GROUP 14

ENGINE COOLING

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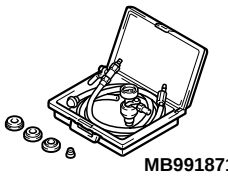
GENERAL DESCRIPTION

M1141000100263

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 and is cooled by the cooling fan.

SPECIAL TOOL

M1141000600116

TOOL	TOOL NUMBER AND NAME	SUPERSESSION	APPLICATION
 MB991871	MB991871 LLC changer	–	Coolant refilling

ENGINE COOLING DIAGNOSIS

INTRODUCTION

M1141005300251

The system cools the engine so that it does not overheat and maintains the engine at an optimum temperature. The system components are the radiator, water pump, thermostat, cooling fan and fan clutch assembly. Possible faults include low coolant, contamination, belt loosening and component damage.

TROUBLESHOOTING STRATEGY

M1141005200254

Use these steps to plan your diagnostic strategy. If you follow them carefully, you will be sure to find most of the engine cooling faults.

1. Gather information from the customer.
2. Verify that the condition described by the customer exists.
3. Find the malfunction by following the SYMPTOM CHART.
4. Verify that the malfunction is eliminated.

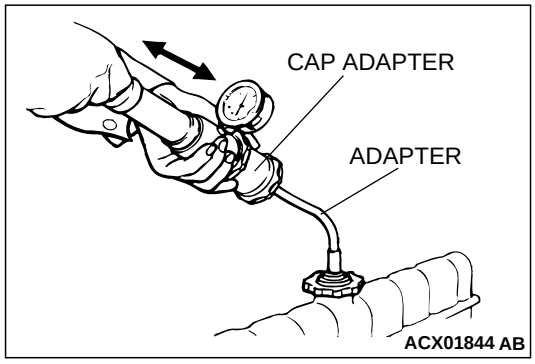
SYMPTOM CHART

M1141005600252

SYMPTOM	INSPECTION PROCEDURE	REFERENCE PAGE
Coolant Leak	1	P.14-3
Engine Overheating	2	P.14-4

SYMPTOM PROCEDURES

INSPECTION PROCEDURE 1: Coolant Leak



DIAGNOSIS

STEP 1. Check for coolant leaks.

⚠ ***WARNING***

When pressure testing the cooling system, slowly release cooling system pressure to avoid getting burned by hot coolant.

⚠ **CAUTION**

- **Be sure to completely clean away any moisture from the places checked.**
- **When the tester is removed, be careful not to spill any coolant.**
- **When installing and removing the tester and when testing, be careful not to deform the filler neck of the radiator.**

Check that the coolant level is up to the filler neck. Install a radiator tester and apply 160 kPa (23 psi) pressure, and then check for leakage from the radiator hose or connections.

Q: Is leakage present from the radiator hose or connections?

YES : Repair or replace the appropriate part, then go to Step 2.

NO : There is no action to be taken.

STEP 2. Retest the system.

Q: Can the symptom be reproduced?

YES : Return to Step 1.

NO : This procedure is complete.

INSPECTION PROCEDURE 2: Engine Overheating

DIAGNOSIS

STEP 1. Remove the radiator cap and check for coolant contamination.

Q: Is the coolant contaminated with rust and oil?

YES : Replace it. Refer to GROUP 00, Maintenance Service – Engine Coolant (Change) P.00-50.

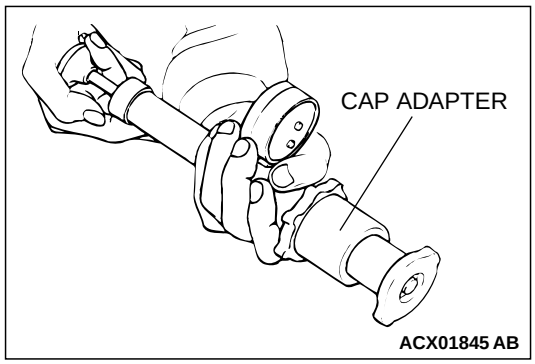
NO : There is no action to be taken, go to Step 2.

STEP 2. Check the radiator cap valve opening pressure.

NOTE: Be sure that the cap is clean before testing. Rust or other foreign material on the cap seal will cause an improper reading.

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

Minimum limit: 64 kPa (9.2 psi)
Standard value: 74 – 103 kPa (11 – 15 psi)



Q: Does the reading remain at or above the minimum limit?

YES : Go to Step 3.

NO : Replace the radiator cap. Then go to Step 5.

STEP 3. Check thermostat operation.

Refer to P.14-12.

Q: Is the thermostat operate correctly?

YES : Go to Step 4.

NO : Replace the thermostat, then go to Step 5.

STEP 4. Check the drive belt for slippage or damage.

Refer to GROUP 00, Maintenance Service – Drive Belts (Check Condition) P.00-43.

Q: Is the drive belt loose or damaged?

YES : Adjust or replace the drive belt, then go to Step 5.

NO : There is no action to be taken.

STEP 5. Retest the system.

Check the coolant temperature gauge.

Q: Is the coolant temperature abnormally high?

YES : Return to Step 2.

NO : This procedure is complete.

ON-VEHICLE SERVICE

ENGINE COOLANT LEAK CHECK

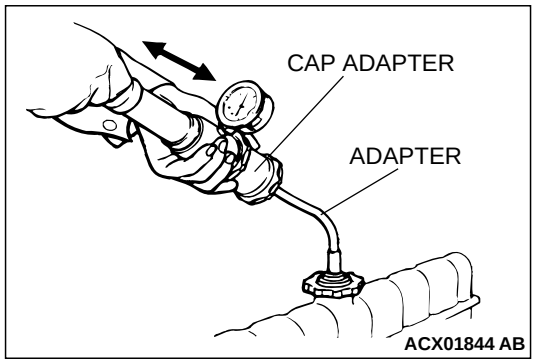
M1141001000203

⚠ *WARNING*

When pressure testing the cooling system, slowly release cooling system pressure to avoid getting burned by hot coolant.

