Heat Treatment

INDUSTRY

Eurotherm® and Nadcap

Technical Note

Aerospace Material Specification

SAE AMS2750 D

EUROTHERM TECHNICAL RESPONSE

Instrumentation Supply and General On Site Services

The specification AMS2750D defines 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.

These are 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 clauses contained in the specification and the way that Eurotherm can help customers meet the exacting demands of heat treatment accreditation.

The notes must be read in conjunction with the specification document AMS2750D a copy of which can be obtained from SAE International at:

http://www.sae.org

The reference to Eurotherm products in this document refers to:

4000, 5000, and 6000 series data recorders

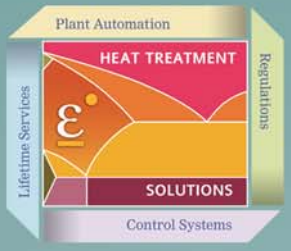
2000 and 3000 series control products

Expert control

- The best PID control algorithm available
- Flexible control strategies
- Setpoint programming

Secure recording

- Tamper proof data storage
- Complete audit trails
- Unlimited unique user accounts
- Batch software
- Ethernet connectivity
- Easy read access of secure data
- Create report from secure data using Review and Report



Section	Topic	Comment
3.1	Temperature Sensors	Applicable to suppliers of accredited thermocouples and sensors Clause defines that sensors must comply with AMS2750D Table 1 and defines how exclusions are detailed
3.1.1	General Sensor Information	Applicable to suppliers of accredited thermocouples and sensors The clause defines general comment on thermocouple manufacture AeroDAQ is capable of recognising inputs from base metal and noble metal thermocouples across the operating range of thermocouples
3.1.1.1	Sensor Certificate of Compliance Requirements	Applicable to suppliers of accredited thermocouples and sensors Clause defines certification for thermocouples and sensors
3.1.1.2	Degrees to Millivolt Conversion	Eurotherm Instrumentation can receive direct inputs from furnace Thermocouples and sensors Conversion from degrees to millivolts is in accordance with ASTM E230 or other national standards
3.1.1.3	Thermocouple Calibration Requirements	Applicable to suppliers of accredited thermocouples and sensors Clause Defines Calibration range for thermocouples and sensors
3.1.1.4 3.1.1.4.1	Thermocouple usage	Clause defines range of usage for thermocouples and sensors Password protected setpoint limits in Eurotherm products restrict use of sensors outside their authorised range AeroDAQ has built-in functionality to calculate time at temperature and number of instances above threshold temperature for specific thermocouple types. See 3.1.8.5 AeroDAQ is capable of recognising inputs from base metal and noble metal thermocouples across the operating range of thermocouples
3.1.1.5	Extension Wire	Applicable to suppliers of accredited thermocouples and sensors Clause defines requirements for thermocouple extension wire
3.1.1.6	Wire Rolls – Calibration Requirements	Applicable to suppliers of accredited thermocouples and sensors Clause and sub clauses defines requirements for calibration of thermocouple wire rolls
3.1.1.7	Wire Rolls – Maximum Allowable Length	Applicable to suppliers of accredited thermocouples and sensors Clause defines maximum thermocouple wire roll sizes
3.1.1.8	Reuse of Type K and E thermocouples as	Applicable to suppliers of accredited thermocouples and sensors
3.1.1.9	Secondary Standards or SAT Sensors Reuse of other Thermocouples	Clause defines conditions for reuse of thermocouples
3.1.1.10	Expendable Base-Metal Test Thermocouple “U” Formula	Applicable to suppliers of accredited thermocouples and sensors Clause and sub clauses defines recalibration of expendable thermocouples and their use and reuse
3.1.2	Reference Standard Sensors	Applicable to suppliers of accredited thermocouples and sensors Clause defines reference standards and refers to AMS2750D Table 1
3.1.3	Primary Standard Sensors	Applicable to suppliers of accredited thermocouples and sensors Clause defines Primary standards and refers to AMS2750D Table 1
3.1.4	Secondary Standard Sensors	Applicable to suppliers of accredited thermocouples and sensors Clause defines Secondary standards and refers to AMS2750D Table 1
3.1.5	Temperature Uniformity Survey Sensors	Applicable to suppliers of accredited thermocouples and sensors Clause and sub clauses defines Temperature Uniformity Survey sensors must comply with AMS2750D Table 1
3.1.6	System Accuracy Test Sensors	Applicable to suppliers of accredited thermocouples and sensors Clause and sub clauses defines System Accuracy Test sensors must comply with AMS2750D Table 1
3.1.7 3.1.7.2	Control, Monitoring, and Recording Sensors	Clause and sub clauses defines Controlling, Monitoring or Recording sensors must comply with AMS2750D Table 1 Also refers to the use of expendable sensors and positioning of Controlling, Monitoring or Recording sensors Eurotherm provide hardware and software features to include load sensors into control equipment and routines for inclusion of load sensors in optional control strategies
3.1.8 3.1.8.2 3.1.8.5	Load Sensors	Clause and sub clauses defines that load sensors must comply with AMS2750D Table 1 And further defines how load sensors can be used Eurotherm provide routines to inhibit Controlling, Monitoring or Recording sensors from exceeding maximum allowed processing temperature when load sensor used for control For in-situ sensors, records can automatically compute maximum allowable sensor usage and elapsed usage with alarms against expired sensor periods. See 3.1.1.4

