

SECTION 6B

ENGINE COOLING

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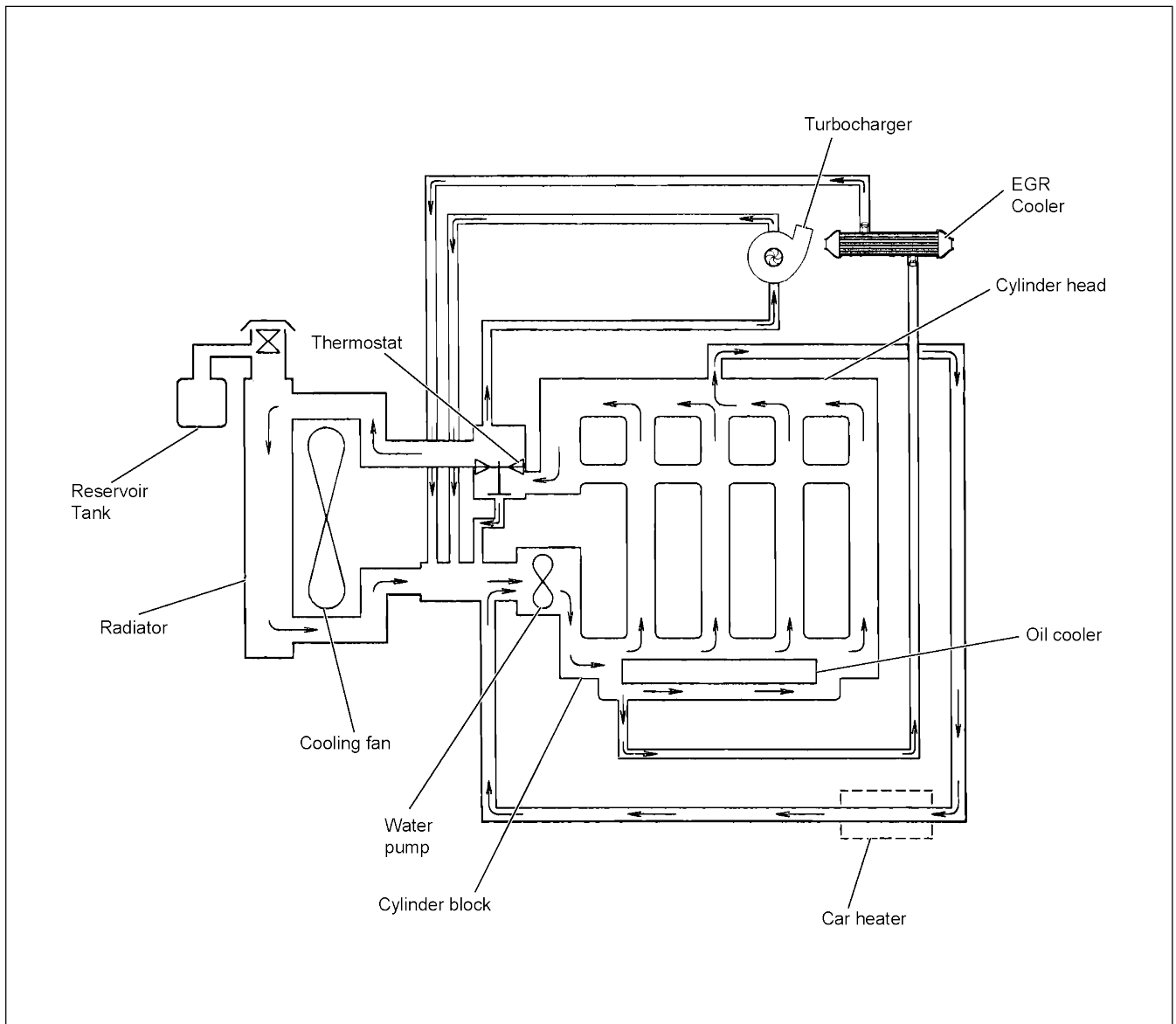
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Main Data and Specifications

Item	Description	
	M/T	A/T
Cooling system	Engine coolant forced circulation	
Water pump type	Centrifugal impeller type	
Pump to crankshaft speed ratio (To 1)	1.25	
Delivery volume lit (US/UK gal)/min	240 (63.1/53.3)	
Pump speed at 5600 rpm		
Water temperature at 30°C (86°F)		
Pump bearing type	Double row shaft	
Thermostat type	Wax pellet with jiggle valve	
Valve initial opening temperature °C (°F)	85 (185)	
Valve full opening temperature °C (°F)	100 (212)	
Valve lift at fully open position mm (in)	10 (0.39)	
Radiator	Tube type corrugated	
Heat radiation capacity kW (kcal/h)	93 (80.2)	
Heat radiation area m ² (ft ²)	11.63 (125.2)	
Radiator front area m ² (ft ²)	0.28 (3)	
Radiator dry weight N (kg/lb)	52	53
Radiator cap valve opening pressure kPa (kg/cm ² /psi)	93.3 - 122.7 (0.95 - 1.25/13.5 - 17.8)	
Engine coolant capacity lit (U.S pint)	4.0 (8.5)	4.0 (8.5)
Engine coolant total capacity lit (U.S pint)	8.7 (18.4)	8.6 (18.2)

General Description

Coolant Flow



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The engine cooling system consists of the radiator, the water pump, the cooling fan, and the thermostat.

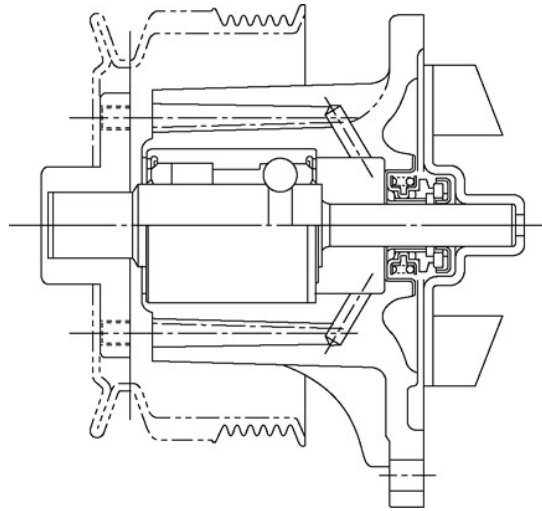
To quickly increase cold engine coolant temperature for smooth engine operation, the coolant is circulated by the water pump and thermostat through the bypass pipe and back to the cylinder body.

The coolant does not circulate through the radiator.

When the coolant temperature reaches the specified value, the thermostat will begin to open and a gradually increasing amount of coolant will circulate through the radiator.

The thermostat will be fully open when the coolant temperature reaches the specified value. All of the coolant is now circulating through the radiator for effective engine cooling.

