INTERNATIONAL STANDARD

IEC 61672-1

First edition
2002-05

Electroacoustics – Sound level meters –

Part 1: Specifications

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*

Reference number
IEC 61672-1:2002(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (www.iec.ch/online_news/ justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

IEC 61672-1

First edition
2002-05

Electroacoustics – Sound level meters –

Part 1: Specifications

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE X

For price, see current catalogue

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROACOUSTICS – SOUND LEVEL METERS –

Part 1: Specifications

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to Technical Committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each Technical Committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports, or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61672-1 has been prepared by IEC technical committee 29: Electroacoustics, in cooperation with the International Organization of Legal Metrology (OIML).

This standard, in conjunction with IEC 61672-2, cancels and replaces IEC 60651, *Sound level meters*, and IEC 60804, *Integrating-averaging sound level meters*.

The text of this standard is based on the following documents:

FDIS	Report on voting
29/507/FDIS	29/515/RVD

Full information on the voting for the approval of this standard can be found in the report of voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 3.

Annex A forms an integral part of this standard.

Annexes B and C are for information only.

At the time of publication of this standard, the IEC 61672 series was scheduled to consist at least of the following parts: IEC 61672-1: *Specifications*, IEC 61672-2: *Pattern evaluation tests*, and IEC 61672-3: *Periodic tests*.

The committee has decided that the contents of IEC 61672-1 will remain unchanged until 2005. At this date, the publication will be:

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

ELECTROACOUSTICS – SOUND LEVEL METERS –

Part 1: Specifications

1 Scope

1.1 This standard gives electroacoustical performance specifications for three kinds of sound measuring instruments:

– a conventional sound level meter that measures exponential time-weighted sound level;

– an integrating-averaging sound level meter that measures time-average sound level; and

– an integrating sound level meter that measures sound exposure level.

A single instrument may make any, or all, of the three kinds of measurements. Additional performance specifications are given for the measurement of maximum time-weighted sound level and peak C sound level. Frequency-weighting A is mandatory for all sound level meters specified in this standard.

1.2 Sound level meters conforming to the requirements of this standard have a specified frequency response for sound incident on the microphone from one principal direction in an acoustic free field or from random directions.

1.3 Sound level meters specified in this standard are intended to measure sounds generally in the range of human hearing.

NOTE For measurement of audible sound in the presence of ultrasound, the AU weighting, specified in IEC 61012 [1], may be applied.[1]

1.4 Two performance categories, class 1 and class 2, are specified in this standard. In general, specifications for class 1 and class 2 sound level meters have the same design goals and differ mainly in the tolerance limits and the range of operational temperatures. Tolerance limits for class 2 specifications are greater than, or equal to, those for class 1 specifications.

1.5 This standard is applicable to a range of designs for sound level meters. A sound level meter may be a self-contained hand-held instrument with an attached microphone and a built-in display device. A sound level meter may be comprised of separate components in one or more enclosures and may be capable of displaying a variety of acoustical signal levels. Sound level meters may include extensive analogue or digital signal processing, separately or in combination, with multiple analogue and digital outputs. Sound level meters may include general-purpose computers, recorders, printers, and other devices that form a necessary part of the complete instrument.

[1] Numbers in square brackets refer to the bibliography.

1.6 Sound level meters may be designed for use with an operator present or for automatic and continuous measurements of sound level without an operator present. Specifications in this standard for the response to sound waves apply without an operator present in the sound field.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CISPR[2] 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1: Radio disturbance and immunity measuring apparatus*

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

IEC 60942, *Electroacoustics – Sound calibrators*

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

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

ISO/IEC GUIDE EXPRES:1995, Guide to the expression of uncertainty in measurement

ISO Publication, ISBN 92-67-01075-1, *International vocabulary of basic and general terms in metrology*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in IEC 60050(801), the *International vocabulary of basic and general terms in metrology*, the *Guide to the expression of uncertainty in measurement*, and IEC 61000-6-2:1999, as well as the following apply. All quantities are expressed in SI units.

3.1
reference sound pressure
reference quantity conventionally chosen equal to 20 μPa for airborne sound

3.2
sound pressure level
twenty times the logarithm to the base ten of the ratio of the root-mean-square of a given sound pressure to the reference sound pressure

NOTE Sound pressure level is expressed in decibels (dB); symbol L_p.

---

2 In English, CISPR stands for International Special Committee on Radio Interference.

3.3
frequency weighting
for a sound level meter, the difference between the level of the signal indicated on the display device and the corresponding level of a constant-amplitude steady-state sinusoidal input signal, specified in this standard as a function of frequency

NOTE The difference in level is expressed in decibels (dB).

