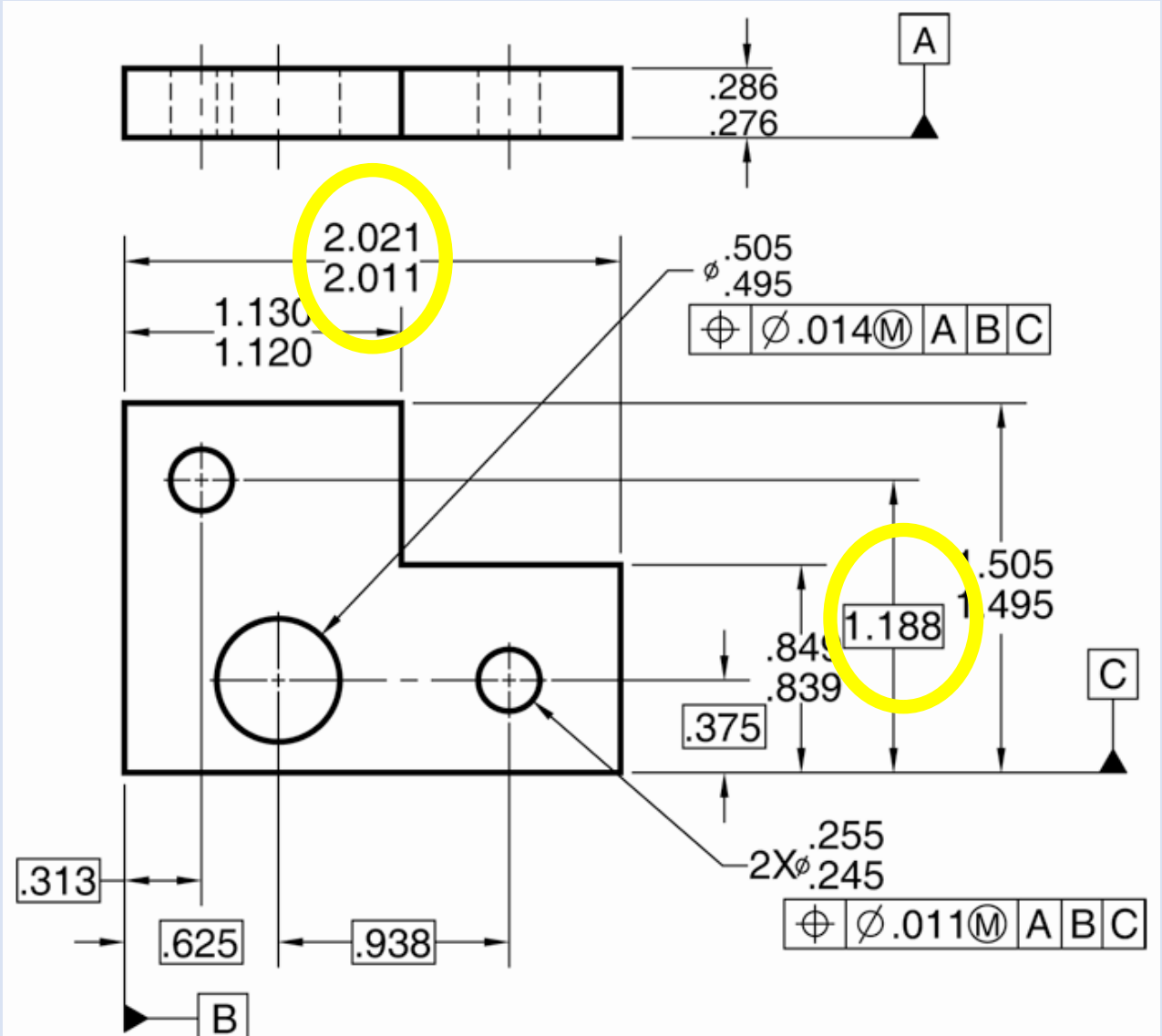
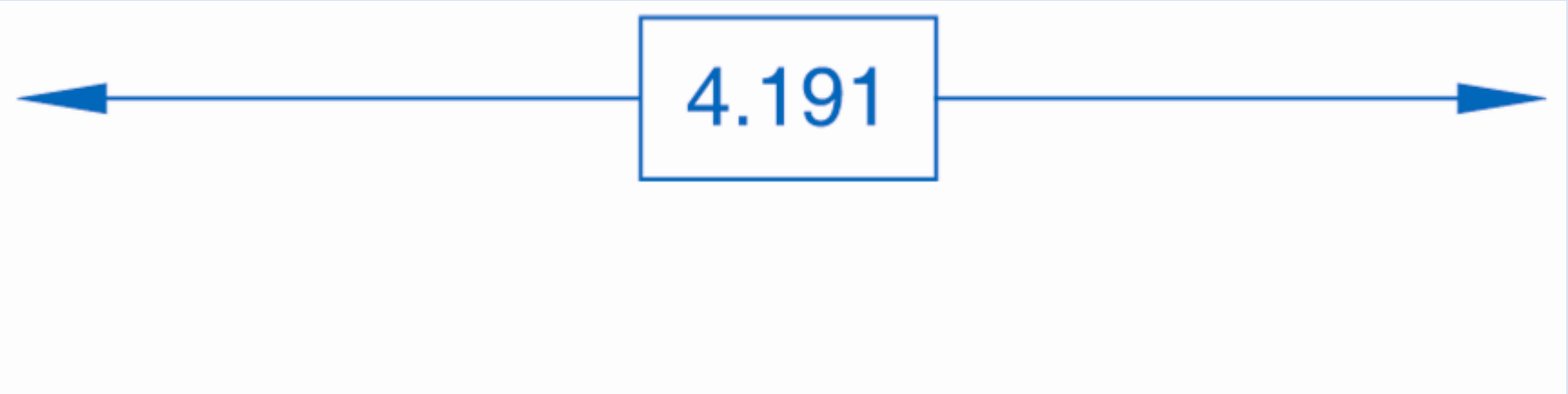
# Welcome to GD&T
# presented by
# Barrow Advanced Manufacturing

