# FUEL INJECTION (FUEL SYSTEMS)

# FU(DOHC TURBO)


| | | Page |
|---|---|---|
| 1. | General Description | 2 |
| 2. | Throttle Body | 14 |
| 3. | Intake Manifold | 15 |
| 4. | Engine Coolant Temperature Sensor | 29 |
| 5. | Crankshaft Position Sensor | 30 |
| 6. | Camshaft Position Sensor | 31 |
| 7. | Knock Sensor | 32 |
| 8. | Throttle Position Sensor | 33 |
| 9. | Mass Air Flow and Intake Air Temperature Sensor | 34 |
| 10. | Pressure Sensor | 35 |
| 11. | Idle Air Control Solenoid Valve | 36 |
| 12. | Fuel Injector | 37 |
| 13. | Tumble Generator Valve Assembly | 40 |
| 14. | Wastegate Control Solenoid Valve | 41 |
| 15. | Front Oxygen (A/F) Sensor | 42 |
| 16. | Rear Oxygen Sensor | 44 |
| 17. | Exhaust Temperature Sensor | 46 |
| 18. | Engine Control Module | 47 |
| 19. | Main Relay | 48 |
| 20. | Fuel Pump Relay | 49 |
| 21. | Fuel Pump Controller | 50 |
| 22. | Fuel | 51 |
| 23. | Fuel Tank | 52 |
| 24. | Fuel Filler Pipe | 55 |
| 25. | Fuel Pump | 60 |
| 26. | Fuel Level Sensor | 62 |
| 27. | Fuel Sub Level Sensor | 63 |
| 28. | Fuel Filter | 65 |
| 29. | Fuel Cut Valve | 66 |
| 30. | Fuel Damper Valve | 67 |
| 31. | Fuel Delivery, Return and Evaporation Lines | 68 |
| 32. | Fuel System Trouble in General | 71 |


GETtheMANUALS.org

# 1. General Description

## A: SPECIFICATIONS

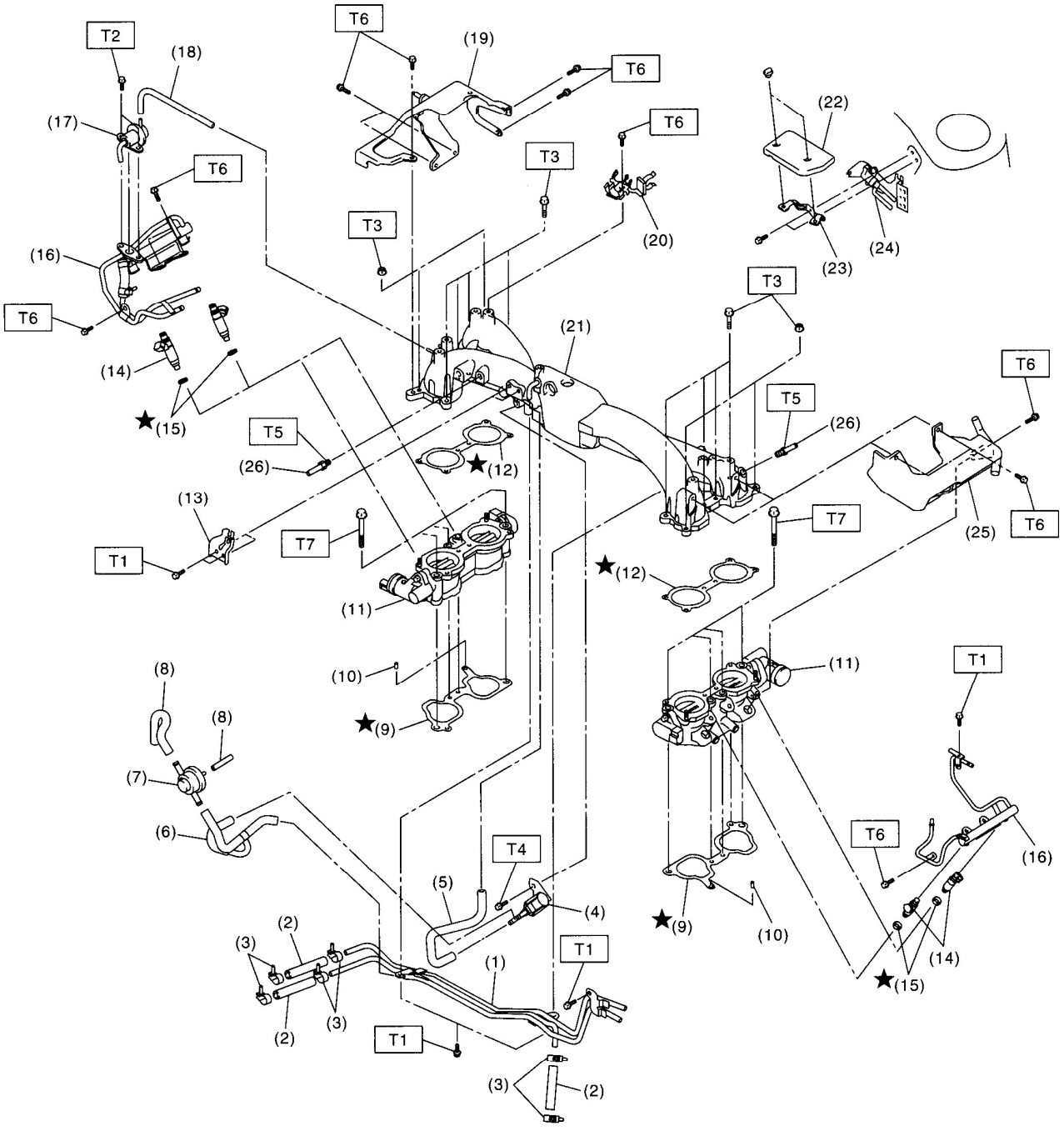
| | | |
|---|---|---|
| Fuel tank | Capacity | 60 ℓ (15.9 US gal, 13.2 Imp gal) |
| | Location | Under rear seat |
| Fuel pump | Type | Impeller |
| | Shutoff discharge pressure | 450 — 677 kPa (4.59 — 6.9 kg/cm$^2$, 65.27 — 98.2 psi) |
| | Discharge flow | More than 130 ℓ (34.3 US gal, 28.6 Imp gal)/h<br>[12 V at 300 kPa (3.06 kg/cm$^2$, 43.5 psi)] |
| Fuel filter | | Cartridge type |


GETtheMANUALS.org

GETtheMANUALS.org

# B: COMPONENT

## 1. INTAKE MANIFOLD




EN1135



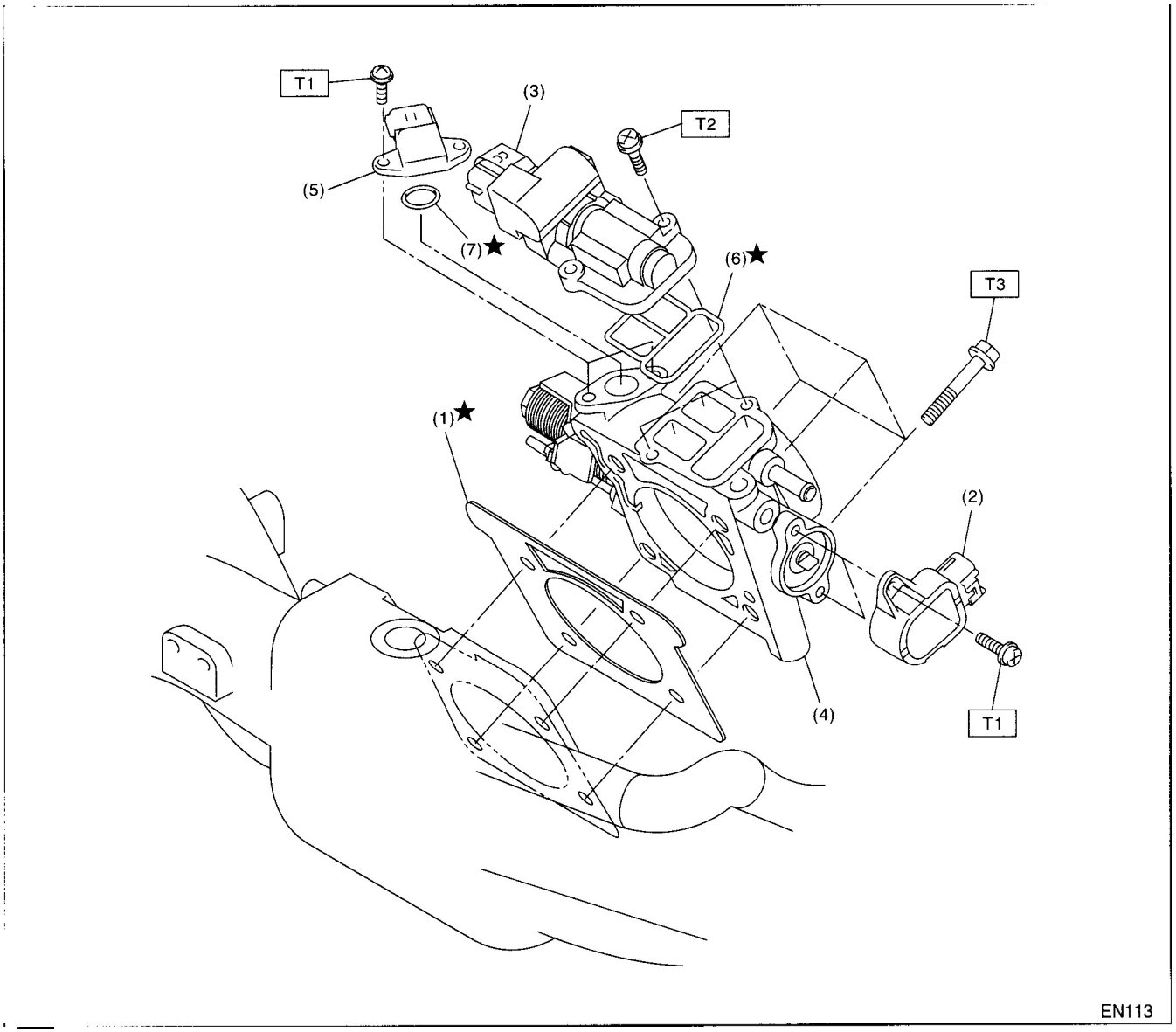
GETtheMANUALS.org

(1) Fuel pipe ASSY
(2) Fuel hose
(3) Clip
(4) Purge control solenoid valve
(5) Vacuum hose
(6) Vacuum control hose
(7) Purge valve
(8) Purge hose
(9) Intake manifold gasket
(10) Guide pin
(11) Tumble generator valve ASSY
(12) Tumble generator valve gasket
(13) Accelerator cable bracket
(14) Fuel injector
(15) Insulator
(16) Fuel injector pipe
(17) Pressure regulator
(18) Pressure regulator hose
(19) Fuel pipe protector RH
(20) Blow-by hose stay
(21) Intake manifold
(22) Solenoid valve cover
(23) Solenoid valve cover stay
(24) Wastegate control solenoid valve ASSY
(25) Fuel pipe protector LH
(26) Nipple

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 4.9 (0.5, 3.6)***
***T2: 6.4 (0.65, 4.7)***
***T3: 8.25 (0.84, 6.1)***
***T4: 16 (1.6, 11.8)***
***T5: 17 (1.73, 12.5)***
***T6: 19 (1.94, 13.7)***
***T7: 25 (2.5, 18.1)***


GETtheMANUALS.org

## 2. AIR INTAKE SYSTEM

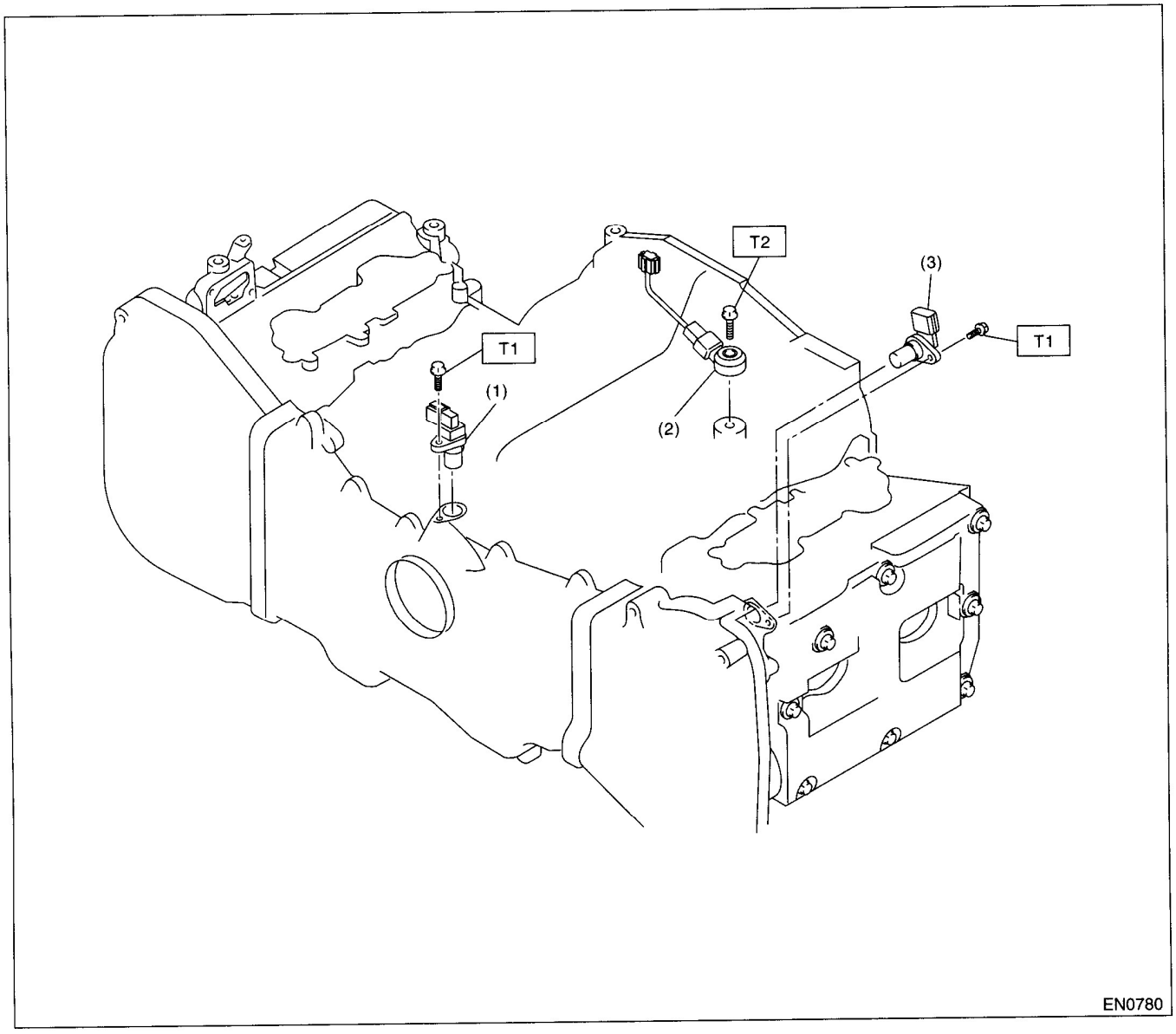



(1) Gasket
(2) Throttle position sensor
(3) Idle air control solenoid valve
(4) Throttle body
(5) Pressure sensor
(6) Gasket
(7) O-ring

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 1.6 (0.16, 1.2)***
***T2: 2.8 (0.29, 2.1)***
***T3: 22 (2.2, 15.9)***


GETtheMANUALS.org

## 3. CRANKSHAFT POSITION, CAMSHAFT POSITION AND KNOCK SENSORS

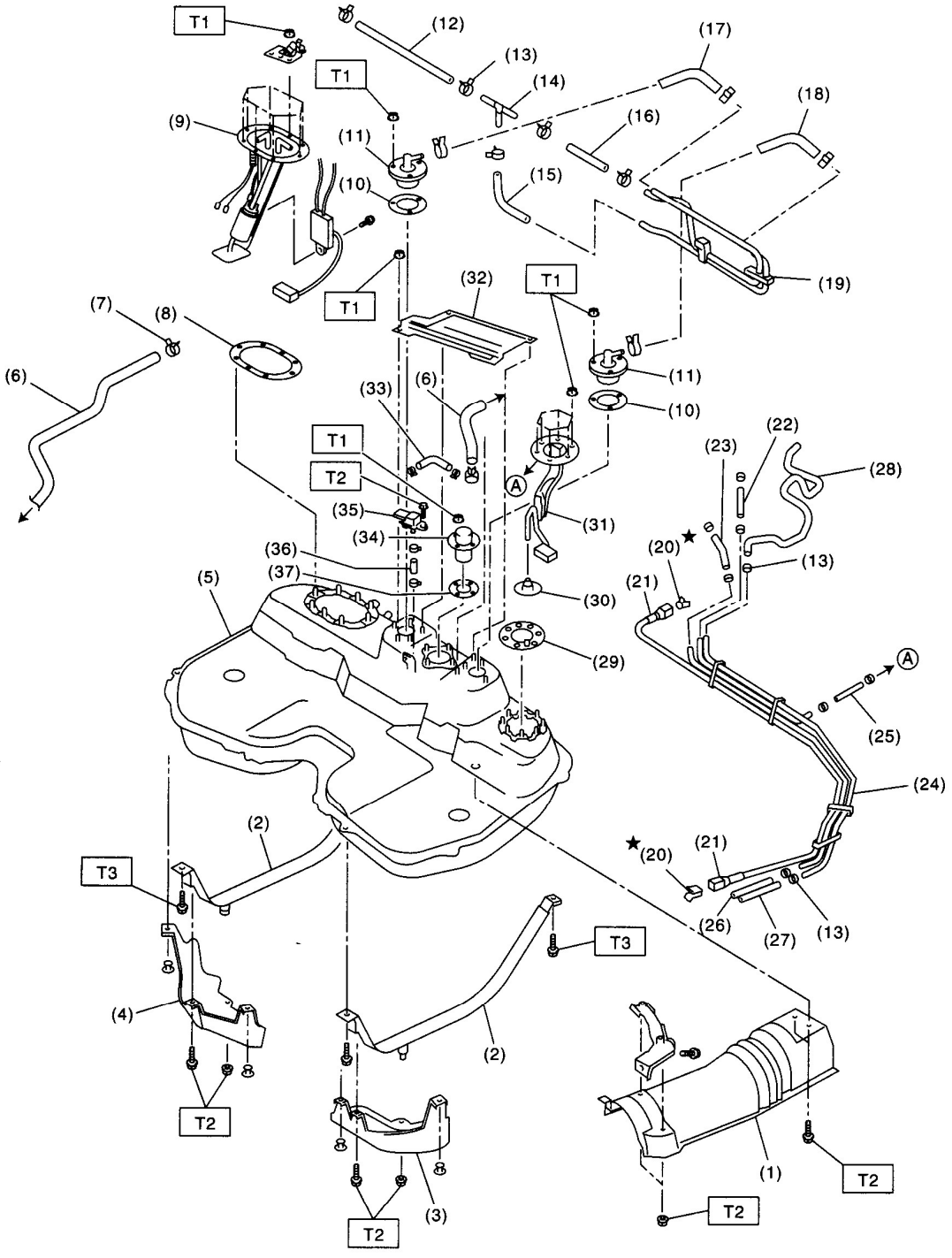



(1) Crankshaft position sensor
(2) Knock sensor
(3) Camshaft position sensor

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 6.4 (0.65, 4.7)***
***T2: 24 (2.4, 17.4)***


GETtheMANUALS.org

## 4. FUEL TANK





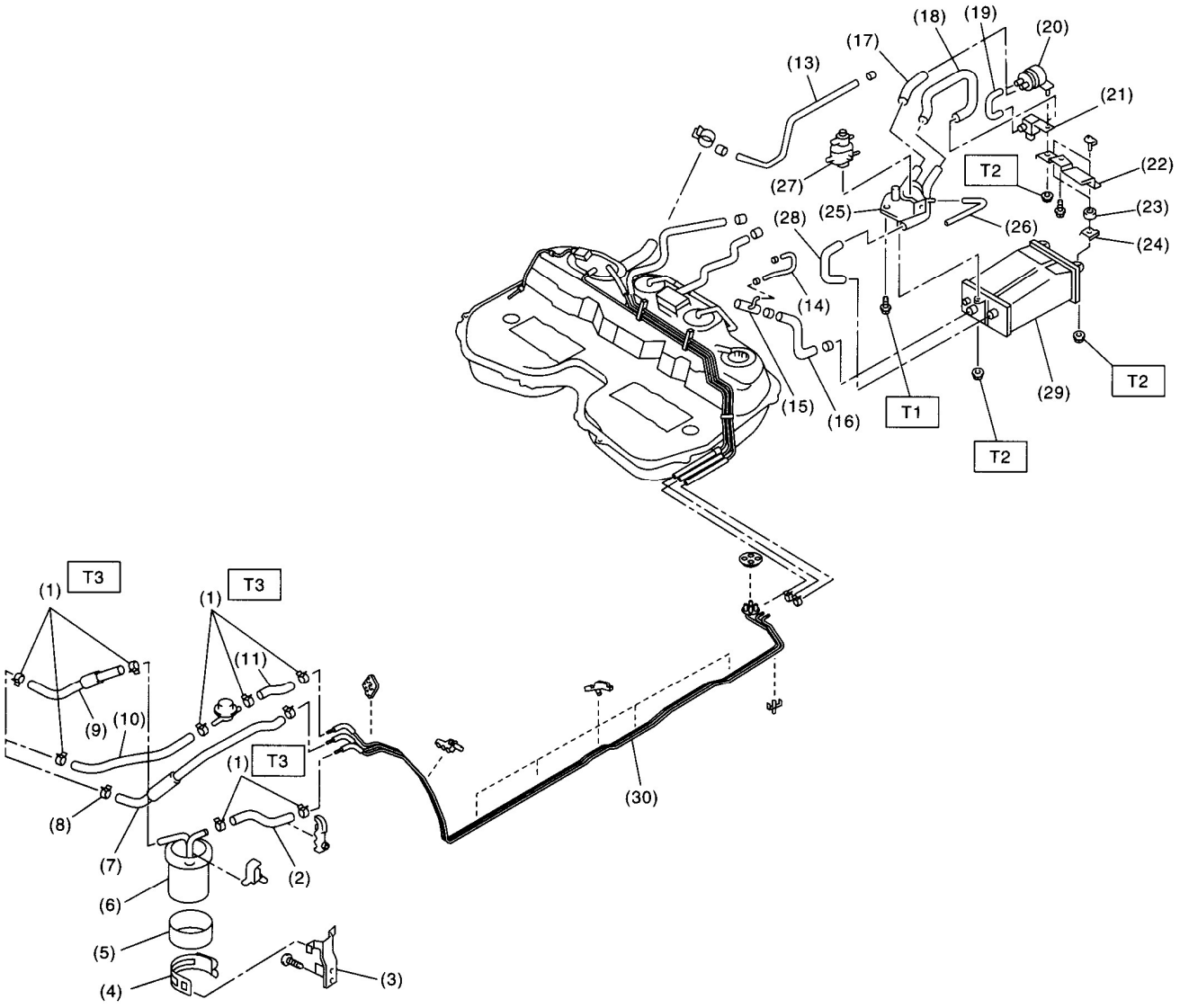
GETtheMANUALS.org

(1) Heat shield cover
(2) Fuel tank band
(3) Protector LH
(4) Protector RH
(5) Fuel tank
(6) Canister hose A
(7) Clamp
(8) Fuel pump gasket
(9) Fuel pump ASSY
(10) Fuel cut valve gasket
(11) Fuel cut valve
(12) Evaporation hose A
(13) Clip
(14) Joint pipe
(15) Evaporation hose C
(16) Evaporation hose B
(17) Evaporation hose D
(18) Evaporation hose E
(19) Evaporation pipe ASSY
(20) Retainer
(21) Quick connector
(22) Jet pump hose A
(23) Fuel return hose A
(24) Fuel pipe ASSY
(25) Jet pump hose B
(26) Fuel return hose B
(27) Evaporation hose F
(28) Evaporation hose G
(29) Fuel sub level sensor gasket
(30) Jet pump filter
(31) Fuel sub level sensor
(32) Protector cover
(33) Vent valve hose
(34) Vent valve
(35) Fuel tank pressure sensor
(36) Fuel tank pressure sensor hose
(37) Vent valve gasket

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 4.4 (0.45, 3.3)***
***T2: 7.4 (0.75, 5.4)***
***T3: 33 (3.4, 25)***


GETtheMANUALS.org

## 5. FUEL LINE




EN1120

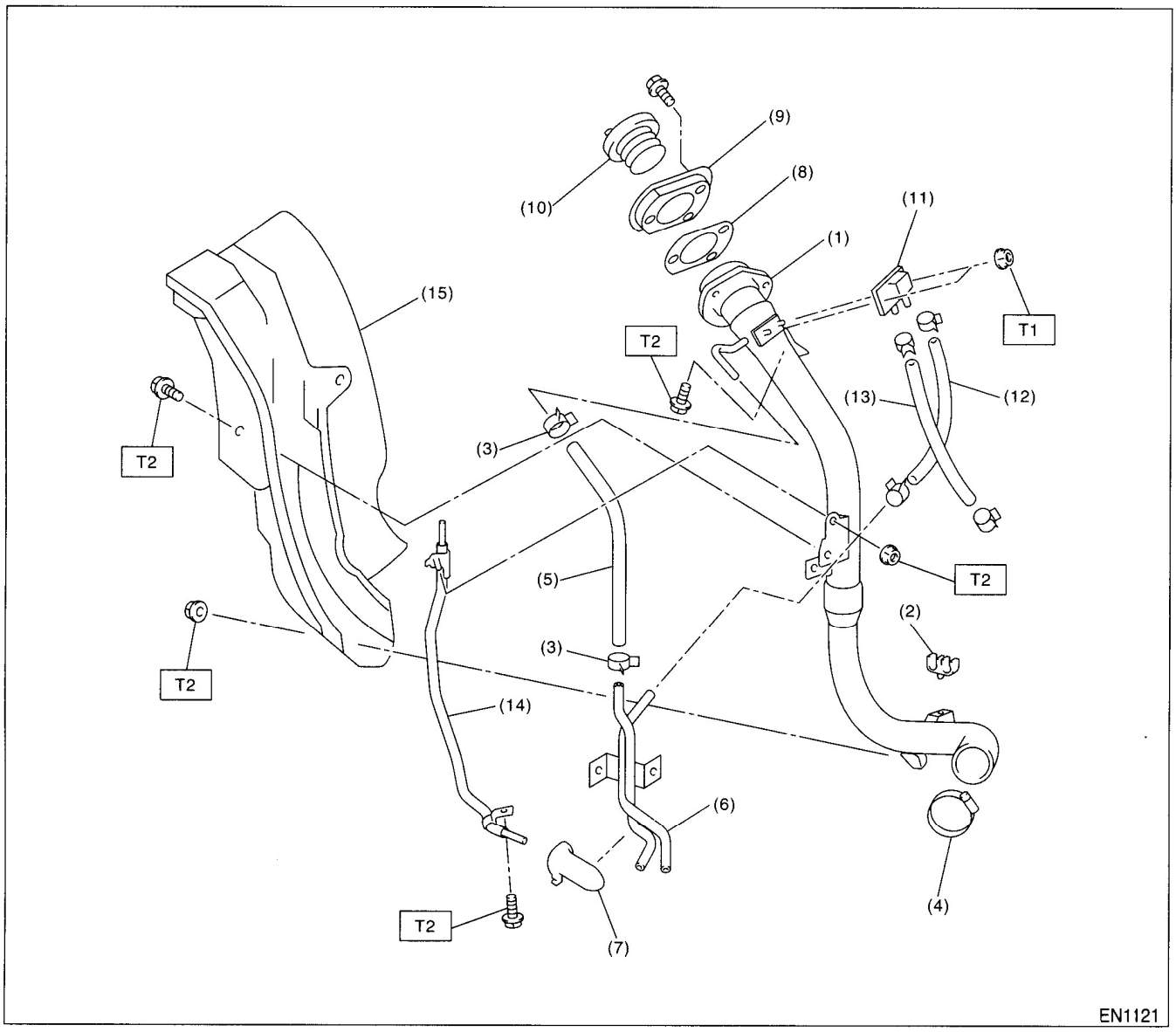

GETtheMANUALS.org

(1) Clamp
(2) Fuel delivery hose A
(3) Fuel filter bracket
(4) Fuel filter holder
(5) Fuel filter cup
(6) Fuel filter
(7) Evaporation hose
(8) Clip
(9) Fuel delivery hose B
(10) Fuel return hose A
(11) Fuel return hose B
(12) Fuel damper
(13) Evaporation hose J
(14) Evaporation hose K
(15) Joint pipe
(16) Canister hose A
(17) Air filter hose A
(18) Drain valve hose
(19) Air filter hose B
(20) Drain filter
(21) Drain valve
(22) Canister upper bracket
(23) Cushion rubber
(24) Canister lower bracket
(25) Canister holder
(26) Evaporation hose L
(27) Pressure control solenoid valve
(28) Canister hose B
(29) Canister
(30) Fuel pipe ASSY

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 25 (2.5, 18.1)***
***T2: 23 (2.3, 16.6)***
***T3: 1.25 (0.13, 0.94)***


GETtheMANUALS.org

## 6. FUEL FILLER PIPE




(1) Fuel filter pipe ASSY
(2) Evaporation hose holder
(3) Clamp
(4) Clamp
(5) Evaporation hose A
(6) Evaporation pipe
(7) Evaporation pipe holder
(8) Filler pipe packing
(9) Filler ring
(10) Filler cap
(11) Shut valve
(12) Evaporation hose B
(13) Evaporation hose C
(14) Joint pipe
(15) Fuel filler pipe protector

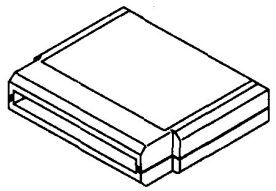
***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 4.4 (0.45, 3.3)***
***T2: 7.5 (0.76, 5.5)***


GETtheMANUALS.org

## C: CAUTION

- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect negative terminal from battery.
- Place "NO FIRE" signs near the working area.
- Be careful not to spill fuel on the floor.

## D: PREPARATION TOOL

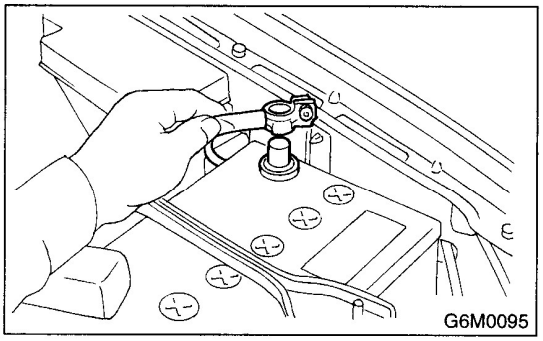
| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M3876 | 24082AA150 (Newly adopted tool) | CARTRIDGE | Troubleshooting for electrical system. |
|  B2M3877 | 22771AA030 | SELECT MONITOR KIT | Troubleshooting for electrical systems.<br>• English: 22771AA030 (Without printer)<br>• German: 22771AA070 (Without printer)<br>• French: 22771AA080 (Without printer)<br>• Spanish: 22771AA090 (Without printer) |


GETtheMANUALS.org

# 2. Throttle Body

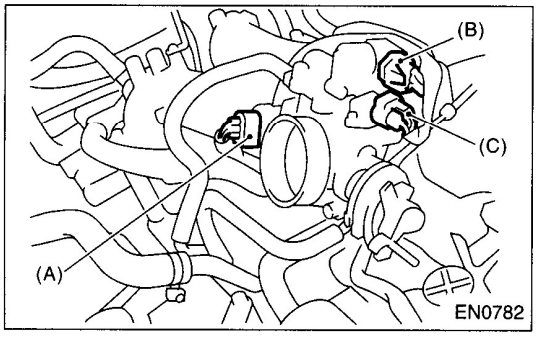
## A: REMOVAL

1) Disconnect the battery ground cable.

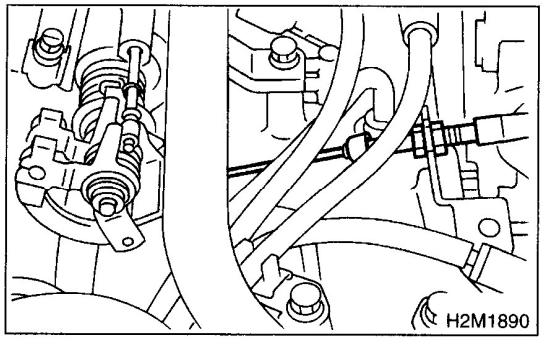



2) Remove the intercooler. <Ref. to IN(DOHC TURBO)-10, REMOVAL, Intercooler.>

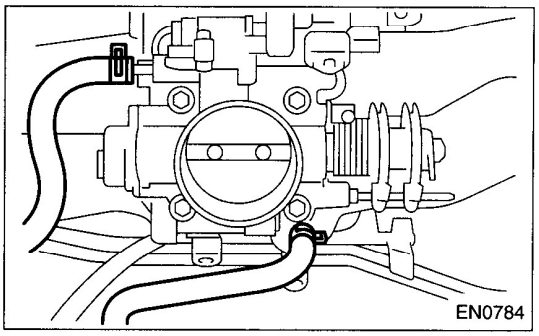
3) Disconnect the connector from the throttle position sensor (A) and idle air cotrol solenoid valve (B) and pressure sensor (C).




4) Disconnect the accelerator cable.




5) Disconnect the engine coolant hoses from the throttle body.



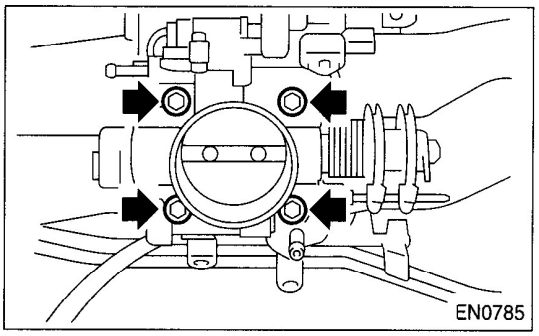

6) Remove the bolts which secure the throttle body to intake manifold.

## B: INSTALLATION

Install in the reverse order of removal.

NOTE:
Always use a new gasket.

***Tightening torque:***
***22 N·m (2.2 kgf-m, 15.9 ft-lb)***



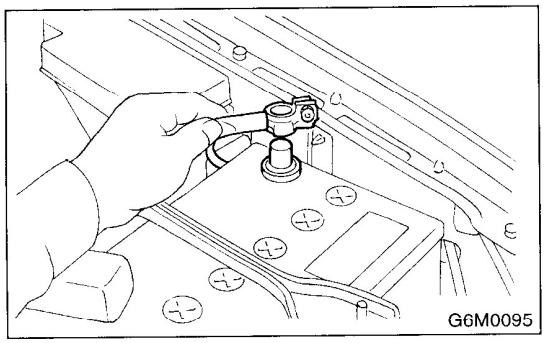



GETtheMANUALS.org

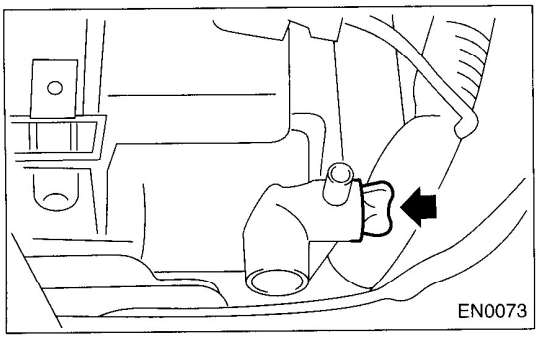
# 3. Intake Manifold

## A: REMOVAL

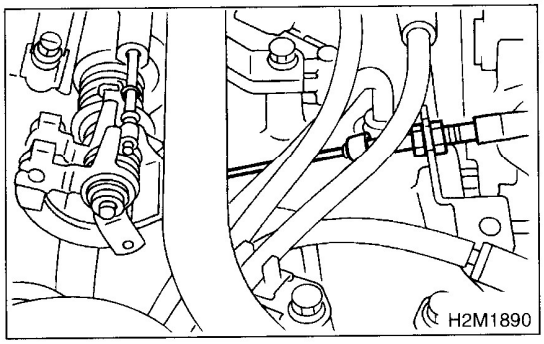
1) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Disconnect the battery ground cable.



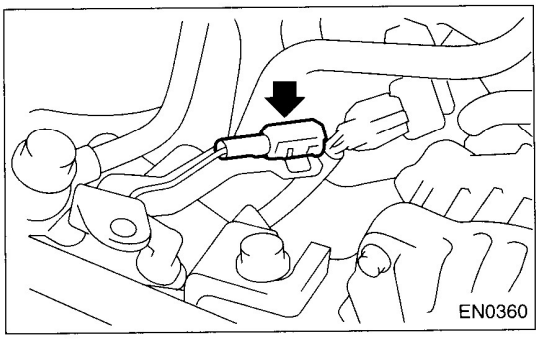

3) Lift up the vehicle.
4) Remove the under cover.
5) Drain the coolant about 3.0 ℓ (3.2 US qt, 2.6 Imp qt).




6) Remove the air cleaner upper cover and air intake boot. <Ref. to IN(DOHC TURBO)-7, REMOVAL, Air Cleaner.>
7) Remove the air cleaner element.
8) Remove the intercooler. <Ref. to IN(DOHC TURBO)-10, REMOVAL, Intercooler.>
9) Disconnect the accelerator cable.

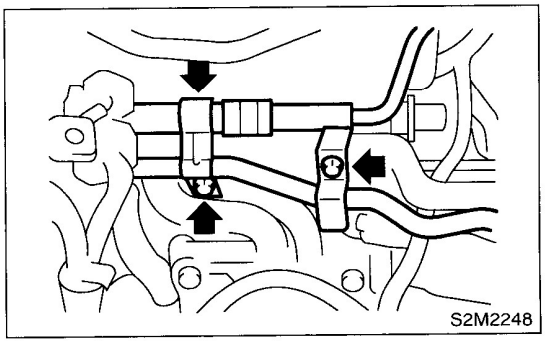



10) Remove the coolant filler tank. <Ref. to CO-51, REMOVAL, Coolant Filler Tank.>
11) Remove the power steering pump.
(1) Remove the front side V-belt.
<Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
(2) Disconnect the power steering switch connector.

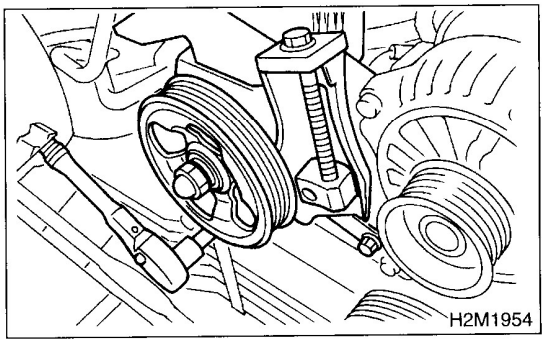



(3) Remove the bolts which secure the power steering pipe brackets to the intake manifold.

NOTE:
Do not disconnect the power steering hose.



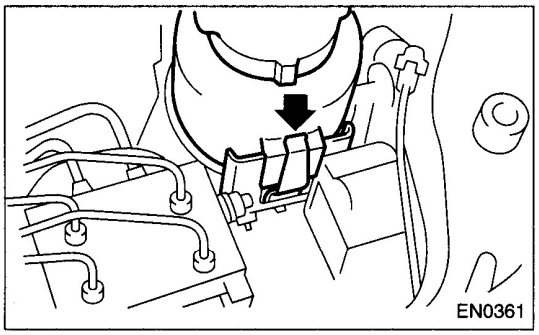

(4) Remove the bolts which secure the power steering pump bracket.



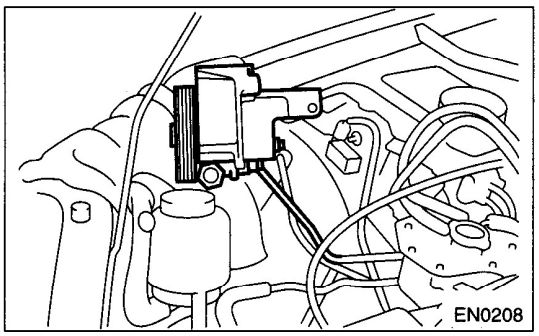


GETtheMANUALS.org

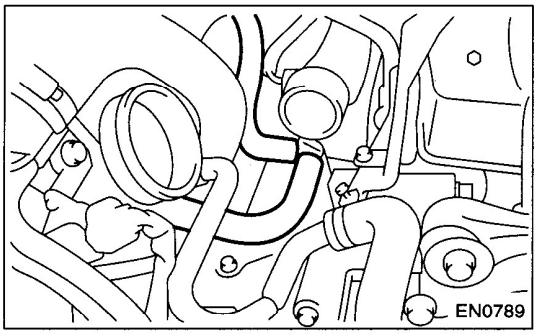
(5) Remove the power steering tank from the bracket by pulling it upward.



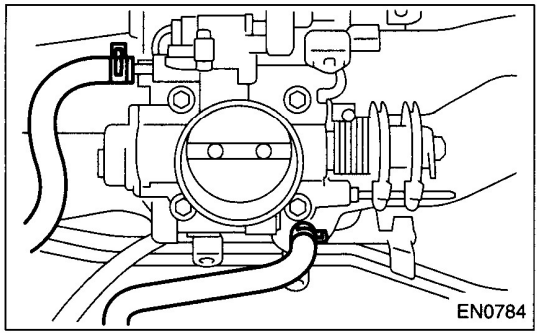

(6) Place the power steering pump on the right side wheel apron.



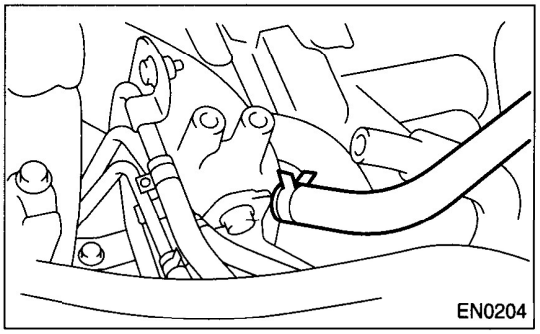

12) Disconnect the emission hose from the PCV valve.



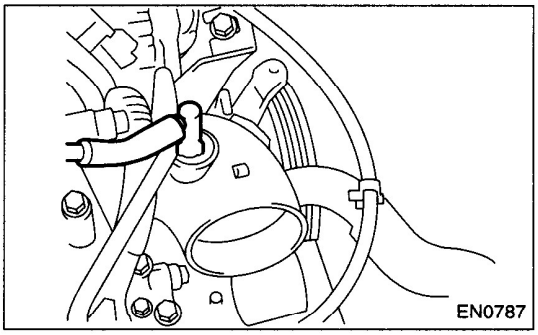

13) Disconnect the engine coolant hoses from the throttle body.



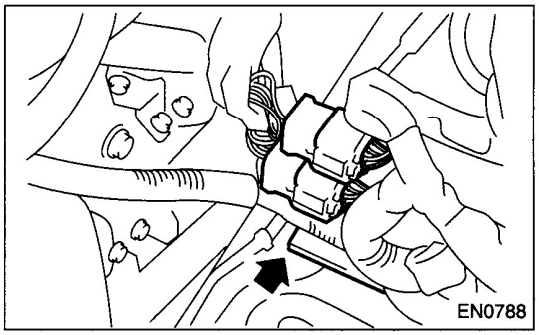

14) Disconnect the brake booster hose.

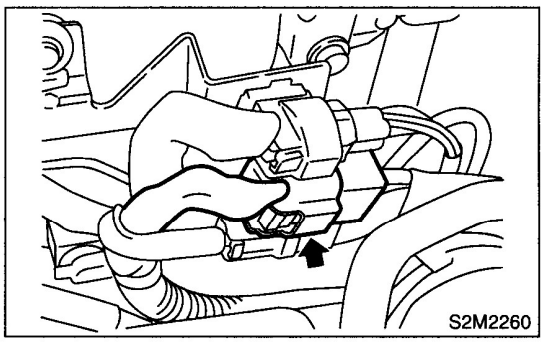



15) Disconnect the pressure hose from the intake duct.




16) Disconnect the engine harness connectors from the bulkhead harness connectors.

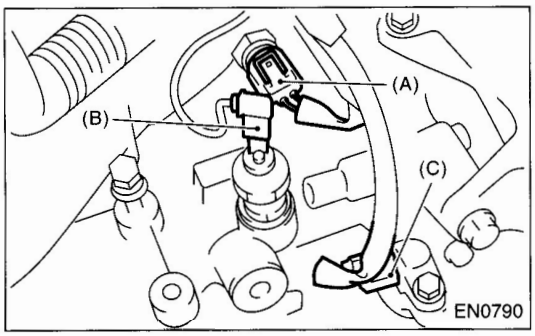


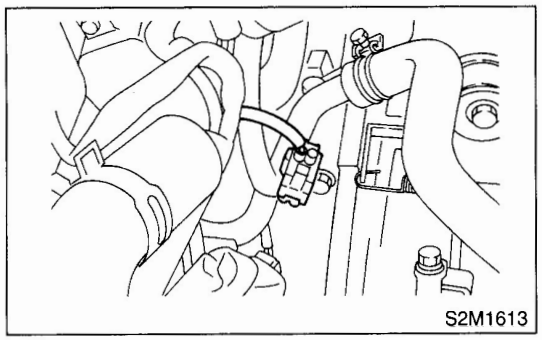


GETtheMANUALS.org

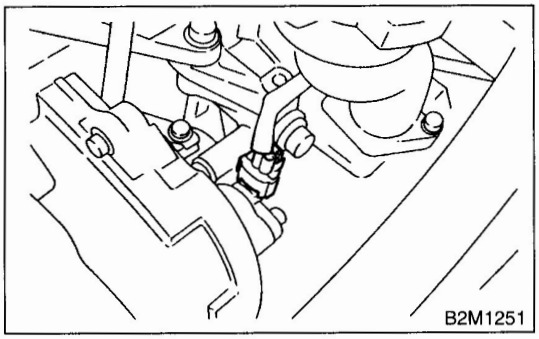
17) Disconnect the connectors from the engine coolant temperature sensor (A), oil pressure switch (B) and crankshaft position sensor (C).



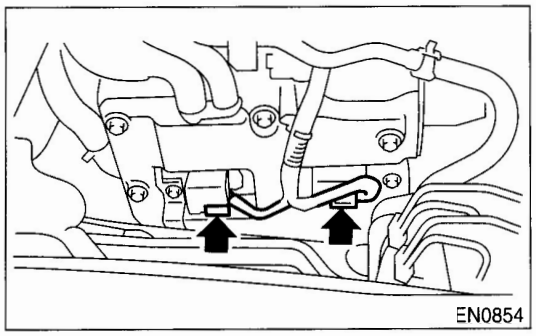

18) Disconnect the knock sensor connector.



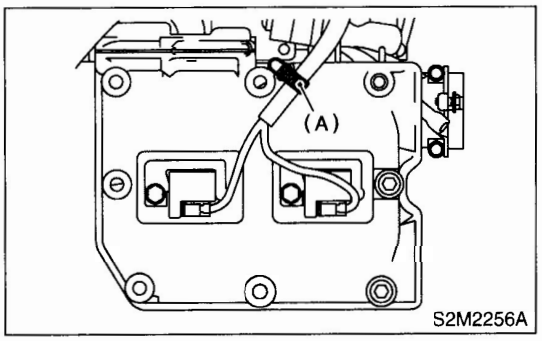

19) Disconnect the connector from the camshaft position sensor.




20) Disconnect the connector from the ignition coil.

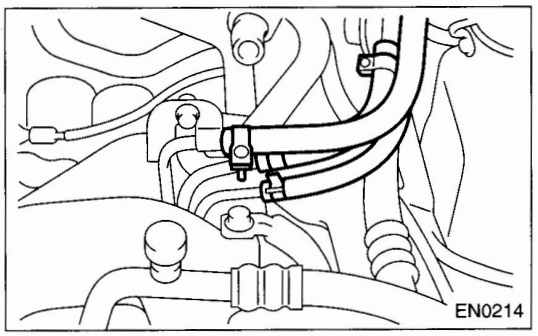



21) Disconnect the engine harness fixed by clip (A) from the bracket.

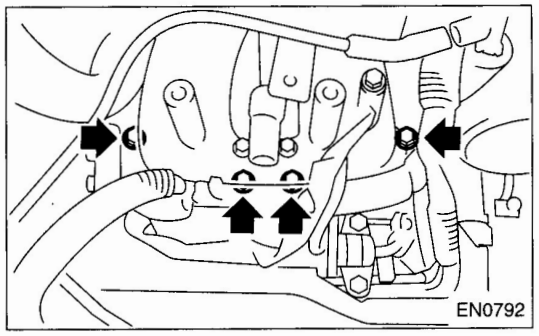



22) Disconnect the fuel delivery hose, return hose and evaporation hose.

**WARNING:**
**Catch the fuel from hoses in a container.**




23) Remove the bolts which secure the intake manifold to the cylinder heads.




24) Remove the intake manifold.

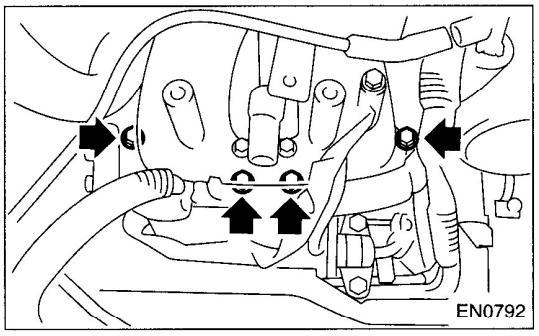

GETtheMANUALS.org

## B: INSTALLATION

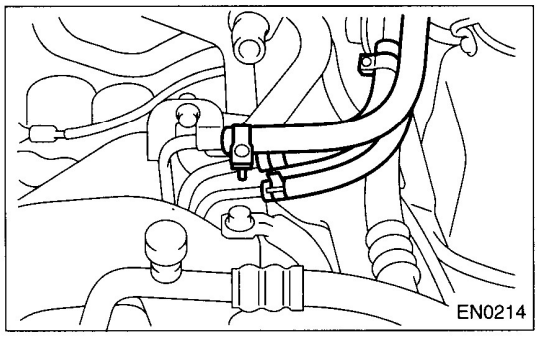
1) Install the intake manifold onto cylinder heads.

NOTE:
Always use new gaskets.

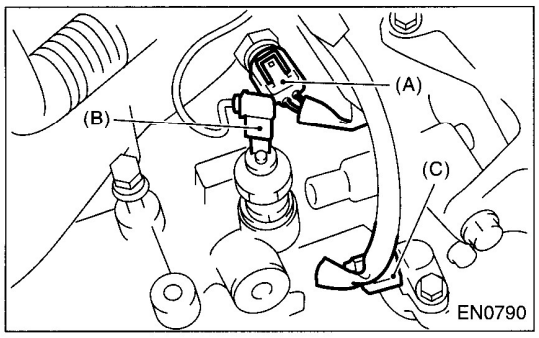
***Tightening torque:***
***25 N·m (2.5 kgf-m, 18.1 ft-lb)***



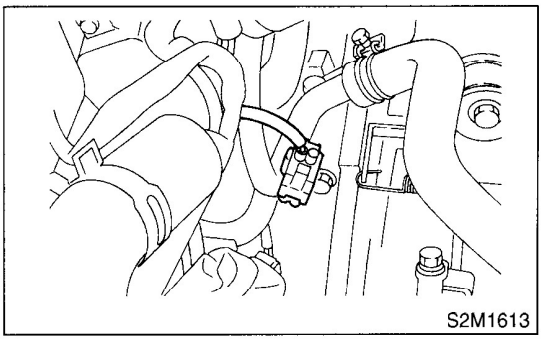

2) Connect the fuel delivery hose, return hose, and evaporation hose.



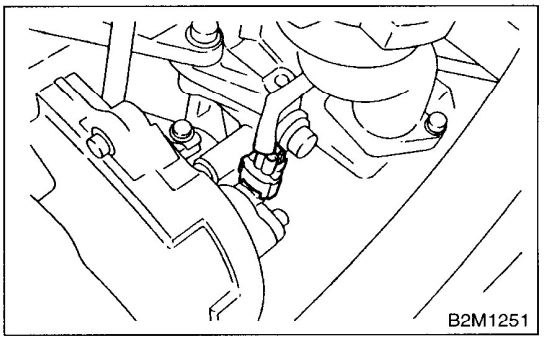

3) Connect the connector to the oil pressure switch (B), crankshaft position sensor (C) and engine coolant temperature sensor (A).



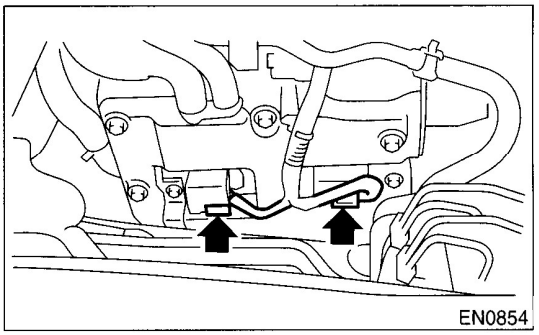

4) Connect the connector to the knock sensor.



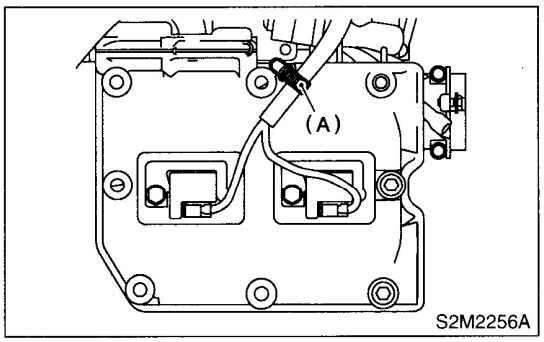

5) Connect the connector to the camshaft position sensor.




6) Connect the connector to the ignition coil.



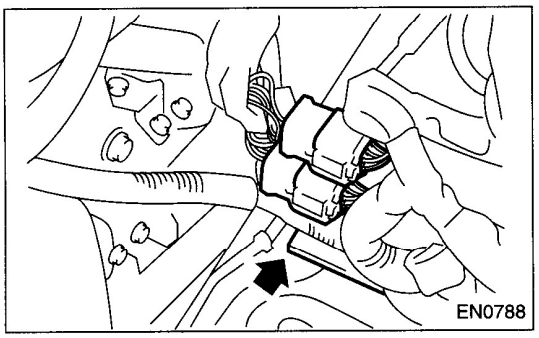

7) Connect the engine harness with clip (A) to the bracket.

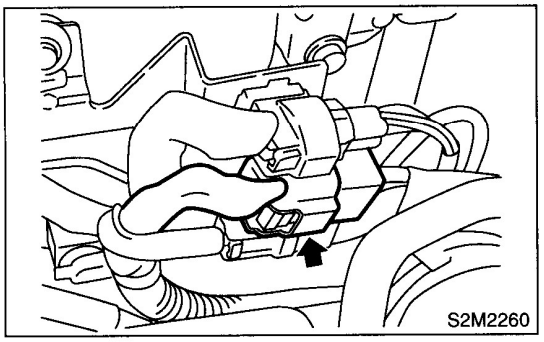




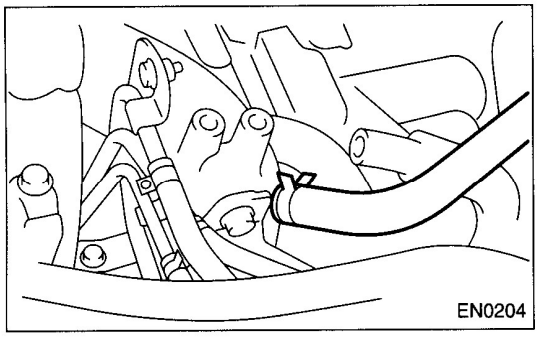
GETtheMANUALS.org

8) Connect the engine harness connector to the bulkhead harness connectors.

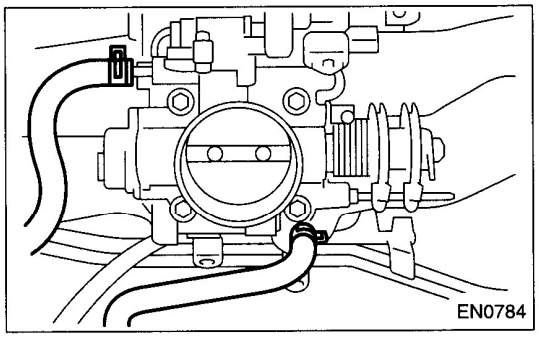


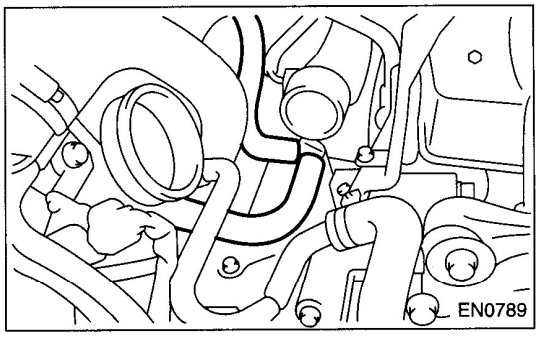

9) Connect the brake booster vacuum hose.



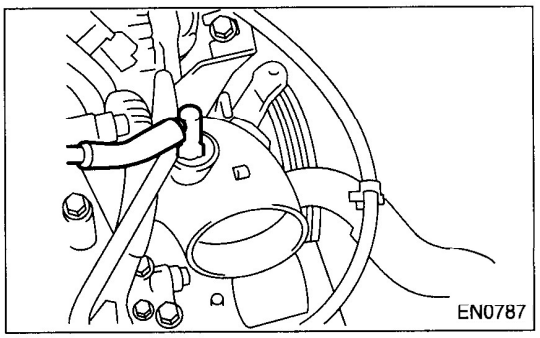

10) Connect the engine coolant hoses to the throttle body.



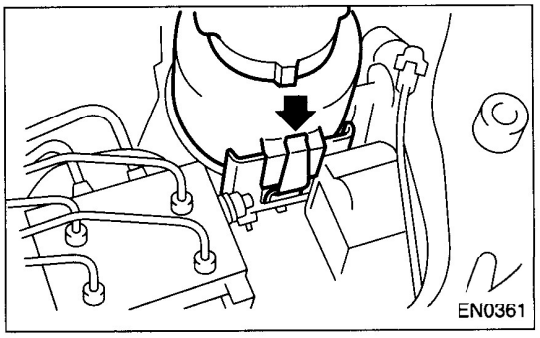

11) Connect the emission hose to the PCV valve.



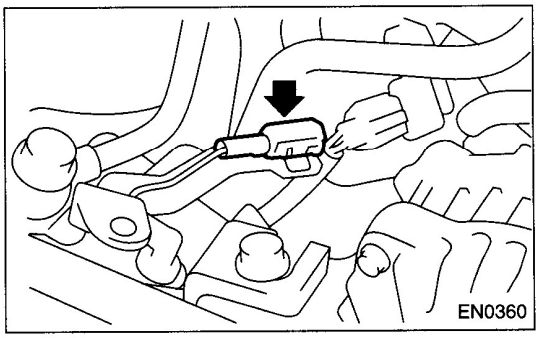

12) Connect the pressure hose to the intake duct.




13) Install the power steering pump.
(1) Install the power steering tank on the bracket.




(2) Connect the connector to the power steering pump switch.

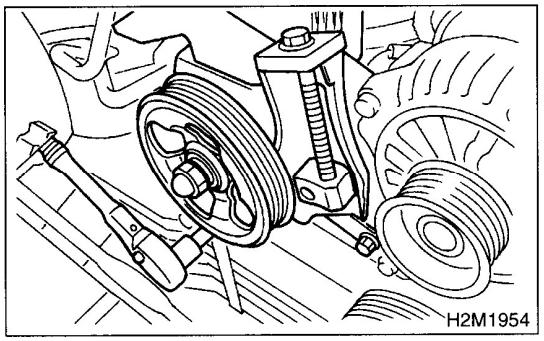




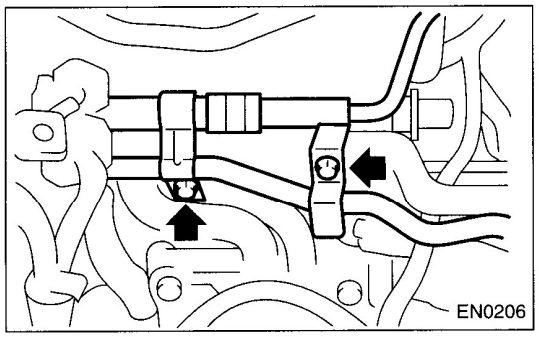
GETtheMANUALS.org

(3) Install the power steering pump, and tighten the bolts.

***Tightening torque:***
***22 N·m (2.2 kgf-m, 15.9 ft-lb)***

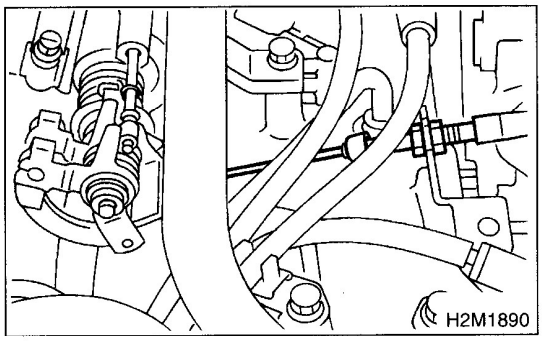



(4) Install the power steering pipe brackets on the right side intake manifold.

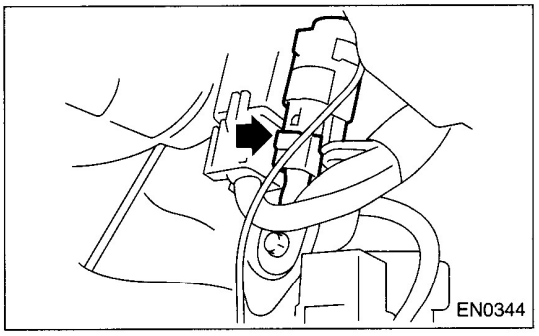



(5) Install the front side V-belt.
<Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>

14) Install the cooler filler tank. <Ref. to CO-51, INSTALLATION, Coolant Filler Tank.>
15) Connect the accelerator cable.




16) Install the intercooler. <Ref. to IN(DOHC TURBO)-11, INSTALLATION, Intercooler.>
17) Install the air cleaner element.
18) Install the air cleaner upper cover and air intake duct as a unit. <Ref. to IN(DOHC TURBO)-7, INSTALLATION, Air Cleaner.>
19) Connect the connector to the fuel pump relay.

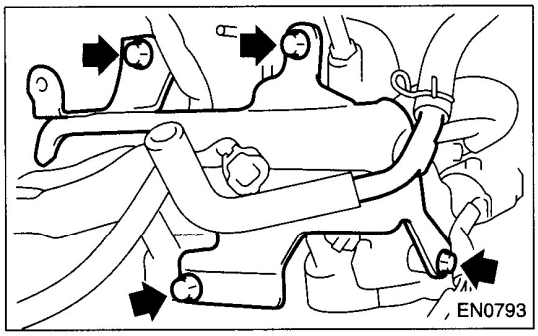



20) Connect the battery ground cable.
21) Lift up the vehicle.
22) Install the under cover.
23) Fill the coolant. <Ref. to CO-25, FILLING OF ENGINE COOLANT, Engine Coolant.>

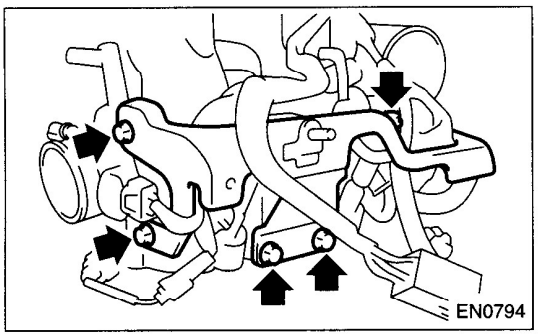

GETtheMANUALS.org

## C: DISASSEMBLY

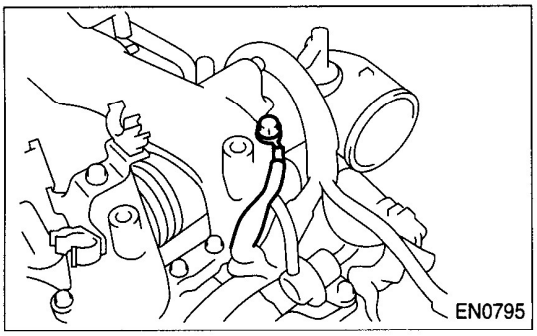
1) Remove the fuel pipe protector LH.

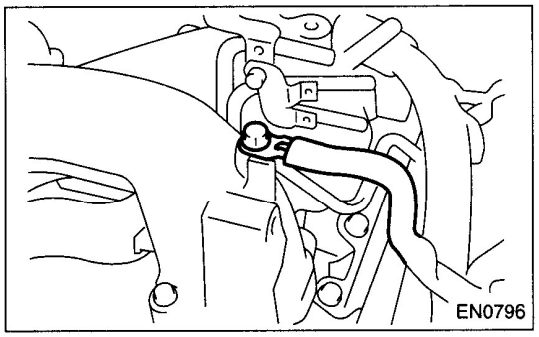



2) Remove the fuel pipe protector RH.

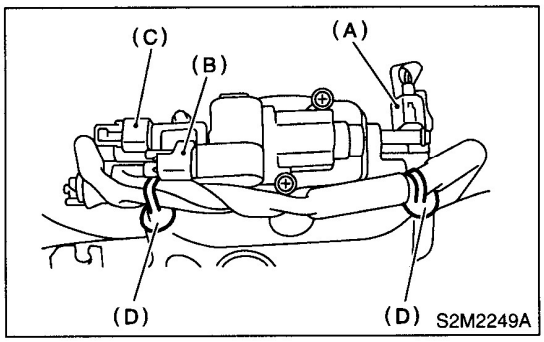



3) Remove the engine ground terminal from the intake manifold.

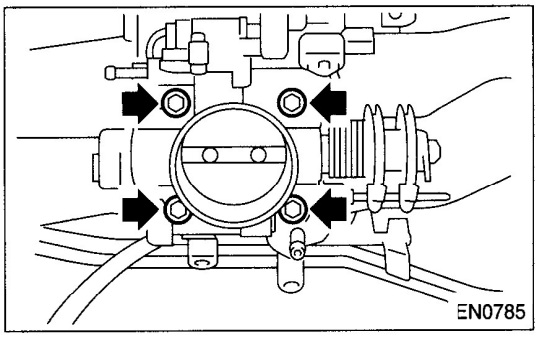


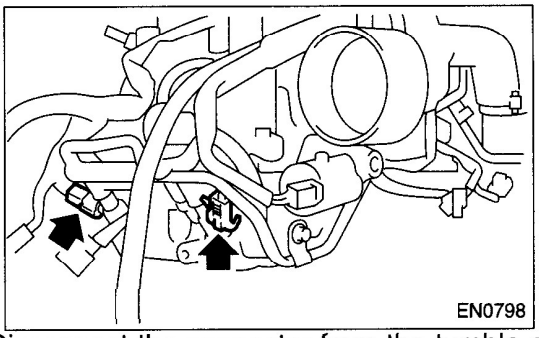

4) Disconnect the connector from the throttle position sensor (A), idle air control solenoid valve (B) and pressure sensor (C).
5) Disconnect the engine harness fixed by clip (D) from the intake manifold.



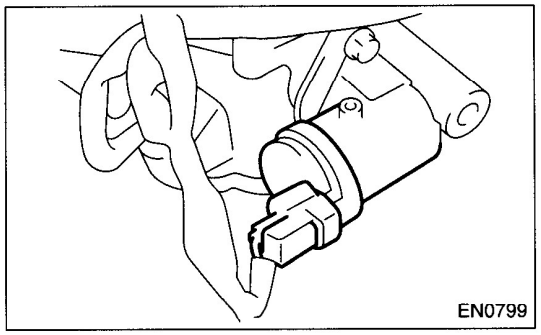

6) Remove the throttle body from the intake manifold.




7) Disconnect the connector from the fuel injector.



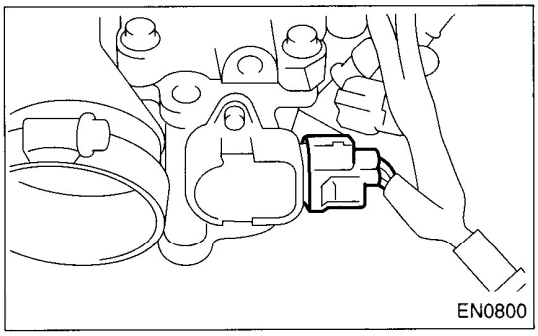

8) Disconnect the connector from the tumble generator valve actuator.



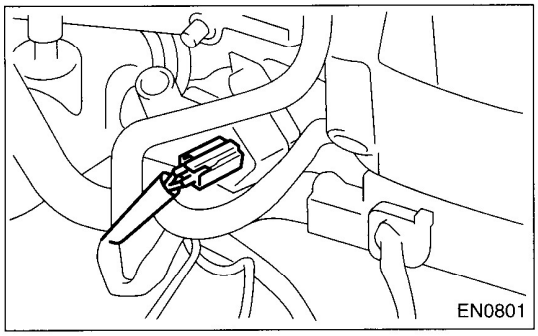


GETtheMANUALS.org

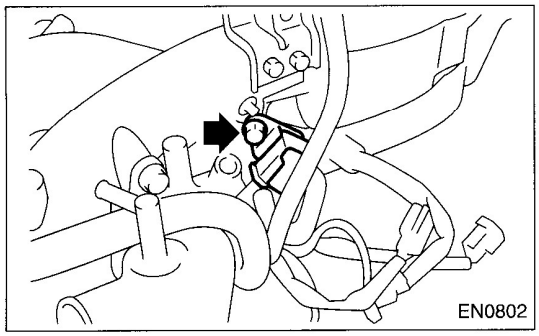
9) Disconnect the connector from the tumble generator valve sensor.



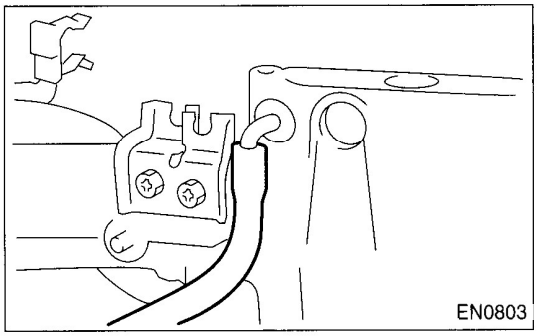

10) Disconnect the connector from the purge control solenoid valve.



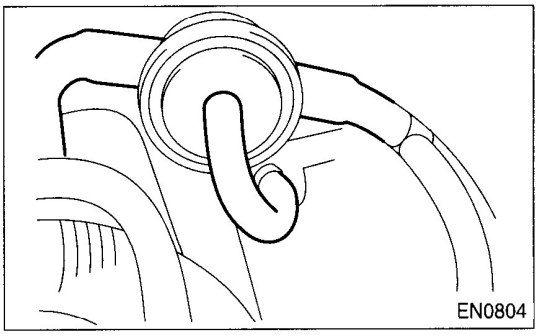

11) Remove the purge control solenoid valve.



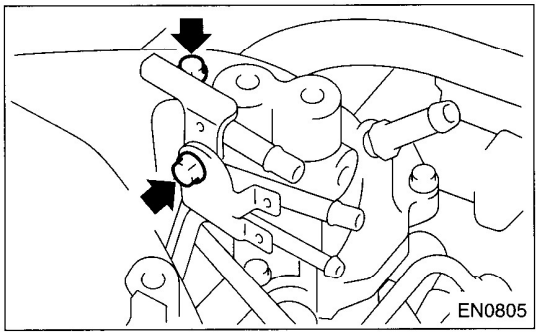

12) Disconnect the evaporation hose from the intake manifold.




13) Disconnect the evaporation hoses from the purge valve.




14) Remove the two bolts which hold the fuel pipes on the left side of intake manifold.

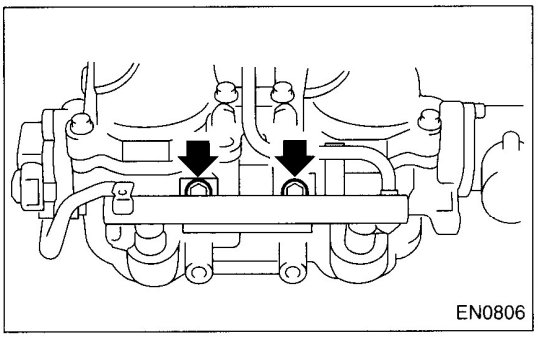


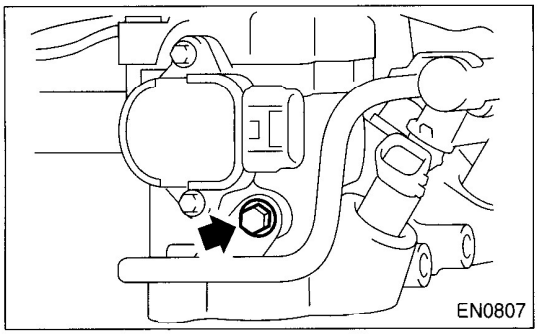


GETtheMANUALS.org

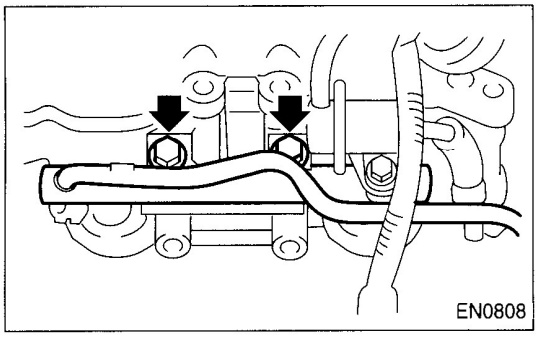
15) Remove the bolt which hold the fuel injector pipe onto intake manifold.

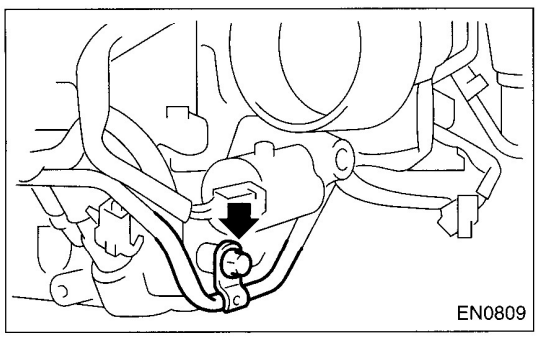
- LH SIDE



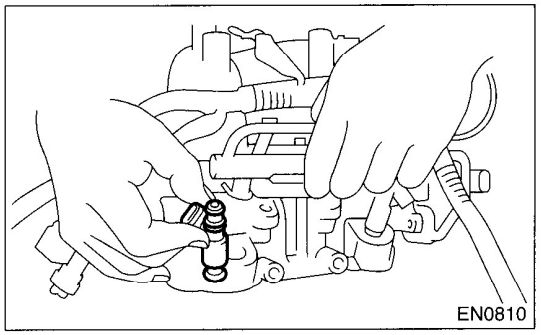




- RH SIDE

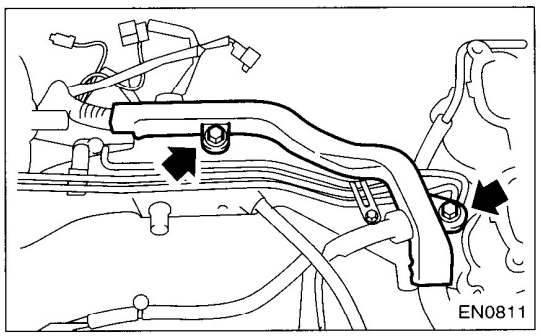


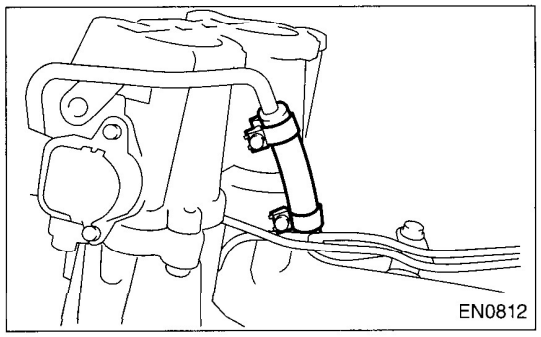

16) Remove the fuel injector.



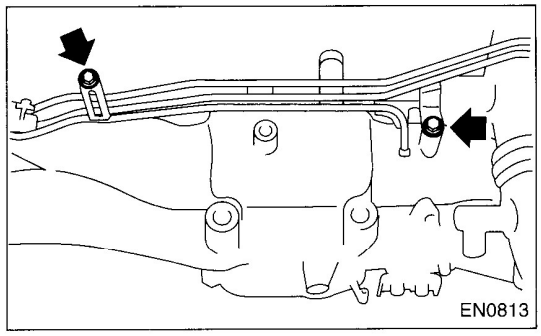

17) Remove the harness bracket which hold the engine harness onto intake manifold.




18) Remove the engine harness from the intake manifold.
19) Loosen the clamp which holds the front left side fuel hose to injector pipe and remove the pipe from clamp.



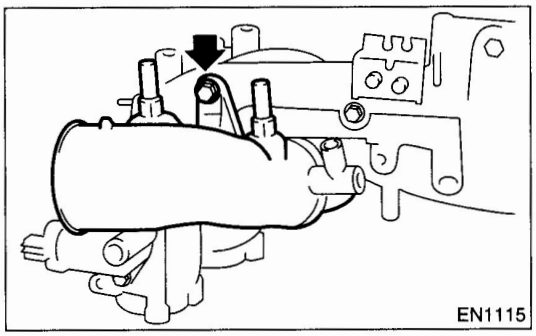

20) Remove the fuel injector pipe LH.
21) Remove the bolts which installs the fuel pipe on intake manifold.



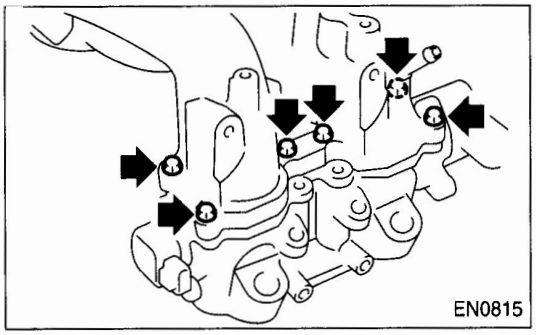


GETtheMANUALS.org

22) Remove the fuel pipe assembly and pressure regulator, from the intake manifold.
23) Remove the intake duct from the intake manifold.




24) Remove the tumble generator valve assembly from the intake manifold.

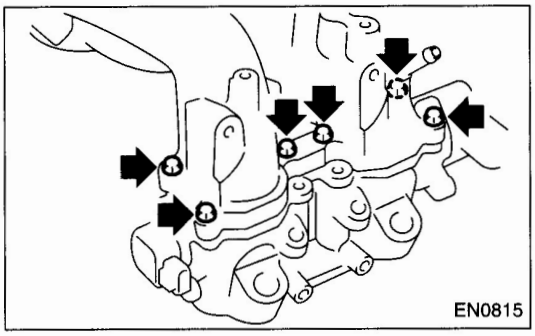



## D: ASSEMBLY

NOTE:
Replace the gasket with a new one.

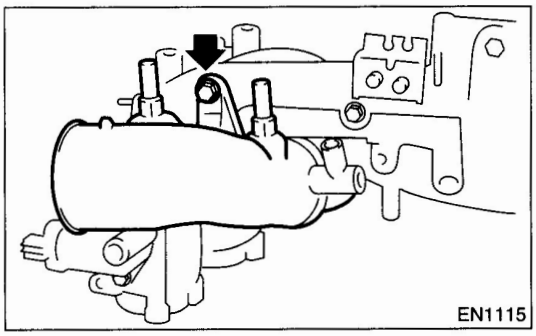
1) Install the tumble generator valve assembly to the intake manifold.

***Tightening torque:***
***8.25 N·m (0.84 kgf-m, 6.08 ft-lb)***



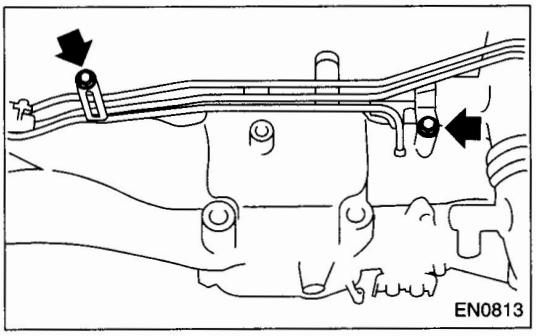

2) Install the air intake duct to the intake manifold.

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***

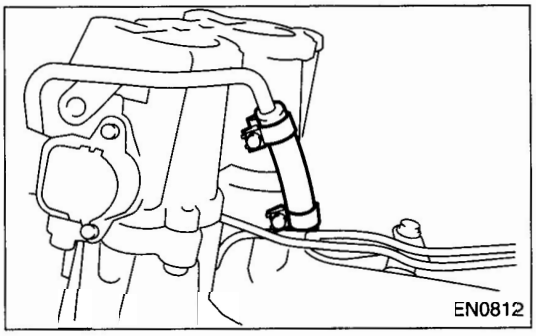



3) Install the fuel pipe assembly and pressure regulator, to the intake manifold.

***Tightening torque:***
***4.9 N·m (0.5 kgf-m, 3.6 ft-lb)***




4) Install the fuel injector pipe LH.
5) Connect the left side fuel hose to injector pipe, and tighten the clamp screw.

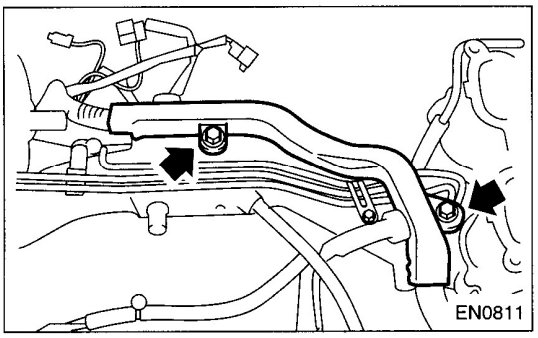



6) Install the engine harness to the intake manifold.

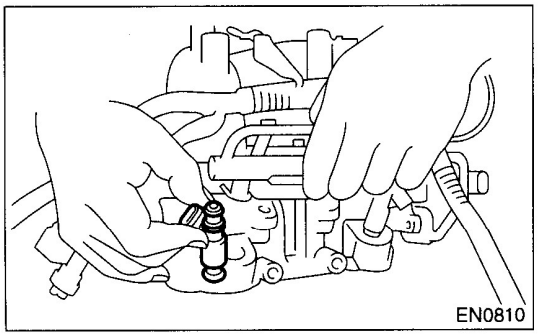

GETtheMANUALS.org

7) Install the harness bracket which hold the engine harness onto intake manifold.

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***



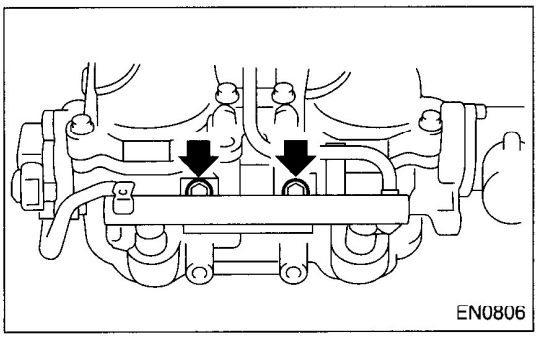

8) Install the fuel injector.

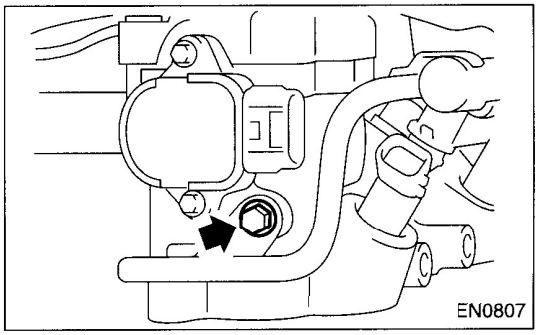



9) Tighten the bolt which install the fuel injector pipe onto intake manifold.

