

ENGINE SECTION 1

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

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

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

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

FUEL INJECTION (FUEL SYSTEMS) FU(H4SO 2.0)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES) EC(H4SO 2.0)

INTAKE (INDUCTION) IN(H4SO 2.0)

MECHANICAL ME(H4SO 2.0)

EXHAUST EX(H4SO 2.0)

COOLING CO(H4SO 2.0)

LUBRICATION LU(H4SO 2.0)

SPEED CONTROL SYSTEMS SP(H4SO 2.0)

IGNITION IG(H4SO 2.0)

STARTING/CHARGING SYSTEMS SC(H4SO 2.0)

**ENGINE (DIAGNOSTICS) EN(H4SO 2.0)
(diag)**

FUEL INJECTION (FUEL SYSTEMS) FU(H4SO 2.5)

EMISSION CONTROL (AUX. EMISSION CONTROL DEVICES) EC(H4SO 2.5)

INTAKE (INDUCTION) IN(H4SO 2.5)

MECHANICAL ME(H4SO 2.5)

EXHAUST EX(H4SO 2.5)

COOLING CO(H4SO 2.5)

ENGINE SECTION 1

LUBRICATION

LU(H4SO 2.5)

SPEED CONTROL SYSTEMS

SP(H4SO 2.5)

IGNITION

IG(H4SO 2.5)

STARTING/CHARGING SYSTEMS

SC(H4SO 2.5)

ENGINE (DIAGNOSTICS)

EN(H4SO 2.5)
(diag)

COOLING

CO(*H4SO 2.0*)

	Page
1. General Description	2
2. Radiator Fan System	7
3. Engine Coolant.....	13
4. Water Pump	15
5. Thermostat	18
6. Radiator.....	20
7. Radiator Cap	24
8. Radiator Main Fan and Fan Motor	25
9. Radiator Sub Fan and Fan Motor.....	27
10. Reservoir Tank.....	29
11. Engine Cooling System Trouble in General	30

General Description

COOLING

1. General Description

A: SPECIFICATION

Cooling system		Electric fan + Forced engine coolant circulation system		
Total engine coolant capacity		ℓ (US qt, Imp qt)	MT: approx. 6.5 (6.9, 5.7) AT: approx. 6.4 (6.8, 5.6) (Model without ATF warmer) AT: approx. 6.8 (7.1, 6.0) (Model with ATF warmer)	
Water pump	Type		Centrifugal impeller type	
	Discharge performance I	Discharge ℓ (US gal, Imp gal) /min	20 (5.3, 4.4)	
		Pump speed — Discharge pressure	760 rpm — 2.9 kPa (0.3 mAq)	
		Engine coolant temperature	85°C (185°F)	
	Discharge performance II	Discharge ℓ (US gal, Imp gal) /min	100 (26.4, 22.0)	
		Pump speed — Discharge pressure	3,000 rpm — 49.0 kPa (5.0 mAq)	
		Engine coolant temperature	85°C (185°F)	
	Discharge performance III	Discharge ℓ (US gal, Imp gal) /min	200 (52.8, 44.0)	
		Pump speed — Discharge pressure	6,000 rpm — 225.4 kPa (23.0 mAq)	
		Engine coolant temperature	85°C (185°F)	
	Impeller diameter		mm (in)	76 (2.99)
Number of impeller vanes			8	
Pump pulley diameter		mm (in)	60 (2.36)	
Clearance between impeller and case		Standard mm (in)	0.5 — 1.5 (0.020 — 0.06)	
Thermostat	Type		Wax pellet type	
	Starting temperature to open		80 — 84°C (176 — 183°F)	
	Fully opens		95°C (203°F)	
	Valve lift		mm (in)	9.0 (0.354) or more
	Valve bore		mm (in)	35 (1.38)
Radiator fan	Motor input	Main fan	90 W	
		Sub fan	90 W	
	Fan diameter / Blades	Main fan	300 mm (11.81 in) /4	
		Sub fan	300 mm (11.81 in) /5	
Radiator	Type		Down flow, pressure type	
	Core dimensions	Width × Height × Thickness mm (in)	687.4 × 340 × 16 (27.06 × 13.39 × 0.63)	
	Pressure range in which cap valve is open		kPa (kg/cm ² , psi) Above: 108±15, or more (1.1±0.15, 16±2) Below: -1.0 — -4.9, or less (-0.01 — -0.05, -0.1 — -0.7)	
	Fins		Corrugated fin type	
Reservoir tank	Capacity	ℓ (US qt, Imp qt)	0.45 (0.48, 0.40)	

General Description

COOLING

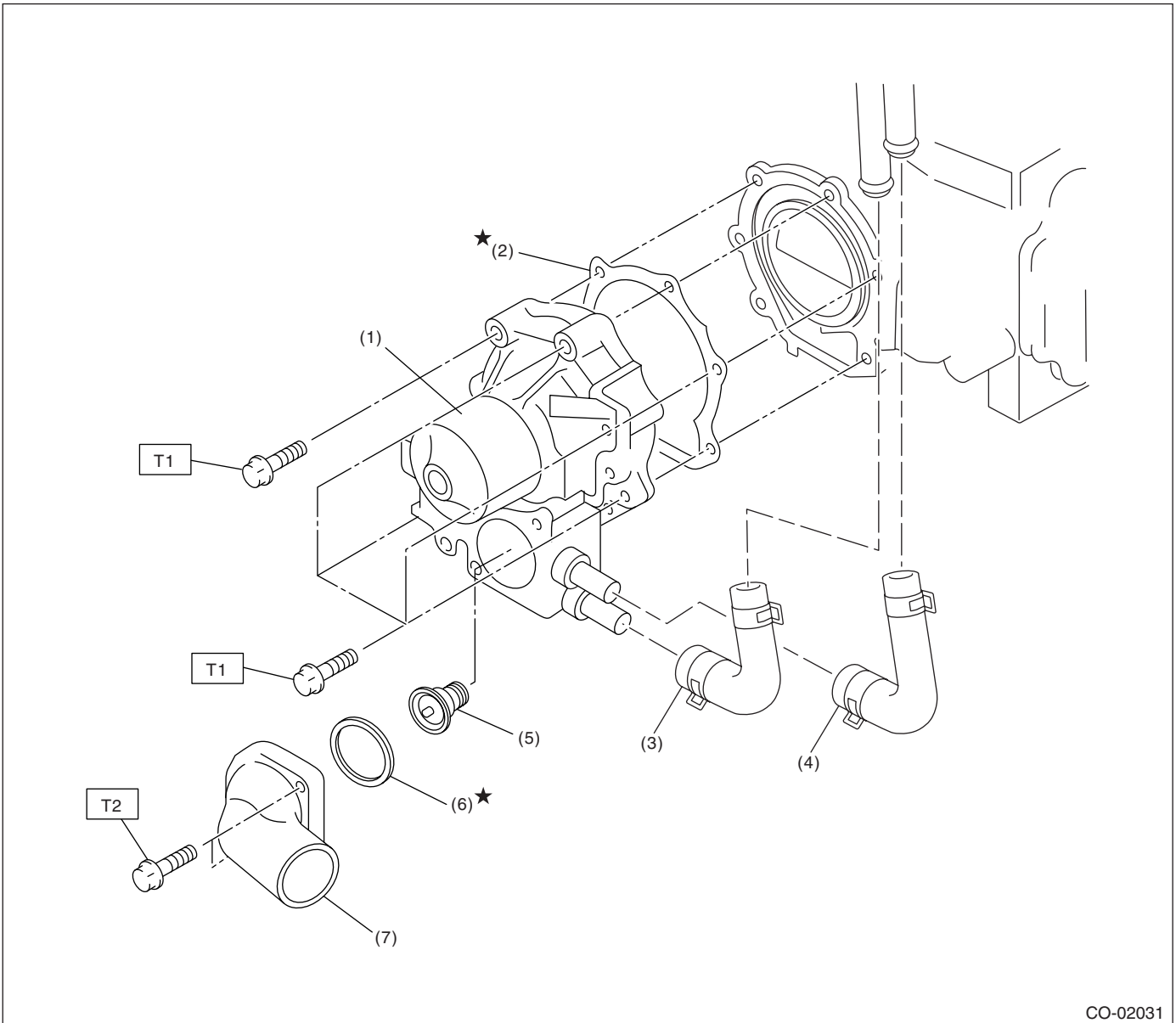
Vehicle speed	A/C compressor load	Engine coolant temperature		
		95°C (203°F) or less	96 — 99°C (203 — 210°F)	100°C (212°F) or more
		Operation of radiator fan	Operation of radiator fan	Operation of radiator fan
19 km/h (12 MPH) or less	OFF	OFF	Low-Speed	High-Speed
	Low	Low-Speed	Low-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
20 — 69 km/h (12 — 43 MPH)	OFF	OFF	Low-Speed	High-Speed
	Low	High-Speed	High-Speed	High-Speed
	High	High-Speed	High-Speed	High-Speed
70 — 105 km/h (43 — 65 MPH)	OFF	OFF	Low-Speed	High-Speed
	Low	OFF	Low-Speed	High-Speed
	High	Low-Speed	High-Speed	High-Speed
106 km/h (66 MPH) or more	OFF	OFF	OFF	High-Speed
	Low	OFF	Low-Speed	High-Speed
	High	OFF	Low-Speed	High-Speed

General Description

COOLING

B: COMPONENT

1. WATER PUMP



CO-02031

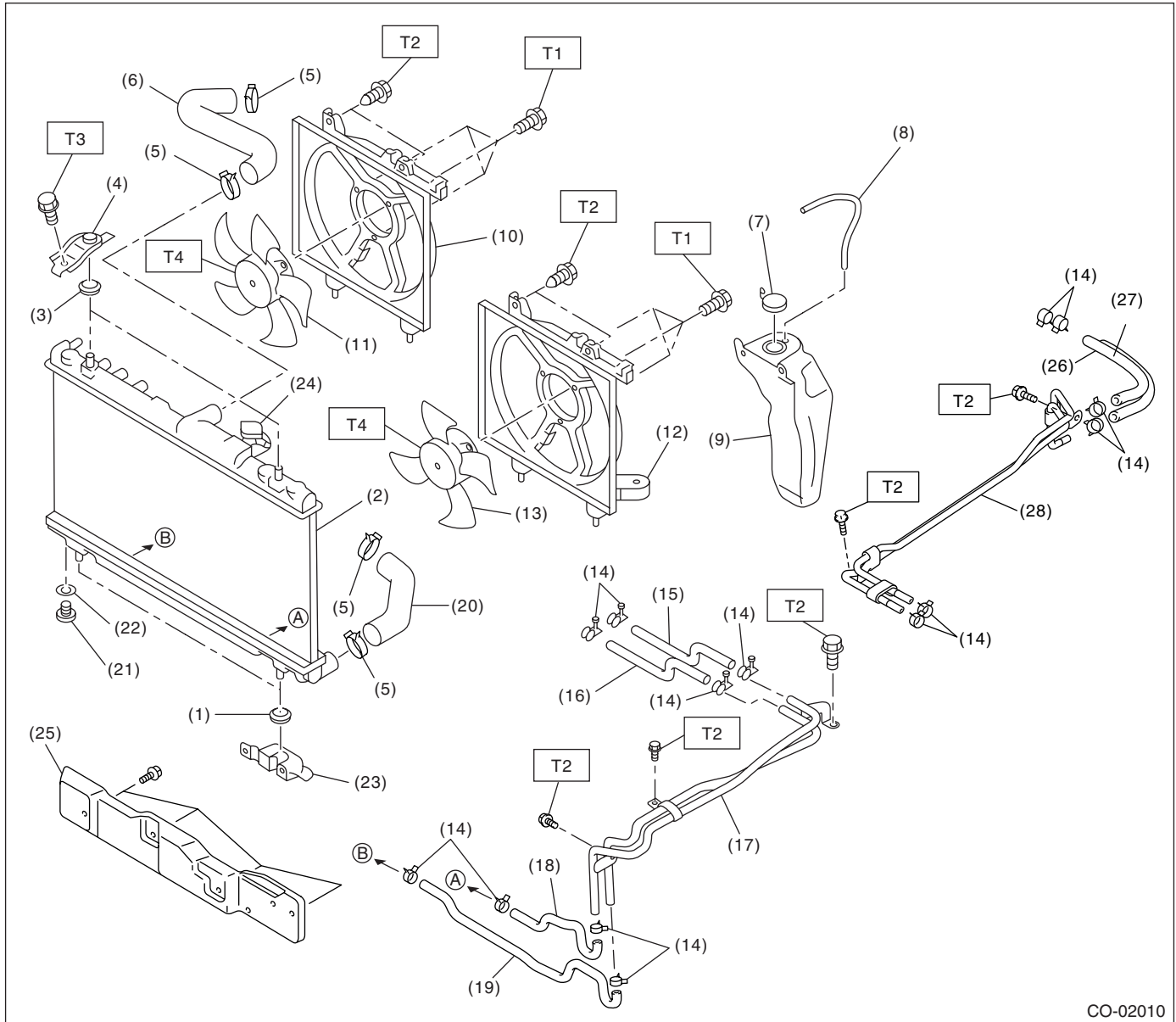
- | | |
|---|----------------------|
| (1) Water pump ASSY | (5) Thermostat |
| (2) Gasket | (6) Gasket |
| (3) Heater by-pass hose | (7) Thermostat cover |
| (4) ATF warmer by-pass hose (Model with ATF warmer) | |

