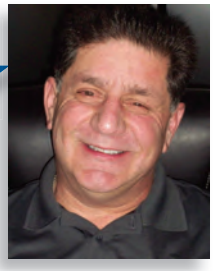
KEEPING COOL:

A Cooling System Primer



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Over the last few decades, we've watched as more and more vehicle operating systems have crossed over into the transmission world. Today you can't just be a transmission specialist: You have to understand the whole car.

But one area that has always had a lot of impact on transmission health is the car's cooling system. That's because the cooling system not only cools the engine; it's also critical for keeping the transmission cool.

And heat has always been the transmission's biggest enemy. In fact, a faulty cooling system will affect transmission life long before the engine overheats.

So, with the summer months upon us, now's the perfect time to give your customers' cooling system a once-over, to make sure they'll be able to keep their transmissions in tiptop condition as temperatures begin to soar.

The Cooling System

Today's cooling system consists of these basic components (figure 1):

Radiator — transfers heat from the engine and transmission to the outside air.

Heater core — transfers heat from the engine to the passenger compartment.

Radiator cap — keeps the cooling system pressure balanced properly.

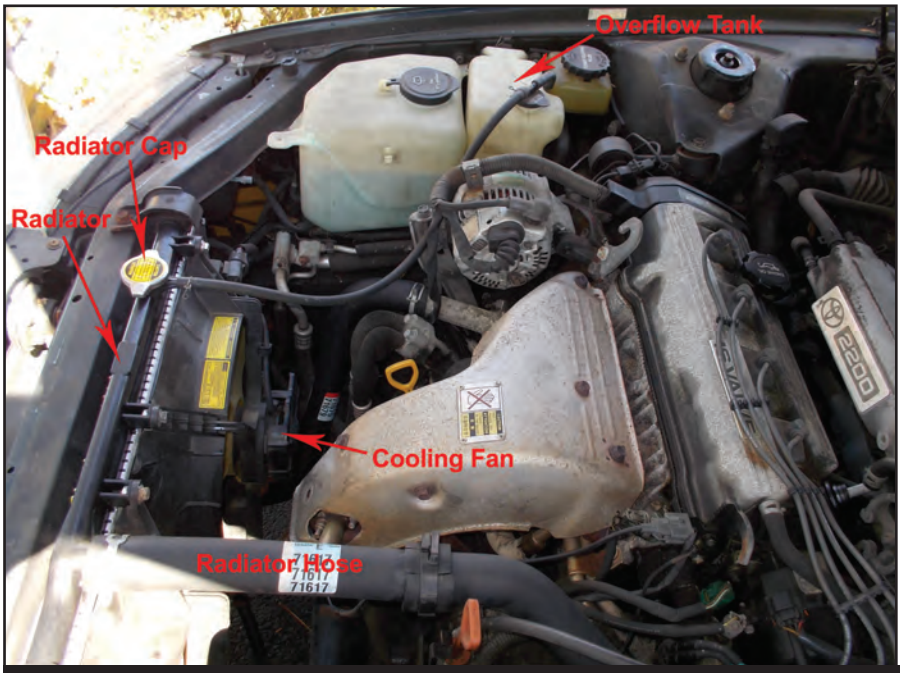

Figure 1: Here are a few of the main components that make up the basic cooling system on today's cars.

Overflow tank — maintains the coolant level in the system at all temperatures.

Thermostat — brings the system to operating temperature quickly and keeps it there.

Cooling fans — moves air past the radiator to transfer heat at low road speeds; may be either mechanical or electric.

Water pump — moves the coolant through the system.

Hoses — connect the cooling system components.

Belts — keep the water pump and fan operating (some vehicles).

And finally, the coolant. While coolant was once just water with a little alcohol added to keep it from freezing, today's coolant is a marvel of chemical technology. And it needs to be checked and maintained to keep it working properly.

Start with Why

As with nearly any vehicle service, your first step should always be to talk to the customer. Ask if they've noticed any problems. Then ask again.

And be specific: If the customer's noticed the engine getting too hot, find out when. If the engine overheats while driving on the expressway, you know you aren't dealing with a fan problem, because the fan isn't necessary at speeds over about 40 MPH.

On the other hand, if it's heating up in traffic but not on the open road, you're probably looking at an airflow problem, such as a faulty fan or even a damaged or missing fan shroud.

Low temperatures (not much of a problem in the summer!) usually indicate a thermostat problem.

And let's not forget heater core leaks; these can show up as a drip on the passenger's shoe or as steam that fogs the windows and won't dry up. It's usually accompanied by a sickeningly sweet smell or taste.

Once you have the customer's observations in hand, you're ready to check the car.