⚠ **CAUTION**

- **Be sure to completely clean away any moisture from the places checked.**
- **When the tester is taken out, be careful not to spill any coolant.**
- **Be careful when installing and removing the tester and when testing not to deform the filler neck of the radiator.**

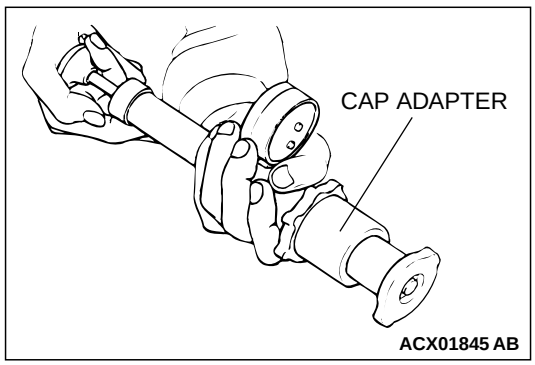


1. Check that the coolant level is up to the filler neck. Install a radiator tester and apply 160 kPa (23 psi) pressure, and then check for leakage from the radiator hose or connections.
2. If there is leakage, repair or replace the appropriate part.

RADIATOR CAP PRESSURE CHECK

M1141001300259

NOTE: Be sure that the cap is clean before testing. Rust or other foreign material on the cap seal will cause an improper reading.



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

   Minimum limit: 64 kPa (9.2 psi)
   Standard value: 74 – 103 kPa (11 – 15 psi)
3. Replace the radiator cap if the reading does not remain at or above the limit.

ENGINE COOLANT REPLACEMENT

M1141001200274

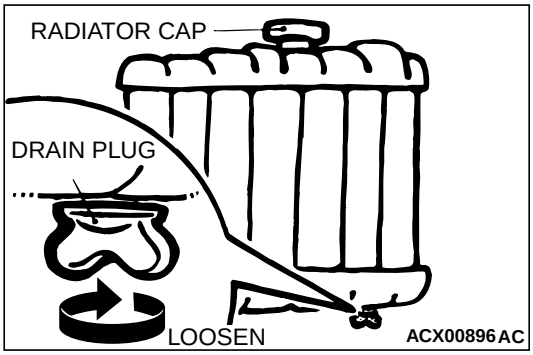
Check the cooling system parts such as the radiator, heater and oil cooler hoses, thermostat and the connections for leakage and damage.

CHANGING COOLANT

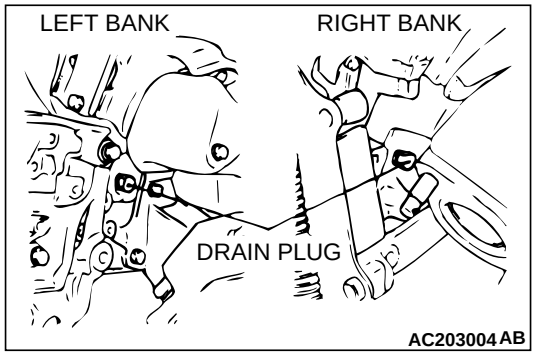
1. Set the temperature control knob to the "HOT" position.

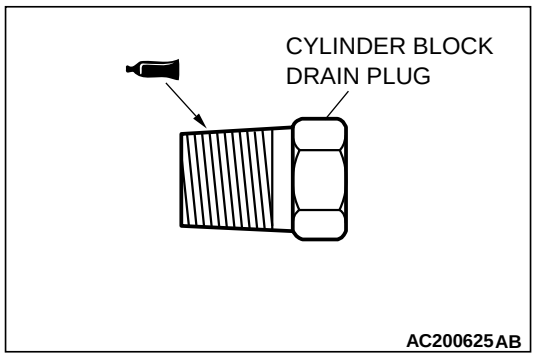
⚠ CAUTION

When removing the radiator cap, use care to avoid contact with hot coolant or steam. Place a shop towel over the cap and turn the cap counterclockwise a little to let the pressure escape through the vinyl tube. After relieving the steam pressure, remove the cap by slowly turning it counterclockwise.



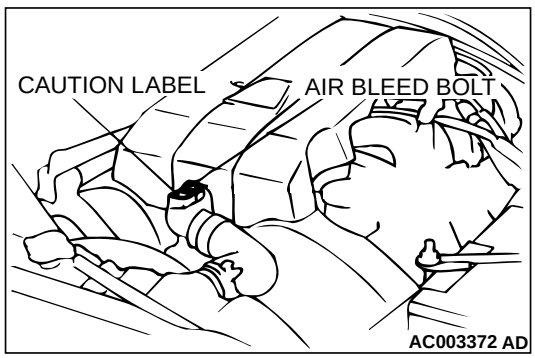
2. Remove the radiator cap, radiator drain plug and cylinder block drain plug to drain the coolant.
3. Remove the reserve tank and drain the coolant.
4. After completely draining the coolant, reinstall the drain plugs and flush the engine and radiator using a radiator cleaning fluid.
5. After the flushing is completed, completely drain the cleaning fluid.



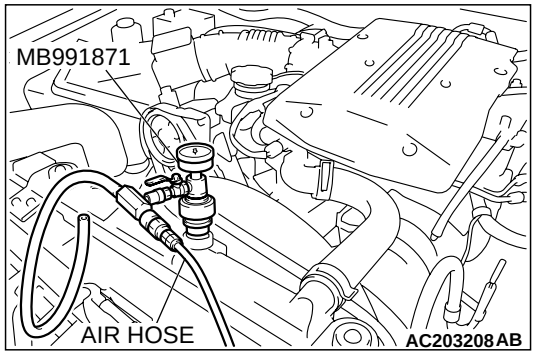


6. Apply the designated sealant to the screw area of the cylinder block drain plug, and then tighten at the standard torque.