Tightening torque: N·m (kgf·m, ft·lb)

**T1: First 12 (1.2, 8.7)
Second 12 (1.2, 8.7)**

T2: 12 (1.2, 8.7)

2. RADIATOR AND RADIATOR FAN



CO-02010

(1) Radiator lower cushion	(14) ATF hose clamp (AT model)	(24) Radiator cap
(2) Radiator	(15) ATF inlet hose A (Model without ATF warmer)	(25) Heat shield cover (Model without ATF warmer)
(3) Radiator upper cushion	(16) ATF outlet hose A (Model without ATF warmer)	(26) ATF inlet hose A (Model with ATF warmer)
(4) Radiator upper bracket	(17) ATF pipe (Model without ATF warmer)	(27) ATF outlet hose A (Model without ATF warmer)
(5) Clamp	(18) ATF outlet hose B (Model without ATF warmer)	(28) ATF pipe (Model with ATF warmer)
(6) Radiator inlet hose	(19) ATF inlet hose B (Model without ATF warmer)	
(7) Engine coolant reservoir tank cap	(20) Radiator outlet hose	
(8) Over flow hose	(21) Radiator drain plug	
(9) Engine coolant reservoir tank	(22) O-ring	
(10) Radiator sub fan shroud	(23) Radiator lower bracket	
(11) Radiator sub fan, radiator sub fan motor assembly		
(12) Radiator main fan shroud		
(13) Radiator main fan, radiator main fan motor assembly		

Tightening torque: N·m (kgf·m, ft·lb)

T1: 4.4 (0.45, 3.3)

T2: 7.5 (0.76, 5.5)

T3: 12 (1.2, 8.9)

T4: 3.4 (0.35, 2.5)

General Description

COOLING

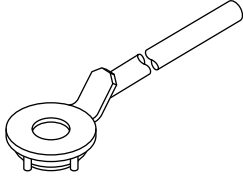
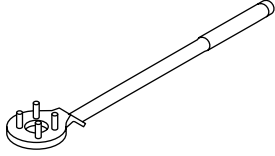
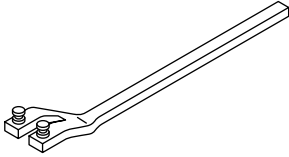
C: CAUTION

- Wear work 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 and dirt.
- Before removal, installation or disassembly, be sure to clarify the failure. Avoid unnecessary removal, installation, disassembly and replacement.

- Be careful not to burn yourself, 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 rigid racks at the specified points.
- Before disconnecting electrical connectors of sensors or units, be sure to disconnect the ground cable from battery.

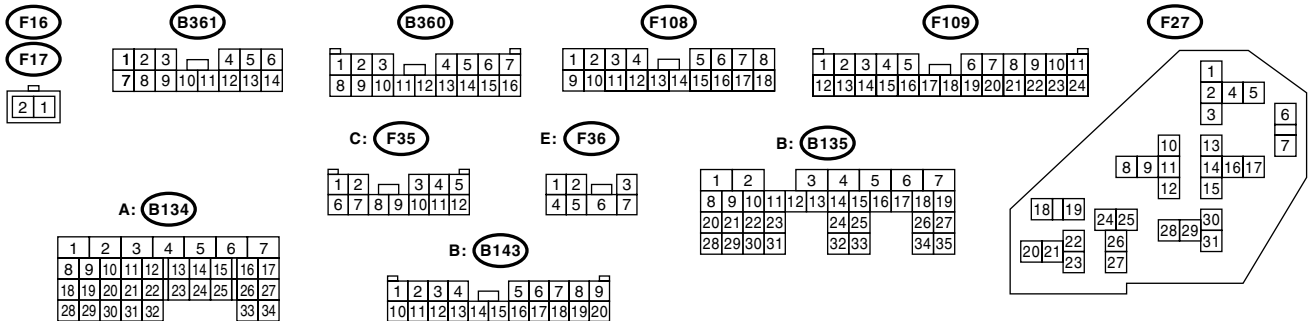
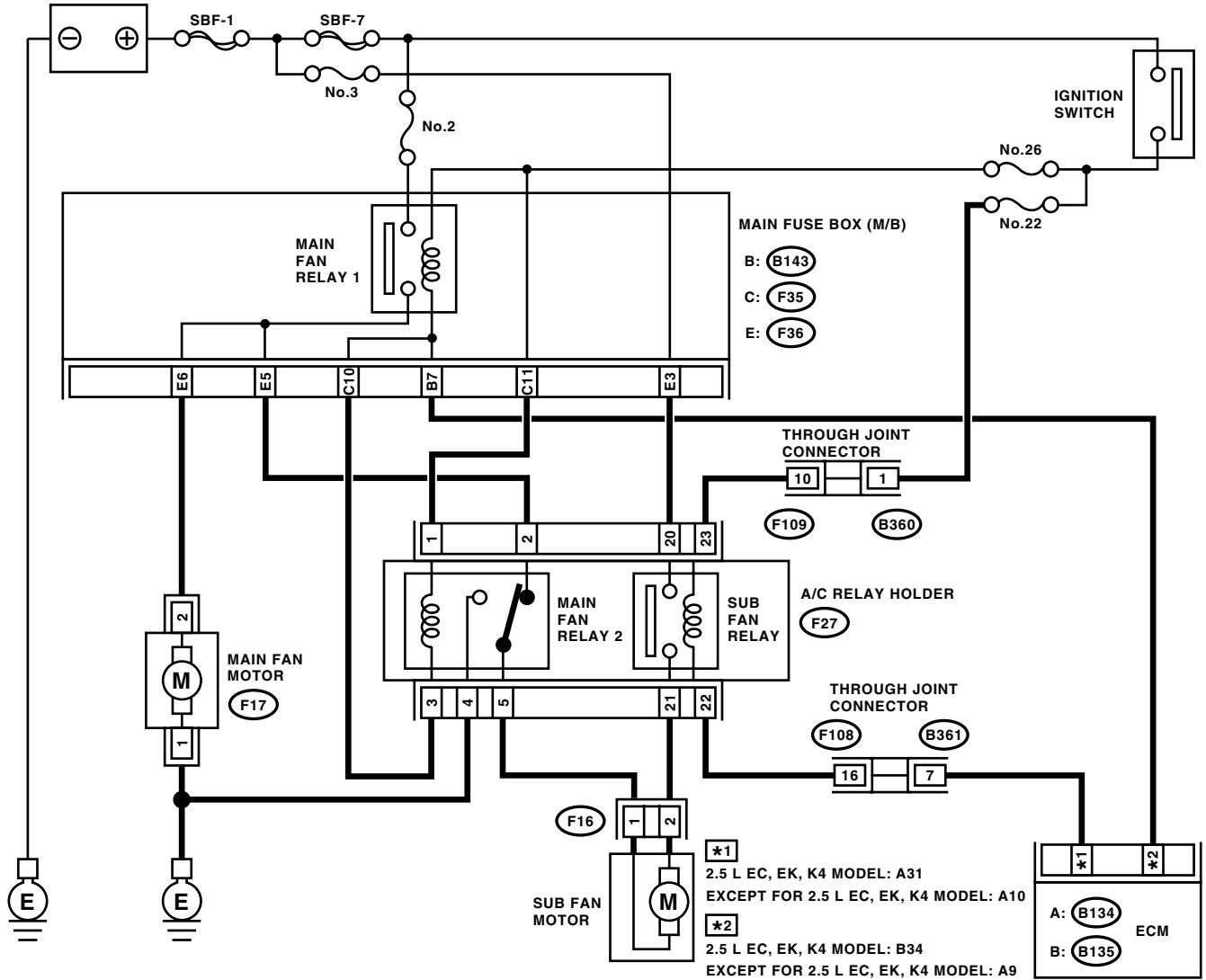
D: PREPARATION TOOL

1. SPECIAL TOOL

ILLUSTRATION	TOOL NUMBER	DESCRIPTION	REMARKS
 ST-499977400	499977400	CRANK PULLEY WRENCH	Used for stopping rotation of crank pulley when loosening/tightening crank pulley bolt. (2.0 L model)
 ST-499977100	499977100	CRANK PULLEY WRENCH	Used for stopping rotation of crank pulley when loosening/tightening crank pulley bolt. (2.5 L model)
 ST18231AA010	18231AA010	CAM SPROCKET WRENCH	<ul style="list-style-type: none"> • Used for removing and installing cam sprocket. • CAM SPROCKET WRENCH (499207100) can also be used.

2. Radiator Fan System

A: WIRING DIAGRAM



CO-02011

Radiator Fan System

COOLING

B: INSPECTION

DETECTING CONDITION:

- Engine coolant temperature is more than 96°C (205°F).
- Vehicle speed is below 19 km/h (12 MPH).

TROUBLE SYMPTOMS:

Radiator main and sub fan do not rotate under the above conditions.

