

Letter symbols to be used in electrical technology —

Part 1: General

ICS 01.060; 01.075; 29.020

National foreword

This British Standard is the UK implementation of EN 60027-1:2006+A2:2007. It is identical with IEC 60027-1:1995, incorporating amendments 1:1997 and 2:2005.

The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by A1 A1.

The UK participation in its preparation was entrusted to Technical Committee SS/7, General metrology, quantities, units and symbols.

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

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 28 February 2009

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ISBN 978 0 580 60194 1

Amendments/corrigenda issued since publication

Date	Comments

English version

Letter symbols to be used in electrical technology
Part 1: General
(IEC 60027-1:1995 (Reprint) + A1:1997)

Symboles littéraux à utiliser en
électrotechnique
Partie 1: Généralités
(CEI 60027-1:1995 (Reprint) + A1:1997)

Formelzeichen für die Elektrotechnik
Teil 1: Allgemeines
(IEC 60027-1:1995 (Reprint) + A1:1997)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 60027-1:1995 (Reprint) + A1:1997, prepared by IEC TC 25, Quantities and units, and their letter symbols, was approved by CENELEC as HD 60027-1:2004 on 2003-12-01.

Following BT Decision D125/089, this Harmonization Document was submitted to the formal vote for conversion into a European Standard and was approved by CENELEC as EN 60027-1 on 2006-10-01.

The following date was fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2007-10-01

Endorsement notice

The text of the International Standard IEC 60027-1:1995 (Reprint) + A1:1997 was approved by CENELEC as a European Standard without any modification.

Foreword to amendment A2

The text of amendment 2:2005 to the International Standard IEC 60027-1:1992, prepared by IEC TC 25, Quantities and units, and their letter symbols, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A2 to EN 60027-1:2006 on 2007-04-01 without any modification.

The following dates were fixed:

- latest date by which the amendment has to be
implemented at national level by publication of
an identical national standard or by endorsement (dop) 2008-04-01
- latest date by which the national standards conflicting
with the amendment have to be withdrawn (dow) 2010-04-01

Endorsement notice

The text of amendment 2:2005 to the International Standard IEC 60027-1:1992 was approved by CENELEC as an amendment to the European Standard without any modification.

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LETTER SYMBOLS TO BE USED IN ELECTRICAL TECHNOLOGY

Part 1: General

SECTION 0: SCOPE

This part 1 of the International Standard, IEC 27, gives information about general quantities, units and their letter symbols and mathematical symbols that are to be used in electrical technology. It also gives rules for writing and printing these symbols and for the use of additional marks (subscripts, superscripts, etc.) with symbols for quantities.

There are no normative references quoted in this International Standard.

SECTION 1: RECOMMENDATIONS FOR PRINTING SYMBOLS AND NUMBERS

1.1 Symbols for quantities

1.1.1 Symbols

The symbols for quantities¹⁾ are generally single letters of the Latin or Greek alphabet, sometimes with subscripts or other modifying signs. These symbols are printed in italic (sloping) type (irrespective of the type used in the rest of the text).

The symbol is not followed by a full stop except for normal punctuation, e.g., at the end of a sentence.

NOTES

- 1 Principles that apply to physical quantities and the expression of their values in units of the International System of Units (SI) are described in ISO 31-0, *Quantities and units – Part 0: General principles*.
- 2 Notations for vectorial and other non-scalar quantities are given in ISO 31-11, *Quantities and units – Part 11: Mathematical signs and symbols for use in the physical sciences and technology*.
- 3 Exceptionally, symbols made up of two letters are sometimes used for combinations of dimension one of quantities (e.g., Reynolds number: *Re*). If such a two-letter symbol appears as a factor in a product, it is recommended that it be separated from the other symbols.
- 4 Standardized symbols for quantities and constants generally used in electrical technology are given in section 3, tables 1, 2, 3, 4, and 5.

1.1.2 Rules for printing of subscripts and use of subscripts in electrical technology

When, in a given context, different quantities have the same letter symbol or when, for one quantity, different applications or different values are of interest, a distinction can be made by use of subscripts.

The following principles for the printing of subscripts are recommended:

A subscript that represents a symbol for a physical quantity is printed in italic (sloping) type.

Other subscripts are printed in roman (upright) type.

¹⁾ See annex E concerning names for quantities and units.