   Specified sealant: 3M™ Nut Locking Part number 4171 or equivalent
   Tightening torque: 39 N·m (29 ft-lb)



7. Loosen the air bleed bolt.



⚠ CAUTION

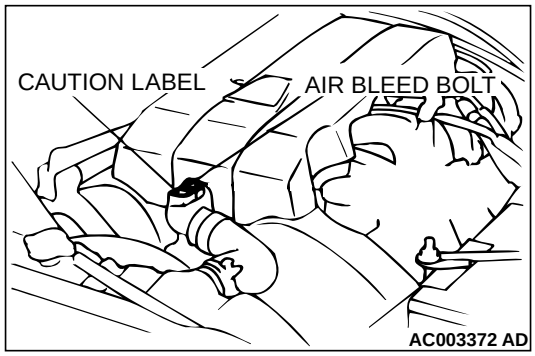
Do not use alcohol or methanol anti-freeze or any engine coolants mixed with alcohol or methanol anti-freeze. The use of an improper anti-freeze can cause the corrosion of the aluminum components.

8. By referring to the section on coolant, select an appropriate concentration for safe operating temperature within the range of 30 to 60%. Use special tool MB991871 to refill the coolant. A convenient mixture is a 50% water and 50% antifreeze solution [freezing point: –31°C (–32.8 °F)].

   Recommended antifreeze:
   MITSUBISHI GENUINE Part number MD970389 or equivalent

   Quantity:
   Without rear heater 9.0 cm^3 (9.5 quart)
   With rear heater 10.0 cm^3 (10.6 quart)

   NOTE: For the usage of special tool MB991870, refer to the instructions enclosed with the special tool.



9. Pour in coolant until it overflows from the air bleed bolt hole, and then tighten the air bleed bolt.

   Tightening torque:
   <3.0L> 17 – 20N·m (12 – 14 ft-lb)
   <3.5L> 12 – 15N·m (106 – 133 in-lb)

10. Reinstall the radiator cap.
11. Start the engine and let it warm up until the thermostat opens.
12. After repeatedly revving the engine up to 3,000 r/min several times, then stop the engine.
13. Remove the radiator cap after the engine has become cold, and pour in coolant up to the brim. Rein stall the cap.

⚠ CAUTION

Do not overfill the tank.

14. Add coolant to the reserve tank between the "FULL" and "LOW" mark if necessary.

ENGINE COOLANT CONCENTRATION TEST

M1141001100233

Refer to GROUP 00, RECOMMENDED LUBRICANTS AND LUBRICANT CAPACITIES TABLE P.00-36.

DRIVE BELT TENSION CHECK AND ADJUSTMENT

M1141004500092

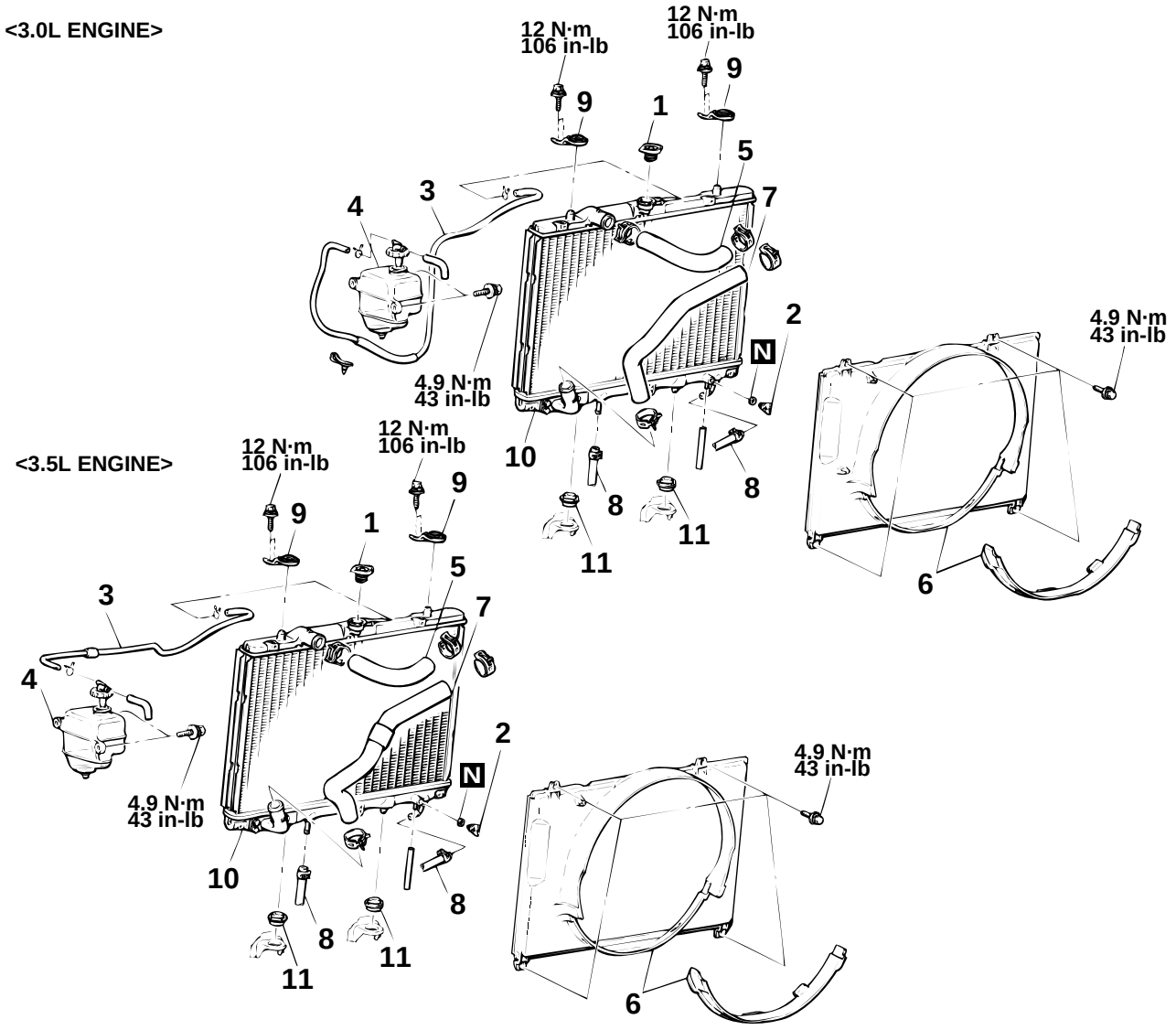
Refer to GROUP 00, Maintenance Service P.00-43.

