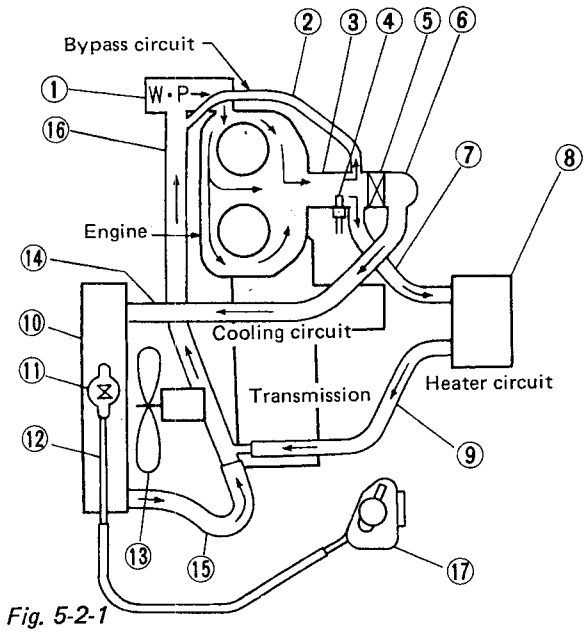
# 5-2. Engine Cooling System

## 1. General

1) The engine cooling system is composed of a down-flow radiator and an electric cooling fan. This cooling system operates in three steps depending on the temperature of the coolant flowing through the cooling circuit.




1 Water pump
2 Water bypass hose
3 Intake manifold
4 Thermoswitch
5 Thermostat
6 Thermostat housing
7 Heater inlet hose
8 Heater core
9 Heater outlet hose
10 Radiator
11 Radiator cap (with pressure valve)
12 Overflow hose
13 Electric fan
14 Radiator inlet hose
15 Radiator outlet hose
16 Water pipe
17 Reservoir

K7-014

*Fig. 5-2-1*

(1) 1st step ... With thermostat closed

When the coolant temperature is below 82°C (180°F), the thermostat remains closed and the coolant flows through the bypass and heater circuits. This permits the engine to warm up quickly.

Intake manifold → Bypass circuit → Water pump
Intake manifold → Heater circuit → Water pump

(2) 2nd step ... With thermostat opened

When the coolant temperature is above 82°C (180°F), the thermostat opens and the coolant flows through the radiator where it is cooled.

Intake manifold → Bypass circuit → Water pump
Intake manifold → Heater circuit → Water pump
Intake manifold → Thermostat → Radiator circuit → Water pump

(3) 3rd step ... With electric cooling fan operating

When the coolant temperature rises above 92°C (198°F), the thermoswitch is turned on and the electric cooling fan rotates.

2) The thermometer is composed of the gauge section and the sensor unit. The gauge is installed in the combination meter on the instrument panel and the sensor unit is installed in the intake manifold.

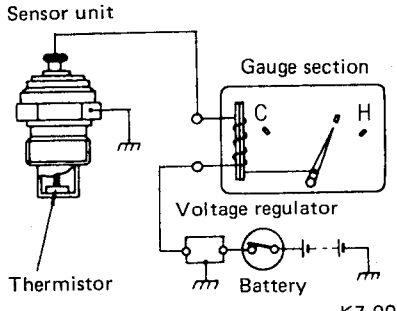



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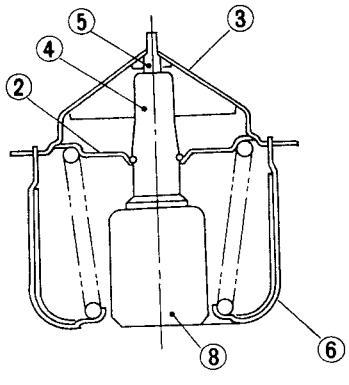
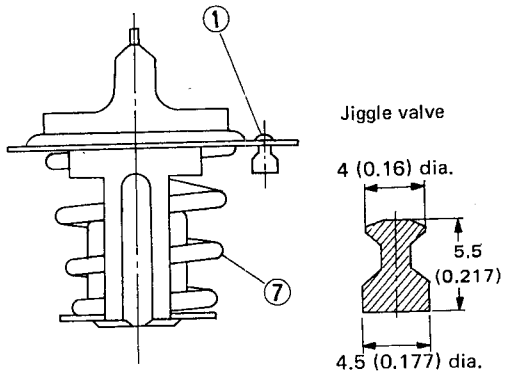
*Fig. 5-2-2*

