International Standard 1683

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Acoustics — Preferred reference quantities for acoustic levels

Acoustique — Grandeurs normales de référence pour les niveaux acoustiques

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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 1683 was developed by Technical Committee ISO/TC 43, *Acoustics*, and was circulated to the member bodies in December 1976.

It has been approved by the member bodies of the following countries :

Australia	India	Romania
Austria	Ireland	South Africa, Rep. of
Belgium	Israel	Spain
Canada	Korea, Rep. of	Sweden
Czechoslovakia	Mexico	Switzerland
Denmark	Netherlands	United Kingdom
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France	Norway	
Germany, F. R.	Poland	

The member bodies of the following countries expressed disapproval of the document on technical grounds :

Japan
USA

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Acoustics — Preferred reference quantities for acoustic levels

0 Introduction

0.1 Various kinds of levels expressed in decibels have become common for acoustic measurements in gases, liquids and solid structures. A reference quantity, which is preferably independent of the medium, is needed for each kind of level.

For airborne sound, a special reference sound pressure is preferred according to widespread use and legal implication.

0.2 For several kinds of levels, different reference quantities have been used from time to time. Thus, for clarity, it is necessary to indicate which reference quantity is being employed.

0.3 The magnitude of a reference quantity determines whether the level for a particular variable quantity is positive or negative. For general measurements and many engineering specifications, it is desirable that levels of a given kind be consistently positive (or consistently negative) rather than both positive and negative.

0.4 In general, a reference quantity should have a magnitude of one and its unit should be a derived SI unit formed by the use of an SI prefix [for example micronewton (μN), nanometer per second (nm/s), picowatt (pW)]. See ISO 1000.

0.5 Only one reference quantity should apply for each given kind of level.

0.6 The purpose of this International Standard is the adoption of a preferred set of reference quantities of convenient magnitudes. This International Standard provides standard reference quantities for use when and if levels are employed. The use of levels is not made mandatory.

1 Scope and field of application

This International Standard specifies reference quantities and gives definitions of some levels for acoustics. It applies to oscillatory quantities.

2 References

ISO 31/2, *Quantities and units of periodic and related phenomena.*

ISO 31/7, *Quantities and units of acoustics.*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 2041, *Vibration and shock — Vocabulary.*

IEC Publication 27-3, *Letter symbols to be used in electrical technology — Part 3 : Logarithmic quantities and units.*

3 Definitions

3.1 acoustic levels : see table 1. Various acoustic levels expressed in decibels are listed in table 1. When the multiplying factor is twenty, the numerator of the ratio is understood to be a root-mean-square value of a field quantity, unless otherwise specified. When the multiplying factor is ten, the numerator of the ratio is understood to be a time average value of a power-like quantity unless otherwise specified. For definitions of levels, see ISO 31/2, ISO 31/7 and ISO 2041.

3.2 decibel : See ISO 31/2, ISO 31/7 and ISO 2041.

3.3 reference quantity : The denominator of the ratio whose logarithm is taken to form a level. See table 1.

Table 1 — Various acoustic levels expressed in decibels

Designation	Definition
Sound pressure level	$L_p = 20 \lg (p/p_0)$ dB
Vibratory velocity level	$L_v = 20 \lg (v/v_0)$ dB
Vibratory acceleration level	$L_a = 20 \lg (a/a_0)$ dB
Vibratory force level	$L_F = 20 \lg (F/F_0)$ dB
Power level	$L_W = 10 \lg (P/P_0)$ dB
Intensity level	$L_I = 10 \lg (I/I_0)$ dB
Energy density level	$L_w = 10 \lg (w/w_0)$ dB
Energy level	$L_E = 10 \lg (E/E_0)$ dB

NOTE — For power level, the symbol L_P may also be used.

4 Reference quantities

4.1 Preferred reference quantities

Preferred reference quantities expressed in SI units are listed in table 2.

4.2 Sound pressure reference quantity

Two reference quantities for sound pressure are listed in table 2. One is to be used exclusively for airborne sound, even though not in accordance with 0.4; it is preferred because of its widespread current use and its legal status in defining allowable sound pressure levels. The other is to be used for sound in all media other than air.

4.3 Vibratory velocity reference quantity

One reference vibratory velocity is listed in table 2. The value of 1 nm/s is based on the current estimate of minimum expected vibratory velocity that is in accordance with 0.3 and 0.4.

NOTE — For airborne and structure-borne sound, a reference velocity of higher value, 50 nm/s, is also in use. This has the property that the intensity level, the sound pressure level and the vibratory velocity level for a progressive plane wave in air are almost equal in magnitude. However, the requirements of 0.4 and 0.5 are not fulfilled.

4.4 Vibratory acceleration reference quantity

One reference vibratory acceleration is listed in table 2. The value of 1 µm/s² is based on the current estimate of minimum expected vibratory acceleration that is in accordance with 0.3 and 0.4.

NOTE — For structure-borne sound, a reference acceleration of higher value, 10 µm/s², is also in use. However, the requirements of 0.4 and 0.5 are not fulfilled.

4.5 Notation for expressing the reference of a level

A reference quantity may be introduced by **re**, which indicates that the level is "with reference to" and may be so read (see IEC Publication 27-3). For example, "the sound power level, **re** 1 pW, is equal to 135 dB".

Table 2 — Preferred reference quantities expressed in SI units

Medium	Reference quantity
Air	p_0 = 20 µPa = 2×10^{-5} Pa
Media other than air	p_0 = 1 µPa = 10^{-6} Pa
All media	a_0 = 1 µm/s² = 10^{-6} m/s²
	v_0 = 1 nm/s = 10^{-9} m/s
	F_0 = 1 µN = 10^{-6} N
	P_0 = 1 pW = 10^{-12} W
	I_0 = 1 pW/m² = 10^{-12} W/m²
	w_0 = 1 pJ/m³ = 10^{-12} J/m³
	E_0 = 1 pJ = 10^{-12} J