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Buildings and civil engineering works — Procedures for setting out, measurement and surveying — Vocabulary

Construction immobilière — Procédés pour l'implantation, le mesurage et la topométrie — Vocabulaire

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 59, *Buildings and civil engineering works*, Subcommittee SC 2, *Terminology and harmonization of languages*.

This second edition cancels and replaces the first edition (ISO 7078:1985), which has been technically revised.

The main changes compared to the previous edition are as follows:

— removal of diagrams describing traditional practices and statistical methods;

— renumbering of all entries;

— terms previously discussed in groups now separated and presented as individual entries.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document has been revised to be compatible with the series of vocabularies being produced by TC 59/SC 2 spanning across several domains within the construction sector. With the growth in the number of international construction projects and the development of the international market for construction products, there is an increasing need for an agreement on a common language across disciplines.

The practical realization of dimensional accuracy in relation to buildings and civil engineering works involves not only land surveyors and measuring technicians but also professionals engaged in the different stages of the construction process. Further, the widespread use of optical measuring instruments and associated electro-optical techniques, many of which make provision for automatic communication of information, makes smooth communication between different professions necessary. In order to promote such a communication agreement on terms and concepts used in setting out, measurement and surveying is necessary. The purpose of this document is, therefore, to provide a consistent language for use by the various professions involved in measurement in the construction industry.

International preferred terms are listed in boldface type. Where a preferred term is specific to a particular English-speaking country, e.g. the United States of America, etc., it is given below the international preferred term and is annotated with the relevant country code. Where no preferred terms are listed indicating usage in a specific geographical location, this signifies that the international preferred term is the accepted term in the English-speaking countries. A term beneath the preferred term not given in boldface type is an admitted (non-preferred) synonym. A country code is assigned to an admitted term if it is specific to a particular English-speaking country.

Buildings and civil engineering works — Procedures for setting out, measurement and surveying — Vocabulary

1 Scope

This document defines terms that are commonly used in procedures for setting out, measurement and surveying in buildings and civil engineering works.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

NOTE ISO 6707-1 defines general terms for buildings and civil engineering works.

3.1 General terms

3.1.1
measurement
operation that has the object of determining the value of a quantity

[SOURCE: ISO 6707-1:2017, 3.5.1.22, modified — Note 1 to entry has been omitted.]

3.1.2
setting out
layout, US
laying out, US
establishment of marks and lines to define the position and level of the elements for the construction work so that work can proceed with reference to them

[SOURCE: ISO 6707-2:2017, 3.3.13]

3.1.3
metrology
science of *measurement* (3.1.1) and its application

Note 1 to entry: Metrology includes all theoretical and practical aspects of measurement, whatever the measurement uncertainty and field of application.

[SOURCE: ISO Guide 99:2007, 2.2]

3.1.4
geodesy
science of *measurement* (3.1.1) on or in the vicinity of the ground to determine form, dimensions and the distribution of mass and fields of gravity on the earth or parts of it

Note 1 to entry: Surveying is the science of measurements necessary to determine the locations of points (features) on or beneath the surface of the earth.

Note 2 to entry: Where measurements cover such a large part of the earth's surface that the curvature cannot be ignored, then the operations are termed geodetic surveying or measuring.

3.1.5
photogrammetry
technique of *measurement* (3.1.1) using photographs, for example aerial photographs, to determine, primarily, geometric properties such as size, location and form of objects

Note 1 to entry: Photogrammetric measurement is often used for mapping, but also has some engineering applications.

3.1.6
measurand
quantity intended to be measured

Note 1 to entry: The measurand including the *measuring system* (3.1.19) and the conditions under which the *measurement* (3.1.1) is carried out, might change the phenomenon, body, or substance such that the quantity being measured may differ from the measurand as defined. In this case, adequate *correction* (3.2.15) is necessary.

[SOURCE: ISO/IEC Guide 99:2007, 2.3, modified — EXAMPLEs and NOTEs 2 to 4 have been omitted.]

3.1.7
measuring instrument
device used for making *measurements* (3.1.1) or for *levelling* (3.6.4)

Note 1 to entry: Measuring instruments are sometimes used in conjunction with one or more supplementary devices.

3.1.8
measuring equipment
measuring instrument (3.1.7), material measure, software, *measurement standard* (3.1.14), reference material, *ancillary equipment* (3.1.9) or *auxiliary equipment* (3.1.10) used in a *measurement* (3.1.1)

Note 1 to entry: The definition is necessarily wider than that of measuring instrument since it includes all the devices used in a measurement.

[SOURCE: ISO 14978:2018, 3.5.1, modified — In the definition, "indicating" has been omitted from beginning, and "ancillary equipment" has been inserted before "auxiliary equipment"; Note 2 to entry has been omitted.]

3.1.9
ancillary equipment
equipment additional to the actual *measuring instrument* (3.1.7) used when carrying out *measurements* (3.1.1)

EXAMPLE Pegs, sighting *targets* (3.6.67) and chalk marking lines.

3.1.10
auxiliary equipment
equipment that gives aid or support to a *measuring instrument* (3.1.7)

EXAMPLE Tripod.

3.1.11
measuring tool
simple measuring device

EXAMPLE *Folding rule* (3.4.5), *measuring tape* (3.4.1), *square* (3.4.12).

3.1.12
indication
quantity value provided by a *measuring instrument* (3.1.7) or a *measuring system* (3.1.19)

Note 1 to entry: An indication may be presented in visual or acoustic form or may be transferred to another device. An indication is often given by the position of a pointer on the display for analogue outputs, a displayed or printed number for digital outputs, a code pattern for code outputs, or an assigned quantity value for material measures.

Note 2 to entry: An indication and a corresponding value of the quantity being measured are not necessarily values of quantities of the same kind.

[SOURCE: ISO/IEC Guide 99:2007, 4.1]

3.1.13
measurement result
set of quantity values being attributed to a *measurand* (3.1.6) together with other available relevant information

Note 1 to entry: A measurement result generally contains "relevant information" about the set of quantity values, such that some may be more representative of the measurand than others. This may be expressed in the form of a probability density function (PDF).

Note 2 to entry: A measurement result is generally expressed as a single measured quantity value and a measurement of uncertainty. If the measurement uncertainty is considered negligible for some purpose, the measurement result may be expressed as a single measured quantity value. In many fields, this is the common way of expressing a measurement result.

[SOURCE: ISO/IEC Guide 99:2007, 2.9, modified — NOTE 3 has been omitted.]

3.1.14
measurement standard
realization of the definition of a given quantity value and associated *measurement* (3.1.1) uncertainty, used as a reference

[SOURCE: ISO Guide 99:2007, 5.1, modified — EXAMPLEs and NOTEs have been omitted.]

3.1.15
observation
act of measuring or otherwise determining the value of a property

[SOURCE: ISO 19109:2015, 4.16]

3.1.16
reading
part of an *observation* (3.1.15) which only involves the operator's notations of values on a *scale* (3.3.1) or other methods of recording values

3.1.17
measurement error
measured quantity value minus a reference quantity value

Note 1 to entry: Measurement error should not be confused with production error or mistake.

Note 2 to entry: A "reference quantity value" is a quantity value used as a basis for comparison.

[SOURCE: ISO/IEC Guide 99:2007, 2.16, modified — NOTE 1 has been omitted; NOTE 2 has been renumbered as Note 1 to entry; new Note 2 to entry has been added.]