3) The thermostat is a wax-pellet lock type. The valve opens or closes depending on the temperature of the coolant.






Weight = 0.35 gr (0.0123 oz)
Unit: mm (in)

1 Jiggle valve
2 Valve
3 Supporter
4 Cap
5 Pin (thermostat)
6 Frame
7 Spring
8 Cover

K7-015

*Fig. 5-2-3*

4) Coolant

The SUBARU genuine coolant is anti-corrosive ethylene glycol. This coolant is especially made for the SUBARU.

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

Relationship of SUBARU coolant concentration and freezing temperature.

[Example]

If the coolant temperature is 25°C (77°F) and its specific gravity is 1.056, the concentration is 35% (point A), the safe operating temperature is −14°C (7°F) (point B), and the freezing temperature is −20°C (−4°F) (point C).

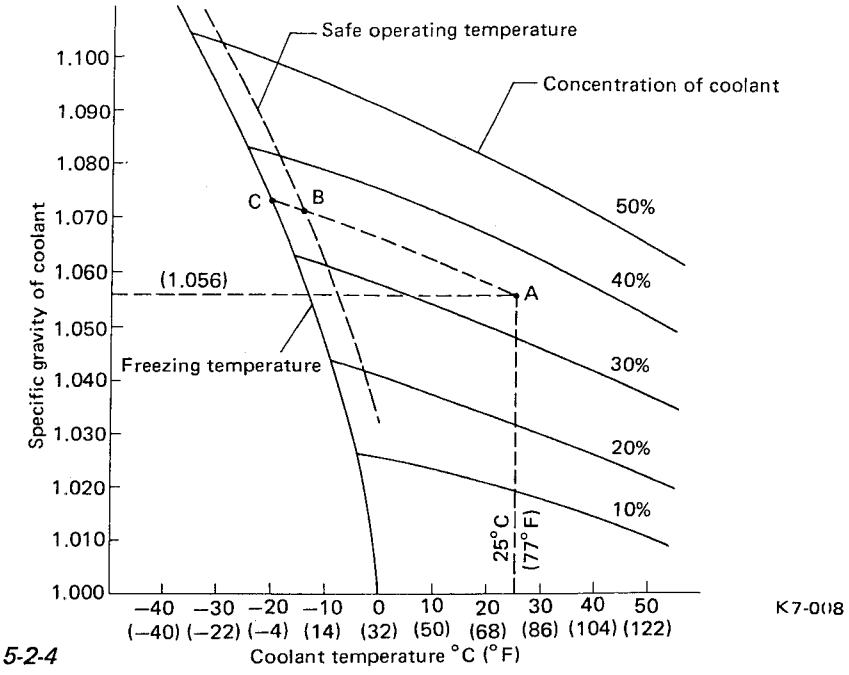



*Fig. 5-2-4*

To adjust the concentration of the 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 following 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 1.8 liters (1.9 US qt, 1.6 Imp qt). Drain 1.8 liters (1.9 US qt, 1.6 Imp qt) of coolant from the cooling system and add 1.8 liters (1.9 US qt, 1.6 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.

