



Morehouse
THE FORCE IN CALIBRATION SINCE 1925

ISO/IEC 17025 / ANSI/NCSLI Z540.3 Accredited

TRAINING GUIDE

MOREHOUSE 3.5-DAY FORCE AND UNCERTAINTY COURSE GUIDE



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This three-and-a-half-day workshop prepares the metrology professional to make better force measurements, understand measurement uncertainty, and implement control charting techniques. Upon completion of the course, the participant will be able to build uncertainty templates, make conformity assessments using the tools provided, and have the knowledge and resources to drastically reduce force measurement errors

Day 1 Control Charting Concepts and Building an Uncertainty Template

Tuesday 8:00 AM – 4:30 PM with Lunch Provided

Day 1 prepares the metrology professional to apply the power of Microsoft Excel's mathematical and statistical tools to assist in managing the laboratory's Quality Management System including Measurement Uncertainty. It covers techniques for laboratories in estimating the measurement uncertainty for their scope of accreditation.

This workshop takes the approach of teaching several tools and techniques that a lab may apply in measurement uncertainty analysis estimation per ISO Guide 98-3 (GUM). The tools are generic in nature so that it can be applied to various parameters.

Participants develop Measurement Uncertainty Budget template using Microsoft Excel on their laptops for a hands-on experience.

Learning Objectives

1. Develop familiarity with Excel mathematical and statistical functions
2. Learn Excel shortcuts for transforming number formats and other similar techniques.
3. Gain familiarity to know which minimum contributors to consider for measurement uncertainty evaluation.
4. Build a Measurement Uncertainty Budget and interpret it for future improvement of the measurement process.

Course Content

- Excel basic statistical functions.
- Basic statistics required for measurement uncertainty.
- Applying Excel statistical functions for Measurement Uncertainty.
- Developing a Measurement Uncertainty spreadsheet.
- Validating a Spreadsheet.
- Problems related to over-adjusting the measurement process.
- Types of variable Control Charts.
- Use of control charts to manage in Test and Calibration laboratory environments.
- Using control charts to comply with ISO/IEC 17025 requirements.

Day 2-3 Force Calibration with Measurement Uncertainty Training

Wednesday-Thursday 8:00 AM – 4:30 PM with Lunch Provided. We will try to have a group dinner on Wednesday night.

Day 2 and 3 of the workshop will start with a discussion on decision rules and how they relate to force measurements. We will then progress to cover applied force calibration techniques with hands on activities and demonstrations. Demonstrations and lectures will expose potential errors made in everyday force measurements. The demonstrations and discussions will include errors associated with:

- Improper alignment;
- Use of different and/or incorrect adapter types;
- Different thread depth;
- Wiring and excitation;
- Trouble shooting a load cell;
- Bottom thread loading.

The workshop will include discussions on measurement uncertainty and provide the tools to put together an uncertainty budget for use with Calibration and Measurement Capability uncertainty parameter as listed on the scope of accreditation.

This workshop will provide examples and worksheets that can be applied to estimate measurement uncertainty required by ISO/IEC 17025. Templates will be provided to help assist in making statements of conformance.

Course Content

- Common types of force measuring instrumentation;
- Understanding Measurement Risk;
- Metrological traceability;
- Types of Force Instrumentation and errors;
- Choosing the right load cell system;
- Proper Adapters for Force Calibration;
- ASTM E74 and other force calibration procedures;
- Requirements for ISO/IEC 17025 and ANSI Z540.3;
- Basic definitions relating to measurement uncertainty (GUM process simplified);
- Basic statistics required for measurement uncertainty;
- The measurement uncertainty budget implemented in a spreadsheet (template provided); and Reporting measurement uncertainty (on a Scope of Accreditation, CMC and customer reports in accordance with ILAC P-14 requirements).



Day 4 (half day) Force Calibration with Measurement Uncertainty

Thursday 8:00 AM to no later than 12:00 PM. If days 2 & 3 run to 5:00 or slightly past, the course may wrap up before noon.

Day 4 may begin with performing repeatability studies and completing a full Uncertainty Budget for load cells used in force machines in a hands-on exercise lasting about 2 hours. We will conduct a review and any additional questions will be answered. The class may break early if everything is wrapped up.

The participant will be given a USB drive with several resources and Excel Sheets to start to implement everything discussed in the class. The USB will contain resources from various sources and will be a useful tool for future reference.

It is strongly recommended the student bring a laptop with Microsoft Excel installed. The tablet or smartphone versions of Excel do not have the full functionality of Excel for PC or Mac.

Registration Fee: \$1295.00 per person