3.1.18
gauge
bar of steel or other suitable material of standard length, accurately made, for the purpose of checking or verification of length measuring devices

3.1.19
measuring system
set of one or more *measuring instruments* (3.1.7) and often other devices, including any reagent and supply, assembled and adapted to give information used to generate measured quantity values within specified intervals for quantities of specified kinds

Note 1 to entry: A measuring system may consist of only one measuring instrument.

[SOURCE: ISO/IEC Guide 99:2007, 3.2]

3.1.20
coordinate system
two-dimensional or three-dimensional reference system for defining the location points on a surface or in space by means of distances (rectangular/Cartesian co-ordinates) or angles (angles co-ordinates) or both (polar co-ordinates), with relation to designated angles or planes

Note 1 to entry: In land surveying, the x-axis may be in the direction of astronomic (true) north, magnetic north, for example grid north, with the y-axis towards east. The z-axis points approximately upwards (towards the zenith). In some countries, the x- and y- axes are reversed whilst in others E, N and H are used to refer to "East", "North" and "Height".

Note 2 to entry: In building surveying, a local orthogonal system is often set up with the reference axes parallel to the building axes or chosen at the convenience of the surveyor.

3.1.21
geodetic coordinate system
coordinate system (3.1.20) in which position is specified by geodetic latitude, geodetic longitude and (in the three-dimensional case) ellipsoidal *height* (3.1.24)

[SOURCE: ISO 19130-1:2018, 3.22]

3.1.22
geographic coordinates
angular coordinates (angular distances) expressed as latitude and longitude to define a point on the surface of the earth with reference to the equator and the meridian of Greenwich

3.1.23
level
value of the vertical dimension of a point above or below a defined reference

[SOURCE: ISO 6707-1:2017, 3.7.2.39]

3.1.24
height
vertical dimension above a horizontal reference *level* (3.1.23)

EXAMPLE Distance of a feature above the ground – height of a building.

[SOURCE: ISO 6707-1:2017, 3.7.2.36, modified — EXAMPLE has been added.]

3.1.25
global positioning system
GPS
instantiation of *GNSS* (3.1.26) controlled by the US Department of Defence

[SOURCE: ISO 15638-12:2014, 4.25]

3.1.26
global navigation satellite system
GNSS
system that comprises several networks of satellites that transmit radio signals containing time and distance data that can be picked up by a receiver, allowing the user to identify the location of the receiver anywhere around the world

[SOURCE: ISO 15638-16:2014, 4.23, modified — The definition has been editorially updated.]

3.1.27
differential GPS
GNSS (3.1.26) application using only observations from *GPS* (3.1.25) (Navistar satellite system) and additional reference point or reference network GPS observations

[SOURCE: ISO 9849:2017, 3.1.5.3]

3.1.28
real-time kinematic positioning
approach for a precise *global positioning system* (3.1.25), enabling the determination of a range signal that can be resolved to a precision of less than 10 cm

Note 1 to entry: Facilitated by resolving the number of cycles in which the signal is transmitted and received by the receiver.

3.1.29
differential GNSS
processing application within mobile *GNSS receivers* (3.5.27), using difference techniques of *GNSS* (3.1.26) observations and additional reference point or reference network GNSS observations

Note 1 to entry: In differential GNSS applications correction data and additional information from a known reference station are used by mobile rovers, enabling them to improve position accuracy from the 15 m nominal GNSS accuracy to about 10 cm or less.

[SOURCE: ISO 9849:2017, 3.1.52, modified — The abbreviated term "DGNSS" has been omitted.]

3.1.30
testing of measuring instruments
procedures designed to determine whether a *measuring instrument* (3.1.7) satisfies requirements in respect of one or more specified *properties* under specified conditions

3.1.31
calibration
operation that, under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by *measurement standards* (3.1.14) and corresponding *indications* (3.1.12) with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a *measurement result* (3.1.13) from an *indication* (3.1.12)

Note 1 to entry: A calibration may be expressed by a statement, calibration function, calibration diagram, calibration curve, or calibration table. In some cases, it may consist of an additive or multiplicative correction of the indication with associated measurement uncertainty.

Note 2 to entry: Calibration should not be confused with adjustment of a *measuring system* (3.1.19), often mistakenly called “self-calibration”, nor with verification of calibration.

Note 3 to entry: Often, the first step alone in the above definition is perceived as being calibration.

[SOURCE: ISO/IEC Guide 99:2007, 2.39]

3.1.32
comparator
measuring equipment (3.1.8) used in addition to a standard for *calibration* (3.1.31) of *measuring instruments* (3.1.7)

EXAMPLE 1 Comparing a *measuring tape* (3.4.1) or an *EDM* (3.5.6) with a bar standard.

EXAMPLE 2 For the determination of the accuracy of an angular scale in a *theodolite* (3.5.4).

EXAMPLE 3 In *photogrammetry* (3.1.5), for determining co-ordinates on photographs using stereocomparators.

3.2 Quality of measurement

3.2.1
true value
value which characterizes a quantity perfectly defined in the conditions that exist when that quantity is considered

Note 1 to entry: It is an ideal value which can be observed only if all causes of *measurement error* (3.1.17) are eliminated.

[SOURCE: ISO 772:2011, 7.9]

3.2.2
influence quantity
quantity that, in a direct *measurement* (3.1.1), does not affect the quantity that is actually measured, but affects the relation between the *indication* (3.1.12) and the *measurement result* (3.1.13)

EXAMPLE *Measuring tape* (3.4.1) temperature when measuring distances.

[SOURCE: ISO/IEC Guide 99:2007, modified — EXAMPLEs and NOTEs have been omitted; a new EXAMPLE has been added.]

3.2.3
measurement accuracy
accuracy of measurement
closeness of agreement between a measured quantity value and a true quantity value of a *measurand* (3.1.6)

Note 1 to entry: The concept 'measurement accuracy' is not a quantity and is not given a numerical quantity value. A *measurement* (3.1.1) is said to be more accurate when it offers a smaller *measurement error* (3.1.17)

Note 2 to entry: The term 'measurement accuracy' should not be used for measurement trueness and the term 'measurement precision' should not be used for 'measurement accuracy' which is related to both these concepts.

Note 3 to entry: 'Measurement accuracy' is sometimes understood as agreement between measured quantity values that are being attributed to the measurand.

[SOURCE: ISO/IEC Guide 99:2007, 2.13]

3.2.4
precision of measurement
closeness of agreement between independent *measurement results* (3.1.13) obtained under stipulated conditions

Note 1 to entry: The degree of precision is expressed numerically by the statistical measures of imprecision of *measurements* (3.1.1), such as *standard deviation* (3.2.22), that are inversely related to precision.

3.2.5
accuracy class
class of *measuring instruments* (3.1.7) or *measuring systems* (3.1.19) that meet stated metrological requirements that are intended to keep *measurement errors* (3.1.17) or instrumental *measurement* (3.1.1) uncertainties within specified limits under specified operating conditions

Note 1 to entry: An accuracy class is usually denoted by a number or symbol adopted by convention.

Note 2 to entry: Accuracy class applies to material measures.

[SOURCE: ISO/IEC Guide 99:2007, 4.25]

3.2.6
repeatability of results of measurement
closeness of the agreement between the results of successive *measurements* (3.1.1) of the same *measurand* (3.1.6) carried out under the same conditions of measurement

Note 1 to entry: These conditions are called repeatability conditions.