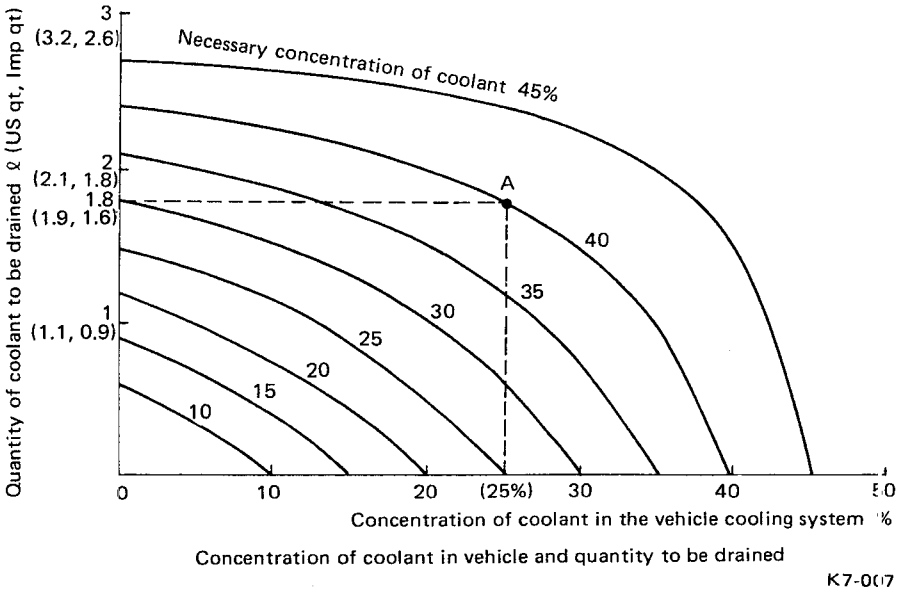


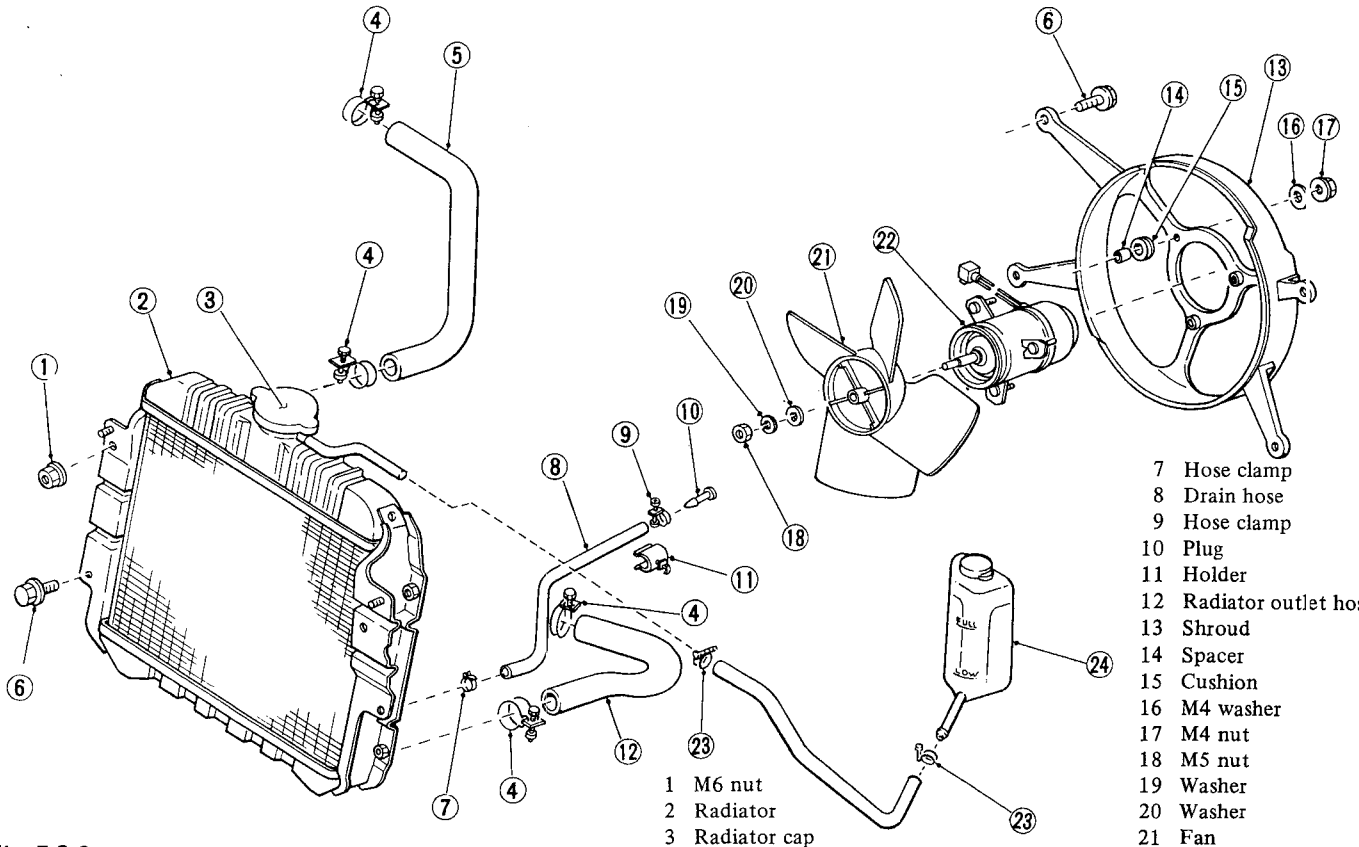

*Fig. 5-2-5*

## 2. Specifications

| | | | | |
|---|---|---|---|---|
| Cooling system | | | | Electric fan + water-cooled, pressurized, forced circulation |
| Water pump | Type | | | Centrifugal impeller |
| | Delivery performance [at water temp. 82°C (180°F)] | 1,000 rpm | Delivery | 6 ℓ (6.3 US qt, 5.3 Imp qt)/min |
| | | | Delivery pressure | 1.961 kPa (200 mmAq, 7.87 inAq) |
| | | 4,000 rpm | Delivery | 25 ℓ (26.4 US qt, 22.0 Imp qt)/min |
| | | | Delivery pressure | 29.421 kPa (3,000 mmAq, 118.11 inAq) |
| | Diameter of blade | | | 54 mm (2.13 in) |
| | No. of blades | | | 8 |
| | Pulley ratio (Water pump/crankshaft) | | | 1 : 1 |
| Thermostat | Type | | | Wax-pellet type |
| | Valve begins to open at | | | 82 ± 1.5°C (180 ± 3°F) |
| | Valve opens fully at | | | 95°C (203°F) |
| | Valve lift | | | 8 mm (0.31 in) |
| | Valve diameter | | | 28 mm (1.10 in) |
| Coolant | Total capacity (Full level of reservoir) | | | 3.4 ℓ (3.6 US qt, 3.0 Imp qt) |
