BRITISH STANDARD

BS EN 60804:2001
IEC 60804:2000

Integrating-averaging sound level meters

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

ICS 17.140.50

National foreword

This British Standard is the official English language version of EN 60804:2000. It is identical with IEC 60804:2000. It supersedes BS EN 60804:1994 which is withdrawn.

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

— aid enquirers to understand the text;

— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications 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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EUROPEAN STANDARD **EN 60804**

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English version

Integrating-averaging sound level meters
(IEC 60804:2000)

Sonomètres intégrateurs moyenneurs
(CEI 60804:2000)

Integrierende mittelwertbildende
Schallpegelmesser
(IEC 60804:2000)

This European Standard 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.

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CENELEC
European Committee for Electrotechnical Standardization
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Foreword

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

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

The following dates were fixed:

– latest date by which the EN has to be implemented 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 EN have to be withdrawn (dow) 2003-11-01

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

Endorsement notice

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

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INTEGRATING-AVERAGING SOUND LEVEL METERS

1 Scope

1.1 General

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

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

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

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

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

1.2 Types

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

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

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

1.3 Characteristics specified

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

a) integrating and averaging characteristics;

b) indicator characteristics;

c) overload sensing and indicating characteristics.

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

a) directional characteristics (clause 5);

b) frequency weighting characteristics (6.1 and 6.2);

c) sensitivity to various environments (clause 8).

1.4 Tolerances

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

1.5 Test specified

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

1.6 Normative references

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

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

IEC 60651:1979, *Sound level meters*

IEC 60942:1997, *Electroacoustics – Sound calibrators*

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

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

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

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

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

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

2 Object and general requirements

2.1 Object

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

2.2 Applications

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

Typical applications for the integrating sound level meter are

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

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

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

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

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

2.3 General requirements

2.3.1 Frequency weighting

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

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

2.3.2 Averaging and integration

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

2.3.3 Calibration

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

2.4 Method of use

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

3 Definitions

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

3.2
frequency-weighted sound pressure level
the frequency-weighted sound pressure level, in decibels (dB), is 20 times the logarithm to the base ten of the ratio of a weighted sound pressure to the reference sound pressure. The reference sound pressure is 20 μPa. The frequency weighting shall be indicated.

3.3
equivalent continuous A-weighted sound pressure level
(also time-average A-weighted sound pressure level or time-average sound level). It is defined as follows:

$$L_{\mathrm{Aeq,T}} = 10\lg\left\{\left(\frac{1}{T}\int_{t_1}^{t_2} p_{\mathrm{A}}^2(t)\,\mathrm{d}t\right)\Big/ p_0^2\right\} \quad \mathrm{dB}$$

where

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

$p_{\mathrm{A}}(t)$ is the instantaneous A-weighted sound pressure of the sound signal;

p_0 is the reference sound pressure of 20 μPa.

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

$$L_{\mathrm{Ceq,T}} = 10\lg\left\{\left(\frac{1}{T}\int_{t_1}^{t_2} p_{\mathrm{c}}^2(t)\,\mathrm{d}t\right)\Big/ p_0^2\right\} \quad \mathrm{dB}$$

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

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

3.4
A-weighted sound exposure level
It is defined as follows:

$$L_{AE} = 10 \lg \left\{ \left(\int_{t1}^{t2} p_A^2(t)\,dt \right) \Big/ \left(p_0^2 \cdot T_0 \right) \right\} \quad \text{dB}$$

where

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

p_0 is equal to 20 μPa;

T_0 is equal to 1 s.

NOTE The expression $\int_{t1}^{t2} p_A^2(t)dt$ is the A-weighted sound exposure, E_A.

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

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

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

3.5
linearity range
difference, in decibels, between the upper and lower r.m.s. levels of continuous sinusoidal signals applied to the input within which the linearity requirements given in 6.2 are met

3.6
pulse range
greatest level difference, in decibels, between the peak signal level of a tone burst and the r.m.s. level of a continuous low-level signal for which the specifications given in 6.2 are met

3.7
reference range (of the integrating sound level meter)
level range specified by the manufacturer for calibration purposes and which includes the reference sound pressure level (see 3.15)

3.8
indicator range
range of levels, in decibels, that can be indicated at each setting of the level range control (if any). It has level linearity tolerances equal to those within the primary indicator range as defined in IEC 60651, except for Type 3 instruments where the tolerances are equal to those for Type 2 instruments (see 1.2)

3.9
tone bursts
one or more complete cycles of sinusoidal signal. For the purpose of this standard, the tone burst signals start and end at a zero crossing of the waveform

3.10
burst duty factor (of the test signal of 9.3.2)
ratio of the duration of the tone burst to the duration of a complete cycle at the repetition frequency

3.11
reference direction
direction of sound incidence specified by the manufacturer to be used for testing the directional characteristics of the integrating sound level meter. For free-field calibration, it is also the direction of sound incidence for the calibration of absolute sensitivity and frequency weighting (see 3.13). If diffuse-field calibration (see 3.14) is used, the reference direction shall be such that for plane progressive waves arriving at the microphone from this direction, the frequency response approximates most closely the response in a diffuse field

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

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

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

3.12
reference frequency
frequency specified by the manufacturer to be used for calibration of the absolute sensitivity (see 3.7 of IEC 60651)

3.13
free-field calibration
calibration of absolute sensitivity and frequency weighting for plane progressive sound waves arriving at the microphone in the reference direction (see 9.1 and annex C)

3.14
diffuse-field calibration
calibration of absolute sensitivity and frequency weighting for a diffuse sound field (see 9.1 and annex C)

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

3.15
reference sound pressure level
sound pressure level specified by the manufacturer used for calibrating the absolute sensitivity of the integrating sound level meter