# Not everything has GD&T associations



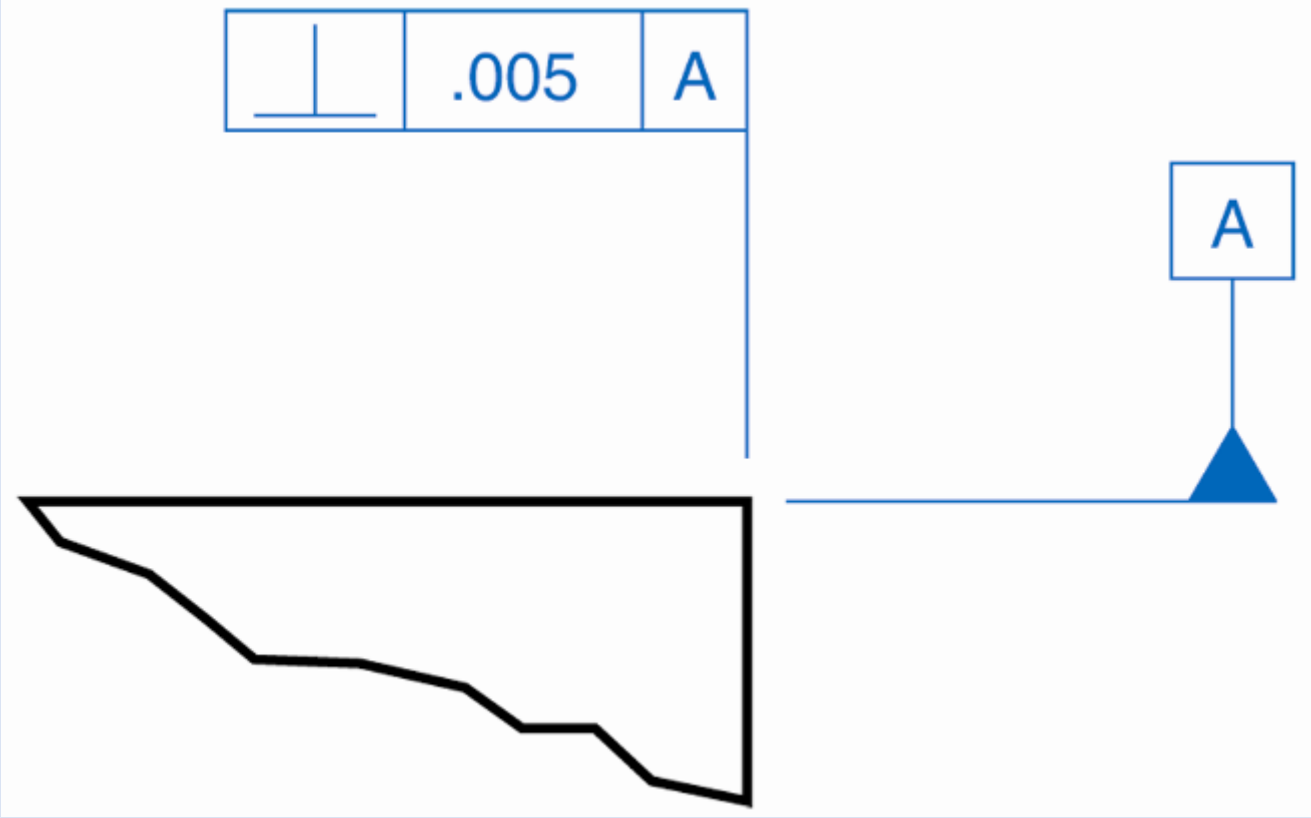
# The “Boxes” of GD&T

- Basic dimension



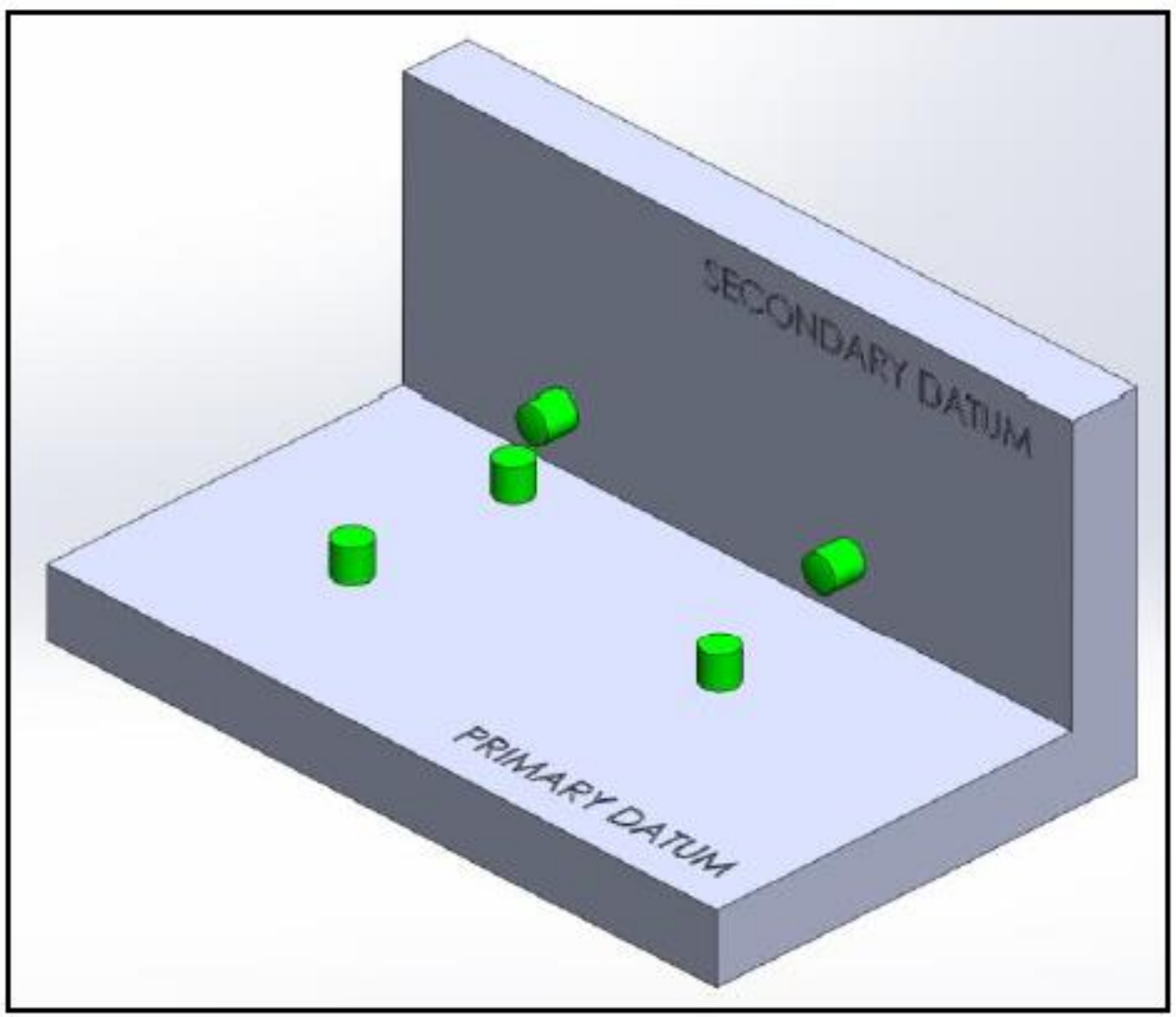
# The “Boxes” of GD&T

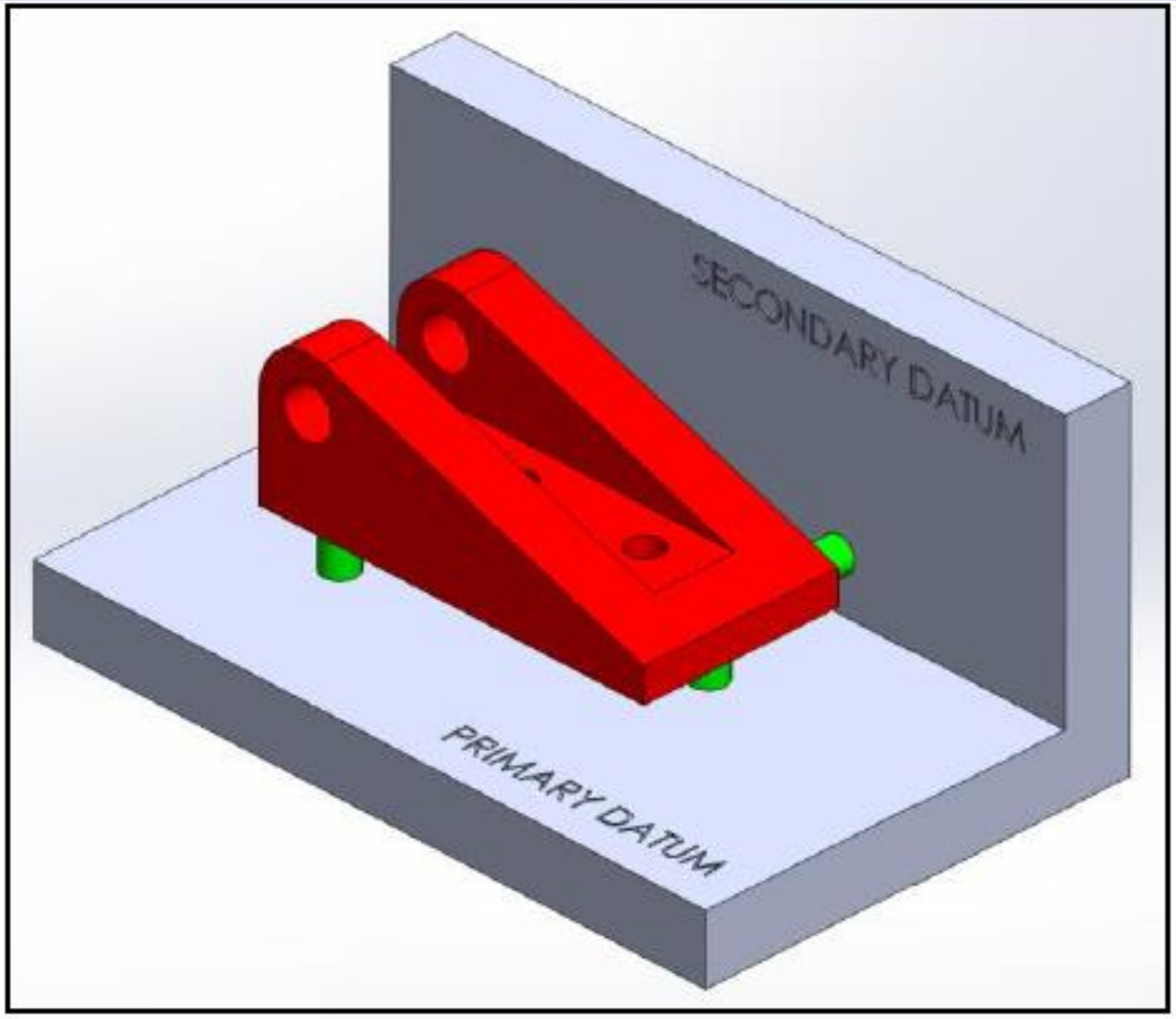
- Datum identification symbol and feature control frame



# Basic Symbols & Convention of GD&T

| Category | Characteristic | Symbol | Uses a datum reference |
|---|---|---|---|
| Form | Straightness |  | Never |
| | Flatness |  | |
| | Circularity (Roundness) |  | |
| | Cylindricity |  | |
| Profile | Profile of a line |  | Sometimes |
| | Profile of a surface |  | |
| Orientation | Angularity |  | Always |
| | Perpendicularity |  | |
| | Parallelism |  | |
| Location | Position |  | |
| | Concentricity |  | |
| | Symmetry |  | |
| Runout | Circular runout |  | |
| | Total runout |  | |


SECONDARY DATUM
PRIMARY DATUM


SECONDARY DATUM
PRIMARY DATUM

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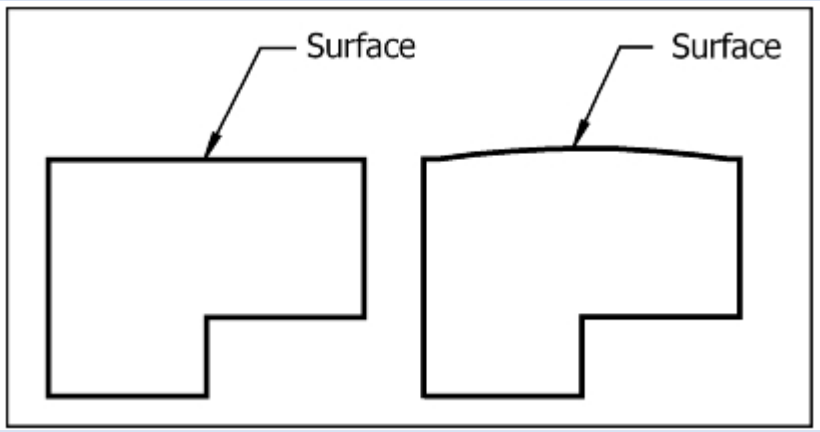
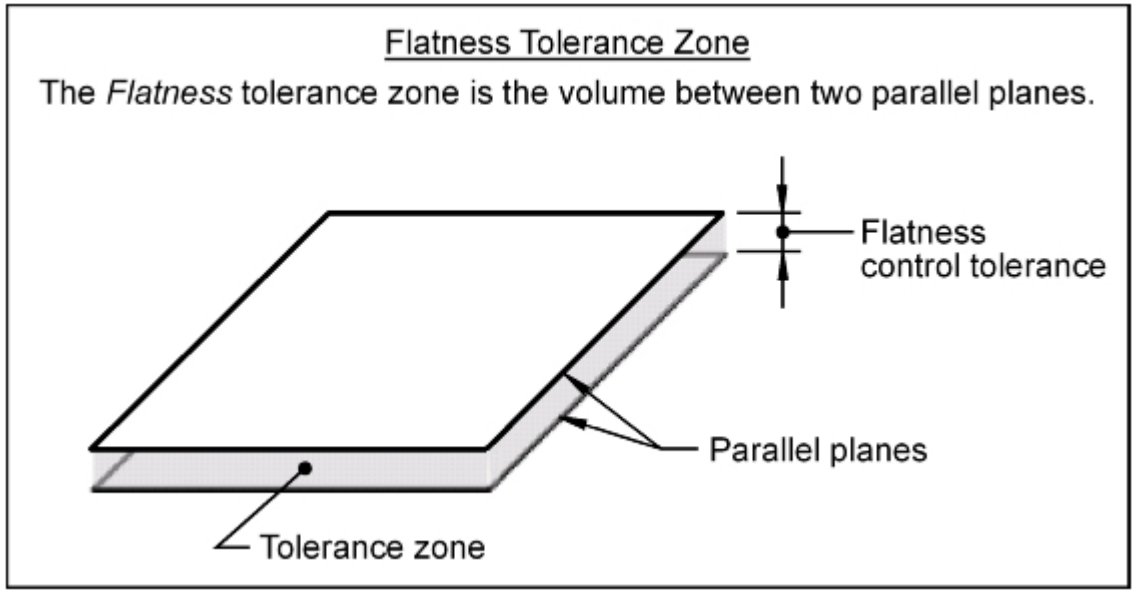
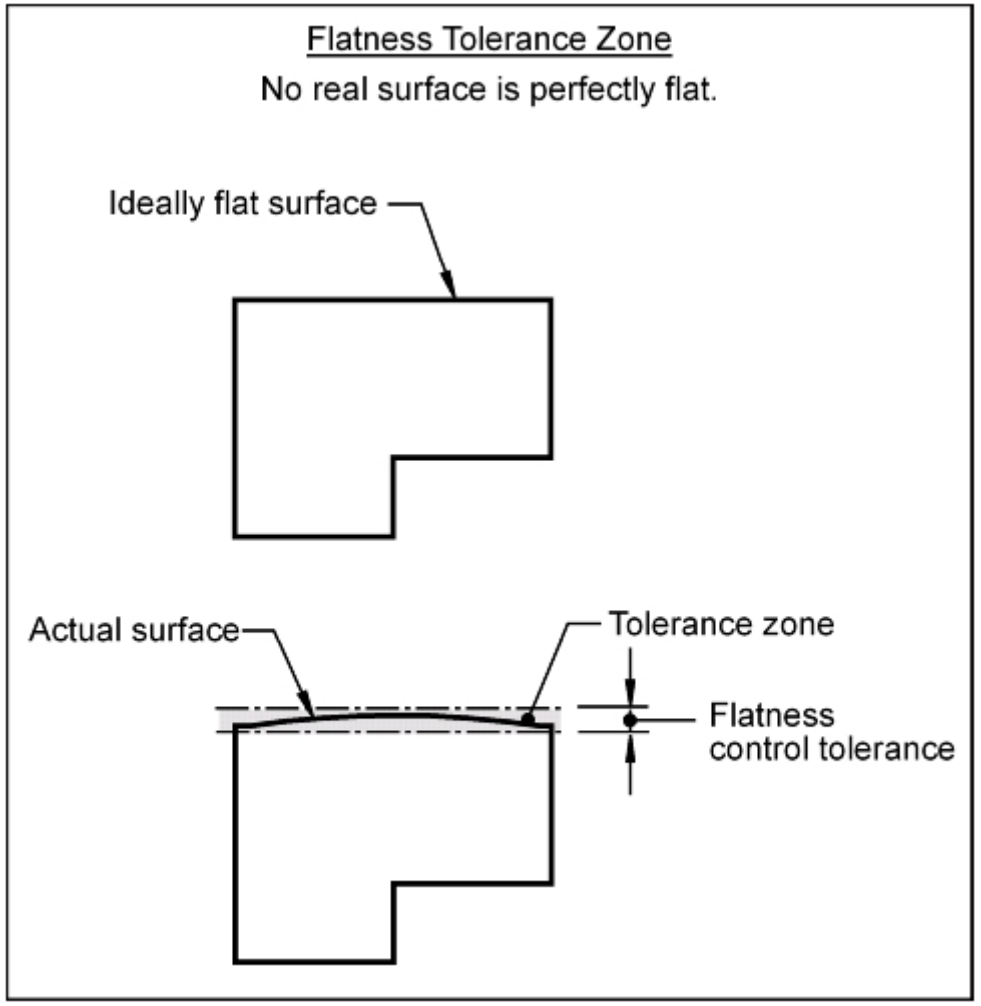
| | Profile of a surface | ⌓ | |
| Orientation | Angularity | ∠ | Always |
| | Perpendicularity | ⊥ | |
| | Parallelism | // | |
| Location | Position | ⌖ | |
| | Concentricity | ◎ | |
| | Symmetry | ⌯ | |
| Runout | Circular runout | ↗ | |
| | Total runout | ⌰ | |