Section	Topic	Comment
3.2 3.2.1 3.2.2 3.2.2.1 3.2.2.2 3.2.3	Instrumentation	Clause and sub clauses define general requirements of instrumentation referenced in AMS2750D Eurotherm manufacture Heat Treatment instrumentation suitable for use in Nadcap approved aerospace accredited control systems Equipment can be supplied with Factory or On-Site calibration traceable to national standards, ensuring that products meet the requirements of Field Test Instruments and Controlling, Monitoring or Recording Instruments as defined in Table 3, AMS2750D Eurotherm provide on-site control system audit services to determine the suitability of a clients instrumentation to meet demands of AMS2750D Temperature uniformity and resolution of Eurotherm chart recorders meets the requirements of Table 4. Print and Chart Speeds of Eurotherm recorders conform to Table 5, AMS2750D Eurotherm manufacture digital Test Instruments which have a readability of 1 degree F or 1 degree C
3.2.4 3.2.4.2 3.2.4.3 3.2.4.4	Controlling, Monitoring or Recording Instruments	Clause and sub clauses define use and requirements of Control Monitoring and Recording Instruments Eurotherm manufacture Digital Controlling, Monitoring or Recording Instruments have a readability of 1 degree F or 1 degree C Full Installation instructions are provided for all equipment Simple single offset adjustments and multipoint calibration adjustments are available in Eurotherm products Procedures for entering offsets and adjustments are fully documented. Eurotherm products interface directly with sensors and receive unmodified signals Digitally process or communicated values are error checked before representation as direct measured values Eurotherm digital instruments meet the calibration accuracy demanded for Field Test Instruments and Controlling, Monitoring or Recording instruments as defined in Table 3
3.2.5 3.2.5.2 3.2.5.3.2 3.2.5.3.3 3.2.5.5	Instrument Calibration	Clause and sub clauses defines requirements for instrumentation calibration AeroDAQ contains alarm routines to alert user when calibration is due in accordance with Table 3 Eurotherm chart recorders conform with 3.2.5.4 Eurotherm supply manufacturer's instructions for instrument calibration procedures. Operator notes can be appended to the recorder secure data file to record in process calibration Each measuring circuit on Controlling, Monitoring or Recording Instruments and Field Test Instruments is independent and can be calibrated and adjusted independently Instruments meet sensitivity requirements of Table 3 note 4 +/- 1 degree F or C for instruments in class 1 & 2 +/- 3 degrees F or 2 degrees C for instruments in class 3-6
3.2.6	Instrumentation Records	Clause and sub clauses define records, documentation and labelling associated with Instrumentation calibration See separate AMS750D "Onsite Services Response" For Regions where accredited services are provided by Eurotherm
3.2.7 3.2.7.1 3.2.7.1.1 3.2.7.1.2 3.2.7.1.3 3.2.7.1.4 3.2.7.1.5	Electronic Records – Instrumentation	Clause and sub clauses define the method, format and procedure for recording, saving and supporting electronic records Eurotherm manufacture data management products which generate, store, archive and replay electronic records Records are stored as compressed, binary, check-summed throughout (for each record) Data files are generated in write_once read_only format which cannot be altered without detection Review Lite and Review Full software applications are available to playback archived data. It is not possible to alter the records of source data in these applications. Data can be exported from Review so that complete copies can be generated in human readable and electronic format. Audited data trail and a lockable media flap is available for data management security File archiving is provided by secure automatic or manual backup and transfer routines Multiple archiving strategies are available. Archive on demand, archive automatically and Archive using 'Review' Multiple Archiving Destinations can be defined, archive to Compact Flash(CF) Secure Digital(SD), archive to USB memory stick, archive to FTP Server Primary and Secondary FTP Server Function Password protection is available with multiple user accounts and custom access

