Heat Treatment INDUSTRY

AMS2750D
Instrumentation System Accuracy Tests and Eurotherm Products
Technical Note

The Aerospace Material Specification AMS2750D covers pyrometric requirements for thermal processing equipment used for heat treatment. It covers temperature sensors, instrumentation, thermal processing equipment systems accuracy tests and temperature uniformity surveys.

Adherence to the specification is necessary to ensure that parts or raw materials are heat treated in accordance with the applicable specifications.

The following notes offer some guidance on the requirements for Instrumentation System Accuracy Tests (SATs) and the way Eurotherm can help customers to meet the exacting demands of heat treatment accreditation.

The Pyrometry specification AMS2750D referred to by Nadcap identifies procedures for performing System Accuracy tests on instrumentation, temperature sensors and thermal processing equipment.

The purpose of the SATs associated with Instrumentation is to provide an authenticated record of the instrument accuracy within a defined level of tolerance difference through a chain of traceability to NIST or equivalent National reference standard.

Results of the tests must be recorded in accordance with AMS275D clause 3.4.6.

Eurotherm provide two types of instrumentation, which meet the requirements of thermal processing equipment as defined in the specification.

1) Field Test Instrumentation

2) Controlling Monitoring or Recording Instrumentation

All instrumentation, used either for Field Test Instrumentation or Controlling, Monitoring or Recording Instrumentation must be fully subjected to (SATs) Systems Accuracy Test calibration, before application to any process.

SATs must also be carried out at a frequency specified in table 6 & 7 of AMS2750D and records must show that Instrumentation types meet the accuracy requirements of AMS2750D Table 3.

Onsite services into NADCAP applications must be supported by relevant quality systems.

Guidance on Eurotherm quality systems listed under DP006 can be found at the following address
http://wwwhost.eurotherm.co.uk/ops/manuals/departmental/

The following notes provide guidance on System Accuracy Tests as they apply to the selection and use of instrumentation for use in Nadcap accredited solutions.

These notes do not cover System Accuracy Tests as they apply to the use and selection of thermocouples and sensors.

The notes must be read in conjunction with AMS2750D section 3.4.

A copy of AMS2750D specification can be obtained from the SAE Aerospace website. http://aerospace.sae.org/

The suitability of instrumentation to meet a specific type, listed in table 3 is not defined by the manufacturers data sheet but by the following criteria.

- The ability to show an observable level of calibration accuracy equal to or better than the difference shown between two layers of traceability as defined in AMS2750D table 3.
- To retain the level of calibrated accuracy for a time period equal to or in excess of the maximum allowable SATs interval as defined in AMS2750D Table 6 & 7.

Levels of Traceability

Figure 1 shows an outline of the layers of instrumentation traceability and limitations of use. Refer to table 3, 6 & 7 for the allowable maximum calibration accuracy differences between the layers.

Within Eurotherm it is common practice is to use a secondary standard instrument to provide laboratory calibration of test instrumentation and calibration of Controlling Monitoring or Recording Instruments.

The arrows indicate that a category of instrumentation can only be calibrated or tested by equipment with a superior traceable level of calibration compliance to the national standard.

Maximum allowable levels of accuracy tolerance for Field Test Instrumentation and Controlling Monitoring Instrumentation as defined in AMS2750D table 3 are as follows.

1) “Field Test Instruments”

Calibration Accuracy +/- 1.0 degree F (+/-0.6 degree C) or +/- 0.1% of reading in degrees F which ever is the greater.

Use is limited to Control, Monitoring or Recording instrument calibration, performance of system accuracy tests and temperature uniformity surveys.

2) “Control Monitoring or Recording Instruments” (Digital)

Calibration Accuracy +/- 2degree F (+/-1.1 degree C)

Use is limited to measuring recording and controlling temperature of thermal processing plant.

For control monitoring and recording instruments the maximum overall furnace SAT difference is further defined against Furnace Class as follows.

Class 1 Furnace

Maximum overall SAT difference +/- 2degree F (+/-1.1 degree C) or 0.2% of reading, which ever is the greater. Maximum permitted SATs adjustment +/-1.5 degrees Centigrade.

