New Correction for BARS Temperature Probe Data

Recent laboratory work with the thermocouple-sensor temperature probes used on the BARS instruments has revealed that the former method of correcting "reported" values (column 11 in the data output) in post-processing, is inadequate in accommodating voltage offsets experienced in the "boot" section of the probe where ambient temperatures are measured. The ambient temperatures are used in calculating the reported "tip" temperature as measured by the K-type thermocouple in the vent fluid. Experimentation with a number of copies of the same temperature probe suggest that it is more appropriate to determine the thermocouple voltage offset in relation to the thermistor temperature and correct the voltage used in the algorithm for K-type thermocouple temperature-voltage relationships. Four probes were evaluated for thermocouple offset as a function of "boot" temperature (as measured by the thermistor and reported as column 9 in the data output). The relation between offset and thermistor temperature were adequately modeled using a 3^{rd} degree polynomial. While each individual probe was better modeled with unique coefficients, data from all four probes was collectively modeled to provide "corrections" for this type of probe when the particular probe was not available for evaluation (current and former BARS probes).

The formulas for correction are as follows with;

TCT= Corrected thermocouple temperature
TCV= thermocouple voltage (column 11, actually a 100 fold amplification of K-type thermocouple voltages)
THT= Thermistor temperature (column 9, note THT is a function of thermistor voltage reported in column 8 and this relationship remains unchanged)
OFF= Offset thermocouple voltage

$$TCT = (OFF + TCV)*244.97$$

$$OFF = (THT^3*-1e-06) + (THT^2*7e-05) + (THT*0.0024) + 0.015$$

The K-type thermocouples used in this device have a stated limit of error of 2.2C or 0.75% whichever is greater. Estimated accuracy for this temperature measuring system is +/- 4.0C at 400.0 C or 1.0%.