3.4
time weighting
exponential function of time, of a specified time constant, that weights the square of the instantaneous sound pressure

3.5
time-weighted sound level
twenty times the logarithm to the base ten of the ratio of a given root-mean-square sound pressure to the reference sound pressure, root-mean-square sound pressure being obtained with a standard frequency weighting and standard time weighting

NOTE 1 Time-weighted sound level is expressed in decibels (dB).

NOTE 2 For time-weighted sound level, example letter symbols are L_{AF}, L_{AS}, L_{CF}, and L_{CS} for frequency weightings A and C and time weightings F and S.

NOTE 3 In symbols, A-weighted and time-weighted sound level, $L_{A\tau}(t)$, at any instant of time t is represented by

$$L_{A\tau}(t) = 20 \lg\left\{\left[(1/\tau)\int_{-\infty}^{t} p_A^2(\xi)\, e^{-(t-\xi)/\tau}\, d\xi\right]^{1/2} \Big/ p_0\right\} \qquad (1)$$

where

– τ is the exponential time constant in seconds for time weighting F or S;

– ξ is a dummy variable of time integration from some time in the past, as indicated by $-\infty$ for the lower limit of the integral, to the time of observation t;

– $p_A(\xi)$ is the A-weighted instantaneous sound pressure; and

– p_0 is the reference sound pressure.

In equation (1), the numerator of the argument of the logarithm is the exponential-time-weighted, root-mean-square, frequency-weighted sound pressure at observation time t.

NOTE 4 The sketch in figure 1 illustrates the process indicated by equation (1).

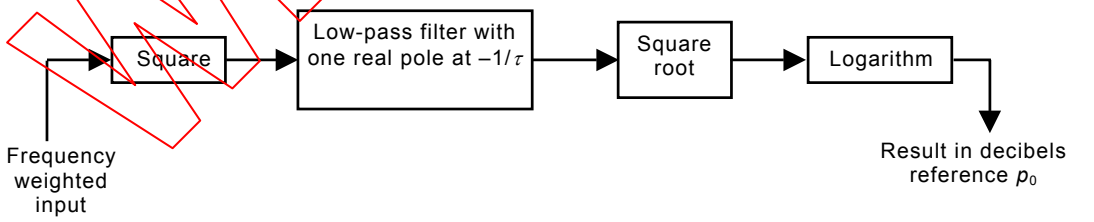

Figure 1 – Principal steps involved in forming an exponential-time-weighted sound level

3.6
maximum time-weighted sound level
greatest time-weighted sound level within a stated time interval

NOTE 1 Maximum time-weighted sound level is expressed in decibels (dB).

NOTE 2 For maximum time-weighted sound level, example letter symbols are L_{AFmax}, L_{ASmax}, L_{CFmax}, and L_{CSmax} for frequency weightings A and C and time weightings F and S.

3.7
peak sound pressure
greatest absolute instantaneous sound pressure during a stated time interval

3.8
peak sound level
twenty times the logarithm to the base ten of the ratio of a peak sound pressure to the reference sound pressure, peak sound pressure being obtained with a standard frequency weighting

NOTE 1 Peak sound level is expressed in decibels (dB).

NOTE 2 This standard provides specifications for measurement of peak C sound level; symbol L_{Cpeak}.

3.9
time-average sound level
equivalent continuous sound level
twenty times the logarithm to the base ten of the ratio of a root-mean-square sound pressure during a stated time interval to the reference sound pressure, sound pressure being obtained with a standard frequency weighting

NOTE 1 Time-average or equivalent continuous sound level is expressed in decibels (dB).

NOTE 2 In symbols, time-average, A-weighted sound level, L_{AT} or L_{AeqT}, is given by

$$L_{AT} = L_{AeqT} = 20 \ \lg \left\{ \left[(1/T) \int_{t-T}^{t} p_A^2(\xi) d\xi \right]^{1/2} \Big/ p_0 \right\} \qquad (2)$$

where

– ξ is a dummy variable of time integration over the averaging time interval ending at the time of observation t;

– T is the averaging time interval;

– $p_A(\xi)$ is the A-weighted instantaneous sound pressure; and

– p_0 is the reference sound pressure.

In equation (2), the numerator of the argument of the logarithm is the root-mean-square, frequency-weighted sound pressure over averaging time interval T.

NOTE 3 In principle, time weighting is not involved in a determination of time-average sound level.

3.10
sound exposure
time integral of the square of sound pressure over a stated time interval or event

NOTE 1 Duration of integration is included implicitly in the time integral and need not be reported explicitly, although the nature of the event should be stated. For measurements of sound exposure over a specified time interval such as 1 h, duration of integration should be reported.

