GETTING GD&T WITHOUT GD&T

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ABSTRACT

Some engineers invoke a note stating the drawing was prepared in accordance with ASME Y14.5 GD&T standard and then promptly ignore the standard. However, there are a set of basic design and drawing interpretations and requirements that are part of the GD&T standard that do not require any geometric controls to be placed on the drawing to still affect the drawing. This presentation will quickly go over the critical items for the basic drafting and design rules of the GD&T standard.

SECTION 4
Fundamental Rules, Tolerancing Defaults, and Dimensioning Practices

- This section describes all the fundamental rules used in Engineering Drawings according to ASME Y14.5-2018 (R2024).
- There are no “GD&T” symbols in this section, however many items in this section affect how dimensions and tolerances are applied and interpreted.
- Traditionally this was a class called “DRAFTING”.
- These are the non-GD&T rules that the standard requires when you state “INTERPRET THIS DRAWING USING ASME Y14.5-2018”.

WHY IS THIS IMPORTANT?

- A poor analogy but if we consider Geometric Dimensioning and Tolerances an engineering language then:
  - The objects and features are the nouns
  - The dimensions are the adjectives
  - The finish could be the adverbs
- Identifying the parts of speech does not help you form sentences, we need structure and punctuation.
  - Some engineers will add note “Interpret this drawing per ASME Y14.5-2018” then ignore it but you really can’t.

SECTION 4
What's Important?

There are four sections of importance to designers:

- 4.1 Fundamental Rules
- 4.4 Application of Dimensions
- 4.5 Dimensioning Features
- 4.6 Location of Features

There are two sections of less importance:

- 4.2 Units of Measure – both millimeters or inches are acceptable
- 4.3 Type of Dimensions – millimeters and inches rules

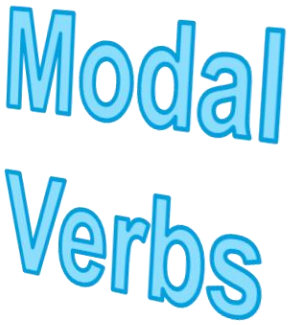
1.4.1 CONVENTIONS IN THE STANDARD

Requirements

- “shall” = requirement
- “will” = declaration

Recommendations

- “should” = recommendation
- “may” = allowable



SECTION 4
4.1 FUNDAMENTAL RULES

a) Each feature **shall** be toleranced.

b) Dimensioning and tolerances **should** be complete.

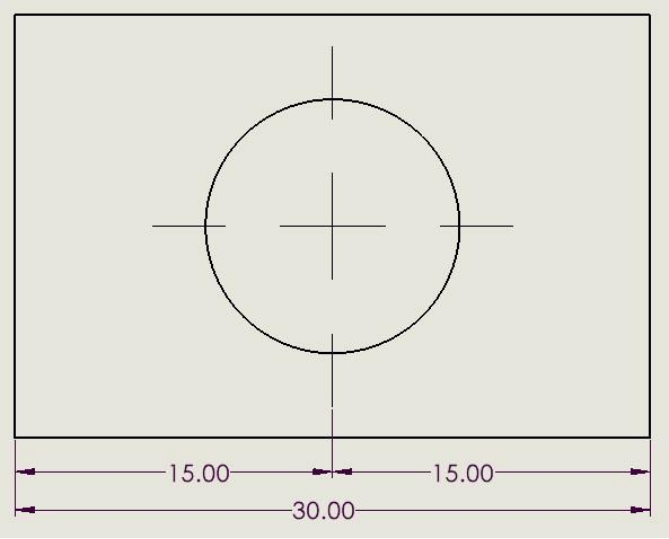
- ***Applies to be 2D drawings and 3D models***
  - ***Includes Model Based Definition (MBD)***

SECTION 4
4.1 FUNDAMENTAL RULES

c) Extra dimensions **shall** not be used.

– reference dimensions **should** be minimized.

