

## MEASUREMENT UNCERTAINTY

### *What is it?*

Test or calibration measurements are subjected to imperfections in each step of the process – from sampling to final measurement. Measurement uncertainty (also referred to as “uncertainty of a measurement”) is the term used to describe this imperfection, and is defined as the parameter associated with the result of a measurement, that defines the range of the values that could reasonably be attributed to the measured quantity. This indicates the interval within which the true value of the quantity being measured is expected to lie with a stated level of confidence.

### *How is it evaluated?*

Measurement uncertainty is evaluated by quantifying and combining a number of uncertainty components, which can be:

- Random Effects – e.g., fluctuations in temperature, humidity, air-pressure, variability in performance of the measurer, sampling.
- Systemic Effects – e.g., offset of measuring instruments, drift in its characteristics between calibrations, personal bias in reading an analogue scale or uncertainty of the value of a reference standard.

The components are quantified either by evaluation of the results of several repeated measurements, or by estimation based on data from records, previous measurements, knowledge of the equipment and experience of the measurement. The evaluation from repeated measurements is done by applying a mathematical formula derived from statistical theory. The parameter determined is the standard uncertainty expressed as a standard deviation. Measurement uncertainty is usually written as an expanded uncertainty and provides an interval within which the value of the measurand is believed to lie with a higher level of confidence. It is obtained by multiplying the combined standard uncertainty by a coverage factor ( $k$ ); where  $k$  is based on the level of confidence desired. For a level of confidence of 95%,  $k$  is 2.

### *Why is it important?*

- It provides laboratories and customers with valuable information about the accuracy and reliability of test or calibration data.
- It tells how well the results represent the value of the quantity being measured.
- It gives confidence in comparability of results (which help to reduce barriers to trade).
- It shows whether the result is well within the acceptable limits or only just makes it.
- It is a requirement of ISO 17025:2005 (5.4.6).