

Integrating-averaging sound level meters

The European Standard EN 60804:2000 has the status of a
British Standard

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee EPL/29, Electroacoustics, which has the responsibility to:

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(CEI 60804:2000)

Integrierende mittelwertbildende
Schallpegelmesser
(IEC 60804:2000)

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 29/459/FDIS, future edition 2 of IEC 60804, prepared by IEC TC 29, Electroacoustics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 60804 on 2000-11-01.

This European Standard supersedes EN 60804:1994 and its amendment A2:1994.

The following dates were fixed:

- latest date by which the EN has to be implemented
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- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2003-11-01

Annexes designated "normative" are part of the body of the standard.

Annexes designated "informative" are given for information only.

In this standard, annexes B and ZA are normative and annexes A, C and D are informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 60804:2000 was approved by CENELEC as a European Standard without any modification.

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INTEGRATING-AVERAGING SOUND LEVEL METERS

1 Scope

1.1 General

This standard describes instruments for the measurement of frequency-weighted and time-averaged sound pressure levels. Optionally, sound exposure levels may be measured. This standard is consistent with the relevant requirements of IEC 60651, but specifies additional characteristics which are necessary to measure the equivalent continuous sound pressure level, L_{eq} , of steady, intermittent, fluctuating and impulsive sounds.

NOTE Standardization of an instrument for the measurement of the equivalent continuous sound pressure level and optionally the sound exposure level does not imply that these quantities completely characterize the psychological and physiological effects of sound on man.

Though a complete integrating sound level meter is specified, the combination of a conventional sound level meter that satisfies IEC 60651 and an accessory or "plug-in" that provides the averaging capability is admissible if the complete system satisfies this standard.

The instrument is called "integrating-averaging sound level meter", but the short form "integrating sound level meter" or "averaging sound level meter" may also be used. In this standard, "integrating sound level meter" is used.

There are some important differences between the time-averaging characteristics of an integrating sound level meter and those of a conventional sound level meter. These differences are discussed in annex A.

1.2 Types

This standard specifies integrating sound level meters of four degrees of accuracy, designated Types 0, 1, 2 and 3.

For each type, the specification for directional characteristics and frequency weighting and amplifier characteristics are identical to those of IEC 60651. Averaging and indicator specifications differ from IEC 60651, and it should be noted that they are identical for Types 2 and 3 instruments.

The mark "R" on the instrument, if any, indicates that this instrument is calibrated for diffuse field (see 2.3.3 and 9.1).

1.3 Characteristics specified

1.3.1 This standard specifies the following characteristics and test methods for integrating sound level meters:

- a) integrating and averaging characteristics;
- b) indicator characteristics;
- c) overload sensing and indicating characteristics.

1.3.2 Integrating sound level meters shall also comply with the requirements in IEC 60651 as follows:

- a) directional characteristics (clause 5);
- b) frequency weighting characteristics (6.1 and 6.2);
- c) sensitivity to various environments (clause 8).

1.4 Tolerances

The specifications for Types 0, 1, 2 and 3 integrating sound level meters have the same centre values and differ only in the tolerances allowed. Tolerances broaden as the type number increases.

1.5 Test specified

This standard specifies electrical and acoustical tests to verify compliance with the characteristics specified (see 1.3).

1.6 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(801):1994, *International Electrotechnical Vocabulary (IEV) – Chapter 801: Acoustics and electroacoustics*

IEC 60651:1979, *Sound level meters*

IEC 60942:1997, *Electroacoustics – Sound calibrators*

IEC 61000-4-2:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 2: Electrostatic discharge immunity test. Basic EMC publication*

IEC 61000-4-3:1995, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 3: Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-6-1:1997, *Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 1: Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2:1999, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity for industrial environments*

CISPR 22:1997, *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

CISPR 61000-6-3:1996, *Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 3: Emission standard for residential, commercial and light-industrial environments*

2 Object and general requirements

2.1 Object

The object of this standard is to ensure specified accuracy and stability of an integrating sound level meter and to reduce to the practical minimum any differences in equivalent measurements taken with instruments of various makes and models which satisfy the requirements of this standard.

