION(STI) > Oil Pressure System

INSPECTION

1. CHECK ENGINE OIL AMOUNT.

Is the engine oil amount normal? Ref. to LUBRICATION(STI)>Engine Oil>INSPECTION.

Yes	Go to 2.
No	Adjust the engine oil amount. Ref. to LUBRICATION(STI)>Engine Oil>INSPECTION. After the operation is complete, go to the next step. Go to 2.

2. CHECK DTC.

Is DTC for engine displayed? Ref. to ENGINE (DIAGNOSTICS)(STI)>Read Diagnostic Trouble Code (DTC).

Yes	Check the appropriate DTC using the "List of Diagnostic Trouble Code (DTC)". Ref. to ENGINE (DIAGNOSTICS)(STI)>List of Diagnostic Trouble Code (DTC).
No	Go to 3.

3. CHECK POWER SUPPLY TO OIL PRESSURE SWITCH.

1. Turn the ignition switch to OFF.
2. Disconnect the terminal from oil pressure switch.
3. Turn the ignition switch to ON (engine OFF).
4. Measure the voltage of harness between oil pressure switch harness terminal and chassis ground.
   Terminals
   (E11) No. 1 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes	Replace the oil pressure switch. Ref. to LUBRICATION(STI)>Oil Pressure Switch.
No	Go to 4.

4. CHECK COMBINATION METER.

Perform the self-diagnosis of combination meter to check if there are any faults in the combination meter. Ref. to INSTRUMENTATION/DRIVER INFO>Combination Meter System>OPERATION.

Is combination meter OK?

Yes	Repair the harness and connector. **Note:** **In this case, repair the following item:** • **Open circuit or short circuit of harness between combination meter and oil pressure switch** • **Poor contact of combination meter connector** • **Poor contact of oil pressure switch terminal** • **Poor contact of coupling connector**
No	Repair or replace the combination meter. Ref. to INSTRUMENTATION/DRIVER INFO>Combination Meter System>INSPECTION.

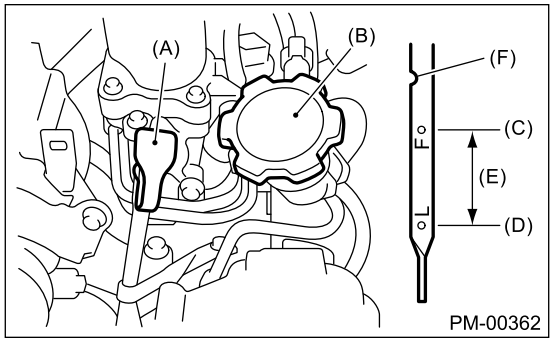
LUBRICATION(STI) > Engine Oil

INSPECTION

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Park the vehicle on a level surface.
2. Remove the oil level gauge and wipe away the oil.
3. Reinsert the oil level gauge all the way. Be sure that the oil level gauge is correctly inserted and properly orientated.
4. Pull out the oil level gauge again, and check the oil level. If the engine oil level is below "L" line, make sure that there is no oil leakage from the engine, then add oil to raise the level up to the "F" line.
5. Start the engine, and spread the oil in engine room.
6. After turning off the engine, wait for five minutes or more for the engine oil to return to the oil pan before checking the engine oil level.

   Note:
   - **To prevent overfilling of engine oil, do not add oil above "F" line when the engine is cold.**
   - **As the oil level gauge is used for daily maintenance, "F" line and "L" line is set assuming that the engine is cold.**



(A) Oil level gauge
(B) Engine oil filler cap
(C) "F" line
(D) "L" line
(E) Approx. 1.0 L (1.1 US qt, 0.9 Imp qt)
(F) Notch mark

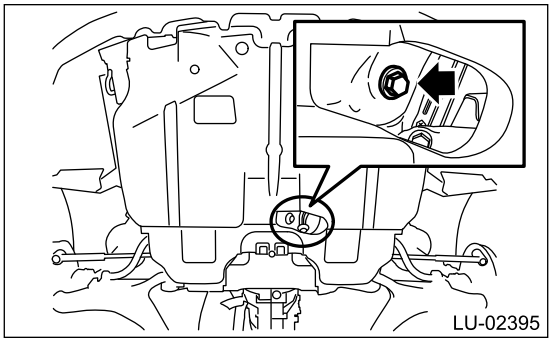
LUBRICATION(STI) > Engine Oil

REPLACEMENT

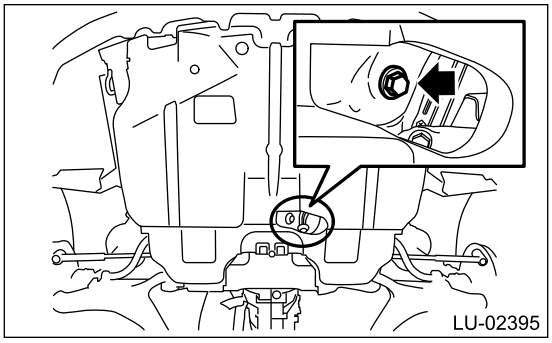
Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Open the engine oil filler cap for quick draining of engine oil.

2. Lift up the vehicle.
3. Drain engine oil by loosening the engine oil drain plug.
   Note:
   Prepare the container for draining of engine oil.



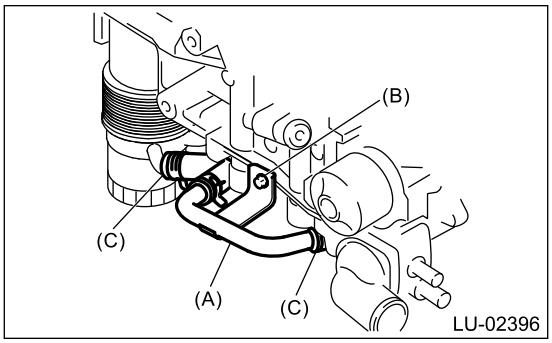
4. Tighten the engine oil drain plug after draining engine oil.
   Note:
   Use a new drain plug gasket.
   Tightening torque:
   46.5 N·m (4.7 kgf-m, 34.3 ft-lb)



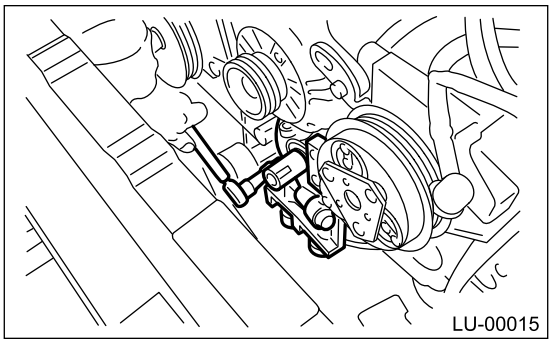
5. Lower the vehicle.
6. Using engine oil of proper quality and viscosity, fill engine oil through the filler duct to the "F" line on the oil level gauge. Make sure that the vehicle is parked on a level surface when checking oil level.
   Recommended oil:
   Refer to "SPECIFICATION" for recommended oil. Ref. to LUBRICATION(STI)>General Description>SPECIFICATION.
   Engine oil capacity:
   Refer to "SPECIFICATION" for engine oil capacity. Ref. to LUBRICATION(STI)>General Description>SPECIFICATION.
7. Close the engine oil filler cap.
8. Check the engine oil level. Ref. to LUBRICATION(STI)>Engine Oil>INSPECTION.

REMOVAL

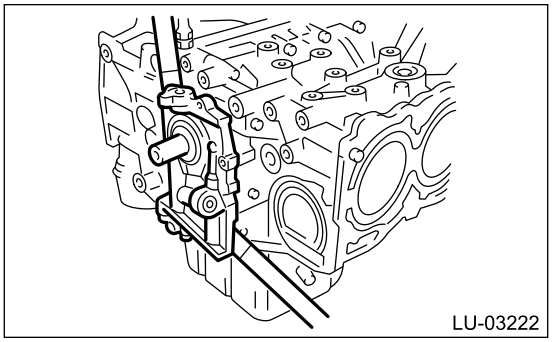
1. Disconnect the ground cable from battery.
2. Remove the radiator. Ref. to COOLING(STI)>Radiator>REMOVAL.
3. Lift up the vehicle.
4. Remove the bolt (B) which secures oil cooler pipe (A) to oil pump.
5. Remove the oil cooler pipe (A) and hose (C).



6. Lower the vehicle.
7. Remove the crankshaft position sensor.
   Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Crankshaft Position Sensor>REMOVAL.
8. Remove the water pump. Ref. to COOLING(STI)>Water Pump>REMOVAL.
9. Remove the crank sprocket. Ref. to MECHANICAL(STI)>Crank Sprocket>REMOVAL.
10. Remove the bolts which install oil pump onto cylinder block.
    Note:
    When disassembling and checking the oil pump, loosen the relief valve plug before removing the oil pump.



11. Remove the oil pump from cylinder block using a crowbar.
    Caution:
    Be careful not to scratch mating surfaces of cylinder block and oil pump.



12. Remove the front oil seal from the oil pump.

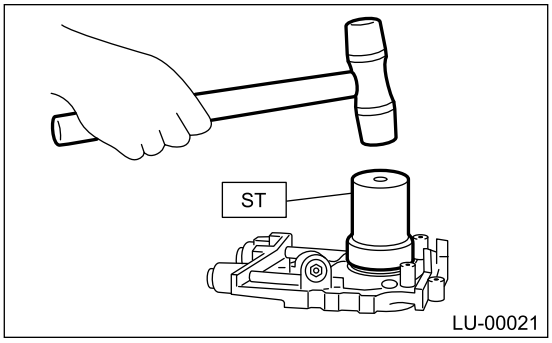
LUBRICATION(STI) > Oil Pump

INSTALLATION

1. Using the ST, install the front oil seal.

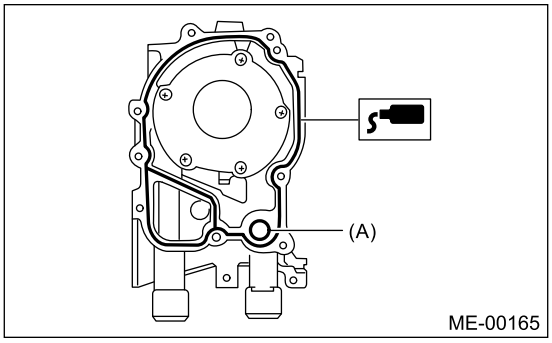
ST 499587100 OIL SEAL INSTALLER

Note:
Use a new front oil seal.



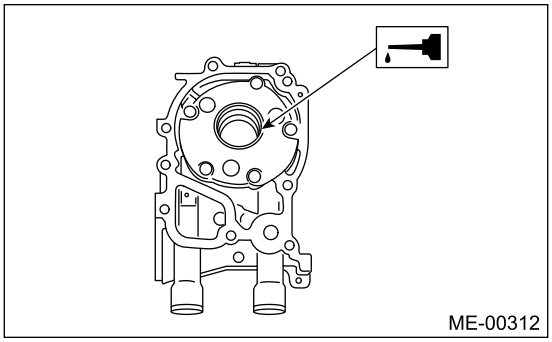
2. Apply liquid gasket to the mating surfaces of oil pump.

Note:
Install within 5 min. after applying liquid gasket.
Liquid gasket:
THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent



(A) O-ring

3. Apply a coat of engine oil to the inside of front oil seal.



4. Install the oil pump to cylinder block.

Caution:

- **Be careful not to damage the front oil seal during installation.**
- **Make sure the front oil seal lip is not folded.**

Note:

- **Align the flat surface of oil pump's inner rotor with that of crankshaft before installation.**
- **Use new O-rings.**
- **Do not forget to install O-rings.**

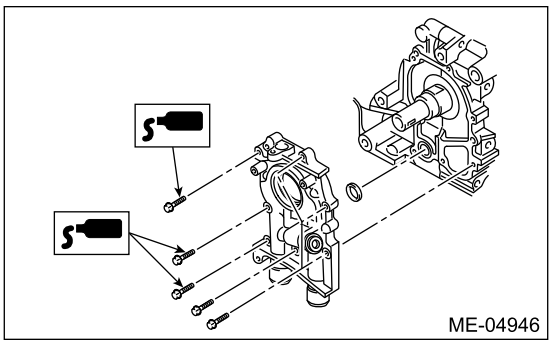
5. Apply liquid gasket to the three bolts thread shown in figure. (When reusing bolts)

Liquid gasket:

THREE BOND 1324 (Part No. 004403042) or equivalent

Tightening torque:

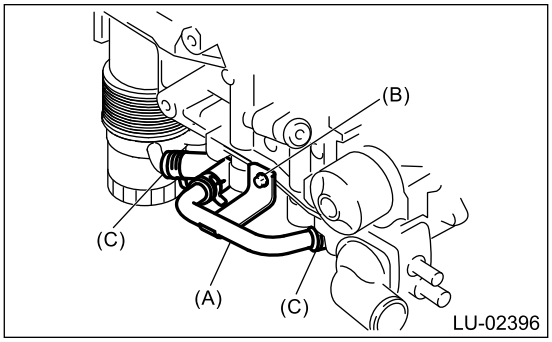
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



6. Install the crank sprocket. Ref. to MECHANICAL(STI)>Crank Sprocket>INSTALLATION.
7. Install the water pump. Ref. to COOLING(STI)>Water Pump>INSTALLATION.
8. Install the crankshaft position sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Crankshaft Position Sensor>INSTALLATION.
9. Lift up the vehicle.
10. Install oil cooler pipe (A) and hose (C).
11. Install the oil cooler pipe (A) to oil pump using the bolts (B).

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



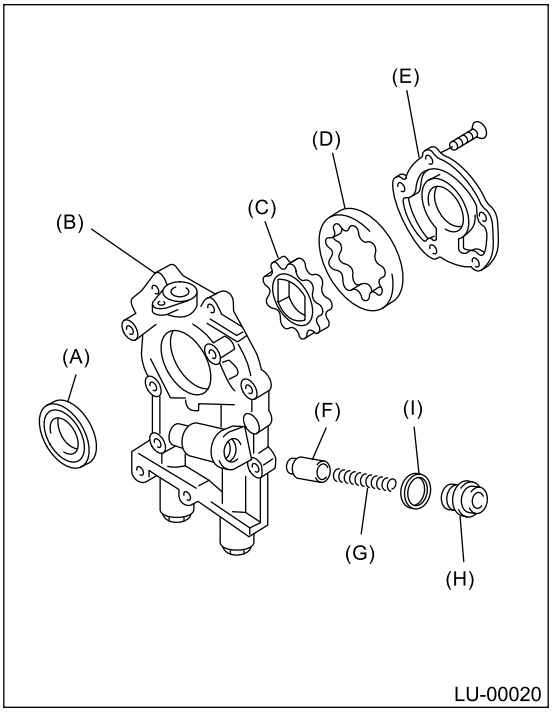
12. Lower the vehicle.
13. Install the radiator. Ref. to COOLING(STI)>Radiator>INSTALLATION.
14. Connect the battery ground terminal.

LUBRICATION(STI) > Oil Pump

DISASSEMBLY

Remove the screw which secures oil pump cover and then disassemble oil pump. Inscribe alignment marks on the inner rotor and outer rotor so that they can be replaced in their original positions during reassembly.

Note:
Before disassembling the oil pump, remove the relief valve.



(A) Front oil seal
(B) Oil pump case
(C) Inner rotor
(D) Outer rotor
(E) Oil pump cover
(F) Relief valve

(G) Relief valve spring

(H) Plug

(I) Gasket

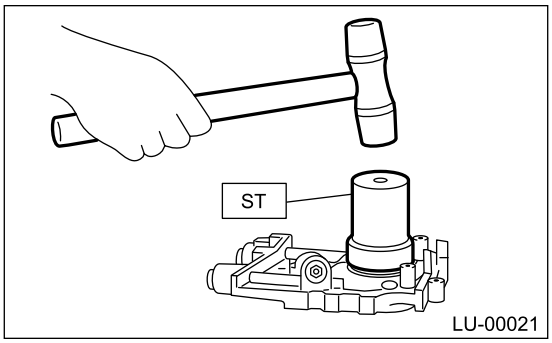
LUBRICATION(STI) > Oil Pump

ASSEMBLY

1. Using the ST, install the front oil seal.

ST 499587100 OIL SEAL INSTALLER

Note:
Use a new front oil seal.



2. Apply a coat of engine oil to the inner rotor and outer rotor.
3. Install the inner rotor and outer rotor.
4. Assemble the oil relief valve and install relief valve spring and plug.

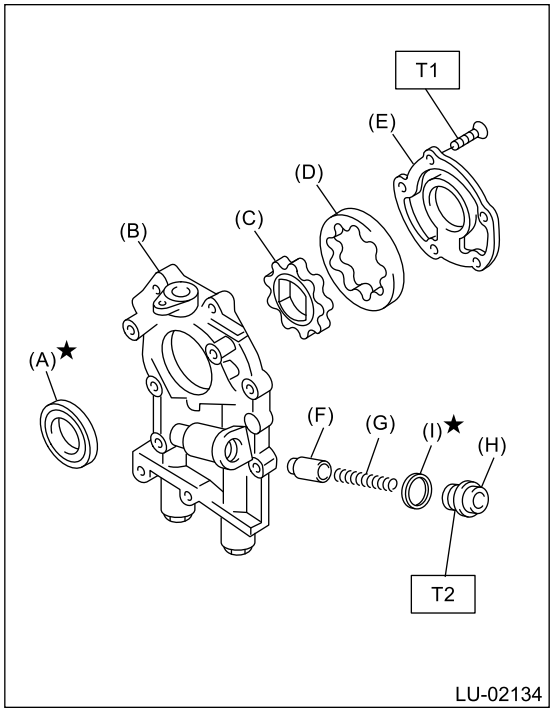
Note:
Use a new gasket.

5. Install the oil pump cover.

Tightening torque:

T1: 5.4 N·m (0.6 kgf-m, 4.0 ft-lb)

T2: 44 N·m (4.5 kgf-m, 32.5 ft-lb)



(A) Front oil seal
(B) Oil pump case
(C) Inner rotor
(D) Outer rotor
(E) Oil pump cover
(F) Relief valve
(G) Relief valve spring
(H) Plug
(I) Gasket

LUBRICATION(STI) > Oil Pump

INSPECTION

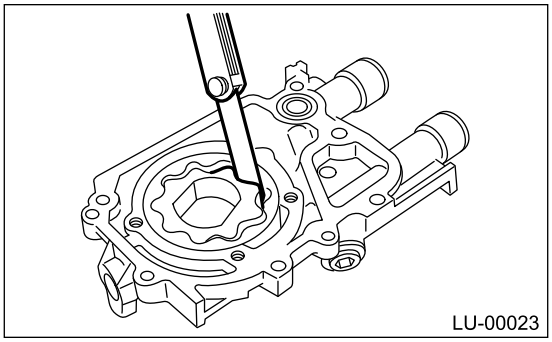
1. TIP CLEARANCE

Measure the tip clearance of rotors. If the clearance is out of standard, replace the rotors as a set.

Tip clearance between inner and outer rotors:

Standard

0.04 — 0.14 mm (0.0016 — 0.0055 in)



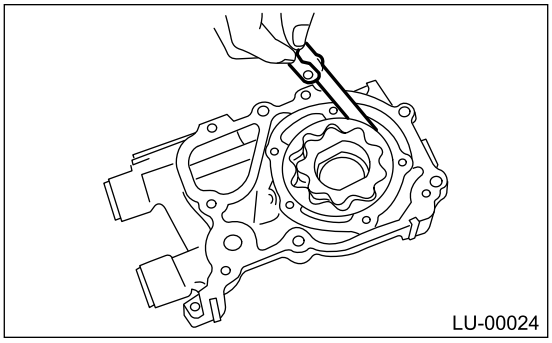
2. CASE CLEARANCE

Measure the clearance between outer rotor and oil pump case. If clearance exceeds the standard, replace the oil pump case.

Case clearance between outer rotor and pump case:

Standard

0.10 — 0.175 mm (0.0039 — 0.0069 in)



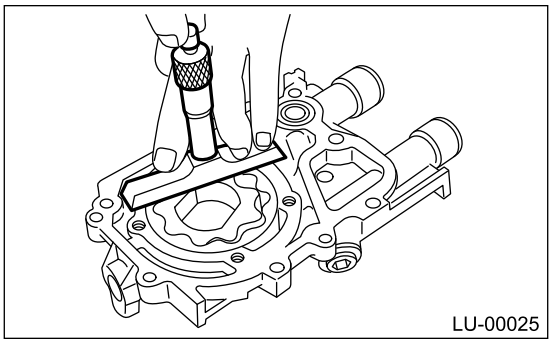
3. SIDE CLEARANCE

Measure the gap between the inner rotor and the oil pump case to measure the clearance between the inner rotor and the oil pump cover as shown in the figure. If clearance is out of standard, replace the rotor or the oil pump case.

Side clearance between inner rotor and pump case:

Standard

0.02 — 0.07 mm (0.0008 — 0.0028 in)



4. OIL RELIEF VALVE

Check the valve for assembly condition and damage, and the relief valve spring for damage and deterioration.
Replace the parts if defective.

Relief valve spring:

Free length

73.7 mm (2.902 in)

Installed length

54.7 mm (2.154 in)

Load when installed

93.1 N (9.49 kgf, 20.93 lbf)

5. OIL PUMP CASE

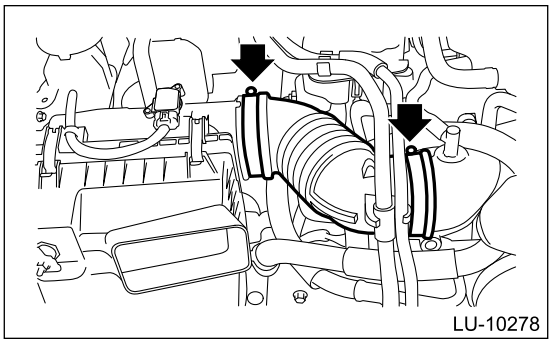
Check for worn shaft hole, clogged oil passage, worn rotor chamber, cracks and other faults.

6. FRONT OIL SEAL

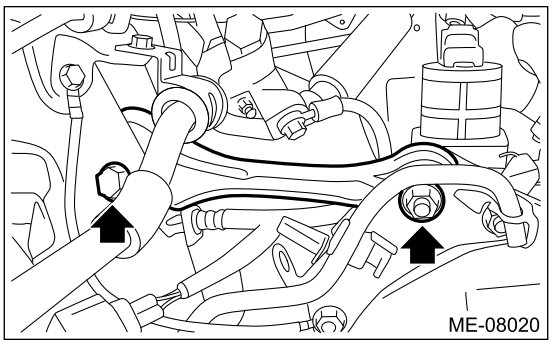
Check the front oil seal lips for deformation, hardening, wear, etc. and replace if defective.

REMOVAL

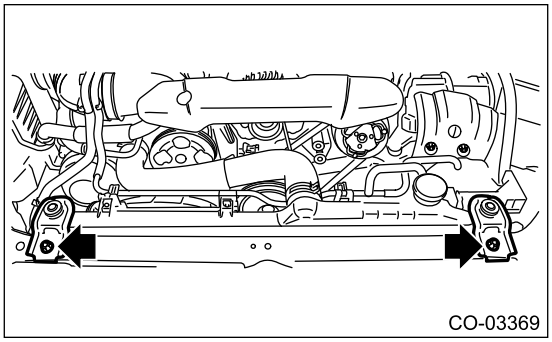
1. Disconnect the ground cable from battery.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>REMOVAL.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
4. Remove the air intake boot.



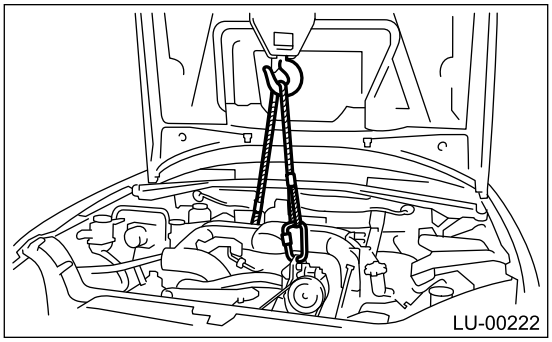
5. Remove the pitching stopper.



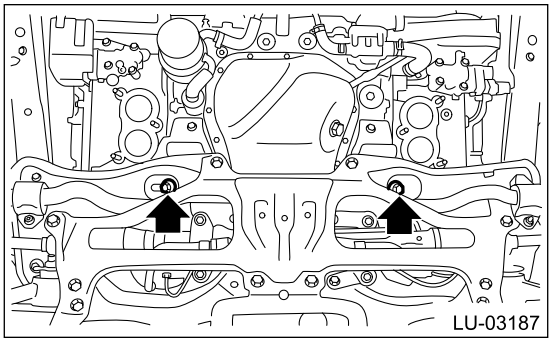
6. Remove the radiator upper brackets.



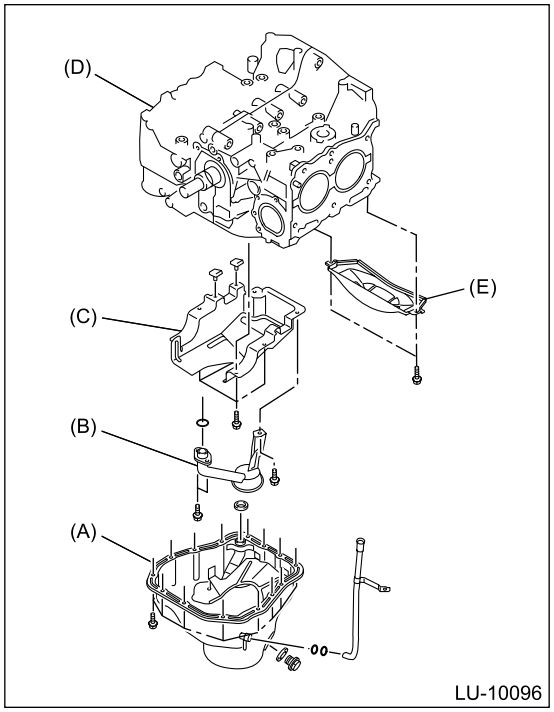
7. Support the engine with a lifting device and wire ropes.



8. Lift up the vehicle.
   Caution:
   When lifting up the vehicle, raise up wire ropes at the same time.
9. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
10. Drain the engine oil. Ref. to LUBRICATION(STI)>Engine Oil>REPLACEMENT.
11. Remove the front exhaust pipe. Ref. to EXHAUST(STI)>Front Exhaust Pipe>REMOVAL.
12. Remove the nuts which secure the engine mounting to the front crossmember.



13. Remove the bolts which secure oil pan on cylinder block with the engine raised up.
14. Insert an oil pan cutter blade between cylinder block-to-oil pan clearance and remove the oil pan.
    Caution:
    Do not use a screwdriver or similar tool in place of oil pan cutter.
15. Remove the oil strainer.
16. Remove the baffle plate.
17. Remove the clutch housing cover.



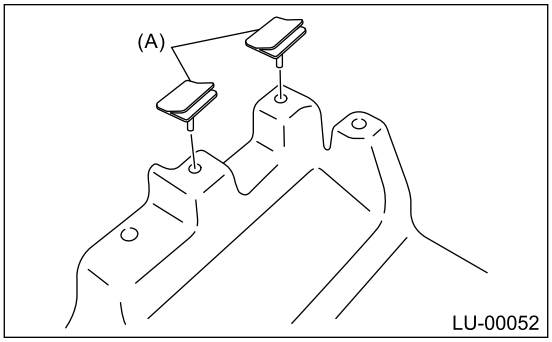
(A) Oil pan
(B) Oil strainer
(C) Baffle plate
(D) Cylinder block
(E) Clutch housing cover

LUBRICATION(STI) > Oil Pan and Strainer

INSTALLATION

Note:
Before installing the oil pan, clean the mating surface of oil pan and engine block.

1. Install the clutch housing cover.
   Tightening torque:
   5 N·m (0.5 kgf-m, 3.7 ft-lb)
2. Make sure that the seals (A) are installed securely on the baffle plate in a direction as shown in the figure below.
   Note:
   Use a new seal.



3. Install the baffle plate.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

4. Install the oil strainer to cylinder block.

Note:

Use new O-rings.

Tightening torque:

10 N·m (1.0 kgf-m, 7.4 ft-lb)

5. Tighten the oil strainer stay together with the baffle plate.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

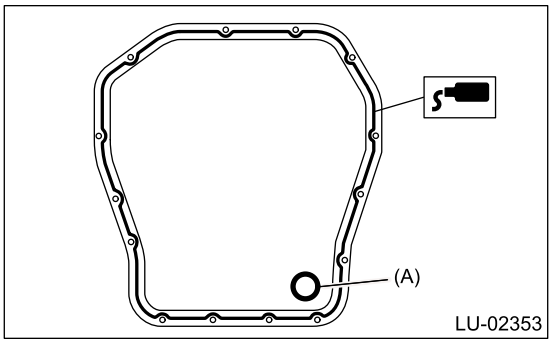
6. Apply liquid gasket to the mating surfaces of oil pan, and install the oil pan.

Note:

- **Use a new gasket.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent



(A) Gasket

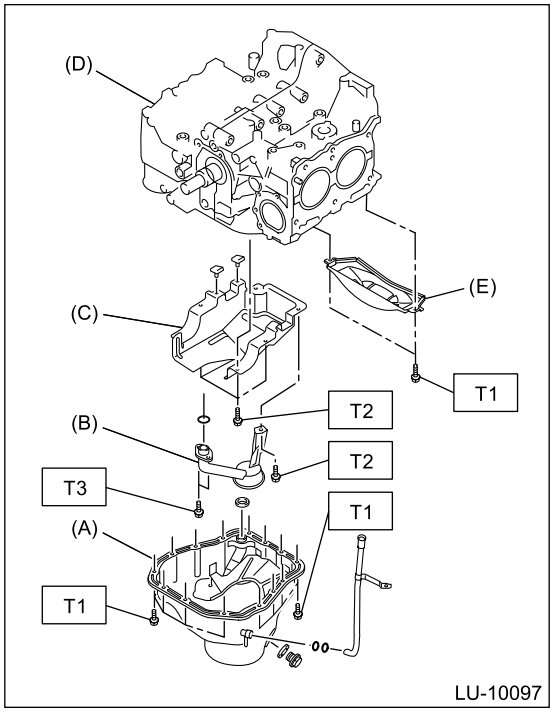
7. Tighten the bolts which install oil pan to cylinder block.

Tightening torque:

T1: 5 N·m (0.5 kgf-m, 3.7 ft-lb)

T2: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T3: 10 N·m (1.0 kgf-m, 7.4 ft-lb)

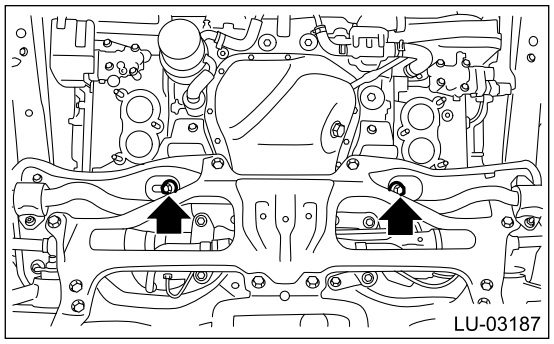


(A) Oil pan
(B) Oil strainer
(C) Baffle plate
(D) Cylinder block
(E) Clutch housing cover

8. Lower the engine onto front crossmember.
9. Install the nuts which hold the engine mounting to the front crossmember.

Note:
Use a new nut.

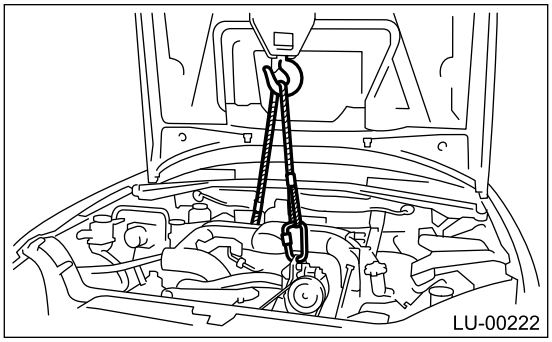
Tightening torque:
60 N·m (6.1 kgf-m, 44.3 ft-lb)



10. Install the front exhaust pipe. Ref. to EXHAUST(STI)>Front Exhaust Pipe>INSTALLATION.
11. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
12. Lower the vehicle.

Caution:
When lowering the vehicle, lower the lift up device and wire ropes at the same time.

13. Remove the lifting device and wire ropes.

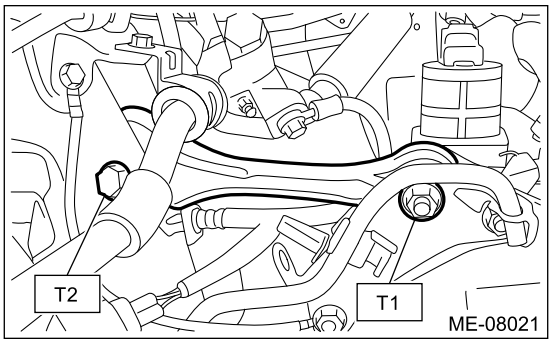


14. Install the pitching stopper.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

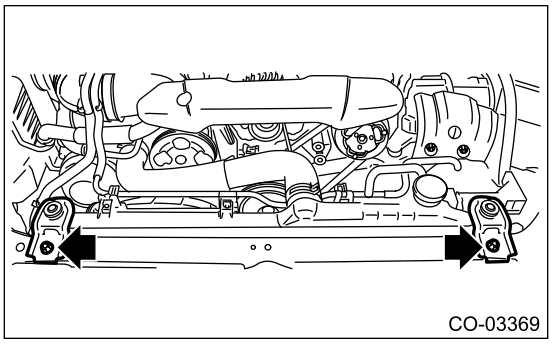
T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)



15. Install the radiator upper brackets.

Tightening torque:

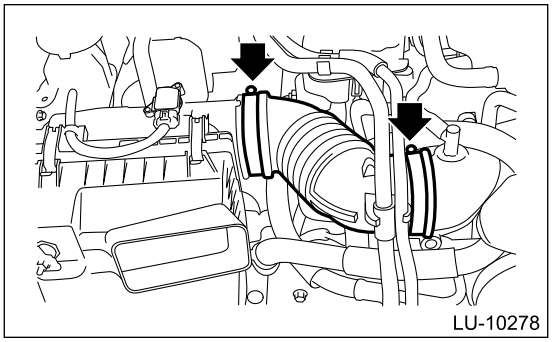
12 N·m (1.2 kgf-m, 8.9 ft-lb)



16. Install the air intake boot.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)



17. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.
18. Install the air intake duct. Ref. to INTAKE (INDUCTION)(STI)>Air Intake Duct>INSTALLATION.
19. Connect the battery ground terminal.
20. Refill the engine oil. Ref. to LUBRICATION(STI)>Engine Oil>REPLACEMENT.

LUBRICATION(STI) > Oil Pan and Strainer

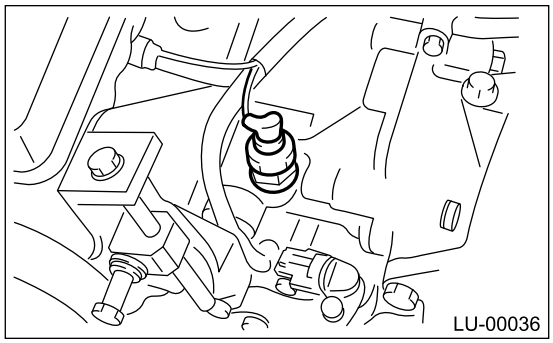
INSPECTION

Check that the oil pan, oil strainer and baffle plate do not have deformation, cracks or damage.

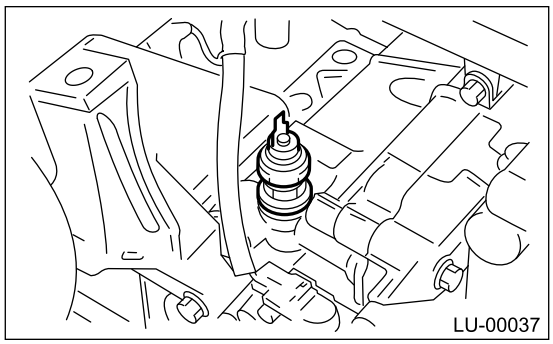
LUBRICATION(STI) > Oil Pressure Switch

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the generator from the bracket. Ref. to STARTING/CHARGING SYSTEMS(STI)>Generator>REMOVAL.
3. Disconnect the terminal from oil pressure switch.



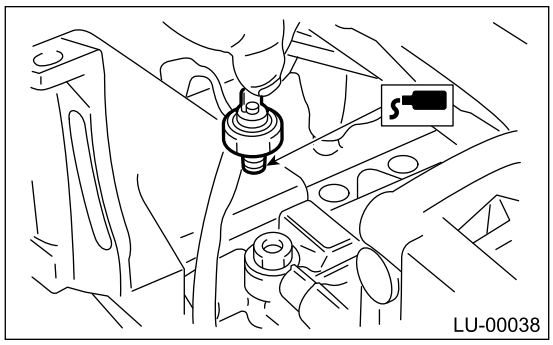
4. Remove the oil pressure switch.



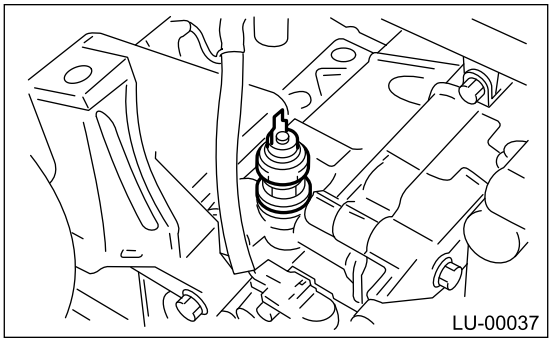
LUBRICATION(STI) > Oil Pressure Switch

INSTALLATION

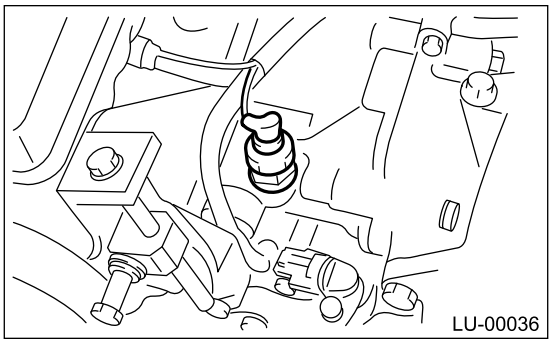
1. Apply liquid gasket to the oil pressure switch threads.
   Liquid gasket:
   THREE BOND 1324 (Part No. 004403042) or equivalent



2. Install the oil pressure switch to cylinder block.
   Tightening torque:
   25 N·m (2.5 kgf-m, 18.4 ft-lb)



3. Connect the terminal to the oil pressure switch.



4. Install the generator to the bracket. Ref. to STARTING/CHARGING SYSTEMS(STI)>Generator>INSTALLATION.
5. Connect the battery ground terminal.

LUBRICATION(STI) > Oil Pressure Switch

INSPECTION

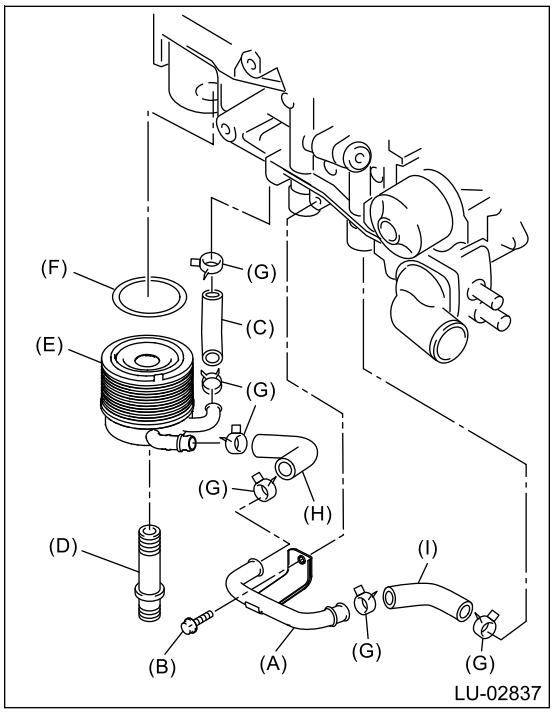
1. Check that the oil pressure switch does not have deformation, cracks or damage.
2. Check that there are no oil leaks or oil oozing from the oil pressure switch installation portion.

LUBRICATION(STI) > Engine Oil Cooler

REMOVAL

Caution:
If engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Drain engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
2. Remove the engine oil filter. Ref. to LUBRICATION(STI)>Engine Oil Filter>REMOVAL.
3. Remove the bolt (B) holding the oil cooler pipe (A) to the oil pump.
4. Remove the oil cooler pipe (A), oil cooler hose A (C), oil cooler hose B (H), and oil cooler hose C (I).
5. Remove the oil cooler connector (D) and oil cooler (E).



(A) Oil cooler pipe
(B) Bolt
(C) Oil cooler hose A
(D) Oil cooler connector
(E) Oil cooler
(F) Gasket
(G) Clip
(H) Oil cooler hose B
(I) Oil cooler hose C

LUBRICATION(STI) > Engine Oil Cooler

INSTALLATION

Install in the reverse order of removal.

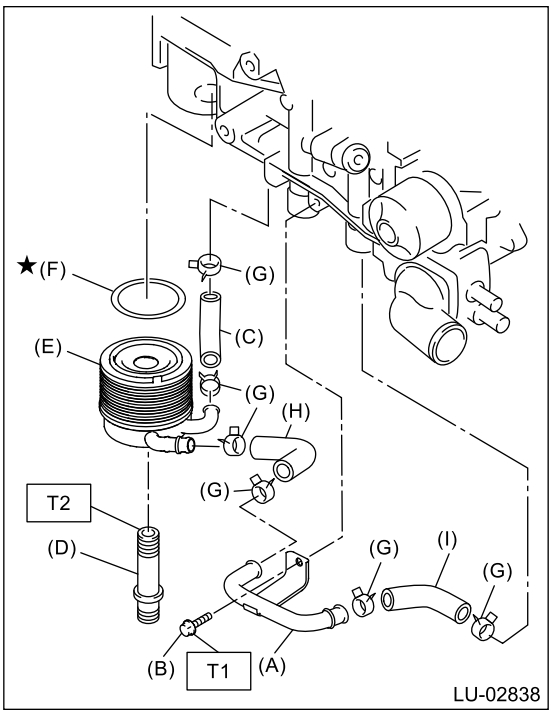
Note:

- **Use a new gasket.**
- **After installing, check the engine oil level and replenish it if necessary. Ref. to LUBRICATION(STI)>Engine Oil>INSPECTION.**

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 54 N·m (5.5 kgf-m, 39.8 ft-lb)



(A) Oil cooler pipe
(B) Bolt
(C) Oil cooler hose A
(D) Oil cooler connector
(E) Oil cooler
(F) Gasket
(G) Clip
(H) Oil cooler hose B
(I) Oil cooler hose C

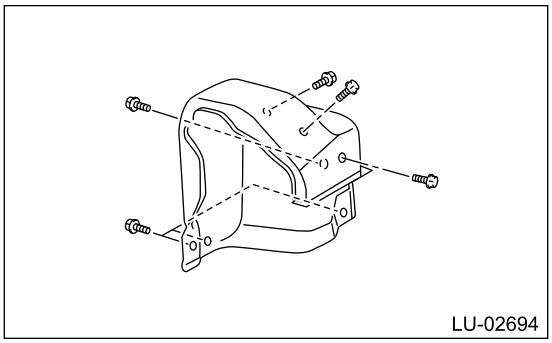
LUBRICATION(STI) > Engine Oil Cooler

INSPECTION

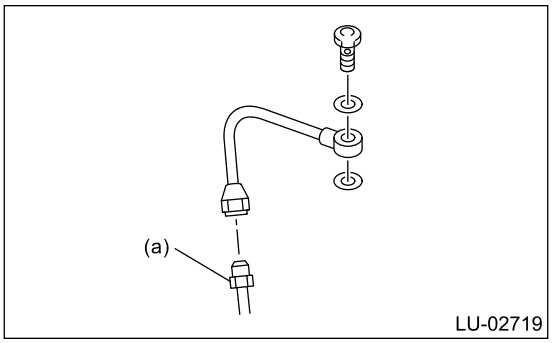
1. Check that the engine oil cooler, oil cooler pipe and oil cooler connector do not have deformation, cracks or damage.
2. Make sure the oil cooler hoses are not cracked, damaged or loose.
3. Blow with compressed air to make sure the coolant passages are not clogged.
4. Make sure the mating surfaces of the cylinder block do not have damage.

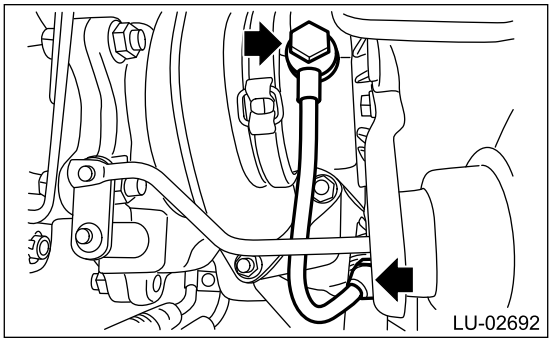
REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
3. Remove the turbocharger upper cover.

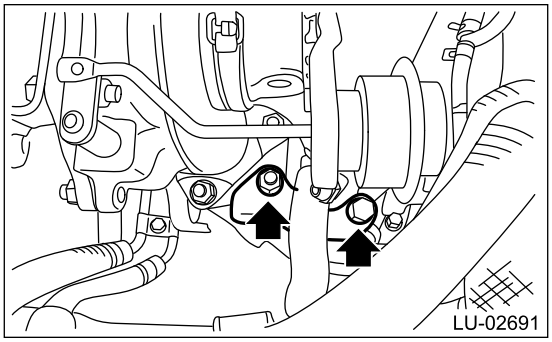


4. Remove the oil inlet pipe from the turbocharger.
   Caution:
   In order to prevent damaging the oil pipe on the cylinder head side, fix the section (a) shown in the figure when loosing the oil inlet pipe flare nut, and avoid the part from rotating together while loosening the nut.

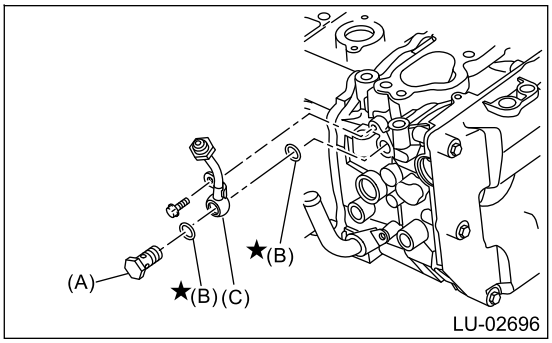




5. Remove the turbocharger stay.



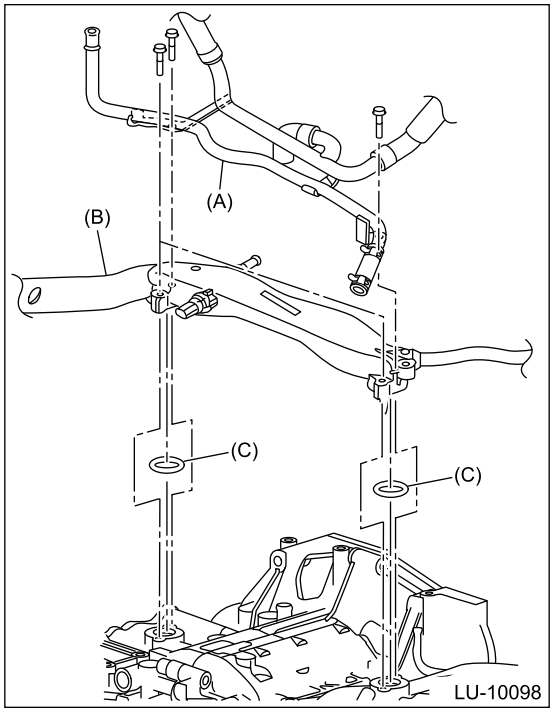
6. Remove the turbocharger oil pipe.



(A) Union bolt without filter (without protrusion)
(B) Gasket
(C) Turbocharger oil pipe

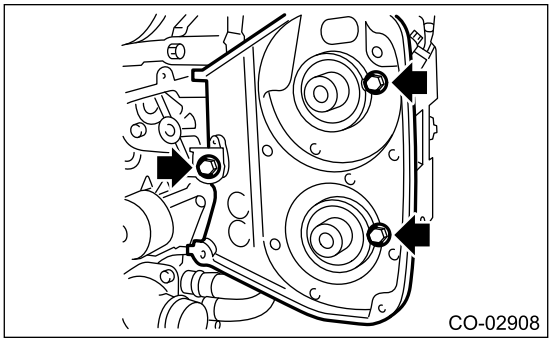
7. Drain engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
8. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>REMOVAL.
9. Remove the secondary air pump. (Oil pipe LH only) Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Pump>REMOVAL.
10. Remove the bolt securing the water tank pipe assembly, and place the water tank pipe assembly aside so that it does not interfere with the work. (Oil pipe RH only)
11. Remove the water pipe assembly. (Oil pipe RH only)

Note:
Do not remove the radiator inlet hose and heater outlet hose.

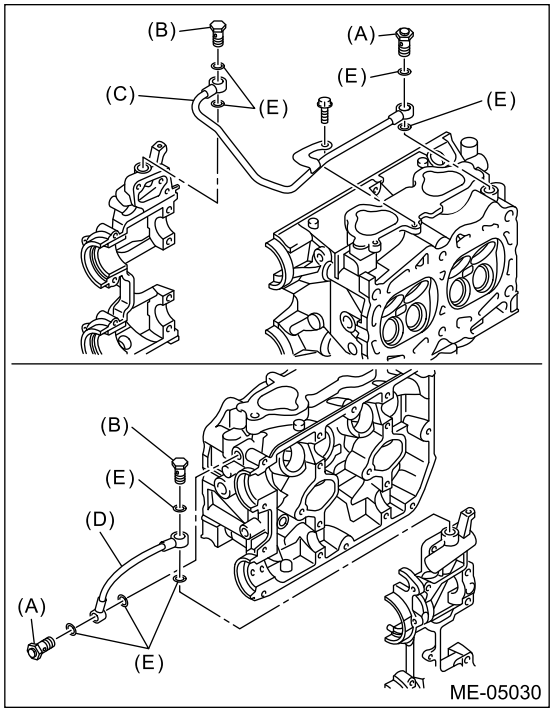


(A) Water tank pipe ASSY
(B) Water pipe ASSY
(C) O-ring

12. Remove the radiator main fan and radiator sub fan. Ref. to COOLING(STI)>Radiator Main Fan and Fan Motor>REMOVAL. Ref. to COOLING(STI)>Radiator Sub Fan and Fan Motor>REMOVAL.
13. Remove the V-belts. Ref. to MECHANICAL(STI)>V-belt>REMOVAL.
14. Remove the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>REMOVAL.
15. Remove the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>REMOVAL.
16. Remove the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>REMOVAL.
17. Remove the cam sprocket LH. Ref. to MECHANICAL(STI)>Cam Sprocket>REMOVAL.
18. Remove the timing belt cover No. 2 LH.



19. Remove the oil pipe.



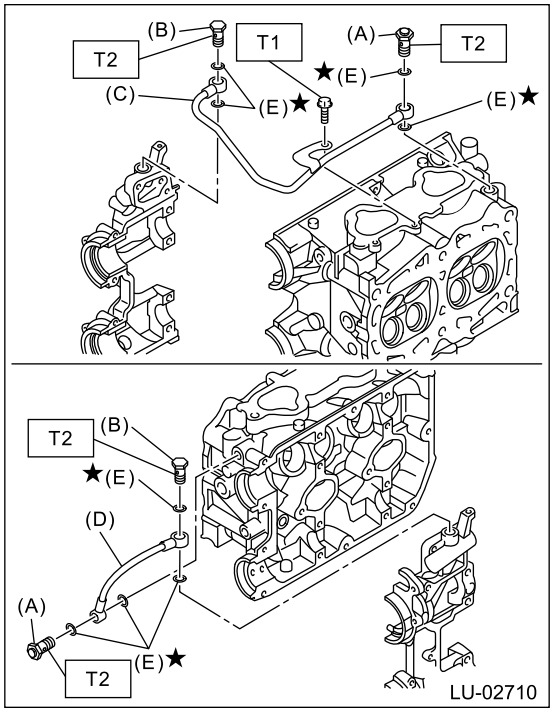
(A) Union bolt with filter (with protrusion)
(B) Union bolt without filter (without protrusion)
(C) Oil pipe RH
(D) Oil pipe LH
(E) Gasket

LUBRICATION(STI) > Oil Pipe

INSTALLATION

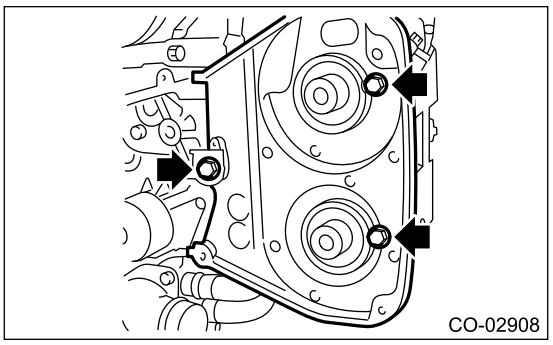
1. Inspect the union bolt with filter. Ref. to LUBRICATION(STI)>Oil Pipe>INSPECTION > INSPECTING UNION BOLT WITH FILTER.
2. Install the oil pipe.
   Note:
   - **Be careful of the install location of the union bolt; the location will differ depending on the presence of filter.**
   - **Use a new gasket.**

   Tightening torque:
   T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
   T2: 31.5 N·m (3.2 kgf-m, 23.2 ft-lb)



(A) Union bolt with filter (with protrusion)
(B) Union bolt without filter (without protrusion)
(C) Oil pipe RH
(D) Oil pipe LH
(E) Gasket

3. Install the timing belt cover No. 2 LH.
Tightening torque:
5 N·m (0.5 kgf-m, 3.7 ft-lb)

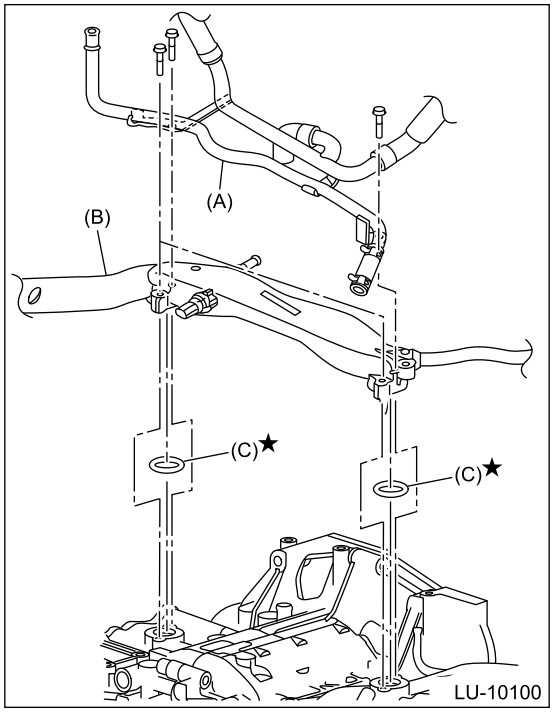


4. Install the cam sprocket LH. Ref. to MECHANICAL(STI)>Cam Sprocket>INSTALLATION.
5. Install the timing belt. Ref. to MECHANICAL(STI)>Timing Belt>INSTALLATION > TIMING BELT.
6. Install the timing belt cover. Ref. to MECHANICAL(STI)>Timing Belt Cover>INSTALLATION.
7. Install the crank pulley. Ref. to MECHANICAL(STI)>Crank Pulley>INSTALLATION.
8. Install the V-belts. Ref. to MECHANICAL(STI)>V-belt>INSTALLATION.
9. Install the radiator main fan and the radiator sub fan. Ref. to COOLING(STI)>Radiator Main Fan and Fan Motor>INSTALLATION. Ref. to COOLING(STI)>Radiator Sub Fan and Fan Motor>INSTALLATION.

10. Install the water tank pipe assembly and water pipe assembly. (Oil pipe RH only)

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)



(A) Water tank pipe ASSY

(B) Water pipe ASSY

(C) O-ring

11. Install the secondary air pump. (Oil pipe LH only) Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Pump>INSTALLATION.

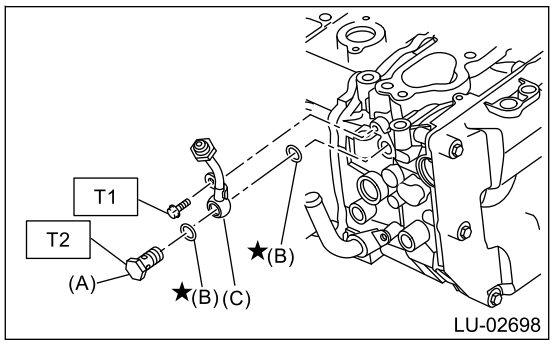
12. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(STI)>Intake Manifold>INSTALLATION.

13. Install the turbocharger oil pipe.

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 31.5 N·m (3.2 kgf-m, 23.2 ft-lb)



(A) Union bolt without filter (without protrusion)

(B) Gasket

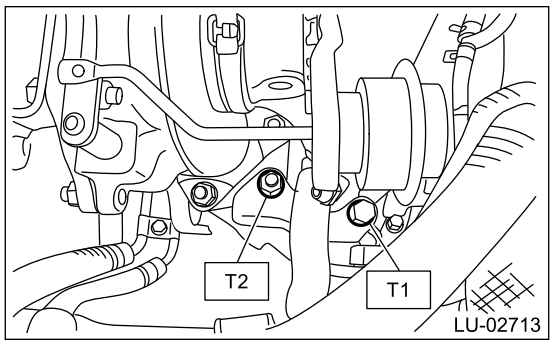
(C) Turbocharger oil pipe

14. Install the turbocharger stay.

Tightening torque:

T1: 33 N·m (3.4 kgf-m, 24.3 ft-lb)

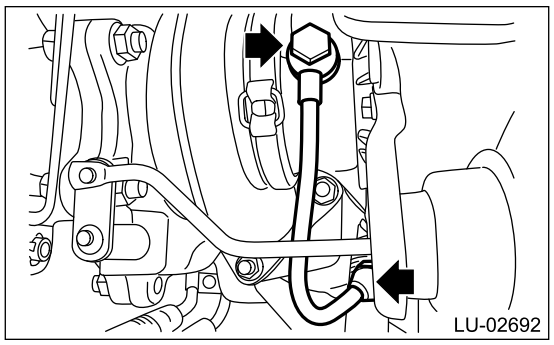
T2: 42.5 N·m (4.3 kgf-m, 31.3 ft-lb)



15. Temporarily tighten the bolts and flare nuts which secure the oil inlet pipe to the turbocharger.

Note:

Use a new gasket.



16. Tighten the union bolts and flare nuts which secure the oil inlet pipe to the turbocharger.

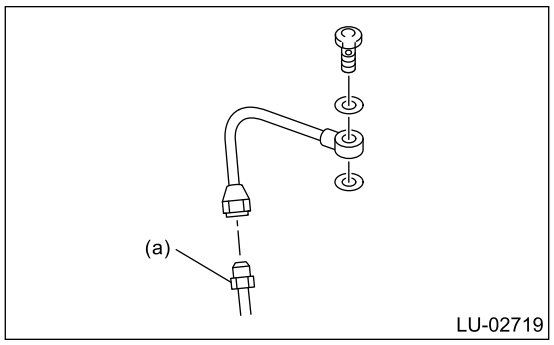
Caution:

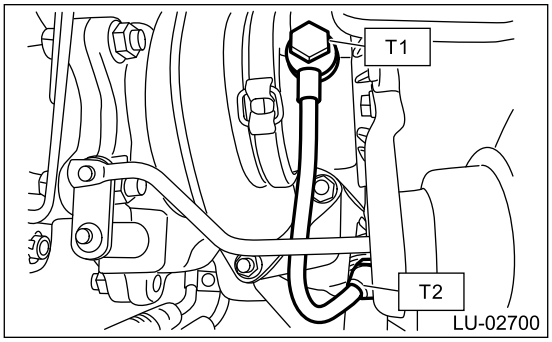
In order to prevent damaging the oil pipe on the cylinder head side, fix the section (a) shown in the figure when tightening the oil inlet pipe flare nut, and avoid the part from rotating together while tightening the nut.

Tightening torque:

T1: 16 N·m (1.6 kgf-m, 11.8 ft-lb)

T2: 20 N·m (2.0 kgf-m, 14.8 ft-lb)

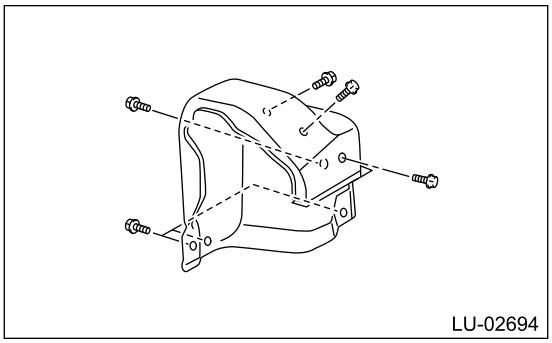




17. Attach the turbocharger upper cover.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



18. Install the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>INSTALLATION.

19. Connect the battery ground terminal.

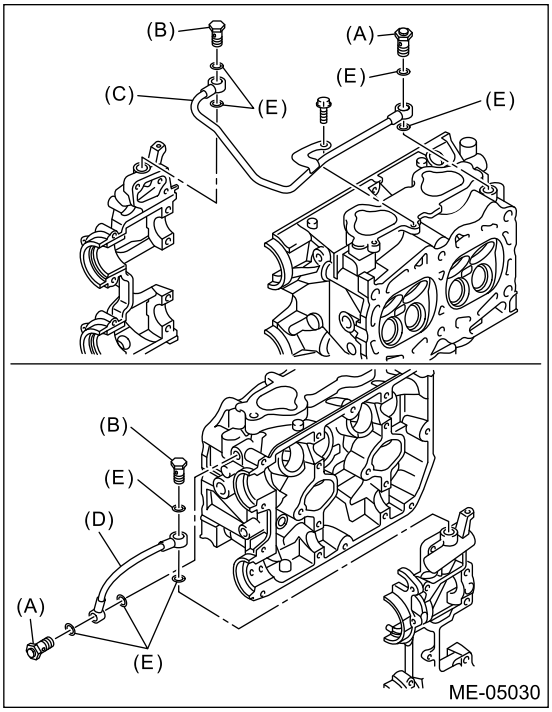
20. Fill engine coolant. Ref. to COOLING(STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

LUBRICATION(STI) > Oil Pipe

INSPECTION

1. INSPECTING UNION BOLT WITH FILTER

Check the filter part of union bolt for clogging or damage, and if defective, replace the union bolt with filter with the new part.



(A) Union bolt with filter (with protrusion)
(B) Union bolt without filter (without protrusion)
(C) Oil pipe RH
(D) Oil pipe LH
(E) Gasket

2. OTHER INSPECTIONS

1. Check that the oil pipe and union bolt have no deformation, cracks and other damages.
2. Check that there are no oil leaks or oil oozing from the oil pipe attachment section.

LUBRICATION(STI) > Engine Oil Filter

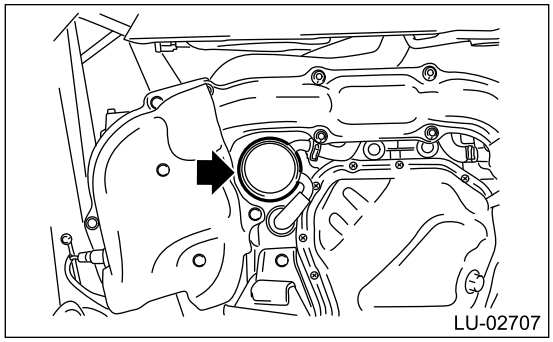
REMOVAL

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emitting smoke or causing a fire.

1. Lift up the vehicle.
2. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
3. Remove the oil filter.
   - Oil filter (black)
     Remove using the ST.

     ST 18332AA000
     OIL FILTER WRENCH (OUTER DIAMETER: 68 MM (2.68 IN) FOR OIL FILTER)

   - Oil filter (blue)
     Remove using a general tool (65/67 mm 14 Flutes).



LUBRICATION(STI) > Engine Oil Filter

INSTALLATION

Caution:
Do not tighten excessively, or oil may leak.

1. Clean the oil filter installation surface of the oil cooler.
2. Obtain a new oil filter and apply a thin coat of engine oil to the seal rubber.
3. Install the oil filter by turning it by hand, being careful not to damage the seal rubber of the oil filter.
   - Tighten the oil filter (black) with an outer diameter of 68 mm (2.68 in) (approx. 1 rotation) after the seal rubber of the oil filter comes in contact with oil cooler. When using a torque wrench, tighten to 14 N·m (1.4 kgf-m, 10.3 ft-lb).
   - Tighten the oil filter (blue) with an outer diameter of 67.4 mm (2.65 in) (approx. 7/8 rotation) after the seal rubber of the oil filter comes in contact with cylinder block. When using a torque wrench, tighten to 12 N·m (1.2 kgf-m, 8.9 ft-lb).
4. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
5. Lower the vehicle.
6. After installing, check the engine oil level and replenish it if necessary. Ref. to LUBRICATION(STI)>Engine Oil>INSPECTION.

INSPECTION

1. After installing the oil filter, run the engine and check for oil leakage around seal rubber.
   Note:
   The filter element and filter case are permanently jointed; therefore, interior cleaning is not necessary.
2. Check the engine oil level. Ref. to LUBRICATION(STI)>Engine Oil>INSPECTION.

INSPECTION

Before performing diagnostics, make sure that the engine oil level is correct and no oil leakage exists.

Trouble	Possible cause	Corrective action
Warning light remains ON.	a. Oil pressure switch failure	
	❍Cracked diaphragm or oil leakage within switch	Replace.
	❍Broken spring or seized contacts	Replace.
	b. Low oil pressure	
	❍Clogging of oil filter	Replace.
	❍Malfunction of oil by-pass valve in oil filter	Replace.
	❍Malfunction of oil relief valve in oil pump	Clean or replace.
	❍Clogged oil passage	Clean.
	❍Excessive tip clearance and side clearance of oil pump rotor	Replace.
	❍Clogged oil strainer or broken pipe	Clean or replace.
	c. No oil pressure	
	❍Insufficient engine oil (degradation, etc.)	Replace.
	❍Broken pipe of oil strainer	Replace.
	❍Stuck oil pump rotor	Replace.
Warning light does not illuminate.	a. Malfunction of combination meter	Replace.
	b. Poor contact of switch contact points	Replace.
	c. Disconnection of wiring	Repair.
Warning light flickers momentarily.	a. Defective terminal contact	Repair.
	b. Defective wiring harness	Repair.
	c. Oil pressure switch failure	
	❍Cracked diaphragm or oil leakage within switch	Replace.
	❍Broken spring or seized contacts	Replace.
	d. Low oil pressure	
	❍Clogging of oil filter	Replace.
	❍Malfunction of oil by-pass valve in oil filter	Replace.
	❍Malfunction of oil relief valve in oil pump	Clean or replace.
	❍Clogged oil passage	Clean.
	❍Excessive tip clearance and side clearance of oil pump rotor	Replace.
	❍Clogged oil strainer or broken pipe	Clean or replace.

SPEED CONTROL SYSTEMS(STI)

SP(STI)

1. General Description
2. Accelerator Pedal

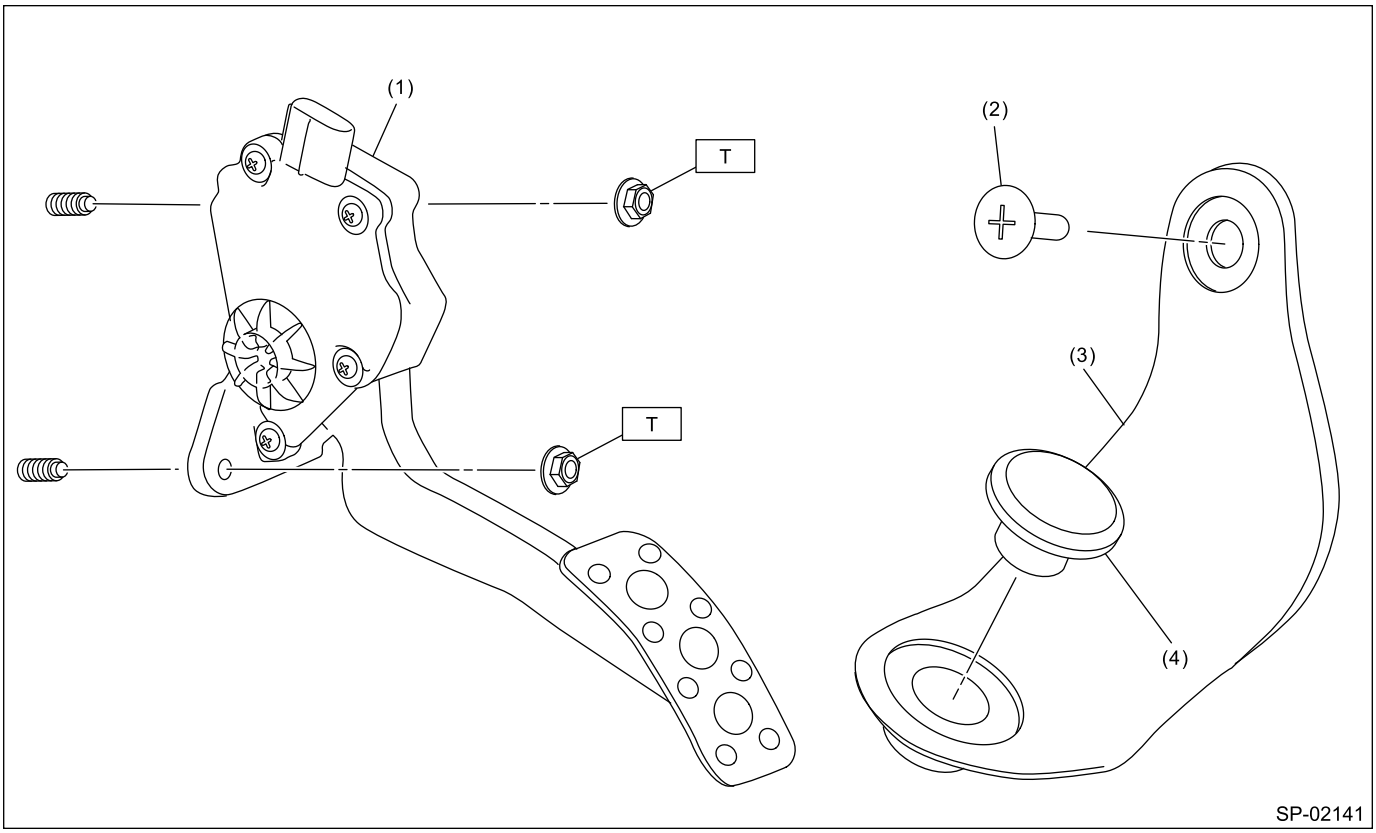
SPEED CONTROL SYSTEMS(STI) > General Description

SPECIFICATION

Accelerator pedal	Stroke	At pedal pad	50 — 59 mm (1.97 — 2.32 in)

SPEED CONTROL SYSTEMS(STI) > General Description

COMPONENT



(1) Accelerator pedal ASSY
(2) Clip
(3) Accelerator plate
(4) Accelerator stopper

Tightening torque: N·m (kgf-m, ft-lb)

T: 7.5 (0.8, 5.5)

SPEED CONTROL SYSTEMS(STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.

- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 STSSM4	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note: For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

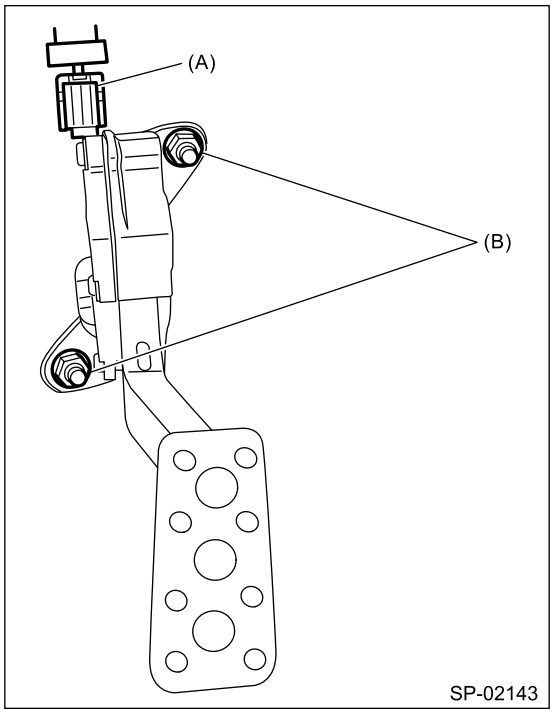
2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
DST-i	Used together with Subaru Select Monitor 4.

SPEED CONTROL SYSTEMS(STI) > Accelerator Pedal

REMOVAL

1. Disconnect the ground cable from battery.
2. Disconnect the connector (A).
3. Remove the nut (B) securing accelerator pedal assembly, and remove the accelerator pedal assembly.



SPEED CONTROL SYSTEMS(STI) > Accelerator Pedal

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

SPEED CONTROL SYSTEMS(STI) > Accelerator Pedal

DISASSEMBLY

Note:
The accelerator pedal cannot be disassembled.

SPEED CONTROL SYSTEMS(STI) > Accelerator Pedal

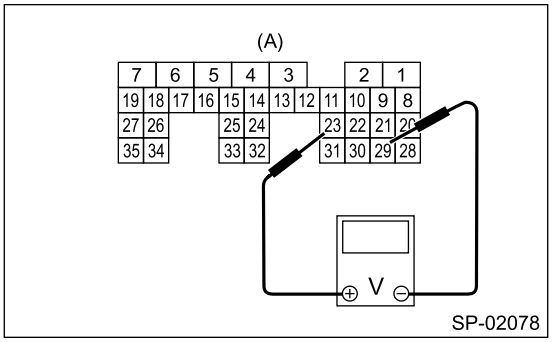
INSPECTION

1. CHECK ACCELERATOR PEDAL SENSOR AREA (METHOD WITH CIRCUIT TESTER)

1. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
2. Turn the ignition switch to ON. (Engine OFF)

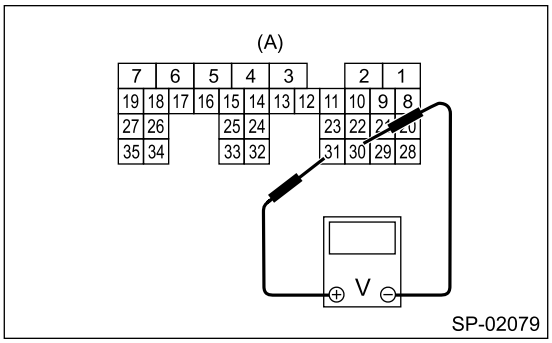
3. Measure the voltage between ECM connector terminals.

- Main sensor side



(A) To ECM connector

- Sub sensor side



(A) To ECM connector

Accelerator pedal sensor	Accelerator pedal	Terminal No.	Standard
Main	Not depressed (full closed)	23 (+) and 29 (−)	0.4 — 1.0 V
	Depressed (full opened)		2.4 — 3.7 V
Sub	Not depressed (full closed)	31 (+) and 30 (−)	0.3 — 1.1 V
	Depressed (full opened)		2.3 — 3.8 V

4. After inspection, install the related parts in the reverse order of removal.

2. CHECK ACCELERATOR PEDAL SENSOR AREA (METHOD WITH SUBARU SELECT MONITOR)

Note:
Individual difference of the accelerator pedal may not be corrected sufficiently on the ECM side after DTCs were cleared or the battery was removed and installed on the vehicle. Therefore, when the accelerator opening angle signal does not indicate 100%, repeat the ignition switch ON (engine OFF) and ignition switch OFF operations at intervals of three seconds or more, until the accelerator opening angle signal indicates 100%.

1. Turn the ignition switch to ON. (Engine OFF)
2. Read the accelerator pedal opening angle signal and voltage of accelerator pedal sensor using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA (NORMAL MODE).

Accelerator pedal sensor	Accelerator pedal opening angle signal	Standard
Main	0.0%	0.4 — 1.0 V
	100.0%	2.4 — 3.7 V
Sub	0.0%	0.3 — 1.1 V
	100.0%	2.3 — 3.8 V

3. OTHER INSPECTIONS

1. Check that the accelerator pedal does not have deformation, cracks or damage.
2. Check for smooth operation when the accelerator pedal is depressed.
3. Check if the accelerator pedal returns to its original position smoothly when the pedal is released.

IGNITION(STI)

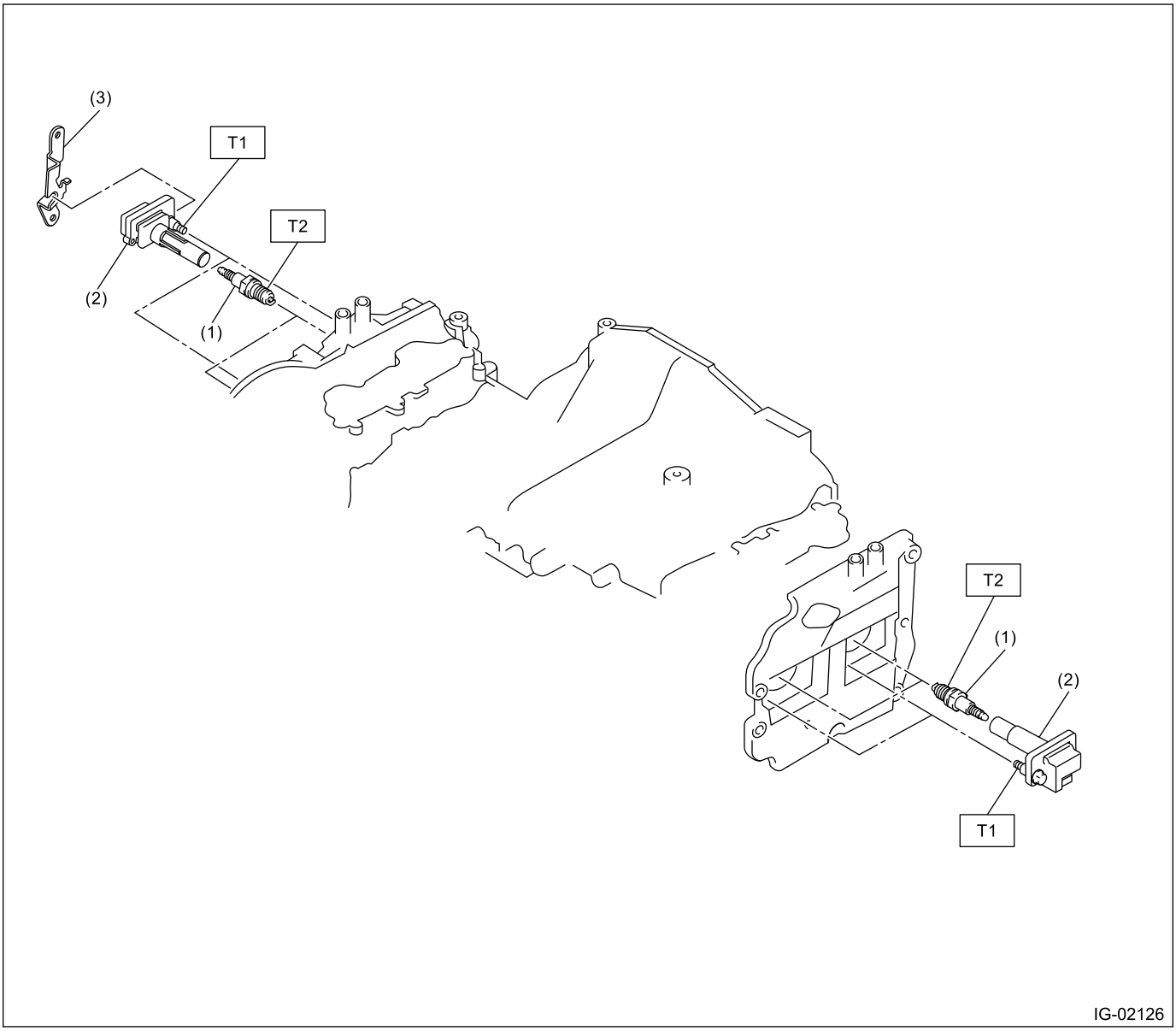
IG(STI)

1. General Description
2. Spark Plug
3. Ignition Coil

SPECIFICATION

Item			Specifications
Ignition coil	Type		FK0368
	Ignition system		Independent ignition coil
	Manufacturer		Diamond Electric
Spark plug	Manufacturer and type		NGK: ILFR7H
	Thread size (diameter, pitch, length) mm		14, 1.25, 26.5
	Spark plug gap mm (in)	Standard	0.5 — 0.6 (0.019 — 0.023)
	Electrode		Center electrode: Iridium Ground electrode: Platinum

COMPONENT



(1) Spark plug

(2) Ignition coil

(3) Engine harness stay (#3 ignition coil side only)

Tightening torque: N·m (kgf-m, ft-lb)

T1: 16 (1.6, 11.8)

T2: 21 (2.1, 15.5)

IGNITION(STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.

- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

REMOVAL

Spark plug:

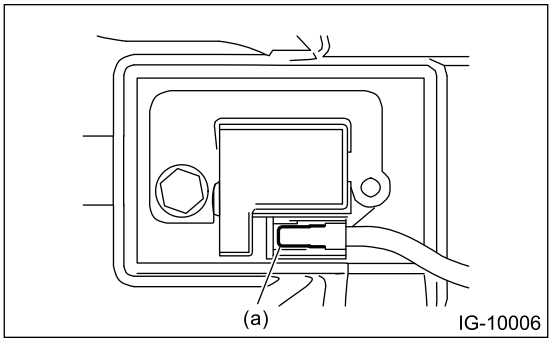
Refer to "SPECIFICATION" for spark plug. Ref. to IGNITION(STI)>General Description>SPECIFICATION.

1. RH SIDE

1. Disconnect the ground cable from battery.
2. Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(STI)>Air Cleaner Case>REMOVAL.
3. Disconnect the connector from ignition coil.

   Caution:

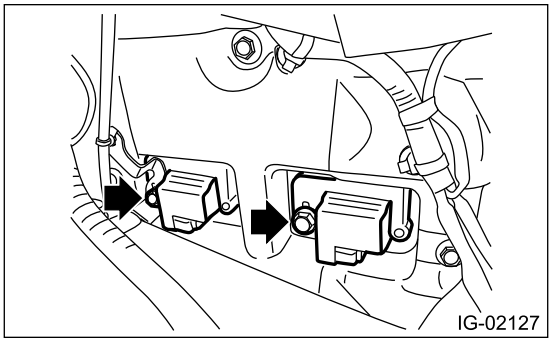
   Be careful not to damage the claw (a) of the connector.



4. Remove the ignition coil.

   Note:

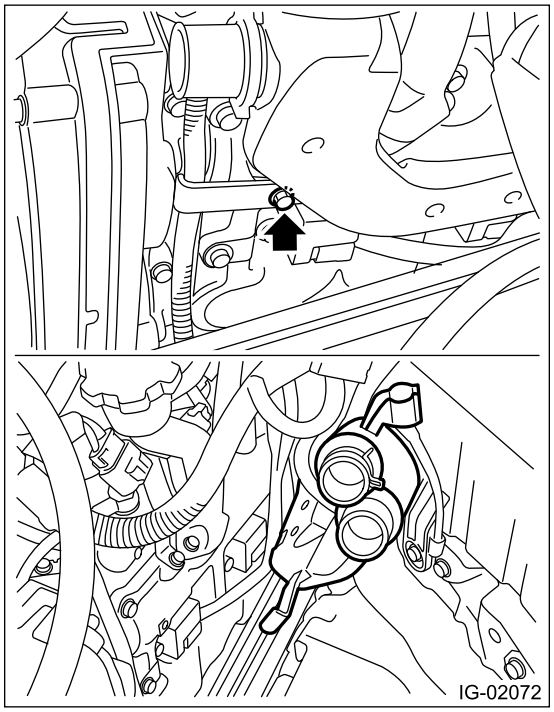
   Turn the ignition coil by 180° to remove it.



5. Remove the spark plug with a spark plug socket.

2. LH SIDE

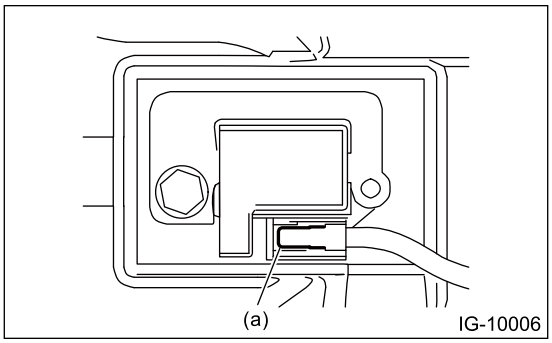
1. Remove the battery. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>REMOVAL.
2. Remove the secondary air pump. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(STI)>Secondary Air Pump>REMOVAL.
3. Remove the bolts that secure the air duct to the rocker cover LH, and lift the air duct.



4. Disconnect the connector from ignition coil.

Caution:

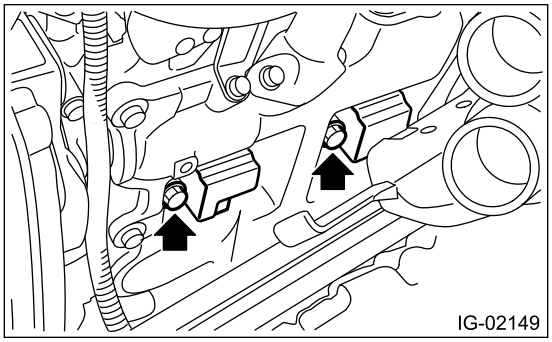
Be careful not to damage the claw (a) of the connector.



5. Remove the ignition coil.

Note:

Turn #4 ignition coil by 180° to remove it.



6. Remove the spark plug with a spark plug socket.

INSTALLATION

1. RH SIDE

Install in the reverse order of removal.

Tightening torque (spark plug):
21 N·m (2.1 kgf-m, 15.5 ft-lb)

Tightening torque (ignition coil):
16 N·m (1.6 kgf-m, 11.8 ft-lb)

2. LH SIDE

Install in the reverse order of removal.

Tightening torque (spark plug):
21 N·m (2.1 kgf-m, 15.5 ft-lb)

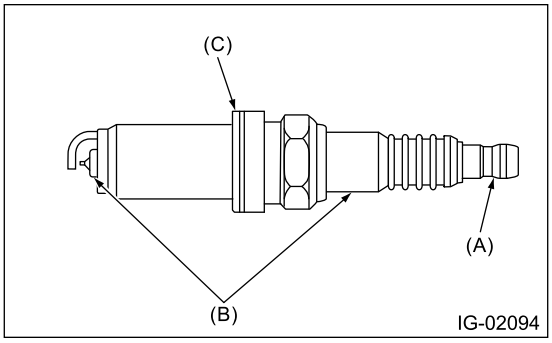
Tightening torque (ignition coil):
16 N·m (1.6 kgf-m, 11.8 ft-lb)

Tightening torque (air duct):
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

IGNITION(STI) > Spark Plug

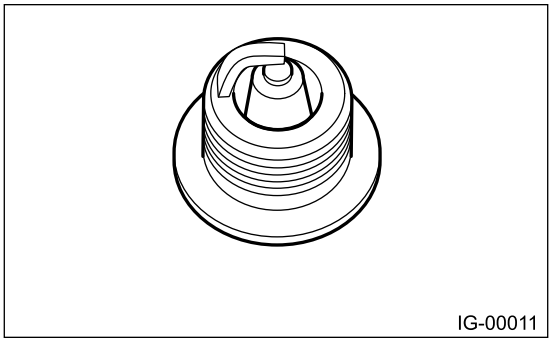
INSPECTION

1. Check the spark plug for abnormalities. If defective, replace the spark plug.



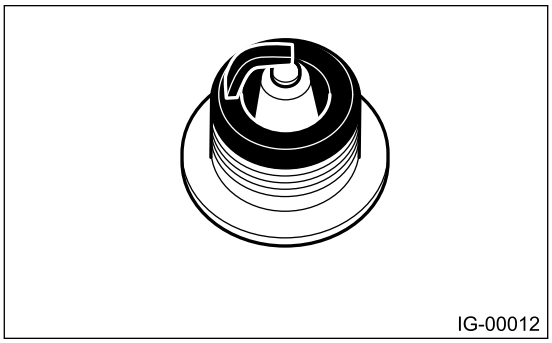
(A) Terminal damage
(B) Crack or damage in insulator
(C) Damaged gasket

2. Check the spark plug electrode and condition of the insulator. If abnormal, check and repair the cause and replace the spark plug.
(1) Normal:
Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range.


IG-00011

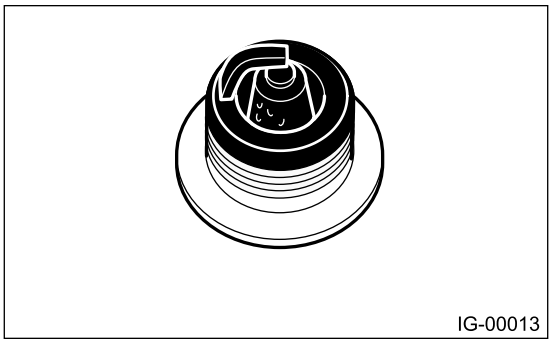
(2) Carbon fouled:

Dry fluffy carbon deposits on the insulator and electrode are mostly caused by slow-speed driving in town, weak ignition, too rich fuel mixture, etc.


IG-00012

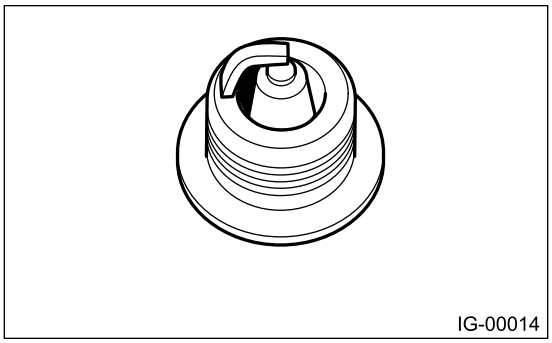
(3) Oil fouled:

Wet black deposits show oil entrance into combustion chamber through worn piston rings or increased clearance between valve guides and valve stems.


IG-00013

(4) Overheating:

A white or light gray insulator with black or brown spots and bluish burnt electrodes indicate engine overheating, wrong selection of fuel, or loose spark plugs.


IG-00014

3. Using a nylon brush, etc., clean and remove the carbon or oxide deposits from the spark plug. If deposits are too stubborn, replace the spark plugs. After cleaning the spark plugs, check the spark plug gap “L” using a gap gauge. If it is not within the standard, replace the spark plug.

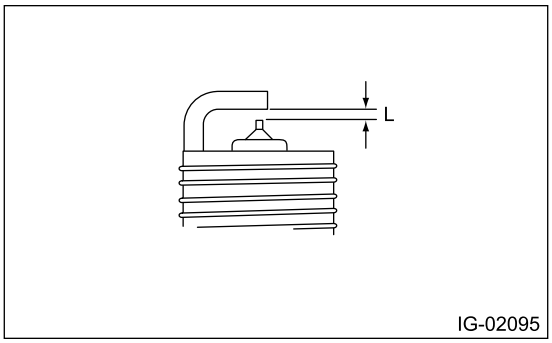
Note:

- **Never use a plug cleaner.**
- **Do not use a metal brush as it may damage the electrode area.**

Spark plug gap L:

Standard

0.5 — 0.6 mm (0.019 — 0.023 in)



IGNITION(STI) > Ignition Coil

REMOVAL

Direct ignition type is adopted. Refer to “Spark Plug” for removal procedure. Ref. to IGNITION(STI)>Spark Plug>REMOVAL.

IGNITION(STI) > Ignition Coil

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

16 N·m (1.6 kgf-m, 11.8 ft-lb)

IGNITION(STI) > Ignition Coil

INSPECTION

For inspection procedure, refer to “Diagnostics for Engine Starting Failure”. Ref. to ENGINE (DIAGNOSTICS)(STI)>Diagnostics for Engine Starting Failure>IGNITION CONTROL SYSTEM.

STARTING/CHARGING SYSTEMS(STI)

SC(STI)

1. General Description
2. Starter
3. Generator
4. Battery

SPECIFICATION

Item			Specifications
Starter	Type		Reduction type
	Model		428000-5760
	Manufacturer		DENSO
	Voltage and output		12 V — 1.0 kW
	Direction of rotation		Counterclockwise (when observed from pinion)
	Number of pinion teeth		9
	Armature commutator runout	Standard	0.05 mm (0.0020 in)
		Limit	0.10 mm (0.0039 in)
	Armature depth of segment mold	Standard	0.5 mm (0.020 in)
	Brush length	Standard	12.3 mm (0.484 in)
		Limit	7.0 mm (0.276 in)
	Brush spring force	Standard	15.9 — 19.5 N (1.62 — 1.99 kgf, 3.57 — 4.38 lbf)
		Limit	2.5 N (0.25 kgf, 0.56 lbf)
	No-load characteristics	Voltage	11 V
		Current	90 A or less
Generator	Type		Rotating-field three-phase type, voltage regulator built-in type, each with load response control system
	Model		A3TG6591
	Manufacturer		Mitsubishi Electric
	Voltage and output		12 V — 110 A
	Polarity on ground side		Negative
	Direction of rotation		Clockwise (when observed from pulley side)
	Stator connection		3-phase Y-type
	Output current		1,500 r/min — 50 A or more 2,500 r/min — 91 A or more 5,000 r/min — 105 A or more
	Regulated voltage		14.1 — 14.8 V [20°C (68°F)]
	Rotor slip ring outer diameter	Standard	22.7 mm (0.894 in)
		Limit	22.1 mm (0.870 in)
	Brush length	Standard	18.5 mm (0.728 in)
		Limit	5.0 mm (0.197 in)
Battery	Type		75D23L

Item		Specifications
	Nominal capacity	5 HR: 53 Ah [25°C (77°F)]
	Nominal voltage	12 V
	CCA	470 A
	BCI group number*	35

*: This is a reference information for battery size, and is not guaranteed by SUBARU CORPORATION.

STARTING/CHARGING SYSTEMS(STI) > General Description

COMPONENT

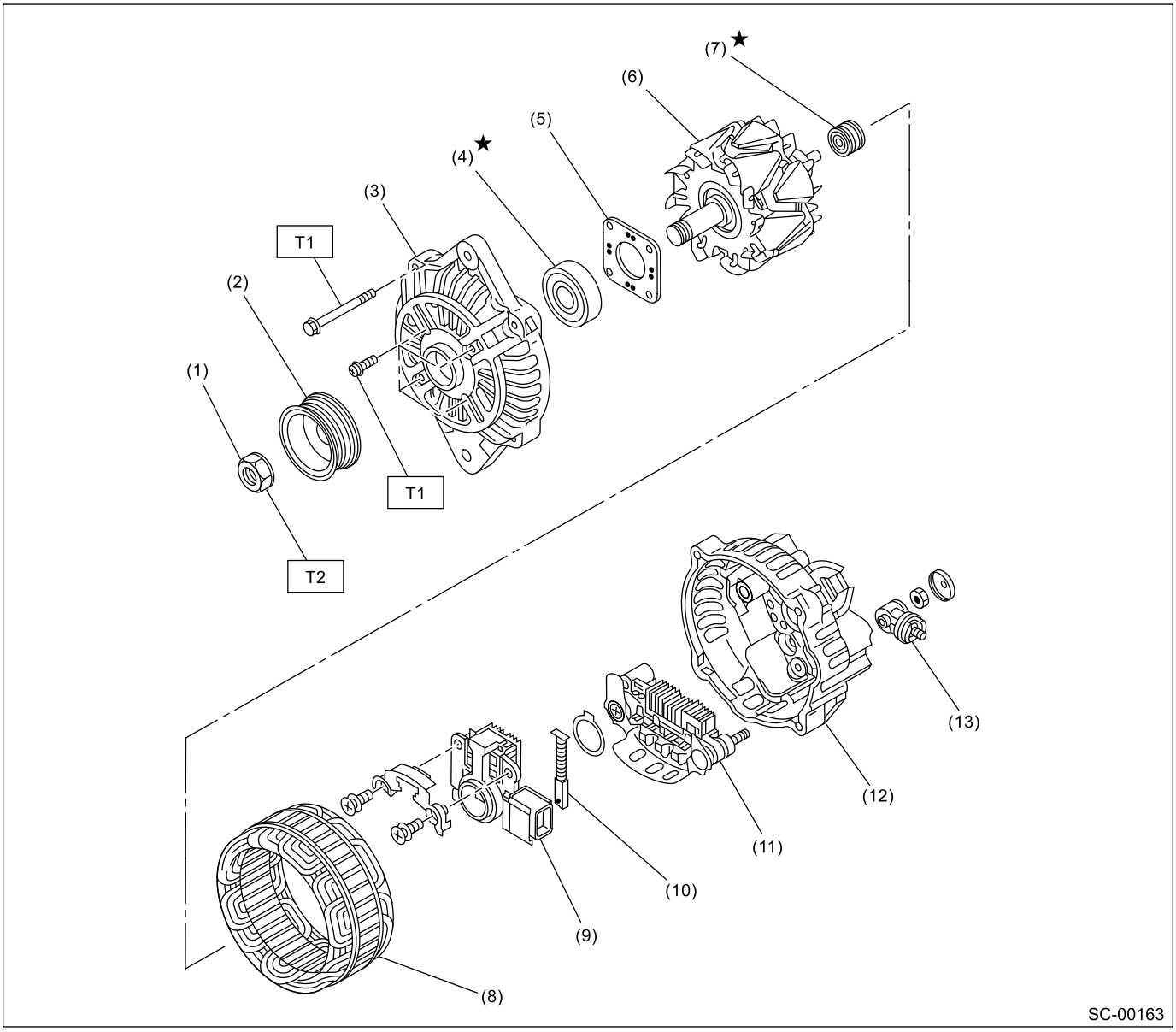
1. STARTER

(1) Starter housing ASSY
(2) Snap ring
(3) Stopper
(4) Overrunning clutch
(5) Snap ring
(6) Washer
(7) Internal gear ASSY
(8) Shaft
(9) Pinion gear
(10) Starter plate
(11) Armature
(12) Yoke ASSY
(13) Brush holder ASSY
(14) Starter cover ASSY
(15) Drain duct
(16) Shift lever
(17) Magnet switch ASSY

Tightening torque: N·m (kgf-m, ft-lb)

T1: 1.4 (0.1, 1.0)
T2: 6 (0.6, 4.4)
T3: 7.5 (0.8, 5.5)
T4: 10 (1.0, 7.4)
T5: 11 (1.1, 8.1)

2. GENERATOR



(1) Pulley nut
(2) Pulley
(3) Front cover
(4) Ball bearing
(5) Bearing retainer
(6) Rotor
(7) Bearing
(8) Stator coil
(9) IC regulator
(10) Brush
(11) Rectifier
(12) Rear cover
(13) Terminal B

Tightening torque: N·m (kgf-m, ft-lb)

T1: 4.7 (0.5, 3.5)
T2: 108 (11.0, 79.8)

3. GENERATOR BRACKET

(1) Generator
(2) Power steering pump bracket
(3) V-belt cover

Tightening torque: N·m (kgf-m, ft-lb)

T1: 7 (0.7, 5.2)
T2: 15.5 (1.6, 11.4)
T3: 22 (2.2, 16.2)
T4: 25 (2.5, 18.4)

STARTING/CHARGING SYSTEMS(STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
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- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

STARTING/CHARGING SYSTEMS(STI) > General Description

PREPARATION TOOL

1. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.

TOOL NAME	REMARKS
	Note: • **When measuring the standby current, prepare a circuit tester which can measure down to 1 mA.** • **When measuring the standby current for models with keyless access function, prepare an analog type.**

STARTING/CHARGING SYSTEMS(STI) > Starter

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(STI)>Intercooler>REMOVAL.
3. Disconnect the connector (B) and terminal (A) from starter.
4. Disconnect the terminal (A) from the cable stay and remove the cable stay and starter from the transmission.
   Caution:
   In order to prevent damaging the terminal (A), fix the terminal (A) when loosing the bolt, and avoid the part from rotating together while loosening the bolt.

STARTING/CHARGING SYSTEMS(STI) > Starter

INSTALLATION

Install in the reverse order of removal.

Note:

Tighten the starter and cable stay (a) together using the upper bolt securing the starter.

Tightening torque:

T1: 14 N·m (1.4 kgf-m, 10.3 ft-lb)

T2: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

Tightening torque:

11 N·m (1.1 kgf-m, 8.1 ft-lb)

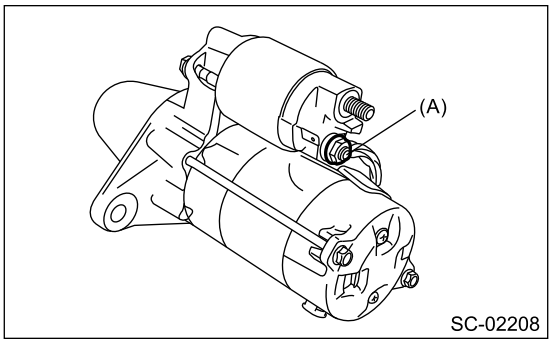
STARTING/CHARGING SYSTEMS(STI) > Starter

DISASSEMBLY

Caution:

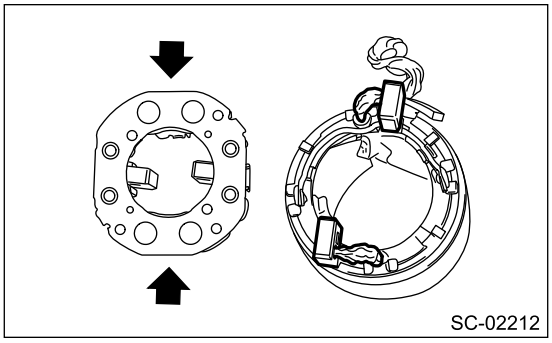
The starter should be placed through a no-load test whenever it has been overhauled.

1. Disconnect cable from terminal M (A) of the magnet switch assembly.

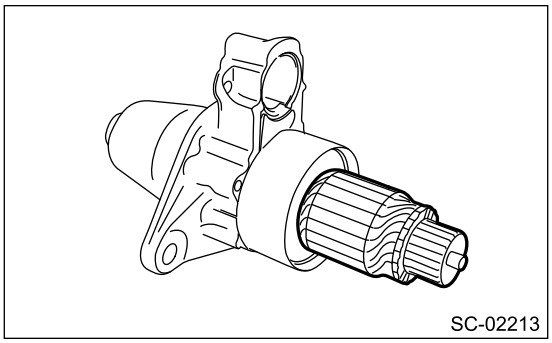


2. Remove the magnet switch assembly from the starter housing assembly.
3. Remove through bolts (A) and screws (B) on both sides, and remove the starter cover assembly.
4. Remove the yoke assembly and brush holder assembly as a unit.
5. Remove the two brushes wired to the yoke assembly, and separate the yoke assembly and the brush holder assembly.

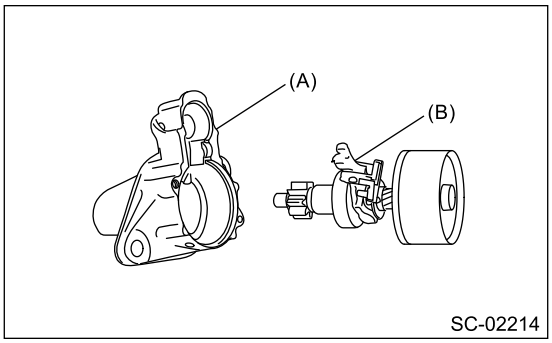
Note:
As shown in the figure, use a flat tip screwdriver, etc. to hold the brush spring and remove the brush.



6. Remove the armature from the internal gear assembly.



7. Remove the starter housing assembly (A) then remove the shift lever (B).



8. Use the following procedures to remove the overrunning clutch from the shaft.

(1) Use an appropriate tool (such as a fit socket wrench), and remove the stopper from snap ring by lightly tapping the stopper with a plastic hammer.

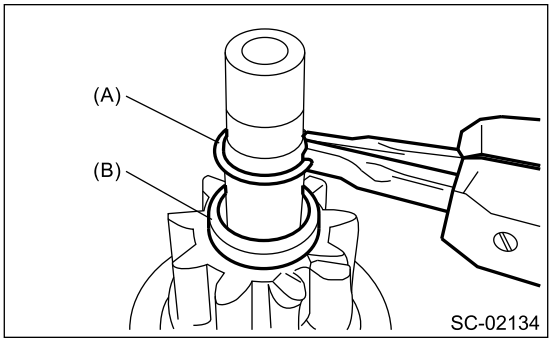
(A) Appropriate tool

(B) Snap ring

(C) Shaft

(D) Stopper

(2) Remove snap ring (A) from the shaft, and remove stopper (B).



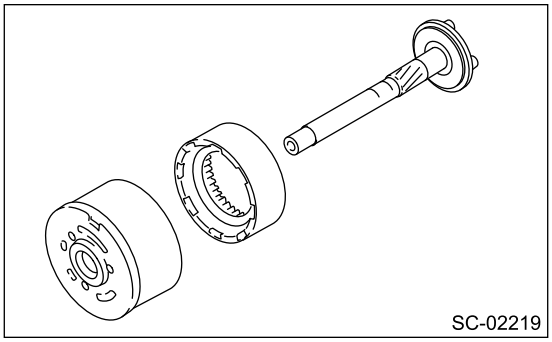
(3) Remove the overrunning clutch from the shaft.

9. Use the following procedures to remove the shaft.

(1) Remove the starter plate, and remove the pinion gear.

(2) Remove the snap ring from the shaft.

(3) Remove the shaft from the internal gear assembly.



STARTING/CHARGING SYSTEMS(STI) > Starter

ASSEMBLY

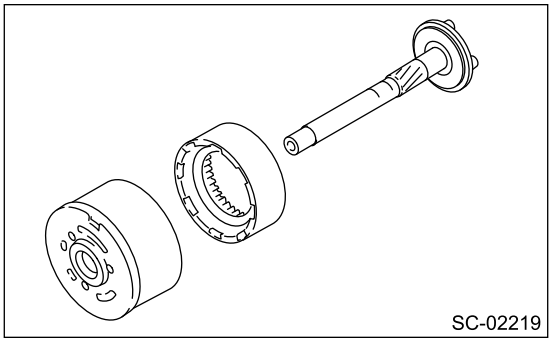
1. Use the following procedures to install the shaft.

(1) Apply grease to the shaft sliding surfaces of the internal gear assembly.

Grease:

DENSO HL50

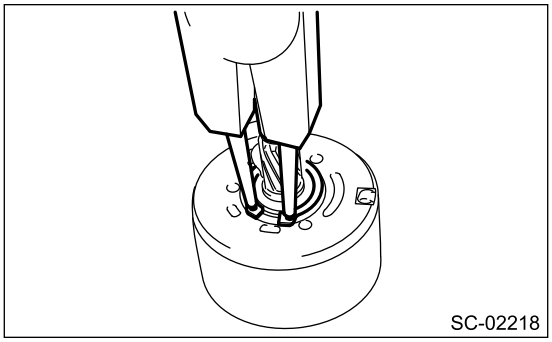
(2) Assemble the shaft to the internal gear assembly.



(3) Install the snap ring to shaft.

Note:

Use new snap rings.



(4) Apply grease to the pinion gear attachment area.

Grease:

DENSO HL50

(5) Attach the pinion gear to the pin.

(6) Apply grease to the pinion gear, internal gear assembly, and on top of the shaft pin.

Note:

- **Apply grease so that it contacts each gear.**
- **Be careful not to allow dirt to get in.**

Grease:

DENSO HL50

(7) Install the starter plate.

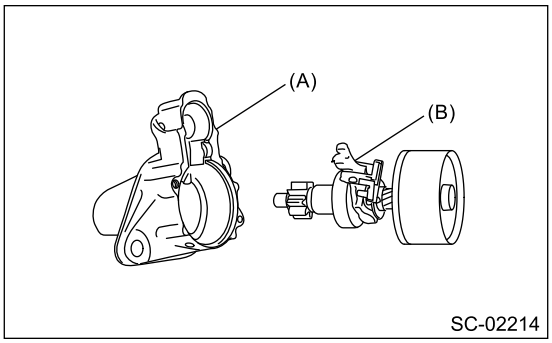
2. Assemble the overrunning clutch and shift lever (B) to the starter housing (A) as a unit.

Note:

Apply grease to the contact portion of the shift lever.

Grease:

DENSO HL50



3. Assemble the overrunning clutch as follows:

(1) Apply grease to the spline portion of the shaft.

Grease:

DENSO HL50

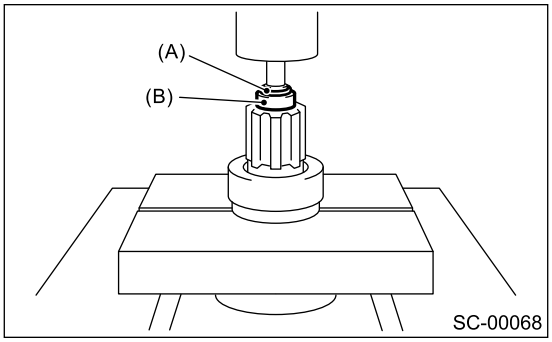
(2) Install the overrunning clutch to shaft.

(3) Pass stopper (B) through the shaft, and attach snap ring (A).

Note:

Use new snap rings.

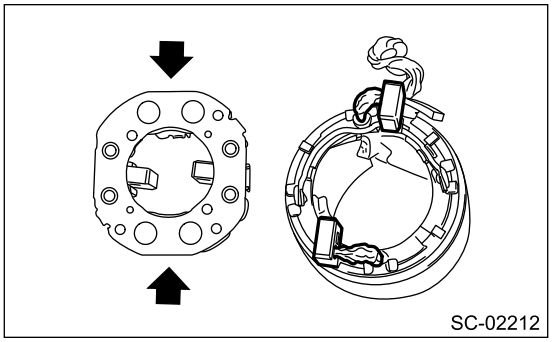
(4) Using a press, pressure fit stopper (B) into snap ring (A).



4. Install the armature to the internal gear assembly.
5. Attach the two brushes wired to the yoke assembly to the brush holder assembly.

   Note:

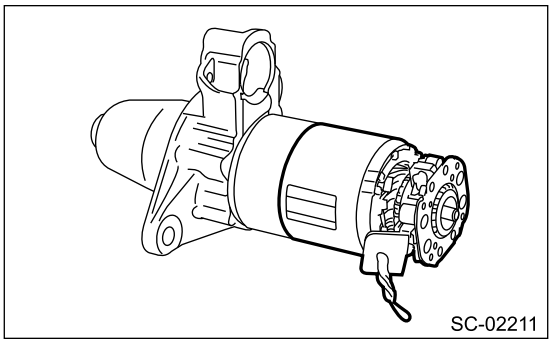
   As shown in the figure, use a flat tip screwdriver, etc. to hold the brush spring and insert the brush while being careful not to damage the brush.



6. Install the yoke assembly and brush holder assembly as a single unit to the armature.

   Note:

   Spread the brush with your fingers, being careful not to damage the brush.



7. Install starter cover assembly to the brush holder assembly with screws (B).

   Tightening torque:

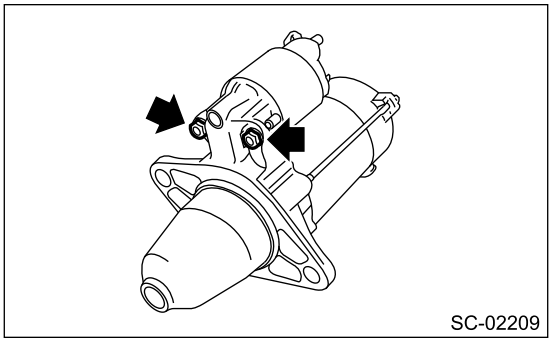
   1.4 N·m (0.1 kgf-m, 1.0 ft-lb)
8. Tighten the through bolts (A) on both sides.

   Tightening torque:

   6 N·m (0.6 kgf-m, 4.4 ft-lb)
9. Attach the magnet switch assembly to the starter housing assembly.

   Tightening torque:

   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)



10. Connect the cable to terminal M (A) of the magnet switch assembly.

Tightening torque:

10 N·m (1.0 kgf-m, 7.4 ft-lb)

STARTING/CHARGING SYSTEMS(STI) > Starter

INSPECTION

Note:

- **After the inspection, reinstall the disassembled or removed parts during the inspection in the reverse order of disassembly/removal procedure.**
- **Refer to component for tightening torque of each part. Ref. to STARTING/CHARGING SYSTEMS(STI)>General Description>COMPONENT > STARTER.**

1. ARMATURE

1. Check the commutator for signs of seizure or stepped wear caused by roughness of the surface. If there is light wear, use sandpaper to repair.

2. Check for runout on the commutator. If excessive, replace the armature.

Commutator runout:

Standard

0.05 mm (0.0020 in)

Limit

0.10 mm (0.0039 in)

(A) Dial gauge

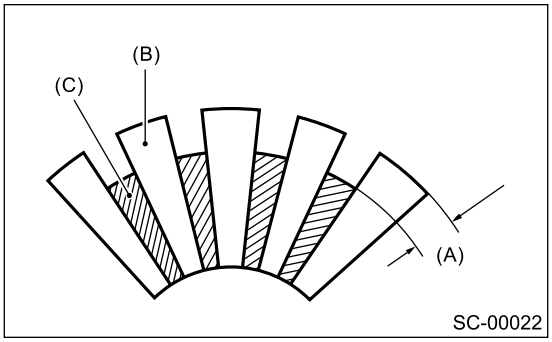
(B) V-block

3. Check the depth of the segment mold. If it is not within the standard, replace the armature.

Depth of segment mold:

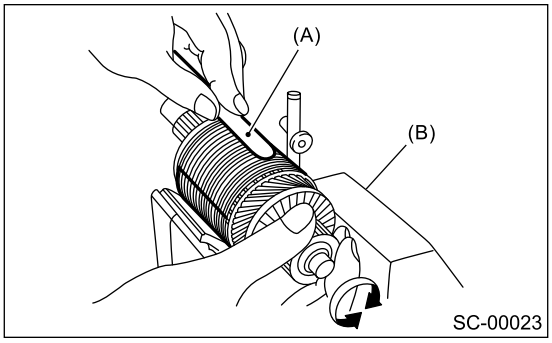
Standard

0.5 mm (0.020 in)



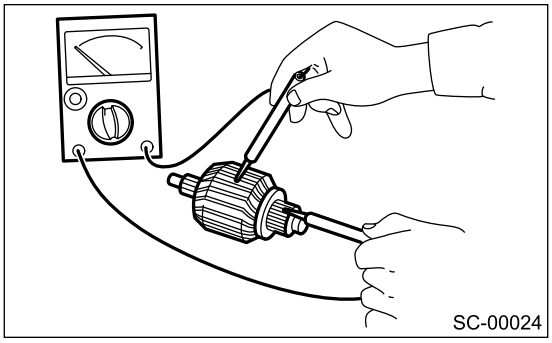
(A) Depth of mold
(B) Segment
(C) Mold

4. Place the armature on the growler tester to check for short circuits. While slowly turning the armature, support the steel sheet for the armature core. If the circuit of the armature is shorted, the steel sheet will vibrate, causing it to move towards the core. When the steel sheet has moved or vibrated, replace the armature.



(A) Steel sheet
(B) Growler tester

5. Use a circuit tester to touch the probe of one side to the commutator segment, and the other probe to the shaft. If there is continuity, replace the armature.



2. YOKE

Make sure that the pole is set at the predetermined position.

3. OVERRUNNING CLUTCH

Check that there is no wear or damage to the piston teeth. Replace the overrunning clutch if it is damaged.
Check that it rotates smoothly when rotated in the correct direction (counterclockwise) and does not return to the other direction. Replace the overrunning clutch if any fault is found.

Caution:

To prevent spilling of grease, do not clean the overrunning clutch with oil.

4. BRUSH AND BRUSH HOLDER

1. Measure the length of the brush. Replace if it exceeds service limits or there is abnormal wear or cracks.

   Brush length:

   Standard

   12.3 mm (0.484 in)

   Limit

   7.0 mm (0.276 in)

   (A) Service limit line

   (B) Brush

2. Check that the brush moves smoothly in the brush holder.
3. Measure the brush spring force with a spring scale. Replace the brush holder if below the service limit.

   Brush spring force:

   Standard

   15.9 — 19.5 N (1.62 — 1.99 kgf, 3.57 — 4.38 lbf) (when new)

   Limit

   2.5 N (0.25 kgf, 0.56 lbf)

5. SWITCH ASSEMBLY

Using a circuit tester, check there is continuity between S terminal and M terminal, and between S terminal and ground. Also, check that there is no continuity between M terminal and B terminal.

(A) Terminal S (B) Terminal M (C) Terminal B

Terminals	Standard
Terminal S — terminal M	1 Ω or less
Terminal S — Ground	1 Ω or less
Terminal M — terminal B	1 MΩ or more

6. SWITCH ASSEMBLY OPERATION

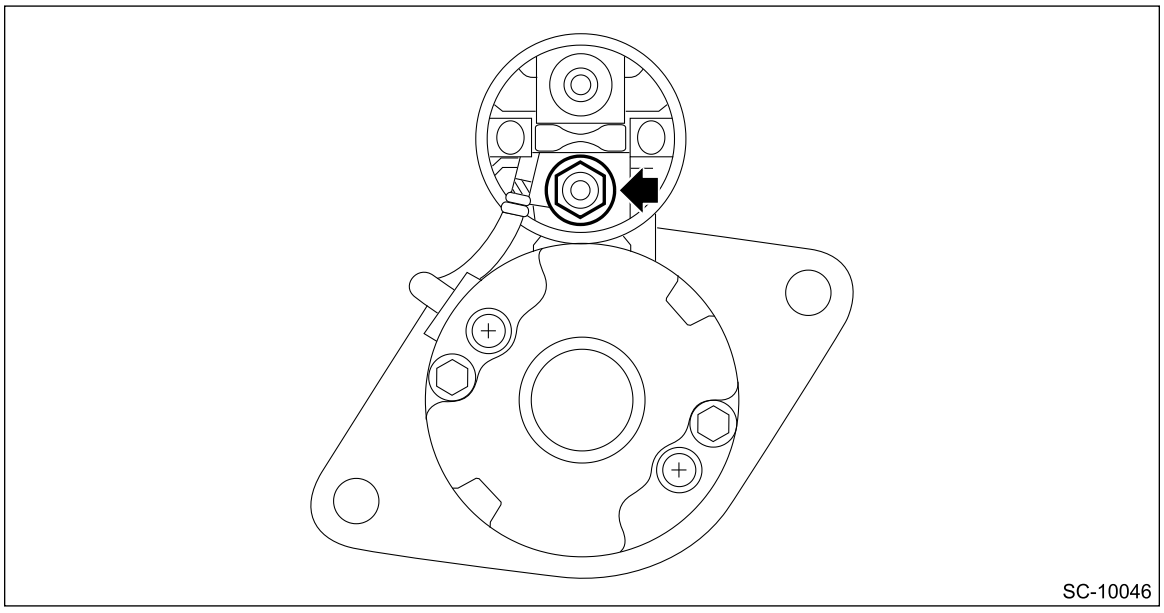
Caution:

Perform the inspection in a short period of time. (Within 3 to 5 seconds)

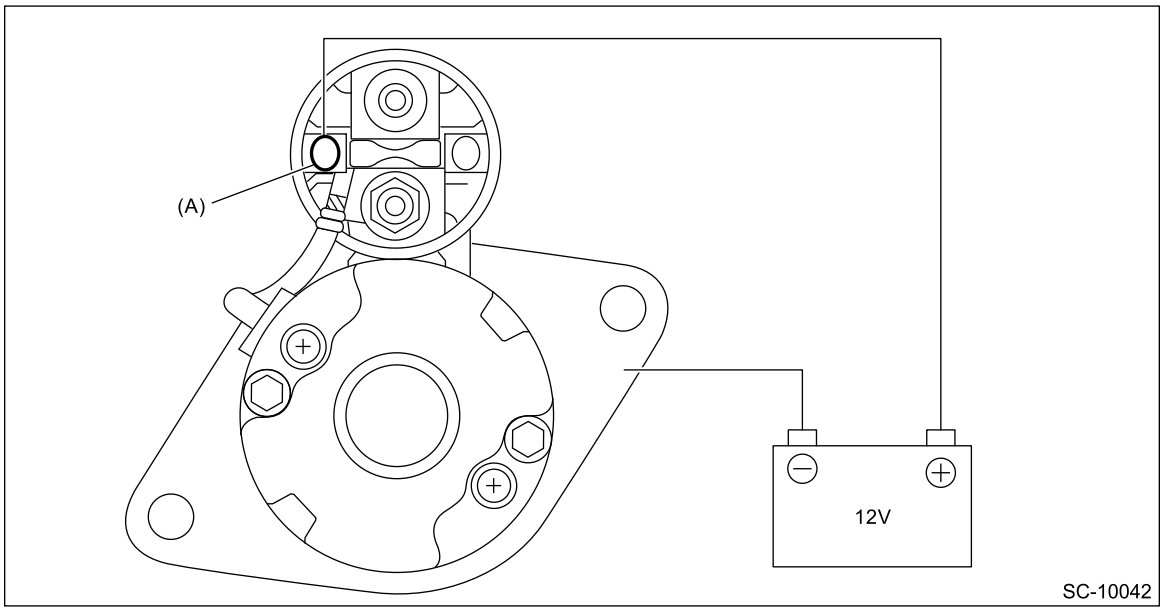
1. Loosen the nut which holds the cable to the M terminal.

   Note:

   This procedure is required to facilitate the cable removal from the M terminal.

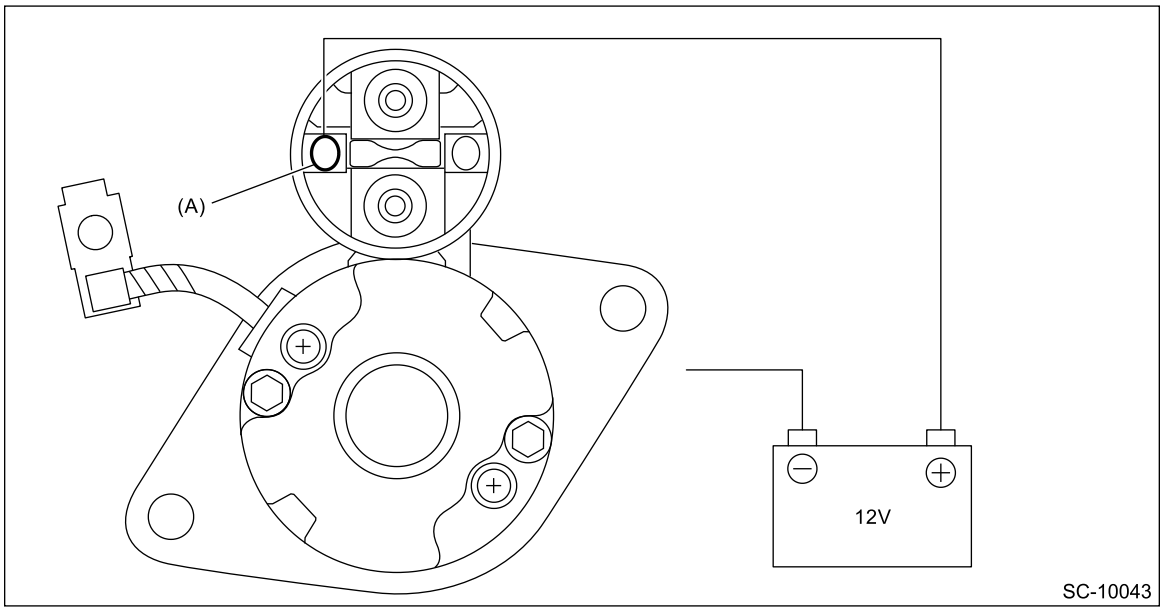


2. Connect the battery positive terminal to the switch assembly S terminal, and connect the battery negative terminal to the starter body. Then, if the pinion protrudes, it is normal.
   Note:
   The starter motor may rotate while the pinion protrudes. This occurs due to current that flows to the motor via pull-in coil. This is not a problem.



(A) Terminal S

3. Disconnect the cable from the M terminal. Check that the pinion is being protruded at this time.
   Caution:
   Hold the disconnected cable so that it does not contact the terminal or wiring.
4. Disconnect the battery negative terminal from the starter body. Then, if the pinion returns to its original position, it is normal.



(A) Terminal S

7. NO-LOAD TEST

Caution:

- **Use a thick cable due to large current flowing through the cable.**
  - **It is recommended that the cross-section area of continuity part (shaded part) should be 20 mm^2 (0.00310 sq in) or more for terminal B and ground, and 1.25 mm^2 (0.00194 sq in) or more for terminal S.**

(a) Cable cross-section (b) Cable shield part (c) Cable continuity part

  - **It is possible to use a booster cable instead of wiring.**
- **Be careful not to burn yourself and cause a fire due to heat.**
- **Perform the no-load test in a short period of time. (Within 3 to 5 seconds)**

Note:

For no-load test, use the circuit shown in figure.

(A) Terminal S (B) Terminal M (C) Terminal B

(D) Magnet switch (E) Switch (F) Circuit tester with clamp-type ammeter

(G) Circuit tester

1. Using a vise, secure the starter.
   Caution:
   Be careful not to deform or damage the starter.
2. Turn the switch ON, and check that the pinion protrudes rapidly into the specified position and rotates powerfully without noise.
3. Check the current and voltage after its rotation speed stabilizes.
   Current/Voltage
   90 A or less (approx. 11 V)

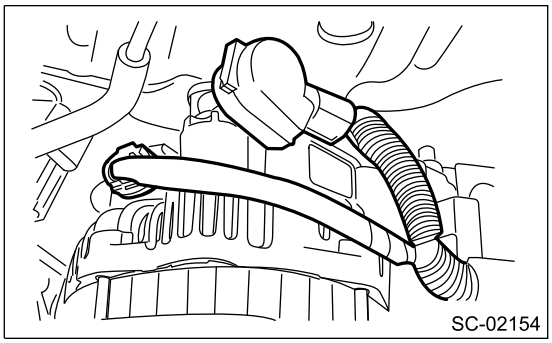
8. OTHER INSPECTIONS

Check that the starter does not have deformation, cracks and any other damage.

STARTING/CHARGING SYSTEMS(STI) > Generator

REMOVAL

1. Disconnect the ground cable from battery.
2. Remove the V-belt covers.
3. Disconnect the connector and terminal from generator.



4. Remove the front side belt. Ref. to MECHANICAL(STI)>V-belt>REMOVAL > FRONT SIDE BELT.
5. Remove the bolts which install the generator onto bracket.

STARTING/CHARGING SYSTEMS(STI) > Generator

INSTALLATION

Install in the reverse order of removal.

Caution:

Check and adjust the front side belt tension. Ref. to MECHANICAL(STI)>V-belt>INSPECTION > FRONT SIDE BELT.

Tightening torque:

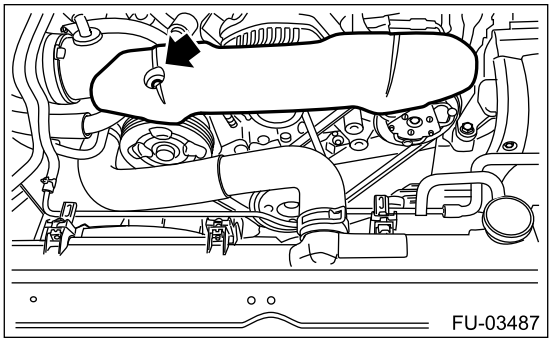
25 N·m (2.5 kgf-m, 18.4 ft-lb)

Tightening torque:

15.5 N·m (1.6 kgf-m, 11.4 ft-lb)

Tightening torque:

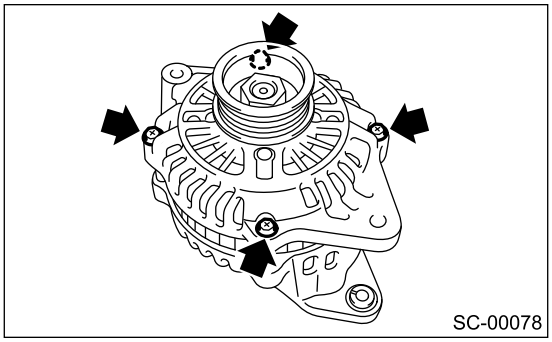
7 N·m (0.7 kgf-m, 5.2 ft-lb)



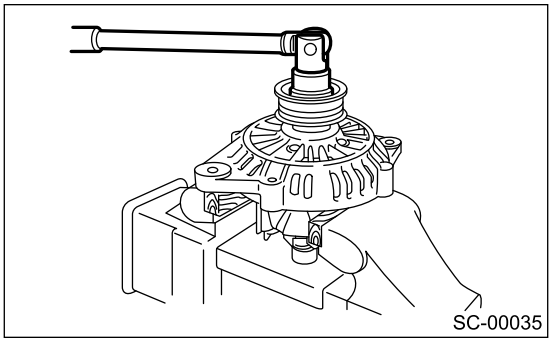
STARTING/CHARGING SYSTEMS(STI) > Generator

DISASSEMBLY

1. Remove the four through-bolts.

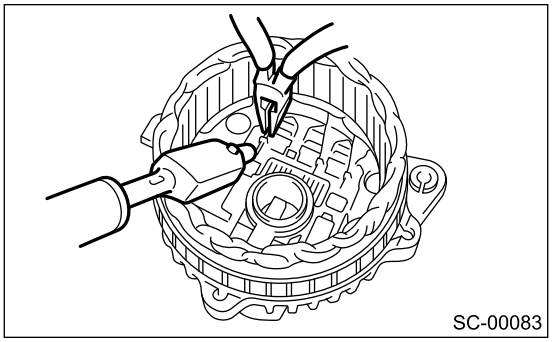


2. Use a drier to heat the rear cover (A) portion to 50°C (122°F).
3. Insert the end of a flat tip screwdriver into the gap between stator core and front cover. Pry them apart to disassemble.
   (A) Screwdriver
4. Using a vise, support the rotor and remove the pulley nut, then remove the rotor from the front cover.
   Caution:
   When holding the rotor with a vise, place aluminum plates or wooden pieces on the vise jaws to prevent rotor from damage.



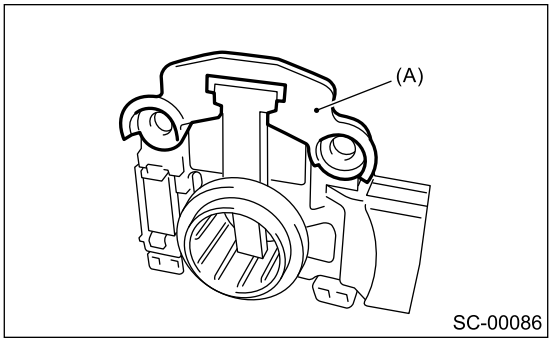
   (A) Front cover
   (B) Pulley
   (C) Pulley nut
   (D) Rotor

5. Use the following procedures to remove the ball bearings.
   (1) Remove the bolt, and then detach the bearing retainer.
   (2) Firmly attach an appropriate tool (such as a correct size socket wrench) to the bearing inner race.
   (3) Use the press to push the ball bearings out from the front cover.
6. Using the bearing puller, remove the bearings from the rotor.
7. Disconnect the connection between the rectifier and stator coil, then remove the stator coil.
   Caution:
   The rectifier is easily damaged by heat. Do not allow a 180 — 270 W soldering iron to contact the terminals for 5 seconds or more at a time.



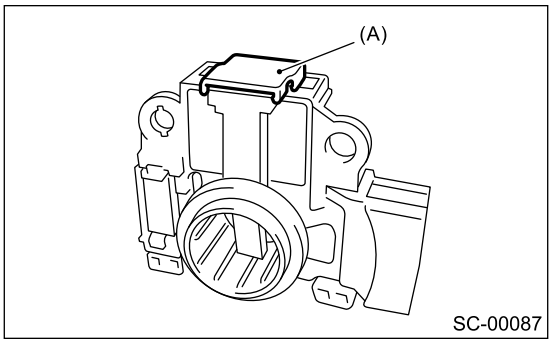
8. Use the following procedures to remove the IC regulator.
(1) Remove the screws which secure the IC regulator to the rear cover.
(2) Disconnect the connection between the IC regulator and rectifier, then remove the IC regulator.

9. Use the following procedures to remove the brush.
(1) Remove the cover A.



(A) Cover A

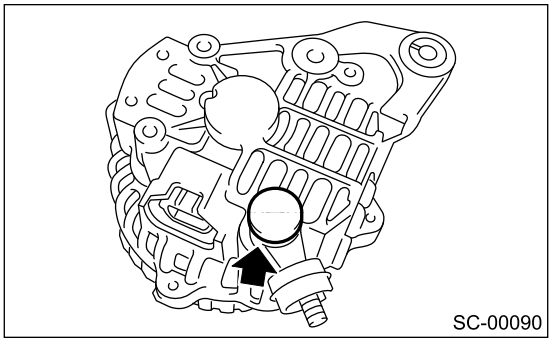
(2) Remove the cover B.



(A) Cover B

(3) Disconnect the connection and remove the brush.

10. Remove the rectifier as follows.
(1) Remove the bolts which secure the rectifier.
(2) Remove the cover on terminal B.



(3) Remove the nuts of terminal B, then remove the rectifier.

STARTING/CHARGING SYSTEMS(STI) > Generator

ASSEMBLY

Assemble in the reverse order of disassembly.

Note:

- **Refer to component for tightening torque of each part. Ref. to STARTING/CHARGING SYSTEMS(STI)>General Description>COMPONENT > GENERATOR.**
- **After assembling, manually turn the pulley to check that the rotor rotates smoothly.**

1. Push of the brush
   Before assembling the front and rear parts, press the brush down into the brush holder, then fix the brush in that position by inserting a [1 mm (0.04 in) dia., 40 — 50 mm (1.6 — 2.0 in) long] wire through the hole as shown in the figure.
   Caution:
   After assembling, remove the wire.
   (A) Wire

2. Install the ball bearings.
   (1) Set the ball bearings in the front cover, then securely install an appropriate tool (such as a socket wrench of proper size) to the bearing outer race.
   (2) Using a press to press the ball bearings into the specified location.
   (3) Install the bearing retainer.
3. Install the bearings.
   Caution:
   Do not apply grease to the bearings. If there is any oil on the bearing box, remove it completely.
   (1) Use a press to install the bearings to the rotor shaft.
   (2) Heat the bearing box in rear cover at 50 to 60°C (122 to 140°F), and then press the bearing into rear cover.

STARTING/CHARGING SYSTEMS(STI) > Generator

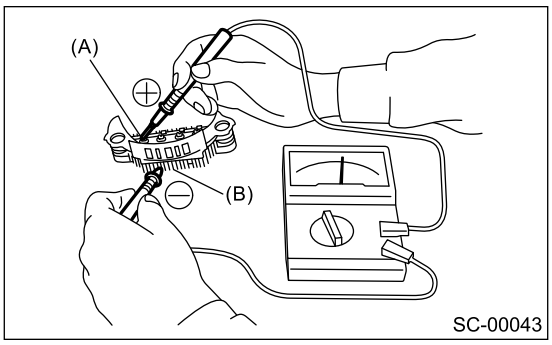
INSPECTION

1. DIODE

Caution:
There is the possibility of damaging the diodes if a mega-tester (used to measure high voltages) or a similar measuring instrument is used. Never use a mega tester or equivalent for this test.

1. Check for continuity between the diode lead and positive side heat sink. If resistance is 1 Ω or more only in the direction from the diode lead to the heat sink, replace the rectifier.
   (A) Diode lead
   (B) Heat sink (positive side)

2. Check for continuity between the negative side heat sink and diode lead. If resistance is 1 Ω or more only in the direction from the heat sink to the diode lead, replace the rectifier.



(A) Diode lead
(B) Heat sink (negative side)

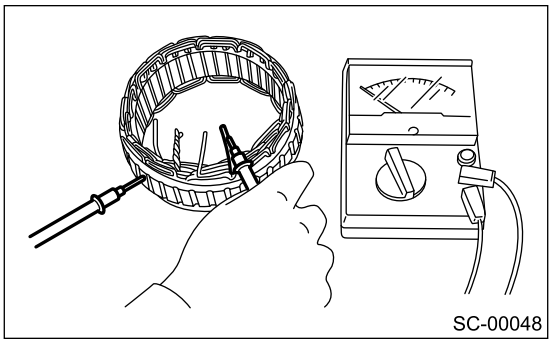
2. ROTOR

1. Inspect the slip rings for contamination or any roughness on the sliding surface. Repair the slip ring surface using a lathe or sand paper.
2. Measure the slip ring outer diameter. Replace the rotor if the slip ring is worn.
   Slip ring outer diameter:
   Standard
   22.7 mm (0.894 in)
   Limit
   22.1 mm (0.870 in)
3. Using a circuit tester, check the resistance between slip rings. If resistance exceeds the standard, replace the rotor.
   Standard:
   Approx. 1.8 — 2.2 Ω
4. Check the continuity between slip ring and rotor core or shaft. If there is continuity, replace the rotor because the rotor coil is grounded.
5. Check the bearings. If there is any noise, or the rotor does not rotate smoothly, replace the bearings.

3. STATOR COIL

1. Inspect continuity between the stator coil lead wire terminals. If the resistance is 1 MΩ or more, replace the stator coil.
   (A) Stator coil

2. Inspect the continuity between the stator coil stator core and lead wire terminals. If the resistance is 1 Ω or less, replace the stator coil.



4. BRUSH

1. Measure the length of each brush. Replace the brush if wear exceeds service limits. There is a service limit mark (A) on each brush.

   Brush length:

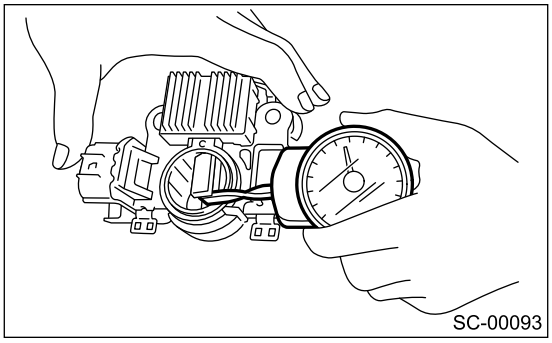
   Standard (1)

   18.5 mm (0.728 in)

   Limit (2)

   5.0 mm (0.197 in)

2. Using a spring pressure indicator, push the brush into the brush holder until its tip protrudes 2 mm (0.08 in). Then measure the pressure of brush spring. If the pressure is 2.648 N (270 g, 9.52 oz) or less, replace the brush spring with a new part. 4.609 — 5.786 N (470 — 590 g, 16.58 — 20.810 oz) pressure is required on the new spring.



5. BALL BEARING

Check the ball bearings. Replace the ball bearings if there is resistance in the rotation, or if there is any abnormal noise.

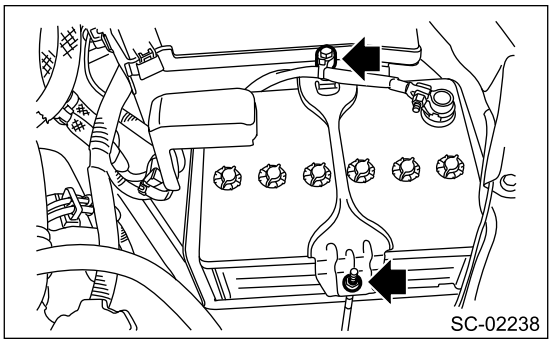
6. OTHER INSPECTIONS

Check that the generator does not have deformation, cracks and any other damage.

STARTING/CHARGING SYSTEMS(STI) > Battery

REMOVAL

1. Disconnect the positive (+) terminal after disconnecting the negative (-) terminal of battery.
2. Remove the harness clip of the negative terminal from the battery rod.
3. Remove the flange nut from battery rod and remove battery holder.



4. Remove the battery.

STARTING/CHARGING SYSTEMS(STI) > Battery

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

Battery holder

3.5 N·m (0.4 kgf-m, 2.6 ft-lb)

Positive terminal

6 N·m (0.6 kgf-m, 4.4 ft-lb)

Ground terminal

6 N·m (0.6 kgf-m, 4.4 ft-lb)

Note:

- **Clean the battery cable terminals and apply grease to retard the formation of corrosion.**
- **Connect the positive (+) terminal, and then connect the negative (-) terminal of the battery.**
- **After the battery is installed, initial diagnosis of the electronic throttle control is performed. Wait for 10 seconds or more after turning the ignition switch to ON, and then start the engine.**

STARTING/CHARGING SYSTEMS(STI) > Battery

INSPECTION

Warning:

- **As batteries produce flammable gases, be careful not to bring an open flame close to the batteries.**
- **Ventilate sufficiently when using or charging battery in enclosed space.**
- **Electrolyte is corrosive acid, and has toxicity; be careful of handling the fluid.**
- **For safety, in case an explosion does occur, wear eye protection or shield your eyes when working near any battery. In addition, never lean over the battery.**
- **Be careful that the electrode does not come into contact with skin, eyes or clothing. Especially at contact with eyes, flush with water for 15 minutes and get prompt medical attention.**
- **Be careful not to let the electrode contact with the coated parts.**
- **Before starting work, remove rings, metal watch-bands, and other metal jewelry.**
- **Be careful not to let the metal tools contact the positive battery terminal and anything connected to it. When the operation using a metal tool to the positive terminal or anything connected to it is required, disconnect the battery ground terminal before starting the operation.**

1. APPEARANCE

Check the battery case, top cover and terminal posts for dirt or cracks, and perform the following work as necessary.

- Clean the battery with water and wipe with a dry cloth.
- Apply a thin coat of grease on the terminal posts to prevent corrosion.

Check

- **Normal** → Go to the check item 2.
- **Abnormal** → Replace the battery.

2. ELECTROLYTE LEVEL

Check the electrolyte level in each cell.

Caution:

Do not fill beyond MAX level.

Note:

If the level is below the middle point between MIN level and MAX level, pour distilled water into the battery cell to bring the level to MAX.

Check

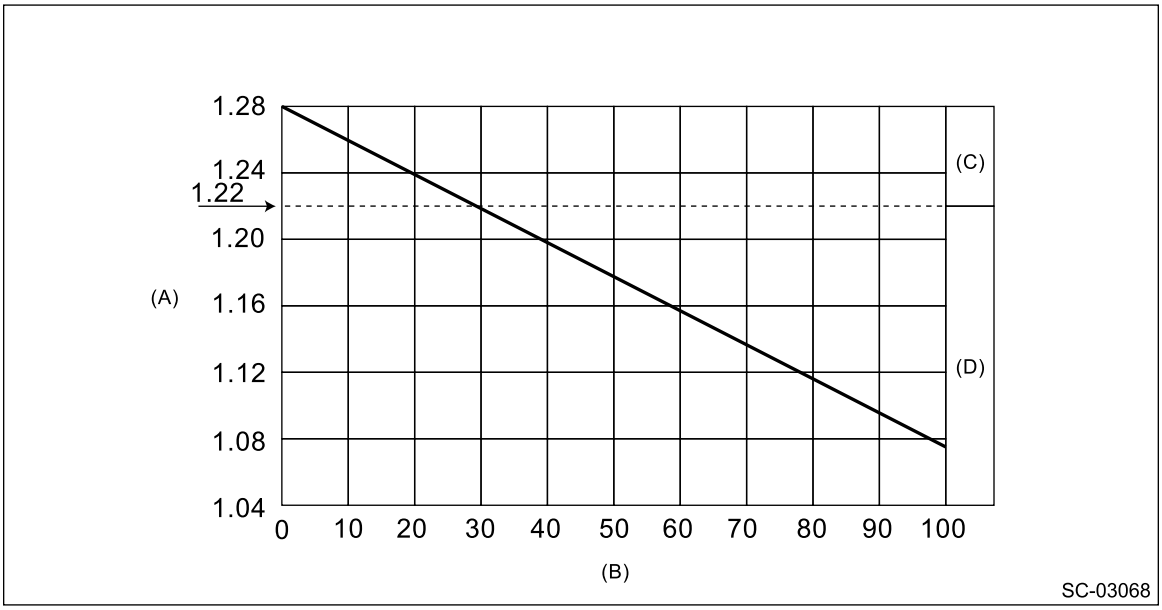
- **MAX level** → Go to the check item 3.
- **Below the middle point between MIN level and MAX level** → **Fill** → Go to the check item 3.

3. SPECIFIC GRAVITY OF ELECTROLYTE

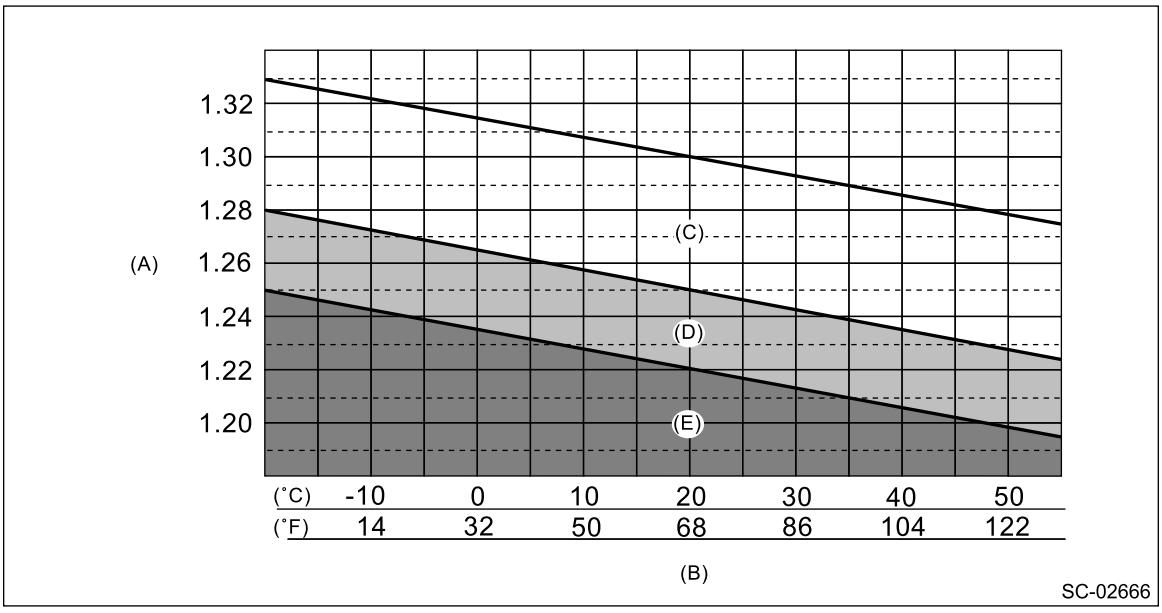
Check the specific gravity of the electrolyte using a hydrometer and a thermometer.

Note:

- **Specific gravity varies with temperature of electrolyte so that it must be corrected at 20°C (68°F) using the following calculation:**
  S_{20} = St + 0.0007 × (t − 20)
  S_{20}: Specific gravity corrected at electrolyte temperature of 20°C
  St: Measured specific gravity
  t: Measured temperature (°C)
- **When measuring in a simplified manner using the battery terminal voltage, calculate the specific gravity by the following formula.**
  Specific gravity = [0.187 × battery terminal voltage (V)] − 1.1
  Perform the steps 1) and 2) before measuring the voltage in order to stabilize the voltage.
  1) Turn the ignition switch to OFF and illuminate the headlight for 30 seconds.
  2) After turning off the headlight, leave the vehicle for one minute.
- **Measuring the specific gravity of the electrolyte in the battery will disclose the state of charge of the battery. The relation between specific gravity and state of charge is as shown in the figure.**



(A) Specific gravity [20°C (68°F)] (B) Amount of discharge (%) (C) Good
(D) Need to charge or replace



(A) Specific gravity [20°C (68°F)] (B) Electrolyte temperature (C) Good
(D) Caution (E) Need charging

Check

- **Specific gravity: 1.250 — 1.290, and difference between cells is 0.04 or less** → Battery is normal
- **Specific gravity: Less than 1.250, or difference between cells is 0.04 or more** → Battery needs to be charged or replaced

4. STANDBY CURRENT

1. Prepare the circuit tester which can measure down to 1 mA.
   Note:
   For model with keyless access function, the standby current changes regularly. Therefore, prepare the analog type circuit tester.
2. Using the circuit tester, check the standby current.
   Note:
   The standby current may be displayed lower than the actual value if the battery is weak, so be sure to check the battery. Charge or replace if necessary.
   (1) Check the battery. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>INSPECTION > APPEARANCE. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>INSPECTION > ELECTROLYTE LEVEL. Ref. to STARTING/CHARGING SYSTEMS(STI)>Battery>INSPECTION > SPECIFIC GRAVITY OF ELECTROLYTE.
   (2) Check that the fuse is not blown out and is properly inserted.
   (3) When non-genuine electrical parts (including parts sold in authorized workshops) are installed, remove all parts except for genuine electrical parts.
   (4) Check that back-up fuse is inserted. Ref. to PRE-DELIVERY INSPECTION>PRE-DELIVERY INSPECTION (PDI) PROCEDURE > FUSE.
   (5) Start the engine, and set the switch positions for each system as shown in the following table.
   Note:
   Some of the listed systems are not equipped depending on the vehicle. Set only the systems equipped on the vehicle to the positions as shown.

System	Position
Headlight	ON or Auto
Fog light	ON
Wiper (front and rear)	ON or Low speed
Audio and navigation system	ON
Rear defogger	ON
Room light	DOOR
Luggage light	DOOR
Map light	OFF
Auto A/C	ON (AUTO)
Manual A/C	ON (Speed 1)
Electronic parking brake	ON
Electrical parts other than listed above (electrical parts that users can confirm the operation with the key removed)	OFF

(6) Turn the ignition switch to OFF.

(7) Operate the front hood lock release lever to unlock the front hood.

(8) Close all the doors (including rear gate and trunk lid) and then lock the doors. (Security alarm is in set condition)

Note:

For model with keyless access function, take the access key 1.5 m or more away from the vehicle after the door lock. And do not put the access key close to the vehicle while measuring the standby current.

(9) Wait for 5 minutes after door lock until the standby current stabilizes.

(10) Loosen the nut which holds the negative terminal to the battery.

Note:

Do not remove the negative terminal.

(11) Connect the circuit tester positive terminal to the negative terminal.

Note:

To prevent the damage to the circuit tester, set the circuit tester range to a large value first, then gradually change it to smaller values.

(12) Connect the circuit tester negative terminal to the negative terminal installation part of the battery.

(13) While connecting the circuit tester positive terminal with the negative terminal as shown in the figure below, remove the negative terminal from the battery.

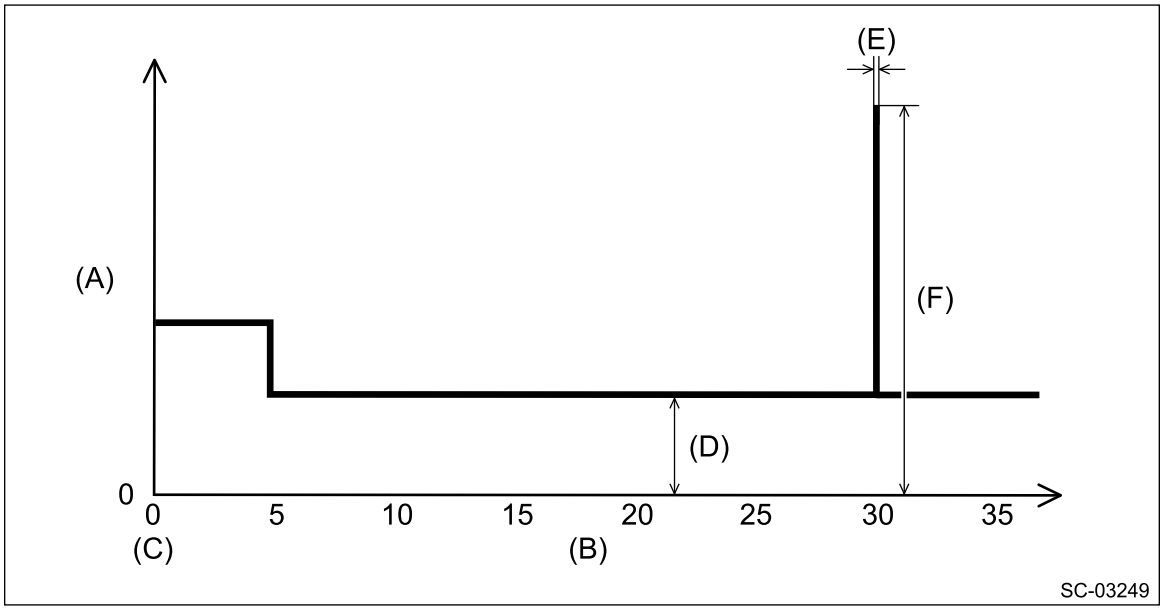
(14) Check the standby current.

Caution:

If the circuit tester is disconnected from any terminal during standby current check, reconnect the ground terminal of the battery and restart the procedure back in the step (9).

Note:

- **For model with keyless access function, the standby current changes periodically because the keyless access system continuously searches the access key (polling).**
- **When measuring the standby current, the reading of the circuit tester oscillates. Therefore, read the average value (median value).**
- **The standby current may become large when the vehicle system is activated 5 times at 30-minute intervals or 5 hours after turning the ignition switch to OFF. Therefore, the measurement should be completed in 20 minutes after turning the ignition switch to OFF. If it takes more than 20 minutes, start the engine and turn the ignition switch to OFF again before performing the inspection.**



(A) Current/mA (B) Time/min (C) Ignition OFF
(D) Less than 70 mA (E) 5 seconds (system operation) (F) 300 mA or more

Check

- **When the maximum measurement value is less than 70 mA** → Standby current is normal.
- **When the maximum measurement value is 70 mA or more** → Go to step (15).

(15)Remove all fuses one by one to identify which system changes the standby current value significantly. Ref. to WIRING SYSTEM>Fuse And Relay.

(16)Check the harness and connector of the system whose standby current has changed significantly.

STARTING/CHARGING SYSTEMS(STI) > Battery

CHARGE

Warning:

- **Do not bring an open flame close to the battery when working.**

Caution:

- **Prior to charging, corroded terminals should be cleaned with a brush and common caustic soda solution.**
- **Be careful while charging the battery because it produces flammable gasses.**
- **Observe instructions when handling the battery charger.**
- **Before charging the battery on the vehicle, disconnect the battery ground terminal to prevent damage of generator diodes or other electrical units.**

1. NORMAL CHARGE (CONSTANT CURRENT CHARGE)

Charge the battery with the current value specified by manufacturer or with approximately 1/10 of battery's rating capacity. (See the table below.)

Type	Charging current (A)	CCA (A)
75D23L	5.0 — 6.0	470

Caution:

- **The charge control feature and specifications for judgment of charge completion depend on the device. Follow the instruction manual of the charger used.**
- **Keep the electrolyte temperature at 45°C (113°F) or less while charging. Stop charging when the temperature exceeds this value.**

Note:

The characteristics of typical charging methods are as follows.

- **Constant current charging**
  This method makes it easy to charge to 100%, since the electrolyte is agitated by the gassing occurred at the end of charging. However, the time for charging is comparatively long because the current value is kept constant.
- **Constant voltage charging**
  This method completes charging in a short period of time due to the large current. However, it is difficult to charge to 100% because no gassing occurred at the end of charging and the electrolyte is not agitated. Therefore, the combined use with the constant current charging is preferable.
- **Quasi-constant voltage charging**
  This method is widely used for commercially available chargers.
  Compared to the constant voltage charging whose charging current at the beginning of charging becomes large, it reduces the charging current by lowering the voltage at the initial stage, resulting in battery load reduction. The time for charging is comparatively long. However, this type of chargers can be manufactured comparatively inexpensive due to the simple control circuit (or manual settings). After the initial stage of charging is completed, it gradually raises the charging voltage so that the charging current is within the specification, until the battery is fully charged.
- **Constant voltage/current charging**
  In addition to the constant voltage charging, this method controls the upper limit of the current.
  The constant current charging is applied at the beginning of charging, and the constant voltage charging is applied at the end. This makes battery charge comparatively efficient in a short period of time. Charging by generators is similar to this method.

Judgment of charge completion

1. Specific gravity of electrolyte should be held within the specific range of 1.250 — 1.290 for one hour or more.
2. Voltage while charging should be held within the specified range of 15.0 — 16.8 V for one hour or more.
3. Gas is actively generated in all cells.
4. The amount of charge reaches 1.2 — 1.5 times of the amount of discharge.

   Note:

   The amount of discharge/charge can be calculated by the following formula.

   Amount of discharge (Ah) = Remaining capacity (%) calculated by specific gravity × 5 hour rate capacity (Ah)

   Amount of charge (Ah) = Charging current value (A) × Time for charging

2. QUICK CHARGING

Charge the battery in a short period of time with a relatively large current by using a quick charger. Charge the battery with the current value at approximately 1/2 of battery's rating capacity. (See the table below.)

Caution:

- **Quick charging is accompanied by a large amount of heat generation. Charging should be completed in up to 30 minutes regardless of battery size.**
- **Quick charging is used to recover the battery until it can start the vehicle. For full charging, use the normal charging method.**
- **Keep the electrolyte temperature at 55°C (131°F) or less while quick charging. Stop charging when the temperature exceeds this value.**

Type	Charging current (A)	CCA (A)
75D23L	24.0 — 29.0	470

FUEL INJECTION (FUEL SYSTEMS)(w/o STI)

FU(w/o STI)

1. General Description
2. Throttle Body
3. Intake Manifold
4. Tumble Generator Valve Assembly
5. Tumble Generator Valve Actuator
6. Fuel Insulator
7. Fuel Injector
8. Fuel Pressure Sensor
9. High Pressure Fuel Pump
10. High Pressure Fuel Delivery Pipe
11. Engine Wiring Harness
12. Engine Coolant Temperature Sensor
13. Engine Oil Temperature Sensor
14. Crankshaft Position Sensor
15. Crankshaft Position Sensor Plate
16. Camshaft Position Sensor
17. Oil Control Solenoid
18. Knock Sensor
19. Throttle Position Sensor
20. Mass Air Flow and Intake Air Temperature Sensor
21. Manifold Absolute Pressure and Intake Air Temperature Sensor
22. Wastegate Control Solenoid Valve
23. Front Oxygen (A/F) Sensor
24. Rear Oxygen Sensor
25. SI-DRIVE (SUBARU Intelligent Drive) Selector
26. Engine Control Module (ECM)
27. Main Relay
28. Oxygen Sensor Relay
29. Electronic Throttle Control Relay
30. Fuel Pump Relay
31. Fuel Injector Relay
32. Fuel Pump Control Unit
33. Fuel
34. Fuel Tank Protector

35. Fuel Tank
36. Fuel Filler Pipe
37. Fuel Pump
38. Fuel Level Sensor
39. Fuel Sub Level Sensor
40. Fuel Filter
41. Fuel Delivery and Evaporation Lines
42. Fuel System Trouble in General

SPECIFICATION

Fuel tank	Capacity	60 L (15.9 US gal, 13.2 Imp gal)
	Location	Under rear seat
Fuel pump	Type	Impeller
	Shutoff discharge pressure	940 kPa (9.6 kg/cm^2, 136.3 psi) or less
	Discharge rate	153 L (40.4 US gal, 33.7 Imp gal)/h or more [12.5 V at 343 kPa (3.5 kg/cm^2, 49.7 psi)]
Fuel filter		In-tank type

COMPONENT

1. INTAKE MANIFOLD

(1) Intake manifold
(2) Manifold absolute pressure and intake air temperature sensor
(3) O-ring
(4) Tumble generator valve ASSY LH
(5) Tumble generator valve ASSY RH
(6) Gasket
(7) Air intake adapter LH
(8) Air intake adapter RH
(9) Gasket

Tightening torque: N·m (kgf-m, ft-lb)

T1: 3.5 (0.4, 2.6)

T2: 25 (2.5, 18.4)

2. FUEL INJECTOR 1

(1)	Fuel injector pipe LH	(7)	Back-up ring	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Fuel injector pipe RH	(8)	Fuel injector	***T1: 19 (1.9, 14.0)***
(3)	Rubber cover	(9)	Injector seal	***T2: 46 (4.7, 33.9)***
(4)	Holder	(10)	Snap ring	
(5)	Spacer	(11)	Fuel pressure sensor	
(6)	O-ring			

* When removing the fuel pressure sensor from the fuel injector pipe RH, replace it with a new one.

3. FUEL INJECTOR 2

(1) Fuel pipe protector
(2) Fuel pipe insulator No. 3
(3) Fuel pipe insulator No. 2
(4) Fuel pipe insulator No. 1
(5) Fuel delivery pipe
(6) High-pressure fuel pump
(7) High-pressure fuel delivery pipe
(8) High-pressure fuel delivery pipe ASSY
(9) Vacuum control hose
(10) Purge control solenoid valve A
(11) Purge control solenoid valve B
(12) Vacuum hose A
(13) Vacuum hose B
(14) Vacuum hose C
(15) Vacuum hose D
(16) Canister pipe
(17) Vacuum hose E
(18) Vacuum pipe ASSY
(19) Fuel pipe ASSY
(20) Vacuum hose F
(21) Vacuum hose G
(22) Pipe clamp

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 19 (1.9, 14.0)
T3: 21 (2.1, 15.5)
T4: 28 (2.9, 20.7)

4. THROTTLE BODY

(1) Throttle body
(2) Gasket

Tightening torque: N·m (kgf-m, ft-lb)
T: 8 (0.8, 5.9)

5. CRANKSHAFT POSITION, CAMSHAFT POSITION AND KNOCK SENSORS

(1) Oil control solenoid
(2) Camshaft position sensor
(3) Crankshaft position sensor
(4) Knock sensor
(5) O-ring
(6) Back-up ring
(7) O-ring

Tightening torque: N·m (kgf-m, ft-lb)
T1: 6.4 (0.7, 4.7)
T2: 24 (2.4, 17.7)

6. FUEL TANK

(1) Fuel tank
(2) Fuel tank band
(3) Fuel delivery tube
(4) Jet pump tube
(5) Fuel pump ASSY
(6) Fuel pump upper plate
(7) Fuel pump gasket
(8) Fuel level sensor
(9) Fuel sub level sensor
(10) Fuel sub level sensor upper plate
(11) Fuel sub level sensor gasket
(12) Fuel sub level sensor filter
(13) Fuel sub level sensor protector
(14) Stopper RH
(15) Stopper LH
(16) Heat shield cover
(17) Fuel tank protector RH
(18) Fuel tank protector LH
(19) Self-locking nut
(20) Rubber cap
(21) Fuel filler hose
(22) Clamp
(23) Clamp
(24) Evaporation hose
(25) Clip
(26) Tube clamp
(27) Fuel pump upper plate cushion
(28) Fuel sub level sensor upper plate cushion
(29) Cushion
(30) Cushion
(31) Cushion

Tightening torque: N·m (kgf-m, ft-lb)
T1: 2 (0.2, 1.5)
T2: 2.5 (0.3, 1.8)
T3: 9 (0.9, 6.6)
T4: 18 (1.8, 13.3)
T5: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Tank>INSTALLATION.
T6: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Pump>INSTALLATION.
T7: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Sub Level Sensor>INSTALLATION.

