

# CALLAB

THE INTERNATIONAL JOURNAL OF METROLOGY



**Metrology 101: How Connector Quality Impacts Measurement Precision**

**Risks and Limitations of a Three-Point Calibration Program in the Regulated Industry**

**Welcoming New Calibration Technicians the Right Way**

2025  
OCTOBER  
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DECEMBER

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**ON THE COVER:** Leadership and expertise come together as Laboratory Director Sean Jaimerena and Lead Technician Elias Sandoval prepare a liquid nitrogen comparison apparatus for SPRT calibrations. Their work demonstrates Micro Quality Calibration's commitment to excellence in precision temperature metrology in Cypress, California.

# CALENDAR

## UPCOMING CONFERENCES & MEETINGS

The following event dates are subject to change. Visit the event URL provided for the latest information.

**Jan 18-21, 2026 106th ARFTG Microwave Measurement Symposium.** “Microwave Measurements for Communication and Sensing Technologies” is co-located with Radio & Wireless Week (RWW-2026). <https://arftg.org/106-conference/>

**Feb 2-5, 2026 MSC Training Symposium.** Garden Grove, CA. Come join us for 100+ hours of classroom training and networking for metrology professionals and newcomers alike. <https://msc-conf.com/>

**Mar 2-5, 2026 NCSLI Technical Exchange.** Albuquerque, NM. Get ready for four dynamic days where the calibration, test & measurement, and metrology community comes together in Albuquerque. <https://ncsli.org/mpage/TE2026>

**Mar 23-27, 2026 IMEKO TC3, TC5, TC16, TC20, TC22 Joint Conference & the 3rd International Conference on Dynamic Measurement.** This international conference aims to convene experts from both the industrial and academic domains, addressing a diverse range of topics

from the fields of “Measurement of Force, Mass, Torque, and Gravity” (IMEKO TC3), “Hardness Measurement” (IMEKO TC5), “Pressure and Vacuum Measurement” (IMEKO TC16), “Measurements of Energy and Related Quantities” (IMEKO TC20) and “Vibration Measurement” (IMEKO TC22). Hangzhou, China. <https://conferences.imeko.org/event/14/>

**Apr 12-15, 2026 ANNCAN.** Nashville, TN. The A2LA Annual Conference is the ultimate opportunity for accreditation professionals to meet face-to-face, learn new skills, and collaborate on topics associated with the accreditation industry. [https://a2la.org/annual\\_conference/](https://a2la.org/annual_conference/)

**Apr 21-23, 2026 ASMEA Flow Measurement Workshop.** Abu Dhabi, UAE. Over three days, this technical conference will cover common measurement topics such as the importance of measurement, measurement uncertainty and real-world application with ample opportunities for networking and learning. <https://www.tuvsud.com/en-gb/events/asmea-flow-measurement-workshop>

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**That's a Wrap!**

As I wrap up this last issue of the year, we're also looking forward to a couple of training events quickly coming up in 2026. Just recently, I loaded up the Google calendar with six months of in-person training events, online seminars, and industry-related meetings and conferences. That calendar is accessible by going to our website: [callabmag.com/calendar](http://callabmag.com/calendar). And if you're looking for self-paced training, apart from those on the calendar, we keep a list on our website--from the main menu, hover on Metrology Related, then click on Online & Independent Study.

In response to the Apr-Jun 2025 Editor's Desk, where I expressed concern over the removal of the Atomic Spectroscopy Group from NIST (National Institute of Standards and Technology), a couple readers felt another similar issue warranted some attention as well. Dr. DeWerd and Dr. Khan responded with their own concerns regarding the dearth of funding for the Radiation Physics Division at NIST and the direct impacts to life-saving medical treatments. Their response is included in a special Letters to the Editor on the following page. Besides the important medical impacts, they also underscore the vital service of standards provided by NIST in the US. I encourage everyone to read Dr. DeWerd and Dr. Khan's response.

For this issue's feature articles, Betty Wang contributed a Metrology 101 article on the importance of differentiating and using quality banana plugs, titled "How Connector Quality Impacts Measurement Precision."

Next up, Ricardo Vilmenay examines the problem of the three-point calibration scheme in "Risks and Limitations of a Three-Point Calibration Program in the Regulated Industry," along with a possible alternative.

Finally, Joseph Rindone answered my request to follow-up on a chain of discussion on LinkedIn with his contribution, "Welcoming New Calibration Technicians the Right Way." Joseph is also scheming a recurring series of articles for the less experienced calibration technician, so stay tuned!

If you think someone would enjoy their own print copy of the magazine, you can sign them up or have them sign up on our website. QR codes can be found in this issue on page 29.

Happy Measuring,

Sita Schwartz



## LETTERS TO THE EDITOR

To the Editors Desk,

We read with interest your editorial on the NIST Atomic Spectroscopy Group in the APR – JUN 2025 issue of *CAL LAB: International Journal of Metrology*. We felt the need to respond on a crucial aspect of another division of NIST.

NIST in the US was established in 1901. Prior to its establishment there were many quantities without standards for measurement. For example, there were 8 volumes for the gallon, meaning that your gallon of milk would be a different volume although it cost the same. NIST was termed the National Bureau of Standards (NBS) when it was established. Presently, at NIST ionizing radiation division, there is a serious lagging of standards establishment due to lack of personnel to perform the measurements. The ionizing radiation division has seen a large decrease in personnel in the past 10 years. This division is responsible for establishing standards for physical quantities used in the treatment of cancer and diagnostic imaging to assess exposures. NIST first met its overwhelming backlog by establishing secondary laboratories. One such laboratory has been described by DeWerd and Khan [1].

We are writing to express our deep concern regarding the declining capacity of NIST's Radiation Physics Division to maintain and develop essential medical standards in radiation measurement. These standards are critical for ensuring accurate diagnosis and effective treatment of patients across the United States. Lest there be any misunderstanding, this is not a criticism to the Radiation Physics Division but in the financial support provided to the group.

The Radiation Physics Division, within NIST's Physical Measurement Laboratory, is responsible for establishing, maintaining, and disseminating national standards for ionizing radiation and radioactivity. However, the Division has been chronically underfunded for years. As staff members have retired or moved on, their positions have not been filled, leading to a steady erosion of expertise and capacity. This loss of personnel is already causing delays, gaps, and missed opportunities in the development and maintenance of critical standards, with direct consequences for patient care. The University of Wisconsin Medical Radiation Research Center has attempted to aid NIST as much as it can. An example of this activity resulted in the mammography standard for Molybdenum anode

beams. The FDA has since approved the use of tungsten anodes with other filters such as Ag. The FDA approves other devices to keep up with manufacturer developments; however, they have not insisted on standards before approval. This could result in a significant problem if there is not accuracy. An example of this is in the use of  $^{103}\text{Pd}$  seeds for prostate treatments [2]. It would be wise to prevent repeating this history.

Below are key examples illustrating the seriousness of the situation:

- **Mammography Standards:** NIST developed molybdenum anode beam standards in 1996. Since then, clinical practice has shifted to tungsten anode systems with different filtration, e.g. Ag, Rh. A new standard was nearly ready when the calibrator specialist left NIST, taking early retirement. Thus, the calibration of current mammography systems is uncertain. There is the question if women are receiving the correct exposure for their mammography exam because there is no standard from the Radiation Physics Division at NIST.
- **Brachytherapy Standards:** There is no official NIST standard for the  $^{192}\text{Ir}$  source used in prostate cancer treatment and other treatments. A standard had to be developed at the University of Wisconsin out of necessity. NIST only recently restored its ability to calibrate low-dose brachytherapy seeds after a year-long interruption.
- **Electronic Brachytherapy Standards:** NIST had provided national calibration for electronic brachytherapy sources (miniature x-ray units used in cancer treatment). A new device has been instituted and has been at NIST prior to COVID, but NIST has not had the personnel to establish the standard. The x-ray source is being used with an interpolated value. Clinics now lack a trusted U.S. reference standard to verify patient doses.
- **Ocular Melanoma Treatment Devices:** Eye plaque therapy devices need a national standard before they can be safely brought to market; however, because manufacturers have problems obtaining the standard, devices have been introduced without a standard. The University of Wisconsin developed

## LETTERS TO THE EDITOR

extrapolation devices and transferred them to NIST but implementing them has been delayed due to staffing shortages.

- Radiobiology & Pre-Clinical Research: As research in cancer treatment, space medicine, and radiological emergency preparedness increasingly relies on x-ray sources and new radionuclide sources, there is an urgent need for new reference beam qualities. Currently, none exists.
- Radiopharmaceutical Dosimetry: This expanding field lacks a standard for absorbed dose to tumors. Without such a standard, both the efficacy and safety of these treatments remain uncertain.

The stakes for medical patient treatments are exceptionally high. In cancer treatment, underdosing allows the disease to progress, overdosing risks severe harm to healthy tissues. Without a robust

Radiation Physics Division providing needed standards, the United States risks falling behind international peers, undermining the accuracy and safety of medical procedures, and compromising patient outcomes.

Sincerely,

LA DeWerd and A U Khan

- [1] L. A DeWerd and A. U. Khan, Accredited Calibration Laboratories for Medical Radiation, *CAL LAB: The International Journal of Metrology*, pp. 24-27 Jan-Feb-Mar 2025
- [2] Williamson JF, Butler W, DeWerd LA, et al. Recommendations of the American Association of Physicists in Medicine regarding the Impact of Implementing the 2004 Task Group 43 Report on Dose Specification for and Interstitial Brachytherapy. *Med Phys.* 2005;32(5):1424-1439. doi:10.1118/1.1884925

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# CALENDAR

**May 17-20, 2026 FLOMEKO.** Nara, Japan. IMEKO TC9 20th International Flow Measurement Conference is recognized as one of the most important international conferences in the field of flow measurement by researchers worldwide. It brings together experts from all over the world to present advances in flow measurements and related areas. <https://flomeko2026.sice.jp/>

**May 25-28, 2026 I<sup>2</sup>MTC.** Nancy, France. The IEEE International Instrumentation and Measurement Technology Conference (I2MTC) focuses on all aspects of instrumentation and measurement science and technology research development and applications. <https://i2mtc2026.ieee-ims.org/>

**Jun 7-12, 2026 IMS.** Boston, MA. The IEEE International Microwave Symposium (IMS) is the world's foremost conference covering the UHF, RF, wireless, microwave, millimeter-wave, terahertz, and optical frequencies; encompassing everything from basic technologies to components to systems including the latest RFIC, MIC, MEMS and filter technologies, advances in CAD, modeling, EM simulation and more. <https://ims-ieee.org/>

**Jun 8-11, 2026 European Test and Telemetry Conference.** Nürnberg, Germany. As a premier event in the test and telemetry field, ETTC brings together leading experts from the aeronautics, space, automotive, and defense industries. <https://telemetry-europe.org/>

**Jun 9-10, 2026 CEESI Ultrasonic Meter User's Conference.** San Antonio, TX. The CEESI USM Conference provides an opportunity for ultrasonic meter manufacturers and end users to discuss challenges in the hydrocarbon measurement industry. <https://www.ceesi.com/Ultrasonic2026>

**Jun 9-10, 2026 ITG/GMA Conference: Sensors and Measuring Systems.** Nürnberg, Germany. The "Sensors and Measurement Systems" conference, first held in 1982, is now the most important German-language scientific event in the field of sensor technology. The conference focuses on sensors and sensor systems for industrial use. <https://sensoren2026.de/>

**Jun 9-11, 2026 SENSOR+TEST.** Nürnberg, Germany. SENSOR+TEST is the world's leading forum for sensor, measurement and testing technology. <https://www.sensor-test.de/>

**Jul 20-24, 2026 CMSC.** Dallas, TX. The Coordinate Metrology Society Conference (CMSC) is the world's premier event for Measurement Technology Professionals sponsored by the Coordinate Metrology Society. <https://www.cmssc.org/>

## SEMINARS & WEBINARS: Dimensional

**Jan 8-9, 2026 Virtual Hands-On ISO Gage Calibration & Repair Training.** IICT Enterprises. Enhance your career knowledge in Metrology with this in-depth Gage use, Calibration, and Repair course. Recommended for people interested in pursuing the ASQ CCT Exam. <https://calibrationtraining.com/calibration-metrology-training-events/>

**Jan 12, 2026 1-Day Virtual ISO Gage Calibration & Repair Training.** IICT Enterprises. Enhance your career knowledge in Metrology with this in-depth Gage use, Calibration, and Repair course. Recommended for people interested in pursuing the ASQ CCT Exam. <https://calibrationtraining.com/calibration-metrology-training-events/>

**Jan 13-14, 2026 Quality 101 Foundational Concepts Class.** Minneapolis, MN and Milwaukee, WI. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Jan 15-16, 2026 ISO Hands-On Gage Calibration & Repair Training.** Bloomington, MN. IICT Enterprises. Enhance your career knowledge in Metrology with this in-depth Gage use, Calibration, and Repair course. Recommended for people interested in pursuing the ASQ CCT Exam. <https://calibrationtraining.com/calibration-metrology-training-events/>

**Jan 27, 2026 1-Day Virtual ISO Gage Calibration & Repair Training.** IICT Enterprises. Enhance your career knowledge in Metrology with this in-depth Gage use, Calibration, and Repair course. Recommended for people interested in pursuing the ASQ CCT Exam. <https://calibrationtraining.com/calibration-metrology-training-events/>

