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# Geometric Dimensioning & Tolerancing (GD&T)

## Applications and Tolerance Stacks

### Course No. 537

**FOR WHOM INTENDED:** Course 537 is an advanced course for design engineers, drafters, manufacturing engineers, quality engineers and others involved with tolerance analysis or drawing review. Anyone who needs to understand how to apply geometric tolerancing and perform tolerance analysis will greatly benefit.

**BRIEF COURSE DESCRIPTION:** People may understand the fundamentals of GD&T such as datums, position with MMC and RFS modifiers, parallelism, profile etc. However they may lack the intimate knowledge of how to expertly apply geometric tolerancing and perform tolerance stacks and analysis to clearly define and optimize their product design.

Tolerance stacks are an important tool used to evaluate the variable features and dimensions of a single part or an assembly of parts. Tolerance stacks are used in the calculation of fits and fit-ups, tolerance accumulation/allocation, datum selection and the use of feature modifiers and datum modifiers.

This course teaches personnel how to apply GD&T and perform tolerance stacks using a series of case study problems including sheet metal, machinings, plastic parts, castings etc. The entire course is 17 units; organizations may select problems as appropriate to customize the program to meet students' needs.

The Tolerance stacks section is designed to teach students how to calculate linear, axial and orientation stacks using parts toleranced with either plus/minus or geometric tolerancing. Student hands-on exercises consist of a variety of case studies on both details and assemblies.

The remaining units contain case study examples where students must establish datum reference frames and apply geometric tolerancing based on clearly defined functional requirements. Afterwards, they perform tolerance stacks to ensure design requirements are met. The problems gradually increase in complexity. Students will apply concepts learned in early lessons to progress to later lessons. Applications may be selected to match the client organization's products and processes.

Lessons in the Stacks section may be alternated with lessons in the Applications section, to provide variety and make the stacks calculations less taxing. This also demonstrates that proper selection of the datums, as well as position and profile values on individual parts, have a great effect on the tolerance accumulation in the overall assembly.

This program provides creative procedures using tables and simple formulas to break the most complex problems into simpler segments. It gives tips and suggestions on how and when to add up form, orientation and location variations due to varying manufacturing processes.

**DIPLOMA PROGRAMS:** This course may be used as an elective for TTI's [Metrology/Calibration Specialist \(MSC\)](#), or [Mechanical Design Specialist \(MDS\)](#) Diploma Programs, or for any other [TTi specialist diploma program](#).

**RELATED COURSES:** For an introduction to GD&T, see TTI Course 535, [Geometric Dimensioning and Tolerancing \(GD&T\) to ASME Y14.5-2009](#). Course 536, [Intermediate/Advanced GD&T](#), picks up where Course 535 leaves off.

**PREREQUISITES:** Students should have completed TTI course 535, or have equivalent experience.

**TEXT** Each student will receive a course workbook, *GeoTol Applications and Tolerance Stacks*, by Scott Neumann and Al Neumann, 2012.

**CERTIFICATE AND CEUs** Upon successful course completion, each participant receives a certificate of completion and one Continuing Education Unit (CEU) for every ten class hours.

### Course Outline

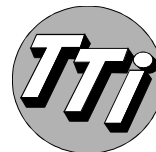
Introduction

#### Tolerance Stacks

Plus/Minus Stacks: Bilateral tolerances • Unequal Tolerances Example • Limit Tolerances • Spool Exercise • 4-part, 7-part Assembly Exercises  
Profile Detail Stacks: Form/Orientation Tolerance Considerations • Hub, Hole Bar & Shaft Exercises  
Profile Assembly Stacks: Form and Orientation Tolerance Considerations • Cage Assembly, Loose Fit and Shaft Assembly Exercises  
Boundary Detail Stacks: Calculating MMB/LMB • Position RFS/MMC/LMC Boundaries • Profile and Runout Boundary Ex. • Position MMC and LMC Boundary Ex. • Stack Table Data Entry Exercise • Hole Edges and Hole-to-Edge Stack Exercises  
Boundary Assembly Stacks: Boundary Formula Review • Cap and Sleeve/RFS/MMC Exercises • Alignment Assembly Pin to Cage Exercise • Stack Table Datum Shift and Size Only (So) Exercises • Datum Modifier Evaluation Exercise • Cap/Sleeve MMB Datum and MMC Feature/Datum Exercises • Hub Assembly and Pilot Tube Assembly Exercises • Switch Assembly Exercise  
Orientation Stacks: Hub and Poker Pin Exercises

#### Applications

Introduction to Design Applications: Floating/Fixed Fastener Formulas • Projected Tolerance Zone  
Specific Design Applications  
Grommet Assembly  
Powder Case Assembly  
Fuel Cooler Bracket  
Valve Assembly  
Step Bracket Assembly  
Regulator Mounting Bracket  
Optic Connector Assembly  
Mixer Assembly  
Alternator Bracket  
Link Assembly  
Summary and Review  
Award of Certificates for Successful Completion



## Technology Training, Inc.

(a tti group company)

Toll-free telephone:

866-884-4338 (866-TTi-4edu)

805-845-5050

E-mail: [Training@ttiedu.com](mailto:Training@ttiedu.com)

[www.ttiedu.com](http://www.ttiedu.com)