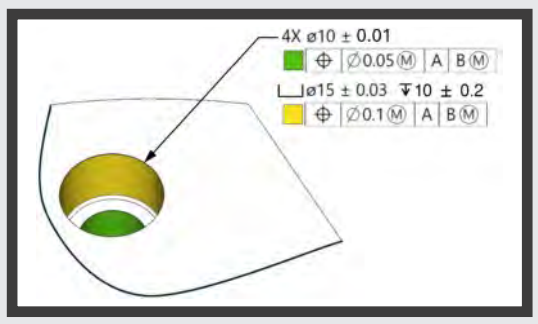
METROLOGY MATTERS

EVALUATING CMM PERFORMANCE STANDARDS

Poster 3 in the "Path to GOOD DECISIONS" series

01 The problem to solve:



Tolerance = +/- 0.01 = 0.02
0.02 * 0.25 TUR = 0.005 mm
at U95 (95% Confidence Interval)

02 CMM Standards

The ISO 10360 series of measurement standards are the universally accepted guidance for evaluating CMM performance

ISO 10360

ISO 10360-2:2009
Geometrical product specifications (GPS) - CMMs used for measuring 3D linear dimensions

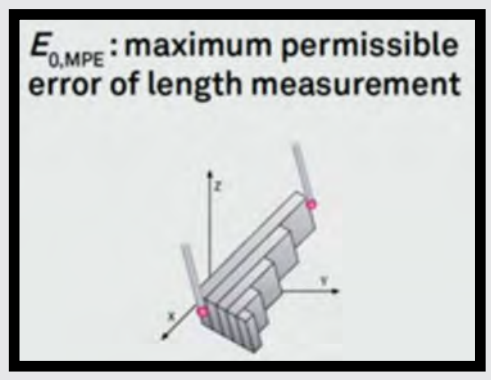
ISO 10360-5:2020
CMMs using single and multiple stylus contacting probing systems using discrete point and/or scanning measuring mode

ISO 10360-7:2011
Part 7: CMMs equipped with imaging probing systems

ISO 10360-10:2021
Laser trackers

ISO 10360-12:2016
Articulating arm coordinate measuring machines (CMM)

03 For our example, we will use ISO 10360-2 where we can find a maximum permissible error of measurement for a contact probe CMM. The calibration artifact is a stack of gage blocks or a step gage



Hexagon 454 CMM Specification:

PERFORMANCE SPECIFICATIONS

According to ISO 10360-2:2009:

$E_{0.MPE}$: 3.1 + L / 1000

Breaking it down:

E0, MPE: 3.1 + L / 1000

E0, MPE
Maximum permissible error with optimal stylus length

Base accuracy 3.1 or 0.0031 mm

Divisor allowing for part length

3.1 + (10 mm length / 1000) = 3.11 = 0.0031 mm

04 Our tolerance has been defined as 10.0 +/- 0.01. The uncertainty portion of our TUR ratio estimate can be defined through:

Manufacturer's Specification GR&R Study Measurement Uncertainty Budget

We'll start with the manufacturer's specification for three potential systems

Used CMM, ISO Cal	
Base Accuracy	6
Length Divisor	500
Total Tolerance	0.02
Feature Size	10
Calculated Error	0.0060
% of Tol. (~TUR)	30.10%

Hexagon SF 454 MFG Spec.	
Base Accuracy	3.1
Length Divisor	1000
Total Tolerance	0.02
Feature Size	10
Calculated Error	0.0031
% of Tol. (~TUR)	15.55%

Hexagon Global MFG Spec.	
Base Accuracy	1.3
Length Divisor	333
Total Tolerance	0.02
Feature Size	10
Calculated Error	0.0013
% of Tol. (~TUR)	6.65%

Metrology Matters is a project of these organizations to provide basic metrology fundamentals to manufacturing.

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