**Jan 28-29, 2026 EDU-113: Dimensional Gage Calibration.** Aurora, IL. Mitutoyo. This Dimensional Gage Calibration course covers the most common dimensional calibrations, and will also address the essential elements, policies, and requirements of a modern gage calibration system. <https://www.mitutoyo.com/training-education/>

**Feb 10-11, 2026 Dimensional Measurement Tools Basics Class.** Oshkosh, WI. QC Training. This program provides a fundamental and practical review of Basic Dimensional Measurement Tools and Methods, including variable gages such as steel rules, depth and dial gages, micrometers, and calipers. In addition, attribute gages such as plug, ring and screw thread gages are covered. <https://qctraininginc.com/course/course-basic-dimensional-measurement-tools/>

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**Feb 11, 2026 EDU-V111: Introduction to Dimensional Gage Calibration.** Virtual or Online Training. Mitutoyo. This 1/2 day Dimensional Gage Calibration course covers the most common dimensional calibrations, and will also address the essential elements, policies, and requirements of a modern gage calibration system. <https://www.mitutoyo.com/training-education/>

**Feb 24-26, 2026 EDU-114: Dimensional Gage Calibration and Repair.** Aurora, IL. Mitutoyo. Mitutoyo America's Gage Calibration course is a unique, active, educational experience designed specifically for those who plan and perform calibrations of dimensional measuring tools, gages, and instruments. <https://www.mitutoyo.com/training-education/>

**Mar 4-5, 2026 Dimensional Measurement Tools Basics Class.** Mason, OH. QC Training. This program provides a fundamental and practical review of Basic Dimensional Measurement Tools and Methods, including variable gages such as steel rules, depth and dial gages, micrometers, and calipers. In addition, attribute gages such as plug, ring and screw thread gages are covered. <https://qctraininginc.com/course/course-basic-dimensional-measurement-tools/>

**Mar 18-19, 2026 ISO Hands-On Calibration & Repair Training.** Denison, TX. IICT Enterprises. Enhance your career knowledge in Metrology with this in-depth Gage use, Calibration, and Repair course. Recommended for people interested in pursuing the ASQ CCT Exam. <https://calibrationtraining.com/calibration-metrology-training-events/>

**Mar 24-26, 2026 EDU-105: Introduction to Dimensional Metrology Hand Tools V.** Aurora, IL. Mitutoyo. EDU-105 is a three-day class for entry-level team members who need to learn the fundamentals of the steel rule, caliper, micrometer, pin gage, gage block, surface plate, height gage, indicator and stands, angle block, v-block, sine bar, depth gages, telescoping gages, holtest gages, bore gages, and thread gages. <https://www.mitutoyo.com/training-education/>

**Mar 30-31, 2026 Dimensional Measurement Tools Basics Class.** Chicago, IL. QC Training. This program provides a fundamental and practical review of Basic Dimensional Measurement Tools and Methods, including variable gages such as steel rules, depth and dial gages, micrometers, and calipers. In addition, attribute gages such as plug, ring and screw thread gages are covered. <https://qctraininginc.com/course/course-basic-dimensional-measurement-tools/>

**May 13-14, 2026 Dimensional Measurement.** Melbourne VIC, Australia. NMI. This two-day course (9 am to 5 pm) presents a comprehensive overview of the fundamental principles in dimensional metrology and

geometric dimensioning and tolerancing. <https://shop.measurement.gov.au/>

**May 13-14, 2026 Surface Roughness, Texture, and Tribology.** Livonia, MI. Michigan Metrology. Looking to expand your knowledge of surface texture? The annual, 2-day class is a great opportunity to learn both fundamental and advanced surface texture analysis and tribology. <https://michmet.com/classes/#liveclasses>

## SEMINARS & WEBINARS: Electrical

**Mar 2-5, 2026 MET-101 Basic Hands-On Metrology Course.** Everett, WA. Fluke Calibration. This Metrology 101 basic metrology training course introduces the student to basic measurement concepts, basic electronics related to measurement instruments and math used in calibration. <https://www.fluke.com/en-us/product/calibration-tools/electrical-calibration/training-met-101>

**May 6-7, 2026 Electrical Measurement.** Lindfield, NSW. Australian NMI. This course provides in-depth knowledge of the theory and practice of electrical measurement using digital multimeters and calibrators; special attention is given to important practical issues such as grounding, interference and thermal effects. The course is most suitable for those already familiar with electrical measurements using digital multimeters and calibrators, as well as with the estimation of measurement uncertainty, wishing to further advance their knowledge and skills. <https://shop.measurement.gov.au/collections/physical-metrology-training>

**May 8, 2026 High-Voltage Test and Measurement.** Lindfield, NSW. Australian NMI. This one-day workshop provides hands-on experience and practical techniques involved in performing high-voltage tests and measurements, and explains how to make such tests and measurements in accordance to relevant international and Australian standards. <https://shop.measurement.gov.au/collections/physical-metrology-training>

**Apr 13-16, 2026 MET-301 Advanced Hands-On Metrology.** Everett, WA. Fluke Calibration. This course introduces the student to advanced measurement concepts and math used in standards laboratories. <https://www.fluke.com/en-us/product/calibration-tools/electrical-calibration/training-met-301>

**May 6-7, 2026 Electrical Measurement.** Lindfield NSW, Australia. NMI. This course provides in-depth knowledge of the theory and practice of electrical measurement using digital multimeters and calibrators; special attention is given to important practical issues such as grounding, interference and thermal effects. <https://shop.measurement.gov.au/>

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## SEMINARS & WEBINARS: Flow

**Jan 26-29, 2026 Gas Flow Calibration Using molbloc/molbox.** Phoenix, AZ. Fluke Calibration. Gas Flow Calibration Using molbloc/molbox is a four day training course in the operation and maintenance of a Fluke

Calibration molbloc/molbox system. <https://www.fluke.com/en-us/product/calibration-tools/flow-calibration/training-trnflwbas>

**Mar 23-26, 2026 Gas Flow Calibration Using molbloc/molbox.** Phoenix, AZ. Fluke Calibration. Gas Flow Calibration Using molbloc/molbox is a four day training course in the operation and maintenance of a Fluke Calibration molbloc/molbox system. <https://www.fluke.com/en-us/learn/online-courses/flow-calibration>

## SEMINARS & WEBINARS: General

**Apr 20-24, 2026 Fundamentals of Metrology.** Gaithersburg, MD. NIST. The 5-day Fundamentals of Metrology seminar is an intensive course that introduces participants to the concepts of measurement systems, units, good laboratory practices, data integrity, measurement uncertainty, measurement assurance, traceability, basic statistics and how they fit into a laboratory Quality Management System. <https://www.nist.gov/pml/owm/owm-training-and-events>

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# CALENDAR

**Apr 20-22, 2026 C-101 Calibration.** Memphis, TN. TriNova Technical Education. This instructor led calibration course is delivered by our experienced technical education specialists who deliver a high-quality course covering calibration fundamentals, detailed documentation procedures, temperature, and pressure basics, and basics of DP flow calibration. In-depth demonstrations and hands-on exercises will follow each lecture. <https://trinova.arlo.co/w/>

**May 12-14, 2026 C-101 Calibration.** Mobile, AL. TriNova Technical Education. This instructor led calibration course is delivered by our experienced technical education specialists who deliver a high-quality course covering calibration fundamentals, detailed documentation procedures, temperature, and pressure basics, and basics of DP flow calibration. In-depth demonstrations and hands-on exercises will follow each lecture. <https://trinova.arlo.co/w/>

**Jun 18, 2026 2062 Documenting Traceability and Calibration Intervals.** Online or Virtual Training. NIST. This 2-hour webinar covers the essential elements of metrological traceability and the documentary evidence required to support traceability and calibration intervals. <https://www.nist.gov/pml/owm/owm-products-and-services/training-classes-and-events>

**Jun 22-24, 2026 C-101 Calibration.** Mobile, AL. TriNova Technical Education. This instructor led calibration course is delivered by our experienced technical education specialists who deliver a high-quality course covering calibration fundamentals, detailed documentation procedures, temperature, and pressure basics, and basics of DP flow calibration. In-depth demonstrations and hands-on exercises will follow each lecture. <https://trinova.arlo.co/w/>

## SEMINARS & WEBINARS: Industry Standards

**Jan 20-21, 2026 Auditing Your Lab to ISO/IEC 17025:2017. Virtual or Online Training.** A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. The participant will learn about auditing principles and develop skills for performing higher-value internal audits. The course includes hands-on exercises for planning, establishing, implementing, and maintaining an audit program, and also focuses on developing auditing methods, questioning techniques, and record sampling. <https://a2lawpt.org/courses/>

**Feb 2-3, 2026 Understanding ISO/IEC 17025:2017 for Testing & Calibration Labs.** Frederick, MD. A2LA WorkPlace Training. This course is a comprehensive review of the philosophies and requirements of ISO/IEC 17025:2017. <https://a2lawpt.org/courses/>

**Feb 3-4, 2026 3004 Understanding ISO/IEC 17025 for Testing and Calibration Labs.** Virtual or Online Training. IAS. Online schedule for the Americas. This 2-day Training Course applies to testing and calibration laboratories and regulatory agencies seeking to specify 17025 within their policies and regulations. <https://www.iasonline.org/training/ias-training-schedule/>

**Feb 4-5, 2026 Auditing Your Laboratory to ISO/IEC 17025:2017.** Frederick, MD. A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. <https://a2lawpt.org/courses/>

**Feb 10-13, 2026 Understanding ISO/IEC 17025:2017 for Testing & Calibration Labs.** Virtual or Online Training. A2LA WorkPlace Training. This course is a comprehensive review of the philosophies and requirements of ISO/IEC 17025:2017. [https://a2lawpt.org/courses](https://a2lawpt.org/courses/)

**Feb 17-20, 2026 Auditing Your Lab to ISO/IEC 17025:2017.** Virtual or Online Training. A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. <https://a2lawpt.org/courses/>

**Feb 24-25, 2026 Understanding the Requirements and Concepts of ISO/IEC 17025:2017.** Virtual or Online Training. ANAB. Understand requirements of ISO/IEC 17025:2017, including general, structural, resource, process, and management system requirements. Learn practical concepts, such as impartiality, documents control, ensuring validity of results and risk management. Gain an understanding of an ISO/IEC 17025:2017 laboratory management system. <https://anab.ansi.org/training/>

**Feb 24-26, 2026 Internal Auditing to ISO/IEC 17025:2017 (Non-Forensic).** Virtual or Online Training. ANAB. This training is designed for laboratory managers, technical staff, and others who want or need to learn better audit practices. Attendees will learn how to coordinate a quality management system audit to ISO/IEC 17025:2017 and collect audit evidence and document observations, including techniques for effective questioning and listening. <https://anab.ansi.org/training/>

**Mar 2-3, 2026 3004 Understanding ISO/IEC 17025 for Testing and Calibration Labs (Spanish).** Virtual or Online Training. IAS. Online schedule for the Americas. This 2-day Training Course applies to testing and calibration laboratories and regulatory agencies seeking to specify 17025 within their policies and regulations. <https://www.iasonline.org/training/ias-training-schedule/>

# Metrology Engineer Standardizes on Vitrek 4700 for HV Measurement Accuracy & Traceability

## About Ken Sams, Metrology & QC Engineer

Ken works for a leading global electrical insulation test equipment provider serving a wide range of industries including high power cable applications. The company provides critical electrical insulation measurement products, from insulation testers to dielectric breakdown testers. Ken's responsibility includes both internal quality and field service.

## Challenge

Achieve high voltage measurement during production testing and calibration procedures, including specialized testing. In these challenging testing environments, even the smallest measurement errors can cost time and money and damage brand credibility.

Most standard digital multimeters (DMMs) only support up to 1,000 V DC or AC. Above that, technicians traditionally resorted to voltage dividers, which complicate measurements by introducing impedance concerns, divider inaccuracies and cumbersome non-linearity tables. Resistive and capacitive dividers often require reference tables and external computation to ensure traceable accuracy — introducing room for human error and slowing workflow.

## Solution: The Vitrek 4700

Vitrek's 4700 system stores the calibration data in the probe itself. The customer preferred the solution enough to install four Vitrek 4700 Precision High Voltage Meters and four high-voltage HVL-series Smart Probes™ (HVL-100 and HVL-150) for daily use by production and repair teams.

The robust Vitrek 4700 solves the limitations of standard multimeters and dividers:

- **Direct  $\pm 0.03\%$  accuracy:** from low voltage to 10,000 V
- **Probe intelligence:** HV Smart Probes™ extend measurement up to 140 kV DC
- **Frequency Bandwidth:** accurate down to 0.1 Hz
- **Ease of use:** intuitive color touch screen with AC/DC info and chart mode
- **Portability:** lightweight, compact and field ready (optional battery pack)
- **Automation Ready:** integrates via Ethernet, RS-232, or GPIB

## Benefits & Results

Initially, adoption of the Vitrek 4700 faced resistance from veteran technicians familiar with divider-based workflows. However, after seeing the benefits — easy, intuitive interface, real-time crest factor display, built-in frequency readouts — they now rely on the 4700. The unit's compact size makes it ideal for the company's field techs, who can travel with it as carry-on luggage for critical service calls involving test systems up to 140 kV.



