AMS 2750 D Revisions

What it means

June 2006

Honeywell

AMS 2750 Spec – What is it?

Honeywell

- **Aerospace Material Specification**
  - **Covers pyrometric requirements for thermal processing equipment**
  - **Used as a basis for the Nadcap certification program**
  - **Covers the following:**
    - Temperature sensors
    - Instrumentation
    - Thermal processing equipment
    - System accuracy tests
    - Temperature uniformity surveys

Why The Interest Now

Honeywell

- **Specification Updated**
  - New Spec - 2750D revised Sept 2005, replaces 2750C
  - Updated to reflect current technology
  - Incorporates requirements when using electronic data
  - Some instrumentation that met 2750C will not meet requirements of 2750D, like older electro-mechanical analog type devices using scale indicators
  - Provides more details on what specific documentation is required for calibration and records
  - Provides more details on Temperature Uniformity Survey Testing (TUS) procedures, furnace repairs and modifications, data collection requirements, survey frequency, number and location of sensors, Pass/Fail requirements
  - Added Corrective Action documentation requirements to the Quality Assurance Provisions

General Update although many requirements have remained the same

Impact & Effective Date

Honeywell

- **Impact**
  - Not all Instruments approved for use in AMS2750C will meet requirements of AMS2750D
  - Generally, the instruments that will not meet the revised AMS2750D specification are the older analog instruments that used scale indicators for reading the process variables and set points.
- **Effective Date**
  - Applies to Control, Monitoring or Recording instruments purchased one year after issue date of AMS2750D (Sept 2006)

AMS 2750D Overview

Honeywell

- **Temperature Sensor - Section 3.1**
  - This section deals with the requirements for the temperature sensors used in these heat treatment processes
  - Details calibration requirements, accuracy, their use as load sensors vs. control sensors and their reuse
- **Instrumentation - Section 3.2**
  - This section deals with the requirements of the instrumentation used in these heat treatment processes
  - Details calibration requirements, frequency and its traceability, temperature resolution, accuracy, instrument records for calibration, electronic data requirements (if used)
- **Thermal Processing Equipment – Section 3.3**
  - This section defines each furnace class (1 – 6) which is based on the minimum requirements for the temperature uniformity
  - Defines the instrumentation types requirements (Type A – F)

AMS 2750D Overview

Honeywell

- **System Accuracy Tests (SAT) – Section 3.4**
  - Defines what equipment requires SAT, the frequency, waiver conditions and the Test Procedure to use

- **Furnace Temperature Uniformity Survey - Section 3.5**
  - Defines the requirements for the Furnace Temperature Uniformity Survey, when they are required, frequency, load conditions, furnace atmosphere, location of TUS sensors
  - Provides examples of Furnace modification that would require a TUS and Furnace Repairs that would not require a TUS
  - Defines the data collection process and requirements

AMS 2750D Overview

Honeywell

- **Laboratory Furnaces - Section 3.6**
  - Provides requirements if a Lab Furnace is being used
- **Records – Section 3.7**
  - Records to be available for inspection & maintained a minimum of 5 years
  - Calibration records to show traceability to NIST or equivalent
- **Quality Assurance Provisions – Section 4.0**
  - Covers responsibilities for inspection - Processor is responsible for performance of all required tests
  - Requires documentation of corrective actions and evaluation of non-conformance

Honeywell Recorders that meet AMS 2750D

Honeywell

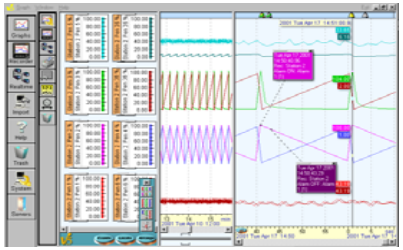
- **Honeywell has Paper and Paperless Recorders that meet AMS 2750D requirements for Controlling, Monitoring and Recording Instruments & Field Test**
  - **Key requirement for Controlling, Monitoring & Recording instruments is a calibrated accuracy of (± 2°F/1.1°C)**
  - **Key requirement for Field Test instruments is a calibrated accuracy of (± 1°F/0.6°C)**

DPR 100C/D

DPR 180

DPR 250

DPR Strip Chart



TrendManager Software

DR4500 Circular Chart

X-Series Paperless

Honeywell UDC Controllers that meet AMS 2750D

Honeywell

- **Honeywell has Controllers that meet AMS 2750D requirements for Controlling, Monitoring and Recording Instruments**
  - **Key requirement for Controlling, Monitoring & Recording instruments is a calibrated accuracy (± 2°F/1.1°C)**