Note 2 to entry: Repeatability conditions include: the same measurement procedure; the same observer; the same *measuring instrument* (3.1.7), used under the same conditions; the same location; repetition over a short period of time.

Note 3 to entry: Repeatability may be expressed quantitatively in terms of the dispersion characteristics of the results.

[SOURCE: ISO/IEC Guide 98-3:2008, B.2.15]

3.2.7
reproducibility condition of measurement
condition of *measurement* (3.1.1), out of a set of conditions that includes different locations, operators, *measuring systems* (3.1.19), and replicate measurements on the same or similar objects

Note 1 to entry: The different measuring systems may use different measurement procedures.

Note 2 to entry: A specification should give the conditions changed and unchanged, to the extent practical.

[SOURCE: ISO/IEC Guide 99:2007, 2.24]

3.2.8
systematic measurement error
component of *measurement error* (3.1.17) that in replicate *measurements* (3.1.1) remains constant or varies in a predictable way when the conditions change

Note 1 to entry: A reference quantity value for a systematic reference error is a true quantity value, or a measured quantity value of a *measurement standard* (3.1.14) of negligible measurement uncertainty, or a conventional quantity value.

Note 2 to entry: Systematic measurement error, and its causes, can be known or unknown. A *correction* (3.2.15) can be applied to compensate for a known systematic measurement error.

Note 3 to entry: Systematic measurement error equals measurement error minus random measurement error.

[SOURCE: ISO/IEC Guide 99:2007, 2.17]

3.2.9
random error
result of a *measurement* (3.1.1) minus the mean that would result from an infinite number of measurements of the same *measurand* (3.1.6) carried out under repeatability conditions

Note 1 to entry: Random error is equal to error minus *systematic measurement error* (3.2.8).

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

[SOURCE: ISO/IEC Guide 98-3:2008, B.2.21]

3.2.10
total measuring error
whole *measurement error* (3.1.17) which consists of a combination of the *random error* (3.2.9) and the *systematic error* (3.2.8)

3.2.11
closing error
error of closure
amount by which the value of one or more quantities obtained by surveying operations fails to agree with a fixed or theoretical value of the same quantities

Note 1 to entry: In *traversing* (3.6.39), this can, for example, be the amounts by which the computed, but not adjusted, coordinates of the end *measuring point* (3.6.50) of a traverse fail to agree with the given coordinates of that measuring point.

3.2.12
discrepancy
difference between results of duplicate or comparable measures of a quantity; or difference in computed values of a quantity obtained by different processes using data from the same survey

3.2.13
adjustment calculation
calculation process designed to distribute discrepancies due to the existence of redundant *observations* (3.1.15) when *measurement* (3.1.1) is carried out according to certain rules, for example the *least squares method* (3.2.14)

Note 1 to entry: A redundant observation is any observation which exceeds the number of observations which are necessary for an unambiguous determination of the value of a quantity.

3.2.14
least squares method
obtaining true measurement values by minimizing the sum of the squares of the deviations from the expected values

Note 1 to entry: Measurements are adjusted so that the sum of the squares of the differences between the observed and adjusted values are minimized.

3.2.15
correction
value added algebraically to the uncorrected result of a *measurement* (3.1.1) to compensate for *systematic measurement error* (3.2.8)

Note 1 to entry: The correction is equal to the negative of the estimated systematic error.

Note 2 to entry: Since the systematic error cannot be known perfectly, the compensation cannot be complete.

[SOURCE: ISO/IEC Guide 98-3:2008, B.2.23]

3.2.16
arithmetic mean
sum of measured values divided by the number of values

[SOURCE: ISO/IEC Guide 98-3:2008, C.2.19, modified – Notes 1 and 2 to entry has been omitted; the admitted term "average" has been omitted.]

3.2.17
weight of measurement
number which expresses the degree of confidence in the result of a *measurement* (3.1.1) of a certain quantity in comparison with the results of another measurement of the same quantity

EXAMPLE 1 When using different types of *measuring instruments* (3.1.7).

EXAMPLE 2 Ratio of the reliability of various quantities in *adjustment calculations* (3.2.14), when determining co-ordinates in *triangulation* (3.6.37) nets.

Note 1 to entry: The higher the number, the greater the confidence.

3.2.18
arithmetic weighted mean
sum of the products of each measured value and its *weight of measurement* (3.2.17) (which can be positive or zero) divided by the sum of the weights of measurement

3.2.19
dispersion
scatter of the measured values obtained in a set of *measurements* (3.1.1) of a quantity

3.2.20
range
difference between the greatest and least values of a number of *observations* (3.1.15)

[SOURCE: ISO 1213-2:2016, 3.173]

3.2.21
variance
for any sample, average of the squares of the deviations from the mean

3.2.22
standard deviation
positive square root of the *variance* (3.2.21)

Note 1 to entry: For a set of data standard deviation is calculated as the square root of the average of the squares of the deviations from the mean.

3.2.23
normal distribution
Laplace-Gauss distribution
symmetrical "bell shaped" density distribution which is fully defined by its mean and *standard deviation* (3.2.22)

3.2.24
root mean squared error
square root of the mean of the squared differences of measured values and predicted values

Note 1 to entry: In *calibration* (3.1.31), measured values are compared with given (true) values.

3.2.25
standard error of position
square root of the sum of the squared errors of the coordinates (x and y or East and North) of a point

Note 1 to entry: This error is normally calculated after adjustment.

3.2.26
absolute error
result of a *measurement* (3.1.1) minus the *true value* (3.2.1)

[SOURCE: ISO 16577:2016, 3.1]

3.2.27
relative error
method of expressing *measurement errors* (3.1.17) in which %RE = [(measured value – *true value* (3.2.1))/true value] × 100 %

Note 1 to entry: In this definition, over-estimates are positive-going errors, and underestimates are negative-going errors.

[SOURCE: ISO 23833:2013, 5.4.2.6, modified — The admitted terms "accuracy" and "%RE" have been omitted.]

3.3 Scales

3.3.1
scale
set of marks, lines or numbers, carried by the *indicating device* (3.3.9) of a *measuring instrument* (3.1.7)

Note 1 to entry: It is also used in *triangulation* (3.6.37) calculations.

3.3.2
spaced scale
field gradation
systematic pattern of marks, of different colours, to permit easy recognition of individual gradations

Note 1 to entry: *Levelling staves* (3.4.7) are usually provided with spaced scales, for example “E-pattern”.

3.3.3
scale mark
gauge mark
line or other mark on an *indicating device* (3.3.9) corresponding to one or more defined values of the quantity measured

3.3.4
scale numbering
ordered set of numbers associated with the *scale marks* (3.3.3)

Note 1 to entry: ISO 14978:2018, Figure 2 illustrates scale numbering on an analogue straight *scale* (3.3.1)

3.3.5
scale division
space on a *scale* (3.3.1) between any two successive *scale marks* (3.3.3)

Note 1 to entry: For a digital scale, the scale division is the difference between two consecutive numbers.

Note 2 to entry: ISO 14978:2018, Figure 2 illustrates scale divisions on an analogue straight scale.

