MSA Gage R&R Cheat Sheet

Key Concepts

◊ MSA Gage R&R is a test of your measurement system, not your parts.

◊ You need bad parts to conduct a good Gage R&R study.

◊ Parts in the study should span the distance between the specification limits.

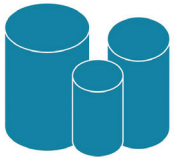
◊ If your parts don't have enough variation, then the Gage R&R study is invalid.

◊ The NDC metric indicates if there is enough part variation for a good test.

◊ NDC (number of distinct categories) should be ≥ 5.

Three Types of Variation

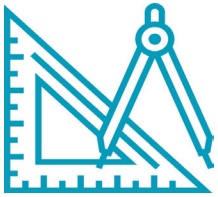
Parts



% PV

Differences between the parts.

Equipment



% EV
Repeatability

Can the same person get the same result using the same gage on the same part in two or more trials?

If % EV > % AV
Gage may need maintenance, redesign, or better clamping.

Appraisers

% AV
Reproducibility

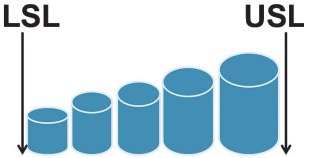
Can two people measuring the same part with the same gage, get the same result consistently?

If % AV > % EV
Appraisers may need better training or gage is hard to read.

How to Conduct a Gage R&R Study

What You Will Need

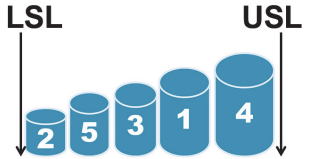
1. Five to ten parts that span the distance between the upper and lower spec limits. The parts should represent the actual or expected range of variation.



2. Two or three appraisers (people who measure the parts).
3. One measurement tool or gage.

Steps to Follow

1. Number the parts in random order, not in order of size.



2. Have each appraiser measure each part two to five times.
3. Input the measurements into the QI Macros Gage R&R Template.
4. Is the NDC ≥ 5? If no, your parts are too similar.

Interpreting the Results

You want most of the variation to be between the parts, and less than 10% to be caused by the measurement system (appraisers and equipment).

- % R&R<10% - Gage system is okay (most variation caused by parts)
- % R&R<30% - May be acceptable
- % R&R>30% - Gage system needs improvement (appraisers and equipment > 1/3 of the variation)

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Types of Gage R&R Studies included in QI Macros for Excel

Gage R&R Study (Long Form) - Type II

Average and Range Method and ANOVA Method
10 parts x 2 or 3 appraisers x 2 or 3 measures

Bias

Calculate the "bias" of a gage using a "target" or "reference" value.

Linearity

Calculate if a gage over or under reads across a range of different sized parts.

Range Method (Short Form)

A quick approximation of overall measurement variability.

Destructive Testing

When a measurement can't be repeated because the product is destroyed during the test.

Type 1 Gage R&R

1 part
1 appraiser
50 measures

Type III Gage R&R

25 parts
1 appraiser
2 or more measures

Attribute Gage Worksheet

For Pass / Fail Gages

Attribute Agreement Analysis

Evaluate appraisers making subjective judgments.

Analytic Attribute Method

Assess the repeatability and bias of an attribute gage.

Advantages of Using QI Macros Gage R&R Template

- Just drop data into yellow shaded input cells.
- Performs calculations and interprets the results for you.
- Red alarm if NDC < 5.
- Validated using AIAG MSA 4th Ed & Ford Data.
- Works in PC and Mac. Excel 2013-2021 and Office 365.
- Reduces risk vs. manual calculations.
- Saves time!

Learn More and Watch Gage R&R Video Series at:
www.qimacros.com/gage-r-and-r-study/video-tutorials/

Example of QI Macros Gage R&R Template

	A	B	C	D	E	F	G
1	Gage R&R			Part Number			
2	Average & Range Method		1	2	3	4	5
3	Appraiser 1	Trial 1	3.64	3.94	3.84	4.17	4.2
4	Enter your data here->	Trial2	3.575	3.93	3.88	4.22	4.3
5		Trial3	3.617	3.9	3.79	4.18	4.2
6		Trial4					
7		Trial 5					
8		Total	10.83	11.8	11.5	12.6	12
9		Average	3.611	3.92	3.84	4.19	4.2
10		Range1	0.064	0.04	0.09	0.06	0.0
11	Appraiser 2	Trial 1	3.588	3.92	3.85	4.16	4.2
12	Enter your data here->	Trial2	3.629	3.91	3.85	4.21	4.2
13		Trial3	3.631	3.95	3.85	4.23	4.2
14		Trial4					
15		Trial 5					
16		Total	10.85	11.8	11.6	12.6	12
17		Average	3.616	3.92	3.85	4.2	4.2
18		Range2	0.043	0.04	0	0.07	0.0
19	Appraiser 3	Trial 1	3.577	3.88	3.85	4.18	4.2
20	Enter your data here->	Trial2	3.583	3.87	3.78	4.16	4.2

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