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

3.16
integrating sound level meter
descriptor applicable to both integrating-averaging and integrating sound level meters

3.17
reference orientation (of an integrating sound level meter)
orientation of an integrating sound level meter with respect to the principal direction of an emitter or receiver of radio-frequency fields such that for integrating sound level meters with the microphone directly attached, the reference orientation specified for the instrument is directly in line with the principal direction of this same emitter or receiver. For instruments that do not have the microphone directly attached, the configuration for the reference orientation is specified in the instruction manual

3.18
group X integrating sound level meter
self-contained instrument that includes time-integration facilities according to this standard and which specifies internal battery power for the normal mode of operation, requiring no external connections to other apparatus to measure sound levels

3.19
group Y integrating sound level meter
self-contained instrument that includes time-integration facilities according to this standard and which specifies connection to a public power supply system for the normal mode of operation, requiring no external connections to other apparatus to measure sound levels

3.20
group Z integrating sound level meter
instrument that includes time-integration facilities according to this standard requiring two or more items of equipment to be connected together by some means for the normal mode of operation, with operation either from batteries or from a public power supply. The configuration for the normal mode of operation is specified in the instruction manual

4 General characteristics

4.1 Specifications in this standard apply to the overall performance of integrating-averaging sound level meters with specified frequency weightings. The principal elements of integrating-averaging sound level meters generally include a microphone, an amplifier, an integrator and a time averager, and an indicator. The specifications also apply to integrating sound level meters with specified frequency weightings. The principal elements of integrating sound level meters generally include a microphone, an amplifier, an integrator and an indicator.

In clauses 4, 5, 6 and 7, specifications are given for the principal elements of integrating-averaging and integrating sound level meters with tolerances for four instrument types. In clause 8, the specifications for the sensitivity to various environments are given. Any additional item necessary to meet any of the requirements (such as an extension rod or cable and a random incidence corrector) is regarded as an integral part of an integrating-averaging or integrating sound level meter.

In addition to indicating the equivalent continuous sound pressure level, the integrating sound level meter may indicate sound exposure level and may include other facilities as described in IEC 60651.

If the integrity sound level meter is designed to indicate the average AI-weighted sound pressure level, the requirements of annex B shall be met.

4.2 The equivalent continuous sound pressure level indicated by the instrument under the reference conditions specified in 9.1, and at the reference sound pressure level and reference frequency, shall be accurate to within ±0,4 dB, ±0,7 dB, ±1,0 dB and ±1,5 dB for Type 0, 1, 2 and 3 instruments respectively, after any warm-up period specified by the manufacturer and after following the manufacturer's recommended field checking/calibrating procedure. A means shall be available (for example, a sound calibrator meeting the requirements of IEC 60942) to check and maintain calibration such that the tolerances specified above are met for the reading under reference conditions.

4.3 The directional characteristics of the microphone and instrument case shall satisfy the requirements of clause 5 of IEC 60651.

4.4 The output signal of the microphone is amplified and frequency weighted to produce the characteristic designated A. Other frequency weightings are optional. Weighting and amplifier circuits shall satisfy the requirements of 6.1 and 6.2 of IEC 60651.

4.5 The averaging and indicator characteristics shall be in accordance with the detailed specifications given in clause 6.

4.6 An integrating sound level meter shall include an overload indicator with characteristics as specified in clause 7.

4.7 Tests to determine the performance of an integrating sound level meter for compliance with this standard are given in clause 9.

4.8 The manufacturer shall provide the means to substitute an electrical signal for the microphone for the purpose of performing tests on the complete instrument without the microphone. The manufacturer shall also provide suitable test points.

4.9 If the instrument is battery operated, suitable means shall be provided to check that a battery voltage adequate to operate the instrument according to the specifications is maintained.

NOTE For averaging times of more than 1 h, the check should be performed without disturbing the measurement.

4.10 After warm-up period to be specified by the manufacturer, but less than 10 min, and for a signal within the linearity range, the reading shall not change during 1 h of continuous operation under constant test conditions by more than the values shown in table 1.

Table 1 – Maximum change of reading, in decibels, during 1 h of operation

Type 0	Type 1	Type 2	Type 3
0,2	0,3	0,5	0,5

4.11 An integrating sound level meter may be equipped to measure and display the time elapsed since the beginning of an integration or to permit presetting of a desired integrating period. If timing facilities are included, they shall measure to an accuracy of 1 % or better. If pre-set averaging times are included, it is recommended that they be chosen from among the following: 10 s, 1 min, 5 min, 10 min, 15 min, 1 h, 8 h and 24 h.

5 Frequency weighting and amplifier characteristics

5.1 The complete instrument comprising the microphone, amplifier, weighting network, averager and indicator shall have the A-weighting frequency characteristic with the response and tolerances specified in 6.1 and 6.2 and tables IV and V of IEC 60651. Where other weightings are provided, they shall meet the requirements of IEC 60537 and 60651 as appropriate.

5.2 When a level range control is included, it shall not introduce errors in excess of those given in 6.3 and table VI of IEC 60651.

6 Averaging and indicator characteristics

6.1 The indicator shall display the equivalent continuous A-weighted sound pressure level in decibels and shall meet the requirements of table 3 when tested as described in 9.3.2. In addition, it may also display the A-weighted sound exposure level in decibels and/or the average AI-weighted sound pressure level (see annex B) in decibels.

6.2 The linearity range (for both equivalent continuous A-weighted sound pressure level and the optional A-weighted sound exposure level) shall be specified by the manufacturer and shall meet or exceed the requirements of table 2 on the reference range and for sinusoidal signals at a frequency of 4 kHz, when tested as described in 9.3.3.

