BRITISH STANDARD

BS EN 61252:1997
IEC 61252:1993
BS 6402:1994 renumbered, incorporating Amendments Nos. 1 and 2

Electroacoustics — Specifications for personal sound exposure meters

The European Standard EN 61252:1997, with the incorporation of amendment A1:2001, has the status of a British Standard.

ICS 17.140.50

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Electronic Equipment Standards Policy Committee (EEL/-) to Technical Committee EEL/24, upon which the following bodies were represented:

British Association of Otolaryngologists
British Hearing Aid Industry Association
British Hearing Aid Manufacturers' Association
British Medical Association
British Society of Audiology
British Telecommunications plc
Confederation of British Industry
Department of Health
Department of Trade and Industry (National Physical Laboratory)
Health and Safety Executive
Institute of Acoustics
Institute of Sound and Vibration Research
Institution of Electrical Engineers
Medical Research Council
Ministry of Defence
National Health Services
Royal Aeronautical Society
Royal National Institute for Deaf People
Society of Environmental Engineers
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9323	January 1997	Addition of Annex ZA
13116	06 September 2001	See national foreword

Contents

National foreword

This British Standard has been prepared by Technical Committee EPL/29 (formerly EEL/24) and is the English language version of EN 61252:1995 *Electroacoustics — Specifications for personal sound exposure meters* including amendment A1:2001, published by the European Committee for Electrotechnical Standardization (CENELEC).

This British Standard supersedes BS 6402:1993, which is withdrawn.

The start and finish of text introduced or altered by amendment is indicated in the text by tags ⟨A1⟩ ⟨A1⟩. Tags indicating changes to IEC text carry the number of the IEC amendment. For example, text altered by IEC amendment 1 is indicated by ⟨A1⟩ ⟨A1⟩.

Specifications in this standard for personal sound exposure meters are consistent, insofar as is practical, with comparable specifications in BS 6698:1986 for integrating-averaging sound level meters. The four principle technical differences from the specifications in BS 6698:1986 are as follows.

a) Sound exposure is measured and displayed rather than equivalent-continuous frequency-weighted sound pressure level or sound exposure level.

b) Accuracy of squaring and intergrating short-duration signals is specified by measurement of the sound exposure of a sequence of repeated constant-amplitude, 1 ms and 10 ms duration, 4 kHz tonebursts rather than by measurement of the response to single 4 kHz tonebursts of varying amplitudes with durations ranging from 1 ms to 1 s, each single toneburst being accompanied by a continuous, in-phase, low-level, 4 kHz background signal.

c) Specifications for a personal sound exposure meter include a limitation on the difference between the sound exposure indicated in response to positive-going and negative-going unipolar pulses.

d) Requirements are not specified for the directional response of the microphone of a personal sound exposure meter intended to be worn on a person.

This standard includes two informative annexes. Annex A provides a table of selected sound exposures and corresponding normalized 8-h-average sound levels. Annex B describes recommendation for tests to verify the performance of a personal sound exposure meter.

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, the EN title page, pages 2 to 21 and a back cover.

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EUROPEAN STANDARD
NORME EUROPÉENNE
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March 1995
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Descriptors: Electroacoustic equipment, exposure meters, sound pressure, definitions, indicating instruments, specifications, characteristics, instrument sensitivity, marking, technical notices

English version

Electroacoustics — Specifications for personal sound exposure meters

(includes amendment A1:2001)
(IEC 61252:1993 + A1:2000)

Electroacoustique
Spécifications des exposimètres acoustiques individuels
(inclut l'amendement A1:2001)
(CEI 61252:1993 + A1:2000)

Elektroakustik
Anforderungen an Personenschallexposimeter
(enthält Änderung A1:2001)
(IEC 61252:1993 + A1:2000)

This European Standard was approved by CENELEC on 1995-03-06. Amendment A1 was approved by CENELEC on 2000-11-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the International Standard IEC 1252:1993, prepared by IEC TC 29, Electroacoustics, was submitted to the formal vote and was approved by CENELEC as EN 61252 on 1995-03-06 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1995-12-15
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1995-12-15

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given for information only. In this standard, Annex ZA is normative and Annex A and Annex B are informative. Annex ZA has been added by CENELEC.

Foreword to amendment A1

The text of the document 29/457/FDIS, future amendment 1 to IEC 61252:1993, prepared by IEC TC 29, Electroacoustics, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 EN 61252 on 2000-11-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-08-01
- latest date by which the national standards conflicting with the amendment 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, Annex ZA is normative and Annex A and Annex B are informative. Annex ZA has been added by CENELEC.

Introduction

According to this International Standard, a personal sound exposure meter is intended to measure sound exposure as the time integral of the square of the instantaneous A-frequency-weighted sound pressure. This operating principle underlies the measurement of sound exposure level according to IEC 804. It is the "equal-energy exchange rate" whereby a doubling (or halving) of the integration time of a constant sound level yields a two-fold increase (or decrease) of sound exposure. Similarly, an increase (or decrease) of 3 dB in a constant input sound level for a constant integration time yields a doubling (or halving) of the sound exposure.

Noise dose meters usually have been designed to indicate noise dose as a percentage of a legal limit. The limit and its definition vary from country to country and are subject to change. To facilitate international comparison of sound exposure records with numerical values of convenient magnitude, this International Standard specifies an instrument that indicates sound exposure in pascal-squared hours. An indication of sound exposure with a unit other than pascal-squared hours is permitted provided the manufacturer specifies a procedure for converting the indication to pascal-squared hours, for example, a display of "dose" as a fraction or a percentage of a specified sound exposure in pascal-squared hours.

The principal application for a personal sound exposure meter is the measurement of sound exposure in the vicinity of a person's head; e.g., for assessment of potential hearing impairment according to Standards such as ISO 1999. The microphone of a personal sound exposure meter may be worn on the shoulder, collar, or other location close to one ear. For many practical situations, such as in a factory where the sound-incidence angle may vary widely during the course of workday, the sound exposure indicated by an instrument worn on a person is likely to be different from that which would be measured in the absence of the person. The influence of the person wearing a personal sound exposure meter should be considered when estimating the sound exposure that would have been measured with the person absent.

1 Scope

1.1 Sound exposure is a physical measure that accounts for both the sound pressure and its duration, at a given location, through an integral-over-time of the square of instantaneous frequency-weighted sound pressure.

1.2 This International Standard is applicable to instruments for measurement of A-frequency-weighted sound exposure resulting from steady, intermittent, fluctuating, irregular, or impulsive sounds. Instruments complying with the specifications of this International Standard are intended to be worn on a person to measure sound exposure. Measurements of sound exposure in the workplace may be useful for determinations of occupational noise exposure, in accordance with ISO 1999 and ISO 9612.

1.3 This International Standard specifies acoustical and electrical performance requirements for personal sound exposure meters of one accuracy grade. The accuracy grade corresponds to that for an integrating sound level meter which complies with the Type 2 requirements of IEC 804 for an A-weighted sound pressure level range from 80 dB to 130 dB and a nominal frequency range from 63 Hz to 8 kHz.

1.4 Tolerances on deviations of an instrument's performance from specified design goals represent the performance capabilities of practical instruments. Personal sound exposure meters are required to operate within the tolerances of this International Standard over specified ranges of environmental conditions.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid normative documents.

IEC 60050(801):1984, *Advance edition of the International Electrotechnical Vocabulary, Chapter 801, Acoustics and electroacoustics*

IEC 60651:1979, *Sound level meters*

IEC 60801-2:1984, *Electromagnetic compatibility for industrial-process measurement and control equipment — Part 2: Electrostatic discharge requirements*

IEC 60801-3:1984, *Electromagnetic compatibility for industrial-process measurement and control equipment — Part 3: Radiated electromagnetic field requirements*

IEC 60804:1985, *Integrating-averaging sound level meters*

IEC 60942:1988, *Sound calibrators*

〈A1〉 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* 〈A1〉

ISO 60266:1975, *Acoustics — Preferred frequencies for measurements*

ISO 61683:1983, *Acoustics — Preferred reference quantities for acoustic levels*

ISO 61999:1990, *Acoustics — Determination of occupational noise exposure and estimation of noise-induced hearing impairment*

ISO 69612:199X, *Acoustics — Guidelines for the measurement and assessment of exposure to noise in the working environment*[1)]

[1)] At present, at the stage of draft.