Examples:

Roman (upright) subscripts

C_g (g: gas)
 g_n (n: normal)
 μ_r (r: relative)
 E_k (k: kinetic)
 χ_e (e: electric)
 $T_{1/2}$ (1/2: half)

Italic (sloping) subscripts

C_p (p: pressure)
 $\Sigma_n a_n g_n$ (n: running number)
 $\Sigma_x a_x b_x$ (x: running number)
 g_{ik} (i, k: running numbers)
 p_x (x: x coordinate)
 I_λ (λ : wavelength)

NOTES

- 1 Numbers as subscripts shall be printed in roman (upright) type. However, letter symbols representing numbers are printed in italic (sloping) type.
- 2 For use of subscripts, see also special remarks to ISO 31-6 and ISO 31-10.
- 3 Standardized subscripts for use in electrical technology are given in section 3, tables 6 and 7.

In most cases, subscripts should be used as distinguishing means but in some cases other distinctions such as typographical signs or variants in type are suitable.

In a few cases, it is permissible to use different but related letter symbols.

EXAMPLES:

Subscripts:

magnetic flux density in vacuum B_0
 intrinsic magnetic flux density B_i
 current in different conductors I_a, I_b, I_c , etc.
 minimum value of frequency $f_{\min}$.

Type variants:

instantaneous value of current i
 root-mean-square value of current I
 force vector F .

Typographical signs:

peak value of current $\hat{i}, \hat{I}$.

Different but related letter symbols:

three different angles α, β and γ .

1.1.3 Rules

1.1.3.1 Order of preference

Subscripts and other distinguishing means that are independent of language (Sub-clause 1.1.3.2) and subscripts of international character (Sub-clause 1.1.3.3) should, as far as possible, be chosen in preference to other subscripts (Sub-clause 1.1.3.4).

1.1.3.2 Subscripts and other distinguishing means which are independent of language

a) Subscripts

Subscripts that are independent of language may be numbers, mathematical symbols and signs, sequences of letters, reference letters, letter symbols for quantities and units and symbols for chemical elements.

b) Numbers

Numbers may represent for instance: order, degree of importance, and reference. The subscript 0 (zero) is used not only as a number, but also for basic, initial, or reference conditions.

Roman numerals as subscripts should be used sparingly.

The letter “l” and the numeral “1” are often identical. Care should be taken to avoid ambiguity.

EXAMPLES:

$i_1 i_2 i_3$	the fundamental and the second and third harmonic components of a current; or current in conductors 1, 2 and 3, or current in the same conductor at three different moments
R_{50}	resistance at a temperature of 50 °C
R_{50}	resistance at a frequency of 50 Hz
U_{99}	sparkover voltage with 99 % probability.

c) *Mathematical signs*

EXAMPLE:

i_{∞} current at infinite time.

d) *Sequence of letters*

There are occasions when samples of the same physical quantity that are classified in a sequence may be distinguished by letter subscripts rather than by number subscripts. Both capital and lower-case letters may be used, but lower-case letters are preferred.

EXAMPLES:

$Q_a Q_b Q_c$ three different electric charges.

e) *Reference letters*

The subscript indicates the applicability of a symbol in some way, for instance restrictions to particular location, to particular points of time, to particular pieces of apparatus or parts of apparatus, to particular processes, to particular substances, to particular fields (electrical, mechanical, etc.). The following few examples illustrate the point.

EXAMPLES:

E_B	could denote electric field strength at point B
s_{EF}	could denote length of path from point E to point F
A_{KLM}	could denote the area of a triangle with the corners K, L and M
I_u	could denote current in phase u.

f) *Quantity or unit symbols used as subscripts*

A letter symbol for a quantity (or for a unit) when used as a subscript, shall be printed in the same style as when used as a quantity symbol (or as a unit symbol).

EXAMPLES:

C_p	heat capacity at constant pressure p
δ_C	loss angle of capacitor of capacitance C
W_{3h}	energy capacity of a battery at three hours (3 h) discharge.

g) *Symbols for chemical elements*

Internationally adopted symbols for chemical elements are independent of language and may be used as subscripts.

EXAMPLE:

ρ_{Cu} resistivity of copper (Cu).

NOTE – Symbols for chemical elements are given in ISO 31-8, *Quantities and units – Part 8: Physical chemistry and molecular physics*.

h) *Other distinguishing means*

For distinguishing between different types of values (e.g. instantaneous value, root-mean-square value, peak value, minimum value, average value) capital and lower-case letters and some signs (^ ~ -) should be used as recommended in 2.1. Other recommendations are given for vector quantities and for complex representation of quantities (1.6).

EXAMPLES:

i	instantaneous value of current
I	root-mean-square value of current
$\bar{Q}$	average value of electric charge
$\hat{\Phi}$	peak value of magnetic flux
H	magnetic field strength as a vector
ε'	real part of complex permittivity.

1.1.3.3 *Subscripts of international character*a) *Proper names*

Abbreviations of proper names are, with extremely few exceptions, the same or practically the same in all languages. Such abbreviations are therefore of international character, and they may be used as subscripts.

