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Understanding the Performance of Test and Measurement Equipment

With careful selection of test and measurement equipment, the risk of an out-of-tolerance condition affecting production and development processes can be greatly reduced. Making assumptions about an instrument, however, can lead to unpleasant surprises during the next calibration cycle.

Test and measurement equipment play a critical role in most production and development processes. These instruments are used to make decisions regarding the effectiveness of processes and to ensure product quality.

It is no surprise, therefore, that the need for regular calibration of test and measurement equipment is included as part of most major quality standards and are a commonly reviewed area for auditors, whether they are from an internal department, accreditation body, or a regulator such as the FDA. Most quality systems will also define the actions that must be followed in the case of an instrument being found out of specification during a calibration.

What sometimes does not get enough attention is the selection of test equipment to reduce the risk of an out-of-tolerance condition affecting the process.

Choose the Appropriate Instrument for Each Process

There is a fine balance to be considered when selecting equipment. Cost is always an important consideration, but let us look at the other critical issue: appropriateness of the instrument to the process. It is

Peace of Mind from Accredited Calibration

With any calibration measurement, confidence in the results and performance of the measurement instruments is critically important. The lab conducting the calibration must instill a high level of confidence in the end user to ensure trust in the measurement device.

Providing a higher level of confidence to the user can be established by using laboratories that are accredited to ISO/IEC 17025, the principal quality standard for testing and calibration laboratories. Laboratories attaining accreditation are audited by an impartial third party to verify that they are technologically competent to carry out the calibration within the laboratory's scope of accreditation.

Accreditation enforces that all the requirements of the ISO/IEC 17025 standard are met. Requirements ranging from proficiency testing, traceability to an international standard and established uncertainties for all measurement parameters to a fully documented quality and management system are assessed annually.

The ISO/IEC 17025 accreditation requires bi-annual assessments covering the entire checklist of the standard. In the interim year, the accredited laboratory must submit an internal assessment to the full checklist of the ISO/IEC 17025, along with a proficiency testing or inter-laboratory comparison, and internal audit results.

critical that the instrument selected meet the measurement requirements of the process, not only on the day it is delivered new, but also for the time period between calibrations.

Even with perfect care, all measurement instruments are prone to drift over time. Unfortunately, from a process view this means there is always some risk that instruments currently in use are actually out of specification. To mitigate this risk, calibration intervals are assigned based on manufacturer specifications, process requirements, equipment history, and acceptable risk requirements.

In most cases the manufacturer's specifications are weighted heaviest when determining the suitability of equipment for a process. It can be difficult to properly determine an instrument's expected long-term performance because all of its specifications must be looked at to gain proper insight into its performance.

Understand Instrument Performance – Every Environment Is Different

When selecting a test or measurement instrument, it is insufficient to look solely at the instrument's accuracy. That value usually does not account for long-term (or one year) drift of the instrument and it may only be

applicable to a narrow operating environment. Not properly understanding the performance of an instrument will lead to unpleasant surprises during the next calibration cycle.

Some instrument types and applications tend to be easier to define than others. A high-end digital multimeter used in a laboratory setting can be relatively straightforward. Many manufacturers will state 24-hour, one-week, one-month, and one-year accuracies as well as provide guidance about the effect of temperature on the readings. The behavior of these types of equipment is well known and, in the grand scheme of metrology, relatively predictable.

On the other end of the spectrum are instruments such as relative humidity meters. These are used in such a wide variety of operating conditions and environments that it is difficult for manufacturers to specify the right instruments for every application. Every environment is different and could have a different effect on the sensors.

Gather All the Information

When looking at specifications, always check to see if all the factors are included in the stated accuracy. Many times the stated accuracy is only valid for a specific temperature range, or it may not include the calibration uncertainty, or perhaps the long-term drift is not included.

It is important to take a careful look at what is and is not being included in an accuracy specification. If it does not explicitly say that long-term drift is included in the accuracy, it likely is not and must be taken into account separately.

The end-user needs to be aware of the requirements of their processes and how the reference equipment will support them. It is critical to gather all the information regarding an instrument before approving it for a process. The repercussions of not knowing are typically far more expensive than the initial effort.