Measurement System Analysis to Improve Quality by GRR% in WE-6HSG

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Abstract—The measurement method is the first step to control the production and improve quality Because the operator needs specific and accurate information to analyse and solve problems. Gauge R & R is a process of equipment, equipment, or operator if they are tested Anti-traditional After measuring the results of the gauge R & R define the cause of the error Results analysis, measuring systems are more specific and more accurate. Very deep and important concept for measuring system analysis (MSA).Very accurate and precise product production. Concerns in the MSA study Measurement capabilities are related to measurement variability. Changer eading the measure gives wrong analysis and increase the distrust, which directly impact of product production and dissatisfaction effectiveness. GRR (Gauge Repetition and reproducibility) used to detect diversification of the term. The difference between the GRR% measurement systems shows the level of difference.

Key words: GRR(Gauge Repetition and reproducibility), WE-6HSG

I. INTRODUCTION MEASUREMENT SYSTEM ANALYSIS

A. The need for Measurement Systems Analysis

In our day-to-day work we often collect and use the information that important decisions in our process are tested, for example, we are properly tested so that we can measure the critical dimensions of the production parts; The documentation and drawings were tested to monitor that they were done correctly; We test our engines to ensure their specification.

B. What is Measurement System Analysis?

Measurement System Analysis (commonly referred to as MSA) is a precise process that we use to evaluate the capabilities of a measurement system to provide good quality information.

C. Different types of Measurement System Analysis

1) Continuous Data

Continuous information comes from a continuous scale measurement, temperature, time, distance, volume, and dimension.

2) Gauge R&R

Short for gauge R & G gauge repeat and reuse. It is a measurement system analysis method used for measuring system analysis, which collects data for seventy-two.

D. How does Measurement Systems Analysis Work?

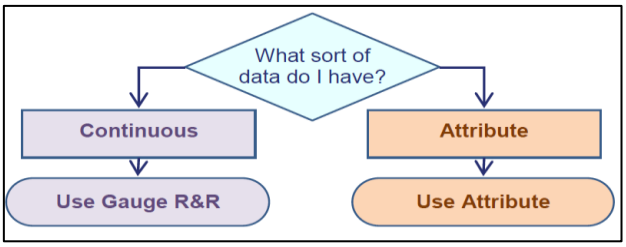
1) Repeatability

Recurrence is evaluated that each person can measure the same measurement multiple times with the same measurement device and may get the same information when regular information is measured.

2) Reproducibility

The evaluation of the reproduction can be measured in the same item multiple times with different same measurements and the same average value can be found.

E. Choosing the Appropriate Type of Study: Variable or Attribute



- A measurement system is a combination of people, tools, materials, methods and environment
- Measurement System Analysis is a precise process that provides good quality data which is used to evaluate a quality measurement efficiency, before collecting it before collecting any decision based information before using it.
- A precise method provider for teams determines whether the measuring system is suitable to use measurement methods for analysis.

There are 2 main types of Measurement System Analysis

1) Gauge R&R

Which is the method used to evaluate the measuring system for continuous data

2) Attribute Agreement Analysis

Which is the method used to evaluate the measurement system for material data

II. LITERATURE GAP

- After all the laboratories related to my interest field, all the measurements of measuring some aspects and measurements which I found in some basic areas were brought more seriously.
- In almost every laboratory, the main purpose is to reduce the time of measurement of each part.
- The main goal (research paper) is to improve the quality but our main objective is to improve productivity and quality needs

III. PROBLEM STATEMENT

- Indicator Control Valves (WE-6) Housing Edges Dimensions Control is one of the very important parameters of impact on product functions.
- Nominal level tolerance for control edge ± 0.05mm
- Hook Vernier Housing's control edge size measurements.

– Hook Vernier Gauge R & R done to measure control edge dimensions.
– Therefore it is necessary to reduce the difference between the measuring system, which ultimately consumes product tolerance.
– Gauge R & R% is 26.93%, which requires 10%. Therefore the measurement system needs to reduce the difference in which ultimately eat the tolerance of the product.