EXAMPLES:

T_C	Curie temperature
R_H	Hall coefficient.

b) *Words derived from Latin and Greek*

Latin and Greek serve as a basis for most scientific and technical words, and abbreviations of such words are suitable as subscripts.

EXAMPLES:

P_{el}	electrical power
p_{cr}	critical pressure
v_i	initial velocity
B_i	intrinsic magnetic flux density
T_{ext}	external thermodynamic temperature
R_{eq}	equivalent resistance
g_n	standard (normal) acceleration of free fall
M_v	luminous (visual) exitance.

c) *International words not derived from Latin and Greek*

Many words which have been coined for scientific and industrial purposes have an international character. Examples of such words are gas, radar, maser. Abbreviations of such words are suitable as subscripts.

EXAMPLE:

C_g	heat capacity in the gas phase.
-------	---------------------------------

1.1.3.4 *Other subscripts*

If it is not possible in a specific case to find Latin, Greek, or other international words from which to derive an acceptable subscript, arbitrarily chosen letters or numbers are preferred. If such a choice is not convenient, subscripts derived from words that are common to many languages are the next best choice.

1.1.3.5 *Some observations*

When a subscript is not self-explanatory, its meaning should be stated.

Subscripts, whether they conform to these recommendations or not, may be ambiguous; thus i (roman, upright) may mean *initial*, *induced* or *intrinsic*. Ambiguity can often be avoided by the use of longer subscripts, as ini for *initial*, ind for *induced*, and $intr$ for *intrinsic*.

Subscripts which are abbreviations of words other than proper names are, as a rule written with lower-case letters. Sometimes it is practical to use both capital and lower-case letters for such

making a difference in their significance which must be defined. Thus, in a certain context a capital letter subscript may be used for the total value of a quantity and lower-case letter subscripts for its components. In another context capital letter subscripts may be used for external quantities and lower-case letter subscripts for internal ones.

1.1.3.6 Multiple subscripts

The use of a subscript consisting of several parts, a multiple subscript, should be avoided if possible. When a multiple subscript is used the parts should be placed on the same level. The only exception may be when a letter symbol consisting of a letter with a subscript is used as subscript, e.g. for the temperature coefficient (α) of reluctance (R_m), then the total symbol can be written either non-simplified α_{R_m} or simplified α_{Rm} .

For the sake of clarity, the different parts of a multiple subscript may be separated by thin spaces. Commas should usually be avoided between parts of a subscript, but may be used if this is necessary to avoid ambiguity. For the same purpose part of a subscript may be put within parentheses. No general rule for the order between parts of a subscript can be given, but, for guidance, a part indicating the kind of quantity should be placed first, a part indicating special circumstances last. The order may thus depend upon the point of view.

The following examples may be mentioned:

$R_{m \max}$	maximum value of reluctance
$\hat{u}_{bv}$	peak value of variable part of voltage at b
$i_{4(2)}$	instantaneous value of the second harmonic of current in conductor 4. To make a distinction the harmonic number has been placed within parentheses
L_{mn}	mutual inductance
$Z_{12,13}$	element in the twelfth row and the thirteenth column of an impedance matrix
J_{3y}	y-component of the third harmonic of current density J
J_{y3}	third harmonic of the y-component of current density J .

Multiple subscripts can sometimes be avoided by expressing the quantity in functional form, e.g. $W(3 \text{ h}, -40^\circ\text{C})$ for the energy capacity of an accumulator battery for a three-hour discharge at a temperature of -40°C .

1.1.4 Combination of symbols for quantities; elementary operations with quantities

When symbols for quantities are combined in a product, this process of combination may be indicated in one of the following ways:

ab , $a \ b$, $a \cdot b$, $a \times b$

NOTES

- 1 In some fields, e.g., in vector analysis, distinction is made between $a \cdot b$ and $a \times b$.
- 2 For multiplication of numbers, see 1.3.
- 3 In systems with limited character sets a dot on the line is used instead of a half-high dot.

Division of one quantity by another may be indicated in one of the following ways:

$\frac{a}{b}$, a/b

or by writing the product of a and b^{-1} , e.g., $a \cdot b^{-1}$

The procedure can be extended to cases where the numerator or the denominator, or both, are

themselves products or quotients, but in such a combination a solidus (/) should not be followed by a multiplication sign or a division sign on the same line unless parentheses be inserted to avoid all ambiguity.

EXAMPLES:

$$\frac{ab}{c} = ab/c = abc^{-1}$$

$$\frac{a/b}{c} = (a/b)/c = ab^{-1}c^{-1}; \text{ but not } a/b/c;$$

$$\text{however, } \frac{a/b}{c/d} = \frac{ad}{bc}$$

$$\frac{a}{bc} = a/(b \cdot c) = a/bc, \text{ but not } a/b \cdot c$$

The solidus (/) can be used in cases where the numerator and the denominator involve addition or subtraction provided parentheses (or brackets or braces) be employed.