3 Definitions

For the purposes of this International Standard, the following definitions apply. Definitions are consistent with corresponding definitions in IEC 50(801).

3.1
sound exposure
time integral of squared, instantaneous A-frequency-weighted sound pressure over a specified event, for example, a working day

NOTE 1 Although the primary SI unit for sound exposure is the pascal-squared second, for measurements of sound exposure in the workplace, the more-convenient derived unit, the pascal-squared hour, is used in this International Standard.

NOTE 2 In symbols, (A-weighted) sound exposure is

$$E = \int_{t_1}^{t_2} p_A^2 (t)\, dt \qquad (1)$$

where $p_A^2(t)$ is the square of instantaneous A-frequency-weighted sound pressure as a function of time t for an integration time period starting at t_1 and ending at t_2. The unit of sound exposure E is pascal-squared hours if A-weighted sound pressure p_A is in pascals and the running time t in hours.

3.2
equivalent-continuous A-weighted sound pressure level; time-average sound level
in decibels, ten times the logarithm to the base ten of the ratio of the time-mean-square, A-frequency-weighted sound pressure, during an averaging time period T, to the square of the standard reference sound pressure

NOTE 1 In symbols, equivalent-continuous A-weighted sound pressure level $L_{Aeq,T}$, or time-average sound level, is given by:

$$L_{Aeq,T} = 10 \lg \{ [(1/T) \int_0^T p_A^2 (t)\, dt] / p_0^2 \} \qquad (2)$$

where running time t and averaging time T are expressed in the same units, $p_A(t)$ is the instantaneous A-weighted sound pressure in pascals, and p_0 is the reference sound pressure of twenty micropascals (20 μPa) per ISO 1683.

NOTE 2 Equivalent-continuous A-weighted sound pressure level during the averaging time period T is related to the total sound exposure occurring within that period by

$$E = (p_0^2\, T)\, [10^{0,1 \times L_{Aeq,T}}] \qquad (3)$$

or, alternatively, by

$$L_{Aeq,T} = 10 \lg [E/(p_0^2\, T)] \qquad (4)$$

where the unit of time is the same for both sound exposure and averaging time.

3.3
normalized 8-h-average sound level
in decibels, level of the time-mean-square, A-weighted sound pressure during a normalization time period T_n of 8 h such that the sound exposure therefrom is equal to that of a time-varying sound at a place where total sound exposure occurs within a time period not necessarily 8 h

NOTE 1 In symbols, a normalized 8-h-average sound level (letter symbol $L_{Aeq,8hn}$), relative to the reference sound pressure p_0 and the 8 h normalization time period T_n, is given by:

$$L_{Aeq,8hn} = 10 \lg [E/(p_0^2\, T_n)] \qquad (5)$$

NOTE 2 For computations, a simpler form of Eq.(5) for normalized 8-h-average sound level in decibels is obtained, for sound exposure E in pascal-squared hours, after substituting the values of 20 micropascals for p_0 and 8 h for T_n, as

$$L_{Aeq,8hn} = 10 \lg [(E \times 10^9)/3,2] \qquad (6)$$

NOTE 3 When a total sound exposure is described indirectly by an equivalent-continuous A-weighted sound pressure level $L_{Aeq,T}$, for an averaging time T greater or less than the normalization time period of 8 h, normalized 8-h-average sound level may be determined from

$$L_{Aeq,8hn} = L_{Aeq,T} + 10 \lg (T/T_n) \qquad (7)$$

NOTE 4 Annex A provides a table of normalized 8-h-average sound levels and corresponding sound exposures. For example, a sound exposure of 1 Pa^2h (irrespective of the period of time over which it is measured) corresponds to a normalized 8-h-average sound level of nearly 85 dB; a sound exposure of 3,2 Pa^2h corresponds exactly to a normalized 8-h-average sound level of 90 dB.

NOTE 5 Normalized 8-h-average sound level in Eq.(5) is identical to "daily personal noise exposure $L_{EP,d}$ in decibels" defined in Article 2 of the "European Communities Council Directive of 12 May 1986 on the protection of workers from the risks related to exposure to noise at work" (Directive 86/188/EEC).

NOTE 6 Normalized 8-h-average sound level in Eq.(5) is also the same as "noise exposure level normalized to a nominal 8 h working day, $L_{Ex,8h}$" defined in ISO 1999.

3.4
sound level range
in decibels, lower and upper time-average, A-weighted sound pressure levels without exponential time weighting, specified by the manufacturer, within which linearity requirements of this International Standard are met

3.5
sound exposure range
range between an upper and a lower sound exposure, both to be specified by the manufacturer, within which the requirements of this International Standard are met and which are displayed on the sound exposure indicator

3.6
reference direction
direction of sound incidence specified by the manufacturer for determining the absolute acoustical sensitivity and frequency response

3.7
reference frequency
frequency of 1 kHz for determining the absolute acoustical sensitivity

3.8
reference sound pressure level
sound pressure level specified by the manufacturer for determining the absolute acoustical sensitivity

3.9
reference integration time
integration time specified by the manufacturer for determining the absolute acoustical sensitivity

3.10
reference sound exposure
calculated sound exposure corresponding to the reference sound pressure level, at the reference frequency, applied for the reference integration time

〈A1〉 The following definition applies in addition to those specified in IEC 61000-4-2, IEC 61000-4-3, IEC 61000-6-1, IEC 61000-6-2, and CISPR 61000-6-3.

3.11
reference orientation (of a personal sound exposure meter)
orientation of a personal sound exposure meter that corresponds to the meter as worn in normal use by a person standing upright and facing the principal direction of an emitter or receiver of radio-frequency electromagnetic fields 〈A1〉

4 General performance requirements

4.1 A personal sound exposure meter is a combination of a microphone, an amplifier with the required A-frequency weighting, a device to square the frequency-weighted sound pressure signal, an integrator over time, an indicator of sound exposure, and a latching overload indicator. Sound exposures that have been accumulated during a measurement period are retained in the memory until the instrument is reset and are not deleted by triggering of the latching overload indicator.

4.2 Because only its overall performance is important, an actual instrument need not be separable into individual functional elements. However, for convenient description of required characteristics, the instrument is considered as if it were a combination of the separate elements shown in Figure 1.

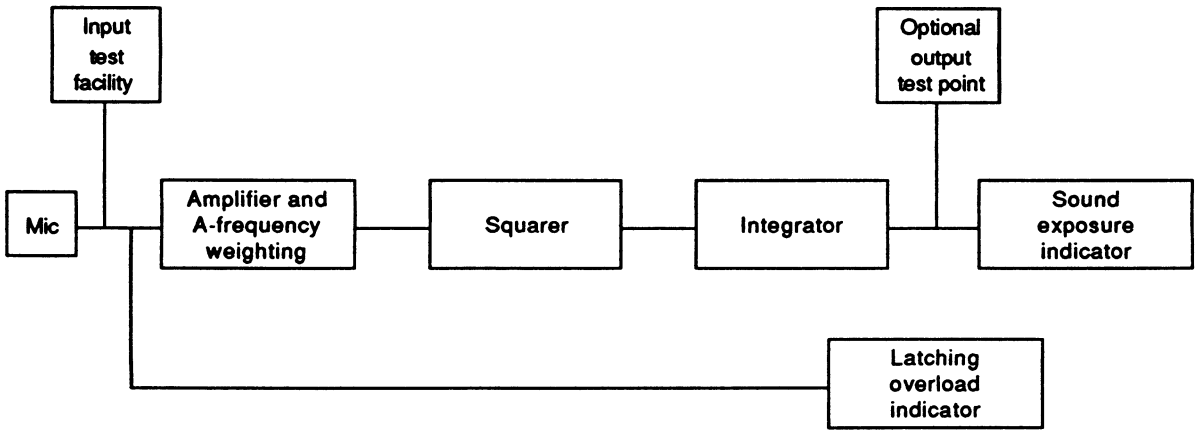

Figure 1 — Functional elements of a personal sound exposure meter

4.3 An optional (but preferred) accessible output test point may be provided.

4.4 The manufacturer shall provide the means to substitute an electrical input signal in place of the microphone, for the purpose of performing tests on the complete instrument without the microphone.