UDC 2500

UDC 3200

UDC 3500

AMS 2750D Instruments

3.2.4 Controlling, Monitoring or Recording Instruments

Honeywell

Requirements for Controlling, Monitoring or Recording Instruments

AMS 2750D Ref.	Requirement	Comment
Readability 3.2.4.1	At least one recording and/or controlling instrument for each zone shall have a minimum readability of 1°F or 1°C	The Honeywell Recorders - X-Series Paperless, DR4500, DPR100C/D, DPR180 & DPR250 recorders & UDC2500, UDC3200 & UDC3500 Controllers have a readability of at least 1°F or 1°C, most read down to 0.1°
Installation 3.2.4.2	Installation shall conform to manufacturer's recommendation	Manuals provide detailed information on proper installation for each product
Offsets 3.2.4.3	If offsets are used, a documented procedure shall exist describing when and how to perform offsets.	The Honeywell Recorders & Controllers allow offsets to be easily entered and shows the offsets as part of the configurations
Signal Inputs 3.2.4.4	Instruments shall receive an unmodified signal from sensors except for A to D and D to A conversions, or a digitally processed, error-checked equivalent representation of a direct measured value.	The Honeywell Recorders & Controllers all accept direct sensor inputs of the T/C listed in Table 2 of AMS 2750D, many of the recorders can accept and document input values over communications

Honeywell Instruments meet the requirements for readability, installation, offsets & signal input

AMS 2750D Instruments
3.2.5 Instrument Calibration

Honeywell

Requirements for Instrument Calibration

AMS 2750D Ref.	Requirement	Comment
Calibration compliance 3.2.5.1	Calibration shall be performed on the instruments in the Instrument Types listed in Table 3 & comply with the Table 3 requirements	The Honeywell Recorders - X-Series Paperless, DR4500, DPR100C/D, DPR180 & DPR250 recorders and UDC2500, UDC3200 & UDC3500 are considered control, monitoring and recording instruments. The recorders can also be used as Field Test instruments for doing Temp Uniformity Surveys
Accuracy & Freq. 3.2.5.2	Calibration accuracy & frequency shall be in accordance with Table 3	The recorders & controllers can meet the 2°F (1.1°C) for Digital Instruments or 2°F (1.1°C) /0.3% of Max Survey Temp for electro-mech. inst.
Calibration Performance 3.2.5.3.1	Calibration shall be to Mfg's instructions or a minimum of 3 simulated sensor inputs at the Min., Midpoint & Max. of the furnace Qualified Operating Temperature Range.	The Honeywell Recorders & Controllers are typically calibrated at the zero and span values for each range. The calibration procedure is documented as part of the product manual.
Calibration Performance 3.2.5.3.2	Calibration may be performed with a load in process if furnace temp remains within the processing tolerance and the record is appropriately annotated to indicated that a calibration occurred.	The Honeywell Recorders - X-Series Paperless and DPR Recorders provide easy annotation of the chart to aid the documentation process.

Honeywell Recorders & Controllers can meet the requirements

AMS 2750D Instruments
3.2.5 Instrument Calibration

Honeywell

Requirements for Instrument Calibration

AMS 2750D Ref.	Requirement	Comment
Calibration Performance 3.2.5.3.3	Calibration shall be performed on each channel or group of channels that can be altered or adjusted.	The Honeywell Recorders & Controllers allow each individual channel to be calibrated
Chart Speed 3.2.5.4	Chart recorder (circular & strip) speed(s) shall be verified annually and shall be accurate within ± 3 minutes per hour	DR4500 – Clock accuracy 32PPM (~1.4 min/mo) DPR100C/D, DPR180 & DPR250 – Clock accuracy – 10PPM (~45sec/mo) X-Series Paperless – 30PPM (~1.3min/mo) – These clock accuracies are @ reference conditions
Sensitivity 3.2.5.5	Sensitivity shall be checked during calibration per Table 3 footnote 4 Class 1 & 2 minimum sensitivity of 1°F (1°C), Classes 3 – 6 a minimum sensitivity of 3°F (2°C),	The sensitivity for these Honeywell recorders & controllers is negligible and is covered by the accuracy specification.

"Sensitivity" is the temperature change in the input that is require to activate a change, either upscale or downscale on the instrumentation. It is normally one-half the numerical value of the dead band, such as a sensitivity of 1°F (0.6°C) is equivalent to a dead band of 2°F (1.1°C).