RADIATOR

REMOVAL AND INSTALLATION

M1141001500264

Pre-removal Operation	Post-installation Operation
• Under Cover Removal • Engine Coolant Draining (Refer to P.14-5.)	• A/T Fluid Refilling and Level Check (Refer to GROUP 00, Maintenance Service P.00-48.) • Engine Coolant Refilling and Level Check (Refer to P.14-5.).



AC004452 AB

REMOVAL STEPS

1. RADIATOR CAP
2. DRAIN PLUG
3. RUBBER HOSE CONNECTION
4. RESERVE TANK ASSEMBLY

<<A>> >>A<< 5. RADIATOR UPPER HOSE

6. SHROUD ASSEMBLY

REMOVAL STEPS (Continued)

<<A>> >>A<< 7. RADIATOR LOWER HOSE

<<B>> 8. A/T OIL COOLER HOSE CONNECTION

9. RADIATOR SUPPORT
10. RADIATOR
11. LOWER INSULATOR

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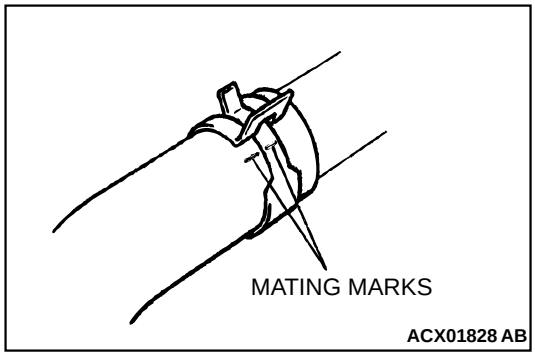
REMOVAL SERVICE POINTS

<<A>> RADIATOR UPPER HOSE/RADIATOR LOWER HOSE DISCONNECTION

Make mating marks on the radiator hose and the hose clamp. Disconnect the radiator hose.



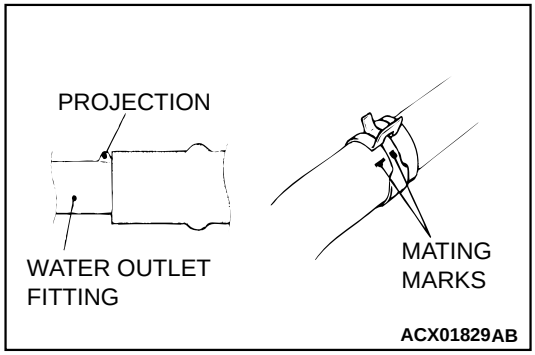
<<B>> A/T OIL COOLER HOSE REMOVAL

After removing the hose from the radiator, plug the hose and the radiator nipple to prevent dust or foreign particles from getting in.

INSTALLATION SERVICE POINT

>>A<< RADIATOR LOWER HOSE/RADIATOR UPPER HOSE CONNECTION

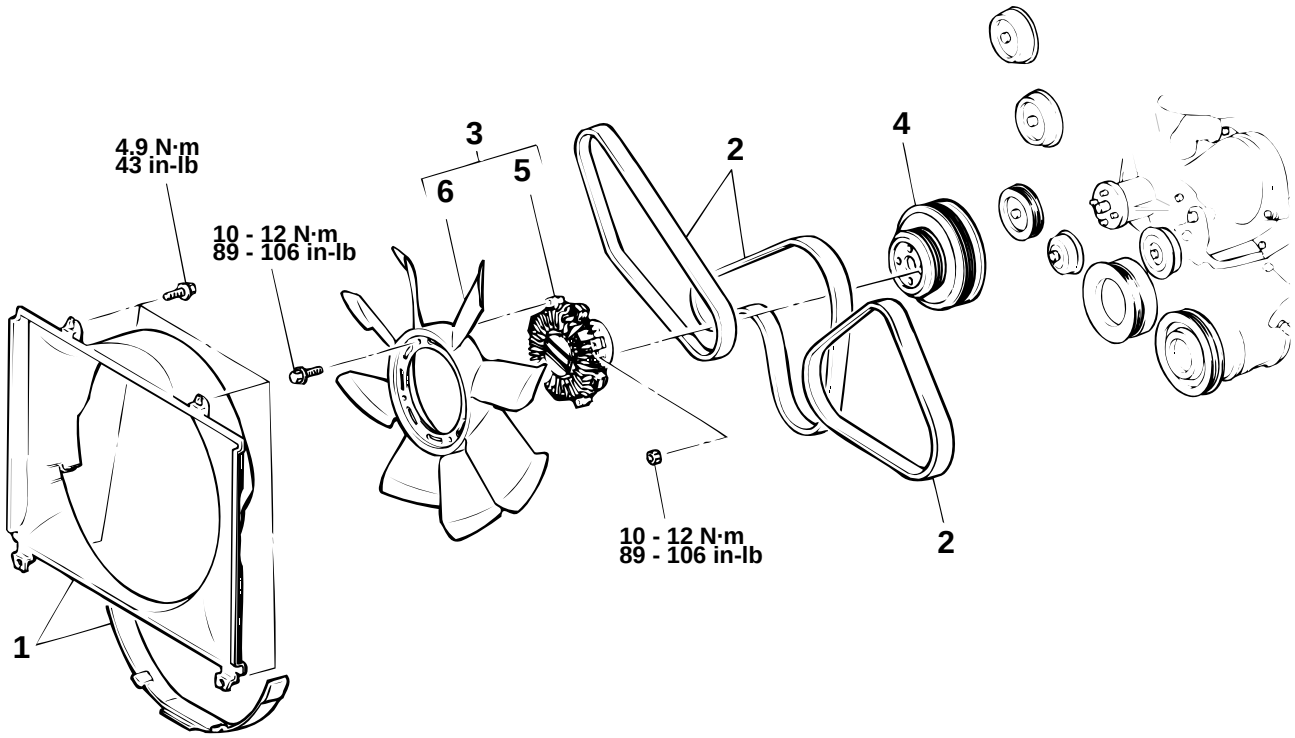
1. Insert each hose as far as the projection of the water inlet fitting.
2. Align the mating marks on the radiator hose and hose clamp, and then connect the radiator hose.