Section	Topic	Comment
3.3	Thermal Processing Equipment	Clause heading for All Thermal Processing clauses
3.3.1	Furnace Classes Definition of the instrument types can be obtained from the Aerospace Material Specification AMS2750D	Clause defines the range of designated Furnace classes 1 -6 Eurotherm manufacture Controlling, Monitoring or Recording instrumentation suitable for all Furnace classes 1 through 6 and for all Instrumentation types A through E Eurotherm provide application support to advise on Instrumentation class requirements
3.3.1.1	Instrumentation Type A	Clause and sub clauses define the scope of requirement for Instrumentation type A Eurotherm manufacture independent or multi-loop digital control products and digital recording products, which when subject to systems accuracy tests meet the requirements of class A instrumentation. Digital recorders support error checked master communications for recording process values from other instrumentation such as independent zone controllers Control systems support tracking over-temperature devices which provide work piece protection and furnace protection through independent Hi-Hi alarms
3.3.1.2	Instrumentation Type B	Clause and sub clauses define the scope of requirement for Instrumentation type B Eurotherm manufacture independent or multi-loop digital control products and digital recording products, which when subject to systems accuracy tests meet the requirements of class B instrumentation. Digital recorders support error checked master communications for recording process values from other instrumentation such as independent zone controllers Control systems support tracking over-temperature devices which provide work piece protection and furnace over protection through independent Hi-Hi alarms
3.3.1.3	Instrumentation Type C	Clause and sub clauses define the scope of requirement for Instrumentation type C Eurotherm manufacture independent or multi-loop digital control products and digital recording products, which when subject to systems accuracy tests meet the requirements of class C instrumentation. Digital recorders support error checked master communications for recording process values from other instrumentation such as independent zone controllers Control systems support tracking over-temperature devices which provide work piece protection and furnace over protection through independent Hi-Hi alarms
3.3.1.4	Instrumentation Type D	Clause and sub clauses define the scope of requirement for Instrumentation type D Eurotherm manufacture independent or multi-loop digital control products and digital or paper recording products, which meet the requirements of class D instrumentation. Digital recorders support error checked master communications for recording process values from other instrumentation such as independent zone controllers Control systems support tracking over-temperature devices which provide work piece protection and furnace over protection through independent Hi-Hi alarms
3.3.1.5	Instrumentation Type E	Clause and sub clauses define the scope of requirement for Instrumentation type E Eurotherm manufacture independent or multi-loop digital control products, which meet the requirements of class E instrumentation
3.3.1.6.1	Instrumentation – Refrigeration Equipment	Clause defines the scope of requirement for Instrumentation suitable for use on Refrigeration equipment
3.3.1.6.2	Instrumentation – Quench Systems	Clause defines the scope of recording equipment for use on quench systems. Eurotherm manufacture recorders suitable for use on quench systems. Recorders can be used to monitor process parameters and record the transfer to quench time for quench hardening processes
3.4	System Accuracy Tests (SAT's)	Clause and sub clauses define the general requirements for System Accuracy Tests and refers to AMS2750D Table 3 Eurotherm manufacture Field test instrumentation and control monitoring and recording equipment as defined in Table 3. Routines are included which aid accurate calibration to meet the requirements of (SATs) for all classes of instrumentation Eurotherm manufacture Field test instrumentation suitable for testing calibration performance of systems accuracy tests On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of (SATs) See separate System Accuracy Test guidance document available from Eurotherm
3.4.2	System Accuracy Test Frequency	Clause and sub clauses define frequency and requirements for System Accuracy Tests AeroDAQ includes routines to calculate the SAT frequency period for specific furnace and instrumentation class as defined in Tables 6 and 7 and notifies the user of the furnace's TUS status

