

## Example – Determining Repeatability and Reproducibility by Range Method

The Range method typically uses two appraisers and five parts for the study. In this study, both appraisers measure each part once. The range for each part is the absolute difference between the measurement obtained by appraiser A and the measurement obtained by appraiser B. The sum of the ranges is found and the average range ( $\bar{R}$ ) is calculated. The total measurement variability is found by multiplying the average range by  $1/d_2^*$ , where  $d_2^*$  is found from  $d_2^*$  table with  $m = 2$  and  $g =$  number of parts.

Parts	Appraiser A	Appraiser B	Range (A, B)
1	0.85	0.80	0.05
2	0.75	0.70	0.05
3	1.00	0.95	0.05
4	0.45	0.55	0.10
5	0.50	0.60	0.10

$$\text{AverageRange } (\bar{R}) = \frac{\sum R_i}{5} = \frac{0.35}{5} = 0.07$$

$$GRR = \left( \frac{\bar{R}}{d_2^*} \right) = \left( \frac{0.07}{1.19} \right) = 0.0588$$

(Process Standard Deviation = 0.0777 from previous study)

$$\%GRR = 100 * \left( \frac{GRR}{\text{Process Standard Deviation}} \right) = 75.7\%$$

To determine what percentage of the process standard deviation the measurement variation consumes, convert the *GRR* to a percentage by multiplying by 100 and dividing by the process standard deviation. In the example, the process standard deviation for this characteristic is 0.0777, the *%GRR* is determined to be 75.7% and the conclusion is that the measurement system is in need of improvement.