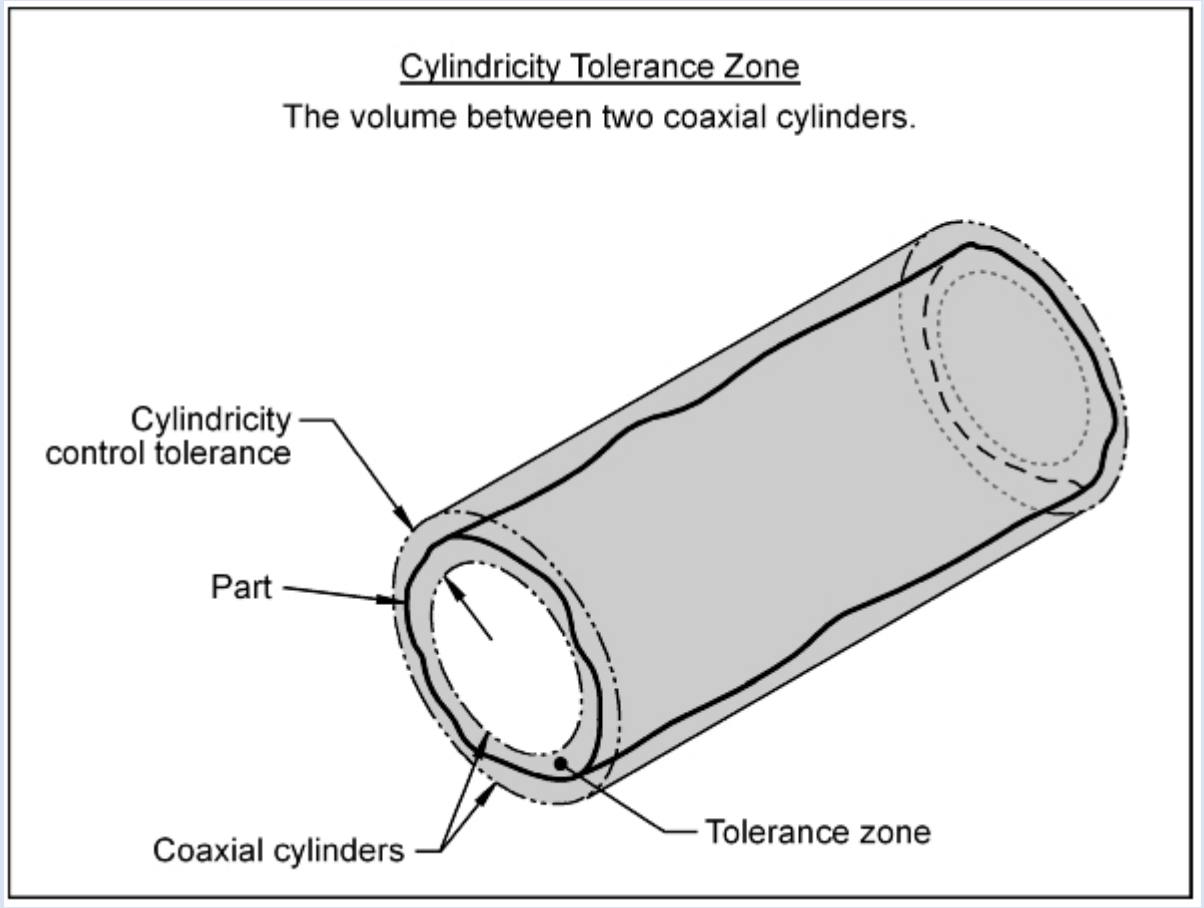
# Flatness

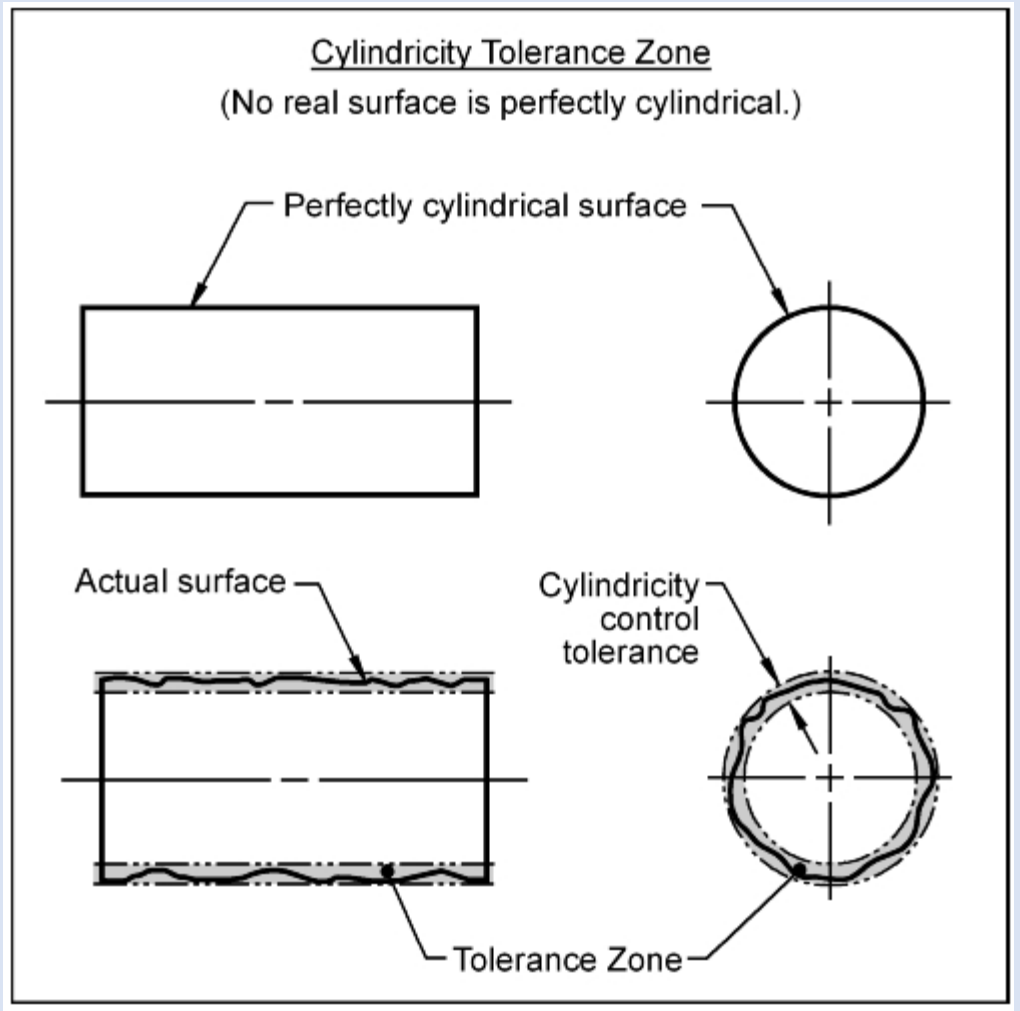

Surface
Surface


Flatness Tolerance Zone
The *Flatness* tolerance zone is the volume between two parallel planes.
Flatness
control tolerance
Parallel planes
Tolerance zone