	Step	Check	Yes	No
1	<p>CHECK OPERATION OF RADIATOR FAN.</p> <ol style="list-style-type: none"> 1) Connect the test mode connector. 2) Turn the ignition switch to ON. 3) Perform the compulsory operation check for the radiator fan relay using Subaru Select Monitor. <p>NOTE:</p> <ul style="list-style-type: none"> • When performing the compulsory operation check for the radiator fan relay using Subaru Select Monitor, the radiator main fan and sub fan will repeat such a operation as low speed revolution → high speed revolution → OFF in this order. • Subaru Select Monitor <p>Refer to Compulsory Valve Operation Check Mode for more operation procedure. <Ref. to EN(H4SO 2.0)(diag)-39, Compulsory Valve Operation Check Mode.> <Ref. to EN(H4SO 2.5)(diag)-42, Compulsory Valve Operation Check Mode.></p>	Do the radiator main fan and sub fan rotate at low speed?	Go to step 2.	Go to step 3.
2	<p>CHECK OPERATION OF RADIATOR FAN.</p> <ol style="list-style-type: none"> 1) Connect the test mode connector. 2) Turn the ignition switch to ON. 3) Perform the compulsory operation check for the radiator fan relay using Subaru Select Monitor. <p>NOTE:</p> <ul style="list-style-type: none"> • When performing the compulsory operation check for the radiator fan relay using Subaru Select Monitor, the radiator main fan and sub fan will repeat such a operation as low speed revolution → high speed revolution → OFF in this order. • Subaru Select Monitor <p>Refer to Compulsory Valve Operation Check Mode for more operation procedure. <Ref. to EN(H4SO 2.0)(diag)-39, Compulsory Valve Operation Check Mode.> <Ref. to EN(H4SO 2.5)(diag)-42, Compulsory Valve Operation Check Mode.></p>	Do the radiator main fan and sub fan rotate at high speed?	Radiator fan system is normal.	Go to step 27.
3	<p>CHECK POWER SUPPLY TO SUB FAN RELAY.</p> <ol style="list-style-type: none"> 1) Turn the ignition switch to OFF. 2) Remove the sub fan relay from A/C relay holder. 3) Measure the voltage between sub fan relay terminal and chassis ground. <p>Connector & terminal (F27) No. 20 (+) — Chassis ground (-):</p>	Is the voltage more than 10 V?	Go to step 4.	Go to step 5.

Radiator Fan System

COOLING

Step	Check	Yes	No
4 CHECK POWER SUPPLY TO SUB FAN RELAY. 1) Turn the ignition switch to ON. 2) Measure the voltage between sub fan relay terminal and chassis ground. <i>Connector & terminal</i> <i>(F27) No. 23 (+) — Chassis ground (-):</i>	Is the voltage more than 10 V?	Go to step 7.	Go to step 6.
5 CHECK FUSE. 1) Turn the ignition switch to OFF. 2) Remove the fuse No. 3. 3) Check the condition of fuse.	Is the fuse blown out?	Replace the fuse.	Repair the power supply line.
6 CHECK FUSE. 1) Turn the ignition switch to OFF. 2) Remove the fuse No. 22. 3) Check the condition of fuse.	Is the fuse blown out?	Replace the fuse.	Repair the power supply line.
7 CHECK SUB FAN RELAY. 1) Turn the ignition switch to OFF. 2) Measure the resistance between sub fan relay terminals. <i>Terminals</i> <i>No. 20 — No. 21:</i>	Is the resistance more than 1 M Ω ?	Go to step 8.	Replace the sub fan relay.
8 CHECK SUB FAN RELAY. 1) Connect the battery to terminals No. 22 and No. 23 of sub fan relay. 2) Measure the resistance between sub fan relay terminals. <i>Terminals</i> <i>No. 20 — No. 21:</i>	Is the resistance less than 1 Ω ?	Go to step 9.	Replace the sub fan relay.
9 CHECK HARNESS BETWEEN SUB FAN RELAY TERMINAL AND SUB FAN MOTOR CONNECTOR. 1) Disconnect the connector from sub fan motor. 2) Measure the resistance of harness between sub fan relay terminal and sub fan motor connector. <i>Connector & terminal</i> <i>(F16) No. 2 — (F27) No. 21:</i>	Is the resistance less than 1 Ω ?	Go to step 10.	Measure the open circuit of harness between sub fan relay terminal and sub fan motor connector.
10 CHECK HARNESS BETWEEN SUB FAN MOTOR CONNECTOR AND MAIN FAN RELAY 2 CONNECTOR. 1) Remove the main fan relay 2 from A/C relay holder. 2) Measure the resistance of harness between sub fan motor connector and main fan relay 2 connector. <i>Connector & terminal</i> <i>(F16) No. 1 — (F27) No. 5:</i>	Is the resistance less than 1 Ω ?	Go to step 11.	Repair the open harness between sub fan motor connector and main fan relay 2 connector.
11 CHECK POOR CONTACT. Check the poor contact in sub fan motor connector.	Is there poor contact in sub fan motor connector?	Repair the poor contact in sub fan motor connector.	Go to step 12.
12 CHECK SUB FAN MOTOR. Connect the battery positive (+) terminal to terminal No. 2 of sub fan motor, and the ground (-) terminal to terminal No. 1.	Does the sub fan rotate?	Go to step 13.	Replace the sub fan motor.
13 CHECK MAIN FAN RELAY 2. Measure the resistance of main fan relay 2. <i>Terminals</i> <i>No. 2 — No. 5:</i>	Is the resistance less than 1 Ω ?	Go to step 14.	Replace the main fan relay 2.

Radiator Fan System

COOLING

Step	Check	Yes	No
14 CHECK HARNESS BETWEEN MAIN FAN RELAY 2 TERMINAL AND MAIN FAN MOTOR CONNECTOR. 1) Disconnect the connector from main fan motor. 2) Measure the resistance of harness between main fan relay 2 terminal and main fan motor connector. Connector & terminal (F17) No. 2 — (F27) No. 2:	Is the resistance less than 1 Ω ?	Go to step 15.	Repair the open circuit of harness between main fan relay 2 terminal and main fan motor connector.
15 CHECK MAIN FAN MOTOR AND GROUND CIRCUIT. Measure the resistance between main fan motor connector and chassis ground. Connector & terminal (F17) No. 1 — Chassis ground:	Is the resistance less than 5 Ω ?	Go to step 16.	Repair the open circuit in harness between main fan motor connector and chassis ground.
16 CHECK POOR CONTACT. Check poor contact in main fan motor connector.	Is there poor contact in main fan motor connector?	Repair the poor contact in main fan motor connector.	Go to step 17.
17 CHECK MAIN FAN MOTOR. Connect the battery positive (+) terminal to terminal No. 2 of main fan motor, and the ground (-) terminal to terminal No. 1.	Does the main fan rotate?	Go to step 18.	Replace the main fan motor.
18 CHECK HARNESS BETWEEN SUB FAN RELAY AND ECM. 1) Disconnect the connector from ECM. 2) Measure the resistance between sub fan relay terminal and ECM connector. Connector & terminal 2.5 L EC, EK, K4 model (B134) No. 31 — (F27) No. 22: Except for 2.5 L EC, EK, K4 model (B134) No. 10 — (F27) No. 22:	Is the resistance less than 1 Ω ?	Go to step 19.	Repair the open circuit in harness between sub fan relay terminal and ECM.
19 CHECK POOR CONTACT. Check poor contact in ECM connector.	Is there poor contact in ECM connector?	Repair the poor contact in ECM connector.	Check the DTC. Repair the trouble cause. <Ref. to EN(H4SO 2.0)(diag)-31, Read Diagnostic Trouble Code (DTC).> <Ref. to EN(H4SO 2.5)(diag)-33, Read Diagnostic Trouble Code (DTC).>
20 CHECK MAIN FAN RELAY 1. 1) Turn the ignition switch to OFF. 2) Remove the main fan relay 1 from A/C relay holder. 3) Measure the resistance of terminal in main fan relay 1 switch.	Is the resistance more than 1 M Ω ?	Go to step 21.	Replace the main fan relay 1.
21 CHECK MAIN FAN RELAY 1. 1) Connect the battery to terminal of main fan relay 1 coil. 2) Measure the resistance between terminals of main fan relay 1 switch.	Is the resistance less than 1 Ω ?	Go to step 22.	Replace the main fan relay 1.

Radiator Fan System

COOLING

Step	Check	Yes	No
22 CHECK HARNESS BETWEEN MAIN FAN RELAY 1 TERMINAL AND MAIN FAN MOTOR CONNECTOR. 1) Disconnect the connector from main fan motor. 2) Measure the resistance of harness between main fan relay 1 terminal and main fan motor connector. <i>Connector & terminal</i> <i>(F17) No. 2 — (F36) No. 6:</i>	Is the resistance less than 1 Ω ?	Go to step 23 .	Repair the open circuit of harness between main fan relay 1 terminal and main fan motor connector.
23 CHECK HARNESS BETWEEN MAIN FAN RELAY 1 AND ECM. 1) Disconnect the connector from ECM. 2) Measure the resistance between main fan relay 1 terminal and ECM connector. <i>Connector & terminal</i> <i>2.5 L EC, EK, K4 model</i> <i>(B135) No. 34 — (B143) No. 7:</i> <i>Except for 2.5 L EC, EK, K4 model</i> <i>(B134) No. 9 — (B143) No. 7:</i>	Is the resistance less than 1 Ω ?	Go to step 24 .	Repair the open circuit of harness between main fan relay 1 terminal and ECM.
24 CHECK HARNESS BETWEEN MAIN FAN RELAY 2 AND ECM. Measure the resistance between main fan relay 2 terminal and ECM connector. <i>Connector & terminal</i> <i>2.5 L EC, EK, K4 model</i> <i>(B135) No. 34 — (F27) No. 3:</i> <i>Except for 2.5 L EC, EK, K4 model</i> <i>(B134) No. 9 — (F27) No. 3:</i>	Is the resistance less than 1 Ω ?	Go to step 25 .	Repair the open circuit of harness between main fan relay 2 terminal and ECM.
25 CHECK FUSE. 1) Turn the ignition switch to OFF. 2) Remove the fuse No. 2 and No. 26. 3) Check the condition of fuse.	Is the fuse blown out?	Replace the fuse.	Go to step 26 .
26 CHECK POOR CONTACT. Check poor contact in ECM connector.	Is there a poor contact in ECM connector?	Repair the poor contact in ECM connector.	Repair the power supply circuit for main fuse box.
27 CHECK OPERATION OF RADIATOR FAN. Check if the sub fan rotates when both fans do not rotate at high speed under the step 2.	Does the sub fan rotate?	Go to step 20 .	Go to step 28 .
28 CHECK GROUND CIRCUIT OF MAIN FAN RELAY 2. 1) Remove the main fan relay 2 from A/C relay holder. 2) Measure the resistance between main fan relay 2 terminal and chassis ground. <i>Connector & terminal</i> <i>(F27) No. 4 — Chassis ground:</i>	Is the resistance less than 1 Ω ?	Go to step 29 .	Repair the open circuit in harness between main fan relay 2 and chassis ground.
29 CHECK POWER SUPPLY TO MAIN FAN RELAY 2. 1) Turn the ignition switch to ON. 2) Measure the voltage between main fan relay 2 terminal and chassis ground. <i>Connector & terminal</i> <i>(F27) No. 1 (+) — Chassis ground (-):</i>	Is the voltage more than 10 V?	Go to step 30 .	Repair the power supply line.

Radiator Fan System

COOLING

Step	Check	Yes	No
30 CHECK MAIN FAN RELAY 2. 1) Turn the ignition switch to OFF. 2) Remove the main fan relay 2. 3) Measure the resistance of main fan relay 2. Terminals (F27) No. 2 — (F27) No. 4:	Is the resistance more than 1 M Ω ?	Go to step 31 .	Replace the main fan relay 2.
31 CHECK MAIN FAN RELAY 2. 1) Connect the battery to terminals No. 1 and No. 3 of main fan relay 2. 2) Measure the resistance of main fan relay 2. Terminals (F27) No. 4 — (F27) No. 5:	Is the resistance less than 1 Ω ?	Go to step 23 .	Replace the main fan relay 2.

