

American National Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics

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Abstract: Letter symbols for physical quantities used in the science and technology of acoustics are covered. Abbreviations for a number of acoustical levels and related measures that are in common use are also given. The symbols given in this standard are intended for all applications.

Keywords: abbreviations, acoustical levels, acoustics, infrasound, letter symbols, physical quantities, sound, sound levels, symbols, ultrasound, units, vibration

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Introduction

(This introduction is not a part of ANSI/IEEE Std 260.4-1996, American National Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics.)

This revision was prepared under the auspices of the IEEE Standards Coordinating Committee on Quantities, Units, and Letter Symbols (SCC14) by its Subcommittee on Acoustics (SCC14.5). At the time of approval of this standard, the membership of Subcommittee 14.5 was as follows:

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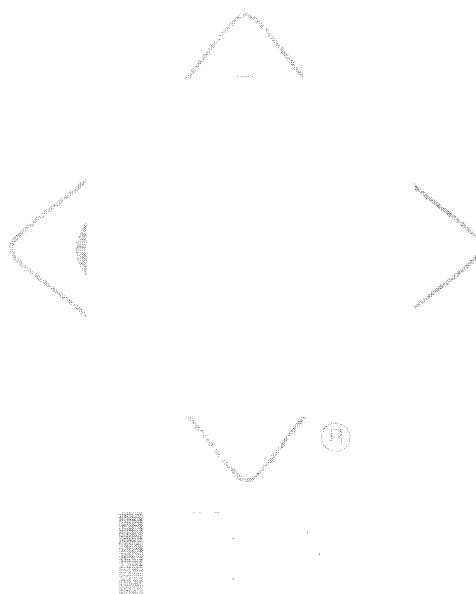
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American National Standard Letter Symbols and Abbreviations for Quantities Used in Acoustics

1. Overview

This standard covers letter symbols¹ for physical quantities² used in the science and technology of acoustics; it also covers abbreviations for a number of acoustical levels and related measures that are in common use.

The science and technology of acoustics include sound, ultrasound, and infra-sound in all media: gases, especially air; liquids, especially water; and solids are examples of media with which acoustics is concerned. There are many specialties in acoustics, a few of which are speech, hearing, music, noise control, vibration, shock, and sonar.

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.

“General principles of letter symbol standardization” common to SCC14 standards are given before the more specialized “principles applicable to letter symbols and abbreviations for quantities used in acoustics.” These are followed by the “introduction to the tables” and a “bibliography.”

2. References

This standard shall be used in conjunction with the following publication. When the following standard is superseded by an approved revision, the revision shall apply.

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

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. Example: For electromotive force, the symbol 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.

3. General principles of letter symbol standardization

3.1 Letter symbols

Letter symbols include symbols for physical quantities (quantity symbols) and symbols for 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 style of type font (e.g., bold, italic) 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.

3.2 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, and 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 fonts 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 type faces 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>

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

⁴Symbols composed 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.

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 preceding 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***).

3.3 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 , 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 and 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:

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

3.4 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 uppercase 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 watthour (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:

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

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:

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

but *not* J/mol/K or J/mol·K

In complicated cases, negative powers should be used.⁸

⁷Many units are derived from proper names. Examples include the ampere, for which the letter symbol is A, and the kelvin, for which the letter symbol is K. Prefixes are considered separately (see 3.5).

⁸The notation for products and quotients of unit symbols is intentionally made more explicit than that given in 3.3 for quantity symbols because some unit symbols are composed of more than one letter.

Letter symbols and mathematical notation should not be mixed with unit names in the same expression. For example, write joules per kilogram or J/kg. Do not write joules/kilogram or joules/kg or J/kilogram.

3.5 The International System of Units (SI)

In this standard, some units are identified as SI units. These units belong to the International System of Units (Système International d'Unités), which is the name given in 1960 by the General Conference on Weights and Measures (Conférence Générale des Poids et Mesures) to the coherent system of units built upon the base units in table A.

Table A—SI base units

Unit	Physical quantity
meter	length
kilogram	mass
second	time
ampere	electric current
kelvin	thermodynamic temperature
mole	amount of substance
candela	luminous intensity

This standard uses the spellings *meter*, *liter*, and *deka* in accordance with common US usage. The alternative spellings *metre*, *litre*, and *deca* may also be used.⁹

The prefixes in table B are used to indicate decimal multiples or submultiples of SI units.

