Terms and Definitions from Documents Referenced in the TNI Standard

The terms and definitions found in VIM, I*nternational vocabulary of basic and general terms in metrology*, ISO/IEC 17000, *Conformity assessment- Vocabulary and general principles*, and ISO/IEC 17011:2004, *Conformity Assessment – General Requirements for Accreditation Bodies Accrediting Conformity Assessment Bodies*, are referenced in the Normative References sections of Modules 1 and 2 of the 2016 TNI laboratory standard. These terms and definitions are freely available on the internet but have been reproduced below for the convenience of laboratories and laboratory assessors.

International Vocabulary of Basic and General Terms in Metrology (VIM)

1 QUANTITIES AND UNITS

1.1 (measurable) quantity
attribute of a phenomenon, body or substance that may be distinguished qualitatively and determined quantitatively

NOTES
1 The term quantity may refer to a quantity in a general sense [see example a)] or to a **particular quantity** [see example b)].

EXAMPLES
a) quantities in a generaĺ sense: length, time, mass, temperature, electrical resistance, amount-of substance concentration;
b) particular quantities:
- length of a given rod
- electrical resistance of a given specimen of wire
- amount-of-substance concentration of ethanol in a given sample of wine.

2 Quantities that can be placed in order of magnitude relative to one another are called **quantities of the same kind**.
3 Quantities of the same kind may be grouped together into **categories of quantities**, for example:
- work, heat, energy
- thickness,
- circumference, wavelength.

4 **Symbols for quantities** are given in ISO 31.

1.2 system of quantities
set of quantities, in the general sense, among which defined relationships exìst

1.3 base quantity
one of the quantities that, in a system of quantities, are conventionally accepted as functionally independent of one another

EXAMPLE
the quantities length, mass and time are generally taken to be base quantities in the field of mechanics.

NOTE
The base quantities corresponding to the base units of the International System of Units (SI) are given in the NOTE to 1.12.

1.4 derived quantity
quantity defined, in a system of quantities, as a function of base quantities of that system

EXAMPLE
in a system having base quantities length, mass and time, velocity is a derived quantity defined as: length

divided by time.

1.5 dimension of a quantity
expression that represents a quantity of a system of quantities as the product of powers of factors that represent the base quantities of the system

EXAMPLES
a) in a system having base quantities length, mass and time, whose dimensions are denoted by L, M and T respectively, LMT^{-2} is the dimension of force;
b) in the same system of quantities,
ML^{-3} is the dimension of mass concentration as well as of mass density.

NOTES
1 The factors that represent the base quantities are called "dimensions" of these base quantities.
2 For details of the relevant algebra, see ISO 31-0.

1.6 quantity of dimension one dimensionless quantity
quantity in the dimensional expression of which all the exponents of the dimensions of the base quantities reduce to zero

EXAMPLES
linear strain, friction factor, Mach number, refractive index, mole fraction (amount-of-substance fraction), mass fraction.

1.7 unit (of measurement)
particular quantity, defined and adopted by convention, with which other quantities of the same kind are compared in order to express their magnitudes relative to that quantity

NOTES
1 Units of measurement have conventionally assigned names and symbols.
2 Units of quantities of the same dimension may have the same names and symbols even when the quantities are not of the same kind.

1.8 symbol of a unit (of measurement)
conventional sign designating a unit of measurement

EXAMPLES
a) m is the symbol for metre;
b) A is the symbol for ampere.

1.9 System of units (of measurement)
set of base units, together with derived units, defined in accordance with given rules, for a given system of quantities

EXAMPLES
a) International System of Units, SI;
b) CGS system of units.

1.10 coherent (derived) unit (of measurement)
derived unit of measurement that may be expressed as a product of powers of base units with the proportionality factor one

NOTE
Coherency can be determined only with respect to the base units of a particular system. A unit may be coherent with respect to one system but not to another.

1.11 coherent system of units (of measurement)
system of units of measurement in which all of the derived units are coherent

EXAMPLE
The following units (expressed by their symbols) form part of the coherent system of units in mechanics within the International System of Units, SI:
m; kg; s;
m^2; m^3; $Hz=s^{-1}$; $m \cdot s^{-1}$; $m \cdot s^{-2}$;
$kg \cdot m^{-3}$; $N=kg \cdot m \cdot s^{-2}$;
$Pa=kg \cdot m^{-1} \cdot s^{-2}$; $J=kg \cdot m^2 \cdot s^{-2}$;
$W=kg \cdot mg^2 \cdot s^{-3}$

1.12 International System of Units, SI
the coherent system of units adopted and recommended by the General Conference on Weights and Measures (CGPM)

NOTE
The SI is based at present on the following seven base units:

Quantity	SI base unit	
	Name	**Symbol**
length	metre	m
mass	kilogram	kg
time	second	s
electric current	amper	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

1.13 base unit (of measurement)
unit of measurement of a base quantity in a given system of quantities

NOTE
In any given coherent system of units Ihere is only one base unit for each base quantity.

1.14 derived unit (of measurement)
unit of measurement of a derived quantity in a given system of quantities

NOTE
Some derived unìts have special names and symbols; for example, in the SI:

Quantity	SI derived unit	
	Name	Symbol
Force	newton	N
Energy	joule	J
Pressure	pascal	Pa

1.15 off-system unit (of measurement)
unit of measurement that does not belong to a given system of units

EXAMPLES
a) the electronvolt (about $1{,}602\ 18 \times 10^{-19}$ J) is an off-system unit of energy with respect to the SI;
b) day, hour, minute are off-system units of time with respect to the SI.

1.16 multiple of a unit (of measurement)

larger unit of measurement that is formed from a given unit according to scaling conventions

EXAMPLES
a) one of the decimal multiples of the metre is the kilometre;
b) one of the non-decimal multiples of the second is the hour.

1.17 submultiple of a unit lof measurement) mesure), m
nit of measurement that is formed from a given unit according to scaling conventions

EXAMPLE
One of the decimal submultiples of the metre is the millimetre.

