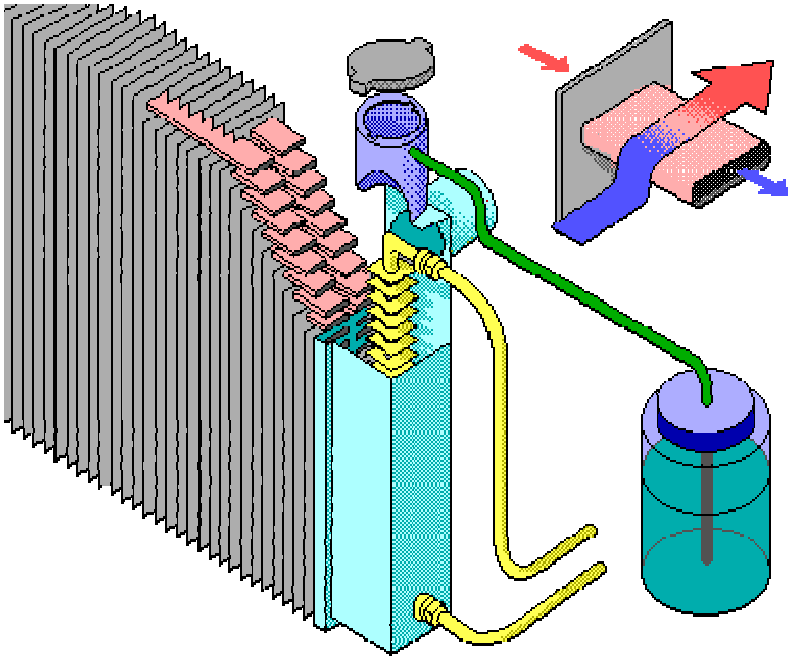
Cooling System Operation



Below is an explanation of this system's operation

Radiator

The radiator is a device designed to dissipate the heat which the coolant has absorbed from the engine. It is constructed to hold a large amount of water in tubes or passages which provide a large area in contact with the atmosphere. It usually consists of a radiator core, with its water-carrying tubes and large cooling area, which are connected to a receiving tank (end cap) at the top and to a dispensing tank at the bottom. Side flow radiators have their "endcaps" on the sides, which allows a lower hood line.

In operation, water is pumped from the engine to the top (receiving) tank, where it spreads over the tops of the tubes. As the water passes down through the tubes, it loses its heat to the airstream which passes around the outside of the tubes. To help spread the heated water over the top of all the tubes, a baffle plate is often placed in the upper tank, directly under the inlet hose from the engine.

Sooner or later, almost everyone has to deal with an overheating car. Since water is readily available, it is not beyond the ability of most people to add some to their radiator if it's low. **BUT PRECAUTIONS MUST BE TAKEN OR SERIOUS BURNS CAN RESULT. Here are a few pointers for dealing with an overheated radiator:**

- Turn off the A/C. If the car is not seriously overheating, this will reduce the engine's temperature. The AC evaporator is located in front of the radiator,

and it adds heat to the air going to your engine. The hotter the incoming air is, the less efficient the radiator will be.

- Turn on your heater (set on highest temperature setting, with blower on highest setting). This will be uncomfortable for you, but it will cool the engine by transferring the heat to the air. Roll down the windows, and remember how 'hot' you'll get if your engine needs replacement!
- If you're stuck in traffic, pull over and stop. Unless you're moving, very little cool air reaches the radiator. Open the hood and let the engine cool off. This takes time, so be patient. Use the time to go get a jug of water or antifreeze.
- Check the overflow tank coolant level. If it's empty, the radiator is probably low on coolant.
- Check the pressure of the system by wrapping a cloth around the upper radiator hose and squeezing it. If it's still under pressure (hot) it will not squeeze easily. Wait until it does.
- Place a large cloth over the radiator cap, and CAREFULLY release the pressure.**DANGER: SERIOUS BURNS CAN RESULT FROM THE HOT COOLANT. IF IN DOUBT, WAIT UNTIL THE ENGINE COOLS COMPLETELY.**
- If the coolant is low, start the engine, and slowly add the water or coolant necessary to fill it up. **THE ENGINE MUST BE RUNNING. ADDING COOLANT TO A WARM ENGINE CAN CRACK THE BLOCK.** By running the engine, the coolant keeps moving and reduces the chances of this type of damage occurring.

Water Pump

Water pumps come in many designs, but most include a rotating impeller, which forces the coolant through the engine block. In most rear wheel drive cars, the fan is installed on the end of the water pump shaft. Many water pumps have a spring-loaded seal to avoid leakage of water around the pump shaft. Modern pumps are fitted with pre-packed ball bearings, which are sealed at each end to eliminate the need for lubrication.

Impeller type water pumps must turn rapidly to be efficient, and worn or loose drive belts can permit slippage which is not easily detected.

Expansion (Overflow) Tank

Several cooling systems make use of a clear plastic container, which is connected to the overflow tube from the radiator. This container provides extra storage space for the coolant when it expands and is called the expansion, or overflow tank. It is also known as the coolant reservoir, or overflow canister.

As the engine heats up, the coolant inside it expands. Without the expansion tank, the coolant would flow out of the overflow tube and be lost from the cooling system onto the street. Instead, the coolant flows into the expansion tank.

Since a vacuum is created in the cooling system when the engine cools, the vacuum causes some of the coolant in the expansion tube to be sucked back into the system. Because a cooling system with an expansion tank is virtually a closed system, the

coolant can flow between the system and the expansion tank as it expands and contracts. This way, no coolant is lost if the system is functioning properly.