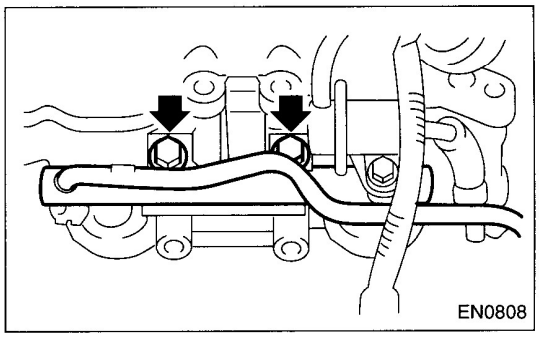
***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***

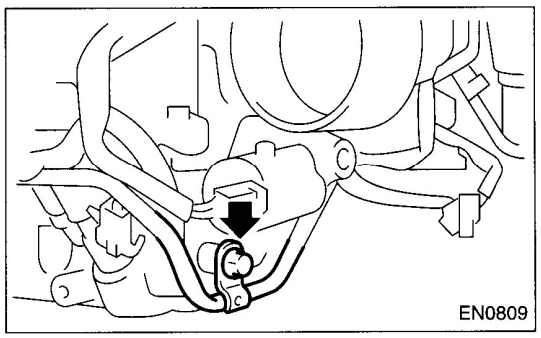
- LH SIDE




- RH SIDE



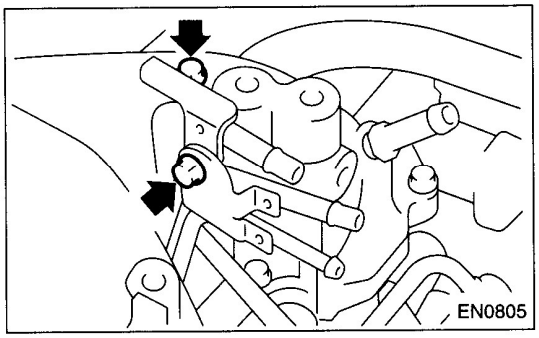





GETtheMANUALS.org

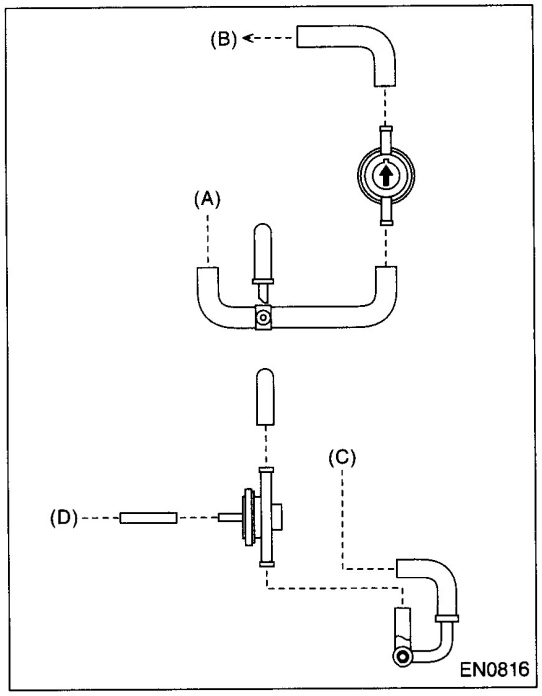
10) Tighten the two bolts which install the fuel pipes on the left side of intake manifold.

***Tightening torque:***
***4.9 N·m (0.5 kgf-m, 3.6 ft-lb)***



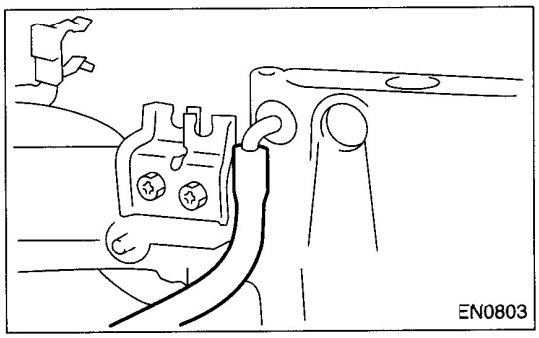

11) Connect the evaporation hoses to the purge valve.

**CAUTION:**
**Carefully connect the evaporation hoses.**



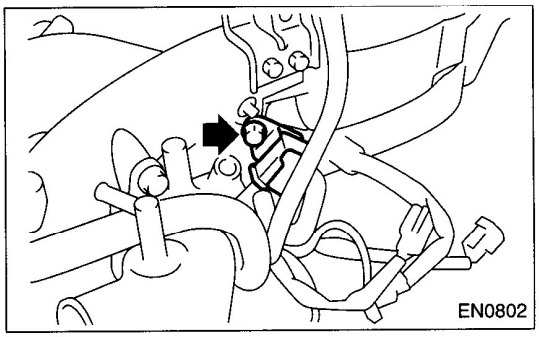

(A) To fuel pipe ASSY
(B) To intake duct
(C) To purge control solenoid valve
(D) To intake manifold

12) Connect the evaporation hose to the intake manifold.



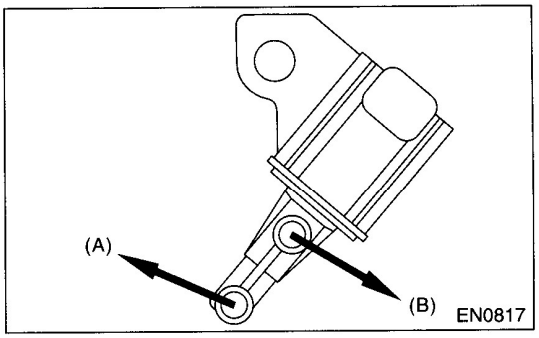

13) Install the purge control solenoid valve.

***Tightening torque:***
***16 N·m (1.6 kgf-m, 11.8 ft-lb)***




14) Connect the hoses to the purge control solenoid valve.

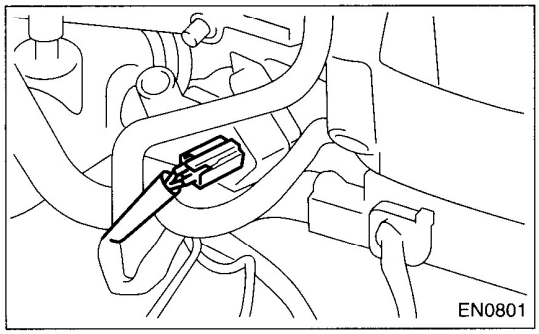
**CAUTION:**
**Carefully connect the evaporation hoses.**



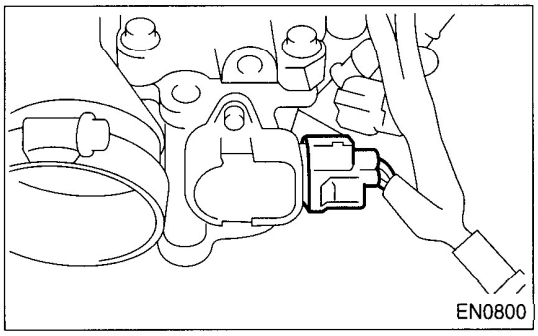

(A) To intake manifold
(B) To purge valve


GETtheMANUALS.org

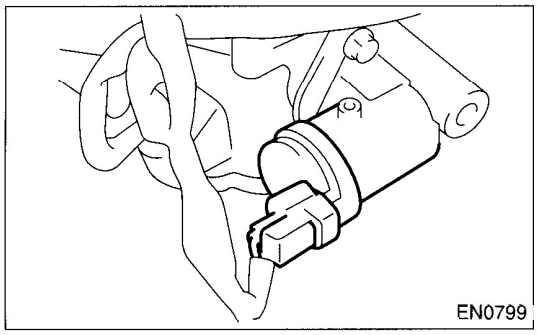
15) Connect the connector to the purge control solenoid valve.



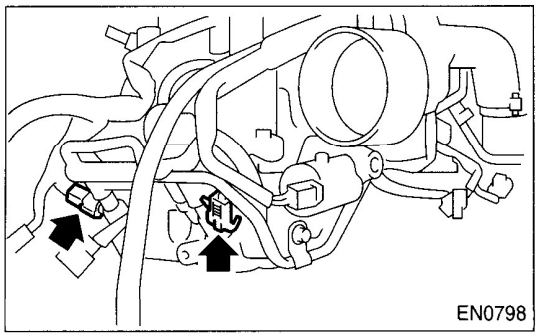

16) Connect the connector to the tumble generator valve sensor.




17) Connect the connector to the tumble generator valve actuator.



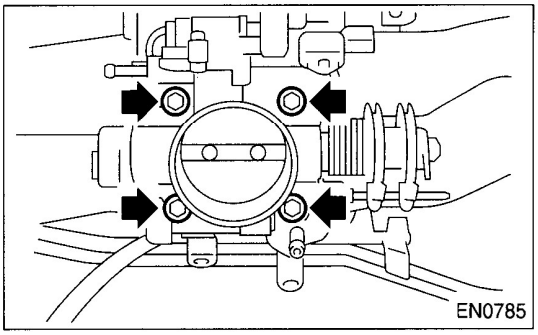

18) Connect the connector to the fuel injector.



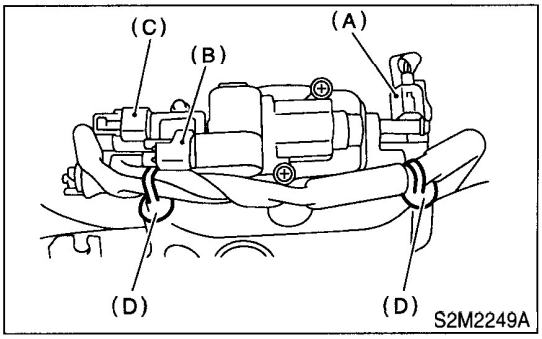

19) Install the throttle body to the intake manifold.

NOTE:
Replace gasket with a new one.

***Tightening torque:***
***22 N·m (2.2 kgf-m, 15.9 ft-lb)***




20) Connect the connector to the throttle position sensor (A), idle air control solenoid valve (B) and pressure sensor (C).
21) Connect the engine harness with clip (D) to the intake manifold.

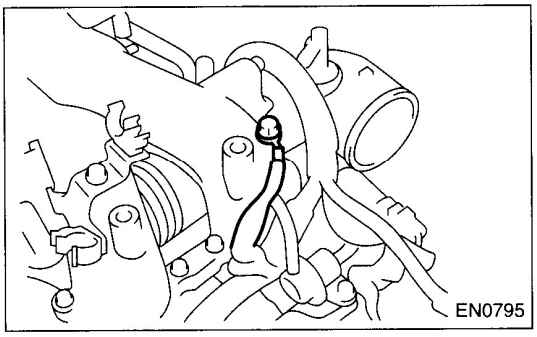


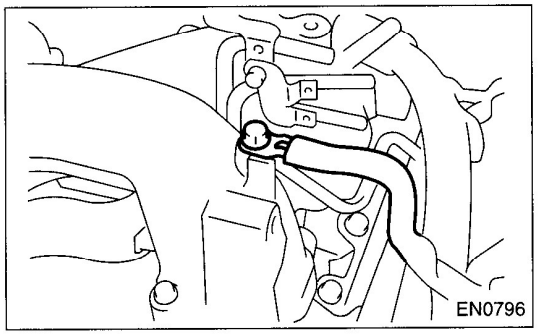


GETtheMANUALS.org

22) Install the engine ground terminal to the intake manifold.

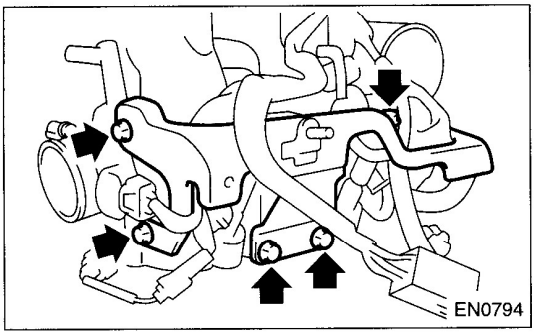
***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***



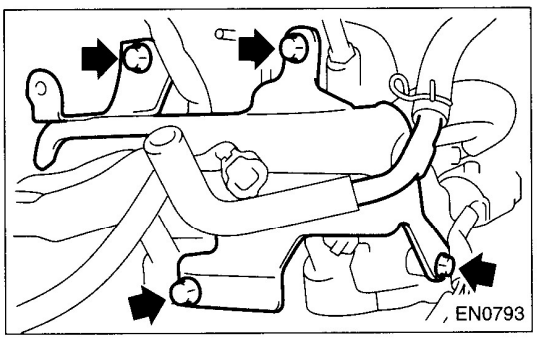

23) Install the fuel pipe protector RH.

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***




24) Install the fuel pipe protector LH.

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***




## E: INSPECTION

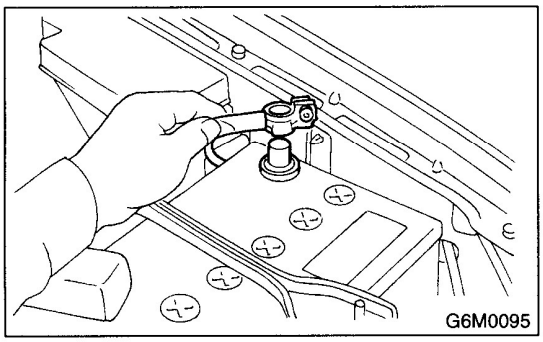
Make sure the fuel pipe and fuel hoses are not cracked and that connections are tight.


GETtheMANUALS.org

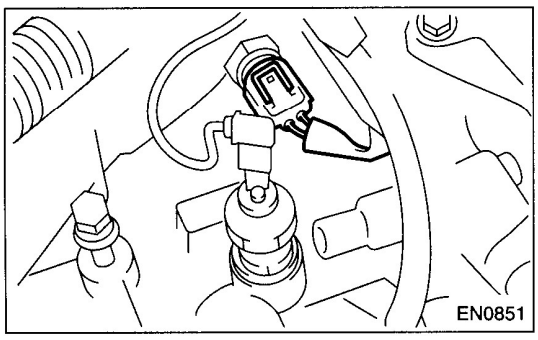
# 4. Engine Coolant Temperature Sensor

## A: REMOVAL

1) Disconnect the battery ground cable.




2) Remove the generator <Ref. to SC-13, REMOVAL, Generator.>
3) Disconnect the connector from the engine coolant temperature sensor.




4) Remove the engine coolant temperature sensor.

## B: INSTALLATION

Install in the reverse order of removal.

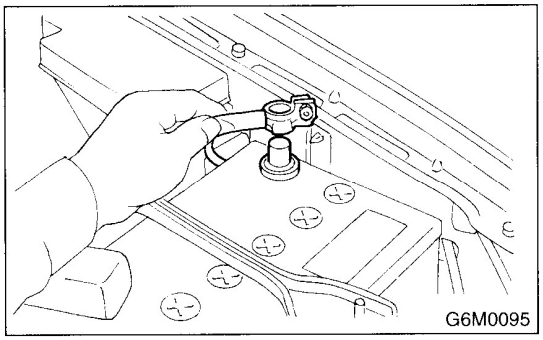
***Tightening torque:***
***18 N·m (1.8 kgf-m, 13.3 ft-lb)***


GETtheMANUALS.org

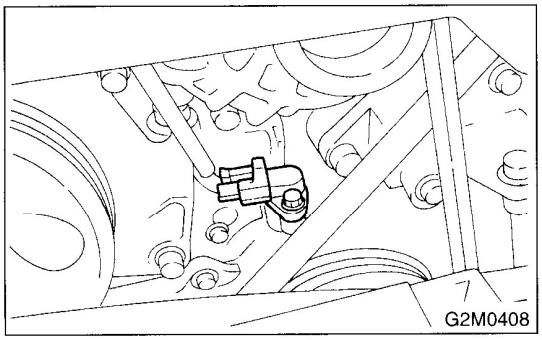
# 5. Crankshaft Position Sensor

## A: REMOVAL

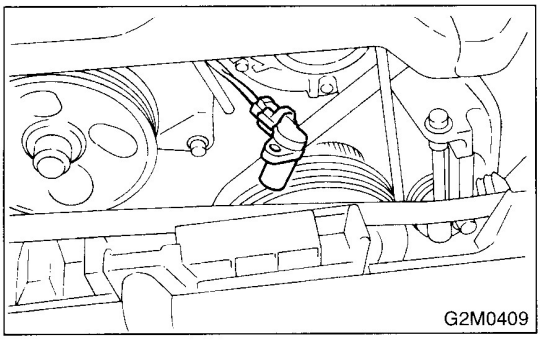
1) Disconnect the battery ground cable.




2) Remove the bolt which install the crankshaft position sensor to cylinder block.



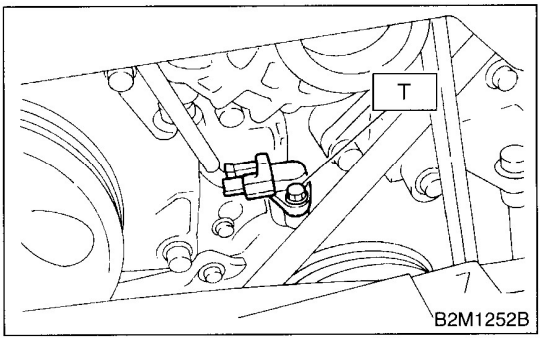

3) Remove the crankshaft position sensor, and disconnect the connector from it.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***T: 6.4 N·m (0.65 kgf-m, 4.7 ft-lb)***



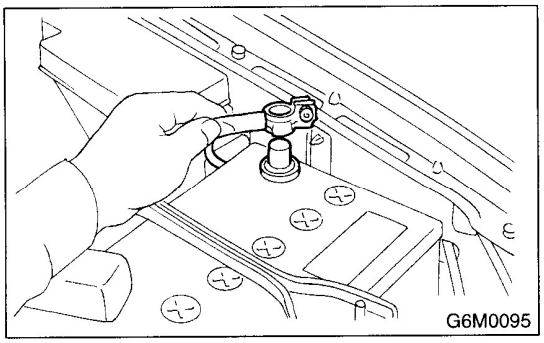


GETtheMANUALS.org

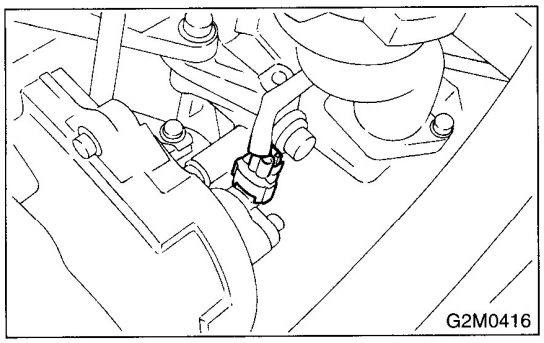
# 6. Camshaft Position Sensor

## A: REMOVAL

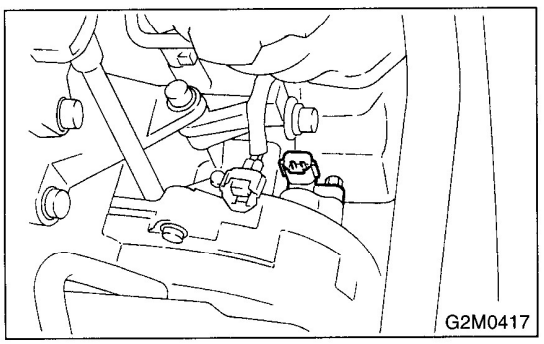
1) Disconnect the battery ground cable.




2) Disconnect the connector from the camshaft position sensor.



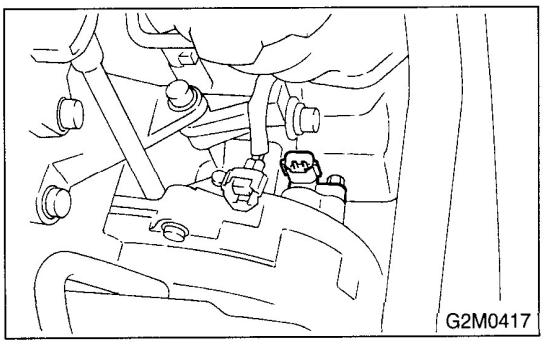

3) Remove the hcamshaft position sensor from the camshaft support LH.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***T: 6.4 N·m (0.65 kgf-m, 4.7 ft-lb)***



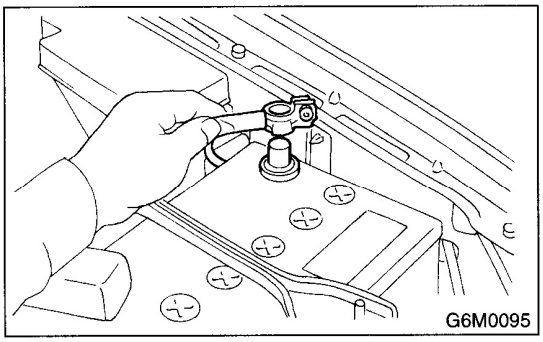


GETtheMANUALS.org

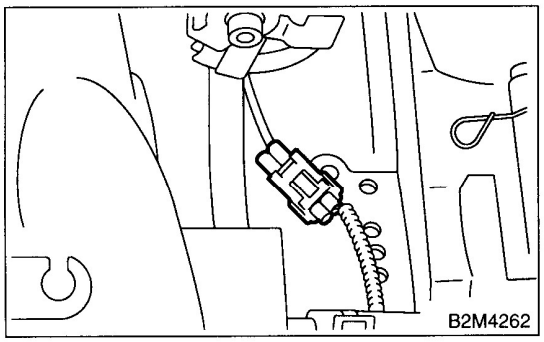
# 7. Knock Sensor

## A: REMOVAL

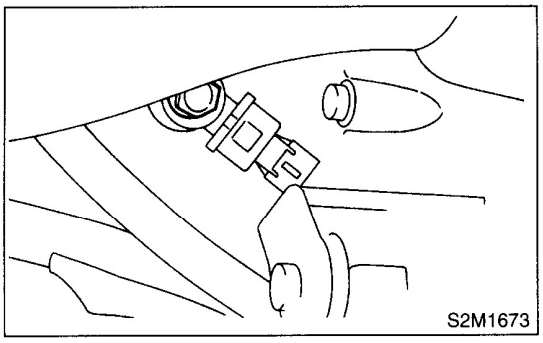
1) Disconnect the battery ground cable.




2) Remove the intercooler. <Ref. to IN(DOHC TURBO)-10, REMOVAL, Intercooler.>
3) Disconnect the knock sensor connector.




4) Remove the knock sensor from the cylinder block.

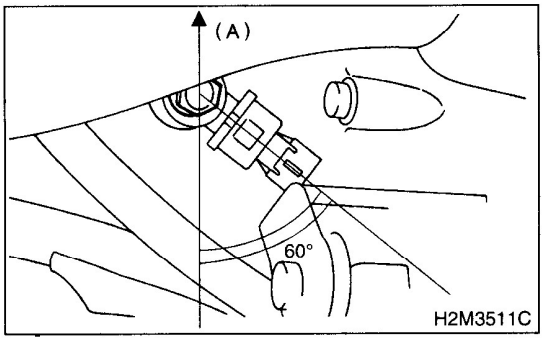



## B: INSTALLATION

1) Install the knock sensor to the cylinder block.

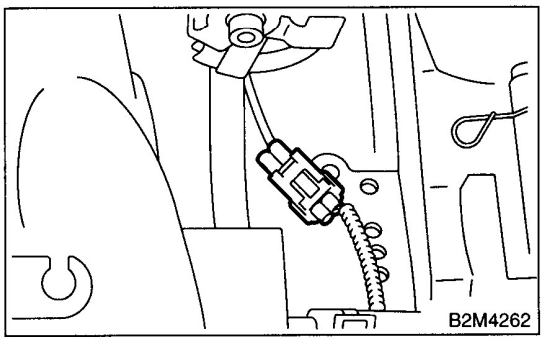
***Tightening torque:***
***24 N·m (2.4 kgf-m, 17.4 ft-lb)***

NOTE:
The extraction area of the knock sensor cord must be positioned at a 60° angle relative to the engine rear.

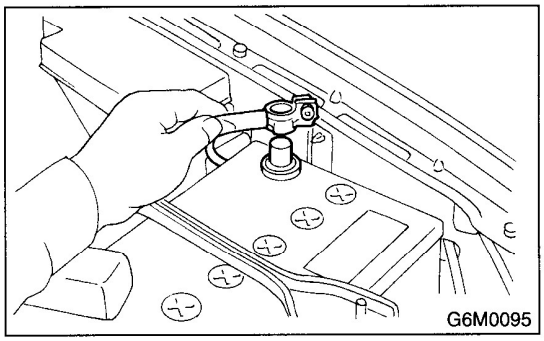



(A) Front side

2) Connect the knock sensor connector.




3) Install the intercooler. <Ref. to IN(DOHC TURBO)-11, INSTALLATION, Intercooler.>
4) Connect the battery ground cable.



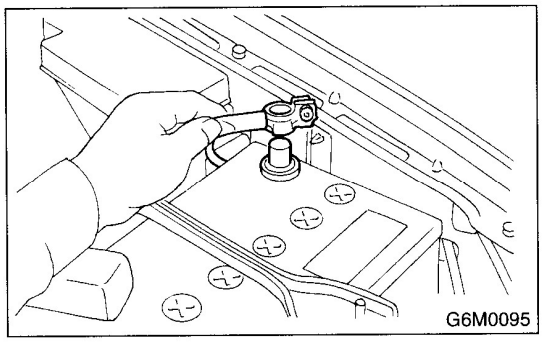


GETtheMANUALS.org

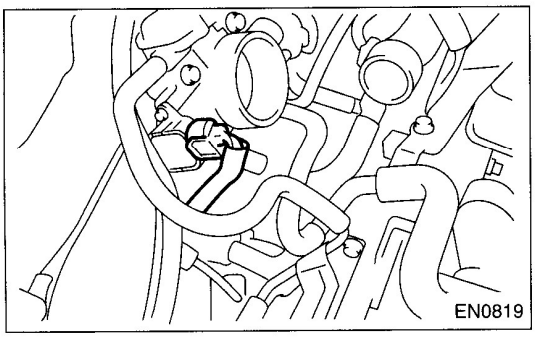
# 8. Throttle Position Sensor

## A: REMOVAL

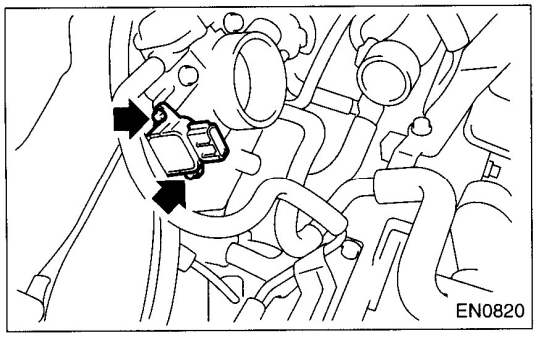
1) Disconnect the battery ground cable.




2) Remove the intercooler. <Ref. to IN(DOHC TURBO)-10, REMOVAL, Intercooler.>
3) Disconnect the connector from the throttle position sensor.



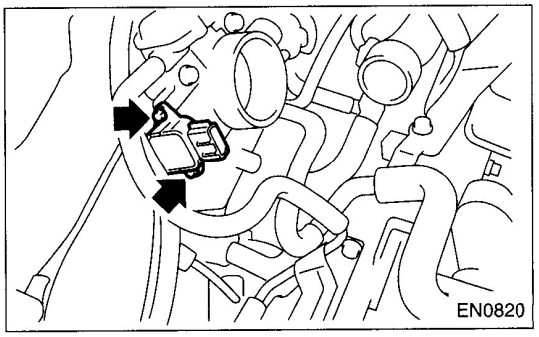

4) Remove the throttle position sensor holding screws, and remove it.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***1.6 N·m (0.16 kgf-m, 1.2 ft-lb)***



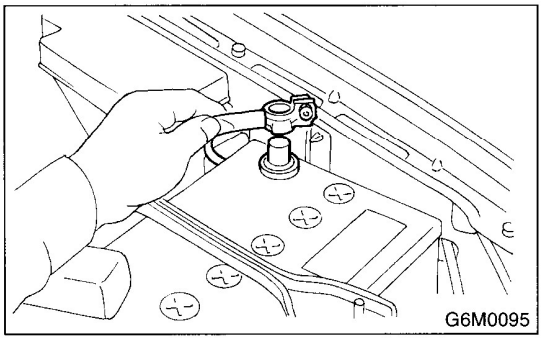


GETtheMANUALS.org

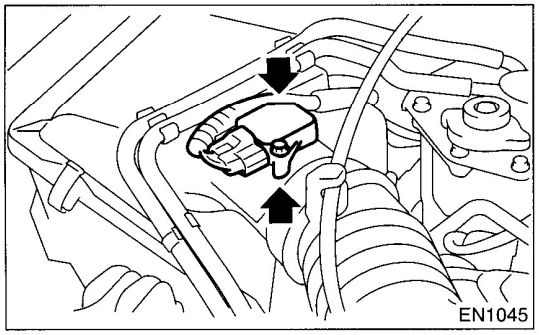
## 9. Mass Air Flow and Intake Air Temperature Sensor

### A: REMOVAL

1) Disconnect the battery ground cable.




2) Disconnect the connector mass air flow and intake air temperature sensor.
3) Remove the mass air flow and intake air temperature sensor.




### B: INSTALLATION

Install in the reverse order of removal.

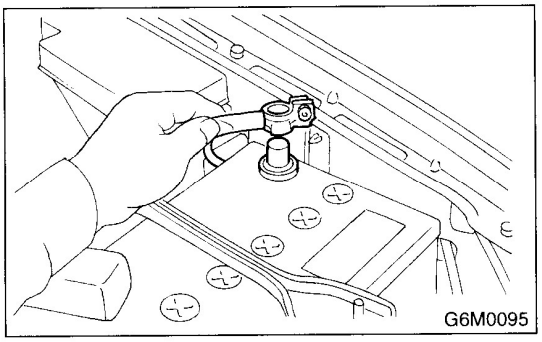
***Tightening torque:***
***7.5 N·m (0.76 kgf-m, 5.5 ft-lb)***


GETtheMANUALS.org

# 10.Pressure Sensor

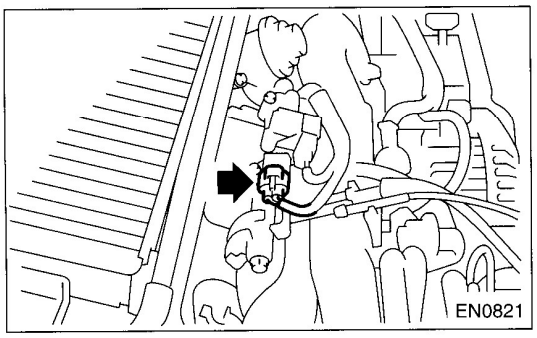
## A: REMOVAL

1) Disconnect the battery ground cable.




2) Remove the idle air control solenoid valve. <Ref. to FU(DOHC TURBO)-36, REMOVAL, Idle Air Control Solenoid Valve.>

3) Disconnect the connectors from pressure sensor.




4) Remove the pressure sensor from the throttle body.

## B: INSTALLATION

Install in the reverse order of removal.

NOTE:
Replace the O-ring for the pressure sensor with new ones.

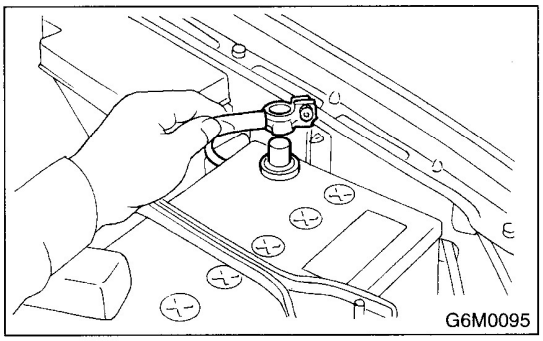
***Tightening torque:***
***1.6 N·m (0.16 kgf-m, 1.2 ft-lb)***


GETtheMANUALS.org

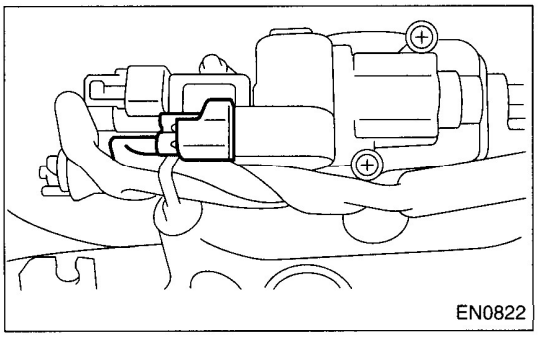
# 11.Idle Air Control Solenoid Valve

## A: REMOVAL

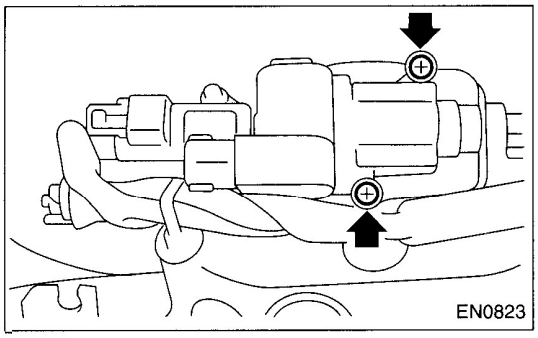
1) Disconnect the battery ground cable.



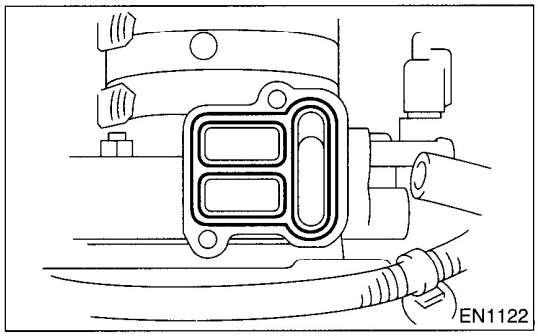

2) Disconnect the connector from the idle air control solenoid valve.




3) Remove the idle air control solenoid valve from the throttle body.




4) Remove the gasket from throttle body.

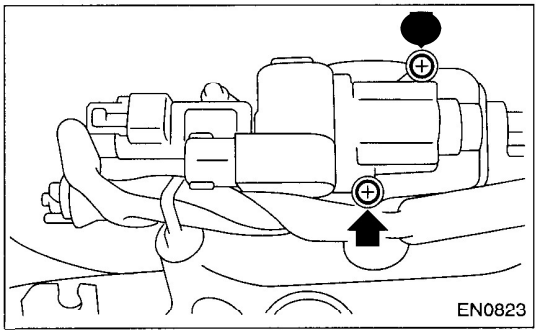



## B: INSTALLATION

Install in the reverse order of removal.

NOTE:
Always use a new gasket.

***Tightening torque:***
***2.8 N·m (0.29 kgf-m, 2.1 ft-lb)***





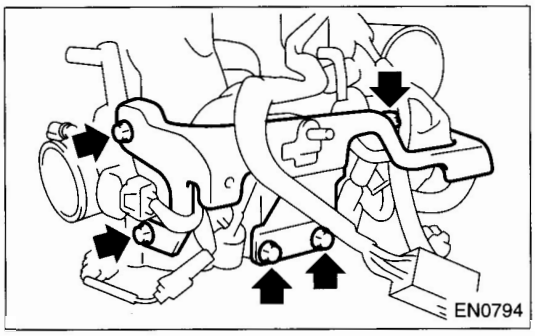
GETtheMANUALS.org

# 12.Fuel Injector

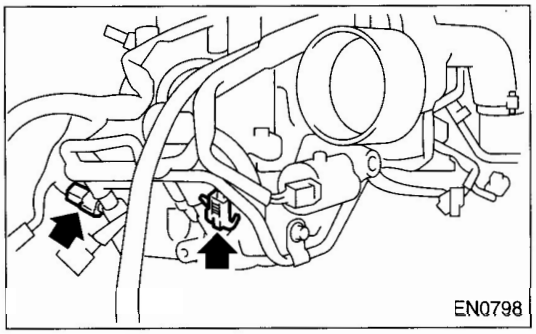
## A: REMOVAL

### 1. RH SIDE

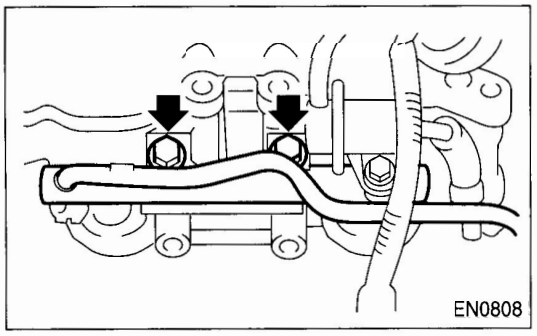
1) Remove the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>
2) Remove the fuel pipe protector RH.

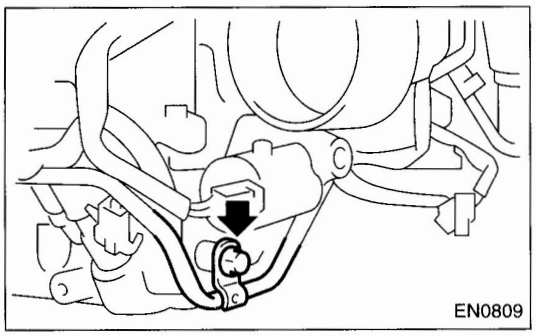



3) Disconnect the connector from the fuel injector.

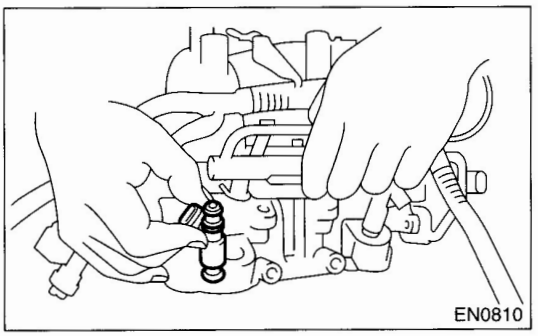



4) Remove the bolts which hold the injector pipe to intake manifold.



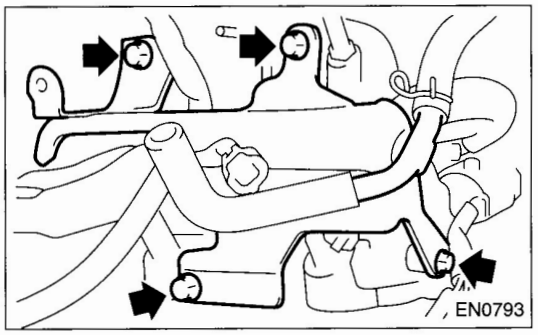




5) Remove the fuel injector while lifting up the fuel injector pipe.

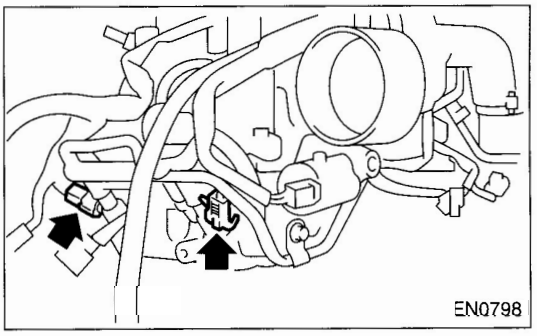



### 2. LH SIDE

1) Remove the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>
2) Remove the fuel pipe protector LH.



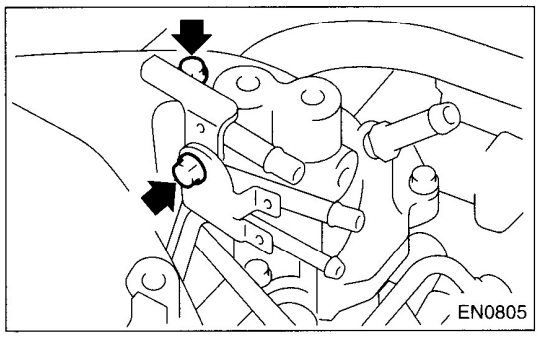

3) Disconnect the connector from the fuel injector.

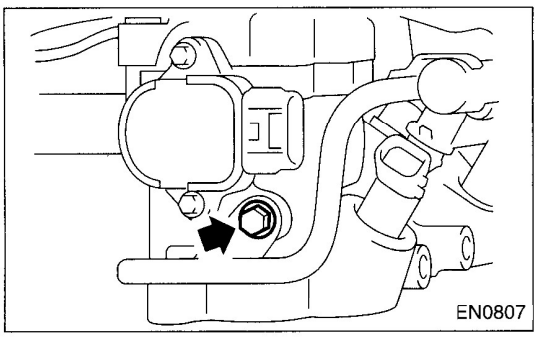


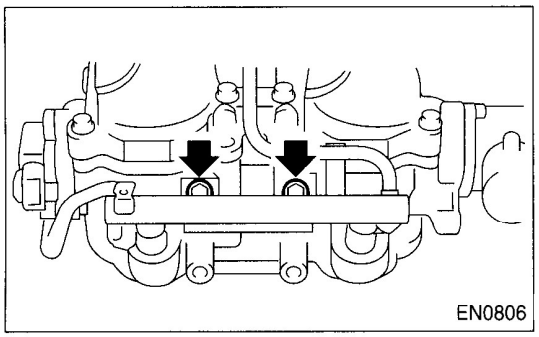


GETtheMANUALS.org

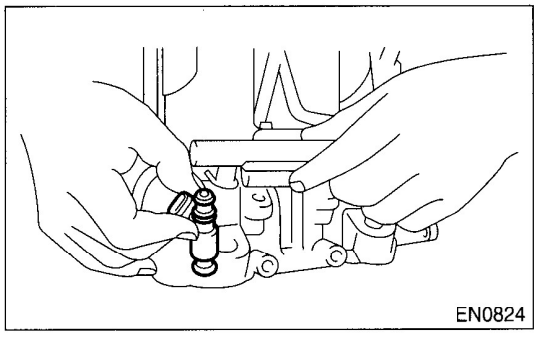
4) Remove the bolts which hold the injector pipe to intake manifold.




5) Remove the fuel injector while lifting up the fuel injector pipe.

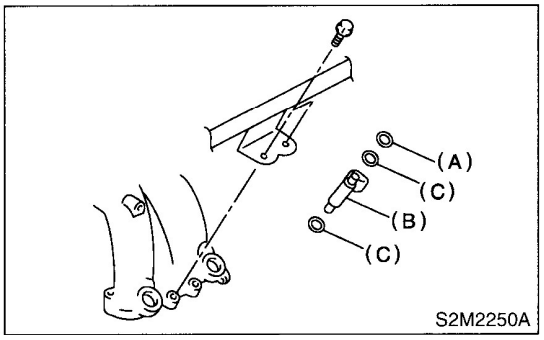



## B: INSTALLATION

### 1. RH SIDE

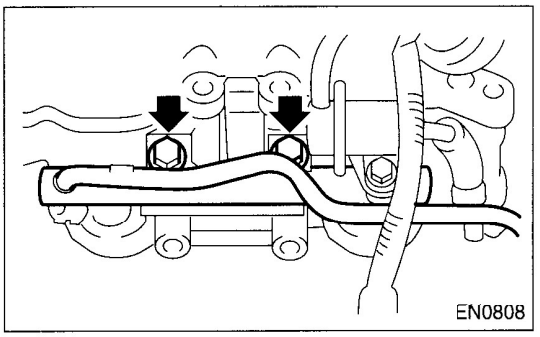
Install in the reverse order of removal.

NOTE:
Replace the O-ring and insulators with new ones.

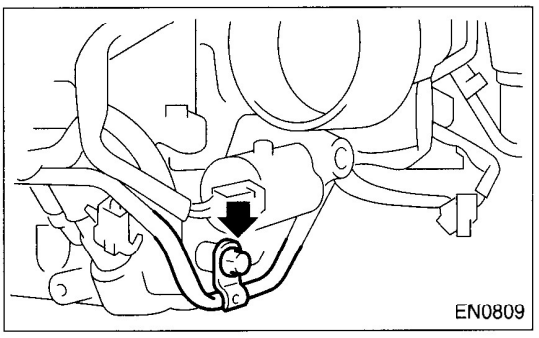



(A) O-ring
(B) Fuel injector
(C) Insulator

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***



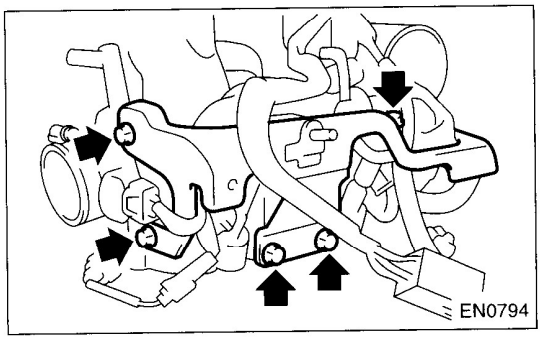

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***





GETtheMANUALS.org

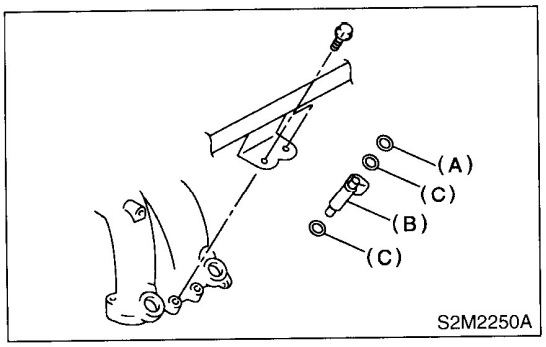
***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***




## 2. LH SIDE

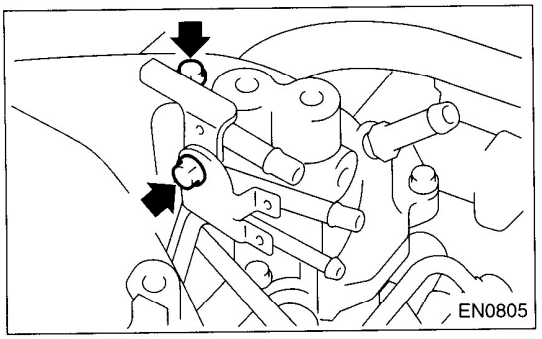
Install in the reverse order of removal.

NOTE:
Replace the O-ring and insulators with new ones.

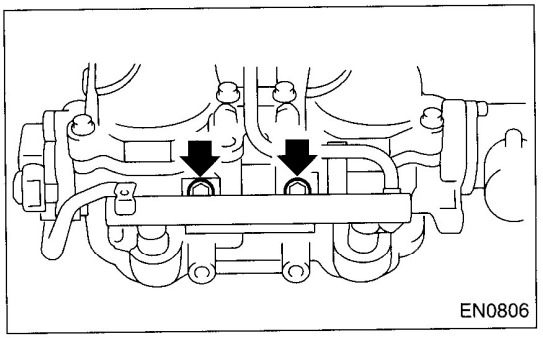



(A) O-ring
(B) Fuel injector
(C) Insulator

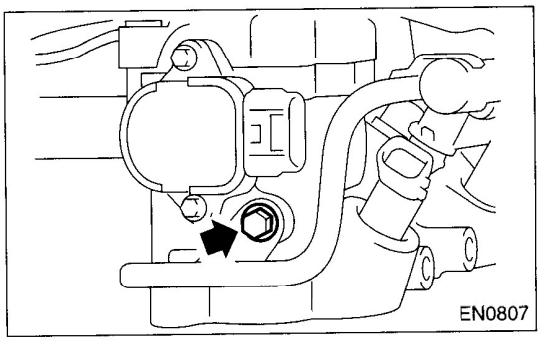
***Tightening torque:***
***4.9 N·m (0.5 kgf-m, 3.6 ft-lb)***



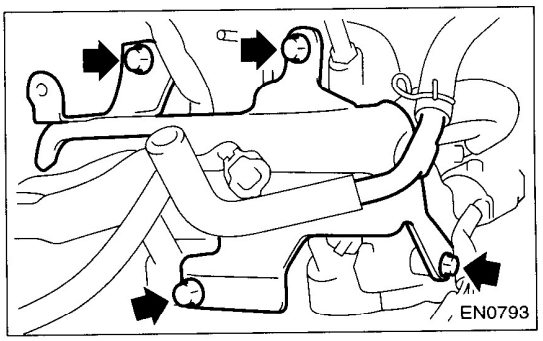

***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***




***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***




***Tightening torque:***
***19 N·m (1.94 kgf-m, 13.7 ft-lb)***



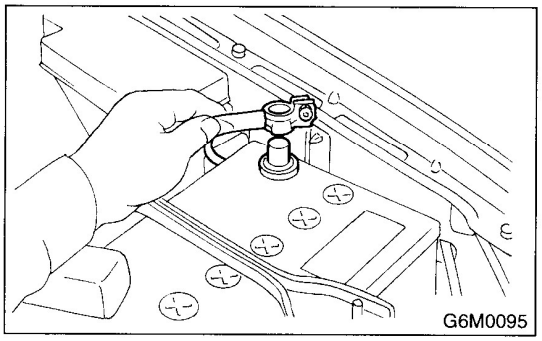


GETtheMANUALS.org

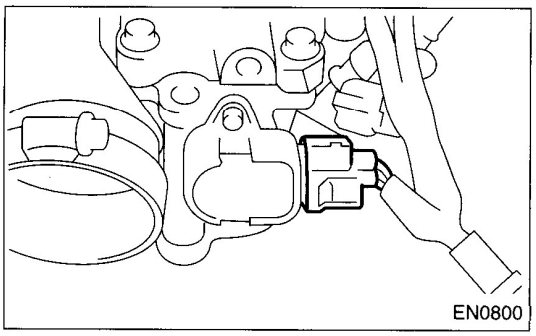
# 13. Tumble Generator Valve Assembly

## A: REMOVAL

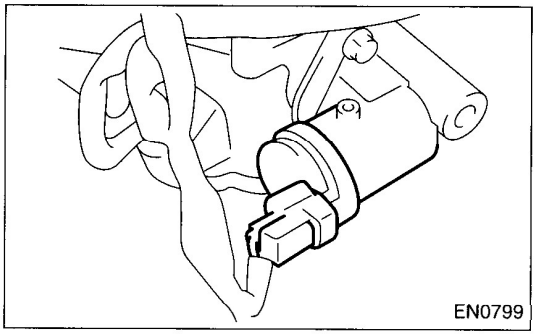
1) Disconnect the battery ground cable.



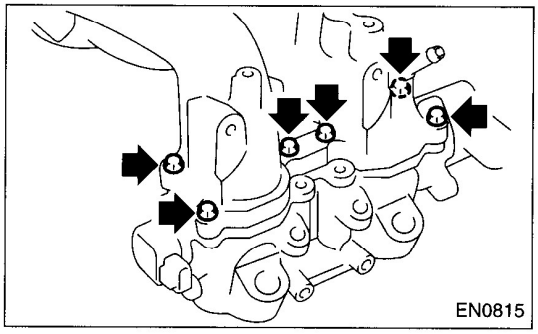

2) Remove the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>
3) Disconnect the connector from the tumble generator valve sensor.




4) Disconnect the connector from the tumble generator valve actuator.




5) Remove the fuel injector. <Ref. to FU(DOHC TURBO)-37, REMOVAL, Fuel Injector.>
6) Remove the tumble generator valve body from the intake manifold.

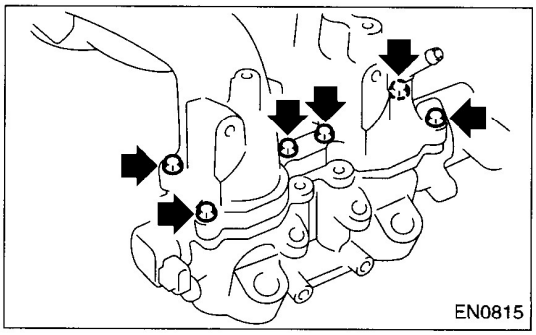



## B: INSTALLATION

Install in the reverse order of removal.

NOTE:
Always use new gaskets.

***Tightening torque:***
***8.25 N·m (0.84 kgf-m, 6.1 ft-lb)***



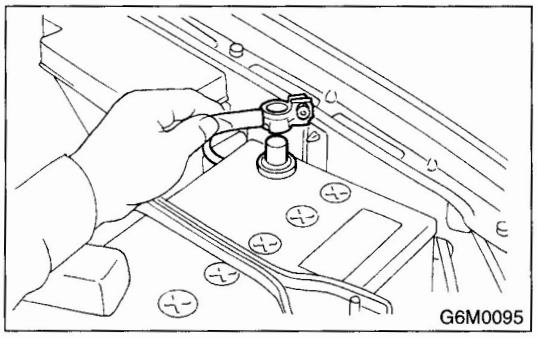


GETtheMANUALS.org

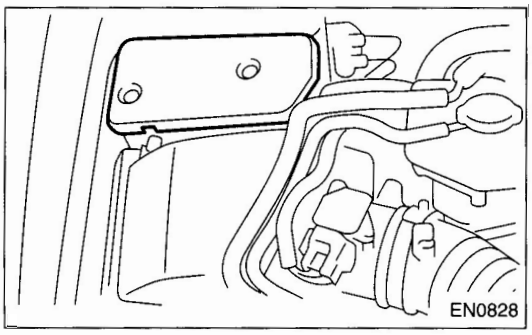
# 14. Wastegate Control Solenoid Valve

## A: REMOVAL

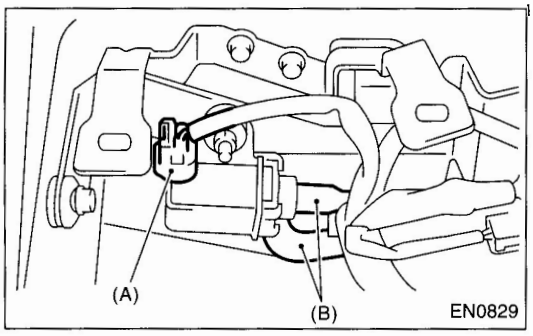
1) Disconnect the battery ground cable.



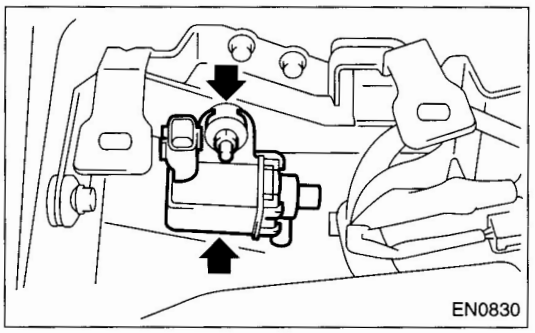

2) Remove the solenoid valve cover.




3) Disconnect the connector (A) from the wastegate control solenoid valve.
4) Disconnect the pressure hoses (B) from the wastegate control solenoid valve.



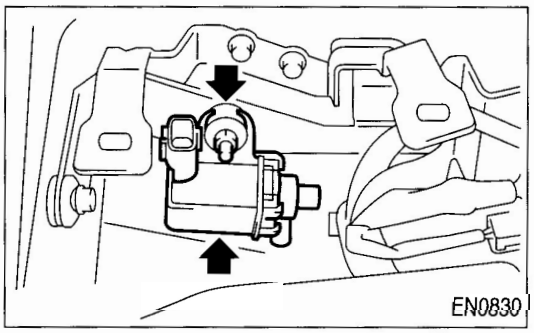

5) Remove the wastegate control solenoid valve from the bracket




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***6.4 N·m (0.65 kgf-m, 4.7 ft-lb)***



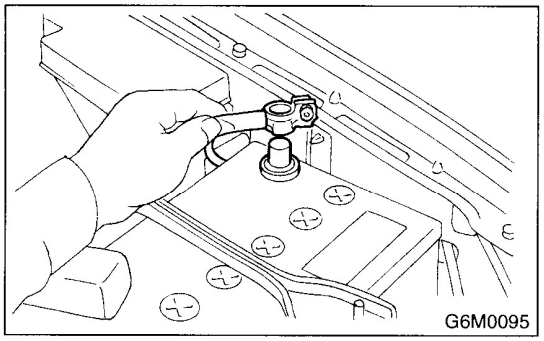


GETtheMANUALS.org

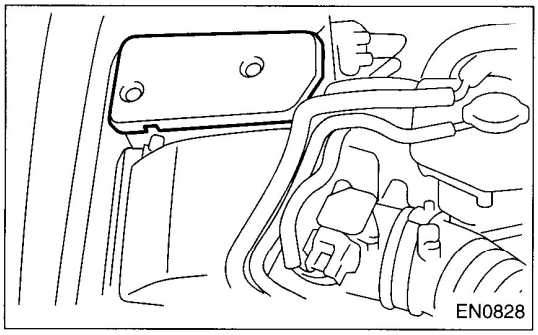
# 15.Front Oxygen (A/F) Sensor

## A: REMOVAL

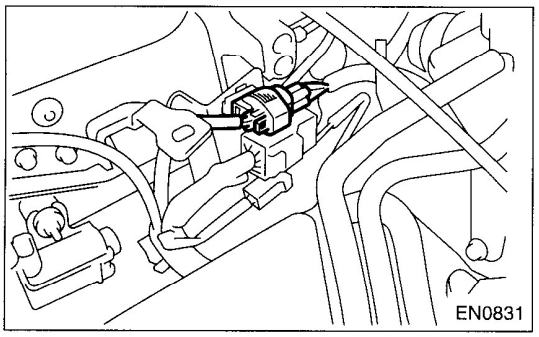
1) Disconnect the battery ground cable.



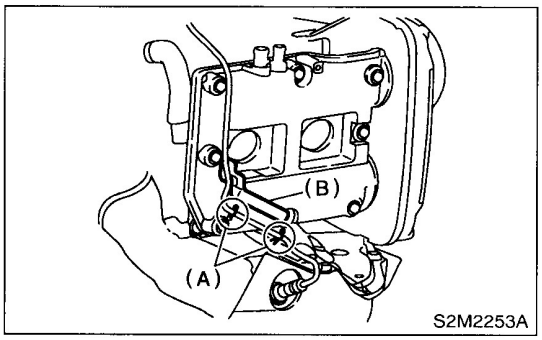

2) Remove the solenoid valve cover.




3) Disconnect the connector from the front oxygen (A/F) sensor.



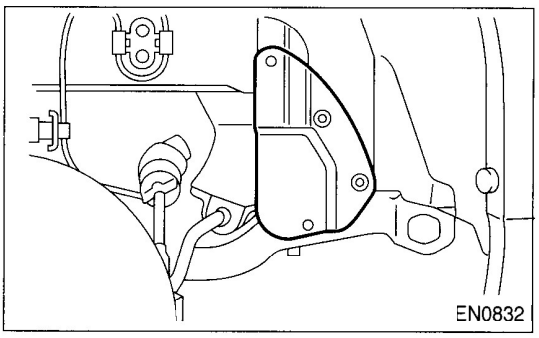

4) Disconnect the engine harness fixed by clip (A) from the bracket (B).




5) Remove the front right side wheel.

6) Lift-up the vehicle.

7) Remove the service hole cover.

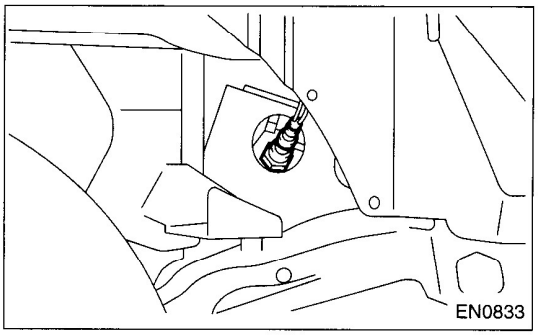



8) Apply SUBARU CRC or its equivalent to the threaded portion of front oxygen (A/F) sensor, and leave it for one minute or more.

***SUBARU CRC (Part No. 004301003)***

9) Remove the front oxygen (A/F) sensor.

**CAUTION:**
**When removing the oxygen (A/F) sensor, wait until exhaust pipe cools, otherwise it will damage exhaust pipe.**





GETtheMANUALS.org

## B: INSTALLATION

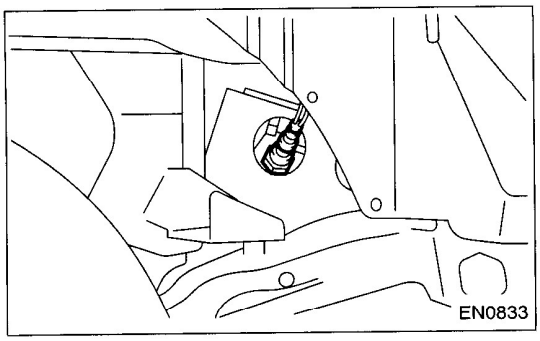
1) Before installing front oxygen (A/F) sensor, apply the anti-seize compound only to the threaded portion of front oxygen (A/F) sensor to make the next removal easier.

***Anti-seize compound:***
***SS-30 by JET LUBE***

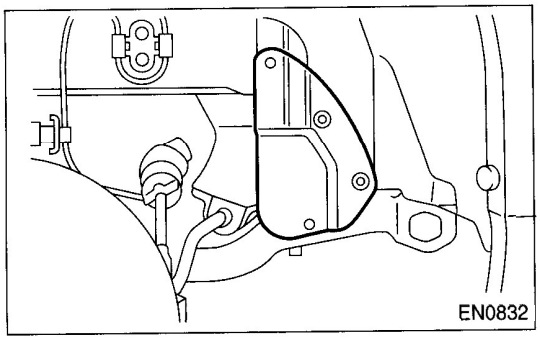
**CAUTION:**
**Never apply anti-seize compound to protector of front oxygen (A/F) sensor.**

2) Install the front oxygen (A/F) sensor.

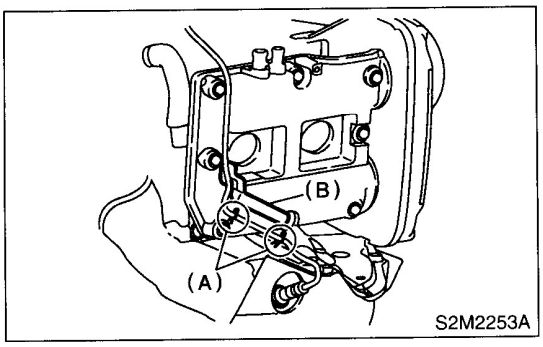
***Tightening torque:***
***21N·m (2.1 kgf-m, 15.2 ft-lb)***



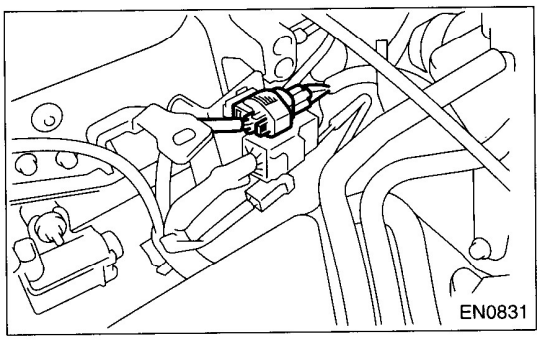

3) Install the service hole cover.



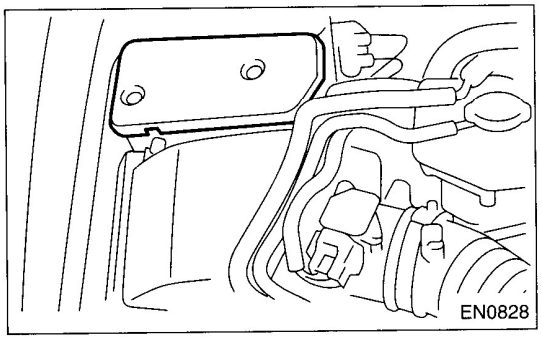

4) Lower the vehicle.
5) Install the front right side wheel.
6) Connect the engine harness with clip (A) to the bracket (B).



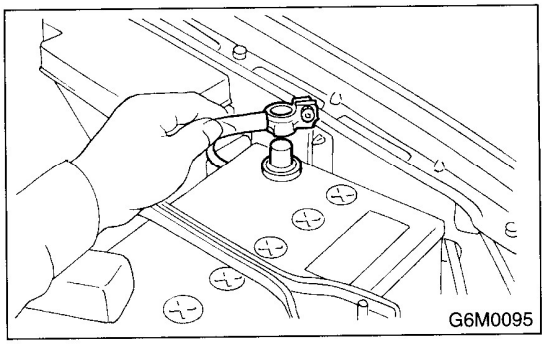

7) Connect the connector of front oxygen (A/F) sensor.




8) Install the solenoid valve cover.




9) Connect the battery ground cable.



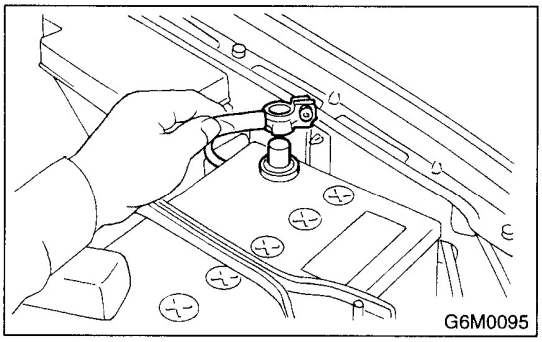


GETtheMANUALS.org

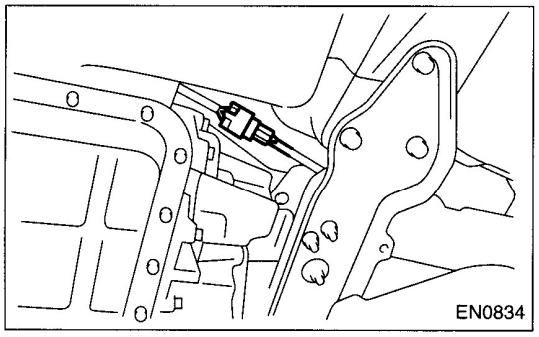
# 16. Rear Oxygen Sensor

## A: REMOVAL

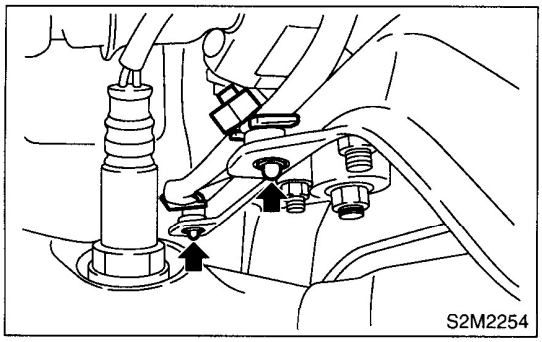
1) Disconnect the battery ground cable.




2) Lift-up the vehicle.
3) Disconnect the connector from the rear oxygen sensor.




4) Remove the clip by pulling out from the upper side of crossmember.

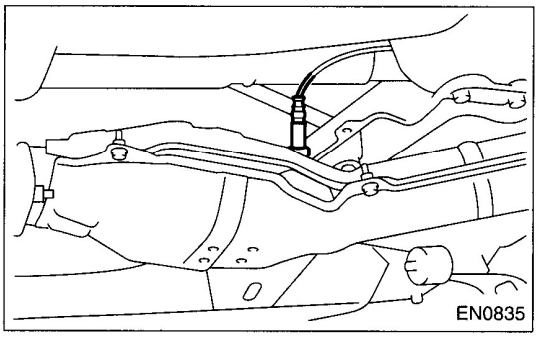



5) Apply SUBARU CRC or its equivalent to the threaded portion of rear oxygen sensor, and leave it for one minute or more.

***SUBARU CRC (Part No. 004301003)***

6) Remove the rear oxygen sensor.

**CAUTION:**
**When removing the oxygen sensor, wait until exhaust pipe cools, otherwise it will damage exhaust pipe.**




## B: INSTALLATION

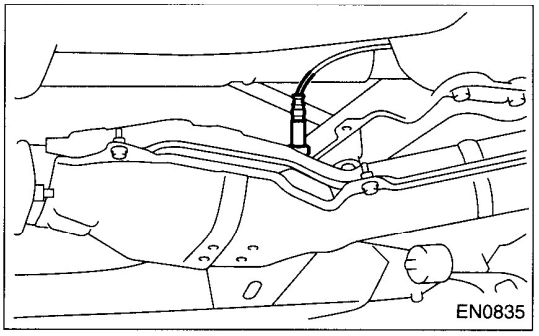
1) Before installing rear oxygen sensor, apply the anti-seize compound only to the threaded portion of rear oxygen sensor to make the next removal easier.

**CAUTION:**
**Never apply anti-seize compound to protector of rear oxygen sensor.**

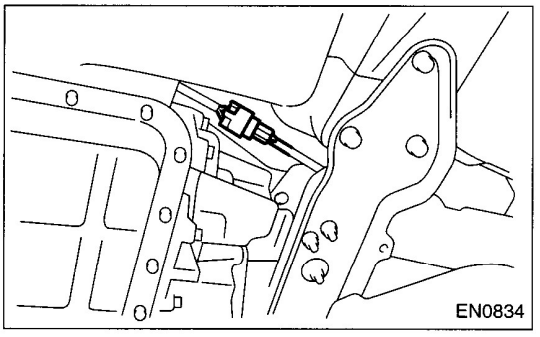
***Anti-seize compound:***
***SS-30 by JET LUBE***

2) Install the rear oxygen sensor.

***Tightening torque:***
***21 N·m (2.1 kgf-m, 15.2 ft-lb)***



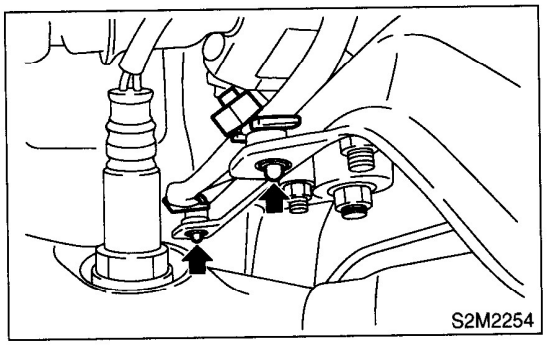

3) Connect the connector to the rear oxygen sensor.



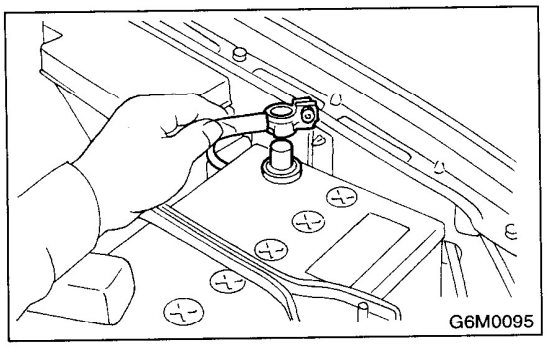


GETtheMANUALS.org

4) Connect the clip to the crossmember.




5) Lower the vehicle.
6) Connect the battery ground cable.



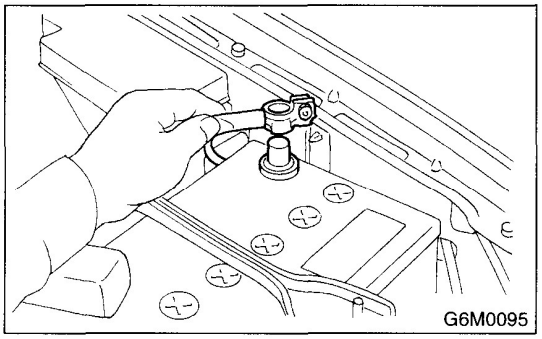


GETtheMANUALS.org

# 17.Exhaust Temperature Sensor

## A: REMOVAL

1) Disconnect the battery ground cable.

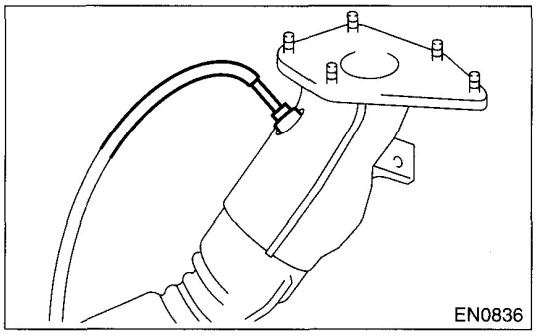



2) Remove the joint pipe. <Ref. to EX(DOHC TURBO)-12, REMOVAL, Joint Pipe.>
3) Apply SUBARU CRC or its equivalent to the threaded portion of exhaust temperature sensor, and leave it for one minute or more.

***SUBARU CRC (Part No. 004301003)***

4) Remove the exhaust temperature sensor.

**CAUTION:**
**When removing the oxygen sensor, wait until exhaust pipe cools, otherwise it will damage exhaust pipe.**




## B: INSTALLATION

1) Before installing exhaust temperature sensor, apply the anti-seize compound only to the threaded portion of rear oxygen sensor to make the next removal easier.

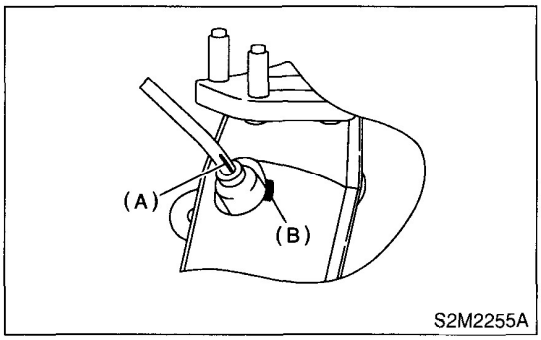
**CAUTION:**
**Never apply anti-seize compound to protector of exhaust temperature sensor.**

***Anti-seize compound:***
***SS-30 by JET LUBE***

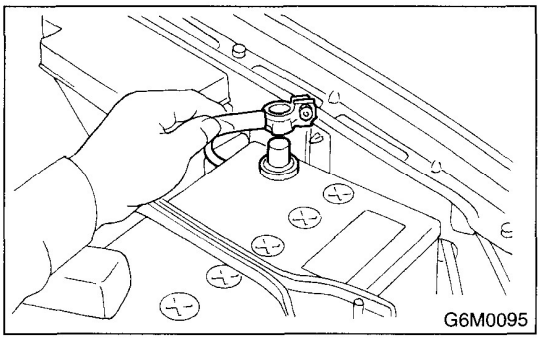
2) Install the exhaust temperature sensor.

NOTE:
Align the marking (A) of exhaust temperature sensor to the marking (B) of joint pipe, and tighten the screws.

***Tightening torque:***
***21 N·m (2.1 kgf-m, 15.2 ft-lb)***




3) Install the joint pipe <Ref. to EX(DOHC TURBO)-12, INSTALLATION, Joint Pipe.>.
4) Connect the battery ground cable.



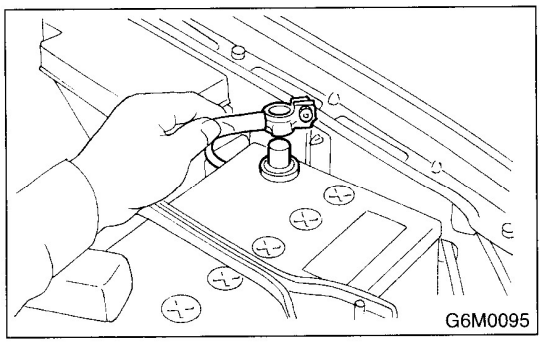


GETtheMANUALS.org

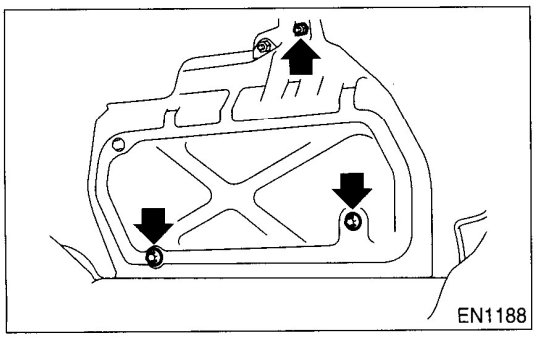
# 18.Engine Control Module

## A: REMOVAL

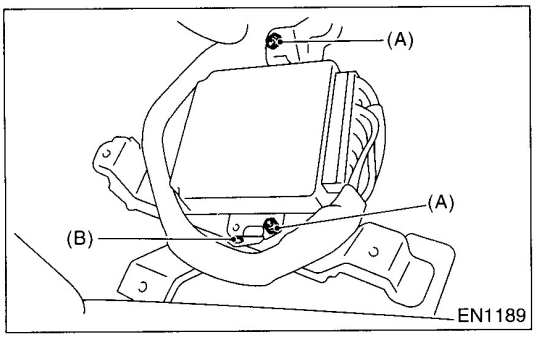
1) Disconnect the battery ground cable.




2) Remove the lower inner trim of the passenger side.
<Ref. to EI-46, REMOVAL, Lower Inner Trim.>
3) Detach the floor mat of the front passenger seat.
4) Remove the protect cover.




5) Remove the nuts (A) which hold ECM to the bracket.
6) Remove the clip (B) from the bracket.




7) Disconnect the ECM connectors and take out the ECM.

## B: INSTALLATION

Install in the reverse order of removal.

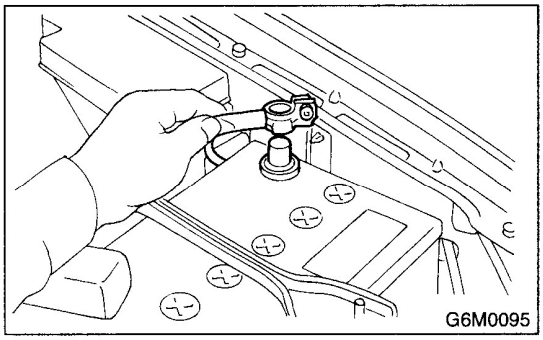
**CAUTION:**
**When replacing ECM, be careful not to use the wrong spec. ECM to avoid any damage to the fuel injection system.**


GETtheMANUALS.org

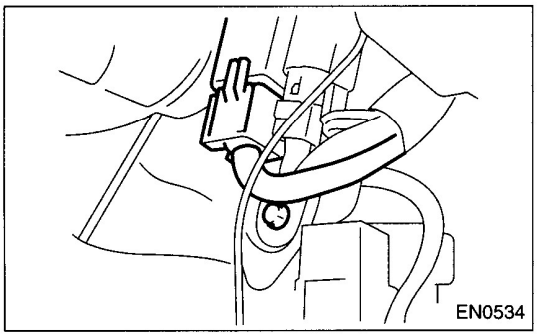
# 19.Main Relay

## A: REMOVAL

1) Disconnect the battery ground cable.




2) Remove the passenger's side front side sill cover.
3) Remove the bolt which holds the main relay bracket on the body.
4) Disconnect the connectors from the main relay.




## B: INSTALLATION

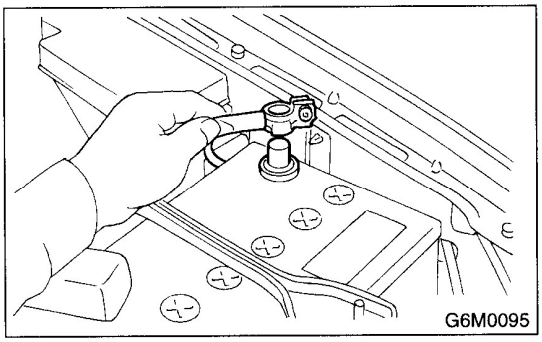
Install in the reverse order of removal.


GETtheMANUALS.org

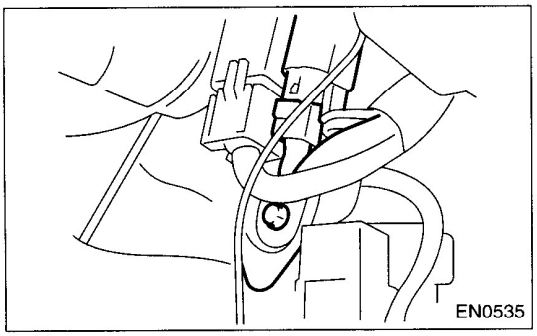
# 20.Fuel Pump Relay

## A: REMOVAL

1) Disconnect the battery ground cable.




2) Remove the passenger's side front side sill cover.
3) Remove the bolt which holds fuel pump relay bracket on the body.
4) Disconnect the connector from the fuel pump relay.




5) Remove the fuel pump relay from the mounting bracket.

## B: INSTALLATION

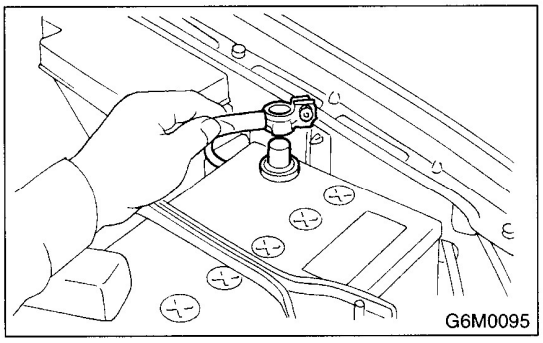
Install in the reverse order of removal.


GETtheMANUALS.org

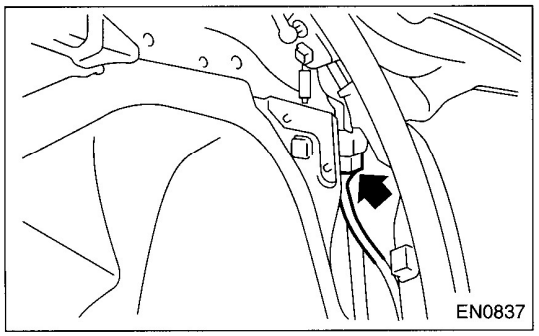
# 21.Fuel Pump Controller

## A: REMOVAL

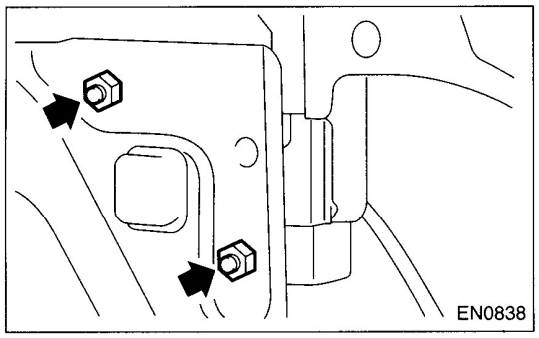
1) Disconnect the battery ground cable.




2) Remove the rear quarter trim. <Ref. to EI-47, REMOVAL, Rear Quarter Trim.>
3) Disconnect the connector from the fuel pump control unit.




4) Remove the fuel pump control unit.




## B: INSTALLATION

Install in the reverse order of removal.


GETtheMANUALS.org

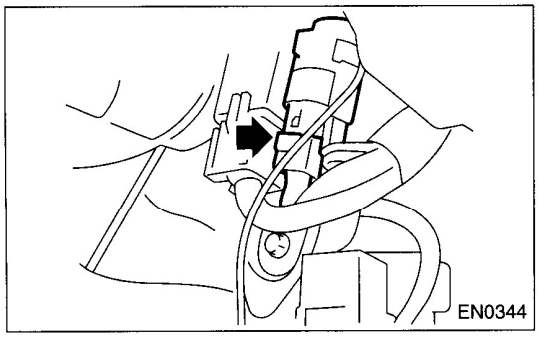
# 22.Fuel

## A: OPERATION

### 1. RELEASING OF FUEL PRESSURE

**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

1) Disconnect the connector from the fuel pump relay.

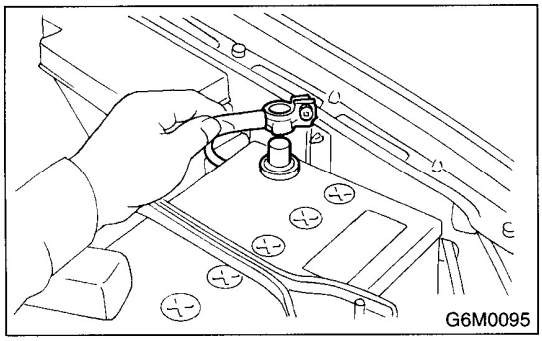



2) Start the engine and run it until it stalls.
3) After the engine stalls, crank it for five more seconds.
4) Turn the ignition switch to OFF.

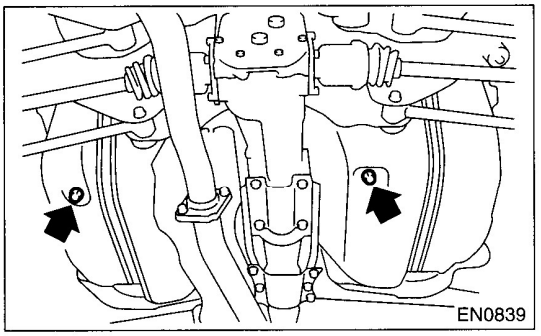
### 2. DRAINING FUEL

**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

1) Set the vehicle on the lift.
2) Disconnect the battery ground cable.

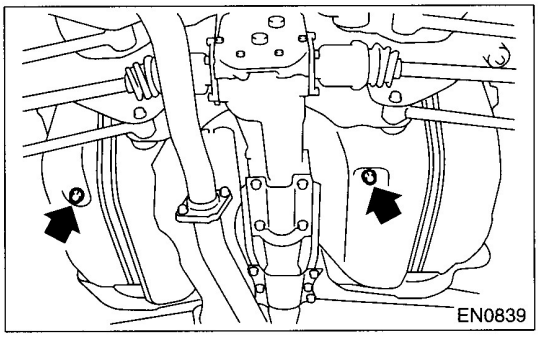



3) Lift-up the vehicle.
4) Drain the fuel from the fuel tank.
Set a container under the vehicle and remove drain plug from the fuel tank.




5) Tighten the fuel drain plug.

***Tightening torque:***
***26 N·m (2.65 kgf-m, 19.2 ft-lb)***





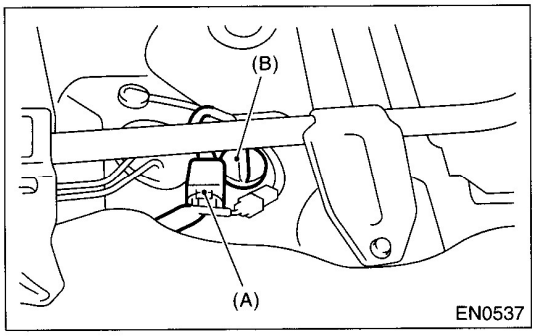
GETtheMANUALS.org

# 23.Fuel Tank

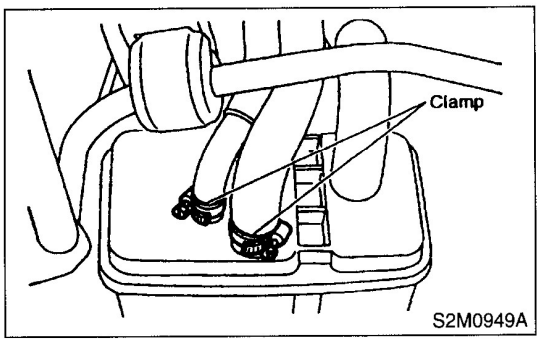
## A: REMOVAL

**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

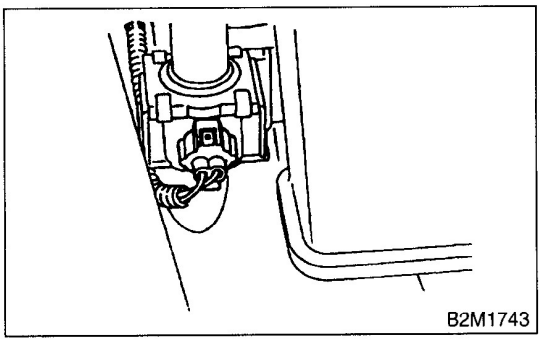
1) Set the vehicle on the lift.
2) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
3) Drain the fuel from the fuel tank. <Ref. to FU(DOHC TURBO)-51, DRAINING FUEL, OPERATION, Fuel.>
4) Remove the rear seat.
5) Disconnect the connector (A) of fuel tank cord to the rear harness.
6) Push the grommet (B) which holds the fuel tank cord on floor panel into under the body.