2.2 Applications

The Type 0 integrating sound level meter is intended as a laboratory reference standard. Type 1 is intended for laboratory use and for field use where the acoustical environment can be closely specified and/or controlled. The Type 2 integrating sound level meter is suitable for general field applications. Type 3 is intended primarily for field noise survey applications.

Typical applications for the integrating sound level meter are

- a) measurement of industrial noise that could produce hearing damage or be annoying;
- b) measurement of community noise (traffic, residential, industrial sites, airports) that may be annoying or violate regulations;
- c) measuring the average sound pressure level around a noisy product or other sound source, in which case the integrating capability may be used to determine an average in space as well as time.

The integrating sound level meter is well-suited for measurement of the equivalent continuous sound pressure level of impulsive sounds. Such impulsive sounds have high peak amplitude and duration as short as 1 ms.

NOTE The measurement of impulses with durations below 1 ms should be regarded as an extrapolation because testing is not required below 1 ms.

Integrating sound level meters intended for field use shall meet rigorous environmental specifications.

Integrating sound level meters are usually designed to be hand-held or bench-mounted. It is anticipated, however, that units to be worn on a person may also become available.

2.3 General requirements

2.3.1 Frequency weighting

An integrating sound level meter shall have the frequency weighting characteristic designated A as specified in IEC 60651.

Other frequency weighting characteristics such as the C-weighting or the Lin (Flat) weighting, specified in IEC 60651 are optional.

2.3.2 Averaging and integration

The integrating sound level meter shall be capable of measuring the equivalent continuous A-weighted sound pressure level (see 3.3). Optionally, the integrating sound level meter may be capable of measuring sound exposure level (see 3.4).

2.3.3 Calibration

The requirements of this standard may be applied to either free-field calibration (see 3.13) or diffuse-field calibration (see 3.14). If the instrument is calibrated for use in a diffuse field, it shall be marked "R" (see 11.1).

2.4 Method of use

Integrating sound level meters are used to measure many types of sound, under different conditions and for a variety of reasons. For each application, the measurement technique should be chosen and controlled carefully to obtain valid and consistent results. It is important to recognize that the method of use may have as much effect on a measurement as the quality of the instrument itself; errors will often result if the effect of the environment and (especially for hand-held instruments) the presence of the observer are ignored.

3 Definitions

3.1 The following definitions apply in addition to those specified in IEC 60050(801), IEC 60651, IEC 61000-4-2, IEC 61000-4-3, IEC 61000-6-1, IEC 61000-6-2, and CISPR 61000-6-3.

3.2

frequency-weighted sound pressure level

the frequency-weighted sound pressure level, in decibels (dB), is 20 times the logarithm to the base ten of the ratio of a weighted sound pressure to the reference sound pressure. The reference sound pressure is 20 µPa. The frequency weighting shall be indicated.

3.3

equivalent continuous A-weighted sound pressure level

(also time-average A-weighted sound pressure level or time-average sound level). It is defined as follows:

$$L_{Aeq,T} = 10 \lg \left\{ \left(\frac{1}{T} \int_{t_1}^{t_2} p_A^2(t) dt \right) / p_0^2 \right\} \text{ dB}$$

where

$L_{Aeq,T}$ is the equivalent continuous A-weighted sound pressure level re 20 µPa determined over a time interval $T = t_2 - t_1$;

$p_A(t)$ is the instantaneous A-weighted sound pressure of the sound signal;

p_0 is the reference sound pressure of 20 µPa.

NOTE 1 When, optionally, a frequency weighting other than A is used, the frequency weighting used shall be included explicitly in the title and the formula of the quantity; for example, equivalent continuous C-weighted sound pressure level:

$$L_{Ceq,T} = 10 \lg \left\{ \left(\frac{1}{T} \int_{t_1}^{t_2} p_c^2(t) dt \right) / p_0^2 \right\} \text{ dB}$$

If no frequency weighting is used, the quantity is simply called equivalent continuous sound pressure level.

NOTE 2 For the definition of the average AI-weighted sound pressure level, see annex B.