IV. OBJECTIVES

– Design and develop system for measuring control edge dimensions.
– Improve gauge R & R% measuring system in 10% by input control.
1) Controlling Equipment Variation (Repeatability)
2) Controlling Appraiser Variation (Reproducibility)

V. RESOURCE DETAILS

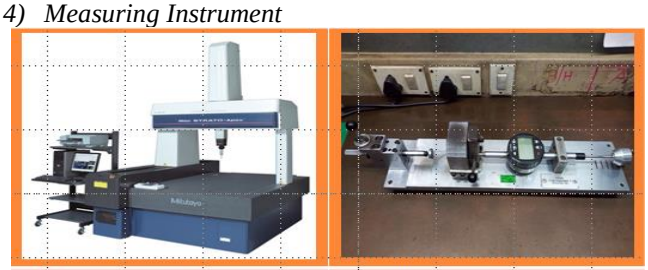
A. Information Regarding Work

1) CNC Machining Center (MCH-10)
– Rexroth Bosch India ltd

2) Standard Room (Measuring place)
– Rexroth Bosch India .Ltd Sanand, Ahmedabad
3) Material (Particular Product)
– WE-6 HSG (Casting- GGG40)

WE-6HSG Raw Material | WE-6 HSG Only Machining | WE-6HSG Painting

4) Measuring Instrument



CMM:- Which is place measure of Flatness, Roughness, Roundness, cylindrisity.

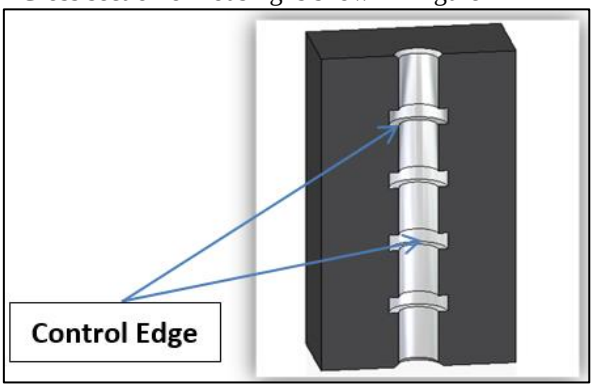
Controlling Edge Measuring Instrument: Hook vernier.

B. Acceptable Criteria

– GRR% < 10% = Acceptable measurement system
– 10%<GRR%<30% = Acceptable based upon importance of application
– GRR%>30% = Not acceptable

C. Description of Product & Effect of Problem

– Directional Control Valve performs three functions
1) Stop or Block fluid flow
2) Allow fluid flow
3) Change direction of fluid flow
– Machining for spool groove is made inside the housing. Cross section of housing is shown in figure



VI. RESULTS

A. Gage R&R for Hook Vernier

Part No. & Name :		808825, WE6 Hosing				Gauge Name :		Hook Vernier				Date :	
Characteristics :		Control edge dimension				Gauge No.:		VKR30505				: Performed By:	
Specification :		27.80 ± 0.05 mm				Gauge Type :		Variable Measurement				NGP	
Total Tolerance :		0.100				Gauge Increment :		0.0100					
Appraiser/ Trial #		PART										Average	
		1	2	3	4	5	6	7	8	9	10		
A (Nkul Patel)	1	27.790	27.800	27.790	27.790	27.790	27.810	27.790	27.800	27.810	27.830		27.8000
	2	27.790	27.800	27.780	27.790	27.790	27.810	27.790	27.800	27.810	27.840		27.8000
	3	27.800	27.800	27.780	27.790	27.800	27.810	27.800	27.800	27.800	27.830		27.8010
	Average	27.793	27.800	27.783	27.790	27.793	27.810	27.793	27.800	27.807	27.833	$\bar{\bar{x}}_a$ =	27.8003
	Range	0.010	0.000	0.010	0.000	0.010	0.000	0.010	0.000	0.010	0.010	$\bar{R}_a$ =	0.0060
B (Pragnesh Patel)	1	27.800	27.800	27.790	27.790	27.790	27.820	27.800	27.810	27.810	27.830		27.8040
	2	27.800	27.800	27.790	27.800	27.800	27.810	27.790	27.810	27.810	27.830		27.8040
	3	27.790	27.800	27.790	27.800	27.800	27.810	27.800	27.810	27.810	27.840		27.8050
	Average	27.797	27.800	27.790	27.797	27.797	27.813	27.797	27.810	27.810	27.833	$\bar{\bar{x}}_b$ =	27.8043
	Range	0.010	0.000	0.000	0.010	0.010	0.010	0.010	0.000	0.000	0.010	$\bar{R}_b$ =	0.0060
C (Rajesh Panchal)	1												
	2												
	3												
	Average											$\bar{\bar{x}}_c$ =	
	Range											$\bar{R}_c$ =	
Part Average		27.7950	27.8000	27.7867	27.7933	27.7950	27.8117	27.7950	27.8050	27.8083	27.8333	$\bar{\bar{x}}$ =	**27.8023**
												Rp =	**0.0467**
([$\bar{R}_a$ =	0.006	]+[$\bar{R}_b$ =	0.006	]+[$\bar{R}_c$ =	0.000	]) / [# of Appraisers =	2	] =				$\bar{R}$ =	**0.0060**
[Max $\bar{\bar{x}}$ =	27.804	] - [Min $\bar{\bar{x}}$ =	27.800	]	= $\bar{\bar{x}}_{DIFF}$ =	**0.0040**							
* [$\bar{R}$ =	**0.006**	] X [D_4 =	2.58	] = UCL_R =	**0.0155**								