COOLING FAN

REMOVAL AND INSTALLATION

M1141002100098



AC004453 AB

REMOVAL STEPS
1. SHROUD ASSEMBLY
2. DRIVE BELTS
3. COOLING FAN AND FAN CLUTCH ASSEMBLY

REMOVAL STEPS (Continued)
4. PULLEY
5. FAN CLUTCH
6. COOLING FAN

INSPECTION

M1141002200095

Cooling Fan Check

- Check the blades for damage and cracks.
- Check for cracks and damage around bolt holes in the fan hub.
- If any portion of the fan is damaged or cracked, replace the cooling fan.

Fan Clutch Check

- Check to ensure that fluid in the fan clutch is not leaking at the case joint and seals. If fluid quantity decreases due to leakage, the fan speed will decrease and engine overheating might result.
- When the fan attached to the engine is turned by hand, it should have some resistance. If the fan turns lightly or freely with no resistance, it is faulty.
- Check the bimetal strip for damage.

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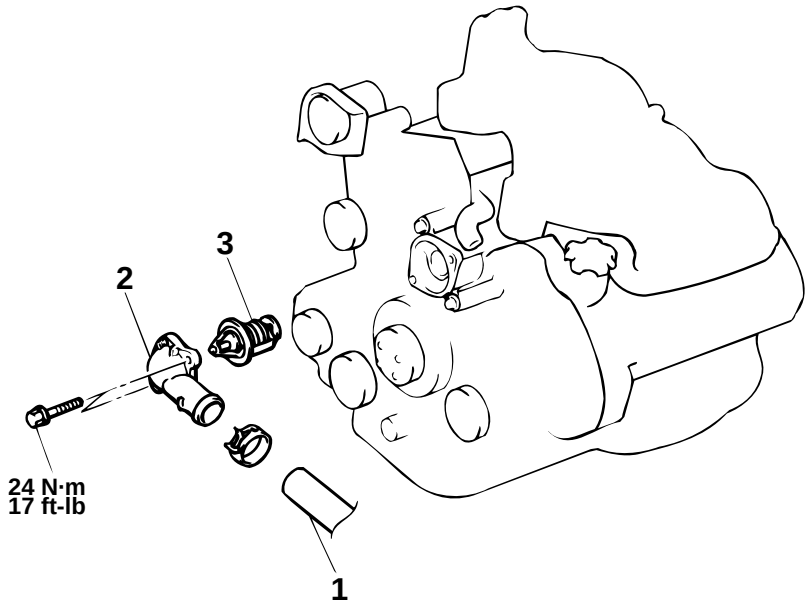
THERMOSTAT

REMOVAL AND INSTALLATION

M1141002400271

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Refilling (Refer to P.14-5.)



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REMOVAL STEPS
1. RADIATOR LOWER HOSE CONNECTION

REMOVAL STEPS (Continued)
2. WATER INLET FITTING
>>A<< 3. THERMOSTAT

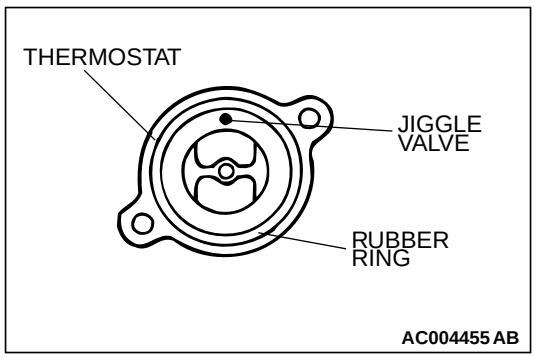
INSTALLATION SERVICE POINT

>>A<< THERMOSTAT INSTALLATION

⚠ CAUTION

Make absolutely sure that no oil adheres to the rubber ring of the thermostat. Also be careful not to fold or scratch the rubber ring during installation.

Install the thermostat so that the jiggle valve is facing straight up. Be careful not to fold or scratch the rubber ring.



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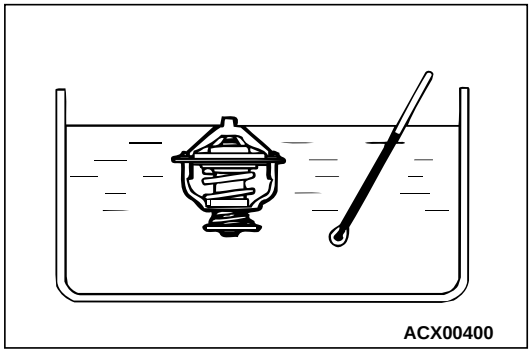
INSPECTION

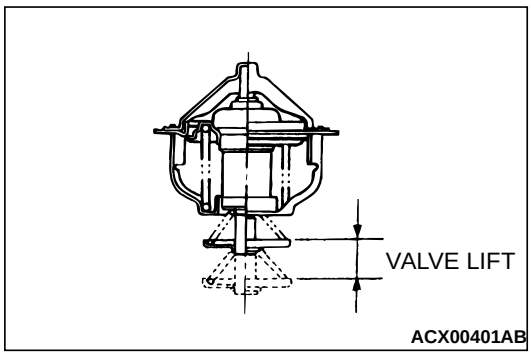
M1141002500267

Thermostat Check


ACX00400

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

   Standard value:
   Valve opening temperature: 88 ± 1.5°C (190 ± 3°F)



