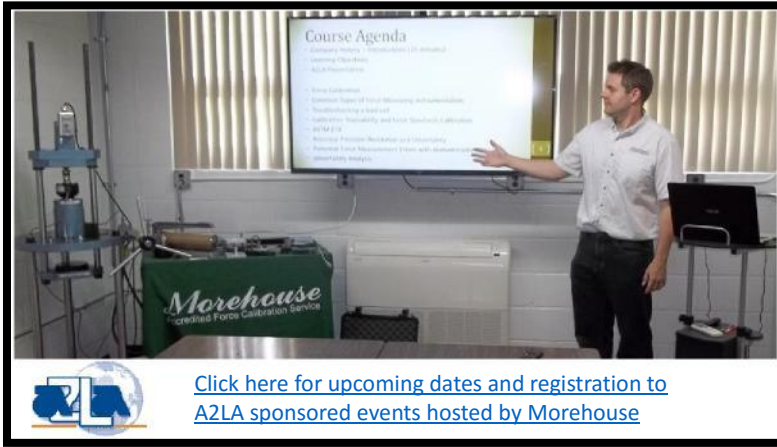




Applied Fundamentals of Force Calibration



- ◆ Hands on force calibration course.
- ◆ One-day course at Morehouse facility, or customer's location. NOTE: If taught at customer's location, videos will be substituted for live demonstrations.
- ◆ A two-day course taught by Dilip A. Shah, with the second full day covering measurement uncertainty, is run twice a year at our facility.

Course Description:

This course will cover applied force calibration techniques and will include live demonstrations using deadweight primary standards (when taught at Morehouse) and secondary standards to exhibit potential errors made in everyday force measurements. The measurement errors demonstrated and discussed will include errors associated with improper alignment, use of different and/or incorrect adapter types, thread depth and thread loading.

This course also covers the importance of calibrating force measurement devices in the manner in which they are being used in order to reduce errors and lower uncertainty.

Topics Include:

- ◆ What is Force Calibration?
- ◆ Common Types of Force Measuring Instrumentation
- ◆ Troubleshooting a Load Cell
- ◆ Calibration Traceability
- ◆ ASTM E74 and Other Force Calibration Procedures
- ◆ Accuracy, Precision, Resolution and Uncertainty
- ◆ Potential Force Measurement Errors with Demonstrations
- ◆ Uncertainty Analysis



Demonstration of misalignment error

One Day Course:

\$500.00 per person or \$1,850.00 minimum per day. Max 8 people at Morehouse, lunch is provided. Courses at customer's site are billed per day price, plus any travel expenses. [Contact us for more information](#)

Two Day Course:

\$750.00 per person. Only available at Morehouse Facility. Day one: Measurement Uncertainty Boot Camp, covered by Dilip A. Shah. Day two: Fundamentals of Force Calibration. [Register Here](#)

Other Classes Offered

Implementing Metrology and SPC concepts with Microsoft Excel

This one-day workshop 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 serves as a pre-requisite for the Measurement Uncertainty workshop and reduces the time spent learning both the Excel and Measurement Uncertainty estimation techniques at the same time.

Learning objectives:

1. Obtain familiarity of Excel mathematical and statistical functions
2. Learn Excel shortcuts for transforming number formats and other similar techniques.
3. Charting and using trend analysis tools for data interpolation.

Attendees will become proficient at applying Excel's mathematical and statistical tools by building templates for data collection and measurement uncertainty estimation.

- ◆ Excel basic statistical functions.
- ◆ Basic statistics required for measurement uncertainty.
- ◆ Applying Excel statistics for Measurement Uncertainty.
- ◆ Developing a Measurement Uncertainty spreadsheet.
- ◆ Validation of Spreadsheet.
- ◆ Central Limit Theorem.
- ◆ Sources of variation.
- ◆ Problems related to over-adjusting the process.
- ◆ Types of variable SPC (Statistical Process Control) charts.
- ◆ Types of attribute SPC (Statistical Process Control) charts.
- ◆ Individual/Moving Range Chart Methods.
- ◆ X-Bar/Range Chart Methods.
- ◆ Troubleshooting Control Charts and improving processes.
- ◆ Use of control charts to manage test and calibration lab environments.
- ◆ Using control charts to comply with ISO 17025 requirements.

- * **It is recommended the student bring a computer with MS Excel spreadsheet program for all classes.**

ISO/IEC 17025 Implementation

This 2-day workshop provides a general framework of tools for the laboratory seeking ISO/IEC accreditation. Attendees will learn how to interpret the standard and what is required of the laboratory to successfully get accredited the first time. Time saving techniques and tools are shared so that the laboratory does not fail major criteria for accreditation.

- ◆ ISO/IEC 17025 Clause 4 Management Requirements
- ◆ ISO/IEC 17025 Clause 5 Technical Requirements
 - o Purchasing process and review
 - o Traceability and measurement uncertainty
 - o Internal auditing techniques
 - o Corrective/preventive actions, root cause analysis
 - o Closing an audit action item
 - o Audit exercises
 - o Records management

Measurement Uncertainty

This workshop 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 (GUM). The tools are generic in nature so that it can be applied to various parameters.

Hands on exercises using Microsoft Excel spreadsheet provide a practical approach that enables the attendees to apply the methods in their particular applications. Several Excel Templates and tools are provided for the attendees to implement.

Learning Objectives:

- ◆ What are the minimum contributors for a laboratory to consider for measurement uncertainty estimation?
- ◆ How are contributors considered for inclusion in the uncertainty budget?
- ◆ How to build a Measurement Uncertainty Budget and interpret it for future improvement of the measurement process?