QIMacros®

KnowWare International, Inc.

FORD MSA GRR 4th Edition using QI Macros for Excel

Ford Verification Data with Average and Range Method, as well as Specification Tolerance

	A	B	C	D	E	F	G	H	I	J	K	L
1	**Gage R&R**											
2	**Average & Range Method**		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
3	Appraiser 1	Trial 1	3.63957	3.93548	3.84455	4.1651	4.28118	3.43333	3.80442	3.93066	4.14554	4.22784
4	Enter your data here->	Trial2	3.57531	3.93015	3.88189	4.22454	4.30886	3.44552	3.84481	3.90602	4.15316	4.21844
5		Trial3	3.61748	3.89916	3.79324	4.18314	4.25248	3.36779	3.78816	3.89789	4.19837	4.24714
6		Trial4										
7		Trial 5										
8	Appraiser 2	Trial 1	3.58826	3.91847	3.85039	4.16154	4.22682	3.40564	3.80264	3.86563	4.14732	4.14732
9	Enter your data here->	Trial2	3.62865	3.90653	3.84887	4.20828	4.23444	3.39446	3.80366	3.84912	4.09804	4.2187
10		Trial3	3.63094	3.94514	3.8509	4.23495	4.27788	3.39599	3.8001	3.87503	4.1237	4.21311
11		Trial4										
12		Trial 5										
13	Appraiser 3	Trial 1	3.57734	3.88087	3.85293	4.17678	4.26467	3.43282	3.81052	3.85141	4.14072	4.22352
14	Enter your data here->	Trial2	3.58268	3.87173	3.78054	4.16129	4.23876	3.37973	3.79959	3.8857	4.15189	4.21133
15		Trial3	3.62865	3.87351	3.7968	4.1745	4.19888	3.3998	3.78664	3.85217	4.12522	4.22454
16		Trial4										
17		Trial 5										
45	Spec Tolerance	2	AIAG - Automotive Industry Action Group Formulas					USL	4.30886	LSL	3.36779	3.923659
46	Historical Variation (HV - 6σ)	1.5										

		% Using TV	% Using Tolerance	% Using HV
47				
48				
49	NDC	13	N/A	12
50	EV (Equipment Variation)	0.0254		0.0254
51	%EV	9.46%	7.61%	10.1%
52	AV: (Appraiser Variation)	0.01326		0.01326
53	%AV	4.95%	3.98%	5.3%
54	R&R (Gage Capability)	0.0286		0.0286
55	%R&R	10.67%	8.59%	11.5%
56	PV (Part Variation)	0.2667		0.2484
57	%PV	99.4%	80%	99.3%
58	TV (Total Variation)	0.2682		0.2500

Gage system may be acceptable based on importance of application and cost
Gage may need maintenance, redesign, or better clamping

# Parts	#Trials	#Ops
10	3	3

Verified results:

- NDC = **13** is greater than **4** which means this is a valid GR&R.
- Average and Range GR&R is **10.67**, while Specification Tolerance GR&R is **8.59**.

Ford Verification Data using ANOVA Method

					With Interaction		Without Interaction	
60	**Calculate GageR&R using Anova**							
61	**Anova Source**	**df**	**SS**	**MS**	**F**	**P**	**F**	**P**
62	**Appraiser**	2	0.0110	0.0055	8.454355	0.003	8.376887	0.001
63	**Parts**	9	6.3333	0.7037	1083.396	0.000	1073.468	0.000
64	**Appraiser x Part**	18	0.0122	0.000676	1.040074	0.432		
65	**Gage w AP Interaction**	60	0.0390	0.0006	**Use Without Interaction**			Constant
66	**Gage w/o AP Interaction**	78	0.0511	0.0007				6
67	**Total**	89	6.395412					

							NDC 14						NDC 14
68		Without Interaction						With Interaction					
69	Without Interaction	Estimate of Variance	Std. Dev		Total Variation	% Contribution	Total Variation Using Tolerance	Estimate of Variance	Std. Dev		Total Variation	% Contribution	Total Variation Using Tolerance
70	**Repeatability**	0.00066	0.025603	EV	**9.1%**	1%	**7.7%**	0.00065	0.025486	EV	**9.1%**	1%	**7.6%**
71	**Appraiser**	0.000161	0.012696	AV	**4.5%**	0%	**3.8%**	0.000161	0.01267	AV	**4.5%**	0%	**3.8%**
72	**AppraiserxPart**	0	0	INT	0.0%	0%	0.0%	8.68E-06	0.002946	INT	1.0%	0%	0.9%
73	**R&R**	0.00082	0.028579	R&R	**10.17%**	1%	**8.57%**	0.00082	0.028614	R&R	**10.2%**	1%	**8.6%**
74	**Part**	0.07812	0.279492	PV	99.5%	99%	83.8%	0.07811	0.279488	PV	99.5%	99%	83.8%
75				TV	1.685698		0.333333			TV	1.00000		