7. FUEL LINE

- Fuel line 1

(1) Fuel delivery tube
(2) Evaporation hose
(3) Tube clamp
(4) Clip
(5) Hose clamp
(6) Hose clamp bracket
(7) Fuel pipe ASSY
(8) Bushing
(9) Fuel pipe front grommet
(10) Pipe clamp
(11) Pipe clamp
(12) Pipe clamp
(13) Pipe clamp
(14) Pipe clamp
(15) Fuel pipe rear grommet

Tightening torque: N·m (kgf-m, ft-lb)

T: 7.5 (0.8, 5.5)

- Fuel line 2

(1) Vent hose
(2) Clip
(3) Vent tube
(4) Harness
(5) Leak check valve ASSY
(6) Leak check valve bracket
(7) Drain tube A
(8) Drain filter
(9) Drain bracket
(10) Drain pipe
(11) Purge tube
(12) Tube clamp
(13) Clamp B
(14) Clamp A
(15) Drain tube B
(16) Tube clamp
(17) Tube clamp
(18) Canister bracket A
(19) Tube clamp
(20) Canister bracket B
(21) Tube clamp
(22) Clip
(23) Canister bracket C
(24) Canister

Tightening torque: N·m (kgf-m, ft-lb)

T1: 5.4 (0.6, 4.0)

T2: 7.5 (0.8, 5.5)

∗1 The canister bracket cannot be separated from the canister. Therefore, be sure to replace both of them with new ones when replacing the canister or canister bracket.

∗2 The drain filter cannot be separated from the drain bracket. Therefore, be sure to replace both of them with new ones when replacing the drain bracket or drain filter.

8. FUEL FILLER PIPE

(1)	Fuel filler pipe ASSY	(5)	Fuel filler cap	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Neck holder A	(6)	Clip	***T: 7.5 (0.8, 5.5)***
(3)	Neck holder B	(7)	Upper bracket	
(4)	Fuel filler pipe protector	(8)	Lower bracket	

9. FUEL PUMP

(1)	Fuel filter ASSY	(6)	Connector cable	(11)	Spring
(2)	O-ring	(7)	Fuel pump holder	(12)	Fuel chamber ASSY
(3)	O-ring	(8)	O-ring	(13)	Clip
(4)	Back-up ring	(9)	Spacer	(14)	Fuel level sensor
(5)	Pressure regulator	(10)	Fuel pump	(15)	Cushion

* When removing the cushion from the fuel chamber assembly, replace it with a new part.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Place “NO OPEN FLAMES” signs near the working area.
- Prepare a container and cloth to prevent scattering of fuels when performing work where fuels can be spilled. If the oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Always inspect for fuel leaks after removing/installing the fuel system components.
- Follow all government and local regulations concerning disposal of refuse when disposing fuel.
- Always use new application oil during work.

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**
	18356AA000	INJECTOR REMOVER	Used for removing the injector.
	18460AA030	CHECK BOARD	Used for measuring voltage and resistance of ECM terminals.
	18471AA000	FUEL PIPE ADAPTER	Used for draining fuel.
	18683AA000	INJECTOR SEAL INSTALLER	Used for installing the injector seal.

2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Oscilloscope	Used for inspecting the waveform of each sensor.
TORX PLUS® bit 40IP	Used for removing and installing high-pressure fuel pump.
Mighty Vac	Used for inspecting the manifold absolute pressure and intake air temperature sensor.
DST-i	Used together with Subaru Select Monitor 4.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Throttle Body

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Lift up the vehicle.
4. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
5. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
6. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
7. Remove the intake duct No. 3. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 3.
8. Disconnect the connector (A) from the throttle position sensor, and disconnect the preheater hose (B) from the throttle body.
9. Remove the throttle body from the intake manifold.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Throttle Body

INSTALLATION

Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

8 N·m (0.8 kgf-m, 5.9 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Throttle Body

INSPECTION

1. THROTTLE SENSOR (METHOD WITH CIRCUIT TESTER)

Note:

Individual difference of the accelerator pedal may not be corrected sufficiently on the ECM side after DTCs were cleared or the battery was removed and installed on the vehicle. Therefore, when the reference voltage is not reached after following the procedure, repeat the ignition switch ON (engine OFF) and ignition switch OFF operations 40 times at intervals of three seconds or more, and then measure the voltage again.

1. After warming-up the engine, turn the ignition switch to OFF.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the engine control module (ECM). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
4. Install the ST between the ECM and bulkhead harness and the engine wiring harness. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>General Description>CAUTION.

ST	**18460AA030**	**CHECK BOARD**

5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
6. Turn the ignition switch to ON. (Engine OFF)

7. Using the ST, check the voltage between ECM connector terminals when accelerator pedal is fully closed and fully open.
   Check
   - **When voltage is within standard values** → Normal
   - **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.
   - **If throttle sensor voltage does not change** → Go to step 8.

   (A) To the check board connector (ECM connector)

Throttle sensor	Accelerator pedal	Terminal No.	Standard
Main	Not depressed (full closed)	17 (+) and 30 (−)	Approx. 0.7 V
	Depressed (full opened)		Approx. 3.9 V
Sub	Not depressed (full closed)	29 (+) and 30 (−)	Approx. 4.4 V
	Depressed (full opened)		Approx. 1.1 V

8. Start the engine.
9. Check the voltage between ECM connector terminals when accelerator pedal is fully closed and fully open.
   Caution:
   When depressing the accelerator pedal to fully open, perform it in as short a time as possible, but within the range where the inspection result is not adversely affected.
   Note:
   Perform the inspection in the following conditions.
   - **For AT model or CVT model: Select lever is in "P" range.**
   - **For MT model: Gear shift lever is in the neutral position.**
   - **Parking brake activated**

   Check
   - **When voltage is within standard values** → Normal
   - **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.
10. After inspection, install the related parts in the reverse order of removal.

2. THROTTLE SENSOR (METHOD WITH SUBARU SELECT MONITOR)

Note:

- **Individual difference of the accelerator pedal may not be corrected sufficiently on the ECM side after DTCs were cleared or the battery was removed and installed on the vehicle. Therefore, using the Subaru Select Monitor, check that the accelerator opening angle signal indicates 100%, when the accelerator pedal is fully depressed, and then perform the inspection.**
- **If the accelerator opening angle signal does not indicate 100%, check the accelerator pedal. Ref. to SPEED CONTROL SYSTEMS(w/o STI)>Accelerator Pedal>INSPECTION > CHECK ACCELERATOR PEDAL SENSOR AREA (METHOD WITH SUBARU SELECT MONITOR).**

1. After warming-up the engine, turn the ignition switch to OFF.
2. Turn the ignition switch to ON. (Engine OFF)
3. Using the Subaru Select Monitor, read the accelerator opening angle signal and throttle sensor voltage when accelerator pedal is fully closed and fully open. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA.
   Note:
   Due to the specification of the Subaru Select Monitor, value read from the accelerator opening angle signal is highlighted and displayed as the voltage readings of sub throttle sensor.
   Check
   - **When voltage is within standard values** → Normal
   - **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.
   - **If throttle sensor voltage does not change** → Go to step 4.

Throttle sensor	Acceleration opening angle signal	Standard
Main	0.0%	Approx. 0.7 V
	100.0%	Approx. 3.9 V
Sub	0.0%	Approx. 1.1 V
	100.0%	Approx. 4.4 V

4. Start the engine.
5. Using the Subaru Select Monitor, read the accelerator opening angle signal and throttle sensor voltage when accelerator pedal is fully closed and fully open.
   Caution:
   When depressing the accelerator pedal to fully open, perform it in as short a time as possible, but within the range where the inspection result is not adversely affected.
   Note:
   Perform the inspection in the following conditions.
   - **For AT model or CVT model: Select lever is in "P" range.**
   - **For MT model: Gear shift lever is in the neutral position.**
   - **Parking brake activated**

   Check
   - **When voltage is within standard values** → Normal

- **When voltage is not within standard values** → It is possible that there is a connector connection failure, harness open circuit, short circuit, or malfunction of the throttle body. Perform inspection or replacement.

3. OTHER INSPECTIONS

1. Check that the throttle body has no deformation, cracks or other damages.
2. Check that the preheater hose has no cracks, damage or loose part.

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
3. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
5. Lift up the vehicle.
6. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
7. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
8. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
9. Remove the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 2.
10. Remove the intake duct No. 3. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 3.
11. Disconnect the PCV hose from the PCV valve.
12. Disconnect the connector (A) from the throttle body, and disconnect the preheater hose (B) from the throttle body.
13. Disconnect sections (A) and (B) of the brake booster vacuum hose from the brake vacuum pump and intake manifold, and remove the brake booster vacuum hose from the clip (C).
14. Remove the brake booster vacuum hose from the clip (D), and place the brake booster vacuum hose aside so that it does not interfere with the work.
15. Remove the clips securing the PCV pipe and generator cord to the intake manifold.
16. Disconnect the vacuum control hose and vacuum hose from the vacuum pipe assembly.
17. Disconnect two vacuum hoses from the canister pipe.
18. Disconnect the connector from the purge control solenoid valve.
19. Disconnect the connector from the manifold absolute pressure and intake air temperature sensor.
20. Disconnect the connector (A) from the tumble generator valve RH.
21. Disconnect the connector (B) from the tumble generator valve LH, and remove the bolt securing the fuel pipe protector to the intake manifold.
22. Remove the engine wiring harness clip from the intake manifold.
23. Remove the bolt securing the EGR pipe to the EGR valve.
24. Disconnect the fuel delivery tube and evaporation hose.
    Caution:
    - **Be careful not to spill fuel.**
    - **Catch the fuel from the tubes using a container or cloth.**

    (1) Disconnect the quick connector on the fuel delivery tube from the fuel pipe assembly, and remove the clip (A) securing the fuel delivery tube.
    Note:
    Disconnect the quick connector as shown in the figure.

(a) Slider

(2) Disconnect the evaporation hose from the fuel pipe assembly.

25. Remove the bolts securing the fuel pipe assembly to the intake manifold.

26. Disconnect the fuel delivery pipe (A) and vacuum hose (B), and remove the fuel pipe assembly.

Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

Note:

Disconnect the quick connector as shown in the figure.

(a) Slider

27. Remove the intake manifold from the air intake adapter together with the tumble generator valve assembly.

28. Remove the vacuum hose assembly from the water pipe assembly.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Intake Manifold

INSTALLATION

1. Install the vacuum hose assembly to the water pipe assembly.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

2. Install the intake manifold and tumble generator valve assembly to the air intake adapter.

Note:

Use a new gasket.

Tightening torque:

25 N·m (2.5 kgf-m, 18.4 ft-lb)

3. Connect the fuel delivery pipe (A) and vacuum hose (B) to the fuel pipe assembly.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

4. Install the fuel pipe assembly to the intake manifold.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

5. Connect the fuel delivery tube and evaporation hose.

(1) Connect the evaporation hose to fuel pipe assembly.

(2) Connect the connector on the fuel delivery tube to the fuel pipe assembly, and secure the fuel delivery tube using clip (A).

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

6. Install the EGR pipe. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Pipe>INSTALLATION.
7. Secure the engine wiring harness to the intake manifold using clip.
8. Connect the connector (A) to the tumble generator valve RH.
9. Connect the connector (B) to the tumble generator valve LH, and secure the fuel pipe protector to the intake manifold.

   Tightening torque:

   19 N·m (1.9 kgf-m, 14.0 ft-lb)
10. Connect connectors to the manifold absolute pressure & intake air temperature sensor.
11. Connect the connector to the purge control solenoid valve.
12. Connect the vacuum hose to the canister pipe.
13. Connect the vacuum control hose and vacuum hose to the vacuum pipe assembly.
14. Secure the PCV pipe and generator cord to the intake manifold using the clip.
15. Install the brake booster vacuum hose to the clip (D).

    Note:

    If the clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.
16. Connect sections (A) and (B) of the brake booster vacuum hose to the brake vacuum pump and intake manifold, and install the brake booster vacuum hose to the clip (C).
17. Connect the preheater hose (B) to the throttle body, and connect the connector (A) to the throttle body.
18. Connect the PCV hose to the PCV valve.
19. Install the intake duct No. 3. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 3.
20. Install the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 2.
21. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
22. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
23. Lower the vehicle.
24. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
25. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

26. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Intake Manifold

DISASSEMBLY

1. Remove the manifold absolute pressure & intake air temperature sensor from the intake manifold.
2. Remove the EGR pipe from intake manifold.
3. Remove the throttle body from the intake manifold.
4. Disconnect the vacuum hose from the intake manifold, and remove the purge control solenoid valve.
5. Disconnect the PCV hose and vacuum control hose from the intake manifold.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Intake Manifold

ASSEMBLY

1. Connect the PCV hose and vacuum control hose to intake manifold.
2. Connect the vacuum hose to the intake manifold, and install the purge control solenoid valve.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
3. Install the throttle body to the intake manifold.
   Note:
   Use a new gasket.
   Tightening torque:
   8 N·m (0.8 kgf-m, 5.9 ft-lb)
4. Temporarily install the EGR pipe to the intake manifold.
   Note:
   - **Use new O-rings.**
   - **Tighten the EGR pipe when installing the intake manifold. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Pipe>INSTALLATION.**
5. Install the manifold absolute pressure & intake air temperature sensor to the intake manifold.
   Note:
   Use new O-rings.
   Tightening torque:
   3.5 N·m (0.3 kgf-m, 2.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Intake Manifold

INSPECTION

1. Check that the intake manifold and fuel pipe have no deformation, cracks and other damages.
2. Check that the hose has no cracks, damage or loose part.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Tumble Generator Valve Assembly

REMOVAL

Note:
The tumble generator valve assembly is tightened together with the intake manifold.

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Remove the air intake adapter from the cylinder head.
   - RH side
   - LH side
4. Remove the cylinder head plate from cylinder head.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Tumble Generator Valve Assembly

INSTALLATION

Install in the reverse order of removal.
Note:
Use a new gasket.
Tightening torque:
25 N·m (2.5 kgf-m, 18.4 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Tumble Generator Valve Assembly

INSPECTION

1. Check that the tumble generator valve assembly or air intake adapter has no deformation, cracks or other damages.
2. Check tumble generator valve assembly or air intake adapter for contamination or clogging.

SPECIFICATION

The tumble generator valve assembly cannot be disassembled.
Refer to “Tumble Generator Valve Assembly” for removal and installation procedures. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Tumble Generator Valve Assembly>REMOVAL. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Tumble Generator Valve Assembly>INSTALLATION.

REMOVAL

1. FUEL PIPE INSULATOR NO. 1

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Remove the clip (A) on the generator cord, and remove the fuel pipe protector.
4. Remove the fuel pipe insulator No. 1.

2. FUEL PIPE INSULATOR NO. 2

1. Remove the fuel pipe insulator No. 1. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 1.
2. Remove the fuel pipe insulator No. 2.

3. FUEL PIPE INSULATOR NO. 3

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Disconnect the connector (A) from the EGR control valve.
4. Remove the bolts (B) securing the EGR cooler to the EGR control valve.
5. Remove the preheater hose (C) from the EGR control valve.
6. Remove the EGR control valve.
7. Disconnect the connector (A) on the fuel pressure sensor, and remove the fuel pipe insulator No. 3.

INSTALLATION

1. FUEL PIPE INSULATOR NO. 1

Install in the reverse order of removal.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

2. FUEL PIPE INSULATOR NO. 2

Install in the reverse order of removal.

3. FUEL PIPE INSULATOR NO. 3

Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

INSPECTION

Check that the fuel insulator has no deformation, cracks or other damages.

REMOVAL

1. FUEL INJECTOR RH

Caution:
- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
3. Disconnect the connector (A) from fuel injector, and remove the fuel injector pipe.
4. Using scissors or the like, remove the rubber cover (A) from the fuel injector.
5. Remove the holder (B) and spacer (C) from the fuel injector.
6. Rotate the snap ring to remove it from the fuel injector.
7. Using ST, remove the fuel injector from the cylinder head.

ST 18356AA000 INJECTOR REMOVER

(1) Set the ST so that its mark faces the center of the engine.
(2) Pinch the fuel injector groove (A) with the claw section (B) of ST.
(3) Press the ST to the cylinder head.
(4) Screw in the threaded section of the ST clockwise, and remove the fuel injector from the cylinder head.

2. FUEL INJECTOR LH

Caution:
- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
3. Remove the high-pressure fuel delivery pipes. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE.
4. Disconnect the connector (A) from fuel injector, and remove the fuel injector pipe LH.
5. Using scissors or the like, remove the rubber cover (A) from the fuel injector.
6. Remove the holder (B) and spacer (C) from the fuel injector.
7. Rotate the snap ring to remove it from the fuel injector.
8. Using ST, remove the fuel injector from the cylinder head.

ST 18356AA000 INJECTOR REMOVER

(1) Set the ST so that its mark faces the center of the engine.
(2) Pinch the fuel injector groove (A) with the claw section (B) of ST.

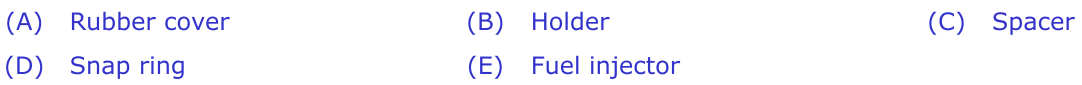
(3) Press the ST to the cylinder head.
(4) Screw in the threaded section of the ST clockwise, and remove the fuel injector from the cylinder head.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Injector

INSTALLATION

1. FUEL INJECTOR RH

1. Replace the injector seal, backup ring and O-ring with a new part. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>REPLACEMENT.
2. Set the spacer, holder, rubber cover and snap ring to the fuel injector, and install it to the fuel injector pipe RH.
   Caution:
   Always use a new spacer, holder, rubber cover and snap ring.

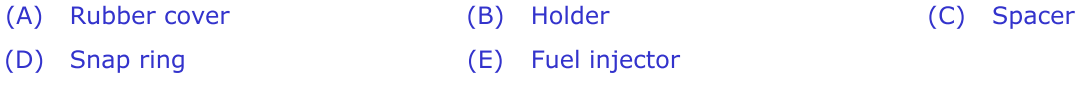


(A) Rubber cover (B) Holder (C) Spacer
(D) Snap ring (E) Fuel injector

3. Set the fuel injector on the fuel injector pipe RH.
   Caution:
   - **● on the fuel injector pipe RH must be aligned with ▲ on the rubber cover.**
   - **Parting line (a) of the rubber cover must be straight.**
   - **The end surface of the fuel injector pipe RH must fit inside the rubber cover.**
   - **There must be no gap between the snap ring and rubber cover.**
4. Install the fuel injector pipe RH and fuel injector as a single unit to the cylinder head.
5. Tighten the bolt on fuel pipe RH, and connect the connector (A) to the fuel injector.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
6. Install the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
7. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

2. FUEL INJECTOR LH

1. Replace the injector seal, backup ring and O-ring with a new part. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>REPLACEMENT.
2. Set the spacer, holder, rubber cover and snap ring to the fuel injector, and install it to the fuel injector pipe LH.
   Caution:
   Always use a new spacer, holder, rubber cover and snap ring.



(A) Rubber cover (B) Holder (C) Spacer
(D) Snap ring (E) Fuel injector

3. Set the fuel injector on the fuel injector pipe LH.

Caution:

- **● on the fuel injector pipe LH must be aligned with ▲ on the rubber cover.**
- **Parting line (a) of the rubber cover must be straight.**
- **The end surface of the fuel injector pipe LH must fit inside the rubber cover.**
- **There must be no gap between the snap ring and rubber cover.**

4. Install the fuel injector pipe LH and fuel injector as a single unit to the cylinder head.
5. Tighten the bolt on fuel injector pipe LH, and connect the connector (A) to the fuel injector.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
6. Install the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
7. Install the high-pressure fuel delivery pipe. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE.
8. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Injector

REPLACEMENT

Caution:

- **Perform work without using gloves.**
- **Always use the ST when installing the injector seal.**

ST	**18683AA000**	**INJECTOR SEAL INSTALLER**

(A) Seal guide A (B) Seal guide B (C) Injector seal installer
(D) Injector seal adjuster

1. Using a pair of nippers, cut off the injector seal by pinching it.
   Caution:
   Be careful not to damage the fuel injector.
2. Remove the O-ring and backup ring from the fuel injector.
3. Attach the seal guide A to the fuel injector.
   Note:
   Two types of seal guides are provided. So, do not mix up the type to be used.
4. Set the injector seal to the injector seal installer.
5. Push in the injector seal installer slowly in the direction of the arrow, and attach the injector seal to the fuel injector.
   Caution:
   - **Insert it so that the injector seal is installed straight.**
   - **Be careful that the injector seal does not go beyond the fuel injector groove.**
6. While rotating the injector seal adjuster to left and right by 90 degrees for each side, slowly insert it all the way.
   Note:
   - **Apply a thin coat of gasoline to the injector seal and injector seal adjuster.**
   - **With the injector seal adjuster fully inserted, rotate it to left and right approx. ten times by 90 degrees for each side to normalize the injector seal.**

7. Attach the seal guide B to the fuel injector.
   Note:
   Two types of seal guides are provided. So, do not mix up the type to be used.
8. Set the injector seal to the injector seal installer.
9. Push in the injector seal installer slowly in the direction of the arrow, and attach the injector seal to the fuel injector.
   Caution:
   - **Insert it so that the injector seal is installed straight.**
   - **Be careful that the injector seal does not go beyond the fuel injector groove.**
10. While rotating the injector seal adjuster to left and right by 90 degrees for each side, slowly insert it all the way.
    Note:
    - **Apply a thin coat of gasoline to the injector seal and injector seal adjuster.**
    - **With the injector seal adjuster fully inserted, rotate it to left and right approx. ten times by 90 degrees for each side to normalize the injector seal.**
11. Attach two backup rings and O-ring to the fuel injector.
    Note:
    Use new backup rings and O-ring.

(A) O-ring (B) Backup ring (brown) (C) Backup ring (white)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Injector

INSPECTION

1. Check that the fuel injector has no deformation, cracks or other damages.
2. Measure the resistance between fuel injector terminals.

Terminal No.	Standard
1 and 2	Approx. 2.1 Ω (when 20°C (68°F))

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pressure Sensor

REMOVAL

Caution:
- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Remove the fuel injector RH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>REMOVAL > FUEL INJECTOR RH.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pressure Sensor

INSTALLATION

1. Replace the injector seal, backup ring and O-ring with a new part. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>REPLACEMENT.
2. Set the spacer, holder, rubber cover and snap ring to the fuel injector, and install it to the fuel injector pipe RH.
   Caution:
   Always use a new spacer, holder, rubber cover and snap ring.

   (A) Rubber cover (B) Holder (C) Spacer
   (D) Snap ring (E) Fuel injector

3. Set the fuel injector on the fuel injector pipe RH.
   Caution:
   - **● on the fuel injector pipe RH must be aligned with ▲ on the rubber cover.**
   - **Parting line (a) of the rubber cover must be straight.**
   - **The end surface of the fuel injector pipe RH must fit inside the rubber cover.**
   - **There must be no gap between the snap ring and rubber cover.**
4. Install the fuel injector pipe RH and fuel injector as a single unit to the cylinder head.
5. Tighten the fuel injector pipe RH.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
6. Temporarily tighten the fuel pressure sensor to the fuel injector pipe RH until it cannot be turned by hand.
   Caution:
   Always use a new fuel pressure sensor.
7. Tighten the fuel pressure sensor.

Caution:

- **Be careful not to spill oil on the screw sections of the fuel pressure sensor and the fuel injector pipe RH.**
- **Be careful not to let foreign matter enter into the fuel pressure sensor during installation.**
- **Do not recheck the tightening torque after tightening the fuel pressure sensor with specified torque.**

Tightening torque:

46 N·m (4.7 kgf-m, 33.9 ft-lb)

8. Install the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
9. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pressure Sensor

INSPECTION

Check that the fuel pressure sensor has no deformation, cracks or other damages.

REMOVAL

1. HIGH-PRESSURE FUEL PUMP

Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the high-pressure fuel delivery pipes. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE.
3. Remove the fuel delivery pipe (A) from the high-pressure fuel pump, and disconnect the connector (B) from the high-pressure fuel pump.
   Note:
   Disconnect the quick connector as shown in the figure.
   (a) Slider
4. Using TORX PLUS® bit 40IP, remove the high-pressure fuel pump.
5. Remove the fuel pump lifter from the fuel pump case.

2. HIGH-PRESSURE FUEL PUMP CASE

1. Remove the high-pressure fuel pump. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Pump>REMOVAL > HIGH-PRESSURE FUEL PUMP.
2. Remove the air intake adapter LH from the cylinder head.
3. Remove the high-pressure fuel pump case from the cam carrier assembly LH.

INSTALLATION

1. HIGH-PRESSURE FUEL PUMP

1. Install the fuel pump lifter to the high-pressure fuel pump case.
   Note:
   Apply engine oil to the side of the high-pressure fuel pump case and to the bottom surface of the fuel pump lifter.
2. Using TORX PLUS® bit 40IP, install the high-pressure fuel pump.
   Note:
   Use new O-rings.
   Tightening torque:
   21 N·m (2.1 kgf-m, 15.5 ft-lb)
3. Connect the connector (B) to the high-pressure fuel pump, and install the fuel delivery pipe (A) to the high-pressure fuel pump.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

4. Install the high-pressure fuel delivery pipe. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE.
5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

2. HIGH-PRESSURE FUEL PUMP CASE

1. Apply liquid gasket to the mating surfaces of fuel pump case, and install the high-pressure fuel pump case.

   Note:

   - **Clean the mating surface of the high-pressure fuel pump case and cam carrier assembly LH.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:

   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

   Liquid gasket applying diameter:

   3±1 mm (0.1181±0.0394 in)

   (A) 1 mm or less (0.0394 in or less) (B) 3 mm (0.1181 in) (C) Chamfer edge

2. Install the high-pressure fuel pump case to the cam carrier assembly LH.

   Tightening torque:

   19 N·m (1.9 kgf-m, 14.0 ft-lb)
3. Install the air intake adapter LH to cylinder heads.

   Note:

   Use a new gasket.

   Tightening torque:

   25 N·m (2.5 kgf-m, 18.4 ft-lb)
4. Install the high-pressure fuel pump. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Pump>INSTALLATION > HIGH-PRESSURE FUEL PUMP.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > High Pressure Fuel Pump

INSPECTION

1. CHECK HIGH-PRESSURE FUEL PUMP

1. Check that the high-pressure fuel pump has no deformation, cracks or other damages.
2. Measure the resistance between high-pressure fuel pump terminals.

Terminal No.	Standard
1 and 2	10±1 Ω (when 20°C (68°F))

2. CHECK HIGH-PRESSURE FUEL PUMP CASE

1. Check that the high-pressure fuel pump case has no deformation, cracks or other damages.
2. Check the clearance between the fuel pump lifter and high-pressure fuel pump case bore. Check the clearance between fuel pump lifter and high-pressure fuel pump case bore by measuring the outer diameter of fuel pump lifter and the inner diameter of high-pressure fuel pump case bore respectively.

   (1) Measure the outer diameter of fuel pump lifter with a micrometer.

   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Record the measured value.**

   (2) Using a caliper gauge, measure the inner diameter of high-pressure fuel pump case bore.

   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Record the measured value.**

   (3) Calculate the clearance between the fuel pump lifter and high-pressure fuel pump case bore. If it is not within the standard, replace the fuel pump lifter and high-pressure fuel pump case as a set.

   Clearance between fuel pump lifter and high-pressure fuel pump case bore:

   Standard

   0.065 — 0.134 mm (0.0026 — 0.0053 in)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > High Pressure Fuel Delivery Pipe

REMOVAL

1. HIGH-PRESSURE FUEL DELIVERY PIPE

Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Remove the fuel pipe insulator No. 1. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 1.
4. Remove the fuel pipe insulator No. 2. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 2.
5. Remove the high-pressure fuel delivery pipes.

2. HIGH-PRESSURE FUEL DELIVERY PIPE ASSY

Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the pipes using a container or cloth.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Remove the fuel pipe insulator No. 1. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 1.
4. Remove the fuel pipe insulator No. 2. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 2.
5. Remove the fuel pipe insulator No. 3. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 3.
6. Remove the flare nut (A) and bolt (B), and then remove the high-pressure fuel delivery pipe assembly.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > High Pressure Fuel Delivery Pipe

INSTALLATION

1. HIGH-PRESSURE FUEL DELIVERY PIPE

1. Temporarily tighten the high-pressure fuel delivery pipe by hand until it is seated, and tighten the flare nuts on both ends.
   Caution:
   Always use a new high-pressure fuel delivery pipe.
   Tightening torque:
   28 N·m (2.9 kgf-m, 20.7 ft-lb)

2. Install the fuel pipe insulator No. 2. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION > FUEL PIPE INSULATOR NO. 2.
3. Install the fuel pipe insulator No. 1. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION > FUEL PIPE INSULATOR NO. 1.
4. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>INSTALLATION.
5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

2. HIGH-PRESSURE FUEL DELIVERY PIPE ASSY

1. Install the high-pressure fuel delivery pipe assembly.
   Caution:
   Always use a new high-pressure fuel delivery pipe assembly.
   (1) Temporarily tighten the flare nut (A) to the fuel injector pipe by hand until it is seated, and secure the high-pressure fuel delivery pipe assembly to the water pipe assembly using bolts (B).
   Tightening torque:
   T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
   (2) Tighten the flare nuts (A).
   Tightening torque:
   T2: 28 N·m (2.9 kgf-m, 20.7 ft-lb)
2. Install the fuel pipe insulator No. 3. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION > FUEL PIPE INSULATOR NO. 3.
3. Install the fuel pipe insulator No. 2. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION > FUEL PIPE INSULATOR NO. 2.
4. Install the fuel pipe insulator No. 1. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION > FUEL PIPE INSULATOR NO. 1.
5. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>INSTALLATION.
6. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > High Pressure Fuel Delivery Pipe

INSPECTION

Check that the high-pressure fuel delivery pipe and the high-pressure fuel delivery pipe assembly have no deformation, cracks and other damages.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Wiring Harness

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
3. Remove the fuel insulator. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL.
4. Remove the engine control module (ECM). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
5. Disconnect the connector from the engine.
   - Structural diagram 1

(1) Knock sensor RH
(2) Engine wiring harness connector (16P)
(3) Engine ground (2 locations)
(4) Crankshaft position sensor
(5) Knock sensor LH
(6) Tumble generator valve actuator LH
(7) Fuel injector (#4)
(8) Fuel injector (#2)
(9) Engine coolant temperature sensor
(10) Fuel pressure sensor
(11) Remove clip from screw hole.
(12) Fuel injector (#1)
(13) Purge control solenoid valve (#2) (black connector)
(14) Purge control solenoid valve (#1) (blue connector)
(15) Fuel injector (#3)
(16) EGR valve
(17) Manifold absolute pressure and intake air temperature sensor
(18) Throttle position sensor
(19) Oil pressure switch
(20) Engine oil temperature sensor
(21) Intake oil control solenoid LH
(22) Remove clip from screw hole.
(23) Remove clip from the round hole of stay.
(24) Exhaust oil control solenoid LH
(25) Remove clip from screw hole.
(26) Front oxygen (A/F) sensor (remove from the front oxygen (A/F) sensor bracket)
(27) Wastegate solenoid
(28) Remove clip from screw hole.
(29) Exhaust oil control solenoid RH
(30) Remove clip from screw hole.
(31) Intake oil control solenoid RH

(32) Engine wiring harness connector (48P)
(33) Engine wiring harness connector (32P)
(34) Tumble generator valve actuator RH
(35) Oil level switch
(36) Blow-by diagnosis connector harness 1
(37) Blow-by diagnosis connector harness 2
(38) Remove the harness connector from the stay.
(39) Remove the harness connector from the stay.
(40) Pull out the blow-by diagnosis connector harness 1 from between the PCV pipe assembly and the vacuum hose.

- Structural diagram 2

(1) Intake camshaft position sensor RH
(2) Exhaust camshaft position sensor RH
(3) Ignition coil No. 1
(4) Ignition coil No. 3
(5) Remove clip from screw hole.
(6) Pull out from the lower side of the tumble generator valve RH.
(7) Remove clip from the round hole.
(8) Remove clip from the oil pipe.
(9) Intake camshaft position sensor LH
(10) High-pressure fuel pump
(11) Pull out from the outside of the fuel tube.
(12) Pull out from the lower side of the tumble generator valve LH.
(13) Remove clip from screw hole.
(14) Ignition coil No. 4
(15) Ignition coil No. 2
(16) Oxygen sensor
(17) Exhaust camshaft position sensor LH
(18) Remove clip from screw hole.

6. Remove the engine wiring harness.
7. Remove the harness stay.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Wiring Harness

INSTALLATION

1. Install the harness stay.
   Tightening torque:
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
2. Set the engine wiring harness to the engine, and connect the connector.

Note:

- **If the clip is damaged, replace it with a new part.**
- **Before replacing the clip, put an alignment mark (a) on both engine wiring harness and clip to remove the clip, and then align to the alignment mark (a) to attach a new clip to the engine wiring harness.**
- Structural diagram 1

(1) Knock sensor RH (routed under the insulator)
(2) Engine wiring harness connector (16P) (secured to engine hanger)
(3) Engine ground (2 places) (During installation, let the terminal tip come in contact with the block step.)
(4) Crankshaft position sensor
(5) Knock sensor LH (routed under the insulator)
(6) Tumble generator valve actuator LH
(7) Fuel injector (#4) (routed under the insulator)
(8) Fuel injector (#2) (routed under the insulator)
(9) Engine coolant temperature sensor
(10) Fuel pressure sensor
(11) Secure the clip to the screw hole.
(12) Fuel injector (#1) (routed under the insulator)
(13) Purge control solenoid valve (#2) (black connector)
(14) Purge control solenoid valve (#1) (blue connector)
(15) Fuel injector (#3) (routed under the insulator)
(16) EGR valve
(17) Manifold absolute pressure and intake air temperature sensor
(18) Throttle position sensor
(19) Oil pressure switch
(20) Engine oil temperature sensor
(21) Intake oil control solenoid LH
(22) Secure the clip to the screw hole.
(23) Secure the clip to the round hole of stay.
(24) Exhaust oil control solenoid LH
(25) Secure the clip to the screw hole.
(26) Front oxygen (A/F) sensor (secured to the front oxygen (A/F) sensor bracket)
(27) Wastegate solenoid
(28) Secure the clip to the screw hole.
(29) Exhaust oil control solenoid RH
(30) Secure the clip to the screw hole.
(31) Intake oil control solenoid RH
(32) Engine wiring harness connector (48P)
(33) Engine wiring harness connector (32P)
(34) Tumble generator valve actuator RH
(35) Oil level switch
(36) Blow-by diagnosis harness connector 1

(37) Blow-by diagnosis harness connector 2
(38) Install the harness connector to the stay.
(39) Install the harness connector to the stay.
(40) Pass the blow-by diagnosis connector harness 1 through between the PCV pipe assembly and the vacuum hose.

- Structural diagram 2

(1) Intake camshaft position sensor RH
(2) Exhaust camshaft position sensor RH
(3) Ignition coil No. 1
(4) Ignition coil No. 3
(5) Secure the clip to the screw hole.
(6) Route under the tumble generator valve.
(7) Secure the clip to the round hole.
(8) Secure the clip to the oil pipe.
(9) Intake camshaft position sensor LH
(10) High-pressure fuel pump
(11) Route outside of the fuel tube.
(12) Route under the tumble generator valve.
(13) Secure the clip to the screw hole.
(14) Ignition coil No. 4
(15) Ignition coil No. 2
(16) Oxygen sensor (secured to the heater pipe)
(17) Exhaust camshaft position sensor LH
(18) Secure the clip to the screw hole.

3. Install the engine wiring harness.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
4. Install the engine control module (ECM). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>INSTALLATION.
5. Install the fuel insulator. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION.
6. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>INSTALLATION.
7. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Wiring Harness

INSPECTION

1. Check that the engine wiring harness does not have deformation, cracks and any other damage.
2. Check the engine wiring harness for contamination or clogging.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Coolant Temperature Sensor

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
4. Disconnect the connector (A) from the engine coolant temperature sensor, and remove the engine coolant temperature sensor.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Coolant Temperature Sensor

INSTALLATION

Install in the reverse order of removal.

Note:

Use a new gasket.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Coolant Temperature Sensor

INSPECTION

1. Check that the engine coolant temperature sensor has no deformation, cracks or other damages.
2. Immerse the engine coolant temperature sensor and a thermometer in water.

   Caution:

   Take care not to allow water to get into the engine coolant temperature sensor connector. Completely remove any water inside.

   (A) Thermometer (B) Engine coolant temperature sensor (C) Hexagonal part height: To approx. $^{1}/_{3}$

3. Raise water temperature gradually, measure the resistance between the engine coolant temperature sensor terminals when the temperature is 20°C (68°F) and 80°C (176°F).

   Note:

   Agitate the water for even temperature distribution.

Water temperature	Terminal No.	Standard
20°C (68°F)	1 and 2	2.45±0.2 kΩ
80°C (176°F)		0.318±0.013 kΩ

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Oil Temperature Sensor

REMOVAL

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Disconnect the connector (A) from the engine oil temperature sensor, and remove the engine oil temperature sensor from the chain cover.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Oil Temperature Sensor

INSTALLATION

Install in the reverse order of removal.
Note:
Use a new gasket.
Tightening torque:
18 N·m (1.8 kgf-m, 13.3 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Oil Temperature Sensor

INSPECTION

1. Check that the engine oil temperature sensor has no deformation, cracks or other damages.
2. Immerse the engine oil temperature sensor and a thermometer in water.
   Caution:
   Take care not to allow water to get into the engine oil temperature sensor connector. Completely remove any water inside.



3. Raise water temperature gradually, measure the resistance between the engine oil temperature sensor terminals when the temperature is 20°C (68°F) and 80°C (176°F).
   Note:
   Agitate the water for even temperature distribution.

Water temperature	Terminal No.	Standard
20°C (68°F)	1 and 2	2.45±0.2 kΩ
80°C (176°F)		0.318±0.013 kΩ

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Crankshaft Position Sensor

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Remove the throttle body. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Throttle Body>REMOVAL.
5. Remove the bolts securing the engine wiring harness.
6. Disconnect the connector (A) from the crankshaft position sensor, and remove the crankshaft position sensor from the cylinder block.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Crankshaft Position Sensor

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Crankshaft Position Sensor

INSPECTION

1. CRANKSHAFT POSITION SENSOR (METHOD WITH OSCILLOSCOPE)

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Prepare an oscilloscope.
3. Remove the engine control module (ECM). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
4. Install the ST between the ECM and bulkhead harness and the engine wiring harness. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>General Description>CAUTION.

   ST 18460AA030 CHECK BOARD

5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
6. Connect the probe to ST.

Terminal No.	Probe
(E158) No. 19	+
(E159) No. 10	–

7. Start the engine and let it idle.
8. Check the waveforms and voltage.

   Note:

   For waveform and voltage, refer to "Engine Control Module (ECM) I/O Signal". Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Engine Control Module (ECM) I/O Signal.
9. After inspection, install the related parts in the reverse order of removal.

2. OTHER INSPECTIONS

Check that the crankshaft position sensor has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Crankshaft Position Sensor Plate

REMOVAL

The crankshaft position sensor plate is tightened together with the drive plate (CVT model) or flywheel (MT model); therefore, refer to "Drive Plate" or "Flywheel" for removal procedure. Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>REMOVAL. Ref. to CLUTCH SYSTEM>Flywheel>REMOVAL.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Crankshaft Position Sensor Plate

INSTALLATION

The crankshaft position sensor plate is tightened together with the drive plate (CVT model) or flywheel (MT model); therefore, refer to "Drive Plate" or "Flywheel" for installation procedure. Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>INSTALLATION. Ref. to CLUTCH SYSTEM>Flywheel>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Crankshaft Position Sensor Plate

INSPECTION

Check that the crankshaft position sensor plate has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Camshaft Position Sensor

REMOVAL

1. INTAKE SIDE

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. (RH side only) Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Disconnect the connector (A) from the camshaft position sensor, and remove the camshaft position sensor from the chain cover.
   - RH side
   - LH side

2. EXHAUST SIDE

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
3. Disconnect the connector (A) from the camshaft position sensor, and remove the camshaft position sensor from the chain cover.
   - RH side
   - LH side

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Camshaft Position Sensor

INSTALLATION

Install in the reverse order of removal.

Note:

- **Use new O-rings.**
- **Apply engine oil to O-ring.**

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Camshaft Position Sensor

INSPECTION

1. CAMSHAFT POSITION SENSOR (METHOD WITH OSCILLOSCOPE)

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Prepare an oscilloscope.
3. Remove the engine control module (ECM). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
4. Install the ST between the ECM and bulkhead harness and the engine wiring harness. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>General Description>CAUTION.

   ST 18460AA030 CHECK BOARD

5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
6. Connect the probe to ST.

Camshaft position sensor		Terminal No.	Probe
Intake	RH	(E158) No. 20	+
	LH	(E158) No. 21	+
Exhaust	RH	(E158) No. 32	+
	LH	(E158) No. 33	+
RH and LH		(E159) No. 10	–

7. Start the engine and let it idle.
8. Check the waveforms and voltage.
   Note:
   For waveform and voltage, refer to "Engine Control Module (ECM) I/O Signal". **Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Engine Control Module (ECM) I/O Signal.**
9. After inspection, install the related parts in the reverse order of removal.

2. OTHER INSPECTIONS

Check that the camshaft position sensor has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Oil Control Solenoid

REMOVAL

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. INTAKE SIDE

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. (RH side only) Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Disconnect the connector (A) from the oil control solenoid, and remove the oil control solenoid from the chain cover.
   - RH side
   - LH side

2. EXHAUST SIDE

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. (RH side only) Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Disconnect the connector (A) from the oil control solenoid, and remove the oil control solenoid from the chain cover.
   - RH side
   - LH side

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Oil Control Solenoid

INSTALLATION

Install in the reverse order of removal.

Note:

- **Use new O-rings.**
- **Apply engine oil to O-ring.**

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Oil Control Solenoid

INSPECTION

1. Check that the oil control solenoid has no deformation, cracks or other damages.
2. Measure the resistance between the oil control solenoid terminals.

Terminal No.	Standard
1 and 2	7.25±0.4 Ω (when 20°C (68°F))

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Knock Sensor

REMOVAL

1. RH SIDE

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
4. Remove the fuel pipe insulator No. 3. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>REMOVAL > FUEL PIPE INSULATOR NO. 3.
5. Disconnect the connector (A) from the knock sensor, and remove the knock sensor from the cylinder block.

2. LH SIDE

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Remove the throttle body. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Throttle Body>REMOVAL.
5. Remove the bolts securing the engine wiring harness.
6. Disconnect the connector (A) from the knock sensor, and remove the knock sensor from the cylinder block.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Knock Sensor

INSTALLATION

1. RH SIDE

1. Install the knock sensor to the cylinder block.
   Note:
   The knock sensor should be installed so that the center of the connector is positioned at a 32.5 — 47.5° angle relative to the rear of engine.
   Tightening torque:
   24 N·m (2.4 kgf-m, 17.7 ft-lb)



(A) Front of engine

2. Connect the connector to the knock sensor.
3. Install the fuel pipe insulator No. 3. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Insulator>INSTALLATION > FUEL PIPE INSULATOR NO. 3.
4. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>INSTALLATION.
5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
6. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

2. LH SIDE

1. Install the knock sensor to the cylinder block.
   Note:
   The knock sensor should be installed so that the center of the connector is positioned at a 47.5 — 62.5° angle relative to the rear of engine.
   Tightening torque:
   24 N·m (2.4 kgf-m, 17.7 ft-lb)
   (A) Front of engine
2. Connect the connector to the knock sensor.
3. Install the bolts securing the engine wiring harness.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
4. Install the throttle body. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Throttle Body>INSTALLATION.
5. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
6. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
7. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Knock Sensor

INSPECTION

1. Check that the knock sensor has no deformation, cracks or other damages.
2. Measure the resistance between knock sensor terminals.

Terminal No.	Standard
1 and 2	560±28 kΩ

SPECIFICATION

Throttle body is a non-disassembled part, so do not remove the throttle position sensor from throttle body.
Refer to “Throttle Body” for removal and installation procedure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Throttle Body>REMOVAL. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Throttle Body>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Mass Air Flow and Intake Air Temperature Sensor

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Disconnect the connector (A) from the mass air flow and intake air temperature sensor, and remove the mass air flow and intake air temperature sensor.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Mass Air Flow and Intake Air Temperature Sensor

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

1 N·m (0.1 kgf-m, 0.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Mass Air Flow and Intake Air Temperature Sensor

INSPECTION

1. CHECK THE MASS AIR FLOW SENSOR UNIT

1. Connect the battery positive terminal to terminal No. 1 and the battery ground terminal to terminal No. 2, and connect the circuit tester positive terminal to terminal No. 3 and the circuit tester ground terminal to terminal No. 2.
2. Check the voltage changes when air is blown to the mass air flow sensor unit in arrow direction.

2. CHECK THE INTAKE AIR TEMPERATURE SENSOR UNIT

Measure the resistance between intake air temperature sensor terminals.

Temperature	Terminal No.	Standard
−20°C (−4°F)	4 and 5	14.7±2.2 kΩ
25°C (77°F)		2.0±0.2 kΩ
60°C (140°F)		0.59±0.09 kΩ

3. OTHER INSPECTIONS

1. Check that the mass air flow and intake air temperature sensor has no deformation, cracks or other damages.
2. Check that the mass air flow and intake air temperature sensor has no dirt.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Manifold Absolute Pressure and Intake Air Temperature Sensor

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Disconnect the connector (A) from the manifold absolute pressure & intake air temperature sensor, and remove the manifold absolute pressure & intake air temperature sensor from the intake manifold.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Manifold Absolute Pressure and Intake Air Temperature Sensor

INSTALLATION

Install in the reverse order of removal.

Note:

Use new O-rings.

Tightening torque:

3.5 N·m (0.4 kgf-m, 2.6 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Manifold Absolute Pressure and Intake Air Temperature Sensor

INSPECTION

1. CHECK MANIFOLD ABSOLUTE PRESSURE SENSOR

1. Connect dry-cell battery positive terminal to terminal No. 4 and dry-cell battery ground terminal to terminal No. 2, circuit tester positive terminal to terminal No. 3 and the circuit tester ground terminal to terminal No. 2.

   Note:

   - **Use new dry-cell batteries.**
   - **Using a circuit tester, check that the initial voltage of each dry-cell battery is 1.6 V or more. And also check that the voltage of three batteries in series is between 4.8 V and 5.2 V.**
   - **For power supply, 5 V DC constant voltage power source can also be used.**
2. Check the voltage at a normal atmospheric pressure.

   Note:

   The atmospheric pressure at higher altitude is lower than normal. Therefore, the voltage is lower than the standard value.

Terminal No.	Standard
3 (+) and 2 (−)	Approx. 2 V (when 25°C (77°F))

3. Connect the Mighty Vac to the pressure port (A).
4. Check the voltage when generating vacuum and positive pressure using Mighty Vac.

Caution:

Do not decompress less than −88 kPa (−0.9 kg/cm^2, −12.8 psi). Doing so may damage the manifold absolute pressure sensor.

Note:

When vacuum pressure occurs at the pressure port, the voltage will drop from the value as in step 3). When positive pressure occurs, on the other hand, the voltage will rise.

Pressure	Terminal No.	Standard
−88 kPa (−0.9 kg/cm^2, −12.8 psi)	3 (+) and 2 (−)	Approx. 1 V (when 25°C (77°F))

2. CHECK MANIFOLD TEMPERATURE SENSOR UNIT

1. Measure the resistance between manifold temperature sensor terminals.

Temperature	Terminal No.	Standard
−20°C (−4°F)	1 and 2	14.7±2.2 kΩ
25°C (77°F)		2.0±0.2 kΩ
60°C (140°F)		0.59±0.09 kΩ

3. OTHER INSPECTIONS

Check that the manifold pressure & intake air temperature sensor has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Wastegate Control Solenoid Valve

REMOVAL

For removal procedures of wastegate control solenoid valve, refer to "Intake Duct No. 1". Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>DISASSEMBLY > INTAKE DUCT NO. 1.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Wastegate Control Solenoid Valve

INSTALLATION

For installation procedures of wastegate control solenoid valve, refer to "Intake Duct No. 1". Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>ASSEMBLY > INTAKE DUCT NO. 1.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Wastegate Control Solenoid Valve

INSPECTION

1. WASTEGATE CONTROL SOLENOID VALVE

1. Check that the wastegate control solenoid valve has no deformation, cracks or other damages.
2. Check the resistance between the wastegate control solenoid valve terminals.

Terminal No.	Standard
1 and 2	24±3 Ω (when 20°C (68°F))

3. Check that air does not come out from (B) when air is blown into (A).
4. Connect the battery positive terminal to the terminal No. 1 and the battery negative terminal to the terminal No. 2. Check that air is discharged from (B), when supplying air to (A).

2. OTHER INSPECTIONS

Check that the air control hose has no cracks, damage or loose part.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Front Oxygen (A/F) Sensor

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the radiator main fan & fan motor assembly. Ref. to COOLING(w/o STI)>Radiator Main Fan and Fan Motor>REMOVAL.
3. Lift up the vehicle.
4. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
5. Disconnect the connector (A) on the front oxygen (A/F) sensor from the engine wiring harness, and remove the clip (B) which secures the front oxygen (A/F) sensor harness to the water pump cover.
6. Apply spray-type lubricant (004301003) to the threaded portion of front oxygen (A/F) sensor, and leave it for one minute or more.
7. Remove the front oxygen (A/F) sensor.
   Caution:
   When removing the front oxygen (A/F) sensor, wait until exhaust pipe cools, otherwise it will damage the exhaust pipe.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Front Oxygen (A/F) Sensor

INSTALLATION

Caution:
If lubricant is spilt over the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Before installing front oxygen (A/F) sensor, apply anti-seize compound only to the threaded portion of front oxygen (A/F) sensor to make the next removal easier.
   Caution:
   Never apply anti-seize compound to the protector of front oxygen (A/F) sensor.
   Anti-seize compound:
   NEVER-SEEZ NSN, JET LUBE SS-30 or equivalent
2. Install the front oxygen (A/F) sensor.
   Tightening torque:
   30 N·m (3.1 kgf-m, 22.1 ft-lb)
3. Secure the front oxygen (A/F) sensor harness to the water pump cover using clip (B), and connect the front oxygen (A/F) sensor connector (A) to the engine wiring harness.
4. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
5. Lower the vehicle.
6. Install the radiator main fan & fan motor assembly. Ref. to COOLING(w/o STI)>Radiator Main Fan and Fan Motor>INSTALLATION.
7. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Front Oxygen (A/F) Sensor

INSPECTION

1. Check that the front oxygen (A/F) sensor has no deformation, cracks or other damages.
2. Measure the resistance between front oxygen (A/F) sensor terminals.

Terminal No.	Standard
2 and 3	2.5 — 4.0 Ω (when 20°C (68°F))

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Rear Oxygen Sensor

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Lift up the vehicle.
3. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
4. Disconnect the connector on the rear oxygen sensor from the engine wiring harness.
5. Apply spray-type lubricant (004301003) to the threaded portion of rear oxygen sensor, and leave it for one minute or more.
6. Remove the rear oxygen sensor.
   Caution:
   When removing the rear oxygen sensor, wait until exhaust pipe cools, otherwise it will damage the exhaust pipe.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Rear Oxygen Sensor

INSTALLATION

Caution:
If lubricant is spilt over the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Before installing rear oxygen sensor, apply the anti-seize compound only to the threaded portion of rear oxygen sensor to make the next removal easier.
   Caution:
   Never apply anti-seize compound to the protector of rear oxygen sensor.
   Anti-seize compound:
   NEVER-SEEZ NSN, JET LUBE SS-30 or equivalent
2. Install the rear oxygen sensor.
   Tightening torque:
   30 N·m (3.1 kgf-m, 22.1 ft-lb)
3. Connect the rear oxygen sensor connector to the engine wiring harness.
4. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
5. Lower the vehicle.
6. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Rear Oxygen Sensor

INSPECTION

1. Check that the rear oxygen sensor has no deformation, cracks or other damages.
2. Measure the resistance between rear oxygen sensor terminals.

Terminal No.	Standard
1 and 2	$6.0^{+0.6}_{-0.6}$ Ω (when 20°C (68°F))

SPECIFICATION

SI-DRIVE (SUBARU Intelligent Drive) selector is integrated as a unit with the cruise control command switch.
For removal, installation and inspection, refer to “Cruise Control Command Switch”. Ref. to CRUISE CONTROL SYSTEM>Cruise Control Command Switch>REMOVAL. Ref. to CRUISE CONTROL SYSTEM>Cruise Control Command Switch>INSTALLATION. Ref. to CRUISE CONTROL SYSTEM>Cruise Control Command Switch>INSPECTION.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Control Module (ECM)

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness from the bracket, and remove the bolt which secures the ECM to the bracket.
3. Pull out the ECM from the bracket.
   Note:
   When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.
4. While pressing the section (A) shown in the figure, move the lock lever (B) in the direction of the arrow to disconnect the connectors from the ECM in numerical order as shown in the figure.
5. Remove the bracket from ECM.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Control Module (ECM)

INSTALLATION

Install in the reverse order of removal.

Caution:

- **When the ECM of model with immobilizer has been replaced, be sure to perform the registration of immobilizer system.**
  - **For model without keyless access with push button start, refer to the Type B in "REGISTRATION MANUAL FOR IMMOBILIZER".**
  - **For model with keyless access with push button start, refer to the Type D in "REGISTRATION MANUAL FOR IMMOBILIZER".**
- **When the ECM has been replaced, be sure to perform the registration of VIN. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > V.I.N REGISTRATION.**

Note:

- **When replacing the ECM, be careful not to use the ECM of wrong specification to avoid any damage on the fuel injection system.**
- **When installing the bracket (A) to the ECM, press to install it in the direction of the arrow.**
- **Insert the ECM into the bracket cushion.**

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Engine Control Module (ECM)

INSPECTION

Check that the ECM has no deformation, cracks or other damages.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Main Relay

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Remove the main relay.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Main Relay

INSTALLATION

Install in the reverse order of removal.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Main Relay

INSPECTION

1. Check that the main relay has no deformation, cracks or other damages.
2. Measure the resistance between main relay terminals.

Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	130.4 — 230.8 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the main relay terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Oxygen Sensor Relay

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the instrument panel lower cover. Ref. to EXTERIOR/INTERIOR TRIM>Instrument Panel Lower Cover>REMOVAL.
3. Remove the nut and bolt, and move the fuse block downwards.
4. Remove the oxygen sensor relay from the relay block.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Oxygen Sensor Relay

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Oxygen Sensor Relay

INSPECTION

1. Check that the oxygen sensor relay has no deformation, cracks or other damages.
2. Measure the resistance between oxygen sensor relay terminals.

Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	93.8 — 136.4 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between oxygen sensor relay terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Electronic Throttle Control Relay

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the instrument panel lower cover. Ref. to EXTERIOR/INTERIOR TRIM>Instrument Panel Lower Cover>REMOVAL.
3. Remove the nut and bolt, and move the fuse block downwards.
4. Remove the electronic throttle control relay from the relay block.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Electronic Throttle Control Relay

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Electronic Throttle Control Relay

INSPECTION

1. Check that the electronic throttle control relay has no deformation, cracks or other damages.
2. Measure the resistance between electronic throttle control relay terminals.

Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	93.8 — 136.4 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the electronic throttle control relay terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump Relay

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the glove box. Ref. to EXTERIOR/INTERIOR TRIM>Glove Box>REMOVAL.
3. Remove the fuel pump relay.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump Relay

INSTALLATION

Install in the reverse order of removal.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump Relay

INSPECTION

1. Check that the fuel pump relay has no deformation, cracks or other damages.
2. Measure the resistance between fuel pump relay terminals.

Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	93.8 — 136.4 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the fuel pump relay terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Injector Relay

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the fuel injector relay from main fuse box.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Injector Relay

INSTALLATION

Install in the reverse order of removal.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Injector Relay

INSPECTION

1. Check that the fuel injector relay has no deformation, cracks or other damages.
2. Measure the resistance between fuel injector relay terminals.

Terminal No.	Standard
1 and 2	1 MΩ or more
3 and 4	93.8 — 136.4 Ω (when 20°C (68°F))

3. Connect battery positive terminal to terminal No. 3 and battery ground terminal to terminal No. 4, and measure the resistance between the fuel injector relay terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump Control Unit

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the right side trunk side trim. Ref. to EXTERIOR/INTERIOR TRIM>Trunk Room Trim>REMOVAL.
3. Disconnect the connector (A), and remove the fuel pump control unit.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump Control Unit

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

5 N·m (0.5 kgf-m, 3.7 ft-lb)

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump Control Unit

INSPECTION

Check that the fuel pump control unit has no deformation, cracks or other damages.

PROCEDURE

1. RELEASING OF FUEL PRESSURE

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Remove the fuse of fuel pump from main fuse box.
2. Start the engine and run it until it stalls.
3. After the engine stalls, crank it for five more seconds.
4. Turn the ignition switch to OFF.
5. Install the fuse of fuel pump to the main fuse box.
6. Make sure that the malfunction indicator light is not lit.
   Note:
   When the fuel pressure is released, the malfunction indicator light illuminates and DTC (P0087) may be stored in ECM. When the malfunction indicator light has illuminated, perform the Clear Memory Mode. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Clear Memory Mode.

2. DRAINING FUEL (WITH SUBARU SELECT MONITOR)

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.
Note:

- **If the fuel pump cannot be driven, refer to the procedures for draining from the fuel filler hose. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (THROUGH THE FUEL FILLER HOSE).**
- **Be careful not to let the battery run-out.**
- **Be aware that the fuel may remain in the fuel tank after draining the fuel.**

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Disconnect the fuel delivery tube from the fuel pipe assembly, and remove the clip (A) securing the fuel delivery tube.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from the tubes using a container or cloth.**

   Note:
   Disconnect the quick connector as shown in the figure.

   (a) Slider

3. Connect ST to the fuel delivery tube.

ST 18471AA000 FUEL PIPE ADAPTER

4. Connect the gasoline proof hose to ST and put the end of the hose in the container.
5. Drive the fuel pump and drain the fuel using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Active Test.

   Caution:

   Be careful not to spill fuel.
6. Install the related parts in the reverse order after draining the fuel.

   Caution:

   - **Be careful not to spill fuel.**
   - **Catch the fuel from the tubes using a container or cloth.**
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
   - **When it is difficult to lock the slider, check that the connector is fully inserted.**
   - **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

   Note:

   - **Disconnect the quick connector on the fuel delivery tube as shown in the figure.**

   (a) Slider

   - **Connect the quick connector on the fuel delivery tube as shown in the figure.**

   (a) Slider

3. DRAINING FUEL (THROUGH THE FUEL FILLER HOSE)

Warning:

Place "NO OPEN FLAMES" signs near the working area.

Caution:

- **Be careful not to spill fuel.**
- **Fuel may remain in the fuel filler pipe. Drain the fuel from the fuel filler pipe through the fill opening using the gasoline proof pump and the gasoline proof hose (ø10 or less) before the operation.**

Note:

Be aware that the fuel may remain in the fuel tank after draining the fuel.

1. Lift up the vehicle.
2. Open the fuel filler lid and remove the fuel filler cap.

   Note:

   This operation is required to release the inner pressure of the fuel tank.
3. Drain the fuel from the fuel filler pipe through the filler opening using the gasoline proof pump and the gasoline proof hose (ø10 or less).
4. Disconnect the fuel filler hose from the fuel filler pipe assembly.

Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from hoses using a container or cloth.**

5. Set the container under the vehicle and insert the gasoline proof hose (ø10 or less) into the fuel filler hose to drain the fuel.

Caution:

Be careful not to spill fuel.

6. Install the related parts in the reverse order after draining the fuel.

Note:

Correctly insert the fuel filler hose to the spool, and then install the clamp as shown.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

(1) Fuel filler hose
(2) Clamp
(3) Spool
(4) Fuel filler pipe

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Tank Protector

REMOVAL

1. Lift up the vehicle.
2. Remove the bolt and nuts and remove the fuel tank protector.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Tank Protector

INSTALLATION

Install in the reverse order of removal.

Note:

Use a new self-locking nut.

Tightening torque:

T1: 9 N·m (0.9 kgf-m, 6.6 ft-lb)

T2: 18 N·m (1.8 kgf-m, 13.3 ft-lb)

(A) Self-locking nut

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Tank

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Remove the rear seat cushion. Ref. to SEATS>Rear Seat>REMOVAL.
5. Remove the service hole cover of fuel pump.
6. Disconnect connectors from the fuel pump, and move aside the service hole cover.
7. Remove the service hole cover of fuel sub level sensor.
8. Disconnect the connector from the fuel sub level sensor, and move aside the service hole cover.
9. Disconnect the quick connector on the fuel delivery tube.
   Note:
   Disconnect the quick connector as shown in the figure.
   (a) Slider
10. Lift up the vehicle.
11. Remove the rear exhaust pipe. Ref. to EXHAUST(w/o STI)>Rear Exhaust Pipe>REMOVAL.
12. Remove the rear differential. Ref. to DIFFERENTIALS>Rear Differential (T-type)>REMOVAL.
13. Disconnect the fuel filler hose (A) and evaporation hose (B) from the fuel filler pipe assembly.
14. Disconnect the vent tube from vent hose.
15. Remove the fuel tank protector. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Tank Protector>REMOVAL.
16. Remove the heat shield cover and stopper.
17. Support the fuel tank with a transmission jack, remove the bolts from the fuel tank band, and remove the fuel tank from the vehicle.
    Warning:
    - **A helper is required to perform this work.**
    - **Fuel may remain in the fuel tank. This will cause the left and right sides to be unbalanced. Be careful not to drop the fuel tank.**

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Tank

INSTALLATION

1. Support the fuel tank with a transmission jack, set the fuel tank in place, and temporarily tighten the bolts of the fuel tank band.
   Warning:
   A helper is required to perform this work.

2. Tighten the bolts of the fuel tank band in the order shown in the figure.
   Tightening torque:
   33 N·m (3.4 kgf-m, 24.3 ft-lb)
3. Install the heat shield cover and stopper.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
4. Install the fuel tank protector. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Tank Protector>INSTALLATION.
5. Connect the vent tube to the vent hose.
6. Securely insert the fuel filler hose (A) and evaporation hose (B) until the hose end contacts the spool, then attach the clamp or clip as shown in the figure.
   Tightening torque:
   2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

(1) Hose (3) Spool (4) Pipe
(2) Clamp or clip

7. Install the rear differential. Ref. to DIFFERENTIALS>Rear Differential (T-type)>INSTALLATION.
8. Install the rear exhaust pipe. Ref. to EXHAUST(w/o STI)>Rear Exhaust Pipe>INSTALLATION.
9. Connect the quick connector of the fuel delivery tube.
   Caution:
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
   - **When it is difficult to lock the slider, check that the connector is fully inserted.**
   - **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

   Note:
   Connect the quick connector as shown in the figure.

(a) Slider

10. Connect the connector to the fuel sub level sensor.
    Caution:
    Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel sub level sensor and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.
11. Install the service hole cover of fuel sub level sensor.
12. Connect the connector to the fuel pump.
    Caution:
    Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel pump and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.
13. Install the service hole cover of fuel pump.
14. Install the rear seat cushion. Ref. to SEATS>Rear Seat>INSTALLATION.
15. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

INSPECTION

1. Check that the fuel tank and fuel pipe have no deformation, cracks and other damages.
2. Check that the fuel hose and tube have no cracks, damage or loose part.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Filler Pipe

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Open the fuel filler lid and remove the fuel filler cap.
4. Turn the fuel filler pipe protector in the direction of the arrow to unlock and remove it.
5. Remove the rear sub frame assembly. Ref. to REAR SUSPENSION>Rear Sub Frame>REMOVAL.
6. Remove the rear mud guard RH. Ref. to EXTERIOR/INTERIOR TRIM>Mud Guard>REMOVAL.
7. Disconnect the fuel filler hose (A) and evaporation hose (B) from the fuel filler pipe assembly.
8. Remove the bolts and nuts which secure the fuel filler pipe assembly to the vehicle.
9. Remove the fuel filler pipe assembly from the underside of the vehicle.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Filler Pipe

INSTALLATION

1. Open the fuel filler lid.
2. Insert the fuel filler pipe assembly from inside of the rear fender.
3. Install the fuel filler pipe assembly to the vehicle.
   Tightening torque:
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
4. Align the cutout on the fuel filler pipe protector and the protrusion of the neck holder and insert them all the way, and then turn the fuel filler pipe protector in the direction of the arrow until it is locked.
5. Securely insert the fuel filler hose (A) and evaporation hose (B) until the hose end contacts the spool, then attach the clamp or clip as shown in the figure.
   Tightening torque:
   2.5 N·m (0.3 kgf-m, 1.8 ft-lb)



(1) Hose (3) Spool (4) Pipe
(2) Clamp or clip

6. Install the rear mud guard RH. Ref. to EXTERIOR/INTERIOR TRIM>Mud Guard>INSTALLATION.
7. Install the rear sub frame assembly. Ref. to REAR SUSPENSION>Rear Sub Frame>INSTALLATION.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Filler Pipe

DISASSEMBLY

1. Using a marker pen, make alignment marks (A) on the fuel filler pipe and the bracket.
2. Remove the bracket bolt (B) which secures the fuel filler pipe.
3. Remove the neck holder from the fuel filler pipe.

ASSEMBLY

Assemble in the reverse order of disassembly.

Note:

- **Use a new neck holder.**
- **Install the bracket to the fuel filler pipe by aligning the alignment marks (A).**

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

INSPECTION

1. Check that the fuel filler pipe assembly has no deformation, cracks or other damages.
2. Check that the fuel hose has no cracks, damage or loose part.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**

Note:
Fuel pump assembly consists of fuel pump, fuel filter and fuel level sensor.

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Remove the rear seat cushion. Ref. to SEATS>Rear Seat>REMOVAL.
5. Remove the service hole cover of fuel pump.
6. Disconnect connectors from the fuel pump, and move aside the service hole cover.
7. Disconnect the quick connector of fuel delivery tube and jet pump tube.
   Note:
   Disconnect the quick connector as shown in the figure.
   (a) Slider
8. Remove the nuts which hold the fuel pump upper plate to the fuel tank.
9. Remove the fuel pump assembly from the fuel tank.
   Caution:
   Be careful not to let the arm and float of fuel level sensor contact the fuel tank.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump

INSTALLATION

1. Install the fuel pump assembly to the fuel tank.
   (1) Make sure the sealing portion is free from fuel or foreign matter before installation.
   (2) Align the protrusion (A) of the gasket to the position shown in the figure, and install the gasket from the lower side of the fuel pump assembly.
   Note:
   Use a new gasket.
   (3) Align the protrusion (C) of fuel pump upper plate cushion with the protrusion (C) of the fuel pump assembly as shown in the figure, and install the fuel pump upper plate cushion from the upper side of the fuel pump assembly.
   (4) Align the cutout of the fuel pump upper plate with the protrusion (C), and install the fuel pump upper plate from the upper side of the fuel pump assembly so that the protrusions (B) (3 places) of the gasket fit the holes of the fuel pump upper plate.

(5) Install the fuel pump assembly to the fuel tank in the direction shown in the figure, and tighten the nuts to the specified torque in the order as shown in the figure.

Caution:

Set the arm and float of the fuel level sensor while paying attention to prevent them from contacting the fuel tank. If the arm of the fuel level sensor is bent, the fuel gauge may not read correctly.

Tightening torque:

4.4 N·m (0.4 kgf-m, 3.2 ft-lb)

(a) Front side of vehicle
(b) Fuel pump ASSY
(c) Fuel pump upper plate cushion
(d) Fuel pump upper plate
(e) Gasket

2. Connect the quick connector of the fuel delivery tube and the jet pump tube.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

3. Connect the connector to the fuel pump.

Caution:

Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel pump and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.

4. Install the service hole cover of fuel pump.
5. Install the rear seat cushion. Ref. to SEATS>Rear Seat>INSTALLATION.
6. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Pump

INSPECTION

1. Check that the fuel pump has no deformation, cracks or other damages.
2. Connect the battery positive terminal to terminal No. 3 and the battery ground terminal to terminal No. 4, and inspect the fuel pump operation.

Warning:

- **Wipe off fuel completely.**
- **Keep the battery as far apart from fuel pump as possible.**
- **Do not run the fuel pump for a long time under non-load condition.**

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Level Sensor

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
- **Be careful not to spill fuel.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**

Note:
The fuel level sensor is built in fuel pump assembly.

1. Remove the fuel pump assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Pump>REMOVAL.
2. Disconnect the fuel level sensor connector (A), and pull out the connector cable and fuel level sensor harness from the clip.
3. While pressing the claw (A) of the fuel level sensor, slide the fuel level sensor in the direction of the arrow, and remove the fuel level sensor.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Level Sensor

INSTALLATION

Install in the reverse order of removal.
Caution:
Be sure to install the fuel level sensor harness to the clip first, then install the connector cable. Otherwise, malfunction may occur.

(A) Fuel level sensor harness (B) Connector cable

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Level Sensor

INSPECTION

1. Check that the fuel level sensor has no damage.
2. Measure the fuel level sensor float position.
   Note:
   When inspecting the fuel level sensor, perform the work with the sensor installed to the fuel pump.

   (1) FULL (2) EMPTY (3) Fuel tank seating surface

Float position	Standard
FULL to Fuel tank seating surface (A)	133.0±4 mm (5.236±0.157 in)
EMPTY to Fuel tank seating surface (B)	21.6±4 mm (0.850±0.157 in)

3. Check the resistance between fuel level sensor terminals by the connector on top of the fuel pump.

Float position	Terminal No.	Standard
FULL (A)	1 and 2	8.7±1.0 Ω
EMPTY (B)		139.1±2.0 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Sub Level Sensor

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Remove the rear seat cushion. Ref. to SEATS>Rear Seat>REMOVAL.
5. Remove the service hole cover of fuel sub level sensor.
6. Disconnect the connector from the fuel sub level sensor, and move aside the service hole cover.
7. Disconnect the quick connector of the jet pump tube.
   Note:
   Disconnect the quick connector as shown in the figure.
   (a) Slider

8. Remove the fuel sub level sensor protector, and remove the rubber cap (A) from nut.
9. Remove the bolts and nuts which hold fuel sub level sensor protector and fuel sub level sensor upper plate to the fuel tank.
10. Remove the fuel sub level sensor from the fuel tank.
    Caution:
    Be careful not to let the arm and float of the fuel sub level sensor contact the fuel tank.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Sub Level Sensor

INSTALLATION

1. Install the fuel sub level sensor to the fuel tank.
   (1) Make sure the sealing portion is free from fuel or foreign matter before installation.
   (2) Align the cutout (B) as shown in the figure, and install the fuel sub level sensor upper plate cushion to the fuel sub level sensor upper plate.
   (3) Align the cutout of the fuel sub level sensor upper plate with the protrusion (B) of the fuel sub level sensor as shown in the figure, and install the fuel sub level sensor upper plate from the upper side of the fuel sub level sensor.
   (4) Install the gasket from the lower side of the fuel sub level sensor so that the protrusion (B) of the fuel sub level sensor and the protrusion (A) of the gasket are positioned as shown in the figure.
   Note:
   Use a new gasket.

(5) Install the fuel sub level sensor to the fuel tank in the direction shown in the figure, and tighten the nuts to the specified torque in the order as shown in the figure.

Caution:

Set the arm and float of the fuel sub level sensor while paying attention to prevent them from contacting the fuel tank. If the arm of the fuel sub level sensor is bent, the fuel gauge may not read correctly.

Tightening torque:

4.4 N·m (0.4 kgf-m, 3.2 ft-lb)

(a) Front side of vehicle
(b) Fuel sub level sensor
(c) Fuel sub level sensor upper plate cushion
(d) Fuel sub level sensor upper plate
(e) Gasket

2. Install the fuel sub level sensor protector, and install the rubber cap (A).

Tightening torque:

4.4 N·m (0.4 kgf-m, 3.2 ft-lb)

3. Connect the quick connector of the jet pump tube.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

4. Connect the connector to the fuel sub level sensor.

Caution:

Before connecting, check that there are no foreign objects, water, etc. in the connectors of the fuel sub level sensor and harness. If any foreign objects and water are found, remove them with air blow and completely dry the connectors to connect.

5. Install the service hole cover of fuel sub level sensor.
6. Install the rear seat cushion. Ref. to SEATS>Rear Seat>INSTALLATION.
7. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Sub Level Sensor

INSPECTION

1. Check that the fuel sub level sensor has no damage.
2. Measure the fuel sub level sensor float position.

(1) FULL
(2) EMPTY
(3) Datum points

Float position	Standard
FULL to Datum point (A)	5.31±3.5 mm (0.209±0.138 in)
EMPTY to Datum point (B)	160.6±3.5 mm (6.32±0.138 in)

3. Measure the resistance between fuel sub level sensor terminals.

Float position	Terminal No.	Standard
FULL (A)	1 and 2	8.7±1.0 Ω
EMPTY (B)		270.9±4.0 Ω

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Filter

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:

- **Be careful not to spill fuel.**
- **If the fuel gauge indicates that two thirds or more of the fuel is remaining, be sure to drain fuel before starting work to avoid the fuel to spill.**
- **Be careful not to drop or apply any impact to the fuel pump during work. This may deteriorate its performance.**

Note:
The fuel filter is built in fuel pump assembly.

1. Remove the fuel pump assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Pump>REMOVAL.
2. Remove the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Level Sensor>REMOVAL.
3. Remove the connector cable from the clip, and disconnect the connector (A) of the connector cable.
4. Push the fuel filter assembly in the direction of the arrow to compress, and detach the clip.
5. Release the claw of the tube assembly using a flat tip screwdriver or similar tool wrapped with a protection tape, and remove the tube assembly from the fuel chamber assembly.
6. Release three claws on the fuel pump holder from the fuel chamber assembly, and raise the fuel filter assembly.
7. Using a flat tip screwdriver or similar tool wrapped with a protection tape, remove the tube assembly from the fuel chamber assembly, and separate the fuel filter assembly and fuel chamber assembly.
8. Using a precision driver or similar tool wrapped with a protection tape, expand the claws on the fuel pump.
9. Release the claws on the fuel pump.
10. Using a flat tip screwdriver or similar tool wrapped with a protection tape, press on the fuel pump and remove the fuel pump together with the fuel pump holder from the fuel filter assembly.
    Caution:
    If O-rings remain on the fuel filter assembly side, carefully remove them with a precision screwdriver or similar tool wrapped with a protection tape.
11. Remove the spacer (A) and connector cable (B) from the fuel pump.
12. Remove the pressure regulator from the fuel filter assembly.
13. Remove O-ring (A), O-ring (B), and backup ring (C) from the pressure regulator.

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Filter

INSTALLATION

1. Install O-ring (A), O-ring (B), and backup ring (C) to the pressure regulator.
   Note:
   - **Use new O-rings.**
   - **Apply gasoline to the O-ring and backup ring.**
2. Install the pressure regulator to the fuel filter assembly.

3. Install O-ring (A), spacer (B), and connector cable (C) to the fuel pump.
   Note:
   - **Use new O-rings and the connector cable.**
   - **Apply gasoline to the O-rings and the spacer.**
4. Install the fuel pump to the fuel filter assembly.
   Note:
   After installation, make sure five claws are correctly engaged in each position.
5. Check that the cushions of the fuel chamber assembly for dislocation. If any of them is dislocated, install a new cushion.
6. Slowly press in and install the tube assembly to the fuel chamber assembly until a clicking sound is heard.
7. Install the tube assembly to the fuel chamber assembly, and connect the tube assembly to the fuel chamber assembly.
8. Install the fuel filter assembly to the fuel chamber assembly.
   Note:
   - **Set the tube (A) and spring (B) for the fuel filter assembly as shown in the figure.**
   - **Check that the claw connecting the fuel camber assembly and the fuel filter assembly is securely fastened.**
9. Push the fuel filter assembly in the direction of the arrow to compress, and attach the clip.
   Note:
   Use a new clip.
10. Secure the connector cable with the clip, and connect the connector (A) of the connector cable.
11. Install the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Level Sensor>INSTALLATION.
12. Inspect the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Level Sensor>INSPECTION.
13. Install the fuel pump assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Pump>INSTALLATION.

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
3. Remove the floor mat. Ref. to EXTERIOR/INTERIOR TRIM>Floor Mat>REMOVAL.
4. In the engine compartment, disconnect the fuel delivery tube (A) and evaporation hose (B).
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from the tubes using a container or cloth.**

   Note:
   Disconnect the quick connector as shown in the figure.

   (a) Slider

5. Remove the fuel tank. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Tank>REMOVAL.
6. Disconnect the quick connector, and remove the fuel delivery tube and jet pump tube from the fuel tank.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from the tubes using a container or cloth.**

   Note:
   Disconnect the quick connector as shown in the figure.

   (a) Slider

7. Disconnect the quick connector and remove the purge tube.
   Note:
   Disconnect the quick connector as shown in the figure.
8. Remove the body integrated unit. Ref. to SECURITY AND LOCKS>Body Integrated Unit>REMOVAL.
9. Remove the fuel pipe assembly from vehicle.

INSTALLATION

Install in the reverse order of removal while being careful of the following.

1. CONNECTING THE EVAPORATION LINE QUICK CONNECTOR

Note:
Connect the quick connector as shown in the figure.
Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

2. CONNECTING THE FUEL LINE QUICK CONNECTOR

Connect the quick connector as shown in the figure.
Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

(a) Slider

3. EVAPORATION HOSE CONNECTION

Connect the evaporation hose by inserting it to the pipe until the hose reaches the spool or bump.

(1) Hose
(2) Clip
(3) Spool or bump
(4) Pipe

FUEL INJECTION (FUEL SYSTEMS)(w/o STI) > Fuel Delivery and Evaporation Lines

INSPECTION

1. Check that the fuel pipe has no deformation, cracks or other damages.
2. Check that the hose and tube have no cracks, damage or loose part.

INSPECTION

Trouble	Possible cause	Corrective action
Insufficient fuel supply to fuel injector	a. Fuel pump does not operate.	
	❍Defective terminal contact	Inspect contact, especially ground, and tighten it securely.
	❍Trouble in electromagnetic or electronic circuit parts	Replace the faulty parts.
	b. Decline of fuel pump function	Replace the fuel pump.
	c. Clogged fuel filter	Replace the fuel filter. Clean or replace the fuel tank if necessary.
	d. Clogged or bent fuel line pipe, hose or tube	Clean, correct or replace the fuel line pipe, hose or tube.
	e. Air is mixed in fuel system.	Check the fuel line connections, correct or replace the defective part.
	f. Damaged diaphragm of pressure regulator	Replace the pressure regulator.
Leakage or blow out of fuel	a. Loose connections of fuel line pipe, hose or tube	Check the fuel line connections, correct or replace the defective part.
	b. Cracked fuel line pipe, hose or tube	Replace the fuel line pipe, hose or tube.
	c. Cracked fuel tank or defective welding part	Replace the fuel tank.
	d. Clogged or bent fuel line pipe, hose or tube	Clean, correct or replace the fuel line pipe, hose or tube.
Gasoline smell inside of compartment	a. Loose connections of fuel line pipe, hose or tube	Check the fuel line connections, correct or replace the defective part.
	b. Defective canister	Replace the canister.
Defective fuel gauge	a. Defective operation of fuel level sensor	Replace the fuel level sensor.
	b. Defective operation of combination meter Ref. to COMBINATION METER (DIAGNOSTICS)>Basic Diagnostic Procedure>PROCEDURE.	Replace the combination meter.
Noise	a. Large operation noise or vibration of fuel pump	Replace the fuel pump.

Note:

- **When the vehicle is left unattended for an extended period of time, water may accumulate in the fuel tank. Fill fuel fully to prevent the problem.**
- **In snow-covered areas, mountainous areas, skiing areas, etc. where ambient temperatures drop to 0°C (32°F) or less throughout the winter season, use a water removing agent in the fuel system to prevent freezing fuel system and accumulating water.**
- **When water is accumulated in fuel filter, fill the water removing agent in the fuel tank.**
- **Before using water removing agent, follow the cautions noted on the bottle.**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)

EC(w/o STI)

1. General Description
2. Front Catalytic Converter
3. Rear Catalytic Converter
4. Canister
5. Purge Control Solenoid Valve
6. EGR Pipe
7. EGR Control Valve
8. EGR Cooler
9. Fuel Level Sensor
10. Fuel Sub Level Sensor
11. Drain Filter
12. Leak Check Valve Assembly
13. PCV Pipe
14. PCV Connector
15. PCV Hose
16. PCV Hose Assembly
17. PCV Valve

COMPONENT

1. CANISTER, PURGE CONTROL SOLENOID VALVE, AND LEAK CHECK VALVE ASSEMBLY

For components of canister, purge control solenoid valve, and leak check valve assembly, refer to FU(w/o STI). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>General Description>COMPONENT.