*"The Vitrek 4700 has direct measurement capabilities that are higher than most other metering solutions at the accuracy we need." — Ken Sams, Metrology & QC Engineer*

### • Higher efficiency and accuracy with probes

Traditional probes like the Fluke 80K-40 assume fixed divider ratios (e.g., 10,000:1), but those are only approximations. Vitrek's HVL probes record and communicate their exact calibration ratio directly to the 4700. This "plug and play" innovation significantly improves measurement accuracy, simplifies set up and reduces operator workload. For our customer, this feature was particularly valuable for servicing insulation testers and cable fault equipment — two product categories with output voltages ranging from 25 kV to 140 kV.

### • Low-frequency and niche application measurement

The customer's equipment includes low-frequency (VLF) devices operating at 0.1 Hz. However, typical DMMs are not specified at such frequencies. Their engineers wrote scripts to simulate waveform readings by averaging DC samples — a tedious, non-traceable workaround. With the Vitrek 4700, this process is replaced by direct, spec-rated measurements, dramatically improving efficiency and audit compliance.

### • Portability and ease-of-use

The 4700's user interface simplifies operations for technicians. Features such as real-time crest factor display, simultaneous AC/DC readout, and frequency measurement have also reduced reliance on manual calculations. As a result, accuracy, consistency, and technician satisfaction have all improved.

### • Calibration and support

The customer sends all units back to Vitrek's ISO 17025 certified calibration lab for annual calibration. Vitrek's turnaround time and support consistently meet the company's industrial lab's expectations. The 4700 HV meters have become so essential to the company that work is scheduled around these annual calibration visits.

View the full article at:  
<https://visit.vitrek.com/CALB2510>

**VITREK**

815.838.0005  
[info@vitrek.com](mailto:info@vitrek.com)

# CALENDAR

**Mar 3-5, 2026 Internal Audit Intensive Workshop.** Virtual or Online Training. ANAB/ANSI. The internal audit intensive training course is an opportunity to burnish your internal auditing skills. Take advantage of the opportunity to engage with an instructor at this training course. <https://anab.ansi.org/training/>

**Mar 10-11, 2026 Understanding ISO/IEC 17025:2017 for Testing & Calibration Labs.** Virtual or Online Training. A2LA WorkPlace Training. This course is a comprehensive review of the philosophies and requirements of ISO/IEC 17025:2017. <https://a2lawpt.org/courses>

**Mar 12-13, 2026 3004 Understanding ISO/IEC 17025 for Testing and Calibration Labs.** Virtual or Online Training. IAS. Online schedule for the Middle East, India, and South Asia. This 2-day Training Course applies to testing and calibration laboratories and regulatory agencies seeking to specify 17025 within their policies and regulations. <https://www.iasonline.org/training/ias-training-schedule/>

**Mar 17-18, 2026 Auditing Your Laboratory to ISO/IEC 17025:2017.** Virtual or Online Training. A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. The participant will learn about auditing principles and develop skills for performing higher-value internal audits. The course includes hands-on exercises for planning, establishing, implementing, and maintaining an audit program, and also focuses on developing auditing methods, questioning techniques, and record sampling. <https://a2lawpt.org/courses>

**Apr 14-15, 2026 3004 Understanding ISO/IEC 17025 for Testing and Calibration Labs.** Virtual or Online Training. IAS. Online schedule for the Americas. This 2-day Training Course applies to testing and calibration laboratories and regulatory agencies seeking to specify 17025 within their policies and regulations. <https://www.iasonline.org/training/ias-training-schedule/>

**Apr 21-22, 2026 Understanding the Requirements and Concepts of ISO/IEC 17025:2017.** Virtual or Online Training. ANAB. Understand requirements of ISO/IEC 17025:2017, including general, structural, resource, process, and management system requirements. Learn practical concepts, such as impartiality, documents control, ensuring validity of results and risk management. Gain an understanding of an ISO/IEC 17025:2017 laboratory management system. <https://anab.ansi.org/training/>

**Apr 21-23, 2026 Internal Auditing to ISO/IEC 17025:2017 (Non-Forensic).** Virtual or Online Training. ANAB. This training is designed for laboratory managers, technical

staff, and others who want or need to learn better audit practices. Attendees of Auditing to ISO/IEC 17025 training course will learn how to coordinate a quality management system audit to ISO/IEC 17025:2017 and collect audit evidence and document observations, including techniques for effective questioning and listening. <https://anab.ansi.org/training/>

**Apr 21-23, 2026 Understanding ISO/IEC 17025:2017 for Testing & Calibration Labs.** Virtual or Online Training. A2LA WorkPlace Training. This course is a comprehensive review of the philosophies and requirements of ISO/IEC 17025:2017. <https://a2lawpt.org/courses>

**Apr 28-30, 2026 Auditing Your Laboratory to ISO/IEC 17025:2017.** Virtual or Online Training. A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. The participant will learn about auditing principles and develop skills for performing higher-value internal audits. <https://a2lawpt.org/courses/>

**May 5-6, 2026 3004 Understanding ISO/IEC 17025 for Testing and Calibration Labs.** Virtual or Online Training. IAS. Online schedule for the Middle-East, India, and South Asia. This 2-day Training Course applies to testing and calibration laboratories and regulatory agencies seeking to specify 17025 within their policies and regulations. <https://www.iasonline.org/training/ias-training-schedule/>

**May 11-12, 2026 Understanding ISO/IEC 17025:2017 for Testing & Calibration Labs.** Frederick, MD. A2LA WorkPlace Training. This course is a comprehensive review of the philosophies and requirements of ISO/IEC 17025:2017. <https://a2lawpt.org/courses>

**May 13-14, 2026 Auditing Your Laboratory to ISO/IEC 17025:2017.** Frederick, MD. A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. The participant will learn about auditing principles and develop skills for performing higher-value internal audits. The course includes hands-on exercises for planning, establishing, implementing, and maintaining an audit program, and also focuses on developing auditing methods, questioning techniques, and record sampling. <https://a2lawpt.org/courses/>

**Jun 9-10, 2026 Understanding the Requirements and Concepts of ISO/IEC 17025:2017.** Virtual or Online Training. ANAB. Understand requirements of ISO/IEC 17025:2017, including general, structural, resource, process, and management system requirements. Learn

# CALENDAR

practical concepts, such as impartiality, documents control, ensuring validity of results and risk management. Gain an understanding of an ISO/IEC 17025:2017 laboratory management system. <https://anab.ansi.org/training/>

**Jun 9-11, 2026 Internal Auditing to ISO/IEC 17025:2017 (Non-Forensic).** Virtual or Online Training. ANAB. This training is designed for laboratory managers, technical staff, and others who want or need to learn better audit practices. Attendees of Auditing to ISO/IEC 17025 training course will learn how to coordinate a quality management system audit to ISO/IEC 17025:2017 and collect audit evidence and document observations, including techniques for effective questioning and listening. <https://anab.ansi.org/training/>

**Jun 9-12, 2026 Understanding ISO/IEC 17025:2017 for Testing & Calibration Labs.** Virtual or Online Training. This course is a comprehensive review of the philosophies and requirements of ISO/IEC 17025:2017. <https://a2lawpt.org/courses/>

**Jun 23-26, 2026 Auditing Your Laboratory to ISO/IEC 17025:2017.** Online or Virtual Event. A2LA WorkPlace Training. This ISO/IEC 17025 auditor training course will introduce participants to ISO 19011, the guideline for auditing management systems as applied to ISO/IEC 17025:2017. The participant will learn about auditing principles and develop skills for performing higher-value internal audits. The course includes hands-on exercises for planning, establishing, implementing, and maintaining an audit program. <https://a2lawpt.org/event/auditing-your-laboratory-to-iso-iec-170252017-8/>

## SEMINARS & WEBINARS: Lab Management

**Feb 12, 2026 2058 Document Control and Record Keeping.** Online Webinar Training. NIST. This 2-hour webinar will introduce the fundamentals of Laboratory Management System Document Control and Record Keeping that are necessary to successfully implement ISO/IEC 17025:2017. <https://www.nist.gov/news-events/events/2026/02/2058-document-control-and-record-keeping>

## High Voltage CALIBRATION LAB

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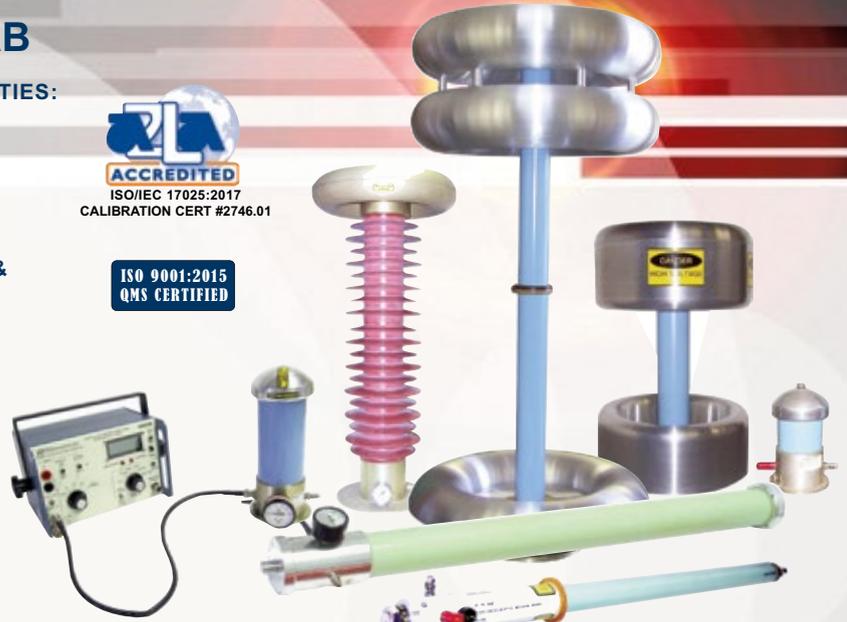
**HV CALIBRATION LAB CAPABILITIES:**

- UP TO 450kV PEAK 60Hz
- UP TO 400kV DC
- UP TO 400kV 1.2x50µs LIGHTNING IMPULSE

**DESIGN, MANUFACTURE, TEST & CALIBRATE:**

- HV VOLTAGE DIVIDERS
- HV PROBES
- HV RELAYS
- HV AC & DC HIPOTS
- HV DIGITAL VOLTMETERS
- HV CONTACTORS
- HV CIRCUIT BREAKERS
- HV RESISTIVE LOADS
- SPARK GAPS
- FIBER OPTIC SYSTEMS

**HV LAB CALIBRATION STANDARDS**  
ISO/IEC 17025:2017 ACCREDITED  
ANSI/NCSLI Z540-1-1994 ACCREDITED  
ISO 9001:2015 QMS CERTIFIED  
N.I.S.T. TRACEABILITY  
N.R.C. TRACEABILITY



**High Voltage Dividers & Probes**

# ROSS ENGINEERING CORPORATION

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info@rossengineeringcorp.com | www.rossengineeringcorp.com

# CALENDAR

## SEMINARS & WEBINARS: Mass

**Mar 2-13, 2026 Mass Metrology Seminar.** Gaithersburg, MD. NIST. The Mass Metrology Seminar is a two-week, "hands-on" seminar. It incorporates approximately 30 percent lectures and 70 percent demonstrations and laboratory work in which the trainee performs measurements by applying procedures and equations discussed in the classroom. <https://www.nist.gov/pml/owm/owm-training-and-events>

## SEMINARS & WEBINARS: Measurement Uncertainty

**Jan 21-22, 2026 Introduction to Measurement Uncertainty.** Virtual or Online Training. A2LA WorkPlace Training. This course is a suitable introduction for both calibration and testing laboratory participants, focusing on the mathematics, basic statistics, key concepts, and approaches of the measurement uncertainty evaluation process. The participant will gain an understanding of the statistical techniques required to estimate measurement uncertainty and will practice those skills to create basic uncertainty budgets (calculator). This course is designed for personnel working in calibration, metrology, testing, or other measurement fields. <https://a2lawpt.org/courses/>

**Feb 17-18, 2026 Measurement Confidence: Fundamentals.** Online or Virtual Training. ANAB. This Measurement Confidence course introduces the foundational concepts of measurement traceability, measurement assurance, and measurement uncertainty and details ISO/IEC 17025 and ISO/IEC 17020 requirements. <https://anab.ansi.org/training/>

**Feb 19-20, 2026 Measurement Uncertainty: Practical Applications.** Virtual or Online Training. ANAB. This course reviews the basic concepts and accreditation requirements associated with measurement traceability, measurement assurance, and measurement uncertainty as well as their interrelationships. <https://anab.ansi.org/training/>

**Feb 26-27, 2026 Applied Measurement Uncertainty for Calibration Laboratories.** Virtual or Online Training. A2LA WorkPlace Training. During this course, the participant will be introduced to several tools and techniques that can be applied in the calibration laboratory environment to efficiently and effectively create measurement uncertainty budgets that comply with ISO/IEC 17025 requirements. <https://a2lawpt.org/courses/>

**Mar 18-19, 2026 Introduction to Measurement Uncertainty.** Virtual or Online Training. A2LA WorkPlace Training. This course is a suitable introduction for both calibration and testing laboratory participants, focusing on the

mathematics, basic statistics, key concepts, and approaches of the measurement uncertainty evaluation process. The participant will gain an understanding of the statistical techniques required to estimate measurement uncertainty and will practice those skills to create basic uncertainty budgets (calculator). This course is designed for personnel working in calibration, metrology, testing, or other measurement fields. <https://a2lawpt.org/courses>

