Temperature Testing

The purpose of this write up to help those who want to take the temperature of their car and have at least some assurance of accuracy. I hope this helps some of you with any temperature issues and how to measure the cars temperature accurately.

There are a couple of ways to take the temperature of an engine. Use an Infrared Pyrometer more commonly known as an IR thermometer or use a thermocouple. We will look at both of these methods and how we can take our cars temperature with a reasonable amount of certainty.

Lets look at IR thermometers – the cheap ones are notoriously inaccurate. I will compare my cheap $50 unit against a Fluke 572 that retails around $1000. Now I am not suggesting you go and spend $1000 on a thermometer, there are cheaper ways to do this and I'll cover that later.

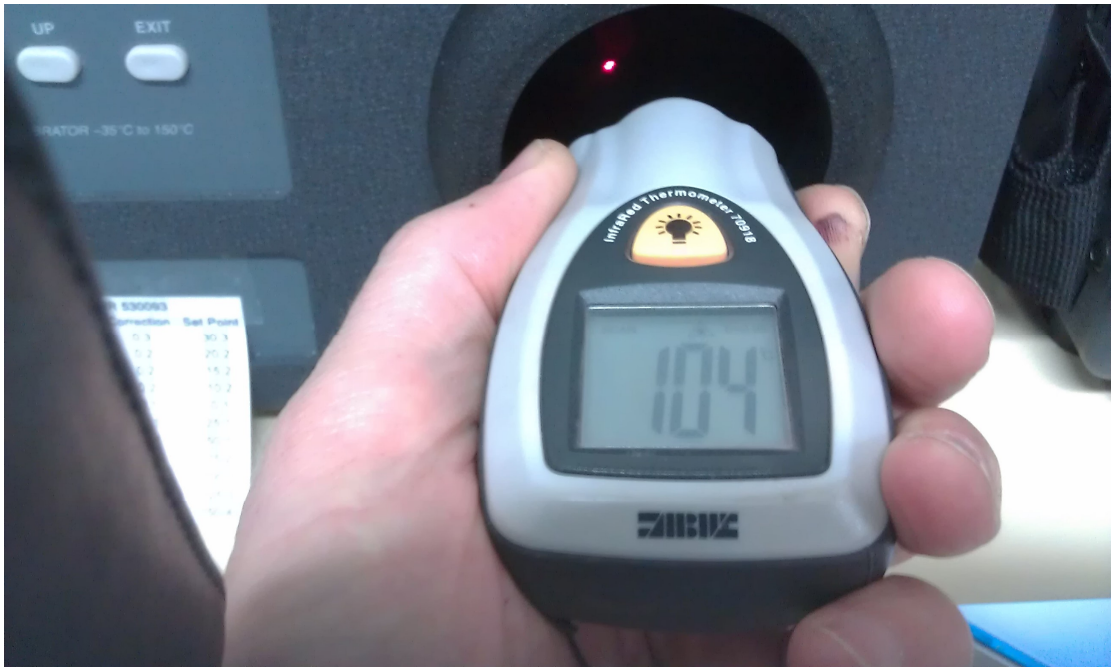
These tests were performed in a temperature controlled environment with calibrated and traceable temperature standards. For this purpose and before anyone asks I am not going apply corrections for uncertainties in our standards as these are very small(less than 0.5°C).

My IR has a DTS of 6:1, meaning with the IR 600mm from the target the spot is 100mm in diameter. These devices average the temperature over the spot area. My unit also has fixed Emissivity at 0.95, the Fluke 572 is adjustable but I have left it fixed at 0.95 as well. Emissivity is the amount of heat reflection a surface gives off. A perfect surface has an emissivity of 1.0 and the little black body temperature calibrator I used is very close to 1.0.

DTS is important – if you are measuring the temperature of you water rail and the DST is 6:1 and hold the IR 600mm from the rail you are measuring everything in that 100mm area including any exhaust manifolds etc.

First picture here is my IR at 30mm reading 104°C moving it to 330mm from the surface the temperature dropped to 88°C a difference of 16°C, quite a significant variation just moving the IR 300mm. The next pictures are the Fluke 570 at the same distances the temperature variation 1.1°C which is still out of tolerance for that unit.

