

COOLING SYSTEM

INTRODUCTION

This section has the description and the repair instructions for some parts of the cooling system. Troubleshooting procedures are also included in this section.

The cooling system has the following parts: radiator, auxiliary coolant reservoir, water pump, thermostat, fan and a fan shroud

DESCRIPTION

The purpose of the cooling system is to control the operating temperature of the engine and in some units the transmission, brakes and hydraulic system. A centrifugal water pump circulates coolant through passages in the engine block and the radiator. A thermostat is installed in the water outlet fitting on the engine. As the coolant flows through the radiator, the fan moves air through the radiator to help cool the system.

The coolant is a mixture of water and anti-freeze. The anti-freeze prevents the coolant from freezing in cold weather, and thereby preventing damage to the engine and radiator. The anti-freeze also prevents rust and lubricates the water pump.

RADIATOR

The radiator is the heat exchanger for the cooling system. The fan causes air to flow through the radiator and reduce the temperature of the coolant. The auxiliary coolant reservoir is connected to the radiator by a hose. As the engine gets hot, the coolant expands. During expansion, coolant moves from the radiator to the reservoir. When the engine stops, the coolant becomes cool and contracts. The coolant in the reservoir flows back into the radiator. In this way the radiator is kept filled with coolant during normal operation.

On units with a powershift transmission, an oil cooler is built into the radiator. Oil from the transmission flows through coils in the radiator tank to help control the oil temperature.

RADIATOR CAP

The radiator cap is a pressure-vent type that lets the pressure in the cooling system increase to 103 kPa (15 psi). The pressure in the system prevents vapor from forming in the coolant flowing to the water pump. This action maintains the efficiency of the water pump and the performance of the cooling system. The increase in pressure also raises the boiling point of the coolant mixture to approximately 125° C (257° F) at sea level.

The radiator cap has a pressure valve and a vacuum valve. The pressure valve is held against its seat by a spring. The pressure valve opens when the pressure in the cooling system exceeds 103 kPa (15 psi).. The vacuum valve is held against its seat by another spring. The vacuum valve opens to relieve the vacuum created when the coolant temperature decreases. In certain conditions this vacuum can cause the radiator or top hose to collapse.

THERMOSTAT

The thermostat is a device that controls coolant flow by opening and closing to regulate coolant temperature. The thermostat uses a wax pellet to control its operation. The wax pellet expands when it is heated and contracts when it is cold. When heated, the wax pellet pushes on the piston, causing the valve in the thermostat to open. As the wax pellet cools, it contracts and lets a spring close the valve. When the engine is first started and the coolant is cold, the thermostat remains closed. During this time the coolant circulates through the engine, letting it warm quickly. As the engine becomes warm the thermostat opens, letting coolant circulate through the radiator.

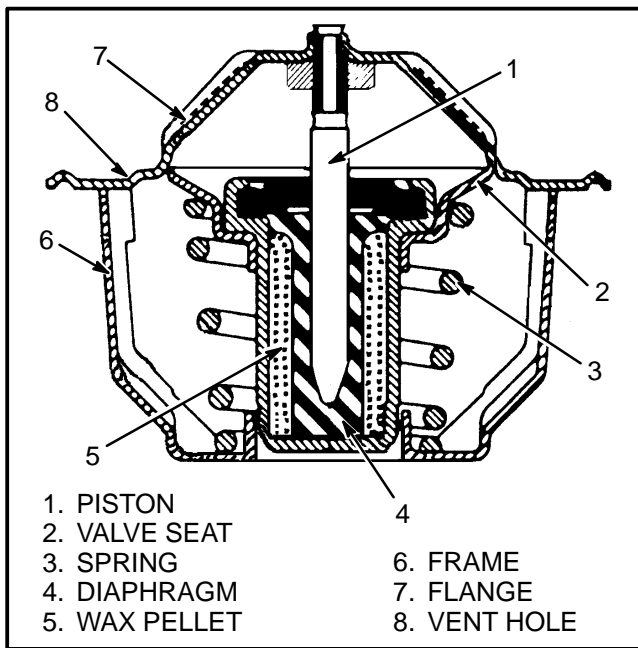


FIGURE 1. TYPICAL THERMOSTAT

The opening and closing of the thermostat helps keep the coolant within the operating limits of the system.

The same thermostat is used for summer and winter seasons. Do not operate the engine without a thermostat. The engine will take longer to get warm and then can run improperly.

WATER PUMP

The centrifugal type water pump is installed at the front of the engine block. The inlet for the pump is connected to the bottom of the radiator by a hose. From the pump, coolant passes through the passages in the engine block to the top of the radiator. The thermostat controls the flow of coolant through the engine and radiator.

