Monitor Engine Temps Accurately

By Larry Klusza, February 2023

> ***NOTE:*** *This article was created drawing from personal experience, as well as bits and pieces of conversations culled from a number of various online bulletin boards and chat groups, edited to help make the overall topic more understandable.*

In our hobby, we seldom consider how best to monitor engine temperature beyond the fact that it should be done. It sounds simple enough but there's more to it than you might think.

In traditional cooling system layouts, coolant leaves the engine at its hottest from the top of the engine. The last thing it passes before going out the upper hose to the radiator is the thermostat. Shedding heat as it passes through the radiator, the coolant exits the radiator at the bottom and returns to the engine via the lower hose.

Since you can't actually tell if an engine is suffering heat related wear or damage just by looking at it, the only other method is to monitor the coolant temperature on an ongoing basis. So, how best to do that? Are you willing to rely on the factory dashboard warning lights or do you want a more complete picture that only gauges can provide? When using aftermarket gauges, you'll likely have to replace the factory sender with one that comes with the new gauge kit.

The placement of the temp sending unit is critical in providing useful information. You'll usually find the temp sensor in the intake manifold, somewhere near the thermostat or in the cylinder head. Be aware that if your temp sensor is in the cylinder head, it will read slightly warmer than if it were installed in the intake manifold, and will easily spike 20°-25° when you put your foot in it because it's closer to the hot exhaust passages. This behavior would be normal.

No matter where it's located, the probe part of the sending unit must project into the water stream without being shrouded or influenced by any adapter should one be required. Not addressing this can result in readings as much as 15° to 20° higher than actual temps. This is exactly what happened on my '38 Chevy street rod. I spent almost two years chasing a perceived "running hot" problem before determining that I was being lied to all along because of both how the sensor was installed and where it was located.

It was equipped with a Chevy 350 with a high-performance cam, headers, dual exhaust, A/C, an automatic trans with a dedicated cooler, and throttle body fuel injection. The radiator used was a two-row aluminum unit from PRC Radiators, equipped with a 16-pound cap and a catch bottle. The core dimensions measured only 16 x 22 inches, which is not much area at all, so airflow was crucial. It had a Cooling Components full shroud with a 2500 cfm two-speed electric fan, activated by a Dakota Digital **PAC-2750** controller (a newer version, **PAC-2800** now adds Bluetooth connectivity). All areas around the radiator were blocked off to force any air entering the cramped nose of the car to go through the radiator. At the time, it was fitted with a Stant™ 180° thermostat. All in all, it was a cramped engine bay! (Photo 1)

Photo 1: Swapping a small block Chevy V8 for the original 6-cylinder engine makes for a very cramped and hot engine bay.

Photo 2 (below) shows a junk thermostat spacer used to illustrate two different types of sending unit installations I tried and that both failed to read accurately. The spacer was required because there were no more holes available on the intake manifold for the sender. Being on the engine side of the thermostat, the sensor should have worked. The inaccuracies were confirmed by the EFI temperature sending unit that was correctly sized for the hole in the spacer, as well as readings taken with a thermal gun on the upper radiator hose, just beyond the thermostat housing.

The problem sender shown below was for a dashboard temperature gauge from Dakota Digital. Their sending units are a 1/8" NPT thread. With almost all tapped holes on the thermostat spacer and intake manifold water jacket being 3/8" NPT threads, an adapter of some sort was necessary.