1.18 value (of a quantity)
magnitude of a particular quantity generally expressed as a unit of measurement multiplied by a number

EXAMPLES

a) length of a rod: 5,34m or 534cm;
b) mass of a body: 0,152kg or 152g;
c) amount of substance of a sample of water (H_2O): 0,012mol or 12mmol.

NOTES
1. The value of a quantity may be positive, negative or zero.
2. The value of a quantity may be expressed in more than one way.
3. The values of quantities of dimension one are generally expressed as pure numbers.
4. A quantity that cannot be expressed as a unit of measurement multiplied by a number may be expressed by reference to a conventional reference scale or to a measurement procedure or to both.

1.19 true value (of a quantity)

value consistent with the definition of a given particular quantity

NOTES
1 This is a value that would be obtained by a perfect measurement.
2 True values are by nature indeterminate.
3 The indefinite article "a", rather than the definite article "the", is used in conjunction with "true value" because there may be many values consistent with the definition of a given particular quantity.

1.20 conventional true value (of a quantity)
value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose

EXAMPLES
a) at a given location, the value assigned to the quantity realized by a reference standard may be taken as a conventional true value;
b) the CODATA (1986) recommended value for the Avogadro constant, N_A: $6,022136\ 7 \times 10^{23}$ mol^{-1}.

NOTES
1 "Conventional true value" is sometimes called **assigned value, best estimate** of the value, **conventional value** or **reference value**. "Reference value", in this sense, should not be confused with "reference value" in the sense used in the NOTE to 5.7.
2 Frequently, a number of results of measurements of a quantity is used to establish a conventional true value.

1.21 numerical value (of a quantity)
quotient of the value of a quantity and the unit used in its expression

EXAMPLES
in the examples in 1.18, the numbers:
a) 5,34,534;
b) 0.152, 152;
c) 0,012, 12.

1.22 conventional reference scale reference-value scale

for particular quantities of a given kind, an ordered set of values, continuous or discrete, defined by convention as a reference for arranging quantities of that kind in order of magnitude

EXAMPLES
a) the Mohs hardness scale;
b) the pH scale in chemistry;
c) the scale of octane numbers for petroleum fuel.

2 MEASUREMENT

2.1 measurement
set of operations having the object of determining a value of a quantity

NOTE
The operations may be performed automatically.

2.2 metrology
science of measurement

NOTE
Metrology includes all aspects both theoretical and practical with reference to measurements, whatever their uncertainty, and in whatever fields of science or technology they occur.

2.3 principle of measurement
scientific basis of a measurement

EXAMPLES
a) the thermoelectric effect applied to the measurement of temperature;
b) the Josephson effect applied to the measurement of electric potential difference;
c) the Doppler effect applied to the measurement of velocity;
d) the Raman effect applied to the measurement of the wave number of molecular vibrations.

2.4 method of measurement
logical sequence of operations, described generically, used in the performance of measure ments

NOTE
Methods of measurement may be qualified in various ways such as:
- **substitution method**
- **differential method**
- **null method.**

2.5 measurement procedure
set of operations, described specifically, used in the performance of particular measurements according to a given method

NOTE
A measurement procedure is usually recorded in a document that is sometimes itself called a "measurement procedure" (or a **measurement method**) and is usually in sufficient detail to enable an operator to carry out a measurement without additional information.

2.6 measurand
particular quantity subject to measurement

EXAMPLE
vapour pressure of a given sample of water at 20 ^{0}C.

NOTE
The specification of a measurand may require statements about quantities such as time, temperature and pressure.

2.7 influence quantity
quantity that is not the measurand but that affects the result of the measurement

EXAMPLES
a) temperature of a micrometer used to measure length;
b) frequency in the measurement of the amplitude of an alternating electric potential difference;
c) bilirubin concentration in the measurement of haemoglobin concentration in a sample of human blood plasma.

2.8 measurement signal
quantity that represents the measurand and which is functionally related to it

EXAMPLES
a) the electrical output signal of a pressure transducer:
b) the frequency from a voltage-to- frequency converter;
c) the electromotive force of an electrochemical concentration cell used to measure a difference in concentration.

NOTE
The input signal to a measuring system may be called the **stimulus**; the output signal may be called the **response**.

2.9 transformed value (of the measurand)
value of measurement signal representing a given measurand

3 MEASUREMENT RESULTS

3.1 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 result

and whether several values are averaged.
2 A complete statement of the result of a measurement includes information about the uncertainty of measurement.

3.2 indication (of a measuring instrument)
value of a quantity provided by a measuring instrument

NOTES
1 The value read from the displaying device may be called the **direct indication**; it is multiplied by the instrument constant to give the indication.
2 The quantity may be the measurand, a measurement signal, or another quantity to be used in calculating the value of the measurand.
3 For a material measure, the indication is the value assigned to it.

3.3 uncorrected result
Result of a measurement before correction for systematic error

3.4 corrected result
result of a measurement after correction for systematic error

3.5 accuracy of measurement
closeness of the agreement between the result of a measurement and a true value of the measurand

NOTES
1 "Accuracy" is a qualitative concept.
2 The term **precision** should not be used for "accuracy".

3.6 repeatability (of results of measurements)
closeness of the agreement between the results of successive measurements of the same measurand carried out under the same conditions of measurement

NOTES
1 These conditions are called **repeatability conditions**.
2 Repeatability conditions include:
- the same measurement procedure
- the same observer
- the same measuring instrument, used under the same conditions
- the same location
- repetition over a short period of time.
3 Repeatability may be expressed quantitatively in terms of the dispersion characteristics of the results.

3.7 reproducibility (of results of measurements)
closeness of the agreement between the results of measurements of the same measurand carried out under changed conditions of measurement

NOTES
1 A valid statement of reproducibility requires specification of the conditions changed.
2 The changed conditions may include:
- principle of measurement
- method of measurement
- observer
- measuring instrument
- reference standard
- location
- conditions of use
- time.
3 Reproducibility may be expressed quantitatively in terms of the dispersion characteristics of the results.
4 Results are here usually understood to be corrected results.