NOTE The manufacturer may provide an accessible input test point or recommend and provide a dummy microphone or equivalent input adapter (electrical or non-electrical) for performing electrical tests on the instrument.

4.5 The sound exposure indicator may be built into, or be separate from, the wearable part of an instrument. The quantity indicated is sound exposure, either as a direct indication or as a fraction or percentage of a manufacturer-specified sound exposure. If sound exposure is not indicated directly in pascal-squared hours (Pa^2h), the manufacturer shall provide suitable means to convert the indication to sound exposure in pascal-squared hours.

4.6 The smallest increment of sound exposure displayed by the indicator shall be not greater than 0,1 Pa^2h. The sound exposure range shall be at least from 0,1 Pa^2h to 99,9 Pa^2h.

4.7 The sound level range shall extend at least from 80 dB to 130 dB.

4.8 The manufacturer shall state in the Instruction Manual the sound exposure range and the sound level range.

4.9 If the manufacturer-specified ranges of sound exposure and sound level exceed the minimum requirements of this International Standard, all specifications and associated tolerances shall apply to the ranges stated by the manufacturer.

4.10 If the specified lower boundary of the sound level range is less than 80 dB, the lower boundary of the sound exposure range shall be less than 0,1 Pa^2h.

4.11 Specifications in subsequent clauses for the acoustical and electrical performance of a personal sound exposure meter are applicable for the reference conditions of clause **5**. Clause **12** provides requirements for limits on the changes in the sensitivity of a personal sound exposure meter when used under environmental conditions different from the reference conditions.

4.12 A power supply of the type recommended by the manufacturer shall be able to operate a personal sound exposure meter within all specifications of this International Standard for at least 8 h at any temperature within the range specified by the manufacturer of the personal sound exposure meter. If a personal sound exposure meter is battery operated, the manufacturer shall provide a method to check that the battery voltage is sufficient to operate the instrument within the specifications at the time the check is made. A check of battery condition shall not disturb a measurement of sound exposure.

5 Reference conditions

Reference conditions for a personal sound exposure meter are: atmospheric pressure of 101,3 kPa; air temperature of 20 °C; relative humidity of 65 %; and absence of significant interference caused by ambient sounds, airflow over the microphone, vibrations, magnetic fields, electromagnetic fields, or electrostatic fields.

NOTE Significant interference is when the effect on the indicated sound exposure exceeds ten percent of an applicable tolerance limit.

6 Absolute acoustical sensitivity

6.1 A means shall be available for the user to check and maintain the sensitivity of a personal sound exposure meter such that the tolerances in **6.2** for reference sound exposure are met under the reference conditions. If this means is a sound calibrator, it shall meet the requirements of IEC 942.

NOTE 1 A sound calibrator meeting the Class 1 requirements of IEC 942 is preferred.

NOTE 2 The integration time period for checking the absolute acoustical sensitivity should not exceed 2 min.

NOTE 3 If another quantity such as sound pressure level can be displayed, it may be used to check the calibration of the instrument.

6.2 The personal sound exposure meter shall be checked and, if necessary, adjusted in accordance with the manufacturer's instructions. Under the reference environmental conditions of clause **5** and for plane-progressive sound waves incident on the microphone from the reference direction, the indicated sound exposure shall be within the range – 21 % to + 26 % of the reference sound exposure at the reference frequency of 1 kHz. This requirement shall apply with the microphone of the personal sound exposure meter mounted as specified by the manufacturer, but not mounted on a person and without an observer disturbing the sound field.

NOTE Calibration of the absolute acoustical sensitivity of a personal sound exposure meter may be carried out by means of a closed coupler pressure-calibration device, in conjunction with manufacturer-specified corrections for the free-field response, applicable to the type of microphone used on the personal sound exposure meter.

Table 1 — Design-goal A-frequency weighting relative to response at 1 kHz and the tolerances ΔA that apply to the performance of a complete personal sound exposure meter

Nominal frequency Hz	A dB	ΔA dB	**Sound exposure ratio**		
			min	design-goal ε	max
63	– 26,2	± 2,0	0,001 5	0,002 4	0,003 8
125	– 16,1	± 1,5	0,017 4	0,024 5	0,034 7
250	– 8,6	± 1,5	0,098	0,138	0,195
500	– 3,2	± 1,5	0,339	0,479	0,676
1 k	0,0			1,000	
2 k	1,2	± 2,0	0,832	1,318	2,089
4 k	1,0	± 3,0	0,631	1,259	2,512
8 k	– 1,1	± 5,0	0,246	0,776	2,455

NOTE 1 At frequencies less than 63 Hz and greater than 8 kHz, the sensitivity of a personal sound exposure meter should follow the standard design-goal A-weighting and the frequency response should not exceed the positive tolerances given in IEC 651 for Type 2 sound level meters.

NOTE 2 It is recommended that a personal sound exposure meter should respond over a range of frequencies extending from 31,5 Hz to 12,5 kHz. The manufacturer should state the nominal frequency range of the instrument and the corresponding tolerances that are maintained.

NOTE 3 In use, the directional characteristics of a personal sound exposure meter are strongly affected by the presence of the wearer of the instrument and the mounting position of the instrument or its microphone. For those reasons, this International Standard includes no specifications for the response to sounds from various directions.

7 Frequency weighting

7.1 Under the reference environmental conditions of clause **5** and for plane-progressive sound waves incident on the microphone from the reference direction and with the reference sound pressure level at the microphone, a complete personal sound exposure meter, with the microphone mounted as specified by the manufacturer but not mounted on a person and without an observer disturbing the sound field, shall have the relative A-weighting frequency characteristic, for constant-amplitude sinusoidal signals, as specified in Table 1. The design-goal A-frequency weighting is a smooth and continuous function of frequency as specified in IEC 651. At each nominal frequency in Table 1, the ratio of a measured sound exposure to the sound exposure at 1 kHz shall fall within the specified sound-exposure tolerances. At intermediate frequencies, the applicable tolerances are the wider limits determined from the A-weighting tolerances in decibels given in Table 1.

7.2 At nominal frequencies from 63 Hz to 8 kHz, Table 1 gives the design-goal A-frequency weighting relative to sound exposure response at 1 kHz, as a relative level in decibels and as a ratio of exposures measured with constant-amplitude, constant-duration sinusoidal signals. Nominal frequencies are the preferred frequencies from ISO 266.

NOTE Sound exposure ratio may be calculated from the following:

The design-goal sound exposure ratio ε is given by:

$$\varepsilon = 10^{0,1\,A} \tag{8}$$

sound exposure ratio max or min:

$$\varepsilon + \Delta\varepsilon = 10^{0,1(A + \Delta^{A})} \tag{9}$$

where weighting A and tolerance ΔA are in decibels.

7.3 Tolerances in decibels are given in the column headed "ΔA" and are relative to the corresponding A-frequency-weighting design-goal response. Tolerances on sound exposure ratio given in columns headed "min" and "max" are relative to the corresponding design-goal sound exposure ratio in the column marked ε in Table 1.

7.4 Compliance with the requirements of Table 1 may be demonstrated by a combination of acoustical and electrical tests. Annex B provides recommendations for tests of frequency weighting.