3.3.6
scale spacing
distance between two successive *scale marks* (3.3.3)

Note 1 to entry: ISO 14978:2018, Figure 2 illustrates scale spacing on an analogue straight *scale* (3.3.1).

3.3.7
scale length
<analogue straight scale> length between the first and the last *scale marks* (3.3.3)

Note 1 to entry: ISO 14978:2018, Figure 2 illustrates scale length on an *analogue straight scale* (3.3.1).

3.3.8
scale interval
absolute value of the difference between the values corresponding to two successive *scale marks* (3.3.3)

Note 1 to entry: ISO 14978:2018, Figure 2 illustrates scale interval on an *analogue straight scale* (3.3.1).

3.3.9
indicating device
<measuring instrument> set of components of a *measuring instrument* (3.1.7) intended to indicate the measured value

[SOURCE: ISO 19970:2017, 3.8, modified — The preferred term "displaying device" has been omitted; domain information has been added.]

3.3.10
index
fixed or movable part of an analogue *indicating device* (3.3.9), whose position with reference to *the scale marks* (3.3.3) enables an indicated value to be determined

Note 1 to entry: For some *measuring equipment* (3.1.8), the index is called the “pointer”.

[SOURCE: ISO 14978:2018, 3.5.21]

3.3.11
vernier
device by means of a movable *scale* (3.3.1) to improve the *reading* (3.1.16) accuracy of optical distance and angle readings

Note 1 to entry: The reading device is usually an auxiliary scale movable along the scale to be read.

Note 2 to entry: The reading mark is the zero line on the auxiliary scale.

[SOURCE: ISO 9849:2017, 3.2.43]

3.3.12
scale range
set of values bounded by the extreme *indications* (3.1.12)

Note 1 to entry: The lower limit of the scale range is not necessarily zero, for example, in the case of an internal micrometer whose *scale* (3.1.1) starts at 5 mm.

Note 2 to entry: ISO 14978:2018, Figure 2 illustrates scale range on an analogue straight scale.

[SOURCE: ISO 14978:2018, 3.5.19, modified — Note 2 to entry has been amended.]

3.3.13
measuring interval
measuring range
measurement range
set of values of quantities of the same kind that can be measured by a given *measuring instrument* (3.1.7) or *measuring system* (3.1.19) with specified instrumental uncertainty, under defined conditions

Note 1 to entry: The lower limit of a measuring interval should not be confused with detection limit.

3.3.14
analogue indication
analogue read-out
form of presentation of the *indications* (3.1.12) of a measured value by means of a *scale* (3.3.1) and an *index* (3.3.10)

3.3.15
digital indication
digital read-out
digital display
form of presentation of the *indications* (3.1.12) of a measured value by means of figures forming a number which directly indicates a numerical value

[SOURCE: ISO/IEC Guide 99:2007, 4.7]

3.4 Measuring tools

3.4.1
measuring tape
ribbon of steel or other suitable material which is graduated for *measurement* (3.1.1) of length

Note 1 to entry: Where a very high degree of *accuracy of measurement* (3.2.3) is required, tapes of invar are used. Invar is an alloy of nickel and iron containing about 36 % nickel. Its coefficient of expansion is extremely small over a wide range of temperatures (11×10^{-7}) which is about one-tenth of that of steel.

3.4.2
traverse tape
narrow, long lightweight steel *measuring tape* (3.4.1) for the *measurement* (3.1.1) of distances up to 100 m

Note 1 to entry: Traverse tapes offer a means of rapid and accurate measurement of distances. To reduce their costs, traverse tapes are normally graduated only at 1 m intervals. Near the ends, however, the internal graduation interval is often 1 mm. For convenience in handling, traverse tapes are almost invariably wound on special reels from which they can easily be unrolled.

Note 2 to entry: Some traverse tapes are brittle and can therefore easily be damaged.

3.4.3
location tape
measuring tape (3.4.1), usually 20 m, 30 m or 50 m in length, intended primarily for *detailed survey* (3.6.75) and *site survey* (3.6.73)

3.4.4
retractable steel pocket tape
measuring tape (3.4.1) up to 5 m in length, usually graduated in intervals of 1 mm throughout and provided with an enclosing case

3.4.5
folding rule
graduated and numbered rule for the *measurement* (3.1.1) of lengths, consisting of two or more lengths of boxwood or other suitable material, connected by hinged joints

3.4.6
measuring rod
straight rod of suitable material of which one edge is graduated for the *measurement* (3.1.1) of lengths

3.4.7
levelling staff
levelling rod
level rod
straight bar with a scale on a flat face

Note 1 to entry: The levelling staff can be made of, for example, metal, glass fibre or wood.

Note 2 to entry: The levelling staff is used to measure the vertical distance between a base point and the horizontal line of sight of a *level* (3.5.2).

[SOURCE: ISO 9849:2017, 3.1.11]

3.4.8
invar levelling staff
levelling staff (3.4.7) for precise *levelling* (3.6.4), having an invar strip with gradation lines or code patterns (bar code)

[SOURCE: ISO 9849:2017, 3.1.11.2, modified — Note 1 to entry has been omitted; the preferred terms "precise levelling rod" and "invar rod" have been omitted.]

3.4.9
digital levelling staff
levelling staff (3.4.7) for *levelling* (3.6.4) with a *digital level* (3.4.10) having a specified code patterns on a flat surface

[SOURCE: ISO 9849:2017, 3.1.11.1, modified — The preferred term "bar code staff" has been omitted.]

3.4.10
digital level
level (3.5.2) which electronically reads a sequence of code patterns on the *levelling staff* (3.4.7) by an image sensor

Note 1 to entry: These *measuring instruments* (3.1.7) usually include data recording capability. The automation removes the requirement for the operator to read a *scale* (3.3.1).

Note 2 to entry: The processing and the display of the results are taken by an integrated computer.

[SOURCE: ISO 9849:2017, 3.1.10.2, modified — In Note 1 to entry, “measuring” has been inserted before “instruments”.]

3.4.11
straightedge
straight bar of suitable material which provides a straight line for the determination of straightness or flatness

3.4.12
square
equipment for marking out or *setting out* (3.1.2) a right angle

3.4.13
measuring wedge
wedge shaped measuring device for the *measurement* (3.1.1) of distances between two surfaces or points

Note 1 to entry: Measuring wedges usually have a slope of 1:10. They are often used for the measurement of joints.

3.4.14
feeler gauge
thin strip of metal of known thickness that can be inserted into a joint gap for the *measurement* (3.1.1) of clearances or into a crack to determine its width

3.4.15
sliding calipers
slide gauge
length measuring device consisting of two shanks of which one is in a fixed position and the other can be moved along a *scale* (3.3.1) on which the distance between the shanks can be read with the aid of an *index* (3.3.10) or a *vernier* (3.3.11)

3.4.16
micrometer screw
measuring device whose measuring length is provided with a *scale* (3.3.1) with thread transmission

3.4.17
spirit level
bubble level
device for indicating or checking horizontal or vertical planes, which consists of one or more sealed tubes made of glass containing a liquid and a trapped air bubble, mounted in a frame

[SOURCE: ISO 6707-1:2017, 3.5.3.19, modified — The preferred term "bubble level" has been added.]

3.4.18
circular level
circular, flat bottomed *spirit level* (3.4.17) with the liquid under a slightly convex glass face with a circle mark at the centre

Note 1 to entry: A circular level is used to level a surface in all directions across a plane.