3.8 experimental standard deviation
for a series of n measurements of the same measurand, the quantity s characterizing the dispersion of the results x_i being the result of the i^{th} 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, $\bar{q}$ is an unbiased estimate of the mean μ, and s^2 is an unbiased estimate of the variance σ^2, of that distribution.
2 The expression $s/\sqrt{n}$ is an estimate of the standard deviation of the distribution of $\bar{q}$ and is called the **experimental standard deviation of the mean**.
3 "Experimental standard deviation of the mean" is sometimes incorrectly called **standard error of the mean**.

3.9 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 experíence 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.
This definition is that of the "Guide to the expression of uncertainty in measurement" in which its rationale is detailed (see, in particular, 2.2.4 and annex D[10]).

3.10 error (of measurement)
result of a measurement minus a true value of the measurand

NOTES
1 Since a true value cannot be determined, in practice a conventional true value is used (see 1.19 and 1.20).
2 When it is necessary to distinguish "error" from "relative error", the former is sometimes called **absolute error of measurement**. This should not be confused with **absolute value of error**, which is the modulus of the error.

3.11 deviation
value minus its reference value

3.12 relative error
error of measurement divided by a true value of the measurand

NOTE
Since a true value cannot be determined, in practice a conventional true value is used (see 1.19 and 1.20).

3.13 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 repeatability 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.

3.14 systematic error
mean that would result from an infinite number of measurements of the same measurand carried out under repeatability conditions minus a true value of the measurand

NOTES
1 Systematic error is equal to error minus random error.
2 Like true value, systematic error and its causes cannot be completely known.
3 For a measuring instrument, see "bias" (5.25).

3.15 correction
value added algebraically to the uncorrected result of a measurement to compensate for svstematic error

NOTES
1 The correction is equal to the negative of the estimated systematic error.
2 Since the systematic error cannot be known perfectly, the compensation cannot be complete.

3.16 correction factor
numerical factor by which the uncorrected result of a measurement is multiplied to compensate for systematic error

NOTE
Since the systematic error cannot be known perfectly, the compensation cannot be complete.

4 MEASURING INSTRUMENTS

Many different terms are employed to describe the artefacts which are used in measurement. This Vocabulary defines only a election of preferred terms; the following list is more complete and is arranged in an approximate order of increasing complexity. These terms are not mutually exclusive.

element
component
part
measuring transducer
measuring device
reference material
material measure

measuring instrument

apparatus
equipment
measuring chain
measuring system
measuring installation

4.1 measuring instrument
device intended to be used to make measurements, alone or in conjunction with supplementary devicels·

4.2 material measure
device intended to reproduce or supply, in a permanent manner during its use, one or more known values of a given quantity

EXAMPLES
a) a weight;
b) a measure of volume (of one or several values, with or without a scale;

c) a standard electrical resistor;
d) a gauge block;
e) a standard signal generator;
f) a reference material.

NOTE
The quantity concerned may be called the **supplied quantity**.

4.3 measuring transducer
device that provides an output quantity having a determined relationship to the input quantity

EXAMPLES
a) thermocouple;
b) current transformer;
c) strain gauge;
d) pH electrode.

4.4 measuring chain
series of elements of a measuring instrument or system that constitutes the path of the measurement signal from the input to the output

EXAMPLE
an electro-acoustic measuring chain comprising a microphone, attenuator, filter, amplifier and volt-meter.

4.5 measuring system
complete set of measuring instruments and other equipment assembled to carry out specified measurements

EXAMPLES
a) apparatus for measuring the conductivity of semiconductor materials;
b) apparatus for the calibration of clinical thermometers.

NOTES
1 The system may include material measures and chemical reagents.
2 A measuring system that is permanently installed is called a **measuring installation**.

4.6 displaying (measuring) instrument
indicating (measuring) instrument
measuring instrument that displays an indication

EXAMPLES
a) analogue indicating voltmeter;
b) digital frequency meter;
c) micrometer.

NOTES
1 The display may be **analogue** (continuous or discontinuous) or **digital**.
2 Values of more than one quantity may be displaved simultaneously.
3 A displaying measuring instrument may also provide a record.

4.7 recording (measuring) instrument
measuring instrument that provides a record of the indicatïon

EXAMPLES
a) barograph;
b) thermoluminescent dosimeter;

c) recording spectrometer.

NOTES
1 The record (display) may be **analogue** (continuous or discontinuous line) or **digital**.
2 Values of more than one quantity may be recorded (displayed) simultaneously.
3 A recording instrument may also display an indication.

4.8 totalizing (measuring) instrument
measuring instrument that determines the value of a measurand by summation of partial values of the measurand obtained simultaneously or consecutively from one or more sources

EXAMPLES
a) totalizing railway weighbridge;
b) electrical power summation-meter.

4.9 integrating (measuring) instrument
measuring instrument that determines the value of a measurand by integrating a quantity with respect to another quantity

EXAMPLE
electrical energy meter.

4.10 analogue measuring instrument analogue indicating instrument
measuring instrument in which the output or display is a continuous function of the measurand or of the input signal

NOTE
This term relates to the form of presentation of the output or display, not to the principle of operation of the instrument.

4.11 digital measuring instrument digital indicating instrument
measuring instrument that provides a digitized output or display

NOTE
This term relates to the form of presentation of the output or display, not to the principle of operation of the instrument.

4.12 displaying device indicating device
part of a measuring instrument that displays an indication

NOTES
1 This term may include the device by which the value supplied by a material measure ís displayed or set.
3 An analogue displaying device provides an **analogue display**; a digital displaying device provides a **digital display**. A form of presentation of the display either by means of a digital display in which the least significant digit moves continuously, thus permitting interpolation, or by means of a digital display supplemented by a scale and index, is called a **semidigital display**.
4 The English term **readout device** is used as a general descriptor of the means whereby the response of a measuring instrument is made available.