3.4

A-weighted sound exposure level

It is defined as follows:

$$L_{AE} = 10 \lg \left\{ \left(\int_{t_1}^{t_2} p_A^2(t) dt \right) / (p_0^2 \cdot T_0) \right\} \text{ dB}$$

where

L_{AE} is the A-weighted sound exposure level, re $4 \times 10^{-10} \text{ Pa}^2 \cdot \text{s}$, determined over a time interval $T = t_2 - t_1$;

p_0 is equal to $20 \text{ } \mu\text{Pa}$;

T_0 is equal to 1 s.

NOTE The expression $\int_{t_1}^{t_2} p_A^2(t) dt$ is the A-weighted sound exposure, E_A .

The quantity $(p_0^2 \cdot T_0)$ is the reference sound exposure and is equal to $4 \times 10^{-10} \text{ Pa}^2 \cdot \text{s}$.

The A-weighted sound exposure level is related to the equivalent continuous A-weighted sound pressure level as follows:

$$L_{EA,T} = L_{Aeq,T} + 10 \lg(T/T_0) \text{ dB}$$

3.5

linearity range

difference, in decibels, between the upper and lower r.m.s. levels of continuous sinusoidal signals applied to the input within which the linearity requirements given in 6.2 are met

3.6

pulse range

greatest level difference, in decibels, between the peak signal level of a tone burst and the r.m.s. level of a continuous low-level signal for which the specifications given in 6.2 are met

3.7

reference range (of the integrating sound level meter)

level range specified by the manufacturer for calibration purposes and which includes the reference sound pressure level (see 3.15)

3.8

indicator range

range of levels, in decibels, that can be indicated at each setting of the level range control (if any). It has level linearity tolerances equal to those within the primary indicator range as defined in IEC 60651, except for Type 3 instruments where the tolerances are equal to those for Type 2 instruments (see 1.2)

3.9

tone bursts

one or more complete cycles of sinusoidal signal. For the purpose of this standard, the tone burst signals start and end at a zero crossing of the waveform

3.10

burst duty factor (of the test signal of 9.3.2)

ratio of the duration of the tone burst to the duration of a complete cycle at the repetition frequency

3.11

reference direction

direction of sound incidence specified by the manufacturer to be used for testing the directional characteristics of the integrating sound level meter. For free-field calibration, it is also the direction of sound incidence for the calibration of absolute sensitivity and frequency weighting (see 3.13). If diffuse-field calibration (see 3.14) is used, the reference direction shall be such that for plane progressive waves arriving at the microphone from this direction, the frequency response approximates most closely the response in a diffuse field

For the reference direction of diffuse-field calibrated microphones or sound level meters, the manufacturer shall specify the free-field frequency response together with the accuracy type for which the tolerances are met.

NOTE 1 It may occur that this accuracy type is different from that for diffuse-field calibration.

NOTE 2 The reference direction will generally differ for the same instrument between calibration for free field and diffuse field.

3.12

reference frequency

frequency specified by the manufacturer to be used for calibration of the absolute sensitivity (see 3.7 of IEC 60651)

3.13

free-field calibration

calibration of absolute sensitivity and frequency weighting for plane progressive sound waves arriving at the microphone in the reference direction (see 9.1 and annex C)

3.14

diffuse-field calibration

calibration of absolute sensitivity and frequency weighting for a diffuse sound field (see 9.1 and annex C)

NOTE The term "random incidence calibration" is also in use in some countries.

3.15

reference sound pressure level

sound pressure level specified by the manufacturer used for calibrating the absolute sensitivity of the integrating sound level meter

NOTE A reference sound pressure level of 94 dB is preferred or, if this level is not within the measuring range of the instrument, 84 dB or 74 dB (see 3.8 of IEC 60651).

3.16

integrating sound level meter

descriptor applicable to both integrating-averaging and integrating sound level meters

3.17

reference orientation (of an integrating sound level meter)

orientation of an integrating sound level meter with respect to the principal direction of an emitter or receiver of radio-frequency fields such that for integrating sound level meters with the microphone directly attached, the reference orientation specified for the instrument is directly in line with the principal direction of this same emitter or receiver. For instruments that do not have the microphone directly attached, the configuration for the reference orientation is specified in the instruction manual