3. Engine Coolant

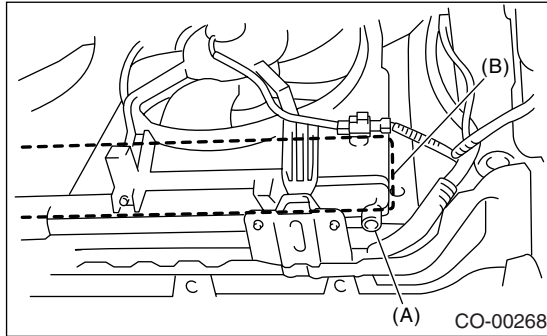
A: REPLACEMENT

1. DRAINING OF ENGINE COOLANT

- 1) Lift-up the vehicle.
- 2) Remove the under cover.
- 3) Remove the drain plug to drain engine coolant into container.

NOTE:

Remove the radiator cap so that engine coolant will drain faster.



- (A) Drain plug
- (B) Heat shield cover

- 4) Install the drain plug.

2. FILLING OF ENGINE COOLANT

- 1) Fill engine coolant into the radiator up to the filler neck position.

Coolant capacity (fill up to “FULL” level):

MT model:

6.5 ℓ (6.9 US qt, 5.7 Imp qt)

AT model (model without ATF warmer):

6.4 ℓ (6.8 US qt, 5.6 Imp qt)

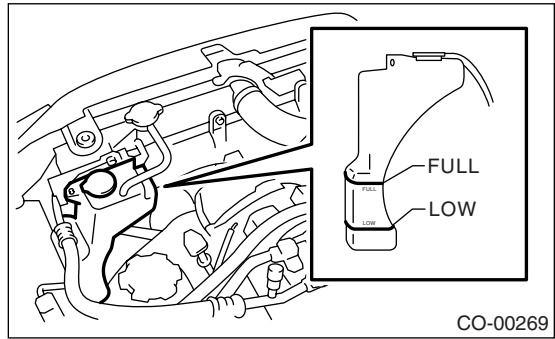
AT model (model with ATF warmer):

6.8 ℓ (7.2 US qt, 6.0 Imp qt)

NOTE:

The SUBARU Genuine Coolant containing anti-freeze and anti-rust agents is especially made for SUBARU engine, which has an aluminum crank-case. Always use SUBARU Genuine Coolant, since other coolant may cause corrosion.

- 2) Fill engine coolant into the reservoir tank up to “FULL” level.



- 3) Warm-up the engine completely for more than five minutes at 2,000 to 3,000 rpm.
- 4) If the engine coolant level drops in radiator, add engine coolant to filler neck position.
- 5) If the engine coolant level drops from “FULL” level of reservoir tank, add engine coolant to “FULL” level.
- 6) Attach the radiator cap and reservoir tank cap properly.

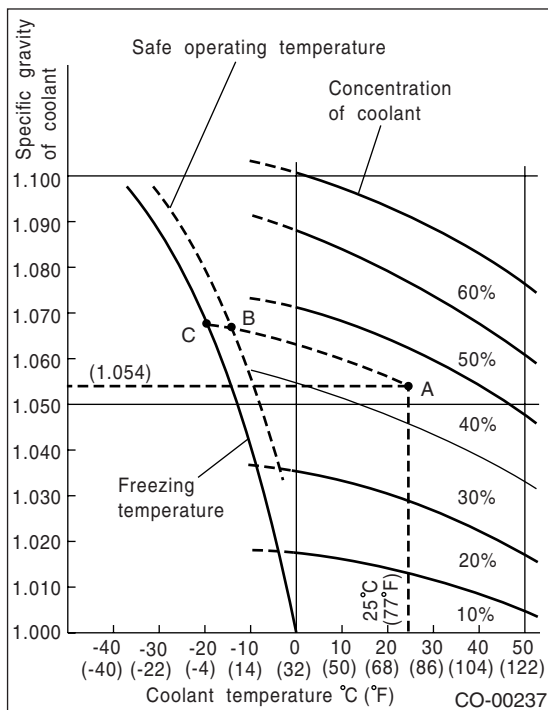
B: INSPECTION

1. RELATIONSHIP OF SUBARU COOLANT CONCENTRATION AND FREEZING TEMPERATURE

The concentration and safe operating temperature of SUBARU coolant is shown in the diagram. Measuring the temperature and specific gravity of the coolant will provide this information.

[Example]

If the coolant temperature is 25°C (77°F) and its specific gravity is 1.054, the concentration is 45% (point A), the safe operating temperature is -14°C (7°F) (point B), and the freezing temperature is -20°C (-4°F) (point C).



2. PROCEDURE TO ADJUST THE CONCENTRATION OF THE COOLANT

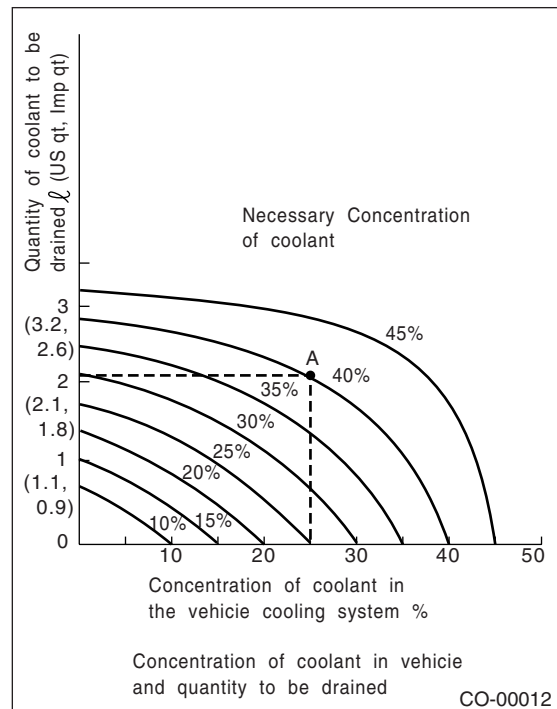
To adjust the concentration of coolant according to temperature, find the proper fluid concentration in the above diagram and replace the necessary amount of coolant with an undiluted solution of SUBARU genuine coolant (concentration 50%).

The amount of coolant that should be replaced can be determined using the diagram.

[Example]

Assume that the coolant concentration must be increased from 25% to 40%. Find point A, where the 25% line of coolant concentration intersects with the 40% curve of the necessary coolant concentration, and read the scale on the vertical axis of the graph at height A. The quantity of coolant to be drained is 2.1 ℓ (2.2 US qt, 1.8 Imp qt). Drain 2.1 ℓ (2.2 US qt, 1.8 Imp qt) of coolant from the cooling system and add 2.1 ℓ (2.2 US qt, 1.8 Imp qt) of the undiluted solution of SUBARU coolant.

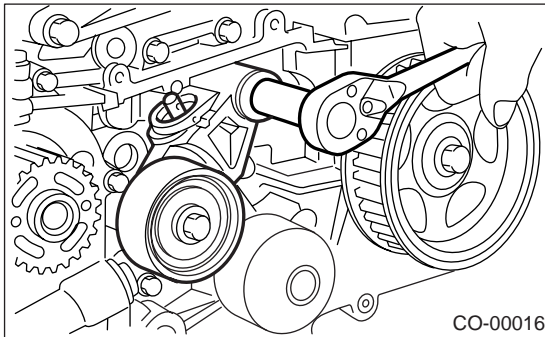
If a coolant concentration of 50% is needed, drain all the coolant and refill with the undiluted solution only.



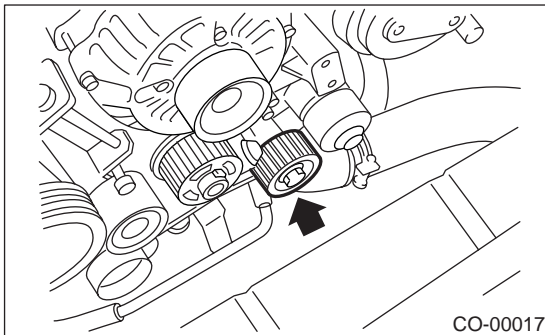
4. Water Pump

A: REMOVAL

- 1) Remove the radiator. <Ref. to CO(H4SO 2.0)-20, REMOVAL, Radiator.>
- 2) Remove the V-belts. <Ref. to ME(H4SO 2.0)-38, REMOVAL, V-belt.>
- 3) Remove the timing belt. <Ref. to ME(H4SO 2.0)-43, TIMING BELT, REMOVAL, Timing Belt.>
- 4) Remove the automatic belt tension adjuster.

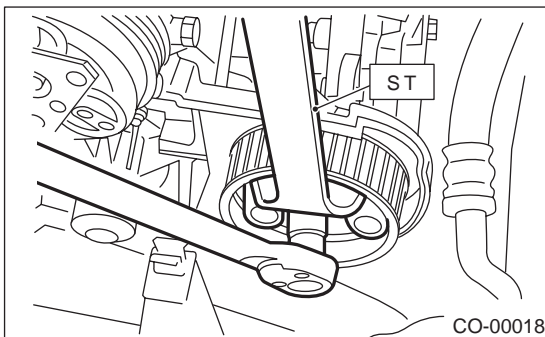


- 5) Remove the belt idler No. 2.

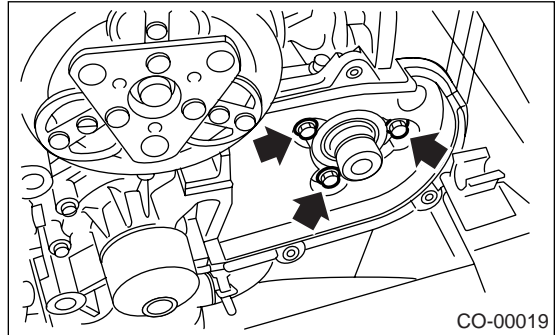


- 6) Remove the cam sprocket (LH) using ST.
ST 18231AA010 CAM SPROCKET WRENCH

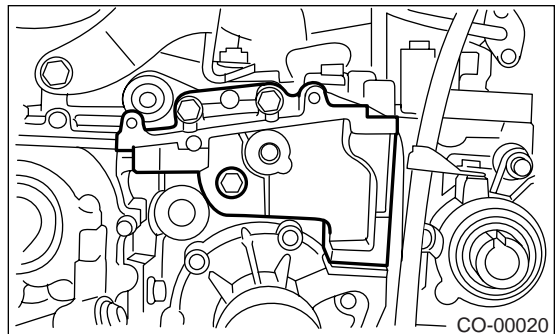
NOTE:
CAM SPROCKET WRENCH (499207100) can also be used.



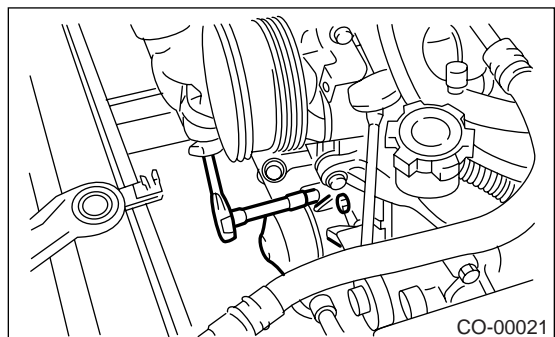
- 7) Remove the belt cover No. 2 (LH).



- 8) Remove the tensioner bracket.



- 9) Disconnect the hose from water pump.
- 10) Remove the water pump.



B: INSTALLATION

- 1) Install the water pump onto cylinder block (LH).

NOTE:

- Use a new gasket.
- When installing the water pump, tighten the bolts in two stages in alphabetical sequence as shown in figure.