Initial Examination

WARNING — Cooling systems can get very hot; over 300ºF (150ºC)! That's hot enough to cause serious damage. To avoid injury, always perform your initial checks with the engine cold. And always make sure the engine is off when reaching into the engine compartment.

Begin your checks with a simple visual examination. Look around for anything obvious, like a stain that indicates a leak, or a puddle of coolant.

If the water pump is exposed, check it for any wobble or looseness in the shaft. Any movement indicates the water pump is worn out. And check the pump vent hole from underneath for indications of a leak.

This is also a good time to reach in and check the hoses and belts. Make sure the hoses are firm and pliable. If a hose is too hard or too mushy it should be replaced. Check the belts for looseness, glazing, cracks, breaks, and so on. Adjust or replace as necessary.

Coolant Checks

Now you're ready to check the coolant. Start with the overflow tank; it should be full to the cold level. Any lower may indicate a leak in the system.

Next remove the radiator cap (or system cap on some vehicles). The coolant should be full and reasonably clean and clear. Any debris or contaminants indicate a problem that you'll need to check carefully.

Figure 2: A refractometer is a great tool for checking the protection level for just about every type of coolant. It's easy to use, but can be a bit pricey.

Figure 3: A less-expensive way to check the coolant is a test strip. Acustrip makes strips for checking a wide range of conditions.

Once you're sure the coolant looks okay, you should test it. Sounds simple, right? Maybe not, because there are a lot of different coolants on the market, and that simple, specific-gravity gauge you bought 25 years ago won't work for all of them.

You could buy a refractometer (figure 2), which will allow you to check nearly every type of coolant, but a simpler — and cheaper! — test is to use a coolant test strip. There are several on the market; the folks at CAT Products (www.run-rite.com) offer the Acustrip brand (figure 3).

These strips allow you to check the coolant for a wide range of issues:

- freeze point protection

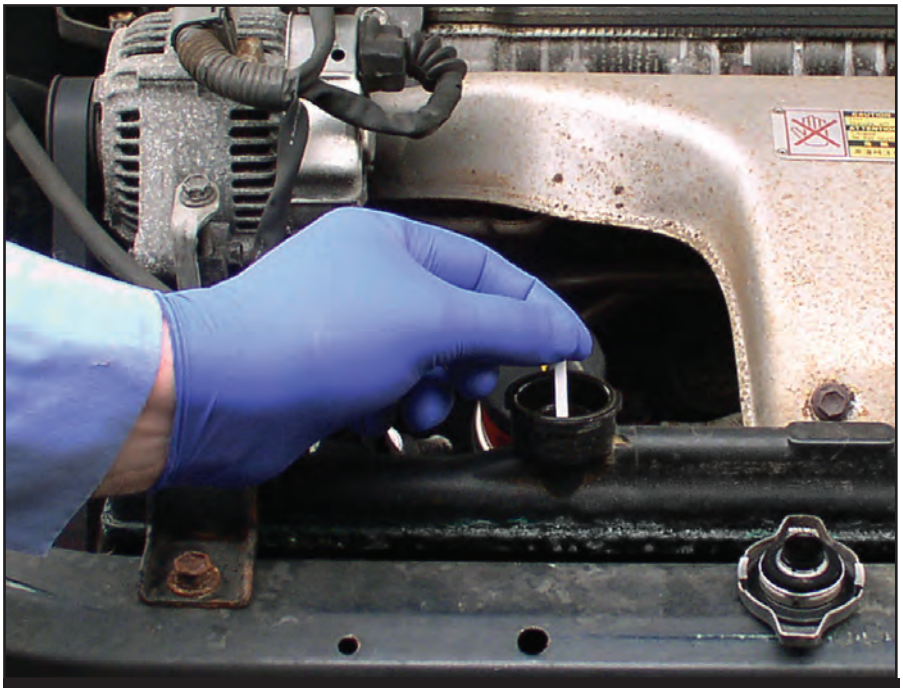

Figure 4: A test strip is easy to use; just dip the strip, wait for a few seconds, and then compare the strip color pads with the colors on the label.

- boil-over protection
- alkalinity
- pH level

There are also strips available for checking other conditions, such as chloride and sulfate contamination. These corrosive elements are often introduced when water was added and can damage the system. So it's a good idea to check for them.

The strips are cheap — only a few cents a test — and easy to use. Just dip the strip into the coolant (figure 4), wait a minute or two, and compare the colors on the strip with the ones on the bottle.

And because they're so easy to read, they provide a great sales tool for showing the customer why he needs the system serviced.

You can address alkalinity or pH problems with an additive to neutralize the acids. Low protection will require adding fresh coolant or even replacing the old coolant completely.

[CAUTION] — Engine coolants are considered a hazardous material; never pour used coolant down the drain. Always dispose of used coolants through a proper hazardous materials handler.

