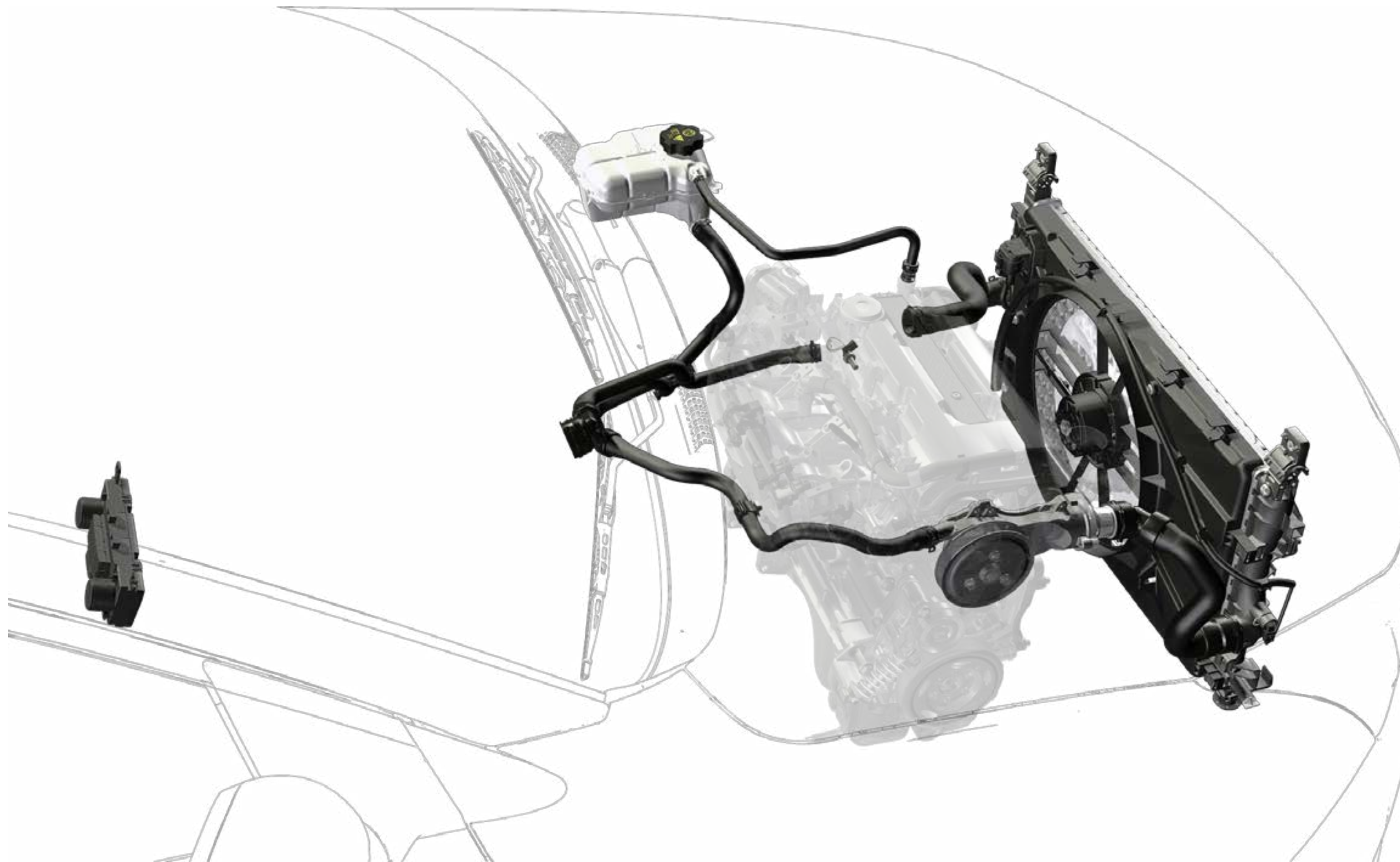


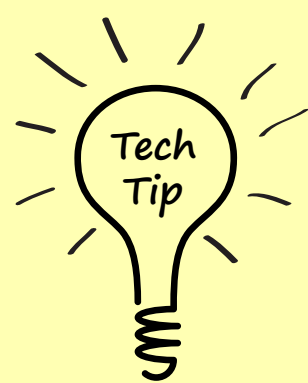
The cooling system is engineered to remove waste heat from the engine cylinder block and cylinder head to prevent damage caused by overheating of those components. The waste heat is transferred through liquid coolant to the radiator where the heat is dissipated to air flowing through the radiator. The system is comprised of the radiator, engine water pump, thermostat, radiator hoses, coolant reservoir/expansion tank, pressure cap and engine coolant. The coolant is circulated through the system by the water pump, which is driven by the engine. A thermostat regulates the engine coolant temperature by controlling the flow of coolant through the radiator.



Water Pump

Description/Function: The heart of the cooling system, it pumps the engine coolant through the engine and out to the radiator. Driven mechanically by either the timing chain/belt or by the engine accessory