Water Pump

COOLING

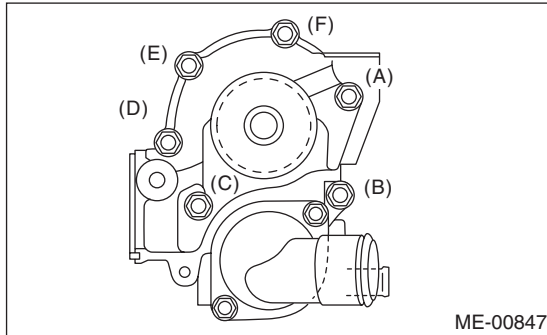
Tightening torque:

First:

12 N·m (1.2 kgf·m, 8.7 ft·lb)

Second:

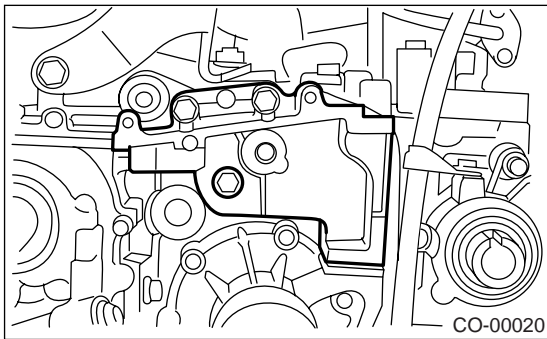
12 N·m (1.2 kgf·m, 8.7 ft·lb)



- 2) Connect the hose to the water pump.
- 3) Install the tensioner bracket.

Tightening torque:

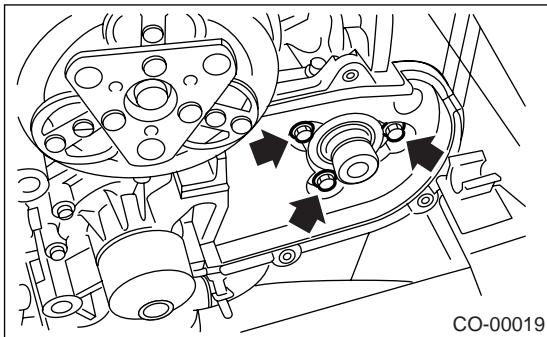
25 N·m (2.5 kgf·m, 18.1 ft·lb)



- 4) Install the belt cover No. 2 (LH).

Tightening torque:

5 N·m (0.5 kgf·m, 3.6 ft·lb)



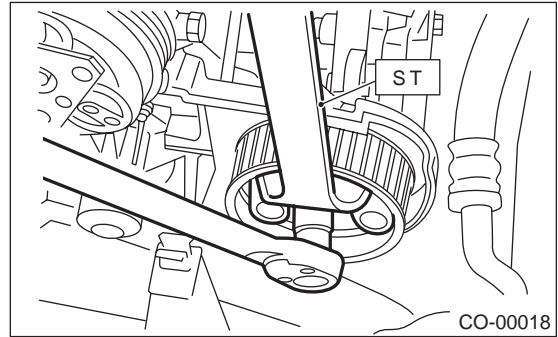
- 5) Install the cam sprocket (LH) using ST.
ST 18231AA010 CAM SPROCKET WRENCH

NOTE:

CAM SPROCKET WRENCH (499207100) can also be used.

Tightening torque:

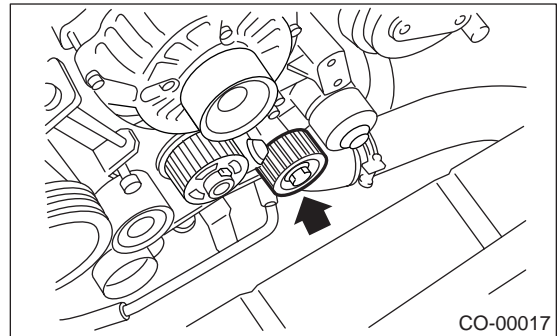
78 N·m (8.0 kgf·m, 57.9 ft·lb)



- 6) Install the belt idler No. 2.

Tightening torque:

39 N·m (4.0 kgf·m, 28.9 ft·lb)



- 7) Install the automatic belt tension adjuster to which tension rod is held with pin. <Ref. to ME(H4SO 2.0)-44, AUTOMATIC BELT TENSION ADJUSTER ASSEMBLY AND BELT IDLER, INSTALLATION, Timing Belt.>
- 8) Install the timing belt. <Ref. to ME(H4SO 2.0)-45, TIMING BELT, INSTALLATION, Timing Belt.>
- 9) Install the V-belts. <Ref. to ME(H4SO 2.0)-38, INSTALLATION, V-belt.>
- 10) Install the radiator. <Ref. to CO(H4SO 2.0)-21, INSTALLATION, Radiator.>

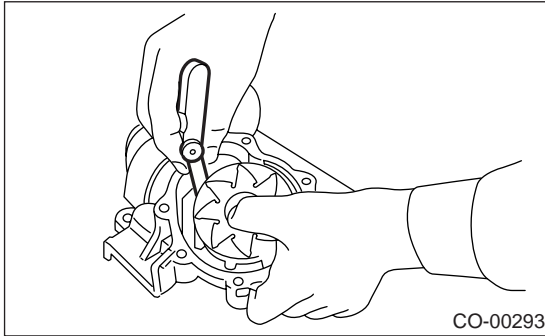
C: INSPECTION

- 1) Check the water pump bearing for smooth rotation.
- 2) Check the water pump pulley for abnormalities.
- 3) Make sure the impeller is not deformed or damaged.
- 4) Inspect the clearance between impeller and pump case.

Clearance between impeller and pump case:

Standard value

0.5 — 1.5 mm (0.020 — 0.060 in)



5) After water pump installation, check the pulley shaft for engine coolant leaks and noise. If leaks or noise are noted, replace the water pump assembly.

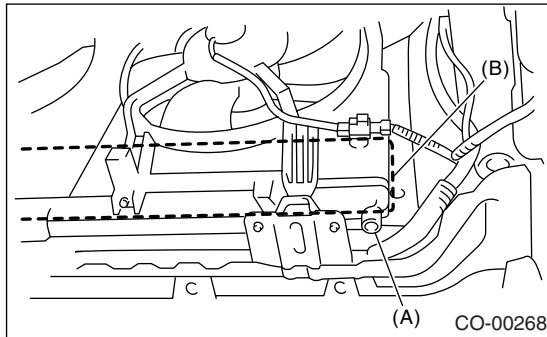
Thermostat

COOLING

5. Thermostat

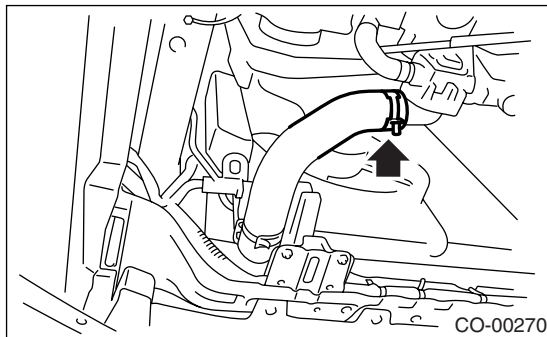
A: REMOVAL

- 1) Set the vehicle on a lift.
- 2) Lift-up the vehicle.
- 3) Remove the under cover.
- 4) Drain engine coolant completely.
<Ref. to CO(H4SO 2.0)-13, DRAINING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

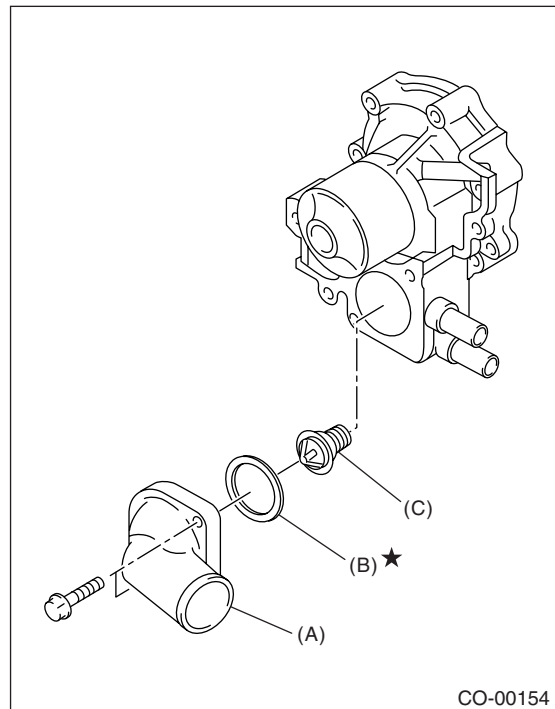


- (A) Drain plug
- (B) Heat shield cover

- 5) Disconnect the radiator outlet hose from thermostat cover.



- 6) Remove the thermostat cover and gasket, and then remove the thermostat.



- (A) Thermostat cover
- (B) Gasket
- (C) Thermostat

B: INSTALLATION

- 1) Install a gasket to thermostat, and install the thermostat and gasket to water pump as a unit. Then, install the thermostat cover.

NOTE:

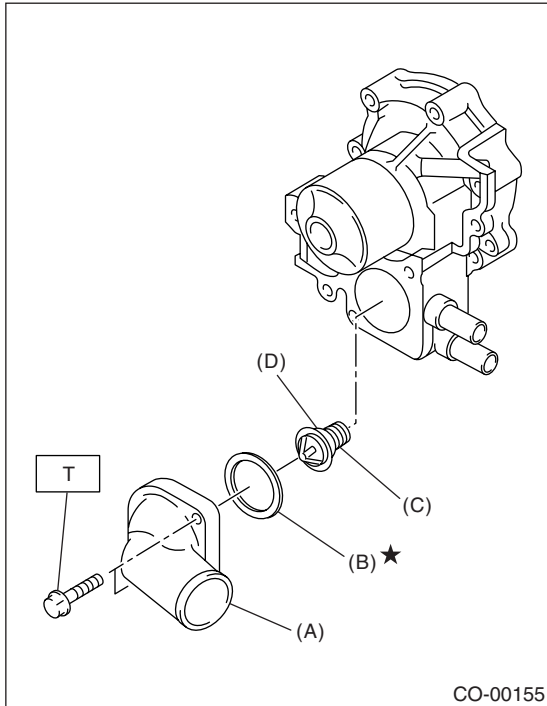
- When reinstalling the thermostat, use a new gasket.
- The thermostat must be installed with the jiggle pin facing to the up side.

Tightening torque:

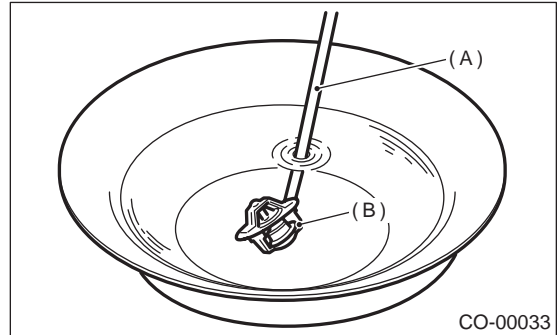
12 N·m (1.2 kgf-m, 8.7 ft-lb)

Valve lift:

9.0 mm (0.354 in) or more



- (A) Thermostat cover
- (B) Gasket
- (C) Thermostat
- (D) Jiggle pin



- (A) Thermometer
- (B) Thermostat

- 2) Connect the radiator outlet hose to thermostat cover.
- 3) Install the under cover.
- 4) Lower the vehicle.
- 5) Fill with engine coolant. <Ref. to CO(H4SO 2.0)-13, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

C: INSPECTION

Replace the thermostat if the valve does not close completely at an ambient temperature or if the following test shows unsatisfactory results.

