Understanding Statistical Test Results

When measurements are repeated, the values that result usually do not agree exactly. The scatter or discrepancies in the data are usually due to systematic or random errors. Systematic errors are caused by material changes, operators and/or instrumentation. Random errors are variations in measurements obtained under similar conditions.

Tests run in our laboratory generate data that is evaluated and expressed as follows:

Number of samples: Typically, 30 samples are taken to ensure statistical accuracy.

Mean: The arithmetic mean (average) is the best approximation of the true value of all the measurements.

Standard deviation: Standard deviation is defined as the square root of the sum of the squares of the individual deviations divided by the number of readings minus one.

Sigma: The Greek letter, s (Sigma), is commonly used when referring to standard deviations, e.g. 1s equals one standard deviation, 2s equals two standard deviations, and so forth. One standard deviation or 1s indicates that 68.3% of all the data points taken, lie within one standard deviation of the mean. Moreover, 2s indicates that 95.5% of the data points taken lie within two standard deviations of the mean.

For example, if the mean value is 1.0 and your standard deviation is 0.005, 68.3% of your data lies between 1.005 and 0.995. Additionally, at two standard deviations (0.010), 95.5% of your data lies between 1.01 and 0.99. See the histogram shown in Fig. 1.

Accuracy: Accuracy is usually expressed as a percentage. In actuality, accuracy is the coefficient of variance which is nothing more than the standard deviation divided by the mean, times 100 (given as a percentage).

Statistically, the standard deviation is a more accurate representation of the material/feeder performance. For example, suppose, you meter several batches obtaining a mean value of 0.5 lb. and a standard deviation of .005 lb. Consider that your calculated accuracy would be 1% at 1s and 2% at 2s. This may not be satisfactory; however, also consider that your batch is ½ lb. with a standard deviation of ± 5 one thousandths of a pound. Practically speaking, these are accurate batches.

Accuracy statements such as ± ¼% at 2s can be misleading. You may be able to meter dry sand or granular products with this type of accuracy; however, poorer flowing materials such as titanium dioxide or carbon black will likely be out of this range. Some other factors that affect feed accuracy are: the number of samples taken, discharge rate or batch size, sampling duration, and scale or system limitations.

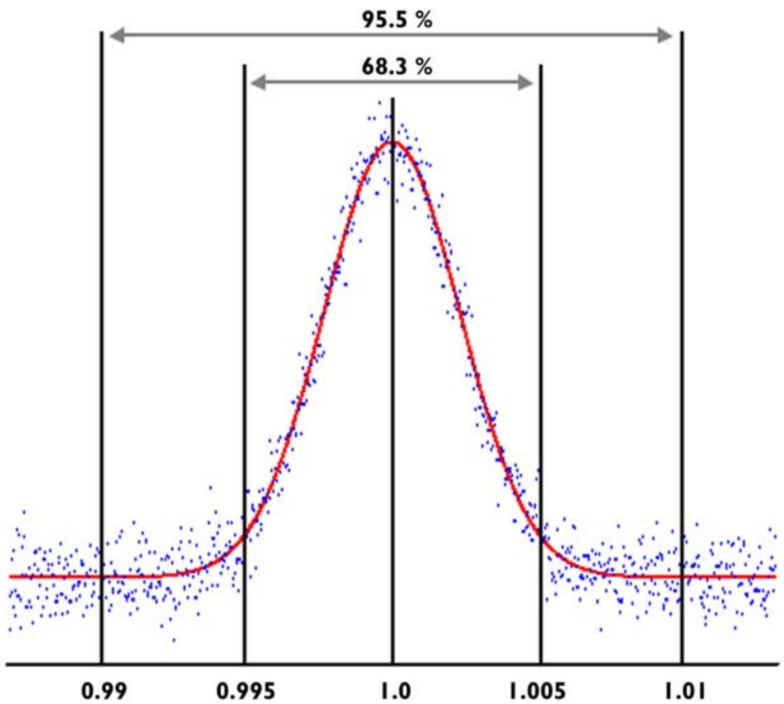

Fig. 1 Normal Distribution Curve

Mean ($\overline{X}$) = the average value of all the data points recorded

$$\overline{X} = \frac{\sum Xi}{n}$$

where: $xi =$ actual data points

$n =$ number of data points

Standard deviation (σ)

$$\sigma = \sqrt{\frac{\sum (Xi - \overline{X})^2}{(n-1)}}$$