Date 1-1-89.

# MC-9 MAINTENANCE MANUAL

# SECTION 6

# COOLING SYSTEM

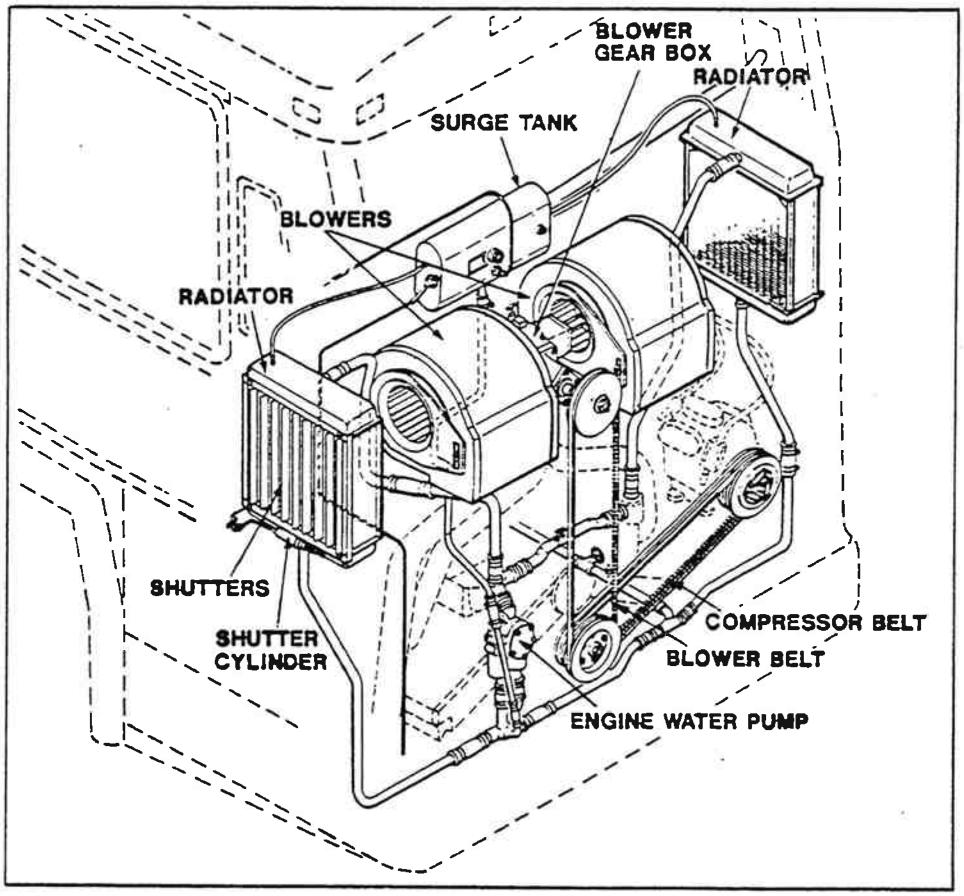


**Figure 6-1. Cooling System Components.**

## COOLING SYSTEM

One radiator is mounted on each side of the coach above the engine. Cores are of fin and tube construction. Dual centrifugal blowers are belt driven from the engine crankshaft through a gear box. They pull outside air through the radiators into a sealed, insulated blower compartment when the air operated, thermostatically controlled shutters are open.

When engine coolant is below normal operating temperature the shutters are automatically closed. With shutters closed, no air is pulled across the radiators and horsepower required to drive the centrifugal blower becomes significantly reduced.

The blower gear box includes a sight gauge for checking lubricant level and an easily accessible oil filler tube. Belt tension is maintained through an automatic, air controlled belt tightener.

The surge tank is mounted in the upper blower compartment. The coolant filler neck and pressure release valve are mounted behind the access door on the right rear side of the coach. A coolant level check can be done rapidly by means of a sight glass installed on the surge tank. Thermostats and alarmstats are provided at the front of each cylinder head.

The function of the coolant is to absorb the heat which develops as a result of the combustion process in the engine. In addition, the heat absorbed by the oil is removed by the engine coolant in the oil cooler.

The engine water pump circulates coolant through the engine oil cooler, block, cylinder heads and aftercooler. From the aftercooler it flows through the thermostats to the radiators and down to the water pump completing the cycle. Anything that interferes with this process of heat transfer can cause engine components to overheat, often resulting in serious engine damage. See figure 6-1.

### COOLANT TEMPERATURE

The heat-dissipating capacity of the V-92 Series engine cooling system and related components must be sufficient to prevent the coolant-out temperature from rising above the maximum allowable coolant-out temperature limit of 210°F (98.9°C).

This temperature must not be exceeded under any engine operating conditions, regardless of altitude, type of coolant used, or cooling system condition. Exceeding these limits can result in malfunction or serious engine damage.

