PD449
Mechanical Tolerancing for Six Sigma

Day One

Module 1: Introduction
- Identifying sources of variation in your design
- Determining how variation drives manufacturing cost
- Documenting how variation impacts design requirements
- Defining assembly requirements for your designs

Module 2: Assigning Component Dimensions and Variation Controls
- Modeling unilateral, unequal bilateral, and bilateral tolerances
- Minimizing the number parts outside the tolerance limits
- Modeling purchased parts
- Modeling in CAD
- Best tolerancing practices
- Establishing (GD&T) datums and applying variation controls to features
- Defining material condition modifiers
  - Maximum Material Condition (MMC)
  - Least Material Condition (LMC)
  - Regardless of Feature Size (RFS)
  - “Competing” requirements

Module 3: Creating the Dimensional Loop Diagram
- Generating 1-D loop diagrams
  - Horizontal loop
- Vertical loop
- Determining component sensitivities
- Writing the assembly requirement equation

Module 4: Analyzing Tolerances
- Difference between analysis and allocation
- Understand the risks and benefits of three classical analysis methods
  - Worst-case tolerancing model
  - Root Sum of the Squares (RSS) tolerancing model
  - Modified Root Sum of the Squares (MRSS) tolerancing model
- Analyze tolerance stacks using classical methods
- Defining “fixed” and “variable” tolerances
- Adjusting parameters to meet assembly requirements
- “Weighting” individual components
Module 5: Modeling Geometric Controls
- Analyzing the 14 geometric controls in stacks
  - Modeling the controls
  - When to include the geometric control in the loop diagram
- Modeling the effects of material condition modifiers
  - Features at MMC
  - Features at LMC
  - Features at RFS

Day Two
Module 6: Reviewing Six Sigma
- Using a Normal distribution Z table to determine the probability of defects
  - Single spec limits (USL or LSL)
  - Dual spec limits (USL and LSL)
- Converting short-term data to long-term data
- Estimating the number of good parts that the process will yield
- Capability indices (Cp and Cpk)

Module 7: Allocating Tolerances
- Allocating tolerances using two methods
  - Worst-case allocation model
  - Statistical allocation model
- Sources of process variation
- Calculating dpos for assembly requirements.
- Calculating dpos for components (part dimensions)
- Adjustments to meet quality goals.

Module 8: MechTOL™ Lite
- Using the MechTOL™ Lite spreadsheet (Excel®) to automate analysis and allocation

Module 9: Communicating Statistical Tolerances to Manufacturing
- Differences between statistical tolerances and worst-case tolerances
- Applying the statistical tolerancing symbol
- Applying a statistical tolerance along with a worst-case tolerance
- Understanding the risks of not communicating statistical requirements

Module 10: Summary
- Analysis versus allocation
  - Benefits
  - Risks
- Mechanical tolerancing for Six Sigma