8 Linearity of response to steady signals

8.1 For steady sinusoidal signals at a frequency of 1 kHz, and for changes in sound exposure with respect to either or both input sound pressure level and integration time, all indicated sound exposures shall be within the range – 21 % to + 26 % of the calculated sound exposure. These tolerances shall apply for any calculated sound exposure over the complete sound level range and from three times the lower boundary of the sound exposure range up to the upper boundary of the sound exposure range, and for integration time periods of up to 8 h.

NOTE Calculated sound exposures may be determined from Eq.(3) for given input sound levels and integration times.

8.2 For steady sinusoidal signals at a frequency of 63 Hz, and for changes in both input sound pressure level and integration time that yield a calculated sound exposure of 1 Pa^2h, the indicated sound exposure shall be within the range – 21 % to + 26 % for input signals corresponding to sound pressure levels from 120 dB (equivalent to an A-weighted sound pressure level of 93,8 dB) up to the upper boundary of the sound level range specified by the manufacturer for 63 Hz. For linearity of response at 63 Hz, the reference is the indicated sound exposure, nominally 1 Pa^2h, for an input sound pressure level of 130 dB (equivalent to an A-weighted sound pressure level of 103,8 dB) at 63 Hz. A reduction of the upper boundary of the sound level range is permitted at 63 Hz, provided the reduction is specified by the manufacturer and the reduction does not exceed the design-goal response of – 26,2 dB for the A-weighting at 63 Hz.

8.3 For steady sinusoidal signals at a frequency of 8 kHz, and for changes in both input sound pressure level and integration time that yield a calculated sound exposure of 1 Pa^2h, the indicated sound exposure shall be within the range – 21 % to + 26 % for input signals corresponding to sound pressure levels from 90 dB (equivalent to an A-weighted sound pressure level of 88,9 dB) up to 110 dB (equivalent to an A-weighted sound pressure level of 108,9 dB). The same tolerances apply when the calculated sound exposure is 50 Pa^2h and the input signals correspond to sound pressure levels from 110 dB up to the upper boundary of the sound level range. For linearity of response at 8 kHz, the reference is the indicated sound exposure, nominally 1 Pa^2h and 50 Pa^2h, for an input sound pressure level of 110 dB at 8 kHz.

8.4 Annex B describes recommendations for tests to demonstrate compliance with the requirements of this clause.

9 Response to short-duration signals

9.1 At a design-goal sound exposure of 1 Pa^2h, the indication of a personal sound exposure meter in response to a sequence of repeated 4 kHz tonebursts shall be within specified tolerances of the corresponding sound exposure indicated in response to a steady 4 kHz sinusoidal signal.

9.2 The level of the steady 4 kHz reference input signal shall correspond to a nominal sound pressure level of 94,0 dB, that is, to a nominal A-weighted sound pressure level of 95 dB.

9.3 The duration of the steady 4 kHz signal shall be such that the indicated sound exposure is between 0,71 Pa^2h and 1,41 Pa^2h.

NOTE For the design-goal sound exposure of 1 Pa^2h and an A-weighted sound pressure level of 95 dB, the duration is 47 min, 26 s.

9.4 All tonebursts shall start and stop at a zero crossing. The duration of individual tonebursts shall be 1 ms (4 cycles) and 10 ms (40 cycles). With 1 ms duration tonebursts, the time between tonebursts shall be 999 ms to yield a 1 : 1 000 ratio of burst "on time" to burst-repetition time. With 10 ms duration tonebursts, the time between tonebursts shall be 990 ms and 9 990 ms to yield 1 : 100 and 1 : 1 000 ratios of burst "on time" to burst-repetition time.

9.5 Sound exposures indicated in response to a sequence of repeated 1 ms and 10 ms tonebursts meeting the requirements of **9.4** shall be within the range – 21 % to + 26 % of the sound exposure indicated for the steady 4 kHz reference signal for toneburst signal levels (that is, levels of the steady 4 kHz sinusoidal signal from which the tonebursts are extracted) up to 125 dB and within the range – 29 % to + 41 % of the sound exposure indicated for the steady 4 kHz reference signal for toneburst signal levels up to the upper boundary of the specified sound level range.

9.6 Annex B describes recommendations for tests to demonstrate compliance with the requirements of this clause.

10 Response to unipolar pulses

For the same nominal integration times, the sound exposure indicated by a personal sound exposure meter in response to a sequence of positive-going, unipolar, approximately 0,5 ms duration pulses, separated by at least 4,5 ms, shall be within the range – 21 % to + 26 % of the sound exposure indicated in response to a sequence of negative-going pulses of the same absolute amplitude, duration, and spacing. Annex B provides a recommended procedure to test the response to unipolar pulses.

11 Latching overload indicator

11.1 A latching overload indicator shall be provided to indicate that the sound pressure level at the microphone has exceeded the upper boundary of the specified sound level range. The overload indicator shall not operate at the upper boundary of the specified sound level range and shall operate between the upper boundary and 3 dB above (peak level 6 dB above) the upper boundary of the specified sound level range and at all higher sound pressure levels for signal durations equal to, or greater than, 4 ms.

NOTE 1 The overload indicator may operate in the presence of high levels of low-frequency sound which are beyond the range of the personal sound exposure meter.

NOTE 2 To avoid spurious overload indications, an exponential time constant not greater than 1 ms may be included in the overload indicator circuit.

11.2 Annex B describes recommendations for tests to demonstrate compliance with the requirements of this clause.

12 Sensitivity to various environments

12.1 General

A complete personal sound exposure meter, including the microphone but not the exposure indicator if separate from the wearable part of the instrument, shall comply with the requirements of this clause. The microphone shall be mounted on an extension cable, if it can be so mounted in normal use, in accordance with the manufacturer's recommendations in the Instruction Manual. Reference environmental conditions are given in clause **5**.

12.2 Atmospheric pressure

For a variation of ± 10 % around the reference atmospheric pressure, the sound exposure indicated in response to the reference sound pressure level, applied for the reference integration time at a frequency of 1 kHz, shall not change by more than – 11 % to + 12 %, referred to the indicated sound exposure at an atmospheric pressure of 101,3 kPa.

12.3 Air temperature

For ambient air temperature at least from 0 °C to 40 °C, the sound exposure indicated in response to the reference sound pressure level, applied for the reference integration time at a frequency of 1 kHz, shall not change by more than – 11 % to + 12 %, referred to the indicated sound exposure at an air temperature of 20 °C. The nominal relative humidity at the time of the test shall be reported.

12.4 Relative humidity

For relative humidity at least from 30 % to 90 %, the sound exposure indicated in response to the reference sound pressure level, applied for the reference integration time at a frequency of 1 kHz, shall not change by more than – 11 % to + 12 %, referred to the indicated sound exposure at a relative humidity of 65 %. The test shall be conducted at a temperature of 40 °C.

12.5 Magnetic field

The Instruction Manual shall state the sound exposure indicated after an integration time period of 1 h when a personal sound exposure meter, with its microphone replaced by an equivalent electrical impedance, if feasible, is immersed in a uniform magnetic field of strength 80 A/m at a test frequency of (50 ± 1) Hz or (60 ± 1) Hz and oriented in the direction for maximum response; both frequency and direction are to be specified by the manufacturer. The manufacturer shall also specify the configuration of the microphone extension cable.

12.6 Radio-frequency electromagnetic fields

The influence of radio-frequency electromagnetic fields on the performance of a personal sound exposure meter shall be reduced as far as practicable. The Instruction Manual shall indicate limitations on the use of a personal sound exposure meter in proximity to a source of electromagnetic radiation.

NOTE The manufacturer should determine the influence of radio-frequency electromagnetic fields in accordance with IEC 801-3.

12.7 Electrostatic discharge

The influence of electrostatic discharge on the performance of a personal sound exposure meter shall be reduced as far as practicable. The Instruction Manual shall indicate limitations on the use of a personal sound exposure meter in proximity to a source of electrostatic discharge.

NOTE The manufacturer should determine the influence of electrostatic discharge in accordance with IEC 801-2.