2. EXHAUST GAS RECIRCULATION CONTROL CIRCUIT RANGE/PERFORMANCE



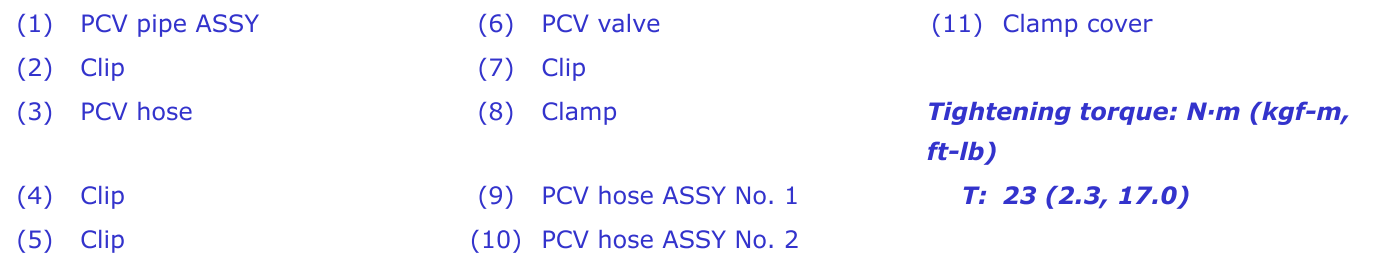
(1)	O-ring	(8)	EGR cooler	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	EGR pipe	(9)	Clip	***T1: 6.4 (0.7, 4.7)***
(3)	Gasket	(10)	Water hose A	***T2: 19 (1.9, 14.0)***
(4)	EGR control valve	(11)	Water hose B (MT model)	***T3: Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Pipe>INSTALLATION.***
(5)	EGR control valve bracket A	(12)	Gasket	***T4: Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Cooler>INSTALLATION.***
(6)	EGR control valve bracket B	(13)	Stud bolt	
(7)	Gasket			

3. PCV SYSTEM 1



(1)	PCV connector	(3)	O-ring	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	O-ring			***T: 6.4 (0.7, 4.7)***

4. PCV SYSTEM 2



(1)	PCV pipe ASSY	(6)	PCV valve	(11)	Clamp cover
(2)	Clip	(7)	Clip		
(3)	PCV hose	(8)	Clamp	***Tightening torque: N·m (kgf-m, ft-lb)***	
(4)	Clip	(9)	PCV hose ASSY No. 1	***T: 23 (2.3, 17.0)***	
(5)	Clip	(10)	PCV hose ASSY No. 2		

CAUTION

- Prior to starting work, pay special attention to the following:

1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
2. Protect the vehicle using a seat cover, fender cover, etc.
3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.

- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

PREPARATION TOOL

1. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Clamp pincer	• Used for installing PCV pipe assembly and PCV hose assembly. • This tool is made by OETIKER. Product No. 14100134

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Front Catalytic Converter

REMOVAL

The front catalytic converter is integrated into the center exhaust pipe (front). Refer to "Center Exhaust Pipe" for removal procedures. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Front Catalytic Converter

INSTALLATION

The front catalytic converter is integrated into the center exhaust pipe (front). Refer to "Center Exhaust Pipe" for installation procedures. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Front Catalytic Converter

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Rear Catalytic Converter

REMOVAL

The rear catalytic converter is integrated into the center exhaust pipe (rear). Refer to "Center Exhaust Pipe" for removal procedures. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Rear Catalytic Converter

INSTALLATION

The rear catalytic converter is integrated into the center exhaust pipe (rear). Refer to "Center Exhaust Pipe" for installation procedures. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Rear Catalytic Converter

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Canister

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Lift up the vehicle.
4. Remove the rear exhaust pipe. Ref. to EXHAUST(w/o STI)>Rear Exhaust Pipe>REMOVAL.
5. Remove the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>REMOVAL.
6. Support the rear differential with the transmission jack.
7. Remove the bolts, then disconnect the rear stabilizer.
8. Remove the mass damper and the self-locking nuts which hold the rear differential to the rear sub frame assembly.
9. Remove the rear differential member from the rear sub frame assembly and the rear differential.
10. Lower the transmission jack gradually until the rear differential is at the position shown in the figure.
    Note:
    - **When pulling out the stud bolt from the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.**
    - **Do not lower the rear differential excessively. Doing so may add extra load to the drive shaft or cause the falling-off of the drive shaft.**
11. Disconnect the vent tube from vent hose.
12. Disconnect the drain tube (A) and purge tube (B) from the canister.
    Note:
    Disconnect the quick connector as shown in the figure.

    (a) Drain tube (b) Purge tube

13. Disconnect the fuel filler hose from the fuel filler pipe assembly.
14. Remove the tube clamp from the canister bracket A, and remove the drain tube from the tube clamp.
15. Remove the bolts and clip (A) securing the canister to the vehicle, and remove the canister.
16. Disconnect the vent tube (B) from the canister and remove the canister bracket A (A).
    Note:
    - **Disconnect the quick connector as shown in the figure.**
    - **The canister bracket cannot be separated from the canister. Therefore, be sure to replace both of them with new ones when replacing the canister or canister bracket.**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Canister

INSTALLATION

1. Move it in the direction of the arrow and install the canister bracket B (A) and canister bracket C (B) to the canister.

Note:

- **Use a new canister and a canister bracket.**
- **Check that the claw (a) is securely tightened.**

2. Connect the vent tube (B) to the canister and remove the canister bracket A (A).

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Install the quick connector as shown in the figure.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

3. Set the canister to the vehicle, and attach the bolts and clip (A) which secure the canister.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

4. Correctly insert the fuel filler hose to the spool, and then install the clamp as shown.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

(1) Hose
(2) Clamp
(3) Spool
(4) Pipe

5. Install the tube clamp to the canister bracket A, and install the drain tube to the tube clamp.
6. Connect the drain tube (A) and purge tube (B) to the canister.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Install the quick connector as shown in the figure.

(a) Drain tube
(b) Purge tube

7. Connect the vent tube to the vent hose.
8. Lift up the transmission jack gradually, and set the rear differential to the rear sub frame assembly.

Note:

When inserting the stud bolt into the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.

9. Set the mass damper to the rear sub frame assembly, and temporarily tighten the self-locking nuts which hold the rear differential.

Note:

Use a new self-locking nut.

10. Set the rear differential member to the rear sub frame assembly and rear differential, and temporarily tighten the self-lock nuts which secure the rear differential member to the rear sub frame

assembly and rear differential.

Note:

Use a new self-locking nut.

11. Remove the transmission jack from the rear differential.
12. Tighten the self-locking nuts which secure the rear differential member to the rear sub frame assembly and rear differential.

    Tightening torque:

    T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

    T2: 110 N·m (11.2 kgf-m, 81.1 ft-lb)
13. Tighten the self-locking nuts which secure the rear differential to the rear sub frame assembly.

    Tightening torque:

    70 N·m (7.1 kgf-m, 51.6 ft-lb)
14. Install the rear stabilizer.

    Caution:

    - **Always tighten the bushing in the state where the vehicle is at curb weight and the wheels are in full contact with the ground.**
    - **Install the clamp - stabilizer bushing with the "G" character facing upward.**
    - **When installing, align the edge of identification paint (a) to the end face of the bushing (b).**

    Tightening torque:

    30 N·m (3.1 kgf-m, 22 ft-lb)
15. Install the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>INSTALLATION.
16. Install the rear exhaust pipe. Ref. to EXHAUST(w/o STI)>Rear Exhaust Pipe>INSTALLATION.
17. Lower the vehicle.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Canister

INSPECTION

1. Check that the canister has no deformation, cracks or other damages.
2. Check that the tube has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Purge Control Solenoid Valve

REMOVAL

1. PURGE CONTROL SOLENOID VALVE 1

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the brake vacuum pump. Ref. to BRAKE>Brake Vacuum Pump>REMOVAL.
4. Remove the bolt which secures the solenoid valve bracket from the intake manifold.
5. Remove the nut which secures the purge control solenoid valve 1 to the solenoid valve bracket.
6. Disconnect the connector (A) and vacuum hose (B) from the purge control solenoid valve 1, and remove the purge control solenoid valve 1.

2. PURGE CONTROL SOLENOID VALVE 2

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the brake vacuum pump. Ref. to BRAKE>Brake Vacuum Pump>REMOVAL.
4. Remove the bolt which secures the solenoid valve bracket from the intake manifold.
5. Remove the nut which secures the purge control solenoid valve 2 to the solenoid valve bracket.
6. Disconnect the connector (A) and vacuum hose (B) from the purge control solenoid valve 2, and remove the purge control solenoid valve 2.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Purge Control Solenoid Valve

INSTALLATION

1. PURGE CONTROL SOLENOID VALVE 1

Install in the reverse order of removal.

Note:

Connect the vacuum hose as shown in the figure.

(a) To intake manifold (b) To fuel pipe

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

2. PURGE CONTROL SOLENOID VALVE 2

Install in the reverse order of removal.

Note:

Connect the vacuum hose as shown in the figure.

(a) To intake duct (b) To fuel pipe

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Purge Control Solenoid Valve

INSPECTION

1. PURGE CONTROL SOLENOID VALVE

1. Check that the purge control solenoid valve has no deformation, cracks or other damages.
2. Measure the resistance between the purge control solenoid valve terminals.

Terminal No.	Standard
1 and 2	24±3 Ω (when 20°C (68°F))

3. Check that air does not come out from (B) when air is blown into (A).
   - Purge control solenoid valve 1
   - Purge control solenoid valve 2
4. Connect the battery positive terminal to the terminal No. 1 and the battery negative terminal to the terminal No. 2. Check that air is discharged from (B), when supplying air to (A).
   - Purge control solenoid valve 1
   - Purge control solenoid valve 2

2. OTHER INSPECTIONS

Check the vacuum hose for cracks, damage or looseness.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Pipe

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Remove the brake booster vacuum hose from the clip, and place the brake booster vacuum hose aside so that it does not interfere with the work.
5. Remove the bolts which secure the EGR pipe to the intake manifold and EGR control valve, and remove the EGR pipe.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Pipe

INSTALLATION

1. Install the EGR pipe to the intake manifold and EGR control valve.
   (1) Set the EGR pipe to the intake manifold and EGR control valve, and temporarily tighten the bolts which secure the EGR pipe to the intake manifold and EGR control valve.
   Note:
   Use new gaskets and O-rings.
   (2) Tighten the bolts which secure the EGR pipe to the intake manifold and EGR control valve in numerical order as shown in the figure.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
2. Install the brake booster vacuum hose to the clip.
   Note:
   If the clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.
3. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
4. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Pipe

INSPECTION

Check that the EGR pipe has no deformation, cracks or other damages.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Control Valve

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Lift up the vehicle.
4. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
5. Drain approximately 3.0 L (3.2 US qt, 2.6 Imp qt) of coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
6. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
7. Remove the EGR pipe. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Pipe>REMOVAL.
8. Remove the bolts which secure the EGR cooler to the EGR control valve, and remove the bolts which secure the EGR control valve bracket A to the EGR control valve bracket B.
9. Disconnect the connector (A) and preheater hose (B) from EGR control valve, and remove the EGR control valve.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Control Valve

INSTALLATION

1. Connect the preheater hose (B) and connector (A) to the EGR control valve.
2. Install the EGR control valve and EGR control valve bracket A to the EGR cooler and EGR control valve bracket B.
   (1) Set the EGR control valve and EGR control valve bracket A to the EGR cooler and EGR control valve bracket B, and temporarily tighten the bolts which secure the EGR control valve and EGR control valve bracket A to the EGR cooler and EGR control valve bracket B.
   Note:
   Use a new gasket.
   (2) Tighten the bolts which secure the EGR control valve and EGR control valve bracket A to the EGR cooler and EGR control valve bracket B in numerical order as shown in the figure.
   Tightening torque:
   T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
   T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)
3. Install the EGR pipe. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Pipe>INSTALLATION.
4. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
5. Lift up the vehicle.
6. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
7. Lower the vehicle.
8. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
9. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
10. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Control Valve

DISASSEMBLY

Remove the EGR control valve bracket A from the EGR control valve.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Control Valve

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

19 N·m (1.9 kgf-m, 14.0 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Control Valve

INSPECTION

1. Check that the EGR control valve and EGR control valve bracket A have no deformation, cracks or other damages.
2. Measure the resistance between EGR control valve terminals.

Terminal No.	Standard
2 and 1	15±2 Ω (when 20°C (68°F))
2 and 3	
5 and 4	
5 and 6	

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Cooler

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Remove the brake booster vacuum hose from the clip, and place the brake booster vacuum hose aside so that it does not interfere with the work.
5. Lift up the vehicle.
6. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
7. Remove the nuts which secure the EGR cooler to the cylinder head RH.
8. Disconnect the water hose A from the water pipe RH.
9. Lower the vehicle.
10. Disconnect the engine coolant inlet hose (CVT model) or water hose B (MT model) from the EGR cooler.
11. Remove the bolts which secure the EGR cooler to the EGR control valve and cylinder head RH, and remove the EGR cooler.
12. Remove the gasket (A) from the stud bolt, and remove the stud bolt from the cylinder head RH.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Cooler

INSTALLATION

1. Install the stud bolt to the cylinder head RH, and set the gasket (A) to the stud bolt.
   Note:
   Use a new stud bolt and gasket.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
2. Lower the vehicle.
3. Set the EGR cooler to the EGR control valve and cylinder head RH, and temporarily tighten the bolts which secure the EGR cooler to the EGR control valve and cylinder head RH.
   Note:
   Use a new gasket.
4. Connect the engine coolant inlet hose (CVT model) or water hose B (MT model) to the EGR cooler.
5. Lift up the vehicle.
6. Connect the water hose A to the water pipe RH.
7. Install the EGR cooler to the cylinder head RH.
   (1) Tighten the nuts which secure the EGR cooler to the cylinder head RH in numerical order as shown in the figure.
   Tightening torque:
   9 N·m (0.9 kgf-m, 6.6 ft-lb)
   (2) Retighten the nut shown in the figure.
   Tightening torque:
   9 N·m (0.9 kgf-m, 6.6 ft-lb)
8. Tighten the bolts holding the EGR cooler to the cylinder head RH.
   Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

9. Tighten the bolt securing the EGR cooler to the EGR control valve.
   Tightening torque:
   T2: 19 N·m (1.9 kgf-m, 14.0 ft-lb)
10. Lower the vehicle.
11. Install the brake booster vacuum hose to the clip.
    Note:
    If the clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.
12. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
13. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
14. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
15. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Cooler

DISASSEMBLY

Remove the water hose A from EGR cooler.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Cooler

ASSEMBLY

Assemble in the reverse order of disassembly.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > EGR Cooler

INSPECTION

1. Check that the EGR cooler has no deformation, cracks or other damages.
2. Check that the water hose has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Fuel Level Sensor

REMOVAL

Refer to “Fuel Level Sensor” for removal procedure of the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Level Sensor>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Fuel Level Sensor

INSTALLATION

Refer to “Fuel Level Sensor” for installation procedure of the fuel level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Level Sensor>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Fuel Level Sensor

INSPECTION

Refer to “Fuel Level Sensor” for the fuel level sensor inspection procedure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Level Sensor>INSPECTION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Fuel Sub Level Sensor

REMOVAL

Refer to "Fuel Sub Level Sensor" for removal procedure of the fuel sub level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Sub Level Sensor>REMOVAL.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Fuel Sub Level Sensor

INSTALLATION

Refer to "Fuel Sub Level Sensor" for installation procedure of the fuel sub level sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Sub Level Sensor>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Fuel Sub Level Sensor

INSPECTION

Refer to "Fuel Sub Level Sensor" for the fuel sub level sensor inspection procedure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Sub Level Sensor>INSPECTION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Drain Filter

REMOVAL

1. Remove the rear wheel LH. Ref. to WHEEL AND TIRE SYSTEM>Tire and Wheel>REMOVAL.
2. Lift up the vehicle.
3. Remove the rear mud guard LH. Ref. to EXTERIOR/INTERIOR TRIM>Mud Guard>REMOVAL.
4. Disconnect the drain tube from the drain pipe.
   Note:
   Disconnect the quick connector as shown in the figure.
5. Remove the drain bracket and drain pipe from vehicle as a unit.
6. Remove the bolt (A) which holds drain pipe from the drain bracket.
7. Disconnect the drain tube (B) from the drain pipe.
   Note:
   - **Disconnect the quick connector as shown in the figure.**
   - **The drain filter cannot be separated from the drain bracket. Therefore, be sure to replace both of them with new ones when replacing the drain bracket or drain filter.**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Drain Filter

INSTALLATION

Install in the reverse order of removal.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

- **Use a new drain bracket and a drain filter.**
- **Before installing the drain filter to the drain bracket, check that the claw (a) is securely tightened.**
- **Install the quick connector as shown in the figure.**

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Drain Filter

INSPECTION

1. Check that the drain filter has no deformation, cracks or other damages.
2. Check that the tube has no cracks, damage or loose part.

REMOVAL

Warning:
Place "NO OPEN FLAMES" signs near the working area.
Caution:
Be careful not to spill fuel.

1. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
2. Drain fuel. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > DRAINING FUEL (WITH SUBARU SELECT MONITOR).
3. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Lift up the vehicle.
5. Remove the rear exhaust pipe. Ref. to EXHAUST(w/o STI)>Rear Exhaust Pipe>REMOVAL.
6. Remove the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>REMOVAL.
7. Support the rear differential with the transmission jack.
8. Remove the bolts, then disconnect the rear stabilizer.
9. Remove the mass damper and the self-locking nuts which hold the rear differential to the rear sub frame assembly.
10. Remove the rear differential member from the rear sub frame assembly and the rear differential.
11. Lower the transmission jack gradually until the rear differential is at the position shown in the figure.
    Note:
    - **When pulling out the stud bolt from the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.**
    - **Do not lower the rear differential excessively. Doing so may add extra load to the drive shaft or cause the falling-off of the drive shaft.**
12. Disconnect the fuel filler hose (A) and evaporation hose (B) from the fuel filler pipe assembly.
13. Disconnect the drain tube from the drain pipe.
    Note:
    Disconnect the quick connector as shown in the figure.
14. Disconnect the drain tube (A) from the canister.
    Note:
    Disconnect the quick connector as shown in the figure.
15. Remove the tube clamp (B) from the canister bracket A, and remove the drain tube from the tube clamp.
16. Disconnect the connector (A) from the leak check valve assembly.
17. Remove the bolts which hold the leak check valve assembly and remove the leak check valve assembly together with drain tube from vehicle.
18. Disconnect the drain tube A (A) and drain tube B (B) from the leak check valve assembly.
    Note:
    Disconnect the quick connector as shown in the figure.
19. Remove the tube clamp from the drain tube A (A) and drain tube B (B).

INSTALLATION

1. Connect the drain tube A (A) and drain tube B (B) to the leak check valve assembly.
   Caution:
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

   Note:
   Connect the quick connector as shown in the figure.
2. Install the tube clamp to the drain tube A (A) and drain tube B (B).
3. Set the leak check valve assembly together with drain tube to the vehicle and install the bolt which holds the leak check valve assembly.
   Tightening torque:
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
4. Connect the connector (A) to the leak check valve assembly.
5. Connect the drain tube (A) to the canister.
   Caution:
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

   Note:
   Connect the quick connector as shown in the figure.
6. Install the tube clamp (B) to the canister bracket A, and install the drain tube to the tube clamp.
7. Connect the drain tube to the drain pipe.
   Caution:
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

   Note:
   Connect the quick connector as shown in the figure.
8. Securely insert the fuel filler hose (A) and evaporation hose (B) until the hose end contacts the spool, then attach the clamp and clip as shown in the figure.
   Tightening torque:
   2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

   (1) Hose
   (2) Clamp and clip
   (3) Spool
   (4) Pipe
9. Lift up the transmission jack gradually, and set the rear differential to the rear sub frame assembly.

Note:
When inserting the stud bolt into the bushing portion of the rear sub frame assembly, adjust the angle and location of transmission jack and jack stand.

10. Set the mass damper to the rear sub frame assembly, and temporarily tighten the self-locking nuts which hold the rear differential.
    Note:
    Use a new self-locking nut.
11. Set the rear differential member to the rear sub frame assembly and rear differential, and temporarily tighten the self-lock nuts which secure the rear differential member to the rear sub frame assembly and rear differential.
    Note:
    Use a new self-locking nut.
12. Remove the transmission jack from the rear differential.
13. Tighten the self-locking nuts which secure the rear differential member to the rear sub frame assembly and rear differential.
    Tightening torque:
    T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)
    T2: 110 N·m (11.2 kgf-m, 81.1 ft-lb)
14. Tighten the self-locking nuts which secure the rear differential to the rear sub frame assembly.
    Tightening torque:
    70 N·m (7.1 kgf-m, 51.6 ft-lb)
15. Install the rear stabilizer.
    Caution:
    - **Always tighten the bushing in the state where the vehicle is at curb weight and the wheels are in full contact with the ground.**
    - **Install the clamp - stabilizer bushing with the "G" character facing upward.**
    - **When installing, align the edge of identification paint (a) to the end face of the bushing (b).**

    Tightening torque:
    30 N·m (3.1 kgf-m, 22 ft-lb)
16. Install the propeller shaft. Ref. to DRIVE SHAFT SYSTEM>Propeller Shaft>INSTALLATION.
17. Install the rear exhaust pipe. Ref. to EXHAUST(w/o STI)>Rear Exhaust Pipe>INSTALLATION.
18. Lower the vehicle.
19. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > Leak Check Valve Assembly

DISASSEMBLY

1. Disconnect the connector (A) from the leak check valve assembly.
2. Remove the bolt (B) securing the leak check valve assembly to the leak check valve bracket.
3. Remove the clamp B (C) which secures the leak check valve assembly, and remove the leak check valve assembly.
4. Remove the harness (A) from the leak check valve bracket.
5. Rotate the clamp A (B) in the direction of the arrow and remove it from the leak check valve bracket.

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

5.4 N·m (0.6 kgf-m, 4.0 ft-lb)

INSPECTION

1. CHECK SWITCHING VALVE

1. Check the resistance between switching valve terminals.

Terminal No.	Standard
1 and 5	27^{+3}_{-2} Ω (when 20°C (68°F))
	31±4 Ω (when 60°C (140°F))

2. Check that air is discharged from (B) when air is blown into (A).
3. Connect the battery positive terminal to the terminal No. 5 and the battery negative terminal to the terminal No. 1. Check that air does not come out from (B) when air is blown into (A).

   Note:

   The purpose of this inspection is to check the valve movement, and it would be success if a large change of flow can be checked resulting from valve opening/closing. Therefore, it does not indicate a malfunction if a small amount of flow from (B) is detected when the valve is closed.

2. CHECK VACUUM PUMP

1. Connect the battery positive terminal to terminal No. 3 and the battery ground terminal to terminal No. 4, and inspect the vacuum pump operation.

   Caution:

   Do not operate the vacuum pump for 5 minutes or more.

3. CHECK PRESSURE SENSOR

1. Connect dry-cell battery positive terminal to terminal No. 6 and dry-cell battery ground terminal to terminal No. 8, circuit tester positive terminal to terminal No. 7 and the circuit tester ground terminal to terminal No. 8.

   Note:

   - **Use new dry-cell batteries.**
   - **Using a circuit tester, check that the initial voltage of each dry-cell battery is 1.6 V or more. And also check that the voltage of three batteries in series is between 4.8 V and 5.2 V.**
   - **For power supply, 5 V DC constant voltage power source can also be used.**
2. Check the voltage at a normal atmospheric pressure.

Note:
The atmospheric pressure at higher altitude is lower than normal. Therefore, the voltage is lower than the standard value.

Terminal No.	Standard
7 (+) and 8 (−)	Approx. 3.5 V (when 25°C (77°F))

3. Connect the battery positive terminal to terminal No. 3 and the battery ground terminal to terminal No. 4, and check that there is a voltage drop from the voltage measured in step 2) when the vacuum pump is operated.

4. OTHER INSPECTIONS

1. Check that the leak check valve assembly and leak check valve bracket have no deformation, cracks or other damages.
2. Check that the tube has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Pipe

REMOVAL

Caution:
Do not remove except when the PCV pipe assembly is broken.

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Collect the refrigerant from A/C system. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Recovery Procedure.
3. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Remove the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 2.
5. Remove the PCV pipe assembly from the clip.
6. Remove the clip securing the PCV pipe assembly to the intake manifold.
7. Remove the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Compressor>REMOVAL.
8. Remove the PCV pipe assembly from the PCV connector.
   (1) Pinch the quick connector of the PCV pipe assembly using pliers and break the quick connector by twisting to the arrow direction. And then, remove the PCV pipe assembly from the PCV connector.
   Caution:
   Be careful not to damage the PCV connector and preheater hose.
   (2) If the PCV pipe assembly cannot be removed after performing the step (1), cut out the shaded area shown in the figure using a pair of nippers and open the spring in the arrow direction to unlock using snap ring pliers. And then, remove the PCV pipe assembly from the PCV connector.
   Caution:
   Be careful not to damage the PCV connector and preheater hose.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Pipe

INSTALLATION

1. Connect the quick connector of the PCV pipe assembly to the PCV connector.
   Caution:
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **After connecting the quick connector, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**
2. Install the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Compressor>INSTALLATION.
3. Attach the clips which secure the PCV pipe assembly to the intake manifold.
4. Install the PCV pipe assembly to the clip.
5. Install the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 2.
6. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
7. Charge the A/C system with refrigerant. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Charging Procedure>PROCEDURE.

8. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Pipe

INSPECTION

1. BLOW-BY DIAGNOSIS CONNECTOR

1. Check that the blow-by diagnosis connector has no deformation, cracks or other damages.
2. Check the resistance between blow-by diagnosis connector terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

2. OTHER INSPECTIONS

Check that the PCV pipe assembly has no cracks, damage or loose part.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Connector

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
4. Remove the PCV pipe assembly. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>PCV Pipe>REMOVAL.
5. Disconnect the preheater hose from the PCV connector, and remove the PCV connector from the cylinder block LH.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Connector

INSTALLATION

Install in the reverse order of removal.

Note:

Use new O-rings.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Connector

INSPECTION

Check that the PCV connector has no deformation, cracks or other damages.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Hose

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Remove the brake booster vacuum hose from the clip, and place the brake booster vacuum hose aside so that it does not interfere with the work.
5. Disconnect the PCV hose from the intake manifold, and remove the PCV hose from the PCV valve.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Hose

INSTALLATION

Install in the reverse order of removal.

Note:

If the brake booster vacuum hose securing clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Hose

INSPECTION

Check that the PCV hose has no cracks, damage or loose part.

REPLACEMENT

Caution:
Do not remove except when the PCV hose assembly is broken.

1. PCV HOSE ASSY NO. 1

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the radiator. Ref. to COOLING(w/o STI)>Radiator>REMOVAL.
3. Remove the condenser. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Condenser>REMOVAL.
4. Unlock the blow-by diagnosis connector, and disconnect the PCV hose assembly No. 2 from the PCV hose assembly No. 1.
5. Remove the blow-by diagnosis connector harness from the PCV hose assembly No. 1.
6. Break the clamp, and remove the PCV hose assembly No. 1 from the chain cover.
7. Install the PCV hose assembly No. 1 to the chain cover, and install the clamp using the Clamp pincer (14100134).
   Note:
   Use a new clamp.
8. Install the blow-by diagnosis connector harness to the PCV hose assembly No. 1, and connect the PCV hose assembly No. 2 to the PCV hose assembly No. 1.
   Note:
   - **There are multiple blow-by diagnosis connectors. Be careful not to connect incorrectly.**
   - **Make sure that the blow-by diagnosis connector is connected securely.**
9. Install the condenser. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Condenser>INSTALLATION.
10. Install the radiator. Ref. to COOLING(w/o STI)>Radiator>INSTALLATION.
11. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
12. Charge the A/C system with refrigerant. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Charging Procedure>PROCEDURE.
13. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

2. PCV HOSE ASSY NO. 2

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the oil catch tank. Ref. to INTAKE (INDUCTION)(w/o STI)>Oil Catch Tank>REMOVAL.
3. Remove the clamp cover.
4. Break the clamp, and remove the PCV hose assembly No. 2 from the oil catch tank.
5. Install the PCV hose assembly No. 2 to the oil catch tank, and install the clamp using the Clamp pincer (14100134).
   Note:
   Use a new clamp.
6. Install the clamp cover.
   Caution:
   Be careful not to allow the lower part of the clamp cover to ride over the PCV hose assembly No. 2.

7. Install the oil catch tank. Ref. to INTAKE (INDUCTION)(w/o STI)>Oil Catch Tank>INSTALLATION.
8. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Hose Assembly

INSPECTION

1. BLOW-BY DIAGNOSIS CONNECTOR

1. Check that the blow-by diagnosis connector has no deformation, cracks or other damages.
2. Check the resistance between blow-by diagnosis connector terminals.

Terminal No.	Standard
1 and 2	Less than 1 Ω

2. OTHER INSPECTIONS

Check the PCV hose assembly for cracks, damage or looseness.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Valve

REMOVAL

Caution:
Do not remove unless the PCV valve is broken.

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Remove the brake booster vacuum hose from the clip, and place the brake booster vacuum hose aside so that it does not interfere with the work.
5. Disconnect the PCV hose from the PCV valve.
6. Remove the PCV valve from the cylinder block RH.

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Valve

INSTALLATION

Install in the reverse order of removal.

Note:

- **Apply liquid gasket to the bolt threads of PCV valve.**
  Liquid gasket:
  THREE BOND 1324 (Part No. 004403042) or equivalent
  Tightening torque:
  23 N·m (2.3 kgf-m, 17.0 ft-lb)
- **If the brake booster vacuum hose securing clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.**

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI) > PCV Valve

INSPECTION

1. Check that the PCV valve has no deformation, cracks or other damages.
2. Check that air is discharged from (B) when air is blown into (A).
3. Check that air does not come out from (B) when air is blown into (A).

INTAKE (INDUCTION)(w/o STI)

IN(w/o STI)

1. General Description
2. Collector Cover
3. Air Cleaner Element
4. Air Cleaner Case
5. Air Intake Boot
6. Air Intake Duct
7. Intake Duct
8. Intercooler
9. Turbocharger
10. Oil Catch Tank
11. Scavenge Pump
12. Air By-pass Valve

COMPONENT

1. AIR CLEANER

(1) Mass air flow and intake air temperature sensor
(2) Air cleaner case (rear)
(3) Clip
(4) Air cleaner element
(5) Air cleaner case (front)
(6) Cushion
(7) Spacer
(8) Cushion
(9) Air cleaner case bracket
(10) Air intake duct
(11) Clip
(12) Clamp
(13) Air intake boot A
(14) Turbo duct
(15) Air intake boot B
(16) Cushion
(17) Duct bracket

Tightening torque: N·m (kgf-m, ft-lb)

T1: 1 (0.1, 0.7)
T2: 2.5 (0.3, 1.8)
T3: 6 (0.6, 4.4)
T4: 7.5 (0.8, 5.5)
T5: 18 (1.8, 13.3)

2. INTAKE DUCT

(1) Intake duct No. 1 (except for Canada)
(2) O-ring
(3) O-ring
(4) Wastegate control solenoid valve
(5) Vacuum control hose
(6) Clip
(7) Air by-pass valve
(8) Clamp
(9) O-ring
(10) Intake duct No. 2
(11) Cushion
(12) Intake duct No. 1 (for Canada)
(13) O-ring (for Canada)
(14) Air by-pass pipe (for Canada)

Tightening torque: N·m (kgf-m, ft-lb)

T1: 2.8 (0.3, 2.1)
T2: 3 (0.3, 2.2)
T3: 6.4 (0.7, 4.7)
T4: 7.5 (0.8, 5.5)
T5: 16 (1.6, 11.8)

3. INTAKE DUCT AND INTERCOOLER

(1) Clamp
(2) Insulator
(3) Intake duct No. 3
(4) Intercooler stay LH
(5) Intercooler stay RH
(6) Intercooler
(7) Cushion
(8) Spacer
(9) Insulator
(10) Clip

Tightening torque: N·m (kgf-m, ft-lb)

T1: 3 (0.3, 2.2)
T2: 16 (1.6, 11.8)

4. TURBOCHARGER

(1)	Turbocharger	(9)	Turbocharger pipe B	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Union screw pipe ASSY	(10)	Stud bolt	***T1: 6.8 (0.7, 5.1)***
(3)	Union bolt	(11)	Exhaust stay	***T2: 7 (0.7, 5.2)***
(4)	Gasket	(12)	Exhaust cover	***T3: 10.5 (1.1, 7.7)***
(5)	Air control hose ASSY	(13)	Gasket	***T4: 14.7 (1.5, 10.8)***
(6)	Gasket	(14)	Oil catch tank	***T5: 16 (1.6, 11.8)***
(7)	Union bolt			***T6: 20 (2.0, 14.8)***
(8)	Turbocharger pipe A			***T7: 31.5 (3.2, 23.2)***

INTAKE (INDUCTION)(w/o STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

INTAKE (INDUCTION)(w/o STI) > General Description

PREPARATION TOOL

1. GENERAL TOOL

TOOL NAME	REMARKS
TORX® socket E10	Used for disassembling and assembling the turbocharger.
Mighty Vac	Used for checking waste gate actuator and air by-pass valve.
Urethane sheet Width × Height × Thickness	Used for removing and installing intercooler. (MT model)

TOOL NAME	REMARKS
Approx. 300 mm × approx. 200 mm × approx. 10 mm (Approx. 11.81 in × approx. 7.87 in × approx. 0.39 in)	

INTAKE (INDUCTION)(w/o STI) > Collector Cover

REMOVAL

Caution:
The operation must be carefully performed; otherwise the collector cover may be damaged.

1. Remove the clip holding the collector cover.
2. Insert a cloth, etc. (A) between the collector cover and bulkhead.
   Note:
   This procedure is required to prevent the collector cover from touching the vehicle during collector cover removal.
3. Remove the bushing inserted section, and remove the collector cover.
   (1) Hold the shaded section (A) of the collector cover LH side by hand, and lift up the section (B) in the direction of the arrow with fingers to remove the bushing inserted section.
   Caution:
   When removing the collector cover from the collector cover bracket, lift up in parallel to the insertion direction of installation part.
   Note:
   Be careful not to deform the collector cover when holding the shaded section (A) by hand.
   (2) Hold the shaded section (A) of the collector cover RH side by hand, and lift up the section (B) in the direction of the arrow with fingers to remove the bushing inserted section. Then, remove the collector cover.
   Caution:
   When removing the collector cover from the collector cover bracket, lift up in parallel to the insertion direction of installation part.
   Note:
   Be careful not to deform the collector cover when holding the shaded section (A) by hand.

INTAKE (INDUCTION)(w/o STI) > Collector Cover

INSTALLATION

Install in the reverse order of removal.
Note:
Insert the collector cover installation part into the collector cover bracket cushion.

INTAKE (INDUCTION)(w/o STI) > Collector Cover

INSPECTION

Check that the collector cover does not have deformation, cracks and any other damage.

INTAKE (INDUCTION)(w/o STI) > Air Cleaner Element

REMOVAL

1. Remove the clip (A) from the air cleaner case (rear).
2. Open the air cleaner case (rear) while lifting it up, and remove the protrusion of the air cleaner case (rear) from the hole on the air cleaner case (front) to remove the air cleaner element.

INTAKE (INDUCTION)(w/o STI) > Air Cleaner Element

INSTALLATION

Install in the reverse order of removal.

Caution:

Be sure to use SUBARU genuine air cleaner element depending on the engine type when replacing the air cleaner elements. Using other air cleaner element may affect the engine performance.

Note:

- **Check that there is no dirt or dust within the air cleaner case. If any dirt or dust is found, clean it.**
- **Install the air cleaner element as shown in the figure.**

  (a) Upside (b) Downside (c) Air cleaner case (front) side

  (d) Air cleaner case (rear) side

- **When installing the air cleaner case (rear), align the protrusion of the air cleaner case (rear) to the hole on the air cleaner case (front) to install.**

INTAKE (INDUCTION)(w/o STI) > Air Cleaner Element

INSPECTION

1. Check that the air cleaner element has no deformation, cracks or other damages.
2. Check the air cleaner element for excessive dirt.

INTAKE (INDUCTION)(w/o STI) > Air Cleaner Case

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness to the bracket, and remove the bolt which secures the engine control module (ECM) to the bracket.
4. Pull out the engine control module (ECM) from the bracket, and move it to a location that does not interfere operation.
   Note:
   When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.
5. Remove the clips (3 places) which secure the front mud guard RH to the vehicle.
6. Turn over the front mud guard RH, and loosen the clamp which secures the air intake boot to the air cleaner case (rear).
7. Disconnect the connector (A) from the mass air flow and intake air temperature sensor, and remove the clip (B) from the air cleaner case (rear).
8. Remove the air cleaner case (rear) and air cleaner element.
9. Remove the bolt (A) and nut (B), and remove the air cleaner case (front).
10. Remove the air cleaner case bracket from the vehicle.

INTAKE (INDUCTION)(w/o STI) > Air Cleaner Case

INSTALLATION

1. Install the air cleaner case bracket to the vehicle.
   Tightening torque:
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
2. Set the air cleaner case (front) and install the bolt (A) and nut (B).
   Tightening torque:
   Bolt (A)
   6 N·m (0.6 kgf-m, 4.4 ft-lb)
   Nut (B)
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
3. Set the air cleaner element to the air cleaner case (front), and install the air cleaner case (rear).
   Note:
   - **Check that there is no dirt or dust within the air cleaner case. If any dirt or dust is found, clean it.**
   - **Install the air cleaner element as shown in the figure.**

   (a) Upside (b) Downside (c) Air cleaner case (front) side
   (d) Air cleaner case (rear) side

   - **When installing the air cleaner case (rear), align the protrusion of the air cleaner case (rear) to the hole on the air cleaner case (front) to install.**
4. Install the clip (B) to the air cleaner case (rear), and connect the connector (A) to the mass air flow and intake air temperature sensor.
5. Tighten the clamp which secures the air intake boot to the air cleaner case (rear).

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

6. Set the front mud guard RH to the vehicle, and install the clips which secure the front mud guard RH.
7. Insert the engine control module (ECM) to the bracket.
8. Install the bolt which secures the engine control module (ECM) to the bracket, and then secure the engine wiring harness and bulkhead harness to the bracket with clip (A) and clip (B).

   Tightening torque:

   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
9. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
10. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

INTAKE (INDUCTION)(w/o STI) > Air Cleaner Case

INSPECTION

Check that the air cleaner case has no deformation, cracks or other damages.

INTAKE (INDUCTION)(w/o STI) > Air Intake Boot

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Cleaner Case>REMOVAL.
3. Lift up the vehicle.
4. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
5. Remove the air intake boot from the intake duct No. 1.
6. Lower the vehicle.
7. Remove the nuts which secure the turbo duct to the vehicle, and remove the air intake boot from the upper side of the vehicle together with the turbo duct.
8. Lift up the vehicle.
9. Remove the clips (A) which secure the front mud guard RH to the front bumper, and remove the screw which secures the front mud guard RH to the vehicle.
10. Turn over the front mud guard RH and remove the duct bracket from the vehicle.

INTAKE (INDUCTION)(w/o STI) > Air Intake Boot

INSTALLATION

Install in the reverse order of removal.

Note:

When installing the air intake boot to the vehicle, pay attention to the mounting hole position, and align the protrusion for stopping rotation of cushion to the cutout portion on the turbo duct.

(a) Attachment hole
(b) Not used
(c) Turbo duct
(d) Cushion
(e) Duct bracket
(f) Cutout portion
(g) Protrusion portion

Tightening torque:
18 N·m (1.8 kgf-m, 13.3 ft-lb)
Tightening torque:
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
Tightening torque:
2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

INTAKE (INDUCTION)(w/o STI) > Air Intake Boot

DISASSEMBLY

Remove the air intake boot from the turbo duct.

INTAKE (INDUCTION)(w/o STI) > Air Intake Boot

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

INTAKE (INDUCTION)(w/o STI) > Air Intake Boot

INSPECTION

Check that the air intake boot and turbo duct have no cracks, damage or loose part.

INTAKE (INDUCTION)(w/o STI) > Air Intake Duct

REMOVAL

Remove the clip which secures the air intake duct, and remove the air intake duct.

INTAKE (INDUCTION)(w/o STI) > Air Intake Duct

INSTALLATION

Install in the reverse order of removal.

INTAKE (INDUCTION)(w/o STI) > Air Intake Duct

INSPECTION

1. Check that the air intake duct has no deformation, cracks or other damages.
2. Inspect that no foreign objects are mixed in the air intake duct.

REMOVAL

1. INTAKE DUCT NO. 1

- **Except for Canada**
  1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
  2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
  3. Lift up the vehicle.
  4. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
  5. Disconnect the blow-by diagnosis connector (A) from the engine wiring harness, and disconnect the vacuum hose (B) from the vacuum pipe assembly.
  6. Disconnect the connector from the wastegate control solenoid valve.
  7. Unlock the blow-by diagnosis connector, and disconnect the PCV pipe assembly from the intake duct No. 1.
  8. Disconnect the vacuum control hose from the wastegate control solenoid valve.
  9. Remove the air intake boot (A) from the intake duct No. 1, and disengage the clip (B) which secures the air by-pass valve to the intake duct No. 1.
  10. Remove the intake duct No. 1 from the turbocharger.
- **For Canada**
  1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
  2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
  3. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
  4. Disconnect the blow-by diagnosis connector (A) from the engine wiring harness, and disconnect the vacuum hose (B) from the vacuum pipe assembly.
  5. Disconnect the connector from the wastegate control solenoid valve.
  6. Remove the engine coolant hose from the intake duct No. 1.
  7. Unlock the blow-by diagnosis connector, and disconnect the PCV pipe assembly from the intake duct No. 1.
  8. Disconnect the vacuum control hose (A) from the wastegate control solenoid valve, and remove the air intake boot (B) from the intake duct No. 1.
  9. Disengage the clip which secures the air by-pass valve to the intake duct No. 1.
  10. Remove the intake duct No. 1 from the turbocharger.

2. INTAKE DUCT NO. 2

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
4. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
5. Remove the radiator sub fan and fan motor. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor>REMOVAL.
6. Lift up the vehicle.
7. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.

8. Unlock the blow-by diagnosis connector, and disconnect the PCV pipe assembly from the intake duct No. 1.
9. Disconnect the vacuum hose (A) from the intake duct No. 1, and disconnect the vacuum hose (B) from the air by-pass valve.
10. Disengage the clip which secures the air by-pass valve to the intake duct No. 1.
11. Lower the vehicle.
12. Remove the bolts which secure the intake duct No. 2 to the turbocharger.
13. Pull out the air by-pass valve from the intake duct No. 1, and remove the intake duct No. 2 from the intake manifold.

3. INTAKE DUCT NO. 3

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
3. Remove the brake booster vacuum hose from the clip, and place the brake booster vacuum hose aside so that it does not interfere with the work.
4. Remove the intake duct No. 3 from the throttle body.

INTAKE (INDUCTION)(w/o STI) > Intake Duct

INSTALLATION

1. INTAKE DUCT NO. 1

- **Except for Canada**
  1. Install the intake duct No. 1 to the turbocharger.
     Note:
     - **Use new O-rings.**
     - **Be careful not to pinch the O-ring.**
     - **Check that the air by-pass valve is firmly inserted into the intake duct No. 1.**

     Tightening torque:
     7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
  2. Install the air intake boot (A) to the intake duct No. 1, and engage the clip (B) which secures the air by-pass valve to the intake duct No. 1.
     Tightening torque:
     2.5 N·m (0.3 kgf-m, 1.8 ft-lb)
  3. Connect the vacuum control hose to the wastegate control solenoid valve.
  4. Connect the PCV pipe assembly to the intake duct No. 1.
     Note:
     Make sure that the blow-by diagnosis connector is connected securely.
  5. Connect the connector to the wastegate control solenoid valve.
  6. Connect the blow-by diagnosis connector (A) to the engine wiring harness, and connect the vacuum hose (B) to the vacuum pipe assembly.
  7. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
  8. Lower the vehicle.
  9. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.

10. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

- **For Canada**

1. Install the intake duct No. 1 to the turbocharger.
   Note:
   - **Use new O-rings.**
   - **Be careful not to pinch the O-ring.**
   - **Check that the air by-pass valve is firmly inserted into the intake duct No. 1.**

   Tightening torque:
   7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
2. Engage the clip which secures the air by-pass valve to the intake duct No. 1.
3. Connect the vacuum control hose (A) to the wastegate control solenoid valve, and install the air intake boot (B) to the intake duct No. 1.
   Tightening torque:
   2.5 N·m (0.3 kgf-m, 1.8 ft-lb)
4. Connect the PCV pipe assembly to the intake duct No. 1.
   Note:
   Make sure that the blow-by diagnosis connector is connected securely.
5. Connect the engine coolant hose to the intake duct No. 1.
6. Connect the connector to the wastegate control solenoid valve.
7. Connect the blow-by diagnosis connector (A) to the engine wiring harness, and connect the vacuum hose (B) to the vacuum pipe assembly.
8. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
9. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
10. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
11. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

2. INTAKE DUCT NO. 2

1. Set the air by-pass valve to the intake duct No. 1, and install the intake duct No. 2 to the intake manifold.
2. Install the bolt which secures the intake duct No. 2 to the turbocharger.
   Note:
   - **Use new O-rings.**
   - **Be careful not to pinch the O-ring.**
   - **Check that the air by-pass valve is firmly inserted into the intake duct No. 1.**

   Tightening torque:
   16 N·m (1.6 kgf-m, 11.8 ft-lb)
3. Lift up the vehicle.
4. Engage the clip which secures the air by-pass valve to the intake duct No. 1.
5. Connect the vacuum hose (A) to the intake duct No. 1, and connect the vacuum hose (B) to the air by-pass valve.
6. Connect the PCV pipe assembly to the intake duct No. 1.
   Note:
   Make sure that the blow-by diagnosis connector is connected securely.

7. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
8. Lower the vehicle.
9. Install the radiator sub fan and fan motor. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor>INSTALLATION.
10. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
11. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
12. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
13. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

3. INTAKE DUCT NO. 3

1. Align the triangle mark (A) on the intake duct No. 3 to the rib (B) on the throttle body, and install the intake duct No. 3 to the throttle body.
   Note:
   - **Use a new insulator.**
   - **Apply a thin coat of SUBARU PS fluid (K0515YA000) or liquid paraffin to the inner periphery of the insulator.**
   - **When inserting the intake duct No. 3 to the throttle body, be careful that the insulator is not turned over.**

   Tightening torque:
   3 N·m (0.3 kgf-m, 2.2 ft-lb)
2. Install the brake booster vacuum hose to the clip.
   Note:
   If the clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.
3. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
4. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

INTAKE (INDUCTION)(w/o STI) > Intake Duct

DISASSEMBLY

1. INTAKE DUCT NO. 1

- **Except for Canada**
  Remove the vacuum hose, blow-by diagnosis connector harness and wastegate control solenoid valve from the intake duct No. 1.
- **For Canada**
  1. Remove the vacuum hose and blow-by diagnosis connector harness from the intake duct No. 1.
  2. Remove the wastegate control solenoid valve and air by-pass pipe from the intake duct No. 1.

2. INTAKE DUCT NO. 2

Remove the air by-pass valve from the intake duct No. 2.

3. INTAKE DUCT NO. 3

Remove the insulator from the intake duct No. 3.

INTAKE (INDUCTION)(w/o STI) > Intake Duct

ASSEMBLY

1. INTAKE DUCT NO. 1

- **Except for Canada**

  Install the vacuum hose, blow-by diagnosis connector harness and wastegate control solenoid valve to the intake duct No. 1.

  Note:

  - **Use new O-rings.**
  - **Check that the wastegate control solenoid valve is securely seated.**

  Tightening torque:

  2.8 N·m (0.3 kgf-m, 2.1 ft-lb)

- **For Canada**

  1. Set the connector bracket, and using new set bolts, tighten the bolt until the bolt head is broken (bolt head wrenched off).

     Note:

     This operation is required only when replacing the intake duct No. 1.

  2. Install the wastegate control solenoid valve and air by-pass pipe to the intake duct No. 1.

     Note:

     - **Use new O-rings.**
     - **Check that the wastegate control solenoid valve is securely seated.**

     Tightening torque:

     T1: 2.5 N·m (0.3 kgf-m, 1.8 ft-lb)

     T2: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

  3. Install the vacuum hose and blow-by diagnosis connector harness to the intake duct No. 1.

2. INTAKE DUCT NO. 2

Assemble in the reverse order of disassembly.

Tightening torque:

3 N·m (0.3 kgf-m, 2.2 ft-lb)

3. INTAKE DUCT NO. 3

Assemble in the reverse order of disassembly.

Note:

Use a new insulator.

INTAKE (INDUCTION)(w/o STI) > Intake Duct

INSPECTION

1. Check that the intake duct has no deformation, cracks or other damages.
2. Check the vacuum hose for cracks, damage or looseness.

INTAKE (INDUCTION)(w/o STI) > Intercooler

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Remove the brake booster vacuum hose from the clip (A).
3. Remove the bolts which secure the intercooler stay LH to the intercooler and intake manifold, and remove the intercooler stay LH.
4. Insert the urethane sheet (A) between intercooler and operating cylinder. (MT model)
   Note:
   - **This procedure is required to prevent the intercooler from touching the operating cylinder during intercooler removal.**
   - **Use the urethane sheet with the size (width × height × thickness) of approx. 300 mm × approx. 200 mm × approx. 10 mm (approx. 11.81 in × approx. 7.87 in × approx. 0.39 in).**
5. Loosen the clamp (A) which holds the intake duct to intercooler.
6. Remove the bolts which secure the intercooler to the intercooler stay RH, and remove the intercooler.
7. Remove the intercooler stay RH from the engine hanger stay.
8. Remove the insulator and clamp from intake duct.

INTAKE (INDUCTION)(w/o STI) > Intercooler

INSTALLATION

1. Install the insulator and clamp to the intake duct.
   Note:
   - **Use a new insulator.**
   - **Apply a thin coat of SUBARU PS fluid (K0515YA000) or liquid paraffin to the inner periphery of the insulator.**
2. Install the intercooler stay RH to the engine hanger stay.
   Tightening torque:
   16 N·m (1.6 kgf-m, 11.8 ft-lb)
3. Set the urethane sheet (A) so that it covers the operating cylinder. (MT model)
   Note:
   - **This procedure is required to prevent the intercooler from touching the operating cylinder during intercooler installation.**
   - **Use the urethane sheet with the size (width × height × thickness) of approx. 300 mm × approx. 200 mm × approx. 10 mm (approx. 11.81 in × approx. 7.87 in × approx. 0.39 in).**
4. Insert the intercooler into the intake duct No. 2, and temporarily tighten the clamp which secures the intake duct No. 2 to the intercooler.
   Note:
   When inserting the intercooler into the intake duct No. 2, be careful that the insulator is not turned over.
5. Insert the intercooler into the intake duct No. 3, and tighten the clamp which secures the intake duct to the intercooler.
   Note:
   When inserting the intercooler into the intake duct No. 3, be careful that the insulator is not turned over.
   Tightening torque:

3 N·m (0.3 kgf-m, 2.2 ft-lb)

6. Pull out the urethane sheet (A) between intercooler and operating cylinder. (MT model)
7. Set the intercooler stay LH to the intake manifold, and temporarily tighten the bolts which secure intercooler stay LH to the intake manifold.
8. Install the bolt which secures the intercooler to the intercooler stay.
9. Tighten the bolts which secure the intercooler stay LH to the intake manifold, and install the brake booster vacuum hose to the clip (A).

   Tightening torque:

   16 N·m (1.6 kgf-m, 11.8 ft-lb)
10. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

INTAKE (INDUCTION)(w/o STI) > Intercooler

INSPECTION

Check that the intercooler and intercooler stay have no deformation, cracks or other damages.

INTAKE (INDUCTION)(w/o STI) > Turbocharger

REMOVAL

Remove the turbo charger and front exhaust pipe as a unit. Refer to "Front Exhaust Pipe" for the removal procedure. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>DISASSEMBLY.

INTAKE (INDUCTION)(w/o STI) > Turbocharger

INSTALLATION

Refer to "Front Exhaust Pipe" for the installation procedure. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>ASSEMBLY.

INTAKE (INDUCTION)(w/o STI) > Turbocharger

DISASSEMBLY

1. Remove the union screw pipe assembly from the turbocharger.
2. Remove the turbocharger pipe from the turbocharger.
3. Remove the air control hose from the turbocharger.
4. Remove the stud bolt from the turbocharger.
5. Remove the exhaust stay from the turbocharger.

INTAKE (INDUCTION)(w/o STI) > Turbocharger

ASSEMBLY

1. Install the exhaust stay to the turbocharger.
   Tightening torque:
   7 N·m (0.7 kgf-m, 5.2 ft-lb)
2. Attach the stud bolts to the turbocharger.
   Tightening torque:
   14.7 N·m (1.5 kgf-m, 10.8 ft-lb)
3. Install the air control hose to the turbocharger.
4. Install the turbocharger pipe to the turbocharger.
   Note:
   Use a new gasket.
   Tightening torque:
   31.5 N·m (3.2 kgf-m, 23.2 ft-lb)
5. Install the union screw pipe assembly to the turbocharger.
   Note:
   Use a new gasket.
   Tightening torque:
   T1: 6.8 N·m (0.7 kgf-m, 5.1 ft-lb)
   T2: 16 N·m (1.6 kgf-m, 11.8 ft-lb)

INTAKE (INDUCTION)(w/o STI) > Turbocharger

INSPECTION

1. WASTE GATE ACTUATOR

1. Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
2. Remove the exhaust cover.
3. Remove the vacuum control hose (B) from the waste gate actuator (A) of the turbocharger, and connect the Mighty Vac to the waste gate actuator (A).

(A) Waste gate actuator (C) Control rod (D) Control rod stroke
(B) Vacuum control hose

4. Pressurize slowly with the Mighty Vac, and check the pressure when the control rod stroke (D) becomes 1±0.15 mm (0.0394±0.0059 in). If it is not within the standard, replace the turbocharger assembly.

Caution:

Do not pressurize over 112.7 kPa (1.15 kg/cm^2, 16.34 psi) to prevent damaging the waste gate actuator.

Operating pressure (control rod stroke 1±0.15 mm (0.0394±0.0059 in)):

Standard

84.0 — 88.0 kPa (0.86 — 0.90 kg/cm^2, 12.18 — 12.76 psi)

5. After inspection, install the related parts in the reverse order of removal.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

2. OTHER INSPECTIONS

1. Check that the turbocharger and pipe have no deformation, cracks or other damages.
2. Check that the hose has no cracks, damage or loose part.
3. Check that there are no oil leakage or water leakage from the pipe attachment section.

INTAKE (INDUCTION)(w/o STI) > Oil Catch Tank

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Unlock the blow-by diagnosis connector, and disconnect the PCV hose assembly No. 2 from the PCV hose assembly No. 1.
4. Lift up the vehicle.
5. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
6. Disconnect the oil hose from the oil pipe, and drain the engine oil in the oil catch tank.
   Note:
   Prepare the container for draining of engine oil.
7. Remove bolts which secure the oil catch tank to the turbocharger and exhaust stay, and remove the oil catch tank.
8. Remove the oil hose from the oil catch tank.

INTAKE (INDUCTION)(w/o STI) > Oil Catch Tank

INSTALLATION

1. Install the oil hose to the oil catch tank.
   Note:
   Use a new oil hose.
2. Install the oil catch tank to the turbocharger and exhaust stay.
   (1) Set the oil catch tank to the turbocharger, and temporarily tighten the bolts which secure the oil catch tank to the turbocharger and exhaust stay.
   Note:
   Use a new gasket.
   (2) Tighten the bolts which secure the oil catch tank to the turbocharger and exhaust stay in numerical order as shown in the figure.
   Tightening torque:
   T1: 7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
   T2: 10.5 N·m (1.1 kgf-m, 7.7 ft-lb)
3. Connect the oil hose to the oil pipe.
4. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
5. Lower the vehicle.
6. Connect the PCV hose assembly No. 2 to the PCV hose assembly No. 1.
   Note:
   - **There are multiple blow-by diagnosis connectors. Be careful not to connect incorrectly.**
   - **Make sure that the blow-by diagnosis connector is connected securely.**
7. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
8. Check the engine oil level and replenish the engine oil if necessary. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.
9. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

INTAKE (INDUCTION)(w/o STI) > Oil Catch Tank

DISASSEMBLY

1. Remove the PCV hose assembly No. 2. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>PCV Hose Assembly>REPLACEMENT > PCV HOSE ASSY NO. 2.

INTAKE (INDUCTION)(w/o STI) > Oil Catch Tank

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

7 N·m (0.7 kgf-m, 5.2 ft-lb)

INTAKE (INDUCTION)(w/o STI) > Oil Catch Tank

INSPECTION

1. Check that the oil catch tank does not have deformation, cracks or damage.
2. Check that the PCV hose and oil hose have no cracks, damage or loose part.

INTAKE (INDUCTION)(w/o STI) > Scavenge Pump

REMOVAL

Refer to “Scavenge Pump” for removal procedure of scavenge pump. Ref. to LUBRICATION(w/o STI)>Scavenge Pump>REMOVAL.

INTAKE (INDUCTION)(w/o STI) > Scavenge Pump

INSTALLATION

Refer to “Scavenge Pump” for installation procedure of scavenge pump. Ref. to LUBRICATION(w/o STI)>Scavenge Pump>INSTALLATION.

INTAKE (INDUCTION)(w/o STI) > Scavenge Pump

INSPECTION

Refer to “Scavenge Pump” for inspection procedure of scavenge pump. Ref. to LUBRICATION(w/o STI)>Scavenge Pump>INSPECTION.

REMOVAL

1. Remove the intake duct No. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 1.
2. Disconnect the vacuum hose from the air by-pass valve, and remove the air by-pass valve from the intake duct No. 2.

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

3 N·m (0.3 kgf-m, 2.2 ft-lb)

INSPECTION

1. AIR BY-PASS VALVE

1. Check that the air by-pass valve has no deformation, cracks or other damages.
2. Connect the Mighty Vac to the nipple (A) of the air by-pass valve.
3. Using the Mighty Vac, generate the vacuum pressure to −93.3 kPa (−0.95 kg/cm^2, −13.5 psi). Check that the Mighty Vac gauge needle indication holds 10 seconds without dropping down to lower than −92.6 kPa (−0.94 kg/cm^2, −13.4 psi).
4. Set a dial gauge to the end of valve rod of the air by-pass valve.
5. Using the Mighty Vac, generate the vacuum pressure, and check the pressure when dial gauge needle (valve stroke) shows 0.5 mm (0.02 in). If it is not within the standard, replace the air by-pass valve.

   Opening pressure (valve stroke 0.5 mm (0.02 in)):

   Standard

   −13.3 — −21.3 kPa (−0.14 — −0.22 kg/cm^2, −1.93 — −3.09 psi)

2. OTHER INSPECTIONS

Check that the vacuum hose and air by-pass pipe have no cracks, damage or loose part.

MECHANICAL(w/o STI)

ME(w/o STI)

1. General Description
2. Compression
3. Idle Speed
4. Ignition Timing
5. Intake Manifold Vacuum
6. Engine Oil Pressure
7. Fuel Pressure
8. Cam Clearance
9. Engine Assembly
10. Engine Mounting
11. Preparation for Overhaul
12. V-belt
13. Crank Pulley
14. Chain Cover
15. Timing Chain Assembly
16. Cam Sprocket
17. Crank Sprocket
18. Rocker Cover
19. Camshaft
20. Cam Carrier
21. Cylinder Head
22. Cylinder Block
23. Intake and Exhaust Valve
24. Piston
25. Connecting Rod
26. Crankshaft
27. Symptoms and causes
28. Engine Noise

SPECIFICATION

Engine	Model				2.0 L
	Cylinder arrangement				Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine
	Valve system mechanism				Chain driven, double overhead camshaft, 4-valve/cylinder
	Bore × Stroke	mm (in)			86.0 × 86.0 (3.39 × 3.39)
	Displacement	cm^3 (cu in)			1,998 (122)
	Compression ratio				10.6
	Compression pressure (at 200 — 300 r/min)	kPa (kg/cm^2, psi)		Standard	1,350 — 1,750 (14 — 18, 196 — 254)
	Number of piston rings				Compression ring: 2 Oil ring: 1
	Intake valve timing		Open	Max. retard	ATDC 26°
				Min. advance	BTDC 42°
			Close	Max. retard	ABDC 82°
				Min. advance	ABDC 14°
	Exhaust valve timing		Open	Max. retard	BBDC 11°
				Min. advance	BBDC 66°
			Close	Max. retard	ATDC 55°
				Min. advance	ATDC 0°
	Cam clearance	mm (in)	Intake	Standard	$0.13^{+0.02}_{-0.03}$ $(0.0051^{+0.0008}_{-0.0012})$

		Exhaust		Standard	0.22±0.02 (0.0087±0.0008)
	Idle speed (For CVT model, select lever in "P" or "N" range. For MT model, gear shift lever in neutral position.) r/min	No load		Standard	700±100
		A/C ON		Standard	700 — 865±50
	Ignition order				1 → 3 → 2 → 4
	Ignition timing BTDC/{r/min}			Standard	CVT model: 8°±10°/700
					MT model: 6°±10°/700

Note:
OS: Oversize US: Undersize

Camshaft	Bending mm (in)			Limit	0.020 (0.0008)
	Cam lobe height mm (in)	Intake	Valve drive section	Standard	40.34 — 40.44 (1.5882 — 1.5921)
			Fuel pump drive section	Standard	41.95 — 42.05 (1.6516 — 1.6555)
		Exhaust		Standard	40.20 — 40.30 (1.5827 — 1.5866)
	Cam base circle diameter mm (in)			Standard	34.0 (1.3386)
	Journal outer diameter mm (in)			Standard	25.946 — 25.963 (1.0215 — 1.0222)
	Thrust clearance mm (in)			Standard	0.068 — 0.116 (0.0027 — 0.0047)
	Oil clearance mm (in)			Standard	0.037 — 0.072 (0.0015 — 0.0028)
Cylinder head	Warpage (mating surface with cylinder block) mm (in)			Limit	0.020 (0.0008)
	Grinding limit mm (in)				To 98.4 (3.8740)
	Height mm (in)			Standard	98.5 (3.8779)
Valve & valve guide	Valve overall length mm (in)		Intake		104.95 (4.1319)
			Exhaust		97.9 (3.8543)
	Valve head edge thickness mm (in)		Intake	Standard	0.8 — 1.2 (0.0315 — 0.0472)
			Exhaust	Standard	1.0 — 1.4 (0.0394 — 0.0551)
	Valve stem outer diameter mm (in)		Intake	Standard	5.455 — 5.470 (0.2148 — 0.2154)
			Exhaust	Standard	5.445 — 5.460 (0.2144 — 0.2150)

	Valve guide inner diameter			mm (in)	Standard	5.500 — 5.512 (0.2165 — 0.2170)
	Clearance between valve and valve guide	mm (in)	Intake		Standard	0.030 — 0.057 (0.0012 — 0.0022)
			Exhaust		Standard	0.040 — 0.067 (0.0016 — 0.0026)
	Valve guide protrusion amount			mm (in)	Standard	11.4 — 11.8 (0.4488 — 0.4646)
Valve & valve shim	Valve stem end outer diameter	mm (in)	Intake		Standard	5.455 — 5.470 (0.2148 — 0.2154)
			Exhaust		Standard	5.445 — 5.460 (0.2144 — 0.2150)
	Valve shim inner diameter			mm (in)	Standard	5.500 — 5.560 (0.2165 — 0.2189)
	Clearance between valve and valve shim	mm (in)	Intake		Standard	0.030 — 0.105 (0.0012 — 0.0041)
			Exhaust		Standard	0.040 — 0.115 (0.0016 — 0.0045)
Valve seat	Seating width between valve and valve seat	mm (in)	Intake		Standard	0.8 — 1.6 (0.0315 — 0.0630)
			Exhaust		Standard	1.1 — 1.7 (0.0433 — 0.0669)
	Seating angle between valve and valve seat					45°
	Seating position between valve and valve seat					Valve face center
Valve spring	Free length (reference)			mm (in)	Standard	CVT model: 41.68 (1.6409)
						MT model: 41.06 (1.6165)
	Tension/spring height	N (kgf, lb)/mm (in)	Set		Standard	182 — 210 (18.56 — 21.41, 40.92 — 47.22)/33.0 (1.2992)
			Lift		Standard	CVT model: 502 — 554 (51.19 — 56.49, 112.87 — 124.56)/22.0 (0.8661)
						MT model: 552 — 610 (56.29 — 62.20, 124.11 — 137.15)/22.0 (0.8661)
	Squareness				Standard	2.5°, 1.8 mm (0.0709 in) or less
Cylinder block & piston	Cylinder block warpage (Mating surface with cylinder head)			mm (in)	Limit	0.025 (0.0010)
	Grinding limit of cylinder block			mm (in)		To 204.9 (8.0669)
	Height of cylinder block			mm (in)	Standard	205.0 (8.0709)

	Inner diameter of cylinder liner mm (in)		Cylinder bore size mark A	Standard	86.005 — 86.015 (3.3860 — 3.3864)
			Cylinder bore size mark B	Standard	85.995 — 86.005 (3.3856 — 3.3860)
	Cylindricality of cylinder liner mm (in)			Limit	0.030 (0.0012)
	Out-of-roundness of cylinder liner mm (in)			Limit	0.030 (0.0012)
	Piston grade point mm (in)				40.0 (1.5748)
	Piston outer diameter mm (in)	Standard Size	Grade A	Standard	85.985 — 85.995 (3.3852 — 3.3856)
			Grade B	Standard	85.975 — 85.985 (3.3848 — 3.3852)
		0.25 (0.0098) OS		Standard	86.225 — 86.245 (3.3947 — 3.3955)
		0.50 (0.0197) OS		Standard	86.475 — 86.495 (3.4045 — 3.4053)
	Clearance between cylinder liner and piston mm (in)			Standard	0.010 — 0.030 (0.0004 — 0.0012)
	Inner diameter of cylinder liner boring limit (diameter) mm (in)				To 86.505 (3.4057)
Piston and piston pin	Degree of fit				Piston pin must be fitted into position with thumb at 20°C (68°F).
	Clearance between piston and piston pin mm (in)			Standard	0.004 — 0.008 (0.0002 — 0.0003)
Piston ring	Closed gap mm (in)	Compression ring	Top ring	Standard	0.20 — 0.25 (0.0079 — 0.0098)
			Second ring	Standard	0.40 — 0.50 (0.0157 — 0.0197)
		Oil ring (Upper rail and lower rail)		Standard	0.10 — 0.35 (0.0039 — 0.0138)
	Clearance between compression ring and piston mm (in)		Top ring	Standard	0.040 — 0.080 (0.0016 — 0.0031)
			Second ring	Standard	0.045 — 0.085 (0.0018 — 0.0033)
Connecting rod and	Bend or twist per 100 mm (3.9370 in) in length mm (in)			Limit	0.10 (0.0039)

connecting rod bearing	Thrust clearance			Standard	0.070 — 0.330 (0.0028 — 0.0130)
	Connecting rod bearing thickness (at center) mm (in)		Standard size	Standard	1.492 — 1.508 (0.0587 — 0.0594)
			0.03 (0.0012) US	Standard	1.511 — 1.515 (0.0595 — 0.0596)
			0.05 (0.0020) US	Standard	1.521 — 1.525 (0.0599 — 0.0600)
			0.25 (0.0098) US	Standard	1.621 — 1.625 (0.0638 — 0.0640)
	Oil clearance			Standard	0.025 — 0.055 (0.0010 — 0.0022)
Piston pin & connecting rod bushing	Clearance between piston pin and connecting rod bushing			Standard	0.004 — 0.026 (0.0002 — 0.0010)
Crankshaft and crankshaft bearing	Bending			Limit	0.035 (0.0014)
	Crankshaft pin	Cylindricality		Limit	0.006 (0.0002)
		Out-of-roundness		Limit	0.005 (0.0002)
		Grinding limit (dia.)			To 49.726 (1.9577)
	Crankshaft journal	Cylindricality		Limit	0.006 (0.0002)
		Out-of-roundness		Limit	0.005 (0.0002)
		Grinding limit (dia.)			To 67.735 (2.6667)
	Crankshaft pin outer diameter mm (in)		Standard size	Standard	49.976 — 50.000 (1.9676 — 1.9685)
			0.03 (0.0012) US	Standard	49.946 — 49.970 (1.9664 — 1.9673)
			0.05 (0.0020) US	Standard	49.926 — 49.950 (1.9656 — 1.9665)

			0.25 (0.0098) US	Standard	49.726 — 49.750 (1.9577 — 1.9587)
	Crankshaft journal outer diameter mm (in)		Standard size	Standard	67.985 — 68.003 (2.6766 — 2.6773)
			0.03 (0.0012) US	Standard	67.955 — 67.979 (2.6754 — 2.6763)
			0.05 (0.0020) US	Standard	67.935 — 67.959 (2.6746 — 2.6755)
			0.25 (0.0098) US	Standard	67.735 — 67.759 (2.6667 — 2.6677)
	Crankshaft bearing thickness (at center) mm (in)	#1, #2, #3, #4	Standard size	Standard	2.498 — 2.513 (0.0983 — 0.0989)
			0.03 (0.0012) US	Standard	2.519 — 2.522 (0.0992 — 0.0993)
			0.05 (0.0020) US	Standard	2.529 — 2.532 (0.0996 — 0.0997)
			0.25 (0.0098) US	Standard	2.629 — 2.632 (0.1035 — 0.1036)
		#5	Standard size	Standard	2.496 — 2.511 (0.0983 — 0.0989)
			0.03 (0.0012) US	Standard	2.517 — 2.520 (0.0991 — 0.0992)
			0.05 (0.0020) US	Standard	2.527 — 2.530 (0.0995 — 0.0996)
			0.25 (0.0098) US	Standard	2.627 — 2.630 (0.1034 — 0.1035)
	Thrust clearance mm (in)			Standard	0.130 — 0.308 (0.0051 — 0.0121)
	Oil clearance mm (in)			Standard	0.013 — 0.031 (0.0005 — 0.0012)

1. CRANK PULLEY

(1) Crank pulley

Tightening torque: N·m (kgf-m, ft-lb)

T: ***Ref. to MECHANICAL(w/o STI)>Crank Pulley>INSTALLATION.***

2. TIMING CHAIN & CAMSHAFT

(1) Intake camshaft RH
(2) Exhaust camshaft RH
(3) Intake cam sprocket RH
(4) Exhaust cam sprocket RH
(5) Timing chain
(6) Chain guide A
(7) Chain tension lever
(8) Chain tensioner RH
(9) Crank sprocket
(10) O-ring
(11) Chain tensioner LH
(12) Intake cam sprocket LH
(13) Exhaust cam sprocket LH
(14) Intake camshaft LH
(15) Exhaust camshaft LH
(16) Chain guide B
(17) Chain guide C
(18) Chain guide D

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 8.5 (0.9, 6.3)
T3: 18 (1.8, 13.3)

3. CHAIN COVER

(1) Oil filler cap
(2) Gasket
(3) Camshaft position sensor
(4) O-ring
(5) Chain cover
(6) Oil control solenoid
(7) Back-up ring
(8) O-ring
(9) Engine oil temperature sensor
(10) Gasket
(11) Oil pressure switch
(12) Front oil seal
(13) Oil level gauge
(14) O-ring
(15) Oil level gauge guide
(16) O-ring
(17) O-ring
(18) O-ring

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 18 (1.8, 13.3)
T3: ***Ref. to MECHANICAL(w/o STI)>Chain Cover>INSTALLATION.***

4. ROCKER COVER

(1) Rocker cover RH
(2) Rocker cover gasket RH
(3) Rocker cover gasket LH
(4) Rocker cover LH

Tightening torque: N·m (kgf-m, ft-lb)

T: ***Ref. to MECHANICAL(w/o STI)>Rocker Cover>INSTALLATION.***

5. CAM CARRIER

(1) Cam carrier ASSY RH
(2) Front camshaft cap RH
(3) Intake center camshaft cap RH
(4) Exhaust center camshaft cap RH
(5) Intake rear camshaft cap RH
(6) Exhaust rear camshaft cap RH
(7) Cam carrier RH
(8) Filter
(9) Oil pipe
(10) Gasket
(11) Cam carrier ASSY LH
(12) Cam carrier LH
(13) Front camshaft cap LH
(14) Intake center camshaft cap LH
(15) Exhaust center camshaft cap LH
(16) Intake rear camshaft cap LH
(17) Exhaust rear camshaft cap LH

Tightening torque: N·m (kgf-m, ft-lb)

T1: ***Ref. to MECHANICAL(w/o STI)>Cam Carrier>ASSEMBLY > CAM CARRIER RH.***

T2: ***Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION.***

T3: ***Ref. to MECHANICAL(w/o STI)>Cam Carrier>ASSEMBLY.***

6. CYLINDER HEAD

(1) Spark plug pipe gasket
(2) O-ring
(3) Cylinder head plate
(4) Cylinder head RH
(5) Cylinder head gasket RH
(6) Cylinder head gasket LH
(7) Cylinder head LH

Tightening torque: N·m (kgf-m, ft-lb)

T: ***Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSTALLATION.***

7. VALVE ASSY

(1) Exhaust valve
(2) Intake valve
(3) Intake valve guide
(4) Valve spring seat
(5) Intake valve oil seal
(6) Valve spring
(7) Valve spring retainer
(8) Valve collet
(9) Valve shim
(10) Roller rocker arm pivot
(11) Roller rocker arm
(12) Exhaust valve guide
(13) Exhaust valve oil seal

8. CYLINDER BLOCK 1

(1) Engine rear hanger
(2) Oil separator cover
(3) Cylinder block plug
(4) Main gallery plug
(5) O-ring
(6) Rear oil seal
(7) Crankshaft position sensor holder
(8) Cylinder block plate

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 21 (2.1, 15.5)
T3: 25 (2.5, 18.4)
T4: Ref. to MECHANICAL(w/o STI)>Cylinder Block>ASSEMBLY > CYLINDER BLOCK.

9. CYLINDER BLOCK 2

(1) Cylinder block ASSY
(2) Washer
(3) Cylinder block RH
(4) Cylinder block LH

Tightening torque: N·m (kgf-m, ft-lb)

T: Ref. to MECHANICAL(w/o STI)>Cylinder Block>INSTALLATION.

10. CRANKSHAFT AND PISTON

(1) Reinforcement drive plate (CVT model)
(2) Drive plate (CVT model)
(3) Flywheel (MT model)
(4) Crankshaft position sensor plate
(5) Top ring
(6) Second ring
(7) Oil ring
(8) Piston RH
(9) Circlip
(10) Piston pin
(11) Connecting rod cap bolt
(12) Connecting rod
(13) Connecting rod bearing
(14) Connecting rod cap
(15) Piston LH
(16) Crankshaft
(17) Woodruff key
(18) Crankshaft bearing #1, #3
(19) Crankshaft bearing #2, #4
(20) Crankshaft bearing #5

Tightening torque: N·m (kgf-m, ft-lb)

T1: Ref. to MECHANICAL(w/o STI)>Cylinder Block>INSTALLATION.
T2: Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>INSTALLATION.
T3: Ref. to CLUTCH SYSTEM>Flywheel>INSTALLATION.

11. ENGINE MOUNTING

(1) Front cushion rubber (2) Nut

Tightening torque: N·m (kgf-m, ft-lb)
T1: 35 (3.6, 25.8)
T2: 60 (6.1, 44.3)

MECHANICAL(w/o STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove or install the engine in an area where chain hoists, lifting devices, etc. are available for ready use. When lifting up the vehicle, make sure to support the vehicle at the jack-up points.
- Be careful not to let any oil or grease contact the clutch disc or flywheel.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil when being assembled.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- Always use new application oil during work.

MECHANICAL(w/o STI) > General Description

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	498277200	STOPPER SET	Used for preventing the torque converter from falling when removing and installing the engine. (CVT model)

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	499765700	VALVE GUIDE REMOVER AND INSTALLER	Used for removing and installing valve guide.
	499765900	VALVE GUIDE REAMER	Used for reaming valve guides.
	18252AA000	CRANKSHAFT SOCKET	Used for rotating crankshaft.
	18261AA010	VALVE OIL SEAL GUIDE	Used for press-fitting of intake valve oil seals and exhaust valve oil seals.
	18270AA020	SOCKET	Used for removing and installing connecting rod.
	18270KA010	SOCKET	Used for installing and removing cam sprocket.
	18334AA000	PULLEY WRENCH PIN SET	• Used for removing and installing the crank pulley. • Used together with PULLEY WRENCH (18355AA000).
	18334AA020	PULLEY WRENCH PIN SET	• Used for rotating the intake cam sprocket LH. • Used for removing and installing cam sprocket. • Used together with PULLEY WRENCH (18355AA000).
	18355AA000	PULLEY WRENCH	• Used for removing and installing the crank pulley. • Used for rotating the intake cam sprocket LH. • Used for removing and installing cam sprocket. • Used together with PULLEY WRENCH PIN SET (18334AA000) or PULLEY WRENCH PIN SET (18334AA020).
	18471AA000	FUEL PIPE ADAPTER	Used for inspecting the fuel pressure.
	18632AA030	STAND ASSY	Used for removing and installing rocker cover LH.
	18657AA030	OIL SEAL INSTALLER	• Used for installing the rear oil seal of engine. • Used together with OIL SEAL GUIDE (18671AA020).
	18671AA020	OIL SEAL GUIDE	• Used for installing the rear oil seal of engine.

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
			• Used together with OIL SEAL INSTALLER (18657AA030).
	41099YC001	ST REAR MOUNT	Used for removing and installing engine. (CVT model)
	41399FG020	SPECIAL TOOL B	Used for installing the front oil seal of engine.
	42075AG690	FUEL HOSE	Used for inspecting the fuel pressure. **Note:** **This is the SUBARU genuine part.**
	42099AE000	QUICK CONNECTOR RELEASE	Used for removing FUEL HOSE (42075AG690). **Note:** **FUEL HOSE (42075AG690) is used for checking the fuel pressure.**
	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

2. GENERAL TOOL

TOOL NAME	REMARKS
Compression gauge	Used for measuring compression.
Vacuum gauge	Used for measuring intake manifold vacuum.
Oil pressure gauge	Used for measuring engine oil pressure.
Fuel pressure gauge	Used for measuring fuel pressure.
Thickness gauge	Used for various inspections.
Engine stand	Used for disassembling and assembling engine.
Angle gauge	Used for angle tightening.
Valve spring compressor	Used for removing and installing valve spring.
Piston ring compressor	Used for installing the piston into the cylinder block.
DST-i	Used together with Subaru Select Monitor 4.

INSPECTION

Caution:
After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.
Note:

- **Before checking the compression pressure, the compression condition of each cylinder can be confirmed as a guide by using the compression measurement mode in Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Active Test>OPERATION.**
- **In the compression measurement mode, the compression condition is judged by each cylinder speed. The high speed cylinder has low compression pressure and low speed cylinder has high compression pressure.**

1. After warming-up the engine, turn the ignition switch to OFF.
2. Make sure that the battery is fully charged.
3. Check the starter motor for satisfactory performance and operation.
4. Remove the fuse of fuel pump from main fuse box.
5. Start the engine and run it until it stalls.
6. After the engine stalls, crank it for five more seconds.
7. Turn the ignition switch to OFF.
8. Remove all spark plugs. Ref. to IGNITION(w/o STI)>Spark Plug>REMOVAL.
9. Install the compression gauge to the spark plug hole.
   Note:
   When using a screw-in type compression gauge, the screw should be less than 25 mm (0.98 in) long.
10. Insert the engine control module (ECM) to the bracket.
11. Install the bolt which secures the engine control module (ECM) to the bracket, and then secure the engine wiring harness and bulkhead harness to the bracket with clip (A) and clip (B).
    Tightening torque:
    7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
12. Install the battery. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>INSTALLATION.
13. Turn the ignition switch to ON.
14. Depress the accelerator pedal to full throttle.
15. Crank the engine by starter motor and read the value when the needle of the compression gauge becomes stable.
    Note:
    - **Perform at least two measurements per cylinder, and make sure that the values are correct.**
    - **If the compression pressure is out of standard, check or adjust the pistons, valves and cylinders.**

    Compression pressure:
    At 200 — 300 r/min
    Standard
    1,350 — 1,750 kPa (14 — 18 kg/cm^2, 196 — 254 psi)
    Difference between cylinders

100 kPa (1 kg/cm^2, 14 psi) or less

16. After inspection, install the related parts in the reverse order of removal.

Note:

When compression pressure is checked, the malfunction indicator light illuminates and DTC (P0087) may be stored in ECM. When the malfunction indicator light has illuminated, perform the Clear Memory Mode. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Clear Memory Mode.

INSPECTION

1. Before checking the idle speed, check the following item:
   (1) Check the air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and hoses are connected properly.
   (2) Check the malfunction indicator light does not illuminate.
2. Warm up the engine.
3. Read the engine idle speed using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA.

   Note:
   - **Idle speed cannot be adjusted manually, because the idle speed is automatically adjusted.**
   - **If idle speed is out of standard, refer to the General Diagnosis Table under "Engine Control System". Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.**

   (1) Check the idle speed when no-loaded. (Headlight, blower fan, rear defroster, radiator fan, A/C and etc. are OFF)

   Idle speed (No load, and for CVT model, select lever in "P" or "N" range, for MT model, gear shift lever in neutral position.):

   Standard

   700±100 r/min

   (2) Check the idle speed when loaded. (Turn the A/C switch to ON and operate the compressor for at least one minute before measurement.)