EXAMPLES:

$$(a + b)/(c + d) \text{ means } \frac{a + b}{c + d};$$

the parentheses are required.

$$a + b/c + d \text{ means } a + \frac{b}{c} + d;$$

misunderstanding may, however, be avoided by writing it as

$$a + (b/c) + d.$$

Parentheses should also be used to remove ambiguities which may arise from the use of certain other signs and symbols for mathematical operations.

1.1.5 Substitution of letters

Capital letters may be used as variants for lower-case letters (and vice versa) only if no ambiguity could result.

The chief symbol for length is l and for inductance L , but l and L may also be used for two lengths or two inductances. If length and inductance appear together, then l should preferably be used only for length and L for inductance and any necessary distinction should be made by means of subscripts.

1.2 Names and symbols for units

1.2.1 International symbols for units

When international symbols for units exist, they, and no other, shall be used. They should be printed in roman (upright) type (irrespective of the type used in the rest of the text), should remain unaltered in the plural, should be written without a final full stop (period) except for normal punctuation, e.g., at the end of a sentence.

Any attachment to a unit symbol as a means of giving information about the special nature of the quantity under consideration is incorrect.

EXAMPLE:

$$U_{\max} = 500 \text{ V (not } U = 500 \text{ V}_{\max})$$

The unit symbols shall in general be printed in lower-case letters except that the first letter is printed in upper case when the name of the unit is derived from a proper name.

EXAMPLES:

m	metre
s	second
A	ampere
Wb	weber

1.2.2 *Combination of symbols for units*

When a compound unit is formed by multiplication of two or more units, this may be indicated in one of the following ways:

$N \cdot m$, $N\ m$

NOTES

- 1 In systems with limited character sets a dot on the line is used instead of a half-high dot.
- 2 The last form may also be written without a space provided that special care is taken when the symbol for one of the units is the same as the symbol for a prefix.

EXAMPLE:

mN means millinewton, not metre newton.

When a compound unit is formed by dividing one unit by another, this may be indicated in one of the following ways:

$\frac{m}{s}$, m/s , $m \cdot s^{-1}$.

A solidus (/) shall not be followed by a multiplication sign or a division sign on the same line unless parentheses are inserted to avoid all ambiguity. In complicated cases negative powers or parentheses shall be used.

1.2.3 *Printing of symbols for units*

No recommendation is made or implied about the font of upright type in which symbols for units are to be printed.

NOTE – In this series of publications the font used in such cases happens generally to be that of the associated text, but this does not constitute a recommendation.

1.2.4 Printing and use of prefixes

In order to avoid large or small numerical values, decimal multiples and submultiples of the SI units are added to the coherent system within the framework of the SI. They are formed by means of the following prefixes:

SI Prefixes

Factor	Prefix	Symbol
10 ²⁴ 10 ²¹ 10 ¹⁸ 10 ¹⁵	yotta zetta exa peta	Y Z E P
10 ¹² 10 ⁹ 10 ⁶ 10 ³	tera giga mega kilo	T G M k
10 ² 10 10 ⁻¹ 10 ⁻²	hecto deca deci centi	h da d c
10 ⁻³ 10 ⁻⁶ 10 ⁻⁹ 10 ⁻¹²	milli micro nano pico	m μ n p
10 ⁻¹⁵ 10 ⁻¹⁸ 10 ⁻²¹ 10 ⁻²⁴	femto atto zepto yocto	f a z y

The SI units and their decimal multiples and submultiples formed by use of the prefixes are specially recommended.

Symbols for prefixes shall be printed in roman (upright) type without space between the symbol for the prefix and the symbol for the unit.

Compound prefixes shall not be used.

EXAMPLE:

Write nm (nanometre) for 10⁻⁹ m, never mμm.

The symbol of a prefix is considered to be combined with the single unit symbol to which it is directly attached, forming with it a new symbol (for a decimal multiple or submultiple) which can be raised to a positive or negative power, and which can be combined with other unit symbols to form symbols for compound units (see 1.2.2).

EXAMPLES:

$$1 \text{ cm}^3 = (10^{-2} \text{ m})^3 = 10^{-6} \text{ m}^3$$

$$1 \text{ μs}^{-1} = (10^{-6} \text{ s})^{-1} = 10^6 \text{ s}^{-1}$$

$$1 \text{ kA/m} = (10^3 \text{ A})/\text{m} = 10^3 \text{ A/m}$$

NOTE – For historical reasons the name of the base unit for mass, kilogram, contains the name of the SI prefix “kilo”. Names of the decimal multiples and submultiples of the unit of mass are formed by adding the prefixes to the word “gram”, e.g. milligram (mg) instead of microkilogram (μkg).

