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# ENGINE COOLING

## CONTENTS

<b>GENERAL INFORMATION</b> .....	2	Engine Coolant Replacement .....	6
<b>SERVICE SPECIFICATIONS</b> .....	2	Concentration Measurement .....	7
<b>LUBRICANT</b> .....	2	Radiator Fan Relay Continuity Check .....	8
<b>SEALANT</b> .....	2	Radiator Fan Controller Check .....	8
<b>SPECIAL TOOLS</b> .....	3	Radiator Fan Motor Check .....	10
<b>TROUBLESHOOTING</b> .....	3	<b>THERMOSTAT</b> .....	11
<b>ON-VEHICLE SERVICE</b> .....	6	<b>WATER PUMP</b> .....	13
Engine Coolant Leak Checking .....	6	<b>WATER HOSE AND WATER PIPE</b> .....	14
Radiator Cap Opening Pressure Check .....	6	<b>RADIATOR</b> .....	15

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## GENERAL INFORMATION

The cooling system is designed to keep every part of the engine at appropriate temperature in whatever condition the engine may be operated. The cooling method is of the water-cooled, pressure forced circulation type in which the water pump pressurizes coolant and circulates it throughout the engine. If the coolant temperature exceeds the prescribed temperature, the thermostat opens to circulate the coolant through the radiator as well so that the heat absorbed by the coolant may be radiated into the air.

The water pump is of the centrifugal type and is driven by the drive belt from the crankshaft. The radiator is the corrugated fin, down flow type. The cooling fan is controlled by the radiator fan controller and engine-ECU depend on driving conditions.

Item	Specification
Radiator performance kJ/h	216,700

## SERVICE SPECIFICATIONS

Items	Standard value	Limit
Radiator cap opening pressure kPa	93 - 123	83
Range of coolant antifreeze concentration of radiator %	30 - 60	-
Thermostat	Valve opening temperature of thermostat °C	80 ± 1.5
	Full-opening temperature of thermostat °C	93
	Valve lift (at 93°C) mm	9.5 or more

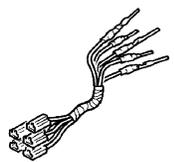
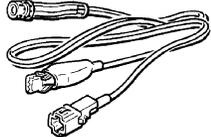
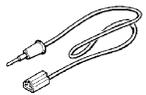
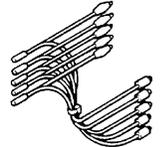
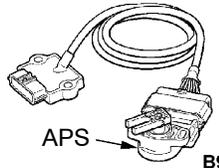
## LUBRICANT

Item	Specified coolant	Quantity L
Engine coolant (including reserve tank)	MITSUBISHI GENUINE COOLANT or equivalent	6.0

## SEALANT

Item	Specified sealant	Remark
Cylinder block drain plug	3M Nut Locking Part No. 4171 or equivalent	Drying sealant

## SPECIAL TOOLS

Tool	Number	Name	Use
<p><b>A</b></p>  <p><b>B</b></p>  <p><b>C</b></p>  <p><b>D</b></p>  <p>C991223</p>	<p>MB991223</p> <p>A: MB991219</p> <p>B: MB991220</p> <p>C: MB991221</p> <p>D: MB991222</p>	<p>Harness set</p> <p>A: Test harness</p> <p>B: LED harness</p> <p>C: LED harness adapter</p> <p>D: Probe</p>	<ul style="list-style-type: none"> <li>● Measurement of terminal voltage</li> <li>● Inspection of radiator fan controller</li> </ul> <p>A: Connector pin contact pressure inspection</p> <p>B: Power circuit inspection</p> <p>C: Power circuit inspection</p> <p>D: Commercial tester connection</p>
 <p>B991658</p>	MB991658	Test harness	Inspection of radiator fan controller
 <p>APS</p> <p>B991791</p>	MB991791	Throttle controller	Inspection of radiator fan controller [Use the accelerator pedal position sensor disconnected from harness.]

## TROUBLESHOOTING

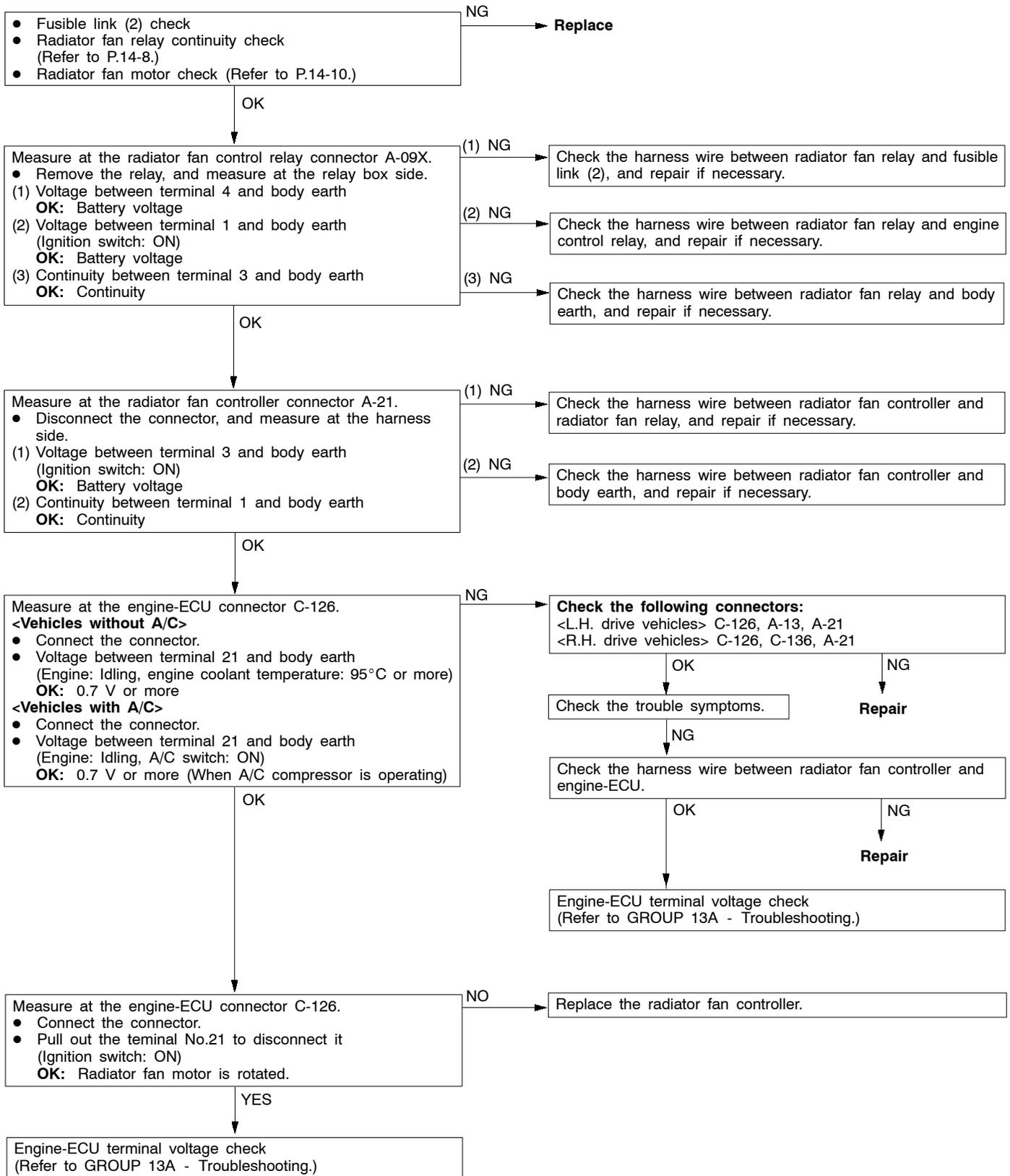
## INSPECTION CHART FOR TROUBLE SYMPTOMS