4.13
recording device
part of a measuring instrument that provides a record of an indication

4.14 sensor
element of a measuring instrument or measuring chain that is directly affected by the measurand

EXAMPLES
a) measuring junction of a thermo- electric thermometer;
b) rotor of a turbine flow meter;
c) Bourdon tube of a pressure gauge;
d) float of a level-measuring instrument;
e) photocell of a spectrophotometer.

NOTE
In some fields the term "detector" is used for this concept.

4.15 detector
device or substance that indicates the presence of a phenomenon without necessarily providing a value of an associated quantity

EXAMPLES
a) halogen leak detector;
b) litmus paper.

NOTES
1 An indication may be produced only when the value of the quantity reaches a threshold, sometimes called the **detection limit** of the detector.
2 In some fields the term "detector" is used for the concept of "sensor".

4.16 index
fixed or movable part of a displaying device whose position with reference to the scale marks enables an indicated value to be determined

EXAMPLES
a) pointer;
b) luminous spot;
c) liquid surface;
d) recording pen.

4.17 scale (of a measuring instrument)
ordered set of marks, together with any associated numbering, forming part of a displaying device of a measuring instrument

NOTE
Each mark is called a **scale mark**.

4.18 scale length
for a given scale, length of the smooth line between the first and last scale marks and passing through the centres of all the shortest scale marks

NOTES
1 The line may be real or imaginary, curved or straight.
2 Scale length is expressed in units of length, regardless of the units of the measurand or the units marked on the scale.

4.19 range of indication

set of values bounded by the extreme indications

NOTES
1 For an analogue display this may be called the **scale range**.
2 The range of indications is expressed in the units marked on the display, regardless of the units of the

measurand, and is normally stated in terms of its lower and upper limits, for example,100 ^{0}C to 200 ^{0}C.
3 See 52 Note.

4.20 scale division
part of a scale between any two successive scale marks

4.21 scale spacing
distance between two successive scale marks measured along the same line as the scale length

NOTE
Scale spacing is expressed in units of length, regardless of the units of the measurand or the units marked on the scale.

4.22 scale interval
difference between the values corresponding to two successive scale marks

NOTE
Scale interval is expressed in the units marked on the scale, regardless of the units of the measurand.

4.23 linear scale
scale in which each scale spacing is related to the corresponding scale interval by a coefficient of proportionality that is constant throughout the scale

NOTE
A linear scale having constant scale intervals is called a **regular scale**.

4.24 nonlinear scale
scale in which each scale spacing is related to the corresponding scale interval by a coefficient of proportionality that is not constant throughout the scale

NOTE
Some nonlinear scales are given special names such as **logarithmic scale**, **square-law scale**.

4.25 suppressed-zero scale
scale whose scale range does not include the value zero

EXAMPLE
scale of a clinical thermometer.

4.26 expanded scale
scale in which a part of the scale range occupies a scale length that is disproportionately larger than other parts

4.27 dial
fixed or moving part of a displaying device that carries the scale or scales

NOTE
In some displaying devices the dial takes the form of drums or discs bearing numbers and moving relative to a fixed index or window.

4.28 scale numbering
ordered set of numbers associated with the scale marks

4.29 Gauging (of a measuring instrument)
operation of fixing the positions of the scale marks of a measuring instrument (in some cases of certain principal marks only), in relation to the corresponding values of the measurands

4.30 adjustment (of a measuring instrument)
operation of bringing a measuring instrument into a state of performance suitable for its use

NOTE
Adjustment may be automatic, semiautomatic or manual.

4.31 user adjustment (of a measuring instrument)
adjustment employing only the means at the disposal of the user

5 CHARACTERISTICS OF MEASURING INSTRUMENTS

Some of the terms used to describe the characteristics of a measuring instrument are equally applicable to a measuring device, a measuring transducer or a measuring system and by analogy may also be applied to a material measure or a reference material.

The input signal to a measuring system may be called the **stimulus**; the output signal may be called the **response**.

In this chapter, the term "measurand" means the quantity that is applied to a measuring instrument.

5.1 nominal range
range of indications obtainable with a particular setting of the controls of a measuring instrument

NOTES
1 Nominal range is normally stated in terms of its lower and upper limits, for example, "100 ^{0}C to 200 ^{0}C". Where the lower limit is zero, the nominal range is commonly stated solely in terms of its upper limit: for example a nominal range of 0 V to 100 V is expressed as "100 V".
2 See 5.2 Note.

5.2 span
modulus of the difference between the two limïts of a nominal range

EXAMPLE
for a nominal range of-10V to +10V, the span is 20V.

NOTE
In some fields of knowledge, the difference between the greatest and smallest values is called **range**.

5.3 nominal value
rounded or approximate value of a characteristic of a measuring instrument that provides a guide to its use

EXAMPLES
a) 100□ as the value marked on a standard resistor;
b) 1L as the value marked on a single- mark volumetric flask;
c) 0,1mol/L as the amount-of-substance concentration of a solution of hydrogen chloride, HCI;
d) 25^{0}C as the set point of a thermostatically controlled bath.

5.4 measuring range working range
set of values of measurands for which the error of a measuring instrument is intended to lie within specified limits

NOTES
1 "error" is determined in relation to a conventional true value.
2 See 5.2 Note.

5.5 rated operating conditions
conditions of use for which specified metrological characteristics of a measuring instrument are intended to lie within given limits

NOTE
The rated operating conditions generally specify ranges or **rated values** of the measurand and of the influence quantities.

5.6 limiting conditions
extreme conditions that a measuring instrument is required to wiithstand without damage, and without degradation of specified metrological characteristics when it is subsequently operated under its rated operating conditions

NOTES
1 The limiting conditions for storage, transport and operation may be different.
2 The limiting conditions may include limiting values of the measurand and of the influence quantities.