12.8 Mechanical vibration

The influence of mechanical vibration on the performance of a personal sound exposure meter shall be reduced as far as practicable. The Instruction Manual shall indicate limitations resulting from mechanical vibrations.

13 Instrument marking

13.1 If practical, the name of the quantity displayed (sound exposure) and its unit, or abbreviation thereof, shall appear near to or within the indicator. If such marking is not practical, the Instruction Manual shall describe the means of determining sound exposure. As an example, the nameplate may be marked SOUND EXPOSURE METER, and the indicator marked in Pa^2h. If marked to display an indication in percent, the sound exposure in pascal-squared hours corresponding to 100 percent shall also be indicated, for example, 3,2 Pa^2h = 100 %, if 100 % corresponds to a normalized 8-h-average sound level of 90 dB.

13.2 A personal sound exposure meter that complies with all specifications of this International Standard shall be marked to show IEC 1252:1993. The name of the manufacturer, the model number, and the serial number shall also be indicated.

14 Instruction manual

An Instruction manual shall be supplied with each personal sound exposure meter and shall contain at least the following information:

a) recommendations for mounting the personal sound exposure meter (and the microphone, if separate) on a wearer;

b) a description of the quantity displayed, and a discussion, including analytical formulae, of how to convert the indications to sound exposure in pascal-squared hours if the sound exposure indicator does not have pascal-squared hours as the unit of sound exposure;

c) the sound exposure range and sound level range over which a personal sound exposure meter of specified model complies with all requirements of this International Standard;

d) the sound pressure levels over the frequency range where the response of the personal sound exposure meter is maintained within the specified tolerances;

e) the frequency range and tolerances maintained when the frequency response extends to frequencies less than 63 Hz or greater than 8 kHz;

f) the reference direction of sound-wave incidence;

g) the reference frequency of 1 kHz;

h) the reference sound pressure level, reference integration time, and reference sound exposure;

i) a description of the recommended procedures for: (1) checking the sensitivity of the personal sound exposure meter in accordance with **6.1**, and (2) calibrating the absolute acoustical sensitivity at 1 kHz in accordance with **6.2**;

j) a description of the recommended mounting of the microphone for the measurement of relative frequency response in accordance with **7.1**;

k) the recommended means to insert electrical signals through the input test facility (input test point, a dummy microphone with specified electrical impedance, or equivalent input adapter) and to measure voltages at the optional electrical output test point;

l) the electrical impedance that may be connected, with negligible error in the indicated sound exposure, to each test point that is provided;

m) for a typical microphone, mounted in accordance with the manufacturer's recommendation, the free-field relative frequency response characteristic for the reference direction;

n) a statement of the typical percentage deviations from the sound exposure indicated, in response to positive-going unipolar pulses and to negative-going unipolar pulses, in accordance with clause **10**;

o) the operational ranges of atmospheric pressure, ambient air temperature, and relative humidity, in accordance with **12.2**, **12.3**, and **12.4**;

p) the limits of ambient air temperature and relative humidity for long-term storage;

q) the effect of alternating magnetic fields, in accordance with **12.5**;

r) a description of the limitations, if any, on the performance of the instrument when exposed to radio-frequency electromagnetic fields, sources of electrostatic discharge, or mechanical vibration, in accordance with **12.6**, **12.7**, and **12.8**;

s) recommendations for acceptable battery types and corresponding nominal lifetimes to be expected from fully charged batteries when operating a personal sound exposure meter;

t) a description of the recommended procedure for checking the condition of the battery voltage supply;

u) the recommended interval for periodic testing of a personal sound exposure meter to verify its acoustical and electrical performance characteristics; and

v) recommendations for test setups and test procedures to verify compliance with the specifications of this International Standard. In particular, when the physical form of the personal sound exposure meter precludes direct connection(s) to external test equipment, the manufacturer shall recommend means for applying suitable test signals either acoustically or otherwise;

〈A1〉 w) the sound level at which the personal sound exposure meter conforms to the specifications of clause 15 (85 dB or less). If tested by an equivalent method, descriptive information shall be provided;

x) the approved cables and accessories as included in the tests in **15.5.2.6** and **15.5.4.4**;

y) the configuration for the normal mode of operation;

z) any specified degradation in performance or loss of functionality following the application of electrostatic discharges;

aa) the configuration for the reference orientation, and method of securing the microphone cable, if appropriate;

ab) the setting and configuration for greatest radio-frequency emissions;

ac) the mode of operation and connecting devices that produce minimum immunity to power- and radio-frequency fields.

15 Electromagnetic and electrostatic compatibility requirements and test procedures

15.1 Field of application

15.1.1 This clause specifies requirements for personal sound exposure meters with respect to their immunity to power- and radio-frequency fields and to electrostatic discharge, and the permitted radio-frequency emissions, together with test procedures to demonstrate conformance to the specifications of this standard. As personal sound exposure meters of this type are principally designed to be worn by a person, these requirements are specified for battery operation of the instruments only. No specific requirements are made for public power supply connection. If the meter is used in such a fashion, then the applicable generic electromagnetic compatibility standards prevail.

15.1.2 The electromagnetic and electrostatic compatibility requirements are equally applicable for personal sound exposure meters used in residential, commercial and light-industrial environments, or industrial sites. The requirements of this clause are additional to those contained in previous clauses and do not alter any of the specifications for personal sound exposure meters contained therein. The requirements do not apply to personal sound exposure meters complying with this standard prior to the publication of the amendment.

15.2 Emission limits

The upper limits on radio-frequency emissions from any apparatus are defined for compatibility with many different standards with the limits laid down in Table 1 of CISPR 61000-6-3 forming the basic requirements for personal sound exposure meters. These are summarized in Annex C.

15.3 Electrostatic discharges

15.3.1 Personal sound exposure meters shall withstand electrostatic discharges of specified magnitudes. The requirements are those specified in **1.4** of Table 1 in IEC 61000-6-1 and are summarized as follows:

— contact discharges up to 4 kV and air discharges up to 8 kV with both positive and negative voltages. The polarity of the electrostatic voltage is with respect to earth ground.

15.3.2 IEC 61000-6-1 specifies performance criterion B during and after the electrostatic discharge tests, given as follows:

"The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer, then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended."

The term "apparatus" means any personal sound exposure meter conforming to the specifications of this standard. 〈A1〉

A1 **15.3.3** After each and every electrostatic discharge test is complete, the personal sound exposure meter shall be fully operational and in a configuration identical to that established before the start of the electrostatic discharge tests. Previously stored data (if any) shall remain unchanged.

15.4 Immunity to power- and radio-frequency fields

15.4.1 Personal sound exposure meters shall exhibit a minimum degree of immunity over a range of power- and radio-frequencies and field strengths. The requirements are those specified in **1.1** of Table 1 in IEC 61000-6-1 and **1.2** of Table 1 in IEC 61000-6-2 with minor amendments. These amendments extend the range of radio-frequency fields to cover from 27 MHz to 1 000 MHz, and increase the field strength for the power-frequency field to 80 A/m, as specified in this standard. The requirements are summarized as follows.

— Frequency range from 27 MHz to 1 000 MHz. Root-mean-square electric field strength up to and including 10 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 1 kHz, except for the frequencies from 87 MHz to 108 MHz, from 174 MHz to 230 MHz and from 470 MHz to 790 MHz as specified in note 3 of Table 1 in IEC 61000-6-2, where the root-mean-square electric field strength is up to and including 3 V/m (unmodulated) with 80 % sinusoidal amplitude modulation at 1 kHz.

— Uniform root-mean-square alternating magnetic field of 80 A/m strength at 50 Hz or 60 Hz.

15.4.2 The immunity of any instrument to power- and radio-frequency fields shall be demonstrated by applying an acoustic source of pink noise, band limited to 1/1 octave of 1 kHz (from 700 Hz to 1,4 kHz), with a roll-off rate of at least 12 dB per octave below and above these frequencies, respectively, at an A-weighted sound level of 85 dB ± 1 dB or corresponding exposure level as indicated by the personal sound exposure meter under test, suitably calibrated. The acoustic signal shall be applied to the microphone in such a manner that causes no interference with either the applied electromagnetic field or the normal operation of the personal sound exposure meter, or of the susceptibility of the instrument to power- or radio-frequency radiation. The personal sound exposure meter shall be positioned in the reference orientation relative to the source of radio-frequency emissions.