FAN AND FAN SHROUD

The fan is used to provide air flow through the radiator at all engine speeds. The fan is a pusher or puller-type and can be installed on the water pump or on a separate hub. The fan is driven by a drive belt from the engine crankshaft.

The fan shroud is used to make sure the air flow from the fan goes through the core of the radiator.

REPAIRS

⚠ WARNING

During engine operation, be careful not to touch the fan, pulleys or drive belts. Contact with these parts can cause serious personal injury.

COOLING SYSTEM CHECKS

Exhaust Leaks

To check for exhaust leaks into the cooling system, use a kit for this purpose. Follow the manufacturer's instructions when doing the test.

RADIATOR (See FIGURE 2.)

Checks

To check for water flow restrictions in the radiator, run the engine until it is warm. Shut the engine OFF and feel the radiator. The temperature must be even across the radiator. (The radiator will be hotter near the top radiator hose.) Cold spots on the radiator indicate restrictions.

If the radiator has leaks, have it repaired by trained personnel.

NOTE: The Removal and Installation procedures for the radiator are in **THE FRAME** section of the SERVICE MANUAL.

Cleaning The Radiator

⚠ CAUTION

Disposal of lubricants and fluids must meet local environmental regulations.

1. Drain the cooling system. Fill the cooling system with clean water.
2. Install the radiator cap. Run the engine until the top radiator hose is hot. Stop the engine and let the engine cool.
3. Drain the water from the radiator. If the water is dirty, fill the system with water and repeat the procedure until the water is clean.

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⚠ CAUTION

Follow the manufacturer's instructions when using a chemical radiator cleaner.

4. If water does not clean the system, use a chemical radiator cleaner.

⚠ CAUTION

Follow the manufacturer's instructions when using

special equipment to reverse clean the radiator.

5. If the radiator or cooling system is very dirty or has a restriction, use the reverse cleaning method. This method uses air pressure to force water through the radiator in the opposite direction of normal flow.