- Inspection method

Immerse the thermostat and a thermometer in water. Raise water temperature gradually, and measure the temperature and valve lift when the valve begins to open and when the valve is fully opened. During the test, agitate the water for even temperature distribution. The measurement should be to the specification.

Starting temperature to open:

80 — 84°C (176 — 183°F)

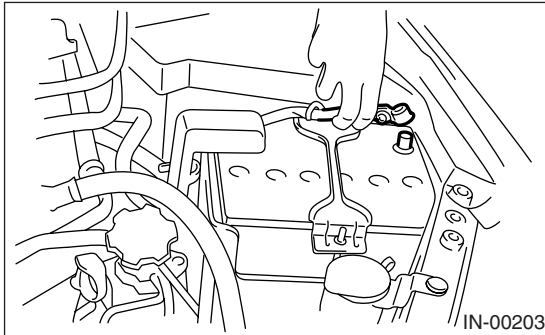
Fully opens:

95°C (203°F)

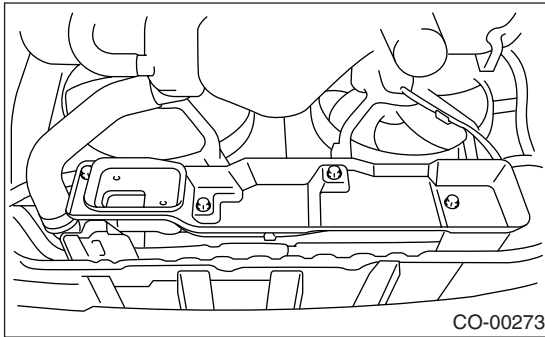
6. Radiator

A: REMOVAL

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

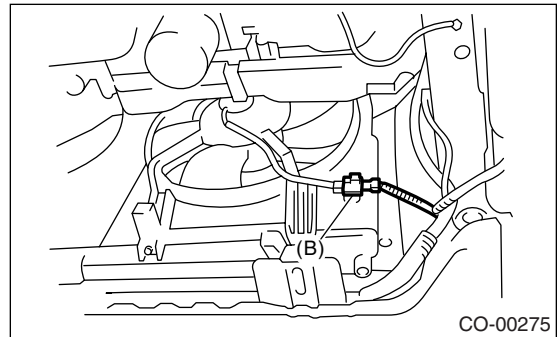
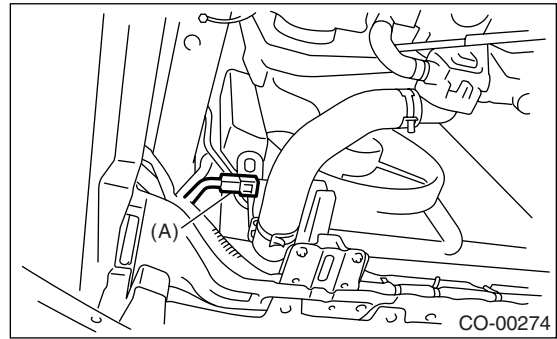


- 3) Lift-up the vehicle.
- 4) Remove the under cover.
- 5) Remove the heat shield cover from radiator. (Model without ATF warmer)

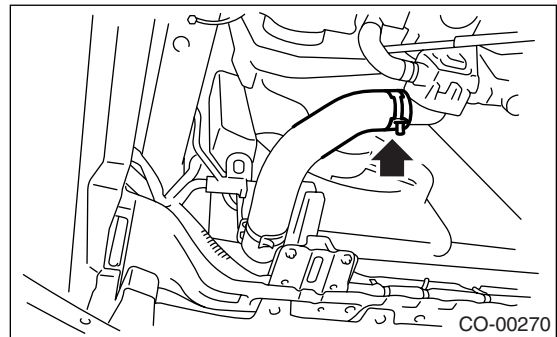


- 6) Drain engine coolant completely.
<Ref. to CO(H4SO 2.0)-13, DRAINING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

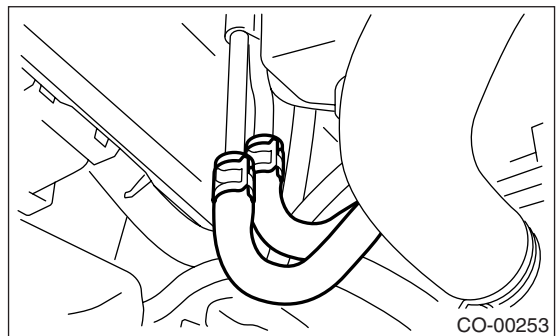
- 7) Disconnect the connector (A) of radiator main fan motor and connector (B) of sub fan motor.



- 8) Disconnect the radiator outlet hose from thermostat cover.

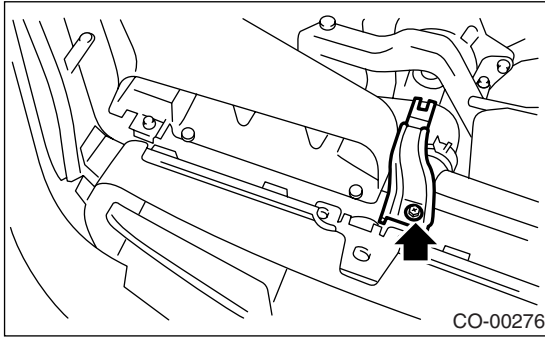


- 9) Disconnect the ATF cooler hoses from ATF pipes. (Model without ATF warmer)
Plug the ATF pipe to prevent ATF leaks.



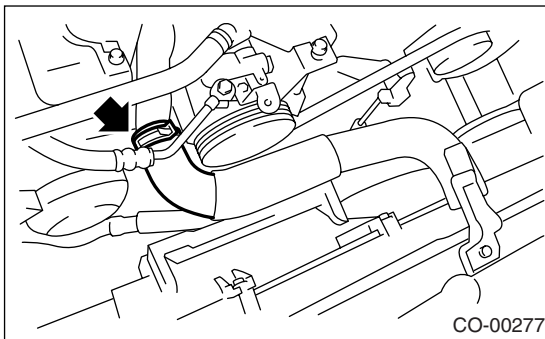
- 10) Lower the vehicle.
- 11) Disconnect the over flow hose.
- 12) Remove the reservoir tank. <Ref. to CO(H4SO 2.0)-29, REMOVAL, Reservoir Tank.>

13) Remove the hood stay holder.

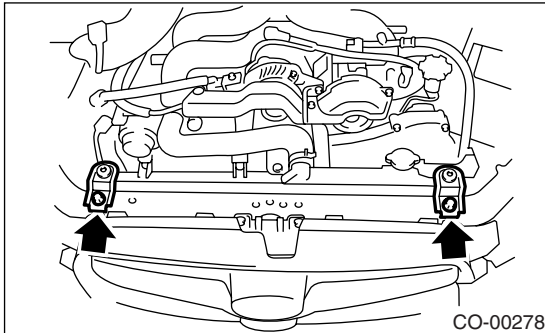


14) Remove the air intake duct. <Ref. to IN(H4SO 2.0)-9, REMOVAL, Air Intake Duct.>

15) Disconnect the radiator inlet hose from engine.



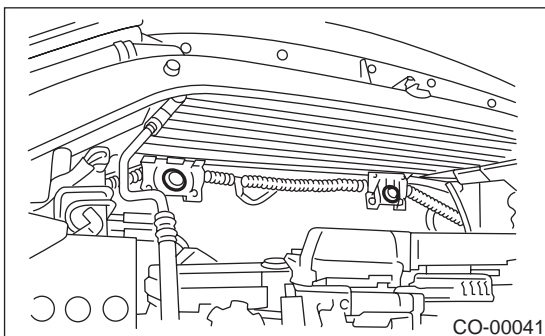
16) Remove the radiator upper brackets.



17) Lift the radiator up and away from vehicle.

B: INSTALLATION

1) Attach the radiator lower cushions to holes on the radiator lower bracket.



2) Install the radiator to vehicle.

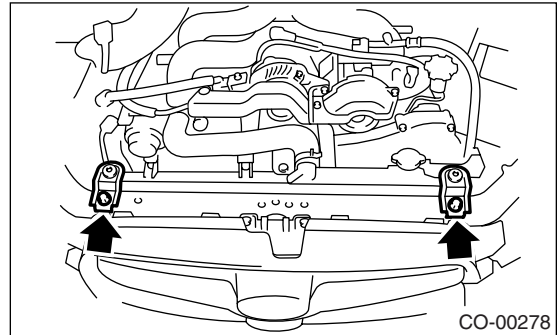
NOTE:

Make pins on the lower side of radiator be fitted into the radiator lower cushions on body side.

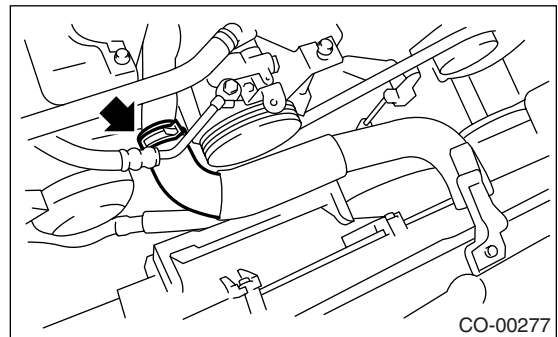
3) Install the radiator upper brackets and tighten the bolts.

Tightening torque:

18 N·m (1.8 kgf-m, 13.0 ft-lb)

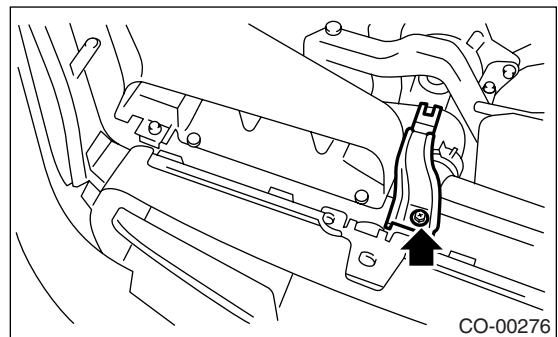


4) Connect the radiator inlet hose.



5) Install the air intake duct. <Ref. to IN(H4SO 2.0)-9, INSTALLATION, Air Intake Duct.>

6) Install the hood stay holder.



7) Install the reservoir tank. <Ref. to CO(H4SO 2.0)-29, INSTALLATION, Reservoir Tank.>

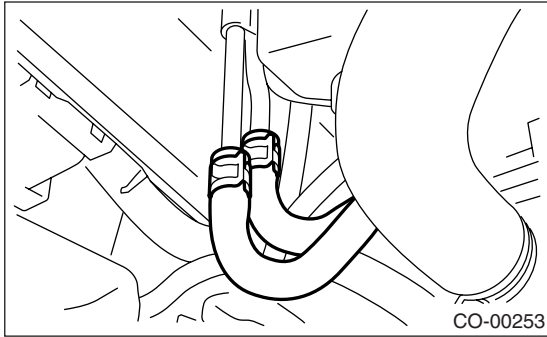
8) Connect the over flow hose.

9) Lift-up the vehicle.

