PRESSURE SOLUTIONS

C303: Temperature Calibrator Performance

This is a brief performance summary of the Jofra Range.

Model	Temperature Range °C	Stability °C	Uncertainty °C
ATC125	-90 + 125	0,03	0,03
ATC140A	-20 + 140	0,02	0,18
ATC140B	-20 + 140	0,02	0,04
ATC156A	-24 + 155	0,01	0,10
ATC156B	-24 + 155	0,01	0,04
ATC157A	-45 + 155	0,01	0,13
ATC157B	-45 + 155	0,01	0,04
ATC250A	28 – 250	0,02	0,28
ATC250B	28 – 250	0,02	0,07
ATC320A	33 - 320	0,01	0,20
ATC320B	33 - 320	0,01	0,07
ATC650A	33 – 650	0,02	0,35
ATC650B	33 – 650	0,02	0,11
ITC155	-23 + 155	0,03	0,25
ITC320	33 - 320	0,03	0,30
ITC650	33 – 650	0,04	0,50
CTC140A	-17 + 140	0,05	0,40
CTC320A	33 - 320	0,10	0,50
CTC320B	33 - 320	0,10	0,50
CTC650A	33 – 650	0,10	0,90
CTC650B	33 – 650	0,05	0,60
CTC1200A	300 – 1 205	0,10	2,00
ETC125A	-10 + 125	0,05	0,50
ETC400A	28 – 400	0,15	0,50

Stability (The forgotten parameter):

Stability as a specification parameter refers to the variation of the block temperature with time, but in practice also applies to the sensor under test. Stability must be looked at in two ways, relating to perfect systems and real world systems.

Perfect Control:
Here the temperature of the dry block is held perfectly at the desired setpoint. There is no deviation from the ideal. The stability is 0°C!
Heat flow is a lot like current flow. It is determined by the potential (temperature) difference and the resistance (conductivity). This means that when the temperature difference is small, the heat flow is small, and the time to change is long.

When it comes to a temperature sensor adjusting its temperature to that of its surroundings, it's a bit like the riddle of how many jumps a frog needs to get out of the pond, if each jump covers only half the remaining distance. He never gets there, but with an infinite number of jumps, the remaining distance becomes infinitely small.

What this means in practice is that it takes time for a temperature sensor to react, and the longer the temperature is stable, the closer the sensor gets to the true temperature. Therefore, the stability of the controlled temperature has an influence on accuracy.

The best control comes with the Jofracal software. When the temperature of an electrical Unit-Under-Test (RTD or TC or Tx) is being read by the software, either through the ATC-B, or using the ASC300 signal calibrator, or ASM scanner, it is possible to use the UUT signal as the stability indicator, so that the reading is only taken when the sensor has stabilized within defined limits.

Imperfect Control:
When we add the complication of a varying block temperature to the above, we see how important stability is. Due to the time lag, the sensor temperature might be increasing while the block temperature is decreasing. What is obvious I that the accuracy will always be worse than the stability in the real world.

EA10/13 Specifications:
The ATC and ITC specifications are based on EA10/13 practice. This means that most of the uncertainties identified by EA10/13 have been brought into the Jofra accuracy statement
The CTC/ETC specifications are not inclusive, and will require a more detailed uncertainty budget to be generated for best performance.

In practice this means that the CTC and ETC should be used with a higher TUR.

When comparing competitive offerings, it means that a Jofra accuracy is much more reliable than most competitor statements.

Typical UUT Uncertainties:
A mechanical temperature indicator is rarely better than 1% of scale.
Electrical sensors are often more accurate but are more difficult to specify. Both RTD's and thermocouples have non-linear responses. There are standardized tables, but sensors depart from the ideal due to manufacturing tolerances. System errors include the sensor uncertainty, plus the uncertainty associated with the linearisation circuitry. A common thermocouple may be no better than 1,5ºC at normal temperatures, while an RTD can get better than 0,5ºC. The linearisation may add 0,5 to 1º error. For example, Rosemount claim ± 1ºC over the 0 – 200ºC with a standard 3144P Tx and type 65 RTD, and can reduce this to 0,2ºC with curve matching.

Customers need to determine their requirements very clearly before making a choice of calibrator.

Re-certification:
Note that to the best of our knowledge, no temperature laboratory outside the NML offers better than 0,1ºC uncertainty. NML can get to about 30 mK uncertainty, but the cost is high. Bear this in mind when making a decision.