Section	Topic	Comment
3.4.3	System Accuracy Test Waiver	Clause and sub clauses define the conditions under which SATs may be waived
		Eurotherm provide routines to enable load sensors to be used for control within the constraints identified in clause 3.4.3.1
3.4.3.6		6100 AeroDAQ has routines to calculate the due dates for SATs when a waiver is applied
3.4.4	System Accuracy Test Procedure	Clause and sub clauses define the procedure for SATs
		See separate System Accuracy Test guidance document available from Eurotherm
3.4.4.2.1 3.4.4.3	Resident Test Sensors	Clauses and sub clauses defines process for use of resident SATs thermocouple and the mechanism for measuring and dealing with system accuracy differences and correction factors
3.4.4.8	Alternative System Accuracy Test Procedure	Clause defines an objective set of requirements for an alternative to System Accuracy Tests
3.4.5	System Accuracy Test Instrumentation	Clause and sub clause defines that Instrumentation used in System Accuracy Tests must comply to Table 3
		Eurotherm manufacture Field Test Instruments and Controlling, Monitoring or Recording Instruments which meet requirements as defined in Table 3
3.4.6	Records – System Accuracy Test	Clause and sub clause defines the scope of recorded information which must be included in SATs reports
3.5	Furnace Temperature Uniformity Surveys (TUS)	Clause and sub clause defines the general requirement for Temperature Uniformity Surveys and refers to AMS2750D Table 8 and 9
		Eurotherm manufacture Field test instrumentation suitable for use in Temperature Uniformity Surveys (TUS)
		Eurotherm manufacture Field test instrumentation suitable for testing calibration performance of systems accuracy tests
		Eurotherm provide control algorithms which improve furnace performance and aid the ability to achieve TUS conformance
		Routines are included to eliminate setpoint overshoot for step changes and ramp-dwell transitions
		Eurotherm provide world renowned steady state control algorithms.
		On-site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.2	Multiple Qualified Operating Temperature Ranges	Clause and sub clauses define the conditions for a furnace to operate across multiple operating temperature ranges
		Eurotherm include automatic furnace optimisation routines in control equipment to aid the approved use of thermal processing equipment across the widest range of setpoints with a wide range of furnace load sizes
		Password protected setpoint limits are available to inhibit the use of equipment outside its approved range
3.5.3	Furnace Modifications	Clause defines furnace modification conditions which result in the requirement for a Temperature Uniformity Survey
		Eurotherm provide control systems which include automatic optimisation routines such as Multiple gain scheduling. Such routines employed to achieve TUS results across wide setpoint ranges are automatically applied during production heat treatments
3.5.4	Furnace Repairs	Clause defines furnace repair conditions which do not require a Temperature Uniformity Surveys. Engineer electronic signature can be recorded on the AeroDAQ and archived
3.5.5	Initial TUS Temperatures	Clause defines conditions for the initial Temperature Uniformity Survey qualified operating range and the interval between uniformity survey temperatures
		On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.6	Periodic TUS Temperatures	Clause defines conditions for the periodic interval between Temperature Uniformity Surveys
		On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
		AeroDAQ has features to calculate TUS dates as defined in Tables 8 + 9
3.5.7	TUS Frequency	Clause and sub clause defines that the frequency of TUS must be in accordance with Table 8 & 9 and the conditions for extending TUS frequency
		On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
		AeroDAQ has features to calculate dates of extended TUS frequency as defined in Table 10
3.5.8	Furnace Parameters During TUS	Clause defines that conditions pertaining during Temperature Uniformity Surveys, must be maintained during production cycles
		On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)