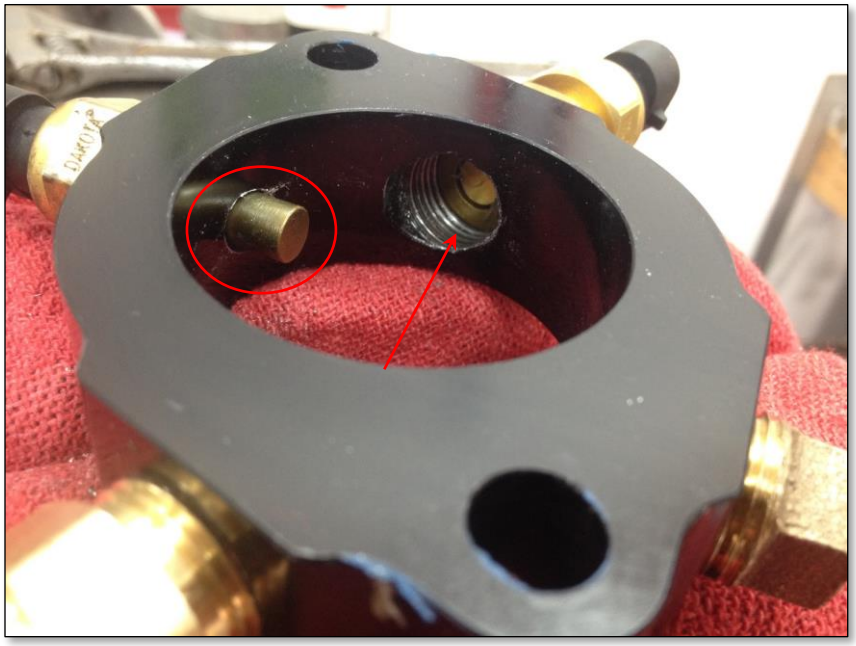

Photo 2: Thermostat spacer showing examples of two different installations that both failed to read properly.

On the left side of the spacer (circled), a blank area was drilled and tapped with 1/8 NPT threads as far as possible, but the excessive wall thickness of the spacer meant that the probe was still not projecting far enough into the water to read properly.

On the right side of the picture (arrow), is a duplicate sender installed with the adapter supplied by Dakota Digital. It also failed to read accurately because the probe was fully shrouded in the adapter as well as being so far back in the hole as to not be anywhere near flowing water. Oddly enough, they both were off by the same 15° amount.

Photo 3: The solution was to relocate the sender to a position in the upper radiator hose where temperatures were confirmed to match what the fuel injection temperature sending unit mounted in the thermostat spacer was reporting. This radiator hose adapter can be found at: Steiger Performance, in the *General Automotive Products* page. Adapters are available with provisions for 1/8" NPT or 3/8" NPT senders.

Photo 3: End view showing proper water flow probe placement.

Photo 4: Assembled with insulation on exposed sections as a precaution against potential heat-soak. The connector is for a separate ground.

Mounting a temperature sensor on the radiator side of the thermostat is *not* a good practice, because a sticking thermostat will cause the engine to overheat while the gauge otherwise reads normally.

However, in this case an appropriately mounted temperature sensor connected to the fuel injection controller would still trigger an overheat alarm.

As long as the temperature gauge matched what the fuel injection controller was displaying, it would be fine. When tested, they measured within 2° .

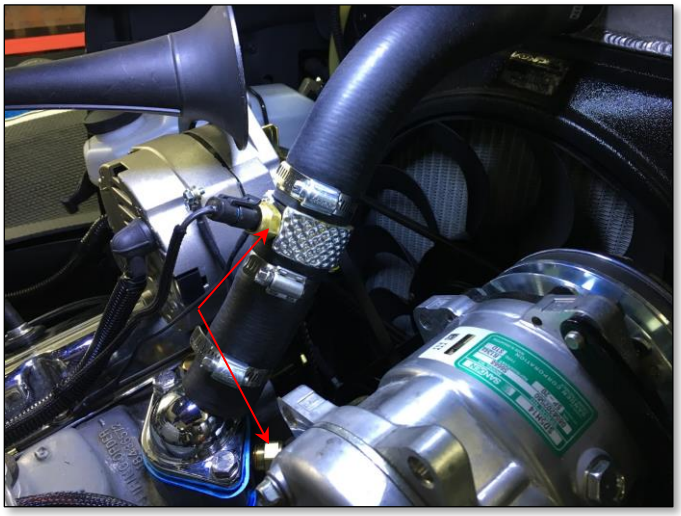

Photo 5: Installation complete. Temp readings at both locations were verified within 2°.