belt. Typically a centrifugal impeller design is used. It draws coolant into the center and forces it outward into the housing where it travels into the engine block, into the cylinder head(s) and out to the radiator before returning to the water pump.

Faults/Symptoms: Symptoms include: loss of coolant, overheating conditions, abnormal noise. Faults include: leaking pump shaft seal, worn pump shaft bearing, loose or damage pump impeller.



Contaminated coolant can accelerate water pump wear and damage the seals. Flush Cooling system when replacing the water pump.

Never mix different types of coolants, most modern coolants are OEM specific, and while they may look similar they may be incompatible.

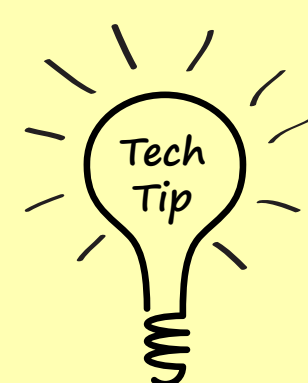
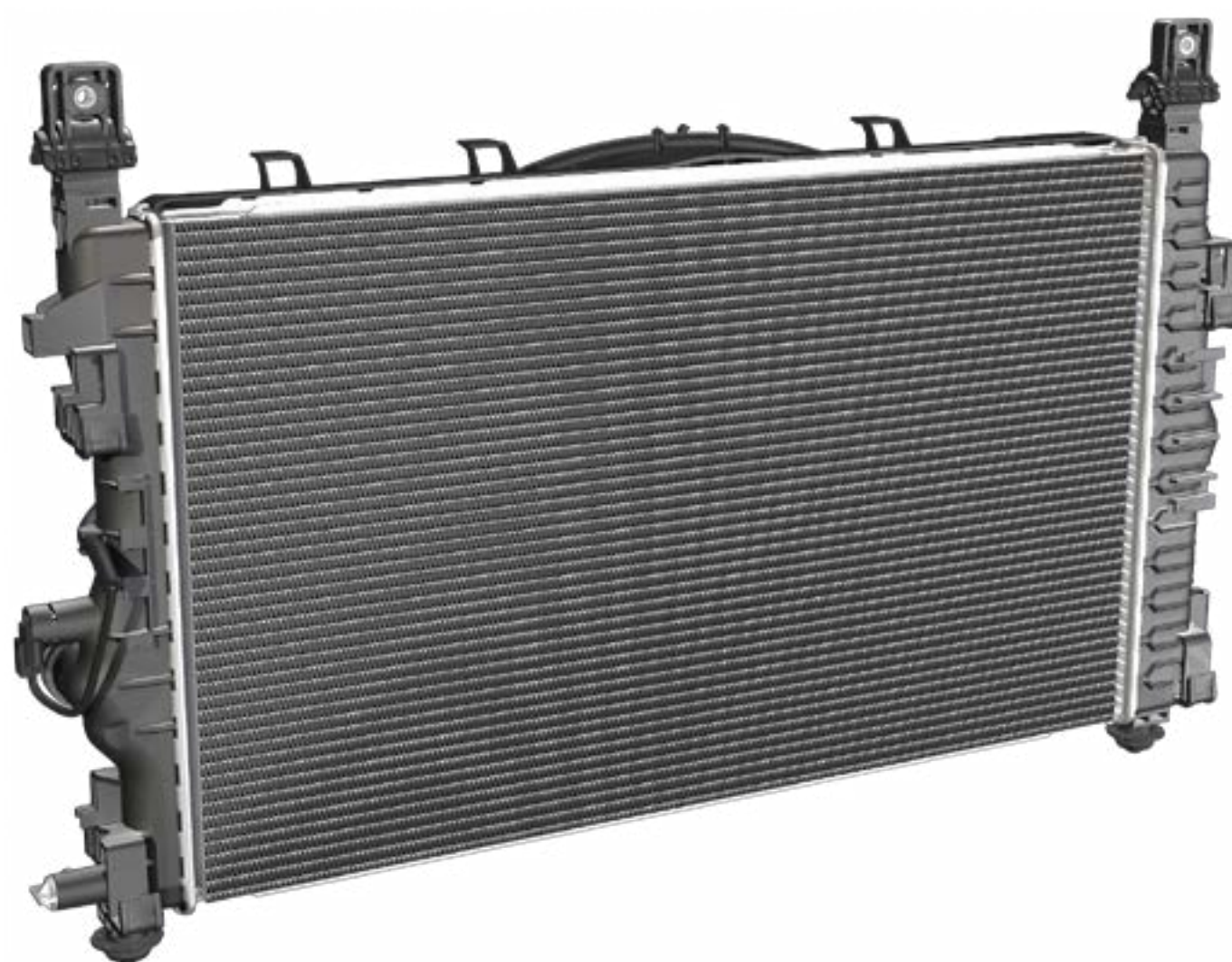
Check belt tension and tensioner function, belts that are loose will slip overheating the pulley which can damage the pump seal. Too tight and the bearing will wear prematurely.