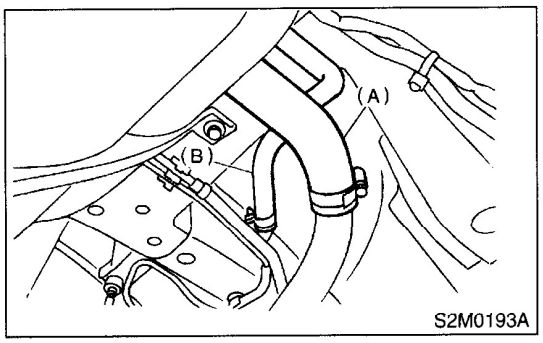

7) Remove the rear crossmember. <Ref. to RS-19, REMOVAL, Rear Crossmember.>
8) Move the clamp, and disconnect the evaporation hose from canister.



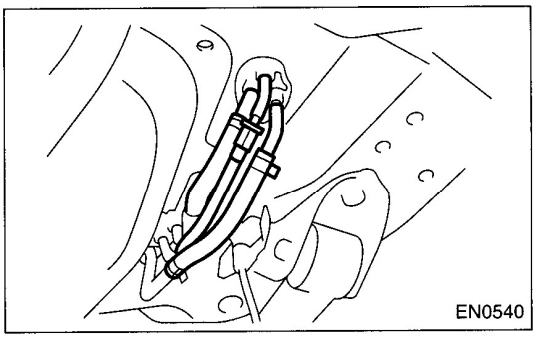

9) Disconnect the connector from the pressure control solenoid valve.
10) Disconnect the connector from the drain valve.




11) Loosen the clamp and disconnect the fuel filler hose (A) and air vent hose (B) from fuel filler pipe and air vent pipe.




12) Move the clips, and disconnect the quick connector. <Ref. to FU(DOHC TURBO)-68, REMOVAL, Fuel Delivery, Return and Evaporation Lines.>
13) Disconnect the fuel hoses.

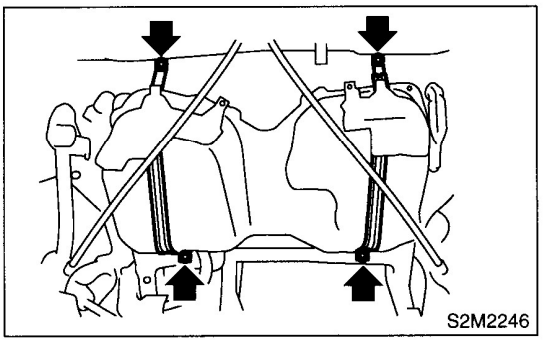




GETtheMANUALS.org

14) Support the fuel tank with transmission jack, remove the bolts from bands and dismount the fuel tank from vehicle.

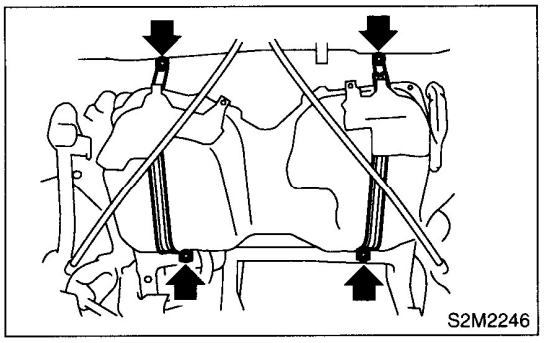
**WARNING:**
**A helper is required to perform this work.**



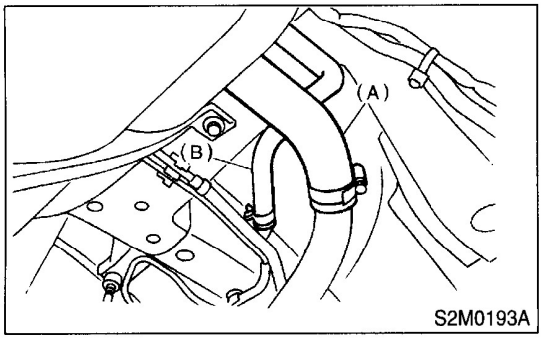

## B: INSTALLATION

1) Support the fuel tank with transmission jack and push the fuel tank harness into the access hole with grommet.
2) Set the fuel tank and temporarily tighten the bolts of fuel tank bands.

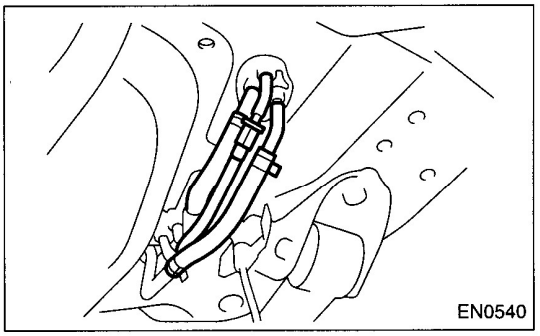
**WARNING:**
**A helper is required to perform this work.**



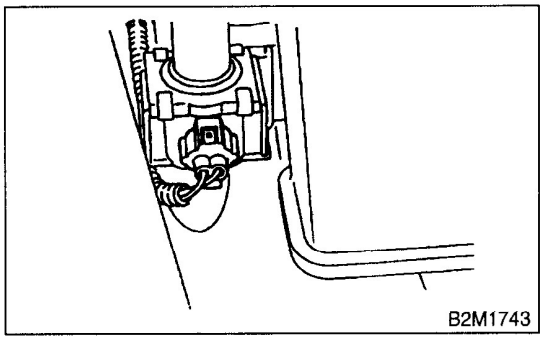

3) Connect the fuel filler hose and air vent hose.



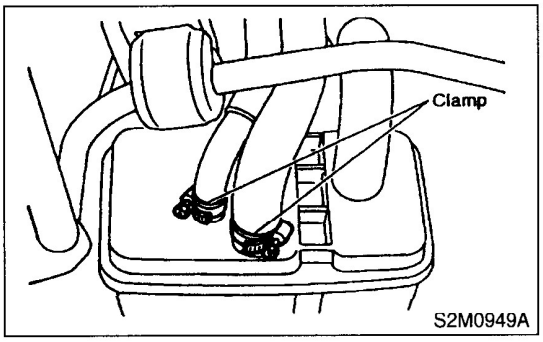

4) Connect the fuel hoses, and hold them with clips and quick connector. <Ref. to FU(DOHC TURBO)-69, INSTALLATION, Fuel Delivery, Return and Evaporation Lines.>




5) Connect the connector to the drain valve.




6) Connect the connector to the pressure control solenoid valve.
7) Connect the evaporation hose to the canister, and hold them with clamp.

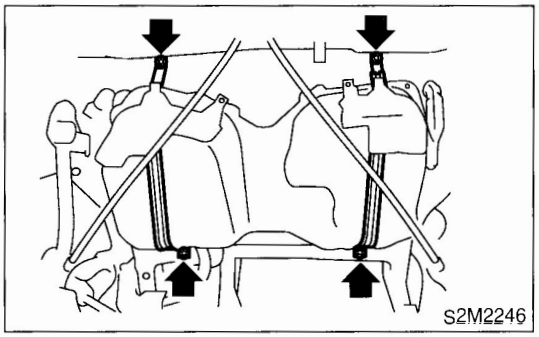




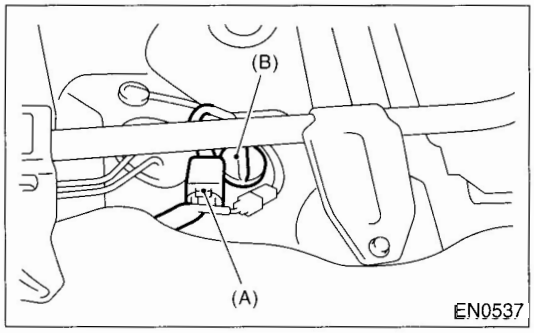
GETtheMANUALS.org

8) Tighten the band mounting bolts.

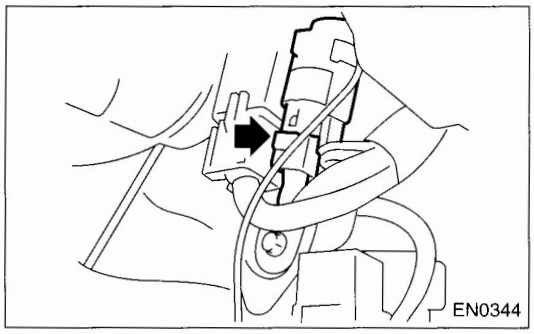
***Tightening torque:***
***33 N·m (3.4 kgf-m, 25 ft-lb)***




9) Install the rear crossmember. <Ref. to RS-19, INSTALLATION, Rear Crossmember.>
10) Connect the connector (A) to the fuel tank cord and plug the service hole with gromment (B).




11) Set the rear seat and floor mat.
12) Connect the connector to the fuel pump relay.




## C: INSPECTION

1) Make sure there are no cracks, holes, or other damage on the fuel tank.
2) Make sure that the fuel hoses and fuel pipes are not cracked and that connections are tight.

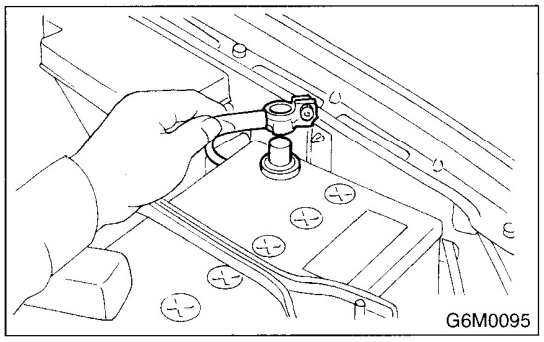

GETtheMANUALS.org

# 24.Fuel Filler Pipe

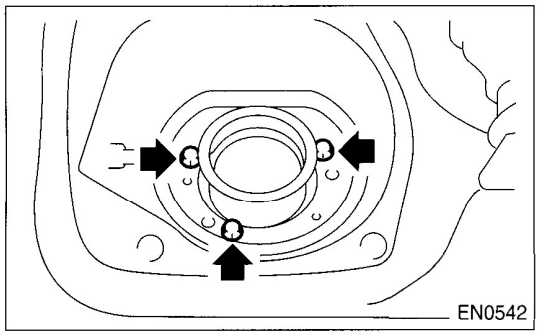
## A: REMOVAL

**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

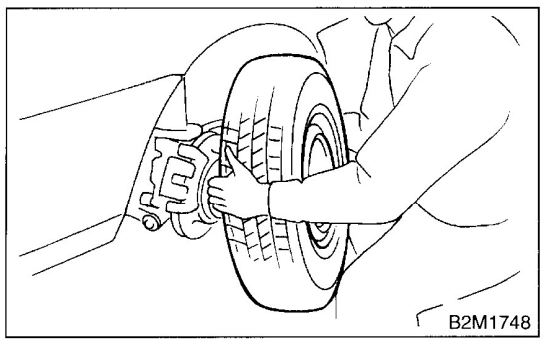
1) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Open the fuel filler flap lid and remove the filler cap.
3) Disconnect the battery ground cable.


G6M0095

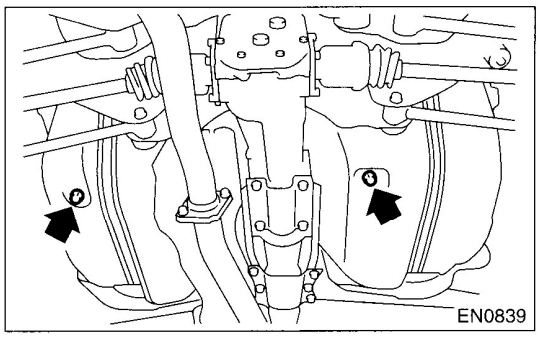
4) Remove the screws holding packing in place.


EN0542

5) Lift-up the vehicle.
6) Remove the rear right side wheel nuts.
7) Remove the rear right side wheel.

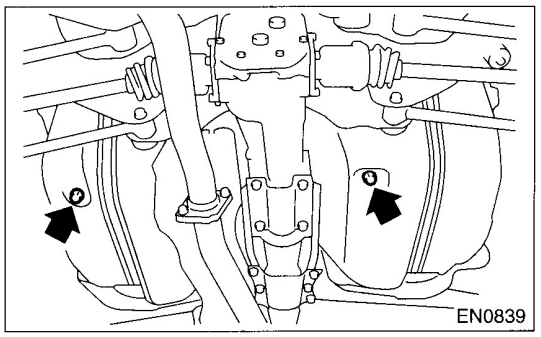

B2M1748

8) Drain the fuel from fuel tank. Set a container under the vehicle and remove the drain plug from fuel tank.

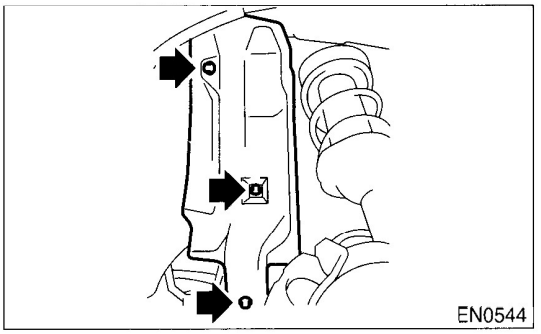

EN0839

9) Tighten the fuel drain plug and then install the front right side tank cover.

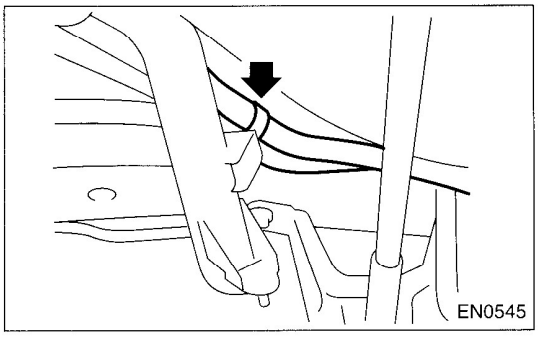
***Tightening torque:***
***26 N·m (2.65 kgf-m, 19.2 ft-lb)***


EN0839

10) Remove the fuel filler pipe protector.

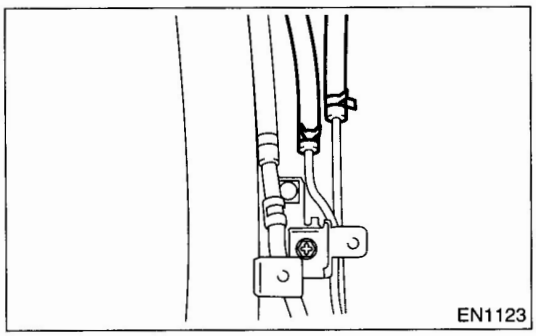

EN0544

11) Separate the evaporation hoses from the clip of fuel filler pipe.

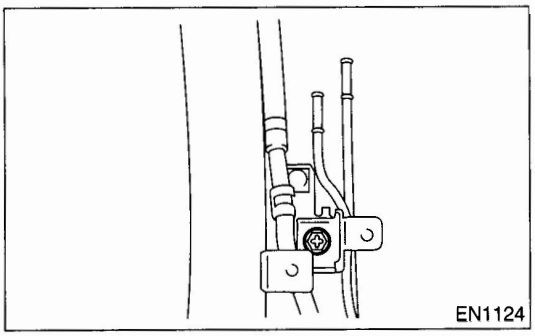

EN0545


GETtheMANUALS.org

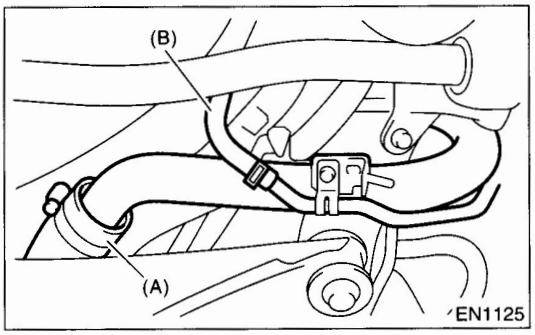
12) Disconnect the evaporation hoses from the pipes.




13) Remove the bolts which hold fuel filler pipe bracket on the body.

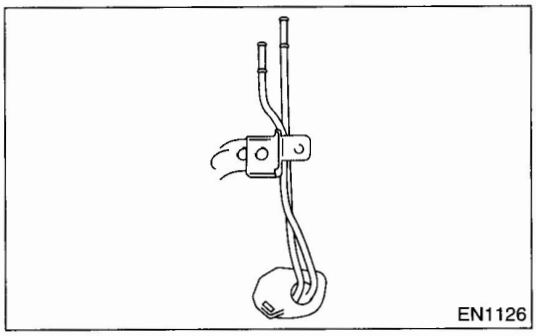



14) Loosen the clamp and separate the fuel filler hose (A) from fuel filler pipe.
15) Move the clip and separate the evaporation hose (B).



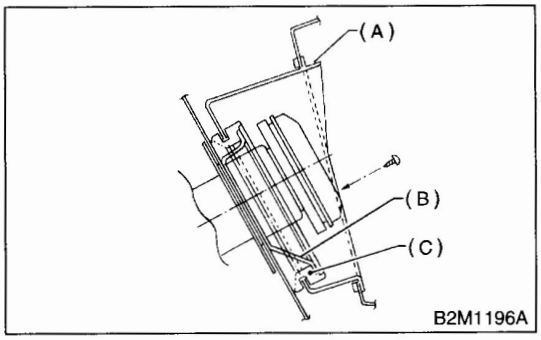

16) Remove the fuel filler pipe to under side of the vehicle.

17) Remove the air vent pipe together with clip from the body.



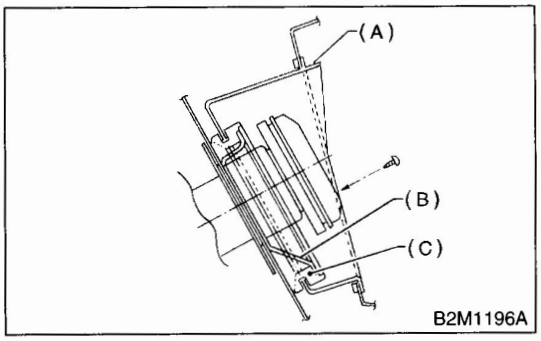

## B: INSTALLATION

1) Hold the fuel filler flap open.
2) Set the fuel saucer (A) with rubber packing (C) and insert the fuel filler pipe into the hole from the inner side of apron.




3) Align the holes in fuel filler pipe neck and set the cup (B), and tighten the screws.

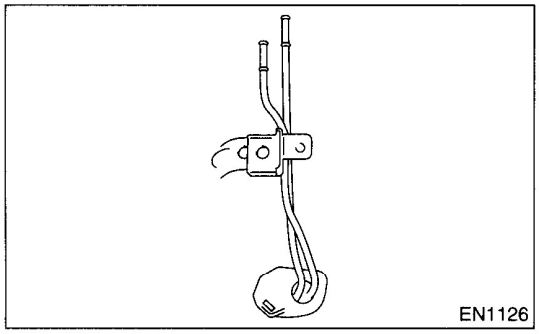
NOTE:
If edges of rubber packing are folded toward the inside, straighten it with a screwdriver.



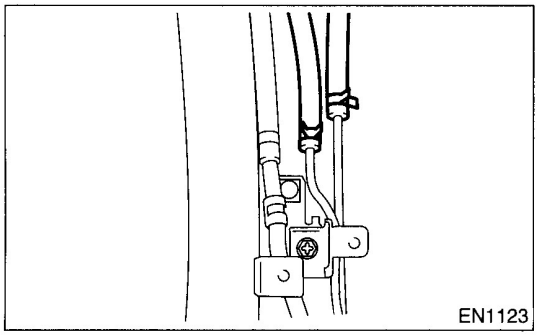


GETtheMANUALS.org

4) Install the evaporation pipes.

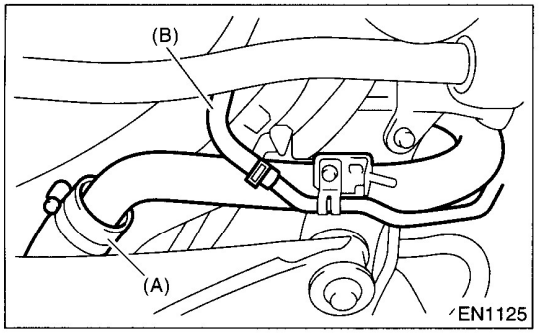



5) Connect the evaporation hose to pipes.



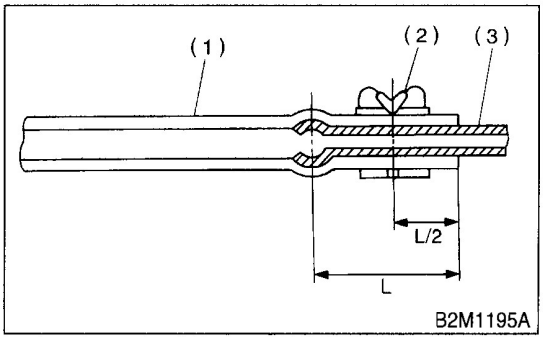

6) Insert the fuel filler hose (A) approximately 35 to 40 mm (1.38 to 1.57 in) over the lower end of fuel filler pipe and tighten the clamp.

**CAUTION:**
**Do not allow clips to touch air vent hose (B) and rear suspension crossmember.**




7) Insert the air vent hose approximately 25 to 30 mm (0.98 to 1.18 in) into the lower end of air vent pipe and hold clip.

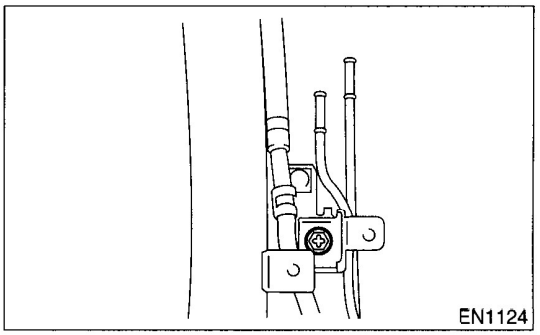
***L = 27.5±2.5 mm (1.083±0.098 in)***



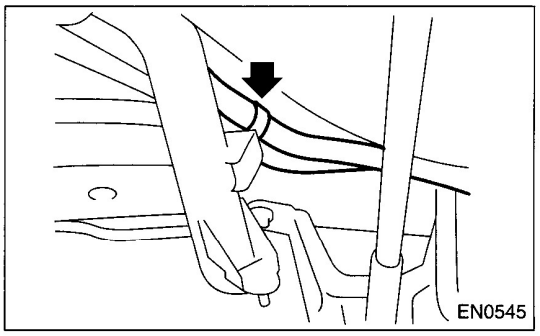

(1) Hose
(2) Clip
(3) Pipe

8) Tighten the bolt which holds fuel filler pipe bracket on the body.

***Tightening torque:***
***7.4 N·m (0.75 kgf-m, 5.4 ft-lb)***



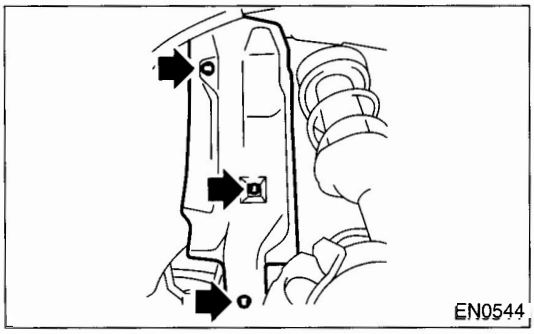

9) Tighten the bolts which hold evaporation hoses onto the clip of fuel filler pipe.



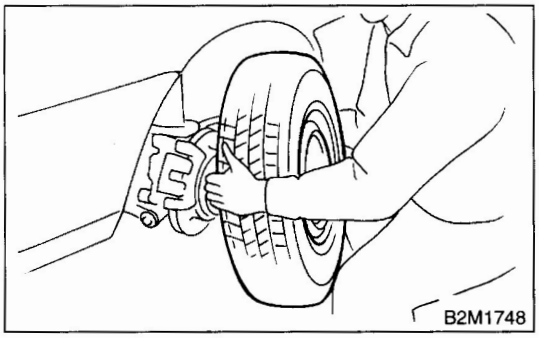


GETtheMANUALS.org

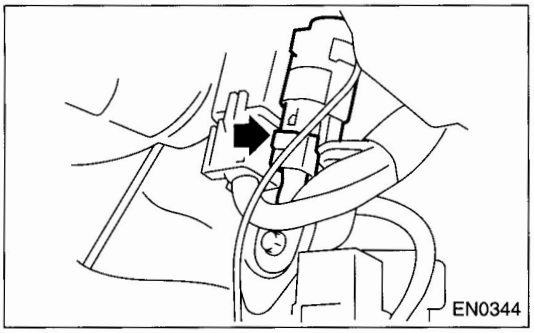
10) Install the fuel filler pipe protector.



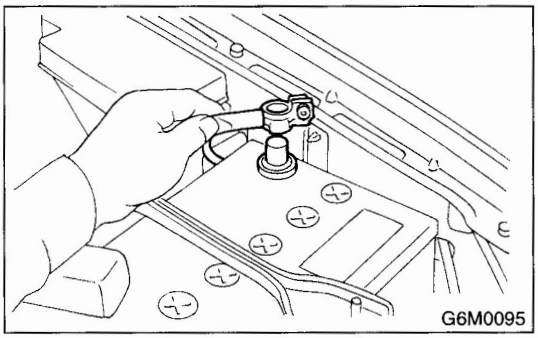

11) Install the rear right wheel.




12) Lower the vehicle.
13) Tighten the wheel nuts.
14) Connect the connector to the fuel pump relay.

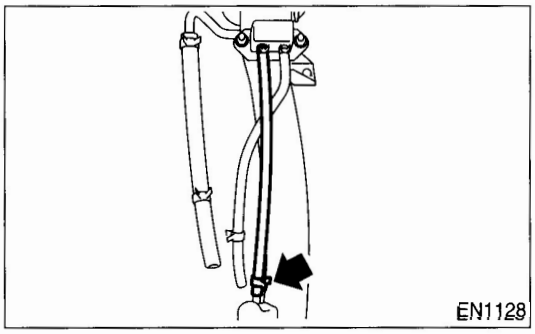



15) Connect the battery ground terminal.

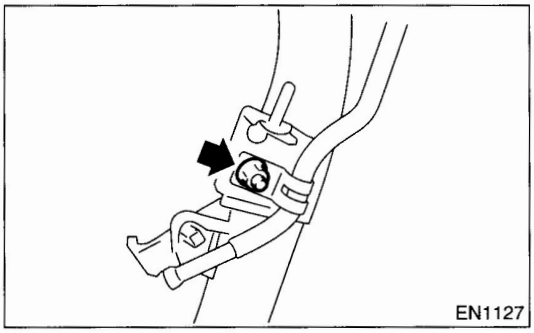



## C: DISASSEMBLY

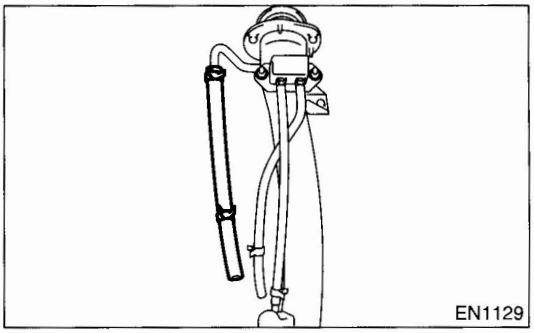
1) Move the clip, and disconnect the evaporation hose from joint pipe.




2) Remove the bolt which installs the joint pipe on fuel filler pipe.




3) Disconnect the evaporation hose from the fuel filler pipe.

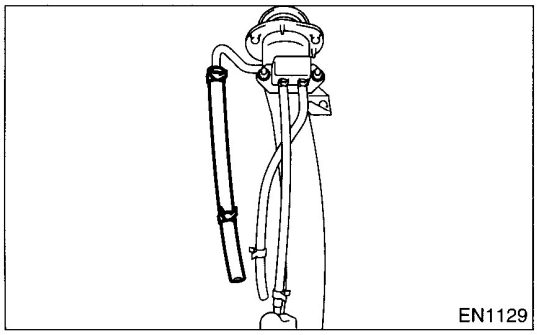



4) Remove the shut valve from the fuel filler pipe. <Ref. to EC(DOHC TURBO)-16, REMOVAL, Shut Valve.>

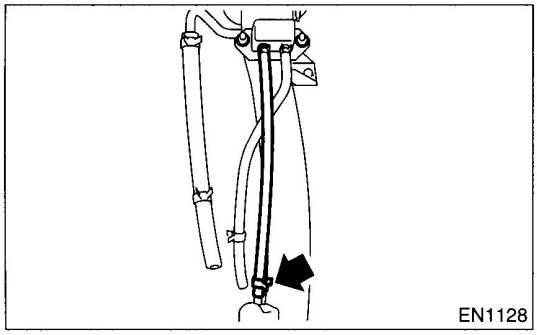

GETtheMANUALS.org

## D: ASSEMBLY

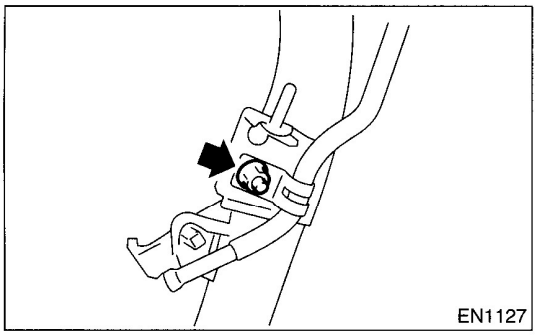
1) Install the shut valve on the fuel filler pipe. <Ref. to EC(DOHC TURBO)-16, INSTALLATION, Shut Valve.>
2) Connect the evaporation hose to the fuel filler pipe.




3) Connect the evaporation hose to the evaporation pipe.




4) Install the evaporation pipe to the fuel filler pipe.





GETtheMANUALS.org

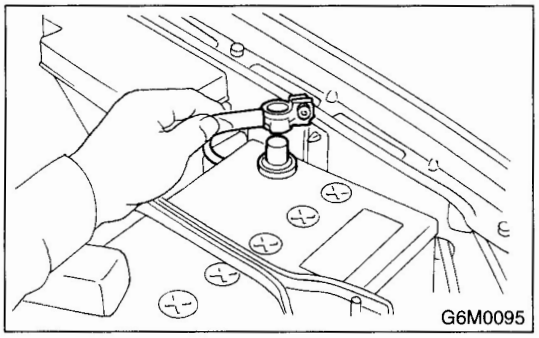
# 25.Fuel Pump

## A: REMOVAL

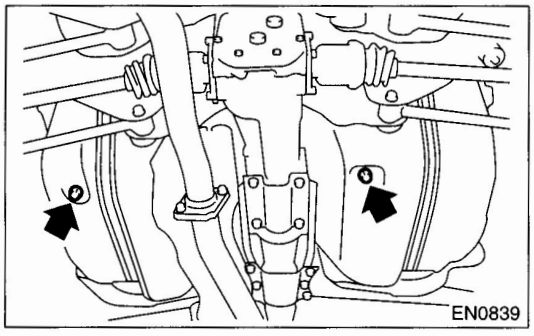
**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

NOTE:
Fuel pump assembly consists of fuel pump and fuel level sensor.

1) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Open the fuel filler flap lid and remove the fuel filler cap.
3) Disconnect the battery ground cable.

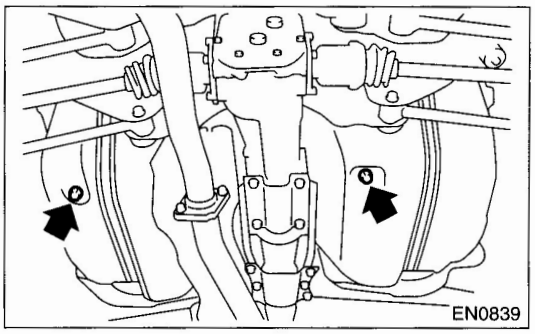

G6M0095

4) Lift-up the vehicle.
5) Drain the fuel from fuel tank. Set a container under the vehicle and remove the drain plug from fuel tank.

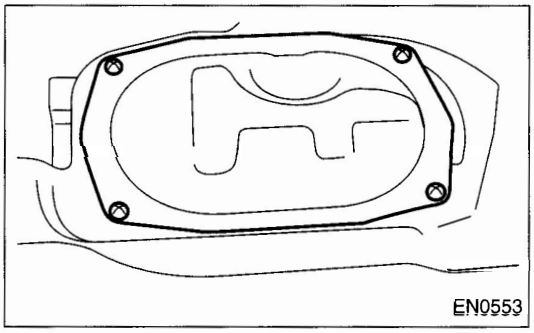

EN0839

6) Tighten the fuel drain plug.

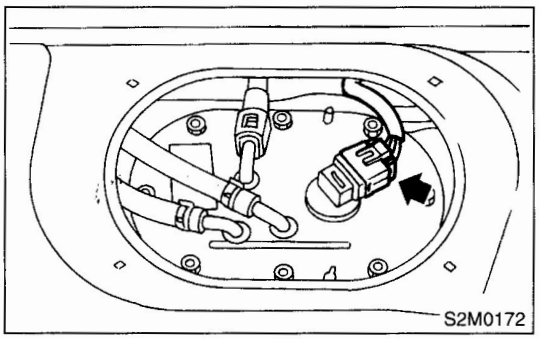
***Tightening torque:***
***26 N·m (2.65 kgf-m, 19.2 ft-lb)***


EN0839

7) Raise the rear seat and turn the floor mat up.
8) Remove the access hole lid.


EN0553

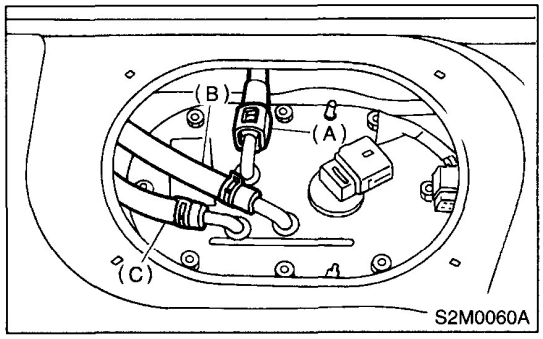
9) Disconnect the connector from the fuel pump.


S2M0172

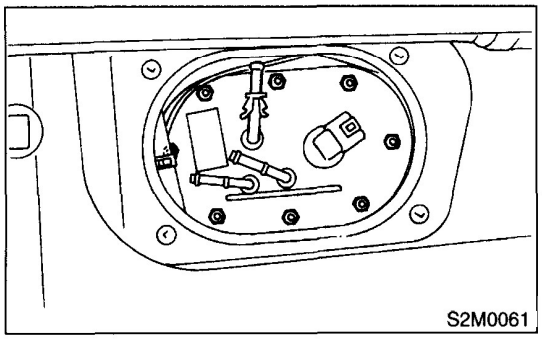
10) Disconnect the quick connector and then disconnect the fuel delivery hose (A). <Ref. to FU(DOHC TURBO)-68, Fuel Delivery, Return and Evaporation Lines.>


GETtheMANUALS.org

11) Move the clips, and then disconnect the fuel return hose (B) and jet pump hose (C).




12) Remove the nuts which install the fuel pump assembly onto fuel tank.

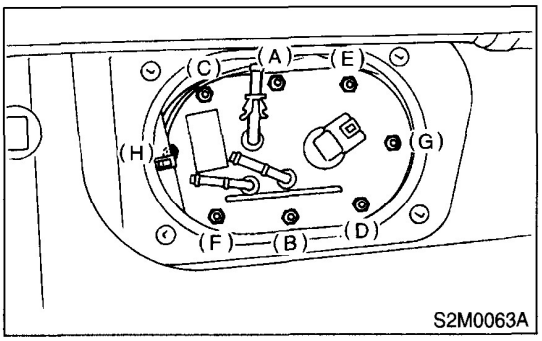



13) Take off the fuel pump assembly from the fuel tank.

## B: INSTALLATION

Install in the reverse order of removal. Do the following:
(1) Always use new gaskets.
(2) Ensure the sealing portion is free from fuel or foreign particles before installation.
(3) Tighten the nuts in alphabetical sequence shown in figure to specified torque.

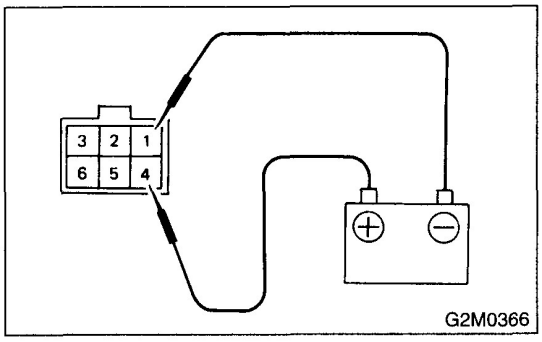
***Tightening torque:***
***4.4 N·m (0.45 kgf-m, 3.3 ft-lb)***




## C: INSPECTION

Connect the lead harness to the connector terminal of fuel pump and apply battery power supply to check whether the pump operate.

**WARNING:**
- **Wipe off the fuel completely.**
- **Keep battery as far apart from fuel pump as possible.**
- **Be sure to turn the battery supply ON and OFF on the battery side.**
- **Do not run fuel pump for a long time under non-load condition.**





GETtheMANUALS.org

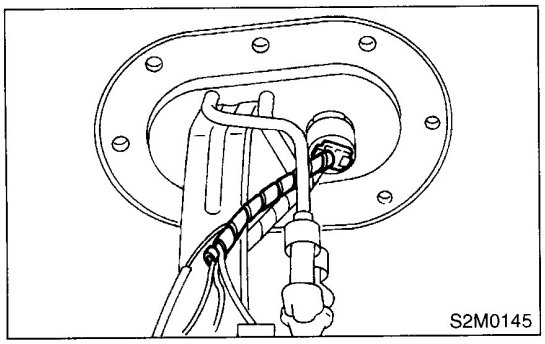
# 26.Fuel Level Sensor

## A: REMOVAL

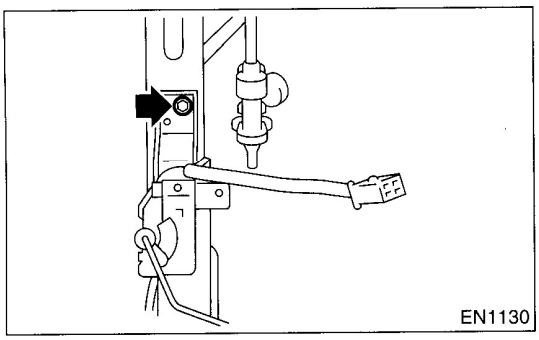
**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

NOTE:
Fuel level sensor is built in fuel pump assembly.

1) Remove the fuel pump assembly. <Ref. to FU(DOHC TURBO)-60, REMOVAL, Fuel Pump.>
2) Disconnect the connector from the fuel pump bracket.




3) Remove the bolt which installs the fuel level sensor on mounting bracket.




## B: INSTALLATION

Install in the reverse order of removal.

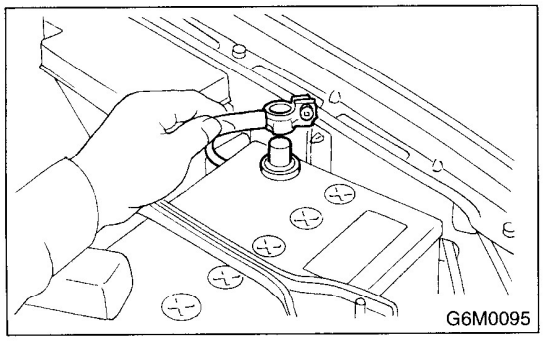

GETtheMANUALS.org

# 27.Fuel Sub Level Sensor

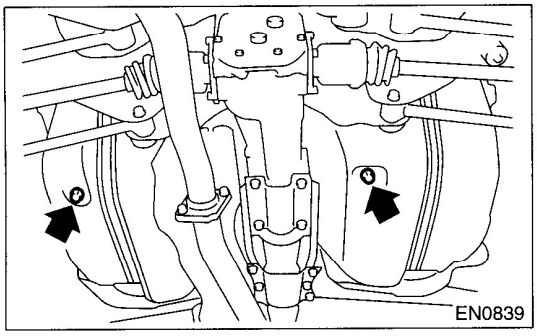
## A: REMOVAL

**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

1) Disconnect the battery ground cable.

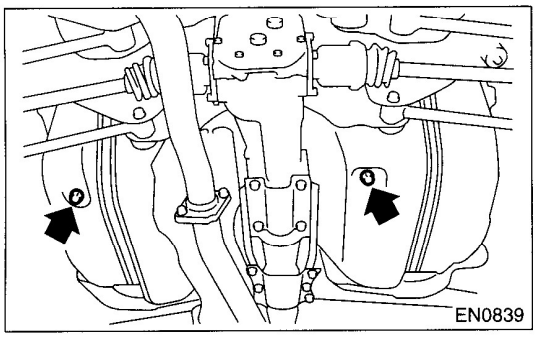



2) Lift-up the vehicle.
3) Drain the fuel from the fuel tank. Set a container under the vehicle and remove drain plug from fuel tank.

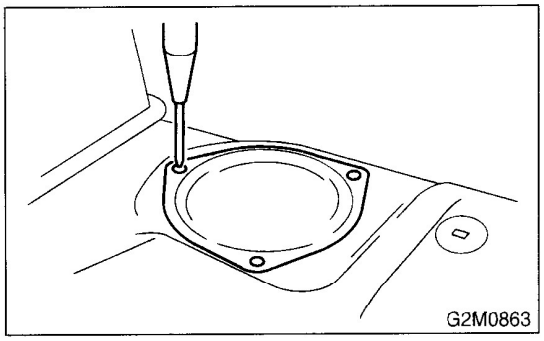



4) Tighten the fuel drain plug.

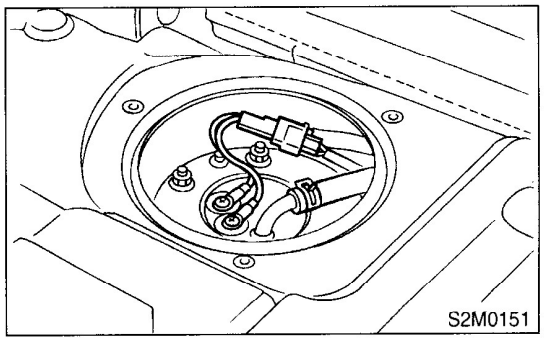
***Tightening torque:***
***26 N·m (2.65 kgf-m, 19.2 ft-lb)***



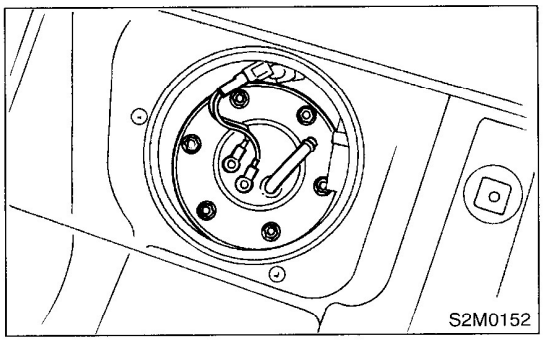

5) Remove the rear seat.
6) Remove the service hole cover.



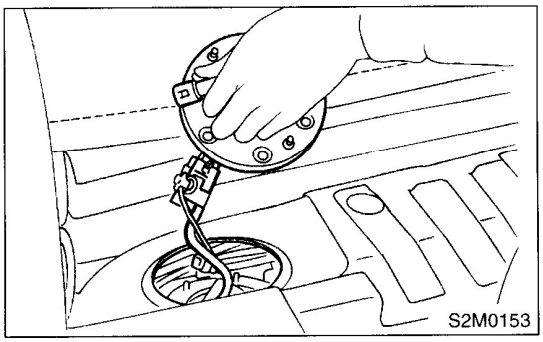

7) Disconnect the connector from the fuel sub meter.
8) Disconnect the fuel jet pump hose.




9) Remove the bolts which install the fuel sub meter unit on fuel tank.




10) Remove the fuel sub meter unit.



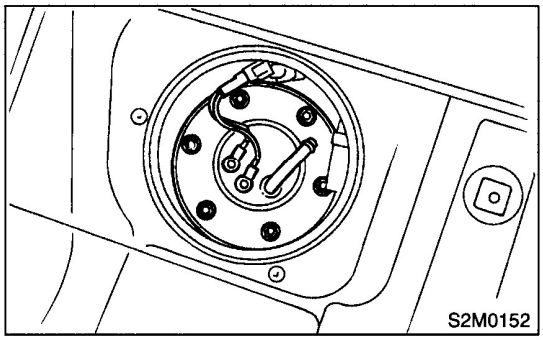


GETtheMANUALS.org

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***4.4 N·m (0.45 kgf-m, 3.3 ft-lb)***





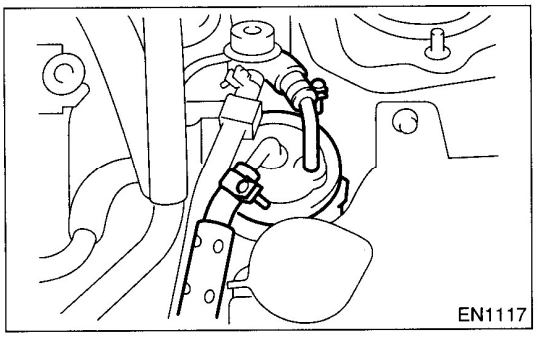
GETtheMANUALS.org

# 28.Fuel Filter

## A: REMOVAL

**WARNING:**
- **Place "NO FIRE" signs near the working area.**
- **Be careful not to spill fuel on the floor.**

1) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Disconnect the fuel delivery hoses from the fuel filter.



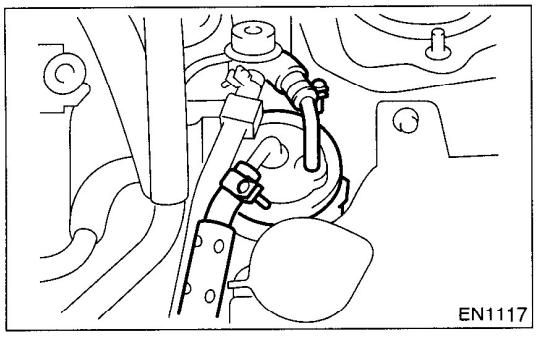

3) Remove the filter from the holder.

## B: INSTALLATION

**CAUTION:**
- **If fuel hoses are damaged at the connecting portion, replace it with a new one.**
- **If clamps are badly damaged, replace with new ones.**

1) Install in the reverse order of removal.
2) Tighten the hose clamp screws.

***Tightening torque:***
***1.25 N·m (0.13 kgf-m, 0.94 ft-lb)***




## C: INSPECTION

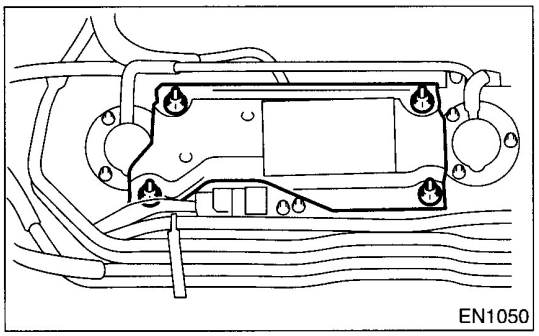
1) Check the inside of fuel filter for dirt and water sediment.
2) If it is clogged, or if replacement interval has been reached, replace it.
3) If water is found in it, shake and expel the water from the inlet port.


GETtheMANUALS.org

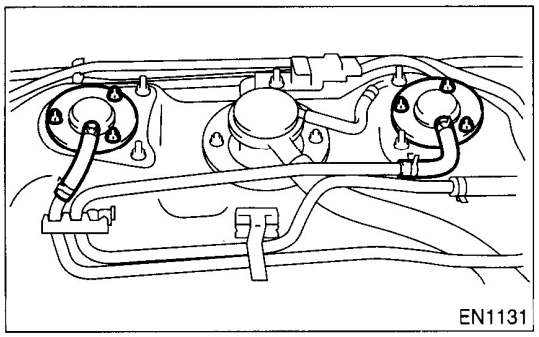
# 29.Fuel Cut Valve

## A: REMOVAL

1) Remove the fuel tank. <Ref. to FU(DOHC TURBO)-52, REMOVAL, Fuel Tank.>
2) Remove the protect cover.




3) Move the clip and disconnect the evaporation hose from fuel cut valve.

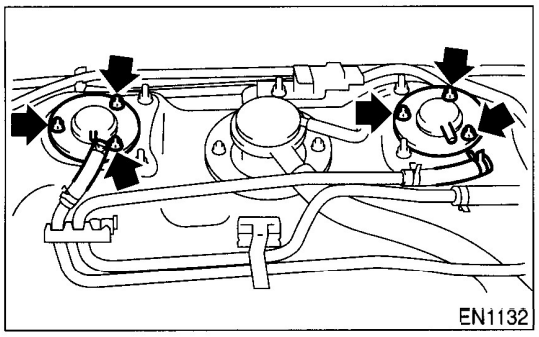



4) Remove the bolts which install the fuel cut valve.

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***4.4 N·m (0.45 kgf-m, 3.3 ft-lb)***



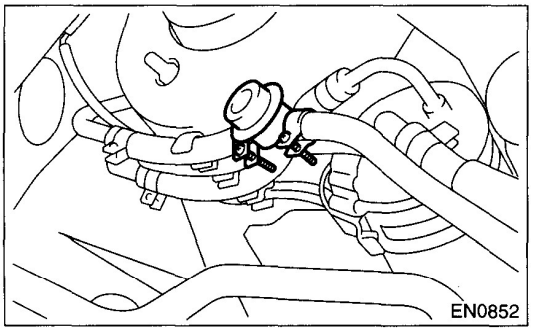


GETtheMANUALS.org

# 30.Fuel Damper Valve

## A: REMOVAL

1) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Remove the fuel damper valve from the fuel return line.




## B: INSTALLATION

Install in the reverse order of removal.

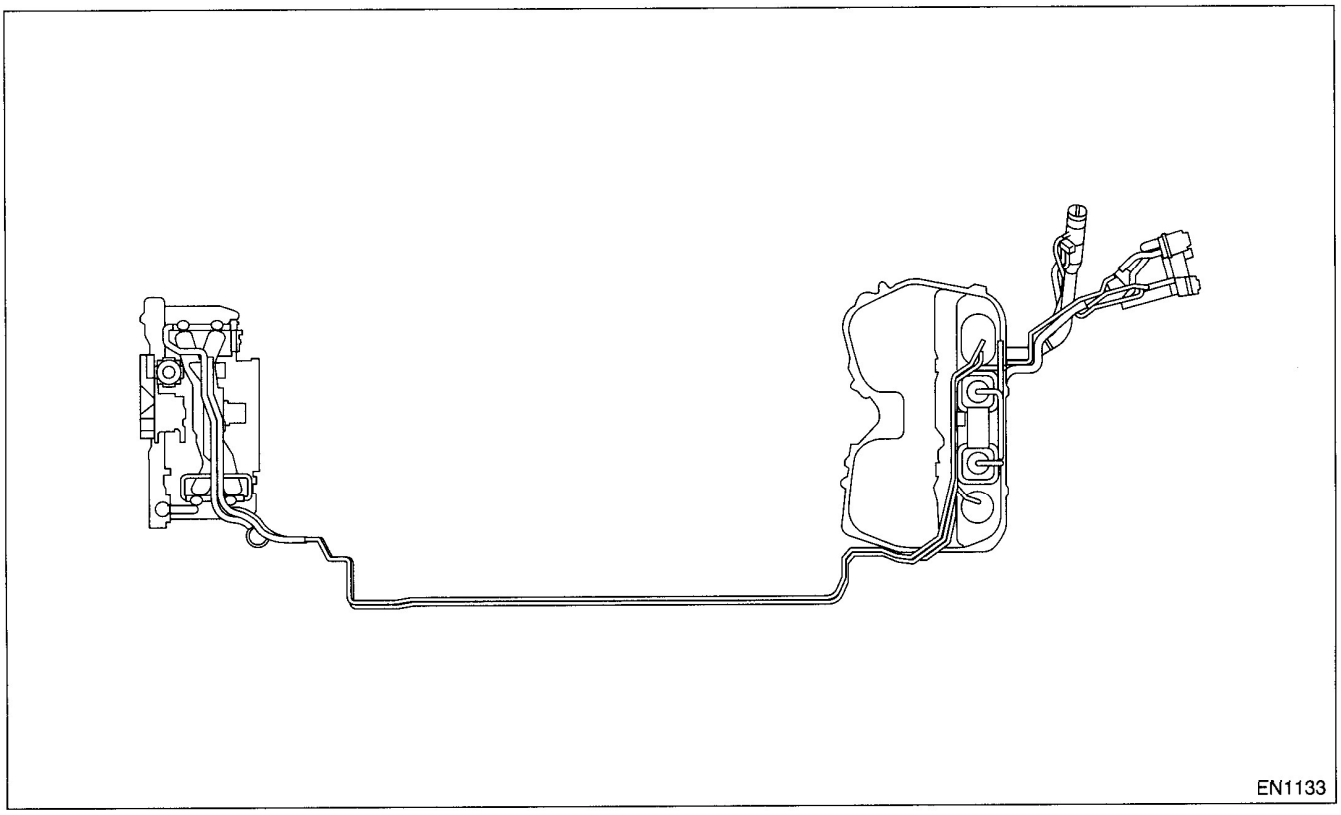
***Tightening torque:***
***1.25 N·m (0.13 kgf-m, 0.94 ft-lb)***


GETtheMANUALS.org

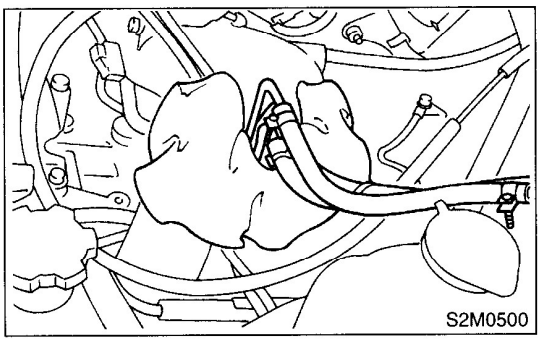
# 31. Fuel Delivery, Return and Evaporation Lines

## A: REMOVAL

1) Set the vehicle on the lift.
2) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
3) Open the fuel filler flap lid and remove the fuel filler cap.
4) Remove the floor mat. <Ref. to EI-55, REMOVAL, Floor Mat.>
5) Remove the fuel delivery pipes and hoses, fuel return pipes and hoses, evaporation pipes and hoses.




6) In engine compartment, detach the fuel delivery hoses, return hoses and evaporation hose.

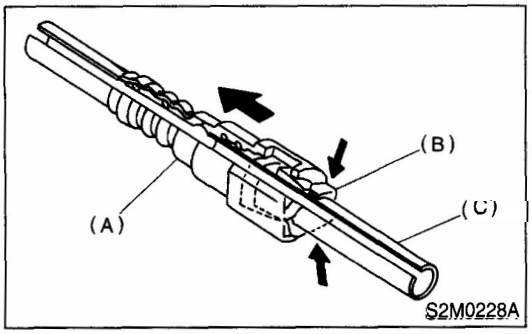



7) Lift-up the vehicle.


GETtheMANUALS.org

8) Separate the quick connector on the fuel delivery and return line.
(1) Clean the pipe and connector, if they are covered with dust.
(2) Hold the connector (A) and push retainer (B) down.
(3) Pull out the connector (A) from retainer (B).

**CAUTION:**
**Replace retainer with new ones.**

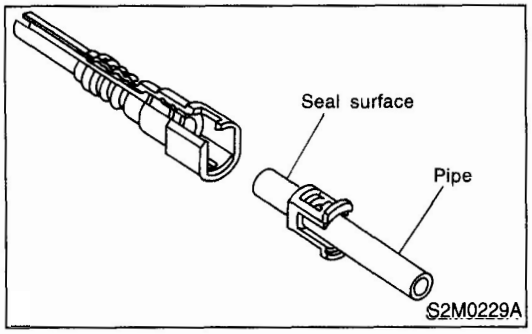



(A) Connector
(B) Retainer
(C) Pipe

## B: INSTALLATION

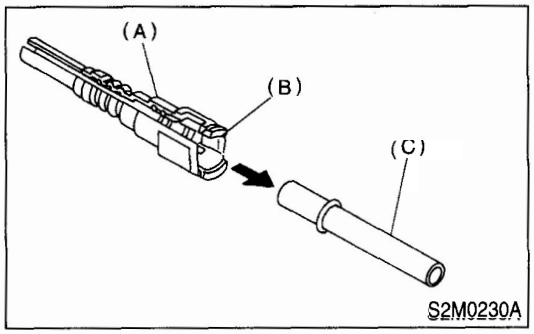
1) Connect the quick connector on the fuel delivery line.

**CAUTION:**
- **Always use a new retainer.**
- **Make sure that the connected portion is not damaged or has dust. If necessary, clean seal surface of pipe.**



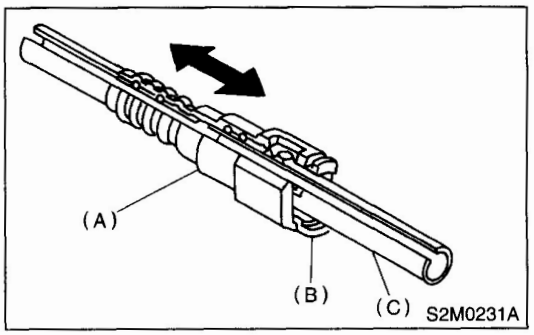

(1) Set the new retainer (B) to connector (A).
(2) Push the pipe into the connector completely.

NOTE:
At this time, two clicking sounds are heard.




(A) Connector
(B) Retainer
(C) Pipe

**CAUTION:**
- **Pull the connector to ensure it is connected securely.**
- **Ensure the two retainer pawls are engaged in their mating positions in the connector.**
- **Be sure to inspect hoses and their connections for any leakage of fuel.**



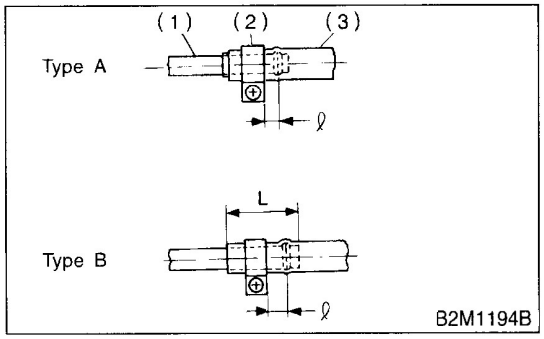

(A) Connector
(B) Retainer
(C) Pipe


GETtheMANUALS.org

2) Connect the fuel delivery hose to the pipe with an overlap of 20 to 25 mm (0.79 to 0.98 in).
Type A: When the fitting length is specified.
Type B: When the fitting length is not specified.

***ℓ : 2.5±1.5 mm (0.098±0.059 in)***

***L: 22.5±2.5 mm (0.886±0.098 in)***



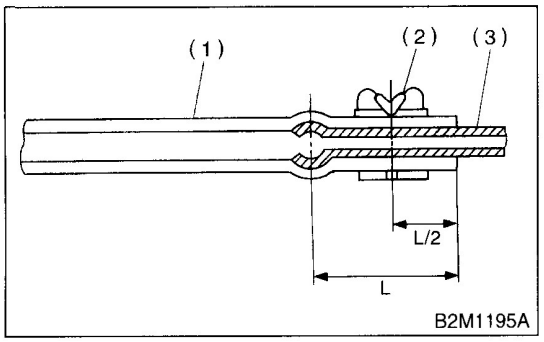

(1) Fitting
(2) Clamp
(3) Hose

3) Connect the return hose and evaporation hose to the pipe by approx. 15 mm (0.59 in) from the hose end.

***Fuel return hose:***
***L = 22.5±2.5 mm (0.885±0.098 in)***

***Fuel evaporation hose:***
***L = 17.5±2.5 mm (0.689±0.098 in)***

**CAUTION:**
**Be sure to inspect hoses and their connections for any leakage of fuel.**




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

## C: INSPECTION

1) Make sure that there are no cracks on the fuel pipes and fuel hoses.
2) Make sure that the fuel pipe and fuel hose connections are tight.


GETtheMANUALS.org

# 32. Fuel System Trouble in General

## A: INSPECTION

| Trouble and possible cause | | | Corrective action |
|---|---|---|---|
| **1. Insufficient fuel supply to the injector** | | | |
| 1) | Fuel pump will not operate. | | |
| | ○ | Defective terminal contact. | Inspect connections, especially ground, and tighten securely. |
| | ○ | Trouble in electromagnetic or electronic circuit parts. | Replace fuel pump. |
| 2) | | Lowering of fuel pump function. | Replace fuel pump. |
| 3) | | Clogged dust or water in the fuel filter. | Replace fuel filter, clean or replace fuel tank. |
| 4) | | Clogged or bent fuel pipe or hose. | Clean, correct or replace fuel pipe or hose. |
| 5) | | Air is mixed in the fuel system. | Inspect or retighten each connection part. |
| 6) | | Clogged or bent breather tube or pipe. | Clean, correct or replace air breather tube or pipe. |
| 7) | | Damaged diaphragm of pressure regulator. | Replace. |
| **2. Leakage or blow out fuel** | | | |
| 1) | | Loosened joints of the fuel pipe. | Retightening. |
| 2) | | Cracked fuel pipe, hose and fuel tank. | Replace. |
| 3) | | Defective welding part on the fuel tank. | Replace. |
| 4) | | Defective drain packing of the fuel tank. | Replace. |
| 5) | | Clogged or bent air breather tube or air vent tube. | Clean, correct or replace air breather tube or air vent tube. |
| **3. Gasoline smell inside of compartment** | | | |
| 1) | | Loose joints at air breather tube, air vent tube and fuel filler pipe. | Retightening. |
| 2) | | Defective packing air tightness on the fuel saucer. | Correct or replace packing. |
| 3) | | Cracked fuel separator. | Replace separator. |
| 4) | | Inoperative fuel pump modulator or circuit. | Replace. |
| **4. Defective fuel meter indicator** | | | |
| 1) | | Defective operation of fuel level sensor. | Replace. |
| 2) | | Defective operation of fuel meter. | Replace. |
| **5. Noise** | | | |
| 1) | | Large operation noise or vibration of fuel pump. | Replace. |

NOTE:

• When the vehicle is left unattended for an extended period of time, water may accumulate in the fuel tank.

To prevent water condensation.

(1) Top off the fuel tank or drain the fuel completely.

(2) Drain the water condensation from the fuel filter.

• Refilling the fuel tank.

Refill the fuel tank while there is still some fuel left in the tank.

• Protecting the fuel system against freezing and water condensation.

(3) Cold areas

In snow-covered areas, mountainous areas, skiing areas, etc. where ambient temperatures drop below 0°C (32°F) throughout the winter season, use an anti-freeze solution in the cooling system. Refueling will also complement the effect of anti-freeze solution each time the fuel level drops to about one-half. After the winter season, drain the water which may have accumulated in the fuel filter and fuel tank in the manner same as that described under Affected areas below.

(4) Affected areas

When the water condensation is notched in the fuel filter, drain the water from both the fuel filter and fuel tank or use a water removing agent (or anti-freeze solution) in the fuel tank.

• Observe the instructions, notes, etc., indicated on the label affixed to the anti-freeze solution (water removing agent) container before use.


GETtheMANUALS.org

GETtheMANUALS.org

# EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES)

# EC(DOHC TURBO)


| | | Page |
|---|---|---|
| 1. | General Description | 2 |
| 2. | Front Catalytic Converter | 3 |
| 3. | Rear Catalytic Converter | 4 |
| 4. | Precatalytic Converter | 5 |
| 5. | Canister | 6 |
| 6. | Purge Control Solenoid Valve | 7 |
| 7. | Main Fuel Level Sensor | 8 |
| 8. | Fuel Temperature Sensor | 9 |
| 9. | Fuel Sub Level Sensor | 10 |
| 10. | Fuel Tank Pressure Sensor | 11 |
| 11. | Pressure Control Solenoid Valve | 12 |
| 12. | Drain Filter | 14 |
| 13. | Vent Valve | 15 |
| 14. | Shut Valve | 16 |
| 15. | Drain Valve | 17 |


GETtheMANUALS.org

# 1. General Description

## A: CAUTION

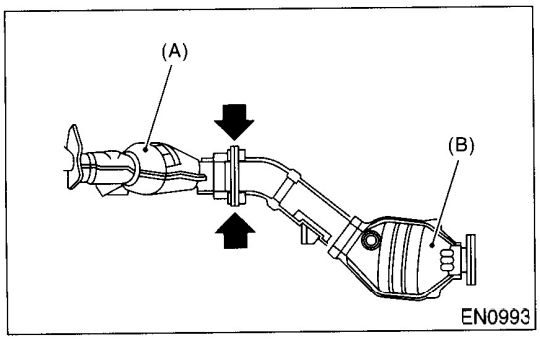
- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the negative terminal from battery.


GETtheMANUALS.org

# 2. Front Catalytic Converter

## A: REMOVAL

1) Remove the center exhaust pipe. <Ref. to EX(DOHC TURBO)-8, REMOVAL, Center Exhaust Pipe.>
2) Separate the front catalytic converter (A) from rear catalytic converter (B).




## B: INSTALLATION

NOTE:
Replace the gaskets with new ones.
Install in the reverse order of removal.

## C: INSPECTION

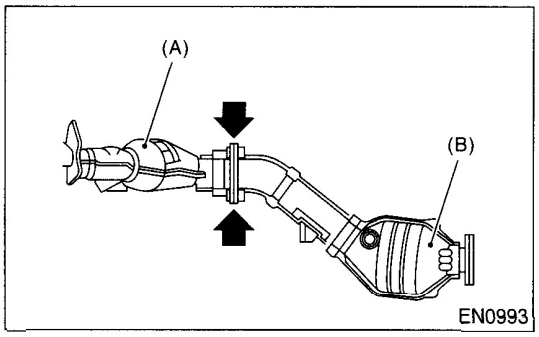
1) Make sure there are no exhaust leaks from connections and welds.
2) Make sure there are no holes or rusting.


GETtheMANUALS.org

# 3. Rear Catalytic Converter

## A: REMOVAL

1) Remove the center exhaust pipe. <Ref. to EX(DOHC TURBO)-8, REMOVAL, Center Exhaust Pipe.>
2) Separate the rear catalytic converter (B) from front catalytic converter (A).




## B: INSTALLATION

NOTE:
Replace the gaskets with new ones.
Install in the reverse order of removal.

## C: INSPECTION

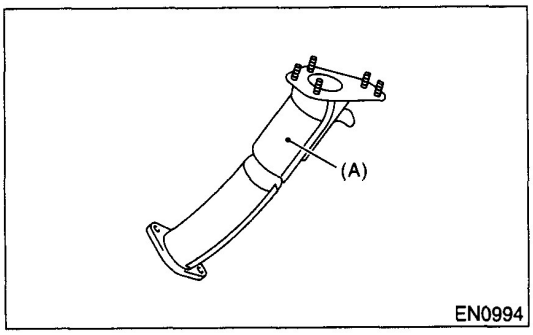
1) Make sure there are no exhaust leaks from connections and welds.
2) Make sure there are no holes or rusting.


GETtheMANUALS.org

# 4. Precatalytic Converter

## A: REMOVAL

Precatalytic converter (A) is built in the joint pipe. Refer to the removal of joint pipe for removal procedure. <Ref. to EX(DOHC TURBO)-12, REMOVAL, Joint Pipe.>




## B: INSTALLATION

Precatalytic converter is built in the joint pipe. Refer to the installation of joint pipe for installation procedure. <Ref. to EX(DOHC TURBO)-12, INSTALLATION, Joint Pipe.>

## C: INSPECTION

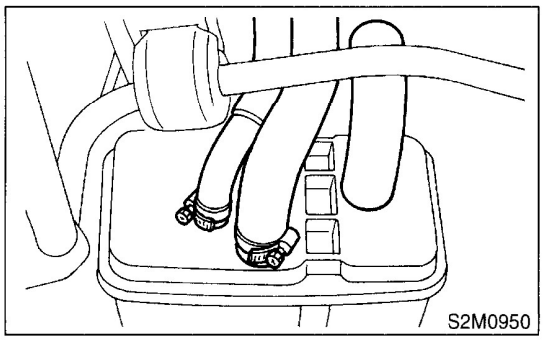
1) Make sure there are no exhaust leaks from connections and welds.
2) Make sure there are no holes or rusting.


GETtheMANUALS.org

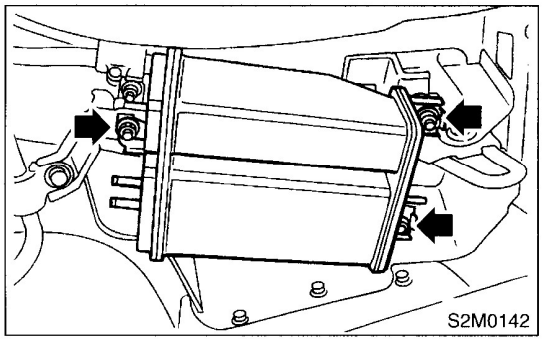
# 5. Canister

## A: REMOVAL

1) Lift-up the vehicle.
2) Loosen the two clamps which hold two canister hoses, and disconnect the evaporation three hoses from canister.



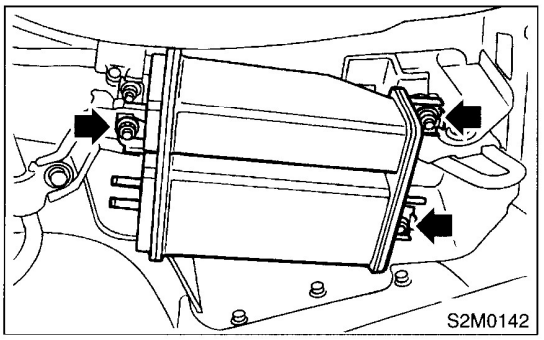

3) Remove the canister from body.




## B: INSTALLATION

1) Install in the reverse order of removal.

***Tightening torque:***
***23 N·m (2.3 kgf-m, 17 ft-lb)***




## C: INSPECTION

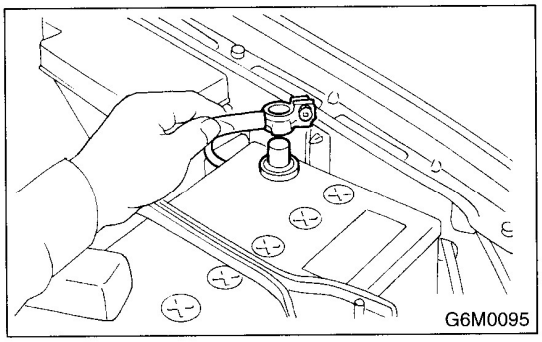
Make sure the canister and canister hoses are not cracked or loose.


GETtheMANUALS.org

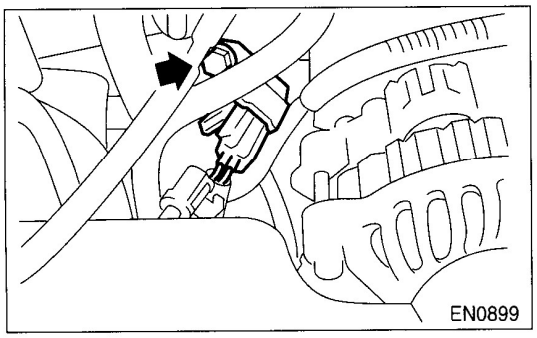
# 6. Purge Control Solenoid Valve

## A: REMOVAL

1) Disconnect the ground terminal from battery.



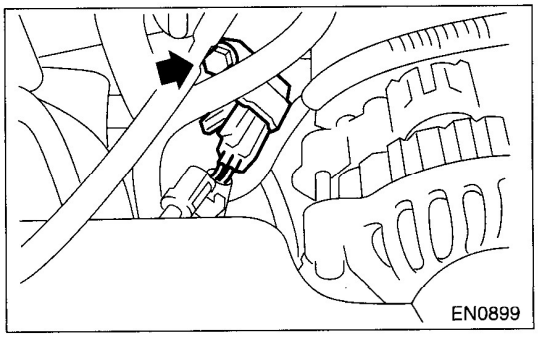

2) Disconnect the connector and hoses from purge control solenoid valve.
3) Remove the bolt which installs the purge control solenoid valve onto intake manifold.



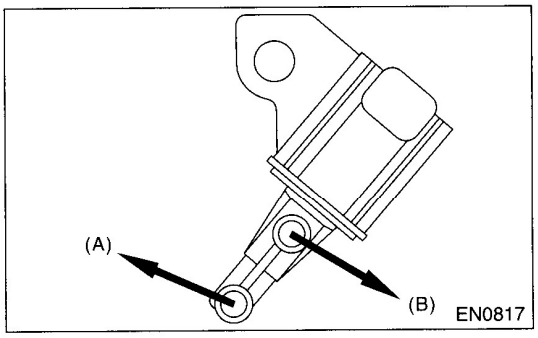

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***16 N·m (1.6 kgf-m, 11.6 ft-lb)***




**CAUTION:**
**Carefully connect the evaporation hoses.**




(A) To intake manifold
(B) To purge value

## C: INSPECTION

Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

# 7. Main Fuel Level Sensor

## A: REMOVAL

For work procedures, refer to "FU" section. <Ref. to FU(DOHC TURBO)-62, REMOVAL, Fuel Level Sensor.>

## B: INSTALLATION

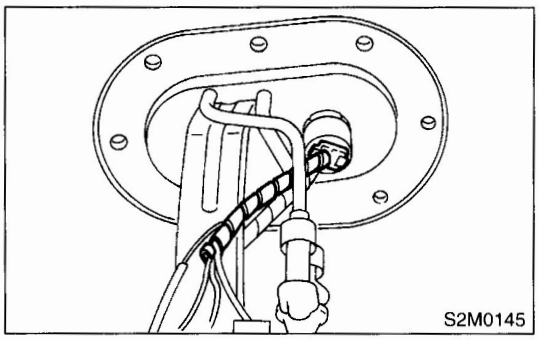
For work procedures, refer to "FU" section.
<Ref. to FU(DOHC TURBO)-62, INSTALLATION, Fuel Level Sensor.>


GETtheMANUALS.org

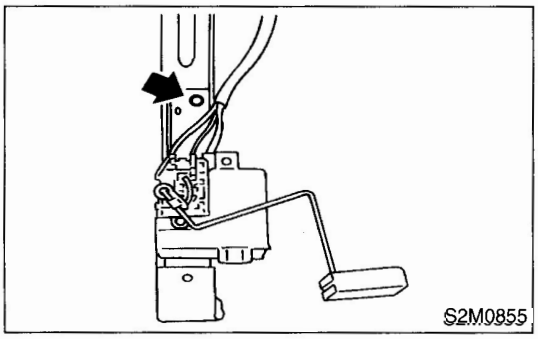
# 8. Fuel Temperature Sensor

## A: REMOVAL

1) Remove the fuel pump assembly. <Ref. to FU(DOHC TURBO)-60, REMOVAL, Fuel Pump.>
2) Disconnect the connector from fuel pump bracket.




3) Remove the main fuel level sensor from fuel pump assembly. <Ref. to FU(DOHC TURBO)-62, REMOVAL, Fuel Level Sensor.>




NOTE:
Fuel temperature sensor is a unit with the fuel pump. If replacing it, replace as a fuel pump.

## B: INSTALLATION

Install in the reverse order of removal.

**WARNING:**
**Spark may occur and ignite if fuel is nearby.**


GETtheMANUALS.org

# 9. Fuel Sub Level Sensor

## A: REMOVAL

For work procedures, refer to "FU(DOHC TURBO)" section. <Ref. to FU(DOHC TURBO)-63, REMOVAL, Fuel Sub Level Sensor.>

## B: INSTALLATION

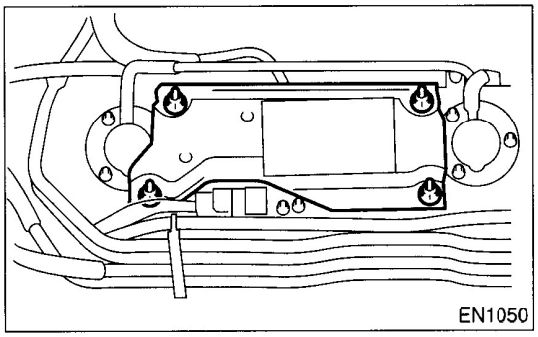
For work procedures, refer to "FU(DOHC TURBO)" section. <Ref. to FU(DOHC TURBO)-64, INSTALLATION, Fuel Sub Level Sensor.>


GETtheMANUALS.org

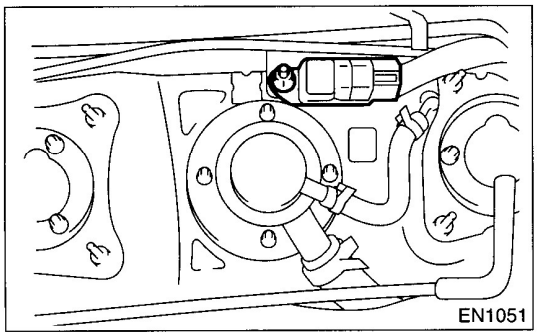
# 10.Fuel Tank Pressure Sensor

## A: REMOVAL

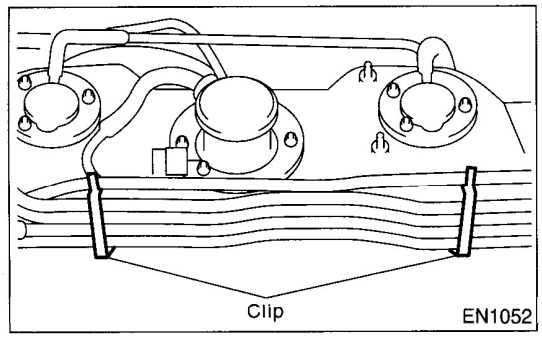
1) Remove the fuel tank. <Ref. to FU(DOHC TURBO)-52, REMOVAL, Fuel Tank.>
2) Remove the protector cover.



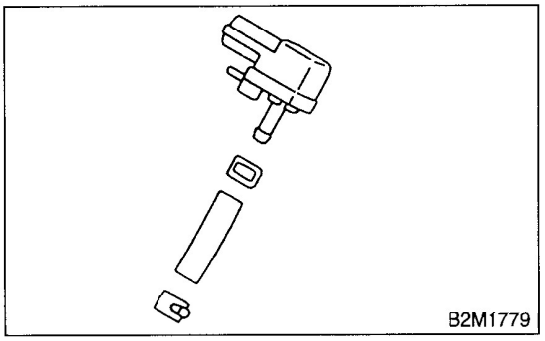

3) Disconnect the connector from fuel pressure sensor, then remove the fixing nut.




4) Release the clips which hold fuel pipes onto fuel tank.



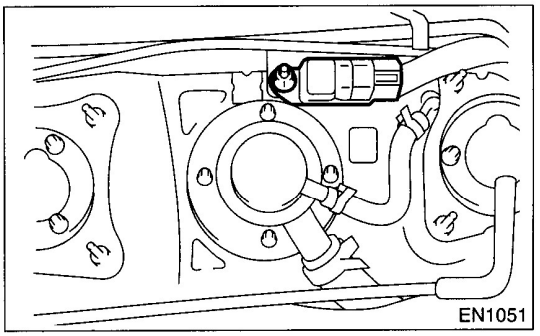

5) Remove the clip, and disconnect pressure hose from fuel tank.
6) Disconnect the pressure hose from fuel tank pressure sensor.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***7.4 N·m (0.75 kgf-m, 5.4 ft-lb)***




## C: INSPECTION

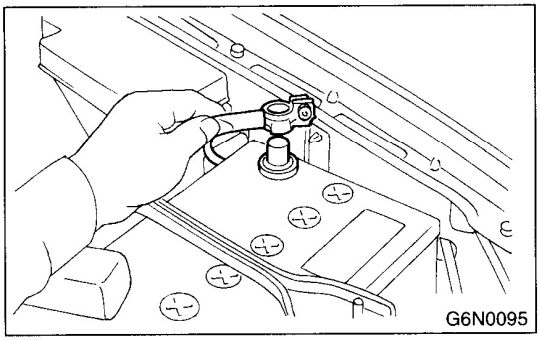
Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

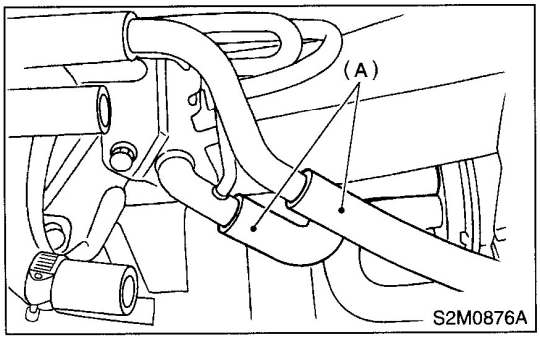
# 11.Pressure Control Solenoid Valve

## A: REMOVAL

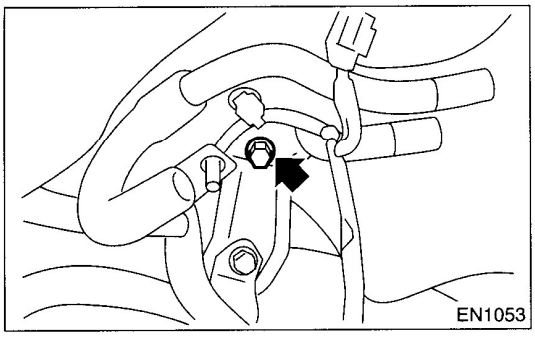
1) Disconnect the ground terminal from battery.



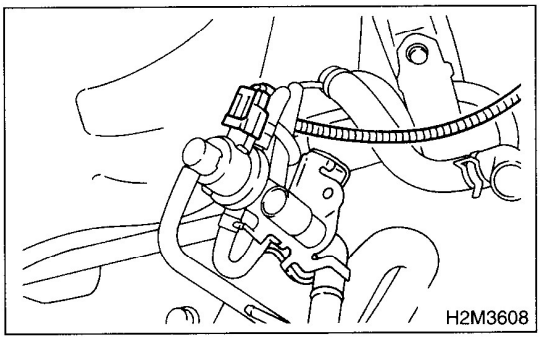

2) Remove the canister. <Ref. to EC(DOHC TURBO)-6, REMOVAL, Canister.>
3) Disconnect the evaporation hoses (A) from joint pipes.



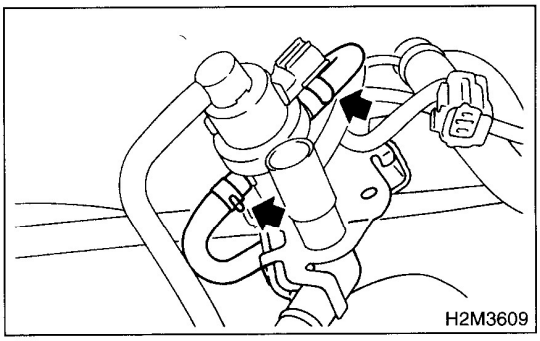

4) Remove the bolt which installs pressure control solenoid valve holding bracket on body.



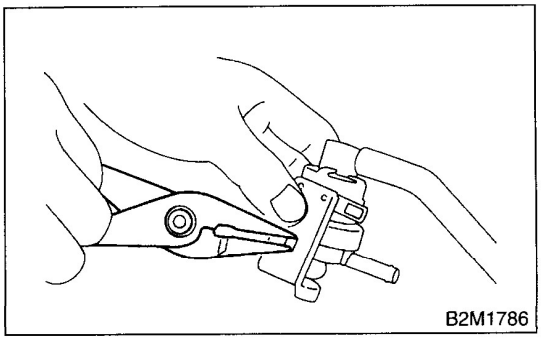

5) Disconnect the connector from pressure control solenoid valve.



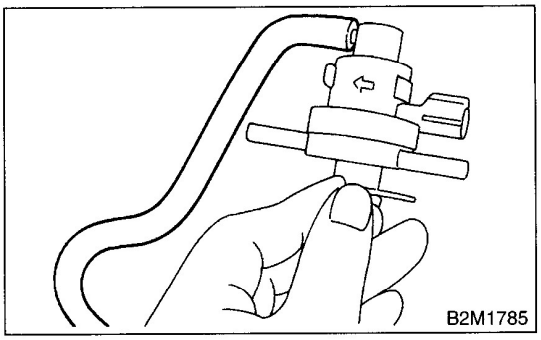

6) Disconnect the two evaporation hoses from pressure control solenoid valve.
7) Remove the pressure control solenoid valve with bracket.




8) Remove the pressure control solenoid valve from bracket.