**Apr 1-2, 2026 3006 Uncertainty of Measurement for Labs.** Virtual or Online Training. IAS. Scheduled online for Middle-East, India, and South Asia. Evaluation and Estimation of Uncertainties of Measurement. Introduction to metrology principles, examples and practical exercises. <https://www.iasonline.org/training/ias-training-schedule/>

**Apr 14-15, 2026 Measurement Confidence: Fundamentals.** Virtual or Online Training. ANAB. This Measurement Confidence course introduces the foundational concepts of measurement traceability, measurement assurance, and measurement uncertainty and details ISO/IEC 17025 and ISO/IEC 17020 requirements. <https://anab.ansi.org/training/>

**Apr 16-17, 2026 Measurement Uncertainty: Practical Applications.** Virtual or Online Training. ANAB. This course reviews the basic concepts and accreditation requirements associated with measurement traceability, measurement assurance, and measurement uncertainty as well as their interrelationships. <https://anab.ansi.org/training/>

**May 12, 2026 Introduction to Measurement Uncertainty.** Frederick, MD. A2LA WorkPlace Training. This course is a suitable introduction for both calibration and testing laboratory participants, focusing on the mathematics, basic statistics, key concepts, and approaches of the measurement uncertainty evaluation process. The participant will gain an understanding of the statistical techniques required to estimate measurement uncertainty and will practice those skills to create basic uncertainty budgets (calculator). This course is designed for personnel working in calibration, metrology, testing, or other measurement fields. <https://a2lawpt.org/courses>

**May 13-14, 2026 Applied Measurement Uncertainty for Calibration Laboratories.** Virtual or Online Training. During this course, the participant will be introduced to several tools and techniques that can be applied in the calibration laboratory environment to efficiently and effectively create measurement uncertainty budgets that comply with ISO/IEC 17025 requirements. <https://a2lawpt.org/courses/>

**May 28, 2026 2059 Basic Uncertainty Concepts.** Virtual or Online Event. NIST. This 2-hour webinar provides a very basic introduction to uncertainty calculations and reporting

# CALENDAR

using the 8-step process published in NIST SOP 29 (NISTIR 6969), beginning with some definitions and concepts from the Guide to the Expression of Uncertainty in Measurement (GUM) and includes some simple calculations. <https://www.nist.gov/news-events/events/2026/05/2059-basic-uncertainty-concepts>

**Jun 2-3, 2026 Introduction to Measurement Uncertainty.** Virtual or Online Training. A2LA WorkPlace Training. This course is a suitable introduction for both calibration and testing laboratory participants, focusing on the mathematics, basic statistics, key concepts, and approaches of the measurement uncertainty evaluation process. The participant will gain an understanding of the statistical techniques required to estimate measurement uncertainty and will practice those skills to create basic uncertainty budgets. This course is designed for personnel working in calibration, metrology, testing, or other measurement fields. <https://a2lawpt.org/courses/>

**Jun 2-3, 2026 Measurement Confidence: Fundamentals.** Virtual or Online Training. This Measurement Confidence

course introduces the foundational concepts of measurement traceability, measurement assurance, and measurement uncertainty and details ISO/IEC 17025 and ISO/IEC 17020 requirements. <https://anab.ansi.org/training/measurement-confidence-fundamentals/>

**Jun 4-5, 2026 Measurement Uncertainty: Practical Applications.** Online or Virtual Training. ANAB. This course reviews the basic concepts and accreditation requirements associated with measurement traceability, measurement assurance, and measurement uncertainty as well as their interrelationships. <https://anab.ansi.org/training/measurement-uncertainty-practical-applications/>

**Jun 23-25, 2026 Applied Measurement Uncertainty for Testing Laboratories.** Online or Virtual Training. A2LA WorkPlace Training. During this workshop, the participant will be introduced to several tools and techniques that can be applied in the testing laboratory environment to efficiently and effectively create measurement uncertainty budgets that comply with ISO/IEC 17025 requirements. <https://a2lawpt.org/courses/>



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# CALENDAR

## SEMINARS & WEBINARS: Pressure

**Mar 9-13, 2026 Principles of Pressure Calibration.** Phoenix, AZ. Fluke Calibration. A five-day training course on the principles and practices of pressure calibration using digital pressure calibrators and piston gauges (pressure balances). <https://www.fluke.com/en-us/product/calibration-tools/pressure-calibration/training-trnprsbas>

**Apr 13-17, 2026 TWB 1061 Principles of Pressure Calibration Web-Based Training.** Fluke Calibration. This is a short form of the regular five-day in-person Principles of Pressure Calibration class. This online class is held for 2-hour sessions each day. <https://www.fluke.com/en-us/product/calibration-tools/pressure-calibration/training-tw-1061>

**Apr 20-24, 2026 Advanced Piston Gauge Metrology.** Phoenix, AZ. Fluke Calibration. Focus is on the theory, use and calibration of piston gauges and dead weight testers. <https://www.fluke.com/en-us/product/calibration-tools/pressure-calibration/training-trnprsadv>

**Jun 17-18, 2026 Pressure Measurement.** Port Melbourne VIC, Australia. NMI. This two-day course (9 am to 5 pm each day) covers essential knowledge of the calibration and use of a wide range of pressure measuring instruments, their principles of operation and potential sources of error – it incorporates extensive hands-on practical exercises. <https://shop.measurement.gov.au/>

## SEMINARS & WEBINARS: Quality

**Jan 13-14, 2026 Quality 101 Foundational Concepts Class.** Minneapolis, MN. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Jan 14, 2026 Quality 101 Foundational Concepts Class.** Milwaukee, WI. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Jan 20-23, 2026 Quality 101 Foundational Concepts Class.** Virtual. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with

statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Feb 17-18, 2026 Quality 101 Foundational Concepts Class.** Greer, SC. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Mar 10-13, 2026 Quality 101 Foundational Concepts Class.** Virtual. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Mar 24-25, 2026 Quality 101 Foundational Concepts Class.** Mason, OH. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Mar 24-25, 2026 Quality 101 Foundational Concepts Class.** Milwaukee, WI. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

**Mar 24-25, 2026 Quality 101 Foundational Concepts Class.** Minneapolis, MN. QC Training. This program provides a fundamental and practical overview of quality, the evolution of quality systems, and their applications. Problem solving tools and root cause analysis, along with statistics are discussed. <https://qctraininginc.com/course/quality-101-foundational-concepts/>

## SEMINARS & WEBINARS: Software

**Feb 9-13, 2026 TWB 1031 MET/CAL® Procedure Development Web-Based Training.** Fluke Calibration. Learn to create procedures with the latest version of MET/CAL, without leaving your office. The workshop is presented as a five-part, ten-hour course with each two-hour session scheduled on consecutive days, typically from 10:00 am to 12:00 pm (Noon) Pacific Standard Time (Everett, WA USA). <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-tw-1031>

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**Feb 23-27, 2026 TWB 1051 MET/TEAM® Basic Web-Based Training.** Fluke Calibration. This web-based course presents an overview of how to use MET/TEAM® Test Equipment and Asset Management Software in an Internet browser to develop your asset management system. This course is typically held from 10:00 am to 12:00 pm (Noon) Pacific Standard Time. <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-tw-1051>

**Mar 16-20, 2026 TWB 1071 Crystal Reports Web-Based Training.** Online or Virtual Training. Fluke Calibration. This course is designed for those who are involved with modifying or writing custom reports for use with MET/TEAM. The duration of this online class is 5 days, 2-hour sessions each day. <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-tw-1071>

**Mar 23-27, 2026 MC-206 Basic MET/CAL® Procedure Writing.** Everett, WA. Fluke Calibration. In this five-day Basic MET/CAL® Procedure Writing course, you will learn to configure MET/CAL® software to create, edit, and maintain calibration solutions, projects and procedures. <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-mc-206>

**Mar 30-Apr 3, 2026 MC-205 MET/TEAM® Asset Management.** Everett, WA. Fluke Calibration. This five-day course presents a comprehensive overview of how to use MET/TEAM® Test Equipment and Asset Management Software in an Internet browser to develop your asset management system. <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-mc-205>

**Apr 21-23, 2026 VNA Tools Training Course.** Beaverton, OR. METAS. VNA Tools is a free software developed by METAS for measurements with the Vector Network Analyzer (VNA). The software facilitates the tasks of evaluating measurement uncertainty in compliance with the ISO-GUM and justifying metrological traceability. The software is available for download at [www.metas.ch/vnatools](http://www.metas.ch/vnatools). The three day course provides a practical and hands-on lesson with this superior and versatile software. [https://www.metas.ch/metas/en/home/dl/kurs\\_uebersicht/vna\\_training\\_usa\\_26.html](https://www.metas.ch/metas/en/home/dl/kurs_uebersicht/vna_training_usa_26.html)

**May 4-8, 2026 MC-206 Basic MET/CAL® Procedure Writing.** Everett, WA. Fluke Calibration. In this five-day Basic MET/CAL® Procedure Writing course, you will learn to configure MET/CAL® software to create, edit, and maintain calibration solutions, projects and procedures. <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-mc-206>

**May 5-8, 2026 VNA Tools Training Course + VNA Expert Day.** Bern-Waburn, Switzerland. METAS. VNA Tools is a free software developed by METAS for measurements with the Vector Network Analyzer (VNA). The software facilitates the tasks of evaluating measurement uncertainty in compliance with the ISO-GUM and justifying metrological traceability. The software is available for download at [www.metas.ch/vnatools](http://www.metas.ch/vnatools). The three day course provides a practical and hands-on lesson with this superior and versatile software. [https://www.metas.ch/metas/en/home/dl/kurs\\_uebersicht/vna\\_training\\_spring\\_26.html](https://www.metas.ch/metas/en/home/dl/kurs_uebersicht/vna_training_spring_26.html)

**May 11-15, 2026 TWB 1051 MET/TEAM® Basic Web-Based Training.** Virtual or Online Training. Fluke Calibration. This web-based course presents an overview of how to use MET/TEAM® Test Equipment and Asset Management Software in an Internet browser to develop your asset management system. This course is typically held from 10:00 am to 12:00 pm (Noon) Pacific Standard Time. <https://www.fluke.com/en-us/product/fluke-software/fluke-calibration-software/training-tw-1051>

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## SEMINARS & WEBINARS: Validation & Verification

**Feb 5, 2026 Validation and Verification of Analytical Methods.** Virtual or Online Training. This course provides an introduction to validation and verification of analytical methods and ISO/IEC 17025 & ISO/IEC 17020 requirements. <https://anab.ansi.org/training/validation-verification-analytical-methods/>

**May 27, 2026 Validation and Verification of Analytical Methods.** Virtual or Online Training. This course provides an introduction to validation and verification of analytical methods and ISO/IEC 17025 & ISO/IEC 17020 requirements. <https://anab.ansi.org/training/validation-verification-analytical-methods/>

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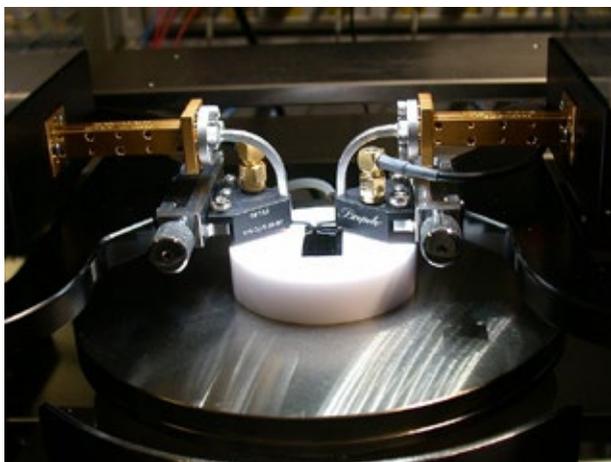
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# TECHNICAL EXCHANGE



PTB's on-wafer measurement setup for characterizing planar high-frequency circuits up to 330 GHz. The feeding waveguides are shown, on which ends the substrate to be measured is contacted by measuring tips. Credit: PTB

## On-Wafer Metrology for High-Frequency Circuits

PTB-News 3.2025 – To date, it has not been possible to compare on-wafer measurements because the measuring equipment and laboratory conditions significantly differ from each other and there have not been any reference substrates. The first international measurement comparison has now taken place. PTB has confirmed its high-frequency calibration capabilities on reference substrates and has developed the world's first complete measurement uncertainty budget of up to 330 GHz.

Precise on-wafer scattering parameter measurements are an indispensable tool for developing and characterizing semiconductor wafers for new high-frequency technologies, which are used in next-generation wireless communication systems (6G), radar sensors (e.g., 77/120-GHz automotive radar), the Internet of Things (IoT) and automated driving.

National metrology institutes such as PTB and NPL (UK), renowned research institutes and universities as well as leading measuring instrument manufacturers were involved in this first comparison measurement. At the University of Lille, a set of identical reference substrates made of highly resistive silicon wafers was manufactured specifically for the comparison, and the participants each received a specimen. Apart from various calibration standards, the reference substrates contained different measuring standards and verification standards, e.g., attenuators, offset shorts and mismatched transmission lines. The coverage of the extremely wide measurement frequency range from 10 GHz to 1.1 THz was reached by using a total of six waveguide frequency band extensions of the respective vector network analyzer, which differ in terms of the manufacturer, the measurement tips and their pitch size. Despite these differences, the measurement

comparison showed a generally good agreement of results from the participants. The measurement results in the upper waveguide frequency band up to 1 THz were within a tolerance band of  $\pm 2.5$  dB, both for an attenuator and for a mismatched transmission line.

