EFFICIENT STRUCTURE FOR QUALIFICATION AND RE-QUALIFICATION MEASURES IN MANUFACTURING PROCESS WITH ITS PRECISION

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Abstract: each bit of instrument is subject to a particular quantity of variation. The subsequent paper will be used as tips indecisive the preciseness, major issues, quantity of variation of all gauging systems used throughout the producing method. It'll conjointly give a controlled structure for qualification and requalification of any such activity systems wont to perform mensuration of product and/or method parameters.
Keywords: Gauge systems, Repeatability, satisfactoriness, dependability.

Introduction: Manufacturers could believe that they need associate applicable and useful gauging system supported the perceived accuracy or style, however, typically the accuracy of the gauge is wrong. the foremost common scenario is that a significant portion of the desired tolerance is lost to mensuration errors, incorrect usage, or instrumentality variation. To avoid this example is in our greatest interest to conduct a study of the instrument to see if it's each "correct" and "repeatable".

Foursquare measure the variation factors that square measure characterizing variable gauges in spite of what the gauges are:

Accuracy: is outlined because the distinction between the ascertained average of measurements and "the true average" of the 2 to urge "the true average", you wish to use the best preciseness measuring system obtainable.

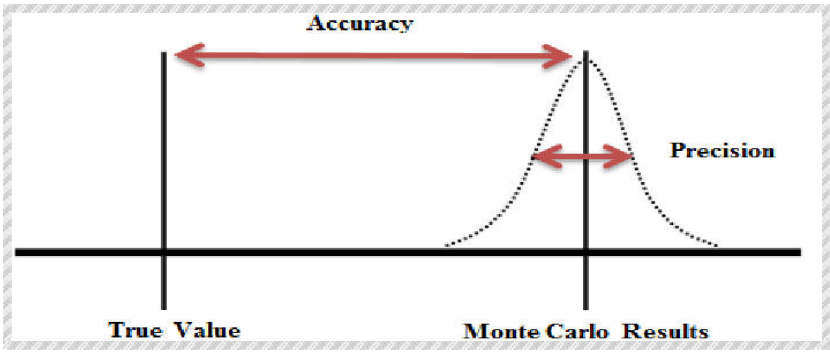

Fig1: Accuracy

Stability: is outlined because the periodic variation that happens because of environmental changes, power fluctuations, wear, or deterioration of gauge.

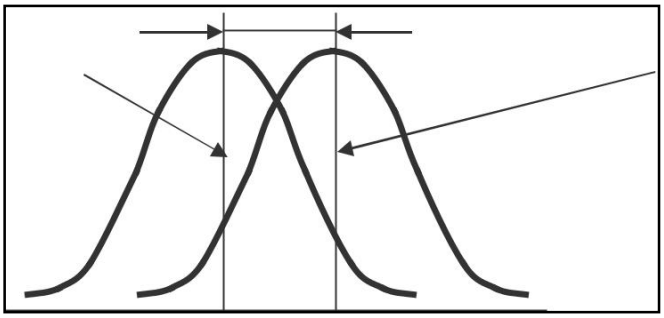

Fig 2: Stability

Repeatability: is outlined because of the quantity of variation within the gauge once the dependability (Operator Variation): is outlined because of the quantity of variation within the measurements.

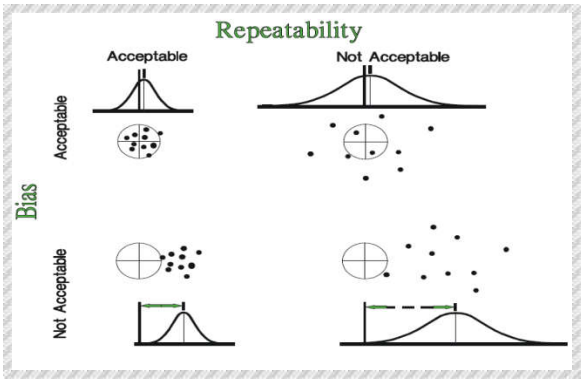

Fig 3: Repeatability

Reproducibility: All the variation factors were given within the previous paragraph. the primary 2 factors (accuracy and stability) square measure typically quite little, therefore we actually don't have to be compelled to concern ourselves with measured because the distinction between 2 ascertained averages of measurements taken within the same conditions in 2 totally different amount of your time.