Trouble symptoms	Inspection procedure No.	Reference page
Radiator fan does not operate.	1	14-3
Radiator fan does not change speed or stop.	2	14-5

## INSPECTION PROCEDURE FOR TROUBLE SYMPTOMS

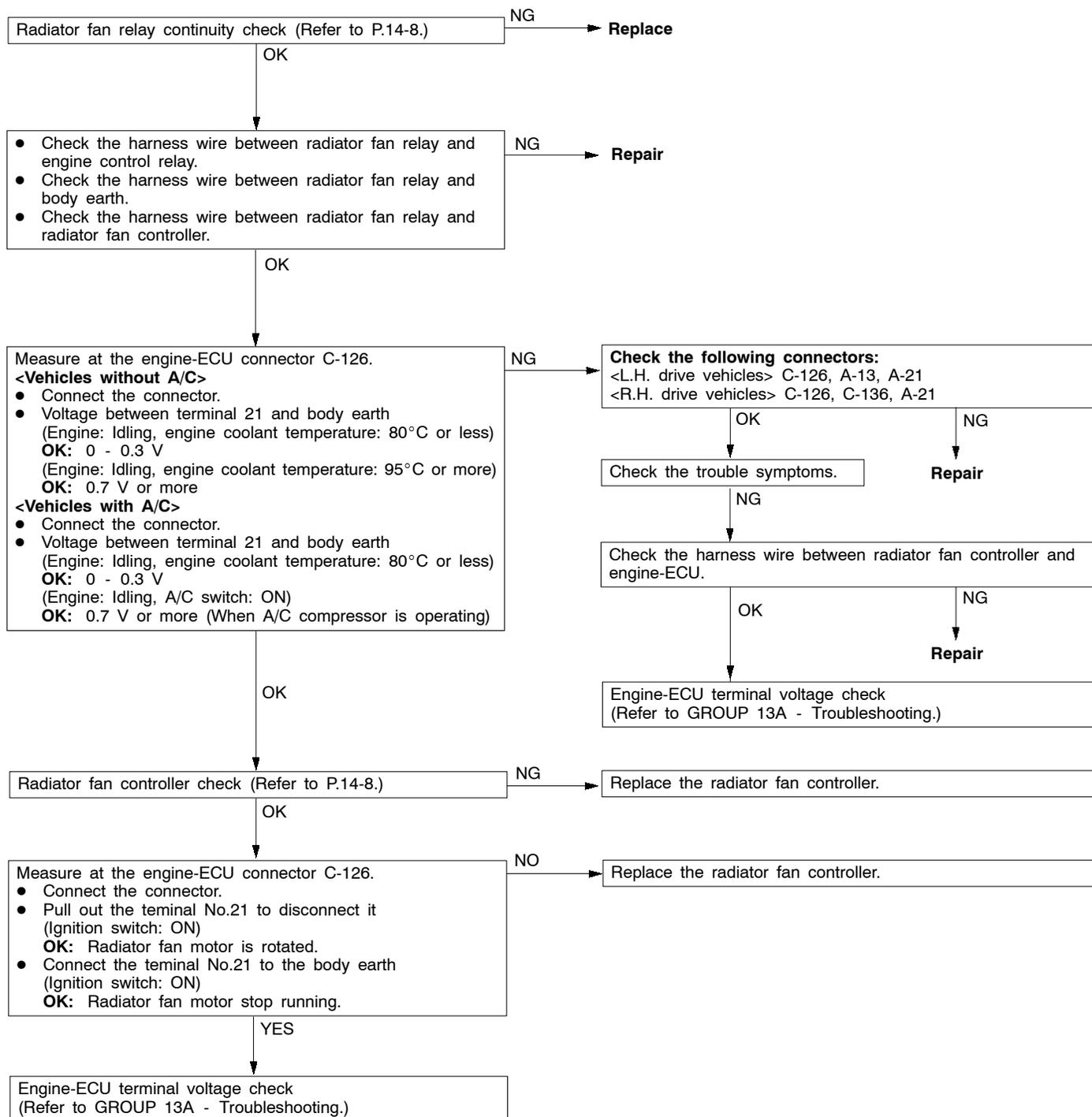
## Inspection Procedure 1

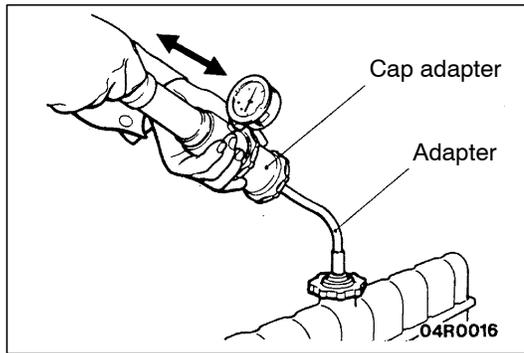
Radiator fan does not operate.	Probable cause
<p>Failure may occur on the power supply of the radiator fan controller and the earth circuit.</p> <p>Failure may also occur on the radiator fan controller and engine-ECU.</p>	<ul style="list-style-type: none"> <li>● Malfunction of fusible link</li> <li>● Malfunction of radiator fan relay</li> <li>● Malfunction of radiator fan controller</li> <li>● Malfunction of radiator fan motor</li> <li>● Malfunction of engine-ECU</li> <li>● Malfunction of harness, connector</li> </ul>



