

History of car cooling system engineering essay



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In the earlier days, automobile compartments were first heated, ventilated and cooled by the obvious and primitive solutions. Ventilation was simple to arrange by opening car windows. However, the air entering was as hot, cold or dusty as the air outside, and so under poor conditions they were often kept closed.

When the weather is cold, clay bricks were easy to warm up on top of a cast-iron stove, and could be placed in a box on the floorboards to provide heat as long as they remained warm. A more sophisticated approach was to purchase a small heater that burned coal or charcoal to warm the passenger compartment continuously.

When the weather turned hot, most drivers simply put up with the discomfort, but more innovative travellers sometimes attempted to cool the passenger compartment by bringing along a block of ice. Neither solution was especially effective or convenient, and manufacturers soon discovered a mechanism for automobile conditioning system. The first prototype was attributed to Karl Benz. Wilhelm Maybach designed the first honeycomb

radiator for the Mercedes 35hp which was the very first successful vehicle with a cooling system.

In 1941, 300 Cadilacs were manufactured with an air conditioning system. Chrysler also produces some of the cars that year with air-conditioning system. In 1948 the Automotive Refrigerated Air Conditioning (ARA) Company was first to offer aftermarket automotive air-conditioning systems. By the mid-1950s there were more than fifteen companies offering air-conditioning system in kit form.

Latest Technology

Automotive engines use the cooling system to achieve and maintain an optimum operating temperature range. An engine gives off enough heat to seize, melt and ignite its components. To prevent this type of severe heat damage, coolant is circulated through passages in the engine block and cylinder head, drawing away excess heat. Coolant is also part of the heating system. The heat absorbed by the coolant is used to warm the passenger compartment.

The Cooling System consists of the following components:-

I. Water pump

II. Thermostat

III. Radiator

IV. Coolant recovery tank

V. Engine fan(s)

VI. Hoses

VII. Core plugs

VIII. Heater Core

Water pump

http://www.aa1car.com/library/water_pump_cutaway.jpg

-On rear-wheel-drive vehicles, the water pump is located between the engine block and engine fan. On a few front-wheel-drive vehicles, the water pump is located at the rear of the engine. The water pump, uses centrifugal force to circulate the coolant, and consists of a fan shaped impeller set in a round chamber with curved inlet and outlet passages. The chamber is called a scroll because of the curved areas. The centrifugal design causes vehicles increase engine speed when the coolant temperature begin to rise.

Thermostat

-Any liquid-cooled car engine has a small device called the thermostat that sits between the engine and the radiator. The thermostat in most cars is about 2 inches (5 cm) in diameter. Its job is to block the flow of coolant to the radiator until the engine has warmed up. When the engine is cold, no coolant flows through the engine. Once the engine reaches its operating temperature (generally about 200 degrees F, 95 degrees C), the thermostat opens. By letting the engine warm up as quickly as possible, the thermostat reduces engine wear, deposits and emissions. As it heats up, its valve opens about an inch, apparently by magic! If you'd like to try this yourself, go to a <https://assignbuster.com/history-of-car-cooling-system-engineering-essay/>

car parts store and buy one for a couple of bucks. http://www.2carpros.com/images/articles/engine/cooling/thermostat/engine_therrmostat.jpg

The secret of the thermostat lies in the small cylinder located on the engine-side of the device. This cylinder is filled with a wax that begins to melt at perhaps 180 degrees F (different thermostats open at different temperatures, but 180 F/82 C is a common temperature).

1. Thermostat Failure

The thermostat is pretty simple and rarely causes problems, but when it fails the results can be disastrous. The worst case scenario is when the thermostat sticks shut, which can happen if the wax element has been damaged by previous overheating, corrosion or age. If it sticks shut, it will block the circulation of coolant between the engine and radiator causing the engine to overheat.

If the thermostat fails to close, which can happen if the sensing element binds up, the return spring breaks or a piece of rust or debris jams it open, the constant flow of coolant through the thermostat will prevent the engine from reaching normal operating temperature. This can cause poor driveability in cold weather, a sharp increase in fuel consumption, little or no heater output, and accelerated blowby and ring and cylinder wear.