Radiator

Description/Function: The radiator is a heat exchanger located typically in front of the vehicle where air can flow through the fins while the vehicle is moving. The engine coolant passes through tubes perpendicular to the fins; heat is conducted from the tubes to the fins and dissipated to the air. Modern radiators are made from aluminum and plastic, while older vehicles used copper and brass. The radiator is connected to the engine by upper and lower radiator hoses which route the engine coolant to and from the radiator.

Faults/Symptoms: Symptoms include: loss of coolant, overheating conditions. Faults include: leaking tubes or header tanks, blocked or restricted fins.



Radiators can become clogged with sediment or "mud" from contaminated coolant.

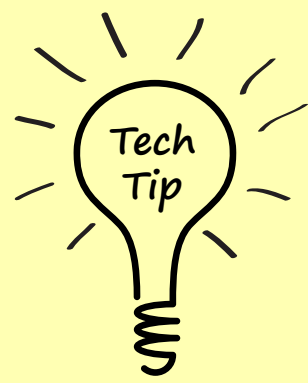
Leaking radiator tubes are typically caused by corrosion, proper coolant maintenance is important. Also check engine and chassis ground straps, missing or broken straps can lead to galvanic corrosion.

Flush cooling system when replacing radiator.

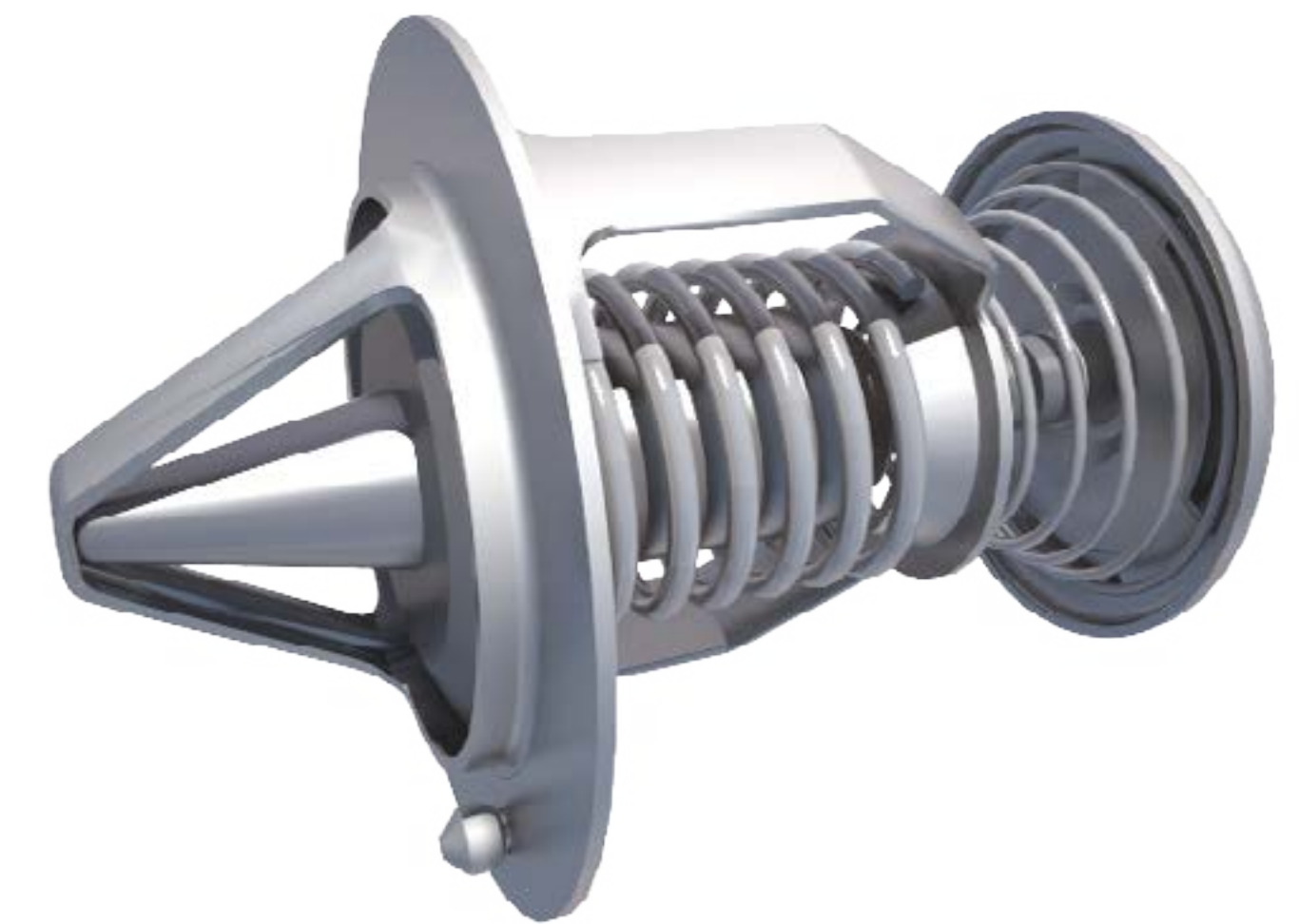
Thermostat