Inspection Procedure 2

Radiator fan does not change speed or stop.	Probable cause
Radiator fan controller uses the signal from engine-ECU to control radiator fan motor in a continuously variable mode.	<ul style="list-style-type: none"> <li>● Malfunction of radiator fan relay</li> <li>● Malfunction of radiator fan controller</li> <li>● Malfunction of engine-ECU</li> <li>● Malfunction of harness, connector</li> </ul>





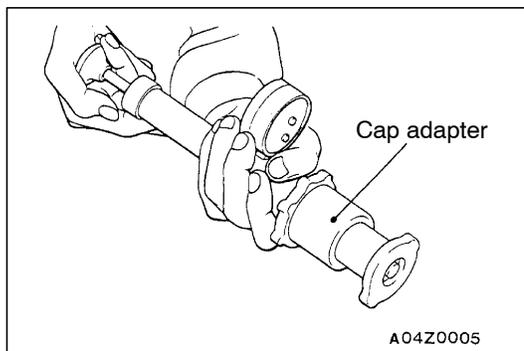
## ON-VEHICLE SERVICE

### ENGINE COOLANT LEAK CHECKING

1. Confirm that the coolant level is up to the filler neck. Install a radiator cap tester and apply 160 kPa pressure, and then check for leakage from the radiator hose or connections.

#### Caution

- (1) **Be sure to completely clean away any moisture from the places checked.**
  - (2) **When the tester is taken out, be careful not to spill any coolant from it.**
  - (3) **Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.**
2. If there is leakage, repair or replace the appropriate part.



### RADIATOR CAP OPENING PRESSURE CHECK

1. Use a cap adapter to attach the cap to the tester.
2. Increase the pressure until the indicator of the gauge stops moving.

**Limit: 83 kPa**

**Standard value: 93 - 123 kPa**

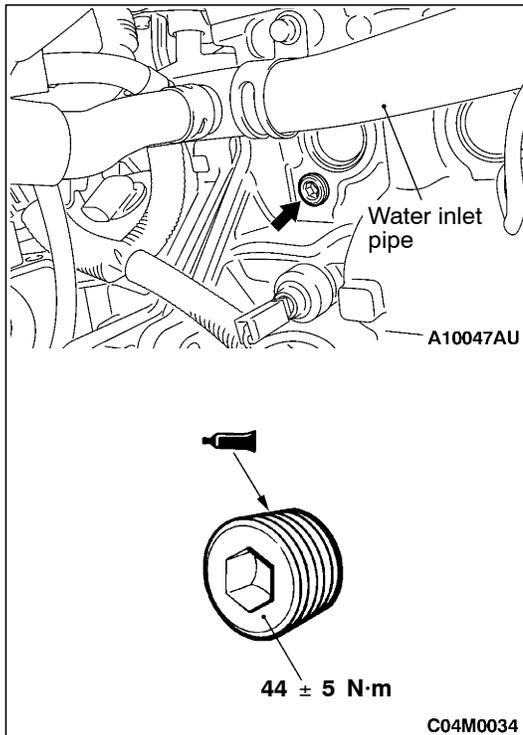
3. Replace the radiator cap if the reading does not remain at or above the limit.

#### NOTE

Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an improper indication.

### ENGINE COOLANT REPLACEMENT

1. Remove the under cover.  
(Refer to GROUP 51 - Front Bumper.)
2. Drain the engine coolant by removing the drain plug and then the radiator cap.



3. Remove the cylinder block drain plug from the cylinder block to drain the engine coolant.
4. Remove the reserve tank to drain the engine coolant.
5. When the engine coolant has drained, pour in water from the radiator cap to clean the engine coolant line.
6. Coat the thread of the cylinder block drain plug with the specified sealant and tighten to the specified torque.

**Specified sealant:**

**3M Nut Locking Part No. 4171 or equivalent**

7. Securely tighten the radiator drain plug.
8. Install the under cover.  
(Refer to GROUP 51 - Front Bumper.)
9. Install the reserve tank.
10. Slowly pour the engine coolant into the mouth of the radiator until the radiator is full, and pour also into the reserve tank up to the FULL line.

**Recommended anti-freeze:**

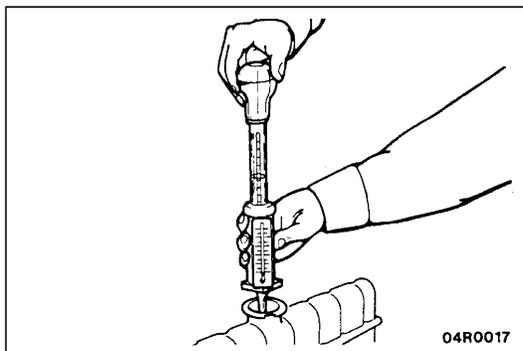
**MITSUBISHI GENUINE COOLANT or equivalent**

**Quantity: 6.0 L**

**Caution**

**Do not use alcohol or methanol anti-freeze or any engine coolants mixed with alcohol or methanol anti-freeze. The use of an improper anti-freeze can cause the corrosion of the aluminium components.**

11. Install the radiator cap securely.
12. Start the engine and warm the engine until the thermostat opens. (Touch the radiator hose with your hand to check that warm water is flowing.)
13. After the thermostat opens, race the engine several times, and then stop the engine.
14. Cool down the engine, and then pour engine coolant into the reserve tank until the level reaches the FULL line. If the level is low, repeat the operation from step 11.



**CONCENTRATION MEASUREMENT**

Measure the temperature and specific gravity of the engine coolant to check the antifreeze concentration.

