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Quantities and units —

Part 8: **Acoustics**

Grandeurs et unités —

Partie 8: Acoustique

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 12, *Quantities and units*, in collaboration with IEC/TC 25, *Quantities and units*.

This second edition cancels and replaces the first edition (ISO 80000-8:2007), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the table giving the quantities and units has been simplified;

— some definitions and the remarks have been stated physically more precisely.

A list of all parts in the ISO 80000 and IEC 80000 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Quantities and units —

Part 8:
Acoustics

1 Scope

This document gives names, symbols, definitions and units for quantities of acoustics. Where appropriate, conversion factors are also given.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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

Names, symbols, definitions and units for quantities used in acoustics are given in Table 1.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
sound particle
material element
smallest element of the medium that represents the medium's mean density

[SOURCE: ISO 18405:2017, 3.1.1.5, modified - Note 1 to entry deleted.]

4 Remark on the use of the symbols lb and lg

In accordance with ISO 80000-2, the abbreviations lb and lg are used to indicate logarithms to the base 2 ($\log_2$) and base 10 ($\log_{10}$), respectively.

Table 1 — Quantities and units used in acoustics

Item No.	Quantity			Unit	Remarks
	Name	Symbol	Definition		
8-1	logarithmic frequency range	G	quantity given by: $G = \mathrm{lb}\left(\frac{f_2}{f_1}\right)\mathrm{oct} = \mathrm{lg}\left(\frac{f_2}{f_1}\right)\mathrm{dec}$ where f_1 and f_2 are two frequencies (ISO 80000-3)	oct dec	One octave (oct) is the logarithmic frequency range between f_1 and f_2 when $\frac{f_2}{f_1}=2$. Similarly, one decade (dec) is the logarithmic frequency range between f_1 and f_2 when $\frac{f_2}{f_1}=10$; thus 1 dec = (lb 10) oct ≈ 3,322 oct. ISO 266 specifies preferred frequencies for acoustics separated by logarithmic frequency ranges equal to one tenth of a decade (0,1 dec). Each 0,1 dec logarithmic frequency range is referred to in ISO 266 as a "one-third-octave interval" because 0,1 dec is approximately equal to 1/3 oct. Similarly, a logarithmic frequency range of 0,3 dec is referred to as a "one-octave interval" because 0,3 dec is approximately equal to 1 oct. A logarithmic frequency range equal to one tenth of a decade can be referred to as a decidecade.
8-2.1	static pressure	p_s	pressure (ISO 80000-4) in a medium when no sound wave is present	Pa kg m^{-1} s^{-2}	This definition applies to a medium with zero flow.
8-2.2	sound pressure	p	difference between instantaneous total pressure and static pressure (item 8-2.1)	Pa kg m^{-1} s^{-2}	
8-3	sound particle displacement	$\boldsymbol{\delta}$	vector (ISO 80000-2) quantity giving the instantaneous displacement (ISO 80000-3) of a particle in a medium from what would be its position in the absence of sound waves	m	
8-4	sound particle velocity	$\boldsymbol{u}$, ($\boldsymbol{v}$)	vector (ISO 80000-2) quantity given by: $\boldsymbol{u}=\frac{\partial \boldsymbol{\delta}}{\partial t}$ where $\boldsymbol{\delta}$ is sound particle displacement (item 8-3) and t is time (ISO 80000-3)	m s^{-1}	The definition is limited to small-amplitude acoustic disturbances such that the magnitude of $\boldsymbol{u}$ is small relative to the phase speed (ISO 80000-3) of sound.

Table 1 *(continued)*

Item No.	Quantity			Unit	Remarks
	Name	Symbol	Definition		
8-5	sound particle acceleration	$\boldsymbol{a}$	vector (ISO 80000-2) quantity given by: $\boldsymbol{a}=\frac{\partial \boldsymbol{u}}{\partial t}$ where $\boldsymbol{u}$ is sound particle velocity (item 8-4) and t is time	$\mathrm{m\ s^{-2}}$	The definition is limited to small-amplitude acoustic disturbances such that the magnitude of the sound particle velocity is small relative to the phase speed (ISO 80000-3) of sound.
8-6	volume velocity volume flow rate	q, q_V	surface integral of the normal component of the sound particle velocity (item 8-4) over a defined surface	$\mathrm{m^3\ s^{-1}}$	
8-7	sound energy density	w	quantity given by: $w=\frac{1}{2}\rho_\mathrm{m}u^2+\frac{1}{2}\frac{p^2}{\rho_\mathrm{m}c^2}$ where ρ_m is mean density (ISO 80000-4), u is the magnitude of the sound particle velocity (item 8-4), p is sound pressure (item 8-2.2), and c is the phase speed (ISO 80000-3) of sound	$\mathrm{J/m^3}$ $\mathrm{kg\ m^{-1}\ s^{-2}}$	This definition can become inapplicable in situations with a high mean fluid flow.
8-8	sound energy	Q	integral of sound energy density (item 8-7) over a specified volume	J $\mathrm{kg\ m^2\ s^{-2}}$	The sound energy in region R can be expressed by: $Q=\oint_\mathrm{R} w(\boldsymbol{x})\mathrm{d}^3\boldsymbol{x}$ where $\mathrm{d}^3\boldsymbol{x}$ is an element of volume.
8-9	sound power	P, W	integral over a surface of the product of sound pressure, p (item 8-2.2), and the component u_n of the particle velocity (item 8-4) in the direction normal to the surface, at a point on the surface	W $\mathrm{kg\ m^2\ s^{-3}}$	This definition holds for waves in the volume of homogenous fluids or gases. This definition can become inapplicable in situations with a high mean fluid flow. Sound power is for example used to indicate the rate at which energy is radiated by a sound source. Sound power is an oscillatory quantity that can be positive or negative. A positive sound power indicates that the sound power is radiated out of the surface. A negative sound power indicates that the sound power is absorbed into the surface.