| Thermoswitch | | | | ON: 92 ± 2°C (198 ± 4°F) |
| | | | | OFF: 88 ± 2°C (190 ± 4°F) |
| Electric fan | Motor input | | | Less than 60W |
| | Fan O.D. | | | 220 mm (8.66 in) |
| Radiator | Type | | | Pressurized, down-flow |
| | Total radiating area | | | Europe model: 2.62 m² (28.2 sq ft)<br>Except Europe model: 3.15 m² (33.9 sq ft) |
| | Radiating capacity | | | Europe model: 15,200 kcal/h<br>Except Europe model: 17,400 kcal/h<br>at { Water flow: 45 ℓ (11.9 US gal, 9.9 Imp gal)/min; Temperature difference: 65°C (149°F); Wind velocity: 8 m (26 ft)/sec } |
| | Core size | | | 334 x 240 x 32 mm (13.15 x 9.45 x 1.26 in) |
| | Coolant capacity | | | 0.81 ℓ (0.9 US qt, 0.7 Imp qt) |
| | Pressure range in which cap valve is open | | | Positive pressure side:<br>88 ± 10 kPa (0.9 ± 0.1 kg/cm², 13 ± 1.4 psi)<br>Negative pressure side:<br>−4.9 to −10 kPa (−0.05 to −0.1 kg/cm², −0.7 to −1.4 psi) |
| | Fins | | | Corrugated fin type |
| Reservoir | Coolant capacity | | | 0.8 ℓ (0.8 US qt, 0.7 Imp qt) |