Note 2 to entry: The graduation is normally a *circle* (3.5.22) of approximately the same diameter as the bubble. In special cases the graduation consists of a number of concentric circles. Circular levels are normally used when a high degree of precision is not required.

[SOURCE: ISO 9849:2017, 3.2.16.1, modified — The preferred terms "bull's eye level", "box bubble" and "circular bubble" have been omitted; note 1 to entry has been editorially updated.]

3.4.19
tubular level
spirit level (3.4.17) with a tube which is barrel-shaped internally and graduated on its upper surface (level gradation), fixed into a metal holder and fitted with adjusting screws

Note 1 to entry: A tubular level is often built and used for high precision *levelling* (3.6.4) in the direction of the tube.

[SOURCE: ISO 9849:2017, 3.2.16.2, modified — “tubular glass vial” has been replaced by “tube”.]

3.4.20
vial sensitivity
angle through which the *tube* of a *spirit level* (3.4.17) must be tilted to cause a displacement of the bubble over one *scale* (3.3.1) spacing

Note 1 to entry: The angle is normally 2 mm of the scale usually engraved on tubes which can be viewed directly.

3.4.21
electronic level
inclinometer
tiltmeter
instrument which detects inclination or changes of inclination under the influence of gravity by the use of electronic sensors

[SOURCE: ISO 9849:2017, 3.1.10.3]

3.4.22
optical square
compact, hand-held instrument that enables the observer by mirrors or prisms to view a point straight ahead as well as one perpendicular to it, and thus to set-out a right angle on the ground

3.4.23
plumb bob
conical device, suspended by a cord, by means of which a point can be projected vertically

Note 1 to entry: Plumb bobs are suitable only for rough centring of *measuring instruments* (3.1.7) over a point.

3.4.24
position piece
ancillary equipment (3.1.9) to facilitate an accurate indication of a *measuring point* (3.6.50)

Note 1 to entry: Examples of measuring points are corner points or points on the objects to be measured.

3.4.25
optical micrometer
reading device which facilitates the improvement of the *reading* (3.1.16) accuracy

Note 1 to entry: A major application is the coincidence micrometer to optically read angles, distances and other scales with a high accuracy.

[SOURCE: ISO 9849:2017, 3.2.29.3]

3.4.26
inclinometer
system for monitoring displacements across a measuring line by means of *inclination measurements* (3.6.34) in the field

Note 1 to entry: The system essentially consists of an instrument with one or more tilt sensors, a guide tube, a means to measure the position of the instrument in the guide tube and a read-out device.

Note 2 to entry: Data from inclinometers require evaluation, which can be done using proprietary software or spreadsheets.

[SOURCE: ISO 18674-3:2017, 3.1]

3.4.27
laser measuring tool
measuring tool (3.1.11) that through the emission of light facilitates *measurement* (3.1.1) of the distance between the tool and the object

3.5 Measuring instruments and their parts

3.5.1
telescope
measuring telescope
part of a *measuring instrument* (3.1.7) that consists of a magnifying optical device in which a line through the optical centre of the objective lens and the cross hairs define the line of sight

Note 1 to entry: It comprises essentially an objective, a *focusing lens* (3.5.18) with focusing drive, a *reticule* (3.5.17) and an adjustable eyepiece.

Note 2 to entry: In total stations, often, the electronics and other parts of an *electro-optical distance meter* (3.5.6) or other devices are placed in the telescope.

[SOURCE: ISO 9849:2017, 3.2.38, modified — In Note 2 to entry, “electronic distance measurement device (EDM)” has been changed to “electro-optical distance meter”.]

3.5.2
level
levelling instrument
measuring instrument (3.1.7) for measuring differences in *height* (3.1.24)- by establishing horizontal lines of sight, comprising as main components a *telescope* (3.5.1) which can be rotated on a *vertical axis* (3.5.15) and a facility for *levelling* (3.6.4) the line of sight

Note 1 to entry: It can be additionally fitted with a horizontal *circle* (3.5.22) and/or a *parallel plate micrometer* (3.5.23). The *reticule* (3.5.17) has sometimes stadia hairs for optical *distance measurement* (3.6.27).

[SOURCE: ISO 9849:2017, 3.1.10, modified — The preferred term "levelling instrument" has been added; "measuring instrument" has added at the beginning of the definition; note 2 to entry has been omitted.]

3.5.3
water level
hydrostatic level
level (3.5.2) that consists of two or more glass tubes connected by flexible tubing filled with a fluid whose surfaces in the glass tubes define a reference *level* (3.1.23)

Note 1 to entry: The glass tubes are usually provided with *scales* (3.3.1) or with sensors.

Note 2 to entry: In building used for simple work, such as establishing points of common level. In land surveying, for measuring the difference in *height* (3.1.24) between points located at opposite sides of a large expanse of water, for example lakes, rivers.

3.5.4
theodolite
transit
measuring instrument (3.1.7) for measuring horizontal directions and *vertical angles* (3.6.10), whose main components are the horizontal *circle* (3.5.22) and the vertical circle inclusive *reading* (3.1.16) systems, the *telescope* (3.5.1) and the alidade inclusive the horizontal and vertical rotation axes

Note 1 to entry: The telescope can be rotated around the *horizontal axis* (3.5.14) and *vertical axis* (3.5.15).

Note 2 to entry: A theodolite can also be used for optical *distance measurement* (3.6.27).

Note 3 to entry: A theodolite used in astronomical work is usually termed an astronomical theodolite or a transit instrument.

[SOURCE: ISO 9849:2017, 3.1.19, modified — "optical instrument" has been replaced by "measuring instrument".]

3.5.5
tachymeter
tacheometer
instrument for measuring horizontal directions, *vertical angles* (3.6.10) and distances

[SOURCE: ISO 9849:2017, 3.1.17]

3.5.6
electro-optical distance meter
electronic distance meter
EDM
measuring instrument (3.1.7) for measuring distances between the instrument and a reflective *target* (3.6.67), using various electro-optical techniques, visible light or infrared radiation as carrier waves

Note 1 to entry: The target can be a reflector or any other surface.

[SOURCE: ISO 9849:2017, 3.1.3, modified — “measuring” has been added to the beginning of definition; Note 2 to entry has been omitted.]

3.5.7
tilting level
level (3.5.2) that has a tilting screw which enables the *telescope* (3.5.1) to be tilted on a pivot so as to obtain a levelled line of sight

3.5.8
automatic level
compensator level
self-levelling level
pendulum level
level (3.5.2) that makes use of a tilt compensator in the form of a system of prisms to ensure that the line of sight is horizontal once the operator has roughly levelled the instrument

3.5.9
optical plummet
instrument or device that realizes a visible line of sight in a vertical zenith or nadir direction

Note 1 to entry: The optical plummet can be levelled by liquid horizon, *tubular levels* (3.4.19) or compensators.

Note 2 to entry: An optical plummet can also be part of a geodetic instrument.

Note 3 to entry: It can also be used for placing a mark on the ground or *centring an instrument* (3.6.36) over a mark on the ground (nadir plummet) as well as for centring an instrument under a point (zenith plummet).