Class 2 Furnace

Maximum overall SAT difference +/- 3degree F (+/-1.7 degree C) or 0.3% of reading which ever is the greater Maximum permitted SATs adjustment +/-3.0 degrees Centigrade.

Class 3 Furnace

Maximum SAT overall difference +/- 4degree F (+/-2.2 degree C) or 0.4% of reading which ever is the greater Maximum permitted SATs adjustment +/-5.0 degrees Centigrade or +/- 0.38% of operating temperature.

Class 4 Furnace

Maximum overall SAT difference +/- 4degree F (+/-2.2 degree C) or 0.4% of reading which ever is the greater Maximum permitted SATs adjustment +/-6.0 degrees Centigrade or +/- 0.38% of operating temperature.

Class 5 Furnace

Maximum overall SAT difference +/- 5degree F (+/-2.8 degree C) or 0.5% of reading which ever is the greater Maximum permitted SATs adjustment +/-7.0 degrees Centigrade or +/- 0.38% of operating temperature.

Class 6 Furnace

Maximum overall SAT difference +/- 10degree F (+/-5.6 degree C) or 1.0% of reading which ever is the greater Maximum permitted SATs adjustment +/- 0.75% of operating temperature.

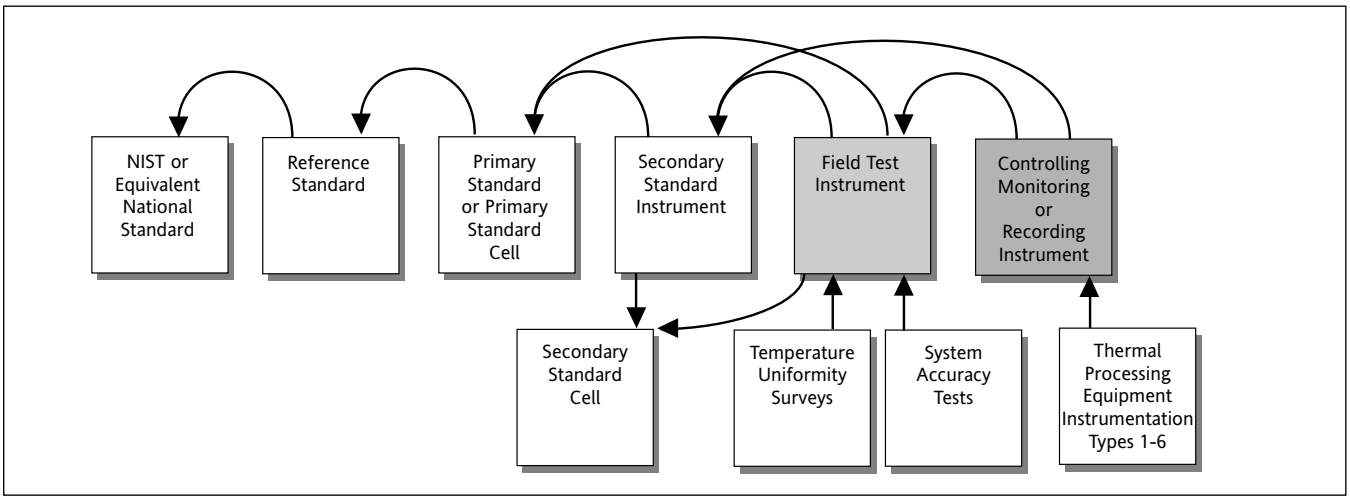

Figure 1

Practical Considerations

In Clause 3.2 : AMS2750D specifies that

Output of sensors shall be converted to temperature readings by instruments specified herein or instruments of equivalent or greater accuracy. Instruments shall be calibrated by NIST or an equivalent national standard, or against standards whose calibration is traceable to NIST or other recognised national equivalent(s) according to Table 3.

AMS 2750D Section 3.4 defines the principles and method for applying System Accuracy Tests to Sensors and Instrumentation used in Thermal Processing equipment.