2. Thermostat Checks

To check the thermostat, remove the radiator cap and start the engine while it is cold. Looking inside the radiator, you should see no movement of

coolant. If you see movement, the thermostat is stuck open or is missing and repairs are required.

After the engine has run for five minutes or so, the upper radiator hose should start to feel hot signaling that the thermostat has opened and the coolant is now circulating through the system. Inside the radiator, you should also see coolant movement. If there is no movement (and the engine starts to overheat), the thermostat is defective and needs to be replaced.

A suspicious thermostat can also be tested by removing it from the engine and dropping it into a bucket of near boiling water. It should be closed when cold, then open once it hits the hot water, then close again after its been removed and allowed to cool. You can use a thermometer to check the exact opening and closing temperature.

Radiator

-A radiator is a type of heat exchanger. It is designed to transfer heat from the hot coolant that flows through it to the air blown through it by the fan.

[http://upload.wikimedia.](http://upload.wikimedia.org/wikipedia/commons/thumb/a/ad/Automobile_radiator.jpg/220px-Automobile_radiator.jpg)

[org/wikipedia/commons/thumb/a/ad/Automobile_radiator. jpg/220px-](http://upload.wikimedia.org/wikipedia/commons/thumb/a/ad/Automobile_radiator.jpg/220px-Automobile_radiator.jpg)

[Automobile_radiator. jpg](http://upload.wikimedia.org/wikipedia/commons/thumb/a/ad/Automobile_radiator.jpg/220px-Automobile_radiator.jpg)

Most modern cars use aluminium radiators. These radiators are made by brazing thin aluminium fins to flattened aluminium tubes. The coolant flows from the inlet to the outlet through many tubes mounted in a parallel arrangement. The fins conduct the heat from the tubes and transfer it to the air flowing through the radiator.

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The tubes sometimes have a type of fin inserted into them called a turbulator, which increases the turbulence of the fluid flowing through the tubes. If the fluid flowed very smoothly through the tubes, only the fluid actually touching the tubes would be cooled directly. The amount of heat transferred to the tubes from the fluid running through them depends on the difference in temperature between the tube and the fluid touching it. So if the fluid that is in contact with the tube cools down quickly, less heat will be transferred. By creating turbulence inside the tube, all of the fluid mixes together, keeping the temperature of the fluid touching the tubes up so that more heat can be extracted, and all of the fluid inside the tube is used effectively.

Radiators usually have a tank on each side, and inside the tank is a transmission cooler. In the picture above, you can see the inlet and outlet where the oil from the transmission enters the cooler. The transmission cooler is like a radiator within a radiator, except instead of exchanging heat with the air, the oil exchanges heat with the coolant in the radiator.

Coolant Recovery Tank-

-The coolant recovery tank, also called an overflow reservoir, is a tank that allows the coolant to expand without being forced out of the radiator. The tank can also ensure that the radiator is always full as it allows the radiator to be refilled as the engine cools.

1. Heating Up

As the engine heats up, the coolant expands as its temperature increases. The increase in heat is accompanied by an increase in pressure. The radiator
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pressure cap, which uses a spring to maintain a seal on the radiator fill hole. Once the pressure reaches around 15 psi, the force of the spring is overcome, and the cap rises.

As the cap rises, the opening of a tube is exposed. The coolant under pressure is forced through the tube into the recovery tank.

2. Cooling Down

As the engine cools, the process works in reverse. Instead of pressure forcing coolant out of the radiator, a vacuum draws it back in. This keeps the coolant at the proper level throughout various engine temperatures.

3. Measuring Coolant Level

The coolant level can be measured by a dipstick in the recovery tank. The dipstick has a range of hot and cold. The coolant level should be at the “cold” mark when the engine is cold, and hot when the engine has reached running temperature.

4. Boiling Over

In the event that too much coolant is in the system, the recovery tank itself has a pressure cap that will allow the excess coolant to exit the vehicle. If the pressure builds too much inside the radiator and recovery tank, the expanding coolant will force the cap open enough for the excess pressure to be relieved.

The use of an overflow tank is done for environmental reasons. It prevents a slightly overfilled radiator system from venting onto the ground. The use of <https://assignbuster.com/history-of-car-cooling-system-engineering-essay/>

an expansion tank, with a conventional radiator, adds a very small amount of additional coolant to the system. If this small amount of additional coolant is sufficient to correct an overheating engine, there is some other form of cooling system problem, which should be addressed.