6. Check the radiator fins. Clean the exterior of the radiator with compressed air or water as needed.

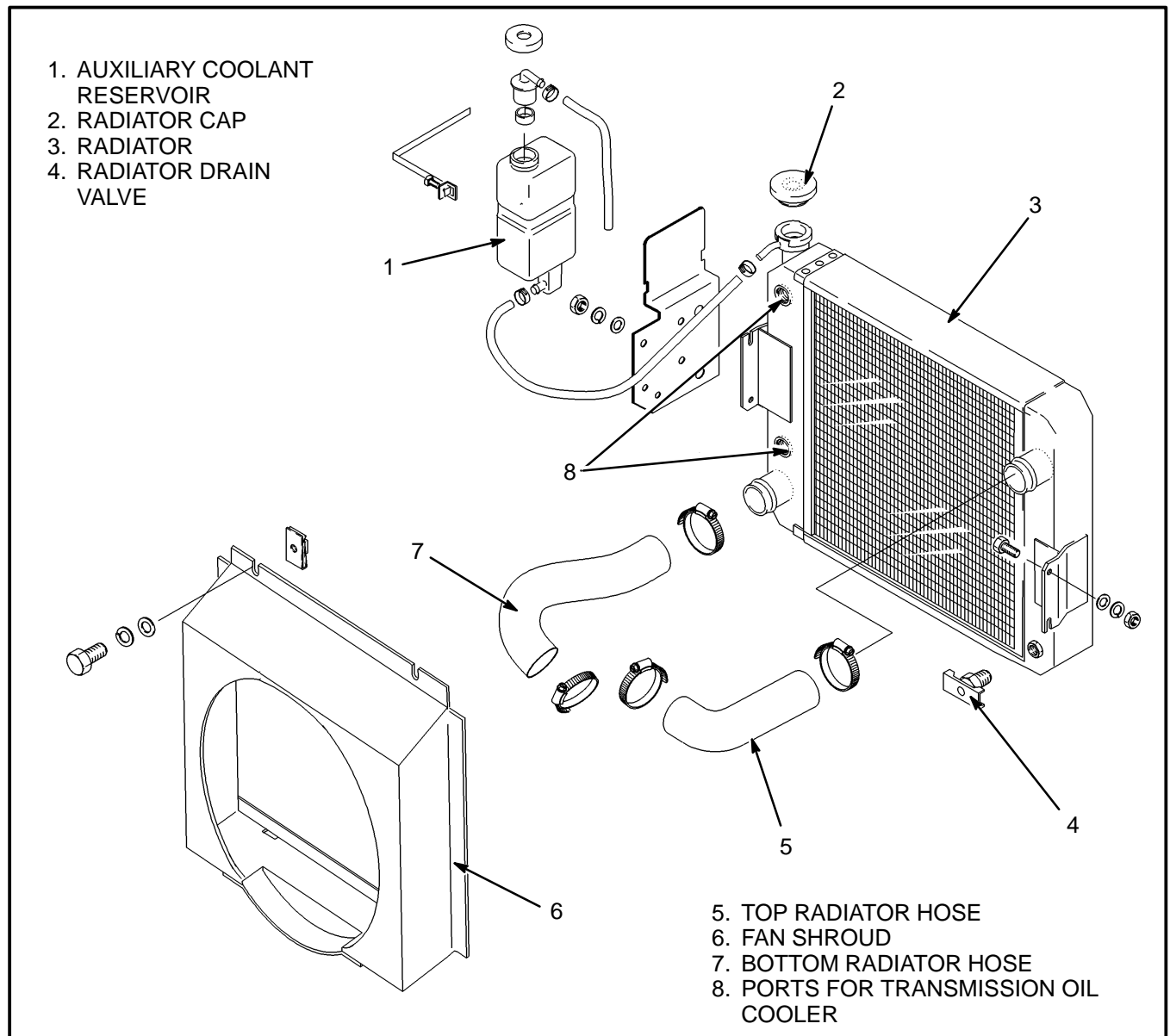


FIGURE 2. TYPICAL RADIATOR ARRANGEMENT

Drain The Cooling System

⚠ WARNING

DO NOT remove the radiator cap from the radiator when the engine is hot. When the radiator cap is removed, the pressure is released from the system. If the system is hot, the steam and boiling coolant can cause burns.

⚠ CAUTION

Disposal of lubricants and fluids must meet local environmental regulations.

1. Let the coolant cool to room temperature. Put a drain pan under the radiator. Remove the radiator cap.
2. Open the drain plug or remove the bottom radiator hose. Remove the drain plug from the engine block to drain the engine.

Fill The Cooling System (See FIGURE 3.)

1. Install the drain plug in the engine block. Install the bottom radiator hose.

⚠ CAUTION

Do not use an alcohol or methanol base anti-freeze. They are flammable and cause personal injury or damage to the lift truck.

2. Fill the cooling system with a mixture of 50% water and 50% ethylene glycol anti-freeze. The 50/50 mixture will protect the cooling system to -37°C (-34°F). Units with a Mazda engine must use a boron-free type of anti-freeze. Install the radiator cap.
3. Use the same coolant mixture and fill the auxiliary coolant reservoir to the "FULL" mark.

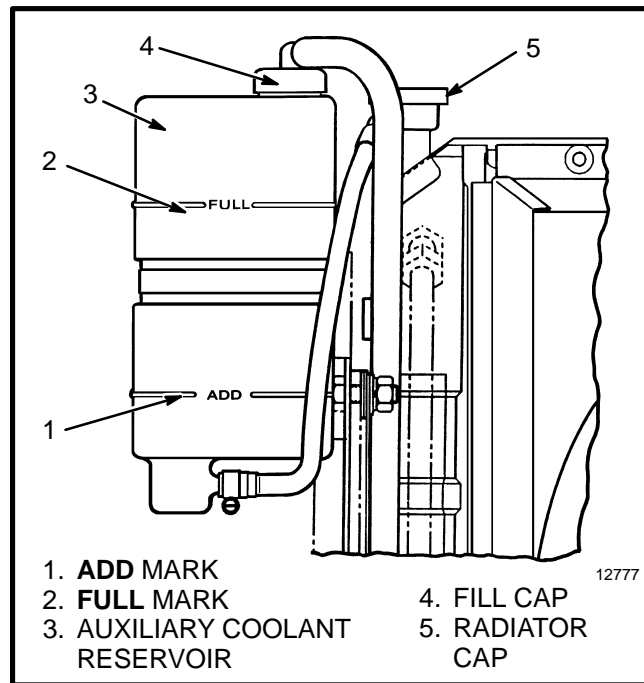


FIGURE 3. AUXILIARY COOLANT RESERVOIR

4. Start and run the engine until the thermostat opens. (The top radiator hose will be warm.)
5. Check the coolant level at the auxiliary coolant reservoir. Add coolant as necessary to keep the level between the "FULL" and "ADD" marks.

WATER PUMP (See FIGURE 4.)

Checks

Run the engine until it is warm. Check the operation of the water pump by holding the top radiator hose. If the pump is operating, there will be pressure surges in the hose.

NOTE: The Removal and Installation procedures for the water pump are in **THE ENGINE** section of the SERVICE MANUAL.