The measurement uncertainty budget established by PTB as part of the comparison takes into account instrument influences such as noise, non-linearity and drift of the applied vector network analyzer, influences of cable movements, contact repeatability as well as the uncertainty contribution caused by crosstalk between measurement ports.

PTB's expertise in the field of on-wafer scattering parameter metrology is the result of continuous research carried out for example by participating in various EU research projects with the objective of metrological traceability of on-wafer measurements. PTB's work has now led to the world's first and, to date, only database entry of the measurement capabilities (CMCs) in the BIPM key comparison database up to 118 GHz and to the issuance of the world's first calibration certificate for commercial calibration substrates. In the years to come, PTB will enhance its on-wafer measurement capabilities by procuring a broadband measurement setup up to at least 220 GHz with temperature variation from  $-40$  °C to 200 °C.

### Contact

Gia Ngoc Phung, Department 2.2, High Frequency and Electromagnetic Fields, Phone: +49 531 592-2226, [gia.phung\(at\)ptb.de](mailto:gia.phung(at)ptb.de)

### Scientific publication

F. Mubarak et al.: An interlaboratory comparison of on-wafer S-parameter measurements up to 1.1 THz. *IEEE Trans. Terahertz Sci. Technol.* (2025), DOI: 10.1109/TTHZ.2025.3537461

### European metrology research

More information on the Onmicro project: <https://www.ptb.de/epm2023/onmicro/home>

Source: <https://www.ptb.de/cms/en/presseaktuelles/journals-magazines/ptb-news.html>

## The NMI-Q Initiative – Accelerating the Development and Adoption of Quantum Technologies Through Trusted Measurements

*The metrology institutes of the G7 countries and Australia establish a network for joint quantum research*

PTB Quantum Technology News, 10/16/2025 – The national metrology institutes (NMIs) of the G7 countries and Australia announce the signing of a memorandum of understanding (MoU) for the creation of NMI-Q. This initiative is aimed at coordinating development and sharing of measurement best practices in support of

future standardization. NMI-Q aspires to lead metrology activities in an agile and responsive manner to foster innovation and keep pace with rapidly evolving quantum technologies. The eight signatory members include Australia (NMIA), Canada (NRC), France (LNE), Germany (PTB), Italy (INRiM), Japan (NMIJ), the United Kingdom (NPL), and the United States (NIST). This agreement was signed in Paris, at the LNE premises, on Wednesday 15th October 2025.

### **A common framework for developing best practices and international standards**

Supported by heads of states and governments at the G7 Leaders' Summit in June 2025 in Canada, the signing of this MoU recognizes the need for international collaboration between governments for harnessing the full potential of quantum technologies. NMI-Q establishes a framework bringing together national metrology institutes in order to advance the measurement and testing work essential to the development of international standards for quantum technologies.

### **A key driver for innovation**

The signing of this MoU comes at a time when many quantum technologies are in the early stages of development. These technologies are now finding applications in computing, sensing and communication, impacting multiple sectors such as manufacturing, health, energy, materials, and logistics. Working with industry and academia, NMI-Q aims to ensure that these technologies are based on reliable, comparable and objective measurement data and specifications, in order to serve and promote the public interest by fostering innovation, commercialization and societal impact.

### **NMI-Q objectives**

NMI-Q will accelerate the development and adoption of quantum technologies through coordinated development and sharing of measurement best practices in support of future standardization.

**Author:** Imke Frischmuth

**Source:** <https://www.ptb.de/cms/en/research-development/ptbs-innovation-clusters/innovationscluster-tech/quantum-technology-news.html>

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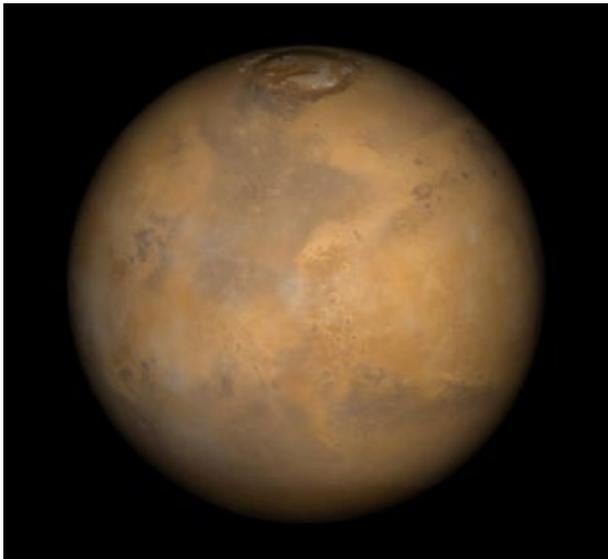
## What Time Is It on Mars? NIST Physicists Have the Answer.

NIST News, December 1, 2025 – Ask someone on Earth for the time and they can give you an exact answer, thanks to our planet’s intricate timekeeping system, built with atomic clocks, GPS satellites and high-speed telecommunications networks.

However, Einstein showed us that clocks don’t tick at the same rate across the universe. Clocks will run slightly faster or slower depending on the strength of gravity in their environment, making it tricky to synchronize our watches here on Earth, let alone across the vast solar system. If humans want to establish a long-term presence on the red planet, scientists need to know: What time is it on Mars?

Physicists at the National Institute of Standards and Technology (NIST) have calculated a precise answer for the first time. On average, clocks on Mars will tick 477 microseconds (millionths of a second) faster than on Earth per day. However, Mars’ eccentric orbit and the gravity from its celestial neighbors can increase or decrease this amount by as much as 226 microseconds a day over the course of the Martian year. These findings, just published in *The Astronomical Journal*, follow a 2024 paper in which NIST physicists developed a plan for precise timekeeping on the Moon.

Knowing how clocks will tick on Mars is a steppingstone for future space missions, said NIST physicist Bijunath Patla. As NASA plans Mars exploration missions, understanding



This image from the Mars Global Surveyor Mars Orbiter Camera shows the region Ares Vallis and the Chryse Plains, where both early Mars missions, Mars Pathfinder and the Viking 1, landed in 1997 and 1976, respectively. As scientists plan for future Mars missions, they need to understand how time passes on Mars to better synchronize communications with rovers on the red planet. Credit: NASA/JPL/MSSS

time on our planetary neighbor will help synchronize navigation and communication across our solar system.

“The time is just right for the Moon and Mars,” Patla said. “This is the closest we have been to realizing the science fiction vision of expanding across the solar system.”

### Mars Time Zone

Martian days and years are longer than those on Earth. The planet’s day, or full rotation on its axis, is 40 minutes longer than Earth’s, and it takes 687 days to complete its orbit around the Sun, compared with Earth’s 365 days. But scientists needed to know how fast or slow each second passes on Mars compared with Earth.

If you were to land on the surface of Mars with an atomic clock, it would still tick the same way it would on Earth. But if you compare the Mars clock with one on Earth, they will be out of sync. The challenge is to determine how much Mars’ time is offset from Earth’s, almost like calculating a time-zone difference.

That was much trickier than NIST physicists had expected. Einstein’s theory of relativity states that the strength of gravity affects the passage of time. Clocks tick slower where gravity is stronger, and faster where gravity is weaker. The velocity of a planet’s orbit will also cause clocks to tick slower or faster.

NIST chose a point on the Martian surface to act as a reference, sort of like sea level at the equator on Earth. Thanks to years of data collected from Mars missions, Patla and fellow NIST physicist Neil Ashby could estimate gravity on the surface of the planet, which is five times weaker than Earth’s.

But they needed to figure in more than just Mars’ gravity. Our solar system has other massive bodies that pull on each other. The Sun alone accounts for more than 99% of the mass in our solar system. Mars’ position in the solar system — its distance from the Sun, its neighbors like Earth, the Moon, Jupiter and Saturn — pulls it into a more eccentric, elongated orbit. The Earth’s and Moon’s orbits are relatively constant; time on the Moon is consistently 56 microseconds faster than time on Earth.

“But for Mars, that’s not the case. Its distance from the Sun and its eccentric orbit make the variations in time larger. A three-body problem is extremely complicated. Now we’re dealing with four: the Sun, Earth, the Moon and Mars,” Patla explained. “The heavy lifting was more challenging than I initially thought.”

After taking all these effects into consideration — Martian surface gravity, Mars’ eccentric orbit, the effect of the Sun, the Earth and the Moon on Mars — Patla and Ashby arrived at their answer.

### Paving the Way for Solar System Internet

Maybe 477 millionths of a second doesn’t sound like a lot — it’s about a thousandth of the time it takes to blink. But accounting for tiny time differences is key to developing communications networks. 5G networks, for example, need

to be accurate to within a tenth of a microsecond.

Right now, communications between Earth and Mars are delayed anywhere from four to 24 minutes (sometimes more). It's almost like pre-telegram communications, Patla explained: People delivered handwritten letters to a ship, which crossed the ocean, and then waited weeks or months for another ship to deliver the reply.

Having a framework for timing between planets paves the way toward creating synchronized networks across vast distances.

"If you get synchronization, it will be almost like real-time communication without any loss of information. You don't have to wait to see what happens," Patla said.

Those networks are a long way from reality; so are long-term human and robotic Mars missions, Ashby pointed out. Studying these issues helps scientists prepare for all the variables they will encounter.

"It may be decades before the surface of Mars is covered by the tracks of wandering rovers, but it is useful now to study the issues involved in establishing navigation systems on other planets and moons," Ashby said. "Like current global navigation systems like GPS, these systems will

depend on accurate clocks, and the effects on clock rates can be analyzed with the help of Einstein's general theory of relativity."

There is also scientific value to this knowledge, Patla added. Understanding how clocks will tick on far-flung planets is new information and builds on Einstein's theories of special and general relativity.

"It's good to know for the first time what is happening on Mars timewise. Nobody knew that before. It improves our knowledge of the theory itself, the theory of how clocks tick and relativity," he said. "The passage of time is fundamental to the theory of relativity: how you realize it, how you calculate it, and what influences it. These may seem like simple concepts, but they can be quite complicated to calculate."

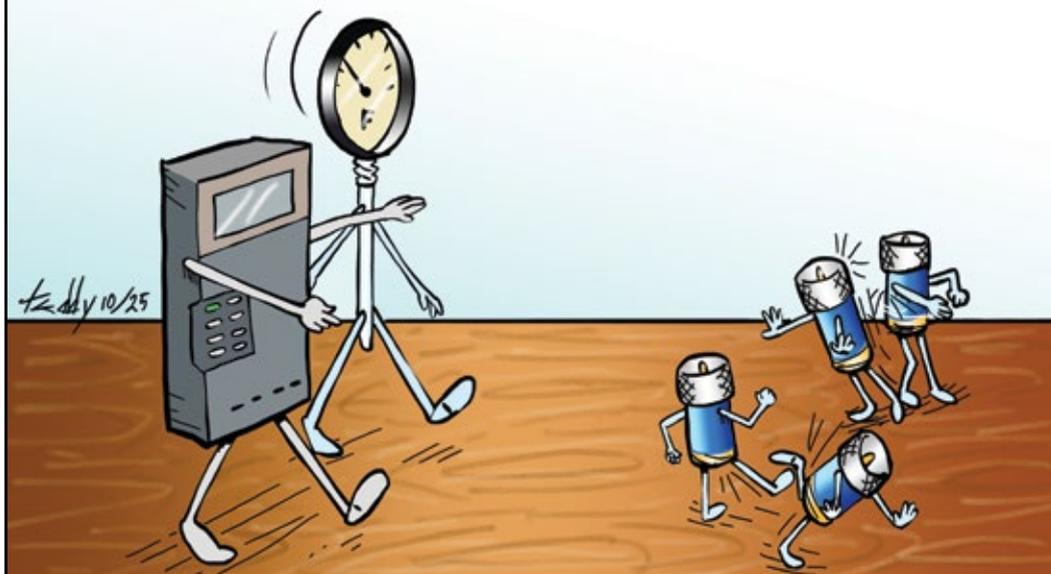
Paper: Neil Ashby and Bijunath R. Patla. A Comparative Study of Time on Mars with Lunar and Terrestrial Clocks. *The Astronomical Journal*. Published online Dec. 1, 2025. DOI: 10.3847/1538-3881/ae0c16

Source: <https://www.nist.gov/news-events/news/2025/12/what-time-it-mars-nist-physicists-have-answer>

## Cal-Toons by Ted Green

@tedgreen.org

WATCH OUT FOR THE ATTENUATOR SET HERE. KNOCKING DOWN SIGNALS ISN'T THE ONLY THING THEY DO.



# How Connector Quality Impacts Measurement Precision

Betty Wang

Hangzhou Qiansineng Technology Co., Ltd.

Let's start with a direct question: To save a few dollars on a connector, are you willing to sacrifice the integrity of a measurement worth thousands, or even risk the safety of your equipment? This isn't hyperbole; it's the daily reality for engineers and technicians who unknowingly use subpar banana plugs. While they may look the part, these cheap components are often the weakest link in the measurement chain, silently sabotaging your data and undermining your work. This breakdown dissects the hidden flaws of cheap banana plugs and provides the knowledge to distinguish true quality from a costly imitation.

