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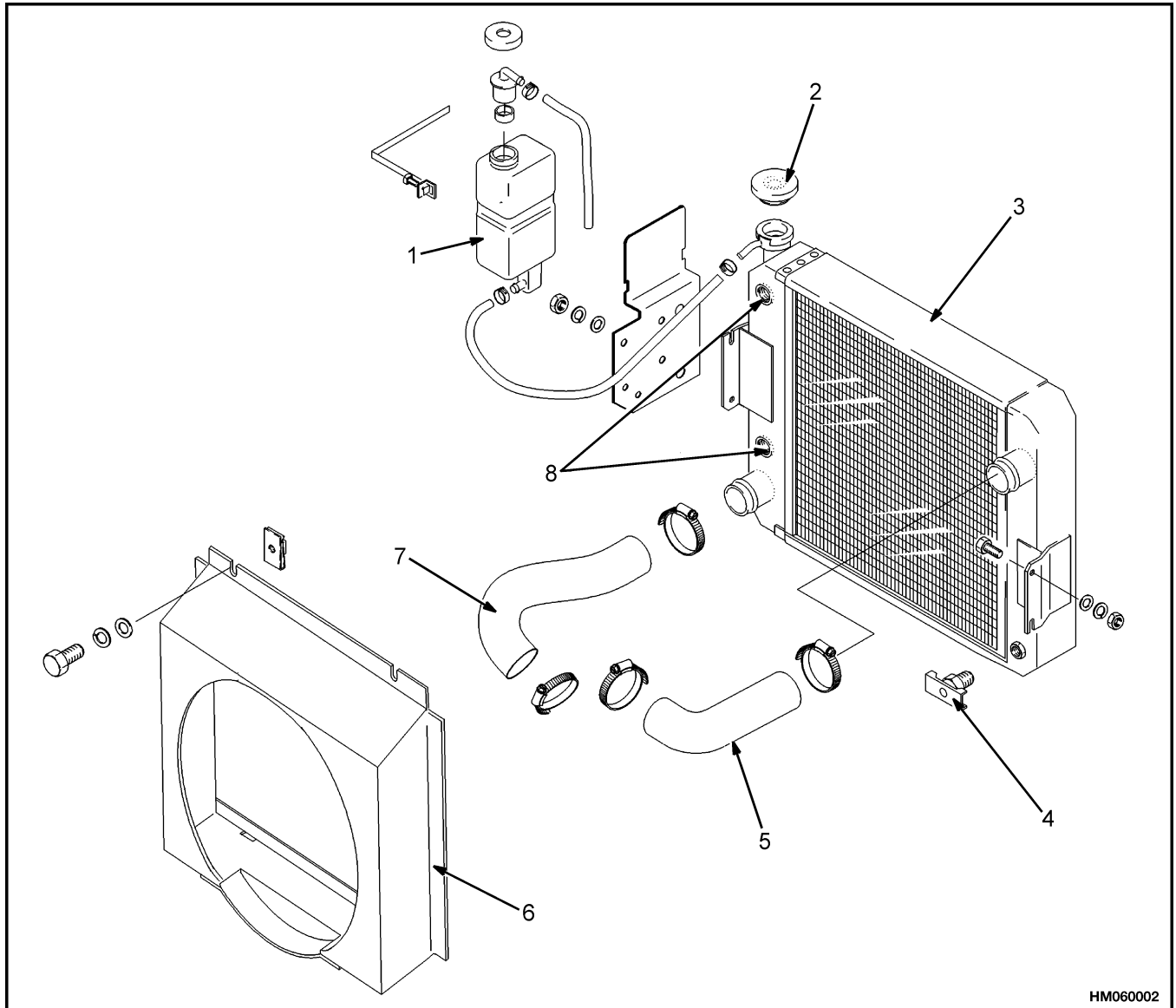
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This section is for the following models:
Internal Combustion Engine Powered Units

General

This section has the description and the checks for some parts of the cooling system. Procedures for cleaning the radiator and troubleshooting are also included in this section.

The cooling system has the following parts: radiator, auxiliary coolant reservoir, water pump, thermostat, fan, and fan shroud. See Figure 1.