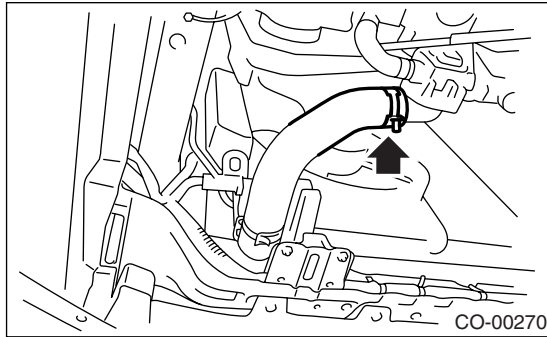
Radiator

COOLING

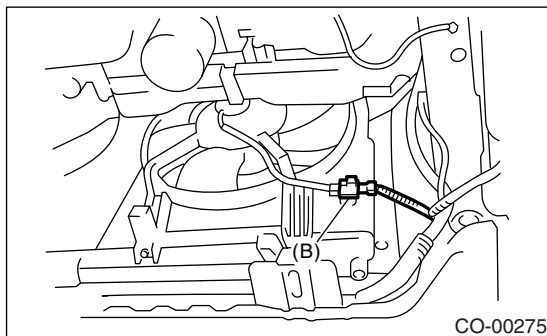
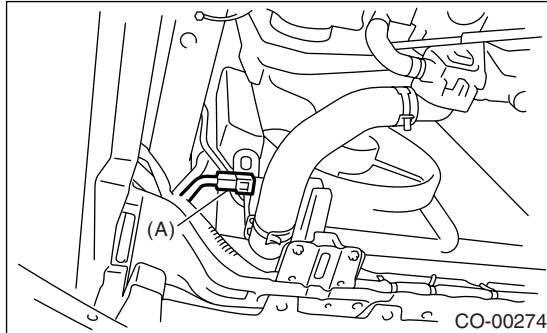
10) Connect the ATF cooler hoses. (Model without ATF warmer)



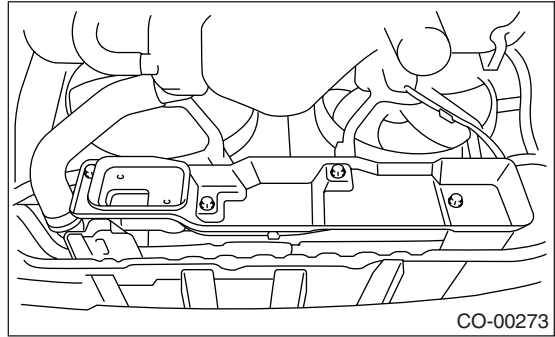
11) Connect the radiator outlet hose.



12) Connect the connector (A) to radiator main fan motor and connector (B) to sub fan motor.



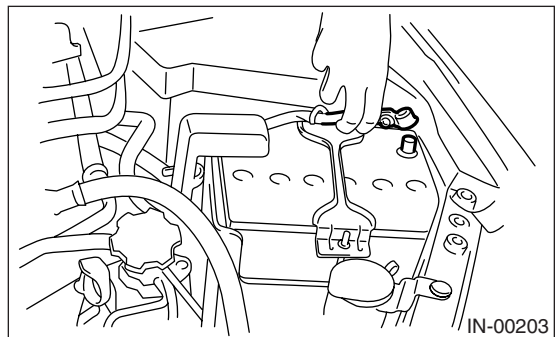
13) Install the heat shield cover. (Model without ATF warmer)



14) Install the under cover.

15) Lower the vehicle.

16) Connect the battery ground cable to battery.

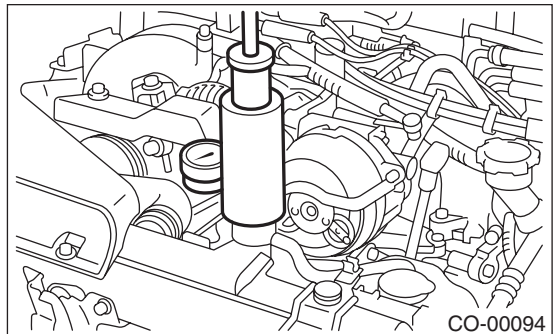


17) Fill with engine coolant. <Ref. to CO(H4SO 2.0)-13, FILLING OF ENGINE COOLANT, REPLACEMENT, Engine Coolant.>

18) Check the ATF level. <Ref. to 4AT-31, INSPECTION, Automatic Transmission Fluid.>

C: INSPECTION

1) Remove the radiator cap, top off the radiator with coolant, and then attach the tester in place of cap.



2) Apply a pressure of 157 kPa (1.6 kg/cm², 23 psi) to the radiator to check if:

- Engine coolant leaks at/around radiator.
- Engine coolant leaks at/around hoses or connections.

CAUTION:

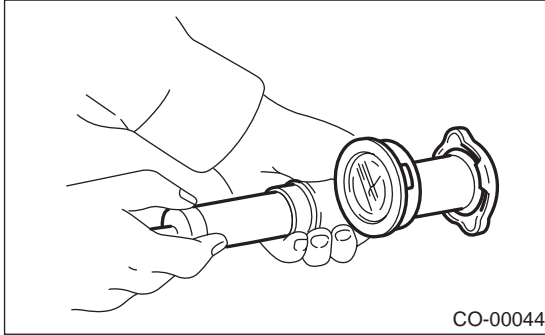
- Engine should be turned off.
- Wipe engine coolant from check points in advance.

- Be careful to prevent engine coolant from spurting out when removing tester.
- Be careful not to deform the filler neck of radiator when installing or removing the tester.

7. Radiator Cap

A: INSPECTION

1) Attach the radiator cap to tester.



2) Increase pressure until the tester gauge pointer stops. Radiator cap is functioning properly if it holds the service limit pressure for five to six seconds.

Standard pressure:

93 — 123 kPa (0.95 — 1.25 kg/cm², 14 — 18 psi)

Service limit pressure:

83 kPa (0.85 kg/cm², 12 psi)

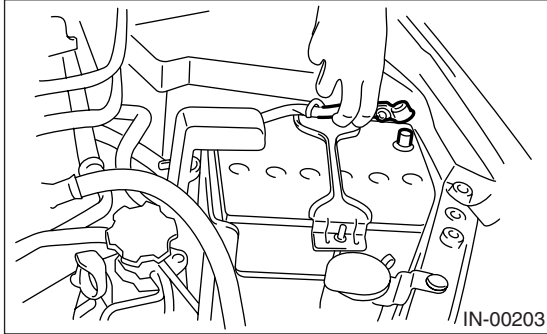
CAUTION:

Be sure to remove foreign matter and rust from the cap in advance, otherwise results of pressure test will be incorrect.

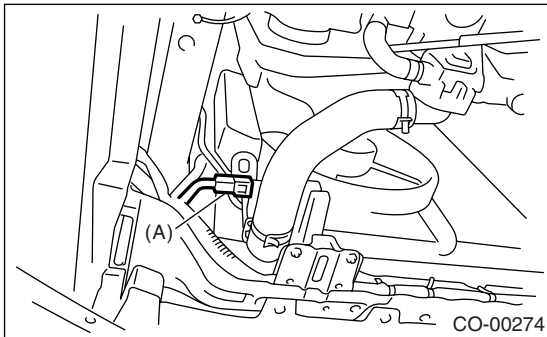
8. Radiator Main Fan and Fan Motor

A: REMOVAL

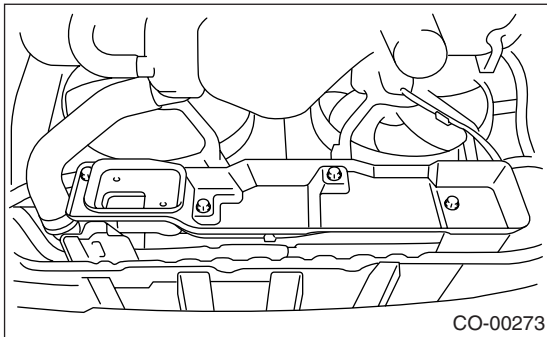
- 1) Set the vehicle on a lift.
- 2) Disconnect the ground cable from battery.



- 3) Lift-up the vehicle.
- 4) Remove the under cover.
- 5) Disconnect the connector (A) of main fan motor.

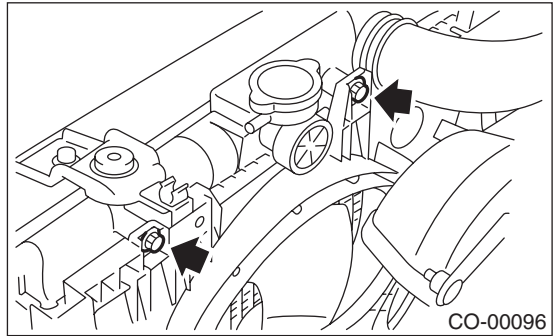


- 6) Remove the heat shield cover. (Model without ATF warmer)



- 7) Remove the ATF hose from the clip of radiator main fan motor assembly. (Model without ATF warmer)
- 8) Lower the vehicle.
- 9) Disconnect the over flow hose.
- 10) Remove the reservoir tank. <Ref. to CO(H4SO 2.0)-29, REMOVAL, Reservoir Tank.>

- 11) Remove the bolts which hold the radiator main fan shroud to radiator.



- 12) Remove the radiator main fan motor assembly.

B: INSTALLATION

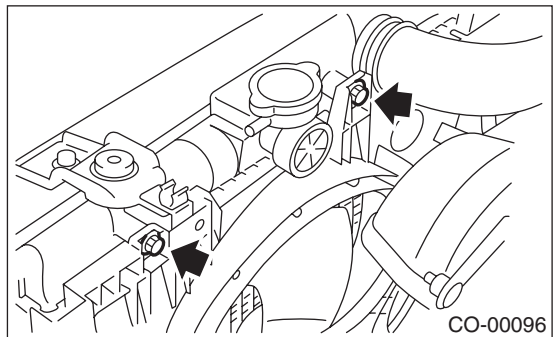
Install in the reverse order of removal.

NOTE:

When the radiator main fan motor assembly cannot be installed, loosen the bolts which secure radiator sub fan motor assembly.

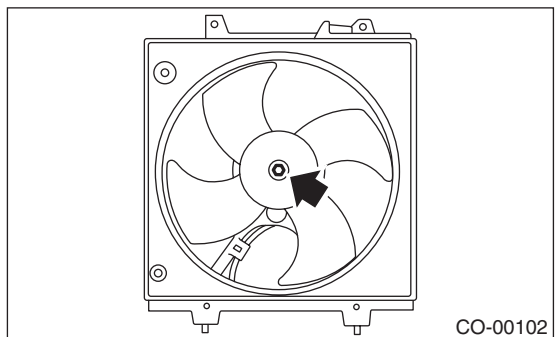
Tightening torque:

7.5 N·m (0.76 kgf-m, 5.5 ft-lb)



C: DISASSEMBLY

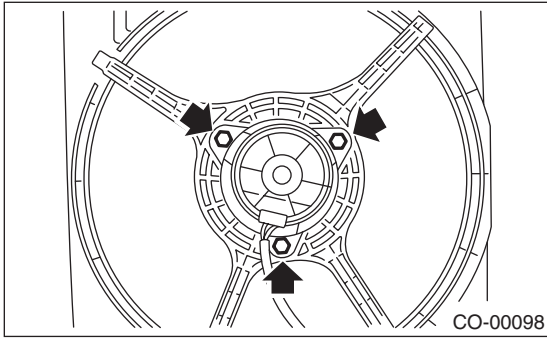
- 1) Remove the clip which holds motor connector onto the shroud.
- 2) Remove the nut which holds the fan onto fan motor and shroud.



Radiator Main Fan and Fan Motor

COOLING

3) Remove the bolts which install fan motor onto the shroud.