Pressure Tests

Cooling systems operate under pressure; about 15 PSI on most vehicles. This pressure is important because it raises the boiling point about 3ºF (1.7ºC) for every PSI added. So 15 PSI raises the boiling point about 45ºF (25ºC).

When combined with the boil-over protection of the coolant, that means a good working system can reach temperatures of around 250ºF (121ºC) without boiling over.

But because the cooling system operates at about 15 PSI, it means that leaks may not show up unless the system's under pressure. So it's important to check the system for leaks while pressurized.

To check the system and the radiator cap, you'll need a cooling system pressure test kit. There are several available on line for prices ranging from about $70 to $250. The more expensive ones generally included more adapters, to allow them to fit more cars.

Your first step should be to check the cap rating. It should say how many PSI it's designed to hold (figure 5). Connect the cap and apply pressure. The cap must hold pressure close to its rating, and it should release pressure instantly as you continue to try to add pressure. If the cap fails either test, replace it.

Next check the cooling system (figure 6): Attach the pressure tester to the radiator and pump it up to the pressure cap rating. Then leave it sit for about 10 minutes or so.

While the system has pressure applied, check for any sign of leaks. That includes the radiator, heater core, water pump, engine block, and so on.

After about 10 minutes, check the gauge; pressure shouldn't have dropped more than about one PSI. Any more than that indicates a leak you didn't see. You'll need to keep looking to identify those leaks. In some cases, fixing them may be as simple as tightening a hose clamp.

If you have to add or replace the coolant, make sure you know how to fill the system. Many cars today have the radiator mounted lower than the engine. These cars have bleeders on the engine to bleed air from the cooling system and let it fill completely.

Failure to bleed the air out of the system will cause overheating problems. So check your shop service data for any specifics for bleeding the cooling system.

Warmup Checks

Once you're sure the rest of the system is okay, you're ready to check its operation. Close the system and start the engine.

Monitor the temperature as it warms up; you can connect a scan tool to keep an eye on the temperature.

Check the thermostat by checking the temperature of the upper radiator hose; the hose should remain fairly cool until the thermostat opens. Then it should heat up almost immediately. Compare when it opens to the temperature shown on your scan tool; the thermostat should open around 180ºF to 195ºF (80ºC to 90ºC) on most vehicles.

If the thermostat opens too early, or if the hose warms up slowly, the thermostat is faulty; replace it with a new one. And make sure you use the one recommended for the vehicle; never use a colder one. That'll just cause performance problems, reduce gas mileage, and increase vehicle emissions.

Another way to monitor temperature is with an infrared thermometer. These things are great: Just point and measure. And their cost has come way down in recent years. Harbor Freight has one on sale for just under $30!

If the fan won't start, look for an electrical problem at the fan, its control relay, or, on some vehicles, the control switch

Check the Fans

Once the engine warms up, check the cooling fan operation. If it's an electric fan, on most cars the fan should start running at about 220ºF to 230ºF (105ºC to 110ºC). The fans should shut off when the temperature drops about 5º to 10º.

If the fan won't start, look for an electrical problem at the fan, its control relay, or, on some vehicles, the control switch. If the fan runs but the cooling system temperature won't drop, suspect a radiator problem.

While the fans are running, consider checking for AC noise in the electrical system. Connect your digital meter to the battery terminals and set it to measure AC Volts. Then check the AC when the fans start running; it shouldn't jump more than about half a volt.

Any more than half a volt indicates a fan motor problem, which can affect engine and transmission operation. While some fans have a capacitor to eliminate this electrical noise, in most cases you'll have to replace the fan.

Of course, not every car uses electric fans. If the car or truck has a mechanical fan clutch, here's an easy check:

With the engine idling, watch the fan. Then turn the engine off and start counting: "one-Mississippi, two-Mississippi…" If the fan doesn't stop by the time you reach the second Mississippi, suspect a faulty fan clutch.

Trans Cooler

There's one more check you'll want to make on the cooling system: the transmission cooler. These coolers have to provide adequate flow and they have to keep the coolant sealed from the transmission fluid.

We discussed how to check the cooler flow on page 36; we'll look at how to check the transmission fluid for signs of glycol contamination in next month's issue of *GEARS*.

Figure 5: The radiator cap should say how much pressure it's designed to hold; this one's rated for 16 PSI. The cap should hold just about 16 PSI and release anything more than that.

Figure 6: Pump the cooling system up to the pressure rating shown on the cap and let it sit for at least 10 minutes. If any more than about 1 PSI leaks out, suspect a leak.

Cooling systems aren't just about the engine; they play an important role in the continued life of your customers' transmissions. So, with the summer approaching, this is a great time to make sure that cooling system will be keeping things cool for you and your customers as the temperatures begin to rise.