1.2.5 *Spelling of names of units in the English language*

Where there are differences in the spelling of names of units within the English language, the spelling as given in the *Oxford English Dictionary* is used in the English-language versions of IEC 27. This does not imply a preference over the spellings used in other English-speaking countries.

1.3 Numbers

1.3.1 *Printing of numbers*

Numbers should generally be printed in roman (upright) type.

To facilitate the reading of numbers with many digits, they may be separated into suitable groups, preferably of three, counting from the decimal sign towards the left and the right; the groups should be separated by a small space but never by a comma, a point or by other means.

1.3.2 *Decimal sign*

 The decimal sign is either a comma on the line or a point on the line.

NOTE This statement is based on Resolution 10 of the 22nd General Conference on Weights and Measures (CGPM 2003) which was unanimously adopted and in which the CGPM declares that “the symbol for the decimal marker is either the point on the line or the comma on the line”.

In accordance with the IEC/ISO Directives, Part 2: Rules for the structure and drafting of International Standards, the decimal sign is a comma on the line in International Standards.

If the absolute value of the number is less than one, the decimal sign shall be preceded by a zero. 

1.3.3 *Multiplication of numbers*

The sign for multiplication of numbers is a cross (×) or a dot half-high (·).

NOTES

- 1 If a dot half-high is used as the multiplication sign, a comma should be used as the decimal sign. If a dot is used as the decimal sign, a cross should be used as the multiplication sign.
- 2 In accordance with IEC/ISO Directives, Part 3: *Drafting and Presentation of International Standards* (1989), a cross is used as the multiplication sign between numbers in International Standards.

1.4 Mathematical signs and symbols

Mathematical signs and symbols recommended for use in the physical sciences and technology are given in ISO 31, part 11. Some of the signs and symbols that are most frequently used in electrical technology are given in section 3, table 8.

1.5 Expressions for quantities

The symbol of the unit shall be placed after the numerical value in the expression for a quantity, leaving a space between the numerical value and the unit symbol. If the quantity to be expressed is a sum or a difference of quantities then either parentheses shall be used to combine the numerical values, placing the common unit symbol after the complete numerical value, or the expression shall be written as the sum or difference of expressions for the quantities.

EXAMPLES:

$l = 12 \text{ m} - 7 \text{ m} = (12 - 7) \text{ m} = 5 \text{ m};$
 $t = 28,4 \text{ °C} \pm 0,2 \text{ °C} = (28,4 \pm 0,2) \text{ °C}$ (not $28,4 \pm 0,2 \text{ °C}$);
 $\lambda = 220 \times (1 \pm 0,02) \text{ W/(m} \cdot \text{K)}.$

1.6 Complex representation of quantities

Complex representation of quantities may be indicated as follows, both systems being on an equal footing:

Real part	X'	$\operatorname{Re} X$
Imaginary part	X''	$\operatorname{Im} X$
Complex quantity	$\underline{X} = X' + jX''$ $\underline{X} = X e^{j\varphi} = X \exp j\varphi$	$X = \operatorname{Re} X + j\operatorname{Im} X$ $X = X e^{j\varphi} = X \exp j\varphi$
Conjugate complex quantity	$\underline{X} = X \angle \varphi$ $\underline{X}^* = X' - jX''$	$X = X \angle \varphi$ $X^* = \operatorname{Re} X - j\operatorname{Im} X$

Additional recommendations concerning complex quantities are given in ISO 31-11.

SECTION 2: GENERAL RECOMMENDATIONS FOR TIME-DEPENDENT QUANTITIES

2.1 Quantities that vary with time periodically

Quantities that vary with time periodically may be indicated as follows:

Case 1 applies if capital and lower-case letters are appropriate.

Case 2 applies if only capital or only lower-case letters are appropriate.

	Case 1	Case 2 A	Case 2 B
Instantaneous value	x	X	x
Root-mean-square value of a periodic quantity ¹⁾	X	$\tilde{X}$ X_{rms}	$\tilde{x}$ x_{rms}
Peak value	$\hat{x}$, $\hat{X}$ x_m , X_m	$\hat{X}$ X_m	$\hat{x}$ x_m
Average value ²⁾	$\bar{x}$, $\bar{X}$ x_{av} , X_{av}	$\bar{X}$ X_{av}	$\bar{x}$ x_{av}
The minimum value of a quantity may be indicated by $\hat{x}$, $\hat{X}$ or x_{min} , X_{min} , so that the peak-to-valley value is $(\hat{x} - \bar{x})$ or $(\hat{X} - \bar{X})$ and $(x_m - x_{min})$ or $(X_m - X_{min})$.			
¹⁾ See also table 6, item number 0201.			
²⁾ See also table 6, item number 0204.			