Another function of the expansion tank is to remove air bubbles from the cooling system. Coolant without air-bubbles is much more efficient than coolant with air bubbles, because it absorbs heat much faster.

The advantage of the expansion tank is that while the level of coolant contained in it rises and falls, the radiator is always full.

Older cars can easily be fitted with expansion tanks, simply by mounting the tank near the radiator, connecting it to the overflow tube, and replacing the radiator cap.

Radiator Cap (Pressure Cap)

The radiator cap acts as more than just a "lid" for your radiator; it keeps your engine cool by sealing and pressurizing the coolant inside it.

What makes the radiator cap special is that it is designed to hold the coolant in your radiator under a predetermined amount of pressure. If the coolant was not kept under pressure, it would start to boil, and soon you would have boiled all of your coolant away.

However, the radiator (or pressure) cap prevents this from happening by exerting enough pressure to keep the coolant from boiling. Normally, water (coolant) boils at 212 degrees F, but if the pressure is increased, the boiling temperature is also increased. Since the boiling point goes up when the pressure goes up, the coolant can be safely heated to a temperature above 212 degrees F without boiling.

What makes this important is that the higher the temperature of the coolant is, the greater the temperature gap between it and the air temperature is. This is the principle that causes the cooling system to work; the hotter the coolant is, the faster the heat in it moves to the radiator and the air passing by. So, a cooling system under pressure takes heat away from the engine faster, which makes it more efficient.

If your cooling system is under too much pressure, it can "blow its top!" To prevent this, the radiator cap has a pressure relief valve. The valve has a preset rating that allows it to take just up to a certain amount of pressure. When you turn the cap on the filler neck of the radiator, you seal the upper and lower sealing surfaces of the filler neck. The pressure relief valve spring is compressed against the lower seal when you lock the cap.

The radiator filler neck has an overflow tube right between the two sealing surfaces. If the pressure in the cooling system exceeds the preset rating of your cap, its pressure relief valve allows the lower seal to be lifted from its seat. Then the excess pressure (coolant,air) can squish through the overflow tube to the ground or the coolant reservoir.

Once enough pressure has been released (the caps preset rating), the pressure relief valve is again closed by the spring.

The pressure cap can be tested with a cooling system pressure tester, using an adapter, to make certain that it is living up to its pressure rating. It should be replaced if it fails the test.

Note: Most radiator pressure caps are not meant to be removed. Coolant should always be added through the expansion (overflow) tank. NEVER REMOVE THE RADIATOR CAP FROM A HOT ENGINE. REMOVING THE PRESSURE CAN CAUSE STEAM TO SHOOT OUT AND SERIOUSLY BURN YOU.

Cooling Fans

The reason the coolant goes into the radiator is to allow air to pass through it and cool the coolant. When you are driving fast enough, the air rushes through the grille of the car and passes through the radiator core. If you aren't driving fast enough to push air through the radiator, then the fan will pull the air through.

The fan improves cooling when you are driving at slow speeds, or if the engine is idling. It is usually mounted on the water pump shaft, and is turned by the same belt that drives the water pump and the alternator, although it can be mounted as an independent unit. Most independently mounted fans are electric.

Belt Powered Fans

The fan's activity is not always necessary, and it takes power from the engine to spin. For this reason a thermostatic control, or fan clutch, is often used to reduce drive torque when it isn't needed (variable-speed fan). A different type of fan uses centrifugal force to move its flexible plastic blades, by flattening them when the engine rpm is high (flexible-blade fan). The less angle the blade shave, the less power they use. The idea of these units is to save horsepower and reduce the noise the fan makes.

A fan can have from four to six blades to suck the air through the radiator. Often the radiator has a shroud for the fan to keep it from recirculating the same hot air that has collected behind the radiator. Many fans have irregularly spaced blades to reduce resonant noise.

Electric Fans

Front-wheel drive engines mounted transversely usually use electric fans to cool the engine. The radiator is located in the usual place, but an electric motor drives the fan. A thermostatic switch is used to turn the fan on and off at predetermined temperature settings, which it senses. The exception to this is air conditioning. If you turn on the air conditioner, you bypass the thermostatic switch, and the fan runs continuously. If you turn off the air conditioner, the thermostatic switch is re-activated, and goes back to turning the fan on and off, according to its instructions. Many cars have one electric fan for normal cooling and a separate one just for when the air conditioner is on.

There are some really nice features about the electric fan. The nicest feature is that you don't have to keep an eye on the treacherous old fan belt -- there isn't one, so you don't have to worry about its health and fitness. It's also quieter, and less of a

power drain on the engine. They also help your engine by continuing to cool it after it's turned off.

V-Belt (Fan Belt)

The fan (drive) belt wedges neatly into the different pulley grooves. The belt uses the tension and friction to turn the auxiliary devices.

The fan belt is usually V-shaped, so it is also called a V-belt. The fan belt friction comes from the sides of the belt and the sides of the pulley grooves to transmit power from one pulley to the other through the belt. Since the sides of the belt are used for transmission of power, the sides have very large surface areas. The reason that the belt does not slip is because of the wedging action of the belt as it curves into the pulley grooves.

Because your belts are so essential to so many parts of your engine, it is a very good idea to periodically check their condition. Check for cracking, splitting, or fraying, especially before summer. Also, check the tightness of the belt and have it adjusted according to your owner's manual specifications. Belts have a tendency to loosen with use. On the other hand, you don't want the belt to be too tight, or it will put too much pressure on the accessory bearings and cause them to die an early death. If a belt is over three years old, have it replaced even if it looks good.