Section	Topic	Comment
3.5.9	Furnace Temperature at Insertion of TUS Sensors	Clause defines conditions under, which load sensors may be inserted into the furnace for Temperature Uniformity Surveys On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.10	Load Condition	Clause and sub clause defines the use of production or simulated loads for carrying out Temperature Uniformity Surveys On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.11	Furnace Atmosphere during TUS	Clause defines conditions for atmospherically controlled furnace during Temperature Uniformity Surveys Eurotherm provide application specific input linearisations on Field Test Instrumentation and Control Monitoring and Recording instruments to monitor and record furnace atmosphere in engineering units during TUS
3.5.12	Furnace Vacuum Level during TUS	Clause defines conditions for vacuum levels during Temperature Uniformity Surveys on vacuum furnaces Eurotherm provide application specific input linearisations on Field Test Instrumentation and Control Monitoring and Recording instruments to monitor and record furnace vacuum levels in engineering units during (TUS)
3.5.13	Batch Furnaces, Salt Baths, Controlled Temperature Liquid Baths and Fluidised Bed Furnaces	Clause defines general conditions for Temperature Uniformity Surveys on this type of Furnace On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.13.1	Number of TUS Sensors	Clause defines the number of Temperature Uniformity Surveys sensors for furnaces types covered in 3.5.13 should be in accordance with Table 11 On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.13.2	Location of TUS Sensors	Clause and sub clauses define the general arrangement for location of Temperature Uniformity Surveys sensors associated with furnaces types covered in 3.5.13 and defines that number of sensors against work zone volume should be in accordance with Table 11 On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS) 5000 and 6000 Series recorders can take up to 48 thermocouples directly connected or upto 176 over Modbus communications
3.5.13.3	TUS Data Collection	Clause and sub clauses define the requirement for monitoring and recording Temperature Uniformity Survey data
3.5.13.3.1		Field Test Instrumentation supplied by Eurotherm, provides secure write once read only files which records information about the TUS Recorders can be scaled and configured to show accurately the following
3.5.13.3.2		That the Recording starts before lowest sensor achieves lower tolerance limit or for prestabilised process when the load is placed in the furnace Records show accurately any sensor exceeding the upper tolerance limit Record frequency can be selected to a maximum frequency of all channel records 9 times per second
3.5.13.3.3		Digital communication or manually entered operator notes which provide detail of other control and recording equipment, as defined in the instrumentation class can be embedded in the secure data files The record shows a time stamped signature of the TUS period and any excursions or trends outside the tolerance limits Manually entered operator notes can be added to the secure data files to show TUS actions
3.5.13.3.4		Eurotherm provide special algorithms to aid the control and uniformity performance of retort furnaces
3.5.13.4	Alternative Probing Method for Salts Baths, Controlled Temperature Liquid Baths and Fluidised Bed Furnaces	Clause and sub clauses define the alternative probe method for temperature conformity of equipment defined in these furnace classes On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)