2.2 Quantities that vary with time non-periodically

2.2.1 Time-dependent quantities can be periodic, transient or random. The variable quantity can often be represented by a combination, e.g. sum, product, polynomial, etc., of components which are functions such as trigonometric functions, exponentials, distributions, etc.

The intention of this standard is to codify additional symbols for the components of a combination of functions or for special values (e.g. instantaneous, root-mean-square) of more complicated time-dependent quantities (e.g. modulated waves, sets of impulses, etc.). In this connection, it is considered highly desirable to have a language-independent system of symbols.

2.2.2 Definitions of special values or components of a time-dependent quantity are those of IEV, Chapter 101, Section 04. No definitions are given here, the meaning of the symbols being illustrated by the figures.

2.2.3 Two types of symbols are given: one using additional marks, the other using only letter subscripts such as are found on an ordinary typewriter. A combination of both systems is possible. Most examples given in table 9 use one set of those symbols only.

2.2.4 The symbol for a time-dependent quantity implies in itself the dependency on time and indicates therefore the instantaneous value.

When both upper-case and lower-case letters are used, the lower-case letter indicates an instantaneous value and an upper-case letter an average value.

EXAMPLE:

- i instantaneous value of a time-dependent electric current.
- I its r.m.s. value.

If it is desirable to state explicitly that the instantaneous value is meant, one may add the letter t in parentheses.

EXAMPLE:

$\Phi(t)$ instantaneous value of a time-dependent magnetic flux.

Remark. – The letter t as right-hand subscript for indicating instantaneous values should not be used because it could be misinterpreted for a mark indicating differentiation by time.

2.2.5 Succession and position of information subscripts:

X_{ABC}

A designates the type of component: alternating, slowly changing, etc.

B specifies the special component

C gives the associate value.

EXAMPLE:

x_{b2min} or $x_{b2,min}$ (see figure 7, annex C).

To avoid excessively long subscripts in a series representation of a quantity, a left-hand superscript may be used to designate the order of the component.

EXAMPLE:

$$x_2 = {}^0X_2 + {}^1\hat{x}_2 \sin(\omega t + {}^1\alpha_2) + {}^2\hat{x}_2 \sin(2\omega t + {}^2\alpha_2) + \dots$$

instead of

$$x_2 = X_{20} + \hat{x}_{21} \sin(\omega t + \alpha_{21}) + \hat{x}_{22} \sin(2\omega t + \alpha_{22}) + \dots$$

or

$$x_2 = X_{2,0} + \hat{x}_{2,1} \sin(\omega t + \alpha_{2,1}) + \hat{x}_{2,2} \sin(2\omega t + \alpha_{2,2}) + \dots$$

2.2.6 Standardized symbols for time-dependent quantities are given in table 9. A few examples of time-dependent quantities, given in annex C, show the scope of such symbols. The list of examples is, by no means, exhaustive; it shows some of the cases encountered and others can be deduced by analogy.

SECTION 3: SYMBOLS FOR QUANTITIES AND THEIR UNITS, SELECTED CONSTANTS AND SIGNS

3.1 Introduction to tables for quantities and their units

The tables include, in addition to certain symbols used in electricity and magnetism, some other symbols that occur in electrical technology.

The item numbers in table 1 are the same as in the sixth edition of IEC 27-1. If the item number is not the same as the item number in the fifth edition of IEC 27-1, the old item number is given in parentheses below the new item number.

In table 1, the vectorial or tensorial character of certain quantities or their complex representation is disregarded.

The first column of symbols for quantities in table 1 gives the chief symbols. The second column gives reserve symbols for use where a chief symbol is found unsuitable, for instance where its use would lead to confusion with the same symbol used with a different meaning.

Names are used only for identification and generally agree with the IEV. If a name or a symbol in a table is not in conformity with those given in the International Standard ISO 31, this is indicated in the Remarks column.

Parentheses are sometimes used in connection with the names of quantities given in table 1 for the following reasons:

- to identify a word that may, optionally, be omitted from the name of the quantity; this use of parentheses is consistent with the IEV;
- to identify an alternate name for a quantity;
- to enclose some explanatory words.

The reasons for using parentheses will be clear from the context.

Sometimes, preference is given to a certain symbol in cases where ISO does not make a distinction.

