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GD&T Reckoner
Course reference material for

A Web-based learning system from

Symphony Technologies

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This is not the complete document.
Only Sample pages are included.

The complete document is available to registered users of GD&T WEB Tutor, a web based GD&T learning course.

Visit
http://www.symphonytech.com/gdtwebtutor.htm
For details

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GD&T WEB Tutor

GD&T Web Tutor is a web based learning system for Geometric Dimensioning & Tolerancing. The learning content is updated to the ASME Y14.5 2009 standard.

This reference material serves as a Reckoner for the topics you learn with GD&T WEB Tutor. It summarizes and tabulates key concepts of GD&T to serve you as a ready reference

GD&T WEB Tutor organizes lessons in a logical sequence, convenient for learning. Each lesson is explained by powerful graphics and animations, and a simple language voice narration. Examples of each concept that you learn makes it easy to visualize the application of the concept.

You may repeat the lesson a number of times to make your understanding clearer.

GD&T WEB Tutor has 5 workouts in quiz format. These help you evaluate your GD&T knowledge.

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Learning Content

GD&T WEB Tutor organizes the GD&T learning content as shown below. This may be updated from time-to-time as we go on fine tuning or enhancing the course content.

GD&T System
- Feature Control Frames
- Definitions of Terms
- Classification of Features

Virtual Conditions
- Understanding MMC and LMC
- Virtual Conditions with MMC
- Virtual Conditions with LMC
- Defining Tolerances RFS

Bonus Tolerance
- Understanding Bonus Tolerance
- Bonus Tolerance for MMC Virtual Conditions
- Bonus Tolerance for LMC Virtual Conditions

Workout 1 – GD&T System, Virtual Conditions and Bonus Tolerance

Rules of GD&T
- Rule #1
- Rule #2

Datums
- Introduction to Datums
- Definitions Related to Datums
- Principles of Datum Specification
- Surface Datums
- Datums on Features of Size
- Datums applied with Maximum Material Boundary
- Datums applied with Least Material Boundary
- Datums applied Regardless of Material Boundary

Workout 2 – Datums

Orientation Tolerances
- Overview of Orientation Tolerances
- Parallelism Tolerance
- Perpendicularity Tolerance
- Projected Tolerance Zone
- Angularity Tolerance

Learning Content (continued)

Learning content covered by GD&T WEB Tutor continued from the last page…

Location Tolerances
- Overview of Location Tolerances
- Positional Tolerance
- Positional Tolerance Applied at MMC
- Positional Tolerance Applied at LMC
- Positional Tolerance Applied RFS
- Composite Positional Tolerancing
- Concentricity Tolerance
- Symmetry Tolerance

Workout 3 – Orientation Tolerances and Location Tolerances

Form Tolerances
- Overview of Form Tolerances
- Straightness Tolerance
- Flatness Tolerance
- Roundness Tolerance
- Cylindricity Tolerance

Runout Tolerances
- Circular Runout Tolerance
- Total Runout Tolerances

Profile Tolerances
- Profile of a Line
- Profile of a Surface

Workout 4 – Form Tolerances, Runout Tolerances and Profile Tolerances

Formulas for determining Positional Tolerances
- Floating Fastener Case
- Fixed Fastener Case

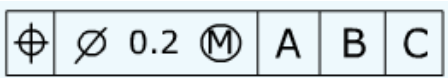
Functional Gage Design
- Principles of Functional Gage Design
- Example of a Functional Gage

GD&T Symbols overview
- Symbols covered in the course above
- Additional Symbols

Workout 5 – All Other Topics

The GD&T System

Feature Control Frames



Geometric Tolerances are expressed using Feature Control Frames. You learn about the composition of a feature control frame in this lesson. Note the presentation of

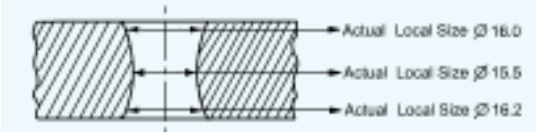
- Tolerance symbols
- Tolerance zone shapes
- Tolerance values
- Modifiers
- Datums
- Modifiers applied to datums

in the feature control frame.