Compound prefixes, formed by the juxtaposition of two or more SI prefixes, are not to be used. For example, use

nm, *not* mμm
pF, *not* μμF

For historical reasons, although the SI unit of mass is the kilogram (kg), the SI prefixes are attached to the gram (g). Thus, milligram (mg), *not* microkilogram (μkg).

If values are required outside the range covered by the prefixes, they should be expressed using powers of ten applied to the unit in question. Thus, 10^{-34} J.

An exponent attached to a symbol containing a prefix indicates that the multiple or submultiple of the unit (the unit with its prefix) is raised to the power expressed by the exponent. For example:

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

⁹The spelling of some unit names varies from language to language. One of the principal advantages of unit symbols is that they are language invariant.

Table B—SI prefixes

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

$$\begin{array}{lcl} \text{ns}^{-1} & \triangleq (10^{-9} \text{ s})^{-1} & = 10^9 \text{ s}^{-1} \\ \text{mm}^2/\text{s} & \triangleq (10^{-3} \text{ m})^2/\text{s} & = 10^{-6} \text{ m}^2/\text{s} \end{array}$$

where $\triangleq$ indicates equality by definition.

For further information concerning metric practice and the SI, refer to ANSI/IEEE Std 268-1992.¹⁰

3.6 Usage

The use of unit symbols in place of full names of the units is frequently desirable where space is restricted. Their use presupposes that the reader will find them intelligible. When an unfamiliar unit symbol is first used in text, it should be followed by its name in parentheses or the name should be given with the symbol in parentheses; the symbol may be used alone thereafter. Explanatory notes or keys should be included where appropriate on drawings and in tabular matter.

¹⁰Information about references can be found in clause 2.

Attachment of letters to a unit symbol as a means of giving information about the quantity under consideration is incorrect. Thus MWe for “megawatts electrical (power),” Vac for “volts ac,” and kJt for “kilojoules thermal (energy)” are not acceptable. For this reason, no attempt should be made to construct SI equivalents of the abbreviations “psia” and “psig,” so often used to distinguish between absolute and gage pressure. If the context leaves any doubt as to which is meant, the word pressure has to be qualified appropriately. For example:

“...at a gage pressure of 13 kPa” or
“...at an absolute pressure of 13 kPa”

When space limitations make it necessary to juxtapose information about the quantity being measured with the unit name or unit symbol, such information shall be separated from the unit symbol by a space, by a comma followed with a space, or the equivalent. Thus, the following examples are appropriate for use on nameplates, gage scale plates, table headings, graph labels, etc.:

rating—115 V ac
kPa, gage
kPa (abs)

On the other hand, letters may be attached to a unit symbol where needed to identify properly the unit involved. In such symbols as inHg, mmHg, and ftH₂O, the suffixes are needed to identify the units, which are units of pressure, not of length. Similarly, it is proper to write Btu_{IT}, cal_{th}, gal_{US}, etc., to distinguish from the related but different units Btu₆₀, cal₁₅, gal_{UK}, etc.

3.7 Unit symbols to be used with limited character sets

Refer to clauses 6.1 through 6.6 of ANSI/IEEE Std 260.1-1993 for a detailed discussion. Topic headings include: Character Set Lacks Greek Letters (6.1); Character Set Lacks Superscript Symbols (6.2); Character Set Lacks Superscript Numerals (6.3); Character Set Lacks Raised Dot (6.4); Character Set Limited to a Single Case (6.5); Examples of Symbols for Limited Character Sets (6.6).

4. Principles applicable to letter symbols and abbreviations for quantities used in acoustics

4.1 Time-varying quantities

When subscripts are used to denote various values associated with a time-varying quantity, the subscripts (for the values indicated) shall conform with the following list:

	<u>Preferred</u>	<u>Reserve</u>
instantaneous value	i	I
peak value	pk, k	PK
average value	av	AV
root-mean-square value	rms	RMS
maximum value	max, m	MAX, M
minimum (valley, nadir) value	min, n	MIN, N

When no subscript appears, the symbol is understood to represent the root-mean-square value. The subscript “eff” has been adopted for root-mean-square (rms) value by the IEC, but it is not recommended in this standard.

4.2 Average values

The average value of a quantity with respect to time may be indicated by a superscript bar, e.g., $\bar{p}$. Likewise, the spatial average may be indicated by enclosing the symbol in elbow brackets, e.g., $\langle w \rangle$.