9) Disconnect the vacuum hose from pressure control solenoid valve.



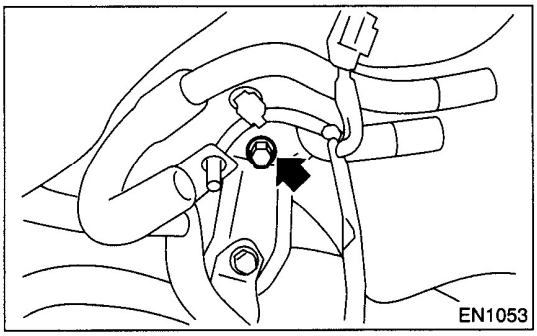


GETtheMANUALS.org

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***17.6 N·m (1.8 kgf-m, 13.0 ft-lb)***




## C: INSPECTION

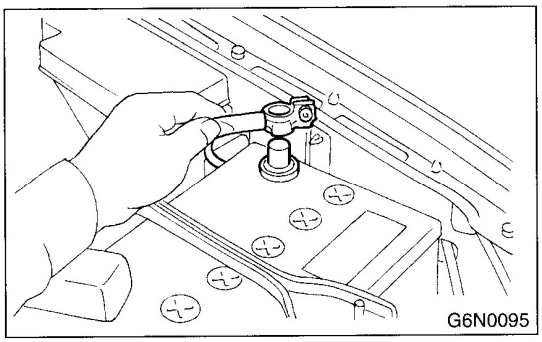
Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

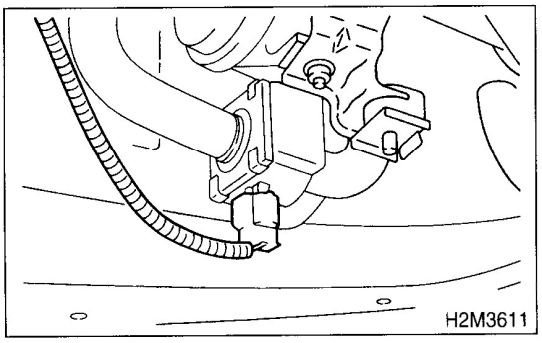
# 12.Drain Filter

## A: REMOVAL

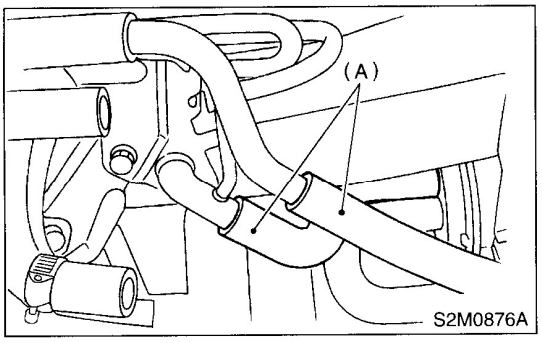
1) Disconnect the ground terminal from battery.



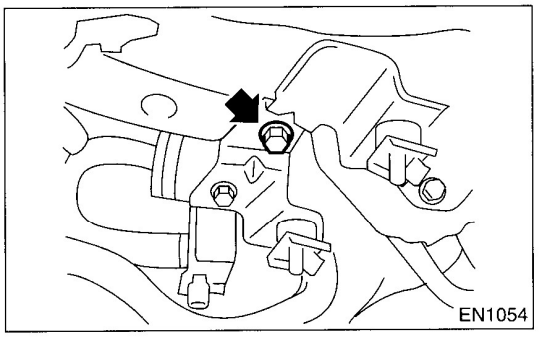

2) Lift-up the vehicle.
3) Remove the canister. <Ref. to EC(DOHC TURBO)-6, REMOVAL, Canister.>
4) Disconnect the connector from drain valve.



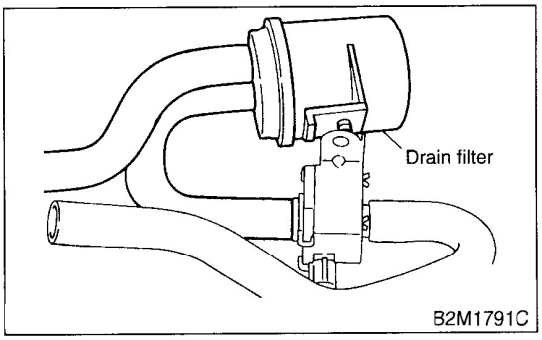

5) Disconnector the evaporation hoses (A) from joint pipes.




6) Remove the bolt which installs the drain filter and drain valve brackets on body, and remove them as a unit.



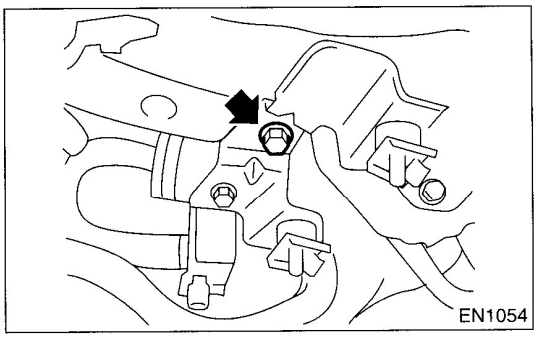

7) Disconnect the evaporation hoses, and remove the drain filter.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***23 N·m (2.3 kgf-m, 17 ft-lb)***




## C: INSPECTION

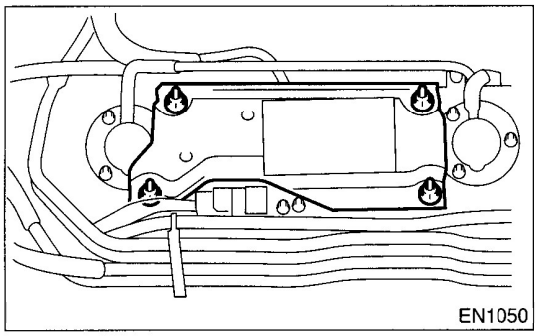
1) Make sure all hoses are installed correctly.
2) Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

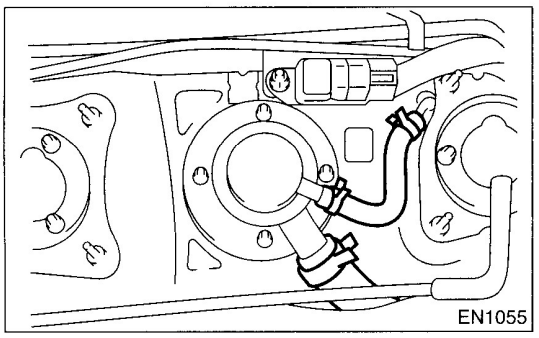
# 13. Vent Valve

## A: REMOVAL

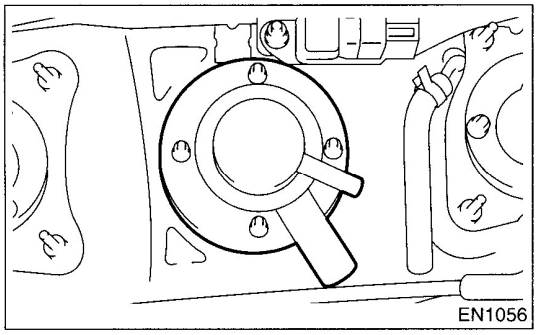
1) Remove the fuel tank. <Ref. to FU(DOHC TURBO)-52, REMOVAL, Fuel Tank.>
2) Remove the protector cover.




3) Remove the clips, and disconnect the hoses from vent valve.




4) Remove the nuts which install the vent on fuel tank.

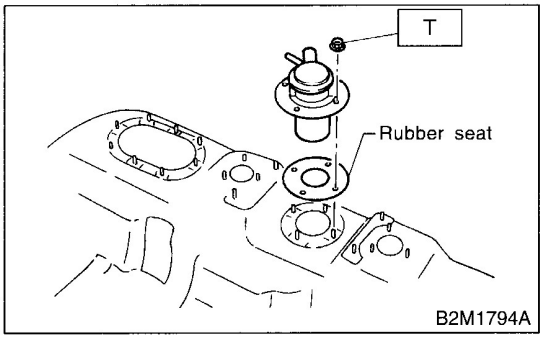



## B: INSTALLATION

Install in the reverse order of removal.

**CAUTION:**
**Replace the rubber seat with a new one.**

***Tightening torque:***
***T: 4.4 N·m (0.45 kgf-m, 3.3 ft-lb)***




## C: INSPECTION

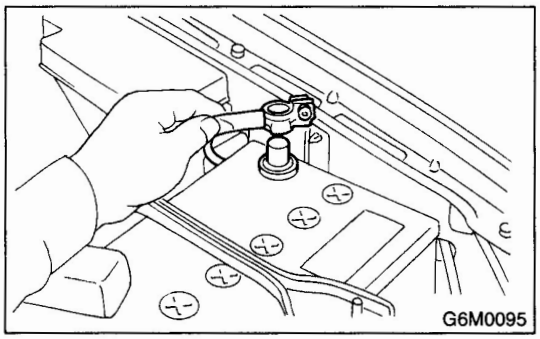
Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

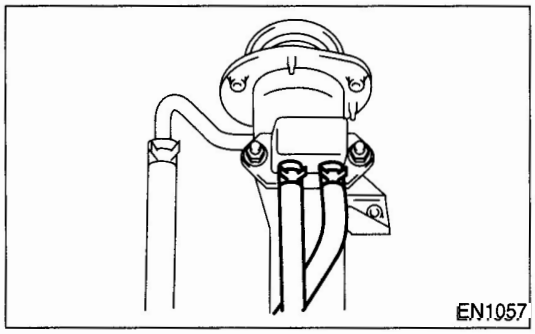
# 14.Shut Valve

## A: REMOVAL

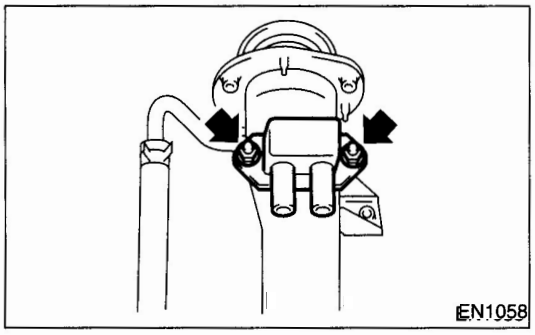
1) Disconnect the ground terminal from battery.




2) Drain fuel from the fuel tank. <Ref. to FU(DOHC TURBO)-52, REMOVAL, Fuel Tank.>
3) Remove the fuel filler pipe. <Ref. to FU(DOHC TURBO)-55, REMOVAL, Fuel Filler Pipe.>
4) Disconnect the evaporation hoses from shut valve.



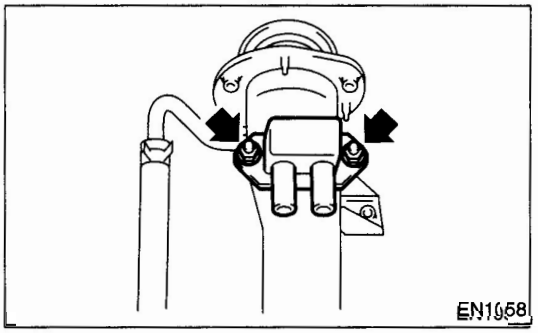

5) Remove the shut valve from fuel filler pipe.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***4.5 N·m (0.46 kgf-m, 3.3 ft-lb)***




## C: INSPECTION

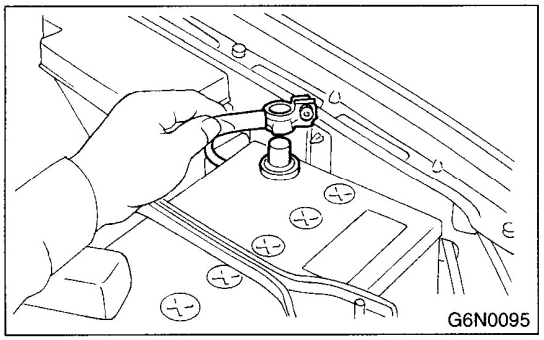
Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

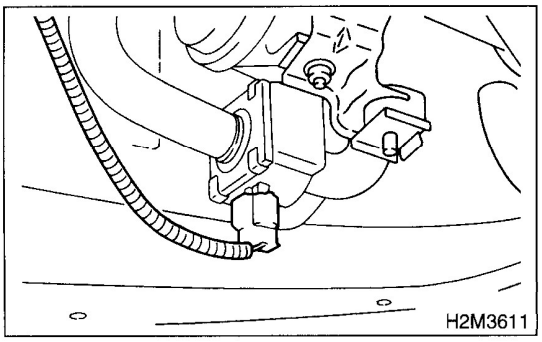
# 15.Drain Valve

## A: REMOVAL

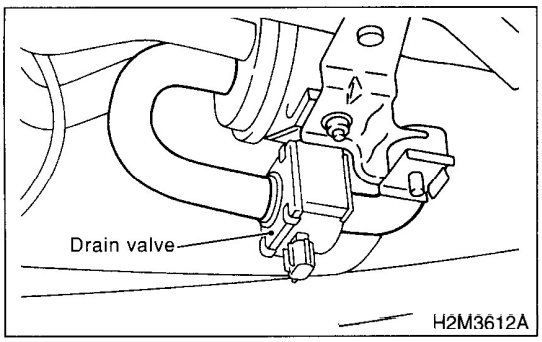
1) Disconnect the ground terminal from battery.



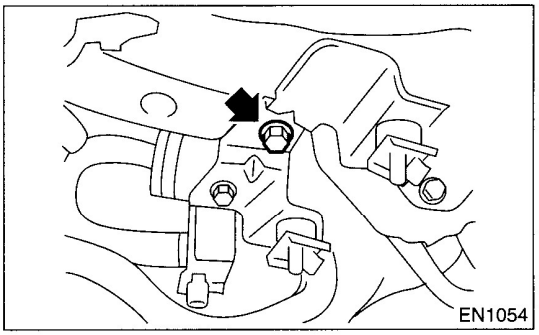

2) Lift-up the vehicle.
3) Remove the canister. <Ref. to EC(DOHC TURBO)-6, REMOVAL, Canister.>
4) Disconnect the connector from drain valve.



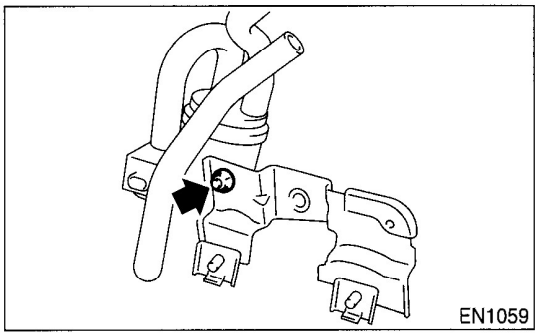

5) Disconnect the evaporation hoses from drain valve.




6) Remove the bolt which installs the drain filter and drain valve brackets on body, and remove them as a unit.



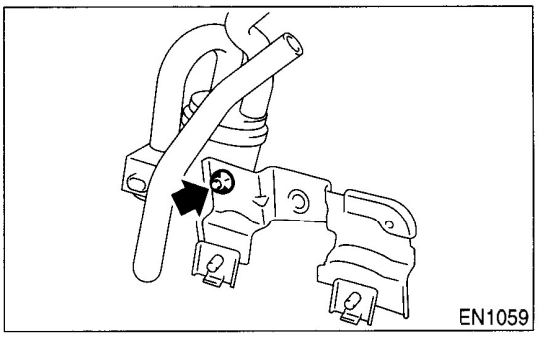

7) Remove the drain valve from bracket.




## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***23 N·m (2.3 kgf-m, 17 ft-lb)***




## C: INSPECTION

1) Make sure all hoses are installed correctly.
2) Make sure the hoses are not cracked or loose.


GETtheMANUALS.org

GETtheMANUALS.org

# INTAKE (INDUCTION)

# IN(DOHC TURBO)

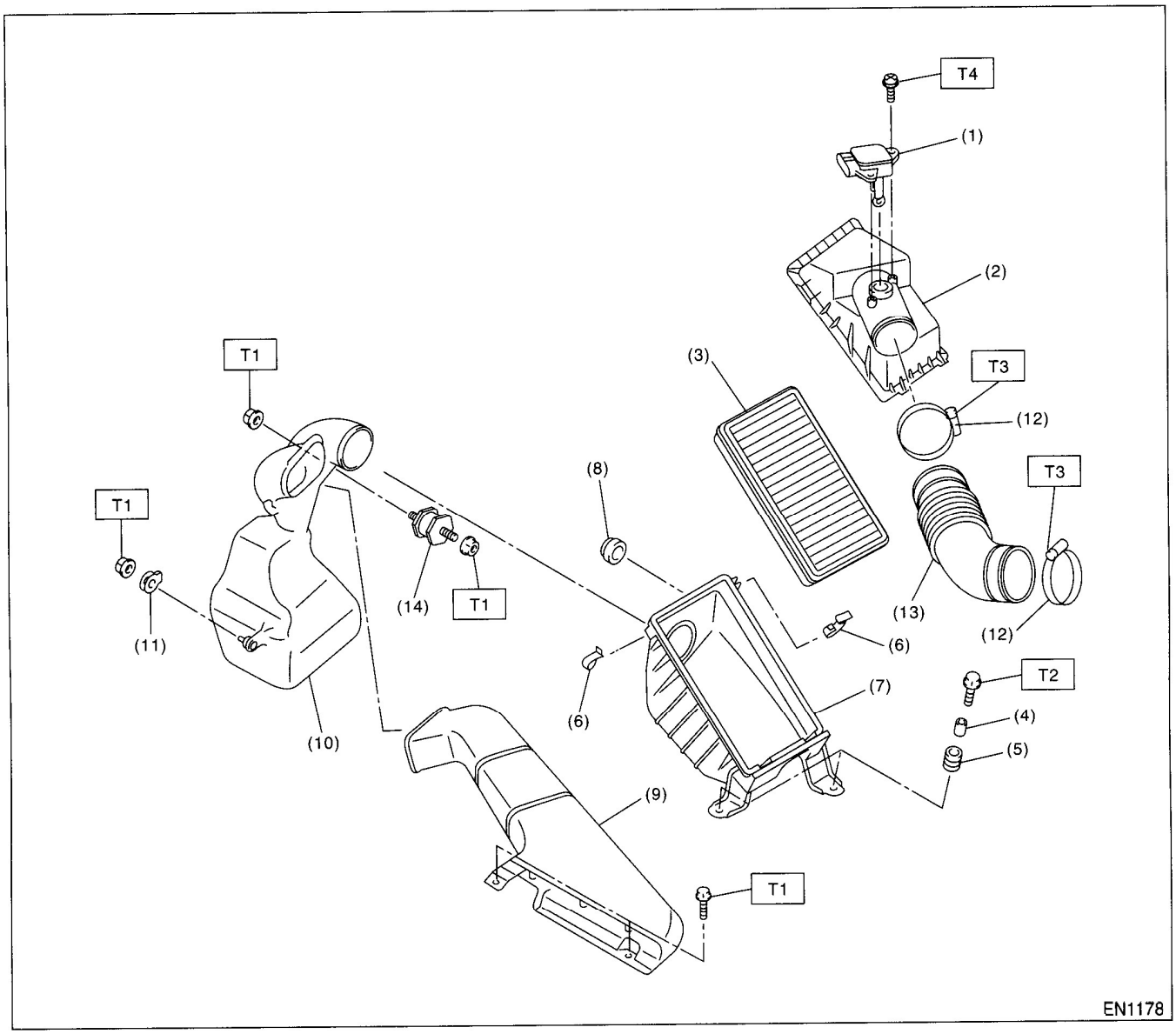

| | | Page |
|---|---|---|
| 1. | General Description | 2 |
| 2. | Air Cleaner | 7 |
| 3. | Air Intake Duct | 8 |
| 4. | Intake Duct | 9 |
| 5. | Intercooler | 10 |
| 6. | Turbocharger | 12 |
| 7. | Air By-pass Valve | 14 |


GETtheMANUALS.org

# 1. General Description

## A: COMPONENT

### 1. AIR CLEANER

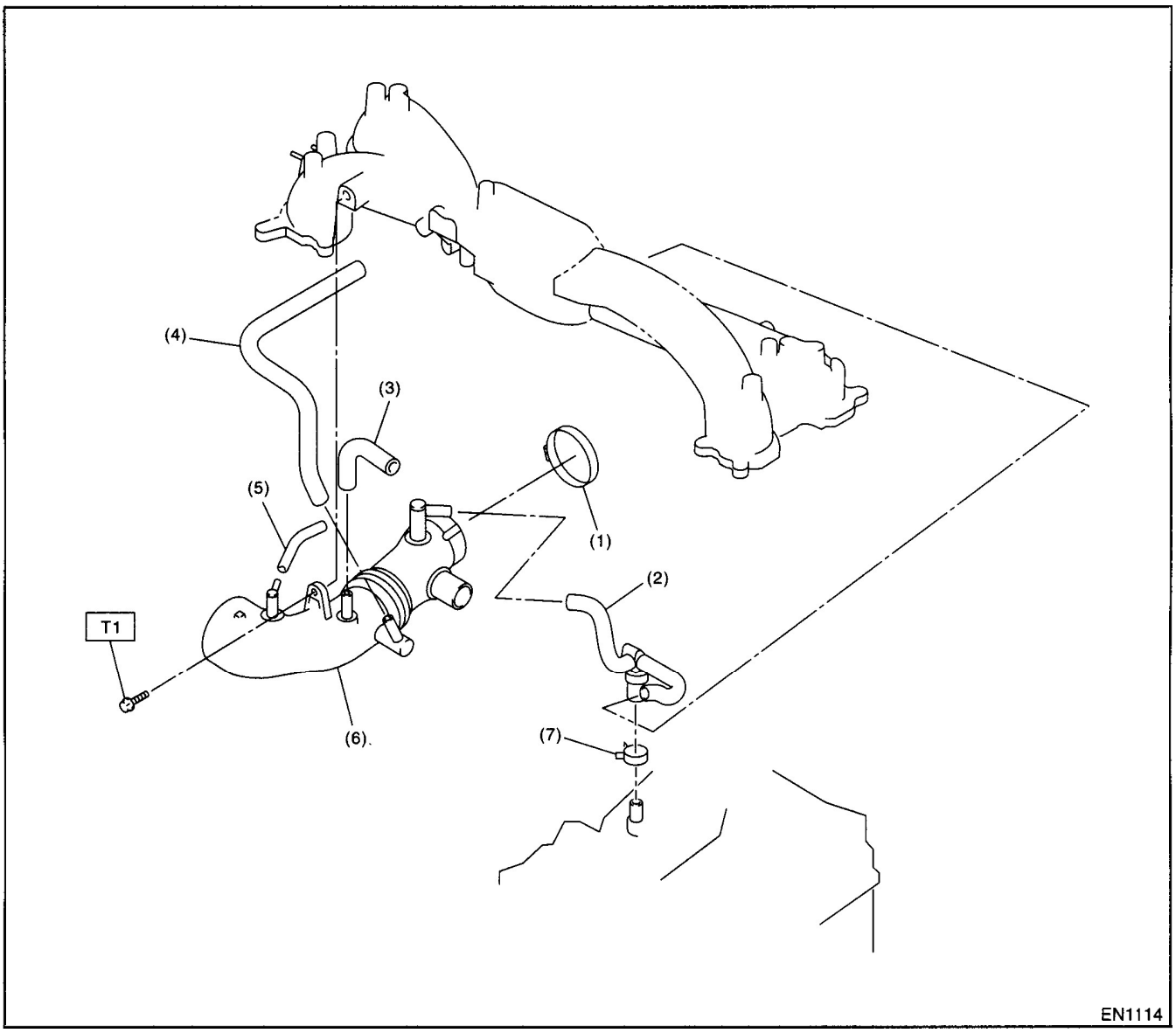



(1) Mass air flow sensor
(2) Air cleaner upper cover
(3) Air cleaner element
(4) Spacer
(5) Bush
(6) Clip
(7) Air cleaner lower case
(8) Cushion rubber
(9) Air intake duct
(10) Resonator chamber ASSY
(11) Cushion rubber
(12) Clamp
(13) Air intake boot
(14) Cushion

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 7.5 (0.76, 5.5)***
***T2: 33 (3.4, 25)***
***T3: 2.5 (0.25, 1.8)***
***T4: 1.7 (0.17, 1.2)***


GETtheMANUALS.org

## 2. INTAKE DUCT

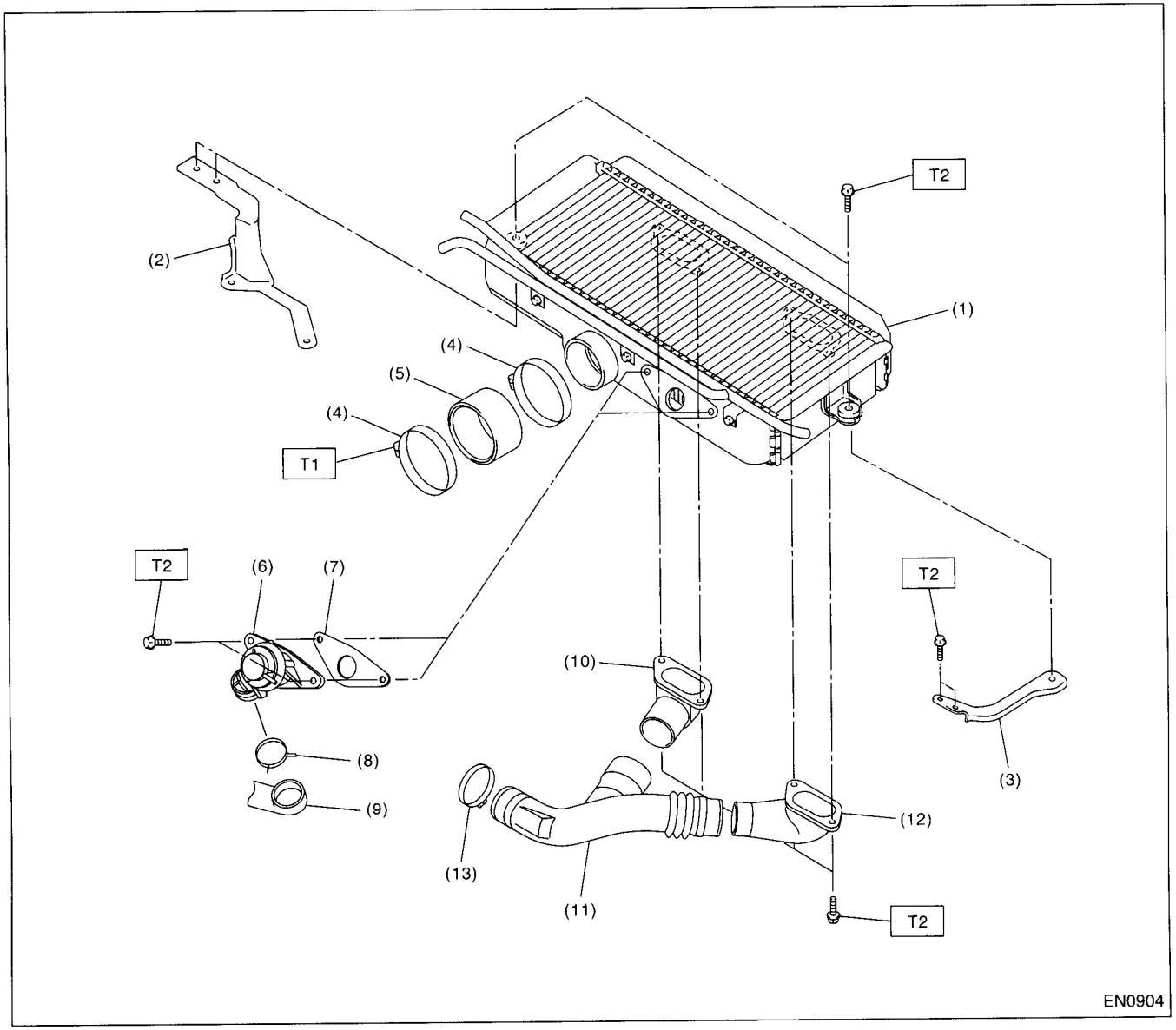



(1) Clamp
(2) PCV hose ASSY
(3) Air by-pass hose B
(4) Air by-pass hose C
(5) Air by-pass hose D
(6) Intake duct
(7) Clamp

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 16 (1.6, 11.7)***


GETtheMANUALS.org

## 3. INTERCOOLER

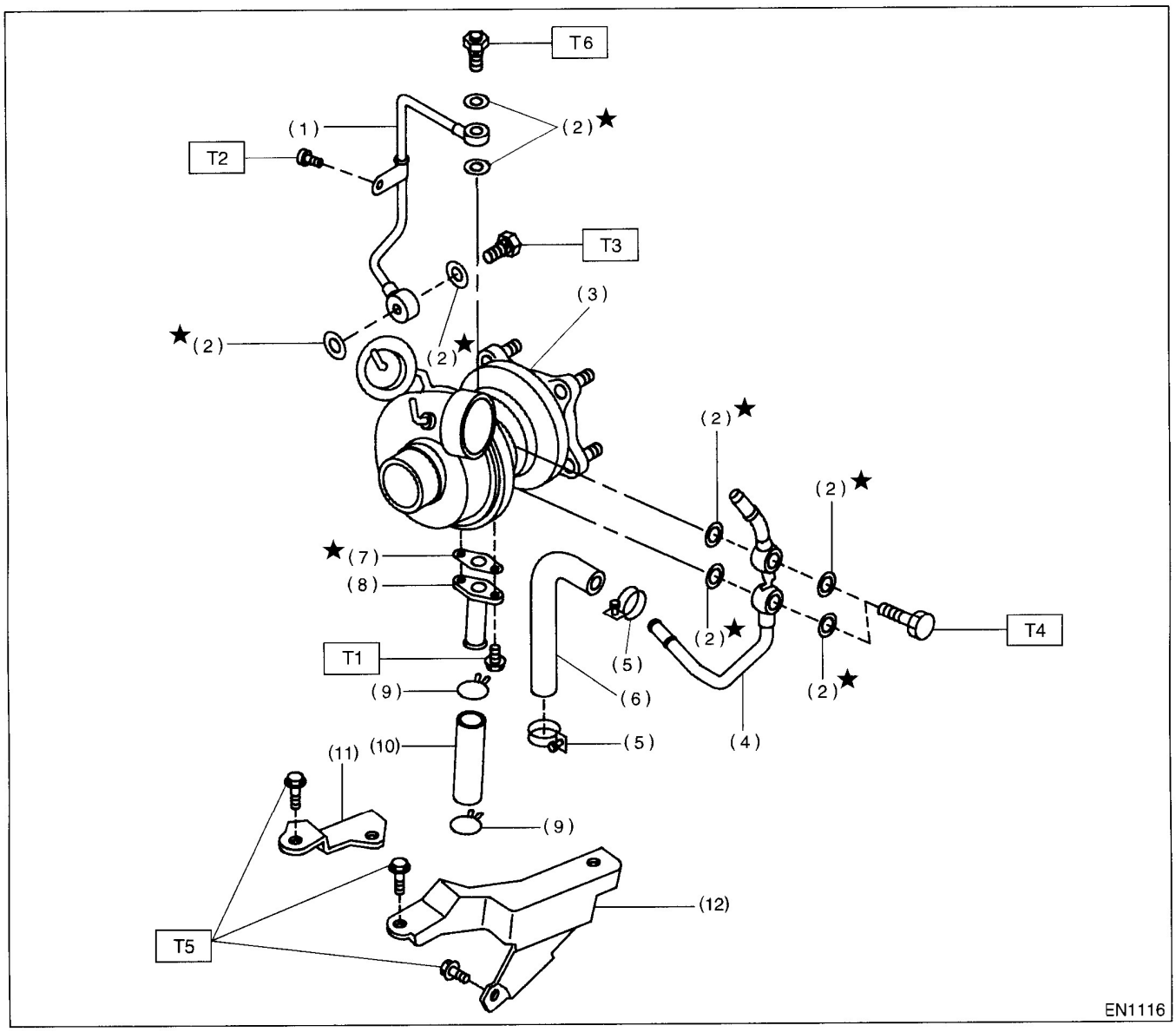



(1) Intercooler
(2) Intercooler bracket RH
(3) Intercooler bracket LH
(4) Clamp
(5) Air intake duct
(6) Air by-pass valve
(7) Gasket
(8) Clamp
(9) Air by-pass hose A
(10) Intercooler duct A
(11) Intercooler duct B
(12) Intercooler duct C
(13) Clamp

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 3 (0.22, 1.6)***
***T2: 16 (1.6, 11.7)***


GETtheMANUALS.org

## 4. TURBOCHARGER




(1) Oil inlet pipe
(2) Metal gasket
(3) Turbocharger
(4) Water pipe
(5) Clamp
(6) Engine coolant hose
(7) Gasket
(8) Oil outlet pipe
(9) Clip
(10) Oil outlet hose
(11) Turbocharger bracket RH
(12) Turbocharger bracket LH

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 4.4 (0.45, 3.3)***
***T2: 4.9 (0.50, 3.6)***
***T3: 29 (3.0, 21.7)***
***T4: 30 (3.1, 22.4)***
***T5: 33 (3.4, 24.6)***
***T6: 16 (1.6, 11.7)***


GETtheMANUALS.org

## B: CAUTION

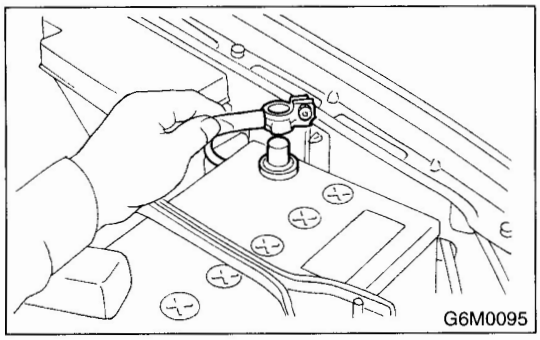
- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensor or units, be sure to disconnect negative terminal from battery.


GETtheMANUALS.org

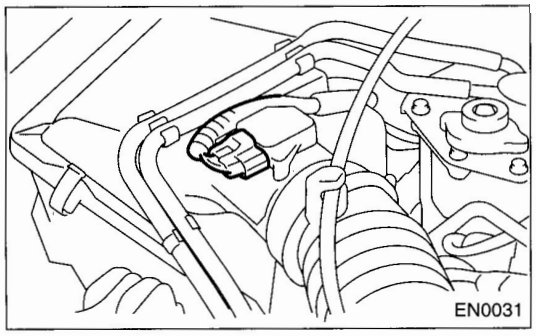
# 2. Air Cleaner

## A: REMOVAL

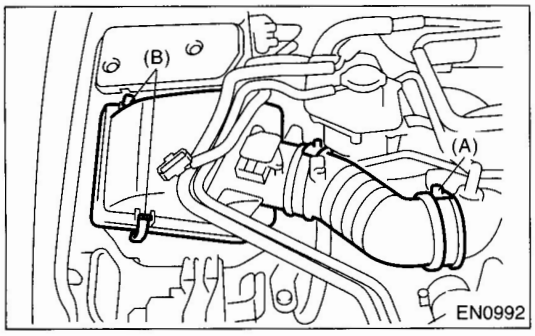
1) Disconnect the ground terminal from battery.



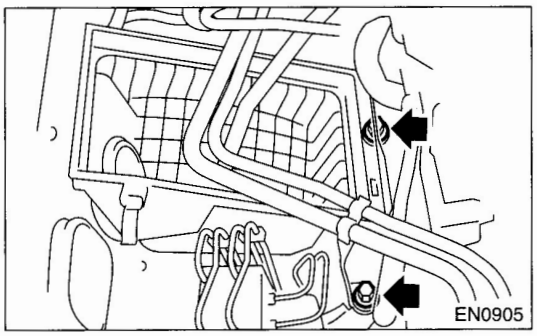

2) Disconnect the connector from mass air flow sensor.




3) Loosen the clamp (A) which connects air intake boot to intake duct.
4) Remove the two clips (B) from air cleaner upper cover.



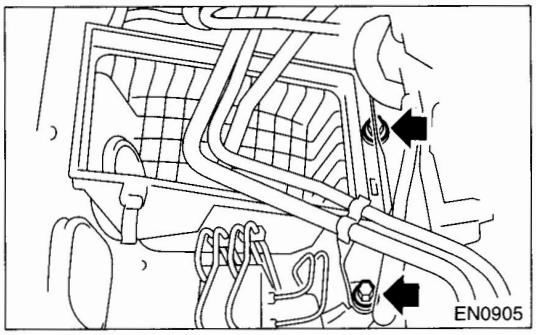

5) Remove the air cleaner upper cover.
6) Remove the air cleaner element.
7) Remove the air cleaner lower case.



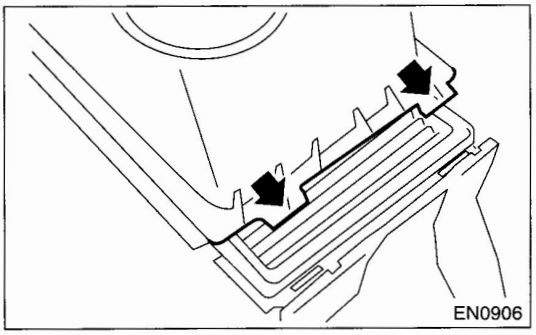

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***33 N·m (3.4 kgf-m, 25 ft-lb)***




**CAUTION:**
**Before installing the air cleaner upper cover, align holes with protruding portions of air cleaner lower case, then secure the upper cover to lower case.**




## C: INSPECTION

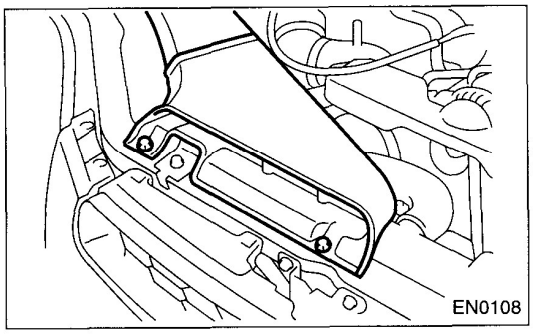
Replace if excessively damaged or dirty.


GETtheMANUALS.org

# 3. Air Intake Duct

## A: REMOVAL

1) Remove the bolts which install air intake duct on the front side of body.




## B: INSTALLATION

Install in the reverse order of removal.

## C: INSPECTION

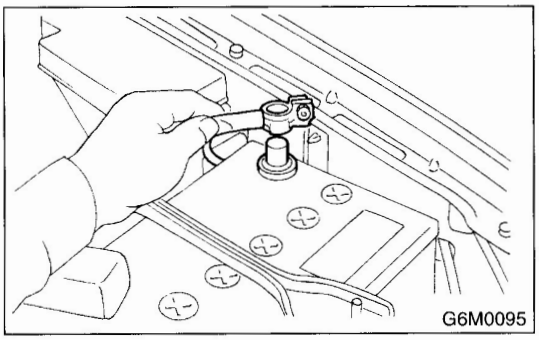
1) Inspect for cracks and loose connections.
2) Inspect that no foreign objects are mixed in the air intake duct.


GETtheMANUALS.org

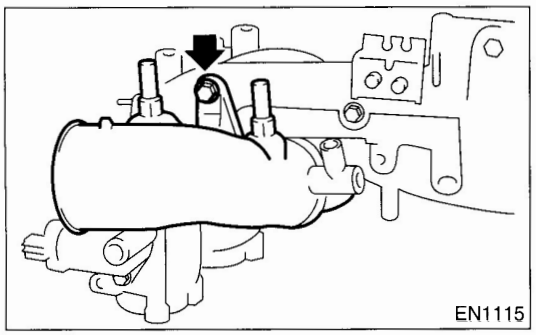
# 4. Intake Duct

## A: REMOVAL

1) Disconnect the ground terminal from battery.




2) Remove the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>
3) Remove the sensor, engine harness, and fuel pipe attached to the intake manifold. <Ref. to FU(DOHC TURBO)-21, DISASSEMBLY, Intake Manifold.>
4) Remove the intake duct from intake manifold.




## B: INSTALLATION

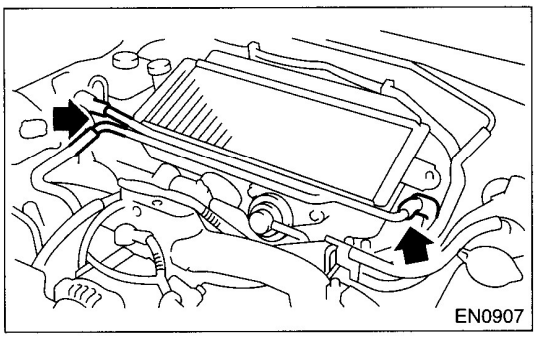
Install in the reverse order of removal.


GETtheMANUALS.org

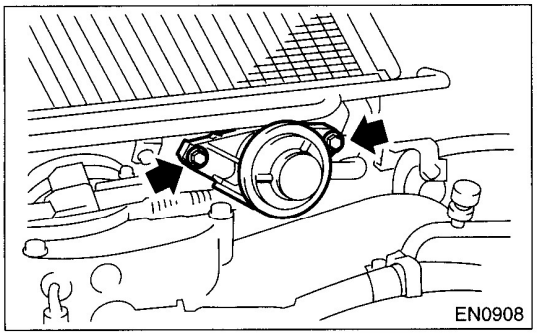
# 5. Intercooler

## A: REMOVAL

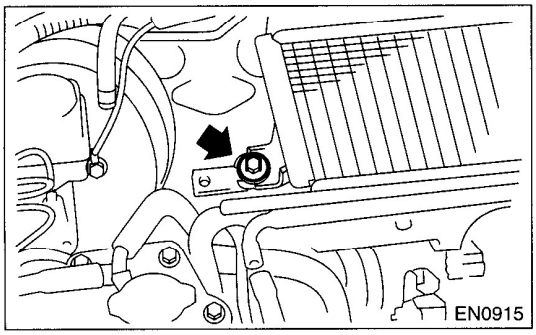
1) Disconnect the air by-pass hoses from intercooler.

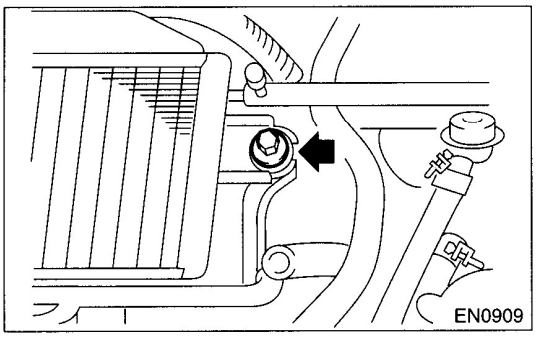



2) Separate the air by-pass valve from intercooler.



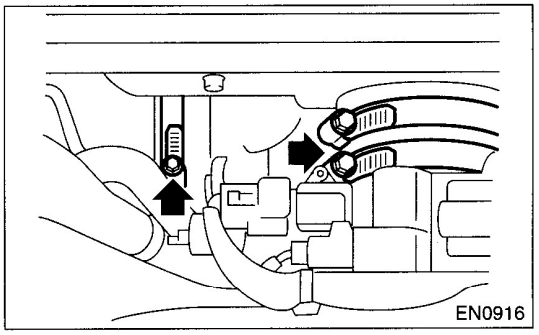

3) Remove the bolts which secure intercooler to bracket.




4) Separate the intercooler air duct from turbocharger.

5) Separate the intercooler from throttle body.



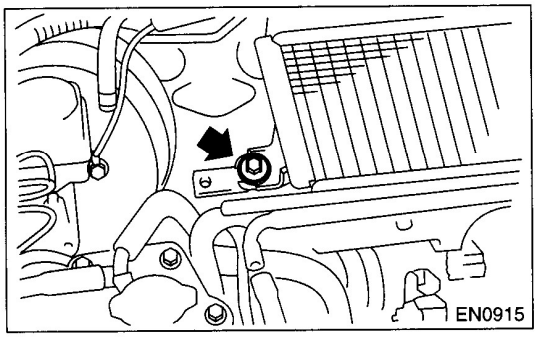


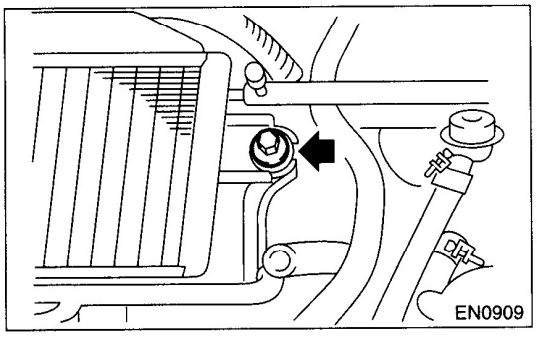
GETtheMANUALS.org

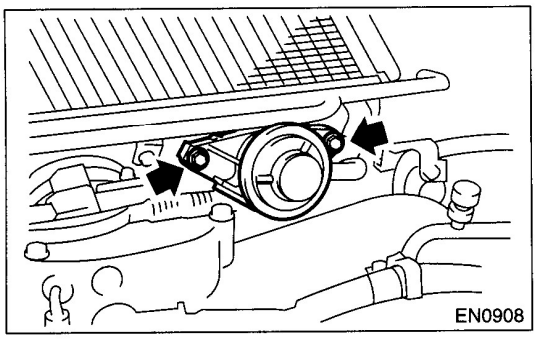
## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***16 N·m (1.6 kgf-m, 11.7 ft-lb)***

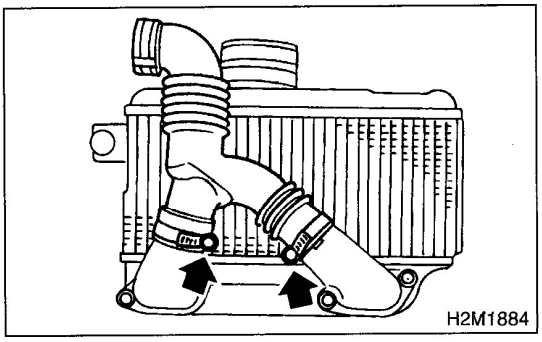


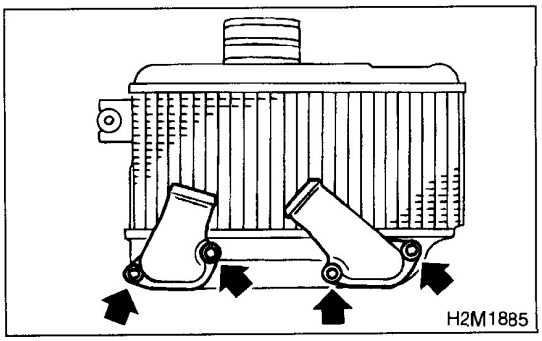




## C: DISASSEMBLY

1) Loosen the clamps, then remove intercooler duct.



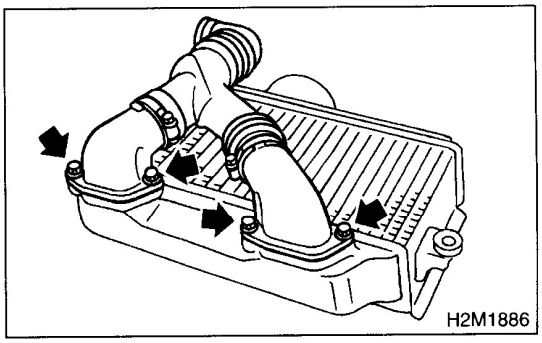

2) Remove the intercooler ducts from intercooler.




## D: ASSEMBLY

Assemble in the reverse order of disassembly.

***Tightening torque:***
***16 N·m (1.6 kgf-m, 11.7 ft-lb)***



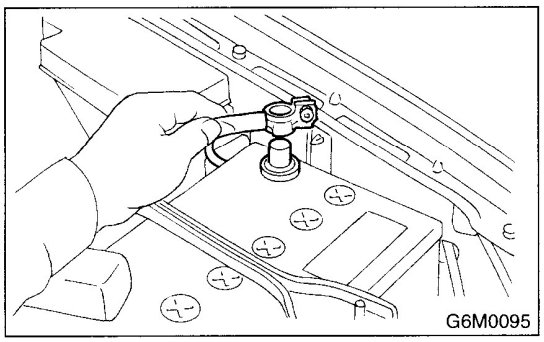


GETtheMANUALS.org

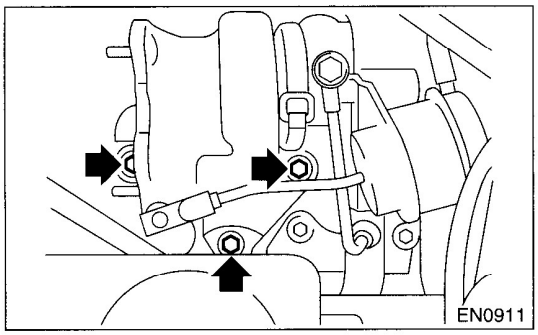
# 6. Turbocharger

## A: REMOVAL

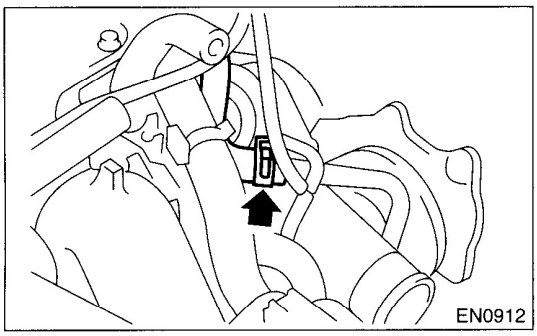
1) Set the vehicle on the lift.
2) Disconnect the ground terminal from battery.



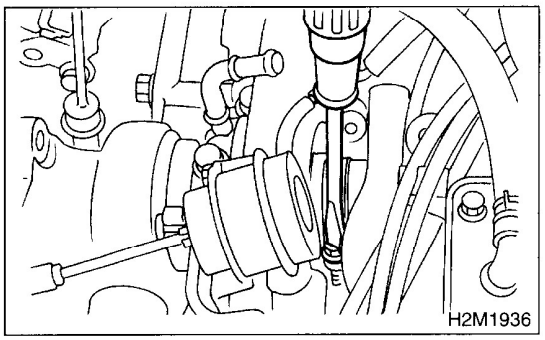

3) Remove the center exhaust pipe. <Ref. to EX(DOHC TURBO)-8, REMOVAL, Center Exhaust Pipe.>
4) Lower the vehicle.
5) Separate the turbocharger joint pipe from turbocharger.



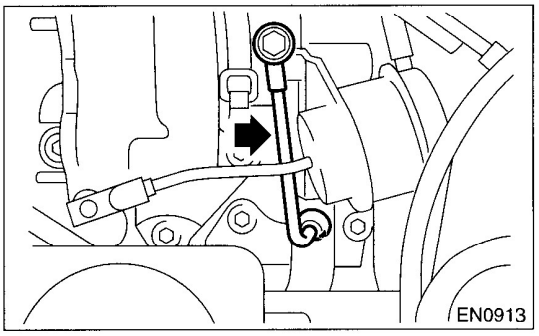

6) Disconnect the engine coolant hose which is connected to coolant filler tank.



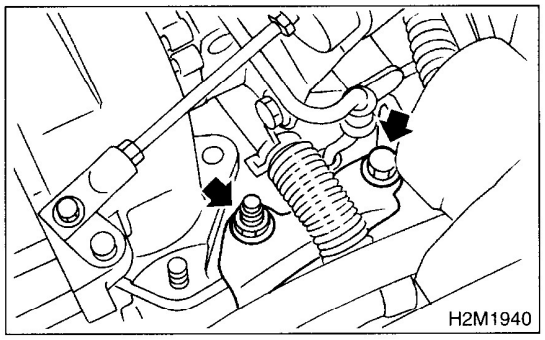

7) Loosen the clamp which secures turbocharger to air inlet duct.



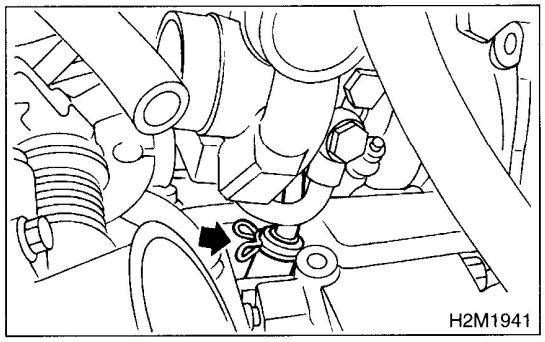

8) Remove the bolt which secures bracket of oil pipe to turbocharger.
9) Remove the oil pipe from turbocharger.




10) Remove the turbocharger bracket.




11) Disconnect the oil outlet hose from pipe.

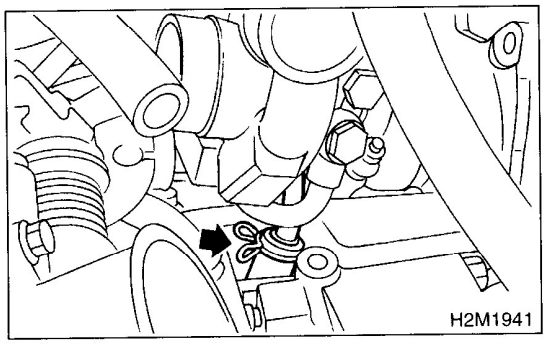



12) Take out the turbocharger from engine compartment.

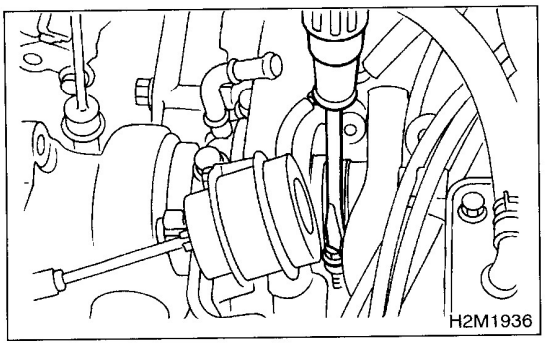

GETtheMANUALS.org

## B: INSTALLATION

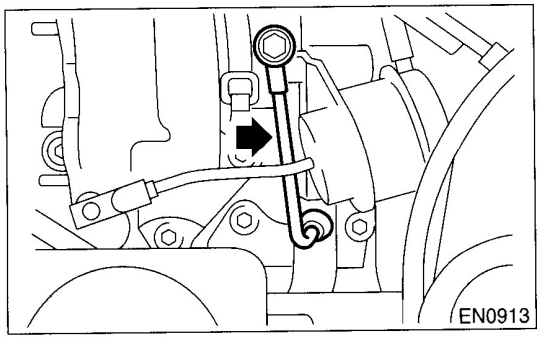
1) Connect the oil outlet hose to outlet pipe.




2) Install the turbocharger to air intake duct.



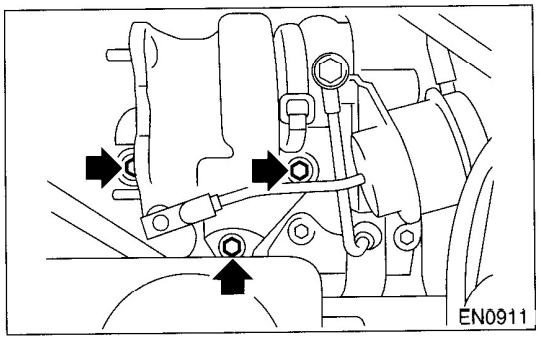

3) Install the oil pipe to turbocharger.



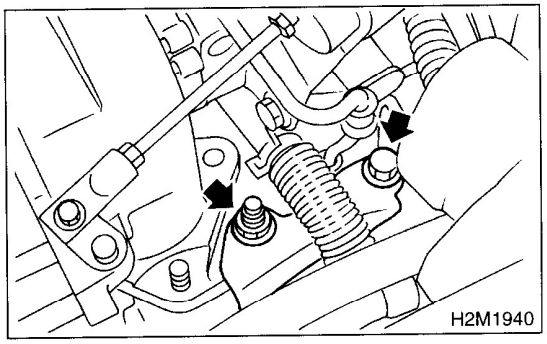

4) Install the joint pipe to turbocharger.

NOTE:
Replace the gasket with a new one.

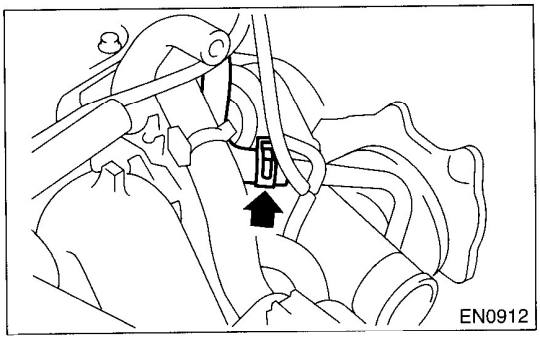
***Tightening torque:***
***30 N·m (3.1 kgf-m, 22.4 ft-lb)***




5) Install the turbocharger bracket.




6) Connect the engine coolant hose which is connected to coolant filler tank.



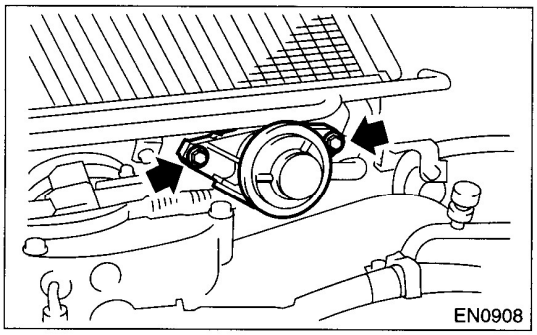

7) Lift-up the vehicle.
8) Install the center exhaust pipe. <Ref. to EX(DOHC TURBO)-9, INSTALLATION, Center Exhaust Pipe.>


GETtheMANUALS.org

# 7. Air By-pass Valve

## A: REMOVAL

1) Remove the air by-pass valve from intercooler.

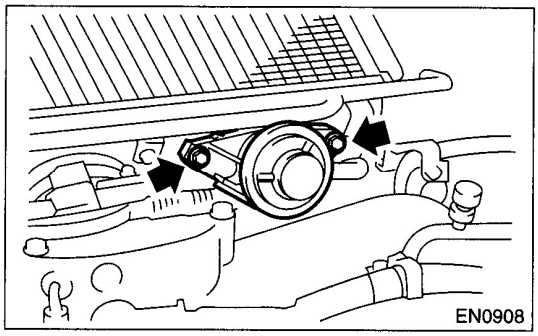



2) Disconnect the air by-pass hoses from air by-pass valve.

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***16 N·m (1.6 kgf-m, 11.7 ft-lb)***





GETtheMANUALS.org

# MECHANICAL

# ME(DOHC TURBO)


| | | Page |
|---|---|---|
| 1. | General Description | 2 |
| 2. | Compression | 22 |
| 3. | Idle Speed | 23 |
| 4. | Ignition Timing | 24 |
| 5. | Intake Manifold Vacuum | 25 |
| 6. | Engine Oil Pressure | 26 |
| 7. | Fuel Pressure | 27 |
| 8. | Valve Clearance | 28 |
| 9. | Engine Assembly | 33 |
| 10. | Engine Mounting | 42 |
| 11. | Preparation for Overhaul | 43 |
| 12. | V-belt | 44 |
| 13. | Crankshaft Pulley | 46 |
| 14. | Belt Cover | 47 |
| 15. | Timing Belt Assembly | 48 |
| 16. | Camshaft Sprocket | 57 |
| 17. | Crankshaft Sprocket | 58 |
| 18. | Camshaft | 59 |
| 19. | Cylinder Head Assembly | 64 |
| 20. | Cylinder Block | 72 |
| 21. | Engine Trouble in General | 91 |
| 22. | Engine Noise | 96 |


GETtheMANUALS.org

# 1. General Description

## A: SPECIFICATIONS

| | | | | | |
|---|---|---|---|---|---|
| Engine | Type | | | Horizontally opposed, liquid cooled, 4-cylinder, 4-stroke gasoline engine | |
| | Valve arrangement | | | Belt driven, double overhead camshaft, 4-valve/cylinder | |
| | Bore x Stroke | | mm (in) | 92 x 75 (3.62 x 2.95) | |
| | Piston displacement | | $cm^3$ (cu in) | 1,994 (121.67) | |
| | Compression ratio | | | 8.0 | |
| | Compression pressure (at 200 — 300 rpm) | | kPa ($kgf/cm^2$, psi) | 981 — 1,177 (10 — 12, 142 — 171) | |
| | Number of piston rings | | | Pressure ring: 2, Oil ring: 1 | |
| | Intake valve timing | Opening | | 10° BTDC | |
| | | Closing | | 50° ABDC | |
| | Exhaust valve timing | Opening | | 53° BBDC | |
| | | Closing | | 7° ATDC | |
| | Valve clearance | Intake | mm (in) | 0.20±0.02 (0.0079±0.0008) | |
| | | Exhaust | mm (in) | 0.25±0.02 (0.0098±0.0008) | |
| | Idling speed [At neutral position] | | rpm | MT | 750±100 (No load)<br>800±150 (A/C switch ON) |
| | | | | AT | 750±100 (No load)<br>825±150 (A/C switch ON) |
| | Firing order | | | 1 → 3 → 2 → 4 | |
| | Ignition timing | | BTDC/rpm | 12°±3°/750 rpm | |


GETtheMANUALS.org

NOTE:
STD: Standard I.D.: Inner Diameter O.D.: Outer Diameter OS: Oversize US: Undersize

| | | | | |
|---|---|---|---|---|
| Belt tension adjuster | Protrusion of adjuster rod | | | 5.2 — 6.2 mm (0.205 — 0.244 in) |
| Belt tensioner | Spacer O.D. | | | 17.955 — 17.975 mm (0.7069 — 0.7077 in) |
| | Tensioner bush I.D. | | | 18.0 — 18.08 mm (0.7087 — 0.7118 in) |
| | Clearance between spacer and bush | | STD | 0.025 — 0.125 mm (0.0010 — 0.0049 in) |
| | | | Limit | 0.175 mm (0.0069 in) |
| | Side clearance of spacer | | STD | 0.2 — 0.55 mm (0.0079 — 0.0217 in) |
| | | | Limit | 0.81 mm (0.0319 in) |
| Camshaft | Bend limit | | | 0.020 mm (0.0079 in) |
| | Thrust clearance | | STD | 0.015 — 0.070 mm (0.0006 — 0.0028 in) |
| | | | Limit | 0.10 mm (0.0039 in) |
| | Cam lobe height | Intake | STD | 46.25 — 46.35 mm (1.821 — 1.825 in) |
| | | | Limit | 46.15 mm (1.817 in) |
| | | Exhaust | STD | 46.15 — 46.25 mm (1.817 — 1.821 in) |
| | | | Limit | 46.05 mm (1.813 in) |
| | Jounal O.D. | STD | Front | 37.946 — 37.963 mm (1.4939 — 1.4946 in) |
| | | | Center rear | 29.946 — 29.963 mm (1.1790 — 1.1796 in) |
| | Oil clearance | | STD | 0.037 — 0.072 mm (0.0015 — 0.0028 in) |
| | | | Limit | 0.10 mm (0.0039 in) |
| Cylinder head | Surface warpage limit | | | 0.05 mm (0.0020 in) |
| | Surface grinding limit | | | 0.3 mm (0.012 in) |
| | Standard height | | | 127.5 mm (5.02 in) |
| Valve seat | Refacing angle | | | 90° |
| | Contacting width | Intake | STD | 1.0 mm (0.039 in) |
| | | | Limit | 1.7 mm (0.067 in) |
| | | Exhaust | STD | 1.5 mm (0.059 in) |
| | | | Limit | 2.2 mm (0.087 in) |
| Valve guide | Inner diameter | | | 6.000 — 6.012 mm (0.2362 — 0.2367 in) |
| | Protrusion above head | | | 12.0 — 12.4 mm (0.472 — 0.488 in) |
| Valve | Head edge thickness | Intake | STD | 1.2 mm (0.047 in) |
| | | | Limit | 0.8 mm (0.031 in) |
| | | Exhaust | STD | 1.5 mm (0.059 in) |
| | | | Limit | 0.8 mm (0.031 in) |
| | Stem diameter | | Intake | 5.950 — 5.965 mm (0.2343 — 0.2348 in) |
| | | | Exhaust | 5.945 — 5.960 mm(0.2341 — 0.2346 in) |
| | Stem oil clearance | STD | Intake | 0.035 — 0.062 mm (0.0014 — 0.0024 in) |
| | | | Exhaust | 0.040 — 0.067 mm (0.0016 — 0.0026 in) |
| | | Limit | — | 0.15 mm (0.0059 in) |
| | Overall length | | Intake | 104.4 mm (4.110 in) |
| | | | Exhaust | 104.7 mm (4.122 in) |
| Valve spring | Free length | | | 44.67 mm (1.7587 in) |
| | Squareness | | | 2.5°, 2.0 mm (0.079 in) |
| | Tension/spring height | | | 220.7±15.7 N (22.5±1.6 kgf, 49.6±3.5 lb)/36.0 mm (1.417 in)<br>510.9±25.5 N (52.1±2.6 kgf, 114.9±5.7 lb)/26.6 mm (1.047 in) |


GETtheMANUALS.org

| | | | | |
|---|---|---|---|---|
| Cylinder block | Surface warpage limit (mating with cylinder head) | | | 0.05 mm (0.0020 in) |
| | Surface grinding limit | | | 0.1 mm (0.004 in) |
| | Cylinder bore | STD | A | 92.005 — 92.015 mm (3.6222 — 3.6226 in) |
| | | | B | 91.995 — 92.005 mm (3.6218 — 3.6222 in) |
| | Taper | | STD | 0.015 mm (0.0006 in) |
| | | | Limit | 0.050 mm (0.0020 in) |
| | Out-of-roundness | | STD | 0.010 mm (0.0004 in) |
| | | | Limit | 0.050 mm (0.0020 in) |
| | Piston clearance | | STD | 0.010 — 0.030 mm (0.0004 — 0.0012 in) |
| | | | Limit | 0.050 mm (0.0020 in) |
| | Enlarging (boring) limit | | | 0.5 mm (0.020 in) |
| Piston | Outer diameter | STD | A | 91.985 — 91.995 mm (3.6214 — 3.6218 in) |
| | | | B | 91.975 — 91.985 mm (3.6211 — 3.6214 in) |
| | | 0.25 mm (0.0098 in) OS | | 92.225 — 92.235 mm (3.6309 — 3.6313 in) |
| | | 0.50 mm (0.0197 in) OS | | 92.475 — 92.485 mm (3.6407 — 3.6411 in) |
| Piston pin | Standard clearance between piston pin and hole in piston | | STD | 0.004 — 0.008 mm (0.0002 — 0.0003 in) |
| | | | Limit | 0.020 mm (0.0008 in) |
| | Degree of fit | | | Piston pin must be fitted into position with thumb at 20°C (68°F). |
| Piston ring | Piston ring gap | Top ring | STD | 0.20 — 0.35 mm (0.0079 — 0.0138 in) |
| | | | Limit | 1.0 mm (0.039 in) |
| | | Second ring | STD | 0.35 — 0.50 mm (0.0138 — 0.0197 in) |
| | | | Limit | 1.0 mm (0.039 in) |
| | | Oil ring | STD | 0.20 — 0.70 mm (0.0079 — 0.0276 in) |
| | | | Limit | 1.5 mm (0.059 in) |
| | Clearance between piston ring and piston ring groove | Top ring | STD | 0.040 — 0.080 mm (0.0016 — 0.0031 in) |
| | | | Limit | 0.15 mm (0.0059 in) |
| | | Second ring | STD | 0.030 — 0.070 mm (0.0012 — 0.0028 in) |
| | | | Limit | 0.15 mm (0.0059 in) |
| Connecting rod | Bend twist per 100 mm (3.94 in) in length | | Limit | 0.10 mm (0.0039 in) |
| | Side clearance | | STD | 0.070 — 0.330 mm (0.0028 — 0.0130 in) |
| | | | Limit | 0.4 mm (0.016 in) |
| Connecting rod bearing | Oil clearance | | STD | 0.020 — 0.046 mm (0.0008 — 0.0018 in) |
| | | | Limit | 0.05 mm (0.0020 in) |
| | Thickness at center portion | | STD | 1.492 — 1.501 mm (0.0587 — 0.0591 in) |
| | | | 0.03 mm (0.0012 in) US | 1.510 — 1.513 mm (0.0594 — 0.0596 in) |
| | | | 0.05 mm (0.0020 in) US | 1.520 — 1.523 mm (0.0598 — 0.0600 in) |
| | | | 0.25 mm (0.0098 in) US | 1.620 — 1.623 mm (0.0638 — 0.0639 in) |
| Connecting rod bushing | Clearance between piston pin and bushing | | STD | 0 — 0.022 mm (0 — 0.0009 in) |
| | | | Limit | 0.030 mm (0.0012 in) |

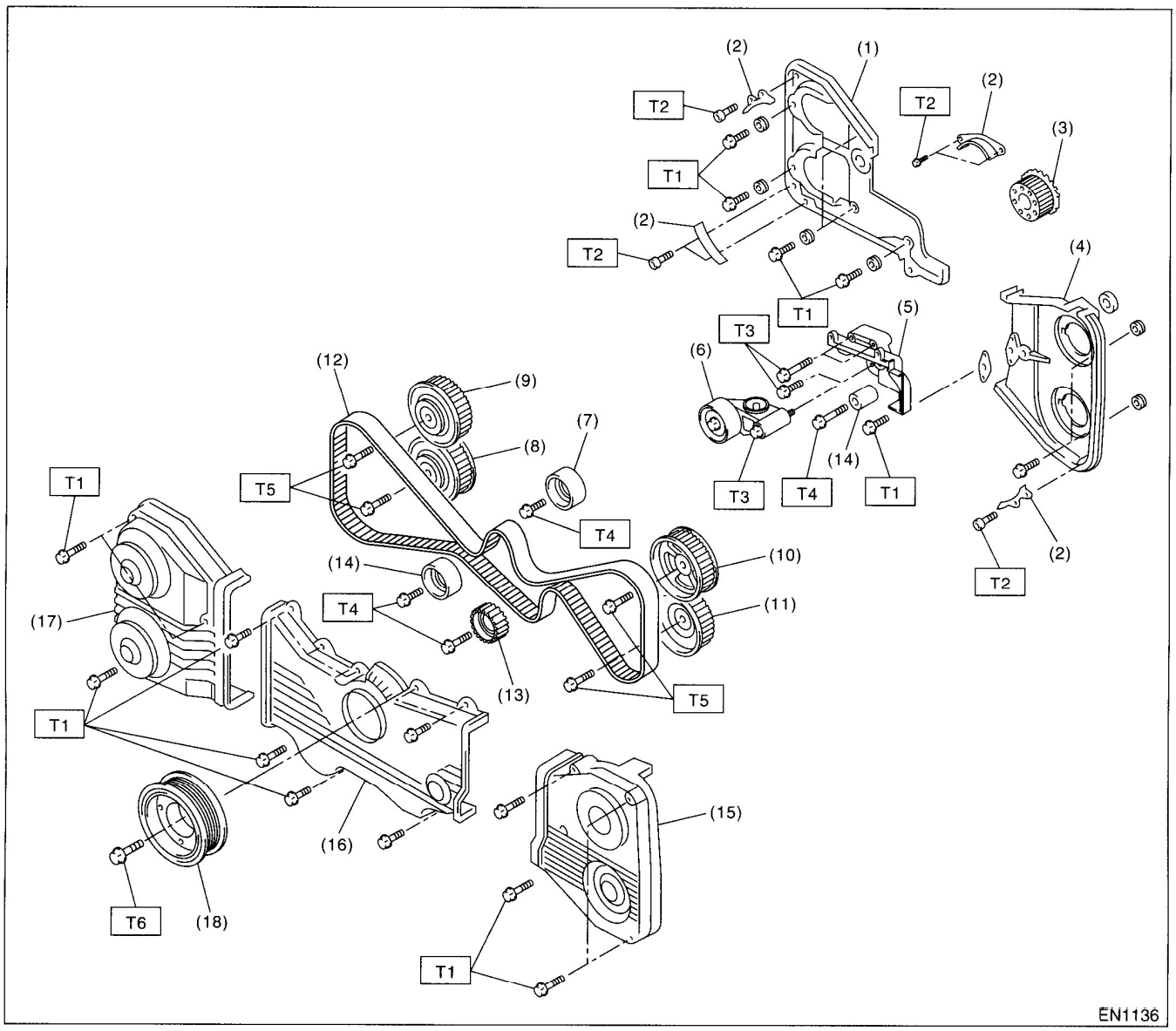

GETtheMANUALS.org

| | | | | |
|---|---|---|---|---|
| Crankshaft | Bend limit | | | 0.035 mm (0.0014 in) |
| | Crank pin and crank journal | Out-of-roundness | | 0.020 mm (0.0008 in) or less |
| | | Grinding limit | | 0.25 mm (0.0098 in) |
| | Crank pin outer diameter | | STD | 47.984 — 48.000 mm (1.8891 — 1.8898) |
| | | | 0.03 mm (0.0012 in) US | 47.954 — 47.970 mm (1.8879 — 1.8886) |
| | | | 0.05 mm (0.0020 in) US | 47.934 — 47.950 mm (1.8872 — 1.8878) |
| | | | 0.25 mm (0.0098 in) US | 47.734 — 47.750 mm (1.8793 — 1.8799) |
| | Crank journal outer diameter | #1, #3, #5 | STD | 59.992 — 60.008 mm (2.3619 — 2.3625 in) |
| | | | 0.03 mm (0.0012 in) US | 59.962 — 59.978 mm (2.3607 — 2.3613 in) |
| | | | 0.05 mm (0.0020 in) US | 59.942 — 59.958 mm (2.3599 — 2.3605 in) |
| | | | 0.25 mm (0.0098 in) US | 59.742 — 59.758 mm (2.3520 — 2.3527 in) |
| | | #2, #4 | STD | 59.992 — 60.008 mm (2.3619 — 2.3625 in) |
| | | | 0.03 mm (0.0012 in) US | 59.962 — 59.978 mm (2.3607 — 2.3613 in) |
| | | | 0.05 mm (0.0020 in) US | 59.942 — 59.958 mm (2.3599 — 2.3605 in) |
| | | | 0.25 mm (0.0098 in) US | 59.742 — 59.758 mm (2.3520 — 2.3527 in) |
| | Thrust clearance | | STD | 0.030 — 0.115 mm (0.0012 — 0.0045 in) |
| | | | Limit | 0.25 mm (0.0098 in) |
| | Oil clearance | | STD | 0.010 — 0.030 mm (0.0004 — 0.0012 in) |
| | | | Limit | 0.040 mm (0.0016 in) |
| Crankshaft bearing | Crankshaft bearing thickness | #1, #3 | STD | 1.998 — 2.011 mm (0.0787 — 0.0792 in) |
| | | | 0.03 mm (0.0012 in) US | 2.017 — 2.020 mm (0.0794 — 0.0795 in) |
| | | | 0.05 mm (0.0020 in) US | 2.027 — 2.030 mm (0.0798 — 0.0799 in) |
| | | | 0.25 mm (0.0098 in) US | 2.127 — 2.130 mm (0.0837 — 0.0839 in) |
| | | #2, #4, #5 | STD | 2.000 — 2.013 mm (0.0787 — 0.0793 in) |
| | | | 0.03 mm (0.0012 in) US | 2.019 — 2.022 mm (0.0795 — 0.0796 in) |
| | | | 0.05 mm (0.0020 in) US | 2.029 — 2.032 mm (0.0799 — 0.0800 in) |
| | | | 0.25 mm (0.0098 in) US | 2.129 — 2.132 mm (0.0838 — 0.0839 in) |


GETtheMANUALS.org

# B: COMPONENT

## 1. TIMING BELT




(1) Right-hand belt cover No. 2
(2) Timing belt guide (MT vehicles only)
(3) Crankshaft sprocket
(4) Left-hand belt cover No. 2
(5) Tensioner bracket
(6) Automatic belt tension adjuster ASSY
(7) Belt idler
(8) Right-hand exhaust camshaft sprocket
(9) Right-hand intake camshaft sprocket
(10) Left-hand intake camshaft sprocket
(11) Left-hand exhaust camshaft sprocket
(12) Timing belt
(13) Belt idler No. 2
(14) Belt idler
(15) Left-hand belt cover
(16) Front belt cover
(17) Right-hand belt cover
(18) Crankshaft pulley

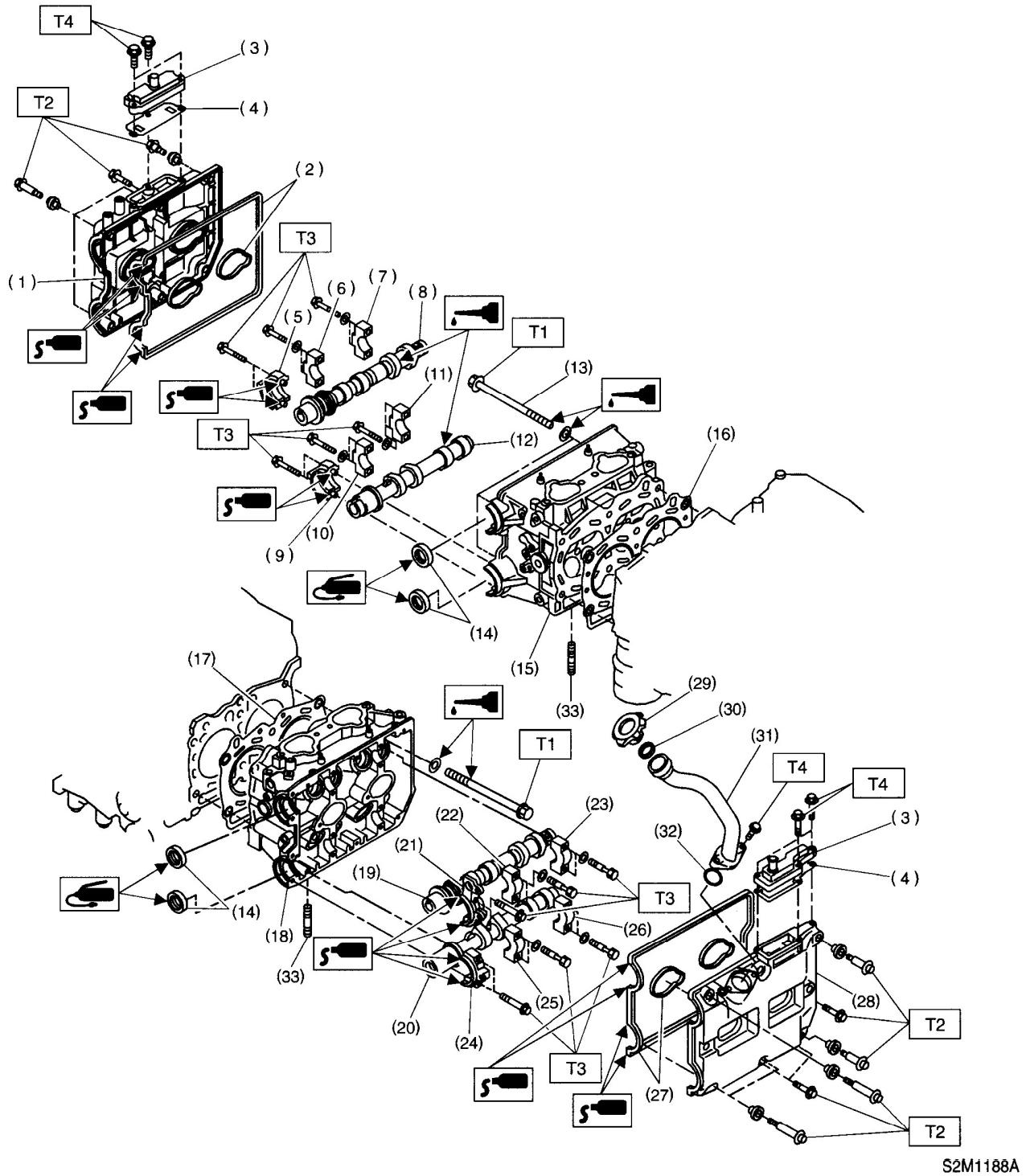
***Tightening torque: N·m (kgf-m, ft-lb)***

***T1: 5 (0.5, 3.6)***
***T2: 10 (1.0, 7)***
***T3: 25 (2.5, 18.1)***
***T4: 39 (4.0, 28.9)***
***T5: 98 (10, 72.4)***
***T6: <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>***


GETtheMANUALS.org

GETtheMANUALS.org

## 2. CYLINDER HEAD AND CAMSHAFT





GETtheMANUALS.org

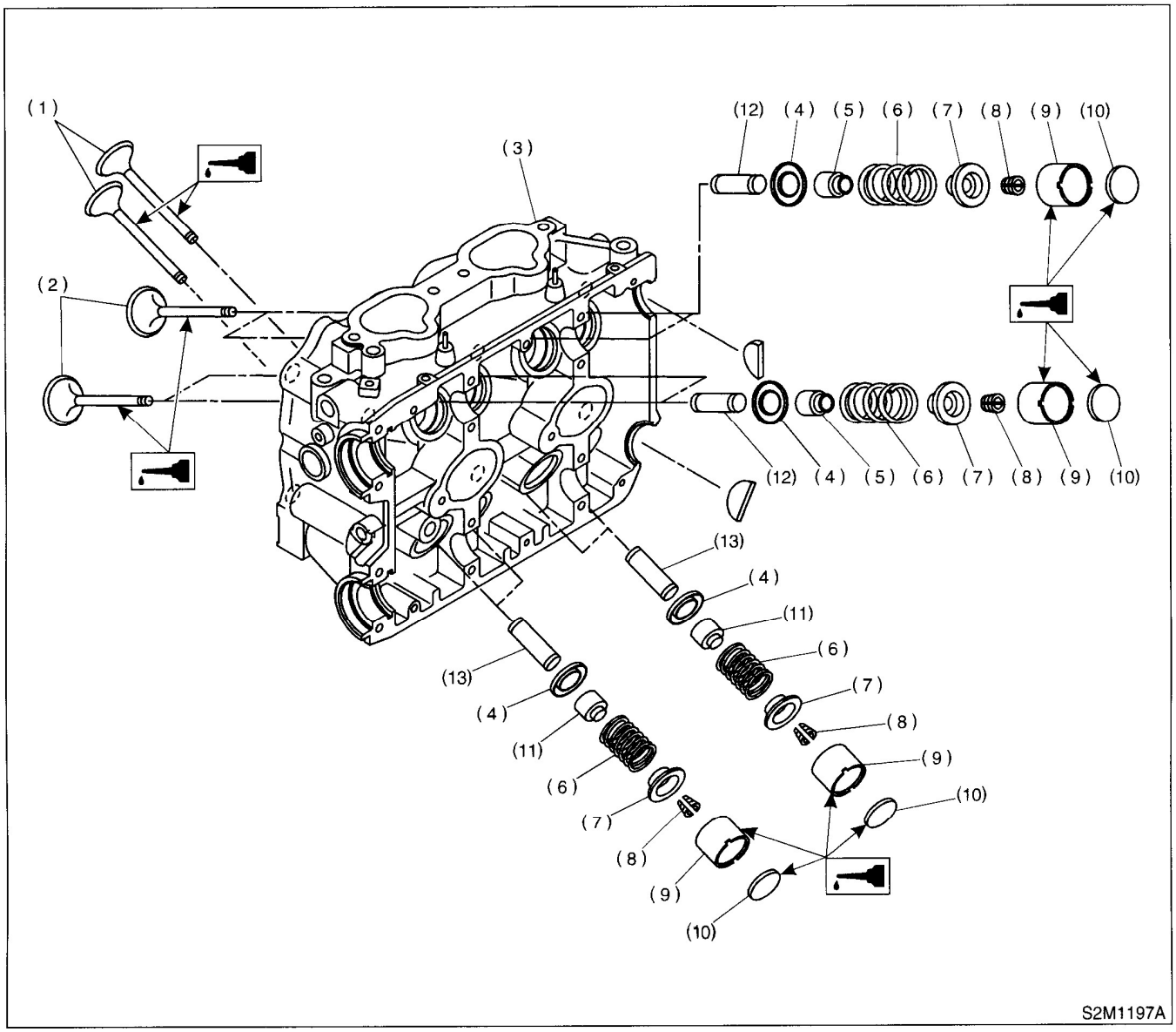
(1) Rocker cover (RH)
(2) Rocker cover gasket (RH)
(3) Oil separator cover
(4) Gasket
(5) Intake camshaft cap (Front RH)
(6) Intake camshaft cap (Center RH)
(7) Intake camshaft cap (Rear RH)
(8) Intake camshaft (RH)
(9) Exhaust camshaft cap (Front RH)
(10) Exhaust camshaft cap (Center RH)
(11) Exhaust camshaft cap (Rear RH)
(12) Exhaust camshaft (RH)
(13) Cylinder head bolt
(14) Oil seal
(15) Cylinder head (RH)
(16) Cylinder head gasket (RH)
(17) Cylinder head gasket (LH)
(18) Cylinder head (LH)
(19) Intake camshaft (LH)
(20) Exhaust camshaft (LH)
(21) Intake camshaft cap (Front LH)
(22) Intake camshaft cap (Center LH)
(23) Intake camshaft cap (Rear LH)
(24) Exhaust camshaft (Front LH)
(25) Exhaust camshaft cap (Center LH)
(26) Exhaust camshaft cap (Rear LH)
(27) Rocker cover gasket (LH)
(28) Rocker cover (LH)
(29) Oil filler cap
(30) Gasket
(31) Oil filler duct
(32) O-ring
(33) Stud bolt

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

***T1:*** ***<Ref. to ME(DOHC TURBO)-64, INSTALLATION, Cylinder Head Assembly.>***
***T2:*** ***5 (0.5, 3.6)***
***T3:*** ***10 (1.0, 7)***
***T4:*** ***6.4 (0.65, 4.7)***


