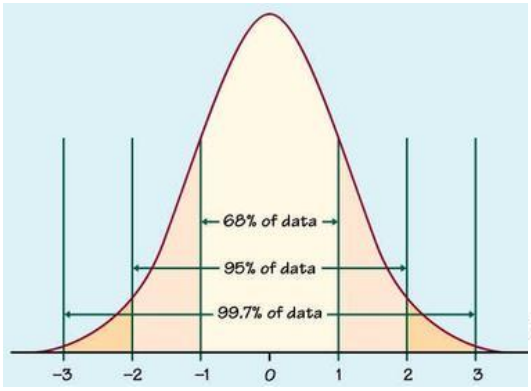
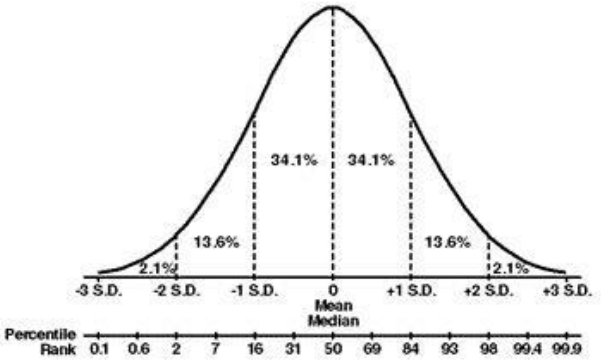
FREQUENTLY ASKED QUESTIONS:

1) *I have received my reference standard and certificate. What do the numbers represent?*

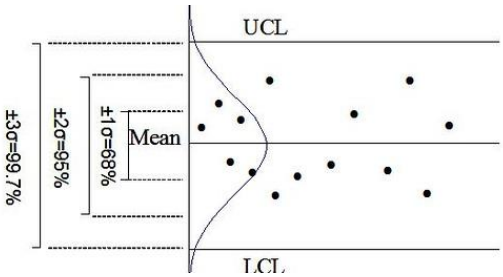
The "mean" is the average value derived from all the data points (n= the number of points or tests). The normal standard deviation or one sigma deviation is the "estimated" variation that we saw from our test comparisons at a 68% level of confidence. The expanded or two sigma deviation is the estimated variation from our tests at a 95% level of confidence. Some examples are below.

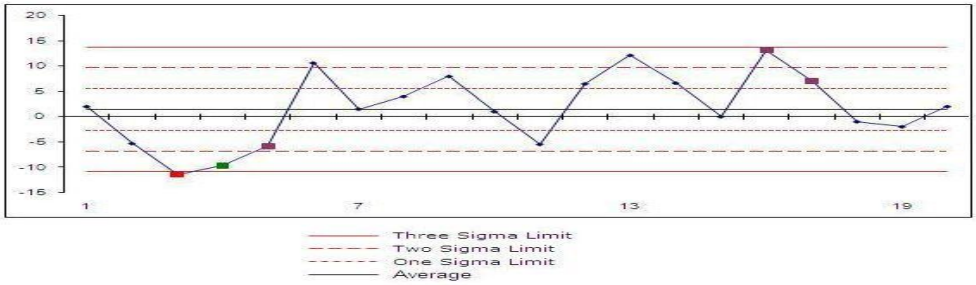




2) *What numbers should I use and how should I use them?*

The mean or average value is what you would plug into your instrument and strive to hold it for the most accurate measurements. You should discuss with your quality manager as to what degree of accuracy you should be holding during your checks. Most use the 95% confidence level. Some have less stringent criteria and allow to the 3 sigma or 99.7% confidence. Some are more strict and will hold to the one sigma or even less. We believe if all is working well with your analyzer, you have calibrated to the mean value, and should run the reference standard immediately afterwards it should be accurate within the expanded 95% confidence level or even closer to the 68% one sigma level. Should your checks exceed or drift beyond the 95% level it may be time to perform a re-calibration.



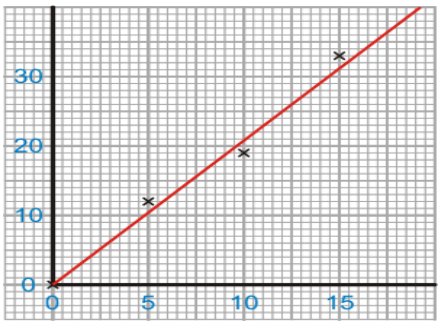


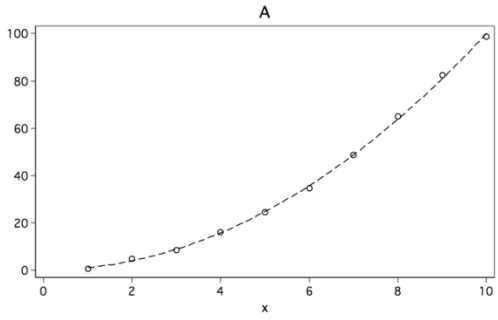
3) *The certificate says to "use the method expanded uncertainty if necessary", what does this mean?*
While we use different analyzers and multiple reference comparisons to establish the most accurate values we can, our information is only a snapshot of the material characteristics and the capability of the test method. The test method(s) (ASTM) we cite on the certificate have developed "precision and accuracy" tables or calculations based on interlaboratory studies (ILS). These are a more accurate example of how well your test method should perform.