Honeywell Recorders & Controllers can meet the requirements

AMS 2750D Instruments
3.2.6 Instrumentation Records

Honeywell

Requirements for Documentation of Instrument Calibration

AMS 2750D Ref.	Requirement	Comment
Instrument Sticker 3.2.6.1	A sticker affixed to the instrument shall indicate the most recent successful calibration. As a minimum the sticker shall include: Date Cal performed, Due date of next Calibration, Technician who performed calibration, and any limits or restrictions of the calibration	The user must establish adequate traceability that the instrumentation has been calibrated. The X-Series Paperless Recorder Status Maintenance & Diagnostic screens can provide an aid for doing this.
Calibration Results 3.2.6.2	The results of calibration shall be documented. Minimum requirements: Inst or Furnace No., Make & Model of instrument, Standard used, method of calibration, Required Accuracy, As Found & as Left data for each cal point, Offset as found & as left, Sensitivity, Statement of acceptance or rejection, Any limitations or restriction, Date of Cal, Next Due Date, Technician name, Calibration Co Name (if not done in house, Signature of Calibration Co , Quality Organization approval	The user must establish a report format to satisfy these requirements.

The user must document instrument calibrations

AMS 2750D Instruments
3.2.7 Electronic Records

Honeywell

Requirements for Electronic Data Recording

AMS 2750D Ref.	Requirement	Comment
Electronic Record Definition 3.2.7.1	An electronic record is any combination of text, graphics, data, audio, pictorial or other information representation in digital form that is created, modified, maintained, archived, retrieved, or distributed by a computer system.	
Record Security 3.2.7.1.1	The system must create write-once, read only electronic records that cannot be altered without detection	The X-Series Paperless recorders create encrypted write-once, read only records. Requires TrendManager Software to read data.
Software & Playback 3.2.7.1.2	The system software and playback utilities shall provide a means of examining and/or compiling the record data, but shall not provide any means for altering the source data.	The TrendManager Pro software provides means to import data, review & examine data, export to other spreadsheets and generate graphs and reports. The Software cannot alter the source data.
Review Copies of records 3.2.7.1.3	The system shall provide the ability to generate accurate and complete copies of records in both human readable and electronic form suitable for inspection, review and copying	The TrendManager Pro software can generate graphs and reports of the data. The graphs use the data as received from the recorder for completeness and accuracy. These are in human readable form or readable using TrendManager Software

X-Series Recorders create secure electronic data

AMS 2750D Instruments
3.2.7 Electronic Records

Honeywell

Requirements for Electronic Data Recording

AMS 2750D Ref.	Requirement	Comment
Retention & retrieval 3.2.7.1.4	The system shall support protection, retention, and retrieval of accurate records throughout the record retention period. The hardware and/or software shall operate throughout the retention period as specified in AMS 2750D section 3.7	The TrendManager Software does not alter the source information and supports the protection, retention and retrieval of records. A data base Management Tool provides the means to move, copy and mange the files for storage on secure servers. TrendManger Software is compatible with current PC Operating Systems and can read data from all generations of Trendview Paperless recorders
System Access – (Passwords) 3.2.7.1.5	The system shall provide methods (e.g. passwords) to limit system access to only individuals whose authorization is documented	The X-Series Paperless Recorders provides full password system to comply with 21CFR Part 11. 50 Users with unique ID & Password, time outs, expirations of passwords, password definitions and audit trail info

TrendManager Pro provides secure analysis & archiving of the data

Section 3.3 Thermal Processing Equipment

Honeywell

- **Defines Furnace Classes**
  - Classes based on Temperature Uniformity requirements
  - Classes are Class 1 through 6
  - Uniformity goes from Class 1 (±5°F/3°C) to Class 6 (±50°F/28°C)
- **Defines Instrumentation Types**
  - Instrumentation types based on level of instrumentation used to control, record or indicate the desired temperature
  - Instrumentation Types are Types A through E
  - Defines number of control sensors, load sensors per zone and over-temperature protection
- **Defines frequencies for system accuracy tests (SAT), temperature uniformity surveys (TUS) and instrument calibration**

Key for Honeywell is that this defines how many points to monitor and control

AMS 2750D System Accuracy Tests

3.4.1 System Accuracy Tests

Honeywell

AMS 2750D Ref.	Requirement	Comment
Requirement 3.4.1	SAT shall be performed on the temperature control and recording systems in each control zone of each piece of thermal processing equipment used for production heat treatments SAT's shall also be performed on additional systems that qualify instrumentation as Types A, B, or C	System accuracy checks are required for the controllers and recorders used for production heat treating.
Requirements 3.4.1.1	SAT shall be performed using a test instrument meeting requirements of Table 3 and a test sensor meeting the requirements of Table 1	A test instrument is one used to perform system accuracy tests, temperature uniformity surveys or calibrations of controllers, recorders, data acquisition instruments or monitoring instruments. The Test Instrument calibrated accuracy allowed is ±1°F (0.6°C) or ±0.1% of reading in °F, which ever is greater Based on this requirement Mintitrend QX, Multitrend SX, DPR180, DPR250 and DR4500 could be used as a test instrument, field calibration is typically required to meet this.

