

Recognized as an
American National Standard (ANSI)

ANSI/IEEE
Std 260.1-1993
(Revision and redesignation of IEEE Std 260-1978)

American National Standard Letter Symbols for Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units)

Sponsor

**Standards Coordinating Committee 14 on
Quantities, Units, and Letter Symbols**

Approved June 17, 1993

IEEE Standards Board

Approved November 24, 1993

American National Standards Institute

Abstract: General principles of letter symbol standardization are discussed. Symbols are given for general use and for use with limited character sets. The symbols given are intended for all applications, including use in text and equations; in graphs and diagrams; and on panels, labels, and nameplates.

Keywords: abbreviations, letter symbols, measurement, SI, symbols, units

The Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street, New York, NY 10017-2394, USA

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ISBN 1-55937-336-9

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Introduction

[This introduction is not a part of ANSI/IEEE Std 260.1-1993, American National Standard Letter Symbols for Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units).]

Since the first edition of this standard appeared in 1965, there has been worldwide acceptance of the International System of Units (SI) and of the associated rules for unit symbols. The US Congress has declared, in the Omnibus Trade and Competitiveness Act of 1988, that it is “the Policy of the United States (1) to designate the metric system of measurement as the preferred system of weights and measurements for United States trade and commerce; (2) to require that each Federal Agency, by a date certain and to the extent economically feasible by the end of fiscal year 1992, use the metric system of measurements in its procurements, grants, and other business-related activities”

This standard covers the symbols for SI units and for certain other units of practical importance at present. As in previous editions, SI units are clearly identified, and the most recent (1991) actions of the International Committee for Weights and Measures have been incorporated.

This revision was prepared under the auspices of IEEE Standards Coordinating Committee 14 on Quantities, Units, and Letter Symbols (SCC14) by its Subcommittee on Letter Symbols for Units (SCC14.3). At the time of approval of this standard, the membership of Subcommittee 14.3 was as follows:

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American National Standard Letter Symbols for Units of Measurement (SI Units, Customary Inch-Pound Units, and Certain Other Units)

1. Scope

This standard covers letter symbols¹ for units of measurement. It does not include abbreviations for technical terms, nor does it cover symbols for physical quantities.²

The symbols given in this standard are intended for all applications, including use in text and equations; in graphs and diagrams; and on panels, labels, and nameplates.

2. References

ANSI/IEEE Std 268-1992, American National Standard for Metric Practice.³

3. Abbreviations

The following abbreviations are used in this standard:

ANSI	American National Standards Institute
CGPM	Conférence Générale des Poids et Mesures (General Conference on Weights and Measures)
CGS	centimeter-gram-second
CIPM	Comité International des Poids et Mesures (International Committee for Weights and Measures)

¹“Letter symbol” as a technical term does not have the same meaning as either “name” or “abbreviation.” An abbreviation is a letter or a combination of letters (plus sometimes an apostrophe or a full stop, i.e., a period) that by convention represents a *word* or a *name* in a particular language; hence, an abbreviation may be different in a different language. A symbol represents a *physical quantity* or a *unit* and is therefore independent of language. For example, the symbol for electromotive force is *E*, whereas the abbreviation is emf in English, fem in French, and EMK in German. The unit names “ampere” and “second” have sometimes been abbreviated amp and sec, respectively, but this usage is now deprecated. The standard unit symbols for ampere and second are A and s, respectively.

²As used in this standard, the term *physical quantity* means a measurable attribute of phenomena or matter. Examples are length, mass, and time.

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
SI	Système International d'Unités (International System of Units)

4. General principles of letter symbol standardization

4.1 Letter symbols

Letter symbols include symbols for physical quantities (quantity symbols) and symbols for the units in which these quantities are measured (unit symbols).

A quantity symbol is, in general,⁴ a single letter (for example, *I* for electric current) specified as to general form of type and modified when appropriate by one or more subscripts or superscripts. In a given work, the same letter symbol should appear throughout for the same physical quantity, regardless of the units employed or of special values assigned.

A unit symbol⁵ is a letter or group of letters (for example, mm for millimeter), or in a few cases a special sign, that may be used in place of the name of a unit.

4.2 Alphabets and typography

Letter symbols are mainly restricted to the English and Greek alphabets. Greek letters that are easily confused with English letters shall be avoided. The type families that are used for text in modern book and journal publishing all include italic (oblique) type faces and related roman (upright) faces. The former are used for quantity symbols; the latter, for unit symbols. The distinctions are discussed more fully in the following paragraphs. (In the context of this standard, the term *roman* is used simply to mean upright in contrast with oblique and carries no connotation regarding serifs, line widths, or the like.) In situations where roman and italic are not both available, care shall be taken to avoid confusion between quantities and units. For example, an underline is frequently used to indicate italic type, and where an underline can be provided, as in manual typewriting, this practice is often helpful.

Unconventional typefaces should generally not be used for letter symbols. Script and Old English faces, for example, are not appropriate for unit symbols. Such special faces have seen limited use for quantity symbols, but good modern practice avoids them.