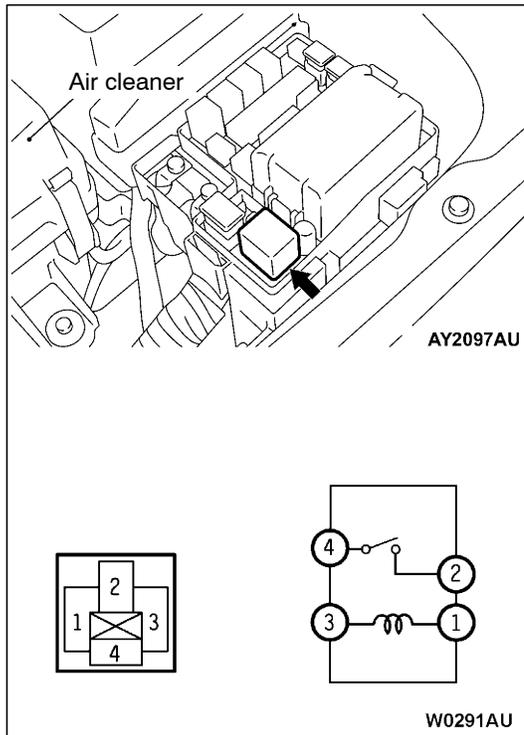
**Standard value: 30 - 60 % (allowable concentration range)**

**RECOMMENDED ANTI-FREEZE**

Antifreeze	Allowable concentration
MITSUBISHI GENUINE COOLANT or equivalent	30 - 60 %

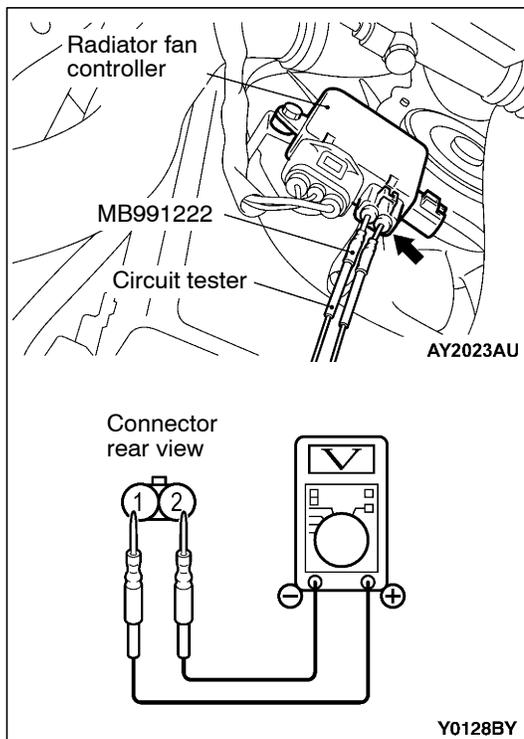
**Caution**

**If the concentration of the anti-freeze is below 30 %, the anti-corrosion property will be adversely affected. In addition, if the concentration is above 60 %, both the anti-freezing and engine cooling properties will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.**



### RADIATOR FAN RELAY CONTINUITY CHECK

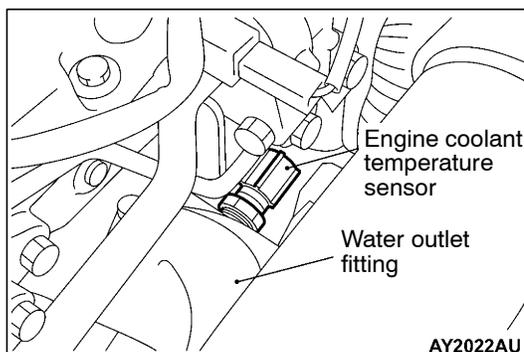
Battery voltage	Terminal No.			
	1	2	3	4
When current is not supplied	○	—	○	
When current is supplied	⊕	○	⊖	○



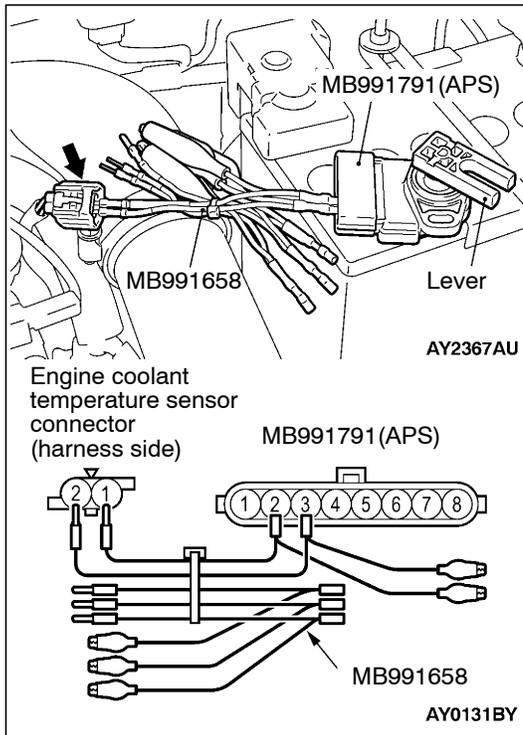
### RADIATOR FAN CONTROLLER CHECK

#### <Vehicles without A/C>

1. Remove the center under cover.  
(Refer to GROUP 51 - Front Bumper.)
2. Insert the special tool at the back of the radiator fan motor connector.
3. Connect the special tool to the circuit tester.



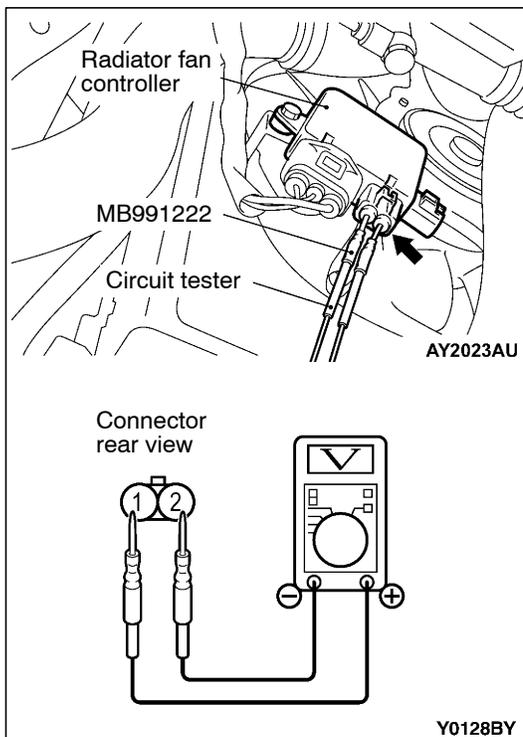
4. Disconnect the engine coolant temperature sensor connector.