15.4.3 During testing, the personal sound exposure meter shall be set for the normal mode of operation as described in the instruction manual. It shall be turned on, powered by its preferred supply, and set to read A-weighted sound levels, if available. The level range control shall be set (if applicable) to cover the range of sound levels from 80 dB to 90 dB. If a choice of ranges covering these sound levels exists, the selected range shall be the one for which the lowest measured sound level within the sound level range is closest to, but not greater than, 80 dB.

15.4.4 When the power- or radio-frequency field is applied, the change in the indication of the sound level measured by the personal sound exposure meter shall not exceed ±2 dB or corresponding exposure levels.

15.4.5 For personal sound exposure meters that do not give readouts of sound level in decibels, the equivalent error limits shall be calculated in appropriate units. If sound exposures (E) are used, the measured time interval shall be appropriate to levels and display resolutions for the tests required by this standard, with a minimum interval of 10 s

15.4.6 If the instruction manual states that a personal sound exposure meter conforms to the specifications of this clause for A-weighted sound levels less than 85 dB, then the personal sound exposure meter shall conform within the tolerance limits of **15.4.4** for all sound levels between 85 dB and the stated lower level on all possible level ranges (if any) of the personal sound exposure meter for all tests. The lower level shall be stated to 1 dB resolution and shall apply to all modes of operation of the instrument.

15.4.7 The instruction manual shall state the mode of operation and the connecting devices (if any) that produce the minimum immunity to power- and radio-frequency fields

15.5 Test procedures

15.5.1 ***General***

15.5.1.1 The tests described in this subclause shall be carried out unless the particular configuration of the personal sound exposure meter renders them inappropriate, in which case equivalent tests shall be substituted if equivalence to these tests can be demonstrated

15.5.1.2 During testing, the personal sound exposure meter shall be set in the configuration for normal operation as described in the instruction manual. The instrument shall be turned on, powered by its preferred source of supply, and set to measure A-weighted sound levels, if available, otherwise sound exposure. The preferred source of supply is a battery, with no connections to other apparatus. A1

A1 **15.5.1.3** Personal sound exposure meters that are not equipped with a means of measuring and displaying the immediate response to the applied radio-frequency electromagnetic fields may require lengthy testing. For the purposes of testing to this standard, and to avoid prolonged testing times, it is recommended that a means be made available for measurements to be made in a short time scale which can be demonstrated to be equivalent to the levels and tolerances specified in this standard. Where a special measurement mode is provided, whether or not it is fitted to the normally supplied version of the personal sound exposure meter, it may be regarded as the normal mode of operation provided its measurement equivalence can be verified.

15.5.1.4 Full details of equipment required to perform the tests and the methods of executing them are mostly contained in other standards with the additional requirements for personal sound exposure meters specified in this clause. Other standards listed in clause **2** shall be referred to for all relevant tests.

15.5.2 ***Emission measurements***

15.5.2.1 The personal sound exposure meter shall be set to produce the greatest emissions in the frequency range being investigated.

15.5.2.2 Measurements of emissions shall be as described in clauses **6** and **10** of CISPR 22. All results from measurements of radiated emissions shall conform to the requirements for enclosure ports given in Table 1 of CISPR 61000-6-3.

15.5.2.3 The personal sound exposure meter shall initially be tested in the reference orientation. For personal sound exposure meters with microphones attached by a cable, the microphone shall be positioned with respect to the body of the meter consistent with normal usage when fitted to a person in an upright stance, but without any wearer present. Any excess cable shall be secured in a manner recommended by the supplier of the personal sound exposure meter

15.5.2.4 Maintaining the configuration of **15.5.2.3**, the personal sound exposure meter shall be tested for emissions in at least one other plane, each approximately orthogonal to the reference orientation, within the limits of suitable positioning for the measuring system employed.

15.5.2.5 Any fixtures and fittings used to maintain the position of the personal sound exposure meter (including the microphone and cable if appropriate), shall be such as to have no significant influence on the measurement of any emissions from the personal sound exposure meter.

15.5.2.6 If the personal sound exposure meter is fitted with any connection device that allows interface or interconnection cables to be attached to it, and the use of an interconnecting cable is essential during the taking of measurements, then all tests of radio-frequency emissions shall be carried out with cables connected to all necessary connection devices. If the use of connection devices are not required during the taking of measurements, but are subsequently required to access information (for example, download to a computer), then the meter shall only be required to be tested with cables connected whilst in a mode of operation consistent with usage of the connecting device. All cables shall be left unterminated and be arranged as described in clause 8 of CISPR 22, unless the manufacturer of the personal sound exposure meter also supplies the device connected to the personal sound exposure meter by this cable, in which case all items shall be tested together.

15.5.2.7 Where several connections can be made to the same connecting device, emissions shall be measured only with the configuration that produces the greatest emissions. Other configurations emitting similar or lower levels of emissions may be included in the instruction manual in a list of compliant configurations without further testing, provided the tested configuration fully conforms to the limits of **15.2**.

15.5.3 ***Tests for electrostatic discharge***

15.5.3.1 Equipment required and methods of testing are described in IEC 61000-4-2.

15.5.3.2 If the instrument under test is fitted with connection devices that are not required as part of the configuration for the normal mode of operation, then no cables shall be fitted during the electrostatic-discharge test. Discharges shall not be made to pins on connectors that are recessed behind the surface of either the connector or the personal sound exposure meter.

15.5.3.3 Any supports or other items used to maintain the position of the personal sound exposure meter during test shall not obscure any part of the personal sound exposure meter required for access for static discharge, nor shall they affect the testing of the personal sound exposure meter. A1

A1 **15.5.3.4** Contact and air discharges of all required polarities and voltages shall be applied 10 times each to all appropriate points of the instrument under test.

NOTE Care should be taken to ensure that the personal sound exposure meter under test is fully discharged from any effects of each test before repeating the application of a discharge.

15.5.3.5 If the instruction manual specifies a performance degradation or loss of function after these tests, this degradation or loss of function shall not allow any reduced operation, change of configuration or corruption or loss of any stored data.

15.5.4 ***Tests for immunity to power- and radio-frequency fields***

15.5.4.1 The equipment required and the test methods are described in IEC 61000-4-3.

15.5.4.2 Testing shall first be made in the reference orientation with any microphone cables arranged as described in **15.5.2.3**. The acoustic source described in **15.4.2** shall be applied to the microphone.

15.5.4.3 Tests for immunity to radio-frequency fields may be performed at discrete frequencies in accordance with clause **8** of IEC 61000-4-3, but increments of up to 4 % for frequencies below 500 MHz and up to 2 % for all other frequencies may be substituted for the 1 % specified therein. Dwell time for each frequency shall be appropriate to the personal sound exposure meter under test. Testing at a limited number of discrete frequencies does not negate the need to meet the requirements of **15.4** at all frequencies within the specified range.

15.5.4.4 If the personal sound exposure meter is fitted with a connection device that allows interface or interconnection cables to be attached to it, and the use of an interconnecting cable is essential during the taking of measurements, then all tests for immunity to radio-frequency fields shall be performed with cables connected to all available connection devices. If the use of connection devices is not required during the taking of measurements, but are subsequently required to access information (for example, download to a computer), then the meter is only required to be tested with cables connected whilst in a mode of operation consistent with usage of the connecting device. All cables shall be left unterminated and shall be arranged as described in clause **8** of CISPR 22, unless the manufacturer of the personal sound exposure meter also supplies the device connected to the personal sound exposure meter by this cable, in which case all items shall be tested together.

