RFM
Resources For Manufacturing, Inc.

CMM's and Accessories <> Video Systems
Manual Gages <> Surface Texture & Geometry
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Why Do I Have To Do Gage R & R's?

The standard tells me that I have to do Gage R&R Studies on each type of gage I have. This seems like a lot of work to do for no reason other than to comply with the standard. What is the purpose of doing this study anyway?……

ISO and QS 9000 requirements state that;

> ***"The supplier must provide evidence that appropriate statistical studies have been performed on all measurement systems referenced in the customer-approved control plan. Methods used to gather analytical evidence should be based on the guidelines spelled out in the "Measurement Systems Analysis" reference manual. Alternative methods can be used with customer approval."***

Isn't it interesting that these standards tell you what you must do, but all to often, they offer no explanation as to the reason for doing so. It's kinda like when as a child you asked your mom, "why?" and her reply was "because I said so."

Doing all the work necessary to comply with the standards can be very labor intensive, and as such, costly. Doing Gage R&R studies on all your types of gages just for the sake of doing them is in the very least, ridiculous. There IS however, a very good reason to do Gage R&R studies. "Ah Ha! And what pray tell might that be you might ask?"

Gages and measurement systems are at the heart of collecting the data by which the acceptance criteria of the manufacturing process is controlled! The ability of the gage to detect variation in your manufacturing process is of the utmost importance for product quality and customer satisfaction. And where does the R&R study fit into this puzzle?

The very nature of "Quality Control" is to control the manufacturing process so that non-conforming products are never going to be produced due to natural causes. By utilizing the GR&R study as one of the tools to isolate and thereby eliminate variation in your processes, you can determine if the gage is capable of detecting variation in the acquired measurements, and how much of the variation present in that measurement process is attributable to the gage itself.

It is extremely helpful to understand what the driving forces in the GR&R study are in order to make intelligent decisions about the measurement process. Anyone who has performed GR&R studies eventually begins to question the reason for doing them. And as such they begin to understand the relationships the calculations provide and what the driving forces are behind those calculations.

Tolerance and range are those two factors that ultimately become the values studied to determine where measurement variation comes from. They are the drivers.

To achieve a GR&R less than 10%. The main consideration is 10% of what? 10% of the tolerance is the primary concern. However, the guideline set forth in the MSA Manual suggests that the measurement system should be based upon 10% of the total process variation.

This brings up some interesting considerations. If gages are chosen to control a process is first based upon choosing a gage the meets the 10:1 rule, in other words, the gage has a discrimination (resolution) of 10% of the blueprint tolerance, and if the characteristic to be controlled meets a 1.33 Cpk, the tolerance has now been reduced to 75% of the drawing tolerance.

SPC tracking should be done on processes based on the order of importance. Feature characteristics should be classified on the drawing by the design engineers as Critical, Major, or Minor. GR&R studies should be performed on all gages that control all critical dimensions, and some selected major characteristics. How do SPC and GR&R tie in together?

Consider the following:

EX: Suppose we are measuring an outside diameter that has a tolerance of +/- .005".
Following the 10:1 rule, this would require a gage that has a resolution of .0001".
However, the SPC indices require a 1.33 Cpk for this characteristic.
This in effect reduces the allowable tolerance by 25%.

Even at 1/10 of the original tolerance, an outside micrometer frequently performs at or near the 10% level. If that total tolerance is now reduced to .0075, this causes the variation due to the measurement system to climb beyond the acceptable limit of 10%.

Another factor to consider is if indeed the process is running at a Cpk of 1.33 or better, and the requirement of the gage system is to meet a GR&R of 10% or less as expressed as part of the total process variation, the gage being used is required to meet this requirement as well. And as one performs Continuous Process Improvement to reduce the amount of variation present in that process, this raises the percentage of variation in that process due to the measurement system beyond the 10% level required.

The bottom line is that your procedures should address these issues when attempting to comply with the requirements set forth in the ISO and QS Standards, and that GR&R studies should be used to help evaluate the amount of variation in your controlled process attributable to the measuring system and **not** just doing the work to be doing work.