GETtheMANUALS.org

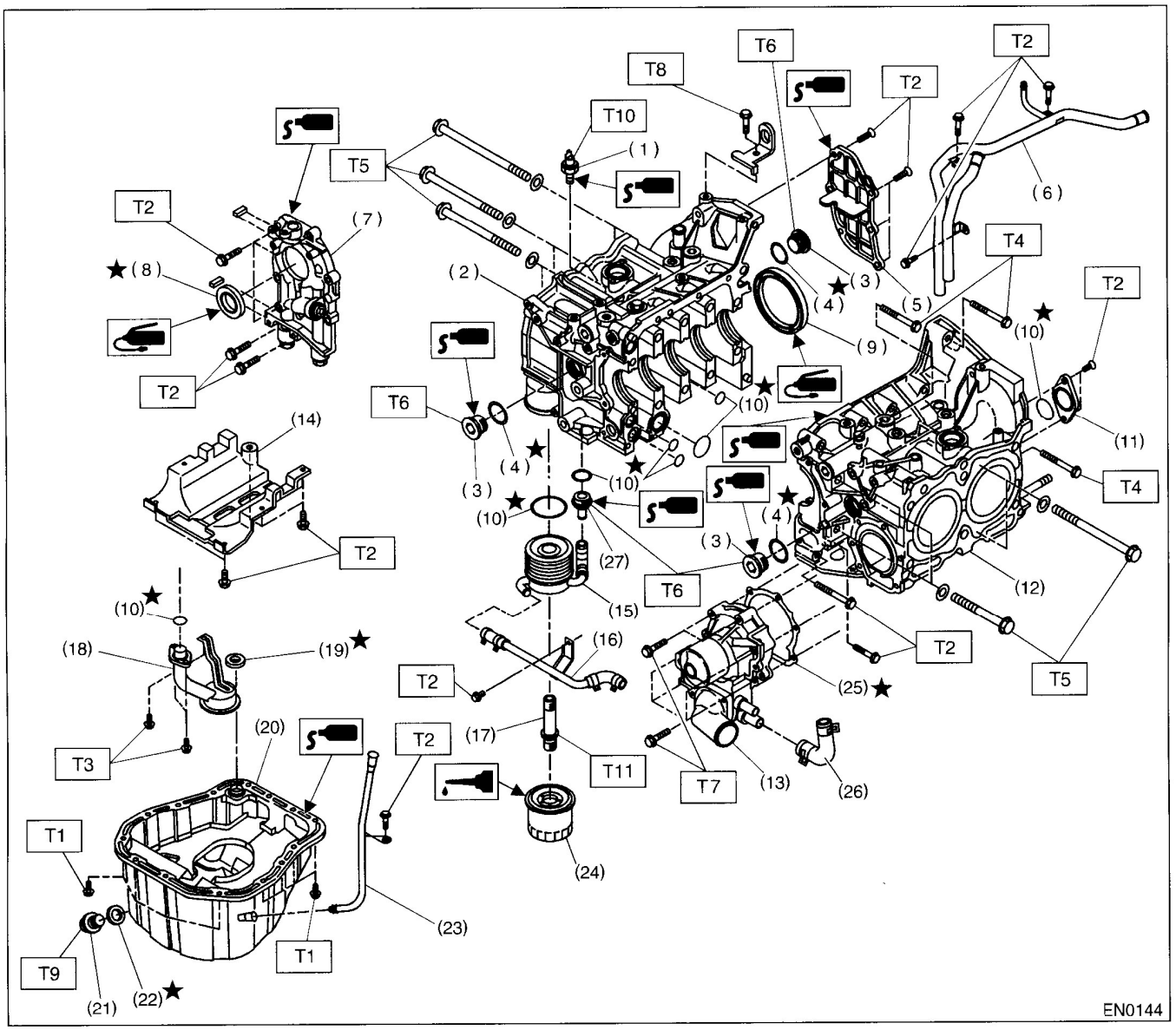
## 3. CYLINDER HEAD AND VALVE ASSEMBLY




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


GETtheMANUALS.org

## 4. CYLINDER BLOCK



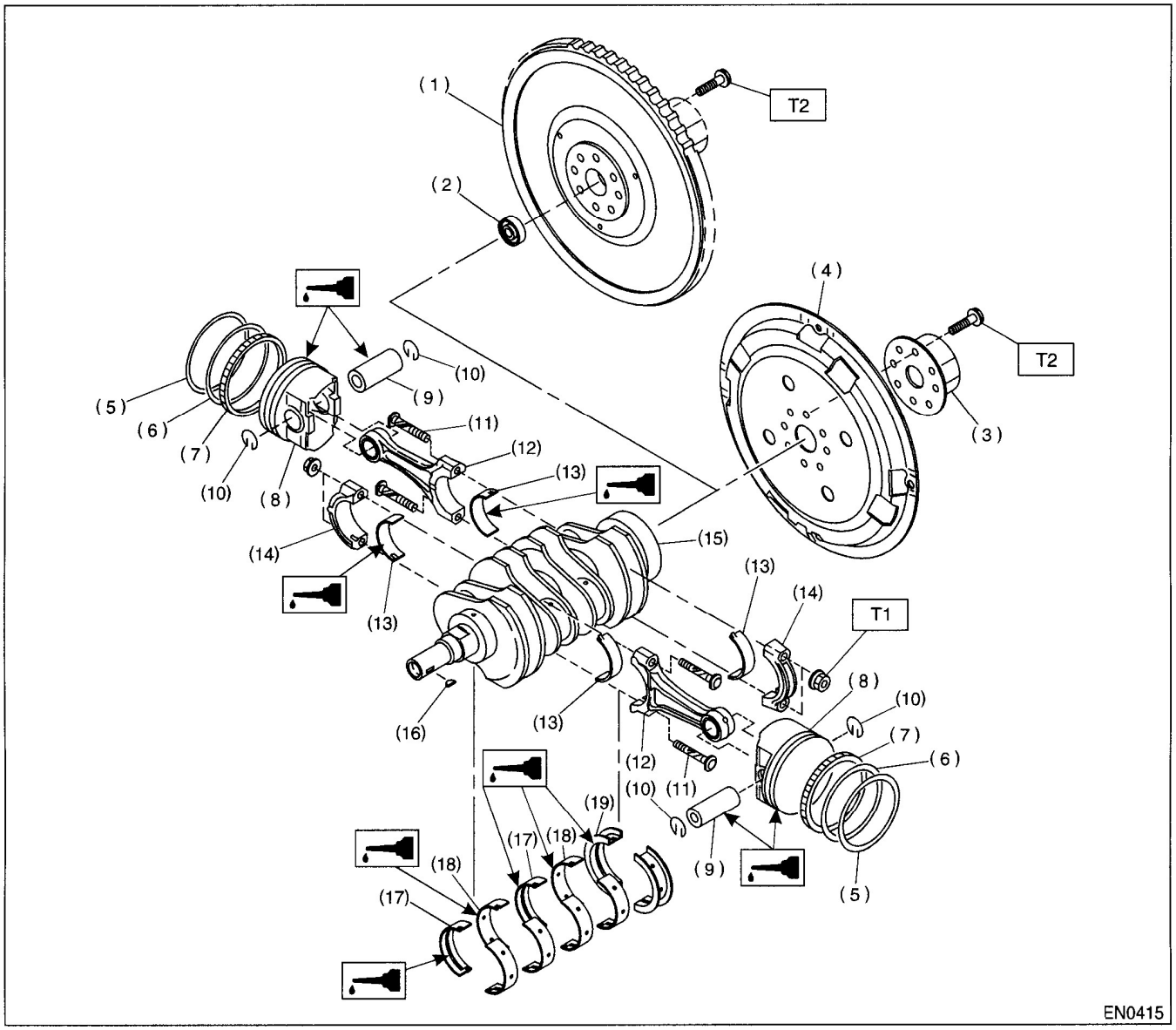

(1) Oil pressure switch
(2) Cylinder block (RH)
(3) Service hole plug
(4) Gasket
(5) Oil separator cover
(6) Water by-pass pipe
(7) Oil pump
(8) Front oil seal
(9) Rear oil seal
(10) O-ring
(11) Service hole cover
(12) Cylinder block (LH)
(13) Water pump
(14) Baffle plate
(15) Oil cooler
(16) Waster by-pass pipe
(17) Connector
(18) Oil strainer
(19) Gasket
(20) Oil pan
(21) Drain plug
(22) Metal gasket
(23) Oil level gauge guide
(24) Oil filter
(25) Gasket
(26) Water pump hose
(27) Plug

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

| | |
|---|---|
| ***T1:*** | ***5 (0.5, 3.6)*** |
| ***T2:*** | ***6.4 (0.65, 4.7)*** |
| ***T3:*** | ***10 (1.0, 7)*** |
| ***T4:*** | ***25 (2.5, 18.1)*** |
| ***T5:*** | ***47 (4.8, 34.7)*** |
| ***T6:*** | ***69 (7.0, 50.6)*** |
| ***T7:*** | ***First 12 (1.2, 8.7)*** <br> ***Second 12 (1.2, 8.7)*** |
| ***T8:*** | ***16 (1.6, 11.6)*** |
| ***T9:*** | ***44 (4.5, 33)*** |
| ***T10:*** | ***25 (2.5, 18.1)*** |
| ***T11:*** | ***55 (5.5, 40)*** |


GETtheMANUALS.org

## 5. CRANKSHAFT AND PISTON

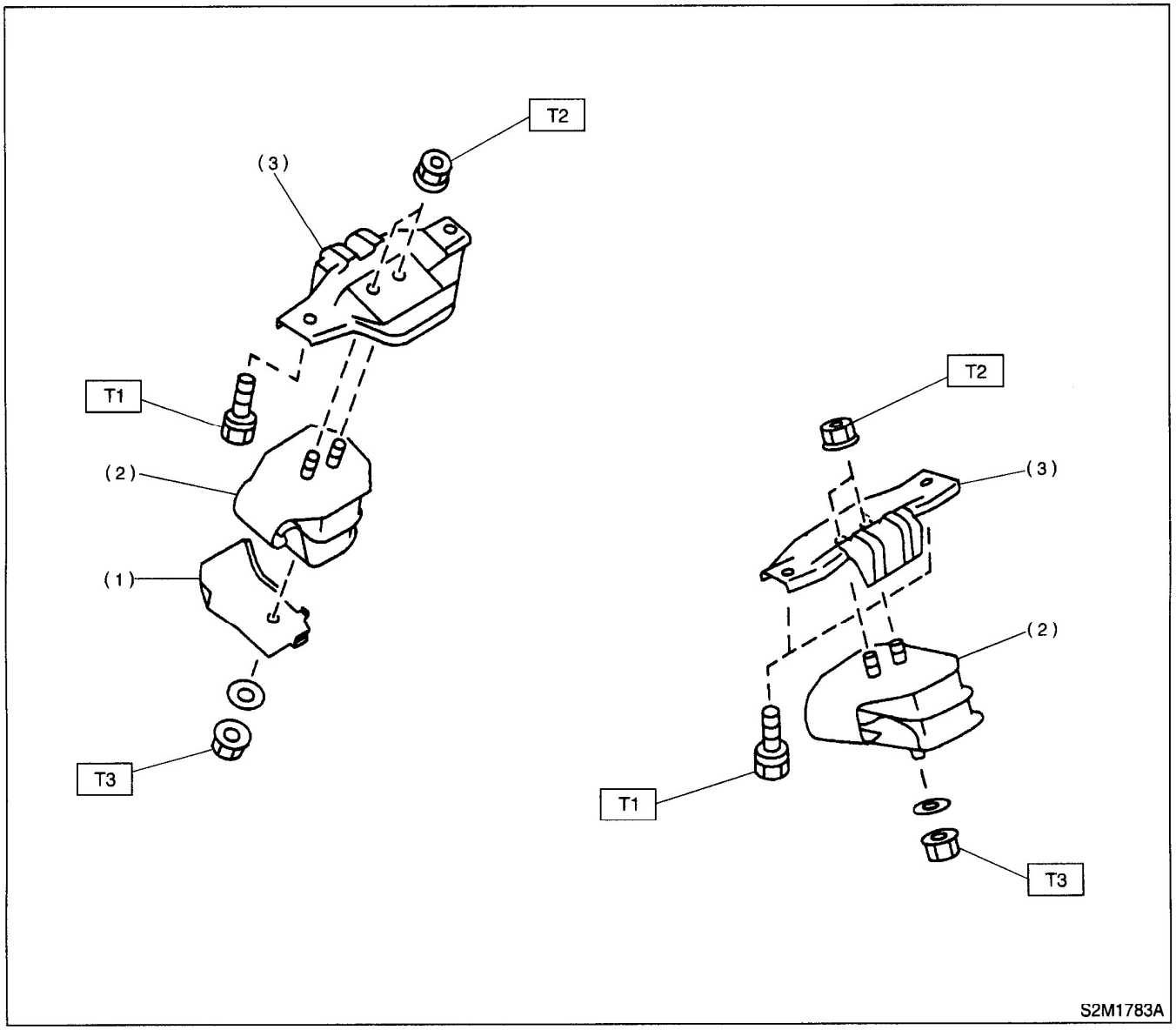



(1) Flywheel (MT vehicles only)
(2) Ball bearing (MT vehicles only)
(3) Reinforcement (AT vehicles only)
(4) Drive plate (AT vehicles only)
(5) Top ring
(6) Second ring
(7) Oil ring
(8) Piston
(9) Piston pin
(10) Circlip
(11) Connecting rod bolt
(12) Connecting rod
(13) Connecting rod bearing
(14) Connecting rod cap
(15) Crankshaft
(16) Woodruff key
(17) Crankshaft bearing #1, #3
(18) Crankshaft bearing #2, #4
(19) Crankshaft bearing #5

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 44.6 (4.55, 32.9)***
***T2: 72 (7.3, 52.8)***


GETtheMANUALS.org

## 6. ENGINE MOUNTING




(1) Hear shield cover
(2) Front cushion rubber
(3) Front engine mounting bracket

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 35 (3.6, 25.8)***
***T2: 42 (4.3, 30.9)***
***T3: 85 (8.7, 62.7)***


GETtheMANUALS.org

## C: CAUTION

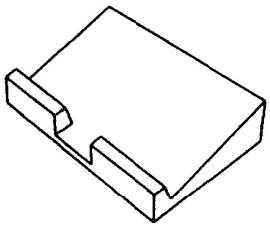
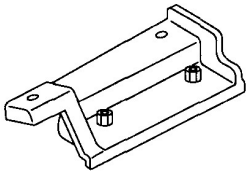
- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part in the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the negative terminal from battery.
- All parts should be thoroughly cleaned, paying special attention to the engine oil passages, pistons and bearings.
- Rotating parts and sliding parts such as piston, bearing and gear should be coated with oil prior to assembly.
- Be careful not to let oil, grease or coolant contact the timing belt, clutch disc and flywheel.
- All removed parts, if to be reused, should be reinstalled in the original positions and directions.
- Bolts, nuts and washers should be replaced with new ones as required.
- Even if necessary inspections have been made in advance, proceed with assembly work while making rechecks.
- Remove or install the engine in an area where chain hoists, lifting devices, etc. are available for ready use.
- Be sure not to damage coated surfaces of body panels with tools or stain seats and windows with coolant or oil. Place a cover over fenders, as required, for protection.
- Prior to starting work, prepare the following:

Service tools, clean cloth, containers to catch coolant and oil, wire ropes, chain hoist, transmission jacks, etc.

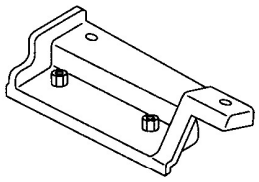
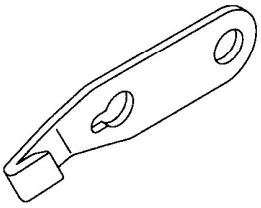
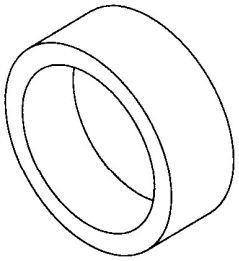
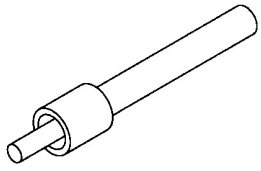
- Lift-up or lower the vehicle when necessary. Make sure to support the correct positions.

## D: PREPARATION TOOL

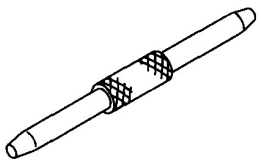
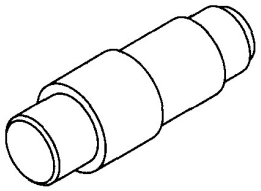
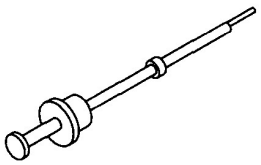
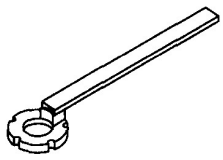
### 1. SPECIAL TOOLS

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  EN0147 | 498267600 | CYLINDER HEAD TABLE | • Used for replacing valve guides.<br>• Used for removing and installing valve springs. |
|  B2M3851 | 498457000 | ENGINE STAND ADAPTER RH | Used with ENGINE STAND (499817000). |

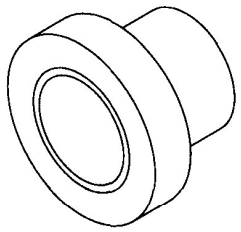
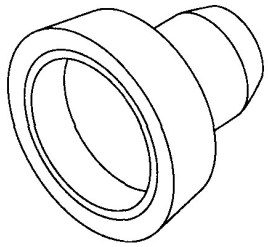
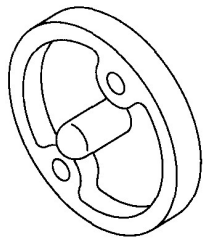
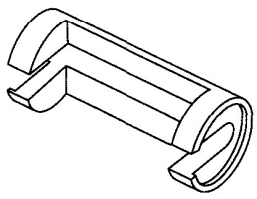

GETtheMANUALS.org

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M3852 | 498457100 | ENGINE STAND ADAPTER LH | Used with ENGINE STAND (499817000). |
|  B2M3853 | 498497100 | CRANKSHAFT STOPPER | Used for stopping rotation of flywheel when loosening and tightening crankshaft pulley bolt, etc. |
|  B2M3854 | 398744300 (Newly adopted tool) | PISTON GUIDE | Used for installing piston in cylinder for 2000 cc engine. |
|  B2M3855 | 498857100 | VALVE OIL SEAL GUIDE | Used for press-fitting of intake and exhaust valve guide oil seals. |

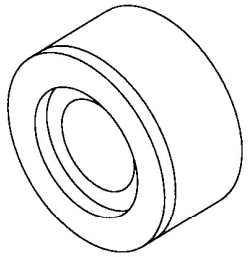
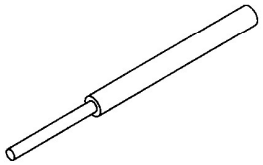
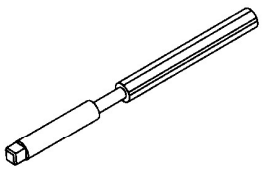
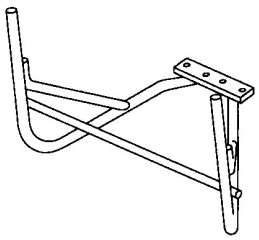

GETtheMANUALS.org

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M3856 | 499017100 | PISTON PIN GUIDE | Used for installing piston pin, piston and connecting rod. |
|  B2M3857 | 499037100 | CONNECTING ROD BUSHING REMOVER & INSTALLER | Used for removing and installing connecting rod bushing. |
|  B2M3858 | 499097700 | PISTON PIN REMOVER ASSY | Used for removing piston pin. |
|  B2M4158 | 499207400 (Newly adopted tool) | CAMSHAFT SPROCKET WRENCH | Used for removing and installing camshaft sprocket. |

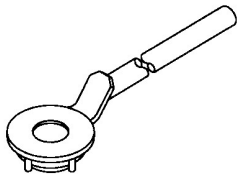
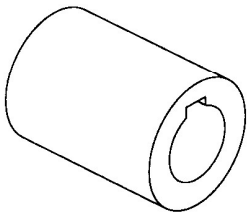
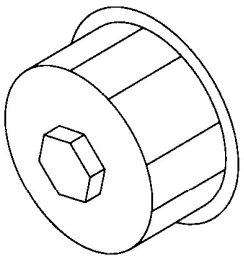
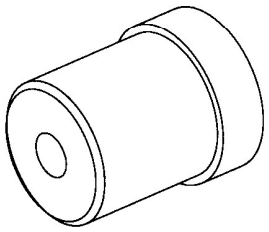

GETtheMANUALS.org

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M3860 | 499587700 (Newly adopted tool) | CAMSHAFT OIL SEAL INSTALLER | Used for installing cylinder head plug for DOHC engine. |
|  B2M3861 | 499587200 | CRANKSHAFT OIL SEAL INSTALLER | • Used for installing crankshaft oil seal.<br>• Used with CRANKSHAFT OIL SEAL GUIDE (499597100). |
|  B2M3863 | 499597100 | CRANKSHAFT OIL SEAL GUIDE | • Used for installing crankshaft oil seal.<br>• Used with CRANKSHAFT OIL SEAL INSTALLER (499587200). |
|  B2M3864 | 499718000 | VALVE SPRING REMOVER | Used for removing and installing valve spring. |

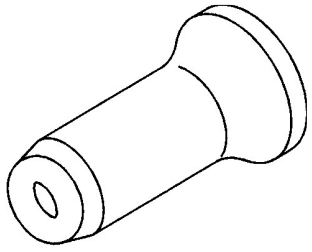
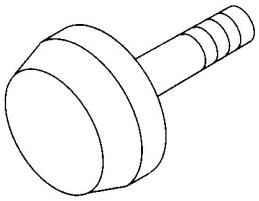
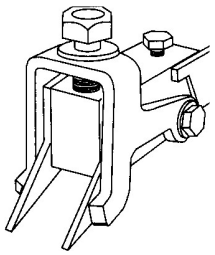
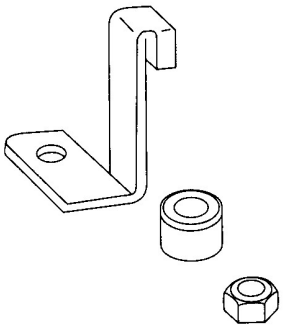

GETtheMANUALS.org

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M3865 | 498267700 | VALVE GUIDE ADJUSTER | Used for installing intake and exhaust valve guides. |
|  B2M3867 | 499767200 | VALVE GUIDE REMOVER | Used for removing valve guides. |
|  B2M3868 | 499767400 | VALVE GUIDE REAMER | Used for reaming valve guides. |
|  B2M3869 | 499817000 | ENGINE STAND | • Stand used for engine disassembly and assembly.<br>• Used with ENGINE STAND ADAPTER RH (498457000) & LH (498457100). |


GETtheMANUALS.org

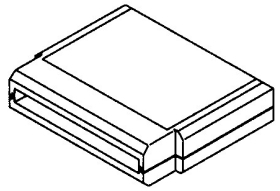
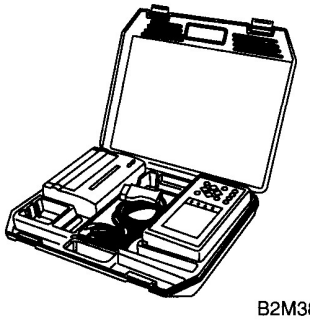
| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M4157 | 499977300 | CRANK PULLEY WRENCH | Used for stopping rotation of crankshaft pulley when loosening and tightening crankshaft pulley bolts. |
|  B2M3871 | 499987500 | CRANKSHAFT SOCKET | Used for rotating crankshaft. |
|  B2M3872 | 498547000 | OIL FILTER WRENCH | Used for removing and installing oil filter. |
|  B2M3875 | 499587100 | OIL SEAL INSTALLER | Used for installing oil pump oil seal. |


GETtheMANUALS.org

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  S1H0136 | 499587600 (Newly adopted tool) | OIL SEAL GUIDE | Used for installing camshaft oil seal for DOHC engine. |
|  EN0168 | 499597200 (Newly adopted tool) | OIL SEAL GUIDE | Used for installing camshaft oil seal for DOHC engine.<br>Used with OIL SEAL GUIDE (499587600). |
|  EN0165 | 498187200 (Newly adopted tool) | SHIM REPLACER | Used for correct valve clearance. |
|  H1H049 | 498277200 | STOPPER SET | Used for installing automatic transmission assembly to engine. |



GETtheMANUALS.org

| ILLUSTRATION | TOOL NUMBER | DESCRIPTION | REMARKS |
|---|---|---|---|
|  B2M3876 | 24082AA150 | CARTRIDGE | Troubleshooting for electrical systems. |
|  B2M3877 | 22771AA030 | SELECT MONITOR KIT | Troubleshooting for electrical systems.<br>• English: 22771AA030 (Without printer)<br>• German: 22771AA070 (Without printer)<br>• French: 22771AA080 (Without printer)<br>• Spanish: 22771AA090 (Without printer) |

## 2. GENERAL PURPOSE TOOLS

| TOOL NAME | REMARKS |
|---|---|
| Compression Gauge | Used for measuring compression. |
| Timing Light | Used for measuring ignition timing. |

# E: PROCEDURE

It is possible to conduct the following service procedures with engine on the vehicle, however, the procedures described in this section are based on the condition that the engine is removed from the vehicle.

- V-belt
- Timing Belt
- Camshaft
- Cylinder Head


GETtheMANUALS.org

# 2. Compression

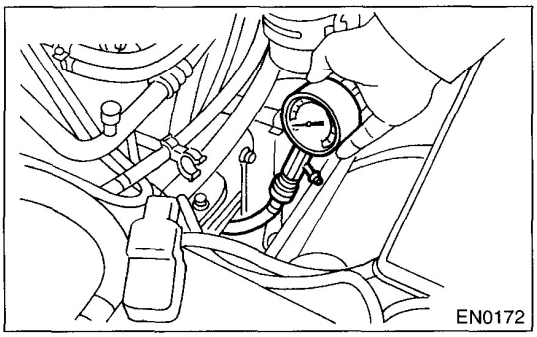
## A: INSPECTION

**CAUTION:**
**After warming-up, engine becomes very hot. Be careful not to burn yourself during measurement.**

1) After warming-up the engine, turn the ignition switch to OFF.
2) Make sure that the battery is fully charged.
3) Release fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
4) Remove all the spark plugs. <Ref. to IG(DOHC TURBO)-4, REMOVAL, Spark Plug.>
5) Fully open the throttle valve.
6) Check the starter motor for satisfactory performance and operation.
7) Hold the compression gauge tight against the spark plug hole.

**CAUTION:**
**When using a screw-in type compression gauge, the screw (put into cylinder head spark plug hole) should be less than 18 mm (0.71 in) long.**

8) Crank the engine by means of the starter motor, and read the maximum value on the gauge when the pointer is steady.




9) Perform at least two measurements per cylinder, and make sure that the values are correct.

***Compression (350 rpm and fully open throttle):***
***Standard;***
***951 — 1,147 kPa (9.7 — 11.7 kgf/cm$^2$, 138 — 166 psi)***
***Limit;***
***834 kPa (8.5 kgf/cm$^2$, 121 psi)***
***Difference between cylinders;***
***49 kPa (0.5 kgf/cm$^2$, 7 psi)***


GETtheMANUALS.org

# 3. Idle Speed

## A: INSPECTION

1) Before checking the idle speed, check the following:
   (1) Ensure the air cleaner element is free from clogging, ignition timing is correct, spark plugs are in good condition, and that hoses are connected properly.
   (2) Ensure the malfunction indicator light (CHECK ENGINE light) does not illuminate.
2) Warm-up the engine.
3) Stop the engine, and turn the ignition switch to OFF.
4) Insert the cartridge to the SUBARU SELECT MONITOR.
5) Connect the SUBARU SELECT MONITOR to the data link connector.
6) Turn the ignition switch to ON, and SUBARU SELECT MONITOR switch to ON.
7) Select {2. Each System Check} in Main Menu.
8) Select {Engine Control System} in Selection Menu.
9) Select {1. Current Data Display & Save} in Engine Control System Diagnosis.
10) Select {1.12 Data Display} in Data Display Menu.
11) Start the engine, and read engine idle speed.
12) Check the idle speed when unloaded. (With headlights, heater fan, rear defroster, radiator fan, air conditioning, etc. OFF)

***Idle speed (No load and gears in neutral:***
***750±100 rpm***

13) Check the idle speed when loaded. (Turn the air conditioning switch to "ON" and operate the compressor for at least one minute before measurement.)

***Idle speed [A/C "ON", no load and gears in neutral]:***
***800±150 rpm (MT model)***
***825±150 rpm (AT model)***

**CAUTION:**
**Never rotate the idle adjusting screw. If the idle speed is out of specifications, refer to General On-board Diagnosis Table under "Engine Control System". <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.>**


GETtheMANUALS.org

# 4. Ignition Timing

## A: INSPECTION

1) Before checking the ignition timing speed, check the following:
   (1) Ensure the air cleaner element is free from clogging, spark plugs are in good condition, and that hoses are connected properly.
   (2) Ensure the malfunction indicator light (CHECK ENGINE light) does not illuminate.
2) Warm-up the engine.
3) Stop the engine, and turn the ignition switch to OFF.
4) Insert the cartridge to the SUBARU SELECT MONITOR.
5) Connect the SUBARU SELECT MONITOR to the data link connector.
6) Turn the ignition switch to ON, and SUBARU SELECT MONITOR switch to ON.
7) Select {2. Each System Check} in Main Menu.
8) Select {Engine Control System} in Selection Menu.
9) Select {1. Current Data Display & Save} in Engine Control System Diagnosis.
10) Select {1.12 Data Display} in Data Display Menu.
11) Start the engine, at idle speed and check the ignition timing.

***Ignition timing [BTDC/rpm]:***
***12°±3°/750***

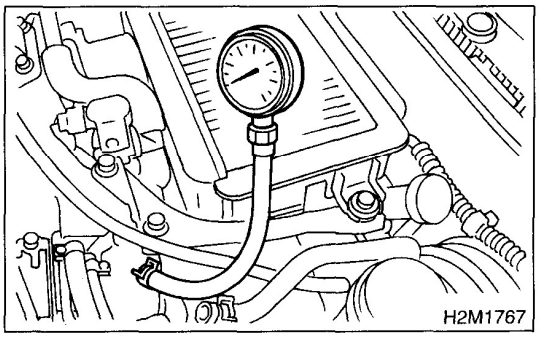
If the timing is not correct, check the ignition control system. Refer to Engine Control System. <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.>


GETtheMANUALS.org

# 5. Intake Manifold Vacuum

## A: INSPECTION

1) Warm-up the engine.
2) Disconnect the brake vacuum hose and install the vacuum gauge to the hose fitting on the manifold.
3) Keep the engine at the idle speed and read the vacuum gauge indication.
By observing the gauge needle movement, the internal condition of the engine can be diagnosed as described below.




***Vacuum pressure (at idling, A/C "OFF"):***
***Less than –60.0 kPa (–450 mmHg, –17.72 in-Hg)***

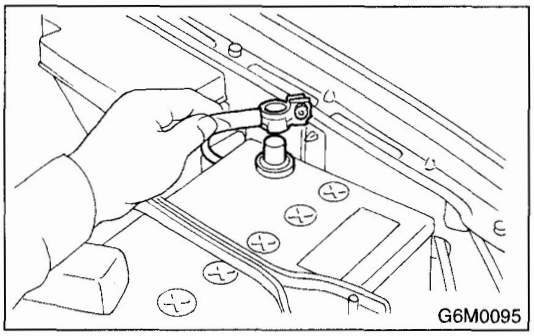
| Diagnosis of engine condition by measurement of manifold vacuum | |
|---|---|
| Vacuum gauge indication | Possible engine condition |
| 1. Needle is steady but lower than normal position. This tendency becomes more evident as engine temperature rises. | Leakage around intake manifold gasket or disconnection or damaged vacuum hose |
| 2. When engine speed is reduced slowly from higher speed, needle stops temporarily when it is lowering or becomes steady above normal position. | Back pressure too high, or exhaust system clogged |
| 3. Needle intermittently drops to position lower than normal position. | Leakage around cylinder |
| 4. Needle drops suddenly and intermittently from normal position. | Sticky valves |
| 5. 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 |
| 6. Needle vibrates above and below normal position in narrow range. | Defective ignition system or throttle chamber idle adjustment |


GETtheMANUALS.org

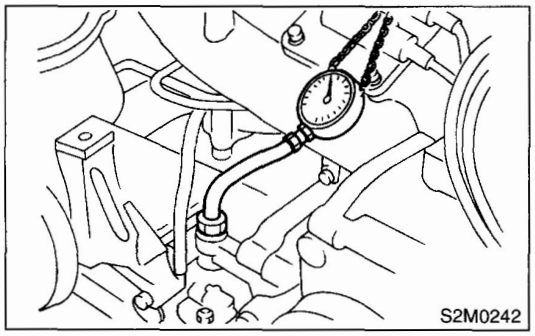
# 6. Engine Oil Pressure

## A: INSPECTION

1) Remove the oil pressure switch from engine cylinder block. <Ref. to LU-22, REMOVAL, Oil Pressure Switch.>
2) Connect the oil pressure gauge hose to cylinder block.
3) Connect the battery ground terminal to battery.


G6M0095

4) Start the engine, and measure oil pressure.


S2M0242

***Oil pressure:***
***98 kPa (1.0 kg/cm², 14 psi) or more at 800 rpm***
***294 kPa (3.0 kg/cm², 43 psi) or more at 5,000 rpm***

**CAUTION:**
**• If the oil pressure is out of specification, check oil pump, oil filter and lubrication line. <Ref. to LU-28, INSPECTION, Engine Lubrication System Trouble in General.>**
**• If the oil pressure warning light is turned ON and oil pressure is in specification, replace the oil pressure switch. <Ref. to LU-28, INSPECTION, Engine Lubrication System Trouble in General.>**

NOTE:
The specified data is based on an engine oil temperature of 80°C (176°F).

5) After measuring the oil pressure, install the oil pressure switch. <Ref. to LU-23, INSTALLATION, Oil Pressure Switch.>

***Tightening torque:***
***25 N·m (2.5 kgf-m, 18.1 ft-lb)***


GETtheMANUALS.org

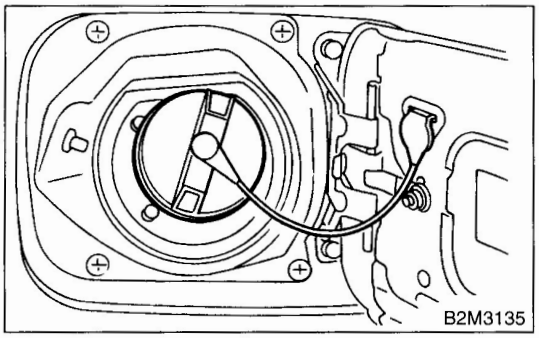
# 7. Fuel Pressure

## A: INSPECTION

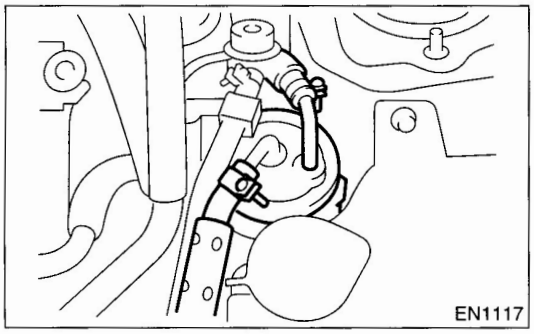
**WARNING:**
**Before removing the fuel pressure gauge, release the fuel pressure.**

NOTE:
If out of specification, check or replace the pressure regulator and pressure regulator vacuum hose.

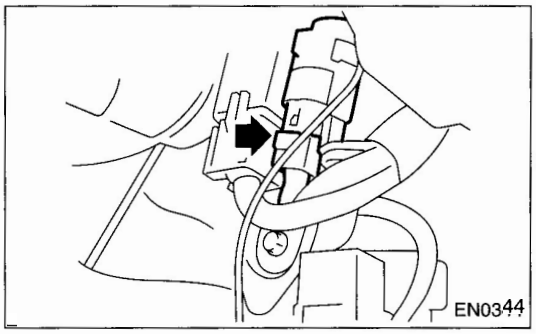
1) Release the fuel pressure. <Ref. to FU(DOHC TURBO)-51, RELEASING OF FUEL PRESSURE, OPERATION, Fuel.>
2) Open the fuel flap lid, and remove the fuel filler cap.




3) Disconnect the fuel delivery hoses from fuel filter, and connect the fuel pressure gauge.

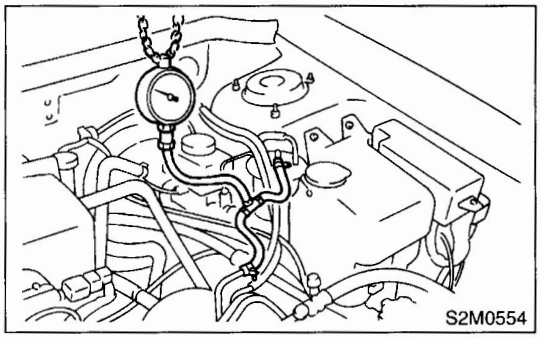



4) Connect the connector of fuel pump relay.



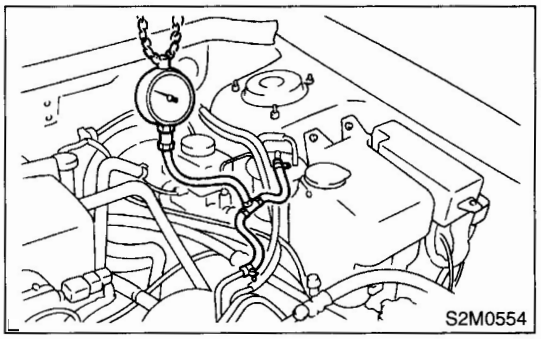

5) Start the engine.
6) Measure fuel pressure while disconnecting the pressure regulator vacuum hose from intake manifold.

***Fuel pressure:***
***Standard; 284 — 314 kPa (2.9 — 3.2 kgf/cm², 41 — 46 psi)***




7) After connecting the pressure regulator vacuum hose, measure fuel pressure.

***Fuel pressure:***
***Standard; 230 — 260 kPa (2.35 — 2.65 kgf/cm², 33 — 38 psi)***




NOTE:
The fuel pressure gauge registers 10 to 20 kPa (0.1 to 0.2 kgf/cm², 1 to 3 psi) higher than standard values during high-altitude operations.

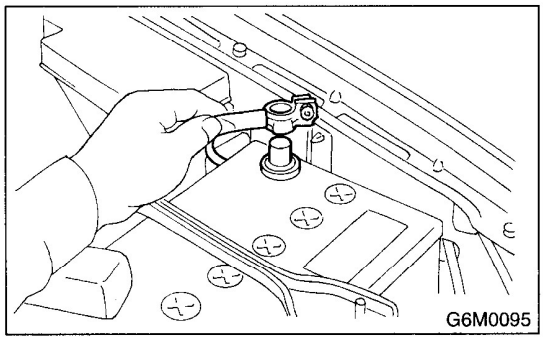

GETtheMANUALS.org

# 8. Valve Clearance

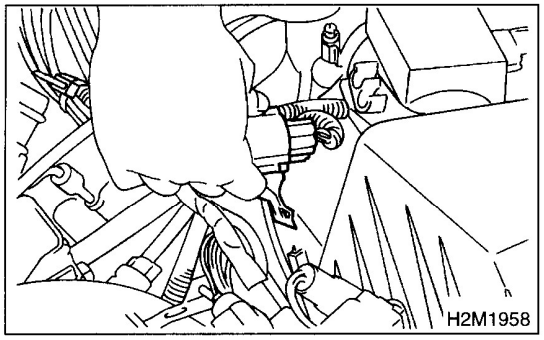
## A: INSPECTION

**CAUTION:**
**Inspection and adjustment of valve clearance should be performed while engine is cold.**

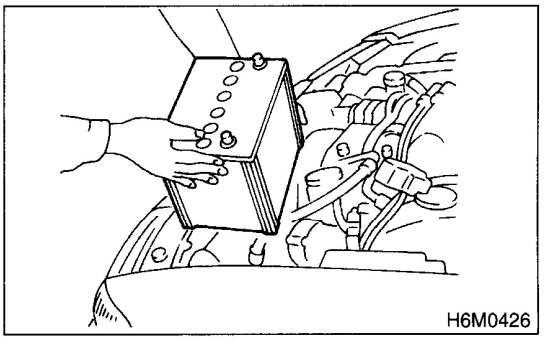
1) Set the vehicle onto the lift.
2) Disconnect the ground terminal from battery.


G6M0095

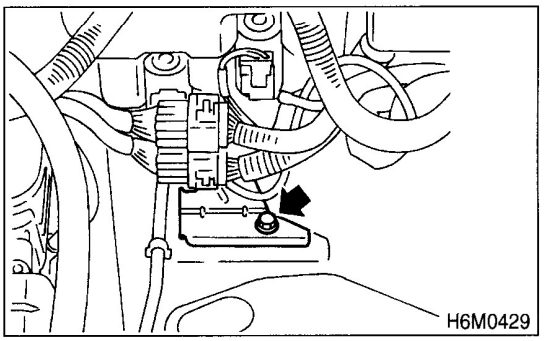
3) Remove the air intake duct. <Ref. to IN(DOHC TURBO)-8, REMOVAL, Air Intake Duct.>
4) Remove one bolt which secures the timing belt cover (RH).
5) Lift-up the vehicle.
6) Remove the under cover.
7) Loosen the remaining bolts which secure the timing belt cover (RH), then remove the belt cover.
8) Lower the vehicle.
9) When inspecting #1 and #3 cylinders:
(1) Pull out the engine harness connector with bracket from air cleaner upper cover.


H2M1958

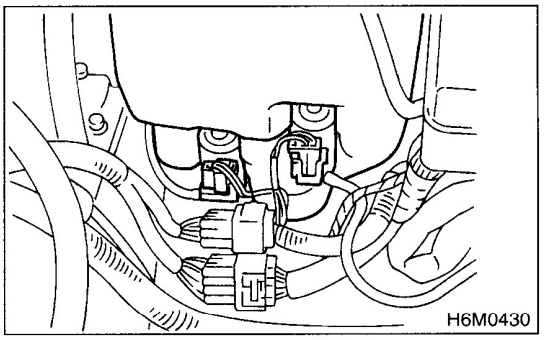
(2) Remove the air cleaner case. <Ref. to IN(DOHC TURBO)-7, REMOVAL, Air Cleaner.>
(3) Disconnect the spark plug cords from spark plugs (#1 and #3 cylinders).
(4) Place a suitable container under the vehicle.
(5) Disconnect the PCV hose from rocker cover (RH).
(6) Remove the bolts, then remove the rocker cover (RH).
10) When inspecting #2 and #4 cylinders:
(1) Disconnect the battery terminal, and then remove the battery and battery carrier.


H6M0426

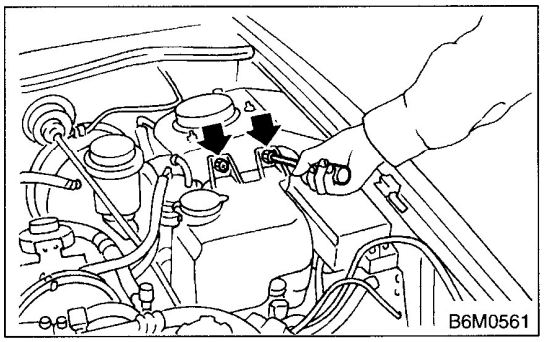
(2) Remove the bolt which secures the engine harness bracket onto body.


H6M0429

(3) Disconnect the washer motor connectors.

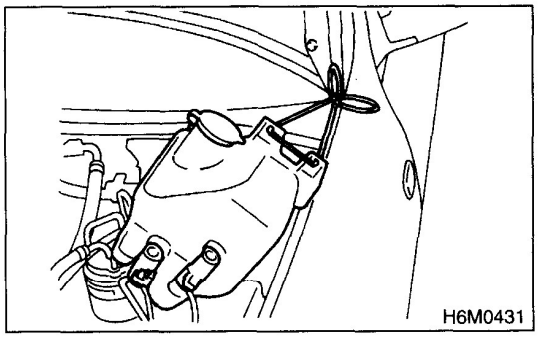

H6M0430

(4) Remove the washer tank mounting bolts.


B6M0561


GETtheMANUALS.org

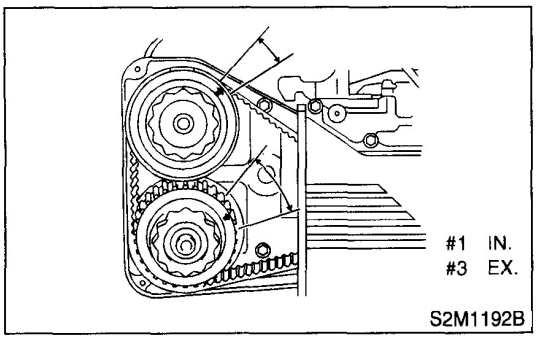
(5) Move the washer tank upward.




(6) Disconnect the spark plug cords from spark plugs (#2 and #4 cylinders).
(7) Place a suitable container under the vehicle.
(8) Disconnect the PCV hose from rocker cover (LH).
(9) Remove the bolts, then remove the rocker cover (LH).

11) Turn the crankshaft pulley clockwise until arrow mark on the camshaft sprocket is set to position shown in the figure.

NOTE:
Turn the crankshaft using ST.
ST 499987500 CRANKSHAFT SOCKET

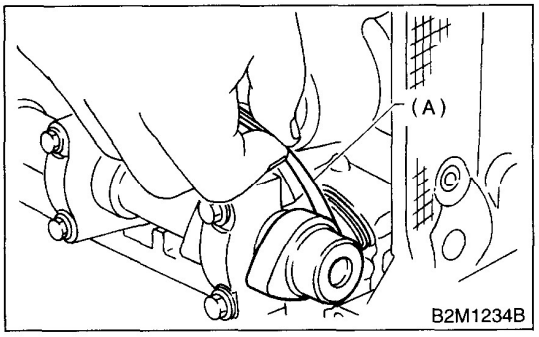



12) Measure #1 cylinder intake valve and #3 cylinder exhaust valve clearance by using thickness gauge (A).

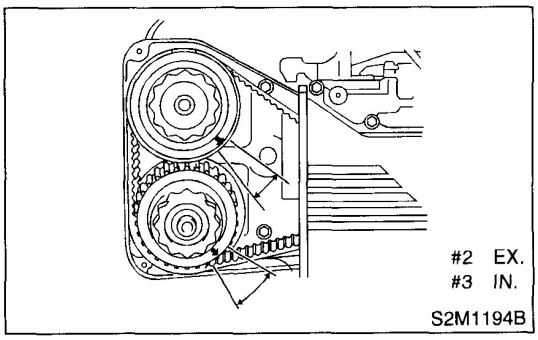
**CAUTION:**
**• Insert the thickness gauge in as horizontal a direction as possible with respect to the shim.**
**• Measure the exhaust valve clearances while lifting-up the vehicle.**

***Valve clearance:***
***Intake: 0.20±0.02 mm (0.0079±0.0008 in)***
***Exhaust: 0.25±0.02 mm (0.0098±0.0008 in)***

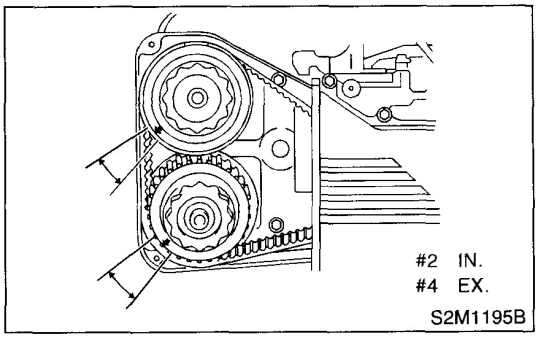
NOTE:
If the measured value is not within specification, take notes of the value in order to adjust the valve clearance later on.




13) If necessary, adjust the valve clearance. <Ref. to ME(DOHC TURBO)-30, ADJUSTMENT, Valve Clearance.>
14) Further turn the crankshaft pulley clockwise.
Using the same procedures described previously, then measure valve clearances again.
(1) Set the arrow mark on camshaft sprocket to position shown in the figure, and measure #2 cylinder exhaust valve and #3 cylinder intake valve clearances.



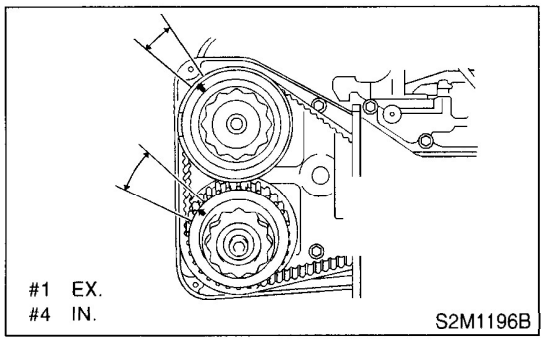

(2) Set the arrow mark on camshaft sprocket to position shown in the figure, and measure #2 cylinder intake valve and #4 cylinder exhaust valve clearances.





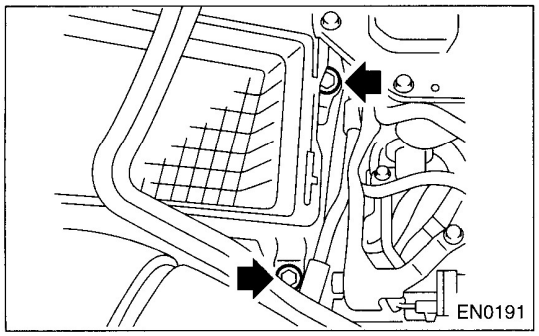
GETtheMANUALS.org

(3) Set the arrow mark on camshaft sprocket to position shown in the figure, and measure #1 cylinder exhaust valve and #4 cylinder intake valve clearances.




15) After inspection, install the related parts in the reverse order of removal.

***Tightening torque:***
***32 N·m (3.3 kgf-m, 24 ft-lb)***

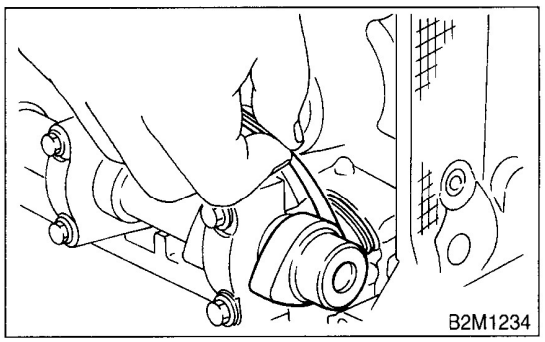



## B: ADJUSTMENT

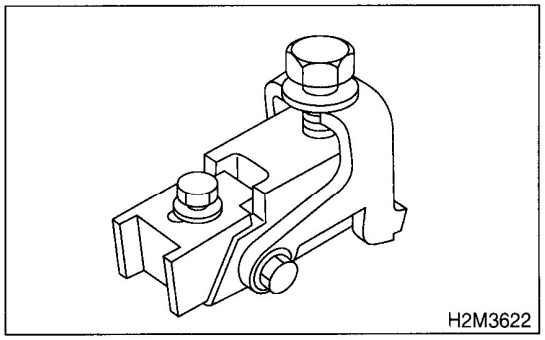
**CAUTION:**
**Adjustment of valve clearance should be performed while engine is cold.**

1) Measure all valve clearances. <Ref. to ME(DOHC TURBO)-28, INSPECTION, Valve Clearance.>

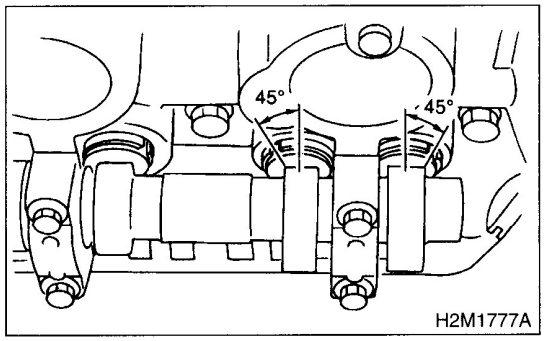
NOTE:
Record each valve clearance after it has been measured.




2) Remove the shim from valve lifter.
(1) Prepare the ST.
ST 498187200 SHIM REPLACER



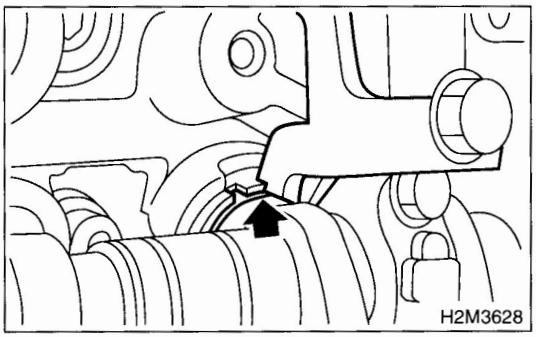

(2) Rotate the notch of the valve lifter outward by 45°.





GETtheMANUALS.org

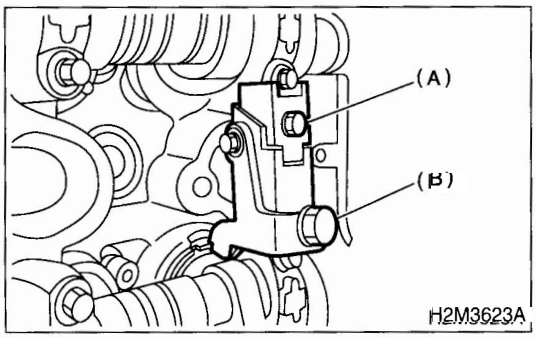
(3) Adjust the SHIM REPLACER notch to valve lifter and set it.



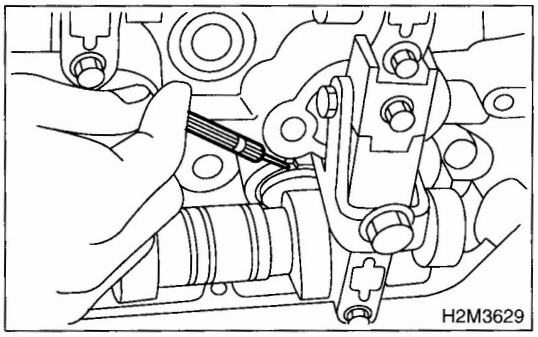

NOTE:
When setting, be careful the SHIM REPLACER edge does not touch shim.

(4) Tighten bolt (A) and install it to the cylinder head.

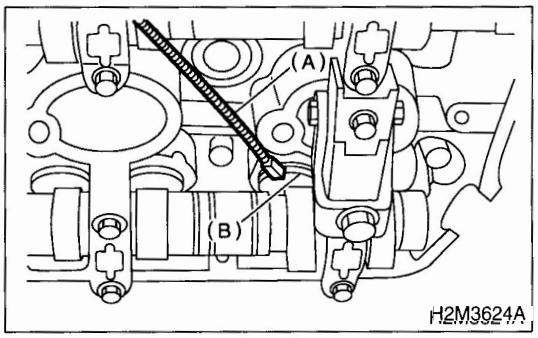
(5) Tighten bolt (B) and insert the valve lifter.



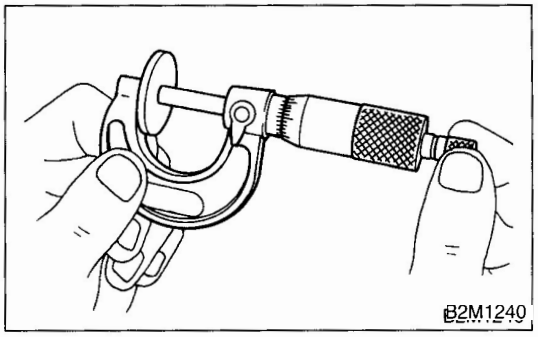

(6) Insert tweezers into the notch of the valve lifter, and take the shim out.




NOTE:
By using a magnet (A), the shim (B) can be taken out without dropping it.




3) Measure the thickness of shim with a micrometer.




4) Select a shim of suitable thickness using measured valve clearance and shim thickness, by referring to the following table.

5) Set the suitable shim selected in step 4) to valve lifter.

| Unit: mm |
|---|
| Intake valve:S =(V + T) - 0.20<br>Exhaust valve:S =(V + T) - 0.25 |
| S: Shim thickness to be used<br>V: Measured valve clearance<br>T: Shim thickness required |


GETtheMANUALS.org

| Part No. | Thickness mm (in) |
|---|---|
| 13218 AK010 | 2.00 (0.0787) |
| 13218 AK020 | 2.02 (0.0795) |
| 13218 AK030 | 2.04 (0.0803) |
| 13218 AK040 | 2.06 (0.0811) |
| 13218 AK050 | 2.08 (0.0819) |
| 13218 AK060 | 2.10 (0.0827) |
| 13218 AK070 | 2.12 (0.0835) |
| 13218 AK080 | 2.14 (0.0843) |
| 13218 AK090 | 2.16 (0.0850) |
| 13218 AK100 | 2.18 (0.0858) |
| 13218 AK110 | 2.20 (0.0866) |
| 13218 AE710 | 2.22 (0.0874) |
| 13218 AE730 | 2.24 (0.0882) |
| 13218 AE750 | 2.26 (0.0890) |
| 13218 AE770 | 2.28 (0.0898) |
| 13218 AE790 | 2.30 (0.0906) |
| 13218 AE810 | 2.32 (0.0913) |
| 13218 AE830 | 2.34 (0.0921) |
| 13218 AE850 | 2.36 (0.0929) |
| 13218 AE870 | 2.38 (0.0937) |
| 13218 AE890 | 2.40 (0.0945) |
| 13218 AE910 | 2.42 (0.0953) |
| 13218 AE920 | 2.43 (0.0957) |
| 13218 AE930 | 2.44 (0.0961) |
| 13218 AE940 | 2.45 (0.0965) |
| 13218 AE950 | 2.46 (0.0969) |
| 13218 AE960 | 2.47 (0.0972) |
| 13218 AE970 | 2.48 (0.0976) |
| 13218 AE980 | 2.49 (0.0980) |
| 13218 AE990 | 2.50 (0.0984) |
| 13218 AF000 | 2.51 (0.0988) |
| 13218 AF010 | 2.52 (0.0992) |
| 13218 AF020 | 2.53 (0.0996) |
| 13218 AF030 | 2.54 (0.1000) |
| 13218 AF040 | 2.55 (0.1004) |
| 13218 AF050 | 2.56 (0.1008) |
| 13218 AF060 | 2.57 (0.1012) |
| 13218 AF070 | 2.58 (0.1016) |
| 13218 AF090 | 2.60 (0.1024) |
| 13218 AF110 | 2.62 (0.1031) |
| 13218 AF130 | 2.64 (0.1039) |
| 13218 AF150 | 2.66 (0.1047) |
| 13218 AF170 | 2.68 (0.1055) |
| 13218 AF190 | 2.70 (0.1063) |

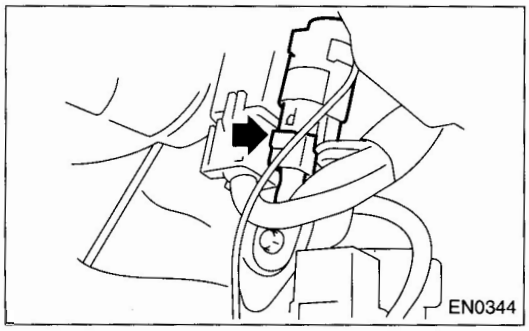
6) Inspect all valves for clearance again at this stage. If the valve clearance is not correct, repeat the procedure over again from the first step.
7) After inspection, install the related parts in the reverse order of removal.


GETtheMANUALS.org

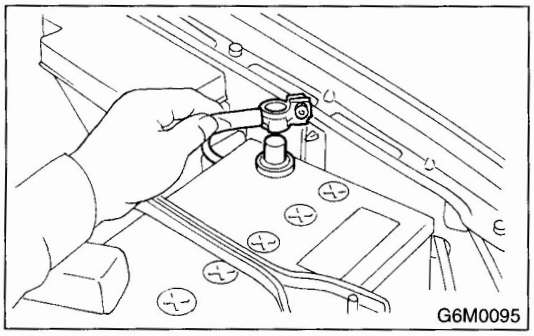
# 9. Engine Assembly

## A: REMOVAL

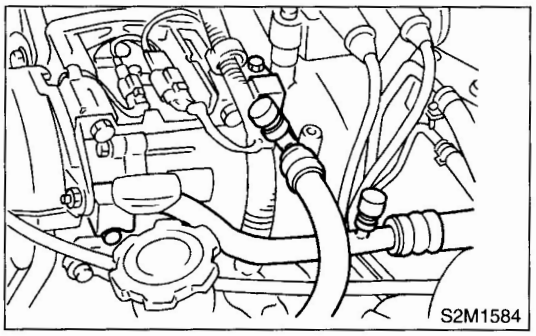
1) Set the vehicle on lift arms.
2) Open the front hood fully and support with stay.
3) Raise the rear seat, and turn the floor mat up.
4) Release the fuel pressure.
   (1) Disconnect the fuel pump relay connector.



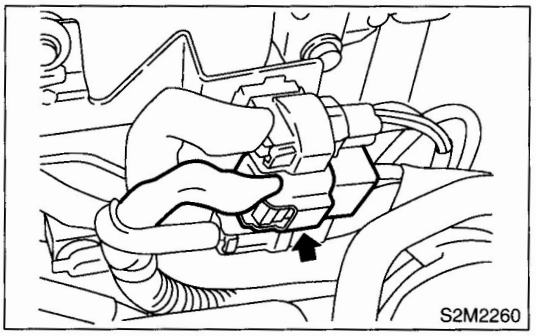

   (2) Start the engine, and run until stalls.
   (3) After the engine stalls, crank it for five seconds more.
   (4) Turn the ignition switch to "OFF".
5) Remove the filler cap.
6) Disconnect the ground terminal from battery.



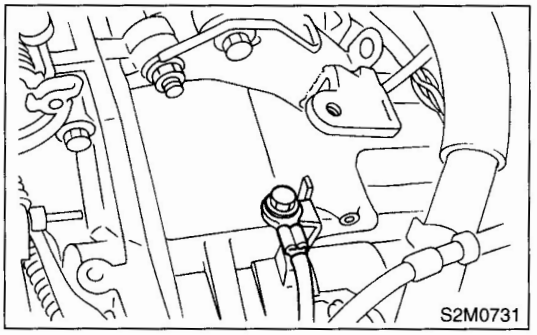

7) Remove the radiator from vehicle. <Ref. to CO-37, REMOVAL, Radiator.>
8) Remove the coolant filler tank. <Ref. to CO-51, REMOVAL, Coolant Filler Tank.>
9) Collect refrigerant, and remove the pressure hoses.
   (1) Place and connect the attachment hose to the refrigerant recycle system.
   (2) Collect the refrigerant from A/C system.
   (3) Disconnect the A/C pressure hoses from A/C compressor.




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



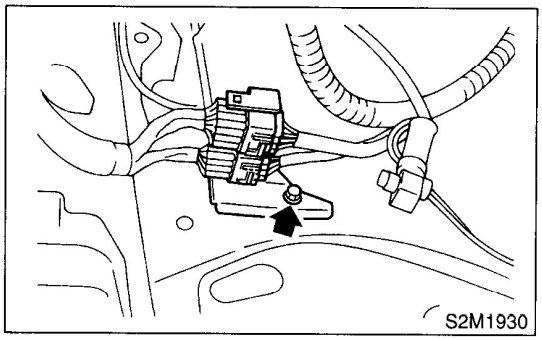

   (2) Engine ground terminal



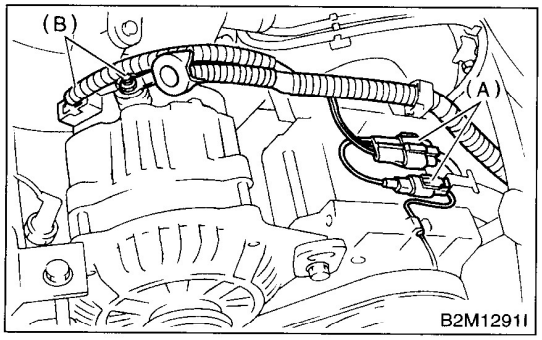


GETtheMANUALS.org

(3) Engine harness connector

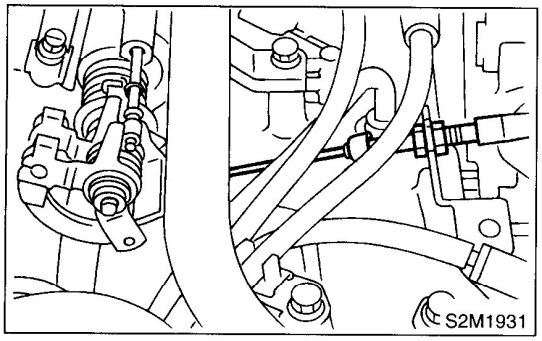



(4) Generator connector, terminal and A/C compressor connectors

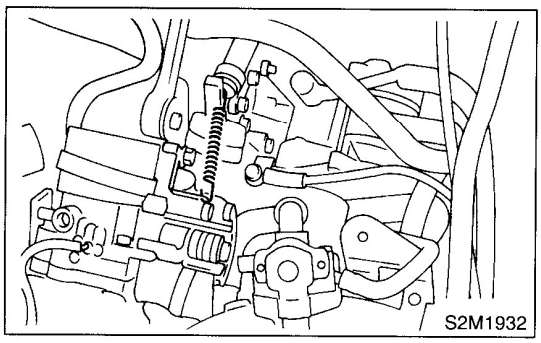



(A) A/C compressor connector
(B) Generator connector and terminal

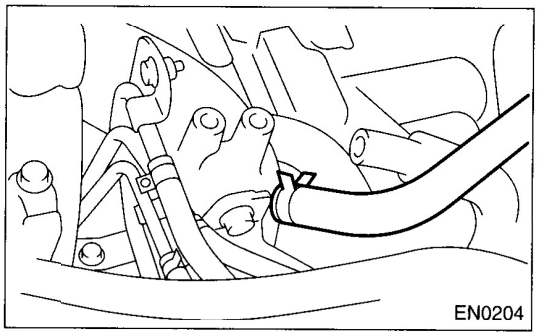
(5) Accelerator cable



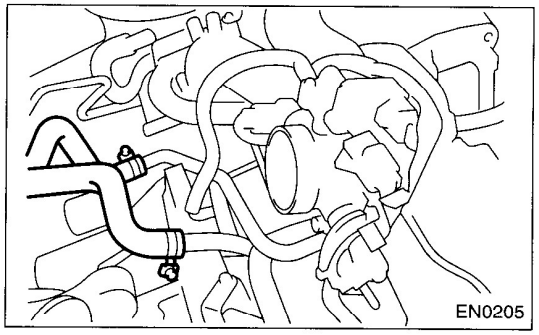

(6) Clutch release spring



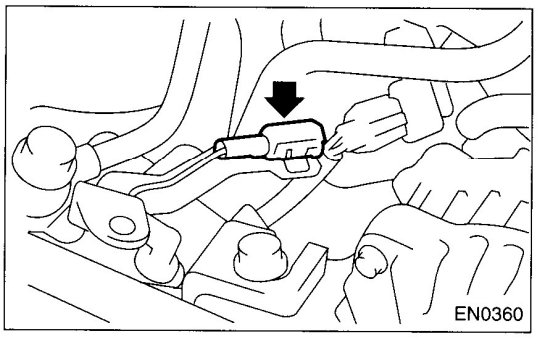

12) Disconnect the following hoses.
(1) Brake booster vacuum hose




(2) Heater inlet outlet hose



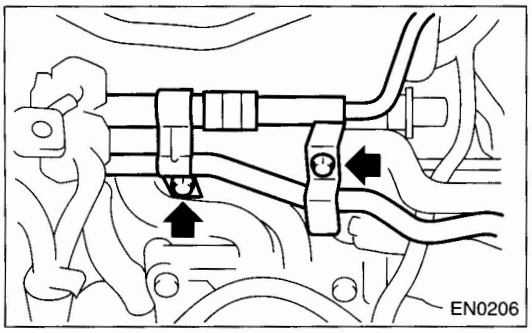

13) Remove the power steering pump from bracket.
(1) Loosen lock bolt and slider bolt, and remove the front side V-belt. <Ref. to ME(DOHC TURBO)-44, FRONT SIDE BELT, REMOVAL, V-belt.>
(2) Disconnect the power steering switch connector.



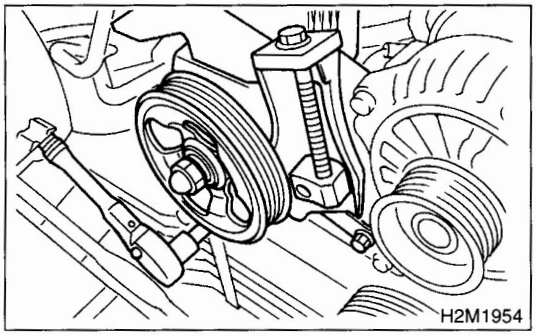


GETtheMANUALS.org

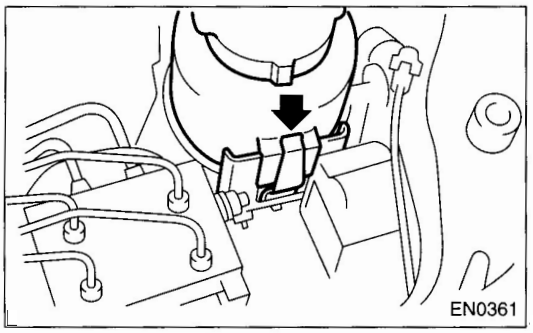
(3) Remove the pipe with bracket from intake manifold.



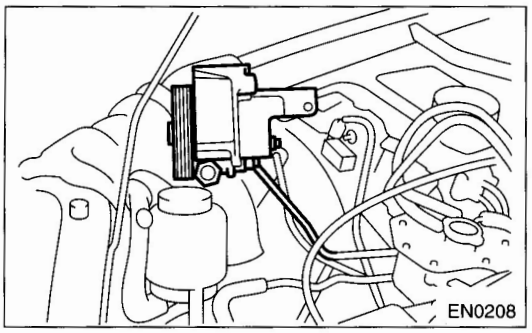

(4) Remove the power steering pump from engine.




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

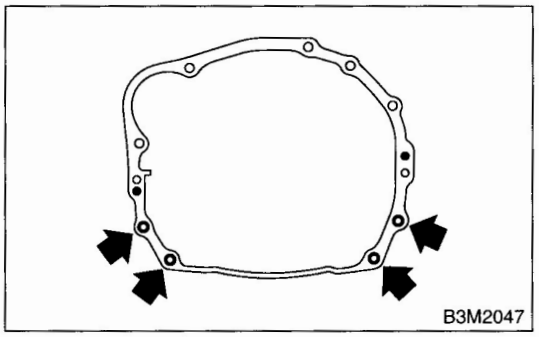



(6) Place the power steering pump on the right side wheel apron.

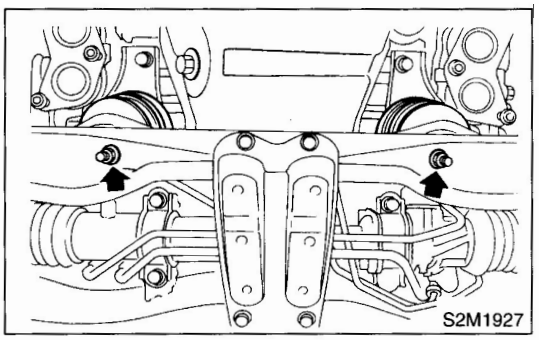



14) Remove the center exhaust pipe. <Ref. to EX(DOHC TURBO)-8, REMOVAL, Center Exhaust Pipe.>

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



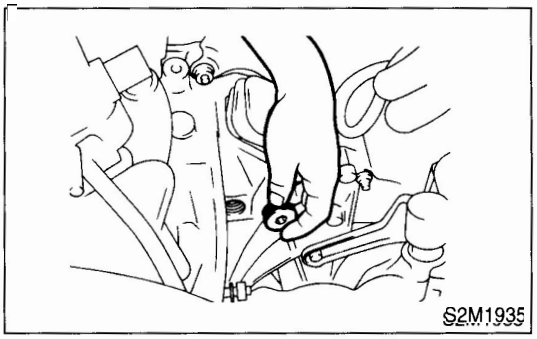

16) Remove the nuts which install the front cushion rubber onto front crossmember.




17) Separate the clutch release fork from release bearing. (MT vehicles)

(1) Remove the clutch operating cylinder from transmission.

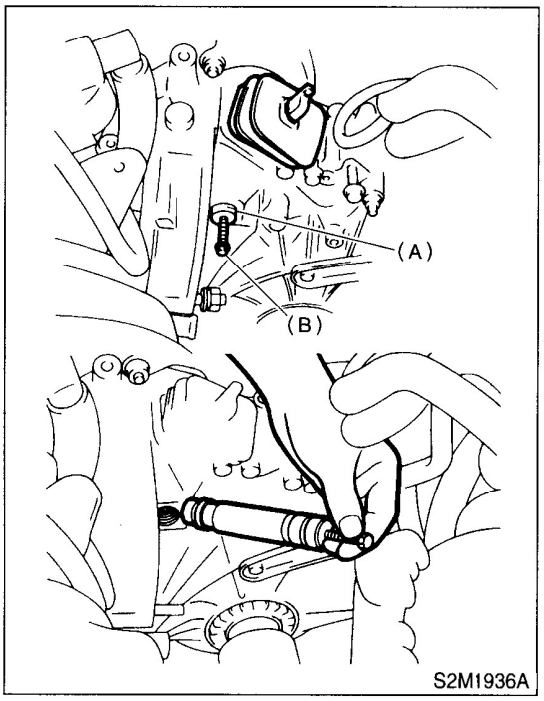
(2) Remove the plug using a 10 mm hexagon wrench.





GETtheMANUALS.org

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



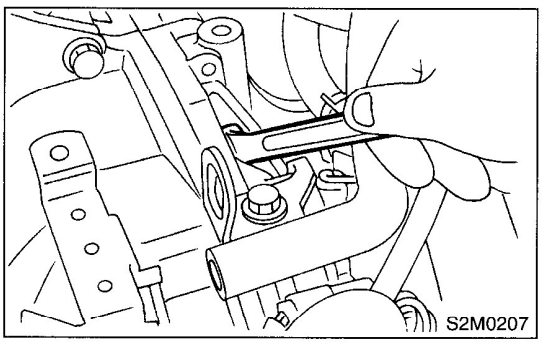

(A) Shaft
(B) Bolt

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

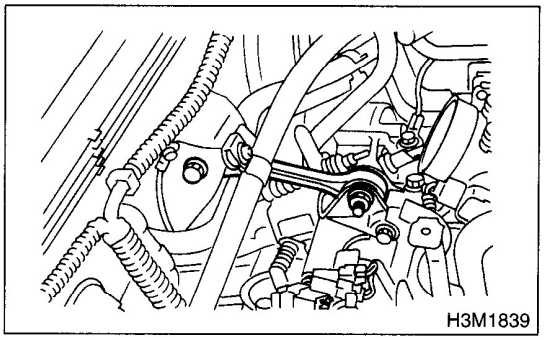
**CAUTION:**
**Step (4) is required to prevent interference with engine when removing the engine from transmission.**

18) Separate the torque converter clutch from drive plate. (AT vehicles)
(1) Lower the vehicle.
(2) Remove the service hole plug.
(3) Remove the bolts which hold torque converter clutch to drive plate.
(4) Remove the other bolts while rotating the engine using ST.

ST 499977300 CRANK PULLEY WRENCH

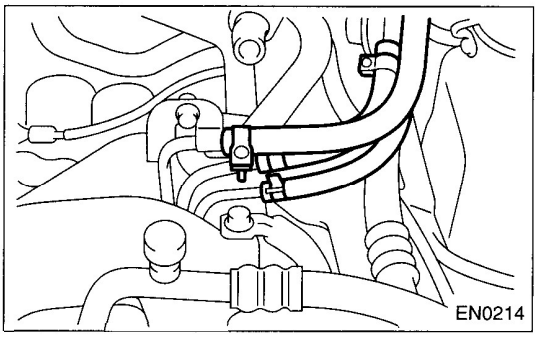



19) Remove the pitching stopper.

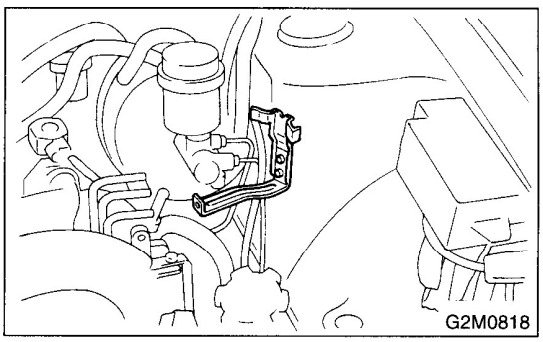



20) Disconnect the fuel delivery hose, return hose and evaporation hose.

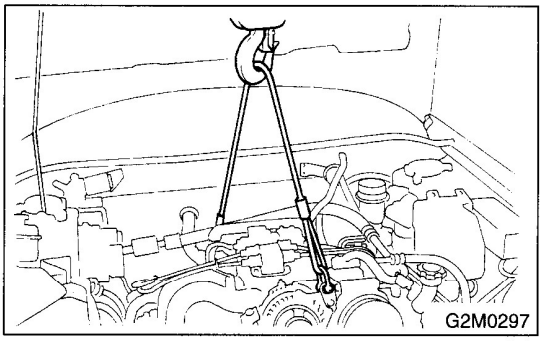
**CAUTION:**
- **Catch fuel from hose into container.**
- **Disconnect the hose with its end wrapped with cloth to prevent fuel from splashing.**




21) Remove the fuel filter and bracket.




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

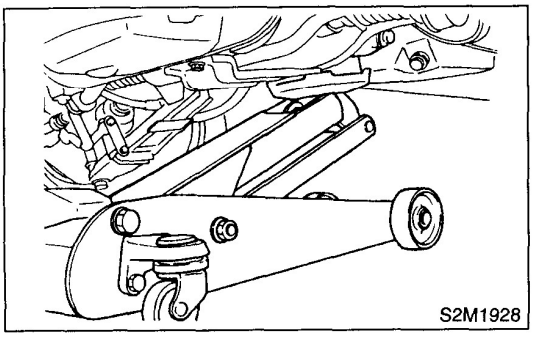




GETtheMANUALS.org

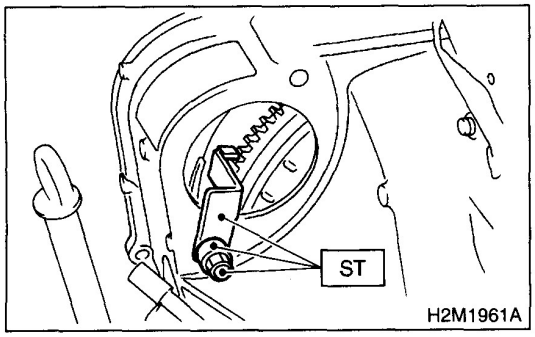
23) Support the transmission with a garage jack.

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

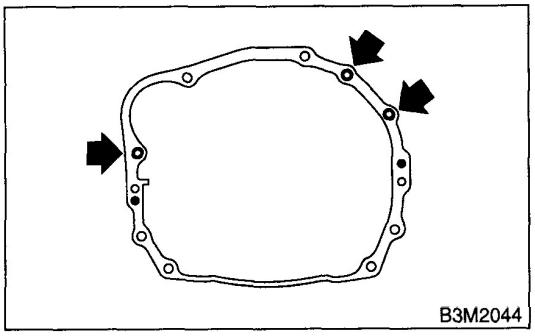



24) Separation of engine and transmission.
(1) Remove the starter. <Ref. to SC-6, REMOVAL, Starter.>
(2) Install the ST to torque converter clutch case. (AT vehicles)

ST 498277200 STOPPER SET




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




25) Remove the engine from vehicle.
(1) Slightly raise the engine.
(2) Raise the transmission with garage jack.
(3) Move the engine horizontally until the mainshaft is withdrawn from clutch cover.
(4) Slowly move the engine away from engine compartment.

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

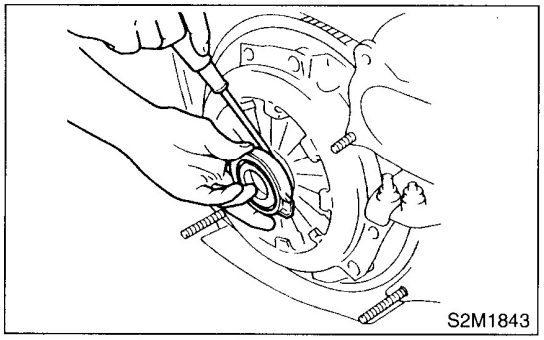
26) Remove the front cushion rubbers.


GETtheMANUALS.org

## B: INSTALLATION

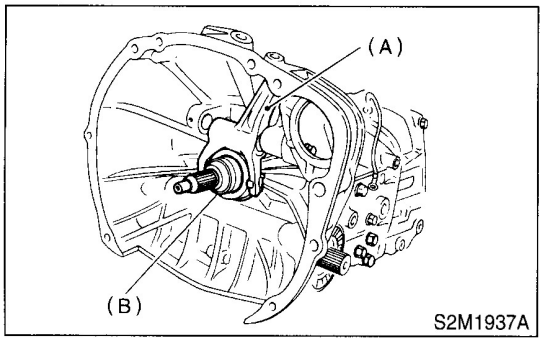
1) Install the clutch release fork and bearing onto transmission. (MT vehicles)

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




(2) Install the release bearing on transmission.

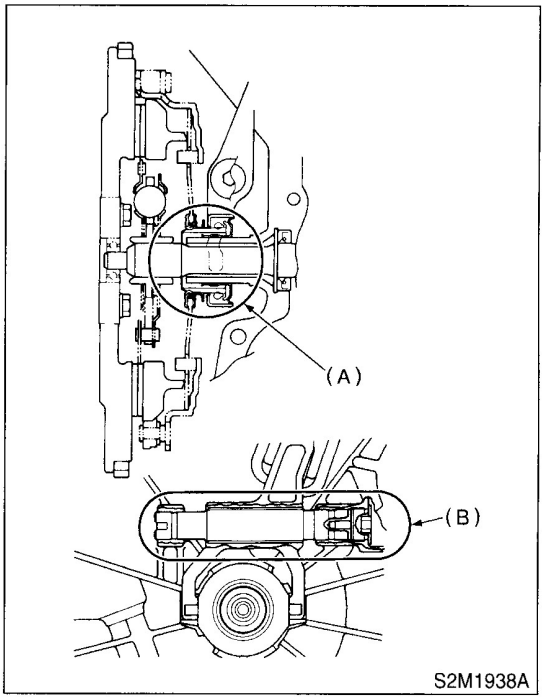
(3) Install the release fork into release bearing tab.




(A) Release fork
(B) Release bearing

(4) Apply grease to the specified points.

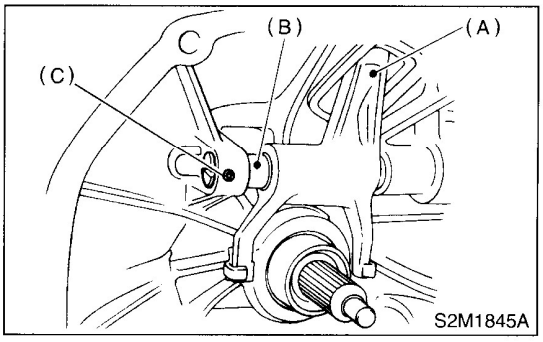
- Spline FX2200
- Shaft SUNLIGHT 2




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

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

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

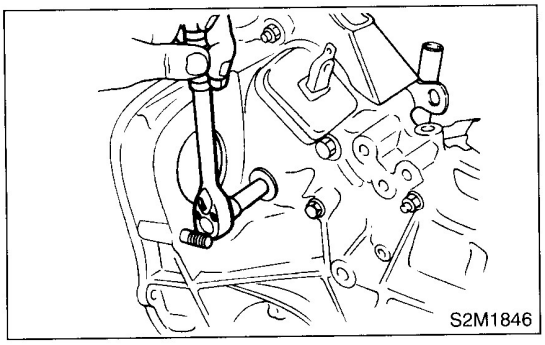



(A) Release fork
(B) Release shaft
(C) Spring pin


GETtheMANUALS.org

(6) Tighten the plug.

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




2) Install the front cushion rubbers to engine.

***Tightening torque:***
***34 N·m (3.5 kgf-m, 25.3 ft-lb)***

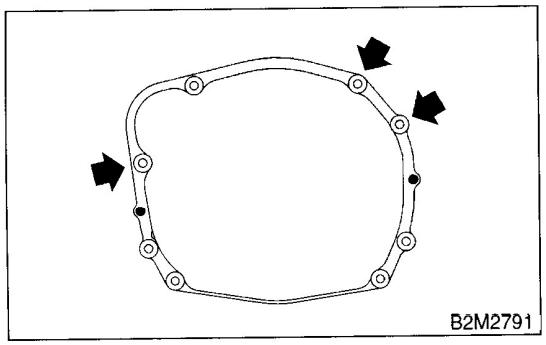
3) Install the engine onto transmission.
(1) Position the engine in engine compartment and align it with transmission.

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

(2) Apply a small amount of grease to splines of mainshaft. (MT vehicles)

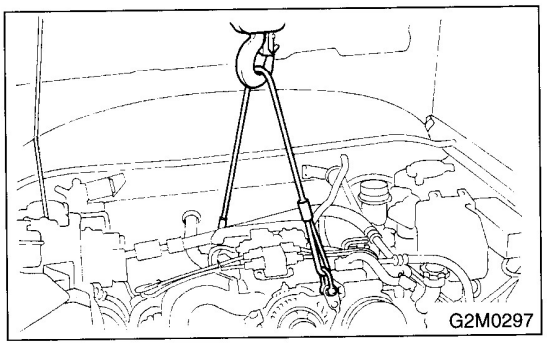
4) Tighten the bolts which hold right upper side of transmission to engine.