Water Pump

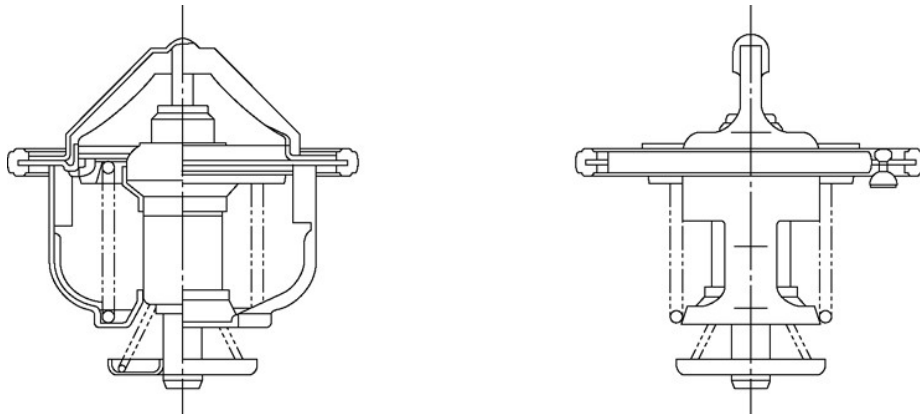


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A centrifugal type water pump forcefully circulates the coolant through the cooling system.

The water pump is not a disassembled type.

Thermostat

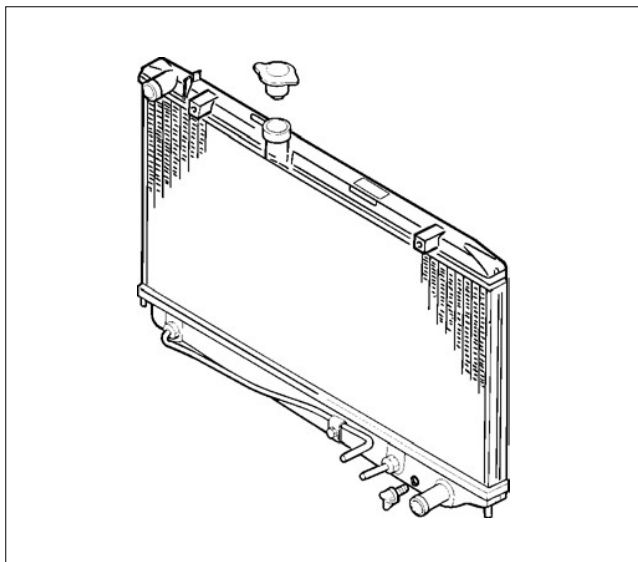


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A wax pellet type thermostat is used.

Radiator

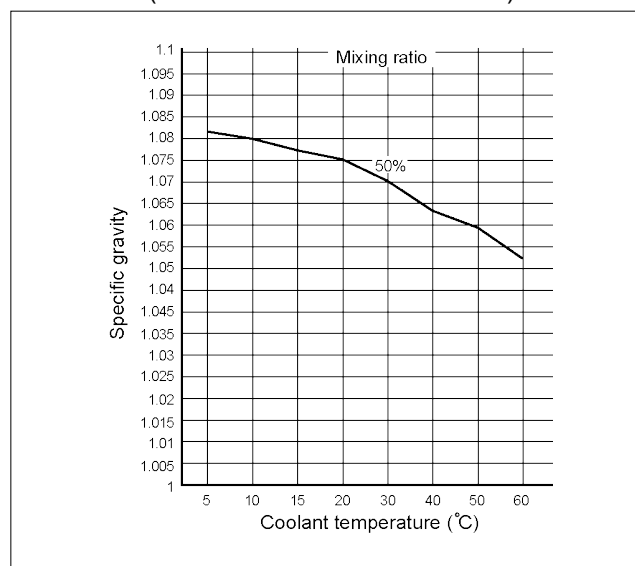
The radiator is a tube type with corrugated fins. In order to raise the boiling point of the coolant, the radiator is fitted with a cap in which the valve is operated at 93.3 - 122.7 kPa (0.95 - 1.25 kg / cm² / 13.5 - 17.8 psi) pressure. (No oil cooler provided for M/T)



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NOTE:

To maintain the corrosion resistance of the aluminum radiator, water and antifreeze must be combined in a 1:1 solution (50% antifreeze and 50% water).



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Antifreeze Solution

NOTE:

Antifreeze solution + Water = Total cooling system capacity.

Total Cooling System Capacity Lit
(US / UK gal) (US pint)

M/T 8.7 (2.3/1.9) (18.4)

A/T 8.6 (2.3/1.9) (18.2)

See section 0B *MAINTENANCE AND LUBRICATION*.

Mixing ratio

$$= \frac{\text{Antifreeze solution (Lit/gal.)}}{\text{Antifreeze solution (Lit/gal.)} + \text{Water (Lit/gal.)}}$$

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Diagnosis

Engine Cooling Trouble

Condition	Possible Cause	Correction
Engine overheating	Low Engine Coolant level	<i>Replenish</i>
	Thermo meter unit faulty	<i>Replace</i>
	Faulty thermostat	<i>Replace</i>
	Faulty Engine Coolant temperature sensor	<i>Repair or replace</i>
	Clogged radiator	<i>Clean or replace</i>
	Faulty radiator cap	<i>Replace</i>
	Low engine oil level or use of improper engine oil	<i>Replenish or change oil</i>
	Clogged exhaust system	<i>Clean exhaust system or replace faulty parts</i>
	Faulty Throttle Position sensor	<i>Replace throttle valve assembly</i>
	Open or shorted Throttle Position sensor circuit	<i>Repair or replace</i>
	Damaged cylinder head gasket	<i>Replace</i>
Engine overcooling	Faulty thermostat	<i>Replace</i>
Engine slow to warm-up	Faulty thermostat	<i>Replace</i>
	Thermo unit faulty	<i>Replace</i>

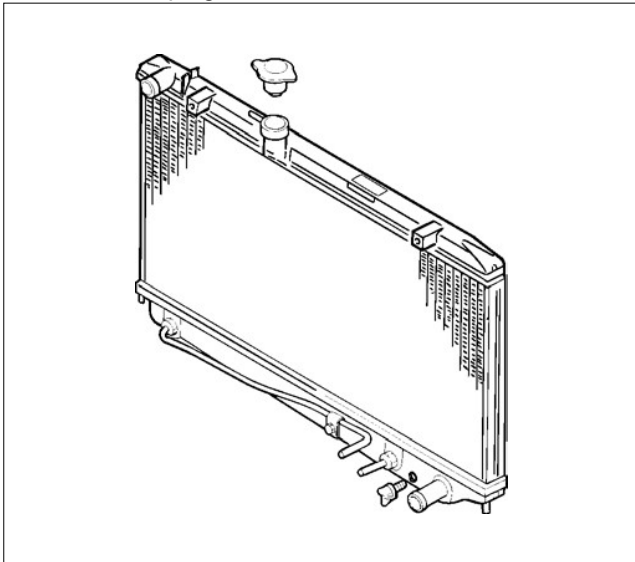
Draining and Refilling Cooling System

Before draining the cooling system, inspect the system and perform any necessary service to ensure that it is clean, does not leak and is in proper working order. The engine coolant (EC) level should be between the "MIN" and "MAX" lines of the reserve tank when the engine is cold. If low, check for leakage and add EC up to the "MAX" line.