Instruments used for System Accuracy tests have a higher accuracy requirement

AMS 2750D System Accuracy Tests

3.4.1 & 3.4.2 System Accuracy Tests

Honeywell

AMS 2750D Ref.	Requirement	Comment
Requirement Sensors 3.4.1.2	An SAT is not required for sensor whose only use is over-temp control, load sensor limited to single use, sensors not used for acceptance as part of production heat treatment or load sensor replacement frequency is shorter than the SAT frequency	There is no exclusion requirement for controlling, recording or monitoring equipment.
Requirements Maintenance 3.4.1.3	A new SAT shall be performed after any maintenance that could affect SAT accuracy Examples include replacement of a thermocouple and recalibration of the instrument when any adjustment has been made.	The X-Series recorders provide T/C Health Maintenance to help avoid unexpected T/C issues and Audit Trail to document changes.
Frequency of SAT's 3.4.2	SAT's shall be performed upon installation and periodically thereafter in accordance with requirements in Table 6 or 7. Frequency is based on equipment class and instrumentation type. The frequency can be reduced one step if allowed and if a preventative maintenance program is in place	The X-Series recorders can help document when the last calibration was done. The recorders can be set up to alarm on difference between control sensor and monitoring sensor as an alert that SAT may be required before it is an issue.

The X-Series Recorders can help monitor if a System Accuracy Test may be required

Section 3.4 System Accuracy Test Procedure

Honeywell

- **Defines Procedure for performing the SAT**
  - Covers comparison of uncorrected temperature indication and corrected temperature indication
  - Provides limitations of using “Resident” Thermocouples
  - Defines what is recorded as system accuracy and application of correction factors
- **Defines Corrective actions if limits are exceeded**
  - Replacement of out of tolerance sensor/lead wire
  - Recalibration of out of tolerance instrument
- **Requires repeating of SAT after corrective action taken**
- **Defines the records required for the system accuracy test report**

Section 3.5 Furnace Temp Uniformity Surveys (TUS)

Honeywell

- **Defines & Details Procedure for performing the TUS**
  - Covers the requirements and criteria for the TUS
  - The requirements for multiple qualified Operating temperature ranges on a single furnace
  - Provides detail of where an initial TUS is required after a repair and where it is not required after a repair
  - Defines initial survey temperatures and periodic survey temps and the required uniformities
  -
- **Defines Furnace Operation criteria during TUS**
  - Load conditions, operational parameters, operating environments (Atm, vacuum levels)
- **Specifies the Location of sensor within the work zone**

Temperature Uniformity is Critical for qualification of the overall system not just the instrumentation

Section 3.5 Furnace Temp Uniformity Surveys (TUS)

Honeywell

- **Defines the Data Collection requirements for the TUS**
  - When data collection starts
  - Frequency of data collection (every 2 min or less but not greater than 6 minutes dependent on the normal production rate)
  - Stabilization requirements for the temperature
  - Alternative methods for Salt baths, Liquid Baths or Fluidized Bed furnaces
  - Data collection for Continuous or Semi-continuous furnaces
- **Criteria for Temp Uniformity Survey Sensors failures**
  - Whether any are allowed and what are the critical positions
- **Specifies Pass/Fail Criteria**
  - Readings must be within limits and run time criteria met

Temperature Uniformity qualifies the furnace

Summary – Questions & Answers

Honeywell

- **Q1. Does the current controlling, recording & monitoring products being used meet the AMS2750D criteria (±2°F/1.1°C)?**

- **A1. The Honeywell Recorders – DR4500, DPR100C/D, DPR180, DPR250, Minitrend QX and Multitrend SX meet the requirements for controlling, recording & Monitoring instruments**
- **The Honeywell Controllers - UDC2500, UDC3200 & UDC3500 meet the requirements for controlling, recording & Monitoring instruments**

- **Q2. Do the recorders meet the requirement (±1°F/0.6°C) for use as Field Test instruments (i.e. survey instruments)?**

- **A2. The Honeywell Recorders – DR4500, DPR100C/D, DPR180, DPR250, Minitrend QX and Multitrend SX meet the requirements for use as Filed Test instruments for doing furnace surveys**

Summary – Questions & Answers

Honeywell

- **Q3. Does the paperless recorders meet the AMS2750D requirements for electronic data and can they be used?**

- **A3. The Minitrend QX and Multitrend SX recorders meet the requirements for electronic recording in these applications**

- **Q4. Are there other issues to be concerned with relative to the instrumentation?**

- **A4. From an Operations standpoint, the user must be concerned with how they use, calibration and document their process, calibrations and surveys but the Honeywell recorders & controllers listed meet the requirements detailed for the instrumentation. In some cases, field calibration is required to achieve the required calibrated accuracy**

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