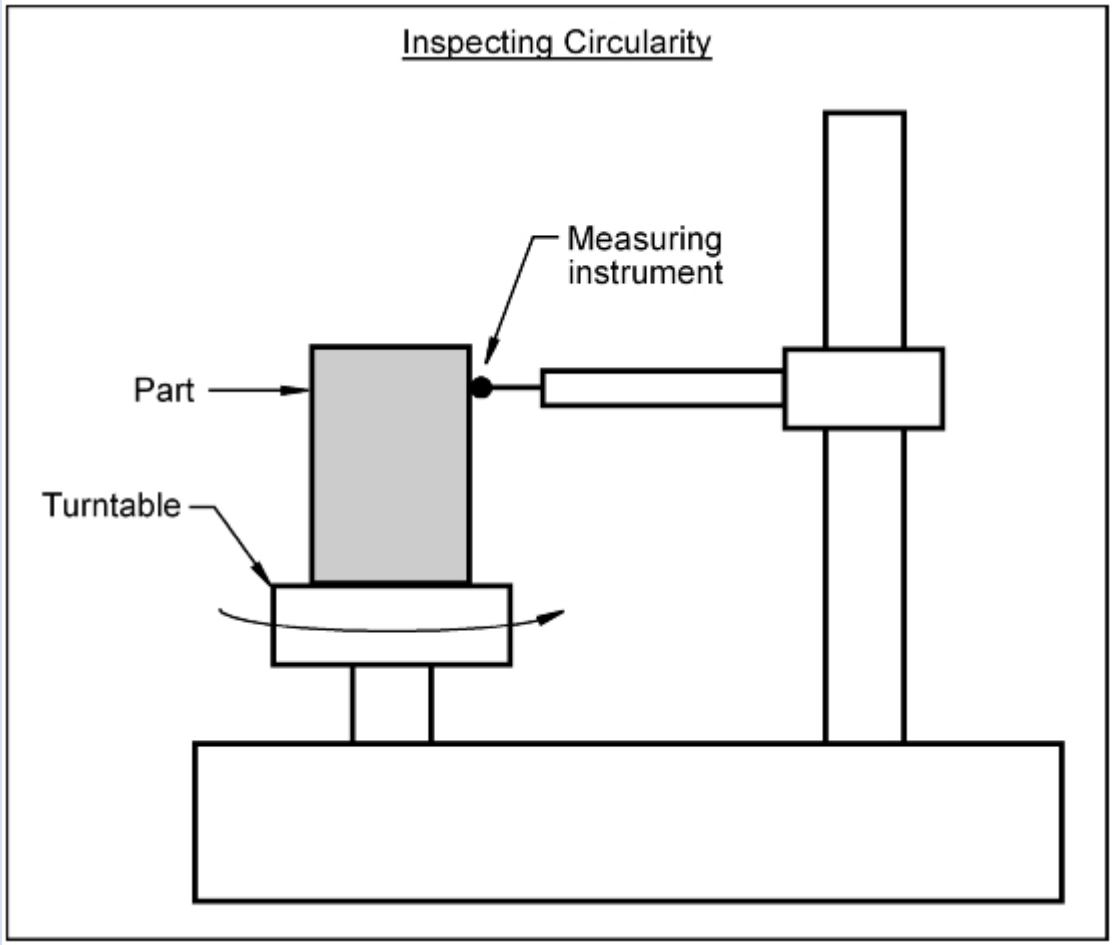

Flatness Tolerance Zone
No real surface is perfectly flat.
Ideally flat surface
Actual surface
Tolerance zone
Flatness
control tolerance

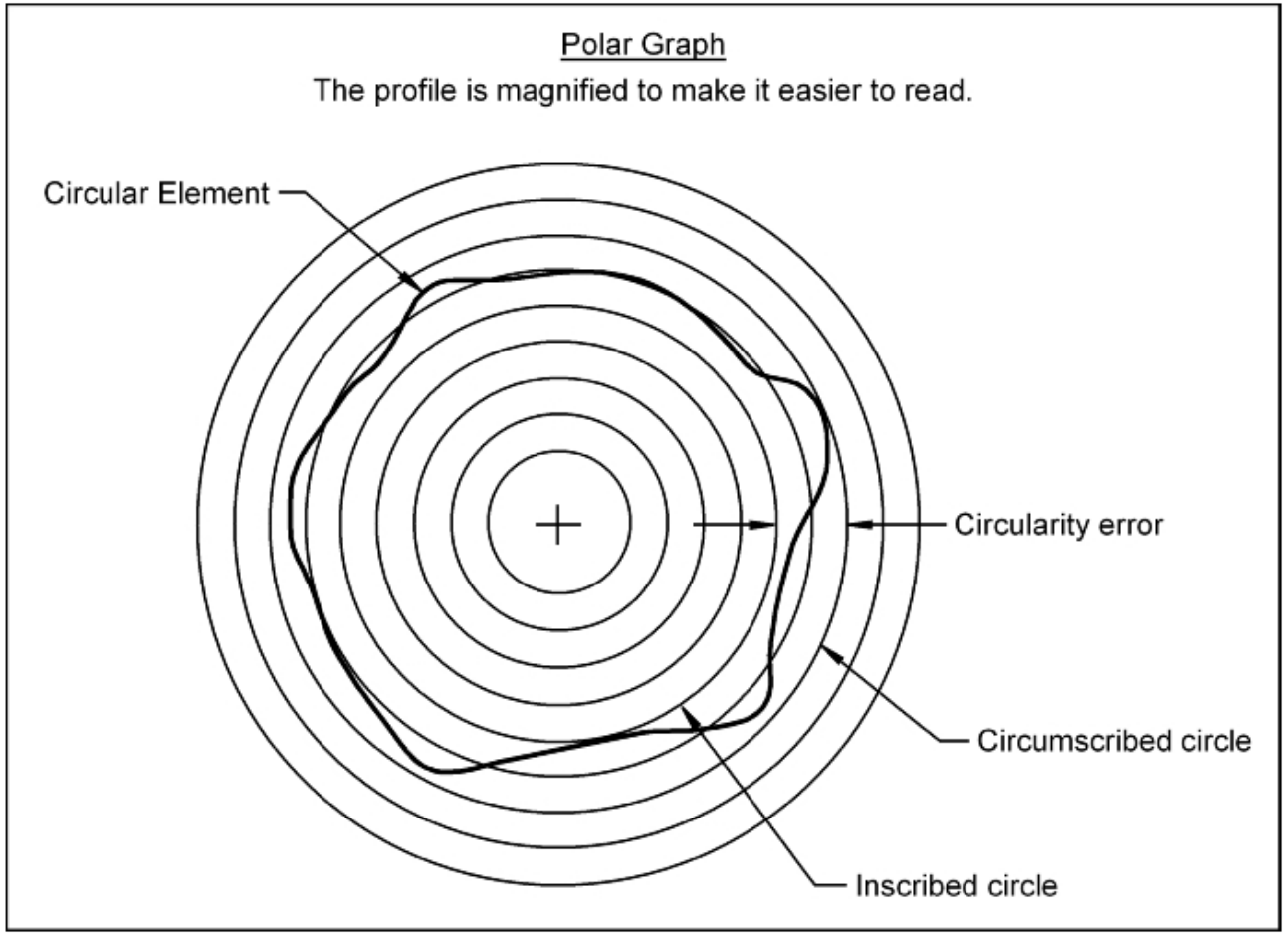
# Cylindricity



# Circularity or Cylindricity Inspection



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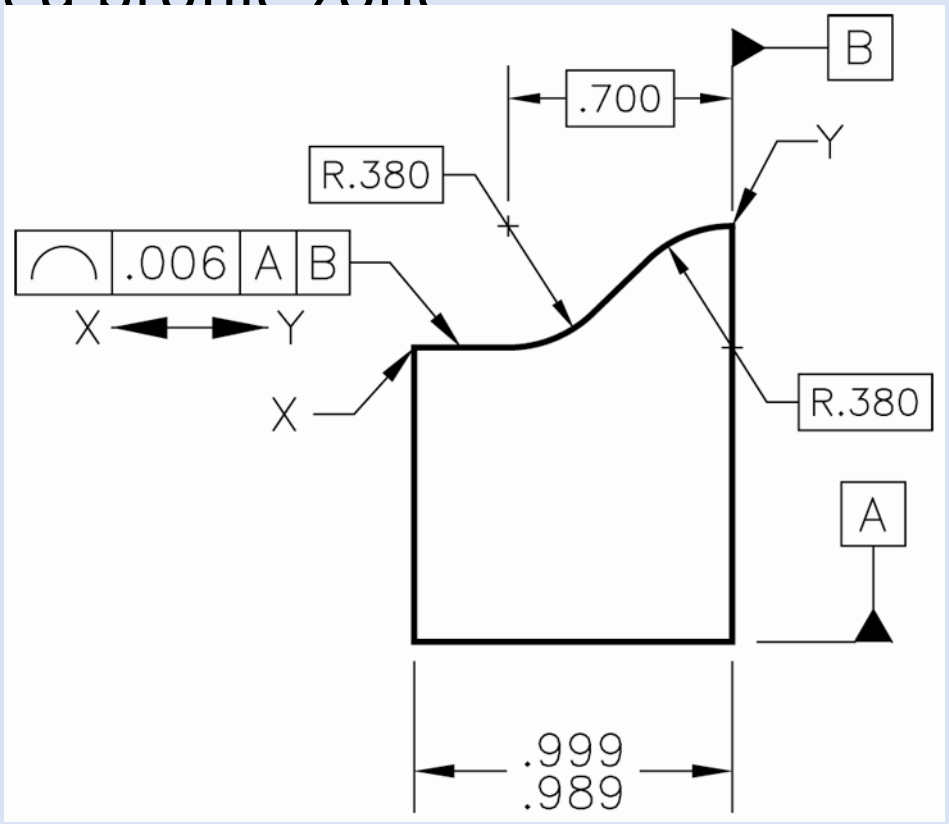
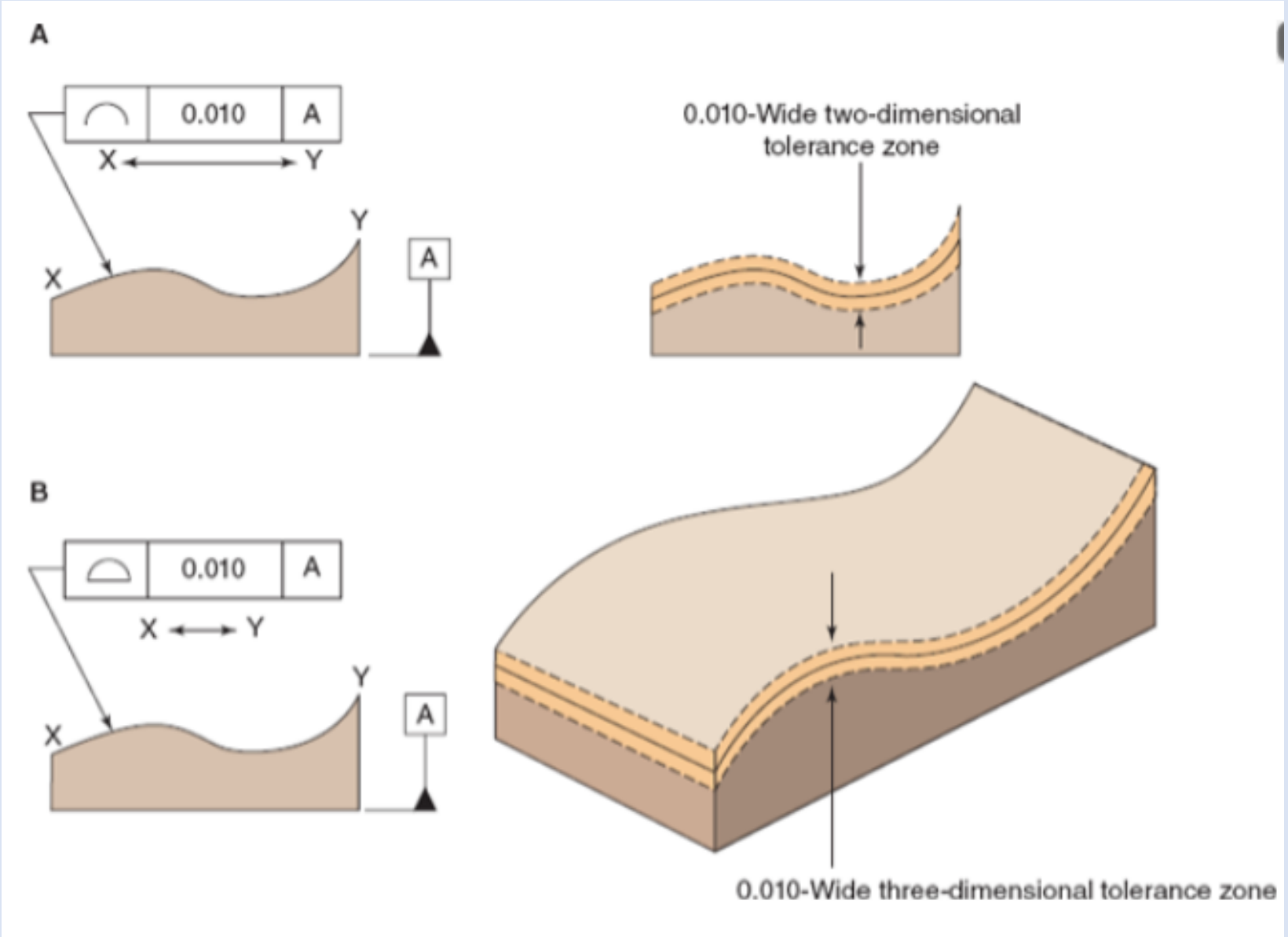
| | Profile of a surface | ⌓ | |
| Orientation | Angularity | ∠ | Always |
| | Perpendicularity | ⊥ | |
| | Parallelism | // | |
| Location | Position | ⌖ | |
| | Concentricity | ◎ | |
| | Symmetry | ⌯ | |
| Runout | Circular runout | ↗ | |
| | Total runout | ⌰ | |