Description/Function: The most commonly used thermostat is the wax-pellet type. It is comprised of an actuator containing a wax-pellet and a valve disc. The wax-pellet is heated by the engine coolant, which causes the wax to expand. The expansion causes the actuator to open the thermostat valve disc allowing coolant to flow to the radiator. Conversely as the coolant temperature decreases the wax contracts causing the actuator to close the valve disc which reduces coolant flow to the radiator. The process repeats maintaining the coolant temperature within the specified operating range.

Faults/Symptoms: Symptoms include: overheating, or insufficient cabin heat. Faults include: Stuck closed or stuck open.



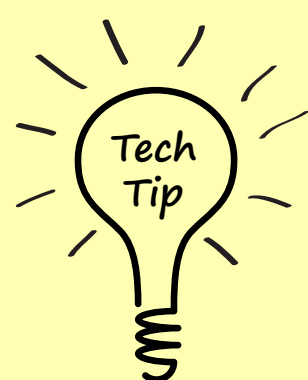
When replacing a water pump or radiator, it's a good idea to replace the thermostat. Contaminated coolant or hard water deposits can cause the thermostat to stick.



Pressure Cap

Description/Function: The pressure cap also known as the radiator cap serves two purposes. First it maintains pressure in the cooling system when the engine is running, typically 12-18 psi. This pressure raises the boiling point of the coolant, which reduces the formation of steam bubbles inside the engine, and helps the water pump work more efficiently. The second purpose is to allow replenishment of coolant from the expansion or surge tank when the engine cools.