So if I point my IR to the water rail and it reads 88°C is my temperature 88°C or 100°C, I do not know, so if I point it at the water rail and it reads 100°C the temperature could be over 120°C. Remember I am using a very stable calibrator with a black surface.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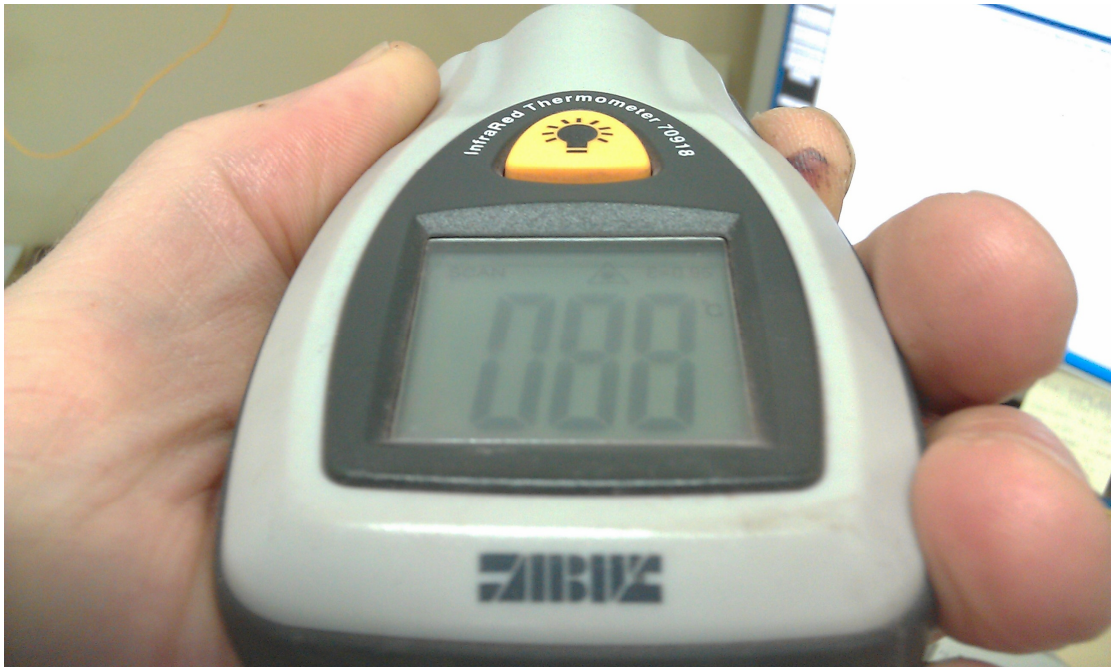
104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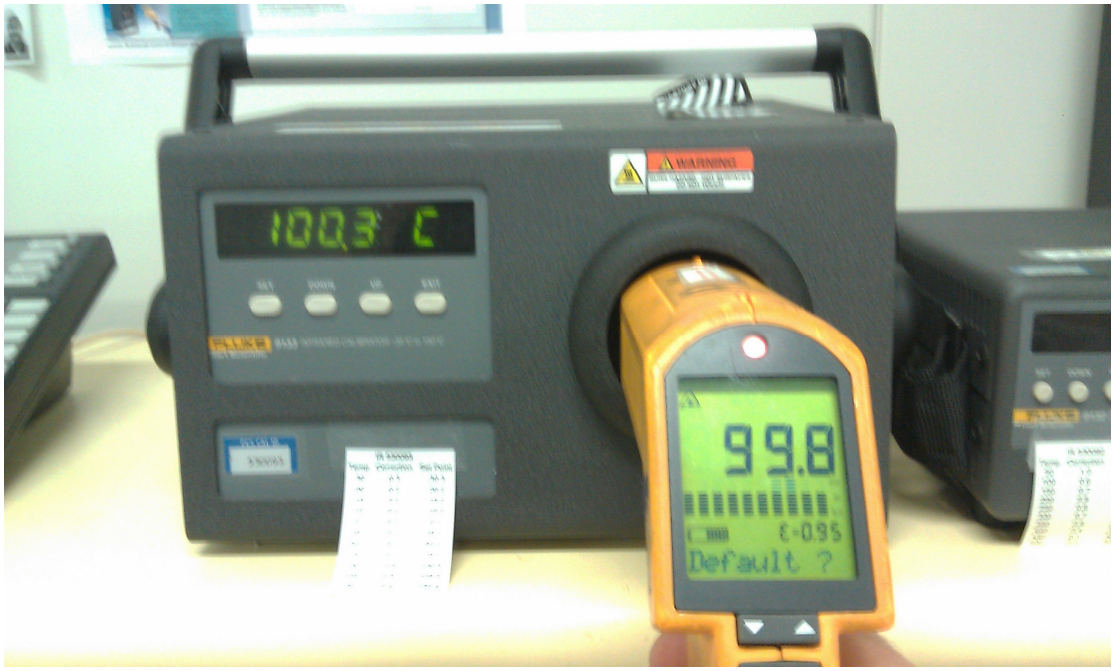
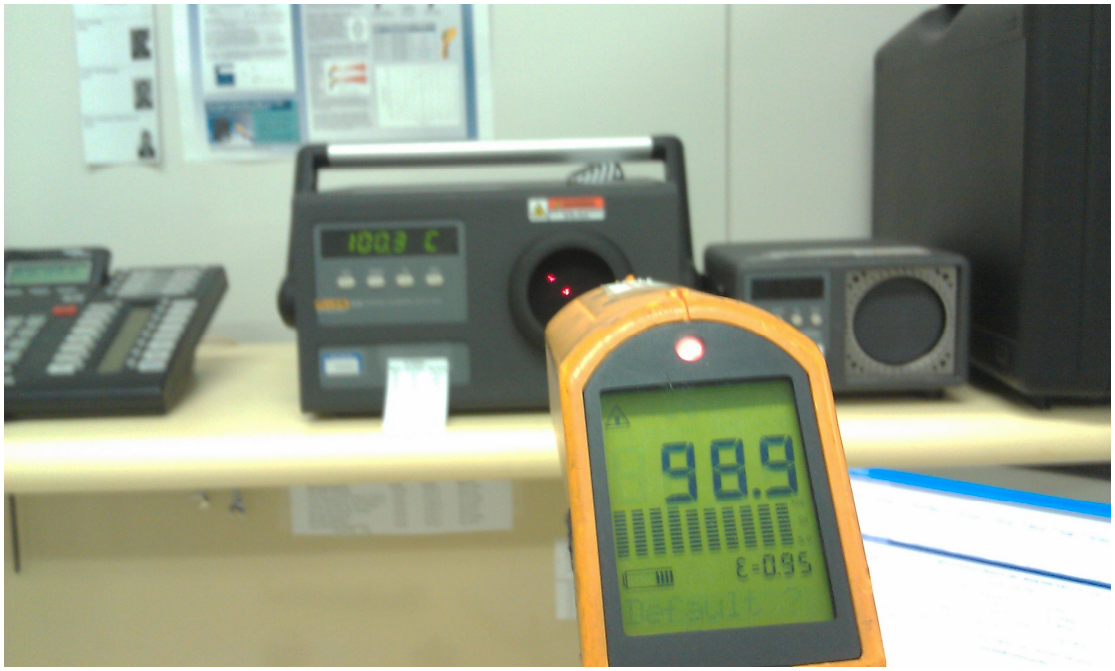