## 3. Component Parts

### Radiator and electric fan



1 M6 nut
2 Radiator
3 Radiator cap
4 Hose clamp
5 Radiator inlet hose
6 M6 flange bolt
7 Hose clamp
8 Drain hose
9 Hose clamp
10 Plug
11 Holder
12 Radiator outlet hose
13 Shroud
14 Spacer
15 Cushion
16 M4 washer
17 M4 nut
18 M5 nut
19 Washer
20 Washer
21 Fan
22 Motor
23 Hose clamp
24 Reservoir tank

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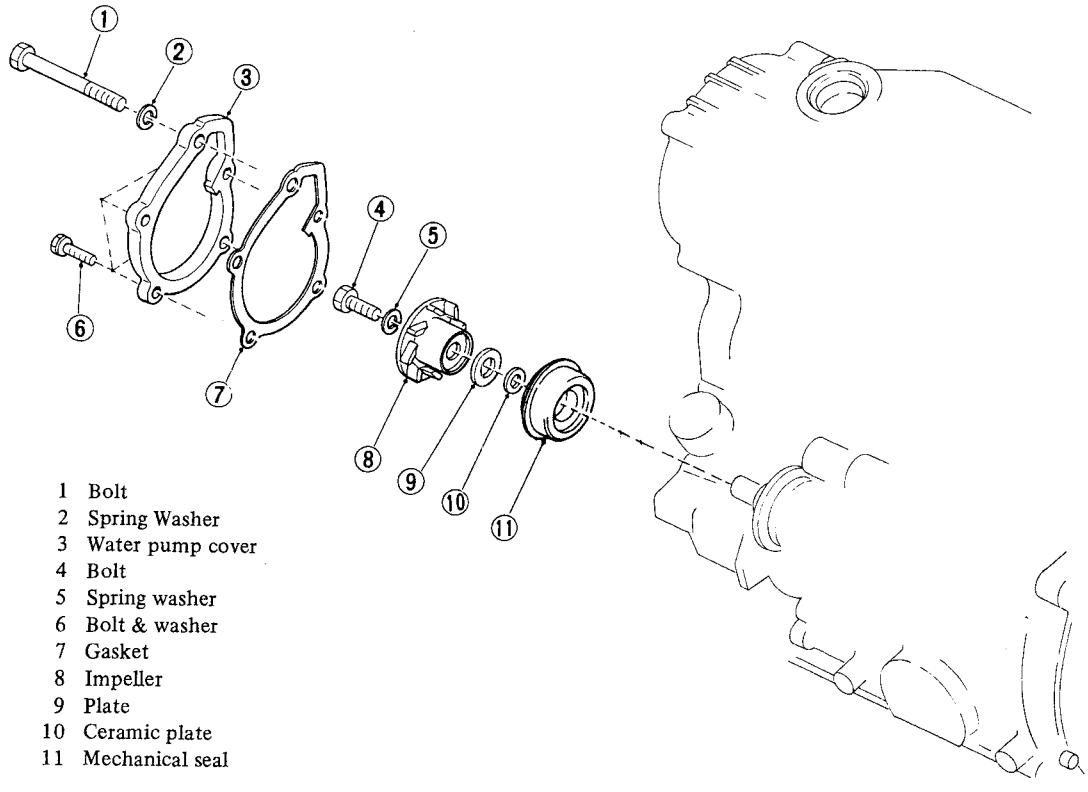
*Fig. 5-2-6*