Section	Topic	Comment
3.5.14	Continuous and Semi-continuous Furnaces	Clause and sub clauses define the general arrangement for carrying out Temperature Uniformity Surveys on continuous furnaces Eurotherm supply Field Test Instrument which can be configured for use in Temperature Uniformity Surveys on continuous furnaces to record data from either the volumetric or plane method Record frequency can be selected to accurately reflect temperature uniformity over the traverse speed of the furnace On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.14.1	Number and Location of TUS Sensors – Volumetric Method	Clause and sub clauses define the number and location of sensors for volumetric method tests to be in accordance with Table 11and sub clauses of clauses 3.5.13.2 On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.14.2	Number of TUS Sensors – Plane Method	Clause and sub clauses define the number of sensors required for Temperature Uniformity Surveys carried out using the plane method On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.14.4	TUS Data Collection	Clause and sub clauses define the requirement for Temperature Uniformity Survey data collection on Continuous and semi-continuous furnaces Field Test Instrumentation supplied by Eurotherm provides secure write once read only files which records information about the TUS Recorders can be scaled and configured to show accurately the following That records are produced for each sensor Records are produced for each zone or furnace region Records show accurately any sensor exceeding the upper tolerance limit Record frequency can be selected to a maximum frequency of all channel records 8 times per second Digital communication or manually entered operator notes which provide detail of other control and recording equipment as defined in the instrumentation class can be embedded in the secure data files. Furnace traverse speed can be incorporated in the data record The record shows a time stamped signature of the TUS period and any excursions or trend outside the tolerance limits Manually entered operator notes to show TUS actions can be added to the secure data files On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.15	Alternative TUS Methods for Continuous or Semi-continuous Furnaces or Furnaces with Retorts	Clause and sub clauses define alternative test methods for continuous or semi-continuous furnaces or furnaces with retorts or muffles Manually entered operator notes can be embedded into the secure TUS record files to show the result for alternative probe method on continuous furnaces On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.15.1	Probing Method	Clause and sub clauses define alternative probe test method retort or muffle furnaces Eurotherm supply recorders which can accept operator notes which are embedded in the secure parameter data file associated with retort of muffle furnace survey On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.15.2	Property Surveys	Clause and sub clauses define an alternative method for verifying thermal characteristics of continuous or semi-continuous and retort or muffle furnaces through material analysis and property surveys Not applicable to Eurotherm

Section	Topic	Comment
3.5.16	TUS Sensor/Failures	Clause and sub clause defines the requirements for dealing with sensor failures during Temperature Uniformity Survey tests Eurotherm supply Field Test Instrumentation that clearly identifies TUS Sensor failures within the TUS records, and via the reporting package, temporary conditions can be identified Operator notes can be embedded into the secure record file to show cause and corrective action associated with any sensor failure
3.5.17	TUS Pass/Fail Requirements	Clause and sub clause defines the pass/fail requirements of Temperature Uniformity Surveys Eurotherm supply Field Test Instrumentation which can be configured to automatically define pass/fail criteria for particular tests The archived file can be used in report software to present TUS data for evaluation Eurotherm supply a TUS reporting package which clearly identifies whether the survey has passed or failed On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.18	Relocation of Hot or Cold Recording Sensors for Class A or C Instrumentation	Clause defines the requirements for relocating hot and cold recording sensor in class A & C furnaces. Following successful TUS. Eurotherm report software advises hottest and coldest sensor location On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.19	TUS Failures	Clause and sub clause defines the requirements for dealing with TUS failures outside the limits in tables 8 & 9 Effects of failures must be evaluated against possible effects as in clause 4.2 AeroDAQ will calculate revised frequency of TUS in case of a failure (Table 6 or 7) On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.20	TUS Instrumentation	Clause and sub clause defines that Temperature Uniformity Surveys must only be carried out using equipment which meets the requirement for Field Test Instruments of Table 3 and that TUS sensors must meet the requirement of Table 1 Eurotherm manufacture Field test instrumentation suitable for use in temperature uniformity surveys (TUS Temperature Uniformity Survey instrumentation meets the accuracy calibration requirement of Table 3 (+/-) 1 degree F or 0.6 degrees C or (+/-) 0.1% of reading in degrees F which ever is the greater Compensation for known deviations can be electronically or mathematically appended to the records for correction of results
3.5.21	TUS Report	Clause and sub clauses defines the requirement of mandatory data and alternative data to be included in the TUS report Eurotherm Field Test Instrumentation used for Temperature Uniformity Surveys produces a secure data file of results including all parameter data from the survey sensors and the furnace control and monitoring equipment as well as manually entered actions, sensor failures or special furnace conditions. Eurotherm provide a TUS reporting package to which can provide a printed report from the recorded TUS data conforming to 3.5.21 Control instrument tuning parameters can be stored on AeroDAQ
3.5.22	Prepublication TUS's	Clause defines conditions for accepting Temperature Uniformity Surveys carried out prior to release of AMS2750D On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.5.23	Radiation Surveys	Clause defines the requirement for carrying out and appending data to TUS results for radiation tests on aluminium alloy solution heat treating air furnaces Eurotherm provide Field Test instruments which can collect radiation data automatically or via operator notes The results of the radiation test can be embedded into the TUS data On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)
3.6	Laboratory Furnaces	Clause and sub clauses define the requirements for carrying out SATs and TUS on laboratory furnaces On site services by Eurotherm and its service channel partners are available on a regional basis for the provision of Temperature Uniformity Surveys (TUS)