15.5.4.5 Where several connections can be made to the same connecting device, tests shall be performed only with the configuration specified in the instruction manual as producing minimum immunity. Other configurations that are equally or more immune may be included in the instruction manual in a list of conforming configurations without further testing, provided the tested configuration fully conforms to the limits of **15.4**.

15.5.4.6 Tests of immunity to radio-frequency fields shall be performed as described in clause **8** of IEC 61000-4-3.

15.5.4.7 Power-frequency testing shall be as specified in **12.5** with the acoustic source of **15.4.2** applied to the microphone in a manner that has no influence on the power-frequency field.

15.5.4.8 Maintaining the configuration of **15.5.4.2** and **15.5.4.4**, the personal sound exposure meter shall be tested in at least one other plane, each approximately orthogonal to the reference orientation, within the limits of suitable positioning for the radio-frequency transmitting system employed

15.5.4.9 During testing, the personal sound exposure meter shall remain fully operational and in the same configuration as it was before testing commenced

15.5.4.10 If the instruction manual states that the instrument conforms to the specifications of this clause at a sound level less than 85 dB, the tests for immunity to power- and radio-frequency fields shall all be repeated in steps of not greater than 5 dB on all applicable level ranges from a sound level of 85 dB down to the lower sound level stated in the instruction manual for conformance with the specifications of this clause to the nearest 1 dB or corresponding exposure levels. The specified acoustic source shall continue to be used for these tests, with its output signal level reduced as required. A1

Annex A (informative)
Sound exposures and corresponding normalized 8-h-average sound levels

Table A.1 — Sound exposures and corresponding normalized 8-h-average sound levels

E Pa^2h	$L_{Aeq,8hn}$ dB
0,32	80
0,40	81
0,51	82
0,64	83
0,80	84
1,01	85
1,27	86
1,60	87
2,02	88
2,54	89
3,20	90
4,03	91
5,07	92
6,39	93
8,04	94
10,12	95
12,74	96
16,04	97
20,19	98
25,42	99
32,00	100
40,29	101
50,72	102
63,85	103
80,38	104
101,19	105

NOTE For normalized 8-h-average sound levels, $L_{Aeq,8hn}$, in decibels, sound exposures E, in pascal-squared hours, were calculated from:

$$E = (p_0^2\ T_n)\ [10^{(0,1\ \times\ L_{Aeq,8hn})}]$$

where p_0 = 20 μPa and the normalization T_n = 8 h; see also Eq.(5).

Annex B (informative)
Recommended tests to verify the performance of a personal sound exposure meter

B.1 Initial procedures

B.1.1 The manufacturer may recommend equivalent tests as alternatives to those described in this annex for demonstrating compliance with the specifications of this International Standard.

B.1.2 If the resolution of a personal sound exposure meter is less than the minimum of 0,1 Pa^2h required in **4.6**, then test times shorter than those given in this annex may be used if consistent with the requirements of this International Standard.

B.1.3 The description of tests in this annex assumes that the personal sound exposure meter to be tested displays sound exposure in pascal-squared hours. Consult the Instruction Manual if the instrument displays other than sound exposure or sound exposure with a unit other than pascal-squared hours.

B.1.4 All tests should be performed at, or referred to, the reference conditions of clause **5**.

B.1.5 The personal sound exposure meter should be checked and adjusted, if necessary, in accordance with the manufacturer's specifications. Check the absolute acoustical sensitivity in accordance with clause **6**.

B.1.6 If the performance of a personal sound exposure meter is to be tested with acoustic signals, the personal sound exposure meter should be installed as recommended by the manufacturer and tested using the recommended type of sound field and test equipment, in accordance with the requirements of **7.1**. When input electric signals are inserted via the input test facility (input test point, dummy microphone, input adapter, or equivalent device provided by the manufacturer), the acoustical characteristics of the microphone are accounted for by separate means, in accordance with **7.4**. The equivalence between the level of an input electrical signal and the level of an input acoustic signal is established by calibration.

B.1.7 A means should be provided to measure sound-exposure integration times within 1 %.

B.2 Linearity of response to steady signals

B.2.1 Linearity of response to steady 1 kHz sinusoidal signals should be tested with different combinations of signal levels and integration times of up to 8 h. Linearity response measurements should be made at intervals no greater than 10 dB from the reference sound pressure level and at the upper and lower boundaries of the specified sound level range. Linearity response measurements should be made from an exposure indication of approximately three times the lower boundary of the sound exposure range up to approximately 80 % of the upper boundary of the sound exposure range, and at intervals in sound exposure which are no greater than a five-fold increase or decrease in sound exposure. For at least one measurement, the integration time should be at least 8 h.

Table B.1 — Minimum set of target conditions for 1 kHz steady-signal linearity tests

Target 1 kHz equivalent input sound level dB	**Target integration time**	**Target calculated sound exposure** Pa^2h
$80 - \Delta R_L$	as required	0,300
80	8 h	0,320
90	4 h	1,600
100	0,5 h (30 min)	2,000
110	0,25 h (15 min)	10,000
120	0,1 h (6 min)	40,000
130	1/50 h (72 s)	80,000
$130 + \Delta R_U$	as required	80,000

NOTE When the manufacturer-specified sound level range extends below 80 dB or above 130 dB, $80 - \Delta R_L$ is the lower boundary and $130 + \Delta R_U$ is the upper boundary of the sound level range.

B.2.2 Table B.1 gives an example of the minimum set of combinations of sound pressure level and integration time for testing the linearity of a personal sound exposure meter at 1 kHz.

B.2.3 For each test condition in Table B.1, apply the target 1 kHz equivalent input signal for the target integration time. Note the indicated sound exposure. By use of Eq.(3), calculate the sound exposure that should have been indicated for the measured input signal level and measured integration time. For all combinations, the indicated sound exposure should equal the calculated sound exposure within the tolerances of **8.1**.

B.2.4 At 63 Hz and 8 kHz, the linearity of response to steady signals may be tested over a more limited range of input sound pressure levels, at intervals no greater than 10 dB, and also for a limited number of target sound exposures, in accordance with the requirements of **8.2** and **8.3**, respectively.

B.3 Frequency weighting

B.3.1 Frequency weighting is tested with constant-amplitude, sinusoidal signals. The sound level of the 1 kHz input signal should be approximately 3 dB less than the upper boundary of the specified sound level range to allow for the response of the A-weighting at frequencies above 1 kHz.

B.3.2 Tests should be performed at the eight nominal frequencies specified in Table 1 in clause **7**. For nominal frequencies of 63 Hz and 125 Hz, the signal duration may be increased as necessary until the indicated sound exposure is more than 20 times the sound exposure resolution. For a personal sound exposure meter with a resolution of 0,1 Pa^2h, for example, the indicated sound exposure should be greater than 2,0 Pa^2h.

B.3.3 As an example, if the 1 kHz input sound pressure level (L_{1k}) is 130 dB, at a frequency of 63 Hz the input sound pressure level (L_{63}) effectively becomes an A-weighted sound pressure level of 130 – 26,2 = 103,8 dB. By Eq.(3), a sound exposure of 2,0 Pa^2h will be indicated after integration for 0,208 h or 750 s, approximately. To obtain the measured sound exposure (E_{63}) at 63 Hz, multiply the indicated sound exposure (E_{ind}) by the ratio of the duration (T_{1k}) of the sound exposure measured at 1 kHz to the duration (T_{63}) of the sound exposure measured at 63 Hz, and also by the ratio of the corresponding mean-square sound pressures of the 1 kHz and 63 Hz signals, that is, $E_{63} = (E_{ind})(T_{1k}/T_{63})(10^{0,1\,\Delta^L})$, where $\Delta L = L_{1k} - L_{63}$ is the difference between the input sound pressure levels.

B.3.4 A measured exposure ratio is the measured sound exposure at some frequency divided by the measured sound exposure at 1 kHz. At all test frequencies, measured sound exposure ratios should equal the corresponding design-goal sound exposure ratios within the tolerances of Table 1 and the requirements of **7.1**. When the sound exposure ratios are measured with electrical signals, they are to be corrected, if necessary, for the influence of the frequency response of the microphone.