Faults/Symptoms: Symptoms include: overheating, or loss of coolant, boiling over. Faults include: leaking or deteriorated seals, weak or collapsed spring.



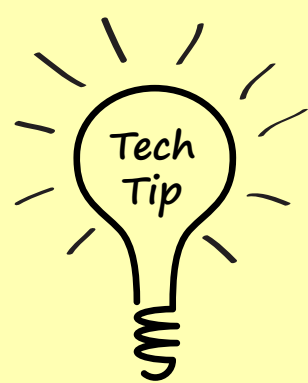
Test pressure caps using a cooling system pressure tester. Replace if they fail test. Replace caps on contaminated systems, oil and other chemicals can deteriorate pressure cap seals.



Fan Clutch

Description/Function: Vehicles with engine driven radiator fans typically have a viscous fan clutch. The fan clutch controls the speed of the radiator fan based on the temperature of the air after it passes through the radiator fins. The clutch contains a special viscous silicone fluid that transfers force between the two halves of the clutch. A bi-metallic element on the front of the clutch housing controls an internal valve which regulates the clutch engagement. When the radiator is cold the fan clutch slips, and when the radiator is hot the clutch is engaged. Note there are some electromagnetic fan clutches that perform similarly to the viscous fan clutch.

Faults/Symptoms: Symptoms include: overheating at low vehicle speed, or while idling, excessive fan noise at higher engine speeds, and abnormal knocking noise from fan clutch area. Faults include: leaking fluid, clutch unable to engage, seized clutch, worn bearings.



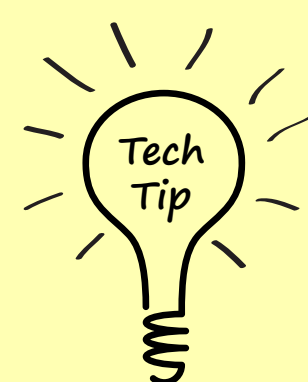
Worn fan clutches that are mounted on the water pump pulley, can cause premature water pump bearing failure.

Broken or missing fan blades may indicate a seized fan clutch.

Electric Fan

Description/Function: Many vehicles use electric radiator fans to pull air through the radiator fins while the vehicle is stopped or at low speeds. The fans are controlled by thermo-fan switches or by computer controlled relays. The coolant temperature is monitored, and the fans are activated to cool the radiator and the coolant circulating within it. The electric fans are also used when the vehicle air conditioning system is operating to assist with dissipating heat from the condenser.

Faults/Symptoms: Symptoms include: overheating at low vehicle speed or while idling, excessive fan noise, fans running all the time, poor A/C performance. Faults include: open or shorted motor windings, worn or seized motor bearings, missing or damaged fan blades, malfunctioning relay or thermo-fan-switch, or engine coolant temperature sensor.



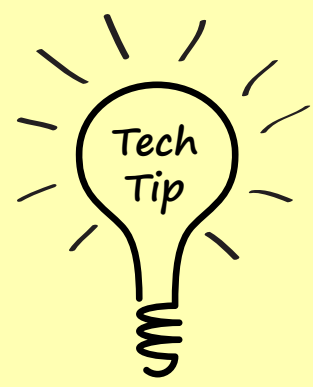
Some computer controlled fans will run continuously with key on if the engine coolant temperature sensor circuit is open.

Fans may also run if there is a malfunction with the A/C pressure switch.

Thermo-Fan-Switch

Description/Function: The thermo-fan switch is a temperature sensitive switch, it contains a bimetallic element that deforms when heated and this is used to close the switch. The switch can have one to two stages corresponding to one or more temperature ranges. The switch when closed conducts electric current to the electric fan motor, until the radiator temperature drops below the temperature switch point.

Faults/Symptoms: Symptoms include: overheating at low vehicle speed or while idling, fans running all the time, poor A/C performance. Faults include: open or shorted switch contacts.