# Profile of a Line

- With respect to datum references, 2D elements of the feature must fall within a specified profile zone



# Profiles of lines and surfaces



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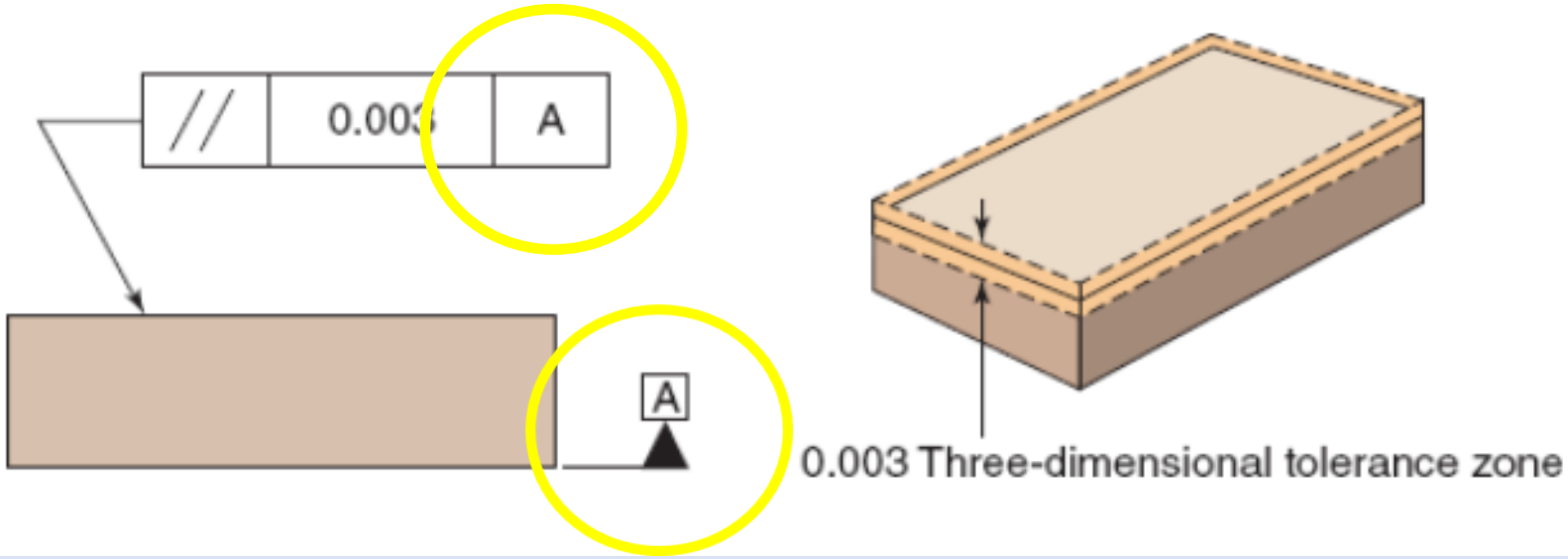
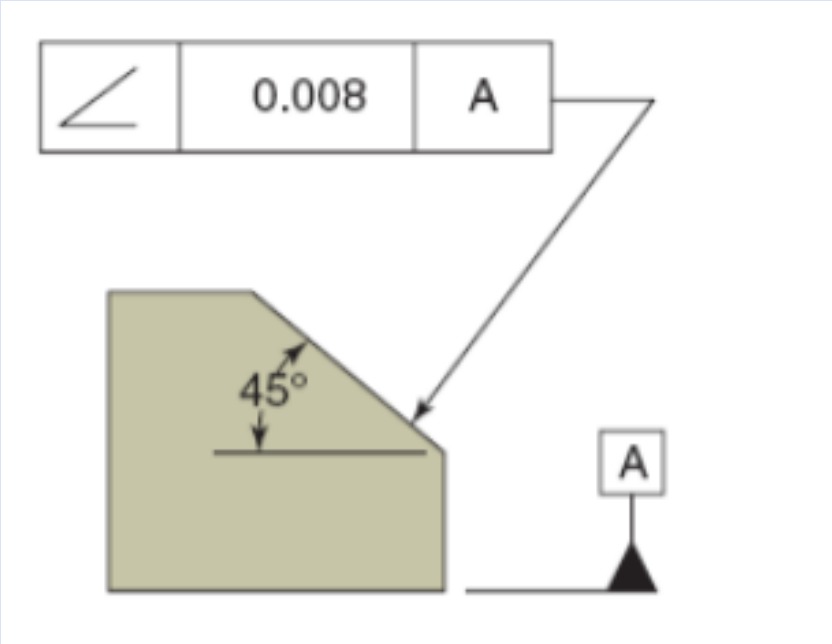
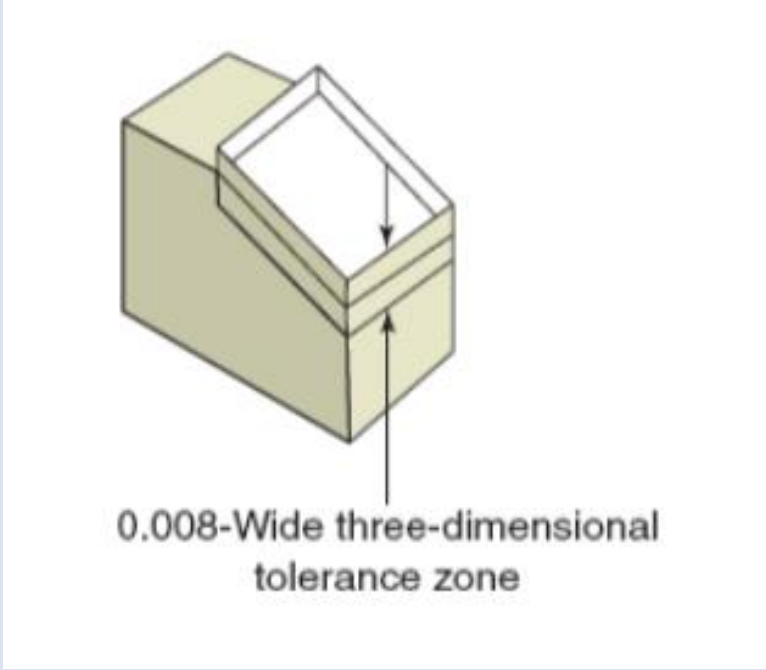
# Orientation…and now we need datums

This parallelism feature control frame creates a 0.003 three-dimensional tolerance zone. All points on the surface must be within that tolerance zone.