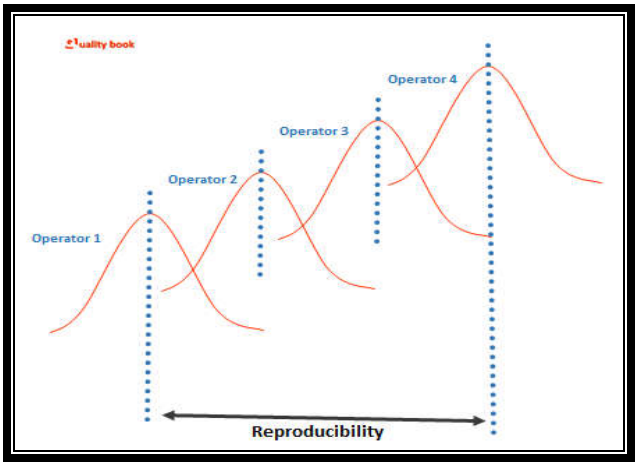

Fig 4: Dependability

% Repeatability and dependability (R&R): same elements and half characteristics square measure measured many times by an equivalent person. Once totally different persons use an equivalent gauge on equivalent elements and elements characteristics. The alternative is true for the last 2 factors (repeatability and reproducibility): they're typically massive and can cause issues with product's acceptance or rejection. That's why additional studies can beware solely regarding the last 2 factors mentioned. The % Repeatability and dependability (% R&R) is that the share of the desired tolerance that's lost to gauging error.

Gauge Satisfactoriness: A team coming up with and preparation are of absolute importance for the success of the gauge study. The characteristics of the gauge range of inspectors, the importance of the characteristic being checked and therefore the range of elements to live square measure all things that require to be thought about before the ultimate arrange is enforced. Following square measure counseled practices for the study:

Number of inspectors/testers: 3(3) or two(2) ought to be used for half mensuration

Reproducibility: of trials: the take a look at is a style for 3 (3) or 2 (2) trials. 3 are usually recommended once previous gauge capability is unknown. 2 will be used once previous gauge capability studies have shown associate R&R of but two hundredth.

The number of parts: typically 10 (10), however, 5 (5) if previous gauge capability studies have shown associate R&R of but two hundredth.

Measuring ability: the gauge ought to have graduations that permit a minimum of common fraction (1/10) of the tolerance of the characteristic to be scan directly.

Measuring ability: the gauge should have graduations that allow at least one-tenth (1/10) of the tolerance of the characteristic to be read directly. After the plan is completely defined, the sample units must be measured. Data is computed using the following formulas: Each part is measured three or two times. Measurements give a certain amount of variation characterized by the average R. Averages Ri is calculated also for each inspectors/testers. Average R is the average of the inspectors /testers averages. The study can provide also the team members with significant information about the causes of gauge errors. For example if the lack of reproducibility is large when compare to repeatability, some possible causes are: User training in method of using and reading the gauge is needed Calibrations of the gauge dial could be more clearly defined. If the lack of repeatability is large when compare to reproducibility, the reasons may be: The gauge could be redesigned for ease of use Gauge maintenance might be required.

Case Study: The present case is referring to an electronic product. The flag was raise when discrepancies were notice between the acceptance/rejection rates for different test equipment. The test parameter under discussion is a product critical parameter. A complete test equipment evaluation was requested by Customer. All data was computed using a special soft. Because no other R&R studies were performed, initially we chose the following R&R strategy:

- ✓ Number of testers: 2
- ✓ Number of trials: 3
- ✓ Number of parts: 10
- ✓ Parameter specification limits: upper specification limit: 25

- ✓ specified tolerance: 7.5
- ✓ Measuring ability: >1/10 of the tolerance

The measurements are presented in Table 1.

Table 1. Tests Measurements.

Data		Tester No: 1				Tester No: 2		
		Trial				Trial		
Sample #	1	2	3	Range	1	2	3	Range
1	24.01	24.00	23.99	0.02	22.55	22.55	22.56	0.01
2	23.98	23.98	23.98	0.00	22.56	22.56	22.55	0.01
3	23.98	23.98	23.98	0.00	22.54	22.56	22.55	0.02
4	23.98	23.97	23.98	0.01	22.54	22.55	22.55	0.01
5	23.97	23.97	23.97	0.00	22.55	22.56	22.53	0.03
6	23.97	23.97	23.96	0.01	22.58	22.54	22.55	0.04
7	23.96	23.96	23.96	0.00	22.59	22.55	22.55	0.04
8	23.96	23.96	23.96	0.00	22.56	22.55	22.54	0.02
9	23.96	23.95	23.96	0.01	22.55	22.59	22.61	0.06
10	23.96	23.96	23.95	0.01	22.58	22.55	22.55	0.03
	Range average R1			0.006	Range average R2			0.027
	Sample average X1			23.97	Sample average X2			
								22.56
Average range R								0.016
X-bar range X								1.414

Data were computed and the test evaluation by R& R point of view is given in Table 2 (initial status). Studying the data presented in table 2 we can draw some conclusions: Test equipment repeatability and reproducibility (R&R) is unacceptable. More than 68% of the tolerance is lost due to the gauge R&R. The explanations are inside the following chart (the X Bar-R chart for measurements): There are two different areas in X-Bar chart: for tester number 1, with an average of the observed measurements of 23.96

Table 2. Data computed and test evaluation by R&R point of view.