### TEMPERATURE CONTROL COMPONENTS

The engine is designed to operate with thermostats which, combined with a radiator, regulate coolant temperature. Radiator shutters, and fans, are used to help control coolant temperature. These "add on" cooling system components must operate in proper sequence to prevent coolant temperature instability and/or engine overheating. An improper operating sequence can also have a detrimental effect on the life of the "add on" components as well.

The following chart gives the **nominal** temperature settings for the 180°F (82°C) thermostat and shutterstat controls, along with standard and optional alarmstat settings. These settings should not be exceeded, under any engine operating condition, regardless of operating altitude, type of coolant used, or cooling system condition. Exceeding the settings will unnecessarily increase the engine coolant and lubricating oil temperature.

**NOTE: Coolant temperature instability will result from improper component operating sequence.**

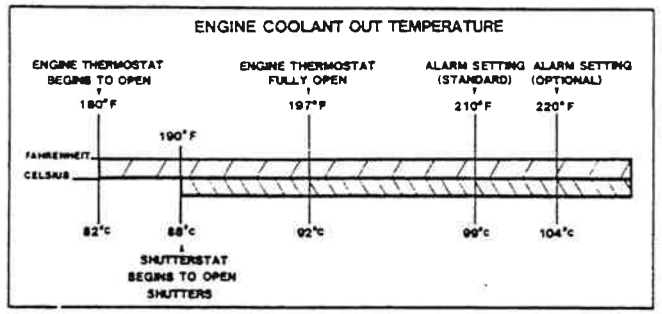


Figure 6-2. Nominal Settings For Coolant Temperature Controls.

The major components of the cooling system are the coolant, radiators, blower gear box and surge tank. These components, as well as the minor ones, are covered in more detail later in this section.

## HOSE INSPECTION

Swollen, cracked or worn out hoses or loose hose connections are frequent causes of cooling system problems.

Serious overheating is often caused by old hose collapsing or from deteriorated rubber shedding from hoses and clogging the coolant passages.

Connections should be inspected periodically and hose clamps tightened. Replace any hose found to be cracked or swollen. When installing a new hose, clean pipe connections and apply a thin layer of a non-hardening sealing compound. Replace worn out clamps or clamps that pinch hoses.

## TESTING ANTIFREEZE SOLUTIONS

Always test solution before adding water or antifreeze. Engine should be warmed to operating temperature. Fill and empty tester several times before using, and ensure that tester is clean inside and out.

If a coolant filter is used, replace the element every 500 hours or 20,000 miles (32,000 km).

Commercial cooling system cleaners of alkaline or acid type may be used. Exercise extreme caution and follow the manufacturer's recommendations when using these types of cleaners.

Problems may develop from leaks and seepage at the engine water pump and thermostat housings hose connections. These may be caused by deformation and rough surfaces on the castings at the hose mounting surfaces. It is recommended that Dow Corning RTV-102 Compound be applied to cast surfaces prior to hose installation.

**CAUTION: Castings should be clean and free of oil and grease before applying compound. No other sealer should be used with RTV compound.**

## COLD WEATHER OPERATIONS

Although not recommended, plain water with an inhibitor may be used as a coolant where temperatures do not reach below 32°F (0°C). In colder regions antifreeze must be used.

Before adding antifreeze the cooling system should be inspected for winter operation. Cylinder head gaskets should be tightened or replaced where necessary to avoid the possibility of coolant leaking into engine and exhaust gases blowing into cooling system.

After antifreeze has been added, the entire system should be inspected regularly to ensure against the development of leaks.

If the cooling system becomes frozen, place the coach in a warm area until the ice is completely thawed. Under no circumstances should the engine be operated when the cooling system is frozen.

## PREVENTIVE MAINTENANCE

A program of maintenance of the cooling system components is essential to ensure maximum system efficiency, and trouble-free operation. Observe the following guidelines.

1. Check, on a daily basis, the coolant level in the surge tank. Keep tank filled with the coolant required for proper operation in the extremes of seasonal temperatures.

2. Every 20,000 miles (32,000 km) perform the following checks:

a. Check belts for condition and tension. Tighten loose belts and replace those frayed or worn.

b. Check water pump operation and installation. A leaking pump will suck air into the cooling system, causing corrosion of engine and cooling system components, and decreasing the efficiency of the coolant. Correct all leaks at once.

c. Check the radiators and all hoses for leaks. Repair leaking components. Clean the radiator cores with low pressure air to remove all dirt and thus provide optimum heat dissipation. Check and tighten radiator mounts as required. Repair all leaks.

d. If a coolant filter is used, replace the element at this interval.

3. The following procedures are necessary every 100,000 miles (161,000 km):

a. Check the strength of the antifreeze with a hydrometer. If too weak, drain a quantity of coolant from the system, and replace with the same quantity of coolant (water/antifreeze mixture) in proper proportion to result in correct overall solution strength.

b. Check the strength of the inhibitor in the coolant. Use a test kit or strip made available by the manufacturer of the inhibitor in use. Follow the instructions of the inhibitor manufacturer. Add inhibitor only in the amount necessary to reach manufacturer's strength recommendations.