4.3 Quantities per unit volume, area, or length

It is recommended that quantities per unit volume, area, or length be represented, where practical, by lowercase letters corresponding to the uppercase letters that represent the total quantities, or by the uppercase letter with the subscript v, a, or l, except for those quantities for which this standard gives a specific symbol for the quantity per unit volume, area, or length.

4.4 Sequence for double subscripts to multiplying operators

The sequence of double subscripts to the multiplying coefficients (mutual impedances, resistances, transconductances, etc.) that occur in systems of equations is to be determined as follows. The first subscript in the symbol shall agree with the subscript of the quantity resulting from the multiplication, and the second subscript shall agree with that of the multiplicand.

Example:

$$V_1 = Z_{11}I_1 + Z_{12}I_2 + Z_{13}I_3$$

4.5 Remarks concerning levels

A level is treated like any other quantity and may be represented by a quantity symbol with a subscript, as listed in tables 8, 9, and 10. The name “level,” by itself, is incomplete because there are many different kinds of levels, e.g., voltage level, power level, and A-weighted sound level. Moreover, the statement of the value of a level is incomplete unless the reference quantity is known to the reader. Levels in decibels are generally expressed as ten times the logarithm of a power or an energy ratio. For field quantities (such as voltage or force, for which the square is proportional to power or energy), levels in decibels are commonly expressed as twenty times the logarithm of a field quantity ratio. For quantities (such as impedance or admittance, which sometimes are proportional to an energy and other times to a field quantity), the use of “level” is deprecated.

4.5.1 Notation for expressing the reference of a level

A level representing a quantity x with a reference quantity x_{ref} may be indicated by:

$$L_x (\text{re } x_{\text{ref}}) \text{ or } L_{x/x_{\text{ref}}}$$

Examples:

The statement that a certain sound pressure level in air is 15 dB above the level corresponding to a reference pressure of 20 μPa can be written as

$$L_p (\text{re } 20 \mu\text{Pa}) = 15 \text{ dB} \quad \text{or} \quad L_{p/20 \mu\text{Pa}} = 15 \text{ dB}$$

The statement that the level of a current is 10 Np below 1 A can be written as

$$L_I (\text{re } 1 \text{ A}) = -10 \text{ Np}$$

The statement that a certain power level is 72 dB above 1 pW can be written as

$$L_W (\text{re } 1 \text{ pW}) = 72 \text{ dB}$$

in a situation where the reserve symbol L_W is needed to avoid confusion.

The statement that a certain electric field strength level is 50 dB above 1 $\mu\text{V/m}$ can be written as

$$L_E (\text{re } 1 \mu\text{V/m}) = 50 \text{ dB}$$

In presenting data, particularly in tabular form or in graphical symbols, a condensed notation is often needed for identifying the reference value. Then the following condensed form, illustrated by application to the above examples, may be used:

15 dB (20 μPa)
 -10 Np (1 A)
 72 dB (1 pW)
 50 dB (1 $\mu\text{V/m}$)

Note that there is a space before the parentheses.

In the expression of a reference quantity, the “1” is sometimes omitted. This is not recommended because confusion may occur.

When a constant reference quantity is explained in the text and used repeatedly in a given context, the reference quantity need not be restated at each subsequent use.

4.5.2 Indication of the weighting of a level

Frequently in acoustics, a sound pressure level or a sound power level is said to be weighted according to the A, B, C, D, or other frequency weighting curve. These are commonly called weighted levels, but they properly should be called levels of weighted pressure or power. With any weighted level, the unit of measurement is unchanged. It is still the decibel, or bel, or neper. The practice of indicating weighting by attaching letters to dB, as in dBA or PNdB, has led to the incorrect belief that weighted levels are measured on a different scale, or by a frequency weighted decibel. *Such attachments are incorrect, and are strongly deprecated.*

The designation PNdB is deprecated for any use, whether to mean perceived noise level or a nonexistent perceived noise decibel.

The decibel itself is never weighted. The symbol dB is a unit symbol, and it is neither a quantity symbol nor an abbreviation for level.

Any qualification of a level should be indicated, not by attaching letters to the unit symbol dB or B or Np, but by attaching appropriate subscripts to the quantity symbol L , or by an appropriate abbreviation, as shown in tables 8, 9, and 10. An example is L_{AF} for fast, A-weighted sound level. In a limited context, where it has been made clear what kind of weighting is concerned, the symbol L may be used without a subscript.

4.5.3 Sequence of subscripts for a level

A succession of subscripts on L , the quantity symbol for a level, identifies the kind of level and the frequencywise and timewise modifications of it. For example, L_{PA} first of all represents the level of a power, for which the symbol is P ; secondly, the A signifies that A-frequency weighting was applied.

