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TECHNICAL SPECIFICATION

Identification of units of measurement for computer-based processing

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TECHNICAL SPECIFICATION

Identification of units of measurement for computer-based processing

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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IDENTIFICATION OF UNITS OF MEASUREMENT FOR COMPUTER-BASED PROCESSING

FOREWORD

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Technical specifications are subject to review within three years of publication to decide whether they can be transformed into International Standards.

International Standard IEC 62720, which is a technical specification, has been prepared by subcommittee 3D: Product properties and classes and their identification, of IEC technical committee 3: Information structures and elements, identification and marking principles, documentation and graphical symbols.

This second edition cancels and replaces the first edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the detailed description of the units is contained in the IEC CDD (http://cdd.iec.ch/ [1]) and removed from this document;
b) Annex B contains the reference to the IEC CDD;
c) Annex C contains an abridged listing of quantities, units and their identifying codes;
d) Annexes D and E are removed.

The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
3D/282/DTS	3D/289/RVC

Full information on the voting for the approval of this technical specification can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

[1] Website checked on 2016-06-10.

INTRODUCTION

For the interpretation of documents such as data sheets, catalogues, or other product related documentation, units of measure play an inconspicuous but important role. All quantitative data can be prone to misinterpretation if its unit of measure is unclear or wrong. Thus, there is a strong requirement to unambiguously identify units of measure and ensure that each unit of measure and its underlying quantity is clearly specified.

As a consequence there is a need to provide computer interpretable identifiers for units of measure. This document assigns identifiers to many standard or non-standard units of measure currently in use.

To ensure timely and fast maintenance of the collection, the content of the document is provided in the IEC Common Data Dictionary (CDD), thus making possible easy maintenance and fast introduction of missing units of measure and quantities.

IDENTIFICATION OF UNITS OF MEASUREMENT FOR COMPUTER-BASED PROCESSING

1 Scope

This document specifies identifiers for units to support computer-based processing of product data. It provides a survey of quantities with associated collections of internationally standardized as well as non–standardized units used in business and science.

Within the scope of this document are any standard or non-standard units of measure currently in use, in two or more distinct ethno-linguistic groups or nations, at least in one domain of industry, for which an explicit method of conversion to a known standard unit of measure or its equivalent is well documented or evident from external references.

IEC 62720 collects units commonly used in business data. It does not purport to be complete. The standardization of units or parts thereof is out of the scope of this document.

NOTE Having assigned an identifier by being mentioned in this document does not imply that the unit of measure in question or parts thereof can be considered to be standardized.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 11179 (all parts), *Information technology – Metadata registries (MDR)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
quantity
property of a phenomenon, body, or substance, where the property has a magnitude that can be expressed by means of a number and a reference

Note 1 to entry: The generic concept “quantity” can be divided into several levels of specific concepts, as shown in Table 1. The left hand side of the table shows specific concepts under “quantity”. These are generic concepts for the individual quantities in the right hand column.

Table 1 – Examples of generic concepts for individual quantities

Generic concepts for individual quantities		Individual quantities
length, l	radius, r	radius of circle A, r_A or r(A)
	wavelength, λ	wavelength of the sodium D radiation, λ_D or λ(D; Na)
energy, E	kinetic energy, T	kinetic energy of particle i in a given system, T_i
	heat, Q	heat of vaporization of sample i of water, Q_i
electric charge, Q		electric charge of the proton, e
electric resistance, R		electric resistance of resistor i in a given circuit, R_i
amount-of-substance concentration of entity B, c_B		amount-of-substance concentration of ethanol in wine sample i, c_i (C_2H_5OH)
number concentration of entity B, C_B		number concentration of erythrocytes in blood sample i, C(Erys; B_i)
Rockwell C hardness (150 kg load), HRC (150 kg)		Rockwell C hardness of steel sample i, HRC_i (150 kg)

Note 2 to entry: A reference can be a measurement unit, a measurement procedure, a reference material, or a combination of them. For magnitude of a quantity.