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



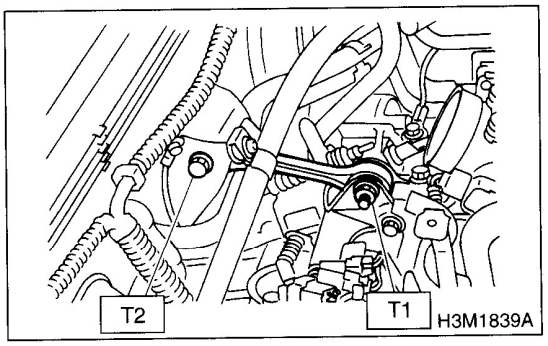

5) Remove the lifting device and wire ropes.

6) Remove the garage jack.




7) Install the pitching stopper.

***Tightening torque:***
***T1: 50 N·m (5.1 kgf-m, 37 ft-lb)***
***T2: 58 N·m (5.9 kgf-m, 43 ft-lb)***




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

NOTE:
Be careful not to drop the ST into the torque converter clutch case when removing ST.
ST 498277200 STOPPER SET

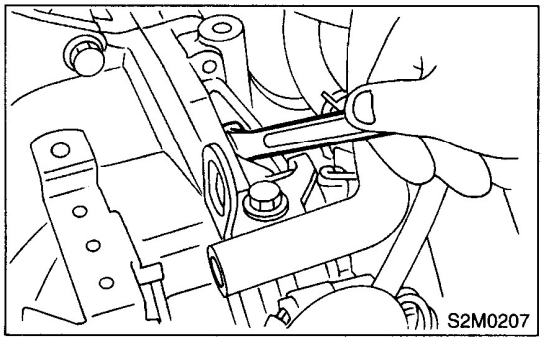
9) Install the starter. <Ref. to SC-7, INSTALLATION, Starter.>


GETtheMANUALS.org

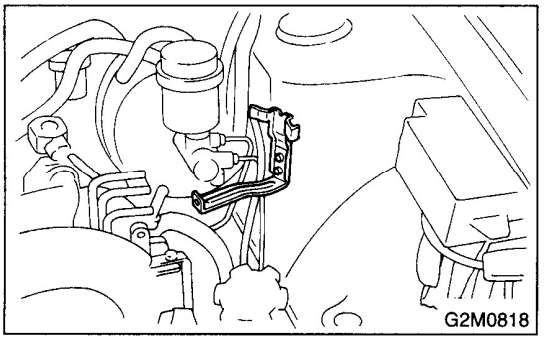
10) Install the torque converter clutch onto drive plate. (AT vehicles)
(1) Tighten the bolts which hold torque converter clutch to drive plate.
(2) Tighten other bolts while rotating the engine by using ST.

**CAUTION:**
**Be careful not to drop bolts into the torque converter clutch housing.**
ST 499977300 CRANK PULLEY WRENCH

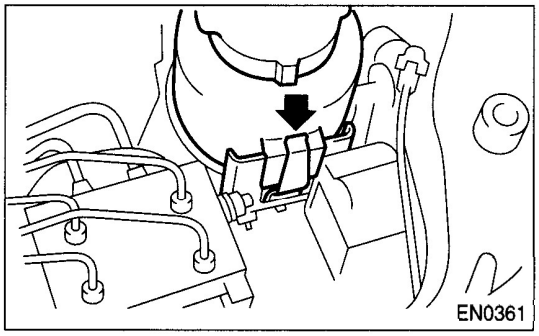
***Tightening torque:***
***25 N·m (2.5 kgf-m, 18.1 ft-lb)***


S2M0207

(3) Clog the service hole with plug.
11) Install the fuel filter and bracket.

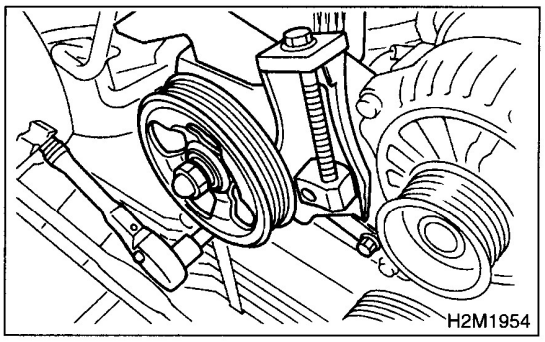

G2M0818

12) Install the power steering pump on bracket.
(1) Install the power steering tank on bracket.

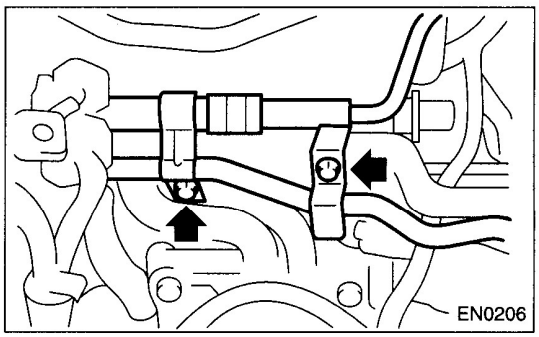

EN0361

(2) Install the power steering pump.

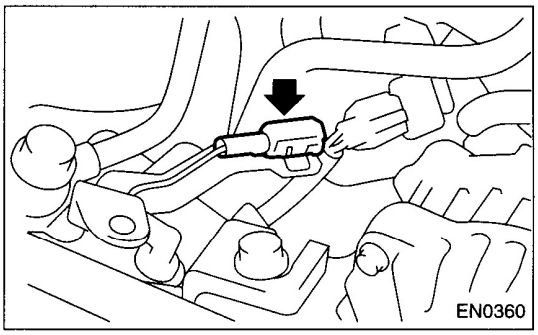
***Tightening torque:***
***20.1 N·m (2.05 kgf-m, 14.8 ft-lb)***


H2M1954

(3) Install the power steering pipe bracket on right side intake manifold, and install the spark plug codes.


EN0206

(4) Connect the power steering switch connector.

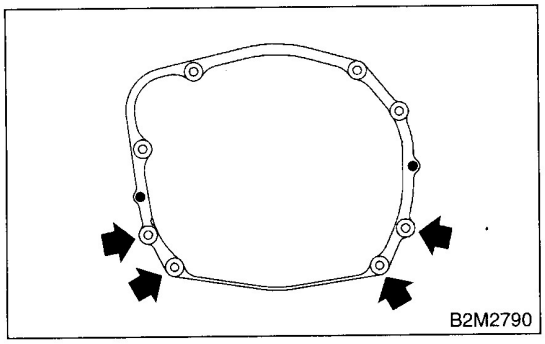

EN0360

(5) Install the front side V-belt, and adjust it. <Ref. to ME(DOHC TURBO)-44, FRONT SIDE BELT, INSTALLATION, V-belt.>


GETtheMANUALS.org

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

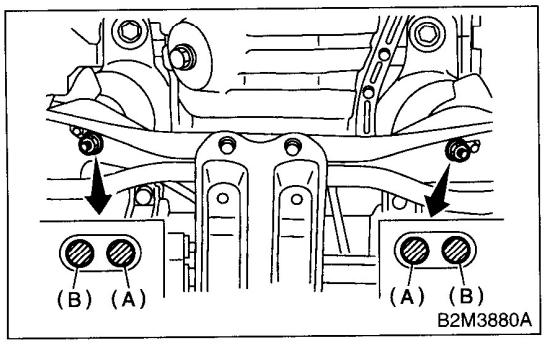
***Tightening torque:***
***50 N·m (5.1 kgf-m, 36.9 ft-lb)***




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

***Tightening torque:***
***83 N·m (8.5 kgf-m, 61 ft-lb)***

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



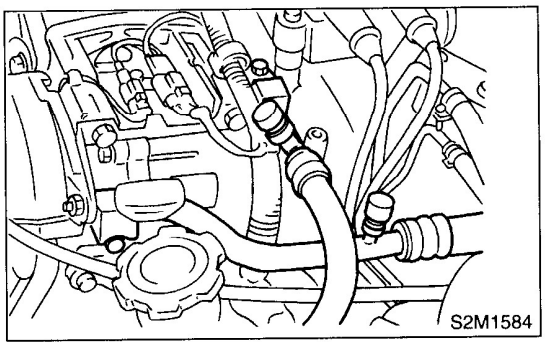

15) Install the center exhaust pipe.
<Ref. to EX(DOHC TURBO)-9, INSTALLATION, Center Exhaust Pipe.>
16) Connect the following hoses:
(1) Fuel delivery hose, return hose and evaporation hose
(2) Heater inlet and outlet hoses
(3) Brake booster vacuum hose
17) Connect the following connectors and terminals:
(1) Engine ground terminal
(2) Engine harness connectors
(3) Generator connector and terminal
(4) A/C compressor connectors
18) Connect the following cables:
(1) Accelerator cable
(2) Clutch release spring

**CAUTION:**
**After connecting each cable, adjust them.**

19) Install the air intake system.
(1) Install the intercooler. <Ref. to IN(DOHC TURBO)-11, INSTALLATION, Intercooler.>
(2) Install the air cleaner element and air cleaner upper cover.
(3) Install the engine harness connector bracket.
(4) Install the filler hose to air cleaner case.
20) Install the A/C pressure hoses.

**CAUTION:**
**Use new O-rings.**

***Tightening torque:***
***25 N·m (2.5 kgf-m, 18.1 ft-lb)***




21) Install the radiator. <Ref. to CO-41, INSTALLATION, Radiator.>
22) Install the coolant filler tank. <Ref. to CO-51, INSTALLATION, Coolant Filler Tank.>
23) Install the window washer tank.
24) Install the battery in the vehicle, and connect cables.
25) Fill coolant.
<Ref. to CO-25, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>
26) Charge the A/C system with refrigerant.
<Ref. to AC-17, OPERATION, Refrigerant Charging Procedure.>
27) Remove the front hood stay, and close the front hood.
28) Take off the vehicle from lift arms.


GETtheMANUALS.org

# 10.Engine Mounting

## A: REMOVAL

1) Remove the engine assembly. <Ref. to ME(DOHC TURBO)-33, REMOVAL, Engine Assembly.>
2) Remove the engine mounting from engine assembly.

## B: INSTALLATION

Install in the reverse order of removal.

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

## C: INSPECTION

Make sure there are no cracks or other damage.

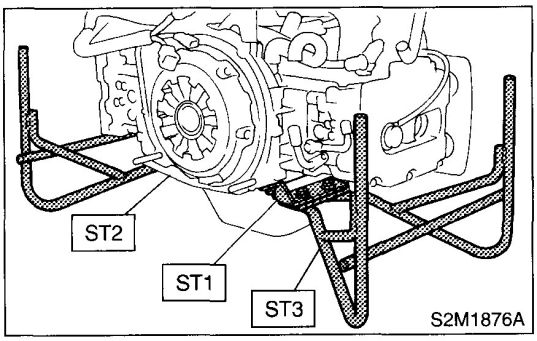

GETtheMANUALS.org

# 11.Preparation for Overhaul

## A: PROCEDURE

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

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




2) In this section the procedures described under each index are all connected and stated in order. It will be the complete procedure for overhauling of the engine itself when you go through all steps in the process.
Therefore, in this section, to conduct the particular procedure within the flow of a section, you need to go back and conduct the procedure described previously in order to do that particular procedure.


GETtheMANUALS.org

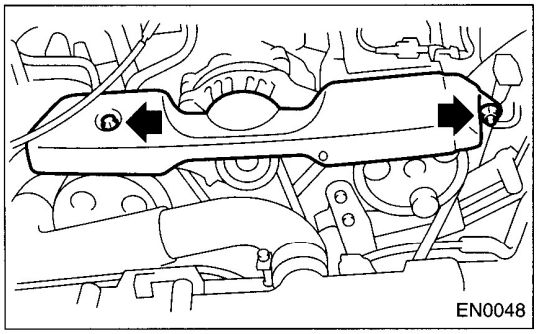
# 12.V-belt

## A: REMOVAL

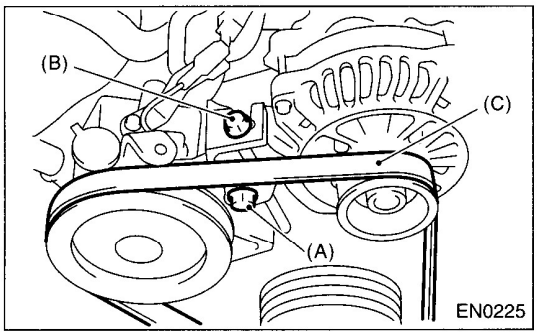
### 1. FRONT SIDE BELT

NOTE:
Perform the following procedures 1) to 4) with the engine installed to the body.

1) Remove the V-belt cover.

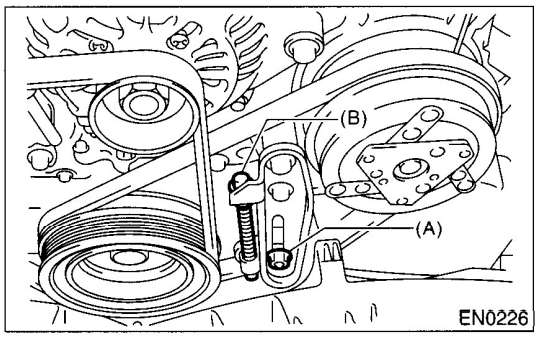



2) Loosen the lock bolt (A).
3) Loosen the slider bolt (B).
4) Remove the front side belt (C).



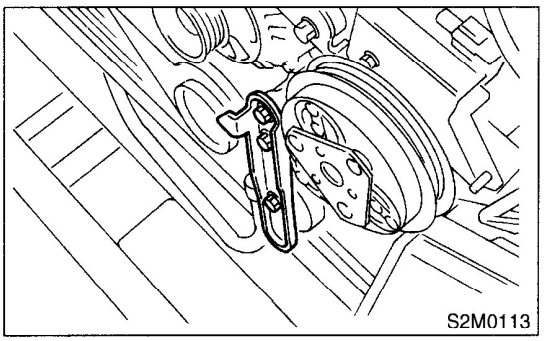

### 2. REAR SIDE BELT

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




3) Remove the A/C belt.

4) Remove the A/C belt tensioner.



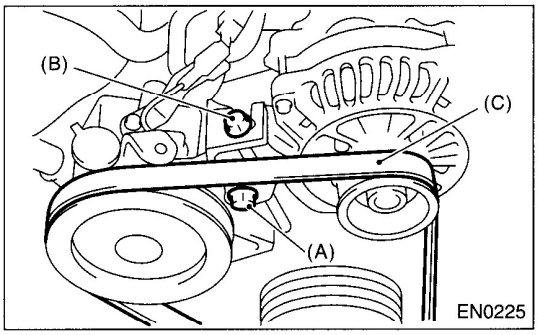

## B: INSTALLATION

### 1. FRONT SIDE BELT

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

1) Install a belt, and tighten the slider bolt so as to obtain the specified belt tension <Ref. to ME(DOHC TURBO)-45, INSPECTION, V-belt.>
2) Tighten the lock bolt (A)
3) Tighten the slider bolt (B).

***Tightening torque:***
***Lock bolt through bolt:***
***25 N·m (2.5 kgf-m, 18 ft-lb)***
***Slider bolt:***
***8 N·m (0.8 kgf-m, 5.5 ft-lb)***



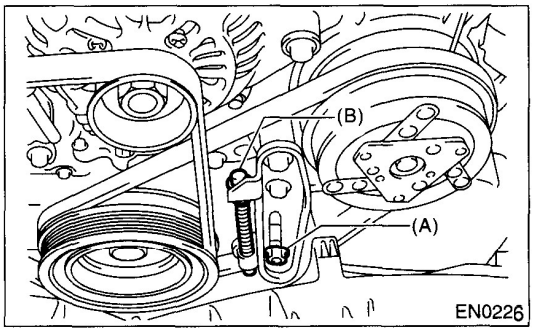


GETtheMANUALS.org

## 2. REAR SIDE BELT

1) Install a belt, and tighten the slider bolt (B) so as to obtain the specified belt tension. <Ref. to ME(DOHC TURBO)-45, INSPECTION, V-belt.>
2) Tighten the lock nut (A).

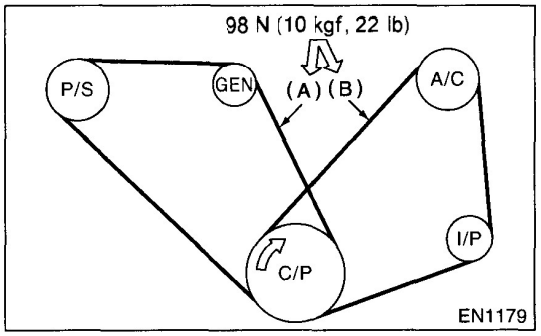
***Tightening torque:***
***Lock nut (A);***
***22.6 N·m (2.3 kgf-m, 16.6 ft-lb)***




## C: INSPECTION

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

***Belt tension***
***(A)***
***replaced: 7 — 9 mm (0.276 — 0.354 in)***
***reused: 9 — 11 mm (0.354 — 0.433 in)***
***(B)****
***replaced: 7.5 — 8.5 mm (0.295 — 0.335 in)***
***reused: 9.0 — 10.0 mm (0.354 — 0.394 in)***
****: With Air conditioner***



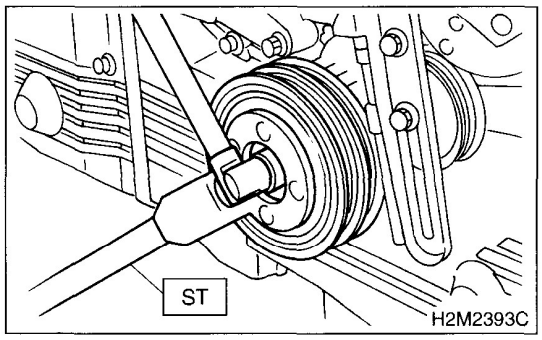

C/P Crankshaft pulley
GEN Generator
P/S Power steering oil pump pulley
A/C Air conditioning compressor pulley
I/P Idler pulley


GETtheMANUALS.org

# 13.Crankshaft Pulley

## A: REMOVAL

1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
2) Remove the crankshaft pulley bolt. To lock crankshaft, use ST.
ST 499977300
CRANKSHAFT PULLEY WRENCH

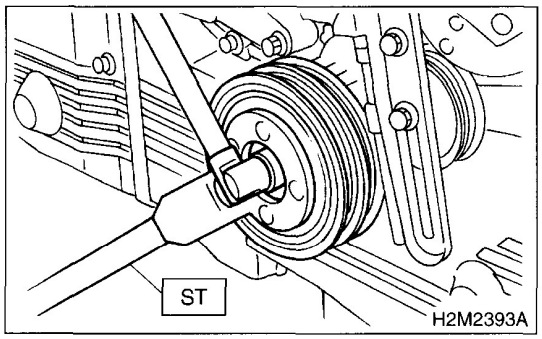



3) Remove the crankshaft pulley.

## B: INSTALLATION

1) Install the crankshaft pulley.
2) Install the pulley bolt.
To lock the crankshaft, use ST.
ST 499977300 CRANKSHAFT PULLEY WRENCH
(1) Clean the crankshaft pulley thread using an air gun.
(2) Apply engine oil to the crankshaft pulley bolt seat and thread.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kgf-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts.

***Tightening torque:***
***127 N·m (13 kgf-m, 94.0 ft-lb)***




3) Confirm that the tightening angle of the crankshaft pulley bolt is 45 degrees or more. If not, conduct the following procedures (1) through (4).

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

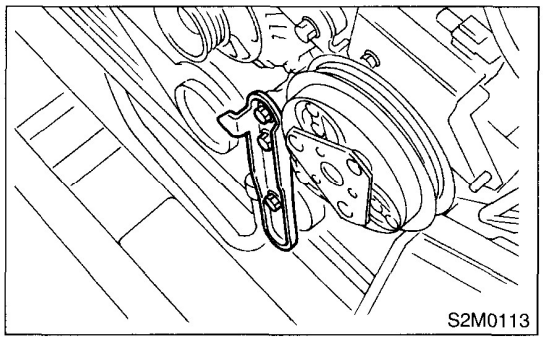
(1) Replace the crankshaft pulley bolts and clean them.

***Crankshaft pulley bolt:***
***12369AA011***

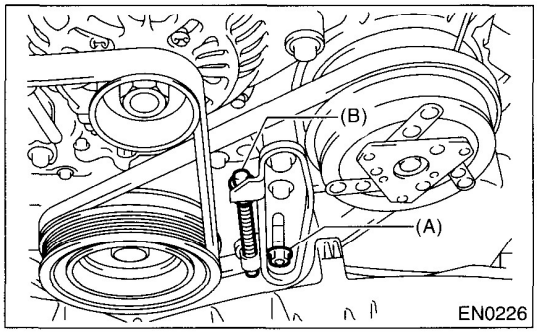
(2) Clean the crankshaft thread using an air gun.
(3) Tighten the bolts temporarily with tightening torque of 44 N·m (4.5 kgf-m, 33 ft-lb).
(4) Tighten the crankshaft pulley bolts keeping them in an angle between 65 degrees and 75 degrees.

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

4) Install the A/C belt tensioner.




5) Install the A/C belt.




## C: INSPECTION

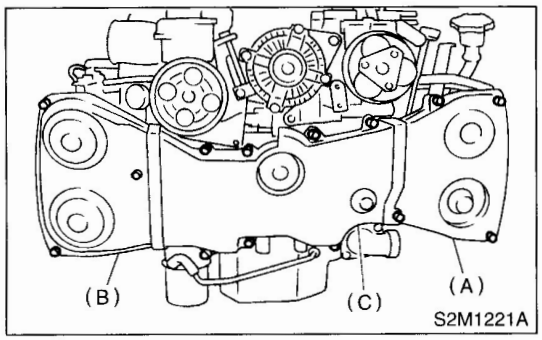
1) Make sure the V-belt is not worn or otherwise damaged.
2) Check the tension of the belt. <Ref. to ME(DOHC TURBO)-45, INSPECTION, V-belt.>


GETtheMANUALS.org

# 14.Belt Cover

## A: REMOVAL

1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
2) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
3) Remove the left-hand belt cover (A).
4) Remove the right-hand belt cover (B).
5) Remove the front belt cover (C).




## B: INSTALLATION

1) Install the front belt cover (C).

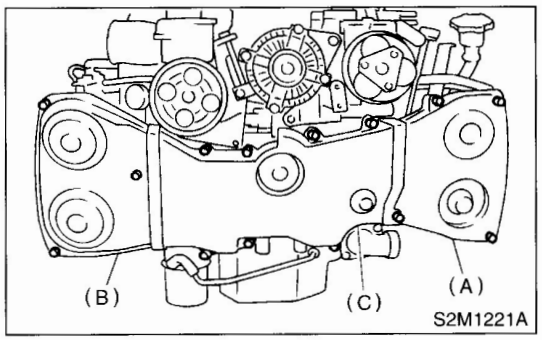
***Tightening torque:***
***5 N·m (0.5 kgf-m, 3.6 ft-lb)***

2) Install the right-hand belt cover (B).

***Tightening torque:***
***5 N·m (0.5 kgf-m, 3.6 ft-lb)***

3) Install the left-hand belt cover (A).

***Tightening torque:***
***5 N·m (0.5 kgf-m, 3.6 ft-lb)***




4) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>
5) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

## C: INSPECTION

Make sure the cover is not damaged.

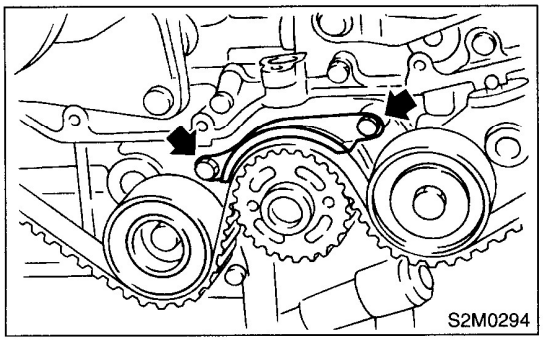

GETtheMANUALS.org

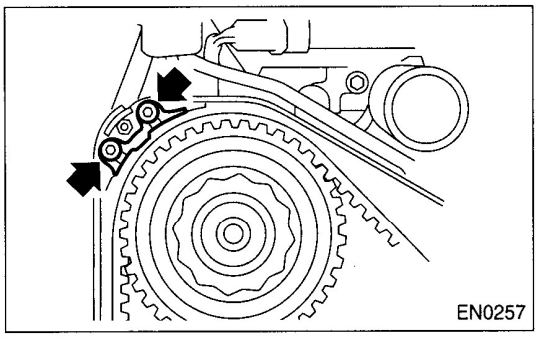
# 15.Timing Belt Assembly

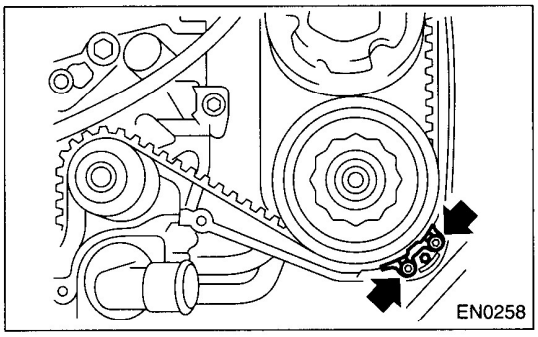
## A: REMOVAL

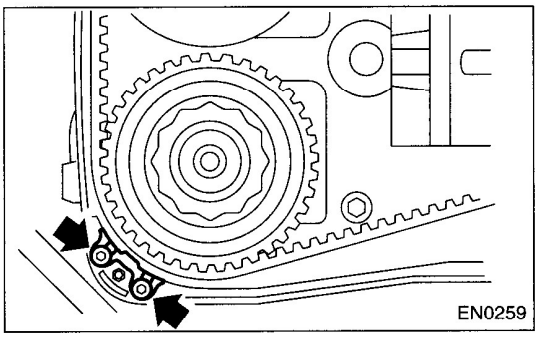
### 1. TIMING BELT

1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
2) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
3) Remove the belt cover. <Ref. to ME(DOHC TURBO)-47, REMOVAL, Belt Cover.>
4) Remove the timing belt guides. (MT vehicle)



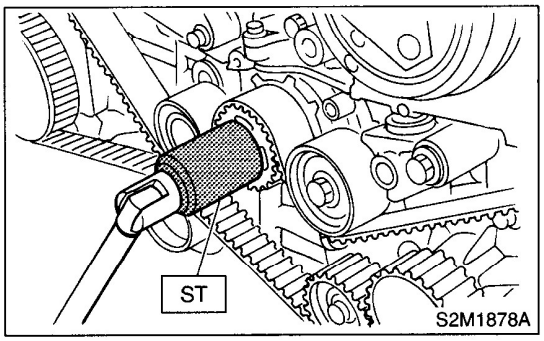




5) If the alignment mark and/or arrow mark (which indicates rotation direction) on timing belt fade away, put new marks before removing the timing belt as follows:
   (1) Turn the crankshaft using ST, and align alignment marks on crankshaft sprocket, left-hand intake camshaft sprocket, left-hand exhaust camshaft sprocket, right-hand intake camshaft sprocket and right hand exhaust camshaft sprocket with notches of belt cover and cylinder block.

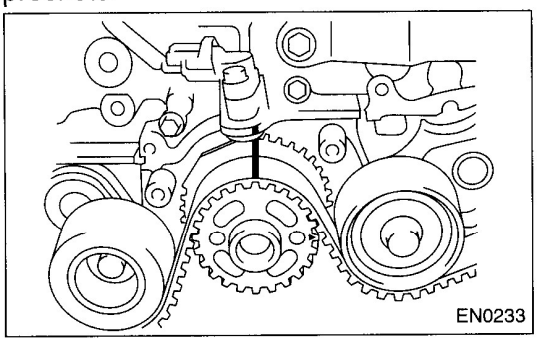
ST 499987500 CRANKSHAFT SOCKET

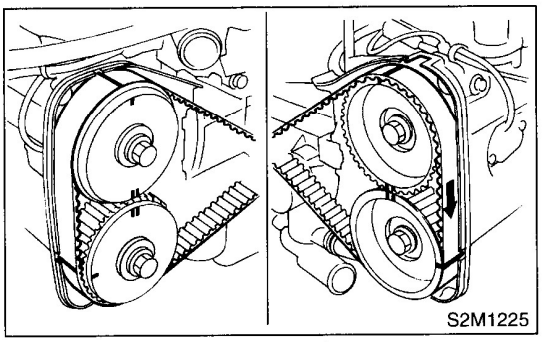




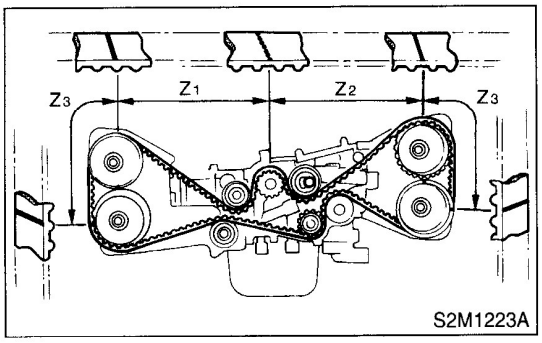
GETtheMANUALS.org

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


EN0233

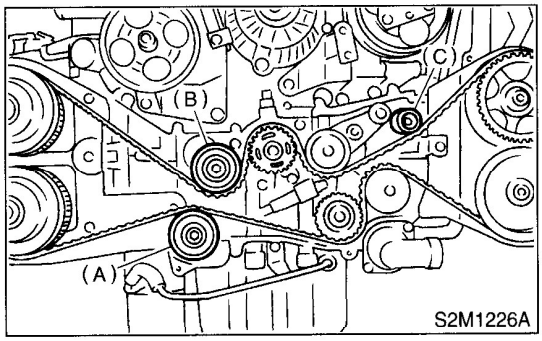

S2M1225

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



S2M1223A

6) Remove the belt idler (A).



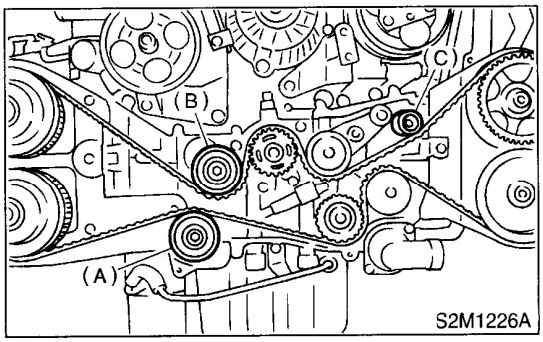
S2M1226A

7) Remove the timing belt.

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

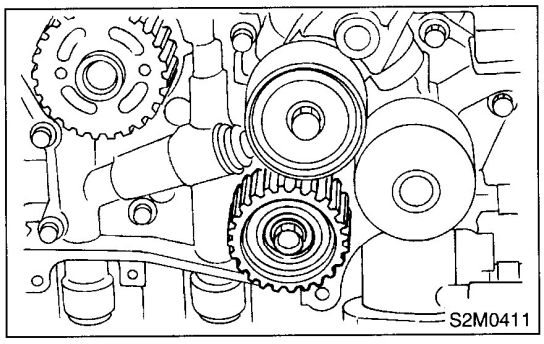
## 2. BELT IDLER AND AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY

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

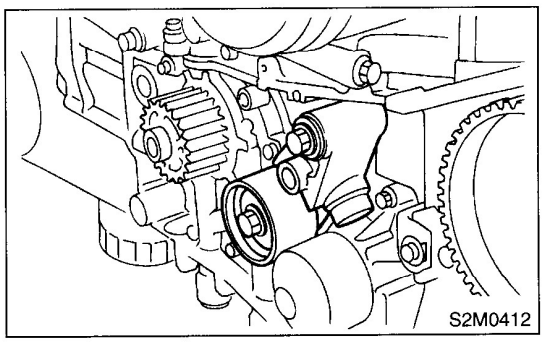


S2M1226A

2) Remove the belt idler No. 2.


S2M0411

3) Remove the automatic belt tension adjuster assembly.


S2M0412


GETtheMANUALS.org

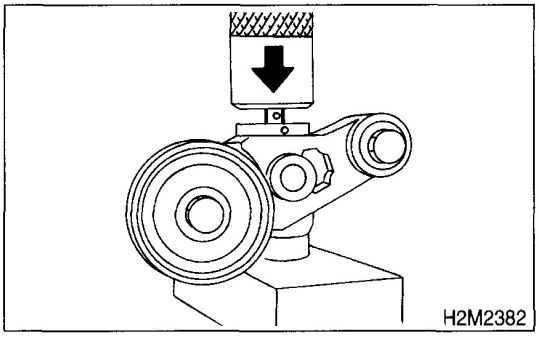
## B: INSTALLATION

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

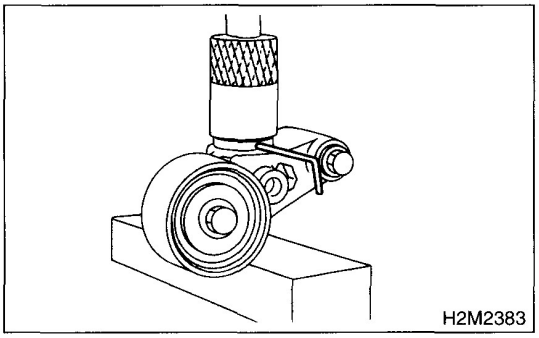
1) Preparation for installation of automatic belt tension adjuster assembly:

**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.**
**• Be sure to slowly move the adjuster rod down applying a pressure of 294 N (30 kgf, 66 lb).**
**• Press-in the push adjuster rod gradually taking more than three minutes.**
**• Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lb).**
**• Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into the cylinder. Doing so may damage the cylinder.**
**• Do not release the press pressure until stopper pin is completely inserted.**

(1) Attach the automatic belt tension adjuster assembly to the vertical pressing tool.
(2) Slowly move the adjuster rod down with a pressure of 294 N (30 kgf, 66 lb) until the adjuster rod is aligned with the stopper pin hole in the cylinder.

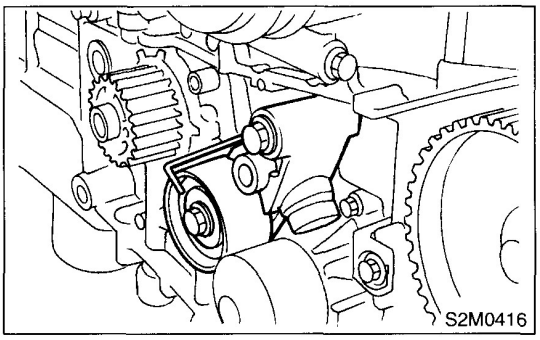

H2M2382

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


H2M2383

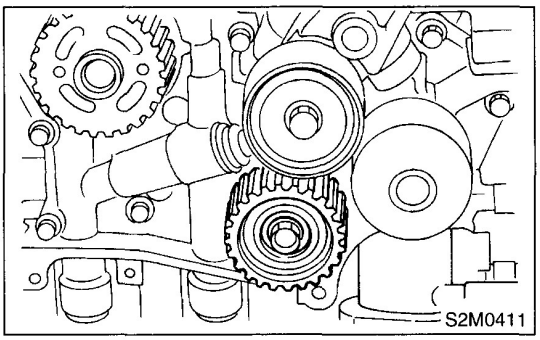
2) Install the automatic belt tension adjuster assembly.

***Tightening torque:***
***39 N·m (4.0 kgf-m, 28.9 ft-lb)***


S2M0416

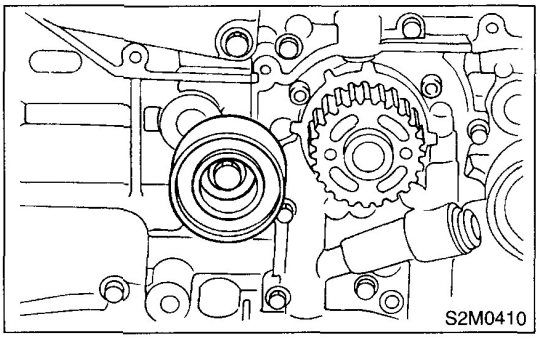
3) Install the belt idler No. 2.

***Tightening torque:***
***39 N·m (4.0 kgf-m, 28.9 ft-lb)***


S2M0411

4) Install the belt idler.

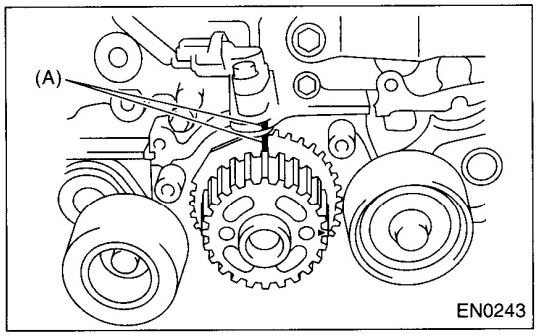
***Tightening torque:***
***39 N·m (4.0 kgf-m, 28.9 ft-lb)***


S2M0410

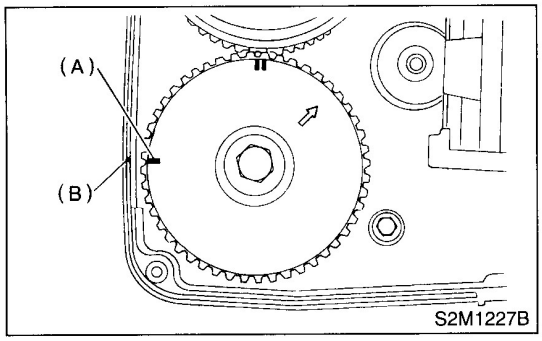

GETtheMANUALS.org

## 2. TIMING BELT

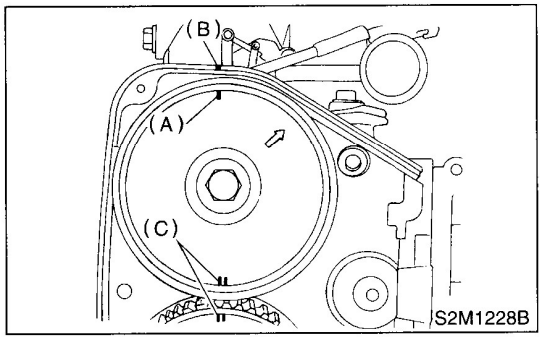
1) Preparation for installation of automatic belt tension adjuster assembly. <Ref. to ME(DOHC TURBO)-50, AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER, Timing Belt Assembly.>
2) Crankshaft and camshaft sprocket alignment.
(1) Align mark (A) on the crankshaft sprocket with mark on the oil pump cover at cylinder block.



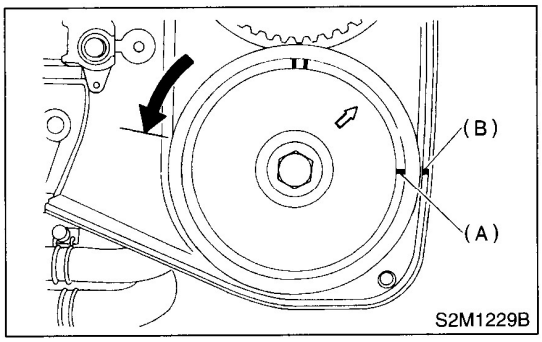

(2) Align single line mark (A) on the right-hand exhaust camshaft sprocket with notch (B) on belt cover.



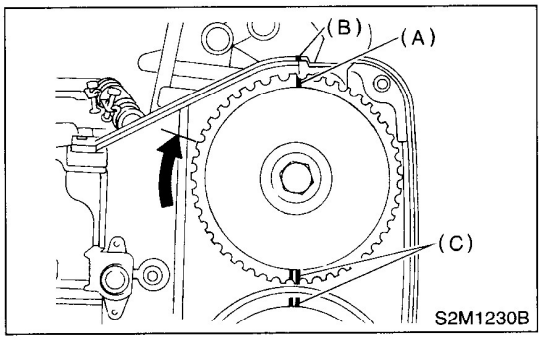

(3) Align single line mark (A) on the right-hand intake camshaft sprocket with notch (B) on belt cover.
(Make sure double lines (C) on intake camshaft and exhaust camshaft sprockets are aligned.)




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




(5) Align single line mark (A) on left-hand intake camshaft sprocket with notch (B) on belt cover by turning the sprocket clockwise (as viewed from front of engine).
Ensure double lines (C) on intake and exhaust camshaft sprockets are aligned.



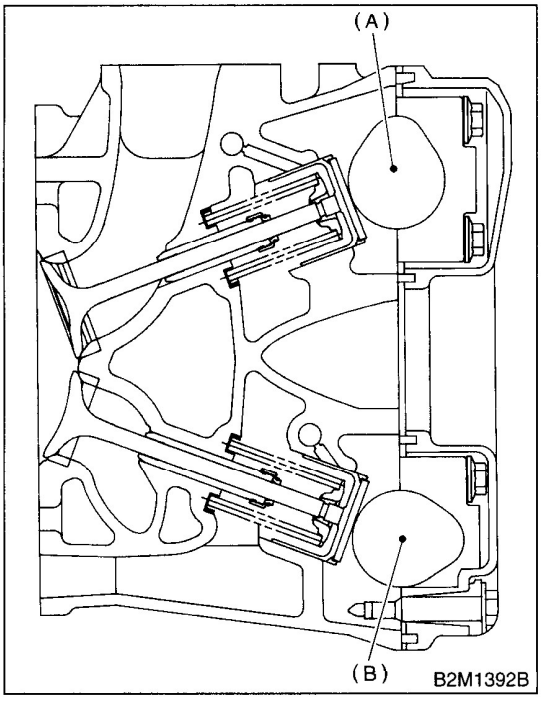


GETtheMANUALS.org

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

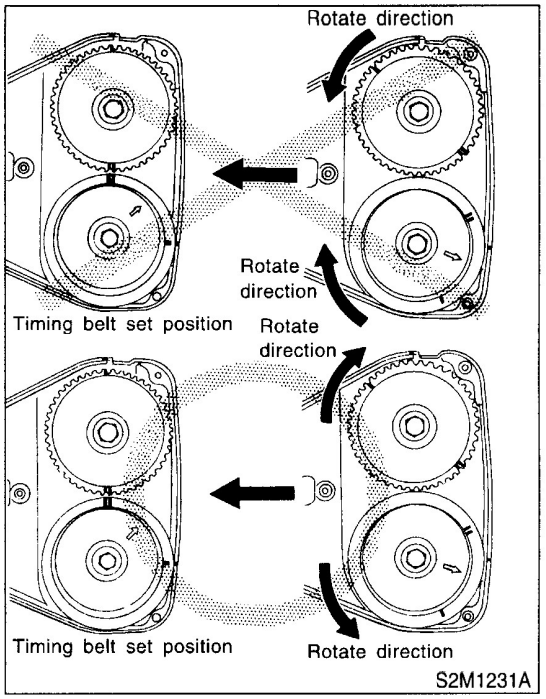
**CAUTION:**

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




(A) Intake camshaft
(B) Exhaust camshaft

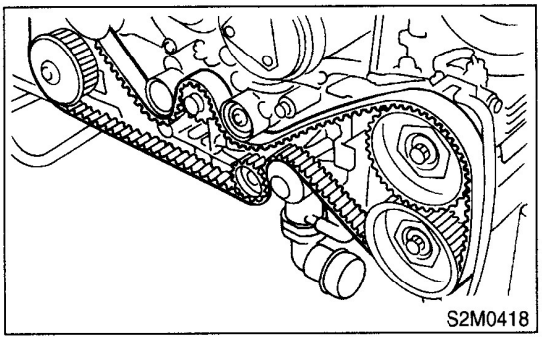
**• When the timing belts are not installed, four camshafts are held at the "zero-lift" position, where all cams on camshafts do not push the intake and exhaust valves down. (Under this condition, all valves remain unlifted.)**
**• When the camshafts are rotated to install the timing belts, #2 intake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





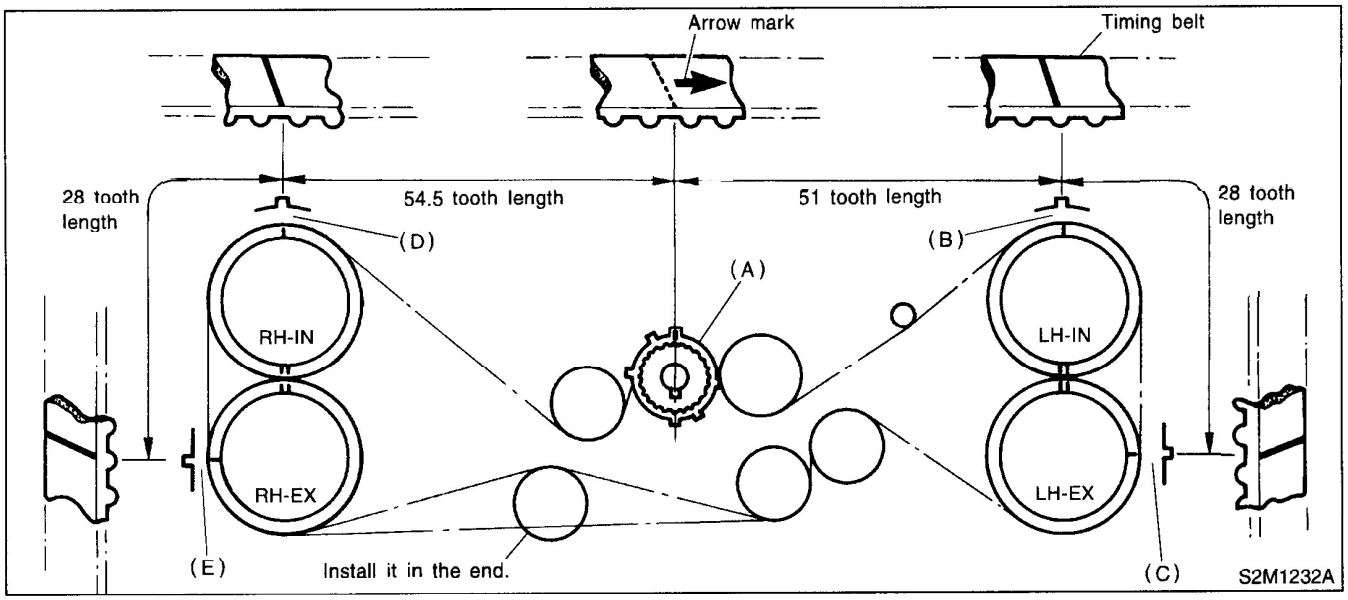
GETtheMANUALS.org

3) Installation of timing belt:




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.

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



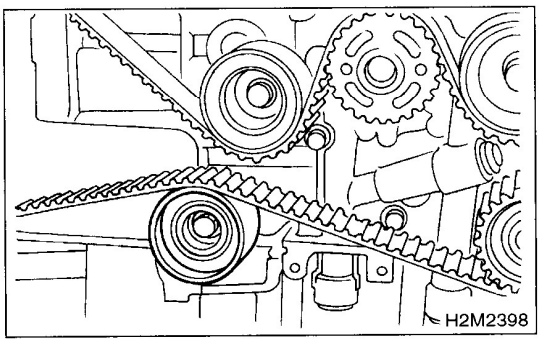


GETtheMANUALS.org

4) Install the belt idlers.

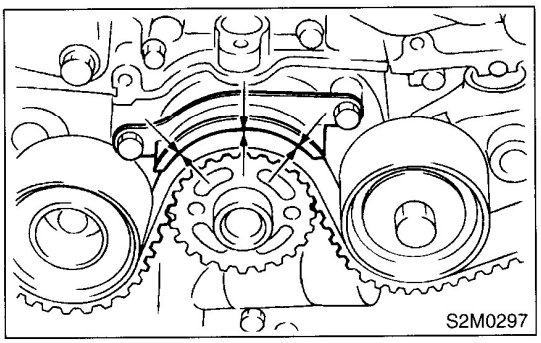
***Tightening torque:***
***39 N·m (4.0 kgf-m, 28.9 ft-lb)***

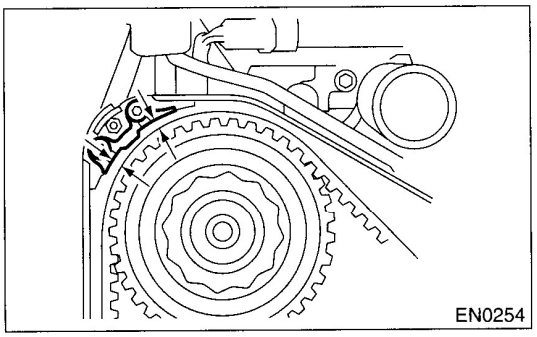
**CAUTION:**
**Make sure that the marks on the timing belt and sprockets are aligned.**

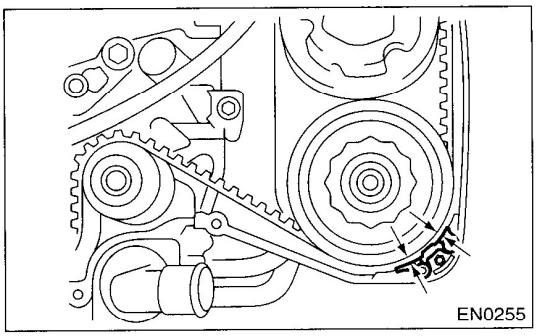


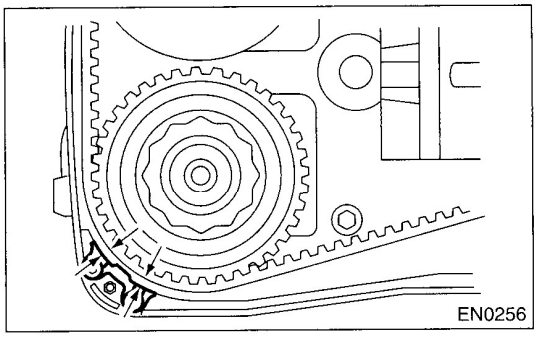

5) After ensuring that the marks on the timing belt and sprockets are aligned, remove the stopper pin from tensioner adjuster.
6) Install the timing belt guide. (MT vehicle)
(1) Temporarily tighten the remaining bolts.
(2) Check and adjust clearance between the timing belt and timing belt guide.

***Clearance:***
***1.0±0.5 mm (0.039±0.020 in)***



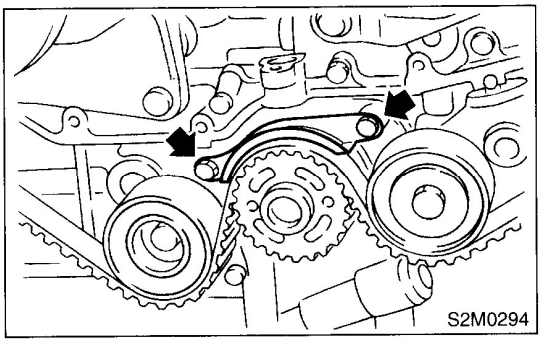



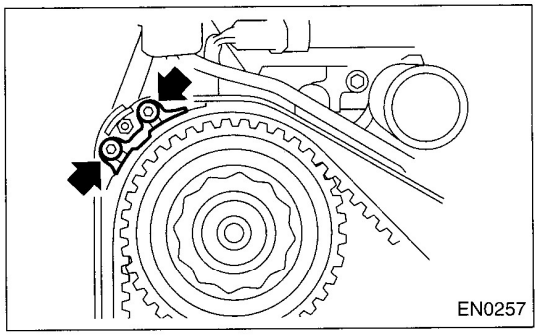




(3) Tighten the remaining bolts.

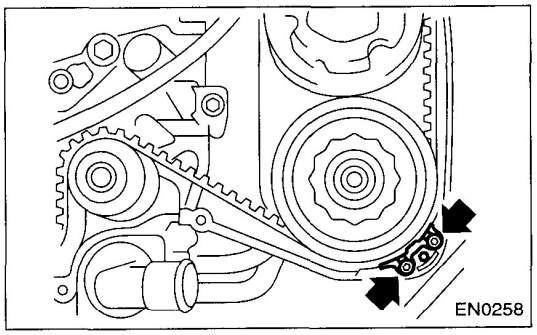
***Tightening torque:***
***9.8 N·m (1.0 kgf-m, 7.2 ft-lb)***

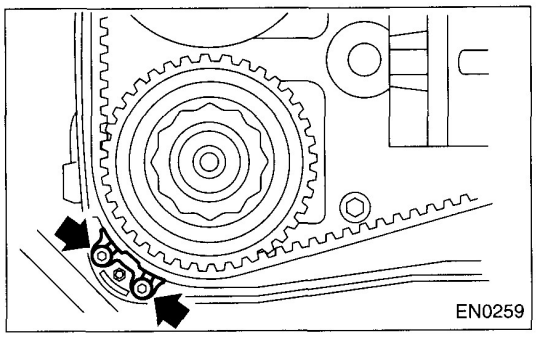




GETtheMANUALS.org




7) Install the belt cover. <Ref. to ME(DOHC TURBO)-47, INSTALLATION, Belt Cover.>
8) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
9) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

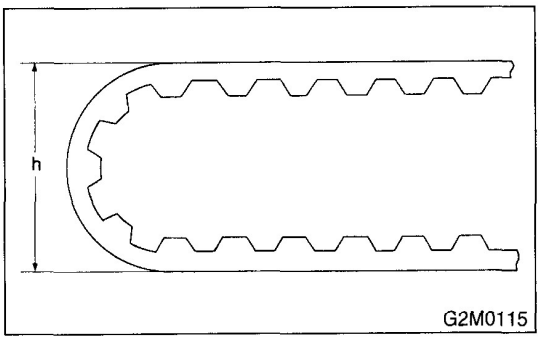
## C: INSPECTION

### 1. TIMING BELT

1) Check the timing belt teeth for breaks, cracks, and wear. If any fault is found, replace the belt.
2) Check the condition of back side of belt; if any crack is found, replace the belt.

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

***Bending radius: h***
***60 mm (2.36 in) or more***





GETtheMANUALS.org

## 2. AUTOMATIC BELT TENSION ADJUSTER

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

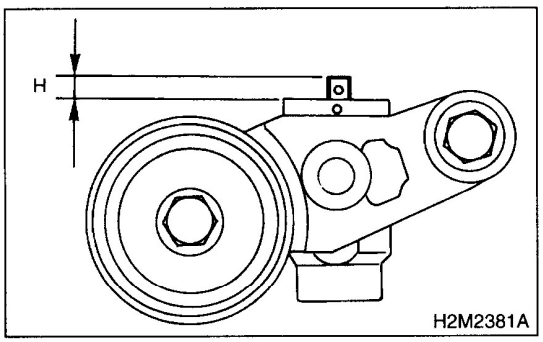
**CAUTION:**
**Slight traces of oil at rod's oil seal does not indicate the a problem.**

2) Check that the adjuster rod does not move when a pressure of 294 N (30 kgf, 66 lb) is applied to it. This is to check adjuster rod stiffness.
3) If the adjuster rod is not stiff and moves freely when applying 294 N (30 kgf, 66 lb), check it using the following procedures:
   (1) Slowly press the adjuster rod down to the end surface of the cylinder. Repeat this motion 2 or 3 times.
   (2) With the adjuster rod moved all the way up, apply a pressure of 294 N (30 kgf, 66 lb) to it. Check the adjuster rod stiffness.
   (3) If the the adjuster rod is not stiff and moves down, replace the automatic belt tension adjuster assembly with a new one.

**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 more than three minutes.**
- **Do not allow press pressure to exceed 9,807 N (1,000 kgf, 2,205 lb).**
- **Press the adjuster rod as far as the end surface of the cylinder. Do not press the adjuster rod into the cylinder. Doing so may damage the cylinder.**

4) Measure the extension of rod beyond the body. If it is not within specifications, replace with a new one.

***Rod extension: H***
***5.7±0.5 mm (0.224±0.020 in)***




## 3. BELT TENSION PULLEY

1) Check the mating surfaces of timing belt and contact point of adjuster rod for abnormal wear or scratches. Replace the belt tension pulley if faulty.
2) Check the belt tension pulley for smooth rotation. Replace if noise or excessive play is noted.
3) Check the belt tension pulley for grease leakage.

## 4. BELT IDLER

1) Check the idler for smooth rotation. Replace if noise or excessive play is noted.
2) Check the outer contacting surfaces of idler pulley for abnormal wear and scratches.
3) Check the idler for grease leakage.

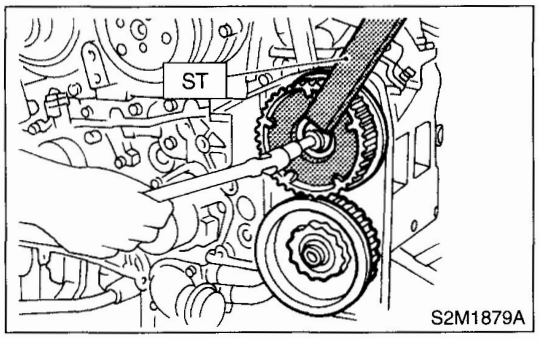

GETtheMANUALS.org

# 16.Camshaft Sprocket

## A: REMOVAL

1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
2) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
3) Remove the belt cover. <Ref. to ME(DOHC TURBO)-47, REMOVAL, Belt Cover.>
4) Remove the timing belt assembly. <Ref. to ME(DOHC TURBO)-48, REMOVAL, Timing Belt Assembly.>
5) Remove the camshaft position sensor. <Ref. to FU(DOHC TURBO)-31, REMOVAL, Camshaft Position Sensor.>
6) Remove the camshaft sprockets. To lock the camshaft, use ST.

ST 499207400 CAMSHAFT SPROCKET WRENCH



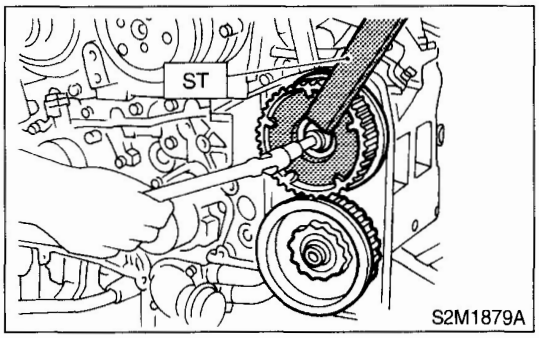

## B: INSTALLATION

1) Install the camshaft sprocket No. 1. and No. 2. To lock camshaft, use ST.

ST 499207100 CAMSHAFT SPROCKET WRENCH

***Tightening torque:***
***98 N·m (10 kgf-m, 72.4 ft-lb)***

**CAUTION:**
**Do not confuse left and right side camshaft sprockets during installation. The camshaft sprocket No. 2 is identified by a projection used to monitor camshaft position sensor.**




2) Install the camshaft position sensor. <Ref. to FU(DOHC TURBO)-31, INSTALLATION, Camshaft Position Sensor.>
3) Install the timing belt assembly. <Ref. to ME(DOHC TURBO)-50, INSTALLATION, Timing Belt Assembly.>
4) Install the belt cover. <Ref. to ME(DOHC TURBO)-47, INSTALLATION, Belt Cover.>
5) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>
6) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

## C: INSPECTION

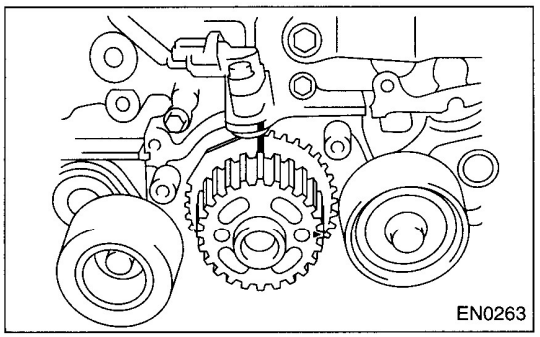
1) Check the sprocket teeth for abnormal wear and scratches.
2) Make sure there is no free play between sprocket and key.
3) Check the crankshaft sprocket notch used for sensor for damage and contamination of foreign matter.


GETtheMANUALS.org

# 17.Crankshaft Sprocket

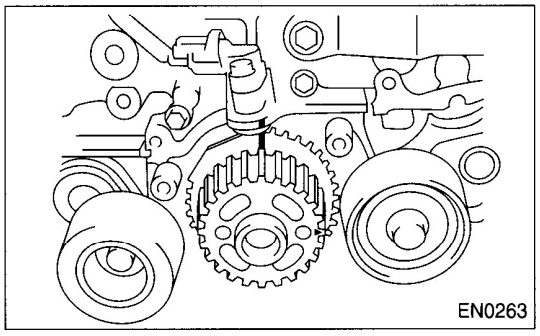
## A: REMOVAL

1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
2) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
3) Remove the belt cover. <Ref. to ME(DOHC TURBO)-47, REMOVAL, Belt Cover.>
4) Remove the timing belt assembly. <Ref. to ME(DOHC TURBO)-48, REMOVAL, Timing Belt Assembly.>
5) Remove the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, REMOVAL, Camshaft Sprocket.>
6) Remove the crankshaft sprocket.


EN0263

## B: INSTALLATION

1) Install the crankshaft sprocket.


EN0263

2) Install the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, INSTALLATION, Camshaft Sprocket.>
3) Install the timing belt assembly. <Ref. to ME(DOHC TURBO)-50, INSTALLATION, Timing Belt Assembly.>
4) Install the belt cover. <Ref. to ME(DOHC TURBO)-47, INSTALLATION, Belt Cover.>
5) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>
6) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

## C: INSPECTION

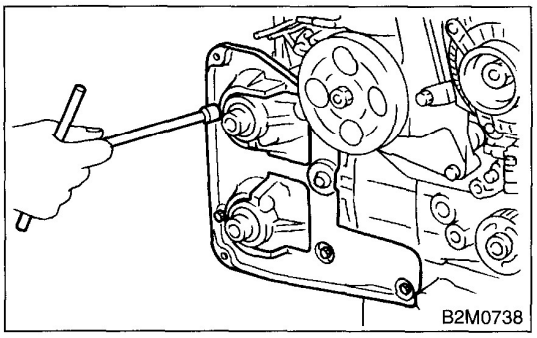
1) Check the sprocket teeth for abnormal wear and scratches.
2) Make sure there is no free play between sprocket and key.
3) Check the crankshaft sprocket notch used for sensor for damage and contamination of foreign matter.


GETtheMANUALS.org

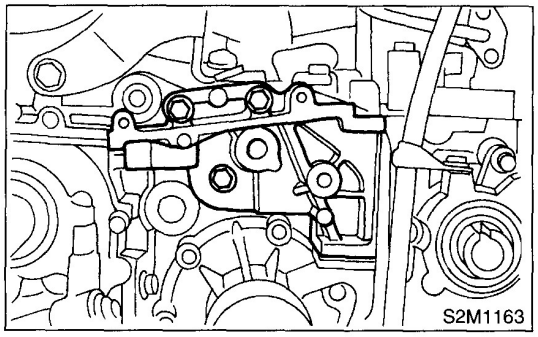
# 18.Camshaft

## A: REMOVAL

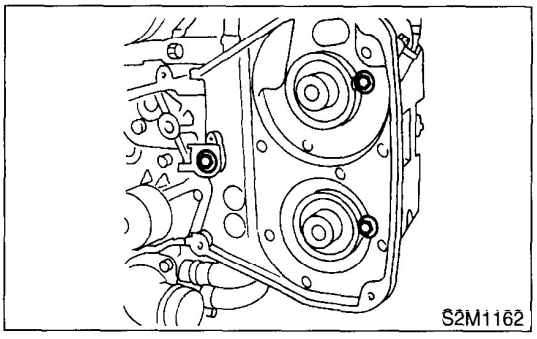
1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>
2) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
3) Remove the belt cover. <Ref. to ME(DOHC TURBO)-47, REMOVAL, Belt Cover.>
4) Remove the timing belt assembly. <Ref. to ME(DOHC TURBO)-48, REMOVAL, Timing Belt Assembly.>
5) Remove the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, REMOVAL, Camshaft Sprocket.>
6) Remove the crankshaft sprocket. <Ref. to ME(DOHC TURBO)-58, REMOVAL, Crankshaft Sprocket.>
7) Remove the right-hand belt cover No.2.


B2M0738

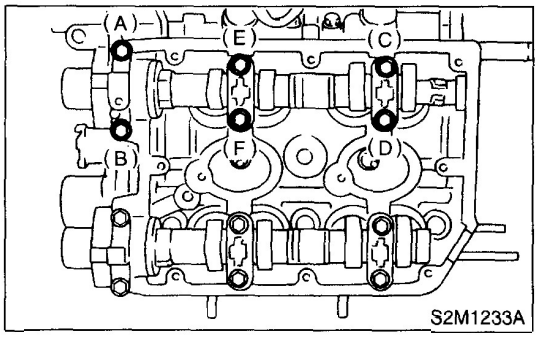
8) Remove the tensioner bracket.


S2M1163

9) Remove the left-hand belt cover No. 2.

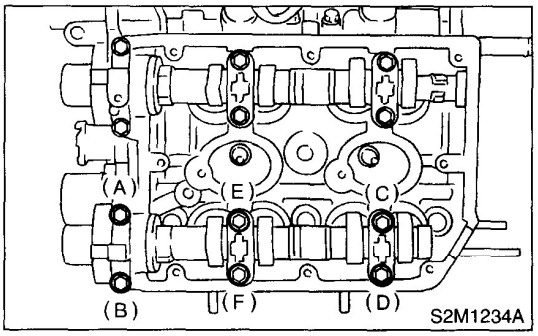

S2M1162

10) Remove the oil level gauge guide. (LH side only)
11) Remove the spark plug cord.
12) Remove the rocker cover and gasket.
13) Loosen the intake camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.



S2M1233A

14) Remove the camshaft caps and intake camshaft.
15) Loosen the exhaust camshaft cap bolts equally, a little at a time in alphabetical sequence shown in the figure.



S2M1234A

16) Remove the camshaft caps and exhaust camshaft.

**CAUTION:**
**Arrange camshaft caps in order so that they can be installed in their original positions.**

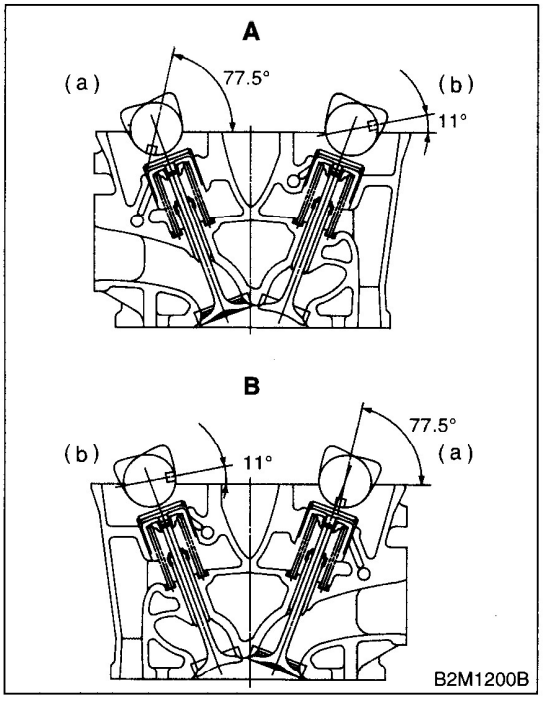
17) Similarly, remove the right-hand camshafts and related parts.


GETtheMANUALS.org

## B: INSTALLATION

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

**CAUTION:**
**• When the camshafts are positioned as shown in the figure, camshafts need to be rotated at a minimum to align with the timing belt during installation.**
**• Right-hand camshaft need not be rotated when set at the position shown in the figure.**
**Left-hand intake camshaft: Rotate 80° clockwise.**
**Left-hand exhaust camshaft: Rotate 45° counterclockwise.**

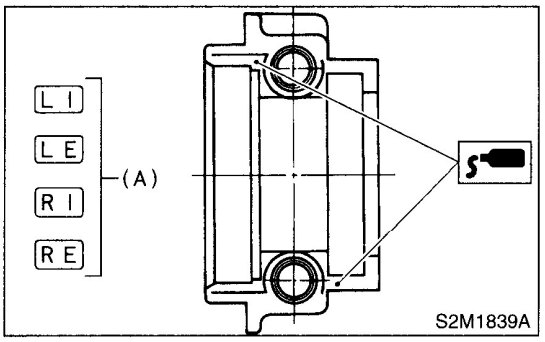



A Left side cylinder head
B Right side cylinder head
(a) Intake camshaft
(b) Exhaust camshaft

2) Camshaft cap installation:
(1) Apply fluid packing sparingly to the cap mating surface.

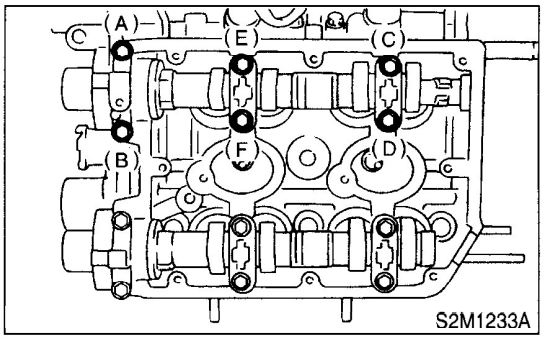
**CAUTION:**
**Do not apply fluid packing excessively. Failure to do so may cause excess packing to come out and flow toward oil seal, resulting in oil leaks.**

***Fluid packing:***
***THREE BOND 1215 or equivalent***




(2) Apply engine oil to cap bearing surface and install the cap on camshaft as shown by identification mark (A).
(3) Gradually tighten the cap in at least two stages in alphabetical sequence shown in the figure, and then tighten to specified torque.

***Tightening torque:***
***20 N·m (2.0 kgf-m, 14.5 ft-lb)***




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

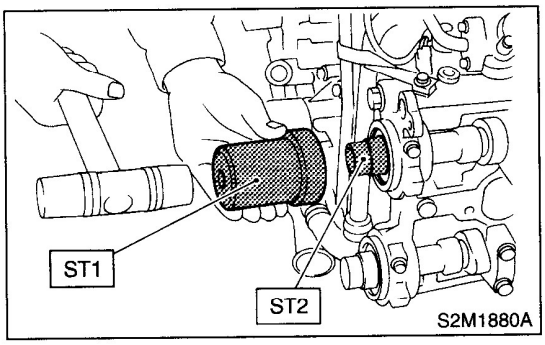
***Tightening torque:***
***20 N·m (2.0 kgf-m, 14.5 ft-lb)***


GETtheMANUALS.org

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

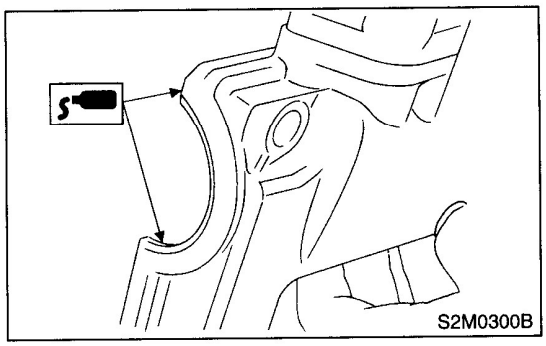
**CAUTION:**
**Use a new oil seal.**

ST1 499587600 OIL SEAL INSTALLER
ST2 499597200 OIL SEAL GUIDE




4) Rocker cover installation:
(1) Install the gasket on rocker cover.
Install the peripheral gasket and ignition coil gasket.
(2) Apply fluid packing to four front open edges of peripheral gasket.

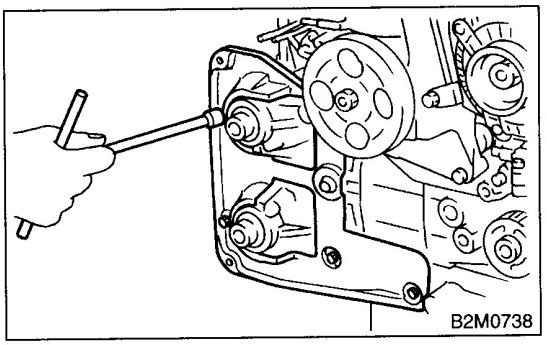
***Fluid packing:***
***THREE BOND 1215 or equivalent***




(3) Install the rocker cover on cylinder head.
Ensure the gasket is properly positioned during installation.
5) Install the spark plug cord.
6) Similarly, install the parts on right-hand side.

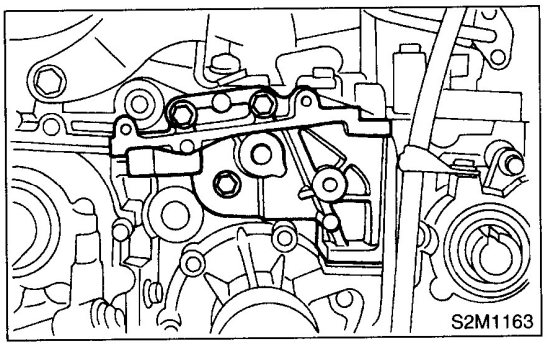
7) Install the right-hand belt cover No. 2.

***Tightening torque:***
***5 N·m (0.5 kgf-m, 3.6 ft-lb)***



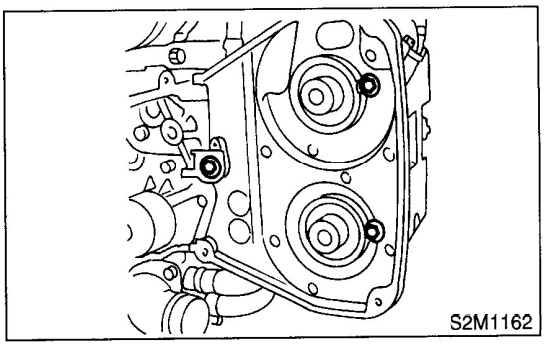

8) Install the tensioner bracket.

***Tightening torque:***
***25 N·m (2.5 kgf-m, 18.1 ft-lb)***




9) Install the left-hand belt cover No. 2.

***Tightening torque:***
***5 N·m (0.5 kgf-m, 3.6 ft-lb)***




10) Install the crankshaft sprocket. <Ref. to ME(DOHC TURBO)-58, INSTALLATION, Crankshaft Sprocket.>
11) Install the camshaft sprockets. <Ref. to ME(DOHC TURBO)-57, INSTALLATION, Camshaft Sprocket.>
12) Install the timing belt assembly. <Ref. to ME(DOHC TURBO)-50, INSTALLATION, Timing Belt Assembly.>
13) Install the belt cover. <Ref. to ME(DOHC TURBO)-47, INSTALLATION, Belt Cover.>

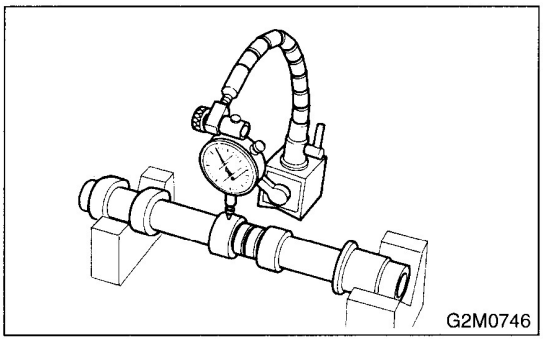

GETtheMANUALS.org

14) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>
15) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

## C: INSPECTION

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

***Limit:***
***0.020 mm (0.0008 in)***

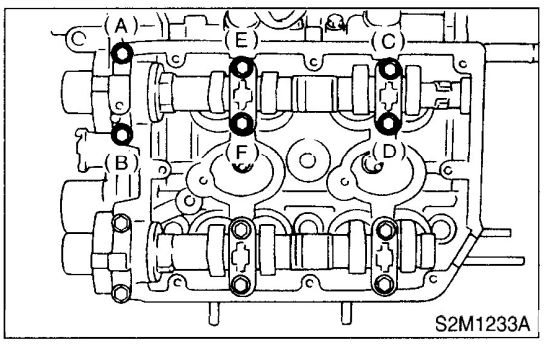

G2M0746

2) Check the journal for damage and wear. Replace if faulty.
3) Measure the outside diameter of camshaft journal. If the jounal diameter is not as specified, check the oil clearance.

| | Camshaft journal | |
|---|---|---|
| | Front | Center, rear |
| Standard | 37.946 — 37.9635 mm (1.4939 — 1.4946 in) | 29.946 — 29.963 mm (1.1790 — 1.1796 in) |

4) Measurement of the camshaft journal oil clearance:
(1) Clean the bearing caps and camshaft journals.
(2) Place the camshafts on the cylinder head. (Without installing the valve rocker.)
(3) Place a plastigauge across each of the camshaft jounals.
(4) Gradually tighten the cap in at least two stages in alphabetical sequence shown in the figure, and then tighten to specified torque.

***Tightening torque:***
***20 N·m (2.0 kgf-m, 14.5 ft-lb)***



S2M1233A

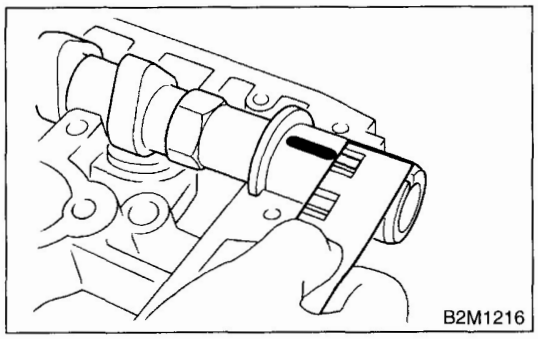
**CAUTION:**
**Do not turn the camshaft.**


GETtheMANUALS.org

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

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

***Limit:***
***0.10 mm (0.0039 in)***


B2M1216

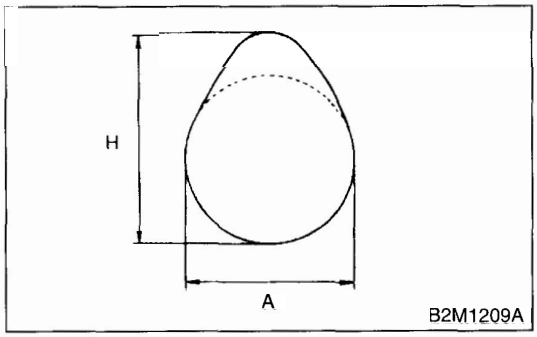
(7) Completely remove the plastigauge.

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

***Cam height: H***
***Standard:***
***Intake:***
***46.25 — 46.35 mm (1.821 — 1.825 in)***
***Exhaust:***
***46.15 — 46.25 mm (1.817 — 1.821 in)***

***Limit:***
***Intake:***
***46.15 mm (1.817 in)***
***Exhaust:***
***46.05 mm (1.813 in)***

***Cam base circle diameter A:***
***37.0 mm (1.457 in)***

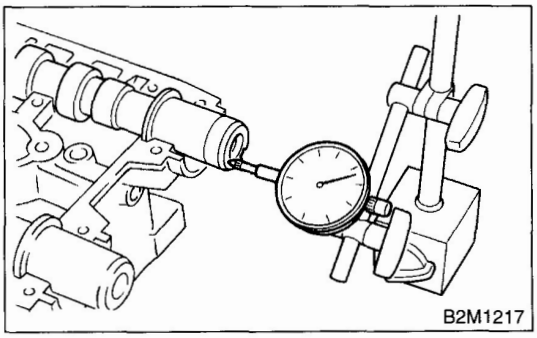


B2M1209A

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

***Standard:***
***0.015 — 0.070 mm (0.0006 — 0.0028 in)***

***Limit:***
***0.1 mm (0.004 in)***


B2M1217

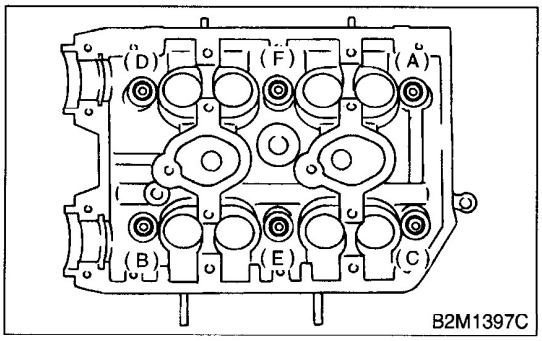

GETtheMANUALS.org

# 19.Cylinder Head Assembly

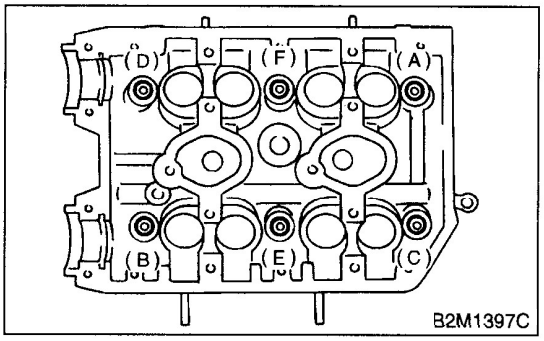
## A: REMOVAL

1) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
2) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
3) Remove the belt cover. <Ref. to ME(DOHC TURBO)-47, REMOVAL, Belt Cover.>
4) Remove the timing belt assembly. <Ref. to ME(DOHC TURBO)-48, REMOVAL, Timing Belt Assembly.>
5) Remove the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, REMOVAL, Camshaft Sprocket.>
6) Remove the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>
7) Remove the bolt which installs the A/C compressor bracket on cylinder head.
8) Remove the camshaft. <Ref. to ME(DOHC TURBO)-59, REMOVAL, Camshaft.>
9) Remove the cylinder head bolts in alphabetical sequence shown in the figure.

**CAUTION:**
**Leave bolts (A) and (D) engaged by three or four threads to prevent the cylinder head from falling.**




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




11) Remove the cylinder head gasket.

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

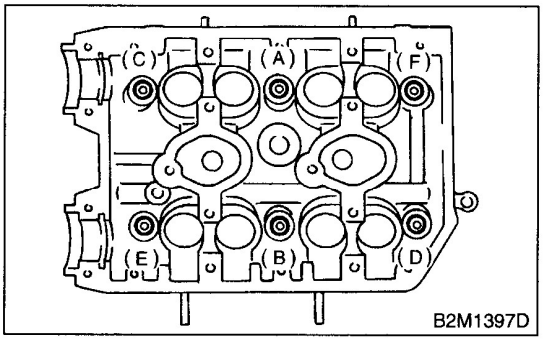
12) Similarly, remove the right side cylinder head.

## B: INSTALLATION

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

**CAUTION:**
- **Use new cylinder head gaskets.**
- **Be careful not to scratch the mating surface of cylinder head and cylinder block.**

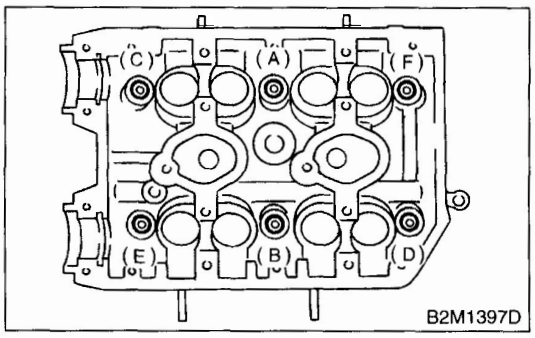
2) Tighten the cylinder head bolts.
(1) Apply a coat of engine oil to washers and bolt threads.
(2) Tighten all bolts to 29 N·m (3.0 kgf-m, 22 ft-lb) in alphabetical sequence.
Then tighten all bolts to 69 N·m (7.0 kgf-m, 51 ft-lb) in alphabetical sequence.
(3) Back off all bolts by 180° first; back them off by 180° again.
(4) Tighten the bolts (A) and (B) to 34 N·m (3.5 kgf-m, 25 ft-lb).





GETtheMANUALS.org

(5) Tighten the bolts (C), (D), (E) and (F) to 15 N·m (1.5 kgf-m, 11 ft-lb).




(6) Tighten all bolts by 80 to 90° in alphabetical sequence.

**CAUTION:**
**Do not tighten the bolts more than 90°.**

(7) Further tighten all bolts by 80 to 90° in alphabetical sequence.