		Tolerance analysis
Repeatability (EV)	0.050325	0.67%
Reproducibility (AV)	5.161092	68.81%
Repeatability and Reproducibility (R&R)	5.161337	68.82%
Control limit for individual ranges	0.042471	

Note: any ranges beyond this limit may be the result of assignable causes. Identify and correct. Discard values and recomputed statistics.

As the Table 2 states, test repeatability is acceptable. About 0.67% of the tolerance is lost due to the equipment variation. The major problem is the reproducibility. Reproducibility is about 68%.

For tester number 2, with an average of observed measurements of 22.55 this drift between testers is the cause for unacceptable percent R&R both tester is working with acceptable variances (there are no major variances inside these two areas).

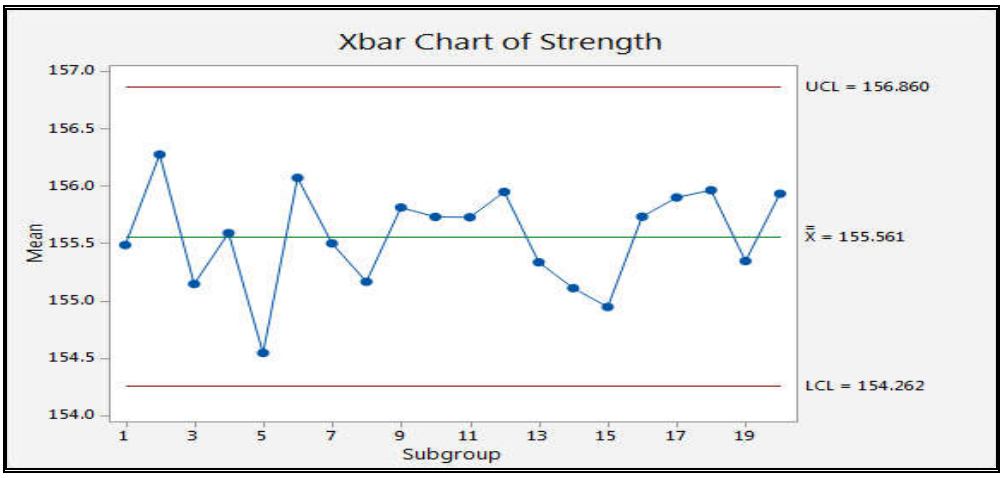

Fig 1: x-bar chart data were computed and the test evaluation by R& R point of view is given in Table 3 (final status).

Table 3.Data computed and test evaluation by R&R point of view.

		Tolerance analysis	
Repeatability (EV)	0.178		2.37%
Reproducibility (AV)	0.32		4.27%
Repeatability and Reproducibility (R&R)	0.366		4.88%
Control limit for individual ranges	0.127		

Studying the data presented in table 3 we can draw some conclusions: Test equipment repeatability and reproducibility (R&R) is acceptable. Less than 5% of the tolerance is lost due to the gauge R&R. We can compare the measurements given by both testers (see the X bar-MR chart presented below):

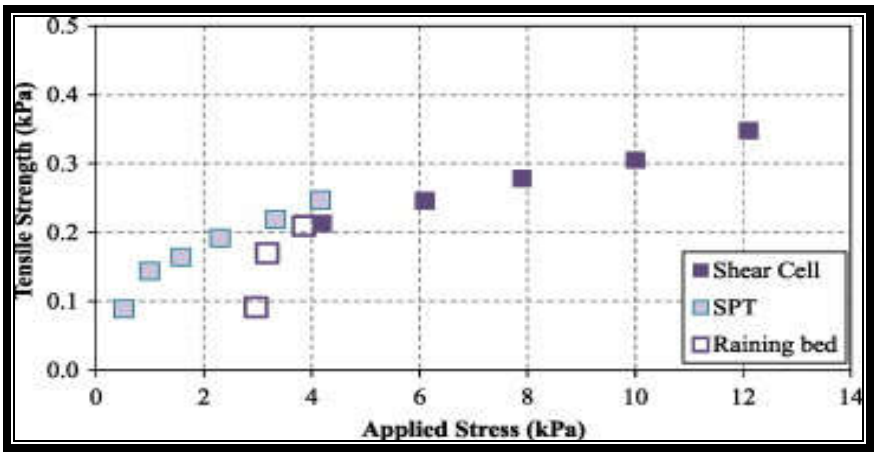

Fig 6. Comparison the measuring data given by testers.

As fig 6 shows, both testers are setup at the same value 23.9. Final test status is characterized by acceptable variances in and within testers. No drift is found in the final measurements.

Conclusions: In order for equipment to be qualified, any system variation must be within an acceptable tolerance, based on the specification of the process being measured. The R&R study presented in this paper is a method for easy equipment evaluation. This technique, combined with other statistical methods, can suggest if any assignable causes are present and can completely evaluate the measurement equipment.

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