## Part 1: The Truth on the Dissection Table

To understand the problem, we must go beyond a surface-level look. We put common, low-cost banana plugs and professional-grade connectors under the microscope and cutting wheel. The findings are stark.

**Material Deception: The Core of the Problem.** The most egregious deception lies in the base material. A high-quality banana plug is machined from a solid brass or beryllium copper billet, ensuring excellent conductivity and mechanical strength. Cheap plugs often use an iron or zinc-alloy core, which is then thinly plated with copper, and finally flash-plated with a layer of "gold" that is often just a gold-colored lacquer or an alloy of insignificant thickness.

This cost-cutting measure has disastrous consequences for performance. Iron is a much poorer conductor than copper and is also magnetic, which can be problematic in sensitive applications.

**Image Analysis:** The cross-section on the left shows a homogenous brass structure, ensuring consistent electrical and thermal performance. The image on the right reveals a deceptive layered structure — an iron

core with a thin copper flash—a design guaranteed to fail under demanding conditions.

**Mechanical Flaws: The Spring's Story.** A banana plug's reliability is dictated by the consistent contact pressure applied by its spring.

- **High-Quality Plugs:** Typically use a "lantern" or "bird cage" style spring made from beryllium copper. This design provides multiple points of contact and maintains its elasticity over thousands of insertion/removal cycles.
- **Low-Cost Plugs:** Often use a simple leaf spring stamped from inferior metal. This design provides fewer contact points and is prone to metal fatigue, quickly losing its tension. The result is a loose connection, intermittent contact, and the dreaded "jumping" readings on your meter.



Figure 1. Brass vs. iron-core.



Figure 2. Thermal test.

## Part 2: The Performance Trial

Visual inspection reveals design flaws, but quantitative testing exposes the real-world performance gap. We subjected both types of plugs to controlled tests simulating common engineering scenarios.

**Trial by Fire: Thermal Performance Under Load.** A connector's resistance turns electrical energy into heat. Higher resistance means more heat, which can lead to connection failure and even become a fire hazard. We passed a continuous 10 A current through both a professional-grade brass plug and a cheap iron-core plug for 30 minutes. The results, viewed with a thermal camera, are definitive.

The infrared image (above) shows the cheap plug reaching temperatures over 85° C due to its high internal resistance. The quality brass plug barely rose above the ambient temperature. This excessive heat not only accelerates material degradation, but also poses a significant safety risk.

**Trial by Signal: The High-Frequency & Audio Perspective.** For signals beyond simple DC voltage, the connector's impact becomes even more critical. In audio and RF applications, poor materials and construction can degrade signal quality.

## Part 3: Developing a Discerning Eye

You don't need a lab to spot a low-quality banana plug. With a trained eye and a simple tool, you can quickly assess quality.

1. **The Magnet Test:** This is the single most effective test. Bring a small magnet (even a refrigerator magnet will do) close to the plug's body. A high-quality plug made of brass or beryllium copper is non-magnetic. If the magnet sticks, you have an iron-core plug.
2. **Visual Inspection:** Look closely at the gold plating. High-quality plating has a deep, uniform golden hue. Cheap plating often looks pale, brassy, or has inconsistent color, especially inside the spring area. Examine the surfaces. A quality plug will be smoothly machined with no rough edges or visible seams from casting.
3. **Mechanical Check:** A solid brass plug will feel significantly heavier and more substantial than a hollow or iron-core counterpart. Insert the plug into a jack. A quality plug has a smooth, firm insertion feel and requires consistent force to remove. A cheap plug may feel gritty, loose, or have a weak "snap."

## Conclusion: Measurement Integrity

In the world of precision electronics, every component in the signal path matters. The belief that "it's just a connector" is a dangerous fallacy. As we've shown through dissection and data, the difference between a cheap banana plug and a professional-grade one is not a matter of luxury, but of fundamental performance and safety. The material, design, and construction of your connector directly determine its resistance, current-carrying capacity, and long-term reliability.

Choosing a low-quality plug is not a saving; it's an invisible tax on the accuracy of your results and the reliability of your entire system. The iron law of engineering applies here: a chain is only as strong as its weakest link. Don't let a one-dollar part compromise a thousand-dollar measurement.

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# Risks and Limitations of a Three-Point Calibration Program in the Regulated Industry

Ricardo Vilmenay, ASQ CCT

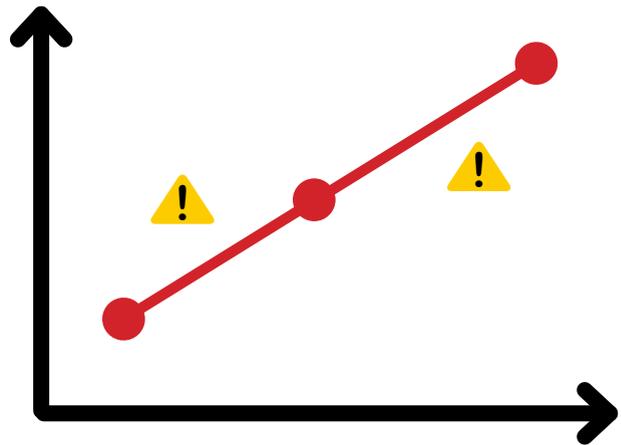
## Why Has the Three-Point Practice Been Institutionalized?

In environments regulated by the FDA, particularly in biotech and pharmaceutical industries, the three-point calibration scheme has become a common practice. However, this practice did not arise from a metrological need but rather from a convergence of operational pressures, generic templates, and external validations that prioritize efficiency over technical robustness.

Manufacturers and service providers promote this calibration as “sufficient” for compliance, without validating the complete functionality or justifying the number of points according to their criticality. In many cases, it is adopted by inertia, simply because “that’s what the auditor accepts,” “that’s what the manual recommends,” or “that’s what the provider does.”

While this simplification may seem efficient and is often accepted in superficial audits, it can obscure functional errors. Additionally, it compromises the validation of the operational range and generates deviations that only become evident once they have impacted the final product.

This normalization has created a false sense of compliance. It is assumed that calibrating at three points with calibration standards traceable to the SI system, while meeting an acceptable TUR (e.g., 4:1), guarantees total reliability. However, this ignores the fact that traceability is only part of the equation for implementing an effective calibration program, and conducting only three test points does not validate the integral functional response of the instrument or the interpolation between those points. Although this simplification may pass in superficial audits, it does not withstand rigorous technical analysis or impact review in the process.



This article not only exposes some of the technical risks associated with calibrating at only three points but also focuses on one of the most common and difficult-to-detect errors: the Type “S” non-linearity error. This type of deviation may align with the ideal line at the extreme points and the midpoint, but it presents hidden curvature in the intermediate areas (e.g., 25% and 75%). It can only be evidenced through more robust calibration programs, such as implementing five points distributed throughout the calibration range.

## Technical Risks of Calibrating with Only Three Points

- **Unvalidated Interpolation and Type ‘S’ Non-Linearity Errors:** When calibrating an instrument using only three points, a linear behavior is assumed between these points without verification. This assumption can mask Type ‘S’ linearity errors, hiding curvatures and non-uniform responses in the instrument (e.g., between 25% and 75% of the range). As a

result, intermediate measurements may be out of specification, leading to false acceptance and compromising both the quality and reliability of calibrations and the final product.

- **Ignored Hysteresis:** In electromechanical instruments such as pressure transmitters, the response in upscale and downscale values can differ. Having only three points in upscale does not allow for the detection or quantification of this difference.
- **Insufficient Functional Validation:** It is not demonstrated that the instrument responds correctly across its entire range. This can lead to undetected deviations in critical processes.
- **False Compliance:** A false sense of conformity is created because the instrument “passes” at three points, while it could be out of specification at intermediate points (e.g., 25% and 75%) where the process is more likely to operate.

### Type “S” Non-linearity (Sigmoidal)

In the figure below, the type “S” Non-linearity error describes a sigmoidal (S-shaped) deviation between the actual calibration curve and the ideal

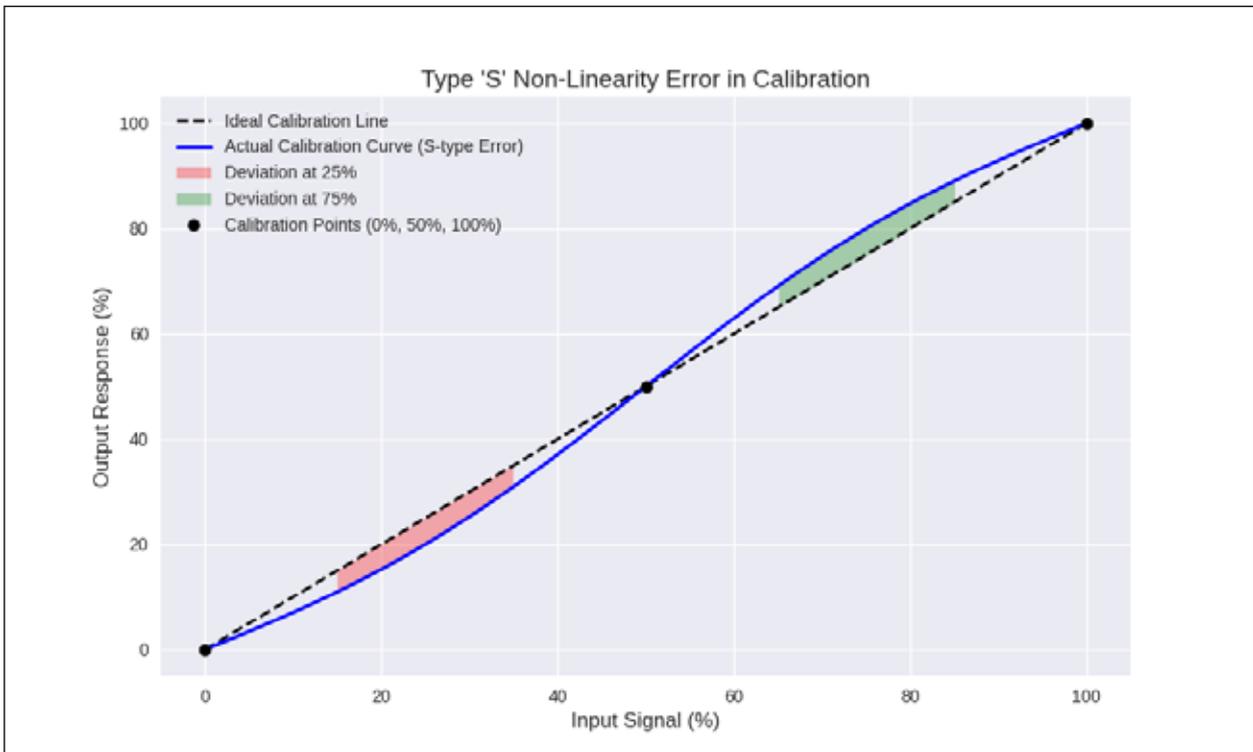
straight line. The curve crosses the ideal line twice, resembling a stretched letter “S.” The deviation can vary in different regions, for example:

- Below the line in the low range indicates underestimation (or above the line, depending on the instrument’s behavior).
- Matching the ideal line in the midrange.
- Above the line in the high range indicates overestimation (or below the line, depending on the instrument’s behavior).

### Typical Causes

These factors describe common mechanical, temperature, and electronics behaviors that introduce non-linear errors in measurement systems.

- **Mechanical Hysteresis:** Variations in the measurement due to the material’s inability to return to its original state after being deformed, affecting the accuracy of pressure, displacement, or force transducers.
- **Mechanical Friction:** Resistance between moving parts within transducers that can introduce errors in measurement by causing delays or discrepancies in response.



- **Temperature Effects:** Changes in sensor linearity at both the low and high ends of the measurement range, which can lead to inaccuracies.
- **Electronic Saturation:** Non-linear behavior of amplifiers or sensors when operating near the limits of their input range, resulting in distorted readings.

## Practical Consequences

This section lists the observed behaviors and the implications of nonlinearity in the measurements.

- The error is not symmetric; it changes sign along the measurement range, which can lead to erroneous interpretations if not properly accounted for.
- A single linear correction (e.g., adjusting zero and span) cannot fully compensate for this type of non-linearity.
- Accurate calibration usually requires more sophisticated methods, such as curve-fitting (polynomial adjustments) or piecewise linearization, to adequately capture the instrument's response.

## Why 5-Point Calibration is Essential

- A 3-point calibration (typically at 0%, 50%, and 100%) only verifies zero, span, and midpoint:
  - It assumes linearity between these points.
  - It cannot detect curvature or inflection points, such as those associated with Type "S" non-linearity.
- In contrast, a 5-point calibration (at 0%, 25%, 50%, 75%, and 100%) offers several advantages:
  - This allows you to observe the overall shape of the response curve.
  - Enable detection of asymmetry or sign changes in deviation, which are typical of Type "S" non-linearity.
  - Quantifies non-linearity errors that could push readings out of tolerance in the critical 25-75% region, where most process operations occur.

**Note:** It's important to note that the end sections (0-25% and 75-100%) often exhibit the largest non-

linear deviations and increased uncertainty, further emphasizing the need for comprehensive calibration.

