PCV Line Air Temperature and its Effect on Coalescing Filter Performance

Virtually everything you buy has a temperature specification, whether it is listed on a "technical data sheet" or not. Certainly, anything that is to be placed under the hood of an automobile should be able to function throughout a wide range of temperatures. The Watts F501-series coalescing filters that I have selected for oil-trapping duties can be ordered from distributors with either of two different "bodies". The polycarbonate (clear) body version is factory-rated from 40 to 125 degrees F. Unfortunately, temperatures in at least some areas of all engine bays will exceed 125 degrees. Even if a filter mounting area that remains under this temperature is chosen, the air flowing past the PCV valve and into the filter may very well be higher. The low temperature limit is normally specified because entrapped water can freeze and expand, possibly damaging the filter element.

Since oil temperatures in your average V-8 engine can easily reach 200 degrees F or more, I thought I'd see just how PCV line air temperature compares to engine oil temperature. The engine oil temperature part is easy to obtain if your vehicle has a gauge to monitor this valuable bit of information. The slightly more involved challenge is to monitor that PCV line temperature.

First, I installed a "T" connector into the PCV hose, just downstream of the PCV and near the (potentially) warmest, yet easily accessible area of the engine bay. Into the "T" end of the connector I fitted an Onset Computer temperature probe, which can measure air temperatures from -40 to 212 degrees F. The other end of this probe was plugged into 2 external channel HOBO data logger. This logger monitors temperature and humidity, internally, so I taped it to my Watts coalescing and particulate filters, at the front (cooler) part of the engine bay. See Figures 1 and 2.

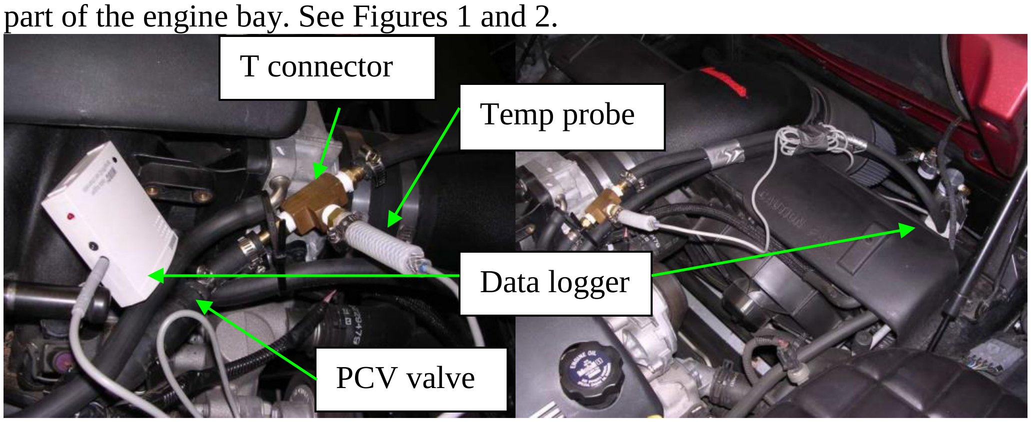

Figure 1

Figure 2

After driving to work (15-20 minutes) and home again (…this time, shifting at 4000+ rpm and frequent downshifting), I plotted the graph shown below (Figure 3).