5. Connect the special tool (MB991658) to the harness side of the engine coolant temperature sensor connector.
6. Connect the special tool [MB991791 (APS)] to the special tool (MB991658).
7. Start the engine and let it run at idle.
 

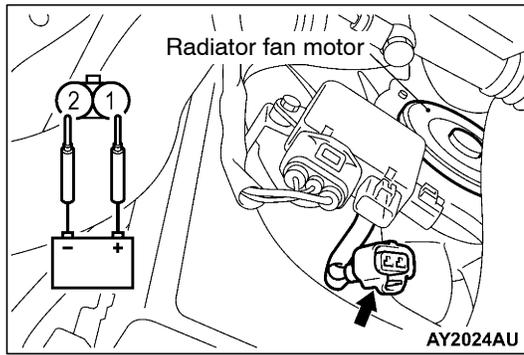
NOTE

Since the resistance value of the special tool (APS) indicates a low engine coolant temperature, engine speed increases.
8. When the lever of the special tool (APS) is turned to the end, check that the engine speed decreases and the radiator fan motor rotates.
9. When the lever of the special tool (APS) is turned to the reverse direction, check that the voltage between terminals of the radiator fan motor connector gradually decreases from the battery voltage to 0 V.
10. If inoperable, replace the radiator fan controller. (Refer to P.14-15.)
11. Install the center under cover. (Refer to GROUP 51 - Front Bumper.)
12. Connect the engine coolant temperature sensor connector.



#### <Vehicles with A/C>

1. Remove the center under cover. (Refer to GROUP 51 - Front Bumper.)
2. Insert the special tool at the back of the radiator fan motor connector.
3. Connect the special tool to the circuit tester.
4. Start the engine and run it at idle.
5. Turn the A/C switch to the ON position and hold the engine coolant temperature at 80°C or lower.
6. When the voltage between the terminals of the radiator fan motor connector, the following values of (1) - (3) can be detected at random.
  - (1) 0 V
  - (2)  $8.2 \pm 2.6$  V
  - (3) Battery voltage  $\pm 2.6$  V
7. If inoperable, replace the radiator fan controller. (Refer to P.14-15.)
8. Install the center under cover. (Refer to GROUP 51 - Front Bumper.)



### RADIATOR FAN MOTOR CHECK

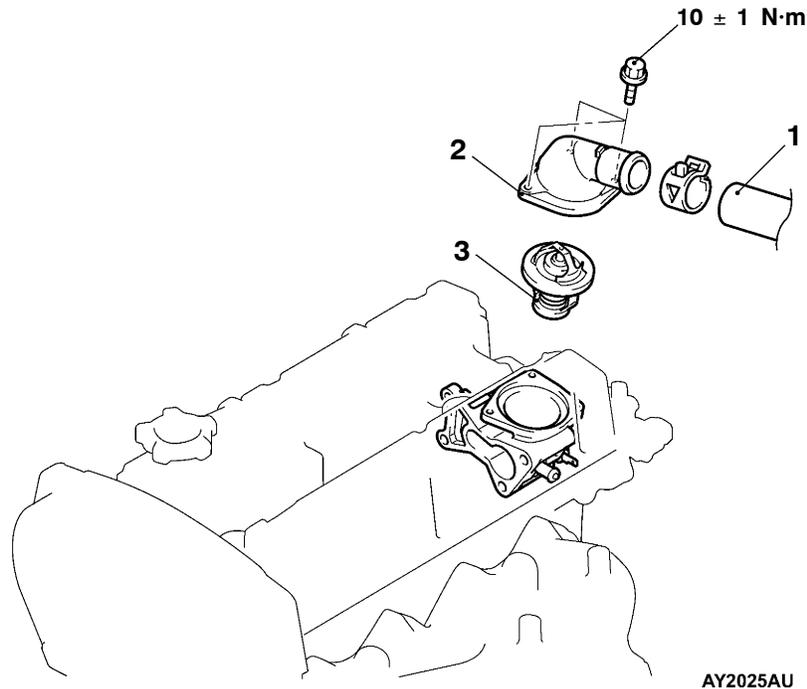
1. Remove the center under cover.  
(Refer to GROUP 51 - Front Bumper.)
2. Disconnect the radiator fan motor connector.
3. Check that the motor rotates when energizing battery voltage between the terminals of connectors of the radiator fan motor side. Check that there is abnormal noise from the radiator fan motor then.
4. If inoperable, replace the radiator fan motor.  
(Refer to P.14-15.)
5. Install the center under cover.  
(Refer to GROUP 51 - Front Bumper.)

# THERMOSTAT

## REMOVAL AND INSTALLATION

### Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying (Refer to P.14-6.)
- Air Duct Assembly Removal and Installation (Refer to GROUP 15 - Air Cleaner.)
- Vacuum Pipe, Secondary Air Pipe Assembly Removal and Installation (Refer to GROUP 15 - Secondary Air Supply System.)



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### Removal steps

- ◀A▶ ▶B▶ 1. Radiator upper hose connection  
 ▶A▶ 2. Water outlet fitting  
 ▶A▶ 3. Thermostat

### REMOVAL SERVICE POINT

#### ◀A▶ RADIATOR UPPER HOSE DISCONNECTION

After making mating marks on the radiator hose and the hose clamp, disconnect the radiator hose.

**INSTALLATION SERVICE POINTS****►A◄ THERMOSTAT INSTALLATION**

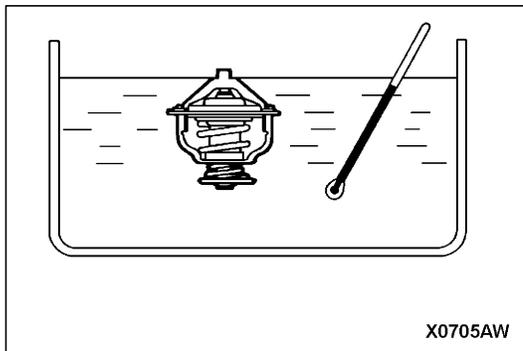
Install the thermostat being careful not to fold over or scratch the rubber ring.

**Caution**

**Make absolutely sure that no oil is adhering to the rubber ring of the thermostat. In addition, be careful not to fold over or scratch the rubber ring when inserting. If the rubber ring is damage, replace the thermostat.**

**►B◄ RADIATOR UPPER HOSE CONNECTION**

1. Insert each hose as far as the projection of the water outlet fitting.
2. Align the mating marks on the radiator hose and hose clamp, and then connect the radiator hose.