[SOURCE: ISO 9849:2017, 3.1.12]

3.5.10
optical precise plummet
optical plummet (3.5.9) comprising a *telescope* (3.5.1) with high magnification and precise devices (e.g. bubbles, compensator) to precisely realize the vertical line of sight

[SOURCE: ISO 9849:2017, 3.1.12.2]

3.5.11
direction indicating device
device which indicates a specified direction in space by means of rays of light, usually laser light

Note 1 to entry: Direction indicating devices are often used in tunnelling and pipe laying.

3.5.12
surface indicating device
device which indicates a specified reference plane in space, usually a horizontal plane, by means of rotating rays of light or by means of the Moiré effect of a screen pattern

3.5.13
sighting axis
collimation axis
lines between the focus points of the objective of a *telescope* (3.5.1) and the *measuring point* (3.6.50) which corresponds with the *reticule* (3.5.17)

3.5.14
horizontal axis
tilting axis
trunnion axis
axis on which the *telescope* (3.5.1) rotates up and down when moved vertically

Note 1 to entry: The horizontal axis is arranged normal to the optical axes of the telescope.

[SOURCE: ISO 9849:2017, 3.2.15]

3.5.15
vertical axis
standing axis
mechanical device defining the axis on which the alidade can be rotated

Note 1 to entry: In the correct *measuring system* (3.1.19), the axis is positioned vertically by means of foot screws. The procedure of setting the axis vertically is called *levelling an instrument* (3.6.35). The vertical axis passes through the centre of the horizontal *circle* (3.5.22) and is perpendicular to its plane. It also defines the point of the instrument to be centred over the point on the ground.

Note 2 to entry: Since the vertical axes are connected to the horizontal circle, they are in some countries, unfortunately, described as “horizontal axes”, although this description is not recommended for use in ISO standards.

[SOURCE: ISO 9849:2017, 3.2.44, modified — Note 2 to entry has been editorially updated.]

3.5.16
level axis
bubble axis
horizontal line tangential to the upper surface of the centred bubble which lies in the vertical plane through the longitudinal axis of the *spirit level* (3.4.17) tube

3.5.17
reticule
cross-hair plate
glass plate in the image plane of *telescopes* (3.5.1) (or of microscopes or *reading* (3.1.16) devices) on which various kinds of sight marks or reading indices are marked

[SOURCE: ISO 9849:2017, 3.2.30]

3.5.18
focusing lens
supplementary optical lens system mounted in a short tube which can be moved to and fro between the objective and the *reticule* (3.5.17) in a *measuring instrument* (3.1.7) so that the image of the object can be seen clearly in the plane of the reticule

Note 1 to entry: The operation is called focusing.

3.5.19
focusing distance
object distance
distance between the *vertical axis* (3.5.15) of a *telescope* (3.5.1) and that *measuring point* (3.6.50) which by focusing gives the clearest image of the object

Note 1 to entry: It is often necessary to pay attention to the shortest focusing distance.

3.5.20
focusing screw
device on a *telescope* (3.5.1) with which the *focusing lens* (3.5.18) can be moved

3.5.21
field of view
angle subtended at the *telescope* (3.5.1) by that portion of the horizon which can be seen through it

Note 1 to entry: Fields of view are specified either in degrees or in metres per kilometre.

3.5.22
circle
graduated circle
part of a *measuring instrument* (3.1.7) that consists of a disc with a circular scale graduated in degrees or other code patterns which may be subdivided

Note 1 to entry: The disc is usually made of glass.

Note 2 to entry: The disc is sometimes graduated in gons.

Note 3 to entry: Electronic *theodolites* (3.5.4) have coded circular scales on discs which are scanned.

Note 4 to entry: The horizontal circle for measuring horizontal directions is mounted centrally on the *vertical axis* (3.5.15) and securely attached to the base part during *measurements* (3.1.1).

Note 5 to entry: The vertical circle for measuring *vertical angles* (3.6.10) is fixed at right angles to and centrally on the horizontally axis.

[SOURCE: ISO 9849:2007, 3.2.7, modified — "part of a measuring instrument that consists of a" has been added at the beginning.]

3.5.23
parallel plate micrometer
optical micrometer
auxiliary device for producing a known parallel displacement of the line of sight

Note 1 to entry: The main component is a thick plate of optical glass with plane parallel surfaces.

[SOURCE: ISO 9849:2017, 3.2.23, modified — "auxiliary" has been added at the beginning; the preferred term "optical micrometer" has been added.]

3.5.24
diagonal eye-piece
auxiliary device for a *telescope* (3.5.1) which deflects the *sighting axis* (3.5.13) through 100 gon or 90° in order to make possible or facilitate steeply inclined sightings

Note 1 to entry: Diagonal eye-pieces enable sightings up to the zenith. They can be used, for example, where an obstacle behind the telescope obstructs access to the standard eye-piece.

3.5.25
line of collimation
line of sight of an optical *measuring instrument* (3.1.7) at the intersection of cross hairs on the *reticule* (3.5.17)

3.5.26
autocollimation
process of automatically producing a horizontal *line of collimation* (3.5.25)

3.5.27
GNSS receiver
electronic device that receives and digitally processes signals from *GNSS* (3.1.26) satellites in order to provide position, velocity and time (of the receiver)

3.6 Methods of measuring

3.6.1
method of measurement
logical sequence of operations, described generally, used in the performance of *measurements* (3.1.1)

[SOURCE: ISO/IEC Guide 98-3:2008, B.2.7, modified — NOTE has been omitted.]

3.6.2
altimetry
determination of the *height* (3.1.24) of a point relative to a reference datum

3.6.3
heighting
altimetry (3.6.2) for buildings

3.6.4
levelling
operation of bringing a line or surface into the horizontal position, or of measuring differences in *level* (3.1.23)

3.6.5
trigonometric levelling
determination of a difference of *level* (3.1.23) by using an angle in the vertical plane and either a slope distance or a horizontal distance

Note 1 to entry: For trigonometric levelling *corrections* (3.2.15) due to earth surface curvature and refraction are taken into account.

Note 2 to entry: For trigonometric levelling attention is paid to the position of the zero point of the vertical *circle* (3.5.22). The vertical circle for measuring *vertical angles* (3.6.10) is fixed at right angles to and horizontally on the horizontal axis.

3.6.6
height of instrument method
method of *levelling* (3.6.4) based on the vertical distance between the *horizontal axis* (3.5.14) of a *measuring instrument* (3.1.7) and the *measuring point* (3.6.50) above which the instrument is centred

3.6.7
level of instrument method
method of *levelling* (3.6.4) based on the vertical distance between the *horizontal axis* (3.5.14) of a *measuring instrument* (3.1.7) and a reference datum

3.6.8
angular measurement
determination of the value of an angle between two directions from a given point

Note 1 to entry: Typically, an angular *measurement* (3.1.1) is obtained by pointing a *theodolite* (3.5.4) towards two *targets* (3.6.67).

Note 2 to entry: Angles are usually measured in horizontal or vertical planes where a complete rotation of the *circle* (3.5.22) equals 400 gons or 360°.

3.6.9
horizontal angle
angle between two convergent lines in a horizontal plane

Note 1 to entry: The two convergent lines are the lines of intersection on the horizontal plane, through the observation point, of the vertical planes containing the *measuring points* (3.6.50).

3.6.10
vertical angle
angle between an arbitrary line and the horizontal or the vertical

Note 1 to entry: Vertical angles are measured from the horizontal or from the vertical relative to the observation point.

