



# Calibration Basics and Best Practices

White Paper

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Individuals who view calibration as a necessary evil are not taking into account the bigger picture. Calibration is essential to improving a company's bottom line, by minimizing risk to 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 with respect to calibration and best practices and how these actions may 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; it is the one in the comparison taken to be the more correct of the two. Calibration finds out 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 can be an insurance policy 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 an out-of-tolerance (OOT) condition, 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 not 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" option.



## Calibration Quality Management Systems

Calibration is the key to quality control. In order to meet calibration standards, a good quality system needs to be in place. Here are some of the requirements:

ISO 9001:2008 Calibration (International Organization for Standardization) - This type of calibration is crucial for many industries and has the following requirements (in alphabetical order):

- Accredited calibration lab—The calibration laboratory must be ISO 9001:2008 accredited or be the original equipment manufacturer.
- Comprehensive equipment list—To pass the 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 recall system—A procedure should be established that includes timeframes for recall notification, an escalation procedure and provisions for due-date extension.

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- **Traceable assets**—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.

ISO IEC 17025 Calibration - As a general rule, ISO IEC 17025 calibrations are required by companies supplying the automotive industry, and it has also been voluntarily adopted by numerous industries that are regulated by the Food and Drug Administration. A 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 Traceable Calibration (National Institute of Standards and Technology) - NIST is a non-regulatory federal agency within the U.S. Commerce Department's Technology Administration. NIST develops and promotes measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life.

## Calibration Program Best Practices

Any successful calibration program must begin with an accurate recall list of test, measurement and diagnostic equipment.

- The recall list should contain:
  - a unique identifier that can be used to track the instrument, the 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 recall list that may not require calibration.
- After creating an accurate recall list:
  - procedures must be established for adding new instruments, removing old or disposed instruments, or making changes in instrument custodianship.
  - recall reports 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 equipment management system for recall and late reports and electronic versions of calibration certificates.

## Determining Calibration Intervals

Calibration intervals are determined by the instrument "owner" based on the manufacturer's recommendations. The OEM's (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 an OOT will have on processes and,
- the performance history of the particular instrument in its application.

## Avoiding Production Delays

The following steps can help companies obtain timely equipment calibrations without shutting down a line for days:

- Look for a calibration service provider that can perform on-site calibrations, especially if 20 or more calibrations are being performed.
- Use a single-source calibration provider that has sufficient capabilities to calibrate nearly all of the equipment during the on-site visit.
- Consider additional options, including:
  - calibrations during shutdowns,
  - mobile calibration lab services,
  - scheduled depot calibrations,
  - scheduled pick-up and delivery and,
  - weekend or night calibrations.

## Calibration, Maybe Not a Do-It-Yourself Operation

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 manufacturer's 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.

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## About Tektronix Service Solutions

Tektronix Service Solutions is the world's leading single-source provider of calibration, repair and related services for companies with test, measurement and control. Value is the company's commitment to every client through unparalleled capabilities, custom-tailored solutions and innovative technology focused on addressing three critical deliverables: ensuring quality, lowering costs and creating competitive advantage.

Tektronix Service Solutions has calibration and repair capabilities for more than 130,000 products from 9,000-plus manufacturers. The company 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 1,000 experienced associates.

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### For Further Information

Tektronix service solutions 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 [service-solutions.tektronix.com](http://service-solutions.tektronix.com)



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