There should not be any excessive deposit of rust or scales around the radiator cap or radiator filler hole, and the EC should also be free from oil.

Replace the EC if excessively dirty.

1. Remove the radiator skid plate.
2. Completely drain the cooling system by opening the drain plug at the bottom of the radiator.



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3. Remove the radiator cap.

WARNING:

To avoid the danger of being burned, do not remove the cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure.

4. Disconnect all hoses from the EC reserve tank.
Scrub and clean the inside of the reserve tank with soap and water. Flush it well with clean water, then drain it. Install the reserve tank and hoses.

5. Refill the cooling system with the EC using a solution that is at least 50 percent antifreeze.

Procedure for filling with coolant (in case of full change).

- Make sure that the engine is cool.
- Open radiator cap and pour coolant up to filler neck.
- Pour coolant into reservoir tank up to "MAX" line.
- Tighten radiator cap and start the engine. After idling for 2 to 3 minutes, stop the engine and reopen the radiator cap. If the water level is lower, replenish.

WARNING:

When the coolant is heated to a high temperature, be sure not to loosen or remove the radiator cap. Otherwise you might get scalded by hot vapor or boiling water. To open the radiator cap, put a piece of thick cloth on the cap and loosen the cap slowly to reduce the pressure when the coolant has become cooler.

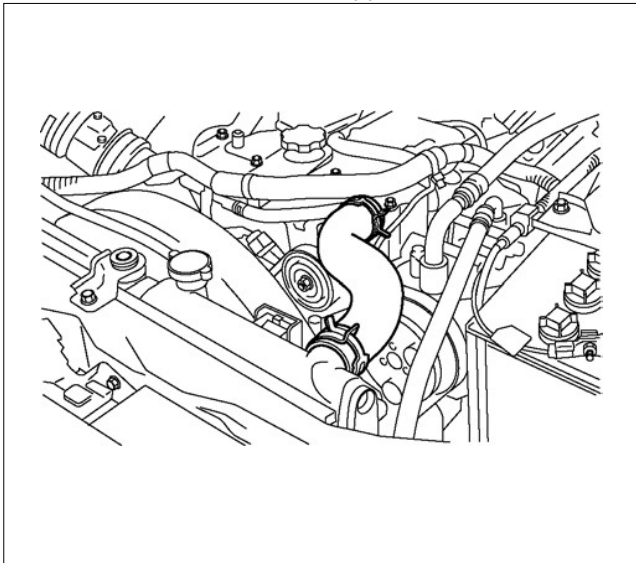
- After tightening the radiator cap, warm up the engine at about 2000 rpm. Set heater adjustment to the highest temperature position, and let the coolant circulate also into heater water system.
- Check to see the thermostat has opened through the needle position of the water thermometer, conduct a 5-minute idling again and stop the engine.
- When the engine has been cooled, check filler neck for water level and replenish if required. Should extreme shortage of coolant be found, check the cooling system and reservoir tank hose for leakage.
- Pour coolant into the reservoir tank up to "MAX" line.

Water Pump

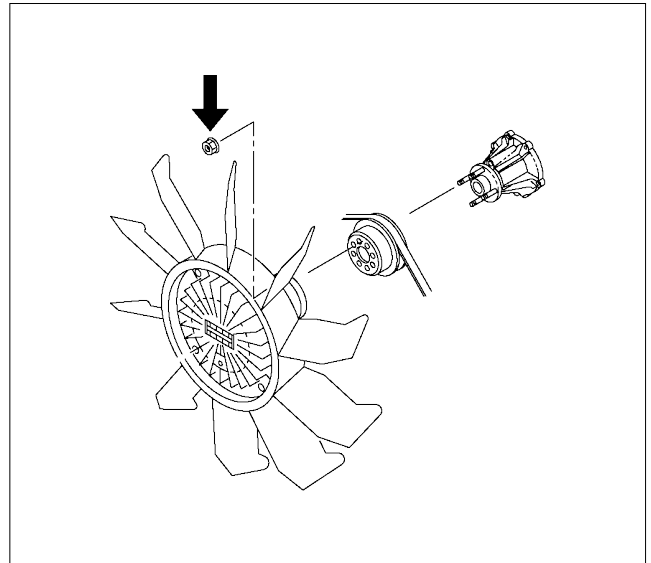
Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Removal

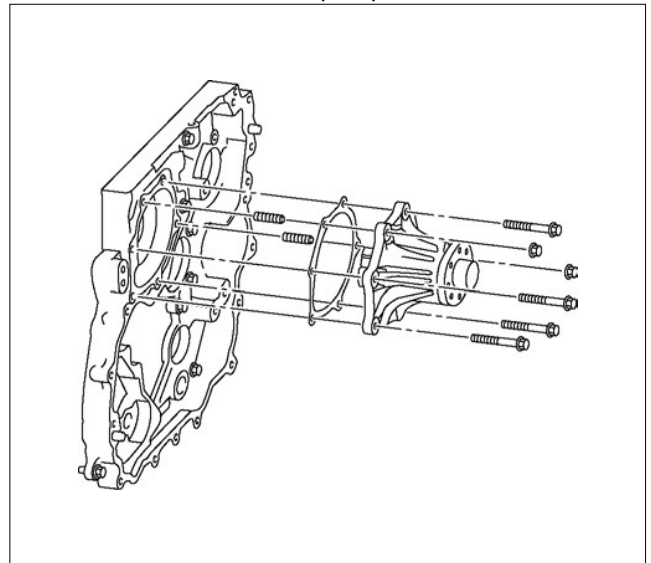
1. Remove the engine cover.
2. Radiator Upper Hose
 - a. Partially drain the engine coolant.
 - b. Remove the radiator upper hose.



3. Water Outlet Pipe
 - a. Disconnect the turbocharger-cooling pipe from the outlet pipe.
 - b. Loosen the fixing bolt and remove the water outlet bolt.
4. Upper Fan Shroud
5. Fan and Fan Clutch
 - a. Loosen the fan clutch nuts.
 - b. Remove the fan together with the fan clutch. Take care not to damage the radiator core.
6. Fan Drive Belt and Pulley
 - a. Loosen the tension adjust bolt on the generator.
 - b. Remove the fan drive belt with the fan pulley.