Note 3 to entry: Symbols for quantities are given in the International Standard ISO/IEC 80000, *Quantities and units*. The symbols for quantities are written in italics. A given symbol can indicate different quantities.

Note 4 to entry: A quantity as defined here is a scalar. However, a vector or a tensor, the components of which are quantities, is also considered to be a quantity.

Note 5 to entry: The concept "quantity" may be generically divided into, e.g. "physical quantity", "chemical quantity", and "biological quantity", or "base quantity" and "derived quantity".

[SOURCE: ISO 80000-1:2009, 3.1, modified – Note 6 omitted.]

3.2
system of quantities
set of quantities together with a set of non-contradictory equations relating those quantities

Note 1 to entry: Ordinal quantities such as Rockwell C hardness, and nominal properties such as colour of light, are usually not considered to be part of a system of quantities because they are related to other quantities through empirical relations only.

[SOURCE: ISO 80000-1:2009, 3.3, modified – Note 2 omitted.]

3.3
International System of Quantities
ISQ
system of quantities based on the seven base quantities: length, mass, time, electric current, thermodynamic temperature, amount of substance, and luminous intensity

Note 1 to entry: This system of quantities is published in the International Standard ISO/IEC 80000, *Quantities and units*, Parts 3 to 14.

Note 2 to entry: The International System of Units is based on the International System of Quantities.

[SOURCE: ISO 80000-1:2009, 3.6, modified – Note 3 omitted.]

3.4
International System of Units
SI
system of units based on the International System of Quantities, their names and symbols, including a series of prefixes and their names and symbols, together with rules for their use, adopted by the General Conference on Weights and Measures (CGPM)

Note 1 to entry: The SI is founded on the seven base quantities of the International System of Quantities and the names and symbols of the corresponding base units that are contained in Table 2:

Table 2 – Base quantity and base unit

Base quantity	Base unit	
Name	**Name**	**Symbol**
length	metre	m
mass	kilogram	kg
time, duration	second	s
electric current	ampere	A
thermodynamic temperature	kelvin	K
amount of substance	mole	mol
luminous intensity	candela	cd

Note 2 to entry: The base units and the coherent derived units of the SI form a coherent set, designated the “set of coherent SI units”.

Note 3 to entry: For a full description and explanation of the International System of Units, see the current edition of the SI brochure published by the International Bureau of Weights and Measures (BIPM) and available on the BIPM website.

Note 4 to entry: In quantity calculus, the quantity “number of entities” is often considered to be a base quantity, with the base unit one, symbol 1.

Note 5 to entry: The SI prefixes for multiples and submultiples of units are given.

[SOURCE: IEC 60050-112:2010, 112-02-02]

3.5
base quantity
quantity in a conventionally chosen subset of a given system of quantities, where no quantity in the subset can be expressed in terms of the other quantities within that subset

Note 1 to entry: The subset mentioned in the definition is termed the “set of base quantities”.

EXAMPLE The set of base quantities in the International System of Quantities is given in Table 2.

Note 2 to entry: Base quantities are referred to as being mutually independent since a base quantity cannot be expressed as a product of powers of the other base quantities.

Note 3 to entry: "Number of entities” can be regarded as a base quantity in any system of quantities.

[SOURCE: ISO 80000-1:2009, 3.4, modified – Note 4 omitted.]

3.6
derived quantity
quantity, in a system of quantities, defined in terms of the base quantities of that system

EXAMPLE In a system of quantities having the base quantities length and mass, mass density is a derived quantity defined as the quotient of mass and volume (length to the power three).

[SOURCE: ISO 80000-1:2009, 3.5, modified – Note omitted.]