- ***Don't double dimension!***



SECTION 4
4.1 FUNDAMENTAL RULES

d) Dimensioning **shall** be based on function.

e) Dimensions **should** define part without manufacturing methods.

- ***Don't include "DRILL, TAP, REAM, GRIND, etc."***

f) Nonmandatory processing dimensions **shall** be noted.

- ***Shrinkage, finish allowance***

g) Dimension **should** be readable.

- ***"in a pleasing manner that makes sense"***

SECTION 4
4.1 FUNDAMENTAL RULES

h) Dimensions **should** be in true profile.

- ***3D CAD makes adding an auxiliary view at the correct orientation easy!***

i) Features made to gage or code numbers **shall** use linear numbers with gage or code numbers in parenthesis.

j) Implied 90° between feature or center lines unless noted.

k) Implied 90° basic angle between features or surfaces unless noted.

SECTION 4
4.1 FUNDAMENTAL RULES

l) Implied zero basic dimension **shall** apply when axes, center places, or surfaces are coincident.

m) Unless otherwise specified, all dimensions and tolerances are applicable at 20°C (68°F).

n) Unless otherwise specified (UOS), all dimensions and tolerances are applicable in the free state.

- ***No implied forces other than gravity***

o) Unless otherwise specified, all dimensions and tolerances are applicable for full depth, length and width of the feature.

- ***This is the reason you can't use a pair of calipers to measure the thickness of most parts***

SECTION 4
4.1 FUNDAMENTAL RULES

p) Dimensions and tolerances apply only to the drawing level they are specified.

q) Unless otherwise specified, the “as-designed” dimension value does not establish a functional or manufacturing target.

- ***For example, 10+/-2 does not imply 10 is special in any way except it is the design intent.***

r) Unless otherwise specified, coordinate systems **shall** be right-handed with axis labeled and positive direction shown.

s) Unless otherwise specified, the surface includes surface texture and / or flaws.

SECTION 4
4.4 APPLICATION OF DIMENSIONS

- 4.4.1 Dimension Lines
  - ***Don’t cross dimensions***
- 4.4.2 Extension Lines
  - ***Don’t cross dimensions or other extension lines***
- 4.4.3 Limited Length or Area Indication
  - ***Chain lines along an edge or a hatched area can be used***

SECTION 4
4.4 APPLICATION OF DIMENSIONS

- 4.4.4 Leaders
- 4.4.5 Reading Direction
  - ***Everything reads from bottom except horizontal ordinate dimensions – this is different from ISO1101***
- 4.4.6 Reference Dimension
  - ***Use ( ) not REF***
- 4.4.7 Overall Dimensions
  - ***See double dimensioning***

SECTION 4
4.4 APPLICATION OF DIMENSIONS

- 4.4.8 Dimensioning Within the Outline of a View
  - ***May be inside but shouldn't unless really needed for clarity***
- 4.4.9 Dimensions Not to Scale
  - ***2D Drawing that can't be edited – draw line under dimension***
  - ***This is not applicable to parametric modeling***

SECTION 4
4.5 DIMENSIONING FEATURES

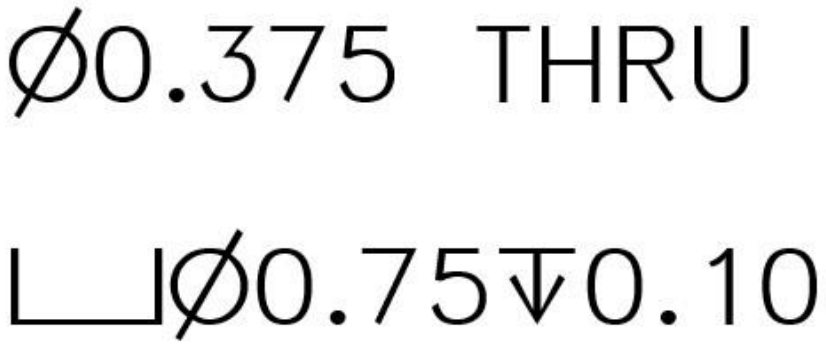
- 4.5.1 Diameters
  - ***Don't use DIA, D, ID, or OD on the face of the drawing but OK in tables***
  - ***Use diameter symbol before number***
- 4.5.2 Radii
  - ***Use R before number***
  - ***Should include radius center***
- 4.5.3 Chord and Arcs
- 4.5.4 Rounded Ends and Slotted Holes
  - ***No more FULL R***
  - ***R with no number implies FULL R***