7. Water Pump
 - a. Remove the water pump bolts and nuts.
 - b. Remove the water pump.



Inspection and Repair

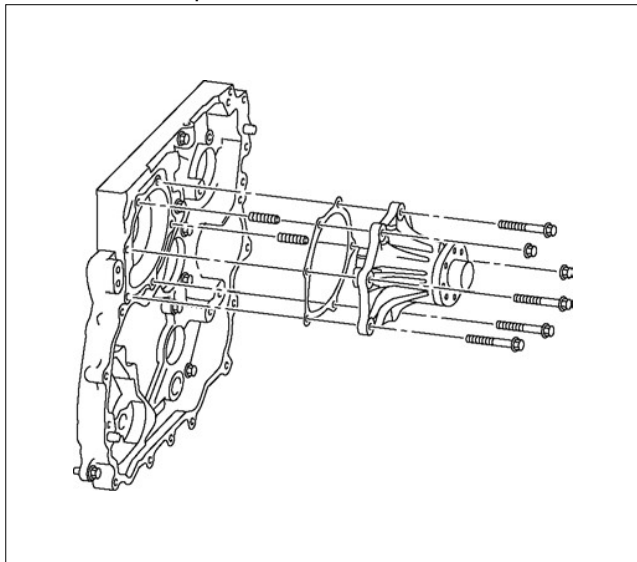
The water pump is not disassembled type.

Make necessary parts replacement if extreme wear or damage is found during inspection. Should any of the following problems occur, the entire water pump assembly must be replaced.

- Cracks in the water pump body.
- Coolant leakage from the sealed unit.
- Excessive radial play or abnormal noise in the fan center when rotated by hand.
- Excessive thrust play in the fan center (Standard play: less than 0.2 mm (0.0078 in)).
- Cracks or corrosion in the impeller.

Installation

1. Water Pump

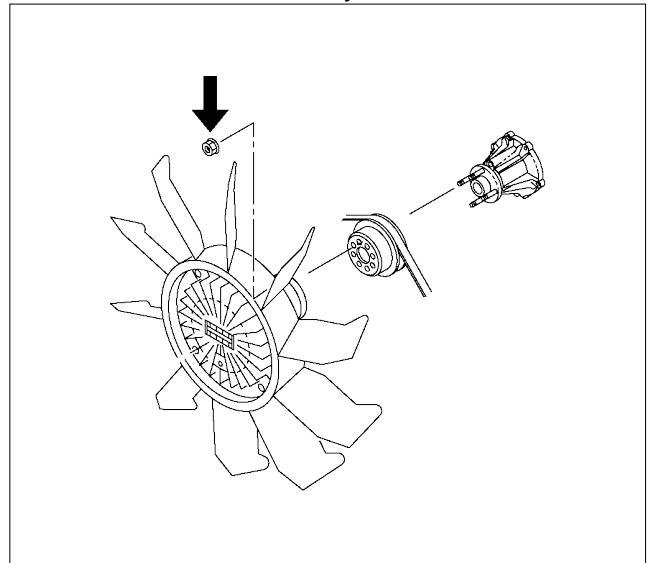


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- Install the water pump with a new gasket.
- Tighten bolts and nuts to specified torque.

Water Pump Nut/Bolt Torque:
25 N·m (2.5 kg·m /18 lb ft)

2. Fan Drive Belt and Pulley and Fan and Fan Clutch.



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- Install the fan drive belt and fan pulley and fan and fan clutch.
- Tighten the nuts to specified torque.

Fan Clutch Nut Torque: 8 N·m (0.8 kg·m /69 lb in)

- Apply tension to the fan drive belt by moving the generator.
- Apply a force of 98 N (10 kg/22 lb) to the drive belt mid-portion to check the drive belt deflection.

Fan Drive Belt Deflection		mm (in)
New belt	5 - 6	(0.20 – 0.24)
Reuse belt	7 - 8	(0.28 – 0.32)

3. Upper Fan Shroud

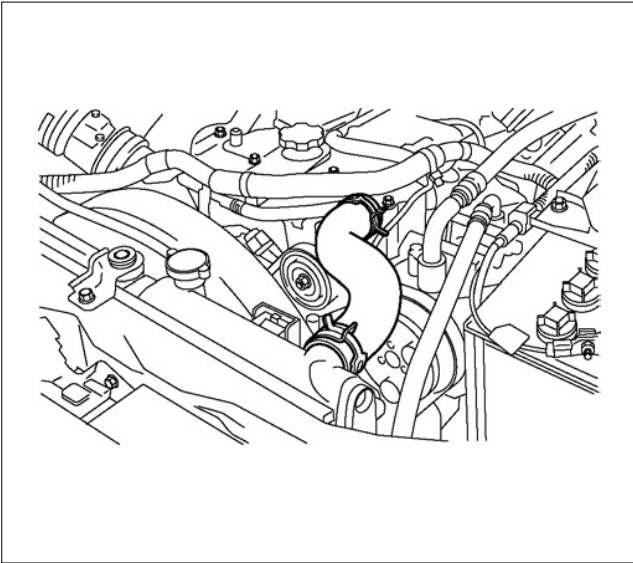
4. Water Outlet Pipe.

- Install the water outlet pipe to the thermostat housing.
- Tighten the outlet pipe bolt to specified torque.

Outlet Pipe Bolt Torque:
25 N·m (2.5 kg·m /18 lb ft)

- Connect the turbocharger-cooling pipe to outlet pipe.

5. Radiator Upper Hose.



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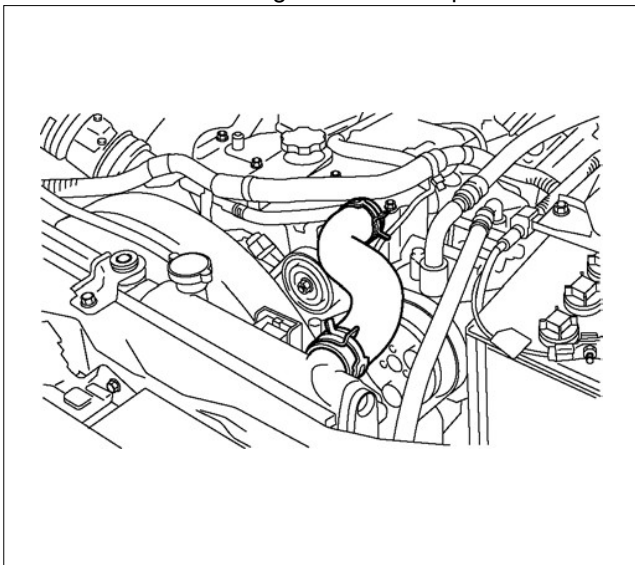
- a. Connect the radiator upper hose to the water outlet pipe.
 - b. The knob of clamp shall be directed to horizontal.
 - c. Replenish the engine coolant.
6. Install the engine cover.