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

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

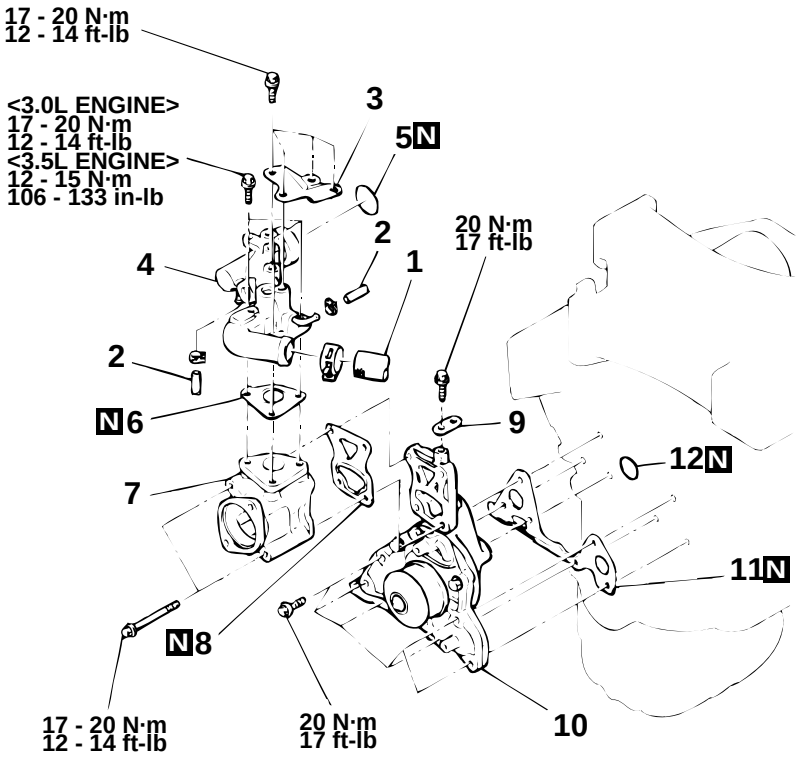
   Standard value:
   Full-opening temperature: 100°C (212°F)
   Amount of valve lift: 10 mm (0.39 inch)

WATER PUMP

REMOVAL AND INSTALLATION

M1141002700283

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Refilling (Refer to P.14-5.)
- Timing Belt Removal and Installation (3.0L Engine: Refer to GROUP 11A, Timing Belt P.11A-30.)(3.5L Engine: Refer to GROUP 11C, Timing Belt P.11C-30.)



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REMOVAL STEPS
- THERMOSTAT (REFER TO P.14-11.)

<<A>> >>C<< 1. RADIATOR UPPER HOSE CONNECTION
2. WATER HOSE CONNECTION
3. WATER OUTLET FITTING BRACKET
4. WATER OUTLET FITTING ASSEMBLY

REMOVAL STEPS (Continued)

>>A<< 5. O-RING
6. GASKET
7. THERMOSTAT CASE
8. GASKET
9. WATER PUMP BRACKET
>>B<< 10. WATER PUMP ASSEMBLY
11. GASKET
>>A<< 12. O-RING

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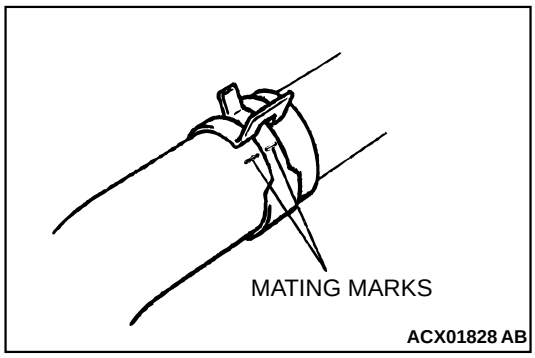
REMOVAL SERVICE POINT



<<A>> RADIATOR UPPER HOSE DISCONNECTION

Make mating marks on the radiator hose and the hose clamp. Disconnect the radiator hose.

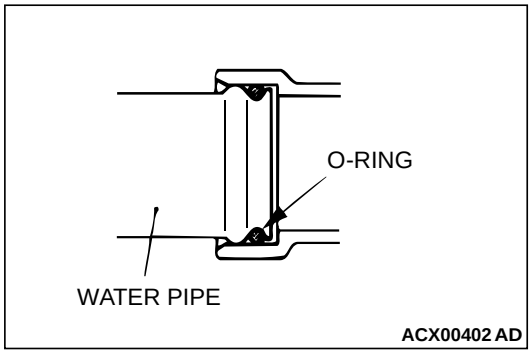
INSTALLATION SERVICE POINTS

>>A<< O-RING INSTALLATION

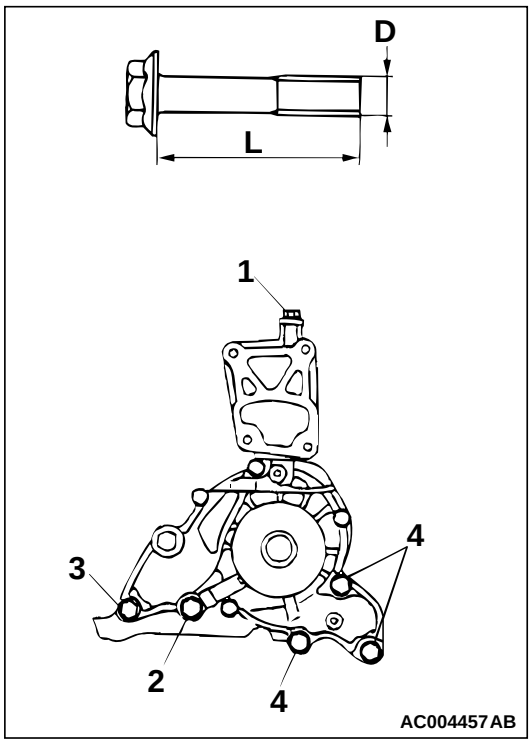
⚠ CAUTION

- **Care must be taken not to permit engine oil or other grease to adhere to the O-ring.**
- **When inserting the pipe, check to be sure that there is no sand, dirt, etc. on its inner surface.**

Rinse the mounting location of O-ring and water pipe with water, and install the O-ring and water pipe.