Table 1 *(continued)*

Item No.	Quantity			Unit	Remarks
	Name	Symbol	Definition		
8-10	sound intensity	$\boldsymbol{I}$	vector (ISO 80000-2) quantity given by: $\boldsymbol{I} = p\,\boldsymbol{u}$ where p is sound pressure (item 8-2.2) and $\boldsymbol{u}$ is sound particle velocity (item 8-4)	W/m^2 kg s^{-3}	This definition can become inapplicable in situations with a high mean fluid flow.
8-11	sound exposure	E	time-integrated squared sound pressure (item 8-2.2)	Pa^2 s kg^2 m^{-2} s^{-3}	In formula form: $E = \int_{t_1}^{t_2} p^2 \mathrm{d}t$ where t_1 and t_2 are the starting and ending times for the integral and p is sound pressure (item 8-2.2). In airborne acoustics, the sound pressure is frequency-weighted and frequency-band-limited. If frequency weightings as specified in IEC 61672-1 are applied, this should be indicated by appropriate subscripts to the symbol E. In underwater acoustics, the term "sound exposure" indicates an unweighted quantity unless indicated otherwise.
8-12	characteristic impedance of a medium for longitudinal waves	Z_c	quotient of sound pressure (item 8-2.2) and the component of the sound particle velocity (item 8-4) in the direction of the wave propagation	Pa s/m kg m^{-2} s^{-1}	The definition is limited to a progressive plane wave in a non-dissipative homogenous gas or fluid. Characteristic impedance is a property of the medium and is equal to ρc where ρ is the time-averaged density (ISO 80000-4) of the medium and c the phase speed of sound (ISO 80000-3). Longitudinal waves are waves in which the displacement of the medium is in the same direction as, or the opposite direction to, the direction of propagation of the wave.

Table 1 *(continued)*

Item No.	Quantity			Unit	Remarks
	Name	Symbol	Definition		
8-13	acoustic impedance	Z_a	at a surface, quotient of the average sound pressure (item 8-2.2) over that surface and the sound volume flow rate (item 8-6) through that surface	Pa s/m³ kg m⁻⁴ s⁻¹	This definition applies to a sound pressure that is in phase with the volume flow rate. In this situation, the acoustic impedance is real. Both the sound pressure, *p*, and sound volume flow rate, *q*, are real quantities that fluctuate with time. If the fluctuations are in phase (phase difference equal to zero), the quotient *p*/*q* is a constant. If they are out of phase (phase difference not equal to zero), they can be represented by complex quantities in the frequency domain, the quotient of which is also complex.
8-14	sound pressure level	L_p	quantity given by: $L_p = 10 \lg \frac{p_{RMS}^2}{p_0^2}$ dB where p_{RMS} is the root-mean-square sound pressure in the time domain and p_0 is the reference value of sound pressure	dB	For sound in air and other gases, the reference value of sound pressure is given by p_0 = 20 µPa. For sound in water and other liquids, the reference value of sound pressure is given by p_0 = 1 µPa. When stating a value of sound pressure level, the reference value shall be specified. The value of sound pressure level depends on the selected frequency range and time duration. When stating a value of sound pressure level, the frequency range and time duration shall be specified. In accordance with ISO 80000-1, any attachment to the unit symbol as a means of giving information about the special nature of the quantity or context of measurement under consideration is not permitted. If specific frequency and time weightings as specified in IEC 61672-1 or specific frequency bands or time duration are applied, this should be indicated by appropriate subscripts to the quantity symbol. In some applications the level of the peak sound pressure is required. This is obtained by replacing the root-mean-square sound pressure, with the instantaneous sound pressure having the greatest absolute value during a stated time interval, in the definition of sound pressure level.