Temperature Uniformity Survey (TUS) is a vital part of the overall equipment performance and validation that ensures the heat treat/vacuum furnace repeatedly and accurately produces the same quality parts with no variance.

Based upon the furnace class and its specifications, the equipment must hold uniform temperature across all zones at a specified set point and time-period, according to SAE AMS2750F pyrometry standards.

**Temperature Uniformity Survey (TUS)** validation of the equipment is half the battle. In order to demonstrate that the equipment meets the outlined pyrometry standards in SAE AMS2750F, heat treaters must be able to produce accurate records of TUS, instrumentation calibration certificate and thermocouple calibration certificate.

In order to maintain an efficient and effective maintenance program, proper documentation is vital to the overall performance of the equipment.

SAE AMS2750F is the current governing pyrometry specification in the thermal-processing industry. It covers temperature sensors, instrumentation, thermal processing equipment, system accuracy tests and TUS. These are necessary to ensure that parts or raw materials are heat treated in accordance with the applicable specification.

National Aerospace and Defense Contractors Accreditation Program (NADCAP) is the leading worldwide cooperative program designed to manage a cost-effective consensus approach to special processes and products and provide continual improvement within the aerospace industries. The NADCAP program provides accreditation for special processes such as heat treat in the aerospace and defense industry. Many heat treaters are NADCAP accredited and routinely undergo NADCAP audit to maintain a high level of standard and quality.
Application

TUS Instrumentation Requirement

TUS is a test or a series of tests where calibrated field test instrumentation and sensors are used to measure temperature variation within the qualified furnace work zone prior to and after thermal stabilization. A TUS may be performed with an actual production load, a simulated production load, a rack or empty. A TUS recorder must have an accuracy of +/-1°F (+/-0.6°C) and have a minimum readability of 1°F or 1°C.

(SAE AMS2750F 3.2.3 and 3.2.5.2)

TUS Data Collection

TUS data collection shall begin on the recorder before the first sensor reaches the lower tolerance limit of each test set point so that any sensor exceeding the upper temperature set point limit is clearly detected. Once data collection begins, temperature data will be recorded from all other temperature sensors at a frequency of at least once every two minutes for the duration of the survey. At no time shall any sensor exceed the upper limit of the test set point; otherwise, the TUS survey is deemed a failure. The furnace will be held at the test temperature until all test sensors have stabilized. After stabilization, data collection will continue for a minimum of 30 minutes.

(SAE AMS2750F 3.5.13.3)

TUS Report

After TUS data collection is complete, a TUS report must be generated and kept on file for audit and review. TUS report criteria must include items outlined in SAE AMS2750F 3.5.21.

Solution

TUS is time-consuming and tedious. Often times, customers are uncertain whether their furnace passed the test until data collection is complete. If the test fails, customers will have to start the test process from the beginning. The down time can drastically impact production and loss in revenue for the company.

Yokogawa’s SMARTDAC+ GX/GP panel mount and portable data acquisition stations are fully integrated DAQ and display systems with built-in TUS capability to ensure accurate and reliable measurements. In addition, the SMARTDAC+ GX/GP offers a multi-touch panel, which allows intuitive user operation at the touch of a finger.

Fig 1 - Yokogawa TUS software
The SMARTDAC+ GX/GP custom screen option also has built-in TUS capabilities that notify the user immediately through an onscreen alarm notification and audible buzzer if the test is going to fail. This is achieved by allowing the users to enter set point criteria, tolerances and correction factors using the touch screen panel and the system can determine if any of the thermocouple sensors inputs are operating outside of the upper and lower tolerances. Additionally, the system has built-in capability to start the survey timer and ensure that the minimum stabilization period is met.

Once data collection is complete, a report is generated through our TUS software by simply importing the data file from the data acquisition station into the software. Yokogawa’s TUS software meets the rigorous requirement of AMS2750F standards. Combined with Yokogawa’s accurate and reliable data acquisition system, end users can easily perform a TUS. Based on the stability criteria and survey measurement, the software algorithm will automatically determine the survey results and generate a printable report that can be used for audit and data analysis. In addition, software allows users to save multiple profiles to minimize repetitive metadata entries for future surveys.

Yokogawa also provides a calibration certificate for all DAQ station products. The calibration certificate validates the instrument measurement calibration for all supported measurement ranges required by SAE AMS2750F. NIST and ISO 17025 calibration certificates are available. All calibration work is performed in Yokogawa’s Newnan, GA ISO 17025-accredited calibration lab. AMS2750F requires a three-month calibration interval for field test instruments. Equipment can be returned to Yokogawa for this purpose or it can be performed by a local accredited calibration lab.