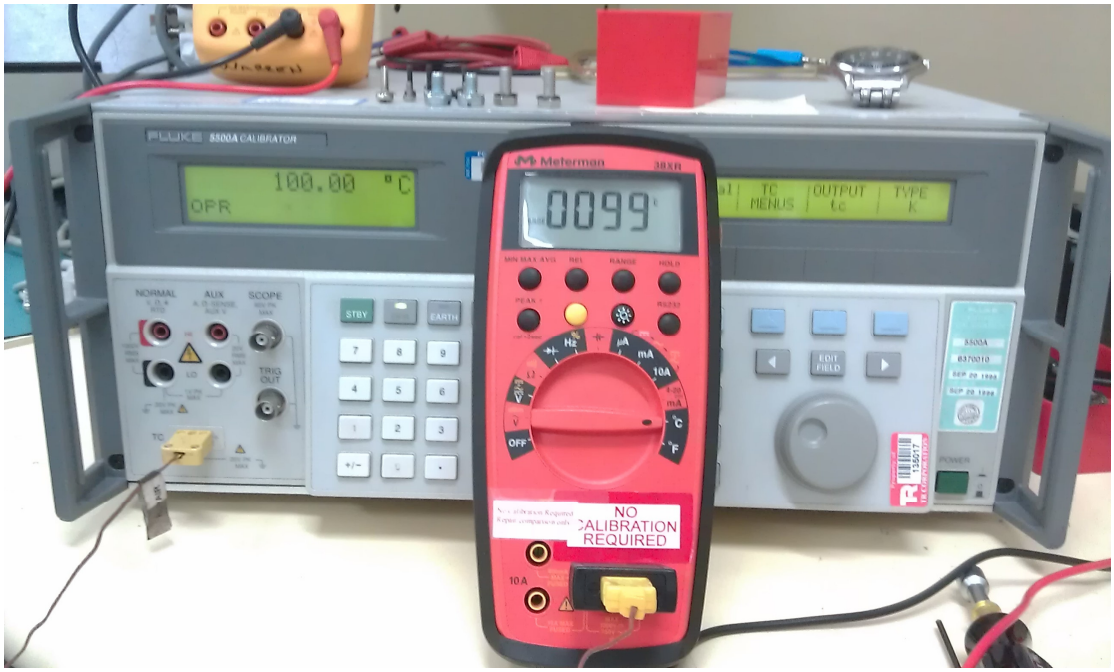
Now lets look at using a K type thermocouple and a digital multimeter (DMM). The meter I am using has a temperature input, you don't absolutely need this but it will make the reading more accurate. These meters have a built in temperature reference. If you use a meter that does not have this facility then you can measure the voltage but you will need to know the ambient temperature where the meter is. (so don't sit the meter in the hot engine bay).

