18.2.3 Measurement results

Result of a measurement

Value attributed to a measurand, obtained by measurement.

Notes:

(1) When a result is given it should be made clear whether it refers to:
- the indication,
- the uncorrected result,
- the corrected results,
and whether several values are averaged.

(2) A complete statement of the results of a measurement includes information about the uncertainty of measurement.

Repeatability

Closeness of the agreement between the results of successive measurement of the same measurand carried out under the same conditions of measurement. For chemical analytical processes see in section 2.2.

Reproducibility

Closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement. For chemical analytical processes see in section 2.2.

Experimental standard deviation

For a series of n measurements of the same measurand, the quantity s characterizing the dispersion of the results and given by the formula

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}}$$

x_i being the result of the ith measurement and $\bar{x}$ being the arithmetic mean of the n results considered.

Notes:

(1) Considering the series of n values as a sample of a distribution, $\bar{x}$ is an unbiased estimate of the mean μ, and s^2 is an unbiased estimate of the variance μ^2, of that distribution.

(2) The expression $s/\sqrt{n}$ is an estimate of the standard deviation of the distribution of $\bar{x}$ and is called the *experimental standard deviation of the mean*.

Uncertainty of measurement

Parameter, associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand.

Notes:

(1) The parameter may be, for example, a standard deviation (or a given multiple of it), or the half-width of an interval having a stated level of confidence.

(2) Uncertainty of measurement comprises, in general, many components. Some of these components may be evaluated from the statistical distribution of the results of series of measurements and can be characterized by experimental standard deviations. The other components, which can also be characterized by standard deviations, are evaluated from assumed probability distributions based on experience or other information.

(3) It is understood that the result of the measurement is the best estimate of the value of the measurand, and that all components of uncertainty, including those arising from systematic effects, such as components associated with corrections and reference standards, contribute to the dispersion.

Error (of measurement)

Result of a measurement minus a *true value* of the measurand.

Note: Since a true value cannot be determined, in practice a conventional true value is used.

Deviation

Observed value minus its *reference value*.

Relative error

Error of measurement divided by a true value of the measurand.

Random error

Result of a measurement minus the mean that would result from an infinite number of measurements of the same measurand carried out under reproducible conditions.

Notes:
(1) Random error is equal to *error* minus *systematic error*.

(2) Because only a finite number of measurements can be made, it is possible to determine only an estimate of random error.

Systematic error

Mean error that would result from an infinite number of measurements of the same measurand carried out under reproducible conditions minus a *true value* of the measurand.

Precision

Closeness of agreement between independent test results obtained under prescribed conditions. For chemical analytical processes see in Section 2.2.

Accuracy

Closeness of agreement between the result of a measurement and a *true value* of the measurand. For chemical analytical processes see in Section 2.2.

Notes:
(1) Accuracy is a qualitative concept.

(2) The term precision should not be used for accuracy.