The pulse range shall be specified by the manufacturer and meet at least the requirements of table 2 when tested as described in 9.3.4.

The numerical value of the linearity range shall be no more than 3 dB below the numerical value of the pulse range. It may, however, be equal to, or exceed, the pulse range.

NOTE A linearity range exceeding the minimum values in table 2 or an automatic level range control may be advantageous for unattended applications.

Table 2 – Minimum values for linearity range and pulse range with tolerances (according to 9.3.3 and 9.3.4 respectively), in decibels

	Type		
	0	**1**	**2 and 3**
Minimum value of linearity range	70	60	50
Tolerance (for testing according to 9.3.3)	±0,4	±0,7	±1,0
Minimum value for pulse range	73	63	53
Tolerance, burst duration <10 ms but ≥1 ms (for testing according to 9.3.4)	±1,9	±2,2	±2,5
Tolerance, burst duration ≥10 ms (for testing according to 9.3.4)	±1,4	±1,7	±2,0
NOTE The tolerances for the linearity range refer to the deviations from the true linearity and those for the pulse range to the theoretical value.			

If the instrument includes a manual level range control, it is permissible to allow a reduced linearity range and pulse range on the lowest and highest level ranges. Any reduction shall be stated by the manufacturer and shall not exceed 10 dB. The reduction shall include the effects of the microphone and preamplifier.

6.3 The indicator range, whether analogue or digital, shall be at least 30 dB. The indicator range shall extend neither above nor below the linearity range, except for the lowest and highest level ranges if the instrument includes a manual level range control.

6.4 When the integrating sound level meter has more than one level range, there shall be an overlap of indicator range of at least 20 dB for Types 0 and 1, and 10 dB for Types 2 and 3 between contiguous level ranges.

6.5 The manufacturer shall state the settling times for integration. After the start of an integration, settling times are the maximum times needed for the indication of the instrument to settle 0,5 dB and within 0,1 dB of the final indication. Settling times shall be determined for constant-level sinusoidal signals within the linearity range of the instrument.

NOTE It is recommended that the time period corresponding to 0,5 dB should be less than 10 s for equivalent continuous weighted sound pressure level indications of more than 30 dB.

In all cases, the time period shall be less than 1 min.

Where optional timing facilities (see 4.11) are operative and no indication is available until the end of the pre-set averaging time, the above requirement for 0,1 dB shall apply when the indication first occurs.

The manufacturer shall state the minimum hold time if the result is not held continuously.

6.6 When an analogue indicator (meter or recorder) is provided, its scale shall be graduated in steps not greater than 1 dB. Each decibel step shall be at least 1 mm wide.

A digital indicator shall have a resolution of 0,1 dB or better. When a discontinuous analogue indicator is used, reduced resolution is permitted. Resolution shall be equal to or better than 0,2 dB for Types 0 and 1 instruments, 1 dB for Type 2 instruments and 3 dB for Type 3 instruments. Because of the low resolution, special test methods will be required in order to demonstrate that all requirements of this standard are met.

6.7 A reset facility shall be fitted which shall re-initiate the computation of equivalent continuous A-weighted sound pressure level or A-weighted sound exposure level. It shall also reset any overload indication.

6.8 A "pause" facility and/or "cancel" facility may be provided either to interrupt the integration for a certain time and/or to cancel an increase due to integration during a specified time. The use of these devices shall not give rise to spurious indications.

NOTE The cancel facility may be such as to delete signal and measured elapsed time for as much as 10 s before the moment of activation.

7 Overload indication

7.1 The integrating sound level meter shall have a peak detecting overload monitor. The monitor shall provide a latched indication if an overload condition has existed during any part of the integration period. The overload indication shall be reset only by re-initiation of the computation of equivalent continuous A-weighted sound pressure level or A-weighted sound exposure level.

7.2 Additional overload indicators with or without automatic reset are optional.

7.3 The overload indication shall be checked in accordance with 9.3.5.

NOTE The requirement that the overload indicator shall be triggered if overload of the input stages by strong low frequency component occurs, as tested by the procedure specified in the second paragraph of 9.3.1 of IEC 60651, persists for the integrating sound level meter.

8 Sensitivity to various environments

Integrating sound level meters shall meet the requirements of 8.1 to 8.6 of IEC 60651.

NOTE Instruments suitable for laboratory use only are distinguished by the marking "L" (see 11.1).

9 Calibration and verification of the basic characteristics

9.1 Introduction

The following tests shall be used to determine that the integrating sound level meter meets the requirements of this standard. All tests shall be made at or referred to the standard reference conditions of 20 °C, 65 % relative humidity and 1,013 $\times$ 10^5 Pa (1 013 mbar) atmospheric pressure. Unless otherwise stated, the tests shall be performed using low distortion sinusoidal signals.

NOTE 1 The manufacturer should provide detailed information as to how tests are performed.

NOTE 2 The observer should preferably not be present in the sound field; for example, by reading the meter remotely.

Testing under free-field conditions refers to a sound field consisting of plane progressive waves arriving at the microphone in the reference direction of incidence.

Testing for diffuse-field calibration is performed with plane progressive waves arriving at the microphone at various angles of incidence as described in appendix B of IEC 60651. For instruments which do not have rotational symmetry, this test has to be performed in two planes perpendicular to each other. From the results of the diffuse-field sensitivities S_1 and S_2 in the two planes, the geometric average is calculated from:

$$S = \sqrt{S_1 \times S_2}$$

During acoustic tests, the sound field shall not be significantly disturbed by the presence of the observer.

NOTE If for a given model of microphone or sound level meter the difference between free-field and diffuse-field sensitivity is known from measurements as described above, the diffuse-field sensitivity can be determined alternatively from the free-field sensitivity by adding this difference as a correction.

9.2 Overall instrument characteristics

Calibration procedure and tests related to the complete integrating sound level meter are described in 9.2.1, 9.2.2 and 9.2.3. The tests may be carried out partly as acoustical and partly as electrical tests if no loss in accuracy results.

9.2.1 The complete instrument shall be tested for absolute sensitivity at the reference sound pressure level and at the reference frequency as specified in 9.2.1 of IEC 60651. The accuracy shall be within the tolerances given in 4.2 for the reference conditions given in 9.1.

The test shall be performed to provide a free-field calibration, except that for instruments marked "R", the test shall be performed to provide a diffuse-field calibration.

9.2.2 The tolerances for frequency weighting relate to the overall acoustical performance of the integrating sound level meter, either free-field or diffuse-field (R) calibrated as appropriate. At the reference frequency, the unweighted sound pressure level should be the reference sound pressure level, but if not, shall be not more than 20 dB below this level during testing.

The testing of the frequency weighting may be divided into

a) testing of the microphone and those parts of the sound level meter which affect the sound field around the microphone in a suitable sound field and

b) testing of all other parts by using an electrical signal and equivalent electrical impedance substituted for the microphone.

In this case, the diffraction correction of the microphone and instrument case shall be applied as a correction to the frequency response of the electrical circuits in determining compliance with 6.1 of IEC 60651. The effects of any electrical circuits used to compensate the frequency response of the microphone shall be taken into account.

9.2.3 The variation in sensitivity as a function of angle of incidence of the sound shall be measured at a sufficient number of angles and frequencies to ensure that the requirements of clause 5 of IEC 60651 are met.

The tests apply to any instrument whether free field or diffuse field (R) calibrated. Angles are measured from the reference direction specified by the manufacturer.

9.3 Amplifier and indicator characteristics

The following tests shall be carried out using an electrical signal and an equivalent electrical impedance substituted for the microphone.

9.3.1 Level range control

When a level range control is included, it shall be tested to verify compliance with the requirements of 6.3 and table VI of IEC 60651.

9.3.2 Time averaging

This test compares the reading indicated on the reference range for continuous sinusoidal signals with that obtained from a sinusoidal tone burst sequence having the same equivalent continuous level.

A continuous signal at 4 kHz is applied to the instrument to give an indication 20 dB above the bottom end of the linearity range. A sequence of tone bursts at a frequency of 4 kHz whose calculated equivalent continuous level is identical to the level of the continuous signal is substituted. The indication shall be identical to that for the continuous signal within the tolerances given in table 3. For burst duty factors between consecutive values of table 3, the wider values of the two corresponding tolerances in decibels shall apply.

The duration of the sequence of tone bursts shall be at least 10 s. At least for the lowest relevant burst duty factor, the test shall also be performed with the test signal applied for a duration equal to the maximum integration time of the instrument or 1 h, whichever is less. The duration of individual tonebursts shall be not less than 1 ms. At least one test shall be performed with tonebursts of 1 ms duration.

For instruments capable of measuring A-weighted sound exposure level, these tests shall be repeated in the A-weighted sound exposure level mode.

All time averaging tests shall be carried out using A-weighting.

NOTE The systematic effect of this weighting on r.m.s. level is below 0,1 dB for all burst duty factors of table 3 and is ignored.

For instruments whose linearity range is greater than their pulse range the test shall be repeated at higher levels for the continuous signal until overload indication occurs.

Table 3 – Tolerances for time averaging tests

Burst duty factor of test signal	RMS amplitude of an individual tone burst relative to the r.m.s. amplitude of the continuous signal dB	Tolerances dB		
		Type 0	Type 1	Types 2 and 3
Continuous	0	–	–	–
1/10	10	±0,5	±0,5	±1,0
$1/10^2$	20	±0,5	±0,5	±1,0
$1/10^3$	30	±0,5	±1,0	±1,5
$1/10^4$	40	±1,0	±1,0	–
$1/10^5$	50	±1,0	–	–
NOTE The continuous signal and all tone burst sequences have identical equivalent continuous levels.				

9.3.3 Linearity range

The linearity range with tolerances on the level linearity is given in table 2. Error in level linearity is referred to the reference level on the reference range. The test shall be performed with sinusoidal signals at a frequency of 4 kHz.

For testing of linearity level outside the indicator range at signal levels which, if continuous, would exceed the limits of the indicator range, a sequence of tone bursts may be used. The duration of the tone burst shall be at least 1 ms and the burst duty factor shall not lie outside the range of values of table 3. Alternatively, if the linearity range extends below or above the indicator range, linearity range may be determined using suitable signals and test points within the integrating sound level meter.

9.3.4 Pulse range

An ideal integrating sound level meter will only be limited in pulse-handling capability by the limit imposed at the upper end of the linearity range. It will measure short duration, impulsive or discontinuous signals as accurately as signals that are continuous or only slowly varying. The following tests ensure that this ideal characteristic will be met within certain tolerance limits.

Testing is achieved by applying a single short-duration tone burst at a frequency of 4 kHz during a predetermined integration period, for example 10 s, superimposed upon a low-level continuous sinusoidal signal at a level corresponding to the lower limit of the linearity range. Timing of the integration period shall be to within 2 %. The low-level continuous signal and the tone burst shall be in phase with one another. The test shall be conducted on the reference range using tone burst durations ranging from 1 ms to 1 s.

The peak level of the tone burst when superimposed on the continuous signal shall be increased gradually until it exceeds the r.m.s. level of the continuous signal by the number of decibels specified in table 2 for the pulse range.

At no peak level of the tone bursts during this test shall the indicated value deviate from the theoretical value of the equivalent continuous level of the test signal by more than the tolerances for the pulse range specified in table 2.