   Idle speed (A/C on, and for CVT model, select lever in "P" or "N" range, for MT model, gear shift lever in neutral position.):

   Standard

   700 — 865±50 r/min

INSPECTION

Caution:
After warming-up, engine becomes very hot. Be careful not to burn yourself at measurement.

1. Before checking the ignition timing, check the following item:
   (1) Check the air cleaner element is free from clogging, spark plugs are in good condition, and hoses are connected properly.
   (2) Check the malfunction indicator light does not illuminate.
2. Warm up the engine.
3. Read the ignition timing using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA.
   Note:
   If ignition timing is out of standard, check the ignition control system. Refer to "Engine Control System". Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.
   Ignition timing [BTDC/{r/min}]:
   CVT model
   Standard
   8°±10°/700
   MT model
   Standard
   6°±10°/700

INSPECTION

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Warm up the engine.
3. Disconnect the brake booster vacuum hose from the intake manifold.
4. Connect the vacuum gauge to the intake manifold.
5. Keep the engine at idle speed and read the vacuum gauge indication.

   Note:
   Condition of engine inside can be diagnosed by observing the behavior of the vacuum gauge needle as described in table below.
   Intake manifold vacuum (at idling, A/C OFF):
   Standard
   −60.0 kPa (−450 mmHg, −17.72 inHg) or more

Diagnosis of engine condition by inspection of intake manifold vacuum	
Vacuum gauge needle behavior	**Possible engine condition**
1. Needle is steady but lower than standard value. This tendency becomes more evident as engine temperature rises.	Leakage around intake manifold gasket, disconnection or damage of vacuum hose
2. Needle intermittently drops to position lower than standard value.	Leakage around cylinder
3. Needle drops suddenly and intermittently from standard value.	Sticky valve
4. When engine speed is gradually increased, needle begins to vibrate rapidly at certain speed, and then vibration increases as engine speed increases.	Weak or broken valve springs
5. Needle vibrates above and below standard value in narrow range.	Defective ignition system

6. After inspection, install the related parts in the reverse order of removal.

INSPECTION

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the oil pressure switch. Ref. to LUBRICATION(w/o STI)>Oil Pressure Switch>REMOVAL.
3. Install the oil pressure gauge to the chain cover.
4. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Start the engine, and check the oil pressure.

   Note:
   - **Standard value is based on an engine oil temperature of 80°C (176°F).**
   - **If the oil pressure is out of specification, check oil pump, oil filter and lubrication line. Ref. to LUBRICATION(w/o STI)>Engine Lubrication System Trouble in General>INSPECTION.**
   - **If the oil pressure warning light is ON and oil pressure is within standard, check the oil pressure switch. Ref. to LUBRICATION(w/o STI)>Engine Lubrication System Trouble in General>INSPECTION.**

   Engine oil pressure:

   Idle speed (No load, and for CVT model, select lever in "P" or "N" range. For MT model, gear shift lever in neutral position.)

   Standard

   65 kPa (0.7 kg/cm^2, 9.4 psi) or more

   At 3,000 r/min

   Standard

   324 kPa (3.3 kg/cm^2, 47 psi) or more
6. After inspection, install the related parts in the reverse order of removal.

INSPECTION

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
3. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
4. Disconnect the fuel delivery tube from the fuel delivery pipe, and connect the fuel pressure gauge.
   Caution:
   - **Be careful not to spill fuel.**
   - **Catch the fuel from the tubes using a container or cloth.**

   (1) Disconnect the quick connector on the fuel delivery tube from the fuel pipe assembly, and remove the clip (A) securing the fuel delivery tube to the fuel pipe assembly.
   Note:
   Disconnect the quick connector as shown in the figure.

   (a) Slider

   (2) Connect the fuel pressure gauge with ST1 and ST2.
   Caution:
   - **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
   - **When connecting the quick connector with slider, make sure to insert it all the way in before locking the slider.**
   - **When it is difficult to lock the slider, check that the connector is fully inserted.**
   - **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

   Note:
   - **ST1 is a SUBARU genuine part.**
   - **When connecting the ST2 to the quick connector on the fuel delivery tube, connect as shown in the figure.**

   (a) Slider

ST1	**42075AG690**	**FUEL HOSE**
ST2	**18471AA000**	**FUEL PIPE ADAPTER**

5. Start the engine.
6. Check the fuel pressure after warming up the engine.
   Note:
   - **The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kg/cm^2, 1 to 3 psi) higher than standard values during high-altitude operations.**
   - **Check or replace the fuel pump and fuel delivery line if the fuel pressure is out of the standard.**

   Fuel pressure:

Standard

340 — 400 kPa (3.5 — 4.1 kg/cm^2, 49 — 58 psi)

7. After inspection, install the related parts in the reverse order of removal.

Caution:

- **Before removing the fuel pressure gauge, release the fuel pressure.**
- **Be careful not to spill fuel.**
- **Catch the fuel from hoses and tubes using a container or cloth.**
- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector with slider, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

- **When disconnecting the ST1, install the ST2 to the fuel pipe assembly, and press the ST2 in the direction of arrow to disconnect the quick connector on the ST1.**

ST1	**42075AG690**	**FUEL HOSE**
ST2	**42099AE000**	**QUICK CONNECTOR RELEASE**

- **Disconnect the quick connector on the fuel delivery tube as shown in the figure.**

(a) Slider

- **Connect the quick connector on the fuel delivery tube as shown in the figure.**

(a) Slider

INSPECTION

1. WHEN TIMING CHAIN ASSEMBLY IS NOT REMOVED

Caution:
When working on the vehicle, if engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.
Note:

- **Inspection of cam clearance should be performed while engine is cold.**
- **If the engine is removed from vehicle, performing the steps 1) to 2) is not necessary.**

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
3. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL.
4. When inspecting #1 and #3 cylinders
   (1) Remove the rocker cover RH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>REMOVAL > ROCKER COVER RH.
   Note:
   When working on the vehicle, place a suitable container under the vehicle.
   (2) Set #1 cylinder piston to top dead center of compression stroke by rotating the crank pulley clockwise using the socket wrench.
   Note:
   When the timing mark (B) on crank pulley is aligned to the 0° in timing gauge (A) on chain cover as shown in the figure, the #1 cylinder piston is located at TDC of compression stroke if the intake camshaft and exhaust camshaft does not depress the #1 cylinder intake side roller rocker arm (intake valve) and exhaust side roller rocker arm (exhaust valve). If roller rocker arm (valve) is depressed, turn the crank pulley by 360° in order to make #1 cylinder piston at TDC of compression stroke.
   (3) Check the cam clearance for #1 cylinder intake, #1 cylinder exhaust and #3 cylinder exhaust.
   Note:
   - **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
   - **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

   Cam clearance:
   Intake
   Standard
   $0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)
   Exhaust
   Standard
   0.22±0.02 mm (0.0087±0.0008 in)
   (4) Turn the crank pulley by 360°.
   (5) Check the cam clearance of #3 cylinder intake.

Note:

- **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
- **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

Cam clearance:

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

5. When inspecting #2 and #4 cylinders

(1) Remove the rocker cover LH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>REMOVAL > ROCKER COVER LH.

Note:

When working on the vehicle, place a suitable container under the vehicle.

(2) Set #2 cylinder piston to top dead center of compression stroke by rotating the crank pulley clockwise using the socket wrench.

Note:

When the timing mark (B) on crank pulley is aligned to the 0° in timing gauge (A) on chain cover as shown in the figure, the #2 cylinder piston is located at TDC of compression stroke if the intake camshaft and exhaust camshaft does not depress the #2 cylinder intake side roller rocker arm (intake valve) and exhaust side roller rocker arm (exhaust valve). If roller rocker arm (valve) is depressed, turn the crank pulley by 360° in order to make #2 cylinder piston at TDC of compression stroke.

(3) Check the cam clearance for #2 cylinder intake, #2 cylinder exhaust and #4 cylinder exhaust.

Note:

- **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
- **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22±0.02 mm (0.0087±0.0008 in)

(4) Turn the crank pulley by 360°.

(5) Check the cam clearance of #4 cylinder intake.

Note:

- **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
- **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

Cam clearance:

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

6. If necessary, adjust the cam clearance. Ref. to MECHANICAL(w/o STI)>Cam Clearance>ADJUSTMENT.
7. After inspection, install the related parts in the reverse order of removal.

2. WHEN TIMING CHAIN ASSEMBLY IS REMOVED

Note:
Inspection of cam clearance should be performed while engine is cold.

1. When inspecting #1 and #3 cylinders
   (1) Remove the rocker cover RH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>REMOVAL > ROCKER COVER RH.
   Note:
   When working on the vehicle, place a suitable container under the vehicle.
   (2) Check the #1 and #3 cylinder cam clearance.
   Caution:
   Intake and exhaust camshafts can be independently rotated with the timing chain removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero lift (cam base circle position) (in range where it can be turned lightly by hand).
   Note:
   - **For cam clearance inspection, adjust the cam base circle position so that the thickness gauge (A) can be inserted easily by hand turning the camshaft (cam sprocket) to be measured.**
   - **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
   - **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

   Cam clearance:
   Intake
   Standard
   $0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)
   Exhaust
   Standard
   0.22±0.02 mm (0.0087±0.0008 in)
2. When inspecting #2 and #4 cylinders
   (1) Remove the rocker cover LH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>REMOVAL > ROCKER COVER LH.
   Note:
   When working on the vehicle, place a suitable container under the vehicle.
   (2) Check the #2 and #4 cylinder cam clearance.

Caution:
Intake and exhaust camshafts can be independently rotated with the timing chain removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero lift (cam base circle position) (in range where it can be turned lightly by hand).
Note:

- **Because the intake camshaft is pressurized by the high-pressure fuel pump, it is almost impossible to turn the intake camshaft lightly by hand. Since the zero-lift position is adjusted at the removal of the timing chain LH, measure the cam clearance at that position.**
- **For cam clearance inspection on exhaust side, adjust the cam base circle position so that the thickness gauge (A) can be inserted easily by hand turning the exhaust camshaft (cam sprocket).**
- **Measure the roller surface of cam base circle and roller rocker arm using thickness gauge (A).**
- **If the measured value is out of standard, take notes of the value in order to adjust the cam clearance later on.**

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22±0.02 mm (0.0087±0.0008 in)

3. If necessary, adjust the cam clearance. Ref. to MECHANICAL(w/o STI)>Cam Clearance>ADJUSTMENT.
4. After inspection, install the related parts in the reverse order of removal.

MECHANICAL(w/o STI) > Cam Clearance

ADJUSTMENT

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the chain cover. Ref. to MECHANICAL(w/o STI)>Chain Cover>REMOVAL.
3. When adjusting #1 and #3 cylinders
   (1) Remove the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
   (2) Remove the cam carrier RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>REMOVAL > CAM CARRIER RH.
   (3) Measure the thickness of valve shim using micrometer.
   Note:
   Measurement should be performed at a temperature of 20°C (68°F).
   (4) Select a valve shim of suitable thickness using the measured cam clearance and valve shim thickness.

Note:
Use a new valve shim.

Intake side: S = T + 1.69 × (V − 0.13 mm (0.0051 in)) Exhaust side: S = T + 1.87 × (V − 0.22 mm (0.0087 in))
S: Valve shim thickness required V: Measured cam clearance T: Current valve shim thickness

(5) Install the cam carrier RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER RH.

(6) Check all the cam clearance of RH side at this time. If the cam clearance is not within the standard value, repeat the procedure over again from step (2).

Note:
When the removing/installing of cam carrier RH has been performed, cam clearance may be outside the standard value. Checking of all cam clearance of RH side is necessary. Refer to INSPECTION of "Cam Clearance" for the cam clearance inspection.
Ref. to MECHANICAL(w/o STI)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22±0.02 mm (0.0087±0.0008 in)

4. When adjusting #2 and #4 cylinders

(1) Remove the timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN LH.

(2) Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.

(3) Remove the cam carrier LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>REMOVAL > CAM CARRIER LH.

(4) Measure the thickness of valve shim using micrometer.

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

(5) Select a valve shim of suitable thickness using the measured cam clearance and valve shim thickness.

Note:
Use a new valve shim.

Intake side: S = T + 1.69 × (V − 0.13 mm (0.0051 in)) Exhaust side: S = T + 1.87 × (V − 0.22 mm (0.0087 in))
S: Valve shim thickness required V: Measured cam clearance T: Current valve shim thickness

(6) Install the cam carrier LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER LH.

(7) Check all the cam clearance of LH side at this time. If the cam clearance is not within the standard value, repeat the procedure over again from step (3).

Note:

When the removing/installing of cam carrier LH has been performed, cam clearance may be outside the standard value. Checking of all cam clearance of LH side is necessary. Refer to INSPECTION of "Cam Clearance" for the cam clearance inspection.

Ref. to MECHANICAL(w/o STI)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.

Cam clearance:

Intake

Standard

$0.13^{+0.02}_{-0.03}$ mm ($0.0051^{+0.0008}_{-0.0012}$ in)

Exhaust

Standard

0.22±0.02 mm (0.0087±0.0008 in)

5. After adjustment, install the related parts in the reverse order of removal.

REMOVAL

1. Remove the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>DISASSEMBLY.
2. Fully open the front hood. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
3. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
4. Collect the refrigerant from A/C system. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Recovery Procedure.
5. Release the fuel pressure. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel>PROCEDURE > RELEASING OF FUEL PRESSURE.
6. Open the fuel filler lid and remove the fuel filler cap.
   Note:
   This operation is required to release the inner pressure of the fuel tank.
7. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
8. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
9. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
10. Remove the ECM. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
11. Remove the intake duct No. 1 and intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 2.
12. Remove the radiator. Ref. to COOLING(w/o STI)>Radiator>REMOVAL.
13. Disconnect sections (A) and (B) of the brake booster vacuum hose from the brake vacuum pump and intake manifold, and remove the brake booster vacuum hose from the clip (C).
14. Remove the brake booster vacuum hose from the clip (D), and place the brake booster vacuum hose aside so that it does not interfere with the work.
15. Disconnect the bulkhead harness connectors from the engine wiring harness connectors.
16. Disconnect the connector (A) from the brake vacuum pump.
17. Disconnect connector (B) and terminal (C) from the generator, and remove the clip (D) securing the generator cord to the intake manifold.
18. Disconnect connector (A) from A/C compressor, and remove the generator cord from clip (B).
19. Remove the clip (C) securing the generator cord to the fuel pipe protector, and move the generator cord aside so that it does not interfere with the work.
20. Remove the bolts securing the hose - pressure suction and the hose - pressure discharge to the A/C compressor, and disconnect the hose - pressure suction and the hose - pressure discharge from the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Hose and Pipe>REMOVAL.
21. Disconnect the heater inlet hose (A) from the water pipe assembly, and disconnect the heater outlet hose (B) from the water pipe LH.
22. Disconnect the engine coolant inlet hose and engine coolant outlet hose from the CVTF cooler (with warmer feature) and EGR cooler. (CVT model)
23. Remove the pitching stopper.
24. Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
25. Set the transmission jack to the transmission. (CVT model)

Note:
Be careful that the support plate of transmission jack does not touch the transmission oil pan.

26. Remove the rear crossmember and attach the ST. (CVT model)

ST 41099YC001 ST REAR MOUNT

Tightening torque:
T1: 35 N·m (3.6 kgf-m, 25.8 ft-lb)
T2: 70 N·m (7.1 kgf-m, 51.6 ft-lb)

27. Remove the transmission jack. (CVT model)

28. Disconnect the ground cable from the oil pipe assembly.

29. Remove the lower bolt securing the CVTF cooler (with warmer feature) to the CVT. (CVT model)

30. Remove the bolts and nuts which hold the lower side of transmission to the engine.
- CVT model
- MT model

31. Remove the nuts which secure the engine mounting to the front crossmember.

32. Lower the vehicle.

33. Remove the starter. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Starter>REMOVAL.

34. Separate the torque converter assembly from the drive plate. (CVT model)
(1) Remove the service hole plug.
(2) Insert the wrench into the crank pulley bolt, and rotate the crank pulley to remove the four bolts securing the torque converter assembly to the drive plate.
(3) Attach the ST to the converter case.

ST 498277200 STOPPER SET

35. Remove the clip (A) securing the bulkhead harness to the CVTF cooler (with warmer feature). (CVT model)

36. Remove the upper bolt securing the CVTF cooler (with warmer feature) to the CVT, and move the CVTF cooler (with warmer feature) at the locations that do not interfere operation. (CVT model)

37. Remove the bolt (A) securing the transmission harness stay to the CVT. (CVT model)
Note:
This procedure is required to prevent the transmission connector from touching the A/C pressure hose during engine removal/installation.

38. Remove the air breather hose from the clip (B), and then remove the clip (B) from the pitching stopper bracket. (CVT model)
Note:
This procedure is required to prevent the clip from touching the A/C pressure hose during engine removal/installation.

39. Disconnect the fuel delivery tube and evaporation hose.
Caution:
- **Be careful not to spill fuel.**
- **Catch the fuel from the tubes using a container or cloth.**

(1) Disconnect the quick connector on the fuel delivery tube from the fuel pipe assembly, and remove the clip (A) securing the fuel delivery tube.

Note:
Disconnect the quick connector as shown in the figure.

(a) Slider

(2) Disconnect the evaporation hose from the fuel pipe assembly.

40. Separate the engine and transmission.

Caution:
Before removing the engine away from transmission, check to be sure no work has been overlooked.

(1) Support the engine with a lifting device and wire ropes.

(2) Support the transmission with a garage jack.

Caution:
Be sure to perform this procedure to prevent the transmission from lowering by its own weight.

(A) Transmission (B) Garage jack

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

- CVT model
- MT model

41. Set the cushioning material such as a waste cloth between pitching stopper bracket and transmission case cover. (CVT model)

Note:

- **This operation is required to prevent damage to the transmission case cover.**
- **Make sure that the height of cushioning material does not become 15 — 20 mm (0.6 — 0.8 in) or less when it is crushed.**

42. Remove the engine from the vehicle.

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

(1) Slightly raise the engine.

(2) Raise the transmission with garage jack.

(3) Move the engine horizontally until engine is withdrawn from transmission. (CVT model)

(4) Move the engine horizontally until main shaft is withdrawn from clutch cover. (MT model)

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

43. Remove the engine mounting from the engine.

MECHANICAL(w/o STI) > Engine Assembly

INSTALLATION

1. Install the engine mounting onto the engine.

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

2. Apply a small amount of grease to splines of main shaft. (MT model)

Grease:
NICHIMOLY N-130 or equivalent

3. Position the engine in engine compartment and align it with transmission.

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

4. Install the bolts which hold upper side of transmission to engine.
   Tightening torque:
   50 N·m (5.1 kgf-m, 36.9 ft-lb)
   - CVT model
   - MT model
5. Remove the lifting device and wire ropes.
6. Remove the garage jack.
7. Remove the cushioning material between pitching stopper bracket and transmission case cover. (CVT model)
8. Install the clip (B) to the pitching stopper bracket, and then install the air breather hose to the clip (B). (CVT model)
9. Install the bolt (A) which secures the transmission harness stay to the CVT. (CVT model)
   Tightening torque:
   16 N·m (1.6 kgf-m, 11.8 ft-lb)
10. Install the CVTF cooler (with warmer feature) to the CVT. (CVT model)
    (1) Temporarily tighten the upper bolt which secures the CVTF cooler (with warmer feature) to the CVT.
    (2) Using clip (A), fix the bulkhead harness to the CVTF cooler (with warmer feature).
    (3) Lift up the vehicle.
    (4) Install the lower bolt which secures CVTF cooler (with warmer feature) to the CVT.
    Tightening torque:
    23 N·m (2.3 kgf-m, 17.0 ft-lb)
    (5) Lower the vehicle.
    (6) Tighten the upper bolt which secures the CVTF cooler (with warmer feature) to the CVT.
    Tightening torque:
    23 N·m (2.3 kgf-m, 17.0 ft-lb)
11. Install the torque converter assembly to the drive plate. (CVT model)
    (1) Remove the ST from converter case.
    Note:
    Be careful not to drop the ST into the converter housing when removing the ST.

    ST 498277200 STOPPER SET

    (2) Insert the wrench into the crank pulley bolt, and rotate the crank pulley to attach the four bolts securing the torque converter assembly to the drive plate.
    Note:
    Be careful not to drop bolts into the converter housing.
    Tightening torque:
    25 N·m (2.5 kgf-m, 18.4 ft-lb)
    (3) Fit the plug to service hole.
12. Install the starter. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Starter>INSTALLATION.
13. Lift up the vehicle.
14. Install the bolts and nuts which hold lower side of the transmission to engine.
    Tightening torque:

50 N·m (5.1 kgf-m, 36.9 ft-lb)

- CVT model
- MT model

15. Install the nuts which hold the engine mounting to the front crossmember.

Note:

- **Make sure that locators (a) of the engine mounting are securely inserted.**
- **Use a new nut.**

Tightening torque:

60 N·m (6.1 kgf-m, 44.3 ft-lb)

16. Connect the ground cable to the oil pipe assembly.

Tightening torque:

7 N·m (0.7 kgf-m, 5.2 ft-lb)

17. Set the transmission jack to the transmission. (CVT model)

Note:

Be careful that the support plate of transmission jack does not touch the transmission oil pan.

18. Remove the ST and install the rear crossmember. (CVT model)

ST 41099YC001 ST REAR MOUNT

Tightening torque:

T1: 18 N·m (1.8 kgf-m, 13.3 ft-lb)
T2: 35 N·m (3.6 kgf-m, 25.8 ft-lb)
T3: 70 N·m (7.1 kgf-m, 51.6 ft-lb)

19. Remove the transmission jack. (CVT model)

20. Install the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.

21. Install the pitching stopper.

Tightening torque:

T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)
T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)

22. Connect the fuel delivery tube and evaporation hose.

(1) Connect the evaporation hose to fuel pipe assembly.

(2) Connect the quick connector on the fuel delivery tube to the fuel pipe assembly, and fix the fuel delivery tube using clip (A).

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

23. Connect the engine coolant inlet hose and engine coolant outlet hose to the CVTF cooler (with warmer feature) and EGR cooler. (CVT model)
24. Connect the heater inlet hose (A) to the water pipe assembly, and connect the heater outlet hose (B) to the water pipe LH.

Note:

Be careful not to mix up the heater inlet hose and the heater outlet hose when connecting them.

(a)	Heater inlet hose	(c)	To water pipe ASSY	(e)	To heater core ASSY
(b)	Heater outlet hose	(d)	To water pipe LH	(f)	Engine coolant flow

25. Connect the hose - pressure suction and the hose - pressure discharge to the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Hose and Pipe>INSTALLATION.
26. Set the generator cord, and fix the generator cord to the fuel pipe protector using clip (C).
27. Install the generator cord to clip (B), and connect the connector (A) to A/C compressor.
28. Using clip (D), fix the generator cord to the generator cord stay, and connect the connector (B) and the terminal (C) to the generator.

Tightening torque:

15.5 N·m (1.6 kgf-m, 11.4 ft-lb)

29. Connect the connector (A) to the brake vacuum pump.
30. Connect the bulkhead harness connector to the engine wiring harness connector.
31. Install the brake booster vacuum hose to the clip (D).

Note:

If the clip is removed from the intake manifold, install the clip to the position of alignment mark ▼ of intake manifold.

32. Connect sections (A) and (B) of the brake booster vacuum hose to the brake vacuum pump and intake manifold, and install the brake booster vacuum hose to the clip (C).
33. Install the radiator. Ref. to COOLING(w/o STI)>Radiator>INSTALLATION.
34. Install the intake duct No. 1 and intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 2.
35. Install the ECM. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>INSTALLATION.
36. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
37. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
38. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
39. Charge the A/C system with refrigerant. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Refrigerant Charging Procedure>PROCEDURE.
40. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
41. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.
42. Set the front hood to the normal position. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
43. Install the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>ASSEMBLY.
44. Close the front hood.

INSPECTION

1. Check that pipes, hoses, connectors and clamps are installed firmly.
2. Check the engine coolant is at specified level.
3. Start the engine and check for exhaust gas, engine coolant, leaks of fuel, etc. Also check for noise and vibrations.

MECHANICAL(w/o STI) > Engine Mounting

REMOVAL

1. Remove the front crossmember. Ref. to FRONT SUSPENSION>Front Crossmember>REMOVAL.
2. Remove the engine mounting from the engine.

MECHANICAL(w/o STI) > Engine Mounting

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

35 N·m (3.6 kgf-m, 25.8 ft-lb)

MECHANICAL(w/o STI) > Engine Mounting

INSPECTION

Make sure that there are no cracks or other damages.

PROCEDURE

1. After engine has been removed from the vehicle, mount the engine to the engine stand while being careful of the following.
   (1) When mounting the engine stand, follow the instructions of engine stand used.
   (2) When disassembling the cylinder block, remove the following parts first, and then mount the engine stand.
      1. Remove the crankshaft position sensor plate with drive plate. (CVT model) Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>REMOVAL.
      2. Remove the clutch disc and cover. (MT model) Ref. to CLUTCH SYSTEM>Clutch Disc and Cover>REMOVAL.
      3. Remove the crankshaft position sensor plate with flywheel. (MT model) Ref. to CLUTCH SYSTEM>Flywheel>REMOVAL.
   (3) Mount the engine stand using the points shown by the arrows in the figure.
      Caution:
      Be sure to mount the engine stand at four points. Otherwise, the engine damage may occur.
      Note:
      - **For points (A), either of them can be used for mounting the engine stand.**
      - **The engine stand shown in the figure is just for reference.**
2. In this section the procedures described under each index are all connected and stated in order. The procedure for overhauling of the engine will be completed 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.

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. V-BELT

1. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
   (2) Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
2. Attach the tool to the V-belt tensioner assembly, and rotate the tool clockwise to loosen and remove the V-belt.

2. V-BELT TENSIONER ASSY

1. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL > V-BELT.
2. Remove the cap from V-belt tensioner assembly.
3. Remove the bolt securing the V-belt tensioner assembly to the generator bracket, and remove the V-belt tensioner assembly.

3. IDLER PULLEY

1. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL > V-BELT.
2. Remove the bolts which secure the idler pulley to the chain cover, and remove the idler pulley.

INSTALLATION

1. V-BELT

Install in the reverse order of removal.

Caution:

- **When reusing the V-belt, wipe off dust and water with cloth.**
- **Do not use the V-belt if there is any oil, grease or coolant on the belt.**
- **Be careful not to rub the V-belt end surface with bare hands; exposed core may cause injury.**
- **Wipe off any dust, oil and water on the groove of each pulley with cloth.**

(A) V-belt
(B) Water pump pulley
(C) Crank pulley
(D) V-belt tensioner ASSY
(E) Generator pulley
(F) Idler pulley
(G) A/C compressor pulley

2. V-BELT TENSIONER ASSY

Install in the reverse order of removal.

Note:
When installing the V-belt tensioner assembly, insert the protrusion of V-belt tensioner assembly into the hole for preventing rotation at the generator bracket.

(A) V-belt tensioner ASSY
(B) Generator bracket
(C) Hole to prevent rotation
(D) Protrusion portion

Tightening torque:
25 N·m (2.5 kgf-m, 18.4 ft-lb)

3. IDLER PULLEY

Install in the reverse order of removal.

Note:
When installing the idler pulley, be careful of the idler pulley cover direction.

(a) Idler pulley cover
(b) Protrusion (3 places)

Tightening torque:
36 N·m (3.7 kgf-m, 26.6 ft-lb)

MECHANICAL(w/o STI) > V-belt

INSPECTION

1. Check the V-belt for cracks, tear or wear.
2. Check the V-belt tensioner assembly and idler pulley for deformation, cracks or other damages.
3. Check that the V-belt ribs are securely placed on the rib grooves for each pulley.
4. Check that the V-belt tensioner assembly (C) moves in the direction of arrow (D), when the V-belt (A) is pushed and released by the area indicated by the arrow (B).
5. Start the engine and confirm that the V-belt rotates smoothly and no abnormal noise is emitted.

MECHANICAL(w/o STI) > Crank Pulley

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Remove the radiator main fan & fan motor assembly and radiator sub fan & fan motor assembly.
   Ref. to COOLING(w/o STI)>Radiator Main Fan and Fan Motor>REMOVAL. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor>REMOVAL.
2. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL > V-BELT.
3. Use the ST to lock the crank pulley, and remove the crank pulley bolt.
   Note:
   To prevent damaging ST1, attach the ST2 onto the ST1 as shown.

ST1	**18355AA000**	**PULLEY WRENCH**
ST2	**18334AA000**	**PULLEY WRENCH PIN SET**

ST1	**18355AA000**	**PULLEY WRENCH**
ST2	**18334AA000**	**PULLEY WRENCH PIN SET**

4. Remove the crank pulley.
5. Remove the front oil seal from the chain cover.

MECHANICAL(w/o STI) > Crank Pulley

INSTALLATION

1. Degrease the press-fit section for the chain cover front oil seal, and install the front oil seal to the chain cover using ST.
   Caution:
   Do not apply fluid such as engine oil to the front oil seal and the chain cover; otherwise engine oil leakage may occur.
   Note:
   - **Use a new front oil seal.**
   - **When tapping the front oil seal in on the vehicle, protect the radiator fin with cardboards etc. so as not to damage the radiator fin by the plastic hammer.**

ST	**41399FG020**	**SPECIAL TOOL B**

Front oil seal press-fit position:
1^{+0}_{-1} mm ($0.0394^{+0}_{-0.0394}$ in) position from chain cover end face

(A) Chain cover (B) Oil seal (C) Front oil seal press-fit position (1^{+0}_{-1} mm ($0.0394^{+0}_{-0.0394}$

in) position from chain cover end face)

2. Clean the crankshaft thread using compressed air.
3. Apply engine oil to the crank pulley bolt seat and thread.
4. Install the crank pulley.
   (1) Use a marker to add lines at the portion of the crank pulley bolt head that has no indented line, as shown in the figure.
   Note:
   - **Four lines are indented by 90° on the crank pulley bolt head.**
   - **To minimize an angular error, use a ruler, etc. to draw a straight line.**



(a) Additional line

   (2) Set the crank pulley to the chain cover.
   (3) Use the ST to lock the crank pulley, and temporarily tighten the crank pulley bolt.
   Note:
   To prevent damaging ST1, attach the ST2 onto the ST1 as shown.

ST1	**18355AA000**	**PULLEY WRENCH**
ST2	**18334AA000**	**PULLEY WRENCH PIN SET**



ST1	**18355AA000**	**PULLEY WRENCH**
ST2	**18334AA000**	**PULLEY WRENCH PIN SET**

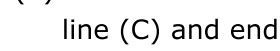
   Tightening torque:
   20 N·m (2.0 kgf-m, 14.8 ft-lb)
   (4) Draw reference lines (A) and (B) using a marker to set the socket to the crank pulley bolt as shown in the figure.
   Note:
   Use a 6-point socket to tighten the crank pulley bolt to avoid the socket being broken.



(a) 6-point socket

   (5) As shown in the figure, use a marker with a different color than in step (1) to draw a reference line (C) on the crank pulley bolt, according to the reference line (A) and the indented line or additional line on the crank pulley bolt head. Then draw a end line (D) on the crank pulley, using the reference line (B) and the indented line or additional line on the crank pulley bolt head as a reference.
   Note:
   Reference line (C) is drawn for prevention of misidentification and better visibility.
   (6) Use the ST to lock the crank pulley, and tighten the crank pulley bolt to the angle where reference line (C) and end line (D) are aligned.
   Note:
   It should be approx. 120° when reference line (C) and end line (D) are aligned.

ST1	**18355AA000**	**PULLEY WRENCH**
ST2	**18334AA000**	**PULLEY WRENCH PIN SET**



   Tightening angle:

120°±5°

5. Install the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>INSTALLATION > V-BELT.
6. When working on the vehicle

Note:

When working on the vehicle, perform the following steps also.

(1) Install the radiator main fan & fan motor assembly and radiator sub fan & fan motor assembly. Ref. to COOLING(w/o STI)>Radiator Main Fan and Fan Motor>INSTALLATION. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor>INSTALLATION.

MECHANICAL(w/o STI) > Crank Pulley

INSPECTION

1. Check that the crank pulley has no deformation, cracks or other damages.
2. Inspect for oil leakage from the front oil seal. If there is an oil leak, replace the front oil seal with a new one. Ref. to MECHANICAL(w/o STI)>Crank Pulley>REMOVAL. Ref. to MECHANICAL(w/o STI)>Crank Pulley>INSTALLATION.

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
   (2) Remove the intake duct No. 1 and intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 2.
   (3) Remove the radiator. Ref. to COOLING(w/o STI)>Radiator>REMOVAL.
   (4) Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
2. Drain the engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
3. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL > V-BELT.
4. Remove the generator. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Generator>REMOVAL.
5. Remove the water pump pulley. Ref. to COOLING(w/o STI)>Water Pump>REMOVAL > WATER PUMP.
6. Remove the crank pulley. Ref. to MECHANICAL(w/o STI)>Crank Pulley>REMOVAL.
7. Remove the engine oil cooler. Ref. to LUBRICATION(w/o STI)>Engine Oil Cooler>REMOVAL.
8. Remove the front engine oil cooler pipe assembly. Ref. to LUBRICATION(w/o STI)>Engine Oil Cooler Pipe>REMOVAL > FRONT ENGINE OIL COOLER PIPE.
9. Remove the clip securing the PCV pipe to the intake manifold.
10. Remove the PCV pipe from the clip (A), and place the PCV pipe aside so that it does not interfere with the work.
11. Disconnect the connector from the engine wiring harness.
12. Remove the connector (A) and connector (B) from the vacuum pipe assembly.
13. Disconnect the vacuum control hose (C) and vacuum hose (D) from the vacuum pipe assembly, and remove the vacuum pipe assembly from the chain cover.
14. Disconnect the connector (A) from the intake oil control solenoid RH, connector (B) from the exhaust oil control solenoid RH, connector (C) from the intake camshaft position sensor RH, and the connector (D) from the exhaust camshaft position sensor RH, and then remove the clips (E) and (F) securing the engine wiring harness.
15. Disconnect the connector (A) from the exhaust camshaft position sensor LH and the connector (B) from the oil level switch, and remove the engine wiring harness stay from the chain cover.
16. Remove the rubber cap from the oil pressure switch.
17. Disconnect the terminal (A) from the oil pressure switch, connector (B) from the engine oil temperature sensor, connector (C) from the intake oil control solenoid LH, connector (D) from the exhaust oil control solenoid LH, and the connector (E) from the intake camshaft position sensor LH, and then remove the clip (F) securing the engine wiring harness.
18. Pull out the oil level gauge (A), and remove the oil level gauge guide (B) and idler pulley (C).
19. Remove the bolts securing the chain cover to engine.
20. Pry the points shown in the figure with a crowbar wrapped by protective tape, and then remove the chain cover from the engine.

Caution:
The chain cover may contact the protrusion (a) of cam sprocket sensor plate and cause damage. When removing the chain cover, move the chain cover horizontally until it cannot contact with the cam sprocket, and then remove it carefully.

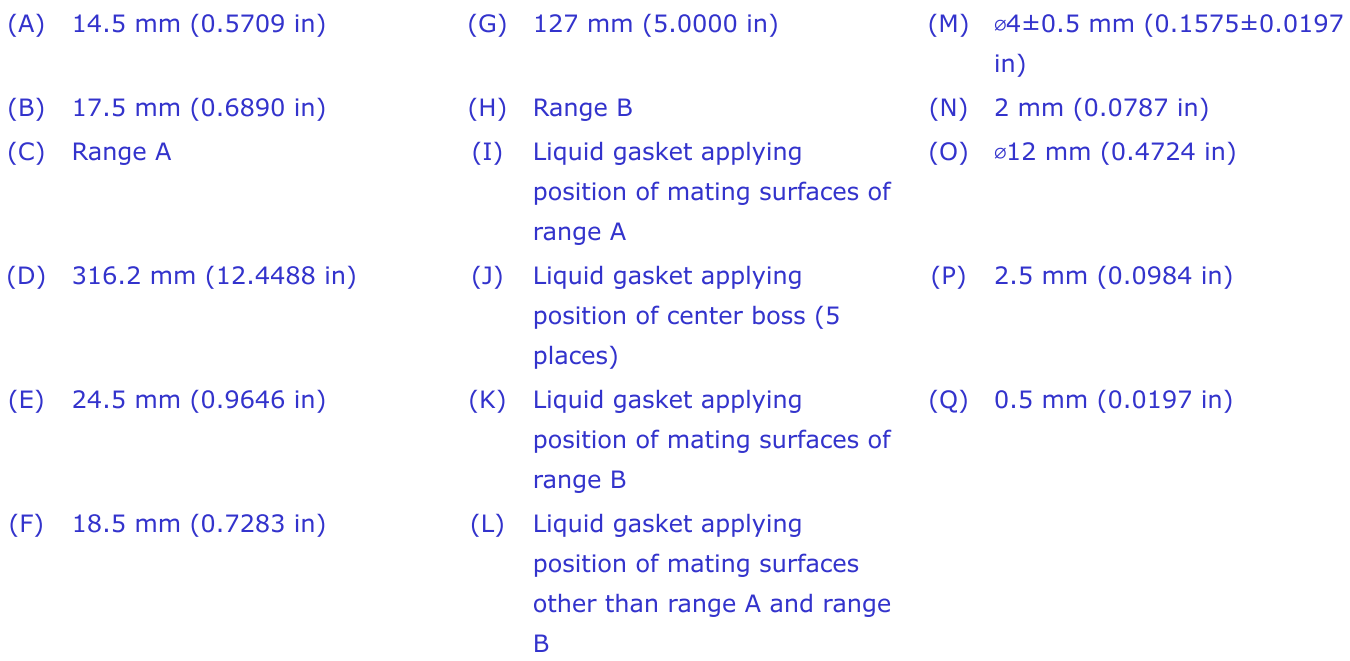
21. Remove the O-rings from cylinder head RH, cylinder head LH, cylinder block LH and oil pan upper.
22. Remove the liquid gasket from the chain cover and engine unit.

MECHANICAL(w/o STI) > Chain Cover

INSTALLATION

1. Install the O-rings to cylinder head RH, cylinder head LH, cylinder block LH and oil pan upper.
   Note:
   - **Use new O-rings.**
   - **Apply a coat of engine oil to the O-rings.**
2. Apply liquid gasket if there are gaps between front camshaft cap and cam carrier (A), cam carrier and cylinder head (B), and cylinder head and cylinder block (C) as shown in the figure.
   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
3. Apply liquid gasket to the chain cover mating surface and center boss (5 places) as shown in the figure.
   Note:
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine and chain cover.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   4±0.5 mm (0.1575±0.0197 in)



(A)	14.5 mm (0.5709 in)	(G)	127 mm (5.0000 in)	(M)	⌀4±0.5 mm (0.1575±0.0197 in)
(B)	17.5 mm (0.6890 in)	(H)	Range B	(N)	2 mm (0.0787 in)
(C)	Range A	(I)	Liquid gasket applying position of mating surfaces of range A	(O)	⌀12 mm (0.4724 in)
(D)	316.2 mm (12.4488 in)	(J)	Liquid gasket applying position of center boss (5 places)	(P)	2.5 mm (0.0984 in)
(E)	24.5 mm (0.9646 in)	(K)	Liquid gasket applying position of mating surfaces of range B	(Q)	0.5 mm (0.0197 in)
(F)	18.5 mm (0.7283 in)	(L)	Liquid gasket applying position of mating surfaces other than range A and range B		

4. Set the chain cover, and tighten the bolts in numerical order as shown in the figure.

Caution:
The chain cover may contact the protrusion (a) of cam sprocket sensor plate and cause damage. When setting the chain cover, move the chain cover horizontally and set it while taking care not to contact with the cam sprocket.

Tightening torque:

T1: 10 N·m (1.0 kgf-m, 7.4 ft-lb)

T2: 25 N·m (2.5 kgf-m, 18.4 ft-lb)

(A) M6 × 20 (C) M8 × 25 (D) M8 × 60

(B) M6 × 50

5. Install the idler pulley (C) and oil level gauge guide (B), and insert the oil level gauge (A).

Note:

- **When installing the idler pulley, be careful of the idler pulley cover direction.**

(a) Idler pulley cover (b) Protrusion (3 places)

- **Use a new O-ring to the oil level gauge guide.**
- **Apply a light coat of engine oil to the O-rings of the oil level gauge guide and the oil level gauge.**

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

T2: 36 N·m (3.7 kgf-m, 26.6 ft-lb)

6. Connect the terminal (A) to the oil pressure switch, connector (B) to the engine oil temperature sensor, connector (C) to the intake oil control solenoid LH, connector (D) to the exhaust oil control solenoid LH, and the connector (E) to the intake camshaft position sensor LH, and fix the engine wiring harness using the clip (F).

Note:

The oil pressure switch harness must be positioned toward the left lower side of the vehicle within the range of 90°.

(a) Left side of vehicle

Tightening torque:

1.5 N·m (0.2 kgf-m, 1.1 ft-lb)

7. Attach the rubber cap to the oil pressure switch.
8. Connect the connector (A) to the exhaust camshaft position sensor LH and the connector (B) to the oil level switch, and install the engine wiring harness stay to the chain cover.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

9. Connect the connector (A) to the intake oil control solenoid RH, connector (B) to the exhaust oil control solenoid RH, connector (C) to the intake camshaft position sensor RH, and the connector (D) to the exhaust camshaft position sensor RH, and then fix the engine wiring harness using the clips (E) and (F).
10. Install the vacuum pipe assembly to the chain cover, and connect the vacuum control hose (C) and vacuum hose (D) to the vacuum pipe assembly.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

11. Install the connector (A) and connector (B) to the vacuum pipe assembly.

12. Connect the connector to the engine wiring harness.
13. Install the PCV pipe to the clip (A).
14. Fix the PCV pipe to the intake manifold using the clip.
15. Install the front engine oil cooler pipe assembly. Ref. to LUBRICATION(w/o STI)>Engine Oil Cooler Pipe>INSTALLATION > FRONT ENGINE OIL COOLER PIPE.
16. Attach the engine oil cooler. Ref. to LUBRICATION(w/o STI)>Engine Oil Cooler>INSTALLATION.
17. Install the crank pulley. Ref. to MECHANICAL(w/o STI)>Crank Pulley>INSTALLATION.
18. Install the water pump pulley. Ref. to COOLING(w/o STI)>Water Pump>INSTALLATION > WATER PUMP.
19. Install the generator. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Generator>INSTALLATION.
20. Install the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>INSTALLATION > V-BELT.
21. Fill engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
22. When working on the vehicle

    Note:

    When working on the vehicle, perform the following steps also.

    (1) Install the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.

    (2) Install the intake duct No. 1 and intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 1. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 2.

    (3) Install the radiator. Ref. to COOLING(w/o STI)>Radiator>INSTALLATION.

MECHANICAL(w/o STI) > Chain Cover

DISASSEMBLY

1. Remove the oil filler cap.
2. Remove the PCV hose assembly No. 1. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>PCV Hose Assembly>REPLACEMENT > PCV HOSE ASSY NO. 1.
3. Remove the oil pressure switch. Ref. to LUBRICATION(w/o STI)>Oil Pressure Switch>REMOVAL.
4. Remove the engine oil temperature sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Oil Temperature Sensor>REMOVAL.
5. Remove the oil control solenoid. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Oil Control Solenoid>REMOVAL.
6. Remove the camshaft position sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Camshaft Position Sensor>REMOVAL.

MECHANICAL(w/o STI) > Chain Cover

ASSEMBLY

1. Install the camshaft position sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Camshaft Position Sensor>INSTALLATION.
2. Install the oil control solenoid. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Oil Control Solenoid>INSTALLATION.
3. Install the engine oil temperature sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Oil Temperature Sensor>INSTALLATION.

4. Install the oil pressure switch. Ref. to LUBRICATION(w/o STI)>Oil Pressure Switch>INSTALLATION.
5. Install the PCV hose assembly No. 1. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>PCV Hose Assembly>REPLACEMENT > PCV HOSE ASSY NO. 1.
6. Install the oil filler cap.

MECHANICAL(w/o STI) > Chain Cover

INSPECTION

Check that the chain cover does not have deformation, cracks and any other damage.

REMOVAL

1. TIMING CHAIN RH

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. Remove the chain cover. Ref. to MECHANICAL(w/o STI)>Chain Cover>REMOVAL.
2. Using ST and by turning the crankshaft, align the alignment marks of crank sprocket, intake cam sprocket RH and exhaust cam sprocket RH to the positions as shown in the figure.
   Note:
   If the alignment marks are aligned to the positions as shown in the figure, the crankshaft key is located at six o'clock position.

   ST 18252AA000 CRANKSHAFT SOCKET
3. Push down the chain lever tensioner RH, and with a 2.5 mm (0.0984 in) dia. stopper pin or a 2.5 mm dia. hex wrench inserted into the stopper pin hole in the chain tensioner RH, secure the plunger (A).
4. Remove the chain tensioner RH, and remove the chain tensioner lever RH (A).
5. Remove the chain guide RH, and remove the timing chain RH (A).
   Caution:
   - **If the timing chain RH is not installed, the intake camshaft RH and exhaust camshaft RH are kept at zero-lift position. All cams on the camshaft are not pressing down the roller rocker arm (intake valve and exhaust valve). (Under this condition, all valves remain unlifted.)**
   - **Intake camshaft RH and exhaust camshaft RH can be independently rotated with the timing chain RH removed. When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn it to the outside of range of zero-lift (in range where it can be turned lightly by hand).**

   Note:
   To avoid mixing with LH side, keep the removed part in order.
6. Remove the chain guide RH from the front camshaft cap RH.

2. TIMING CHAIN LH

1. Remove the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
2. Using ST and by turning the crankshaft, align the alignment marks of crankshaft key, intake cam sprocket LH and exhaust cam sprocket LH to the positions as shown in the figure.

   ST 18252AA000 CRANKSHAFT SOCKET
3. Push up the chain tensioner lever LH as shown in the figure, and with a stopper pin measuring 1.2 mm (0.0472 in) dia. or less (clips, etc.), or with a hex wrench measuring 1.2 mm dia. inserted into the stopper pin hole in the chain tensioner LH, secure the plunger (A).
4. Remove the chain tensioner LH, and remove the chain tensioner lever LH (A).
5. Remove the O-ring from the cylinder block LH.
6. Remove the chain guide LH, and remove the timing chain LH (A).

Caution:

- **If the timing chain LH is not installed, the exhaust camshaft LH is kept at zero-lift position. All cams on the exhaust camshaft LH are not pressing down the roller rocker arm (exhaust valve). (Under this condition, exhaust valves remain unlifted.)**
- **Intake camshaft LH is kept at lift position. All cams on the intake camshaft LH are pressing down the roller rocker arm (intake valve). (Under this condition, intake valves remain lifted.)**
- **Intake camshaft LH and exhaust camshaft RH can be independently rotated with the timing chain LH removed. When the exhaust camshaft LH is turned, the valve heads contact each other and valve stem may bend as described in above. Do not turn the exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).**
- **#4 piston is located near TDC. If the intake camshaft LH is turned, the valve and the piston may contact and valve stem may bend. Do not turn the intake camshaft LH at this time.**

Note:

To avoid mixing with RH side, keep the removed part in order.

7. Using ST and by turning the crankshaft approximately 200° clockwise, align the alignment marks of crank sprocket to the positions as shown in the figure.

Caution:

- **This procedure is required to prevent the valve and piston contacting with each other, by moving the all pistons to the middle of the cylinders.**
- **Never turn counterclockwise because the valve and piston may contact. Counterclockwise turn is allowed only when adjusting precisely the alignment marks, after turning the crank sprocket alignment mark clockwise near the position as shown in the figure.**

ST 18252AA000 CRANKSHAFT SOCKET

8. Using ST and by turning the intake cam sprocket LH approximately 130° clockwise, align the alignment marks of intake cam sprocket LH to the positions (zero-lift position) as shown in the figure.

Caution:

- **After this work, when the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn the intake camshaft LH and exhaust camshaft LH to the outside of range of zero-lift (in range where it can be turned lightly by hand).**
- **Perform the operation carefully since the ST comes off easily.**

Note:

Intake camshaft LH has three peaks of drive sections for the high-pressure fuel pump. Therefore, there is little range where it can be turned lightly by hand in zero-lift position.

ST1 18355AA000 PULLEY WRENCH

ST2 18334AA020 PULLEY WRENCH PIN SET

9. Remove the chain guide LH from the front camshaft cap LH.

INSTALLATION

1. TIMING CHAIN LH

Note:

- **Be careful that the foreign matter is not into or onto the assembled component during installation.**
- **Apply engine oil to all component parts of the timing chain.**

1. Install the chain guide LH to the front camshaft cap LH.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
2. Prepare to attach the chain tensioner LH.
   (1) Move the link plate (A) in the direction of arrow to press in the plunger (B).
   (2) With a stopper pin measuring 1.2 mm (0.0472 in) dia. or less (clips, etc.) or a hex wrench measuring 1.2 mm dia. inserted into the stopper pin hole, secure the plunger.
   Note:
   If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of plunger rack (A) is engaged with the stopper tooth (B). If not engaged, retract the plunger a little so that the first notch of plunger rack (A) is engaged with the stopper tooth (B).
3. Check that the crank sprocket is located at the position shown in the figure. If not aligned, using ST turn the crankshaft to align the crank sprocket alignment mark to the position shown in the figure.
   Note:
   This procedure is required to prevent the valve and piston contacting with each other in the next step.

   ST 18252AA000 CRANKSHAFT SOCKET

4. Using ST and by turning the intake cam sprocket LH, align the alignment marks to the positions as shown in the figure.
   Caution:
   - **When the intake valve and exhaust valve lift at the same time, the valve heads contact each other and valve stem may bend. Do not turn the exhaust camshaft LH.**
   - **Perform the operation carefully since the ST comes off easily.**

   ST1 18355AA000 PULLEY WRENCH

   ST2 18334AA020 PULLEY WRENCH PIN SET

5. Using ST and by turning the crankshaft approximately 200° counterclockwise, align the alignment marks of crankshaft key to the positions as shown in the figure.
   Caution:
   Never turn clockwise because the valve and piston may contact. Clockwise turn is allowed only when adjusting the key position precisely, after turning the crankshaft counterclockwise to bring the key near the position as shown in the figure.

   ST 18252AA000 CRANKSHAFT SOCKET

6. Align the alignment mark of exhaust cam sprocket LH to the position shown in the figure.
Caution:
To prevent valve damage, turn the exhaust cam sprocket LH only within the range of zero-lift (in range where it can be turned lightly by hand).

7. Install the timing chain LH and the timing chain guide LH.
(1) Match the timing chain mark (blue) to the alignment mark of the crank sprocket.
(2) Match the timing chain mark (pink) to the timing mark position of the intake cam sprocket LH.
(3) Match the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket LH.
(4) Install timing chain guide LH.
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

(A) Alignment mark (C) Blue (D) Pink
(B) Timing mark

8. Install O-rings to the cylinder block LH.
Note:
Use new O-rings.

9. Install the chain tensioner lever LH (A) and chain tensioner LH.
Tightening torque:
8.5 N·m (0.9 kgf-m, 6.3 ft-lb)

10. Pull out the stopper pin from the chain tensioner LH.
Caution:
Confirm the following before pulling out the stopper pin.
- **Matching of the timing chain mark (blue) to the alignment mark of the crank sprocket.**
- **Matching of the timing chain mark (pink) to the timing mark position of the intake cam sprocket LH.**
- **Matching of the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket LH.**

Note:
If the stopper pin cannot be removed, lift the chain tension lever LH to remove as shown in the figure.

(A) Alignment mark (C) Blue (D) Pink
(B) Timing mark

11. Using the ST, turn the crankshaft clockwise, and make sure that there are no abnormal conditions.
Caution:
Always make sure to perform this confirmation.

ST 18252AA000 CRANKSHAFT SOCKET

12. Using ST and by turning the crankshaft, align the alignment marks of crank sprocket, intake cam sprocket LH and exhaust cam sprocket LH to the positions as shown in the figure.
Note:
If the alignment marks are aligned to the positions as shown in the figure, the crankshaft key is located at six o'clock position.

ST 18252AA000 CRANKSHAFT SOCKET

13. Install the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN RH.

2. TIMING CHAIN RH

Note:

- **Be careful that the foreign matter is not into or onto the assembled component during installation.**
- **Apply engine oil to all component parts of the timing chain.**

1. Install timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.
2. Install the chain guide RH to the front camshaft cap RH.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
3. Prepare to attach the chain tensioner RH.
   (1) Move the link plate (A) in the direction of arrow to press in the plunger (B).
   (2) With a 2.5 mm (0.0984 in) dia. stopper pin or a 2.5 mm dia. hex wrench inserted into the stopper pin hole, secure the plunger.
   Note:
   If the stopper pin hole on the link plate and the stopper pin hole on the chain tensioner are not aligned, check that the first notch of plunger rack (A) is engaged with the stopper tooth (B). If not engaged, retract the plunger a little so that the first notch of plunger rack (A) is engaged with the stopper tooth (B).
4. Make sure that the alignment marks of the crank sprocket, intake cam sprocket LH and exhaust cam sprocket LH are aligned to the positions as shown in the figure.
5. Align the alignment marks of intake cam sprocket RH and exhaust cam sprocket RH to the positions as shown in the figure.
   Caution:
   To prevent valve damage, turn the intake cam sprocket RH and exhaust cam sprocket RH only within the range of zero-lift (in range where it can be turned lightly by hand).
6. Install the timing chain RH and the timing chain guide RH.
   (1) Match the timing chain mark (blue) to the alignment mark of the crank sprocket.
   (2) Match the timing chain mark (pink) to the timing mark position of the intake cam sprocket RH.
   (3) Match the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket RH.
   (4) Install the timing chain guide RH.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

(A) Alignment mark (C) Blue (D) Pink
(B) Timing mark

7. Install the chain tensioner lever RH (A) and chain tensioner RH.
   Tightening torque:
   8.5 N·m (0.9 kgf-m, 6.3 ft-lb)
8. Pull out the stopper pin from the chain tensioner RH.

Caution:
Confirm the following before pulling out the stopper pin.

- **Matching of the timing chain mark (blue) to the alignment mark of the crank sprocket.**
- **Matching of the timing chain mark (pink) to the timing mark position of the intake cam sprocket RH.**
- **Matching of the timing chain mark (pink) to the timing mark position of the exhaust cam sprocket RH.**

(A) Alignment mark
(B) Timing mark
(C) Blue
(D) Pink

9. Make sure that the alignment marks of the cam sprocket and crank sprocket are aligned to the positions as shown in the figure.
10. Using the ST, turn the crankshaft clockwise, and make sure that there are no abnormal conditions.
Caution:
Always make sure to perform this confirmation.

ST 18252AA000 CRANKSHAFT SOCKET

11. Install the chain cover. Ref. to MECHANICAL(w/o STI)>Chain Cover>INSTALLATION.

MECHANICAL(w/o STI) > Timing Chain Assembly

INSPECTION

1. Check the timing chain, chain guide, chain tensioner lever and chain tensioner for deformation, cracks or other damages.
2. Check the chain guide and chain tensioner lever for abnormal wear.

REMOVAL

1. CAM SPROCKET RH

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

- **Intake cam sprocket RH**
  1. Remove the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
  2. Hold the intake cam sprocket RH using the ST1 and ST2, and remove the bolts using the ST3.
     Caution:
     Perform the operation carefully since the ST comes off easily.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA020	PULLEY WRENCH PIN SET
ST3	18270KA010	SOCKET

  3. Remove the intake cam sprocket RH.
- **Exhaust cam sprocket RH**
  1. Remove the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
  2. Hold the exhaust cam sprocket RH using the ST1 and ST2, and remove the bolts using the ST3.
     Caution:
     Perform the operation carefully since the ST comes off easily.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA020	PULLEY WRENCH PIN SET
ST3	18270KA010	SOCKET

  3. Remove the exhaust cam sprocket RH.

2. CAM SPROCKET LH

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

- **Intake cam sprocket LH**
  1. Remove the timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN LH.
  2. Hold the intake cam sprocket LH using the ST1 and ST2, and remove the bolts using the ST3.
     Caution:
     Perform the operation carefully since the ST comes off easily.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA020	PULLEY WRENCH PIN SET

ST3 18270KA010 SOCKET

3. Remove the intake cam sprocket LH.

- **Exhaust cam sprocket LH**

1. Remove the timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN LH.
2. Hold the exhaust cam sprocket LH using the ST1 and ST2, and remove the bolts using the ST3.
   Caution:
   Perform the operation carefully since the ST comes off easily.

   ST1 18355AA000 PULLEY WRENCH

   ST2 18334AA020 PULLEY WRENCH PIN SET

   ST3 18270KA010 SOCKET

3. Remove the exhaust cam sprocket LH.

MECHANICAL(w/o STI) > Cam Sprocket

INSTALLATION

1. CAM SPROCKET RH

- **Intake cam sprocket RH**

1. Install the intake cam sprocket RH by aligning the knock hole (A) of intake cam sprocket RH and the knock pin (B) of intake camshaft RH.
   Note:
   Before installation, check that there is no foreign matter on the intake cam sprocket RH and intake camshaft RH.
2. Hold the intake cam sprocket RH using the ST1 and ST2, and install the bolts using the ST3.
   Caution:
   Perform the operation carefully since the ST comes off easily.
   Note:
   Apply engine oil to the bolt thread.

   ST1 18355AA000 PULLEY WRENCH

   ST2 18334AA020 PULLEY WRENCH PIN SET

   ST3 18270KA010 SOCKET

   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
3. Install the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN RH.

- **Exhaust cam sprocket RH**

1. Install the exhaust cam sprocket RH by aligning the knock hole (A) of exhaust cam sprocket RH and the knock pin (B) of exhaust camshaft RH.

Note:
Before installation, check that there is no foreign matter on the exhaust cam sprocket RH and exhaust camshaft RH.

2. Hold the exhaust cam sprocket RH using ST1 and ST2, and install the bolts using ST3.
Caution:
Perform the operation carefully since the ST comes off easily.
Note:
Apply engine oil to the bolt thread.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA020	PULLEY WRENCH PIN SET
ST3	18270KA010	SOCKET

Tightening torque:
18 N·m (1.8 kgf-m, 13.3 ft-lb)

3. Install the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN RH.

2. CAM SPROCKET LH

- **Intake cam sprocket LH**

1. Install the intake cam sprocket LH by aligning the knock hole (A) of intake cam sprocket LH and the knock pin (B) of intake camshaft LH.
Note:
Before installation, check that there is no foreign matter on the intake cam sprocket LH and intake camshaft LH.
2. Hold the intake cam sprocket LH using the ST1 and ST2, and install the bolts using the ST3.
Caution:
Perform the operation carefully since the ST comes off easily.
Note:
Apply engine oil to the bolt thread.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA020	PULLEY WRENCH PIN SET
ST3	18270KA010	SOCKET

Tightening torque:
18 N·m (1.8 kgf-m, 13.3 ft-lb)

3. Install timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.

- **Exhaust cam sprocket LH**

1. Install the exhaust cam sprocket LH by aligning the knock hole (A) of exhaust cam sprocket LH and the knock pin (B) of exhaust camshaft LH.
Note:
Before installation, check that there is no foreign matter on the exhaust cam sprocket LH and exhaust camshaft LH.
2. Hold the exhaust cam sprocket LH using the ST1 and ST2, and install the bolts using the ST3.

Caution:
Perform the operation carefully since the ST comes off easily.
Note:
Apply engine oil to the bolt thread.

ST1	**18355AA000**	**PULLEY WRENCH**
ST2	**18334AA020**	**PULLEY WRENCH PIN SET**
ST3	**18270KA010**	**SOCKET**

Tightening torque:
18 N·m (1.8 kgf-m, 13.3 ft-lb)

3. Install timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.

MECHANICAL(w/o STI) > Cam Sprocket

INSPECTION

Check the cam sprocket teeth for abnormal wear and scratches.

MECHANICAL(w/o STI) > Crank Sprocket

REMOVAL

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. Remove the timing chain. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL.
2. Remove the crank sprocket.

MECHANICAL(w/o STI) > Crank Sprocket

INSTALLATION

1. Install the crank sprocket.
   Note:
   The direction of installation is not specified for the crank sprocket.
2. Install the timing chain. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION.

MECHANICAL(w/o STI) > Crank Sprocket

INSPECTION

1. Check the crank sprocket teeth for abnormal wear and scratches.
2. Make sure there is no free play between crank sprocket and key.

REMOVAL

1. ROCKER COVER RH

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Remove the air cleaner case. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Cleaner Case>REMOVAL.
2. Remove the #1 ignition coil and the #3 ignition coil. Ref. to IGNITION(w/o STI)>Ignition Coil>REMOVAL.
3. Remove the rocker cover RH.
4. Remove the rocker cover gasket RH, #1 spark plug pipe gasket and #3 spark plug pipe gasket, and remove the liquid gasket.
   Caution:
   - **When removing the liquid gasket from engine unit using scraper, use special care not to damage the cam lobe of camshaft RH.**
   - **If the cam lobe of camshaft RH interferes, turn the crankshaft to the position where the scraper does not touch.**

2. ROCKER COVER LH

Note:
When replacing a single part, perform the work with the engine assembly installed to body.

1. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Remove the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>DISASSEMBLY.
   (2) Fully open the front hood. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
   (3) Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
   (4) Remove the battery. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>REMOVAL.
   (5) Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
   (6) Remove the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.
   (7) Remove the nuts which secure the engine mounting to the front crossmember.
   (8) Lower the vehicle.
   (9) Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness to the bracket, and remove the bolt which secures the engine control module (ECM) to the bracket.
   (10) Pull out the engine control module (ECM) from the bracket, and move it to a location that does not interfere operation.

Note:
When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.

(11)Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.

(12)Remove the clip (A) securing the generator cord to the fuel pipe protector, and remove the fuel pipe protector from the high-pressure fuel pump case and intake manifold.

(13)Disconnect the connector from pressure switch (triple pressure switch).

(14)Remove the pitching stopper.

(15)Support the engine with a lifting device and wire ropes.

(16)Set the cushioning material such as a waste cloth between pitching stopper bracket and transmission case cover. (CVT model)

Note:

- **This operation is required to prevent damage to the transmission case cover.**
- **Make sure that the height of cushioning material does not become 15 — 20 mm (0.6 — 0.8 in) or less when it is crushed.**

(17)While gradually lifting up the engine, set the ST between the engine mount LH and front crossmember, and then slowly lower the engine.

Caution:

- **When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.**
- **To avoid the damage, be sure to set the ST as shown in the figure.**

(A) Direction mark (B) Engine mounting side (C) Front crossmember side

- **After lowering the engine, check that the ST does not come off even if the engine is bounced.**

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(18)Remove the lifting device and wire ropes.

2. Remove the side engine oil cooler pipe assembly. Ref. to LUBRICATION(w/o STI)>Engine Oil Cooler Pipe>REMOVAL > SIDE ENGINE OIL COOLER PIPE.
3. Remove the #2 ignition coil and the #4 ignition coil. Ref. to IGNITION(w/o STI)>Ignition Coil>REMOVAL.
4. Remove the connector from the water pipe LH.
5. Remove the rocker cover LH.
6. Remove the rocker cover gasket LH, #2 spark plug pipe gasket and #4 spark plug pipe gasket, and remove the liquid gasket.

Caution:

- **When removing the liquid gasket from engine unit using scraper, use special care not to damage the cam lobe of camshaft LH.**
- **If the cam lobe of camshaft LH interferes, turn the crankshaft to the position where the scraper does not touch.**

MECHANICAL(w/o STI) > Rocker Cover

INSTALLATION

1. ROCKER COVER RH

1. Install the #1 spark plug pipe gasket and #3 spark plug pipe gasket to the #1 spark plug pipe and #3 spark plug pipe.
   Note:
   - **Use a new #1 spark plug pipe gasket and #3 spark plug pipe gasket.**
   - **Apply a light coat of engine oil to the #1 spark plug pipe gasket and #3 spark plug pipe gasket, and insert them onto the spark plug pipe edge (A).**
2. Install the rocker cover gasket RH to the rocker cover RH.
   Note:
   Use a new rocker cover gasket RH.
3. Apply liquid gasket to the mating surface of rocker cover RH as shown in the figure.
   Note:
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine.**
   - **Be careful not to allow liquid gasket to be squeezed out from rocker cover RH.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   3±1 mm (0.1181±0.0394 in)



4. Set the rocker cover RH, and tighten the bolts in numerical order as shown in the figure.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
5. Install the #1 ignition coil and the #3 ignition coil. Ref. to IGNITION(w/o STI)>Ignition Coil>INSTALLATION.
6. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Install the air cleaner case. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Cleaner Case>INSTALLATION.

2. ROCKER COVER LH

1. Install the #2 spark plug pipe gasket and #4 spark plug pipe gasket to the #2 spark plug pipe and #4 spark plug pipe.
   Note:
   - **Use a new #2 spark plug pipe gasket and #4 spark plug pipe gasket.**
   - **Apply a light coat of engine oil to the #2 spark plug pipe gasket and #4 spark plug pipe gasket, and insert them onto the spark plug pipe edge (A).**
2. Install the rocker cover gasket LH to the rocker cover LH.
   Note:
   Use a new rocker cover gasket LH.
3. Apply liquid gasket to the mating surface of rocker cover LH as shown in the figure.

Note:

- **Before applying liquid gasket, degrease the old liquid gasket seal surface of the engine.**
- **Be careful not to allow liquid gasket to be squeezed out from rocker cover LH.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

3±1 mm (0.1181±0.0394 in)

(A) 10 mm (0.3937 in) or more (C) 63 mm (2.4803 in) or more (D) Arch starting point

(B) 18.8 mm (0.7402 in) or less

4. Set the rocker cover LH, and tighten the bolts in numerical order as shown in the figure.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
5. Connect the connector to the water pipe LH.
6. Install the #2 ignition coil and the #4 ignition coil. Ref. to IGNITION(w/o STI)>Ignition Coil>INSTALLATION.
7. Install the side engine oil cooler pipe assembly. Ref. to LUBRICATION(w/o STI)>Engine Oil Cooler Pipe>INSTALLATION > SIDE ENGINE OIL COOLER PIPE.
8. When working on the vehicle
   Note:
   When working on the vehicle, perform the following steps also.
   (1) Support the engine with a lifting device and wire ropes.
   (2) Lift the engine a little, and remove the ST.
   Caution:
   When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

   ST 18632AA030 STAND ASSY

   (3) Lower the engine and remove the lifting device and wire ropes.
   (4) Remove the cushioning material between pitching stopper bracket and transmission case cover. (CVT model)
   (5) Install the pitching stopper.
   Tightening torque:
   T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)
   T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)
   (6) Connect the connector to the pressure switch (triple pressure switch).
   (7) Install the fuel pipe protector to the high-pressure fuel pump case and intake manifold, and secure the generator cord to the fuel pipe protector using the clip (A).
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
   (8) Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
   (9) Insert the engine control module (ECM) to the bracket.
   (10)Install the bolt which secures the engine control module (ECM) to the bracket, and then secure the engine wiring harness and bulkhead harness to the bracket with clip (A) and clip (B).
   Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

(11)Lift up the vehicle.

(12)Install the nuts which hold the engine mounting to the front crossmember.

Note:

- **Make sure that locators (a) of the engine mounting are securely inserted.**
- **Use a new nut.**

Tightening torque:

60 N·m (6.1 kgf-m, 44.3 ft-lb)

(13)Install the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>INSTALLATION.

(14)Lower the vehicle.

(15)Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.

(16)Install the battery. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>INSTALLATION.

(17)Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

(18)Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

(19)Set the front hood to the normal position. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.

(20)Install the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>ASSEMBLY.

(21)Close the front hood.

MECHANICAL(w/o STI) > Rocker Cover

INSPECTION

Check that the rocker cover does not have deformation, cracks and any other damage.

MECHANICAL(w/o STI) > Camshaft

REMOVAL

1. CAMSHAFT RH

The camshaft RH and cam carrier are designed as removing as a unit. Refer to "Cam Carrier" for removal procedures of camshaft RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>REMOVAL > CAM CARRIER RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>DISASSEMBLY > CAM CARRIER RH.

2. CAMSHAFT LH

The camshaft LH and cam carrier are designed as removing as a unit. Refer to "Cam Carrier" for removal procedures of camshaft LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>REMOVAL > CAM CARRIER LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>DISASSEMBLY > CAM CARRIER LH.

MECHANICAL(w/o STI) > Camshaft

INSTALLATION

1. CAMSHAFT RH

The camshaft RH and cam carrier are designed as installing as a unit. Refer to "Cam Carrier" for installation procedures of camshaft RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>ASSEMBLY > CAM CARRIER RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER RH.

2. CAMSHAFT LH

The camshaft LH and cam carrier are designed as installing as a unit. Refer to "Cam Carrier" for installation procedures of camshaft LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>ASSEMBLY > CAM CARRIER LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER LH.

REMOVAL

1. CAM CARRIER RH

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN RH.
3. Remove the rocker cover RH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>REMOVAL > ROCKER COVER RH.
4. Remove the oil pipe assembly. Ref. to LUBRICATION(w/o STI)>Oil Pipe>REMOVAL > OIL PIPE ASSEMBLY.
5. Remove the clip holding the engine wiring harness from cam carrier RH.
6. Disconnect the water pipe hose from oil pan upper and EGR cooler, and remove the water pipe assembly.
7. When disassembling the cam carrier RH
   Note:
   When disassembling the cam carrier RH, perform the following steps also.
   (1) Remove the scavenge pump. Ref. to LUBRICATION(w/o STI)>Scavenge Pump>REMOVAL.
   (2) Remove the cam sprocket RH. Ref. to MECHANICAL(w/o STI)>Cam Sprocket>REMOVAL > CAM SPROCKET RH.
8. Set the part so that the cam carrier RH is on the upper side.
9. Loosen the bolts holding the cam carrier RH equally, a little at a time in numerical sequence as shown in the figure and remove the cam carrier RH.
10. Remove the O-ring and the roller rocker arm from cylinder head RH.
    Note:
    Be careful not to confuse the roller rocker arms.
11. Remove the valve shim and the roller rocker arm pivot from cylinder head RH.
    Note:
    Be careful not to confuse the valve shim and the roller rocker arm pivot.
12. Remove the liquid gasket from cam carrier RH and cylinder head RH.

2. CAM CARRIER LH

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>REMOVAL > TIMING CHAIN LH.
3. Remove the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>REMOVAL.
4. Remove the rocker cover LH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>REMOVAL > ROCKER COVER LH.
5. Remove the clip holding the engine wiring harness from cam carrier LH.
6. Remove the fuel pipe protector from the high-pressure fuel pump case.
7. Remove the fuel pipe insulator No. 1 from the high pressure fuel pump and high pressure fuel delivery pipe.

8. Disconnect the connector (A) from the high-pressure fuel pump, and remove the fuel delivery pipe from the high-pressure fuel pump.
   Note:
   Disconnect the quick connector as shown in the figure.
   (a) Slider

9. Remove the high-pressure fuel delivery pipe from the high-pressure fuel pump and fuel injector pipe.
10. Disconnect the water pipe hose from oil pan upper, and remove the water pipe assembly.
11. When disassembling the cam carrier LH
    Note:
    When disassembling the cam carrier LH, perform the following steps also.
    (1) Remove the high-pressure fuel pump. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Pump>REMOVAL.
    (2) Remove the cam sprocket LH. Ref. to MECHANICAL(w/o STI)>Cam Sprocket>REMOVAL > CAM SPROCKET LH.
12. Set the part so that the cam carrier LH is on the upper side.
13. Loosen the bolts holding the cam carrier LH equally, a little at a time in numerical sequence as shown in the figure and remove the cam carrier LH.
14. Remove the O-ring and the roller rocker arm from cylinder head LH.
    Note:
    Be careful not to confuse the roller rocker arms.
15. Remove the valve shim and the roller rocker arm pivot from cylinder head LH.
    Note:
    Be careful not to confuse the valve shim and the roller rocker arm pivot.
16. Remove the liquid gasket from cam carrier LH and cylinder head LH.

MECHANICAL(w/o STI) > Cam Carrier

INSTALLATION

1. CAM CARRIER RH

1. Set the part so that the cylinder head RH is on the upper side.
2. Apply engine oil to the valve shim and the roller rocker arm pivot, and install the valve shim and the roller rocker arm pivot to the cylinder head RH.
3. Apply engine oil to the O-ring and the roller rocker arm, and install the O-ring and the roller rocker arm to the cylinder head RH.
   Note:
   Use new O-rings.
4. Apply liquid gasket to the mating surface of cam carrier RH as shown in the figure.
   Note:
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder head RH and cam carrier RH.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   3±0.5 mm (0.1181±0.0197 in)

(A) Range A

(B) ⌀18 mm (0.7087 in)

(C) Liquid gasket applying position of mating surfaces other than range A

(D) Liquid gasket applying position of mating surfaces of range A

(E) ⌀3±0.5 mm (0.1181±0.0197 in)

(F) 1 mm (0.0394 in) or less

(G) 0±0.5 mm (0±0.0197 in)

(H) Chamfer edge

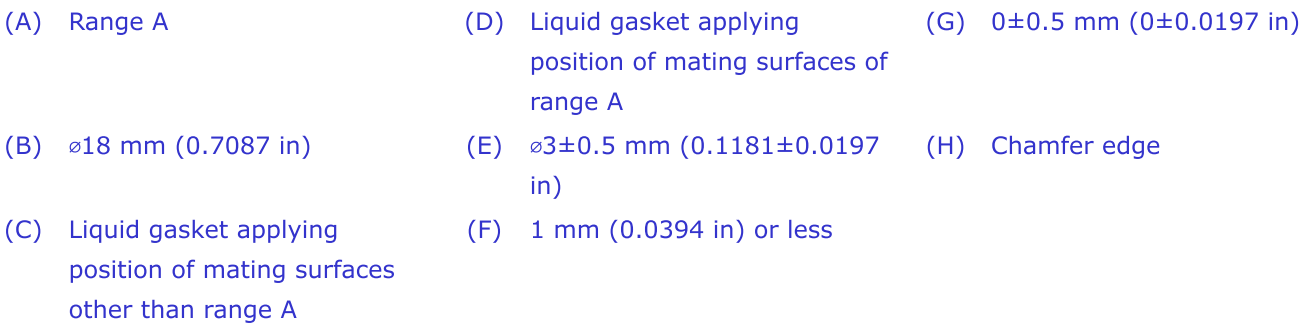
5. Install the cam carrier RH to the cylinder head RH.
   (1) Mount the cam carrier RH, then tighten all bolts with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   Note:
   Set the intake camshaft RH and the exhaust camshaft RH to the zero-lift position as shown in the figure.
   (2) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.
   (3) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   (4) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.
   (5) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   (6) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.
   (7) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   Note:
   After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.
6. Set the part so that the intake manifold is on the upper side.
7. When the cam carrier RH has been disassembled
   Note:
   When the cam carrier RH has been disassembled, perform the following steps also.
   (1) Install the cam sprocket RH. Ref. to MECHANICAL(w/o STI)>Cam Sprocket>INSTALLATION > CAM SPROCKET RH.
   (2) Install the scavenge pump. Ref. to LUBRICATION(w/o STI)>Scavenge Pump>INSTALLATION.
   Note:
   When installing the scavenge pump, do not turn the intake camshaft RH to the outside of range of zero-lift (in range where it can be turned lightly by hand).
8. Check the cam clearance. Ref. to MECHANICAL(w/o STI)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.
9. Connect the water pipe hose to oil pan upper and EGR cooler, and install the water pipe assembly.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
10. Secure the engine wiring harness to the cam carrier RH with a clip.
11. Install the oil pipe assembly. Ref. to LUBRICATION(w/o STI)>Oil Pipe>INSTALLATION > OIL PIPE ASSEMBLY.

12. Install the rocker cover RH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>INSTALLATION > ROCKER COVER RH.
13. Install the timing chain RH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN RH.
14. Install the engine to the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>INSTALLATION.

2. CAM CARRIER LH

1. Set the part so that the cylinder head LH is on the upper side.
2. Apply engine oil to the valve shim and the roller rocker arm pivot, and install the valve shim and the roller rocker arm pivot to the cylinder head LH.
3. Apply engine oil to the O-ring and the roller rocker arm, and install the O-ring and the roller rocker arm to the cylinder head LH.
   Note:
   Use new O-rings.
4. Apply liquid gasket to the mating surface of cam carrier LH as shown in the figure.
   Note:
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder head LH and cam carrier LH.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   3±0.5 mm (0.1181±0.0197 in)



(A)	Range A	(D)	Liquid gasket applying position of mating surfaces of range A	(G)	0±0.5 mm (0±0.0197 in)
(B)	⌀18 mm (0.7087 in)	(E)	⌀3±0.5 mm (0.1181±0.0197 in)	(H)	Chamfer edge
(C)	Liquid gasket applying position of mating surfaces other than range A	(F)	1 mm (0.0394 in) or less		

5. Install the cam carrier LH to the cylinder head LH.
   (1) Mount the cam carrier LH, then tighten all bolts with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   Note:
   Set the intake camshaft LH and the exhaust camshaft LH to the zero-lift position as shown in the figure.
   (2) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.
   (3) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   (4) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.
   (5) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.
   (6) Loosen the bolts (3 places) by 180° in numerical order as shown in the figure.

(7) Tighten the bolts (3 places) with a torque of 18 N·m (1.8 kgf-m, 13.3 ft-lb) in numerical order as shown in the figure.

Note:

After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.

6. Set the part so that the installation surface of the intake manifold is on the upper side.
7. When the cam carrier LH has been disassembled

Note:

When the cam carrier LH has been disassembled, perform the following steps also.

(1) Install the cam sprocket LH. Ref. to MECHANICAL(w/o STI)>Cam Sprocket>INSTALLATION > CAM SPROCKET LH.

(2) Install the high-pressure fuel pump. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Pump>INSTALLATION.

Note:

Install the high-pressure fuel pump so that the cam lobes on the intake camshaft LH are positioned as shown in the figure. Perform adjustment within the range of zero-lift (in range where it can be turned lightly by hand).

8. Check the cam clearance. Ref. to MECHANICAL(w/o STI)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.
9. Connect the water pipe hose to oil pan upper, and install the water pipe assembly.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

10. Temporarily tighten the flare nuts of the high-pressure fuel delivery pipe to the high-pressure fuel pump and fuel injector pipe by hand until they are seated, and then tighten the flare nuts.

Caution:

Always use a new high-pressure fuel delivery pipe.

Tightening torque:

28 N·m (2.9 kgf-m, 20.7 ft-lb)

11. Install the fuel delivery pipe to the high-pressure fuel pump, and connect the connector (A) to the high-pressure fuel pump.

Caution:

- **Check that there is no damage or dust on the quick connector. If necessary, clean the seal surface of the pipe.**
- **When connecting the quick connector, make sure to insert it all the way in before locking the slider.**
- **When it is difficult to lock the slider, check that the connector is fully inserted.**
- **After locking the slider, pull the quick connector itself to the disconnecting direction, and then push to the connecting direction in order to confirm secure connection. Make sure to end this check with a pushing step.**

Note:

Connect the quick connector as shown in the figure.

(a) Slider

12. Install the fuel pipe insulator No. 1 to the high pressure fuel pump and high pressure fuel delivery pipe.
13. Temporarily tighten the bolts securing the fuel pipe protector to the high-pressure fuel pump case.

14. Secure the engine wiring harness to the cam carrier LH with a clip.
15. Install the rocker cover LH. Ref. to MECHANICAL(w/o STI)>Rocker Cover>INSTALLATION > ROCKER COVER LH.
16. Install the intake manifold. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Intake Manifold>INSTALLATION.
17. Tighten the bolts securing the fuel pipe protector to the high-pressure fuel pump case.
    Tightening torque:
    19 N·m (1.9 kgf-m, 14.0 ft-lb)
18. Install timing chain LH. Ref. to MECHANICAL(w/o STI)>Timing Chain Assembly>INSTALLATION > TIMING CHAIN LH.
19. Install the engine to the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>INSTALLATION.

MECHANICAL(w/o STI) > Cam Carrier

DISASSEMBLY

1. CAM CARRIER RH

1. Remove the oil pipe from cam carrier RH.
2. Loosen the bolts (front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH, and exhaust rear camshaft cap RH) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.
   Note:
   Arrange camshaft caps in order so that they can be installed in their original positions.
3. Remove the intake camshaft RH and the exhaust camshaft RH from cam carrier RH.
4. Remove the filter from cam carrier RH.
5. Remove the liquid gasket from cam carrier RH, front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH.

2. CAM CARRIER LH

1. Loosen the bolts (front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.
   Note:
   Arrange camshaft caps in order so that they can be installed in their original positions.
2. Remove the intake camshaft LH and the exhaust camshaft LH from cam carrier LH.
3. Remove the filter from cam carrier LH.
4. Remove the liquid gasket from cam carrier LH, front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH.

