



# IIGDT Training

## “Applied Dimensional Metrology”



**Objective:** To provide fundamental to advanced information in applications and analysis of measurement equipment used to determine compliance to mechanical engineering drawings per the ASME Y14.5M standards.

**Course Length:** 3 days

### Course Content:

#### Introduction to Measurement

- Measurement Error Sources

#### Precision hand tools and hard gaging:

- Micrometers, Calipers, Indicators, pin & ring gages and thread gaging.

#### Bench top measurement instruments:

- Height Gages, Bore Gages, Fixture Gages and Laser Micrometers.

#### Surface and form instruments:

- Profilometers, Contour Measurement, Roundness and Cylindricity Systems.

#### Optical measurement systems:

- Optical Comparators, Toolmaker’s Microscopes, Viewing Systems and Video Measurement Systems.

#### Contact coordinate measuring machines:

- Manual & Automatic CMMs, Single Point Touch Sensors & Scanning Sensors and Measuring Arms.

#### Multi sensor and hybrid coordinate measuring machines:

- Video Sensors, Laser Sensors, White Light Interferometers and Micro Probes.

#### Methods for analyzing and interpreting data results (2D & 3D)

- PC-DMIS, Measure-X, MeasureMind, VMS & SmartProfile Software
- Working with CAD and Measurement Data (Point Clouds)
- Understanding Least-Squares -vs- Minimum-Zone Fitting
- Understanding Criticality of Simultaneity Requirements within ASME Y14.5 Standard

#### Measurement Uncertainty / Traceability

- Gage Repeatability & Reproducibility (corrected and uncorrected error sources)
- Limitations of GR&R and Benefits of Measurement Uncertainty
- Step by Step Approach in Calculating Measurement Uncertainty
- Task-based -vs- Feature-based Measurement Uncertainty
- Traceability (NIST,  $U_{95}$ )

In each subject group an overview of the tools is followed by a demonstration of best application practices and a discussion of measurement uncertainty factors. Each subject session is concluded with a hands-on lab activity.

Various parts will be utilized during this seminar to provide the greatest understanding of measurement technology applicable to multiple industries. Students are encouraged to bring a part (with CAD modal and drawing) that represents their measurement challenges.

**Prerequisites:** GD&T Introduction & Fundamental Principles or equivalent knowledge

### Who should attend?

This course is for those who require a greater understanding of the state of technology in measurement systems used for the measurement of components and assemblies dimensioned and toleranced per the ASME Y14.5 standards from an advanced applications and analysis perspective. Specifiers of engineering requirements as well as specifiers of manufacturing processes and measurement applications will greatly benefit. Machinists, toolmakers, designers, senior inspectors, senior technicians and engineers (all levels)