Verified results:

- ANOVA GR&R is **10.17**.
- Specification Tolerance GR&R is **8.57**.

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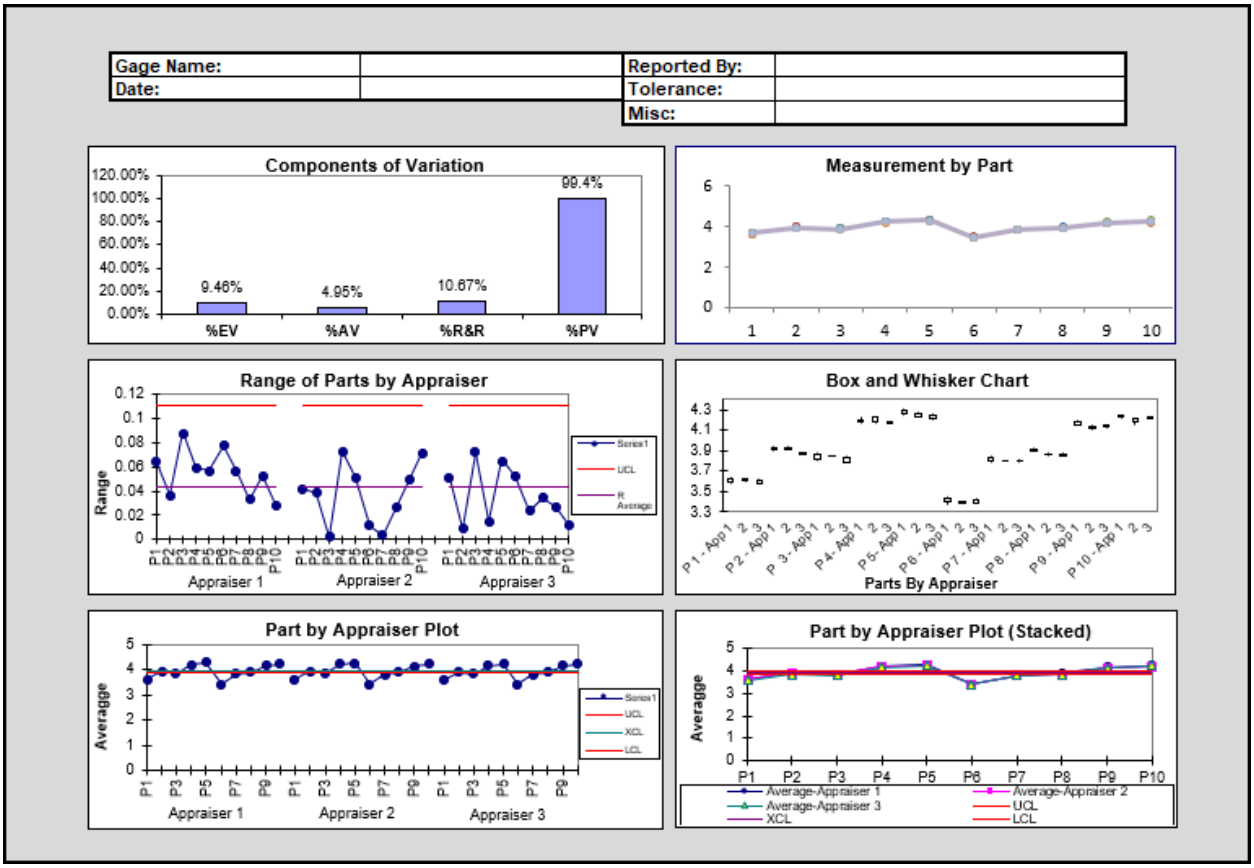
Ford Verification Data Charts



Find out more about MSA and Gage R&R at:

https://www.qimacros.com/gage-r-and-r-study/aiag-msa-gage-r-and-r/