Replace Engine Thermostat

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A defective thermostat is a common cause of engine overheating. The thermostat regulates the flow of coolant between the engine and radiator. The thermostat is usually located in a housing where the UPPER radiator hose connects to the engine.

If the thermostat fails to open, heat will build up inside the engine causing it to run hot and overheat. The result can be loss of coolant if the radiator boils over, and possible engine damage including a damaged head gasket.

If a thermostat fails to close, the engine may be very slow to warm up following a cold start, and it may never reach normal operating temperature. This can cause reduced heater output during cold weather as well as increased fuel consumption and engine wear.

How the Thermostat Works

Inside the thermostat is a small wax-filled noncorrosive brass tube that extends in length as the coolant gets hot. As the wax inside the brass tube expands, it opens the thermostat valve so coolant to flow through the thermostat. The temperature at which the thermostat is calibrated to open is usually stamped on the unit. Most late model thermostats are calibrated to open around 195 to 200 degrees F. The thermostat should be fully open about 20 degrees F higher than its rated temperature for maximum flow, and should maintain engine temperature in the 200 to 230 degree range.

As coolant circulates between the engine and radiator, the thermostat usually remains open to maintain a consistent operating temperature (which is important for good fuel economy and emissions). However, when the engine is idling or when engine speeds and loads are very low, less heat is produced in the engine so the thermostat may close temporarily to restrict coolant flow until the engine temperature can...
come back up to normal range.

When the engine is shut off and cools down, the wax element inside the thermostat contracts, allowing spring-pressure on the thermostat valve to close the thermostat so it will be ready for the next drive cycle.

The thermostats in some late model vehicles are also electronically-controlled by the engine computer or a thermostat control module. Electronically-controlled thermostats have a small electric heater element added to the wax-filled brass tube. You will see an electrical connector on the thermostat housing for the heater. Engine temperature is monitored by a coolant sensor. Electronically-controlled thermostats remain closed to speed engine warm-up, and typically minimize flow to maintain optimum engine temperature in the 220 to 230 degree F. range. When additional coolant flow between the engine and radiator is needed to handle higher engine loads or speeds, the heater element is energized forcing the thermostat to fully open. The advantage of this approach is better temperature control under all driving conditions, faster engine warm-up (more heater output sooner during cold weather), improved fuel economy and lower emissions.

**Diagnosing a Bad Thermostat**

Thermostats have a limited service life, so the older the thermostat the greater the chance it might be defective.

If your engine has been overheating, carefully feel the UPPER radiator hose after the engine has been running for 5 to 10 minutes. If the upper hose does not feel HOT, the thermostat is not opening and is blocking the flow of coolant from the engine to the radiator.

This likely means the thermostat has failed and needs to be replaced. However, the same condition could also be due to a low coolant level, an air bubble trapped under the thermostat or even a bad water pump. Check the coolant level, and if it is okay, the thermostat should be removed for testing (see below).

A suspicious thermostat can be tested by removing it from the engine and dropping it into a bucket of boiling water (Be Careful!). The thermostat should be fully closed when cold, then open when it is exposed to the hot water. It should close again when you pull it out of the hot water. If it fails this test, replace the thermostat.

If your vehicle has an electronic thermostat, you can check the integrity of the heater element with an ohmmeter. Disconnect the heater connector, and connect your ohmmeter to the two pins on the thermostat. A good heater element will show some resistance (look up the exact specs for your vehicle). If resistance is outside of specs, replace the thermostat. No resistance would indicate a shorted heater element, while infinite resistance would indicate an open or burned out heater element.

**NOTE:** If your engine has overheated, a new thermostat is recommended because excessive heat can damage the wax element inside the brass tube.
If your heater is not putting out much warmth during cold weather, or your temperature gauge indicates the engine is very slow to warm up or is not reaching normal operating temperature, the thermostat may be stuck open. The most common cause would be a bad thermostat due to a defective wax element or broken return spring. Either way, you need a new thermostat.

Another reason to replace a thermostat is for preventive maintenance on older, high mileage vehicles. A new thermostat will reduce the risk of a thermostat failure and overheating. If you are doing other cooling system repairs such as replacing a water pump, radiator or heater hoses or a radiator, or you are changing a head gasket or rebuilding an engine, replace the thermostat too, especially if it is more than 10 years old.

**Choosing A Replacement Thermostat**

First, make sure the replacement thermostat has the SAME temperature rating as the original. If someone has previously replaced the original thermostat with one that has a different temperature rating (too cold or too hot for your engine), have the person in the auto parts store look up the recommended thermostat temperature for your vehicle and go with that.