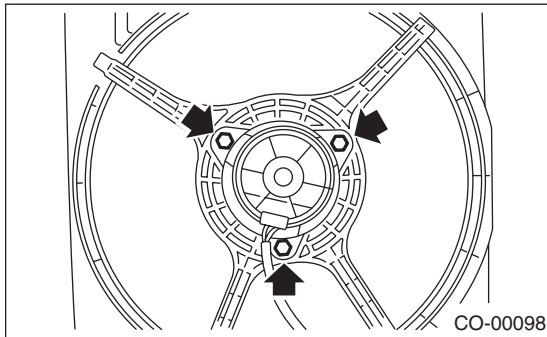


D: ASSEMBLY

Assemble in the reverse order of disassembly.

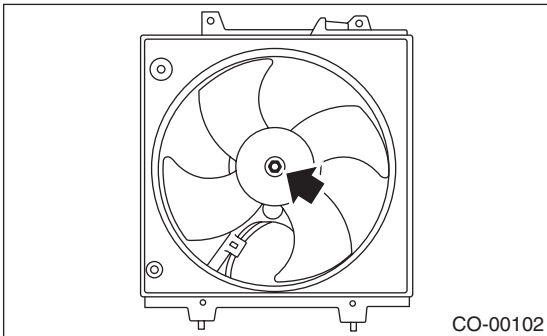
Tightening torque:

4.4 N·m (0.45 kgf-m, 3.3 ft-lb)



Tightening torque:

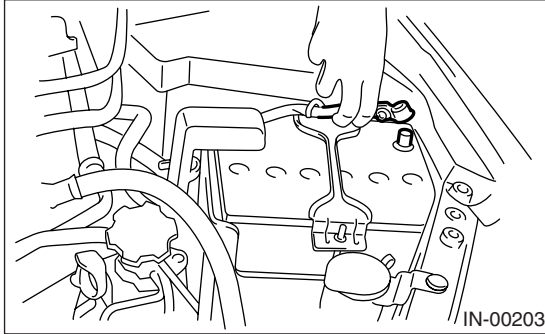
3.4 N·m (0.35 kgf-m, 2.5 ft-lb)



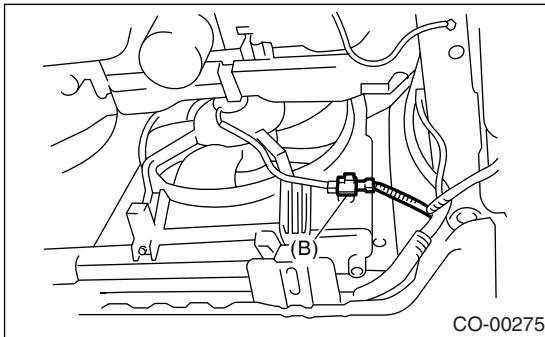
9. Radiator Sub Fan and Fan Motor

A: REMOVAL

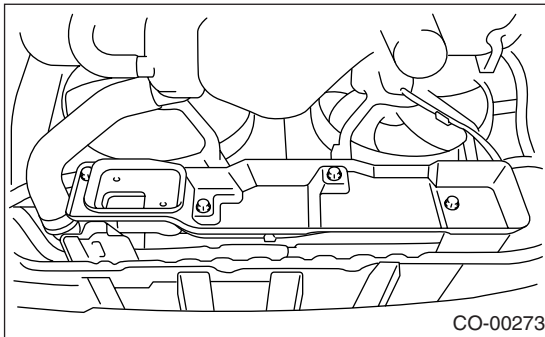
- 1) Set the vehicle on a lift.
- 2) Disconnect the ground cable from battery.



- 3) Lift-up the vehicle.
- 4) Remove the under cover.
- 5) Disconnect the connector (B) of sub fan motor.

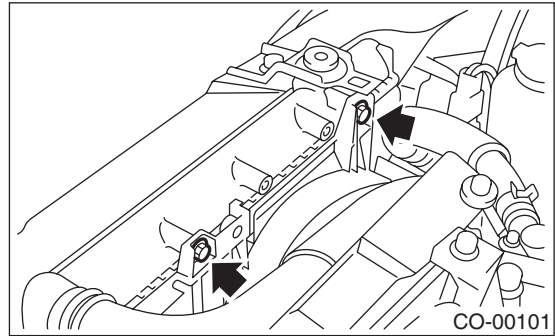


- 6) Remove the heat shield cover. (Model without ATF warmer)



- 7) Remove the ATF hose from the clip of radiator sub fan motor assembly. (Model without ATF warmer)
- 8) Lower the vehicle.
- 9) Remove the air intake duct. <Ref. to IN(H4SO 2.0)-9, REMOVAL, Air Intake Duct.>

- 10) Remove the bolts which hold the radiator sub fan shroud to radiator.



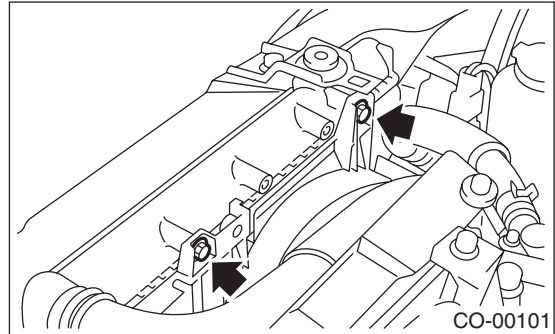
- 11) Remove the radiator sub fan motor assembly from the lower side of vehicle.

B: INSTALLATION

Install in the reverse order of removal.

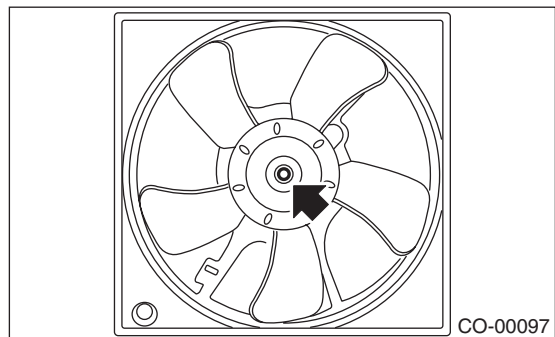
Tightening torque:

7.5 N·m (0.76 kgf-m, 5.5 ft-lb)



C: DISASSEMBLY

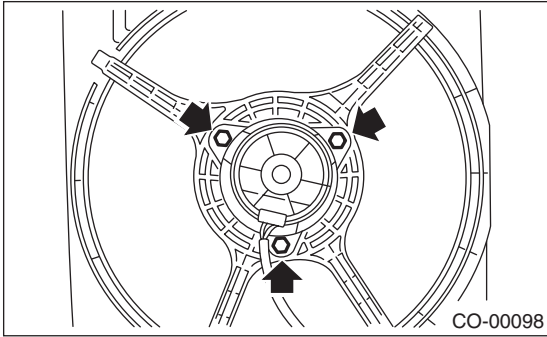
- 1) Remove the clip which holds the fan motor connector onto shroud.
- 2) Remove the nut which holds fan onto the fan motor and shroud assembly.



Radiator Sub Fan and Fan Motor

COOLING

3) Remove the bolts which install fan motor onto the shroud.

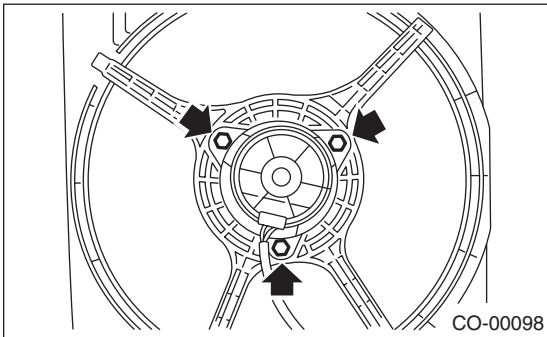


D: ASSEMBLY

Assemble in the reverse order of disassembly.

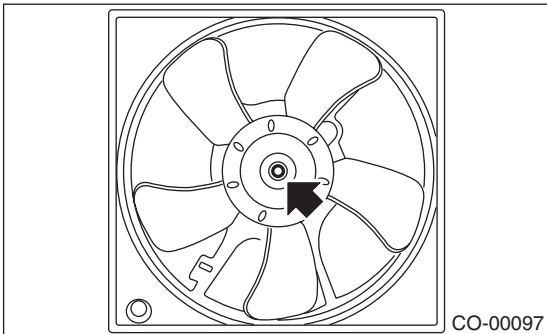
Tightening torque:

4.4 N·m (0.45 kgf-m, 3.3 ft-lb)



Tightening torque:

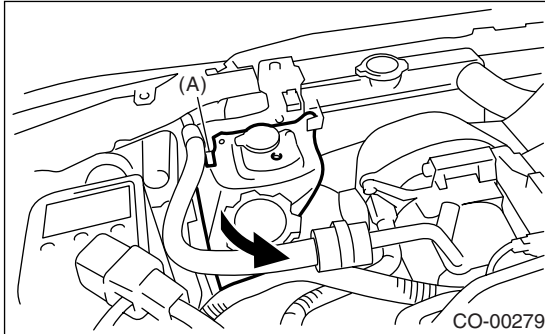
3.4 N·m (0.35 kgf-m, 2.5 ft-lb)



10. Reservoir Tank

A: REMOVAL

- 1) Disconnect the over flow hose.
- 2) Pull out the reservoir tank to the direction of arrow while pushing the pawl (A).



B: INSTALLATION

Install in the reverse order of removal.

C: INSPECTION

Make sure the engine coolant level is between "FULL" and "LOW".

Engine Cooling System Trouble in General

COOLING

11.Engine Cooling System Trouble in General

A: INSPECTION

Trouble	Possible cause	Corrective action
Over-heating	a. Insufficient engine coolant	Replenish engine coolant, inspect for leakage, and repair it if necessary.
	b. Loose timing belt	Repair or replace timing belt tensioner.
	c. Oil on timing belt	Replace.
	d. Malfunction of thermostat	Replace.
	e. Malfunction of water pump	Replace.
	f. Clogged engine coolant passage	Clean.
	g. Improper ignition timing	Inspect and repair ignition control system. <Ref. to EN(H4SO 2.0)(diag)-2, Basic Diagnostic Procedure.>
	h. Clogged or leaking radiator	Clean, repair or replace.
	i. Improper engine oil in engine coolant	Replace engine coolant.
	j. Air/fuel mixture ratio too lean	Inspect and repair the fuel injection system. <Ref. to EN(H4SO 2.0)(diag)-2, Basic Diagnostic Procedure.>
	k. Excessive back pressure in exhaust system	Clean or replace.
	l. Insufficient clearance between piston and cylinder	Adjust or replace.
	m. Slipping clutch	Correct or replace.
	n. Dragging brake	Adjustment.
	o. Defective radiator fan	Inspect radiator fan relay, engine coolant temperature sensor or radiator motor and replace them.
Over-cooling	a. Ambient temperature extremely low	Partly cover radiator front area.
	b. Defective thermostat	Replace.
Engine coolant leaks	a. Loosened or damaged connecting units on hoses	Correct or replace.
	b. Leakage from water pump	Replace.
	c. Leakage from water pipe	Correct or replace.
	d. Leakage around cylinder head gasket	Retighten cylinder head bolts or replace gasket.
	e. Damaged or cracked cylinder head and crankcase	Correct or replace.
	f. Damaged or cracked thermostat case	Correct or replace.
	g. Leakage from radiator	Correct or replace.
Strange noise	a. Defective timing belt	Replace.
	b. Defective radiator fan	Replace.
	c. Defective water pump bearing	Replace water pump.
	d. Defective water pump mechanical seal	Replace water pump.