Thermostat

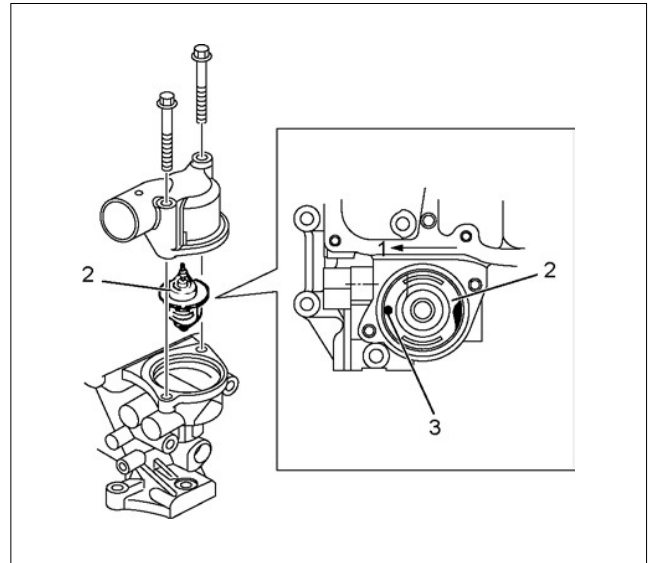
Read this Section carefully before performing any removal and installation procedure. This Section gives you important points as well as the order of operation. Be sure that you understand everything in this Section before you begin.

Removal

1. Remove the engine cover.
2. Radiator Upper Hose
 - a. Partially drain the engine coolant.
 - b. Remove the radiator upper hose.
 - c. Remove the engine harness clip.



3. Water Outlet Pipe
 - a. Disconnect the turbocharger-cooling pipe from outlet pipe.
 - b. Loosen the fixing bolt and remove the water outlet bolt.
4. Thermostat
Remove the thermostat from the thermostat housing.
Take care not to damage the thermostat.



Legend

1. Front
2. Thermostat
3. Jiggle Valve

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Operating Test of Thermostat

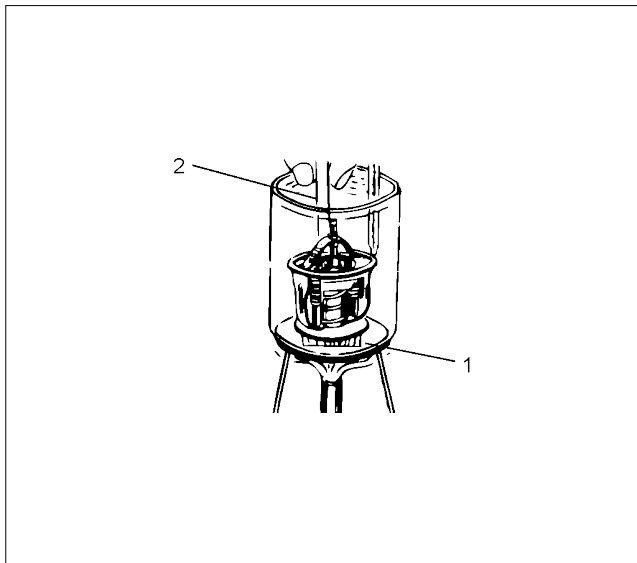
1. Completely submerge the thermostat in water.
2. Heat the water. Stir the water constantly to avoid direct heat being applied to the thermostat.
3. Check the thermostat initial opening temperature.

Thermostat Initial Opening Temperature	°C (°F)
85 (185)	

4. Check the thermostat full opening temperature.

Thermostat Full Opening Temperature	°C (°F)
100 (212)	

Valve Lift At Fully Open Position	mm (in)
10 (0.39)	



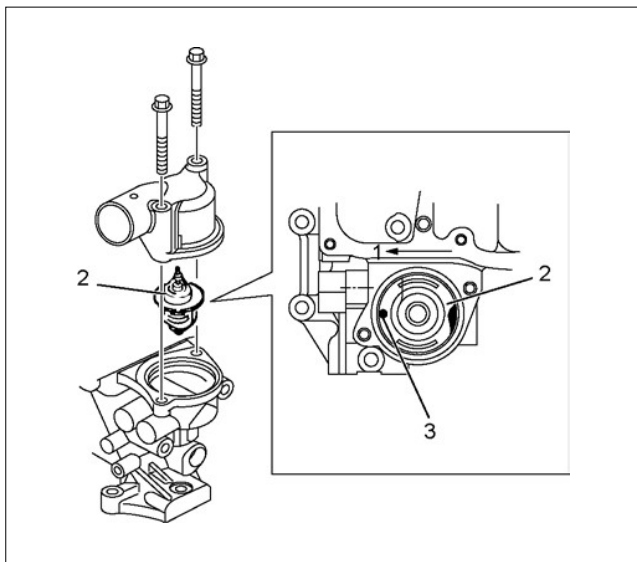
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Legend

1. Wooden Piece
2. Agitating Rod

Installation

1. Thermostat
Install the thermostat.
Mount the jiggle valve with the valve facing engine front.



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Legend

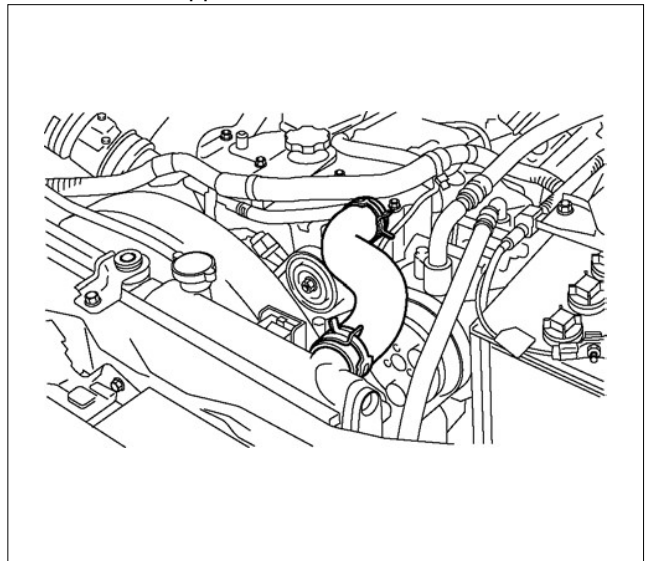
1. Front
2. Thermostat
3. Jiggle Valve

2. Water Outlet Pipe.
 - a. Install the water outlet pipe with new gasket to the thermostat housing.
 - b. Tighten the outlet pipe bolt to specified torque.

Outlet Pipe Bolt Torque:

25 N·m (2.5 kg·m /18 lb ft)

- c. Connect the turbocharger-cooling pipe to outlet pipe.
 - d. Install the engine harness clip.
3. Radiator Upper Hose.