MECHANICAL(w/o STI) > Cam Carrier

ASSEMBLY

1. CAM CARRIER RH

1. Install the filter to the cam carrier RH.

Note:
Use a new filter.
Filter insert position:

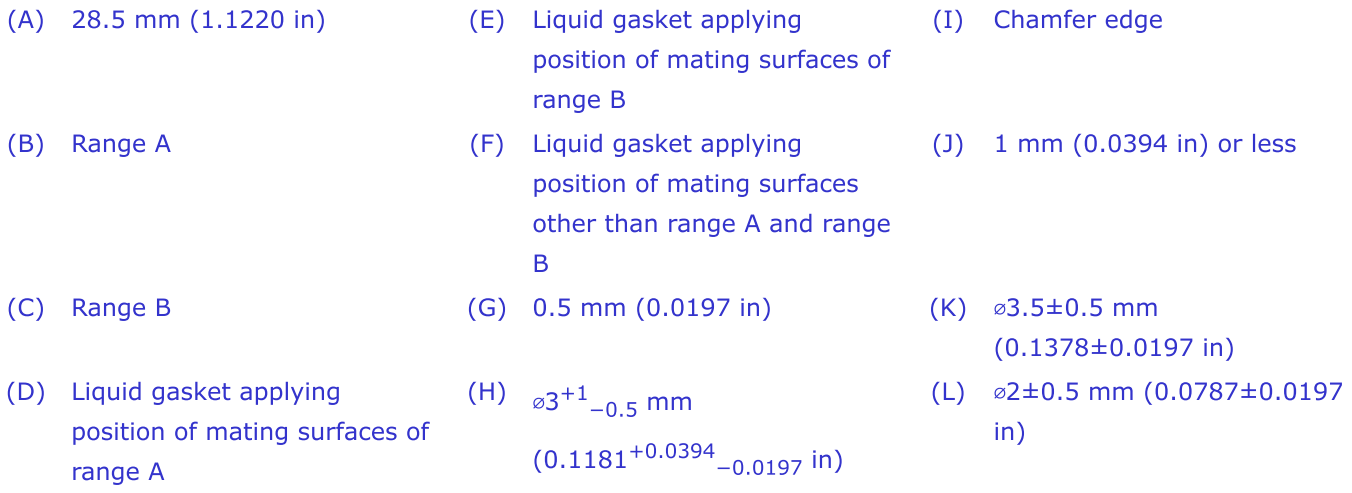
Cam carrier RH end face $0^{+0}_{-0.5}$ mm ($^{+0}_{-0.0197}$ in) position

(A) 0 — 0.5 mm (0 — 0.0197 in)

2. Set the intake camshaft RH and the exhaust camshaft RH to the cam carrier RH.
Note:
Apply engine oil to the journals of cam carrier RH before setting the intake camshaft RH and exhaust camshaft RH.
3. Install the front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH.
(1) Apply liquid gasket to the mating surface of front camshaft cap RH, intake rear camshaft cap RH and exhaust rear camshaft cap RH as shown in the figure.
Caution:
- **Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to flow toward camshaft journal, resulting in engine seizure.**
- **Do not apply liquid gasket excessively to the intake center camshaft cap RH and exhaust center camshaft cap RH.**

Note:
- **Before applying liquid gasket, degrease the old liquid gasket seal surface of the front camshaft cap RH, intake rear camshaft cap RH, exhaust rear camshaft cap RH, and cam carrier RH.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:
THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
Liquid gasket applying diameter:
Mating surfaces other than ranges A and B
2±0.5 mm (0.0787±0.0197 in)
Mating surfaces of range A
$3^{+1}_{-0.5}$ mm ($0.1181^{+0.0394}_{-0.0197}$ in)
Mating surfaces of range B
3.5±0.5 mm (0.1378±0.0197 in)



(A) 28.5 mm (1.1220 in)
(B) Range A
(C) Range B
(D) Liquid gasket applying position of mating surfaces of range A
(E) Liquid gasket applying position of mating surfaces of range B
(F) Liquid gasket applying position of mating surfaces other than range A and range B
(G) 0.5 mm (0.0197 in)
(H) ⌀$3^{+1}_{-0.5}$ mm ($0.1181^{+0.0394}_{-0.0197}$ in)
(I) Chamfer edge
(J) 1 mm (0.0394 in) or less
(K) ⌀3.5±0.5 mm (0.1378±0.0197 in)
(L) ⌀2±0.5 mm (0.0787±0.0197 in)

(2) Apply engine oil to the journals of each camshaft cap before setting the camshaft cap.
(3) Tighten the bolts which secure front camshaft cap RH, intake center camshaft cap RH, intake rear camshaft cap RH, exhaust center camshaft cap RH and exhaust rear camshaft cap RH in numerical order as shown in the figure.
Tightening torque:
18 N·m (1.8 kgf-m, 13.3 ft-lb)
(4) Remove the liquid gasket from the installation area of scavenge pump.
Note:
This procedure is required to prevent the coupling of scavenge pump and liquid gasket contacting with each other resulting in poor sealing.
1. Remove the liquid gasket in portions (A) in the arrowed direction (from inside to outside) shown in figure using a scraper.
Caution:
To avoid poor sealing, pay special attention to the following:
- **Remove the liquid gasket within five minutes after installing the camshaft cap.**
- **Do not use cloth when removing the liquid gasket.**
- **Do not remove liquid gasket in the opposite direction from arrow (from outside to inside).**

4. Install the oil pipe to the cam carrier RH.
(1) Set the oil pipe to the cam carrier RH, and temporarily tighten the bolts which secure the oil pipe to the cam carrier RH.
Note:
Use a new gasket.
(2) Tighten the bolts which secures the oil pipe to the cam carrier RH in numerical order as shown in the figure.
Tightening torque:
T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
T2: 31 N·m (3.2 kgf-m, 22.9 ft-lb)

2. CAM CARRIER LH

1. Install the filter to the cam carrier LH.
Note:
Use a new filter.
Filter insert position:
Cam carrier LH end face $0^{+0}_{-0.5}$ mm ($^{+0}_{-0.0197}$ in) position
(A) 0 — 0.5 mm (0 — 0.0197 in)

2. Set the intake camshaft LH and the exhaust camshaft LH to the cam carrier LH.
Note:
Apply engine oil to the journals of cam carrier LH before setting the intake camshaft LH and exhaust camshaft LH.
3. Install the front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH.
(1) Apply liquid gasket to the mating surface of front camshaft cap LH, intake rear camshaft cap LH and exhaust rear camshaft cap LH as shown in the figure.

Caution:

- **Do not apply liquid gasket excessively. Applying excessively may cause excess gasket to flow toward camshaft journal, resulting in engine seizure.**
- **Do not apply liquid gasket excessively to the intake center camshaft cap LH and exhaust center camshaft cap LH.**

Note:

- **Before applying liquid gasket, degrease the old liquid gasket seal surface of the front camshaft cap LH, intake rear camshaft cap LH, exhaust rear camshaft cap LH, and cam carrier LH.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

Mating surfaces other than ranges A, B and C

2±0.5 mm (0.0787±0.0197 in)

Mating surfaces of range A

3.5±0.5 mm (0.1378±0.0197 in)

Mating surfaces of range B

3±0.5 mm (0.1181±0.0197 in)

Mating surfaces of range C

$3^{+1}_{-0.5}$ mm ($0.1181^{+0.0394}_{-0.0197}$ in)

(A)	28.5 mm (1.1220 in)	(G)	Liquid gasket applying position of mating surfaces of range A	(M)	Chamfer edge
(B)	11.6 mm (0.4567 in)	(H)	Liquid gasket applying position of mating surfaces of range B	(N)	⌀3±0.5 mm (0.1181±0.0197 in)
(C)	5.1 mm (0.2008 in)	(I)	Liquid gasket applying position of mating surfaces of range C	(O)	$\varnothing 3^{+1}_{-0.5}$ mm ($0.1181^{+0.0394}_{-0.0197}$ in)
(D)	Range A	(J)	Liquid gasket applying position of mating surfaces other than range A, range B and range C	(P)	1 mm (0.0394 in) or less
(E)	Range B	(K)	0.5 mm (0.0197 in)	(Q)	⌀2±0.5 mm (0.0787±0.0197 in)
(F)	Range C	(L)	⌀3.5±0.5 mm (0.1378±0.0197 in)		

(2) Apply engine oil to the journals of each camshaft cap before setting the camshaft cap.

(3) Tighten the bolts which secure front camshaft cap LH, intake center camshaft cap LH, intake rear camshaft cap LH, exhaust center camshaft cap LH and exhaust rear camshaft cap LH in numerical order as shown in the figure.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

INSPECTION

1. Visually check the cam carrier filter, and if clogging is found, replace with a new part.
2. Check the camshaft journals for damage and wear. Replace the camshaft if faulty.
3. Check the cam face condition of camshaft, and remove the minor faults by grinding with oil stone. Replace the camshaft if uneven wear is found.
4. Using a dial gauge, check the camshaft bend. If it exceeds the limit, replace the camshaft.
   Note:
   Measurement should be performed at a temperature of 20°C (68°F).
   Camshaft bend:
   Limit
   0.020 mm (0.0008 in)
5. Check the cam lobe height "H" and cam base circle diameter "A" of camshaft as shown in the figure, using micrometer. If it is not within the standard, replace the camshaft.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Perform measurement of cam lobe height for fuel pump drive section at three points.**

   Camshaft cam lobe overall height H:
   Intake
   Valve drive section
   Standard
   40.34 — 40.44 mm (1.5882 — 1.5921 in)
   Fuel pump drive section
   Standard
   41.95 — 42.05 mm (1.6516 — 1.6555 in)
   Exhaust
   Standard
   40.20 — 40.30 mm (1.5827 — 1.5866 in)
   Camshaft cam base circle diameter A:
   Standard
   34.0 mm (1.3386 in)

   (A) Valve drive section (B) Fuel pump drive section
6. Check the camshaft journal outer diameter using micrometer. If it is not within the standard, replace the camshaft.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Measure outer diameter of each journal at several points, and read the value of most worn location.**

   Camshaft journal outer diameter:
   Standard
   25.946 — 25.963 mm (1.0215 — 1.0222 in)
7. Using a dial gauge, check the thrust clearance of the camshaft. If it is not within the standard or if uneven wear is found, replace each camshaft cap and cam carrier as a set. If necessary replace the camshaft.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Set the dial gauge at end surface of camshaft.**

Camshaft thrust clearance:

Standard

0.068 — 0.116 mm (0.0027 — 0.0047 in)

8. Check the oil clearance on the camshaft using a plastigauge.

Note:

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

(1) Remove the liquid gasket from cam carrier, front camshaft cap, intake rear camshaft cap and exhaust rear camshaft cap.

(2) Clean each camshaft cap and cam carrier journals.

(3) Set the camshaft to the cam carrier.

(4) Place a plastigauge across the camshaft journals of each camshaft and set the camshaft caps.

(5) Tighten the bolts which secure front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap in numerical order as shown in the figure.

Tightening torque:

18 N·m (1.8 kgf-m, 13.3 ft-lb)

(6) Loosen the bolts (front camshaft cap, intake center camshaft cap, intake rear camshaft cap, exhaust center camshaft cap and exhaust rear camshaft cap) equally, a little at a time in numerical sequence as shown in the figure, and remove each camshaft cap.

(7) Determine camshaft oil clearance by matching the widest point of plastigauge on each journal against scale printed on a package of plastigauge. If it is not within the standard, replace each camshaft cap and cam carrier as a set. If necessary replace the camshaft.

Camshaft oil clearance:

Standard

0.037 — 0.072 mm (0.0015 — 0.0028 in)

(8) Completely remove the plastigauge.

REMOVAL

1. CYLINDER HEAD RH

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the engine wiring harness. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Wiring Harness>REMOVAL.
3. Remove the cam carrier RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>REMOVAL > CAM CARRIER RH.
4. Remove the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
5. When disassembling the cylinder head RH
   Note:
   When disassembling the cylinder head RH, perform the following steps also.
   (1) Remove the air intake adapter RH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Tumble Generator Valve Assembly>REMOVAL.
   (2) Remove the fuel injector RH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>REMOVAL > FUEL INJECTOR RH.
   (3) Remove the EGR cooler. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Cooler>REMOVAL.
6. Set the part so that the cylinder head RH is on the upper side.
7. Loosen the bolts securing the cylinder head RH equally, a little at a time in numerical sequence as shown in the figure and remove the cylinder head bolt.
8. While tapping the cylinder head RH with a plastic hammer, separate to remove it from the cylinder block RH.
9. Remove the cylinder head gasket RH.
   Caution:
   Be careful not to scratch the mating surface of cylinder head and cylinder block.
10. Remove the liquid gasket from the cylinder head RH and cylinder block RH.

2. CYLINDER HEAD LH

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the engine wiring harness. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Wiring Harness>REMOVAL.
3. Remove the cam carrier LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>REMOVAL > CAM CARRIER LH.
4. Remove the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>REMOVAL > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.
5. Remove the A/C compressor. Ref. to HVAC SYSTEM (HEATER, VENTILATOR AND A/C)>Compressor>REMOVAL.
6. When disassembling the cylinder head LH

Note:
When disassembling the cylinder head LH, perform the following steps also.
(1) Remove the air intake adapter LH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Tumble Generator Valve Assembly>REMOVAL.
(2) Remove the fuel injector LH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>REMOVAL > FUEL INJECTOR LH.

7. Set the part so that the cylinder head LH is on the upper side.
8. Loosen the bolts securing the cylinder head LH equally, a little at a time in numerical sequence as shown in the figure and remove the cylinder head bolt.
9. While tapping the cylinder head LH with a plastic hammer, separate to remove it from the cylinder block LH.
10. Remove the cylinder head gasket LH.
Caution:
Be careful not to scratch the mating surface of cylinder head and cylinder block.
11. Remove the liquid gasket from cylinder head LH and cylinder block LH.

INSTALLATION

1. CYLINDER HEAD RH

1. Set the part so that the cylinder block RH is on the upper side.
2. Clean the bolt holes in the cylinder block RH.
Caution:
To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.
3. Apply liquid gasket to both sides of the cylinder head gasket RH as shown in the figure.
Note:
- **Use a new cylinder head gasket RH.**
- **Before applying liquid gasket, degrease the mating surface of cylinder blocks RH and cylinder head RH.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:
THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
Liquid gasket applying diameter:
3±1 mm (0.1181±0.0394 in)

(A)	Liquid gasket applying position to the cylinder head side	(C)	1 mm (0.0394 in) or less	(E)	Cylinder head gasket edge
(B)	Liquid gasket applying position to the cylinder block side	(D)	⌀3±1 mm (0.1181±0.0394 in)	(F)	Overlap margin of bead end and liquid gasket: 3 — 10 mm (0.1181 — 0.3937 in)

4. Attach the cylinder head gasket RH.
Note:
Check that liquid gasket RH is squeezed out from the cylinder head gasket.

5. Install the cylinder head RH to the cylinder block RH.

Caution:

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

(1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.

(2) Mount the cylinder head RH onto the cylinder block RH, and tighten all bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.

(3) Tighten all cylinder head bolts further with a torque of 100 N·m (10.2 kgf-m, 73.8 ft-lb) in numerical order as shown in the figure.

Caution:

If the bolt makes stick-slip sound during tightening, repeat the procedure from step 1). In that case, the cylinder head gasket RH can be reused. But it is necessary to remove liquid gasket completely from cylinder block RH, cylinder head RH and cylinder head gasket RH and re-apply to them.

(4) Loosen all cylinder head bolts by 360° in the numerical order as shown in the figure.

(5) Tighten all bolts with torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical sequence as shown in the figure.

(6) Tighten all cylinder head bolts with a torque of 42 N·m (4.3 kgf-m, 31.0 ft-lb) in numerical order as shown in the figure.

(7) Using angle gauge, tighten all cylinder head bolts with specified angle in numerical order as shown in the figure.

Tightening angle:

100°±2°

(8) Using angle gauge, tighten the cylinder head bolts (2 places) with specified angle in numerical order as shown in the figure.

Tightening angle:

100°±2°

(9) Using angle gauge, tighten the cylinder head bolts (4 places) with specified angle in numerical order as shown in the figure.

Note:

After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.

Tightening angle:

50°±2°

6. Set the part so that the installation surface of the intake manifold is on the upper side.

7. When the cylinder head RH has been disassembled

Note:

When the cylinder head RH has been disassembled, perform the following steps also.

(1) Install the EGR cooler. Ref. to EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)(w/o STI)>EGR Cooler>INSTALLATION.

(2) Install the fuel injector RH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>INSTALLATION > FUEL INJECTOR RH.

(3) Install the air intake adapter RH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Tumble Generator Valve Assembly>INSTALLATION.

8. Install the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE

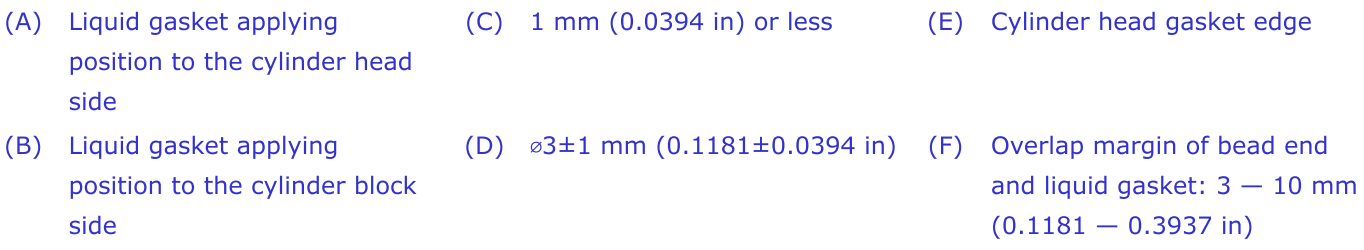
ASSY.

9. Install the cam carrier RH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER RH.
10. Install the engine wiring harness. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Wiring Harness>INSTALLATION.
11. Install the engine to the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>INSTALLATION.

2. CYLINDER HEAD LH

1. Set the part so that the cylinder block LH is on the upper side.
2. Clean the bolt holes in the cylinder block LH.
   Caution:
   To avoid erroneous tightening of the bolts, clean out the bolt holes sufficiently by blowing with compressed air to eliminate engine coolant etc.
3. Apply liquid gasket to both sides of the cylinder head gasket LH as shown in the figure.
   Note:
   - **Use a new cylinder head gasket LH.**
   - **Before applying liquid gasket, degrease the mating surface of cylinder blocks LH and cylinder head LH.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   3±1 mm (0.1181±0.0394 in)



(A)	Liquid gasket applying position to the cylinder head side	(C)	1 mm (0.0394 in) or less	(E)	Cylinder head gasket edge
(B)	Liquid gasket applying position to the cylinder block side	(D)	⌀3±1 mm (0.1181±0.0394 in)	(F)	Overlap margin of bead end and liquid gasket: 3 — 10 mm (0.1181 — 0.3937 in)

4. Attach the cylinder head gasket LH.
   Note:
   Check that liquid gasket is squeezed out from the cylinder head gasket LH.
5. Install the cylinder head LH to the cylinder block LH.
   Caution:
   Be careful not to scratch the mating surface of cylinder head LH and cylinder block LH.
   (1) Clean the cylinder head bolt threads and apply sufficient engine oil to the washer and cylinder head bolts threads.
   (2) Set the cylinder head LH to the cylinder block LH, then tighten all bolts with a torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical order as shown in the figure.
   (3) Tighten all cylinder head bolts further with a torque of 100 N·m (10.2 kgf-m, 73.8 ft-lb) in numerical order as shown in the figure.

Caution:
If the bolt makes stick-slip sound during tightening, repeat the procedure from step 1). In that case, the cylinder head gasket LH can be reused. But it is necessary to remove liquid gasket completely from cylinder block LH, cylinder head LH and cylinder head gasket LH and re-apply to them.

(4) Loosen all cylinder head bolts by 360° in the numerical order as shown in the figure.

(5) Tighten all bolts with torque of 20 N·m (2.0 kgf-m, 14.8 ft-lb) in numerical sequence as shown in the figure.

(6) Tighten all cylinder head bolts with a torque of 42 N·m (4.3 kgf-m, 31.0 ft-lb) in numerical order as shown in the figure.

(7) Using angle gauge, tighten all cylinder head bolts with specified angle in numerical order as shown in the figure.

Tightening angle:

100°±2°

(8) Using angle gauge, tighten the cylinder head bolts (2 places) with specified angle in numerical order as shown in the figure.

Tightening angle:

100°±2°

(9) Using angle gauge, tighten the cylinder head bolts (4 places) with specified angle in numerical order as shown in the figure.

Note:
After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.

Tightening angle:

50°±2°

6. Set the part so that the installation surface of the intake manifold is on the upper side.

7. When the cylinder head LH has been disassembled

Note:
When the cylinder head LH has been disassembled, perform the following steps also.

(1) Install the fuel injector LH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Fuel Injector>INSTALLATION > FUEL INJECTOR LH.

(2) Install the air intake adapter LH. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Tumble Generator Valve Assembly>INSTALLATION.

8. Install the A/C compressor. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER LH.

9. Install the high-pressure fuel delivery pipe assembly. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>High Pressure Fuel Delivery Pipe>INSTALLATION > HIGH-PRESSURE FUEL DELIVERY PIPE ASSY.

10. Install the cam carrier LH. Ref. to MECHANICAL(w/o STI)>Cam Carrier>INSTALLATION > CAM CARRIER LH.

11. Install the engine wiring harness. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Wiring Harness>INSTALLATION.

12. Install the engine to the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>INSTALLATION.

DISASSEMBLY

1. Remove the chain cover securing bolt from the cylinder head LH.
2. Remove the stud bolts from the cylinder head.
3. Remove the valve collet, valve, valve spring retainer, valve spring and valve spring seat from the cylinder head RH.

   Warning:

   Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL". Ref. to MECHANICAL(w/o STI)>Cylinder Head>DISPOSAL.

   Caution:

   During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.

   Note:

   - **Mark each part to prevent confusion.**
   - **Keep all the removed parts in order for re-installing in their original positions.**

   (1) Compress the valve spring and remove the valve collet using a valve spring compressor.
   (2) Remove valve, valve spring retainer, valve spring and valve spring seat.
4. Remove the valve collet, valve, valve spring retainer, valve spring and valve spring seat from the cylinder head LH.
5. Remove the valve oil seals from valve guides of cylinder head RH.

   Caution:

   - **During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.**
   - **Use special care not to damage the cylinder head RH and guide during work.**

   Note:

   For removal of valve guide, refer to INSPECTION. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE & VALVE GUIDE.
6. For cylinder head LH, remove the valve oil seal in the same manner.

MECHANICAL(w/o STI) > Cylinder Head

ASSEMBLY

(1)	Exhaust valve	(6)	Valve spring	(11)	Roller rocker arm
(2)	Intake valve	(7)	Valve spring retainer	(12)	Exhaust valve guide
(3)	Intake valve guide	(8)	Valve collet	(13)	Exhaust valve oil seal
(4)	Valve spring seat	(9)	Valve shim		
(5)	Intake valve oil seal	(10)	Roller rocker arm pivot		

1. Using the ST, install the valve oil seals to valve guides of cylinder head RH.

Caution:

- **During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.**
- **Use special care not to damage the cylinder head RH and guide during work.**
- **When installing the valve oil seal, press the ST with hands to install it and never drive the ST with a plastic hammer, otherwise the valve oil seal can be damaged.**

Note:

- **Use a new valve oil seal.**
- **Apply engine oil to valve oil seal before installing.**
- **The intake valve oil seals and exhaust valve oil seals are distinguished by their colors.**
  Identification colors:
  Intake [Gray]
  Exhaust [Green]
- **For installation of valve guide, refer to INSPECTION. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE & VALVE GUIDE.**

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2. For cylinder head LH, install the valve oil seal in the same manner.
3. Install the valve spring seat, valve spring, valve spring retainer, valve and valve collet to the cylinder head RH.
   Caution:
   During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head RH.
   (1) Set the valve spring seat, valve spring and valve spring retainer onto the cylinder head RH.
   Note:
   Be sure to install the valve spring with its close-coiled end facing the cylinder head side.
   (2) Coat the valve 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.
   (3) Compress the valve spring and install the valve collet using a valve spring compressor.
4. Install the valve spring seat, valve spring, valve spring retainer, valve and valve collet to the cylinder head LH.
5. Lightly tap the valve spring retainer with a plastic hammer, and make sure that the valve collet is securely attached.
6. Install the stud bolts onto cylinder heads.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
7. Install the chain cover securing bolt to the cylinder head LH.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

MECHANICAL(w/o STI) > Cylinder Head

INSPECTION

1. CYLINDER HEAD

1. Visually inspect to make sure that there are no cracks, scratches or other damage.
2. Use liquid penetrant tester on the important sections to check for fissures.
3. Check that there are no marks of gas leaking or water leaking on gasket attachment surface.
4. Check the warping of the cylinder head mating surface that mates with cylinder block at the locations shown in the figure using a straight edge (A) and thickness gauge (B). If it exceeds the limit, correct the surface by grinding it with a surface grinder or replace the cylinder head.

   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **If there is warpage on the cylinder head mating surface, the cylinder head bolt tightening torque and angle tightening may be improper. When installing the cylinder head, make sure that tightening torque and angle tightening work is performed precisely according to the operation procedures.**
   - **When the cylinder head is replaced, lap each valve. Refer to "VALVE SEAT" for lapping. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.**

   Cylinder head warpage:

   Limit

   0.020 mm (0.0008 in)

   Cylinder head grinding limit:

   To 98.4 mm (3.8740 in)

   Cylinder head height:

   Standard

   98.5 mm (3.8779 in)

2. VALVE & VALVE GUIDE

Warning:
Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL". Ref. to MECHANICAL(w/o STI)>Cylinder Head>DISPOSAL.

1. Check the valve flange and stem for damage, wear or deformation.
2. Measure the thickness "H" of valve head edge as shown in the figure using a caliper gauge. If it is not within the standard, replace the valve.

   Note:
   - **It is possible to differentiate between the intake valve and the exhaust valve by their overall length.**

     Valve overall length:

     Intake

     104.95 mm (4.1319 in)

     Exhaust

     97.9 mm (3.8543 in)
   - **When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.**

   Valve head edge thickness H:

   Intake (A)

Standard

0.8 — 1.2 mm (0.0315 — 0.0472 in)

Exhaust (B)

Standard

1.0 — 1.4 mm (0.0394 — 0.0551 in)

3. Check the clearance between valve and valve guide. Check the clearance between valve and valve guide by measuring the outer diameter of valve stem and the inner diameter of valve guide respectively.

(1) Measure the outer diameter of valve stem with a micrometer. If it is not within the standard, replace the valve.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Measure the outer diameter of the valve stem at the six locations as shown in the figure, and read the value of most worn location.**
- **When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.**

Valve stem outer diameter:

Intake

Standard

5.455 — 5.470 mm (0.2148 — 0.2154 in)

Exhaust

Standard

5.445 — 5.460 mm (0.2144 — 0.2150 in)

(2) Using a caliper gauge, measure the inner diameter of valve guide. If it is not within the standard, replace the valve guide. For replacement procedure, refer to step 4).

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Measure the inner diameter of the valve guide at the six locations as shown in the figure, and read the value of most worn location.**

Valve guide inner diameter:

Standard

5.500 — 5.512 mm (0.2165 — 0.2170 in)

(3) Calculate the clearance between valve and valve guide.

Clearance between valve and valve guide:

Intake

Standard

0.030 — 0.057 mm (0.0012 — 0.0022 in)

Exhaust

Standard

0.040 — 0.067 mm (0.0016 — 0.0026 in)

4. If the clearance between valve and valve guide exceeds the standard, replace the valve or valve guide, whichever shows the greater amount of wear or damage. For replacement procedure of valve guide, refer to the following.

Note:

When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.

(1) Insert ST into the valve guide with the combustion chamber upward and remove the valve guide using plastic hammer.

Caution:

- **Place a wood board wrapped with a waste cloth to stabilize the cylinder head before work.**
- **Use special care not to damage the cylinder head during work.**
- **Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.**

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(2) Before installing the valve guide, make sure that neither scratches nor damages exist on the inner surface of valve guide installation holes of cylinder head.

(3) Draw a reference line (A) for insert on the valve guide using a marker as shown in the figure.

Note:

- **Use a new valve guide.**
- **A reference line for insert is used as a guide when tapping-in the valve guide.**

Valve guide inserting reference line position L:

15 mm (0.5906 in)

(4) Apply a enough coat of engine oil to the valve guide, and set the valve guide on the cylinder head with the combustion chamber downward.

(5) Insert the ST into the valve guide, and tap-in the valve guide to the reference line (A) for insert using plastic hammer.

Caution:

- **During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head.**
- **Use special care not to damage the cylinder head during work.**
- **Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.**

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(6) Measure the valve guide protrusion amount "L" as shown in the figure using a caliper gauge. Insert the ST into the valve guide again, and tap-in the valve guide so that it is positioned within standard by referring to the measured value using plastic hammer.

Caution:

- **During work, place a waste cloth, etc. to avoid scratching the mating surface of the cylinder head.**
- **Use special care not to damage the cylinder head during work.**
- **Always strike the ST vertically with a plastic hammer. Otherwise, the ST can be damaged.**

Note:

Be careful not to tap-in excessively by repeating the steps of Tapping-in → Measurement → Tapping-in → Measurement ... when installing the valve guide.

ST 499765700 VALVE GUIDE REMOVER AND INSTALLER

Valve guide protrusion amount L:

Standard

11.4 — 11.8 mm (0.4488 — 0.4646 in)

(7) Ream the inside of valve guide with the combustion chamber upward using the ST. Put the ST in valve guide, and rotate the ST slowly clockwise while pushing it lightly. Bring the ST back while rotating it clockwise.

Caution:

- **Place a wood board wrapped with a waste cloth to stabilize the cylinder head before work.**
- **Use special care not to damage the cylinder head during work.**

Note:

- **Apply engine oil to the ST.**
- **If the inner surface of valve guide is damaged, the edge of ST should be slightly ground with oil stone.**
- **If the inner surface of valve guide becomes lustrous and the ST does not chip, use a new ST or remedy the ST.**

ST 499765900 VALVE GUIDE REAMER

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

(9) Check the seating width between valve and valve seat. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.

3. VALVE & VALVE SHIM

Warning:

Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and thus prone to serious chemical reaction. When handling or disposing of the valve, be sure to confirm "DISPOSAL". Ref. to MECHANICAL(w/o STI)>Cylinder Head>DISPOSAL.

1. Visually check the valve shim for damage.
2. Check the clearance between valve and valve shim. Check the clearance between valve and valve shim by measuring the outer diameter of valve stem end and the inner diameter of valve shim respectively.

(1) Measure the outer diameter of valve stem end with a micrometer. If it is not within the standard, replace the valve.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Measure the outer diameter of the valve stem end at the two locations as shown in the figure, and read the value of most worn location.**
- **When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.**

Valve stem end outer diameter:

Intake

Standard

5.455 — 5.470 mm (0.2148 — 0.2154 in)

Exhaust

Standard

5.445 — 5.460 mm (0.2144 — 0.2150 in)

(2) Using a caliper gauge, measure the inner diameter of valve shim. If it is not within the standard, replace the valve shim.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Measure the inner diameter of the valve shim at the two locations as shown in the figure, and read the value of most worn location.**
- **If the valve shim has to be replaced, check the cam clearance and replace with the suitable valve shim. Ref. to MECHANICAL(w/o STI)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.**

Valve shim inner diameter:

Standard

5.500 — 5.560 mm (0.2165 — 0.2189 in)

(3) Calculate the clearance between valve and valve shim. If the clearance exceeds the standard, replace the valve or valve shim, whichever shows the greater amount of wear or damage.

Note:

- **When the valve is replaced, lap the valve. Refer to "VALVE SEAT" for lapping. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSPECTION > VALVE SEAT.**
- **If the valve shim has to be replaced, check the cam clearance and replace with the suitable valve shim. Ref. to MECHANICAL(w/o STI)>Cam Clearance>INSPECTION > WHEN TIMING CHAIN ASSEMBLY IS REMOVED.**

Clearance between valve and valve shim:

Intake

Standard

0.030 — 0.105 mm (0.0012 — 0.0041 in)

Exhaust

Standard

0.040 — 0.115 mm (0.0016 — 0.0045 in)

4. VALVE SEAT

1. Check the valve seat for damage and deformation.
2. Check the seating width and seating position between valve and valve seat for the intake valve seat and exhaust valve seat.
   (1) Clean the valve and valve seat.
   (2) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the valve face (B).
   (3) Using the valve lapper, slowly insert the valve with red dye applied into the valve guide. Lightly press the valve against the valve seat without turning the valve, and then slowly pull out the valve.
   (4) Check the seating width "W" of valve seat as shown in the figure, using a caliper gauge. Check the seating width "W" between valve and valve seat by measuring the width of red dye on the seating surface of valve seat. If the seating width "W" between valve and valve seat is out of the standard, correct the seating surface of valve seat using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3).

Note:

- **When the red dye does not appear seamlessly on the valve seat seating surface, lap the valve. For lapping procedure, refer to step 4).**
- **When the red dye does not appear seamlessly on the valve seat seating surface even after lapping the valve, correct the valve seat seating surface using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3).**

Seating width W between valve and valve seat:

Intake

Standard

0.8 — 1.6 mm (0.0315 — 0.0630 in)

Exhaust

Standard

1.1 — 1.7 mm (0.0433 — 0.0669 in)

(5) Wipe off the red dye on the valve and valve seat completely.

(6) Coat the stem (A) of the valve lightly with engine oil and apply red dye evenly on the seating surface (B) between valve and valve seat.

(7) Using the valve lapper, slowly insert the valve into the valve guide. Lightly press the valve against the valve seat without turning the valve, and then slowly pull out the valve.

(8) Check the seating position between valve and valve seat. Check the seating position between valve and valve seat by checking the position of red dye on the valve face. If the seating position between valve and valve seat is not at the center of valve face, correct the seating surface of valve seat using the valve seat cutter. For correcting procedures of the valve seat seating surface, refer to step 3).

Seating position between valve and valve seat:

Valve face center

(9) After inspection, wipe off the red dye completely.

3. When correcting the seating surfaces of valve seat

(1) Correct the seating angle between valve and valve seat using the 45° valve seat cutter.

Note:

- **Select the size of the valve seat cutter by referring to the outer diameters of the intake valve and exhaust valve.**

  Valve outer diameter:

  Intake

  Standard

  33.9 — 34.1 mm (1.3346 — 1.3425 in)

  Exhaust

  Standard

  28.9 — 29.1 mm (1.1378 — 1.1457 in)
- **Grind the seating surface so that the seating width between valve and valve seat becomes slightly larger than the standard value.**
- **Gradually reduce pressure at the end of grinding process in order to avoid creating a gap on the valve seat correcting surface.**

Seating angle between valve and valve seat:

45°

(2) Lap the valve. For lapping procedure of the valve, refer to step 4).

(3) Check the seating position between valve and valve seat. For inspection of the seating position between valve and valve seat, refer to step 2).

Note:

This procedure is necessary to select a seat cutter to be used in step (4).

(4) Using a seat cutter, correct the valve seat so that the seating width between valve and valve seat becomes the standard value.

Note:

- **Select a proper valve seat cutter according to the following table.**

Seating position between valve and valve seat	Seat cutter selection
	When the seating position of valve face is high, grind the surface using the 30° seat cutter until seating width between valve and valve seat becomes the standard value.
	When the seating position of valve face is low, grind the surface using the 75° (IN) or 62° (EX) seat cutter until seating width between valve and valve seat becomes the standard value.
	When the seating position of valve face is at center, grind the surface evenly using the 30° and 75° (IN) or 62° (EX) seat cutters until seating width between valve and valve seat becomes the standard value.

- **Gradually reduce pressure at the end of grinding process in order to avoid creating a gap on the valve seat correcting surface.**

(5) Lap the valve. For lapping procedure of the valve, refer to step 4).

4. When lapping the valve

(1) Coat the stem (A) of the valve lightly with engine oil and put a small amount of valve compound evenly on the valve face (B).

Note:

- **Be careful not to put the valve compound more than necessary.**
- **To avoid damaging the valve guide and valve stem, be careful not to let the valve compound contact the valve stem.**

(2) Using the valve lapper, slowly insert the valve with the valve compound applied into the valve guide, and lap the seating surface between valve and valve seat. First, lift the valve and strike it against the valve seat twice, and then slightly turn the valve once. Repeat these steps as one set.

Note:

- **To prevent the seating width between valve and valve seat from exceeding the standard value, be careful not to keep turning the valve while pressing it against the valve seat during lapping.**
- **Be careful not to lift the valve too far during lapping in order to prevent the valve from coming off the valve guide.**

(3) Wipe off the valve compound on the valve and valve seat completely after lapping.

Note:

Be careful not to leave any valve compound in order to avoid malfunction.

(4) Check the seating width and seating position between valve and valve seat.

5. VALVE SPRING

1. Check the valve spring for damage and deformation.
2. Using a caliper gauge, valve spring tester, surface plate and try square, check the valve spring free length (reference), tension/spring height and squareness. If it is not within the standard, replace the valve spring.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **The free length of the valve spring is described as a reference. There is no need to replace the valve spring if the free length of the valve spring alone is out of standard.**
- **To check the squareness of the valve spring, stand the valve spring on a surface plate and check its deflection at the top of the valve spring using a try square.**

Valve spring free length (reference):

CVT model

Standard

41.68 mm (1.6409 in)

MT model

Standard

41.06 mm (1.6165 in)

Valve spring tension/spring height:

CVT model

Set

Standard

182 — 210 N (18.56 — 21.41 kgf, 40.92 — 47.22 lbf)/33.0 mm (1.2992 in)

Lift

Standard

502 — 554 N (51.19 — 56.49 kgf, 112.87 — 124.56 lbf)/22.0 mm (0.8661 in)

MT model

Set

Standard

182 — 210 N (18.56 — 21.41 kgf, 40.92 — 47.22 lbf)/33.0 mm (1.2992 in)

Lift

Standard

552 — 610 N (56.29 — 62.20 kgf, 124.11 — 137.15 lbf)/22.0 mm (0.8661 in)

Valve spring squareness:

Standard

2.5°, 1.8 mm (0.0709 in) or less

Warning:

- **Metallic sodium is encapsulated in the exhaust valve. Metallic sodium is a strong alkaline material and poses a risk of causing a severe chemical reaction. Use great care when handling and disposing it.**
- **If the metallic sodium gets into your eyes, you may lose your sight. If it touches the skin, you may get burned severely or if it touches flame, fire may be caused by chemical reaction. Therefore, do not disassemble the exhaust valve.**
- **It is safe when the metallic sodium encapsulated in the exhaust valve is not exposed to the air.**
- **When the exhaust valve is broken, remove the broken exhaust valve, and dispose of the metallic sodium.**
- **Do not intentionally break the exhaust valve and take out the metallic sodium.**
- **Identify the exhaust valve in which the metallic sodium is encapsulated with the embossed mark.**

  (a) Embossed mark
  (Identification: E3B)

Caution:

- **When disposing of the exhaust valve that is not broken, entrust the disposal processing to the industrial waste disposer in charge of dissolution treatment.**
- **When the exhaust valve is broken, remove it from the cylinder head, perform appropriate processing in the same manner as the general steel material.**
- **When performing processing, be careful of the following.**
  1. **Prepare the fire extinguisher nearby.**
  2. **Wear the protective goggles.**
  3. **Wear rubber gloves.**

1. Wear rubber gloves and remove the broken exhaust valve from the cylinder head.
2. Prepare large container (bucket or oil can) in well-ventilated place, and fill the container with water (10 L or more).
3. Using a pair of large tweezers or pliers, immerse the broken exhaust valve in the water vertically.
   Caution:
   - **Completely immerse the broken exhaust valve in the water.**
   - **Hydrogen gas is produced by the chemical reaction. Therefore, always keep the container away from open flames such as sparks.**
   - **Because the severe chemical reaction is developed, keep at least 2 to 3 m away from the container.**
4. After completion of chemical reaction (after the elapse of 4 to 5 hours), carefully take out the exhaust valve using a pair of large tweezers or pliers, and dispose of the exhaust valve according to the same disposal procedure as general steel materials.
   Caution:
   - **Concerning the liquid waste disposal of the liquid (sodium hydrate) produced in a chemical reaction, follow all governmental regulations and local regulations related to the liquid waste disposal.**
   - **If the liquid produced in a chemical reaction (sodium hydrate) should touch the skin, immediately wash it away with plenty water.**

REMOVAL

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the crankshaft position sensor plate with drive plate. (CVT model) Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>REMOVAL.
3. Remove the clutch disc and cover. (MT model) Ref. to CLUTCH SYSTEM>Clutch Disc and Cover>REMOVAL.
4. Remove the crankshaft position sensor plate with flywheel. (MT model) Ref. to CLUTCH SYSTEM>Flywheel>REMOVAL.
5. Remove the cylinder head. Ref. to MECHANICAL(w/o STI)>Cylinder Head>REMOVAL.
6. Remove the crank sprocket. Ref. to MECHANICAL(w/o STI)>Crank Sprocket>REMOVAL.
7. Remove the engine rear hanger from cylinder block RH.
8. Remove the bolts securing the water pipe assembly and PCV connector to the cylinder block, and remove the water pipe assembly and PCV connector as a set from cylinder block.
9. Remove the O-ring from the cylinder block and PCV connector.
10. Remove the knock sensor from cylinder block LH.
11. Remove the PCV valve from the cylinder block RH.
12. Remove the bolts securing the crankshaft position sensor holder from the cylinder block LH, and remove the crankshaft position sensor with crankshaft position sensor holder.
13. Remove the oil pan upper. Ref. to LUBRICATION(w/o STI)>Oil Pan>REMOVAL > OIL PAN UPPER.
14. Set the part so that the cylinder block RH is on the upper side.
15. Remove the #1 and #3 connecting rod caps and pistons from the cylinder block.

Note:
Mark each connecting rod cap and piston with a cylinder number.

(1) Turn the crankshaft so that the #1 connecting rod cap (A) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET

(2) Using ST, loosen the #1 connecting rod cap bolt, and remove the #1 connecting rod cap bolt and #1 connecting rod cap.

ST 18270AA020 SOCKET

(3) Using the ST, turn the crankshaft counterclockwise and separate the positions of the #1 pin (A) of crankshaft and the large end (B) of #1 connecting rod.

ST 18252AA000 CRANKSHAFT SOCKET

(4) Push the #1 connecting rod in the direction of the arrow, and remove the #1 piston with #1 connecting rod from the cylinder block.

(5) Turn the crankshaft so that the #3 connecting rod cap (A) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET

(6) Using ST, loosen the #3 connecting rod cap bolt, and remove the #3 connecting rod cap bolt and #3 connecting rod cap.

ST 18270AA020 SOCKET

(7) Using the ST, turn the crankshaft counterclockwise and separate the positions of the #3 pin (A) of crankshaft and the large end (B) of #3 connecting rod.

ST 18252AA000 CRANKSHAFT SOCKET

(8) Push the #3 connecting rod in the direction of the arrow, and remove the #3 piston with #3 connecting rod from the cylinder block.

16. Set the part so that the cylinder block LH is on the upper side.

17. Remove #2 and #4 connecting rod caps and pistons in the same removal procedure as #1 and #3 connecting rod caps and pistons.

18. Set the part so that the cylinder block RH is on the upper side, and separate the cylinder block.

(1) Remove the engine stand from the cylinder block RH.

(2) Remove the bolt shown in the figure.

(3) Loosen the cylinder block mounting bolts in numerical order as shown in the figure.

(4) While tapping the cylinder block RH with a plastic hammer, separate the cylinder block RH from the cylinder block LH.

Note:

Lift the cylinder block RH gradually, and confirm that the crankshaft is remaining in the cylinder block LH. If the cylinder block RH is lifted carelessly when separating, the crankshaft may stick to cylinder block RH, then fall off.

19. Remove the crankshaft from cylinder block LH, and remove the rear oil seal.

20. Remove the O-ring from the cylinder block LH.

21. Remove the crankshaft bearings from the cylinder block.

Note:

- **Be careful not to confuse the crankshaft bearing combination.**
- **Press the bearing at the end opposite to locking lip (A).**

22. Remove the liquid gasket from cylinder block.

23. Remove the cylinder block LH from the engine stand.

INSTALLATION

1. Install the cylinder block LH to the engine stand.

2. Apply engine oil to the crankshaft bearing, and install the crankshaft bearing to the cylinder block.

Caution:

When performing the operation of the cylinder block RH, be careful of the following.

1. Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.

2. Be careful not to scratch the mating surface of cylinder block during work.

3. Install O-rings to the cylinder block LH.

Note:

Use new O-rings.

4. Apply engine oil to the crankshaft journal, and set the crankshaft to cylinder block LH.

5. Apply liquid gasket to the mating surface of cylinder block RH as shown in the figure.

Caution:

- **Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.**
- **Be careful not to scratch the mating surface of cylinder block during work.**
- **Do not let the liquid gasket overflow to the oil passage and crankshaft bearing portions, because the engine seizure may result.**

Note:

- **Before applying liquid gasket, degrease the old liquid gasket seal surface of the cylinder block RH and cylinder block LH.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:

THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent

Liquid gasket applying diameter:

Mating surfaces other than ranges A, B and C

1±0.5 mm (0.0394±0.0197 in)

Mating surfaces of ranges A and C

4±0.5 mm (0.1575±0.0197 in)

Mating surfaces of range B

3.2±0.5 mm (0.1260±0.0197 in)

(A)	Range A	(F)	Liquid gasket applying position of mating surfaces (the edge) of range C	(K)	2 mm (0.0787 in)
(B)	Range B	(G)	1 mm (0.0394 in) or less	(L)	36 mm (1.4173 in)
(C)	Range C	(H)	⌀3.2±0.5 mm (0.1260±0.0197 in)	(M)	2.5 mm (0.0984 in)
(D)	Liquid gasket applying position of mating surfaces of range B	(I)	Chamfer edge		
(E)	Liquid gasket applying position of mating surfaces (other than the edge) of range C	(J)	⌀4±0.5 mm (0.1575±0.0197 in)		

6. Install the cylinder block RH to the cylinder block LH.

7. Join the cylinder blocks.

(1) Apply a coat of engine oil to the washers and cylinder block mounting bolt threads.

Note:

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

(2) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(3) Loosen all mounting bolts by 180° in numerical order as shown in the figure.

Caution:
When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(4) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

Caution:
When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(5) Loosen the mounting bolts (4 places) by 180° in numerical order as shown in the figure.

Caution:
When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(6) Tighten the mounting bolts (4 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

Caution:
When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(7) Using angle gauge, tighten the mounting bolts (4 places) with specified angle in numerical order as shown in the figure.

Caution:
When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

Tightening angle:
60°±2°

(8) Loosen the mounting bolts (6 places) by 180° in numerical order as shown in the figure.

Caution:
When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(9) Tighten the mounting bolts (6 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

Caution:
When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(10) Using angle gauge, tighten the mounting bolts (6 places) with specified angle in numerical order as shown in the figure.

Caution:
When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

Tightening angle:
60°±2°

(11) Install the bolt shown in the figure.

Note:
After tightening, if the liquid gasket is squeezed out in the seal surface area of the chain cover and oil pan upper, completely remove any liquid gasket that is squeezed out. Any liquid gasket on the chamfer area, however, should not be removed.
Tightening torque:
25 N·m (2.5 kgf-m, 18.4 ft-lb)

8. Set the part so that the installation surface of the oil pan upper is on the upper side.

9. Check that the piston ring gap for each piston is positioned correctly. Ref. to MECHANICAL(w/o STI)>Cylinder Block>ASSEMBLY > PISTON AND CONNECTING ROD.

10. Install the piston and connecting rod to the cylinder block.

(1) Apply engine oil to the outer circumference of each piston, crankshaft pin, and in the cylinder block.

(2) Turn the crankshaft so that the #1 pin (A) of crankshaft is positioned at TDC using ST.

ST 18252AA000 CRANKSHAFT SOCKET

(3) Compress the piston ring using piston ring compressor, and insert the #1 connecting rod with #1 piston into cylinder block.

Caution:
- **Be careful not to damage the cylinder liner and #1 pin of crankshaft by the #1 connecting rod large end.**
- **Be careful not to apply strong impact when inserting to prevent connecting rod bearing from falling off.**

Note:
- **Face the piston front mark (round mark) towards the front of the engine.**

(a) Front mark

- **Insert while lightly tapping the crown of the piston with the handle of a plastic hammer.**

(4) Turn the crankshaft counterclockwise so that the #1 pin of crankshaft and the large end (A) of #1 connecting rod are positioned as shown in the figure using ST, while pressing the #1 piston crown, and then set the #1 connecting rod cap and #1 connecting rod cap bolt.

Note:
- **Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.**
- **Use a new connecting rod cap bolt.**
- **Apply a coat of engine oil to the #1 connecting rod cap seat and the connecting rod cap bolt threads.**

ST 18252AA000 CRANKSHAFT SOCKET

(5) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 25 N·m (2.5 kgf-m, 18.4 ft-lb) in numerical order as shown in the figure.

ST 18270AA020 SOCKET

(6) Turn the crankshaft clockwise so that the #2 pin (A) of crankshaft is positioned at TDC using ST.

ST 18252AA000 CRANKSHAFT SOCKET

(7) Compress the piston ring using piston ring compressor, and insert the #2 connecting rod with #2 piston into cylinder block.

Caution:

- **Be careful not to damage the cylinder liner and #2 pin of crankshaft by the #2 connecting rod large end.**
- **Be careful not to apply strong impact when inserting to prevent connecting rod bearing from falling off.**

Note:

- **Face the piston front mark (round mark) towards the front of the engine.**

(a) Front mark

- **Insert while lightly tapping the crown of the piston with the handle of a plastic hammer.**

(8) Turn the crankshaft clockwise so that the #2 pin of crankshaft and the large end (A) of #2 connecting rod are positioned as shown in the figure using ST, while pressing the #2 piston crown, and then set the #2 connecting rod cap and #2 connecting rod cap bolt.

Note:

- **Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.**
- **Use a new connecting rod cap bolt.**
- **Apply a coat of engine oil to the #2 connecting rod cap seat and the connecting rod cap bolt threads.**

ST 18252AA000 CRANKSHAFT SOCKET

(9) Using ST, tighten the #2 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 25 N·m (2.5 kgf-m, 18.4 ft-lb) in numerical order as shown in the figure.

ST 18270AA020 SOCKET

(10) Install #3 and #4 pistons and connecting rod caps in the same installation procedure as #1 and #2 pistons and connecting rod caps.

(11) Using ST and angle gauge, tighten the #1 connecting rod cap bolts and #4 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

ST 18270AA020 SOCKET

Tightening angle:

$90°^{+5°}_{-0°}$

(12) Turn the crankshaft so that the #2 connecting rod cap (A) and #3 connecting rod cap (B) is located at the position shown in the figure using ST.

ST 18252AA000 CRANKSHAFT SOCKET

(13) Using ST and angle gauge, tighten the #2 connecting rod cap bolts and #3 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

ST 18270AA020 SOCKET

Tightening angle:

$90°^{+5°}_{-0°}$

11. Install the oil pan upper. Ref. to LUBRICATION(w/o STI)>Oil Pan>INSTALLATION > OIL PAN UPPER.
12. Set the part so that the installation surface of the intake manifold is on the upper side.
13. Install the crankshaft position sensor with crankshaft position sensor holder to the cylinder block LH.
    Tightening torque:
    6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
14. Install the PCV valve onto the cylinder block RH.
    Note:
    Apply liquid gasket to the bolt threads of PCV valve.
    Liquid gasket:
    THREE BOND 1324 (Part No. 004403042) or equivalent
    Tightening torque:
    23 N·m (2.3 kgf-m, 17.0 ft-lb)
15. Install the knock sensor to the cylinder block LH.
    Note:
    Knock sensor must be positioned toward engine front so that the connector center position is within the range of shaded area shown in the figure.
    Tightening torque:
    24 N·m (2.4 kgf-m, 17.7 ft-lb)

(A) Front of engine

16. Install the O-ring to the cylinder block and PCV connector.
    Note:
    Use new O-rings.
17. Install the water pipe assembly and PCV connector to the cylinder block.
    Tightening torque:
    6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
18. Install the engine rear hanger to the cylinder block RH.
    Tightening torque:
    21 N·m (2.1 kgf-m, 15.5 ft-lb)
19. Install the crank sprocket. Ref. to MECHANICAL(w/o STI)>Crank Sprocket>INSTALLATION.
20. Install the cylinder head. Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSTALLATION.
21. Apply a coat of engine oil to the oil seal inner periphery and outer periphery, and install the rear oil seal using ST1 and ST2.
    Note:
    Use a new rear oil seal.

ST1	**18671AA020**	**OIL SEAL GUIDE**
ST2	**18657AA030**	**OIL SEAL INSTALLER**

(A) Rear oil seal
(B) Drive plate or flywheel mounting bolt

22. Install the crankshaft position sensor plate with drive plate. (CVT model) Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>INSTALLATION.

23. Install the crankshaft position sensor plate with flywheel. (MT model) Ref. to CLUTCH SYSTEM>Flywheel>INSTALLATION.
24. Install the clutch disc and cover. (MT model) Ref. to CLUTCH SYSTEM>Clutch Disc and Cover>INSTALLATION.
25. Install the engine to the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>INSTALLATION.

MECHANICAL(w/o STI) > Cylinder Block

DISASSEMBLY

1. CYLINDER BLOCK

1. Remove the oil separator cover from cylinder block RH.
2. Remove the liquid gasket from cylinder block RH.
3. Remove the cylinder block plug (A) and the main gallery plug (B) from cylinder block RH.
4. Remove the liquid gasket from the thread holes of the cylinder block RH, and from the threaded portions of cylinder block plug and main gallery plug.
5. Remove the cylinder block plate from cylinder block LH.
6. Remove the main gallery plug from cylinder block LH.
7. Remove the liquid gasket from the thread holes of the cylinder block LH and main gallery plug.

2. PISTON AND CONNECTING ROD

(1)	Connecting rod	(4)	Piston	(7)	Oil ring
(2)	Connecting rod bearing	(5)	Piston pin	(8)	Second ring
(3)	Connecting rod cap	(6)	Circlip	(9)	Top ring

Note:
To prevent confusion of various parts, mark each part.

1. Remove the connecting rod bearing from connecting rod and connecting rod cap.
2. Remove the piston rings from the piston.
   Note:
   Arrange the piston rings in order so that they can be installed in their original positions without confusion.
   (1) Remove the compression rings in the order of top ring and second ring, using piston ring expander.
   (2) Remove the oil rings in the order of upper rail, lower rail and expander by hand.
3. Remove the circlip on one end from the piston using a flat tip screwdriver.
   Note:
   Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.
4. Remove the piston pin from piston, and remove the connecting rod from piston.
5. Remove the circlip on other end from the piston using a flat tip screwdriver.
   Note:
   Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.

ASSEMBLY

1. CYLINDER BLOCK

1. Apply liquid gasket to the threaded portion of the main gallery plug, and install the main gallery plug to the cylinder block LH.
   Note:
   Before applying liquid gasket, degrease the thread holes of the cylinder block LH and main gallery plug.
   Liquid gasket:
   THREE BOND 1105 (Part No. 004403010) or equivalent
   Tightening torque:
   37 N·m (3.8 kgf-m, 27.3 ft-lb)
2. Install the cylinder block plate onto cylinder block LH.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
3. Apply liquid gasket to the threaded portions of cylinder block plug and main gallery plug, and install the cylinder block plug (A) and main gallery plug (B) to cylinder block RH.
   Note:
   Before applying liquid gasket, degrease the thread holes of the cylinder block RH, and the threaded portions of cylinder block plug and main gallery plug.
   Liquid gasket:
   THREE BOND 1105 (Part No. 004403010) or equivalent
   Tightening torque:
   T1: 16 N·m (1.6 kgf-m, 11.8 ft-lb)
   T2: 37 N·m (3.8 kgf-m, 27.3 ft-lb)
4. Install the oil separator cover to the cylinder block RH.
   (1) Apply liquid gasket to the mating surfaces of oil separator cover.
   Note:
   - **Use new oil separator cover.**
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of cylinder block RH.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   4±1 mm (0.1772±0.0394 in)
   (2) Install the oil separator cover to the cylinder block RH, and tighten the oil separator cover bolts in numerical order as shown in the figure.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

2. PISTON AND CONNECTING ROD

(1) Connecting rod
(2) Connecting rod bearing
(3) Connecting rod cap
(4) Piston
(5) Piston pin
(6) Circlip
(7) Oil ring
(8) Second ring
(9) Top ring

1. Install the connecting rod bearing to the connecting rod and connecting rod cap.
2. Install the circlip on one end of the piston using a flat tip screwdriver.
   Note:
   - **Be careful not damage the piston, by wrapping the tip of flat tip screwdriver with tape.**
   - **Make sure the circlip is firmly inserted into the circlip groove.**
   - **After installing the circlip, rotate the circlip so that its end part (a) and the cutout portion of circlip groove (b) do not match.**
3. Set the piston to the connecting rod.
   Note:
   Align the front mark of piston and the connecting rod direction correctly as shown in the figure.

(a) RH side (#1 and #3)
(b) LH side (#2 and #4)
(c) Front mark

4. Apply engine oil to the piston pin, and attach the piston pin.
5. Install the circlip on the piston using a flat tip screwdriver.
   Note:
   - **Be careful not damage the piston and piston pin, by wrapping the tip of flat tip screwdriver with tape.**
   - **Make sure the circlip is firmly inserted into the circlip groove.**
   - **After installing the circlip, rotate the circlip so that its end part (a) and the cutout portion of circlip groove (b) do not match.**
6. Install the oil rings to the piston in the order of expander, lower rail and upper rail by hand.
   Note:
   Oil ring consists of the upper rail, expander and lower rail.

(a) Upper rail
(b) Expander
(c) Lower rail

   (1) Set the ring gap of the expander to the position (A).
   (2) Set the lower rail spin stopper (D) to the oil groove (C) located above the cutout portion (B) of the piston skirt coating, and hook the lower rail spin stopper (F) to the expander (E).
   (3) Set the upper rail gap to the position (G), and hook the upper rail spin stopper (H) to the expander (E).
7. Install the compression rings to the piston in the order of second ring and top ring, using piston ring expander.
   (1) Set the ring gap of the second ring to the position (A) in the figure.
   Note:
   Install the second ring so that the ring mark (2N) faces the piston crown.
   (2) Set the ring gap of top ring at (B) in the figure on the 180° opposite direction of (A).
   Note:
   Install the top ring so that the ring mark (TN) faces the piston crown.
8. Check that the piston ring is installed correctly.

INSPECTION

1. CYLINDER BLOCK & PISTON

1. Visually inspect to make sure that there are no cracks, scratches or other damage.
2. Use liquid penetrant tester on the important sections to check for fissures.
3. Check that there are no traces of gas leaking or water leaking on the gasket attachment surface.
4. Check the oil passages for clogging.
5. Check for warpage of mating surfaces of the cylinder block that contacts cylinder head using a straight edge and thickness gauge. If it exceeds the limit, correct the surface by grinding it with a surface grinder or replace the cylinder block.

   Note:

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

   Cylinder block warpage:

   Limit

   0.025 mm (0.0010 in)

   Grinding limit of cylinder block:

   To 204.9 mm (8.0669 in)

   Height of cylinder block:

   Standard

   205.0 mm (8.0709 in)
6. Using a cylinder bore gauge, check the cylindricality and out-of-roundness of cylinder liner. If it is not within the standard, perform reboring (including honing), or replace the cylinder block and piston as a set. For reboring and honing procedure, refer to step 8).

Note:

- **Measure the cylinder liner with cylinder blocks separated (into cylinder block RH and cylinder block LH).**
- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Write down all measurement values as the values are used in the next procedure.**
- **Measure the inner diameter of each cylinder liner in both the thrust and piston pin directions at the heights as shown in the figure.**

(A) Piston pin direction (B) Thrust direction

H1: 10 mm (0.3937 in) H2: 45 mm (1.7717 in) H3: 80 mm (3.1496 in)

H4: 105 mm (4.1339 in)

- **Calculate the cylindricality of cylinder liner by using the following formula.**

Calculation formula
C = The larger value between the calculation values C' and C'' C' = (D(a)−D(b))/2 C'' = (D(c)−D(d))/2
C: Cylindricality of cylinder liner D(a): The largest value of all the values obtained by measuring the cylinder liner inner diameter in the direction of the piston pin D(b): The smallest value of all the values obtained by measuring the cylinder liner inner diameter in the direction of the piston pin D(c): The largest value of all the values obtained by measuring the cylinder liner inner diameter in the thrust direction D(d): The smallest value of all the values obtained by measuring the cylinder liner inner diameter in the thrust direction

- **Calculate the out-of-roundness of cylinder liner at each measurement height by using the following formula.**

Calculation formula
R = (D(e)−D(f))/2
R: Out-of-roundness of cylinder liner D(e): The larger value between the measurement values in the piston pin direction and in the thrust direction of cylinder liner inner diameter D(f): The smaller value between the measurement values in the piston pin direction and in the thrust direction of cylinder liner inner diameter

Cylindricality of cylinder liner:

Limit

0.030 mm (0.0012 in)

Out-of-roundness of cylinder liner:

Limit

0.030 mm (0.0012 in)

7. Check the clearance between cylinder liner and piston. Check the clearance between cylinder liner and piston by measuring the inner diameter of cylinder liner and the outer diameter of piston respectively.

(1) Measure the inner diameter of cylinder liner. If it is not within the standard, perform reboring (including honing), or replace the cylinder block and piston as a set. For reboring and honing procedure, refer to step 8).

Note:

- **Measure the cylinder liner with cylinder blocks separated (into cylinder block RH and cylinder block LH).**
- **Measurement should be performed at a temperature of 20°C (68°F).**
- **The cylinder bore size mark is stamped on the upper face of the cylinder block.**

(A) Main journal size mark
(B) Cylinder block (RH) - (LH) combination mark
(C) #1 cylinder bore size mark
(D) #2 cylinder bore size mark
(E) #3 cylinder bore size mark
(F) #4 cylinder bore size mark

- **Measure the inner diameter of each cylinder liner in both the thrust and piston pin directions at the heights as shown in the figure and read the value of the most worn location.**

(A) Piston pin direction
(B) Thrust direction
H1: 10 mm (0.3937 in)
H2: 45 mm (1.7717 in)
H3: 80 mm (3.1496 in)
H4: 105 mm (4.1339 in)

Inner diameter of cylinder liner:

Cylinder bore size mark A

Standard

86.005 — 86.015 mm (3.3860 — 3.3864 in)

Cylinder bore size mark B

Standard

85.995 — 86.005 mm (3.3856 — 3.3860 in)

(2) Check the outer diameter of piston with a micrometer. If it is not within the standard, replace the piston.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Measure the outer diameter of each piston in thrust direction at the height as shown in the figure.**
- **Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as guide lines in selecting a standard piston.**
- **The grade can be judged by the stamp of cylinder bore size mark on the upper face of the cylinder block.**

(A) Main journal size mark
(B) Cylinder block (RH) – (LH) combination mark
(C) #1 cylinder bore size mark
(D) #2 cylinder bore size mark
(E) #3 cylinder bore size mark
(F) #4 cylinder bore size mark

- **If the piston is replaced, check the clearance between cylinder liner and piston in the step (3), and select a suitable sized piston.**

Piston grade point H:

40.0 mm (1.5748 in)

Piston outer diameter:

Standard size (grade A = cylinder bore size mark A)

Standard

85.985 — 85.995 mm (3.3852 — 3.3856 in)

Standard size (grade B = cylinder bore size mark B)

Standard

85.975 — 85.985 mm (3.3848 — 3.3852 in)

(3) Calculate the clearance between cylinder liner and piston. If it is not within the standard, perform reboring (including honing), or replace the cylinder block and piston as a set. For reboring and honing procedure, refer to step 8).

Note:

The clearance between cylinder liner and piston is decided by matching the cylinder block bore size mark and the grade of piston outer diameter (grade A or B).

Clearance between cylinder liner and piston:

Standard

0.010 — 0.030 mm (0.0004 — 0.0012 in)

8. Reboring and honing

(1) If any of the cylindricality, out-of-roundness, inner diameter or clearance between cylinder liner and piston is out of standard or if there is any damage on the cylinder liner, perform reboring (including honing).

Caution:

When any of the cylinder liner needs reboring, all other cylinder liners must be rebored at the same time, and replaced with proper size pistons.

Oversize piston outer diameter:

0.25 mm (0.0098 in) oversize

Standard

86.225 — 86.245 mm (3.3947 — 3.3955 in)

0.50 mm (0.0197 in) oversize

Standard

86.475 — 86.495 mm (3.4045 — 3.4053 in)

(2) If the inner diameter of cylinder liner exceeds the limit after reboring (including honing), replace the cylinder block and piston as a set.

Note:

- **Immediately after reboring (including honing), the inner diameter of cylinder liner may differ from its real diameter due to temperature rise. Thus, when measuring the inner diameter of cylinder liner, wait until the temperature has cooled to 20°C (68°F).**
- **For the measurement of the inner diameter of cylinder liner, refer to step 7).**

Inner diameter of cylinder liner boring limit (diameter):

To 86.505 mm (3.4057 in)

2. PISTON AND PISTON PIN

1. Check the piston and piston pin for wear or crack.

2. Check the snap ring for distortion or wear.

3. Check the piston ring groove for damage.

4. Check the circlip groove (A) for burr.

Note:

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

5. Check that the piston pin can be inserted into the piston with a thumb at 20°C (68°F).

6. Check the clearance between piston and piston pin. Check the clearance between piston and piston pin by measuring the inner diameter of piston pin hole and the outer diameter of piston pin respectively.
   (1) Using a caliper gauge, measure the inner diameter of piston pin hole.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Measure the inner diameter of the piston pin hole at the four locations as shown in the figure, and read the value of most worn location.**
   - **Record the measured value.**

   (2) Measure the outer diameter of piston pin with a micrometer.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Measure the outer diameter of the piston pin at the four locations as shown in the figure, and read the value of most worn location.**
   - **Record the measured value.**

(A) 10 mm (0.3937 in)

   (3) Calculate the clearance between piston and piston pin. If it is not within the standard, replace the piston and piston pin as a set.
   Clearance between piston and piston pin:
   Standard
   0.004 — 0.008 mm (0.0002 — 0.0003 in)

3. PISTON RING

1. Make sure the piston ring is not broken or damaged.
2. Using a cylindrical guide, insert the piston ring into the cylinder liner so that they are perpendicular to the cylinder wall, and check the piston ring gap using a thickness gauge. If it is not within the standard, replace the piston ring.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Use piston ring with same size as piston when replacing piston ring.**

   Piston ring gap:
   Compression ring (top ring)
   Standard
   0.20 — 0.25 mm (0.0079 — 0.0098 in)
   Compression ring (second ring)
   Standard
   0.40 — 0.50 mm (0.0157 — 0.0197 in)
   Oil ring (upper rail and lower rail)
   Standard
   0.10 — 0.35 mm (0.0039 — 0.0138 in)
3. Fit the compression ring straight into the piston ring groove, then check the clearance between compression ring and piston with a thickness gauge. If it is not within the standard, replace the compression ring.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Before inspecting the clearance, clean the piston ring groove and compression ring.**
- **Use compression ring with same size as piston when replacing compression ring.**

Clearance between compression ring and piston:

Top ring

Standard

0.040 — 0.080 mm (0.0016 — 0.0031 in)

Second ring

Standard

0.045 — 0.085 mm (0.0018 — 0.0033 in)

4. CONNECTING ROD AND CONNECTING ROD BEARING

1. Check for bend or twist using a connecting rod aligner. If it exceeds the limit, replace the connecting rod.

   Note:

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

   Bend or twist per 100 mm (3.9370 in) in length:

   Limit

   0.10 mm (0.0039 in)

(A) Thickness gauge (B) Connecting rod

2. Check that the large or small end thrust surface of each connecting rod is not damaged.
3. Check each connecting rod bearing for scar, peeling, seizure, melting or wear, etc.
4. Check the thrust clearance of each connecting rod using a thickness gauge.

   Note:

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

   (1) Clean the #1 connecting rod bearing and the #1 pin of crankshaft, and apply engine oil to the #1 pin of crankshaft.

   (2) Set the #1 connecting rod bearing to the #1 connecting rod and #1 connecting rod cap.

   (3) Set the #1 connecting rod, #1 connecting rod cap and #1 connecting rod cap bolt to the #1 pin of crankshaft.

   Note:

   - **Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.**
   - **Use a new connecting rod cap bolt.**
   - **Apply a coat of engine oil to the #1 connecting rod cap bolt thread.**

   (4) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 25 N·m (2.5 kgf-m, 18.4 ft-lb) in numerical order as shown in the figure.

   Caution:

   - **Make sure to hold the crankshaft securely during work.**
   - **When holding the crankshaft, be careful not to damage the crankshaft.**

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(5) Using ST and angle gauge, tighten the #1 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

Caution:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**

Note:

Prevent angle gauge from rotating using a V-block, etc.

ST 18270AA020 SOCKET

Tightening angle:

$90°^{+5°}_{-0°}$

(6) In the same manner, install the #2, #3 and #4 connecting rods.

(7) Check the thrust clearance of each connecting rod using a thickness gauge. If it is not within the standard, replace the connecting rod.

Note:

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

Connecting rod thrust clearance:

Standard

0.070 — 0.330 mm (0.0028 — 0.0130 in)

5. Check the oil clearance on each connecting rod bearing using plastigauge.

Note:

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

(1) Clean the #1 connecting rod bearing and the #1 pin of crankshaft.

(2) Set the #1 connecting rod bearing to the #1 connecting rod and #1 connecting rod cap.

(3) Place a plastigauge across the #1 pin of crankshaft, and set the #1 connecting rod, #1 connecting rod cap and #1 connecting rod cap bolt to the #1 pin of crankshaft.

Note:

- **Each connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching symbol.**
- **Use a new connecting rod cap bolt.**
- **Apply a coat of engine oil to the #1 connecting rod cap bolt thread.**

(4) Using ST, tighten the #1 connecting rod cap bolts to 10 N·m (1.0 kgf-m, 7.4 ft-lb) in numerical order as shown in the figure, then retighten the bolts to 25 N·m (2.5 kgf-m, 18.4 ft-lb) in numerical order as shown in the figure.

Caution:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**
- **During tightening, be careful not to move the #1 connecting rod and the #1 connecting rod cap.**

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(5) Using ST and angle gauge, tighten the #1 connecting rod cap bolts with specified angle in numerical order as shown in the figure.

Caution:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**
- **During tightening, be careful not to move the #1 connecting rod and the #1 connecting rod cap.**

Note:

Prevent angle gauge from rotating using a V-block, etc.

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Tightening angle:

$90°^{+5°}_{-0°}$

(6) Using ST, loosen the #1 connecting rod cap bolt, and remove the #1 connecting rod cap bolt and #1 connecting rod cap.

Caution:

- **Make sure to hold the crankshaft securely during work.**
- **When holding the crankshaft, be careful not to damage the crankshaft.**
- **During removal, be careful not to move the #1 connecting rod and the #1 connecting rod cap.**

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(7) Determine oil clearance of the #1 connecting rod bearing by matching the widest point of the plastigauge on #1 pin of crankshaft against scale printed on a package of the plastigauge. If it is not within the standard, replace the #1 connecting rod bearing.

Note:

Measure the outer diameter of crankshaft pin using micrometer, and select the suitable size connecting rod bearing when replacing the connecting rod bearing.

Unit: mm (in)

Bearing	Connecting rod bearing thickness (at center)	Crankshaft pin outer diameter
	Standard	Standard
Standard size	1.492 — 1.508 (0.0587 — 0.0594)	49.976 — 50.000 (1.9676 — 1.9685)
0.03 (0.0012) Undersize	1.511 — 1.515 (0.0595 — 0.0596)	49.946 — 49.970 (1.9664 — 1.9673)
0.05 (0.0020) Undersize	1.521 — 1.525 (0.0599 — 0.0600)	49.926 — 49.950 (1.9656 — 1.9665)
0.25 (0.0098) Undersize	1.621 — 1.625 (0.0638 — 0.0640)	49.726 — 49.750 (1.9577 — 1.9587)

Connecting rod bearing oil clearance:

Standard

0.025 — 0.055 mm (0.0010 — 0.0022 in)

(8) Completely remove the plastigauge.
(9) In the same manner, check oil clearance of the #2, #3 and #4 connecting rod bearings.

5. PISTON PIN & CONNECTING ROD BUSHING

1. Check that the connecting rod bushing is not damaged.
2. Check the clearance between piston pin and connecting rod bushing. Check the clearance between piston pin and connecting rod bushing by measuring the outer diameter of piston pin and the inner diameter of connecting rod bushing respectively.
   (1) Measure the outer diameter of piston pin with a micrometer.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Measure the outer diameter of the piston pin at the two locations as shown in the figure, and read the value of most worn location.**
   - **Record the measured value.**

   (2) Using a caliper gauge, measure the inner diameter of connecting rod bushing.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **Measure the inner diameter of the connecting rod bushing at the two locations as shown in the figure, and read the value of most worn location.**
   - **Record the measured value.**

   (3) Calculate the clearance between piston pin and connecting rod bushing.
   Clearance between piston pin and connecting rod bushing:
   Standard
   0.004 — 0.026 mm (0.0002 — 0.0010 in)
3. If the clearance between piston pin and connecting rod bushing is not within the standard, replace the connecting rod and piston pin as a set.

6. CRANKSHAFT AND CRANKSHAFT BEARING

1. Clean the crankshaft completely, and check it for cracks using liquid penetrant tester.
2. Using a dial gauge, check the crankshaft bend. If it exceeds the limit, grind to correct the crankshaft journal or replace the crankshaft.
   Note:
   - **Measurement should be performed at a temperature of 20°C (68°F).**
   - **If a suitable V-block is not available, using just the #1 and #5 crankshaft bearings on cylinder block, position the crankshaft on cylinder block. Then, measure the crankshaft bend using a dial gauge.**
   - **When grinding to correct the crankshaft journal, refer to step 3).**

   Crankshaft bend:
   Limit
   0.035 mm (0.0014 in)
3. Using a micrometer, check the outer diameter of crankshaft pin, outer diameter of journal, cylindricality, and out-of-roundness. If it is not within the standard, replace the connecting rod bearing or crankshaft bearing, and grind to correct the crankshaft pin or journal or replace the crankshaft as required.

Note:

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

Unit: mm (in)

Bearing	Connecting rod bearing thickness (at center)	Crankshaft pin outer diameter	Crankshaft bearing thickness (at center)		Crankshaft journal outer diameter
			#1, #2, #3, #4	#5	
	Standard	Standard	Standard	Standard	Standard
Standard size	1.492 — 1.508 (0.0587 — 0.0594)	49.976 — 50.000 (1.9676 — 1.9685)	2.498 — 2.513 (0.0983 — 0.0989)	2.496 — 2.511 (0.0983 — 0.0989)	67.985 — 68.003 (2.6766 — 2.6773)
0.03 (0.0012) Undersize	1.511 — 1.515 (0.0595 — 0.0596)	49.946 — 49.970 (1.9664 — 1.9673)	2.519 — 2.522 (0.0992 — 0.0993)	2.517 — 2.520 (0.0991 — 0.0992)	67.955 — 67.979 (2.6754 — 2.6763)
0.05 (0.0020) Undersize	1.521 — 1.525 (0.0599 — 0.0600)	49.926 — 49.950 (1.9656 — 1.9665)	2.529 — 2.532 (0.0996 — 0.0997)	2.527 — 2.530 (0.0995 — 0.0996)	67.935 — 67.959 (2.6746 — 2.6755)
0.25 (0.0098) Undersize	1.621 — 1.625 (0.0638 — 0.0640)	49.726 — 49.750 (1.9577 — 1.9587)	2.629 — 2.632 (0.1035 — 0.1036)	2.627 — 2.630 (0.1034 — 0.1035)	67.735 — 67.759 (2.6667 — 2.6677)

Crankshaft pin:

Cylindricality

Limit

0.006 mm (0.0002 in)

Out-of-roundness

Limit

0.005 mm (0.0002 in)

Grinding limit (dia.)

To 49.726 mm (1.9577 in)

Crankshaft journal:

Cylindricality

Limit

0.006 mm (0.0002 in)

Out-of-roundness

Limit

0.005 mm (0.0002 in)

Grinding limit (dia.)

To 67.735 mm (2.6667 in)

4. Inspect the crankshaft bearing for scar, peeling, seizure, melting or wear, etc.
5. Use a thickness gauge to check the thrust clearance of crankshaft at thrust of #5 crankshaft bearing. If it is not within the standard, replace the #5 crankshaft bearing.

Note:

- **Measurement should be performed at a temperature of 20°C (68°F).**
- **Set all the crankshaft bearings onto the cylinder block, then mount the crankshaft on the cylinder block, and use a thickness gauge to measure the thrust clearance of crankshaft.**
- **Select the #5 crankshaft bearing of suitable size by referring to step 3) when replacing #5 crankshaft bearing.**

Crankshaft thrust clearance:

Standard

0.130 — 0.308 mm (0.0051 — 0.0121 in)

6. Check the oil clearance on each crankshaft bearing using plastigauge.

Note:

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

(1) Install the cylinder block LH to the engine stand.

Caution:

- **When the engine stand is not used, place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.**
- **Be careful not to scratch the mating surface of cylinder block during work.**

(2) Remove the liquid gasket from cylinder block.

(3) Clean each crankshaft bearing and crankshaft journal.

(4) Set each crankshaft bearing to the cylinder block.

Caution:

When performing the operation of the cylinder block RH, be careful of the following.

1. **Place a wood board wrapped with a waste cloth to prevent the knock pin damage and to stabilize the cylinder block before work.**
2. **Be careful not to scratch the mating surface of cylinder block during work.**

(5) Set the crankshaft to the cylinder block LH.

(6) Place a plastigauge across the crankshaft journals and set the cylinder block RH to the cylinder block LH.

(7) Apply a coat of engine oil to the washers and cylinder block mounting bolt threads.

Note:

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

(8) Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(9) Loosen all mounting bolts by 180° in numerical order as shown in the figure.

Caution:

When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(10)Tighten all mounting bolts with a torque of 35 N·m (3.6 kgf-m, 25.8 ft-lb) in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(11)Loosen the mounting bolts (4 places) by 180° in numerical order as shown in the figure.

Caution:

When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(12)Tighten the mounting bolts (4 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(13)Using angle gauge, tighten the mounting bolts (4 places) with specified angle in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

Tightening angle:

60°±2°

(14)Loosen the mounting bolts (6 places) by 180° in numerical order as shown in the figure.

Caution:

When loosening the mounting bolts, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(15)Tighten the mounting bolts (6 places) with a torque of 17 N·m (1.7 kgf-m, 12.5 ft-lb) in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified torque, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

(16)Using angle gauge, tighten the mounting bolts (6 places) with specified angle in numerical order as shown in the figure.

Caution:

When tightening the mounting bolts with specified angle, hold the cylinder block LH while not holding the cylinder block RH to ensure the joint accuracy of the cylinder block.

Tightening angle:

60°±2°

(17)Loosen the cylinder block mounting bolts in numerical order as shown in the figure, and separate the cylinder block RH and LH.

Note:
Lift the cylinder block RH slightly, and confirm that the crankshaft is remaining in the cylinder block LH. If the cylinder block RH is lifted carelessly when separating, the crankshaft may stick to cylinder block RH, then fall off.

(18)Determine the crankshaft oil clearance by matching the widest point of the plastigauge on each journal against scale printed on a package of the plastigauge. If it is not within the standard, replace the crankshaft bearing, and grind to correct the crankshaft journal or replace the crankshaft as required.

Note:

- **Select the crankshaft bearing of suitable size by referring to step 3) when replacing crankshaft bearing.**
- **When grinding to correct the crankshaft journal, finish it to the suitable outer diameter by referring to step 3) according to the undersize bearing to be used.**

Crankshaft oil clearance:

Standard

0.013 — 0.031 mm (0.0005 — 0.0012 in)

(19)Completely remove the plastigauge.

7. REAR OIL SEAL

1. Inspect for oil leakage from the rear oil seal. If there is an oil leak, replace the rear oil seal with a new part according to the following procedures.

(1) When working on the vehicle

Caution:
When working on the vehicle, perform the following steps also.

1. Remove the transmission body from the vehicle. CVT model Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Automatic Transmission Assembly>REMOVAL. mt model Ref. to MANUAL TRANSMISSION AND DIFFERENTIAL(6MT)(TY85)>Manual Transmission Assembly>REMOVAL.

(2) Remove the crankshaft position sensor plate with drive plate. (CVT model) Ref. to CONTINUOUSLY VARIABLE TRANSMISSION(TR690)>Drive Plate>REMOVAL.

(3) Remove the clutch disc and cover. (MT model) Ref. to CLUTCH SYSTEM>Clutch Disc and Cover>REMOVAL.

(4) Remove the crankshaft position sensor plate with flywheel. (MT model) Ref. to CLUTCH SYSTEM>Flywheel>REMOVAL.

(5) Remove the rear oil seal from the cylinder block using a oil seal puller, etc.

Caution:
Be careful not to damage the crankshaft during operation.

(6) Apply a coat of engine oil to the oil seal inner periphery and outer periphery, and install the rear oil seal using ST1 and ST2.

ST1 18671AA020 OIL SEAL GUIDE

ST2 18657AA030 OIL SEAL INSTALLER

(A) Rear oil seal

(B) Drive plate or flywheel mounting bolt

(7) Install in the reverse order of removal after replacement.

SPECIFICATION

Refer to “Cylinder Head” for removal and installation procedures of the intake and exhaust valves.

Ref. to MECHANICAL(w/o STI)>Cylinder Head>REMOVAL.
Ref. to MECHANICAL(w/o STI)>Cylinder Head>INSTALLATION.
Ref. to MECHANICAL(w/o STI)>Cylinder Head>DISASSEMBLY.
Ref. to MECHANICAL(w/o STI)>Cylinder Head>ASSEMBLY.

SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of pistons.

Ref. to MECHANICAL(w/o STI)>Cylinder Block>REMOVAL.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>INSTALLATION.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>DISASSEMBLY > PISTON AND CONNECTING ROD.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>ASSEMBLY > PISTON AND CONNECTING ROD.

SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of connecting rod.