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|--------------------------------|--------------------------------------|
| 1. AUXILIARY COOLANT RESERVOIR | 5. TOP RADIATOR HOSE |
| 2. RADIATOR CAP | 6. FAN SHROUD |
| 3. RADIATOR | 7. BOTTOM RADIATOR HOSE |
| 4. RADIATOR DRAIN VALVE | 8. PORTS FOR TRANSMISSION OIL COOLER |

Figure 1. Typical Radiator Arrangement

(More Content includes: Brake system, Capacities, and specifications, Frame, Hydraulic, System, Industrial battery, Main control, Valve, Mast repair, Fasteners, Schematics diagrams, Steering axle, Steering system, Wire harness repair And more)

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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 antifreeze. The antifreeze prevents the coolant from freezing in cold weather, and thereby preventing damage to the engine and radiator. The antifreeze 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 reduces 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.

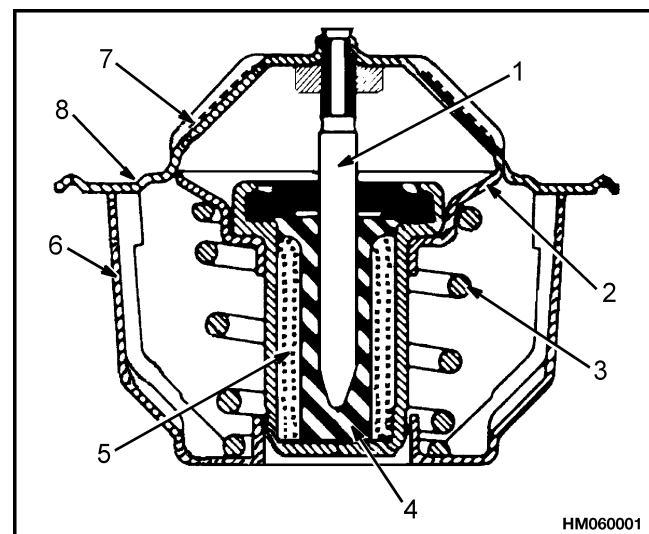
The radiator cap has a pressure valve and a vacuum valve. The pressure valve is held against its seat by a spring. The pressure valve opens when the pressure in the cooling system exceeds 103 kPa (15 psi). The vacuum valve is held against its seat

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.

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 may run improperly. See Figure 2.



- | | |
|---------------|----------------|
| 1. PISTON | 5. WAX PELLETT |
| 2. VALVE SEAT | 6. FRAME |
| 3. SPRING | 7. FLANGE |
| 4. DIAPHRAGM | 8. VENT HOLE |

Figure 2. Typical Thermostat

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 airflow through the radiator at all engine speeds. The fan is a pusher-type 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 ensures the air flow from the fan goes through the core of the radiator.

Cooling System Checks

RADIATOR



WARNING

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

NOTE: The Repair procedures for the radiator are in the **Frame** section of the **Service Manual**.

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.

THERMOSTAT



WARNING

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



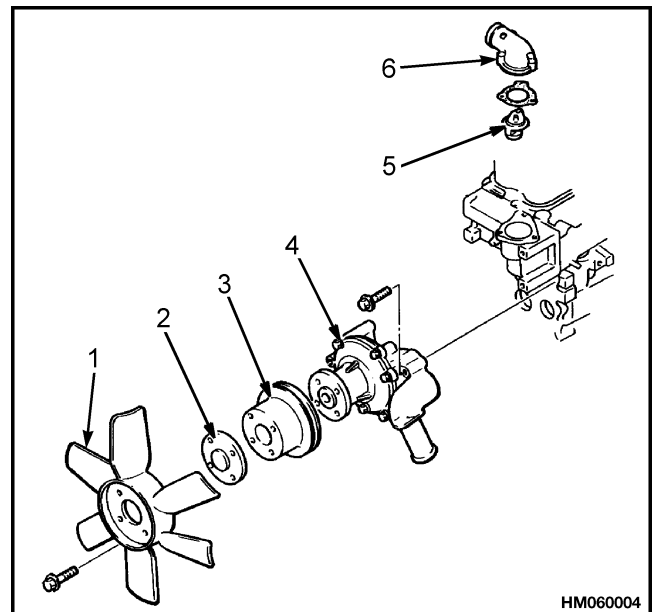
CAUTION

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

NOTE: Repair procedures for the thermostat are in the **Engine** section of the **Service Manual**.

1. Remove thermostat from cooling system. See Figure 3.

2. Mix solution of water with 33% antifreeze. Heat solution to 14°C (57°F) above temperature on thermostat.
3. Hold thermostat with wire and put it in solution. Stir solution. If operating correctly, thermostat will open.
4. Remove thermostat and put in same solution at -12°C (10°F) below temperature on thermostat. Valve must close completely.