5.7 reference conditions
conditions of use prescribed for testing the performance of a measuring instrument or for intercomparison of results of measurements

NOTE
The reference conditions generally include **reference values** or **reference ranges** for the influence quantities affecting the measuring instrument.

5.8 instrument constant
coefficient by which the direct indication of a measuring instrument must be multiplied to give the indicated value of the measurand or of a quantity to be used to calculate the value of the measurand

NOTES
1 Multirange measuring instruments with a single display have several instrument constants that correspond, for example, to different positions of a selector mechanism.
2 Where the instrument constant is the number one, it is generally not shown on the instrument.

5.9 response characteristic
relationship between a stimulus and the corresponding response, for defined conditions

EXAMPLE
the e.m.f. (electromotive force) of a thermocouple as a function of temperature.

NOTES
1 The relationship may be expressed in the form of a mathematical equation, a numerical table, or a graph.
2 When the stimulus varies as a function of time, one form of the response characteristic is the transfer function (the Laplace transform of the response divided by that of the stimulus).

5.10 sensitivity
change in the response of a measuring instrument divided by the corresponding change in the stimulus

NOTE
The sensitivity may depend on the value of the stimulus.

5.11 discrimination (threshold)
largest change in a stimulus that produces no detectable change in the response of a measuring instrument, the change in the stimulus taking place slowly and monotonically

NOTE

The discrimination threshold may depend on, for example, noise (internal or external) or friction. It may also depend on the value of the stimulus.

5.12 resolution (of a displaying device)
smallest difference between indications of a displaying device that can be meaningfully distinguished

NOTES
1 For a digital displaying device, this is the change in the indication when the least significant digit changes by one step.
2 This concept applies also to a recording device.

5.13 dead band
maximum interval through which a stimulus may be changed in both directions without producing a change in response of a measuring instrument

NOTES
1 The dead band may depend on the rate of change.
2 The dead band is sometimes deliberately made large to prevent change in the response for small changes in the stimulus.

5.14 stability
ability of a measuring instrument to maintain constant its metrological characteristics with time

NOTES
1 Where stability with respect to a quantity other than time is considered, this should be stated explicitly.
2 Stability may be quantified in several ways, for example:
- in terms of the time over which a metrological characteristic changes by a stated amount, or
- in terms of the change in a characteristic over a stated time.

5.15 transparency
ability of a measuring instrument not to alter the measurand

EXAMPLES
a) a mass balance is transparent;
b) a resistance thermometer that heats the medium whose temperature it is intended to measure is not transparent.

5.16 drift
Slow change of a metrological characteristic of a measuring instrument

5.17 response time
time interval between the instant when a stimulus is subjected to a specified abrupt change and the instant when the response reaches and remains within specified limits around its final steady value

5.18 accuracy of a measuring instrument
ability of a measuring instrument to give responses close to a true value

NOTE
"Accuracy" is a qualitative concept.

5.19 accuracy class
class of measuring instruments that meet certain metrological requirements that are intended to keep errors within specified limits

NOTE
An accuracy class is usually denoted by a number or symbol adopted by convention and called the **class**

index.

5.20 error (of indication) of a measuring instrument
indication of a measuring instrument minus a true value of the corresponding input quantity

NOTES
1 Since a true value cannot be determined, in practice a conventional true value is used (see 1.19 and 1.20).
2 This concept applies mainly where the instrument is compared to a reference standard.
3 For a material measure, the indication is the value assigned to it.

5.21 maximum permissible errors (of a measuring instrument) limits of permissible error (of a measuring instrument)
extreme values of an error permitted by specifications, regulations, etc. for a given measuring instrument

5.22 datum error (of a measuring instrument)
error of a measuring instrument at a specified indication or a specified value of the measurand, chosen for checking the instrument

5.23 zero error (of a measuring instrument)
datum error for zero value of the measurand

5.24 intrinsic error (of a measuring instrument)
error of a measuring instrument, determined under reference conditions

5.25 bias (of a measuring instrument)
systematic error of the indication of a measuring instrument

NOTE
The bias of a measuring instrument is normally estimated by averaging the error of indication over an appropriate number of repeated measurements.

5.26 freedom from bias (of a measuring instrument)
ability of a measuring instrument to give indications free from systematic error

5.27 repeatability (of a measuring instrument)
ability of a measuring instrument to provide closely similar indications for repeated applications of the same measurand under the same conditions of measurement

NOTES
1 These conditions include:
- reduction to a minimum of the variations due to the observer
- the same measurement procedure
- the same observer
- the same measuring equipment, used under the same conditions
- the same location
- repetition over a short period of time.

2 Repeatability may be expressed quantitatively in terms of the dispersion characteristics of the indications.

5.28 fiducial error (of a measuring instrument)
error of a measuring instrument divided by a value specified for the instrument

NOTE
The specified value is generally called the **fiducial value**, and may be, for example, the span or the upper limit of the nominal range of the measuring instrument.

6 MEASUREMENT STANDARDS

In science and technology, the English word "standard" is used with two different meanings: as a widely adopted written technical standard, specification, technical recommendation or similar document (in French "norme") and also as a measurement standard (in French "étalon"). This Vocabulary is concerned solely with the second meaning and the qualifier "measurement" is generally omitted for brevity.

6.1 (measurement) standard etalon

material measure, measuring instrument, reference material or measuring system intended to define, realize, conserve or reproduce a unit or one or more values of a quantity to serve as a reference

EXAMPLES

a) 1 kg mass standard;
b) 100 □ standard resistor;
c) standard ammeter;
d) caesium frequency standard;
e) standard hydrogen electrode;
f) reference solution of cortisol in human serum having a certified concentration.

NOTES

1 A set of similar material measures or measuring instruments that, through their combined use, constitutes a standard is called a **collective standard**.

2 A set of standards of chosen values that, individually or in combination, provides a series of values of quantities of the same kind is called a **group standard**.

