

# CALIBRATION BASICS AND BEST PRACTICES

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WHITEPAPER



## Calibration Basics and Best Practices

Calibration is essential to improving a company's bottom line by minimizing the risk of product defects and recalls and enhancing a reputation for consistent quality.

Calibration, in its most basic form, is the measuring of an instrument against a standard. As instruments become more complicated, successfully identifying and applying best practices can reduce business expenses and improve organizational capabilities.

The following explains the basic concepts and best practices with respect to calibration and describes how these actions can ensure product quality, increase efficiency, decrease turnaround time and reduce costs.

### What is Calibration?

Calibration is the comparison of a measurement device (an unknown) against an equal or better standard. A standard in a measurement is considered the reference. Calibration reveals how far the unknown is from the standard.

A typical commercial calibration uses the manufacturer's calibration procedure and is performed with a reference standard at least four times more accurate than the instrument under test.

### Why Calibrate?

Calibration is crucial because out-of-tolerance (OOT) instruments may give false information leading to unreliable products, customer dissatisfaction and increased warranty costs. In addition, OOT conditions may cause good products to fail tests, which ultimately results in unnecessary rework costs and production delays.

### Calibration Terms

- "As found" data — The reading of the instrument before it is adjusted.
- "As left" data — The reading of the instrument after adjustment or "same as found," if no adjustment was made.
- Optimization — Adjusting a measuring instrument to make it more accurate is NOT part of a typical calibration and is frequently referred to as "optimizing" or "nominalizing" an instrument.
- Out-of-tolerance (OOT) condition — When an instrument's performance is outside its specifications, it is considered out-of-tolerance, resulting in the need to adjust the instrument back into specification.
- Limited calibration — It may be more cost effective to have a limited calibration when only certain functions of an instrument are utilized by the user.

- Test uncertainty ratio (TUR) — This is the ratio of the accuracy of the instrument under test compared to the accuracy of the reference standard.
- Without data — Most calibration labs charge more to provide the certificate with data and will offer a "no-data", or "pass-fail" option.



## Quality Management Systems and Accreditation

Calibration is the key to quality control. In order to meet calibration standards, a good quality system needs to be in place.

Standards for quality management systems and accredited calibration are set by the International Organization for Standardization (ISO). ISO 9001:2008 certification provides assurance that a company's quality management systems and processes ensure the consistent delivery of quality products and services. Adherence to ISO 9001:2008 requires:

- Comprehensive equipment list — To pass an ISO audit, the company must demonstrate that it has a comprehensive equipment list with controls in place for additions, subtractions and custodianship of equipment.
- Calibrated and "no calibration required" items properly identified — The equipment list must identify any units that do not require calibration, and controls must be in place to ensure that these units are not used in an application that will require calibration.
- Documented calibration procedures — The valid calibration procedure is based on the manufacturer's recommendations and covers all aspects of the instrument under test.
- Equipment custodianship — There is an assignment of responsibility for ensuring equipment is returned to the calibration lab.
- An OOT investigation log — For any instrument found OOT, an investigation must be performed and recorded.
- Proper documentation — All critical aspects of the calibration must be properly documented for the certificate to be recognized by an ISO auditor.
- Proper calibration schedule — A procedure should be established that includes timeframes for scheduling calibration, an escalation procedure and provisions for due-date extensions.

- Traceable assets — In the United States, the calibration provider must be able to demonstrate an unbroken chain of traceability back to National Institute of Standards and Technology (NIST).
- Trained technicians — The proper training of each technician must be documented for each discipline involved in performing the calibration.

### Accredited Calibration

ISO/IEC 17025 accredited calibrations are required in many heavily regulated industries. An ISO/IEC 17025 calibration is a premium option that provides additional information about the quality of each measurement made during the calibration process by individually stating the uncertainty calculation of each test point.

### NIST Traceability

The National Institute of Standards and Technology (NIST) is a non-regulatory federal agency within the U.S. Commerce Department's Technology Administration. Most calibrations done in the United States must be traceable to NIST standards.

### Calibration Program Best Practices

Any successful calibration program must begin with an accurate calibration schedule for test, measurement and diagnostic equipment.

- The calibration schedule should contain:
  - A unique identifier that can be used to track the instrument, its location and the instrument's custodian.
  - Modules, plug-ins and small handheld tools along with any "home-made" measuring devices (e.g., test fixtures).
- Identify all of the instruments on the calibration schedule that may not require calibration.
- After creating an accurate calibration schedule:
  - Procedures must be established for adding new instruments, removing old or disposed instruments, or making changes in instrument custodianship.
  - Calibration schedules should be run with sufficient time for both the end user and the service provider to have the unit calibrated with minimal impact on production.
- A late report identifying any units about to expire or already expired will ensure 100 percent conformity, which can be supplied by a full-service calibration laboratory along with special escalation reporting.
- For efficiency, companies should consider a web-based application to manage calibration schedules, late reports and calibration certificates. CalWeb®, web-based calibration management application from Tektronix, is available to all calibration customers.

### Determining Calibration Intervals

Calibration intervals are determined by the instrument "owner" based on the manufacturer's recommendations. The original equipment manufacturer intervals are typically based on parameters like mean drift rates for the various components within the instrument. However, when determining calibration intervals as an instrument "owner," several other factors should be taken into consideration such as:

- The required accuracy vs. the instrument's accuracy.
- The impact of an OOT event.
- The performance history of the particular instrument in its application

### Avoiding Production Delays

The following steps can help companies obtain timely equipment calibrations to avoid costly downtime:

- Look for a calibration service provider that can perform onsite calibrations, especially if 20 or more instruments are being calibrated.
- Use a single-source calibration provider that has sufficient capabilities to calibrate nearly all of the equipment during the onsite visit.
- Consider additional options, including:
  - Calibrations during shutdowns.
  - Mobile calibration lab services.
  - Scheduled service center calibrations.
  - Scheduled pick-up and delivery.
  - Weekend or night calibrations.

### Outsourcing Calibration

Most companies discover they cannot effectively perform their own calibrations for many reasons. The most frequent issues with performing their own internal calibrations are:

- Cost of standards — Assets with the required accuracy to perform the calibration can be costly.
- Developing procedures — Many manufacturers' calibration procedures are not readily available, requiring research and development that can take hundreds of hours of labor.
- Productivity of technicians — A non-commercial calibration laboratory's productivity per employee is only a fraction of that of an external commercial calibration laboratory's.
- Cost of management — Managing the employees, assets, maintenance and processes of a calibration laboratory can be burdensome for existing staff.
- Not a core competency — The management burden of a calibration operation can distract from a company's core competencies.

## ABOUT TEKTRONIX

Tektronix is the world's leading provider of multi-brand commercial calibration, repair and related services of test, measurement and control equipment. Delivering unparalleled capabilities and unmatched quality allows Tektronix to provide calibration services for more than 140,000 different instruments from 9,000-plus manufacturers—far more than just Tektronix.

Tektronix provides superior quality with 181 ISO/IEC 17025 accreditation parameters and has an extensive global service network that encompasses 100-plus locations with more than 1,100 experienced associates.

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### For Further Information

Tektronix maintains a comprehensive, constantly expanding collection of application notes, technical briefs and other resources to help engineers working on the cutting edge of technology. Please visit [www.tek.com](http://www.tek.com)



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