

R&R Study

Gauge Serial No: EM123

Study No: 8
 Date: 13/09/2007
 Ref:
 Type: External Micrometer
 Description: Ext Mike Digital

Specification and Tolerances

Nominal:	2.50000	No of Operators:	2
+ Tolerance:	0.50000	No of Trials:	2
- Tolerance:	0.50000	No of Parts:	2
Offset Zero:	0.00000		

Trial Data

Operator									
Part/Trial	1	2	3	1	2	3	1	2	3
1	2.30000	2.60000	0.00000	2.21300	2.35000	0.00000	0.00000	0.00000	0.00000
2	2.20000	2.10000	0.00000	2.64000	2.41000	0.00000	0.00000	0.00000	0.00000

Average and Range Results

Op No	XBar	RBar
1:	2.300000	0.200000
2:	2.403250	0.183500

UCLr:	0.627023	LCLr:	0.000000
Average R Bar:	0.191750	Average X Bar:	2.351625
X Bar Difference:	0.103250	Rp:	0.028250

Equipment Variation:	0.874380	Operator Variation:	0.000000
Total R&R Variation:	0.874380	Part Variation:	0.103112
Total Variation:	0.880439		

% Equipment Variation:	99.311837	% Operator Variation:	0.000000
% Part Variation:	11.711489	% R&R Variation:	99.311837

Under 10% error - the measurement system is acceptable
 10% to 30% error - may be acceptable based upon importance of application, cost of gauge, etc.
 Over 30% error - measurement system needs improvement.

EU1880A

% Operator Variation: 0.100016
 % Equipment Variation: 0.043124
 % R&R Variation: 0.108917

Analysis of Variance (ANOVA)

Source	DF	SS	MS	F	EMS
Op No	1	0.021321	0.021321		$\sigma^2 + 20\sigma^2$
Parts	1	0.001596	0.001596		$\sigma^2 + 6\sigma^2$
Op x Part	1	0.147696	0.147696	6.882833	σ^2
Gauge(Error)	4	0.085834	0.021459		σ^2
Total	7	0.256448			

Source	5.15 σ	% Contribution	% Study	% Tol
R&R:	1.497733	100.00	100.00	149.77
Equipment Variation:	0.754411	25.37	50.37	75.44
Reproducibility:	1.293857	74.63	86.39	129.39
Operator Variation:	0.000000	0.00	0.00	0.00
Interaction x Operator (I):	1.293857	74.63	86.39	129.39
Part Variation:	0.000000	0.00	0.00	0.00
Total Variation	1.497733			

EMP Short Study

Data taken from first two trials of the first operator

Test-Retest Error: 0.177305
 Probable Error: 0.118794
 S.D. of Product Measurements: 0.265957
 Intraclass Correlation Coefficient: 0.555556
Discrimination Ratio DR: 1.870829

EMP Long Method

Range Chart		Mean Chart	
RBar:	0.191750	Aver X bar:	2.351625
UCLr:	0.627023	UCLx:	2.712115
LCLr:	0.000000	LCLx:	1.991135
Test-Retest Error: 0.169991		Probable Error: 0.113894	
Intraclass Correlation Coefficient: -0.309228		Discrimination Ratio DR: 0.726373	

DR<2.0 - Must improve the measurement process
 2.0<DR<4.0 - May be necessary to improve the measurement process
 DR>4.0 - Continue to improve the measurement process