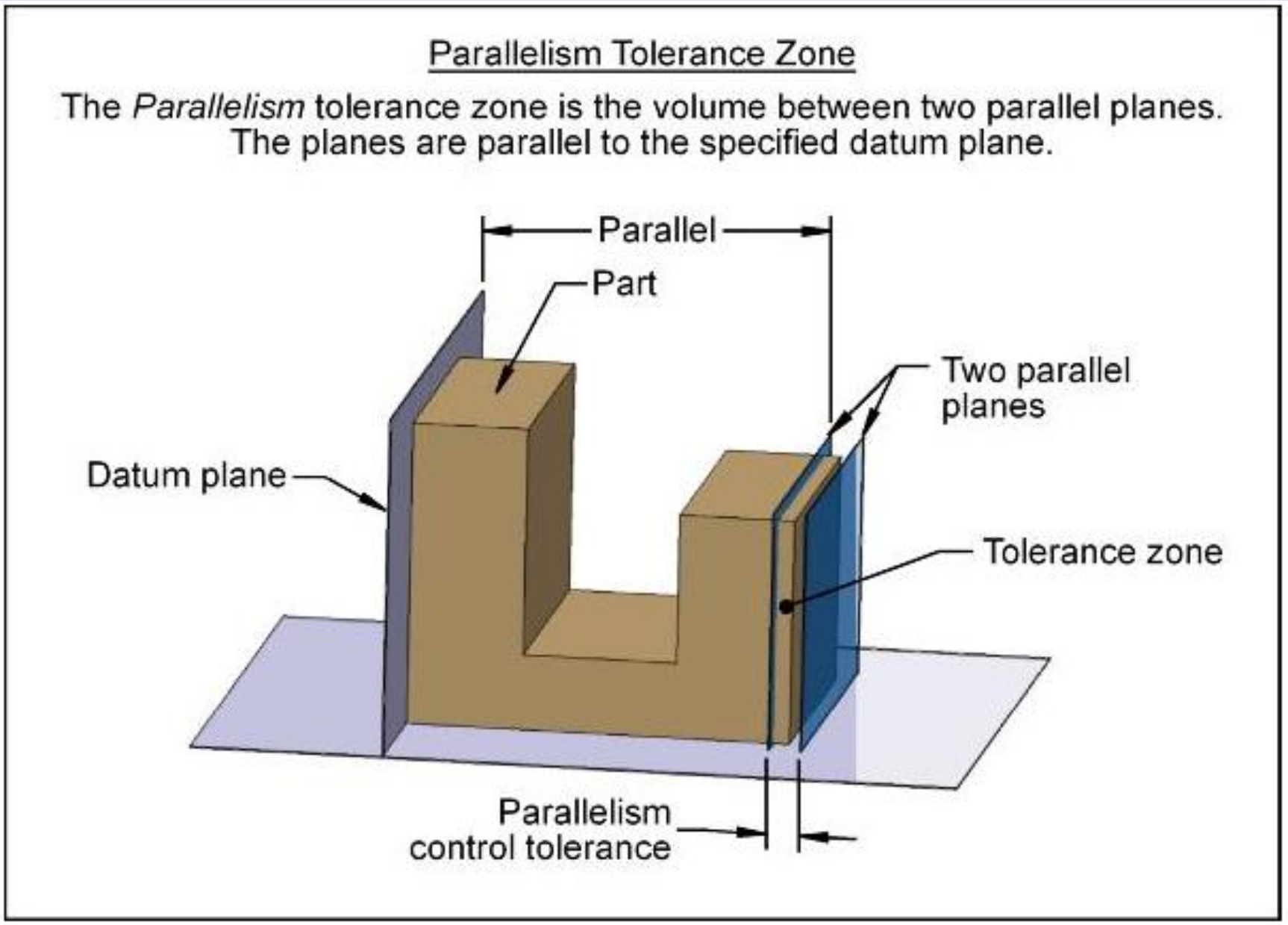


# Angularity (or perpendicularity at an angle other than 90°)



# Parallelism



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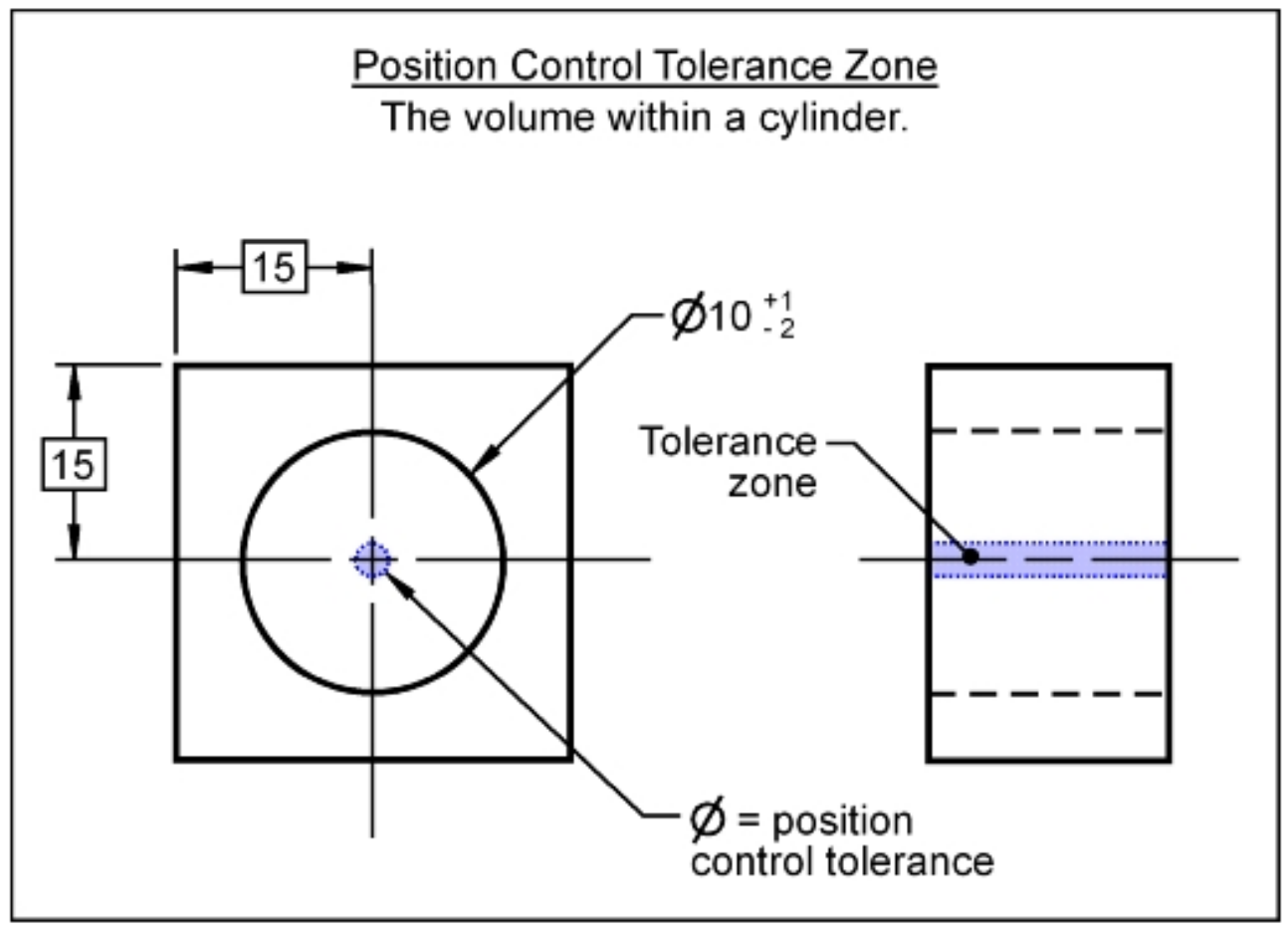
| | Concentricity | ◎ | |
| | Symmetry | ⌯ | |
| Runout | Circular runout | ↗ | |
| | Total runout | ⌰ | |

# Position

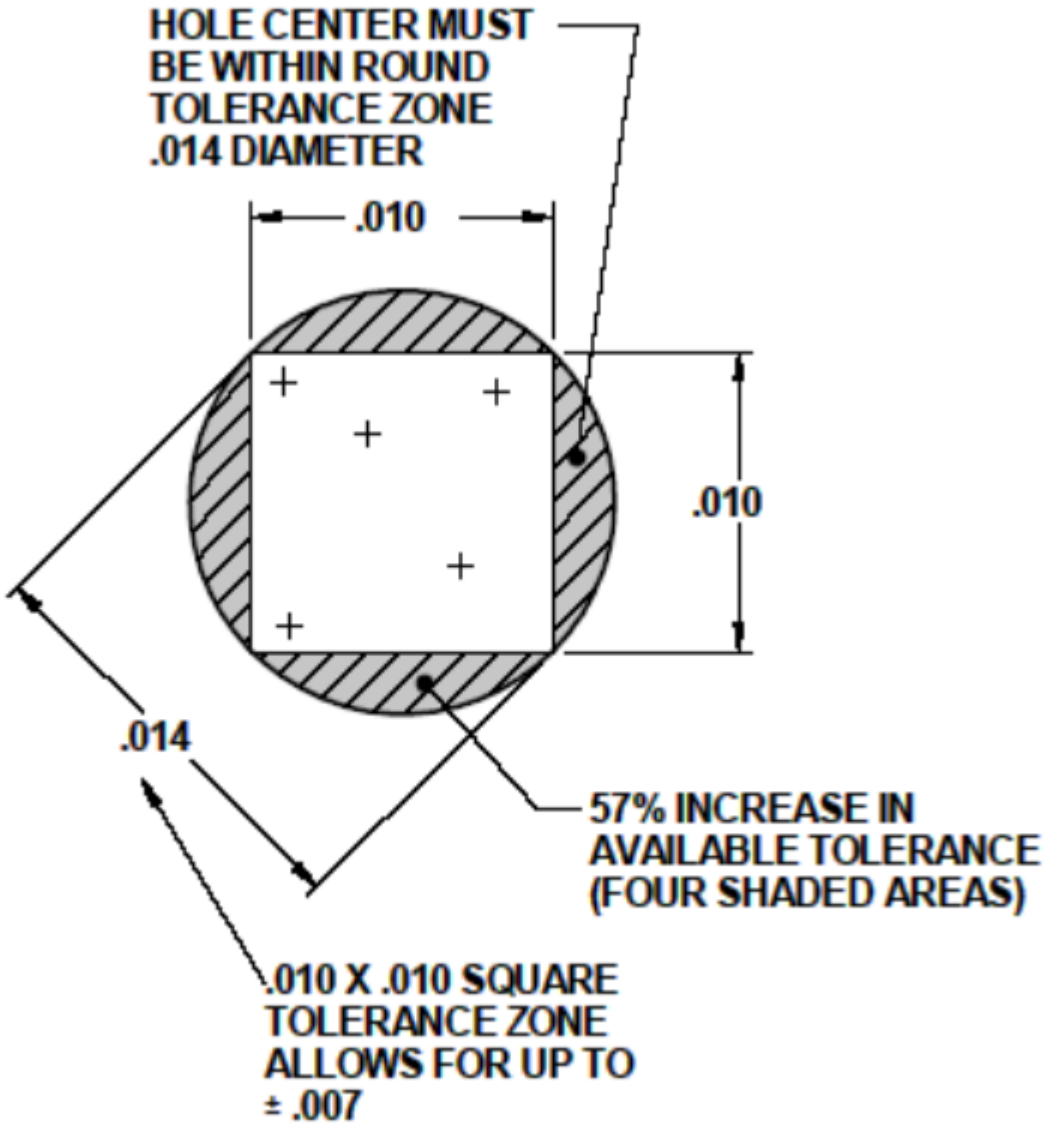



Position control
**True position** is the theoretically exact location of a feature of size. True position is defined, through the use of basic dimension.

Tolerance Zone
**Position control** defines how much a center point, axis or center plane, on a real part, may vary from its true position.

