

MEASUREMENT SYSTEM ANALYSIS FOR VARIABLES

• **APTIV** •

Non-Destructive Test

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

Input data in green-shaded cells as required

K ₁	Number of Trials	3	Must be either 2 or 3	Study Method: ☒ TOLERANCE ☐ PART to PART VARIATION	USL	73.100	Reset form and delete data	
K ₂	Number of Operators	3	Must be either 2 or 3		LSL	72.700		
K ₃	Number of Parts	10	Between 2 and 10					
				Tolerance / 6 >>	0.06667			
Initiator		Eliezer Vazquez		Gage Number	E200298		Plant	9800
Phone #		844-311-3705		Gage Name	OGP		Location	Confiability
Date		16-feb-22		Gage ECL / Revision			Supplier	Eliezer Vazquez
e-mail		eliezer.vazquez.martinez@aptiv.com		Segment			Part Number	15509572
							Part Name	HOUSING FOR 48
							Part ECL / Revision	5
							Customer P/N	

OPERATOR		NUMBER of PARTS										RESULTS:	
TRIAL #		1	2	3	4	5	6	7	8	9	10	AVG	
A	1	72.928	72.926	72.926	72.923	72.926	72.922	72.92	72.926	72.923	72.923	A ₁	72.92430
	2	72.92	72.911	72.911	72.913	72.911	72.924	72.923	72.911	72.923	72.928	A ₂	72.91750
	3	72.922	72.919	72.919	72.911	72.919	72.923	72.923	72.919	72.913	72.92	A ₃	72.91880
	Average	72.92333	72.91867	72.91867	72.91567	72.91867	72.923	72.922	72.91867	72.91967	72.92367	X _A	72.92020
	Range	0.008	0.015	0.015	0.012	0.015	0.002	0.003	0.015	0.01	0.008	R _A	0.01030
B	1	72.923	72.928	72.926	72.926	72.923	72.926	72.922	72.92	72.923	72.919	B ₁	72.92360
	2	72.923	72.92	72.919	72.911	72.913	72.911	72.924	72.923	72.913	72.928	B ₂	72.91850
	3	72.926	72.922	72.919	72.919	72.911	72.919	72.923	72.923	72.911	72.92	B ₃	72.91930
	Average	72.924	72.92333	72.92133	72.91867	72.91567	72.91867	72.923	72.922	72.91567	72.92233	X _B	72.92047
	Range	0.003	0.008	0.007	0.015	0.012	0.015	0.002	0.003	0.012	0.009	R _B	0.00860
C	1	72.919	72.926	72.922	72.919	72.923	72.924	72.923	72.911	72.923	72.92	C ₁	72.92100
	2	72.928	72.911	72.923	72.928	72.923	72.923	72.923	72.915	72.926	72.922	C ₂	72.92220
	3	72.92	72.919	72.923	72.92	72.913	72.928	72.913	72.921	72.911	72.923	C ₃	72.91910
	Average	72.92233	72.91867	72.92267	72.92233	72.91967	72.925	72.91967	72.91567	72.92	72.92167	X _C	72.92077
	Range	0.009	0.015	0.001	0.009	0.01	0.005	0.01	0.01	0.015	0.003	R _C	0.00870
Part Avg		72.92322	72.92022	72.92089	72.91889	72.918	72.92222	72.92156	72.91878	72.91844	72.92256	X _{PART}	72.92048
Part Range				0.01500	0.01700	0.01500	0.01700	0.01100	0.01500	0.01500	0.00900	R _{PART}	0.00522
R = R _A + R _B + R _C / No of operators = 0.01030 + 0.00860 + 0.00870 / 3												R	0.00920
X _{DIFF} = [Max (X) _{ABC}] - [Min (X) _{ABC}] = 72.92077 - 72.92020												X _{DIFF}	0.00057
UCL _R = R * D ₄ = 0.00920 * 2.580												UCL _R	0.02374
LCL _R = R * D ₃ = 0.00920 * 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	Carlos Cerda Lobaton	
B	Jose Luis Robledo	
C	Hector de Jesus Andrade	

FROM DATA SHEET: R = 0.00920 X_{DIFF} = 0.00057 R_{PART} = 0.00522

Measurement Unit Analysis	Based on the TOLERANCE Method
Repeatability - Equipment Variation (EV) $EV = \bar{R} * K_1$ $EV = 0.00544$	% EV = 100[EV/Tol] % EV = 8.15
Reproducibility - Appraiser Variation (AV) $AV = \sqrt{[(\bar{X}_{DIFF} * K_2)^2 - (EV^2 / nr)]}$ $AV = 0.00000$	% AV = 100[AV/Tol] % AV = 0.00
Repeatability & Reproducibility (GRR) $GRR = \sqrt{(EV^2 + AV^2)}$ $GRR = 0.00544$	%GRR = 100[GRR/Tol] % GRR = 8.15
Part Variation (PV) $PV = \text{SQRT}(TV^2 - GRR^2)$ $PV = 0.06644$	% PV = 100[PV/Tol] % PV = 99.67
Total Variation (TV) $TV = (USL - LSL) / 6$ $TV = 0.06667$	Number of Distinct Categories $ndc = 1.41[PV/GRR]$ $ndc = 17.237 \sim 17$

GUIDELINES for ACCEPTANCE of GAGE R&R (%GRR)

- LESS than 10% ERROR: Gage is acceptable
- 10% to 30% ERROR: May be acceptable based upon importance of application:
 - Reference the RISK MATRIX of the FMEA or
 - Use the "BREAKPOINT" calculation method shown below, (result should be < 37.8 and % Gage R&R < 30%).
- OVER 30% ERROR: Gage system needs improvement. Identify the problems and have them corrected.