The equivalent continuous level of the test signal shall be calculated from the amplitude and duration of the tone burst, the amplitude of the continuous signal and the integration time interval. It is recommended that tests be conducted with burst durations of 1 ms, 10 ms, 100 ms and 1 s, for which the theoretical levels for the pulse ranges specified in table 2 and an integration time interval of 10 s are given in table 4.

Table 4 – Examples of theoretical equivalent continuous levels, in decibels, of test signals relative to r.m.s. level of continuous signal alone for an integration time interval of 10 s

Peak level of the tone burst relative to the r.m.s. level of the continuous signal in decibels **		**73**	**63**	**53**
Tone burst duration	1 ms	30	20	10,4*
	10 ms	40	30	20
	100 ms	50	40	30
	1 s	60	50	40

* The increase from 10 to 10,4 is due to the continuous low-level signal.

** These relative peak levels correspond to the minimum values of the pulse range, as specified in table 2.

For instruments whose linearity range is greater than their pulse range, the test shall be repeated at a level for the continuous signal equal to the upper limit of the linearity range minus the pulse range given in table 2.

For instruments capable of measuring A-weighted sound exposure level, these pulse-duration tests shall be repeated with the instrument set to the A-weighted sound exposure level mode.

9.3.5 The overload indicator shall be checked at the same time as the performance of the pulse test described in 9.3.4.

The overload indicator is checked by a 1 ms burst of a 4 kHz signal. The amplitude of the tone burst is increased until overload indication occurs.

10 Provision for use with auxiliary equipment

10.1 If the integrating sound level meter can be used with a cable between the microphone and the amplifier, the corrections corresponding to this method of use shall be stated by the manufacturer.

NOTE Corrections due to the use of other available accessories should be stated. These accessories include windscreens, rain protectors, etc.

10.2 If the integrating sound level meter is provided with one or more outputs for use in driving analysers, recorders and other equipment, the following requirements shall apply.

a) If connection of external equipment having an impedance within the range specified by the manufacturer would affect the indicator by more than 0,1 dB for Type 0, 0,2 dB for Type 1, 0,5 dB for Type 2 and 1 dB for Type 3 instruments, the indicator shall be automatically muted or disconnected when such external equipment is connected.

b) Full details relating to the output characteristics of the signal shall be given.

NOTE It is recommended that when an output signal is provided, it should be possible to terminate the output in any impedance without affecting either the indicator or the linear operation of the instrument.

10.3 If connections are provided to permit insertion of an external filter, the instructions provided with the integrating sound level meter shall state clearly how these connections are to be used.

10.4 If a digital output is provided, the data format shall be specified. EIA-RS 232 serial interface or IEC-625 bus compatibility is preferred.

11 Rating information and instruction manual

11.1 An integrating sound level meter that complies with this standard shall be marked to show the number of this standard, its year of issue and the instrument type. If the instrument is intended for laboratory use only, it shall be marked additionally with the letter "L". It shall also be marked with the name of the manufacturer, the model number and the serial number. If the integrating sound level meter is calibrated for diffuse field, it shall be marked additionally with the letter "R".

If the instrument consists of several separate units, each principal unit or component shall be marked, if practical, with the name of the manufacturer, model number, serial number and a designation of its function. All principal units or components constituting the instrument shall be identified.

11.2 An instruction manual shall be supplied with the instrument which shall include at least the information listed below:

1) The kind of microphone (piezoelectric, condenser, etc.) and method of mounting necessary to attain the tolerances required for that particular type of integrating sound level meter.
2) The reference direction of incidence as defined in 3.11 and the free-field frequency response in this direction for diffuse-field-calibrated instruments.
3) The range of equivalent-continuous A-weighted sound pressure levels and the range of A-weighted sound exposure levels, if available, which the instrument is designed to measure within the tolerances specified in this standard. The ranges shall be stated separately for each frequency-weighting characteristic.
4) The linearity range and pulse range for each indicator range as defined in 3.5 and 3.6.
5) The fixed integration periods provided, if any.
6) The reference frequency, as defined in 3.7 of IEC 60651.
7) The reference sound pressure level, as defined in 3.8 of IEC 60651.

8) The reference range, as defined in 3.7.

9) The effect of vibrations on the operation of the integrating sound level meter as tested in accordance with 8.3 of IEC 60651.

10) The effect of magnetic fields as tested in accordance with 8.4 of IEC 60651.

11) The effects of temperature as tested in accordance with 8.5 of IEC 60651.

12) The effects of humidity as tested in accordance with 8.6 of IEC 60651.

13) The limits of temperature and humidity beyond which permanent damage to the integrating sound level meter may result.

14) Any correction to calibration required when a microphone extension cable is used.

15) The effect on the performance of the instrument caused by the use of recommended microphone accessories such as windscreens, etc.

16) The calibration procedure necessary to maintain the accuracy as specified in 4.2 for free-field calibration and/or diffuse-field calibration.

17) The position of the instrument case and observer relative to the microphone in order to minimize their influence on the measured sound field.

18) A procedure to ensure optimum operating conditions when the integrating sound level meter is used with external filters or analysers if applicable.

19) The limitations on the electrical impedance that may be connected to the output connectors, if provided.

20) The warm-up time before valid readings can be made, as defined in 4.10.

21) The settling time before valid readings are obtained, as defined in 6.5.

22) The nominal battery life.

23) For Types 0, 1 and 2 instruments, correction information between the sensitivity in a diffuse field and that in the reference direction, as a function of frequency. These data shall be given for frequencies at least up to 10 kHz for Types 0 and 1, or 8 kHz for Type 2.