3.6.11
zenith angle
vertical angle (3.6.10) measured from the vertical above the observation point

3.6.12
measuring direction
horizontal angle (3.6.9) between a *survey line* (3.6.17) and an arbitrary reference line

3.6.13
oriented direction
measuring direction (3.6.12) whose reference line is parallel with the N-axis of a *coordinate system* (3.1.17)

Note 1 to entry: In construction works, the coordinate axis of a *secondary system* (3.6.83) is often parallel with the main construction axis.

3.6.14
bearing of a line
bearing
oriented direction (3.6.13) in a *coordinate system* (3.1.17) whose N-axis is approximately directed towards north (or south)

3.6.15
azimuth
angle between a connecting direction (3.6.16) and a line from the observer to a *measuring point* (3.6.50) of interest in the same plane)

3.6.16
connecting direction
reference direction
known *oriented direction* (3.6.13) from one known point towards another known point in a *higher order system* (3.6.80), or a system of the same order used for the transfer of a direction

EXAMPLE Direction from the control system into the *primary system* (3.6.82) of a site.

3.6.17
survey line
straight line, marked or sighted by a *telescope* (3.5.1), from which points can be set out or measured

3.6.18
face left
when viewed from the eyepiece of the *telescope* (3.5.1) the vertical scale is to the left

3.6.19
face right
when viewed from the eyepiece of the *telescope* (3.5.1) the vertical scale is to the right

3.6.20
nadir angle
vertical angle (3.6.10) measured from the vertical below the observation point

3.6.21
ranging in
establishment of a point on a line between two *measuring points* (3.6.50)

3.6.22
wiggling in
establishment of a point on a line between two *measuring points* (3.6.50), neither of which can be occupied and which are not visible from each other

3.6.23
transitting
face changing
operation by which the *telescope* (3.5.1) is rotated through 200 gons or 180° about the *horizontal axis* (3.5.14)

Note 1 to entry: Transitting is used to eliminate the effects of some instrument errors.

3.6.24
half a set of observations
observation in one face
half a round
measurement (3.1.1) of a series of directions, from the same *measuring point* (3.6.50), between the same reference line and different measuring lines carried out with the vertical *circle* (3.5.22) on the same side of the eyepiece, i.e. either *face left* (3.6.18) or *face right* (3.6.19)

Note 1 to entry: After the measurement of the last direction, the *telescope* (3.5.1) is again pointed in the direction of the reference line where the *reading* (3.1.16) on the horizontal circle should be the same as the initial one.

3.6.25
set of observations
observation in both faces
round of angles
measurement (3.1.1) of a series of directions, from the same *measuring point* (3.6.50), between the same reference line and different measuring lines carried out when *transitting* (3.6.23) the *theodolite* (3.5.4) between two half sets in both faces (*face left* (3.6.18) and *face right* (3.6.19))

Note 1 to entry: The accepted observed value of the measured direction is the mean value of the values in face left and face right.

3.6.26
set of readings
record of a *set of observations* (3.6.25)

3.6.27
distance measurement
determination of the distance between two given points

3.6.28
reference tension
standard tension force
particular tension applied to a *measuring tape* (3.4.1), for which the specified tolerance of the tape is valid

Note 1 to entry: Reference tension for a measuring tape of steel is normally 50 N or 100 N (approximately 5 kgf or 10 kgf).

3.6.29
sag correction
correction (3.2.15) which is applied to eliminate the difference between the length of a *measuring tape* (3.4.1) in catenary and its length when supported continuously

3.6.30
reference temperature
particular temperature for which the specified tolerance of a *measuring instrument* (3.1.7) or *measuring tool* (3.1.11) is valid

Note 1 to entry: The reference temperature for a *measuring tape* (3.4.1) of steel is normally 20°.

3.6.31
slope correction
correction (3.2.15) which is applied to a distance measured on a slope to reduce it to a horizontal distance between the vertical lines through its end points

3.6.32
plumbing
establishment of a vertical line or the measuring in of the point of intersection between a vertical line through a *measuring point* (3.6.50) and a specified horizontal plane

3.6.33
plumb line
vertical line determined by a *plumb bob* (3.4.23) or optical *plumbing* (3.6.32)

Note 1 to entry: In construction works, the plumb line is a reference line in assembling or checking the "plumbness" of components.

3.6.34
inclination measurement
determination of the direction of a line in relation to the horizontal or vertical plane

3.6.35
levelling an instrument
procedure carried out by the operator to bring the *vertical axis* (3.5.15) to a vertical position

Note 1 to entry: In *tilting levels* (3.5.7) the final *levelling* (3.6.4) of the *telescope* (3.5.1) is carried out with the aid of a tilting screw.

3.6.36
centring an instrument
procedure carried out by the operator to bring the *vertical axis* (3.5.15) vertically over a mark on the ground or under a mark overhead using a *plumb bob* (3.4.23) or an *optical plummet* (3.5.9)

3.6.37
triangulation
measurement (3.1.1) of the angles of a network of connected triangles and the determination of the lengths of the sides by computation from measured selected sides or bases and for the purpose of determining the location of the points in the network

3.6.38
trilateration
method of determining the relative positions of objects using the known locations of three reference points and the measured distance between the object to be located and each reference point

[SOURCE: ISO/IEC 24730-5:2010, 3.11]

3.6.39
traversing
procedure in which *measuring points* (3.6.50) are located by the successive *measurement* (3.1.1) of distances between each measuring point and the *horizontal angles* (3.6.9) between the intersecting lines joining adjacent measuring points to form either a closed loop, starting and finishing at the same point, or an open loop

3.6.40
closed traversing
traversing (3.6.39) which is either *loop traversing* (3.6.42) or *connecting traversing* (3.6.43)

3.6.41
open traversing
traversing (3.6.39) which starts from one *measuring point* (3.6.50) of known or adopted position but does not end at such a position

3.6.42
loop traversing
closed traversing (3.6.40) which starts and ends at the same position

3.6.43
connecting traversing
control traversing
closed traversing (3.6.40) which starts and ends at *measuring points* (3.6.50) whose positions have been determined

3.6.44
offset method
determination of the location of a *new point* (3.6.54), by measuring or *setting out* (3.1.2) two distances, one along a given *survey line* (3.6.17) and one along a line perpendicular to the given survey line

3.6.45
polar method
determination of a *new point* (3.6.54) by measuring or *setting out* (3.1.2) a direction and a distance from a previously determined *measuring point* (3.6.50)

3.6.46
intersection method
determination of a *new point* (3.6.54) by measuring or *setting out* (3.1.2) the angles α and β from at least two previously determined *measuring points* (3.6.50)

3.6.47
resection method
determination of a *new point* (3.6.54) by measuring angles α and β from the point towards at least three previously determined *measuring points* (3.6.50)

Note 1 to entry: A minimum of three *observations* (3.1.15) are required with a fourth as a check.

3.6.48
tying in
determination of the location of a *new point* (3.6.54) by measuring distances (d, e) between the point and at least two previously determined *measuring points* (3.6.50)

3.6.49
constrained centring
arrangement whereby different units can be interchanged in such a way that they are always accurately re-centred at the same point on tripods, tribrachs or measuring pillars

3.6.50
measuring point
station
point from which or towards which a *measurement* (3.1.1) is carried out

3.6.51
recognition sign
sign that facilitates the recovery of *measuring points* (3.6.50)

3.6.52
ranging rod
rod (2 m or 3 m long), painted in two or three colours, and shod with iron shoes, used to mark *measuring points* (3.6.50) so that straight lines may be laid out over the ground and chained if necessary

[SOURCE: ISO 772:2011, 6.50, modified — "stations or other points in a survey" has been replaced by "measuring points".]