Ref. to MECHANICAL(w/o STI)>Cylinder Block>REMOVAL.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>INSTALLATION.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>DISASSEMBLY > PISTON AND CONNECTING ROD.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>ASSEMBLY > PISTON AND CONNECTING ROD.

SPECIFICATION

Refer to “Cylinder Block” for removal and installation procedures of the crankshaft.

Ref. to MECHANICAL(w/o STI)>Cylinder Block>REMOVAL.
Ref. to MECHANICAL(w/o STI)>Cylinder Block>INSTALLATION.

INSPECTION

Note:
The "RANK" shown in the chart shows the possibilities of the cause of trouble in order from "Very often" to "Rarely".
A — Very often
B — Sometimes
C — Rarely

Symptoms	Problem parts etc.	Possible cause	RANK
1. Engine does not start.			
1) Starter does not turn.	Starter	Defective battery-to-starter harness	B
		Defective starter switch	C
		Defective relay	C
		Defective inhibitor switch	C
		Defective clutch start switch	C
		Defective starter	B
	Battery	Improper connection of terminal	A
		Run-down battery	A
		Defective charging system	B
	Friction	Seizure of crankshaft and connecting rod bearing	C
		Seized camshaft	C
		Seized or stuck piston and cylinder	C
	Immobilizer system Ref. to IMMOBILIZER (DIAGNOSTICS)>Basic Diagnostic Procedure.		A
2) Initial combustion does not occur.	Starter	Defective starter	C
	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Fuel line	Defective fuel pump and relay	A
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B

Symptoms	Problem parts etc.	Possible cause	RANK
		Worn or stuck piston rings, cylinder liner and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
3) Initial combustion occurs.	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Defective intake manifold gasket	B
		Defective throttle body gasket	B
	Fuel line	Defective fuel pump and relay	C
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder liner and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
4) Engine stalls after initial combustion.	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	B
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	C
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Dirty air cleaner element	C
		Air by-pass valve malfunction	C
	Fuel line	Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Trouble	B
		Defective timing	B
	Compression	Incorrect cam clearance	C
		Loosened spark plug or defective gasket	C

Symptoms	Problem parts etc.	Possible cause	RANK
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	B
		Improper engine oil (low viscosity)	B
2. Rough idle and engine stall	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	A
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	C
		Loosened oil filler cap	B
		Dirty air cleaner element	C
		Air by-pass valve malfunction	B
	Fuel line	Defective fuel pump and relay	C
		Clogged fuel line	C
		Lack of fuel or insufficient fuel	B
	Timing chain	Defective timing	C
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective cylinder head gasket	B
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	B
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Lubrication system	Incorrect oil pressure	B
		Defective rocker cover gasket	C
	Cooling system	Over-heating	C
	Other	Evaporative emission control system malfunction	A

Symptoms	Problem parts etc.	Possible cause	RANK
		Stuck or damaged throttle valve	B
3. Low output, hesitation and poor acceleration	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	B
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	B
		Loosened oil filler cap	B
		Dirty air cleaner element	A
		Air by-pass valve malfunction	B
	Fuel line	Defective fuel pump and relay	B
		Clogged fuel line	B
		Lack of fuel or insufficient fuel	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	B
		Loosened cylinder head bolt or defective cylinder head gasket	B
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	B
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Lubrication system	Incorrect oil pressure	B
	Cooling system	Over-heating	C
		Over-cooling	C
	Other	Evaporative emission control system malfunction	A
4. Surging	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	A
		Loosened or cracked PCV hose	A
		Loosened or cracked vacuum hose	A
		Defective intake manifold gasket	B
		Defective throttle body gasket	B
		Defective PCV valve	B

Symptoms	Problem parts etc.	Possible cause	RANK
		Loosened oil filler cap	B
		Dirty air cleaner element	B
		Air by-pass valve malfunction	B
	Fuel line	Defective fuel pump and relay	B
		Clogged fuel line	B
		Lack of fuel or insufficient fuel	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	C
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
		Improper engine oil (low viscosity)	B
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	C
5. Engine does not return to idle.	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked vacuum hose	A
	Other	Stuck or damaged throttle valve	A
6. Dieseling (run-on)	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Cooling system	Over-heating	B
	Other	Evaporative emission control system malfunction	B
7. After burning in exhaust system	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened or cracked intake duct	C
		Loosened or cracked PCV hose	C
		Loosened or cracked vacuum hose	B
		Defective PCV valve	B
		Loosened oil filler cap	C
		Air by-pass valve malfunction	C
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B

Symptoms	Problem parts etc.	Possible cause	RANK
		Loosened spark plug or defective gasket	C
		Loosened cylinder head bolt or defective cylinder head gasket	C
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	C
		Incorrect valve timing	A
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C
	Other	Evaporative emission control system malfunction	C
8. Knocking	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Loosened oil filler cap	B
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	C
		Incorrect valve timing	B
	Cooling system	Over-heating	A
9. Excessive engine oil consumption	Intake system	Loosened or cracked PCV hose	A
		Defective PCV valve	B
		Loosened oil filler cap	C
	Compression	Defective valve stem	A
		Worn or stuck piston rings, cylinder and piston	A
	Lubrication system	Loosened chain cover attaching bolts and defective gasket	B
		Defective oil filter gasket	B
		Defective crankshaft oil seal	B
		Defective rocker cover gasket	B
		Loosened oil drain plug or defective gasket	B
		Loosened oil pan mounting bolt or defective oil pan	B
10. Excessive fuel consumption	Engine control system Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.		A
	Intake system	Dirty air cleaner element	A
	Timing chain	Defective timing	B
	Compression	Incorrect cam clearance	B
		Loosened spark plug or defective gasket	C

Symptoms	Problem parts etc.	Possible cause	RANK
		Loosened cylinder head bolt or defective cylinder gasket	C
		Improper valve sealing	B
		Defective valve stem	C
		Worn or broken valve spring	C
		Worn or stuck piston rings, cylinder and piston	B
		Incorrect valve timing	B
	Lubrication system	Incorrect oil pressure	C
	Cooling system	Over-cooling	C

INSPECTION

Type of sound	Condition	Possible cause
Regular clicking sound	Sound increases as engine speed increases.	• Valve mechanism is defective • Incorrect cam clearance • Worn camshaft • Broken valve spring • Defective valve shim
Heavy and dull clank	Oil pressure is low.	• Worn crankshaft bearing • Worn connecting rod bearing
	Oil pressure is normal.	• Loosened flywheel mounting bolt • Damaged engine mounting
High-pitched clank	Sound is noticeable when accelerating with an overload condition.	• Ignition timing advanced • Accumulation of carbon inside combustion chamber • Wrong heat range of spark plug • Improper octane value gasoline
Clank noise when engine speed is between 1,000 and 2,000 r/min	Sound is reduced when the fuel injector of the noisy cylinder is stopped.*	• Worn crankshaft bearing • Worn connecting rod bearing
Knocking sound when engine is operating under idling speed and engine is warm	Sound is reduced when the fuel injector of the noisy cylinder is stopped.*	• Worn cylinder liner and piston ring • Broken or stuck piston ring • Worn piston pin and piton pin hole of piston
	Sound is not reduced if each fuel injector is stopped in turn.*	• Unusually worn valve rocker • Unusually worn valve shim • Worn cam sprocket • Worn journal of cam carrier and camshaft cap
Squeaky sound	—	• Insufficient generator lubrication
Rubbing sound	—	• Poor contact of generator brush and rotor
Gear scream when starting engine	—	• Defective ignition starter switch • Worn gear and starter pinion
Sound like polishing glass with a dry cloth	—	• Defective V-belt tensioner assembly (loose V-belt) • Defective water pump shaft
Hissing sound	—	• Insufficient compression • Air leakage in air intake system, hose, connection or manifold
Timing chain noise	—	• Loose timing chain • Timing chain contacting with adjacent part
Valve noise	—	• Incorrect cam clearance

*Fuel injector can be stopped using the Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Active Test>OPERATION.

EXHAUST(w/o STI)

EX(w/o STI)

1. General Description
2. Front Exhaust Pipe
3. Center Exhaust Pipe
4. Rear Exhaust Pipe
5. Muffler

COMPONENT

1. FRONT EXHAUST PIPE

(1) Intake duct No. 1
(2) O-ring
(3) Turbocharger
(4) Exhaust pipe cover A
(5) Gasket
(6) Center exhaust pipe (front)
(7) Turbocharger stay A
(8) Self-locking nut
(9) Exhaust pipe cover B
(10) Gasket
(11) Exhaust pipe stay A
(12) Front exhaust pipe
(13) Exhaust pipe cover C
(14) Gasket
(15) Exhaust pipe stay B
(16) Water pump pulley cover
(17) Turbocharger stay B
(18) Exhaust pipe cover D
(19) Exhaust pipe cover E
(20) Exhaust pipe cover F
(21) Exhaust pipe cover G
(22) Exhaust pipe cover H
(23) Exhaust pipe cover I
(24) Exhaust pipe cover J
(25) Exhaust pipe cover K
(26) Front exhaust pipe band

Tightening torque: N·m (kgf-m, ft-lb)

T1: 7.4 (0.8, 5.4)
T2: 19 (1.9, 14.0)
T3: 30 (3.1, 22.1)
T4: 33 (3.4, 24.3)
T5: 42.5 (4.3, 31.3)
T6: Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.

2. CENTER AND REAR EXHAUST PIPE, AND MUFFLER

- CVT model

(1)	Center exhaust pipe (front)	(14)	Exhaust pipe cover G	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Front catalytic converter	(15)	Center exhaust pipe band	***T1: 7.4 (0.8, 5.4)***
(3)	Rear catalytic converter	(16)	Exhaust pipe cover H	***T2: 13 (1.3, 9.6)***
(4)	Exhaust pipe cover A	(17)	Hanger bracket	***T3: 18 (1.8, 13.3)***
(5)	Exhaust pipe cover B	(18)	Gasket	***T4: 23 (2.3, 17.0)***
(6)	Exhaust pipe cover C	(19)	Spring	***T5: 35 (3.6, 25.8)***
(7)	Exhaust pipe cover D	(20)	Bolt	***T6: 42.5 (4.3, 31.3)***
(8)	Exhaust pipe cover E	(21)	Rear exhaust pipe	***T7: 48 (4.9, 35.4)***
(9)	Front oxygen (A/F) sensor	(22)	Cushion rubber	***T8: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Front Oxygen (A/F) Sensor>INSTALLATION.***
(10)	Rear oxygen sensor	(23)	Self-locking nut	***T9: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Rear Oxygen Sensor>INSTALLATION.***
(11)	Gasket	(24)	Gasket	
(12)	Center exhaust pipe (rear)	(25)	Muffler RH	
(13)	Exhaust pipe cover F	(26)	Muffler LH	

- MT model

(1)	Center exhaust pipe (front)	(14)	Exhaust pipe cover G	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Front catalytic converter	(15)	Center exhaust pipe band	***T1: 7.4 (0.8, 5.4)***
(3)	Rear catalytic converter	(16)	Exhaust pipe cover H	***T2: 13 (1.3, 9.6)***
(4)	Exhaust pipe cover A	(17)	Hanger bracket	***T3: 18 (1.8, 13.3)***
(5)	Exhaust pipe cover B	(18)	Gasket	***T4: 23 (2.3, 17.0)***
(6)	Exhaust pipe cover C	(19)	Spring	***T5: 35 (3.6, 25.8)***
(7)	Exhaust pipe cover D	(20)	Bolt	***T6: 42.5 (4.3, 31.3)***
(8)	Exhaust pipe cover E	(21)	Rear exhaust pipe	***T7: 48 (4.9, 35.4)***
(9)	Front oxygen (A/F) sensor	(22)	Cushion rubber	***T8: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Front Oxygen (A/F) Sensor>INSTALLATION.***
(10)	Rear oxygen sensor	(23)	Self-locking nut	***T9: Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Rear***

Oxygen Sensor>INSTALLATION.

(11) Gasket
(12) Center exhaust pipe (rear)
(13) Exhaust pipe cover F
(24) Gasket
(25) Muffler RH
(26) Muffler LH

3. HEAT SHIELD COVER

(1) Center exhaust cover (CVT model)
(2) Center exhaust cover (MT model)
(3) Rear exhaust cover RH
(4) Rear exhaust cover LH

Tightening torque: N·m (kgf-m, ft-lb)
T1: 10 (1.0, 7.4)
T2: 18 (1.8, 13.3)

EXHAUST(w/o STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- If any grease adheres to the exhaust pipe, wipe it off. Otherwise a fire may happen.

EXHAUST(w/o STI) > General Description

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	18283AA010	WRENCH ADAPTER	Used for removing and installing center exhaust pipe (front).

2. GENERAL TOOL

TOOL NAME	REMARKS
TORX® socket E10	Used for removing and installing center exhaust pipe (front).

REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
4. Remove the radiator sub fan and fan motor. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor>REMOVAL.
5. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
6. Lower the vehicle.
7. Remove the bolts which secure the water pump pulley cover to the turbocharger stay.
8. Disconnect the engine coolant hose from the water pipe assembly.
9. Remove the bolts which secure the intake duct No. 2 to the turbocharger.
10. Lift up the vehicle.
11. Disconnect the connector on the front oxygen (A/F) sensor from the engine wiring harness, and remove the clip (A) which secures the front oxygen (A/F) sensor harness to the water pump pulley cover.
12. Disconnect the connector on the rear oxygen sensor from the engine wiring harness, and disconnect the ground cable from the exhaust pipe cover.
13. Disconnect the union screw pipe assembly from the oil pipe assembly, and disconnect the engine coolant hose from the water pipe RH.
    Caution:
    In order to prevent damaging the oil pipe assembly, fix the section (a) shown in the figure when loosing the flare nut on the union screw pipe assembly, and avoid the part from rotating together while loosening the nut.
14. Disconnect the vacuum control hose from the wastegate control solenoid valve. (Except for Canada)
15. Disconnect the vacuum control hose from the wastegate control solenoid valve, and disconnect the engine coolant hose from the intake duct No. 1. (For Canada)
16. Remove the bolts which secure the intake duct No. 1 to the turbocharger.
17. Remove the nuts which secure the center exhaust pipe (rear) to the center exhaust pipe (front).
18. Remove the bolts, springs, and nuts which secure the rear exhaust pipe to the center exhaust pipe (rear).
19. Remove the bolt which holds center exhaust pipe (rear) to the hanger bracket, and remove the center exhaust pipe (rear).
    Note:
    For CVT model, removing the exhaust pipe bracket from the center exhaust pipe (rear) will adversely affect the positioning accuracy. Therefore, do not remove the bolts in section (a) shown in the figure.
    - CVT model
    - MT model
20. Remove the oil catch tank. Ref. to INTAKE (INDUCTION)(w/o STI)>Oil Catch Tank>REMOVAL.

Caution:
This procedure is required to prevent oil from remaining in the compressor and turbine areas if the residual oil inside the oil catch tank back flows.

21. Remove the bolts which secure the turbocharger stay.
22. While holding the front exhaust pipe with transmission jack, remove the nuts which hold the front exhaust pipe to the cylinder head exhaust port, and remove the front exhaust pipe.
23. Remove the water pump pulley cover and exhaust pipe stay from the engine and turbocharger stay.
24. Remove the turbocharger stay from the engine.

EXHAUST(w/o STI) > Front Exhaust Pipe

INSTALLATION

1. Install the turbocharger stay to the engine.
   Tightening torque:
   30 N·m (3.1 kgf-m, 22.1 ft-lb)
2. Install the water pump pulley cover and exhaust pipe stay to the engine and turbocharger stay.
   Tightening torque:
   19 N·m (1.9 kgf-m, 14.0 ft-lb)
3. While holding the front exhaust pipe with transmission jack, set the front exhaust pipe, and temporarily install the front exhaust pipe to the cylinder head exhaust port.
   Caution:
   Be sure to install the front exhaust pipe to the cylinder head.
   Note:
   Use a new gasket.
4. Tighten the nuts in the numerical order as shown in the figure.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
5. Tighten the nuts again in the numerical order as shown in the figure.
   Note:
   This operation is required to completely install the front exhaust pipe to the cylinder head.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
6. Attach the bolt which holds the turbocharger stay.
   Tightening torque:
   33 N·m (3.4 kgf-m, 24.3 ft-lb)
7. Install the oil catch tank. Ref. to INTAKE (INDUCTION)(w/o STI)>Oil Catch Tank>INSTALLATION.
8. Set the center exhaust pipe (rear), and temporarily tighten the bolt which holds the center exhaust pipe (rear) to the hanger bracket.
   - CVT model
   - MT model
9. Install the bolts, springs, and nuts which secure the rear exhaust pipe to the center exhaust pipe (rear).
   Note:
   Use a new gasket.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)

10. Install the nuts which secure the center exhaust pipe (rear) to the center exhaust pipe (front).
    Note:
    Use a new gasket.
    Tightening torque:
    42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
11. Tighten the bolts which hold center exhaust pipe (rear) to the hanger bracket.
    Tightening torque:
    35 N·m (3.6 kgf-m, 25.8 ft-lb)
    - CVT model
    - MT model
12. Install the bolt which secures the intake duct No. 1 to the turbocharger.
    Note:
    - **Use new O-rings.**
    - **Be careful not to pinch the O-ring.**

    Tightening torque:
    7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
13. Connect the vacuum control hose to the wastegate control solenoid valve. (Except for Canada)
14. Connect the vacuum control hose to the wastegate control solenoid valve, and connect the engine coolant hose to the intake duct No. 1. (For Canada)
15. Connect the union screw pipe assembly to the oil pipe assembly, and connect the engine coolant hose to the water pipe RH.
    Caution:
    In order to prevent damaging the oil pipe assembly, fix the section (a) shown in the figure when tightening the flare nut on the union screw pipe assembly, and avoid the part from rotating together while tightening the nut.
    Tightening torque:
    20 N·m (2.0 kgf-m, 14.8 ft-lb)
16. Connect the connector on the rear oxygen sensor to the engine wiring harness, and connect the ground cable to the exhaust pipe cover.
    Tightening torque:
    7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
17. Secure the front oxygen (A/F) sensor harness to the water pump pulley cover with the clip (A), and connect the front oxygen (A/F) sensor connector to the engine wiring harness.
18. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
19. Lower the vehicle.
20. Install the bolt which secures the intake duct No. 2 to the turbocharger.
    Tightening torque:
    16 N·m (1.6 kgf-m, 11.8 ft-lb)
21. Connect the engine coolant hoses to the water pipe assembly.
22. Attach the bolt which secures the water pump pulley cover to the turbocharger stay.
    Tightening torque:
    33 N·m (3.4 kgf-m, 24.3 ft-lb)
23. Install the radiator sub fan and fan motor. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor>INSTALLATION.
24. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.

25. Check the engine oil level and replenish the engine oil if necessary. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.
26. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
27. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
28. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

EXHAUST(w/o STI) > Front Exhaust Pipe

DISASSEMBLY

1. Remove the exhaust pipe cover from the turbocharger stay.
2. Remove nuts which hold the center exhaust pipe (front) to the turbocharger, and remove the center exhaust pipe (front) together with the turbocharger stay (A).
3. Remove the exhaust pipe cover from the front exhaust pipe.
4. Remove nuts which secure the front exhaust pipe to the turbocharger, and remove the front exhaust pipe together with the turbocharger stay (A).
5. Remove the exhaust pipe cover from the front exhaust pipe.

EXHAUST(w/o STI) > Front Exhaust Pipe

ASSEMBLY

1. Install the exhaust pipe cover to the front exhaust pipe.
   Tightening torque:
   7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
2. Install the front exhaust pipe together with the turbocharger stay (A) to the turbocharger.
   Note:
   Use a new gasket and self-locking nut.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
3. Install the exhaust pipe cover to the front exhaust pipe.
   Tightening torque:
   7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
4. Install the center exhaust pipe (front) together with the turbocharger stay (A) to the turbocharger.
   Note:
   Use a new gasket and self-locking nut.
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
5. Install the exhaust pipe cover to the turbocharger stay.
   Tightening torque:
   7.4 N·m (0.8 kgf-m, 5.4 ft-lb)

EXHAUST(w/o STI) > Front Exhaust Pipe

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

EXHAUST(w/o STI) > Center Exhaust Pipe

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Lift up the vehicle.
4. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
5. Disconnect the connector on the front oxygen (A/F) sensor from the engine wiring harness, and remove the clip (A) which secures the front oxygen (A/F) sensor harness to the water pump pulley cover.
6. Disconnect the connector on the rear oxygen sensor from the engine wiring harness, and disconnect the ground cable from the exhaust pipe cover.
7. Lower the vehicle.
8. Remove the bolts which secure the water pump pulley cover (A) and exhaust pipe stay (B) to the turbocharger stay, and remove the water pump pulley cover (A) and exhaust pipe stay (B) from the water pump and turbocharger stay.
9. Lift up the vehicle.
10. Remove the nuts which secure the center exhaust pipe (rear) to the center exhaust pipe (front).
11. Remove the bolts, springs, and nuts which secure the rear exhaust pipe to the center exhaust pipe (rear).
12. Remove the bolt which holds center exhaust pipe (rear) to the hanger bracket, and remove the center exhaust pipe (rear).

    Note:

    For CVT model, removing the exhaust pipe bracket from the center exhaust pipe (rear) will adversely affect the positioning accuracy. Therefore, do not remove the bolts in section (a) shown in the figure.

    - CVT model
    - MT model
13. Remove the exhaust pipe cover (A) from the center exhaust pipe (front), and remove the bolts which secure the turbocharger stay.
14. Using ST, remove the nut (1 place) which secures the center exhaust pipe (front) to the turbocharger.

    ST 18283AA010 WRENCH ADAPTER
15. Remove the nuts (3 places) which secure the center exhaust pipe (front) to the turbocharger.
16. Using the TORX® socket E10, remove stud bolts (3 places) from the turbocharger, and remove the center exhaust pipe (front) together with turbocharger stay (A).

EXHAUST(w/o STI) > Center Exhaust Pipe

INSTALLATION

1. Set the center exhaust pipe (front) together with turbocharger upper stay (A), and install stud bolts (3 places) to the turbocharger by using the TORX® socket E10.

    Note:

    Use a new gasket.

    Tightening torque:

    14.7 N·m (1.5 kgf-m, 10.8 ft-lb)

2. Temporarily tighten the nuts (3 places) which secure the center exhaust pipe (front) to the turbocharger together with the turbocharger upper stay (A).
   Note:
   Use a new self-locking nut.
3. Using ST, install the nut (1 place) which secures the center exhaust pipe (front) to the turbocharger.
   Note:
   Use a new self-locking nut.

   ST 18283AA010 WRENCH ADAPTER

   Tightening torque:

Calculation formula
T = L/(120 mm (4.72 in) + L) × 42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
T: Tightening torque L: Effective length of torque wrench **Note:** **If the effective length of the torque wrench used is unknown, consult the manufacturer of the torque wrench.** (a) Effective length of the ST (b) Effective length of the torque wrench (c) Center of drive angle of the ST (d) Center of drive angle of the torque wrench (e) Center of the position where a force is applied by hand

4. Temporarily tighten the nuts (3 places) which secure the center exhaust pipe (front) to the turbocharger together with the turbocharger stay (A).
   Tightening torque:
   42.5 N·m (4.3 kgf-m, 31.3 ft-lb)
5. Install the bolt which secures the turbocharger stay, and install the exhaust pipe cover (A) to the center exhaust pipe (front).
   Tightening torque:
   T1: 7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
   T2: 33 N·m (3.4 kgf-m, 24.3 ft-lb)
6. Install the center exhaust pipe (rear) and temporarily tighten the bolt which holds center exhaust pipe (rear) to the hanger bracket.
   - CVT model
   - MT model
7. Install the bolts, springs, and nuts which secure the rear exhaust pipe to the center exhaust pipe (rear).
   Note:
   Use a new gasket.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
8. Install the nuts which secure the center exhaust pipe (front) to the center exhaust pipe (rear).
   Note:
   Use a new gasket.
   Tightening torque:

42.5 N·m (4.3 kgf-m, 31.3 ft-lb)

9. Tighten the bolts which hold center exhaust pipe (rear) to the hanger bracket.
   Tightening torque:
   35 N·m (3.6 kgf-m, 25.8 ft-lb)
   - CVT model
   - MT model
10. Lower the vehicle.
11. Install the exhaust pipe stay (B) and water pump pulley cover (A) to the turbocharger stay and water pump, and install the bolts which secure the water pump pulley cover (A) and exhaust pipe stay (B) to the turbocharger stay.
    Tightening torque:
    T1: 19 N·m (1.9 kgf-m, 14.0 ft-lb)
    T2: 33 N·m (3.4 kgf-m, 24.3 ft-lb)
12. Lift up the vehicle.
13. Connect the connector on the rear oxygen sensor to the engine wiring harness, and connect the ground cable to the exhaust pipe cover.
    Tightening torque:
    7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
14. Secure the front oxygen (A/F) sensor harness to the water pump pulley cover with the clip (A), and connect the front oxygen (A/F) sensor connector to the engine wiring harness.
15. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
16. Lower the vehicle.
17. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
18. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

EXHAUST(w/o STI) > Center Exhaust Pipe

DISASSEMBLY

1. Remove the front oxygen (A/F) sensor and rear oxygen sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Front Oxygen (A/F) Sensor>REMOVAL. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Rear Oxygen Sensor>REMOVAL.
2. Remove the exhaust pipe cover from the center exhaust pipe (front) and center exhaust pipe (rear).

EXHAUST(w/o STI) > Center Exhaust Pipe

ASSEMBLY

1. Install the exhaust pipe cover to the center exhaust pipe (front) and center exhaust pipe (rear).
   Tightening torque:
   T1: 7.4 N·m (0.8 kgf-m, 5.4 ft-lb)
   T2: 13 N·m (1.3 kgf-m, 9.6 ft-lb)
2. Install the front oxygen (A/F) sensor and rear oxygen sensor. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Front Oxygen (A/F) Sensor>INSTALLATION. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Rear Oxygen Sensor>INSTALLATION.

EXHAUST(w/o STI) > Center Exhaust Pipe

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.

EXHAUST(w/o STI) > Rear Exhaust Pipe

REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

1. Lift up the vehicle.
2. Remove the bolts, springs, and nuts which secure the center exhaust pipe (rear) to the rear exhaust pipe.
3. Remove the bolts and self-locking nuts securing the mufflers to the rear exhaust pipes.
   Caution:
   Be careful not to drop the rear exhaust pipe.
4. Apply a coat of spray type lubricant to the mating area of cushion rubber.
5. Remove the rear exhaust pipe from the cushion rubber.
   Caution:
   Be careful not to let the muffler contact the rear bumper.

EXHAUST(w/o STI) > Rear Exhaust Pipe

INSTALLATION

1. Apply a coat of spray type lubricant to the mating area of cushion rubber.
2. Install the rear exhaust pipe to cushion rubber.
   Note:
   After assembling, degrease the lubricant which was applied to the cushion rubber while removing/installing.
3. Install the bolts and self-locking nuts which secure the muffler to the rear exhaust pipe.
   Note:
   Use a new gasket and self-locking nut.
   Tightening torque:
   48 N·m (4.9 kgf-m, 35.4 ft-lb)
4. Install the bolts, springs, and nuts which secure the center exhaust pipe (rear) to the rear exhaust pipe.
   Note:
   Use a new gasket.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
5. Lower the vehicle.

EXHAUST(w/o STI) > Rear Exhaust Pipe

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.
3. Check the cushion rubber for wear or crack.

EXHAUST(w/o STI) > Muffler

REMOVAL

Caution:
Vehicle components are extremely hot after driving. Be wary of receiving burns from heated parts.

1. Lift up the vehicle.
2. Remove the clip (A) which holds the cover - rear bumper side to the vehicle and rear bumper.
   Note:
   This procedure is required to facilitate the removal/installation of the muffler.
3. Remove the bolts and self-locking nuts which secure the rear exhaust pipe to the muffler.
4. Apply a coat of spray type lubricant to the mating area of cushion rubber.
5. Remove the muffler from the cushion rubber.
   Caution:
   Be careful not to drop the muffler during removal.
6. Remove the cushion rubber and rear exhaust cover from the vehicle.

EXHAUST(w/o STI) > Muffler

INSTALLATION

Install in the reverse order of removal.
Note:
- **Use a new gasket and self-locking nut.**
- **After assembling, degrease the lubricant which was applied to the cushion rubber while removing/installing.**

Tightening torque:
10 N·m (1.0 kgf-m, 7.4 ft-lb)
Tightening torque:
48 N·m (4.9 kgf-m, 35.4 ft-lb)

EXHAUST(w/o STI) > Muffler

INSPECTION

1. Check the connections and welded parts for exhaust leaks.
2. Make sure there are no holes or rusting.
3. Check the cushion rubber for wear or crack.

COOLING(w/o STI)

CO(w/o STI)

1. General Description
2. Radiator Fan System
3. Engine Coolant
4. Water Pump
5. Water Pipe Assembly
6. Thermostat
7. Radiator
8. Radiator Cap
9. Radiator Main Fan and Fan Motor
10. Radiator Sub Fan and Fan Motor
11. Reservoir Tank
12. Engine Cooling System Trouble in General

SPECIFICATION

Cooling system				Electric fan + Forced engine coolant circulation system
Total engine coolant capacity L (US qt, Imp qt)				CVT model: Approx. 8.3 (8.8, 7.3) MT model: Approx. 8.1 (8.6, 7.2)
Water pump	Type			Centrifugal impeller type
	Discharge performance	Discharge rate L (US gal, Imp gal)/min		248 (65.5, 54.6)
		Pump speed — System pressure		8,580 r/min — 88 kPa (8.9 mAq)
		Engine coolant temperature		80°C (176°F)
	Impeller diameter mm (in)			56 (2.2)
	Number of impeller vanes			7
	Pump pulley diameter mm (in)			100 (3.9)
Thermostat	Type			Wax pellet type
	Starting temperature to open			86 — 90°C (187 — 194°F)
	Full open temperature			95°C (203°F)
	Valve lift mm (in)			8.0 (0.315) or more
	Valve opening size mm (in)			32 (1.26)
Radiator fan	Motor input	Main fan W		120
		Sub fan W		120
	Fan diameter / Blade	Main fan		320 mm (12.6 in)/9
		Sub fan		320 mm (12.6 in)/11
Radiator	Type			Down flow, pressure type
	Core dimensions	Width × Height × Thickness mm (in)		687.4 × 340 × 16 (27.06 × 13.39 × 0.63)
	Pressure range in which cap valve is open kPa (kg/cm^2, psi)		Positive pressure side	Standard: 93 — 123 (0.95 — 1.25, 14 — 18) Limit: 83 (0.85, 12)
			Negative pressure side	Standard: −1.0 to −4.9 or less (−0.01 ——0.05, −0.1 ——0.7)
	Fins			Corrugated fin type
Reservoir tank	Capacity L (US qt, Imp qt)			0.45 (0.48, 0.40)

	Recommended materials	Item number	Alternative
Engine coolant	SUBARU SUPER COOLANT (concentrated	—	—

	Recommended materials	Item number	Alternative
	type)		
	SUBARU SUPER COOLANT (diluted type)	K0670Y0001	
Water for dilution	Distilled water	—	Soft water or tap water
Cooling system protective agent	Cooling system conditioner	SOA345001	—

COOLING(w/o STI) > General Description

COMPONENT

1. WATER PUMP

(1) Water pump pulley
(2) Water pump ASSY
(3) Gasket
(4) Thermostat
(5) Gasket
(6) Thermostat cover
(7) Clip
(8) Water pipe hose LH
(9) Water pipe LH
(10) Preheater hose
(11) Clip
(12) Water pipe RH
(13) Clip
(14) Water pipe hose RH
(15) Water pipe ASSY
(16) O-ring
(17) Engine coolant temperature sensor
(18) Gasket
(19) Preheater hose
(20) Clip
(21) Engine coolant hose
(22) Clip

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 14 (1.4, 10.3)
T3: 18 (1.8, 13.3)

2. RADIATOR & RADIATOR FAN

(1) Radiator lower bracket
(2) Radiator lower cushion
(3) Radiator drain plug
(4) O-ring
(5) Radiator
(6) Radiator upper cushion
(7) Radiator upper bracket
(8) Clip
(9) Radiator inlet hose
(10) Radiator cap
(11) Radiator outlet hose
(12) Engine coolant reservoir tank
(13) Engine coolant reservoir tank cap
(14) Over flow hose
(15) Nut (with lock agent)
(16) Radiator sub fan
(17) Radiator main fan
(18) Radiator sub fan shroud
(19) Radiator main fan shroud
(20) Sub fan motor
(21) Main fan motor
(22) Radiator upper gasket
(23) Radiator lower gasket

Tightening torque: N·m (kgf-m, ft-lb)

T1: 3.43 (0.35, 2.53)
T2: 4.41 (0.45, 3.25)
T3: 7.5 (0.8, 5.5)
T4: 12 (1.2, 8.9)

COOLING(w/o STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:

1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
2. Protect the vehicle using a seat cover, fender cover, etc.
3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.

- Prepare a container and cloth to prevent scattering of engine coolant when performing work where engine coolant can be spilled. If the oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- Follow all government and local regulations concerning disposal of refuse when disposing engine coolant.

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	18355AA000	PULLEY WRENCH	• Used for removing and installing water pump pulley. • Used with PULLEY WRENCH PIN SET (18334AA030).
	18334AA030	PULLEY WRENCH PIN SET	• Used for removing and installing water pump pulley. • Used together with PULLEY WRENCH (18355AA000).
	18632AA030	STAND ASSY	Used for removing and installing the water pipe assembly LH.
	45099SJ000	ST COOLANT CHARGER	Used for filling radiator with engine coolant.
	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system.

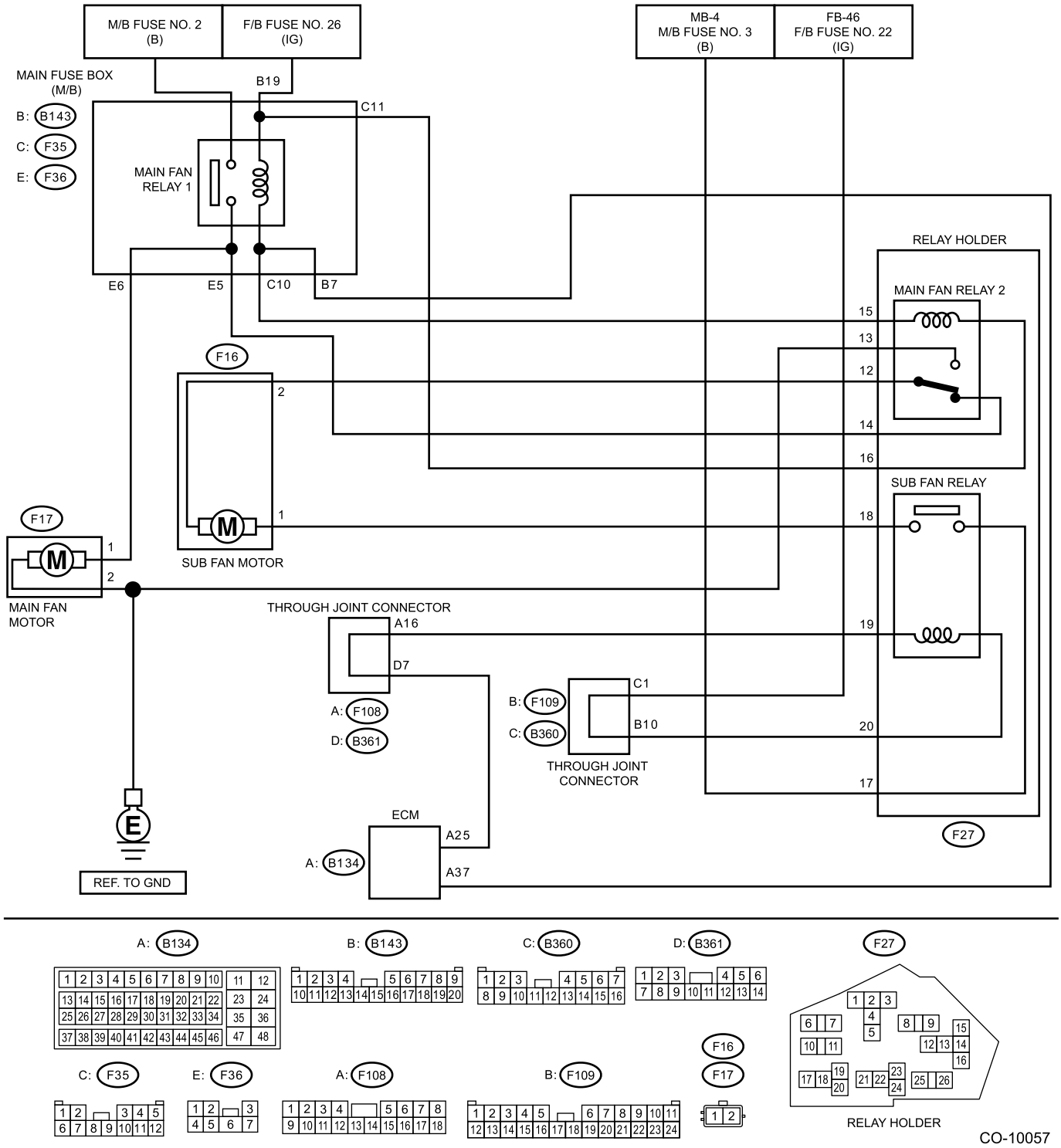
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
			Note: **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
Radiator cap tester	Used for checking radiator and radiator cap.
DST-i	Used together with Subaru Select Monitor 4.

WIRING DIAGRAM

Radiator fan system Ref. to WIRING SYSTEM>Radiator Fan System>WIRING DIAGRAM.



INSPECTION

Operating condition:

Vehicle speed	A/C compress or load	Engine coolant temperature		
		Increase: 94°C (201°F) or less Decrease: 92°C (198°F) or less	**Increase: 95 — 99°C (203 — 210°F) Decrease: 93 — 94°C (199 — 201°F)**	**Increase: 100°C (212°F) or more Decrease: 95°C (203°F) or more**
		Radiator fan operation	**Radiator fan operation**	**Radiator fan operation**
During acceleration: 19 km/h (12 MPH) or less*1 During deceleration: 10 km/h (6 MPH) or less*1	OFF	OFF	Low-Speed	High-Speed
	Low	Low-Speed	Low-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
During acceleration: 20 — 69 km/h (12 — 43 MPH) During deceleration: 11 — 64 km/h (7 — 40 MPH)	OFF	OFF	Low-Speed	High-Speed
	Low	High-Speed	High-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
During acceleration: 70 — 134 km/h (43 — 83 MPH) During deceleration: 65 — 129 km/h (40 — 80 MPH)	OFF	OFF	Low-Speed	High-Speed
	Low	OFF*2	Low-Speed*2	High-Speed
	High	Low-Speed*2	High-Speed	High-Speed
During acceleration: 135 km/h (84 MPH) or more During deceleration: 130 km/h (81 MPH) or more	OFF	OFF	OFF	High-Speed
	Low	OFF	Low-Speed	High-Speed
	High	OFF	Low-Speed	High-Speed

*1: Including the condition under which vehicle is stopped (0 km/h (0 MPH)).

*2: The fan may run at High-Speed when ambient temperature is high.

Diagnosis:

Radiator main fan and radiator sub fan do not rotate under the above operating conditions.

1. CHECK OPERATION OF RADIATOR FAN.

1. Install the delivery mode fuse.
2. Turn the ignition switch to ON.
3. Using the Subaru Select Monitor, perform the active test for the radiator fan relay.
   Note:
   - **When performing the active test for the radiator fan relay using the Subaru Select Monitor, the radiator main fan and radiator sub fan will repeat low speed revolution → high speed revolution → OFF in this order.**
   - **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

Do the radiator main fans and radiator sub fans rotate at low speed?

Yes	Go to 2.
No	Go to 3.

2. CHECK OPERATION OF RADIATOR FAN.

Using the Subaru Select Monitor, perform the active test for the radiator fan relay.

Note:

- **When performing the active test for the radiator fan relay using the Subaru Select Monitor, the radiator main fan and radiator sub fan will repeat low speed revolution → high speed revolution → OFF in this order.**
- **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

Do the radiator main fans and radiator sub fans rotate at high speed?

Yes	Radiator main fan system is normal.
No	Go to 27.

3. CHECK POWER SUPPLY TO SUB FAN RELAY.

1. Turn the ignition switch to OFF.
2. Remove the sub fan relay.
3. Measure the voltage between the sub fan relay terminal and chassis ground.
   Connector & terminal
   (F27) No. 17 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes	Go to 4.
No	Go to 5.

4. CHECK POWER SUPPLY TO SUB FAN RELAY.

1. Turn the ignition switch to ON.
2. Measure the voltage between the sub fan relay terminal and chassis ground.
   Connector & terminal
   (F27) No. 20 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes	Go to 7.
No	Go to 6.

5. CHECK FUSE.

1. Remove the fuse No. 3.
2. Check the condition of fuse.

Is the fuse blown out?

Yes	Replace the fuse.
No	Repair the power supply line.

6. CHECK FUSE.

1. Turn the ignition switch to OFF.
2. Remove the fuse No. 22.
3. Check the condition of fuse.

Is the fuse blown out?

Yes	Replace the fuse.
No	Repair the power supply line.

7. CHECK SUB FAN RELAY.

Measure the resistance between sub fan relay switch terminals.

Is the resistance 1 MΩ or more?

Yes	Go to 8.
No	Replace the sub fan relay. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

8. CHECK SUB FAN RELAY.

1. Connect the battery to the terminal on the sub fan relay coil side.
2. Measure the resistance between sub fan relay switch terminals.

Is the resistance less than 1 Ω?

Yes	Go to 9.
No	Replace the sub fan relay. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

9. CHECK HARNESS BETWEEN SUB FAN RELAY TERMINAL AND SUB FAN MOTOR CONNECTOR.

1. Turn the ignition switch to OFF.
2. Disconnect the connector from the sub fan motor.
3. Measure the resistance of harness between the sub fan relay terminal and sub fan motor connector.
   Connector & terminal
   (F16) No. 1 — (F27) No. 18:

Is the resistance less than 1 Ω?

Yes	Go to 10.
No	Repair the open circuit of harness between sub fan relay terminal and sub fan motor connector.

10. CHECK HARNESS BETWEEN SUB FAN MOTOR CONNECTOR AND MAIN FAN RELAY 2 CONNECTOR.

1. Remove the main fan relay 2.
2. Measure the resistance of harness between sub fan motor connector and main fan relay 2 connector.
   Connector & terminal
   (F16) No. 2 — (F27) No. 12:

Is the resistance less than 1 Ω?

Yes	Go to 11.
No	Repair the open circuit of the harness between sub fan motor connector and main fan relay 2 connector.

11. CHECK FOR POOR CONTACT.

Check poor contact of sub fan motor connector.

Is there poor contact of the sub fan motor connector?

Yes	Repair the poor contact of sub fan motor connector.
No	Go to 12.

12. CHECK SUB FAN MOTOR.

Connect the battery positive (+) terminal to terminal No. 1 of the sub fan motor, and the ground (−) terminal to terminal No. 2.

Does the radiator sub fan rotate?

Yes	Go to 13.
No	Replace the sub fan motor. Ref. to COOLING(w/o STI)>Radiator Sub Fan and Fan Motor.

13. CHECK MAIN FAN RELAY 2.

Measure the resistance between terminals of main fan relay 2 switch (always ON side).

Is the resistance less than 1 Ω?

Yes	Go to 14.
No	Replace the main fan relay 2. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

14. CHECK HARNESS BETWEEN MAIN FAN RELAY 2 AND MAIN FAN MOTOR CONNECTOR.

1. Disconnect the connector from the main fan motor.
2. Measure the resistance of the harness between main fan relay 2 terminal and main fan motor connector.
   Connector & terminal
   (F17) No. 1 — (F27) No. 14:

Is the resistance less than 1 Ω?

Yes	Go to 15.
No	Repair the open circuit of the harness between main fan relay 2 terminal and main fan motor connector.

15. CHECK GROUND CIRCUIT OF MAIN FAN MOTOR.

Measure the resistance between main fan motor connector and chassis ground.
Connector & terminal
(F17) No. 2 — Chassis ground:

Is the resistance less than 5 Ω?

Yes	Go to 16.
No	Repair the open circuit of the harness between main fan motor connector and chassis ground.

16. CHECK FOR POOR CONTACT.

Check poor contact of main fan motor connector.

Is there poor contact of the main fan motor connector?

Yes	Repair the poor contact of main fan motor connector.
No	Go to 17.

17. CHECK MAIN FAN MOTOR.

Connect the battery positive (+) terminal to terminal No. 1 of the main fan motor, and the ground (−) terminal to terminal No. 2.

Does the radiator main fan rotate?

Yes	Go to 18.
No	Replace the main fan motor. Ref. to COOLING(w/o STI)>Radiator Main Fan and Fan Motor.

18. CHECK HARNESS BETWEEN SUB FAN RELAY AND ECM.

1. Disconnect the connector from ECM.
2. Measure the resistance between the sub fan relay terminal and ECM connector.
   Connector & terminal
   (B134) No. 25 — (F27) No. 19:

Is the resistance less than 1 Ω?

Yes	Go to 19.
No	Repair the open circuit of harness between sub fan relay terminal and ECM.

19. CHECK FOR POOR CONTACT.

Check for poor contact of ECM connector.

Is there poor contact of ECM connector?

Yes	Repair the poor contact of ECM connector.
No	Check the DTC. Repair the trouble cause. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Read Diagnostic Trouble Code (DTC).

20. CHECK MAIN FAN RELAY 1.

1. Turn the ignition switch to OFF.
2. Remove the main fan relay 1.
3. Measure the resistance between terminals of main fan relay 1 switch.

Is the resistance 1 MΩ or more?

Yes	Go to 21.
No	Replace the main fan relay 1. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

21. CHECK MAIN FAN RELAY 1.

1. Connect the main fan relay 1 coil side terminal to the battery.
2. Measure the resistance between terminals of main fan relay 1 switch.

Is the resistance less than 1 Ω?

Yes	Go to 22.
No	Replace the main fan relay 1. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

22. CHECK HARNESS BETWEEN MAIN FAN RELAY 1 AND MAIN FAN MOTOR CONNECTOR.

1. Disconnect the connector from the main fan motor.
2. Measure the resistance of the harness between main fan relay 1 terminal and main fan motor connector.
   Connector & terminal
   (F17) No. 1 — (F36) No. 6:

Is the resistance less than 1 Ω?

Yes	Go to 23.
No	Repair the open circuit of the harness between main fan relay 1 terminal and main fan motor connector.

23. CHECK HARNESS BETWEEN MAIN FAN RELAY 1 AND ECM.

1. Disconnect the connector from ECM.
2. Measure the resistance between main fan relay 1 terminal and ECM connector.
   Connector & terminal
   (B134) No. 37 — (B143) No. 7:

Is the resistance less than 1 Ω?

Yes	Go to 24.
No	Repair the open circuit of the harness between main fan relay 1 terminal and ECM.

24. CHECK HARNESS BETWEEN MAIN FAN RELAY 2 AND ECM.

Measure the resistance between main fan relay 2 terminal and ECM connector.

Connector & terminal

(B134) No. 37 — (F27) No. 15:

Is the resistance less than 1 Ω?

Yes	Go to 25.
No	Repair the open circuit of the harness between main fan relay 2 terminal and ECM.

25. CHECK FUSE.

1. Remove the fuse No. 2 and No. 26.
2. Check the condition of fuse.

Is the fuse blown out?

Yes	Replace the fuse.
No	Go to 26.

26. CHECK FOR POOR CONTACT.

Check for poor contact of ECM connector.

Is there poor contact of ECM connector?

Yes	Repair the poor contact of ECM connector.
No	Repair the power supply circuit to the main fuse box.

27. CHECK OPERATION OF RADIATOR FAN.

If the both fans do not rotate at high speed in the condition of step 2, check whether the radiator sub fan is rotating.

Does the radiator sub fan rotate?

Yes — Go to 20.

No — Go to 28.

28. CHECK GROUND CIRCUIT OF MAIN FAN RELAY 2.

1. Turn the ignition switch to OFF.
2. Remove the main fan relay 2.
3. Measure the resistance between main fan relay 2 terminal and chassis ground.

Connector & terminal

(F27) No. 13 — Chassis ground:

Is the resistance less than 1 Ω?

Yes — Go to 29.

No — Repair the open circuit of harness between main fan relay 2 and chassis ground.

29. CHECK POWER SUPPLY TO MAIN FAN RELAY 2.

1. Turn the ignition switch to ON.
2. Measure the voltage between main fan relay 2 terminal and chassis ground.

Connector & terminal

(F27) No. 16 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes — Go to 30.

No — Repair the power supply line.

30. CHECK MAIN FAN RELAY 2.

Measure the resistance between terminals of main fan relay 2 switch (always OFF side).

Is the resistance 1 MΩ or more?

Yes	Go to 31.
No	Replace the main fan relay 2. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

31. CHECK MAIN FAN RELAY 2.

1. Connect the main fan relay 2 coil side terminal to the battery.
2. Measure the resistance between terminals of main fan relay 2 switch (always OFF side).

Is the resistance less than 1 Ω?

Yes	Go to 23.
No	Replace the main fan relay 2. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Electrical Component Location>LOCATION > SOLENOID VALVE, ACTUATOR, EMISSION CONTROL SYSTEM PARTS AND IGNITION SYSTEM PARTS.

INSPECTION

Note:
When adding the engine coolant, always use SUBARU Super Coolant.

1. Park the vehicle on a level surface.
2. Check the engine coolant amount, and if the coolant level is low, check for the coolant leakage, and then add the engine coolant.
   (1) Make sure the engine coolant level in the reservoir tank is between "FULL" and "LOW" with the engine in a cold condition.
   (2) Open the radiator cap and make sure that the radiator is filled with the engine coolant up to its filler neck position.

REPLACEMENT

1. DRAINING OF ENGINE COOLANT

1. Lift up the vehicle.
2. Remove the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>REMOVAL.
3. Set a vinyl sheet (A), etc. at the base of drain plug.
   Caution:
   This operation is required to prevent engine coolant from scattering around.
4. Remove the drain plug (B) to drain engine coolant into container.
   Note:
   Remove the radiator cap so that engine coolant will drain faster.
5. Install the drain plug.
   Note:
   Use new O-rings.
6. Remove the vinyl sheet, etc.
7. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.

2. FILLING OF ENGINE COOLANT

Caution:
For CVT models, set the select lever to "P" or "N" range (for MT models, the shift lever in neutral) during work, and do not shift the lever.

1. Set the ST to the radiator filler neck.

   ST 45099SJ000 ST COOLANT CHARGER

2. Fill the ST with cooling system conditioner.
   Cooling system protective agent:
   Refer to "SPECIFICATION" for cooling system protective agent. Ref. to COOLING(w/o STI)>General Description>SPECIFICATION.
3. Fill the ST with engine coolant.
   Recommended engine coolant:

Refer to "SPECIFICATION" for recommended engine coolant. Ref. to COOLING(w/o STI)>General Description>SPECIFICATION.

Engine coolant level:

Refer to "SPECIFICATION" for engine coolant level. Ref. to COOLING(w/o STI)>General Description>SPECIFICATION.

Engine coolant concentration:

Refer to "ADJUSTMENT" for the recommended engine coolant concentration. Ref. to COOLING(w/o STI)>Engine Coolant>ADJUSTMENT.

Note:

The SUBARU Super Coolant contains anti-freeze and anti-rust agents, and is especially made for Subaru engines with an aluminum cylinder block. Be sure to use SUBARU Super Coolant, since other coolant may cause corrosion.

4. Start the engine, and race 5 to 6 times at 3,000 r/min or less, then stop the engine. (Complete this operation within 40 seconds.)
5. Wait for one minute after the engine stops. If the engine coolant level drops, fill the ST with engine coolant.
6. Perform the procedures 4) and 5) again.
7. Start the engine and operate the heater at maximum hot position and the blower speed setting to "LO". (A/C OFF)
8. Run the engine at 3,000 r/min or less until radiator fan starts and stops.

   Note:

   Be careful with the engine coolant temperature to prevent overheating.
9. Stop the engine and wait until the engine coolant temperature lowers to 30°C (86°F) or less.
10. If the engine coolant level drops, fill the ST with engine coolant.
11. Set the heater setting to maximum hot position and the blower speed setting to "LO" and start the engine. Perform racing at 3,000 r/min or less. If the flowing sound is heard from the heater core, repeat the procedures from step 8).
12. Stop the engine and remove the ST, and then install the radiator cap.

    Caution:

    Prepare a container and cloth when performing the work in order to prevent scattering of engine coolant. If the oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
13. Make sure the engine coolant level in the reservoir tank is between "FULL" and "LOW", and adjust if necessary.

COOLING(w/o STI) > Engine Coolant

ADJUSTMENT

1. PROCEDURE TO ADJUST THE SUBARU SUPER COOLANT CONCENTRATION

Caution:

Use the SUBARU Super Coolant with a 50 — 60% concentration in order to obtain maximum anti-freeze and anti-rust performance.

To adjust the concentration of SUBARU Super Coolant according to temperature, find the proper SUBARU Super Coolant concentration in the table, and add dilution water to the SUBARU Super Coolant (concentrated type) until it reaches the proper dilution.

Relationship of SUBARU Super Coolant concentration and freezing temperature			
SUBARU Super Coolant concentration	50%	55%	60%
Freezing temperature	−36°C (−33°F)	−41°C (−42°F)	−50°C (−58°F)

Engine coolant and diluting water:

Refer to "SPECIFICATION" for recommended engine coolant and diluting water. Ref. to COOLING(w/o STI)>General Description>SPECIFICATION.

REMOVAL

1. WATER PUMP PULLEY

1. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL.
2. Remove the water pump pulley using the ST.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA030	PULLEY WRENCH PIN SET

2. WATER PUMP

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the water pump pulley. Ref. to COOLING(w/o STI)>Water Pump>REMOVAL > WATER PUMP PULLEY.
3. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
4. Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
5. Remove the water pump from the oil pan upper.

INSTALLATION

1. WATER PUMP PULLEY

1. Using the ST, install the water pump pulley.

ST1	18355AA000	PULLEY WRENCH
ST2	18334AA030	PULLEY WRENCH PIN SET

Tightening torque:
14 N·m (1.4 kgf-m, 10.3 ft-lb)

2. Install the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>INSTALLATION.

2. WATER PUMP

1. Install the water pump to oil pan upper.
Note:
Use a new gasket.
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
2. Install the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.
3. Install the water pump pulley. Ref. to COOLING(w/o STI)>Water Pump>INSTALLATION > WATER PUMP PULLEY.
4. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

INSPECTION

1. Check that the water pump pulley does not have deformation, cracks and any other damage.
2. Check the water pump bearing for smooth rotation.
3. Make sure the impeller is not abnormally deformed or damaged.

REMOVAL

1. WATER PIPE ASSEMBLY RH

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
3. Remove the oil pipe assembly. Ref. to LUBRICATION(w/o STI)>Oil Pipe>REMOVAL > OIL PIPE ASSEMBLY.
4. Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
5. Disconnect the water hose (A) from the water pipe assembly RH, and remove the bolt (B) securing the water pipe assembly RH to the cam carrier RH.
6. Remove the bolt (A) which secures the water pipe assembly RH to the cylinder head RH.
7. Disconnect the water pipe hose RH (B) from oil pan upper, and remove the water pipe assembly RH.

2. WATER PIPE ASSEMBLY LH

1. Remove the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>DISASSEMBLY.
2. Fully open the front hood. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
3. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
4. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
6. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
7. Remove the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.
8. Remove the nuts which secure the engine mounting to the front crossmember.
9. Lower the vehicle.
10. Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness to the bracket, and remove the bolt which secures the engine control module (ECM) to the bracket.
11. Pull out the engine control module (ECM) from the bracket, and move it to a location that does not interfere operation.
    Note:
    When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.
12. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
13. Disconnect the preheater hose (A) and the heater outlet hose (B) from the water pipe assembly LH.
14. Remove the bolt which holds the water pipe assembly LH from the cylinder head LH.
15. Remove the pitching stopper.
16. Support the engine with a lifting device and wire ropes.
17. Set the cushioning material such as a waste cloth between pitching stopper bracket and transmission case cover. (CVT model)
    Note:
    - **This operation is required to prevent damage to the transmission case cover.**
    - **Make sure that the height of cushioning material does not become 15 — 20 mm (0.6 — 0.8 in) or less when it is crushed.**

18. While gradually lifting up the engine, set the ST between the engine mount LH and front crossmember, and then slowly lower the engine.
Caution:
- **When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.**
- **To avoid the damage, be sure to set the ST as shown in the figure.**

(A) Direction mark (B) Engine mounting side (C) Front crossmember side

- **After lowering the engine, check that the ST does not come off even if the engine is bounced.**

ST 18632AA030 STAND ASSY

19. Remove the lifting device and wire ropes.
20. Lift up the vehicle.
21. Remove the rear oxygen sensor connector (A) from the water pipe assembly LH.
22. Disconnect the side engine oil cooler hose B (B) from the water pipe assembly LH.
23. Remove the bolt (C) which secures the water pipe assembly LH to the cylinder head LH.
24. Disconnect the water pipe hose LH (D) from oil pan upper, and remove the water pipe assembly LH.

COOLING(w/o STI) > Water Pipe Assembly

INSTALLATION

1. WATER PIPE ASSEMBLY RH

1. Set the water pipe assembly RH on the engine, and connect the water pipe hose RH (B) to the oil pan upper.
2. Install the bolt (A) which secures the water pipe assembly RH to the cylinder head RH.
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
3. Connect the water hose (A) to the water pipe assembly RH, and install the bolt (B) which secures the water pipe assembly RH to the cam carrier RH.
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
4. Install the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.
5. Install the oil pipe assembly. Ref. to LUBRICATION(w/o STI)>Oil Pipe>INSTALLATION > OIL PIPE ASSEMBLY.
6. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
7. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

2. WATER PIPE ASSEMBLY LH

1. Set the water pipe assembly LH on the engine, and connect the water pipe hose LH (D) to the oil pan upper.
2. Install the bolt (C) which secures the water pipe assembly LH to the cylinder head LH.
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

3. Connect the side engine oil cooler hose B (B) to the water pipe assembly LH.
4. Install the rear oxygen sensor connector (A) to the water pipe assembly LH.
5. Lower the vehicle.
6. Support the engine with a lifting device and wire ropes.
7. Lift the engine a little, and remove the ST.

   Caution:

   When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

   ST 18632AA030 STAND ASSY

8. Lower the engine and remove the lifting device and wire ropes.
9. Remove the cushioning material between pitching stopper bracket and transmission case cover. (CVT model)
10. Install the pitching stopper.

    Tightening torque:

    T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

    T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)
11. Connect the preheater hose (A) and the heater outlet hose (B) to the water pipe assembly LH.
12. Install the bolt which secures the water pipe assembly LH to the cylinder head LH.

    Tightening torque:

    6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
13. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
14. Insert the engine control module (ECM) to the bracket.
15. Install the bolt which secures the engine control module (ECM) to the bracket, and then secure the engine wiring harness and bulkhead harness to the bracket with clip (A) and clip (B).

    Tightening torque:

    7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
16. Lift up the vehicle.
17. Install the nuts which hold the engine mounting to the front crossmember.

    Note:

    - **Use a new nut.**
    - **Make sure that locators (a) of the engine mounting are securely inserted.**

    Tightening torque:

    60 N·m (6.1 kgf-m, 44.3 ft-lb)
18. Install the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>INSTALLATION.
19. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
20. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
21. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
22. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.
23. Set the front hood to the normal position. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
24. Install the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>ASSEMBLY.
25. Close the front hood.

INSPECTION

1. Check that the water pipe assembly has no deformation, cracks or other damages.
2. Check that the hose has no cracks, damage or loose part.

COOLING(w/o STI) > Thermostat

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
3. Remove the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.
4. Disconnect the radiator outlet hose from thermostat cover.
5. Remove the thermostat cover, and then remove the thermostat.
6. Remove the gasket from thermostat.

COOLING(w/o STI) > Thermostat

INSTALLATION

1. Install a gasket to thermostat.
   Note:
   - **Use a new gasket.**
   - **Align the positions of the jig pin (a) and gasket ribs (b).**
2. Install the thermostat and thermostat cover.
   Note:
   Align the oil pan upper cutout (a) with the position of the thermostat rib (b).
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
3. Connect the radiator outlet hose to thermostat cover.
4. Install the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>INSTALLATION.
5. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
6. Lower the vehicle.
7. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
8. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

COOLING(w/o STI) > Thermostat

INSPECTION

1. Check that the thermostat does not have deformation, cracks or damage.
2. Check that the thermostat valve closes completely at an ambient temperature.
3. Immerse the thermostat and a thermometer in water. Raise water temperature gradually, and check the temperature and valve lift when the valve begins to open and when the valve is fully opened. Replace the thermostat if faulty.
   Note:
   - **During the test, agitate the water for even temperature distribution.**
   - **Leave the thermostat in the boiling water for five minutes or more before measuring the valve lift.**
   - **Hold the thermostat with a wire or the like to avoid contacting with container bottom.**
   Starting temperature to open:
   86 — 90°C (187 — 194°F)

Full open temperature:

95°C (203°F)

Total valve lift:

8.0 mm (0.315 in) or more

(A) Thermometer (B) Thermostat

COOLING(w/o STI) > Radiator

REMOVAL

Caution:
The radiator is pressurized when the engine and radiator are hot. Wait until engine and radiator cool down before working on the radiator.

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Remove the reservoir tank. Ref. to COOLING(w/o STI)>Reservoir Tank>REMOVAL.
4. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
5. Disconnect the radiator outlet hose from thermostat cover.
6. Lower the vehicle.
7. Disconnect the connector (A) from the main fan motor and the connector (B) from the sub fan motor.
8. Disconnect the radiator inlet hose from the water tank pipe assembly.
9. Remove the radiator upper brackets.
10. Remove the radiator from vehicle.
11. Remove the radiator lower cushion from the radiator lower bracket.

COOLING(w/o STI) > Radiator

INSTALLATION

1. Attach the radiator lower cushion to the radiator lower bracket.
2. Install the radiator to vehicle.
   Note:
   Make pins on the lower side of radiator be fitted into the radiator lower cushions.
3. Install the radiator upper brackets.
   Tightening torque:
   12 N·m (1.2 kgf-m, 8.9 ft-lb)
4. Connect the radiator inlet hose to the water tank pipe assembly.
5. Connect the connector (A) to the main fan motor and the connector (B) to the sub fan motor.
6. Lift up the vehicle.
7. Connect the radiator outlet hose to thermostat cover.
8. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
9. Lower the vehicle.
10. Install the reservoir tank. Ref. to COOLING(w/o STI)>Reservoir Tank>INSTALLATION.
11. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
12. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
13. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

COOLING(w/o STI) > Radiator

INSPECTION

1. Check that the radiator does not have deformation, cracks or damage.
2. Check that the hose has no cracks, damage or loose part.
3. Remove the radiator cap, fill the radiator with engine coolant, and then install the radiator cap tester to the filler neck of radiator.
4. Apply a pressure of 157 kPa (1.6 kg/cm^2, 23 psi) to the radiator and check the following points:
   - Leakage from the radiator or its vicinity
   - Leakage from the hose or its connections

   Caution:
   - **Engine should be turned off.**
   - **Clean the check points.**
   - **Be careful not to deform the filler neck of radiator when installing and removing the radiator cap tester.**
   - **Be careful of engine coolant from spurting out when removing the radiator cap tester.**

INSPECTION

1. Check that the radiator cap does not have deformation, cracks or damage.
2. Attach the radiator cap tester to radiator cap.
3. Increase pressure until the radiator cap tester gauge needle stops. Radiator cap is functioning properly if it holds the service limit pressure for 5 — 6 seconds. Replace the radiator cap if its valve opens at less than the service limit.

   Caution:

   Be sure to remove foreign matter and rust from the cap in advance. Otherwise, results of pressure test will be incorrect.

   Standard:

   93 — 123 kPa (0.95 — 1.25 kg/cm^2, 14 — 18 psi)

   Service limit:

   83 kPa (0.85 kg/cm^2, 12 psi)

COOLING(w/o STI) > Radiator Main Fan and Fan Motor

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the reservoir tank. Ref. to COOLING(w/o STI)>Reservoir Tank>REMOVAL.
3. Disconnect the connector from the main fan motor.
4. Remove the bolts which secure the radiator main fan motor assembly onto the radiator.
5. Remove the radiator main fan motor assembly from the vehicle.

COOLING(w/o STI) > Radiator Main Fan and Fan Motor

INSTALLATION

Install in the reverse order of removal.

Caution:

Confirm that the radiator hose is securely connected.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

COOLING(w/o STI) > Radiator Main Fan and Fan Motor

DISASSEMBLY

1. Remove the clip which holds the main fan motor connector onto the radiator main fan shroud.
2. Disconnect the radiator main fan from the main fan motor.

   Note:

   Remove the lock agent from the threaded portion of the main fan motor.
3. Disconnect the main fan motor from the radiator main fan shroud.

COOLING(w/o STI) > Radiator Main Fan and Fan Motor

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

4.41 N·m (0.45 kgf-m, 3.25 ft-lb)

Caution:

Be sure to use a new nut (with lock agent).

Tightening torque:

3.43 N·m (0.35 kgf-m, 2.53 ft-lb)

COOLING(w/o STI) > Radiator Main Fan and Fan Motor

INSPECTION

Check that the radiator main fan, radiator main fan shroud and main fan motor do not have deformation, cracks or damage.

COOLING(w/o STI) > Radiator Sub Fan and Fan Motor

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
3. Disconnect the connector from the sub fan motor.
4. Remove the bolts which secure the radiator sub fan motor assembly onto the radiator.
5. Remove the radiator sub fan motor assembly from the vehicle.

COOLING(w/o STI) > Radiator Sub Fan and Fan Motor

INSTALLATION

Install in the reverse order of removal.

Caution:

Confirm that the radiator hose is securely connected.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

COOLING(w/o STI) > Radiator Sub Fan and Fan Motor

DISASSEMBLY

1. Remove the clip which holds the sub fan motor connector onto the radiator sub fan shroud.
2. Disconnect the radiator sub fan from the sub fan motor.

   Note:

   Remove the lock agent from the threaded portion of the sub fan motor.
3. Disconnect the sub fan motor from the radiator sub fan shroud.

COOLING(w/o STI) > Radiator Sub Fan and Fan Motor

ASSEMBLY

Assemble in the reverse order of disassembly.

Tightening torque:

4.41 N·m (0.45 kgf-m, 3.25 ft-lb)

Caution:

Be sure to use a new nut (with lock agent).

Tightening torque:

3.43 N·m (0.35 kgf-m, 2.53 ft-lb)

COOLING(w/o STI) > Radiator Sub Fan and Fan Motor

INSPECTION

Check that the radiator sub fan, radiator sub fan shroud and sub fan motor do not have deformation, cracks or damage.

COOLING(w/o STI) > Reservoir Tank

REMOVAL

1. Disconnect the over flow hose (A) connected to the radiator filler neck from the reservoir tank.
2. Pull out the reservoir tank in the direction of the arrow while pushing the claw (B).

COOLING(w/o STI) > Reservoir Tank

INSTALLATION

Install in the reverse order of removal.

COOLING(w/o STI) > Reservoir Tank

INSPECTION

1. Check that the reservoir tank does not have deformation, cracks or damage.
2. Make sure the over flow hoses are not cracked, damaged or loose.
3. Make sure the engine coolant level is between “FULL” and “LOW”.

INSPECTION

Trouble	Possible cause	Corrective action
Over-heating	a. Insufficient engine coolant	Replenish engine coolant, inspect for leakage, and repair it if necessary.
	b. Defective thermostat	Replace.
	c. Malfunction of water pump	Replace.
	d. Clogged engine coolant passage	Clean.
	e. Improper ignition timing	Inspect and repair ignition control system. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.
	f. Clogged or leaking radiator	Clean, repair or replace.
	g. Defective radiator cap	Replace.
	h. Improper engine oil in engine coolant	Replace the engine coolant. If ineffective, check, repair or replace engine components.
	i. Air/fuel mixture ratio too lean	Inspect and repair the fuel injection system. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Basic Diagnostic Procedure.
	j. Excessive back pressure in exhaust system	Clean or replace.
	k. Insufficient clearance between piston and cylinder	Adjust or replace.
	l. Dragging brake	Adjust.
	m. Slipping clutch	Repair or replace.
	n. Malfunction of radiator fan	Inspect the radiator fan relay, engine coolant temperature sensor or fan motor and replace them.
Over-cooling	a. Ambient temperature extremely low	Partly cover radiator front area.
	b. Defective thermostat	Replace.
Engine coolant leaks	a. Loosened or damaged connecting units on hoses	Repair or replace.
	b. Leakage from water pump	Replace.
	c. Leakage from water pipe	Repair or replace.
	d. Leakage around cylinder head gasket	Retighten cylinder head bolts or replace cylinder head gasket.
	e. Damaged or cracked cylinder head and cylinder block	Repair or replace.
	f. Damaged or cracked thermostat cover	Repair or replace.
	g. Leakage from radiator	Repair or replace.
Noise	a. Defective radiator fan	Replace.

Trouble	Possible cause	Corrective action
	b. Defective water pump bearing	Replace water pump.
	c. Defective water pump mechanical seal	Replace water pump.

LUBRICATION(w/o STI)

LU(w/o STI)

1. General Description
2. Oil Pressure System
3. Engine Oil
4. Oil Pump
5. Oil Pan
6. Oil Pressure Switch
7. Engine Oil Cooler
8. Engine Oil Cooler Pipe
9. Oil Catch Tank
10. Scavenge Pump
11. Oil Pipe
12. Engine Oil Filter
13. Oil Level Switch
14. Engine Lubrication System Trouble in General

SPECIFICATION

Lubrication method					Forced lubrication
Oil pump	Pump type				Trochoid type
	Number of teeth	Inner rotor			11
		Outer rotor			12
	Outer rotor diameter × Thickness			mm (in)	77 × 14 (3.03 × 0.55)
	Performance (Oil temperature 120°C (248°F))	600 r/min	Discharge pressure	kPa (kg/cm^2, psi)	35 (0.4, 5.1)
			Discharge rate	L (US qt, Imp qt)/min	7.4 (7.8, 6.5) or more
		6,700 r/min	Discharge pressure	kPa (kg/cm^2, psi)	321 (3.3, 46.6)
			Discharge rate	L (US qt, Imp qt)/min	60.2 (63.6, 53.0) or more
	Relief valve working pressure			kPa (kg/cm^2, psi)	700 (7.1, 102)
Oil filter*	Filter type				Full-flow filter type
	Filtration area			cm^2 (sq in)	900 (139.5)
	By-pass valve opening pressure			kPa (kg/cm^2, psi)	160 (1.6, 23.2)
	Outer diameter × Width			mm (in)	80 × 65 (3.15 × 2.55)
	Installation screw specifications				M 20 × 1.5
Oil pressure switch	Type				Immersed contact point type
	Operating voltage				12 V
	Warning light operating pressure			kPa (kg/cm^2, psi)	14.7 (0.1, 2.1)
	Proof pressure			kPa (kg/cm^2, psi)	981 (10, 142.2)
Engine oil	Total capacity (at overhaul)			L (US qt, Imp qt)	6.0 (6.3, 5.3)
	When replacing engine oil and oil filter			L (US qt, Imp qt)	5.1 (5.4, 4.5)
	When replacing engine oil only			L (US qt, Imp qt)	4.9 (5.2, 4.3)

*: Do not use any oil filters other than that of 80 mm (3.15 in) dia. × 65 mm (2.55 in) height.

Specified oil:

Caution:

- **Use 5W-30 (synthetic oil).**
- **It is acceptable to fill an engine with oil of another brand when replacing the oil, but make sure to use the following engine oil specified by Subaru.**

Note:

The proper viscosity oil helps the engine maintain its ideal temperature, and cranking speed increased by reducing viscosity friction in hot condition.

Engine oil standard			SAE viscosity No.
Those with SN or SN PLUS "Resource Conserving" logo in case of API standard.	or	Those with GF-5 "starburst mark" displayed on top of the container in case of ILSAC standard.	5W-30 (synthetic oil)

COMPONENT

1. OIL PAN

(1) Oil pan upper
(2) O-ring
(3) Baffle plate
(4) O-ring
(5) Oil strainer
(6) Oil pan
(7) Oil pan seal ring
(8) Drain plug gasket
(9) Drain plug
(10) Oil level switch
(11) O-ring
(12) Plug
(13) Clutch housing cover (MT model)

Tightening torque: N·m (kgf-m, ft-lb)

T1: 5 (0.5, 3.7)
T2: 6.4 (0.7, 4.7)
T3: 10 (1.0, 7.4)
T4: 41.7 (4.3, 30.8)
T5: 90 (9.2, 66.4)
T6: Ref. to LUBRICATION(w/o STI)>Oil Pan>INSTALLATION > OIL PAN.
T7: Ref. to LUBRICATION(w/o STI)>Oil Pan>INSTALLATION > OIL PAN UPPER.

2. OIL FILTER AND OIL LEVEL GAUGE

(A) To front camshaft cap LH
(1) Engine oil filter
(2) Oil cooler connector
(3) Engine oil cooler
(4) Gasket
(5) Oil filler cap
(6) Gasket
(7) Chain cover
(8) Engine oil temperature sensor
(9) Gasket
(10) Oil pressure switch
(11) Oil level gauge guide
(12) O-ring
(13) Oil level gauge
(14) O-ring
(15) Side engine oil cooler hose A
(16) Clip
(17) Side engine oil cooler pipe
(18) Side engine oil cooler hose B
(19) Front engine oil cooler hose A
(20) Front engine oil cooler pipe
(21) Front engine oil cooler hose B

Tightening torque: N·m (kgf-m, ft-lb)

T1: 1.5 (0.2, 1.1)
T2: 6.4 (0.7, 4.7)
T3: 18 (1.8, 13.3)
T4: 45 (4.6, 33.2)

3. SCAVENGE PUMP

(1) Scavenge pump

Tightening torque: N·m (kgf-m, ft-lb)

T: 6.4 (0.7, 4.7)

4. OIL PIPE ASSEMBLY

(1) Oil pipe
(2) Union bolt
(3) Gasket
(4) Clip
(5) Engine oil hose
(6) Union screw pipe ASSY

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.8 (0.7, 5.0)
T2: 20 (2.0, 14.8)
T3: 31.5 (3.2, 23.2)

LUBRICATION(w/o STI) > General Description

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Prepare a container and cloth when performing work which oil possibly spills. If oil spills, wipe it off immediately to prevent from penetrating into floor or flowing out for environmental protection.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.
- If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emitting smoke or causing a fire.
- Follow all government and local regulations concerning disposal of refuse when disposing of oil.
- Always use new application oil during work.

LUBRICATION(w/o STI) > General Description

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	41099YC001	ST REAR MOUNT	Used for removing and installing oil level switch. (CVT model)

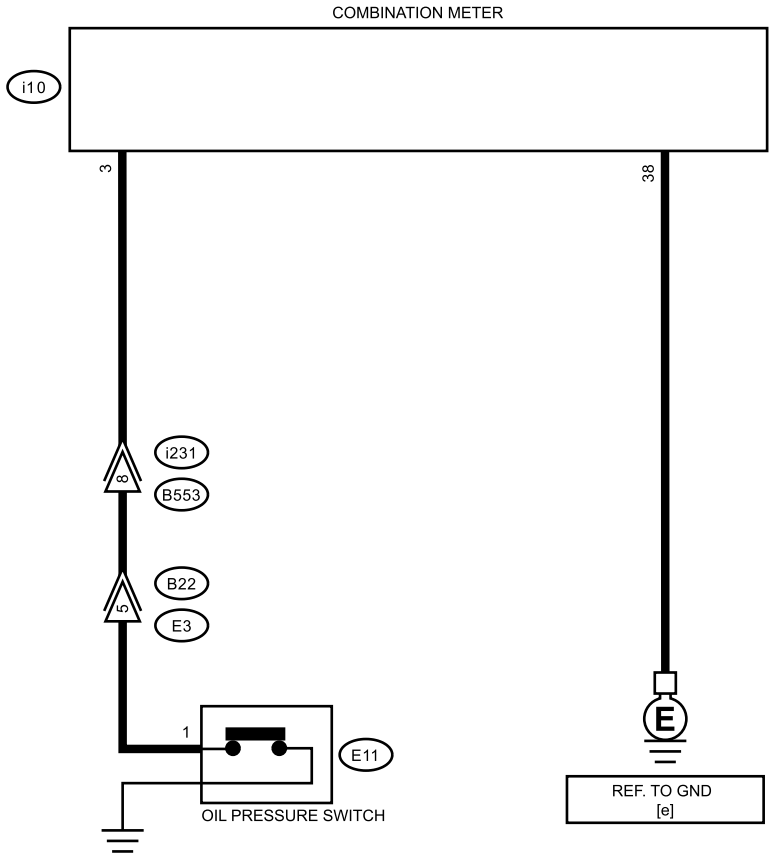
ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	498547000	OIL FILTER WRENCH	Used for removing and installing oil filter.
	18632AA030	STAND ASSY	Used for removing and installing oil pan.
	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**

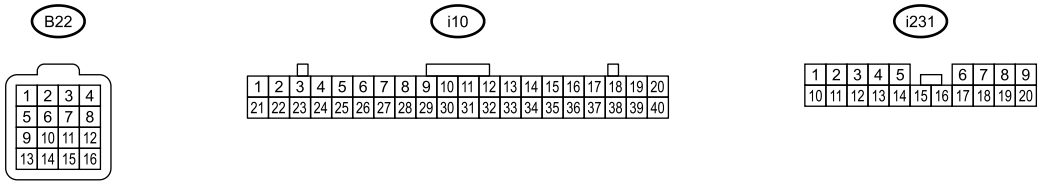
2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
DST-i	Used together with Subaru Select Monitor 4.
TORX® bit T45	Used for removing and installing oil pan upper.

WIRING DIAGRAM

Oil pressure warning system Ref. to WIRING SYSTEM>Oil Pressure Warning Light System>WIRING DIAGRAM.





INSPECTION

1. CHECK ENGINE OIL AMOUNT.

Is the engine oil amount normal? Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.

Yes — Go to 2.

No — Adjust the engine oil amount. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.
After the operation is complete, go to the next step. Go to 2.

2. CHECK DTC.

Is DTC for engine displayed? Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Read Diagnostic Trouble Code (DTC).

Yes — Check the appropriate DTC using the "List of Diagnostic Trouble Code (DTC)". Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>List of Diagnostic Trouble Code (DTC).

No — Go to 3.

3. CHECK POWER SUPPLY TO OIL PRESSURE SWITCH.

1. Turn the ignition switch to OFF.
2. Disconnect the terminal from oil pressure switch.
3. Turn the ignition switch to ON (engine OFF).
4. Measure the voltage of harness between oil pressure switch harness terminal and chassis ground.
   Terminals
   (E11) No. 1 (+) — Chassis ground (−):

Is the voltage 10 V or more?

Yes — Replace the oil pressure switch. Ref. to LUBRICATION(w/o STI)>Oil Pressure Switch.

No — Go to 4.

4. CHECK COMBINATION METER.

Perform the self-diagnosis of combination meter to check if there are any faults in the combination meter. Ref. to INSTRUMENTATION/DRIVER INFO>Combination Meter System>OPERATION.

Is combination meter OK?

Yes	Repair the harness and connector. **Note:** **In this case, repair the following item:** • **Open circuit or short circuit of harness between combination meter and oil pressure switch** • **Poor contact of combination meter connector** • **Poor contact of oil pressure switch terminal** • **Poor contact of coupling connector**
No	Repair or replace the combination meter. Ref. to INSTRUMENTATION/DRIVER INFO>Combination Meter System>INSPECTION.

INSPECTION

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Park the vehicle on a level surface.
2. Remove the oil level gauge and wipe away the oil.
3. Reinsert the oil level gauge all the way. Be sure that the oil level gauge is correctly inserted and properly orientated.
4. Pull out the oil level gauge again, and check both sides of the oil level gauge. Use a lower side to determine the engine oil level. If the engine oil level is below "L" line, check for oil leakage from engine and add oil to bring the level up to "F" line.
5. Start the engine to circulate the oil in engine.
6. After turning off the engine, wait for five minutes or more for the engine oil to return to the oil pan before checking the engine oil level.
   Note:
   - **To prevent overfilling of engine oil, do not add oil above "F" line when the engine is cold.**
   - **As the oil level gauge is used for daily maintenance, "F" line and "L" line is set assuming that the engine is cold.**

(A) Oil level gauge
(B) Oil filler cap
(C) "F" line
(D) "L" line
(E) Approx. 1.0 L (1.1 US qt, 0.9 Imp qt)

REPLACEMENT

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Open the oil filler cap for quick draining of engine oil.
2. Lift up the vehicle.
3. Drain engine oil by loosening the drain plug.
   Note:
   Prepare the container for draining of engine oil.
4. After draining the engine oil, tighten the engine oil drain plug.
   Note:
   Use a new drain plug gasket.
   Tightening torque:
   41.7 N·m (4.3 kgf-m, 30.8 ft-lb)
5. Lower the vehicle.
6. Select engine oil of adequate quality and viscosity and fill it through the chain cover to the "F" line on the oil level gauge. Make sure that the vehicle is parked on a level surface when checking oil level.
   Recommended oil:

Refer to “SPECIFICATION” for recommended oil. Ref. to LUBRICATION(w/o STI)>General Description>SPECIFICATION.

Engine oil capacity:

Refer to “SPECIFICATION” for engine oil capacity. Ref. to LUBRICATION(w/o STI)>General Description>SPECIFICATION.