**INSPECTION****THERMOSTAT CHECK**

1. Immerse the thermostat in water, and heat the water while stirring. Check the thermostat valve opening temperature.

**Standard value:**

**Valve opening temperature:  $80 \pm 1.5^{\circ}\text{C}$**

2. Check that the amount of valve lift is at the standard value when the water is at the full-opening temperature.

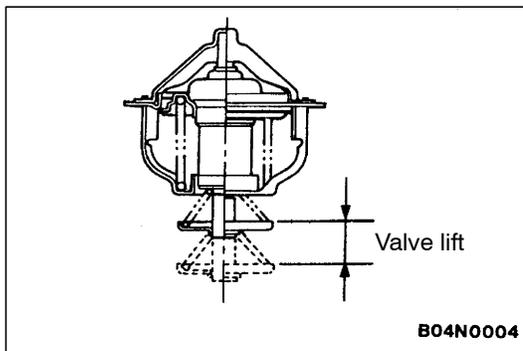
**Standard value:**

**Full-opening temperature:  $93^{\circ}\text{C}$**

**Amount of valve lift: 9.5 mm or more**

**NOTE**

Measure the valve height when the thermostat is fully closed, and use this measurement to calculate the valve height when the thermostat is fully open.



## WATER PUMP

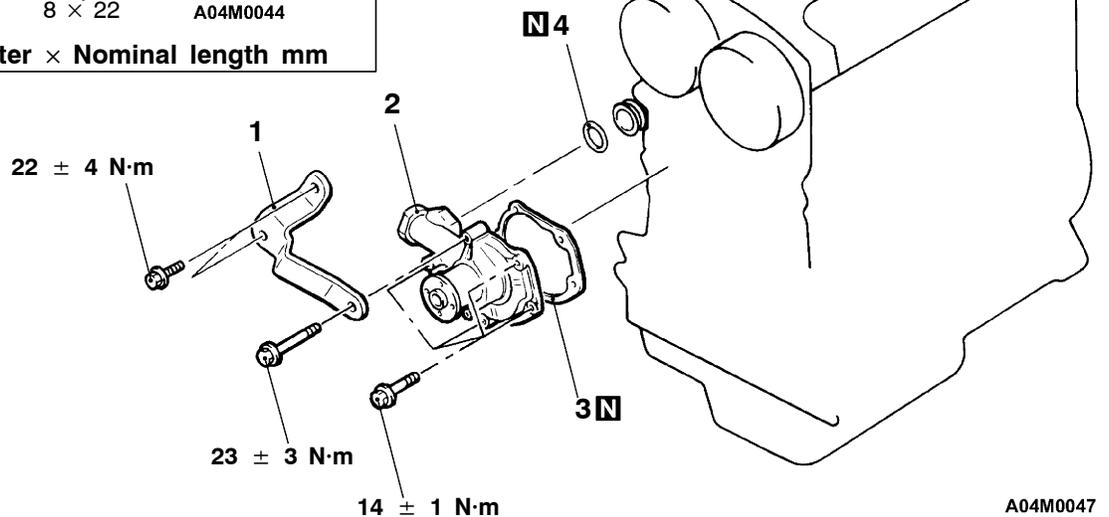
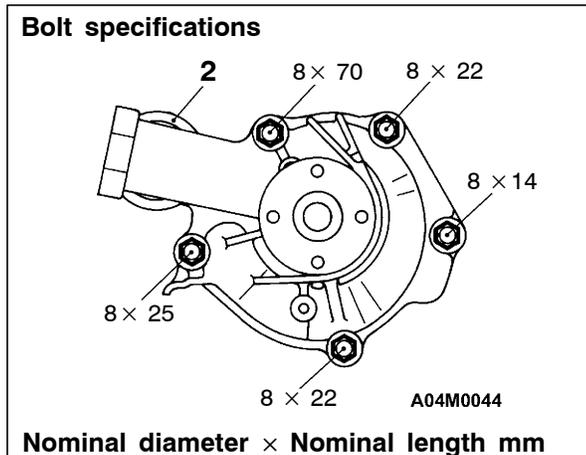
### Caution

If the vehicle is equipped with the Brembo disc brake, during maintenance, take care not to contact the parts or tools to the caliper because the paint of caliper will be scratched.

### REMOVAL AND INSTALLATION

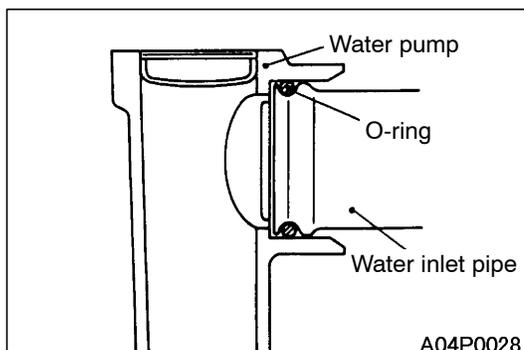
#### Pre-removal and Post-installation Operation

- Engine Coolant Draining and Supplying (Refer to P.14-6.)
- Timing Belt Removal and installation (Refer to GROUP 11A.)



#### Removal steps

1. Alternator brace
2. Water pump
3. Water pump Gasket
4. O-ring



#### INSTALLATION SERVICE POINT

##### ▶◀ O-RING INSTALLATION

Fit an O-ring into the O-ring groove located at the end of the water inlet pipe and apply water to the O-ring or the inside of the mounting surface of the water pump for insertion.