3.6.53
permanent point
permanent mark
monument, US
measuring point (3.6.50) of a permanent character, whose co-ordinates have been determined and which can thereafter be used as a reference point for other *measurements* (3.1.1)

3.6.54
new point
measuring point (3.6.50) whose position is to be determined or set out

3.6.55
secondary point
permanent point (3.6.53) in a *secondary system* (3.6.83) from which base lines are established for *setting out* (3.1.2) of *position points* (3.6.61)

3.6.56
free station point
position of the *theodolite* (3.5.4) when using the *resection method* (3.6.47)

3.6.57
instrument station
point at which a *measuring instrument* (3.1.7) is set up

3.6.58
control point
measuring point (3.6.50) for a *site survey* (3.6.73) derived from the *higher order system* (3.6.80) established by the *control survey* (3.6.69)

3.6.59
primary point
permanent point (3.6.53) in a *primary system* (3.6.82)

3.6.60
station description
document that contains the data needed for the recovery of a *measuring point* (3.6.50)

3.6.61
position point
measuring point (3.6.50) which marks the position or the *level* (3.1.23) of a certain detail

3.6.62
bench mark
BM
mark whose *height* (3.1.24) above (or below) a certain datum is known and from which the *level* (3.1.23) of other points may be established

3.6.63
witness mark
mark placed at a known distance and direction from a *measuring point* (3.6.50) to aid in its recovery and identification

Note 1 to entry: A witness mark may be used to restore the original measuring point.

3.6.64
master bench mark
<site> *bench mark* (3.6.62) whose datum is obtained from a public survey

3.6.65
transferred bench mark
<site> *subsidiary bench mark* (3.6.62) whose datum is derived from the *master bench mark* (3.6.64)

3.6.66
temporary bench mark
<site> *bench mark* (3.6.62) set up for a particular project

3.6.67
target
ancillary equipment (3.1.9) used to indicate the location of *measuring point* (3.6.50)

3.6.68
aiming target
target (3.6.67) mounted or painted on a wall

3.6.69
control survey
measuring operations carried out by or ordered by the authorities in charge and according to rules laid down in ordinance and regulations, mainly for the purposes of mapping, registration of boundaries and providing accessible *bench marks* (3.6.62) to be used as reference points throughout the given area

3.6.70
topographic survey
determination for presentation in the form of maps of the configuration of the surface of the earth and the location of natural and artificial objects thereon

3.6.71
plane survey
survey for which *measurements* (3.1.1) are made on the assumption that the earth is flat and has no curvature

Note 1 to entry: Where the area concerned is small (a few square kilometres) and the *accuracy of measurement* (3.2.3) required is not of the highest order, calculations can be simplified by considering the earth to be flat or plane.

3.6.72
engineering survey
survey executed for the purpose of obtaining information for planning an engineering project or development and estimating its cost

3.6.73
site survey
location survey
report in advance of construction, on an area proposed for development

Note 1 to entry: Site survey involves, as well as *measurements* (3.1.1), geographical, planning and regulatory constraints as well as enquiry into risks.

3.6.74
cadastral survey
boundary survey
land survey
property survey
topographic survey (3.6.70) to determine and record the boundaries of properties

Note 1 to entry: The accuracy of the determination depends on the scale and purpose of the mapping.

3.6.75
detail survey
measuring in
topographic survey (3.6.70) for the determination of the position or size of objects in *site survey* (3.6.73)

3.6.76
optical tooling
method of measurement (3.6.1), mainly applied in the mechanical industries, using instruments of the same nature as surveying instruments, but provided with powerful *telescopes* (3.5.1) in order to obtain accurate reference lines and planes from which *measurement* (3.1.1) is made with micrometers and optical *scales* (3.3.1) and rods

Note 1 to entry: Special *auxiliary equipment* (3.1.10) makes facilitates the performance of more operations that would be possible with the normal types of survey instruments.

3.6.77
product measurement
measurement (3.3.1) to determine shape and dimensions of products

3.6.78
check measurement
independent informal *measurement* (3.1.1) to check the correctness and accuracy of a previous measurement

3.6.79
compliance measurement
construction survey, US
measurement (3.1.1) to verify compliance of a completed *stage* (ISO 6707-2:2017, 3.3.4)

3.6.80
higher order system
network of *measuring points* (3.6.50) which serves as a reference to establish another system of measuring points

3.6.81
official control system
higher order system (3.6.80) established by the *control survey* (3.6.69) and on which a *site survey* (3.6.73) is based

3.6.82
primary system
system of *permanent points* (3.6.53) on a particular measuring area to which all further *measurements* (3.1.1) on that area are related

3.6.83
secondary system
system of *permanent points* (3.6.53) on a *site* based on the *primary system* (3.6.82) and from which base lines are established for *setting out* (3.1.2) *position points* (3.6.61)

3.6.84
grid
two sets of parallel horizontal lines, usually at right angles to each other, that facilitate the positioning of construction works

3.6.85
structural grid
grid (3.6.84) that facilitates the positioning of structural elements

3.6.86
site grid
grid (3.6.84) that facilitates *setting out* (3.1.2) on sites

3.6.87
location grid
grid (3.6.84) that indicates the legal position of boundaries, axes of streets, and serves similar purposes

3.6.88
structural line
base line for *setting out* (3.1.2) *position points* (3.6.61) in a *secondary system* (3.6.83)

3.6.89
profile board
batterboard
offset board
board on which a line is marked for control of excavations, slopes or the *setting out* (3.1.2) of foundations

Note 1 to entry: The batterboard is set at the corner of an excavation to indicate the desired level and as a fastening for strings that show the outline of a foundation.

Note 2 to entry: An offset board is set at a horizontal distance perpendicular to a *survey line* (3.6.17) to establish the position of a specific point or feature.

3.6.90
single profile board
intermediate profile board
profile board (3.6.89) that marks an important line

3.6.91
corner profile
profile board (3.6.89) for a corner point

3.6.92
sight rail
short board, fixed horizontally to a stake at a certain *level*, to establish a line of sight (usually a horizontal line) between two points

3.6.93
boning rod
short board nailed horizontally to a stake of the right *length* and used to establish *levels* (3.1.23) or gradients between *sight rails* (3.6.92)

3.6.94
traveller
central *boning rod* (3.6.93) that is moved along the ground to check ground *levels* (3.1.23) or gradients between two *sight rails* (3.6.92)

3.6.95
free net
primary system (3.6.82) that is not connected to a *higher order system* (3.6.80)

3.6.96
user adjustment
permanent instrument adjustment
adjustment of a *measuring instrument* (3.1.7) employing only the means at the disposal of the user

Note 1 to entry: This is an operation normally carried out by the user. It involves the use of a *measurement standard* (3.1.14), usually supplied with the instrument. The result of this operation automatically or manually adjusts certain parameters in order for the instrument to operate correctly.

[SOURCE: ISO 25178-602:2010, 3.1.10, modified — The preferred term "permanent instrument adjustment" has been added; the domain "<measuring instrument>" has been omitted.]

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