NOTE 2 In symbols, A-weighted sound exposure E_A of a specified event is represented by

$$E_A = \int_{t_1}^{t_2} p_A^2(t) dt \qquad (3)$$

where $p_A^2(t)$ is the square of the A-weighted instantaneous sound pressure during an integration time starting at t_1 and ending at t_2.

The unit of A-weighted sound exposure is pascal-squared seconds if A-weighted sound pressure is in pascals and running time is in seconds.

NOTE 3 Sound exposure in pascal-squared hours is more convenient for applications such as measurement of exposure to noise in the workplace; see IEC 61252 [2].

3.11
sound exposure level
ten times the logarithm to the base ten of the ratio of a sound exposure to the reference sound exposure, reference sound exposure being the product of the square of the reference sound pressure and the reference time interval of 1 s

NOTE 1 Sound exposure level is expressed in decibels (dB).

NOTE 2 In symbols, A-weighted sound exposure level, L_{AE}, is related to a corresponding measurement of time-average, A-weighted sound level, L_{AT} or L_{AeqT}, by

$$L_{AE} = 10 \lg\left\{\left[\int_{t_1}^{t_2} p_A^2(t)\,dt\right] \Big/ \left(p_0^2 T_0\right)\right\} = 10 \lg(E_A / E_0) = L_{AT} + 10 \lg(T / T_0) \quad (4)$$

where

– E_A is the A-weighted sound exposure in pascal-squared seconds (see equation (3));

– E_0 is the reference sound exposure of (20 μPa)^2 × (1 s) = 400 × 10^{-12} Pa^{2}s;

– T_0 = 1 s; and

– $T = t_2 - t_1$ is the time interval for measurement, in seconds, for sound exposure level and time-average sound level.

NOTE 3 Time-average, A-weighted sound level L_{AT} or L_{AeqT} during time interval T is related to the total A-weighted sound exposure E_A occurring within that interval by

$$E_A = \left(p_0^2 T\right)\left(10^{0.1 L_{AT}}\right) \quad (5a)$$

or

$$L_{AT} = 10 \lg\left[E_A \Big/ \left(p_0^2 T\right)\right] = L_{AE} - 10 \lg(T / T_0) \quad (5b)$$

3.12
microphone reference point
point specified on, or close to, the microphone to describe the position of the microphone

NOTE The microphone reference point may be at the centre of the diaphragm of the microphone.

3.13
reference direction
inward direction toward the microphone reference point and specified for determining the acoustical response, directional response, and frequency weighting of a sound level meter

NOTE The reference direction may be specified with respect to an axis of symmetry.

3.14
sound-incidence angle
angle between the reference direction and a line between the acoustic centre of a sound source and the microphone reference point

NOTE Sound-incidence angle is expressed in degrees.

3.15
level range
range of nominal sound levels measured with a particular setting of the controls of a sound level meter

NOTE Level range is expressed in decibels (dB).

3.16
reference sound pressure level
sound pressure level specified for testing the electroacoustical performance of a sound level meter

NOTE Reference sound pressure level is expressed in decibels (dB).

3.17
reference level range
level range specified for testing the electroacoustical characteristics of a sound level meter and containing the reference sound pressure level

NOTE Reference level range is expressed in decibels (dB).

3.18
calibration check frequency
nominal frequency, in the range from 160 Hz to 1 250 Hz, of the sinusoidal sound pressure produced by a sound calibrator that is used in checking and adjusting a sound level meter

3.19
level linearity error
at a stated frequency, an indicated signal level minus the anticipated signal level

NOTE Level linearity error is expressed in decibels (dB).

3.20
linear operating range
on any level range and at a stated frequency, the range of sound levels over which level linearity errors are within the tolerance limits specified in this standard

NOTE Linear operating range is expressed in decibels (dB).

3.21
total range
range of A-weighted sound levels, in response to sinusoidal signals, from the smallest sound level, on the most-sensitive level range, to the highest sound level, on the least-sensitive level range, that can be measured without indication of overload or under-range and within the tolerance limits specified in this standard for level linearity error

NOTE Total range is expressed in decibels (dB).

3.22
toneburst
one or more complete cycles of a sinusoidal signal starting and stopping at a zero crossing of the waveform

3.23
toneburst response
maximum time-weighted sound level, time-average sound level, or sound exposure level, measured in response to a sinusoidal electrical toneburst minus the corresponding measured sound level of the steady sinusoidal input signal from which the toneburst was extracted

NOTE Toneburst response is expressed in decibels (dB).