

Are you comparing the correct numbers?

This article focuses on the traditional SAT in an attempt to clarify a common misunderstanding about how to determine pass/fail status of an SAT. We will start off by answering two simple questions:

- what does an SAT involve?
- what is the purpose of an SAT?

Fortunately, AMS-2750E (section 2.2.62) does us a favor by answering both of these questions in no uncertain terms:

2.2.62 SYSTEM ACCURACY TEST (SAT) or PROBE CHECK:

An on-site **comparison** of the **instrument/ leadwire/sensor readings or values**, with the readings or **values of a calibrated test instrument/ leadwire/sensor** to **determine** if the measured **temperature deviations** are within applicable requirements. [emphasis added]

Performed to assure the accuracy of the furnace control and recording system in each control zone.

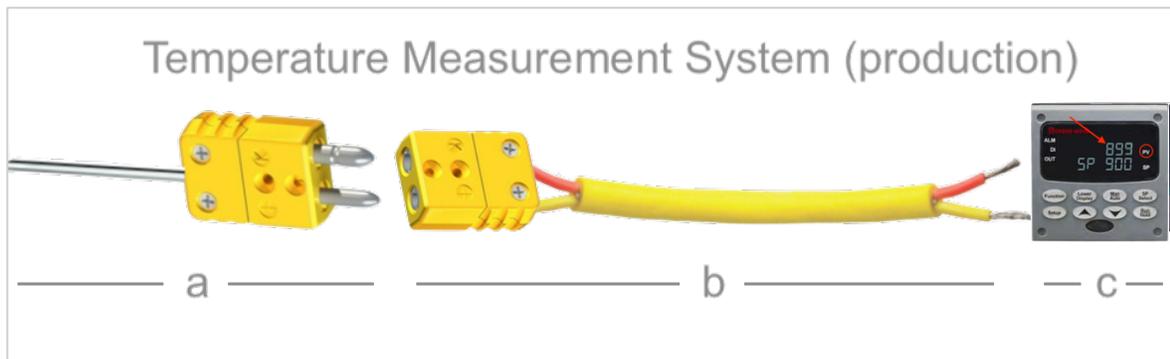
In order to know if our SAT has passed or failed, we first must clearly understand the above definition. Afterall, how can we **determine** if the **temperature deviations** described above are within tolerance if we first don't understand what two temperatures we are supposed to be comparing?

Section 3.4.5.1 of AMS2750E states: *The displayed temperature indication and/or recording of the sensor being tested **as used in production**, with appropriate offsets or correction factors, at any operating temperature, shall be compared with the **corrected temperature indication of the test sensor on a test instrument**.*

The two measurement systems being compared are:

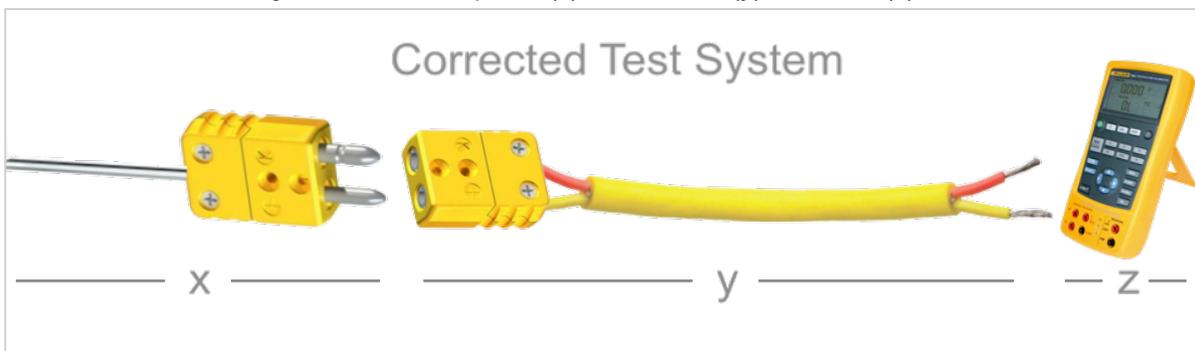
- the production instrument/leadwire/sensor (Figure-1)
- the calibrated field test instrument/leadwire/sensor (Figure-2)

Temperature Measurement System made up of: (a) **sensor**, (b) **lead-wire** (c) **control or recording instrument**:



(Figure-1)

Corrected Test System made up of up the: (x) **test sensor**, (y) **lead-wire** (z) **field test instrument**.