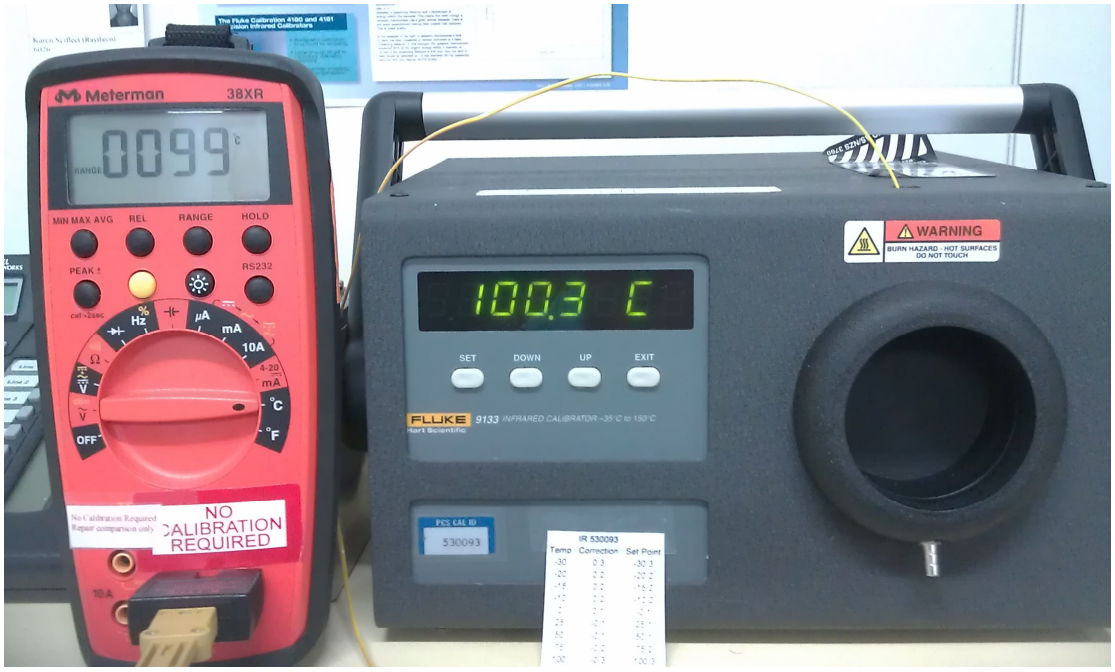
The first picture is of the meter connect to a Fluke 5500A calibrator to check its reference (I only did this as the meter is faulty, but it was all I had in a regular handheld).