#### CAUTION

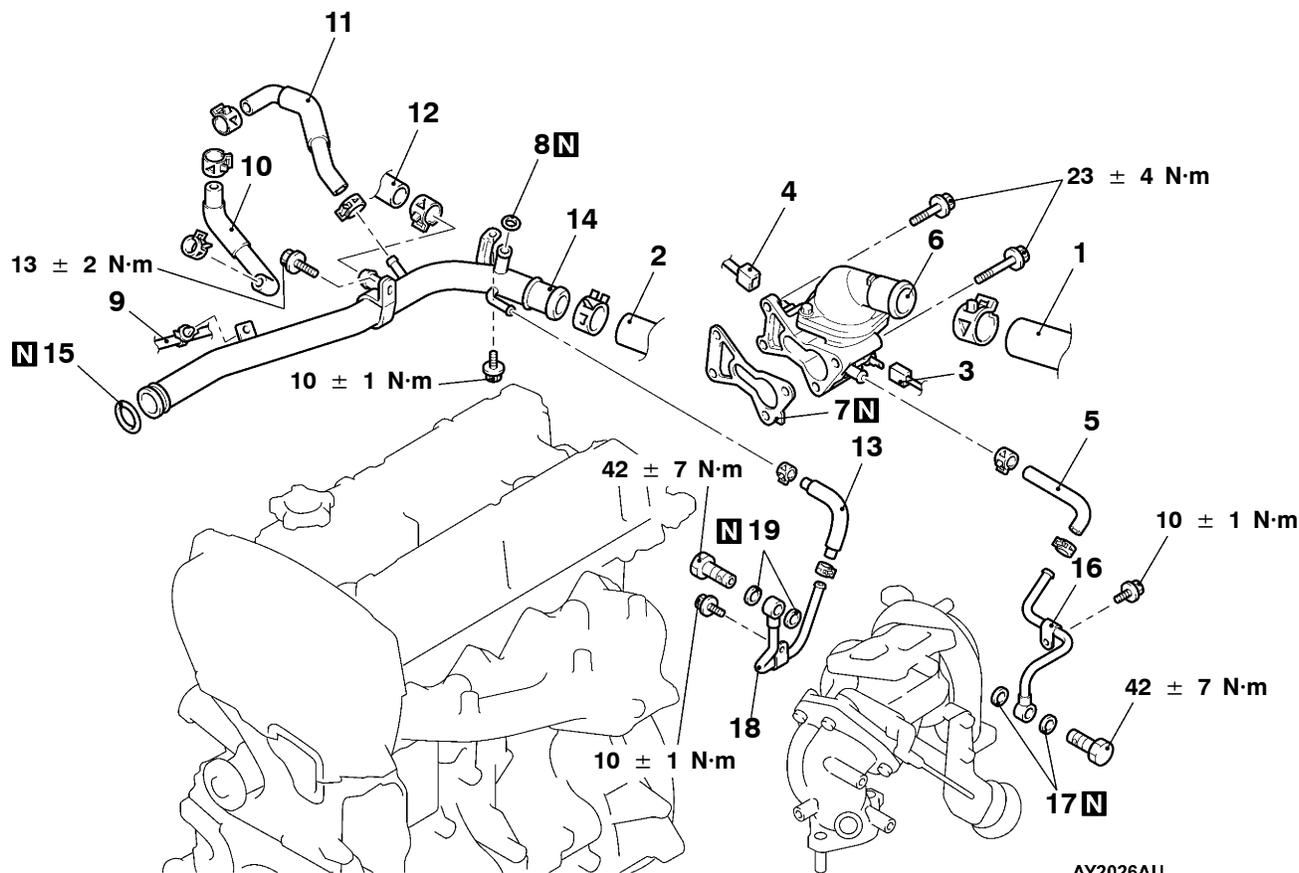
Do not let the O-ring get contaminated with grease, such as engine oil.

## WATER HOSE AND WATER PIPE

## REMOVAL AND INSTALLATION

**Pre-removal and Post-installation Operation**

- Engine Coolant Draining and Supplying (Refer to P.14-6.)
- Air Cleaner Assembly Removal and Installation (Refer to GROUP 15 - Air Cleaner.)
- Air Bypass Valve Assembly, Air Bypass Hose, Air Hose E and Air Pipe C, Air Hose D Removal and Installation (Refer to GROUP 15 - Intercooler.)
- Secondary Air Control Valve Bracket Removal and Installation (Refer to GROUP 15 - Secondary Air Supply System.)
- Battery, Battery Tray Removal and Installation



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**Removal steps**

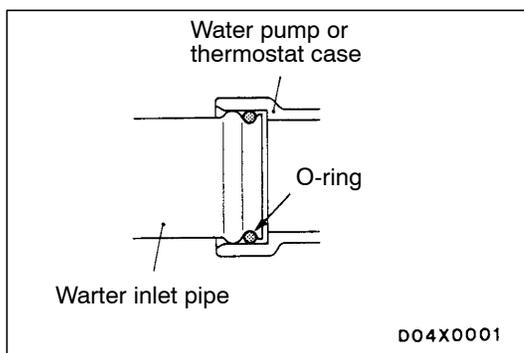
1. Radiator upper hose connection
2. Radiator lower hose connection
3. Engine coolant temperature gauge unit connector
4. Engine coolant temperature sensor connector
5. Water hose
6. Water outlet fitting and thermostat case assembly
7. Thermostat case gasket
8. O-ring
9. Detonation sensor connection
10. Water hose



11. Water hose
12. Heater hose connection
13. Water hose
14. Water inlet pipe
15. O-ring
16. Turbocharger water feed pipe
17. Gasket
  - Turbocharger assembly (Refer to GROUP 15.)
18. Turbocharger water return pipe
19. Gasket

**REMOVAL SERVICE POINT****◀A▶ RADIATOR UPPER HOSE/RADIATOR LOWER HOSE DISCONNECTION**

After making mating marks on the hose and the hose clamp, disconnect the hose.

**INSTALLATION SERVICE POINTS****▶A◀ O-RING INSTALLATION**

Fit an O-ring into the groove of the water inlet pipe and apply water to the circumference of the O-ring or the inside of the mounting surface of the pipe for insertion.

**CAUTION**

**Do not let the O-ring get contaminated with grease, such as engine oil.**

**▶B◀ WATER INLET PIPE INSTALLATION**

After installing the water outlet fitting and the thermostat case assembly, tighten the mounting bolt of the water inlet pipe to the specified torque.