Symbols for physical quantities, mathematical variables, indexes, and general functions⁶ are printed in italic type. For example:

<i>A</i>	area
<i>e</i>	elementary electric charge
<i>x, y, z</i>	Cartesian coordinates
<i>i, j, k, n</i>	indexes
<i>f(x)</i>	function of <i>x</i>

⁴Symbols comprised of two letters are sometimes used for numerical transport parameters, such as *Re* for Reynolds number.

⁵Unit symbols have sometimes been treated in the same manner as general abbreviations, but the recommendations of the International Committee for Weights and Measures (CIPM), and of many other international and national bodies concerned with standardization, emphasize the symbolic character of these designations and rigidly prescribe the manner in which they shall be treated. This concept of the unit symbol is therefore adopted in this standard.

⁶The term *general functions* is here used to contrast with *specific mathematical functions*, for which roman type is to be used.

Symbols for units of measurement, mathematical constants, specific mathematical functions, operators, and numerals used as indexes are printed in roman type. For example:

cm	centimeter
e	base of natural logarithms
$\sin x$	sine of x
$J_2(z)$, $J_n(z)$	Bessel functions
dx	differential of x

Subscripts and superscripts are governed by the above principles. Those that are letter symbols for quantities or for indexes are printed in italic type, while all others are printed in roman type. For example:

C_p	heat capacity at constant pressure p
a_{ij} , a_{45}	matrix elements
I_i , I_o	input current, output current
x_{av}	average value of x

For indicating the vector character of a quantity, boldface italic type is used. For example:

<i>F</i>	force
<i>H</i>	magnetic field strength

Ordinary italic type is used to represent the magnitude of a vector quantity. It is also commonly used for a vector quantity when there is no need to draw attention to the vector character of the quantity.

When tensor quantities of second or higher order are to be represented by a single letter, sans serif type should be used (for example, A , B).

4.3 Remarks concerning quantity symbols

Quantity symbols may be used in mathematical expressions in any way consistent with good mathematical usage. The product of two quantities, a and b , is indicated by writing ab . The quotient may be indicated by writing

$$\frac{a}{b}, a/b, \text{ or } ab^{-1}$$

If more than one slash (/) is used in any algebraic term, parentheses shall be inserted to remove any ambiguity. Thus, one may write $(a/b)/c$, or $a/(b/c)$, but not $a/b/c$.

Subscripts and superscripts are widely used with quantity symbols. Several subscripts or superscripts, sometimes separated by commas, may be attached to a single letter. But, so far as logical clarity permits, subscripts and superscripts should not be attached to other subscripts and superscripts. A symbol that has been modified by a superscript should be enclosed in parentheses before an exponent is attached.

Conflicts that occur because different quantities are assigned identical symbols in the same or different standard symbol lists should be resolved in one of the following ways:

- a) By use of a reserve symbol (alternative symbol) if one is listed

- b) By use of a subscript or superscript selected by the author for one or more of the conflicting requirements
- c) By use of uppercase letters as variants for lowercase letters and vice versa, but only if no ambiguity results

4.4 Remarks concerning unit symbols

A roman (upright) type font shall be used for unit symbols, even when the surrounding text is in an italic font. In general, unit symbols are lowercase letters, except for a very few that use special signs (such as ° for degree). If, however, the symbol is for a unit whose name is derived from a proper name, uppercase roman type is used for the first letter.⁷ As a further exception to the general rule, the symbol L is used for liter to avoid confusion between the lowercase letter l and the numeral 1. Some additional exceptions arise in the special cases where symbols are joined, as in eV, the symbol for electronvolt, and in mmHg, the symbol for conventional millimeter of mercury, a unit of pressure. The distinction between upper- and lowercase letters shall be followed, even if the symbol appears in applications where the other lettering is uppercased. The form of unit symbols is the same for both singular and plural, and they are not followed by a period except at the end of a sentence.

In the complete expression for a quantity, a space should be left between the numerical value and the unit symbol. For example, write 35 mm, not 35mm, and 2.371 m, not 2.371m. When the quantity is used in an adjectival sense, a hyphen is often used in lieu of a space between the number and the unit name or between the number and the symbol.

Examples:

A 3-meter pole The length is 3 meters.
A 35-mm film The width is 35 mm.

EXCEPTION: No space is left between the numerical value and the symbols for degree, minute, and second of plane angle.

When a compound unit is formed by multiplication of two or more other units, its symbol consists of the symbols for the separate units joined by a raised dot (preferred) or separated by a space (for example, N·m or N m for newton meter). The dot may be omitted in the case of familiar compounds such as watt-hour (symbol Wh) if confusion is unlikely. Hyphens should not be used in symbols for compound units. Positive and negative exponents may be used with the symbols for units.

When a compound unit is formed by division of one unit by another, its symbol is constructed in one of the following forms:

$$\text{m/s} \quad \text{or} \quad \text{m} \cdot \text{s}^{-1} \quad \text{or} \quad \frac{\text{m}}{\text{s}}$$

In simple cases use of the slash is preferred, but in no case should more than one slash, or a slash followed by a product, be used in the same expression unless parentheses are inserted to avoid ambiguity. For example, write:

$$\text{J}/(\text{mol} \cdot \text{K}) \quad \text{or} \quad \text{J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1} \quad \text{or} \quad (\text{J}/\text{mol})/\text{K}$$

but *not* J/mol/K or J/mol·K

⁷Prefixes are considered separately (see 4.5).