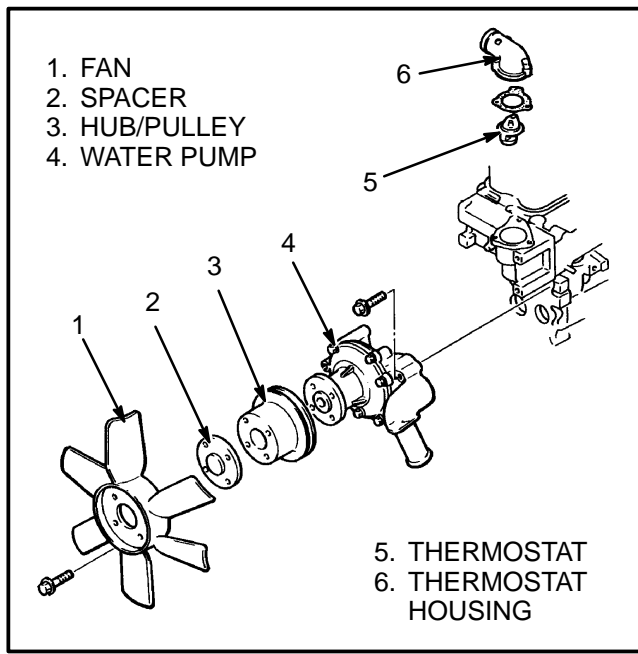


FIGURE 4. TYPICAL ARRANGEMENT, COOLING SYSTEM COMPONENTS

THERMOSTAT (See FIGURE 4.)

NOTE: The Removal and Installation procedures for the thermostat are in **THE ENGINE** section of the SERVICE MANUAL.

CAUTION

DO NOT operate the engine without a thermostat. The engine and cooling system can be damaged.

Checks

Check the operation of the thermostat as follows:

1. Mix a solution (33% anti-freeze and water). Heat the solution to 14° C (25° F) above the temperature on the thermostat.

2. Hold the thermostat with a wire and put it in the solution. Stir the solution. When operating correctly the thermostat will open.

3. Remove the thermostat and put in a solution (33% anti-freeze and water) that is -12° C (10° F) below the temperature on the thermostat. The valve must close completely.

FAN AND FAN SHROUD (See FIGURE 2. and FIGURE 4.)

NOTE: The Removal and Installation procedures for the fan and shroud are in **THE FRAME** section of the SERVICE MANUAL.

WARNING

DO NOT try to repair a damaged fan. If a fan has a bent blade or is cracked, install a new fan. A damaged fan can break during use and cause damage or serious injury.

1. When installing the fan make sure the correct spacers are installed and the mounting capscrews are tight.

2. When installing the fan shroud make sure the correct seals are on the shroud. Before tightening the capscrews for the fan shroud, make sure that the clearance around the circumference of the fan is even with the shroud. Also check that 1/3 to 1/2 of the cross-section of the fan blade extends into the fan shroud. Check that the WARNING labels are installed on the shroud.

TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSE	PROCEDURE OR ACTION
Coolant leakage.	<p>There is a leak in the radiator.</p> <p>There is a leak in a radiator hose or coolant hose.</p> <p>There is a leak from a plug or sensor in the engine block.</p> <p>Water pump leaks.</p> <p>Thermostat housing leaks.</p> <p>Cylinder head gasket is damaged.</p> <p>Cylinder head is cracked.</p> <p>Engine block is cracked.</p>	<p>Repair the radiator.</p> <p>Install new hoses.</p> <p>Check the sensors and plugs and repair the leaks.</p> <p>Install a new water pump.</p> <p>Install a new thermostat housing.</p> <p>Check for correct installation of the thermostat.</p> <p>Install a new head gasket.</p> <p>Install a new cylinder head.</p> <p>Install a new cylinder block.</p>
The engine is too hot during operation.	<p>There is not enough coolant in the cooling system.</p> <p>The radiator is dirty.</p> <p>The drive belt for water pump is not adjusted correctly, worn, or broken.</p> <p>The thermostat is wrong heat range or does not operate correctly.</p> <p>The cooling system has restrictions.</p> <p>The water pump worn or damaged.</p> <p>The exhaust system has restrictions.</p> <p>Ignition timing is not correct.</p>	<p>Check coolant level in radiator and coolant recovery bottle. Add coolant to correct level.</p> <p>Drain and clean radiator. Clean radiator fins with low pressure air or water in reverse direction of normal air flow. Be careful not to bend fins. Refill with clean coolant.</p> <p>Check water pump drive belt. Adjust or install new belt as required.</p> <p>Check heat range. Install new thermostat.</p> <p>Drain and back-flush engine and radiator. Refill with clean coolant.</p> <p>Install new water pump.</p> <p>Check the exhaust system. Remove restrictions.</p> <p>Check and adjust timing.</p>
Exhaust leakage into coolant.	<p>Head gasket(s) leaks.</p> <p>Cylinder head is damaged.</p>	<p>Install new gasket(s).</p> <p>Install new cylinder head.</p>