

PLEASE SPECIFY THE FOLLOWING PARAMETERS AND COMPLETE THE FORM ACCORDINGLY

PARAMETERS ARE:

K₁	Number of Trials	Must be either 2 or 3	3	OK
K₂	Number of Operators	Must be either 2 or 3	2	OK
K₃	Number of Parts	Can be any value between 2 and 10	10	OK

				GAGE APPROVED, USE IT	
Part number	13964789	Part name	Terminal	Plant	11
Characteristic	Blade Width	Gage number	801	Coord by	Randy Stitt
USL	1.550	LSL	1.450	Phone #	330-373-3499
Tolerance (ToI) / 6	0.01667	Gage name	Vision System	Date	4/13/2021
		Gage ECL/revision			

OPERATOR		P		A		R		T		RESULTS					
TRIAL #		1	2	3	4	5	6	7	8	9	10	AVG			
A	1	1.522431	1.526241	1.520086	1.523429	1.523378	1.521276	1.526294	1.522543	1.524213	1.523147	A ₁	1.52330		
	2	1.522194	1.522694	1.522494	1.522649	1.522694	1.522694	1.522694	1.522694	1.522694	1.522694	A ₂	1.52262		
	3	1.522182	1.523082	1.521082	1.522082	1.524282	1.522082	1.521082	1.524082	1.523082	1.522082	A ₃	1.52251		
	Average	1.52227	1.52401	1.52122	1.52272	1.52345	1.52202	1.52336	1.52311	1.52333	1.52264	$\bar{X}_A$	1.52281		
	Range	0.00025	0.00355	0.00241	0.00135	0.00159	0.00142	0.00521	0.00154	0.00152	0.00107	$\bar{R}_A$	0.00199		
B	1	1.525742	1.524642	1.523842	1.523242	1.523342	1.523542	1.523542	1.523442	1.524538	1.523542	B ₁	1.52394		
	2	1.524958	1.523958	1.522158	1.524958	1.522958	1.521958	1.523458	1.524458	1.524158	1.521908	B ₂	1.52349		
	3	1.524076	1.520768	1.520768	1.520768	1.522768	1.520768	1.524768	1.520768	1.524768	1.523768	B ₃	1.52240		
	Average	1.52493	1.52312	1.52226	1.52299	1.52302	1.52209	1.52392	1.52289	1.52449	1.52307	$\bar{X}_B$	1.52328		
	Range	0.00167	0.00387	0.00307	0.00419	0.00057	0.00277	0.00131	0.00369	0.00061	0.00186	$\bar{R}_B$	0.00236		
C	1											C ₁			
	2											C ₂			
	3											C ₃			
	Average											$\bar{X}_C$			
	Range											$\bar{R}_C$			
Part Avg		1.5236	1.52356	1.52174	1.52285	1.52324	1.52205	1.52364	1.523	1.52391	1.52286	$\bar{\bar{X}}_{PART}$ =	1.52304		
Part Range												$\bar{\bar{R}}_{PART}$ =	0.00217		
$\bar{R} = R_A + R_B + R_C / \text{No of operators} =$		0.00199				+	0.00236				/	2	$\bar{\bar{R}} =$	0.00218	
$\bar{X}_{DIFF} = [\text{Max}(\bar{X})_{ABC}] - [\text{Min}(\bar{X})_{ABC}] =$		1.52328				-	1.52281							$\bar{X}_{DIFF} =$	0.00047
UCL _R = $\bar{R} * D_4 =$		0.00218				*	2.580							UCL _R =	0.00561
LCL _R = $\bar{R} * D_3 =$		0.00218				*	0.000							LCL _R =	0.00000
OPERATOR		NAME				NOTE: The Total Tolerance Method should be used when the gage is used for product release. When out of control conditions exist, analyze the data for Gage acceptability. The total variation method is generally used for variation reduction activities.									
A															
B															
C															
GOOD UNTIL GAGE ECL/revision CHANGE															
FROM DATA SHEET:		$\bar{R} =$ 0.00218				$\bar{X}_{DIFF} =$ 0.00047		$R_{PART} =$ 0.00217							
Measurement Unit Analysis						Based on the TOLERANCE Method									
Repeatability - Equipment Variation (EV)															
EV = $\bar{R} * K_1$				Trials		K ₁		% EV = 100[EV/ToI]							
EV = 0.00129				3		0.5908		% EV = 7.71							
Reproducibility - Appraiser Variation (AV)															
AV = $\sqrt{[(\bar{X}_{DIFF} * K_2)^2 - (EV^2 / nr)]}$				Oper		K ₂		% AV = 100[AV/ToI]							
AV = 0.00023				2		0.71		% AV = 1.39							
Repeatability & Reproducibility (GRR)															
GRR = $\sqrt{(EV^2 + AV^2)}$								%GRR = 100[GRR/ToI]							
GRR = 0.00131								% GRR = 7.84							
Part Variation (PV)															
PV = $\text{SQRT}(TV^2 - GRR^2)$				Parts		K ₃		% PV = 100[PV/ToI]							
PV = 0.01662				10		0.31		% PV = 99.69							
Total Variation (TV)						Number of Distinct Categories									
TV = (USL-LSL)/6								ndc = 1.41[PV/GRR]							
TV = 0.01667								ndc = 17.938 ~ 18		should be greater than or equal to 5					
						Conclusion:									
						GAGE IS ACCEPTED									
						All ranges OK									

Guidelines for acceptance of gage repeatability and reproducibility (%R&R):

UNDER 10% ERROR: Gage system OK

10% to 30% ERROR: May be acceptable based upon importance of application. Calculate "breakpoint" = RPN x (% Gage R&R/100) and check that is less than 37.8 and (% Gage R&R) less than 30%. See next page for conclusion of usage.

OVER 30% ERROR: Gage system needs improvement. Identify the problems and have them corrected.

DETERMINE THE RISK PRIORITY NUMBER (RPN) FROM THE FMEA ASSOCIATED WITH THE DIMENSION BEING GAGED. TYPE THE RPN # UNDER THE RPN # FIELD PROVIDED (RIGHT) AND FOLLOW INSTRUCTION OF USAGE IN NEXT ROW:	BREAKPOINT	=	RPN #	x	%GRR/100
	0.00	=	0.0	x	0.07836

For information on the theory and constants used in the form see MSA Reference Manual , 4th edition.