Granted, your engine bay might not be so hot and cramped as the street rod, but the probe shrouding/adapter mis-match issue may still cause inaccurate temperature readings for you even if you do have a port available in your intake manifold. Whether for an EFI install or custom gauges, it all comes down to the thread size of the sensor you're working with. Drawing on my street rod experience, I applied the same principle when it came to the GTO.

When my A/C and auto trans equipped 1970 Pontiac GTO left the factory, it was equipped with a 195° thermostat and a 3-row core radiator. According to the factory documentation, the TEMP warning light on the dashboard wouldn't light up until the temperature reached 254°! The implication here is that standard operating temperatures likely ranged from an estimated 200° to 225°.

While too high for my liking, it does illustrate the fact that engines can tolerate higher temperatures more reliably than one might think. However, I also think 250+° is excessive. If the warning light doesn't come on until around 254°, it would already be too late to prevent engine damage. No wonder it was called an "idiot light", as in *"Hey idiot! –your car just seized up!".* It also makes monitoring engine temperature accurately more important than ever.

In this case, the GTO dash temperature gauge was fine. My problem was finding a spot for the temperature sender that comes with the Holley Sniper Quadrajet fuel injection I was installing. Fortunately, I had an easily accessible port on the intake manifold to use, but it was another case of needing an adapter for the included Holley sending unit.

Photo 6: Here is the port chosen for the EFI temperature sensor.

The goal was to get the probe extended enough without being shrouded by the adapter.

(Photo 6) I started by measuring the depth of the threaded area of the hole. This told me how deep the adapter needed to be and still be flush with the bottom.

(Photo 7) I shortened the adapter to a length of about the distance I measured. I then had to re-tap the intake a bit deeper to take the larger section of threads left on the adapter. I also re-tapped the inside of the adapter to take the sending unit as deep as possible to ensure the probe was fully exposed to coolant flow and as flush as possible on the bottom.

Photo 7: The modified intake manifold adapter: Before (L) and after (R).

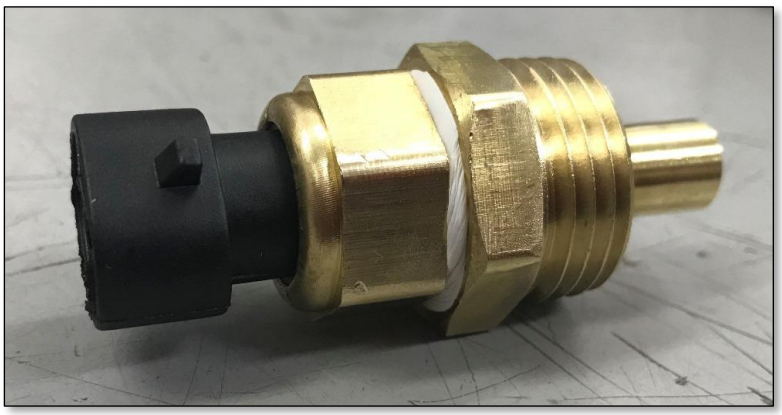

Photo 8

Photo 9:

Photos 8 and 9 show the finished assembly which was made using Teflon paste thread sealant.

Photo 10 The completed installation.

Photo 10 shows the completed installation. Readings taken with a thermal gun on the upper radiator hose, just beyond the thermostat housing and the factory gauge temp sender matched what the EFI controller was reporting perfectly.

Making a classic car dependable can become quite a challenge. For some of us, it's the journey; working on our cars is where we get the most satisfaction. For others it's the driving. In either case, having to address cooling system issues isn't much fun.

Monitoring it accurately will let you enjoy driving your car or focus on the next modification – preferably both!