6.2 International (measurement) standard

standard recognized by an international agreement to serve internationally as the basis for assigning values to other standards of the quantity concerned

6.3 national (measurement) standard

standard recognized by a national decision to serve, in a country, as the basis for assigning values to other standards of the quantity concerned

6.4 primary standard

standard that is designated or widely acknowledged as having the highest metrological qualities and whose value is accepted without reference to other standards of the same quantity

NOTE

The concept of primary standard is equally valid for base quantities and derived quantities.

6.5 secondary standard

standard whose value is assigned by comparison with a primary standard of the same quantity

6.6 reference standard

standard, generally having the highest metrological quality available at a given location or in a given organization, from which measurements made there are derived

6.7 working standard

standard that is used routinely to calibrate or check material measures, measuring instruments or reference materials

NOTES

1 A working standard is usually calibrated against a reference standard.

2 A working standard used routinely to ensure that measurements are being carried out correctly is called a **check standard**.

6.8 transfer standard
standard used as an intermediary to compare standards

NOTE
The term **transfer device** should be used when the intermediary is not a standard.

6.9 travelling standard
standard, sometimes of special construction, intended for transport between different locations

EXAMPLE
a portable battery-operated cesium frequency standard.

6.10 traceability
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

NOTES
1 The concept is often expressed by the adjective **traceable**.
2 The unbroken chain of comparisons is called a **traceability chain**.
3 (Applicable only to the French text.)

6.11 calibration
set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards

NOTES
1 The result of a calibration permits either the assignment of values of measurands to the indications or the determination of corrections with respect to indications.
2 A calibration may also determine other metrological properties such as the effect of influence quantities.
3 The result of a calibration may be recorded in a document, sometimes called a **calibration certificate** or a **calibration report**.

6.12 conservation of a (measurement) standard
set of operations necessary to preserve the metrological characteristics of a measurement standard within appropriate limits

NOTE
The operations commonly include periodic calibration, storage under suitable conditions and care in use.

6.13 reference material (RM)
material or substance one or more of whose property values are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials

NOTE
A reference material may be in the form of a pure or mixed gas, liquid or solid. Examples are water for the calibration of viscometers, sapphire as a heat- capacity calibrant in calorimetry, and solutions used for calibration in chemical analysis.
This definition, including the Note, is taken from ISO Guide 30:1992.

6.14 certified reference material (CRM)
reference material, accompanied by a certificate, one or more of whose property values are certified by a procedure which establishes traceability to an accurate realization of the unit in which the property values

are expressed, and for which each certified value is accompanied by an uncertainty at a stated level of confidence

NOTES
1 The definition of a "reference material certificate" is given in 4.2*****.
2 CRMs are generally prepared in batches for which the property values are determined within stated uncertainty limits by measurements on samples representative of the whole batch.
3 The certified properties of certified reference materials are sometimes conveniently and reliably realized when the material is incorporated into a specially fabricated device, e.g. a substance of known triple-point into a triple-point cell, a glass of known optical density into a transmission filter, spheres of uniform particle size mounted on a microscope slide. Such devices may also be considered as CRMs.
4 All CRMs lie within the definition of "measurement standards" or "etalons" given in the "International Vocabulary of basic and general terms in metrology (VIM)".
5 Some RMs and CRMs have properties which, because they cannot be correlated with an established chemical structure or for other reasons, cannot be determined by exactly defined physical and chemical measurement methods. Such materials include certain biological materials such as vaccines to which an International unit has been assigned by the World Health Organization.
This definition, includìng the Notes, is taken from ISO Guide 30:1992.

***** The term "Reference material certificate" mentioned in Note 1 above is given in ISO Guide 30:1992.

BIBLIOGRAPHY

[1] BIPM: The International System of Units, SI.

[2] ISO 31, Quantities and units - Parts 0 to 13.

[3] ISO 1000:1992, SI units and recommendations for the use of their multiples and of certain other units.

[4] ISO Guide 30:1992, Terms and definitions used in connection with reference materials.

[5] ISO 3534:1993, Statistics - Vocabulary and symbols – Part 1: Probability and general statistical terms.

[6] IEC Publication 50: International Electrotechnical Vocabulary - Chapters 111, 151, 301, 302 and 303.

[7] OIML: Vocabulary of Legal Metrology.

[8] IUPAP: Symbols, Units, Nomenclature and Fundamental Constants in Physics. Document I.U.P.A.P.-25 (SUNAMCO 87-1).

[9] IUPAC: Quantities, Units and Symbols in Physical Chemistry.

[10] Guide to the expression of uncertainty in measurement. [Published by ISO in the name of BIPM, IEC, IFCC, IUPAC, IUPAP and OIML.1

[11] IFCC/IUPAC: Approved recommendation (1978). Quantities and units in clinical chemistry. Clin Chim Acta 1979:96:157F- 83F.

Terms and Definitions from ISO/IEC 17000

2 Terms relating to conformity assessment in general

2.1 conformity assessment
demonstration that **specified requirements** (3.1) relating to a **product** (3.3), process, system, person or body are fulfilled

Note 1: The subject field of conformity assessment includes activities defined elsewhere in this International Standard, such as **testing** (4.2), **inspection** (4.3) and **certification** (5.5), as well as the **accreditation** (5.6) of **conformity assessment bodies** (2.5).

Note 2: The expression “object of conformity assessment” or “object” is used in this International Standard to encompass any particular material, product, installation, process, system, person or body to which conformity assessment is applied. A service is covered by the definition of a product (see Note 1 to 3.3).

2.2 first-party conformity assessment activity
conformity assessment activity that is performed by the person or organization that provides the object

Note 1: The first-, second- and third-party descriptors used to characterize conformity assessment activities with respect to a given object are not to be confused with the legal identification of the relevant parties to a contract.

2.3 second-party conformity assessment activity
conformity assessment activity that is performed by a person or organization that has a user interest in the object

Note 1: Persons or organizations performing second-party conformity assessment activities include, for example, purchasers or users of products, or potential customers seeking to rely on a supplier's management system, or organizations representing those interests.
Note 2: See Note to 2.2.