**NOTE: Specific instructions are set forth below concerning coolant requirements, antifreeze, use of water in the system, corrosion inhibitors, silicate gel formation and coolant testing.**

## COOLANT REQUIREMENTS

Coolant solutions must meet the following basic requirements:

1. Provide for adequate heat transfer.
2. Provide a corrosion-resistant environment within the cooling system.
3. Prevent formation of scale or sludge deposits in the cooling system. Figure 6-3 contains water quality data.
4. Be compatible with cooling system hose and seal materials.
5. Provide adequate freeze protection during cold weather operation and boil-over protection in hot weather.

The first four requirements are satisfied by combining a suitable water with reliable inhibitors. When freeze protection is required, a solution of suitable water and an antifreeze containing adequate inhibitors will provide a satisfactory coolant. Ethylene glycol-based antifreeze solutions are recommended for year-round use.

## WATER

Whether of drinking quality or not, any water will produce a corrosive environment in the cooling system, and the mineral content may permit scale deposits to form on internal cooling system surfaces. Therefore, water selected as a coolent must be properly treated with inhibitors to control corrosion and scale deposition.

To determine if a particular water is suitable for use as a coolant when properly inhibited, the following characteristics must be considered: the concentration of chlorides and sulfates, total hardness, and total dissolved solids.

Chlorides and/or sulfates tend to accelerate corrosion, while hardness (percentage of magnesium and calcium salts broadly classified as carbonates) cause deposits of scale. Total dissolved solids may cause scale deposits, sludge deposits, corrosion, or a combination of any of these. Chlorides, sulfates, magnesium and calcium are among the materials which make up dissolved solids. Water within the limits specified in Table 1 (figure 6-3) is satisfactory as an engine coolant when proper inhibitors are added. The procedure for evaluating water intended for use in a coolant solution is shown in Table 2.

**TABLE 1**

| | PARTS PER MILLION | GRAINS PER GALLON* |
|---|---|---|
| Chloride (Maximum) | 40 | 2.5 |
| Sulfates (Maximum) | 100 | 5.8 |
| Total Dissolved Solids (Maximum) | 340 | 20 |
| Total Hardness (Maximum) | 170 | 10 |

Refer to Table 2 for evaluation of water intended for use in a coolant solution.

*4.5 liters

**TABLE 2**

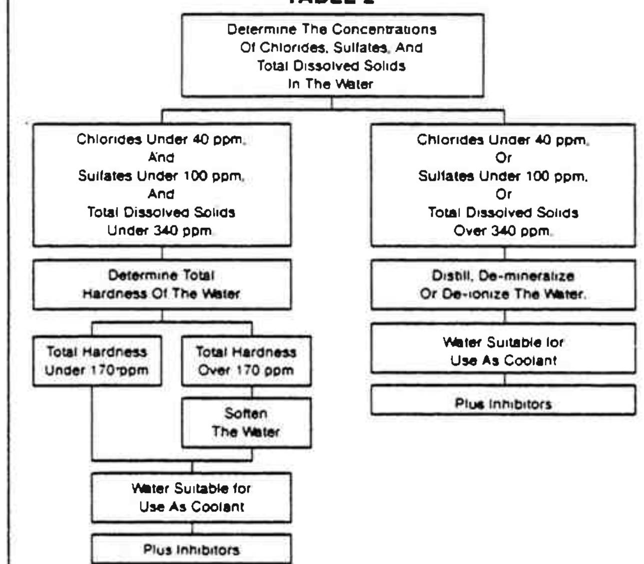


Figure 6-3. Cooling Fluid Characteristics.

## ANTIFREEZE

When freeze protection is required, use an antifreeze that meets the GM 6038M formulation, which limits silicate to 0.15% maximum, or an equivalent formulation meeting the 0.15% maximum silicate and GM 1899M performance requirements.

Solutions of less than 30% do not provide adequate corrosion protection. Concentrations over 67% adversely affect freeze protection, heat transfer rates, and silicate stability. A 50% antifreeze solution is normally used as factory-fill.

Ethylene glycol base antifreeze is recommended. Methyl alcohol base antifreeze is not recommended because of its effect on the non-metallic components of the cooling system and because of its low boiling point. Methoxy propanol base antifreeze is not recommended due to the presence of fluoroelastomer seals in the cooling system.

The inhibitors in antifreeze solutions should be replenished with a non-chromate corrosion inhibitor supplement when indicated by testing the coolant. Engine coolant should be checked at approximately 500 hour or 20,000 mile intervals. (See Coolant Testing, below.)

Antifreeze solutions should be used year-round to provide freeze protection in the winter, boil-over protection in the summer, and a stable environment for seals and hoses in the cooling system of the engine. (See figure 6-4.)