## Final Thoughts

The implementation of five measurement calibration points is not always feasible or practical in certain types of calibrations. Equipment such as incubators, refrigerators, freezers, small stability chambers, thermal baths, compact autoclaves, or in-line sensors, among others, present physical, thermal, or operational limitations that prevent applying this scheme without compromising functionality or representativeness.

The recommendation to use five measurement calibration points is not intended to impose a universal standard, but rather to encourage the use of higher-density measurement schemes only in systems involving critical variables, where technically viable, and where they add real value to process reliability.

Through rigorous calibration practices, organizations can enhance the accuracy and quality of measurements in critical systems, ensure compliance with industry quality standards, which will be reflected in on-site audits, and, most importantly, this commitment is crucial for improving the quality of the final product.

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# Welcoming New Calibration Technicians the Right Way

Joseph Rindone

## Introduction

Bringing new technicians into a calibration lab is more than an HR formality—it's an investment in the accuracy, reliability, and reputation of the entire organization. Too often, onboarding is treated as a checklist: review procedures, shadow a senior tech, sign off on training. But if we want calibration professionals to succeed, the approach must go deeper. Onboarding is where values are instilled, expectations are shaped, and the foundation for excellence is laid.

Unlike many industries, calibration operates at the intersection of science, compliance, and trust. When a measurement is wrong, the effects can ripple through production lines, medical devices, aircraft, and defense systems. That's why onboarding must be deliberate, structured, and inspiring. This article organizes a practical approach around six pillars—Mission & Standards, Technical Competency, Documentation & Accountability, Mentorship & Feedback, Growth Pathways, and a Culture of Precision—with short case studies and a toolkit to help labs implement immediately.

## The Six Pillars

### 1. *Mission & Standards: Anchor New Technicians in Purpose*

From day one, technicians should see themselves as guardians of measurement integrity. Orientation should clearly connect the lab's work to ISO/IEC 17025 competence and impartiality, measurement traceability, and customer confidence (ISO, 2017). Explain how traceability links measurements through an unbroken chain back to national or international standards—and how every link adds to total

measurement uncertainty. Use concrete examples: guidance sensors, infusion pumps, torque tools, and dimensional gaging all rely on trustworthy calibration data (Thomas, 2009).

This early framing prevents new hires from viewing procedures as bureaucratic tasks. It also establishes a balanced mindset: compliance and curiosity. Compliance without curiosity yields rigid rule-following; curiosity without compliance risks inconsistency. The right balance builds technical pride, good judgment, and durable professional identity.

### 2. *Technical Competency: Build Skill with Structure and Context*

Technical training is the backbone of onboarding, but its design determines whether new hires merely follow steps or develop deep expertise. A practical progression looks like this:

- **Phase 0 – Pre-boarding (before Day 1):** Safety (including ESD), quality policy overview, accounts and tool access, introduction to the quality manual and scope.
- **Phase 1 – Foundations (Days 1–30):** Instrument care, ESD discipline, reading procedures, basic DC/low-frequency measurements, data integrity, and coached hands-on tasks.
- **Phase 2 – Practice (Days 31–90):** Supervised calibrations with growing complexity, error-trapping checklists, peer review of data and certificates, and participation in internal verifications.
- **Phase 3 – Independence (Months 4–12):** Independent work within a defined scope, formal competency sign-offs, participation in internal audits, and contribution to uncertainty budgets.

Time in Role	Technical Skills	Documentation	Quality & MU	Professional Skills
0–30 days	Instrument care, ESD, basic DC	Forms, IDs, units	Intro to traceability	Safety, communication
31–90 days	Guided SOP execution	Certificates (draft), peer review	Read MU tables	Mentor check-ins
4–6 months	Independent within scope	Accurate, complete certs	Apply decision rules	Teamwork, time mgmt
6–12 months	Multi-discipline tasks	Review others' work	Assist internal audits	Mentor peers
12+ months	Complex systems	Coach others	Lead method validations	Present/publish

Table 1. Technician Competency Matrix (example)

Link theory to every procedure. When teaching multifunction calibrators, pressure benches, or CMMs, explain uncertainty contributors (resolution, repeatability, environmental effects, reference standard uncertainty), error propagation, and decision rules. Without this context, technicians may know what to do but not why it matters—leaving them vulnerable during assessments and blind to improvement opportunities (Henderson, 2025).

ESD discipline belongs on Day 1. Wrist-strap verification, workstation checks, and handling practices prevent latent damage that later shows up as drift. If ESD is sloppy, measurement uncertainty grows unnoticed and intervals may tighten for the wrong reasons.

Provide a competency matrix (Table 1) that maps skill milestones by time in role (e.g., 0–30 days, 31–90 days, 4–6 months, 6–12 months, 12+ months). This clarifies expectations, guides coaching, and makes progress visible.



Modern onboarding also benefits from a learning management system (LMS) with SCORM/xAPI content and, when appropriate, Virtual Reality (VR) modules that let new hires practice connections and fault isolation safely. These tools allow technicians to gain hands-on familiarity before working with high-value standards, reinforcing safety and confidence.

### 3. Documentation & Accountability: If It Isn't Documented, It Didn't Happen

Calibration is not just about accurate measurements—it's about traceability through documentation. A technician's work is only as reliable as the records they produce. Make documentation a primary onboarding skill, not an afterthought. Early exercises should include mock certificates, cross-checking entries, validating units, confirming uncertainty statements, and explicitly recording decision rules where applicable (ISO & Henderson, 2025).

Help new hires understand downstream impact: a wrong serial number can invalidate a certificate; missing environmental conditions can cast doubt on results; omitting measurement uncertainty breaks metrological traceability claims. Peer reviews of draft certificates teach technicians to catch issues before a customer or assessor does. Introduce contemporary, brand-neutral examples of how labs manage records—systems that log training, link assets to methods, and make certificates readily accessible for customers and auditors.

#### *4. Mentorship & Feedback: Turn Shadowing into Structured Growth*

“Shadow a senior tech” is common—but ambiguous. Transform it into a deliberate mentorship program with milestones and regular feedback. A mentor is both a technical guide and a culture-bearer—modeling documentation habits, reinforcing safety (including ESD), and demonstrating how to reason about uncertainty and decision rules in real scenarios.

Set expectations: weekly check-ins for the first 90 days, then monthly. Keep the discussion practical: What did you learn? Where did you struggle? What will you try next time? This cadence builds confidence, reduces rework, and shortens time-to-competence.

Respected voices in the metrology community often emphasize that advanced disciplines—RF/microwave network analysis, precision force/torque, or high-accuracy dimensional calibration—demand both rigorous theory and disciplined execution. Mentorship bridges those two worlds, ensuring that knowledge is passed forward with consistency and integrity.

#### *5. Growth Pathways: Show the Road Ahead to Keep Talent*

One of the leading causes of turnover in technical fields is lack of career visibility. If technicians see no path beyond repetitive calibrations, they leave. Use onboarding to map clear paths: senior technician, discipline specialist, lead auditor, trainer, or quality manager. Encourage participation in professional societies and events.

Leaders in government calibration programs—such as those at NAVSEA’s Metrology Engineering Center (MEC) in Corona—regularly highlight education and professional growth. Bringing that spirit into onboarding signals that the lab invests in people, not just output (Hazzard, 2024). When new hires see that today’s lead auditor or technical manager once started at the same bench, they recognize a future worth pursuing.

#### *6. Culture of Precision: Celebrate the Quiet Foundation of Trust*

Calibration is often called the quiet foundation of trust. Few outside the profession notice it, yet countless industries depend on it. Build a culture where precision is celebrated and where technicians understand that small improvements accumulate into large reliability gains.

Recognize meaningful milestones: a technician’s first independent certificate, a successful audit witness, or completion of a proficiency test cycle. Tie these achievements back to the lab’s mission and customer outcomes. Keep learning continuous with short micro-lessons, lunch-and-learns, and opportunities to present at local or regional meetings. Culture compounds; precision becomes a habit.

### **Case Studies: How Onboarding Principles Work in Practice**

**Why these examples?** The following brief cases show how the six pillars appear in real laboratories. Each scenario highlights a different emphasis—mission, mentorship, documentation, or digital enablement—while keeping onboarding squarely at the center.

**A) Mission-Critical Mindset (Space & Aerospace)**  
New technicians joining a guidance-sensor calibration team are immersed in the mission before they touch an instrument: how a millivolt offset can propagate through control loops, why SI traceability matters, and how uncertainty influences decision rules for acceptance. By month four, the technician contributes to an internal audit, connecting bench work to the quality system and ISO/IEC 17025 mandates.

**B) PMEL Roots & Modern Mentorship (Defense)** “Figure it out” cultures produced resilient technicians, but at the cost of attrition and variability. A defense lab retooled onboarding into a mentor model: each new hire is paired with a senior who models documentation, uncertainty reasoning, and disciplined setups. Weekly feedback in the first 90 days is mandatory. Results: reduced rework, fewer certificate corrections, and faster time-to-competence.

### C) Commercial Lab with Digital Acceleration

A commercial lab combined structured learning modules with micro-learning and implemented certificate access that customers and auditors can retrieve instantly. New technicians saw the full lifecycle—from measurement to certificate to audit—in their first 60 days. The lab reported shorter audit cycles and higher customer satisfaction.

### Practical Toolkit: Use These Today

- **Day-1 Orientation (90 minutes):** Safety and ESD qualification; lab tour; quality policy and scope overview; traceability primer; systems logins; mentor assignment; first-week goals.
- **First-90-Days Plan (one page):** Weekly mentor check-ins; competency milestones tied to the matrix; certificate-reading sessions every two weeks; one internal presentation by Day 90.
- **SOP-to-Theory Link Sheet:** Physics summary, primary uncertainty contributors, common failure modes, and why each procedural step exists.
- **Certificate Quality Gate (checklist):** IDs/serials; method revision; units and significant figures; environmental conditions; traceability statements; MU and decision rule; as-found/as-left; signatures and change control.
- **MU Starter Worksheets:** Pre-filled examples for common tasks that show how to combine Type A/Type B contributors, record assumptions, and state coverage factors and confidence levels.

### Conclusion

Successful onboarding in calibration is not a checklist—it's a culture. When laboratories invest early in mission awareness, structured competency building, rigorous documentation habits, purposeful mentorship, visible growth paths, and a shared pride in precision, they don't just develop technicians—they cultivate stewards of measurement integrity. Build that foundation today and you strengthen audit readiness, customer confidence, and—most importantly—the next generation of metrologists who will carry the profession forward.

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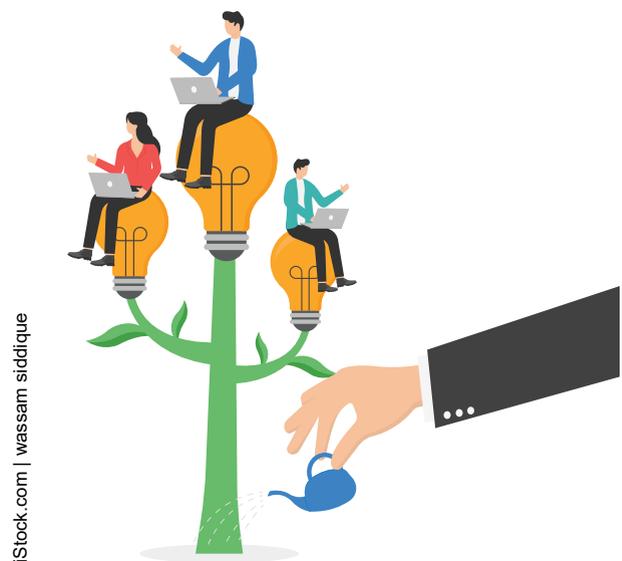
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The R&S NRP-Z47 power sensor module turns the R&S FSMR3000 measuring receiver into a precision power meter for precise calibration.

## Rohde & Schwarz Presents a New Power Sensor Module for Calibration Tasks up to 50 GHz

Munich 12-Nov-2025 — The new R&S NRP-Z47 power sensor module from Rohde & Schwarz turns an R&S FSMR3000 measuring receiver into a precision power meter with a wide dynamic range from -23 dBm to +30 dBm. Providing frequency ranges up to 50 GHz this solution fits perfect for level calibration of generators and attenuators in radar systems.

Calibration labs – whether within military facilities, at major mobile network manufacturers, or as independent civilian services – can leverage the R&S NRP-Z47 power sensor module and R&S FSMR3000 measuring receiver for precise calibrations. This equipment combination offers for example a powerful solution to ensure the accuracy of components crucial to radar systems, such as generators and attenuators, maintaining high standards in testing and measurement.

The new R&S NRP-Z47 power sensor module is a highly accurate instrument for determining the absolute power level. R&S FSMR3000 measurement receivers are designed for measurement tasks involved in the calibration of signal generators and attenuators. They provide excellent linearity and allow precise power calibration over its entire level range.

For maximum accuracy, this calibration solution measures absolute power with the R&S NRP-Z47 power sensor module within its dynamic range of from -23 dBm to +30 dBm. Beyond this range the R&S FSMR3000 measures the relative levels down to -150 dBm depending on frequency range. The receiver utilizes the TRFL (Tuned RF Level) method, calibrating across multiple overlapping ranges to minimize errors from preamplifier activation, gain or attenuation changes.