Section	Topic	Comment
3.7	Records	Clause and sub clauses define the requirements for saving and storing data associated with SATs and TUS Eurotherm Field Test Instrumentation used for the TUS produces a secure data file of results including all parameter data from the survey sensors and the furnace control and monitoring equipment as well as manually entered actions, sensor failures or special furnace conditions Results can be replayed in Eurotherm Review or exported in an human readable format to other common electronic applications Regional and on-site calibration services provided by Eurotherm are traceable back to National Standards
4.0	Quality Assurance Provisions	To aid end user quality responsibility Eurotherm operate an exacting quality programme supported by the following statement Eurotherm Ltd aims to establish, document, review and continually improve an effective and economical Management System in accordance with ISO 9001 and the Tick IT Guide to ensure and demonstrate that the design, development and manufacture of the products and services conform to their specified requirements The achievement of quality shall be the prime responsibility of all personnel and compliance with the organisation's Management System (Quality) is mandatory. Line Management where necessary, shall delegate authority for personnel to identify and investigate quality problems Quality Department will monitor customer satisfaction, the performance, and the agreed quality objectives and ensure adherence to the quality procedures within Eurotherm Ltd The objective of Eurotherm Ltd is continued profitable growth in its role of supplier of quality instrumentation, control equipment and principal systems integrator of group products. This will be achieved through open communication, teamwork and by the implementation of a continuous improvement programme aimed at providing customer satisfaction by increasing efficiency and reducing costs. In addition, the development of application expertise and the total life cycle cost management programmes will enable the organisation to maintain its competitive edge and ensure its international expansion The organisation intends to maintain its reputation as a supplier of high quality equipment and software and a provider of efficient engineering services through out the lifetime of its products
Table 1	Sensors and Sensor Calibration	Table 1 Defines types, usage, calibration period and reference with permitted maximum error associated with multiple sensor categories Where Eurotherm provide On-site services for the provision of AMS2750D System Accuracy Tests (SATs) or Temperature Uniformity Surveys (TUS), Sensors Usage and Sensor calibration is undertaken in accordance with Table 1
Table 2	Thermocouples and Extension Wire	Table 2 Defines standards associated with thermocouples and extension wire Colour codes are in accordance with ASTM E 230 + other relevant National Standards Where Eurotherm provide On-site services for the provision of AMS2750D System Accuracy Tests (SATs) or Temperature Uniformity Surveys (TUS) Thermocouple and extension wire usage and identification is in accordance with Table 2
Table 3	Instruments and Instrument Calibration	Table 3 defines aspects of instrumentation types, calibration periods and calibration accuracy and instrument use associated with multiple categories of instrumentation Eurotherm manufacture Heat Treatment instrumentation suitable for use in aerospace and automotive accredited control systems Equipment can be supplied with fully documented SATS calibration to national standards, ensuring that products meet the requirements of the following instrumentation groups from Table 3 **Field Test Instruments** Digital instruments, Electronic data recorders and data acquisition systems **Controlling, Monitoring or Recording Instruments** Digital instruments Electro Mechanical Chart Recorders Instruments meet the sensitivity requirements of note 4 Table 3
Table 4	Resolution Requirements for Furnace Chart Recorders	Table 4 defines the resolution requirements for chart recorders Eurotherm manufacture chart recorders, which meet the resolution requirement Table 4 and associated notes Digital instruments have a readability of 1 degree F or 1 degree C
Table 5	Process Recorder Print and Chart Speeds	Table 5 defines the requirements for chart recorder print speeds Eurotherm digital and paper chart recorders meet the requirements of Table 5 and associated notes for print and chart speeds