The units in table 1 that belong to the International System of Units¹⁾ should be used in preference to others. The International System of Units is based on seven base units (m, kg, s, A, K, cd, mol) and includes the Giorgi or MKSA system. These units are called SI units. The designation “SI” was adopted in 1960 by the 11th “Conférence Générale des Poids et Mesures”. The column headed “SI unit” gives names and symbols adopted by the CGPM.

Wherever the symbol for the unit is *l*, the corresponding quantity is a number and its value is written as a numerical value without the unit symbol.

When two types of sloping (italic) letters exist, as with *ℑ*, *θ*; *φ*, *ϕ*; and *g*, *g*, only one of these is given. This does not mean that the other is not equally acceptable.

¹⁾ See annex F.

Table 1 – Symbols for quantities and their units

		Quantities				Units				
Item number	Item number in ISO 31	Name of quantity	Chief symbol	Reserve symbol	Remarks	SI unit		Some other units or designations		Remarks
						Name	Symbol	Name	Symbol	
Space and time										
1	1-1	angle (plane angle)	$\alpha, \beta, \gamma, \vartheta, \varphi$		other suitable letters of the Greek alphabet can also be used as chief symbols When one wishes to identify an angle of rotation, the symbol ϑ is recommended	radian	rad	degree minute second	$\dots^\circ$ $\dots'$ $\dots''$	1)
2	1-2	solid angle	Ω	ω	ISO does not give ω	steradian	sr			1)
3	1-3.1	length	l, L			metre	m			2)
4	1-3.2	breadth	b			metre	m			
5	1-3.3	height, depth	h		ISO does not give "depth"	metre	m			
6	1-3.4	thickness	d, δ			metre	m			
7	1-3.5	radius, radial distance	r, R		ISO does not give "radial distance"	metre	m			
8	1-3.6	diameter	d, D			metre	m			
9	1-3.7	length of path, line segment	s		ISO does not give "line segment"	metre	m			
10 (11)	1-5	area, surface area	A	S	ISO does not give "surface area"	square metre	m ²			
11 (12)	1-6	volume	V	v		cubic metre	m ³			
12 (13)	1-7	time	t		ISO gives also "time interval" and "duration"	second	s	minute hour	min h	
13 (20)	1-8	angular velocity	ω	Ω	ISO does not give Ω 3)	radian per second	rad/s			3)
14 (21)	1-9	angular acceleration	α			radian per second squared	rad/s ²			

1) "rad" and "sr" can be replaced by "1".

2) For the units with the symbol m, in English, the spelling "meter" is also used. This alternative spelling is not used in this International Standard.

3) See item 19.

Quantities					Units				
Item number	Item number in ISO 31	Name of quantity	Chief symbol	Reserve symbol	Remarks	SI unit		Some other units or designations	
						Name	Symbol	Name	Symbol
15 (22)	1-10	speed (linear), velocity	v		ISO does not give "speed". ISO gives also c, u, w	metre per second	m/s		
16 (24)	1-11.1	(linear) acceleration	a		$a = dv/dt$	metre per second squared	m/s ²		
17 (25)	1-11.2	acceleration of free fall	g		ISO gives also "acceleration due to gravity"	metre per second squared	m/s ²		
Periodic and related phenomena									
18 (16)	2-3.1	frequency	f	ν		hertz	Hz		¹⁾
19 (17)	2-3.2	rotational frequency	n		²⁾	one per second	s ⁻¹	²⁾	^{1,4)}
20 (18)	–	slip	s	g		one	l	per cent	%
21 (19)	2-4	angular frequency	ω		$\omega = 2\pi f$ ISO gives also "pulsatance"	radian per second	rad/s		³⁾
22 (10)	2-5	wavelength	λ			metre	m		
23 (14)	2-1	period	T		ISO gives also "periodic time"	second	s		
24 (15)	2-2	time constant	τ	T		second	s		
25 (23)	2-8.1 5-32.1	velocity (speed) of propagation of electromagnetic waves	c		in vacuum c_0 , see table 2	metre per second	m/s		
26	2-11	damping coefficient	δ			one per second	s ⁻¹	neper per second	Np/s ⁴⁾
27	2-13.1	attenuation coefficient	α	a	ISO does not give a	one per metre	m ⁻¹	neper per metre	Np/m ⁵⁾
28	2-13.2	phase coefficient	β	b	ISO does not give b	radian per metre	rad/m		⁶⁾
29	2-13.3	propagation coefficient	γ	p	$\gamma = \alpha + j\beta$ ISO does not give p	one per metre	m ⁻¹		⁶⁾