3.7
quantity value
value of a quantity
value
number and reference together expressing magnitude of a quantity

EXAMPLE 1 length of a given rod	5,34 m or 534 cm
EXAMPLE 2 mass of a given body	0,152 kg or 152 g
EXAMPLE 3 curvature of a given arc	112 m^{-1}
EXAMPLE 4 Celsius temperature of a given sample	–5 °C
EXAMPLE 5 electric impedance of a given circuit element at a given frequency, where “j” is the imaginary unit	(7 + 3j) Ω
EXAMPLE 6 refractive index of a given sample of glass	1,32
EXAMPLE 7 Rockwell C hardness of a given sample (150 kg load)	43,5 HRC(150 kg)
EXAMPLE 8 mass fraction of cadmium in a given sample of copper	3 µg/kg or $3 \cdot 10^{-9}$
EXAMPLE 9 molality of Pb^{2+} in a given sample of water	1,76 µmol/kg
EXAMPLE 10 amount-of-substance concentration of lutropin in a given sample of plasma (WHO International Standard 80/552)	5,0 IU/l (WHO International Units per litre)

Note 1 to entry: According to the type of reference, a quantity value is either

- a product of a number and a measurement unit (see Examples 1, 2, 3, 4, 5, 6, and 9); the measurement unit one is generally not indicated for quantities of dimension one (see Examples 6 and 8), or
- a number and a reference to a measurement procedure (see Example 7), or
- a number and a reference material (see Example 10).

Note 2 to entry: The number can be complex (see Example 5).

Note 3 to entry: A quantity value can be presented in more than one way (see Examples 1, 2, and 8).

Note 4 to entry: In the case of vector or tensor quantities, each component has a quantity value.

EXAMPLE Force acting on a given particle, e.g. in Cartesian components $(F_x; F_y; F_z)$ = (31,5; 43,2; 17,0) N, where (31,5; 43,2; 17,0) is a numerical-value vector and “N” (newton) is the unit, or $(F_x; F_y; F_z)$ = (31,5 N; 43,2 N; 17,0 N) where each component is a quantity.

[SOURCE: ISO 80000-1:2009, 3.19, modified – Note 5 omitted]

3.8
dimension of a quantity
quantity dimension
dimension
expression of the dependence of a quantity on the base quantities of a system of quantities as a product of powers of factors corresponding to the base quantities, omitting any numerical factor

EXAMPLE 1 In the International System of Quantities, the quantity dimension of force is denoted by dim F = LMT^{-2}.

EXAMPLE 2 In the same system of quantities, dim $\rho_B = ML^{-3}$ is the quantity dimension of mass concentration of component B, and ML^{-3} is also the quantity dimension of mass density, ρ.

EXAMPLE 3 The period T of a particle pendulum of length l at a place with the local acceleration of free fall g is

$$T = 2\pi\sqrt{\frac{l}{g}} \quad \text{or} \quad T = C(g)\sqrt{l} \quad \text{where} \quad C(g) = \frac{2\pi}{\sqrt{g}}$$

Hence $\dim C(g) = T \cdot L^{-1/2}$

Note 1 to entry: A power of a factor is the factor raised to an exponent. Each factor is the dimension of a base quantity.

Note 2 to entry: The conventional symbolic representation of the dimension of a base quantity is a single upper case letter in roman (upright) type. The conventional symbolic representation of the dimension of a derived quantity is the product of powers of the dimensions of the base quantities according to the definition of the derived quantity. The dimension of a quantity Q is denoted by dim Q.

Note 3 to entry: In deriving the dimension of a quantity, no account is taken of its scalar, vector, or tensor character.

Note 4 to entry: In a given system of quantities,
– quantities of the same kind have the same quantity dimension,
– quantities of different quantity dimensions are always of different kinds, and
– quantities having the same quantity dimension are not necessarily of the same kind.

Note 5 to entry: Symbols representing the dimensions of the base quantities in the International System of Quantities are (see Table 3):

Table 3 – Base quantities

Base quantity	Symbol for dimension
length	L
mass	M
time	T
electric current	I
thermodynamic temperature	Θ
amount of substance	N
luminous intensity	J

Thus, the dimension of a quantity Q is denoted by dim Q = $\mathrm{L}^{\alpha}\mathrm{M}^{\beta}\mathrm{T}^{\gamma}\mathrm{I}^{\delta}\Theta^{\varepsilon}\mathrm{N}^{\xi}\mathrm{J}^{\eta}$ where the exponents, named dimensional exponents, are positive, negative, or zero. Factors with exponent zero or the exponent 1 are usually omitted.