Section	Topic	Comment
Table 6	Parts Furnace Class, Instrument Type, and SAT Interval	Table 6 defines for classes of Parts Furnaces the instrumentation type, SATs interval and performance with associated levels of temperature uniformity, accuracy and permitted offset Eurotherm manufacture Field Test Instruments and Controlling, Monitoring or Recording Instruments which meet the requirement of Table 6 and associated notes On site services by Eurotherm and its service channel partners are available on a regional basis to achieve SATs and TUS performance on thermal processing equipment to meet the requirement of Table 6
Table 7	Raw Material Furnace Class, Instrument Type, and SAT Interval	Table 7 defines for classes of Raw Material Furnaces the instrumentation type, SATs interval and performance with associated levels of temperature uniformity, accuracy and permitted offset Eurotherm manufacture Field Test Instruments and Controlling, Monitoring or Recording Instruments which meet the requirement of Table 7 and associated notes On site services by Eurotherm and its service channel partners are available on a regional basis to achieve SATs and TUS performance on thermal processing equipment to meet the requirement of Table 7
Table 8	Parts Furnace Class, Instrument Type, and TUS Interval	Table 8 defines for classes of Parts Furnaces the instrumentation type, TUS interval and performance with associated levels of temperature uniformity, accuracy and permitted offset Eurotherm manufacture Field Test Instruments and Controlling, Monitoring or Recording Instruments, which meet the requirement of Table 8 and associated notes On site services by Eurotherm and its service channel partners are available on a regional basis to achieve SATs and TUS performance on thermal processing equipment to meet the requirement of Table 8
Table 9	Raw Material Furnace Class, Instrument Type, and TUS Interval	Table 9 defines for classes of Raw Material Furnaces the instrumentation type, TUS interval and performance with associated levels of temperature uniformity, accuracy and permitted offset Eurotherm manufacture Field Test Instruments and Controlling, Monitoring or Recording Instruments, which meet the requirement of Table 9 and associated notes On site services by Eurotherm and its service channel partners are available on a regional basis to achieve SATs and TUS performance on thermal processing equipment to meet the requirement of Table 9
Table 10	Permitted Calibration/Test Interval Extension	Table 10 defines the allowable days extension allowed for any Calibration test interval
Table 11	Number of TUS sensors required	Table 11 and associated notes defines the number of TUS sensors required for batch furnaces, salt baths, controlled temperature liquid baths, Fluidised bed furnaces, or continuous furnaces tested by the volumetric method Eurotherm manufacture Field Test Instruments with up to 48 channels of recording Sample rates can be selected with a maximum speed of all channels sampled at 8 times per second ensuring that complete data files are maintained for even the highest level of TUS sensor densities
8.1	Notes	Notes contain a publishers note for locating specific sections of the specification
8.2	Definitions	Definitions includes a useful glossary of words and phrases as defined in ARP1917 and used in AMS2750D

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