CADSAGA

"GD&T + Tolerance Stack-up Analysis"

Course Contents

GD&T: What, Where, When, Why.. ?

- Introduction to GD&T? What is GD&T and NOT?
- 14 GD&T Symbols

- Feature Control Frame (FCF) and its placement
- Part Features, Feature of Size, Non-size Features
- Modifier symbols: MMC, LMC, RFS
- When to use MMC, LMC and RFS modifier in design
- Bonus tolerance calculations
- Rule # 1 and Rule # 2

Virtual Condition Boundary

- Virtual condition calculations
- 100% interchangeability guarantee in design phase itself by using virtual condition correctly
- Classroom exercise for virtual condition

Form Tolerances

- Straightness tolerances for line elements
- Flatness tolerance for single planar feature
- Circularity Tolerance
- Cylindricity Tolerance
- Inspection methods to verify form tolerances

Datums

- What is datum?
- Six Degrees of Freedom
- 3-2-1 Principle
- Datum Reference Frame (DRF)
- Datum Feature Selection, Functional Hierarchy
- Datum feature identification / placements and interpretation
- Datum plane, datum axis, Datum center plane
- Datum feature simulators
- Datum feature qualification
- Importance of Datum Precedence
- Selection of datum features according to the design intent

Orientation Tolerances

- Perpendicularity tolerance
- Parallelism tolerance
- Angularity tolerance
- When do we use Orientation Tolerance?
- Datums for Orientation Control
- Inspection methods to verify orientation tolerances

Location Tolerances

A) Position Tolerance

- Position tolerance for cylindrical features (holes / shafts) on MMC, LMC and RFS basis
- Detailed table calculations for position tolerance on MMC, LMC and RFS
- Position on Boundary basis for rectangular or oblong slots
- Datums for Position Control
- Inspection methods to verify position tolerances
- Class room exercise for position

B) Runout Tolerances

- Circular Runout Tolerance
- Total Run out Tolerance
- Datums for Run out Controls
- Inspection methods to verify runout tolerances

C) Profile Tolerances

- Profile of a Line Tolerance
- Profile of a Surface Tolerance
- Profile Tolerance Zones: Bi-lateral type default tolerance zone
- Controlling extent of profile tolerance
- Inspection methods to verify Profile tolerances
- Class room exercise for profile

D) Concentricity & Symmetry Tolerances

(Deleted in ASME Y14.5 2018 standard)

- Overview of Concentricity Tolerance
- Overview of Symmetry Tolerance
- Inspection methods to verify concentricity & symmetry tolerances

Gauges to verify Geometrical tolerances

- Functional / Fixed Gauges:
  - Go-Gauges / No Go-Gauges
  - Functional Gauges (Also known as Attribute / Fixed / Receiving / Qualifying gauges)
  - Gauge design exercises
- Variable Gauges
- Various geometrical tolerance inspection tools

"Tolerance Stack-up Analysis"

Introduction to Stack-up methodology

- Importance of Tolerance Stack-up Analysis: Why, when and how
- Introduction to Tolerance Stack-up Analysis:
  - Coordinate dimensioning and tolerancing stacks
  - GD&T stacks
  - Statistical tolerancing stacks: RSS and MRSS
- Methodical steps involved in any stack-up analysis
  - Loop diagram creation
  - Universal sign language of tolerance stack-up analysis
  - Identification of correct dimensional contributors (vectors)
  - Two-column method introduction and applications
  - Drawing improvements to reduce tolerance stack-up

Part Level Stack-up Analysis

- Part stacks using coordinate dimensioning and tolerancing
- Part stacks using position
  - Review of Virtual Condition (VC) Boundary
- Part stacks using profile
- Part stacks using runout
- Part stacks using position (planar & RFS datums)
- Part stacks using position with bonus tolerance and datum feature shift (MMC & MMB datum)
- Part stacks using combined geometric tolerances

Assembly Level Stack-up Analysis

- Assembly stacks using coordinate dimensioning and tolerancing
- Assembly stacks using position:
  - Floating fastener assembly stack-up
  - Fixed fastener assembly stack-up
- Assembly stacks using position at MMC and datum at MMB
- Assembly stack using profile
- Assembly stack using runout
- Assembly stack using combined geometric tolerances
- Stacks using form controls applied to a feature
- Stacks using orientation controls applied to a feature without size
- Stacks using orientation controls applied to a feature of size (FOS)
- Introduction to Statistical Tolerancing:
  - RSS (Root Sum Square) Stacks
  - MRSS (Modified Root Sum Square) Stacks
- Comparison between Worst-case method, RSS & MRSS methods
- Assembly stack using statistical tolerancing

Contact

Mr. Swapnil Gujarathi

Senior GD&T Trainer: ASME-GD&T & ISO-GPS
Certified ASME GD&T Senior-Level Professional

CADSaga Consultancy Services

7, Vihar Sankul, Tidake Nagar,
Untwadi, Nashik - 422009

+91 90110 81591 swapnil@cadsaga.com www.cadsaga.com

Thank You !