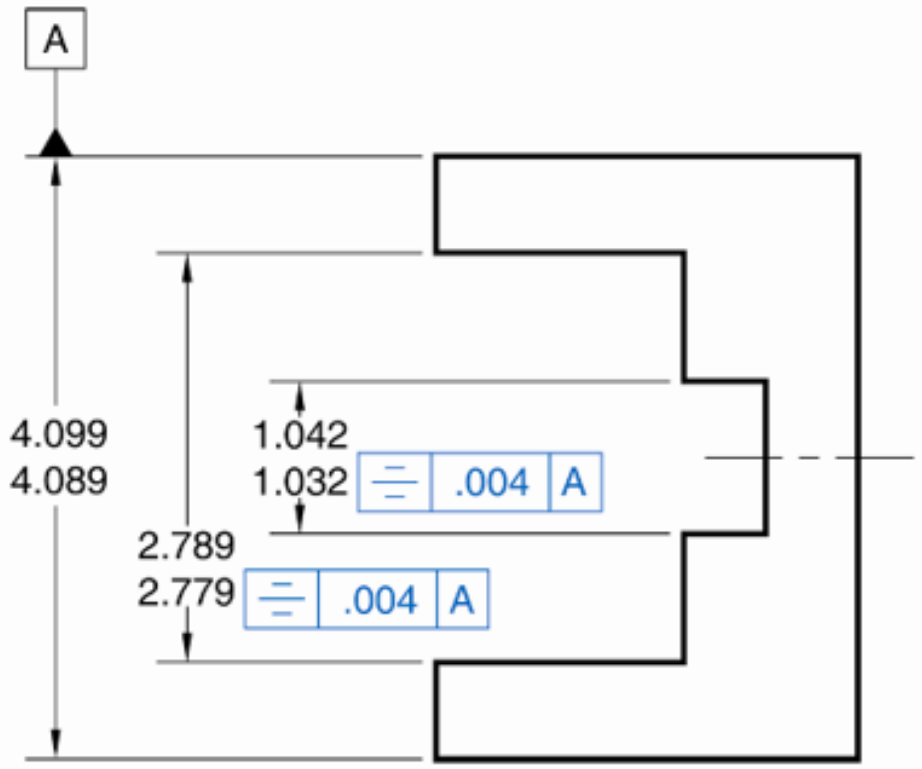
# Location, location, location, **position**, concentricity and symmetry

- Add location **positioning**, 57% increase in area, etc. here



# Symmetry

- With respect to a datum center plane, all features are symmetrical (balanced on each side), regardless of feature size



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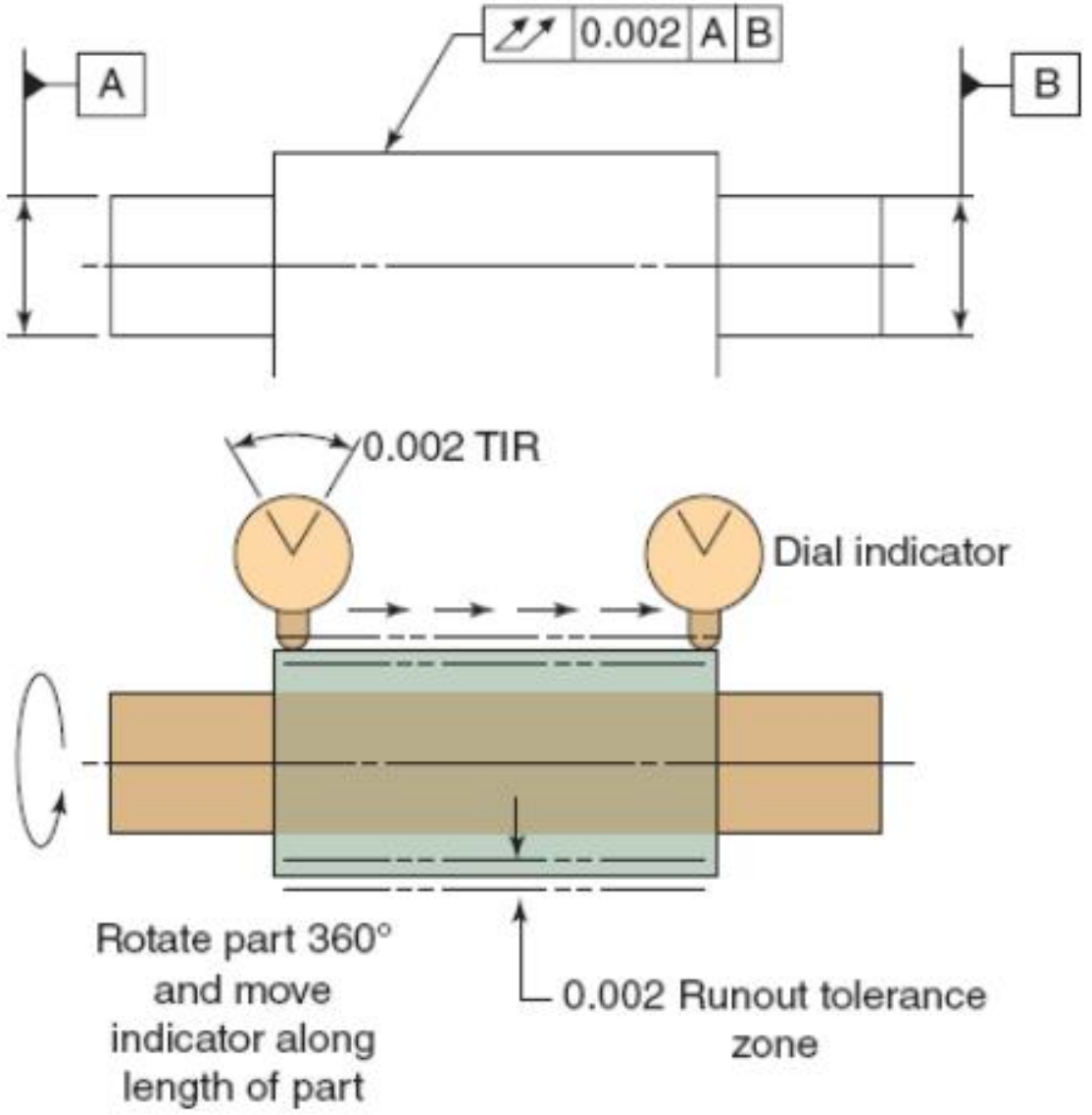
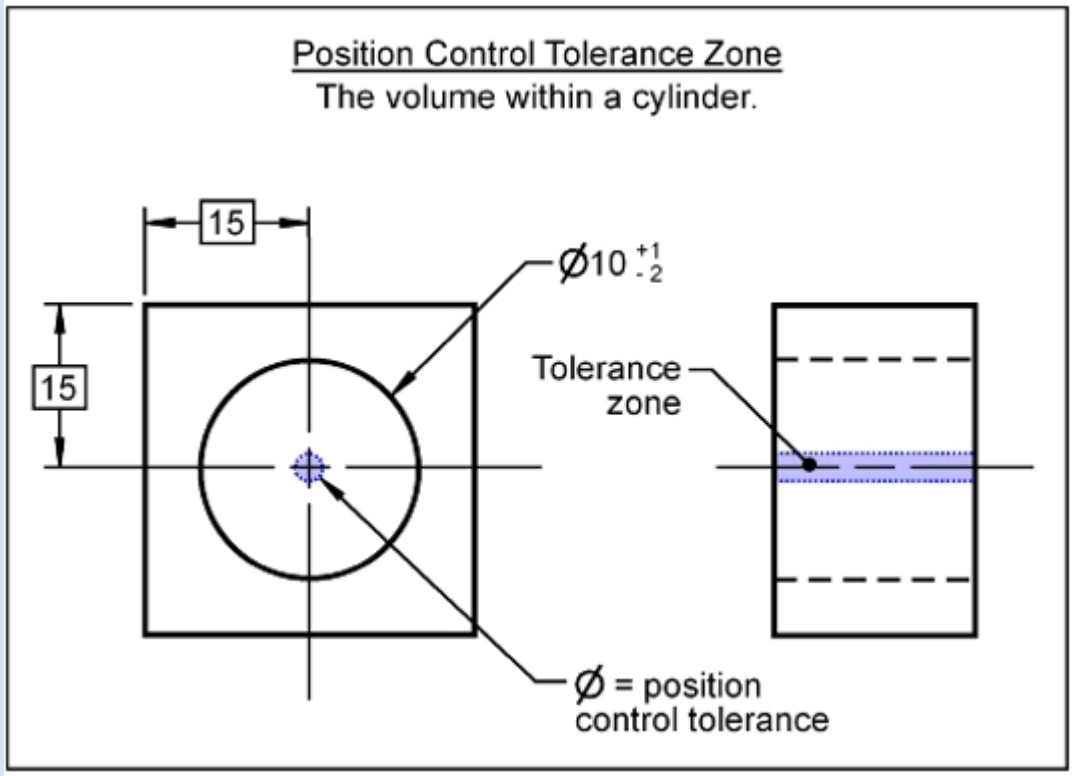
| | Concentricity | ◎ | |
| | Symmetry | ⌯ | |
| Runout | Circular runout | ↗ | |
| | Total runout | ⌰ | |

# Total Runout




Total runout requires the TIR when rotating the part to be within the specified tolerance at every location. Again, assure the datum diameters are first made to run true. Then the TIR is checked at every location on the surface by moving an indicator across the part while rotating it. If the TIR is within the tolerance amount across the entire surface, the part is acceptable

# A word on MMC




Effect of an MMC modifier on position and the bonus tolerance.


| | Hole diameter | Tolerance zone diameter |
|---|---|---|
| MMC | 0.498 | 0.004 |
| | 0.499 | 0.005 |
| | 0.500 | 0.006 |
| | 0.501 | 0.007 |
| LMC | 0.502 | 0.008 |

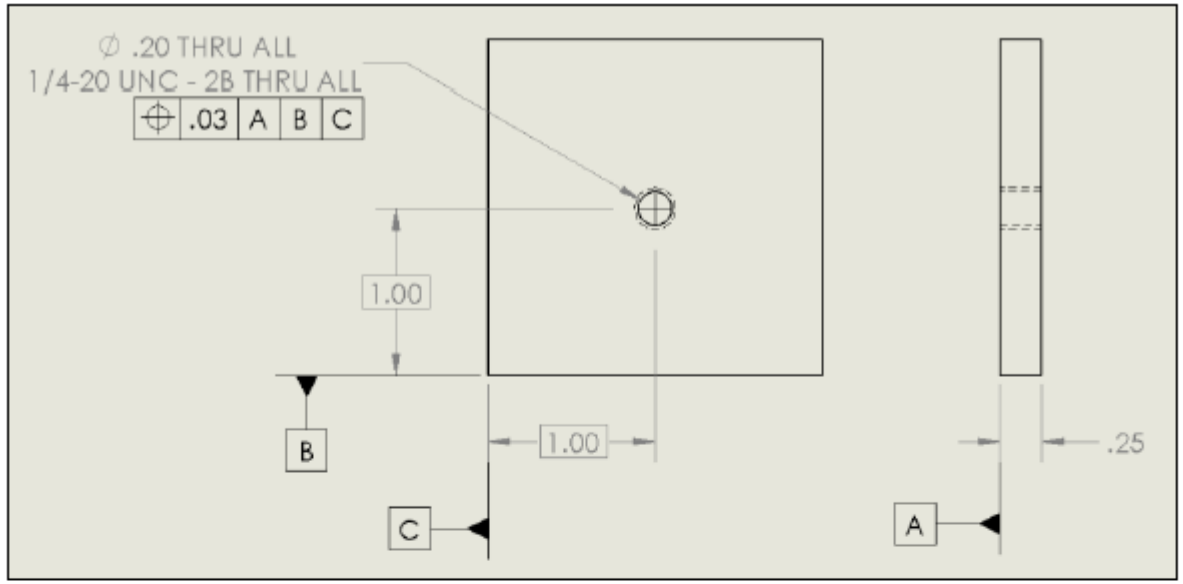
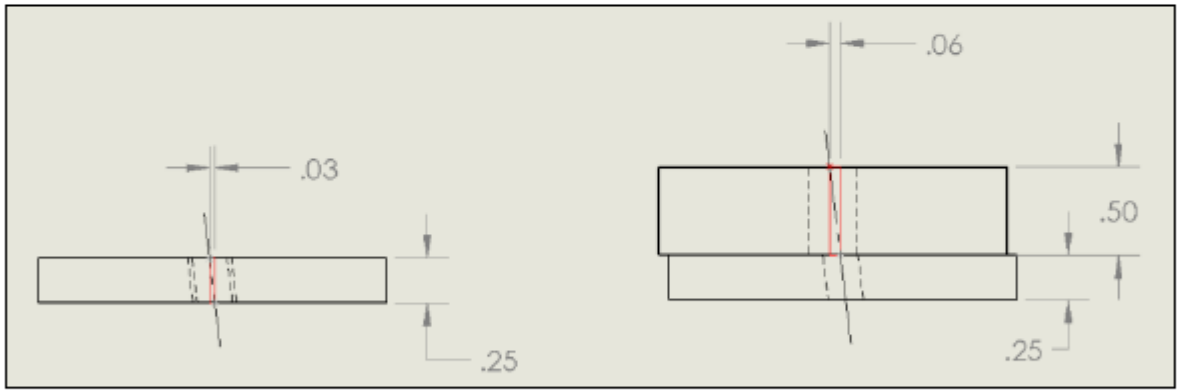