- | | |
|---------------|-----------------------|
| 1. FAN | 5. THERMOSTAT |
| 2. SPACER | 6. THERMOSTAT HOUSING |
| 3. HUB/PULLEY | |
| 4. WATER PUMP | |

Figure 3. Cooling System Components Typical Arrangement

WATER PUMP**WARNING**

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

NOTE: Repair procedures for the water pump are in the **Engine** section of the **Service Manual**.

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. See Figure 3.

EXHAUST LEAKS**WARNING**

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

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

FAN AND FAN SHROUD**WARNING**

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

**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.

NOTE: Repair procedures for the fan and shroud are in the **Frame** section of the **Service Manual**.

1. When installing fan, make sure correct spacers are installed and mounting capscrews are tight. See Figure 1 and Figure 3.
2. When installing fan shroud, make sure correct seals are on shroud. Before tightening capscrews, make sure clearance around circumference of fan is even with shroud. Also make sure 1/3 to 1/2 of cross-section of fan blade extends into fan shroud.
3. Make sure WARNING labels are installed on shroud.

Radiator Cleaning**DRAIN****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 coolant cool to room temperature. Put drain pan under radiator. Remove radiator cap. See Figure 1.

2. Open drain valve or remove bottom radiator hose. Remove drain plug from engine block to drain engine.

CLEAN**CAUTION**

Disposal of lubricants and fluids must meet local environmental regulations.

1. Drain cooling system. Fill cooling system with clean water.
2. Install radiator cap. Run engine until top radiator hose is hot. Stop engine and let engine cool.

3. Drain water from radiator. If water is dirty, fill system with water and repeat procedure until water is clean.

**CAUTION**

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

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

**CAUTION**

Follow the manufacturer's instructions when using special equipment to reverse clean the radiator.

NOTE: On lift truck models S3.50-5.50XM (S70-120XM) (E004), the cooling system may be equipped with an optional radiator screen.

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

**WARNING**

Compressed air can move particles so they cause injury to the user or to other personnel. Make sure the path of the compressed air is away from all personnel. Wear protective goggles or a face shield to prevent injury to the eyes.

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

FILL

1. Install drain plug in engine block. Close drain valve or install bottom radiator hose as needed.

**WARNING**

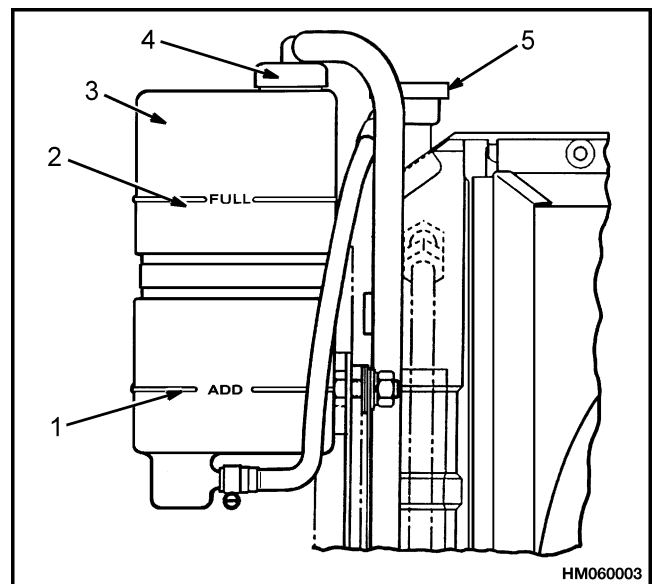
Do not use an alcohol or methanol-base antifreeze. They are flammable and can cause personal injury or damage to the lift truck.

NOTE: Units with a Mazda engine must use a boron-free type of antifreeze.

2. Fill cooling system with mixture of 50% water and 50% ethylene glycol antifreeze. Install radiator cap.

The 50/50 mixture will protect the cooling system to -37°C (-35°F).

3. Use same coolant mixture to fill auxiliary coolant reservoir to **FULL** mark. See Figure 4.
4. Start and run engine until thermostat opens. (Top radiator hose will be warm.)
5. Check coolant level at auxiliary coolant reservoir. Add coolant as necessary to keep level between **FULL** and **ADD** marks.



1. **ADD MARK**
2. **FULL MARK**
3. **AUXILIARY COOLANT RESERVOIR**
4. **FILL CAP**
5. **RADIATOR CAP**

Figure 4. Auxiliary Coolant Reservoir

Troubleshooting

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