4) *So a lower deviation means a better standard?*
Not necessarily. While it may represent some portion of the material homogeneity, there are many variables that are necessary to review. Items such as multiple reference standards used, number of test points, different manufacturer of instrument, and varied test methods are a few that can play a part in the outcome of the deviation. This is why the ASTM or other test methods that evaluate by ILS are a more accurate method specific description of the test and its capabilities. Ultimately you can only perform within the capabilities of your test instrument and methods. This means to hold a tighter deviation you will need to check more often and calibrate more often.

5) *My standard does not have an uncertainty or it is lower/higher than I can realistically hold to, what should I do?*
The standard may be older or they may have used test methods very different from yours (by gravimetric, volumetric, titration, or mass spectrometer for example). Their accuracy and yours may be quite different due to the method or means in which the values were determined. We suggest you refer to the ASTM or test method precision and accuracy tables (repeatability and reproducibility) to help determine a realistic uncertainty to hold to.

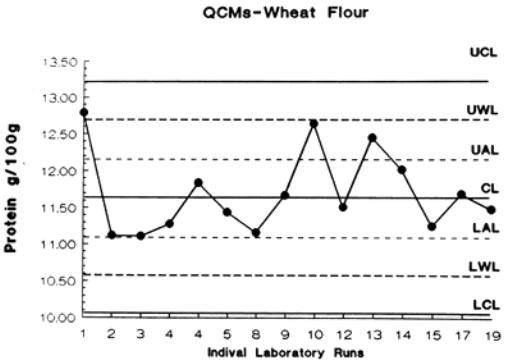
6) *My reference standard is 0.500% and I want to measure a sample at 0.005%.Is this a good comparison?*
No. The detection systems for the instruments we use are not truly linear and are quadratic in form. When we calibrate we are only linear across a portion of the quadratic curve. This is why we strive to use references that are similar in material and concentration to develop the most accurate tests.

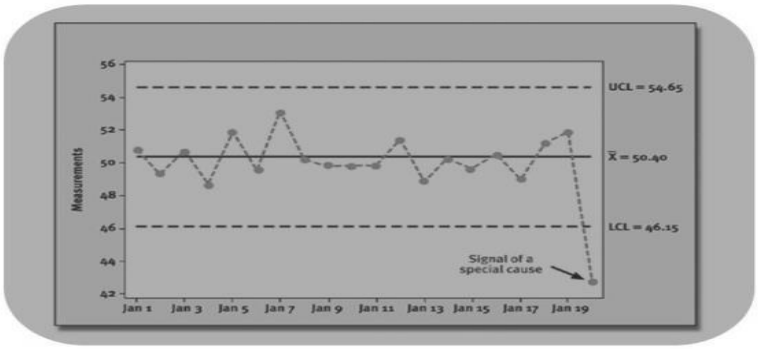




7) *What is drift and why does my analyzer drift from the true value?*

Our instruments have many variables that affect the outcome of the test. Things like flow changes due to dust, leaks, or change in the chemical reagents are just a portion. Good maintenance, calibration and quality checks are how we keep our tests at the highest level.





8) *My 1g steel pin is certified at 70ppm± 8ppm and my 0.1g titanium is 70ppm ±24ppm both at 95% confidence. Why is there a big difference?*

The instrument response to a 10x smaller weight sample is reflected in the deviation. Your instrument has a window of optimum detection. The steel sample at 1g provides a strong signal response that has much less variation than the sample with a "peak response" that is 10x less. The more you deviate from the optimum detection range the broader your relative standard deviation (RSD) will become. This is also why we make similar comparisons in material type, sample size, and concentration. To calculate the RSD:

8ppm / 70ppm * 100 = 11.43% RSD (1g steel pin)

24ppm / 70ppm *100 = 34.29% RSD (0.1g titanium pin)

Another example: 1g steel pin 730ppm ± 20ppm (20ppm / 730ppm *100 = 2.74% RSD)

9) *The statistical k factor is 2.1 does that mean it is 2.1 sigma and greater than 95% confidence?*

No, the expanded uncertainty is still at 95% confidence. The k value is the unique symmetric unbiased estimator of the statistical distribution. When all is perfect in the world of chemical testing the data, the k will equal 2. Factors such as rounding, instrument sensitivity capabilities (%RSD), data flyers (distribution symmetry), and homogeneity contribute to how the standard deviation and the expanded uncertainty calculates.

For Example:

Mean concentration is 0.00060%

One standard deviation is = ±0.000147% = k=1, 68% confidence = 1σ

Two standard deviations = ±0.000294 = k=2, 95% confidence = 2σ

By rounding to significant figures:

Mean= 0.0006%

One standard deviation = ±0.0001%

Two standard deviation = ±0.0003%, k=3, 95% confidence = 2σ

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