Figure 20 - GD&T used to control the threaded hole



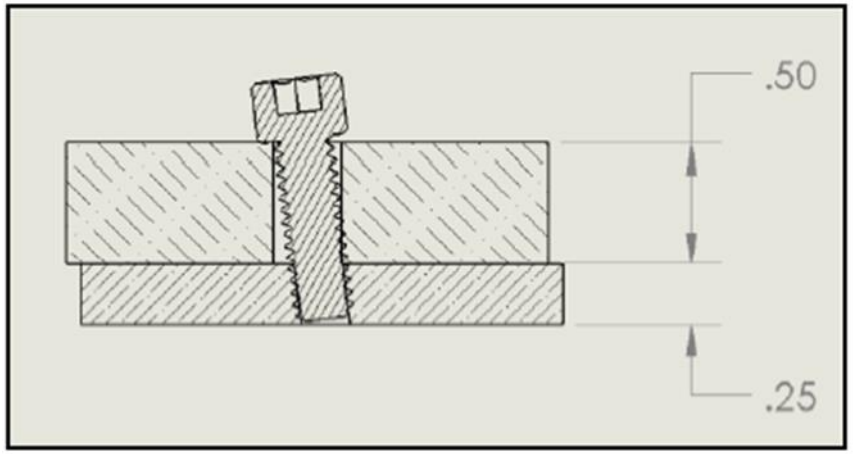



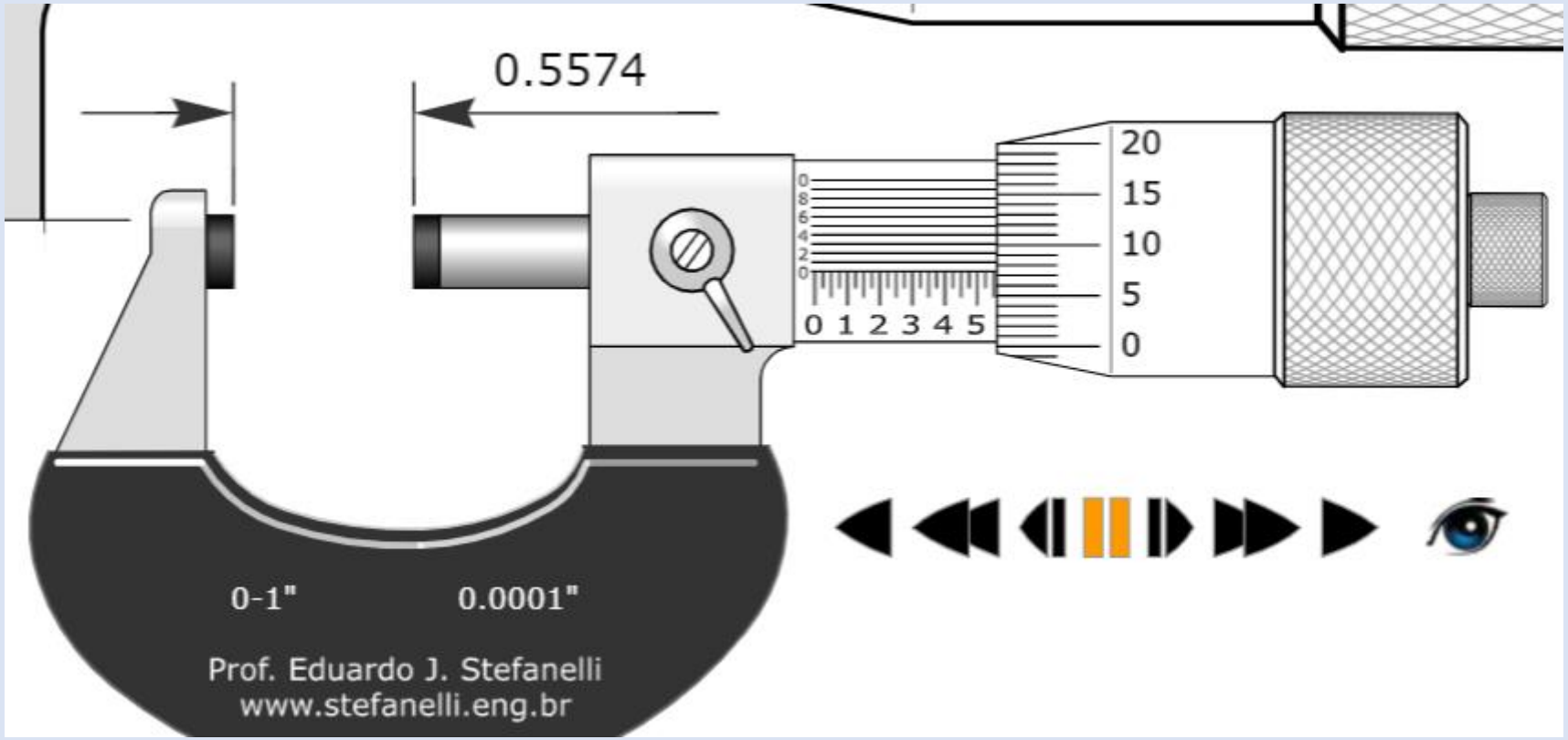

Figure 21 - Visual description for the angular tolerances shown in Fig 20

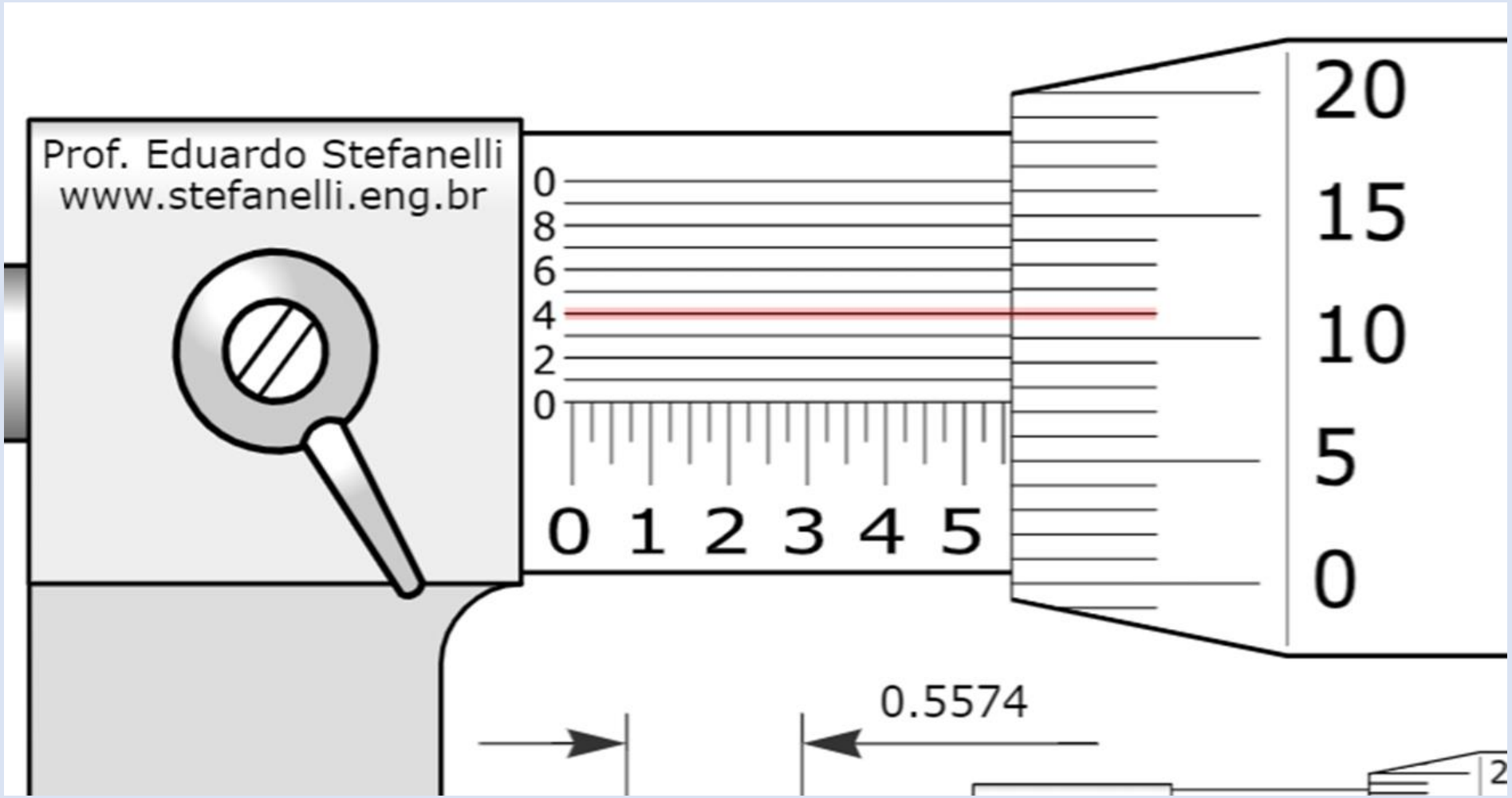
Above; the 0.03" tolerance applies *within* the material

Above; the same 0.03" tolerance and the same angle, but extended upward through a thicker plate means a larger lineal offset.

# A parting word on measurements

https://www.stefanelli.eng.br/en/simulator-virtual-micrometer-tenths-thousandth-inch/




Prof. Eduardo Stefanelli
www.stefanelli.eng.br
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My pleasure and honor to have worked with you today
Q&A