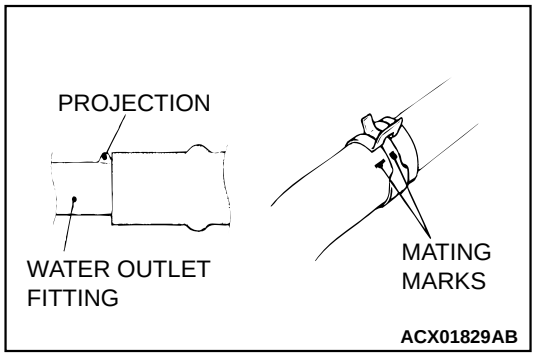
>>B<< WATER PUMP ASSEMBLY INSTALLATION



BOLT NO.	DIAMETER (D) × LENGTH (L) mm (in)
1	8 × 14 (0.3 × 0.6)
2	8 × 20 (0.3 × 0.8)
3	8 × 25 (0.3 × 1.0)
4	8 × 65 (0.3 × 2.6)

>>C<< 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.

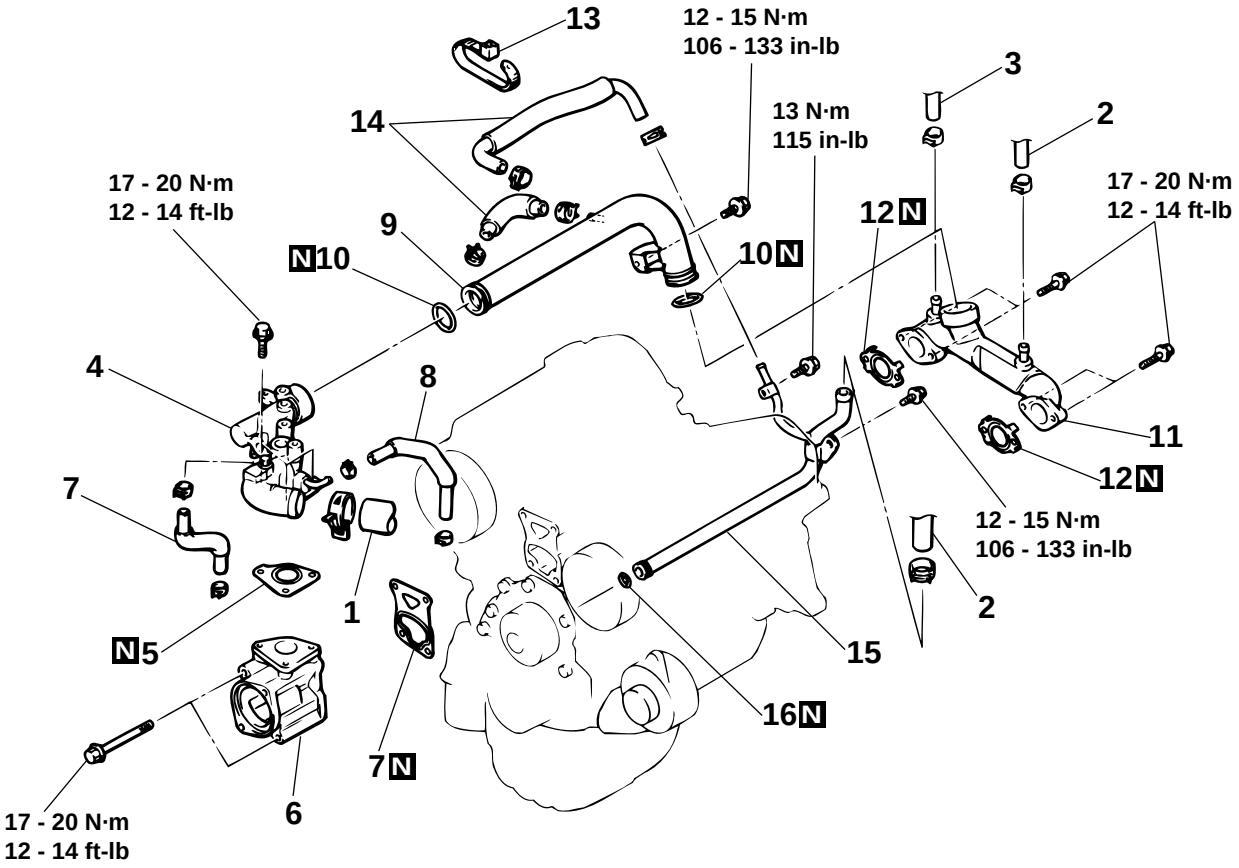


WATER HOSE AND WATER PIPE

REMOVAL AND INSTALLATION

M1141003300244

Pre-removal and Post-installation Operation
- Engine Coolant Draining and Supplying [Refer to P.14-5.)
- Front Exhaust Pipe and Heat Protector Removal and Installation (Refer to GROUP 15, Exhaust Pipe and Main Muffler P.15-14.)
- Shift Cable Bracket (Refer to GROUP 23A, Transmission Control P.23Aa-30.)
- Intake Manifold Removal and Installation (3.0L Engine: Refer to GROUP 15, Intake Manifold P.15-5.) (3.5L Engine: Refer to GROUP 15, Intake Manifold P.15-9.)
- Thermostat Removal and Installation (Refer to P.14-11.)



