



01

The Hexagon SF 454 has a TUR of 6.5:1 or 15.5%, which exceeds our goal of better than 4:1 or 25%. Consideration must also be given to the TUR value in comparison to other tests such as Gage Repeatability & Reproducibility (GR&R) and an Uncertainty Budget (UNC)

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

Hexagon SF 454 MFG Spec.

02

	TUR	GR&R	Uncertainty Budget
Advantages	Can be determined before any part measurement takes place. Straightforward calculation.	Includes the effect of the interaction of the gage, parts, and operators.	Includes the effect of the interaction of the gage, parts, operators, and other influences like surface finish, form, and environment calculations.
Disadvantages	Ignores many influences that will effect gage capability.	Time consuming and demands for following proper procedure. Looks at repeatability and assumes accuracy.	Time consuming. Requires careful analysis and quantification of hundreds of potential measurement influences.
Measurement Artifact	Traceable artifact identified in the applicable standard and applied in system calibration.	Multiple production parts and assumes use of traceable artifact in system calibration.	Traceable calibration standard, production parts, other traceable artifacts as analysis identifies.

03

Comparison

Tolerance to Uncertainty Ratio		GR&R		Uncertainty Budget	
Base Accuracy	3.1	Pooled Standard Deviation	0.00090	GR&R Data	13.56%
Length Divisor	1000	Sigma Multiplier	4	Resolution	2.13%
Total Tolerance	0.02	R&R Value	0.00359	CTE	1.58%
Feature Size	10	Total Tolerance	0.0200	UNDE	0.16%
Calculated Error	0.0031	% of Tol. (~TUR)	18.0%	Accuracy Statement	66.02%
% of Tol. (~TUR)	15.55%			Surface Roughness Rz	15.06%
				Form Deviations	1.51%
				Combined Standard Uncertainty	0.00187
				Expanded Uncertainty (K=2)	0.00375
				% of Tol. (TUR)	37.48%

04

Now what?

TUR = 15.5% GR&R = 18% UNC Budget = 37.5%

These are *expected results*. GR&R and UNC calculation bring in additional sources of measurement uncertainty. Following the Metrology Risk poster will help determine the right path for your application. If the risk consequences are great, like a critical medical device or flight safety aerospace component, the time and effort of developing an uncertainty budget is easily justified.

Want to learn more? Join us for our 3-day Metrology Boot Camp course on metrology basics and measurement uncertainty.