

Measurement Uncertainty

What's it about?

History

- Calibration Laboratories are concerned with the uncertainty of their standards, because it affects how well they can calibrate equipment and standards for their customers
- QS-9000, an automotive industry quality standard, changed its language so that all measurements were required to be "traceable".

Traceability

- In the "old days" traceability meant physical tracking – i.e. we know where the part has been at all times.
- Now, the accepted metrology definition is: *"property of the result of a measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties"* – from the "VIM."
- VIM: *vocabulaire international des termes fondamentaux et generaux de metrologie.*

It's the "stated uncertainties" that we're trying to manage

- Uncertainty of measurement (again, from VIM)
- *parameter, associated with the result of a measurement, that characterizes the dispersion of values that could reasonably be attributed to the measurand*

A great quote about uncertainty

Dr. C. H. Meyers, reporting on his measurements of the heat capacity of ammonia.

"We think that our reported value is good to 1 part in 10,000.

We are willing to bet our own money at even odds that it is correct to 2 parts in 10,000.

Furthermore, if by any chance our value is shown to be in error by more than 1 part in 1000, we are prepared to eat the apparatus and drink the ammonia."

How do we calculate and express Uncertainty ?

- We refer to the GUM – ***Guide to the expression of uncertainty in measurement.***

Definitions: u – standard uncertainty (essentially standard deviation)
 u_c – combined standard uncertainty (root – sum – squares)
 k – the coverage factor (how many standard deviations)
 U – expanded uncertainty (equal to k times u_c)

An uncertainty statement: **"Best uncertainties represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$."**

The above is from the scope of accreditation for a Calibration lab.