2.4 third-party conformity assessment activity
conformity assessment activity that is performed by a person or body that is independent of the person or organization that provides the object, and of user interests in that object

Note 1: Criteria for the independence of conformity assessment bodies and accreditation bodies are provided in the International Standards and Guides applicable to their activities (see Bibliography).
Note 2: See Note to 2.2.

2.5 conformity assessment body
body that performs conformity assessment services
Note 1: An **accreditation body** (2.6) is not a conformity assessment body.

2.6 accreditation body
authoritative body that performs **accreditation** (5.6)

Note 1: The authority of an accreditation body is generally derived from government.

2.7 conformity assessment system
rules, **procedures** (3.2) and management for carrying out **conformity assessment** (2.1)
Note 1: Conformity assessment systems may be operated at international, regional, national or sub-national level.

2.8 conformity assessment scheme
conformity assessment system (2.7) related to specified objects of conformity assessment, to which the same **specified requirements** (3.1), specific rules and **procedures** (3.2) apply

Note 1 : Conformity assessment schemes may be operated at international, regional, national or sub-national level.

2.9 access
access to a system or scheme
opportunity for an applicant to obtain **conformity assessment** (2.1) under the rules of the system or scheme

2.10 participant
participant in a system or scheme
body that operates under the applicable rules without having the opportunity to take part in the management of the system or scheme

2.11 member
member of a system or scheme
body that operates under the applicable rules and has the opportunity to take part in the management of the system or scheme

3 Basic terms

3.1 specified requirement
need or expectation that is stated

Note 1: Specified requirements may be stated in normative documents such as regulations, standards and technical specifications.

3.2 procedure
specified way to carry out an activity or a process
[SOURCE: ISO 9000:2000, 3.4.5]

3.3 product
result of a process
[SOURCE: ISO 9000:2000, 3.4.2]

Note 1: Four generic product categories are noted in ISO 9000:2000: services (e.g. transport); software (e.g. computer program, dictionary); hardware (e.g. engine, mechanical part); processed materials (e.g. lubricant). Many products comprise elements belonging to different generic product categories. Whether the product is then called service, software, hardware or processed material depends on the dominant element.
Note 2: The statement of conformity described in Note 1 to 5.2 can be regarded as a product of **attestation** (5.2).

4 Conformity assessment terms relating to selection and determination (see Figure A.1)

4.1 sampling
provision of a sample of the object of conformity assessment, according to a **procedure** (3.2)

4.2 testing
determination of one or more characteristics of an object of conformity assessment, according to a **procedure** (3.2)

Note 1: “Testing” typically applies to materials, products or processes.

4.3 inspection
examination of a product design, **product** (3.3), process or installation and determination of its conformity with specific requirements or, on the basis of professional judgement, with general requirements

Note 1: Inspection of a process may include inspection of persons, facilities, technology and methodology.

4.4 audit
systematic, independent, documented process for obtaining records, statements of fact or other relevant information and assessing them objectively to determine the extent to which **specified requirements** (3.1) are fulfilled

Note 1: Whilst “audit” applies to management systems, “assessment” applies to conformity assessment bodies as well as more generally.

4.5 peer assessment
assessment of a body against **specified requirements** (3.1) by representatives of other bodies in, or candidates for, an **agreement group** (7.10)

5 Conformity assessment terms relating to review and attestation

5.1 review
verification of the suitability, adequacy and effectiveness of selection and determination activities, and the results of these activities, with regard to fulfilment of **specified requirements** (3.1) by an object of conformity assessment

5.2 attestation
issue of a statement, based on a decision following **review** (5.1), that fulfilment of **specified requirements** (3.1) has been demonstrated

Note 1: The resulting statement, referred to in this International Standard as a “statement of conformity”, conveys the assurance that the specified requirements have been fulfilled. Such an assurance does not, of itself, afford contractual or other legal guarantees.
Note 2: First-party and third-party attestation activities are distinguished by the terms 5.4 to 5.6. For second-party attestation, no special term is available.

5.3 scope of attestation
range or characteristics of objects of conformity assessment covered by **attestation** (5.2)

5.4 declaration
first-party **attestation** (5.2)

5.5 certification
third-party **attestation** (5.2) related to products, processes, systems or persons

Note 1: Certification of a management system is sometimes also called registration.
Note 2: Certification is applicable to all objects of conformity assessment except for **conformity assessment bodies** (2.5) themselves, to which **accreditation** (5.6) is applicable.

5.6 accreditation
third-party **attestation** (5.2) related to a **conformity assessment body** (2.5) conveying formal demonstration of its competence to carry out specific conformity assessment tasks

6 Conformity assessment terms relating to surveillance

6.1 surveillance
systematic iteration of conformity assessment activities as a basis for maintaining the validity of the statement of conformity

6.2 suspension
temporary invalidation of the statement of conformity for all or part of the specified **scope of attestation** (5.3)

6.3 withdrawal
revocation
cancellation of the statement of conformity

6.4 appeal
request by the provider of the object of conformity assessment to the **conformity assessment body** (2.5) or **accreditation body** (2.6) for reconsideration by that body of a decision it has made relating to that object

6.5 complaint
expression of dissatisfaction, other than **appeal** (6.4), by any person or organization to a **conformity assessment body** (2.5) or **accreditation body** (2.6), relating to the activities of that body, where a response is expected

7 Terms relating to conformity assessment and facilitation of trade

NOTE The general expression “conformity assessment result” is used in 7.4 to 7.9 to mean the **product** (3.3) of any conformity assessment activity (e.g. a report or certificate) and may include a finding of nonconformity.

7.1 approval
permission for a **product** (3.3) or process to be marketed or used for stated purposes or under stated conditions

Note: Approval can be based on fulfilment of **specified requirements** (3.1) or completion of specified **procedures** (3.2).