Gage Repeatability And Reproducibility Report

Part No. & Name :	808825, WE6 Hosing		Gauge Name :	Hook Vernier		Date :	
Characteristics :	Control edge dimension		Gauge No. :	VKR30505		: Performed By :	
Specification :	27.80 ± 0.05 mm		Gauge Type :	Variable Measurement		NGP	
From Data Sheet	$\bar{R}$ =	0.006	$\bar{\bar{x}}_{DIFF}$ =	0.004	Rp =	0.047	

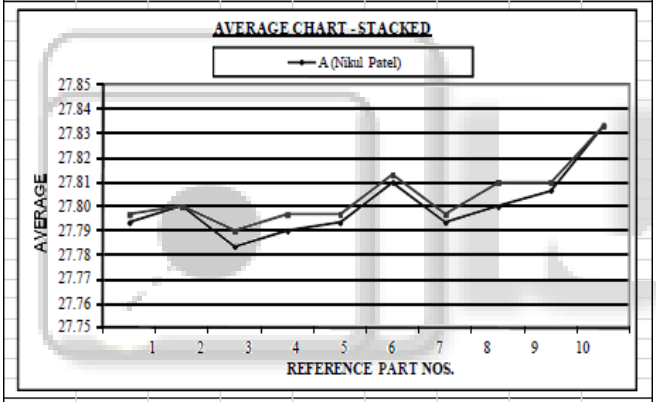
MEASUREMENT UNIT ANALYSIS						*% TOTAL VARIATION (TV)*					
Repeatability - Equipment Variation (*EV*)											
EV	=	$\bar{R}$ X K_1				%EV	=	100 X [EV / TV]			
	=	0.006 X 0.5908		Trials	K_1		=	100 X [0.0035 /	0.1000]		
	=	**0.0035**		2	0.8862		=	**3.545 %**			
				3	0.5908						

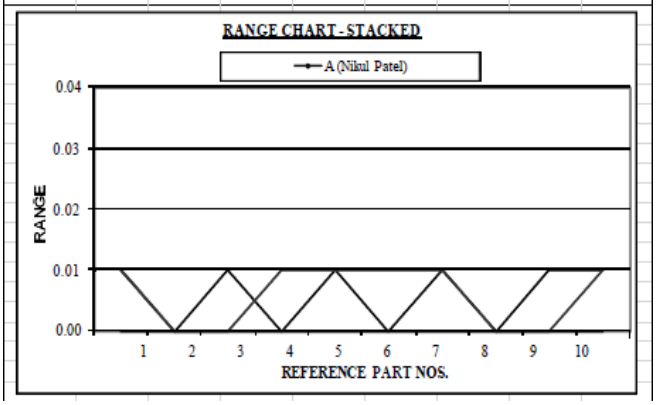
Reproducibility - Appraiser Variation (*AV*)											
AV	=	$(\bar{x}_{DIFF} \times K_2)^2$	-	$(EV^2 / (nr))$			%AV	=	100 X [AV / TV]		
	=	0.00001	-	0.0000004				=	100 X [0.0028 /	0.1000]	
	=	**0.0028**						=	**2.753** %		
			Appraiser	2	3						
			K_2	0.7071	0.5231						
Repeatability & Reproducibility (GRR)											
GRR	=	EV^2	+	AV^2			%GRR	=	6 X 100 X [GRR / TV]		
	=	1.3E-05	+	7.58099E-06				=	6 X 100 X [0.0045 /	0.1000]	
	=	**0.0045**			Parts	K_3		=	**26.931** %		
					2	0.7071					
Part Variataion (PV)					3	0.5231	%PV	=	100 X [PV / TV]		
PV	=	$R_P \times K_3$			4	0.4467		=	100 X [0.0147 /	0.1000]	
	=	0.047	X	0.3146	5	0.403		=	**14.681** %		
	=	**0.01468**			6	0.3742					
Total Variation (TV)					7	0.3534	ndc	=	1.41 (PV / GRR)		
TV	=	TOLERANCE			8	0.3375		=	1.41 (0.01468 /	0.00449)	
	=				9	0.3249		=	4.6119409		
	=	**0.1000**			10	0.3146		=	**5**		

Conclusion & Sign-Off :	Gauge R & R Performance is found satisfactory.			
MSA Coordinator	**Cell Sup. / Cell Leader**	**Appraiser-A**	**Appraiser-B**	**Appraiser-C**
NGP	RAP	Nikul Patel	Pragnesh Patel	Rajesh Panch

All Dimensions Are In MM.