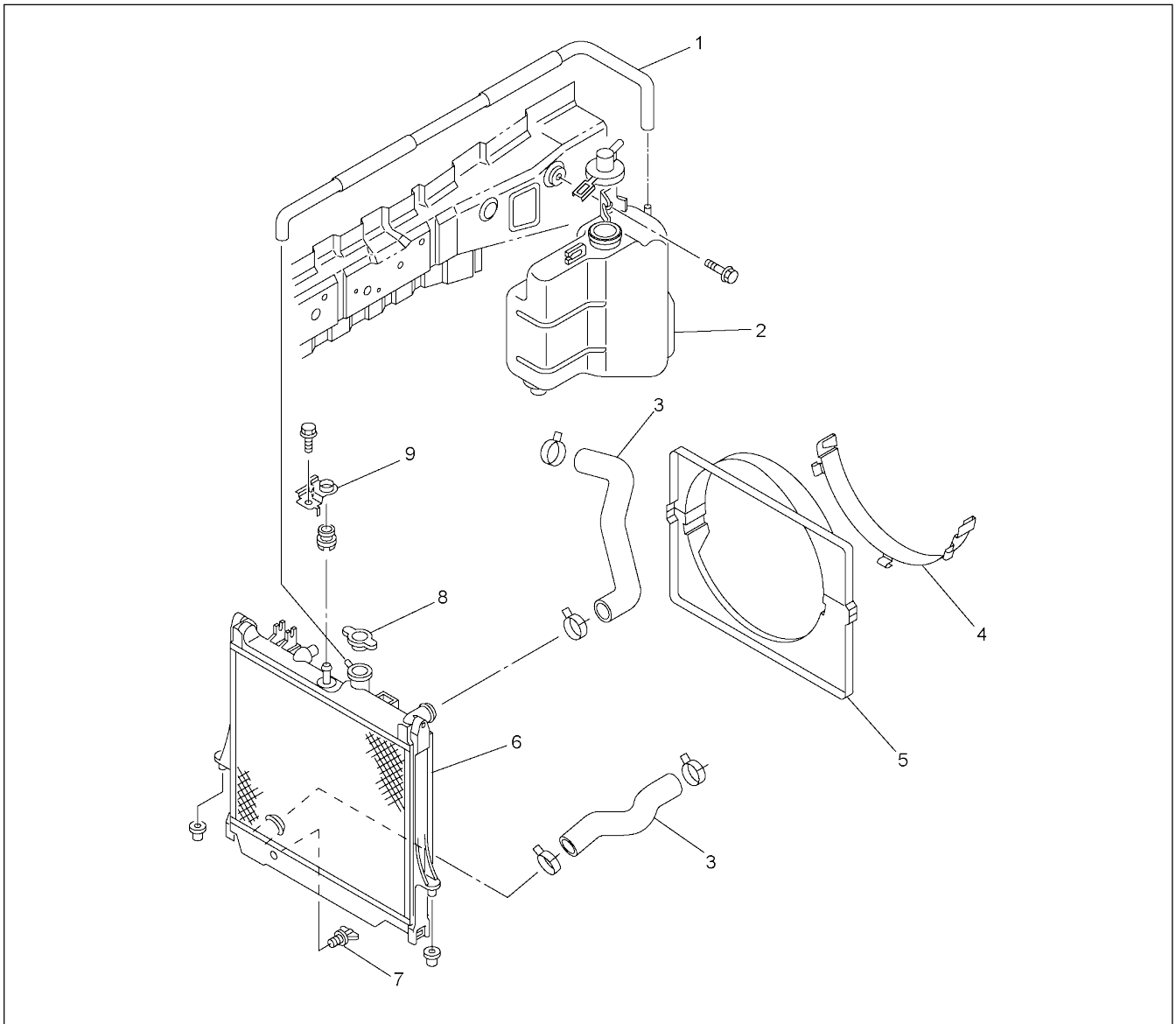


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- a. Connect the radiator upper hose to the water outlet pipe.
 - b. The knob of the clamp should be directed to the horizontal side.
 - c. Replenish the engine coolant.
4. Install the engine cover.

Radiator

Radiator and Associated Parts



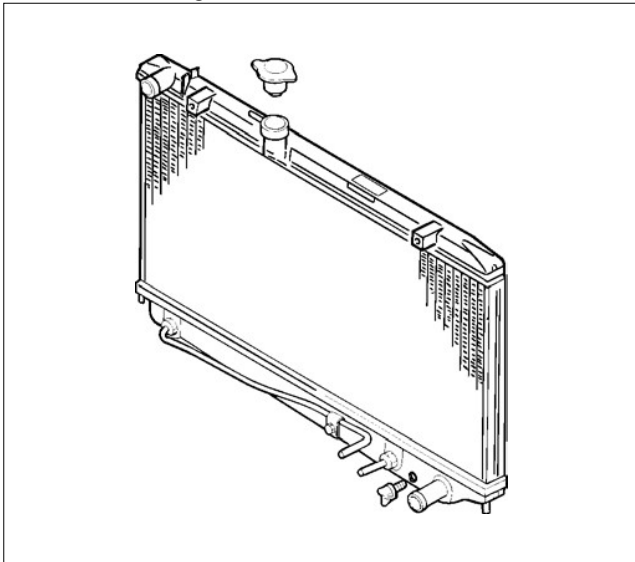
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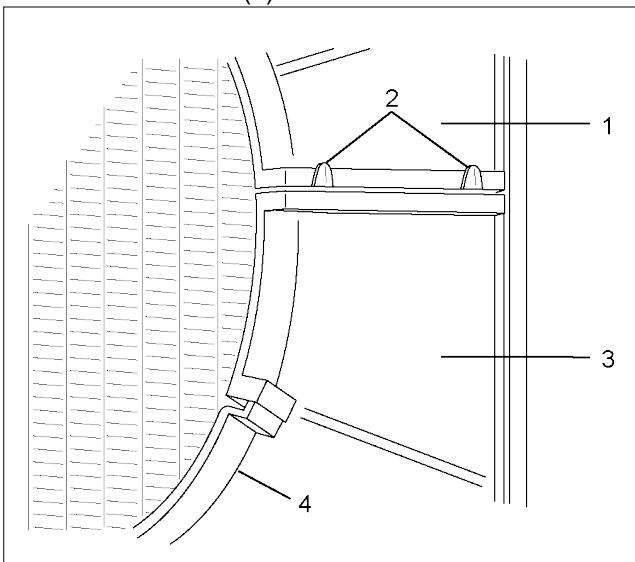
- | | |
|----------------------|----------------------|
| 1. Reserve Tank Hose | 6. Radiator Assembly |
| 2. Reserve Tank | 7. Drain Plug |
| 3. Radiator Hose | 8. Radiator Cap |
| 4. Fan Guide; Lower | 9. Bracket |
| 5. Fan Guide | |

Removal

1. Disconnect battery ground cable.
2. Loosen a drain plug to drain EC.
3. Disconnect oil cooler hose on automatic transmission (A/T).
4. Remove the engine cover.
5. Disconnect radiator inlet hose and outlet hose from the engine.