7.2 designation
governmental authorization of a **conformity assessment body** (2.5) to perform specified conformity assessment activities

7.3 designating authority
body established within government or empowered by government to designate **conformity assessment bodies** (2.5), suspend or withdraw their designation or remove their suspension from **designation** (7.2)

7.4 equivalence
equivalence of conformity assessment results
sufficiency of different conformity assessment results to provide the same level of assurance of conformity with regard to the same **specified requirements** (3.1)

7.5 recognition
recognition of conformity assessment results
acknowledgement of the validity of a conformity assessment result provided by another person or body

7.6 acceptance

acceptance of conformity assessment results
use of a conformity assessment result provided by another person or body

7.7 unilateral arrangement
arrangement whereby one party recognizes or accepts the conformity assessment results of another party

7.8 bilateral arrangement
arrangement whereby two parties recognize or accept each other's conformity assessment results

7.9 multilateral arrangement
arrangement whereby more than two parties recognize or accept one another's conformity assessment results

7.10 agreement group
bodies that are signatories to the agreement on which an arrangement is based

7.11 reciprocity
relationship between two parties where both have the same rights and obligations towards each other

Note 1: Reciprocity can exist within a multilateral arrangement comprising a network of bilateral reciprocal relationships.

Note 2: Although rights and obligations are the same, opportunities emanating from them can differ; this can lead to unequal relationships between parties.

7.12 equal treatment
treatment accorded to **products** (3.3) or processes from one supplier that is no less favourable than that accorded to like products or processes from any other supplier, in a comparable situation

7.13 national treatment
treatment accorded to **products** (3.3) or processes originating in other countries that is no less favouable than that accorded to like products or processes of national origin, in a comparable situation

7.14 equal and national treatment
treatment accorded to **products** (3.3) or processes originating in other countries that is no less favouable than that accorded to like products or processes of national origin, or originating in any other country, in a comparable situation

Terms and Definitions from ISO/IEC 17011:2004(E)

3.1 Accreditation
Third-party attestation related to a conformity assessment body conveying formal demonstration of its competence to carry out specific conformity assessment tasks.

3.2 Accreditation Body
Authoritative body that performs accreditation.

NOTE: The authority of an accreditation body is generally derived from government.

3.3 Accreditation Body Logo
Logo used by an accreditation body to identify itself.

3.4 Accreditation Certificate
Formal document or a set of documents, stating that accreditation has been granted for the defined scope.

3.5 Accreditation Symbol
Symbol issued by an accreditation body to be used by accredited CABs to indicate their accredited status.

NOTE: "Mark" is to be reserved to indicate direct conformity of an entity against a set of requirements.

3.6 Appeal *(ISO/IEC 17011:2004(E) Clause 3.6)*
Request by a CAB for reconsideration of any adverse decision made by the accreditation body related to its desired accreditation status.

NOTE: Adverse decisions include

- refusal to accept an application,
- refusal to proceed with an assessment,
- corrective action requests,
- changes in accreditation scope,
- decisions to deny, suspend or withdraw accreditation, and
- any other action that impedes the attainment of accreditation.

3.7 Assessment
Process undertaken by an accreditation body to assess the competence of a CAB, based on particular standard(s) and/or other normative documents and for a defined scope of accreditation.

NOTE: Assessing the competence of a CAB involves assessing the competence of the entire operations of the CAB, including the competence of the personnel, the validity of the conformity assessment methodology and the validity of the conformity assessment results.

3.8 Assessor
Person assigned by an accreditation body to perform, alone or as part of an assessment team, an assessment of a CAB.

3.9 Complaint
Expression of dissatisfaction, other than appeal, by any person or organization, to an accreditation body, relating to the activities of that accreditation body or of an accredited CAB, where a response is expected.

3.10 Conformity Assessment Body

Body that performs conformity assessment services and that can be the object of accreditation.

NOTE 1: Whenever the word “CAB” is used in the text, it applies to both the “applicant and accredited CABs” unless otherwise specified.

3.11 Consultancy
Participation in any of the activities of a CAB subject to accreditation.

EXAMPLES:
- preparing or producing manuals or procedures for a CAB;
- participating in the operation or management of the system of a CAB;
- giving specific advice or specific training towards the development and implementation of the management system and/or competence of a CAB;
- giving specific advice or specific training for the development and implementation of the operational procedures of a CAB.

3.12 Expert
Person assigned by an accreditation body to provide specific knowledge or expertise with respect to the scope of accreditation to be assessed.

3.13 Extending Accreditation
Process of enlarging the scope of accreditation.

3.14 Interested Parties
Parties with a direct or indirect interest in accreditation.

NOTE: Direct interest refers to the interest of those who undergo accreditation; indirect interest refers to the interests of those who use or rely on accredited conformity assessment services.

3.15 Lead Assessor
Assessor who is given the overall responsibility for specified assessment activities.

3.16 Reducing Accreditation
Process of cancelling accreditation for part of the scope of accreditation.

3.17 Scope of Accreditation
Specific conformity assessment services for which accreditation is sought or has been granted.

3.18 Surveillance
Set of activities, except reassessment, to monitor the continued fulfillment by accredited CABs of requirements for accreditation.

NOTE: Surveillance includes both surveillance on-site assessments and other surveillance activities, such as the following:

a) enquiries from the accreditation body to the CAB on aspects concerning the accreditation;
b) reviewing the declarations of the CAB with respect to what is covered by the accreditation;
c) requests to the CAB to provide documents and records (e.g. audit reports, results of internal quality control for verifying the validity of CAB services, complaints records, management review records);
d) monitoring the performance of the CAB (such as results of participating in proficiency testing).

3.19 Suspending Accreditation
Process of temporarily making accreditation invalid, in full or for part of the scope of accreditation.

3.20 Withdrawing Accreditation

Process of canceling accreditation in full.

NOTE: In the context of this module, withdrawal includes involuntary revocation of accreditation and voluntary relinquishment of accreditation.

3.21 Witnessing

Observation of the CAB carrying out conformity assessment services within its scope of accreditation.