With the built-in splitter of the R&S NRP-Z47 power sensor module, users can connect both the power sensor module and the R&S FSMR3000 to the device under test (DUT) at the same time providing a single connection to the DUT delivering accurate and repeatable power measurements by

avoiding cable connection and disconnection.

The new R&S NRP-Z47 power sensor module expands the R&S NRP-Zx7 series of power sensor modules with internal splitters used for calibration with an R&S FSMR measurement receiver with a module for frequencies up to 50 GHz. It is now available from Rohde & Schwarz.

For further information visit: [https://www.rohde-schwarz.com/products/test-and-measurement/rf-and-microwave-power-sensors/rs-nrp-zx7\\_334288.html](https://www.rohde-schwarz.com/products/test-and-measurement/rf-and-microwave-power-sensors/rs-nrp-zx7_334288.html)

## Anritsu Breaks Bandwidth Barrier with World's First 145 GHz O/E Calibration Module

Morgan Hill, CA – October 28, 2025 – Anritsu Company has launched the MN4765B-0140 O/E Reference Calibration Module, the world's fastest and first traceable solution to support the testing demands of next-generation data centers and the explosive growth of Artificial Intelligence (AI) and Machine Learning.

As data centers transition from 224 Gbps to 448 Gbps per lane to achieve total data rates like 1.6T, the required bandwidth for electrical-optical (E/O) modulators and optical-to-electrical (O/E) photodetectors now exceeds 130 GHz. The new MN4765B-0140 is engineered to meet this critical need, pushing the measurement frontier to 145 GHz.

### Key Technological Breakthroughs

The MN4765B-0140 is a monumental step forward for high-speed component verification:

**World's First 145 GHz Reference Photodetector:** It offers the widest commercially available frequency range from 70 kHz to 145 GHz for O/E calibration at the 1550 nm wavelength, enabling the high-confidence characterization of cutting-edge E/O and O/E devices.

**Traceability to 145 GHz:** Anritsu secured traceability for the new module to a recognized National Metrology Institute. This is a crucial differentiator, as existing standards from NIST are limited to 110 GHz, making the MN4765B-0140 the only solution providing verifiable measurement accuracy at these extreme bandwidths.

**Unique, Cost-Effective System Solution:** When integrated with Anritsu's VectorStar ME7838D 145 GHz Vector Network Analyzer (VNA), the combination creates the world's only complete, traceable, and flexible system for testing the entire high-speed opto-electronic ecosystem,



# NEW PRODUCTS AND SERVICES

including TOSA, ROSA, BOSA, and Coherent Optical Sub-Assemblies (COSAs).

## Securing Investment in High-Speed R&D

Anritsu's solution provides significant advantages over competing systems, which typically forces customers into a more expensive solution lacking the necessary 145 GHz reference calibration module entirely.

"The AI revolution is demanding a massive leap in data center interconnect speeds, making the 145 GHz bandwidth non-negotiable for 1.6T deployment," said a spokesperson for Anritsu Company. "The MN4765B-0140 eliminates measurement uncertainty at these critical frequencies. Coupled with the flexible and future-proof VectorStar VNA platform, our customers gain a powerful, cost-effective tool that secures their investment by offering a simple upgrade path and superior measurement speed."

The MN4765B-0140 O/E Calibration Module is available for order immediately. To learn more visit [www.anritsu.com](http://www.anritsu.com).

## Additel Launches the ADT835 Portable Calibration Bath: Precision Meets Portability



Brea, California – Additel Corporation is proud to announce the release of the all-new ADT835 Portable Calibration Bath, a revolutionary solution that sets a new benchmark in portable temperature calibration technology. The ADT835 is engineered to meet the highest demands of field and laboratory professionals alike.

Designed with performance and versatility at its core, the ADT835 features a generous 3.54" x 3.54" (90mm x 90mm) bath opening, supporting the calibration of virtually any

type, size, or shape of temperature sensor and is in a class of its own when it comes to speed. Whether you're performing batch calibrations in the lab or demanding on-site tasks in the field, the ADT835 delivers with exceptional stability, uniformity, and accuracy.

Available in two models — ADT835-150 and ADT835-250 — this portable calibration bath combines the reliability of traditional liquid baths with the portability of a dry well, offering a wide temperature range from -30 °C to 250 °C, high accuracy of  $\pm 0.1$  °C, and quick temperature stabilization.

### Key features include:

- Engineered for exceptional portability and performance
- Quick to temperature

- Extended temperature range: -30 °C to 250 °C
- High-precision accuracy:  $\pm 0.1$  °C
- Compatible with a wide range of probe types and sizes
- Optional built-in process calibrator (PC)

The ADT835 Portable Calibration Bath is available now. For more information, visit [www.additel.com](http://www.additel.com) or contact your local Additel representative.

## Fluke Introduces CalStudio, Software that Drives Efficiency and Collaboration in Calibration Labs

EVERETT, Washington, November 3, 2025 – Fluke Corporation today announced CalStudio, a software-as-a-service (SaaS)-based solution that transforms the way calibration labs operate by centralizing knowledge and procedures into a single, cloud-based platform. CalStudio empowers technicians to streamline workflows, enhance collaboration across multiple labs, and boost both efficiency and accuracy, driving a new era of productivity and operational excellence in the calibration industry.

Powered by Cubyt - the comprehensive database of technical data for measurement devices - CalStudio gives users instant access to the latest methods and updates from any location through a web browser. This shared, always-current database eliminates the need for standalone software or local installations, enabling multiple labs to work from the same set of procedures and data. As a result, technicians spend less time managing files and more time performing accurate, efficient calibrations, while also increasing billable hours and revenue opportunities.

"CalStudio represents a major step forward in how calibration labs operate," said Michael Johnston, Software Portfolio Product Manager at Fluke Corporation. "By bringing all calibration procedures, data, and updates into one connected platform, we're giving technicians the tools to work faster, collaborate seamlessly across locations, and focus on what matters most; delivering precise, high-quality calibrations that drive greater efficiency and profitability."

### Key capabilities in CalStudio:

- Leverages Cubyt data, a comprehensive database of calibration procedures that provides lab technicians with instant, up-to-date access to standardized methods, enabling faster, more accurate, and consistent calibrations across multiple labs.
- Simplifies procedure authoring with drag-and-drop, low-code/no-code tools making workflow creation faster and easier.
- Authors calibration procedures once that lab technicians can run anywhere, with reference and configuration-agnostic flexibility.

Learn more about CalStudio on [youtube.com/@FlukeCalibration](https://www.youtube.com/@FlukeCalibration) or visit <https://www.fluke.com/en-us/products/fluke-software/calstudio-calibration-management-software>

# Computers Can Do Math!

Michael L. Schwartz

Today, in a meeting, we discussed separating raw data from its presentation. It is such a simple concept, but explaining the purpose of each one is more complex than I expected. So I'm dedicating this quarter's Automation Corner to "Computers Can DO Math!"

In the meeting, we were discussing PTB's DCC, the Digital Certificate of Calibration XML document created by Germany's National Metrology Institute. The idea behind the XML document is to digitize calibration results, moving the calibration certificate from a paper to a digital/computer-ready format. Truly a bold move for the slow-moving metrology industry!

The problem hinges around the presentation layer of the DCC. More to the point, the entire XML schema focuses on the presentation layer without including the complete underlying data that is part of the calibration.

The case in point when measuring the length of a gauge block. A typical report will indicate the measured error of the gauge block. For example, on the report, it might say "-3.5 μin," indicating that the gauge block is short by 3.5 micro-inches.

The problem is that the measurement data is missing! The report simplified the data, but it didn't provide the actual measurement and details needed to better understand how the lab concluded that the gauge block was, in fact, short.

The data has been over-simplified, reporting only the error and uncertainties. What was the nominal value? Was it tested against the nominal value of 5 inches or against the length measurement made last year, 4.999999 inches? Was it

measured once or multiple times? If it was measured multiple times, what were the individual measurements?

A better way to present the measurement data would be to include all relevant information about the measurement, i.e., the work performed by the calibration lab. This data should include the nominal value, upper and lower test limits that reference a specification, and the measured value or values, along with the measurement uncertainties. It should also include any additional information related to the measurement conditions.

Yes, a computer can calculate the measured value, assuming the gauge block was a 5-inch gauge block that measures 3.5 micro inches short, resulting in a 4.999965-inch measurement; but that is a calculation, not the calibration provider stating that they made a measurement of a certified value. I know it is splitting hairs, but if an error was made in the calculation, who is at fault, and where did the error occur?

This is the real problem: Without the actual measurement data in the report, tracking down a math error or

a simple typo, now becomes a task!

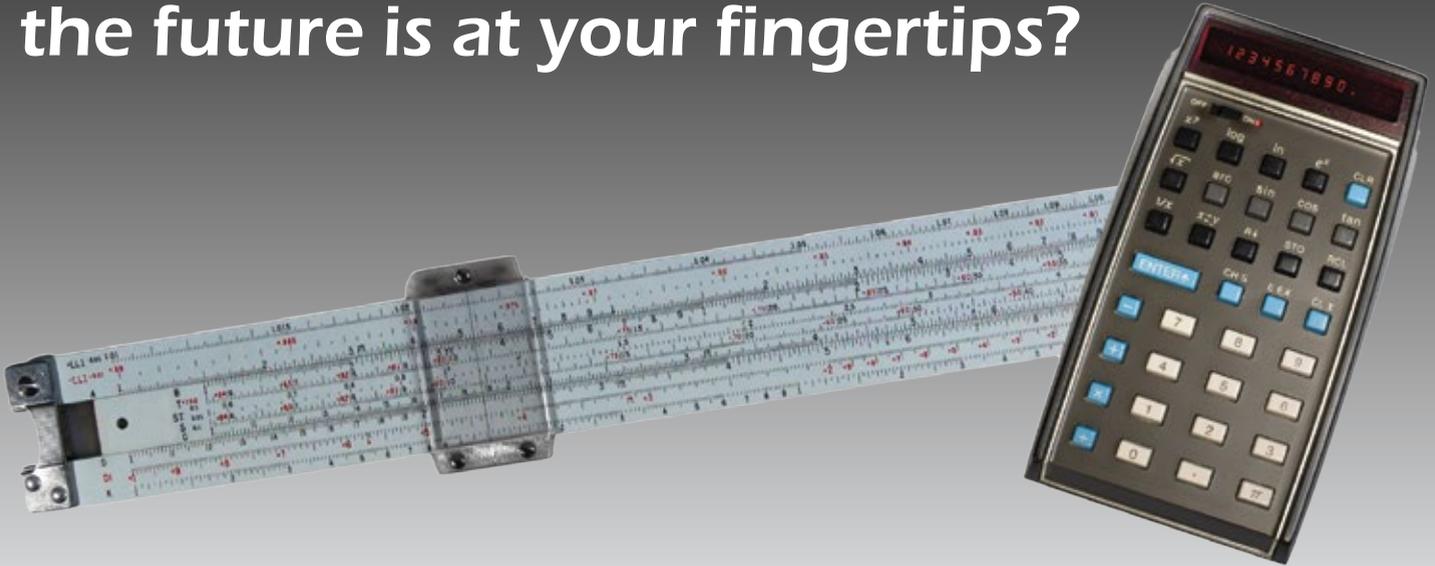
Simple calculations, such as Measured-Value minus Nominal-Value, can be performed by the report engine. Better yet, both the values are known, and the math is now auditable. Things like rounding errors can be addressed and evaluated, then corrected if needed.

The digital transition in metrology demands a complete overhaul of conventional, opaque data presentation. We must move beyond outdated paper or simplistic digital methods to present comprehensive measurement data. This includes integrating the final value with critical context: uncertainty, environmental conditions, equipment traceability, and procedures used.

Crucially, documentation—from planning to reporting—must be straightforward yet auditable. We need to adopt standardized digital protocols, like digital calibration certificates and blockchain logging, to ensure data integrity, permanence, and full traceability. Establishing this robust digital chain of custody guarantees transparency and confidence in metrological results.



# Why struggle with the past when the future is at your fingertips?



## DISRUPTIVE INNOVATION

The **1972 introduction of the HP-35 scientific calculator** by Hewlett-Packard was a **classic example of disruptive innovation** that also triggered a **paradigm shift** in engineering and scientific calculations. The HP-35 effectively rendered the **slide rule**, the dominant tool for engineers and scientists for decades, **obsolete almost overnight**.

Similarly, **Metrology.NET** is positioned to revolutionize the calibration industry by replacing outdated legacy software with a modern, integrated, and automated solution.

Aspect	Slide Rule (Legacy Software)	HP-35 Calculator (Metrology.NET)
Ease of Use	Complex, requires expertise and training	Simple, intuitive, minimal learning curve
Speed & Efficiency	Slow, manual calculations	Fast, automated processing
Accuracy	Prone to human error	Highly precise with minimal error
Portability/Scalability	Bulky, single-user	Compact, multi-user, and scalable
Technological Advancement	Mechanical, limited in functions	Digital, continuously evolving
Market Disruption	Decades of dominance ended overnight	Established software is now outdated
Cost & ROI	Initially cheaper, but labor-intensive	Higher upfront, but massive long-term savings

# Additel 835

## Portable Calibration Bath

Unmatched Speed,  
Stability and Uniformity



90 x 90 mm Bath  
fits 4 Tri-Clamp Probes



Comprehensive Accessories



Advanced Process Calibrator