Definitions of terms

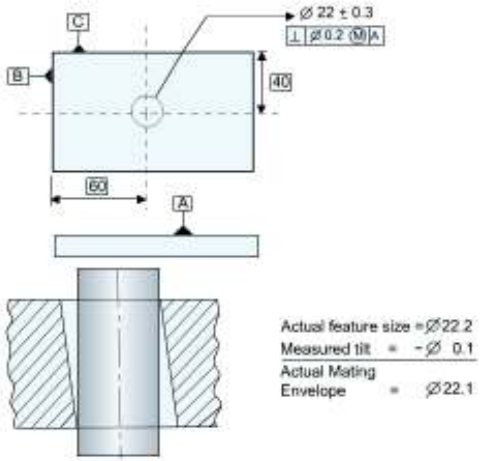
Actual Local Size

Study the definition of actual local size for a feature



Definition- Actual Mating Envelope

Study the definition of actual mating envelope for a feature



Virtual Conditions

Defining MMC & LMC

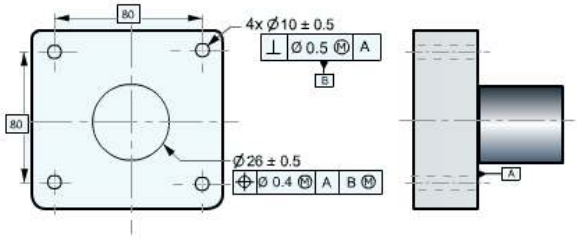
Maximum Material Condition (MMC) and Least Material Condition (LMC) are defined for Features of Size.

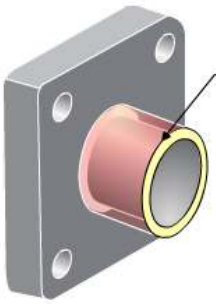
Learn through examples in this lesson how MMC and LMC are defined.

Virtual Condition with MMC

Virtual Conditions are defined for features of size. Virtual conditions are extreme case envelopes that account for combined variation due to size tolerance as well as geometric tolerances.

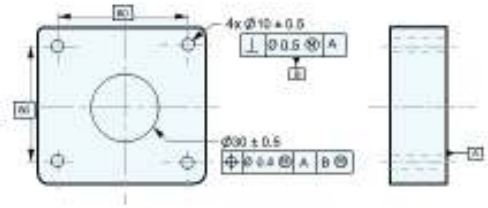
Note through the examples and animated explanations, how Virtual Conditions defined with the MMC modifier help you design functional fit ad assembly of mating components.





Virtual Condition:

Pin MMC	Ø 26.5
Pin ⌖	+ Ø 0.4
Pin Virtual Condition	Ø 26.9

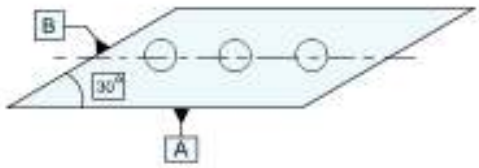


Datums

What are Datums

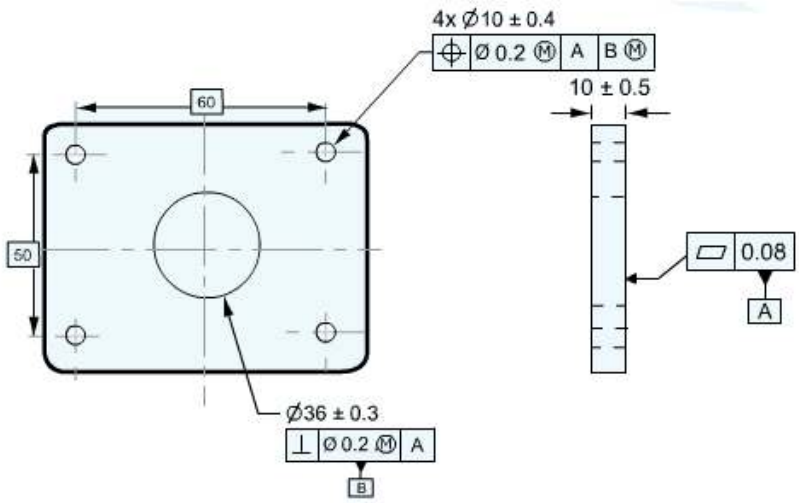
Datums are reference features from which location, orientation, shape or runout of the geometry is defined.
Understand through the explanations in this lesson how datums are derived from features, and how the unevenness in actual features is accounted for while deriving datums from these.
Datums applied on nominally planar surfaces are explained in this lesson. Application of nominally angular surface datums, as well datums defined multiple planar surfaces are also explored.
Understand the application of Datum Targets to achieve a uniformity of datum location.
Datums derived from Features of Size are discussed in these lessons. Note the difference between applying datums on Features of Size at MMB, LMB and RMB. Examples of applications of surface datums and FOS datums at MMB, LMB and RMB are shown here.

Surface Datums



Datums on Features of Size:

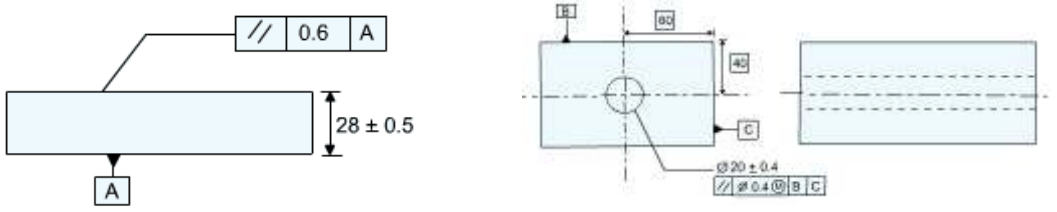
Datums applied at Maximum Material Boundary