Initial Result: GAGE IS ACCEPTED

SELECT EVALUATION METHOD for 10% to 30% ERROR:
 RISK MATRIX EVALUATION
 BREAKPOINT CALCULATION

DETERMINE THE RISK PRIORITY NUMBER (RPN) FROM THE FMEA ASSOCIATED WITH THE DIMENSION BEING GAGED. TYPE THE RPN # IN THE RPN # CELL AND OBSERVE THE RESULT OF SUGGESTED USAGE:

BREAKPOINT	=	RPN#	X	%GRR
0.00	=		X	0.08153

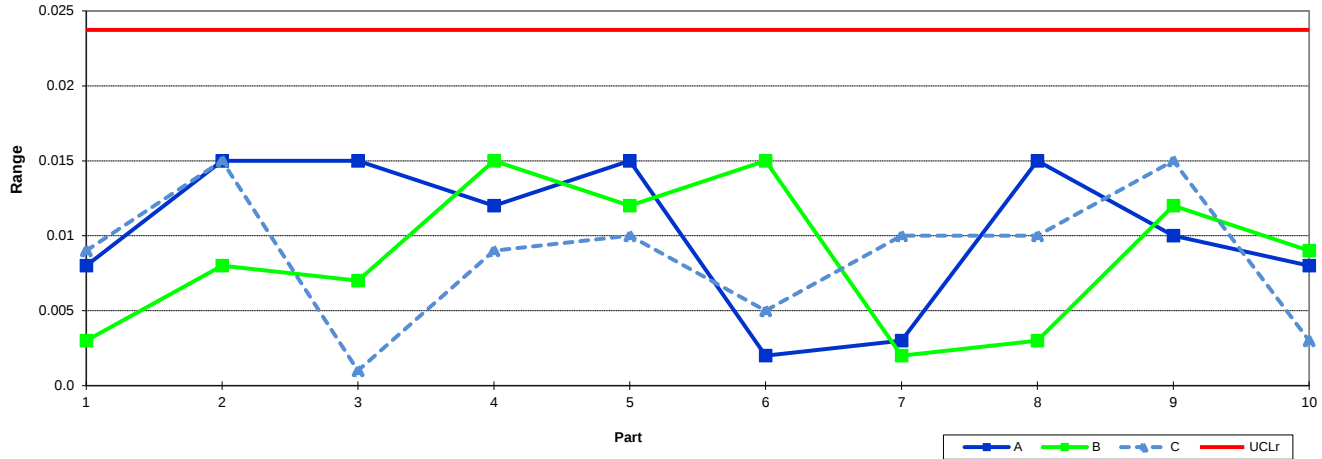
CONCLUSION:

GAGE APPROVED, USE IT

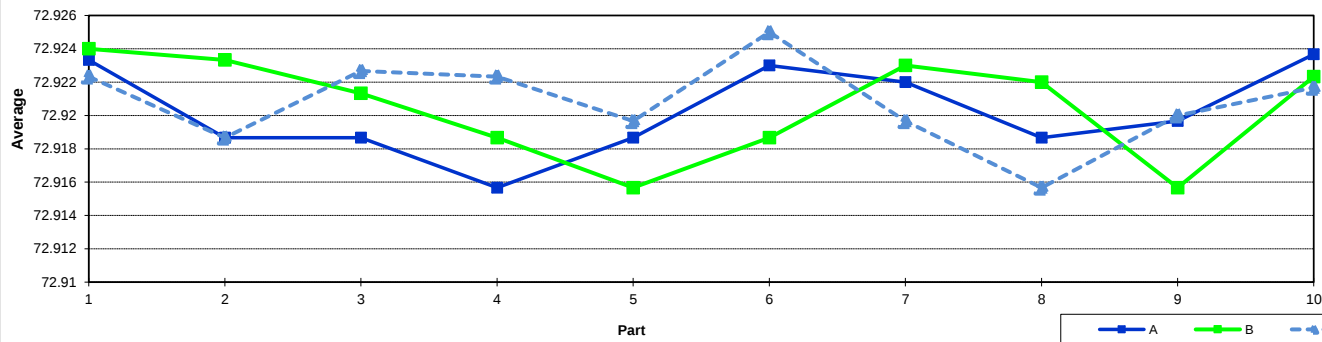
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Phone # 844-311-3705		Gage Name OGP		Location Confiabilidad		Part Name HOUSING FOR 48	
Date 16-feb-22		Gage ECL/ Revision		Supplier Eliezer Vazquez		Part ECL / Revision 5	
e-mail eliezer.vazquez.martinez@				Segment		Customer P/N	

Range Chart by Operator

All Ranges OK



Average Run Chart by Operator



Comments / Notes: