



BSI Standards Publication

Identification of units of measurement for computer-based processing

National foreword

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The UK participation in its preparation was entrusted to Technical Committee GEL/3, Documentation and graphical symbols.

A list of organizations represented on this committee can be obtained on request to its secretary.

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TECHNICAL SPECIFICATION

Identification of units of measurement for computer-based processing

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 01.040.35; 01.060; 35.240.60

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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 $\lambda(D; Na)$
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	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 · 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 $(F_x; F_y; F_z) = (31,5 \text{ N}; 43,2 \text{ N}; 17,0 \text{ N})$ 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 $\dim F = \text{LMT}^{-2}$.

EXAMPLE 2 In the same system of quantities, $\dim \rho_B = \text{ML}^{-3}$ 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 $\dim Q = L^{\alpha}M^{\beta}T^{\gamma}I^{\delta}\Theta^{\epsilon}N^{\zeta}J^{\eta}$ 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 fractions 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 kilohm, 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.

Table 4 – Base quantities and base units in the International System of Units

Base quantity	Base unit		Definition
	Name	Symbol	
length	metre	m	The metre is the length of the path travelled by light in vacuum during a time interval of $1/299\,792\,458$ of a second.
mass	kilogram	kg	The kilogram is the unit of mass; it is equal to the mass of the international prototype of the kilogram.
time, duration	second	s	The second is the duration of $9\,192\,631\,770$ periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.
electric current	ampere	A	The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed one metre apart in vacuum, would produce between these conductors a force equal to $2 \cdot 10^{-7}$ Newton per metre of length.
thermodynamic temperature	kelvin	K	The kelvin, unit of thermodynamic temperature, is the fraction $1/273,16$ of the thermodynamic temperature of the triple point of water.
amount of substance	mole	mol	The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in $0,012$ kilogram of carbon 12; its symbol is "mol". When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.
luminous intensity	candela	cd	The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency $540 \cdot 10^{12}$ hertz and that has a radiant intensity in that direction of $1/683$ watt per steradian.

NOTE 1 See INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES (BIPM), *The International System of Units (SI)*.

Table 5 – Representation of base quantities in the International System of Units

Name	Symbol for quantity	Symbol for dimension
length	l, x, τ , etc.	L
mass	m	M
time, duration	t	T
electric current	I, i	I
thermodynamic temperature	T	Θ
amount of substance	n	N
luminous intensity	I_V	J

NOTE 2 See INTERNATIONAL BUREAU OF WEIGHTS AND MEASURES (BIPM), *The International System of Units (SI)*.

The dimension of each quantity in the International System of Quantities is represented as a product of powers of the base dimensions assigned to the base quantities. In the International System of Quantities, whose base quantities are length, mass, time, electric current, thermodynamic temperature, amount of substance, and luminous intensity, their dimensions

are characterized by the symbols L, M, T, I, Θ , N and J (see Table 5). Thus every unit in the International System of Units can be represented by the combination of SI base units.

EXAMPLE 1 In the International System of Quantities, LMT^{-2} is the dimension for force, with the canonical formulation: $L^1 M^1 T^{-2} I^0 \Theta^0 N^0 J^0$.

EXAMPLE 2 In the International System of Quantities, ML^{-3} is both the dimension for mass concentration and the dimension for density.

A one-to-one assignment exists between the base quantities of the International System of Quantities and the base units of the International System of Units, and an n-to-m relationship exists between derived quantities of the International System of Quantities and derived SI units of the International System of Units.

4.3 Other systems of quantities and units

In addition to the International System of Quantities other domain-specific systems exist. In these systems the number of base units may differ from the system described in 4.2.

EXAMPLE 1 In the CGS-ESU system (Centimetre Gram Second-ElectroStatic Unit system) the electric constant ϵ_0 (the permittivity of vacuum) is defined as being equal to 1, i.e., of dimension one.

EXAMPLE 2 Quantities can be associated by defining so-called coherent units. Depending on the context, the unit 1/s (reciprocal second) is represented in the International System of Units as Hz (Hertz) or Bq (Becquerel).

NOTE Units that are based on the Anglo-American or Imperial System of units are linked to SI units by a fixed relationship (conversion formula or conversion factor). The corresponding data is made available by NIST and UN ECE, in particular in the following documents:

- *Guide for the Use of the International System of Units (SI)*;
- *Codes for units of measure used in international trade*.

4.4 List of quantities and units

The list of quantities and units and their identifiers together with their relationships is maintained in the IEC Common Data Dictionary (CDD) and is available at:

<http://cdd.iec.ch/2>

The content of the IEC CDD may be updated without changing this document.

For the convenience of the reader informative Annex C lists the quantities, their identifiers, names and associated units as contained in the IEC CDD.

NOTE The data was retrieved on 2016-08.

5 Prefixes and prefix symbols

5.1 General

Prefixes and prefix symbols are specified in ISO 80000-1 and IEC 80000-13. They are repeated here for the convenience of the reader.

5.2 Formation of multiples and factors

Decimal multiples or fractions of a unit may be created by using SI prefixes. Such prefixes may be put in front of the concerned part(s) of a unit to keep the numeric value of the unit in a

² Website checked on 2016-06-10.

convenient size. Adding a prefix corresponds to the multiplication of the unit with the factor related to the prefix.

Table 6 lists names and symbols of the SI prefixes.

In information technology prefixes on the base of 2 are common. Table 7 lists names and symbols of the related prefixes.

Table 6 – Formation of multiples and factors of units to the base of 10

Factor		Prefix	
		Name	Symbol
0,000 000 000 000 000 000 000 001 =	10^{-24}	yocto	y
0,000 000 000 000 000 000 000 001 =	10^{-21}	zepto	z
0,000 000 000 000 000 000 001 =	10^{-18}	atto	a
0,000 000 000 000 000 001 =	10^{-15}	femto	f
0,000 000 000 001 =	10^{-12}	pico	p
0,000 000 001 =	10^{-9}	nano	n
0,000 001 =	10^{-6}	micro	μ
0,001 =	10^{-3}	milli	m
0,01 =	10^{-2}	centi	c
0,1 =	10^{-1}	deci	d
1 =	10^0	—	—
10 =	10^1	deca	da
100 =	10^2	hecto	h
1 000 =	10^3	kilo	k
1 000 000 =	10^6	mega	M
1 000 000 000 =	10^9	giga	G
1 000 000 000 000 =	10^{12}	tera	T
1 000 000 000 000 000 =	10^{15}	peta	P
1 000 000 000 000 000 000 =	10^{18}	exa	E
1 000 000 000 000 000 000 000 =	10^{21}	zetta	Z
1 000 000 000 000 000 000 000 000 =	10^{24}	yotta	Y

Table 7 – Formation of multiples of units to the base of 2

Factor		Prefix		
		Root	Name	Symbol
1 024 =	2^{10}	kilobinary: $(2^{10})^1$	Kibi	Ki
1 048 576 =	2^{20}	megabinary: $(2^{10})^2$	Mebi	Mi
1 073 741 824 =	2^{30}	gigabinary: $(2^{10})^3$	Gibi	Gi
1 099 511 627 776 =	2^{40}	terabinary: $(2^{10})^4$	Tebi	Ti
1 125 899 906 842 624 =	2^{50}	petabinary: $(2^{10})^5$	Pebi	Pi
1 152 921 504 606 846 976 =	2^{60}	exabinary: $(2^{10})^6$	Exbi	Ei
1 180 591 620 717 411 303 424 =	2^{70}	zettabinary: $(2^{10})^7$	Zebi	Zi
1 208 925 819 614 629 174 706 176 =	2^{80}	yottabinary: $(2^{10})^8$	Yobi	Yi

5.3 Usage of SI prefixes and SI prefix symbols

5.3.1 General

Subclauses 5.3 and 5.4 collect the rules related to the use of prefixes and prefix symbols (see ISO/IEC Guide 99, ISO 80000–1 and *The International System of Units (SI)*).

5.3.2 Combination of SI prefixes, SI prefix symbols, names of units and symbols for units

Prefix names may only be used in conjunction with names of units. Prefix symbols are to be used together with symbols for units. Only SI prefixes and SI prefix symbols may be combined.

A combination of names (of the prefix or unit) with symbols (for prefix or unit) is not permitted.

EXAMPLE 1 “mC” or “millicoulomb”, but neither “mCoulomb”, nor “milliC”.

The prefix name shall be placed in front of the unit name without any intermediate sign.

EXAMPLE 2 “kilograms”, but neither “kilo grams”, nor “kilo-grams”.

The prefix symbol shall be placed in front of the unit symbol without any intermediate sign.

EXAMPLE 3 “kg”, but neither “k g”, nor “k.g”, nor “k · g”.

Prefixes shall not be strung together in sequence.

NOTE The designation of the decimal multiples and parts of the mass unit are formed by appending the prefix name in front of the name “gram” or the prefix symbol in front of the symbol “g”.

EXAMPLE 4 “milligram”, or “mg”, but neither “microkilogram”, nor “µkg”.

Compound prefix names or compound symbols, i.e., prefix names or symbols formed by the juxtaposition of two or more prefix names or symbols, are not permitted. This rule also applies to compound prefix names. Prefix symbols can neither stand alone nor be attached to the

number “1”, the symbol for the unit one. Similarly, prefix names cannot be attached to the name of the unit one, i.e., to the word “one”.

EXAMPLE 5 “nm” (nanometre), but not: “mµm” (millimicrometre).

Prefixes may be used in the numerator and in the denominator. To designate decimal multiples and parts of derived units that consist of a quotient, a prefix may be used in the numerator, in the denominator or in both parts of the quotient.

EXAMPLE 6 “kA/cm”.

5.3.3 Use of power exponentials in conjunction with SI prefixes, SI prefix symbols, names of units or symbols for units.

An exponent always applies to the entire combination of symbols.

EXAMPLE $1 \text{ km}^3 = (10^3 \text{ m})^3 = 10^9 \text{ m}^3$

5.3.4 Restrictions on combining SI prefixes, SI prefix symbols, names of units and symbols for units

No prefixes or prefix symbols may be used for the units contained in Table 8.

Table 8 – Units that are used without prefixes or prefix symbols

degree	°
dioptré	dpt
degree Celsius	°C
kilogram	kg
metric carat	Kt
millimetre of mercury column	mmHg
minute	min
hour	h
day	d
reciprocal second (for rotational speed information)	s ⁻¹
reciprocal minute (for rotational speed information)	min ⁻¹

5.4 Selecting SI prefixes and SI prefix symbols

There is no general rule that specifies whether a prefix should be used and which prefix should be chosen for a unit to express the value of a quantity. The selection of a respective SI prefix may be influenced by

- the necessity to indicate which digits of a numerical value are significant;
- the necessity to have numerical values that can be easily understood;
- conventions valid within a technical domain.

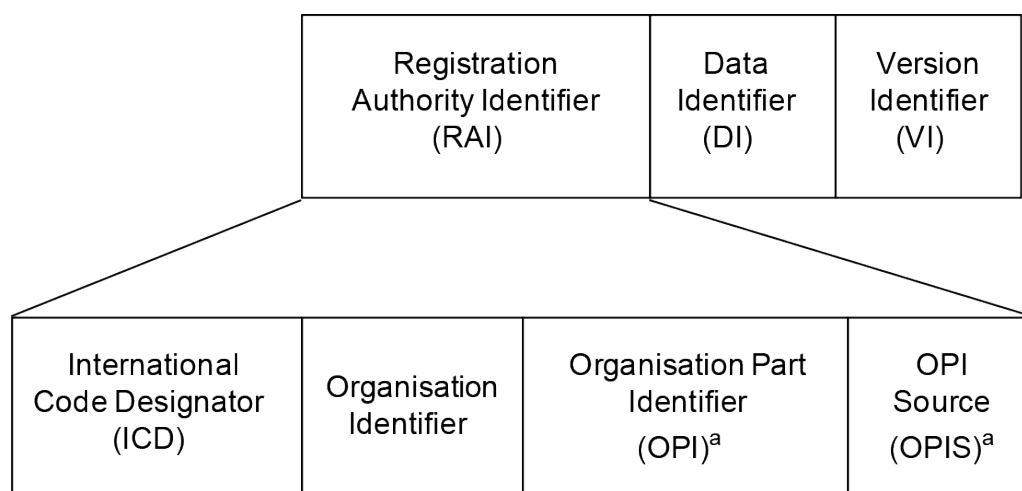
As a matter of principle, however, a unit shall have only one single SI prefix in the numerator and one single SI prefix in the denominator, even if there is a product of units on both sides of the fraction bar.

Combinations of SI prefixes and non-SI units are not allowed.

When specifying units, only the prefixes specified in the respective product standards should be used.

6 Identification of units

The complete identification of a unit complies with the specifications in ISO/IEC 11179 (all parts).



^a Optional, Ref.: ISO/IEC 6523

IEC

Figure 1 – International Registration Data Identifier (IRDI)

NOTE 1 See ISO/IEC 11179-5 for a detailed description of the elements of the International Registration Data Identifier.

This document uses ISO/IEC 11179 (all parts), in particular ISO/IEC 11179-3 and ISO/IEC 11179-5, for the basic identification of units (see Figure 1). Each unit plays a role similar to “Administered Item” defined in ISO/IEC 11179-3.

The units referenced in this document may be registered in a reference dictionary administered by a registration authority based on ISO/IEC 11179 (all parts). ISO/IEC 11179 (all parts) uses the IRDI (International Registration Data Identifier) mechanism to identify administered items as described in ISO/IEC 11179-5.

The identifiers used in this document are called “International Concept Identifier” (ICID). For the purpose of this document, the function of ICID is identical to IRDI. So it may be regarded as an extension of the IRDI.

Each ICID is unique across the boundary of organizations, and it has the following sequence:

ICID::= RAI”#”DI”##”VI

where

- “RAI” is the Registration Authority Identifier,
- “DI” is the Data Identifier, and
- “VI” is the Version Identifier,

as described in ISO/IEC 11179-5.

NOTE 2 In this document, two consecutive pound signs, i.e., “##” are used to separate “DI” and “VI”, while “RAI” and “DI” are separated by one single “#” character. This allows a short hand notation of the identifier eliminating either “RAI” or “VI”, or both if the context for “DI” is clear.

EXAMPLE 0112/2///62720#UAA163##001,

where 0112/2///62720: Registration Authority Identifier (RAI): International Electrotechnical Commission, Geneva, IEC 62720
UAA163: Data Identifier (DI): UAA163
001: Version Identifier (VI): 001

NOTE 3 In the tables within Annex C only the Data Identifier (DI) is listed.

See ISO/IEC 11179-6 for a detailed description of the elements.

Annex A (informative)

Information about units

There are many units in use that are outside of the SI system. They are either of historical interest or are used in particular domains or countries.

EXAMPLE 1 Barrel for the volume of petroleum, inch as a length measure in the Imperial System.

ISO and IEC discourage the use of such units in scientific and technical discourses. However, it is important to know the relationship between these units and the corresponding SI units. For this reason, non-SI units are listed in this document.

EXAMPLE 2 Year, week, percent, ångström.

This document makes no reference to legal stipulations regarding the units.

At national level, many countries mandate by law the use of specific units.

EXAMPLE 3 Sectors that are subject of legal stipulation concerning units include the business sector, healthcare, public safety, or educational sector.

NOTE The International Organization of Legal Metrology (OIML), founded in 1955, is committed to the international harmonization of this legislation.

Annex B (normative)

Identifiers for units and quantities

The quantities (see 3.1) and units (see 3.10) and their identifiers together with their relationships are maintained in the IEC CDD and are available at:

<http://cdd.iec.ch/3>

The content of IEC CDD may be updated without changing this document.