7. Close the oil filler cap.
8. Check the engine oil level. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.

SPECIFICATION

The oil pump cannot be disassembled.
Refer to “Chain Cover” for removal and installation procedures. Ref. to MECHANICAL(w/o STI)>Chain Cover>REMOVAL. Ref. to MECHANICAL(w/o STI)>Chain Cover>INSTALLATION.

REMOVAL

1. OIL PAN

1. Remove the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>DISASSEMBLY.
2. Fully open the front hood. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
3. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
4. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
6. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
7. Drain the engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
8. Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
9. Remove the nuts which secure the engine mounting to the front crossmember.
10. Lower the vehicle.
11. Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness to the bracket, and remove the bolt which secures the engine control module (ECM) to the bracket.
12. Pull out the engine control module (ECM) from the bracket, and move it to a location that does not interfere operation.
    Note:
    When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.
13. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
14. Remove the pitching stopper.
15. Support the engine with a lifting device and wire ropes.
16. Set the cushioning material such as a waste cloth between pitching stopper bracket and transmission case cover. (CVT model)
    Note:
    - **This operation is required to prevent damage to the transmission case cover.**
    - **Make sure that the height of cushioning material does not become 15 — 20 mm (0.6 — 0.8 in) or less when it is crushed.**
17. While gradually lifting up the engine, set the ST between the engine mount LH and front crossmember, and then slowly lower the engine.
    Caution:
    - **When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.**
    - **To avoid the damage, be sure to set the ST as shown in the figure.**

    (A) Direction mark (B) Engine mounting side (C) Front crossmember side

    - **After lowering the engine, check that the ST does not come off even if the engine is bounced.**

    ST 18632AA030 STAND ASSY
18. Remove the lifting device and wire ropes.
19. Lift up the vehicle.

20. Remove the bolts which secure oil pan to oil pan upper.
21. Insert an oil pan cutter blade into the gap between oil pan upper and oil pan, and remove the oil pan.
    Caution:
    Do not use a screwdriver or similar tool in place of oil pan cutter.
22. Remove the liquid gasket from the oil pan and the oil pan upper.

2. OIL PAN UPPER

1. Remove the engine from the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>REMOVAL.
2. Remove the water pump. Ref. to COOLING(w/o STI)>Water Pump>REMOVAL.
3. Remove the thermostat cover. Ref. to COOLING(w/o STI)>Thermostat>REMOVAL.
4. Remove the water pipe assembly. Ref. to COOLING(w/o STI)>Water Pipe Assembly>REMOVAL.
5. Remove the chain cover. Ref. to MECHANICAL(w/o STI)>Chain Cover>REMOVAL.
6. Remove the oil pan. Ref. to LUBRICATION(w/o STI)>Oil Pan>REMOVAL > OIL PAN.
7. Remove the oil level switch. Ref. to LUBRICATION(w/o STI)>Oil Level Switch>REMOVAL.
8. Remove the bolts which secure oil pan upper to cylinder block, and remove the oil pan upper.
   Note:
   Remove the bolt (a) shown in the figure using TORX® bit T45.
9. Remove the baffle plate from the oil pan upper.
10. Remove the oil strainer from the oil pan upper.
11. Remove stud bolts from the oil pan upper.
12. Remove the clutch housing cover from the oil pan upper. (MT model)
13. Remove the O-ring from the cylinder block.

(A)	Oil pan upper	(B)	O-ring	(C)	Baffle plate
(D)	Stud bolt	(E)	Oil strainer	(F)	O-ring
(G)	Clutch housing cover (MT model)				

14. Remove the liquid gasket from oil pan upper and cylinder block.

LUBRICATION(w/o STI) > Oil Pan

INSTALLATION

1. OIL PAN

1. Apply liquid gasket to the mating surface of the oil pan as shown in the figure, and install the oil pan to the oil pan upper.
   Note:
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of the oil pan and the oil pan upper.**
   - **Use a new oil pan seal ring.**
   - **Install within 5 min. after applying liquid gasket.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   5.0±1.0 mm (0.1969±0.0394 in)

(A) 11.5 mm (0.453 in) (B) ⌀5.0±1.0 mm (0.1969±0.0394 in) (C) Liquid gasket applying position of mating surfaces

2. Tighten the bolts to secure the oil pan to the oil pan upper in the numerical order shown in the figure.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
3. Lower the vehicle.
4. Support the engine with a lifting device and wire ropes.
5. Lift the engine a little, and remove the ST.
   Caution:
   When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

   ST 18632AA030 STAND ASSY

6. Lower the engine and remove the lifting device and wire ropes.
7. Remove the cushioning material between pitching stopper bracket and transmission case cover. (CVT model)
8. Install the pitching stopper.
   Tightening torque:
   T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)
   T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)
9. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
10. Insert the engine control module (ECM) to the bracket.
11. Install the bolt which secures the engine control module (ECM) to the bracket, and then secure the engine wiring harness and bulkhead harness to the bracket with clip (A) and clip (B).
    Tightening torque:
    7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
12. Lift up the vehicle.
13. Install the nuts which hold the engine mounting to the front crossmember.
    Note:
    - **Use a new nut.**
    - **Make sure that locators (a) of the engine mounting are securely inserted.**

    Tightening torque:
    60 N·m (6.1 kgf-m, 44.3 ft-lb)
14. Install the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.
15. Install the under cover. Ref. to EXTERIOR/INTERIOR TRIM>Front Under Cover>INSTALLATION.
16. Lower the vehicle.
17. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
18. Refill the engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
19. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
20. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
21. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.
22. Set the front hood to the normal position. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.

23. Install the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>ASSEMBLY.
24. Close the front hood.

2. OIL PAN UPPER

1. Install the O-ring to the cylinder block.
   Note:
   Use new O-rings.
2. Attach the clutch housing cover to the oil pan upper. (MT model)
3. Attach the stud bolts to the oil pan upper.
4. Attach the oil strainer to the oil pan upper.
   Note:
   Use new O-rings.
5. Attach the baffle plate to the oil pan upper.
   Tightening torque:
   T1: 5 N·m (0.5 kgf-m, 3.7 ft-lb)
   T2: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
   T3: 10 N·m (1.0 kgf-m, 7.4 ft-lb)

(A)	Oil pan upper	(B)	O-ring	(C)	Baffle plate
(D)	Stud bolt	(E)	Oil strainer	(F)	O-ring
(G)	Clutch housing cover (MT model)				

6. Apply liquid gasket to the mating surface of the oil pan upper as shown in the figure, and install the oil pan upper to the cylinder block.
   Note:
   - **Before applying liquid gasket, degrease the old liquid gasket seal surface of the oil pan upper and the cylinder block.**
   - **Install within 5 min. after applying liquid gasket.**
   - **Apply liquid gasket 1.5 mm (0.0591 in) outside from the chamfer surface. However, application of liquid gasket on the chamfer surface around the bolt hole is allowed.**

   Liquid gasket:
   THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
   Liquid gasket applying diameter:
   5.0±1.0 mm (0.1969±0.0394 in)

(A)	Chamfer surface	(B)	1.5 mm (0.0591 in)

7. Tighten the bolts to secure the oil pan upper to the cylinder block in the numerical order shown in the figure.
   Note:
   - **Install the bolt (a) shown in the figure using TORX® bit T45.**
   - **After tightening, if the liquid gasket is squeezed out onto the seal surface of the chain cover, completely remove any squeezed-out liquid gasket.**

   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
8. Install the oil level switch. Ref. to LUBRICATION(w/o STI)>Oil Level Switch>INSTALLATION.
9. Install the oil pan. Ref. to LUBRICATION(w/o STI)>Oil Pan>INSTALLATION > OIL PAN.

10. Install the chain cover. Ref. to MECHANICAL(w/o STI)>Chain Cover>INSTALLATION.
11. Install the water pipe assembly. Ref. to COOLING(w/o STI)>Water Pipe Assembly>INSTALLATION.
12. Install the thermostat cover. Ref. to COOLING(w/o STI)>Thermostat>INSTALLATION.
13. Install the water pump. Ref. to COOLING(w/o STI)>Water Pump>INSTALLATION.
14. Install the engine to the vehicle. Ref. to MECHANICAL(w/o STI)>Engine Assembly>INSTALLATION.
15. Refill the engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
16. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.

LUBRICATION(w/o STI) > Oil Pan

INSPECTION

Check that the oil pan, oil pan upper, oil strainer and baffle plate do not have deformation, cracks or damage.

LUBRICATION(w/o STI) > Oil Pressure Switch

REMOVAL

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emitting smoke or causing a fire.

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the rubber cap.
3. Disconnect the terminal from oil pressure switch.
4. Remove the oil pressure switch.
   Caution:
   Catch the engine oil using cloth to prevent it from splashing.

LUBRICATION(w/o STI) > Oil Pressure Switch

INSTALLATION

1. Apply liquid gasket to the oil pressure switch threads.
   Liquid gasket:
   THREE BOND 1324 (Part No. 004403042) or equivalent
2. Install the oil pressure switch to the chain cover.
   Tightening torque:
   18 N·m (1.8 kgf-m, 13.3 ft-lb)
3. Connect the terminal to the oil pressure switch.
   Note:
   The oil pressure switch harness must be tightened within the range of a 90° angle as shown below.
   Tightening torque:
   1.5 N·m (0.2 kgf-m, 1.1 ft-lb)



(A) Upper side of the engine

4. Attach the rubber cap.
5. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.

LUBRICATION(w/o STI) > Oil Pressure Switch

INSPECTION

1. Check that the oil pressure switch does not have deformation, cracks or damage.
2. Check the oil pressure switch installation portion for oil leakage and oil seepage.

LUBRICATION(w/o STI) > Engine Oil Cooler

REMOVAL

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
3. Lower the vehicle.
4. Remove the engine oil filter. Ref. to LUBRICATION(w/o STI)>Engine Oil Filter>REMOVAL.
5. Disconnect the front engine oil cooler hose A (A) and the side engine oil cooler hose A (B) from the engine oil cooler.
6. Remove the oil cooler connector and remove the engine oil cooler.

LUBRICATION(w/o STI) > Engine Oil Cooler

INSTALLATION

Install in the reverse order of removal.

Note:

- **Use a new gasket.**
- **When connecting the side engine oil cooler hose A to the engine oil cooler, the direction of the clip claw should be matched within the position (a) shown in the figure.**
- **After installing, check the engine oil level and replenish it if necessary. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.**

Tightening torque:

45 N·m (4.6 kgf-m, 33.2 ft-lb)

LUBRICATION(w/o STI) > Engine Oil Cooler

INSPECTION

1. Check that the engine oil cooler, engine oil cooler pipe, and oil cooler connector do not have deformation, cracks or damage.
2. Make sure the engine oil cooler hoses are not cracked, damaged or loose.
3. Blow with compressed air to make sure the coolant passages are not clogged.
4. Make sure the mating surfaces of the chain cover do not have damage.

LUBRICATION(w/o STI) > Engine Oil Cooler Pipe

REMOVAL

1. FRONT ENGINE OIL COOLER PIPE

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
4. Remove the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.
5. Remove the clip (B) which holds the front engine oil cooler hose B (A) and the oil level switch harness from the front engine oil cooler pipe. Remove the bolt which secures the front engine oil cooler pipe to the chain cover.
6. Lower the vehicle.
7. Disconnect the front engine oil cooler hose A from the engine oil cooler.
8. Remove the clip (A) holding the engine oil temperature sensor harness from the front engine oil cooler pipe.
9. Remove the bolt which secures the front engine oil cooler pipe to the chain cover. Remove the front engine oil cooler pipe together with the front engine oil cooler hose A.
10. Remove the front engine oil cooler hose A from the front engine oil cooler pipe.

2. SIDE ENGINE OIL COOLER PIPE

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
4. Remove the center exhaust pipe. Ref. to EXHAUST(w/o STI)>Center Exhaust Pipe>REMOVAL.
5. Remove the clip (B) which holds the side engine oil cooler hose B (A) and the rear oxygen sensor harness from the side engine oil cooler pipe. Remove the bolt which secures the side engine oil cooler pipe to the cam carrier RH.
6. Lower the vehicle.
7. Disconnect the side engine oil cooler hose A from the engine oil cooler.
8. Remove the bolt which secures the side engine oil cooler pipe to the cam carrier RH. Remove the side engine oil cooler pipe together with the side engine oil cooler hose A.
9. Remove the side engine oil cooler hose A from the side engine oil cooler pipe.

LUBRICATION(w/o STI) > Engine Oil Cooler Pipe

INSTALLATION

1. FRONT ENGINE OIL COOLER PIPE

Install in the reverse order of removal.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

2. SIDE ENGINE OIL COOLER PIPE

Install in the reverse order of removal.

Note:

When connecting the side engine oil cooler hose A to the engine oil cooler, the direction of the clip claw should be matched within the position (a) shown in the figure.

Tightening torque:

6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

LUBRICATION(w/o STI) > Engine Oil Cooler Pipe

INSPECTION

1. Check that the engine oil cooler pipes have no deformation, cracks or other damages.
2. Make sure the engine oil cooler hoses are not cracked, damaged or loose.

LUBRICATION(w/o STI) > Oil Catch Tank

REMOVAL

Refer to "Oil Catch Tank" for removal procedure of the oil catch tank. Ref. to INTAKE (INDUCTION) (w/o STI)>Oil Catch Tank>REMOVAL.

LUBRICATION(w/o STI) > Oil Catch Tank

INSTALLATION

Refer to "Oil Catch Tank" for installation procedure of the oil catch tank. Ref. to INTAKE (INDUCTION) (w/o STI)>Oil Catch Tank>INSTALLATION.

LUBRICATION(w/o STI) > Oil Catch Tank

INSPECTION

Refer to "Oil Catch Tank" for inspection procedure of the oil catch tank. Ref. to INTAKE (INDUCTION) (w/o STI)>Oil Catch Tank>INSPECTION.

LUBRICATION(w/o STI) > Scavenge Pump

REMOVAL

Caution:
If engine oil is spilt onto the exhaust pipe, wipe it off with cloth to avoid emission of smoke or causing a fire.

1. Remove the oil pipe assembly. Ref. to LUBRICATION(w/o STI)>Oil Pipe>REMOVAL > OIL PIPE ASSEMBLY.
2. Remove the bolts which secure the scavenge pump to the intake rear camshaft cap RH and the cam carrier RH. Using a crowbar, remove the scavenge pump.
   Caution:
   Be careful not to damage the mating surfaces of the cylinder head and scavenge pump.
3. Remove the liquid gasket from the scavenge pump, intake rear camshaft cap RH, and cam carrier RH.

LUBRICATION(w/o STI) > Scavenge Pump

INSTALLATION

Install in the reverse order of removal.
Caution:
Do not start applying the gasket in the (a) range shown in the figure.
Note:

- **Before applying liquid gasket, degrease the liquid gasket seal surface of the scavenge pump, intake rear camshaft cap RH, and cam carrier RH.**
- **Install within 5 min. after applying liquid gasket.**

Liquid gasket:
THREE BOND 1217G (Part No. K0877Y0100), THREE BOND 1217H or equivalent
Liquid gasket applying diameter:
3.0±1.0 mm (0.1181±0.0394 in)
Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

LUBRICATION(w/o STI) > Scavenge Pump

INSPECTION

1. Check that the scavenge hose has no deformation, cracks or other damages.
2. Check that the scavenge pump has no crack, damage, or looseness.

REMOVAL

1. OIL PIPE ASSEMBLY

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 2.
4. Lift up the vehicle.
5. Disconnect the ground cable (A) from the oil pipe assembly.
6. Disconnect the engine oil hose (B) from the oil pipe assembly, and drain the engine oil in the oil catch tank.
   Note:
   Prepare the container for draining of engine oil.
7. Remove the engine oil hose from the oil catch tank.
8. Disconnect the union screw pipe assembly from the oil pipe assembly, and remove the bolt which holds the oil pipe assembly.
   Caution:
   In order to prevent damaging the oil pipe assembly, fix the section (a) shown in the figure when loosing the flare nut on the union screw pipe assembly, and avoid the part from rotating together while loosening the nut.
9. Remove the bolt which secures the oil pipe assembly to the cam carrier RH.
10. Lower the vehicle.
11. Remove the union bolts which secure the oil pipe assembly from the scavenge pump and the intake rear camshaft cap RH, and remove the oil pipe assembly.

2. OIL PIPE

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Remove the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>REMOVAL > INTAKE DUCT NO. 2.
3. Remove the clip (A) which secures the engine wiring harness to the oil pipe, and remove the bolt (B) which secures the oil pipe to the cam carrier RH.
4. Remove the union bolts which secure the oil pipes from the intake rear camshaft cap RH and the cam carrier RH.

INSTALLATION

1. OIL PIPE ASSEMBLY

1. Temporarily install the oil pipe assembly.
   (1) Temporarily tighten the union bolts (B) and (C) which secure the oil pipe assembly (A) to the scavenge pump and the intake rear camshaft cap RH.
   Note:
   Use a new gasket.

(2) Temporarily tighten the bolts (D) and (E) which secure the oil pipe assembly (A) to the cam carrier RH.
(3) Temporarily tighten the union screw pipe assembly (F) to the oil pipe assembly (A).

(A) Oil pipe ASSY
(B) Union bolt
(C) Union bolt
(D) Bolt
(E) Bolt
(F) Union screw pipe ASSY
(G) Gasket

2. Tighten the union bolts which secure the oil pipe assembly to the scavenge pump and the intake rear camshaft cap RH.
Tightening torque:
31.5 N·m (3.2 kgf-m, 23.2 ft-lb)
3. Lift up the vehicle.
4. Tighten the bolt which secures the oil pipe assembly to the cam carrier RH.
Tightening torque:
6.8 N·m (0.7 kgf-m, 5.0 ft-lb)
5. Tighten the union screw pipe assembly to the oil pipe assembly, and tighten the oil pipe assembly mounting bolts.
Caution:
In order to prevent damaging the oil pipe assembly, fix the section (a) shown in the figure when tightening the flare nut on the union screw pipe assembly, and avoid the part from rotating together while tightening the nut.
Tightening torque:
T1: 6.8 N·m (0.7 kgf-m, 5.0 ft-lb)
T2: 20 N·m (2.0 kgf-m, 14.8 ft-lb)
6. Install the engine oil hose to the oil catch tank.
Note:
Use a new engine oil hose.
7. Connect the ground cable (A) and the oil outlet hose (B) to the oil pipe assembly.
Tightening torque:
7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
8. Lower the vehicle.
9. Install the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 2.
10. After installing, check the engine oil level and replenish it if necessary. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.
11. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
12. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

2. OIL PIPE

1. Temporarily tighten the union bolts which secure the oil pipes to the intake rear camshaft cap RH and the cam carrier RH.
Note:
Use a new gasket.
2. Install the bolt (A) which secures the oil pipe to the cam carrier RH, and install the clip (B) which secures the engine wiring harness to the oil pipe.

Tightening torque:

T1: 6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

3. Tighten the union bolts which secure the oil pipes to the intake rear camshaft cap RH and the cam carrier RH.

   Tightening torque:

   T2: 31 N·m (3.2 kgf-m, 22.9 ft-lb)

4. Install the intake duct No. 2. Ref. to INTAKE (INDUCTION)(w/o STI)>Intake Duct>INSTALLATION > INTAKE DUCT NO. 2.
5. After installing, check the engine oil level and replenish it if necessary. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.
6. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

LUBRICATION(w/o STI) > Oil Pipe

INSPECTION

1. Check that the oil pipe assembly, oil pipes, and the union bolts have no deformation, cracks and other damages.
2. Check that there are no oil leaks or oil oozing from the areas where the oil pipe assembly and oil pipes are installed.

REMOVAL

Caution:
If the engine oil is spilt over exhaust pipe or the under cover, wipe it off with cloth to avoid emission of smoke or causing a fire.
Remove the oil filter using ST.
Note:
Clean off water or dust from the oil filter mating surface using air.

ST 498547000 OIL FILTER WRENCH

INSTALLATION

Caution:
- **Do not use any oil filters other than that of 80 mm (3.15 in) dia. × 65 mm (2.55 in) height.**
- **Do not tighten excessively, or oil may leak.**

1. Clean the oil filter installation surface.
2. Obtain a new oil filter and apply a thin coat of engine oil to the seal rubber.
3. Install the oil filter by turning it by hand, being careful not to damage the seal rubber of the oil filter.
4. Further tighten the oil filter (approx. 3/4 rotation) after the seal rubber of the oil filter comes in contact with the oil cooler. When using a torque wrench, tighten it to 14 N·m (1.4 kgf-m, 10.3 ft-lb).
5. After installing, check the engine oil level and replenish it if necessary. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.

INSPECTION

1. After installing the oil filter, run the engine and check for oil leakage.
   Note:
   The filter element and filter case are permanently jointed; therefore, interior cleaning is not necessary.
2. Check the engine oil level. Ref. to LUBRICATION(w/o STI)>Engine Oil>INSPECTION.

REMOVAL

1. WHEN REMOVING FRONT CROSSMEMBER

1. Remove the front crossmember. Ref. to FRONT SUSPENSION>Front Crossmember>REMOVAL.
2. Disconnect the oil level switch connector from the engine wiring harness, and remove the clip (A) securing the harness.
3. Remove clip (A) from the oil pan upper, and remove the oil level switch.

2. WHEN NOT REMOVING FRONT CROSSMEMBER

1. Remove the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>DISASSEMBLY.
2. Fully open the front hood. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
3. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
4. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Remove the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>REMOVAL.
6. Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness to the bracket, and remove the bolt which secures the engine control module (ECM) to the bracket.
7. Pull out the engine control module (ECM) from the bracket, and move it to a location that does not interfere operation.
   Note:
   When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.
8. Drain engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > DRAINING OF ENGINE COOLANT.
9. Drain the engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
10. Remove the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>REMOVAL.
11. Disconnect the oil level switch connector from the engine wiring harness, and remove the clip (A) securing the harness.
12. Remove the nuts which secure the engine mounting to the front crossmember.
13. Remove the electric power steering gearbox. Ref. to POWER ASSISTED SYSTEM (POWER STEERING)>Electric Power Steering Gearbox>REMOVAL.
14. Remove the front drive shaft LH. Ref. to DRIVE SHAFT SYSTEM>Front Drive Shaft>REMOVAL.
15. Lower the vehicle.
16. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
17. Disconnect the connector (A) from the brake vacuum pump.
18. Disconnect connector (B) and terminal (C) from the generator, and remove the clip (D) securing the generator cord to the intake manifold.
19. Disconnect connector (A) from A/C compressor, and remove the generator cord from clip (B).
20. Remove the clip (C) securing the generator cord to the fuel pipe protector, and move the generator cord aside so that it does not interfere with the work.
21. Remove the pitching stopper.
22. Lift up the vehicle. (CVT model)
23. Set the transmission jack to the transmission. (CVT model)

Note:
Be careful that the support plate of transmission jack does not touch the transmission oil pan.

24. Remove the rear crossmember and attach the ST. (CVT model)

ST 41099YC001 ST REAR MOUNT

Tightening torque:
T1: 35 N·m (3.6 kgf-m, 25.8 ft-lb)
T2: 70 N·m (7.1 kgf-m, 51.6 ft-lb)

25. Remove the transmission jack. (CVT model)

26. Lower the vehicle. (CVT model)

27. Remove the bolt (A) securing the transmission harness stay to the CVT. (CVT model)

Note:
This procedure is required to prevent the transmission connector from touching the A/C pressure hose during engine lift-up.

28. Remove the air breather hose from the clip (B), and then remove the clip (B) from the pitching stopper bracket. (CVT model)

Note:
This procedure is required to prevent the clip from touching the A/C pressure hose during engine lift-up.

29. Set the cushioning material such as a waste cloth between pitching stopper bracket and transmission case cover. (CVT model)

Note:
- **This operation is required to prevent damage to the transmission case cover.**
- **Make sure that the height of cushioning material does not become 15 — 20 mm (0.6 — 0.8 in) or less when it is crushed.**

30. Lift up the engine with a lifting device and wire ropes.

Caution:
When lifting up the engine, pay attention to the clearance of each part and be careful not to lift the engine too much, in order to prevent damaging the vehicle.

31. Remove the engine mounting LH from the engine.

(A) Front side (B) Rear side

32. Remove clip (A) from the oil pan upper, and remove the oil level switch.

LUBRICATION(w/o STI) > Oil Level Switch

INSTALLATION

1. WHEN FRONT CROSSMEMBER HAS BEEN REMOVED

1. Install the oil level switch and the clip (A) to the oil pan upper.

Note:
- **Use new O-rings.**
- **Apply a coat of engine oil to the O-rings.**

Tightening torque:
6.4 N·m (0.7 kgf-m, 4.7 ft-lb)

2. Connect the connector of oil level switch to the engine wiring harness, and install the clip (A) securing the harness.
3. Install the front crossmember. Ref. to FRONT SUSPENSION>Front Crossmember>INSTALLATION.

2. WHEN FRONT CROSSMEMBER HAS NOT BEEN REMOVED

1. Install the oil level switch and the clip (A) to the oil pan upper.
   Note:
   - **Use new O-rings.**
   - **Apply a coat of engine oil to the O-rings.**

   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
2. Install the engine mounting LH onto the engine.
   Tightening torque:
   35 N·m (3.6 kgf-m, 25.8 ft-lb)

(A) Front side (B) Rear side

3. Lower the engine and remove the lifting device and wire ropes.
4. Remove the cushioning material between pitching stopper bracket and transmission case cover. (CVT model)
5. Install the clip (B) to the pitching stopper bracket, and then install the air breather hose to the clip (B). (CVT model)
6. Install the bolt (A) which secures the transmission harness stay to the CVT. (CVT model)
   Tightening torque:
   16 N·m (1.6 kgf-m, 11.8 ft-lb)
7. Lift up the vehicle. (CVT model)
8. Set the transmission jack to the transmission. (CVT model)
   Note:
   Be careful that the support plate of transmission jack does not touch the transmission oil pan.
9. Remove the ST and install the rear crossmember. (CVT model)

   ST 41099YC001 ST REAR MOUNT

   Tightening torque:
   T1: 18 N·m (1.8 kgf-m, 13.3 ft-lb)
   T2: 35 N·m (3.6 kgf-m, 25.8 ft-lb)
   T3: 70 N·m (7.1 kgf-m, 51.6 ft-lb)
10. Remove the transmission jack. (CVT model)
11. Lower the vehicle. (CVT model)
12. Install the pitching stopper.
    Tightening torque:
    T1: 50 N·m (5.1 kgf-m, 36.9 ft-lb)
    T2: 58 N·m (5.9 kgf-m, 42.8 ft-lb)
13. Set the generator cord, and fix the generator cord to the fuel pipe protector using clip (C).
14. Install the generator cord to clip (B), and connect the connector (A) to A/C compressor.
15. Using clip (D), fix the generator cord to the generator cord stay, and connect the connector (B) and the terminal (C) to the generator.

Tightening torque:
15 N·m (1.5 kgf-m, 11.1 ft-lb)

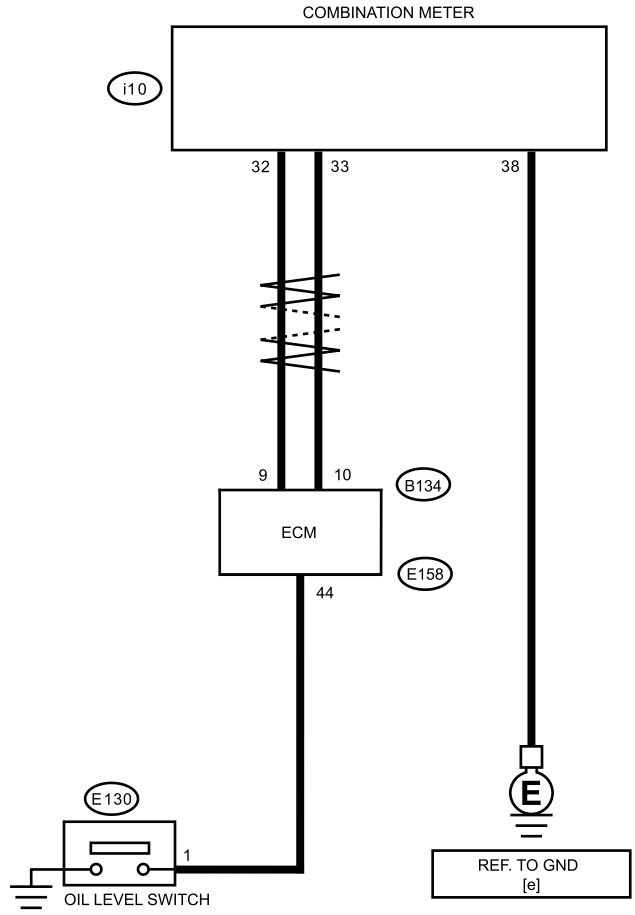
16. Connect the connector (A) to the brake vacuum pump.
17. Install the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>INSTALLATION.
18. Lift up the vehicle.
19. Install the electric power steering gearbox. Ref. to POWER ASSISTED SYSTEM (POWER STEERING)>Electric Power Steering Gearbox>INSTALLATION.
20. Install the front drive shaft LH. Ref. to DRIVE SHAFT SYSTEM>Front Drive Shaft>INSTALLATION.
21. Install the nuts which hold the engine mounting to the front crossmember.
    Note:
    - **Use a new nut.**
    - **Make sure that locators (a) of the engine mounting are securely inserted.**

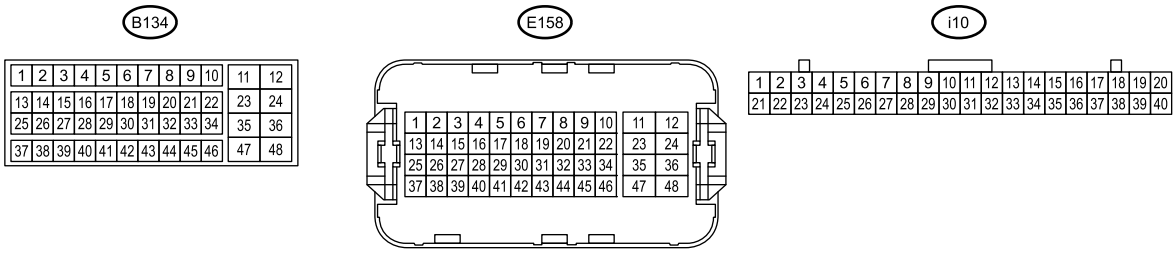
    Tightening torque:
    60 N·m (6.1 kgf-m, 44.3 ft-lb)
22. Connect the connector of oil level switch to the engine wiring harness, and install the clip (A) securing the harness.
23. Install the front exhaust pipe. Ref. to EXHAUST(w/o STI)>Front Exhaust Pipe>INSTALLATION.
24. Insert the engine control module (ECM) to the bracket.
25. Install the bolt which secures the engine control module (ECM) to the bracket, and then secure the engine wiring harness and bulkhead harness to the bracket with clip (A) and clip (B).
    Tightening torque:
    7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
26. Install the air intake duct. Ref. to INTAKE (INDUCTION)(w/o STI)>Air Intake Duct>INSTALLATION.
27. Refill the engine oil. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT.
28. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
29. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.
30. Fill engine coolant. Ref. to COOLING(w/o STI)>Engine Coolant>REPLACEMENT > FILLING OF ENGINE COOLANT.
31. Set the front hood to the normal position. Ref. to NOTE>NOTE > FRONT HOOD GAS STAY.
32. Install the striker - front hood. Ref. to EXTERIOR BODY PANELS>Front Hood>ASSEMBLY.
33. Close the front hood.

LUBRICATION(w/o STI) > Oil Level Switch

WIRING DIAGRAM

- Engine electrical system Ref. to WIRING SYSTEM>Engine Electrical System>WIRING DIAGRAM.
- CAN communication system Ref. to WIRING SYSTEM>CAN Communication System>WIRING DIAGRAM.


COMBINATION METER
i10
32
33
38
9
10
B134
ECM
E158
44
E130
1
OIL LEVEL SWITCH
E
REF. TO GND
[e]


B134
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36
37 38 39 40 41 42 43 44 45 46 47 48
E158
1 2 3 4 5 6 7 8 9 10 11 12
13 14 15 16 17 18 19 20 21 22 23 24
25 26 27 28 29 30 31 32 33 34 35 36
37 38 39 40 41 42 43 44 45 46 47 48
i10
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40

LU-10070

INSPECTION

1. INSPECTION WHEN LOW ENGINE OIL WARNING LIGHT ILLUMINATES ON LCD

1. CHECK ENGINE OIL LEVEL.

Is engine oil level normal?

Yes	Go to 2.
No	Replace engine oil or refill, and check again while the oil level is normal condition. Ref. to LUBRICATION(w/o STI)>Engine Oil>REPLACEMENT. To disable the low engine oil warning, install the spare fuse at the delivery mode fuse in the main fuse box. Then turn the ignition switch to ON (engine off) again, to confirm the low engine oil warning is not displayed. Remove the spare fuse installed to finish. **Note:** **The engine oil level switch is normal if the low engine oil level warning is not displayed with the delivery mode fuse inserted.**

2. CHECK LAN SYSTEM.

Has a DTC of the LAN system been input?

Yes	Perform the diagnosis according to DTC.
No	Go to 3.

3. CHECK OIL LEVEL SWITCH CIRCUIT.

1. Turn the ignition switch to ON (engine OFF).
2. Read the current data for engine in the Subaru Select Monitor to confirm the item for "Oil level switch". Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA.

Is the "Oil level switch" signal displayed in Subaru Select Monitor HIGH?

Yes	To disable the low engine oil warning, install the spare fuse at the delivery mode fuse in the main fuse box. Then turn the ignition switch to ON (engine off) again, to confirm the low engine oil warning is not displayed. Remove the spare fuse installed to finish. **Note:** **The engine oil level switch is normal if the low engine oil level warning is not displayed with the delivery mode fuse inserted.**
No	Go to 4.

4. CHECK COMBINATION METER.

Perform the self-diagnosis of combination meter to check if there are any faults in the combination meter. Ref. to INSTRUMENTATION/DRIVER INFO>Combination Meter System>OPERATION.

Is combination meter OK?

Yes	Go to 5.
No	Replace the combination meter. Ref. to INSTRUMENTATION/DRIVER INFO>Combination Meter>REMOVAL.

5. CHECK SECURE CONNECTION OF CONNECTOR BETWEEN ENGINE WIRING HARNESS AND OIL LEVEL SWITCH.

Is there any insecure connection?

Yes	Repair the connection condition. Then, to disable the low engine oil warning display, install the spare fuse at the delivery mode fuse in the main fuse box. Then turn the ignition switch to ON (engine OFF) again to confirm the low engine oil warning is not displayed. Remove the spare fuse installed to finish. **Note:** **The engine oil level switch is normal if the low engine oil level warning is not displayed with the delivery mode fuse inserted.**
No	Go to 6.

6. CHECK OIL LEVEL SWITCH.

1. Deliberately short circuits by connecting the engine wiring harness connector terminal and chassis ground.
2. Turn the ignition switch to ON (engine OFF).
3. Read the current data for engine in the Subaru Select Monitor to confirm the item for "Oil level switch". Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA.
   Connector & terminal
   (E130) No. 1 — Chassis ground:

Is the "Oil level switch" signal displayed in Subaru Select Monitor HIGH?

Yes	Replace the oil level switch. Ref. to LUBRICATION(w/o STI)>Oil Level Switch>REMOVAL.
No	Go to 7.

7. CHECK SECURE CONNECTION OF CONNECTOR BETWEEN ENGINE CONTROL MODULE (ECM) AND ENGINE WIRING HARNESS.

Is there any insecure connection?

Yes	Repair the connection condition. Then, to disable the low engine oil warning display, install the spare fuse at the delivery mode fuse in the main fuse box. Then turn the ignition switch to ON (engine OFF) again to confirm the low engine oil warning is not displayed. Remove the spare fuse installed to finish. **Note:** **The engine oil level switch is normal if the low engine oil level warning is not displayed with the delivery mode fuse inserted.**
No	Go to 8.

8. CHECK ENGINE WRING HARNESS.

1. Disconnect the engine control module (ECM) side connector.
2. Disconnect the connector between the engine wiring harness and the oil level switch.
3. Measure the resistance between connector terminals.
   Connector & terminal
   (E158) No. 44 — (E130) No. 1:

Is the resistance less than 1 Ω?

Yes	Replace the engine control module (ECM). Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
No	Repair or replace the open circuit of the engine wiring harness.

2. OTHER INSPECTIONS

1. Check that the oil level switch does not have deformation, cracks, or damage.
2. Check the oil level switch installation part for oil leakage and oil seepage.

INSPECTION

Before performing diagnostics, make sure that the engine oil level is correct and no oil leakage exists.

Trouble	Possible cause	Corrective action
Warning light remains ON.	a. Oil pressure switch failure	
	❍Cracked diaphragm or oil leakage within switch	Replace.
	❍Broken spring or seized contacts	Replace.
	b. Low oil pressure	
	❍Clogging of oil filter	Replace.
	❍Malfunction of oil by-pass valve in oil filter	Replace.
	❍Clogged oil passage	Clean.
	❍Excessive tip clearance and side clearance of oil pump rotor	Replace.
	❍Clogged oil strainer or broken pipe	Clean or replace.
	c. No oil pressure	
	❍Insufficient engine oil (degradation, etc.)	Replace.
	❍Broken pipe of oil strainer	Replace.
	❍Stuck oil pump rotor	Replace.
Warning light does not illuminate.	a. Malfunction of combination meter	Replace.
	b. Poor contact of switch contact points	Replace.
	c. Disconnection of wiring	Repair.
Warning light flickers momentarily.	a. Defective terminal contact	Repair.
	b. Defective wiring harness	Repair.
	c. Oil pressure switch failure	
	❍Cracked diaphragm or oil leakage within switch	Replace.
	❍Broken spring or seized contacts	Replace.
	d. Low oil pressure	
	❍Clogging of oil filter	Replace.
	❍Malfunction of oil by-pass valve in oil filter	Replace.
	❍Clogged oil passage	Clean.
	❍Excessive tip clearance and side clearance of oil pump rotor	Replace.
	❍Clogged oil strainer or broken pipe	Clean or replace.

SPEED CONTROL SYSTEMS(w/o STI)

SP(w/o STI)

1. General Description
2. Accelerator Pedal

SPECIFICATION

Accelerator pedal	Stroke	At pedal pad	50 — 59 mm (1.97 — 2.32 in)

COMPONENT

(1)	Accelerator pedal ASSY	(3)	Accelerator plate	***Tightening torque: N·m (kgf-m, ft-lb)***
(2)	Clip	(4)	Accelerator stopper	***T: 7.5 (0.8, 5.5)***

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
	—	SUBARU SELECT MONITOR 4	Used for setting of each function and troubleshooting for electrical system. **Note:** **For detailed operation procedures of Subaru Select Monitor 4, refer to "Application help".**
	18460AA030	CHECK BOARD	Used for measuring voltage and resistance of ECM terminals.

2. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current.
DST-i	Used together with Subaru Select Monitor 4.

SPEED CONTROL SYSTEMS(w/o STI) > Accelerator Pedal

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Disconnect the connector (A).
3. Remove the nut (B) securing accelerator pedal assembly, and remove the accelerator pedal assembly.

SPEED CONTROL SYSTEMS(w/o STI) > Accelerator Pedal

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

SPEED CONTROL SYSTEMS(w/o STI) > Accelerator Pedal

DISASSEMBLY

Note:

The accelerator pedal cannot be disassembled.

SPEED CONTROL SYSTEMS(w/o STI) > Accelerator Pedal

INSPECTION

1. CHECK ACCELERATOR PEDAL SENSOR AREA (METHOD WITH CIRCUIT TESTER)

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the ECM. Ref. to FUEL INJECTION (FUEL SYSTEMS)(w/o STI)>Engine Control Module (ECM)>REMOVAL.
3. Install the ST between the ECM and bulkhead harness and the engine wiring harness. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>General Description>CAUTION.

ST 18460AA030 CHECK BOARD

4. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
5. Turn the ignition switch to ON. (Engine OFF)
6. Measure the voltage between ECM connector terminals using ST.
   - Main sensor side

   (A) To the check board connector (ECM connector)

   - Sub sensor side

   (A) To the check board connector (ECM connector)

Accelerator pedal sensor	Accelerator pedal	Terminal No.	Standard
Main	Not depressed (full closed)	17 (+) and 31 (−)	0.4 — 1.0 V
	Depressed (full opened)		2.4 — 3.7 V
Sub	Not depressed (full closed)	29 (+) and 19 (−)	0.4 — 1.0 V
	Depressed (full opened)		2.4 — 3.7 V

7. After inspection, install the related parts in the reverse order of removal.

2. CHECK ACCELERATOR PEDAL SENSOR AREA (METHOD WITH SUBARU SELECT MONITOR)

Note:
Individual difference of the accelerator pedal may not be corrected sufficiently on the ECM side after DTCs were cleared or the battery was removed and installed on the vehicle. Therefore, when the accelerator opening angle signal does not indicate 100%, repeat the ignition switch ON (engine OFF) and ignition switch OFF operations at intervals of three seconds or more, until the accelerator opening angle signal indicates 100%.

1. Turn the ignition switch to ON. (Engine OFF)
2. Read the accelerator pedal opening angle signal and voltage of accelerator pedal sensor using Subaru Select Monitor. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Subaru Select Monitor>OPERATION > DISPLAY CURRENT ENGINE DATA.

Accelerator pedal sensor	Accelerator pedal opening angle signal	Standard
Main	0.0%	0.4 — 1.0 V
	100.0%	2.4 — 3.7 V
Sub	0.0%	0.4 — 1.0 V
	100.0%	2.4 — 3.7 V

3. OTHER INSPECTIONS

1. Check that the accelerator pedal does not have deformation, cracks or damage.
2. Check for smooth operation when the accelerator pedal is depressed.
3. Check if the accelerator pedal returns to its original position smoothly when the pedal is released.

IGNITION(w/o STI)

IG(w/o STI)

1. General Description
2. Spark Plug
3. Ignition Coil

SPECIFICATION

Item			Specifications
Ignition coil	Type		FK0463
	Ignition system		Independent ignition coil
	Manufacturer		Diamond Electric
Spark plug	Manufacturer and type		NGK: ILKAR8H6
	Thread size (diameter, pitch, length) mm		12, 1.25, 26.5
	Spark plug gap mm (in)	Standard	0.50 — 0.55 (0.020 — 0.022)
	Electrode		Center electrode: Iridium Ground electrode: Platinum

COMPONENT

(1) Spark plug

(2) Ignition coil

Tightening torque: N·m (kgf-m, ft-lb)

T1: 8.5 (0.9, 6.3)

T2: 17.5 (1.8, 12.9)

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

REMOVAL

Spark plug:

Refer to "SPECIFICATION" for spark plug. Ref. to IGNITION(w/o STI)>General Description>SPECIFICATION.

1. RH SIDE

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Remove the clip (A) and clip (B) which secure the engine wiring harness and bulkhead harness to the bracket, and remove the bolt which secures the engine control module (ECM) to the bracket.
3. Pull out the engine control module (ECM) from the bracket, and move it to a location that does not interfere operation.
   Note:
   When performing the pulling out operation, pay attention not to apply excessive load to the breather filter portion (a) in order to avoid the damage.
4. Disconnect the connector from ignition coil.
   Note:
   While pressing the spring (a) shown in the figure, slide it in the direction of the arrow with a clip remover.
5. Remove the ignition coil.
6. Remove the spark plug with a spark plug socket.

2. LH SIDE

1. Remove the battery. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>REMOVAL.
2. Disconnect the connector from ignition coil.
   Note:
   While pressing the spring (a) shown in the figure, slide it in the direction of the arrow with a clip remover.
3. Remove the ignition coil.
4. Remove the spark plug with a spark plug socket.

INSTALLATION

1. RH SIDE

Install in the reverse order of removal.

Caution:

Degrease the ignition coil fixing portion and the ignition coil mounting bolt.

Note:

Insert the engine control module (ECM) to the bracket cushion.

Tightening torque:

Spark plug:

17.5 N·m (1.8 kgf-m, 12.9 ft-lb)

Ignition coil:

8.5 N·m (0.9 kgf-m, 6.3 ft-lb)

Engine control module (ECM):

7.5 N·m (0.8 kgf-m, 5.5 ft-lb)

2. LH SIDE

Install in the reverse order of removal.

Caution:

Degrease the ignition coil fixing portion and the ignition coil mounting bolt.

Tightening torque:

Spark plug:

17.5 N·m (1.8 kgf-m, 12.9 ft-lb)

Ignition coil:

8.5 N·m (0.9 kgf-m, 6.3 ft-lb)

IGNITION(w/o STI) > Spark Plug

INSPECTION

1. Check the spark plug for abnormalities. If defective, replace the spark plug.

(A) Terminal damage (B) Crack or damage in insulator (C) Damaged gasket

2. Check the spark plug electrode and condition of the insulator. If abnormal, check and repair the cause and replace the spark plug.

(1) Normal:

Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range.

(2) Carbon fouled:

Dry fluffy carbon deposits on the insulator and electrode are mostly caused by slow-speed driving in town, weak ignition, too rich fuel mixture, etc.

(3) Oil fouled:

Wet black deposits show oil entrance into combustion chamber through worn piston rings or increased clearance between valve guides and valve stems.

(4) Overheating:

A white or light gray insulator with black or brown spots and bluish burnt electrodes indicate engine overheating, wrong selection of fuel, or loose spark plugs.

3. Using a nylon brush, etc., clean and remove the carbon or oxide deposits from the spark plug. If deposits are too stubborn, replace the spark plugs. After cleaning the spark plugs, check the spark plug gap "L" using a gap gauge. If it is not within the standard, replace the spark plug.

Note:

- **Never use a plug cleaner.**
- **Do not use a metal brush as it may damage the electrode area.**

Spark plug gap L:

Standard

0.50 — 0.55 mm (0.020 — 0.022 in)

IGNITION(w/o STI) > Ignition Coil

REMOVAL

Direct ignition type is adopted. Refer to “Spark Plug” for removal procedure. Ref. to IGNITION(w/o STI)>Spark Plug>REMOVAL.

IGNITION(w/o STI) > Ignition Coil

INSTALLATION

Direct ignition type is adopted. Refer to “Spark Plug” for the installation procedure. Ref. to IGNITION(w/o STI)>Spark Plug>INSTALLATION.

IGNITION(w/o STI) > Ignition Coil

INSPECTION

For inspection procedure, refer to “Diagnostics for Engine Starting Failure”. Ref. to ENGINE (DIAGNOSTICS)(w/o STI)>Diagnostics for Engine Starting Failure>IGNITION CONTROL SYSTEM.

STARTING/CHARGING SYSTEMS(w/o STI)

SC(w/o STI)

1. General Description
2. Starter
3. Generator
4. Battery
5. Battery Sensor

SPECIFICATION

Item			Specifications	
Vehicle model			CVT	MT
Starter	Type		Reduction type	
	Model		M000T38571	M000T33176
	Manufacturer		Mitsubishi Electric	
	Voltage and output		12 V — 1.2 kW	12 V — 1.0 kW
	Direction of rotation		Counterclockwise (when observed from pinion)	
	Number of pinion teeth		9	8
	No-load characteristics	Voltage	11 V	
		Current	90 A or less	95 A or less
Generator	Type		Rotating-field three-phase type, voltage regulator built-in type, each with load response control system	
	Model		A2TX5081	
	Manufacturer		Mitsubishi Electric	
	Voltage and output		12 V — 130 A	
	Polarity on ground side		Negative	
	Direction of rotation		Clockwise (when observed from pulley side)	
	Stator connection		3-phase △ type	
	Output current		1,500 r/min — 50 A or more 2,500 r/min — 111 A or more 5,000 r/min — 133 A or more	
	Regulated voltage		14.1 — 14.8 V [20°C (68°F)]	
	Rotor slip ring outer diameter	Standard	22.7 mm (0.894 in)	
		Limit	22.1 mm (0.870 in)	
	Brush length	Standard	22.5 mm (0.886 in)	
		Limit	5.0 mm (0.197 in)	
Battery	Type		75D23L	
	Nominal capacity		5 HR: 53 Ah [25°C (77°F)]	
	Nominal voltage		12 V	
	CCA		470 A	
	BCI group number*		35	

*: This is a reference information for battery size, and is not guaranteed by SUBARU CORPORATION.

COMPONENT

1. STARTER

(1) Starter housing ASSY
(2) Sleeve bearing
(3) Shift lever
(4) Plate
(5) Seal rubber
(6) Magnet switch ASSY
(7) Snap ring
(8) Stopper
(9) Overrunning clutch
(10) Internal gear ASSY
(11) Shaft
(12) Pinion gear
(13) Seal rubber
(14) Yoke ASSY
(15) Armature ASSY
(16) Brush holder ASSY
(17) Sleeve bearing
(18) Starter cover ASSY

Tightening torque: N·m (kgf-m, ft-lb)

T1: 1.4 (0.1, 1.0)
T2: 6 (0.6, 4.4)
T3: 7.5 (0.8, 5.5)
T4: 10 (1.0, 7.4)
T5: 11 (1.1, 8.1)

2. GENERATOR

(1) Cap
(2) Pulley
(3) Front cover
(4) Ball bearing
(5) Bearing retainer
(6) Spacer
(7) Rotor
(8) Bearing
(9) Stator coil
(10) IC regulator
(11) Brush
(12) Rectifier
(13) Rear cover
(14) Terminal B

Tightening torque: N·m (kgf-m, ft-lb)

T1: 2 (0.2, 1.5)
T2: 3.9 (0.4, 2.9)
T3: 4.4 (0.4, 3.2)
T4: 8.9 (0.9, 6.6)
T5: 108 (11.0, 79.8)

3. GENERATOR BRACKET

(1) Generator
(2) Collector cover bracket
(3) Generator bracket
(4) V-belt tensioner ASSY
(5) Cap
(6) Idler pulley
(7) Idler pulley cover
(8) V-belt

Tightening torque: N·m (kgf-m, ft-lb)

T1: 6.4 (0.7, 4.7)
T2: 15.5 (1.6, 11.4)
T3: 25 (2.5, 18.4)
T4: 36 (3.7, 26.6)
T5: Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Generator>INSTALLATION.

4. BATTERY SENSOR

(1) Battery sensor

Tightening torque: N·m (kgf-m, ft-lb)

T: 7.5 (0.8, 5.5)

CAUTION

- Prior to starting work, pay special attention to the following:
  1. Always wear work clothes, a work cap, and protective shoes. Additionally, wear a helmet, protective goggles, etc. if necessary.
  2. Protect the vehicle using a seat cover, fender cover, etc.
  3. Prepare the service tools, clean cloth, containers to catch grease and oil, etc.
- Vehicle components are extremely hot immediately after driving. Be wary of receiving burns from heated parts.
- When performing a repair, identify the cause of trouble and avoid unnecessary removal, disassembly and replacement.
- Before disconnecting connectors of sensors or units, be sure to disconnect the ground cable from battery.
- Always use the jack-up point when the shop jacks or rigid racks are used to support the vehicle.
- Remove contamination including dirt and corrosion before removal, installation, disassembly or assembly.
- Keep the removed parts in order and protect them from dust and dirt.
- All removed parts, if to be reused, should be reinstalled in the original positions with attention to the correct directions, etc.
- Bolts, nuts and washers should be replaced with new parts as required.
- Be sure to tighten the fasteners including bolts and nuts to the specified torque.

PREPARATION TOOL

1. GENERAL TOOL

TOOL NAME	REMARKS
Circuit tester	Used for measuring resistance, voltage and current. **Note:** • **When measuring the standby current, prepare a circuit tester which can measure down to 1 mA.** • **When measuring the standby current for models with keyless access function, prepare an analog type.**

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the intercooler. Ref. to INTAKE (INDUCTION)(w/o STI)>Intercooler>REMOVAL.
4. Disconnect the connector (A) and terminal (B) from starter.
5. Lift up the vehicle.
6. Remove the nut or bolt at the bottom of the starter.
   Note:
   For the MT model, a bolt is used to the location (A).
7. Lower the vehicle.
8. Disconnect the terminal (A) from the cable stay and remove the cable stay and starter from the transmission.
   Caution:
   In order to prevent damaging the terminal (A), fix the terminal (A) when loosing the bolt, and avoid the part from rotating together while loosening the bolt.

INSTALLATION

Install in the reverse order of removal.

Note:

- **Tighten the starter and cable stay (a) together using the upper bolt securing the starter.**
- **For the MT model, a bolt is used to the location (b).**

Tightening torque:

T1: 14 N·m (1.4 kgf-m, 10.3 ft-lb)
T2: 50 N·m (5.1 kgf-m, 36.9 ft-lb)

Tightening torque:

11 N·m (1.1 kgf-m, 8.1 ft-lb)

DISASSEMBLY

Caution:
The starter should be placed through a no-load test whenever it has been overhauled.

1. Disconnect the cable from the terminal M of the magnet switch assembly.
2. Remove the magnet switch assembly from the starter housing assembly.
3. Remove screws (A) of the brush holder assembly, and through bolts (B) on both sides, and remove the starter cover assembly.
4. Remove the brush holder assembly from the armature assembly.
   Note:
   Hold the brush with your fingers so that the brush spring does not come flying out.
5. Remove the armature assembly and yoke assembly from the starter housing assembly together as a single unit.

6. Separate the armature assembly and yoke assembly.
7. Remove the pinion gear from the internal gear assembly.
8. Remove seal rubber (A), plate (B), and seal rubber (C).
9. Lightly tap the starter housing assembly with a plastic hammer as shown in the figure, and remove the overrunning clutch, internal gear assembly, shaft and shift lever together as one unit.
10. Use the following procedures to remove the overrunning clutch from the shaft.
    (1) Use an appropriate tool (such as a fit socket wrench), and remove the stopper from snap ring by lightly tapping the stopper with a plastic hammer.

    (A) Appropriate tool (B) Snap ring (C) Shaft
    (D) Stopper

    (2) Remove snap ring (A) from the shaft, and remove stopper (B).
    (3) Remove the overrunning clutch from the shaft.
11. Separate the internal gear assembly and shaft.

STARTING/CHARGING SYSTEMS(w/o STI) > Starter

ASSEMBLY

1. Apply grease to the shaft sliding surfaces of the internal gear assembly.
   Grease:
   Multemp #6129 or equivalent
2. Assemble the shaft to the internal gear assembly.
3. Assemble the overrunning clutch as follows:
   (1) Apply grease to the spline portion of the shaft.
   Grease:
   Multemp #6129 or equivalent
   (2) Install the overrunning clutch to shaft.
   (3) Pass stopper (B) through the shaft assembly, and attach snap ring (A).
   Note:
   Use new stoppers and snap rings.
   (4) Using a press, pressure fit stopper (B) into snap ring (A).
4. Assemble the overrunning clutch, internal gear assembly, shaft and shift lever as a single unit into the starter housing assembly.
   Note:
   Apply grease to the moving parts of the shift lever.
   Grease:
   Multemp #6129 or equivalent
5. Apply grease to the inside of the internal gear assembly and pinion gear, and attach the pinion gear to the internal gear assembly.
   Note:
   - **Apply grease evenly to the contact surfaces of each gear.**
   - **Be careful that no debris becomes attached.**

   Grease:
   Molykote® AG650 or equivalent
6. Install seal rubber (A), plate (B), and seal rubber (C).
7. Assemble the armature assembly to the yoke assembly.

8. Attach the armature assembly and yoke assembly to the starter housing assembly together as a single unit.
   Note:
   As shown in the figure, match the protrusion of the yoke assembly to the cut out of the starter housing assembly.
9. Use an appropriate tool (such as correctly sized socket wrenches) and attach the brush holder assembly to the armature assembly.
   Note:
   Be careful not to damage the brushes.
10. Secure starter cover assembly to the brush holder assembly with screws (A).
    Tightening torque:
    1.4 N·m (0.1 kgf-m, 1.0 ft-lb)
11. Tighten through bolts (B) on both sides.
    Tightening torque:
    6 N·m (0.6 kgf-m, 4.4 ft-lb)
12. Attach the magnet switch assembly to the starter housing assembly.
    Tightening torque:
    7.5 N·m (0.8 kgf-m, 5.5 ft-lb)
13. Connect the cable to the terminal M of the magnet switch assembly.
    Tightening torque:
    10 N·m (1.0 kgf-m, 7.4 ft-lb)

STARTING/CHARGING SYSTEMS(w/o STI) > Starter

INSPECTION

Note:

- **After the inspection, reinstall the disassembled or removed parts during the inspection in the reverse order of disassembly/removal procedure.**
- **Refer to component for tightening torque of each part. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>General Description>COMPONENT > STARTER.**

1. ARMATURE

1. Check the commutator for signs of seizure or stepped wear caused by roughness of the surface. If there is light wear, use sandpaper to repair.
2. Check for runout on the commutator. If excessive, replace the armature.
   Commutator runout:
   Standard
   0.05 mm (0.0020 in)
   Limit
   0.10 mm (0.0039 in)



3. Check the depth of the segment mold. If it is not within the standard, replace the armature.
   Depth of segment mold:
   Standard
   0.50 mm (0.020 in)

(A) Depth of mold (B) Segment (C) Mold

4. Place the armature on the growler tester to check for short circuits. While slowly turning the armature, support the steel sheet for the armature core. If the circuit of the armature is shorted, the steel sheet will vibrate, causing it to move towards the core. When the steel sheet has moved or vibrated, replace the armature.

(A) Steel sheet (B) Growler tester

5. Use a circuit tester to touch the probe of one side to the commutator segment, and the other probe to the shaft. If there is continuity, replace the armature.

2. YOKE

Make sure that the pole is set at the predetermined position.

3. OVERRUNNING CLUTCH

Inspect the pinion, and if there is any wear or damage, replace the overrunning clutch. Also, check that the pinion rotates counterclockwise smoothly and does not rotate clockwise. If there is any fault, replace the overrunning clutch.

Caution:

To prevent spilling of grease, do not clean the overrunning clutch with oil.

4. BRUSH AND BRUSH HOLDER

1. Visually check the brush. If there is any abnormal wear or cracks, replace the brush.
2. Measure the length of the brush. If it exceeds service limits, replace the brush.

Brush length:

Standard

12.3 mm (0.484 in)

Limit

7.0 mm (0.276 in)

(A) Service limit line (B) Brush

3. Check that the brush moves smoothly in the brush holder.
4. Measure the brush spring force with a spring scale. Replace the brush holder if below the service limit.

Brush spring force:

Standard

15.9 — 19.5 N (1.62 — 1.99 kgf, 3.57 — 4.38 lbf) (when new)

Limit

2.5 N (0.25 kgf, 0.56 lbf)

5. SWITCH ASSEMBLY

Using a circuit tester, check there is continuity between S terminal and M terminal, and between S terminal and ground. Also, check that there is no continuity between M terminal and B terminal.

(A) Terminal S (B) Terminal M (C) Terminal B

Terminals	Standard
Terminal S — terminal M	1 Ω or less
Terminal S — Ground	1 Ω or less
Terminal M — terminal B	1 MΩ or more

6. SWITCH ASSEMBLY OPERATION

Caution:
Perform the inspection in a short period of time. (Within 3 to 5 seconds)

1. Loosen the nut which holds the cable to the M terminal.
   Note:
   This procedure is required to facilitate the cable removal from the M terminal.
2. Connect the battery positive terminal to the switch assembly S terminal, and connect the battery negative terminal to the starter body. Then, if the pinion protrudes, it is normal.
   Note:
   The starter motor may rotate while the pinion protrudes. This occurs due to current that flows to the motor via pull-in coil. This is not a problem.

   (A) Terminal S

3. Disconnect the cable from the M terminal. Check that the pinion is being protruded at this time.
   Caution:
   Hold the disconnected cable so that it does not contact the terminal or wiring.
4. Disconnect the battery negative terminal from the starter body. Then, if the pinion returns to its original position, it is normal.

   (A) Terminal S

7. NO-LOAD TEST

Caution:

- **Use a thick cable due to large current flowing through the cable.**
  - **It is recommended that the cross-section area of continuity part (shaded part) should be 20 mm^2 (0.00310 sq in) or more for terminal B and ground, and 1.25 mm^2 (0.00194 sq in) or more for terminal S.**

    (a) Cable cross-section (b) Cable shield part (c) Cable continuity part

  - **It is possible to use a booster cable instead of wiring.**
- **Be careful not to burn yourself and cause a fire due to heat.**
- **Perform the no-load test in a short period of time. (Within 3 to 5 seconds)**

Note:
For no-load test, use the circuit shown in figure.

(A) Terminal S (B) Terminal M (C) Terminal B
(D) Magnet switch (E) Switch (F) Circuit tester with clamp-type ammeter
(G) Circuit tester

1. Using a vise, secure the starter.

Caution:
Be careful not to deform or damage the starter.

2. Turn the switch ON, and check that the pinion protrudes rapidly into the specified position and rotates powerfully without noise.
3. Check the current and voltage after its rotation speed stabilizes.
   Current/Voltage
   CVT model
   90 A or less (approx. 11 V)
   MT model
   95 A or less (approx. 11 V)

8. OTHER INSPECTIONS

Check that the starter does not have deformation, cracks and any other damage.

STARTING/CHARGING SYSTEMS(w/o STI) > Generator

REMOVAL

1. Remove the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>REMOVAL.
2. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
3. Remove the brake vacuum pump. Ref. to BRAKE>Brake Vacuum Pump>REMOVAL.
4. Remove the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL > V-BELT.
5. Remove the collector cover bracket.
6. Disconnect the connector (A) and terminal (B) from the generator.
7. Remove the generator from the generator bracket.
8. Remove the V-belt tensioner assembly. Ref. to MECHANICAL(w/o STI)>V-belt>REMOVAL > V-BELT TENSIONER ASSY.
9. Remove the generator bracket from the engine.

STARTING/CHARGING SYSTEMS(w/o STI) > Generator

INSTALLATION

1. Temporarily install the generator bracket to the engine and tighten the bolts in the numerical order.
   Tightening torque:
   36 N·m (3.7 kgf-m, 26.6 ft-lb)
2. Install the V-belt tensioner assembly. Ref. to MECHANICAL(w/o STI)>V-belt>INSTALLATION > V-BELT TENSIONER ASSY.
3. Temporarily install the generator bracket to the generator and tighten the bolts in the numerical order.
   Tightening torque:
   25 N·m (2.5 kgf-m, 18.4 ft-lb)
4. Connect the connector (A) and terminal (B) to the generator.
   Tightening torque:
   15.5 N·m (1.6 kgf-m, 11.4 ft-lb)
5. Install the collector cover bracket.
   Tightening torque:
   6.4 N·m (0.7 kgf-m, 4.7 ft-lb)
6. Install the V-belts. Ref. to MECHANICAL(w/o STI)>V-belt>INSTALLATION > V-BELT.
7. Install the brake vacuum pump. Ref. to BRAKE>Brake Vacuum Pump>INSTALLATION.
8. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
9. Install the collector cover. Ref. to INTAKE (INDUCTION)(w/o STI)>Collector Cover>INSTALLATION.

STARTING/CHARGING SYSTEMS(w/o STI) > Generator

DISASSEMBLY

1. Remove the cap from the generator.
2. Remove the four through bolts.
3. Use a drier to heat the rear cover (A) portion to 50 — 60°C (122 — 140°F).
4. Insert a flat tip screwdriver or similar tool wrapped with protective tape into the gap between stator core and the front cover to disassemble.

(A) Flat tip screwdriver

5. Hold the rotor on a vise and remove the pulley.
   Caution:
   When holding the rotor with a vise, place aluminum plates or wooden pieces on the vise jaws to prevent rotor from damage.
6. Remove the rotor from the front cover.

(A) Pulley (B) Front cover (C) Rotor

7. Use the following procedures to remove the ball bearings.
   (1) Remove the bolt, and then detach the bearing retainer.
   (2) Firmly attach an appropriate tool (such as a correct size socket wrench) to the bearing inner race.
   (3) Use the press to push the ball bearings out from the front cover.
8. Using the bearing puller, remove the bearings from the rotor.
9. Remove six bolts which connect the rectifier and stator coil, then remove the stator coil.
10. Remove four screws which secure the IC regulator to the rear cover, then remove the IC regulator.
11. Use the following procedures to remove the brush.
    (1) Remove the cover A.

(A) Cover A

    (2) Remove the cover B.

(A) Cover B

    (3) Disconnect the connection and remove the brush.
12. Remove the rectifier as follows.
    (1) Remove the cover on terminal B.
    (2) Remove the nut on terminal B.
    (3) Remove the bolts which secure the rectifier, and remove the rectifier.

STARTING/CHARGING SYSTEMS(w/o STI) > Generator

ASSEMBLY

Assemble in the reverse order of disassembly.

Note:

- **Refer to component for tightening torque of each part. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>General Description>COMPONENT > GENERATOR.**
- **After assembling, manually turn the pulley to check that the rotor rotates smoothly.**

1. Assembling the rear cover and rectifier
   Remove old silicone grease on the mating surface of rear cover and rectifier and apply new silicone grease.
   Caution:
   Do not apply silicone grease to the attachment threads of rectifier.
2. Push of the brush
   Before assembling the front and rear parts, press the brush down into the brush holder, then fix the brush in that position by inserting a [1 mm (0.0394 in) dia., 40 — 50 mm (1.5748 — 1.9685 in) long] wire through the hole as shown in the figure.

Caution:
After assembling, remove the wire.

(A) Wire

3. Install the ball bearings.
(1) Set the ball bearings in the front cover, then securely install an appropriate tool (such as a socket wrench of proper size) to the bearing outer race.
(2) Using a press to press the ball bearings into the specified location.
(3) Install the bearing retainer.

4. Install the bearings.
Caution:
Do not apply grease to the bearings. If there is any oil on the bearing box, remove it completely.
(1) Use a press to install the bearings to the rotor shaft.
(2) Heat the bearing box in rear cover at 50 to 60°C (122 to 140°F), and then press the bearing into rear cover.

INSPECTION

1. DIODE

Caution:
There is the possibility of damaging the diodes if a mega-tester (used to measure high voltages) or a similar measuring instrument is used. Never use a mega tester or equivalent for this test.

1. Check for continuity between the diode lead and terminal E or B. If continuity is not as shown in the table, replace the rectifier.

- At analog type tester

Tester lead		Continuity
−lead	+lead	
E	P1, P2, P3, P4, P5, P6	Yes
B		None
P1, P2, P3, P4, P5, P6	E	None
	B	Yes

- At digital type tester

Tester lead		Continuity
−lead	+lead	
E	P1, P2, P3, P4, P5, P6	None
B		Yes
P1, P2, P3, P4, P5, P6	E	Yes
	B	None

2. ROTOR

1. Slip ring surface
   Inspect the slip rings for contamination or any roughness on the sliding surface. Repair the slip ring surface using a lathe or sand paper.
2. Slip ring outer diameter
   Measure the slip ring outer diameter. Replace the rotor if the slip ring is worn.
   Slip ring outer diameter:
   Standard
   22.7 mm (0.894 in)
   Limit
   22.1 mm (0.870 in)
3. Continuity test
   Using a circuit tester, check the resistance between slip rings. If the resistance is not within the standard, replace the rotor.
   Standard:
   Approx. 2.0 — 2.4 Ω
4. Insulation test
   Check the continuity between slip ring and rotor core or shaft. If there is continuity, replace the rotor because the rotor coil is grounded.
5. Bearing
   Check the bearings. If there is any noise, or the rotor does not rotate smoothly, replace the bearings.

3. STATOR COIL

1. Continuity test
   Inspect the continuity between the stator coil terminals. If continuity is not as shown in the table, replace the stator coil.
   (A) Terminals

2. Insulation test
   Inspect the continuity between the stator coil stator core and lead wire terminals. If there is continuity, replace the stator coil because the stator coil is grounded.

4. BRUSH

1. Measure the length of each brush. Replace the brush if wear exceeds service limits. There is a service limit mark (A) on each brush.
   Brush length:
   Standard (1)
   22.5 mm (0.886 in)
   Limit (2)
   5.0 mm (0.197 in)
2. Check that there is appropriate pressure on the brush spring. Using a spring pressure indicator, push the brush into the brush holder until its tip protrudes 2 mm (0.0787 in). Then measure the pressure of brush spring. If the pressure is 1.7 N (173 gf, 6.11 ozf) or less, replace the brush spring. 4.1 — 5.3 N (418 — 540 gf, 14.75 — 19.06 ozf) pressure is required on the new spring.

5. BALL BEARING

Check the ball bearings. Replace the ball bearings if there is resistance in the rotation, or if there is any abnormal noise.

STARTING/CHARGING SYSTEMS(w/o STI) > Battery

REMOVAL

1. Remove the battery sensor. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery Sensor>REMOVAL.
2. Disconnect the positive terminal of battery.
3. Remove the battery cable holder from the battery rod.
4. Remove the flange nut from battery rod and remove battery holder.
5. Remove the battery.

STARTING/CHARGING SYSTEMS(w/o STI) > Battery

INSTALLATION

Install in the reverse order of removal.

Tightening torque:

Battery holder

3.5 N·m (0.4 kgf-m, 2.6 ft-lb)

Positive terminal

6 N·m (0.6 kgf-m, 4.4 ft-lb)

Battery sensor

6 N·m (0.6 kgf-m, 4.4 ft-lb)

Note:

- **Clean the battery cable terminals and apply grease to retard the formation of corrosion.**
- **Connect the positive (+) terminal, and then connect the battery sensor.**
- **After the battery is installed, initial diagnosis of the electronic throttle control is performed. Wait for 10 seconds or more after turning the ignition switch to ON, and then start the engine.**

STARTING/CHARGING SYSTEMS(w/o STI) > Battery

INSPECTION

Warning:

- **As batteries produce flammable gases, be careful not to bring an open flame close to the batteries.**
- **Ventilate sufficiently when using or charging battery in enclosed space.**
- **Electrolyte is corrosive acid, and has toxicity; be careful of handling the fluid.**
- **For safety, in case an explosion does occur, wear eye protection or shield your eyes when working near any battery. In addition, never lean over the battery.**
- **Be careful that the electrode does not come into contact with skin, eyes or clothing. Especially at contact with eyes, flush with water for 15 minutes and get prompt medical attention.**
- **Be careful not to let the electrode contact with the coated parts.**
- **Before starting work, remove rings, metal watch-bands, and other metal jewelry.**
- **Be careful not to let the metal tools contact the positive battery terminal and anything connected to it. When the operation using a metal tool to the positive terminal or anything connected to it is required, disconnect the battery ground terminal before starting the operation.**

1. APPEARANCE

Check the battery case, top cover and terminal posts for dirt or cracks, and perform the following work as necessary.

- Clean the battery with water and wipe with a dry cloth.
- Apply a thin coat of grease on the terminal posts to prevent corrosion.

Check

- **Normal** → Go to the check item 2.
- **Abnormal** → Replace the battery.

2. ELECTROLYTE LEVEL

Check the electrolyte level in each cell.

Caution:

Do not fill beyond MAX level.

Note:

If the level is below the middle point between MIN level and MAX level, pour distilled water into the battery cell to bring the level to MAX.

Check

- **MAX level** → Go to the check item 3.
- **Below the middle point between MIN level and MAX level** → **Fill** → Go to the check item 3.

3. SPECIFIC GRAVITY OF ELECTROLYTE

Check the specific gravity of the electrolyte using a hydrometer and a thermometer.

Note:

- **Specific gravity varies with temperature of electrolyte so that it must be corrected at 20°C (68°F) using the following calculation:**
  S_{20} = St + 0.0007 × (t − 20)
  S_{20}: Specific gravity corrected at electrolyte temperature of 20°C
  St: Measured specific gravity
  t: Measured temperature (°C)
- **When measuring in a simplified manner using the battery terminal voltage, calculate the specific gravity by the following formula.**
  Specific gravity = [0.187 × battery terminal voltage (V)] − 1.1
  Perform the steps 1) and 2) before measuring the voltage in order to stabilize the voltage.
  1) Turn the ignition switch to OFF and illuminate the headlight for 30 seconds.
  2) After turning off the headlight, leave the vehicle for one minute.
- **Measuring the specific gravity of the electrolyte in the battery will disclose the state of charge of the battery. The relation between specific gravity and state of charge is as shown in the figure.**

(A) Specific gravity [20°C (68°F)] (B) Amount of discharge (%) (C) Good
(D) Need to charge or replace

(A) Specific gravity [20°C (68°F)] (B) Electrolyte temperature (C) Good
(D) Caution (E) Need charging

Check

- **Specific gravity: 1.250 — 1.290, and difference between cells is 0.04 or less** → Battery is normal
- **Specific gravity: Less than 1.250, or difference between cells is 0.04 or more** → Battery needs to be charged or replaced

4. STANDBY CURRENT

1. Prepare the circuit tester which can measure down to 1 mA.
   Note:
   For model with keyless access function, the standby current changes regularly. Therefore, prepare the analog type circuit tester.
2. Using the circuit tester, check the standby current.
   Note:
   The standby current may be displayed lower than the actual value if the battery is weak, so be sure to check the battery. Charge or replace if necessary.
   (1) Check the battery. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>INSPECTION > APPEARANCE. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>INSPECTION > ELECTROLYTE LEVEL. Ref. to STARTING/CHARGING SYSTEMS(w/o STI)>Battery>INSPECTION > SPECIFIC GRAVITY OF ELECTROLYTE.
   (2) Check that the fuse is not blown out and is properly inserted.
   (3) When non-genuine electrical parts (including parts sold in authorized workshops) are installed, remove all parts except for genuine electrical parts.
   (4) Check that back-up fuse is inserted. Ref. to PRE-DELIVERY INSPECTION>PRE-DELIVERY INSPECTION (PDI) PROCEDURE > FUSE.

(5) Start the engine, and set the switch positions for each system as shown in the following table.

Note:

Some of the listed systems are not equipped depending on the vehicle. Set only the systems equipped on the vehicle to the positions as shown.

System	Position
Headlight	ON or Auto
Fog light	ON
Wiper (front and rear)	ON or Low speed
Audio and navigation system	ON
Rear defogger	ON
Room light	DOOR
Luggage light	DOOR
Map light	OFF
Auto A/C	ON (AUTO)
Manual A/C	ON (Speed 1)
Electronic parking brake	ON
Electrical parts other than listed above (electrical parts that users can confirm the operation with the key removed)	OFF

(6) Turn the ignition switch to OFF.

(7) Operate the front hood lock release lever to unlock the front hood.

(8) Close all the doors (including rear gate and trunk lid) and then lock the doors. (Security alarm is in set condition)

Note:

For model with keyless access function, take the access key 1.5 m or more away from the vehicle after the door lock. And do not put the access key close to the vehicle while measuring the standby current.

(9) Wait for 5 minutes after door lock until the standby current stabilizes.

(10)Loosen the nut which holds the ground terminal to the battery sensor.

Note:

Do not remove the ground terminal.

(11)Connect the circuit tester positive terminal to the ground terminal.

Note:

To prevent the damage to the circuit tester, set the circuit tester range to a large value first, then gradually change it to smaller values.

(12)Connect the circuit tester negative terminal to the ground terminal installation part of the battery sensor.

(13)While connecting the circuit tester positive terminal with the ground terminal as shown in the figure below, remove the ground terminal from the battery sensor.

(14)Check the standby current.

Caution:
If the circuit tester is disconnected from any terminal during standby current check, reconnect the ground terminal to the battery sensor and restart the procedure back in the step (9).
Note:

- **For model with keyless access function, the standby current changes periodically because the keyless access system continuously searches the access key (polling).**
- **When measuring the standby current, the reading of the circuit tester oscillates. Therefore, read the average value (median value).**
- **The standby current may become large when the vehicle system is activated 5 times at 30-minute intervals or 5 hours after turning the ignition switch to OFF. Therefore, the measurement should be completed in 20 minutes with the ignition switch OFF. If it takes more than 20 minutes, start the engine and turn the ignition switch to OFF again before performing the inspection.**

(A) Current/mA (B) Time/min (C) Ignition OFF
(D) Less than 70 mA (E) 5 seconds (system operation) (F) 300 mA or more

Check

- **When the maximum measurement value is less than 70 mA** → Standby current is normal.
- **When the maximum measurement value is 70 mA or more** → Go to step (15).

(15)Remove all fuses one by one to identify which system changes the standby current value significantly. Ref. to WIRING SYSTEM>Fuse And Relay.
(16)Check the harness and connector of the system whose standby current has changed significantly.

STARTING/CHARGING SYSTEMS(w/o STI) > Battery

CHARGE

Warning:

- **Do not bring an open flame close to the battery when working.**

Caution:

- **Prior to charging, corroded terminals should be cleaned with a brush and common caustic soda solution.**
- **Be careful while charging the battery because it produces flammable gasses.**
- **Observe instructions when handling the battery charger.**
- **Before charging the battery on the vehicle, disconnect the battery ground terminal to prevent damage of generator diodes or other electrical units.**

1. NORMAL CHARGE (CONSTANT CURRENT CHARGE)

Charge the battery with the current value specified by manufacturer or with approximately 1/10 of battery's rating capacity. (See the table below.)

Type	Charging current (A)	CCA (A)
75D23L	5.0 — 6.0	470

Caution:

- **The charge control feature and specifications for judgment of charge completion depend on the device. Follow the instruction manual of the charger used.**
- **Keep the electrolyte temperature at 45°C (113°F) or less while charging. Stop charging when the temperature exceeds this value.**

Note:

The characteristics of typical charging methods are as follows.

- **Constant current charging**
  This method makes it easy to charge to 100%, since the electrolyte is agitated by the gassing occurred at the end of charging. However, the time for charging is comparatively long because the current value is kept constant.
- **Constant voltage charging**
  This method completes charging in a short period of time due to the large current. However, it is difficult to charge to 100% because no gassing occurred at the end of charging and the electrolyte is not agitated. Therefore, the combined use with the constant current charging is preferable.
- **Quasi-constant voltage charging**
  This method is widely used for commercially available chargers.
  Compared to the constant voltage charging whose charging current at the beginning of charging becomes large, it reduces the charging current by lowering the voltage at the initial stage, resulting in battery load reduction. The time for charging is comparatively long. However, this type of chargers can be manufactured comparatively inexpensive due to the simple control circuit (or manual settings). After the initial stage of charging is completed, it gradually raises the charging voltage so that the charging current is within the specification, until the battery is fully charged.
- **Constant voltage/current charging**
  In addition to the constant voltage charging, this method controls the upper limit of the current.
  The constant current charging is applied at the beginning of charging, and the constant voltage charging is applied at the end. This makes battery charge comparatively efficient in a short period of time. Charging by generators is similar to this method.

Judgment of charge completion

1. Specific gravity of electrolyte should be held within the specific range of 1.250 — 1.290 for one hour or more.
2. Voltage while charging should be held within the specified range of 15.0 — 16.8 V for one hour or more.
3. Gas is actively generated in all cells.
4. The amount of charge reaches 1.2 — 1.5 times of the amount of discharge.
   Note:
   The amount of discharge/charge can be calculated by the following formula.
   Amount of discharge (Ah) = Remaining capacity (%) calculated by specific gravity × 5 hour rate capacity (Ah)
   Amount of charge (Ah) = Charging current value (A) × Time for charging

2. QUICK CHARGING

Charge the battery in a short period of time with a relatively large current by using a quick charger.

Charge the battery with the current value at approximately 1/2 of battery’s rating capacity. (See the table below.)

Caution:

- **Quick charging is accompanied by a large amount of heat generation. Charging should be completed in up to 30 minutes regardless of battery size.**
- **Quick charging is used to recover the battery until it can start the vehicle. For full charging, use the normal charging method.**
- **Keep the electrolyte temperature at 55°C (131°F) or less while quick charging. Stop charging when the temperature exceeds this value.**

Type	Charging current (A)	CCA (A)
75D23L	24.0 — 29.0	470

REMOVAL

1. Disconnect the ground terminal from battery sensor. Ref. to NOTE>NOTE > BATTERY.
2. Disconnect the connector (A) from the battery sensor, and remove the battery sensor.
   Caution:
   The end of the bolt (a) of the battery sensor is crimped. Therefore, do not loosen the nut (b) to the crimped portion.

INSTALLATION

Caution:
- **If the battery terminal is worn or the terminal part is loose, replace it with a new battery.**
- **After connecting the ground terminal to the battery sensor, the initial diagnosis of the electronic throttle control is conducted by the vehicle. Therefore, wait for 10 seconds or more after turning the ignition switch to ON, and then start the engine.**

1. Install the battery sensor.
   (1) Clean and degrease the battery terminal, inside of the battery sensor terminal, ground terminal connecting area, and ground terminal.
   Caution:
   As residual grease on the bolt thread may cause overtorque, clean and degrease the thread if grease remains on it. Also, be careful to avoid battery sensor deformation and intrusion of grease into the inside of the connector when wiping.

   (A) Battery terminal
   (B) Inside of the battery sensor terminal
   (C) Ground terminal connecting area and ground terminal
   (D) Ground terminal
   (E) Bolt thread

   (2) Loosen the battery sensor nut up to just before the crimp to make sure that the clamp is open.
   Note:
   This operation is required to firmly insert the battery sensor into the battery terminal.
   (3) Set the battery sensor to the battery terminal, and tighten the nut.
   Caution:
   Insert until the battery terminal upper end (a) exceeds the height of the battery sensor terminal upper end (b).
   Tightening torque:
   6 N·m (0.6 kgf-m, 4.4 ft-lb)
2. Connect the connector to the battery sensor.
3. Connect the ground terminal to battery sensor. Ref. to NOTE>NOTE > BATTERY.
4. Apply a thin coat of grease to cover the battery terminal surface (A), connection between the battery terminal and the battery sensor (B), and connection between the ground terminal and the battery sensor (C).

Caution:
This procedure is required for rust prevention and sulfation control. Be careful to avoid overgreasing as it causes insulation.

INSPECTION

Check the battery sensor for deformation, cracks and any other damage.