**CAUTION:**
**Ensure the total "re-tightening angle" [in the two previous steps] do not exceed 180°.**

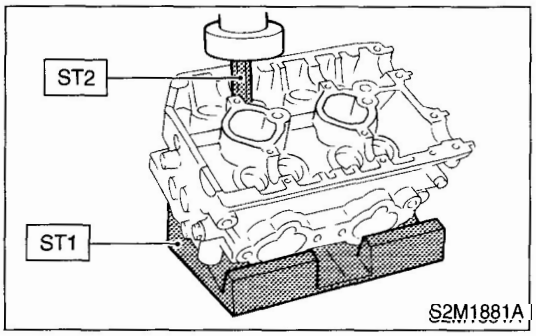
3) Install the camshaft. <Ref. to ME(DOHC TURBO)-60, INSTALLATION, Camshaft.>
4) Install the A/C compressor bracket on cylinder head.
5) Install the intake manifold. <Ref. to FU(DOHC TURBO)-18, INSTALLATION, Intake Manifold.>
6) Install the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, INSTALLATION, Camshaft Sprocket.>
7) Install the timing belt assembly. <Ref. to ME(DOHC TURBO)-50, INSTALLATION, Timing Belt Assembly.>
8) Install the belt cover. <Ref. to ME(DOHC TURBO)-47, INSTALLATION, Belt Cover.>
9) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>
10) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>

## C: DISASSEMBLY

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

| | | |
|---|---|---|
| ST1 | 498267600 | CYLINDER HEAD TABLE |
| ST2 | 499718000 | VALVE SPRING REMOVER |

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

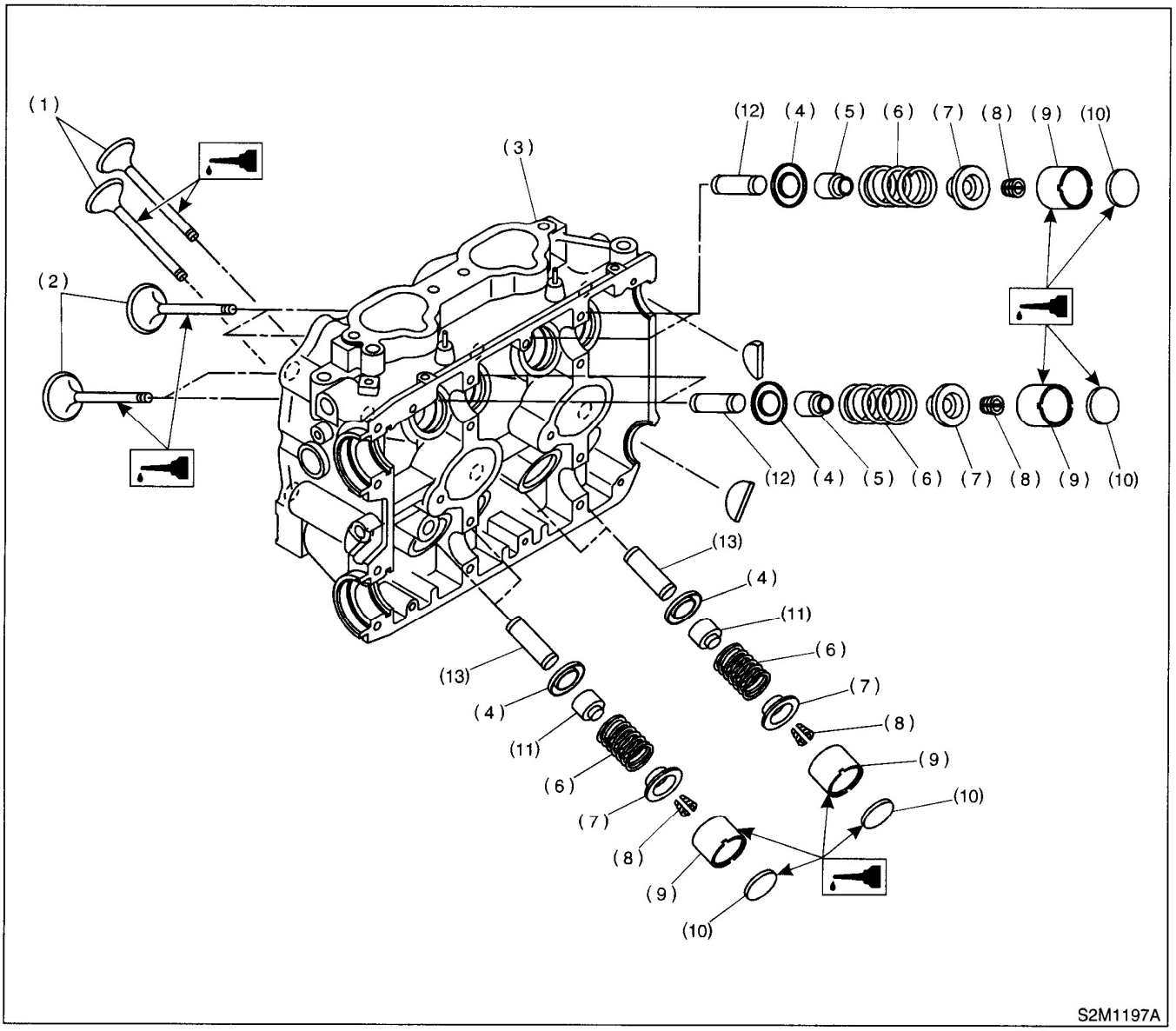




GETtheMANUALS.org

# CYLINDER HEAD ASSEMBLY

## D: ASSEMBLY




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



GETtheMANUALS.org

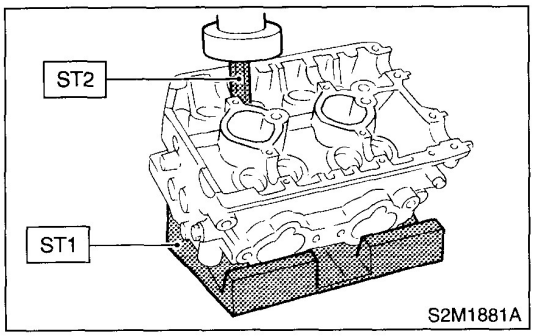
1) Installation of valve spring and valve:
(1) Coat the stem of each valve with engine oil and insert the valve into valve guide.

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

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

ST1 498267600 CYLINDER HEAD TABLE
ST2 499718000 VALVE SPRING REMOVER

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




(4) Compress the valve spring and fit the valve spring retainer key.
(5) After installing, tap the valve spring retainers lightly with wooden hammer for better seating.

2) Apply oil to the surface of the valve lifter and valve shim.
3) Install the valve lifter and valve shim.

# E: INSPECTION

## 1. CYLINDER HEAD

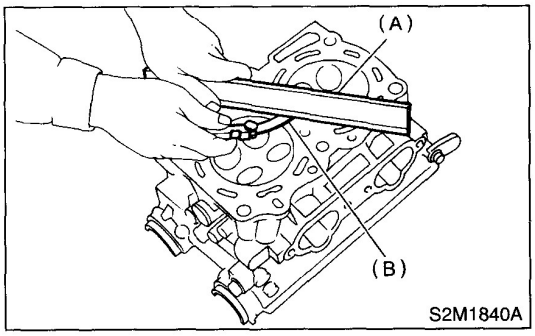
1) Make sure that no crack or other damage exists. In addition to visual inspection, inspect the important areas by means of red check.
2) Measure the warping of the cylinder head surface that mates with crankcase by using a straight edge (A) and thickness gauge (B).
If the warping exceeds 0.05 mm (0.0020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

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

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

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

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



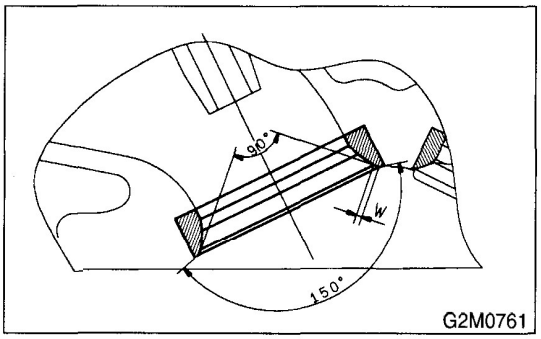


GETtheMANUALS.org

## 2. VALVE SEAT

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

***Valve seat width: W***
***Intake***
***Standard***
***1.0 mm (0.039 in)***
***Limit***
***1.7 mm (0.067 in)***
***Exhaust***
***Standard***
***1.5 mm (0.059 in)***
***Limit***
***2.2 mm (0.087 in)***




## 3. VALVE GUIDE

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

***Clearance between the valve guide and valve stem:***
***Standard***
***Intake***
***0.035 — 0.062 mm (0.0014 — 0.0024 in)***
***Exhaust***
***0.040 — 0.067 mm (0.0016 — 0.0026 in)***
***Limit***
***0.15 mm (0.0059 in)***

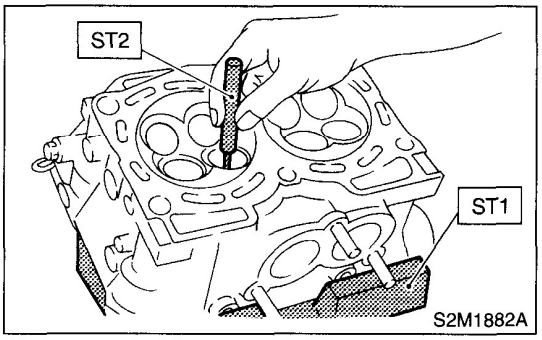
2) If the clearance between valve guide and stem exceeds the limit, replace the valve guide or valve itself whichever shows greater amount of wear. See the following procedure for valve guide replacement.

***Valve guide inner diameter:***
***6.000 — 6.012 mm (0.2362 — 0.2367 in)***

***Valve stem outer diameters:***
***Intake***
***5.950 — 5.965 mm (0.2343 — 0.2348 in)***
***Exhaust***
***5.945 — 5.960 mm (0.2341 — 0.2346 in)***

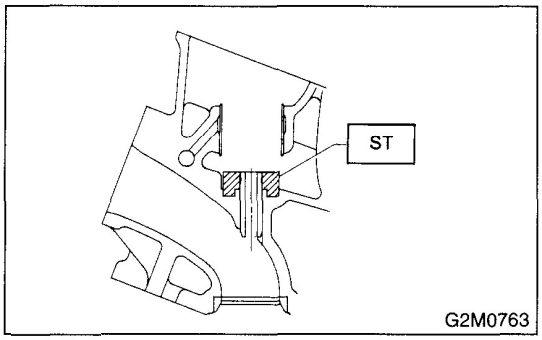
(1) Place the cylinder head on ST1 with the combustion chamber upward so that valve guides enter the holes in ST1.
(2) Insert the ST2 into valve guide and press it down to remove the valve guide.

ST1 498267600 CYLINDER HEAD TABLE
ST2 499767200 VALVE GUIDE REMOVER




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

ST 498767700 VALVE GUIDE ADJUSTER

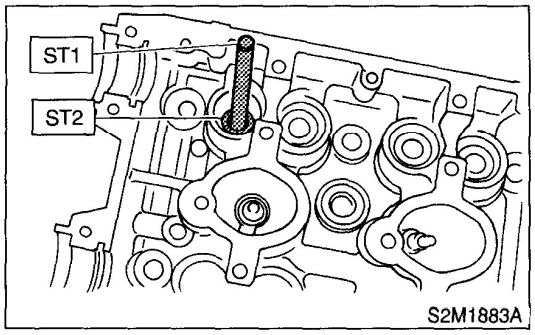



(4) Before installing a new valve guide, make sure that neither scratches nor damages exist on the inside surface of the valve guide holes in cylinder head.


GETtheMANUALS.org

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

ST1 499767200 VALVE GUIDE REMOVER
ST2 498267700 VALVE GUIDE ADJUSTER




(6) Check the valve guide protrusion.

***Valve guide protrusion: L***
***12.0 — 12.4 mm (0.472 — 0.488 in)***

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

ST 499767400 VALVE GUIDE REAMER

**CAUTION:**
**• Apply engine oil to the reamer when reaming.**
**• If the inner surface of the valve guide is torn, the edge of the reamer should be slightly ground with an oil stone.**
**• If the inner surface of the valve guide becomes lustrous and the reamer does not chips, use a new reamer or remedy the reamer.**

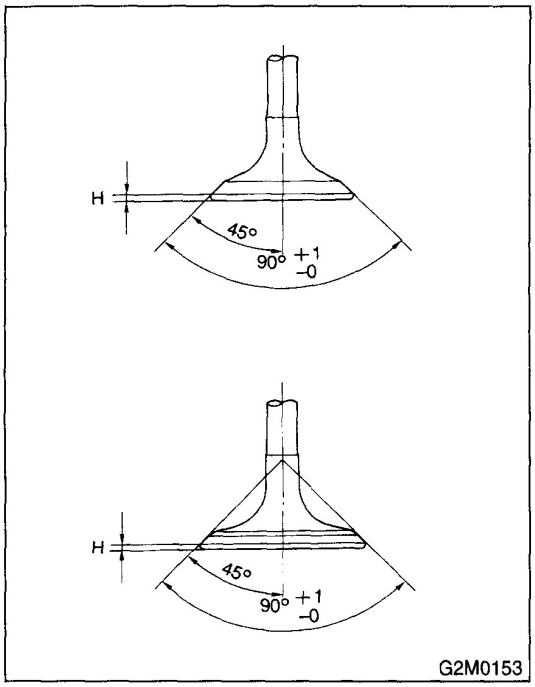
(8) Recheck the contact condition between valve and valve seat after replacing the valve guide.

## 4. INTAKE AND EXHAUST VALVE

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

***H:***
***Intake***
***Standard***
***1.2 mm (0.047 in)***
***Limit***
***0.8 mm (0.031 in)***
***Exhaust***
***Standard***
***1.5 mm (0.059 in)***
***Limit***
***0.8 mm (0.031 in)***

***Valve overall length:***
***Intake***
***104.4 mm (4.110 in)***
***Exhaust***
***104.7 mm (4.122 in)***



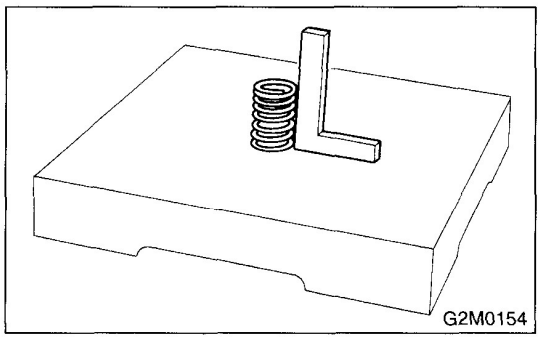

2) Put a small amount of grinding compound on the seat surface and lap the valve and seat surface. Install a new intake valve oil seal after lapping.


GETtheMANUALS.org

## 5. VALVE SPRINGS

1) Check the valve springs for damage, free length, and tension. Replace the valve spring if it is not within specifications presented in the table.
2) To measure the squareness of the valve spring, stand the spring on a surface plate and measure its deflection at the top using a try square.

| | Valve spring |
|---|---|
| Free length | 44.67 mm (1.7587 in) |
| Tension/spring height | 220.7±15.7 N (22.5 ± 1.6 kgf, 49.6±3.5 lb)/36.0 mm (1.417 in) |
| | 510.9±25.5 N (52.1±2.6 kgf, 114.9±5.7 lb)/26.6 mm (1.047 in) |
| Squareness | 2.5°, 2.0 mm (0.079 in) |


G2M0154

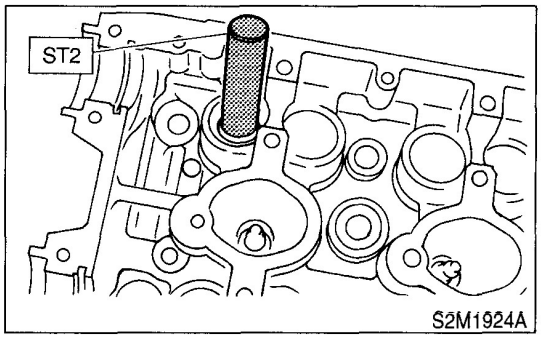
## 6. INTAKE AND EXHAUST VALVE OIL SEAL

Replace the oil seal with a new one, if the lip is damaged or spring out of place, or when the surfaces of intake valve and valve seat are reconditioned or intake valve guide is replaced.
1) Place the cylinder head on ST1.
2) Press in the oil seal to the specified dimension indicated in the figure by using ST2.
ST1 498267600 CYLINDER HEAD TABLE
ST2 498857100 VALVE GUIDE REMOVER

**CAUTION:**
**• Apply engine oil to oil seal before force-fitting.**
**• Differentiate between the intake valve oil seal and exhaust valve oil seal by noting their difference in color.**

***Color of rubber part:***
***Intake [Black]***
***Exhaust [Brown]***

***Color of spring part:***
***Intake [Silver]***
***Exhaust [Silver]***



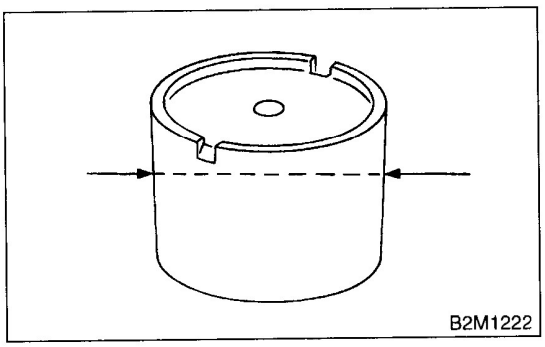
S2M1924A


GETtheMANUALS.org

## 7. VALVE LIFTER

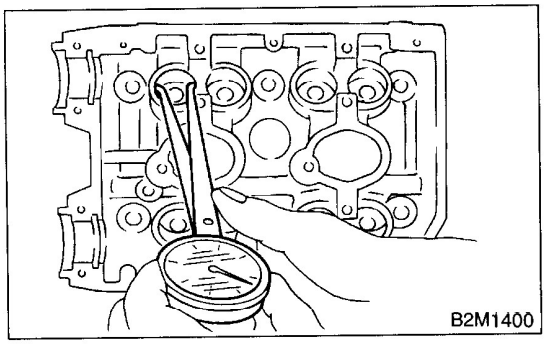
1) Check the valve lifter visually.
2) Measure the outer diameter of valve lifter.

***Outer diameter:***
***34.959 — 34.975 mm (1.3763 — 1.3770 in)***




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

***Inner diameter:***
***34.994 — 35.016 mm (1.3777 — 1.3786 in)***




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

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

***Limit:***
***0.100 mm (0.0039 in)***

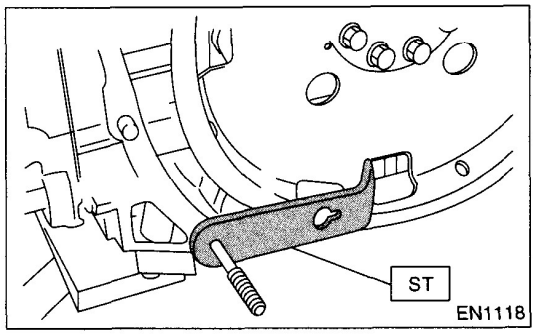

GETtheMANUALS.org

# 20.Cylinder Block

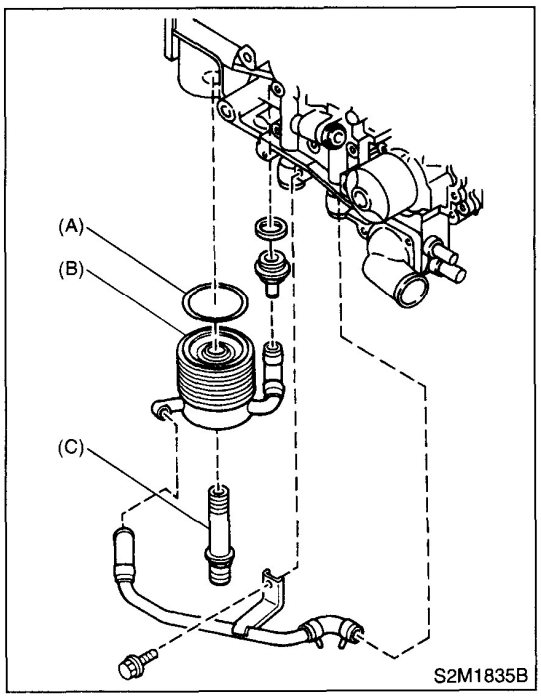
## A: REMOVAL

NOTE:
Before conducting this procedure, drain the engine oil completely if applicable.

1) Remove the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>
2) Remove the V-belt. <Ref. to ME(DOHC TURBO)-44, REMOVAL, V-belt.>
3) Remove the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, REMOVAL, Crankshaft Pulley.>
4) Remove the belt cover. <Ref. to ME(DOHC TURBO)-47, REMOVAL, Belt Cover.>
5) Remove the timing belt assembly. <Ref. to ME(DOHC TURBO)-48, REMOVAL, Timing Belt Assembly.>
6) Remove the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, REMOVAL, Camshaft Sprocket.>
7) Remove the crankshaft sprocket. <Ref. to ME(DOHC TURBO)-58, REMOVAL, Crankshaft Sprocket.>
8) Remove the generator and A/C compressor with their brackets.
9) Remove the cylinder head assembly. <Ref. to ME(DOHC TURBO)-64, REMOVAL, Cylinder Head Assembly.>
10) Remove the clutch disc and cover. (MT vehicles) <Ref. to CL-11, REMOVAL, Clutch Disc and Cover.>
11) Remove the flywheel. (MT vehicles) <Ref. to CL-14, REMOVAL, Flywheel.>
12) Remove the drive plate. (AT vehicles)
Using the ST, lock crankshaft.
ST 498497100 CRANKSHAFT STOPPER



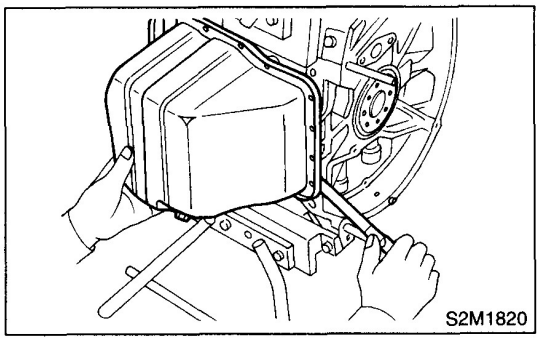

13) Remove the oil separator cover.
14) Remove the water by-pass pipe for heater.
15) Remove the oil filter.
16) Remove the oil cooler.




(a) Gasket
(b) Oil cooler
(c) Connector

17) Removal of oil pan:
(1) Turn the cylinder block with #2 and #4 piston sides facing upward.
(2) Remove the bolts which secure oil pan to cylinder block.
(3) Insert a 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.**

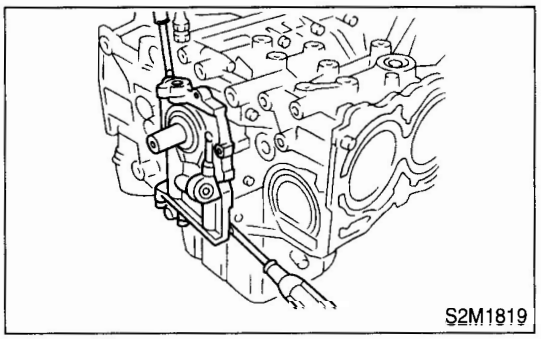


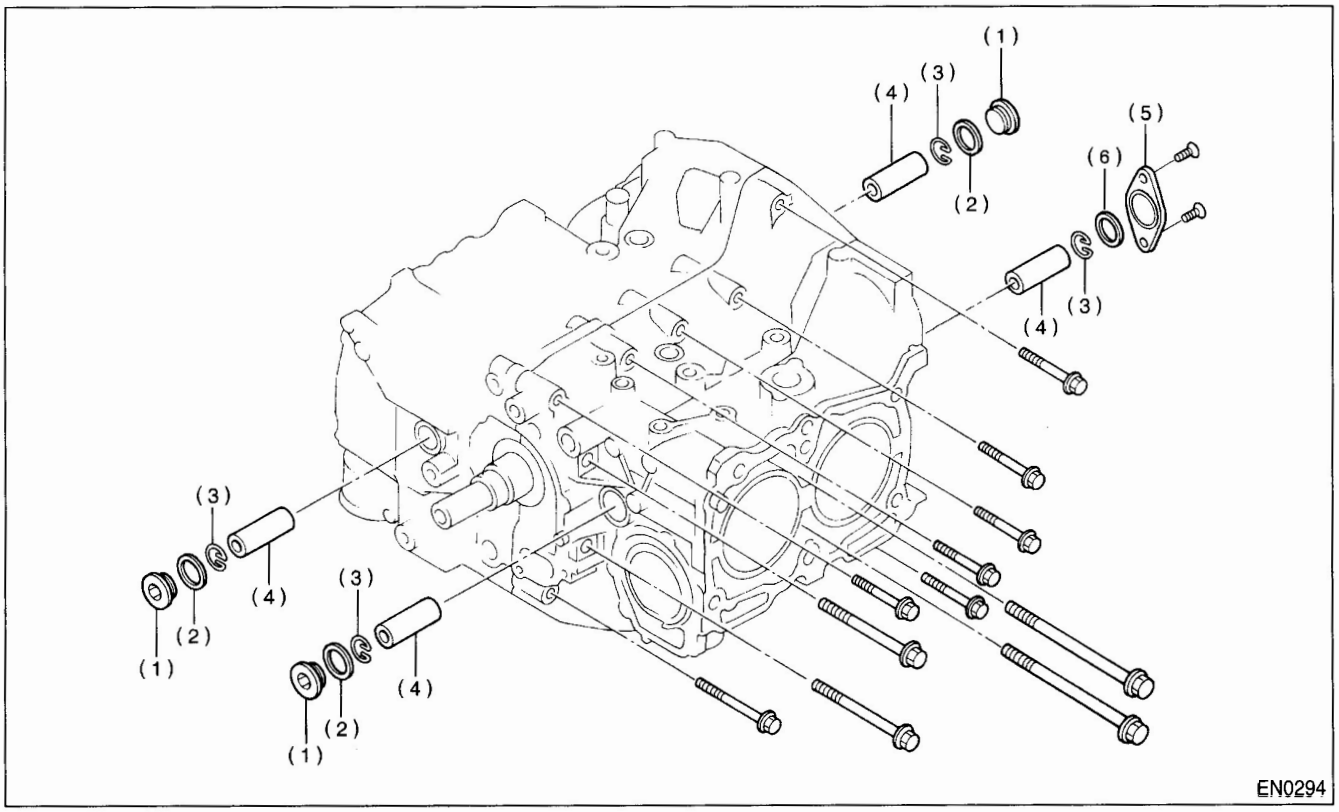

18) Remove the oil strainer stay.
19) Remove the oil strainer.
20) Remove the baffle plate.
21) Remove the water pipes.
22) Remove the water pump.


GETtheMANUALS.org

23) Remove the oil pump from cylinder block.
Use a flat-bladed screwdriver as shown in the figure when removing the oil pump.

**CAUTION:**
**Be careful not to scratch the mating surface of cylinder block and oil pump.**

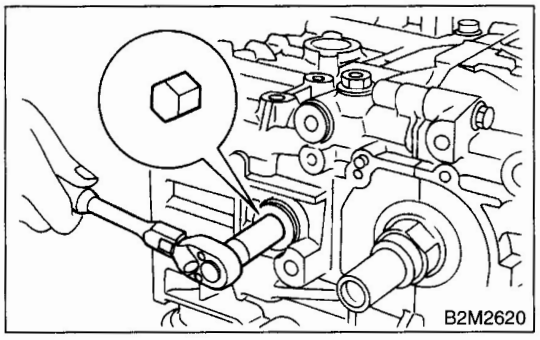

S2M1819



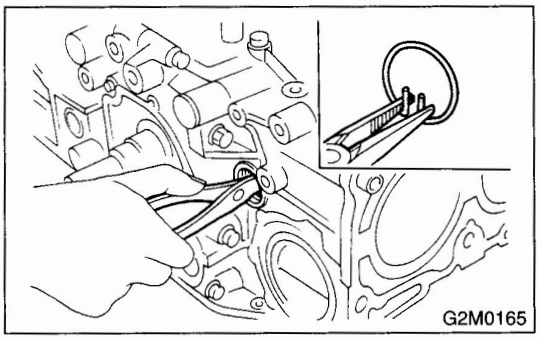
EN0294

(1) Service hole plug
(2) Gasket
(3) Circlip
(4) Piston pin
(5) Service hole cover
(6) O-ring

24) Remove the service hole cover and service hole plugs using the hexagon wrench [14 mm (0.55 in)].


B2M2620

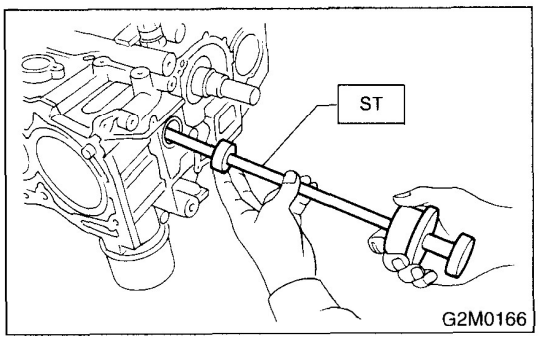
25) Rotate the crankshaft to bring #1 and #2 pistons to bottom dead center position, then remove the piston circlip through service hole of #1 and #2 cylinders.


G2M0165


GETtheMANUALS.org

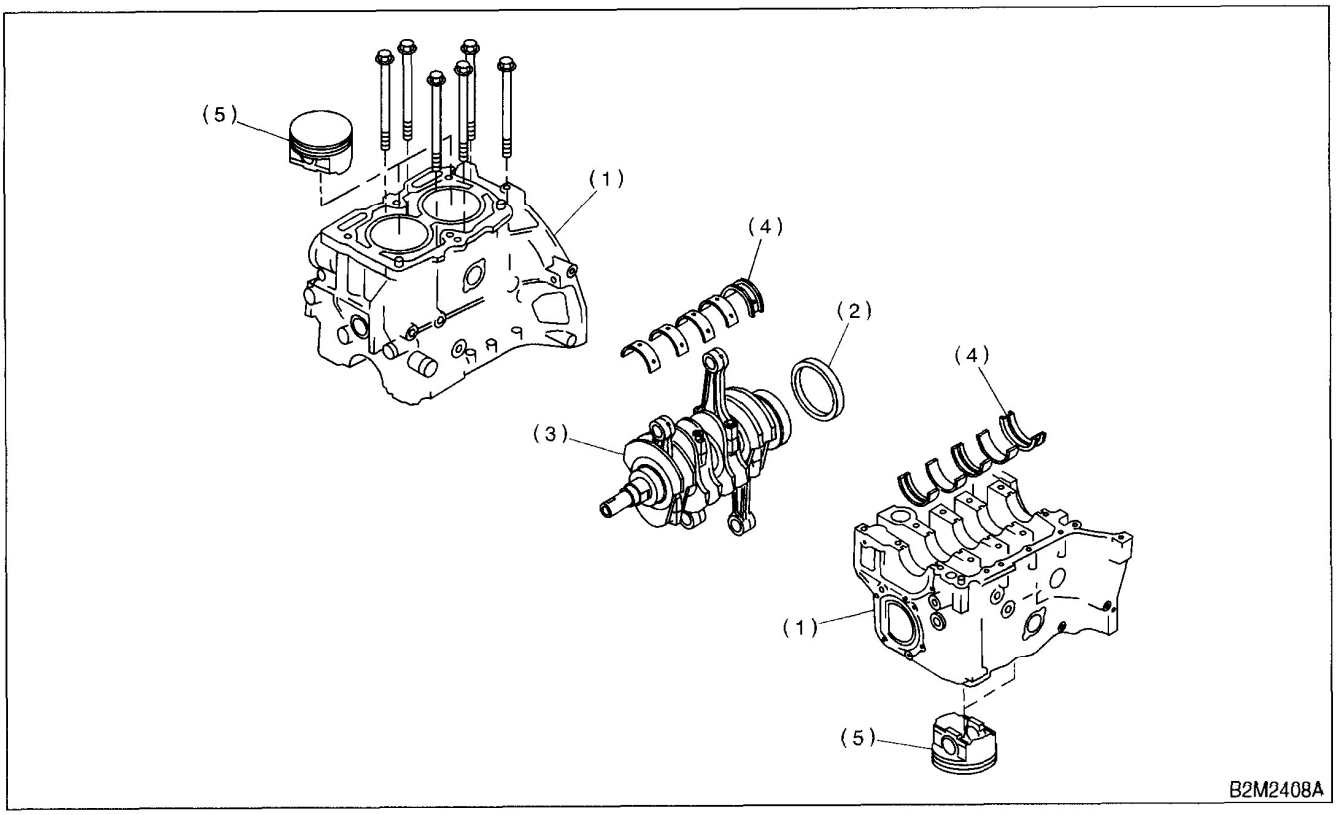
26) Draw out the piston pin from #1 and #2 pistons using ST.
ST 499097700 PISTON PIN REMOVER

**CAUTION:**
**Be careful not to confuse the original combination of piston, piston pin and cylinder.**




27) Similarly remove the piston pins from #3 and #4 pistons.
28) Remove the bolts which connect cylinder block on the side of #2 and #4 cylinders.
29) Back off the bolts which connect cylinder block on the side of #1 and #3 cylinders two or three turns.
30) Set up the cylinder block so that #1 and #3 cylinders are on the upper side, then remove the cylinder block connecting bolts.
31) Separate the left-hand and right-hand cylinder blocks.

**CAUTION:**
**When separating the cylinder block, do not allow the connecting rod to fall and damage the cylinder block.**




(1) Cylinder block
(2) Rear oil seal
(3) Crankshaft
(4) Crankshaft bearing
(5) Piston

32) Remove the rear oil seal.
33) Remove the crankshaft together with connecting rod.
34) Remove the crankshaft bearings from cylinder block using a hammer handle.

**CAUTION:**
**Do not confuse the combination of crankshaft bearings.**

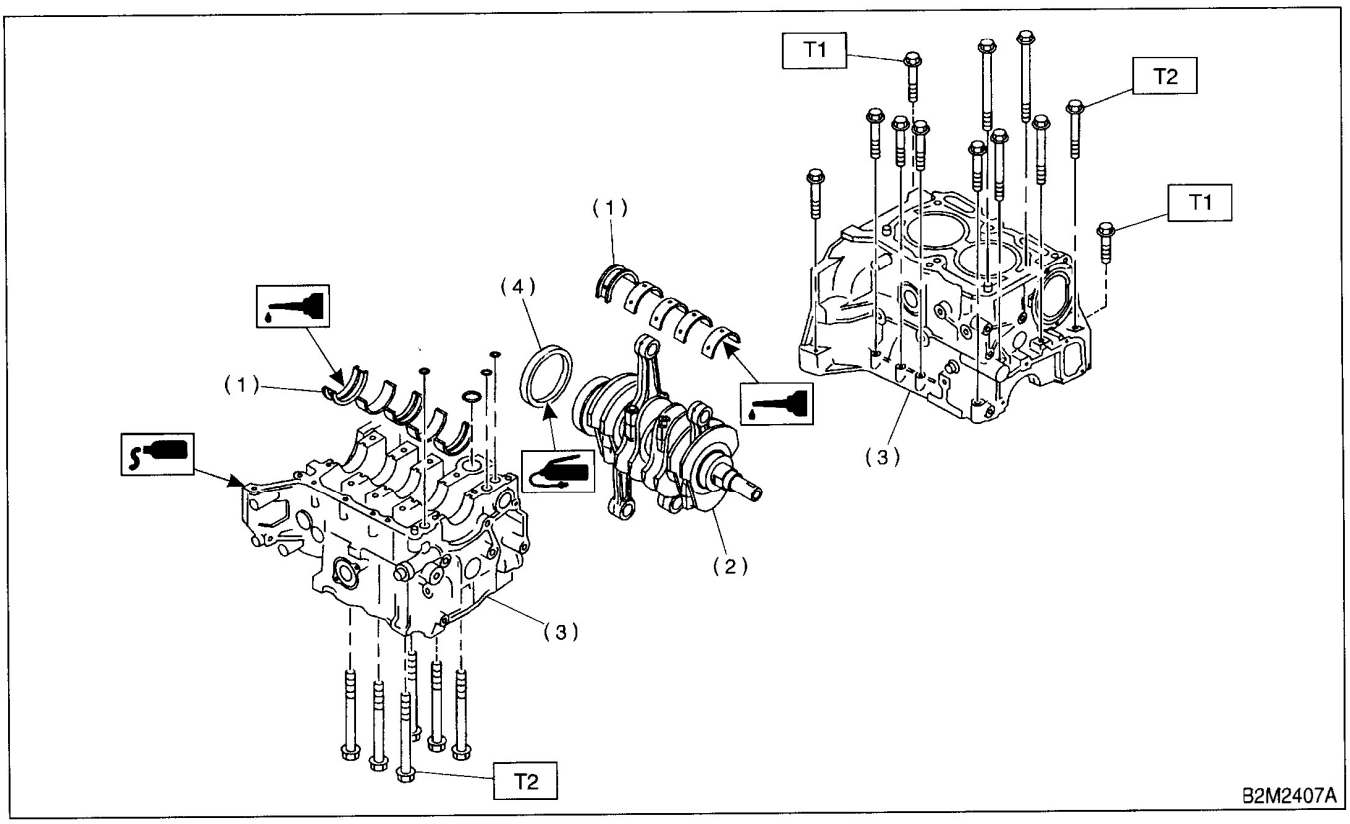
**Press the bearing at the end opposite to locking lip.**

35) Draw out each piston from cylinder block using a wooden bar or hammer handle.

**CAUTION:**
**Do not confuse the combination of piston and cylinder.**


GETtheMANUALS.org

## B: INSTALLATION



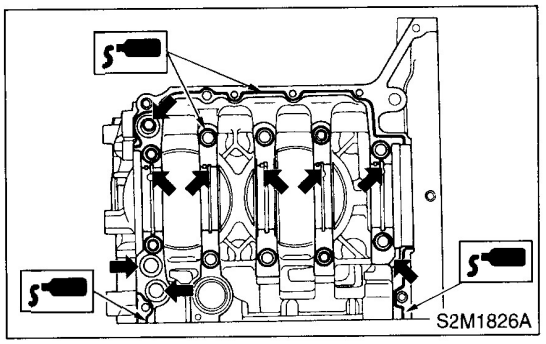

(1) Crankshaft bearing
(2) Crankshaft
(3) Cylinder block
(4) Rear oil seal

*Tightening torque: N·m (kgf-m, ft-lb)*
*T1: 25 (2.5, 18.1)*
*T2: 47 (4.8, 34.7)*

**CAUTION:**
**Remove oil in the mating surface of bearing and cylinder block before installation. Also apply a coat of engine oil to crankshaft pins.**

1) Position the crankshaft on the #2 and #4 cylinder block.
2) Apply fluid packing to the mating surface of #1 and #3 cylinder block, and position it on #2 and #4 cylinder block.

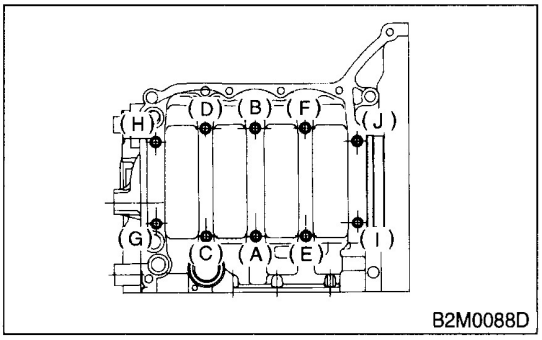
***Fluid packing:***
***THREE BOND 1215 or equivalent***




**CAUTION:**
**Do not allow fluid packing to jut into O-ring grooves, oil passages, bearing grooves, etc.**

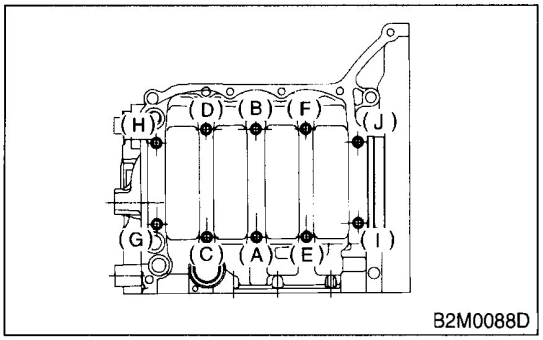

GETtheMANUALS.org

3) Temporarily tighten the 10 mm cylinder block connecting bolts in alphabetical sequence shown in the figure.



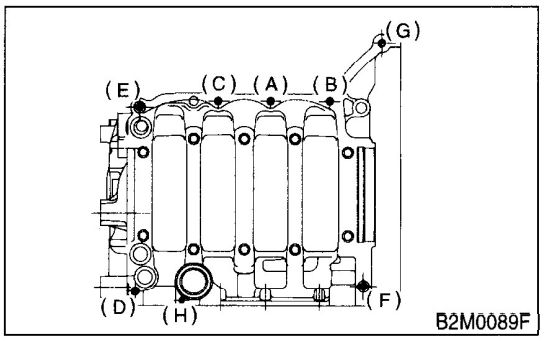

4) Tighten the 10 mm cylinder block connecting bolts in alphabetical sequence.

***Tightening torque:***
***47 N·m (4.8 kgf-m, 34.7 ft-lb)***

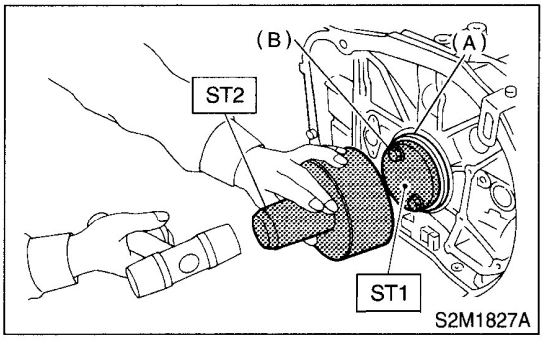



5) Tighten the 8 mm and 6 mm cylinder block connecting bolts in alphabetical sequence shown in the figure.

***Tightening torque:***
***(A) — (G): 25 N·m (2.5 kgf-m, 18.1 ft-lb)***
***(H): 6.4 N·m (0.65 kgf-m, 4.7 ft-lb)***

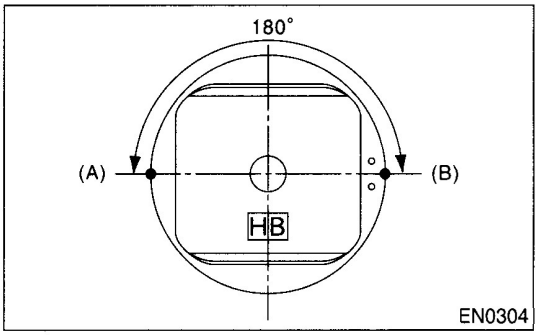



6) Install the rear oil seal using ST1 and ST2.
ST1 499597100 OIL SEAL GUIDE
ST2 499587200 OIL SEAL INSTALLER

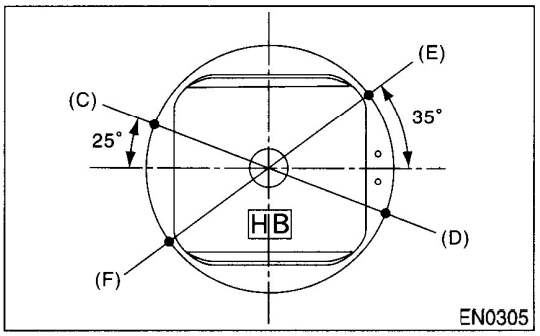



(A) Rear oil seal
(B) Flywheel attaching bolt

7) Position the top ring gap at (A) or (B) in the figure.




8) Position the second ring gap at 180° on the reverse side for the top ring gap.
9) Position the upper rail gap at (C) or (D) in the figure.

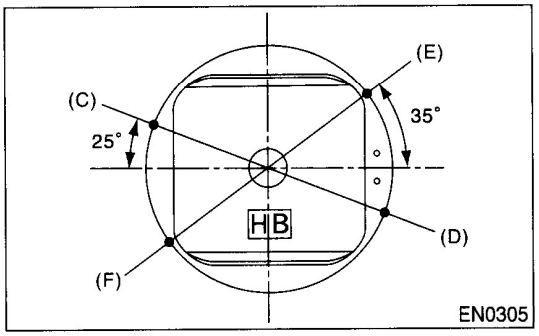



10) Position the expander gap at 180° of the reverse side for the upper rail gap.


GETtheMANUALS.org

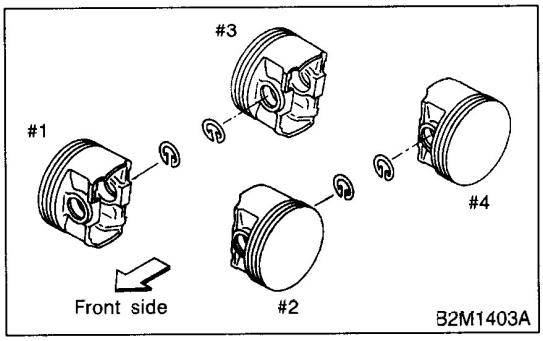
11) Position the lower rail gap at (E) or (F) in the figure.

**CAUTION:**
**• Ensure ring gaps do not face the same direction.**
**• Ensure ring gaps are not within the piston skirt area.**

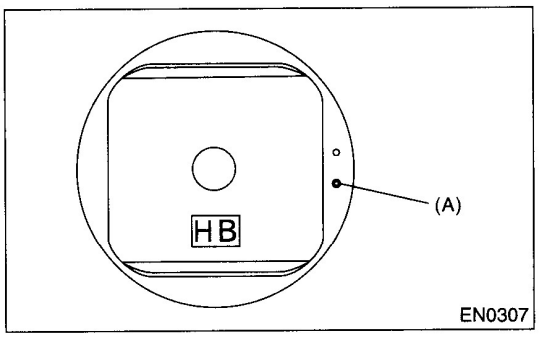



12) Installing the circlip:
Install the circlips in piston holes located opposite of the service holes in cylinder block, when positioning all pistons in the corresponding cylinders.

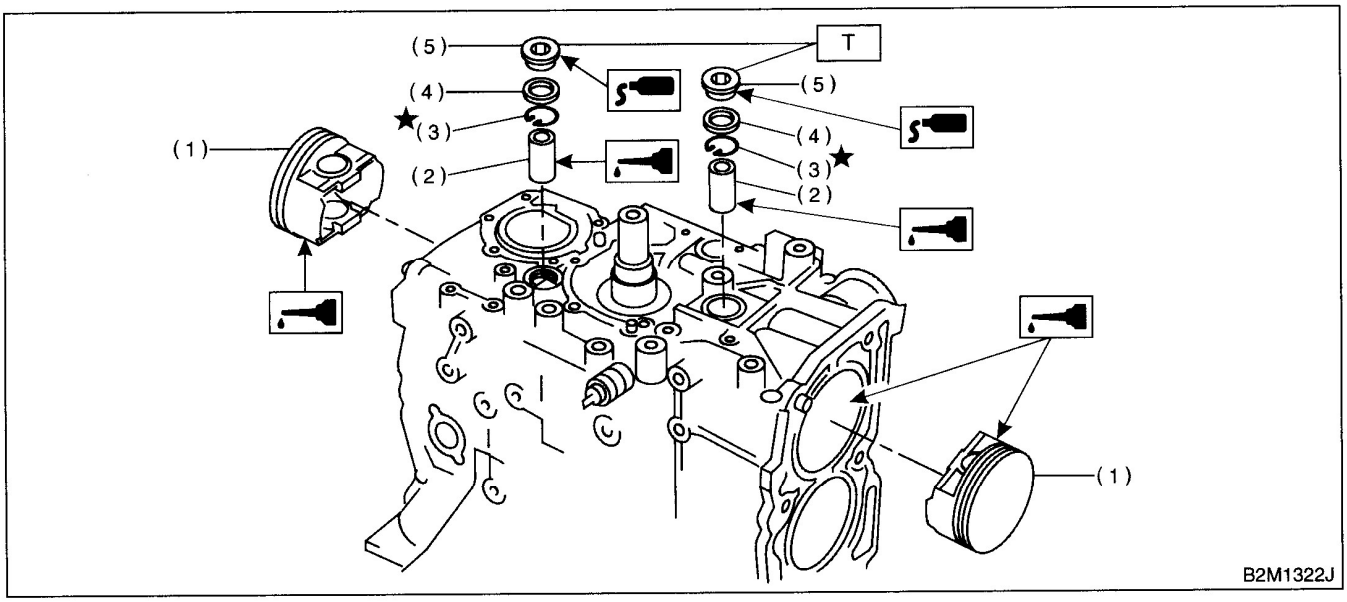
**CAUTION:**
**Use new circlips.**




**CAUTION:**
**Piston front mark faces towards the front of the engine.**




(A) Front mark




(1) Piston
(2) Piston pin
(3) Circlip
(4) Gasket
(5) Service hole plug

***Tightening torque: N·m (kgf-m, ft-lb)***
***T: 69 (7.0, 50.6)***

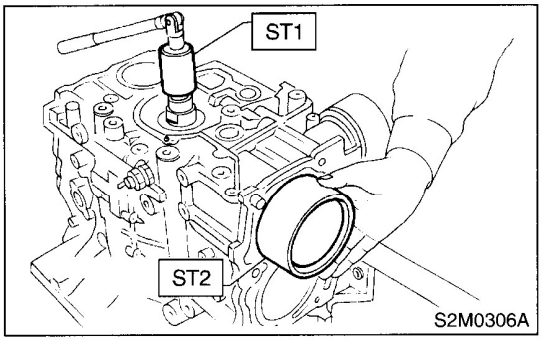

GETtheMANUALS.org

13) Installing the piston:
(1) Turn the cylinder block so that #1 and #2 cylinders face upward.
(2) Using 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.

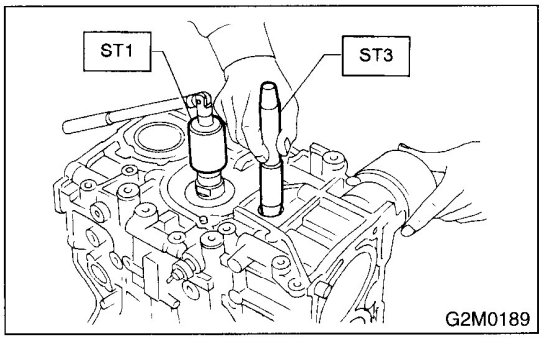
ST2 498744300 PISTON GUIDE




14) Installing piston pin:
(1) Insert ST3 into service hole to align piston pin hole with connecting rod small end.

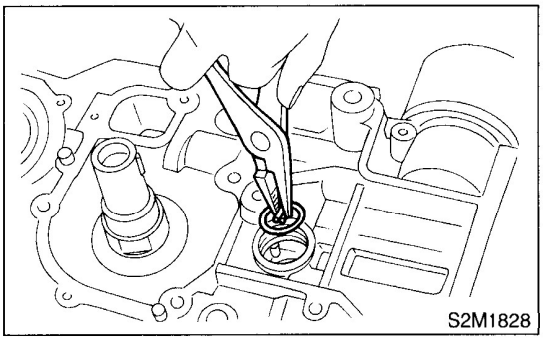
**CAUTION:**
**Apply a coat of engine oil to ST3 before insertion.**

ST3 499017100 PISTON PIN GUIDE



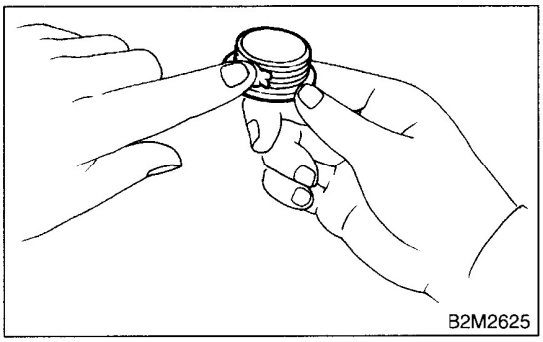

(2) Apply a coat of engine oil to the piston pin and insert piston pin into piston and connecting rod through service hole.
(3) Install the circlip.

**CAUTION:**
**Use new circlips.**



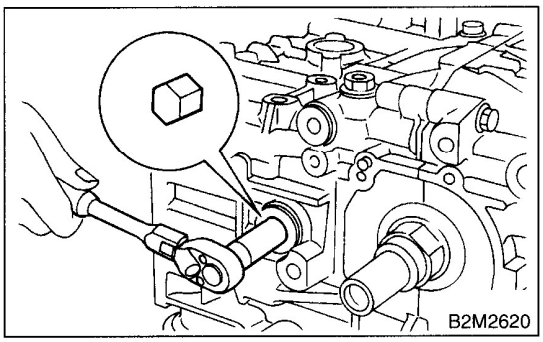

(4) Apply fluid packing around the service hole plug.

***Fluid packing:***
***THREE BOND 1215 or equivalent***



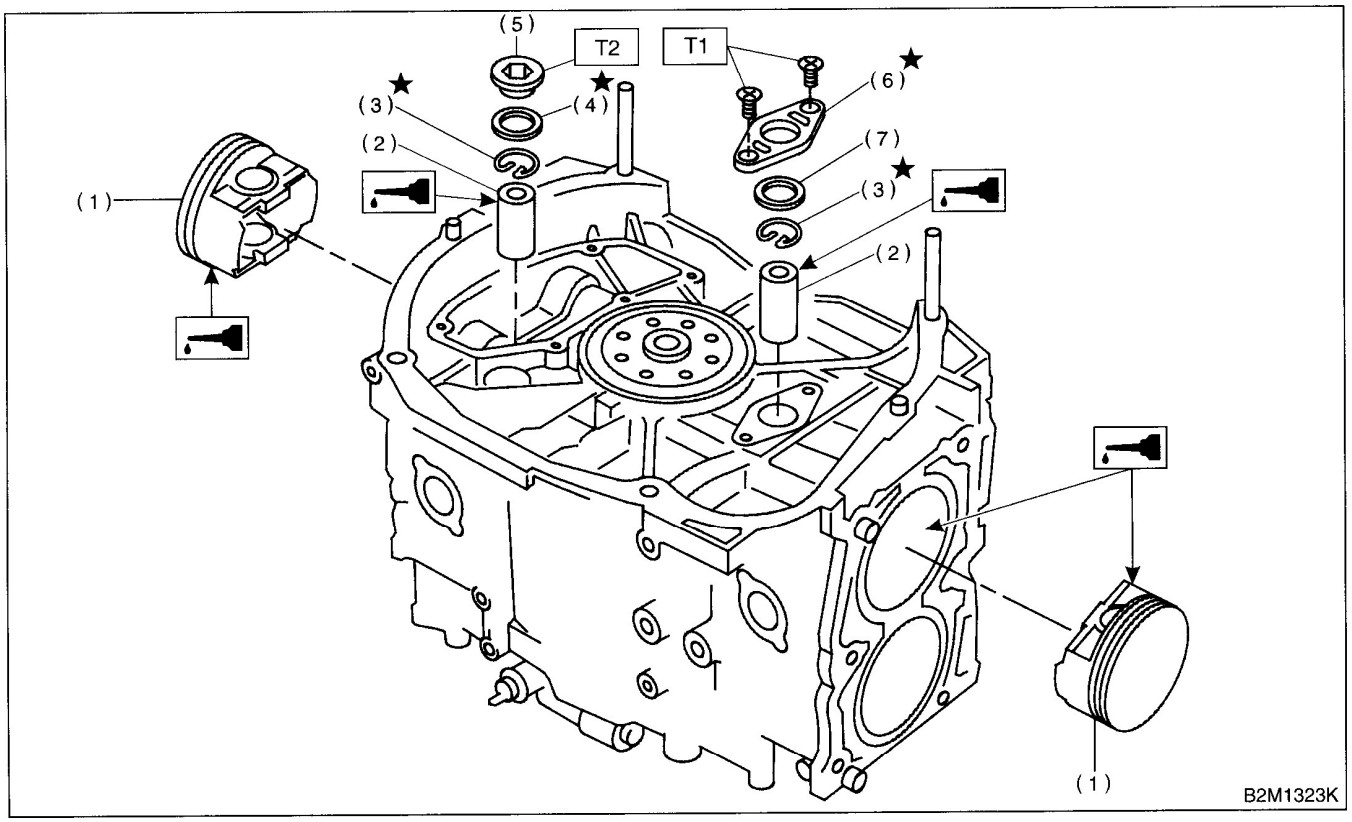

(5) Install the service hole plug and gasket.

**CAUTION:**
**Use a new gasket.**





GETtheMANUALS.org




(1) Piston
(2) Piston pin
(3) Circlip
(4) Gasket
(5) Service hole plug
(6) Service hole cover
(7) O-ring

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 6.4 (0.65, 4.7)***
***T2: 69 (7.0, 50.6)***

(6) Turn the cylinder block so that #3 and #4 cylinders face upward. Using the same procedures as used for #1 and #2 cylinders, install the pistons and piston pins.

15) Install the water pipe.

16) Install the baffle plate.

***Tightening torque:***
***6.4 N·m (0.65 kgf-m, 4.7 ft-lb)***

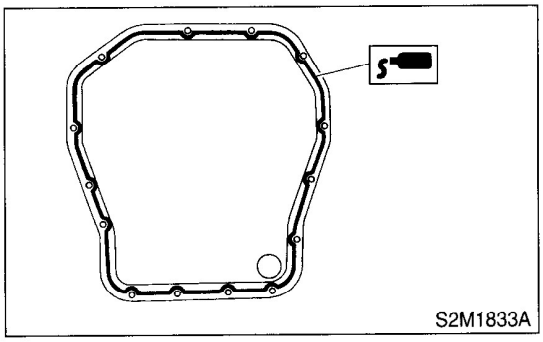
17) Install the oil strainer and O-ring

***Tightening torque:***
***10 N·m (1.0 kgf-m, 7 ft-lb)***

18) Install the oil strainer stay.

19) Apply fluid packing to matching surfaces and install the oil pan.

***Fluid packing:***
***THREE BOND 1215 or equivalent***

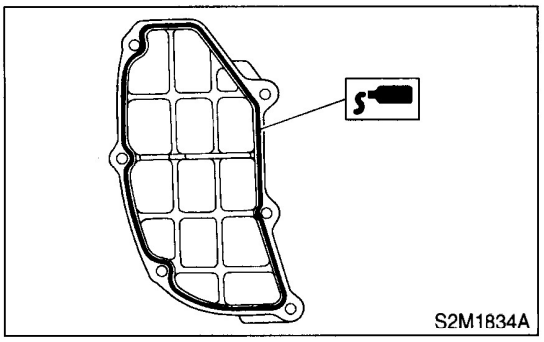




GETtheMANUALS.org

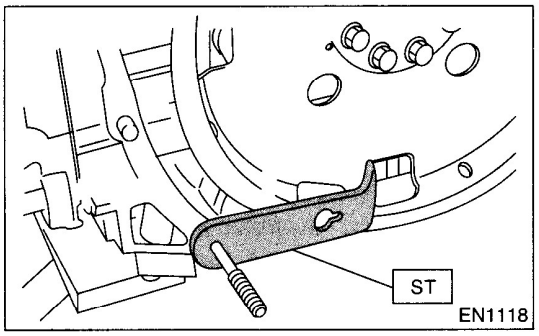
20) Apply fluid packing to matching surfaces and install the oil separator cover.

***Fluid packing:***
***THREE BOND 1215 or equivalent***

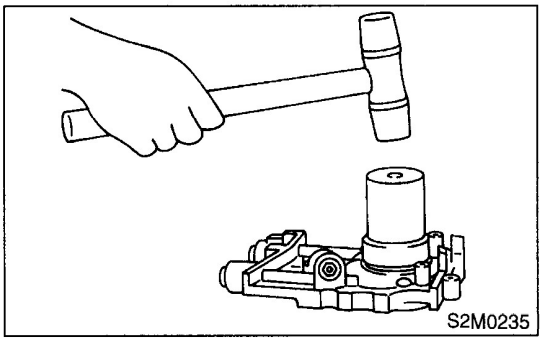



21) Install the drive plate. (AT vehicles)
To lock the crankshaft, use ST.
ST 498497100 CRANKSHAFT STOPPER

***Tightening torque:***
***72 N·m (7.3 kgf-m, 52.8 ft-lb)***

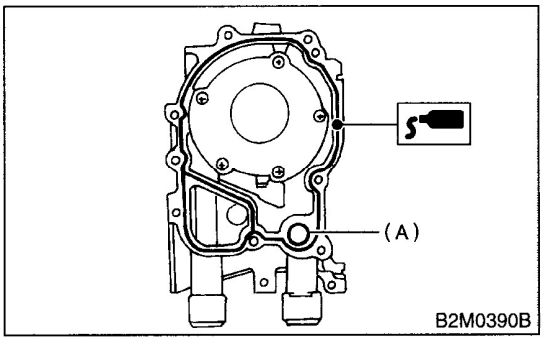



22) Install the flywheel. (MT vehicles) <Ref. to CL-14, INSTALLATION, Flywheel.>
23) Install the clutch disc and cover. (MT vehicles) <Ref. to CL-11, INSTALLATION, Clutch Disc and Cover.>
24) Installation of oil pump:
(1) Discard the front oil seal after removal. Replace with a new one using ST.
ST 499587100 OIL SEAL INSTALLER



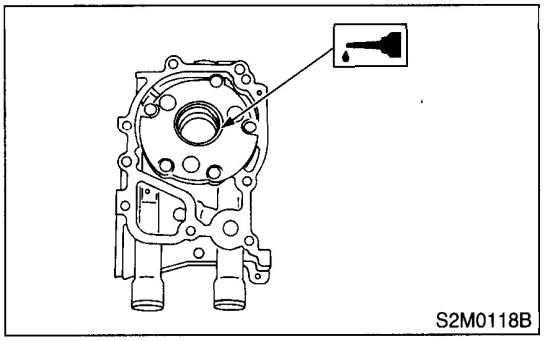

(2) Apply fluid packing to the matching surface of oil pump.

***Fluid packing:***
***THREE BOND 1215 or equivalent***




(A) O-ring

(3) Apply a coat of engine oil to the inside of the oil seal.




(4) Install the oil pump on cylinder block. Be careful not to damage the oil seal during installation.

***Tightening torque:***
***6.4 N·m (0.65 kgf-m, 4.7 ft-lb)***

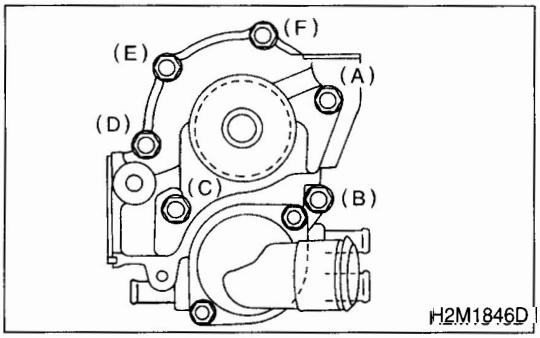
**CAUTION:**
**• Do not forget to install the O-ring and seal when installing the oil pump.**
**• Align the flat surface of oil pump's inner rotor with crankshaft before installation.**


GETtheMANUALS.org

25) Install the water pump and gasket.

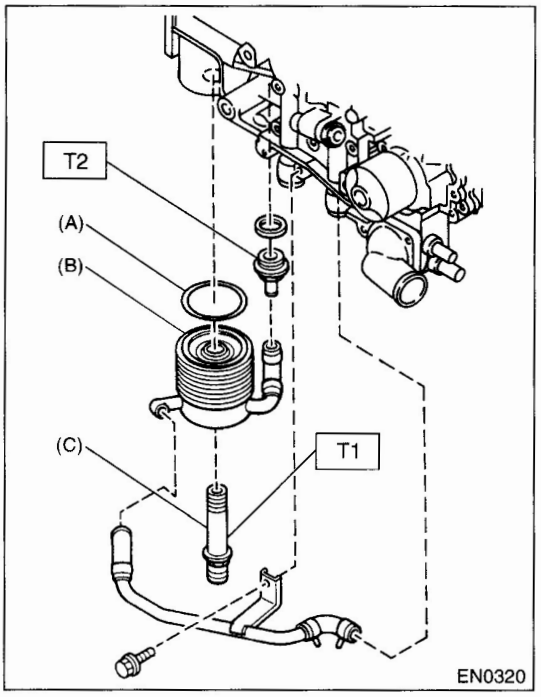
***Tightening torque:***
***First; 12 N·m (1.2 kgf-m, 8.7 ft-lb)***
***Second; 12 N·m (1.2 kgf-m, 8.7 ft-lb)***

**CAUTION:**
- **Be sure to use a new gasket.**
- **When installing the water pump, tighten bolts in two stages in alphabetical sequence as shown in the figure.**




26) Install the water by-pass pipe for heater.
27) Install the oil cooler.

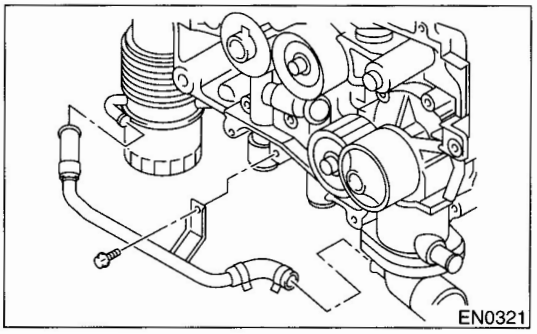
***Tightening torque:***
***T1: 55 N·m (5.5 kgf-m, 40 ft-lb)***
***T2: 69 N·m (7.0 kgf-m, 50.6 ft-lb)***




(A) O-ring
(B) Oil cooler
(C) Connector

28) Install the oil filter using ST.
ST 498547000 OIL FILTER WRENCH

29) Install the water by-pass pipe between oil cooler and water pump.



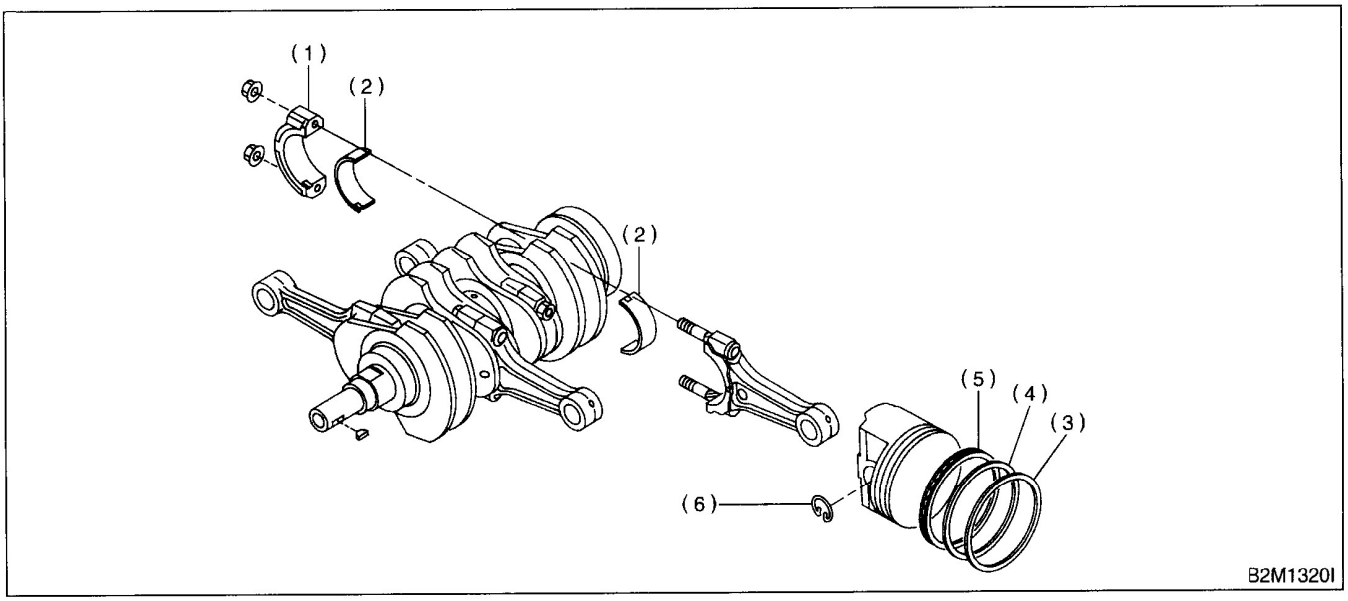

30) Install the water pipe.

NOTE:
Always use a new O-ring.

31) Install the cylinder head assembly. <Ref. to ME(DOHC TURBO)-64, INSTALLATION, Cylinder Head Assembly.>
32) Install the oil level gauge guide and tighten the attaching bolt (left side only).
33) Install the rocker cover.
34) Install the crankshaft sprocket. <Ref. to ME(DOHC TURBO)-58, INSTALLATION, Crankshaft Sprocket.>
35) Install the camshaft sprocket. <Ref. to ME(DOHC TURBO)-57, INSTALLATION, Camshaft Sprocket.>
36) Install the timing belt assembly. <Ref. to ME(DOHC TURBO)-50, INSTALLATION, Timing Belt Assembly.>
37) Install the belt cover. <Ref. to ME(DOHC TURBO)-47, INSTALLATION, Belt Cover.>
38) Install the crankshaft pulley. <Ref. to ME(DOHC TURBO)-46, INSTALLATION, Crankshaft Pulley.>
39) Install the generator and A/C compressor brackets on cylinder head.
40) Install the V-belt. <Ref. to ME(DOHC TURBO)-44, INSTALLATION, V-belt.>
41) Install the intake manifold. <Ref. to FU(DOHC TURBO)-15, REMOVAL, Intake Manifold.>


GETtheMANUALS.org

## C: DISASSEMBLY




(1) Connecting rod cap
(2) Connecting rod bearing
(3) Top ring
(4) Second ring
(5) Oil ring
(6) Circlip

1) Remove the connecting rod cap.
2) Remove the connecting rod bearing.

**CAUTION:**
**Arrange the removed connecting rod, connecting rod cap and bearing in order to prevent confusion.**

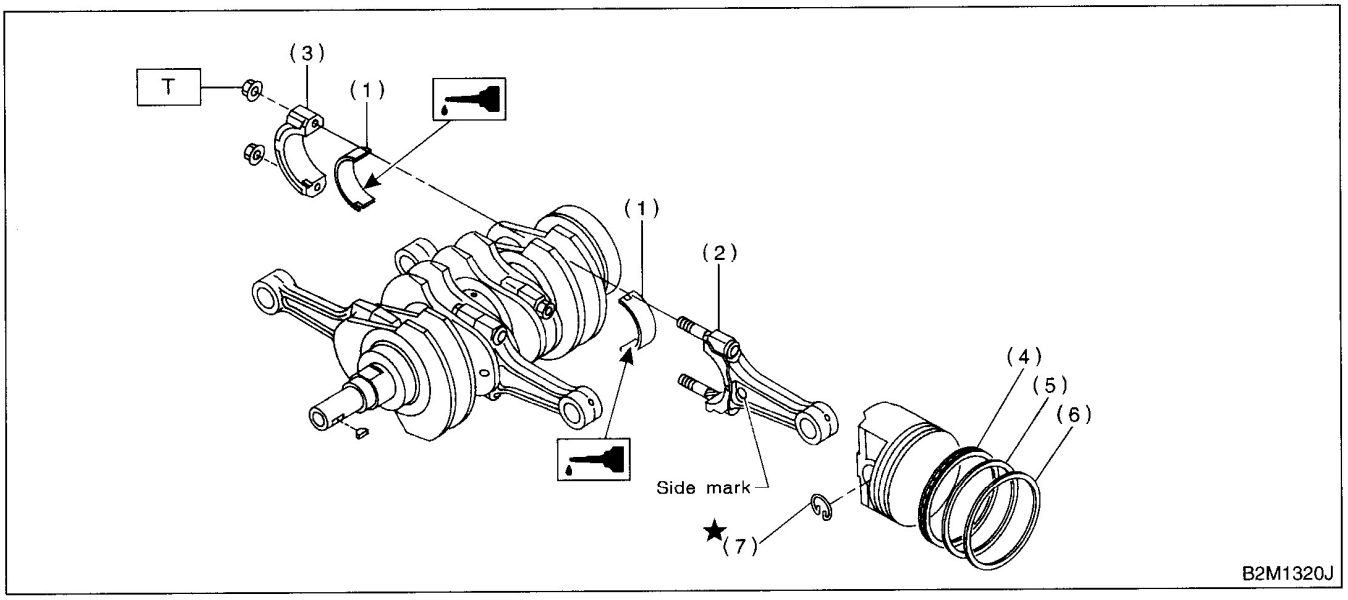
3) Remove the piston rings using the piston ring expander.
4) Remove the oil ring by hand.

**CAUTION:**
**Arrange the removed piston rings in proper order to prevent confusion.**

5) Remove the circlip.


GETtheMANUALS.org

## D: ASSEMBLY




(1) Connecting rod bearing
(2) Connecting rod
(3) Connecting rod cap
(4) Oil ring
(5) Second ring
(6) Top ring
(7) Circlip

***Tightening torque: N·m (kgf-m, ft-lb)***
***T: 44.6 (4.55, 32.9)***

1) Install the connecting rod bearings on connecting rods and connecting rod caps.

**CAUTION:**
**Apply oil to the surfaces of the connecting rod bearings.**

2) Install the connecting rod on crankshaft.

**CAUTION:**
**Position each connecting rod with the side marked facing forward.**

3) Install the connecting rod cap with connecting rod nut.
Ensure the arrow on connecting rod cap faces the front during installation.

**CAUTION:**
- **Each the connecting rod has its own mating cap. Make sure that they are assembled correctly by checking their matching number.**
- **When tightening the connecting rod nuts, apply oil on the threads.**

4) Install the oil ring spacer, upper rail and lower rail in this order by hand. Then install the second ring and top ring with a piston ring expander.

## E: INSPECTION

### 1. CYLINDER BLOCK

1) Visually check for cracks and damage. Especially, inspect the important parts by means of red lead check.
2) Check the oil passages for clogging.
3) Inspect the crankcase surface that mates with cylinder head for warping by using a straight edge, and correct by grinding if necessary.

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

***Grinding limit:***
***0.1 mm (0.004 in)***

***Standard height of cylinder block:***
***201.0 mm (7.91 in)***


GETtheMANUALS.org

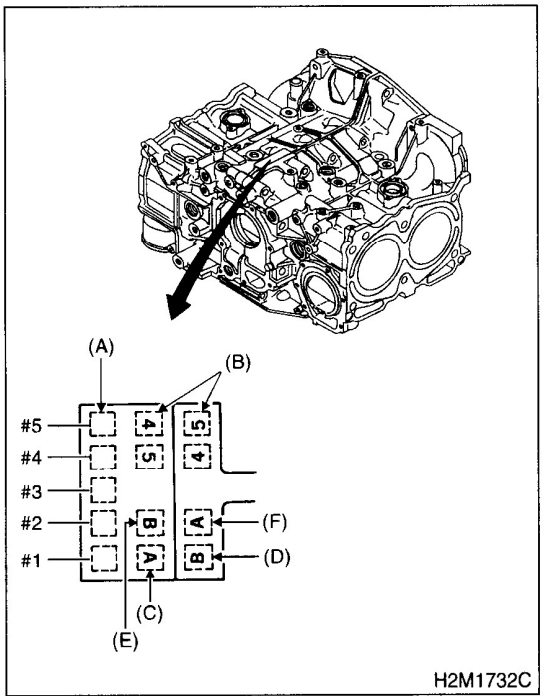
## 2. CYLINDER AND PISTON

1) The cylinder bore size is stamped on the cylinder block's front upper surface.

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

NOTE:
Standard sized pistons are classified into two grades, "A" and "B". These grades should be used as a guide line in selecting a standard piston.

***Standard diameter:***
***A: 92.005 — 92.015 mm (3.6222 — 3.6226 in)***
***B: 91.995 — 92.005 mm (3.6218 — 3.6222 in)***



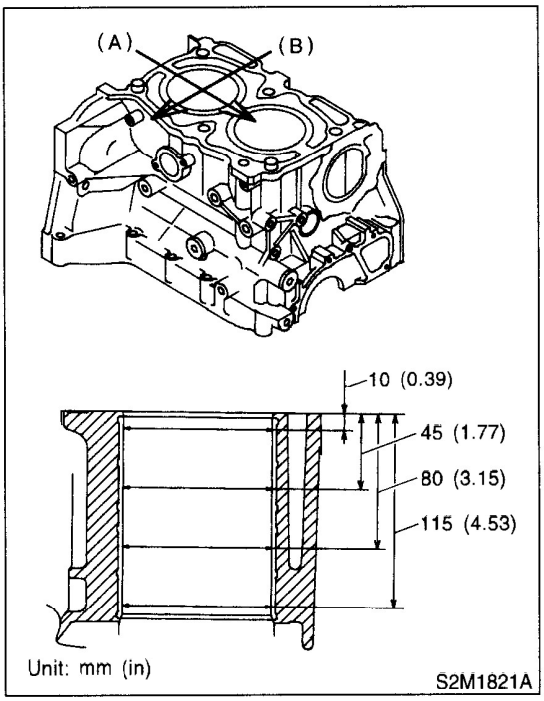

(A) Main journal size mark
(B) Cylinder block RH-LH combination mark
(C) #1 cylinder bore size mark
(D) #2 cylinder bore size mark
(E) #3 cylinder bore size mark
(F) #4 cylinder bore size mark

2) How to measure the inner diameter of each cylinder:
Measure the inner diameter of each cylinder in both the thrust and piston pin directions at the heights shown in the figure, using a cylinder bore gauge.

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

***Taper:***
***Standard***
***0.015 mm (0.0006 in)***
***Limit***
***0.050 mm (0.0020 in)***

***Out-of-roundness:***
***Standard***
***0.010 mm (0.0004 in)***
***Limit***
***0.050 mm (0.0020 in)***




(A) Piston pin direction
(B) Thrust direction

3) When the piston is to be replaced due to general or cylinder wear, determine a suitable sized piston by measuring the piston clearance.

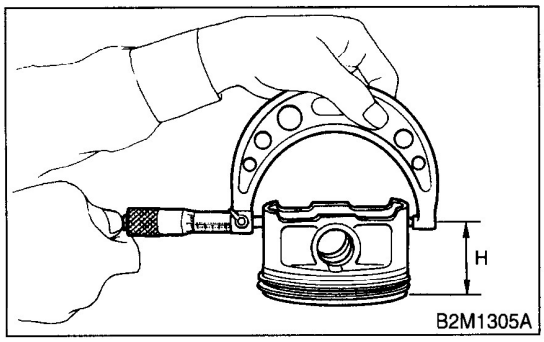

GETtheMANUALS.org

4) How to measure the outer diameter of each piston:
Measure the outer diameter of each piston at the height shown in the figure. (Thrust direction)

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

***Piston grade point H:***
***37.0 mm (1.457 in)***

***Piston outer diameter:***
***Standard***
***A: 91.985 — 91.995 mm***
***(3.6214 — 3.6218 in)***
***B: 91.975 — 91.985 mm***
***(3.6211 — 3.6214 in)***
***0.25 mm (0.0098 in) oversize***
***92.225 — 92.235 mm***
***(3.6309 — 3.6313 in)***
***0.50 mm (0.0197 in) oversize***
***92.475 — 92.485 mm***
***(3.6407 — 3.6411 in)***




5) Calculate the clearance between cylinder and piston.

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

***Cylinder to piston clearance at 20°C (68°F):***
***Standard***
***0.010 — 0.030 mm (0.0004 — 0.0012 in)***
***Limit***
***0.050 mm (0.0020 in)***

6) Boring and honing:
(1) If the value of taper, out-of-roundness, or cylinder-to-piston clearance measured exceeds the specified limit or if there is any damage on the cylinder wall, rebore it to use an oversize piston.

**CAUTION:**
**When any of the cylinders needs reboring, all other cylinders must be bored at the same time, and use oversize pistons. Do not perform boring on one cylinder only, nor use an oversize piston for one cylinder only.**

(2) If the cylinder inner diameter exceeds the limit after boring and honing, replace the crankcase.

**CAUTION:**
**Immediately after reboring, the cylinder diameter may differ from its real diameter due to temperature rise. Thus, pay attention to this when measuring the cylinder diameter.**

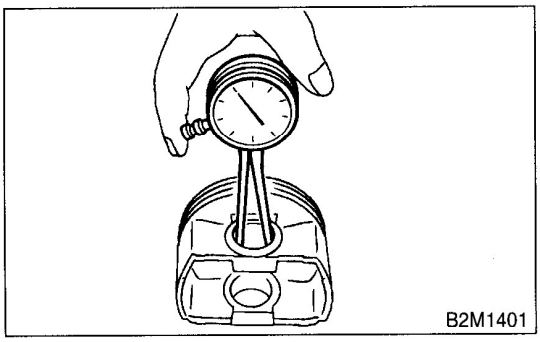
***Limit of cylinder enlarging (boring):***
***0.5 mm (0.020 in)***

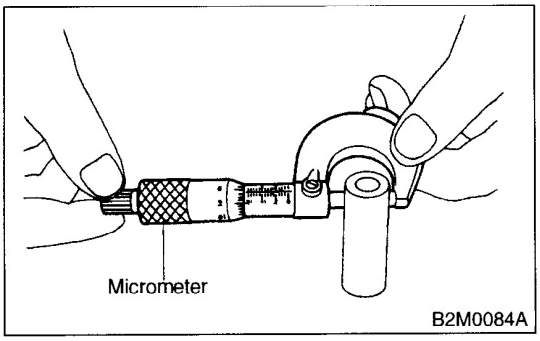

GETtheMANUALS.org

## 3. PISTON AND PISTON PIN

1) Check the pistons and piston pins for damage, cracks, and wear and the piston ring grooves for wear and damage. Replace if defective.
2) Measure the piston-to-cylinder clearance at each cylinder. <Ref. to ME(DOHC TURBO)-84, CYLINDER AND PISTON, INSPECTION, Cylinder Block.> If any of the clearances is not within specification, replace the piston or bore the cylinder to use an oversize piston.
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 defective.

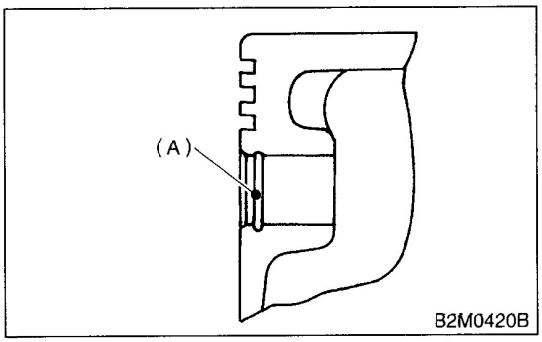
***Standard clearance between piston pin and hole in piston:***
***Standard***
***0.004 — 0.008 mm (0.0002 — 0.0003 in)***
***Limit***
***0.020 mm (0.0008 in)***


B2M1401



B2M0084A

4) Check the circlip installation groove on the piston for burr (A). If necessary, remove burr from the groove so that the piston pin can lightly move.



B2M0420B

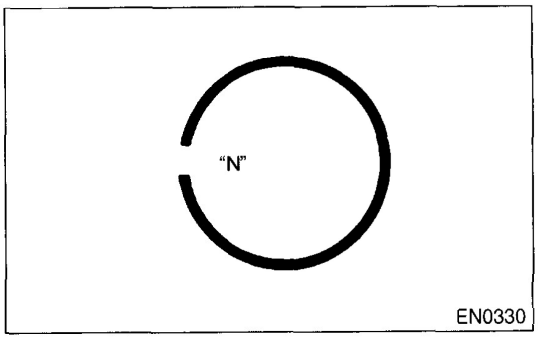
5) Check the piston pin circlip for distortion, cracks and wear.


GETtheMANUALS.org

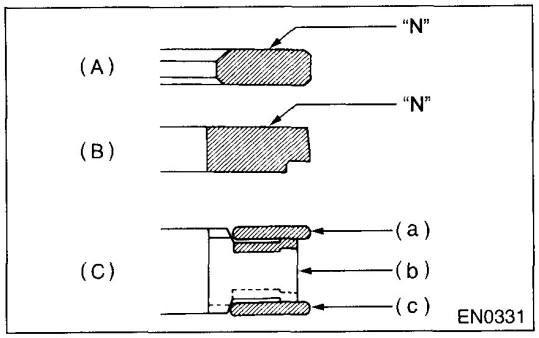
## 4. PISTON RING

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 one of the same size as the piston.

**CAUTION:**
**• "N" is marked on the end of the top and second rings. When installing the rings to the piston, face this mark upward.**




**• The oil ring is a combined ring consisting of two rails and a spacer in between. When installing, be *careful to assemble correctly*.**

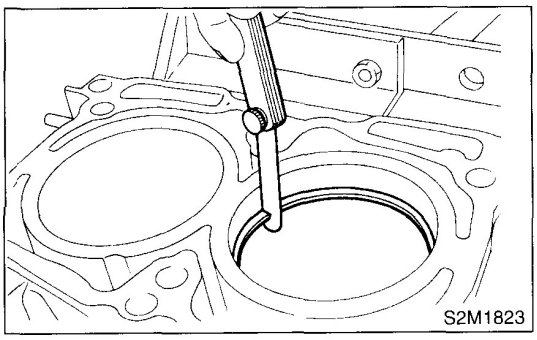



(A) Top ring
(B) Second ring
(C) Oil ring
(a) Upper rail
(b) Spacer
(c) Lower rail

2) Squarely place the piston ring and oil ring in cylinder, and measure the piston ring gap with a thickness gauge.

Unit: mm (in)

| | | Standard | Limit |
|---|---|---|---|
| Piston ring gap | Top ring | 0.20 — 0.35 (0.0079 — 0.0138) | 1.0 (0.039) |
| | Second ring | 0.35 — 0.50 (0.0138 — 0.0197) | 1.0 (0.039) |
| | Oil ring rail | 0.20 — 0.70 (0.0079 — 0.0276) | 1.5 (0.059) |

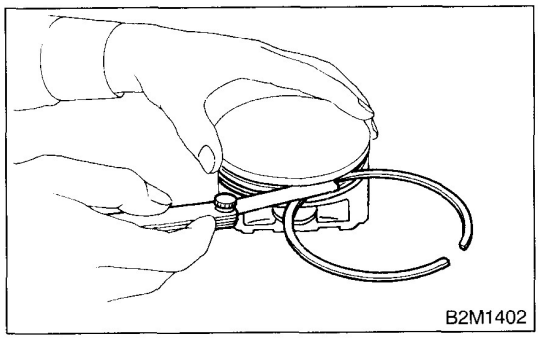



3) Measure the clearance between piston ring and piston ring groove with a thickness gauge.