ANALYSIS OF RESULTS - GRAPHICAL





– The elastic design of the measuring instrument that reduces the measurement and GRR% is reduced by 10.068%, which is 10% less and therefore the measurement system's prosperity zone.

B. Gage R&R for Dial Indicator

Gage Repeatability And Reproducibility Data Collection Sheet

Part No. & Name :	WE6 Housing	Gauge Name :	Dial Indicator	Date :	
Characteristics :	Control Edge Dimension	Gauge No.:	DPL35101	: Performed By :	
Specification :	30.6	Gauge Type :	Variable Measurement	Rajesh Bhimani	
Total Tolerance :	0.100	Gauge Increment :	0.0010		

Appraiser/ Trial #		PART 1	2	3	4	5	6	7	8	9	10	Average	
A (Rajesh Panchal)	1	30.567	30.570	30.644	30.578	30.620	30.601	30.647	30.590	30.632	30.601		30.6050
	2	30.567	30.568	30.643	30.580	30.623	30.600	30.650	30.589	30.630	30.602		30.6052
	3	30.568	30.570	30.643	30.582	30.621	30.602	30.649	30.589	30.631	30.602		30.6057
	Average	30.567	30.569	30.643	30.580	30.621	30.601	30.649	30.589	30.631	30.602	$\bar{\bar{x}}_a$ =	30.6053
	Range	0.001	0.002	0.001	0.004	0.003	0.002	0.003	0.001	0.002	0.001	$\bar{R}_a$ =	0.0020
B (Pragnesh Patel)	1	30.568	30.573	30.643	30.576	30.620	30.604	30.648	30.590	30.632	30.602		30.6056
	2	30.566	30.571	30.640	30.577	30.622	30.600	30.649	30.589	30.631	30.600		30.6045
	3	30.569	30.573	30.643	30.576	30.620	30.604	30.647	30.587	30.630	30.603		30.6052
	Average	30.568	30.572	30.642	30.576	30.621	30.603	30.648	30.589	30.631	30.602	$\bar{\bar{x}}_b$ =	30.6051
	Range	0.003	0.002	0.003	0.001	0.002	0.004	0.002	0.003	0.002	0.003	$\bar{R}_b$ =	0.0025
C (Nikul Patel)	1	30.571	30.573	30.644	30.582	30.622	30.598	30.647	30.588	30.631	30.602		30.606
	2	30.573	30.572	30.640	30.583	30.623	30.601	30.647	30.586	30.633	30.601		30.606
	3	30.571	30.573	30.644	30.584	30.622	30.600	30.648	30.589	30.631	30.601		30.606
	Average	30.572	30.573	30.643	30.583	30.622	30.600	30.647	30.588	30.632	30.601	$\bar{\bar{x}}_c$ =	30.606
	Range	0.002	0.001	0.004	0.002	0.001	0.003	0.001	0.003	0.002	0.001	$\bar{R}_c$ =	0.002
Part Average		30.5689	30.5714	30.6427	30.5798	30.6214	30.6011	30.6480	30.5886	30.6312	30.6016	$\bar{\bar{x}}$ =	**30.6055**
												Rp =	**0.0791**

([$\bar{R}_a$ = 0.002]+[$\bar{R}_b$ = 0.003]+[$\bar{R}_c$ = 0.002]) / [# of Appraisers = 3] = $\bar{R}$ = **0.0022**

[Max $\bar{\bar{x}}$ = 30.606] - [Min $\bar{\bar{x}}$ = 30.605] = $\bar{\bar{x}}_{DIFF}$ = **0.0009**