For the convenience of the reader Annex C lists the quantities, their identifiers, names and associated units as contained in the IEC CDD.

NOTE The data was retrieved on 2016-08.

³ Website checked 2016-06-10.

Annex C (informative)

Quantities and assigned units of measure

Annex C lists the quantities (see 3.1) as listed in the IEC CDD and their related units (see 3.10). Table C.1 lists the quantities and Table C.2 lists the referenced units of measure.

The data was retrieved on 2016-08. The units and their identifiers are available in the the IEC CDD at:

<http://cdd.iec.ch/4>

Table C.1 – Codes of quantities (1 of 12)

Item code	Name of quantity	Associated units
UAD000	absorbed dose	UAA163, UAA788, UAB503, UAB504, UAB505
UAD001	absorbed dose rate	UAA164, UAB298, UAB299, UAB300, UAB476, UAB477, UAB478, UAB479, UAB472, UAB473, UAB474, UAB475
UAD002	acceleration	UAA736, UAB397, UAB398, UAB400, UAB042, UAB043, UAB401, UAB044, UAA452, UAB399, UAA521
UAD003	active power	UAA935, UAA910, UAA080, UAA807, UAA583, UAA224, UAA154, UAA289, UAB506, UAB507, UAA306, UAB508, UAB509, UAB510, UAB511, UAB447, UAB177, UAB512, UAB513, UAB514, UAB515, UAB356, UAB445, UAB449, UAB444, UAB448, UAB446, UAB450, UAA430, UAA129, UAA121, UAB184, UAA446, UAA128, UAA120, UAA445, UAA124, UAA116, UAA444, UAA369, UAA592, UAA591, UAA368, UAA534, UAB438, UAA536, UAA537, UAA538, UAB154, UAA535
UAD004	amount of substance	UAA882, UAA640, UAA877, UAA093, UAB523, UAB402
UAD005	amount of substance concentration	UAA891, UAB500, UAA642, UAA883, UAA888
UAD006	angular acceleration	UAB407, UAA969
UAD007	angular cross-section	UAA755, UAB128
UAD008	angular momentum	UAA245, UAA623
UAD009	angular velocity	UAA026, UAA968, UAB231
UAD010	angular wave number	UAA025, UAA967
UAD011	apparent power	UAB530, UAB531, UAB532, UAB533, UAA581, UAA222, UAB534, UAB535, UAB536, UAB537, UAA298
UAD012	areic bit density	UAA195, UAA231, UAA160, UAA293, UAA272, UAA141
UAD013	areic charge density	UAA134, UAA564, UAB101, UAB100, UAA207, UAA060, UAA784
UAD014	areic mass	UAA617, UAB103, UAB389, UAB174, UAA818, UAA486, UAA829, UAB105, UAB104, UAB261, UAB262, UAB390, UAB137, UAB599
UAD015	avogadro constant	UAA896

⁴ Website checked 2016-06-10

Table C.1 (2 of 12)