SECTION 4
4.5 DIMENSIONING FEATURES

- 4.5.5 Rounded Corners
- 4.5.6 Outlines Consisting of Arcs
- 4.5.7 Irregular Features
- 4.5.8 Grid System
- 4.5.9 Symmetrical Outlines
  - ***Don't use CL anymore, use symmetric symbol (looks like = sign)***
- 4.5.10 Round Holes
  - ***Add THRU if it isn't clear that hole goes all the way through part***

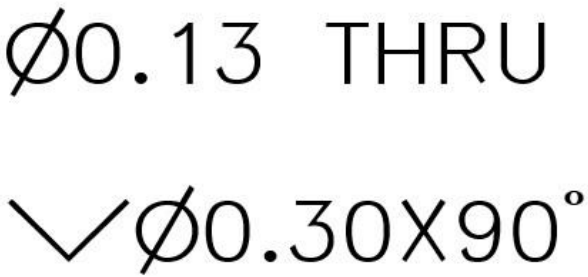
SECTION 4
4.5 DIMENSIONING FEATURES

- 4.5.11 Counterbore Holes
  - ***Don't use CBORE***
  - ***If there's a through hole then put it on the first line***
  - ***Use counterbore symbol followed by diameter symbol then diameter size followed by depth symbol and then depth***



SECTION 4
4.5 DIMENSIONING FEATURES

- 4.5.12 Countersink Holes
  - ***Don't use CSK***
  - ***If there's a through hole then put it on the first line***
  - ***Use countersink symbol followed by diameter symbol then diameter size followed by an "X" then the included angle***



SECTION 4
4.5 DIMENSIONING FEATURES

- 4.5.13 Curved Surface Holes
- 4.5.14 Spotfaces
  - ***Don't use the word SPOTFACE***
  - ***If there's a through hole then put it on the first line***
  - ***Use spotface symbol followed by diameter symbol then diameter size followed by "R" and bottom radius (if present)***
- 4.5.15 Machining Centers

SECTION 4
4.5 DIMENSIONING FEATURES

- 4.5.16 Chamfers
  - ***"Distance X Distance" or "Distance X Angle" are both allowed***
- 4.5.17 Keyseats
- 4.5.18 Knurling
- 4.5.19 Rod and Tubing Details

SECTION 4
4.5 DIMENSIONING FEATURES

- 4.5.20 Screw Threads
  - ***Refers you to ASME Y14.6***
- 4.5.21 Surface Texture
- 4.5.22 Involute Splines
- 4.5.23 Castings, Forgings, and Molded Parts

SECTION 4
4.6 LOCATION OF FEATURES

- 4.6.1 Rectangular-Coordinate Dimensioning
- 4.6.2 Rectangular-Coordinate Dimensioning without Dimension Lines
- 4.6.3 Tabular Dimensioning
- 4.6.4 Polar Coordinate Dimensioning

SECTION 4
4.6 LOCATION OF FEATURES

- 4.6.5 Repetitive Features or Dimensions
  - ***No longer use TYP (for typical), all features are now numbered***
  - ***Number of occurrences followed immediately with an X then a space, then the feature or dimension***
- 4.6.6 Use of “X” to Indicate “by”
  - ***Number space X space number***

DISCUSSION

- As stated before, these fundamental ***drafting*** rules were first documented in Drawing Requirements Manuals (DRM) and became the guidelines for drafters even before the ASME Y14 standard became as well accepted.
- As engineers increasingly take over drafting responsibilities, these guidelines must now be learned and used by all.

YOUR VOICE MATTERS!

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