* [$\bar{R}$ = 0.002] X [D_4 = 2.58] = UCL_R = **0.0056**

Gage Repeatability And Reproducibility Report

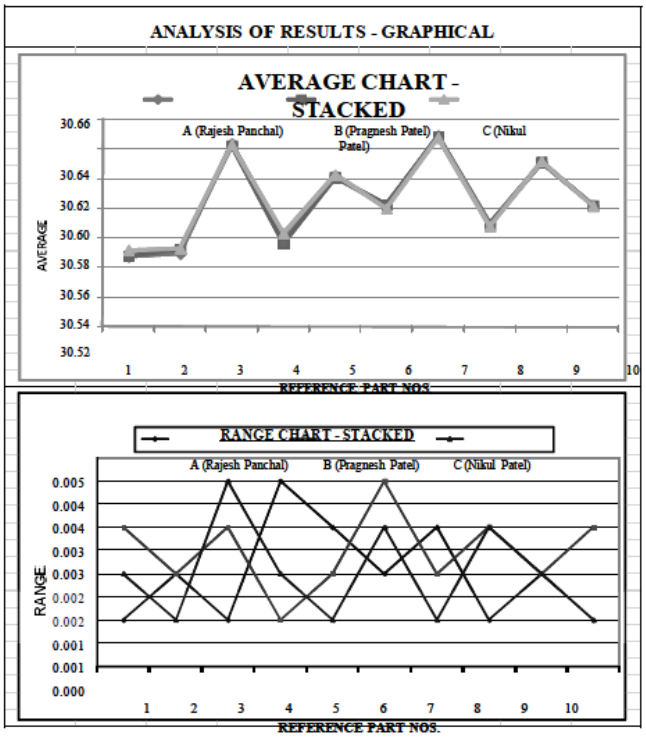
Part No. & Name :	WE6 Housing	Gauge Name :	Dial Indicator	Date :
Characteristics :	Control Edge Dimension	Gauge No. :	DPL35101	: Performed By :
Specification :	30.60	Gauge Type :	Variable Measurement	Rajesh Bhimani

From Data Sheet	$\bar{R}$ = 0.0022	$\bar{\bar{x}}_{DIFF}$ = 0.0009	Rp = 0.079

MEASUREMENT UNIT ANALYSIS							*% TOTAL VARIATION (TV)*				
Repeatability - Equipment Variation (*EV*)											
EV	=	$\bar{R}$	X	K_1			%EV	=	100 X [EV / TV]		
	=	0.00217	X	0.5908	Trials	K_1		=	100 X [0.0013 /	0.1000]	
	=	**0.0013**			2	0.8862		=	**1.280** %		
					3	0.5908					
Reproducibility - Appraiser Variation (*AV*)											
AV	=	$(\bar{x}_{DIFF} \times K_2)^2$		- $(EV^2 / (nr))$			%AV	=	100 X [AV / TV]		
	=	0.00000	-	0.0000001				=	100 X [0.0004 /	0.1000]	
	=	**0.0004**						=	**0.409** %		
				Appraiser	2	3					
				K_2	0.7071	0.5231					
Repeatability & Reproducibility (GRR)											
GRR	=	$\sqrt{EV^2 + AV^2}$					%GRR	=	6 X 100 X [GRR / TV]		
	=	1.6E-06	+	1.67024E-07				=	6 X 100 X [0.0013 /	0.1000]	
	=	**0.0013**			Parts	K_3		=	**8.062** %		
					2	0.7071					
Part Variataion (PV)					3	0.5231	%PV	=	100 X [PV / TV]		
PV	=	$R_P \times K_3$			4	0.4467		=	100 X [0.0249 /	0.1000]	
	=	0.079	X	0.3146	5	0.403		=	**24.888** %		
	=	**0.02489**			6	0.3742					
Total Variation (TV)					7	0.3534	ndc	=	1.41 (PV / GRR)		
TV	=	TOLERANCE			8	0.3375		=	1.41 (0.02489 /	0.00134)	
	=				9	0.3249		=	26.11591		
	=	**0.1000**			10	0.3146		=	**26**		

Conclusion & Sign-Off :	Gauge R & R Performance is found satisfactory.			
MSA Coordinator	**Cell Sup. / Cell Leader**	**Appraiser-A**	**Appraiser-B**	**Appraiser-C**
Rajesh Bhimani	R.A. Patel	A (Rajesh Panchal)	B (Pragnesh Patel)	C (Nikul Patel

All Dimensions Are In MM.



1) Reduction in GRR% could possible after providing fixture to the measurement system.
2) So, this type using this method.
3) All criteria maintained by above results.

VII. CONCLUSION

Production Tolerance Increasing Accurate Measurement Process for Satisfactory Machine Measurement Process Should Reduce Tolerance. Measurement type has been introduced only for two main reasons because firstly inarplayer disqualification and other wrong assessment taking measurement by appraiser Instrument disability under analysis of measurement management difference level between GRR% measurement device and the improvements are necessary to achieve the standard.

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