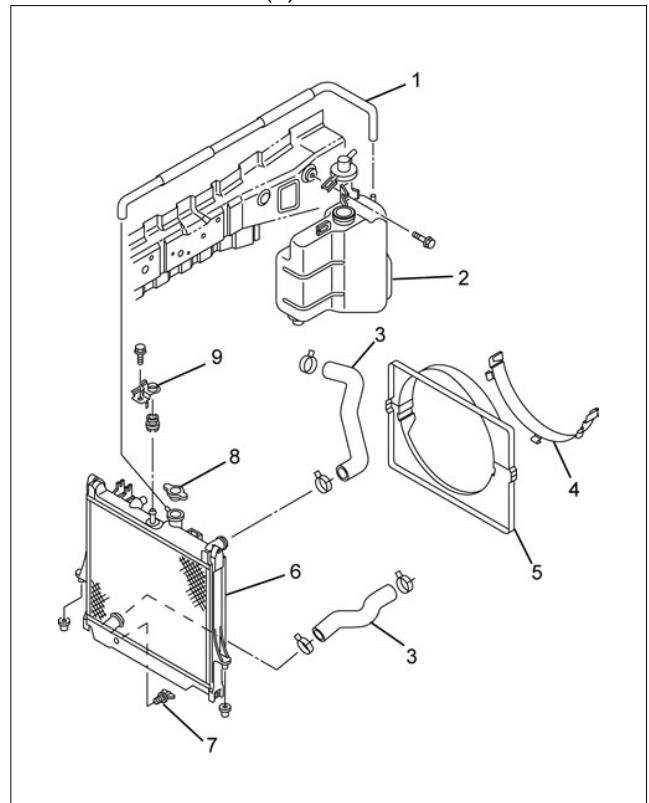
6. Remove fan guide (1), clips (2) on both sides and the bottom lock, then remove lower fan guide (3) with fan shroud (4).



Legend

1. Fan Guide
2. Clips
3. Lower Fan Guide
4. Fan Shroud

7. Disconnect the reserve tank hose (1) from radiator.
8. Remove bracket (9).



Legend

1. Reserve Tank Hose
2. Reserve Tank
3. Radiator Hose
4. Fan Guide; Lower
5. Fan Guide
6. Radiator Assembly
7. Drain Plug
8. Radiator Cap
9. Bracket

9. Lift up and remove the radiator assembly with hose, taking care not to damage the radiator core with a fan blade.

Inspection and Repair

Make the necessary adjustments, repairs, and part replacements if excessive wear or damage is discovered during inspection.

Radiator Cap

Measure the valve opening pressure of the pressurizing valve with a radiator filler cap tester.

Replace the cap if the valve opening pressure is outside the standard range.

Valve opening pressure:

93.3 - 122.7 kPa (0.95 - 1.25 kg / cm² / 13.5 - 17.8 psi)

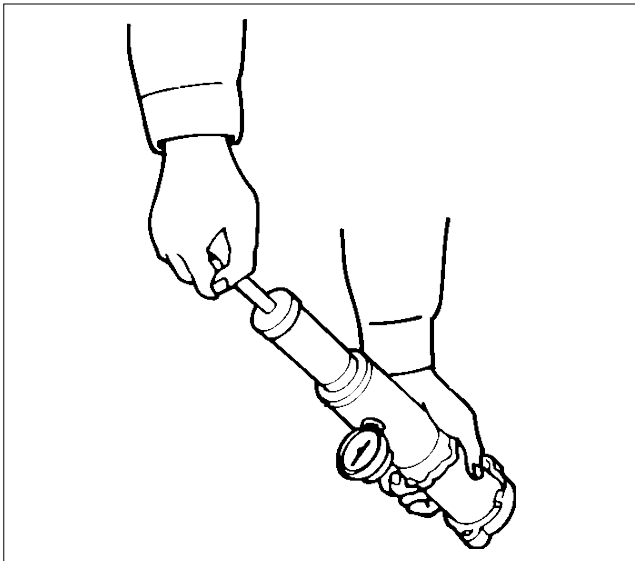
Cap tester: 5-8840-0277-0

Adapter: 5-8840-2603-0

Check the condition of the vacuum valve in the center of the valve seat side of the cap. If considerable rust or dirt is found, or if the valve seat cannot be moved by hand, clean or replace the cap.

Valve opening vacuum:

1.96 - 4.91 kPa (0.02 - 0.05 kg / cm² / 0.28 - 0.71 psi)



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Radiator Core

1. A bent fin may result in reduced ventilation and overheating may occur. All bent fins must be straightened. Pay close attention to the base of the fin when it is being straightened.
2. Remove all dust, bugs and other foreign material.

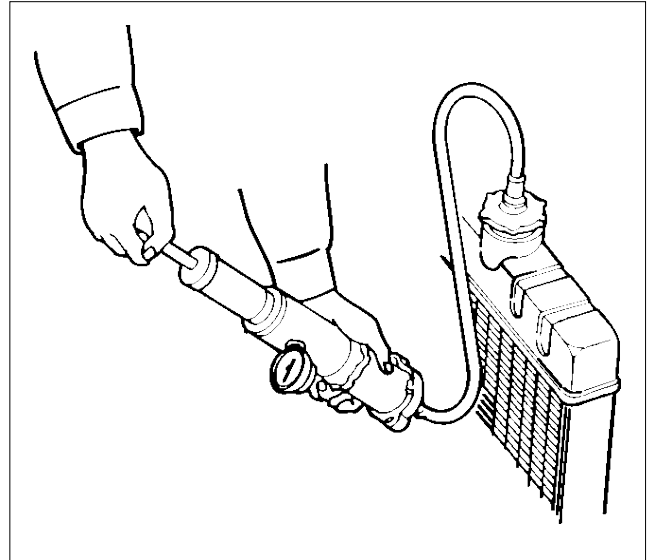
Flushing the Radiator

Thoroughly wash the inside of the radiator and the engine coolant passages with cold water and mild detergent. Remove all signs of scale and rust.

Cooling System Leakage Check

Use a radiator cap tester to force air into the radiator through the filler neck at the specified pressure of 196 kPa (2.0 kg / cm² / 28.5 psi) with a cap tester:

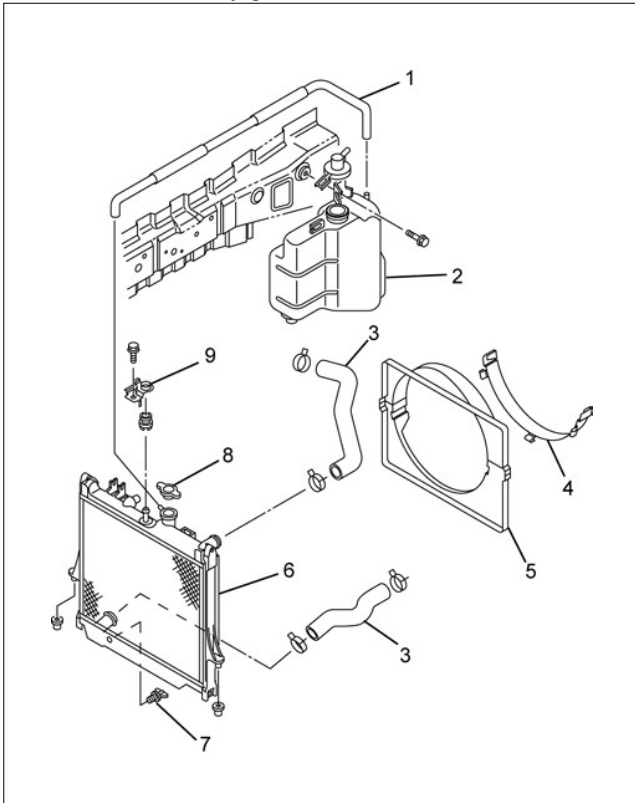
- Leakage from the radiator.
- Leakage from the coolant pump.
- Leakage from the water hoses.
- Check the rubber hoses for swelling.