**CAUTION:**
**Before measuring the clearance, clean the piston ring groove and piston ring.**

Unit: mm (in)

| | | Standard | Limit |
|---|---|---|---|
| Clearance between piston ring and piston ring groove | Top ring | 0.040 — 0.080 (0.0016 — 0.0031) | 0.15 (0.0059) |
| | Second ring | 0.030 — 0.070 (0.0012 — 0.0028) | 0.15 (0.0059) |



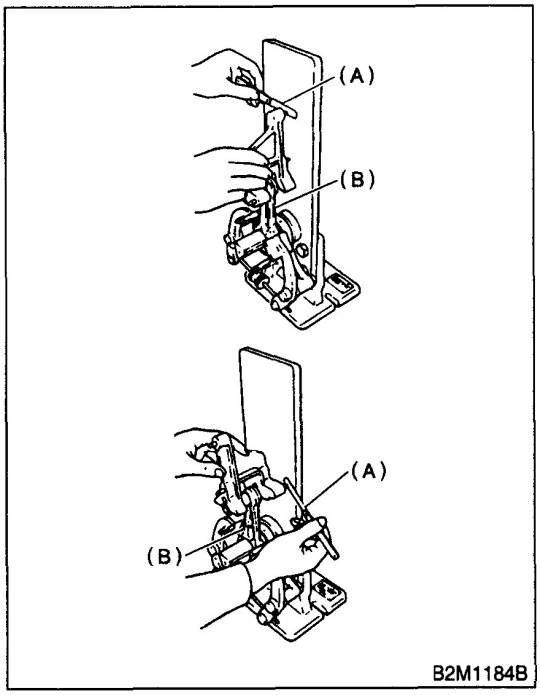


GETtheMANUALS.org

## 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.

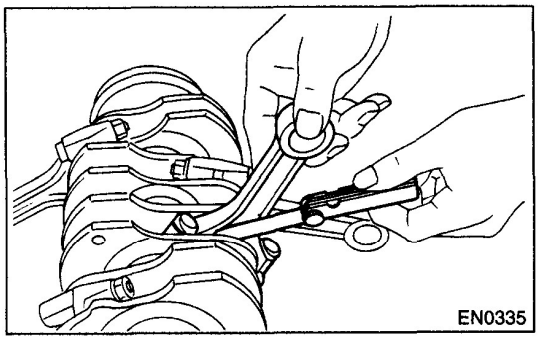
***Limit of bend or twist per 100 mm (3.94 in) in length:***
***0.10 mm (0.0039 in)***




(A) Thickness gauge
(B) Connecting rod

3) Install the connecting rod fitted with bearing to crankshaft and measure the side clearance (thrust clearance). Replace the connecting rod if the side clearance exceeds the specified limit.

***Connecting rod side clearance:***
***Standard***
***0.070 — 0.330 mm (0.0028 — 0.0130 in)***
***Limit***
***0.4 mm (0.016 in)***




4) Inspect the connecting rod bearing for scar, peeling, seizure, melting, wear, etc.
5) Measure the oil clearance on individual connecting rod bearings by means of plastigauge. If any oil clearance is not within specification, replace the defective bearing with a new one of standard size or undersize as necessary. (See the table below.)

***Connecting rod oil clearance:***
***Standard***
***0.020 — 0.046 mm (0.0008 — 0.0018 in)***
***Limit***
***0.05 mm (0.0020 in)***

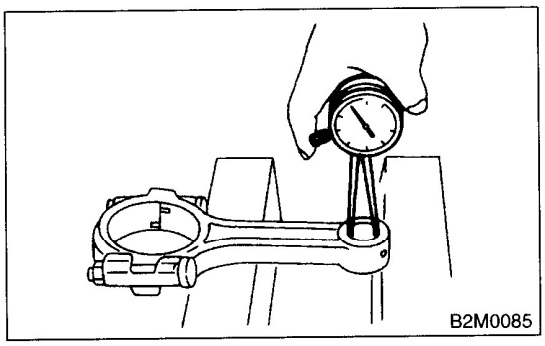
Unit: mm (in)

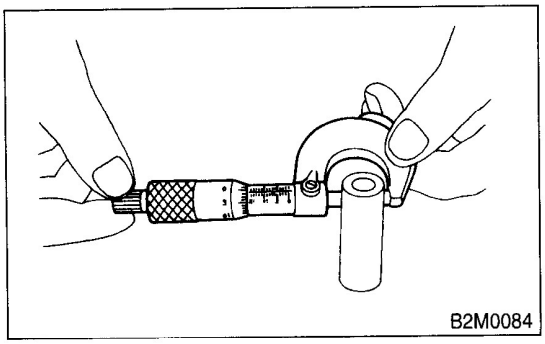
| Bearing | Bearing size (Thickness at center) | Outer diameter of crank pin |
|---|---|---|
| Standard | 1.492 — 1.501 (0.0587 — 0.0591) | 47.984 — 48.000 (4.8891 — 1.8898) |
| 0.03 (0.0012) undersize | 1.510 — 1.513 (0.0594 — 0.0596) | 47.954 — 47.970 (1.8879 — 1.8886) |
| 0.05 (0.0020) undersize | 1.520 — 1.523 (0.0598 — 0.0600) | 47.934 — 47.950 (1.8872 — 1.8878) |
| 0.25 (0.0098) undersize | 1.620 — 1.623 (0.0638 — 0.0639) | 47.734 — 47.750 (1.8793 — 1.8799) |


GETtheMANUALS.org

6) Inspect the bushing at connecting rod small end, and replace if worn or damaged. Also measure the piston pin clearance at the connecting rod small end.

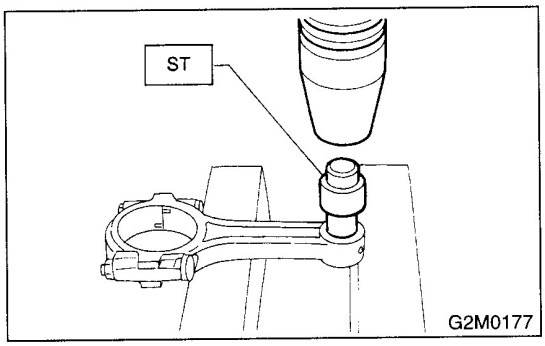
***Clearance between piston pin and bushing:***
***Standard***
***0 — 0.022 mm (0 — 0.0009 in)***
***Limit***
***0.030 mm (0.0012 in)***


B2M0085


B2M0084

7) Replacement procedure is as follows:
(1) Remove the bushing from connecting rod with ST and press.
(2) Press the bushing with ST after applying oil on the periphery of bushing.

ST 499037100 CONNECTING ROD BUSHING REMOVER AND INSTALLER



G2M0177

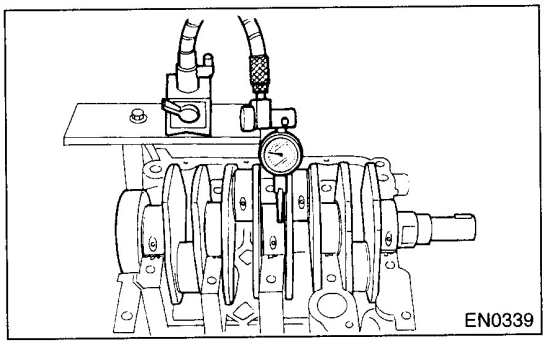
(3) Make two 3 mm (0.12 in) holes in bushing. Ream the inside of bushing.
(4) After completion of reaming, clean the bushing to remove chips.

## 6. CRANKSHAFT AND CRANKSHAFT BEARING

1) Clean the crankshaft completely and check for cracks by means of red lead check etc., and replace if defective.
2) Measure the crankshaft bend, and correct or replace if it exceeds the limit.

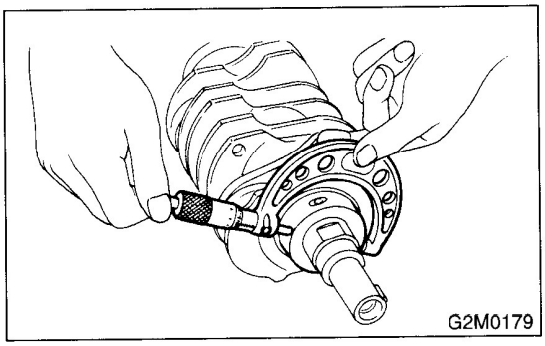
**CAUTION:**
**If a suitable V-block is not available, install #1 and #5 crankshaft bearing on cylinder block, position crankshaft on these bearings and measure the crankshaft bend using a dial gauge.**

***Crankshaft bend limit:***
***0.035 mm (0.0014 in)***


EN0339

3) Inspect the crank journal and crank pin for wear. If they are not within the specifications, replace the bearing with a suitable (undersize) one, and replace or recondition 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 and crank journal:***
***Out-of-roundness***
***0.020 mm (0.0008 in) or less***
***Taper limit***
***0.07 mm (0.0028 in)***
***Grinding limit***
***0.250 mm (0.0098 in)***


G2M0179


GETtheMANUALS.org

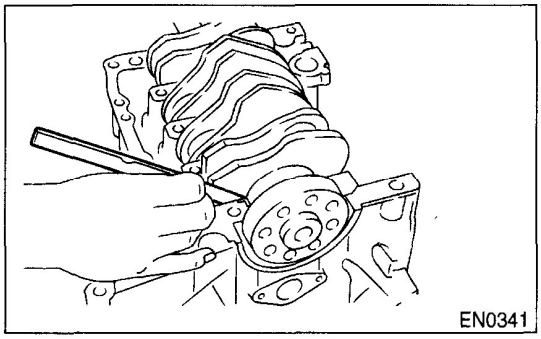
Unit: mm (in)

| | | Crank journal diameter | | Crank pin diameter |
|---|---|---|---|---|
| | | #1, #3, #5 | #2, #4 | |
| Standard | Journal O.D. | 59.992 — 60.008 (2.3619 — 2.3625) | 59.992 — 60.008 (2.3619 — 2.3625) | 47.984 — 48.000 (1.8891 — 1.8898) |
| | Bearing size (Thickness at center) | 1.998 — 2.011 (0.0787 — 0.0792) | 2.000 — 2.013 (0.0787 — 0.0793) | 1.492 — 1.510 (0.0587 — 0.0591) |
| 0.03 (0.0012) undersize | Journal O.D. | 59.962 — 59.978 (2.3607 — 2.3613) | 59.962 — 59.978 (2.3607 — 2.3613) | 47.954 — 47.970 (1.8879 — 1.8886) |
| | Bearing size (Thickness at center) | 2.017 — 2.020 (0.0794 — 0.0795) | 2.019 — 2.022 (0.0795 — 0.0796) | 1.510 — 1.513 (0.0594 — 0.0596) |
| 0.05 (0.0020) undersize | Journal O.D. | 59.942 — 59.958 (2.3599 — 2.3605) | 59.942 — 59.958 (2.3599 — 2.3605) | 47.934 — 47.950 (1.8872 — 1.8878) |
| | Bearing size (Thickness at center) | 2.027 — 2.030 (0.0798 — 0.0799) | 2.029 — 2.032 (0.0799 — 0.0800) | 1.520 — 1.523 (0.0598 — 0.0600) |
| 0.25 (0.0098) undersize | Journal O.D. | 59.742 — 59.758 (2.3520 — 2.3527) | 59.742 — 59.758 (2.3520 — 2.3527) | 47.734 — 47.750 (1.8793 — 1.8799) |
| | Bearing size (Thickness at center) | 2.127 — 2.130 (0.0837 — 0.0839) | 2.129 — 2.132 (0.0838 — 0.0839) | 1.620 — 1.623 (0.0638 — 0.0639) |

O.D.: Outer Diameter

4) Measure the thrust clearance of crankshaft at center bearing. If the clearance exceeds the limit, replace the bearing.

***Crankshaft thrust clearance:***
***Standard***
***0.030 — 0.115 mm (0.0012 — 0.0045 in)***
***Limit***
***0.25 mm (0.0098 in)***


EN0341

5) Inspect individual crankshaft bearings for signs of flaking, seizure, melting, and wear.

6) Measure the oil clearance on each crankshaft bearing by means of plastigauge. If the measurement is not within the specification, replace the defective bearing with an undersize one, and replace or recondition the crankshaft as necessary.

Unit: mm (in)

| Crankshaft oil clearance | |
|---|---|
| Standard | 0.010 — 0.030 (0.0004 — 0.0012) |
| Limit | 0.040 (0.0016) |



GETtheMANUALS.org

# 21.Engine Trouble in General

## A: INSPECTION

NOTE:
"RANK" shown in the chart refers to the possibility of reason for the trouble in order ("Very often" to "Rarely")

A — Very often
B — Sometimes
C — Rarely

| TROUBLE | PROBLEM PARTS, ETC. | POSSIBLE CAUSE | RANK |
|---|---|---|---|
| 1. Engine will not start. | | | |
| 1) Starter does not turn. | • Starter | • Defective battery-to-starter harness | B |
| | | • Defective starter switch | C |
| | | • Defective inhibitor switch or neutral switch | C |
| | | • Defective starter | B |
| | • Battery | • Poor terminal connection | 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 |
| 2) Initial combustion does not occur. | • Starter | • Defective starter | C |
| | • Engine control system <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.> | | A |
| | • Fuel line | • Defective fuel pump and relay | A |
| | | • Lack of or insufficient fuel | B |
| | • Belt | • Defective | B |
| | | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | C |
| | | • Loosened spark plugs or defective gasket | C |
| | | • Loosened cylinder head bolts or defective gasket | C |
| | | • Improper valve seating | 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 |
| 3) Initial combustion occur. | • Engine control system <Ref. to EN(DOHC TURBO)-2, 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 or insufficient fuel | B |
| | • Belt | • Defective | B |
| | | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | C |
| | | • Loosened spark plugs or defective gasket | C |
| | | • Loosened cylinder head bolts or defective gasket | C |
| | | • Improper valve seating | 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 |


GETtheMANUALS.org

# ENGINE TROUBLE IN GENERAL

| TROUBLE | PROBLEM PARTS, ETC. | POSSIBLE CAUSE | RANK |
|---|---|---|---|
| 4) Engine stalls after initial combustion. | • Engine control system <Ref. to EN(DOHC TURBO)-2, 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 |
| | • Fuel line | • Clogged fuel line | C |
| | | • Lack of or insufficient fuel | B |
| | • Belt | • Defective | B |
| | | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | C |
| | | • Loosened spark plugs or defective gasket | C |
| | | • Loosened cylinder head bolts or defective gasket | C |
| | | • Improper valve seating | 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 EN(DOHC TURBO)-2, 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 |
| | • Fuel line | • Defective fuel pump and relay | C |
| | | • Clogged fuel line | C |
| | | • Lack of or insufficient fuel | B |
| | • Belt | • Defective timing | C |
| | • Compression | • Incorrect valve clearance | B |
| | | • Loosened spark plugs or defective gasket | B |
| | | • Loosened cylinder head bolts or defective gasket | B |
| | | • Improper valve seating | 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 | • Overheating | C |
| | • Others | • Malfunction of evaporative emission control system | A |
| | | • Stuck or damaged throttle valve | B |
| | | • Accelerator cable out of adjustment | C |



GETtheMANUALS.org

| TROUBLE | PROBLEM PARTS, ETC. | POSSIBLE CAUSE | RANK |
|---|---|---|---|
| 3. Low output, hesitation and poor acceleration | • Engine control system <Ref. to EN(DOHC TURBO)-2, 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 |
| | • Fuel line | • Defective fuel pump and relay | B |
| | | • Clogged fuel line | B |
| | | • Lack of or insufficient fuel | C |
| | • Belt | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | B |
| | | • Loosened spark plugs or defective gasket | B |
| | | • Loosened cylinder head bolts or defective gasket | B |
| | | • Improper valve seating | 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 | • Overheating | C |
| | | • Over cooling | C |
| | • Others | • Malfunction of evaporative emission control system | A |
| 4. Surging | • Engine control system <Ref. to EN(DOHC TURBO)-2, 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 |
| | • Fuel line | • Defective fuel pump and relay | B |
| | | • Clogged fuel line | B |
| | | • Lack of or insufficient fuel | C |
| | • Belt | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | B |
| | | • Loosened spark plugs or defective gasket | C |
| | | • Loosened cylinder head bolts or defective gasket | C |
| | | • Improper valve seating | 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 | • Overheating | B |
| | • Others | • Malfunction of evaporative emission control system | C |


GETtheMANUALS.org

| TROUBLE | PROBLEM PARTS, ETC. | POSSIBLE CAUSE | RANK |
|---|---|---|---|
| 5. Engine does not return to idle. | • Engine control system <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.> | | A |
| | • Intake system | • Loosened or cracked vacuum hose | A |
| | • Others | • Stuck or damaged throttle valve | A |
| | | • Accelerator cable out of adjustment | B |
| 6. Dieseling (Run-on) | • Engine control system <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.> | | A |
| | • Cooling system | • Overheating | B |
| | • Others | • Malfunction of evaporative emission control system | B |
| 7. After burning in exhaust system | • Engine control system <Ref. to EN(DOHC TURBO)-2, 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 |
| | • Belt | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | B |
| | | • Loosened spark plugs or defective gasket | C |
| | | • Loosened cylinder head bolts or defective gasket | C |
| | | • Improper valve seating | 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 |
| | • Others | • Malfunction of evaporative emission control system | C |
| 8. Knocking | • Engine control system <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.> | | A |
| | • Intake system | • Loosened oil filler cap | B |
| | • Belt | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | C |
| | | • Incorrect valve timing | B |
| | • Cooling system | • Overheating | 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 o-ring | 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 |


GETtheMANUALS.org

| TROUBLE | PROBLEM PARTS, ETC. | POSSIBLE CAUSE | RANK |
|---|---|---|---|
| 10. Excessive fuel consumption | • Engine control system | <Ref. to EN(DOHC TURBO)-2, Basic Diagnostic Procedure.> | A |
| | • Intake system | • Dirty air cleaner element | A |
| | • Belt | • Defective timing | B |
| | • Compression | • Incorrect valve clearance | B |
| | | • Loosened spark plugs or defective gasket | C |
| | | • Loosened cylinder head bolts or defective gasket | C |
| | | • Improper valve seating | 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 |
| | • Others | • Accelerator cable out of adjustment | B |


GETtheMANUALS.org

# 22.Engine Noise

## A: INSPECTION

| Type of sound | Condition | Possible cause |
|---|---|---|
| Regular clicking sound | Sound increases as engine speed increases. | • Valve mechanism is defective.<br>• Incorrect valve clearance<br>• Worn valve rocker<br>• Worn camshaft<br>• Broken valve spring |
| Heavy and dull clank | Oil pressure is low. | • Worn crankshaft main bearing<br>• Worn connecting rod bearing (big end) |
| | Oil pressure is normal. | • Loose flywheel mounting bolts<br>• Damaged engine mounting |
| High-pitched clank (Spark knock) | Sound is noticeable when accelerating with an overload. | • Ignition timing advanced<br>• Accumulation of carbon inside combustion chamber<br>• Wrong spark plug<br>• Improper gasoline |
| Clank when engine speed is medium (1,000 to 2,000 rpm). | Sound is reduced when fuel injector connector of noisy cylinder is disconnected. (NOTE*) | • Worn crankshaft main bearing<br>• Worn bearing at crankshaft end of connecting rod |
| Knocking sound when engine is operating under idling speed and engine is warm | Sound is reduced when fuel injector connector of noisy cylinder is disconnected. (NOTE*) | • Worn cylinder liner and piston ring<br>• Broken or stuck piston ring<br>• Worn piston pin and hole at piston end of connecting rod |
| | Sound is not reduced if each fuel injector connector is disconnected in turn. (NOTE*) | • Unusually worn valve lifter<br>• Worn cam gear<br>• Worn camshaft journal bore in crankcase |
| Squeaky sound | — | • Insufficient generator lubrication |
| Rubbing sound | — | • Defective generator brush and rotor contact |
| Gear scream when starting engine | — | • Defective ignition starter switch<br>• Worn gear and starter pinion |
| Sound like polishing glass with a dry cloth | — | • Loose drive belt<br>• Defective water pump shaft |
| Hissing sound | — | • Loss of compression<br>• Air leakage in air intake system, hoses, connections or manifolds |
| Timing belt noise | — | • Loose timing belt<br>• Belt contacting case/adjacent part |
| Valve tappet noise | — | • Incorrect valve clearance |

NOTE*:
When disconnecting the fuel injector connector, Malfunction Indicator Light (CHECK ENGINE light) illuminates and trouble code is stored in ECM memory.
Therefore, carry out the CLEAR MEMORY MODE <Ref. to EN(DOHC TURBO)-49, OPERATION, Clear Memory Mode.> and INSPECTION MODE <Ref. to EN(DOHC TURBO)-46, OPERATION, Inspection Mode.> after connecting the fuel injector connector.


GETtheMANUALS.org

# EXHAUST

# EX(DOHC TURBO)

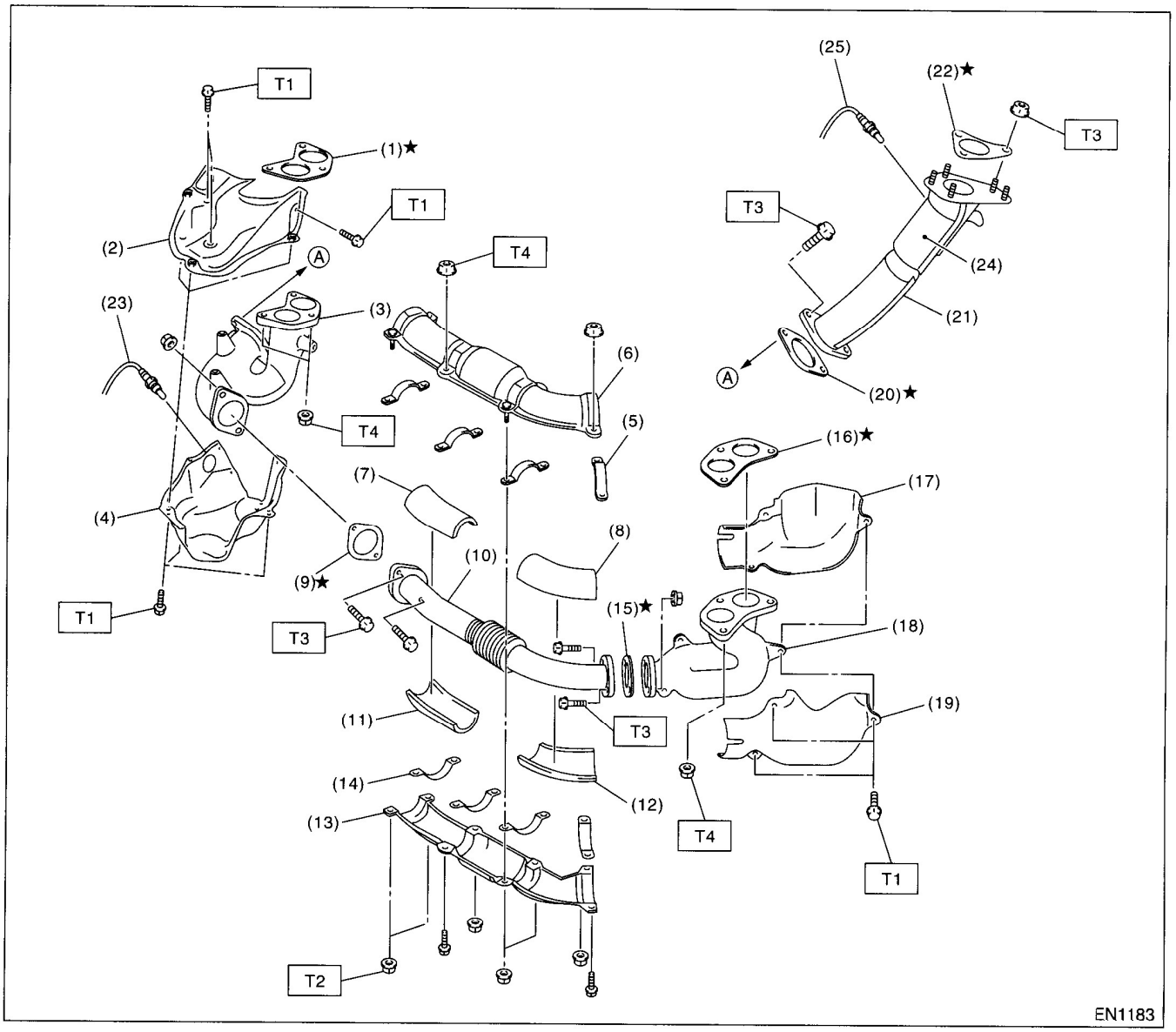

| | | Page |
|---|---|---|
| 1. | General Description | 2 |
| 2. | Front Exhaust Pipe | 6 |
| 3. | Center Exhaust Pipe | 8 |
| 4. | Joint Pipe | 12 |
| 5. | Rear Exhaust Pipe | 13 |
| 6. | Muffler | 14 |


GETtheMANUALS.org

# 1. General Description

## A: COMPONENT

### 1. FRONT EXHAUST PIPE





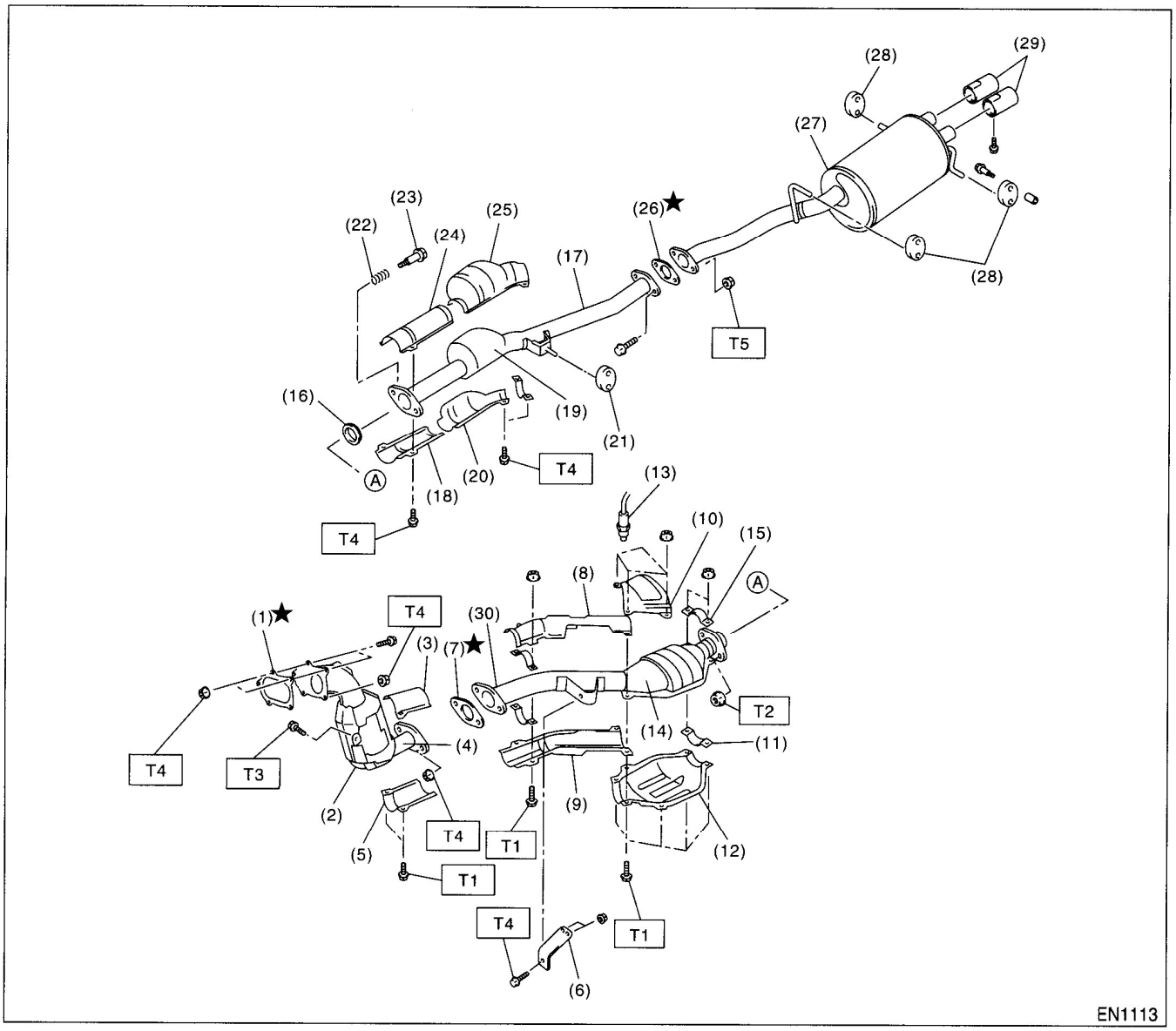
GETtheMANUALS.org

(1) Gasket
(2) Upper exhaust manifold cover (RH)
(3) Exhaust manifold (RH)
(4) Lower exhaust manifold cover (RH)
(5) Front exhaust pipe upper clamp
(6) Front exhaust pipe upper cover
(7) Front exhaust pipe upper insulator (RH)
(8) Front exhaust pipe upper insulator (LH)
(9) Gasket
(10) Front exhaust pipe
(11) Front exhaust pipe lower insulator (RH)
(12) Front exhaust pipe lower insulator (LH)
(13) Front exhaust pipe lower cover
(14) Front exhaust pipe lower clamp
(15) Gasket
(16) Gasket
(17) Upper exhaust manifold cover (LH)
(18) Exhaust manifold (LH)
(19) Lower exhaust manifold cover (LH)
(20) Gasket
(21) Turbocharger joint pipe
(22) Gasket
(23) Front oxygen (A/F) sensor
(24) Precatalytic converter
(25) Exhaust temperature sensor

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 19 (1.9, 13.7)***
***T2: 25 (2.5, 18.1)***
***T3: 35 (3.6, 26.0)***
***T4: 40 (4, 28.9)***


GETtheMANUALS.org

## 2. CENTER AND REAR EXHAUST PIPE, AND MUFFLER




(1) Gasket
(2) Front catalytic converter
(3) Upper center pipe cover (Front)
(4) Center exhaust pipe (Front)
(5) Lower center pipe cover (Front)
(6) Bracket
(7) Gasket
(8) Upper center pipe cover (Rear)
(9) Lower center pipe cover (Rear)
(10) Upper rear catalytic converter cover
(11) Lower clamp
(12) Lower rear catalytic converter cover
(13) Rear oxygen sensor
(14) Rear catalytic converter
(15) Upper clamp
(16) Gasket
(17) Rear exhaust pipe
(18) Lower rear exhaust pipe cover (Front)
(19) Chamber
(20) Lower rear exhaust pipe cover (Rear)
(21) Cushion
(22) Spring
(23) Bolt
(24) Upper rear exhaust pipe cover (Front)
(25) Upper rear exhaust pipe cover (Rear)
(26) Gasket
(27) Muffler
(28) Cushion
(29) Muffler cutter
(30) Center exhaust pipe (Rear)

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 13 (1.3, 9.6)***
***T2: 18 (1.8, 13.0)***
***T3: 30 (3.1, 22.4)***
***T4: 35 (3.6, 26.0)***
***T5: 48 (4.9, 35.4)***


GETtheMANUALS.org

## B: CAUTION

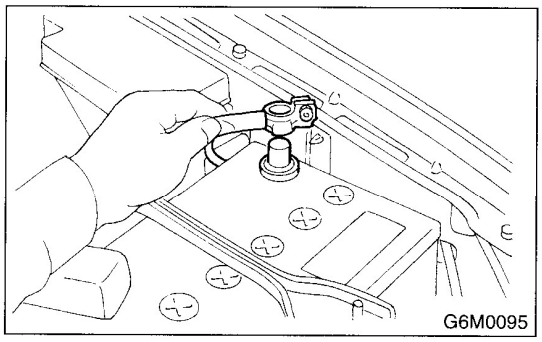
- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the negative terminal from battery.


GETtheMANUALS.org

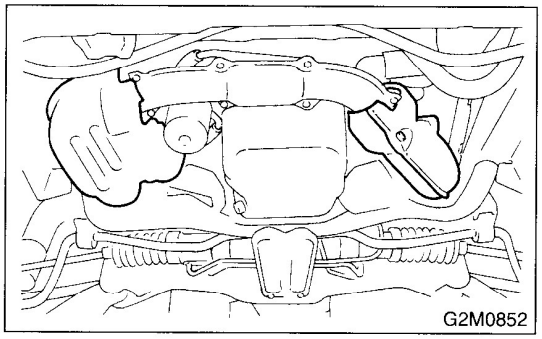
# 2. Front Exhaust Pipe

## A: REMOVAL

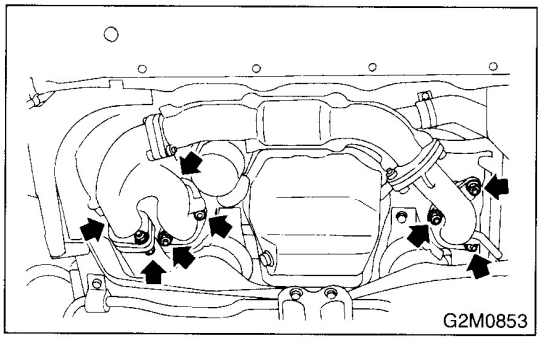
1) Disconnect the ground terminal from battery.


G6M0095

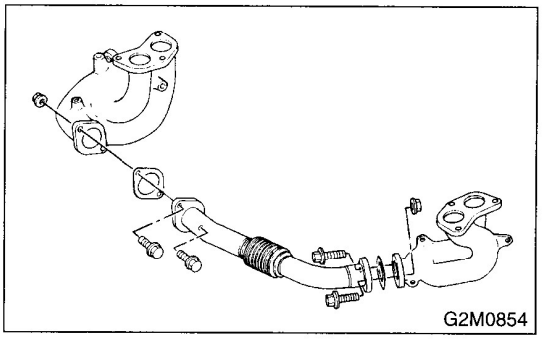
2) Remove the front oxygen (A/F) sensor. <Ref. to FU(DOHC TURBO)-42, REMOVAL, Front Oxygen (A/F) Sensor.>
3) Remove the under cover.
4) Remove the lower exhaust manifold cover (RH).
5) Remove the lower and upper exhaust manifold covers (LH).


G2M0852

6) Remove the bolts and nuts which hold the front exhaust pipe assembly to turbocharger joint pipe.
7) While holding the front exhaust pipe assembly with one hand, remove the nuts which hold the front exhaust pipe assembly to cylinder head exhaust port.


G2M0853

8) Remove the front exhaust pipe assembly.
9) Remove the covers from exhaust manifold and front exhaust pipe.
10) Separate the front exhaust pipe from exhaust manifolds.

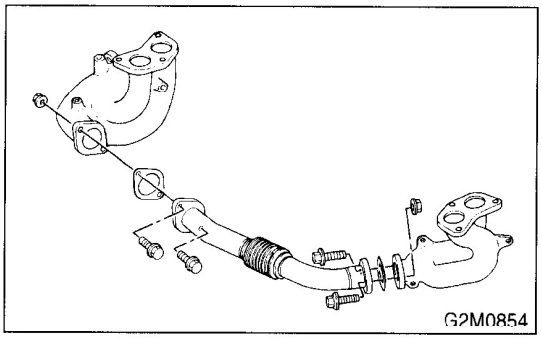

G2M0854

## B: INSTALLATION

**CAUTION:**
**Replace the gaskets with new ones.**

1) Assemble the front exhaust pipe and exhaust manifolds.

***Tightening torque:***
***35 N·m (3.6 kgf-m, 26.0 ft-lb)***


G2M0854

2) Install the front exhaust pipe covers.

***Tightening torque:***
***25 N·m (2.5 kgf-m, 18.1 ft-lb)***

3) Install the upper exhaust manifold cover (RH).

***Tightening torque:***
***19 N·m (1.9 kgf-m, 13.7 ft-lb)***

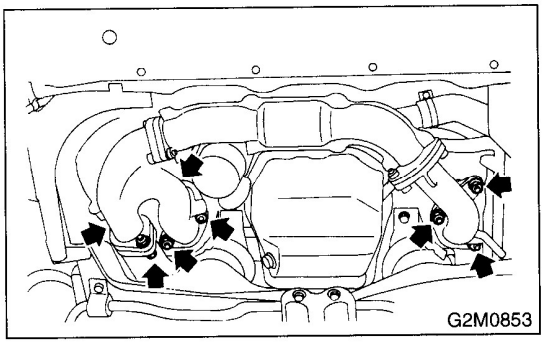
4) Install the front exhaust pipe assembly.

***Tightening torque:***
***35 N·m (3.6 kgf-m, 26.0 ft-lb)***


GETtheMANUALS.org

5) Connect the exhaust manifold (RH) to turbo-charger joint pipe.

***Tightening torque:***
***35 N·m (3.6 kgf-m, 26.0 ft-lb)***

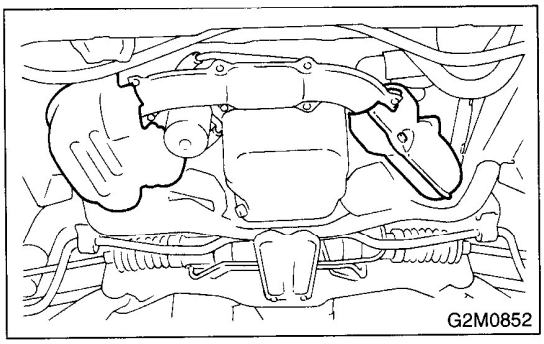



6) Install the upper and lower exhaust manifold covers (LH).

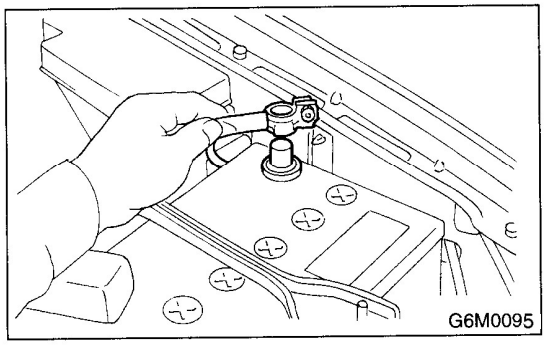
***Tightening torque:***
***19 N·m (1.9 kgf-m, 13.7 ft-lb)***

7) Install the lower exhaust manifold cover (RH).

***Tightening torque:***
***19 N·m (1.9 kgf-m, 13.7 ft-lb)***




8) Install the front oxygen (A/F) sensor. <Ref. to FU(DOHC TURBO)-43, INSTALLATION, Front Oxygen (A/F) Sensor.>
9) Install the under cover.
10) Connect the battery ground terminal to battery.



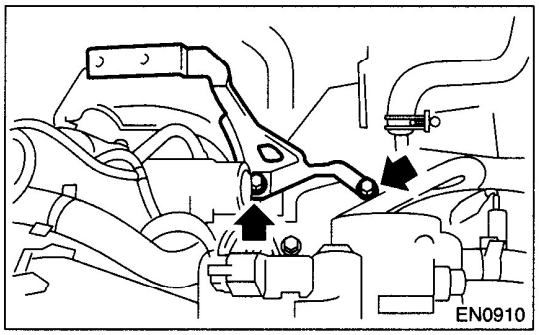


GETtheMANUALS.org

# 3. Center Exhaust Pipe

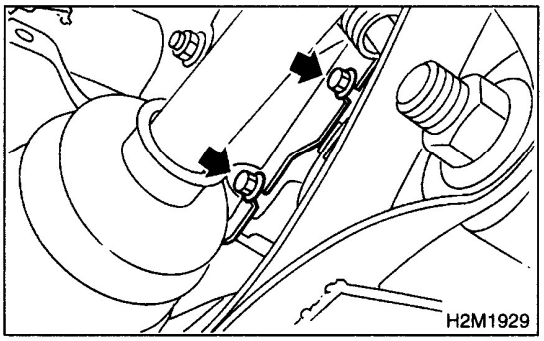
## A: REMOVAL

1) Set the vehicle on the lift.
2) Disconnect the ground terminal from battery.
3) Remove the intercooler. <Ref. to IN(DOHC TURBO)-10, REMOVAL, Intercooler.>
4) Remove the intercooler bracket.

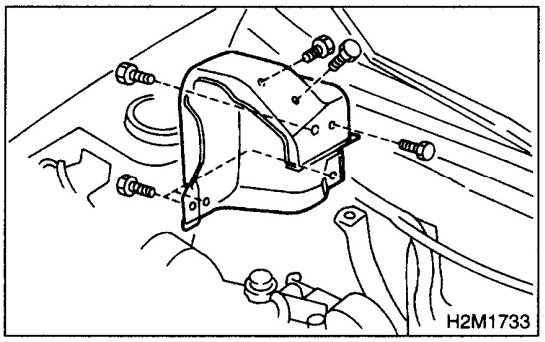



5) Lift-up the vehicle.
6) Remove the under cover.
7) Remove the bolts which install the lower side of turbocharger upper cover.

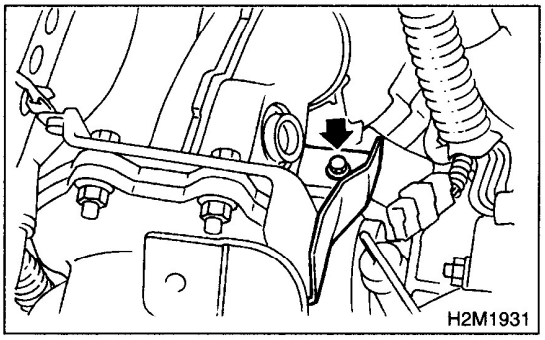
**CAUTION:**
**Be careful, the turbocharger and exhaust pipe are hot.**



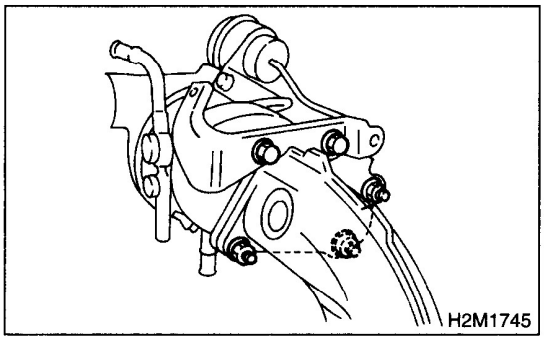

8) Lower the vehicle.
9) Remove the turbocharger upper cover.



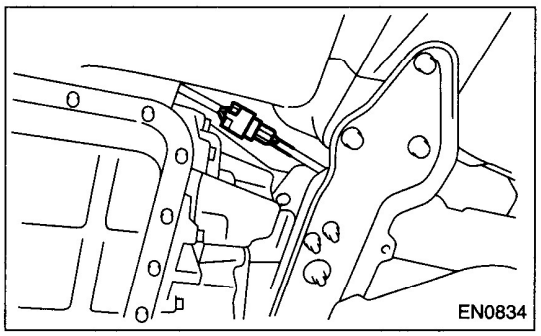

10) Remove the bolts which install the lower upper side of turbocharger upper cover, and remove it.



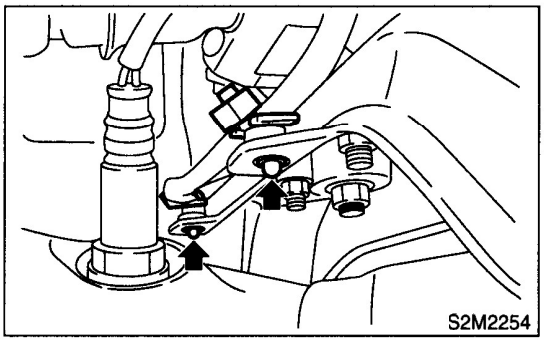

11) Separate the center exhaust pipe from turbocharger.




12) Lift-up the vehicle.
13) Disconnect the connector from rear oxygen sensor.



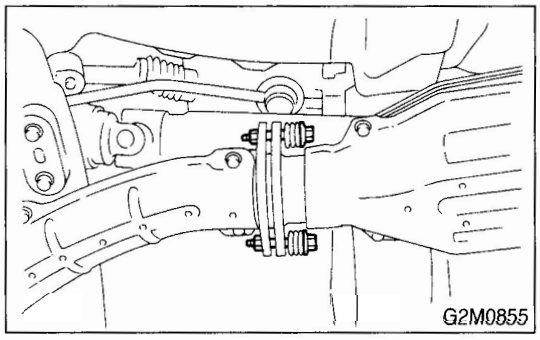

14) Vertically draw out clip from crossmember.



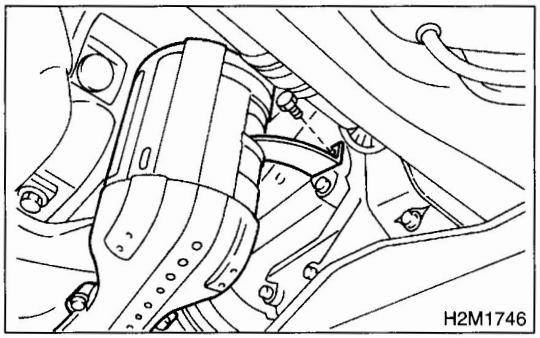


GETtheMANUALS.org

15) Separate the center exhaust pipe from rear exhaust pipe.

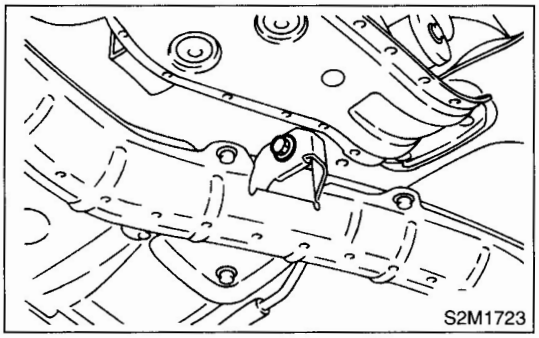



16) Remove the bolt which holds center exhaust pipe bracket to transmission.

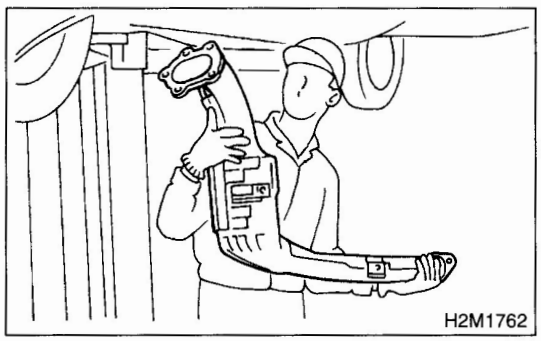



17) Remove the intercooler bracket.
18) Remove the bolt which holds center exhaust pipe to hanger bracket.

**CAUTION:**
**Be careful not to pull down the center exhaust pipe.**




19) Remove the center exhaust pipe.

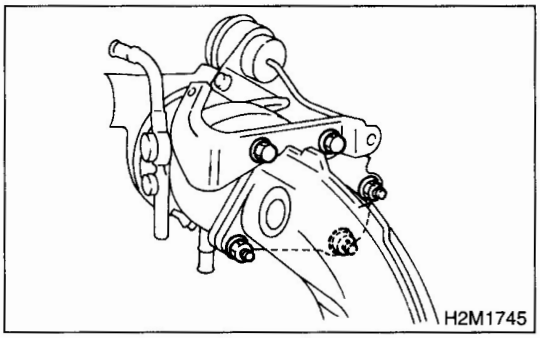



## B: INSTALLATION

**CAUTION:**
**Replace the gaskets with new ones.**

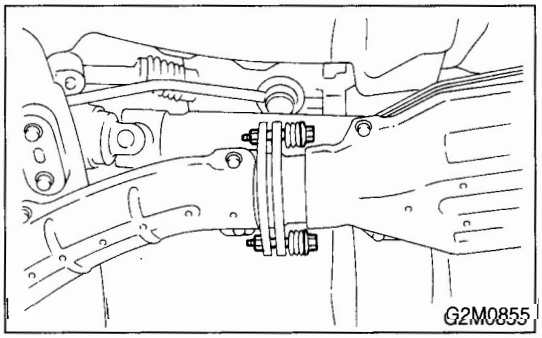
1) Install the center exhaust pipe and temporarily tighten the bolt which holds center exhaust pipe to hanger bracket.
2) Temporarily tighten the bolt which holds the center pipe to transmission.
3) Connect the center exhaust pipe to turbocharger.

***Tightening torque:***
***35 N·m (3.6 kgf-m, 26.0 ft-lb)***

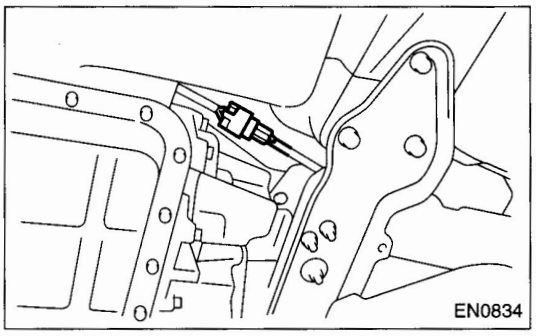



4) Install the center exhaust pipe to rear exhaust pipe.

***Tightening torque:***
***18 N·m (1.8 kgf-m, 13.0 ft-lb)***



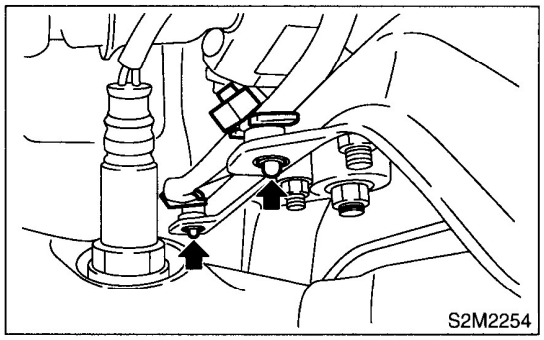

5) Connect the connector to rear oxygen sensor.





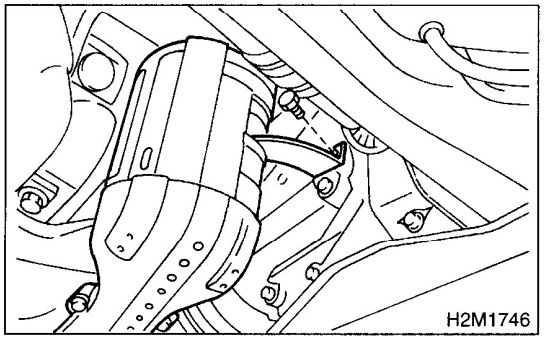
GETtheMANUALS.org

6) Secure clip on the crossmember.



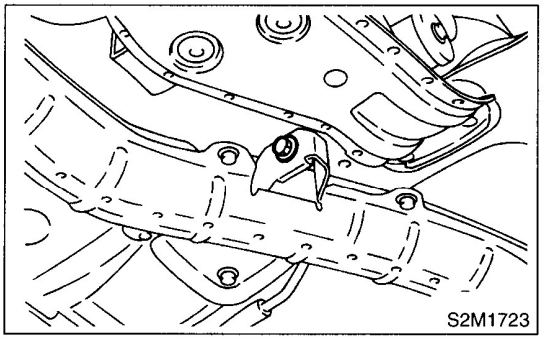

7) Tighten the bolt which holds the center exhaust pipe bracket to transmission.

***Tightening torque:***
***30 N·m (3.1 kgf-m, 22.4 ft-lb)***




8) Tighten the bolt which holds the center exhaust pipe to hanger bracket.

***Tightening torque:***
***35 N·m (3.6 kgf-m, 26.0 ft-lb)***



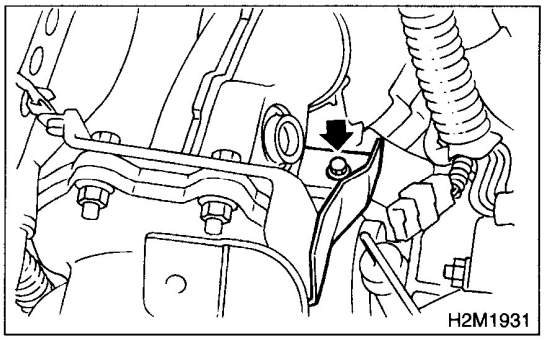

9) Tighten the bolts which hold the intercooler bracket.

***Tightening torque:***
***35 N·m (3.6 kgf-m, 26.0 ft-lb)***

10) Lower the vehicle.

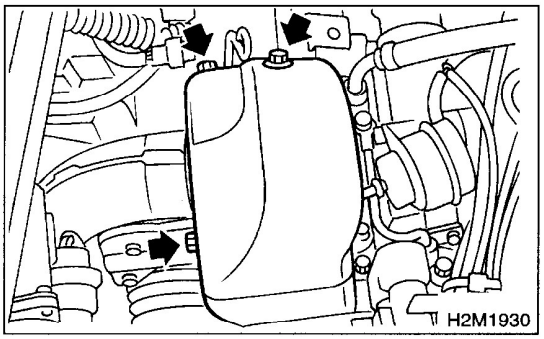
11) Place the turbocharger lower cover, and tighten the bolts which install the upper side of lower cover.

***Tightening torque:***
***7.4 N·m (0.75 kgf-m, 5.4 ft-lb)***



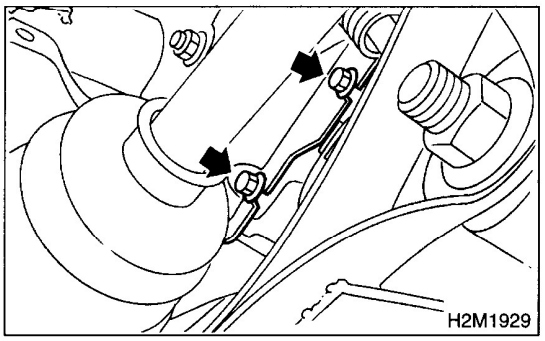

12) Place the turbocharger upper cover, and tighten the bolts which install the upper side of upper cover.

***Tightening torque:***
***7.4 N·m (0.75 kgf-m, 5.4 ft-lb)***




13) Lift-up the vehicle.
14) Tighten the bolts which install the under side of turbocharger upper cover.

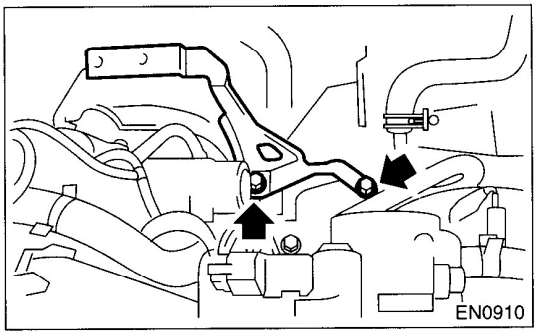
***Tightening torque:***
***7.4 N·m (0.75 kgf-m, 5.4 ft-lb)***




15) Install the under cover.
16) Lower the vehicle.


GETtheMANUALS.org

17) Install the intercooler bracket.



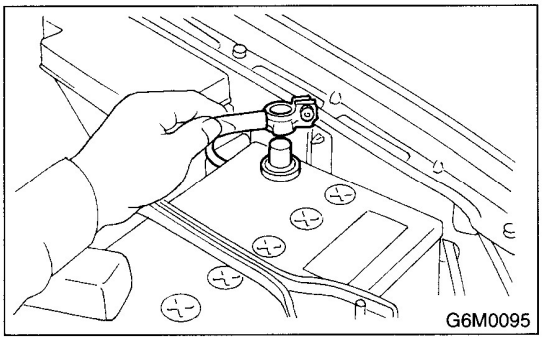

18) Install the intercooler. <Ref. to IN(DOHC TURBO)-11, INSTALLATION, Intercooler.>


GETtheMANUALS.org

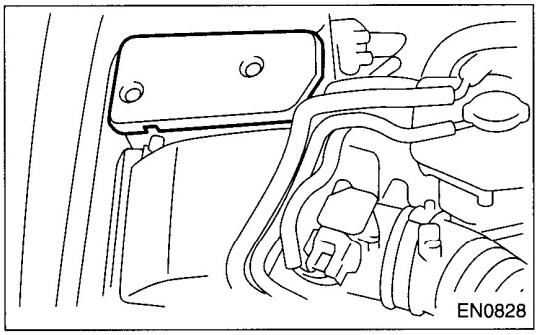
# 4. Joint Pipe

## A: REMOVAL

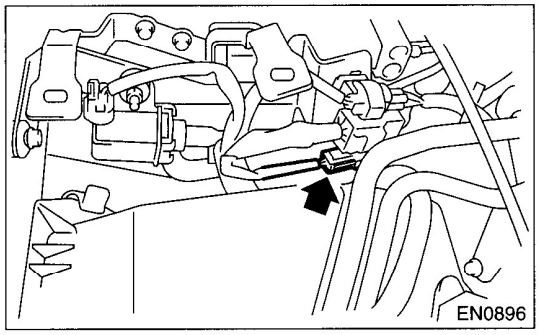
1) Disconnect the ground terminal from battery.



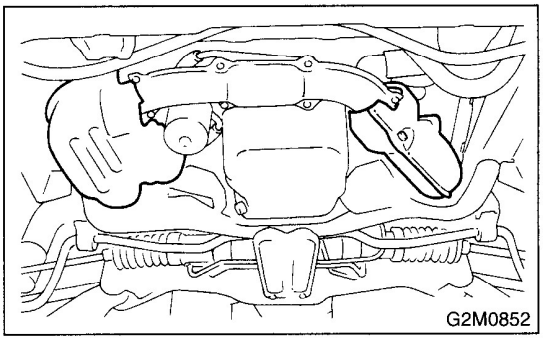

2) Remove the solenoid valve cover.



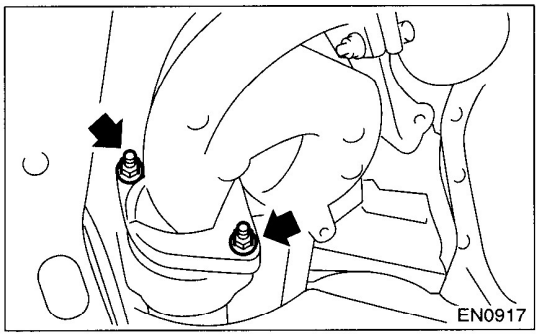

3) Disconnect the exhaust temperature sensor connector.




4) Remove the front oxygen (A/F) sensor. <Ref. to FU(DOHC TURBO)-42, REMOVAL, Front Oxygen (A/F) Sensor.>
5) Remove the under cover.
6) Remove the lower exhaust manifold cover (RH).




7) Remove the nuts which hold the front exhaust manifold to joint pipe.

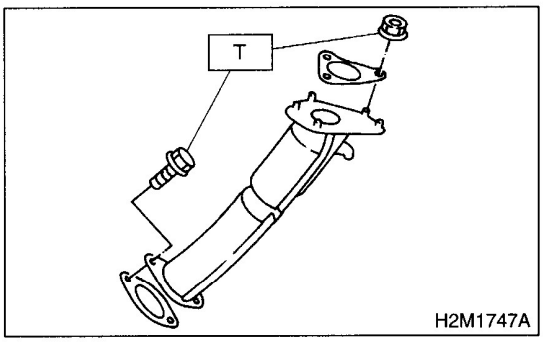



8) Remove the center exhaust pipe. <Ref. to EX(DOHC TURBO)-8, REMOVAL, Center Exhaust Pipe.>
9) Remove the turbocharger. <Ref. to IN(DOHC TURBO)-12, REMOVAL, Turbocharger.>
10) Take off the joint pipe in the upward direction.

## B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***T: 35 N·m (3.6 kgf-m, 26.0 ft-lb)***



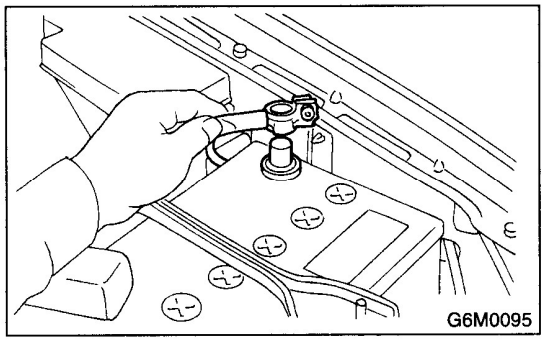


GETtheMANUALS.org

# 5. Rear Exhaust Pipe

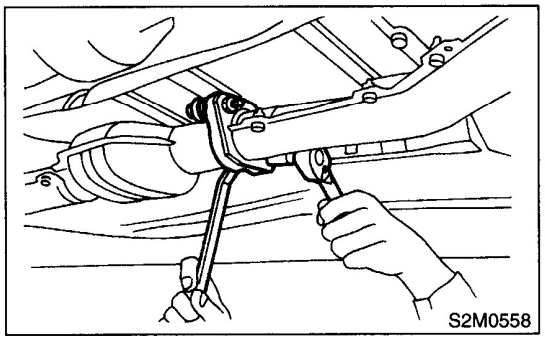
## A: REMOVAL

1) Disconnect the ground terminal from battery.



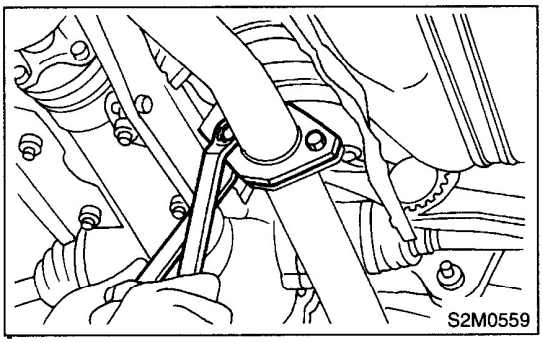

2) Lift up the vehicle.
3) Separate the rear exhaust pipe from center exhaust pipe.

**CAUTION:**
**Be careful, the exhaust pipe is hot.**




4) Separate the rear exhaust pipe from muffler.

**CAUTION:**
**Be careful not to pull down the rear exhaust pipe.**



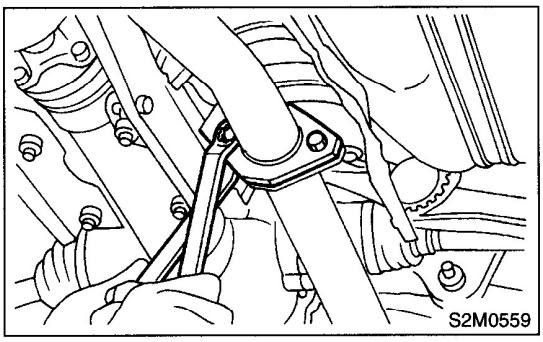

5) Remove the rear exhaust pipe.

## B: INSTALLATION

**CAUTION:**
**Replace the gaskets with new ones.**

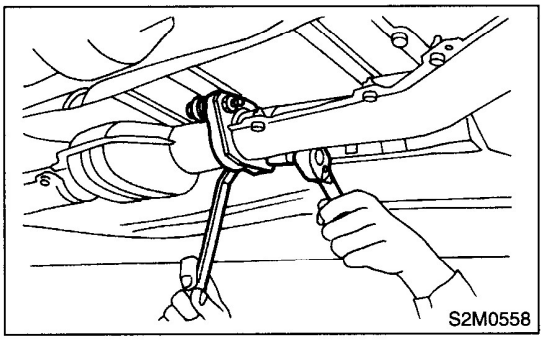
1) Install the rear exhaust pipe to muffler.

***Tightening torque:***
***48 N·m (4.9 kgf-m, 35.4 ft-lb)***

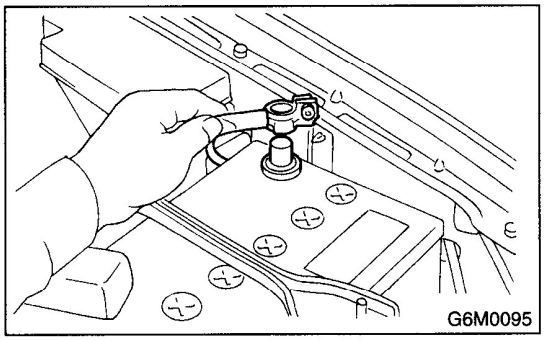



2) Install the rear exhaust pipe to center exhaust pipe.

***Tightening torque:***
***18 N·m (1.8 kgf-m, 13.0 ft-lb)***




3) Lower the vehicle.
4) Connect the battery ground terminal to battery.




## C: INSPECTION

1) Make sure there are no exhaust leaks from connections and welds.
2) Make sure there are no holes or rusting.
3) Make sure the cushion rubber is not worn or cracked.

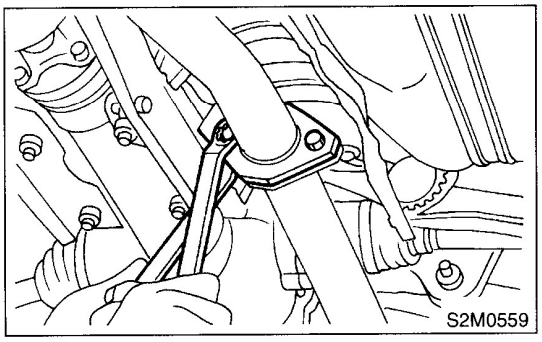

GETtheMANUALS.org

# 6. Muffler

## A: REMOVAL

1) Separate the muffler from rear exhaust pipe.

**CAUTION:**
**Be careful, the exhaust pipe is hot.**

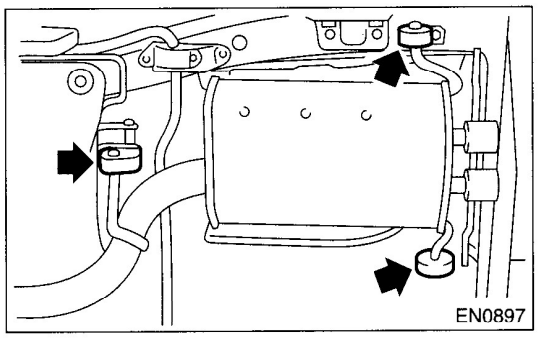



2) Remove the rubber cushions, and detach muffler.

**CAUTION:**
**Be careful not to drop the muffler during removal.**

NOTE:
To facilitate removal, apply a coat of SUBARU CRC to the mating area of rubber cushions in advance.

***SUBARU CRC (Part No. 004301003)***

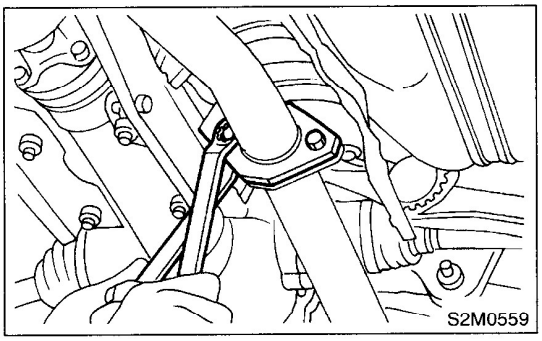



## B: INSTALLATION

1) Install in the reverse order of removal.

**CAUTION:**
**Replace the gasket with a new one.**

***Tightening torque:***
***48 N·m (4.9 kgf-m, 35.4 ft-lb)***




## C: INSPECTION

1) Make sure there are no exhaust leaks from connections and welds.
2) Make sure there are no holes or rusting.
3) Make sure the cushion rubber is not worn or cracked.


GETtheMANUALS.org

# IGNITION

# IG(DOHC TURBO)


Page

1. General Description ..... 2
2. Spark Plug ..... 4
3. Ignition Coil and Ignitor Assembly ..... 8


GETtheMANUALS.org

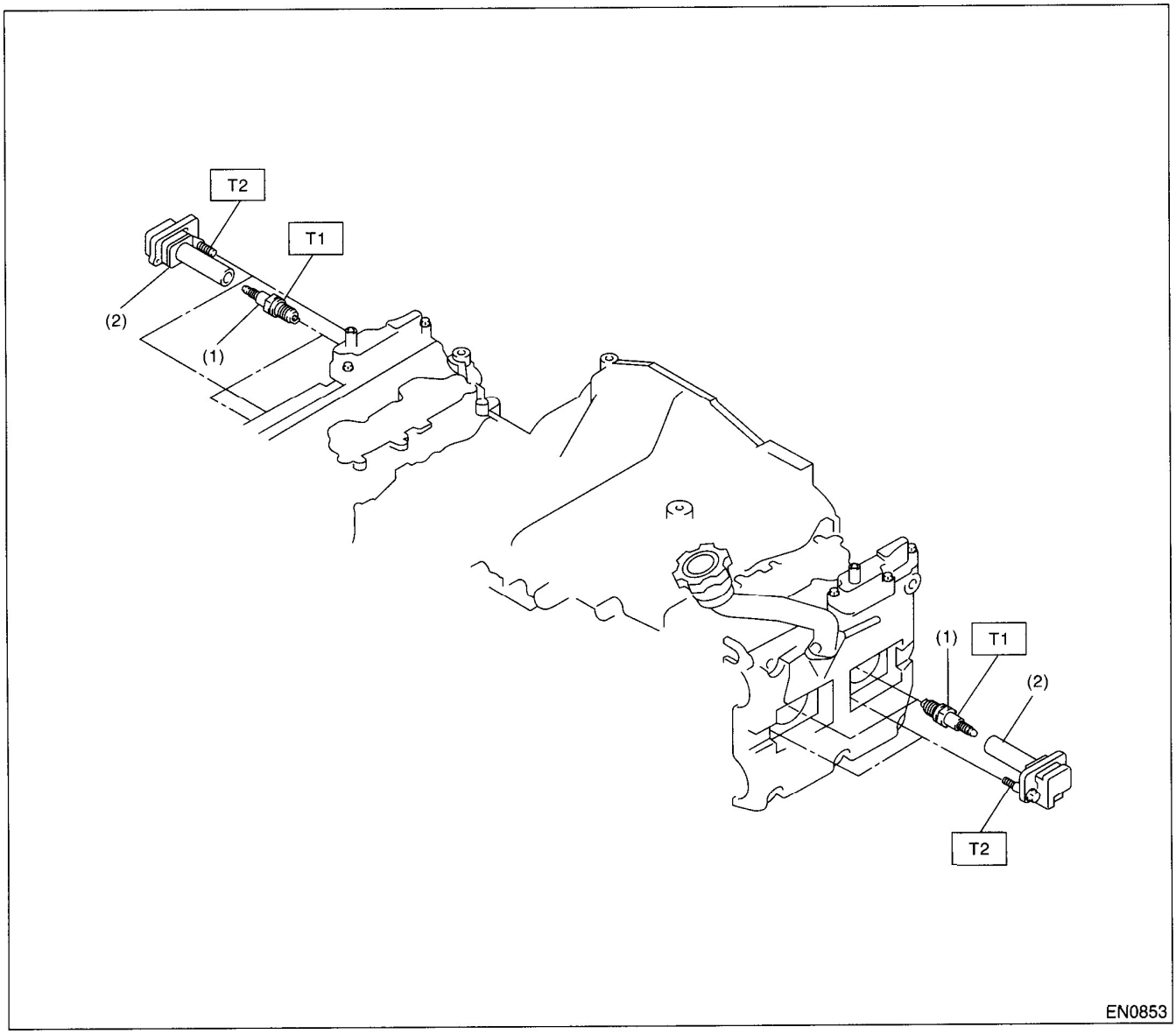
# 1. General Description

## A: SPECIFICATIONS

| Item | | | Designation |
|---|---|---|---|
| Ignition coil and ignitor assembly | Model | | FK0140 |
| | Manufacturer | | DIAMOND |
| Spark plug | Type and manufacturer | | PFR6G: NGK |
| | Thread size | mm | 14, P = 1.25 |
| | Spark gap | mm (in) | 0.7 — 0.8 (0.028 — 0.031) |


GETtheMANUALS.org

## B: COMPONENT




(1) Spark plug
(2) Ignition coil and ignitor ASSY

***Tightening torque: N·m (kgf-m, ft-lb)***
***T1: 21 (2.1, 15)***
***T2: 16 (1.6, 11.7)***

## C: CAUTION

- Wear working clothing, including a cap, protective goggles, and protective shoes during operation.
- Remove contamination including dirt and corrosion before removal, installation or disassembly.
- Keep the disassembled parts in order and protect them from dust or dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly, and replacement.
- Be careful not to burn your hands, because each part on the vehicle is hot after running.
- Be sure to tighten fasteners including bolts and nuts to the specified torque.
- Place shop jacks or safety stands at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the negative terminal from battery.

GETU MANUALS.org

# 2. Spark Plug

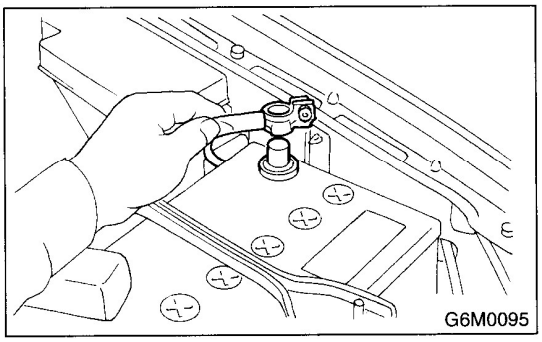
## A: REMOVAL

**CAUTION:**
**All spark plugs installed on an engine, must be of the same heat range.**

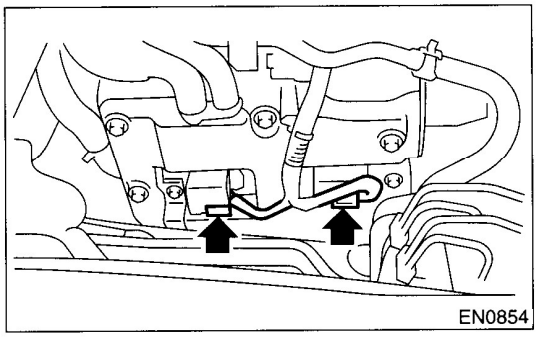
***Spark plug:***
***NGK: PFR6G***

### 1. RH SIDE

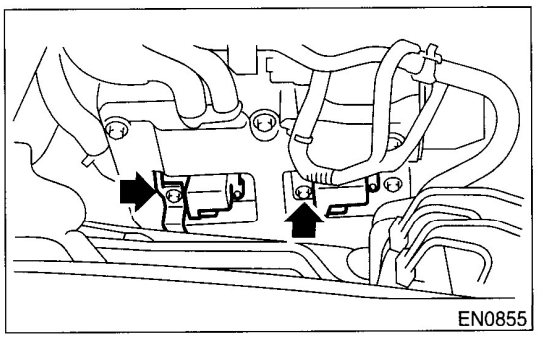
1) Disconnect the ground terminal from battery.



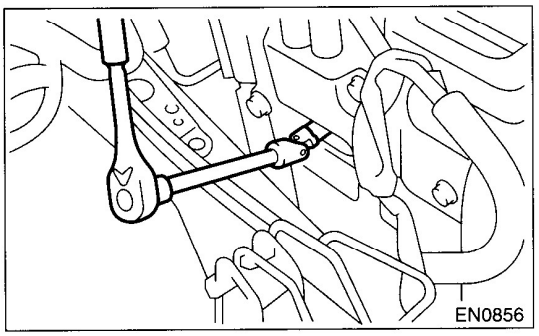

2) Remove the air cleaner lower case. <Ref. to IN(DOHC TURBO)-7, REMOVAL, Air Cleaner.>
3) Disconnect the connector from ignition coil.




4) Remove the ignition coil.

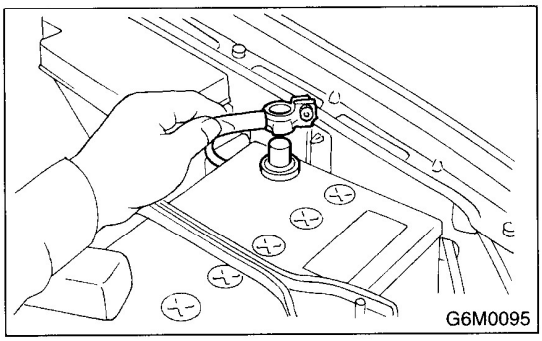



5) Remove the spark plugs with the spark plug sockets.

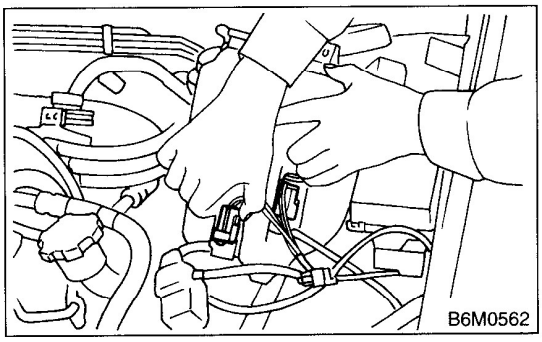



### 2. LH SIDE

1) Disconnect the battery terminals, and then remove the battery and battery carrier.



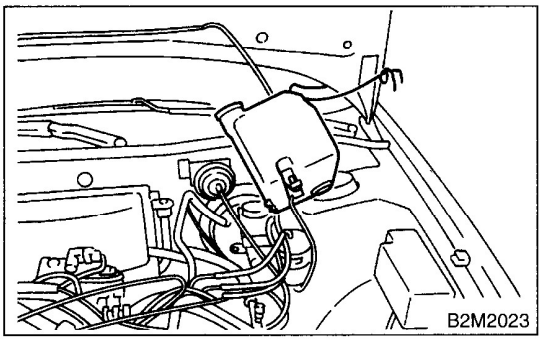

2) Disconnect the washer motor connector.



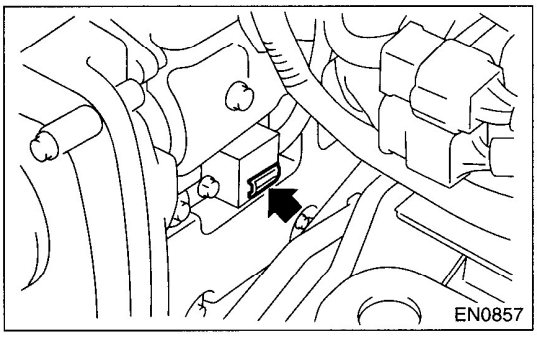

3) Disconnect the rear window glass washer hose from washer motor, then plug connection with a suitable cap.


GETtheMANUALS.org

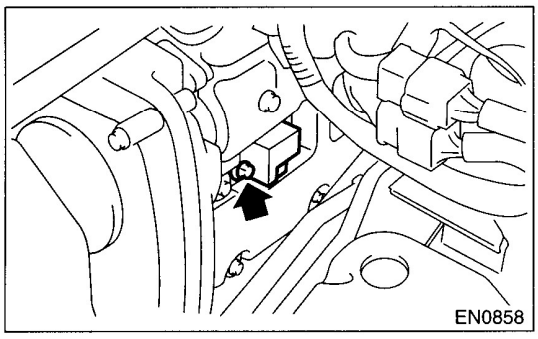
4) Remove the two bolts which hold the washer tank, then take the tank away from the working area.



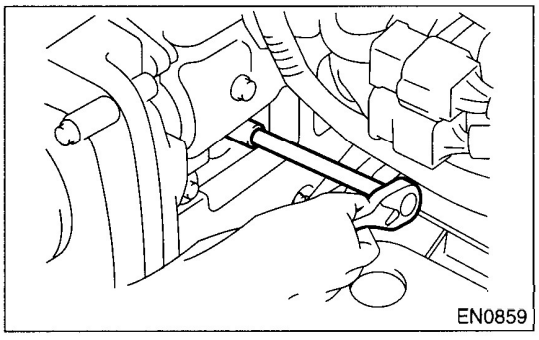

5) Disconnect the connector from ignition coil.




6) Remove the ignition coil.




7) Remove the spark plug with the spark plug sockets.




## B: INSTALLATION

### 1. RH SIDE

1) Install in the reverse order of removal.

***Tightening torque (Spark plug):***
***21 N·m (2.1 kgf-m, 15 ft-lb)***

***Tightening torque (Ignition coil):***
***16 N·m (1.63 kgf-m, 11.8 ft-lb)***

**CAUTION:**
**The above torque should be only applied to new spark plugs without oil on their threads. In case their threads are lubricated, the torque should be reduced by approximately 1/3 of the specified torque in order to avoid over-stressing.**

### 2. LH SIDE

1) Install in the reverse order of removal.

***Tightening torque (Spark plug):***
***21 N·m (2.1 kgf-m, 15 ft-lb)***

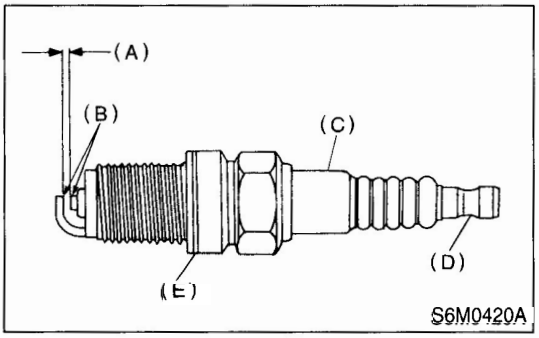
***Tightening torque (Ignition coil):***
***16 N·m (1.63 kgf-m, 11.8 ft-lb)***

**CAUTION:**
**The above torque should be only applied to new spark plugs without oil on their threads. In case their threads are lubricated, the torque should be reduced by approximately 1/3 of the specified torque in order to avoid over-stressing.**


GETtheMANUALS.org

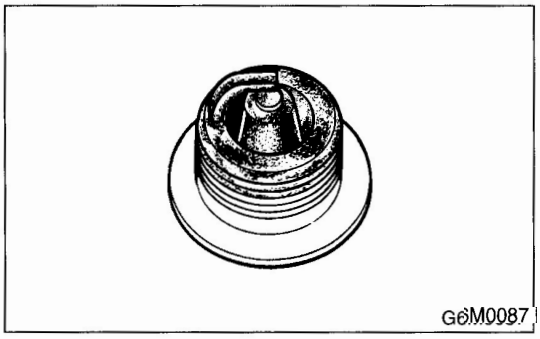
## C: INSPECTION

Check the electrodes and inner and outer porcelain of plugs, noting the type of deposits and the degree of electrode erosion.

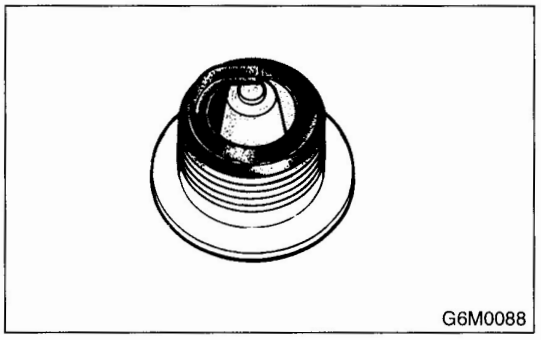



(A) Electrode gap
(B) Carbon accumulation or wear
(C) Cracks
(D) Damage
(E) Damaged gasket

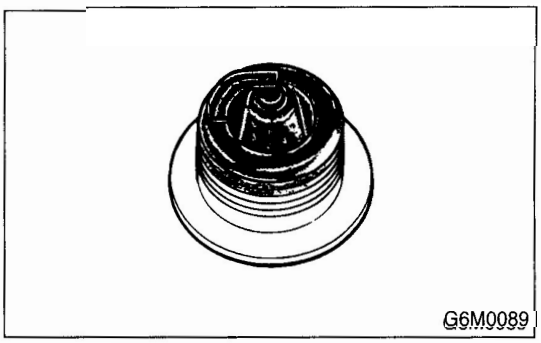
1) Normal:
Brown to grayish-tan deposits and slight electrode wear indicate correct spark plug heat range.



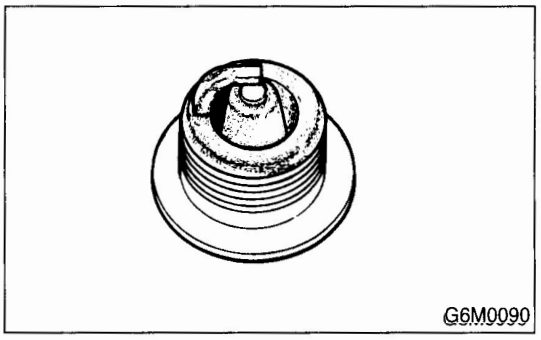

2) Carbon fouled:
Dry fluffy carbon deposits on insulator and electrode are mostly caused by slow speed driving in city, weak ignition, too rich fuel mixture, dirty air cleaner, etc.
It is advisable to replace with plugs having hotter heat range.




3) Oil fouled:
Wet black deposits show excessive oil entrance into combustion chamber through worn rings and pistons or excessive clearance between valve guides and stems. If the same condition remains after repair, use a hotter plug.




4) Overheating:
White or light gray insulator with black or gray brown spots and bluish burnt electrodes indicate engine overheating. Moreover, the appearance results from incorrect ignition timing, loose spark plugs, wrong selection of fuel, hotter range plug, etc. It is advisable to replace with plugs having colder heat range.



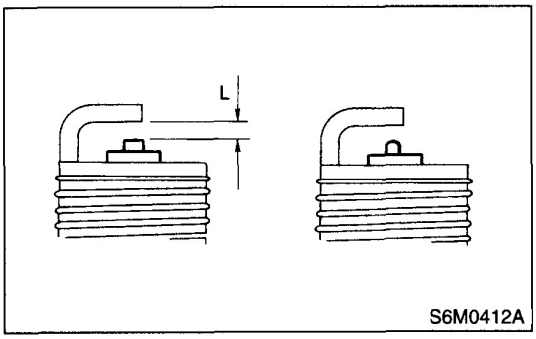


GETtheMANUALS.org

## D: ADJUSTMENT

Clean the spark plugs in a sand blast type cleaner. Avoid excessive blasting. Clean and remove the carbon or oxide deposits, but do not wear away porcelain.
If deposits are too stubborn, replace the plugs.
After cleaning the spark plugs, recondition the firing surface of electrodes with file. Then correct the spark plug gap using a gap gauge.

***Spark plug gap: L***
***0.7 — 0.8 mm (0.028 — 0.031 in)***




NOTE:
Replace with a new spark plug if this area is worn to "ball" shape.


GETtheMANUALS.org

## 3. Ignition Coil and Ignitor Assembly

### A: REMOVAL

Direct ignition type has been adopted.
Refer to the "Spark Plug Removal" for removal procedure. <Ref. to IG(DOHC TURBO)-4, REMOVAL, Spark Plug.>

### B: INSTALLATION

Install in the reverse order of removal.

***Tightening torque:***
***16 N·m (1.63 kgf-m, 11.8 ft-lb)***

### C: INSPECTION

Ignitor is integrated with the coil. Therefore resistance cannot be measured.


GETtheMANUALS.org