As discussed above the purpose of the system accuracy test for instrumentation is to determine the difference between the instrument under test and the accredited calibration test instrument such that a complete chain of traceability can be formed between the instrument under test and NIST or equivalent national standard.

The importance is to determine that the observable difference, between any two layers of traceability is within tolerances determined in AMS2750D.

This ensures that observable accuracy takes account of all possible components of instrument error including input accuracy, sensor linearisation, cold junction compensation and drift.

As part of the reporting procedures for SATs defined in 3.4.6.1 it is also necessary to show approval of the quality organisation under which the SATs have been completed.

Two typical quoted levels of accuracy for Eurotherm 3000 instruments are identified below but this does not define their suitability or unsuitability to meet SATs.

Data sheet specification for the 3200 is as follows

Analogue Input accuracy +/- 0.25%

Linearisation accuracy 0.1%

CJC rejection 30:1 (+/- 1.0 degree C at 25 degrees)

Data sheet specification for the 3500 is as follows

Analogue Input accuracy +/- 0.1%

Linearisation accuracy 0.2%

CJC rejection 40:! (+/- 1.0 degree C at 25 degrees)

Eurotherm products include comprehensive 2 point or multipoint calibration routines, which enable instruments to be calibrated to meet SAT difference tolerances under NIST or an equivalent national standard, or against standards whose calibration is traceable to NIST or other recognised national equivalent(s) according to Table 3. (Field Test Instruments and Control Monitoring or Recording instruments)

AMS2750D Further specifies under table 6 and 7 the maximum allowable level of offset for System Accuracy Tests allowed for each furnace class.

Many Eurotherm products provide password protected offsets, which can be applied to remove simple single point errors within the allowable level defined in table 6 and 7.

Systems Accuracy Tests for Degree Centigrade Installations

Tables in AMS2750D refer to tolerances in degrees F with decimal point resolution conversion to degrees C. Care must be taken when applying instrumentation particularly to Class 1 and Class 2 furnaces and when choosing instruments for use in any specific application so that instruments can be configured to accommodate the desired range of use with the required decimal point resolution.

The range of use, which allows observable calibration error to decimal point resolution may restrict instrument use to 999.9 degrees C for 4 digit products.

Furnace Class Temperature Uniformity

Table 6 and 7 further define the allowable level of temperature uniformity allowable for each furnace class.

Temperature Uniformity Survey tolerances are as follows

Furnace Class 1 +/- 5 degrees F or +/- 3 degrees C

Furnace Class 2 +/- 10 degrees F or +/- 6 degrees C

Furnace Class 1 +/- 15 degrees F or +/- 8 degrees C

Furnace Class 1 +/- 20 degrees F or +/- 10 degrees C

Furnace Class 1 +/- 25 degrees F or +/- 14 degrees C

Furnace Class 1 +/- 50 degrees F or +/- 28 degrees C

Class 1 furnaces are invariably used for high value precision work. To achieve the level of uniformity tolerance required for this class of furnace across the furnace volume and across the desired setpoint range will invariably require a controller which aids not only SAT compliance but control uniformity stability and overshoot elimination.

It can be seen from this that choosing a controller for use on a class 1 furnace needs careful consideration not only on the ability to meet SAT but the demands for overall furnace performance.

Training and advice on System Accuracy Tests can be obtained from Eurotherm Heat Treatment.

EUROTHERM LIMITED UK
Faraday Close Durrington Worthing BN13 3PL
Tel. +44 (0)1903 268500 Fax +44 (0)1903 695666
Email info@eurotherm.co.uk
www.eurotherm.co.uk

EUROTHERM US
741-F Miller Drive Leesburg VA 20175-8993
Tel. 1-703-443-0000 Fax 1-703-669-1300
Email info@eurotherm.com
www.eurotherm.com

EUROTHERM WORLDWIDE
www.eurotherm.co.uk/contact.asp

Part No. HA029265U001 Issue 1 Heat Treatment and AMS2750D Technical Note Printed in England 03.06