**▶C◀ RADIATOR LOWER HOSE/RADIATOR UPPER HOSE CONNECTION**

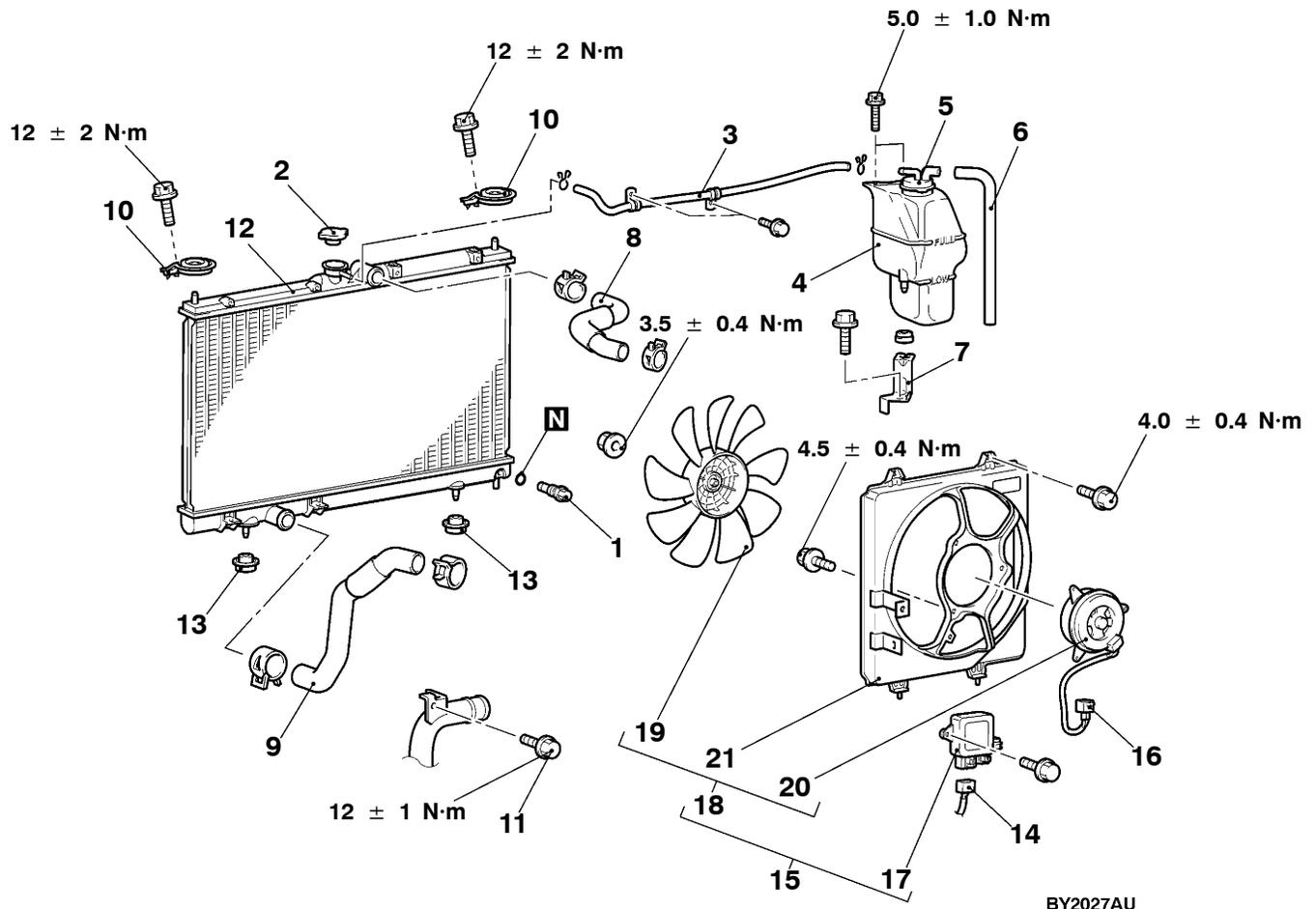
1. Insert each hose as far as the projection of the water inlet pipe or water outlet fitting.
2. Align the mating marks on the radiator hose and hose clamp, and then connect the radiator hose.

**INSPECTION****WATER PIPE AND HOSE CHECK**

Check the water pipe and hose for cracks, damage, clog and replace them if necessary.

**RADIATOR****REMOVAL AND INSTALLATION****Pre-removal and Post-installation Operation**

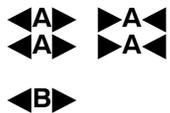
- Engine Coolant Draining and Supplying (Refer to P.14-6.)
- Under Cover Removal and Installation (Refer to GROUP 51 - Front Bumper.)
- Air Cleaner Assembly Removal and Installation (Refer to GROUP 15.)
- Air Hose E, Air Pipe C, Air hose D Removal and Installation (Refer to GROUP 15 - Intercooler.)
- Battery and Battery Tray Removal and Installation



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**Radiator removal steps**

1. Radiator drain plug
2. Radiator cap
3. Reserve tank hose
4. Reserve tank
5. Reserve tank cap
6. Reserve tank hose
7. Reserve tank bracket
8. Radiator upper hose
9. Radiator lower hose
10. Upper insulator
11. Air Pipe B mounting bolt
12. Radiator assembly
13. Lower insulator
14. Radiator fan controller connector
15. Radiator fan controller, radiator fan motor, fan and shroud assembly

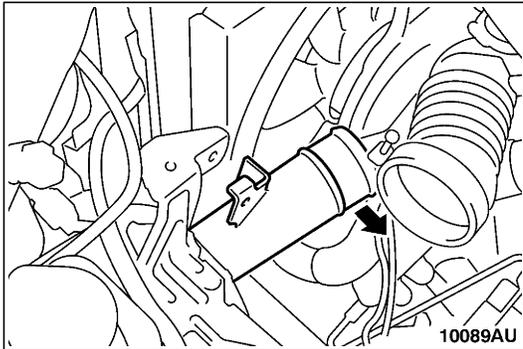


**Radiator fan controller and radiator fan motor removal steps**

11. Air Pipe B mounting bolt
14. Radiator fan controller connector
16. Radiator fan motor connector
17. Radiator fan controller
18. Radiator fan motor fan and shroud assembly
19. Fan
20. Radiator fan motor
21. Shroud

**REMOVAL SERVICE POINTS****◀A▶ RADIATOR UPPER HOSE/RADIATOR LOWER HOSE REMOVAL**

After making mating marks on the radiator hose and the hose clamp, disconnect the radiator hose.

**◀B▶ AIR PIPE B MOUNTING BOLT REMOVAL**

After removing the bolt, position air pipe B out of the way so that the pipe does not interfere with the radiator assembly or the radiator fan motor, the fan and shroud assembly.

**INSTALLATION SERVICE POINT****▶A◀ RADIATOR LOWER HOSE/RADIATOR UPPER HOSE INSTALLATION**

1. Insert each hose as far as the projection of the water inlet pipe, water outlet fitting or radiator.
2. Align the mating marks on the radiator upper hose and hose clamp, and then connect the radiator hose.

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## NOTES