¹⁾ ISO gives Hz and s⁻¹.
²⁾ Item 19 and Item 13 represent the same physical phenomenon, which is known also under other names such as "rotational speed", "number of revolutions per time", and "speed of rotation". This phenomenon is here expressed by two quantities, one of frequency character, n , Item 19, and the other of velocity character, ω , Item 13, with the relationship $\omega = n \cdot 2\pi \text{ rad}$.
On nameplates of rotating electrical machinery, r/min and r/s may be used as (international) symbols instead of language-dependent abbreviations such as the English rev/min and rpm (revolutions per minute), rev/s, and rps (revolutions per second), and the French tr/min (tours par minute), tr/s (tours par seconde).
³⁾ ISO gives also s⁻¹.
⁴⁾ "one per second" is the name of the unit in the form adopted by the 13th CGPM (1967). ISO uses "reciprocal second"; this was adopted by ISO before there was a CGPM decision.
⁵⁾ Same as Note 4, with "second" replaced by "metre".
⁶⁾ ISO gives "reciprocal metre".

		Quantities				Units				
Item number	Item number in ISO 31	Name of quantity	Chief symbol	Reserve symbol	Remarks	SI unit		Some other units or designations		Remarks
						Name	Symbol	Name	Symbol	
Mechanics										
30	3-1	mass	m			kilogram	kg			1)
31	3-2	density (mass density), volumic mass	ρ	ρ_m	mass divided by volume ISO does not give ρ_m	kilogram per cubic metre	kg/m ³			
32	3-8	momentum	p		product of mass and velocity	kilogram metre per second	kg·m/s			
33	3-7	moment of inertia	I, J			kilogram metre squared	kg·m ²			
34	3-9.1	force	F			newton	N	dyne	dyn	3)
35	3-9.2	weight	F_g	G, P, W	varies with acceleration of free fall	newton	N	kilogram-force kilopond	kgf kp	
36	–	weight density	γ		weight divided by volume	newton per cubic metre	N/m ³			
37	3-12.1	moment of force	M			newton metre	N·m			
38	3-12.3	torque	T		ISO gives also “mo- ment of a couple”	newton metre	N·m			
39	3-15.1	pressure	p			pascal	Pa	bar	bar	2)
40	3-22.6	work	W	A		joule	J			
41	3-26.1	energy	E	W	U is recommended in thermodynamics for internal energy and for black body radiation energy	joule	J	erg kilowatt hour electronvolt	erg kWh eV	4)
42	–	energy (volume) density	e	w		joule per cubic metre	J/m ³			
43	3-27	power	P		see items 99-100-101	watt	W			
44	3-28	efficiency	η			one	1	per cent	%	

1) For the unit with the symbol “kg”, in English the spelling “kilogramme” is also used. This alternative spelling is not used in this International Standard.

2) The bar is designated as a temporary unit in the BIPM brochure.

3) The dyne is the CGS unit.

4) The erg is the CGS unit.

		Quantities				Units				
Item number	Item number in ISO 31	Name of quantity	Chief symbol	Reserve symbol	Remarks	SI unit		Some other units or designations		Remarks
						Name	Symbol	Name	Symbol	
Heat										
45	4-1	thermodynamic temperature	T	Θ		kelvin	K			1)
46	4-2	Celsius temperature	t, ϑ			degree Celsius	°C			2)
47	4-6	heat, quantity of heat	Q			joule	J			
48	4-3.1 4-3.2 4-3.3	temperature coefficient	α		a temperature coefficient is not defined unless the quantity that changes is specified (e.g. resistance, length, pressure); the pressure (temperature) coefficient is designated by β , the cubic expansion (temperature) coefficient by α , α_p or γ	one per kelvin	K ⁻¹			3)
49	4-9	thermal conductivity	λ	κ		watt per metre kelvin	$\frac{W}{m \cdot K}$			1)
50	4-15	heat capacity	C			joule per kelvin	J/K			1)
51	4-16.7	specific heat capacity, massic heat capacity	c		heat capacity divided by mass; the term "specific heat" is deprecated	joule per kilogram kelvin	$\frac{J}{kg \cdot K}$			1)
1) Resolution 3 of the 13th Conférence Générale des Poids et Mesures adopted "kelvin", symbol K, for both thermodynamic temperature and temperature interval. 2) The degree Celsius is a temperature interval of one kelvin. 3) ISO uses "reciprocal ..." instead of "one per ..." See notes to Items 26, 27.										
Electricity and magnetism										
52	5-2	electric charge	Q		ISO gives also "quantity of electricity"	coulomb	C	ampere hour	A · h	
53	5-4	surface density of charge, areic charge	σ			coulomb per square metre	C/m ²			
54	5-3	volume density of charge, volumic charge	ϱ	η	ISO gives also "charge density"	coulomb per cubic metre	C/m ³			
55	5-5	electric field strength	E			volt per metre	V/m			
56	5-6.1	electric potential	V	φ		volt	V			