### Water pump



1 Bolt
2 Spring Washer
3 Water pump cover
4 Bolt
5 Spring washer
6 Bolt & washer
7 Gasket
8 Impeller
9 Plate
10 Ceramic plate
11 Mechanical seal

K7-017

*Fig. 5-2-7*

## 4. Service Precautions for Major Components

### 1) Radiator

1) To remove the radiator, proceed as follows:
(1) Remove the front grille and dismount the battery.
(2) Detach the drain hose from the holder and remove the hose plug. Place a container under the hose to receive the coolant and drain by loosening the radiator cap.
(3) Disconnect the inlet hose by loosening the hose clamp on the radiator side and disconnect the outlet hose by loosening the hose clamp on pipe side.

**NOTE:**
**When disconnecting the hose, do not attempt to pry off the hose by levering with a screwdriver on the shroud or fan motor.**

(4) Move the hose clamp from the pipe to the hose and disconnect the overflow hose.
(5) Separate the fan motor leads from the main harness and dismount the radiator by removing the radiator securing bolts and nuts.
2) To install the radiator, reverse the removal procedure carefully observing the following points:
(1) Be sure to install the drain hose with the hose clamp facing the right upper side.
(2) Install the outlet hose, if it has been removed, so that the white paint mark is facing up.
(3) Use care not to twist the radiator inlet and outlet hoses when installing.
3) Check the radiator cap valve open pressure using a radiator cap tester.

Raise the pressure until the needle of the gauge stops and see if the pressure can be retained for five to six seconds. The radiator cap is normal if a pressure above the service limit value has been maintained for this period.

| Standard value: |
|---|
| 88 ± 10 kPa |
| (0.9 ± 0.1 kg/cm$^2$, 13 ± 1.4 psi) |

| Service limit: |
|---|
| 69 kPa |
| (0.7 kg/cm$^2$, 10 psi) |

**NOTE:**
**Rust or dirt on the cap may prevent the valve from functioning normally; be sure to clean the cap before testing.**

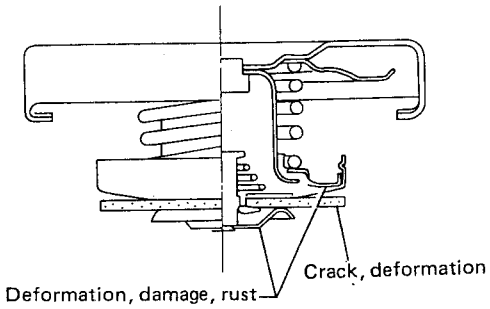



*Fig. 5-2-8*

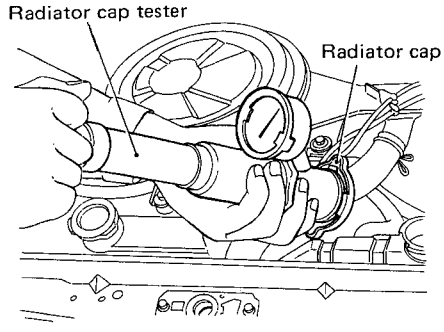



*Fig. 5-2-9*

4) To check the radiator for leakage, fill it with cooling water and attach a radiator cap tester to the coolant inlet. Then apply a pressure of 157 kPa (1.6 kg/cm , 23 psi) and check the following points:
(1) Each portion of the radiator for leakage
(2) Hose joints and other connections for leakage

**NOTE:**
**a. When performing this check, be sure to keep the engine stationary and fill the radiator with coolant.**
**b. Wipe the water off the check points before applying pressure.**
**c. When attaching or detaching the tester and when operating the tester, use special care not to deform the radiator filler neck.**
**d. Use care not to spill the coolant when detaching the tester from the radiator.**

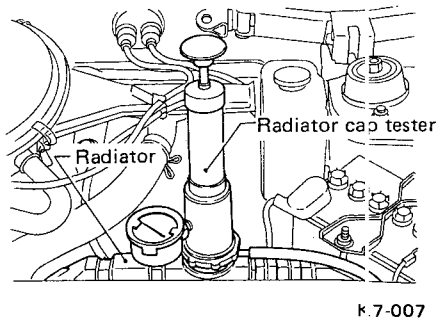



*Fig. 5-2-10*

### 2) Coolant

1) To check the coolant level, observe the reservoir tank.