24) The directional response of the integrating sound level meter at various frequencies including at least 1 kHz, 2 kHz, 4 kHz and 8 kHz (for Types 2 and 3), and additionally 12,5 kHz for Types 0 and 1 instruments.

25) The electrical impedance which shall be substituted for the microphone for testing purposes.

26) Details of how to change calibration from free-field to diffuse-field calibration or vice versa, if applicable.

27) Indicator range, as defined in 3.8.

28) The manufacturer should state how the instrument may be mounted for testing compliance with the requirements of this standard.

29) the equivalent-continuous sound pressure level or sound exposure level at which the instrument conforms to the specifications of this clause;

30) the approved cables and accessories as included in the tests of 12.5.2.6 and 12.5.4.4;

31) the configuration for the normal mode of operation;

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

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

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

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

12 Electromagnetic and electrostatic compatibility requirements and test procedures

12.1 Field of application

12.1.1 This clause specifies requirements for integrating sound level meters with respect to their immunity to power- and radio-frequency fields and to electrostatic discharge, and the permitted radio-frequency electromagnetic emissions, together with test procedures to demonstrate conformance to the specifications of this standard. Integrating sound level meters are available in many different configurations and may be powered by batteries or from external power supply systems. The technical requirements in this clause are for three configurations: first, for self-contained instruments that are designed primarily for battery operation; second, for self-contained instruments that incorporate a time-integration facility according to this standard and that are operated from public power supply systems; third, for instruments that are formed by interconnection of two or more items of equipment.

12.1.2 The electromagnetic and electrostatic compatibility requirements are equally applicable for integrating sound level 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 integrating sound level meters contained therein. The requirements do not apply to integrating sound level meters complying with the first edition of this standard.

12.2 Emission limits

12.2.1 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 integrating sound level meters in groups X, Y or Z. These are summarized in annex D.

12.2.2 Integrating sound level meters in groups Y or Z powered from a public power supply system shall also comply with the limits for disturbance to the public supply system specified in CISPR 22. For integrating sound level meters, the requirements are summarized in annex D.

12.2.3 The instruction manual shall state the mode of operation of, and the connecting devices (if any) to, the instrument that produces the greatest radio-frequency emissions.

12.3 Electrostatic discharges

12.3.1 Integrating sound level meters in groups X, Y or Z 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.

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

"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, either of these may be derived from the product description and documentation and what the user may reasonably expect from the apparatus if used as intended."

The term “apparatus” means any integrating sound level meter conforming to this standard.

12.3.3 After each and every electrostatic discharge test is complete, the integrating sound level 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.

12.4 Immunity to power- and radio-frequency fields and conducted disturbances

12.4.1 Integrating sound level meters in groups X, Y and Z 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 8.4 of IEC 60651. 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.

12.4.2 For integrating sound level meters in groups Y or Z that are connected to a public power supply, the instruments shall conform to additional requirements. These requirements are specified in table 4 in IEC 61000-6-2.

12.4.3 For integrating sound level meters in group Z, and where any interconnecting cable between any two parts of the system exceeds 3 m in length, the instruments shall also conform to the requirements of table 2 in IEC 61000-6-2.

12.4.4 For all groups of integrating sound level meters, the immunity to 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 a frequency-weighted sound level of 74 dB ± 1 dB as indicated by the integrating sound level 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 integrating sound level meter, or of the susceptibility of the instrument to power- or radio-frequency radiation. The integrating sound level meter shall be positioned in the reference orientation relative to the source of radio-frequency emissions.

For integrating sound level meters that only indicate sound exposure level, the level of the signal from the acoustic source indicated by the instrument shall be adjusted to 84 dB ± 1 dB after an integration time of 10 s.

12.4.5 During testing, the integrating sound level 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 time average sound pressure level, or A-weighted sound exposure level if this is not available. The level range control shall be set (if applicable) to cover the range from 70 dB to 80 dB in the indicator range. 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 indicator range is closest to, but not greater than, 70 dB.

12.4.6 When the power- or radio-frequency field as specified in 12.4.1 is applied, the change in the indication of the integrating sound level meter shall not exceed ±1 dB for a type 0 or 1 integrating sound level meter, or ±2 dB for a type 2 or 3 integrating sound level meter.

12.4.7 The specifications of 12.4.6 also apply to the additional requirements in 12.4.2 and 12.4.3. No power- or radio-frequency field is applied during the testing of these additional requirements.

12.4.8 If the instruction manual states that an integrating sound level meter conforms to the specifications of this clause for time-average, frequency-weighted sound levels down to a specified lower limit less than 74 dB, then the integrating sound level meter shall conform within the tolerance limits of 12.4.6 to all time-average sound levels from 74 dB down to the stated lower level on all possible level ranges (if any) for all tests relevant to its group. If the instruction manual states that an integrating sound level meter conforms to the specifications of this clause for sound exposure levels down to a specified lower limit less than 84 dB for integration durations of 10 s, then the integrating sound level meter shall conform within the tolerance limits of 12.4.6 to all sound exposure levels from 84 dB down to the stated lower level on all possible level ranges (if any) for all tests relevant to its group. For both cases, the lower level shall be stated to 1 dB resolution and shall apply to all modes of operation of the instrument.

12.4.9 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.

12.5 Test procedures

12.5.1 General

If an instrument also operates within the specifications of conventional sound level meters with exponential time averaging (according to the specifications of IEC 60651), then the tests to determine conformance to the requirements of this clause shall be performed in the operational mode that produces the greatest radio-frequency emissions and provides the least immunity to electrostatic discharges, power- and radio-frequency fields. The instruction manual shall then state that conformance is achieved for both operational modes.