Geometric Tolerances

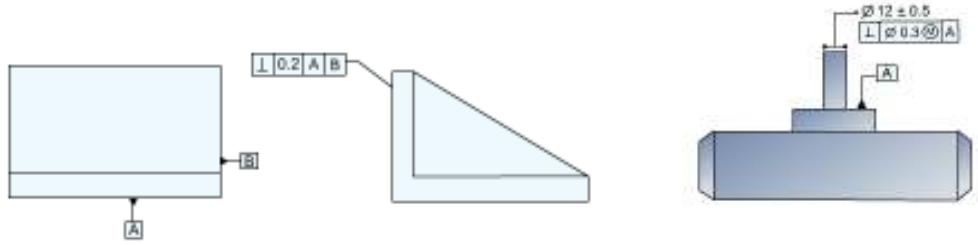
Tolerances of Orientation

Parallelism



Tolerance	Applies to	Applied with Ø symbol	Whether applied RFS	Modifiers allowed
Parallelism on Surfaces	Surfaces	No	Yes	Ⓣ
Parallelism on Features of Size	Features of Size	Can be applied with Ø as well as without Ø symbol	Can be applied RFS as well as with MMC or LMC modifiers	Ⓜ Ⓛ Ⓟ

Perpendicularity

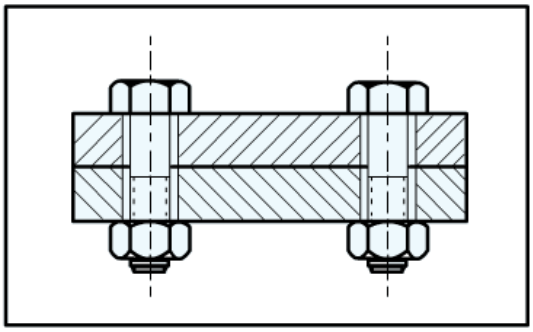


Tolerance	Applies to	Applied with Ø symbol	Whether applied RFS	Modifiers allowed
Perpendicularity on Surfaces	Surfaces	No	Yes	Ⓣ
Perpendicularity on Features of Size	Features of Size	Can be applied with Ø as well as without Ø symbol	Can be applied RFS as well as with MMC or LMC modifiers	Ⓜ Ⓛ Ⓟ

Formulas for determining Position Tolerance

In this lesson, you understand how formulas for determining positional tolerance for fastener related features in component assemblies are derived. Examples illustrate the formulas used for floating fastener and fixed fastener cases.

Floating Fastener Case



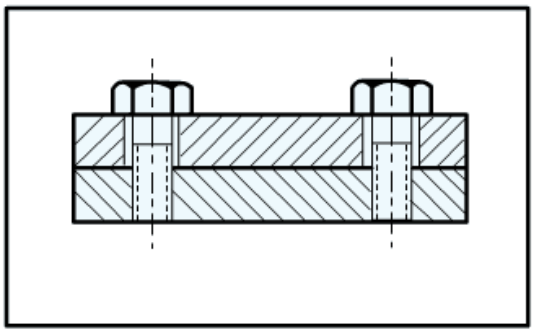
$T = H - F$

T = Diameter of the cylindrical tolerance zone on the position of each hole

H = Minimum diameter of the hole (hole MMC)

F = Maximum diameter of the fastener (fastener MMC)

Fixed Fastener Case



$H = F + T_1 + T_2$

H = Minimum diameter of the clearance hole (clearance hole MMC)

F = Maximum diameter of the fastener (fastener MMC)

T_1 = Positional tolerance on the clearance hole

T_2 = Positional tolerance of the or tight fitting hole

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GD&T Symbols Reckoner

Shown below are the GD&T symbols that we learn about in the GD&T WEB Tutor course.

Tolerance Type	Characteristic	Symbol
Form	Straightness	
	Flatness	
	Circularity (Roundness)	
	Cylindricity	
Profile	Profile of a Line	
	Profile of a Surface	
Orientation	Angularity	
	Perpendicularity	
	Parallelism	
Location	Position	
	Concentricity	
	Symmetry	
Runout	Circular Runout	
	Total Runout	

Characteristic	Symbol
Maximum Material Condition	Ⓜ
Least Material Condition	Ⓛ
Projected Tolerance Zone	Ⓟ
Reference Dimension	( )
Basic Dimension	
Datum Feature	
All Around	
Regardless of Feature size	Ⓢ
Diameter	Ø

Characteristic	Symbol
Free State	Ⓕ
Tangent Plane	Ⓣ
Radius	R
Controlled Radius	CR
All Around	
Arc Length	
Statistical Tolerance	ST
Counterbore & Spotface	
Countersink	
Depth	
Dimension Origin	
Flat Taper	
Conical Taper	
All Over	
Continuous Features	CF