If the coolant level drops close to the Low level on the reservoir tank, add genuine SUBARU coolant (concentration of undiluted solution: 50%) to the upper level.

**NOTE:**
**If the coolant is heavily contaminated, change the entire amount.**

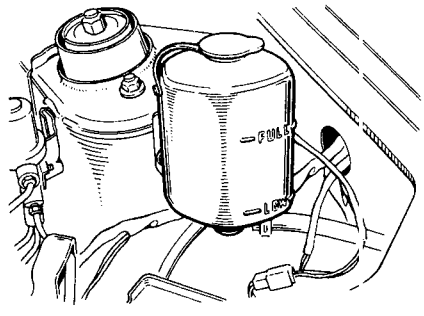



*Fig. 5-2-11*

2) To change the coolant, first thoroughly drain the hose and proceed as follows:
(1) Slowly pour the coolant into the filler port up to the filler neck position.
(2) Drain the coolant from the reservoir tank and fill the tank with coolant up to the Full level.
(3) Install the radiator cap securely and run the engine at 2,000 to 3,000 rpm until the radiator becomes hot.

(4) Stop the engine and wait until the coolant temperature drops to a safe level.

If the coolant drops below the Full level of the reservoir tank, add coolant to the Full level.

**NOTE:**

**a. Do not pour the coolant quickly. Air may be trapped inside the system due to insufficient air bleeding.**

**b. Do not attempt to remove the radiator cap immediately after the engine has stopped; boiling water may spurt out and result in injury. Be sure to wait for the coolant temperature to lower and slightly loosen the cap to release inside pressure before removing the cap.**

Coolant capacity:
- Up to reservoir filler neck: 3.6 ℓ (3.8 US qt, 3.2 Imp qt)
- Up to reservoir full level: 3.4 ℓ (3.6 US qt, 3.0 Imp qt)

### 3) Thermometer

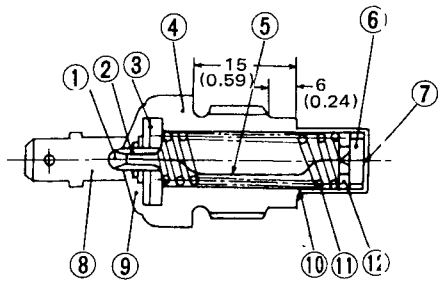
1) To test the thermometer, connect the gauge section and the sensor unit in series.

**NOTE:**

**a. Do not apply battery voltage directly to the single unit of the gauge or sensor unit. This may result in burnt leads or burnt thermistor.**

**b. The gauge section and sensor unit are precision components; use special care not to drop or strike them against hard substances.**

2) The thermometer performance data are shown below.




Unit: mm (in)

| | | | |
|---|---|---|---|
| 1 | Soldered | 7 | Case |
| 2 | Terminal | 8 | Faston termina |
| 3 | Terminal plate | 9 | Epoxy resin (black) |
| 4 | Case | 10 | Insulation tube |
| 5 | Lead | 11 | Spring |
| 6 | Thermistor | 12 | Bakelite washer |

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*Fig. 5-2-12*

| Temperature °C (°F) | Resistance value Ω | Current value mA |
|---|---|---|
| 120 (248) | 16.1 ± 1.2 | 98.5 ± 1.6 |
| 100 (212) | $27.4^{+1.9}_{-1.2}$ | $85^{+1.2}_{-2.0}$ |
| 80 (176) | $51.9^{+4.9}_{-4.4}$ | $65.5^{+2.8}_{-2.9}$ |
| 50 (122) | $153.9^{+25.0}_{-30.0}$ | 33.5 ± 3.6 |