In acoustics, the absence of a first subscript for the kind of level is an indication that the symbol L stands for a sound pressure level. The subscripts signify modifications of sound pressure level. For example, L_{AS} represents the level of A-frequency weighted, squared sound pressure followed by slow exponential time averaging.

As another example, L_{C8h} represents an 8-h average, C-weighted sound level; the C-frequency weighting was applied to the sound pressure signal; next, the sound pressure was squared; then the arithmetic mean of the squared sound pressures was taken during 8 h; finally, the level was obtained.

Sound level is understood to mean A-weighted sound pressure level if no frequency weighting is specified. Hence, in a context in which only sound level is involved, L represents (A-weighted) sound level, and L_{av8h} or simply L_{8h} represents an 8-h average sound level. The usual unit of all these levels is the decibel.

Maximum tone-corrected perceived noise level is a special frequency-weighted sound pressure level with nominally "slow" time averaging. The quantity symbol is L_{PNTmax} . The first two subscript letters PN signify the somewhat involved "perceived noise" frequency weighting; the subscript T signifies a further frequency weighting for prominent tonal components; after the slow exponential time average, another time weighting identified by max is applied by selection of the greatest tone-corrected perceived noise level that occurs during (for example) the flyover of an aircraft.

4.6 Remarks concerning abbreviations

An abbreviation is a shortened form of a word or phrase, used to represent the complete form. The shortened form is obtained by omission of some letters, even all of the letters of some words. The abbreviations recommended in this standard use capital letters.

4.6.1 Use of abbreviations

Abbreviations are to be used only where necessary to save space and time. The time saved by a writer who uses an abbreviation is often less than the time lost by each reader who has to find its meaning. An abbreviated term should be spelled out in full at its first appearance in text, followed by the abbreviation in parentheses. In addition, a glossary may be provided for the convenience of the reader.

Abbreviations for the names of quantities are used as nouns because the names they stand for are nouns or noun phrases. They may also be used as adjectives, as for example: "the day-night average sound level limit" may be abbreviated to "the DNL limit." As a further example, the statement, "The limit is 92 decibels, fast, A-weighted sound level at 15 meters" can be shortened to "The FA limit at 15 m is 92 dB."

Abbreviations should not immediately follow a unit symbol. For example, instead of "92 dB FA," use "FA: 92 dB."

4.6.2 International use

Abbreviations should be carefully considered, and perhaps especially avoided, in publications and drawings that are intended for circulation internationally because they are formed from words that often differ from one language to another. In this respect, abbreviations stand in contrast to letter symbols for quantities and units that are standardized internationally.

4.6.3 Mathematics

Abbreviations should not be used in mathematical formulations. Letter symbols should be used instead.

4.6.4 Sequence of letters in an abbreviation

The original sequence of letters in the words and of words in any phrase is to be maintained in an abbreviation. As an example, day-night average sound level is abbreviated to DNL; the single letter L in this context serves as the abbreviation for average sound level. LDN or Ldn is not a correct abbreviation for day-night average sound level because LDN or Ldn is not a shortened form of the full phrase.

In phrases and abbreviations in this standard for oscillating quantities, the averaging time is stated first, the limiting frequency band second, the kind of variable next, and, finally, the level. For example, 8HL is the abbreviation for 8-h average sound level; much of the abbreviation is feasible because sound level unmodified has the connotation of sound pressure level within the frequency band delimited by the A-frequency weighting. As a longer example of the sequence, slow octave-band sound pressure level centered on 125 Hz may be abbreviated to SOBSPL at 125 Hz.

4.6.5 Invariance of form

The form of an abbreviation shall be invariant. Syntactical endings shall not be used. For example, an “s” shall not be added to indicate plural.

4.6.6 Subscripts

Subscripts shall not be used in or with abbreviations.

4.6.7 Punctuation

Except as shown in abbreviations in this standard, punctuation marks shall not be used as part of an abbreviation. However, a period may be placed at the end of any abbreviation that spells an English word if the omission of such a period could result in confusion.

4.6.8 Additional abbreviations

For abbreviations of terms other than those in this standard, refer to ANSI Y10.1-1972 [B3].¹¹

5. Introduction to the tables

Tables 1 through 10 list quantities, grouped in several categories, and give quantity symbols for each. In addition, tables 8 through 10 give standard abbreviations for the quantities listed. (Abbreviations are usually not appropriate for the quantities listed in tables 1 through 7.) Only abbreviations are given for some quantities that are not operated on mathematically and that therefore do not require letter symbols. To aid in identifying the quantities, their units based on the International System of Units (SI) and their standard unit symbols are included.