We also highly recommend buying a quality NAME BRAND thermostat (original equipment or aftermarket). Some cheaply made thermostats may not open at the correct temperature or may fail after a few thousand miles.

In some older high performance muscle cars or ones with highly modified engines, a colder thermostat may be needed to prevent the engine from running too hot. But for most street applications and certainly all late model computer-controlled engines, installing a colder thermostat is NOT recommended because you will not gain anything and it will screw up how the engine control and emissions systems function. Your engine will run worse, not better!

In very cold climates, a slightly hotter thermostat may be installed to increase heater output. But this trick should only be used during cold weather. A hotter thermostat may prove to be too hot during warm weather, and may cause your engine to run too hot and detonate (engine-damaging spark knock or pinging).

Under no circumstances should an engine be run without a thermostat. Coolant flow needs to be managed so different parts of the engine do not run too hot or too cold. Uneven cooling can increase the risk of cylinder head cracking, head gasket damage/leaks, increased cylinder wear and moisture/sludge buildup inside the crankcase.
Always replace the gasket when changing a thermostat

How to Replace the Thermostat

The only tools you should need to replace a thermostat are a wrench, pliers, maybe a screwdriver, something to scrape with, a funnel and a bucket. For parts, you will need a new thermostat and a new gasket for the thermostat housing (or RTV silicone sealer to make your own gasket), and antifreeze if you also plan to change the antifreeze at this time. On an older high mileage vehicle, you may also have to replace a corroded thermostat housing.

1. Drain some coolant out of the cooling system by placing your bucket under the radiator drain plug and opening the plug. You do not have to completely drain the radiator or engine unless you are also changing the antifreeze. Drain only enough coolant so the level is below that of the thermostat.

2. Locate the thermostat housing on the engine (usually where the UPPER radiator hose attaches to the engine), and remove the two or three bolts that hold the thermostat housing to the engine. Pull the housing loose. Tapping the housing lightly can help loosen it if it is stuck. There is no need to disconnect the upper radiator hose from the housing unless the hose makes the housing difficult to remove.

3. Note the position of the thermostat in the housing (which side faces up and the relative position of any bleed holes or jiggle valves if used), then remove the thermostat. Note the condition of the original thermostat housing. Aluminum housings can be badly corroded. If the housing is pitted where the hose attaches to the housing, replace the housing to prevent leaks.
Old housing are often corroded and need to be replaced when changing a thermostat.

4. Stuff a rag into the engine opening to keep debris from falling into the cooling system, then scrape away the old gasket material from both the housing flange and engine mating surfaces. Both surfaces must be perfectly clean, dry and flat before installing a new gasket (which is always recommended!). Be careful not to scratch or gouge the soft metal housing.

5. Position the new thermostat in the housing or on the engine mounting surface (whichever is easiest) with the heat-sensing element facing the engine. Be careful, because if the thermostat is installed backwards it will not open and your engine will overheat!

Make sure you install the thermostat correctly!
Some thermostats have a small bleed hole or vent hole to prevent air bubbles from getting trapped under the thermostat (which could prevent it from opening and cause the engine to overheat). The bleed hole also makes it easier to refill the cooling system.

6. Apply a coat of gasket sealer to both sides of a new gasket, then position the gasket and reinstall the housing. Some gaskets come with adhesive backings to hold them in position so additional sealer is not needed. If using RTV silicone to make your own gasket, run a one-eighth inch bead of sealer along the mating surface of either the engine or housing.

7. Make sure the thermostat is properly seated, then tighten down the housing bolts. Do not over-tighten the housing bolts because too much torque can break or distort an aluminum housing.

8. Inspect the radiator hoses and clamps at this time. Pinch the hoses to check for age hardening or cracks. Also check for physical damage caused by rubbing or over-tightened clamps. If the hoses are not in A-1 perfect condition, replace them. Hoses that are more than 10 years old should be replaced to reduce the risk of a hose failure. If any hoses are replaced, do not reuse the original equipment ring type equipment clamps. They lose tension with age. Replace them with new stainless steel screw-on worm drive clamps.

9. Refill the cooling system with the coolant from your bucket, or a fresh 50/50 mixture of water and antifreeze. Use the type of coolant recommended for your vehicle.

10. Start the engine and run it at fast idle until the new thermostat opens and coolant starts to flow. Add coolant as needed to maintain a full level. Replace the radiator cap, let the system build up pressure and check for leaks.
11. After the vehicle has been driven some distance, shut the engine off, allow the engine to cool down, then recheck the coolant level and top off with coolant as needed. The coolant level should be maintained between the FULL and LOW marks. **Do not overfill.**

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