Note 6 to entry Adapted from ISO/IEC Guide 99:2007, 1.7, in which Note 5 and Examples 2 and 3 are different and in which "dimension of a quantity" and "dimension" are given as admitted terms.

[SOURCE: ISO 80000-1:2009, 3.7]

3.9
dimensional exponent
exponent of the dimension of a base quantity in the dimension of a quantity

[SOURCE: IEC 60050-112:2010, 112-01-12]

3.10
unit of measurement
measurement unit
unit
real scalar quantity, defined and adopted by convention, with which any other quantity of the same kind can be compared to express the ratio of the second quantity to the first one as a number

Note 1 to entry: Measurement units are designated by conventionally assigned names and symbols.

Note 2 to entry: Measurement units of quantities of the same quantity dimension may be designated by the same name and symbol even when the quantities are not of the same kind. For example joule per kelvin and J/K are respectively the name and symbol of both a measurement unit of heat capacity and a measurement unit of entropy, which are generally not considered to be quantities of the same kind. However, in some cases special measurement unit names are restricted to be used with quantities of specific kind only. For example, the measurement unit "second to the power minus one" (1/s) is called hertz (Hz) when used for frequencies and becquerel (Bq) when used for activities of radionuclides. As another example, the joule (J) is used as a unit of energy, but never as a unit of moment of force, i.e., the newton metre (Nm).

Note 3 to entry: Measurement units of quantities of dimension one are numbers. In some cases these measurement units are given special names, e.g., radian, steradian, and decibel, or are expressed by quotients such as millimole per mole equal to 10^{-3} and microgram per kilogram equal to 10^{-9}.

Note 4 to entry: For a given quantity, the short term “unit” is often combined with the quantity name, such as “mass unit” or “unit of mass”.

[SOURCE: ISO 80000-1:2009, 3.9, modified – Note 5 omitted.]

3.11
unit name
name of unit
term designating a unit of measurement

Note 1 to entry: Names of derived units are special or compound. Rules for the formation of compound names are given in ISO 80000-1 and IEC 60027-1. For example, the derived unit of resistivity is the ohm metre, the derived unit of speed is the metre per second.

Note 2 to entry: Unit names are given in the various parts of ISO/IEC 80000, and IEC 60027, and also in INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES (BIPM), *The International System of Units (SI)*.

[SOURCE: IEC 60050-112:2010, 112-01-15]

3.12
special unit name
name of a derived unit not comprising other unit names

Note 1 to entry: A special unit name may be restricted to a unit for quantities of a specific kind, for example hertz for frequency and becquerel for activity.

[SOURCE: IEC 60050-112:2010, 112-01-16]

3.13
unit symbol
symbol of a unit
character or combination of characters denoting a unit of measurement

Note 1 to entry: Most unit symbols are one or more letters of the Latin or Greek alphabets and are always printed in roman (upright) type and in the same font as the main text. Products of powers of such symbols are used to form the symbols for compound units according to the laws of algebra. In values of quantities, there is a space between the numerical value and the unit symbol, including the degree Celsius (°C) and the percent (%); exceptions are the units degree (°), minute ('), and second (") for plane angles.

Note 2 to entry: Internationally adopted unit symbols are given in INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES (BIPM), *The International System of Units (SI)*, in ISO/IEC 80000, and in IEC 60027.

[SOURCE: IEC 60050-112:2010, 112-01-17]

3.14
multiple of a unit
unit of measurement obtained by multiplying a given unit of measurement by a number greater than one

Note 1 to entry: The kilometre (km) is a decimal multiple of the metre (m). The hour (h) is a non-decimal integer multiple of the second (s). The light year is a non-integer multiple of the metre (in the VIM, only integer multiples are considered).