(Figure-2)

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Now that we have a clear image in our head of what two systems we are supposed to be comparing, let's illustrate an example of an SAT calculation and determine if it passes or fails.

For the purposes of this illustration the following assumptions are made:

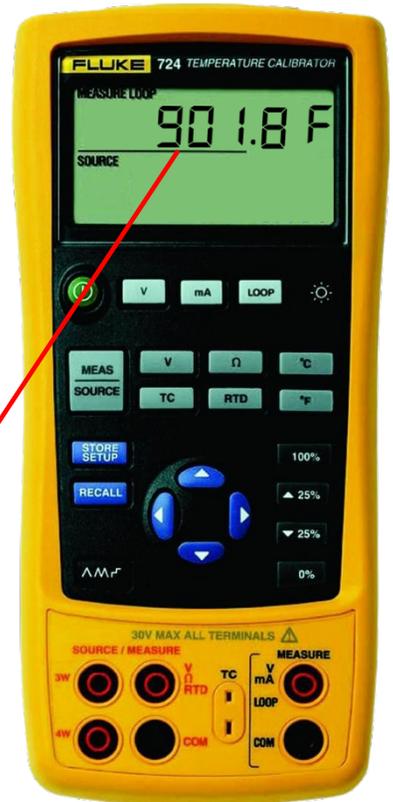
- all temperatures are in °F, and no offsets are in use for the last SAT or TUS.
- no correction factors in use for control instrument or control sensor
- furnace class = Parts Class 4

Furnace Temperature Controller



IMPORTANT: The instrument's SP (set point) must be documented but is not used whatsoever when calculating SAT Difference. Doing so can yield incorrect pass/fail results. **
Instead we are to use the Instrument Reading, ...

Field Test Instrument



Temperature Measurement System (°F)	
Instrument Set Point	900
Instrument Reading (A)	899
Correction factor from CAL of instrument (B _{inst})	-
Manual thermocouple calibration correction factor (B _{tc})	-
Correction Factor from TUS offset of control instrument (B _{tus})	-
A + B_{inst} + B_{tc} + B_{tus} = Corrected control instrument temperature (C)	899
Corrected Test System (°F)	
Test instrument reading (uncorrected) (D)	901.8
Test thermocouple correction factor (E)	+1.6
Test instrument correction factor (F)	+0.6
(D) + (E) + (F) = True Test Temperature (G)	904.0
SAT Difference = (C) – (G)	
	5.0

Now that calculations for both systems are complete, we simply compare the temperature of the two systems (highlighted above) to determine that the SAT Difference is 5.0°F.

Per Table 6 of AMS-2750E, our Parts Class 4 furnace at this temperature is only allowed a maximum tolerance of +/-4°F, so our SAT test has failed.

****IMPORTANT:** If we had improperly calculated the SAT Difference by comparing the **Set Point** (900°F) to our True Test Temperature (904°F), then we would have subjected ourselves to an NCR. Worse yet, we would have incorrectly determined that the SAT had passed when in fact it had failed.

SAT Pass or Fail

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It is common for users of our pyrometry software to show us the old system they used previously to subscribing to C3 Data, and we've noticed that many of these systems make this mistake. This article attempts to bring awareness of this potential pitfall to all those in the metal processing industry who aren't currently using C3 Data to comply with the requirements of AMS2750E.

For questions about this or any other article from C3data.com please reach out to your C3 Data representative.

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