Item code	Name of quantity	Associated units
UAD016	bandwidth distance product	UAA567, UAA210, UAA151, UAA171
UAD017	battery capacity	UAA107, UAA777, UAB053, UAA102, UAB383
UAD018	bit rate	UAA343, UAA291, UAA270, UAA139, UAA586, UAA226, UAA156, UAB342
UAD019	burst factor	UAB462, UAB130
UAD020	byte rate	UAB305, UAB306, UAB307, UAA157
UAD021	capacitance	UAA319, UAB588, UAA930, UAA903, UAA063, UAA787, UAB384, UAA144
UAD022	catalytic activity	UAB196
UAD023	Celsius temperature	UAA033
UAD024	compressibility	UAA269, UAB492, UAA328, UAA709, UAA010, UAB373, UAA016
UAD025	conductivity	UAA934, UAA908, UAA076, UAA579, UAA220, UAA279, UAA907, UAA075, UAA801, UAA278
UAD026	cross-section	UAB297
UAD027	dataset of bits	UAA339, UAB191, UAB190, UAB159, UAB171, UAB156, UAB158, UAB167, UAB152, UAB341
UAD028	dataset of bytes	UAA354, UAB186, UAB187, UAB129, UAB131, UAB185, UAA197, UAA233, UAA162, UAA295, UAA274, UAA143
UAD029	density	UAA740, UAA667, UAA383, UAA870, UAB033, UAA453, UAA546
UAD030	density of states	UAB165, UAB164
UAD031	diffusion constant	UAA752, UAB408, UAA872, UAA281, UAA359, UAB247, UAA548, UAA455
UAD032	digit rate	UAA109, UAA560, UAA204
UAD033	dose equivalent	UAA802, UAA284, UAA971, UAA898
UAD034	dose equivalent rate	UAB304, UAB303, UAB302, UAB301, UAB467, UAB466, UAB465, UAB464, UAB471, UAB470, UAB469, UAB468, UAB442
UAD035	dynamic viscosity	UAA797, UAA265, UAB428, UAB429, UAB433, UAB432, UAB430, UAB431, UAA255, UAA356, UAA072, UAB227, UAA675, UAB435, UAB436, UAB434, UAA674, UAA707, UAA980, UAA708
UAD036	Einstein coefficients	UAB349
UAD037	electric charge	UAA130, UAA929, UAA902, UAA059, UAA782, UAA563, UAA206, UAB212
UAD038	electrical conductance	UAB357, UAA074, UAA800, UAA578, UAA277, UAB200, UAB201
UAD039	electric current	UAB637, UAB638, UAA928, UAA901, UAA057, UAA775, UAA557, UAA202, UAB639, UAB640, UAB641, UAA101, UAB210, UAB211
UAD040	electric current density	UAA559, UAA203, UAA105, UAB052, UAB051
UAD041	electric dipole moment	UAA133

Table C.1 (3 of 12)

Item code	Name of quantity	Associated units
UAD042	electric field strength	UAA079, UAA805, UAA582, UAA223, UAA301, UAB054, UAA302, UAA300
UAD043	electric flux density	UAA134, UAA564, UAB101, UAB100, UAA207, UAA784
UAD044	electric polarization	UAA134, UAA564, UAB101, UAB100, UAA207, UAA784
UAD045	electric resistance	UAB359, UAA055, UAA741, UAA555, UAA198, UAA147, UAA286, UAA017
UAD046	energy content	UAA313, UAB160, UAB195, UAB198, UAA308, UAA584, UAA225, UAA155, UAA290
UAD047	energy density	UAA212, UAA180, UAB146, UAB281, UAB280
UAD048	equilibrium constant based on concentration	UAB334
UAD049	equilibrium constant based on pressure	UAB335
UAD050	exposure rate	UAA132, UAA276
UAD051	failure rate	UAB403
UAD052	Faraday constant	UAB142
UAD053	first radiation constant	UAB350
UAD054	force	UAA070, UAA793, UAA573, UAA213, UAA235, UAB355, UAA422, UAB233, UAA926, UAA696, UAB232, UAB021, UAA632, UAB059, UAB412
UAD055	force constant	UAA236
UAD056	frequency	UAB698, UAA566, UAA209, UAA150, UAA287, UAB699, UAA170
UAD057	gas leak rate	UAA813, UAA531, UAA219, UAA264, UAA326, UAA327, UAA814, UAA530, UAA218, UAA261, UAA703, UAA706, UAA704, UAA705
UAD058	gradient	UAC001, UAC002
UAD059	gravitational constant	UAB491
UAD060	Hall coefficient	UAB143
UAD061	I^2t -value	UAA108
UAD062	illumination	UAA723, UAB255, UAB256
UAD063	impulse	UAA251, UAA615, UAB413, UAB414, UAB416, UAB415
UAD064	incidence	UAA973, UAB027, UAA526, UAA843, UAA099, UAA408, UAA881, UAB372
UAD065	inductance	UAA165, UAB386, UAA932, UAA789, UAA066, UAA905
UAD066	information content	UAB343, UAB344, UAB345
UAD067	ionic strength	UAA885, UAA878, UAB404, UAA879, UAB405