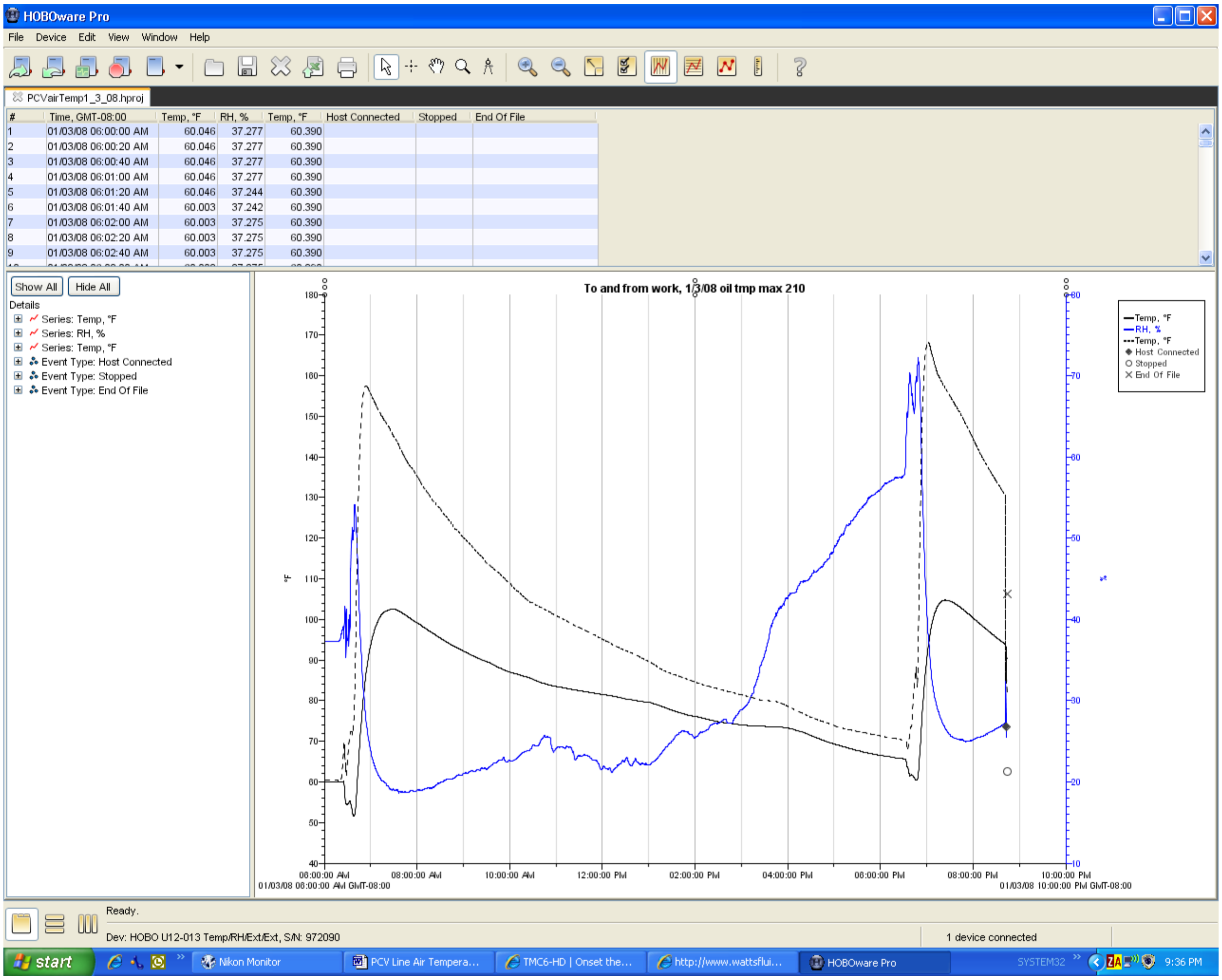

Figure 3: HOBO data logger graph

The dotted black line represents the PCV line air temperature and the solid black line represents the air temperature at the logger (taped to the Watts filters). The logger was programmed to start at 6:00 AM (shortly before I left for work). As you can see, the PCV air temperature was still climbing at 158F (engine oil temperature was 200F) when I turned off the engine at approx 6:40 AM. Heat soak allowed the Watts filter area to reach 104 degrees F. Side note: Without the Cold Air Mod radiator cover opening and under-car cold air scoop, that temperature near the filters would've been much higher.

The ride home generated slightly higher temperatures, partly because ambient air temps were higher, but also because of my more aggressive driving. This time, the PCV line air temperature reached 167F, while the engine oil temperature attained 205F. After letting the engine idle for 7 minutes, (not shown in graph, since the data logger was read and then re-launched), the engine oil temp. reached 212, while the PCV air temp. started to level off at 170F.

Obviously, a longer drive under warmer ambient temperatures would have pushed the PCV air temps a bit higher. …..how much higher? I'll have to repeat this test during mid-Summer and report back!

"Okay", you might ponder, "what about the Watts filter's 180 degree max temperature rating. Isn't that a bit scary?" Well, to probe more deeply into the origin of that specification, I called Watts to query an applications engineer. I discovered that the borosilicate glass filter element itself has a max temperature limit of 225F. The black plastic retainer piece, which is an acetal copolymer, is rated to 230F. The Nitrile gasket is good for approx. 275F. All of these represent continuous operating temperatures. The applications engineer and I concluded that the 180 degrees F max temperature rating includes a safety factor (1.25) and is probably based upon partial-to-full pressure operating conditions. (which are well in excess of PCV line pressures)

Ah – time to do some more testing…….

This time, I placed a Watts coalescing filter assembly in an environmental chamber, while flowing air through it, under a constant vacuum pressure of 20 inches of mercury. During each different temperature dwell time, a ball valve was used to shut off flow to the filter, allowing me to check for any leaks. After subjecting the filter assembly to -5F (4 hours), 200F (1 hour), 180F (16 hours), 0F (2 hours), and finally, 212F (3.5 hours), I allowed the filter assembly to cool off before inspecting all components.

I am happy to report that there is no damage at all to the filter element, Acetal retaining piece, gasket, or upper/lower bodies. In addition, no leaks attributed to the gasket seal could be detected.

My advice? If possible, check the temperature (during an average driving cycle) of the area within which you will mount your coalescing or particulate filter. 212 degrees F appears to be a safe temperature for this type of filter. And remember, keeping the filter in a cooler area will allow it to trap more of the air-born oil. As far as low temperatures go, drain all water from the filter bowl before exposing it to freezing temperatures.

Best regards,

Dave
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