12.5.1.1 The tests described in this subclause shall be carried out unless the particular configuration of the integrating sound level meter renders them inappropriate, in which case equivalent tests shall be substituted if equivalence to these tests can be demonstrated. Unless stated otherwise, these tests apply to all integrating sound level meters in groups X, Y, and Z.

12.5.1.2 During testing, the instrument under test shall be set in the configuration for the normal mode of 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 time average sound pressure level, or A-weighted sound exposure level if the time average, A-weighted sound pressure level is not available.

12.5.1.3 To facilitate testing, a special operating mode giving a short duration measurement, reset at a defined time interval, may be made available exclusively for the purpose of demonstrating conformance to the specifications of this clause. Details of the special operating mode shall be recorded.

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

12.5.2 Emission measurements

12.5.2.1 The instrument under test shall be configured and set according to the specification in the instruction manual to produce the greatest emissions in the frequency range being investigated.

12.5.2.2 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.

12.5.2.3 The instrument under test shall initially be tested in the reference orientation. For instruments with microphones attached by a cable, the microphone shall be positioned centrally above the case of the meter at a height of 250 mm, or as close to this distance as is practical. If the cable is longer than 250 mm, then it may be folded back on itself in a figure-of-eight configuration with an even number of folds of equal length, and all parts secured closely together at each end of the folds, and in their centre.

12.5.2.4 Maintaining the configuration of 12.5.2.3, the instrument under test 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.

12.5.2.5 Any fixtures and fittings used to maintain the position of the instrument under test (including the microphone and cable if appropriate), shall be such as to have no significant influence on the measurement of any emissions from the instrument.

12.5.2.6 If the instrument under test is fitted with a connection device that allows interface or interconnection cables to be attached to it, then all tests of emissions shall be carried out with cables connected to all available connection devices. All cables shall be left unterminated and arranged as described in clause 8 of CISPR 22, unless the manufacturer of the integrating sound level meter also supplies the device connected to the integrating sound level meter by this cable, in which case all items shall be tested together.

12.5.2.7 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 12.2.

12.5.2.8 For integrating sound level meters in groups Y and Z connected to a public power supply, disturbances conducted to the public power supply shall be measured as described in CISPR 22 and shall conform to the requirements of clause 5 of that standard for class B equipment.

12.5.3 Tests for electrostatic discharge

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

12.5.3.2 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 integrating sound level meter.

12.5.3.3 Any supports or other items used to maintain the position of the instrument under test shall not obscure any part of the integrating sound level meter required for access for static discharge, nor shall they affect the testing of the integrating sound level meter.

12.5.3.4 Contact and air discharges of all required polarities and voltages shall be applied ten times each to all appropriate parts of the instrument under test.

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

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

12.5.4 Tests for immunity to power- and radio-frequency fields and conducted disturbances

12.5.4.1 The equipment required and the test methods needed to test for radio-frequency fields are described in IEC 61000-4-3.

12.5.4.2 Testing shall first be made in the reference orientation with any microphone cables arranged as described in 12.5.2.3. The signal from the acoustic source described in 12.4.4 shall be applied to the microphone.

12.5.4.3 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 less than 500 MHz and up to 2 % for all other frequencies may be substituted for the 1 % specified therein. Testing at a limited number of discrete frequencies does not negate the need to meet the requirements of 12.4 at all frequencies within the specified range. For each frequency applied, the equivalent-continuous sound pressure level (or the sound exposure level) reading shall be reset at the start of measurement, and an interval of at least 10 s in both the presence and absence of the radio-frequency field be used to determine the reading under each condition.

12.5.4.4 If the instrument under test is fitted with a connection device that allows interface or interconnection cables to be attached to it, then all tests for immunity to power- and radio-frequency fields shall be performed with cables connected to all available connection devices. All cables shall be left unterminated and shall be arranged as described in clause 8 of CISPR 22, unless the supplier of the integrating sound level meter also supplies the device connected to the integrating sound level meter by this cable, in which case all items shall be tested together.

12.5.4.5 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 complies with the limits of 12.4.

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

12.5.4.7 Power-frequency testing shall be as specified in clause 8 (i.e. refer to 8.4 of IEC 60651) with the acoustic source of 12.4.4 applied to the microphone in a manner that has no influence on the power frequency field.

12.5.4.8 Maintaining the configuration of 12.5.4.2 and 12.5.4.4, the instrument under test 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.

12.5.4.9 During testing, the instrument under test shall remain fully operational and in the same configuration as it was before testing commenced.

12.5.4.10 If the instruction manual states that the instrument conforms to the specifications of this clause at a time-average sound level less than 74 dB, or a sound exposure level, over a 10 s duration, less than 84 dB, the tests for immunity to power- and radio-frequency fields shall be repeated in steps of not greater than 5 dB on all applicable level ranges down to the lower level stated in the instruction manual for conformance with the specifications of this clause to the nearest decibel. The specified acoustic source shall continue to be used for these tests, with its output signal reduced as required.

12.5.4.11 For integrating sound level meters in groups Y and Z operating from a public power supply, tests shall be performed to demonstrate conformance to the additional specifications given in 12.4.2.

12.5.4.12 For integrating sound level meters in group Z using or specifying interconnecting cables longer than 3 m, tests shall be performed to demonstrate conformance to the additional specifications given in 12.4.3.

Annex A
(informative)

Difference between averaging capability of integrating and conventional sound level meters

Both integrating sound level meters and conventional sound level meters average frequency-weighted sound pressures. The averaging process are somewhat different, however, in two respects.

First, the conventional sound level meter has a limited number of fixed and relatively short duration averaging characteristics, the most common ones being designated F and S. In contrast, averaging durations for the integrating sound level meter are typically much longer extending to many minutes or hours.