B.4 Response to short-duration signals

B.4.1 The response of a personal sound exposure meter to short-duration signals is determined by comparing (a) the sound exposure indicated in response to a sequence of repeated 1 ms or 10 ms duration, 4 kHz tonebursts with (b) the sound exposure, E_{4k}, indicated in response to a steady 4 kHz sinusoidal reference signal.

B.4.2 The measured sound exposure, E_{4k}, is that sound exposure indicated by the instrument under test in response to a steady, 4 kHz sinusoidal signal at an equivalent input sound pressure level of 94,0 dB (i.e., an A-weighted input sound pressure level of 95 dB) applied for a duration of 47 min and 26 s so as to yield a nominal sound exposure of 1 Pa^2h within tolerances from 0,71 Pa^2h to 1,41 Pa^2h.

B.4.3 The input signal level, time between tonebursts, and total sound-exposure integration time of the sequences of repeated tonebursts should be selected to yield a nominal sound exposure of 1 Pa^2h. The sound pressure level of the 4 kHz sinusoidal signals, from which tonebursts are extracted, should extend at least from 114,0 dB to 129,0 dB, or to (129,0 + ΔR_U) dB if applicable, corresponding to A-weighted sound pressure levels of at least from 115 dB to 130 dB, or to (130 + ΔR_U) dB if applicable. See Table B.1 for the definition of the upper boundary of the sound level range at (130 + ΔR_U) dB.

B.4.4 Any suitable combination of 1 ms or 10 ms duration, 4 kHz tonebursts meeting the requirements of clause **9** may be used to demonstrate compliance with the specifications on response to short-duration signals. The toneburst tests of Table B.2 constitute minimum combinations of (a) ratios of "on-time" to burst-repetition time, (b) input sound pressure level and (c) integration time durations, all of which yield a nominal sound exposure of 1 Pa^2h. Sound exposures indicated in response to toneburst signals should be within the applicable tolerances from **9.5**, as shown in Table B.2.

B.5 Response to unipolar pulses

B.5.1 The recommended test for response to unipolar signals utilizes a sequence of rectangular pulses. Each pulse should have a duration of 0,5 ms. The interval between pulses should be at least 4,5 ms. The peak input sound pressure level of an individual pulse should be adjusted to be approximately 5 dB less than the steady 1 kHz input sound pressure level at the upper boundary of the specified sound level range.

B.5.2 Apply a sequence of positive-going pulses until the indicated sound exposure is greater than 10 Pa^2h and note the integration time. Invert the polarity of the input signal and apply a sequence of negative-going pulses of the same amplitude and for the same integration time. The indicated sound exposure in response to positive-going pulses should equal the sound exposure indicated in response to negative-going pulses, within the tolerances of clause **10**.

B.6 Latching overload indicator

B.6.1 The recommended electric signal for testing the response of the latching overload indicator is a single toneburst with four cycles of a 1 kHz sinusoid starting and stopping at a zero crossing.

Table B.2 — Conditions for testing response to short-duration signals

4 kHz tonebursts		4 kHz input[a] sound pressure level	Equivalent-continuous A-weighted sound level of toneburst signal	Integration period[b]	Sound exposure Pa^2h		
Duration ms	Burst ratio	dB	dB	seconds	Min.	Ref.[d]	Max.
10	1 : 100	114,0	95	2 846[c]	0,79 E_{4k}	E_{4k}	1,26 E_{4k}
1	1 : 1 000	124,0	95	2 846[c]	0,79 E_{4k}	E_{4k}	1,26 E_{4k}
1	1 : 1 000	129,0	100	900[c]	0,71 E_{4k}	E_{4k}	1,41 E_{4k}
10	1 : 1 000	129,0	100	900[c]	0,71 E_{4k}	E_{4k}	1,41 E_{4k}
1	1 : 1 000	129,0 + ΔR_U	100 + ΔR_U	$900/10^{0,1\Delta R_U}$	0,71 E_{4k}	E_{4k}	1,41 E_{4k}

[a] The 4 kHz input sound pressure level is that of the steady sinusoidal signal from which the tonebursts are extracted.
[b] Toneburst test duration in seconds = $(9 \times 10^{12})(10^{-0,1L})$, where L is the equivalent-continuous A-weighted sound pressure level, in decibels, of a toneburst or the A-weighted level of the steady signal minus 20 dB (for a burst ratio of 1 : 100) or minus 30 dB (for a burst ratio of 1 : 1 000).
[c] 2 846 s = 47 min and 26 s; 900 s = 15 min.
[d] The reference is the measured 4 kHz sound exposure, E_{4k}, determined as described in **B.4.2**.

B.6.2 With the test signal applied through the input test facility, the overload indicator should trigger and remain latched when the equivalent sound level of the steady 1 kHz signal, from which the toneburst is extracted, is 3 dB greater (peak level 6 dB greater) than the upper boundary of the specified sound level range.

B.6.3 The overload indicator should not trigger when the equivalent sound level of a continuous 1 kHz sinusoidal signal, or when the equivalent sound level of the steady 1 kHz signal from which the 4 ms duration, 1 kHz tonebursts are extracted, equals the upper boundary of the sound level range.

A1 Annex C (informative) Emission limits

Table C.1 — Limits for radiated disturbance of class 8 ITE at a measuring distance of 10 m

Frequency range MHz	**Quasi-peak limits** dB (μV/m)
30 to 230	30
230 to 1 000	37
Note 1 The lower limit applies at the transition frequency Note 2 Additional provisions may be required for cases where interference occurs.	

NOTE The characteristics of a quasi-peak receiver are specified in **4.1.2** of CISPR 16-1 [2].

[2] CISPR 16-1:1999, *Specification for radio disturbance and immunity measuring apparatus and methods — Part 1: Radio disturbance and immunity measuring apparatus.* A1

Annex ZA (normative)
Other international publications quoted in this standard with the references of the relevant European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

IEC publication	Date	Title	EN/HD	Date
60050(801)	1984	*International Electrotechnical Vocabulary (IEV) — Chapter 801: Acoustics and electro-acoustics*	—	—
60651	1979	*Sound level meters*	EN 60651	1994
60801-2	1984	*Electromagnetic compatibility for industrial-process measurement and control equipment — Part 2: Electrostatic discharge requirements*	EN 60801-2	1993
60801-3	1984	*Part 3: Radiated electromagnetic field requirements*	HD 481.3 S1	1987
60804	1985	*Integrating-averaging sound level meters*	EN 60804[a]	1994
60942	1988	*Sound calibrators*	HD 556 S1	1991
⟨A1⟩ IEC 61000-4-2	1995	*Electromagnetic compatibility (EMC) — Part 4-2: Testing and measurement techniques — Electrostatic discharge immunity test*	EN 61000-4-2	1995
IEC 61000-4-3 (mod)	1995	*Part 4-3: Testing and measurement techniques — Radiated, radio-frequency electromagnetic field immunity test*	EN 61000-4-3	1996
IEC 61000-6-1	1997	*Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments*	—	—
IEC 61000-6-2	1999	*Part 6-2: Generic standards — Immunity for industrial environments*	EN 61000-6-2	1999
IEC 61000-6-3	1996	*Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments*	—	— ⟨A1⟩

Other publications:

ISO 266:1975	*Acoustics — Preferred frequencies for measurements*
ISO 1683:1983	*Acoustics — Preferred reference quantities for acoustic levels*
ISO 1999:1990	*Acoustics — Determination of occupational noise exposure and estimation of noise-induced hearing impairment*
ISO 9612:199x	*Acoustics — Guidelines for the measurement and assessment of exposure to noise in the working environment* (in preparation)

⟨A1⟩ CISPR 22 (mod)	1997	*Information technology equipment — Radio disturbances characteristics — Limits and methods of measurement*	EN 55022 + corr. August	1998 1999 ⟨A1⟩

[a] EN 60804 includes A1:1989 to IEC 804.

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