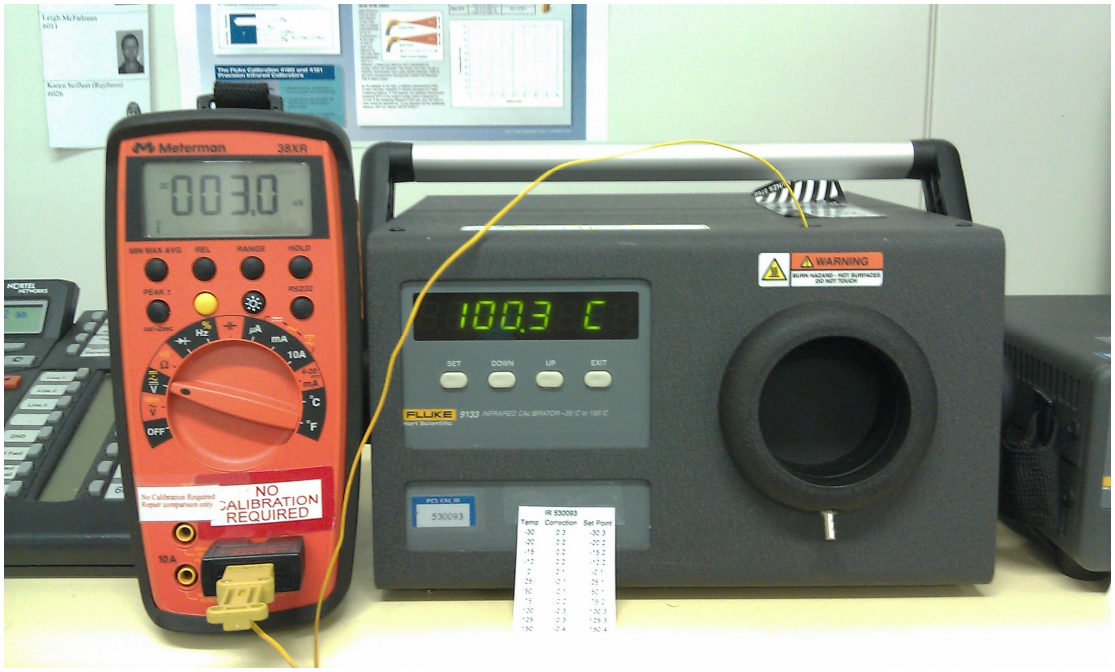
The next picture is with the K type thermocouple in the thermowell of the calibrator so I am happy this is accurate and if I put this under one of the hose clamps on a radiator hose the temperature will be accurate.

Not everyone has access to a meter with Temperature function so lets look at how we can make a measurement using a regular DMM. In the third picture you will see the meter is reading 3.0mVolts, if we look up the K type thermocouple tables 3.0mV is 74°C now we need to add the ambient temperature which is 22°C so we have a temperature of 96°C. Not as accurate as the Fluke 572 or using the Temperature function on the DMM. But far more accurate than my IR thermometer, and the uncertainty is a lot better, I do not have a 16°C variation.

K type thermocouples can be had very cheaply on eBay and anyone buying a meter I would recommend one with Temperature function if you want to use it on the car, these meters are available for under $50.







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