A quantity shall be represented by the standard symbol appearing in the tables, regardless of the units in which it is expressed. Those quantity symbols that are separated by a comma are alternatives on equal standing. A symbol enclosed in parentheses is a reserve symbol to be used only when there is a specific need to avoid a conflict.

Tables 1, 2, 3, and 5 contain quantities of interest in acoustics, many of whose symbols have already been standardized for broad fields of application. These have been copied from ANSI Y10.5-1968 [B4] and the same item numbers retained with conversion to all-numeric designation. For example, items 3.14.1, 3.14.2,

¹¹The numbers in brackets preceded by the letter B correspond to those of the bibliography in clause 6.

3.14.3, and 3.14.4 were formerly 3.14a, 3.14b, 3.14c, and 3.14d. Those items of more recent interest in acoustics, including most of table 4, have been copied in part from the corresponding section of ISO 31: 1992 [B14]. Consequently, there are intentional gaps in the item numbers to make it easier to compare ANSI Y10.5-1968 [B4], ANSI Y10.11-1984, and ISO 31: 1992 [B14] with the present standard. A few items not in ANSI Y10.5-1968 [B4] have been added and given numbers.

Tables 6 through 10 contain quantities of interest primarily in acoustics and bear no particular relation to ANSI Y10.5-1968 [B4]. Table 6 has been compared to the section on acoustics of ISO 31: 1992 [B14] to reduce differences between them, but it does not necessarily eliminate these differences completely. The coverage in table 6 is the more extensive.

Quantity symbols and abbreviations are listed alphabetically in tables 11 and 12 for ready reference. Finally, all quantities, together with variants of their names, are listed in table 13.

6. Bibliography

- [B1] ANSI S1.1-1994, American National Standard for Acoustical Terminology.
- [B2] ANSI S3.14-1977 (Reaff 1986), American National Standard Rating Noise with Respect to Speech Interference.
- [B3] ANSI Y10.1-1972 (Reaff 1988), American National Standard Glossary of Terms Concerning Letter Symbols.
- [B4] ANSI Y10.5-1968, American National Standard Letter Symbols for Quantities Used in Electrical Science and Electrical Engineering.
- [B5] ARI 275-1984, Application of Sound Rated Outdoor Unitary Equipment.
- [B6] *ASHRAE Handbook: Fundamentals, SI Edition*, 1993.
- [B7] IEC 27-3 (1989), Letter symbols to be used in electrical technology—Part 3: Logarithmic quantities and units.
- [B8] IEC 50-801: 1994, International Electrotechnical Vocabulary—Chapter 801: Acoustics and electroacoustics.
- [B9] IEEE Std 100-1992, The New IEEE Standard Dictionary of Electrical and Electronics Terms (ANSI).
- [B10] IEEE Std 152-1991, IEEE Standard for Audio Program Level Measurement (ANSI).
- [B11] IEEE Std 176-1987, IEEE Standard on Piezoelectricity.
- [B12] 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).
- [B13] IEEE Std 319-1990, IEEE Standard on Magnetostrictive Materials: Piezomagnetic Nomenclature (ANSI).
- [B14] ISO 31: 1992, Quantities and units.

NOTE—May also be listed by its separate parts, e.g., Part 7: Acoustics.

- [B15] ISO 532: 1975, Acoustics—Method for calculating loudness level.
- [B16] ISO 717: 1982, Acoustics—Rating of sound insulation in buildings and of building elements.
- [B17] Beranek, Blazier, and Figwer, *Journal of the Acoustical Society of America*, vol. 50, no. 1223, 1971.
- [B18] Peterson, *Handbook of Noise Measurement*, 9th ed. GenRad, Inc., 1980.