Note 2 to entry: Multiples of a unit are often named by adding a unit prefix to the name of the unit.

[SOURCE: ISO 80000-1:2009, 3.17, modified – Notes 1 and 2 have been modified and Note 3 omitted.]

3.15
submultiple of a unit
measurement unit obtained by dividing a given measurement unit by an integer greater than one

EXAMPLE 1 The millimetre is a decimal sub-multiple of the metre.

EXAMPLE 2 For plane angle, the second is a non-decimal sub-multiple of the minute.

Note 1 to entry: SI prefixes for decimal submultiples of SI base units and SI derived units are given in Table 6 and Table 7.

[SOURCE: ISO 80000-1:2009, 3.18, modified – Reference to Table 6 and Table 7.]

3.16
unit prefix
prefix used together with a unit of measurement to form a multiple or a submultiple of this unit

EXAMPLE kiloohm, kΩ.

Note 1 to entry: Lists of prefixes together with their symbols are given in 112-02-03 for SI prefixes and in 112-01-27 for binary prefixes.

Note 2 to entry: A prefix or its symbol is attached to the unit name or symbol, respectively, without any space or other sign.

[SOURCE: IEC 60050-112:2010, 112-01-26]

3.17
base unit
measurement unit that is adopted by convention for a base quantity

Note 1 to entry: In each coherent system of units, there is only one base unit for each base quantity.

EXAMPLE In the SI, the metre is the base unit of length. In the CGS systems, the centimetre is the base unit of length.

Note 2 to entry: A base unit may also serve for a derived quantity of the same quantity dimension.

EXAMPLE The derived quantity rainfall, when defined as areic volume (volume per area), has the metre as a coherent derived unit in the SI.

Note 3 to entry: For number of entities, the number one, symbol 1, can be regarded as a base unit in any system of units. Compare Note 3 in 3.4.

Note 4 to entry: Adapted from ISO/IEC Guide 99:2007, 1.10, in which the example in Note 2 is slightly different. The last sentence in Note 3 has been added.

[SOURCE: ISO 80000-1:2009, 3.10]

3.18
derived unit
measurement unit for a derived quantity

EXAMPLE The metre per second, symbol m/s, and the centimetre per second, symbol cm/s, are derived units of speed in the SI. The kilometre per hour, symbol km/h, is a measurement unit of speed outside the SI but accepted for use with the SI. The knot, equal to one nautical mile per hour, is a measurement unit of speed outside the SI.

[SOURCE: ISO 80000-1:2009, 3.11]

3.19
system of units
set of base units and derived units, together with their multiples and submultiples, defined in accordance with given rules, for a given system of quantities

[SOURCE: ISO 80000-1:2009, 3.13]

3.20
coherent system of units
system of units, based on a given system of quantities, in which the measurement unit for each derived quantity is a coherent derived unit

EXAMPLE Set of coherent SI units and relations between them.

Note 1 to entry: A system of units can be coherent only with respect to a system of quantities and the adopted base units.

Note 2 to entry: For a coherent system of units, numerical value equations have the same form, including numerical factors, as the corresponding quantity equations.

Note 3 to entry: Adapted from ISO/IEC Guide 99:2007, 1.14, in which Note 2 is different.

[SOURCE: ISO 80000-1:2009, 3.14]

4 Relations between quantities, units and their systems

4.1 General

Clause 4 provides background information on the concepts used to identify units and the methodology for combining units.

4.2 The International System of Quantities and the International System of Units

The International System of Quantities contains the set of base quantities and all the derived quantities which are defined by a given set of equations on the basis of the base quantities.

The International System of Quantities and the International System of Units are used for the systematic classification of physical quantities. The International System of Quantities is determined by the definition of a multitude of base quantities (see Table 4). By definition, a base quantity cannot be expressed through other base quantities. However, according to agreed calculation rules, any number of quantities from the International System of Quantities can be derived from the base quantities. Every base quantity in the International System of Quantities is assigned precisely to one SI base unit. The International System of Units is formed by the set of base units and their derived units.