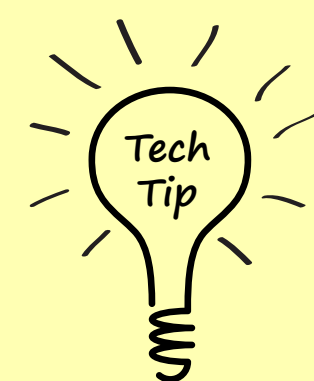
Use a fused jumper wire to bypass the switch to test the function of the electric fans and circuit.



Engine Coolant Temperature Sensor

Description/Function: The Engine Coolant Temperature Sensor or ECT is a negative temperature coefficient (NTC) resistor. An NTC resistor exhibits a change in resistance with change in temperature. Its resistance decreases as it is heated. It does this linearly and so it is ideal for electrically measuring coolant temperature. Some vehicles have more than one sensor or a combination sensor. The signal from the sensor is used by the ECM on some vehicles to control the electric radiator fans.

Faults/Symptoms: Symptoms include: overheating at low vehicle speed or idling, fans running all the time, poor A/C performance. Faults include: open or shorted sensor/circuit.



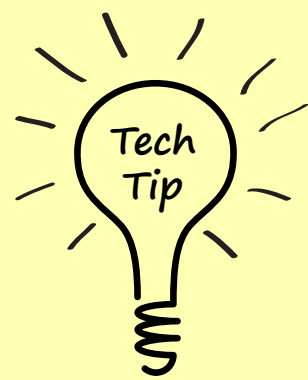
Some computer controlled fans will run continuously with key on if the engine coolant temperature sensor circuit is open.

Some vehicles may have an ECT in the radiator near the radiator outlet hose.

Expansion Tank/Overflow Tank/Coolant Recovery Bottle

Description/Function: An expansion tank is a reservoir that contains additional coolant to allow for the expansion and contraction of the coolant within the engine cooling system. An expansion tank is not under pressure during engine operation.

Faults/Symptoms: Symptoms include: Loss of coolant. Faults include: cracks, leaks.



The expansion tank should not be overfilled, typically low and full markings are provided.

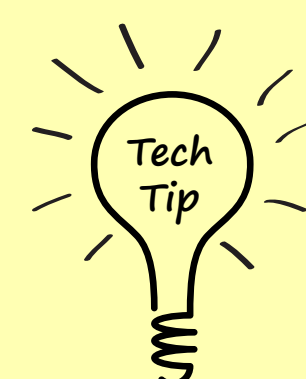
Some expansion tanks are equipped with coolant level sensors which alert driver to low coolant level.



Surge Tank/Degas Bottle

Description/Function: Some vehicles are not equipped with expansion tanks, instead they have surge tanks which are similar to the expansion tank in that they contain additional coolant. However they are under pressure during engine operation. They are connected by hoses to the radiator or engine. When the engine cools the coolant in the engine contracts, drawing coolant from the surge tank.

Faults/Symptoms: Symptoms include: overheating, Low engine coolant. Faults include: Cracked or leaking tank, no coolant in surge tank, cracked, leaking or blocked surge hose, and malfunctioning pressure cap.



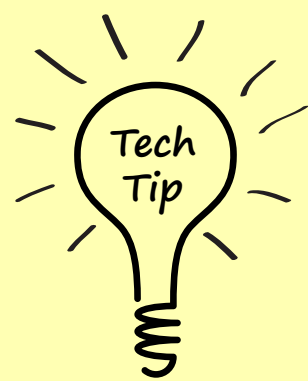
If the pressure cap is not maintaining cooling system pressure the cooling system will not transfer heat efficiently and may result in coolant boiling at normal operating temperatures.



Engine Coolant

Description/Function: Engine coolant is a mixture of water and glycol along with various additives to lower the freeze point and raise the boiling point of the coolant mixture. Additionally there are additives to reduce corrosion, lubricate the water pump seal and reduce scale formations.

Faults/Symptoms: Symptoms include: overheating, corrosion, frozen coolant, leaks, no heat. Faults include: Deteriorated coolant, contamination with other coolants or chemicals.



Coolant should be replaced according to manufacturer's maintenance schedule.

Use only the manufacturer specified coolant in the appropriate concentration for the climate.

Use distilled water when mixing coolant. Distilled water does not have the minerals that tap water has, and will prevent formation of mineral scale inside the cooling system.