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REMOVAL STEPS

<<A>> >>D<<
1. RADIATOR UPPER HOSE CONNECTION
2. HEATER HOSE CONNECTION
3. HEATER HOSE CONNECTION <VEHICLES WITH REAR HEATER>
4. WATER OUTLET FITTING ASSEMBLY
5. GASKET
6. THERMOSTAT CASE
7. GASKET

REMOVAL STEPS (Continued)

8. WATER HOSE
9. WATER OUTLET PIPE ASSEMBLY

>>A<< 10. O-RING

11. HEATER PASSAGE ASSEMBLY

>>C<< 12. GASKET

13. CABLE BAND

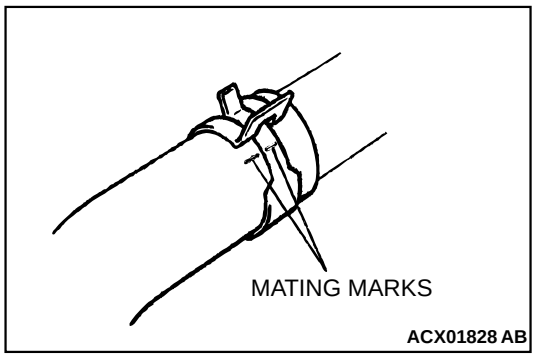
>>B<< 14. WATER HOSE

15. WATER PIPE ASSEMBLY

>>A<< 16. O-RING

TSB Revision

REMOVAL SERVICE POINT

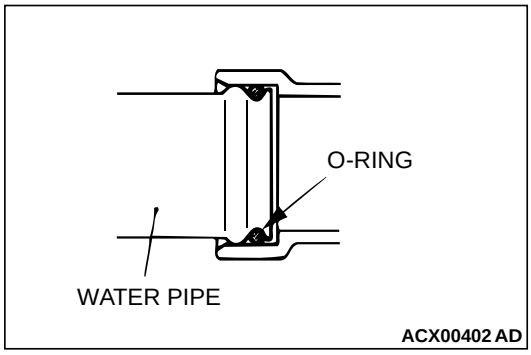


<<A>> RADIATOR UPPER HOSE DISCONNECTION

Make mating marks on the radiator hose and hose clamp. Disconnect the radiator hose.

INSTALLATION SERVICE POINTS

>>A<< O-RING INSTALLATION



⚠ CAUTION

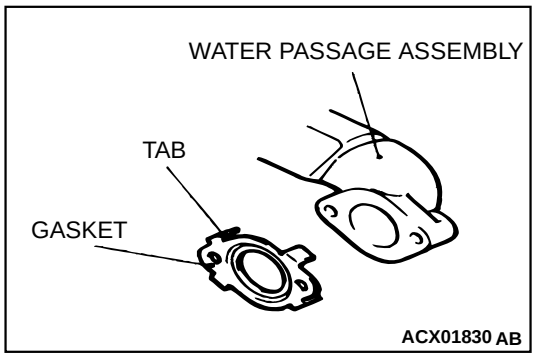
Do not allow engine oil or other grease to adhere to the O-ring.

Insert the O-ring to the water pipe, and coat the outer portion of the O-ring with water or engine coolant.

>>B<< WATER HOSE CONNECTION

To reuse the water hose, align the mating marks that were made during removal, and then install the hose clamp.

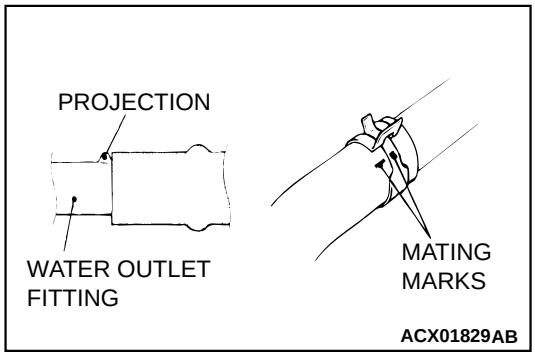
>>C<< GASKET INSTALLATION



Bend over the tabs to secure the gasket to the water passage assembly.

>>D<< 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

M1141003400207

Water Pipe and Hose Check

Check the water pipe and hose for cracks, damage and clogs. Replace them if necessary.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

M1141005000205

ITEM		SPECIFICATION
Cooling fan		
Cooling fan bolt		10 – 12 N·m (89 – 106 in-lb)
Fan clutch nut		10 – 12 N·m (89 – 106 in-lb)
Shroud bolt		4.9 N·m (43 in-lb)
Radiator		
Radiator support bolt		12 N·m (106 in-lb)
Reserve tank bolt		4.9 N·m (43 in-lb)
Shroud bolt		4.9 N·m (43 in-lb)
Thermostat		
Water inlet fitting bolt		24 N·m (17 ft-lb)
Water hose and water pipe		
Thermostat case bolt		17 – 20 N·m (12 – 14 ft-lb)
Water outlet fitting bolt		17 – 20 N·m (12 – 14 ft-lb)
Water outlet pipe bolt		12 – 15 N·m (106 – 133 in-lb)
Water passage bolt		17 – 20 N·m (12 – 14 ft-lb)
Water pipe bolt	M8 × 12	12 – 15 N·m (106 – 133 in-lb)
	M8 × 18	13 N·m (115 in-lb)
Water pump		
Thermostat case bolt		17 – 20 N·m (12 – 14 ft-lb)

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ITEM		SPECIFICATION
Water outlet fitting and Bracket bolt	3.0L Engine	17 – 20 N·m (12 – 14 ft-lb)
	3.5L Engine	12 – 15 N·m (106 – 133 in-lb)
Water pump bolt		20 N·m (17 ft-lb)
Water pump Bracket bolt		20 N·m (17 ft-lb)

SERVICE SPECIFICATIONS

M1141000300267

ITEM		STANDARD VALUE	LIMIT
Radiator cap opening pressure kPa (psi)		74 – 103 (11 – 15)	Minimum 64 (9.2)
Thermostat	Valve opening temperature of thermostat °C (°F)	88 ± 1.5 (190 ± 3)	-
	Full-opening temperature of thermostat °C (°F)	100 (212)	-
	Valve lift mm (in)	10 (0.39) or more	-

COOLANT

M1141000400231

ITEM		QUANTITY dm^3 (qt)
MITSUBISHI GENUINE Part MD970389 or equivalent	Without rear heater	9.0 (9.5)
	With rear heater	10.0 (10.6)

SEALANT

M1141000500227

ITEM	SPECIFIED SEALANT
Cylinder block drain plug	3M™ Nut Locking Part number 4171 or equivalent

NOTES