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Installation

1. Install radiator assembly (6) with hose, taking care not to damage the radiator core with a fan blade.
2. Support the radiator upper tank with the bracket (9) and secure the radiator.
3. Connect reserve tank hose (1).
4. Install lower fan guide (4).
5. Connect radiator inlet hose and outlet hose (3) to the engine.
6. Install the engine cover.
7. Connect oil cooler hose to automatic transmission.
8. Connect battery ground cable.

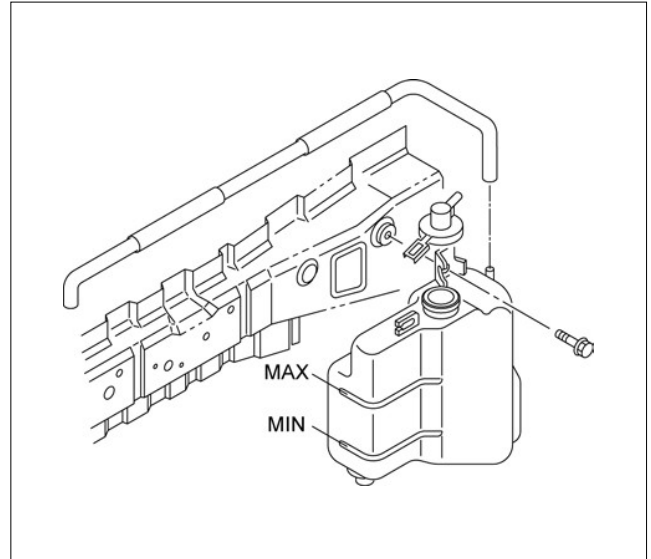


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Legend

1. Reserve Tank Hose
2. Reserve Tank
3. Radiator Hose
4. Fan Guide; Lower
5. Fan Guide
6. Radiator Assembly
7. Drain Plug
8. Radiator Cap
9. Bracket

9. Pour engine coolant up to filler neck of radiator, and up to MAX mark of reserve tank.
Important operation (in case of 100% engine coolant change) procedure for filling with engine coolant.



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Engine coolant change

Refer to change procedure for Draining and Refilling Cooling System in this section.

Fan Clutch with Cooling Fan

Inspection and Repair

Make necessary correction or parts replacement if wear, damage or any other abnormal conditions are found through inspection.

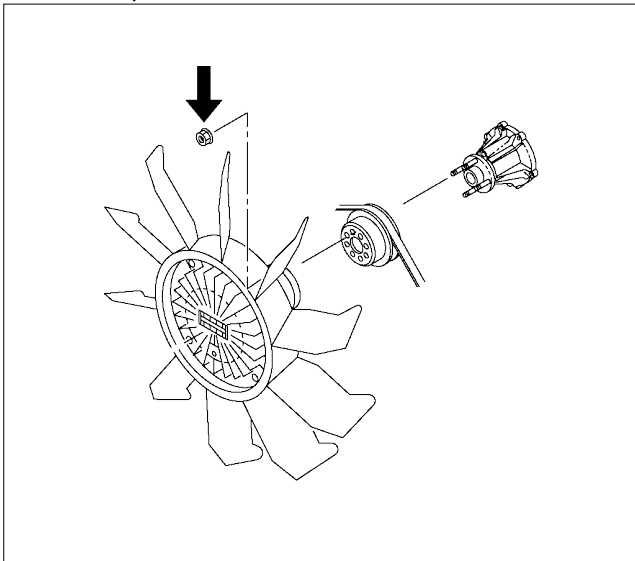
Visually inspect for damage, leak (silicone grease) or other abnormal conditions.

1. Inspection (on-vehicle)

- a) Turn the fan clutch by hand when in a low temperature condition before starting the engine, and confirm that it can be turned readily.
- b) Start the engine to warm it up until the temperature at the fan clutch portion gets to around 85°C (185°F). Then stop the engine and confirm that the fan clutch can be turned with considerable effort (clutch torque) when turned by hand.

If the fan clutch rotates more readily, however, this indicates that the silicone grease is leaking internally.

Replace the fan clutch with a new one.



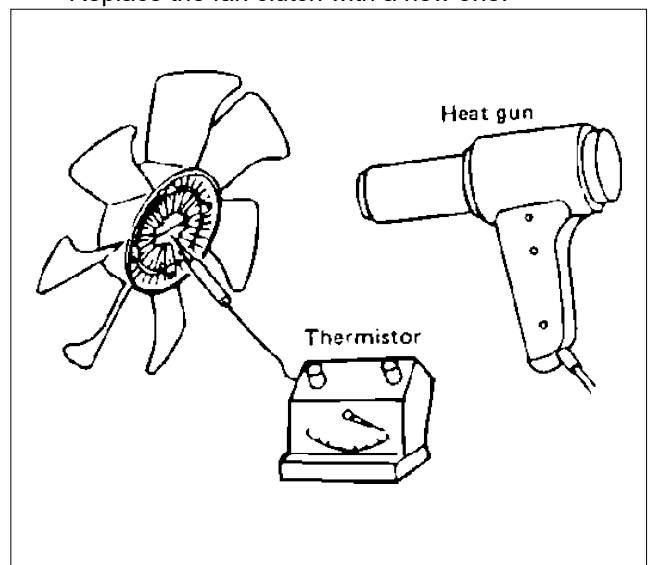
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2. Inspection (in unit)

Warm up the bimetal of the fan clutch by using the heat gun until the temperature gets to about 85°C when measured with the thermistor. Then confirm that the fan clutch can be turned with considerable effort (clutch torque).

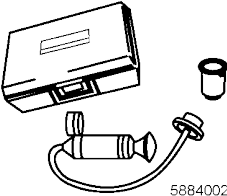
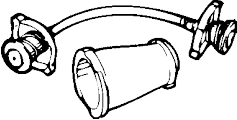
If the fan clutch rotates more readily at this time, this indicates that the silicone grease is leaking internally.

Replace the fan clutch with a new one.



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Special Tools

ILLUSTRATION	PART NO. PART NAME
 5884002770	5-8840-0277-0 Cap tester
	5-8840-2603-0 Adapter