Cooling Fan

-The cooling fan is only needed when engine temperature rises above a predetermined level — or when there is an increased load placed on the cooling system (as when running your air conditioner). The rest of the time, running the fan would be a waste of electrical energy so it is turned off.

Electric cooling fans are found on most front-wheel drive vehicles with transverse mounted engines as well as many late model rear-wheel drive vehicles. Electric fans are used on FWD cars because the fan doesn't require a belt drive and can be mounted independent of the engine's location.

What's more, electric fans require less power to operate (for improved fuel economy and performance), they're quieter, and they allow more precise control over cooling.

By comparison, a mechanical belt-driven fan can require anywhere from 5 to 15 horsepower depending on engine speed and the size of the fan. Even with a fan clutch to reduce the drag at higher speeds, it's still a lot of wasted power.

1. Fan Operation

At highway speeds, there is usually enough airflow through the radiator that a fan isn't needed. So the fan usually only operates when the vehicle is sitting in traffic or driving at slower speeds.

On older applications, the electric fan is controlled by a temperature switch located in the radiator or engine. When the temperature of the coolant exceeds the switch's rating (typically 195 to 235 degrees F), the switch closes and energizes a relay that supplies voltage to run the fan. The fan then continues to run until the coolant temperature drops back below the opening point of the switch. Most electric fans are also wired to come on when the A/C is on. Many vehicles also have a separate fan for the A/C condenser (dual fan systems). One or both fans come on when the A/C is on.

In newer vehicles with computerized engine controls, fan operation is regulated by the engine control module. Input from the coolant sensor, and in many cases the vehicle speed sensor too, is used to determine when the fan needs to be on.

CAUTION: Many electric fans are wired to come on anytime the engine is above a certain temperature, regardless of whether the engine is running or not. This means the fan may come on after the engine has been shut off. So keep your fingers away from the fan at all times unless the battery or fan motor wires have been disconnected.

2. Checking The Fan

Four things can prevent a fan from coming on when it should: a bad temperature switch or coolant sensor (or problem in the switch or sensor

wiring circuit); a bad fan relay; a wiring a problem (blown fuse, loose or corroded connector, shorts, opens, etc.); or a failure of the fan motor itself. Only the latter would require replacing the fan motor.

One way to check the operation of the fan motor is to jump it directly to the battery. If it spins, the motor is good, and the problem is elsewhere in the wiring or control circuit. Another check is to test for voltage with a voltmeter or test light at the fan's wiring connector. There should be voltage when the engine is hot and when the A/C is on.

Hoses

-Radiator hoses must be the correct size, material, and be kept in good repair. The upper and lower radiator hoses must be large enough to handle the maximum flow of coolant when the thermostat is fully open. The smaller heater hoses divert a portion of the coolant to and from the heater core. Additionally, the hoses must be of the specified type of material for high pressure, high temperature systems. Always inspect the hoses for any sign of damage when you service a cooling system. The rubber material of hoses becomes brittle and cracked from the severe heat of engine compartment.

Core Plugs

-Core plugs seal the holes used during the manufacturing process. The plugs are round discs of sheet metal pressed into openings on the side of the engine block that lead directly into the water jackets. These plugs may leak or pop out if the morning cooling system freezes or is not properly maintained. Core plugs tend to pop out if the block freezes. Originally it was

thought that these plugs were designed for this reason, to lessen the pressure on the block and prevent it from cracking, which is why they are sometimes(incorrectly) referred as to freezed plugs.

Heater core

-You may not normally think of the heater core as part of the cooling system, as we generally consider the heater core as a compartment of the heating system. However, the heater core is directlyconnected to the cooling system by the heater hoses. A heater core failure can lead to other cooling system malfunctions.

The heater core is a heat exchanger, and is constructed much like a radiator. It is mounted inside a housing assembly and is located either on the engine compartment cowl panel. As warmend coolant circulates through the heater core, the heater core fins absorbs heat. At the same time, a blower motor blows air across the heated core fins. The air absorbs the heat from the fins and the warm air is vented into the passenger compartment.

Findings

-Respondent 1, 2, 3