Secondly, the integrating sound level meter gives equal emphasis to all sounds that occur during the selected averaging period whereas the conventional sound level meter gives greater emphasis to recently occurring sounds than to sounds that occurred less recently. The time weightings of conventional sound level meters decay exponentially so that, for example, using the S characteristic which has an exponential time constant of 1 s, principal weight is given to sounds that occurred less than 1 s previously, and very little weight is given to sounds that occurred even 10 s previously.

Annex B
(normative)

Additional specifications for integrating sound level meters indicating the average AI-weighted sound pressure level

B.1 Definition

Average AI-weighted sound pressure level is defined as follows:

$$L_{\mathrm{AIeq,T}} = 10 \lg \left\{ \left(\frac{1}{T} \int_{t_1}^{t_2} p_{\mathrm{AI}}^2(t) \mathrm{d}t \right) \Big/ p_0^2 \right\} \quad \mathrm{dB}$$

where

$L_{\mathrm{AIeq,T}}$ is the average AI-weighted sound pressure level, meaning the average sound pressure level using frequency weighting A and time weighting I, determined over a time interval $T = T_2 - t_1$;

$p^2_{\mathrm{AI}}(t)$ is the square of the sound pressure of the sound signal, frequency weighted A and time weighted I at the time t.

NOTE 1 If instead of $p^2_{\mathrm{AI}}(t)$ only $L_{\mathrm{pAI}}(t)$ is available in the integrating sound level meter, the formula can be written as follows:

$$L_{\mathrm{AIeq,T}} = 10 \lg \left(\frac{1}{T} \int_{t_1}^{t_2} 10^{0{,}1\, L_{\mathrm{pAI}}(t)} \, \mathrm{d}t \right) \quad \mathrm{dB}$$

where $L_{\mathrm{pAI}}(t)$ is the AI-weighted sound pressure level at the time t, in decibels.

NOTE 2 Instead of the symbol $L_{\mathrm{AIeq,T}}$, the symbol L_{AIm} is used in some countries.

B.2 Characteristics

An integrating sound level meter set to the I time weighting performs the time weighting I on the squared signal as specified in 7.3 of IEC 60651 before the final averaging operation.

Testing with a sequence of tone bursts is described in clause B.3. The indication of the integrating sound level meter with tolerances is given in table B.1.

Table B.1 – Response to a continuous sequence of tone bursts of repetition frequency 0,2 Hz with tolerances, in decibels

Burst duration ms	Response to test tone bursts referred to response to a continuous reference signal	Tolerances	
		Types 0 and 1	Types 2 and 3
1 000	–3,3	±0,5	±1,0
20	–9,0	±1,0	±2,0
5	–14,1	±2,0	±3,0
1	–20,9	±2,0	±3,0

B.3 Test

A sequence of tone bursts at a frequency of 4 kHz shall be applied (see 9.3.2). The repetition frequency of the sequence shall be 0,2 Hz.

The continuous reference signal shall have the same r.m.s. amplitude as the tone bursts and produce an indication at the upper end of the indicator range.

The averaging time interval shall be at least 10 s.

The test shall be performed with frequency weighting A.

NOTE The systematic effects of this weighting on r.m.s. level are below 0,1 dB for the test signal and are ignored.

When the range of the indicator is more than 30 dB, the test shall be repeated at intervals of 10 dB below full scale down to the lowest level that produces an indication inside the indicator range specified by the manufacturer.

If the amplitude of the burst is increased by 10 dB for the burst duration of 5 ms and by 20 dB for the burst duration of 1 ms, the indication shall increase by (10 ± 1) dB and (20 ± 1) dB, respectively.

The above requirements shall be met for all level ranges of the instrument.

Annex C
(informative)

Use of free-field and diffuse-field microphones

It has been pointed out in 2.4 that the method of use of the instrument may have as much effect on a measurement as the quality of the instrument itself, and that errors will often result if the effects of the environment are ignored. Among the acoustic environments to be considered are the free field and the diffuse field.

Generally an instrument equipped and calibrated for diffuse field will not comply with the requirements for diffuse field within the tolerances of the same accuracy type.

Conversely, an instrument equipped and calibrated for free field will not comply with the requirements for diffuse field within the tolerances of the same accuracy type.

Choice of calibration convention is clearly dependent upon the environment in which an integrating sound level meter will be used.

If the same integrating sound level meter is equipped to change the calibration convention, the manufacturer shall state clearly which kind of microphone and/or which switch position belongs to free field and which to diffuse field calibration. Such change should preferably not alter the accuracy type of the instrument.

Annex D
(informative)

Emission limits

Table D.1 – Limits for radiated disturbance of class B 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[1)].

For mains-powered equipment, the following is also required:

Table D.2 – Limits for conducted disturbance at the mains ports of class B ITE

Frequency range MHz	**Limits** dB (μV/m)	
	Quasi-peak	**Average**
0,15 to 0,50	66 to 56	56 to 46
0,50 to 5	56	46
5 to 30	60	50
NOTE 1 The lower limit applies at the transition frequencies. NOTE 2 The limit decreases linearly with the logarithm of the frequency in the range 0,15 MHz to 0,50 MHz.		

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

Annex ZA
(normative)

Normative references to international publications with their corresponding 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 (including amendments).

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

Publication	Year	Title	EN/HD	Year
IEC 60050-801	1994	International Electrotechnical Vocabulary (IEV) - Chapter 801: Acoustics and electroacoustics	-	-
IEC 60651	1979	Sound level meters	EN 60651	1994
IEC 60942	1997	Electroacoustics - Sound calibrators	EN 60942	1998
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	-	-
CISPR 22 (mod)	1997	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement	EN 55022 + corr. August	1998 1999

BS EN 60804:2001 IEC 60804:2000

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