Table 1—Space and time: symbols for quantities

Item	Quantity	Quantity symbol	Unit based on international system	Unit symbol	Remarks
1.1	angle, plane	$\alpha, \beta, \gamma, \theta, \phi, \psi$	radian, (numeric)	rad	Other Greek letters are permitted where no conflict results.
1.2	angle, solid	$\Omega, (\omega)$	steradian, (numeric)	sr	
1.3	length	l, L	meter	m	
1.4	breadth, width	b	meter	m	
1.5	height	h	meter	m	
1.6	thickness	d, δ	meter	m	
1.7	radius, distance from source	r, R	meter	m	
1.8	diameter	d, D	meter	m	
1.9	length of path, line segment, distance	s	meter	m	
1.10	wavelength	λ	meter	m	
1.12	circular wave number, angular wave number	k	radian per meter	rad/m	$k = 2\pi/\lambda$
1.13	area	$A, (S)$	square meter	m ²	
1.14	volume	V, v	cubic meter	m ³	
1.15	time	t	second	s	
1.16	period, time of one cycle	T	second	s	
1.17	time constant	$\tau, (T)$	second	s	
1.18	frequency	$f, (\nu)$	hertz	Hz	1 Hz is the frequency of a periodic phenomenon of which the period is 1 s.
1.18.1	bandwidth	B	hertz	Hz	
1.19	speed of rotation, rotational frequency	n	revolution per second	r/s	
1.20	angular frequency	ω	radian per second	rad/s	$\omega = 2\pi f$
1.21	angular velocity	ω	radian per second	rad/s	

Table 1—Space and time: symbols for quantities (continued)

Item	Quantity	Quantity symbol	Unit based on international system	Unit symbol	Remarks
1.23	angular acceleration	α	radian per second squared	rad/s^2	
1.24	velocity	v	meter per second	m/s	
1.25	speed of sound	$c, (c_a)$	meter per second	m/s	Not always equal to the phase velocity.
1.25.1	phase velocity	c_ϕ	meter per second	m/s	
1.25.2	group velocity	c_g	meter per second	m/s	
1.26	acceleration (linear)	a	meter per second squared	m/s^2	
1.27	acceleration of free fall, gravitational acceleration	g	meter per second squared	m/s^2	Standard value, $g_n = 9.80665 \text{ m/s}^2$ (exact; see ISO 31-1: 1992 [B14]).
1.28	damping coefficient	δ	neper per second	Np/s	1 Np = 8.686 dB. If $f(t) = A e^{-\delta t} \sin(2\pi f t)$, then δ is the damping coefficient.
1.29	logarithmic decrement	Λ	neper, (numeric)	Np	$\Lambda = T\delta$, where T and δ are as given in the equation for Item 1.28.
1.30	attenuation coefficient	α	neper per meter	Np/m	See Item 6.70.
1.31	phase coefficient	β	radian per meter	rad/m	Same as Item 6.71.
1.32	propagation coefficient	γ	reciprocal meter	m^{-1}	$\gamma = \alpha + j\beta$. See Item 6.72.

Table 2—Mechanics: symbols for quantities

Item	Quantity	Quantity symbol	Unit based on international system	Unit symbol	Remarks
2.1	mass	m	kilogram	kg	
2.2	(mass) density	ρ	kilogram per cubic meter	kg/m ³	Mass divided by volume.
2.3	momentum	p	kilogram meter per second	kg·m/s	1 kg·m/s = 1 N·s
2.4	moment of inertia	I, J	kilogram meter squared	kg·m ²	
2.5	second (axial) moment of area	I, I_a	meter to the fourth power	m ⁴	Items 2.5 and 2.6 should be distinguished from Item 2.4. They have often been given the name "moment of inertia."
2.6	second (polar) moment of area	J, I_p	meter to the fourth power	m ⁴	
2.7	force	F	newton	N	
2.8	moment of force	M	newton meter	N·m	
2.9	torque	$T, (M)$	newton meter	N·m	
2.10	pressure	p	pascal	Pa	1 Pa = 1 N/m ²
2.11	normal stress	$\sigma, \sigma_{ij}, (T_{ij})$	pascal	Pa	The reserve symbols in Items 2.11 to 2.16 are recommended for use in the context of piezoelectricity and piezomagnetism (magnetostriction).
2.12	shear stress	$\tau, \sigma_{ij}, (T_{ij}),$ where $i \neq j$	pascal	Pa	
2.13	stress tensor	$\sigma, (T)$	pascal	Pa	
2.14	linear strain	$\epsilon, \epsilon_{ij}, (S_{ij})$	(numeric)		
2.15	shear strain	$\gamma, \epsilon_{ij}, (S_{ij}),$ where $i \neq j$	(numeric)		
2.16	strain tensor	$\epsilon, (S)$	(numeric)		
2.17	volume strain	θ	(numeric)		See Item 6.67.
2.18	Poisson's ratio	μ, ν	(numeric)		Lateral contraction divided by elongation.